

# DISCOVERY



## Workshop Manual

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# Workshop manual DISCOVERY
















This manual covers vehicles from  
1995 model year

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## INTRODUCTION

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**This workshop manual covers vehicles from 1995 model year onwards. Amendments and additional pages will be issued to ensure that the manual covers latest models. Amendments and additions will be identified by the addition of a dated footer at the bottom of the page.**

This Workshop Manual is designed to assist skilled technicians in the efficient repair and maintenance of Land Rover vehicles.

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

**WARNINGS, CAUTIONS and NOTES** are given throughout this Manual in the following form:



**WARNING: Procedures which must be followed precisely to avoid the possibility of personal injury.**



**CAUTION: This calls attention to procedures which must be followed to avoid damage to components.**



**NOTE: This calls attention to methods which make a job easier or gives helpful information.**

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## DIMENSIONS

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The dimensions quoted are to design engineering specification. Alternative unit equivalents, shown in brackets following the dimensions, have been converted from the original specification.

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## REFERENCES

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References to the left or right hand side in the manual are made when viewing the vehicle from the rear. With the engine and gearbox assembly removed, the water pump end of the engine is referred to as the front.

To reduce repetition, some operations covered in this Manual do not include reference to testing the vehicle after repair.

It is essential that work is inspected and tested after completion and if necessary a road test of the vehicle is carried out particularly where safety related items are concerned.

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## REPAIRS AND REPLACEMENTS

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When replacement parts are required it is essential that Land Rover parts are used.

Attention is particularly drawn to the following points concerning repairs and the fitting of replacement parts and accessories: Safety features embodied in the vehicle may be impaired if other than Land Rover parts are fitted. In certain territories, legislation prohibits the fitting of parts not to the vehicle manufacturer's specification. Torque spanner values given in the Workshop Manual must be strictly adhered to. Locking devices, where specified, must be fitted. If the efficiency of a locking device is impaired during removal it must be replaced with a new one. Certain fasteners must not be re-used. These fasteners are specified in the Workshop Manual.

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## POISONOUS SUBSTANCES

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Many liquids and other substances used are poisonous and therefore must not be consumed. It is also advisable to keep all substances away from open wounds. These substances among others include anti-freeze, brake fluid, fuel, windscreen washer additives, air conditioning refrigerant, lubricants and various adhesives.

## FUEL HANDLING PRECAUTIONS

The following information provides basic precautions which must be observed if fuel is to be handled safely. It also outlines the other areas of risk which must not be ignored.

This information is issued for basic guidance only, and in any case of doubt, appropriate enquiries should be made of your local Fire Officer or Fire Department.

Fuel vapour is highly flammable and in confined spaces is also very explosive and toxic.

When fuel evaporates it produces 150 times its own volume in vapour, which when diluted with air becomes a readily ignitable mixture. The vapour is heavier than air and will always fall to the lowest level. It can readily be distributed throughout a workshop by air current, consequently, even a small spillage of fuel is very dangerous.

Always have a fire extinguisher containing **FOAM CO<sup>2</sup> GAS**, or **POWDER** close at hand when handling fuel, or when dismantling fuel systems and in areas where fuel containers are stored.



**WARNING: It is imperative that the battery is not disconnected during fuel system repairs as arcing at the battery terminal could ignite fuel vapour in the atmosphere. Always disconnect the vehicle battery BEFORE carrying out work on the fuel system.**

**Whenever fuel is being handled, transferred or stored, or when fuel systems are being dismantled all forms of ignition must be extinguished or removed, any leadlamps used must be flame proof and kept clear of spillage.**

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

### Hot fuel handling precautions



**WARNING: Before commencing any operation requiring fuel to be drained from the fuel tank, the following procedure must be adhered to:**

1. Allow sufficient time for the fuel to cool, thus avoiding contact with hot fuels.
2. Vent the system by removing the fuel filler cap in a well ventilated area. Refit the filler cap until the commencement of fuel drainage.

### Fuel transfer



**WARNING: Fuel must not be extracted or drained from any vehicle while it is standing over a pit.**

The transfer of fuel from the vehicle fuel tank must be carried out in a well ventilated area. An approved transfer tank must be used according to the transfer tank manufacturer's instructions and local regulations, including attention to grounding of tanks.

### Fuel tank removal

A **FUEL VAPOUR** warning label must be attached to the fuel tank upon removal from the vehicle.

### Fuel tank repair

Under no circumstances should a repair to any tank be attempted.





## SYNTHETIC RUBBER

Many 'O' ring seals, flexible pipes and other similar items which appear to be natural rubber are made of synthetic materials called Fluoroelastomers. Under normal operating conditions this material is safe, and does not present a health hazard. However, if the material is damaged by fire or excessive heat, it can break down and produce highly corrosive Hydrofluoric acid which can cause serious burns on contact with skin. Should the material be in a burnt or overheated condition handle only with seamless industrial gloves. Decontaminate and dispose of the gloves immediately after use.

If skin contact does occur, remove any contaminated clothing immediately and obtain medical assistance without delay. In the meantime, wash the affected area with copious amounts of cold water or limewater for fifteen to sixty minutes.

## RECOMMENDED SEALANTS

A number of branded products are recommended in this manual for use during maintenance and repair work.

These items include:

**HYLOMAR GASKET AND JOINTING COMPOUND**  
and  
**HYLOSIL RTV SILICON COMPOUND.**

They should be available locally from garage equipment suppliers. If there is any problem obtaining supplies, contact the following company for advice and the address of the nearest supplier.

### MARSTON LUBRICANTS LTD.

Hylo House,  
Cale Lane,  
New Springs,  
Wigan WN2 1JR

Tel 01942 824242

## USED ENGINE OIL



**WARNING: Prolonged and repeated contact with engine or motor oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis.**

**Used engine oil contains potentially harmful contaminants which may cause skin cancer. Adequate means of skin protection and washing facilities should be provided.**

### Handling precautions

1. Avoid prolonged and repeated contact with oils, particularly used engine oils.
2. Wear protective clothing, including impervious gloves where applicable.
3. Do not put oily rags in pockets.
4. Avoid contaminating clothes, particularly underwear, with oil.
5. Overalls must be cleaned regularly. Discard unwashable clothing and oil impregnated footwear.
6. First aid treatment must be obtained immediately for open cuts and wounds.
7. Use barrier creams, before each work period, to help the removal of oil from the skin.
8. Wash with soap and water to ensure all oil is removed (skin cleansers and nail brushes will help). Preparations containing lanolin replace the natural skin oils which have been removed.
9. Do not use gasoline, kerosene, diesel fuel, petrol, thinners or solvents for washing the skin.
10. If skin disorders develop, obtain medical advice.
11. Where practicable, degrease components prior to handling.
12. Where there is a risk of eye contact, eye protection should be worn, for example, goggles or face shields; in addition an eye wash facility should be provided.

### Disposing of used oils

#### Environmental protection precaution

It is illegal to pour used oil onto the ground, down sewers or drains, or into waterways.

Dispose of used oil through authorised waste disposal contractors. If in doubt contact your Local Authority for advice on disposal facilities.

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## ACCESSORIES AND CONVERSIONS

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**DO NOT FIT** unapproved accessories or conversions, as they could affect the safety of the vehicle.

Land Rover will not accept liability for death, personal injury, or damage to property which may occur as a direct result of the fitting of non-approved conversions to the vehicle.

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## WHEELS AND TYRES

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**WARNING: DO NOT** replace the road wheels with any type other than genuine Land Rover wheels which are designed for multi-purpose on and off road use and have very important relationships with the proper operation of the suspension system and vehicle handling. Replacement tyres must be of the make and sizes recommended for the vehicle, and all tyres must be the same make, ply rating and tread pattern.

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## STEAM CLEANING

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To prevent consequential rusting, any steam cleaning within the engine bay **MUST** be followed by careful re-waxing of the metallic components affected. Particular attention must be given to the steering column, engine water pipes, hose clips and ignition coil clamp.

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## SPECIFICATION

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The specification details and instructions set out in this Manual apply only to a range of vehicles and not to any one. For the specification of a particular vehicle purchasers should consult their Dealer

The Manufacturer reserve the right to vary their specifications with or without notice, and at such times and in such manner as they think fit. Major as well as minor changes may be involved in accordance with the Manufacturer's policy of constant product improvement.

Whilst every effort is made to ensure the accuracy of the particulars contained in this Manual, neither the Manufacturer or Dealer, by whom this Manual is supplied, shall in any circumstances be held liable for any inaccuracy or the consequences thereof.

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## SPECIAL SERVICE TOOLS

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The use of approved special service tools is important. They are essential if service operations are to be carried out efficiently, and safely. Where special tools are specified, **only these tools should be used to avoid the possibility of personal injury or damage to the components.** Also the amount of time which they save can be considerable.

Every special tool is designed with the close co-operation of Land Rover, and no tool is put into production which has not been tested and approved by us. New tools are only introduced where an operation cannot be satisfactorily carried out using existing tools or standard equipment. The user is therefore assured that the tool is necessary and that it will perform accurately, efficiently and safely.

Special tools bulletins will be issued periodically giving details of new tools as they are introduced.

All orders and enquiries from the United Kingdom should be sent direct to V. L. Churchill. Overseas orders should be placed with the local V. L. Churchill distributor, where one exists. Countries where there is no distributor may order direct from:

V. L. Churchill Limited,  
PO Box 3,  
Daventry, Northants,  
England, NN11 4NF.

The tools recommended in this Workshop Manual are listed in a multi-language illustrated catalogue, obtainable from:

Messrs. V. L. Churchill at the above address, or from:

Land Rover Merchandising Service,  
PO Box 534,  
Erdington,  
Birmingham, B24 0Q5,

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**JACKING**

The following instructions must be carried out before raising the vehicle off the ground.

1. Use a solid level ground surface.
2. Apply parking brake.
3. Select 'P' or 1st gear in main gearbox.
4. Select Low range in transfer gearbox.



**CAUTION:** To avoid damage occurring to the under body components of the vehicle the following jacking procedures must be adhered to.

**DO NOT POSITION JACKS OR AXLE STANDS UNDER THE FOLLOWING COMPONENTS.**

- Body structure
- Bumpers
- Fuel lines
- Brake lines
- Front radius arms
- Panhard rod
- Steering linkage
- Rear Trailing links
- Fuel tank
- Engine sump
- Gearbox bell housing

Jack or support vehicle by axles only.

**Vehicle jack**

The jack provided with the vehicle is only intended to be used in an emergency, for changing a tyre. Do **NOT** use the jack for any other purpose. Refer to Owner's Manual for vehicle jack location points and procedure. Never work under a vehicle supported by the vehicle jack.

**Hydraulic jack**

A hydraulic jack with a minimum 1500 kg, 3,300 lbs load capacity must be used.



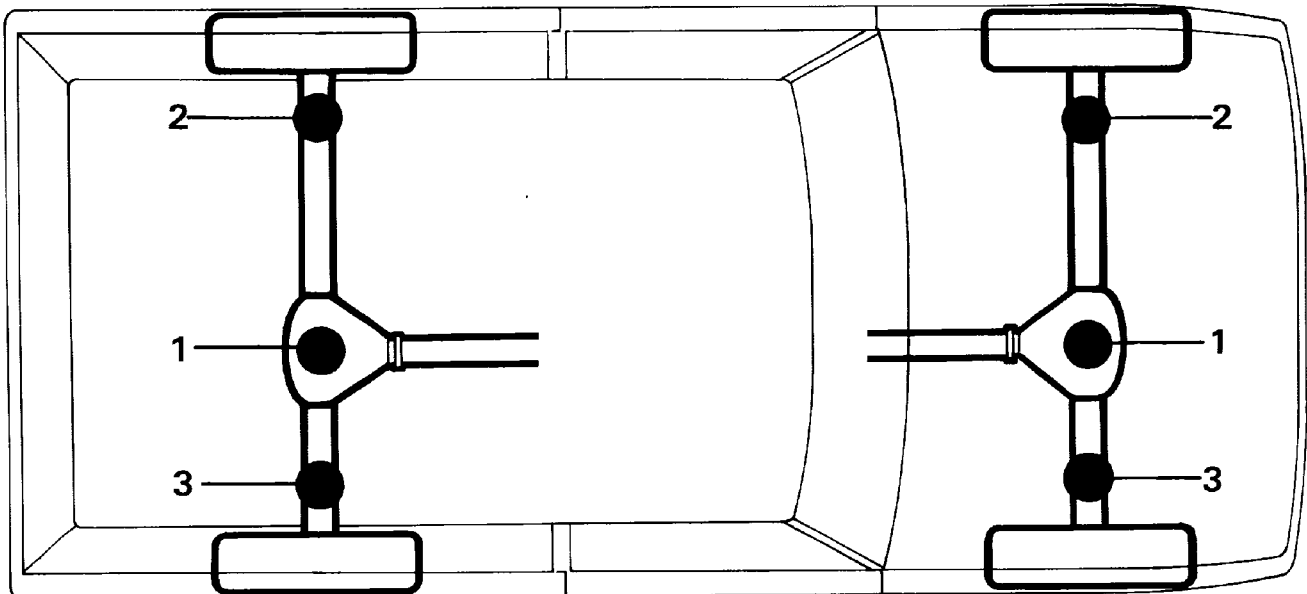
**CAUTION:** Do not commence work on the underside of the vehicle until suitable axle stands have been positioned under the axle.

**Raise the front of the vehicle**

1. Position cup of hydraulic arm under differential casing.



**NOTE:** The differential casing is not central to the axle. Care should be taken when raising the front road wheels off the ground as the rear axle has less sway stiffness.



RR1839E

2. Raise front road wheels to enable an axle stand to be installed under left hand axle tube.
3. Position an axle stand under right hand axle tube, carefully lower jack until axle sits securely on both axle stands, remove trolley jack.
4. Before commencing work on underside of vehicle re-check security of vehicle on stands.
5. Reverse procedure when removing vehicle from stands.

## Raise rear of vehicle

1. Position cup of hydraulic arm under differential casing.
2. Raise vehicle to enable axle stands to be installed under left and right hand axle tubes.
3. Lower jack until axle sits securely on axle stands, remove trolley jack.
4. Before commencing work on underside of vehicle re-check security of vehicle on stands.
5. Reverse procedure when removing vehicle from stands.

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## HYDRAULIC VEHICLE RAMP (FOUR POST)

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Use only a 'drive on' type ramp which supports vehicle by its own road wheels. If a 'wheel-free' condition is required, use a 'drive on' ramp incorporating a 'wheel-free' system that supports under axle casings. Alternatively, place vehicle on a firm, flat floor and support on axle stands.

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## TWO POST VEHICLE RAMPS

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The manufacturer of **LAND ROVER VEHICLES** **DOES NOT** recommend using 'Two Post' ramps that employ four adjustable support arms. These are **NOT** considered safe for Land Rover vehicles. If vehicle is installed on a Two Post ramp responsibility for safety of vehicle and personnel performing service operations is in the hands of the Service Provider.

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## DYNAMOMETER TESTING - NON ANTI-LOCK BRAKE VEHICLES

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### Viscous coupling

The front and rear axles cannot be driven independently due to the viscous coupling. This eliminates the need for differential lock by progressively locking the centre differential automatically if slip occurs at any wheel.



**WARNING: DO NOT attempt to drive individual wheels with vehicle supported on floor jacks or stands.**

### Four wheel dynamometers

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

### Two wheel dynamometers

**IMPORTANT: Use a four wheel dynamometer for brake testing if possible.**

If brake testing on a single axle rig is necessary it must be carried out with propeller shaft to rear axle removed, AND neutral selected in BOTH main gearbox and transfer gearbox. When checking brakes, run engine at idle speed to maintain servo vacuum. If checking engine performance, the transfer box must be in high range and propeller shaft to stationary axle must be removed.

## DYNAMOMETER TESTING - VEHICLES WITH ANTI-LOCK BRAKES (ABS)



**WARNING:** Do not attempt to test ABS function on a dynamometer

### Four wheel dynamometers



**NOTE:** Before testing a vehicle on a four wheel dynamometer disconnect the valve relay. See *Electrical Trouble Shooting Manual*.

The ABS function will not work, the ABS warning light will illuminate. Normal braking will be available.

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

### Two wheel dynamometers

**IMPORTANT:** Use a four wheel dynamometer for brake testing if possible.



**NOTE:** ABS will not function on a two wheel dynamometer. The ABS light will illuminate during testing. Normal braking will be available.

If brake testing on a single rig is necessary it must be carried out with propeller shaft to the rear axle removed, AND neutral selected in BOTH main and transfer boxes.

If checking engine performance, the transfer box must be in high range and drive shaft to stationary axle removed.

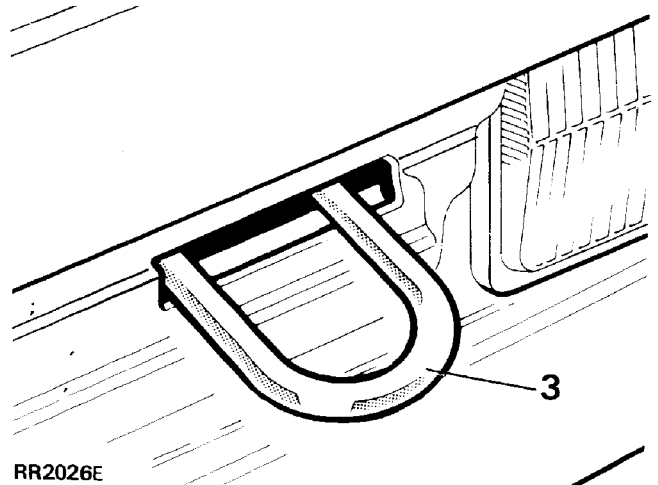
## TOWING



**CAUTION:** The vehicle has permanent four-wheel drive. The following towing instructions must be adhered to:

Towing the vehicle on all four wheels with driver operating steering and brakes.

1. Turn ignition key turn to position '1' to release steering lock.
2. Select neutral in main gearbox and transfer gearbox.



3. Secure tow rope, chain or cable to towing eye.
4. Release the parking brake.



**CAUTION:** The brake servo and power assisted steering system will not be functional without the engine running.

Greater pedal pressure will be required to apply the brakes, the steering system will require greater effort to turn the front road wheels. The vehicle tow connection should be used only in normal road conditions, 'snatch' recovery should be avoided.

### Suspended tow by breakdown vehicle



**CAUTION:** To prevent vehicle damage, front or rear propeller shaft **MUST BE** removed, dependent upon which axle is being trailed.

1. Mark propeller shaft drive flanges at transfer gearbox and axles with identification lines to enable the propeller shaft to be refitted in its original position.
2. Remove the propeller shaft fixings, remove the shaft from the vehicle.
3. If the front axle is to be trailed turn ignition key to position '1' to release steering lock.



**CAUTION:** The steering wheel and/or linkage must be secured in a straight ahead position. **DO NOT** use the steering lock mechanism for this purpose.

## TRANSPORTING THE VEHICLE BY TRAILER

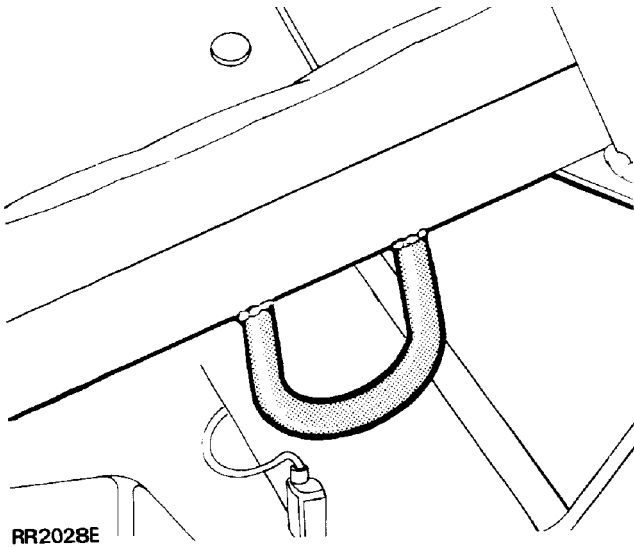
Lashing eyes are provided on front and rear of the chassis side members, to facilitate the securing of the vehicle to a trailer or other means of transportation.



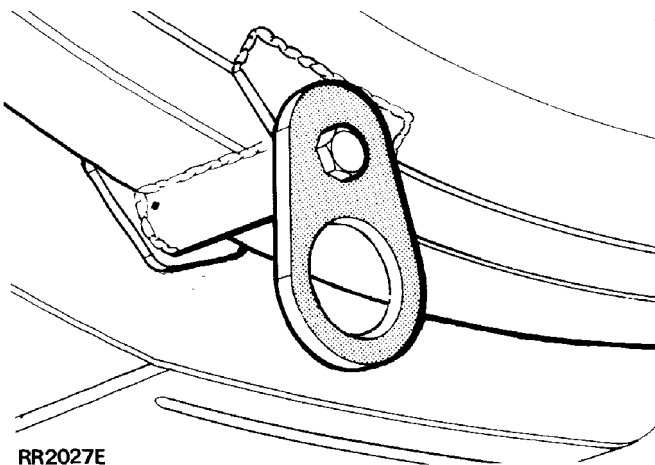
**CAUTION:** Underbody components must not be used as lashing points.

Install vehicle on trailer and apply park brake. Select neutral in main gearbox. Selecting 'N' will prevent damage to parking pawl of the automatic gearbox.

### FRONT OF CHASSIS



### REAR OF CHASSIS



## JUMP STARTING



**WARNING:** Hydrogen and oxygen gases are produced during normal battery operation. This gas mixture can explode if flames, sparks or lighted tobacco are brought near battery. When charging or using a battery in an enclosed space, always provide ventilation and shield your eyes.

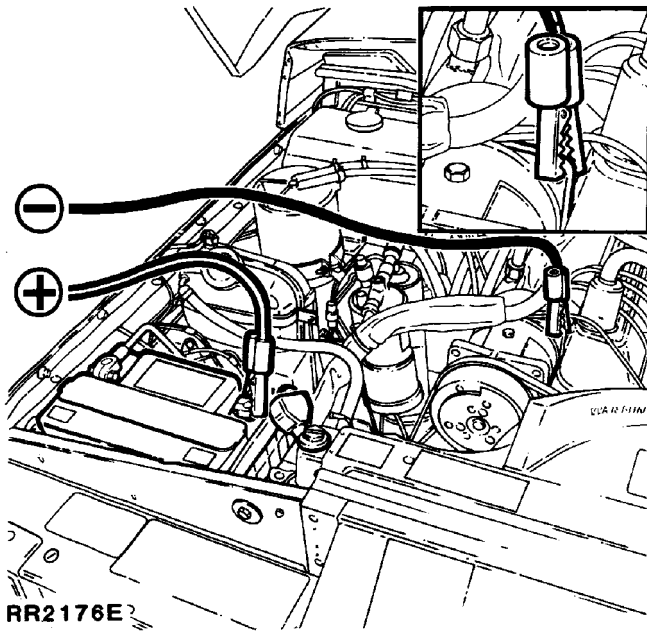
Keep out of reach of children. Batteries contain sulphuric acid. Avoid contact with skin, eyes, or clothing. Also, shield eyes when working near battery to protect against possible splashing of acid solution. In case of acid contact with skin, eyes, or clothing, flush immediately with water for a minimum of fifteen minutes. If acid is swallowed, drink large quantities of milk or water, followed by milk of magnesia, a beaten egg, or vegetable oil. **SEEK MEDICAL AID IMMEDIATELY.**

### To Jump Start - Negative Ground Battery



**WARNING:** To avoid any possibility of injury use particular care when connecting a booster battery to a discharged battery.

1. Position vehicles so that jump leads will reach, ensuring that vehicles **DO NOT TOUCH**, alternatively a fully charged slave battery may be positioned on floor adjacent to vehicle.
2. Ensuring that ignition and all electrical accessories are switched off, that parking brake is applied and neutral is selected on a manual gearbox, with an automatic gearbox select neutral (N) or park (P) and then connect the jump leads as follows;
  - A. Connect one end of first jumper cable to positive (+) terminal of booster battery.
  - B. Connect other end of first jumper cable to positive (+) terminal of discharged battery.
  - C. Connect one end of second jumper cable to negative terminal of booster battery.



- D. Connect other end of second jumper cable to a good earth point on the engine, **NOT TO NEGATIVE TERMINAL OF DISCHARGED BATTERY**. Keep jumper lead away from moving parts, pulleys, drive belts and fan blade assembly.



**WARNING: Making final cable connection could cause an electrical arc which if made near battery could cause an**

**explosion.**

3. If booster battery is installed in another vehicle, start engine and allow to idle.
4. Start engine of vehicle with discharged battery, following starting procedure in Owners' Manual.



**CAUTION: If vehicle fails to start within a maximum time of 12 seconds, switch ignition off and investigate cause. Failing to follow this instruction could result in irreparable damage to catalyts.**

5. Remove negative (-) jumper cable from the engine and then terminal of booster battery.
6. Remove positive (+) jumper cable from positive terminals of booster battery and discharged battery.

## ABBREVIATIONS AND SYMBOLS USED IN THIS MANUAL

Across flats (bolt size) ..... AF  
 After bottom dead centre ..... ABDC  
 After top dead centre ..... ATDC  
 Alternating current ..... a.c.  
 Ampere ..... amp  
 Ampere hour ..... amp hr  
 Before bottom dead centre ..... BBDC  
 Before top dead centre ..... BTDC  
 Bottom dead centre ..... BDC  
 Brake horse power ..... bhp  
 British Standards ..... BS  
 Carbon monoxide ..... CO  
 Centimetre ..... cm  
 Centigrade (Celsius) ..... C  
 Cubic centimetre ..... cm<sup>3</sup>  
 Cubic inch ..... in<sup>3</sup>  
 Degree (angle) ..... deg or °  
 Degree (temperature) ..... deg or °  
 Diameter ..... dia.  
 Direct current ..... d.c.  
 Electronic Control Unit ..... ECU  
 Electronic Fuel Injection ..... EFI  
 Fahrenheit ..... F  
 Feet ..... ft  
 Feet per minute ..... ft/min  
 Fifth ..... 5th  
 First ..... 1st  
 Fluid ounce ..... fl oz  
 Foot pounds (torque) ..... lbf ft  
 Fourth ..... 4th  
 Gramme (force) ..... gf  
 Gramme (mass) ..... g  
 Gallons ..... gal  
 Gallons (US) ..... US gal  
 High tension (electrical) ..... H.T.  
 Internal diameter ..... I.D.  
 Inches of mercury ..... in. Hg  
 Inches ..... in  
 Kilogramme (force) ..... kgf  
 Kilogramme (mass.) ..... kg  
 Kilogramme centimetre (torque) ..... kgf.cm  
 Kilogramme per square millimetre ..... kgf/mm<sup>2</sup>  
 Kilogramme per square centimetre ..... kgf/cm<sup>2</sup>  
 Kilogramme metres (torque) ..... kgf.m  
 Kilometres ..... km  
 Kilometres per hour ..... km/h  
 Kilovolts ..... kV  
 Left-hand ..... LH  
 Left-hand steering ..... LHStg  
 Left-hand thread ..... LHThd  
 Litres ..... litre

Low tension ..... l.t.  
 Maximum ..... max.  
 Metre ..... m  
 Millilitre ..... ml  
 Millimetre ..... mm  
 Miles per gallon ..... mpg  
 Miles per hour ..... mph  
 Minute (angle) ..... '  
 Minus (of tolerance) ..... -  
 Negative (electrical) ..... -  
 Newton metres (torque) ..... Nm  
 Number ..... No.  
 Ohms ..... ohm  
 Ounces (force) ..... ozf  
 Ounces (mass) ..... oz  
 Ounce inch (torque) ..... ozf.in.  
 Outside diameter ..... O.D.  
 Part number ..... Part No.  
 Percentage ..... %  
 Pints ..... pt  
 Pints (US) ..... US pt  
 Plus (tolerance) ..... +  
 Positive (electrical) ..... +  
 Pound (force) ..... lbf  
 Pounds inch (torque) ..... in.lbf.  
 Pound (mass) ..... lb  
 Pounds per square inch ..... P.S.I.  
 Ratio ..... :  
 Reference ..... ref.  
 Revolution per minute ..... rev/min  
 Right-hand ..... RH  
 Second (angle) ..... "  
 Second (numerical order) ..... 2nd  
 Specific gravity ..... sp.gr.  
 Square centimetres ..... cm<sup>2</sup>  
 Square inches ..... in<sup>2</sup>  
 Standard wire gauge ..... s.w.g.  
 Synchroniser/Synchromesh ..... synchro.  
 Third ..... 3rd  
 Top dead centre ..... TDC  
 United Kingdom ..... UK  
 Vehicle Identification Number ..... VIN  
 Volts ..... V  
 Watts ..... W

### SCREW THREADS

American Standard Taper Pipe ..... NPTF  
 British Standard Pipe ..... BSP  
 Unified Coarse ..... UNC  
 Unified Fine ..... UNF



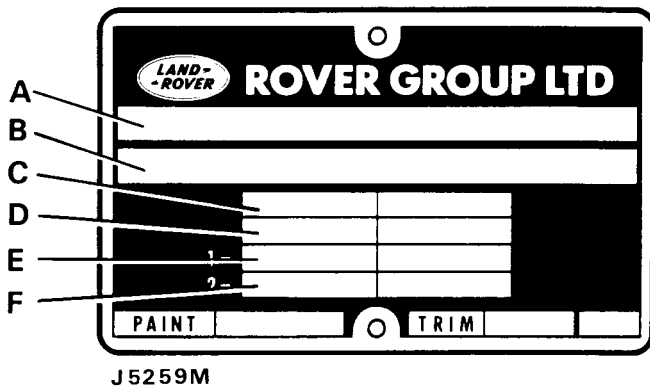
**CROSS REFERENCE OF EMISSION SYSTEM  
TERMINOLOGY**

<b>NEW TERM</b>	<b>(ACRONYM)</b>	<b>OLD TERM</b>	<b>(ACRONYM)</b>
Accelerator pedal .....	(AP)	Throttle pedal .....	(-)
Air cleaner .....	(ACL)	Air cleaner .....	(-)
Air conditioning .....	(AC)	Air conditioning .....	(AC)
Battery positive voltage .....	(B+)	Battery plus, bat +, bat feed .....	(B+)
Closed loop .....	(CL)	Closed loop .....	(-)
Closed throttle position .....	(CTP)	Closed throttle, idle position .....	(-)
Canister purge valve .....	(CANPV)	Charcoal canister purge valve .....	(-)
Data link connector .....	(DLC)	Serial link .....	(-)
Diagnostic trouble code .....	(DTC)	Fault code .....	(-)
Distributor ignition .....	(DI)	Electronic ignition .....	(-)
Engine control module .....	(ECM)	Electronic control unit .....	(ECU)
Engine coolant level .....	(ECL)	Coolant level .....	(-)
Engine coolant temperature .....	(ECT)	Coolant temperature .....	(temp)
Engine coolant temperature sensor .....	(ECTS)	Coolant temperature thermistor .....	(-)
Engine speed .....	(RPM)	Engine speed .....	(rev/min)
Evaporative emission system .....	(EVAP)	Evaporative loss system .....	(ELC)
Engine fuel temperature sensor .....	(EFTS)	Fuel temperature thermistor .....	(-)
4th gear, 3rd gear etc. ....	(4GR, 3GR)	Fourth gear, 3rd gear .....	(-)
Fuel pump .....	(FP)	Fuel pump .....	(-)
Fan control module .....	(FCM)	Condenser fan timer .....	(-)
Generator .....	(GEN)	Alternator .....	(-)
Ground .....	(GND)	Ground, earth .....	(B-)
Heated oxygen sensor .....	(H02S)	Lambda (O2) sensor .....	(-)
Idle air control .....	(IAC)	Idle speed control .....	(ISC)
Idle air control valve .....	(IACV)	Stepper motor .....	(-)
Ignition control module .....	(ICM)	Ignition module .....	(-)
Inertia fuel shutoff .....	(IFS)	Inertia switch .....	(-)
Inertia fuel shutoff switch .....	(IFSS)	Inertia switch .....	(-)
Intake air temperature .....	(IAT)	Intake temperature/ambient temperature .....	(-)
Malfunction indicator lamp .....	(MIL)	EFI warning lamp .....	(-)
Manifold vacuum zone .....	(MVZ)	Manifold depression, vacuum .....	(-)
Mass air flow sensor .....	(MAFS)	Air flow meter .....	(-)
Multipoint fuel injection .....	(MFI)	Electronic fuel injection .....	(EFI)
On board diagnostic .....	(OBD)	Fault code display unit .....	(-)
Open loop .....	(OL)	Open loop .....	(-)
Park/neutral position .....	(PNP)	Park or neutral .....	(-)
Park/neutral position switch .....	(PNPS)	Start inhibit switch .....	(-)
Programmable read only memory .....	(PROM)	Chip, PROM .....	(PROM)
Relay module .....	(RM)	Relay .....	(-)
Service reminder indicator .....	(SRI)	Check engine light .....	(-)
Solid state relay module .....	(SSRM)	Control unit .....	(-)
Three way catalytic converter .....	(TWC)	Catalyst, catalytic converter .....	(CAT)
Throttle body .....	(TB)	Throttle housing .....	(-)
Throttle position sensor .....	(TPS)	Throttle potentiometer .....	(-)
Torque converter clutch .....	(TCC)	Direct drive clutch .....	(DDC)
Transmission range .....	(TR)	Transmission gear .....	(-)
Transmission range selector .....	(TRS)	Shift lever, shifter .....	(-)
Vehicle speed sensor .....	(VSS)	Road speed transducer .....	(-)
Wide open throttle .....	(WOT)	Full throttle, wide open throttle .....	(WOT)

## VEHICLE IDENTIFICATION NUMBER (VIN)

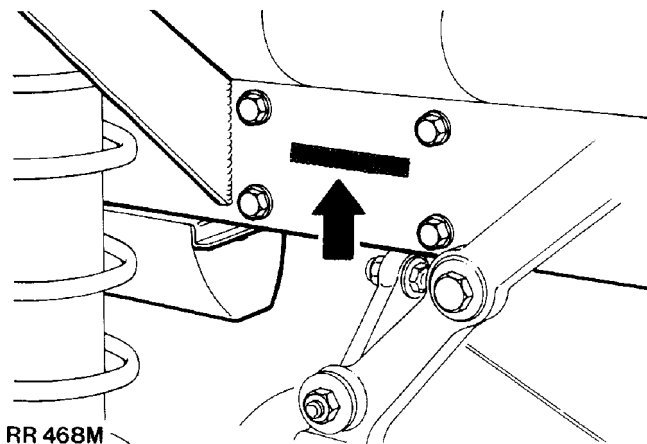
The Vehicle Identification Number and the recommended maximum vehicle weights are stamped on a plate located under the bonnet [hood] riveted to the front of the engine compartment.

### Vehicle Identification Number Plate (UK, Australia, R.O.W., Europe)

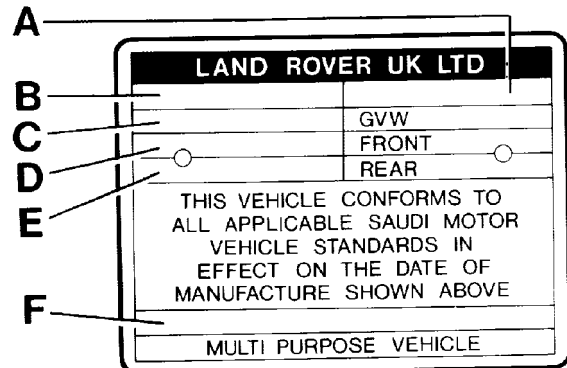


- A. Build date (Australia). Type approval
- B. VIN (17 digits)
- C. Maximum permitted laden weight for vehicle
- D. Maximum vehicle and trailer weight
- E. Maximum road weight-front axle
- F. Maximum road weight-rear axle

The number is also stamped on the right side of the chassis forward of the spring mounting turret.



### Vehicle Identification Number Plate (Saudi Arabia)



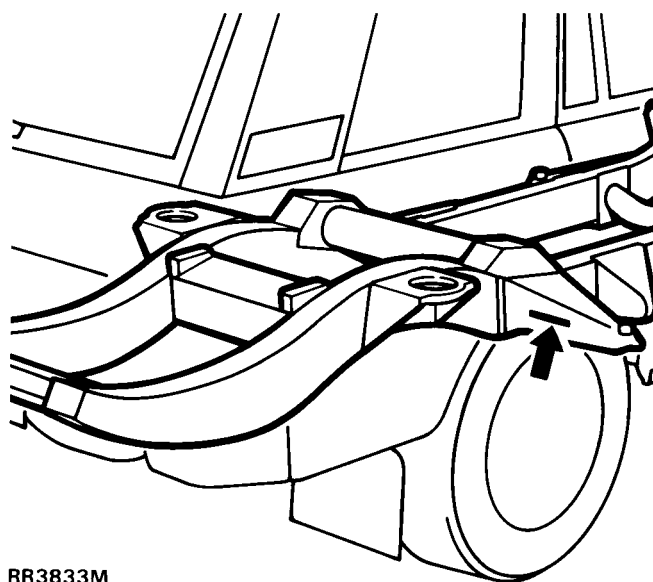
- A. Year of manufacture
- B. Month of manufacture
- C. Maximum vehicle weight
- D. Maximum road weight-front axle
- E. Maximum road weight-rear axle
- F. VIN (17 digits)

The vehicle identification number identifies the manufacturer, model range, wheel base, body type, engine, steering, transmission, model year and place of manufacture. The following example shows the coding process.

- SAL World manufacturer identifier
- LH Range Rover or
- LJ Discovery
- G Class 100 inch
- B 2 door
- F 300 Tdi or
- V V8i Petrol
- 8 5 speed LHD or
- 7 5 speed RHD
- M 1995 MY
- A Solihull site



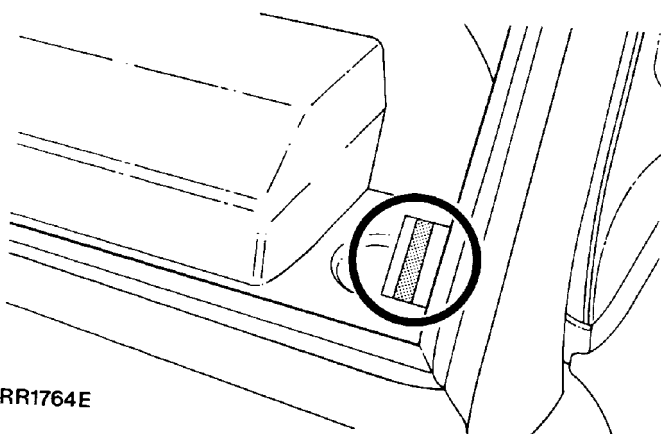
**European vehicle identification number (VIN)**



RR3833M

Stamped on the right hand side chassis forward of rear wheel.

**Federal (USA) vehicle identification number**

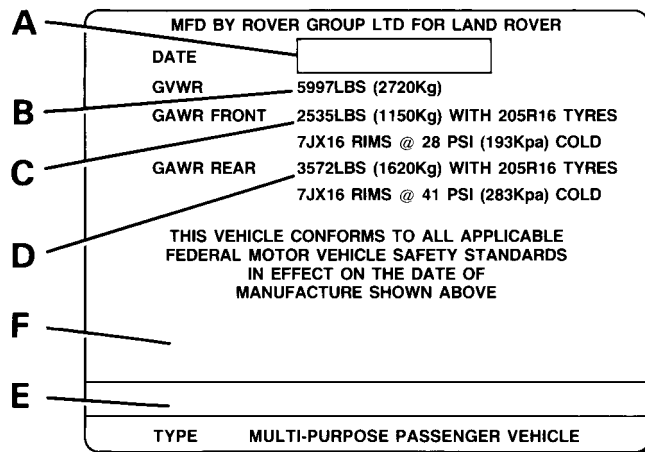


RR1764E

Stamped on a plate rivetted to the upper left hand 'A' - post, visible through the front screen of the vehicle.

**Vehicle identification number (VIN)**

An adhesive label containing the Vehicle Identification Number, date of manufacture and gross axle weight ratings is fixed to the lock face of the front left hand door. The information includes wheel and tyre sizes and tyre pressures at gross axle weight ratings.



RR2944E

**Key to vehicle identification label**

- A. Month and year of manufacture
- B. Gross vehicle weight rating
- C. Gross axle weight rating for front axle
- D. Gross axle weight rating for rear axle
- E. Vehicle identification number (17 digits)
- F. Vehicle identification number - bar code

## LOCATION OF IDENTIFICATION NUMBERS

### Engine serial number - 300Tdi Engine

The 300Tdi engine number is stamped on the cylinder block on the right hand side of the engine above the camshaft front cover plate.

### Engine serial number - Mpi engine

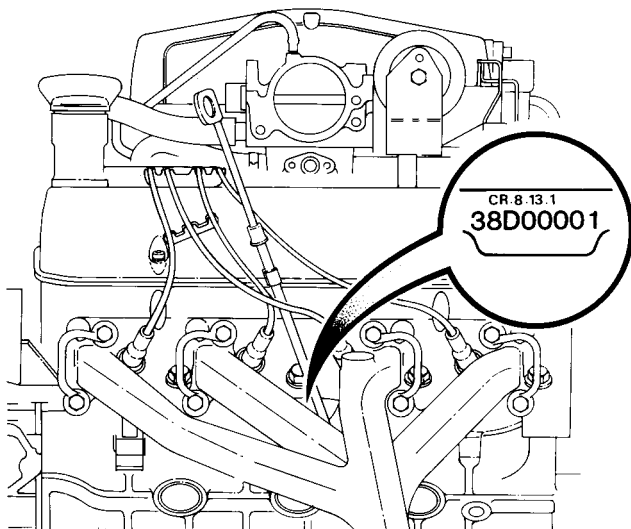
Stamped on the R.H. face of the cylinder block adjacent to the gearbox.

### Engine serial number - V8i engine

Stamped on a cast pad on the cylinder block, between numbers 3 and 5 cylinders.



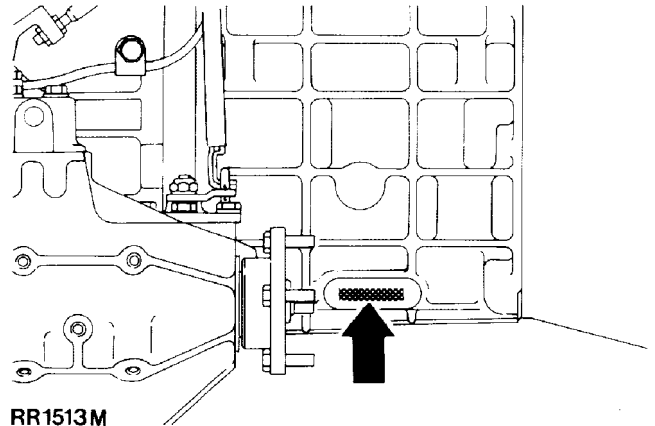
**NOTE:** The appropriate engine compression ratio is stamped above the serial number.



RR2758E

### Main gearbox R380

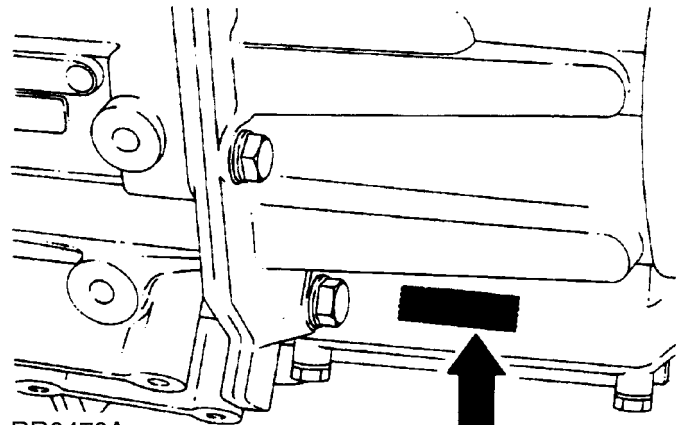
Stamped on a cast pad on the bottom right hand side of the gearbox.



RR1513M

### Transfer gearbox LT230

The serial number is stamped on the left hand side of the gearbox casing below the mainshaft rear bearing housing adjacent to the bottom cover.



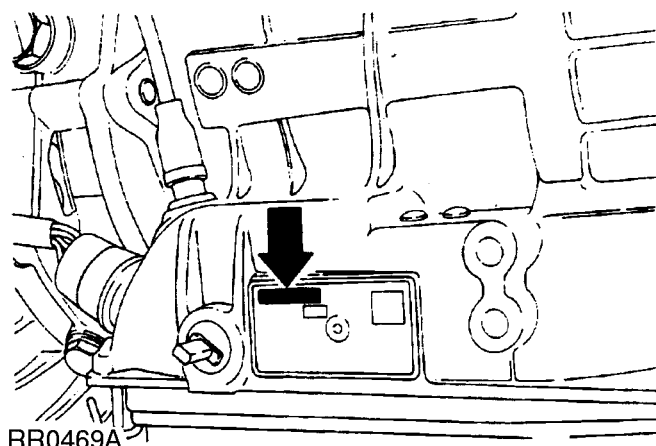
RR0470A

### Front and rear axles

Serial number is stamped on top of the left hand axle tube.

### Automatic gearbox

Stamped on a plate riveted to the bottom left hand side of the gearbox casing.



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**FAULT DIAGNOSTIC EQUIPMENT**

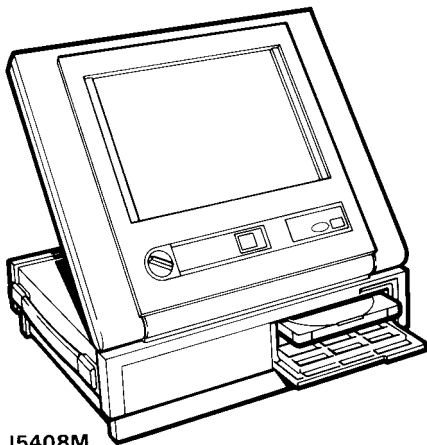

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**TESTBOOK**

Today's Land Rover Vehicles are equipped with a large amount of electronics to provide the best performance of the vehicles systems.

Diagnostic equipment named TESTBOOK is available to expand the diagnostic abilities of the dealer workshop. This repair manual is produced with Testbook in mind.

Features of Testbook include :- Fully upgradable support for the technician. Structured diagnostics to accommodate all skill levels. Touch screen operation. Direct print out of screen information and test results.



J5408M

**ELECTRICAL TROUBLESHOOTING MANUAL**

The Electrical Troubleshooting Manual is a separate publication that is intended for use by trained Land Rover technicians as an aid to diagnosing electrical concerns.

It provides circuit diagrams, system diagnosis flow charts, electrical component location tables, electrical component location views and circuit operation details.

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**READING THIS MANUAL**


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This manual is divided into sections shown on the contents page, alongside a range of icons, familiar to service technicians.

Relevant information is contained within each of these sections. These are further divided into the following sub-sections which appear at the foot of each page :-

**Description and operation.**

**Fault diagnosis.**

**Adjustment.**

**Repair.**

**Overhaul.**

**Specifications, Torque.**

**Service tools.**

To avoid repeating information through the sections, where part of the repair operation impacts on another section, a cross reference is given to direct the reader to where the information is sited.

For example:

The maintenance section states the need to renew V8i drive belt. A cross reference sites this information in: Section: V8i Engine

- Sub-section: Repairs

- Heading: Drive belt renew.

Sections that contain derivatives such as engines are further separated within that section.

**American terminology.**

A few words used in this manual differ to words used in America. Where this occurs the American word is placed inside brackets. For example: bonnet [hood], wing [fender], ramp [hoist].




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**ENGINE 3.9 V8i**


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Type .....	V8i
Number of cylinders .....	Eight, two banks of four
Bore .....	94,00 mm
Stroke .....	71,12 mm
Capacity .....	3950 cc
Compression ratio .....	8.13:1 or 9.35:1
Valve operation .....	Overhead by push-rod
Maximum power	
- 8.13:1 .....	127kW at 4550 rev/min
- 9.35:1 .....	134kW at 4750 rev/min

**Crankshaft**

Main journal diameter .....	58,409-58,422 mm
Minimum regrind diameter .....	57,393-57,406 mm
Crankpin journal diameter .....	50,800-50,812 mm
Minimum regrind diameter .....	49,784-49,797 mm
Crankshaft end thrust/(end float) .....	Taken on thrust washers of centre main bearing 0,10-0,20 mm

**Main bearings**

Number and material .....	5, Lead-indium
Diametrical clearance .....	0,010-0,048 mm
Undersize bearing shells .....	0,254 mm, 0,508 mm

**Connecting rods**

Type .....	Horizontally split big-end, plain small-end
Length between centres .....	143,81-143,71 mm

**Big-end bearings**

Type and material .....	Lead-indium
Diametrical clearance .....	0,015-0,055 mm
End-float crankpin .....	0,15-0,36mm
Undersize bearing shells .....	0,254 mm, 0,508 mm

**Piston pins**

Length .....	72,67-72,79 mm
Diameter .....	22,215-22,220 mm
Fit-in connecting rod .....	Press fit
Clearance in piston .....	0,002-0,007 mm

**Pistons**

Clearance in bore, measured at bottom  
of skirt at right angles to piston pin ..... 0,018-0,041 mm

**Piston rings**

Number of compression rings ..... 2  
 Number of control rings ..... 1  
 No 1 compression ring ..... Molybdenum barrel faced  
 No 2 compression ring ..... Tapered and marked 'T' or 'TOP'  
 Width of compression rings ..... 1,478-1,49 mm  
 Compression ring gap ..... 0,40-0,65 mm  
 Oil control ring width ..... 3,0 mm  
 Oil control ring rail gap ..... 0,38-1,40 mm

**Camshaft**

Location ..... Central  
 Bearings ..... Tin - aluminium  
 Number of bearings ..... 5  
 Drive ..... Chain 9,52 mm pitch x 54 pitches.

**Tappets** ..... Hydraulic-self-adjusting

**Valves**

Length: Inlet ..... 116,59-117,35 mm  
 Exhaust ..... 116,59-117,35 mm  
 Seat angle: Inlet ..... 45° to 45 1/2°  
 Exhaust ..... 45° to 45 1/2°  
 Head diameter: Inlet ..... 39,75-40,00 mm  
 Exhaust ..... 34,226-34,480 mm  
 Stem diameter: Inlet ..... 8,664-8,679 mm  
 Exhaust ..... 8,651-8,666 mm  
 Stem to guide clearance: Inlet ..... 0,025-0,066 mm  
 Exhaust ..... 0,038-0,078 mm  
 Valve lift (Inlet and Exhaust) ..... 9,49 mm  
 Valve spring length fitted ..... 40,4 mm at pressure of 29,5 kg

**Lubrication**

System type ..... Wet sump, pressure fed  
 Oil pump type ..... Eccentric rotor  
 Oil pressure ..... 2.75 bar (40 lb/in<sup>2</sup>) at 2500 rev/min with engine at  
 running temperature  
 Oil filter-internal ..... Wire screen, pump intake filter.  
 Oil filter-external ..... Full flow, self-contained cartridge






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**ENGINE 4.0 V8**


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Type .....	4.0 litre V8	
Number of cylinders .....	Eight, two banks of four	
Bore .....	94.00 mm	3.70 in
Stroke .....	71.12 mm	2.80 in
Capacity .....	3950 cm <sup>3</sup>	241 cu in
Valve operation .....	Overhead by push-rod	
	<b>High Compression</b>	<b>Low Compression</b>
Compression ratio .....	9.35:1	8.2:1
Valve operation .....	Overhead by push-rod	
Maximum power:		
9.35:1 .....	140kW at 4750 rev/min	
8.2:1 .....	132kW at 4750 rev/min	

**Crankshaft**

Main journal diameter .....	63.500 - 63.487 mm	2.50 - 2.4995 in
Crankpin journal diameter .....	55.513 - 55.500 mm	2.1855 - 2.1850 in
Crankshaft end thrust/end float .....	Taken on thrust washers of centre main bearing	
	0.10 - 0.20 mm	0.004 - 0.008 in

**Main bearings**

Number and type .....	5, Vandervell shells	
Material .....	Lead bronze with lead-indium overlay	
Diametrical clearance .....	0.015 - 0.060 mm	0.0006 - 0.0024 in

**Connecting rods**

Type .....	Horizontally split big-end, plain small-end	
Length between centres .....	155.12 - 155.22 mm	6.1071 - 6.1110 in

**Big-end bearings**

Type and material .....	Vandervell VP3 Lead bronze with lead-indium overlay	
Diametrical clearance .....	0.015 - 0.016 mm	0.0006 - 0.0024 in

**Piston pins**

Length .....	60.00 - 60.50 mm	2.3622 - 2.3819 in
Diameter .....	23.995 - 24.000 mm	0.9447 - 0.9449 in
Fit-in connecting rod .....	Press fit	
Clearance in piston .....	0.015 - 0.006 mm	0.0006 - 0.0002 in

**Pistons**

Clearance in bore, measured at bottom of skirt at right angles to piston pin .....	0.020 - 0.050 mm	0.0008 - 0.0020 in
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### Piston rings

Number of compression rings .....	2	
Number of control rings .....	1	
No 1 compression ring .....	Nitrided steel barrel faced	
No 2 compression ring .....	Tapered spherical barrel marked 'TOP'	
Width of compression rings .....	1.478 - 1.49 mm	0.0582 - 0.0587 in
(Top) .....	1.21 - 1.23 mm	0.0476 - 0.0484 in
Compression ring gap .....	0.40-0.65 mm	0.0157 - 0.0256 in
(Top) .....	0.3 - 0.5 mm	0.0118 - 0.0197 in
Oil control ring type .....	Aclonoforn	
Oil control ring width .....	3.0 mm	0.1181 in
Oil control ring rail gap .....	0.38-1.40 mm	0.0150 - 0.0551 in

### Camshaft

Location .....	Central	
Bearings .....	Non serviceable	
Number of bearings .....	5	
Drive .....	Chain 9.52 mm pitch x 54 pitches.	
Camshaft End Float .....	0.076 - 0.355 mm	0.003 - 0.014 in

**Tappets** ..... Hydraulic self-adjusting

### Valves

Length:	Inlet .....	116.59 - 117.35 mm	4.590 - 4.620 in
	Exhaust .....	116.59 - 117.35 mm	4.590 - 4.620 in
Seat angle:	Inlet .....	46° - 46°25'	
	Exhaust .....	46° - 46°25'	
Head diameter:	Inlet .....	39.75 - 40.00 mm	1.565 - 1.575 in
	Exhaust .....	34.227 - 34.48 mm	1.3475 - 1.3575 in
Stem diameter:	Inlet .....	8.664 - 8.679 mm	0.3411 - 0.3417 in
	Exhaust .....	8.651 - 8.666 mm	0.3406 - 0.3412 in
Stem to guide clearance:	Inlet .....	0.025 - 0.066 mm	0.0010 - 0.0026 in
	Exhaust .....	0.038 - 0.078 mm	0.0015 - 0.0031 in
Valve lift (Inlet and Exhaust) .....	9.94 mm	0.3913 in	
Valve spring length fitted .....	40.4 mm (1.59 in) at pressure of 29.5 kg (65 lb)		

### Lubrication

System type .....	Wet sump, pressure fed	
Oil pump type .....	Rotor	
Oil pressure .....	2.11 to 2.81 kg/cm <sup>2</sup> (30 to 40 psi) at 2400 rev/min with engine warm	
Oil filter-internal .....	Wire screen, pump intake filter in sump	
Oil filter-external .....	Full flow, self-contained cartridge	




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**FUEL SYSTEM 3.9 V8i**


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Fuel system type .....	Lucas 14CUX hot wire system electronically controlled
Fuel pump-make/type .....	ACX delco high pressure electrical, immersed in the fuel tank
Fuel pump delivery pressure .....	2.4-2.6 bar (34-37 lbf/in <sup>2</sup> )
Fuel filter .....	Bosch in-line filter 'canister' type

**Airflow Sensor**

Make and type .....	Lucas 'Hot Wire' 5AM
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**Injectors**

Make and type .....	Lucas 8NJ
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**Electronic Control Unit**

Make and type .....	Lucas 14CUX
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**Fuel pressure regulator**

Make and type .....	Lucas 8RV
---------------------	-----------

**Fuel temperature sensor**

Make and type .....	Lucas 6TT
---------------------	-----------

**Coolant temperature sensor**

Make and type .....	Lucas 3TT
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**Bypass Airvalve (Stepper motor)**

Make and type .....	Lucas 2ACM
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**Throttle potentiometer**

Make and type .....	Lucas 215SA
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**Lambda sensor - catalyst vehicles**

Make and type .....	Lucas 3LS
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**FUEL SYSTEM (GEMS) 4.0 V8 ENGINE**

Type ..... Sagem - Lucas Gems 8 hot wire system electronically controlled

Fuel pump-make/type ..... High pressure electrical, immersed in the fuel tank

Fuel pump delivery pressure ..... 2.4-2.6 bar (34-37 lbf/in<sup>2</sup>)

Fuel filter ..... Bosch in-line filter 'canister' type

**Mass airflow sensor**

Make and type ..... Lucas 'Hot Wire' 20AM

**Injectors**

Make and type ..... Lucas D1000

**Electronic Control Module**

Make and type ..... Lucas GEMS 8.3

**Fuel pressure regulator**

Make and type ..... Lucas 8RV

**Coolant temperature sensor**

Make and type ..... Lucas 8TT

**Bypass Air valve (Stepper motor)**

Make and type ..... Lucas 3ACM

**Throttle position sensor**

Make and type ..... Lucas 3TP

**Heated oxygen sensor - catalyst vehicles**

Make and type ..... Lucas 4LS

**Camshaft position sensor**

Make and Land Rover part no. .... Lucas ERR6170

**Crankshaft position sensor**

Make and type ..... Lucas 3VRS, Honeywell ERR6049

**Knock sensor**

Make and type ..... Lucas 2KS

**Intake air temperature sensor**

Make and type ..... Lucas 10TT

**Ignition coils**

Make and type ..... Lucas 2DIS2

**Fuel temperature sensor**

Make and type ..... Lucas 6TT


**SHIFT SPEED AUTOMATIC ZF ON 3.9 V8i**

OPERATION	SELECTOR POSITION	VEHICLE SPEED APPROX		ENGINE SPEED APPROX (RPM)
<b>KICKDOWN</b>				
		<b>MPH</b>	<b>KPH</b>	
KD4 - 3	D	84 - 92	136 - 150	
KD3 - 2	3(D)	57 - 62	91 - 99	
KD2 - 1	2(D,3)	27 - 34	44 - 56	
KD3 - 4	D	N/A	N/A	
KD2 - 3	D(3)	60 - 63	96 - 104	4750 - 5200
KD1 - 2	D(3,2)	34 - 40	56 - 64	4600 - 5250
<b>FULL THROTTLE</b>				
FT4 - 3	D	61 - 67	98 - 108	
FT3 - 2	3(D)	40 - 46	64 - 73	
FT3 - 4	D	74 - 80	119 - 129	3980 - 4330
FT2 - 3	D(3)	55 - 60	88 - 96	4350 - 4800
FT1 - 2	D(3,2)	29 - 34	48 - 56	3950 - 4650
<b>PART THROTTLE</b>				
PT4 - 3	D	47 - 54	75 - 86	
PT3 - 2	D(3)	29 - 37	48 - 59	
PT2 - 1	D(3,2)	10 - 12	16 - 19	
<b>LIGHT THROTTLE</b>				
LT3 - 4	D	26 - 30	43 - 49	1430 - 1650
LT2 - 3	D(3)	18 - 22	29 - 35	1420 - 1820
LT1 - 2	D(3,2)	9 - 10	14 - 16	1180 - 1220
<b>ZERO THROTTLE</b>				
ZT4 - 3	D	19 - 25	31 - 41	
ZT3 - 2	D(3)	12 - 15	19 - 24	
ZT2 - 1	D(3,2)	6 - 7	10 - 11	
<b>TORQUE CONVERTER</b>				
Lock up (IN)	D	51 - 54	81 - 86	1875 - 2000
Unlock (OUT)	D	49 - 52	78 - 83	1825 - 1930

NOTE: The speeds given in the above chart are approximate and only intended as a guide. Maximum shift changes should take place within these tolerance parameters.

## SHIFT SPEED AUTOMATIC ZF ON Tdi ENGINE

OPERATION	SELECTOR POSITION	VEHICLE SPEED APPROX		ENGINE SPEED APPROX (RPM)
<b>KICKDOWN</b>				
		<b>MPH</b>	<b>KPH</b>	
KD4 - 3	D	62 - 72	99 - 115	
KD3 - 2	3(D)	43 - 49	69 - 78	
KD2 - 1	2(D,3)	23 - 36	37 - 58	
KD3 - 4	D	64 - 76	102 - 122	3400 - 4000
KD2 - 3	D(3)	46 - 51	74 - 82	3600 - 3900
KD1 - 2	D(3,2)	26 - 29	42 - 46	3500 - 3800
<b>PART THROTTLE</b>				
PT4 - 3	D	39 - 45	62 - 72	
PT3 - 2	D(3)	24 - 30	38 - 48	
PT2 - 1	D(3,2)	18 - 20	29 - 32	
<b>LIGHT THROTTLE</b>				
LT3 - 4	D	24 - 28	38 - 45	1300 - 1400
LT2 - 3	D(3)	21 - 23	34 - 37	1700 - 1800
LT1 - 2	D(3,2)	13 - 14	21 - 22	1700 - 1900
<b>ZERO THROTTLE</b>				
ZT4 - 3	D	22 - 27	35 - 43	
ZT3 - 2	D(3)	18 - 22	29 - 35	
ZT2 - 1	D(3,2)	9 - 11	14 - 18	
<b>TORQUE CONVERTER</b>				
Lock up (IN)	D	46 - 49	74 - 78	1600 - 1850
Unlock (OUT)	D	45 - 48	72 - 77	1700 - 1800

NOTE: The speeds given in the above chart are approximate and only intended as a guide. Maximum shift changes should take place within these tolerance parameters.




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**TRANSMISSION 3.9 V8i**


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**Manual gearbox**

Type R380 ..... Single helical constant mesh  
 Speeds ..... 5 forward 1 reverse all synchromesh

**Clutch**

Make and type ..... Borg and beck diaphragm type.  
 Clutch plate diameter ..... 266.5mm.

**Automatic gearbox**

Type ZF4HP ..... Four speed and reverse with fluid torque converter

**Transfer box**

Type LT230T ..... Two speed reduction on main gearbox output, front and rear drive permanently engaged via a lockable differential.

**Propeller shafts**

Type  
 Front ..... Tubular 51mm diameter  
 Front - Catalyst vehicles ..... Solid bar 28.6mm diameter  
 Rear ..... Tubular 51mm diameter  
 Universal joints ..... Open type Hookes O3EHD

**Rear axle**

Type ..... Spiral bevel, fully floating shafts  
 Ratio ..... 3.54:1

**Front axle**

Type ..... Spiral bevel, enclosed constant velocity joints, fully floating shafts  
 Angularity of universal joint on full lock ..... 32°  
 Ratio ..... 3.54:1

**COOLING SYSTEM 3.9 V8i**

System type .....	Pressurised, spill return, thermostatically controlled water and anti-freeze mixture. Pump assisted thermo syphon. Coolant radiator combined with oil cooler.
Fan and viscous coupling assembly .....	11 blade axial flow 433mm diameter.
Pump type .....	Centifugal, impellor, belt driven.
Thermostat opening .....	88 degrees.
Expansion tank cap pressure .....	15 p.s.i. (system pressure).

**STEERING****Power steering box**

Make/type .....	Adwest Varamatic - worm and roller box
Ratio .....	Variable: straight ahead 19.3:1 on lock 14.3:1
Steering wheel turns, lock-to-lock .....	3.375

**Steering pump**

Make/type -V8i .....	ZF - Unicorn
Make/type - Mpi & Tdi .....	Hobourn-Eaton series 500

**Steering geometry**

Steering wheel diameter .....	405mm
Steering wheel diameter airbag model .....	400mm
Toe-out measurement .....	0 to 2mm toe out
Toe-out included angle .....	0° to 0° 16'
Camber angle .....	0° ..... Check with vehicle in static unladen condition, that is, vehicle with water,
Castor angle .....	3° ..... oil and five gallons of fuel. Rock the vehicle up and down at the front to allow
Swivel pin inclination static .....	7° ..... it to take up a position





**SUSPENSION**

Type .....	Coil springs controlled by telescopic dampers front and rear.
Front .....	Lateral location of axle by Panhard rod, and longitudinal location by two radius arms.
Rear .....	Lateral location of axle by a centrally positioned 'A' frame bolted at the apex to a ball joint mounting. Longitudinal location of axle by two tubular trailing links.

**ROAD SPRING DATA**

**V8i - Mpi**

<b>LEFT HAND DRIVE</b>	<b>Part No</b>	<b>Colour Code</b>
Left hand front	NRC 4306	Blue/White
Right hand front	572315	Blue
Left/Right hand rear	ANR 3477 or ANR 4352	Brown/Green Orange/Orange *

<b>RIGHT HAND DRIVE</b>	<b>Part No</b>	<b>Colour Code</b>
Left hand front	572315	Blue
Right hand front	572315	Blue
Left/Right hand rear	ANR 3477 or ANR 4352	Brown/Green Orange/Orange *

**Tdi Diesel**

<b>RIGHT HAND DRIVE</b>	<b>Part No</b>	<b>Colour Code</b>
Left hand front	ANR 1975 or ANR 4350	Blue/Pink/Red Brown/Brown **
Right hand front	ANR 1976 or ANR 4351	Blue/Pink/Yellow Grey/Grey **
Left/Right hand rear	ANR 3477 or ANR 4352	Brown/Green Orange/Orange *

<b>LEFT HAND DRIVE</b>	<b>Part No</b>	<b>Colour Code</b>
Left hand front	ANR 1976 or ANR 4351	Blue/Pink/Yellow Grey/Grey **
Right hand front	ANR 1975 or ANR 4350	Blue/Pink/Red Brown/Brown **
Left/Right hand rear	ANR 3477 or ANR 4352	Brown/Green Orange/Orange *

\* VIN 119534 onwards  
\*\* VIN 116461 onwards

**SHOCK ABSORBERS**

Type ..... Telescopic, double-acting non-adjustable  
 Bore diameter ..... 35.47mm

**BRAKES****Front service brake**

Type ..... Outboard discs with four piston calipers  
 Operation ..... Hydraulic, servo assisted self-adjusting  
 Pad material ..... non asbestos

**Rear service brake**

Type ..... Outboard discs with two piston calipers  
 Operation ..... Hydraulic, servo assisted, self-adjusting  
 Pad material ..... non asbestos

**Parking brake**

Type ..... Mechanical-cable operated drum brake on the rear of  
 the transfer gearbox output shaft  
 Lining material ..... non asbestos

**Servo/master cylinder non ABS**

Manufacturer ..... Lucas  
 Servo type ..... LSC 115  
 Master cylinder type ..... AS/AS

**Anti-lock brake system**

Manufacturer/type ..... Wabco 4 wheel sensed add on anti-lock brake  
 system.

**Servo/master cylinder ABS**

Manufacturer ..... Lucas  
 Master cylinder type ..... CV/CV

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**AIR CONDITIONING**


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System .....	Nippon Denso
Compressor .....	Nippon Denso 10 PA 17
Refrigerant .....	R134a
Charge quantity .....	0.9Kg
Charge quantity with rear air conditioning .....	1.15Kg

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**WIPER MOTORS**


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**Tailgate wiper motor**

Make/type .....	IMOS (non-serviceable)
Running current, wet screen at 20°C ambient .....	1.0 to 2.8 amps
Wiper speed, wet screen at 20°C ambient .....	37 to 43 cycles per minute

**Windscreen wiper motor**

Make/type .....	Delco AMR 1514/5
Running current (Link disconnected) .....	1.5 amps at 39 to 45 rev/min (normal speed)
Rotary link speed .....	60 to 73 rev/min (high speed)

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**ELECTRICAL**


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System .....	12 volt, negative ground
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**Battery**

Make/type - basic .....	Land Rover Parts and Equipment/Lucas maintenance free 9-plate-YGD 10017
Make/type - heavy duty .....	Land Rover Parts and Equipment/Lucas maintenance free 14-plate-YGD 10015

**Generator**

Manufacturer .....	Magnetti Marelli
Type .....	A127i 100amp
Polarity .....	Negative ground
Brush length	
New .....	17 mm
Worn, minimum free protrusion from moulding .....	5 mm
Brush spring pressure flush with moulding .....	1.3N to 2.7N
Regulator voltage .....	13.6 to 14.4 volts
Nominal output	
Generator speed .....	6000 rev/min
Control voltage .....	14 volt
Amp .....	100 amp

**Coil**

Make/type ..... Bosch 0221 122 392

**Distributor**

Make/type ..... Lucas 35 DLM8  
Firing angles ..... 0°- 45°- 90°(every 45°) ± 1°  
Application ..... 12V Negative ground  
Pick-up air gap adjustment  
(Pick-up limb/reluctor tooth) ..... 0.20 mm to 0.35 mm  
Pick-up winding resistance ..... 2k to 5k ohms

**Fuses**

Type ..... Autofuse (blade type)  
blow ratings to suit individual circuits

**Horns**

Make/type ..... Klamix (Mixo) TR99

**Starter motor**

Make and type ..... Bosch 12v

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**BULBS**


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REPLACEMENT BULBS	TYPE		
<b>Exterior lights</b>			
Headlamps	12V	60/55W	(Halogen)
Headlamps - France amber	12V	60/55W	(Halogen)
Auxiliary driving lamps	12V	55W H3	(Halogen)
Sidelamps	12V	5W	bayonet
Tail lamps	12V	5/21W	bayonet
Reverse lamps	12V	21W	bayonet
Stop lamps	12V	21W	bayonet
Direction indicator lamps	12V	21W	bayonet
Rear side marker lamps	12V	5W	capless
Number plate lamps	12V	5W	capless
<b>Interior lights</b>			
Instrument panel lamps and warning lamps	12V	1.2W	bulb/holder unit
Ignition warning lamp (Instrument panel)	12V	2W	capless
Interior roof lamps	12V	10W	'Festoon'
Clock illumination	12V	1.2	capless
Cigar lighter illumination	12V	1.2W	capless
Door shut face/puddle lamps	12V	5W	capless
Auxiliary switch panel illumination (green)	12V	1.2W	capless
Heated rear screen warning lamp (amber)	12V	1.2W	capless
Hazard warning lamp	12V	1.2W	capless
Automatic graphics illumination	12V	5W	capless
Heater/air conditioning graphics illumination	12V	1.2W	bulb/holder unit
Differential lock warning lamp	12V	1.2W	bulb/holder unit
Column switch illumination	12V	1.2W	capless



**CAUTION:** The fitting of new bulbs with wattages in excess of those specified will result in damage to vehicle wiring and switches.

## VEHICLE WEIGHTS AND PAYLOAD

When loading a vehicle to its maximum (Gross Vehicle Weight), consideration must be taken of the unladen vehicle weight and the distribution of the payload to ensure that axle loadings do not exceed the permitted maximum values.

It is the customer's responsibility to limit the vehicle's payload in an appropriate manner such that neither maximum axle loads nor Gross Vehicle Weight are exceeded.

### Maximum EEC kerb weight and distribution - all optional equipment

#### VEHICLE WEIGHTS - Mpi

	3 Door	5 Door
Front axle .....	930 kg	930 kg
Rear axle .....	1010 kg	1055 kg
Total .....	1940 kg	1985 kg

#### Maximum axle weights

Front axle .....	1110 kg
Rear axle .....	1650 kg
Gross vehicle weight .....	2720 kg

#### VEHICLE WEIGHTS - V8i

Front axle .....	970 kg	970 kg
Rear axle .....	1010 kg	1055 kg
Total .....	1980 kg	2025 kg

#### Maximum axle weights

Front axle .....	1100 kg
Rear axle .....	1650 kg
Gross vehicle weight .....	2720 kg

#### VEHICLE WEIGHTS - 300 Tdi

Front axle .....	1040 kg	1040 kg
Rear axle .....	1015 kg	1060 kg
Total .....	2055 kg	2100 kg

#### Maximum axle weights

Front axle .....	1200 kg
Rear axle .....	1650 kg
Gross vehicle weight .....	2720 kg

EEC kerb weight = Unladen weight + Full fuel tank + 75 kg driver.



**TYRE PRESSURES**

Pressures: Check with tyres cold	Normal on and off-road use.		Off-road 'emergency' soft use maximum speed of 40 kph (25 mph)	
	All speeds and loads			
205R16 Radial	Front	Rear	Front	Rear
bars	1.9	2.6	1.2	1.8
lbf/in <sup>2</sup>	28	38	17	25
kgf/cm <sup>2</sup>	2.0	2.7	1.2	1.8



**WARNING:** Vehicles fitted with tubeless alloy road wheels as original equipment, note that these wheels **DO NOT** accept inner tubes and tubed tyres **MUST NOT** be fitted.



**NOTE:** Emergency soft pressures should only be used in extreme conditions where extra floatation is required. Max speed 40km/h (25mph).

**WHEELS AND TYRES**

Type and size ..... Alloy 7.00J X 16  
 Tyre size ..... 205R16 (tubeless)

Type and size ..... Steel 6.00JK X 16  
 Tyre size ..... 205R16 (tubed)

**'Freestyle' choice tyre specification**

Tyre size ..... 235/70 R16  
 Front  
 Tyre pressure ..... 26 lbf/in<sup>2</sup>      Rear  
 34 lbf/in<sup>2</sup>



**NOTE:** Petrol vehicles must be fitted with 'S' or 'T' rated tyres.

**300 Tdi ENGINE**

Type .....	Direct injection, turbocharged, intercooled
Number of cylinders .....	4
Bore .....	90,47 mm
Stroke .....	97,00 mm
Capacity .....	2495 cc
Compression ratio .....	19.5:1 ± 0.5:1
Valve operation .....	O.H.V. pushrod operated

**Crankshaft**

Main bearing journal diameter .....	63,475 - 63,487 mm
Regrind dimensions .....	63,2333 - 63,246 mm
	Use 0.010 in U/S bearings
Crankpin journal diameter .....	58,725 - 58,744 mm
Regrind dimensions .....	58,4708 - 58,48985 mm
	Use 0.010 in U/S bearings
Crankshaft end thrust .....	Taken on thrust washers at centre main bearing
Crankshaft end float .....	0,05 - 0,15 mm

**Main bearings**

Number and type .....	5 halved shells with oil grooves
Diametrical clearance .....	0,0792 - 0,0307 mm

**Connecting rods**

Length between centres .....	175,38 - 175,43 mm
Diametrical clearance (big-end bearings) .....	0,025 - 0,075 mm
End float on crankpin .....	0,15 - 0,356 mm

**Pistons**

Type .....	Aluminium alloy, combustion chamber in crown. Graphite coating on sidewalls.
Skirt diametrical clearance (at right angle to gudgeon pin) .....	0,025 - 0,05 mm
Maximum height above combustion face .....	0,8 mm

**Gudgeon pins**

Type .....	Floating
Fit in piston .....	Hand push fit
Diameter .....	30,1564 - 30,1625 mm
Clearance in connecting rod .....	0,0025 - 0,0163 mm



### Piston rings

#### Type:

- Top ..... Barrel edge, chrome plated
- Second ..... Taper faced
- Oil control ..... Expander and rails

#### Gap in bore:

- Top ..... 0,40 - 0,60 mm
- Second ..... 0,30 - 0,50 mm
- Oil control ..... 0,3 - 0,6 mm

#### Clearance in piston grooves:

- Second ..... 0,050 - 0,085 mm
- Oil control ..... 0,050 - 0,085 mm

### Camshaft

- Drive ..... 30 mm wide dry toothed belt
- Location ..... Right hand side (thrust side)
- End float ..... 0,1 - 0,2 mm
- Number of bearings ..... 4
- Material ..... Steel shell, white metal lined

### Valves

#### Tappet clearance:

- Inlet and exhaust ..... 0,20 mm

#### Seat angle:

- Inlet ..... 30°
- Exhaust ..... 45°

#### Head diameter:

- Inlet ..... 38,75 - 39,05 mm
- Exhaust ..... 36,35 - 36,65 mm

#### Stem diameter:

- Inlet ..... 7,960 - 7,975 mm
- Exhaust ..... 7,940 - 7,960 mm

#### Valve lift:

- Inlet ..... 9,67 mm
- Exhaust ..... 9,97 mm

#### Cam lift:

- Inlet ..... 6,81 mm
- Exhaust ..... 7,06 mm

#### Valve head stand down

- Inlet ..... 0,81 - 1,09 mm
- Exhaust ..... 0,86 - 1,14 mm

### Valve springs

- Type ..... Single coil
- Length, free ..... 46,28 mm
- Length, under 21 kg load ..... 40,30 mm

**Lubrication**

System .....	Wet sump, pressure fed
Pressure, engine warm at normal operating speeds .....	25 - 55lb/in <sup>2</sup> = 1,76 - 3,87Kgf cm <sup>2</sup>
Oil pump:	
- Type .....	G-rotor integral with front cover.
- Drive .....	off crankshaft nose
Oil pressure relief valve .....	Non-adjustable
Relief valve spring:	
- Full length .....	51,6mm
- Compressed length at 7.71Kg load .....	31mm
Oil filter .....	Screw-on disposable canister
Engine oil cooler .....	Combined with coolant radiator and intercooler

**FUEL SYSTEM - 300 Tdi**

Fuel lift pump type .....	Mechanical with hand primer
Fuel lift pump pressure .....	42 - 55 kpa at 1800 rpm
Fuel filter .....	Paper element in disposable canister
Air cleaner .....	Paper element type

**COOLING SYSTEM - 300 Tdi**

System type .....	Pressurised, spill return, thermostatically controlled water and anti freeze mixture. Pump assisted thermo syphon. Coolant radiator combined with oil cooler and turbo intercooler.
Cooling fan .....	11 blade axial flow 433 mm diameter. 1.29:1 drive ratio. Viscous coupling.
Pump type .....	Centrifugal, impellor, belt driven.
Thermostat opening .....	88°
Expansion tank cap pressure .....	15lb/in <sup>2</sup> = 1,06Kgf cm <sup>2</sup> (system pressure)

**CLUTCH - 300 Tdi**

Type .....	Valeo diaphragm spring
Centre plate diameter .....	235 mm
Facing material .....	Verto F202 grooved
Release bearing .....	Ball journal



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**TRANSMISSION - 300 Tdi**

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**Manual gearbox**

Type R380 ..... Single helical constant mesh  
Speeds ..... 5 forward 1 reverse all synchromesh

**Automatic gearbox**

Type ZF4HP ..... Four speed and reverse with fluid torque converter

**Transfer box**

Type LT230T ..... Two speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential

**ENGINE - Mpi - 2.0 LITRE**

Type .....	20 T4 - 16 valve twin overhead camshaft
Cylinder arrangement .....	4 in line
Bore .....	84.45 mm 3.325 in
Stroke .....	89.00 mm 3.504 in
Capacity .....	1994 cm <sup>3</sup> 121.68 in <sup>3</sup>
Firing order .....	1-3-4-2
Compression ratio .....	10 : 1

**Oil pump**

Outer rotor to body clearance .....	0.05 to 0.10 mm
Inner rotor tip clearance .....	0.025 to 0.12 mm
Outer rotor end float .....	0.03 to 0.08 mm

**Oil pressure relief valve**

Spring free length .....	42.0 mm
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**Cooling system**

Starts to open .....	82 to 86°C
Thermostat fully open .....	88°C
Open travel A .....	9 mm

**Camshaft**

Camshaft end-float .....	0.06 to 0.25 mm
Bearing clearance .....	0.060 to 0.094 mm
Service limit .....	0.15 mm

**Timing belt tensioner**

Spring free length .....	57.5 to 58.5 mm
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**Cylinder head**

Longitudinal warp - maximum .....	0.1 mm
Transverse warp - maximum .....	0.1 mm
Diagonal warp - maximum .....	0.1 mm
Cylinder head height .....	135.0 to 135.1 mm

**Valve springs**

Free length .....	46.25 mm
Fitted length .....	37.0 mm
Load at fitted length .....	255 ± 12 N
Load at valve open length .....	560 ± 22.5 N

**Valves**

Valve stem diameter:	
Inlet .....	7.09 to 7.10 mm
Exhaust .....	7.07 to 7.09 mm
Valve head diameter:	
Inlet .....	31.7 to 31.95 mm
Exhaust .....	29.2 to 29.43 mm
Valve installed height - maximum .....	43.4 mm
Valve stem to guide clearance:	
Inlet .....	0.04 to 0.06 mm
Service limit .....	0.09 mm
Exhaust .....	0.06 to 0.07 mm
Service limit .....	0.10 mm

**Valve guides**

Internal diameter - Inlet and Exhaust .....	7.137 to 7.162 mm
Overall length:	
Inlet .....	48.5 mm
Exhaust .....	52.9 mm

**Valve seats**

Valve seat angle - Inlet and Exhaust .....	45°
Valve seat width - Inlet and Exhaust .....	1.5 to 2.0 mm
Valve face angle:	
Inlet and Exhaust .....	45° to 45°15'

**Crankshaft**

End-float .....	0.03 to 0.2 mm
Thrust washer halves thickness .....	2.31 to 2.36 mm
Main journal diameter .....	54.005 to 54.026 mm
Maximum out of round .....	0.010 mm
Main bearing diametric clearance .....	0.03 to 0.07 mm
Big-end journal diameter .....	47.648 to 47.661 mm
Maximum out of round .....	0.010 mm
Big-end bearing diametric clearance .....	0.04 to 0.08 mm

**Piston rings**

New ring to groove clearance:	
Top compression .....	0.06 to 0.09 mm
2nd compression .....	0.05 to 0.07 mm
Oil control rails - expander fitted .....	0.03 to 0.05 mm
Ring fitted gap:	
Top compression .....	0.25 to 0.35 mm
2nd compression .....	0.3 to 0.5 mm
Oil control rails .....	0.38 to 1.14 mm

**Pistons**

Piston diameter:	
Grade A .....	84.409 to 84.422 mm
Grade B .....	84.423 to 84.436 mm
Clearance in bore .....	0.01 to 0.03 mm

**Cylinder bore**

Grade A .....	84.442 to 84.455 mm
Grade B .....	84.456 to 84.469 mm

**FUEL SYSTEM - Mpi**

Electronic fuel injection data ..... *See ENGINE TUNING DATA, Information, Engine - Mpi - 2.0 Litre*

**Fuel Pump:**

Make/Type ..... A.C. Rochester/Electric immersible  
 Pump pressure ..... 3.2 bar  
 Delivery at 3 bar pressure & 12V (min) ..... 64 litre/h  
 Regulated pressure range ..... 3.0  $\pm$  0.2 bar  
 Fuel pump delivery pressure ..... 2.3 - 2.5 kgf/cm<sup>2</sup>  
 Fuel filter ..... Bosch in-line filter 'canister' type

**COOLING SYSTEM - Mpi**

Pressure cap ..... 15lbf/in<sup>2</sup> (1.03 bar) (system pressure)  
 Thermostat ..... 88 °C

**CLUTCH - Mpi**

Type ..... Diaphragm spring, hydraulically operated  
 Adjustment ..... Self adjusting  
 Clutch plate diameter ..... 215.13 mm

**TRANSMISSION - Mpi****Manual gearbox**

Type R380 ..... Single helical constant mesh  
 Speeds ..... 5 forward 1 reverse all synchromesh

**Transfer box**

Type LT230T ..... Two speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential

**Overall ratios (final drive):**

	<b>In high transfer</b>	<b>In low transfer</b>
Fifth .....	4.146:1	9.761:1
Fourth .....	4.989:1	11.746:1
Third .....	7.518:1	17.701:1
Second .....	11.479:1	27.109:1
First .....	17.884:1	42.109:1
Reverse .....	18.463:1	43.472:1



**VEHICLE DIMENSIONS**

**Dimensions**

Overall length (including spare wheel) .....	4538 mm
Overall length (including tow hitch) .....	4581 mm
Overall width .....	2189 mm
Overall height .....	1914 mm
Wheelbase .....	2540 mm
Track front/rear .....	1486 mm
Width between wheel boxes .....	1080 mm
Seating capacity .....	5 to 7

**Performance**

Tyre size fitted .....	205 R16 radial
Tyre size fitted .....	235/70 R16 radial
Max. gradient (EEC kerb weight) .....	45°
Approach angle (EEC kerb weight) .....	35°
Departure angle with tow hitch (EEC kerb weight) .....	20°
Departure angle without tow hitch (EEC kerb weight) .....	29°
Ramp break over angle .....	33°
Min. ground clearance (unladen) .....	204 mm
Wading depth .....	500 mm

**Towing weights**

	<b>On road</b>	<b>Off road</b>
Unbraked trailers .....	750 kg	500 kg
Trailers with overrun brakes - Mpi .....	2750 kg	1000 kg
Trailers with overrun brakes - V8i & Tdi .....	3500 kg	1000 kg
4 wheel trailers with coupled brakes (FULLY BRAKED)* .....	4000 kg	1000 kg



**NOTE: \* Only applies to vehicles modified to accept coupled brakes.**



**NOTE: All weight figures are subject to local restrictions.**




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**ENGINE 3.9 V8i**


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<b>Type</b> .....	3.9 Litre V8i	
<b>Firing order</b> .....	1-8-4-3-6-5-7-2	
<b>Cylinder Numbers</b>		
Left bank .....	1-3-5-7	
Right bank .....	2-4-6-8	
<b>No 1 Cylinder location</b> .....	Pulley end of left bank	
<b>Timing marks</b> .....	On crankshaft vibration damper	
<b>Spark plugs</b>		
Make/type(8.13:1 Compression) .....	Champion RN11YCC	
Gap .....	0.84-0.96mm	
Make/type(9.35:1 Compression) .....	Champion RN11YCC	
Gap .....	0.84-0.96mm	
<b>Coil</b>		
Make/type .....	Bosch 0-221-122-392,	
<b>Compression ratio</b> .....	8.13:1 or 9.35:1	
<b>Fuel injection system</b> .....	Lucas 14 CUX Hot-wire air flow sensor system electronically controlled	
<b>Valve Timing</b>	<b>Inlet</b>	<b>Exhaust</b>
Opens .....	32°BTDC	70°BBDC
Closes .....	73°ABDC	35°ATDC
Duration .....	285°	285°
Valve peak .....	104°ATDC	114°BTDC
<b>Idle speed - controlled by MFI system</b>		
- all loads off in neutral .....	665 to 735 rev/min	
- auto gearbox in gear, air con operating .....	650 ± 28 rev/min	
- auto gearbox in gear, air con off .....	600 ± 28 rev/min	
- manual gearbox .....	700 ± 28 rev/min	
- manual gearbox, air con operating .....	750 ± 28 rev/min	
<b>Base idle speed</b> .....	525 ± 25 rev/min <b>See FUEL SYSTEM, Fault diagnosis, Base idle speed setting.</b>	
<b>Ignition Timing - dynamic at 800 rev/min max, vacuum disconnected</b>		
8.13:1 compression, non catalyst .....	2°BTDC ± 1°	
9.35:1 compression, non catalyst .....	4°BTDC ± 1°	
9.35:1 compression, catalyst .....	5°BTDC ± 1°	
<b>Exhaust gas</b>		
CO content at idle .....	0.5 to 1.0% max.	



**Distributor**

Make/type .....	Lucas 35DLM8 electronic
Rotation .....	Clockwise
Air gap .....	0.20-0.35mm

**Part number**

	<b>Lucas</b>	<b>Rover</b>
8.13:1, non catalyst .....	42584A	ERR 4753
9.35:1, non catalyst .....	42582A	ERR 4754
9.35:1, catalyst .....	42583A	ERR 4755

**Centrifugal Advance**

Decelerating check-vacuum hose disconnected  
Distributor rpm decelerating speeds

**8.13:1 non catalyst**

2000 .....	Distributor advance	5°30' to 8°30'
1400 .....		6°18' to 8°30'
800 .....		2° to 4°

**9.35:1 non catalyst**

2200 .....	Distributor advance	7° to 10°
1400 .....		7°48' to 10°
650 .....		1° to 3°

**9.35:1 catalyst**

2200 .....	Distributor advance	5°30' to 8°30'
1400 .....		6°18' to 8°30'
800 .....		2° to 4°

**Fuel**

8.13:1, non catalyst .....	91 RON minimum unleaded
9.35:1, non catalyst .....	95 RON minimum unleaded
9.35:1, catalyst .....	95 RON minimum unleaded
USA-Premium unleaded (PUG) .....	CLC or AKI 90 octane minimum 95 RON minimum

**Australian market variations**

Fuel .....	91 RON minimum unleaded
Compression ratio .....	8.13:1
Spark plug .....	Champion RN12YC
Spark plug gap .....	0.84-0.96mm (0.033-0.038 in)
Ignition Timing at 800 rev/min max (vacuum pipe disconnected) .....	2° BTDC ± 1°
Exhaust gas idle CO .....	1% max (hot)




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**ENGINE 4.0 V8**


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<b>Type</b> .....	4.0 Litre V8	
<b>Firing order</b> .....	1-8-4-3-6-5-7-2	
<b>Cylinder Numbers</b>		
Left bank .....	1-3-5-7	
Right bank .....	2-4-6-8	
<b>No 1 Cylinder location</b> .....	Pulley end of left bank	
<b>Spark plugs</b>		
Make/type .....	Champion RN11YCC	
Gap .....	0.90 - 1.00 mm	0.035 - 0.040 in
<b>Coils</b>		
Make .....	Lucas 2D1S2	
Type .....	Twin coils, bank of 4	
	<b>High Compression</b>	<b>Low Compression</b>
Compression ratio .....	9.35:1	8.2:1
<b>Fuel injection system</b> .....	Sagem - Lucas GEMS8 Hot-wire air flow sensor system electronically controlled	
<b>Valve Timing</b>		
	<b>Inlet</b>	<b>Exhaust</b>
Opens .....	28°BTDC	66°BBDC
Closes .....	77°ABDC	39°ATDC
Duration .....	285°	285°
Valve peak .....	108°ATDC	110°BTDC
<b>Idle speed - controlled by GEMS system</b>		
all loads off .....	700 ± 20 rev/min	
<b>Base idle speed</b> .....	Not adjustable Idle air control valve position, checked via <b>TestBook</b>	
<b>CO at idle</b>		
vehicles without heated oxygen sensors .....	1.5% æ 0.5%	
<b>Fuel</b>		
9.35:1 catalyst .....	95 RON minimum unleaded	
USA vehicles - Premium unleaded (PUG) .....	95 RON minimum	
8.2:1 catalyst .....	91 RON minimum unleaded	
Non catalyst .....	91 RON minimum unleaded or leaded	

**300 Tdi ENGINE**

**Type** ..... 2.5 Litre Turbo diesel intercooled

**Firing order** ..... 1-3-4-2

**Injection timing** ..... 1,54 mm lift at T.D.C.

**Injection timing with electronic EGR** ..... 1,40 mm lift at T.D.C.

**Injection timing with EDC** ..... 0,45 mm lift at T.D.C.

**Timing marks:**

Valve timing - manual ..... Slot for pin in flywheel and TDC mark on front pulley.

Valve timing - automatic ..... Slot for pin in ring gear. Access through rear engine plate. TDC mark on front pulley

Injection timing ..... Timing pin (service tool)

Tappet clearances inlet and exhaust ..... 0,20 mm cold

**Valve timing:**

	<b>Inlet</b>	<b>Exhaust</b>
- Opens .....	16°B.T.D.C.	51°B.B.D.C.
- Closes .....	42°A.B.D.C.	13°A.T.D.C.
- Peak .....	103°A.T.D.C.	109°B.T.D.C.
- Lift .....	9,67 mm	9,97 mm

**Maximum governed speeds:**

- No load (neutral/full throttle) ..... 4600 + 40 - 120 rev/min

- Idle speed at running temperature ..... 720 ± 20 rev/min

- Die-down time ..... 4 seconds

**INJECTION PUMP**

Make & type - standard ..... Bosch rotary R509 type with boost control and two speed mechanical governor with auto advance and solenoid electrical shut-off. Tamper proof sealing on, no load governed speed and fuel adjustment screws. Constant volume delivery valves

Make & type - Electronic EGR ..... Bosch rotary R509/1 type with boost control and two speed mechanical governor with auto advance and solenoid electrical shut-off. Tamper proof sealing on flight speed and fuel adjustment screws. Constant volume delivery valves. Throttle position sensor for EGR control.

Make & type - Electronic diesel control - EDC ..... Bosch rotary R500 type with full electronic control of fuelling and timing. Constant pressure delivery valves.



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**GLOW PLUGS**

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Make & type ..... Probe type, No.0100226129A Beru 12 volts  
Time to reach operating temperature of 850°C ..... 8 seconds

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**INJECTORS**

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Make & type - standard ..... Bosch KBAL 90 P37  
Nozzle type ..... DSLA 145P366  
Opening pressure (working pressure) ..... Initial pressure 200 atmospheres  
Secondary 280 atmospheres  
Make & type - EDC feedback 1 in each engine ..... Bosch KBAL 90 P38  
Nozzle type ..... DSLA 145P365  
Opening pressure (working pressure) ..... Initial pressure 200 atmospheres  
Secondary 300 atmospheres  
Make & type - EDC standard injector 3 in each engine .... Bosch KBAL 90 P36  
Nozzle type ..... DSLA 145P365  
Opening pressure (working pressure) ..... Initial pressure 200 atmospheres  
Secondary 300 atmospheres

---

**TURBOCHARGER**

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Make & type ..... Allied signal  
Maximum boost pressure ..... 0.8-1.0 bar (12-15lbf/in<sup>2</sup>) measured at wastegate  
actuator 'T' piece

**ENGINE - Mpi - 2.0 LITRE**

Type/Capacity .....	20 T4/1994 cm <sup>3</sup>
Firing order .....	1-3-4-2
Compression ration .....	10 : 1
Idle speed:	
Controlled by ECM .....	875 ± 50 rev/min
Exhaust gas Co content:	
- Catalyst .....	0.5% Max. Not adjustable.
- Non Catalyst .....	1,0 ± 25% adjustable using Testbook

**Ignition**

Knock sensor .....	ADU 8229
Crankshaft sensor .....	ADU 7340

**Ignition Coils**

Type .....	NEC 10049
Primary resistance at 20°C .....	0.4 to 0.61 ohm
Consumption - engine idling .....	0.25 to 0.75 amp

**Spark Plugs**

Type/Gap .....	GSP 6662 -0,85 mm
----------------	-------------------

**Multipoint Fuel Injection**

Type .....	Indirect multipoint injection with engine control module using speed/density method of air flow measurement.
Fuel pressure regulator .....	MKW 10011
Fuel pump delivery pressure .....	2.3 - 2.5 bar
Throttle potentiometer voltage	
- Throttle closed .....	0 - 1 Volt
- Throttle open .....	4 - 5 Volts
MEMS engine control module .....	MKC 10121

95 RON minimum - **UNLEADED** fuel

**CAUTION: Do not use LEADED fuel as it will damage the catalyst. Serious damage to the engine may occur if a lower octane number fuel than that recommended is used.**



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**GENERAL FITTING REMINDERS**

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**WORKSHOP SAFETY IS YOUR RESPONSIBILITY!**

The suggestions, cautions and warnings in the section are intended to serve as reminders for trained and experienced mechanics. This manual is not a course in automotive mechanics or workshop safety.

Shop equipment, shop environment, and the use and disposal of solvents, fluids, and chemicals are subject to government regulations which are intended to provide a level of safety. It is your responsibility to know and comply with such regulations.

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**PRECAUTIONS AGAINST DAMAGE**

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1. Always fit covers to protect fenders before commencing work in engine compartment.
2. Cover seats and carpets, wear clean overalls and wash hands or wear gloves before working inside vehicle.
3. Avoid spilling hydraulic fluid or battery acid on paint work. Wash off with water immediately if this occurs. Use Polythene sheets to protect carpets and seats.
4. Always use a recommended Service Tool, or a satisfactory equivalent, where specified.
5. Protect temporarily exposed screw threads by replacing nuts or fitting plastic caps.

---

**SAFETY PRECAUTIONS**

---

1. Whenever possible use a lift or pit when working beneath vehicle, in preference to jacking. Chock wheels as well as applying parking brake.



**WARNING: Do not use a pit when removing fuel system components.**

2. Never rely on a jack alone to support vehicle. Use axle stands carefully placed at jacking points to provide rigid support.
3. Ensure that a suitable form of fire extinguisher is conveniently located.
4. Check that any lifting equipment used has adequate capacity and is fully serviceable.
5. Disconnect battery negative lead.



**WARNING: Do not disconnect any pipes in air conditioning refrigeration system, unless trained and instructed to do so. A refrigerant is used which can cause blindness if allowed to contact eyes.**

6. Ensure that adequate ventilation is provided when volatile degreasing agents are being used.
7. Do not apply heat in an attempt to free stiff nuts or fittings; as well as causing damage to protective coatings, there is a risk of damage to electronic equipment and brake linings from stray heat.

---

**PREPARATION**

---

1. Before removing a component, clean it and its surrounding areas as thoroughly as possible.
2. Blank off any openings exposed by component removal, using greaseproof paper and masking tape.
3. Immediately seal fuel, oil or hydraulic lines when separated, using plastic caps or plugs, to prevent loss of fluid and entry of dirt.
4. Close open ends of oilways, exposed by component removal, with tapered hardwood plugs or readily visible plastic plugs.
5. Immediately a component is removed, place it in a suitable container; use a separate container for each component and its associated parts.
6. Before dismantling a component, clean it thoroughly with a recommended cleaning agent; check that agent is suitable for all materials of component.
7. Clean bench and provide marking materials, labels, containers and locking wire before dismantling a component.

---

**DISMANTLING**

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1. Observe scrupulous cleanliness when dismantling components, particularly when brake, fuel or hydraulic system parts are being worked on. A particle of dirt or a cloth fragment could cause a dangerous malfunction if trapped in these systems.
2. Blow out all tapped holes, crevices, oilways and fluid passages with an air line. Ensure that any O-rings used for sealing are correctly replaced or renewed, if disturbed.
3. Use marking ink to identify mating parts, to ensure correct reassembly. If a centre punch or scriber is used they may initiate cracks or distortion of components.
4. Wire together mating parts where necessary to prevent accidental interchange (e.g. roller bearing components).
5. Wire labels on to all parts which are to be renewed, and to parts requiring further inspection before being passed for reassembly; place these parts in separate containers from those containing parts for rebuild.
6. Do not discard a part due for renewal until after comparing it with a new part, to ensure that its correct replacement has been obtained.

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**INSPECTION-GENERAL**

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1. Never inspect a component for wear or dimensional check unless it is absolutely clean; a slight smear of grease can conceal an incipient failure.
2. When a component is to be checked dimensionally against figures quoted for it, use correct equipment (surface plates, micrometers, dial gauges, etc.) in serviceable condition. Makeshift checking equipment can be dangerous.
3. Reject a component if its dimensions are outside limits quoted, or if damage is apparent. A part may, however, be refitted if its critical dimension is exactly limit size, and is otherwise satisfactory.
4. Use 'Plastigauge' 12 Type PG-1 for checking bearing surface clearances. Directions for its use, and a scale giving bearing clearances in 0,0025 mm steps are provided with it.

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**BALL AND ROLLER BEARINGS**

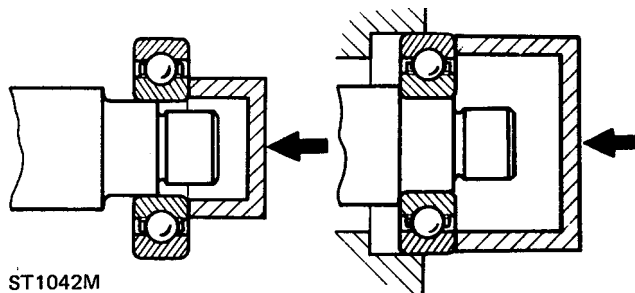

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**CAUTION: Never refit a ball or roller bearing without first ensuring that it is in a fully serviceable condition.**

1. Remove all traces of lubricant from bearing under inspection by washing in a suitable degreaser; maintain absolute cleanliness throughout operations.
2. Inspect visually for markings of any form on rolling elements, raceways, outer surface of outer rings or inner surface of inner rings. Reject any bearings found to be marked, since any marking in these areas indicates onset of wear.
3. Holding inner race between finger and thumb of one hand, spin outer race and check that it revolves absolutely smoothly. Repeat, holding outer race and spinning inner race.
4. Rotate outer ring gently with a reciprocating motion, while holding inner ring; feel for any check or obstruction to rotation, and reject bearing if action is not perfectly smooth.
5. Lubricate bearing generously with lubricant appropriate to installation.
6. Inspect shaft and bearing housing for discoloration or other marking suggesting that movement has taken place between bearing and seatings. (This is particularly to be expected if related markings were found in operation 2).
7. Ensure that shaft and housing are clean and free from burrs before fitting bearing.

8. If one bearing assembly of a pair shows an imperfection it is generally advisable to replace both with new bearings; an exception could be made if the faulty bearing had covered a low mileage, and it could be established that damage was confined to it only.
9. When fitting bearing to shaft, apply force only to inner ring of bearing, and only to outer ring when fitting into housing. (Refer to ST1042M).



10. In the case of grease lubricated bearings (e.g. hub bearings) fill space between bearing and outer seal with recommended grade of grease before fitting seal.
11. Always mark components of separable bearings (e.g. taper roller bearings) in dismantling, to ensure correct reassembly. Never fit new rollers in a used outer ring, always fit a complete new bearing assembly.



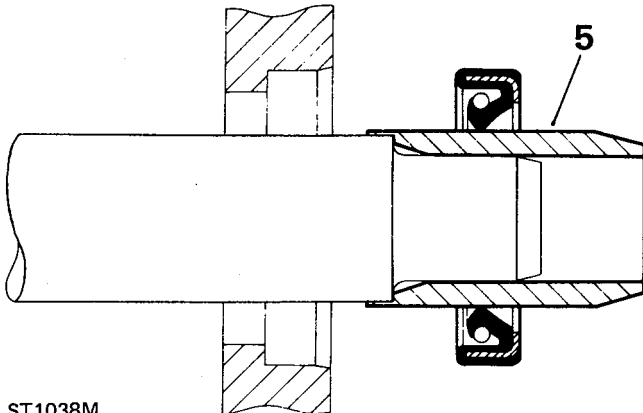
## OIL SEALS



**NOTE:** Ensure that the seal running track is free from pits, scores, corrosion and general damage prior to fitting replacement seal.

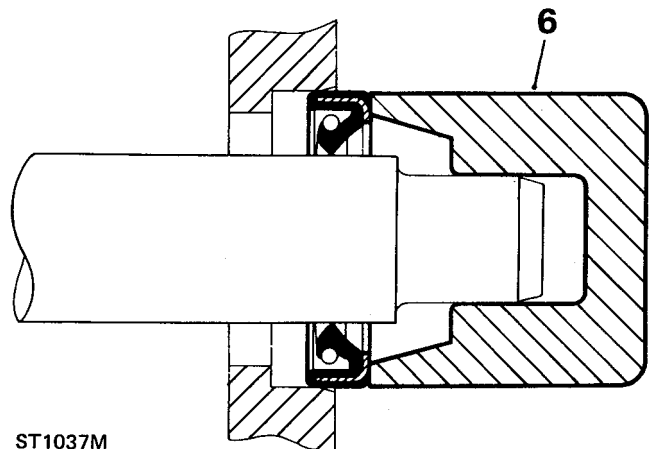
replacement seal.

1. Always fit new oil seals when rebuilding an assembly.
2. Carefully examine seal before fitting to ensure that it is clean and undamaged.
3. Coat the sealing lips with clean grease; pack dust excluder seals with grease, and heavily grease duplex seals in cavity between sealing lips.
4. Ensure that seal spring, if provided, is correctly fitted.
5. Place lip of seal towards fluid to be sealed and slide into position on shaft, using fitting sleeve when possible to protect sealing lip from damage by sharp corners, threads or splines. If fitting sleeve is not available, use plastic tube or tape to prevent damage to sealing lip.



ST1038M

6. Grease outside diameter of seal, place square to housing recess and press into position, using great care and if possible a 'bell piece' to ensure that seal is not tilted. (In some cases it may be preferable to fit seal to housing before fitting to shaft). Never let weight of unsupported shaft rest in seal.



ST1037M

7. If correct service tool is not available, use a suitable drift approximately 0.4mm (0.015 in) smaller than outside diameter of seal. Use a hammer **VERY GENTLY** on drift if a press is not suitable.
8. Press or drift seal in to depth of housing if housing is shouldered, or flush with face of housing where no shoulder is provided. Ensure that the seal does not enter the housing in a tilted position.



**NOTE:** Most cases of failure or leakage of oil seals are due to careless fitting, and resulting damage to both seals and sealing surfaces. Care in fitting is essential if good results are to be obtained. **NEVER** use a seal which has been improperly stored or handled, such as hung on a hook or nail.



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**JOINTS AND JOINT FACES**

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1. Always use correct gaskets where they are specified.
2. Use jointing compound only when recommended. Otherwise fit joints dry.
3. When jointing compound is used, apply in a thin uniform film to metal surfaces; take great care to prevent it from entering oilways, pipes or blind tapped holes.
4. Remove all traces of old jointing materials prior to reassembly. Do not use a tool which could damage joint faces.
5. Inspect joint faces for scratches or burrs and remove with a fine file or oil stone; do not allow removed material or dirt to enter tapped holes or enclosed parts.
6. Blow out any pipes, channels or crevices with compressed air, fit new 'O' rings or seals displaced by air blast.

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**FLEXIBLE HYDRAULIC PIPES, HOSES**

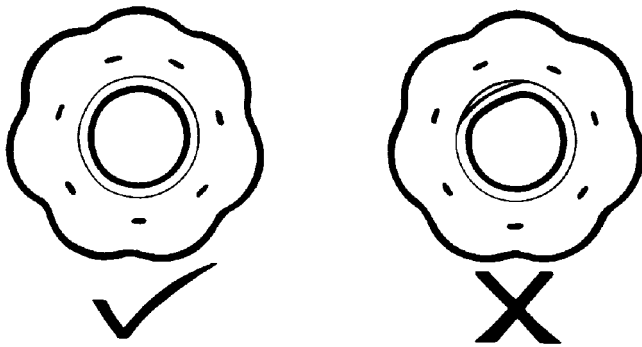
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1. Before removing any brake or power steering hose, clean end fittings and area surrounding them as thoroughly as possible.
2. Obtain appropriate plugs or caps before detaching hose end fittings, so that ports can be immediately covered to exclude dirt.
3. Clean hose externally and blow through with airline. Examine carefully for cracks, separation of plies, security of end fittings and external damage. Reject any hose found faulty.
4. When refitting hose, ensure that no unnecessary bends are introduced, and that hose is not twisted before or during tightening of union nuts.
5. Containers for hydraulic fluid must be kept absolutely clean.
6. Do not store brake fluid in an unsealed container. It will absorb water, and fluid in this condition would be dangerous to use due to a lowering of its boiling point.
7. Do not allow brake fluid to be contaminated with mineral oil, or use a container which has previously contained mineral oil.
8. Do not re-use brake fluid bled from system.
9. Always use clean brake fluid to clean hydraulic components.
10. Fit a cap to seal a hydraulic union and a plug to its socket after removal to prevent ingress of dirt.
11. Absolute cleanliness must be observed with hydraulic components at all times.
12. After any work on hydraulic systems, inspect carefully for leaks underneath the vehicle while a second operator applies maximum pressure to the brakes (engine running) and operates the steering.

### FUEL SYSTEM HOSES



**CAUTION:** All fuel hoses are made up of two laminations, an armoured rubber outer sleeve and an inner viton core. If any of the fuel system hoses have been disconnected, it is imperative that the internal bore is inspected to ensure that the viton lining has not become separated from the armoured outer sleeve. A new hose must be fitted if separation is evident.



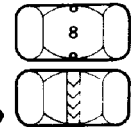
RR2302M

### METRIC NUT IDENTIFICATION

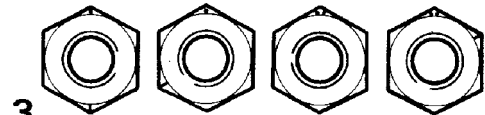
1. A nut with an ISO metric thread is marked on one face or on one of the flats of the hexagon with the strength grade symbol 8, 12 or 14. Some nuts with a strength 4, 5 or 6 are also marked and some have the metric symbol M on the flat opposite the strength grade marking.
2. A clock face system is used as an alternative method of indicating the strength grade. The external chamfers or a face of the nut is marked in a position relative to the appropriate hour mark on a clock face to indicate the strength grade.
3. A dot is used to locate the 12 o'clock position and a dash to indicate the strength grade. If the grade is above 12, two dots identify the 12 o'clock position.



1



2

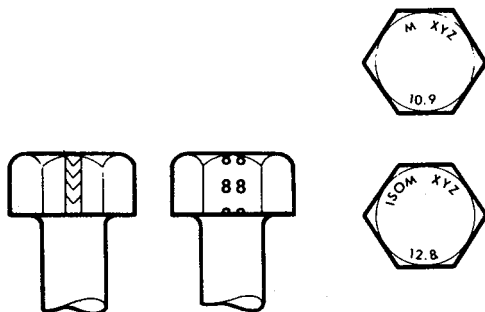


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ST1036M

### METRIC BOLT IDENTIFICATION

1. An ISO metric bolt or screw, made of steel and larger than 6 mm in diameter can be identified by either of the symbols ISO M or M embossed or indented on top of the head.
2. In addition to marks to identify the manufacture, the head is also marked with symbols to indicate the strength grade, e.g. 8.8, 12.9 or 14.9, where the first figure gives the minimum tensile strength of the bolt material in tens of kgf/mm<sup>2</sup>.
3. Zinc plated ISO metric bolts and nuts are chromate passivated, a gold-bronze colour.



ST1035M

### KEYS AND KEYWAYS

1. Remove burrs from edges of keyways with a fine file and clean thoroughly before attempting to refit key.
2. Clean and inspect key closely; keys are suitable for refitting only if indistinguishable from new, as any indentation may indicate the onset of wear.

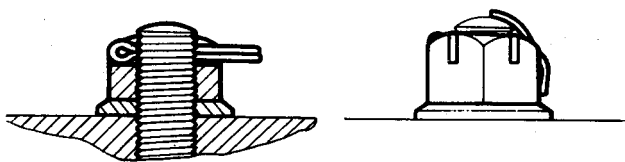
### TAB WASHERS

1. Fit new washers in all places where they are used. Always fit a new tab washer.
2. Ensure that the new tab washer is of the same design as that replaced.



**COTTER PINS**

1. Fit new cotter pins throughout when replacing any unit.
2. Always fit cotter pins where cotter pins were originally used. Do not substitute spring washers: there is always a good reason for the use of a cotter pin.
3. All cotter pins should be fitted as shown unless otherwise stated.



ST1030M

**NUTS**

1. When tightening a slotted or castellated nut never loosen it back to insert cotter pin or locking wire except in those recommended cases where this forms part of an adjustment. If difficulty is experienced, alternative washers or nuts should be selected, or washer thickness reduced.
2. Where self-locking nuts have been removed it is advisable to replace them with new ones of the same type.



**NOTE: Where bearing pre-load is involved nuts should be tightened in accordance with special instructions.**

**LOCKING WIRE**

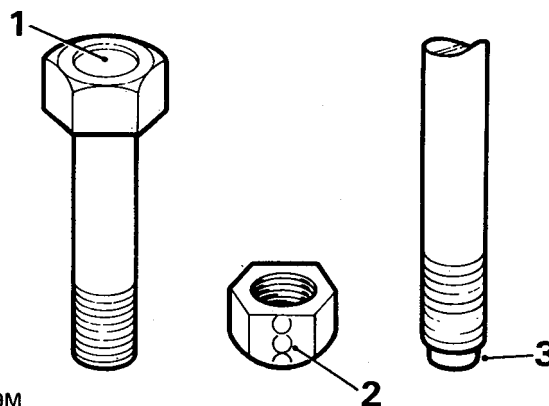
1. Fit new locking wire of the correct type for all assemblies incorporating it.
2. Arrange wire so that its tension tends to tighten the bolt heads, or nuts, to which it is fitted.

**SCREW THREADS**

1. Both UNF and Metric threads to ISO standards are used. See below for thread identification.
2. Damaged threads must always be discarded. Cleaning up threads with a die or tap impairs the strength and closeness of fit of the threads and is not recommended.
3. Always ensure that replacement bolts are at least equal in strength to those replaced.
4. Do not allow oil, grease or jointing compound to enter blind threaded holes. The hydraulic action on screwing in the bolt or stud could split the housing.
5. Always tighten a nut or bolt to the recommended torque value. Damaged or corroded threads can affect the torque reading.
6. To check or re-tighten a bolt or screw to a specified torque value first loosen a quarter of a turn, then re-tighten to the correct value.
7. Oil thread lightly before tightening to ensure a free running thread, except in the case of threads treated with sealant/lubricant, and self-locking nuts.

**UNIFIED THREAD IDENTIFICATION**

1. **Bolts**  
A circular recess is stamped in the upper surface of the bolt head.
2. **Nuts**  
A continuous line of circles is indented on one of the flats of the hexagon, parallel to the axis of the nut.
3. **Studs, Brake Rods, etc.**  
The component is reduced to the core diameter for a short length at its extremity.



ST1039M



**RECOMMENDED LUBRICANTS AND FLUIDS - USA VEHICLES**

COMPONENT	SPECIFICATION	VISCOSITY	AMBIENT TEMPERATURE °C							
			-30	-20	-10	0	10	20	30	40
Engine	Use oils to API service level SGSH or RES.22.OL.G4 or CCMC G4	5W/20 )	_____							
		5W/30 ) 5W/40 )	_____							
		10W/30	_____							
		10W/40 ) 10W/50 )	_____							
		15W/40 ) 15W/50 )	_____							
		20W/40 ) 20W/50 )	_____							
Automatic gearbox	ATF Dexron IID		_____							
Final drive units Swivel pin housings	API or GL5 MIL - L - 2105 or MIL - L - 2105B, C or D	90 EP	_____							
		80W EP	_____							
Power steering	ATF Dexron IID		_____							
LT 230T transfer gearbox	API GL4 or GL5 MIL - L - 2105 or MIL - L - 2105B		_____							
Brake reservoir	Brake fluid must have a minimum boiling point of 260°C (500°F) and comply with FMVSS/116/DOT 4		_____							
Lubrication nipples (hubs, ball joints, etc.)	NLGI-2 multipurpose lithium based grease		_____							

See table on page 3 for remaining vehicle components





Propeller shaft Front and Rear Lubrication nipples (hubs, ball joints etc.) Seat slides Door lock striker	NLGI - 2 Multi-purpose Lithium based GREASE
Brake and clutch reservoirs	Brake fluids having a minimum boiling point of 260°C (500°F) and complying with FMVSS 116 DOT4
Engine coolant V8i, Tdi, Mpi	Use an ethylene glycol based anti-freeze (containing no methanol) with non-phosphate corrosion inhibitors suitable for use in aluminium engines to ensure the protection of the cooling system against frost and corrosion in all seasons. Use one part anti-freeze to one part water for protection down to -36°C (-33°F). <b>IMPORTANT: Coolant solution must not fall below proportions one part anti-freeze to three parts water, i.e. minimum 25% anti-freeze in coolant otherwise damage to engine is liable to occur. Or a maximum of 60%.</b>
Battery lugs, Earthing surfaces where paint has been removed	Petroleum jelly. <b>NOTE: Do not use Silicone Grease</b>
Air Conditioning System Refrigerant	Use only refrigerant R134a
Compressor Oil	Nippon Denso ND-oil8    Unipart ND-oil8
ABS Sensor bush-rear	Silicone grease: Staborags NBU - Wabco 830 502,0634 Wacker chemie 704 - Wabco 830 502,0164 Kluber GL301

**LUBRICATION PRACTICE**

Use a high quality oil of the correct viscosity range and service classification in the engine during maintenance and when topping up. The use of oil not to the correct specification can lead to high oil and fuel consumption and ultimately to damaged components.

Oil to the correct specification contains additives which disperse the corrosive acids formed by combustion and prevent the formation of sludge which can block the oilways. Additional oil additives should not be used. Always adhere to the recommended servicing intervals.



**WARNING: Many liquids and other substances used in motor vehicles are poisonous. They must not be consumed and must be kept away from open wounds. These substances, among others, include anti-freeze windscreen washer additives, lubricants and various adhesives.**

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**CAPACITIES**


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The following capacity figures are approximate and are provided as a guide only.

Capacities (approx.)*	Litres	Imp.Unit	US unit
Engine sump oil			
- 300Tdi models .....	5,8	10.20 pt	12.30 pt
- V8i petrol models 3.9 .....	6,1	10.70 pt	12.90 pt
- Mpi petrol models .....	4,90	8.70 pt	10.40 pt
Extra when refilling after fitting new filter			
- 300Tdi models .....	0,85	1.50 pt	1.80 pt
- V8i petrol models .....	0,56	1.00 pt	1.20 pt
- Mpi .....	0,4	0.70 pt	0.85 pt
Manual gearbox .....	2,67	4.70 pt	5.70 pt
Automatic gearbox .....	9,1	16.00 pt	19.20 pt
Transfer gearbox oil .....	2,30	4.00 pt	4.90 pt
Front differential .....	1,70	3.00 pt	3.60 pt
Rear differential .....	1,70	3.00 pt	3.60 pt
Power steering box and reservoir LHD .....	2,90	5.00 pt	6.00 pt
Power steering box and reservoir RHD .....	3,40	6.00 pt	7.20 pt
Swivel pin housing oil (each) .....	0,35	0.60 pt	0.75 pt
Fuel tank usable fuel .....	89,0	19.5 gall	23 gall
Cooling system			
- 300Tdi models .....	11,50	20.20 pt	24.30 pt
- V8i petrol models .....	11,30	20.00 pt	23.90 pt
- Mpi .....	10,00	17.60 pt	21.00 pt
Washer bottle .....	7,0	12.30 pt	14.80 pt



**NOTE: \* All levels must be checked by dipstick or level plugs as applicable. When draining oil from the ZF automatic gearbox, oil will remain in the torque converter, refill to high level on dipstick only.**



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**ANTI-FREEZE**


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ENGINE TYPE	MIXTURE STRENGTH	PERCENTAGE CONCENTRATION	PROTECTION LOWER TEMPERATURE LIMIT
V8i Engine Diesel Engine	One part anti-freeze One part water	50%	
<b>Complete protection</b> Vehicle may be driven away immediately from cold			- 33°F - 36°C
<b>Safe limit protection</b> Coolant in mushy state. Engine may be started and driven away after warm-up period			- 41°C - 42°F
<b>Lower protection</b> Prevents frost damage to cylinder head, block and radiator. Thaw out before starting engine			- 47°C - 53°F



**CAUTION:** Anti-freeze content must never be allowed to fall below 25% otherwise damage to the engine is liable to occur. Also, anti-freeze content should not exceed 60% as this will greatly reduce the cooling effect of the coolant.

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**FUEL REQUIREMENTS**


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**Catalyst vehicles**

Vehicles equipped with catalytic converter are designed to use **ONLY** unleaded fuel. Unleaded fuel must be used for the emission control system to operate properly. Its use will also reduce spark plug fouling, exhaust system corrosion and engine oil deterioration.

Using fuel that contains lead will result in damage to the emission control system and could result in loss of warranty coverage. The effectiveness of the catalysts in the catalytic converters will be seriously impaired if leaded fuel is used. The vehicle is equipped with an electronic fuel injection system, which includes two oxygen sensors. Leaded fuel will damage the sensors, and will deteriorate the emission control system.

Regulations require that pumps delivering unleaded fuel be labelled **UNLEADED**. Only these pumps have nozzles which fit the filler neck of the vehicle fuel tank.

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**RECOMMENDED FUEL**

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**Petrol engines**

- with catalytic converter ..... unleaded only, 95 RON (USA 90 CLC or AKI)
- non catalytic, 9.35:1 compression ratio ..... leaded 97 RON/unleaded 95 RON
- non catalytic, 8.13:1 compression ratio ..... leaded 90 RON/unleaded 95 RON
- Australia ..... minimum 91 RON unleaded

**Diesel engines**

- 300Tdi ..... Diesel fuel oil, distillate, diesel fuel, automotive gas or Derv to British standard 2869, Class A1 or A2

Using fuel with an octane rating lower than stated above could seriously impair vehicle performance.



**CAUTION: Do not use oxygenated fuels such as blends of methanol/ gasoline or ethanol/gasoline (e.g. 'Gasohol'). Take care not to spill fuel during refuelling.**



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## SERVICE SCHEDULE

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This section gives information on the range of service procedures.

Where required, instructions are given for carrying out each service procedure, or a cross reference is given, where the procedure can be found in this manual.

Service Schedule sheets are published separately to reflect the maintenance needs and intervals for each vehicle variant and model year. The procedures given must be used in conjunction with the Service Schedule sheets.

The Service Schedule sheets are available from:-  
Land Rover Merchandising  
PO Box 534  
Erdington  
Birmingham B24 0QS.  
England.

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## VEHICLE INTERIOR

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### **CHECK SEATS & BELTS**

Check condition and security of seats, seat belt mountings, seat belts, buckles and operation of inertia seat belts. Lubricate seat tilt pivots.

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### **CHECK OPERATION OF FOOT BRAKE AND CLUTCH**

If pedal feels 'spongy' bleed system. **See BRAKES, Repair, Brake System Bleed** or. **See CLUTCH, Repair, Bleed hydraulic system**

Check all hoses and pipes for security, fractures and leaks. Fit new hoses and pipes as necessary.

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### **CHECK OPERATION OF LAMPS**

Check operation of all lamps, horns and warning indicators.

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### **CHECK OPERATION OF WIPERS**

Check operation of front/rear screen wipers and washers and condition of wiper blades.

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### **AIR BAG MODULE(S)**

Check air bag module covers.

Check visually for signs of damage.

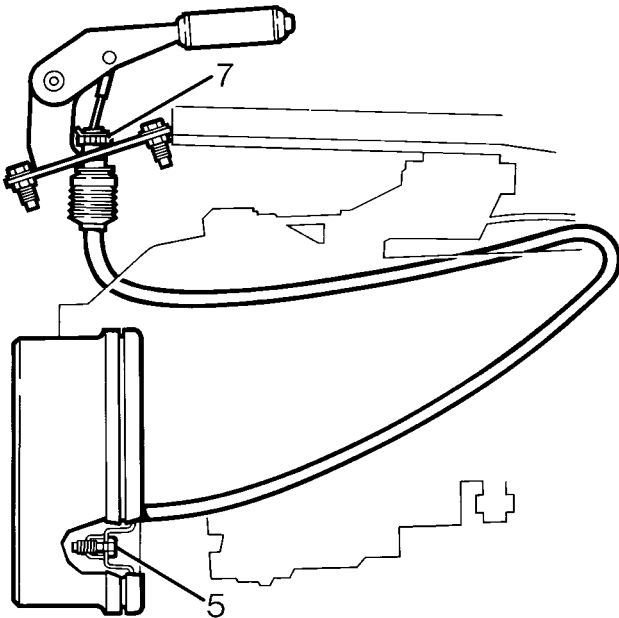
Renew every ten years.

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## CHECK SECURITY AND OPERATION OF PARK BRAKE


### Parking brake adjust

1. Select a gear or 'P' in main gearbox.
2. Chock road wheels.
3. Release parkbrake lever.
4. Remove switch panel from centre console.



J5960

5. Underneath vehicle, rotate brake adjuster clockwise until brake shoes are fully expanded against drum.
6. Back off adjuster until drum is free to rotate.
7. Rotate adjustment thumbwheel below parkbrake lever until parking brake is fully operational on third notch of ratchet.

 **NOTE: Cable adjustment must ONLY be used for initial setting and to compensate for cable stretch. It MUST NOT be used to take up brake shoe wear, which MUST be adjusted at brake drum.**

8. Operate parking brake to settle shoes. Recheck parkbrake is fully operational on third notch of ratchet. Readjust if necessary.
9. Refit switch panel.




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**VEHICLE EXTERIOR**

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**CHECK/ADJUST HEADLAMP ALIGNMENT**

Check/adjust headlamp and auxiliary alignment.

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**CHECK FRONT WHEEL ALIGNMENT**

Use recognised wheel alignment equipment to perform this check and adjustment. **See STEERING, Adjustment, Front Wheel Alignment**

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**REMOVE WHEELS, CHECK TYRES**

Check tyres (including spare) for compliance with manufacturers' specification.

Check visually for cuts, lumps, bulges, uneven tread wear and tread depth. Check road wheels for damage.

Check/adjust tyre pressures.

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**CHECK/TIGHTEN TOWING BRACKET FITTINGS**

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**INSPECT BRAKE PADS FOR WEAR, CALIPERS FOR LEAKS AND CONDITION**

Check thickness of brake pads, fit new pads if minimum thickness is less than 3,0mm. Check brake pads for oil contamination. If new brake pads required. **See BRAKES, Repair, Front Brake Pads** or. **See BRAKES, Repair, Rear Brake Pads**



**WARNING: When renewing brake pads, it is essential that only genuine components with correct grade of lining are used.**

**Always fit new pads as complete axle sets, NEVER individually or as a single wheel set. Serious consequences could result from out of balance braking due to mixing of linings.**

Refit road wheels

Fit road wheels in original hub position. Secure in position with wheel nuts, do not fully tighten wheel nuts at this stage, lower vehicle and finally tighten wheel nuts to correct torque.

Alloy wheels: **130 Nm.**

Steel wheels: **130 Nm.**

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**LUBRICATE ALL HINGES, DOOR CHECK MECHANISMS, BONNET [HOOD] CATCHES AND FUEL FILLER FLAP**

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**UNDER BONNET [HOOD] MAINTENANCE****CHECK COOLING/HEATER SYSTEMS**

Check cooling/heater systems for leaks and hoses for security and condition.

Cooling system hoses should be changed at first signs of deterioration.

**CHECK CONDITION OF ENGINE MOUNTING RUBBERS****CHECK BRAKE SERVO HOSE FOR SECURITY AND CONDITION****CHECK FUEL EVAPORATIVE LOSS CONTROL SYSTEM FOR LEAKS - V8i CATALYST, Mpi****CHECK FUEL FILLER CAP SEAL FOR LEAKS - V8i - CATALYST, Mpi****CHECK CONDITION OF HEATER PLUG WIRING FOR FRAYING, CHAFING AND DETERIORATION - Tdi****CHECK IGNITION WIRING**

Check ignition wiring and high tension leads for fraying, chafing and deterioration.

**CLEAN DISTRIBUTOR CAP - V8i**

The electronic ignition employs a Lucas 35DLM8 distributor.

Internal operating parts of distributor are pre-set at factory and do not normally require resetting. Adjustments should only be made if unit is known to be faulty or damaged. Distributor maintenance consists of following items.

1. Clean outer surfaces of distributor cap to remove dirt, grease etc.
2. Unclip cap, check cap for cracks.
3. Wipe inside cap with lint free cloth.
4. Check rotor arm, cap and flash shield tracking.

**DO NOT DISTURB** clear plastic insulating cover (flash shield) which protects magnetic pick-up module.

**LUBRICATE DISTRIBUTOR ROTOR SPINDLE - V8i**

Apply a spot of clean engine oil into rotor spindle after rotor arm has been removed.

**CLEAN/ADJUST SPARK PLUGS - V8i CATALYST****RENEW SPARK PLUGS V8i - V8i CATALYST**

Clean, adjust and renew

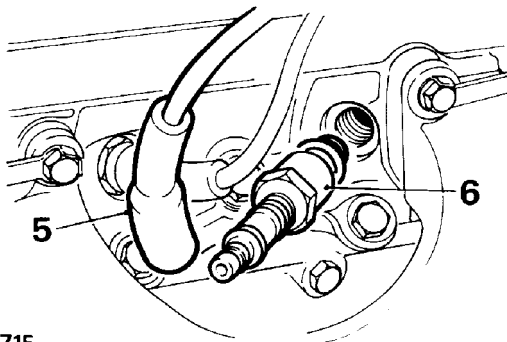
1. Take great care when fitting spark plugs not to cross-thread plug, otherwise costly damage to cylinder head will result.



2. Clean or replace spark plugs as applicable.
3. It is essential that correct type of spark plugs are fitted.
4. Incorrect grade of plugs may lead to piston overheating and engine failure.

**Remove**

5. Disconnect battery negative lead. Remove H.T. leads from spark plugs.
6. Remove plugs and washers.



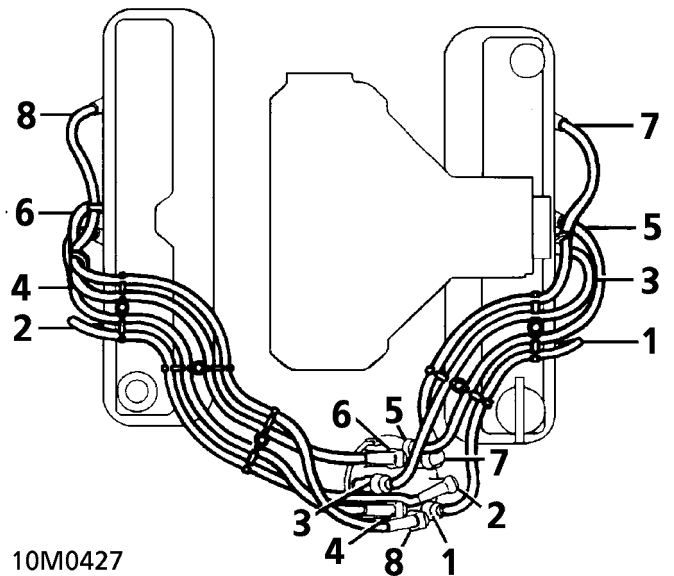
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7. When pushing leads onto plugs, ensure that shrouds are firmly seated.

**Fitting H.T. leads**

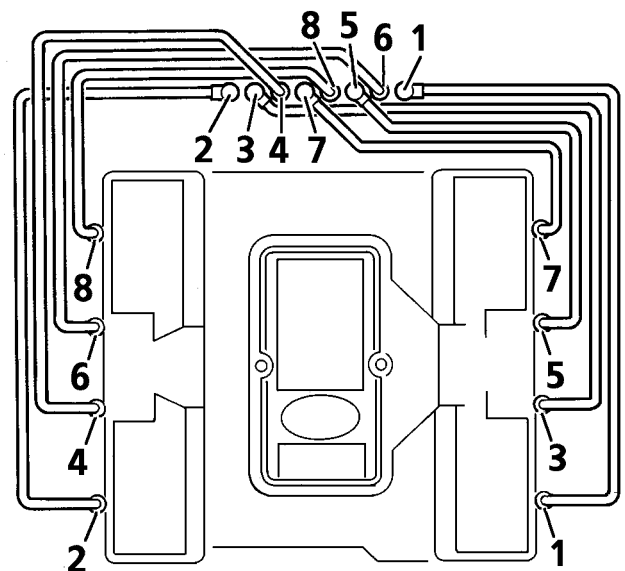
8. Ensure replacement H.T. leads are correctly refitted as illustrated. Failure to observe this instruction may result in cross-firing between two closely fitted leads which are consecutive in firing order.

**3.9 V8**



10M0427

**4.0 V8**



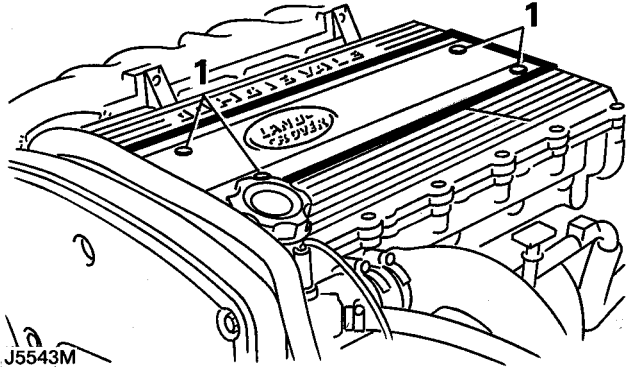
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## RENEW SPARK PLUGS - Mpi

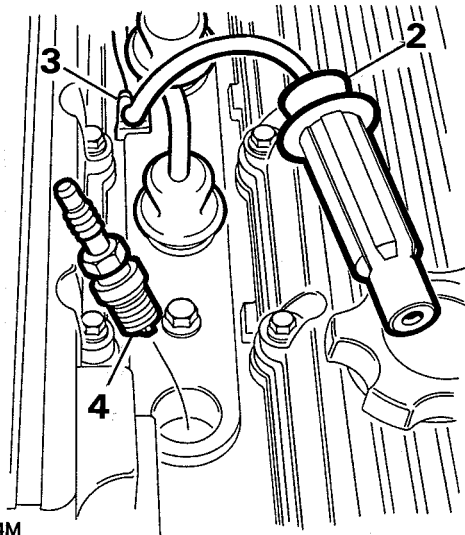
### Spark plugs - Mpi

#### Remove

1. Release 4 screws and remove spark plug cover.



2. Disconnect 4 plug leads.
3. Release plug leads from securing clips.
4. Remove spark plugs from cylinder head.



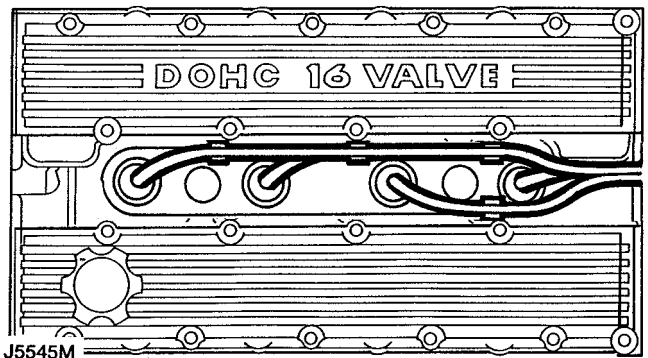
#### Refit

5. Inspect spark plugs.
6. Set plug gaps.



**CAUTION: Use correct type and grade of plug.**

7. Apply anti-seize to plug threads. Fit spark plugs.
8. Connect and route spark plug leads as illustrated.



9. Refit spark plug cover.





**CHECK/ADJUST VALVE CLEARANCES. - Tdi**

Valve adjustment. **See GENERAL SPECIFICATION DATA, Information, 300 Tdi Engine**

**RENEW FUEL FILTER ELEMENT - Tdi**

Drain off water and sediment



**CAUTION:** It is essential that any water and sediment in fuel filter is drained off, as water in fuel can result in damage to injection pump.

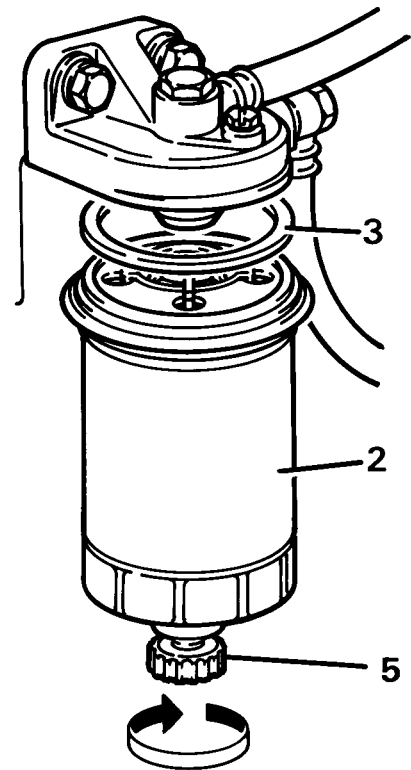
1. Hold a small receptacle beneath drain cock. Unscrew the drain cock half a turn.
2. Drain off water and sediment.
3. Tighten the drain cock immediately fuel starts to flow from drain cock.



**NOTE:** Any delay in tightening drain cock when fuel starts to flow could possibly mean bleeding fuel system.

**Renew fuel filter element**

1. Clean area around filter, place a container beneath.
2. Unscrew filter, a quantity of fuel will be released, and discard filter.



RR3700M

3. Wet seal of new filter with fuel.
4. Screw new filter into position.
5. Ensure that drain cock is secure.

**RENEW AIR CLEANER ELEMENT V8i CATALYST  
Mpi - Tdi - V8i NON CATALYST**

To renew air cleaner element - V8i, Mpi, Tdi  
**See FUEL SYSTEM, Repair, Air Cleaner**

## CLEAN PLENUM CHAMBER VENTILATION PASSAGEWAY - V8i

Cleaning plenum chamber ventilation passageway can be carried out without removing plenum chamber from ram housing.

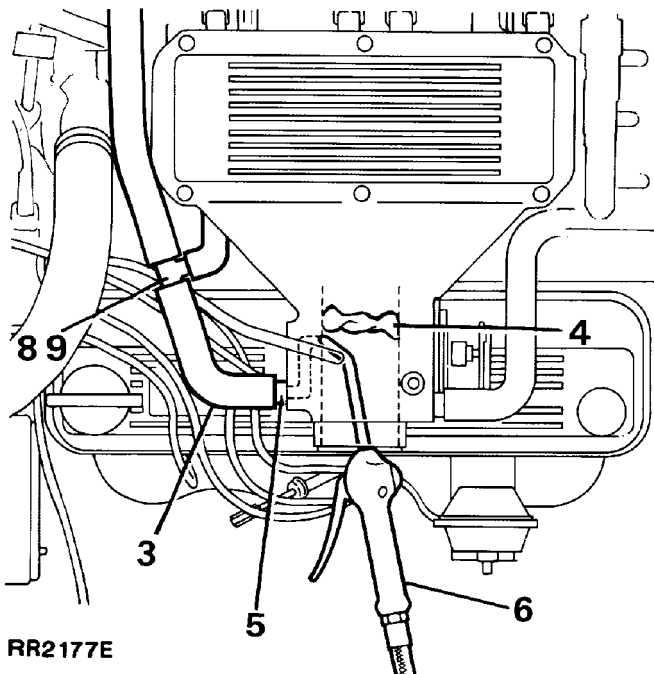


**CAUTION:** Care must be taken to prevent debris from passageway passing beyond throttle butterfly disc.



**WARNING:** Safety glasses must be worn when performing this operation. Ensure that debris is not blown into atmosphere which could be harmful to other persons closeby.

1. Disconnect battery negative lead.
2. Release hose clamp and remove hose from plenum chamber inlet.
3. Remove crankcase ventilation hose from side of plenum chamber.
4. Insert a piece of lint free cloth down throttle butterfly bore to prevent debris passing throttle butterfly.
5. Place a cloth over tube protruding from side of plenum from which ventilation hose was removed to prevent debris from passageway being blown into atmosphere.



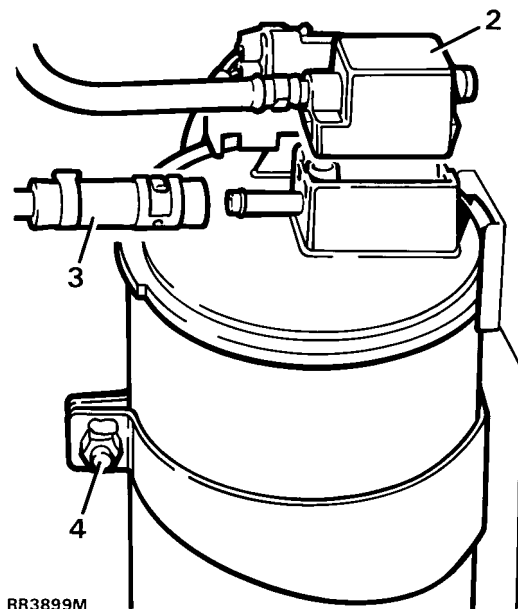
6. Use a compressed air line with a slim bent nozzle to enable passageway to be cleaned out from within throttle butterfly bore.
7. Any remaining matter can be dislodged using soft bent wire or pipe cleaner. Finally blow out passageway again to remove remaining debris.
8. Remove small 'T' piece between crankcase ventilation hoses and check it is free from blockages, clean as necessary.
9. Refit 'T' piece and hoses, tighten hose clamps securely.

## RENEW CHARCOAL CANISTER - V8i- Mpi

### Charcoal canister

#### Remove

1. Disconnect battery negative lead.
2. Pry out purge valve.
3. Disconnect pipe.
4. Loosen bolt.
5. Remove charcoal canister.



#### Refit

6. Reverse removal procedure.



**CHECK CONDITION OF DRIVE BELT - V8i - Tdi - Mpi**

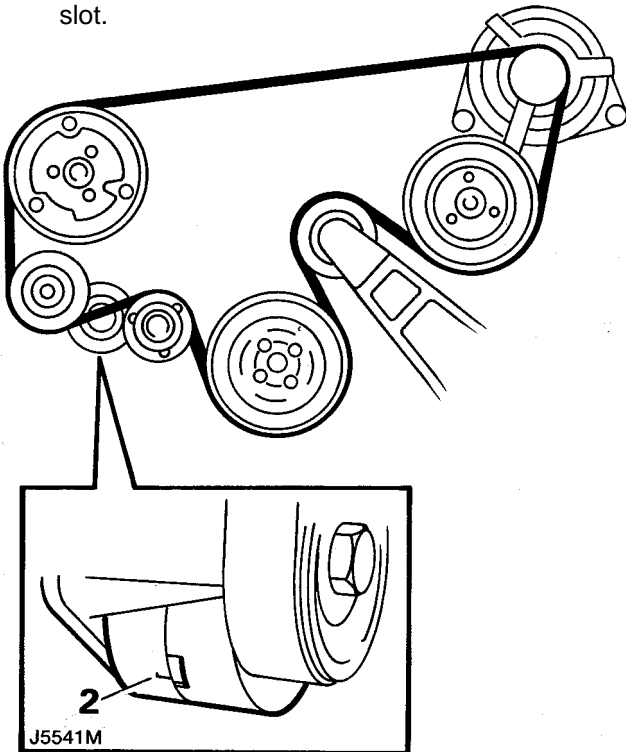
**RENEW - V8i - Tdi**

Renew drive belt V8i. **See ENGINE, Repair, Drive Belt Renew**

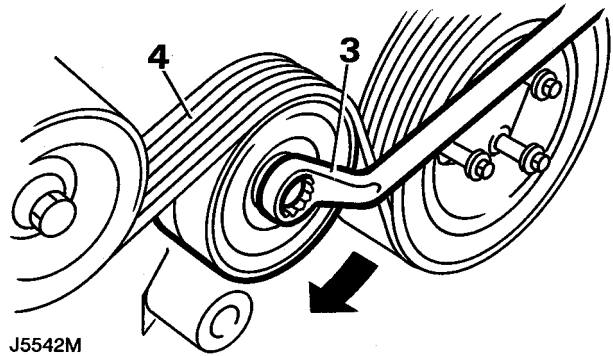
Renew drive belt Tdi. **See ENGINE, Repair, Drive Belt Renew**

**RENEW - Mpi**

1. Check condition of drive belt, renew a belt that shows signs of wear, splitting or oil contamination.
2. Check belt length indicator, belt must be renewed before indicator reaches R.H. end of slot.



3. Use 15mm ring wrench on bolt and hold tensioner pulley fully clockwise.
4. Release drive belt from tensioner pulley and remove ring wrench.
5. Remove belt from between pulleys.



6. Clean drive belt pulley grooves and ensure grooves are not damaged.
7. Fit new drive belt around pulley, except tensioner pulley, ensuring all grooves are correctly engaged.
8. Hold tensioner pulley fully clockwise and fit drive centrally around tensioner pulley.

**RENEW ANCILLARY DRIVE BELTS**

**CHECK/TOP UP AUTOMATIC TRANSMISSION FLUID LEVEL**




**NOTE: Transmission fluid level is checked when fluid is cold with engine idling in neutral.**

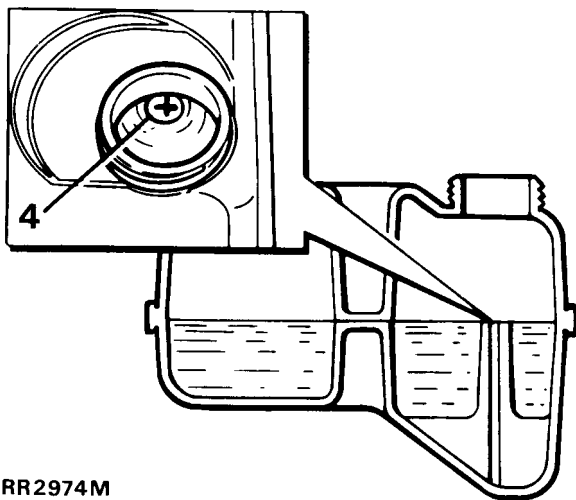
1. Ensure vehicle is on level ground.
2. Check fluid level registers between MAX and MIN marking on dipstick.

## CHECK/TOP UP COOLING SYSTEM

1. To prevent corrosion of aluminium alloy engine parts it is imperative that cooling system is filled with a solution of water and phosphate free anti-freeze, winter or summer. Never fill or top up with plain water.

 **WARNING: Do not remove filler cap when engine is hot because cooling system is pressurised and personal scalding could result.**

2. When removing filler cap, turn cap slowly anti-clockwise, pause and allow all pressure to escape.
3. Continue to turn until cap is removed.
4. When engine is cold expansion tank coolant should be level with top of indicator post, visible inside tank through filler hole.
5. If necessary, top up cooling system with premixed coolant. Use soft water whenever possible, if local water supply is hard, rainwater should be used.



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6. When replacing filler cap it is important that it is tightened down fully. Failure to tighten filler cap properly may result in water loss, with possible damage to engine

The cooling system should be drained and flushed at 2 year intervals or at onset of second winter. Refer to Coolant Requirements. **See COOLING SYSTEM, Adjustment, Coolant Requirements**

## CHECK/ TOP UP POWER STEERING FLUID RESERVOIR

1. Remove fluid reservoir cap. Check that fluid is up to high mark on dipstick.

## CHECK/ TOP UP CLUTCH AND BRAKE FLUID RESERVOIRS

 **CAUTION: Brake fluid can damage paintwork. If spillage occurs, wash affected area IMMEDIATELY with a large quantity of water.**

## CHECK/TOP UP WASHER RESERVOIR

Top up washer reservoir to within 25 mm of filler neck. Use a screen washer solvent/anti-freeze solution to assist removing mud, flies and road film and protect against freezing.

## LUBRICATE ACCELERATOR AND CRUISE CONTROL LINKAGES

## CHECK/ADJUST IGNITION TIMING - V8i CATALYST

Check ignition timing. **See ENGINE TUNING DATA, Information, Engine 3.9 V8i**



**CHECK/ADJUST ENGINE IDLE SPEED - Tdi**

For idle speed. **See ENGINE TUNING DATA, Information, 300 Tdi Engine**

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**CHECK ENGINE IDLE SPEED - Mpi**

For idle speed. **See ENGINE TUNING DATA, Information, Engine - Mpi - 2.0 Litre**

---

**CHECK/ADJUST STEERING BOX V8i - Tdi - Mpi**

**Check steering box for fluid leaks.**

Check that there is no backlash in steering box in straight ahead position. Adjust steering box if necessary. **See STEERING, Adjustment, Power Steering Box**

---

**CLEAN BATTERY CONNECTIONS**



**NOTE: Some 96 models are fitted with battery backed-up sounder See ELECTRICAL, Repair, Battery**

Remove battery terminals, clean and coat with petroleum jelly.

A low maintenance battery is installed in vehicle. Dependent upon climate conditions electrolyte levels should be checked as follows:

Temperate climates every three years.  
Hot climates every year.

---

**RENEW CAMSHAFT DRIVE BELT - Tdi**

Renew camshaft drive belt. **See ENGINE, Repair, Camshaft Drive Belt and Gears**

The engine timing gears are driven by a flexible rubber belt which must be renewed at intervals determined by the severity of operating conditions. In reasonable, temperate climate operation, renew the belt every 120,000 km (72,000 miles) or every 6 years whichever occurs earlier.

In adverse operating conditions such as work in dusty atmospheres, high ambient temperatures and desert and tropical zones, renew the belt every 60,000 km (36,000 miles) or every 3 years whichever occurs earlier.



**CAUTION: If the drive belt is not renewed at the correct interval, it could fail, resulting in serious damage.**

---

**RENEW CAMSHAFT DRIVE BELT - Mpi**

Renew every 160,000 km (96,000 miles) or every 6 years. In adverse conditions every 80,000 km (48,000 miles).

For details of renewing camshaft drive belt. **See ENGINE, Repair, Camshaft Drive Belt - Mpi**

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**CHECK CAMSHAFT DRIVE BELT - Mpi**

For details of checking camshaft drive belt. **See ENGINE, Repair, Check Camshaft Drive Belt - Mpi**

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## **EXTERNALLY CHECK INTERCOOLER FOR OBSTRUCTION - Tdi**

Clear any trapped dirt or flies from vanes of intercooler

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## **CLEAN INTERCOOLER ELEMENT - Tdi**

### **Remove**

1. Remove intercooler element.
2. Flush intercooler with ICI 'GENKLENE' or ôD-SOLVE' propriety cleaner, following the manufacturer's instructions.
3. Dry the intercooler completely ensuring that no liquid remains in the element.

### **Refit**

4. Refit intercooler element.
- 

## **UNDER VEHICLE MAINTENANCE**

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Vehicles operating under severe conditions of dust, sand, mud and water should have oils changed and lubrication carried out at more frequent intervals than is recommended in maintenance schedules.

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## **RENEW ENGINE OIL AND FILTER - Tdi**



**CAUTION:** Serious damage to the turbocharger will result if engine is run above idling speed before oil pressure is restored.

## **RENEW ENGINE OIL - V8i**

## **RENEW ENGINE OIL AND FILTER - V8i**



**CAUTION:** To prevent an airlock occurring after removing filter, fill new filter with oil and fit immediately after removing old filter. If airlock does occur fill oil pump with petroleum jelly.

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## **RENEW ENGINE OIL AND FILTER - Mpi**

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## **CHECK/TOP UP MANUAL GEARBOX OIL - V8i**

1. Site vehicle on lift or level ground.
  2. Remove oil filler level plug. If necessary, inject new oil into the gearbox until it runs out of filler hole. Fit plug. Tighten to **30 Nm**.
- 

## **RENEW MANUAL GEARBOX OIL - Tdi - Mpi**

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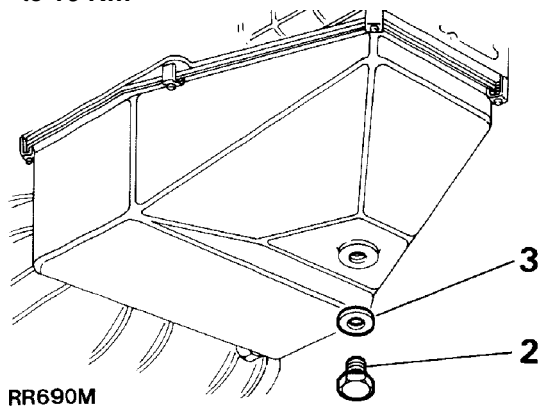
## **RENEW MANUAL GEARBOX OIL - V8i**

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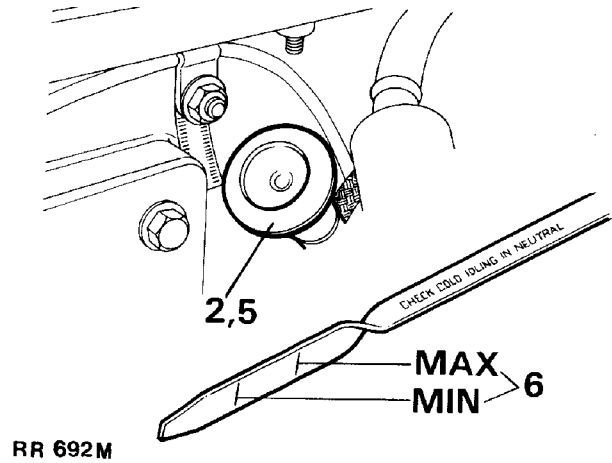


**RENEW AUTOMATIC GEARBOX FLUID AND OIL SCREEN**

1. Site vehicle on lift or level ground. Place container to drain gearbox fluid into. Disconnect battery negative lead.
2. Remove gearbox dipstick, located at rear of right hand rocker cover, to aid oil drainage. Release plug from bottom of sump and allow fluid to drain completely.
3. Refit plug using a new sealing washer. Tighten to **10 Nm**



6. Start and run engine. Apply footbrake, select position 1 then back to park. Check fluid level, this must be between the two marks on the dipstick.



Oil screen replacement ZF automatic gearbox.  
See *AUTOMATIC GEARBOX, Repair, Oil Screen*

**Refill ZF Automatic Gearbox and Check Fluid Level.**



**NOTE:** The fluid level must checked when fluid is cold and engine idling in park.

4. Ensure vehicle is on level ground.
5. Refill or top-up with correct quantity and grade of fluid. See **LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**

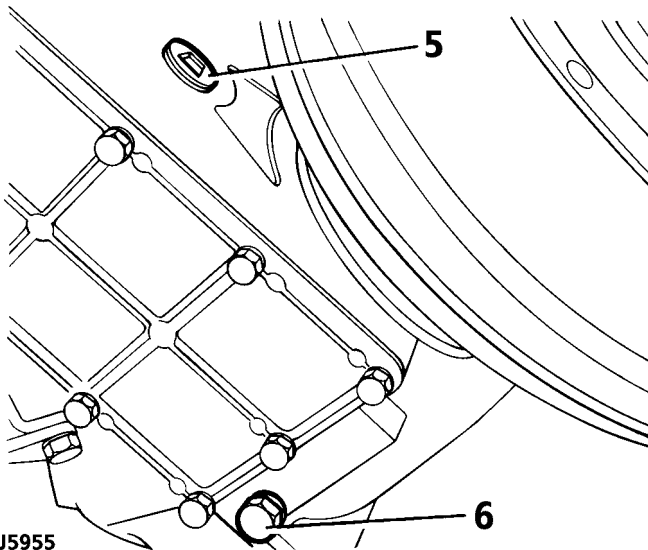
## RENEW TRANSFER GEARBOX OIL

1. Site vehicle on lift or level ground.
2. Disconnect battery negative lead.
3. Clean immediate area around filler/level and drain plugs.



**WARNING: When draining gearbox care should be taken to ensure that oil is not hot as personal scalding could result.**

4. Place a container under gearbox to drain oil into.
5. Remove filler/level plug to vent gearbox and assist draining.
6. Remove drain plug and allow oil to drain.



7. Thoroughly clean drain plug threads prior to applying fresh 'Hylomar' sealant. Fit plug Tighten to **30 Nm**.
8. Fill gearbox with correct quantity and grade of oil until oil seeps from filler level hole. Wipe away any surplus oil.
9. Thoroughly clean filler/level plug threads prior to applying fresh 'Hylomar' sealant. Fit plug Tighten to **30 Nm**.
10. Reconnect battery negative lead.

## CHECK/TOP UP TRANSFER GEARBOX OIL

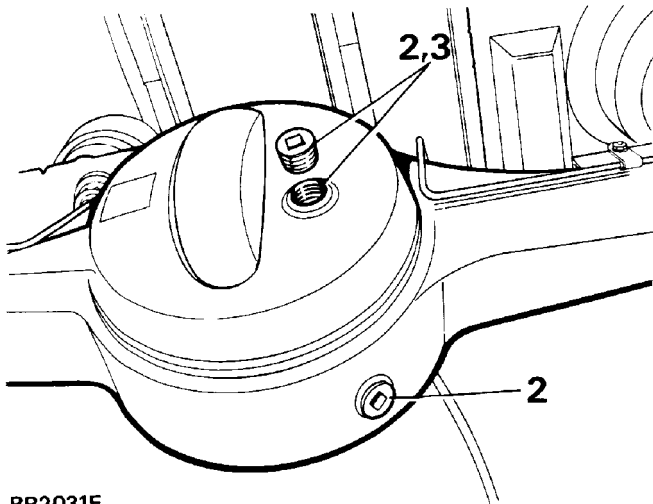
1. Site vehicle on lift or level ground.
2. Disconnect battery negative lead.
3. Clean immediate area around filler/level plug.
4. Remove plug and fill gearbox with recommended grade of oil, until oil starts to seep from filler/level hole.
5. Clean any previously applied sealant from filler/level plug.
6. Apply Hylomar sealant to threads of plug and refit plug. Tighten to **30 Nm**.
7. Wipe away any surplus oil.
8. Reconnect battery negative lead.





**RENEW FRONT AND REAR AXLE OIL**

1. Site vehicle on lift or level ground. Place container under axle to be drained.
2. Using a 13mm square drive wrench, remove drain and filler/level plugs from axle. Allow oil to drain completely. Clean and refit drain plug.
3. Inject new oil of recommended make and grade until it reaches level hole. Clean and refit filler/level plug and wipe away surplus oil.

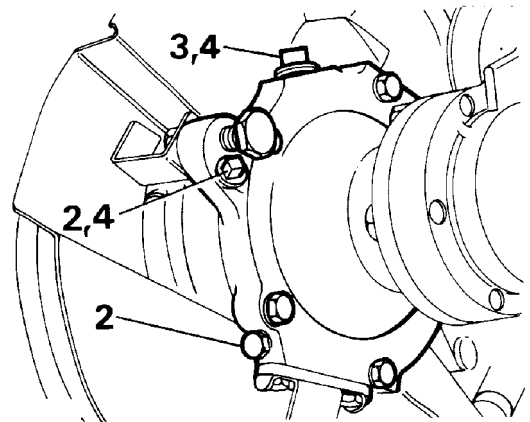


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**CHECK/TOP UP SWIVEL PIN HOUSING OIL**

**RENEW SWIVEL PIN HOUSING OIL**

1. Site vehicle on lift or level ground. Place container under swivel to be drained.
2. Remove drain and level plugs, allow oil to drain completely, clean and refit drain plug.
3. Remove filler plug and inject recommended make and grade of oil it reaches level hole.
4. Clean and refit level and filler plugs, wipe away any surplus oil.



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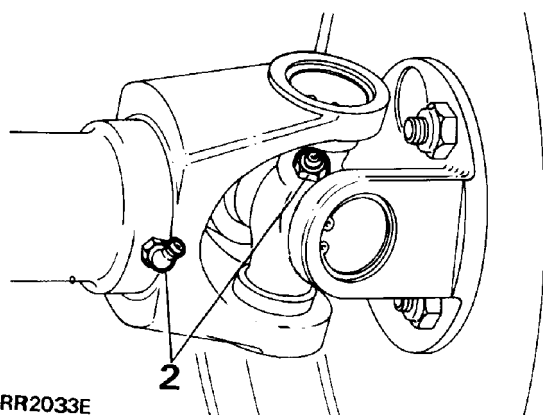
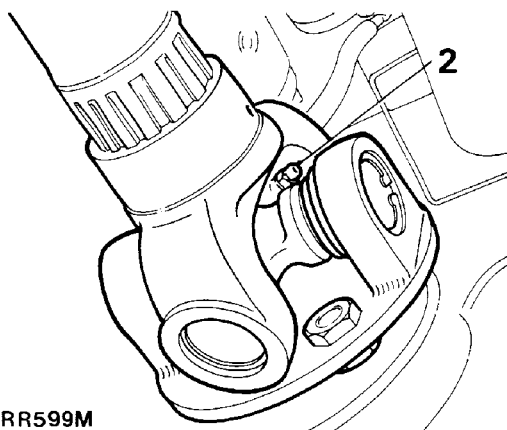
**CHECK/TOP UP FRONT AND REAR AXLE OIL**

1. Site vehicle on lift or level ground.
2. Using a 13mm square drive wrench, remove filler/level plug from axle.
3. If necessary inject new oil of recommended make and grade until it reaches level hole. Clean and refit filler/level plug and wipe away surplus oil.

## **LUBRICATE PROPELLER SHAFT SLIDING , AND UNIVERSAL JOINTS**

1. Clean all grease nipples on front and rear propeller shafts.
2. Using a low pressure hand grease gun, apply recommended grease, to grease nipples at front and rear propeller shaft universal and sliding joints.

 **NOTE:** The rear propeller shaft flexible coupling is not fitted with a grease nipple.



## **CHECK VISUALLY BRAKE, FUEL, CLUTCH PIPES/UNIONS FOR CHAFING LEAKS AND CORROSION**

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## **CHECK EXHAUST SYSTEM FOR LEAKS, SECURITY AND DAMAGE**

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## **CHECK FOR FLUID LEAKS FROM POWER STEERING AND SUSPENSION SYSTEMS, HYDRAULIC PIPES AND UNIONS FOR CHAFING AND CORROSION**

---

## **CHECK/TIGHTEN STEERING UNIT AND STEERING ROD BALL JOINT FIXINGS, CHECK CONDITION OF OF BALL JOINTS AND DUST COVERS**

Ball joints are lubricated for their normal life during manufacture and require no further lubrication. This applies **ONLY** if rubber boot has not been dislodged or damaged. Joints should be checked at specified mileage intervals but more frequently if vehicle is used under arduous conditions.

1. Check for wear in joints by moving ball joint up and down vigorously. If free movement is apparent fit a new joint assembly.
-



**CHECK/TIGHTEN FRONT AND REAR AXLE  
SUSPENSION LINK FIXINGS, CHECK CONDITION  
OF MOUNTING RUBBERS**

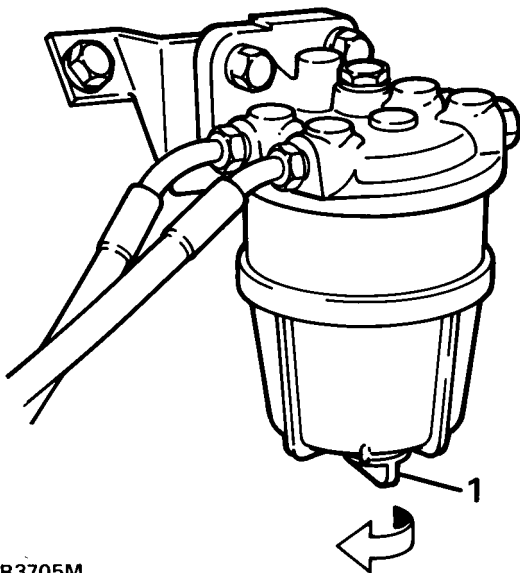
**DRAIN FUEL SEDIMENTER - Tdi**

**Fuel sedimenter**

The sedimenter is attached to left-hand side of chassis frame near fuel tank. It increases the working life of the fuel filter by removing larger droplets of water and larger particles of foreign matter from fuel.

**Drain off water**

1. Loosen drain plug, allow water to run out. Tighten plug immediately pure diesel fuel starts to flow.



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**RENEW FUEL FILTER**

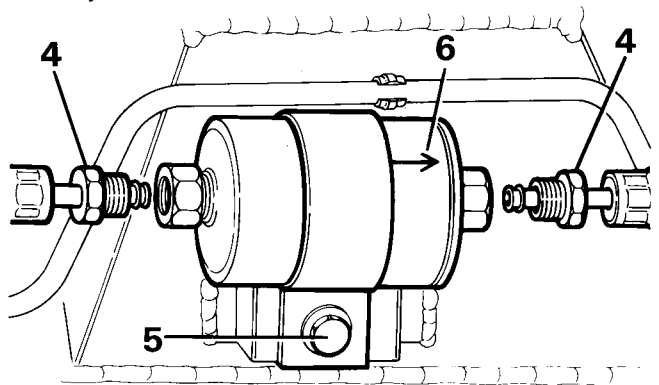


**WARNING:** Ensure that fuel handling precautions given in Section 01 - Introduction regarding fuel handling are strictly adhered to when carrying out following instructions. See *INTRODUCTION, Information, Fuel Handling Precautions*



**WARNING:** The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

1. Depressurise fuel system. See *FUEL SYSTEM, Repair, Depressurising Fuel System*
2. The fuel line filter is located on right hand chassis side member forward of fuel tank filler neck. Access to filter is gained through right hand rear wheel arch.
3. Thoroughly clean area around hose connections to prevent ingress of foreign matter into fuel system.



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4. Loosen two fuel unions and remove hoses from filter canister.
5. Release securing bolt and bracket, remove filter from chassis side member.
6. Fit a new filter observing direction of flow arrow on canister.
7. Fit inlet and outlet hoses. Tighten to **30 Nm**.
8. Refit fuel pump relay.
9. Reconnect battery negative lead.
10. Recode radio.
11. Start engine and inspect hose connections for fuel leaks.

**ABS VEHICLES - CHECK ROAD WHEEL SPEED  
SENSOR ELECTRICAL HARNESS FOR DAMAGE**

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**RENEW OXYGEN SENSORS**

*See EMISSION CONTROL, Repair, Heated  
Oxygen Sensor (HO2S)*

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**RENEW CATALYTIC CONVERTERS**

*See MANIFOLD AND EXHAUST SYSTEM, Repair,  
Exhaust System Complete*

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**REPORT ANY UNUSUAL FEATURES OF VEHICLE  
CONDITION AND ADDITIONAL WORK REQUIRED**

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**CARRY OUT ROAD TEST**

For details of dynamometer testing. *See  
INTRODUCTION, Information, Dynamometer  
Testing - Non Anti-lock brake vehicles See  
INTRODUCTION, Information, Dynamometer  
Testing - Vehicles with Anti-lock brakes (ABS)*

Check following items:

1. Inhibitor switch only operates in P and N.
  2. Engine for excessive noise.
  3. Clutch for slip, judder or spin.
  4. Automatic gear selection/shift speeds.
  5. Gear selection/noise - high/low range.
  6. Steering for abnormal noise/effort.
  7. Steering for free play.
  8. All instruments, gauges and warning indicators.
  9. Heater and air conditioning systems.
  10. Heated rear screen.
  11. Shock absorbers - ride irregularities.
  12. Foot brake, on emergency stop, pulling to one side, binding, pedal effort.
  13. Parkbrake efficiency.
  14. Seat reclining and latching.
  15. Fully extend seat belt, check operation of retraction and latching. Inertia belts lock when snatched or vehicle on slope.
  16. Road wheel balance.
  17. Transmission for vibrations.
  18. Body noises, squeaks and rattles.
  19. Excessive exhaust smoke.
  20. Engine idle speed.
  21. Endorse service record.
  22. Report any unusual features of vehicle condition and additional work required.
- 

**ENDORSE SERVICE RECORD**

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### **RESET EMISSION MAINTENANCE REMINDER - USA**

The emission maintenance reminder is designed to activate at 52,500 and 105,000 miles respectively and will illuminate a 'Service Engine' red warning light in instrument binnacle.

The emission maintenance reminder must be reset after required maintenance has been carried out and a new tamperproof label fitted by a Land Rover of North America dealer. This emission maintenance reminder is part of the Emission Control System

#### **Reset**

1. The control unit is located in the passenger footwell.
2. Identify control unit and remove from plug.
3. Remove tamperproof label to reveal access hole for resetting.
4. Place a thin metallic probe into access hole and momentarily electrically short between reset pins inside unit.

### **RECOMMENDED SERVICE ITEMS**

Refer Service Schedule sheets for intervals.

Clean sunroof drain tubes, clean and lubricate guide rails and slides.

Renew the hydraulic brake fluid. **See BRAKES, Repair, Brake System Bleed**

Renew all hydraulic brake fluid, seals, brake servo filter and flexible hoses.

All working surfaces of the master cylinder and caliper cylinders should be examined and renewed where necessary.

ABS vehicles only - renew hydraulic brake fluid and flexible hoses examine the working surfaces of the caliper cylinders and renew the seals or cylinders where necessary.

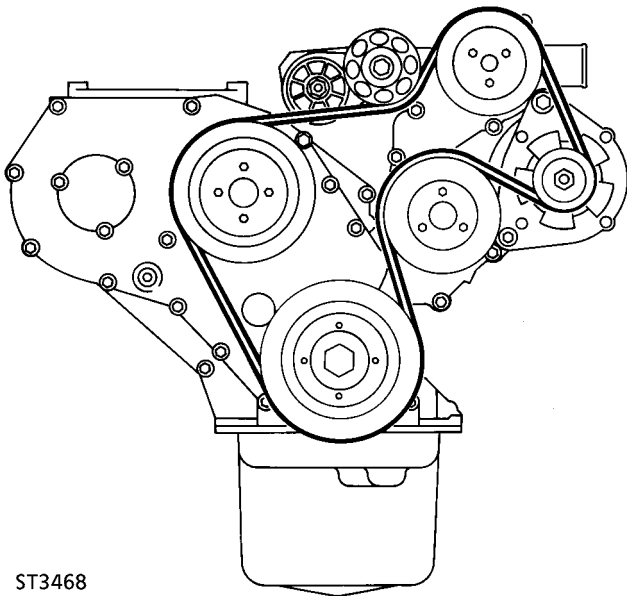
Air cleaner - When the vehicle is used in dusty or field conditions or deep wading, frequent attention to the air cleaner may be required.

ABS vehicles used extensively in arduous off-road conditions - check the rear wheel road speed sensor for abrasive wear.



## DRIVE BELT INFORMATION

A single 'serpentine drive belt' drives all the ancillaries bar the air conditioning compressor, which has a separate drive belt. It is essential that the belts are fitted exactly as shown. It should also be noted that the water pump/viscous fan is driven in a clockwise direction.



ST3468

A drive belt tensioner automatically tensions the drive belt, eliminating the need for tensioning individual drive belts. Turning the tensioner pulley in a clockwise direction will release drive belt tension.

Under normal highway use the belt must be changed at 160,000 kilometres, 96,000 miles or eight years whichever occurs first.

The drive belt must be examined at every service and replaced if necessary.

## Off road driving

Regular examination of the drive belt is essential if the vehicle is used off road. The vehicle driver should be requested to identify the type of mileage the vehicle has covered.

After every off road session the owner should inspect the belt for cuts and possible damage caused by stones. If belt has jumped, reposition belt correctly. A new belt must be fitted at the next service or before, dependant on the type of damage sustained.

## Fan cowl

To ensure easy access to the drive belt the top portion of the fan cowl is detachable.

## Check condition

Check condition of drive belt. Renew a belt that shows signs of wear, splitting or oil contamination.

## DRIVE BELT RENEW

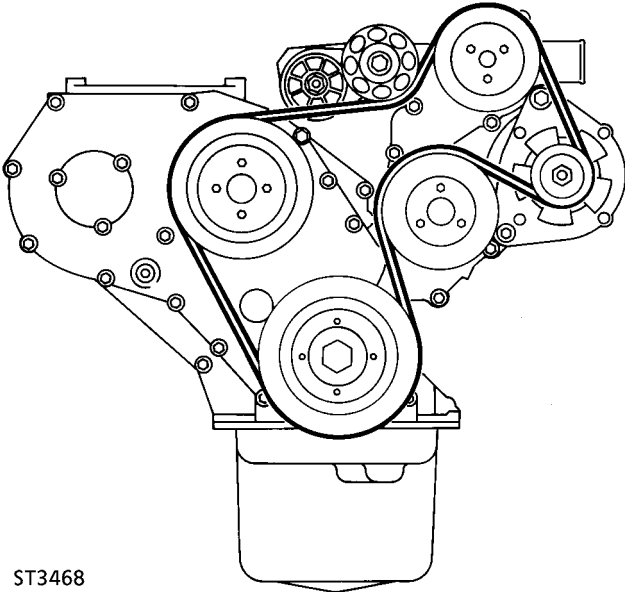
Service repair no - 86.10.03



**NOTE:** If cast lines on tensioner arm and tensioner spring case are aligned, a new drive belt must be fitted.

### Remove

1. Remove fan cowl upper.
2. Apply ring spanner to tensioner pulley retaining bolt.
3. Turn spanner to release pulley tension from belt.
4. Detach belt from pulley.
5. Release tensioner.
6. Complete removal of belt. Mark direction on belt if refitting.



ST3468

### Refit

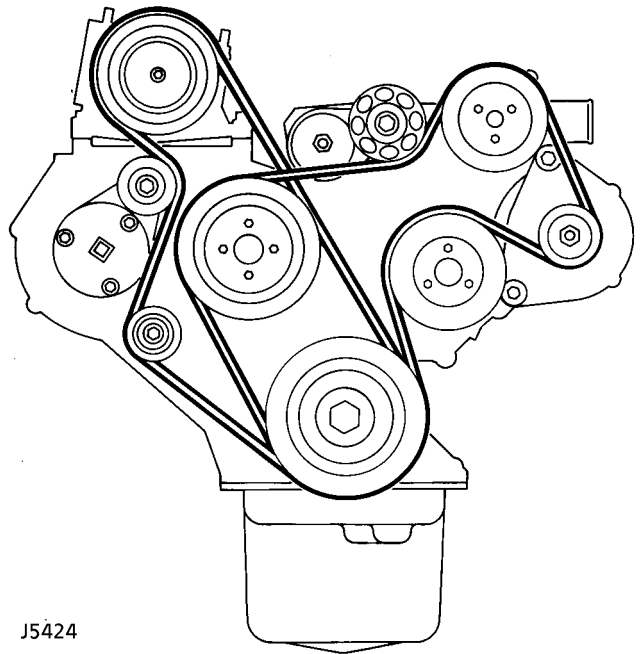
7. Reverse removal procedure.

## COMPRESSOR DRIVE BELT

Service repair no - 86.10.02

### Remove

1. Remove auxiliary drive belt. **See Drive Belt Renew**
2. Remove compressor shield.
3. Loosen tensioner retaining bolts.
4. Remove compressor drive belt. Mark direction on belt if refitting.



J5424

### Refit

5. Fit compressor drive belt.
6. Fit torque meter to centre of tensioner and apply and hold a torque of **35 Nm**. Tighten 3 tensioner retaining bolts.
7. Rotate crankshaft 2 full turns.
8. Reapply and hold a torque of **35 Nm** to tensioner, then fully loosen and retighten 3 tensioner retaining screws to **25 Nm**.



## ENGINE

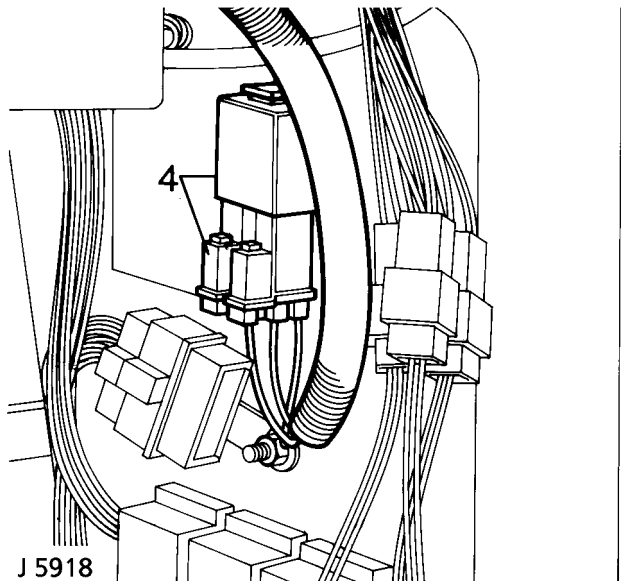
Service repair no - 12.41.01

### Remove

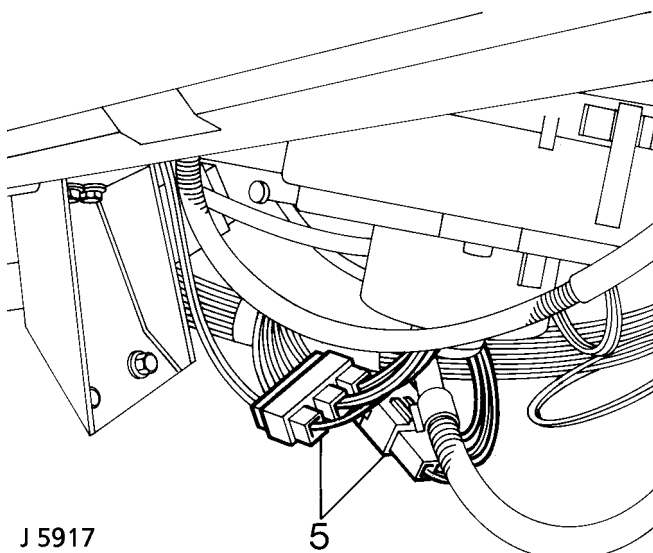


**CAUTION:** Seal all exposed pipe ends against ingress of dirt after disconnection.

1. Park vehicle on level ground and apply park brake.
2. Disconnect battery negative lead.
3. Remove bonnet [hood]. **See CHASSIS AND BODY, Repair, Bonnet [Hood]**
4. If air conditioning is fitted, remove RH footwell side trim panel and disconnect harness multiplug from relay.



5. Disconnect the two engine harness multiplugs on LH side of footwell.

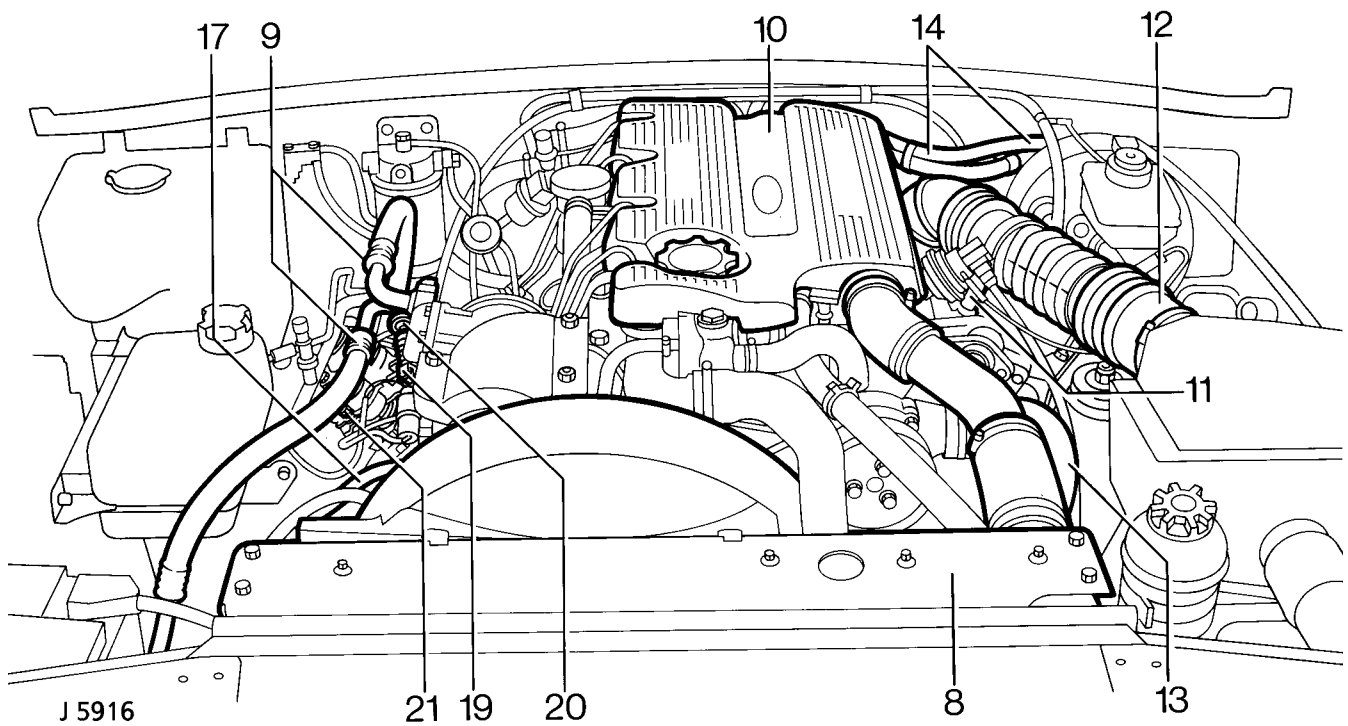


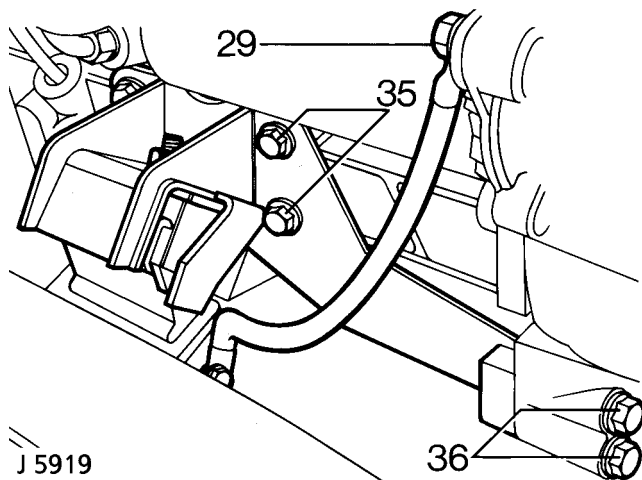
6. Remove engine harness grommet from bulkhead and move harness into engine bay.
7. Release battery positive lead from retaining clip at base of suspension turret.
8. Remove Radiator Assembly. **See COOLING SYSTEM, Repair, Radiator**
9. Discharge air conditioning system. **See AIR CONDITIONING, Adjustment, Refrigerant Recovery Recycling Recharging**  
Remove retaining bolts and disconnect both pipe adaptors from rear of compressor.
10. Remove rocker cover insulation.
11. Disconnect cyclone hose from air cleaner hose.
12. Remove air cleaner hose from turbocharger.
13. Remove feed pipe/hose from turbocharger and intercooler.
14. Disconnect heater hoses from cylinder head and heater rails.
15. Remove bolt securing transmission breather pipe clip to cylinder head; move breather pipes aside.
16. Disconnect inlet and outlet hoses from power steering pump.
17. Disconnect bypass hose from thermostat housing.
18. Release bypass hose from retaining clips on front timing cover.
19. Remove split pin securing inner throttle cable to injector pump.
20. Depress tags on outer cable adjusting nut, remove cable from mounting bracket, and move aside.
21. If automatic transmission is fitted, release kickdown cable from injector pump and mounting bracket.



## 12 ENGINE

22. Disconnect feed pipe and spill return pipe from injector pump.
23. Disconnect both pipes from fuel lift pump.
24. Disconnect servo hose from vacuum pump.
25. Remove three retaining nuts and disconnect exhaust down pipe.
26. Remove oil cooler pipes from oil filter adaptor.
27. If automatic transmission is fitted, disconnect feed and return pipes at gearbox oil cooler. Remove retaining bracket from LH side of cylinder block and release both oil cooler pipes.
28. Support gearbox.
29. Disconnect ground strap from starter motor.
30. On vehicles with automatic transmission, remove fixings and detach drive plate housing access panel and gasket.
31. Working through drive plate housing aperture mark the torque converter and drive plate to facilitate reassembly.
32. Remove the four converter to flexible drive securing bolts, rotating crankshaft to gain access to each individual bolt.
33. Fit engine lifting bracket to the two RH rear cylinder head fixing bolts.
34. Using suitable hoist, fit lifting chains to engine.
35. Remove four bolts, from both sides, securing front engine mounting brackets to cylinder block.
36. Remove two bolts, from both sides, securing front engine mounting bracket to bell housing.





37. Remove nuts and plain washers securing front engine mountings to chassis, and lift both engine mounting bracket assemblies from vehicle.
38. Remove engine to bell housing fixings. Leave starter motor attached.
39. Raise engine to separate from transmission.
40. Check all connections to engine have been disconnected.
41. Remove engine.

#### Refit

42. Apply Hylomar to mating faces of bell housing. Lubricate splines of gearbox primary pinion with Rocol MV 3.  
If automatic transmission, coat the four drive plate to torque convertor bolts with Loctite 290. Tighten to **39 Nm**.
43. Lower engine and locate with transmission. If manual transmission locate primary pinion into clutch and engage bell housing dowels. Fit engine to bell housing fixings. Tighten to **40 Nm**. If automatic transmission fixings. Tighten to **46 Nm**.
44. Raise engine, refit front engine mounting brackets to cylinder block and bell housing.
45. Remove gearbox support and lower engine.
46. Tighten front engine mountings to chassis fixings. Tighten to **45 Nm**.
47. Reverse removal procedure. 1 to 37.

## CRANKSHAFT PULLEY

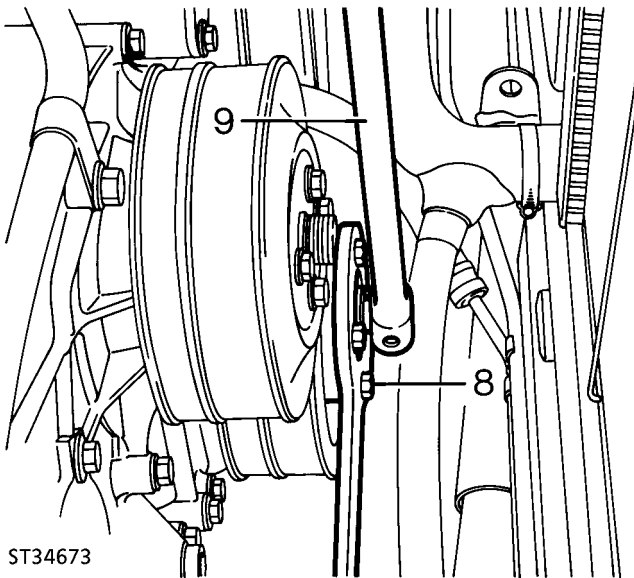
Service repair no - 12.21.01

### Remove

1. Disconnect battery negative lead.
2. Drain coolant.
3. Remove top hose from radiator.
4. Remove intercooler to induction manifold hose.
5. Remove viscous fan and coupling. **See COOLING SYSTEM, Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl**
6. Remove fan cowl.
7. Remove drive belt. **See Drive Belt Renew**
8. Fit crankshaft pulley retainer LRT-12-080 and secure with four bolts.
9. Remove crankshaft pulley retaining bolt using socket and suitable long bar.

### Refit

12. Refit in reverse order, lightly greasing pulley spigot. Tighten to **80 Nm + 90°**.



10. Remove pulley retainer.
11. Remove pulley, if necessary using extractor LRT-12-049 with thrust pad from LRT-12-031.



## FRONT COVER PLATE

Service repair no - 12.65.01

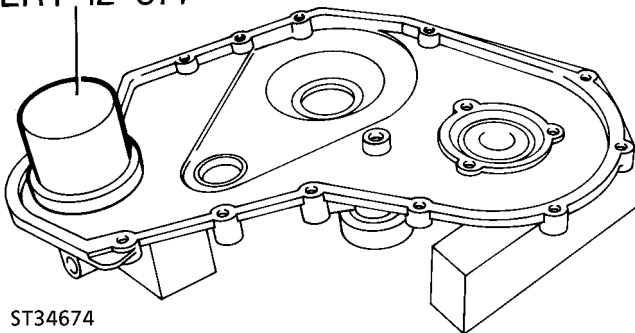
### Remove

1. Disconnect battery negative lead.
2. Drain coolant.
3. Remove top hose from radiator.
4. Remove inter-cooler to induction manifold hose.
5. Remove viscous coupling and fan. **See COOLING SYSTEM, Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl**
6. Remove fan cowl.
7. Remove drive belt. **See Drive Belt Renew**
8. Remove crankshaft pulley. **See Crankshaft Pulley**
9. Remove 14 bolts securing front cover plate, noting top two bolts also retain thermostat hose clips.
10. Remove cover plate complete with gasket.
11. Remove small gasket from centre bolt boss.

### Seal replacement

12. Remove worn seal from cover and clean recess.
13. Support cover and fit new seal, open side fitted into recess, using special tool LRT-12-077.

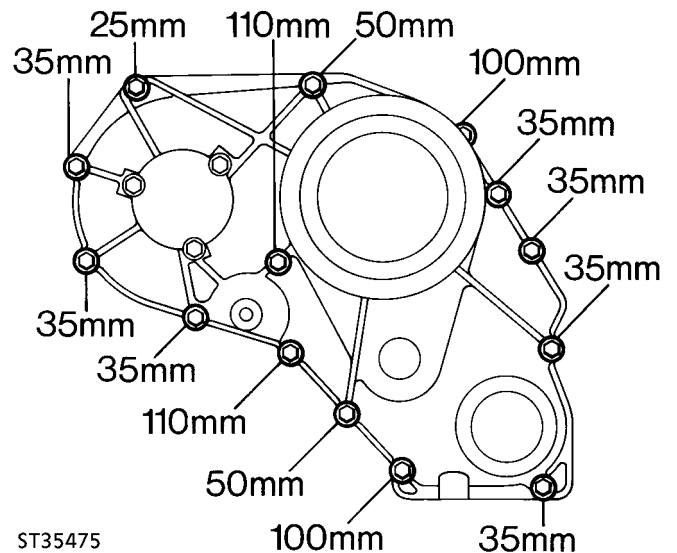
LRT-12-077



ST34674

### Refit

14. Refit in reverse order to removal using new gaskets, fitting the securing bolts as shown in illustration ST3475. Tighten to **25 Nm**.



ST35475

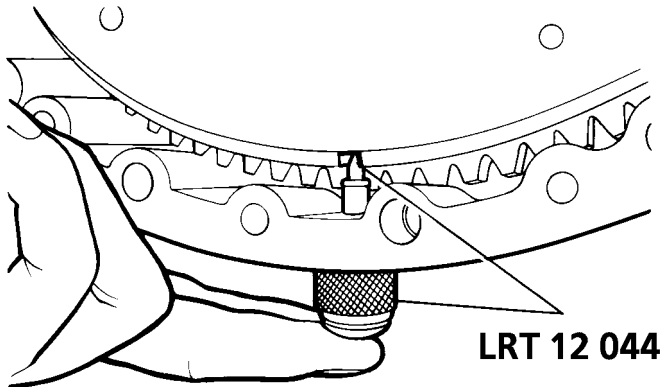
## CAMSHAFT DRIVE BELT AND GEARS

Service repair no - 12.65.18

### TIMING BELT

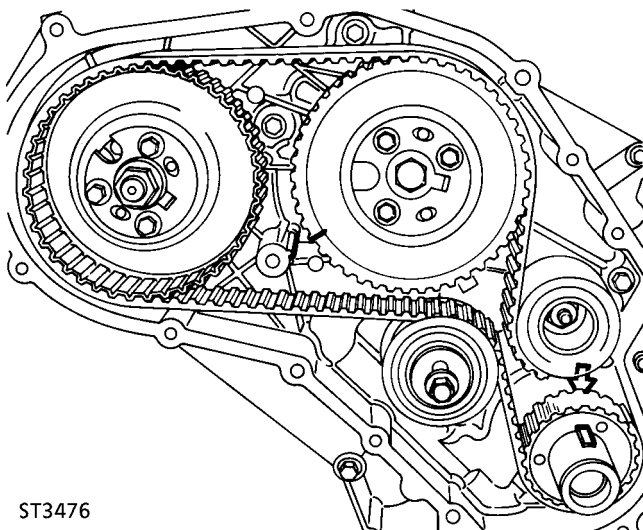
#### Remove

1. Remove front cover plate. *See Front Cover Plate*
2. Position engine at TDC on No. 1 cylinder.
3. If manual gearbox: Remove blanking plug from flywheel housing and insert timing tool LRT-12-044. If EDC - timing tool LRT-12-085 must be used.  
If automatic gearbox: Sited to the rear of the engine sump on engine backplate is a blanking plate. Remove 2 blanking plate bolts and insert timing tool LRT-12-044 into the larger bolt hole.




ST3531

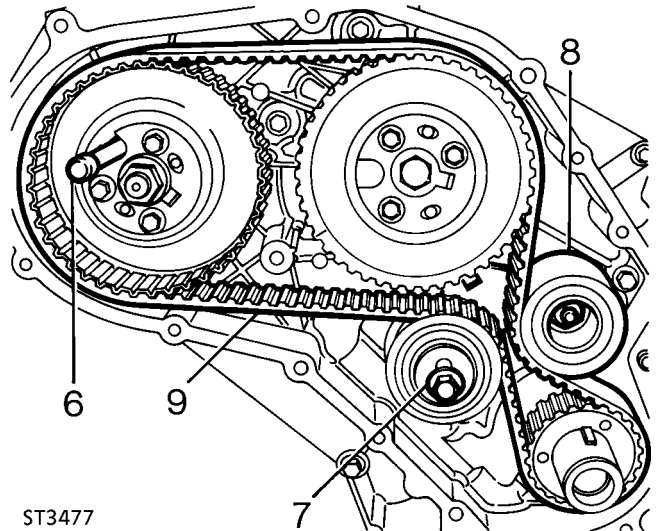
4. Engage timing tool pin with slot in flywheel.
5. Check correct alignment of timing mark on camshaft gear and that crankshaft key aligns with cast arrow on housing.



ST3476


6. Insert pin from special tool LRT-12-045 in injection pump gear and through into pump flange.


 **NOTE:** If the camshaft gear is to be removed during these operations its retaining bolt should be slackeden before the timing belt is removed.



ST3477

7. Slacken belt tensioner bolt.
8. Remove idler pulley.
9. Remove timing belt.

 **NOTE:** During use, a belt develops a wear pattern relative to its running direction, if the original belt is to be re-used it must be refitted so that it rotates in the original direction.

 **CAUTION:** Belts must be stored on edge on a clean surface and in such a manner that bends are not less than 50 mm radius. Do not bend belts at an acute angle or radius of less than 50 mm, otherwise premature failure could result.

10. Mark belt direction of rotation, using soft chalk, to ensure correct refitment.



### Belt tensioner

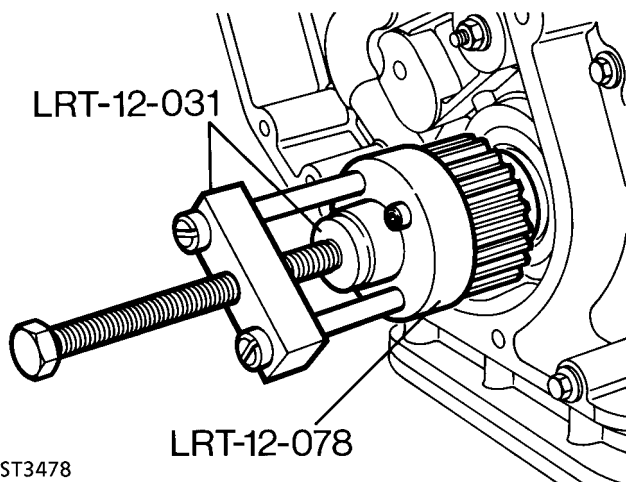


**NOTE:** The belt tensioner need only be removed if it is being replaced or for access purposes to remove front cover.

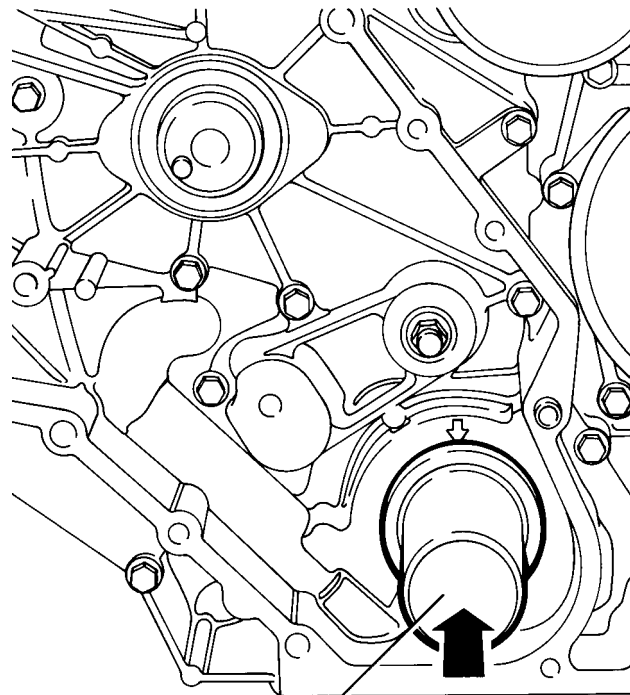
11. Remove securing bolt and withdraw tensioner complete with spacer.

### Crankshaft gear/front cover oil seal

12. If the crankshaft gear cannot be removed by hand, use special tool LRT-12-078 with main body and thrust button from special tool LRT-12-031 as illustrated ST3478M. Withdraw gear complete with 'O' ring seal.



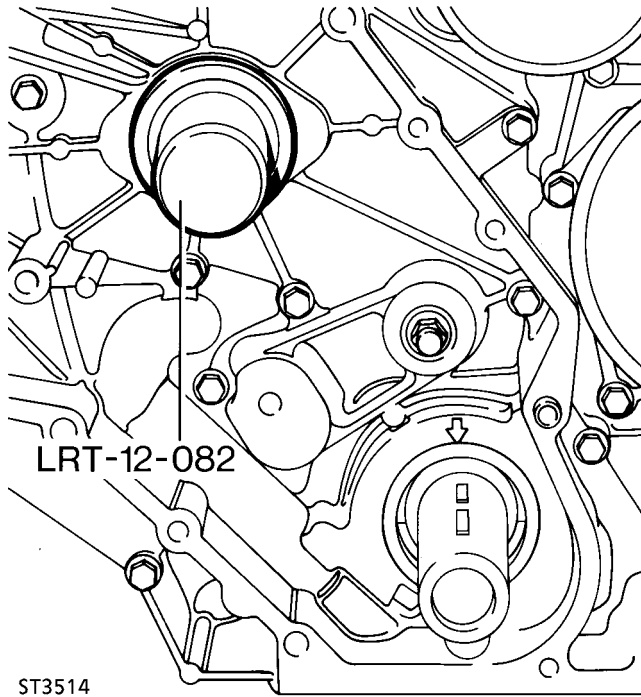
13. If necessary prise out oil seal from front cover.
14. Lubricate a new crankshaft oil seal with clean engine oil.
15. With lip side leading, drive-in seal squarely using special tool LRT-12-079.



16. Lubricate new 'O' ring seal with petroleum jelly and slide onto shaft, taking care not to damage seal on the woodruff keys.
17. Fit crankshaft gear, tap fully home ensuring 'O' ring seal is properly seated.

### CAMSHAFT GEAR/FRONT COVER OIL SEAL Service repair no - 12.13.05

18. Remove centre bolt from camshaft gear and withdraw gear.
19. Remove existing oil seal from front cover using special tool LRT-12-038.
20. Lubricate a new camshaft oil seal with clean engine oil.



21. With lip side leading, drive-in seal squarely using special tool LRT-12-082.
22. Refit gear.

## FUEL INJECTION PUMP GEAR

Service repair no - 19.30.06

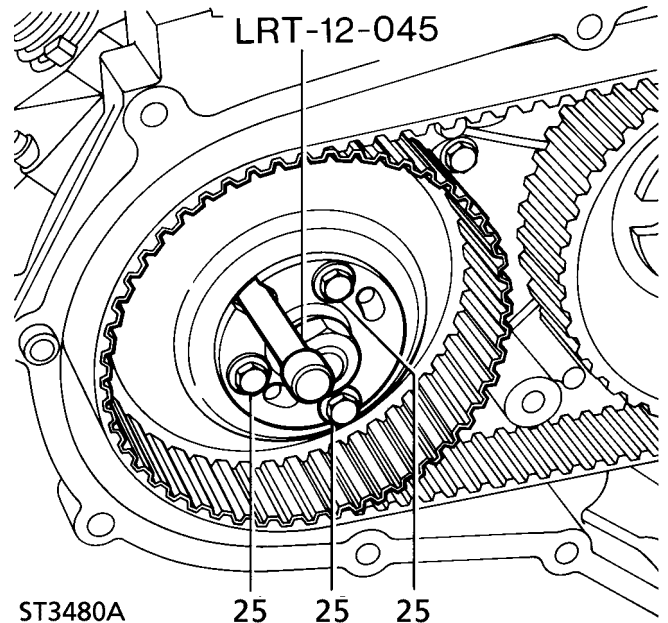
### Remove

23. Slacken the three bolts on front of gear.



**CAUTION:** It is important to ensure that when the injection pump is locked no attempt must be made to rotate it. Take care not to allow the crankshaft to be turned.

24. Remove special tool pin from gear.
25. Remove three bolts and withdraw plate and gear.



### Refit

26. Fit gear and plate and secure with three bolts.
27. Insert pin from special tool LRT-12-045 in injection pump gear and through into pump flange.

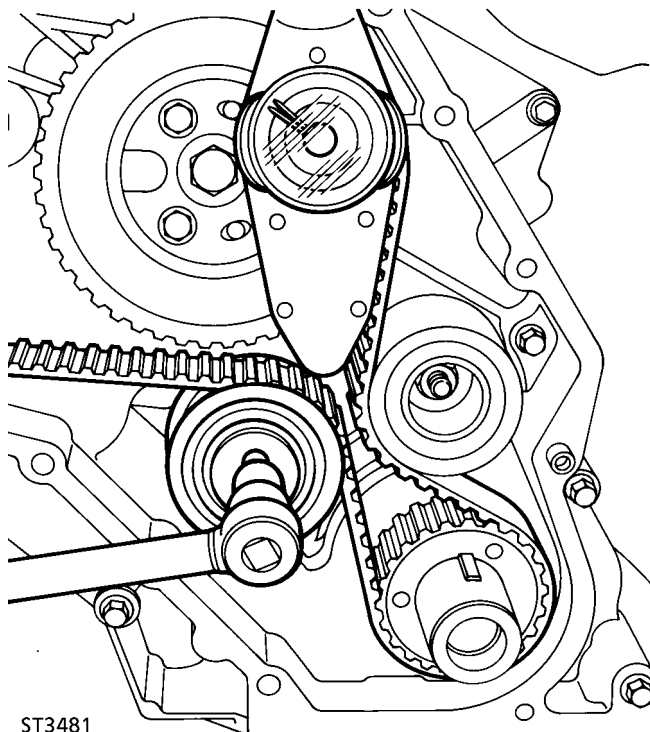


### Timing belt fitting and tensioning



**NOTE:** It is important that belt tensioning is carried out carefully and accurately. The following procedure involves tensioning the belt twice to ensure that it is equally tensioned between each gear. New and original belts are tensioned to different figures.

28. Ensure timing marks are correctly aligned, pin from special tool LRT-12-045 is correctly inserted in injection pump gear and timing tool LRT-12-044 (LRT-12-085 if EDC) is fitted to flywheel housing with pin located in flywheel slot. Or if automatic: Timing tool LRT-12-044 is fitted to engine backplate and pin located in ring gear.
29. Fit belt observing rotational marks made during removal. Feed belt over gears keeping it tight on drive side.
30. Fit idler pulley.
31. Slacken injection pump gear retaining bolts.
32. Adjust belt to correctly sit in gears.



ST3481

33. Slacken belt tensioner securing bolt to finger tight.
34. Insert 13 mm square drive extension bar in tensioner plate.



**NOTE:** Belt tensioning should be carried out using a dial type torque meter having a range not exceeding **60 Nm**. The torque meter should be used in the almost vertical position.

35. Apply a tension of **14 to 16 Nm** for a new belt or **11 to 13 Nm** for an original belt. When tension is correct tighten clamp bolt.
36. Tighten injection pump gear bolts.
37. Remove pin from injection pump gear.
38. Disengage timing pin from timing slot in flywheel or ring gear.
39. Rotate crankshaft one and three quarter turns in a clockwise direction; then continue rotation until timing pin in timing tool can be engaged with slot in flywheel or ring gear.
40. Disengage timing pin.
41. Insert pin from special tool LRT-12-045 in injection pump gear and through into pump flange.
42. Slacken injection pump gear retaining bolts.
43. Slacken tensioner and retension belt.
44. Tighten injection pump gear retaining bolts.
45. Remove pin from injection pump gear.
46. Remove timing tool and refit plug.
47. Fit front cover plate using new gaskets. **See Front Cover Plate**

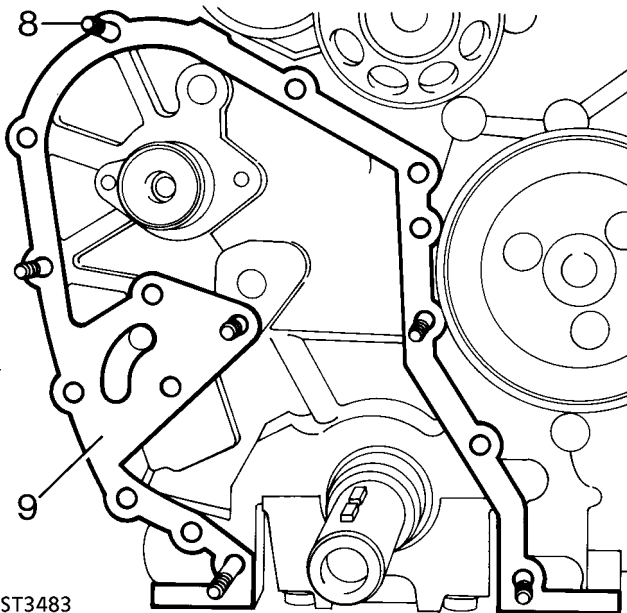


## FRONT COVER/TIMING GEAR HOUSING GASKET

Service repair no - 12.65.10

### Remove

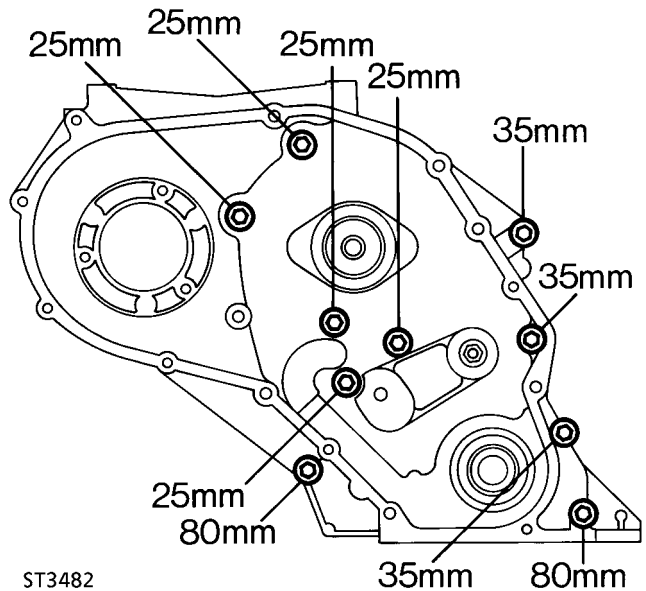
1. Remove timing belt and gears. *See Camshaft Drive Belt and Gears*
2. Remove fuel injection pump. *See FUEL SYSTEM, Repair, Fuel Injection Pump and Timing*
3. Remove engine oil sump. *See Oil Sump*
4. Remove oil pick up strainer. *See Oil Pick-Up Strainer*
5. Remove bolts securing timing gear housing to block.
6. Withdraw timing gear housing complete with gasket.
7. Clean all gasket material from mating faces.



ST3483

### Refit

8. Fit slave guide studs to locate gasket.
9. Fit new gasket, over slave studs, to cylinder block.
10. Align flats on oil pump with flats on crankshaft.
11. Fit front cover to block taking care not to damage oil seal.
12. Secure with bolts of correct length in locations where slave studs are not fitted (ST3482).
13. Remove slave studs and fit correct length bolts.
14. Tighten to **25 Nm**.



ST3482

15. Fit oil pick-up strainer. *See Oil Pick-Up Strainer*
16. Fit oil sump. *See Oil Sump*
17. Refit fuel injection pump. *See FUEL SYSTEM, Repair, Fuel Injection Pump and Timing*

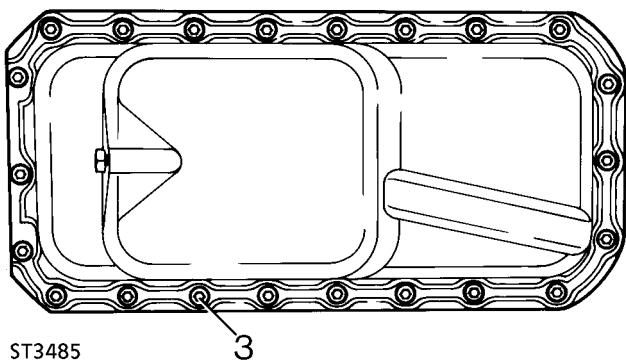


## OIL SUMP

Service repair no - 12.60.44

### Remove

1. Disconnect battery negative lead.
2. Drain engine oil.
3. Slacken sump securing bolts and, using a sharp knife, break sealant around sump flange.
4. Remove bolts and withdraw sump.



ST3485

### Refit

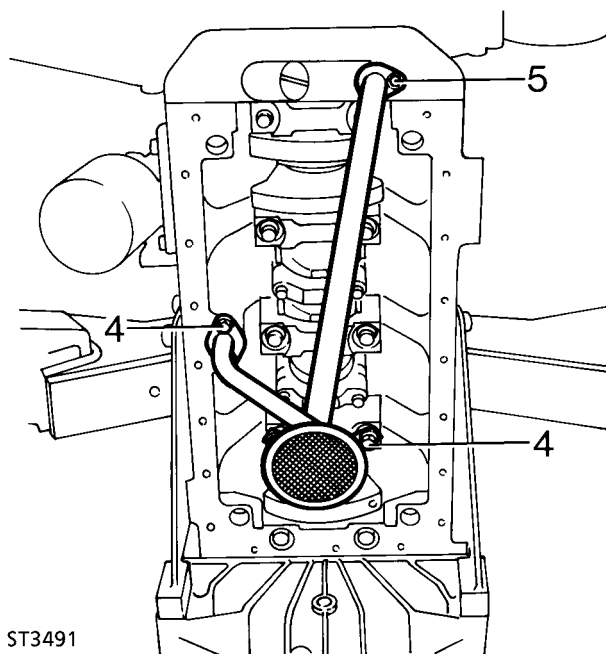
5. Clean mating faces of sump, timing gear housing and cylinder block.
6. Apply a 2,0 mm bead of 'Hylosil RTV102' to the sump flange, ensuring bead is applied inboard of the bolt holes.
7. Secure sump to block with bolts. Tighten to **25 Nm**.
8. Refill engine oil. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**
9. Reconnect battery negative lead.

## OIL PICK-UP STRAINER

Service repair no - 12.60.20

### Remove

1. Disconnect battery negative lead.
2. Drain engine oil.
3. Remove engine oil sump. **See Oil Sump**
4. Remove bolts securing pipe support bracket.
5. Remove bolts from pipe flanges.
6. Withdraw pick-up strainer assembly.



ST3491

### Refit

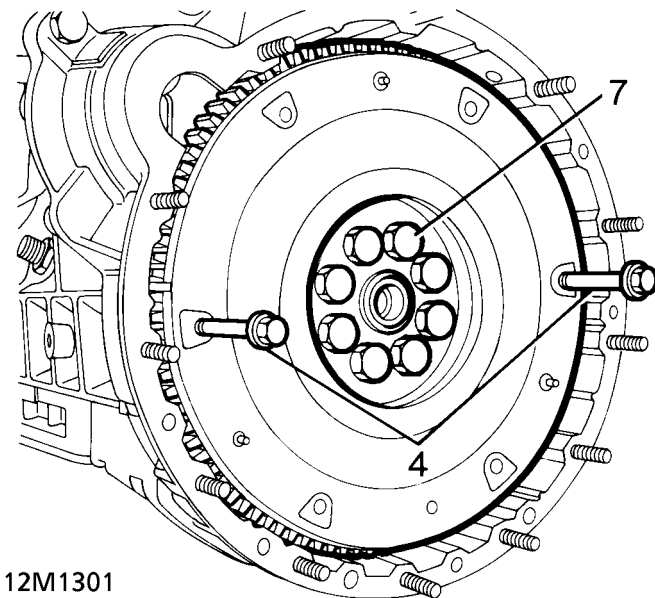
7. Refit pick-up strainer assembly, fitting a new 'O' ring seal at oil pump connection.
8. Apply Loctite 242E to the two screws at the bearing cap. Tighten to **9 Nm**.
9. Fit bolts to pipe flanges. Tighten to **25 Nm**.
10. Refit engine oil sump. **See Oil Sump**
11. Reconnect battery negative lead.

## FLYWHEEL

Service repair no - 12.53.07

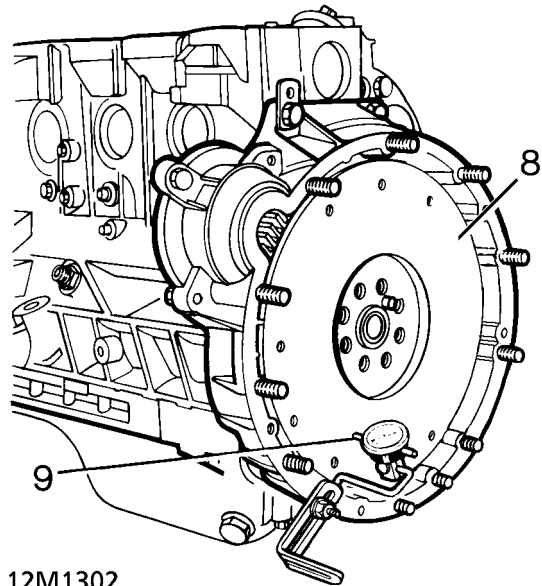
### Remove

1. Disconnect battery negative lead.
2. Remove gearbox. **See MANUAL GEARBOX, Repair, R380 Manual Gearbox**
3. Remove clutch. **See CLUTCH, Repair, Clutch Assembly**
4. Fit two long 8mm bolts into the clutch bolt holes, diametrically opposite, to use as handles when lifting the flywheel off the crankshaft.
5. Remove fan cowl
6. Fit crankshaft pulley retainer LRT-12-080 and secure with four bolts, to restrain crankshaft while removing flywheel retaining bolts.
7. Remove the bolts and lift off flywheel.



### Refit

8. Locate the flywheel on the crankshaft and secure with new patched retaining bolts, progressively tighten to **147 Nm**.



9. Check the flywheel for possible run-out by mounting a dial test indicator with the stylus in a loaded condition resting on the flywheel face at a radius of 114mm from the centre.
10. Turn the flywheel and check that run-out does not exceed 0,05 to 0,07mm. Should run-out be excessive, remove the flywheel and check again for irregularities on the crankshaft and flywheel mating faces and the dowel.
11. Reverse removal procedure. 1 to 6.



**NOTE:** To prevent excessive flywheel run-out, ensure that the mating faces of the flywheel and crankshaft are clean.



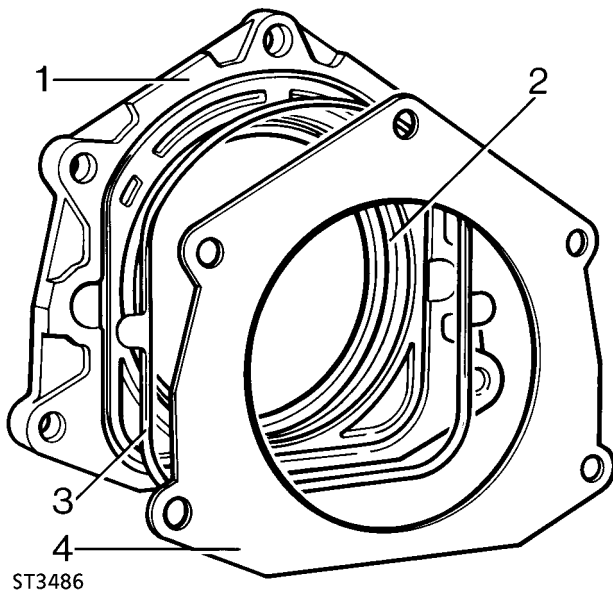
## CRANKSHAFT REAR OIL SEAL

Service repair no - 12.21.20

### Remove

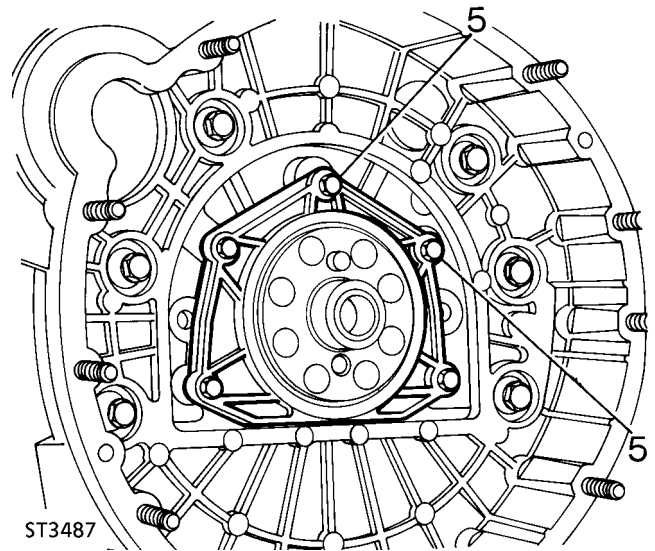


**NOTE:** The crankshaft rear oil seal is retained in its own housing, if the seal requires replacing the housing and seal assembly (1) must be renewed complete with the housing seal (3). Housing and seal assemblies are supplied with their own former/seal guide (2) already fitted. This former must not be removed before fitting the assembly to the engine. If a seal and housing assembly is received without a former/guide fitted it must be returned to the supplier. Used formers/guides must be discarded immediately after use, under no circumstances should they be reused on other assemblies.



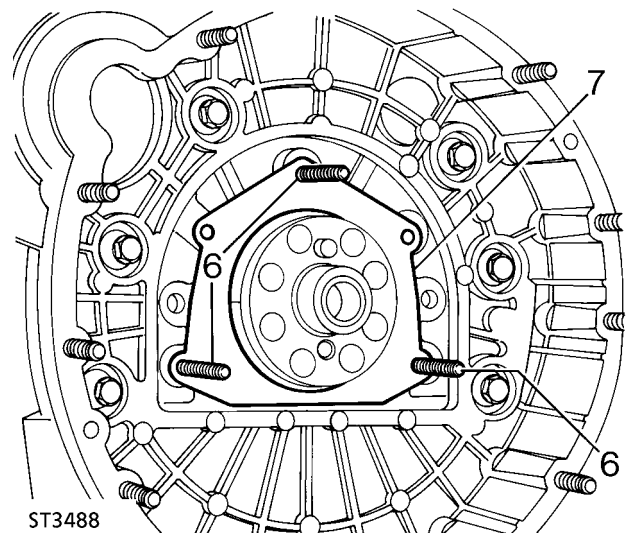
1. Disconnect battery negative lead.
2. Remove gearbox. *See MANUAL GEARBOX, Repair, R380 Manual Gearbox*

3. Remove clutch. *See CLUTCH, Repair, Clutch Assembly*
4. Remove flywheel. *See Flywheel*
5. Remove five bolts and withdraw seal housing and seal assembly complete with gasket.



### Refit

6. Insert slave studs to seal housing mounting face.
7. Position new seal housing gasket over slave studs and crankshaft flange onto cylinder block.

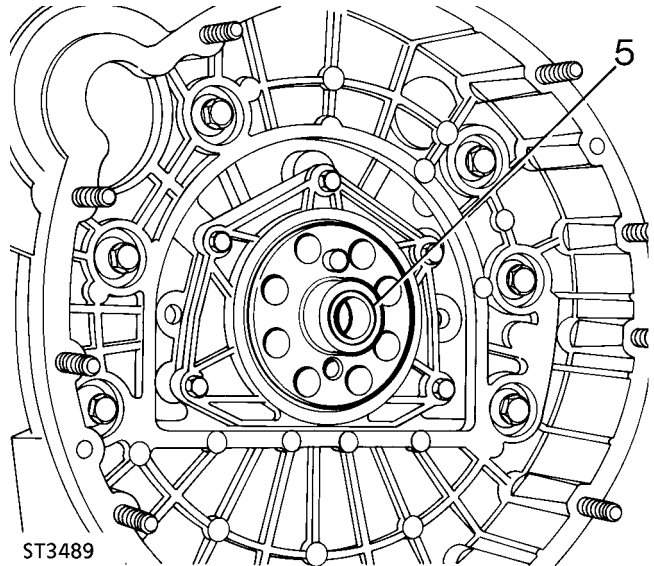


8. Ensure housing seal is correctly seated in its groove in new housing and seal assembly.
9. Fit new assembly, with former/guide in-situ, over crankshaft flange, this action will eject former/guide.
10. Secure assembly to cylinder block with five bolts tightened to correct torque, removing slave studs individually and inserting bolts.
11. Refit flywheel. *See Flywheel*
12. Refit clutch. *See CLUTCH, Repair, Clutch Assembly*
13. Refit gearbox. *See MANUAL GEARBOX, Repair, R380 Manual Gearbox*
14. Reconnect battery negative lead.

## CRANKSHAFT BEARING BUSH

Service repair no - 12.21.45

1. Disconnect battery negative lead.
2. Remove gearbox. *See MANUAL GEARBOX, Repair, R380 Manual Gearbox*
3. Remove clutch. *See CLUTCH, Repair, Clutch Assembly*



4. Remove flywheel. *See Flywheel*
5. Remove bearing bush.



**NOTE:** The bearing bush can be removed by using one of the following methods.

### Method 1.

Obtain a short length of steel rod of a diameter having a good slide fit in the bore of the bush. Pack the bore with grease and insert the steel rod into the end of the bore, give a sharp blow with a hammer and the grease should drive out the bush. It is recommended that the bush and rod be covered by a suitable cloth or rag to prevent grease from splashing.



### Method 2.

Thread the bore of the existing bush and using a suitable bolt extract the bush. Thoroughly clean bush location ensuring all swarf is removed.

### Fitting

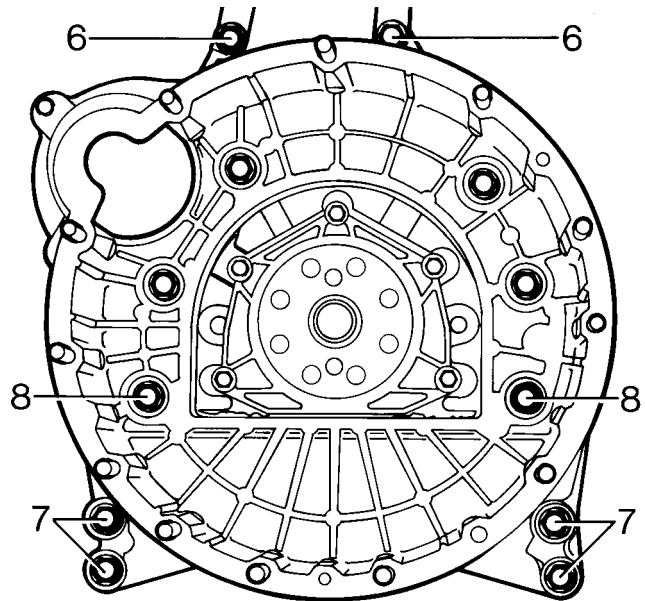
6. Fit new bush using a suitable shouldered drift, inserting bush flush with end of crankshaft.
7. Refit flywheel. *See Flywheel*
8. Refit clutch. *See CLUTCH, Repair, Clutch Assembly*
9. Refit gearbox. *See MANUAL GEARBOX, Repair, R380 Manual Gearbox*
10. Reconnect battery negative lead.

## FLYWHEEL HOUSING

Service repair no - 12.53.01

### Remove

1. Disconnect battery negative lead.
2. Remove gearbox. *See MANUAL GEARBOX, Repair, R380 Manual Gearbox*
3. Remove clutch. *See CLUTCH, Repair, Clutch Assembly*
4. Remove flywheel. *See Flywheel*
5. Remove starter motor.
6. Remove two bolts from top of flywheel housing.
7. Remove four bolts from bottom of flywheel housing.
8. Remove six inner bolts and lift off flywheel housing.

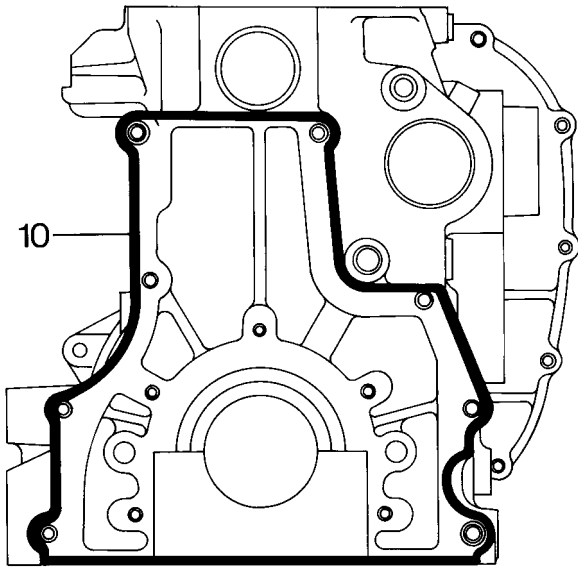


ST3490

### Refit

9. Clean rear face of housing and mating face on block, ensuring all old sealant is removed.

10. Apply sealant to flywheel housing mating face on cylinder block (Fig. J5944).



J5944

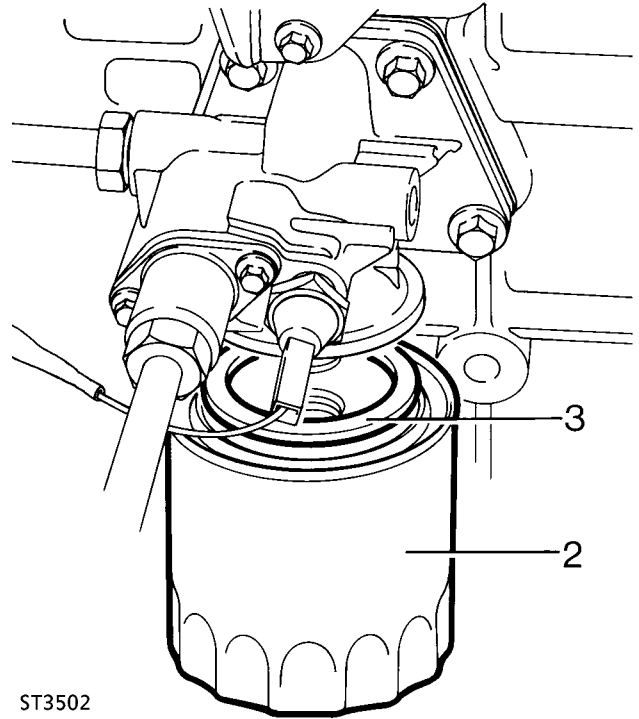
11. Fit housing to cylinder block and secure with bolts as removed. Tighten to **45 Nm**.
12. Remove surplus sealant from block.
13. Refit starter motor.
14. Refit flywheel. *See Flywheel*
15. Refit clutch. *See CLUTCH, Repair, Clutch Assembly*
16. Refit gearbox. *See MANUAL GEARBOX, Repair, R380 Manual Gearbox*
17. Reconnect battery negative lead.

## OIL FILTER

Service repair no - 12.60.01

### Remove

1. Place drain tray under filter.
2. Unscrew filter anti-clockwise, using a strap or spanner.



### Refit

3. Smear clean engine oil on seal of new filter.
4. Screw on filter until sealing ring touches machined face, then tighten a further half turn by hand only. Do not over tighten.

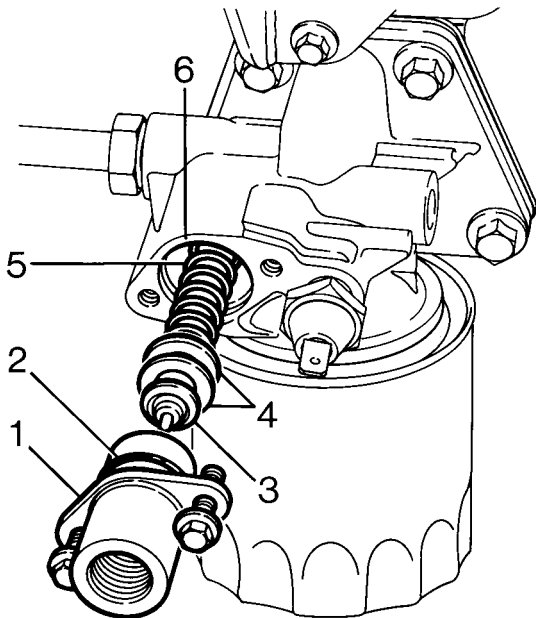


## OIL TEMPERATURE CONTROL VALVE

Service repair no - 12.60.69

### Remove

1. Disconnect oil cooler pipes.
2. Remove two bolts and carefully withdraw thermostat extension housing (1) complete with O ring seal (2), thermostat (3), two washers (4) and spring (5).



ST3504

3. Clean adaptor housing.
4. Inspect all parts and renew as necessary.

### Refit

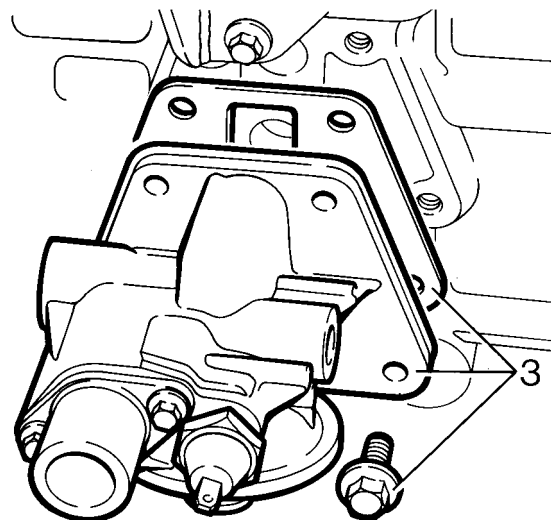
5. Fit thermostat to extension housing ensuring pin locates in hole.
6. Fit two washers and spring to thermostat.
7. Fit a new 'O' ring to extension housing.
8. Insert spring into adaptor and secure extension housing to adaptor with bolts. Tighten to **9 Nm**.

## OIL FILTER HEAD GASKET

Service repair no - 12.60.03

### Renew

1. Disconnect oil cooler pipes.
2. Disconnect pressure switch lead.
3. Remove securing bolts and withdraw head complete with gasket.
4. Clean mating faces.



ST3503

5. Refit head with new gasket.
6. Secure with bolts. Tighten to **45 Nm**.
7. Refit pipes and reconnect pressure switch.

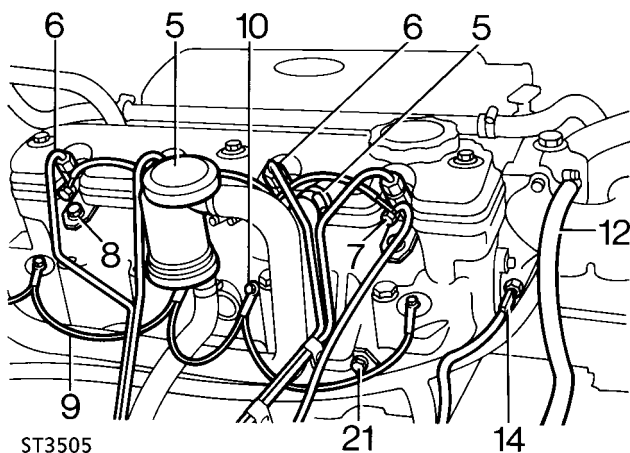


## CYLINDER HEAD GASKET

Service repair no - 12.29.02

### Remove

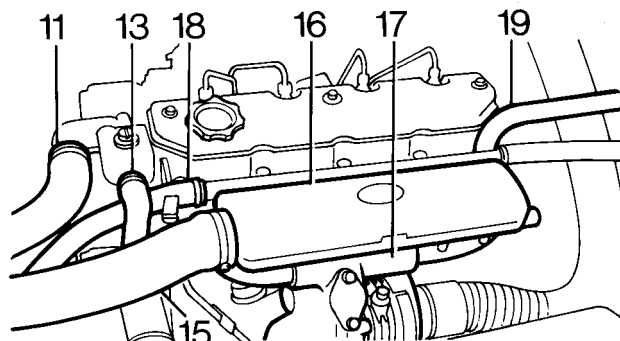
1. Disconnect battery negative lead.
2. Remove bonnet [Hood]. **See CHASSIS AND BODY, Repair, Bonnet [Hood]**
3. Drain coolant.
4. Remove air cleaner assembly. **See FUEL SYSTEM, Repair, Air Cleaner**
5. Detach crankcase ventilation valve and side breather hose from rocker cover and move to one side.
6. Remove injection pipes.



ST3505

7. Disconnect spill rail from fuel injectors.
8. Remove fuel injectors and sealing washers. Identify each injector to the location from which it is removed. **See FUEL SYSTEM, Repair, Injectors**
9. Remove inter-connecting harness from glow plugs.
10. Remove glow plugs. **See FUEL SYSTEM, Repair, Glow Plugs**

11. Remove top hose, radiator to thermostat.
12. Disconnect by-pass hose from thermostat.
13. Disconnect hose, thermostat to water pump.
14. Disconnect water temperature sensor lead.

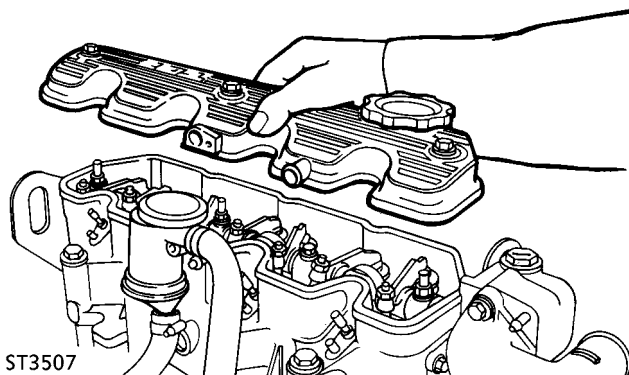


ST3506

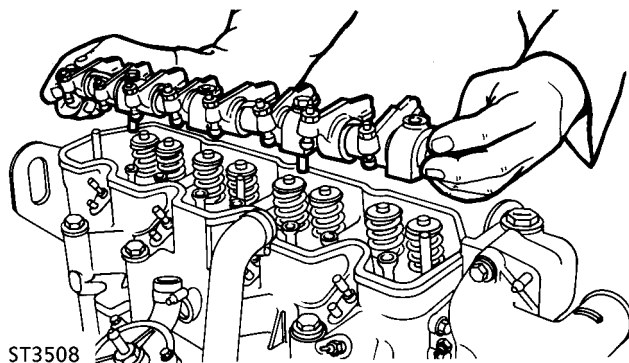
15. Remove hose inter-cooler to induction manifold.
16. Remove induction manifold. **See MANIFOLD AND EXHAUST SYSTEM, Repair, Exhaust Manifold - Tdi**
17. Remove exhaust manifold and turbocharger assembly. **See MANIFOLD AND EXHAUST SYSTEM, Repair, Exhaust Manifold - Tdi**
18. Disconnect heater hose from water pump and move heater rail aside.
19. Disconnect heater hose from rear of cylinder head.
20. Remove bolt securing air cleaner mounting bracket to support strut.
21. Remove bolt securing harness bracket to cylinder head.
22. Remove rear lifting bracket, this will also release clips securing transmission and engine breather pipes and multiplug. Note loose spacer under clip securing engine breather pipe and multiplug.



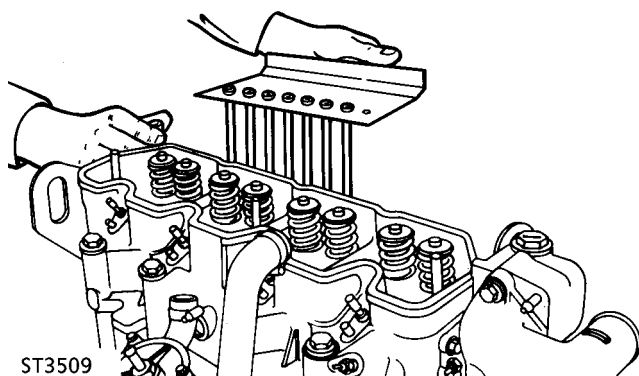
23. Remove rocker cover.



24. Remove nuts and bolts and withdraw rocker shaft assembly.



25. Remove push rods, store as an identified set to allow refitment to same location.



26. Remove valve stem caps.  
27. Evenly slacken, then remove, bolts retaining cylinder head to block. Two of the bolts also secure the air cleaner mounting bracket.  
28. Lift off cylinder head and remove gasket.

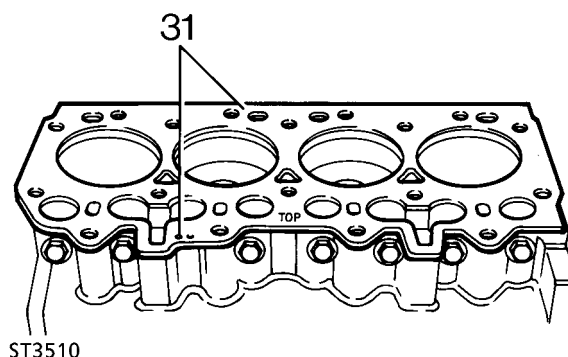
#### Refit

29. Ensure face of cylinder block is thoroughly clean.  
30. Select new gasket of correct thickness.



**CAUTION:** Three thicknesses of gasket are available, different thicknesses are identified by the number of small holes punched in the right hand side of the gasket. One hole identifies the thinnest gasket and three holes the thickest. When renewing gaskets the gasket being fitted must be of the same thickness as the one removed. Therefore if the removed gasket had two holes punched in the side the replacement gasket must also have two holes punched in the side.

31. Place gasket on cylinder block with identification holes positioned towards rear on right hand side and side marked TOP uppermost.



32. Clean mating face of cylinder head.  
33. Lower cylinder head onto block ensuring correct location with dowels.



**NOTE: Cylinder head retaining bolts can be used up to a maximum of five times.**

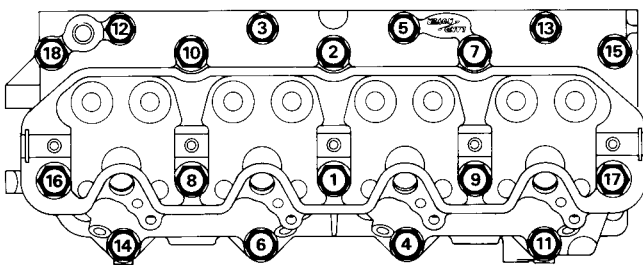
34. Lubricate threads of bolts with light oil and fit to positions illustrated.

**Bolt sizes:**

M10 x 117mm locations 3, 5, 12, and 13.

M12 x 140mm locations 1, 2, 7, 8, 9, 10, 15, 16, 17, and 18.

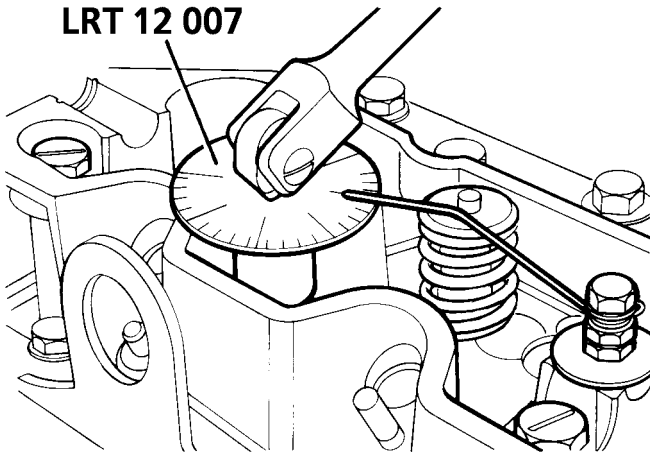
M12 x 100mm locations 4, 6, 11, 14.



ST2619M

35. Tighten bolts so that underside of heads just make contact with cylinder head.
36. Following the sequence illustrated tighten all bolts to **40 Nm**.
37. Attach degree disc special tool LRT-12-007 to a power bar.
38. Make a suitable pointer from welding rod and attach to a bolt screwed into a rocker shaft securing bolt hole.

**LRT 12 007**



ST3515

39. Tighten all bolts through 60° strictly in sequence illustrated.
40. Repeat 60° tightening procedure, again strictly in sequence illustrated.
41. Tighten the ten longer bolts (M12 x 140mm) a further 20°, again following the sequence illustrated.



**NOTE: Repositioning of the pointer will be necessary to reach all bolts, the pointer can be fitted to the rocker shaft securing studs using two nuts.**



**CAUTION: The double tightening procedure must be carried out, on no account should tightening be performed in one operation, otherwise damage to the cylinder head may occur.**

42. Fit valve stem caps.
43. Fit push rods to locations from which they were removed.
44. Fit rocker shaft assembly evenly tightening securing nuts and bolts to correct torque.
45. Fit rocker cover ensuring oil seal is satisfactory for continued use.



**NOTE: Rocker cover seals can be re-used up to a maximum of five times.**

46. Secure rocker cover with special seal washers and nuts tightened to correct torque.
47. Refit remainder of items by reversing operations 1 to 22 tightening securing bolts to correct torque where applicable.



## VACUUM PUMP

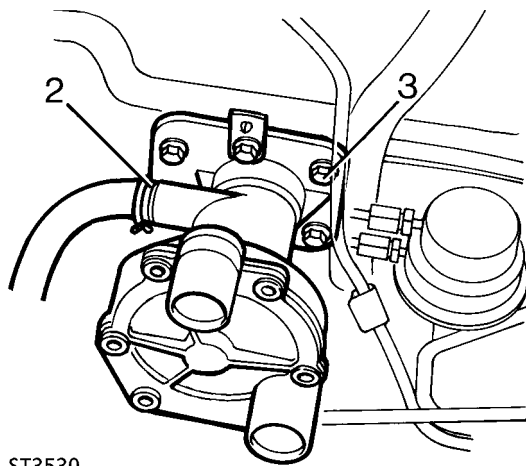
Service repair no - 70.50.19

### Remove



**NOTE:** To ease pump removal set engine to T.D.C. on No.1 cylinder.

1. Disconnect battery negative lead.
2. Detach servo hose from vacuum pump.



ST3530

3. Remove six bolts securing vacuum pump.
4. Detach pump complete with harness bracket. Note location of bracket for refitting.

### Refit

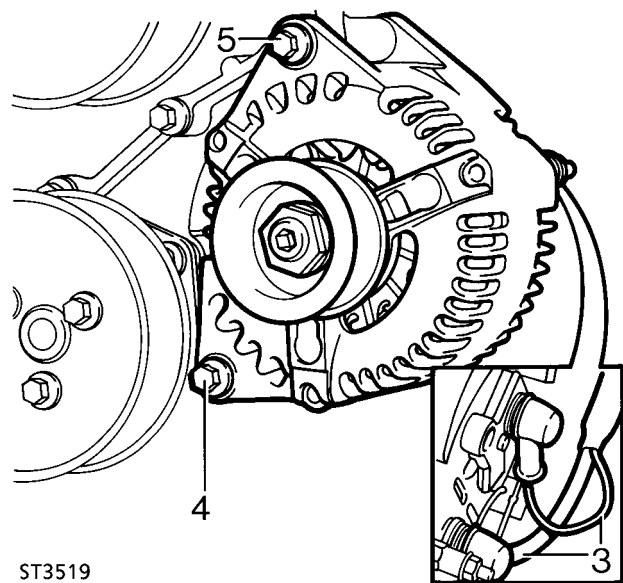
5. Clean mating faces of pump and block.
6. Loosely assemble pump to block with a new gasket and with harness bracket located under head of bolt noted during removal.
7. Evenly tighten bolts, to depress pump plunger, finally tightening to **25 Nm**.
8. Connect vacuum hose and secure with clip.
9. Reconnect battery negative lead.

## GENERATOR

Service repair no - 86.10.02

### Remove

1. Disconnect battery negative lead.
2. Remove drive belt. **See Drive Belt Renew**
3. Disconnect electrical leads from rear of generator.
4. Remove securing bolt from bottom of generator.
5. Remove long through bolt from top fixing and withdraw generator.



ST3519

### Refit

6. Reverse removal procedure.




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**TORQUE VALUES**


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**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
<b>Engine block</b>	
Bearing cap .....	133
Blanking plug, oil gallery, rear .....	37
Oil squirt jet assembly .....	17
Drain plug, cylinder block .....	25
Oil squirt jet, vacuum pump cam .....	7
Connecting rod to cap .....	59
Oil pick up assembly to bearing cap .....	9
Oil pick up assembly to front cover .....	25
Camshaft thrust plate .....	9
Oil drain pipe to block (internal) .....	25
Oil drain pipe to block (external) .....	25
Sump to cylinder block and front cover .....	25
Drain plug, oil sump .....	35
Tappet guide .....	14
Breather side cover assembly .....	25
Baffle plate to breather side cover .....	4
Vacuum pump .....	25
Fuel lift pump .....	25
Flywheel housing .....	45
Flywheel housing clutch cover stud .....	10
Plug, flywheel housing .....	12
Rear oil seal assembly .....	25
Oil filter adaptor .....	45
Waxstat adaptor to oil filter adaptor .....	9
Oil pressure switch .....	17
Oil filter, spin on .....	13
Oil cooler unions to filter adaptor .....	45
Oil level tube .....	25
Engine mounting foot to cylinder block .....	85
Engine mounting foot to flywheel housing .....	45
Engine mounting foot rubber to mounting foot (bolt and nut) .....	85
Flywheel to crankshaft .....	146
Clutch cover plate to flywheel .....	34
Flex drive plate to crankshaft (auto) .....	146
Flex drive plate to ring gear (auto) .....	25
Flex drive plate to torque converter (auto) .....	45

## Cylinder head

Cylinder head to cylinder block .....	See repair section
Stub pipe heater feed .....	22
Water temperature sensor .....	14
Blanking plug cylinder head .....	14
Engine lifting brackets .....	25
Electrical harness clip bracket .....	25
Exhaust manifold stud .....	10
Exhaust manifold nut .....	45
Inlet manifold stud .....	8
Inlet manifold nut and bolt .....	25
Air temperature sensor, inlet manifold .....	14
Blanking plug, inlet manifold .....	14
Heatshield to inlet manifold .....	6
Glow plug .....	20
Glow plug terminal nut .....	2
Injector clamp (stud) .....	8
Injector clamp (nut) .....	25
Thermostat housing .....	25
Water outlet elbow to thermostat housing .....	25
Water temperature switch, thermostat housing .....	11
Plug thermostat housing .....	6
Rocker shaft pedestal bolt .....	5 + 50°
Rocker cover (stud) .....	8
Rocker cover (fixing nut) .....	10
Breather cyclone to rocker cover .....	9
Tappet adjusting nut .....	16
Front cover to cylinder block .....	25
Front cover plate to front cover .....	25
Static idler - timing belt (stud) .....	10
Static idler - timing belt (nut) .....	45
Tensioner (timing belt) .....	45
Camshaft hub bolt .....	80
Timing pulley to camshaft hub .....	25
Fuel injection pump (stud) .....	8
Fuel injection pump (nut) .....	25
Abutment bracket to injection pump .....	25
Support bracket injection pump to cylinder block .....	25
Fuel injection pump access plate to front cover plate .....	25
Timing pulley to injection pump hub .....	25
TV Damper pulley bolt to crankshaft .....	80 + 90°
Fan pulley to hub .....	25
Fan and viscous coupling to hub .....	45
Auto tensioner, auxiliary drive (stud) .....	14
Auto tensioner, auxiliary drive (nut) .....	45
Auxiliary mounting bracket to cylinder block (stud) .....	8
Auxiliary mounting bracket to cylinder block (bolt and nut) .....	25
Water pump to block and mounting plate .....	25
Water pump pulley to hub .....	25



Turbo charger oil drain adaptor to block .....	42
Oil drain pipe to turbocharger .....	25
Turbocharger oil drain pipe to adaptor .....	38
Turbocharger oil feed pipe adaptor to block .....	25
Turbocharger oil feed pipe to adaptor .....	25
Oil feed pipe to turbocharger .....	19
Turbocharger to cylinder head (stud) .....	10
Turbocharger to cylinder head (nut) .....	45
Turbocharger to blanking plate .....	25
Turbocharger to EGR valve .....	25
EGR delivery tube to valve .....	25
EGR delivery tube to mixing tube .....	25
Fuel lift pump to filter (union) .....	15
Fuel filter from lift pump (banjo bolt) .....	33
Fuel filter to fuel injection pump (banjo bolt) .....	33
Fuel injection pump from fuel filter (banjo bolt) .....	25
Injector pipes to injectors and fuel injection pump .....	29
Spill rail to injectors (banjo bolt) .....	10
Spill rail to injection pump (banjo bolt) .....	25
Boost pipe injection pump (banjo bolt) .....	10
Plug, rear of injection pump .....	29
PAS pump to mounting plate .....	25
PAS pump mounting plate to auxiliaries mounting bracket .....	25
PAS pump pulley to hub .....	25
Generator to auxiliaries mounting bracket .....	25
Starter motor (bolt and nut) .....	45
Tachometer electrical connection .....	4
<b>Air conditioning compressor</b>	
Compressor mounting bracket to front cover .....	45
Compressor to mounting bracket (stud) .....	8
Compressor to mounting bracket (nut) .....	25
Belt tensioner pulley to tensioner arm .....	45
Belt tensioner assembly to front cover plate .....	25
Idler pulley to front cover plate .....	45
Compressor belt guard (nut) .....	25
Sensors to water outlet elbow (air/con) .....	25
Blanking plug, water outlet elbow (air/con) .....	25
Generator mounting bracket to front cover .....	45
Generator to mounting bracket .....	85
Generator pulley to hub .....	95
Generator belt guard .....	25

METRIC	Nm
M5 .....	6
M6 .....	9
M8 .....	25
M10 .....	45
M12 .....	90
M14 .....	105
M16 .....	180

UNC / UNF	Nm
1/4 .....	9
5/16 .....	24
3/8 .....	39
7/16 .....	78
1/2 .....	90
5/8 .....	136



**NOTE: Torque values above are for all screws and bolts used except for those specified.**





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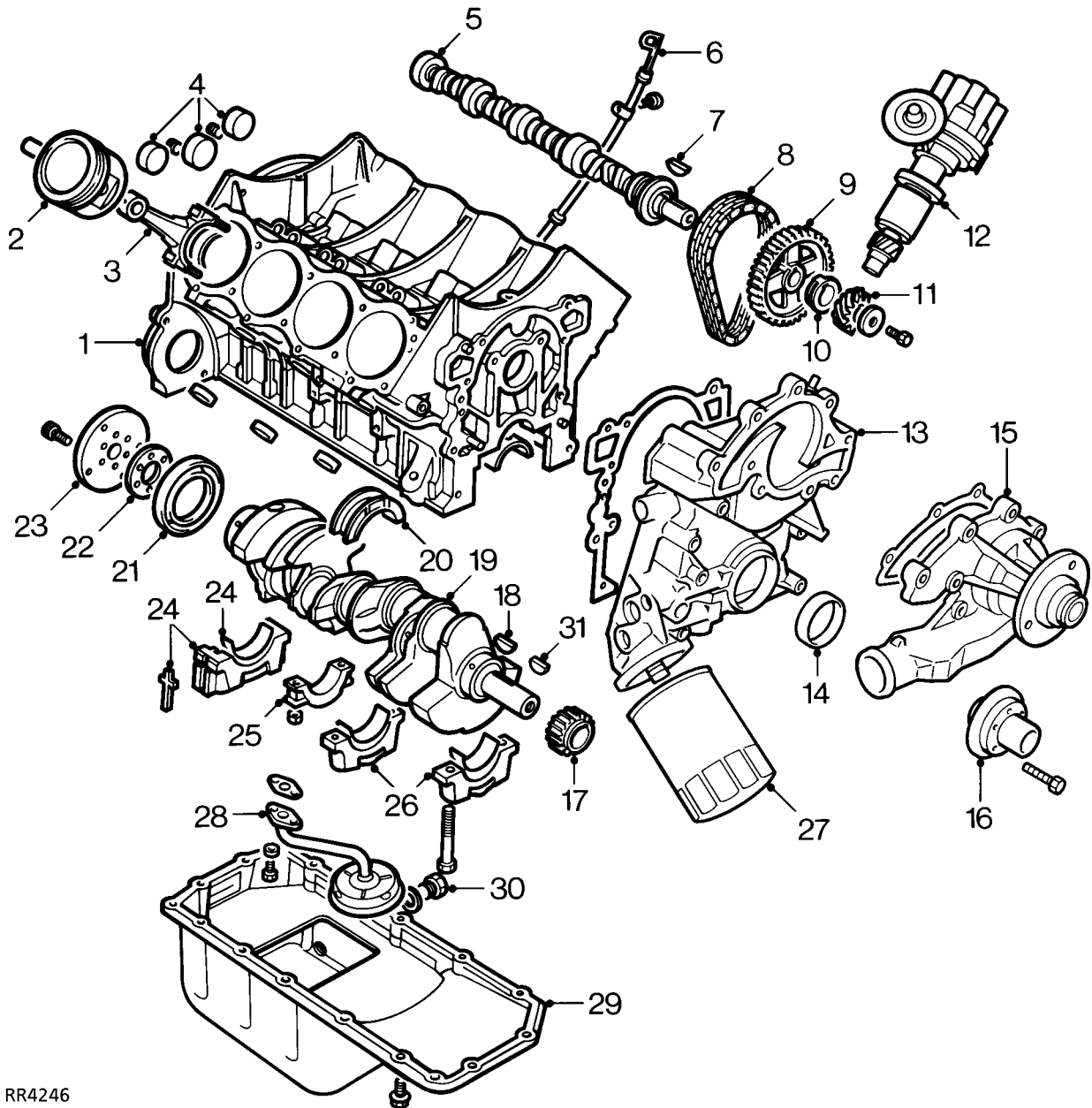
## DESCRIPTION

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The V8i engine has cast aluminium cylinder heads and cylinder block. The two banks of steel cylinder liners which are pressed down to stops in the block, are set at 90° to one another. The three ringed aluminium pistons transmit the power through the connecting rods to a cast iron five bearing crankshaft, which drives the centrally located camshaft via a duplex type chain.

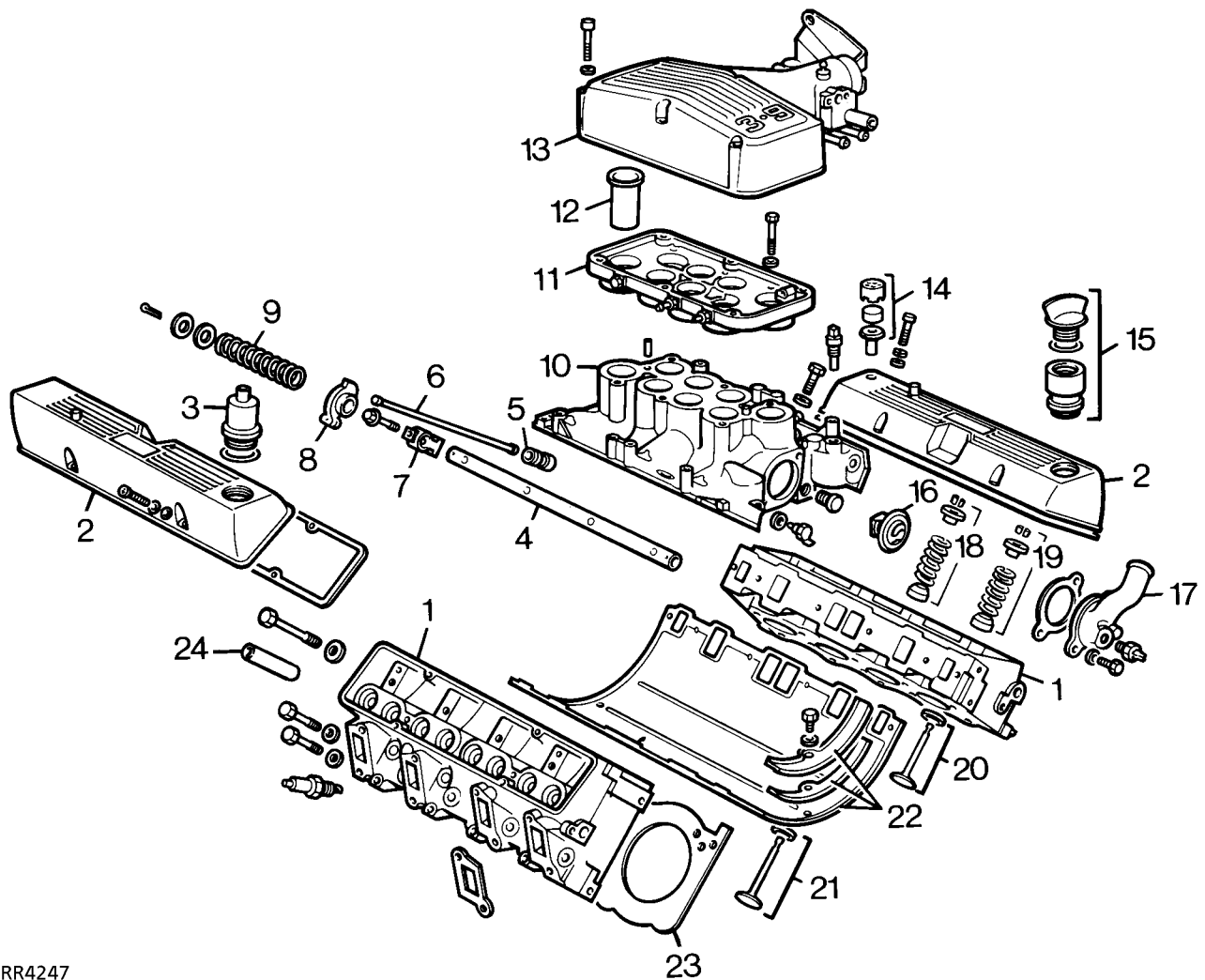
The electronic ignition distributor is driven by a gear off the front of the camshaft and the lubrication oil pump is driven by a gear off the front of the crankshaft. The overhead inlet and exhaust valves are operated by rocker shafts, pushrods and self adjusting hydraulic tappets.

Multiport fuel injection ensures that engine performance, economy and exhaust emissions are automatically correct for the demands of highway and off road operation.



RR4246

- |                                 |   |
|---------------------------------|---|
| 1. Cylinder block               | 17. Crankshaft sprocket                         |
| 2. Pistons and gudgeon pins (8) | 18. Crankshaft sprocket key                     |
| 3. Connecting rods (8)          | 19. Crankshaft                                  |
| 4. Core plugs                   | 20. Centre main bearing shells (2)              |
| 5. Camshaft                     | 21. Crankshaft rear oil seal                    |
| 6. Dipstick                     | 22. Spacer                                      |
| 7. Camshaft key                 | 23. Adaptor plate                               |
| 8. Timing chain                 | 24. Rear main bearing cap, shell and side seals |
| 9. Camshaft sprocket            | 25. Connecting rod caps                         |
| 10. Distance piece              | 26. Main bearing caps and shell bearings        |
| 11. Distributor drive gear      | 27. Oil filter                                  |
| 12. Distributor                 | 28. Oil pump suction pipe/strainer              |
| 13. Front cover                 | 29. Oil sump                                    |
| 14. Front cover oil seal        | 30. Oil sump drain plug                         |
| 15. Coolant pump                | 31. Oil pump drive key                          |
| 16. Crankshaft damper / pulley  |   |



RR4247

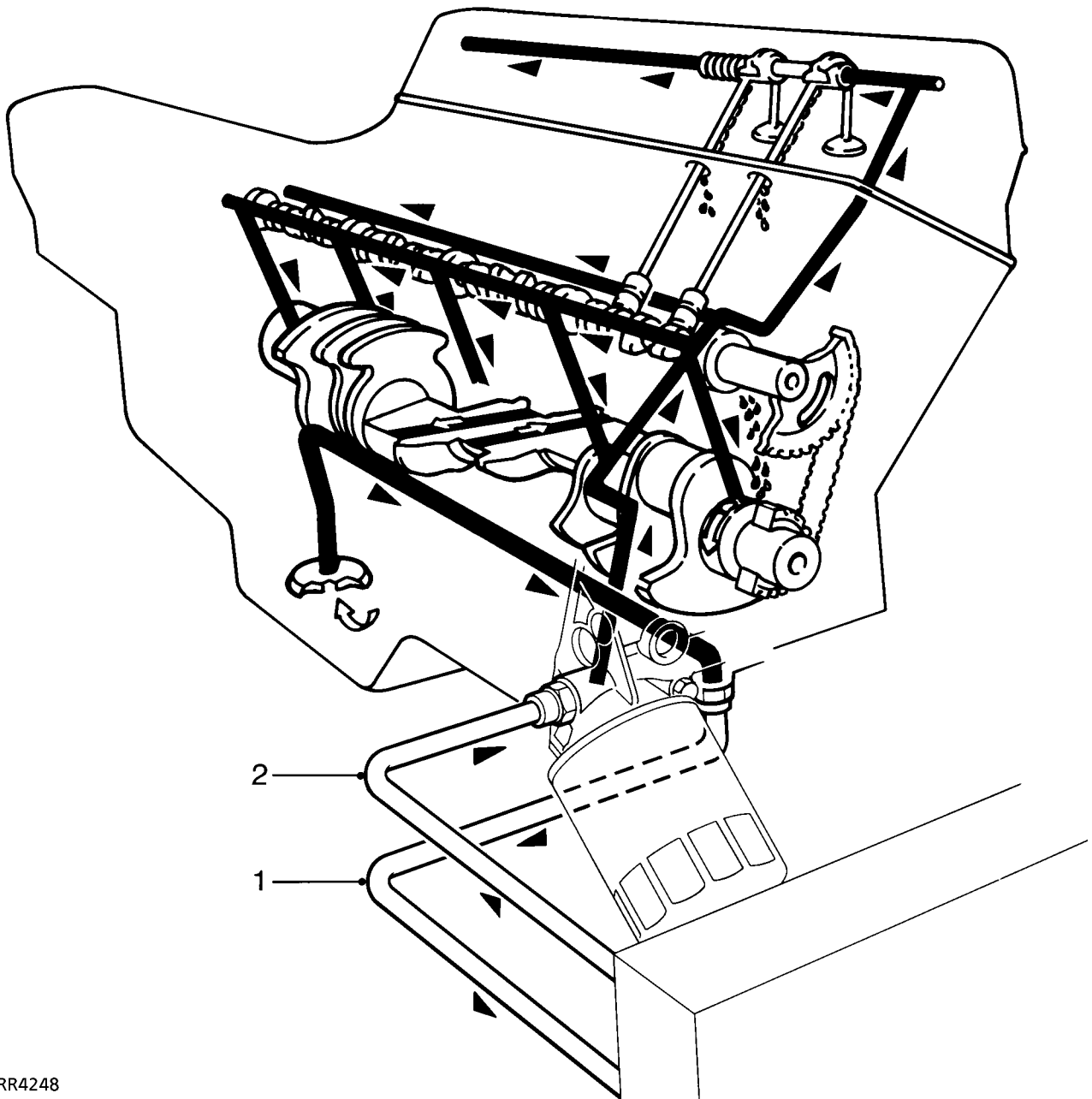
- |                                       |   |
|---------------------------------------|---|
| 1. Cylinder heads (2)                 | 13. Plenum chamber upper                            |
| 2. Rocker covers (2)                  | 14. PCV air intake filter                           |
| 3. PCV filter                         | 15. Oil filler                                      |
| 4. Rocker shafts (2)                  | 16. Thermostat                                      |
| 5. Hydraulic tappets (8)              | 17. Thermostat cover                                |
| 6. Pushrods (8)                       | 18. Inlet valve seal, spring, cap and collets (8)   |
| 7. Rocker brackets (8)                | 19. Exhaust valve seal, spring, cap and collets (8) |
| 8. Rocker arms (4) left and (4) right | 20. Inlet valve and seat (8)                        |
| 9. Rocker shaft springs (6)           | 21. Exhaust valve and seat (8)                      |
| 10. Inlet manifold                    | 22. Inlet manifold gasket and seals                 |
| 11. Plenum chamber lower              | 23. Cylinder head gaskets (2)                       |
| 12. Ram pipes (8)                     | 24. Valve guides (16)                               |

## Lubrication system

The V8i full flow lubrication system uses a gear type oil pump which is driven from the front of the crankshaft. The oil pump gears are housed in the front cover and the pressure relief valve, warning light switch and filter are also fitted to the front cover.

Oil drawn through the centrally located steel gauze strainer in the sump, is pumped under pressure through oil cooler located in the lower half of the main coolant radiator. The cooled oil then passes through the filter, before being distributed from the main gallery via drillings, to the various components in the engine.

Lubrication to the thrust side of the cylinders is by oil grooves machined in each connecting rod big end joint face, which are timed to align with holes in the big end journals on the power and exhaust strokes.



RR4248

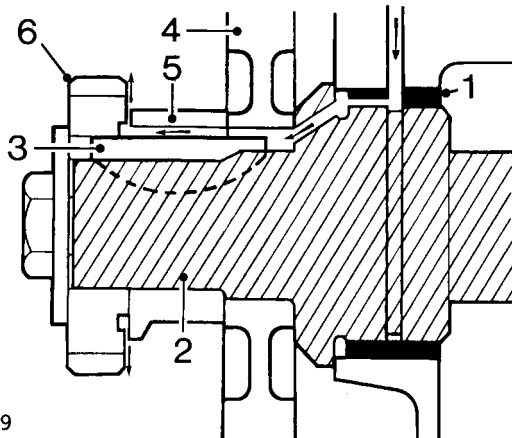
## Lubrication system

1. Oil to cooler
2. Oil from cooler



### Distributor and timing chain lubrication

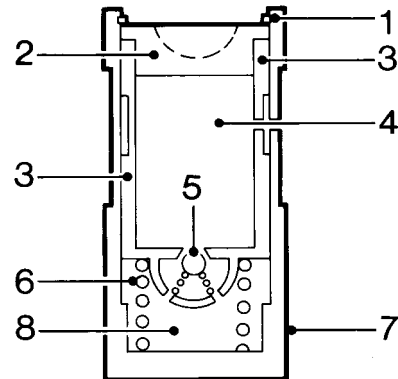
The distributor and timing chain are lubricated from the camshaft front bearing. The feed to the timing chain is channelled along the camshaft sprocket, key and spacer where it sprays onto the chain.



RR4249

1. Bearing
2. Camshaft
3. Key
4. Camshaft timing chain sprocket
5. Spacer
6. Distributor drive gear

### Hydraulic tappets



RR4250

1. Clip
2. Pushrod seat
3. Inner sleeve
4. Upper chamber
5. Non-return ball valve
6. Spring
7. Outer sleeve
8. Lower chamber - high pressure

The purpose of the hydraulic tappet is to provide maintenance free and quiet operation of the inlet and exhaust valves. It achieves its designed purpose by utilizing engine oil pressure to eliminate the mechanical clearance between the rockers and the valve stems.

During normal operation, engine oil pressure present in the upper chamber 4, passes through the non-return ball valve 5 and into the lower (high pressure) chamber 8.

When the cam begins to lift the outer sleeve 7, the resistance of the cylinder valve spring felt through the pushrod seat 2, causes the inner sleeve 3, to move downwards inside the outer. This slight downward movement of the inner sleeve closes the ball valve 5 and increases the hydraulic pressure in the high pressure chamber, sufficient to ensure that the push rod opens the valve fully.

As the tappet assembly moves off the peak of the cam the ball valve 5 opens to equalize the pressure in both chambers which ensures that the valve fully closes when the tappet is on the back of the cam.



## ENGINE OIL PRESSURE TEST

### Service tools:

LRT-12-052: Pressure test equipment



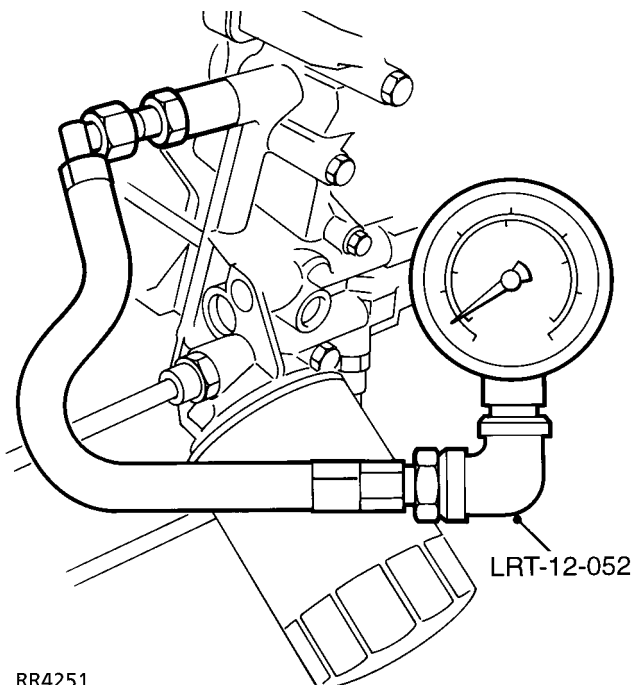
**WARNING:** Use suitable exhaust extraction equipment, if test is being carried out in workshop.



**WARNING:** If vehicle has been running, engine oil will be hot, care must be taken when fitting equipment to prevent personal injury due to scalding.

### Test

1. Check lubricant is to correct level.
2. Place vehicle on a ramp [hoist].
3. Disconnect battery negative lead. Remove oil pressure switch.
4. Fit the test gauge.
5. Reconnect battery negative lead.
6. Start and run engine to normal operating temperature.
7. At a steady engine speed of 2500 rev/min - engine oil pressure reading should be - 2.75 bar (40 lbf/in<sup>2</sup>).
8. If the pressure is low - Remove and overhaul oil pump



RR4251

## CYLINDER COMPRESSION - TEST

### Equipment:

Compression pressure gauge

### Test

1. Start and run engine until normal engine operating temperature is achieved (thermostat open).
2. Remove all spark plugs.
3. Disconnect both coil negative (WB) leads
4. Insert compression gauge, crank engine until reading stabilises.
5. Expected readings, throttle fully open, battery fully charged:
  - 8.31:1 = 10.2-10.9 bar, 150-160lbf/in<sup>2</sup>
  - 9.35:1 = 11.5-12.2 bar, 170-180lbf/in<sup>2</sup>

## ENGINE NOISES

Excessive or obtrusive noise from the engine compartment originates from three main sources:

- A. The exhaust system, which makes an unmistakable and easy to diagnose noise.
- B. External components emit the greatest variety of noises, but are also easy to diagnose by simply removing the drive belt.
- C. Engine internal mechanical noises which can vary in volume and pitch and may be a combination of, tapping - knocking or rumbling, are the most difficult to diagnose. The following is therefore a guide to diagnosis of engine internal mechanical noises only.

### Engine internal mechanical noises.

**Single or multiple, light tapping noise, particularly when engine is cold. See Description and operation, Description**

- 1. Is engine oil level correct?  
NO - Top up to correct level. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**  
YES - Continue.
- 2. Is the lubricating pressure correct?  
NO - **See Engine Oil Pressure Test**  
YES - Suspect valve operating mechanism.
- 3. To confirm diagnosis, remove the rocker covers and with the engine idling, insert a feeler gauge of 0,015mm between each rocker and valve stem. A faulty valve operating mechanism will emit a different noise when the feeler gauge is inserted. **See Repair, Rocker Shaft Renew**

**Heavy knocking noise (particularly on load and when engine is hot). See Description and operation, Description**

- 1. Is engine oil level correct?  
NO - Top up to correct level. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**  
YES - Continue.
- 2. Is the lubricating pressure correct?  
NO - **See Engine Oil Pressure Test**  
YES - Drain engine oil and filter, and examine for metallic contamination.
- 3. Is the oil contaminated with metal particles?  
YES - Suspect faulty big end bearings. To confirm diagnosis, short out the ignition to each spark plug in turn. The noise will disappear or be reduced when the cylinder with the faulty big end is shorted out.
- 4. If noise is not conclusively diagnosed, check the security of the flywheel and crankshaft front pulley. Temporarily release the drive belt to reduce general noise level and use a stethoscope to locate source of noise.

**Heavy rumbling noise (particularly during hard acceleration). See Description and operation, Description**

- 1. Is engine oil level correct?  
NO - Top up to correct level. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**  
YES - Continue.
- 2. Is the lubricating pressure correct?  
NO - **See Engine Oil Pressure Test**  
YES - Drain engine oil and filter, and examine for metallic contamination.
- 3. Is the oil contaminated with metal particles?  
YES - Suspect faulty main bearings. If noise is not conclusively diagnosed, check the security of the flywheel and crankshaft front pulley. Temporarily release the drive belt to reduce general noise level and use a stethoscope to locate source of noise.



## ENGINE STARTING PROBLEMS

### Engine fails to crank in park or neutral (Automatic Transmission)

1. Is battery in good state of charge?  
NO - **See INTRODUCTION, Information, Jump Starting**  
YES - Continue.
2. Is automatic transmission inhibitor switch faulty or gear selection linkage incorrectly adjusted?  
YES - **See AUTOMATIC GEARBOX, Repair, Inhibitor Switch**,  
NO - **See Electrical Trouble Shooting Manual**.  
If problem is not diagnosed repeat tests, starting at 1.

### Engine fails to crank (Manual Transmission)

1. Is battery in good state of charge?  
NO - **See INTRODUCTION, Information, Jump Starting**  
YES - **See Electrical Trouble Shooting Manual**.  
If problem is not diagnosed repeat tests, starting at 1.

### Engine cranks but fails to start

1. Is the cranking speed fast enough (120 rpm)?  
NO - **See INTRODUCTION, Information, Jump Starting**  
If necessary also. **See Electrical Trouble Shooting Manual**.  
YES - Continue.
2. Is there combustion in any cylinder?  
NO - **See ELECTRICAL, Fault diagnosis, Lucas Constant Energy Ignition System - V8i See Electrical Trouble Shooting Manual**.  
YES - Continue.
3. Are the fuel supply, tank, pump, ventilation and emission control systems in correct working order or the fuel contaminated?  
NO - **See FUEL SYSTEM, Repair, Fuel Filter See FUEL SYSTEM, Repair, Fuel Tank See FUEL SYSTEM, Repair, Fuel pump and Sender Unit See EMISSION CONTROL, Description and operation, Emission control**  
If problem is not diagnosed repeat tests, starting at 2.

## ENGINE RUNNING PROBLEMS

### Engine runs at high speed but will not idle (stops) Engine idle speed erratic Engine starts but stops immediately

### Engine stalls Engine misfires/hesitation

1. Multiport fuel injection. **See Electrical Trouble Shooting Manual. See ELECTRICAL, Fault diagnosis, Lucas Constant Energy Ignition System - V8i**  
Check brake vacuum connections. **See BRAKES, Description and operation, Brake Servo Unit**  
Check heater/ventilation unit vacuum connections. **See HEATING AND VENTILATION, Description and operation, Heating and Ventilation Unit**  
If problem is not diagnosed continue.
2. Are HT leads correctly routed and clipped?  
NO - **See ELECTRICAL, Repair, Distributor - V8i**  
YES - Continue.
3. Is fuel supply, tank, pump, ventilation and emission control systems in correct working order or the fuel contaminated?  
NO - **See FUEL SYSTEM, Repair, Fuel Filter See FUEL SYSTEM, Repair, Fuel Tank See FUEL SYSTEM, Repair, Fuel Pump and Sender Unit See EMISSION CONTROL, Description and operation, Emission Control**  
If problem is not diagnosed repeat tests, starting at 1.

### Engine lacks power/poor performance

1. Is throttle travel restricted or cable incorrectly adjusted?  
YES - Check thickness of carpets. **See FUEL SYSTEM, Repair, Throttle Cable See FUEL SYSTEM, Repair, Accelerator Pedal**  
NO - Continue.
2. Are the Ignition and Multiport Fuel Injection systems in order?  
NO - **See Electrical Trouble Shooting Manual.A1 See ELECTRICAL, Fault diagnosis, Lucas Constant Energy Ignition System - V8i See ELECTRICAL, Repair, Distributor - V8i**  
YES - Continue.



3. Are fuel supply, tank, pump, ventilation and emission control systems in correct working order or the fuel contaminated?  
NO - **See FUEL SYSTEM, Repair, Fuel Filter See FUEL SYSTEM, Repair, Fuel Tank See FUEL SYSTEM, Repair, Fuel Pump and Sender Unit**  
YES - Suspect valves held open by hydraulic tappets due to high oil pressure. **See Engine Oil Pressure Test**
4. Is oil pressure high?  
YES - Remove oil filter and cooler adaptor and check pressure relief valve strainer gauze for blockage and that the relief valve is not stuck closed. **See Description and operation, Description**  
NO - Carry out cylinder compression tests to determine condition of head gaskets and valves. **See Cylinder Compression - Test**
5. Are cylinder compressions satisfactory?  
NO - **See Repair, Cylinder Heads - Renew**  
YES - Check brake vacuum connections. **See BRAKES, Description and operation, Brake Servo Unit**

Check heater/ventilation unit vacuum connections. **See HEATING AND VENTILATION, Description and operation, Heating and Ventilation Unit**

If problem is not diagnosed: Continue.

6. Are the brakes binding?  
YES - Investigate cause of binding.  
NO - Continue.
7. Automatic Transmission only. Is the Torque Converter and Transmission operating correctly?  
Carry out Road test, Static tests and Stall tests to determine condition of Automatic transmission.

If problem is not diagnosed: repeat tests starting at 1.

### Engine backfires into exhaust system

1. Are there any leaking joints/connections or holes in the exhaust system?  
YES - **See MANIFOLD AND EXHAUST SYSTEM, Repair, Exhaust System Complete**  
NO - Continue.
2. Is distributor fitted correctly, HT leads in correct firing order and routed correctly?  
NO - **See ELECTRICAL, Repair, Distributor - V8i**  
YES - Continue.
3. Is air fuel ratio correct?  
NO - Check multiport fuel injection. **See Electrical Trouble Shooting Manual.** Check brake vacuum connections. **See BRAKES, Description and operation, Brake Servo Unit**  
Check heater/ventilation unit vacuum connections. **See HEATING AND VENTILATION, Description and operation, Heating and Ventilation Unit**  
Check the crank case and fuel tank ventilation system. **See EMISSION CONTROL, Description and operation, Emission Control**  
YES - Continue.
4. Are cylinder compressions satisfactory?  
NO - Carry out compression test to check for leaking gaskets valves etc. **See Cylinder Compression - Test See Repair, Cylinder Heads - Renew**

If problem is not diagnosed: repeat tests starting at 1.



### Engine backfires into inlet system

1. Is the Distributor, HT connections and routing correct?  
NO - **See *ELECTRICAL, Repair, Distributor - V8i***  
YES - Continue.
2. Is air fuel ratio correct?  
NO - Check multipoint fuel injection. **See *Electrical Trouble Shooting Manual***.  
Check brake vacuum connections. **See *BRAKES, Description and operation, Brake Servo Unit***  
Check heater/ventilation unit vacuum connections. **See *HEATING AND VENTILATION, Description and operation, Heating and Ventilation Unit***  
Check the crank case and fuel tank ventilation system. **See *EMISSION CONTROL, Description and operation, Emission Control***  
YES - Continue.
3. Are cylinder compressions satisfactory?  
NO - Carry out compression test to check for leaking gaskets valves etc. **See *Cylinder Compression - Test***  
For repair **See *Repair, Cylinder Heads - Renew***

If problem is not diagnosed: repeat tests starting at 1.



## DRIVE BELT

A single 'serpentine drive belt' is introduced for 1995 model year. This belt drives the water pump and all the ancillaries. It is essential that the belt is fitted exactly as shown in illustrations RR3956 and RR3957. It should also be noted that the water pump/viscous fan is driven in a counter clockwise direction.

A drive belt tensioner automatically tensions the drive belt, eliminating the need for tensioning individual drive belts. Turning the tensioner pulley in a clockwise direction will release drive belt tension.

Under normal highway use the belt must be changed at 120,000 kilometres, 75,000 miles or five years whichever occurs first.

The drive belt must be examined at every service and replaced if necessary.

### Off road driving

Regular examination of the drive belt is essential if the vehicle is used off road. The vehicle driver should be requested to identify the type of mileage the vehicle has covered.

After every off road session the owner should inspect the belt for cuts and possible damage caused by stones. If belt has jumped, reposition belt correctly. A new belt must be fitted at the next service or before, dependant on the type of damage sustained.

### Fan cowl

To ensure easy access to the drive belt the top portion of the fan cowl is detachable.

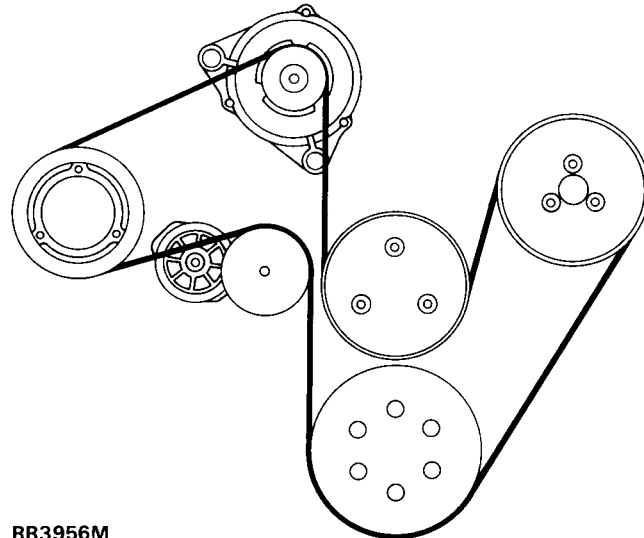
### Check condition

Check condition of drive belt. Renew a belt that shows signs of wear, splitting or oil contamination.

## DRIVE BELT RENEW

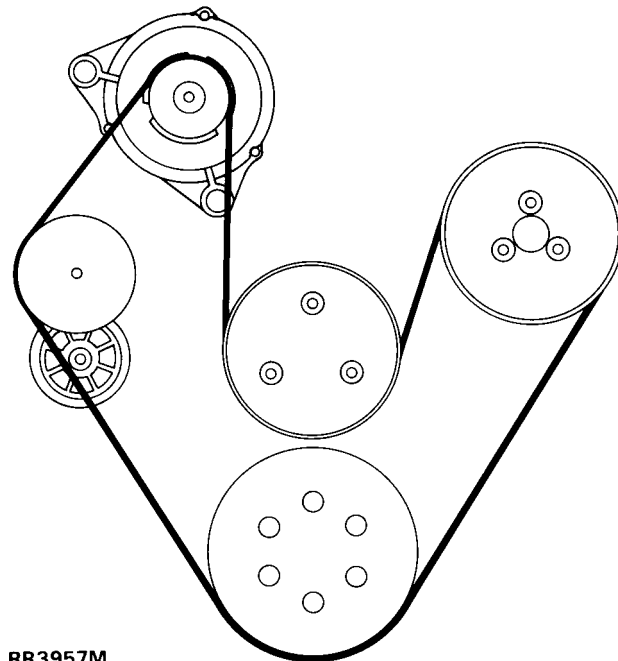
Service repair no - 86.10.03

### Air conditioning



RR3956M

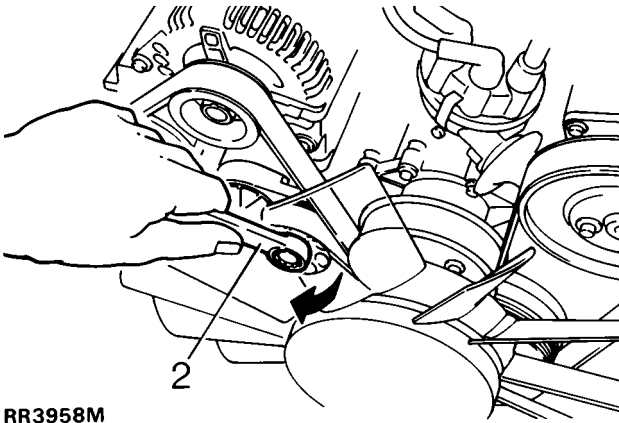
### Non air conditioning



RR3957M

## Remove

1. Remove fan cowl upper.
2. Release drive belt tension by turning tensioner clockwise.



RR3958M

3. With tension released, remove belt from generator pulley.
4. Release tensioner pulley.
5. Remove drive belt. Mark direction of rotation on belt if refitting

## Refit

6. Clean drive belt pulley grooves and ensure grooves are not damaged.
7. Position belt correctly around all pulleys except generator. Illustrations RR3956 and RR3957 show correct drive belt run.
8. Turn drive belt tensioner clockwise.
9. Locate drive belt on generator pulley.
10. Ensure drive belt is squarely located on pulleys with all grooves engaged.
11. Release tensioner to tension drive belt.
12. Fit upper fan cowl section.

## DRIVE BELT - CHECK TENSION

As the drive belt is automatically tensioned, no tension check or adjustment should be necessary. If the drive belt is believed to be slack carry out the following checks:

1. Visually check drive belt tension.
2. Watch movement of tensioner with engine running, 5 mm 'bounce' is normal. If tensioner movement is 12 mm or more, fit a new tensioner.  
**See Drive Belt Tensioner**
3. Inspect tensioner. Is the tensioner arm and spring case in contact? If so fit a new tensioner.
4. Using a recognised drive belt tensioning gauge, check belt tension several times, running engine between checks. The checks should be made at the same point on the belt, away from the tensioner.

Drive belt tension, with used tensioner and used drive belt should be more than:-

270N. Non air conditioning or  
295N with air conditioning.



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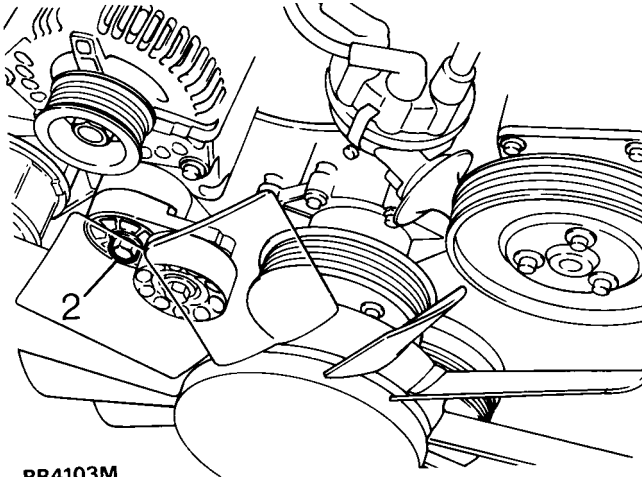
## DRIVE BELT TENSIONER

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Service repair no - 86.10.09

### Remove

1. Remove drive belt from tensioner. **See Drive Belt Renew**
2. Loosen tensioner centre bolt.
3. Remove bolt and tensioner.



RR4103M

### Refit

4. Reverse removal procedure.

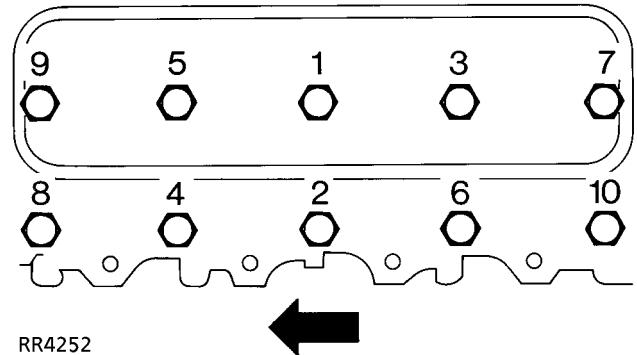
## CYLINDER HEAD GASKETS - RENEW

Service repair no - 12.29.01

1. Drain cooling system. *See COOLING SYSTEM, Adjustment, Coolant*
2. Remove inlet manifold. *See FUEL SYSTEM, Repair, Intake Manifold*
3. Remove generator.
4. If fitted, remove compressor. *See AIR CONDITIONING, Repair, Compressor*
5. Remove rocker shafts. *See Rocker Shaft Renew*
6. Remove push rods.
7. Remove both exhaust manifolds. *See MANIFOLD AND EXHAUST SYSTEM, Repair, Exhaust Manifold - V8i*
8. Remove air cleaner assembly. *See FUEL SYSTEM, Repair, Air Cleaner Assembly*
9. Remove air flow sensor. *See FUEL SYSTEM, Repair, Air Flow Sensor*
10. Remove ground leads from rear of left hand cylinder head
11. Right hand cylinder head - remove breather pipe from lifting bracket.
12. Loosen cylinder head bolts, reversing tightening sequence.
13. Remove cylinder heads.
14. Remove cylinder head gaskets.
15. Clean exhaust mating faces.
16. Clean head and block faces.
17. Fit new cylinder head gaskets, word TOP uppermost. DO NOT use sealant.
18. Oil cylinder bores.
19. Clean threads of head bolts and lightly oil.
20. Locate cylinder heads on block.
21. Locate cylinder head bolts in position illustrated.  
96 mm long bolts - 2, 4, 6, 7, 8, 9, 10  
66 mm long bolts - 1, 3, 5



**NOTE:** There are no bolts fitted in the four lower holes in each cylinder head.



**NOTE:** Left hand cylinder head illustrated, arrow points to front of vehicle.

22. Tighten bolts progressively in sequence, shown to **20 Nm** then a further  $180^\circ \pm 5^\circ$
23. Reverse removal procedure. 1 to 11.

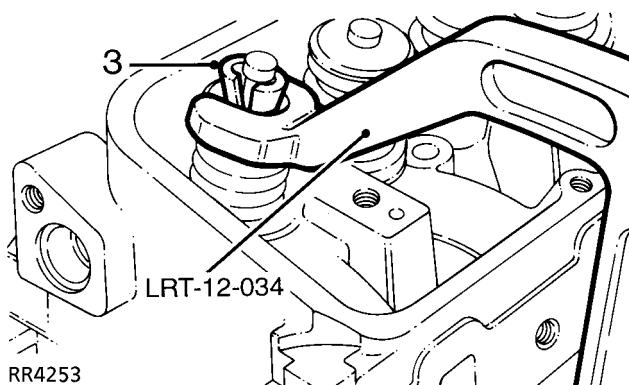


## CYLINDER HEADS - RENEW

Service repair no - 12.29.15

1. Remove cylinder heads and gaskets. **See *Cylinder Head Gaskets - Renew***
2. Remove spark plugs.
3. Using spring compressor LRT-12-034, remove seals, valves, collets, springs and caps.

 **CAUTION: Keep components in fitted order**



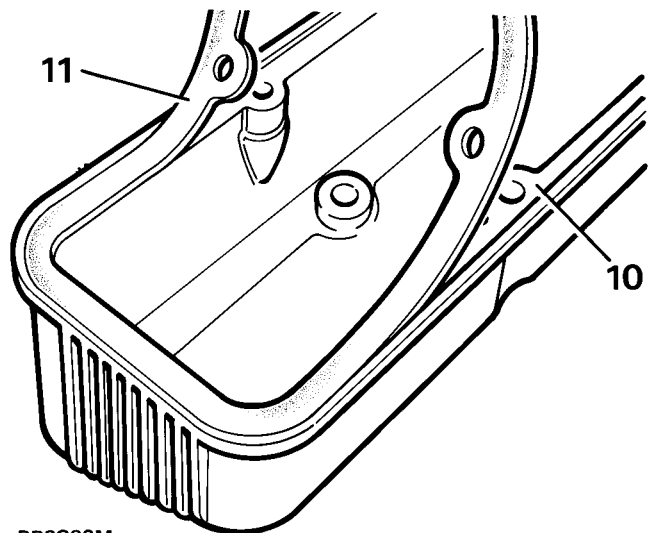
4. From left hand cylinder head, remove earth lead studs.
5. Remove three bolts securing power steering pump mounting bracket to cylinder head.
6. Remove four bolts securing generator mounting bracket to cylinder head.
7. Right hand cylinder head, remove rear lifting bracket.
8. Fit lifting bracket to new right hand cylinder head.
9. Fit mounting brackets and earth lead studs to new cylinder head. Tighten bolts to **30 Nm**.
10. Regrind valves- refer to engine overhaul publication
11. Lubricate valve stems, fit valves, springs, and caps. Fit new inlet and exhaust valve stem seals.
12. Using spring compressor LRT-12-034, compress springs, fit collets. Tap valve to check correct collet seating.
13. Fit spark plugs.
14. Fit cylinder heads with new gaskets. **See *Cylinder Head Gaskets - Renew***

## ROCKER COVER - RIGHT HAND - RENEW

Service repair no - 12.29.41

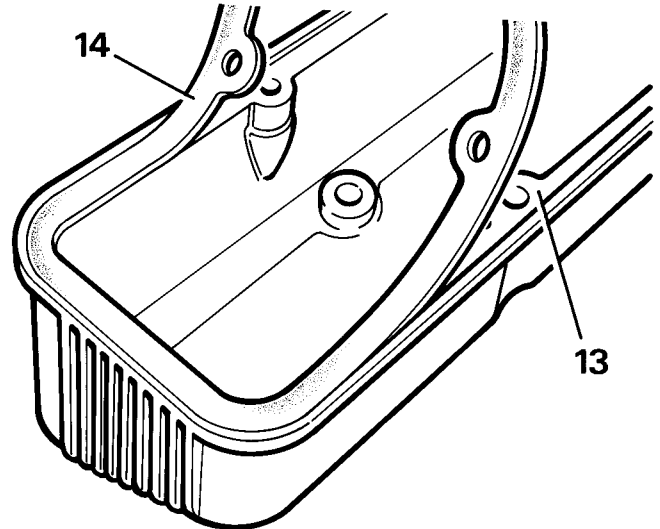
1. Disconnect battery negative lead.
2. Disconnect purge pipe from charcoal canister at plenum.
3. Remove breather pipe from rocker cover.
4. Remove coolant pipes from inlet manifold.
5. Remove spark plug leads from plugs and retaining clips.
6. Remove four rocker cover bolts. Moving fuel pipes aside, remove rocker cover.
7. Discard rocker cover gasket.
8. Remove plug lead retaining clips from rocker cover, fit to new rocker cover.
9. Clean and dry rocker cover and cylinder head mating faces, using Bostik cleaner 6001.

 **NOTE: Gasket fits one way round only. It must be fitted accurately, first time. Subsequent movement will destroy bonding.**



10. Apply Bostik 1775 impact adhesive to rocker cover seal face and gasket, using a brush to ensure an even film. Allow adhesive to become touch dry.

11. Place one end of gasket into cover recess with edge firmly against recess wall, holding remainder of gasket clear. Work around cover, pressing gasket into place ensuring edge firmly contacts recess wall.
12. Allow cover to stand for thirty minutes before fitting.
13. Fit rocker cover to cylinder head with four screws, short screws inboard, tighten to **9 Nm**.
14. Position fuel pipes.
15. Fit breather pipe to rocker cover, tighten clip.
16. Fit coolant pipes to inlet manifold, tighten bolts.
17. Fit spark plug leads to plugs and retaining clips.
18. Connect purge pipe from charcoal canister at plenum, tighten clip.



RR3821M

## ROCKER COVER - LEFT HAND - RENEW

### Service repair no - 12.29.40

1. Remove air flow sensor. **See FUEL SYSTEM, Repair, Air Flow Sensor**
2. Remove plenum chamber. **See FUEL SYSTEM, Repair, Plenum Chamber**
3. Remove dipstick.
4. Remove spark plug leads from plugs and retaining clips.
5. Disconnect HT lead from coil.
6. Remove generator heat shield securing nut from rocker cover.
7. Remove air flow meter harness clip.
8. Remove bolt securing dipstick tube clip.
9. Remove four rocker cover bolts, remove rocker cover.
10. Discard gasket
11. Remove plug lead retaining clips from rocker cover, fit to new rocker cover.
12. Clean and dry rocker cover and cylinder head mating faces, using Bostik cleaner 6001.



**NOTE: Gasket fits one way round only. It must be fitted accurately, first time. Subsequent movement will destroy**

**bonding.**

13. Apply Bostik 1775 impact adhesive to rocker cover seal face and gasket, using a brush to ensure an even film. Allow adhesive to become touch dry, approximately fifteen minutes.
14. Place one end of gasket into cover recess with edge firmly against recess wall, holding remainder of gasket clear. Work around cover, pressing gasket into place ensuring edge firmly contacts recess wall.
15. Allow cover to stand for thirty minutes before fitting.
16. Fit rocker cover to cylinder head with four screws, short screws inboard. Tighten to **9 Nm**.
17. Position dipstick tube clip. Fit and tighten bolts.
18. Fit and tighten air flow meter harness clip.
19. Fit generator heat shield to rocker cover.
20. Connect HT lead to coil.
21. Connect spark plug leads to plugs and retaining clips.
22. Fit dipstick.
23. Fit plenum chamber.
24. Fit air flow meter.

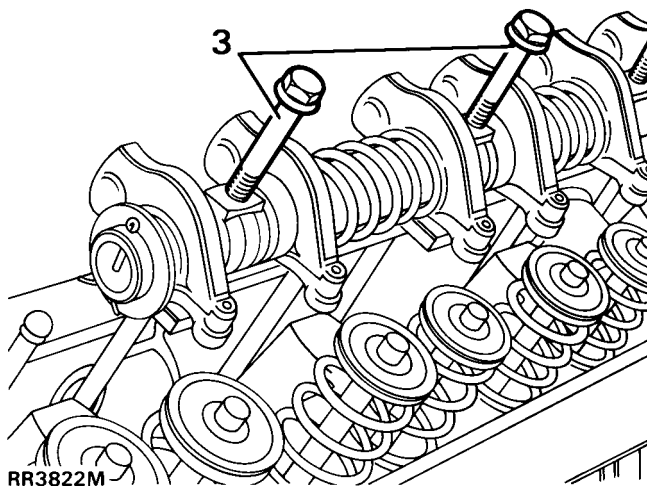




## ROCKER SHAFT RENEW

Service repair no - 12.29.29

1. Remove rocker covers as required. **See *Rocker Cover - Right Hand - Renew*** or. **See *Rocker Cover - Left Hand - Renew***
2. Loosen four rocker shaft fixings.



RR3822M

3. Remove rocker shaft assembly.



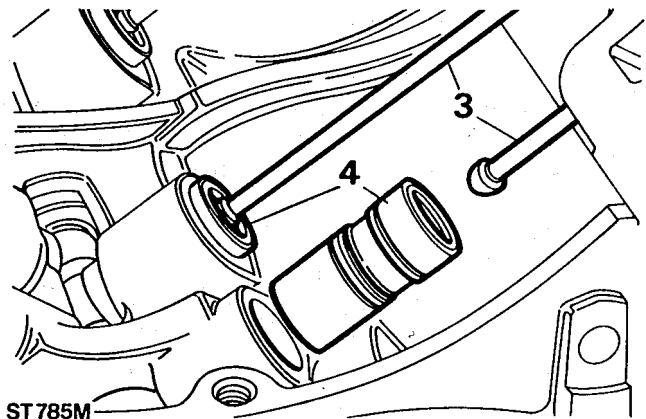
**NOTE: Each rocker shaft is notched at ONE end. Notch must be uppermost and towards front of engine on right hand side, towards rear on left hand side.**

4. Clean rocker pedestal locations on cylinder head.
5. Fit rocker shaft assembly, locating push rods to rockers.
6. Tighten rocker shaft fixings to **38 Nm**.
7. Fit rocker covers.

## HYDRAULIC TAPPETS RENEW

Service repair no - 12.29.57

1. Remove rocker shafts. **See *Rocker Shaft Renew***
2. Remove intake manifold. **See *FUEL SYSTEM, Repair, Intake Manifold***
3. Remove push rods, retain in removal sequence.



ST785M

4. Remove hydraulic tappets
5. Fit tappets, push rods and rocker assemblies. **See *V8i Overhaul Manual***.
6. Fit inlet manifold.
7. Reverse removal procedure.

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## CRANKSHAFT PULLEY ASSEMBLY

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### Service repair no - 12.21.01

1. Remove viscous coupling. **See COOLING SYSTEM, Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl**
2. Remove drive belt. **See Drive Belt**
3. Raise vehicle on ramp [hoist].
4. Remove bell housing bottom cover.
5. Remove engine undertray.
6. With assistance to stop flywheel rotation, remove crankshaft pulley assembly retaining bolt.
7. Remove crankshaft pulley assembly.
8. If required: Place assembly in vice and remove pulley.
9. Fit pulley to torsional vibration damper.
10. Lubricate seal face of assembly.
11. Fit pulley assembly.
12. With assistance to stop flywheel rotation, fit retaining bolt. Tighten to **280 Nm**.
13. Reverse removal procedure. 1 to 5.

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## FRONT COVER OIL SEAL - RENEW

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### Service repair no - 12.21.14

1. Remove crankshaft pulley. **See Crankshaft Pulley Assembly. Do not remove pulleys.**
2. Remove eight screws and remove mud excluder.
3. Fit button of 18G1328 to crankshaft, fit extractor to seal.
4. Turn centre bolt of extractor to remove seal.
5. Remove seal from extractor.
6. Clean seal seating.
7. Lubricate outside diameter of seal.
8. Locate seal in front cover.
9. Fit adaptor 18G1291/5 to 18G1291/4.
10. Fit tool to seal.
11. Fit and tighten centre bolt to crankshaft, tighten centre locknut to seat seal.
12. Slacken locknut and remove tool.
13. Lubricate seal lip.
14. Fit mud excluder and tighten screws.
15. Fit crankshaft pulley assembly.



## FRONT COVER GASKET

### Service repair no - 12.65.04

1. Remove crankshaft pulley. **See Crankshaft Pulley Assembly. Do not remove pulleys**
2. Remove water pump pulley.
3. Release distributor cap clips.
4. Release plug leads from plugs and clips.
5. Place cap and leads to one side.
6. Turn engine until No. 1 piston is at T.D.C.
7. Check position of rotor arm.
8. Remove fixings securing power steering pump bracket to water pump bracket.
9. Remove power steering pump bracket from water pump.
10. Remove clips securing wiring to generator tensioner.
11. Disconnect distributor feed wire.
12. Pivot power steering pump away from front cover, tighten pivot to retain in position.
13. Disconnect vacuum pipe from distributor.
14. Remove water pump bottom hose.
15. Disconnect oil pressure switch.
16. Disconnect heater hose at water pump.
17. Remove generator tensioner from water pump, move tensioner aside.
18. Mark distributor position to front cover.
19. Remove distributor clamp, remove distributor. **See ELECTRICAL, Repair, Distributor - V8i**
20. Remove fixings sump to front cover.
21. Loosen four adjacent sump fixings.
22. Remove generator support strut from front cover, move strut aside.
23. Loosen remaining front cover fixings and remove front cover.
24. Remove front cover gasket.

### Refit

25. Clean timing cover, clean block face.
26. Lightly grease gasket faces.
27. Fit new gasket to block face.
28. Apply hylosil to sump gasket.
29. Clean threads of cover fixing bolts, apply Loctite 372 to threads.
30. Fit timing cover, fit fixing bolts. Tighten to **28 Nm**.
31. Fit generator support strut to front cover.
32. Tighten sump to timing cover fixings to **10 Nm**.
33. Tighten sump fixings to **10 Nm**.
34. Lubricate distributor O ring.
35. Fit distributor in position marked.
36. Align oil pump drive, if distributor does not seat correctly.
37. Fit distributor clamp. Tighten to **20 Nm**.
38. Locate generator tensioner on water pump bracket.
39. Connect heater hose, tighten clip.
40. Connect oil pressure switch.
41. Connect bottom hose, tighten clip.
42. Connect vacuum pipe to distributor.
43. Loosen power steering pump pivot, lower pump.
44. Connect distributor feed wire.
45. Connect wire ties to generator tensioner.
46. Fit power steering pump bracket to water pump. Tighten to **28 Nm**.
47. Fit power steering pump to bracket.
48. Position distributor cap. Fit plug leads to plugs and clips.
49. Clip distributor cap in position.
50. Fit water pump pulley. Tighten to **10 Nm**.
51. Fit crankshaft pulley. **See Crankshaft Pulley Assembly**
52. Tension drive belts correctly.
53. Check ignition timing.
54. Refill cooling system.

## TIMING CHAIN AND CHAINWHEELS

Service repair no - 12.65.12

### Remove

1. Remove front cover. **See Front Cover Gasket**
2. Remove retaining bolt and washer, remove distributor drive gear and spacer.
3. Ensure number one piston is at TDC.
4. Remove chainwheels and chain as an assembly. **See V8i Overhaul Manual.**

### Refit

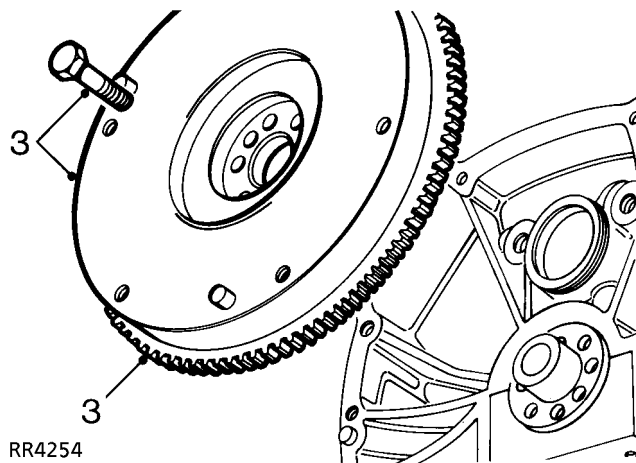
5. Clean chainwheels and chain.
6. Fit chainwheels to chain, aligning timing marks.
7. Ensure camshaft key is fitted parallel to shaft axis to ensure adequate lubrication to distributor drive gear.
8. Engage chainwheel assembly on camshaft and crankshaft keys, ensure chain wheels are fully located.
9. Check alignment of timing marks with straight edge.
10. Fit spacer with flange to front,
11. Fit distributor drive gear with groove towards spacer.
12. Fit retaining bolt and washer. Tighten to **58 Nm**.
13. Fit front cover. **See Front Cover Gasket**

## FLYWHEEL

Service repair no - 12.53.07

### Remove

1. Remove gearbox and clutch. **See CLUTCH, Repair, Clutch Assembly**
2. Loosen starter motor bolts.



3. Lock flywheel, remove flywheel bolts and flywheel.

### Refit

4. Clean components for reassembly.
5. Fit flywheel.
6. Clean threads, apply Loctite 270 to threads.
7. Lock flywheel, fit flywheel bolts. Tighten to **80 Nm**.



## FLEXIBLE DRIVE PLATE AND RING GEAR

Service repair no - 12.53.13

### Remove

1. Remove transmission. *See AUTOMATIC GEARBOX, Repair, LT230T Transfer Gearbox with Automatic Gearbox Assembly - V8i*
2. Remove flexible drive plate and ring gear assembly. *See V8i Overhaul Manual.*

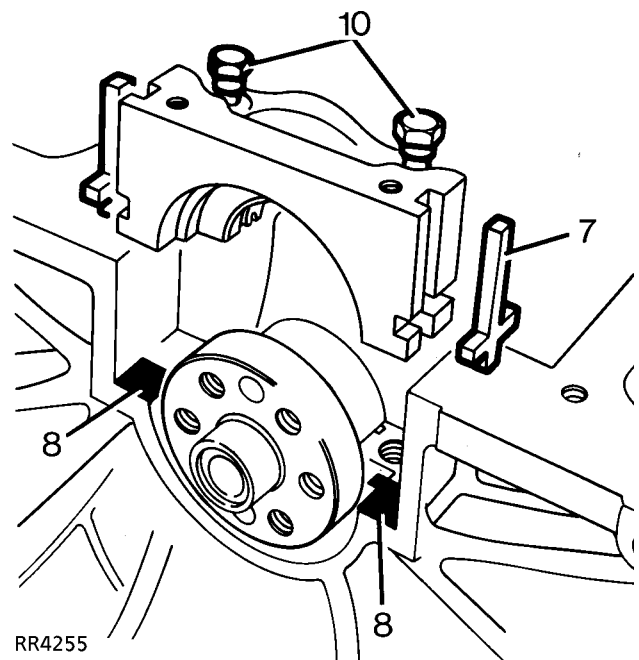
### Refit

3. Clean all components for reassembly.
4. Fit ring gear and flexible drive plate assembly. *See V8i Overhaul Manual.*
5. Fit transmission.

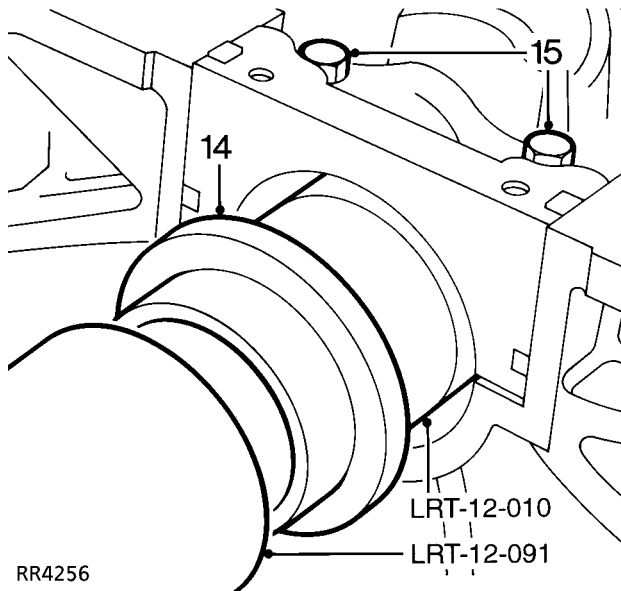
## CRANKSHAFT REAR OIL SEAL

Service repair no - 12.21.20

1. Automatic transmission, remove drive plate. *See Flexible Drive Plate and Ring Gear*  
OR manual transmission, remove flywheel. *See Flywheel*
2. Remove sump. *See Oil Sump*
3. Remove rear main bearing cap.
4. Remove cross seals from cap.
5. Remove crankshaft rear oil seal.
6. Clean main bearing cap and oil seal area of block.
7. Fit new cross seals to bearing cap.
8. Apply Hylomar SQ32M to block as illustrated.



9. Lubricate bearing shell and cross seals using clean engine oil.
10. Fit bearing cap, do not tighten bolts.
11. Ensure cap is fully home and seated squarely on the block.



12. Ensure service tools LRT-12-010 and LRT-12-091 are scrupulously clean. Coat seal guide and oil seal journal with clean engine oil.



**CAUTION: Do not handle oilseal lip, check it is not damaged. Ensure outside diameter remains clean and dry.**

13. Position oil seal guide LRT-12-010 on crankshaft flange.



**NOTE: Lubricant coating must cover seal guide outer surface completely to ensure that oil seal lip is not turned back during assembly. Position oil seal, lipped side towards engine, on seal guide. Seal outside diameter MUST be clean and dry.**

14. Fit oil seal using tool LRT-12-091. Remove seal guide.  
 15. Tighten rear main bearing cap to **90 Nm**.  
 16. Fit sump.  
 17. Fit flywheel or flexible drive plate and ring gear.

## ENGINE

Service repair no - 12.41.01

### Remove

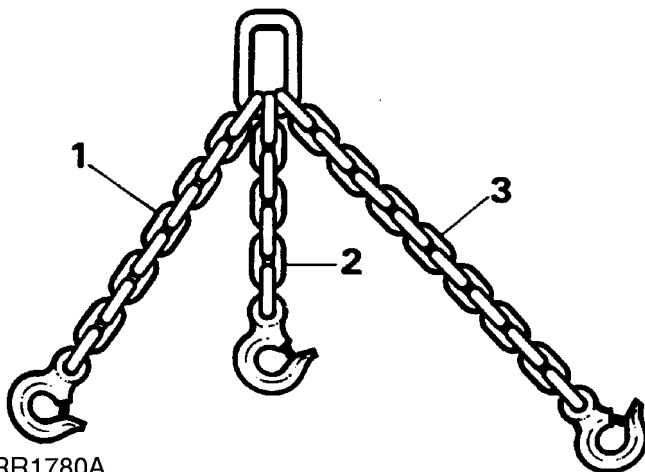
1. Park vehicle on level ground and apply park brake.
2. De-pressurise fuel system. **See FUEL SYSTEM, Repair, Depressurising Fuel System**
3. Remove bonnet [hood]. **See CHASSIS AND BODY, Repair, Bonnet [Hood]**
4. Remove battery. **See ELECTRICAL, Repair, Battery**
5. Remove radiator/oil coolers. **See COOLING SYSTEM, Repair, Radiator/Oil Coolers**
6. Place an absorbent cloth around fuel feed hose at fuel rail and release compression nut. Remove feed hose from rail, seal end of pipes with masking tape to prevent ingress of dirt.
7. Release fuel return hose clamp and remove hose from pressure regulator, seal both openings with masking tape to prevent ingress of dirt.
8. Remove vacuum hose from rear of regulator.
9. Manual vehicles: Disconnect throttle cable from bracket. Automatic vehicles: Detach throttle bracket from plenum chamber and lay assembly to one side. **See FUEL SYSTEM, Repair, Plenum Chamber DO NOT DISTURB KICK DOWN CABLE SETTING.**
10. Remove ram housing. **See FUEL SYSTEM, Repair, Ram Housing**
11. Remove air flow sensor. **See FUEL SYSTEM, Repair, Air Flow Sensor**
12. Remove air cleaner assembly. **See FUEL SYSTEM, Repair, Air Cleaner Assembly**
13. Remove Generator. **See ELECTRICAL, Description and operation, Generator**
14. Release air conditioning compressor from its mounting and lay to one side. DO NOT discharge air conditioning system. **See AIR CONDITIONING, Repair, Compressor**



**NOTE:** Release bolts securing compressor mounting bracket to engine and remove bracket to enable temporary lifting eye

ETC 5964 to be fitted. Secure lifting eye to mounting bracket fixing points with suitable bolts of equivalent size, pitch and thread. Leave lifting eye attached until engine is reinstalled in vehicle.

15. Place drain tray underneath vehicle.
16. Disconnect hose from reservoir to power steering pump. Secure hose end above level of fluid reservoir to avoid unnecessary loss of fluid.
17. Disconnect power steering pump to power steering box hose. Seal hose and pump openings with masking tape to prevent ingress of dirt. Wipe away any fluid spillage from chassis or steering box.
18. Disconnect fuel temperature and coolant temperature sensor multi-plugs.
19. Disconnect leads from coil.
20. Identify each injector multi-plug for re-assembly and disconnect plugs from injectors.
21. Manoeuvre harness from behind fuel rails and place to one side clear of engine assembly.
22. Remove two clamps securing gearbox oil cooler pipes to engine block.
23. Remove engine mounting fixings on both sides of cylinder block.
24. Fit lifting chains to engine lifting eyes as shown in illustration RR1780E.



RR1780A

1. L/H Front chain 356mm total overall length.
2. R/H Front chain 330mm total overall length.
3. R/H Rear chain 457mm total overall length.



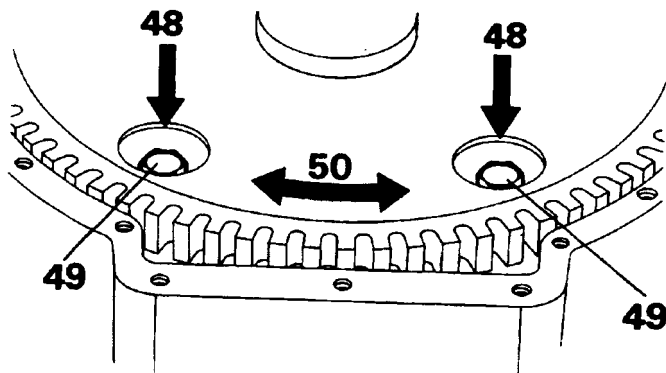
**NOTE:** All chain dimensions are measured from end of lifting hook to end of last link in chain.

25. Fit chain lifting eye to a suitable engine hoist. Raise hoist high enough to enable engine mountings to be removed, and withdraw rubber mountings.
26. Lower hoist until engine rests securely on engine mounting brackets. Remove lifting chains and hoist.
27. Disconnect two heater hoses located on top of right hand rocker cover.
28. Remove ground strap from rear of left hand cylinder head. DO NOT remove from retaining clip.
29. Remove all electrical harnesses from retaining clips at rear of engine.
30. Remove transmission breather pipes from retaining clip on rear lifting eye.
31. Remove top two bolts securing bell housing to cylinder block.
32. Raise front of vehicle, lower vehicle on to axle stands.
33. Remove bell housing bottom cover. Remove gasket from bell housing face.
34. Remove nuts securing exhaust downpipes to manifolds, remove heat shield from right hand side downpipe.
35. Remove electrical leads from starter motor solenoid. Disconnect multi-plug from oil level sensor on side of sump, if fitted.



**NOTE:** Instructions 37, 38 and 39 refer to automatic vehicles only.

36. With assistance rotate engine at crankshaft pulley until two access holes in drive plate/ring gear assembly are visible.
37. Remove two bolts visible through access holes. Mark one access hole and one bolt hole to ensure unit is reassembled in its original position.
38. Rotate crankshaft 180° until two remaining access holes are visible, remove two bolts.



RR1808A

39. Remove remaining bell housing to cylinder block bolts.
40. Remove starter motor ground strap from chassis.
41. Remove stands and lower vehicle.
42. Position hydraulic trolley jack under bell housing to support gearbox when engine and gearbox are separated.
43. Fit lifting chains to engine. Carefully raise hoist a little, ease engine and gearbox apart, steady engine on hoist.
44. Ensure no components remain that will prevent engine being removed.
45. Slowly raise engine clear of engine compartment. Move engine away from vehicle and place on a suitable engine stand.

## Refit

46. Fit lifting chains to engine. Raise engine using hoist.
47. Lower engine into engine compartment. Ensure all components are clear of engine assembly.
48. Automatic vehicles: With assistance, manoeuvre engine until bottom two engine and bellhousing bolt holes align. Ensure that two cylinder block dowels locate in bell housing.  
Manual vehicles: Lower engine into position. Locate primary pinion into clutch. Engage bell housing dowels.
49. Fit two bolts and partially tighten.
50. Remove jack and lower hoist until engine rests securely on engine mounting brackets.
51. Fit top two bell housing securing bolts. Tighten to **40 Nm**.
52. Fit remaining bell housing to cylinder block bolts. Tighten to **40 Nm**.
53. Automatic vehicles: With assistance, rotate crankshaft pulley, line up marked holes in drive plate and torque converter. Fit two bolts. Tighten to **40 Nm**.
54. Rotate crankshaft 180° and fit remaining two bolts tighten to correct torque, **40 Nm**.
55. Fit new gasket and refit bottom cover, tighten bolts to **9 Nm**.
56. Fit new exhaust flange gaskets, fit exhaust to manifold.
57. Refit all harnesses, ground straps breather pipes and hoses at rear of engine.
58. Raise engine and refit engine mounting rubbers, tighten nuts to **20 Nm**.
59. Remove temporary lifting eye ETC 5964 and reverse instructions 1 to 23, ensuring that all electrical plugs and harnesses are fitted in correct locations.



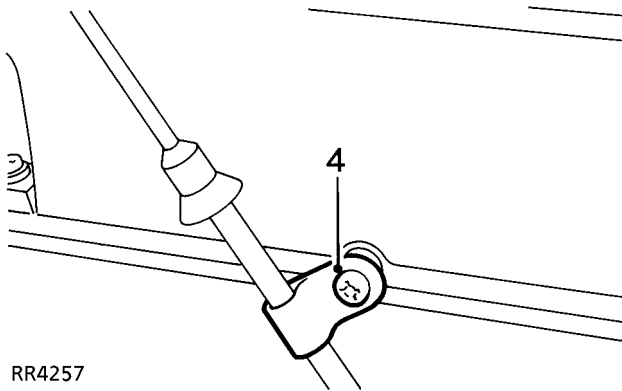


## OIL SUMP

Service repair no - 12.60.44

### Remove

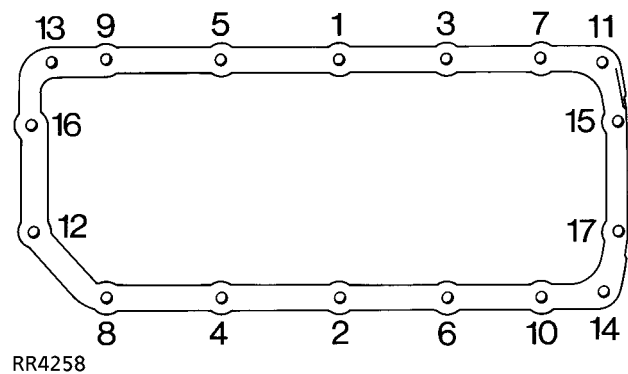
1. Drain engine oil **See SECTION 10, Maintenance, Under Vehicle Maintenance**
2. Fit drain plug. Tighten to **40 Nm**.
3. If fitted, disconnect low oil level sensor multiplug.



4. Remove bolt securing dipstick tube to rocker cover.
5. Working from the centre outwards, progressively loosen and remove 17 bolts securing sump. Remove sump.
6. Remove all traces of sealant from mating surfaces of sump, cylinder block and front cover, using a suitable solvent or plastic scraper.
7. Degrease mating surfaces of sump, cylinder block and front cover.

### Refit

8. Apply RTV Hylosil White sealant to mating surface of sump.
9. Position sump, tighten bolts finger tight.



10. Tighten bolts progressively in sequence shown. Tighten to **18 Nm**.
11. Fit bolt securing dipstick tube to rocker cover.
12. If fitted, connect low oil level sensor multiplug.



## TORQUE VALUES



**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
<b>Engine</b>	
Adaptor plate to crankshaft .....	84
Generator and power steering mounting bracket to cylinder head .....	30
Cylinder head:	
Stage 1: .....	20
Stage 2: - Further 180° ± 5°	
Drive plate to converter .....	39
Engine mountings to engine and chassis .....	55
Engine mounting rubbers to brackets .....	30
Flexible drive plate to crankshaft adaptor plate .....	41**
Flywheel to crankshaft bolts .....	78**
Lifting eye to cylinder heads .....	39
Main bearing cap rear bolts .....	92*
Oil sump drain plug .....	40
Oil sump to cylinder block .....	18
Rocker cover to cylinder head .....	9
Rocker shaft bracket to cylinder head .....	38
Spark plug .....	21
Starter motor attachment .....	44

\* These bolts must have threads coated in lubricant EXP16A before assembly.

\*\* These bolts must have threads coated in sealant Loctite 270

<b>METRIC</b>	<b>Nm</b>
M5 .....	6
M6 .....	9
M8 .....	25
M10 .....	45
M12 .....	90
M14 .....	105
M16 .....	180

<b>UNC / UNF</b>	
1/4 .....	9
5/16 .....	24
3/8 .....	39
7/16 .....	78
1/2 .....	90
5/8 .....	136



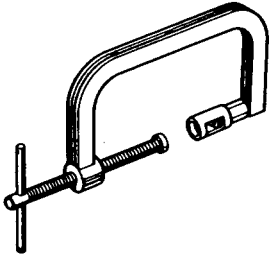
**NOTE:** Torque values above are for all screws and bolts used except for those specified.



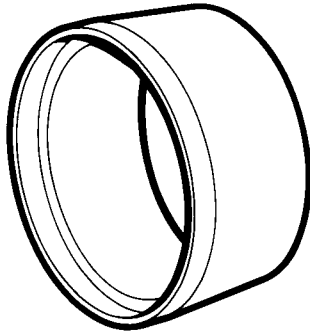
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**ENGINE**

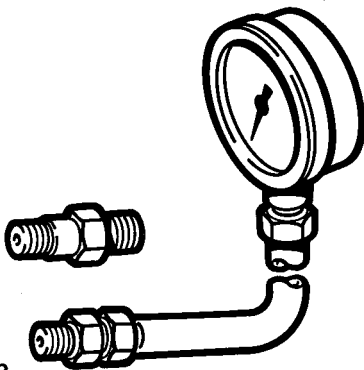
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LRT-12-034 Spring compressor  
MS1519A

MS1519A

LRT-12-010 Crankshaft rear seal guide  
RO1014

RO1014



LRT-12-052 Oil pressure test kit

LRT12052



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**DESCRIPTION**

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For description and operation refer to overhaul manual 4.0/4.6 V8 engine.

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**CONTENT OF THIS SECTION**

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Only service repair operations not covered in engine section V8i or unique to 4.0 V8 engines appear in the repair sub-section of this section.

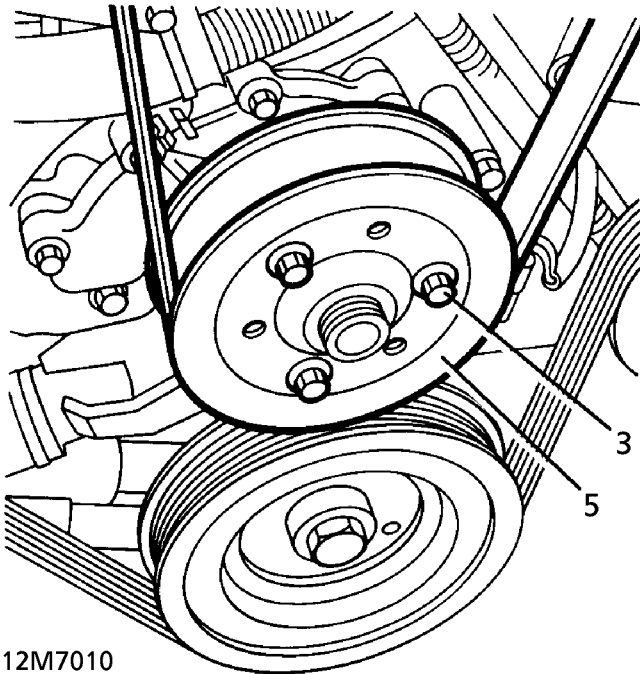


## CRANKSHAFT PULLEY

Service repair no - 12.21.01 - Crankshaft Pulley

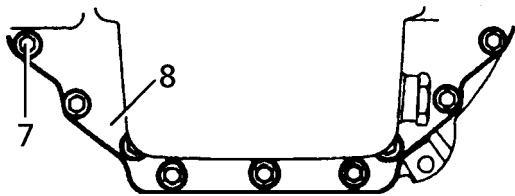
### Remove

1. Disconnect battery negative lead.
2. Remove cooling fan. **See COOLING SYSTEM, Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl**




12M7010

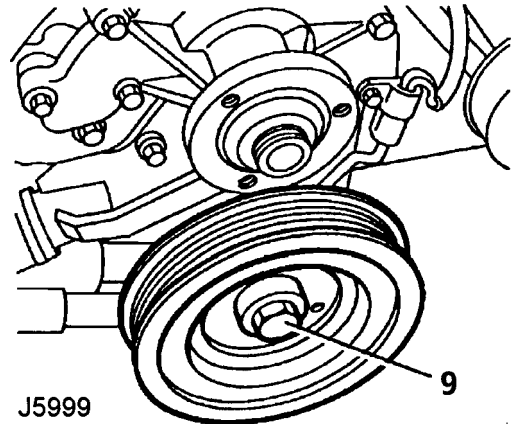
3. Slacken 3 water pump pulley securing bolts.
4. Remove drive belt. **See ENGINE 3.9 V8, Repair, Drive Belt Renew**
5. Remove water pump pulley bolts. Remove water pump pulley.
6. Raise and support front of vehicle.



J5998

7. Remove 9 bolts securing bell housing access cover (2 dowel bolts).
8. Remove access plate.

 **NOTE:** It will be necessary to have an assistant position a large flat ended screwdriver between ring gear and adaptor plate to prevent ring gear rotating.



J5999

9. Remove crankshaft pulley bolt. Collect pulley and tool.

### Refit

10. Clean seal running surface on pulley.
11. Clean key and keyway.
12. Fit crankshaft pulley.



**NOTE:** It will be necessary to have an assistant position a large flat ended screwdriver between ring gear and adaptor plate to prevent ring gear rotating.

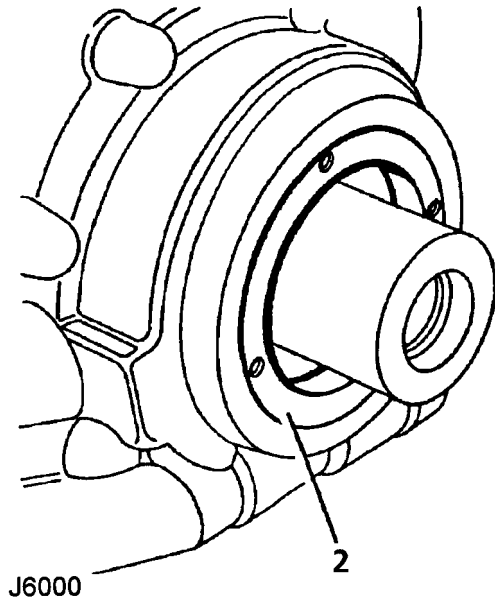
13. Refit crankshaft pulley bolt. Tighten to **270 Nm**.
14. Ensure mating faces between bell housing access cover and mating face are clean.
15. Fit access cover.
16. Fit cover bolts. Tighten to **10 Nm**.
17. Remove supports and lower vehicle.
18. Ensure mating faces between water pump pulley and pump are clean.
19. Refit water pump pulley. Fit bolts finger tight.
20. Fit drive belt. **See ENGINE 3.9 V8, Repair, Drive Belt Renew**
21. Tighten water pump pulley bolts to Tighten to **24 Nm**.
22. Refit cooling fan. **See COOLING SYSTEM, Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl**
23. Reconnect battery negative lead.

## CRANKSHAFT FRONT OIL SEAL

Service repair no - 12.21.14 - Crankshaft Front Oil Seal

### Remove

1. Remove crankshaft pulley. **See ENGINE 3.9 V8, Repair, Crankshaft Pulley Assembly**



2. Screw tool LRT-12-088 into oil seal.
3. Turn centre bolt of tool to extract oil seal.
4. Remove oil seal from tool.

### Refit

5. Clean seal seating and pulley seal register.
6. Lubricate seal with oil.
7. Locate oil seal in housing and drive into place using LRT-12-089.
8. Lubricate oil seal lip.
9. Locate seat in front cover.
10. Drift seat into position using tool LRT-12-089.
11. Refit crankshaft pulley. **See ENGINE 3.9 V8, Repair, Crankshaft Pulley Assembly; Refit**




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**ENGINE ASSEMBLY**


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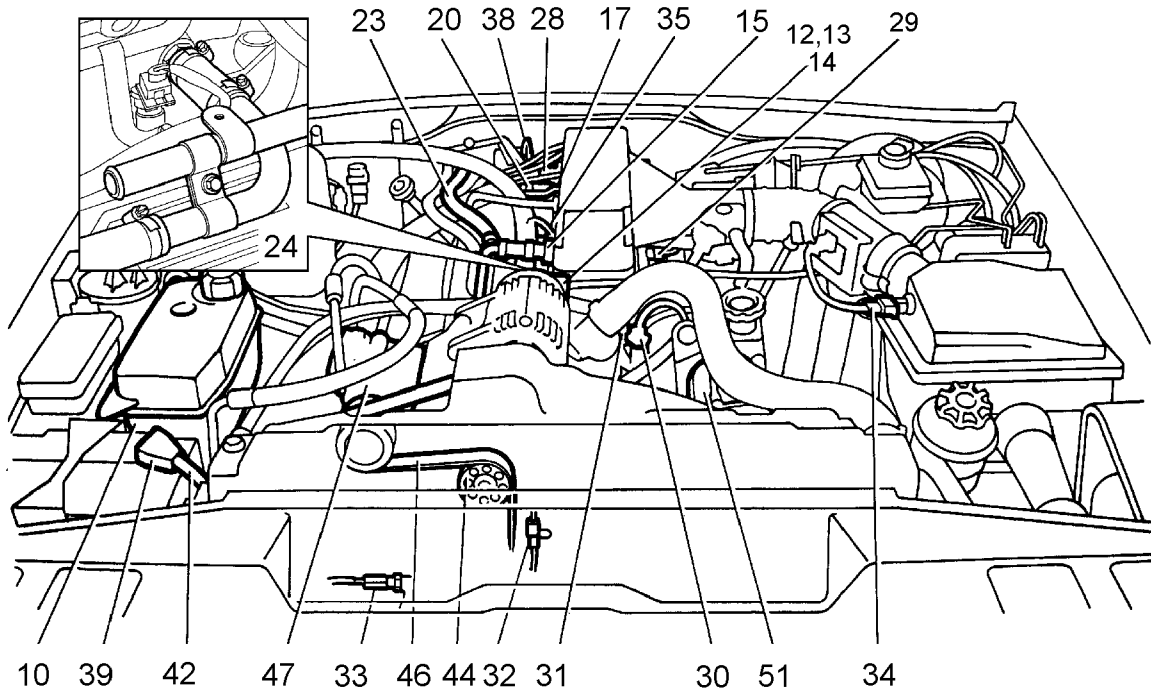
Service repair no - 12.41.01/99

**Remove**

1. Position vehicle on ramp.
2. Remove bonnet. **See CHASSIS AND BODY,**

**Repair, Bonnet [Hood]**

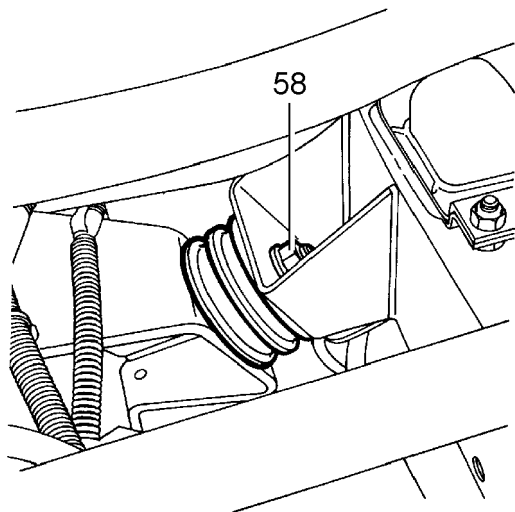
3. Remove radiator. **See COOLING SYSTEM, Repair, Radiator**
4. Remove plenum chamber. **See FUEL SYSTEM SFI, Repair, Plenum Chamber**
5. Remove mass air flow sensor. **See FUEL SYSTEM SFI, Repair, Mass Air Flow Sensor (MAF Sensor)**



J5983

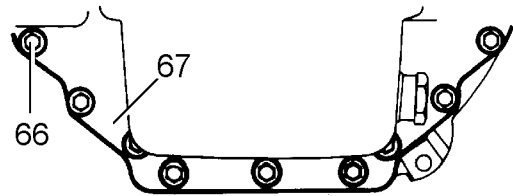
6. Slacken hose clip securing bottom hose to expansion tank.
7. Disconnect hose.
8. Remove 2 nuts securing expansion tank.
9. Remove nut and bolt securing expansion tank.
10. Remove expansion tank.
11. Disconnect servo vacuum hose from ram housing.
12. Disconnect battery sensing lead Lucar from generator.
13. Remove generator terminal cover.
14. Remove 2 terminal nuts and release leads from terminals.
15. Release purge hose from ram pipe housing.
16. Position cloth to absorb fuel spillage.
17. Slacken clip securing fuel return hose to fuel rail.
18. Disconnect hose.
19. Plug connections.
20. Disconnect fuel feed hose union.
21. Plug connections. Position hoses aside.
22. Slacken clip securing heater return hose to pipe.
23. Disconnect hose.
24. Slacken clip securing heater feed adaptor hose to inlet manifold.
25. Remove bolt securing pipe bracket.
26. Disconnect feed hose from inlet manifold.
27. Disconnect hose/pipe assembly.
28. Disconnect leads from spark plugs and remove ignition coils. **See FUEL SYSTEM SFI, Repair, Ignition Coils**
29. Disconnect fuel temperature sensor multiplug.
30. Disconnect coolant sensor multiplug.
31. Disconnect temperature gauge sensor lead.
32. Release camshaft sensor multiplug from bracket and disconnect multiplug.
33. Disconnect oil pressure switch Lucar.
34. Disconnect air intake temperature sensor multiplug.
35. Disconnect 8 injector multiplugs.
36. Remove 4 nuts securing harness brackets to inlet manifold.
37. Release harness brackets.
38. Remove bolts securing gearbox breather pipes to engine lifting bracket.

39. Release battery positive lead terminal cover.
40. Remove terminal nut
41. Release terminal from battery.
42. Release fusebox main feed lead.
43. Position battery cable over engine.
44. Pivot jockey pulley downwards to release drive belt tension.
45. Release belt from pulleys.
46. Remove drive belt.
47. Disconnect compressor multiplug
48. Remove 4 bolts securing compressor.
49. Remove heatshield.
50. Release compressor from bracket and tie aside.
51. Slacken clip securing PAS hose to pump.
52. Disconnect hose.
53. Plug hose and pump.
54. Disconnect PAS hose connection at pump and steering box.
55. Release unions and remove hose.
56. Remove and discard 'O' rings.
57. Plug pump and steering box.



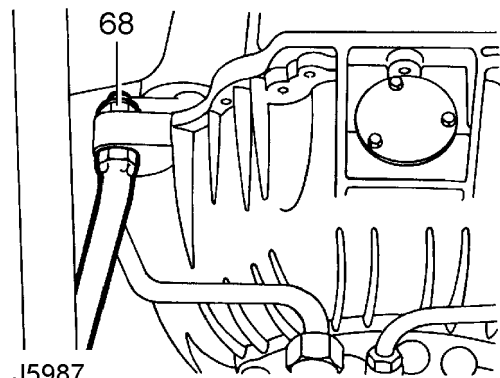
J5985

58. Remove LH and RH engine mounting nuts.
59. Position lifting chains and attach hooks to engine lifting eyes.
60. Raise engine sufficiently to release engine mountings.
61. Release engine mountings and remove.
62. Lower engine until it just rests on engine mounting brackets.
63. Disconnect chains.
64. Raise ramp.
65. Remove catalytic converter/front pipe assembly.  
**See EMISSION CONTROL, Repair, Catalytic Converter/Front Pipe - 4.0 V8**



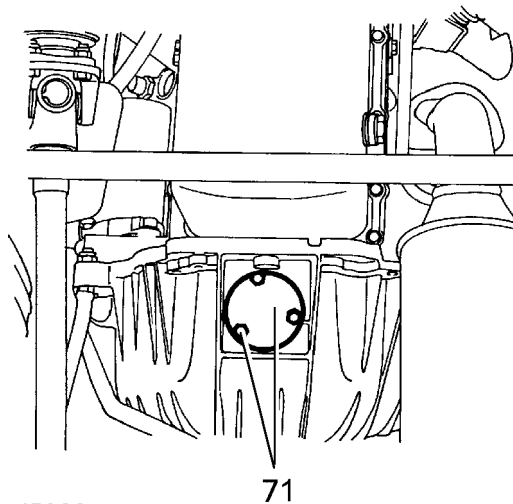
J5986

66. Remove 9 bolts securing bell housing bottom cover. Note position of 2 dowel bolts.
67. Remove cover.



J5987

68. Remove locknut securing transfer box tie bar.
69. Remove 2 bolts securing tie bar to transmission.
70. Remove tie bar.



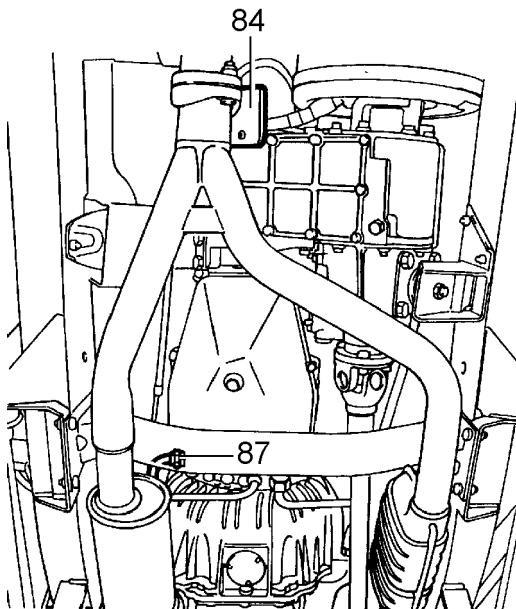
J5988

71. Remove 2 and slacken 1 bolt, securing bell housing access plate and position aside.
72. Mark drive plate to torque converter relationship.
73. With assistance, rotate crankshaft for access to first bolt (torque converter to drive plate).
74. Remove first bolt.
75. Repeat steps for the remaining 3 bolts.
76. Remove 2 bolts securing crankshaft sensor shield to engine backplate. **See FUEL SYSTEM SFI, Repair, Crankshaft Position Sensor (CKP Sensor)**



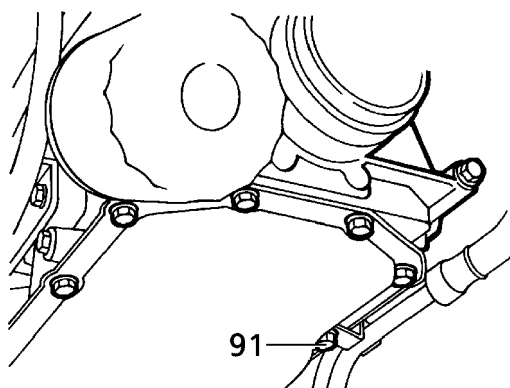


77. Release sensor/shield and remove.
78. Disconnect sensor multiplug.
79. Remove sensor.
80. Remove starter motor heatshield. *See ELECTRICAL, Repair, Starter Motor Heatshield - 4.0 V8*
81. Disconnect solenoid Lucar.
82. Disconnect RH and LH knock sensor multiplugs. *See FUEL SYSTEM SFI, Repair, Knock Sensor*
83. Release harness from engine.



J5989

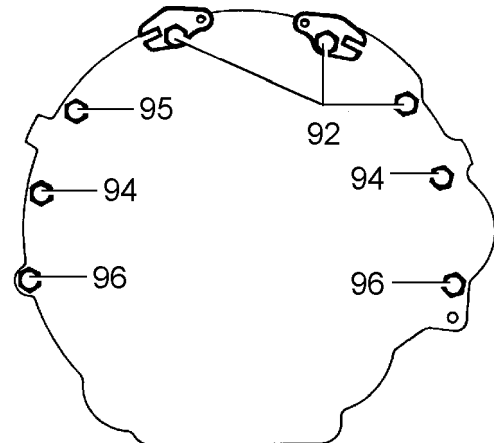
84. Remove nut securing handbrake cable heatshield.
85. Release speed sensor lead from clip on heatshield.
86. Remove heatshield.
87. Disconnect top oil cooler pipe union from transmission.
88. Release union.
89. Remove 'O' ring and discard.
90. Plug pipe and transmission.



J5990

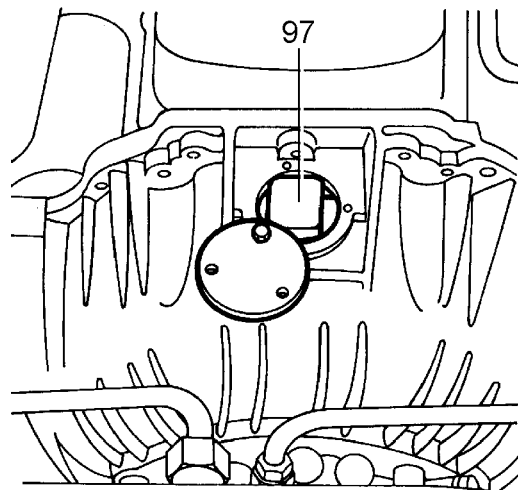
91. Remove bolt securing oil cooler pipe bracket to

sump. Collect spacer.



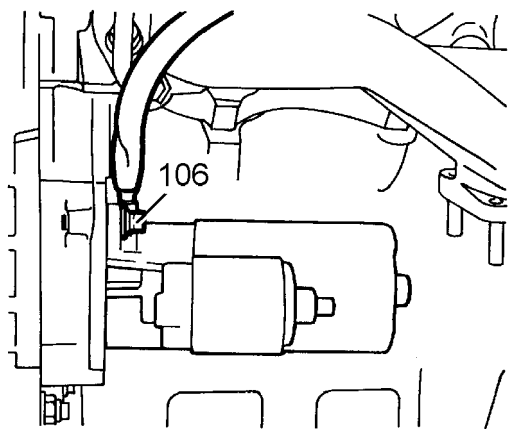
J5991

92. Remove 3 bolts from top of bell housing.
93. Collect 2 harness brackets.
94. Remove 2 bolts, LH and RH side of bell housing.
95. Remove centre LH bell housing bolt using long extension.
96. Remove 2 lower bolts from bell housing.



J5992

97. Fit suitable wooden block in access plate hole to retain torque converter.
98. Secure block with cover plate and tighten one cover plate bolt.
99. Support gearbox on a jack.
100. Lower ramp.
101. Position lifting chains and attach hooks to engine lifting eyes.
102. Raise engine.
103. Raise jack.
104. Break engine to gearbox joint.
105. Raise engine.



J5993

- 106. Remove top starter bolt securing engine earth cable.
- 107. Remove nut securing kick-down cable clip to LH cylinder head.
- 108. With assistance, raise engine, move aside all pipes and wires. Move engine clear of vehicle.
- 109. Lower engine onto bench.

### Refit

- 110. Clean engine and gearbox mating faces.
- 111. Clean dowel and dowel holes.
- 112. With assistance raise engine off bench. Lower and guide engine into engine compartment ensuring no wires or pipes become trapped.
- 113. Position clip securing kick-down cable to LH cylinder head.
- 114. Fit and tighten nut.
- 115. Position engine earth cable and secure to starter with top bolt. Tighten to **45 Nm**.
- 116. Lower engine.
- 117. With assistance, engage engine with gearbox.
- 118. Fit 3 bottom bell housing bolts. Tighten to **46 Nm**.
- 119. Lower jack supporting gearbox.
- 120. Lower engine onto mounting brackets.
- 121. Fit centre RH bell housing bolt.
- 122. Fit centre LH bell housing bolt.
- 123. Fit harness brackets to 2 top bell housing bolts.
- 124. Fit bolts. Tighten to **46 Nm**.
- 125. Remove plugs from transmission and oil cooler pipe.
- 126. Clean pipe, lubricate NEW 'O' ring and fit to pipe.
- 127. Connect pipe to transmission and secure with union. Tighten to **30 Nm**.
- 128. Align pipe bracket to sump, position spacer and fit bolt. Tighten to **18 Nm**.
- 129. Fit heatshield and secure with nut.
- 130. Secure transducer lead to clip on heatshield.
- 131. Slacken bell housing access plate bolt.
- 132. Move plate aside.
- 133. Remove block.
- 134. Align drive plate and torque converter.
- 135. Fit 2 torque converter bolts.
- 136. Rotate engine and fit second 2 bolts. Tighten to **45 Nm**.
- 137. Rotate engine and tighten first 2 bolts to Tighten to **45 Nm**.
- 138. Clean cover plate and mating face.
- 139. Position cover plate and fit bolts. Tighten to **45 Nm**.
- 140. Position access plate.
- 141. Fit 2 remaining bolts and tighten all bolts to Tighten to **9 Nm**.
- 142. Position engine harness around engine.
- 143. Connect knock sensor multiplug.
- 144. Connect starter solenoid Lucar.
- 145. Position starter motor heatshield and secure clip to solenoid.
- 146. Align shield bracket to engine mounting bracket and fit bolt. Tighten to **9 Nm**.
- 147. Clean crankshaft sensor mating faces.
- 148. Position sensor and connect multiplug.
- 149. Position/align sensor and shield to backplate. Fit bolts. Tighten to **6 Nm**.
- 150. Fit tie bar, align to transmission and fit bolts. Tighten to **25 Nm**.
- 151. Fit tie bar securing nut. Tighten to **45 Nm**.
- 152. Fit catalytic converter/front pipe assembly. **See EMISSION CONTROL, Repair, Catalytic Converter/Front Pipe - 4.0 V8**
- 153. Raise engine.
- 154. Fit RH mounting rubber.
- 155. Move engine over.
- 156. Fit LH mounting rubber.
- 157. Lower engine.
- 158. Disconnect hoist.
- 159. Fit engine mounting nuts. Tighten to **55 Nm**.
- 160. Remove plugs from steering pump and steering box.
- 161. Clean PAS hose unions.
- 162. Lubricate 'O' rings and fit to hose unions.
- 163. Position hose.
- 164. Align unions to pump and steering box. Tighten 14mm thread to **15 Nm**, 16mm thread to Tighten to **20 Nm**.
- 165. Remove plugs from feed hose and PAS pump.
- 166. Connect hose to pump and tighten clip.
- 167. Untie compressor and position to engine bracket.
- 168. Position heatshield and fit bolts. Tighten to **25 Nm**.
- 169. Connect compressor multiplug.
- 170. Position drive belt.



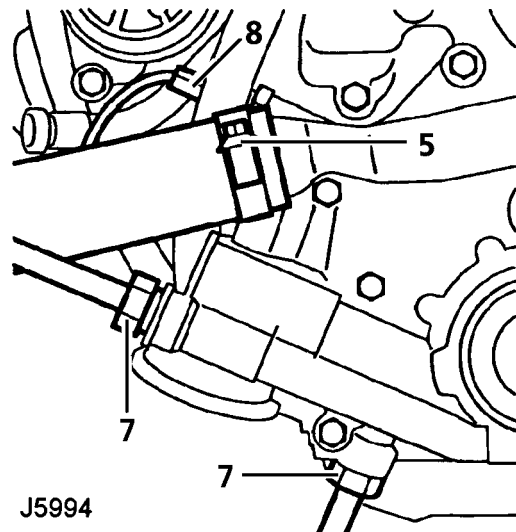
171. Route drive belt around pulleys.
172. Pivot tensioner downwards.
173. Align belt to tensioner and release tensioner.
174. Connect battery positive lead and tighten.
175. Secure terminal cover.
176. Align gearbox breather pipe, clip to engine lifting eye and fit bolt. Tighten to **9 Nm**.
177. Align and secure engine harness brackets to inlet manifold and fit nuts. Tighten to **9 Nm**.
178. Connect injector multiplugs.
179. Connect air intake temperature sensor multiplug.
180. Connect fuel temperature sensor multiplug.
181. Connect coolant temperature multiplug.
182. Connect temperature gauge connector.
183. Connect oil pressure switch Lucar.
184. Connect camshaft sensor multiplug and secure to bracket.
185. Fit ignition coil bracket. **See FUEL SYSTEM SFI, Repair, Ignition Coils**
186. Position heater hose/pipe assembly.
187. Connect hose to inlet manifold.
188. Align pipe to bracket and fit bolt. Tighten to **9 Nm**.
189. Tighten hose clip.
190. Connect heater return hose and tighten clip.
191. Remove plugs from fuel feed and return hose connections.
192. Clean feed unions.
193. Connect return hose and tighten clip.
194. Connect feed hose union and tighten.
195. Remove cloth.
196. Connect purge hose.
197. Connect leads to generator, tighten terminal nuts and fit cover.
198. Connect sensing Lucar.
199. Connect servo vacuum hose.
200. Position expansion tank and secure with fixings.
201. Connect hose and tighten clip.
202. Lower ramp.
203. Fit mass air flow sensor. **See FUEL SYSTEM SFI, Repair, Mass Air Flow Sensor (MAF Sensor)**
204. Fit plenum chamber. **See FUEL SYSTEM SFI, Repair, Plenum Chamber**
205. Fit radiator. **See COOLING SYSTEM, Repair, Radiator**
206. Fit bonnet. **See CHASSIS AND BODY, Repair, Bonnet [Hood]**
207. Reconnect battery negative lead.
208. Bleed power steering system. **See STEERING, Repair, Power Steering System - Bleed**
209. Drain engine oil and refill. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids - USA Vehicles**
210. Start engine. Check for fuel, coolant and oil leaks.

## FRONT COVER GASKET

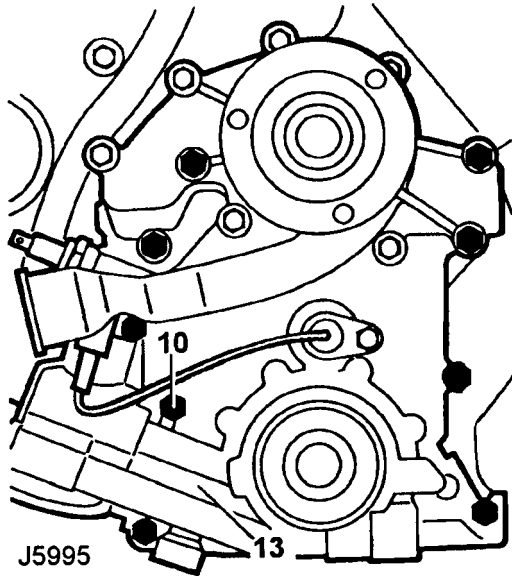
Service repair no - 12.65.04 - Front Cover Gasket

### Remove

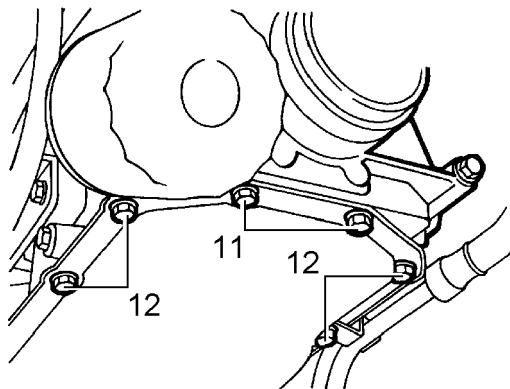
1. Disconnect battery negative lead.
2. Drain cooling system. **See COOLING SYSTEM V8, Adjustment, Coolant**
3. Remove radiator **See COOLING SYSTEM, Repair, Radiator**
4. Remove water pump pulley. **See COOLING SYSTEM, Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl**



5. Slacken bottom hose clip. Remove hose from water pump.
6. Raise vehicle on ramp.
7. Disconnect oil cooler hoses from front cover and position aside. Plug hoses and connections.
8. Disconnect Lucar from oil pressure switch.



9. Disconnect multiplug from camshaft sensor. *See FUEL SYSTEM SFI, Repair, Camshaft Position Sensor (CMP Sensor)*
10. Remove 9 bolts securing front cover.



11. Remove 2 bolts securing sump to front cover.
12. Loosen 4 bolts securing sump adjacent to front cover (2 each side).
13. Release front cover assembly.
14. Remove oil seal.
15. Remove and discard gasket.

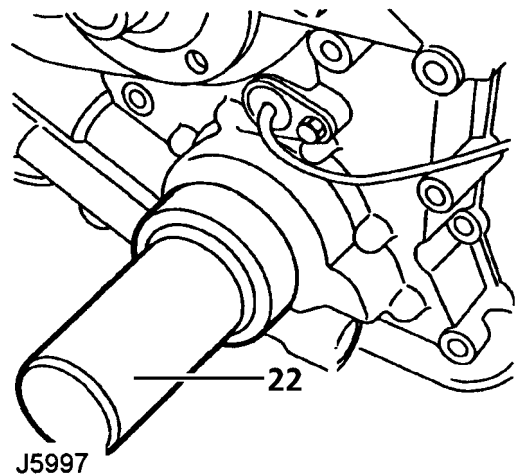
## Refit

16. Clean sealant from threads of cover bolts.
17. Clean old sealant from front cover and block joint face.

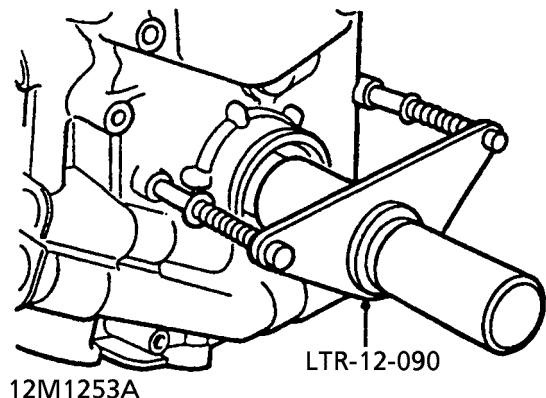


**CAUTION: Use a plastic scraper.**

18. Apply Hylosil jointing compound to gasket position on cover and block.
19. Fit new gasket to block face.
20. Ensure oil seal register in cover is clean.
21. Lubricate outer face of NEW oil seal.



22. Using LRT-12-089, fit seal to cover.
23. Lubricate oil pump drive gear and position in pump with groove away from engine.



24. Locate alignment tool LRT-12-090 on front cover and oil pump drive gear.
25. Position front cover over crankshaft.
26. Press and rotate tool to engage drive gear until drive gear keyway aligns with Woodruff key.
27. Fit cover to cylinder block.



28. Remove alignment tool LRT-12-090.
29. Apply a small amount of Loctite 242 to threads and refit front cover bolts. Tighten to **22 Nm**.
30. Fit sump bolts. Tighten to **23 Nm**.
31. Connect camshaft sensor multiplug.
32. Connect Lucar to oil pressure switch terminal.
33. Remove plugs from oil cooler pipes and cover.
34. Fit new 'O' ring seals, reconnect oil cooler pipes. Tighten to **15 Nm**.



**CAUTION: Over tightening of oil cooler pipe unions can crack front cover.**

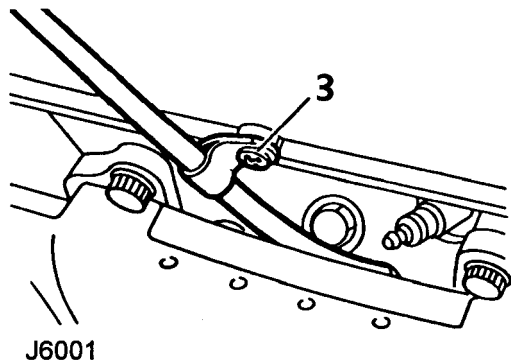
35. Refit bottom hose to water pump. Tighten clip.
36. Refit water pump pulley. **See COOLING SYSTEM, Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl**
37. Refit radiator assembly. **See COOLING SYSTEM, Repair, Radiator**
38. Refill cooling system. **See COOLING SYSTEM V8, Adjustment, Coolant**
39. Check/top-up engine oil.
40. Lower ramp.
41. Reconnect battery negative lead.

## ROCKER COVER GASKET - LEFT HAND

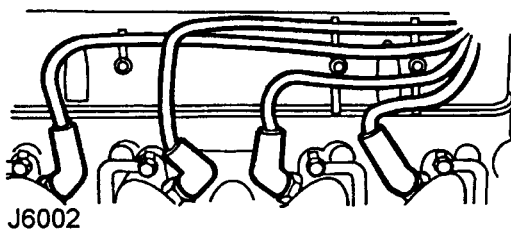
Service repair no - 12.29.40 - LH Cover Gasket  
 Service repair no - 12.29.41 - RH Cover Gasket

### Remove

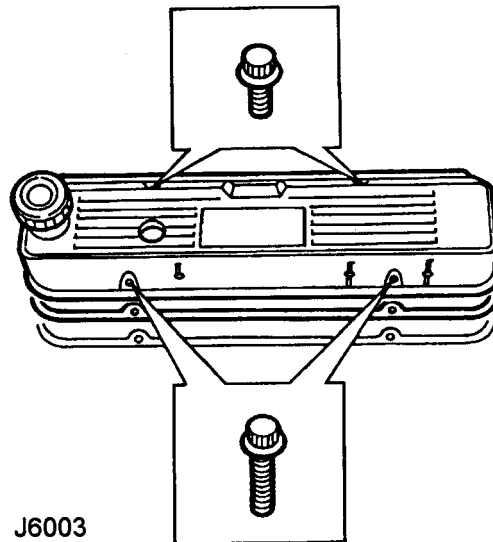
1. Disconnect battery negative lead.
2. Remove plenum chamber. **See FUEL SYSTEM SFI, Repair, Plenum Chamber**



3. Remove screw securing dipstick tube to rocker cover.



4. Release plug leads from guide clips and disconnect from 4 spark plugs.



5. Remove 4 bolts securing rocker cover to cylinder head.
6. Remove rocker cover.
7. Remove and discard rocker cover gasket.

### Refit

8. Clean mating faces between rocker cover and cylinder head using Bostick cleaner 6001 or equivalent. Allow to dry.



**NOTE: Gasket fits one way round only. It must be fitted accurately, first time. Subsequent movement will destroy bonding.**

### bonding.

9. Apply a thin coating of impact adhesive (Bostick 1775 or equivalent) to mating faces of rocker cover seal face and new gasket. Use a brush to ensure an even film. Allow adhesive to become touch dry.
10. Place one end of gasket into cover recess with edge firmly against recess wall, holding remainder of gasket clear. Work around cover, pressing gasket into place ensuring edge firmly contacts recess wall.



**CAUTION: Allow cover to stand for thirty minutes before fitting.**

11. Fit rocker cover to cylinder head, ensure short screws are inboard. Tighten to **9 Nm**.
12. Connect leads to spark plugs and secure to guide clips on rocker cover.
13. Secure dipstick tube to rocker cover.
14. Refit plenum chamber. **See FUEL SYSTEM SFI, Repair, Plenum Chamber**
15. Reconnect battery negative lead.



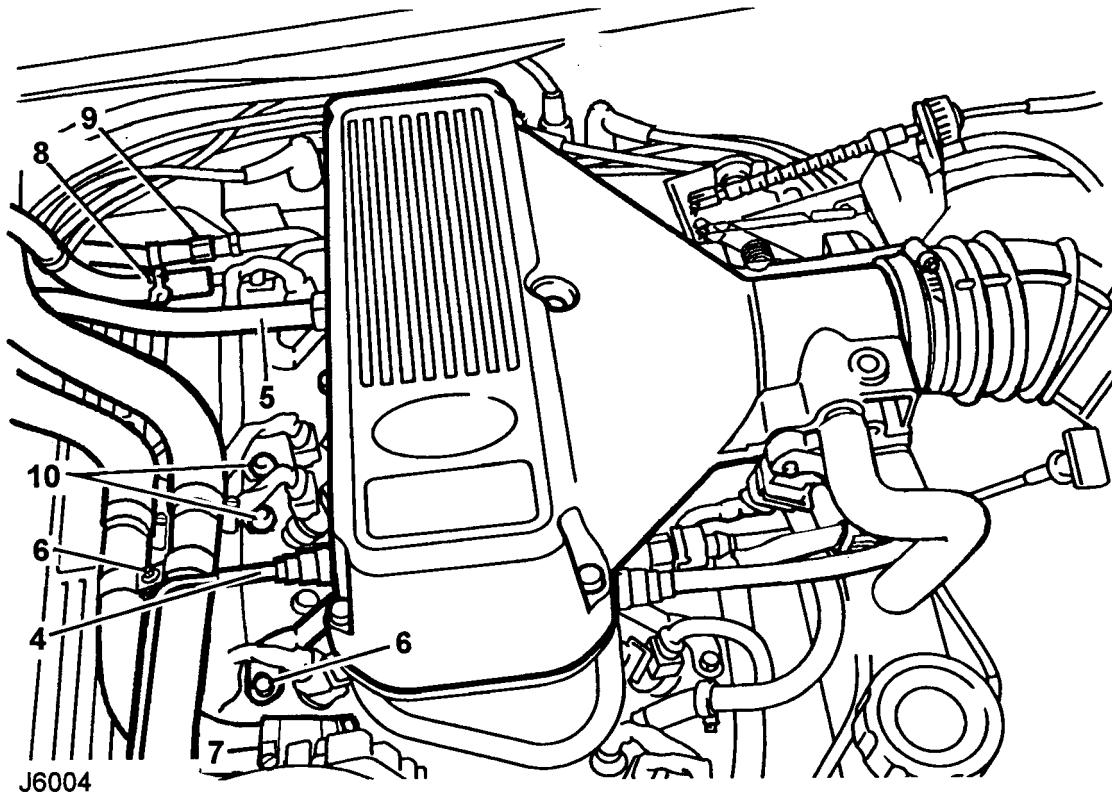
## ROCKER COVER GASKET - RIGHT HAND

Service repair no - 12.29.41 - RH Cover Gasket

1. Depressurise fuel system. *See FUEL SYSTEM SFI, Repair, Fuel System - Depressurise*
2. Disconnect battery negative lead.

3. Drain cooling system. *See COOLING SYSTEM V8, Adjustment, Coolant*

NOTE: Leave hose disconnected.



4. Disconnect purge pipe from plenum chamber hose.
5. Disconnect breather pipe from rocker cover.
6. Remove bolt securing coolant pipe brackets and nut securing bracket to manifold.
7. Loosen hose clip and disconnect coolant return hose from pipe.

**CAUTION: Plug connection.**

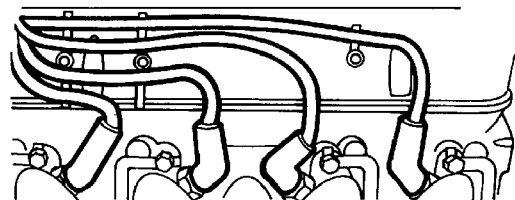


8. Loosen clip and disconnect fuel return hose from pipe.
9. Disconnect fuel hose from injector pipe.

**CAUTION: Use 2 spanners.**

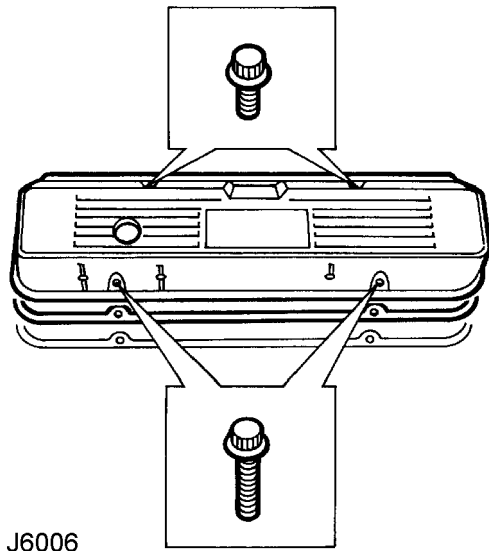


10. Remove 2 nuts securing engine harness brackets to manifold.



J6005

11. Release 4 ht leads from 2 brackets on rocker cover.



12. Remove 4 bolts securing rocker cover to cylinder head.
13. Remove rocker cover.
14. Remove and discard rocker cover gasket.

## Refit

15. Clean mating faces between rocker cover and cylinder head using Bostick cleaner 6001 or equivalent. Allow to dry.



**NOTE: Gasket fits one way round only. It must be fitted accurately, first time. Subsequent movement will destroy bonding.**

16. Apply a thin coating of impact adhesive (Bostick 1775 or equivalent) to mating faces of rocker cover seal face and new gasket. Use a brush to ensure an even film. Allow adhesive to become touch dry.
17. Place one end of gasket into cover recess with edge firmly against recess wall, holding remainder of gasket clear. Work around cover, pressing gasket into place ensuring edge firmly contacts recess wall.



**CAUTION: Allow cover to stand for thirty minutes before fitting.**

18. Fit rocker cover to cylinder head, ensure short screws are inboard. Tighten to **9 Nm**.
19. Connect fuel feed and return hoses.
20. Refit ht leads into retaining brackets.
21. Secure engine harness to brackets.
22. Connect coolant pipes to hoses and secure brackets.
23. Connect breather hose to rocker cover.
24. Connect purge hose to plenum chamber.
25. Connect bottom hose to radiator.
26. Refill cooling system. **See COOLING SYSTEM V8, Adjustment, Coolant**
27. Reconnect battery negative lead.



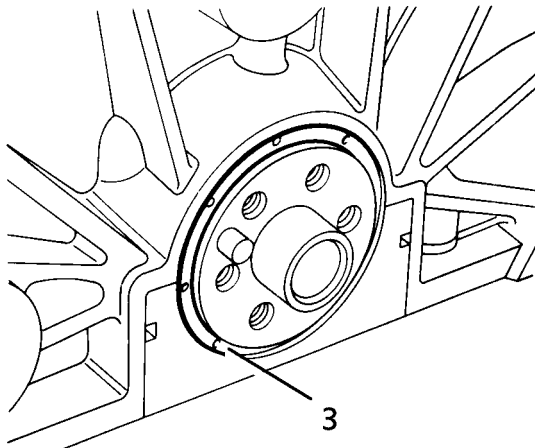


## CRANKSHAFT REAR OIL SEAL

Service repair no - 12.21.20

### Remove

1. **Manual vehicles:** Remove flywheel. *See ENGINE 3.9 V8, Repair, Flywheel*
2. **Automatic vehicles:** Remove drive plate. *See ENGINE 4.0 V8, Repair, Drive Plate - Automatic*



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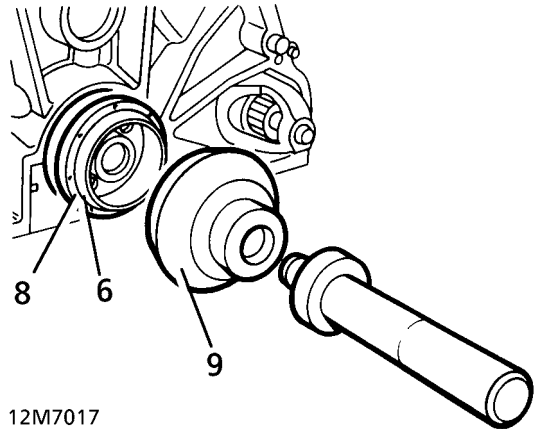
3. Remove oil seal from location.



**CAUTION:** Do not damage seal location or running surface on crankshaft.

### Refit

4. Ensure both seal location and running surface on crankshaft are clean.
5. Ensure mating faces of flywheel and crankshaft are clean.
6. Lubricate seal guide LRT-12-095 with clean engine oil. Position over crankshaft boss.



12M7017

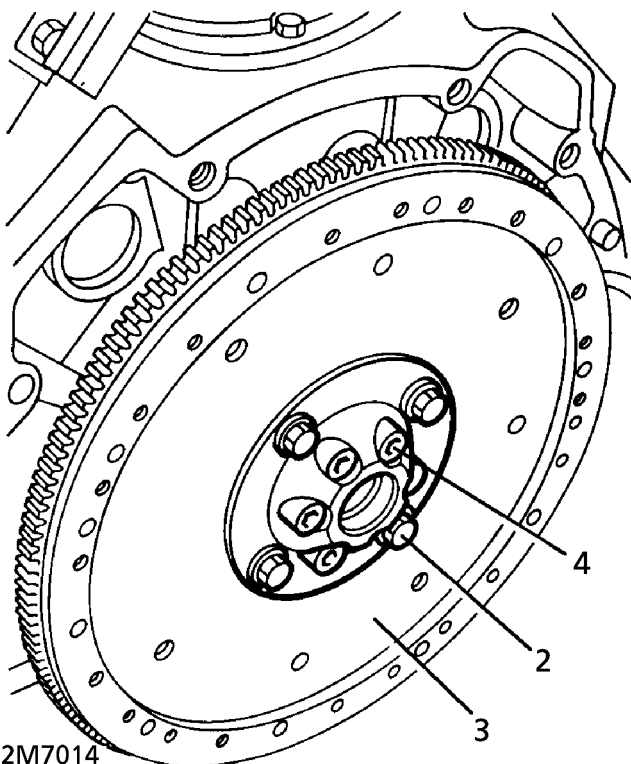
7. Lubricate oil seal lip.
8. Position seal squarely. Remove guide.
9. Drift seal into location using LRT-12-091.
10. **Manual vehicles:** Fit flywheel. *See ENGINE 3.9 V8, Repair, Flywheel*
11. **Automatic vehicles:** Fit drive plate. *See ENGINE 4.0 V8, Repair, Drive Plate - Automatic*

## DRIVE PLATE - AUTOMATIC

Service repair no - 12.53.13

### Remove

1. Remove automatic gearbox and torque converter. **See AUTOMATIC GEARBOX, Repair, LT230T Transfer Gearbox with Automatic Gearbox Assembly - V8i**



2. Remove 4 clamp ring bolts. Collect clamp ring.
3. Remove flexible drive plate/starter ring gear assembly from hub aligner.
4. Remove 6 screws from hub aligner. Remove hub aligner from crankshaft. Collect shim.
5. Check drive plate for distortion or cracks. Check starter ring gear for chipped or broken teeth. If either component shows signs of damage, fit a new assembly.

### Refit

6. Ensure all mating surfaces are clean.
7. Fit shim and hub aligner to crankshaft.
8. Fit hub aligner screws. Tighten to **85 Nm**.
9. Fit drive plate and clamp ring.
10. Fit clamp ring bolts. Tighten to **45 Nm**.



**NOTE:** It is only necessary to reshim the drive plate when a new crankshaft or hub aligner is fitted.

11. Fit automatic gearbox and converter assembly. **See AUTOMATIC GEARBOX, Repair, LT230T Transfer Gearbox with Automatic Gearbox Assembly - V8i**

## ROCKER SHAFT - OVERHAUL

Service repair no - 12.29.29 - Rocker shaft - overhaul

See Overhaul Manual 4.0/4.6 V8 Engine

## TAPPETS - ENGINE SET

Service repair no - 12.29.57 - Tappets - engine set

See Overhaul Manual 4.0/4.6 V8 Engine



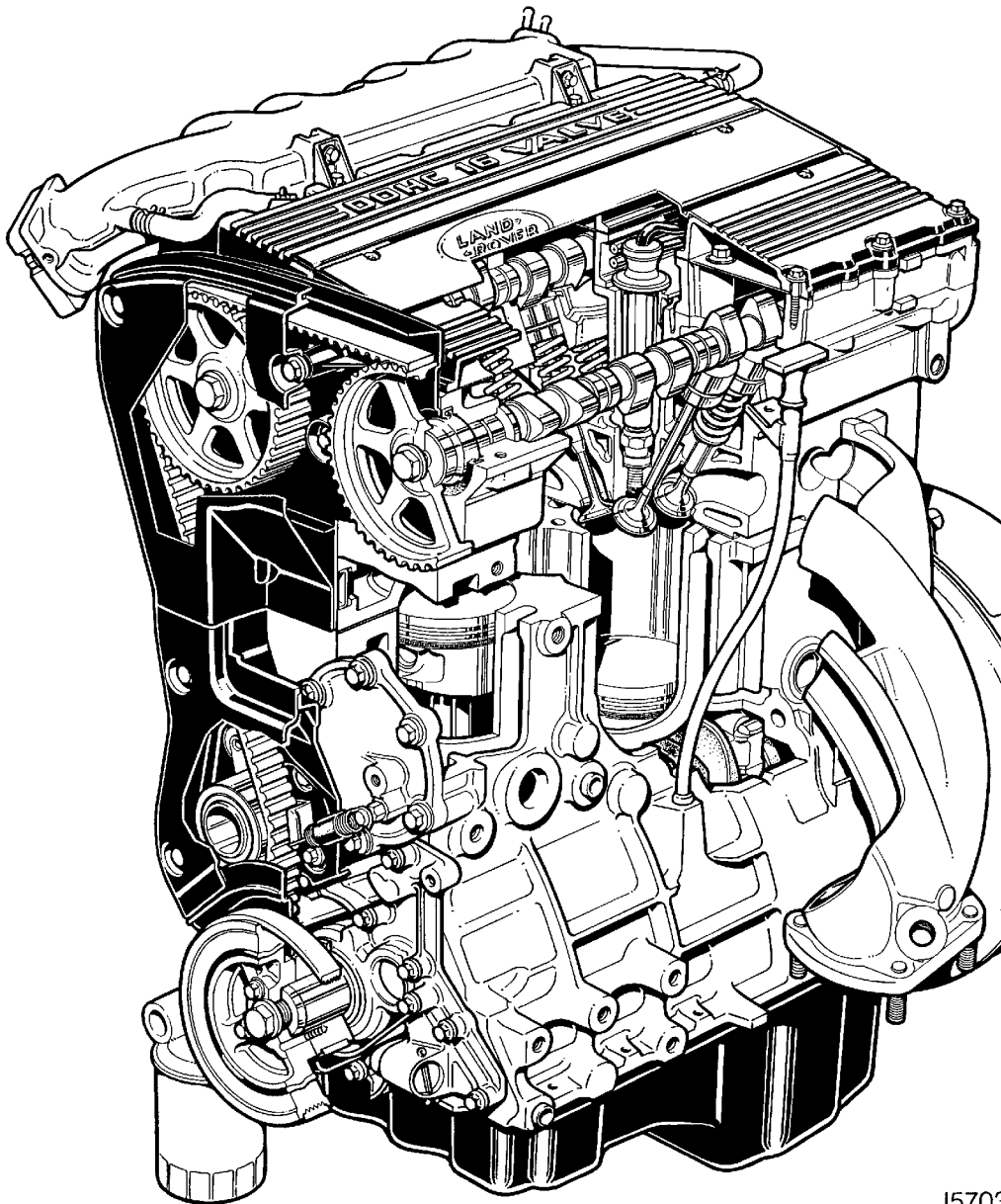
## DESCRIPTION

The 'T' Series engine is a four cylinder, water cooled unit comprising a cast iron cylinder block, aluminium alloy cylinder head and twin aluminium alloy camshaft carriers.

The cylinder block incorporates direct bored, siamesed cylinder bores which provide good structural rigidity. The crankshaft is carried in five main bearings, end-float being controlled by thrust washers positioned each side of the centre main bearing.

The main bearing caps are located to the cylinder block by dowels; the bearing shells fitted to Nos. 1, 3 and 5 bearings are fully grooved whilst those fitted to Nos. 2 and 4 bearings are plain.

The cylinder head carries twin camshafts operating four valves per cylinder via hydraulic tappets. Both camshafts are driven by the timing belt and run directly in journals line bored in the cylinder head and camshaft carriers. The plastic camshaft covers are bolted to the camshaft carriers.



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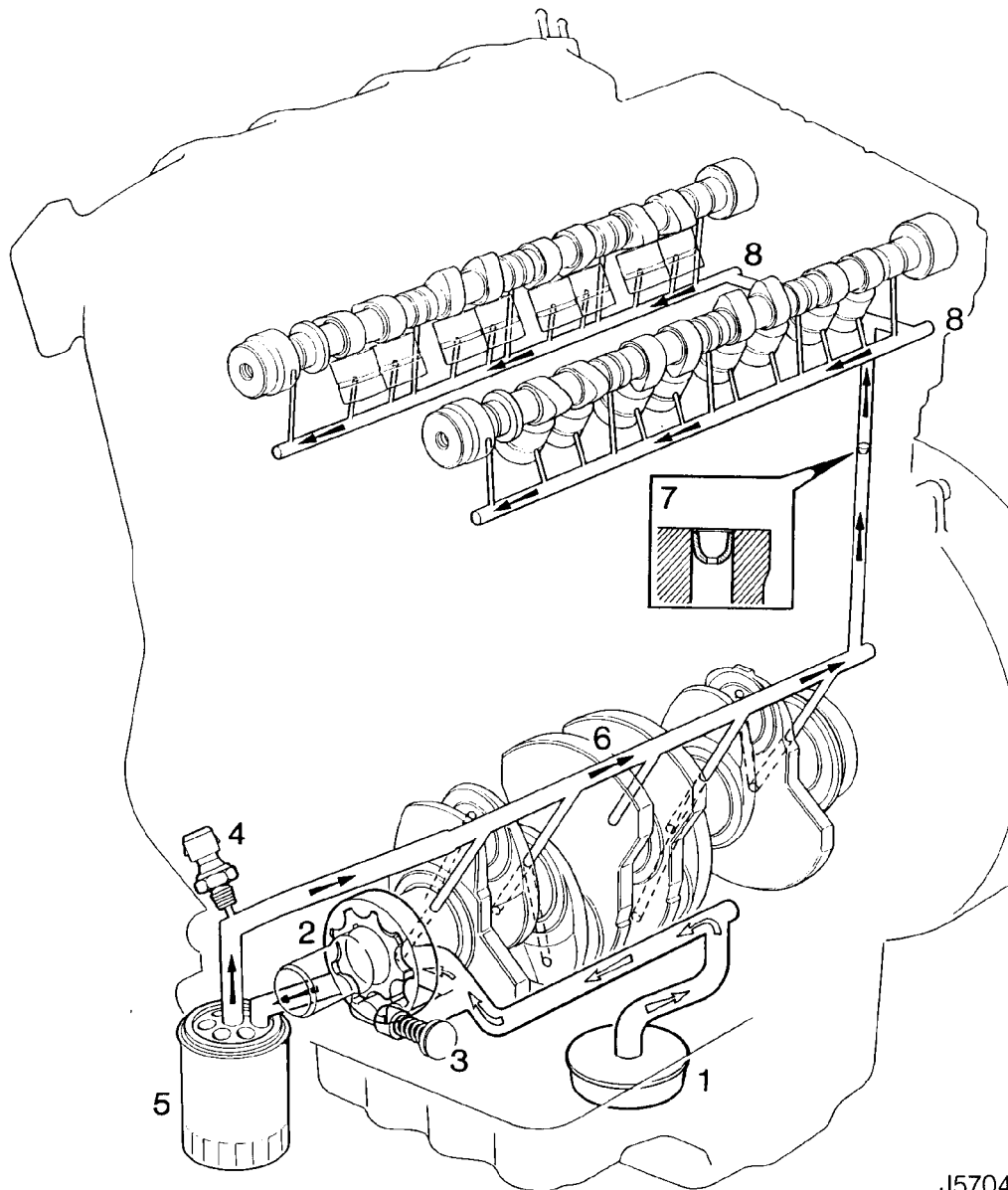
# 12 ENGINE

The aluminium alloy, tin coated pistons have two compression and an oil control ring and are secured to the connecting rods by semi-floating gudgeon pins which are an interference fit in the small-end bush. Gudgeon pins are offset towards the thrust side of the pistons to reduce frictional drag.

Plain, big-end bearing shells are fitted to each connecting rod.

The internally toothed timing belt is driven from a gear which is keyed to the crankshaft, belt tension being controlled by a semi-automatic tensioner.

The trochoidal type oil pump is mounted on the front of the engine and carries the crankshaft front oil seal. Drive to the pump is via a Woodruff key inserted in the crankshaft.



J5704



### Lubrication

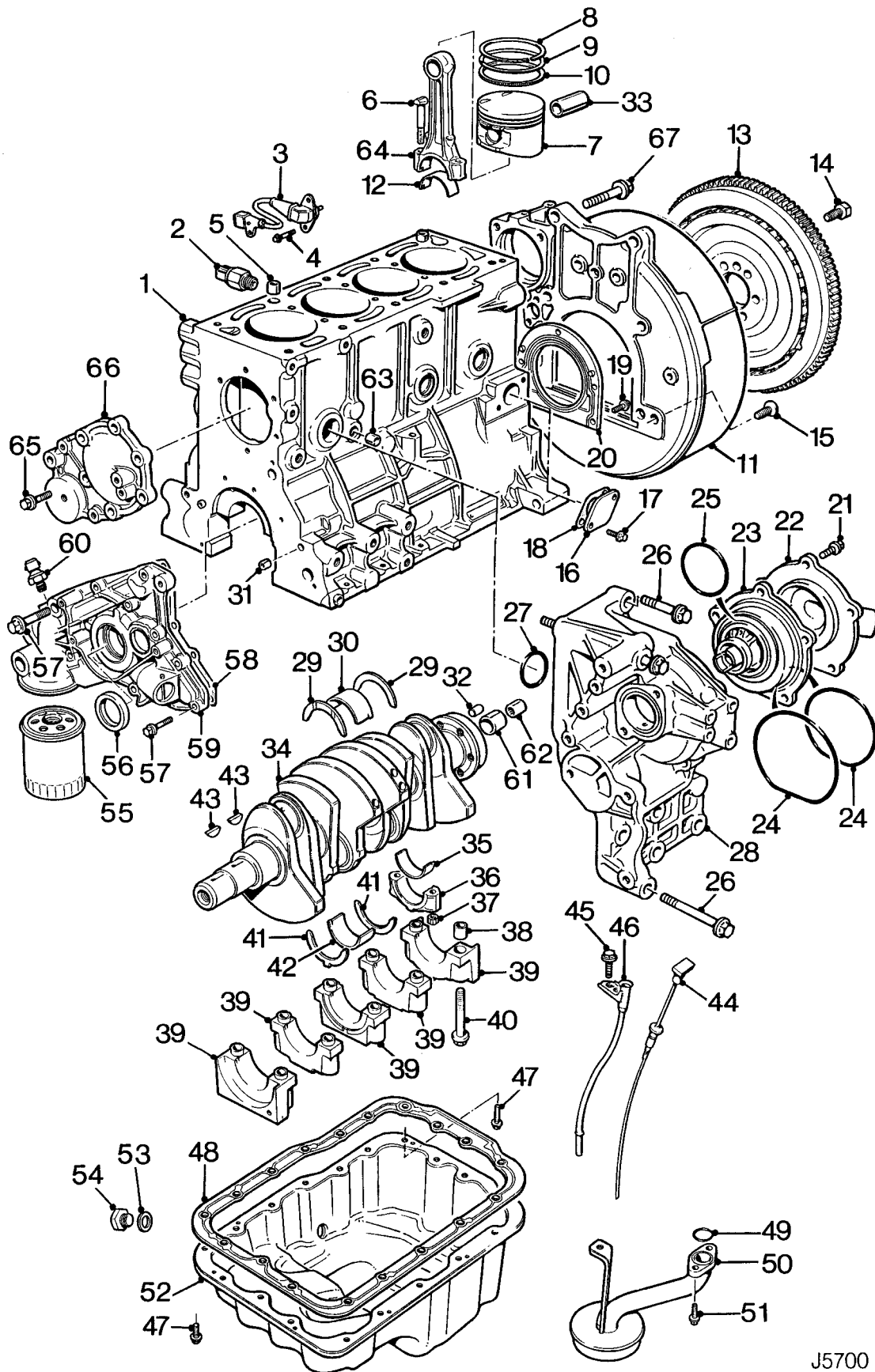
Oil is drawn from the pressed steel sump through a strainer (1) and into the oil pump (2); excess pressure being relieved by a pressure relief valve (3) integral with the pump. The low oil pressure sensor (4) registers the oil pressure in the main oil gallery on the outflow side of the filter. Pressurised oil passes through the full flow oil filter (5) to internal drillings in the crankshaft where it is directed to each main bearing and to the big end bearings via Nos. 1, 3 and 5 main bearings (6). An internal drilling in the cylinder block directs oil, via a restrictor (7) to the cylinder head where it passes through further internal drillings to the hydraulic tappets and camshaft journals (8). Gudgeon pin and small-end bush lubrication is by splash from the big-end bearings.

### Crankcase ventilation

With the exception of two hoses connected from the inlet camshaft cover to the inlet manifold and throttle housing all crankcase ventilation is via internal voids in the cylinder head and block. The inlet camshaft cover carries a wire gauze flame trap located over the breather pipe connections.

## CYLINDER BLOCK COMPONENTS

1. Cylinder block
2. Knock sensor
3. Crankshaft sensor
4. Bolt - crankshaft sensor
5. Locating dowel - cylinder head
6. Bolt - connecting rod
7. Piston
8. Piston ring - top compression
9. Piston ring - 2nd compression
10. Piston ring - oil control
11. Gearbox adapter plate
12. Bearing shell - big end - upper
13. Flywheel
14. Bolt - flywheel
15. Torx screw - gearbox adapter plate
16. Blanking plate
17. Bolt - blanking plate
18. Gasket
19. Bolt - crankshaft rear oil seal housing
20. Crankshaft rear oil seal and housing
21. Bolt - coolant pump cover
22. Coolant pump cover
23. Impeller
24. Sealing rings
25. 'O' ring
26. Bolts - coolant pump
27. 'O' ring
28. Coolant pump body
29. Thrust washer halves - upper
30. Bearing shell - main bearing - upper
31. Locating dowel - oil pump
32. Locating dowel - flywheel
33. Gudgeon pin
34. Crankshaft
35. Bearing shell - big end - lower
36. Bearing cap - big end
37. Nut - big end bearing cap
38. Locating dowel - main bearing cap
39. Bearing caps - main bearings
40. Bolt - main bearing cap
41. Thrust washer halves - lower
42. Bearing shell - main bearing - lower
43. Woodruff keys
44. Dipstick
45. Bolt - dipstick tube
46. Dipstick tube
47. Bolts - sump
48. Gasket - sump
49. 'O' ring
50. Oil strainer
51. Bolts - oil strainer
52. Sump
53. Washer - drain plug
54. Drain plug
55. Oil filter element
56. Crankshaft front oil seal
57. Bolts - oil pump
58. Gasket - oil pump
59. Oil pump
60. Oil pressure switch
61. Crankshaft spigot bush
62. Crankshaft spigot bearing
63. Locating dowel - coolant pump
64. Connecting rod
65. Bolts belt tensioner mounting plate
66. Belt tensioner mounting plate
67. Bolt - gearbox adapter plate



J5700

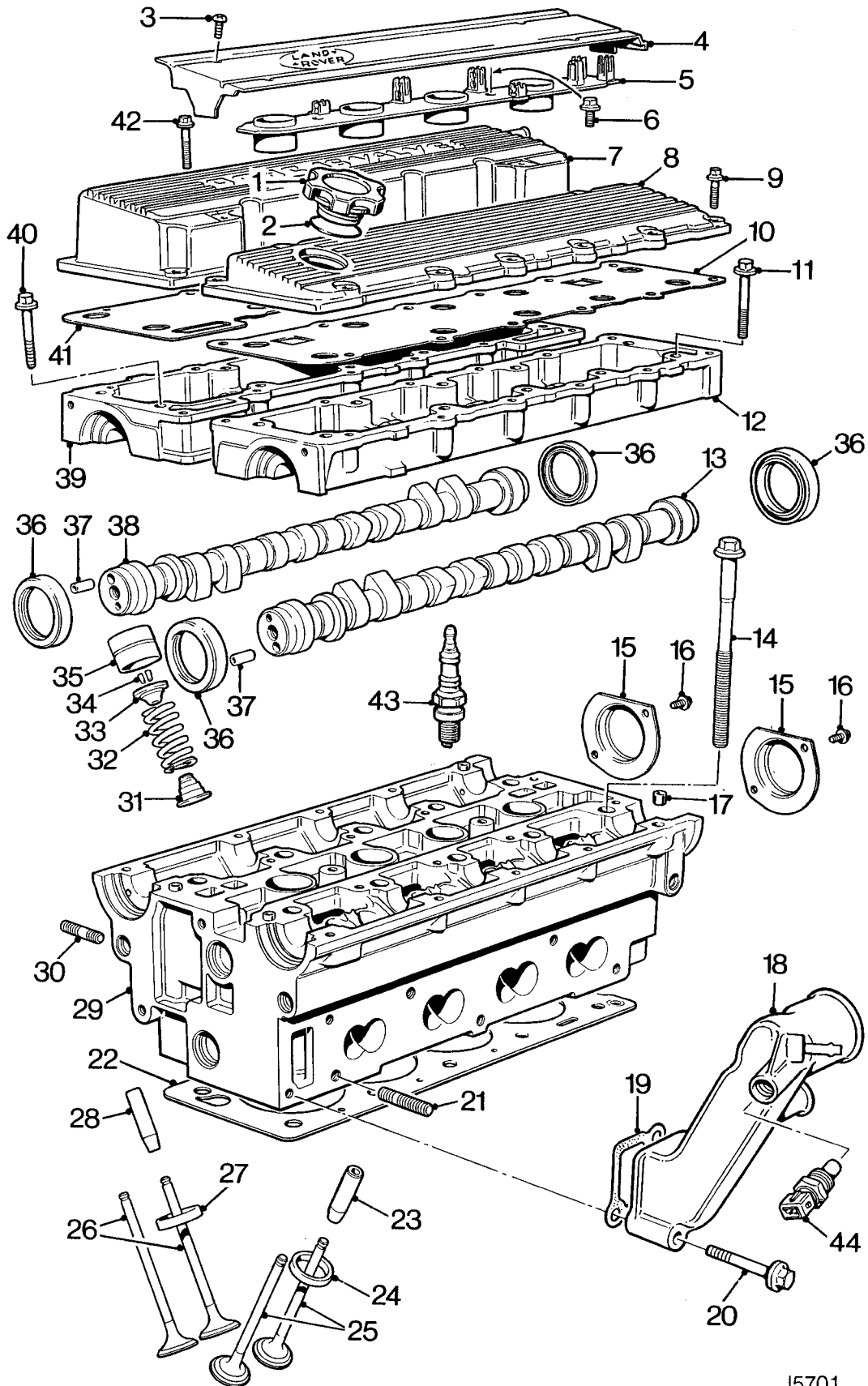
## CYLINDER HEAD COMPONENTS

1. Engine oil filler cap
2. Filler cap seal
3. Screw - spark plug cover
4. Spark plug cover
5. h.t. lead plate
6. Screw - h.t. lead plate
7. Inlet camshaft cover
8. Exhaust camshaft cover
9. Bolt - exhaust camshaft cover
10. Exhaust camshaft cover gasket/baffle plate
11. Bolt - exhaust camshaft carrier
12. Exhaust camshaft carrier
13. Exhaust camshaft
14. Cylinder head bolt
15. Blanking plate
16. Bolt - blanking plate
17. Locating dowel - camshaft carrier
18. Coolant outlet elbow
19. Gasket
20. Bolt - coolant outlet elbow
21. Stud - exhaust manifold
22. Cylinder head gasket
23. Guide - exhaust valve
24. Insert - exhaust valve seat
25. Exhaust valves
26. Inlet valves
27. Insert - inlet valve seat
28. Guide - inlet valve
29. Cylinder head
30. Stud - inlet manifold
31. Valve stem oil seal
32. Valve spring
33. Valve spring cap
34. Collets
35. Tappet
36. Camshaft oil seals
37. Drive pins - camshaft timing gears
38. Inlet camshaft
39. Inlet camshaft carrier
40. Bolt - inlet camshaft carrier
41. Inlet camshaft cover gasket/baffle plate
42. Bolt - inlet camshaft cover
43. Spark plug
44. Coolant temperature sensor



**NOTE:** Items 15,16 & 36 on current engines replaced by an oil plug. *See Repair, Inlet - Exhaust Camshaft Rear Oil Plug*

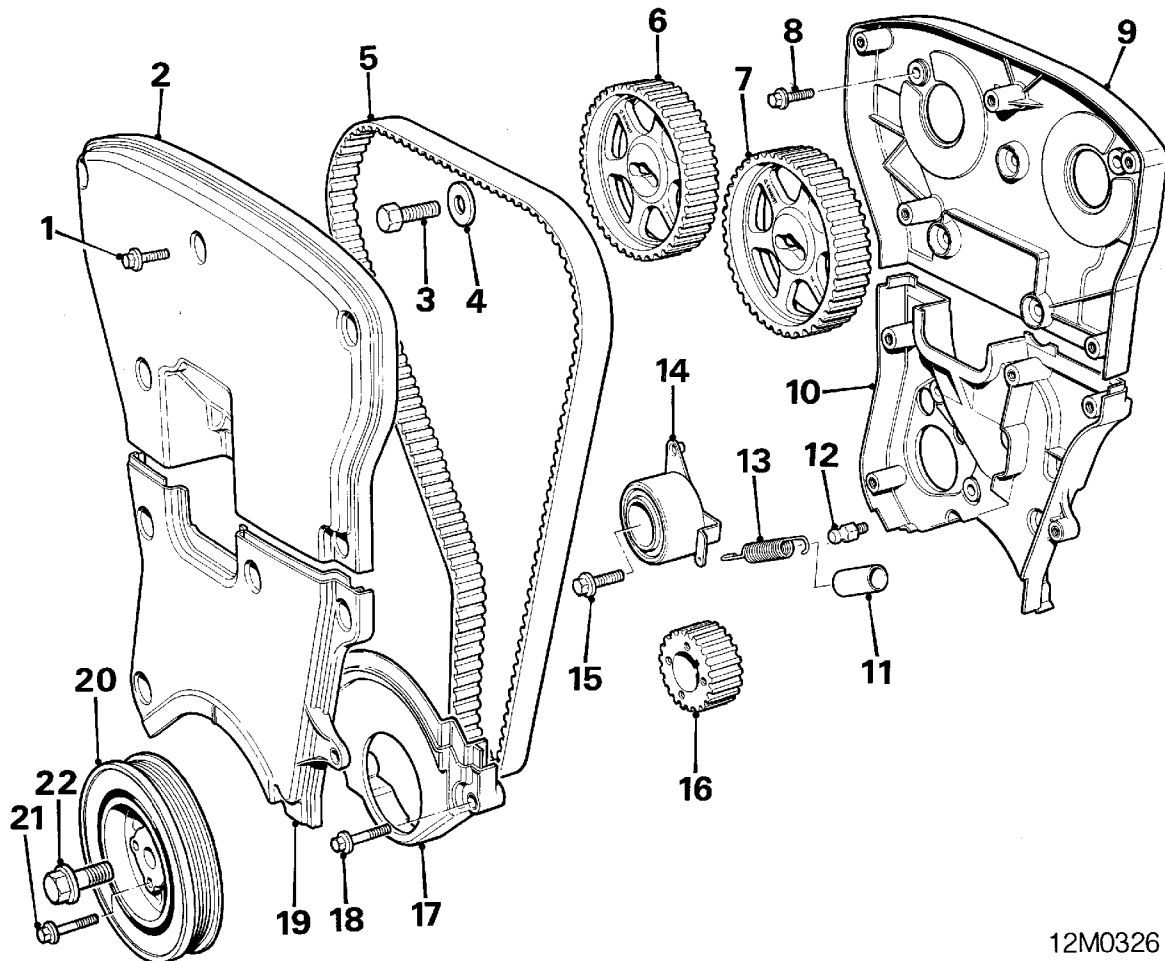




J5701

## TIMING BELT COMPONENTS

- |  |  |
|--|--|
| 1. Bolt - timing belt upper cover      | 13. Tensioner spring                   |
| 2. Timing belt upper cover             | 14. Tensioner pulley                   |
| 3. Bolt - camshaft timing gear         | 15. Tensioner clamp bolt               |
| 4. Plain washer                        | 16. Crankshaft timing gear             |
| 5. Timing belt                         | 17. Timing belt lower cover            |
| 6. Inlet camshaft timing gear          | 18. Bolt - timing belt lower cover     |
| 7. Exhaust camshaft timing gear        | 19. Timing belt centre cover           |
| 8. Bolt - upper timing cover backplate | 20. Crankshaft pulley                  |
| 9. Upper timing cover backplate        | 21. Crankshaft pulley/timing gear bolt |
| 10. Lower timing cover backplate       | 22. Crankshaft pulley bolt             |
| 11. Tensioner spring sleeve            |  |
| 12. Anchorage bolt                     |  |



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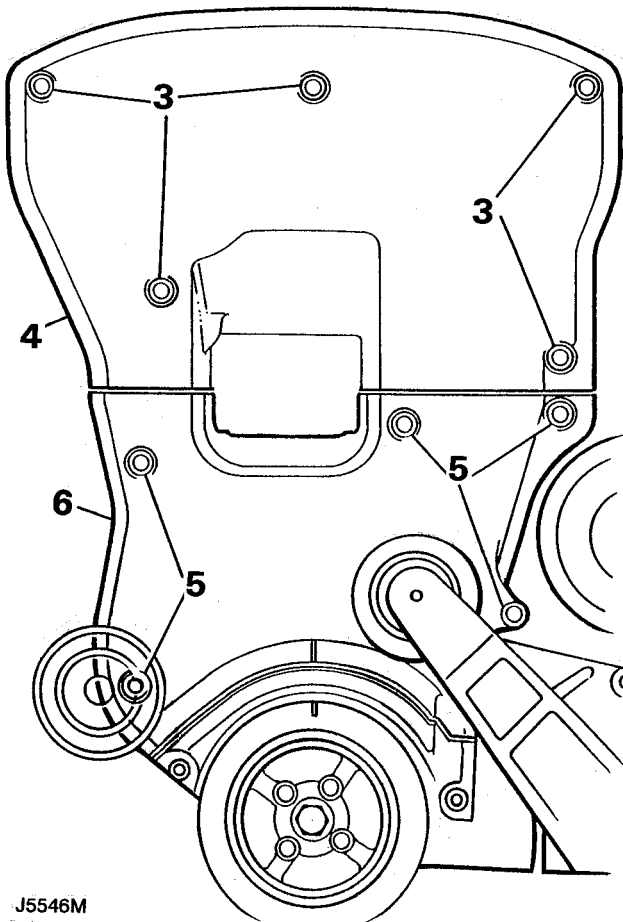
## CAMSHAFT FRONT OIL SEAL

Service repair no - 12.13.07 - Exhaust

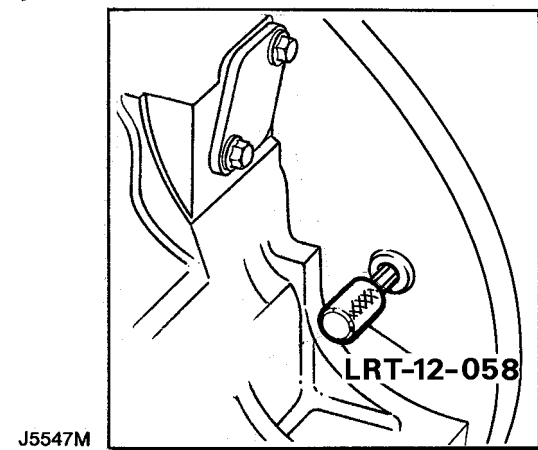
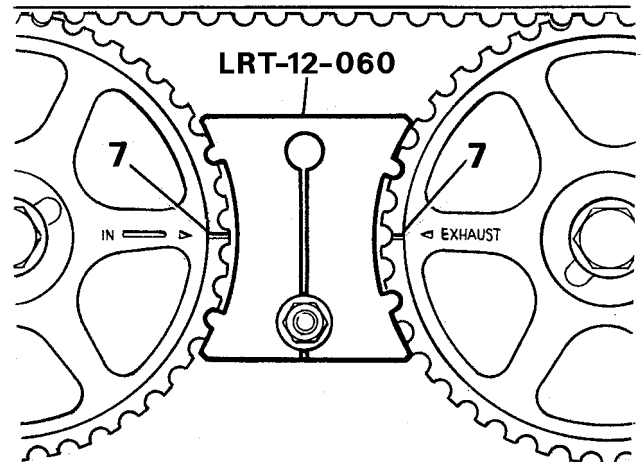
Service repair no - 12.13.09 - Inlet

### Remove

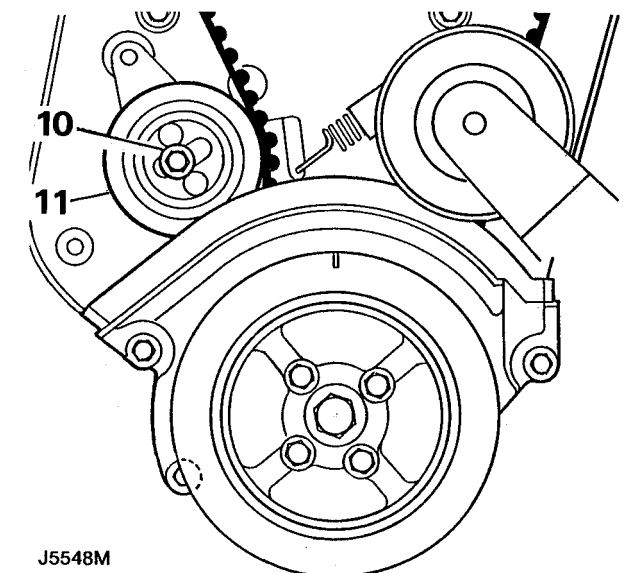
1. Disconnect battery negative lead.
2. Remove drive belt. **See SECTION 10, Maintenance, Under Bonnet [Hood] Maintenance**
3. Remove 5 bolts, timing belt upper cover.
4. Remove timing belt upper cover.
5. Remove 5 bolts, timing belt centre cover.
6. Remove timing belt centre cover.



7. Rotate crankshaft to align camshaft gear timing marks - 90°B.T.D.C.
8. Fit tool LRT-12-058 to lock flywheel.
9. Fit tool LRT-12-060 to lock camshaft gears.



10. Loosen camshaft belt tensioner bolt.
11. Move tensioner away from belt and tighten tensioner bolt.
12. Remove belt from camshaft gears.



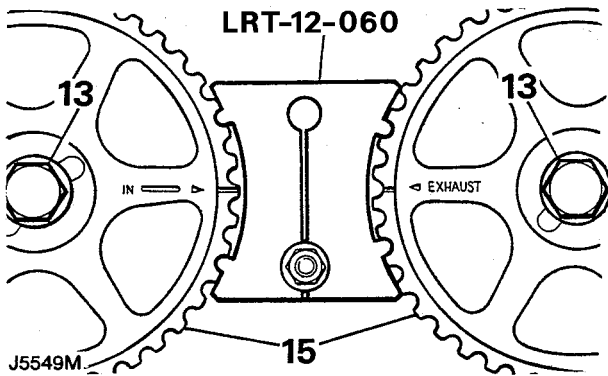
# 12 ENGINE

- 13. Remove 2 bolts securing camshaft gears to camshafts.
- 14. Remove tool LRT-12-060.

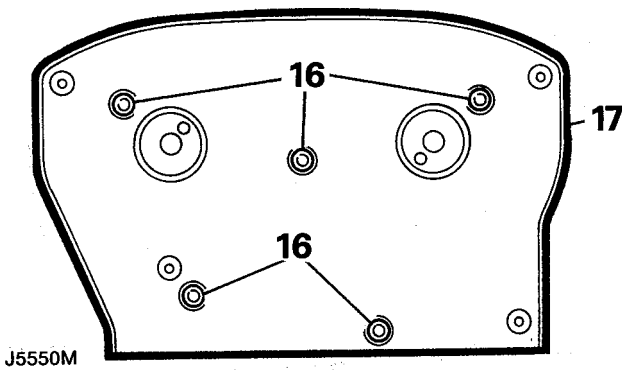
**CAUTION: Do not rotate camshafts.**



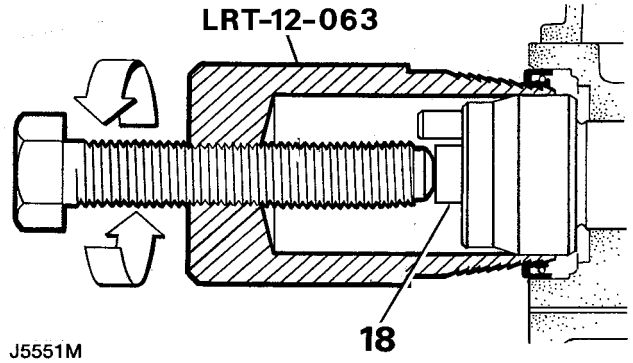
- 15. Remove gears noting the 'IN' and 'EXHAUST' identifying marks.



- 16. Remove 5 bolts securing timing belt upper backplate.
- 17. Remove belt upper backplate.



- 18. Remove seals using tool LRT-12-063 fit thrustpad as shown.

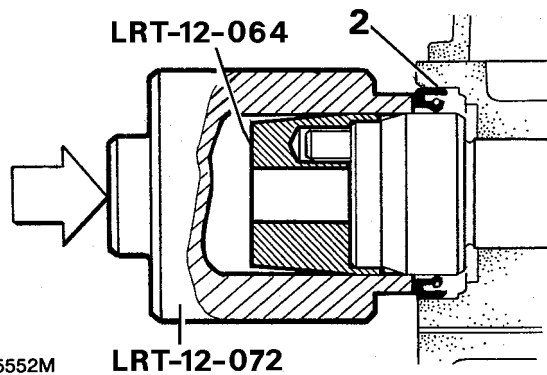


## Refit

- 1. Clean sealing area of cylinder head and camshaft, ensure all traces of rubber are removed - do not scrape.
- 2. Using tool LRT-12-064 and LRT-12-072 fit new camshaft oil seals.



**CAUTION: Ensure sealing lip of seal is not distorted.**



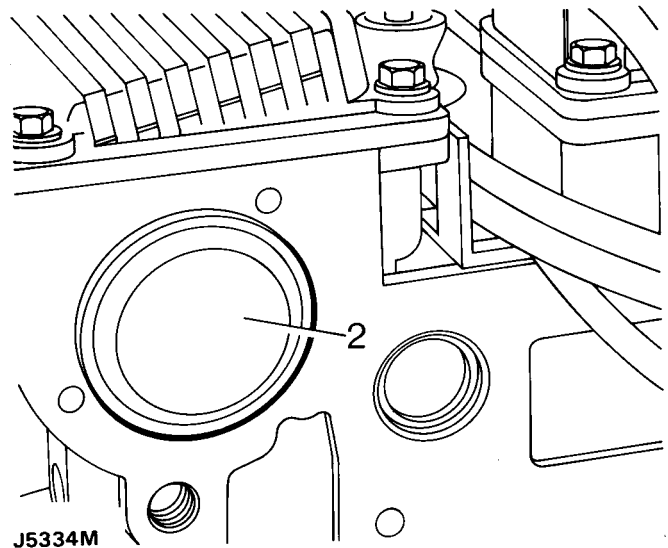
For torque values. **See Specifications, torque, Torque Values**

3. Fit timing belt upper backplate and tighten bolts to the correct torque.
4. Fit camshaft gears noting the 'IN' and 'EXHAUST' identifying marks.
5. Fit, but do not tighten, camshaft gear centre bolts.
6. Ensure timing marks are aligned.
7. Fit camshaft locking tool LRT-12-060.
8. Tighten camshaft gear bolts to the correct torque.
9. Fit timing belt. **See Camshaft Drive Belt**
10. Adjust timing belt tension.
11. Remove tool LRT-12-058 from flywheel.
12. Fit timing belt centre cover and tighten bolts to correct torque.
13. Fit timing belt upper cover and tighten bolts to correct torque.
14. Fit drive belt. **See SECTION 10, Maintenance, Under Bonnet [Hood] Maintenance**
15. Reconnect battery negative lead.

## INLET - EXHAUST CAMSHAFT REAR OIL PLUG

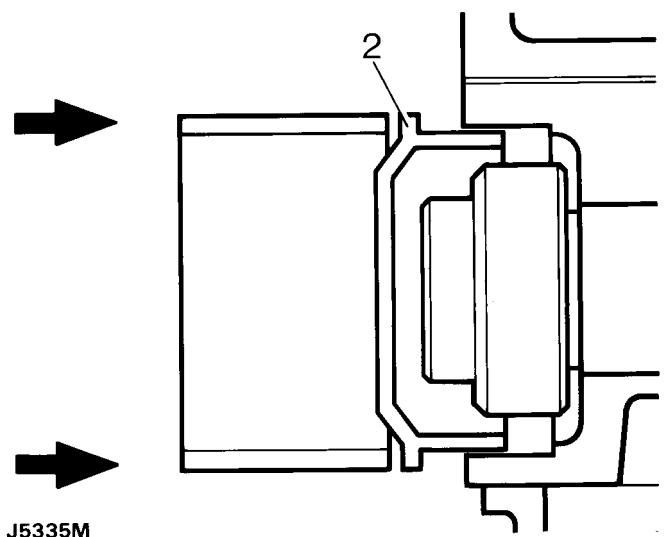
### Remove

1. Remove cylinder head.
2. Lever out, camshaft rear oil seal plug.



### Refit

1. Clean plug housing.
2. Fit new plug applying force to outer edge only.



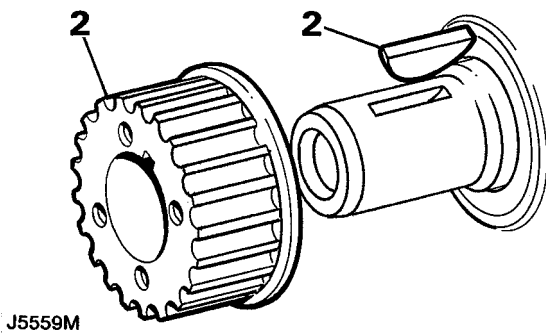
3. Refit cylinder head.

## CRANKSHAFT FRONT OIL SEAL

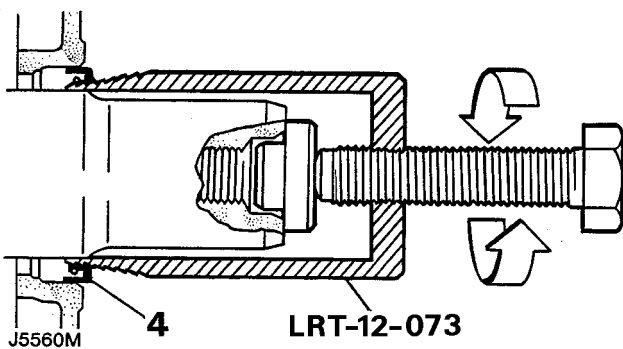
Service repair no - 12.21.14

### Remove

1. Remove timing belt. **See Camshaft Drive Belt**
2. Slide timing gear off crankshaft and remove drive key.

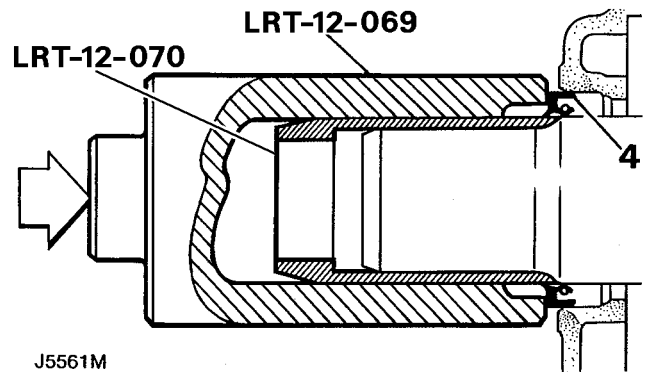


3. Ensure bore of tool is burr free, fit and tighten tool LRT-12-073 into crankshaft front oil seal.
4. Using thrustpad, tighten centre screw of tool to remove oil seal.
5. Remove thrust button from crankshaft.



### Refit

1. Use lint free cloth and thoroughly clean seal recess and running surface on crankshaft. Clean crankshaft gear and pulley.
2. Lubricate oil seal sealing surfaces with engine oil.
3. Fit tool LRT-12-070 onto crankshaft.
4. Position new oil seal on crankshaft, drift into place using LRT-12-069 and remove protector.



5. Fit drive key to crankshaft and slide timing gear onto crankshaft.
6. Fit and tension timing belt. **See Camshaft Drive Belt**

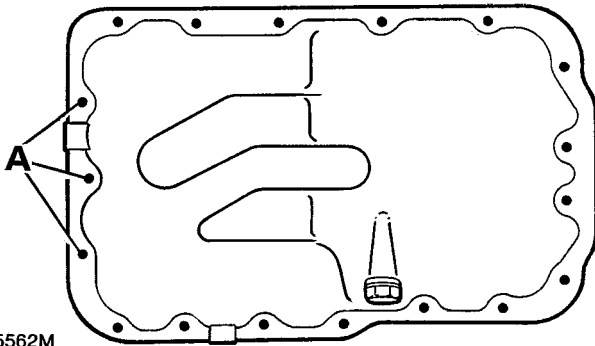


## CRANKSHAFT REAR OIL SEAL

Service repair no - 12.21.20

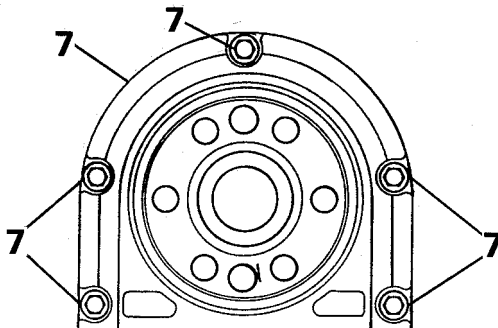
### Remove

1. Remove gearbox.
2. Remove clutch assembly.
3. Remove flywheel.
4. Drain engine oil.
5. Fit sump plug, replacing sealing washer if damaged and tighten to the correct torque.
6. Loosen 15 sump bolts by approximately 3 turns, allowing sump to drop away from rear oil seal housing. Do not loosen 3 bolts **A** around oil pump housing.



J5562M

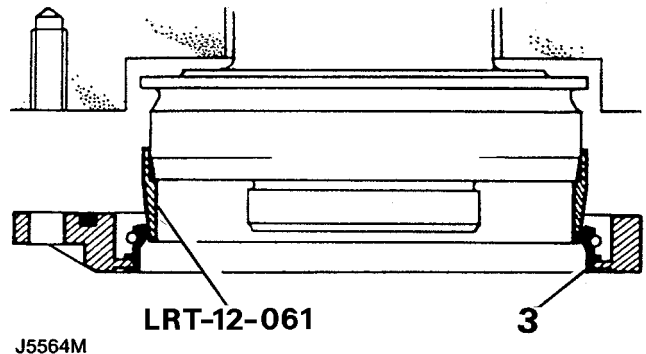
7. Remove bolts securing oil seal housing, remove seal and housing assembly.



J5563M

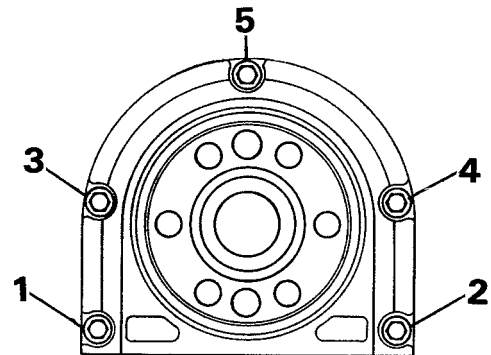
### Refit

1. Clean seal seating area of block and accessible area of sump gasket. Sump gasket must be replaced if damaged.
2. Lubricate oil seal sealing surfaces with engine oil.
3. Fit tool LRT-12-061 over crankshaft boss and fit oil seal and housing assembly.
4. Remove tool.



J5564M

5. Fit and tighten seal housing bolts to correct torque in sequence shown. **10Nm**



J5565M

6. Tighten sump bolts to correct torque and in the correct sequence. **See Engine Sump Gasket**
7. Fit flywheel.
8. Fit clutch assembly.
9. Fit gearbox.

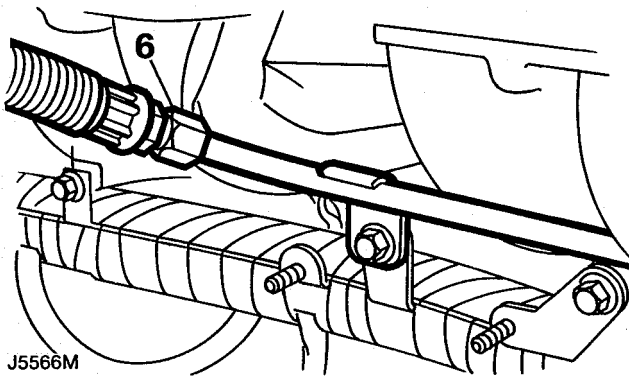
## ENGINE

Service repair no - 12.41.01

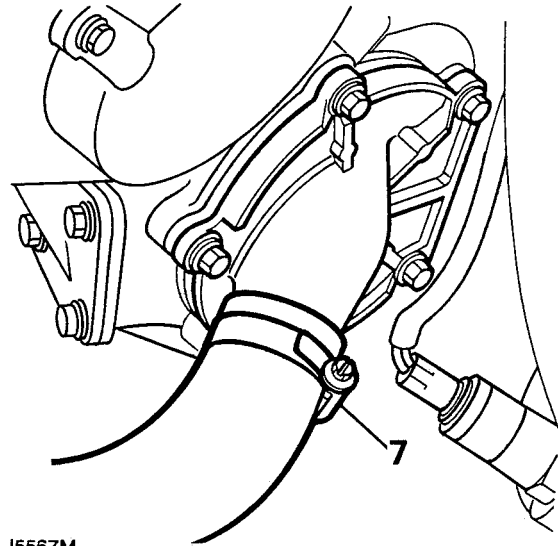
### Remove

1. Site vehicle onto ramp [hoist].
2. Remove the drive belt. **See SECTION 10, Maintenance, Under Bonnet [Hood] Maintenance**
3. Remove radiator. **See COOLING SYSTEM, Repair, Radiator - Mpi**
4. Remove bonnet [hood]. **See CHASSIS AND BODY, Repair, Bonnet [Hood]**
5. Drain engine oil.
6. Position absorbent cloth around fuel pipe to fuel rail union.  
Unscrew union to relieve pressure.

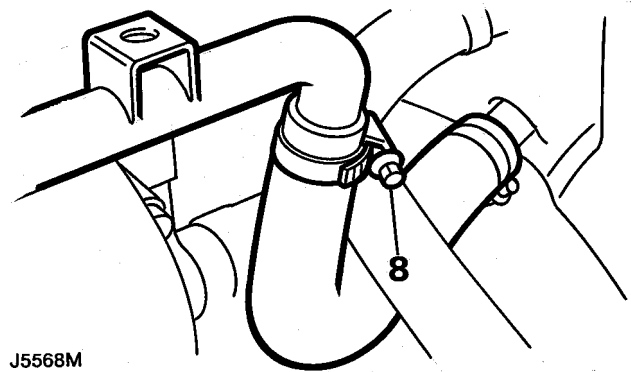
**CAUTION: Plug the connections**



7. Release clip and disconnect hose from coolant pump.



8. Release clip and disconnect hose from heater rail.

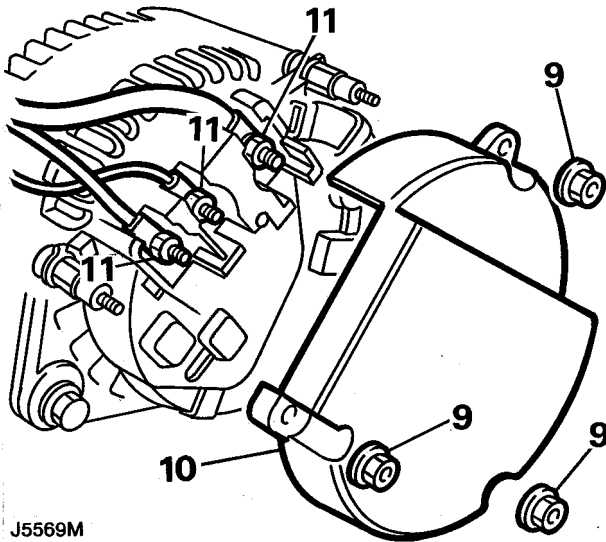




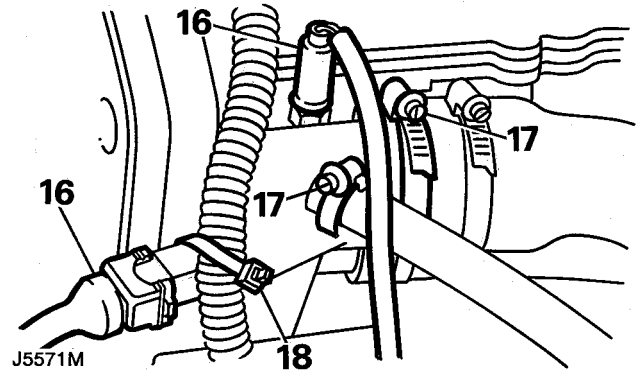


**NOTE: On current models the generator cover is omitted.**

9. Remove 3 nuts securing generator rear cover.
10. Remove rear cover.
11. Remove 3 nuts securing harness to generator.
12. Remove harness.

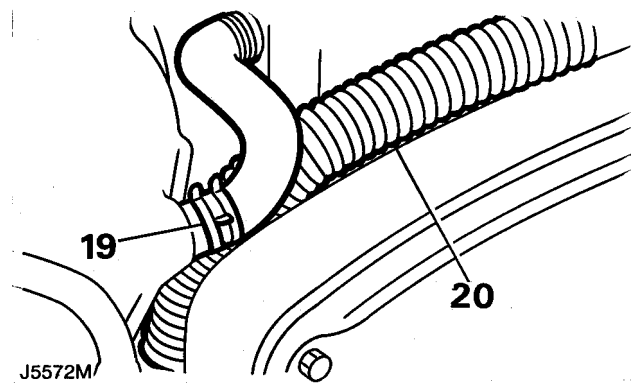
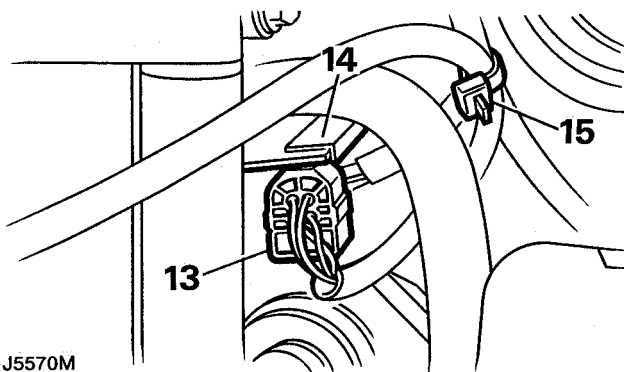


16. Disconnect 2 coolant temperature sensor multiplugs.
17. Release clips and disconnect the bypass and top hose.
18. Release harness lead from cable tie.



19. Release clip and disconnect breather hose from inlet manifold.
20. Feed harness between inlet manifold and cam cover.

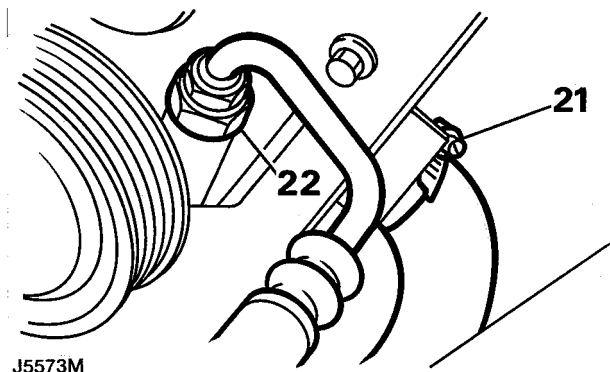
13. Disconnect oxygen sensor multiplug.
14. Release multiplug from bracket.
15. Release harness from cable tie.



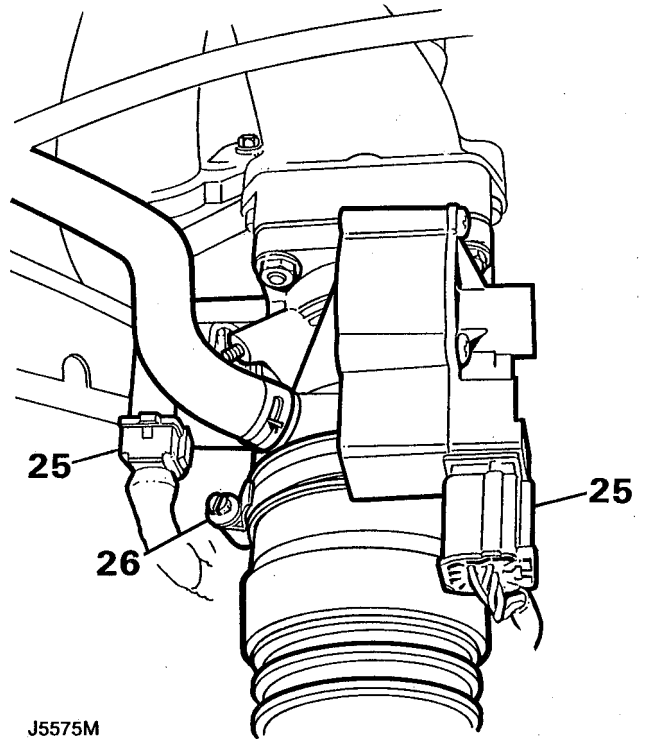
# 12 ENGINE

21. Release clip and disconnect inlet hose from power steering pump.
22. Disconnect outlet pipe union at power steering pump, discard 'O' ring.

**CAUTION: Plug the connections**

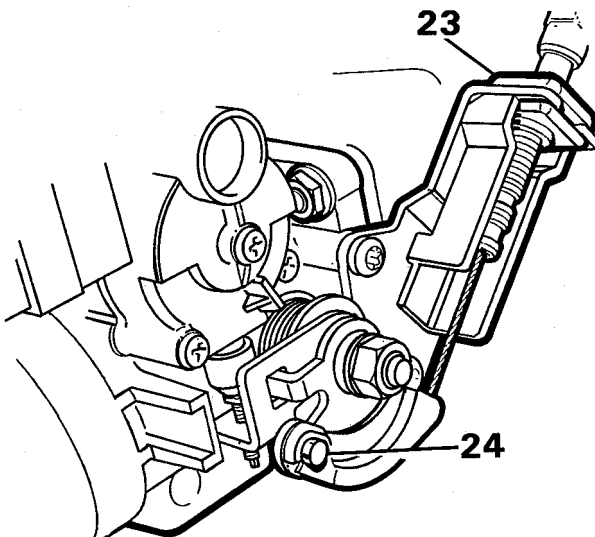


J5573M



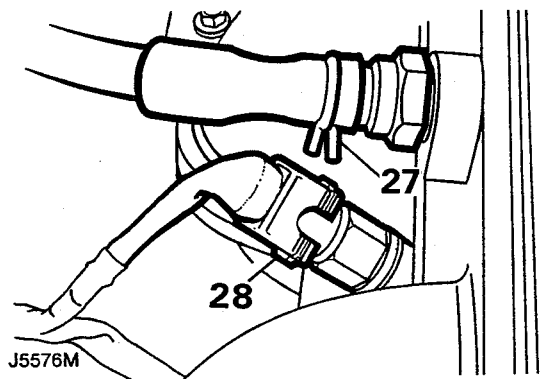
J5575M

23. Release throttle cable from abutment bracket.
24. Release throttle cable from cam. Also remove coolant bypass hose from throttle housing.



J5574M

27. Release clip and disconnect brake servo hose from manifold.
28. Disconnect fuel temperature sensor multiplug.

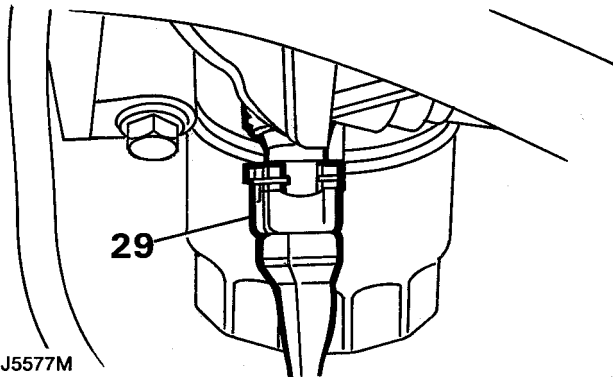


J5576M

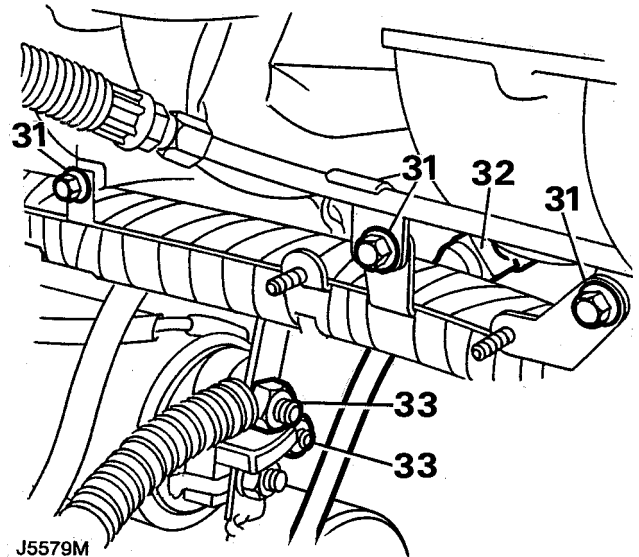
25. Disconnect stepper motor and throttle potentiometer multiplugs.
26. Release clip and disconnect hose, air cleaner to throttle housing.



29. Disconnect oil pressure switch multiplug.

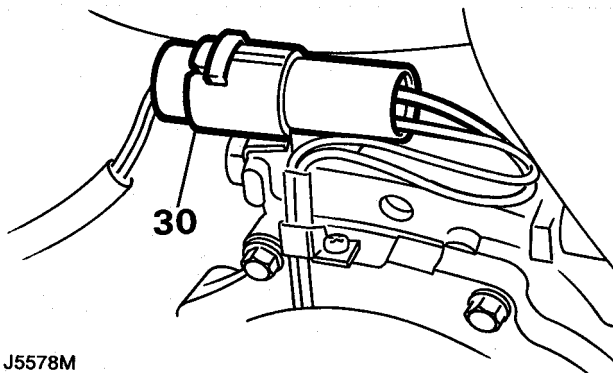


J5577M



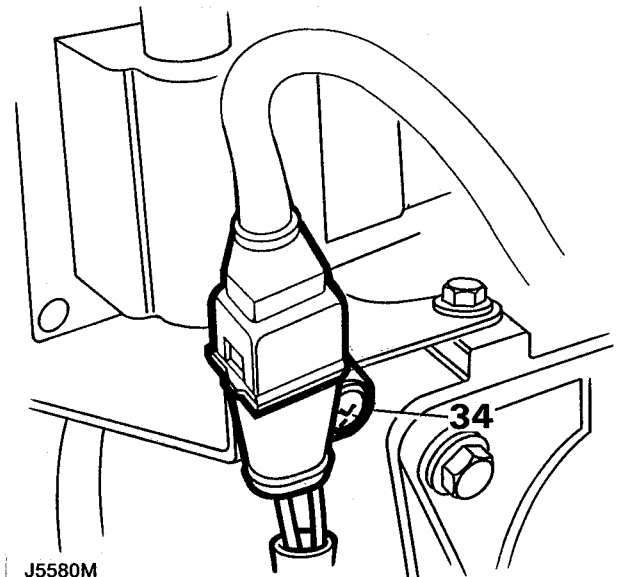
J5579M

30. Disconnect air conditioning compressor multiplug.



J5578M

34. Disconnect crankshaft sensor multiplug.



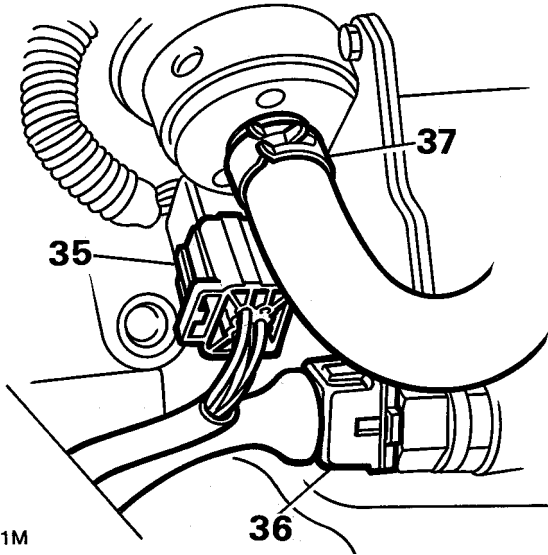
J5580M

31. Remove 3 bolts securing engine harness to manifold and fuel pipe.  
 32. Disconnect knock sensor multiplug.  
 33. Remove 2 nuts securing harness to starter motor solenoid, remove harness.

35. Disconnect fuel injection harness multiplug.  
 36. Disconnect inlet manifold air temperature sensor multiplug.  
 37. Release clip and disconnect fuel hose from pressure regulator.

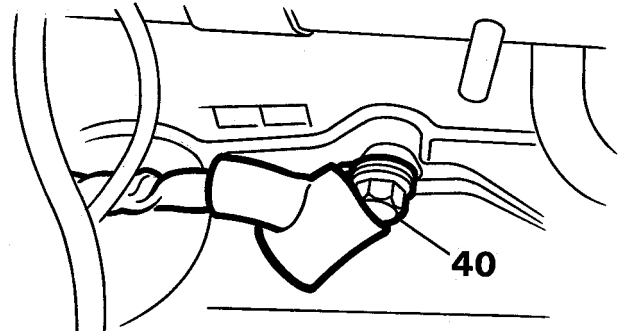


**CAUTION: Plug the connections.**



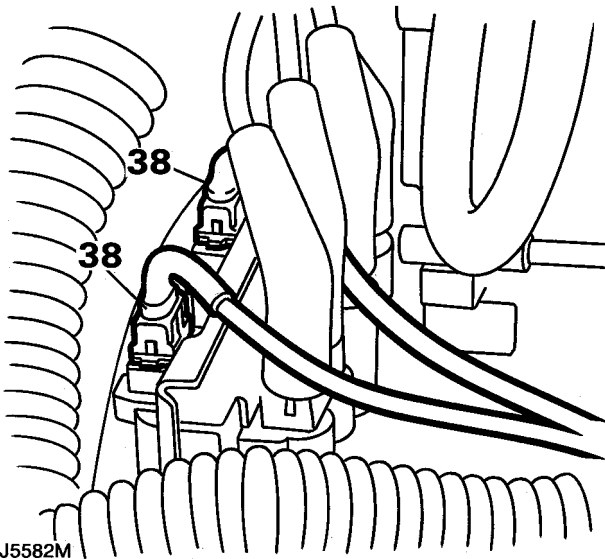
J5581M

- 40. Release cover and remove bolt securing earth lead to cylinder block.
- 41. Move earth lead aside.



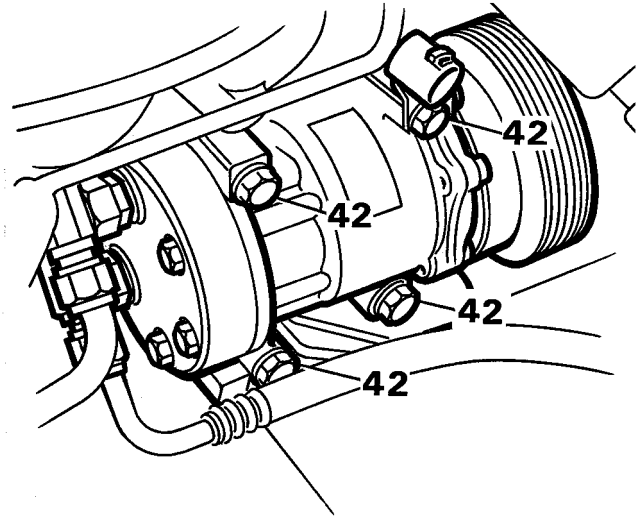
J5584M

- 38. Disconnect 2 ignition coil multiplugs.



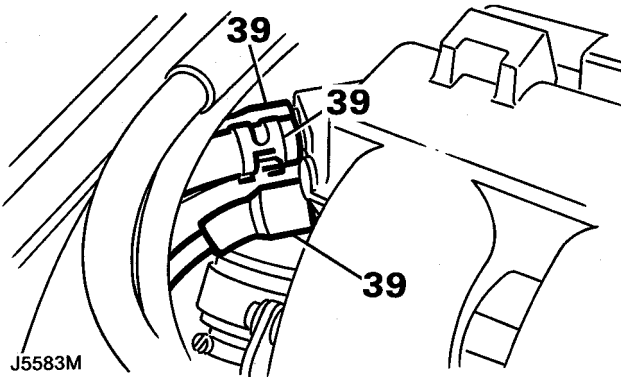
J5582M

- 42. Remove 4 bolts securing air conditioning compressor, move compressor aside.



J5585M

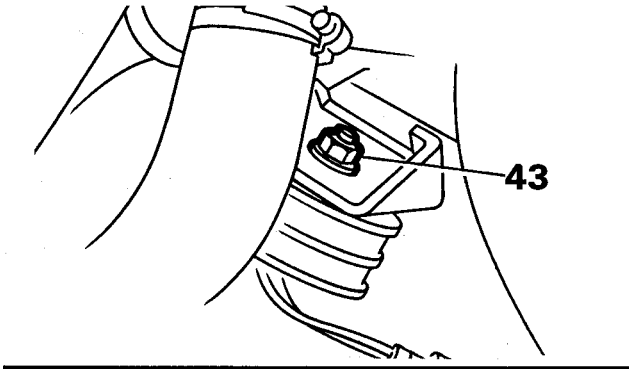
- 39. Disconnect 3 vacuum hoses from manifold.



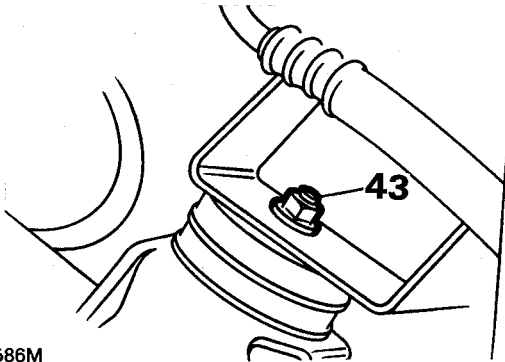
J5583M



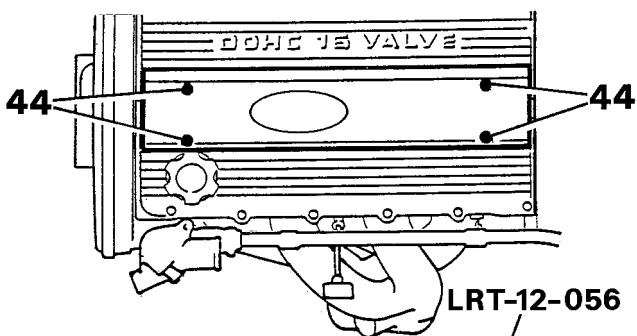
43. Remove engine mounting heat shield. Remove upper nuts from engine L.H. and R.H. mountings.



J5586M



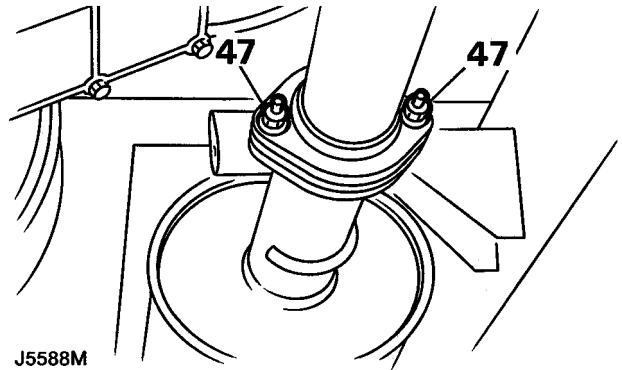
44. Release 4 screws and remove spark plug cover.  
45. Fit tool LRT-12-056, support engine using suitable hoist.



J5587M

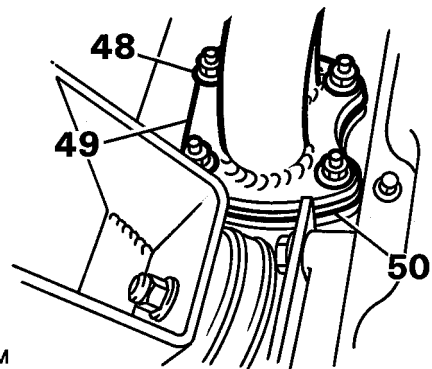


46. Raise vehicle.  
47. Loosen 2 nuts securing downpipe to silencer.



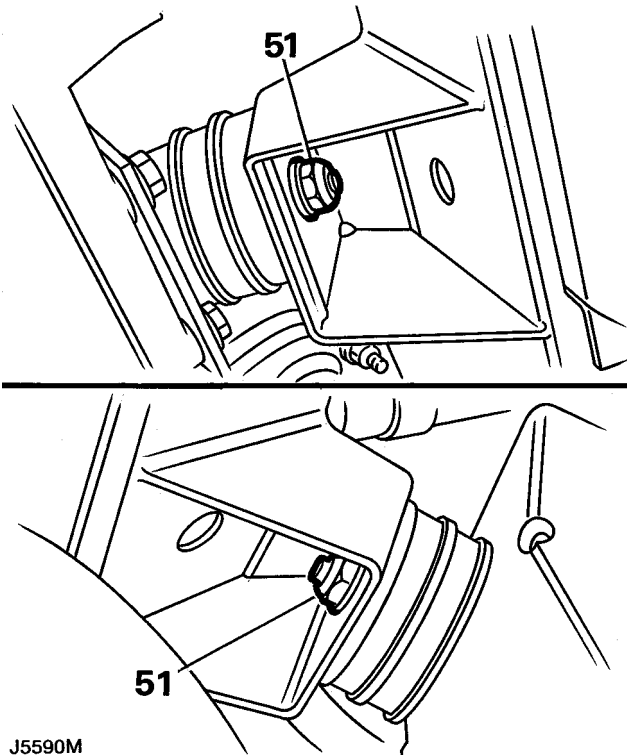
J5588M

48. Remove 4 nuts securing downpipe to exhaust manifold.  
49. Release downpipe from exhaust manifold.  
50. Collect gasket.

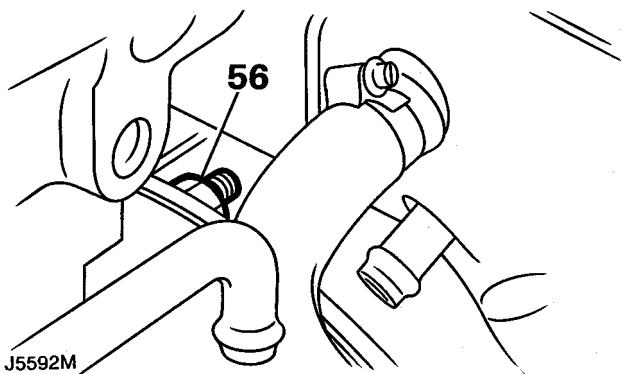


J5589M

51. Remove engine L.H. and R.H. mounting lower nuts.

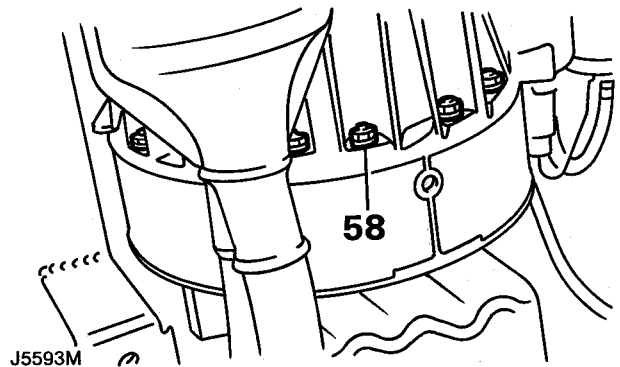


52. Lower vehicle.  
 53. Raise engine.  
 54. Remove engine mountings.  
 55. Lower engine.  
 56. Remove bell housing top nut.



57. Raise engine and support gearbox.

58. Remove 12 remaining bell housing nuts.



59. Remove engine.

### Refit



**NOTE: For torque values. See Specifications, torque, Torque Values**

1. Using assistance, lower engine into position.
2. Fit bell housing nuts, tighten to the correct torque.
3. Remove gearbox support.
4. Lower engine.
5. Fit bell housing top nut, tighten to the correct torque.
6. Raise engine.
7. Position engine mountings, partially tighten nuts.
8. Lower engine.
9. Remove hoist and chains.
10. Tighten L.H. and R.H. mounting nuts to the correct torque. Fit engine mounting heatshield.
11. Fit new gasket to exhaust downpipe.
12. Fit exhaust manifold to downpipe nuts and tighten to the correct torque.
13. Tighten exhaust downpipe to silencer box nuts to the correct torque.
14. Position air conditioning compressor and secure with bolts. Tighten to the correct torque.
15. Connect coil multiplugs.
16. Connect harness to starter solenoid and secure with nuts.
17. Connect earth lead to cylinder block and secure with nut.
18. Position engine harness to manifold, secure with bolts.



19. Connect crankshaft sensor, knock sensor, air conditioning compressor, fuel injector harness, inlet manifold air temperature and fuel temperature sensor multiplugs.
20. Connect fuel hose to pressure regulator and secure with clip.
21. Fit and tighten fuel pipe to fuel rail union.
22. Connect multiplugs to throttle housing.
23. Connect vacuum hose to manifold.
24. Connect oil pressure switch multiplug.
25. Connect brake servo hose to manifold, secure with clip.
26. Connect throttle cable to cam.
27. Position engine harness and connect breather hose to inlet manifold, secure with clip.
28. Connect coolant temperature sensor multiplugs, secure harness with cable tie.
29. Connect oxygen sensor multiplug, secure harness with cable tie.
30. Connect alternator harness.
31. Connect heater hose to heater rail and secure with clip.
32. Connect hose to coolant pump and secure with clip.
33. Connect inlet hose to power steering pump and secure with clip.
34. Fit and tighten outlet pipe union to power steering pump.
35. Connect bypass and top hose, secure with clip.
36. Connect air cleaner to throttle housing hose and secure with clip.
37. Remove engine lifting bracket.
38. Position spark plug cover and secure with screws.
39. Fill engine with oil.
40. Fit bonnet [hood]. **See CHASSIS AND BODY, Repair, Bonnet [Hood]**
41. Fit radiator. **See COOLING SYSTEM, Repair, Radiator - Mpi**
42. Adjust throttle cable. **See FUEL SYSTEM, Adjustment, Throttle Cable Adjustment**

## ENGINE SUMP GASKET

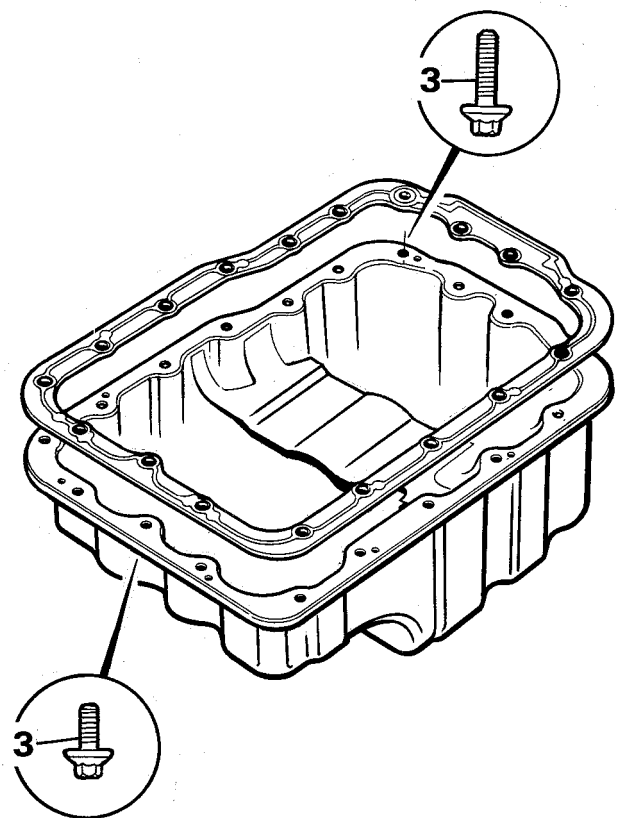
Service repair no - 12.60.43

### Remove

1. Drain engine oil.
2. Refit drain plug, use new sealing washer if necessary, tighten to the correct torque.
3. Remove 18 bolts securing sump.



**NOTE: 25mm long bolt is fitted at rear L.H. corner of sump.**

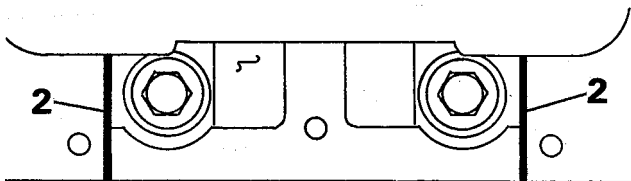


J5594M

4. Release sump from cylinder block.
5. Discard gasket.

## Refit

1. Clean sump, remove all traces of gasket from mating faces of sump and cylinder block. Visually check sump for damage.
2. Apply beads of RTV sealant to front main bearing cap.

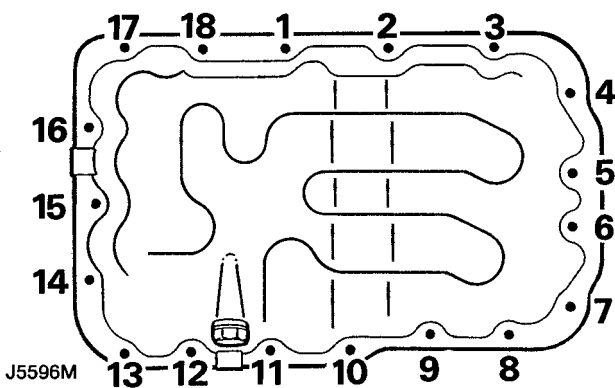


J5595M

3. Position new gasket to sump, ensuring that location pips on gasket are located in sump. Check gasket lays flat on sump flange.
4. Fit sump. Fit bolts, ensuring that longest bolt is inserted at position 7.
5. Working around the sump in the sequence illustrated, tighten the bolts to the stage 1 torque figure. Then, in the same sequence, tighten the bolts to the stage 2 torque figure.



**NOTE:** For torque values. See *Specifications, torque, Torque Values*



J5596M

6. Fill engine with oil.

## CYLINDER HEAD GASKET

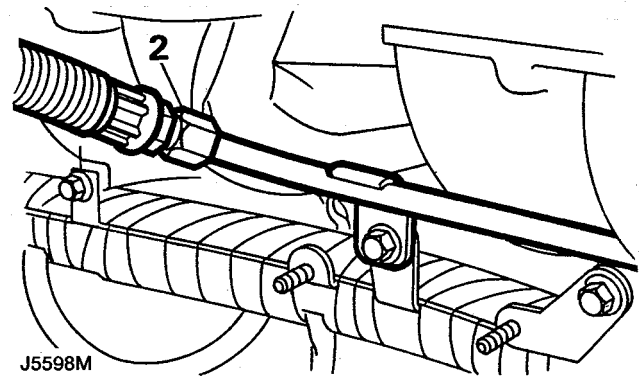
Service repair no - 12.29.01

## Remove

1. Disconnect battery negative lead.
2. Position absorbent cloth around fuel pipe to fuel rail union. Unscrew union to relieve pressure.



**CAUTION:** Plug the connections.

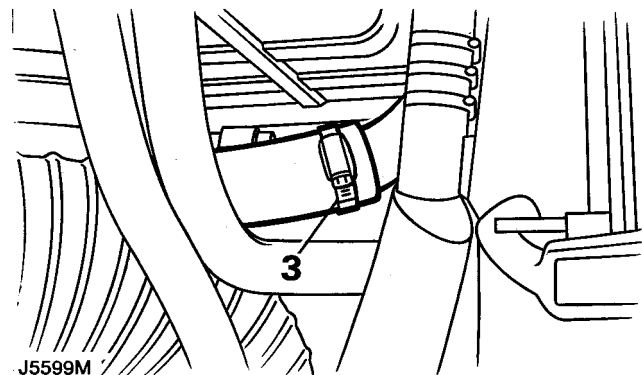


J5598M



**WARNING:** Do not carry out the next instruction until the coolant is cool to avoid personal injury from scalding.

3. Release clip and disconnect radiator bottom hose, allowing coolant to drain into a suitable container.

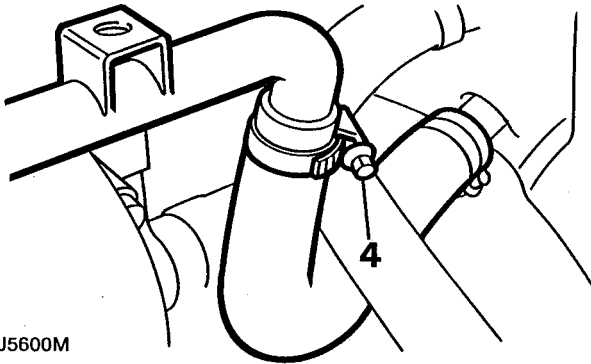


J5599M



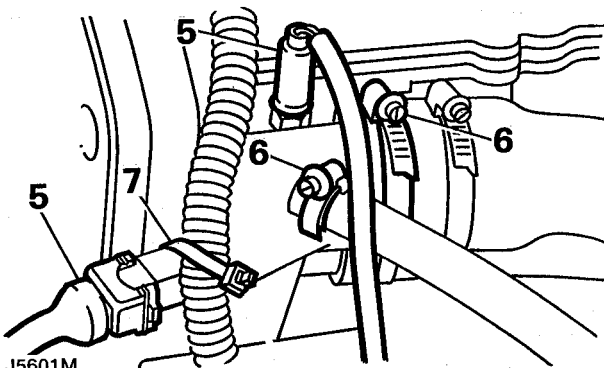


4. Release clip and disconnect hose from heater rail.



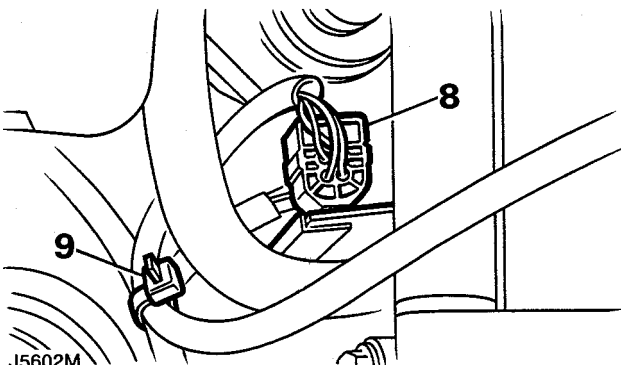
J5600M

5. Disconnect 2 coolant temperature sensor multiplugs.
6. Release clips and disconnect the bypass hose and top hose.
7. Release harness from cable tie.



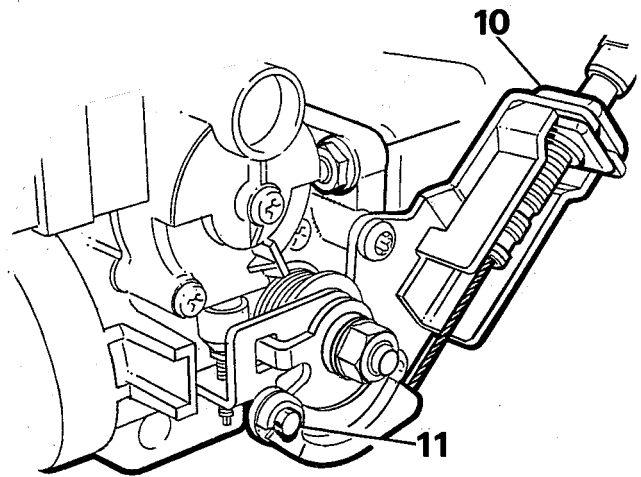
J5601M

8. Disconnect oxygen sensor multiplug.
9. Release harness lead from cable tie.



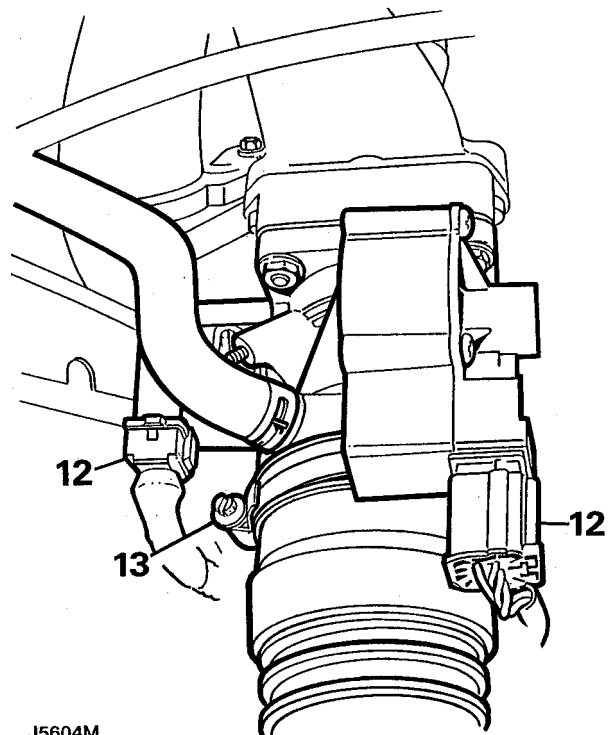
J5602M

10. Release throttle cable from abutment bracket.
11. Release throttle cable from cam. Also remove coolant bypass hose from throttle housing.



J5603M

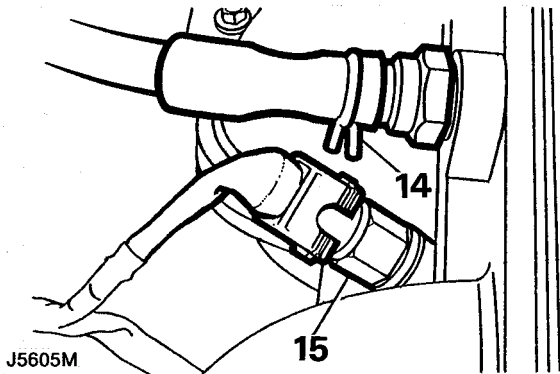
12. Disconnect stepper motor and throttle potentiometer multiplugs.
13. Release clip and disconnect hose, air cleaner to throttle housing.



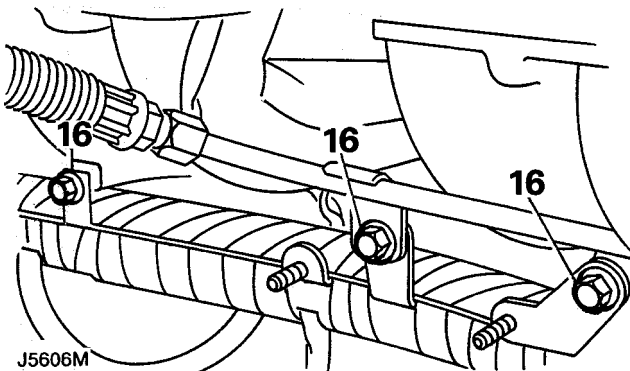
J5604M

# 12 ENGINE

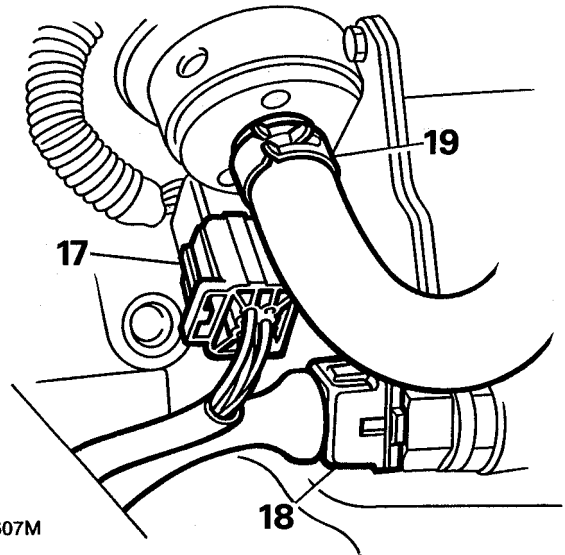
- 14. Release clip and disconnect brake servo hose from manifold.
- 15. Disconnect fuel temperature sensor multiplug.



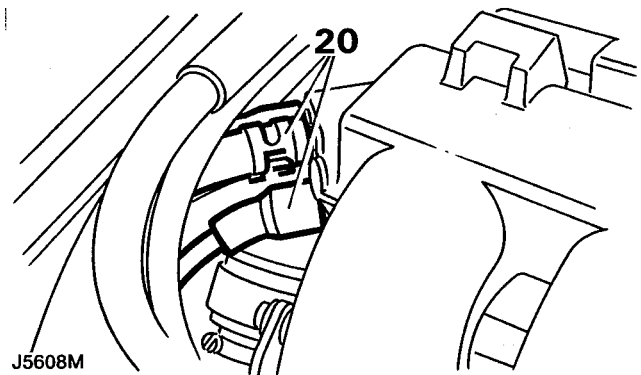
- 16. Remove 3 bolts securing engine harness to manifold.



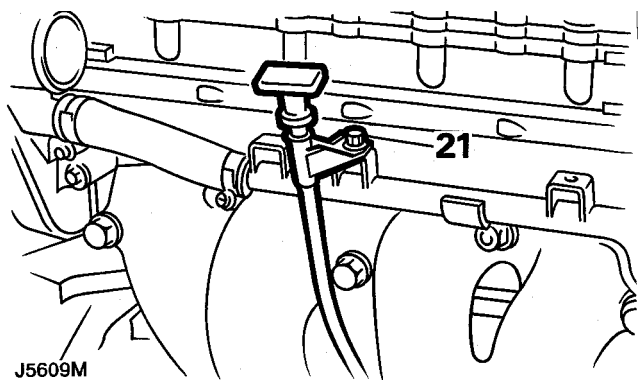
- 17. Disconnect fuel injection harness multiplug.
- 18. Disconnect inlet manifold air temperature sensor multiplug.
- 19. Release clip and disconnect fuel hose from pressure regulator.



- 20. Release clips and disconnect 3 hoses from manifold.



- 21. Remove bolt securing dipstick tube to coolant rail.

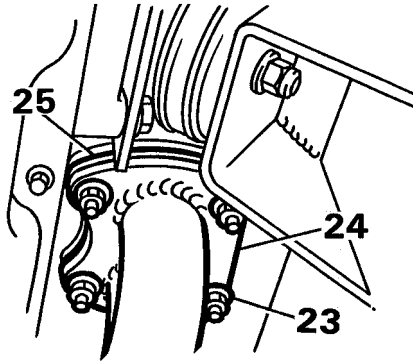


**CAUTION: Plug the connections**



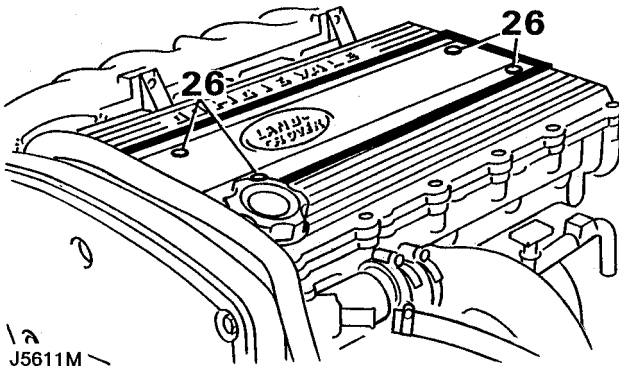


22. Raise vehicle
23. Remove 4 nuts securing downpipe to exhaust manifold.
24. Release downpipe from exhaust manifold.
25. Collect gasket.



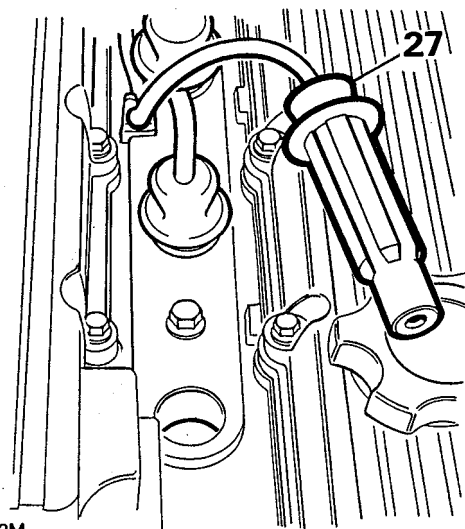
J5610M

26. Release 4 screws and remove spark plug cover.



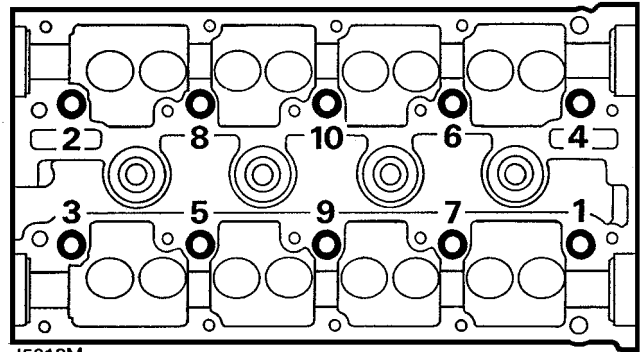
J5611M

27. Release spark plug leads from spark plugs and release from clips. Place aside.



J5612M

28. Remove camshaft covers.
29. Remove timing belt. **See Camshaft Front Oil Seal**
30. Progressively loosen and remove 10 cylinder head bolts in sequence shown.

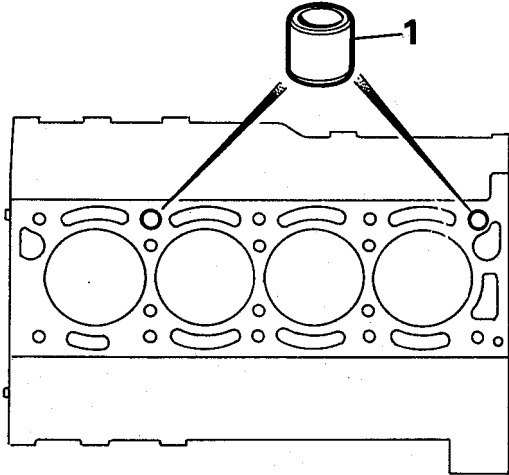


J5613M

31. Remove cylinder head complete with manifold, place on blocks to prevent damage.
32. Remove and discard cylinder head gasket.
33. Remove location dowels from cylinder block.
34. Inspect cylinder head for damage, cracks and burning.
35. Inspect cylinder block. Ensure that the oil restrictor is clear and fitted below the block face.
36. Clean all traces of gasket material from head and block mating faces, using release agent and plastic scraper.
37. Check cylinder head and block faces for warpage:  
 Longitudinal warp = 0.1 mm max.  
 Transverse warp = 0.1 mm max.  
 Diagonal warp = 0.1 mm max.
38. Decarbonize cylinder head and pistons if necessary.
39. Clean cylinder head bolt threads with a wire brush, check for damage, replace if necessary.
40. Check cylinder block threads by running bolts into threads using fingers only. Clean any tight threads using M11 x 1.5 mm tap. Remove all traces of oil from bolt holes.

## Refit

1. Fit location dowels to cylinder head.

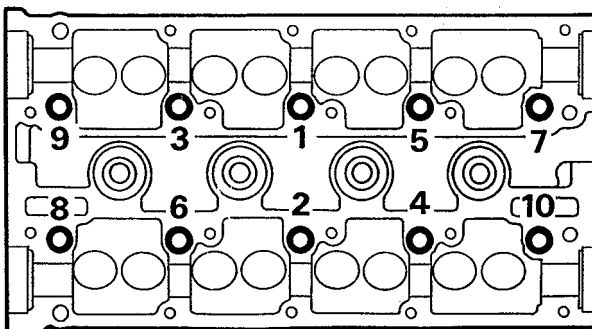


J5614M

2. Fit cylinder head gasket to cylinder block.
3. Using assistance fit cylinder head to cylinder block.
4. Lubricate cylinder head bolts.
5. Fit and tighten cylinder head bolts to the correct torque and in the correct sequence.



**NOTE:** For torque values. See *Specifications, torque, Torque values*



J5615M

6. Fit timing belt.
7. Fit camshaft covers.
8. Fit spark plug leads to spark plugs and secure to clips.
9. Fit spark plug cover and secure with screws.
10. Fit new gasket and secure downpipe to exhaust manifold with nuts.
11. Fit bolt securing dipstick tube to coolant rail.
12. Connect 3 vacuum hoses to inlet manifold.
13. Connect fuel to pressure regulator, secure with clip.
14. Connect fuel injection harness, inlet manifold air temperature sensor and fuel temperature sensor multiplugs.
15. Secure engine harness to manifold with bolts.
16. Connect brake servo hose to manifold, secure with clip.
17. Connect air cleaner hose to throttle housing, secure with clip.
18. Connect stepper motor and throttle potentiometer multiplugs.
19. Fit and adjust throttle cable.
20. Connect oxygen sensor multiplug, secure with cable tie.
21. Connect the bypass and top hose, secure with clips.
22. Connect coolant temperature sensor multiplugs, secure with cable tie.
23. Connect hose to heater rail and secure with clip.
24. Connect radiator bottom hose and secure with clip.
25. Tighten fuel pipe to fuel rail union.
26. Reconnect battery negative lead.



## CAMSHAFT COVER GASKET

Service repair no - 12.29.40 - Exhaust

Service repair no - 12.29.41 - Inlet

### Remove

1. Release 4 screws from spark plug cover.
2. Remove spark plug cover.

### Inlet only

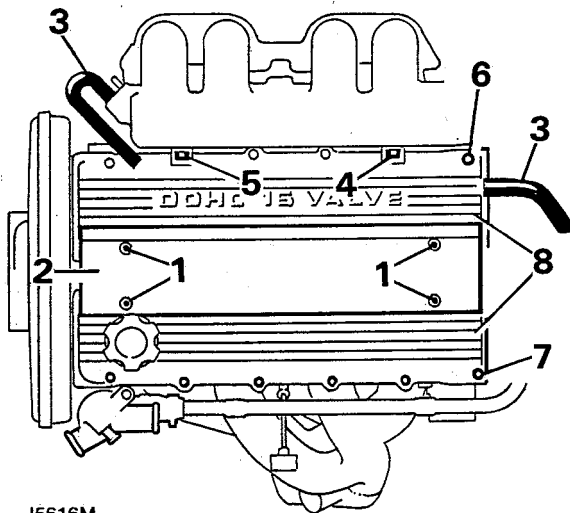
3. Release clips and disconnect 2 breather hoses from camshaft cover.
4. Remove 4 bolts securing support brackets to manifold and cover.
5. Remove support brackets.
6. Remove 12 bolts from camshaft cover.

### Exhaust only

7. Remove 13 bolts from camshaft cover.

### Inlet and exhaust

8. Remove camshaft cover assemblies.
9. Remove and discard baffle/gasket plate(s).



J5616M

### Refit

1. Place protective cloth over tappets.
2. Using an M8 x 1,25 mm tap, remove all traces of sealing compound from camshaft housing bolt holes.
3. Blow out bolt holes using an airline.
4. Ensure all traces of oil are removed from bolt holes, remove protective cloth.
5. Clean camshaft cover(s) and mating face of camshaft housing(s).
6. Position new baffle/gasket plate to camshaft housing(s).

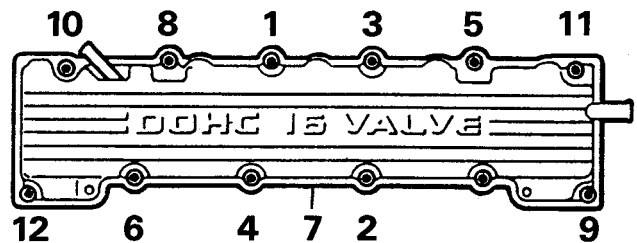
**NOTE: Fit baffle/gasket dry.**



7. Fit camshaft cover(s).

### Inlet only

8. Position spacers and manifold support brackets.
9. Fit bolts finger tight.
10. Working from the centre outwards, progressively tighten bolts to torque. **10Nm**

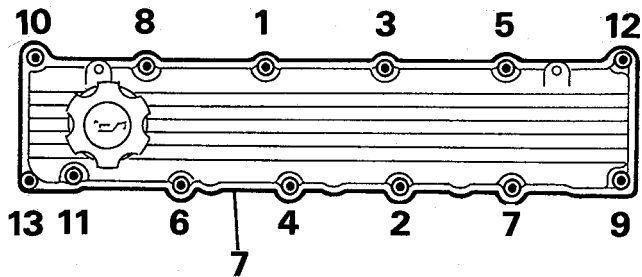


J5617M

11. Tighten support bracket to inlet manifold bolts.
12. Connect breather hoses to camshaft cover.

## Exhaust only

13. Fit bolts finger tight.
14. Working from the centre outwards, progressively tighten bolts to the correct torque. **10Nm**



J5618M


## Inlet and exhaust

15. Fit spark plug cover to camshaft cover, tighten screws.

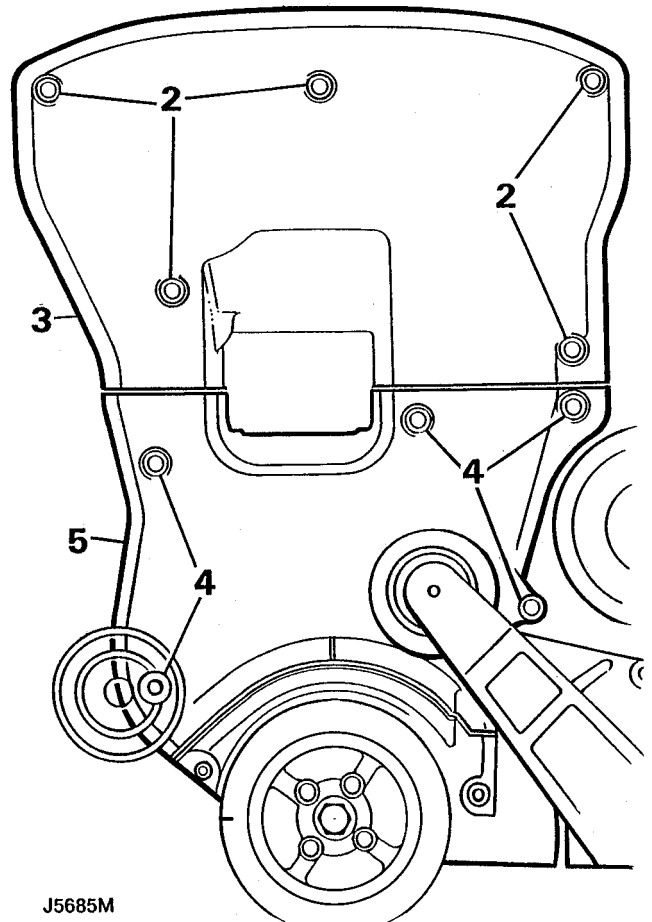
## CAMSHAFT DRIVE BELT

Service repair no - 12.65.17

### Remove

 **NOTE:** If the timing belt is to be removed from the camshaft gears only, it is not necessary to remove the drive belt, crankshaft pulley or timing belt lower cover.

1. Remove drive belt.
2. Remove 5 bolts securing timing belt top cover.
3. Remove top cover.
4. Remove 5 bolts securing timing belt centre cover.
5. Remove timing belt centre cover.



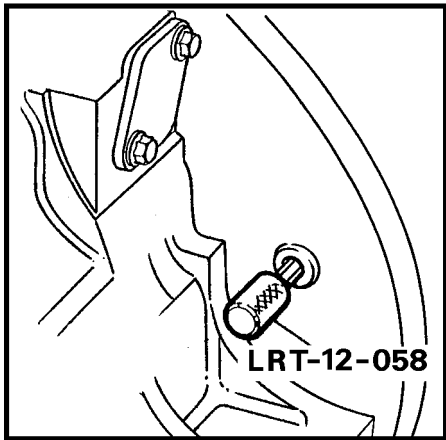
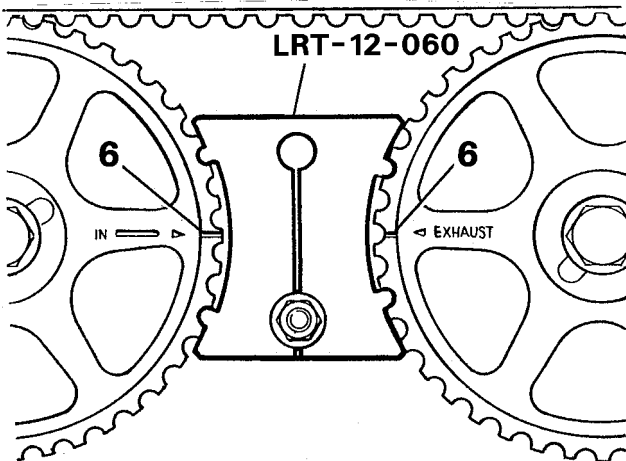
J5685M

6. Rotate crankshaft to align timing marks on camshaft gears - 90°BTDC.



**CAUTION:** Never use the camshaft gears, gear retaining bolts or timing belt to rotate crankshaft.

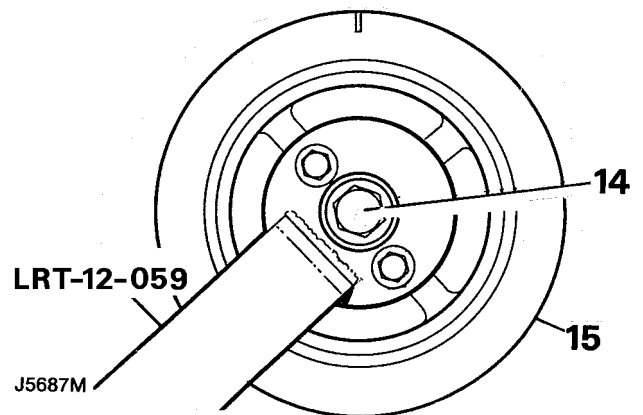
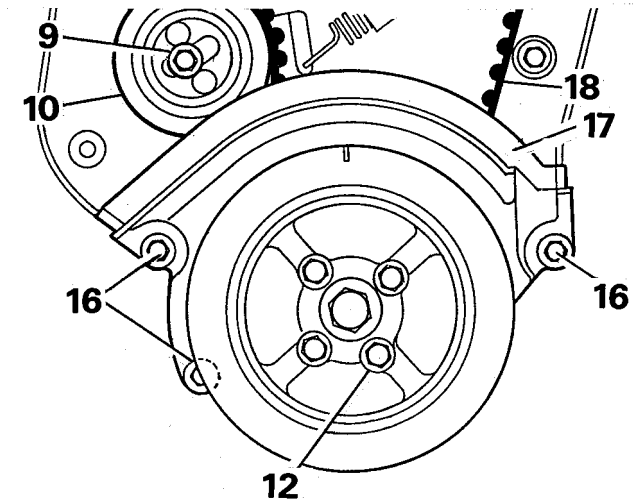
7. Fit tool LRT-12-058 to lock flywheel.
8. Position tool LRT-12-060 to lock camshaft gears.



J5686M

9. Loosen camshaft belt tensioner pulley bolt.
10. Move tensioner to release timing belt tension.
11. Retighten tensioner pulley bolt.
12. Remove 4 bolts securing crankshaft pulley to crankshaft timing gear.

13. Fit tool LRT-12-059 to crankshaft pulley, fit 2 pulley bolts to retain tool.
14. Restrain crankshaft pulley using tool LRT-12-059 and remove crankshaft pulley bolt.
15. Remove bolts securing tool LRT-12-059, remove crankshaft pulley.
16. Remove timing belt lower cover.



J5687M

17. If timing belt is to be refitted, mark direction of rotation of belt.
18. Remove timing belt.



**CAUTION:** Ease timing belt off gears using fingers only. Metal levers may damage the belt and gears. Do not rotate engine with timing belt removed and cylinder head fitted. Timing belts must be stored and handled with care. Always store a timing belt on its edge with a bend radius greater than 50 mm. Do not use a timing belt which has been twisted or bent double as this can fracture reinforcing fibres. Do not use an oil contaminated timing belt. Although the belt has a service life of 96,000 miles, 160,000 km, an existing belt should only be refitted if it has completed less than 48,000 miles, 80,000 km.

## Refit



**NOTE:** For torque values. See *Specifications, torque, Torque values*

1. Clean timing belt gears and pulleys.
2. Clean crankshaft pulley.



**CAUTION:** If original belt is to be refitted, ensure direction of rotation mark is facing correct way.

3. Fit timing belt to gears, starting at the crankshaft gear and working in an anti-clockwise direction.



**CAUTION:** Ensure the belt run between the crankshaft and exhaust camshaft gear is kept taut during the fitting procedure.

4. Fit timing belt lower cover, tighten 3 bolts to the correct torque.
5. Fit crankshaft pulley to crankshaft timing gear.
6. Fit tool LRT-12-059 to crankshaft pulley, fit 2 bolts to retain tool.
7. Fit crankshaft pulley centre bolt, and using tool LRT-12-059 to restrain pulley, tighten bolt to the correct torque.
8. Remove tool LRT-12-059
9. Fit bolts securing crankshaft pulley to timing gear, tighten bolts to the correct torque.
10. Remove tool LRT-12-060.

## Tension belt

1. Loosen timing belt tensioner pulley bolt.
2. Apply **40Nm** anti-clockwise torque to inlet cam pulley bolt and release.
3. Tighten tensioner pulley bolt to the correct torque.
4. Remove tool LRT-12-058 from flywheel.
5. Fit timing belt centre cover, tighten 5 bolts to the correct torque.
6. Fit timing belt upper cover, tighten 5 bolts to the correct torque.
7. Fit drive belt.





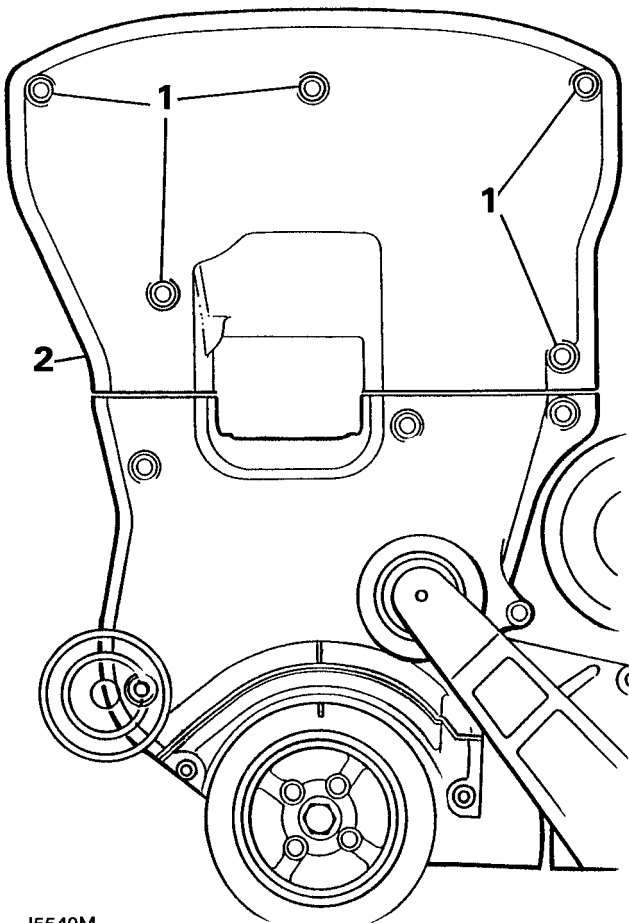
## CHECK CAMSHAFT DRIVE BELT

Service repair no - 12.65.17



**CAUTION:** This check must be carried out at the service intervals specified and whenever carrying out any repair which requires the timing belt to be disturbed. Pay particular attention for signs of belt splitting at base of teeth.

1. Remove 5 bolts securing timing belt upper cover
2. Remove upper cover.



J5540M

3. Using a socket and extension bar on the crankshaft pulley bolt, rotate engine to allow the timing belt to be inspected.



**CAUTION:** Do not use camshaft gears or retaining bolts to rotate engine.

4. Check timing belt condition, renew any belt that shows signs of oil contamination, cracking, fraying or splitting at base of teeth.



**CAUTION:** Cause of oil contamination, if present, must be rectified.

5. Clean timing belt upper cover.
6. Position upper cover.
7. Fit upper cover securing bolts.




---

**TORQUE VALUES**


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**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
<b>ENGINE</b>	
Timing belt upper cover bolts .....	5
Timing belt centre cover bolts .....	5
Timing belt lower cover bolts .....	5
Crankshaft pulley centre bolt .....	85
Crankshaft pulley to timing gear bolts .....	10
Tensioner pulley bolt .....	30
Spark plugs .....	27
Timing belt upper backplate bolts .....	10
Camshaft gear bolts .....	65
Exhaust camshaft rear oil seal cover plate bolts .....	10
Inlet camshaft rear oil seal cover plate bolts .....	10
Crankshaft rear oil seal housing bolts .....	10
Engine sump bolts	
Stage 1 .....	3
Stage 2 .....	10
Bell housing nuts .....	40
L.H. and R.H. engine mounting nuts .....	85
Exhaust manifold to downpipe nuts .....	10
Exhaust downpipe to silencer box nuts .....	30
Air conditioning compressor to engine block bolts .....	45
Cylinder head bolts	
Stage 1 .....	45
Stage 2 .....	80
Stage 3 - Further 90°	
Camshaft cover bolts .....	10
Knock sensor .....	15
Ignition coil bracket bolts .....	25
Coolant temperature sensor .....	15
Crankshaft sensor bolts .....	7
Fuel temperature sensor .....	7
Intake air temperature sensor .....	7
Fuel rail to inlet manifold bolts .....	10
Fuel feed hose stiffening bracket bolts .....	7
Throttle housing mounting nuts .....	7
Fuel pressure regulator steady bracket bolts .....	7
Oxygen sensor .....	55

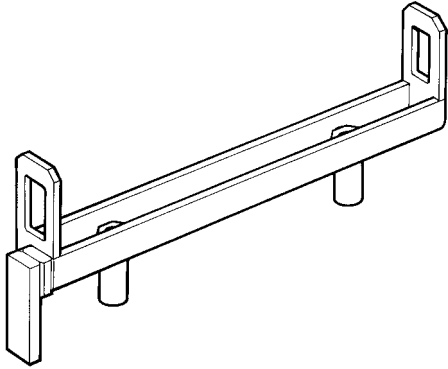


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**ENGINE**

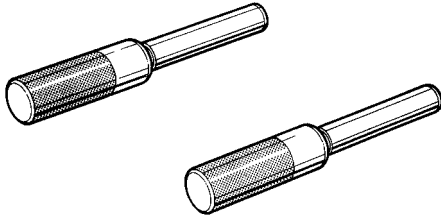
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LRT12056

LRT-12-056  
18G 1644

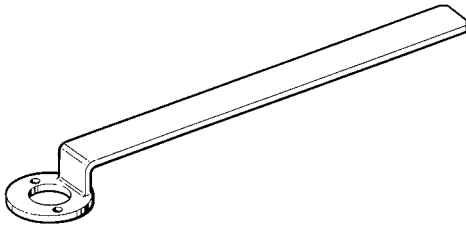
Engine lifting bracket

LRT12058

LRT-12-058  
18G 1523

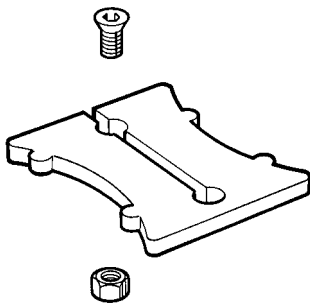
Location pin valve timing

LRT12059

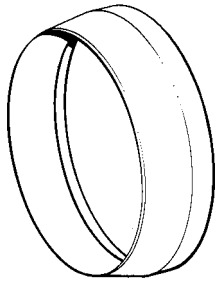
LRT-12-059  
18G 1641

Crankshaft pulley locking tool

LRT12060

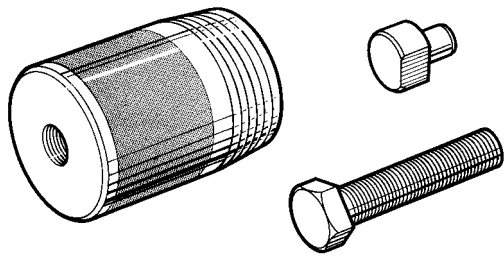
LRT-12-060  
18G 1524

Locking tool crankshaft gear



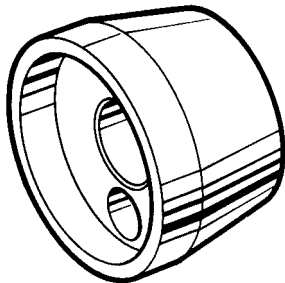
LRT-12-061      Protection sleeve crankshaft rear oil seal  
18G 1108

LRT12061



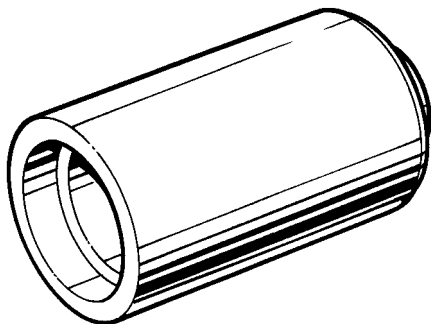
LRT-12-063      Remover camshaft oil seals  
18G 1476

LRT12063



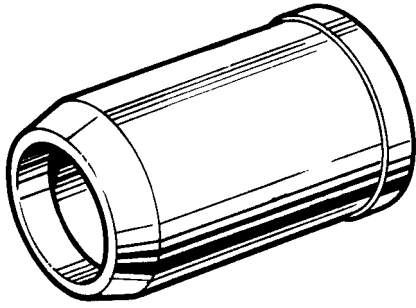
LRT-12-064      Replacer pilot camshaft front  
18G 1475

LRT12064



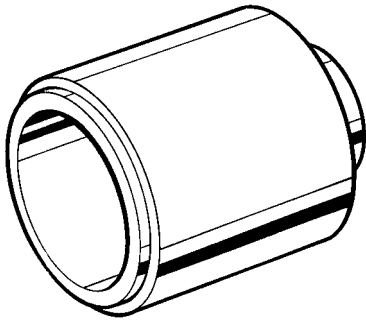
LRT-12-069      Replacer crankshaft front oil seal  
18G 1509

LRT12069



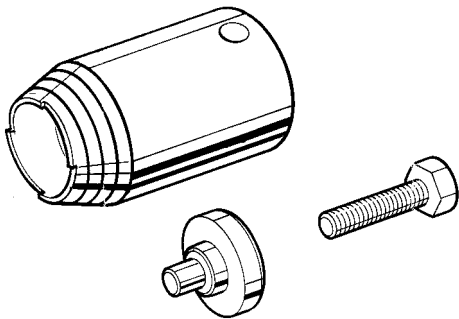
LRT-12-070 Sleeve crankshaft front oil seal  
18G 1510

LRT12070



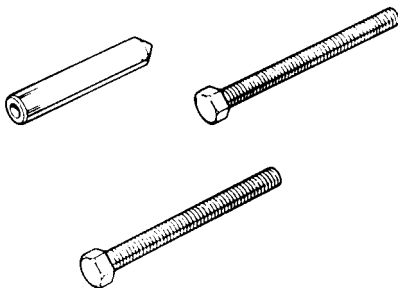
LRT-12-072 Replacer drift camshaft front oil seals

LRT12072



LRT-12-073 Remover crankshaft front oil seal

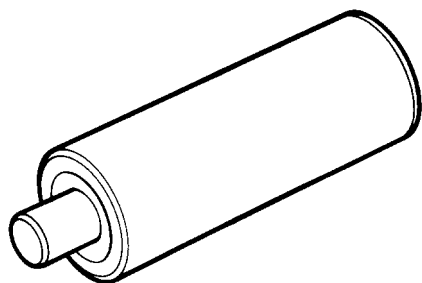
LRT12073



LRT-12-074 Remover adapter bit

LRT12074

LRT-12-076 Replacer needle crankshaft bearing



LRT12076



## EMISSION CONTROL

Three systems are used to control the vehicle atmospheric emissions these are:

- Engine crankcase fume emissions.
- Fuel tank Evaporative emissions
- Engine exhaust gas emissions.

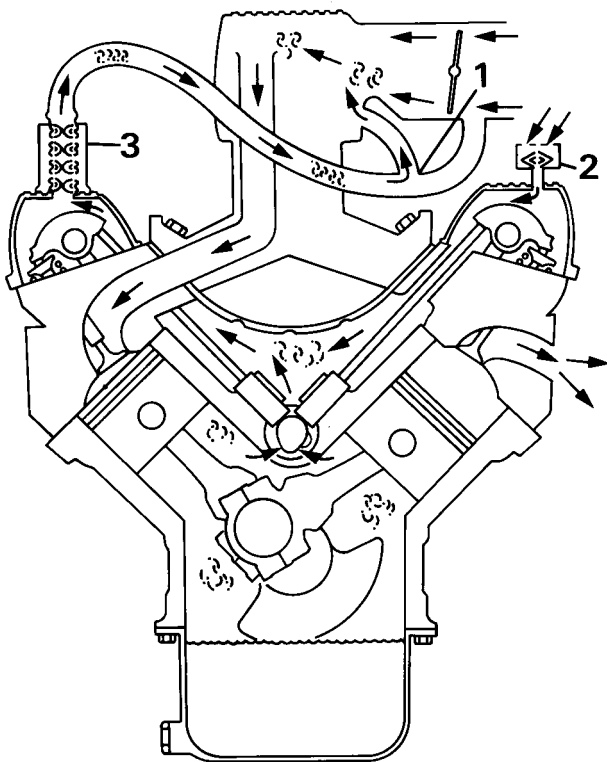
### Crankcase ventilation system - 3.9 MFi models only

The crankcase ventilation system which is an integral part of the air supply to the engine combustion chambers, is often overlooked when diagnosing problems associated with engine performance. A blocked ventilation pipe or filter or excessive air leak into the inlet system through a damaged pipe or leaking gasket can effect the mixture, performance and economy of the engine.

The purpose of the crankcase ventilation system is to ensure that any noxious gas generated in the engine crankcase is rendered harmless by burning in the combustion chambers as follows:

Oil laden noxious gas in the engine crankcase is drawn through an oil separator 3 located on the right cylinder head rocker cover, where the oil is separated and returned to the sump. The gas flows through a restrictor in the three way connection 1 and into the inlet plenum chamber where it is drawn into the combustion chambers and burned. The volume of fresh air which is drawn from the atmospheric side of the throttle butterfly to mix with the gas, depends on the position of the throttle and the engine speed.

The air filter 2 fitted to the left cylinder head rocker cover, must be maintained in clean condition to ensure sufficient air enters the crankcase under varying throttle openings and manifold depression, to prevent excessive crankcase pressure or depression developing.



RR3534M

1. Three way connector
2. Air filter
3. Oil separator

**Exhaust emission control.**

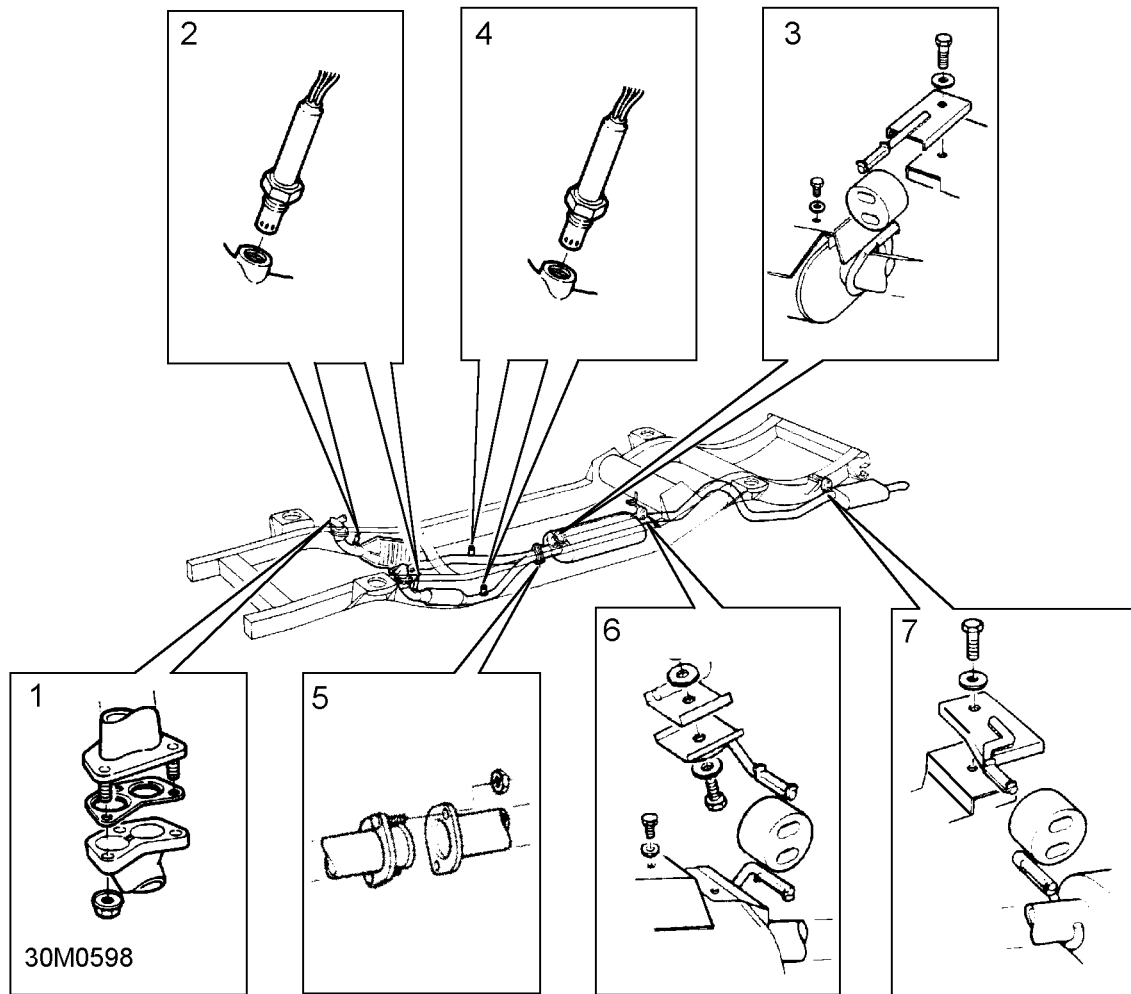
The fuel injection system provides accurately metered quantities of fuel to the combustion chambers to ensure the most efficient air to fuel ratio under all conditions of operation. A further improvement to combustion is made by measuring the oxygen content of the exhaust gases to enable the quantity of fuel injected to be varied, according to conditions, to correct any unsatisfactory composition of the exhaust.

The main components of the exhaust emission system are two Catalytic converters which are an integral part of the front exhaust pipe assembly. The Catalytic converters are included in the system to reduce the emission, to atmosphere, of carbon monoxide, oxides of nitrogen, and hydrocarbons. The active constituents of the converters are platinum and rhodium. The correct functioning of the converters is dependent upon close control of the oxygen concentration in the exhaust gas entering the catalyst. The oxygen content of the exhaust gas is monitored by the heated oxygen sensors. Information on the heated oxygen sensors is contained in the relevant Fuel System section, **See FUEL SYSTEM MFI, Description and operation, or See FUEL SYSTEM SFI, Description and operation**, The ECM can then make an appropriate adjustment to the fuel supply to correct the composition of the exhaust.



**CAUTION: Unleaded fuel only must be used on vehicles fitted with catalytic converters. As a reminder, a label to indicate this is adhered to the inside of the fuel filler flap. Furthermore the filler neck is designed to accommodate only unleaded fuel pump nozzles.**



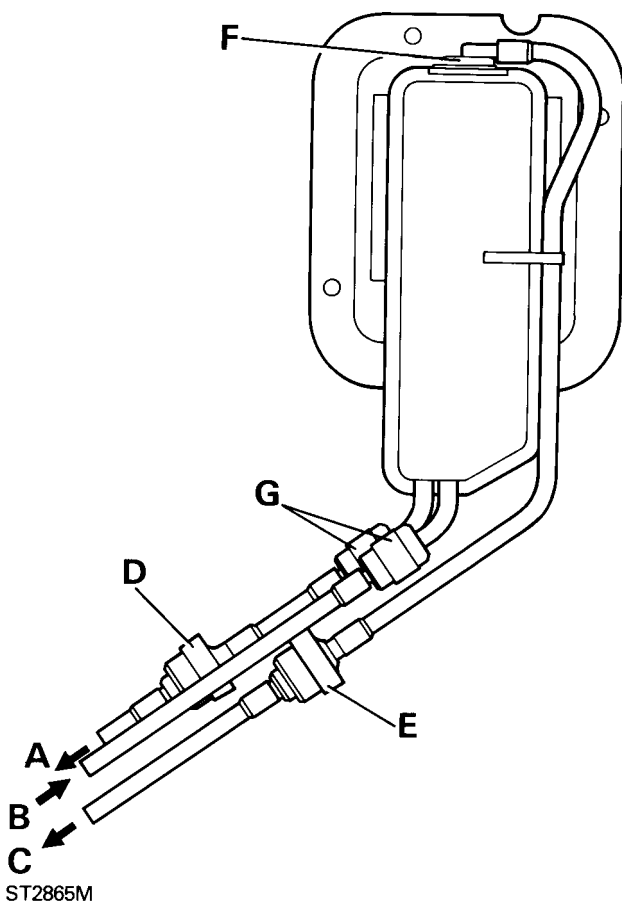


## EXHAUST SYSTEM

1. Manifold to front pipe connection.
2. Heated oxygen sensor - pre-catalytic converter.
3. Front silencer support bracket.
4. Heated oxygen sensor - post-catalytic converter.
5. Front pipe to silencer joint.
6. Silencer rear support bracket.
7. Rear silencer support bracket.

### Evaporative emission control system - pre advanced EVAPS.

The system is designed to prevent harmful fuel vapour from escaping to the atmosphere. The system consists of a vapour separator tank, connected to the fuel tank and located between the body inner and outer panels on the right hand side of the vehicle near the rear wheel arch. An adsorption canister, containing activated charcoal, is positioned in the engine compartment attached to the front right valance. The two components are connected by a pipe running the length of the chassis.



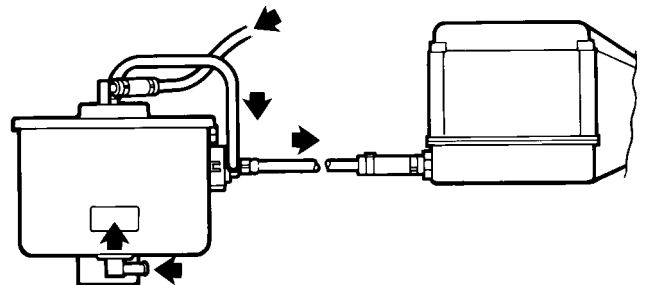
- A Pressure relief to atmosphere.
- B From fuel tank to separator.
- C To adsorption canister.
- D Pressure relief valve.
- E Pressure relief valve.
- F Shut-off valve.
- G "Speed Fit" connectors.

A pressure relief valve is fitted in the hose which is open to atmosphere. This valve acts as a safety valve should a build-up of pressure occur in the system, for example if a hose became blocked or kinked. The volume of vapour emitted, in such an instance, would be acceptable.

A pressure relief valve is also fitted in the hose connected to the adsorption canister and releases vapor to the canister when the pressure in the separator reaches between 5 and 7 Kpa.

In the top of the separator a shut-off valve is incorporated in the vapor exit port to prevent the possible presence of any liquid fuel being transmitted to the adsorption canister should the vehicle roll over.

The adsorption canister, which is connected by a hose to the plenum chamber, absorbs and stores the fuel vapour from the fuel tank while the engine is not running. When the engine is started, the vapour is purged from the canister by air drawn through an orifice in the base of the canister and by the influence of vacuum at the top. The vapour drawn into the plenum chamber through a solenoid operated purge valve is finally burnt in the combustion chambers.

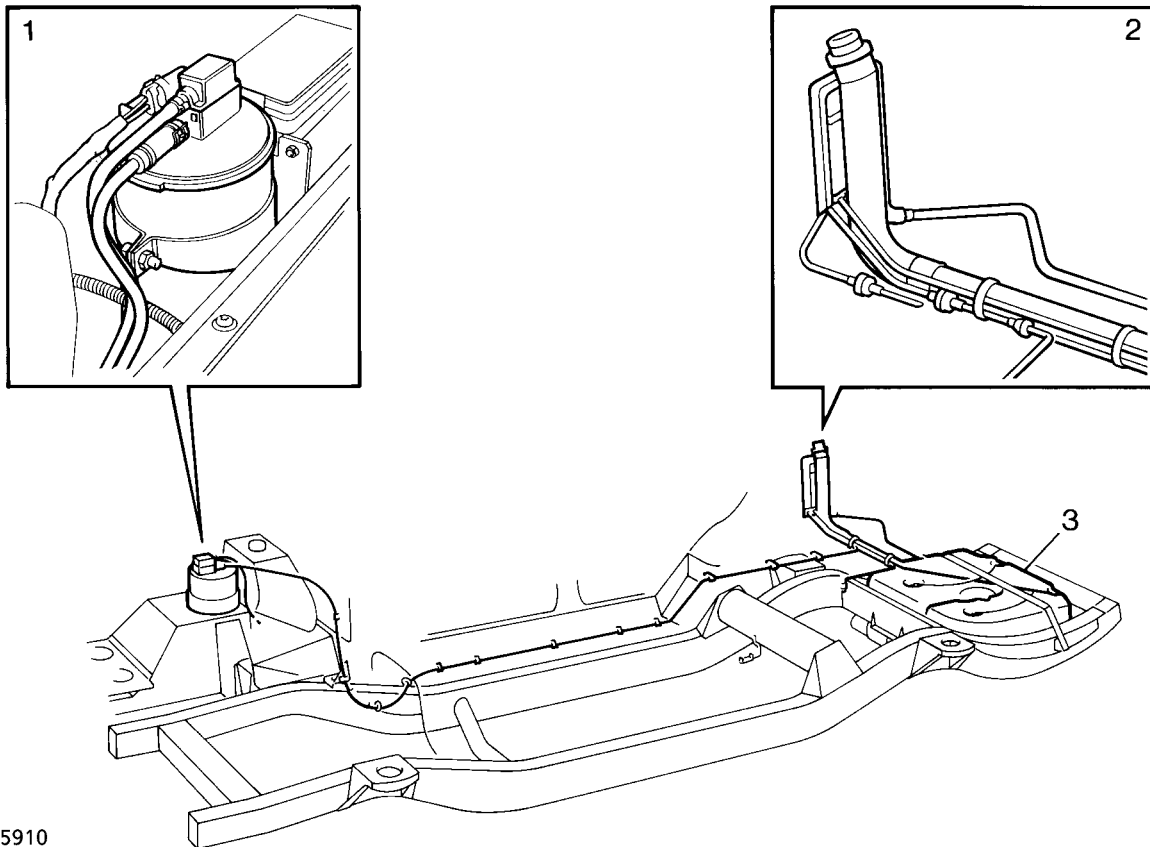


The purge valve, which is attached to the adsorption canister support bracket, is controlled by the Engine Control Module ECM which determines the most emission acceptable time at which purging should take place. This will normally be at engine speeds above idle and when the vehicle is in motion. A signal from the ECM to the purge valve operates the solenoid and opens the valve to purge the canister of fuel vapour.

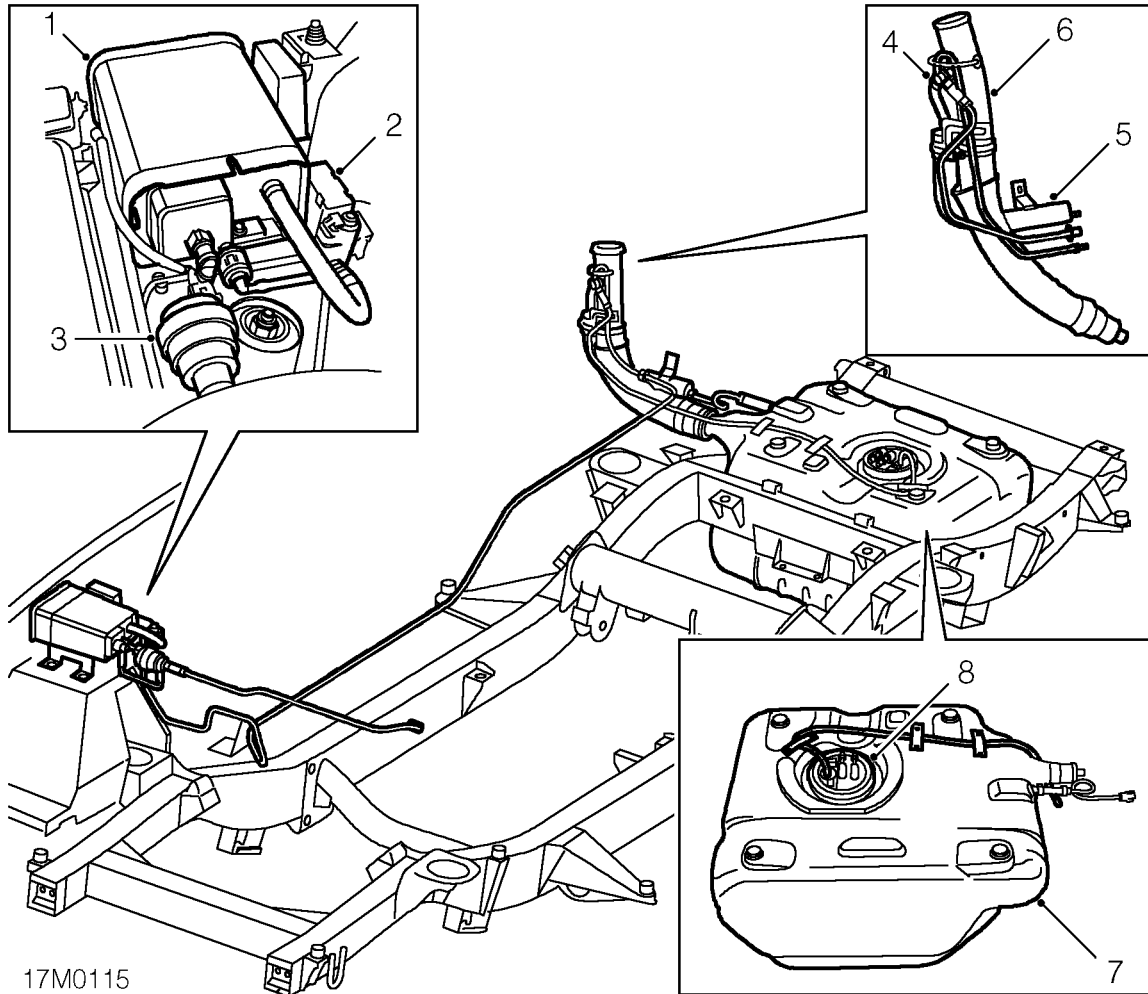


### EVAPORATIVE CONTROL SYSTEM - PRE ADVANCED EVAPS

1. Adsorption canister and purge valve.
2. Location of vapour separator and pipes.
3. Fuel tank.

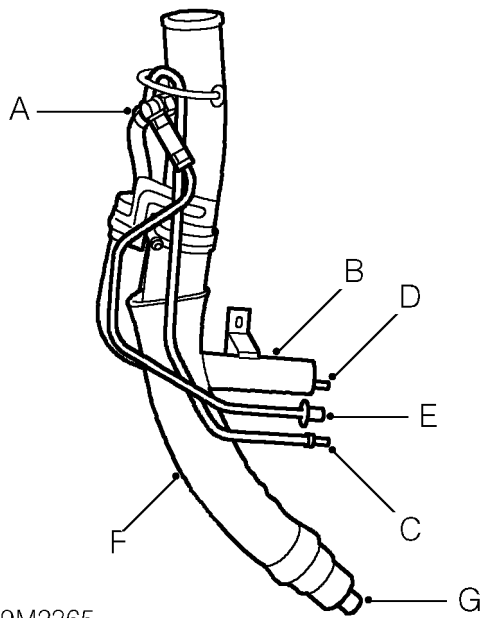


## EVAPORATIVE EMISSION CONTROL SYSTEM - ADVANCED EVAPS



### Component location

1. EVAP canister
2. EVAP canister vent solenoid (ECVS)
3. EVAP canister purge valve
4. Anti-trickle fill valve
5. Liquid/vapour separator
6. Fuel filler neck assembly
7. Fuel tank
8. Fuel pump and gauge sender unit

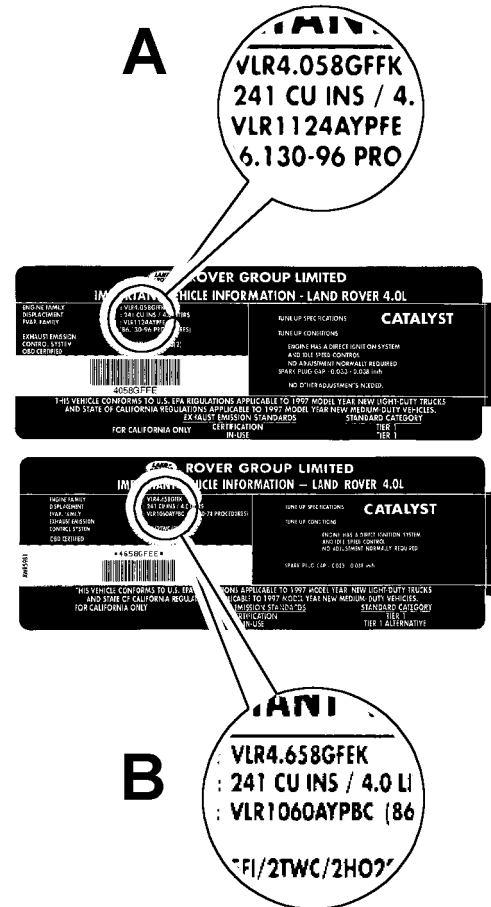


19M2365

### Fuel filler neck components

- A Anti-trickle fill valve
- B Liquid/Vapour Separator
- C Vent line to pressure sensor
- D From fuel tank to liquid/vapour separator
- E From EVAP canister to anti-trickle fill valve
- F Fuel filler hose, Dual layer, convolute nylon
- G Fuel tank internal breather hose

### Identification



19M2400

The system was introduced on all North American specification vehicles from October 1996 and the vehicles can be recognised by the information contained in the **EVAP. FAMILY** entry on the underbonnet Emission label (mounted on the vertical face of the bonnet lock platform).

#### A - Vehicles with advanced EVAPS

VLR1124AYPFE

#### B - Vehicles without advanced EVAPS

VLR1060AYPBC

### System operation

The system is designed to prevent fuel vapour escaping to atmosphere, and consists of four roll-over valves fitted internally in the fuel tank, connected to the liquid/vapour separator by a nylon line. The separator is mounted to the side of the filler neck. An EVAP canister is positioned in the engine compartment mounted on the right front side valance. The liquid/vapour separator and EVAP canister are connected by a nylon line which runs the length of the chassis.

Pressure/vacuum relief valves are incorporated into the fuel filler cap and are designed to protect the fuel tank from permanent deformation in the event of system pressure or vacuum exceeding the system operating parameters. There are no other relief or one-way valves in the system.

A vent line flow restrictor known as an anti-trickle fill valve is fitted to the filler pipe in the line between the tank and EVAP canister. The function of this valve is to prevent overfilling the tank by trickling fuel in, thereby preserving the vapour space in the tank to allow for fuel expansion during hot weather.

The valve achieves this by blocking the vent line during the fuel filling process. The valve is operated by the action of inserting the filler gun so that when the fuel in the tank reaches the level of the filling breather, flow cut off occurs due to fuel filling the filler pipe.

During normal vehicle operation and when the engine is switched off, the venting system between the fuel tank and EVAP canister is open to allow the free passage of vapour.

The EVAP canister, which is connected by a nylon hose to the plenum chamber, absorbs and stores the fuel vapour from the fuel tank when the engine is not running. With the engine running, vapour is purged from the EVAP canister by allowing outside air to be drawn through the EVAP canister vent solenoid and link pipe by the influence of manifold vacuum to the EVAP canister purge connection on the canister.

Filter pads are fitted above and below the charcoal and in the EVAP canister vent solenoid to prevent the ingress of foreign matter into the purge line.

The EVAP canister purge valve, which is fitted in the line from the EVAP canister to the plenum, is controlled by the ECM which determines the most emission acceptable time at which purging should take place. This will normally be at engine speeds above idle and when the vehicle is in motion.

The EVAP canister vent solenoid is mounted on the side of the EVAP canister bracket and is connected to the EVAP canister by a length of large bore hose. The ECVS is controlled by the ECM and is normally open. The function of the ECVS is to block the air intake side of the EVAP canister. When the system receives an ECM signal the valve closes; this allows the system leak check to take place. The leak check only occurs when pre-determined vehicle operating conditions are met.



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### TESTING EVAPORATIVE EMISSION CONTROL - PRE ADVANCED EVAPS

---

The following pressure test procedure is intended to provide a method for ensuring that the system does not leak excessively and will effectively control evaporative emissions.

#### Equipment required.

Nitrogen cylinder (compressed air may be used to pressure the system when there has NEVER been fuel present in the fuel or evaporative control systems).

Water manometer (0 - 30" H<sub>2</sub>O or more).

Pipework and a "T" piece.

#### Method.

1. Ensure that there is at least two gallons of fuel in the petrol tank unless there has never been any fuel in the system.
2. Disconnect, at the adsorption canister, the pipe to the vapour separator.
3. Connect this pipe to the nitrogen cylinder and the water manometer using the "T" piece.
4. Pressurize the system to between 26.5 and 27.5 inches of water, allow the reading to stabilize, then turn off the nitrogen supply.
5. Measure the pressure drop within a period of 2 minutes 30 seconds. If the drop is greater than 2.5 inches of water the system has failed the test. Note that a fully sealed system will show a slight increase in pressure.
6. Should the system fail the test, maintain the pressure in the system and apply a soap solution round all the joints and connections until bubbles appear to reveal the source of the leak.
7. Repeat the test and if successful, dismantle the test equipment and reconnect the pipe to the adsorption canister.

---

### LEAK DETECTION PROCEDURE - ADVANCED EVAPS

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1. Connect TestBook to the vehicle and confirm that the fault code(s) displayed relate to an EVAP system fault.
2. Examine components in fuel and EVAP system for damage or poorly connected joints.
3. Repair or replace components to rectify any faults found, then reset the Check Engine light using TestBook.
4. Carry out Drive Cycle, **See Drive Cycle - Advanced EVAPS**
5. Using TestBook confirm that the Evaporative Loss Control (ELC) Inspection and Maintenance (IM) flag has cleared. This procedure should confirm that the ELC test was carried out during the drive cycle and that the fault was cured.
6. If the IM flag is still shown, use TestBook to interrogate the engine management system to ascertain which of the following situations exists:
  - If a fault code is shown then further investigation is required, proceed to the next step.
  - If the IM flag is still shown, but no faults are indicated the conditions for the ELC check have not been met and the drive cycle must be repeated.
7. Connect the Leak Detection/EVAP Diagnostic Station to the vehicle and carry out the procedures given in the operating instructions supplied with the equipment.
8. Rectify faults indicated by the Leak Detection/EVAP Diagnostic Station and return to step 4.

---

**DRIVE CYCLE - ADVANCED EVAPS**

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1. Switch on ignition for 30 seconds.
2. Ensure that coolant temperature is less than 140 °F (30°C).
3. Start engine and allow to idle for 2 minutes.
4. Perform 2 light accelerations (0 to 35 mph with light pedal pressure).
5. Perform 2 medium accelerations (0 to 45 mph with moderate pedal pressure).
6. Perform 2 hard accelerations (0 to 55 mph with heavy pedal pressure).
7. Cruise at 60 mph for 5 minutes.
8. Cruise at 50 mph for 5 minutes.
9. Cruise at 35 mph for 5 minutes.
10. Allow engine to idle for 2 minutes.
11. Connect TestBook and check for fault codes.





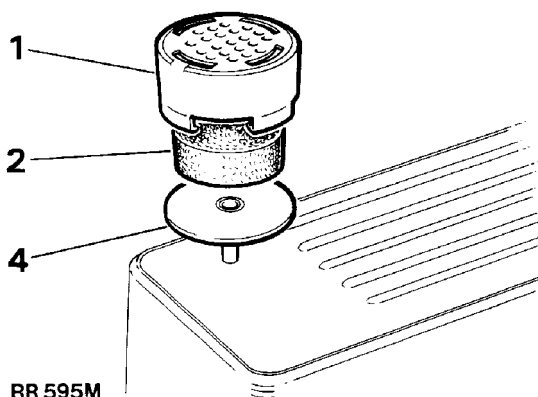
## POSITIVE CRANKCASE VENTILATION AIR INTAKE FILTER

### Service repair no - 17.10.02

The PCV air intake filter is located at the rear of the left hand rocker cover, beneath the throttle linkage bracket.

#### Remove

1. Pry the filter outer cover upwards to release it from its mounting.
2. Remove the sponge filter from the cover and discard the sponge.



#### Refit

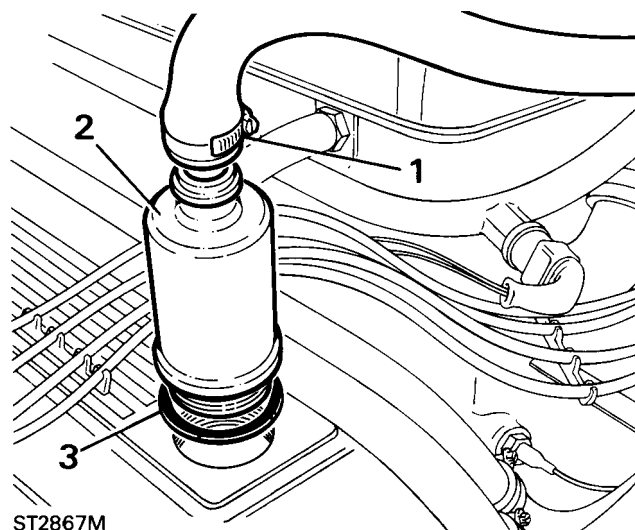
3. Insert a new filter into the filter cover.
4. Press the filter onto its mounting until it clips firmly into position.

## POSITIVE CRANKCASE VENTILATION BREATHER FILTER

### Service repair no - 17.10.03

#### Remove

1. Release the hose clamp and pull the hose off the canister.
2. Unscrew the canister and remove it from the rocker cover.
3. Remove the large rubber 'O' ring and inspect for deterioration.



4. Visually inspect the condition of the wire screen within the canister, if in poor condition, replace the whole assembly, if the filter unit is in an acceptable condition, clean as follows.
5. Immerse the canister in a small amount of solvent (mineral spirits) and allow time for the solvent to dissolve or loosen any debris.
6. Remove the canister from the solvent bath and allow to dry in still air.



**WARNING: Do not use a compressed air line to dry, clean or remove any remaining particles of debris within the canister as this could cause fire or personal injury.**

#### Refit

7. If the original canister is being refitted, fit a new 'O' ring.
8. Screw the canister into the rocker cover securely - hand tight only.
9. Refit the hose and tighten the hose clamp securely.

**HEATED OXYGEN SENSOR (HO2S)**

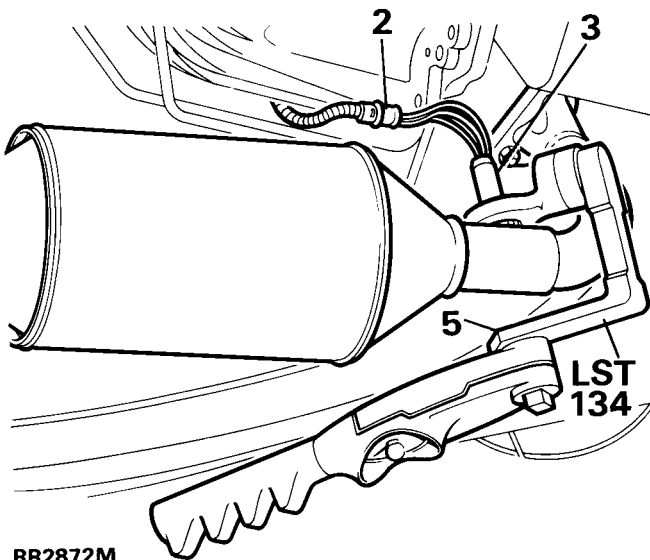
Service repair no - 19.26.16



**CAUTION:** The removal of the sensors from the exhaust system must only be carried out when the engine is cold.

**Remove**

1. Disconnect battery negative lead.
2. Disconnect the electrical plugs from the sensors.
3. Unscrew and remove the sensors from the two exhaust downpipes.

**Refit**

4. Coat the threads of the sensors with anti-seize compound.



**CAUTION:** To ensure that the efficiency of the sensor is not impaired, DO NOT allow anti-seize compound to come into contact with the sensor nose.

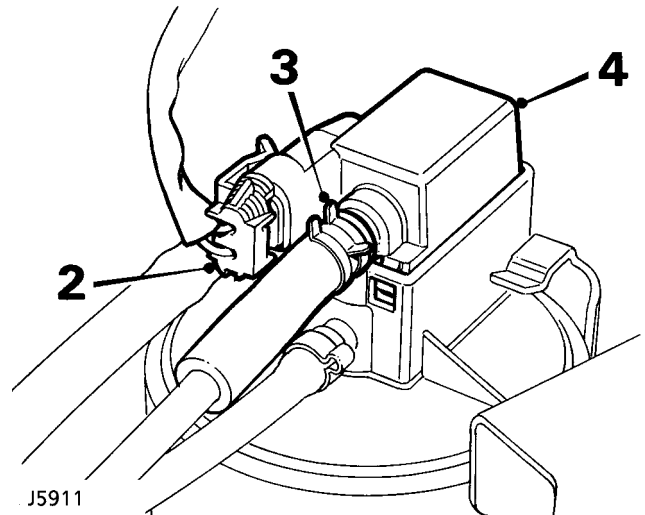
5. Screw in the sensor and tighten to the correct torque using special tool LST134.
6. Connect the electrical plugs and battery lead.

**PURGE CONTROL VALVE**

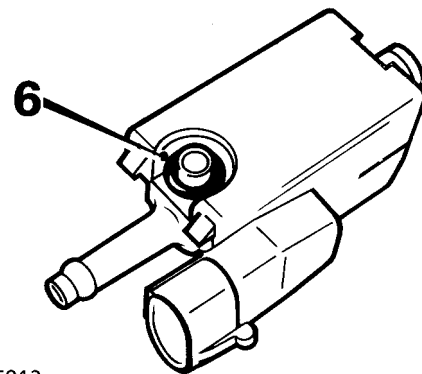
Service repair no - 17.15.39

**Remove**

1. Disconnect battery negative lead.



2. Disconnect multiplug from purge control valve.
3. Release clip and disconnect hose from valve.
4. Release valve from charcoal canister.
5. Remove valve.



6. Discard 'O' ring.

**Refit**

7. Clean valve and valve location.
8. Fit new 'O' ring to purge valve.
9. Position and secure valve to charcoal canister.
10. Connect hose to purge valve and secure with clip.
11. Connect multiplug to valve.
12. Reconnect battery negative lead.



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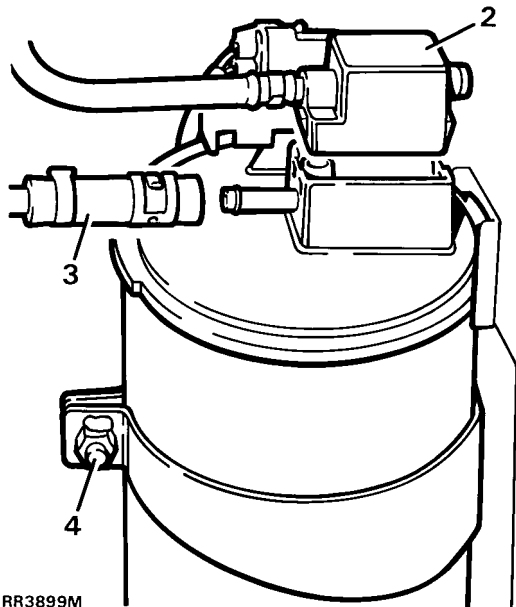
**CHARCOAL CANISTER**

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Service repair no - 17.15.13

**Remove**

1. Disconnect battery negative lead.
2. Pry out purge valve.
3. Disconnect pipe.



RR3899M

4. Loosen bolt.
5. Remove charcoal canister.

**Refit**

6. Reverse removal procedure.

## HEATED OXYGEN SENSOR (HO2S) - 4.0 V8



**WARNING:** Do not attempt HO2S removal when the exhaust is hot.

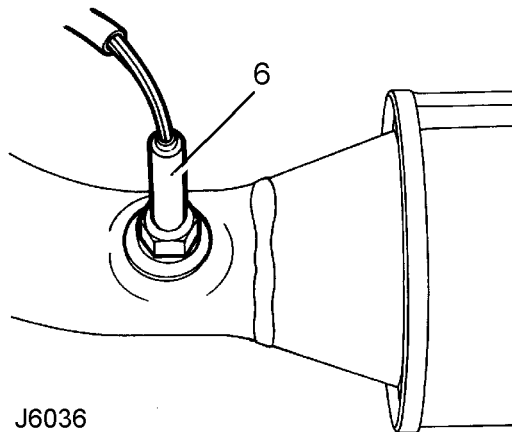
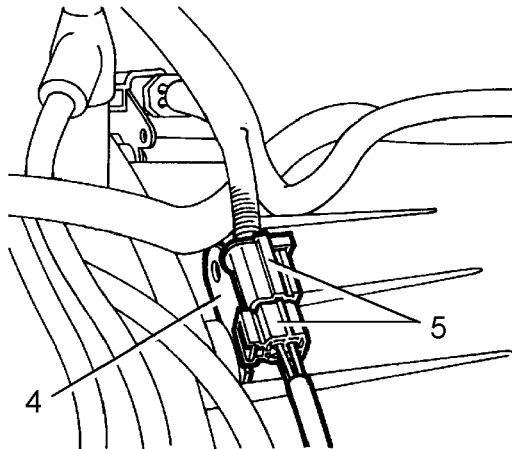
## Remove

## For all sensors:

1. Raise and support front of vehicle.
2. Release sensor lead from clips.

## RH front sensor only

3. Remove nuts retaining coil bracket and position bracket aside. **See FUEL SYSTEM SFI, Repair, Ignition Coils**

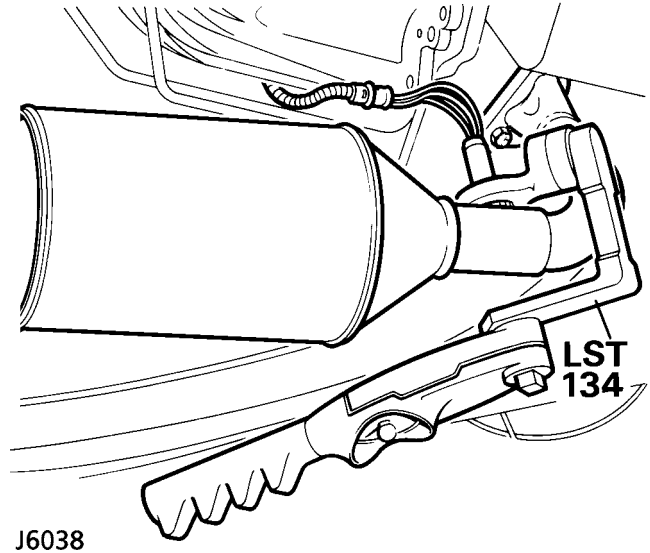


J6036

4. Release multiplug from bracket behind cylinder head.
5. Disconnect multiplug and release sensor lead from clip.
6. Unscrew and remove sensor from exhaust pipe.

## LH front sensor

7. Disconnect multiplug and release from bracket.

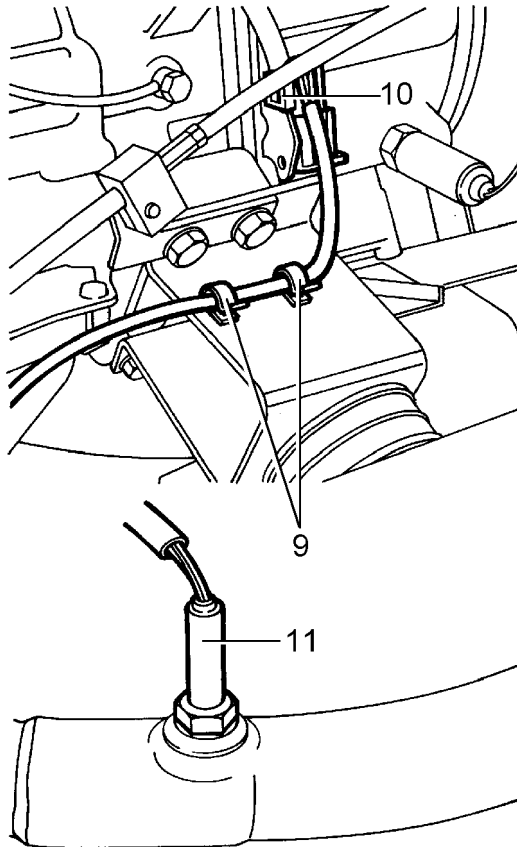


J6038

8. Unscrew and remove sensor from exhaust pipe using special tool LRT-12-047 (LST134).

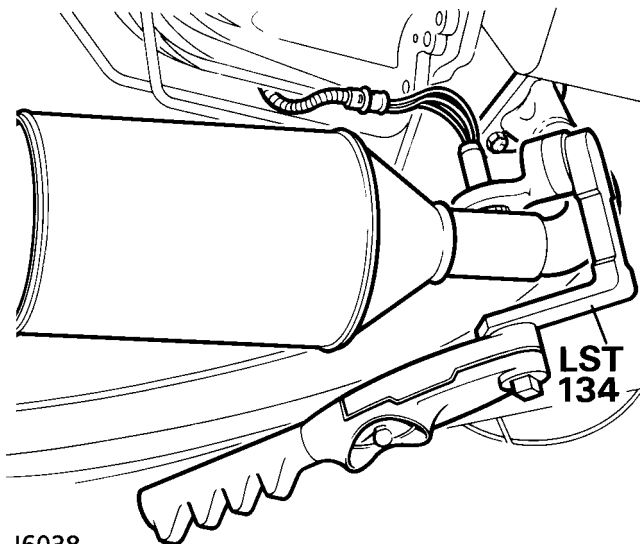


## Rear sensors



J6037

9. Release sensor cable from clips.
10. Release multiplug from bracket and disconnect.



J6038

11. Unscrew and remove sensor from exhaust pipe using special tool LRT-12-047 (LST134).

## Refit

12. Ensure mating faces are clean.



**NOTE: New HO2S is supplied pre-treated with anti-seize compound.**

13. If refitting existing HO2S, coat threads with anti-seize compound.



**CAUTION: Do not allow anti-seize compound to come into contact with HO2S nose or enter exhaust system.**

14. Position HO2S with new sealing washer on exhaust pipe. Tighten to **20 Nm** using special tool LRT-12-047 (not RH front sensor).
15. Reconnect multiplug to engine harness and secure to bracket.
16. **RH front sensor only:** Place coil bracket in position and fit nuts. Tighten to **8 Nm**.



**CAUTION: Ensure sensor leads are secured using clips provided. Failure to correctly secure leads could result in damage to HO2S.**

17. Remove stands. Lower vehicle.

**CATALYTIC CONVERTER/FRONT PIPE - 4.0 V8**

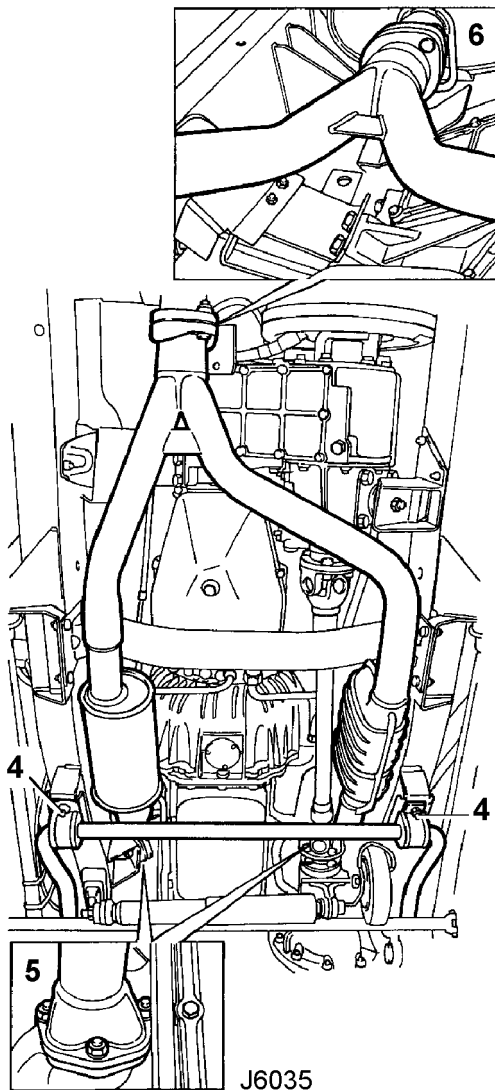
Service repair no - 17.50.09



**WARNING:** The removal of the exhaust system must only be carried out when the engine is cold.

**Remove**

1. Disconnect battery negative lead.
2. Raise vehicle on ramp.
3. Remove oxygen sensors *See Heated Oxygen Sensor (HO2S) - 4.0 V8*



4. Remove 4 nuts/bolts securing front anti-roll bar brackets.
5. Remove 6 nuts securing front pipe flanges to manifolds.
6. Remove 2 nuts securing front pipe to intermediate pipe.
7. With assistance, release front pipe from manifold flanges.

8. With assistance, release front pipe from intermediate pipe.
9. With assistance, lower anti-roll bar.
10. With assistance, remove exhaust front pipe.
11. Remove flange gaskets and discard.

**Refit**

12. Reverse removal procedure.

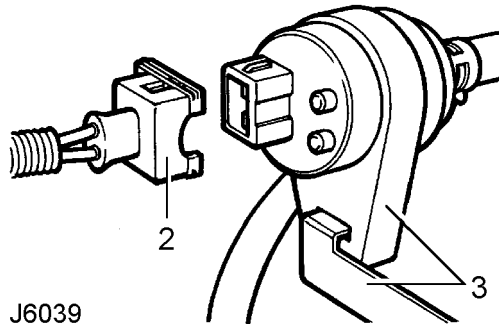


## EVAP CANISTER AND PURGE VALVE - 4.0 V8

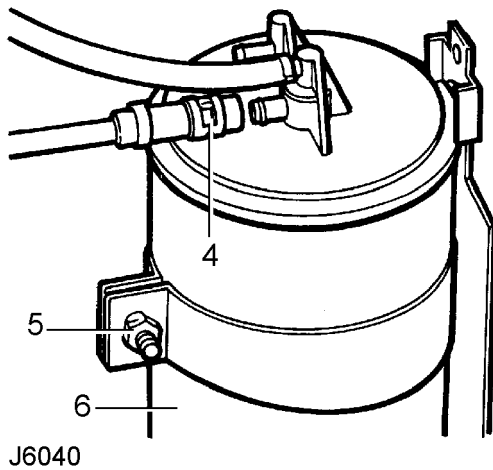
Service repair no - 17.15.13

### Remove

1. Disconnect battery negative lead.



2. Disconnect multiplug from EVAP purge valve.
3. Release purge valve rubber mounting from bracket.



4. Release clip and remove hose from EAVP canister.
5. Loosen bolt.
6. Remove EVAP canister and purge valve complete.

### Refit

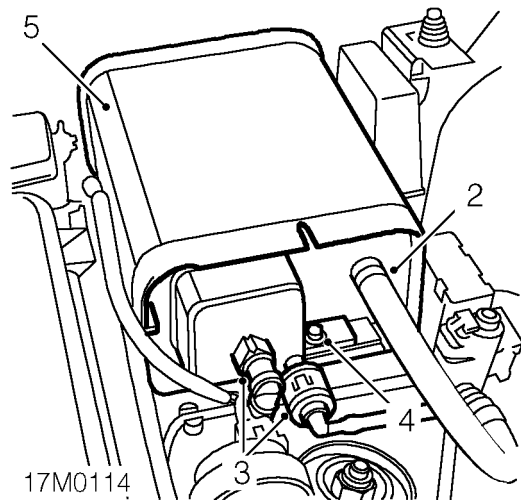
7. Reverse removal procedure.

## EVAP CANISTER - ADVANCED EVAPS

Service repair no - 17.15.13

### Remove

1. Disconnect battery negative lead.



2. Release clip securing vent solenoid hose to canister and disconnect hose.
3. Release vent and purge line quickfit connections from canister.
4. Remove nut and bolt securing canister to mounting bracket, collect fixture clamp.
5. Remove canister.

### Refit

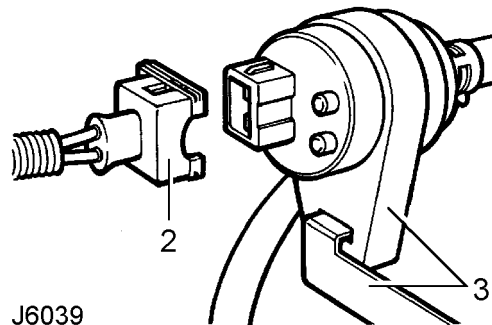
6. Fit canister to mounting bracket.
7. Position fixture clamp and secure canister to mounting bracket with nut and bolt.
8. Connect vent and purge line quickfit connections to canister.
9. Connect vent solenoid hose to canister and secure with clip.
10. Reconnect battery negative lead.

## EVAP CANISTER PURGE VALVE - ADVANCED EVAPS

Service repair no - 17.15.39

### Remove

1. Disconnect battery negative lead.



2. Disconnect multiplug from purge valve.
3. Release purge valve rubber mounting from bracket.
4. Release quickfit hose connections from throttle body plenum and EVAP canister.
5. Remove purge valve assembly.

### Refit

6. Locate purge valve adjacent to bracket.
7. Connect quickfit hose connections to throttle body plenum and EVAP canister.
8. Connect multiplug to purge valve and secure purge valve rubber mounting to bracket.
9. Reconnect battery negative lead.





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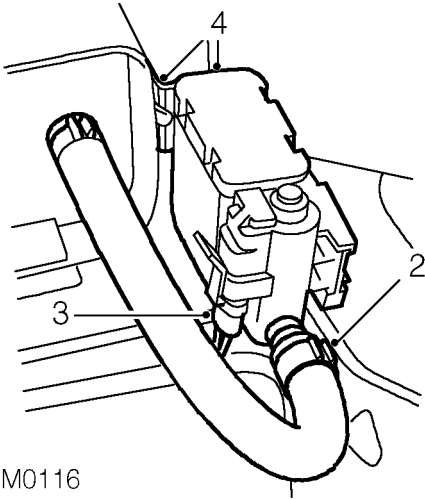
**EVAP CANISTER VENT SOLENOID - ADVANCED EVAPS**

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Service repair no - 17.15.43

**Remove**

1. Disconnect battery negative lead.



2. Release clip securing hose to vent solenoid and disconnect hose.
3. Disconnect multiplug from vent solenoid.
4. Remove vent solenoid from mounting bracket.

**Refit**

5. Fit vent solenoid to mounting bracket.
6. Connect multiplug to vent solenoid.
7. Connect hose to vent solenoid and secure with clip.
8. Reconnect battery negative lead.



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## DESCRIPTION

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### Air intake

The air cleaner is positioned to the right of the engine and connected by hoses to a cold air intake duct and the turbocharger inlet. A crankcase breather hose is fitted between the air cleaner and the separator.

A single stage turbocharger, fitted between the exhaust manifold and exhaust pipe, is connected by hoses to the air cleaner and to an intercooler mounted on the right of the radiator. The intercooler is connected by a hose to the inlet manifold.

### Fuel system

A 89 litre fuel tank is mounted at the rear of the vehicle beneath the load space floor. The tank is vented by a 2 way valve in the filler cap.

A mechanical lift pump, driven by the camshaft, is mounted on the side of the engine.

A fuel filter, fitted with a replaceable element and incorporating a water separator, is positioned on the LH side of the bulkhead.

A Bosch Type injection pump, incorporating a cold start advance unit and a high idle setting is mounted on the LH side of the engine and is directly driven by gears from the crankshaft. The pump meters and distributes fuel to 4 pintle type injectors located in pre-combustion chambers in the cylinder heads.

A return line passes excess fuel from the injection pump and injectors back to the fuel tank.

### Glow plugs

Four glow plugs are located in the cylinder head, directly below each injector.

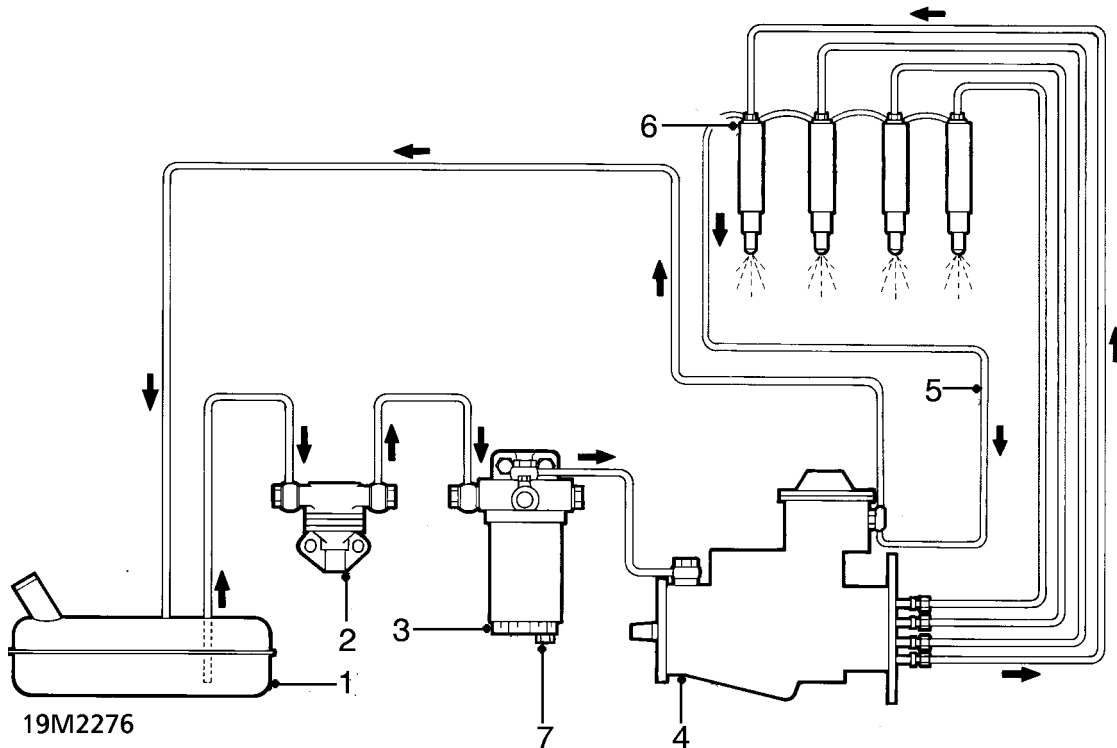
### Exhaust gas recirculation (EGR)

Exhaust gas recirculation is controlled by the EGR control unit mounted in the passenger compartment on the RH 'A' post behind the fascia and receives the following inputs:

- a. Engine temperature from coolant temperature transmitter in No. 4 cylinder head.
- b. Throttle position from the sensor on the injection pump.
- c. Engine speed from the tachometer.
- d. EGR valve lift position.

When all correct signals are received, the EGR solenoid allows vacuum to open the EGR valve and recirculate a portion of the exhaust gas.

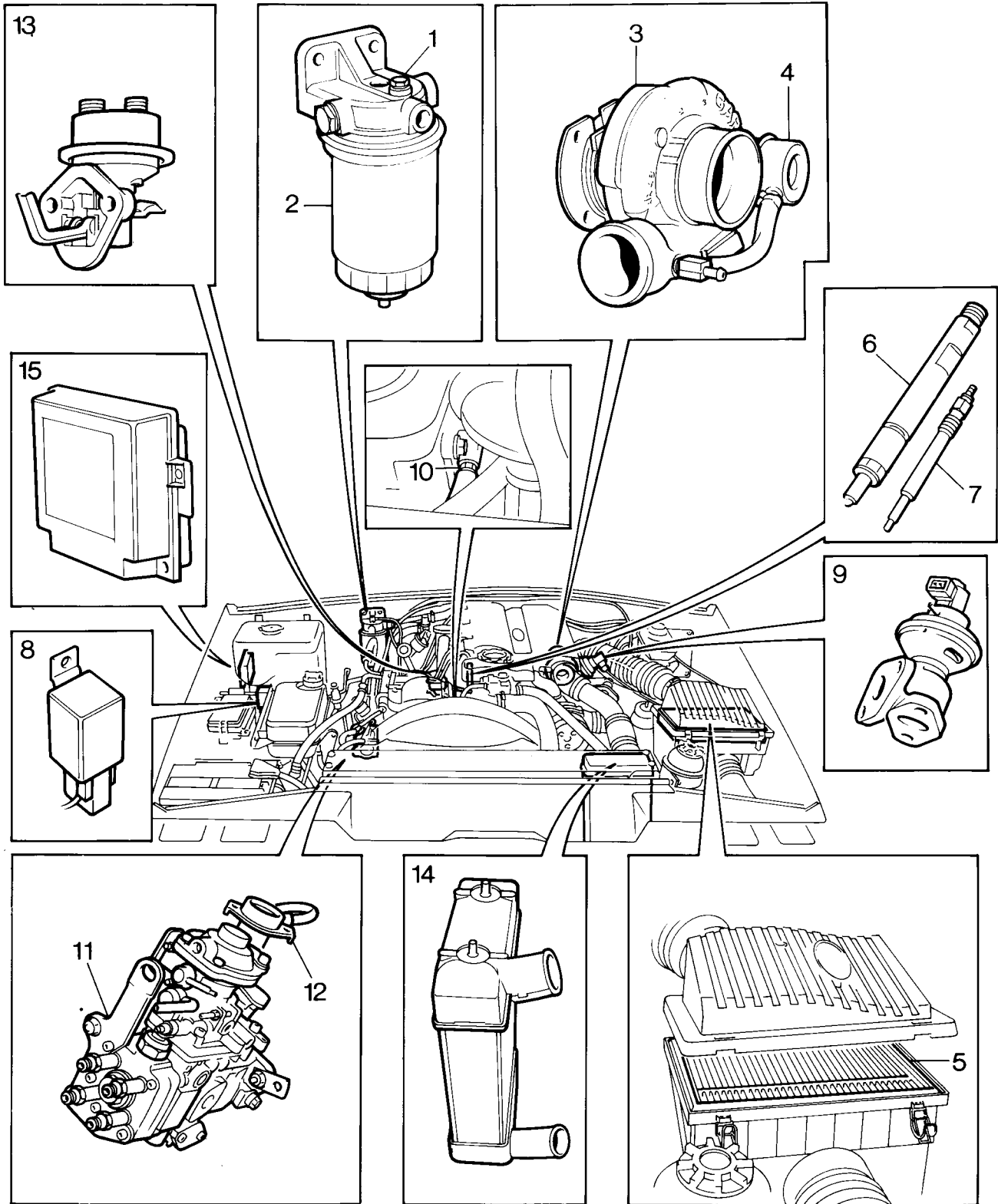
## FUEL SYSTEM LAYOUT



1. Fuel tank
2. Fuel lift pump
3. Fuel filter
4. Fuel injection pump
5. Spill return line
6. Fuel injectors
7. Sediment plug

## FUEL SYSTEM COMPONENT LOCATION

1. Fuel filter bleed screw
2. Fuel filter
3. Turbocharger
4. Wastegate
5. Air cleaner
6. Fuel injector
7. Glow plug
8. Glow plug controller
9. EGR valve and valve lift position sensor
10. Coolant temperature transmitter - EGR and instruments
11. Fuel injection pump
12. EGR throttle position sensor
13. Fuel lift pump
14. Intercooler
15. EGR Control unit



J5456

## OPERATION

Diesel engines operate by compression ignition. The rapid compression of air in the cylinder during the compression cycle heats the injected fuel, causing it to self ignite. During cold starting, automatically controlled glow plugs assist in raising the temperature of the compressed air to ignition point.

A cold start advance unit advances the injection timing to further assist starting. Idle quality is improved by the high idle setting.

The engine is supplied with pre-compressed air by a single stage turbocharger.

Exhaust gases passing over a turbine cause it to rotate, driving a compressor mounted on the turbine shaft. Air drawn from the cold air intake passes, via the air cleaner, to the turbocharger where it is compressed. The compressed air passes to the cylinders via an intercooler, which reduces the temperature of the compressed air, increasing its density.

Fuel is drawn from the tank by a mechanical lift pump and passes to the injection pump via a filter. In addition to removing particle contamination from the fuel, the filter incorporates a water separator, which removes and stores both bound and unbound water.

The injection pump meters a precisely timed, exact quantity of fuel to the injectors in response to throttle variations, injection timing varying with engine speed. Any excess fuel delivered to the injection pump is not injected, passing back to the tank via the fuel return line.

Fuel is injected in a finely atomised form into a pre-combustion chamber in the cylinder head where it ignites. The burning fuel expands rapidly into the main combustion chamber, creating extreme turbulence which mixes the burning fuel thoroughly with the compressed air, providing complete combustion.

Cold Starting is assisted by glow plugs, a cold start advance unit and a high idle setting.

## Glow plugs

Glow plug operation is controlled by a timer unit, start relay and resistor. When the ignition is turned on the timer unit is energised, the glow plugs start to operate and a warning light on the dashboard illuminates, remaining illuminated until the glow plugs are automatically switched off.

The length of time the glow plugs will operate is dependent on under bonnet temperature, which is monitored by a sensor located in the timer unit.

Starting the engine results in the power supply to the glow plugs passing through the resistor, which reduces their operating temperature. The glow plugs are cut out either by the temperature sensor in the timer, or by a microswitch on the injection pump which operates when the throttle is depressed.

## Cold start advance

The cold start advance unit is connected to the engine cooling system via hoses. It contains a temperature sensitive element which is retracted when cold and pulls the advance lever, via cable, towards the rear of the pump against spring pressure. As coolant temperature rises, the cold start element expands releasing tension on the cable and allowing spring pressure to move the advance lever forwards.



## Exhaust Gas Recirculation (EGR)

Operation of the EGR system is dependent on the following:

- a. Engine temperature - must be between 20 °C and 100 °C approx.
- b. Engine speed - must be between 630 and 2850 rev/min.
- c. Engine load - calculated by throttle position sensor.
- d. EGR valve lift position.
- e. Duration of engine idling.

Under varying engine speed and load conditions the control unit sends a signal to open the vacuum modulator which allows a vacuum to be applied above the EGR valve diaphragm, the vacuum supply being taken from a 'T' connector in the brake servo hose. This process is controlled by an engine speed/load map stored in the EGR control unit memory.

Engine speed is measured by monitoring the waveform present on one phase of the generator. Throttle position is measured via a sensor mounted on the fuel injection pump throttle lever. Closed loop control is achieved by allowing the control unit to continually monitor EGR valve lift via a position sensor mounted on the valve; this valve lift is compared with the actual valve lift required on the control unit map and adjusted if necessary.

With coolant temperature between 20 °C and 100 °C; the engine having just returned to idle, EGR will shut off after 25-30 seconds idling.

**DESCRIPTION ELECTRONIC DIESEL CONTROL**

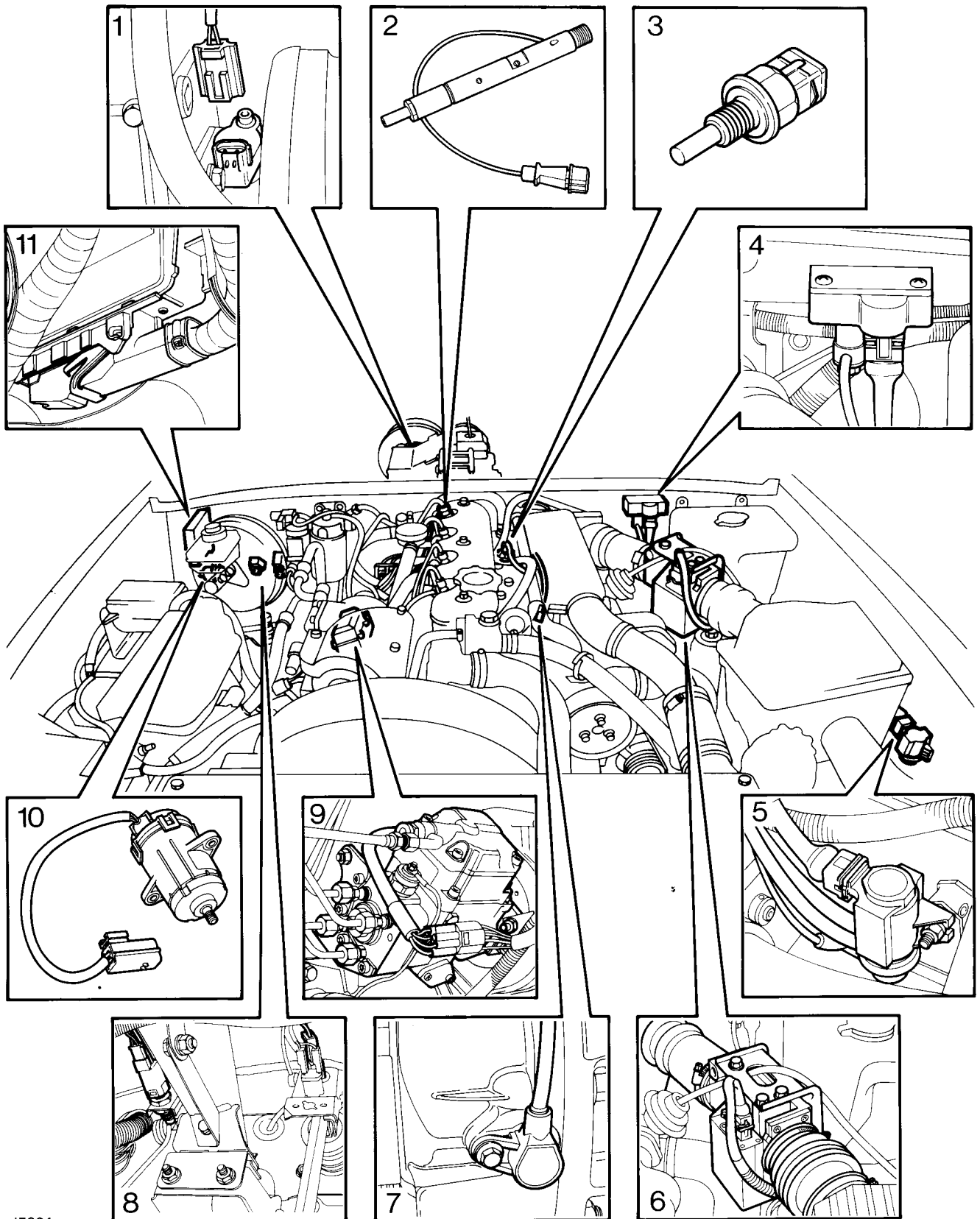
The Electronic Diesel Control (EDC) 'drive by wire' system derives its from the replacement of conventional mechanical controls by electronic components.

The EDC system supplies the exact amount of fuel to the engine according to the prevailing engine operating conditions. To monitor these conditions, sensors are fitted to the engine to measure engine parameters. Data from the sensors is received by the Engine Control Module (ECM) which determines the exact amount of fuel, injection timing and Exhaust Gas Recirculation (EGR) required for any running condition.

Safety and emergency features are built into the system which protect the engine against overspeed and overheating damage. In the event of component failure the system is designed to compensate and allow emergency start and limp home facilities to operate. The ECM does this by substituting a default value for the failed component which may result in a noticeable loss in power but keeps the engine running.

**FUEL SYSTEM COMPONENT LOCATION EDC**

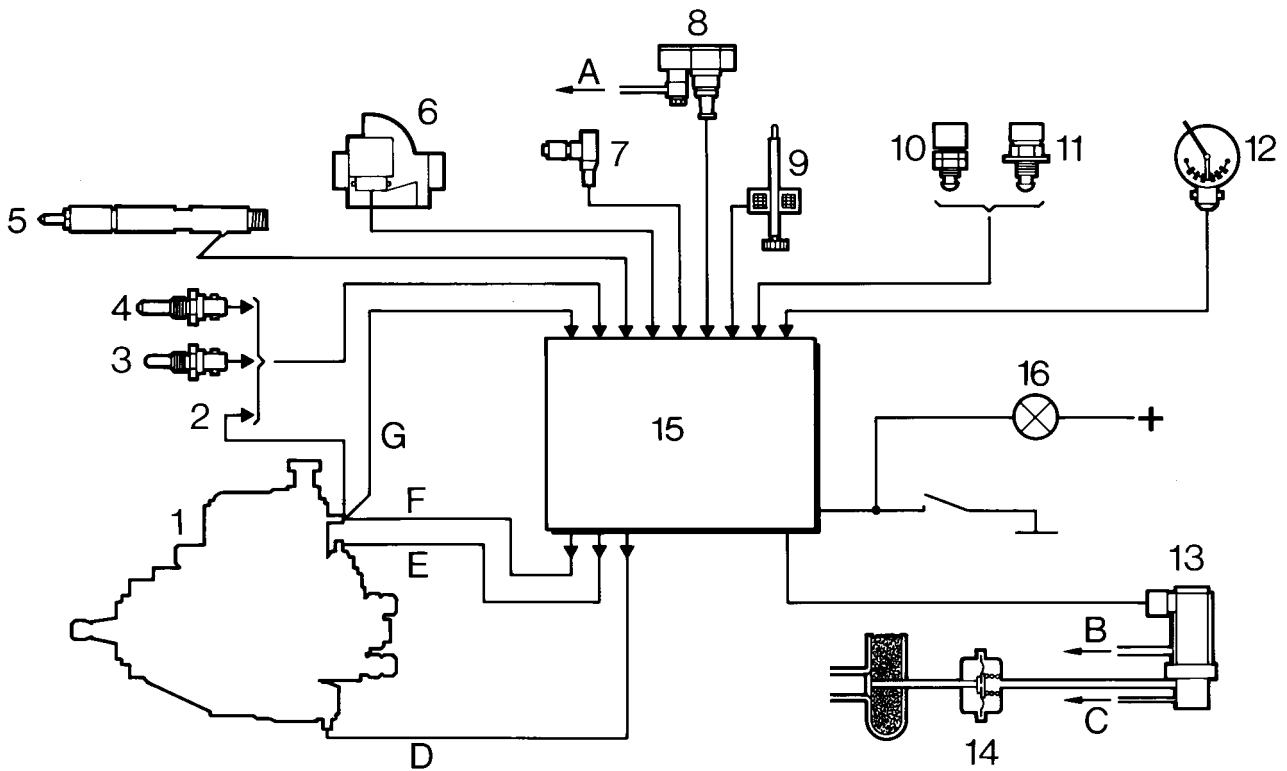
1. Vehicle speed sensor
2. No. 4 injector sensor
3. Coolant temperature sensor
4. Boost pressure sensor
5. Electro-pneumatic modulator
6. Airflow sensor
7. Engine speed sensor
8. Brake/clutch switches
9. Injector pump
10. Throttle position sensor
11. Engine control module



J5921



## FUEL SYSTEM LAYOUT EDC



J5920

1. Fuel injection pump
  2. Fuel temperature sensor
  3. Air temperature sensor
  4. Water temperature sensor
  5. No. 4 injector sensor
  6. Air flow sensor
  7. Engine speed sensor
  8. Boost pressure sensor
  9. Vehicle speed sensor
  10. Clutch switch
  11. Brake switch
  12. Throttle position sensor
  13. Electro-pneumatic modulator
  14. Exhaust gas recirculation (EGR) valve
  15. Engine control module (ECM)
  16. Diagnostic indicator
- A. To turbo  
 B. To air box.  
 C. To 'T' piece on brake servo hose position  
 D. Solenoid operated valve energization timing device.  
 E. Fuel cut off  
 F. Actuator current  
 G. Control collar



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## OPERATION EDC

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Under start up conditions, signals from the crank speed and water temperature sensors are relayed to the ECM to control starting fuel quantity and injection timing. Once the engine has started the ECM initiates a 'closed loop' monitoring system for fuel quantity, injector timing and EGR relative to the appropriate engine operating conditions.

As driver demand increases, signals from the throttle position sensor are received by the ECM together with crank speed and position pulses. The ECM signals the injection pump to adjust fuel quantity and timing relative to driver demand.

As engine coolant, fuel and air temperature changes the ECM will correct fuel delivery and injection timing for more efficient and accurate running. The ECM will also make corrections for atmospheric pressure on injection timing and EGR.

### Electronic Control Unit (ECM)

The EDC system is controlled by the ECM located in the drivers footwell on the 'A' post beneath the fascia. The unit consists of a microprocessor with integrated circuits and components and is connected to the main harness by a 55 pin plug.

Inputs to the ECM from engine sensors control start of injection, injected fuel quantity, fuel cut-off and EGR.

The ECM will also make corrections for engine coolant, fuel and air temperature and atmospheric pressure.

### Injection pump

The injection pump incorporates actuator controlled injected fuel quantity and solenoid operated timing which operate in response to ECM signals against driver demand, engine speed, temperature and boost pressure.

A fuel cut-off facility and fuel temperature sensor is incorporated in the pump.

### Injection timing sensor

An inductive sensor in No 4 injector body monitors needle movement. This forms part of a 'closed loop' system to control start of injection.

The system measures timing, relating the needle movement signal to crank position (determined by flywheel pulses from the engine speed sensor).

### Air flow sensor

The Air Flow Sensor is mounted on a bracket attached to the wheel arch valance, and connected by hose to the air cleaner and turbo charger inlet.

The unit consists of a flap valve airflow sensor which measures the fresh air flow into the engine. The sensor informs the ECM and, provided that the other conditions are met, will implement EGR.

### Engine speed sensor

The engine speed sensor is an active inductive sensor mounted on the flywheel housing. Pulses from the sensor activated by radial slots in the flywheel give engine speed and position information to the ECM.

**Vehicle speed sensor**

The vehicle speed sensor is located on the transfer box behind the transmission brake. The unit has a multirole as the vehicle electronic speedometer sensor and as a sensor for 'surge damping', (a function which smooths out engine response to sharp accelerator movement and reduces vehicle 'bucking').

The sensor is an additional input for engine overheat protection.

**Brake and clutch switches**

The brake and clutch switches are located on the pedal box and serve as safety features to the system. They return information to the ECM which limits maximum fuel quantity under braking.

**Throttle position sensor**

The accelerator pedal is connected directly to a sensor mounted in the pedal box. Driver demand is relayed back to the ECM to increase or decrease injected fuel quantity.

Incorporated in the sensor is a backup idle switch which the system will default to in the event of sensor failure.

**Boost pressure sensor**

The boost pressure sensor is mounted on the bulkhead. It relays boost pressure information to the ECM which compensates fuel quantity to reduce smoke during acceleration.

**Electro-pneumatic modulator**

The electro-pneumatic modulator is located on the inner wing just forward of the air cleaner. It regulates vacuum signals from the source to the EGR valve. The ECM controls the modulator to open the EGR valve according to required airflow.

**Exhaust gas recirculation valve**

The EGR valve is located on the engine exhaust manifold and is controlled by vacuum from the electro-pneumatic modulator.

Once open the EGR valve directs a quantity of exhaust gas back into the inlet manifold to be burnt inside the engine. This reduces NO<sub>x</sub> (Oxides of nitrogen) emissions of the engine.

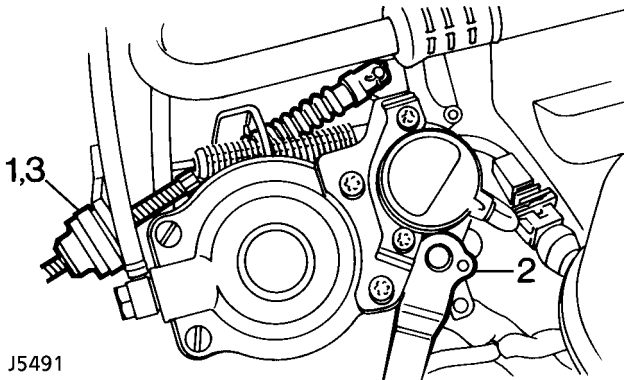
**Temperature sensors**

Water, Fuel and Air temperature sensors monitor engine conditions and relay their information back to the ECM which makes adjustments to injected fuel quantity, injection timing, EGR and corrections to measured boost pressure and airflow.



## THROTTLE CABLE

### Adjust



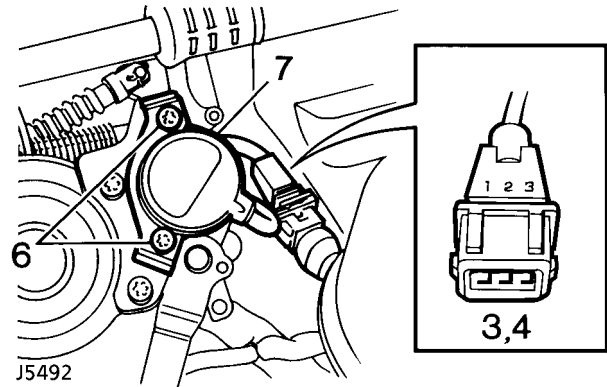
J5491

1. Loosen throttle cable adjustment ferrule.
2. Hold throttle lever in fully closed position.
3. Adjust outer cable, by rotating ferrule, to give 1.57 mm (0.062 in) of free play in the inner cable.
4. Check that throttle opens fully when the throttle is depressed.

## EGR THROTTLE POSITION SENSOR

### Check

1. Run engine until normal operating temperature is reached.



J5492

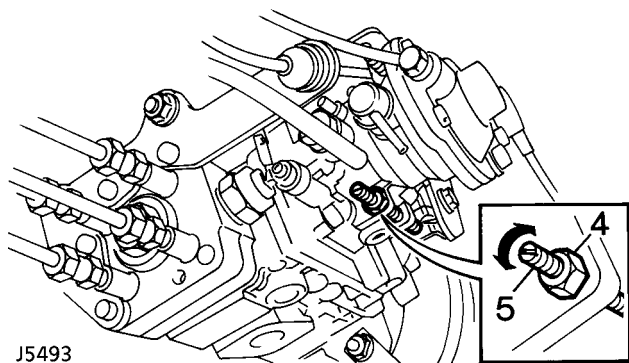
2. Switch off engine and disconnect sensor multiplug.
3. Connect an Ohmmeter across pins 1 and 3 of multiplug. Ohmmeter should read between 1K and 1.05K ohms.
4. Connect an Ohmmeter across pins 1 and 2 of multiplug. Ohmmeter should read between 850 and 900 ohms.
5. If the readings are correct, EGR throttle position sensor is Ok - reconnect multiplug.
6. Loosen 2 Torx screws securing sensor.
7. Rotate sensor to achieve correct Ohmmeter readings, then tighten Torx screws.
8. Re-check Ohmmeter readings, then reconnect multiplug.

## LOW AND HIGH IDLE SPEED

### Adjust

The high idle speed (cold start idle) is automatically set by the setting of the low idle speed and can not be adjusted individually.

1. Check and adjust throttle cable.
2. Start engine and run it until normal operating temperature is reached.
3. Using a suitable tachometer, check the engine idle speed. **See ENGINE TUNING DATA, Information, 300 Tdi Engine**



J5493

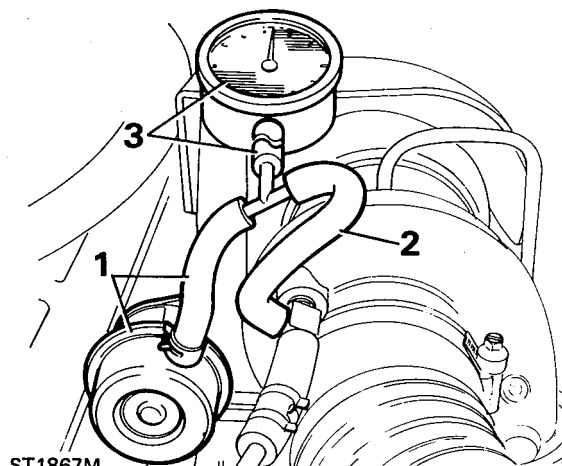
4. If adjustment is necessary, loosen the locknut on the injector pump.
5. Turn the adjustment screw either clockwise to increase the engine speed or anti-clockwise to decrease the speed. Run the engine at an increased speed for a few seconds then check the idle speed again.
6. When the correct speed has been achieved, hold the adjuster screw steady while tightening the locknut.



**NOTE:** The low idle speed control is the only permitted adjustment in service. Any additional adjustments required must be entrusted to authorised Bosch agents.

## CHECK TURBOCHARGER BOOST PRESSURE

For boost pressure. **See ENGINE TUNING DATA, Information, 300 Tdi Engine**



ST1867M

1. Disconnect, from turbocharger, hose to actuator. Insert into a suitable "T" piece.
2. Connect a short length of suitable hose to turbocharger and connect other end to "T" piece.
3. Connect a further length of hose to third leg of the "T" piece and other end to a pressure gauge capable of reading in excess of 61 cm Hg. The pressure gauge hose must be capable of reaching passenger compartment so that gauge may be observed.
4. To check maximum boost pressure, drive vehicle normally but in such a manner that full throttle can be maintained whilst climbing a hill with engine speed held steady between 2,500 and 3,000 rev/min.



## TANK SENDER UNIT

Service repair no - 88.25.32



**WARNING:** Ensure that the **WARNINGS** and **FUEL HANDLING PRECAUTIONS** given in Section 01 are adhered to before carrying out the following operations.

Special tool - LST131

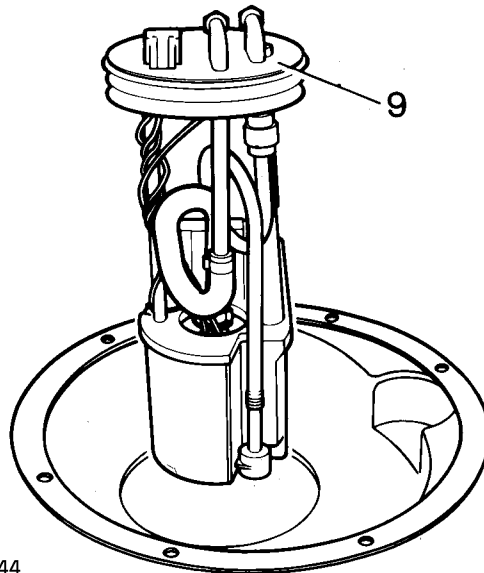
### Remove

1. Disconnect battery negative lead.
2. Remove the rear carpet retainer.
3. Ease the carpet from under the lower trim panels at the rear of the fold down seats.
4. Raise the carpet to expose the sound insulation.
5. Fold back the sound insulation to reveal the access panel.
6. Remove the securing screws and detach the access panel from the floor.
7. Disconnect the multi-plug from sender unit.

8. Disconnect the fuel pipes from the sender unit.
9. Using special tool LST131 remove the locking ring and withdraw the sender unit from the fuel tank.

### Refit

10. Fit the sender unit to the fuel tank and secure with the locking ring. Tighten to **45 to 50 Nm**.
11. Connect the fuel pipes to the sender unit.
12. Connect multi-plug to sender unit.
13. Inspect the access panel seal to ensure that it is satisfactory for further use, renew as necessary.
14. Fit the access panel to the aperture in the floor and secure with the screws.
15. Reverse removal procedure. 1 to 5. Refit the sound insulation and carpet.



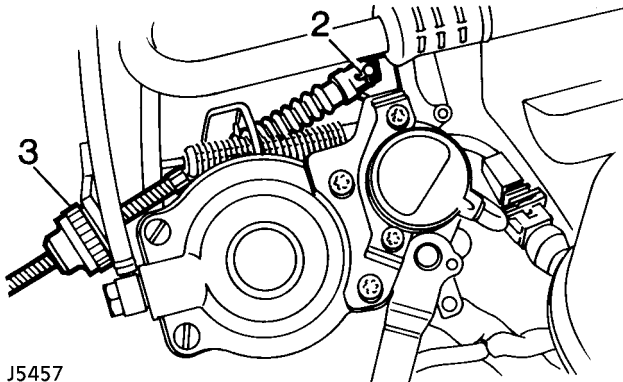
J5444

## THROTTLE CABLE

Service repair no - 19.20.06

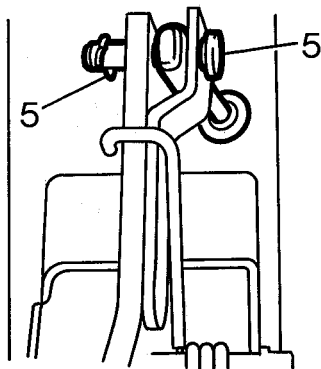
### Remove

1. Disconnect battery negative lead.



J5457

2. Remove pin and clevis pin securing throttle cable to throttle lever.
3. Pull ferrule from abutment bracket and withdraw throttle cable.
4. Release throttle cable from clip on bulkhead.



J5458

5. Remove pin and clevis pin securing throttle cable to throttle lever.
6. Release grommet from bulkhead.
7. Withdraw throttle cable from engine compartment.

### Refit

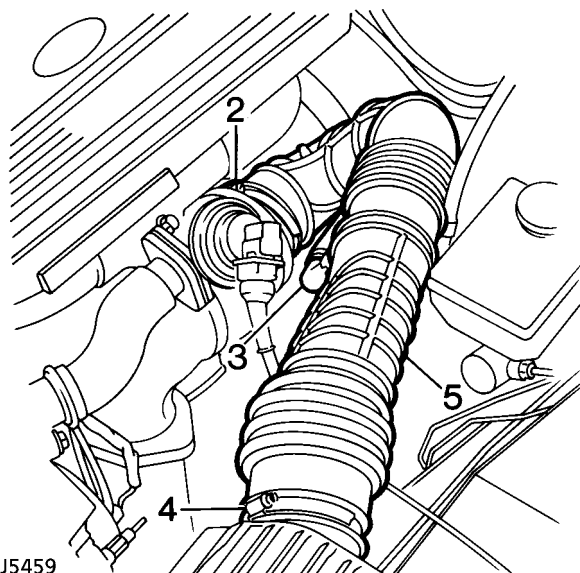
8. Reverse removal procedure. Use new pins to secure clevis pins.
9. Adjust throttle cable. **See Adjustment, Throttle Cable**

## INTAKE HOSE TURBOCHARGER

Service repair no - 19.42.11

### Remove

1. Disconnect battery negative lead.



J5459

2. Loosen clip and disconnect intake hose from turbocharger.
3. Loosen clip and disconnect breather hose from intake hose.
4. Remove clip and disconnect hose from air cleaner, discard clip.
5. Remove intake hose

### Refit

6. Reverse removal procedure. Use a new clip to secure intake hose to air cleaner.

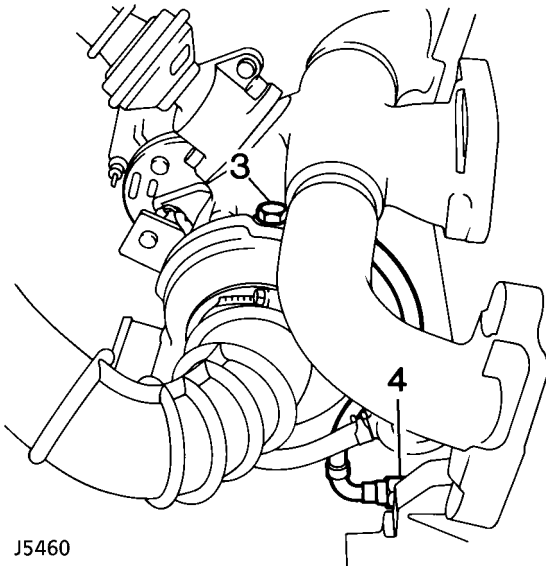


## TURBOCHARGER OIL FEED PIPE

Service repair no - 19.42.14

### Remove

1. Disconnect battery negative lead.
2. Remove exhaust front pipe. **See MANIFOLD AND EXHAUST SYSTEM, Repair, Manifold and Exhaust System - Tdi**



J5460

3. Remove banjo bolt securing oil feed pipe to turbocharger, discard 2 sealing washers.
4. Unscrew union, disconnect oil feed pipe from cylinder block.



**CAUTION: Plug the connections.**

5. Move oil feed pipe from behind turbocharger and remove.

### Refit

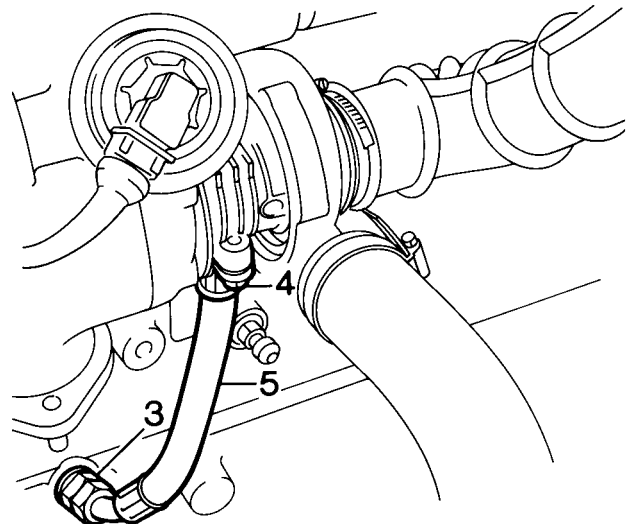
6. Reverse removal procedure. use new sealing washers.
7. Tighten banjo bolt to **20 Nm**.
8. Check/top-up engine oil level.

## TURBOCHARGER OIL DRAIN PIPE

Service repair no - 19.42.12

### Remove

1. Disconnect battery negative lead.
2. Remove exhaust front pipe. **See MANIFOLD AND EXHAUST SYSTEM, Repair, Manifold and Exhaust System - Tdi**



J5461

3. Unscrew union and disconnect oil drain pipe from cylinder lock.
4. Remove 2 bolts securing oil drain pipe to turbocharger.
5. Remove oil drain pipe, remove and discard gasket.



**CAUTION: Plug the connection.**

### Refit

6. Ensure mating surfaces of oil pipe, turbocharger and engine block are clean.
7. Reverse removal procedure. Use a new gasket.
8. Tighten oil drain pipe to turbocharger bolts to **25 Nm**.
9. Check/top-up engine oil level.

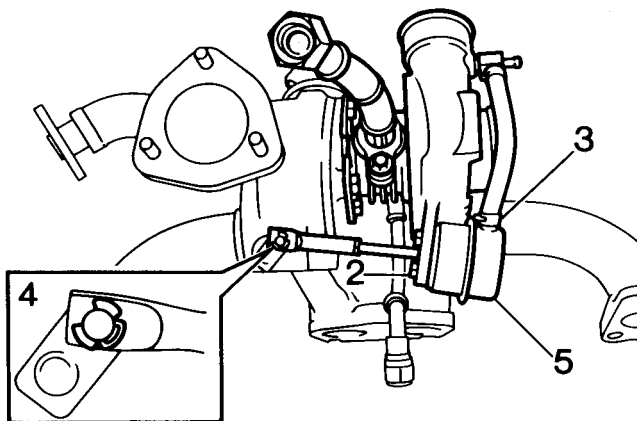


## TURBOCHARGER ACTUATOR

Service repair no - 19.42.31

### Remove

1. Remove exhaust manifold and turbocharger.  
**See MANIFOLD AND EXHAUST SYSTEM, Repair, Exhaust Manifold - Tdi**



J5488

2. Remove 2 nuts securing the actuator to the turbocharger bracket.
3. Release clip and disconnect hose from actuator.
4. Remove and discard clip securing control lever to wastegate spindle.
5. Remove turbocharger actuator.

### Refit

6. Fit the replacement actuator and secure with nuts.
7. Push the control lever as far as possible towards the actuator and apply pressure to keep the lever in this position.
8. Pressurise the actuator to 57 - 62 cm Hg and hold this pressure.



**CAUTION:** Use only the threaded end of the lever to make adjustments. Forcing the complete lever in or out will change the calibration with the possibility of damaging engine boost.

9. Screw the lever in either direction until the eye on the end will locate easily over the wastegate spindle and secure with a new clip.
10. Release the pressure and tighten the locknut.
11. Refit exhaust manifold and turbocharger. **See MANIFOLD AND EXHAUST SYSTEM, Repair, Exhaust Manifold - Tdi**

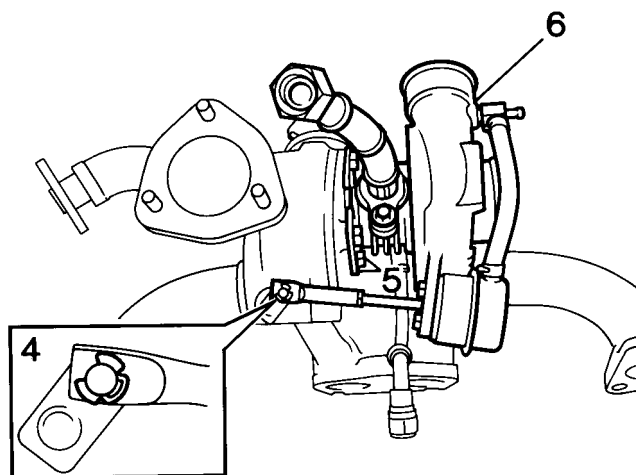
## TURBOCHARGER AND GASKET

Service repair no - Turbocharger - 19.42.01

Service repair no - Gasket - 19.42.25

### Remove

1. Disconnect battery negative lead.
2. Remove air cleaner assembly. **See Air Cleaner**
3. Remove exhaust manifold assembly. **See MANIFOLD AND EXHAUST SYSTEM, Repair, Exhaust Manifold - Tdi**



J5469

4. Remove and discard clip securing control lever to wastegate spindle.
5. Remove 4 bolts and 2 clamp plates securing turbocharger to exhaust manifold.
6. Remove turbocharger and discard gaskets.

### Refit

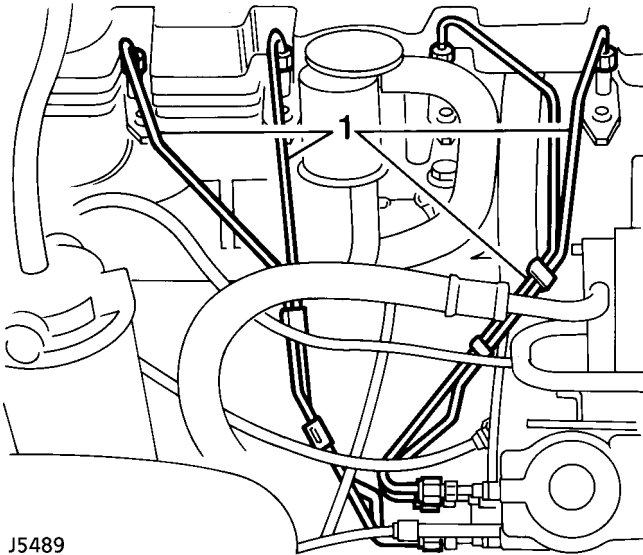
7. Clean mating faces of turbocharger and exhaust manifold.
8. Reverse removal procedure. Use new clip to secure control lever to wastegate spindle. Tighten to **45 Nm**.
9. Check/top-up engine oil level.



## FUEL LIFT PUMP

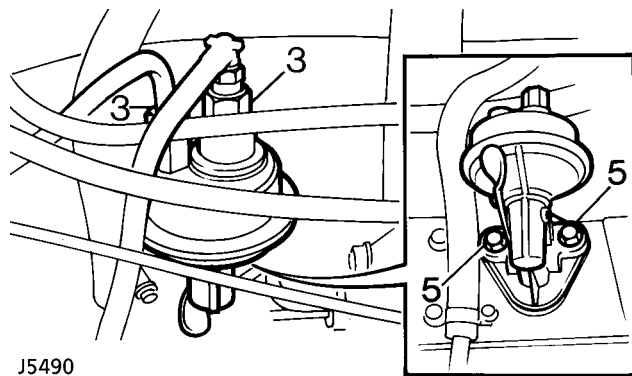
Service repair no - 19.45.09

### Remove



J5489

1. Loosen unions securing fuel injection pipes to injectors and injector pump. Remove injection pipes.
2. Plug the connections to prevent the ingress of foreign material.



J5490

3. Loosen unions and disconnect fuel supply and feed hoses from fuel lift pump.
4. Plug the connections to prevent the ingress of foreign material.
5. Remove 2 bolts securing lift pump to engine block.
6. Remove fuel lift pump and discard gasket.

### Refit

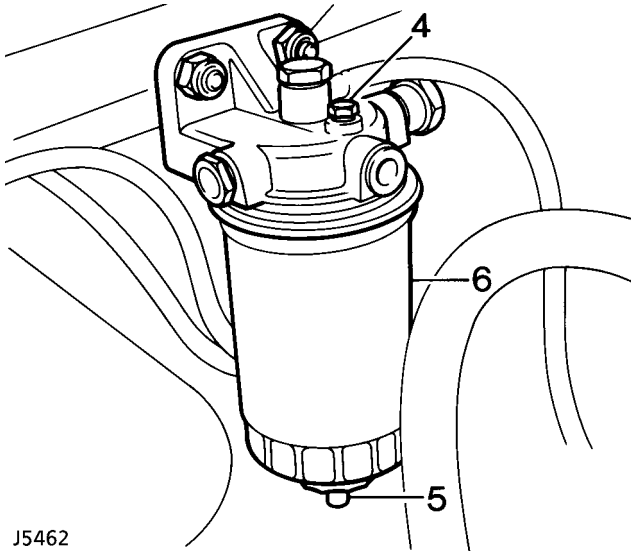
7. Clean mating faces of fuel lift pump and engine block.
8. Using a new gasket, fit fuel pump, ensure correct location of lever with camshaft. Fit securing bolts. Tighten to **25 Nm**.
9. Connect fuel hoses to pump and secure unions. Tighten to **33 Nm**.
10. Fit injector pipes to injectors and injection pump, and secure unions. Tighten to **28 Nm**.

## FUEL FILTER ELEMENT

Service repair no - 19.25.07

### Remove

1. Disconnect battery negative lead.
2. Clean area around filter head.
3. Place a suitable container beneath filter bowl to collect any spillage.



J5462

4. Loosen bleed screw.
5. Loosen drain tap, allow fuel to drain into container.
6. Unscrew filter element, discard element.

### Refit

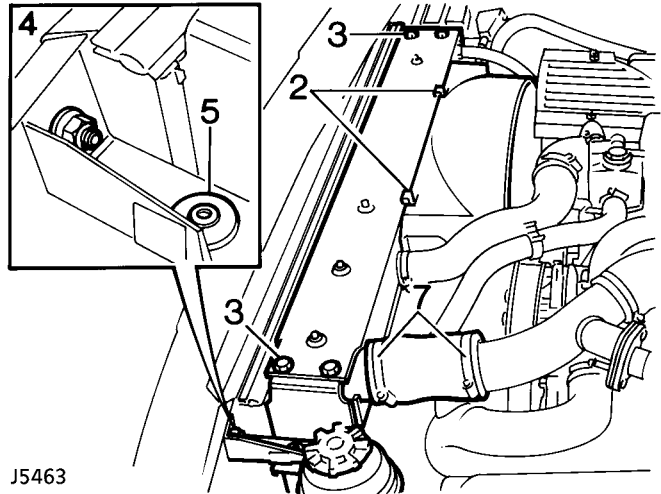
7. Clean seal and seating in filter head.
8. Lubricate filter element seal with fuel.
9. Position filter element to filter head and hand tighten.
10. Reconnect battery negative lead.
11. Crank engine until fuel is drawn through the system and starts.

## INTERCOOLER

Service repair no - 19.42.15

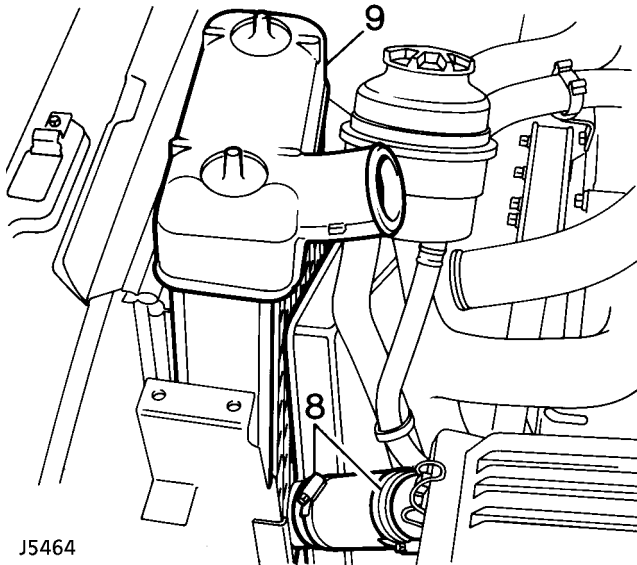
### Remove

1. Disconnect battery negative lead.



J5463

2. Release 2 clips securing fan cowl to radiator top cover.
3. Remove 4 bolts securing radiator top cover, remove top cover.
4. Remove nut, bolt and washers securing intercooler side cover bracket to bonnet [hood] platform.
5. Release bracket from side cover lug, position bracket and power steering reservoir aside.
6. Position side cover away from intercooler.
7. Loosen 2 clips and disconnect top hose from intercooler.
8. Loosen 2 clips and disconnect bottom hose from intercooler.



J5464

9. Move intercooler upwards and clear of fan cowl.

#### Refit

10. Ensure locating lug grommets are fitted and in good condition.
11. Ensure foam pad is in good condition and attached to intercooler.
12. Move intercooler into position.
13. Reverse removal procedure.

## GLOW PLUGS

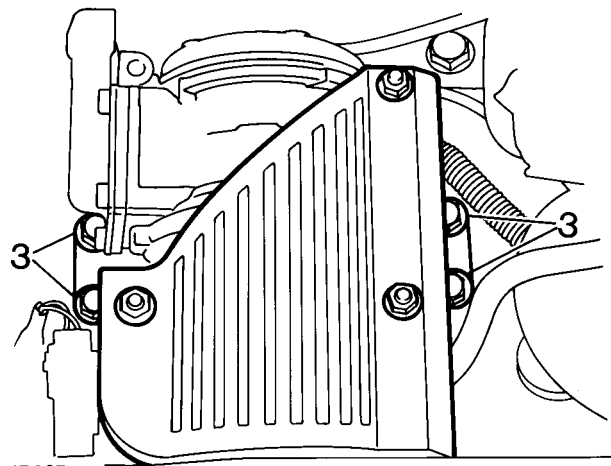
Service repair no - 19.60.31

### Remove

1. Disconnect battery negative lead.

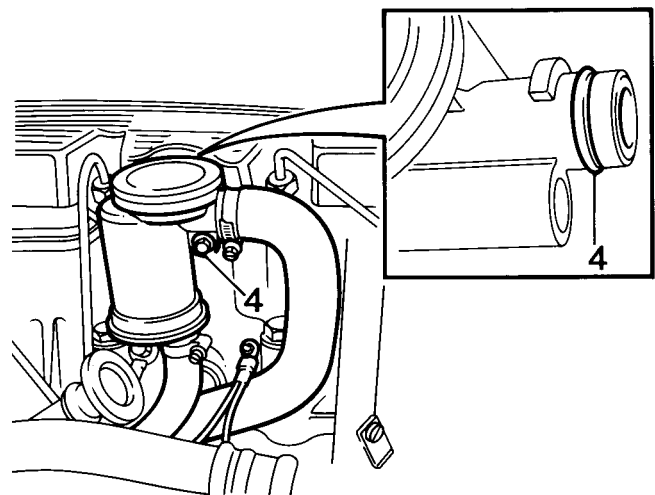
*No.1 glow plug - air conditioning models*

2. Release drive belt from compressor pulley. **See ENGINE, Repair, Drive Belt Renew**



J5465

3. Remove 4 bolts securing compressor to front cover, move compressor aside.

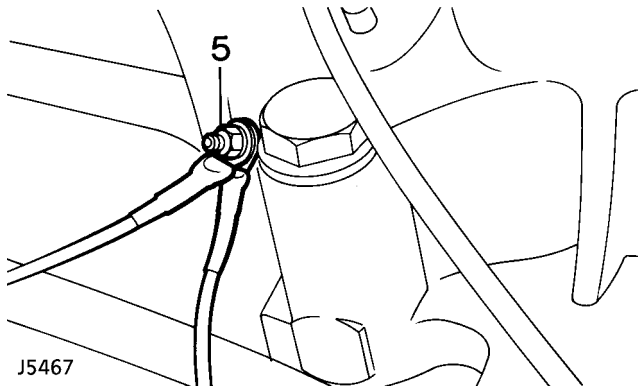


J5466

*No.3 glow plug*

4. Remove bolt securing Hummel valve, withdraw valve, remove and discard 'O' ring.

All glow plugs



J5467

5. Remove terminal nut from glow plug, disconnect wire from glow plug terminal.
6. Remove glow plug.

### Refit

7. Clean glow plug and seating.
8. Coat threads of glow plug with suitable anti-seize compound operational to a temperature of 1000°C.
9. Fit glow plug. Tighten to **23 Nm**.
10. Connect wire to glow plug terminal and secure with nut.



**NOTE: Feed wire must be connected to No. 4 glow plug terminal.**

11. *No. 3 glow plug:* Lubricate new 'O' ring with engine oil and fit to Hummel valve. Fit valve and secure with bolt. Tighten to **15 Nm**.

*No. 1 glow plug - air conditioning models*

12. Position compressor to front cover, fit bolts. Tighten to **25 Nm**.
13. Fit drive belt to compressor pulley and adjust tension. **See ENGINE, Repair, Drive Belt Renew**

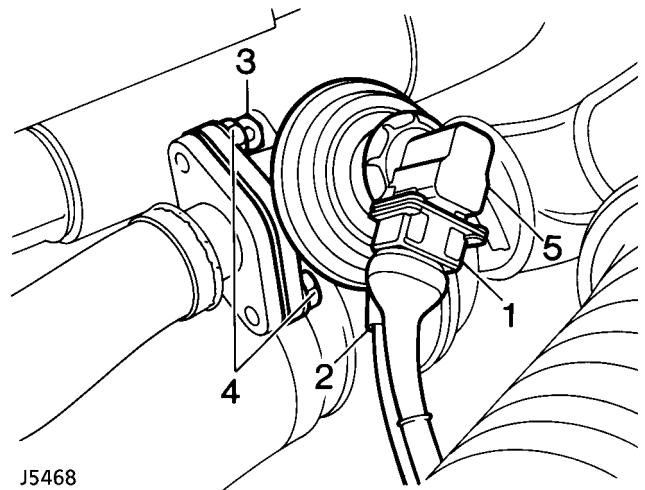
All models

14. Reconnect battery negative lead.

## EGR VALVE

Service repair no - 19.45.01

### Remove



J5468

1. Disconnect multiplug from EGR valve.
2. Disconnect vacuum pipe from EGR valve.
3. Remove 2 Allen screws securing EGR valve to exhaust manifold.
4. Remove 2 bolts securing hose to EGR valve.
5. Remove EGR valve and discard gaskets.

### Refit

6. Clean mating faces of EGR valve and exhaust manifold.
7. Reverse removal procedure. Tighten bolts to **25 Nm**.

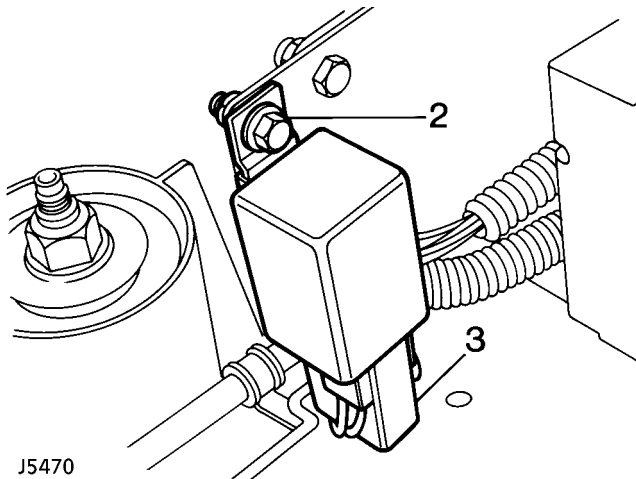


## GLOW PLUG CONTROL UNIT

Service repair no - 19.60.33

### Remove

1. Disconnect battery negative lead.



J5470

2. Remove nut and bolt securing control unit to mounting bracket.
3. Disconnect multiplug and remove control unit.

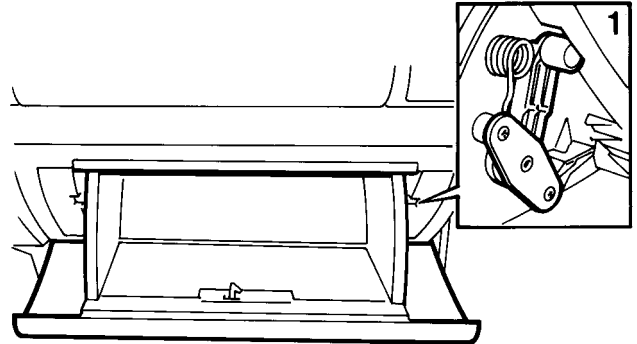
### Refit

4. Reverse removal procedure.

## EGR CONTROL UNIT

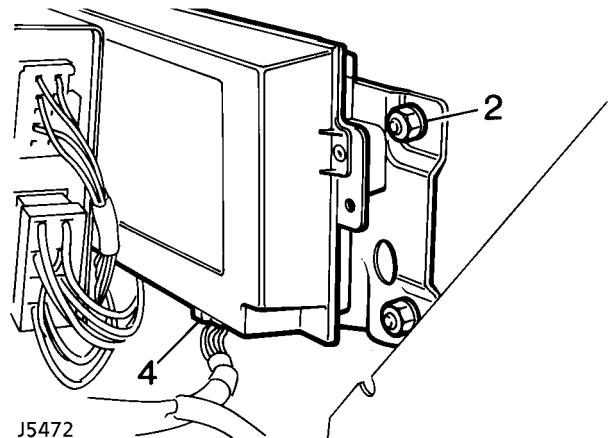
Service repair no - 19.45.06

### Remove



J5471

1. Release 2 glovebox stays from fascia and pivot glovebox fully downwards.



J5472

2. Remove 2 plastic nuts securing control unit to body.
3. Release control unit from fixings.
4. Disconnect multiplug and remove control unit.

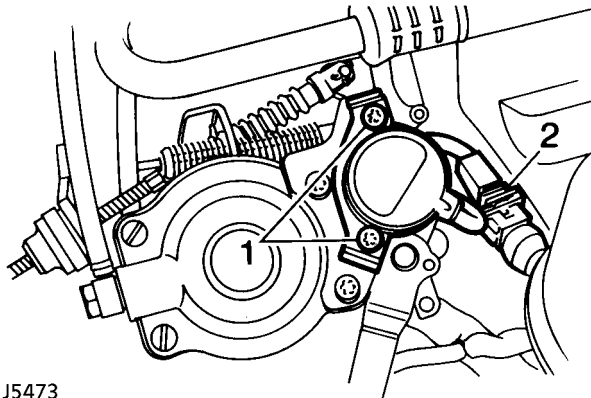
### Refit

5. Reverse removal procedure.

## EGR THROTTLE POSITION SENSOR

Service repair no - 19.30.14

### Remove



J5473

1. Remove 2 screws securing sensor mounting plate to injection pump.
2. Disconnect sensor multiplug from harness.
3. Remove sensor assembly.

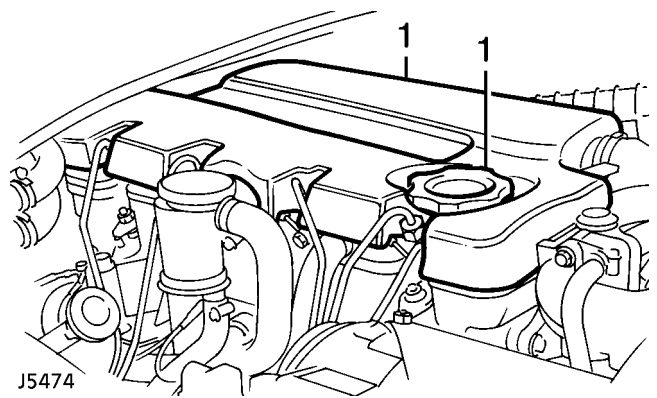
### Refit

4. Position sensor assembly on injection pump and fit and tighten screws.
5. Connect multiplug.
6. Adjust sensor. **See Adjustment, EGR Throttle Position Sensor**

## INJECTORS

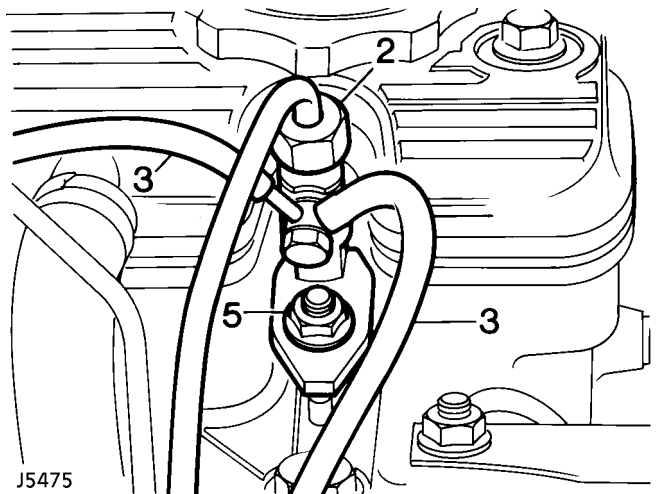
Service repair no - 19.60.10

### Remove



J5474

1. Remove oil filler cap and remove sound deadening pad from top of engine.
2. Remove high pressure pipe from relevant injector and injection pump.
3. Disconnect spill return hose(s) from injector.
4. Plug pipes and injector connections to prevent the ingress of dirt and foreign matter.
5. Remove nut securing injector clamp plate to cylinder head.
6. Remove injector.



J5475

### Refit

7. Reverse removal procedure. Renew copper washer on injector. Tighten injector clamp plate nut to **25 Nm**.



## FUEL INJECTION PUMP AND TIMING

Service repair no - 19.30.07

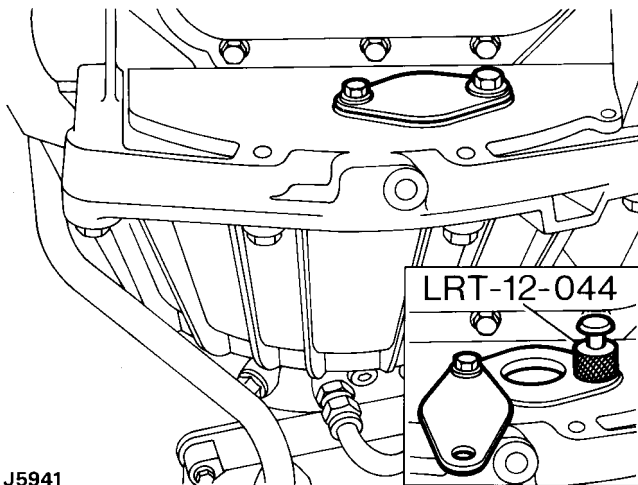


**NOTE:** The following text refers to a Tdi vehicle with a manual gearbox without electronic diesel control. Where reference is made to the timing tool substitute the following information for automatic and EDC variants.

**If manual gearbox:** Timing tool LRT-12-044 fits into the base of the flywheel housing

**If manual gearbox with EDC:** Timing tool LRT-12-085 must be used and also fits into the base of the flywheel housing.

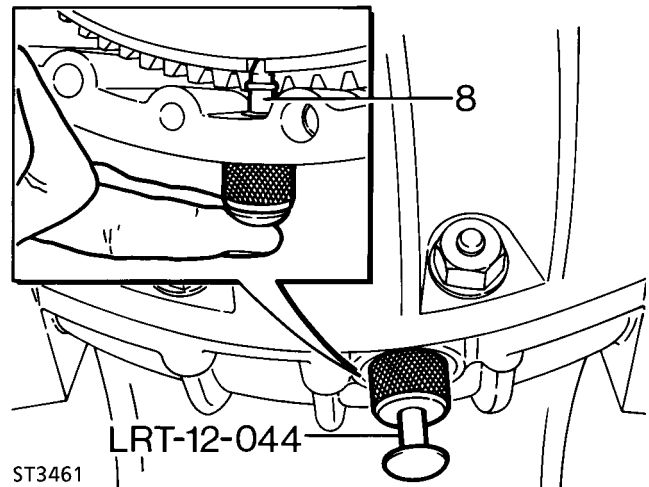
**If automatic gearbox:** Timing tool LRT-12-044 fits into the larger bolt hole of coverplate on engine backplate, sited near to the rear of sump. Pin locates in ring gear.



J5941

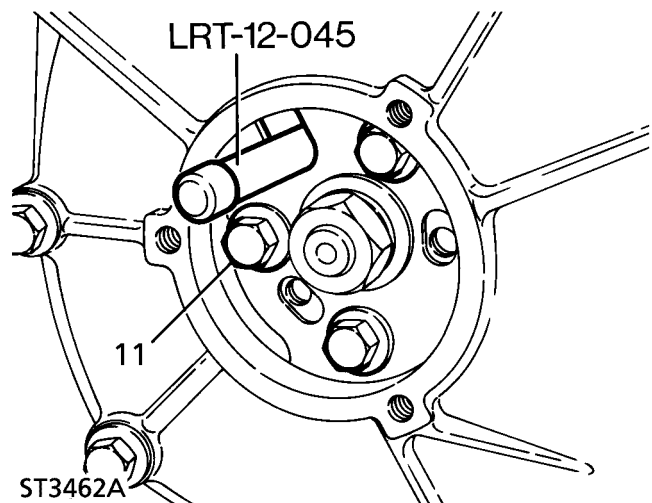
### Remove

1. Disconnect battery negative lead.
2. Remove injection pipes, pump to injector.
3. Remove oil filler cap from rocker cover.
4. Viewing valve mechanism through filler aperture, turn crankshaft clockwise until No. 1 cylinder is just before TDC.
5. Refit oil filler cap.
6. Remove blanking plug from flywheel housing.
7. Fit timing tool LRT-12-044 to flywheel housing, do not engage centre pin.



ST3461

8. Continue rotating crankshaft clockwise until centre pin engages with timing slot in flywheel.
9. Remove injection pump access plate, complete with gasket, from front cover plate.
10. Fit pin from LRT-12-045 to injection pump gear.



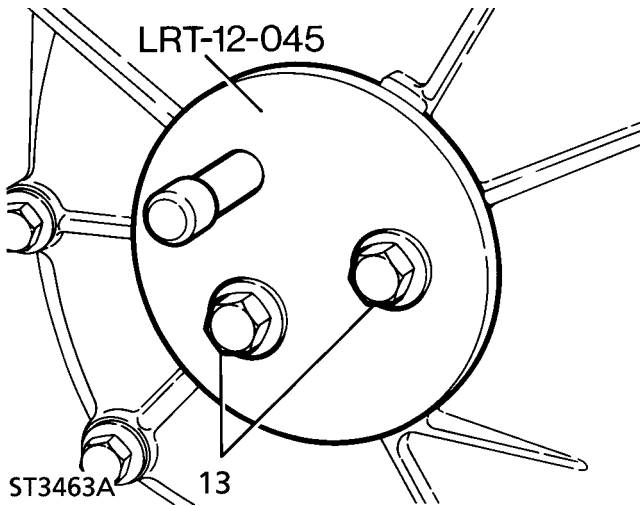
ST3462A

11. Remove drive gear to pump hub fixing bolts and plate.



# 19 FUEL SYSTEM

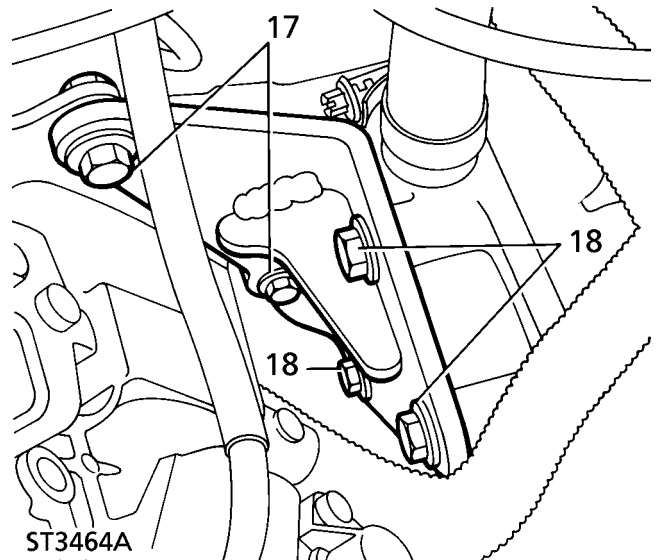
12. Remove pin from pump gear.



13. Fit gear retaining tool LRT-12-045 with an 8 mm washer, 1.5 to 2 mm thick, under each bolt head in addition to the existing washer.
14. Remove throttle cable and hand throttle cable if fitted.

15. Disconnect stop control solenoid connector.

16. Remove banjo bolts securing spill return, main fuel and boost signal pipes, refit banjo bolts after disconnecting pipes.

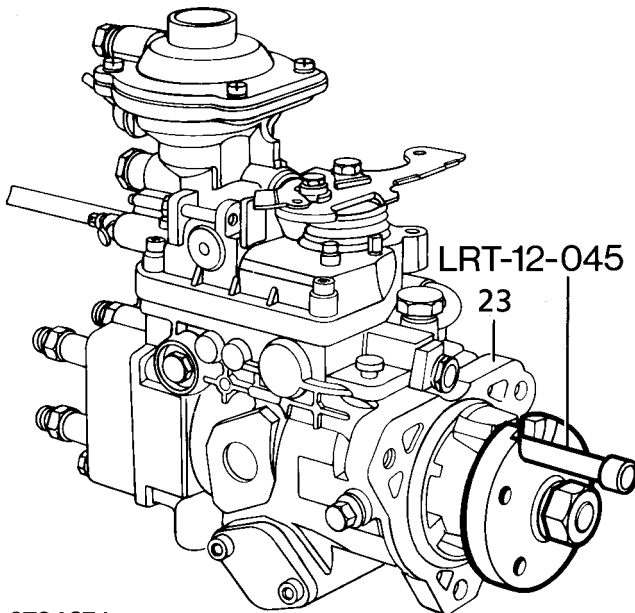


17. Remove pump mounting bracket bolts 2 off.
18. Loosen pump support bracket bolts to block, sufficient for bracket to just move.
19. Remove pump securing nuts at flange and withdraw pump and gasket.
20. Fit blanks to pipe connections.



## Refit

21. Remove blanks from pump.



ST3467A

22. Remove special tool pin from pump.
23. Clean mating faces of pump and front cover.
24. Fit pump to cover with a new gasket and secure with nuts. Tighten to **25 Nm**.
25. Attach pump to bracket and finger tighten nuts and bolts
26. First tighten bolts securing bracket to block and then bolts securing pump to bracket.
27. Connect spill return, main fuel pipes. Tighten to **25 Nm**.
28. Connect boost signal pipe and secure with banjo bolts. Tighten to **10 Nm**.
29. Connect stop control solenoid lead.
30. Connect throttle cable and where applicable hand throttle cable.
31. Remove special tool LRT-12-045.
32. Fit gear lock plate.
33. Fit pin from special tool LRT-12-045.
34. Secure gear with bolts.
35. Remove special tool pin.
36. Turn crankshaft two complete revolutions, check timing pin from LRT-12-045 can be fully and easily inserted into the pump. At the same time check flywheel timing pin LST-12-044 can also be inserted in the flywheel slot.
37. If, with the flywheel timing pin located, the timing pin cannot be inserted cleanly into the injection pump, carry out the following:
- Ensure flywheel timing pin is disengaged from slot in flywheel.
  - Turn the crankshaft the small amount necessary to enable the timing pin to be inserted into the pump.
  - Loosen the three pump gear retaining bolts.
  - Turn the crankshaft to T.D.C..
  - Check that the timing pin is an easy fit in the pump and that the flywheel timing pin locates.
  - Tighten the pump gear retaining bolts to the correct torque.
  - Remove the timing pin from the pump and the timing tool from the flywheel housing.
38. Using antisieze compound, fit the blanking plug to flywheel housing. Tighten to **12 Nm**.
39. Fit access plate with gasket to front cover plate. Tighten to **25 Nm**.
40. Refit injector pipes. Tighten to **29 Nm**.

## ENGINE CONTROL MODULE (ECM)

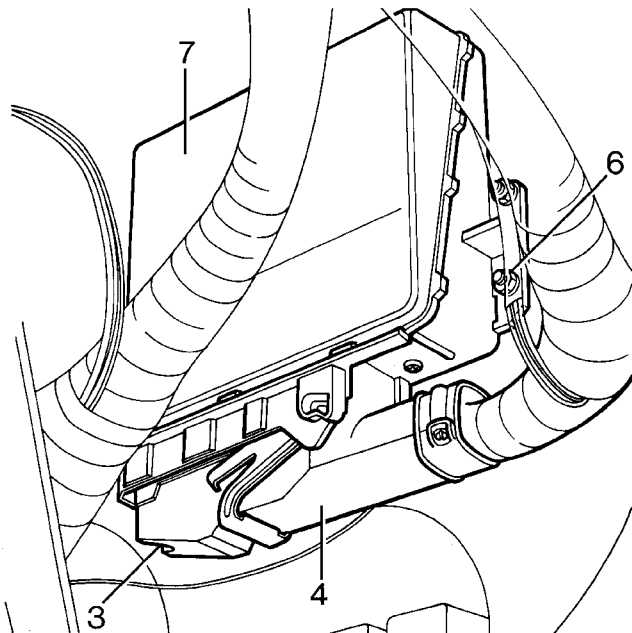
Service repair no - 18.30.03



**NOTE:** The ECM is not a serviceable item, in the event of failure it must be renewed.

### Remove

1. Disconnect battery negative lead.
2. Remove 'A' post trim pad.



J5922

3. Loosen multi-plug screw to ECM.
4. Disconnect multi-plug from ECM.
5. Secure multi-plug and harness aside.
6. Remove retaining nuts from ECM.
7. Manoeuvre ECM from its mounted position.

### Refit

8. Refitting is the reverse of removal procedure.
9. Reconnect harness plug. Ensure plug is pushed firmly into location and retaining clip secures plug in position.
10. Tighten screw securing multi-plug.

## AIRFLOW METER

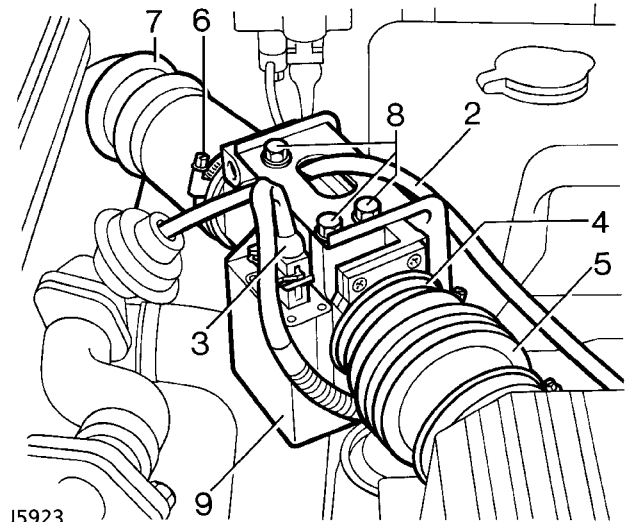
Service repair no - 18.30.15



**NOTE:** The air flow meter is not a serviceable item, in the event of failure it must be renewed.

### Remove

1. Disconnect battery negative lead.



J5923

2. Release vacuum tube from EGR vacuum capsule.
3. Disconnect airflow meter multi-plug.
4. Loosen air cleaner hose to air flow meter retaining clip.
5. Disconnect hose from airflow meter.
6. Loosen turbo charger hose to airflow meter retaining clip.
7. Disconnect hose from airflow meter.
8. Remove meter to mounting bracket bolts.
9. Remove airflow meter.

### Refit

10. Reverse removal procedure. Ensure multi-plug is firmly reconnected and hose clamps are securely tightened to prevent unmeasured air entering the engine.

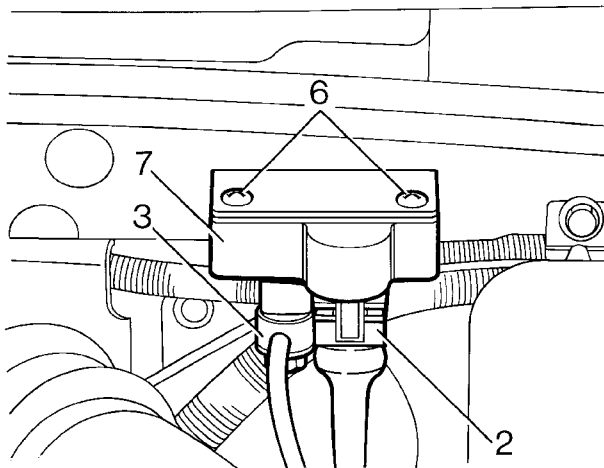


## BOOST PRESSURE SENSOR

Service repair no - 18.30.63

### Remove

1. Disconnect battery negative lead.



J5924

2. Disconnect sensor multi-plug.
3. Disconnect pressure tube union.
4. Retrieve and discard union copper washers.
5. Place pressure tube aside.
6. Remove sensor to mounting bracket bolts.
7. Remove sensor.

### Refit

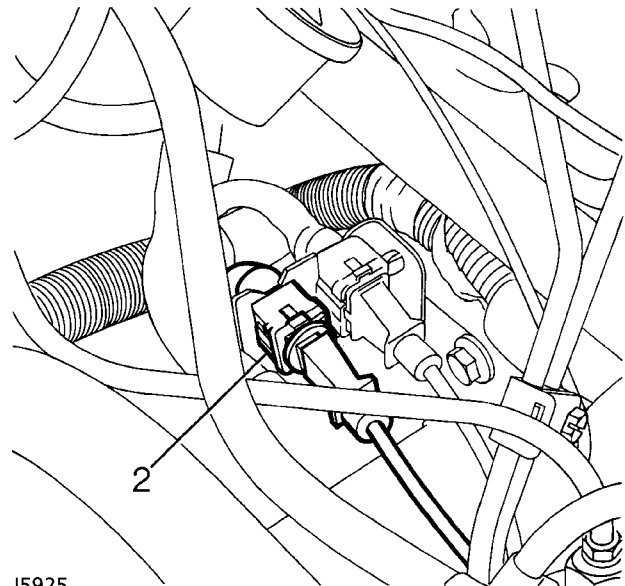
8. Renew all copper washers.
9. Reverse removal procedure.

## INJECTION TIMING SENSOR

Service repair no - 18.30.64

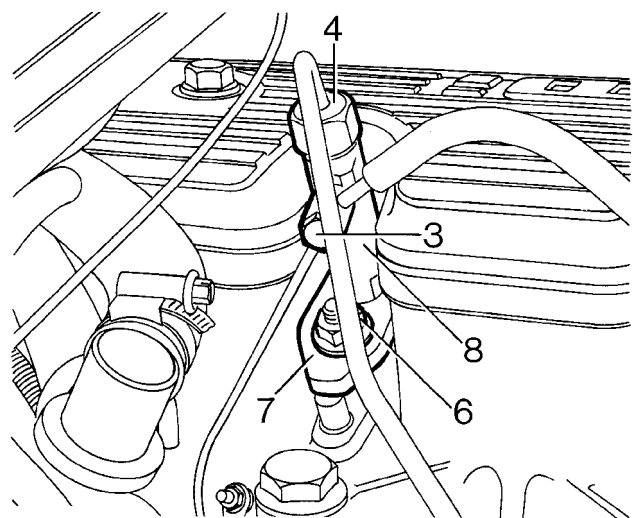
### Remove

1. Disconnect battery negative lead.



J5925

2. Disconnect sensor multi-plug.
3. Disconnect spill return pipe to injector.
4. Disconnect injector union.



J5926

5. Remove copper washers.
6. Remove injector clamp fixing.
7. Remove clamp.
8. Remove injector.
9. Remove injector copper washers.

### Refit

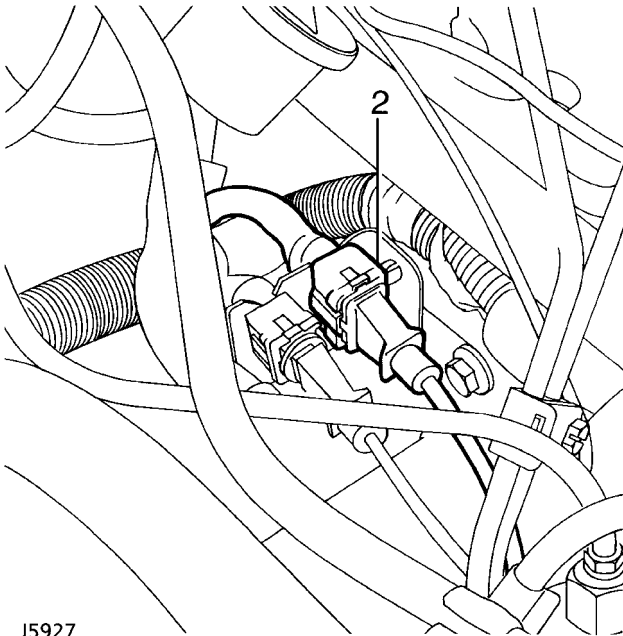
10. Renew all copper washers.
11. Reverse removal procedure.
12. Check for leaks when running.

## ENGINE SPEED SENSOR

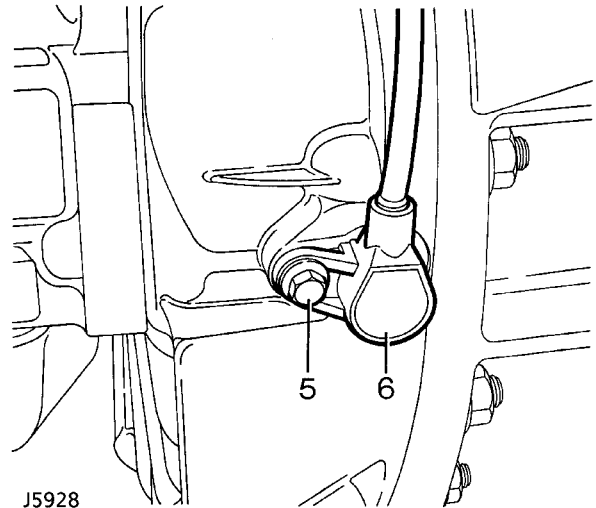
Service repair no - 18.30.65

### Remove

1. Disconnect battery negative lead.



2. Disconnect sensor multi-plug.
3. Place vehicle on ramp and apply handbrake.
4. Raise ramp.



5. Remove sensor retaining nut.
6. Remove sensor from housing.
7. Clean housing mating faces.

### Refit

8. Reverse removal procedure.



## VEHICLE SPEED SENSOR

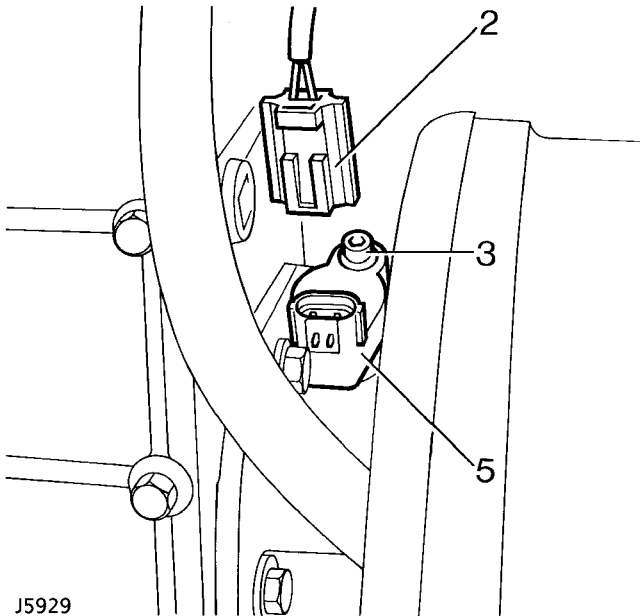
Service repair no - 18.30.22

### Remove



**NOTE:** The following procedure is carried out with the ramp still raised.

1. Disconnect battery negative lead.



2. Disconnect sensor multi-plug.
3. Remove sensor retaining screw.
4. Remove sensor retaining plate.
5. Remove sensor from transfer box.

### Refit

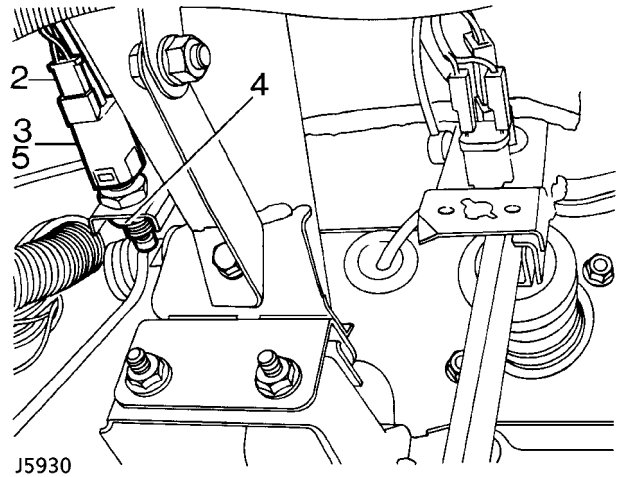
6. Reverse removal procedure.

## CLUTCH PEDAL SWITCH

Service repair no - 18.30.67

### Remove

1. Disconnect battery negative lead.



2. Disconnect switch wiring lucars.
3. Turn rear body of switch to release locknut
4. Remove locknut.
5. Remove switch from mounting bracket.

### Refit

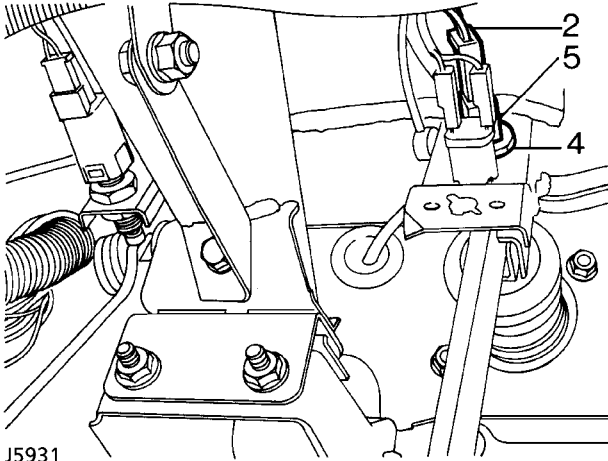
6. Reverse removal procedure.

**BRAKE PEDAL SWITCH**

Service repair no - 18.30.66

**Remove**

1. Disconnect battery negative lead.



2. Disconnect switch wiring Lucars.
3. Loosen rear locknut.
4. Remove front locknut.
5. Remove switch from mounting bracket.

**Refit**

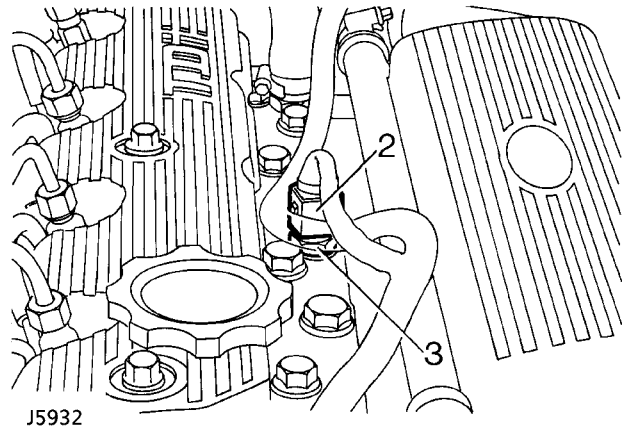
6. Reverse removal procedure.

**COOLANT TEMPERATURE SENSOR**

Service repair no - 18.30.68

**Remove**

1. Disconnect battery negative lead.



2. Disconnect sensor multi-plug.
3. Remove sensor.
4. Clean off water spillage from sensor area.

**Refit**

5. Fit a new copper washer.
6. Fit sensor and tighten securely.
7. Refill cooling system.
8. Run engine, check for water leaks around sensor.



## THROTTLE POSITION SENSOR

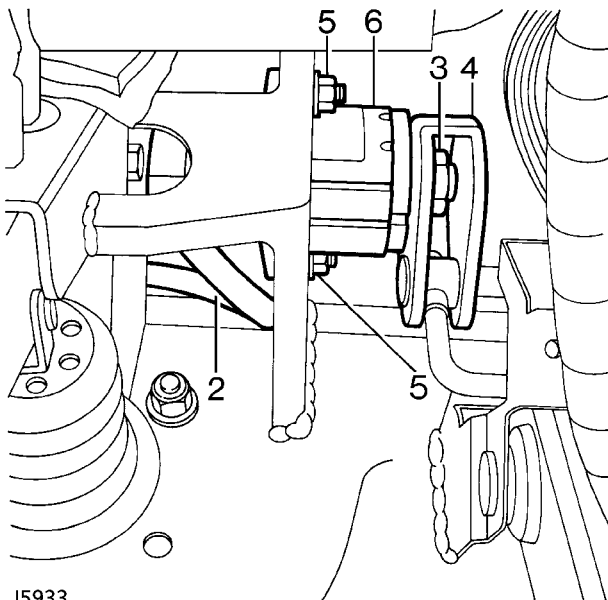
Service repair no - 18.30.17



**NOTE:** The throttle position sensor is not a serviceable item, in the event of failure it must be renewed.

### Remove

1. Disconnect battery negative lead.
2. Disconnect multiplug from sensor.



3. Remove nut securing throttle pedal quadrant to sensor. Remove throttle pedal quadrant.
4. Remove two screws securing sensor to pedal box.
5. Remove sensor.

### Refit

6. Reverse removal procedure.



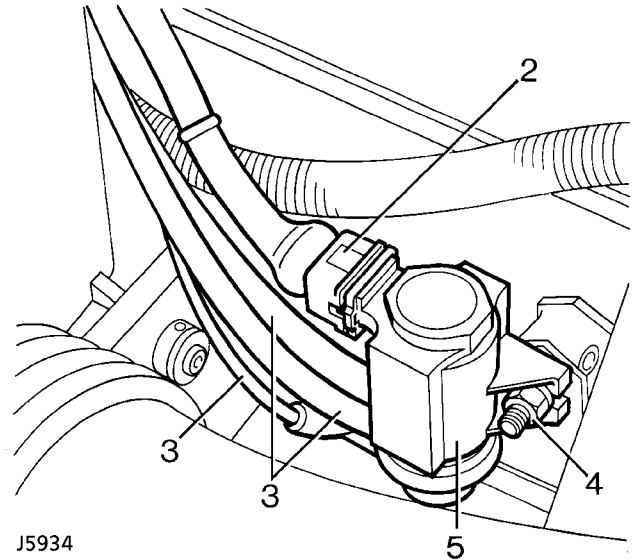
**CAUTION:** DO NOT operate throttle mechanism while sensor is loosely fitted, damage may be caused to sensor wiper track.

## ELECTRO-PNEUMATIC MODULATOR

Service repair no - 18.30.69

### Remove

1. Disconnect battery negative lead.



2. Disconnect multi-plug from modulator.
3. Remove three vacuum pipes from modulator.
4. Remove nut securing modulator to inner wing.
5. Remove modulator.

### Refit

6. Reverse removal procedure.





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## DESCRIPTION

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### Hot Wire Multiport Fuel Injection

The 'Hot Wire' Multiport fuel injection system derives its name from the mass air flow sensor which uses one cold wire and one electrically heated wire to measure the volume of air entering the engine.

The function of the system is to supply the exact amount of fuel directly into the intake manifold according to the prevailing engine operating conditions.

To monitor these conditions, various sensors are fitted to the engine to measure engine parameters. Data from the sensors is received by the Engine control module (ECM), the ECM will then determine the exact amount of fuel required at any condition.

The ECM having received data from the sensors produces pulses, the length of which will determine the simultaneous open time of each bank of injectors in turn, which will govern the amount of fuel injected.

### Engine control module - ECM

The Multiport fuel injection system is controlled by the 14 CUX Engine Control Module comprising of a microprocessor with integrated circuits and components mounted on printed circuit boards. The ECM is connected to the main harness by a 40 pin plug.

### Injectors

The eight fuel injectors are fitted between the pressurized fuel rail and inlet manifold. Each injector comprises a solenoid operated needle valve with a movable plunger rigidly attached to the nozzle valve. When the solenoid is energized the plunger is attracted off its seat and allows pressurized fuel into the intake manifold.

### Engine coolant temperature sensor

The engine coolant temperature sensor is located in the front of the thermostat housing. The sensor provides engine coolant information to the ECM. The ECM increases the injector opening time when cold to provide improved driveability, and reduces the opening time as the engine reaches normal operating temperature.

### Engine fuel temperature sensor

The engine fuel temperature sensor is located in the rail on the RH side of the ram housing. The sensor sends fuel temperature data to the ECM, the ECM on receiving the data will adjust the injector open time accordingly to produce good hot starting in high ambient temperatures.

### Idle air control valve

The idle air control valve is screwed into a housing attached to the rear of the plenum chamber, between the plenum chamber and bulkhead. The idle air control valve has two windings which enable the motor to be energised in both directions thus opening or closing the air valve as required by the ECM. The idle air control valve will open and allow extra air into the plenum chamber to maintain engine idle speed when the engine is under increased (Electrical and Mechanical) loads. The idle air control valve will control engine idle speed when the vehicle is stationary.

### Heated oxygen sensors (O<sub>2</sub> sensors) - Catalyst vehicles

The two heated oxygen sensors are located forward of the catalysts mounted in the exhaust downpipes. The sensors monitor the oxygen content of the exhaust gases and provide feedback information of the air/fuel ratio to the ECM. Each sensor is heated by an electrical element to improve its response time when the ignition is switched on.

## Fuel pressure regulator

The fuel pressure regulator is mounted in the fuel rail at the rear of the plenum chamber. The regulator is a mechanical device controlled by plenum chamber vacuum, it ensures that fuel rail pressure is maintained at a constant pressure difference of 2.5 bar above that of the manifold.

When pressure exceeds the regulator setting excess fuel is returned to the fuel tank.

## Fuel pump

The electric fuel pump is located in the fuel tank, and is a self priming 'wet' pump, the motor is immersed in the fuel within the tank.

## Air flow sensor

The hot-wire air flow sensor is mounted on a bracket attached to the left hand valance, rigidly connected to the air cleaner and by hose to the plenum chamber inlet neck.

The air flow sensor consists of a cast alloy body through which air flows. A proportion of this air flows through a bypass in which two wire elements are situated: one is a sensing wire and the other is a compensating wire. Under the control of an electronic module which is mounted on the air flow sensor body, a small current is passed through the sensing wire to produce a heating effect. The compensating wire is also connected to the module but is not heated, but reacts to the temperature of the air taken in, as engine intake air passes over the wires a cooling effect takes place.

The electronic module monitors the reaction of the wires in proportion to the air stream and provides output signals in proportion to the air mass flow rate which are compatible with the requirements of the ECM.

## Throttle position sensor

The throttle position sensor is mounted on the side of the plenum chamber inlet neck and is directly coupled to the throttle butterfly shaft.

The throttle position sensor is a resistive device supplied with a voltage from the ECM. Movement of the accelerator pedal causes the throttle valve to open, thus rotating the wiper arm within the throttle position sensor which in turn varies the resistance in proportion to the valve position. The ECM lengthens the injector open time when it detects a change in output voltage (rising) from the throttle position sensor.

In addition the ECM will weaken the mixture when it detects the throttle position sensor output voltage is decreasing under deceleration and will shorten the length of time the injectors are open.

When the throttle is fully open, the ECM will detect the corresponding throttle position sensor voltage and will apply full load enrichment. This is a fixed percentage and is independent of temperature. Full load enrichment is also achieved by adjusting the length of the injector open time.

When the throttle is closed, overrun fuel cut off or idle speed control may be facilitated dependant on other inputs to the ECM.

The throttle position sensor is 'self adaptive', which means that adjustment is not possible. It also means the throttle position sensor setting is not lost, for example, when throttle stop wear occurs.



**CAUTION: Do not attempt to adjust throttle position sensor.**



### Tune select resistor -

To suit individual market requirements a tune select resistor is connected across pins 5 and 27 of the ECM.

It is located adjacent to the ECM, and strapped to the MFI cable assembly. The value of the resistor is dependent on the market application:

Red wire, 180 ohms, Australia, Rest of world.

Green wire, 470 Ohms, UK and Europe - non catalyst.

Yellow wire 910 Ohms, Saudi non catalyst.

White wire, 3K9 Ohms, European catalyst

### Condenser fans

It should be noted that under high coolant temperatures, when the engine is switched off, the condenser fans will be activated and will run for approximately ten minutes.

### Vehicle speed sensor

The vehicle speed sensor is located on the side of the Transfer box adjacent to the parking brake. The sensor provides road speed data to the ECM. The ECM in turn detects vehicle movement from the road speed input and ensures that idle air control mode is disengaged. Should the vehicle speed sensor fail in service the ECM idle air control would become erratic.

The sensor also provides road speed data to the electric speedometer and cruise control ECU.

### Inertia fuel shutoff switch

The inertia fuel shutoff switch is a mechanically operated switch, located on the bulkhead adjacent to the washer reservoir under bonnet [hood]. The switch is normally closed and is in line with the fuel pump. In the event of a sudden impact the switch opens, and disconnects the electrical feed to the fuel pump. The switch is reset by pressing down the button.



**WARNING: Check the integrity of the fuel system before the inertia switch is reset.**

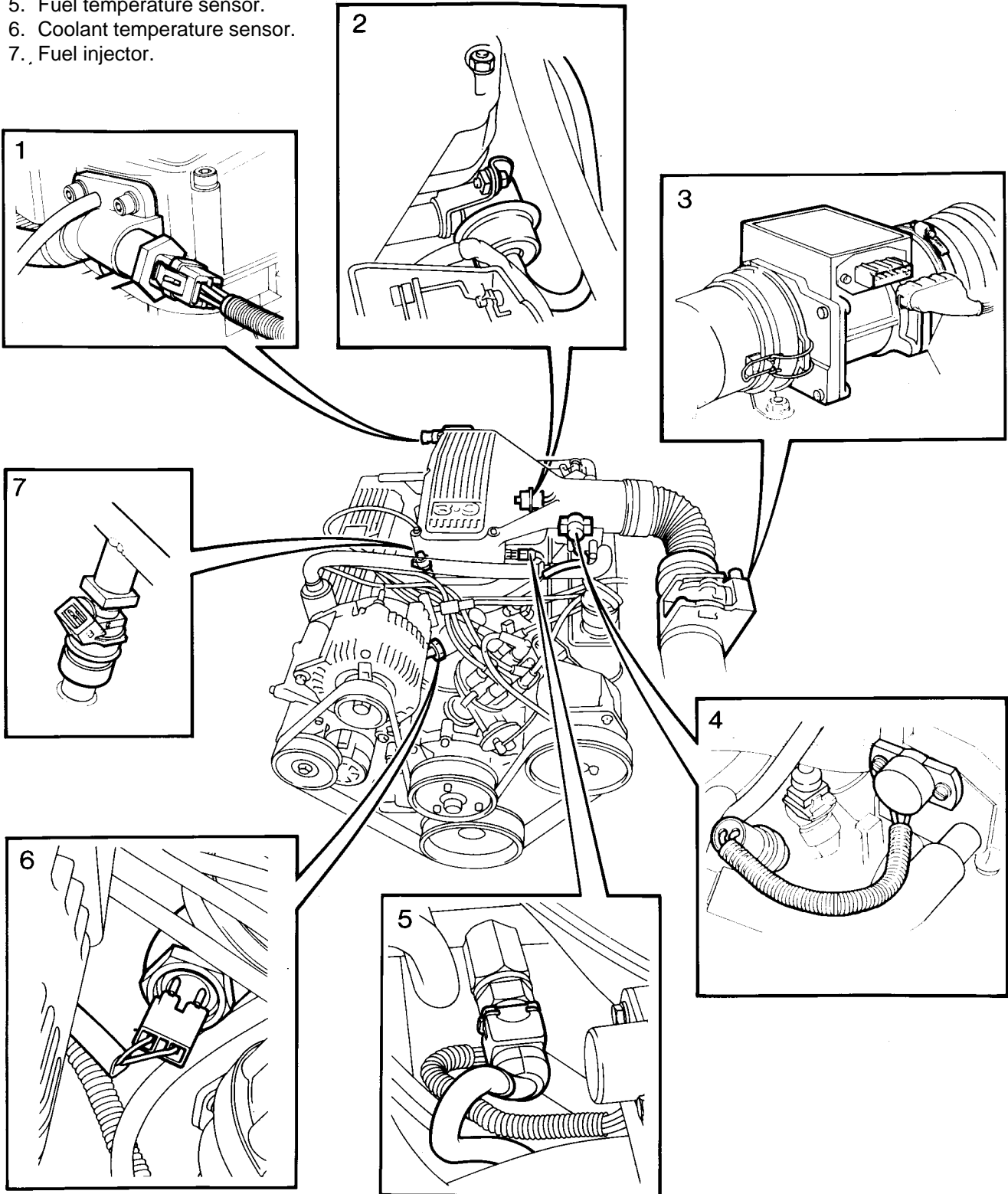
### Relay modules

The two multiport fuel injection relays are located in the RH footwell area behind the 'A' post panel. The main relay module is energized via the ECM when the ignition is switched on and supplies current to the multiport fuel injection system. The fuel pump relay module is energized by the ECM which in turn operates the fuel pump to pressurize the fuel system.

# 19 FUEL SYSTEM

## ENGINE MOUNTED COMPONENTS

1. By-pass air valve (stepper motor).
2. Fuel pressure regulator.
3. Air flow meter.
4. Throttle potentiometer.
5. Fuel temperature sensor.
6. Coolant temperature sensor.
7. Fuel injector.

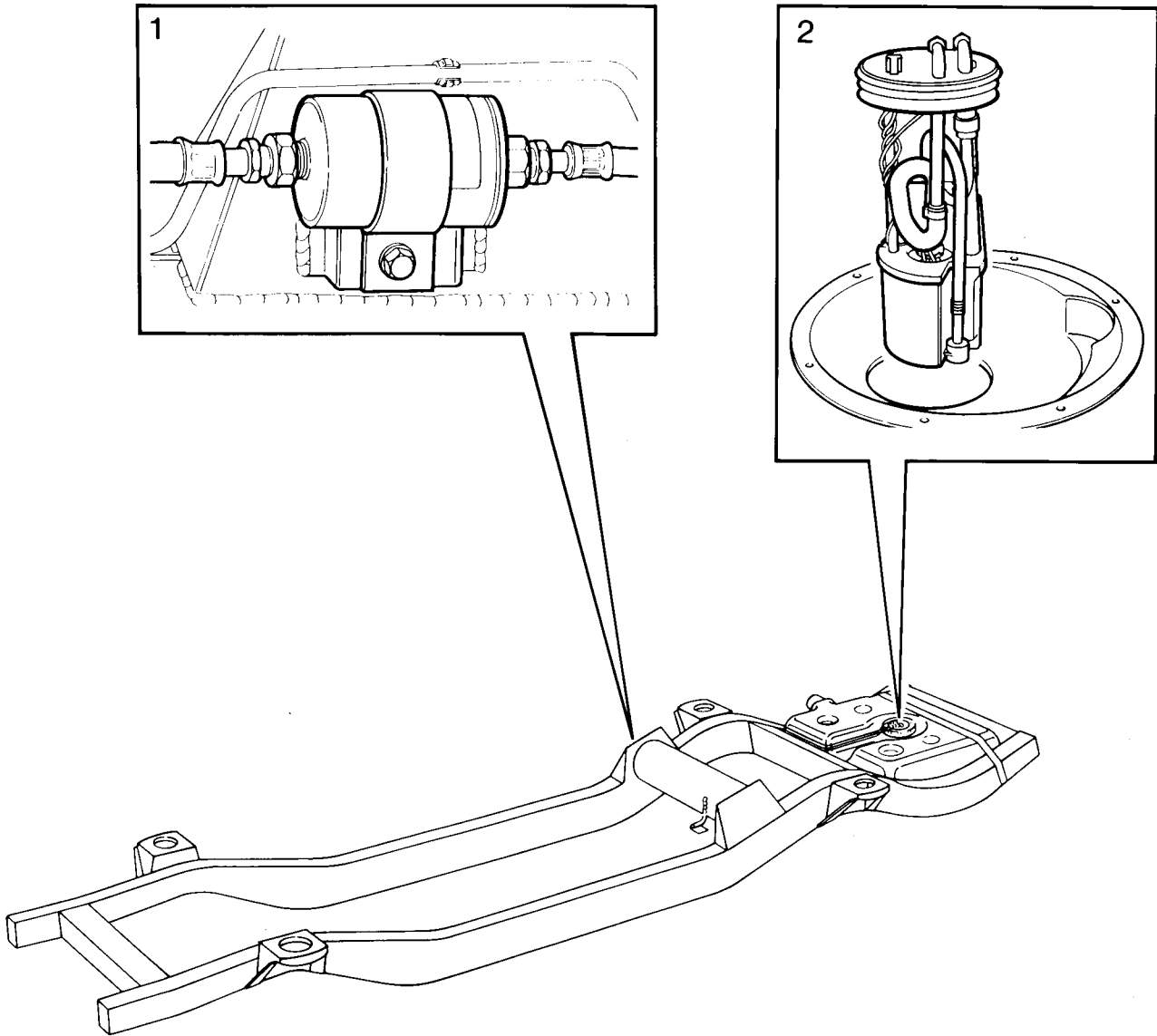


J5425



## CHASSIS MOUNTED COMPONENTS

1. Fuel filter.
2. Fuel pump (in fuel tank).

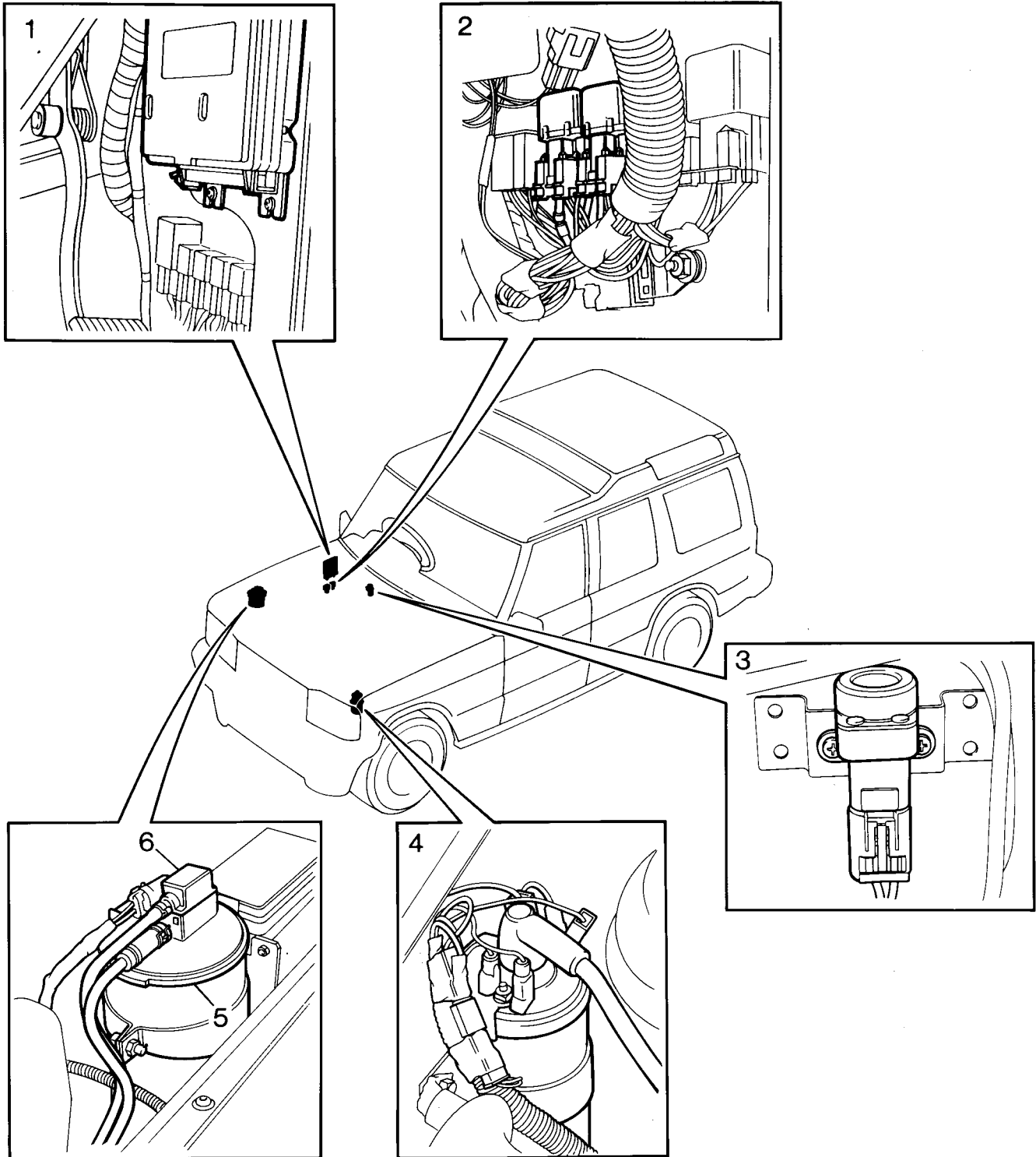


J5426

# 19 FUEL SYSTEM

## BODY MOUNTED COMPONENTS

1. Engine control module (ECM).
2. Main relay and fuel pump relay.
3. Inertia switch.
4. Ignition coil.
5. Charcoal canister.
6. Purge control valve.



J5427



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**MICRO PROCESSOR POWER CHECK**  
(Instrument binnacle - Service use only)

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As part of the engine starting procedure, this symbol will illuminate momentarily.

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**FUEL INJECTION SYSTEM**

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**CAUTION:** The fuel system incorporates fine metering components that would be affected by any dirt in the system; therefore it is essential that working conditions are scrupulously clean. If it is necessary to disconnect any part of the fuel injection system, the system **MUST** be depressurized. All openings left open after the removal of any component from the fuel system, **MUST** be sealed off to prevent ingress of dirt.

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**ENGINE SETTING PROCEDURE**

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If a major overhaul has been undertaken of the fuel injection/engine system, the following check and adjustments must be carried out before attempting to start the engine.

1. Spark plug gaps. *See ENGINE TUNING DATA, Information, Engine 3.9 V8i*
2. Ignition timing. *See ELECTRICAL, Adjustment, Ignition Timing*



**CAUTION:** Catalyst vehicle - if the engine is misfiring, it should be immediately shut down and the cause rectified. Failure to do so will result in irreparable damage to the catalysts.



**NOTE:** If the previous checks and adjustments are satisfactory but the engine will not start, the ignition and fuel injection electrical circuits must be checked using the appropriate recommended equipment.



## ENGINE TUNING

Circuit fault diagnosis may be carried out on all V8i vehicles, using Testbook. Testbook will guide the operator by visual prompts through a series of diagnostic checks.

Before commencing any fault diagnosis, the following preliminary checks must be carried out.

### Preliminary checks



**CAUTION: Catalyst exhaust: If engine is misfiring or fails to start within 12 seconds the cause must be rectified. Failure to do so will result in irreparable damage to the catalyts. After rectification the engine must be run at 1500 rev/min (no load) for 3 minutes to purge any accumulation of fuel in the system.**

1. Check that the inertia fuel shut off switch is not tripped.
2. Check fuse in main fuse panel.
3. Check for ample fuel in tank.
4. Check air inlet system for possible leaks into the intake manifold.
5. Check HT cables for correct firing order and routing.
6. Check ignition timing.

Only when the above checks have been carried out, should circuit diagnosis begin. **See *Electrical Trouble Shooting Manual***.

## INJECTOR TESTS



**NOTE: Before removing any of the injectors, remove and examine the spark plugs, check for consistent colouration of plugs. A leaking injector will result in the appropriate spark plug being 'sooted up'.**

The following test may only be carried out using suitable injector test equipment.

### Leak Test

Leak test with the injectors closed but pressurise to 2.54 Kg/cm<sup>2</sup>. No injector should leak more than 2 drops of fuel per minute.

### Fuel Delivery Test

Fuel delivery test with the injector open and pressurised as above, fuel delivery from each injector should be 160-175cc per minute using white spirit, or 180-195cc per minute using petrol at 20°C ± 2°C.



### BASE IDLE SPEED SETTING



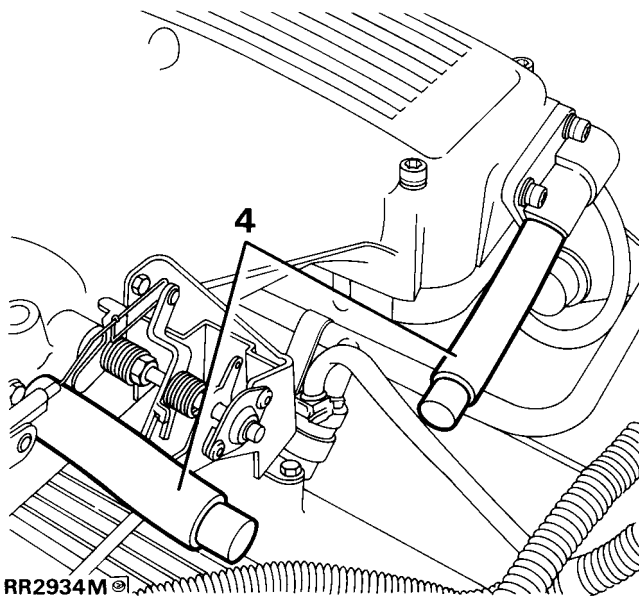
**NOTE:** Base idle speed is set at factory. It should not require further adjustment unless plenum chamber is changed. The adjustment screw is sealed with a plug to prevent unauthorised alteration. Check ignition timing before attempting following procedure, since this will affect idle speed.

#### Equipment required

**Two blanking hoses.** these are manufactured using a new air by-pass valve hose - Part No.ETC7874. Cut two equal pieces 90mm long from hose and seal one end of each, using 13mm diameter bar. Use a suitable clamp to ensure an air tight seal.

#### Checking procedure

1. Drive vehicle at least two miles until engine and transmission are hot. Switch off engine.
2. Check all electrical loads are OFF, including air conditioning.
3. Remove air by-pass valve hose.

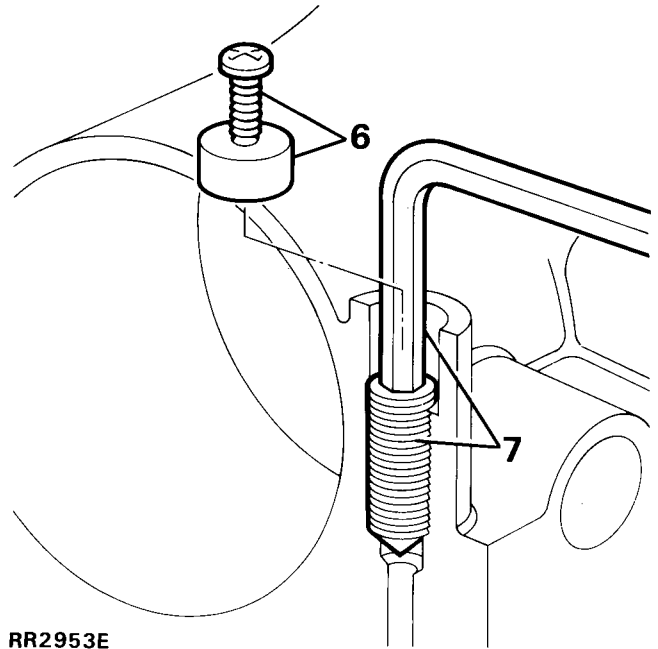


RR2934M

4. Fit blanking hoses to both plenum chamber and air by-pass valve. Ensure hoses are securely fitted to prevent air leaks. Note throttle cable and cruise control actuator have been omitted from illustration.

5. Start engine and check idle speed is within limits. **See ENGINE TUNING DATA, Information, Engine 3.9 v8i**

#### Adjusting base idle speed



RR2953E

6. Drill tamper proof plug and insert a self tapping screw to enable plug to be extracted.
7. Start engine, adjust idle screw clockwise to decrease or counter-clockwise to increase idle speed.
8. Stop engine, remove blanking hoses. Reconnect hose to plenum.
9. Fit new tamper proof plug.



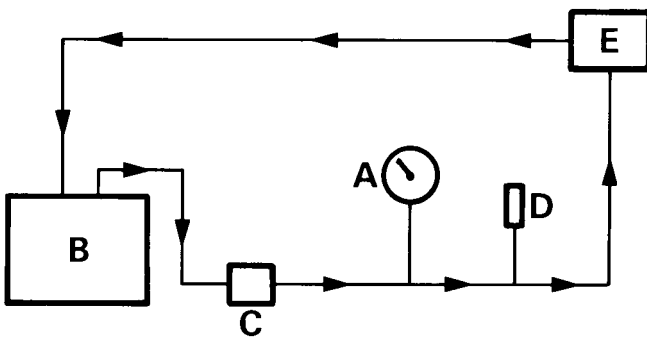
## FUEL PRESSURE CHECK

In order to check the fuel pressure it is necessary to first depressurise the fuel system as follows:

**WARNING:** Under normal operating conditions the multiport fuel injection system is pressurised by a high pressure fuel pump, operating at up to 2.3 to 2.5 bar. When engine is stationary pressure is maintained within system. To prevent pressurised fuel escaping and to avoid personal injury it is necessary to depressurise multiport fuel injection system before any service operations are carried out.

If vehicle has not been run there will be a small amount of residual pressure in fuel line. The depressurising procedure must still be carried out before disconnecting any component within the fuel system.

The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.



RR3834M

- A Pressure gauge 18G1500
- B Fuel tank and pump
- C Fuel filter
- D Fuel injectors x 8
- E Regulator

1. Remove fuel pump relay module. **See Repair, Multiport Fuel Injection Relay**
2. Start and run engine.
3. When sufficient fuel has been used to cause fuel line pressure to drop, injectors will become inoperative, resulting in engine stall. Switch off ignition.
4. Disconnect battery negative lead. .



**NOTE:** Fuel at low pressure will remain in system. To remove low pressure fuel, place absorbent cloth around fuel pipe at the filter during disconnection.

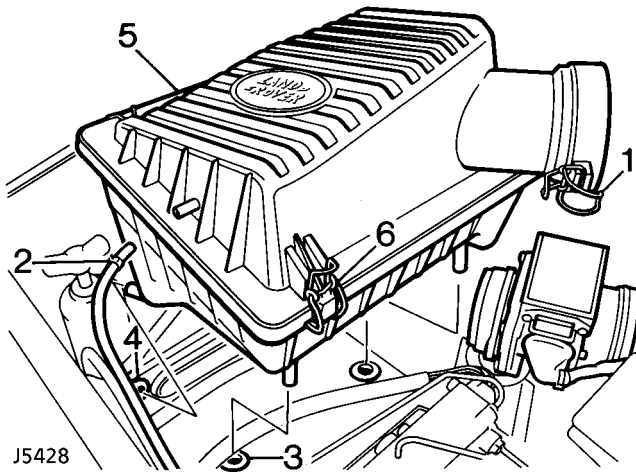
5. Connect the pressure gauge on the outlet from the filter, located on the chassis under the right rear wheel arch.
6. Reconnect the battery and turn the ignition to position II while observing the pressure gauge. Results  
Expected reading 2,39-2,672 kgf/cm<sup>2</sup>  
Pressure drop-max 0.7 kgf/cm<sup>2</sup> in one minute.  
If pressure is low check that filter is not blocked and pump is operating satisfactorily. Then recheck pressure. If pressure is still low renew regulator. **See Repair, Fuel Pressure Regulator**



## AIR CLEANER ASSEMBLY

Service repair no - 19.10.01

### Remove



J5428

### 3.9 V8 vehicle illustrated

1. Release 2 clips securing air cleaner to air flow sensor.
2. **3.9 V8 only:** Release clip and disconnect hose from air cleaner.  
**4.0 V8 only:** Release clip and disconnect multiplug from intake air temperature sensor.  
**See FUEL SYSTEM SFI, Repair, Intake Air Temperature Sensor**
3. From below wheel arch, release 2 rubber mountings securing bottom of air cleaner to body.
4. Slide air cleaner backwards and release from mounting bracket.
5. Remove air cleaner assembly. **Do not carry out further dismantling if component is removed for access only.**
6. Release 4 clips securing top of air cleaner and remove.
7. Withdraw air cleaner element and discard.
8. **4.0 V8 only:** Remove intake air temperature sensor from cover.
9. Remove rubber mountings.

### Refit

10. Fit rubber mountings to new body.
11. **4.0 V8 only:** Fit intake air temperature sensor to new cover. Tighten to **8Nm**.
12. Fit new air cleaner element and secure in position.
13. Reverse removal procedure.



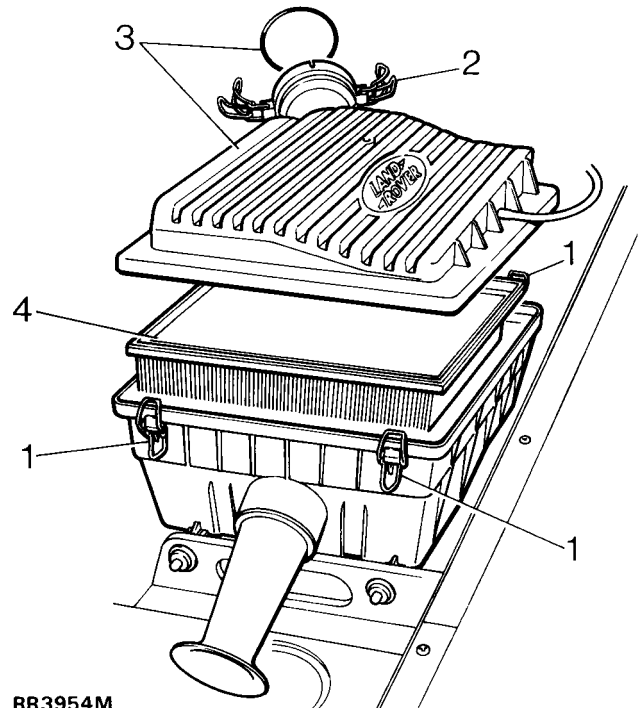
**NOTE: Pull rubber mountings from below to secure unit to wheel arch.**

## AIR CLEANER ELEMENT

Service repair no - 19.10.08

### Remove

1. Release four clips retaining air cleaner cover.
2. Release two clips to air flow meter.
3. Remove air cleaner cover, retain air flow meter 'O'ring.
4. Remove element.



RR3954M

### Refit

5. Fit new element.
6. Fit O ring.
7. Position air cleaner cover, secure two clips to air flow meter.
8. Secure four air cleaner cover clips.

## AIR FLOW SENSOR

Service repair no - 19.22.25

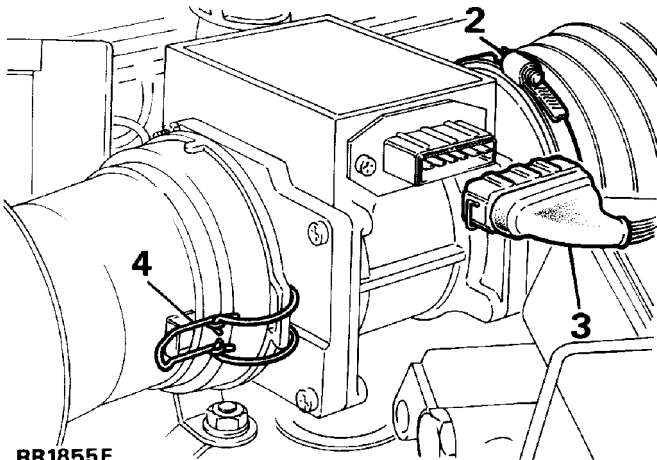
### Remove



**NOTE: The air flow sensor is not a serviceable item. In event of failure or damage the complete unit must be replaced.**

replaced.

1. Disconnect battery negative lead.
2. Release intake hose clamp, disconnect from sensor.
3. Disconnect multi-plug.
4. Release two clips securing air cleaner to air flow sensor. Remove sensor from engine compartment.



RR1855E

### Refit

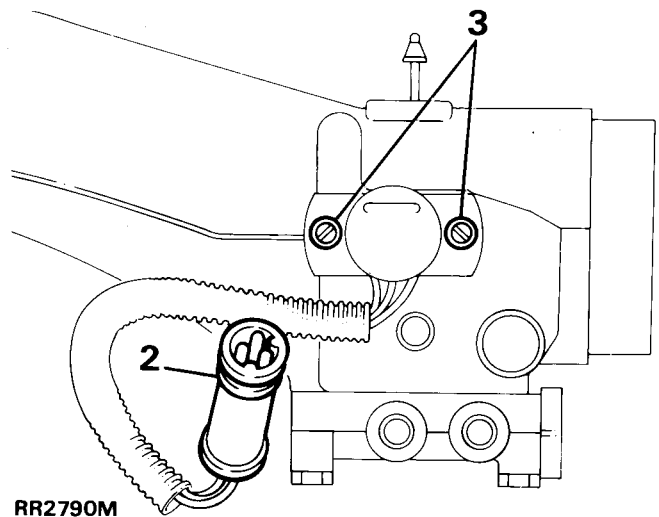
5. Reverse removal procedure. Ensure multi-plug is firmly reconnected, and hose clamp at the rear of sensor is securely tightened, to prevent unmeasured air entering engine.

## THROTTLE POSITION SENSOR

Service repair no - 19.22.49

### Remove

1. Disconnect battery negative lead.
2. Disconnect multi-plug from harness.
3. Remove two screws securing sensor to plenum chamber and carefully pull sensor off throttle shaft.



RR2790M

4. Remove old gasket.

### Refit

5. Fit new gasket.
6. Align sensor and shaft flats, slide sensor on to throttle shaft. Secure sensor to plenum chamber.



**CAUTION: DO NOT operate throttle mechanism while throttle position sensor is loosely fitted, damage may be caused to throttle position sensor wiper track.**

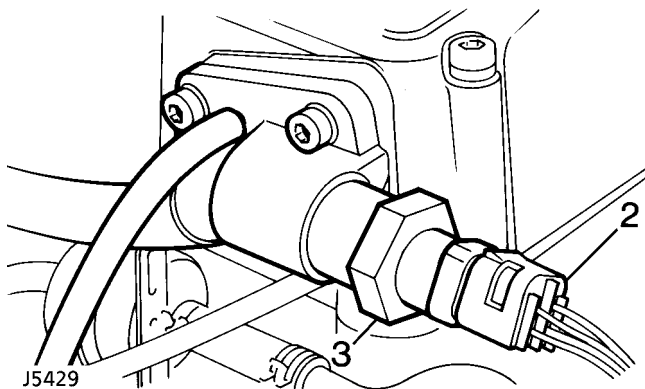


## IDLE AIR CONTROL VALVE

Service repair no - 19.22.54


### Remove

1. Disconnect battery negative lead.
2. Disconnect multi-plug.
3. Unscrew valve from rear plenum chamber.
4. Remove washer.



### Refit

5. Fit **NEW** sealing washer.

 **NOTE: If same idle air control valve is being refitted clean sealing compounds from threads. Apply Loctite 241 to threads of valve before reassembly.**

6. Tighten valve to **20 Nm**.
7. Reverse removal procedure.

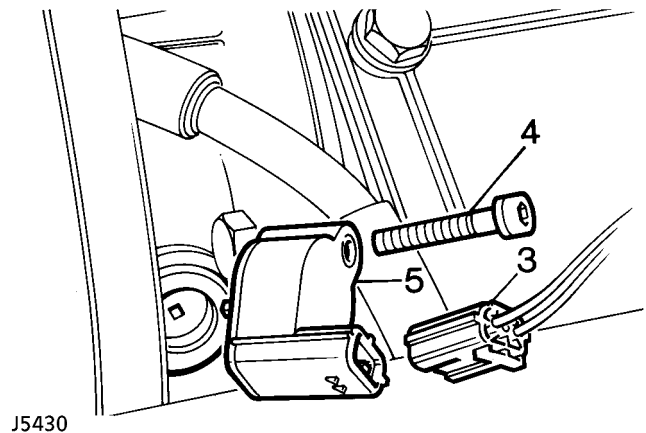
## VEHICLE SPEED SENSOR

Service repair no - 88.30.14

The vehicle speed sensor is located in the LH side of the transfer box.

### Remove

1. Place vehicle on lift, apply parking brake.
2. Disconnect battery negative lead.
3. Raise lift, disconnect multiplug from vehicle speed sensor.
4. Remove screw securing sensor to transfer box.
5. Remove vehicle speed sensor



### Refit

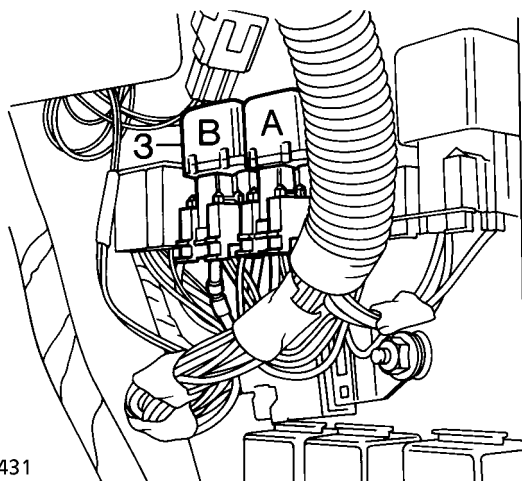
6. Reverse removal procedure.

## MULTIPOINT FUEL INJECTION RELAYS

Service repair no - 19.22.08

The two Multiport fuel injection relays are located in the RH footwell area behind the 'A' post trim panel. The fuel injection relays can be identified as follows:

- A. Fuel pump relay - Blue base
- B. Main relay - Black base



### Remove

1. Release front door seal from 'A' post.
2. Remove lower 'A' post trim panel.
3. Pull relay from base.

### Refit

4. Reverse removal procedure.

## ENGINE CONTROL MODULE (ECM)-14 CUX

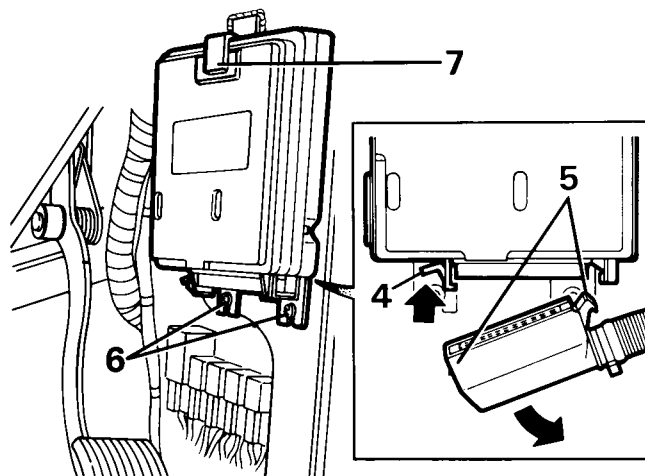
Service repair no - 19.22.34



**NOTE: The ECM is not serviceable, in event of unit failure it must be replaced.**

### Remove

1. Remove the fascia right-hand closing panel.
2. Remove the right-hand footwell side panel trim.
3. Disconnect battery negative lead.
4. Release ECM plug retaining clip.
5. Maneuvre the front of the plug (in the direction of the bold arrow) and detach the other end of the plug from the retaining peg.
6. Release the two screws securing the ECM to the right-hand footwell side panel.
7. Withdraw the ECM from the clip.



### Refit

8. Refit the ECM securely in the clip and fit the two screws.
9. Reconnect the ECM harness plug. Ensure that the plug is pushed firmly into its location and that the retaining clip secures the plug in position.
10. Reverse removal procedure.



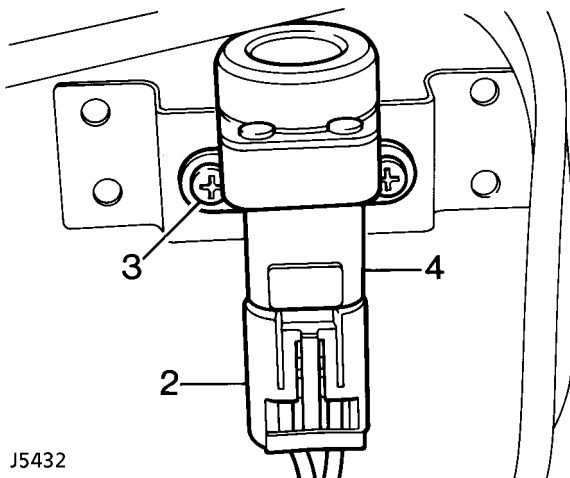
## INERTIA FUEL SHUTOFF SWITCH

Service repair no - 18.30.35

The inertia fuel shutoff switch is located on the bulkhead next to the washer reservoir under bonnet [hood].

### Remove

1. Disconnect battery negative lead.
2. Disconnect multiplug from inertia switch.
3. Remove 2 screws securing inertia switch to mounting bracket.
4. Remove inertia switch.



J5432

### Refit

5. Position inertia switch to mounting bracket and secure with screws.
6. Connect multiplug to inertia switch.
7. Reconnect battery negative lead.

## ENGINE FUEL TEMPERATURE SENSOR

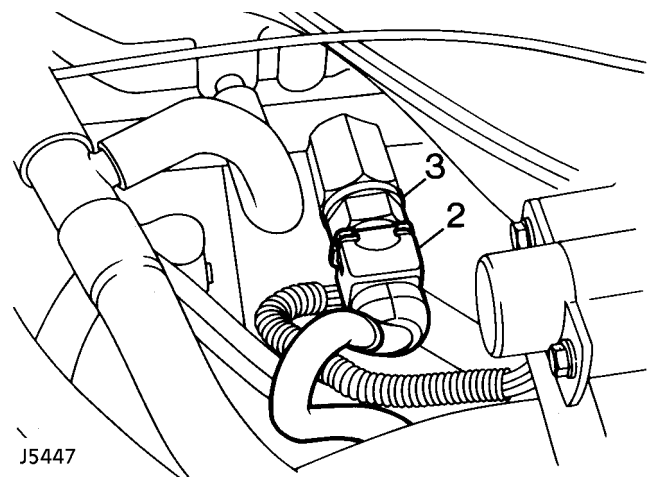
Service repair no - 19.22.08

### Remove



**NOTE:** Fuel leakage will not occur when sensor is removed from fuel rail, therefore it is not necessary to depressurise the fuel system.

1. Disconnect battery negative lead.
2. Disconnect multi-plug from sensor.
3. Release sensor from fuel feed rail.



J5447

### Refit

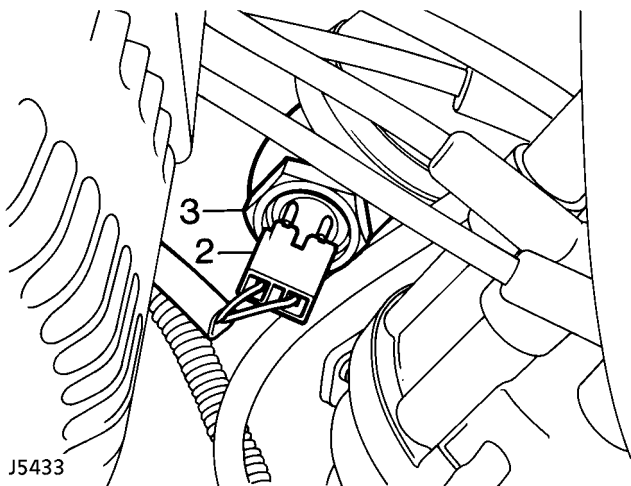
4. Reverse removal procedure. Ensure sensor is tightened securely in fuel rail.

## ENGINE COOLANT TEMPERATURE SENSOR

Service repair no - 19.22.18

### Remove

1. Position drain tray to collect coolant spillage.
2. Disconnect multiplug from coolant sensor.
3. Remove sensor from thermostat housing.
4. Remove and discard copper washer.



### Refit

5. Fit a new copper washer.
6. Fit sensor and tighten securely.
7. Top-up cooling system.
8. Run engine, check for water leaks around sensor.

## DEPRESSURISING FUEL SYSTEM



**WARNING:** Under normal operating conditions the Multiport fuel injection system is pressurised by a high pressure fuel pump, operating at up to 2.3 to 2.5 bar. When engine is stationary pressure is maintained within system. To prevent pressurised fuel escaping and to avoid personal injury it is necessary to depressurise multiport fuel injection system before any service operations are carried out.

If vehicle has not been run there will be a small amount of residual pressure in fuel line. The depressurising procedure must still be carried out before disconnecting any component within the fuel system.

The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

1. Remove fuel pump relay module. *See Multiport Fuel Injection Relays*
2. Start and run engine.
3. When sufficient fuel has been used to cause fuel line pressure to drop, injectors will become inoperative, resulting in engine stall. Switch off ignition.
4. Disconnect battery negative lead.



**NOTE:** Fuel at low pressure will remain in system. To remove low pressure fuel, place absorbent cloth around fuel feed hose at fuel rail.

5. Disconnect either:
  - a) Nut and olive at fuel railOR
  - b) Hose at inlet end of fuel filter.

### Refit

6. Refit fuel feed hose.
7. Refit fuel pump relay module, reconnect battery.
8. Crank engine (engine will fire in approximately 6 to 8 seconds).



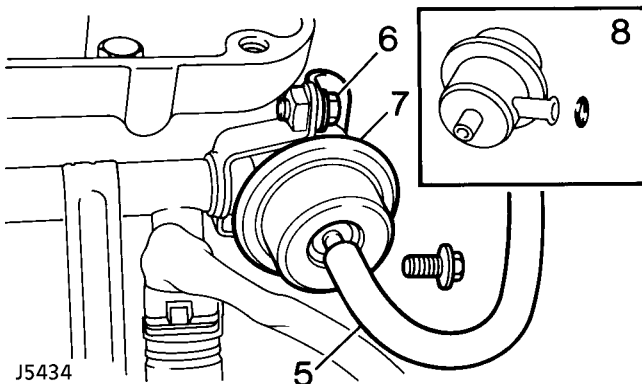


## FUEL PRESSURE REGULATOR

Service repair no - 19.45.06

### Remove

1. Depressurise fuel system. *See Depressurising Fuel System*
2. Disconnect battery negative lead.
3. Remove plenum chamber. *See Plenum Chamber*
4. Release clip and disconnect fuel return hose from regulator.
5. Disconnect vacuum hose from regulator.
6. Remove 2 bolts securing pressure regulator to fuel rail.
7. Release regulator from fuel rail and withdraw.
8. Remove and discard 'O' ring.



### Refit

9. Lightly coat 'O' ring with silicon grease 300 and fit to regulator.
10. Reverse removal procedure.
11. Reconnect battery and pressurise fuel system. Check there are no fuel leaks around regulator connections.

## FUEL RAIL-INJECTORS R/H AND L/H

Service repair no - 19.60.04 - Rail

Service repair no - 19.60.01 - Injectors

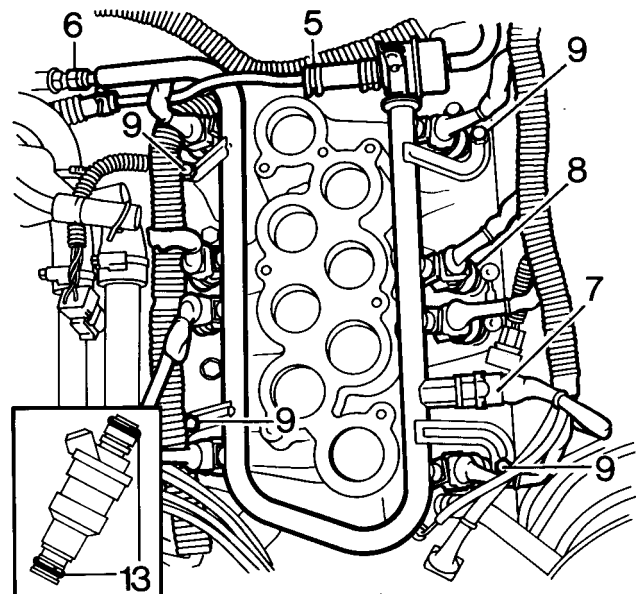
### Remove

1. Depressurise fuel system. *See Depressurising Fuel System*
2. Disconnect battery negative lead.
3. Remove plenum chamber. *See Plenum Chamber*
4. Remove ram housing. *See Ram Housing*



**NOTE:** Place cloth over ram tube openings to prevent ingress of dirt.

5. Loosen clip and disconnect fuel return hose from regulator.
6. Loosen union and disconnect fuel supply hose from fuel rail.
7. Disconnect multi-plug from fuel temperature sensor.
8. Disconnect multi-plugs from injectors.
9. Remove four bolts securing fuel rail support brackets to intake manifold. Lay injector harnesses to one side.



J5435

10. Remove fuel rail and injectors.
11. Remove injector retaining clips, ease injectors from rail. Remove and discard 'O' rings from injectors.
12. Remove fuel pressure regulator if required.

## Refit

13. Fit **NEW** 'O' rings, to injectors. Lightly coat 'O' rings with silicon grease 300. Insert injectors into fuel rail, multi-plug connections facing outwards.
14. Refit retaining clips.



**CAUTION: Care must be taken when refitting the fuel rail and injectors to intake manifold to prevent damage to 'O' rings.**

15. Fit a **NEW** 'O' ring to pressure regulator lightly coat 'O' ring with silicon grease 300 and secure regulator to the fuel rail.
16. Fit fuel rail and heater pipe assemblies to intake manifold. Secure rail and pipes in position with five bolts.
17. Reverse removal procedure. 2 to 7.
18. Pressurise fuel system and check for fuel leaks around injectors and pressure regulator.

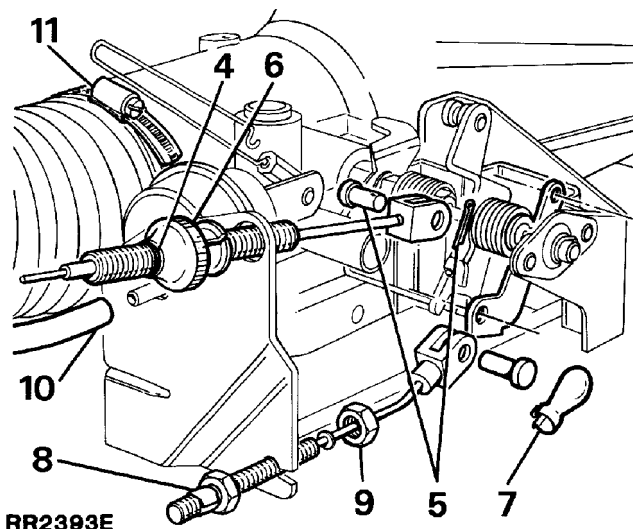
## PLENUM CHAMBER

**Service repair no - 19.22.46**

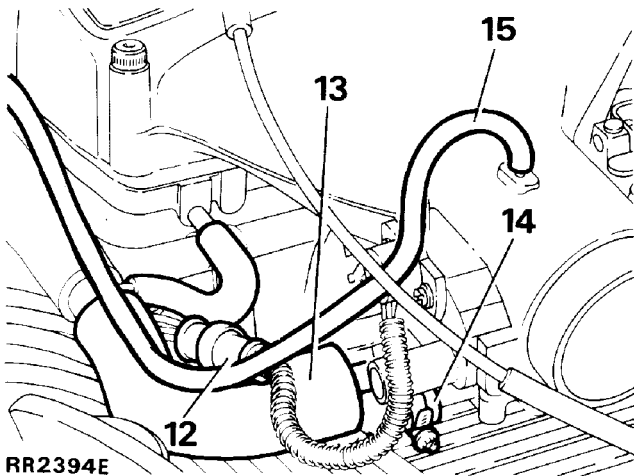
**Includes throttle levers and throttle disc**

## Remove

1. Disconnect battery negative lead.
2. Disconnect electrical multi-plug from bypass air valve.
3. Disconnect vacuum hose adjacent to bypass air valve.
4. Mark an identification line on throttle cable outer to assist re-assembly.
5. Remove clevis pin from throttle cable.
6. Pry adjustment thumb wheel from throttle bracket. Lay cable aside.
7. Remove retaining clip and clevis pin from kick down cable (automatic vehicles).
8. Apply adhesive tape behind rear adjustment nut on kick down cable to prevent nut moving.
9. Remove front lock nut. Remove cable and lay aside.
10. Remove cruise control vacuum hose.



11. Remove intake hose from neck of plenum chamber.
12. Disconnect throttle position sensor multi-plug.
13. Remove PCV breather hose.
14. Disconnect two coolant hoses and plug each hose to prevent excessive loss of coolant. Identify each hose for re-assembly.

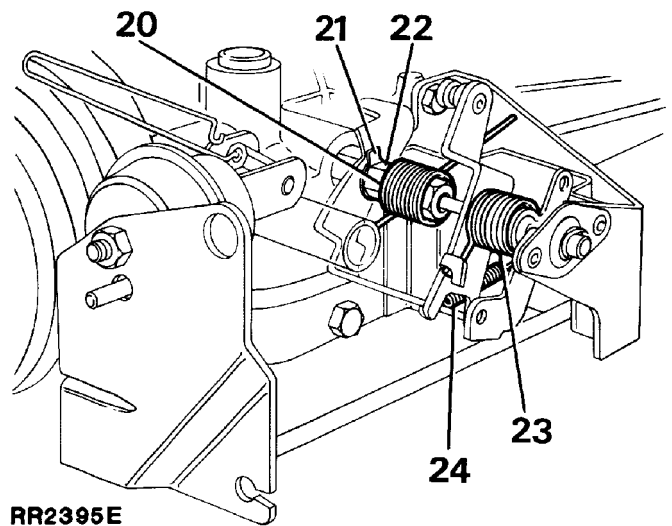


RR2394E

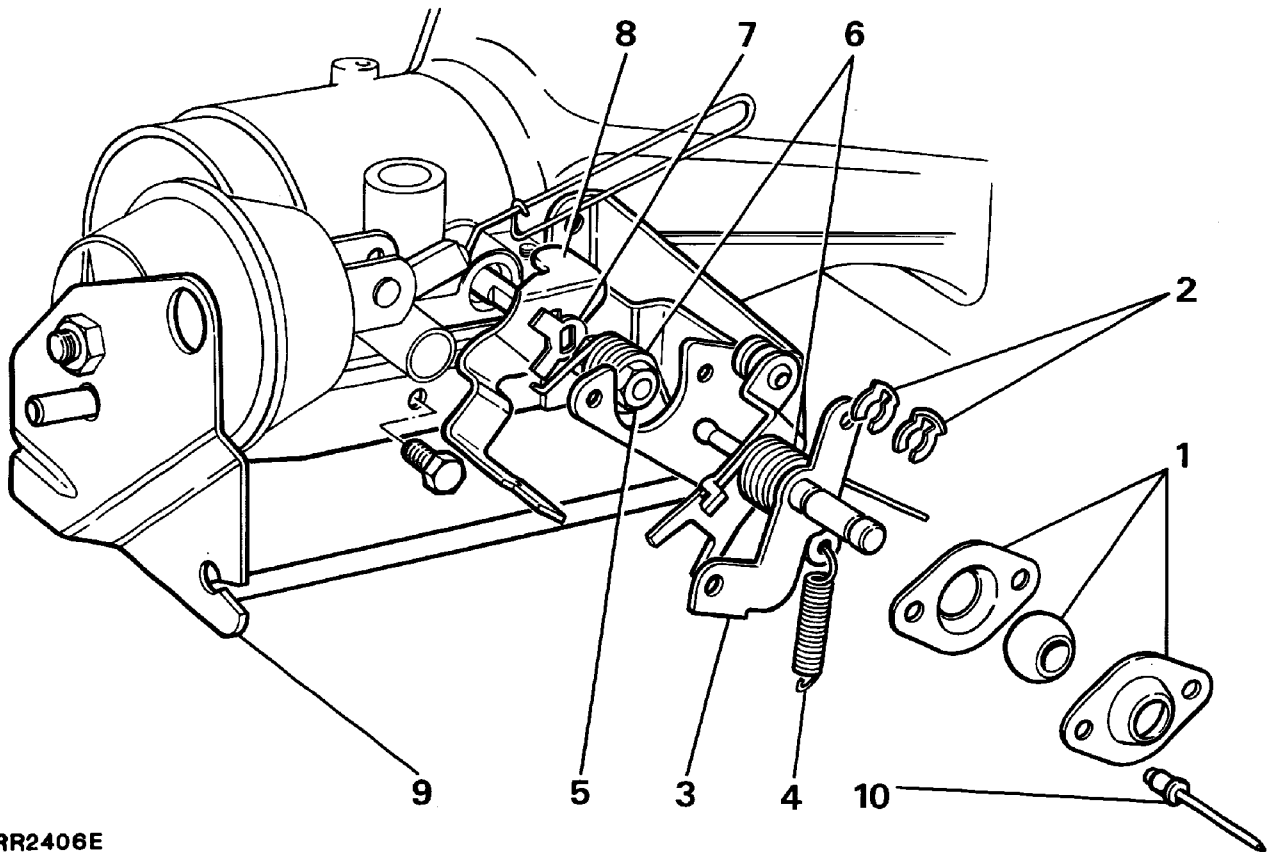
15. Remove distributor vacuum hose.
16. Release two screws and remove throttle position sensor.
17. Remove six screws securing plenum chamber. Remove plenum chamber.
18. Remove air idle air control valve hose.

### Throttle lever assembly - remove

19. If fitted - unclip cruise control actuator link. Hold throttle fully open, release link from countershaft assembly. Carefully return lever assembly to close throttle.
20. Release tension on inboard throttle spring.
21. Bend back lock washer tabs.
22. Hold throttle stop lever in closed position, release nut from throttle shaft.
23. Release tension on outboard throttle spring.
24. Remove overtravel spring.



RR2395E



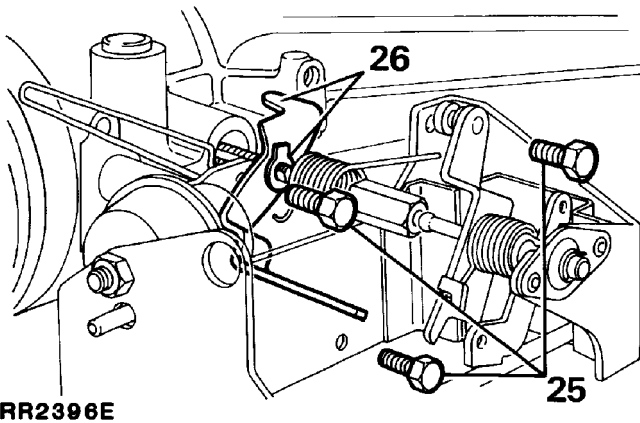
RR2406E

## KEY

1. Spherical bush/housing
2. Retaining clips (2)
3. Countershaft assembly
4. Overtravel spring
5. Throttle shaft nut
6. Throttle return spring (2)
7. Tab washer
8. Throttle stop lever
9. Throttle bracket assembly
10. Pop rivets (2)

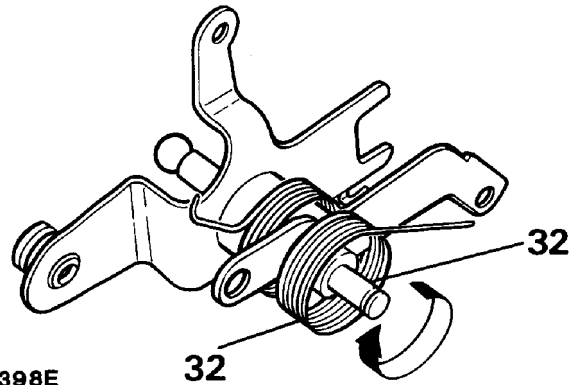


25. Remove three bolts securing throttle bracket to plenum chamber, withdraw bracket assembly.
26. Remove tab washer and throttle stop lever from throttle shaft.



RR2398E

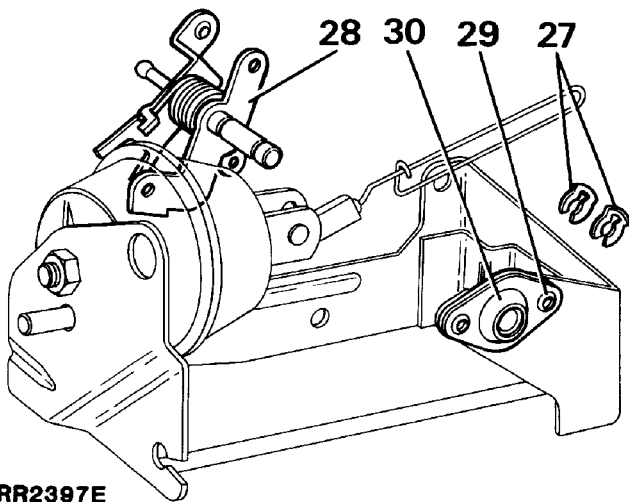
31. Grease new bush with Admax L3 or Energrease LS3. Assemble bush into housing. Assemble to throttle bracket using two 4.7 mm (3/16 in) diameter domed head rivets.
32. Examine bearing surface of countershaft assembly. If worn fit new assembly, otherwise wind throttle return spring off levers.



RR2398E

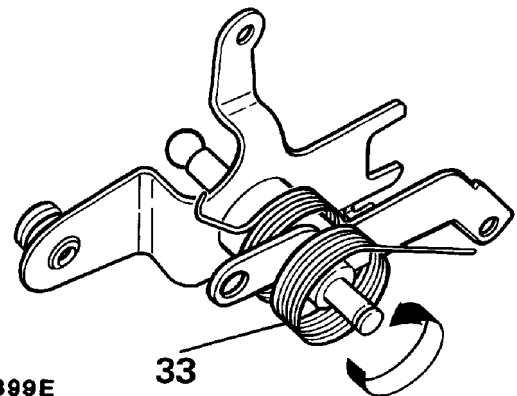
#### Throttle lever assembly - inspect and overhaul

27. Remove two retaining clips from spherical bush.
28. Remove the countershaft assembly.
29. If spherical bush worn, drill out two securing rivets (4,7 mm, (3/16 in) diameter drill).
30. Split assembly, discard worn bush.



RR2397E

33. Wind new spring onto countershaft assembly, small hooked end of spring is wound on first.



RR2399E

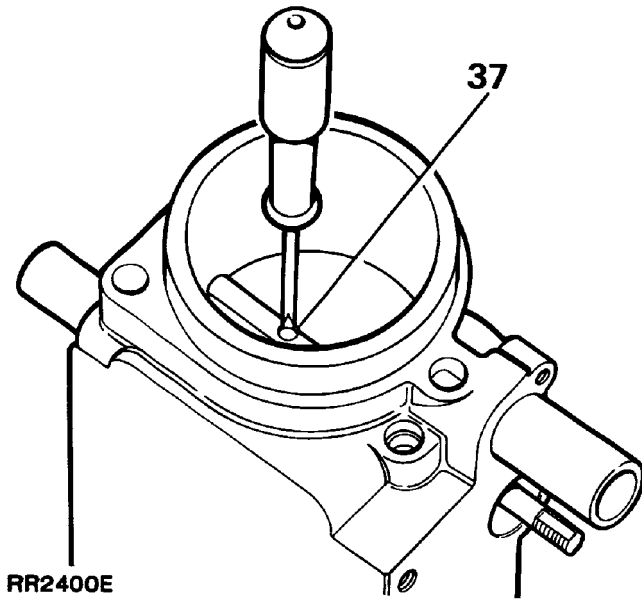
34. Grease shaft with Admax L3 or Energrease LS3, fit countershaft assembly to spherical bearing, secure with two clips.
35. Examine throttle stop lever for wear, fit a new lever if necessary.

## Throttle disc - inspect and overhaul

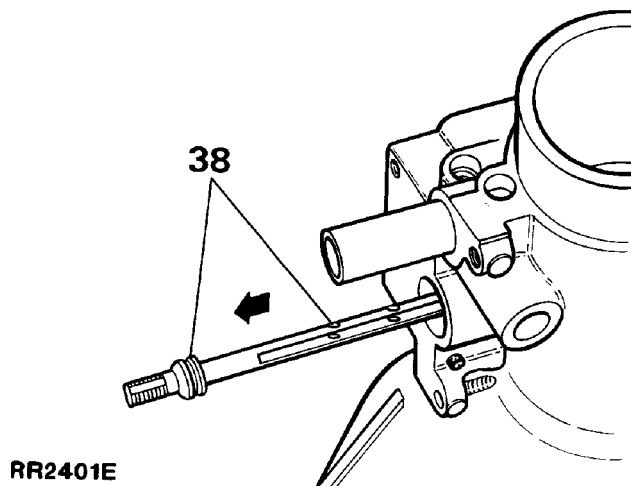
36. Examine throttle shaft for excessive wear between bushes in plenum chamber and shaft. A small amount of clearance is permissible. If excessive wear is evident fit new shaft and bushes as follows.
37. Remove two split screws securing throttle disc and withdraw disc.



**CAUTION:** Take care not to damage shaft.



38. Remove shaft and air seal from plenum chamber.



39. Using suitable drift, drive out bushes.

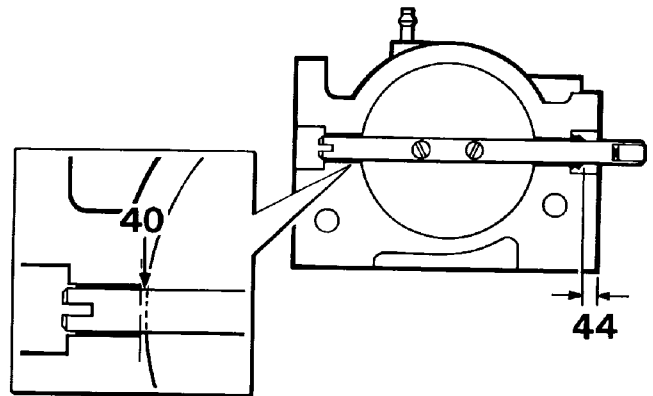


**CAUTION:** Take care not to damage plenum chamber bores

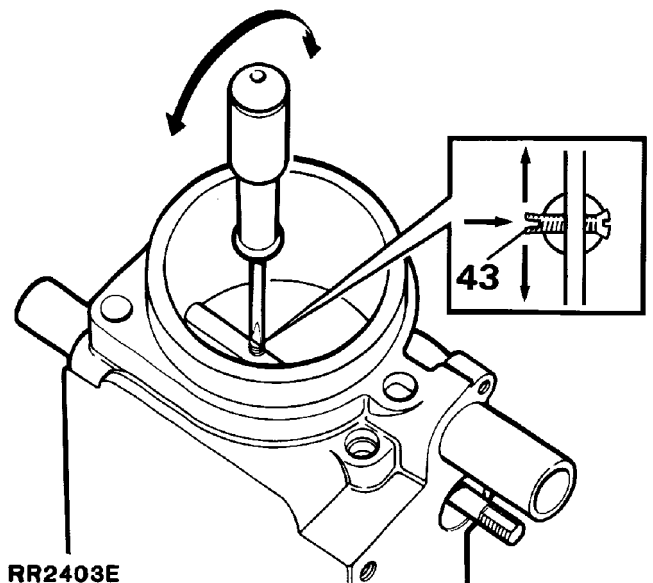
40. Press in new bushes until flush with throttle disc bore.



**CAUTION:** Ensure that bushes do not protrude into bore, as they will interfere with movement of throttle disc.



41. Fit throttle shaft and disc, secure with two split screws. Do not fully tighten screws.
42. Rotate throttle shaft 360° once or twice to centralise disc in bore. Tighten split screws.
43. Rotate shaft. Use screw driver to spread split.

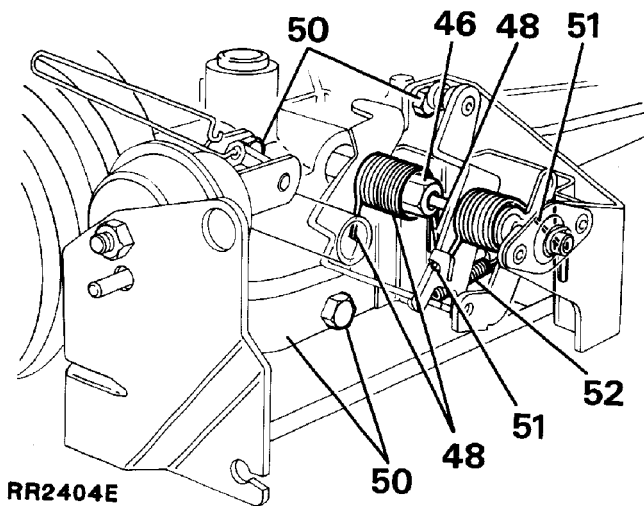




44. Grease new air seal with Admax L3 or Energrease LS3. Push seal down shaft, into counterbore until seal is 6.0 mm (0.236 in) below face of plenum.

#### Throttle levers and bracket - assemble

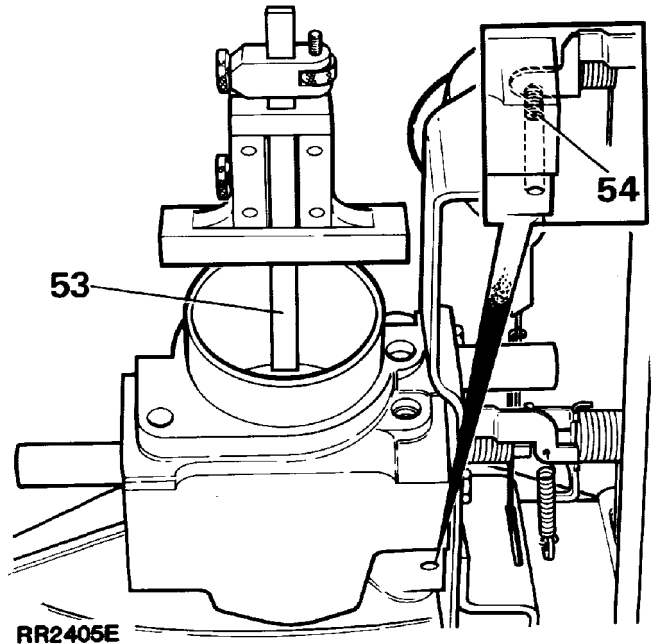
45. Fit stop lever to throttle shaft, a new tab washer and secure with throttle shaft nut.  
 46. Holding stop lever on stop, tighten throttle shaft nut securely, bend over tabs to lock nut in position.  
 47. Fit inboard throttle return spring noting that small hooked end of spring is nearest plenum.  
 48. Locate hooked end of inboard spring on stop lever. Wind up straight end one full turn and locate in appropriate slot.  
 49. Fit countershaft to interconnecting nut of throttle valve shaft.  
 50. Secure throttle bracket assembly to plenum. Secure with three retaining bolts.  
 51. Ensure hooked end of outboard spring is retained by lever, wind spring up one full turn and locate free end in appropriate slot.  
 52. Fit overtravel spring.  
 Lightly grease throttle return and overtravel springs with Admax L3 or Energrease LS3.



bore.

**NOTE:** If new throttle levers have been fitted, minimum throttle setting of disc must be checked to ensure it is 90° to

53. Using a depth vernier or depth micrometer, check dimension from mouth of bore to top and bottom of valve disc. Dimension must be within 0.5 mm (0.019 in) total indicator reading across diameter of disc.  
 54. If dimension is out of limits, adjust small set screw below stop lever.



#### Refit

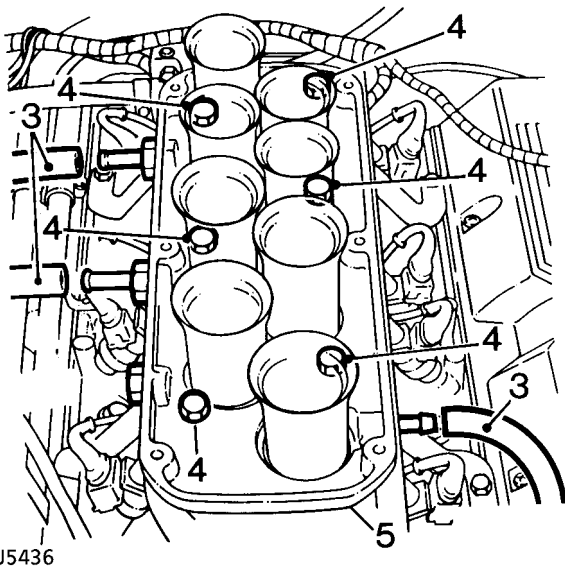
55. Reconnect and adjust cruise control actuator link. **See Actuator Link Setting**  
 56. Clean joint faces of plenum and ram housing. Apply 'Hylomar' sealant, refit plenum chamber. Tighten bolts to **26 Nm**.  
 57. Reverse removal procedure.

## RAM HOUSING

Service repair no - 19.70.04

### Remove

1. Disconnect battery negative lead.
2. Remove plenum chamber. *See Plenum Chamber*
3. Release hoses from ram housing.
4. Remove six through bolts (with plain washers) securing ram housing to intake manifold.



5. Remove ram housing from intake manifold.
6. Place a protective cover over inlet bores to prevent ingress of dirt.

### Refit

7. Clean all mating faces.
8. Apply 'Hylomar' sealant to intake manifold face.
9. Fit ram housing. Tighten bolts, working from two centre bolts, diagonally towards outer four bolts.
10. Tighten to **26 Nm**.

## INTAKE MANIFOLD

Service repair no - 30.15.08

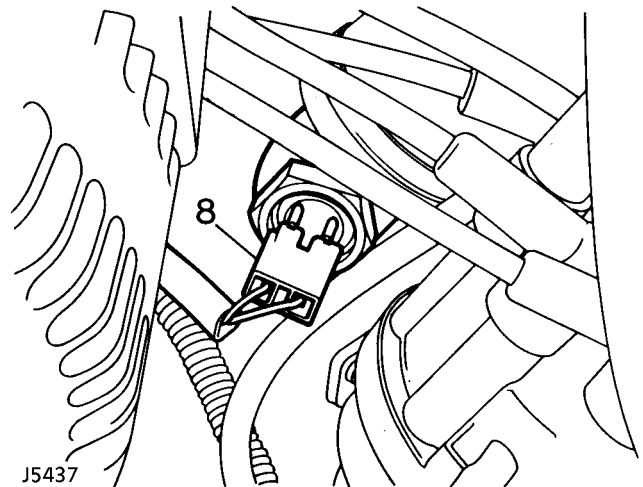
### Remove

1. Depressurise fuel system. *See Depressurising Fuel System*
2. Disconnect battery negative lead.
3. Drain cooling system. *See COOLING SYSTEM, Repair, Radiator*
4. Remove plenum chamber. *See Plenum chamber*
5. Remove ram housing. *See Ram Housing*



**CAUTION:** Place a protective cover over intake manifold openings to prevent the ingress of dirt.

6. Disconnect the fuel temperature sensor and injector multiplugs.
7. Remove fuel pressure regulator. *See Fuel Pressure Regulator*

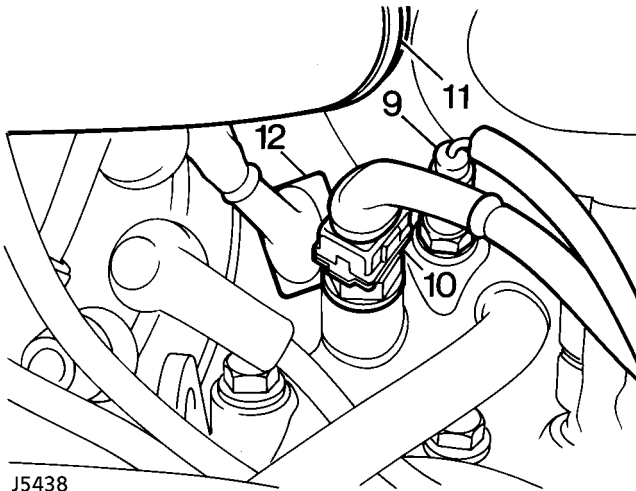


8. Disconnect multiplug from coolant temperature sensor.
9. Disconnect instrument pack temperature thermistor.
10. Disconnect coolant sensor multiplug.





11. Loosen clip and disconnect top hose from thermostat housing.
12. Disconnect multiplug from distributor amplifier module.



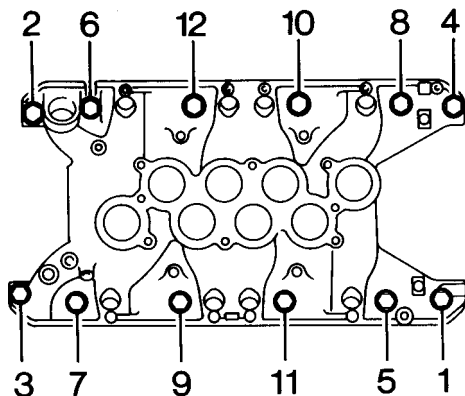
J5438

13. Loosen clip and disconnect hose from heater valve.
14. Remove injector harnesses from behind fuel rail and lay to one side.
15. Loosen union and disconnect fuel return hose from fuel rail.



**NOTE:** The intake manifold can be removed from the cylinder block without removing the fuel rail and injectors.

16. Using the sequence shown, remove 12 bolts securing the intake manifold to cylinder block.



J5439

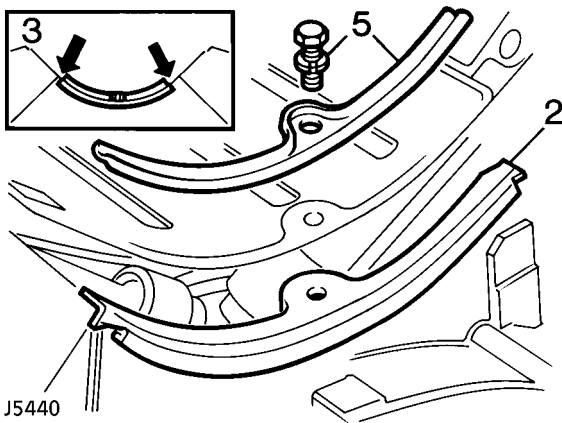
17. Remove the intake manifold.
18. Noting their fitted position, remove bolts and clamps securing intake manifold gasket to cylinder block.
19. Remove and discard gasket.
20. Remove and discard gasket seals.

**Do not carry out further dismantling if component is removed for access only.**

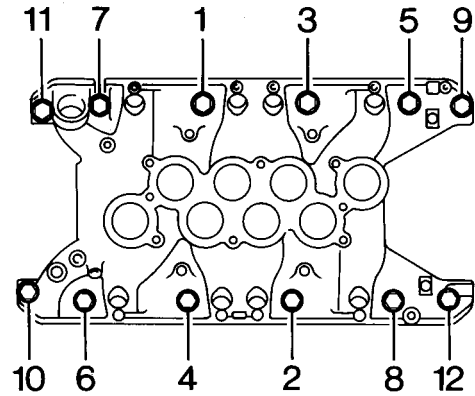
21. Remove 5 nuts securing fuel rail support brackets to intake manifold.
22. Remove fuel rail and injectors.
23. Remove 2 bolts securing thermostat housing to intake manifold.
24. Remove thermostat housing.
25. Remove bolt securing coolant pipe to intake manifold. Loosen union and remove coolant pipe. Remove and discard 'O' ring.
26. Fit new 'O' ring to coolant pipe. Position coolant pipe to intake manifold. Fit bolt securing coolant pipe support bracket to intake manifold and tighten pipe union.
27. Clean mating faces of thermostat housing and intake manifold.
28. Fit thermostat housing to intake manifold using a new gasket, fit and tighten bolts.
29. Position fuel rail to intake manifold, fit and tighten retaining bolts.

## Refit

1. Clean mating faces of cylinder heads, cylinder block and intake manifold.
2. Locate NEW seals in position with ends engaged in notches formed between the cylinder heads and block.
3. Apply RTV sealant between ends of seals, cylinder head and block.
4. Fit intake manifold gasket with the word 'FRONT' to the front and open bolts hole to the front RH side.
5. Fit gasket clamps and tighten bolts finger tight.



6. Locate intake manifold onto cylinder heads, clean threads of manifold securing bolts.
7. Allow 10 minutes for RTV sealant to cure.
8. Fit manifold bolts finger tight. Working in the sequence shown tighten the bolts to **38 Nm**.



J5441

9. Tighten the gasket clamp bolts to **18 Nm**.
10. Reverse removal procedure.
11. Fill cooling system. **See COOLING SYSTEM, Repair, Radiator**
12. Start engine check for water and fuel leaks.



## FUEL FILTER

Service repair no - 19.25.02

### Remove



**WARNING: Spilling of fuel is unavoidable during this operation. Ensure all necessary precautions are taken to prevent fire and explosion.**

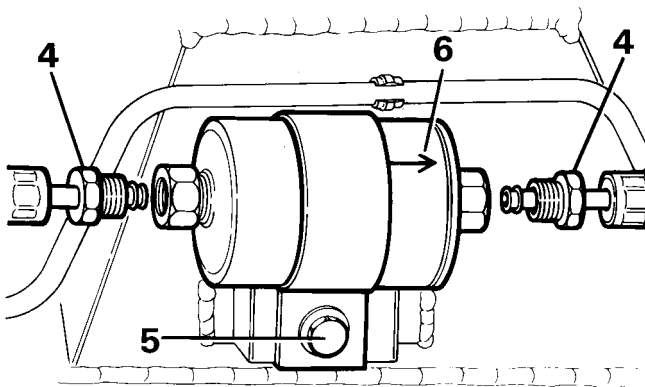


**WARNING: Ensure fuel handling precautions given in Section 01 - Introduction are strictly adhered to when carrying out following instructions.**

1. Depressurise fuel system. *See Depressurising Fuel System*
2. Access to filter is gained through right hand rear wheel arch.
3. Clean area around hose connections to prevent ingress of foreign matter into fuel system. Clamp inlet and outlet hoses to prevent fuel spillage when disconnecting hoses.
4. Loosen two fuel line unions and remove hoses. Plug ends of hoses to prevent ingress of dirt.
5. Release securing bolt and bracket and remove filter from chassis side member.

### Refit

6. Fit a new filter observing direction of flow arrows stamped on canister.
7. Tighten securing nut and bolt.
8. Fit inlet and outlet hoses. Tighten to **30Nm**.
9. Refit fuel pump relay module, reconnect battery.
10. Start engine and inspect for fuel leaks around hose connections.



RR2966E

# 19 FUEL SYSTEM

## FUEL PIPES

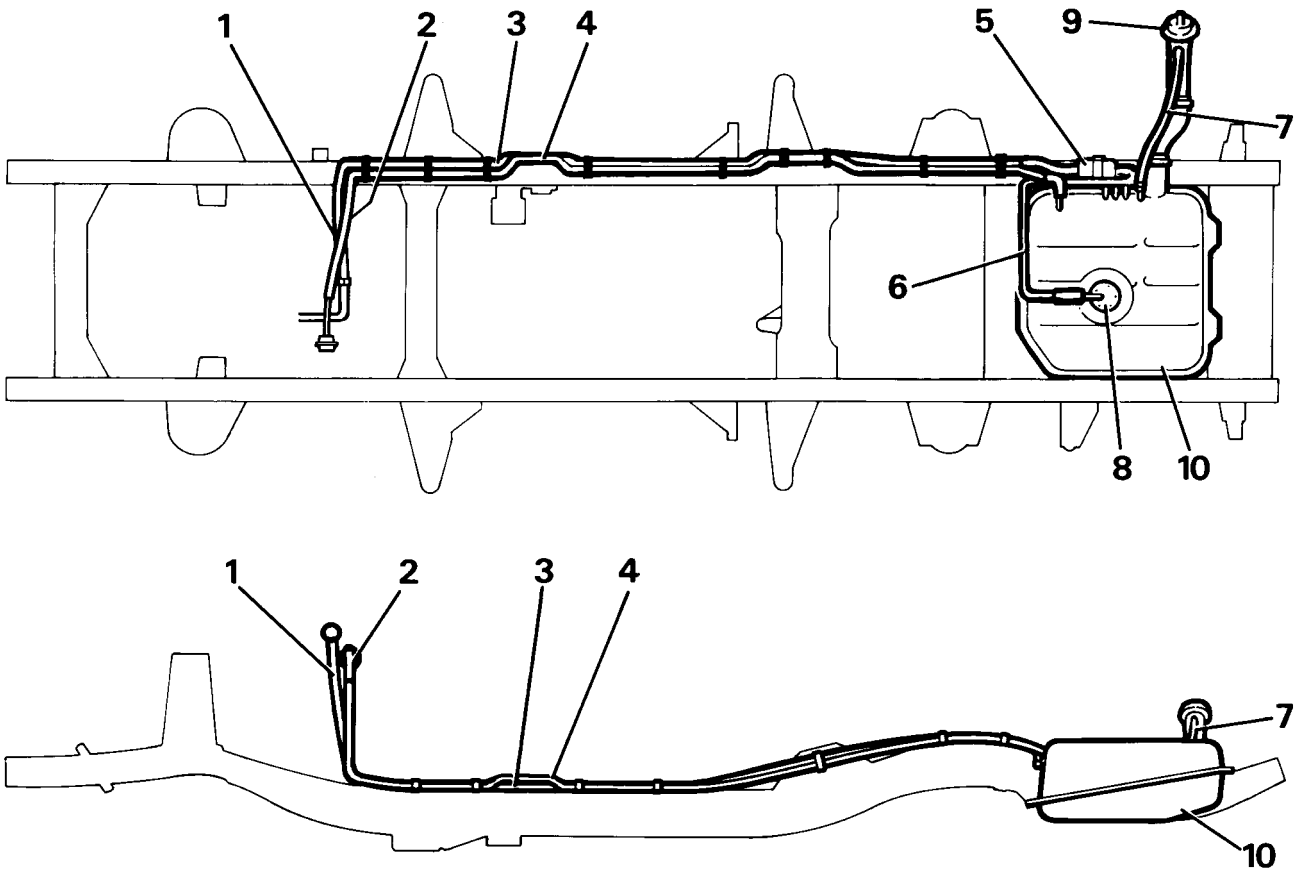
Service repair no - 19.40.92



**WARNING:** Depressurise fuel system. See *Depressurise Fuel System* before disconnecting any fuel pipes ensure that all necessary precautions are taken against fuel spillage



**WARNING:** Ensure fuel handling precautions given in Section 01 - introduction are strictly adhered to when carrying out following instructions.



J5442

### KEY

- |                                   |                                    |
|-----------------------------------|------------------------------------|
| 1. Fuel feed hose to fuel rail.   | 6. Rigid fuel feed pipe to filter. |
| 2. Fuel return hose to fuel tank. | 7. Breather hose.                  |
| 3. Rigid fuel feed pipe.          | 8. In-tank fuel pump.              |
| 4. Rigid fuel return pipe.        | 9. Fuel filler neck.               |
| 5. Fuel filter.                   | 10. Fuel tank.                     |

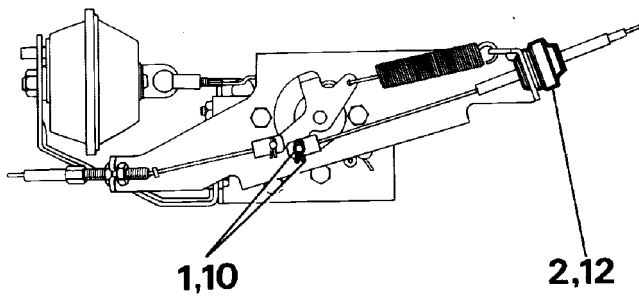


## THROTTLE CABLE

Service repair no - 19.20.06

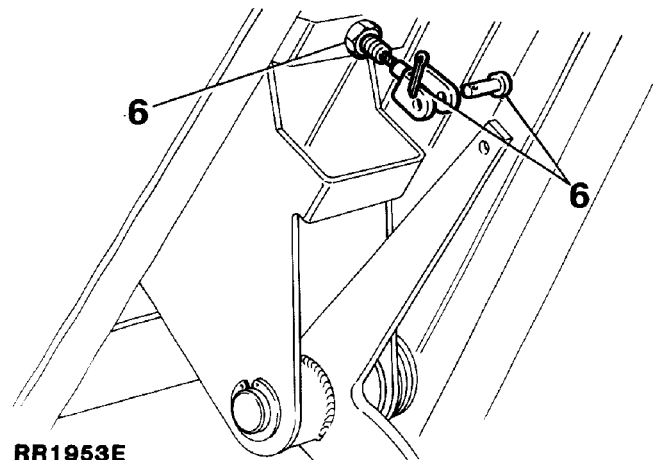
### Remove

1. Remove clevis pin securing cable to lever.
2. Carefully pry throttle cable adjustment nut out of mounting bracket.
3. Remove cable from mounting bracket.



### RR1954E

4. Release outer cable from retaining clips in engine compartment.
5. Remove lower dash panel.
6. Disconnect cable from accelerator pedal and release cable locknut.
7. Feed cable through bulkhead grommet into engine compartment.



### RR1953E

### Refit

8. Feed new cable from engine compartment through bulkhead grommet.
9. Connect cable to accelerator pedal.
10. Connect cable to throttle linkage, using a new cotter pin.
11. Clip outer cable adjustment nut into mounting bracket.
12. Adjust outer cable to give 1.57 mm free play in inner cable. Check throttle operation.

## ACCELERATOR PEDAL

Service repair no - 18.30.35

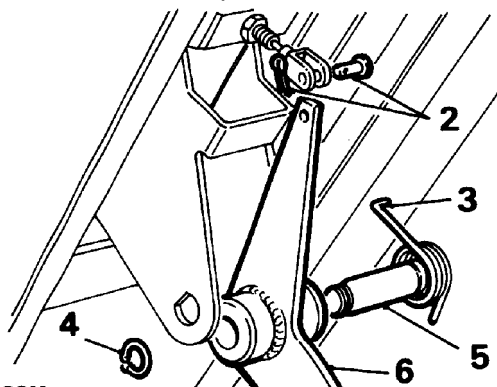
### Remove

1. Remove lower dash panel.
2. Remove clevis pin securing throttle cable to accelerator pedal.
3. Release tension from pedal return spring.
4. Remove circlip from pedal pivot pin.
5. Withdraw pivot pin.



**NOTE:** It may be necessary to lower steering column to gain access to pivot pin circlip.

6. Remove accelerator pedal.



RR 732M

### Refit

7. Lightly grease pivot and clevis pins.
8. Fit clevis pin using a **NEW** cotter pin.
9. Reverse removal procedure.

## FUEL PUMP AND SENDER UNIT

Service repair no - 19.45.03

A plastic fuel tank with a combined fuel pump/sender unit is fitted. The fuel pump/sender unit is accessed through a panel in the load space floor.

### Fuel pump/sender unit



**WARNING:** Ensure that fuel handling precautions given in Section 01 - Introduction are strictly adhered to when carrying out following instructions.



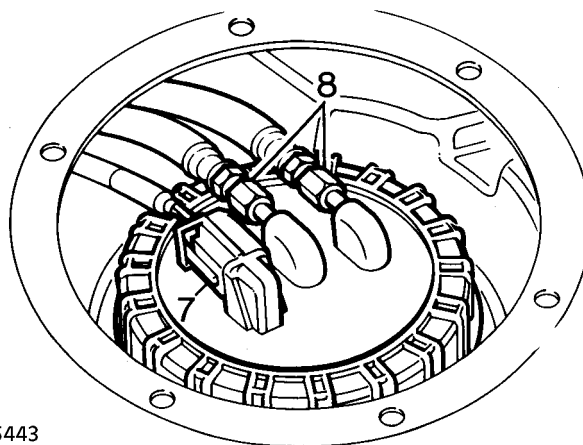
**CAUTION:** Before disconnecting any part of fuel system, it is imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into fuel system.

### Service Tools:

LRT-19-001 wrench - pump retaining ring  
LRT-19-002 'Speedfit' disconnecter

### Remove

1. Depressurise fuel system. *See Depressurising Fuel System*
2. Disconnect battery negative lead.
3. Syphon at least 9 litres (2 gallons) of fuel from fuel tank into a suitable container that can be sealed.
4. Remove carpet from loadspace floor and tailgate.
5. Fold back loadspace sound insulation to reveal access panel.



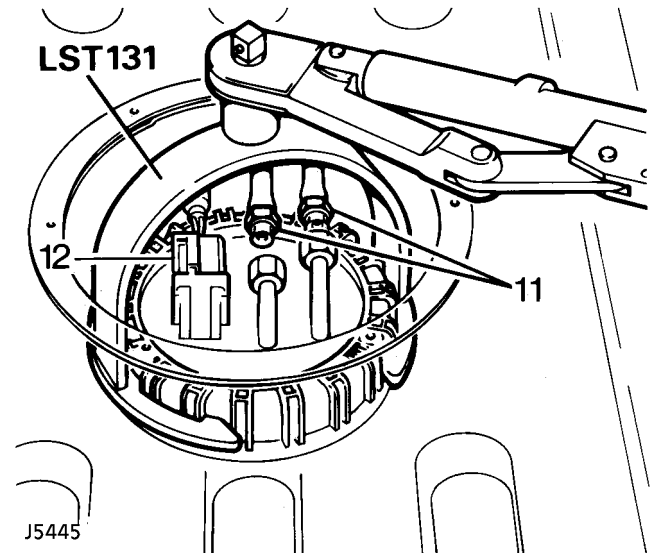
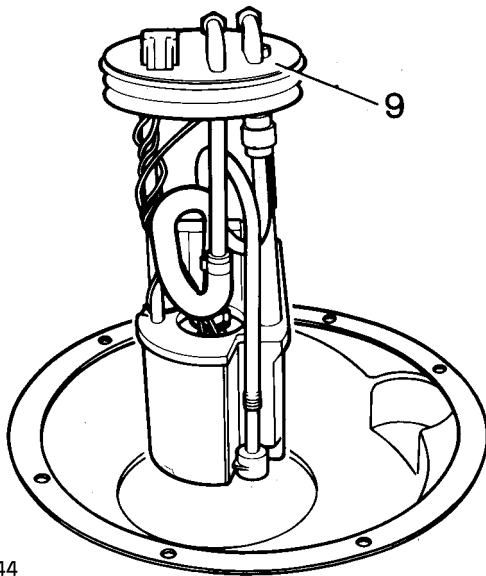
J5443



6. Remove access panel from floor.
7. Disconnect multi-plug from fuel sender unit.
8. Disconnect two fuel line unions from fuel pump.
9. Using service tool no. LRT-19-001, remove pump unit retaining ring. Withdraw unit from fuel tank.



**WARNING:** A quantity of fuel will be retained in body of unit, care must be taken to prevent fuel spillage when unit is removed.



#### Refit

10. Insert fuel pump into tank. Fit retaining ring. Tighten to **48 Nm**.
11. Connect fuel lines to pump.
12. Connect multi-plug to sender unit.
13. After assembly, check all fuel pipes, sealing rings and hose connections are secure.
14. Run engine to check for fuel leaks.
15. Inspect access panel seal, fit a new seal if necessary.
16. Fit access panel and tighten screws.
17. Reverse removal procedure. 4 - 5. Fit insulation and carpet.

## FUEL TANK

Service repair no - 19.55.01



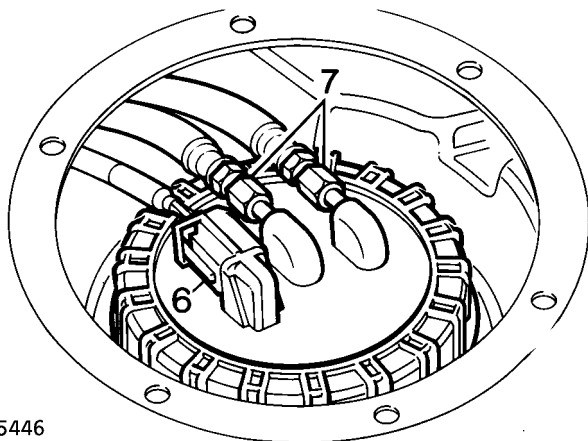
**WARNING:** Ensure that fuel handling precautions given in Section 01 - introduction are strictly adhered to when carrying out following instructions.



**CAUTION:** Before disconnecting any part of fuel system, it is imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into fuel system.

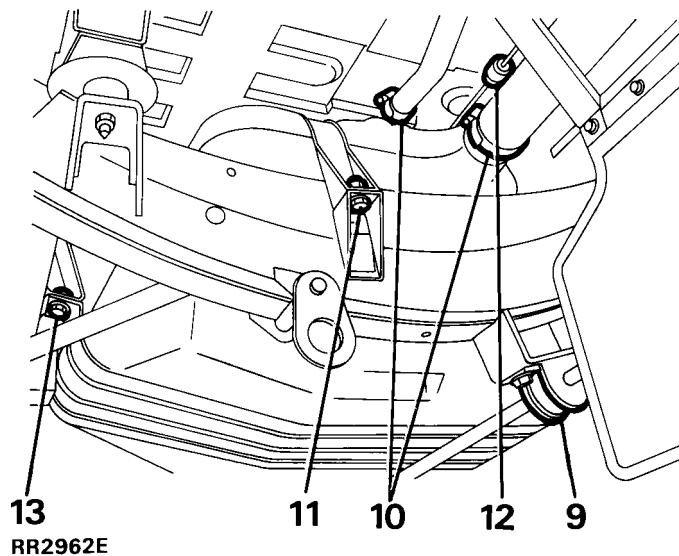
### Remove

1. Depressurise fuel system. Disconnect battery negative lead.
2. Syphon fuel tank into a suitable container that can be sealed afterwards.  
**ENSURE TANK IS DRAINED COMPLETELY.** (refer to Warning concerning fuel vapour and spillage at start of procedure).
3. Remove carpet loadspace floor and tailgate.
4. Fold back sound insulation to reveal access panel.



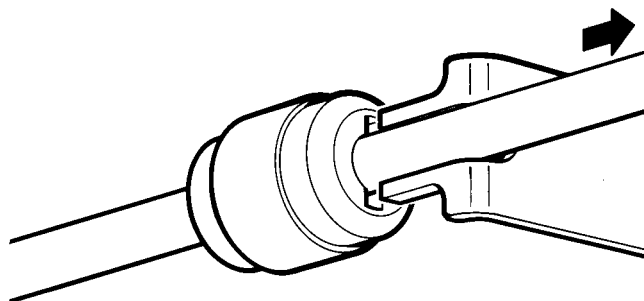
J5446

5. Remove access panel.
6. Disconnect electrical multi-plug.
7. Disconnect two fuel line unions from fuel pump.
8. Working underneath vehicle mark location of anti-roll [sway] bar straps.
9. Remove rear anti-roll [sway] bar straps, and allow bar to swing down clear of tank.



RR2962E

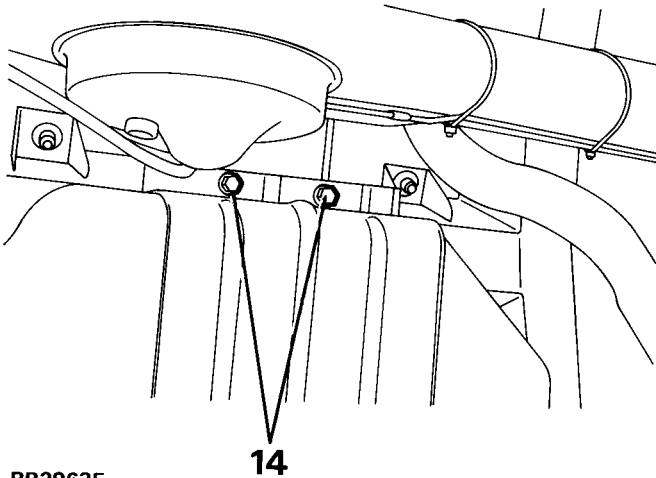
10. Remove tank filler and vent hoses at fuel tank.
11. Remove nut and bolt securing right hand side fuel tank strap.
12. Disconnect evaporative control pipe at green end of 'speedfit' connector.



ST2877M

**NOTE:** To disconnect 'speedfit' connector, insert forked end of LRT-19-002 into slots of connector see illustration. Press down on collet and simultaneously pull pipe from connector.





RR2963E

14

13. Remove back two bolts and nut plates securing fuel tank cradle.
14. Remove front nuts, bolts and washers. Remove fuel tank cradle.
15. With assistance, tilt right hand side of tank upwards and manoeuvre tank through chassis to remove.

#### Refit

16. Reverse removal procedure. Ensuring sealing ring, fuel pipe and hose connections are secure.
17. Run engine, check all connections for fuel leaks.




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**TORQUE VALUES**


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**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	<b>Nm</b>
Air-Bypass valve (stepper motor) .....	20
All flexible hose securing clamps .....	1,3
Fuel feed pipe - hose to fuel rail .....	22
Fuel filter .....	31

**EVAPORATIVE LOSS CONTROL SYSTEM**

All flexible hose securing clamps .....	1,7
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<b>METRIC</b>	<b>Nm</b>
M5 .....	6
M6 .....	9
M8 .....	25
M10 .....	45
M12 .....	90
M14 .....	105
M16 .....	180

<b>UNC / UNF</b>	
1/4 .....	9
5/16 .....	24
3/8 .....	39
7/16 .....	78
1/2 .....	90
5/8 .....	136



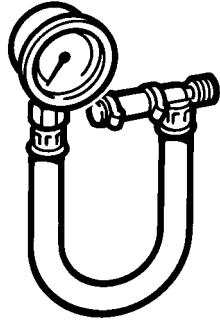
**NOTE:** Torque values above are for all screws and bolts used except for those specified.



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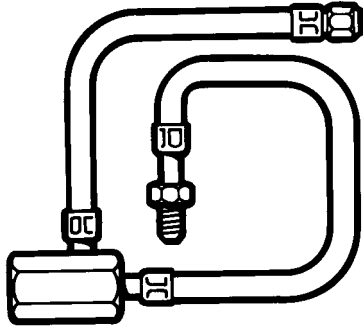
**FUEL SYSTEM**

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LRT-19-004  
18G 500

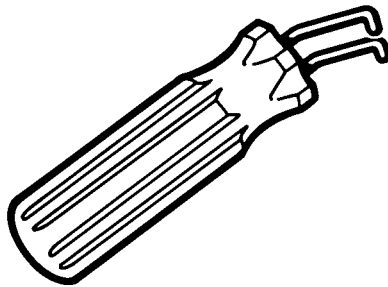
Test equipment fuel pressure

18G1500

LRT-19-003  
LST 143

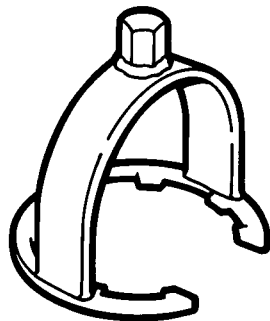
MFI pressure test adaptor

LST143

LRT-19-002  
LST 144

Connector splitter

LST 144

LRT-19-001  
LST 131

Fuel pump remover

LST131



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## ENGINE MANAGEMENT SYSTEM

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### Description

The engine management system (EMS) maintains optimum engine performance over the entire operating range. The correct amount of fuel is metered into each cylinder inlet tract and the ignition timing is adjusted at each spark plug.

The system is controlled by the ENGINE CONTROL MODULE (ECM) which receives data from sensors located on and around the engine. From this information it provides the correct fuel requirements and ignition timing at all engine loads and speeds.

The fuel injection system uses a hot wire Mass Air Flow Sensor to calculate the amount of air flowing into the engine.

The ignition system does not use a distributor. It is a direct ignition system (DIS), using four double ended coils. The circuit to each coil is completed by switching inside the ECM.

The on board diagnostic system detects any faults which may occur within the EMS. Fault diagnosis includes failure of all EMS sensors and actuators, emissions related items, fuel supply and exhaust systems.

The system incorporates certain default strategies to enable the vehicle to be driven in case of sensor failure. This may mean that a fault is not detected by the driver. The fault is indicated by illumination of the malfunction indicator light (MIL) on North American specification vehicles.

A further feature of the system is 'robust immobilisation'.

### Crankshaft position sensor (CKP Sensor)

The crankshaft position sensor is the most important sensor on the engine. It is located in the left hand side of the flywheel housing and uses a different thickness of spacer for manual and automatic gearboxes. The signal it produces informs the ECM:

- the engine is turning
- how fast the engine is turning
- which stage the engine is at in the cycle.

As there is no default strategy, failure of the crankshaft sensor will result in the engine failing to start. The fault is indicated by illumination of the malfunction indicator light (MIL) on North American specification vehicles.

### Camshaft position sensor (CMP Sensor)

The camshaft position sensor is located in the engine front cover. It produces one pulse every two revolutions. The signal is used in two areas, injector timing corrections for fully sequential fuelling and active knock control.

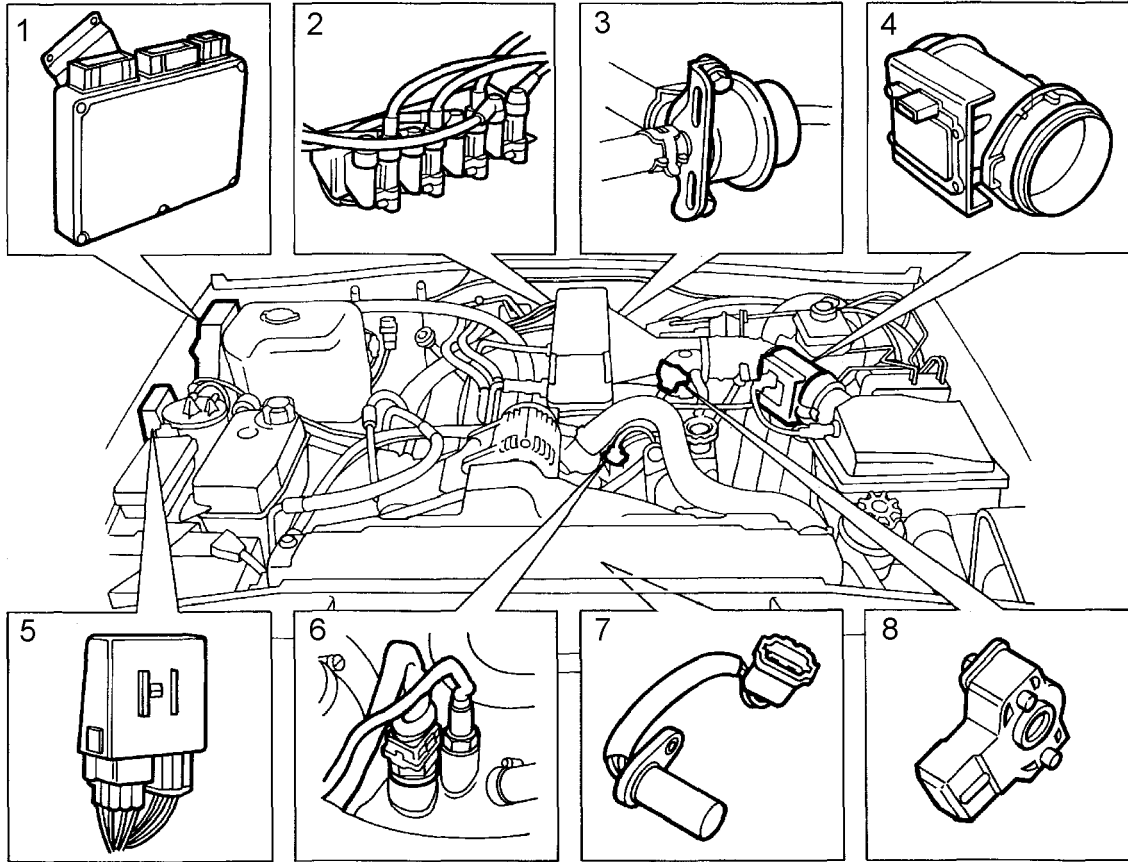
If the camshaft sensor fails, default operation is to continue normal ignition timing. The fuel injectors will be actuated sequentially, timing the injection with respect to top dead centre. Injection will either be correct or one revolution out of synchronisation. The fault is not easily detected by the driver. The fault is indicated by illumination of the malfunction indicator light (MIL) on North American specification vehicles.

### Mass air flow sensor (MAF Sensor)

The 'hot wire' type mass air flow sensor is mounted rigidly to the air filter and connected by flexible hose to the plenum chamber inlet. The sensing element of the MAF Sensor is a hot wire anemometer consisting of two wires, a sensing wire which is heated and a compensating wire which is not heated. Air flows across the wires cooling the heated one, changing its resistance. The ECM measures this change in resistance and calculates the amount of air flowing into the engine.

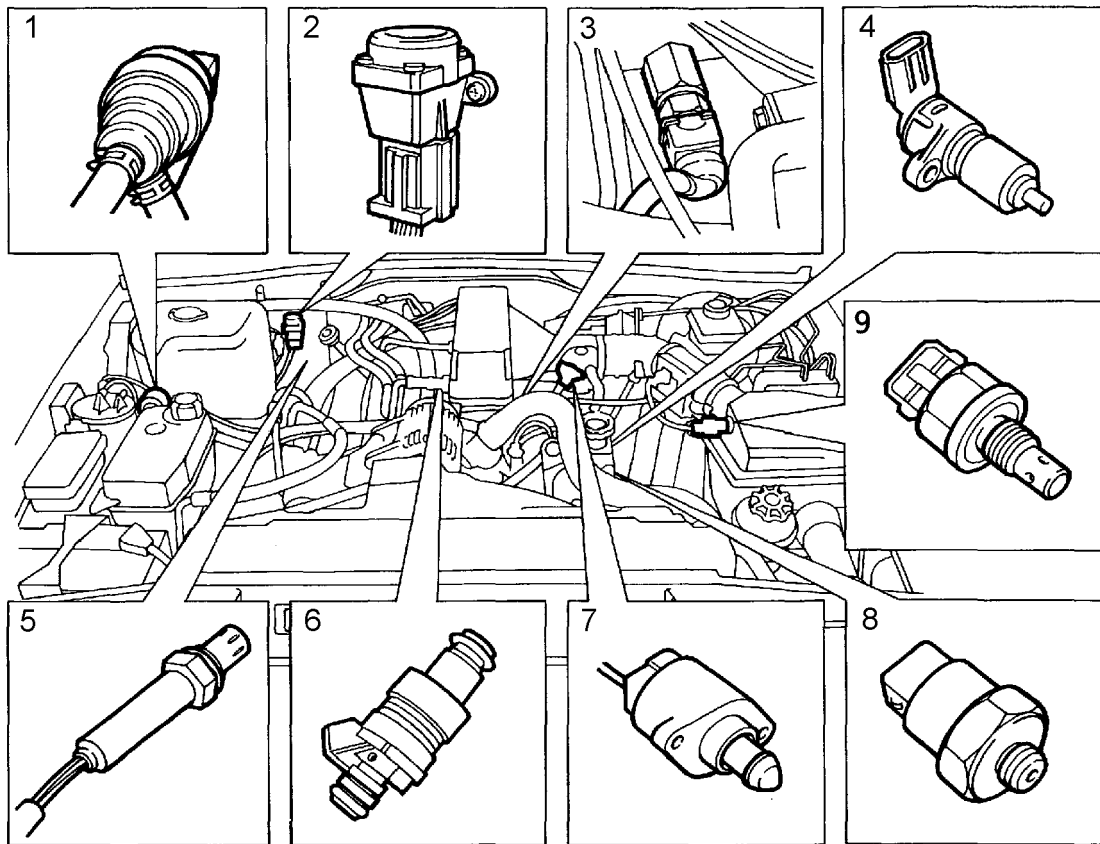
As there is no default strategy, failure will result in the engine starting, and dying when it reaches 550 rev/min, when the ECM detects no MAF Sensor signal. The fault is indicated by illumination of the malfunction indicator light (MIL) on North American specification vehicles.

## ENGINE MANAGEMENT SYSTEM COMPONENT LOCATION - PRE ADVANCED EVAPS



J6007

1. Engine control module
2. Ignition coils
3. Fuel pressure regulator
4. Mass air flow sensor
5. Relay module
  - Main relay
  - Fuel pump relay
6. Engine coolant temperature sensor
7. Camshaft position sensor
8. Throttle position sensor



J6008

1. EVAP purge valve
2. Inertia switch
3. Engine fuel temperature sensor
4. Crankshaft position sensor
5. Oxygen sensor (4 off)
6. Injectors
7. Idle air control
8. Knock sensors (2 off)
9. Intake air temperature sensor

**Throttle position sensor (TP Sensor)**

The throttle position sensor is mounted on the plenum chamber and connected directly to the throttle shaft. The sensor is a variable resistor, the signal from which (0 - 5V) informs the ECM of the actual position of the throttle disc. As there is no default strategy, failure of the sensor will result in poor idle and lack of throttle response. If failure occurs in the closed position the engine will only reach 1750 rev/min when the ECM will initiate overrun fuel cut off. The fault is indicated by illumination of the malfunction indicator light (MIL) on North American specification vehicles.

**Engine coolant temperature sensor (ECT Sensor)**

This sensor consists of a temperature dependant resistive metal strip. The resistance of the strip varies considerably with coolant temperature, i.e. from 28K ohms at - 30°C to 90 ohms at 130°C, and 300 Ohms at 85°C. The ECT Sensor signal is vital to engine running, as the correct fuelling is dependant upon engine temperature i.e. richer mixture at low temperatures. If the sensor is disconnected or failure occurs a default value will be supplied to the system. The initial default value selected will be based on the value of the air intake temperature. This will increase to a nominal warmed up value over an individual time, programmed for each default value. The fault may not be evident to the driver, there may be a hot restart problem. The fault is indicated by illumination of the malfunction indicator light (MIL) on North American specification vehicles.

**Intake air temperature sensor (IAT Sensor)**

This is another resistive sensor, located in the body of the air cleaner. The resistance varies with changes in air temperature. The signal from the IAT Sensor is used to retard the ignition timing if the air temperature rises above 55°C. If the sensor is disconnected or failure occurs a default value will be supplied to the system. The default value selected will represent normal operating conditions. The fault may not be evident to the driver, there may be slight power loss in high ambient temperatures. The fault is indicated by illumination of the malfunction indicator light (MIL) on North American specification vehicles.



### Engine fuel temperature sensor (EFT Sensor)

This is another resistive sensor. Located on the fuel rail it measures temperature of the rail rather than the fuel. The resistance varies with changes in temperature. The signal is used to increase the injection pulse time when undergoing hot restarts. When the fuel is hot, vapourisation occurs in the rail and bubbles can occur in the injectors. Increasing the pulse time flushes the bubbles away, and cools the fuel rail with fuel from the tank. The fault may not be evident to the driver, there may be a hot restart problem. The fault is indicated by illumination of the malfunction indicator light (MIL) on North American specification vehicles.

### Knock sensors

The knock sensor produces an output voltage in proportion to mechanical vibration caused by the engine. A sensor is located in each cylinder bank between 2/4 and 3/5 cylinders. The ECM calculates if the engine is knocking due to camshaft and crankshaft sensor signals regarding the position of the engine in the cycle. The ECM can also work out exactly which cylinder is knocking and retards the ignition on that particular cylinder until the knock disappears. It then advances the ignition to find the optimum ignition timing for that cylinder. The ECM can adjust the timing of each cylinder for knock simultaneously. It is possible that all eight cylinders could have different advance angles at the same time. If the camshaft sensor fails, the knock sensor will continue to work, but as the engine may be running one revolution out of synchronisation the ECM may retard the wrong cylinder of the pair e.g. 1 instead of 6. If the knock sensor fails engine knock will not be detected and corrected. The fault is indicated by illumination of the malfunction indicator light (MIL) on North American specification vehicles.

### Ignition coils

The electronic ignition system uses four double ended coils. They are mounted on a bracket fitted to the rear of the engine. The circuit to each coil is completed by switching within the ECM, allowing each coil to charge up and fire. Sparks are produced in two cylinders simultaneously, one on compression stroke, the other on exhaust stroke. Note that coil 1 feeds cylinders 1 and 6, coil 2 feeds cylinders 5 and 8, coil 3 feeds cylinders 4 and 7, and coil 4 feeds cylinders 2 and 3. Due to the ease of combustion in the cylinder on the compression stroke, more energy is dissipated in that cylinder. Coil failure will result in a lack of sparks and misfire in the affected cylinders. The fault is indicated by illumination of the malfunction indicator light (MIL) on North American specification vehicles.

### Injectors

A multiport fuel injection system (MFI) is used, one injector per cylinder. Each injector consists of a small solenoid which is activated by the ECM to allow a metered amount of fuel to pass into the combustion chamber. Due to the pressure in the fuel rail and the shape of the injector orifice, the fuel squirts into the cylinder in a fine spray to aid combustion. In the unlikely event of injector failure a misfire will occur as there will be no fuel to the affected cylinder. The fault is indicated by illumination of the malfunction indicator light (MIL) on North American specification vehicles.



### Idle air control (IAC)

Idle speed is controlled by a stepper motor which consists of two coils. When energised in the correct sequence the coils move a plunger which opens and closes the throttle bypass controlling the quantity of idle air. The stepper motor controls idle speed by moving the plunger a set distance called a step. Fully open is zero steps and fully closed 180 steps. Failure of the stepper motor will result in low or high idle speed, poor idle, engine stall or non start. The fault is indicated by illumination of the malfunction indicator light (MIL) on North American specification vehicles.

### Heated oxygen sensor (HO2S)

The oxygen sensors consist of a titanium metal sensor surrounded by a gas permeable ceramic coating. Oxygen in the exhaust gas diffuses through the ceramic coating on the sensor, and reacts with the titanium wire altering the resistance of the wire. From this resistance change the ECM calculates the amount of oxygen in the exhaust gas. The injected fuel quantity is then adjusted to achieve the correct air/fuel ratio, thus reducing the emissions of carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NO<sup>2</sup>). Two HO2 sensors are fitted, one in each exhaust downpipe just ahead of the catalyst. Note that if the wiring to these sensors is crossed, the vehicle will start and idle correctly until the sensors reach operating temperature. Then the ECM will read the signals from them and send one bank of cylinders very rich and the other very weak. The engine will misfire, have a rough idle and emit black smoke, with possible catalyst damage.

In the event of sensor failure, the system will default to 'open loop'. Operation and fuelling will be calculated using signals from the remaining ECM inputs.

The fault is indicated by illumination of the malfunction indicator light (MIL). ECM diagnostics also uses HO2 sensors to detect catalyst damage, misfire and fuel system faults.

North American vehicles have two extra HO2 sensors mounted one after each catalyst. These are used to determine whether the catalysts are operating efficiently.



**CAUTION: Although robust within the vehicle environment, HO2 sensors are easily damaged by dropping, excessive heat and contamination. Care must be exercised when working on the exhaust system not to damage the sensor housing or tip.**



### **Fuel pressure regulator**

The fuel pressure regulator is located at the rear of the engine in the fuel rail. It consists of a fuel inlet, outlet, vacuum port and internal diaphragm.

When the engine is under high manifold depression, the applied vacuum sucks the diaphragm of its seat, allowing fuel to return to the tank, resulting in a lower fuel pressure. This is necessary because the high depression will try to suck the fuel from the injector, resulting in overfuelling if the pressure remained constant. Failure will result in a rich mixture at idle but normal at full load, or a rich mixture resulting in engine flooding, or a weak mixture. Although the fault will not illuminate the MIL, faults caused by the failure may be indicated.

### **Relay module**

The engine management system employs a relay module, which houses the main relay and the fuel pump relay.

#### **Main relay**

The main relay supplies the power feed to the ECM with a tap off to feed the fuel injectors (8 amps) and air flow sensor (4 amps). This relay is controlled by the engine management ECM. This enables the ECM to remain powered up after ignition is switched off. During this 'ECM power down routine' the ECM records all temperature readings and powers the stepper motor to the fully open position. Failure of this relay will result in the engine management ECM not being switched on resulting in engine not starting due to absence of fuel and ignition.

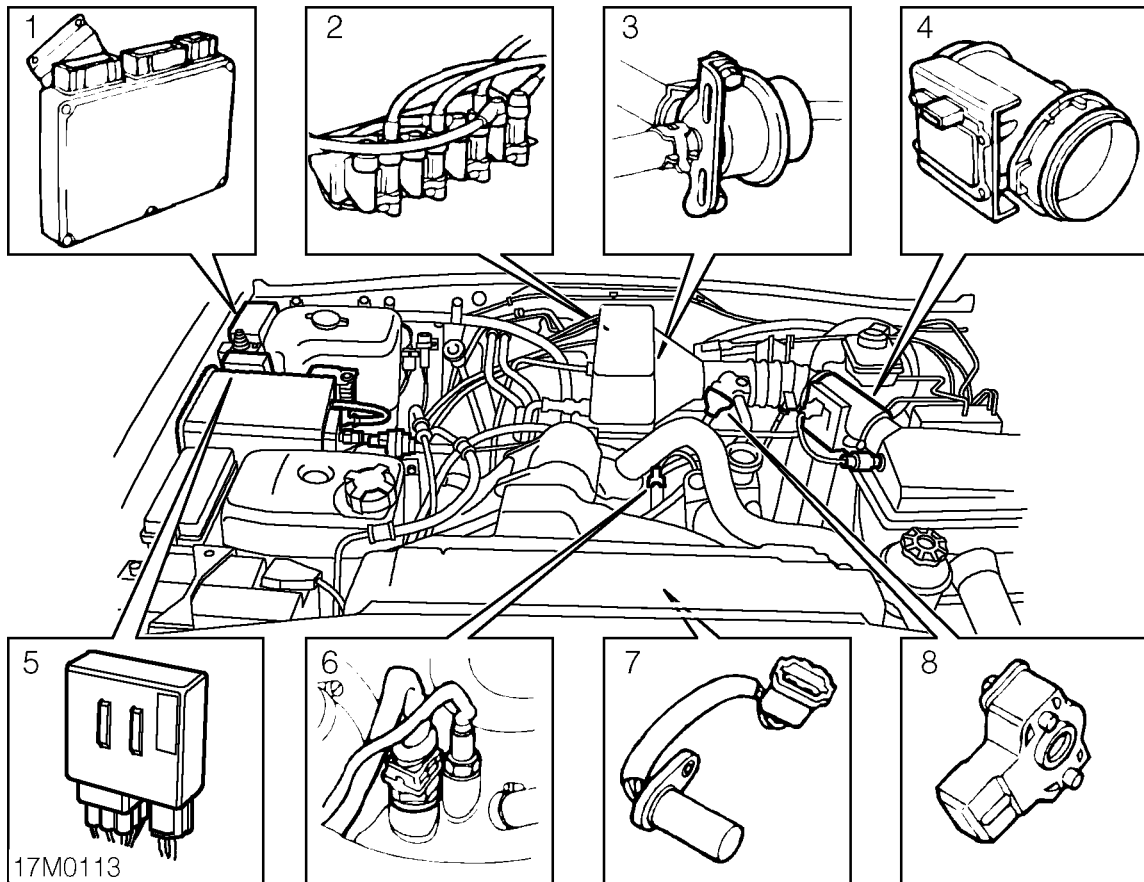
#### **Fuel pump relay**

The fuel pump relay is fed from the ignition relay and controlled by the engine management ECM. The relay is activated in ignition key position 2 to prime the fuel system for a period of time controlled by the ECM. Failure of this relay will result in no fuel pressure.

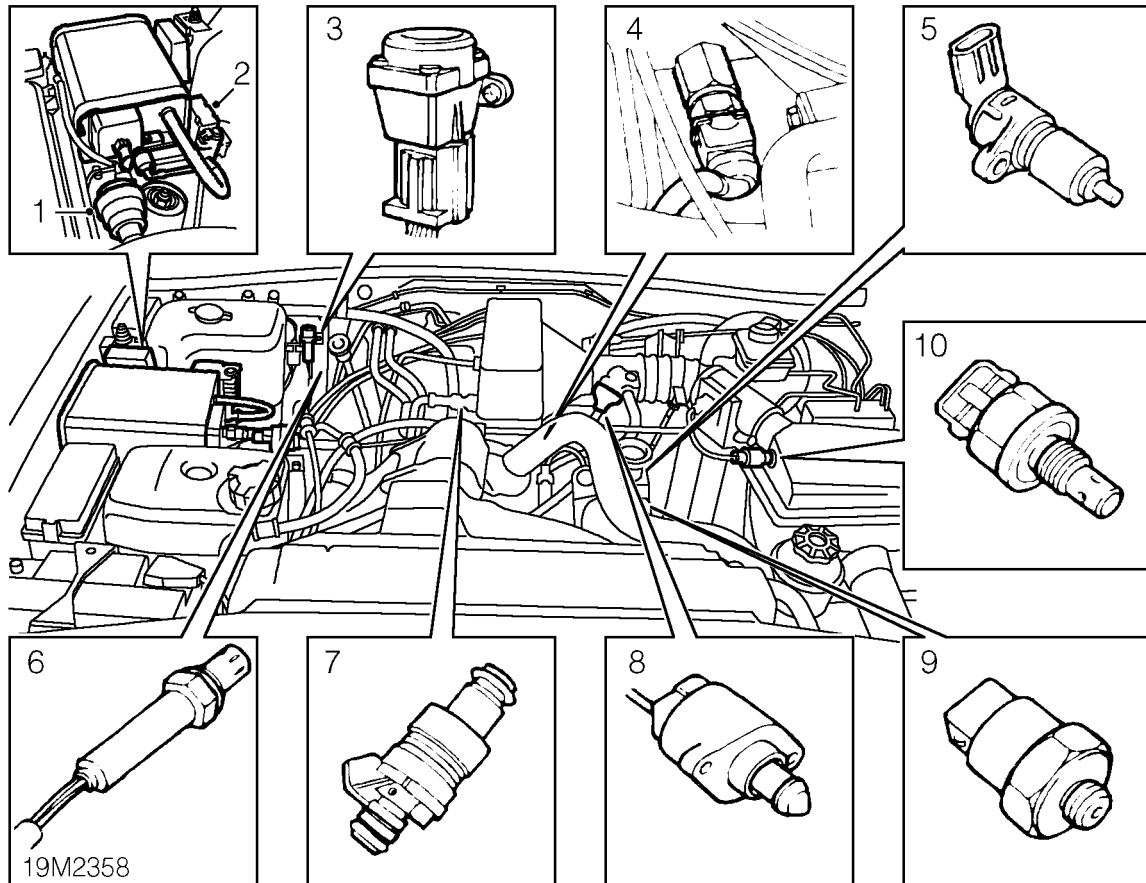
#### **Inertia switch**

The inertia switch isolates the power supply to the fuel pump in the event of sudden deceleration. The inertia switch is located in the engine compartment. It is reset by depressing the central plunger at the top of the switch.

## ENGINE MANAGEMENT SYSTEM COMPONENT LOCATION - ADVANCED EVAPS

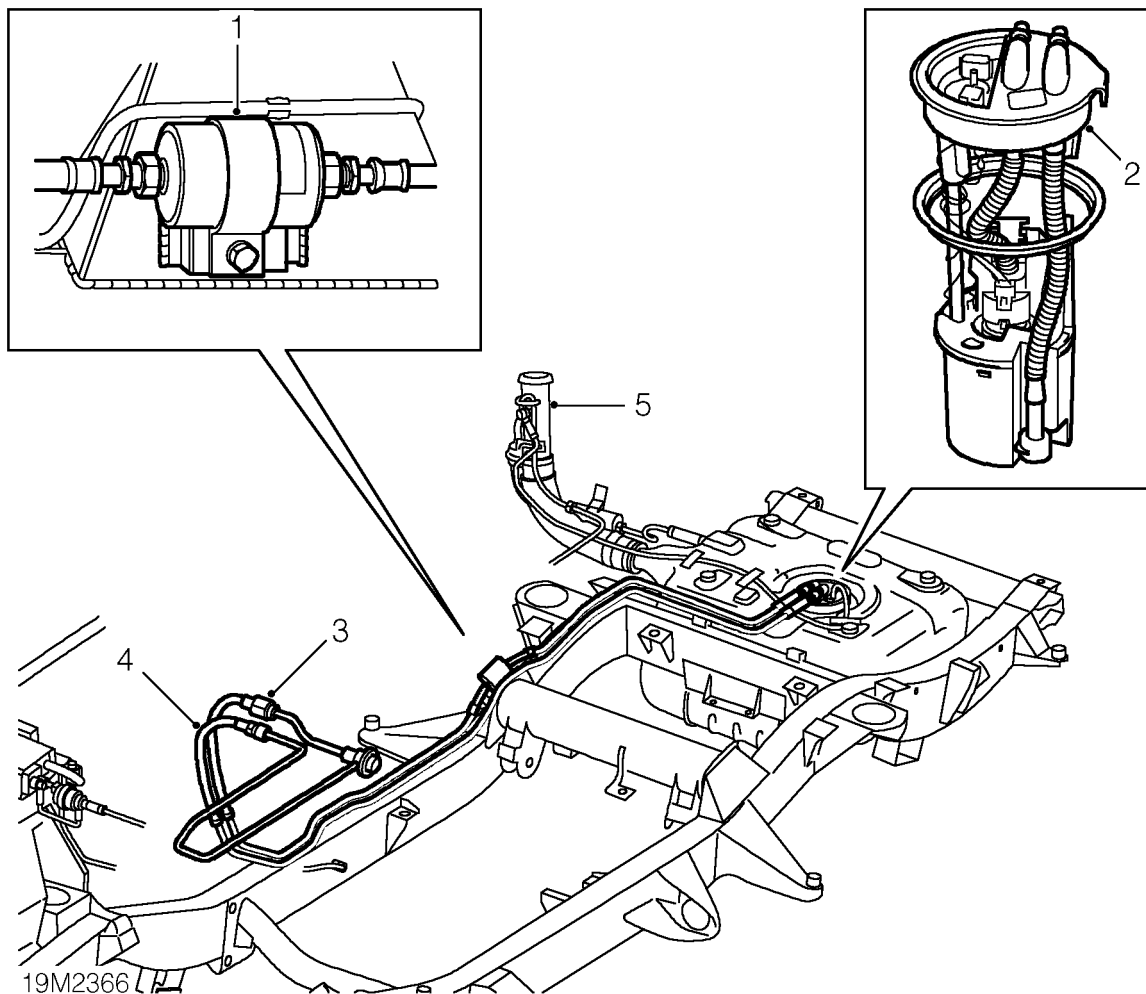


1. Engine control module (ECM)
2. Ignition coils
3. Fuel pressure regulator
4. Mass air flow (MAF) sensor
5. Relay module
  - Main relay
  - Fuel pump relay
6. Engine coolant temperature (ECT) sensor
7. Camshaft position (CMP) sensor
8. Throttle position (TP) sensor



1. EVAP canister purge valve
2. EVAP canister vent solenoid (ECVS)
3. Inertia fuel shut-off (IFS)
4. Engine fuel temperature (EFT) sensor
5. Crankshaft position (CKP) sensor
6. Heated oxygen (HO2) sensor (4 off)
7. Fuel injectors
8. Idle air control valve (IACV)
9. Knock sensors (2 off)
10. Intake air temperature (IAT) sensor

## DESCRIPTION AND OPERATION - ADVANCED EVAPS



1. Fuel filter
2. Fuel pump and gauge sender unit
3. Fuel feed hose
4. Fuel return hose
5. Fuel filler neck assembly

### Fuel Tank Assembly

The fuel tank consists of a moulded High Density Polyethylene (HDPE) fuel cell into which is fitted an electric fuel pump and four roll-over valves. The pump is a self priming "æwet" type where the motor is immersed in fuel. The pump assembly is sealed to the tank with a rubber seal and secured in place using a coated steel locking ring. The pump also incorporates a fuel tank pressure sensor in the top flange.



**NOTE: If the pump is removed, a new seal must always be fitted.**



### Fuel Filler Neck Assembly

The filler neck consists of a stainless steel upper section and a convolute nylon lower section. The nylon lower is joined at one end to the tank and at the other to the stainless upper section where both joints utilise a short piece of rubber hose. The joint at the fuel tank is secured using a spring assisted hose clip which has a shear off cap.



**NOTE: The spring assisted clip must never be re-used, if removed a new clip of the same type must be fitted.**

Tank vent connections are achieved using serviceable plastic quickfit connectors. The filler cap is tethered to the body of the vehicle. Only a cap of this type must be used as a replacement.

### Fuel Lines

The fuel lines consist of two coated steel lines fitted along the length of the chassis from the fuel pump at the rear of the vehicle to the connections at the fuel rail on the engine, via a fuel filter on the feed line.

Connections at the pump are metal quickfits, while those at the filter and fuel rail are threaded unions utilising "O" rings for effective sealing.



**NOTE: When the fuel filter is serviced or the fuel rail joints are disconnected, new "O" rings must always be fitted.**

Connections at the fuel rail are made using "Saginaw" screw thread type connectors with "O" rings as the sealing medium. The fuel lines in the engine compartment are made from a braided nylon material.



**NOTE: This material must not be clamped or kinked as this impairs its performance.**



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## ENGINE TUNING

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### Service repair no - 19.22.13

The position of the Idle Air Control (IAC) valve can be checked using TestBook and adjusted if necessary through the by-pass screw in the plenum chamber. The bypass screw is covered by a tamper proof plug which can be extracted using a self tapping screw.

#### All vehicles:

1. Ensure air conditioning and all electrical loads are off. Vehicle must be in neutral or park with air suspension in kneel and disabled.
2. Carry out tuning or base idle setting procedure as applicable using TestBook.

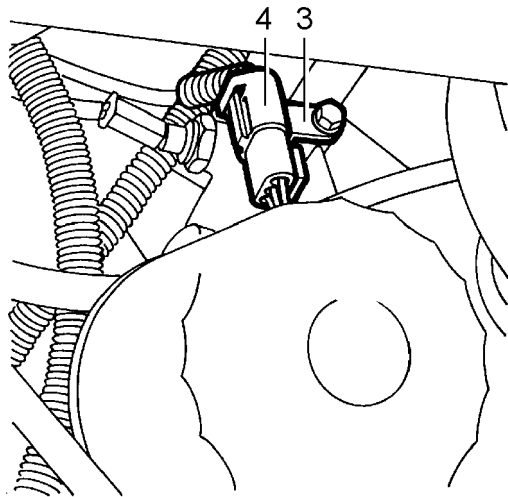


## CAMSHAFT POSITION SENSOR (CMP SENSOR)

Service repair no - 19.22.07

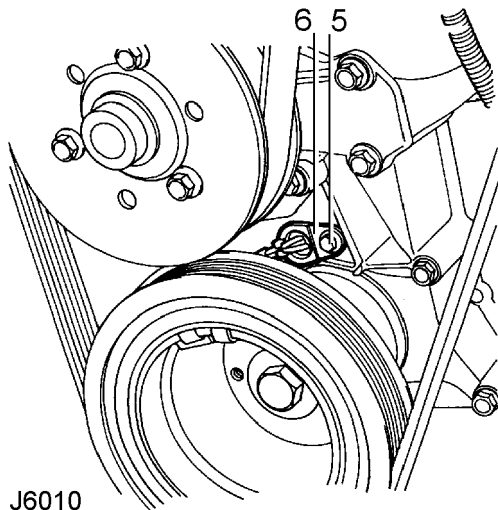
### Remove

1. Disconnect battery negative lead.
2. Raise vehicle on a ramp.



J6009

3. Release sensor multiplug from clip located on front cover.
4. Disconnect multiplug.



J6010

5. Remove bolt securing sensor.
6. Remove sensor from front cover.
7. Remove 'O' ring from sensor and discard.

### Refit

8. Clean sensor and mating face on front cover.
9. Lubricate NEW 'O' ring and fit to sensor.
10. Engage CMP sensor in front cover location.  
Secure with bolt. Tighten to **8 Nm**.
11. Connect sensor multiplug and secure to bracket.
12. Lower ramp.
13. Reconnect battery negative lead.

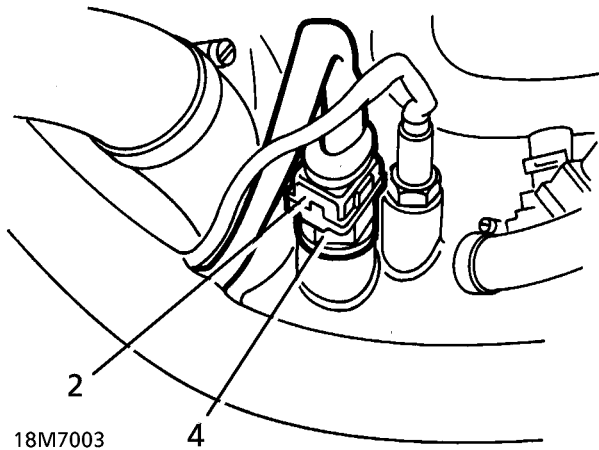


## ENGINE COOLANT TEMPERATURE SENSOR (ECT SENSOR)

Service repair no - 18.30.10

### Remove

1. Disconnect battery negative lead.



2. Remove spring clip and disconnect ECT sensor multiplug.
3. Position cloth around ECT sensor to absorb coolant spillage.
4. Remove ECT sensor.
5. Remove sealing washer and discard.

### Refit

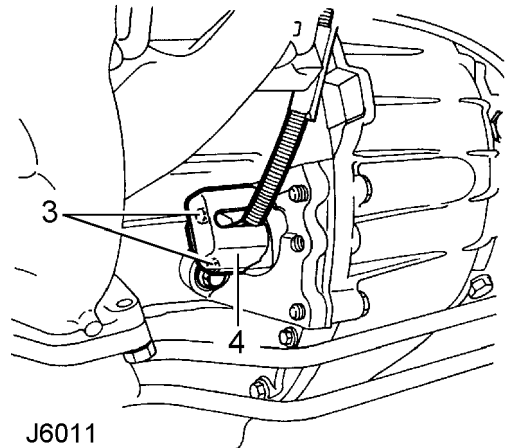
6. Clean sealing washer, sensor threads and sensor location.
7. Coat sensor threads with Loctite 577 and fit new sealing washer.
8. Fit ECT sensor. Tighten to **20 Nm**.
9. Fit spring clip to multiplug and connect multiplug to ECT sensor.
10. Top up cooling system.
11. Run engine to normal operating temperature. Check for leaks around ECT sensor.

## CRANKSHAFT POSITION SENSOR (CKP SENSOR)

Service repair no - 18.30.12

### Remove

1. Disconnect battery negative lead.
2. Raise vehicle on ramp.



3. Remove 2 bolts securing sensor/shield to engine backplate.
4. Remove sensor/shield.
5. Remove shield.
6. Disconnect sensor multiplug and remove sensor.
7. Remove spacer from sensor.



**CAUTION: All vehicles have a spacer fitted to the sensor. Ensure spacer is correctly refitted.**

### Refit

8. Clean mating faces.
9. Fit spacer to sensor.
10. Position sensor and connect multiplug.
11. Position shield to sensor and align sensor/shield to engine backplate.
12. Fit bolts. Tighten to **6 Nm**.
13. Lower ramp.
14. Reconnect battery negative lead.



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## FUEL SYSTEM - DEPRESSURISE

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**WARNING:** Fuel pressure of up to 2.5 bar will be present in the system, even if the engine has not been run for some time.

Always depressurise the system before disconnecting any components in the fuel feed line (between fuel pump and pressure regulator). The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.



**NOTE:** Fuel pressure can be relieved at fuel rail feed union or fuel filter unions.

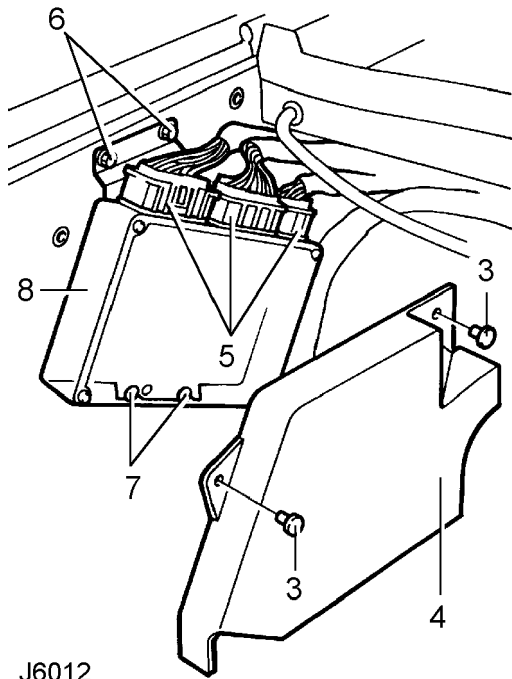
1. Position cloth around relevant union to protect against fuel spray.
2. Carefully slacken union.
3. Tighten union to correct torque once pressure has relieved.

## ENGINE CONTROL MODULE (ECM)

Service repair no - 18.30.01

### Remove

1. Disconnect battery negative lead.



J6012

2. Release and move washer reservoir aside. **See WIPERS AND WASHERS, Repair, Washer Reservoir**
3. Remove 2 studs securing ECM cover.
4. Remove cover.
5. Disconnect 3 ECM multiplugs.
6. Remove 2 bolts securing ECM.
7. Release ECM from 2 lower retainers.
8. Remove ECM.

### Refit

9. Reverse removal procedure.



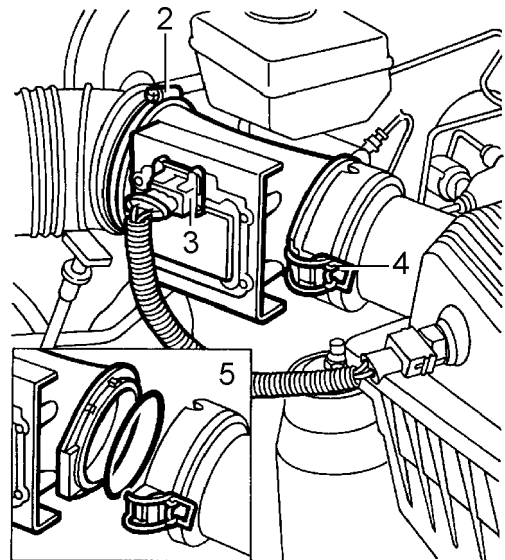
**NOTE:** Ensure ECM is correctly located by lower retainers.

## MASS AIR FLOW SENSOR (MAF SENSOR)

Service repair no - 19.22.25

### Remove

1. Disconnect battery negative lead.



J6013

2. Loosen clip and disconnect intake hose from MAF sensor.
3. Disconnect multiplug from MAF sensor.
4. Release 2 clips and remove MAF sensor from air cleaner.
5. Collect 'O' ring seal.

### Refit

6. Ensure mating faces of air cleaner, MAF sensor and intake hose are clean.
7. Fit 'O' ring to MAF sensor.
8. Fit MAF sensor to air cleaner and secure with clips.
9. Connect multiplug to MAF sensor.
10. Connect intake hose and secure with clip.



**CAUTION:** Failure to connect intake hose securely will allow unmetered air to enter the engine, causing running problems.

11. Reconnect battery negative lead.



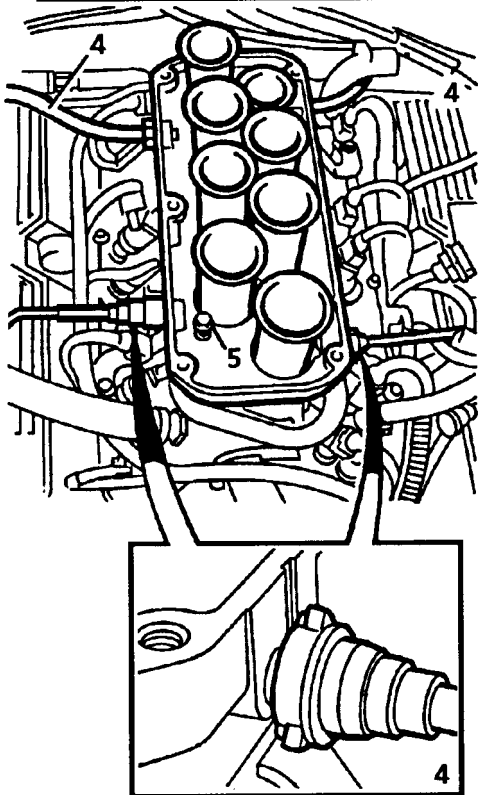
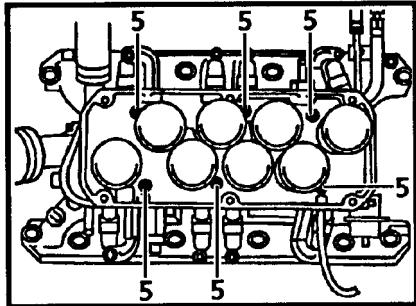
## FUEL RAIL AND INJECTORS

Service repair no - 19.60.04 - Fuel Rail

Service repair no - 19.60.12 - Injectors

### Remove

1. Disconnect battery negative lead.
2. Depressurise fuel system. **See Fuel System - Depressurise**
3. Release plenum chamber and place aside. **See Plenum Chamber**



J6014

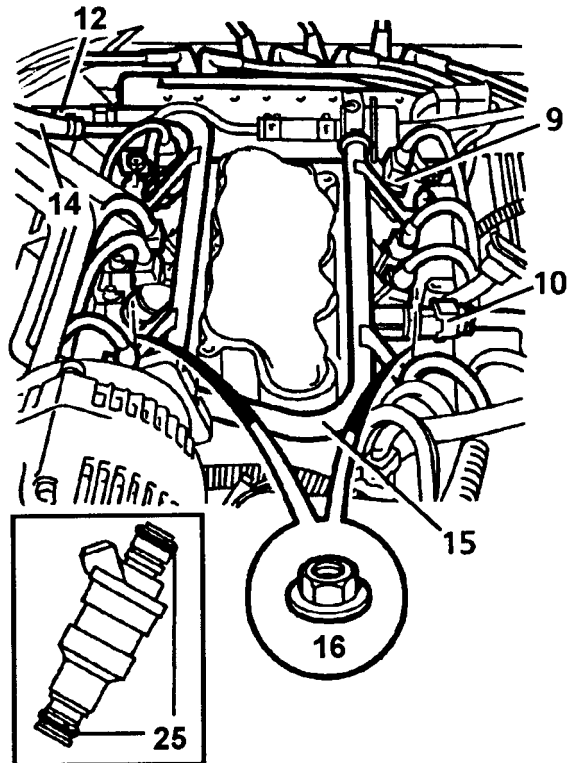
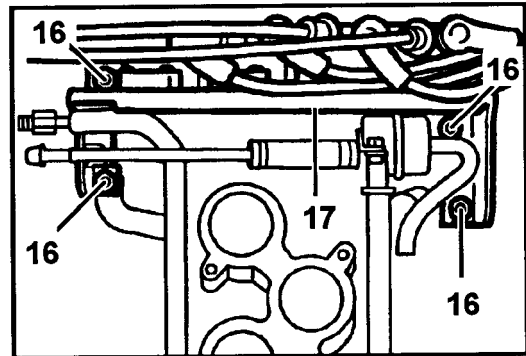
4. Disconnect purge hose, crankcase breather hose, servo vacuum hose and fuel regulator hose from ram housing.
5. Remove 6 bolts securing ram housing to inlet manifold.

6. Place small packing block on inlet manifold. Lever between packing block and ram pipe housing to break seal.



**CAUTION: Do not lever against fuel rail.**

7. Remove ram housing.
8. Place cloth over inlet manifold to prevent ingress of foreign matter.



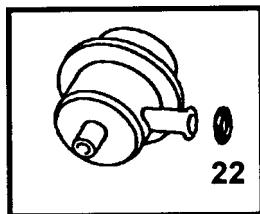
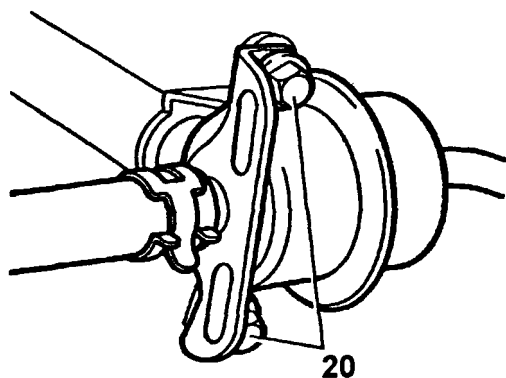
J6015

9. Disconnect 8 injector multiplugs.
10. Disconnect fuel temperature sensor multiplug.
11. Position cloth around fuel feed pipe union to absorb fuel spillage.
12. Disconnect fuel feed pipe from fuel rail.
13. Plug fuel pipe and rail.
14. Slacken clip securing fuel return hose.

15. Disconnect hose, plug return hose and rail. Remove cloth.
16. Remove 6 nuts securing fuel rail and ignition coil bracket to inlet manifold.
17. Release ignition coil bracket from inlet manifold studs. Place aside.
18. Release fuel rail and injectors from inlet manifold.

**Do not carry out further dismantling if component is removed for access only.**

19. Remove fuel rail and injectors.



J6016

20. Remove 2 bolts securing fuel pressure regulator to fuel rail.
21. Remove pressure regulator assembly.
22. Remove 'O' ring from fuel pressure regulator and discard.
23. Remove 8 clips securing injectors to fuel rail.
24. Remove injectors from fuel rail.
25. Remove 2 'O' rings from each injector and discard.

## Refit

26. Ensure mating surfaces between inlet manifold and ram pipe housing are clean.
27. Ensure all locations in fuel rail and inlet manifold are clean.
28. Lubricate and fit new 'O' rings to injectors and fuel pressure regulator.
29. Fit fuel pressure regulator to fuel rail. Secure with bolts. Tighten to **10 Nm**.
30. Fit injectors to fuel rail. Secure with clips.
31. Position fuel rail to inlet manifold. Engage injectors, one bank at a time.
32. Position ignition coil bracket on inlet manifold studs.
33. Secure ignition coil bracket and fuel rail to inlet manifold with nuts. Tighten to **8 Nm**.
34. Remove plugs from fuel feed and return pipes and rail.
35. Connect hose and tighten clip.
36. Clean feed pipe union and connect fuel feed pipe to fuel rail. Tighten union to **16 Nm**.
37. Connect multiplugs to fuel injectors and fuel temperature sensor.
38. Remove cloth from inlet manifold.
39. Apply a thin, uniform coating of Loctite 577 sealant to mating face of inlet manifold.
40. Fit ram housing to inlet manifold. Secure with bolts. Tighten to **24 Nm**.
41. Connect purge hose, crankcase breather hose, servo and pressure regulator vacuum hoses to ram housing.
42. Fit plenum chamber. **See Plenum Chamber**
43. Reconnect battery negative lead.
44. Start engine. Check for leaks around fuel rail and injectors.



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## FUEL TEMPERATURE SENSOR

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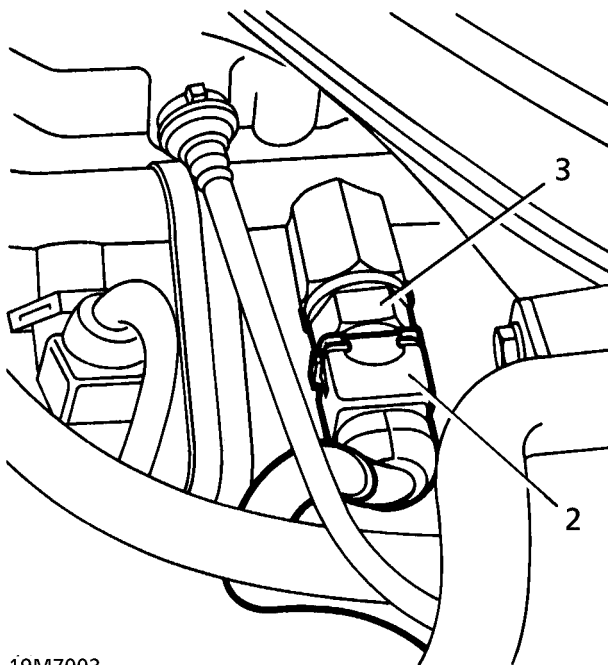
Service repair no - 19.22.08

### Remove



**NOTE:** Because fuel leakage will not occur when sensor is removed, it is not necessary to depressurise the fuel system for this operation.

1. Disconnect battery negative lead.



19M7003

2. Disconnect multiplug from fuel temperature sensor.
3. Remove sensor from fuel rail.

### Refit

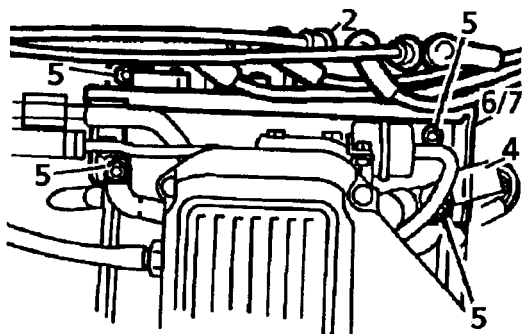
4. Ensure sensor and location in fuel rail are clean.
5. Fit sensor. Tighten to **17 Nm**.
6. Connect multiplug.
7. Reconnect battery negative lead.

## IGNITION COILS

Service repair no - 18.20.45 - Set  
 Service repair no - 18.20.43 - Each  
 Service repair no - 18.20.44 - Extra - Each

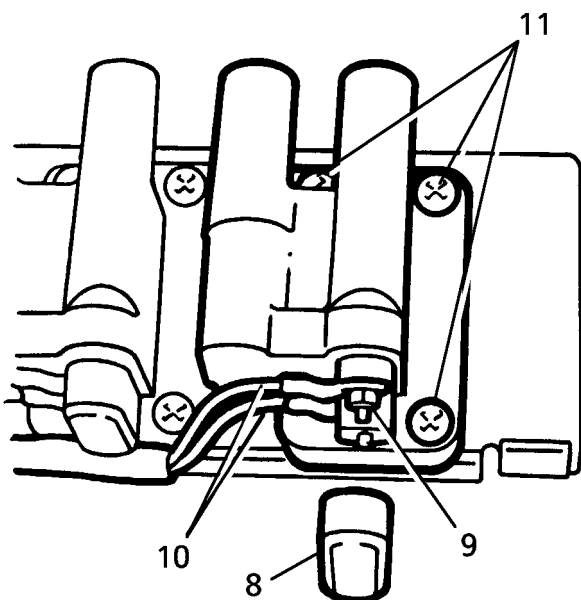
### Remove

1. Disconnect battery negative lead.



J6017

2. Disconnect H.T. leads from ignition coils. Note positions of leads.
3. Place H.T. leads aside.
4. Disconnect ignition coil multiplug.
5. Remove 4 nuts securing coil bracket.
6. Release ignition coil bracket from inlet manifold studs.
7. Manoeuvre coil/bracket assembly from behind plenum chamber and remove.



18M7001

8. Remove terminal cover. Note lead positions.
9. Remove 2 nuts securing leads to coil terminals.
10. Remove leads from terminals.
11. Remove 3 Torx screws securing ignition coil to bracket and remove coil.

### Refit

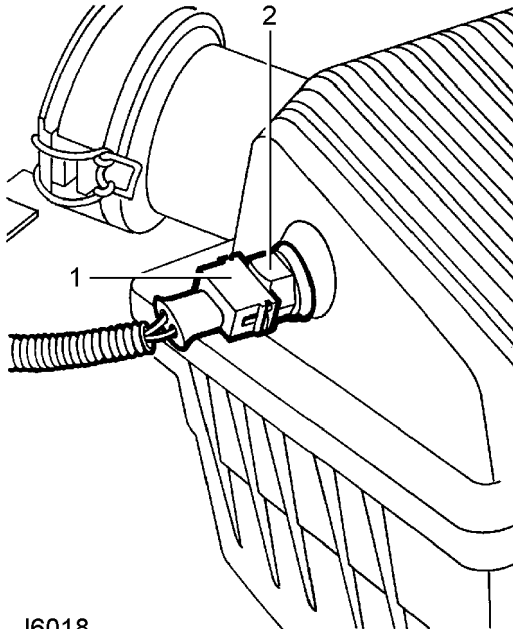
12. Fit ignition coil to bracket. Secure with screws.
13. Connect leads to terminals. Secure with nuts.
14. Fit terminal cover.
15. Position ignition coil bracket on inlet manifold studs.
16. Secure fuel rail and ignition coil bracket with nuts. Tighten to **8 Nm**.
17. Connect multiplug.
18. Connect H.T. leads to respective coil towers.
19. Reconnect battery negative lead.



## INTAKE AIR TEMPERATURE SENSOR (IAT SENSOR)

Service repair no - 18.30.09

### Remove



J6018

1. Disconnect multiplug from IAT sensor.
2. Remove IAT sensor from air cleaner.

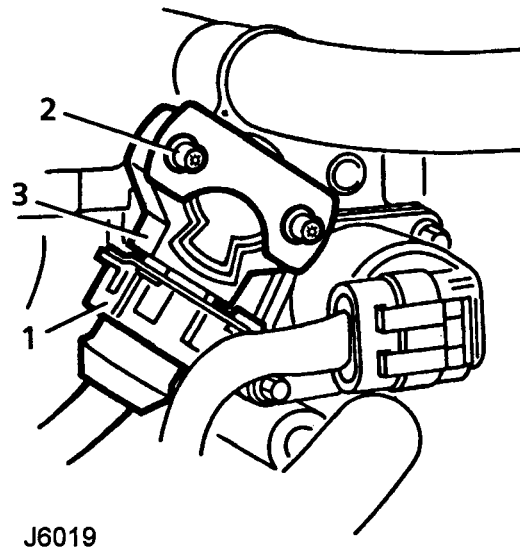
### Refit

3. Clean sensor and mating face.
4. Fit IAT sensor. Tighten to **8 Nm**.
5. Connect multiplug.

## THROTTLE POSITION SENSOR (TP SENSOR)

Service repair no - 19.22.49

### Remove



J6019

1. Disconnect multiplug from TP sensor.
2. Remove 2 Torx screws securing TP sensor. Collect clamp plate.
3. Remove TP sensor.

### Refit

4. Clean mating faces.
5. Fit TP sensor. Ensure drive engages correctly with throttle spindle.
6. Position clamp plate. Secure TP sensor with Torx screws. Tighten to **2 Nm**.
7. Connect multiplug.



## KNOCK SENSOR

Service repair no - 18.30.28 - Sensor - LH

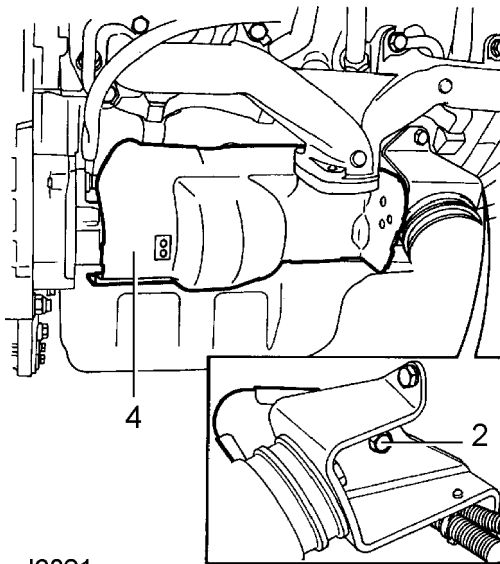
Service repair no - 18.30.30 - Sensor - RH



**CAUTION:** Due to the sensitivity of the sensors, do not apply tape or sealant to sensor threads.

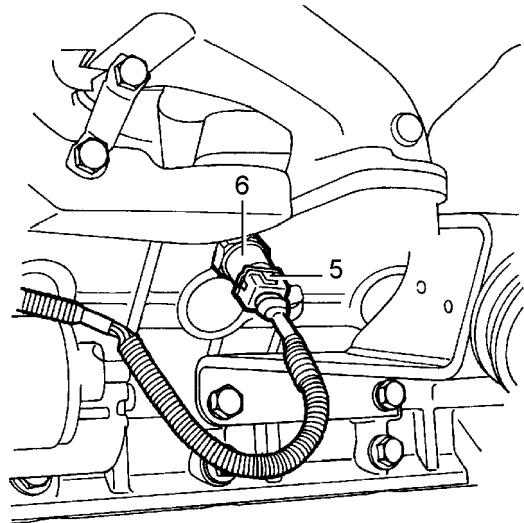
### Remove

1. Raise vehicle on ramp.



J6021

2. **RH Sensor only:** Remove bolt securing starter motor heatshield to RH engine mounting.
3. Release heatshield clip from starter solenoid.
4. Move heatshield aside for access to knock sensor.



J6020

5. **Both sensors:** Disconnect sensor multiplug.
6. Remove sensor.

### Refit

7. Clean sensor and mating face.
8. Fit sensor. Tighten to **16 Nm**.
9. Connect sensor multiplug.
10. **RH Sensor only:** Manoeuvre heatshield into position.
11. Secure clip to solenoid.
12. Align bracket to mounting and fit bolt. Fit and tighten bolt.
13. Lower ramp.



**CAUTION:** Failure to tighten sensor to correct torque will result in malfunction or sensor damage.

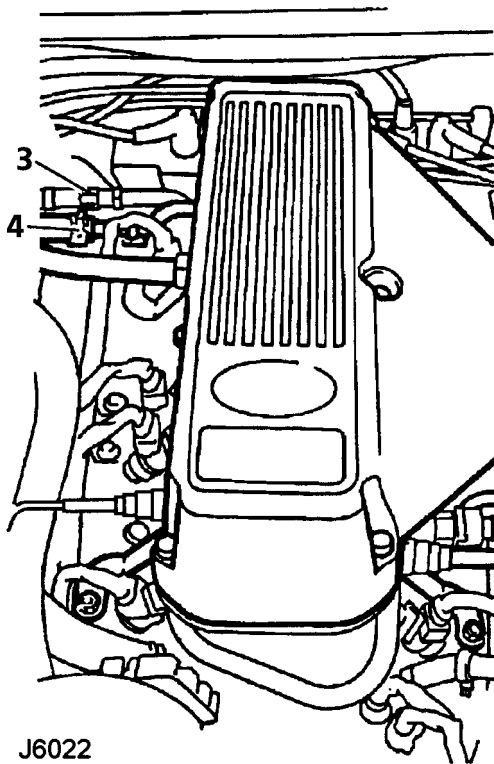
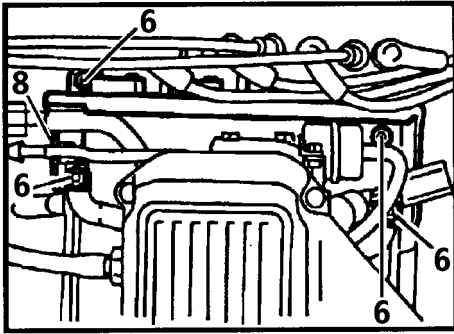


## FUEL PRESSURE REGULATOR

Service repair no - 19.45.06

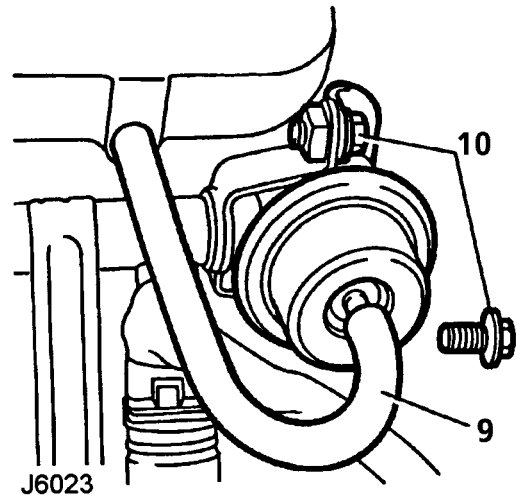
### Remove

1. Disconnect battery negative lead.
2. Depressurise fuel system. *See Fuel System - Depressurise*



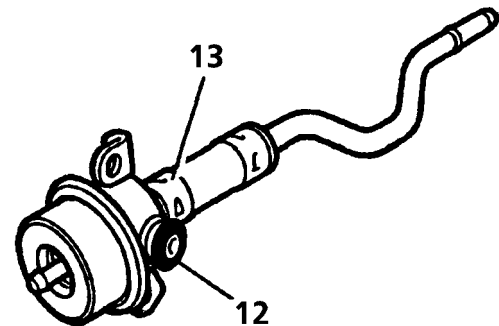
J6022

3. Position cloth over fuel feed union, slacken union to release fuel pressure, then re-tighten union.
4. Release fuel return hose clip. Remove fuel return hose from regulator connecting pipe.
5. Plug connections.
6. Remove 4 nuts ignition coil bracket to inlet manifold.
7. Release ignition coil bracket from inlet manifold studs and place aside.
8. Release regulator connecting pipe from clip.



J6023

9. Disconnect vacuum hose from fuel pressure regulator.
10. Remove 2 bolts securing fuel pressure regulator to fuel rail.
11. Remove fuel pressure regulator assembly.



J6024

12. Remove 'O' ring and spacer ring from fuel pressure regulator. Discard 'O' ring.
13. Release clip and remove connecting pipe from regulator.
14. Fit plugs to regulator and rail.

## Refit

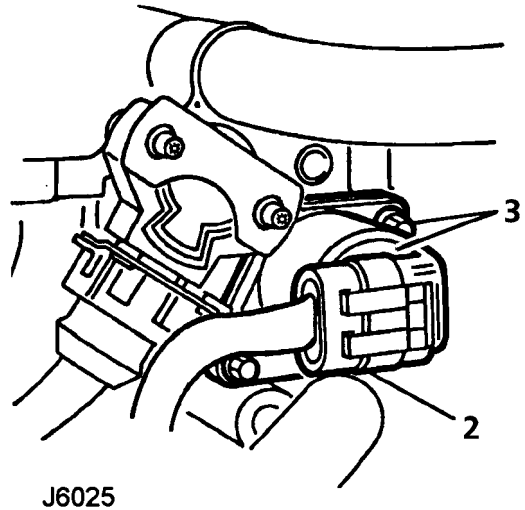
15. Ensure locations on fuel pressure regulator and fuel rail are clean.
16. Fit new spacer ring and 'O' ring to fuel pressure regulator. Lubricate 'O' ring with silicone grease.
17. Fit pressure regulator assembly to fuel rail.
18. Secure regulator connecting pipe in clip.
19. Secure with bolts. Tighten to **10 Nm**.
20. Align ignition coil bracket to inlet manifold studs.
21. Secure ignition coil bracket and fuel rail to inlet manifold with nuts. Tighten to **8 Nm**.
22. Remove plugs.
23. Connect return pipe to regulator connecting pipe. Secure with clip.
24. Connect vacuum hose to fuel pressure regulator.
25. Remove cloth.
26. Reconnect battery negative lead.
27. Start engine. Check for leaks around fuel pressure regulator, fuel feed and fuel return unions.

## IDLE AIR CONTROL (IAC)

Service repair no - 19.22.54

### Remove

1. Disconnect battery negative lead.



2. Disconnect IAC multiplug.
3. Remove 2 bolts securing IAC to plenum.
4. Remove IAC.
5. Remove gasket and discard.

### Refit

6. Ensure all mating faces are clean.
7. Using a new gasket, fit IAC to plenum. Secure with bolts. Tighten to **2.3 Nm**.
8. Connect multiplug.
9. Reconnect battery negative lead.

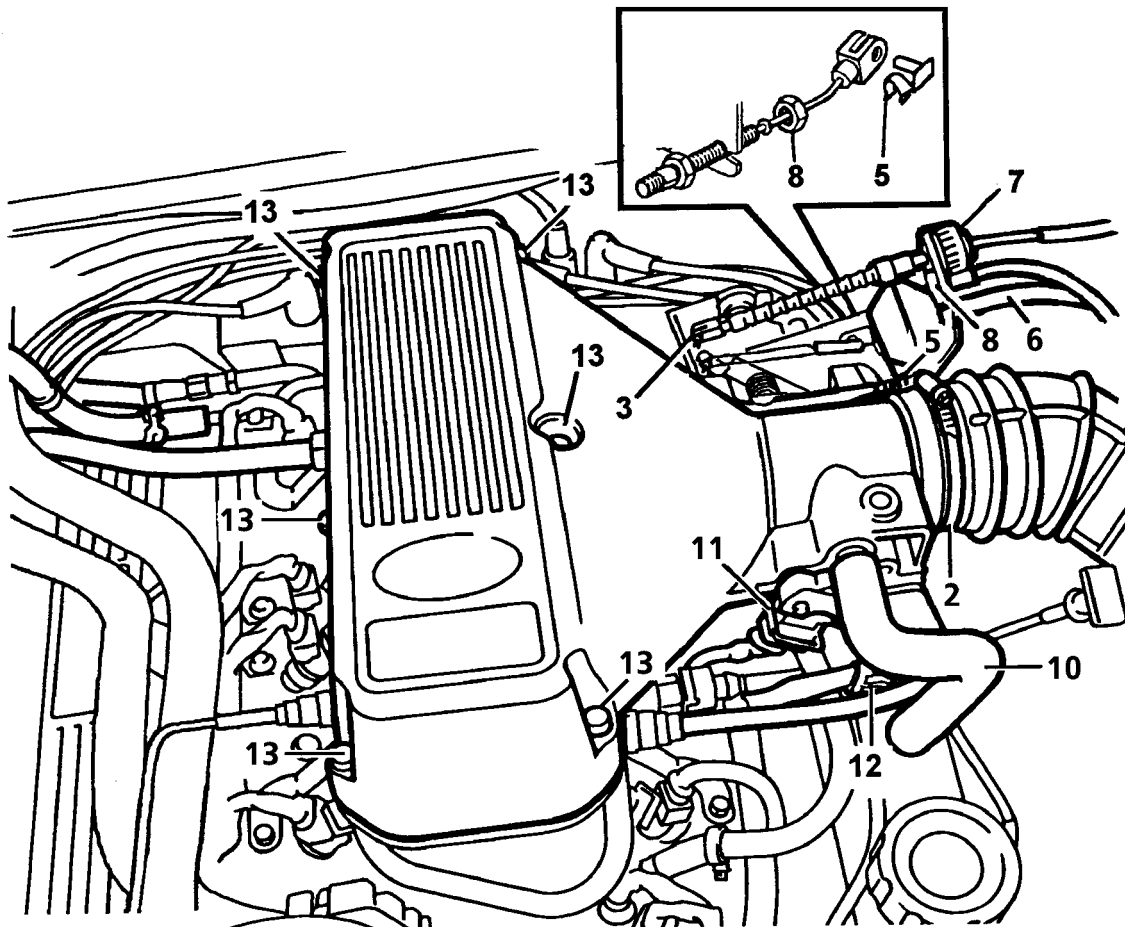


## PLENUM CHAMBER

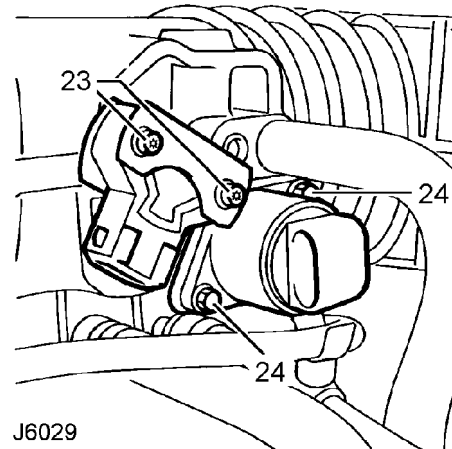
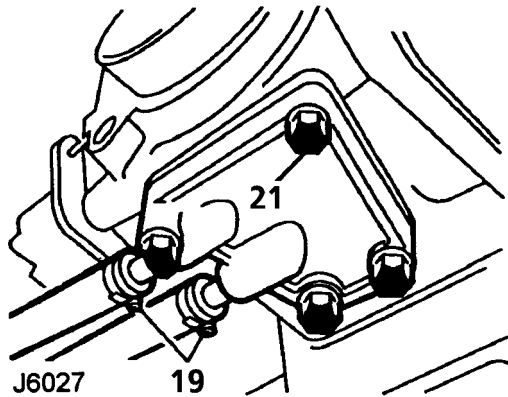
Service repair no - 19.22.46

### Remove

1. Disconnect battery negative lead.
2. Slacken clip securing intake hose to plenum chamber and release hose.
3. Remove split pin from throttle cable clevis pin.
4. Remove clevis pin.
5. Release and remove kick down cable clevis pin.
6. Disconnect vacuum hose from cruise actuator.
7. Release throttle cable from abutment bracket.
8. Remove front locknut from kick down cable.
9. Release cable from bracket.
10. Disconnect breather hose from plenum.
11. Release clip and disconnect multiplug from throttle position sensor (TP Sensor).
12. Disconnect multiplug from idle air control (IAC).
13. Remove 6 bolts securing plenum chamber.
14. Release plenum chamber from ram pipe housing.
15. Fit approved hose clamp to water jacket coolant hoses.
16. Tighten clamp.
17. Position cloth to absorb coolant spillage.
18. Slacken clips securing coolant hoses to plenum.

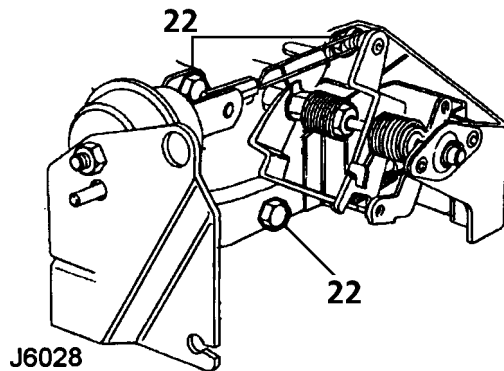


J6026



- 19. Disconnect hoses and remove plenum chamber.
- 20. Place cloth over ram pipes to prevent ingress of foreign matter.
- 21. Remove 4 bolts securing water jacket to plenum chamber. Remove water jacket. Remove gasket and discard.

- 23. Remove 2 Torx bolts securing TP sensor. Collect clamp plate. Remove TP sensor.
- 24. Remove 2 bolts securing IAC. Remove motor. Remove gasket and discard.



- 22. Remove 3 bolts securing throttle linkage bracket to plenum chamber. Remove bracket. Collect return spring.



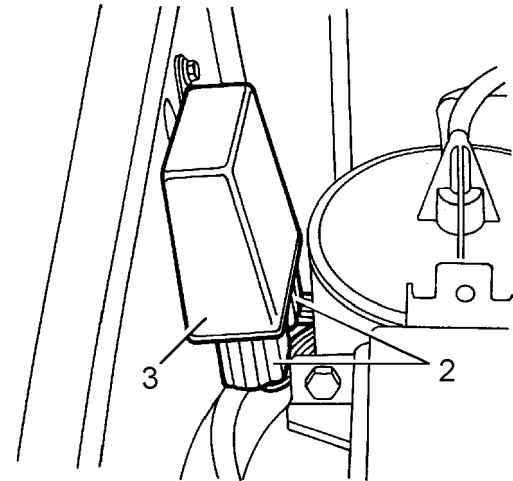
## Refit

25. Ensure all mating surfaces are clean.
26. Fit TP sensor. Ensure drive engages correctly with throttle spindle.
27. Position clamp plate. Secure TP sensor with bolts. Tighten to **2 Nm**.
28. Using a new gasket, fit IAC. Secure with bolts. Tighten to **2.3 Nm**.
29. Ensure mating faces of water jacket and plenum chamber are clean.
30. Using a new gasket, fit water jacket. Secure with bolts. Tighten to **13 Nm**.
31. Position throttle linkage bracket, fit and engage return spring.
32. Secure linkage bracket to plenum chamber with bolts. Tighten to **8 Nm**.
33. Remove cloth from ram housing.
34. Ensure mating faces of plenum chamber and ram pipe housing are clean.
35. Position plenum chamber. Connect coolant hoses to water jacket. Secure with clips.
36. Remove clamp from coolant pipes. Remove cloth.
37. Apply a thin, uniform coating of Loctite 577 sealant to sealing face of plenum chamber.
38. Fit plenum chamber.
39. Fit plenum chamber bolts. Tighten to **24 Nm**.
40. Connect multiplugs to TP sensor and IAC.
41. Connect breather hose to plenum chamber.
42. Fit kick down cable to abutment bracket and fit locknut.
43. Connect throttle cable to abutment bracket.
44. Connect vacuum hose to actuator.
45. Align throttle cable to lever. Fit clevis pin. Secure clevis pin with split pin.
46. Align kick down cable to lever.
47. Fit clevis pin and secure clip.
48. Connect intake hose and secure with clip.
49. Reconnect battery negative lead.
50. Top up cooling system.

## RELAY MODULE - PRE ADVANCED EVAPS

Service repair no - 18.30.71

### Remove



J6030

1. Release module from bracket.
2. Disconnect 2 multiplugs.
3. Remove module.

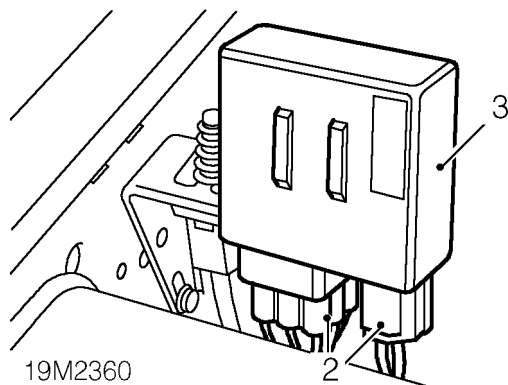
### Refit

4. Reverse removal procedure.

## RELAY MODULE - ADVANCED EVAPS

Service repair no - 18.30.71

Remove



1. Release module from bracket.
2. Disconnect 2 multiplugs from module.
3. Remove module.

Refit

4. Position module, connect multiplugs and secure to bracket.

## FUEL FILTER - ADVANCED EVAPS

Service repair no - 19.25.02

Remove

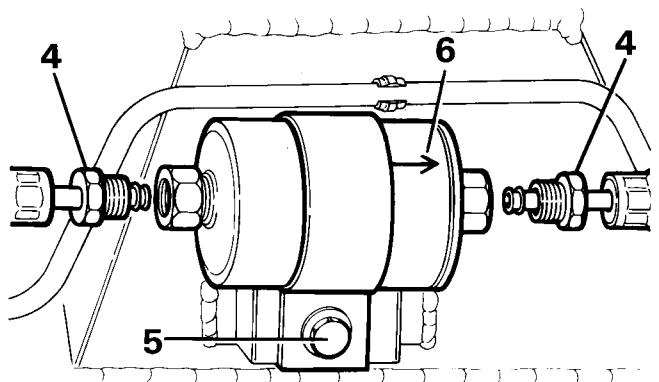
**WARNING:** Spilling of fuel is unavoidable during this operation. Ensure all necessary precautions are taken to prevent fire and explosion.

**WARNING:** Ensure fuel handling precautions given in section 1 - Introduction are strictly adhered to when carrying out following instructions.

1. Depressurise fuel system. *See fuel system - depressurise - advanced evaps*
2. Raise rear of vehicle.

**WARNING:** Support on safety stands.

3. Clean area around hose connections to prevent ingress of foreign matter into fuel system. Clamp inlet and outlet hoses to prevent fuel spillage when disconnecting hoses.



RR2966E

4. Loosen 2 fuel line unions and disconnect hoses. Remove and discard 'O' rings. Plug ends of hoses to prevent ingress of dirt.

**CAUTION:** Use two spanners when loosening or tightening unions.

5. Remove nut and bolt securing fuel filter bracket to chassis and remove filter from bracket.



## Refit

- Fit a NEW filter to bracket.



**NOTE: Ensure direction of flow arrow stamped on canister is correct.**

- Position filter mounting bracket to chassis and secure with nut and bolt.
- Remove plugs from fuel hose ends.
- Lubricate NEW 'O' rings with clean fuel and fit to fuel hoses.
- Connect fuel hoses to filter and tighten unions to **18 Nm**.



**CAUTION: Use two spanners when loosening or tightening unions.**

- Remove stand(s) and lower vehicle.
- Run the engine to check for any fuel leaks.

## FUEL PUMP AND GAUGE SENDER UNIT - ADVANCED EVAPS

### Service repair no - 19.45.03

A plastic fuel tank with a combined fuel pump and gauge sender unit is fitted. The top flange of the pump also houses a pressure sensor which is not removable from the pump. The fuel pump is accessed through a panel in the load space floor.



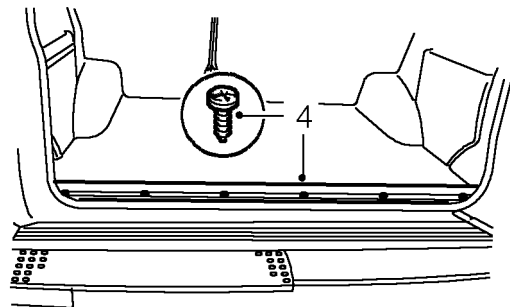
**WARNING: Ensure that fuel handling precautions given in 01 - Introduction are strictly adhered to when carrying out following instructions.**



**CAUTION: Before disconnecting any part of fuel system, it is imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into fuel system.**

### Remove

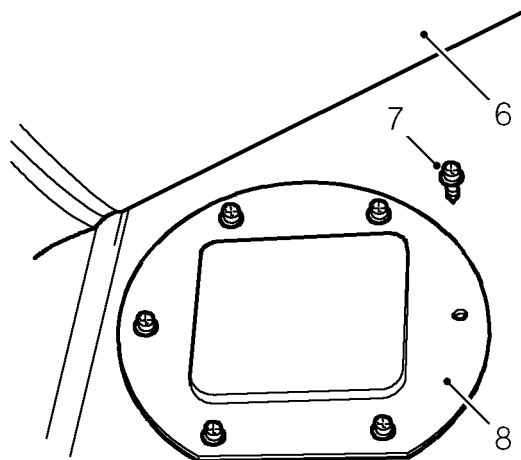
- Depressurise fuel system. **See fuel system - depressurise - advanced evaps**
- Disconnect battery negative lead.
- Check the amount of fuel in the tank. If the tank is full, drain 2.4 US gallons (9 litres) minimum. **See fuel tank - draining - advanced evaps**



19M2361

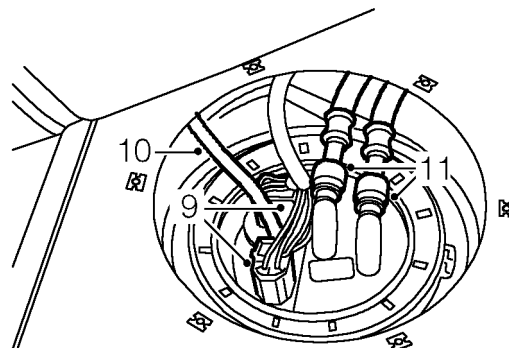
- Remove 6 screws securing tail door tread strip and remove tread strip.
- Remove RH luggage compartment side panel. **See CHASSIS AND BODY, Repair, rear compartment lower trim panels**





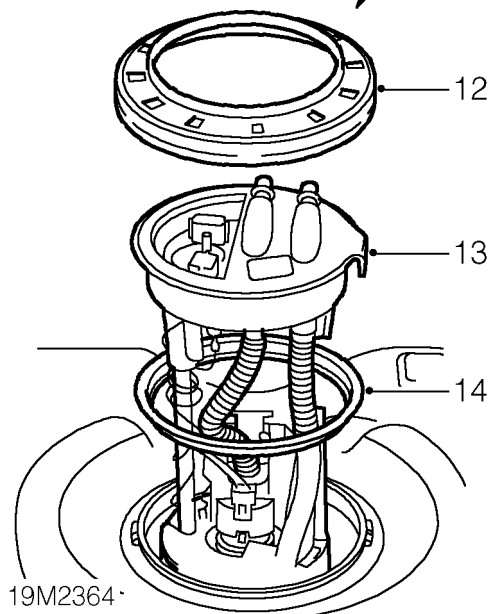
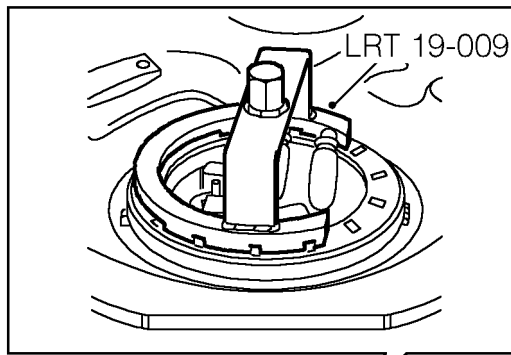
19M2362

6. Fold back loadspace carpet and sound insulation to reveal access panel.
7. Remove 6 screws securing fuel pump access panel.
8. Remove access panel.



19M2363

9. Disconnect multiplugs from fuel pump and pressure sensor.
10. Release vent hose from pressure sensor body.
11. Noting their fitted positions, disconnect both fuel connections by pressing the black release latches on each connector and pushing the connector back down the line. Care must be taken to catch any excess fuel which may spill from the fuel lines once removed.



12. Using service tool LRT-19-009 loosen and remove the metal locking ring.
13. Prise the pump from the tank opening using a blunt instrument under the edge of the pump flange. Once clear of the seal, tip the pump to the right to allow fuel contained in the body of the pump to drain into the tank.



**CAUTION:** Do not lift the pump from the tank using the feed and return stubs.

14. Remove and discard seal.

### Refit

15. Fit NEW pump seal to tank opening.
16. Carefully lower pump into tank opening, pressing firmly on the pump top flange to allow correct positioning.



**NOTE:** Ensure location tag on pump top flange is engaged correctly to tank opening lip.

17. Fit locking ring and tighten to **35 Nm** using service tool LRT-19-009.
18. Connect both fuel lines to the pump by pushing the connectors down each line square to the pump connection until the connectors positively latch.
19. Connect vent hose to pressure sensor body.
20. Connect multiplugs to fuel pump and pressure sensor.
21. Reconnect battery negative lead.
22. Refill tank with drained fuel.
23. Run the engine to check for any fuel leaks.
24. Fit access panel and secure with screws.
25. Reposition loadspace sound insulation and carpet.
26. Fit RH luggage compartment side panel. **See CHASSIS AND BODY, Repair, rear compartment lower trim panels**
27. Fit tail door tread strip and secure with screws.

## FUEL SYSTEM - DEPRESSURISE - ADVANCED EVAPS

Service repair no - 19.50.02



**WARNING:** Fuel pressure of up to 2.5 bar will be present in the system, even if the engine has not been run for some time.

Always depressurise the system before disconnecting any components in the fuel feed line (between fuel pump and pressure regulator). The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.



**NOTE:** Fuel pressure can be relieved at fuel filter unions.

1. Position cloth around relevant union to protect against fuel spray.
2. Carefully loosen union.



**CAUTION:** Use two spanners when loosening or tightening unions.

3. Tighten union once fuel pressure is relieved.
4. Remove cloth.

## FUEL TANK - ADVANCED EVAPS

Service repair no - 19.55.01



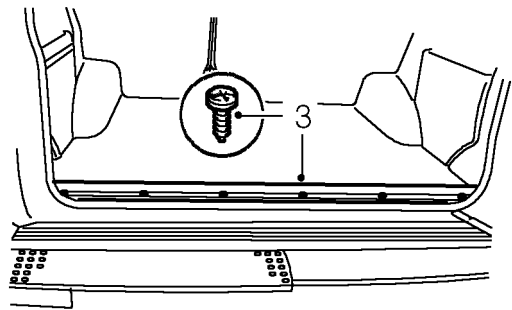
**WARNING:** Ensure fuel handling precautions given in section 01 Introduction are strictly adhered to when carrying out following instructions.



**CAUTION:** Before disconnecting any part of fuel system, it imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into fuel system.

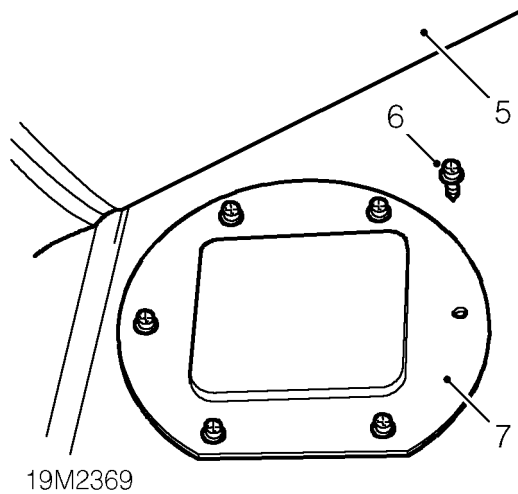
Remove

1. Disconnect battery negative lead.
2. Drain fuel tank completely. **See fuel tank - draining - advanced evaps**

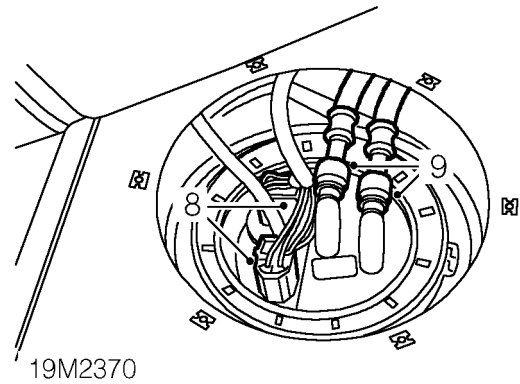


19M2368

3. Remove 6 screws securing tail door tread strip and remove tread strip.
4. Remove RH luggage compartment side panel. **See CHASSIS AND BODY, Repair, rear compartment lower trim panels**



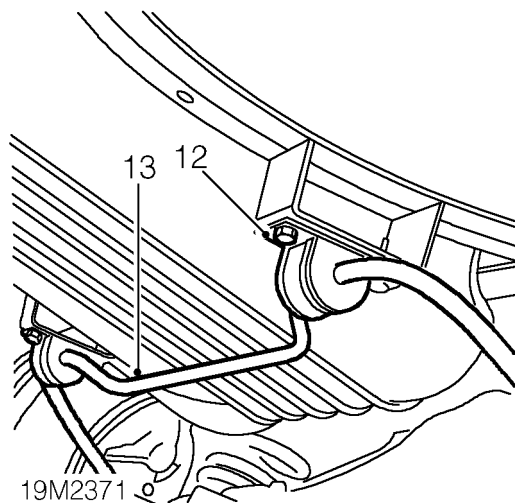
5. Fold back loadspace carpet and sound insulation to reveal access panel.
6. Remove 6 screws securing fuel pump access panel.
7. Remove access panel.



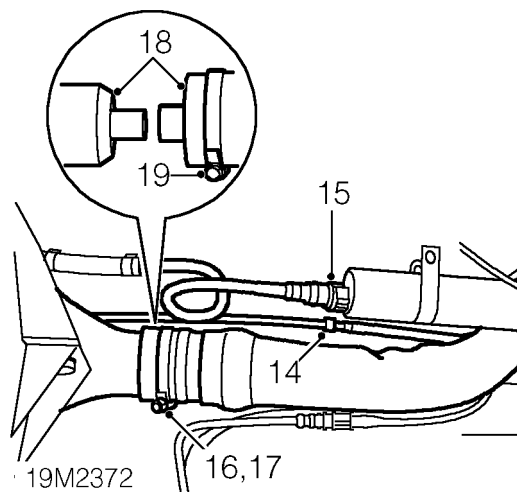
8. Disconnect multiplugs from fuel pump and pressure sensor
9. Noting their fitted positions, disconnect both fuel connections by pressing the black release latches on each connector and pushing the connector back down the line.
10. Care must be taken to catch any excess fuel which may spill from the fuel lines once removed.
11. Raise rear of vehicle.



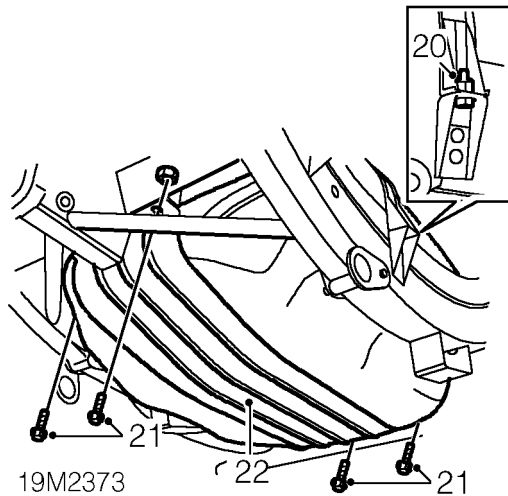
**WARNING: Support on safety stands.**



12. Mark location of anti-roll [sway] bar straps.
13. Remove nuts and bolts securing anti-roll [sway] bar straps, and allow bar to swing down clear of tank.

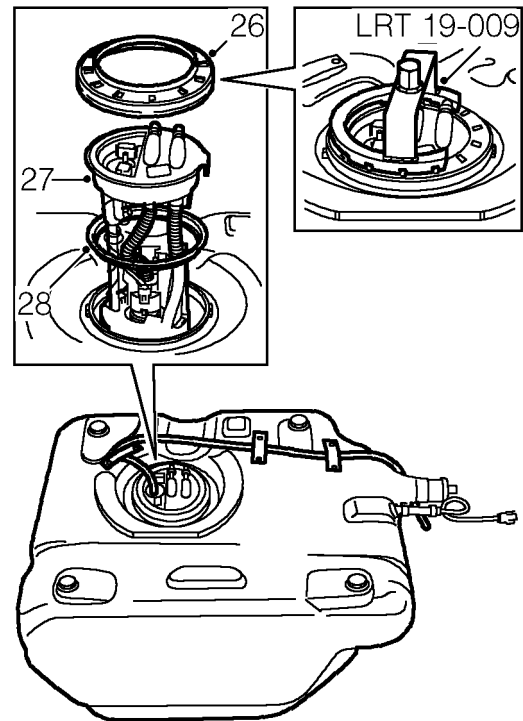


14. Disconnect pressure sensor breather pipe connection.
15. Disconnect vent line quickfit connector from liquid/vapour separator.
16. Remove torque screw cap from hose to tank filler neck clip.
17. Loosen clip screw securing hose to tank filler neck.
18. Release hose from filler neck and internal filler neck breather hose from fuel tank.
19. Remove and discard fuel filler neck clip.



19M2373

20. Remove nut and bolt securing RH side of upper fuel tank strap to chassis.
21. Remove 4 nuts and bolts securing fuel tank cradle.
22. Remove fuel tank cradle.
23. With assistance, tilt right hand side of tank upwards and manoeuvre through chassis to remove.  
***Do not carry out further dismantling if component is removed for access only.***
24. Release vent hose from tank pressure sensor.
25. Remove vent hose from 3 fuel tank clips.



19M2367

26. Using service tool LRT-19-009 loosen and remove the metal locking ring.
27. Prise the pump from the tank opening using a blunt instrument under the edge of the lip of the pump flange.



**CAUTION: Do not lift the pump from the tank using the feed and return stubs.**

28. Remove and discard seal.

## Refit

29. Fit NEW pump seal to tank opening.
30. Carefully lower pump into tank opening, pressing firmly on the pump top flange to allow correct positioning.



**NOTE:** Ensure location tag on pump top flange is engaged correctly to tank opening lip.

31. Fit locking ring and tighten to **35 Nm** using service tool LRT-19-009.
32. Fit vent hose to fuel tank clips and connect to pressure sensor.
33. With assistance, fit fuel tank into position.
34. Fit fuel tank cradle and secure with nuts and bolts.
35. Align upper fuel tank strap and secure with nut and bolt.
36. Fit NEW clip to fuel filler neck hose.
37. Connect fuel filler neck internal breather to tank.
38. Connect fuel filler neck hose to tank.
39. Position fuel filler neck hose clip and tighten until head shears.
40. Connect vent line quickfit connector to liquid/vapour separator.
41. Connect vent line hose connection.
42. Position anti-roll [sway] bar straps and secure with nuts and bolts.
43. Remove stand(s) and lower vehicle.
44. Connect both fuel lines to the pump by pushing the connectors down each line square to the pump connection until the connectors positively latch.
45. Connect multiplugs to fuel pump and pressure sensor.
46. Reconnect battery negative lead.
47. Refill tank with drained fuel.
48. Run the engine to check for any fuel leaks.
49. Fit access panel and secure with screws.
50. Reposition loadspace sound insulation and carpet.
51. Fit RH luggage compartment side panel. **See CHASSIS AND BODY, Repair, rear compartment trim panels**
52. Fit tail door tread strip and secure with screws.

## FUEL TANK - DRAINING - ADVANCED EVAPS

Service repair no - 19.55.02



**WARNING:** Before removing the fuel tank it must be drained.



**WARNING:** Petrol/gasoline vapour is highly flammable and in confined spaces is also explosive and toxic. Always have a fire extinguisher containing FOAM, CO2, GAS or POWDER close at hand when handling or draining fuel. See Introduction



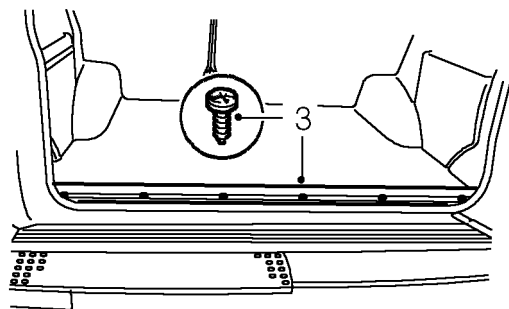
**CAUTION:** Before disconnecting any part of fuel system, it is imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into fuel system.



**NOTE:** Assuming the fuel tank is FULL drain the following quantities:

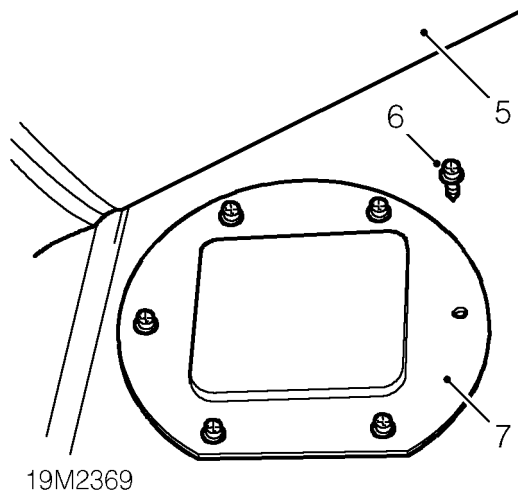
Renew Fuel pump = 9 Litres (2.4 US Gallons)  
 Renew Fuel filler neck = 22 Litres (6 US Gallons)  
 Renew Fuel tank = COMPLETE DRAIN

1. Depressurise fuel system. **See fuel system - depressurise - advanced evaps**
2. Disconnect battery negative lead.



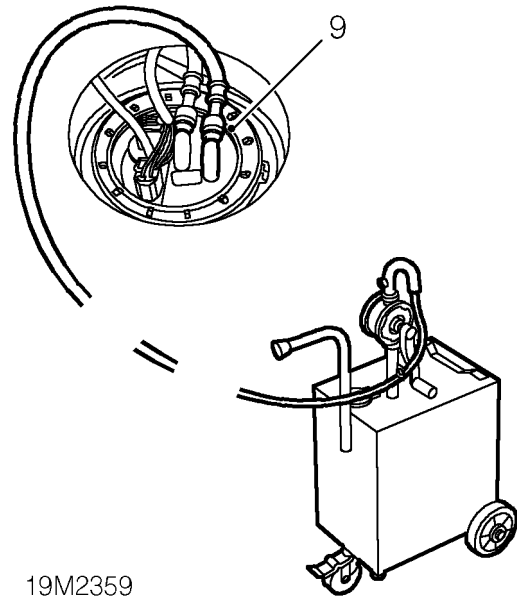
19M2368

3. Remove 6 screws securing tail door tread strip and remove tread strip.
4. Remove RH luggage compartment side panel. **See CHASSIS AND BODY, Repair,**



19M2369

5. Fold back loadspace carpet and sound insulation to reveal access panel.
6. Remove 6 screws securing fuel pump access panel.
7. Remove access panel.
8. Disconnect the fuel return connection by pressing the black release latch on connector and pushing the connector back down the line. Care must be taken to catch any excess fuel which may spill from the fuel line once removed.



19M2359

9. Using a bowser, with a 7 mm inside diameter hose connection attach to fuel pump return stub, drain fuel into a sealed container. Follow the manufacturers instructions for the connection and safe use of the bowser.
10. Continue draining until air bubbles appear and fuel ceases to flow.
11. Disconnect bowser from fuel pump return stub.
12. Connect fuel return line to pump by pushing the connector down line square to the pump connection until the connector positively latches.
13. Fit access panel and secure with screws.
14. Reposition loadspace sound insulation and carpet.
15. Fit RH luggage compartment side panel. **See CHASSIS AND BODY, Repair, rear compartment trim panels**
16. Fit tail door tread strip and secure with screws.
17. Reconnect battery negative lead.



## FUEL FILLER NECK - ADVANCED EVAPS

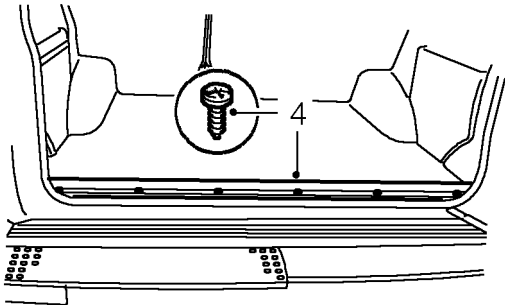
Service repair no - 19.55.07

**WARNING:** Ensure that fuel handling precautions given in 1 - Introduction are strictly adhered to when carrying out following instructions.

**CAUTION:** Before disconnecting any part of fuel system, it is imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into fuel system.

### Remove

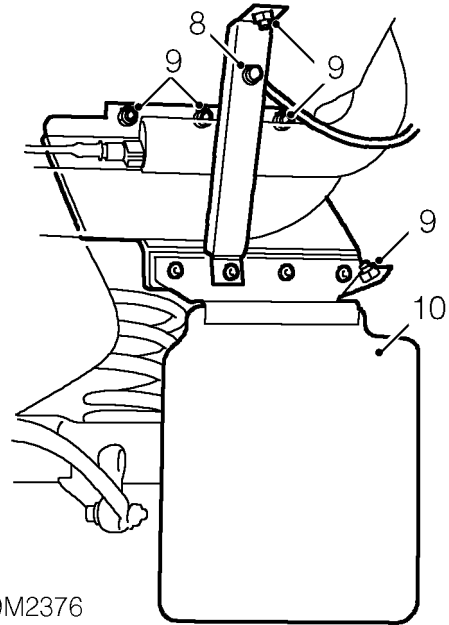
1. Depressurise fuel system. **See fuel system - depressurise - advanced evaps**
2. Disconnect battery negative lead.
3. Check the amount of fuel in the tank. If the tank is full drain 6 US gallons (22 litres) minimum. See fuel tank - draining.



19M2375

4. Remove 6 screws securing tail door tread strip and remove tread strip.
5. Remove RH luggage compartment side panel. **See CHASSIS AND BODY, Repair, rear compartment trim panels**
6. Fold back loadspace carpet and sound insulation to gain access to RH mudflap fixing.
7. Raise rear of vehicle.

**WARNING:** Support on safety stands.



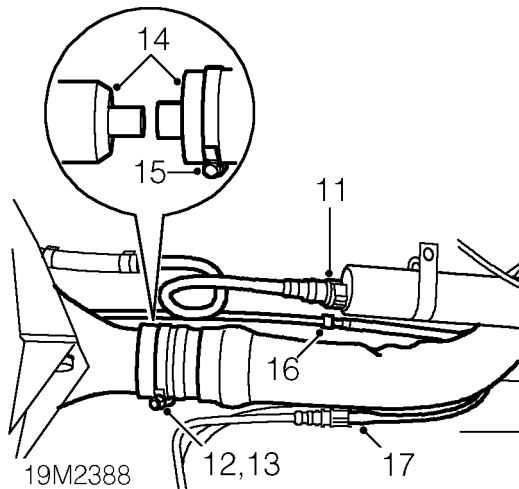
19M2376

8. Remove nut and bolt securing filler neck support bracket to mud flap bracket.



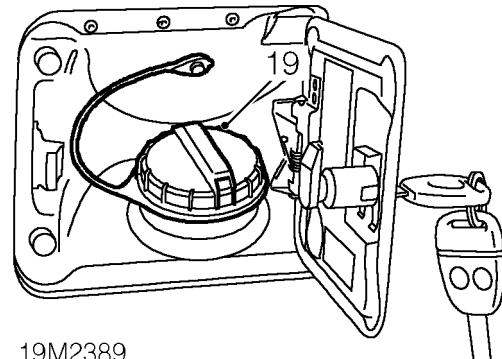
**NOTE:** This fixing also retains the filler neck earth strap.

9. Remove 5 nuts and bolts securing mud flap to body.
10. Remove mud flap.



19M2388

11. Disconnect vent line quickfit connector from liquid/vapour separator.
12. Remove torque screw cap from hose to tank filler neck clip.
13. Loosen clip screw securing hose to tank filler neck.
14. Release hose from filler neck and internal filler neck breather hose from fuel tank.
15. Remove and discard fuel filler neck clip.
16. Disconnect the pressure sensor breather pipe connection.
17. Disconnect the vent line hose connection.



19M2389

18. Fit ignition key to fuel filler flap lock and open flap.
19. Release fuel filler cap from filler neck.
20. Remove filler neck assembly from vehicle.  
**Do not carry out further dismantling if component is removed for access only.**
21. Remove torque screw cap from hose to filler neck clip.
22. Loosen clip screw securing hose to filler neck.
23. Remove hose from filler neck.
24. Remove and discard fuel filler hose clip.
25. Remove vent line from filler neck.

## Refit

26. Fit vent line to filler neck.
27. Fit NEW clip to filler neck hose.
28. Fit hose to filler neck.
29. Position filler neck hose clip and tighten until head shears.
30. Fit filler neck assembly to vehicle.



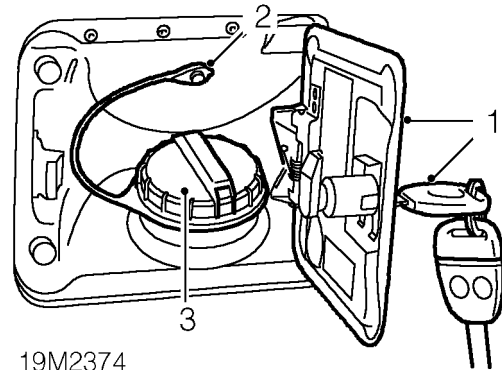
**NOTE: To aid fitment of filler neck through body grommet apply a soap solution to lip of grommet.**

31. Fit NEW clip to fuel filler neck hose.
32. Connect fuel filler neck internal breather to tank.
33. Connect fuel filler neck hose to tank.
34. Position fuel filler neck hose clip and tighten until head shears.
35. Connect vent line quickfit connector to liquid/vapour separator.
36. Connect the pressure sensor breather pipe connection.
37. Connect the vent line hose connection.
38. Fit mud flap and secure with nuts and bolts.
39. Position filler neck support bracket and earth strap to mud flap bracket and secure with nut and bolt.
40. Remove stand(s) and lower vehicle.
41. Reposition loadspace sound insulation and carpet.
42. Fit RH luggage compartment side panel. **See CHASSIS AND BODY, Repair,**
43. Fit tail door tread strip and secure with screws.
44. Refill tank with drained fuel.
45. Fit fuel filler cap to filler neck.
46. Close filler flap, lock with ignition key and remove key.
47. Reconnect battery negative lead.

## FUEL TANK FILLER CAP - ADVANCED EVAPS

Service repair no - 19.55.08

### Remove



19M2374

1. Fit ignition key to fuel filler flap lock and open flap.
2. Remove screw securing cap retaining strap to body.
3. Remove fuel filler cap.

### Refit

4. Fit fuel filler cap.
5. Position cap retaining strap to body and secure with screw.
6. Close filler flap, lock with ignition key and remove key.

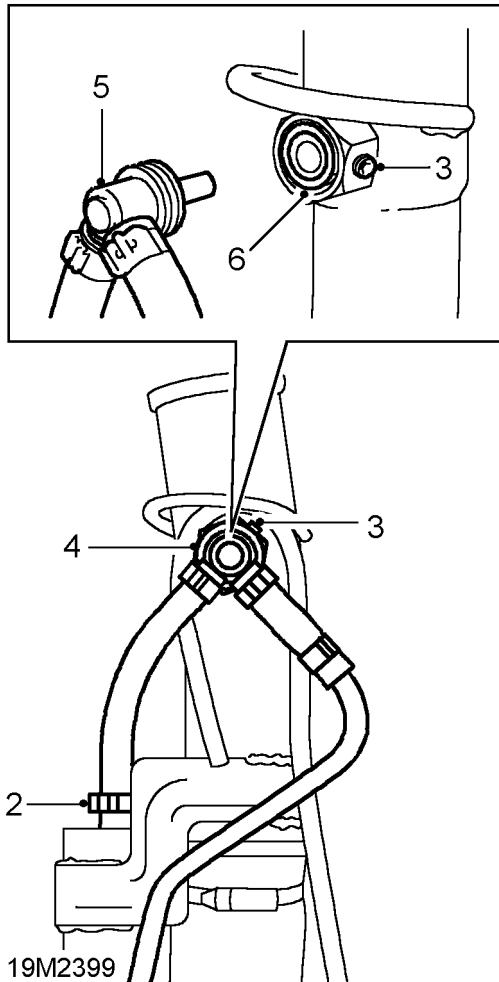


## ANTI-TRICKLE FILL VALVE - ADVANCED EVAPS

Service repair no - 19.55.31

### Remove

1. Remove the fuel filler neck. *See fuel filler neck - advanced evaps*



2. Release the cobra clip securing the hose to the liquid/vapour separator and disconnect the hose.
3. Loosen the grub screw on the valve nut, two complete turns.
4. Loosen the valve nut completely.



**NOTE: The nut is held captive by the stub pipe on the filler neck.**

5. Carefully remove the valve and hose assembly from the filler neck

### Refit

6. Fit a new 'O' ring to the recess in the stub pipe.
7. Fit the valve and hose assembly to the filler neck stub pipe, ensuring that the 'O' ring is fitted around the body of the valve as it is pushed into the filler neck stub pipe.
8. Hand tighten the nut, then tighten to **3 Nm**.
9. Tighten the grub screw to **2 Nm**.
10. Connect the hose to the liquid/vapour separator and secure with the cobra clip.
11. Fit the fuel filler neck. *See fuel filler neck - advanced evaps;refit*



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## DESCRIPTION

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The Mpi Modular Engine Management System (MEMS) controls the fuel injection and programmed ignition systems.

The main features are as follows:

- The Engine Control Module (ECM) controls programmed ignition and fuel injection. The ECM incorporates short circuit protection and can store intermittent faults on certain inputs. Testbook can interrogate the ECM for these stored faults.
- The ECM uses the speed/density method of air flow measurement to calculate fuel delivery. This method measures the inlet air temperature and inlet manifold pressure and assumes that the engine is a calibrated vacuum pump with its characteristics stored in the ECM
- If certain system inputs fail, the ECM implements a back-up facility to enable the system to continue functioning, although at a reduced level of performance.
- A separate diagnostic connector allows engine tuning or fault diagnosis to be carried out using Testbook without disconnecting the ECM harness connector.
- The ECM harness multiplug incorporates specially plated pins to minimise oxidation and give improved reliability.
- The throttle potentiometer requires no adjustment in service. The following components supply data for both fuelling and ignition:

## Ignition system

The ECM determines the optimum ignition timing based on the signals it receives from the following sensors:

1. Crankshaft sensor - Engine speed and crankshaft position.
2. Manifold absolute pressure sensor - Engine load
3. Coolant temperature sensor - Engine temperature.
4. Manifold absolute pressure sensor - Throttle closed.
5. Knock sensor - Engine noise and vibration.

MEMS uses no centrifugal or vacuum advance, timing being controlled by the ECM which is energised by the main relay, within the relay module. Spark distribution is achieved by 2 coils mounted at the rear of the engine and controlled by the ECM.

### Basic ignition timing

MEMS provides the optimum ignition timing for the relevant engine speed and load. The speed and position of the engine is detected by the crankshaft sensor which is bolted to, and projects through the engine adapter plate.

The sensor incorporates an armature which runs adjacent to a reluctor insert in the flywheel, the insert consisting of 34 poles spaced at 10 °intervals, with two missing poles 180 °apart to identify the T.D.C. positions.

The sensor 'reads' these poles to provide a constant up-date of engine speed and crankshaft position to the ECM

The load signal is provided by the manifold absolute pressure sensor mounted inside the ECM casing which detects manifold pressure via a hose connected to the manifold chamber. The sensor converts pressure variations into graduated electrical signals which can be read by the ECM

### Ignition timing compensation

#### ***Coolant temperature sensor***

When the ECM receives a low engine temperature signal from the coolant sensor, it provides optimum driveability and emissions by advancing or retarding the ignition timing.

#### ***Knock sensor***

The knock sensor is a capacitive device mounted in the cylinder block between nos. 2 and 3 cylinders below the inlet manifold. The sensor monitors noise and vibration in the engine and passes this information to the ECM which is able to identify the characteristics of the knocking and make the necessary corrections to the ignition timing of individual cylinders.

#### ***Idle speed control***

When the throttle pedal is released and the engine is at idle, the ECM uses the fast response of ignition timing to assist idle speed control.

When loads are placed on, or removed from the engine the ECM senses the change in engine speed and in conjunction with the opening of the throttle disc by the stepper motor, advances or retards the ignition timing to maintain the specified idle speed. When load is removed from the engine and the stepper motor returns to it's original position, the ignition timing returns to the idle setting.



**NOTE: Due to the sensitivity of this system the ignition timing will be constantly changing at idle speed.**



## Fuel system

### ECM

The MEMS system is controlled by the ECM which is located in the engine compartment.

The ECM is an adaptive unit and can learn the load and wear characteristics of a particular engine.

The ECM remembers and updates two main engine requirements when the engine is fully warm:

1. The idle stepper position required to achieve the specified idle speed.
2. The fuelling change or offset required to achieve a set oxygen sensor voltage.

The stepper position is used as a reference to update the amount of stepper motor movement required to achieve the specified idle speed under all conditions.

The fuelling offset is required to enable the system when not in closed loop control to provide the correct fuelling and while in closed loop control to prevent having to apply excessive adjustments to the fuelling which can adversely affect the emissions and driveability.



**NOTE: After fitting a different ECM, a full tune procedure must be carried out using Testbook.**

The ECM inputs and outputs are shown in the table.

## INPUTS TO MEMS ECM

Crankshaft sensor  
 Manifold absolute pressure  
 Coolant temperature sensor  
 Inlet air temperature sensor  
 Knock sensor  
 Oxygen sensor  
 Throttle potentiometer  
 Throttle closed  
 Battery supply  
 Ignition supply  
 Diagnostic input  
 Power earth  
 Sensor earth  
 Fuel temperature sensor  
 Oxygen sensor  
 Air conditioning switch

## OUTPUTS FROM MEMS ECM

Ignition coil  
 Injectors  
 Aircon relays  
 Stepper motor  
 Temperature gauge  
 Fuel pump relay (inside relay module)  
 Main relay (inside relay module)  
 Diagnostic output

**Injectors**

The four fuel injectors are fitted between the pressurised fuel rail and inlet manifold. Each injector comprises of a solenoid operated needle valve and a specially designed nozzle to ensure good fuel atomisation.

**Engine coolant temperature sensor**

The coolant temperature sensor is mounted in the thermostat housing and is immersed in the engine coolant. The sensor is a resistive device in which the resistance varies with temperature

**Throttle housing**

The throttle housing is attached to the inlet manifold via a rubber sandwich plate and incorporates a throttle disc which is connected to the throttle pedal via the throttle lever and a cable.

There are two breather pipes; one either side of the throttle disc. When the engine is running with the throttle disc open, both pipes are subject to manifold depression and draw crankcase fumes into the manifold. When the throttle disc is closed, only the pipe on the inlet manifold side of the disc is subject to manifold depression. This pipe incorporates a restrictor to prevent engine oil being drawn into the engine by the substantially greater manifold depression.

Also incorporated in the throttle housing are the throttle potentiometer and stepper motor.

**Throttle potentiometer**

The throttle potentiometer is mounted in front of the throttle housing and is directly coupled to the throttle disc shaft.

Three wires connect the throttle potentiometer to the ECM; a 5 volt supply to the potentiometer, an earth return to the ECM and an output voltage to the ECM which indicates the rate of throttle disc movement.

**Stepper motor**

The stepper motor is contained within the throttle housing and operates a cam and push rod via a reduction gear. The push rod is in direct contact with the throttle lever and moves the throttle disc to control idle and fast idle speed. The stepper motor maximum movement is 3.75 revolutions accomplished in steps of 7.5°. The reduction gear converts this into 180° of cam movement.

The throttle lever has a throttle position setting screw which rests on the stepper motor operating pin when the throttle pedal is released and is used to set the relationship between engine speed and stepper motor position.

In the side of the throttle housing is a throttle air bypass bleed screw to provide easier and more sensitive setting of the stepper motor position at idle.

The stepper motor position is checked using Testbook and should be within the range of 20 to 40 steps when the engine is run in. If it is identified as being outside this range it can be adjusted to within range by turning the throttle air bypass bleed screw. It is important to follow Testbook setting procedure when adjusting this screw to prevent mismatching of throttle body settings. This ensures that the stepper motor is at the optimum position within its range for providing further movement to compensate for changes in engine load or temperature in accordance with signals from the ECM



**NOTE: The stepper motor and throttle position setting screws must only be adjusted when Testbook identifies the requirement.**





### **Fuel pump**

The electric fuel pump, located inside the fuel tank, is a self-priming centrifugal 'wet' pump, the motor and pump are filled with fuel.

The fuel pump supplies more fuel than the maximum load requirement for the engine, so that pressure in the fuel system can be maintained under all conditions.

### **Fuel pressure regulator**

The pressure regulator is a mechanical device controlled by manifold depression and is mounted in the fuel rail. The regulator ensures that fuel rail pressure is maintained at a constant pressure difference to that in the inlet manifold, as manifold depression increases the regulated fuel pressure is reduced in direct proportion.

When pressure exceeds the regulator setting excess fuel is spill returned to the fuel tank swirl pot which contains the fuel pick-up strainer.

### **Relay module**

The relay module contains the main relay, fuel pump relay, starter relay and oxygen sensor relay and is mounted on the ECM mounting bracket.

The main relay is energised when the ignition is switched on and supplies current to the ECM

The fuel pump relay is energised by the ECM for a short period when the ignition is switched on, during cranking and while the engine is running.

The starter relay is energised by the cranking signal from the ignition switch.

This oxygen sensor relay is energised when the ignition is switched on and supplies current to the ECM

### **Intake air temperature sensor**

The intake air temperature sensor is fitted in the side of the inlet manifold and sends the ECM a signal relating to air temperature. The ECM uses this signal in its calculations on air flow.

### **Inertia switch**

The fuel pump circuit incorporates an inertia switch which in the event of sudden deceleration isolates the power supply to the fuel pump. The inertia switch is situated in the engine compartment on the bulkhead and can, if tripped, be reset by depressing the central plunger.



**WARNING: Check the integrity of the fuel system before the inertia switch is reset.**

### **Diagnostic connector**

A diagnostic connector is provided to enable diagnosis to be carried out without disturbing the system electrical connections and to allow the ECM's ability to store certain faults to be utilised.

### **Oxygen sensor - Closed-loop emission control**

The MEMS Mpi system operates a closed loop emission system to ensure the most efficient level of exhaust gas conversion.

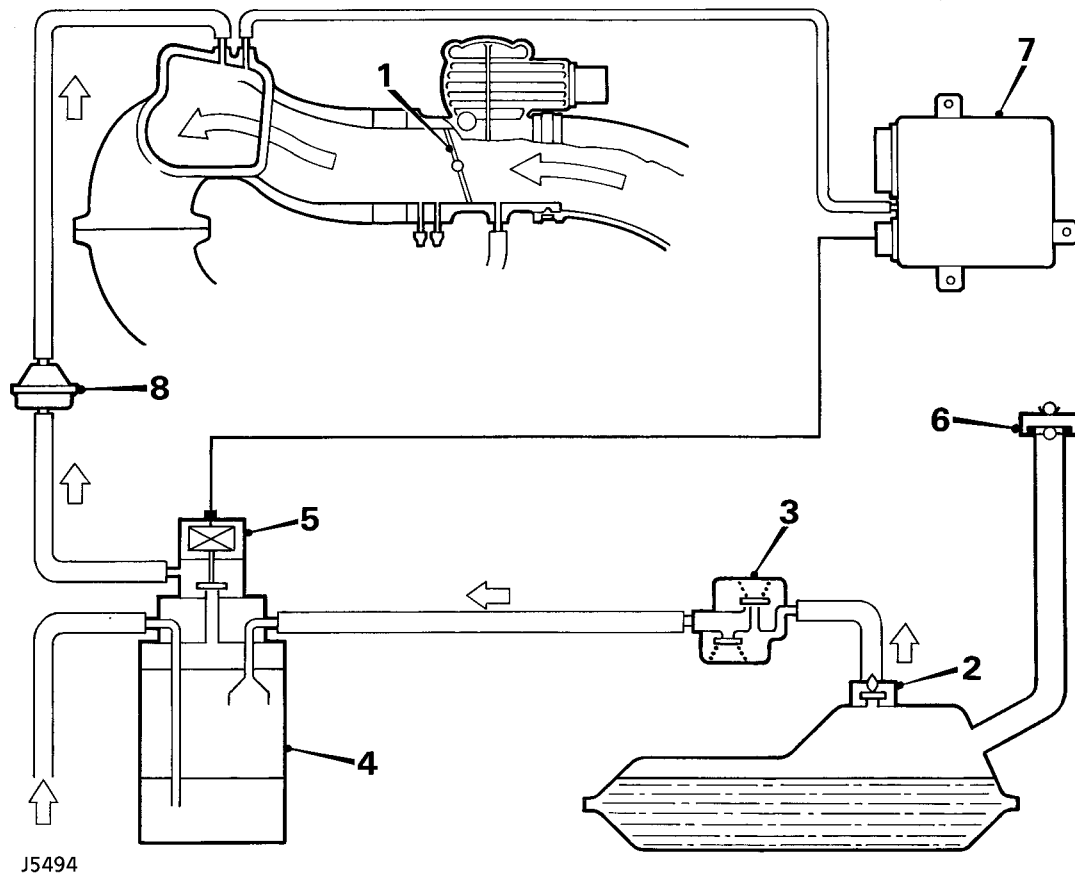
An oxygen sensor fitted in the exhaust manifold monitors the exhaust gases. It then supplies a small voltage proportional to exhaust oxygen content to the ECM. As the air/fuel mixture weakens, the exhaust oxygen content increases and so the voltage to the ECM decreases. If the mixture becomes richer so the oxygen content decreases and the voltage increases.

The ECM uses this signal voltage to determine the air/fuel mixture being delivered to the engine, and adjusts the injector duration to maintain the ratio necessary for efficient gas conversion by the catalyst.

The oxygen sensor has an integral heating element to ensure an efficient operating temperature is quickly reached from cold. The electrical supply for the heater element is controlled by the oxygen sensor relay.

### **Fuel temperature sensor**

The fuel temperature sensor is inserted in the fuel rail and measures fuel and fuel rail temperatures. During engine cranking at high temperatures, the ECM increases fuel supply, and opens the throttle disc via the stepper motor to aid hot starting.



### Non - evaporative loss equipment

- |                       |                        |                  |
|-----------------------|------------------------|------------------|
| 1. Throttle disc      | 4. Charcoal canister   | 7. ECM           |
| 2. Fuel cut-off valve | 5. Purge control valve | 8. One way valve |
| 3. Two way valve      | 6. Fuel filler cap     |                  |

#### **Charcoal canister**

A charcoal canister is used for the temporary storage of fuel vapour from the fuel tank until the vapour can be purged from the canister into the engine and burned.

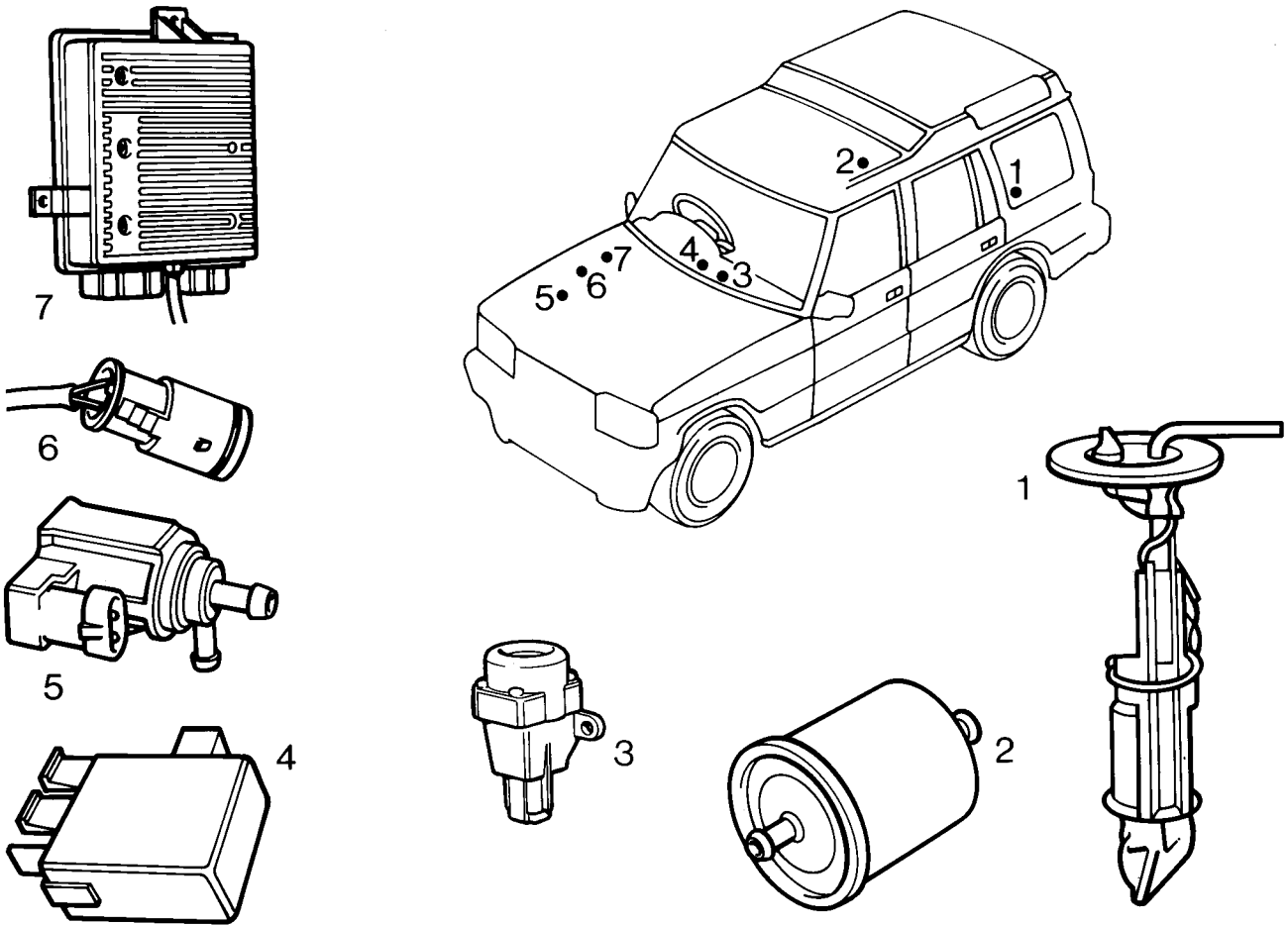
The charcoal canister is purged when the purge control valve is open, fresh air is drawn through the purge air hose, through the charcoal canister and into a port in the inlet manifold.

#### **Purge control valve**

A purge control valve is operated by the ECM. The valve remains closed when the engine is cold and at idling speed to protect engine tune and catalyst performance. If the charcoal canister was purged during cold running or at idling speed, the additional enrichment in fuel mixture would delay catalyst light off time and cause erratic idle. When the engine temperature is above 75°C, the purge control valve will be operational (modulated ON and OFF) whenever the engine speed is above approximately 1600 rev/min. When the purge valve is opened, fuel vapour from the charcoal canister is drawn into the inlet manifold for combustion.



**MEMS COMPONENTS & LOCATION ON VEHICLE**



J5476

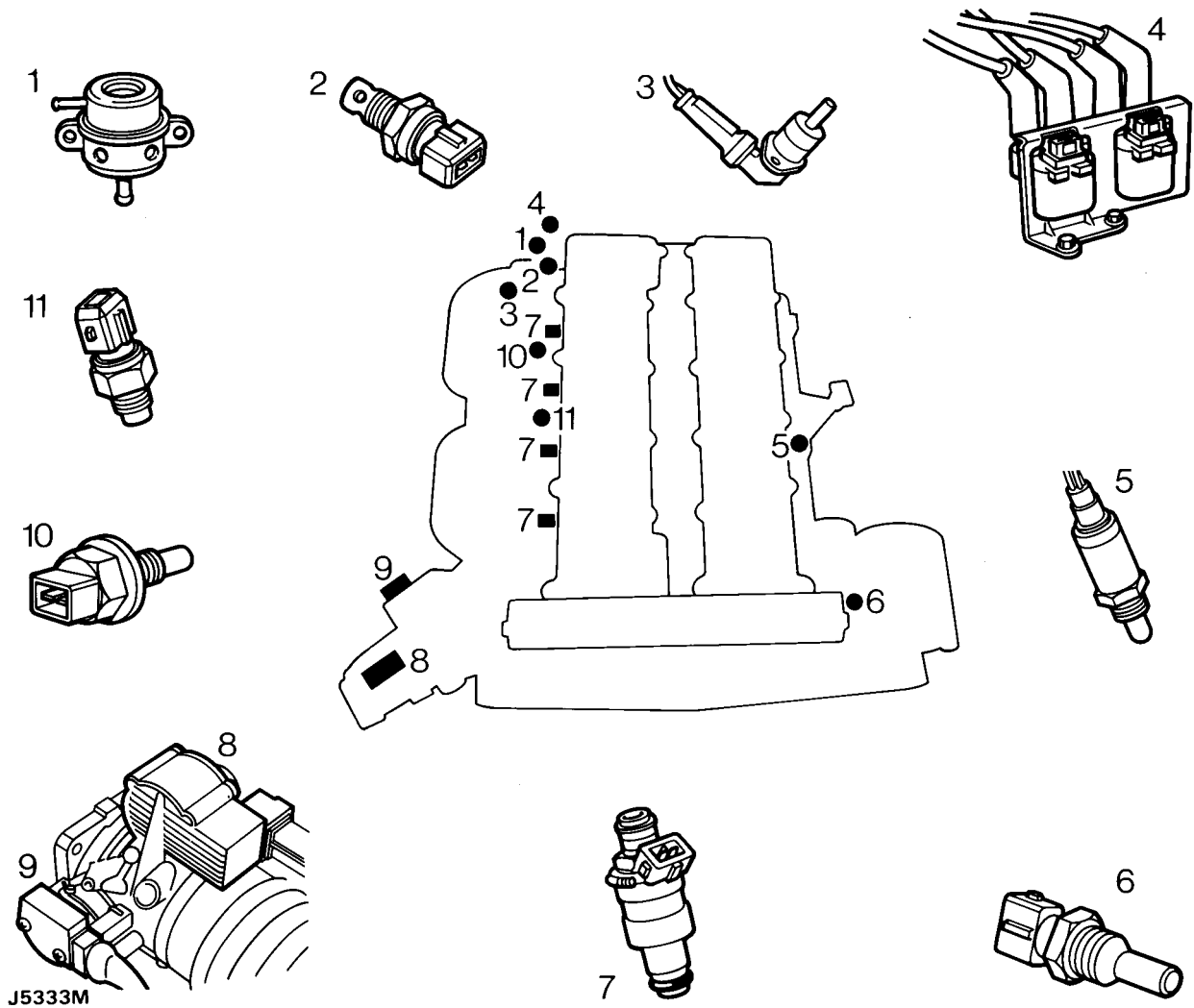
**Components**

**Location**

1	Fuel pump .....	Fuel tank
2	Fuel filter .....	Right chassis rear
3	Fuel inertia switch .....	Bulkhead
4	Relay module .....	Under bonnet [hood]
5	Purge control valve .....	On charcoal canister
6	Diagnostic connector .....	Right inner wing [fender]
7	MEMS ECM. ....	Right inner wing [fender]

# 19 FUEL SYSTEM

## MEMS COMPONENTS & LOCATION ON ENGINE



### Components

### Location

1	Fuel pressure regulator .....	Engine rear
2	Intake air temperature sensor .....	Inlet manifold
3	Crankshaft sensor .....	Under starter motor on flywheel housing
4	Twin ignition coils .....	Engine rear
5	Oxygen sensor .....	Exhaust manifold
6	Coolant temperature sensor .....	Coolant chamber
7	Injectors	
8	Stepper motor	
9	Throttle potentiometer	
10	Fuel temperature sensor .....	Fuel rail
11	Knock sensor .....	Engine block



## SYSTEM OPERATION

### Ignition on

When the ignition is switched on, voltage is applied to ECM pin 11. The ECM then switches on the main relay by supplying an earth path at pin 4. This allows battery voltage to pass to ECM pin 28, to the four injectors and through the ignition coil to ECM pin 25. In addition, the fuel pump relay is switched on by the ECM supplying an earth path on pin 20. Voltage is applied through the inertia switch to the fuel pump.

The pump runs for a short period to pressurise the fuel rail. The fuel pressure regulator will open at its maximum setting and excess fuel is spill returned to the tank.

The ECM determines the amount of stepper motor movement from the following signals:

- Engine coolant temperature data at pin 33.
- Inlet air temperature data at pin 16.
- Throttle potentiometer data at pin 8.
- Engine speed data at pins 31 and 32.
- Manifold absolute pressure data (via pipe from manifold).
- Battery voltage at pin 28.
- Ignition signal at pin 11.

If one or more of the following inputs fail, the ECM will substitute the back-up values shown to maintain driveability.

Input	Back-up value
Coolant temperature	Idle Speed controlled until engine is fully warm. 60°C at speeds above idle.
Inlet air temperature	Derived from engine speed and engine load.
Manifold absolute pressure	Derived from engine speed and throttle position.

### Starter operation

Whilst the starter relay is energised, battery voltage is applied to the starter motor solenoid. The solenoid also energises and supplies battery voltage directly to the starter motor.

Ignition is controlled by the ECM switching the low tension circuit via pin 25.

The ECM provides an earth signal on pins 24, 23, 26 and 1 for the period the injectors are required to be open, the injector solenoids are energised (simultaneously on naturally aspirated models) and fuel is sprayed into the manifold onto the back of the inlet valves. The ECM carefully meters the amount of fuel injected by adjusting the injector opening period (pulse width). During cranking, when the engine speed is below approx. 400 rev/min, the ECM increases the injector pulse width to aid starting. The amount of increase depends upon coolant temperature. To prevent flooding, injector pulses are intermittent i.e. 24 on then 8 pulses off.

### Idling

After start enrichment is provided at all temperatures immediately cranking ceases. The ECM controls the enrichment by increasing injector pulse width. The enrichment decays in relation to the rising coolant temperature.

Provided the ECM is receiving a signal that the engine speed is close to the idle speed set point, the ECM will implement idle speed control.

The ECM activates a unipolar stepper motor acting directly on the throttle lever. Idle speed response is improved by the ignition system advancing or retarding the timing when load is placed on, or removed from the engine.

If, during engine idle, the load on the engine is increased sufficiently to cause engine speed to fall, the ECM will sense this via the crankshaft sensor and instantly advance the ignition timing to increase idle speed and then energise the stepper motor to open the throttle disc thus maintaining the idle speed. Finally the ignition timing is retarded to its nominal value.

The ECM monitors battery voltage and, if voltage falls sufficiently to cause fluctuations in injector pulse widths, it increases the injector pulse widths to compensate.

On return to idle, the ECM will implement a slightly higher idle speed to prevent the engine stalling.

***Driving***

When the throttle pedal is depressed, the ECM implements the cruise air/fuel ratio map. During driving the ECM continually monitors inlet air temperature and engine speed and load for its air flow calculations, together with coolant temperature for any temperature corrections. Additional inputs are throttle potentiometer for acceleration and throttle pedal switch for cruise/idle fuel map selection and over-run fuel cut-off.

***Acceleration enrichment***

When the throttle pedal is depressed, the ECM receives a rising voltage from the throttle potentiometer and detects a rise in manifold pressure from the manifold absolute pressure sensor. The ECM provides additional fuel by increasing the normal injector pulse width and also provides a small number of extra injector pulses on rapid throttle openings.

***Over-run fuel cut-off***

The ECM implements over-run fuel cut-off when the following signals are received.

- Throttle disc closed.
- Engine speed is above 2000 rev/min - engine at normal operating temperature.

Fuel is reinstated progressively when any of the above signals cease.

***Over-speed fuel cut-off***

To prevent damage at high engine speeds the ECM inhibits the earth path for the injectors, cutting off injection. As engine speed falls, injection is reinstated.

***Ignition switch off***

When the ignition is switched off, the ECM will keep the main relay energised for approx. 30 seconds while it drives the stepper motor to the 35 step position for the next engine start.



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## THROTTLE CABLE

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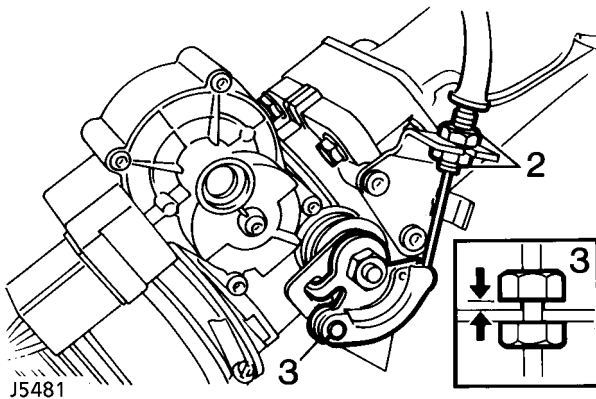
### Adjust



**NOTE:** Use diagnostic equipment to ensure that the throttle potentiometer and stepper motor are synchronised before adjusting the throttle cable.

Ensure that the cable is correctly routed and located.

1. Switch ignition on, wait 5 seconds and switch ignition off to ensure stepper motor is in setting position.
2. Loosen throttle cable adjustment nut and locknut from abutment bracket.
3. Hold cam in "throttle closed" position and rotate cable adjustment nut until a gap of 2mm exists between the nut and abutment bracket.



4. Tighten cable locknut to contact abutment bracket.
5. Using two wrenches tighten nuts onto abutment bracket.
6. Operate throttle pedal and ensure throttle opens fully.

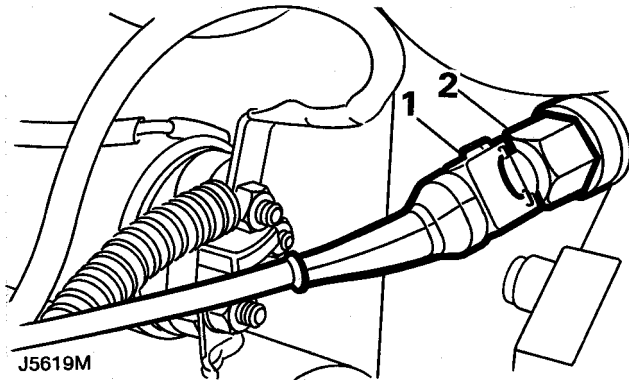


## KNOCK SENSOR

Service repair no - 18.30.18

### Remove

1. Disconnect multiplug from knock sensor.
2. Remove knock sensor.



### Refit

3. Clean mating face of cylinder block.
4. Fit knock sensor. Tighten to **15 Nm**
5. Connect multiplug.

## IGNITION COILS

Service repair no - 18.20.40 - 1 & 4 Cylinders

Service repair no - 18.20.41 - 2 & 3 Cylinders

### Remove

1. Disconnect battery negative lead.
2. Disconnect 4 h.t. leads from coils.



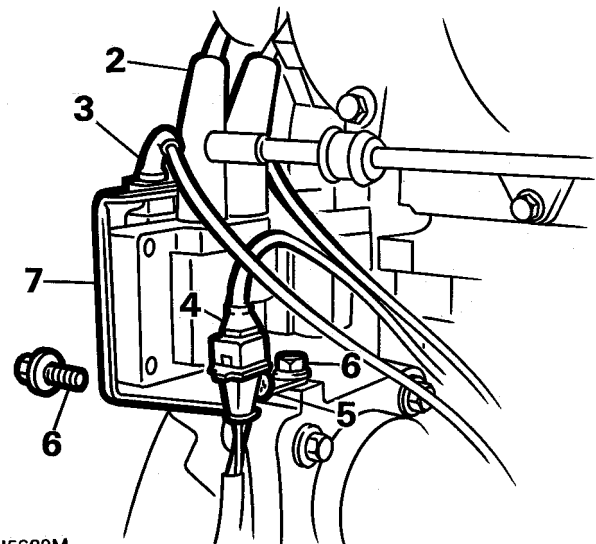
**NOTE:** Mark the position of the h.t. leads to ensure correct refitment.

3. Disconnect 2 multiplugs from coils.
4. Disconnect crankshaft sensor multiplug.
5. Remove screw securing crankshaft sensor multiplug to coil bracket.
6. Remove 3 bolts securing coil bracket to bell housing.



**NOTE:** Access to the rear bolts is from under the vehicle.

7. Remove coil assembly.



### Refit

8. Position coil assembly to bell housing.
9. Fit 3 bolts and tighten to the correct torque.
10. Secure crankshaft sensor multiplug to coil bracket with screw.
11. Connect crankshaft sensor multiplug.
12. Connect multiplugs and h.t. leads to coils.
13. Reconnect battery negative lead.

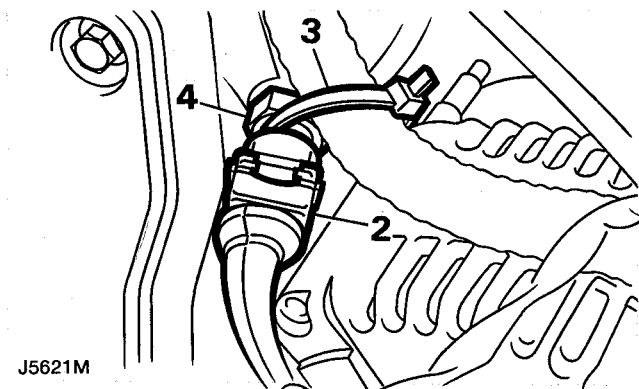


## COOLANT TEMPERATURE SENSOR

Service repair no - 18.30.10

### Remove

1. Position drain tin below coolant pump hose.
2. Disconnect sensor multiplug.
3. Release harness clip and harness.
4. Remove sensor.



### Refit

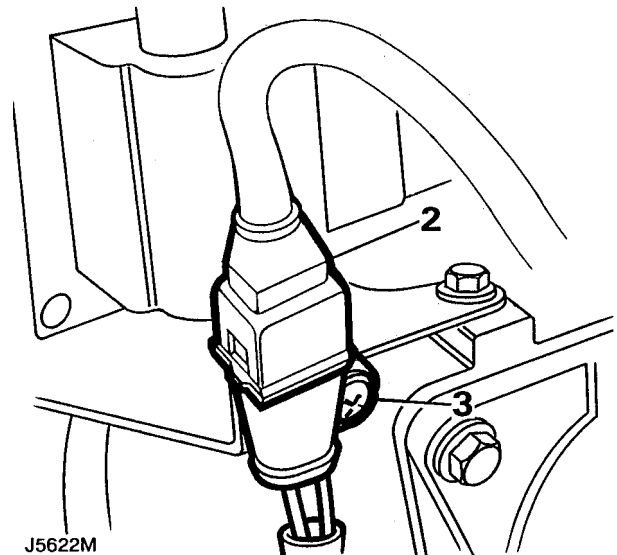
5. Clean sensor.
6. Fit sensor and tighten to the correct torque.
7. Position harness and secure with clip.
8. Connect multiplug.
9. Top-up cooling system.

## CRANKSHAFT SENSOR

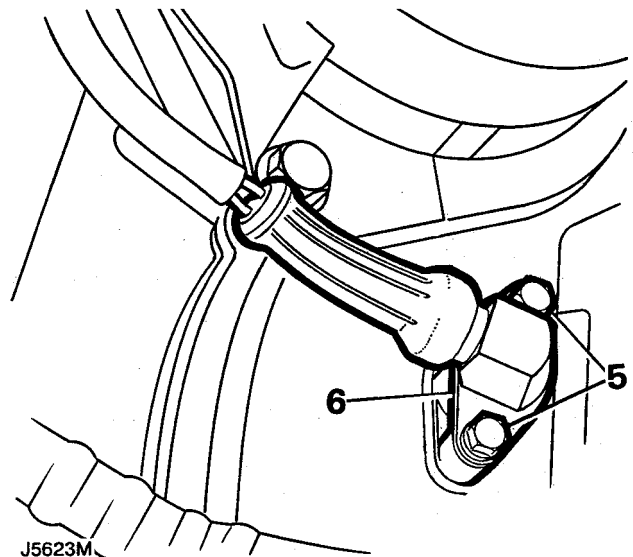
Service repair no - 18.30.12

### Remove

1. Position vehicle on ramp [hoist].
2. Disconnect multiplug from crankshaft sensor flylead.
3. Remove screw, release lead from bracket.



4. Raise ramp [hoist].
5. Remove 2 bolts securing crankshaft sensor.
6. Remove crankshaft sensor.



### Refit

7. Clean crankshaft sensor and mating surface of backplate.
8. Fit crankshaft sensor, fit bolts. Tighten to **7 Nm**
9. Lower vehicle.
10. Position lead to bracket, fit and tighten screw.
11. Connect multiplug

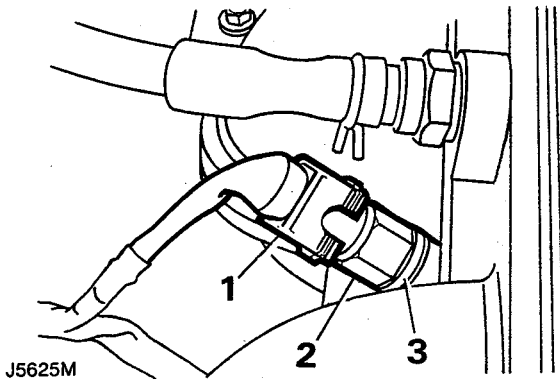


## FUEL TEMPERATURE SENSOR

Service repair no - 18.30.08

### Remove

1. Disconnect fuel temperature sensor multiplug.
2. Remove fuel temperature sensor.
3. Discard sealing washer.



### Refit

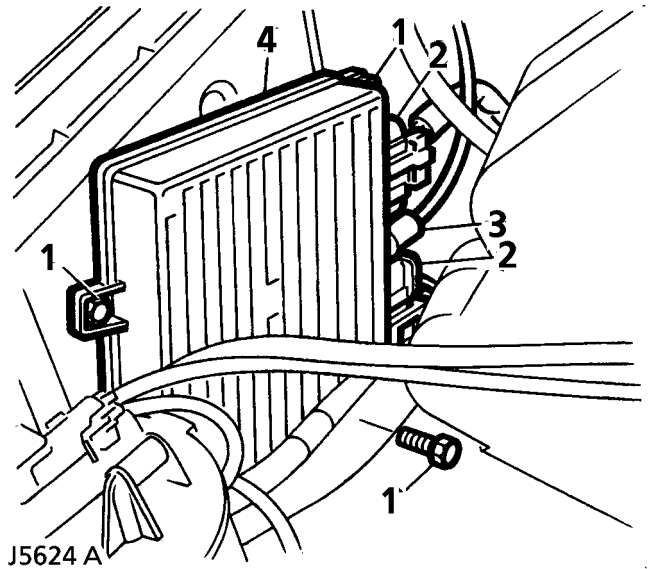
4. Clean mating face of fuel rail.
5. Fit a new sealing washer to sensor.
6. Fit temperature sensor. Tighten to **7 Nm**
7. Connect fuel temperature sensor multiplug.

## MEMS ENGINE CONTROL MODULE (ECM)

Service repair no - 18.30.01

### Remove

1. Remove 3 bolts securing ECM.
2. Disconnect 2 multiplugs from ECM.
3. Disconnect vacuum hose from ECM.
4. Remove ECM.
5. Collect ECM spacers (LHD only)



### Refit

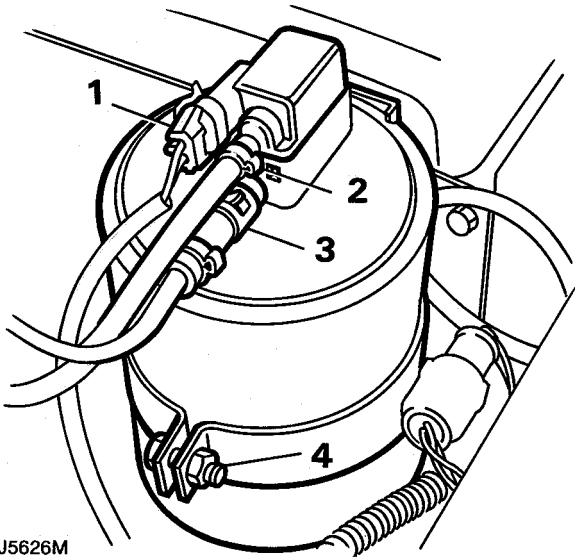
6. Position ECM and spacers to wing [fender].
7. Connect vacuum hose to ECM.
8. Connect multiplugs to ECM.
9. Position ECM to mounting.
10. Fit bolts and tighten.

## CHARCOAL CANISTER

Service repair no - 17.15.13

### Remove

1. Disconnect multiplug from purge valve.
2. Release clip and disconnect hose from purge valve.
3. Release clip and disconnect fuel tank hose from charcoal canister.
4. Unscrew bolt to release securing strap and remove charcoal canister.



### Refit

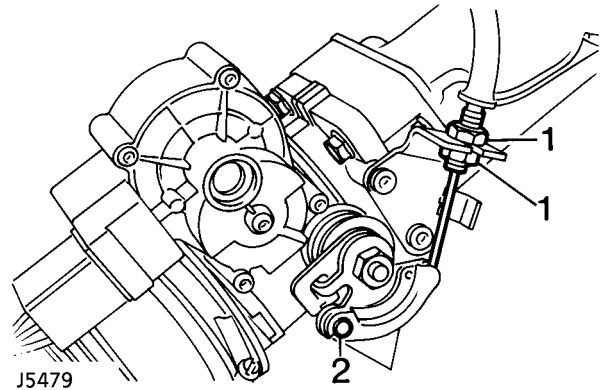
5. Fit charcoal canister and secure strap.
6. Connect fuel tank hose to charcoal canister and secure clip.
7. Connect hose to purge valve and secure clip.
8. Connect multiplug to purge valve.

## THROTTLE CABLE

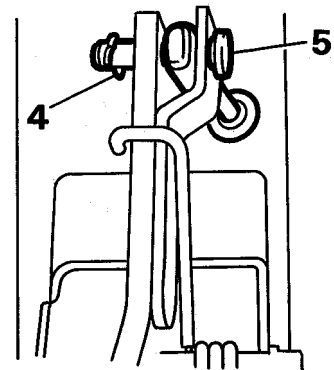
Service repair no - 19.20.06

### Remove

1. Loosen 2 nuts securing throttle cable to abutment bracket.
2. Release throttle cable from throttle lever.

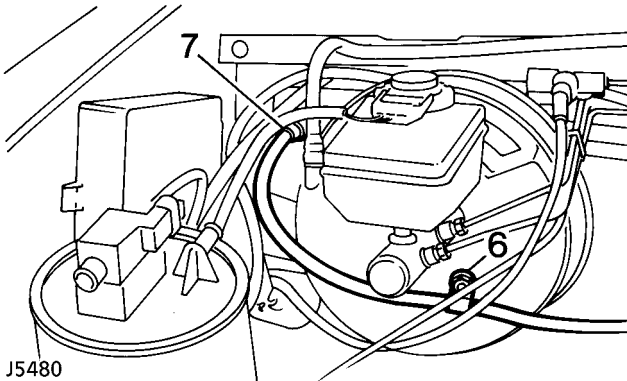


3. Remove footwell closing panel.
4. Release split [cotter] pin from throttle pedal clevis pin.
5. Remove clevis pin and release cable from throttle pedal.





6. Remove nut securing throttle cable bracket to brake servo and release cable.
7. Release grommet from bulkhead and withdraw cable.



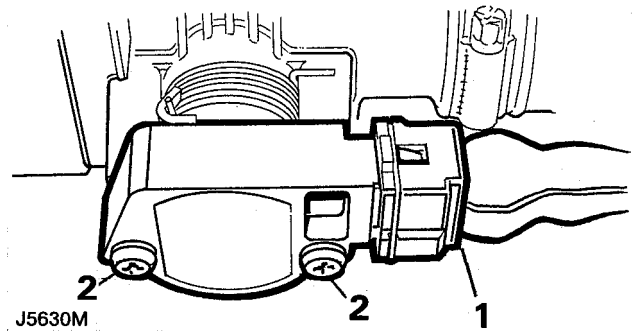
8. Locate cable in bulkhead.
9. Connect cable to throttle pedal.
10. Connect cable to cam.
11. Adjust throttle cable.

## THROTTLE POTENTIOMETER

Service repair no - 19.22.49

### Remove

1. Disconnect throttle potentiometer multiplug.
2. Remove 2 screws securing throttle potentiometer, remove potentiometer.



### Refit

3. Clean mating faces of throttle potentiometer and throttle housing.
4. Fit throttle potentiometer, fit and tighten screws.



**CAUTION: Ensure throttle potentiometer is correctly engaged with throttle cam and that wiring outlet faces downwards.**

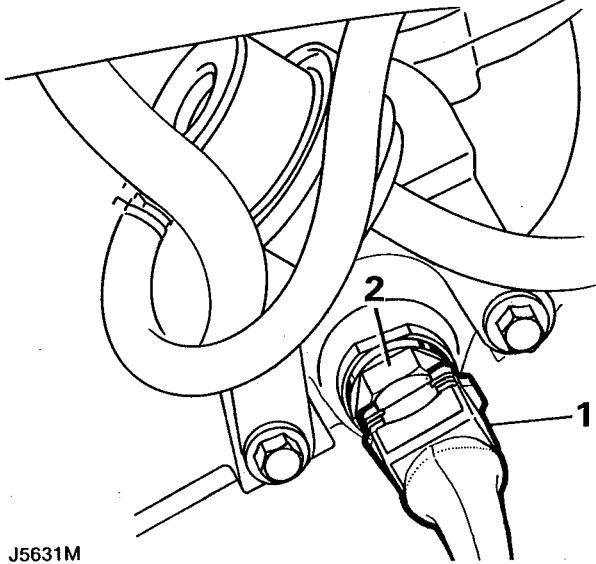
5. Connect multiplug.
6. Check with diagnostic equipment.

## INTAKE AIR TEMPERATURE SENSOR

Service repair no - 18.30.09

### Remove

1. Disconnect multiplug from temperature sensor.
2. Remove sensor from inlet manifold.



### Refit

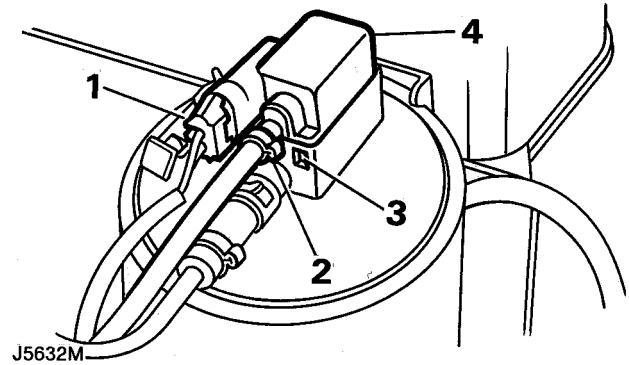
3. Clean sensor threads and mating face.
4. Fit sensor to inlet manifold. Tighten to **7 Nm**
5. Connect multiplug to sensor.

## PURGE CONTROL VALVE

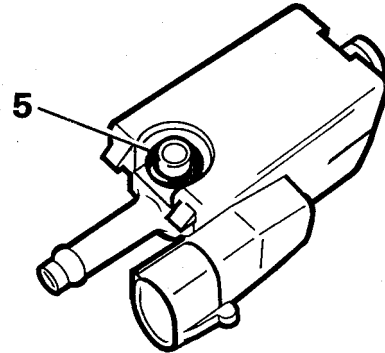
Service repair no - 17.15.39

### Remove

1. Disconnect multiplug from purge control valve.
2. Release clip and disconnect hose from valve.
3. Release valve from charcoal canister.
4. Remove valve.



5. Discard 'O' ring.



### Refit

6. Clean valve and valve location.
7. Position and secure valve to charcoal canister.
8. Connect hose to purge valve and secure with clip.
9. Connect multiplug to valve.



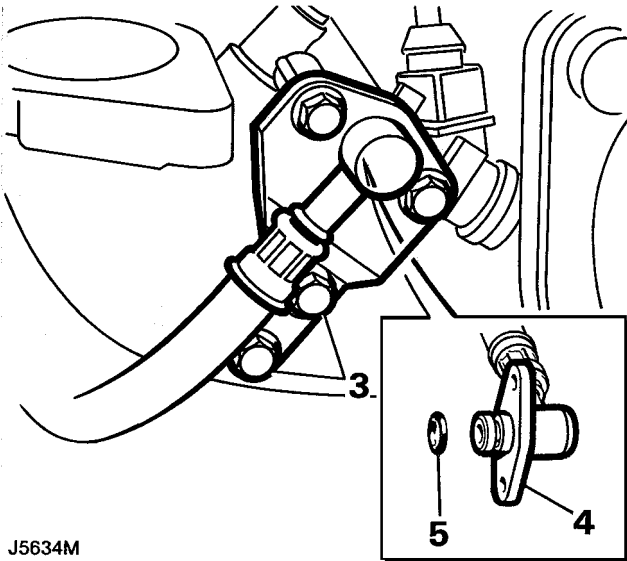
## FUEL RAIL AND INJECTORS

Service repair no - 19.60.04 - Rail

Service repair no - 19.60.10 - Injectors

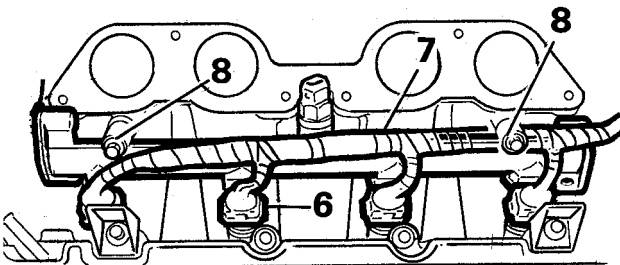
### Remove

1. Remove inlet manifold chamber gasket. **See MANIFOLD AND EXHAUST SYSTEM, Repair, Manifold Chamber Gasket - Mpi**
2. Remove pressure regulator.
3. Remove 4 bolts securing fuel feed hose flange stiffening bracket, remove stiffening bracket.
4. Release fuel feed hose from fuel rail.
5. Discard 'O' ring.



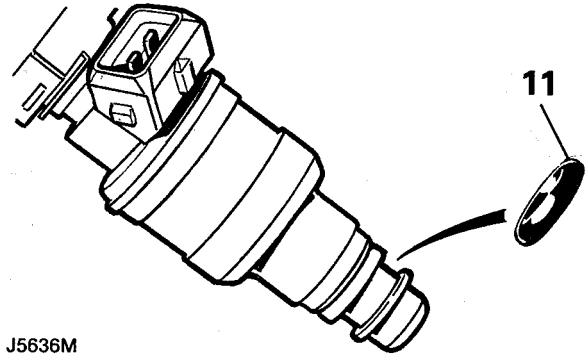
J5634M

6. Disconnect 4 injector multiplugs.
7. Move injector harness aside.
8. Remove 2 bolts securing fuel rail to inlet manifold.
9. Release 4 injectors from inlet manifold.
10. Remove fuel rail complete with injectors.



J5635M

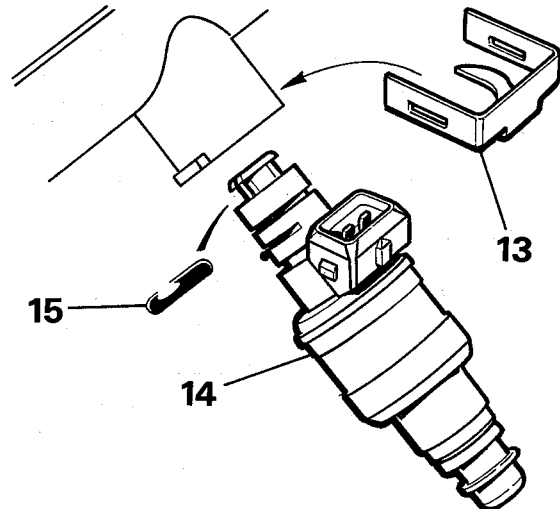
11. Discard outlet 'O' rings from injectors.
12. Fix protective cap to each injector.



J5636M

**Do not carry out further dismantling if component is removed for access only.**

13. Remove clip(s) securing injector(s) to fuel rail.
14. Remove injector(s).
15. Discard inlet 'O' ring(s) from injector(s).



J5637M

16. Remove fuel temperature sensor.

## Refit

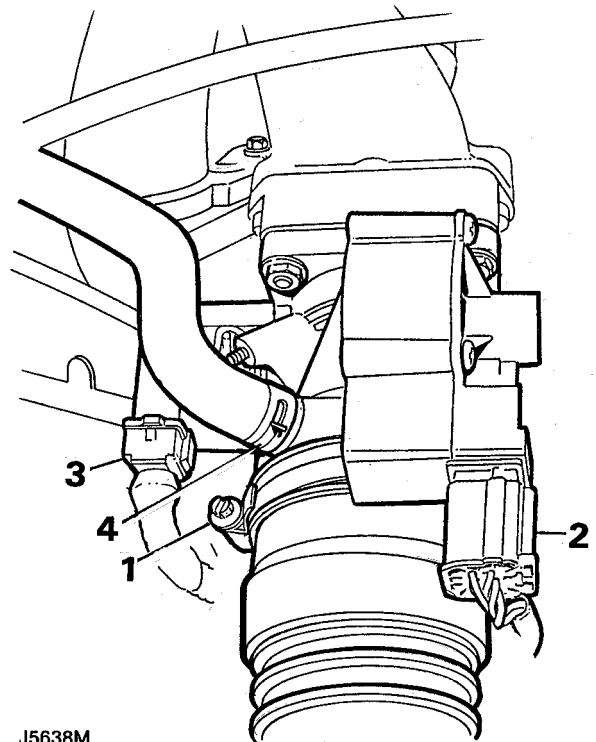
17. Clean fuel rail, temperature sensor and pressure regulator mating surfaces.
18. Fit fuel temperature sensor. Tighten to **7 Nm**
19. Clean injectors and injector recesses in fuel rail and inlet manifold.
20. Fit new 'O' ring(s) to inlet end of injector(s).
21. Fit injector(s) to fuel rail, fit and secure clip(s).
22. Fit new 'O' rings to outlet ends of injectors.
23. Align injectors to inlet manifold and push fuel rail into position.
24. Fit fuel rail securing bolts. Tighten to **10 Nm**
25. Connect injector multiplugs.
26. Remove plugs from fuel feed hose and fuel rail.
27. Fit new 'O' ring to fuel feed hose.
28. Connect fuel feed hose to fuel rail.
29. Fit stiffening bracket.
30. Tighten stiffening bracket and feed hose bolts.
31. Fit pressure regulator.
32. Fit inlet manifold chamber.

## THROTTLE HOUSING

Service repair no - 19.22.45

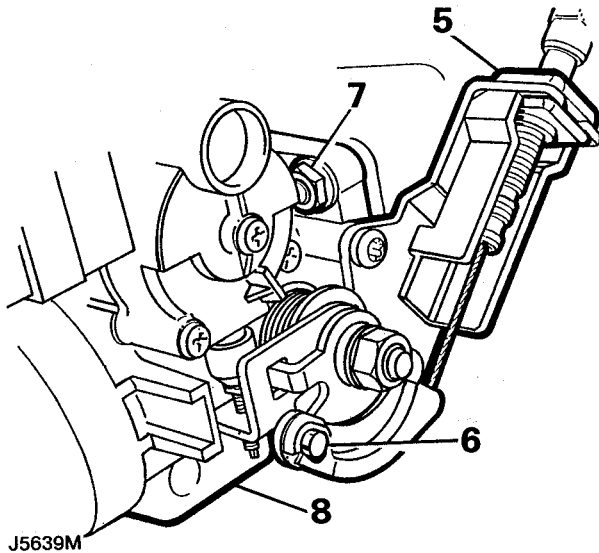
## Remove

1. Loosen clip, disconnect hose from throttle housing.
2. Disconnect multiplug from stepper motor.
3. Disconnect multiplug from throttle potentiometer.
4. Disconnect breather hose from throttle housing.



J5638M

5. Loosen 2 nuts securing throttle cable to abutment bracket and release cable.
6. Release throttle cable from cam.
7. Remove 4 nuts securing throttle housing to flexible mounting.
8. Release throttle housing from studs.



### Refit

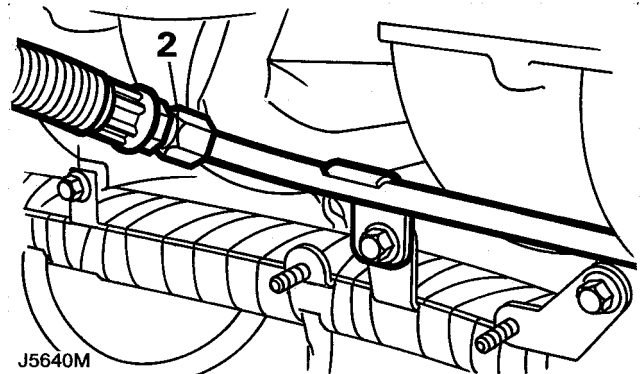
9. Examine flexible mounting for splits or damage; renew as necessary.
10. Thoroughly clean throttle housing and mating face of flexible mounting.
11. Connect breather hose to throttle housing.
12. Position throttle housing to mounting studs, fit nuts. Tighten to **7 Nm**.
13. Connect throttle cable to cam.
14. Adjust throttle cable.
15. Connect multiplug to stepper motor.
16. Connect multiplug to throttle potentiometer.
17. Connect hose to throttle housing, tighten clip.

## FUEL PRESSURE REGULATOR

Service repair no - 19.45.06

### Remove

1. Disconnect battery negative lead.
2. Position absorbant cloth around fuel pipe to fuel rail union. Loosen bolt to relieve pressure. Re-tighten bolt.



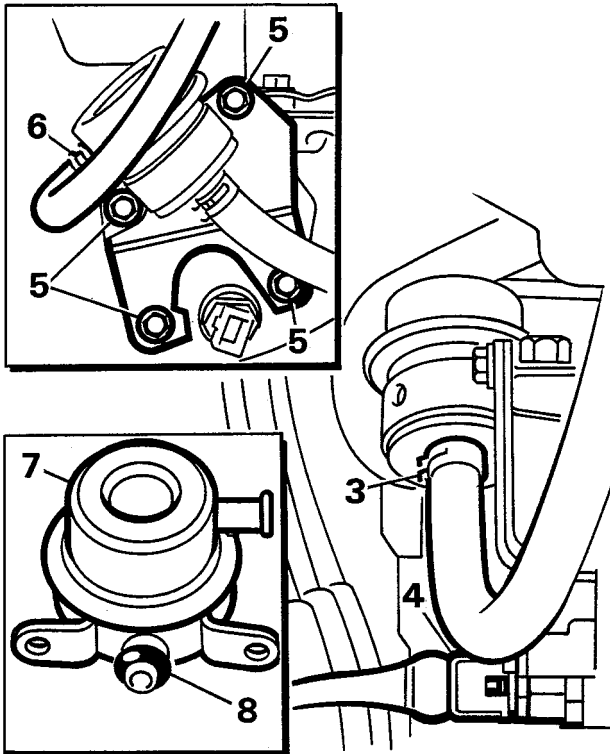
3. Release clip and disconnect fuel hose from pressure regulator.



**CAUTION: Plug the connectors.**

4. Disconnect intake air temperature sensor multiplug.
5. Remove 4 bolts securing pressure regulator steady bracket to fuel rail and manifold, remove steady bracket.
6. Disconnect vacuum hose from pressure regulator.
7. Manoeuvre pressure regulator from fuel rail.
8. Discard 'O' ring.





J5641M

### Refit

9. Clean pressure regulator and mating surfaces.
10. Fit new 'O' ring to pressure regulator.
11. Fit vacuum hose to pressure regulator.
12. Position pressure regulator.
13. Fit steady bracket.
14. Fit bolts and tighten.
15. Connect multiplug to air temperature sensor.
16. Remove plugs, fit fuel hose to regulator and secure with clip.
17. Reconnect battery negative lead.

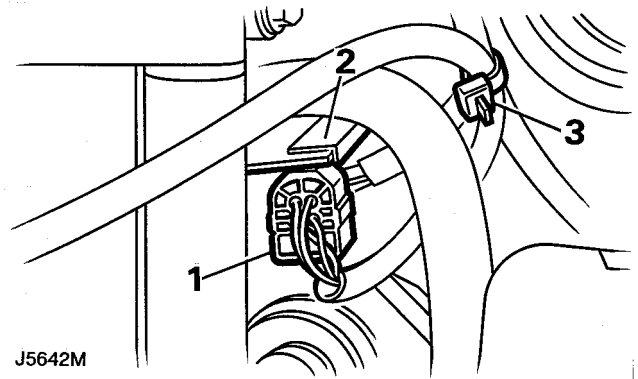
### OXYGEN SENSOR

Service repair no - 18.30.41 - L.H

Service repair no - 18.30.42 - R.H

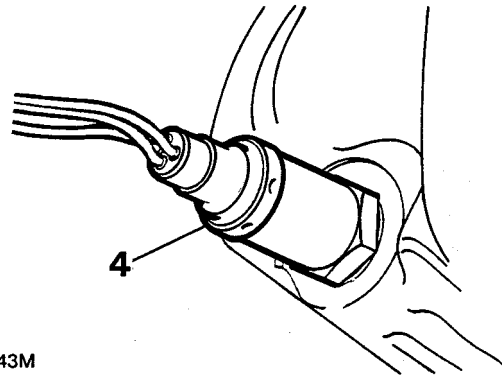
### Remove

1. Disconnect oxygen sensor multiplug.
2. Release multiplug from bracket.
3. Release harness lead from cable tie.



J5642M

4. Remove oxygen sensor; recover sealing washer.



J5643M

### Refit

5. Fit sealing washer to oxygen sensor.
6. Fit oxygen sensor. Tighten to **55 Nm**.
7. Secure multiplug to bracket, connect multiplug.
8. Secure harness lead with cable tie.

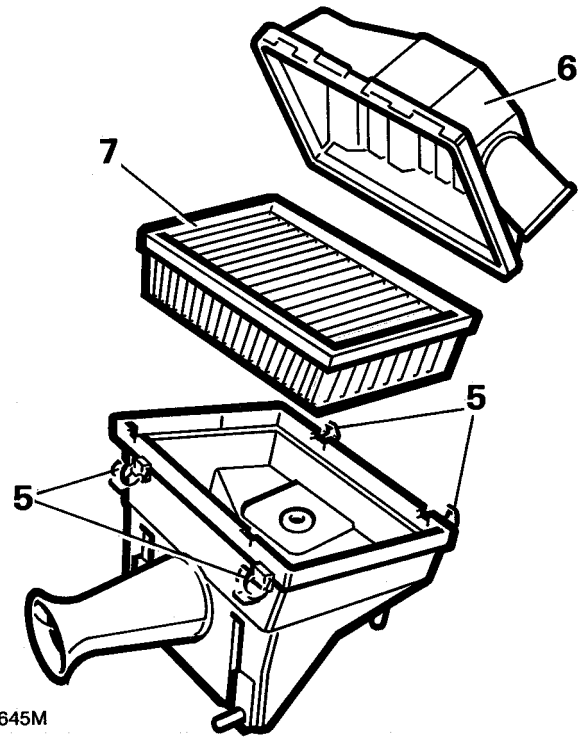
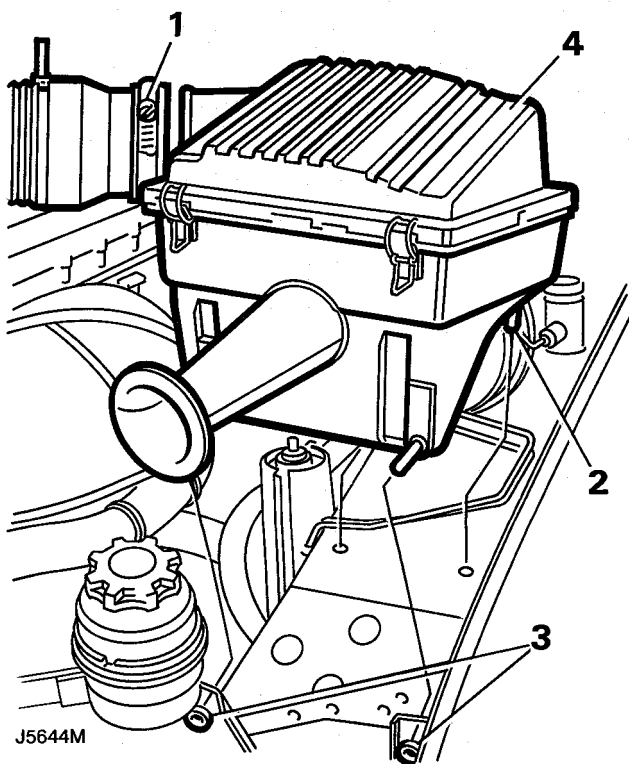


## AIR CLEANER

Service repair no - 19.10.01

### Remove

1. Release clip and remove intake hose from air cleaner.
2. Ease air cleaner assembly bottom mounting rubbers from body.
3. Ease air cleaner from inner wing [fender] mounting rubber
4. Remove air cleaner.



### Refit

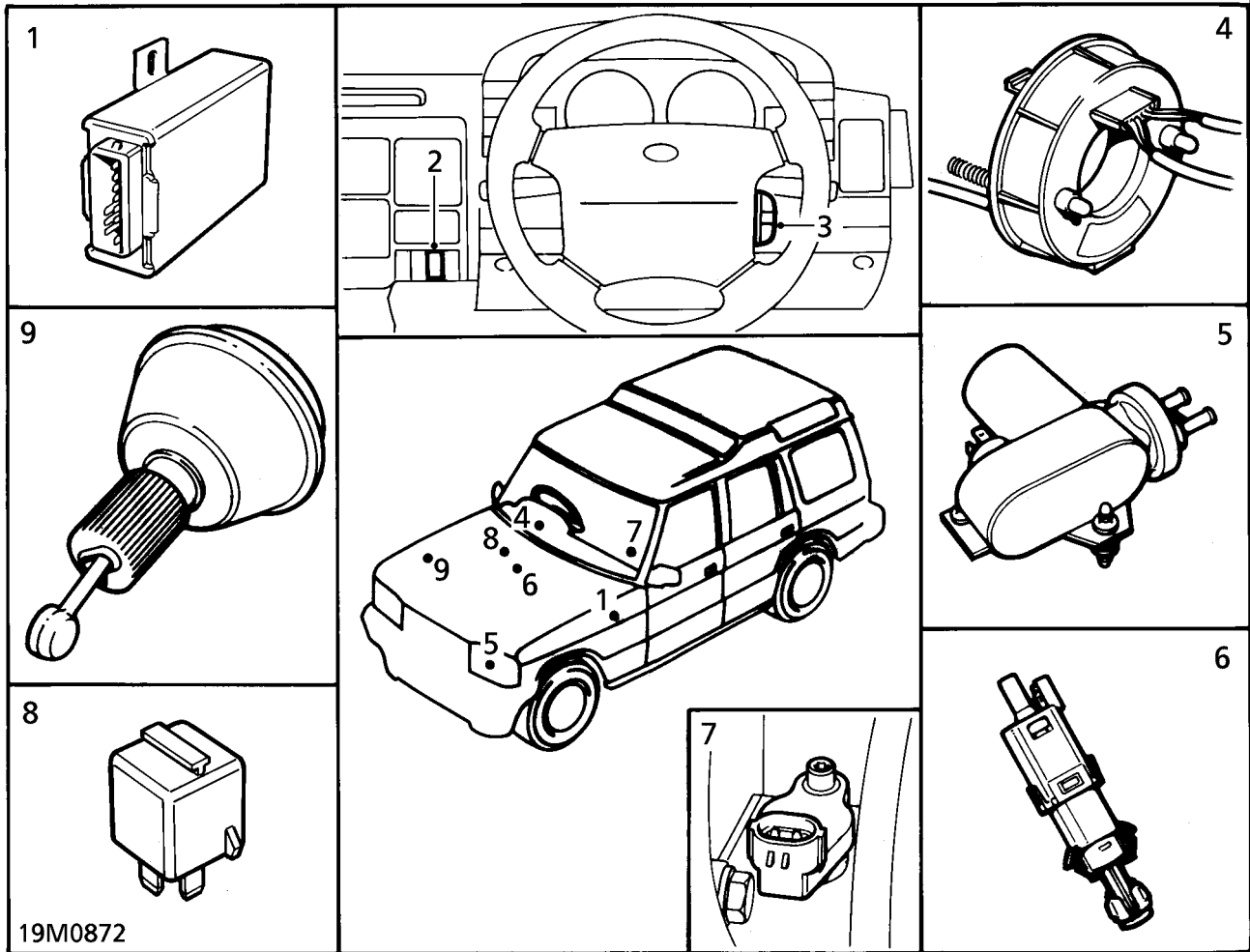
8. Clean assembly body and top cover.
9. Fit air cleaner element.
10. Position top cover and secure with clips.
11. Position air cleaner assembly to body ensuring front spigots locate securely in wing [fender] mounting rubbers and bottom mounting rubbers are located in the body.
12. Fit intake hose and secure with clip.

**Do not carry out further dismantling if component is removed for access only.**

5. Release 4 clips securing top cover.
6. Raise top cover.
7. Remove air cleaner element.



**CRUISE CONTROL COMPONENT LOCATIONS -  
Tdi AUTO EDC**



**COMPONENT**

**LOCATION**

- |    |                                  |  |
|----|----------------------------------|--|
| 1. | Cruise control unit .....        | Under LH dash                          |
| 2. | Engagement (on/off) switch ..... | Dash panel                             |
| 3. | Cruise control switch .....      | Steering wheel                         |
| 4. | Rotary coupler .....             | Steering wheel                         |
| 5. | Vacuum pump .....                | Box section under jack                 |
| 6. | Brake/vent switch .....          | Brake pedal                            |
| 7. | Vehicle speed sensor .....       | Transfer box behind transmission brake |
| 8. | Neutral lock-out relay .....     | Behind RH lower 'A' post trim casing   |
| 9. | Actuator .....                   | RH engine compartment                  |

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**CRUISE CONTROL SYSTEM - V8i/Tdi AUTO EDC**

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**Description**

The cruise control system consists of electro-mechanical devices, and comprises of the following components.

**ELECTRONIC CONTROL UNIT (ECU)**

The microprocessor based ECU evaluates the signals provided by the driver controls, brake pedal switch, clutch pedal switch on manual models, and the vehicle speed sensor. The ECU activates the vacuum pump as required. The ECU also has a memory function for set speed storage.

**Driver operated switches**

The main cruise control switch is located in the auxiliary switch panel and activates the cruise control system. The steering wheel switches provide 'set/accelerate' and 'resume/decelerate' features. These switches provide the interface between driver and cruise control system.

**Brake pedal switch**

The brake pedal switch is located under the lower dash attached to the brake pedal mounting bracket. The switch provides for fast disengagement of the cruise control system and rapid return of the throttle levers to the idle position when the brake pedal is applied.

**Clutch pedal switch**

The clutch pedal switch is located under the lower dash attached to the clutch pedal mounting bracket. The switch provides for fast disengagement of the cruise control system and rapid return of the throttle levers to the idle position when the clutch pedal is applied.

**Vehicle speed sensor**

The vehicle speed sensor is located on the side of the transfer box adjacent to park brake. The sensor provides road speed data to the ECU. The cruise control system cannot be engaged until the road speed exceeds 45 km/h, (28 mph) the system will automatically disengage at a road speed of 42 km/h (26 mph).

**Vacuum pump**

The vacuum pump is energised when the main cruise control switch is operated, and is actuated by the steering wheel and brake pedal switches. The pump provides a vacuum source to the cruise control actuator. A control valve in the pump provides for steady increase of road speed or purge of the system when the brake pedal is applied.

**Actuator**

The actuator provides the servo mechanism link between the cruise control system and throttle linkage and is operated by vacuum from the vacuum pump.

**Neutral lockout relay - automatic vehicles**

The relay module is located in the right hand side footwell, accessible by removing the trim casing.

The function of the relay module is to disengage the cruise control system if neutral, or park, is selected in the main gearbox, when the system is engaged.

**Engine speed trip ECU - Manual vehicles**

This unit is located in the right hand side footwell, accessible by removing the trim casing.

The function of the unit is to disengage cruise control if engine speed exceeds 5000 rev/min.




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**ROAD TEST**


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**CAUTION:** Do not engage cruise control when vehicle is being used in low transfer gear or reverse.



**WARNING:** The use of cruise control is not recommended on winding, snow covered or slippery roads or in heavy traffic conditions where a constant speed cannot be maintained.

1. Start engine, depress main control switch to actuate cruise control system. Accelerate to approximately 50 km/h, (30 mph), operate '**set/acc**' switch, immediately release switch, remove foot from accelerator pedal. Vehicle should maintain speed at which '**set/acc**' switch was operated.
2. Operate '**set/acc**' switch and hold at that position, vehicle should accelerate smoothly until switch is released. Vehicle should now maintain new speed at which '**set/acc**' switch was released.
3. Momentarily touch and release '**set/acc**' switch, vehicle speed should increase 1.6 km/h (1 mph) for each touch. Note that five touches will increase speed 8 km/h (5 mph).
4. Apply '**res/deccl**' switch while vehicle is in cruise control mode, cruise control should disengage. Slow to approximately 55 km/h, (35 mph) operate '**res/deccl**' switch, immediately release switch and remove foot from accelerator, vehicle should smoothly accelerate to previously set speed. Increase speed using accelerator pedal, release pedal, vehicle should return to previously set speed.



**NOTE:** The cruise control system fitted to the diesel engine is not as responsive as that fitted to the petrol engine, due to the characteristics of diesel engines. Therefore, at speeds below approx. 65 km/h (40 mph), the vehicle speed may drop when cruise is selected and then slowly regain the 'set' speed.

5. Operate brake pedal, cruise control system should immediately disengage returning vehicle to driver control at accelerator pedal. Operate '**res/deccl**' switch, vehicle should accelerate to previously set speed without driver operation of accelerator pedal.
6. Operate '**res/deccl**' switch and allow vehicle to decelerate to below 42 km/h, (26 mph). Operate '**res/deccl**' switch, cruise control system should remain disengaged.
7. Operate '**set/acc**' switch below 40 km/h, (28 mph), cruise control system should remain disengaged. Accelerate, using accelerator pedal to above 45 km/h, (28 mph), operate '**res/deccl**' switch, and remove foot from accelerator pedal, vehicle should smoothly adjust to previously memorised speed.
8. **Automatic vehicles** - select neutral, system should disengage. **Manual vehicles** - depress clutch, system should disengage.
9. Cruise at 80 km/h (50 mph), declutch, select neutral, remove foot from clutch. Operate '**res/deccl**' switch. Engine should rev to 5000 rev/min, cruise control disengages, engine returns to idle.
10. Engage forward gear. Operate '**res/deccl**' switch. Remove foot from accelerator. Speed should accelerate to previous set speed.
11. Depress main control switch in control system should immediately disengage and erase previously set speed from ECU memory. **See *Electrical Trouble Shooting Manual*.**

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**ELECTRICAL TESTS**


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Electrical functionality can be checked using TestBook.

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**CABLE SETTING - TDi AUTOMATIC MODELS**


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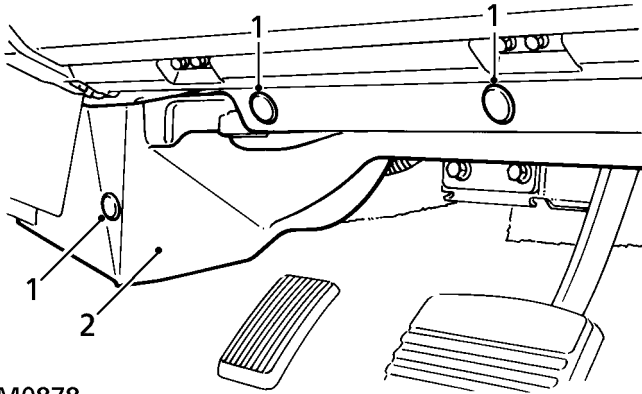
1. An incorrectly adjusted kickdown cable can prevent correct operation of the cruise control system. **See *AUTOMATIC GEARBOX, Adjustment, kickdown cable adjustment*.**



**BRAKE AND CLUTCH PEDAL SWITCHES/VENT VALVES**

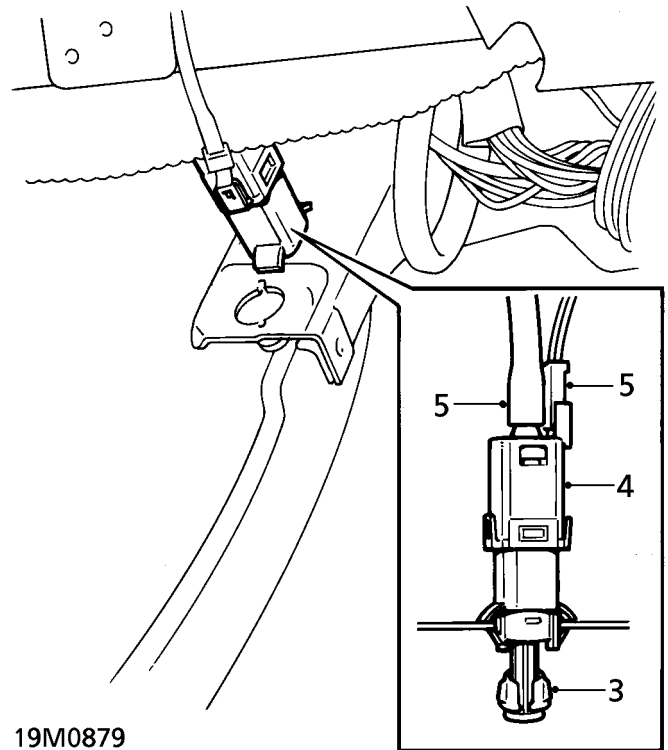
Service repair no - 19.75.34 - Clutch Switch  
 Service repair no - 19.75.35 - Brake Switch

**Remove**



19M0878

1. Remove 3 studs securing driver's side fascia closing panel.
2. Release and move closing panel aside.



19M0879

3. Locate and release locking sleeve.
4. Release switch/vent valve from pedal bracket.
5. Disconnect vacuum hose and harness connector from switch.
6. Remove switch.

**Refit**

7. Reverse removal procedure.



**NOTE: Ensure locking sleeve is correctly positioned.**

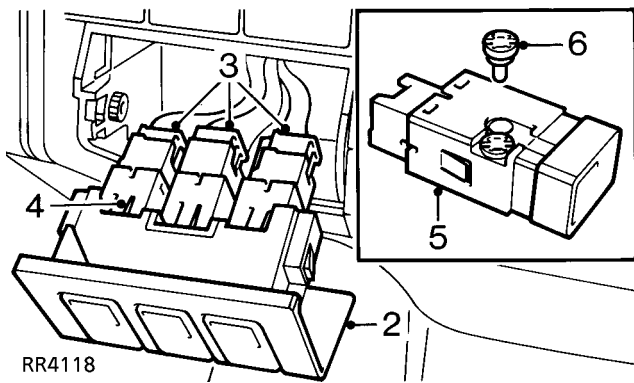
## ENGAGEMENT (ON/OFF) SWITCH

Service repair no - 19.75.30

### Switch Replacement

#### Remove

1. Disconnect battery negative lead.



2. Carefully release auxiliary switch panel from fascia.
3. Disconnect multiplug from switch.
4. Depress retaining lugs on switch, remove switch from panel.

#### Bulb replacement

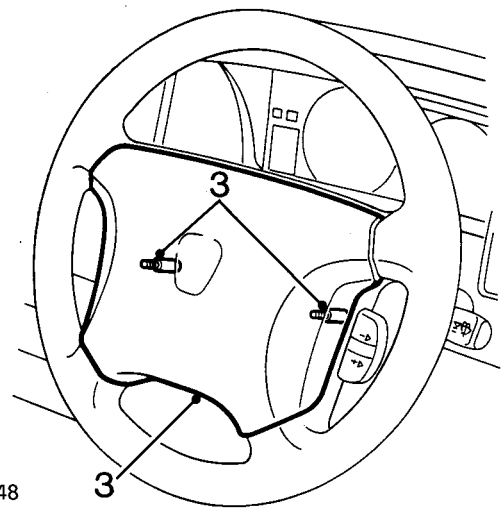
5. Position switch to facilitate removal of bulb.
6. Rotate bulb holder 90° and withdraw it from switch.

## CRUISE CONTROL SWITCH

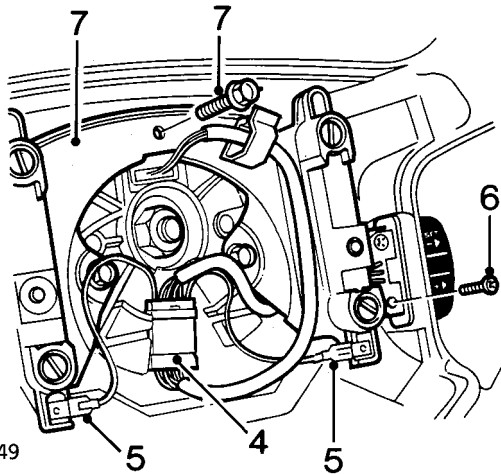
Service repair no - 19.75.36

### Remove

1. Disconnect battery negative lead.
2. **Models fitted with airbags:** Remove driver's airbag module. **See SUPPLEMENTARY RESTRAINT SYSTEM, Repair, Driver's Airbag Module**



3. **Models without airbags:** Turn steering wheel through 90°. Remove 2 Torx screws securing pad to steering wheel and remove steering wheel pad.
4. Disconnect cruise control switch multiplug from main harness.



J5449

- 5. Disconnect 2 Lucars from horn contacts.
- 6. Remove 2 screws securing cruise control switch to steering wheel.
- 7. Remove 3 bolts securing mounting bracket to steering wheel and remove mounting bracket.
- 8. Remove cruise control switch from steering wheel.

**Refit**

- 9. Reverse removal procedure. Ensuring wiring harness is routed correctly.
- 10. **Models fitted with airbags:** Refit driver's airbag module and follow all safety precautions. **See SUPPLEMENTARY RESTRAINT SYSTEM, Repair, Driver's Airbag Module**

**ROTARY COUPLER**

**Service repair no - 19.75.54**

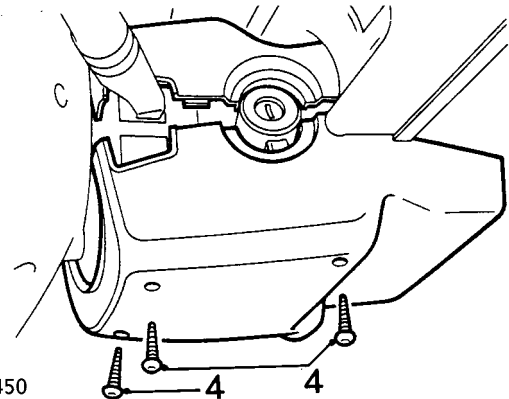
The rotary coupler is located behind the steering wheel. Access is gained by removing the steering wheel and steering column shroud.



**NOTE: On vehicles fitted with airbags. See SUPPLEMENTARY RESTRAINT SYSTEM, Repair, Rotary Coupler**

**Remove**

- 1. Disconnect battery negative lead.
- 2. Remove steering wheel. **See STEERING, Repair, Steering Wheel**
- 3. Release 2 turnbuckles securing lower dash closing panel and lower.
- 4. Remove 3 screws securing lower half of shroud to steering column.



J5450

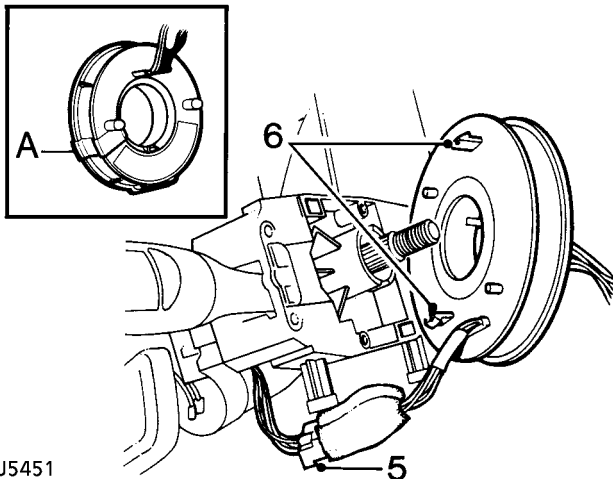
- 5. Disconnect rotary coupler multiplug from steering column harness.





**NOTE:** If rotary coupler is to be re-used a piece of adhesive tape should be placed around the moulding in position A to prevent rotation. Failure to do this may result in damage to the wires inside the coupler.

6. Release clips securing rotary coupler to column stalk assembly.
7. Remove rotary coupler from column stalk assembly.



J5451



**CAUTION:** Ensure front wheels are in the straight ahead position before removal and refitting. Store in a plastic bag. **DO NOT** rotate mechanism whilst removed.

### Refit

8. Reverse removal procedure. Ensuring that the column harnesses are not trapped by the column shroud.



**NOTE:** If original rotary coupler is to be fitted and there is evidence of tampering, it is imperative that the coupler is centralised. See *SUPPLEMENTARY RESTRAINT SYSTEM, Repair, Rotary Coupler*



**NOTE:** If a new rotary coupler is to be fitted and the sealing tape is broken it **MUST NOT** be used. Ensure rotary coupler lugs are correctly engaged in the rear of the steering wheel.

## ACTUATOR - V8i

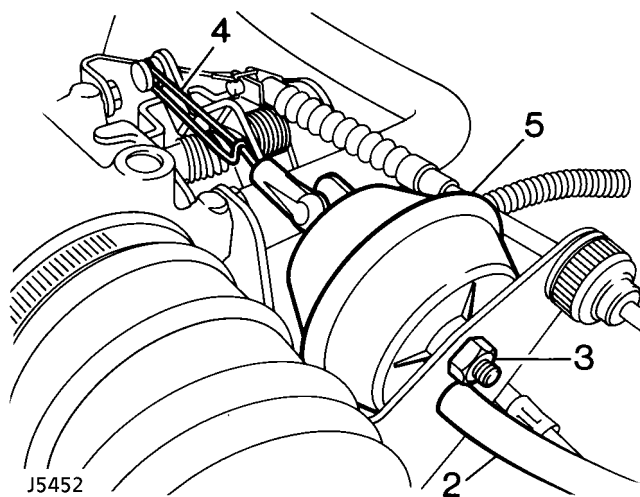
Service repair no - 19.75.12



**NOTE:** The actuator is non serviceable, fit a new unit if failure or damage occurs.

### Remove

1. Disconnect battery negative lead.
2. Disconnect vacuum hose from actuator.
3. Remove nut securing actuator to throttle bracket.
4. Remove actuator, and manoeuvre actuator operating link off throttle lever.
5. Withdraw actuator.



J5452

### Refit

6. Inspect rubber diaphragm. Fit a new actuator assembly if diaphragm is damaged.
7. Reverse removal procedure. Fitting the hook uppermost.



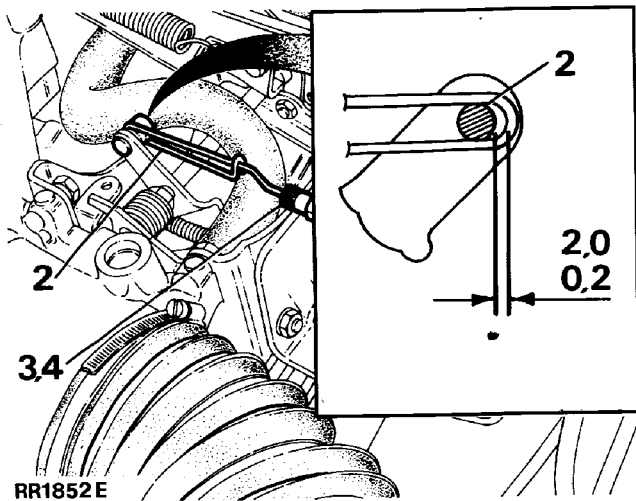
**ACTUATOR LINK-SETTING - V8i**

Service repair no - 19.75.21



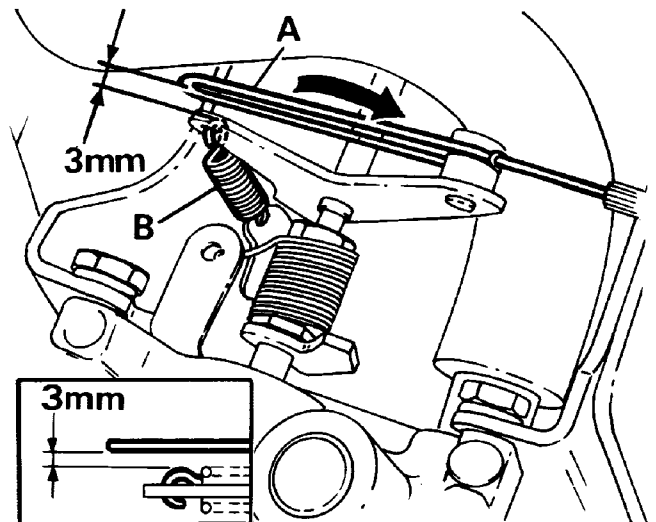
**NOTE: Setting procedure is carried out at minimum throttle condition only.**

1. Ensure ignition is switched 'OFF'.
2. Check clearance between inside edge of actuator link and recessed diameter of throttle lever. Clearance should be 0.2 to 2.0 mm.



**Link - adjust**

3. Remove link from actuator.
4. Rotate socket joint adjuster as necessary.
5. Refit link to actuator and recheck clearance between link and lever.
6. With throttle fully open, check a gap of at least 3mm exists between side of link ("A" in illustration) and side of small spring ("B" in illustration). Realign link by bending to achieve correct gap. Recheck clearance at closed throttle/open throttle. Check link slides smoothly in groove of throttle lever.



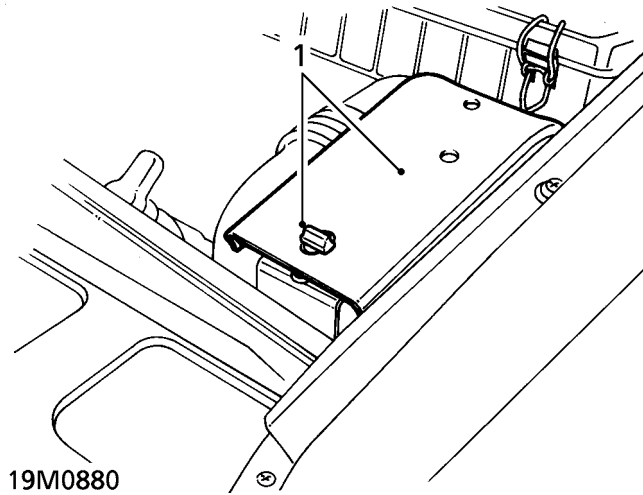
## VACUUM PUMP - TDI

Service repair no - 19.75.06



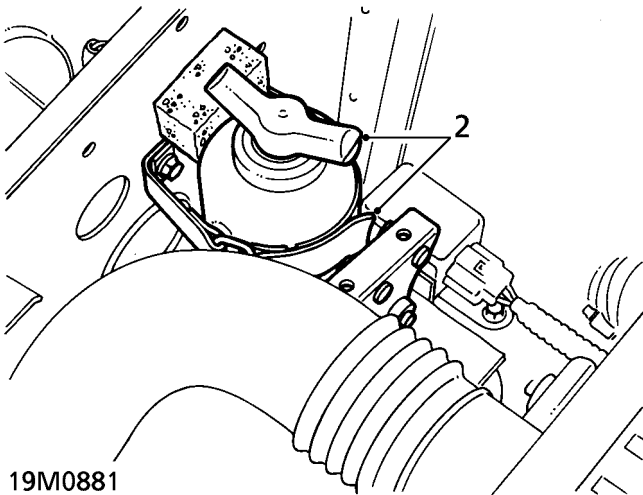
**NOTE:** The vacuum pump is non serviceable, fit a new unit if failure or damage occurs.

### Remove



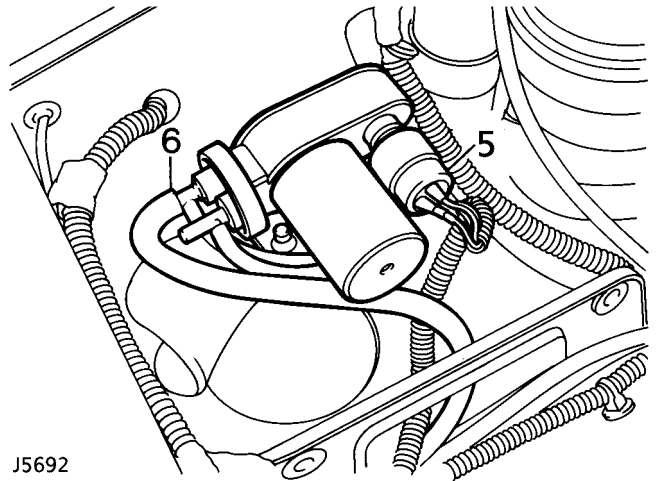
19M0880

1. Release turnbuckle securing wheel chock and remove.



19M0881

2. Release strap securing jack and remove.
3. Release 3 pump mounting rubbers from vehicle body.
4. Manoeuvre pump out of box section.



J5692

5. Release multiplug cover and disconnect multiplug from pump.
6. Disconnect vacuum hose from pump.
7. Remove pump.

### Refit

8. Reverse removal procedure. Ensure all hose and electrical connections are secure.

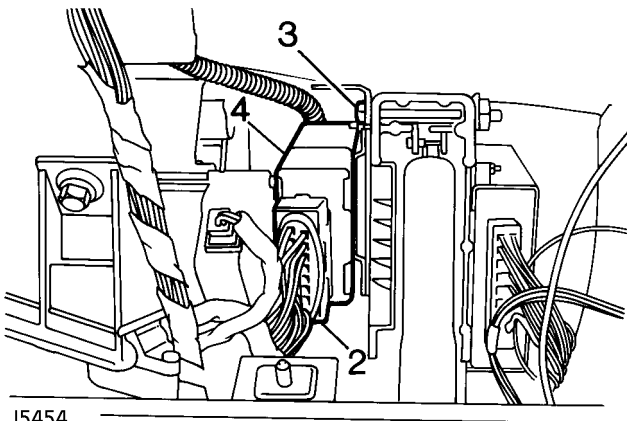


**CRUISE CONTROL ECU - V8i**

Service repair no - 19.75.49

**Remove**

1. Remove lower dash panel.



J5454

2. Disconnect ECU multi-plug.
3. Remove ECU fixing.
4. Remove ECU.
5. Reverse removal procedure. Ensuring that electrical multi-plug is securely reconnected.

**SPEED TRIP ECU - MANUAL V8i**

**NOTE:** The neutral lock out relay module/speed trip ECU is mounted in the right hand side footwell. To identify components. See *Electrical Trouble Shooting Manual*.

**VEHICLE SPEED SENSOR**

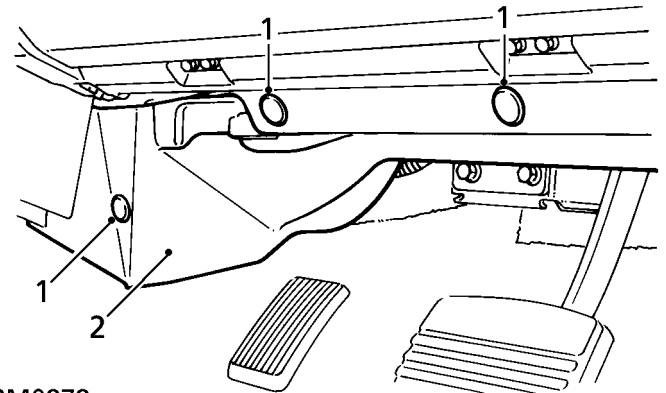
Service repair no - 18.30.22

For Tdi See *FUEL SYSTEM Tdi, Repair, Vehicle Speed Sensor*

For V8i See *FUEL SYSTEM MFI, Repair, Vehicle Speed Sensor*

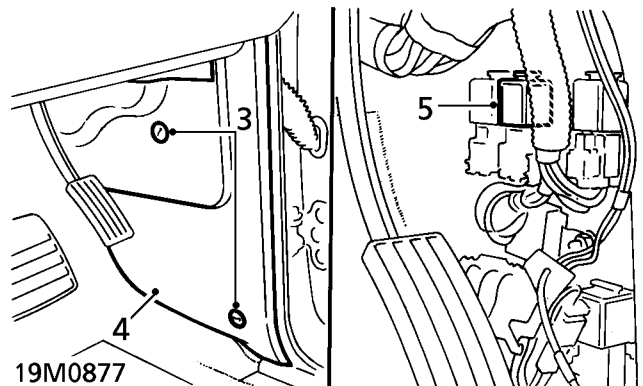
**NEUTRAL LOCK OUT RELAY**

Service repair no - 19.75.28



19M0878

1. Remove 3 studs securing fascia right hand side closing panel.
2. Release and move closing panel aside.



19M0877

3. Remove 2 studs securing right hand side 'A' post lower trim casing.
4. Remove casing.
5. Locate relay (neutral coloured base) and release base from bracket.
6. Remove relay.

**NOTE:** For further information. See *Electrical Trouble Shooting Manual*.

**Refit**

7. Reverse removal procedure.

## ACTUATOR - Tdi

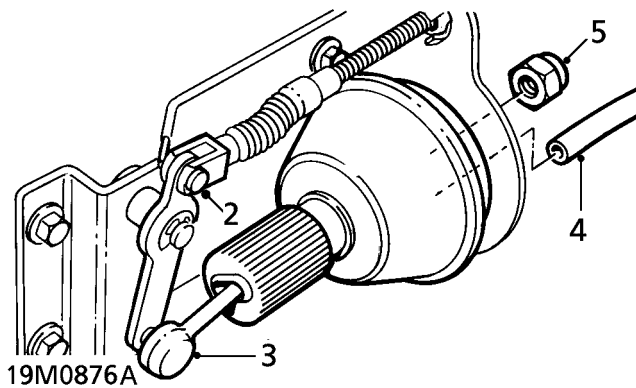
Service repair no - 19.75.05



**NOTE:** The actuator is non serviceable, fit a new unit if failure or damage occurs.

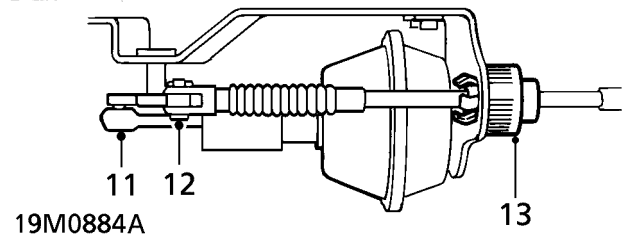
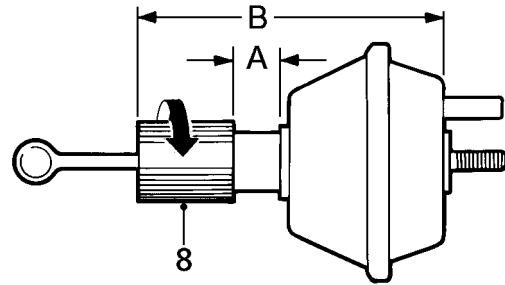
### Remove

1. Disconnect battery negative lead.



2. Remove split pin, withdraw clevis pin and disconnect cable from lever.
3. Disconnect link ball end from cable lever.
4. Disconnect vacuum hose from actuator.
5. Remove nut securing actuator to bracket and remove actuator.
6. Inspect rubber diaphragm. Fit a new actuator assembly if diaphragm is damaged.

### Refit



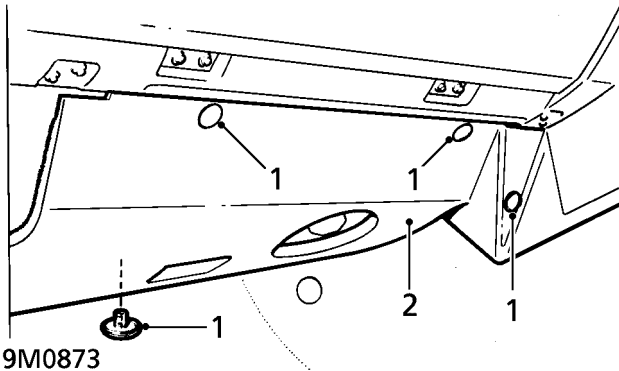
7. Check that link setting distance (dimension 'A') equals 16 mm and that the retainer is locked in position. If correct, proceed to paragraph 9.
8. If dimension 'A' is not correct, proceed as follows:
  - Measure 16 mm from diaphragm collar and mark the position.
  - Position link and retainer to the mark and rotate retainer half a turn to secure.
  - Check measurement 'A' is still 16 mm, then turn retainer a further quarter turn to lock.
9. Fit actuator and secure to bracket with nut.
10. Connect vacuum hose.
11. Connect link ball end to cable lever.
12. Connect cable to lever and secure with clevis pin and split pin.
13. Adjust cable position to remove any free play from link, setting dimension 'B' should be 103 mm.



**CRUISE CONTROL ECU - Tdi**

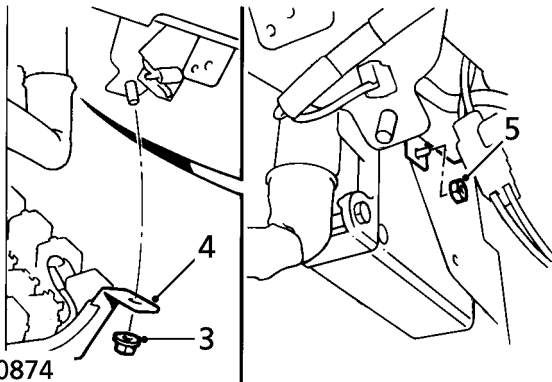
Service repair no - 19.75.49

**Remove**



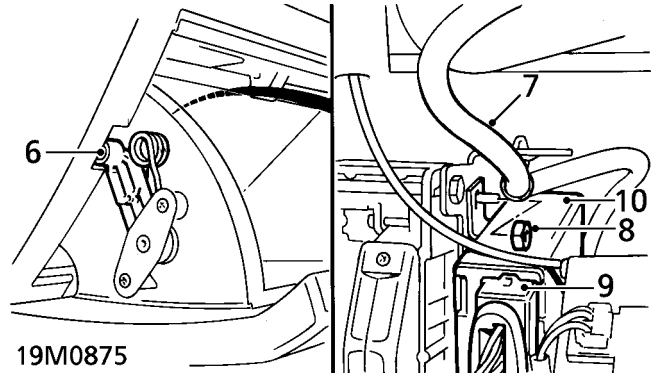
19M0873

1. Remove 4 studs securing fascia left hand closing panel.
2. Remove closing panel.



19M0874

3. Remove nut securing ECU/relay bracket.
4. Lower bracket for access.
5. Remove bottom nut securing ECU to bracket.



19M0875

6. Open glove box, align stops with cut-outs in fascia panel and lower.
7. Move SRS harness aside.
8. Remove top nut securing ECU to bracket.
9. Disconnect ECU multiplug.
10. Remove ECU.

**Refit**

11. Reverse removal procedure. Ensure electrical multiplug is securely reconnected.

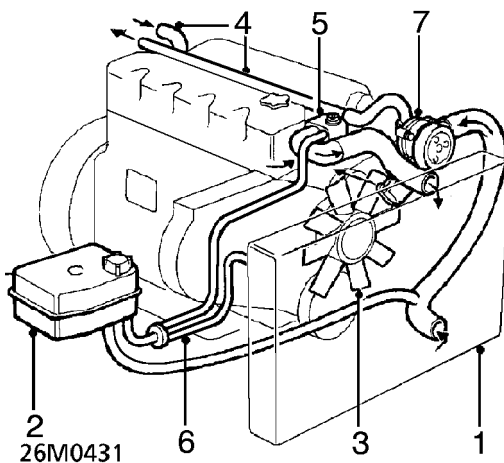


## ENGINE COOLING

### Description

The Tdi engine uses a pressurized cooling system and cross flow radiator which is supplied from a separate header tank. The radiator assembly is in three sections. The largest section is for engine coolant and the other two sections which are cast in aluminium, are the engine oil cooler and the turbo charger intercooler.

A belt driven viscous fan and centrifugal water pump is located in the front of the cylinder block. Hot coolant is supplied to the heater through hoses. Two small diameter air purge hoses connect the top of the radiator and cylinder head water gallery, to the header tank.



### Coolant circulation (engine cold)

1. Cross flow radiator
2. Header tank
3. Viscous fan
4. Heater hoses
5. By pass hose and engine thermostat
6. Air purge hoses
7. Coolant pump

## COOLANT CIRCULATION

### Operation

When the engine is started from cold the thermostat prevents any coolant circulation through the radiator by closing off the top hose. During the engine warm up period, the water pump, pumps coolant towards the rear of the cylinder block around each of the cylinders. Coolant as it is heated rises through ports in the cylinder block and head gasket, into the cylinder head. The coolant flows forwards to the thermostat, by-pass port and radiator top hose connection.

#### Start from cold (thermostat closed)

While the thermostat is closed, coolant circulates around the cylinder block and cylinder head via the by-pass.

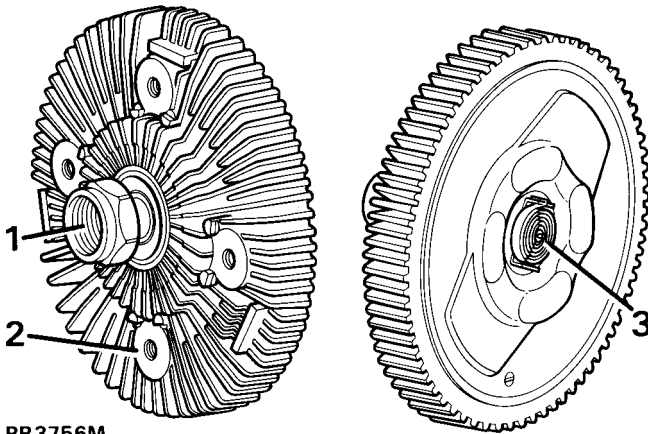
#### Engine warm (thermostat open)

When the engine reaches normal running temperature the thermostat closes off the by-pass and opens the flow to the top of the radiator.

## VISCOUS FAN

### Description

The viscous drive unit for the engine cooling fan, provides a means of controlling the speed of the fan relative to the running temperature of the engine. The viscous unit is a type of fluid coupling, which drives the fan blades through the medium of a special 'silicone fluid' injected into the unit during manufacture.



RR3756M

1. Drive in from water pump spindle
2. Drive out to fan blades
3. Bi-metal

### Operation

The viscous unit consists of two principal components: An inner member 1 which is secured to water pump spindle and is driven by the fan belt.

An outer member 2 which has the fan blades attached, houses the working parts and is driven through the medium of the viscous fluid.

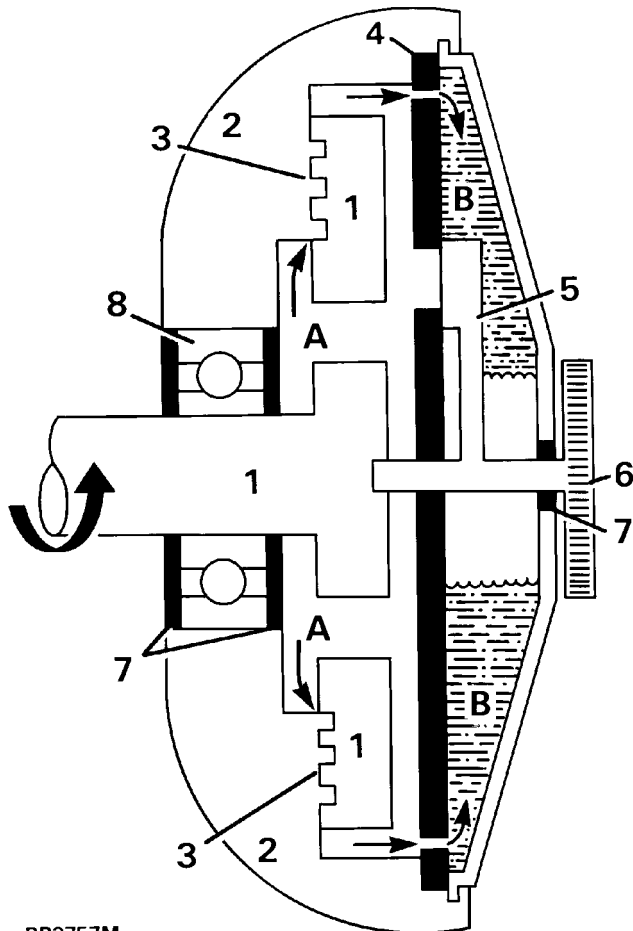
The inner and outer members have interlocking annular grooves machined in each, with a small running clearance 3 to allow the silicone fluid to circulate through the valve plate 4.

The unit also contains a valve 5 which is controlled by an external bi-metal thermostat 6.

### Starting engine from cold

During the time the engine is at rest the silicone fluid drains down, half filling chambers A and B. Thus when the engine is first started sufficient fluid is present in chamber A to provide a positive drive between the members, as is evident by the initial noise of the fan. However within a very short period of time, after starting the engine, the fan speed and noise will decline indicating that the fluid is being centrifuged into chamber B (as seen in RR3757M) causing the drive to slip.





RR3757M

#### Viscous unit slipping (Engine at normal running temperature)

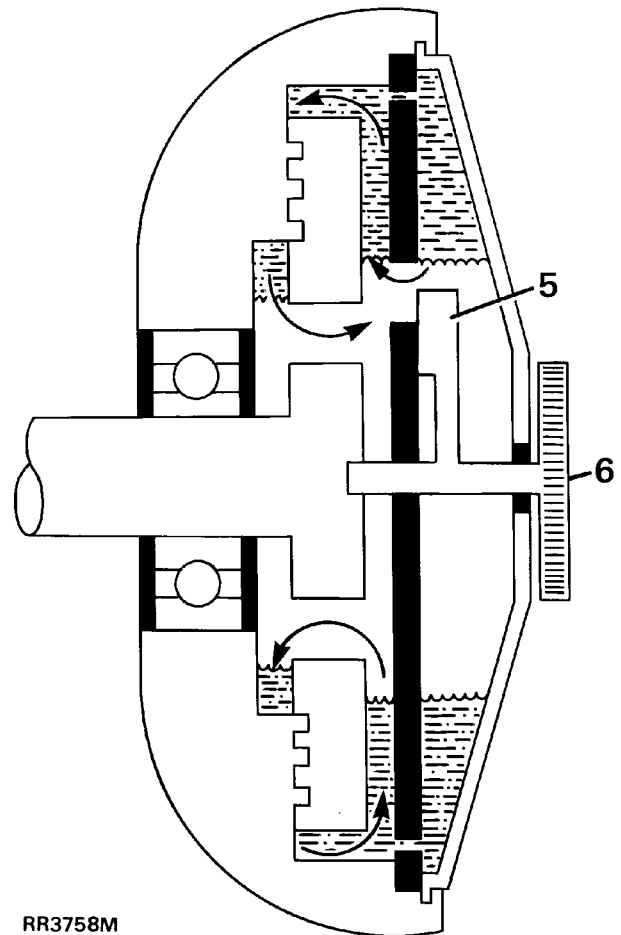
1. Inner member (drive in fast)
2. Outer member (drive out slow)
3. Running clearance
4. Valve plate
5. Valve (closed)
6. Bi-metal
7. Fluid seals
8. Ball race
- A Fluid chamber
- B Fluid chamber

If the engine speed is increased the degree of slip will also increase to limit the maximum fan speed.

#### Hot conditions

When operating in high ambient temperatures or when stationary in traffic, the bi-metal thermostat will operate and open the valve port between chambers A and B.

Opening the valve (as shown in RR3758M) allows the fluid to circulate between the two members, causing the unit to couple, thus increasing the fan speed and cooling effect.



RR3758M

#### Viscous unit coupled (Hot running conditions)

Bi-metal expanded, valve (open)



## ENGINE OVERHEATING

Before conducting any cooling system diagnosis: **See Description and operation, Engine Cooling**

1. Is coolant level correct?  
NO - Allow engine to cool, top up level to expansion tank seam.  
YES - Continue.
2. Is drive belt tension correct?  
NO - **See ENGINE, Repair, Compressor Drive Belt**  
YES - Continue.
3. Is coolant in radiator frozen?  
YES - Slowly thaw and drain system. **See Adjustment, Coolant**  
NO - Continue.
4. Is air flow through radiator restricted or blocked?  
YES - Apply air pressure from engine side of radiator to clear obstruction.  
NO - Continue.
5. Are there any external leaks, from water pump, engine gaskets, fast idle thermostat or the heater unit?  
YES - Investigate and rectify. **See Adjustment, Coolant**  
NO - Continue.
6. Are fan blades fitted correct way round, concave side towards engine?  
NO - Rectify.  
YES - Continue
7. Is viscous unit operating correctly? **See Description and operation, Viscous Fan**  
NO - Renew. **See Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl**  
YES - Carry out a pressure test on radiator cap and system. Check thermostat type, operation and correct fitting. **See Repair, Thermostat**

If pressure test leads you to suspect coolant leakage across gaskets, go to check 10, otherwise: Continue.

8. Are the air conditioning fans operating correctly?  
**See Electrical Trouble Shooting Manual.**  
NO - Rectify.  
YES - Continue.
9. Is temperature sender and gauge giving accurate readings?  
NO - Substitute parts and compare readings.  
YES - Continue.
10. Carry out cylinder pressure test to determine if pressure is leaking into cooling system causing over pressurising and loss of coolant.

If problem is not diagnosed, check the coolant system for engine oil contamination and engine lubrication system for coolant contamination.

If only the coolant system is contaminated suspect a cylinder head gasket.

If both systems are contaminated, suspect the radiator.

If only the lubrication system is contaminated with coolant, suspect leakage past cylinder liner seals or cylinder head gasket.

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**ENGINE RUNS COLD**

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Before conducting any cooling system diagnosis: **See Description and operation, Engine Cooling**

1. Check operation of viscous unit. **See Description and operation, Viscous Fan**  
Is viscous unit operating correctly?  
NO - **See Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl**  
YES - Continue.
2. Is thermostat correct type and operating? **See Repair, Thermostat**  
If problem is not diagnosed: Continue.
3. Are the air conditioning fans operating continuously?  
YES - **See Electrical Trouble Shooting Manual.**  
NO - Continue.
4. Is temperature sender and gauge giving accurate readings? Substitute parts and compare readings. If problem is not diagnosed repeat tests, starting at 1.



## COOLANT

Service repair no - 26.10.01

### Draining



**WARNING:** Do not remove any caps or plugs when the engine is hot. The cooling system is pressurised and personal scalding could result.

1. Remove expansion tank filler cap.
2. Disconnect bottom hose from radiator and allow coolant to drain into a container. Ensure container is clean if reusing coolant.



**NOTE:** When expansion tank has emptied, remove thermostat housing plug to assist drainage. Similarly when coolant level is below top of radiator, remove radiator plug.

3. Reconnect hose after draining and tighten hose clamp.

### Refit



**CAUTION:** In order to expel ALL air from the cooling system, follow the procedures carefully.

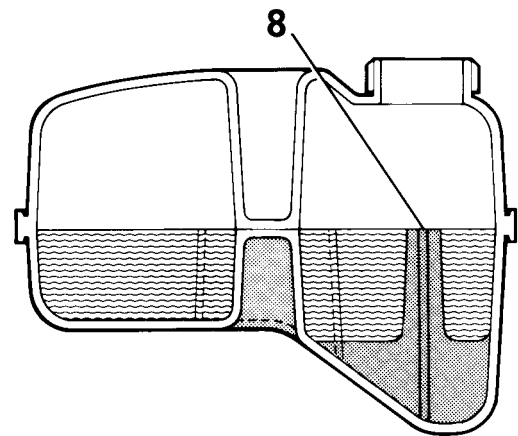


**NOTE:** Refill procedure is slow but can be accelerated by squeezing hoses to assist removal of air from the system.

4. Add correct mix of coolant into expansion tank until radiator is full (as seen through plug hole on top of radiator). **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Anti-Freeze**



**CAUTION:** Take care to avoid excess coolant spillage from radiator.



RR2897A

5. Fit radiator plug.
6. Continue adding coolant into expansion tank until coolant appears in thermostat housing.



**CAUTION:** Take care to avoid excess coolant spillage from thermostat housing.

7. Fit thermostat housing plug.
8. Check coolant in expansion tank is level with indicator post. Add more coolant if necessary.
9. Start engine and run for 5 minutes.
10. Allow engine to cool, check coolant level in expansion tank; top up to level indicator post if necessary.
11. Fit expansion tank filler cap.



## VISCOUS COUPLING, FAN BLADES, PULLEY AND FAN COWL

Service repair no - 26.25.03/05

Viscous coupling	- <b>Remove</b> 1 to 3
Fan blades	- <b>Remove</b> 1 to 4
Fan cowl	- <b>Remove</b> 1 to 3
Fan pulley	- <b>Remove</b> 1 to 6

### Remove



**WARNING: Disconnect battery negative terminal to prevent engine being started before removing or adjusting drive belt.**

- Slacken nut securing viscous coupling/fan blade assembly to pulley.



**NOTE: Nut securing viscous unit to pulley has a left hand thread. Release by turning clockwise when viewed from front of viscous unit.**

- Drop viscous unit and fan assembly into bottom of cowl
- Remove two fixings clips from top of cowl and lift cowl complete with viscous unit and fan out of lower mountings.
- Remove fan blades from viscous coupling if necessary.
- Remove serpentine drive belt and, if fitted, air conditioning compressor belt.
- Remove pulley fixings, remove pulley.



**NOTE: The serpentine belt is removed by using a hexagonal socket and tommy bar on the auto-tensioning pulley nut. Whilst tensioning the device the belt can be removed.**

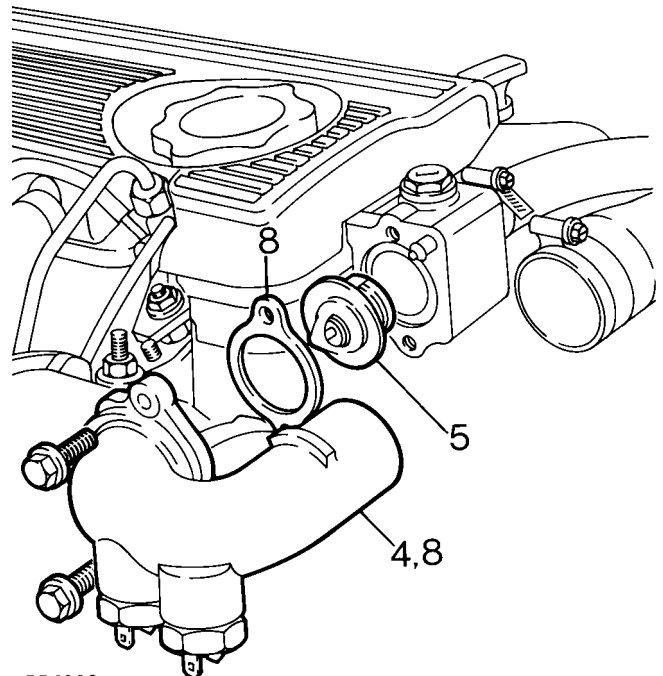
- Reverse removal procedure. Ensure fan blades are fitted correctly. Fan is marked 'front' and should be fitted with word 'front' closest to radiator. Tighten to **30 Nm**.
- Refit drive belt. **See ENGINE, Repair, Drive Belt**

## THERMOSTAT

Service repair no - 26.45.01

### Remove

- Partially drain cooling system, until coolant level is below thermostat housing.
- Disconnect hose from thermostat housing.
- Disconnect electrical connections to water temperature switch.



RR4223

- Remove outlet elbow.
- Withdraw thermostat.

### Test

- Note rating of thermostat is 88°C. Place thermostat in a container half full of water. Heat water, observe temperature at which thermostat begins to open. Thermostat is satisfactory if its open between 85°C and 89°C.

### Refit

- Insert thermostat with jiggle pin/vent hole upper most (12 o'clock position).
- Fit the outlet elbow and new joint washer. Tighten to **28 Nm**.
- Reverse removal procedure. 1 to 3.
- Check for coolant leaks around all connections and joint faces.

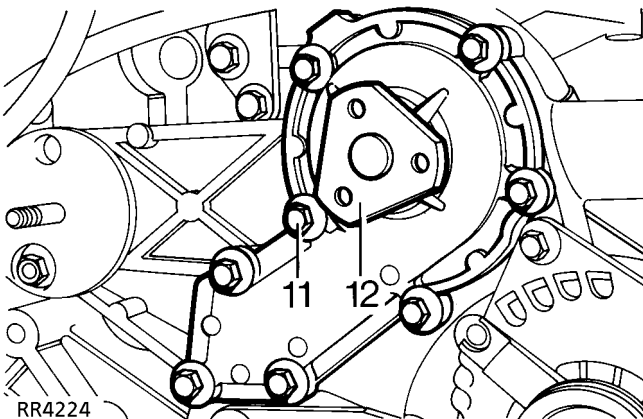
**WATER PUMP**

Service repair no - 26.50.01

**Remove**

**WARNING: Disconnect battery negative terminal to prevent engine being started before removing drive belts.**

1. Drain engine cooling system. *See Adjustment, Coolant*
2. Remove top hose radiator to thermostat.
3. Remove top hose intercooler to induction manifold.
4. Slacken water pump and power steering pump pulley retaining bolts.
5. Remove drive belt.
6. Remove centre nut from belt tensioner.
7. Manoeuvre pulley upwards and withdraw tensioner from retaining stud.
8. Disconnect hose thermostat to bottom hose, release hose from clip on water pump and move aside.
9. Remove water pump pulley.
10. Remove power steering pump pulley.



11. Remove 8 bolts securing water pump, noting location of 3 through bolts.
12. Withdraw pump and gasket, clean all gasket material from mating surfaces.

**Refit**

13. Refit water pump in reverse order to removal using new gasket.

**RADIATOR**

Service repair no - 26.40.01

**Remove**

1. Drain cooling system. *See Adjustment, Coolant*
2. Disconnect radiator top hose.
3. Remove fan blade assembly.
4. Remove cowl.
5. Disconnect engine oil cooler connections and turbo intercooler connections from radiator ends.



**NOTE: Oil spillage will occur when connections are loosened. Blank off exposed oil connections.**

6. Disconnect expansion tank bleed hose from radiator.
7. Remove radiator securing brackets from each side.
8. Remove radiator unit by lifting from its location. Check condition of rubber mounting pads.

**Refit**

9. Check radiator sealing strips are securely located.
10. Transfer oil cooler adaptors if fitting new radiator.
11. Reverse removal procedure. Tighten oil cooler connections to **30 Nm** before fitting fan blades and cowl.
12. Check all connections for leaks.



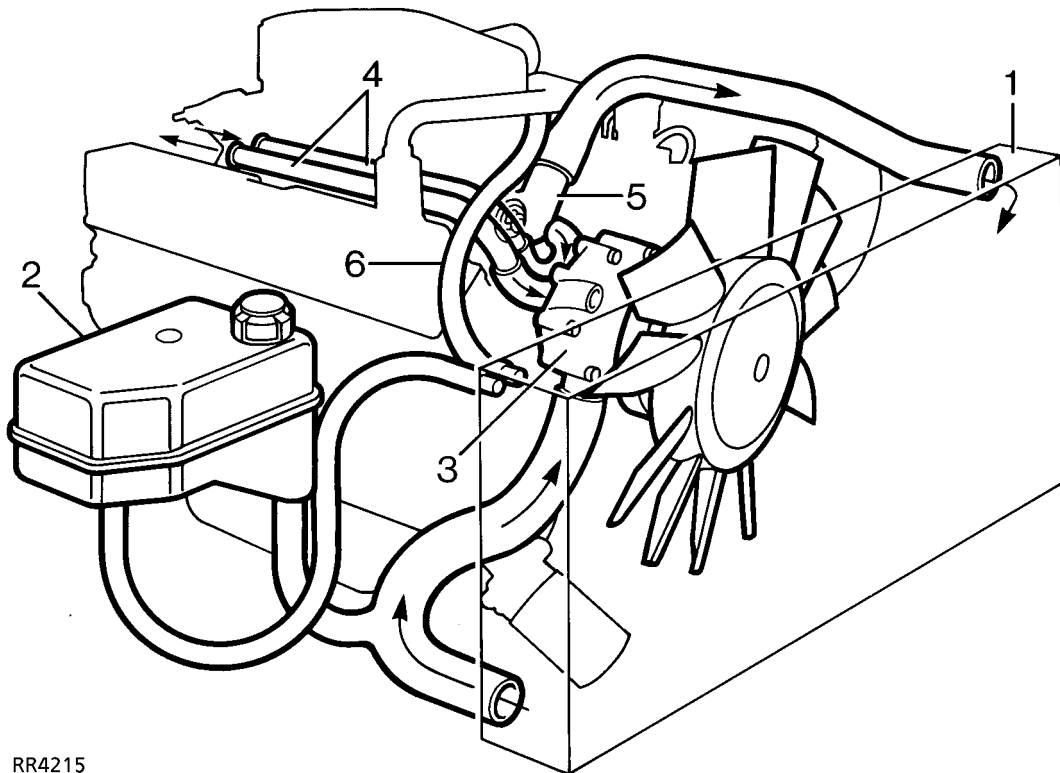
## ENGINE COOLING

### Description

The V8i engine uses a pressurised cooling system and cross flow radiator which is supplied from a separate header tank. The coolant radiator also incorporates a section at the left hand end for cooling the transmission oil and a section at the other end for cooling the engine oil.

The belt driven viscous fan and centrifugal water pump is located in the engine front cover with ports for circulation of coolant to both banks of cylinders and cylinder heads. Coolant returns to the top of the radiator via ports in the inlet manifold where the thermostat is mounted horizontally.

Coolant also circulates through the vehicle heating system and is used to heat air entering the inlet manifold plenum chamber.



RR4215

### Coolant circulation (engine hot)

1. Cross flow radiator
2. Header tank
3. Viscous fan and water pump
4. Heater pipes
5. Plenum chamber connection
6. Thermostat

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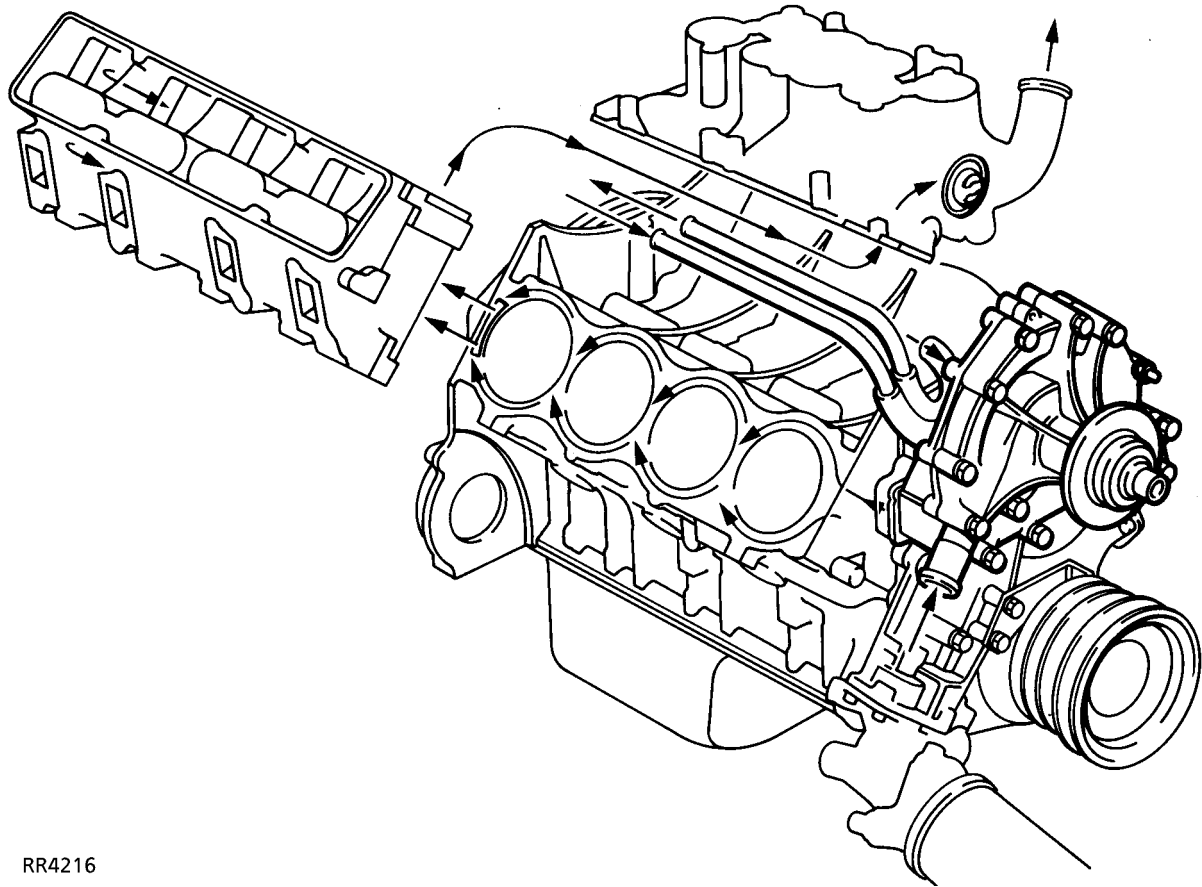
**COOLANT CIRCULATION**

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**Operation**

When the engine is started from cold the thermostat prevents any coolant circulation through the radiator by closing off the top hose. During the engine warm up period, the water pump, pumps coolant around the cylinders to the rear of the cylinder block along the main galleries in both cylinder banks. At the rear of the cylinder block the coolant rises through a large port in each cylinder head/block joint face, and then flows forward to connect with ports at the front of the inlet manifold. From the manifold the coolant is carried by an external pipe to the heater unit and from the heater through another external pipe to the pump inlet.

The coolant circulation through the cylinder block and heads, does not change when normal running temperature is reached and the thermostat opens. But with the thermostat open, coolant flows through the top hose to the radiator where it is cooled and drawn back into the pump via the bottom hose.



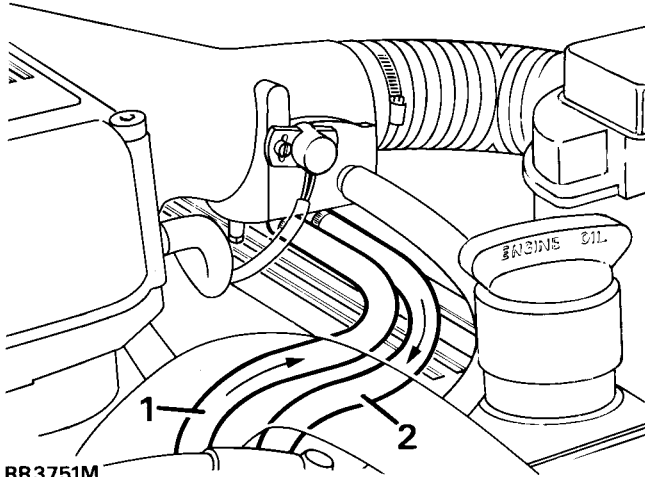
RR4216





### Plenum chamber heating

Air entering the plenum chamber is heated by a flow of coolant from the inlet manifold which returns through a long hose, to the top right corner of the radiator.



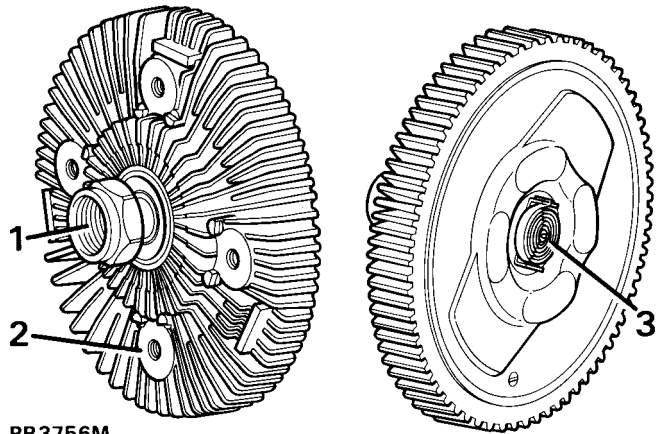
RR3751M

1. Hot water supply
2. Cold return to radiator

### VISCOUS FAN

#### Description

The viscous drive unit for the engine cooling fan, provides a means of controlling the speed of the fan relative to the running temperature of the engine. The viscous unit is a type of fluid coupling, which drives the fan blades through the medium of a special 'silicone fluid' injected into the unit during manufacture.



RR3756M

1. Drive in from water pump spindle
2. Drive out to fan blades
3. Bi-metal

### Operation

The viscous unit consists of two principal components:  
An inner member 1 which is secured to water pump spindle and is driven by the fan belt.

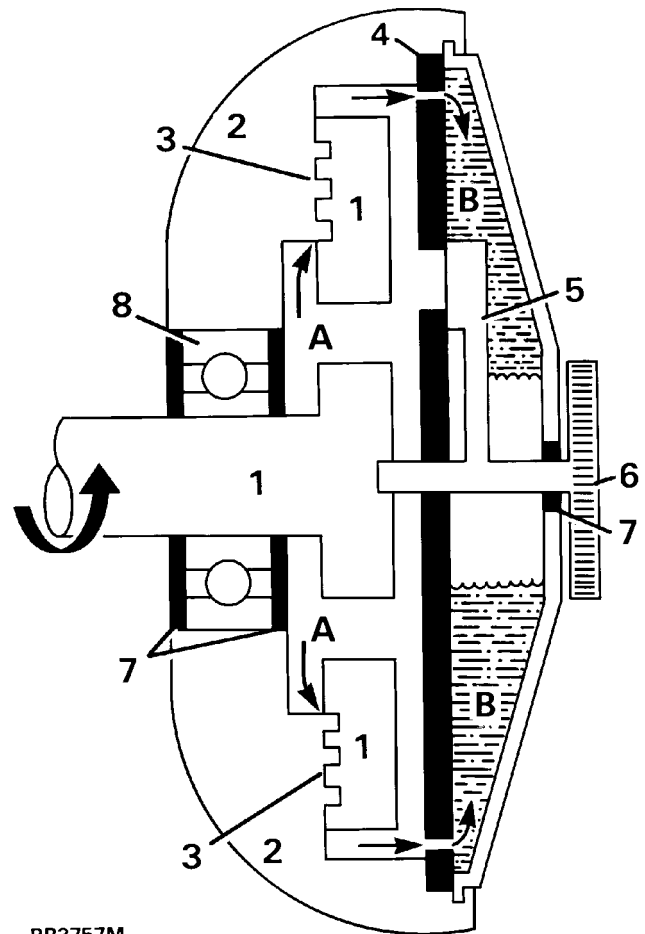
An outer member 2 which has the fan blades attached, houses the working parts and is driven through the medium of the viscous fluid.

The inner and outer members have interlocking annular grooves machined in each, with a small running clearance 3 to allow the silicone fluid to circulate through the valve plate 4.

The unit also contains a valve 5 which is controlled by an external bi-metal thermostat 6.

### Starting engine from cold

During the time the engine is at rest the silicone fluid drains down, half filling chambers A and B. Thus when the engine is first started sufficient fluid is present in chamber A to provide a positive drive between the members, as is evident by the initial noise of the fan. However within a very short period of time, after starting the engine, the fan speed and noise will decline indicating that the fluid is being centrifuged into chamber B (as seen in RR3757M) causing the drive to slip.



RR3757M

### Viscous unit slipping (Engine at normal running temperature)

1. Inner member (drive in fast)
2. Outer member (drive out slow)
3. Running clearance
4. Valve plate
5. Valve (closed)
6. Bi-metal
7. Fluid seals
8. Ball race
- A. Fluid chamber
- B. Fluid chamber

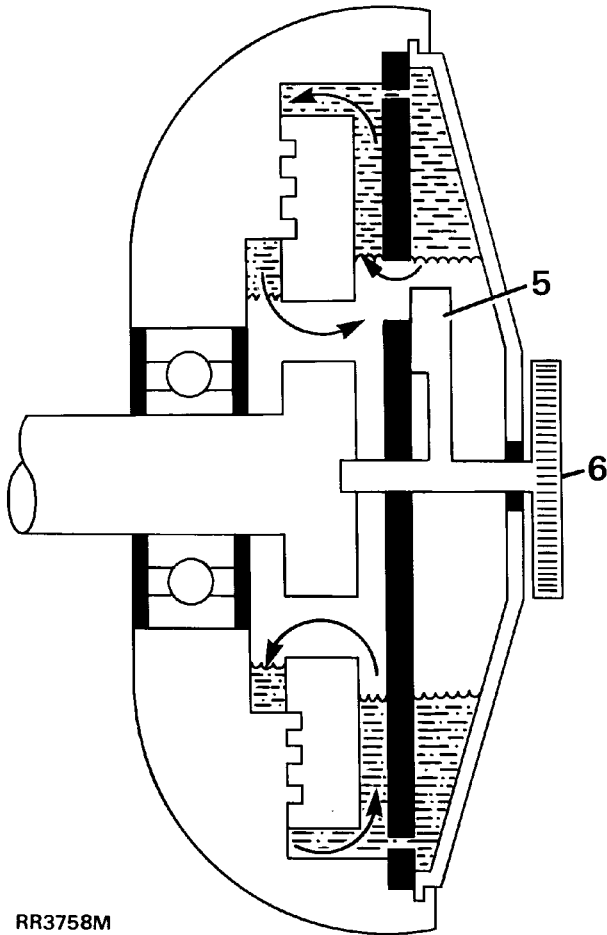
If the engine speed is increased the degree of slip will also increase to limit the maximum fan speed.



### Hot conditions

When operating in high ambient temperatures or when stationary in traffic, the bi-metal thermostat will operate and open the valve port between chambers A and B.

Opening the valve (as shown in RR3758M) allows the fluid to circulate between the two members, causing the unit to couple, thus increasing the fan speed and cooling effect.



### Viscous unit coupled (Hot running conditions)

Bi-metal expanded, valve (open)



## ENGINE OVERHEATING

Before conducting any cooling system diagnosis: **See Description and operation, Engine Cooling**

1. Is coolant level correct?  
NO - Allow engine to cool, top up level to expansion tank seam.  
YES - Continue.
2. Is drive belt tension correct?  
NO - **See ENGINE, Repair, Drive Belt - Check Tension**  
YES - Continue.
3. Is ignition timing correct?  
NO - **See ELECTRICAL, Adjustment, Ignition Timing**  
YES - Continue.
4. Is coolant in radiator frozen?  
YES - Slowly thaw and drain system. **See Adjustment, Coolant Requirements**  
NO - Continue.
5. Is air flow through radiator restricted or blocked?  
YES - Apply air pressure from engine side of radiator to clear obstruction.  
NO - Continue.
6. Are there any external leaks, from water pump, engine gaskets or the heater unit?  
YES - Investigate and rectify. **See Adjustment, Coolant Requirements**  
NO - Continue.
7. Are fan blades fitted correct way round, concave side towards engine?  
NO - Rectify.  
YES - Continue.
8. Is viscous unit operating correctly? **See Description and operation, Viscous Fan**  
NO - Renew. **See Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl**  
YES - Carry out a pressure test on radiator cap and system. Check thermostat type, operation and correct fitting **See Repair, Thermostat**  
If pressure test leads you to suspect coolant leakage across gaskets, go to check 11, otherwise: Continue.
9. Are the air conditioning fans operating correctly? **See Electrical Trouble Shooting Manual.K5**  
NO - Rectify.  
YES - Continue.
10. Is temperature sender and gauge giving accurate readings?  
NO - Substitute parts and compare readings.  
YES - Continue.
11. Carry out cylinder pressure test to determine if pressure is leaking into cooling system causing over pressurising and loss of coolant.

If problem is not diagnosed, check the coolant system for engine oil contamination and engine lubrication system for coolant contamination.

If the coolant only, or both systems are contaminated, suspect cylinder head gaskets or radiator.

If only the lubrication system is contaminated with coolant, suspect inlet manifold or front cover gaskets.

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**ENGINE RUNS COLD**

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Before conducting any cooling system diagnosis: **See Description and operation, Engine cooling**

1. Check operation of viscous unit. **See Description and operation, Viscous Fan**  
Is viscous unit operating correctly?  
NO - **See Repair, Viscous coupling, fan blades, pulley and fan cowl**  
YES - Continue.
2. Is thermostat correct type and operating? **See Repair, Thermostat**  
If problem is not diagnosed: Continue.
3. Are the air conditioning fans operating continuously?  
YES - **See Electrical Trouble Shooting Manual.**  
NO - Continue.
4. Is temperature sender and gauge giving accurate readings? Substitute parts and compare readings. If problem is not diagnosed repeat tests, starting at 1.



## COOLANT REQUIREMENTS

### Frost precautions and engine protection.

Cooling system **MUST ALWAYS** be filled and topped-up with solution of water and anti-freeze, winter and summer. **NEVER** use water alone, this may corrode aluminium alloy.



**CAUTION:** Do not use salt water otherwise corrosion will occur. In certain territories where only available natural water supply has some salt content use only rain or distilled water.

### Recommended solutions

**Anti-freeze:** Universal anti-freeze or permanent type ethylene base, without methanol, containing a suitable inhibitor for aluminium engines and engine parts.

Use one part of anti-freeze to one part of water.

Anti-freeze can remain in the cooling system and will provide adequate protection for two years provided that specific gravity of coolant is checked before onset of second winter and topped-up with new anti-freeze as required.

Vehicles leaving factory have cooling system filled with 50% solution of anti-freeze and water. This gives protection against frost down to minus 36°C (minus 33°F). Vehicles so filled are identified by a label affixed to radiator.



**NOTE:** Should ambient temperatures be below that stated above refer to Anti-Freeze Data in Recommended Lubricants, Fluids and Capacities in Section 09. Instructions in chart must be strictly adhered to before driving vehicle.

After the second winter the system should be drained and thoroughly flushed. Before adding new anti-freeze examine all joints and replace defective hoses to make sure that the system is leakproof.

See the 'Recommended Lubricants Fluids and Capacities' for protection quantities. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**

## COOLANT

Service repair no - 26.10.01

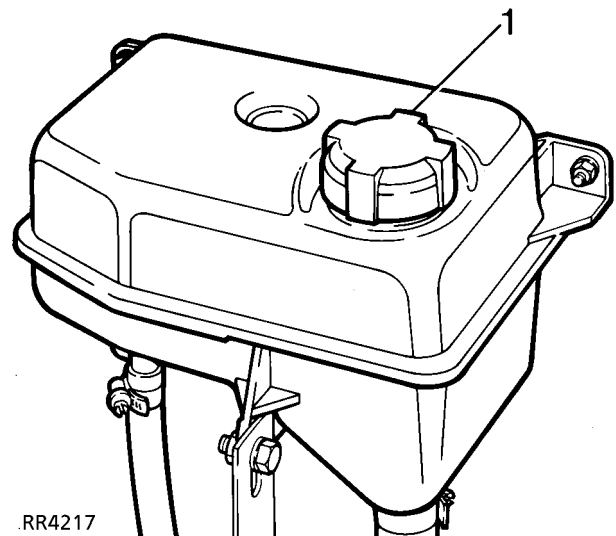
### Draining



**WARNING:** Do not remove expansion tank filler cap when engine is hot. The cooling system is pressurised and personal scalding could result.

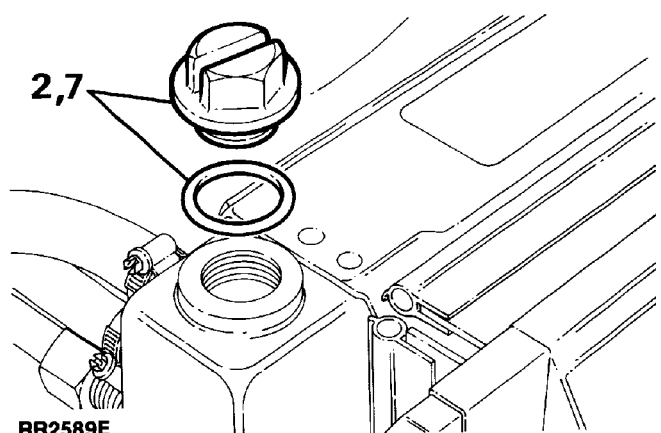
See coolant requirements before refilling system.

1. Remove expansion tank filler cap by slowly turning it anti-clockwise, pause to allow pressure to escape. Continue turning it in same direction and remove.



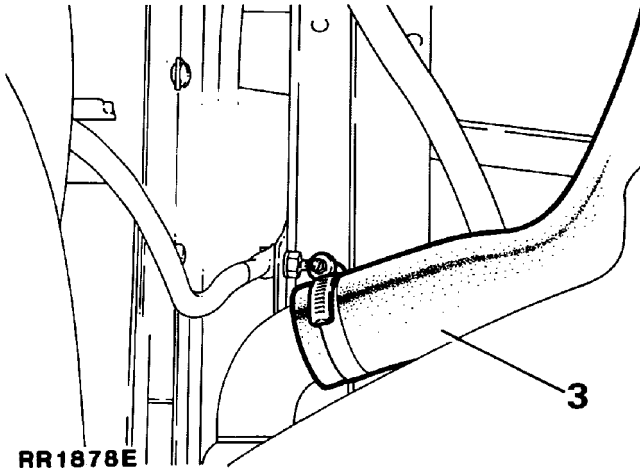
RR4217

2. Remove radiator filler plug and 'O' ring to assist drainage.



RR2589E

3. Disconnect bottom hose from radiator. Drain coolant into a clean container. Reconnect bottom hose, re-tighten hose clamp.

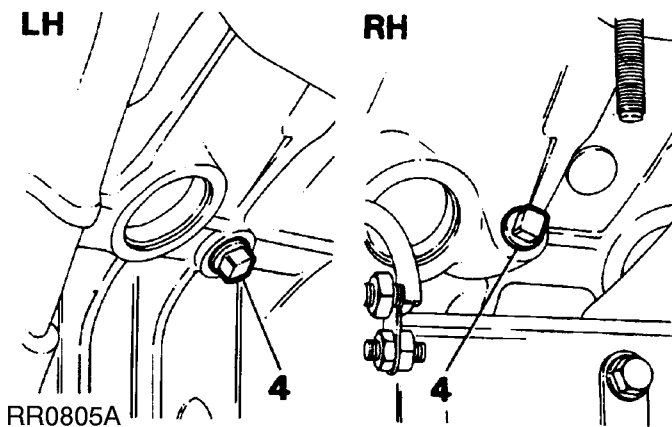


5. Pour correct solution of water and anti-freeze into expansion tank until radiator is full.
6. Start engine, run it until normal operating temperature is attained, topping up as necessary.
7. Refit radiator filler plug and 'O' ring, with new 'O' ring if required. Tighten to **6 Nm**.
8. Fit expansion tank filler cap.
9. Allow engine to cool, check coolant level. Finally top up expansion tank until level reaches seam of expansion tank.



**NOTE:** It is not possible to drain all coolant retained in heater system. It is not desirable to flush through system, after draining.

4. Remove engine drain plugs, one each side of cylinder block, beneath exhaust manifolds. Drain coolant, refit and tighten plugs.





## EXPANSION TANK

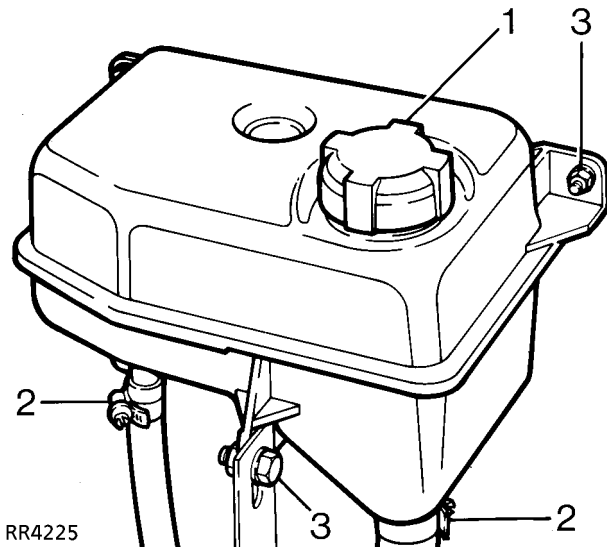
Service repair no - 26.15.01

### Remove



**WARNING:** Do not remove expansion tank filler cap when engine is hot. The cooling system is pressurised and personal scalding could result.

1. Remove expansion tank filler cap by first turning it slowly anti-clockwise, pause to allow pressure to escape. Continue turning in same direction and lift off.
2. Disconnect two hoses from bottom of expansion tank, allowing coolant to drain into a suitable container.
3. Remove three fixing bolts, remove expansion tank.



### Refit

4. Reverse removal procedure.
5. Replenish cooling system.
6. Check for leaks around all hose connections.

## VISCOUS COUPLING, FAN BLADES, PULLEY AND COWL

Service repair no - 26.25.19 - Viscous coupling and fan assembly

Service repair no - 26.25.03 - Water pump pulley

Service repair no - 26.25.05 - Fan blades

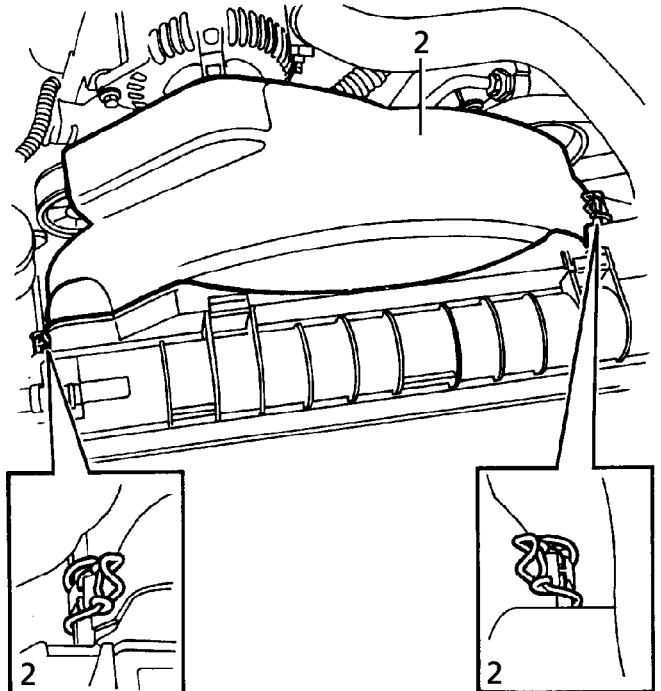
### Special tools:

LRT-12-093

LRT-12-094 - Viscous coupling removal

### Remove

1. Disconnect battery negative lead.

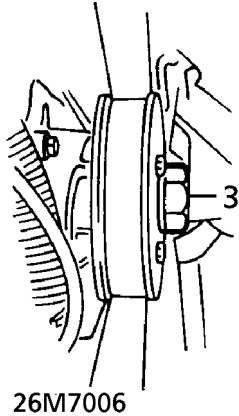


### NOTE: 4.0 V8 only:

Release coolant hose from cooling fan upper cowl.

2. Release 2 clips securing cooling fan upper cowl. Remove cowl.



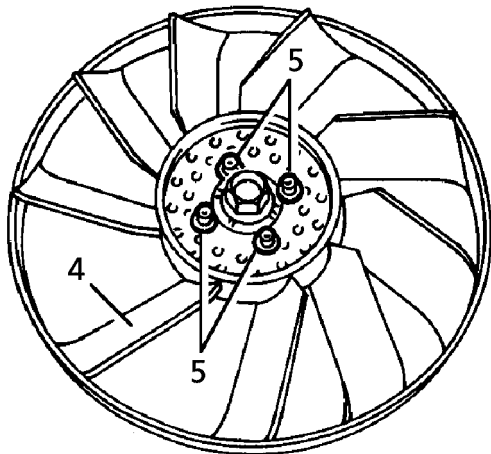


3. Use LRT-12-093 to prevent coolant pump pulley from turning and using LRT-12-094, unscrew viscous coupling from water pump.



**NOTE:** Nut securing viscous unit to water pump has a right hand thread. Release by turning anti-clockwise when viewed from front of viscous unit.

4. Remove fan and coupling assembly.



*Do not carry out further dismantling if component is removed for access only.*



**NOTE:** Mark fan with reference to assist refitting.

5. Remove 4 Allen screws securing blades to coupling. Remove coupling.
6. Remove serpentine drive belt.
7. Remove pulley fixings, remove pulley.

#### Refit

8. Clean fan blades and mating faces.
9. Fit fan blades to coupling. Secure with screws. Tighten to **24 Nm**.
10. Using LRT-12-093 and LRT-12-094, fit fan assembly to pump. Tighten to **56 Nm**.
11. Fit cooling fan upper cowl. Secure with clips.
12. **4.0 V8 only:** Fit coolant hose to cooling fan upper cowl.
13. Fit serpentine drive belt.
14. Fit pulley fixings, remove pulley.
15. Reconnect battery negative lead.

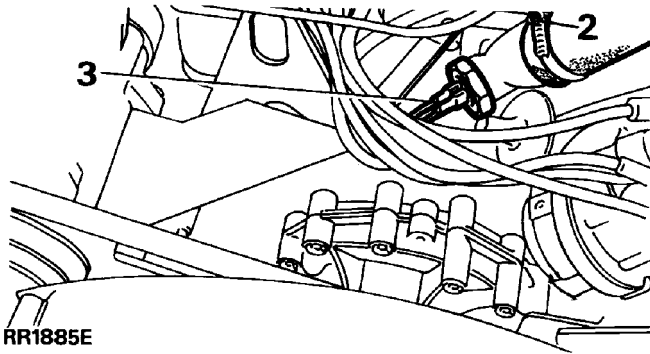


## THERMOSTAT

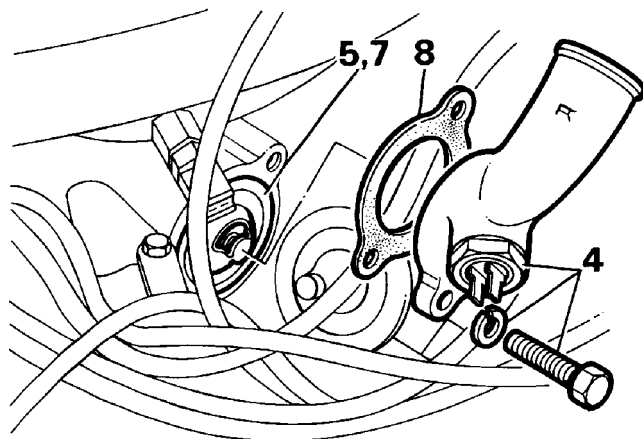
Service repair no - 26.45.01

### Remove

1. Partially drain cooling system, until coolant level is below thermostat housing.
2. Disconnect hose from thermostat housing.
3. Disconnect electrical connections to water temperature switch.



4. Remove outlet elbow.
5. Withdraw thermostat.



RR1792E

### Test

6. Note rating of thermostat is 88°C. Place thermostat in a container half full of water. Heat water, observe temperature at which thermostat opens. Thermostat is satisfactory if it opens between 85°C and 89°C.

### Refit

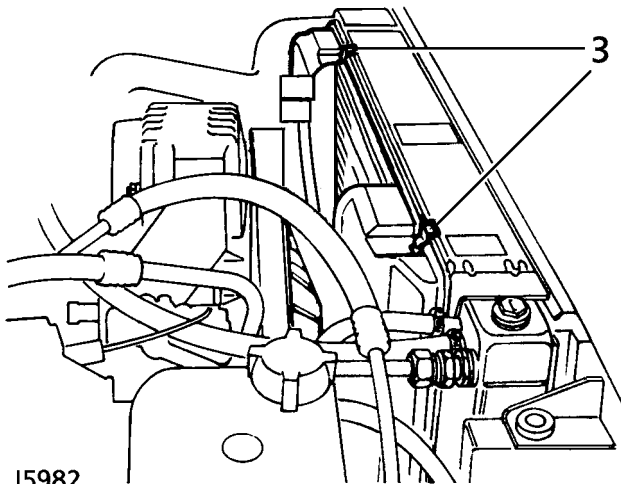
7. Insert thermostat with jiggle pin/vent hole uppermost (12 o'clock position).
8. Fit the outlet elbow and new joint washer. Tighten to **28 Nm**.
9. Reverse removal procedure. 1 to 3.
10. Check for coolant leaks around all connections and joint faces.

## RADIATOR

Service repair no - 26.40.01

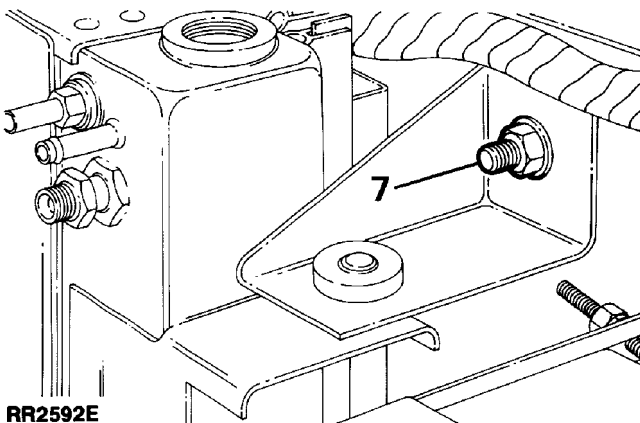
## Remove

1. Drain cooling system. *See Adjustment, Coolant*
2. Remove viscous coupling and fan assembly. *See Viscous Coupling, Fan Blades, Pulley and Fan Cowl*



J5982

3. Release 2 clips and remove fan cowl.
4. Disconnect radiator top hoses.
5. Disconnect four transmission and engine oil cooler connections to radiator end tanks. Note oil spillage will occur when connections are loosened. Blank off exposed oil connections.
6. Disconnect transmission oil temperature sensor.

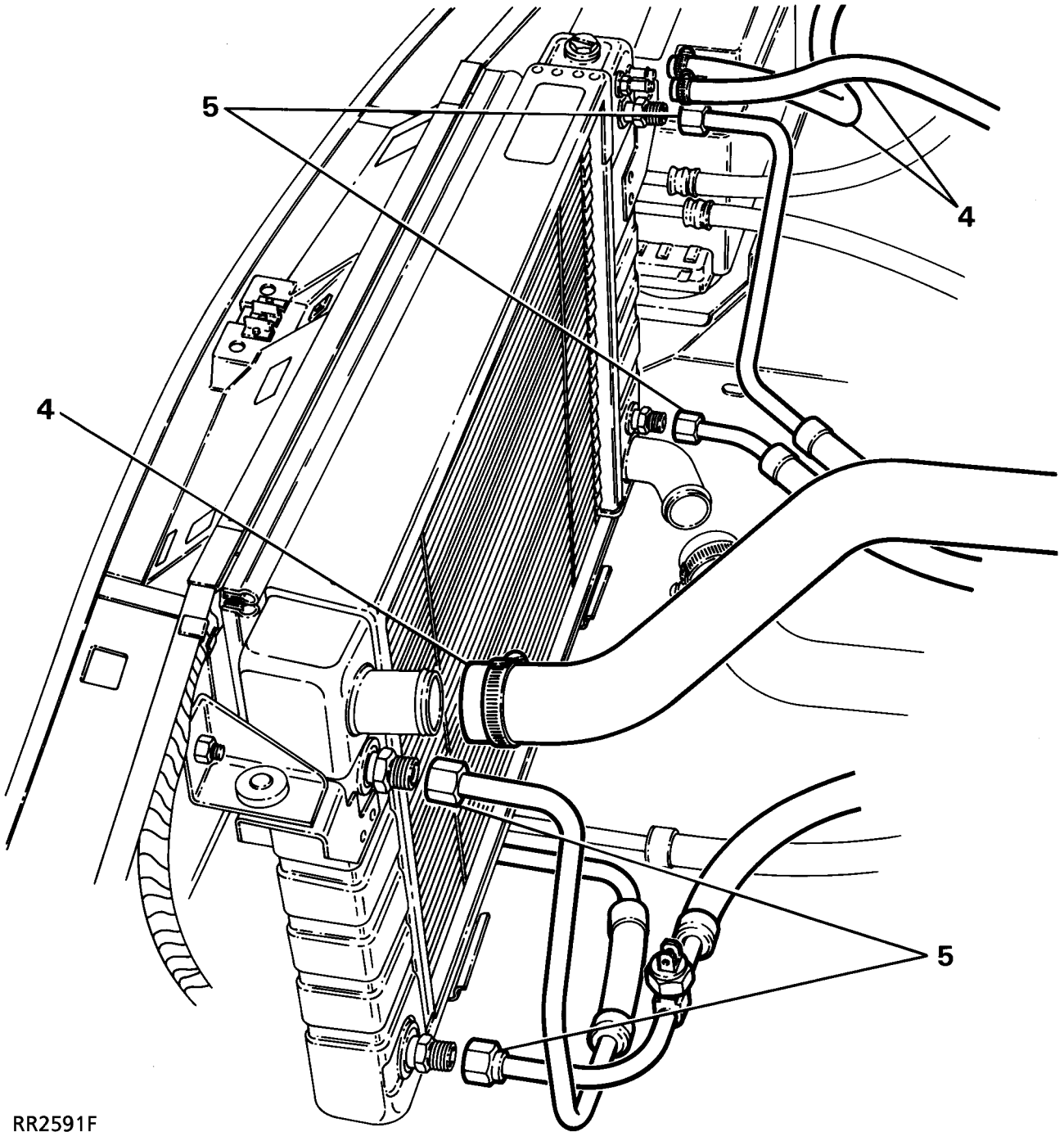


RR2592E

7. Remove radiator securing brackets from each side.
8. Remove radiator unit by lifting from its location. Check condition of rubber mounting pads.

## Refit

9. Reverse removal procedure.
10. Clean unions and apply sealant.
11. Lubricate new 'O' rings before fitting.
12. Check radiator sealing strips are securely located.
13. Transfer oil cooler adaptors if fitting new radiator.
14. Ensure that oil cooler connections are tightened to **30 Nm**. before fitting fan blades and cowl.
15. Clean coolant/oil spillage from vehicle.
16. Check all connections for coolant/oil leaks.



RR2591F

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**WATER PUMP**

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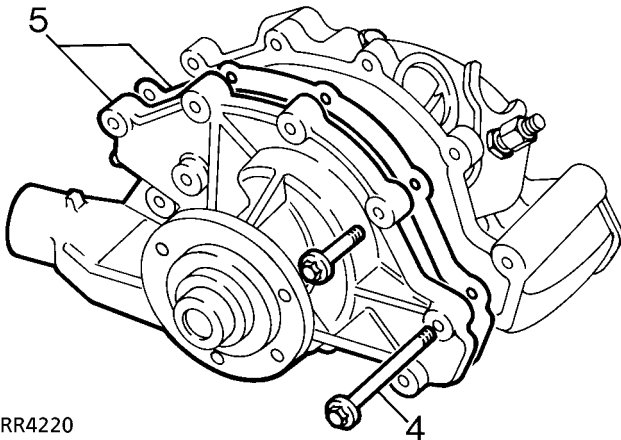
Service repair no - 26.50.01

Remove



**WARNING:** Disconnect battery negative terminal to prevent engine being started before removing or adjusting drive belts.

1. Drain engine cooling system. *See Adjustment, Coolant*
2. Remove fan blades and pulley. *See Viscous Coupling, Fan Blades, Pulley and Fan Cowl*
3. Disconnect inlet hose from water pump.
4. Remove water pump bolts.
5. Remove water pump and joint washer.



RR4220

Refit

6. Lightly grease new joint washer, position on timing cover.
7. Clean threads of all long bolts and coat with Loctite 572 thread lubricant-sealant.
8. Locate water pump in position. Tighten remaining water pump housing bolts evenly to **28 Nm**.
9. Reverse removal procedure. 1 to 3.
10. Check for coolant leaks around all hose connections and joint faces.



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**TORQUE VALUES**

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**NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.**

	<b>Nm</b>
Oil cooler pipes .....	30
Radiator filler plug (plastic) .....	6



## COOLANT PUMP

Service repair no - 26.50.01

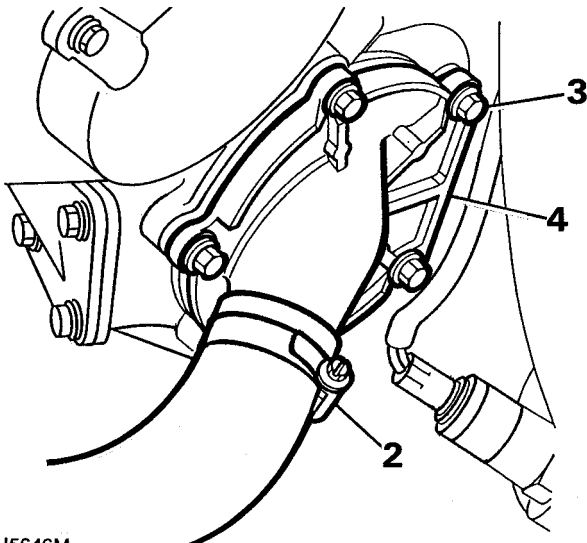
### Remove

1. Position drain tin below coolant pump hose.



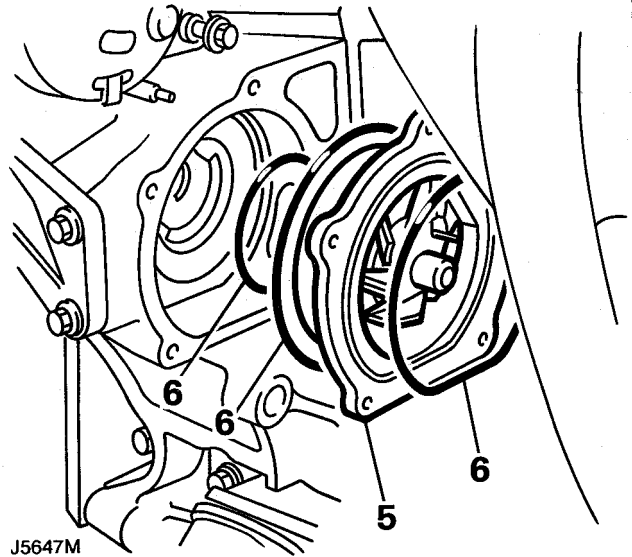
**WARNING:** Do not carry out the next instruction until the coolant is cool to avoid personal injury from scalding.

2. Release clip and disconnect hose from coolant pump housing cover.
3. Remove 5 bolts securing housing cover.
4. Remove housing cover.



J5646M

5. Remove coolant pump from housing.
6. Discard 3 sealing rings.



J5647M

### Refit

7. Clean coolant pump housing and mating faces.
8. Lubricate new sealing rings with Loctite 405 and fit to coolant pump.
9. Fit coolant pump to housing.
10. Position housing cover, fit 5 bolts. Tighten to **25Nm**
11. Connect hose to housing cover and tighten clip.
12. Refill cooling system.

## RADIATOR

Service repair no - 26.40.01

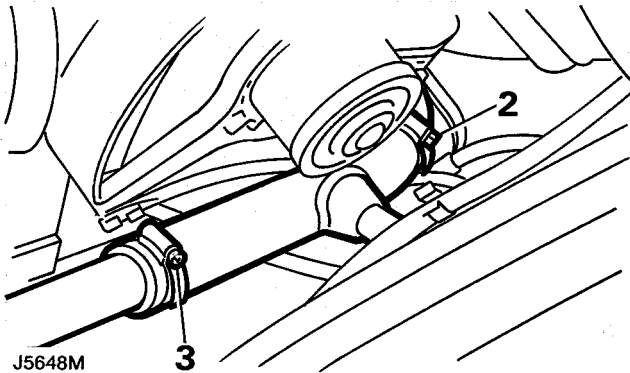
## Remove

1. Disconnect battery negative lead.

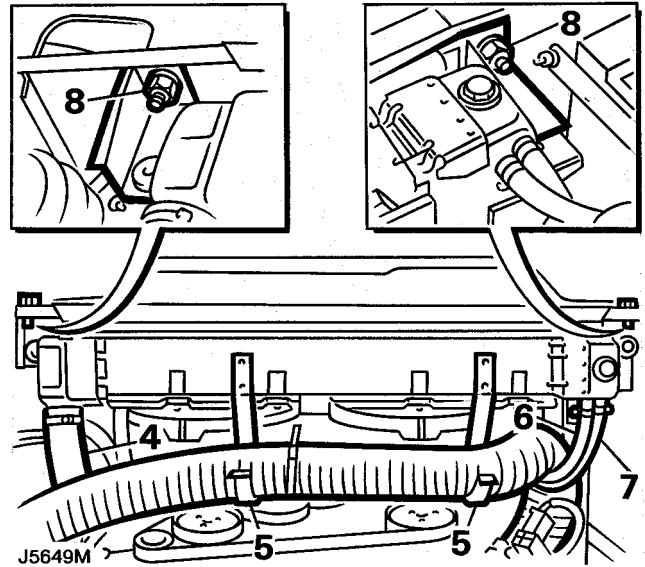


**WARNING:** Do not carry out the next instruction until the coolant is cool to avoid personal injury from scalding.

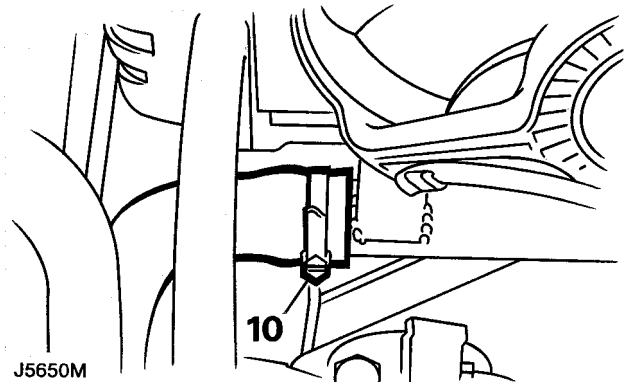
2. Slacken clip and release bottom hose from radiator, allow coolant to drain into a suitable container
3. Slacken clip and release bottom hose from radiator rail.



4. Slacken clip and release top hose from radiator.
5. Release air cleaner to throttle housing hose from securing brackets.
6. Slacken clip and release bypass hose from radiator.
7. Slacken clip and release top expansion hose from radiator.
8. Remove 2 bolts securing radiator side support brackets.
9. Collect L.H. support bracket and position R.H. support bracket aside.

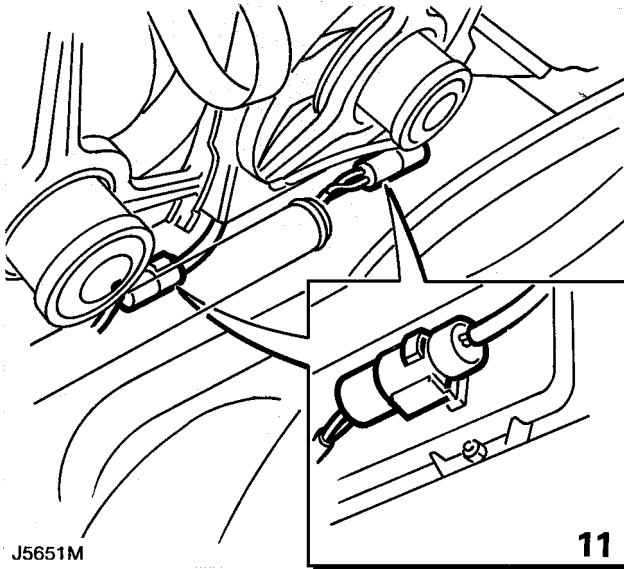


10. Slacken clip and release heater hose from radiator rail.



11. Disconnect 2 multiplugs from cooling fan assemblies.



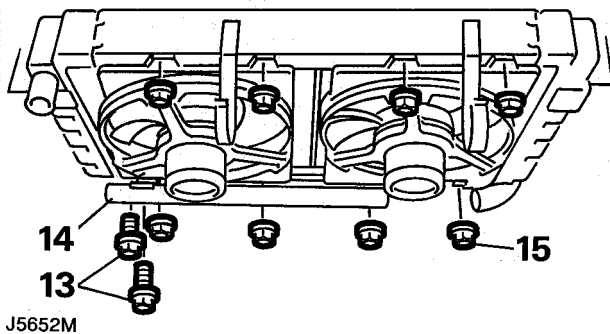


12. With assistance lift out radiator assembly.

***Do not carry out further dismantling if component is removed for access only.***

13. Remove 2 bolts securing radiator rail to radiator.  
 14. Remove radiator rail.  
 15. Remove 8 nuts securing fan assemblies to radiator.

**NOTE:** Vehicles without air conditioning have one cooling fan fitted.



### Refit

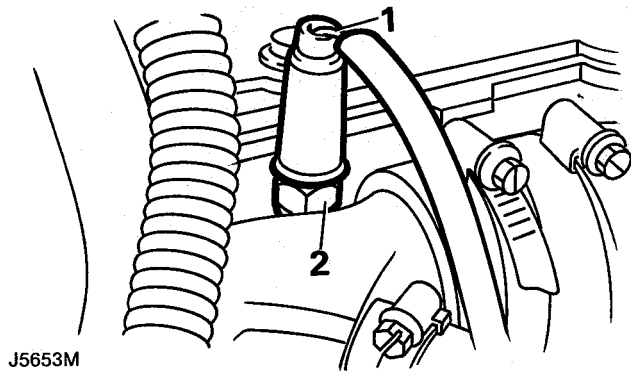
16. Position fan assemblies to radiator and tighten nuts to **6Nm**  
 17. Position radiator rail to radiator and secure with bolts.  
 18. Position radiator to vehicle.  
 19. Secure radiator to body with the side support brackets and retaining bolts.  
 20. Connect multiplugs to cooling fans.  
 21. Fit and secure 6 hoses to radiator.  
 22. Secure air cleaner to throttle housing to brackets.  
 23. Refill cooling system.  
 24. Reconnect battery negative lead.

**THERMOSTATIC SENSOR**

Service repair no - 19.22.18

**Remove**

1. Disconnect Lucar connector from sensor.
2. Remove sensor.

**Refit**

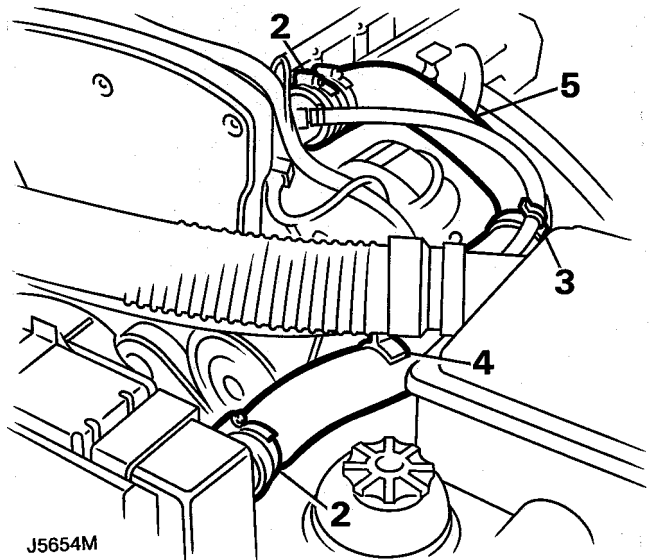
3. Clean sensor.
4. Apply Loctite 405 to threads of sensor.
5. Fit sensor and tighten to **15Nm**
6. Connect Lucar to sensor.
7. Top-up cooling system.

**THERMOSTAT**

Service repair no - 26.45.01

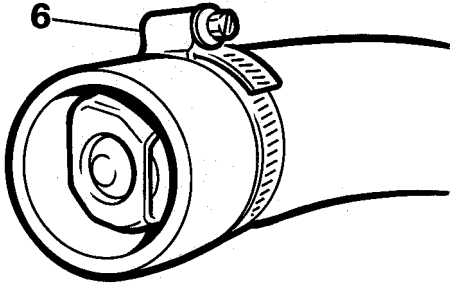
**Remove**

1. Position suitable container to collect coolant.
2. Slacken 2 clips and release radiator top hose.
3. Release bypass hose from securing bracket.
4. Release top hose from securing bracket.
5. Remove top hose.



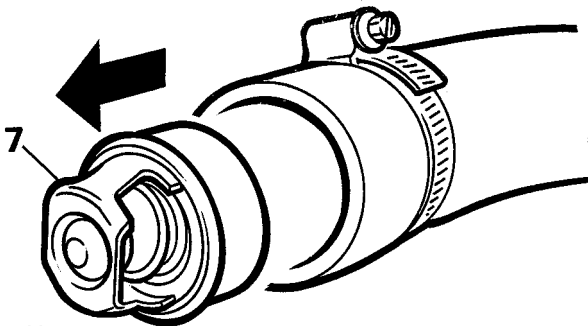


6. Remove clip securing thermostat in hose.



J5655M

7. Lubricate hose in front of thermostat and manoeuvre thermostat from hose.



J5656M

### Refit

8. Lubricate inside of top hose with liquid soap.
9. Manoeuvre thermostat into hose to previous position.
10. Fit and tighten clip securing thermostat to top hose.
11. Refit radiator hose.
12. Top-up cooling system.



## CATALYTIC CONVERTERS - V8i

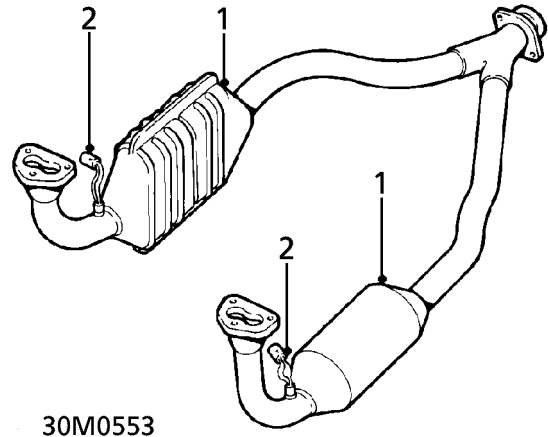
### Description

Catalytic converters which form part of the engine emission control system, are designed to 'clean' the exhaust gases, by closely controlling the fuel air ratio delivered to the engine and converting the residual exhaust compounds into products more acceptable to the environment.

The front section of the exhaust system to each cylinder bank contain the ceramic elements of the catalytic converters. The oxygen sensors which transmit information to the fuel ECU for control of the mixture, are located in the exhaust down pipes.

The Hydrocarbons (HC), Nitrogen oxides (NO<sub>x</sub>) and Carbon monoxide (CO) emitted by the engine react with the catalytic element and exhaust temperature to convert the toxic gas, into Nitrogen (N), Carbon dioxide (CO<sub>2</sub>) and water vapour.

Should the engine be supplied with a rich mixture causing high CO in the exhaust gas, the ceramic element will become coated and the useful life of the catalyst reduced. If the mixture is too weak, excess oxygen in the exhaust gas will cause the catalysts to burn out.

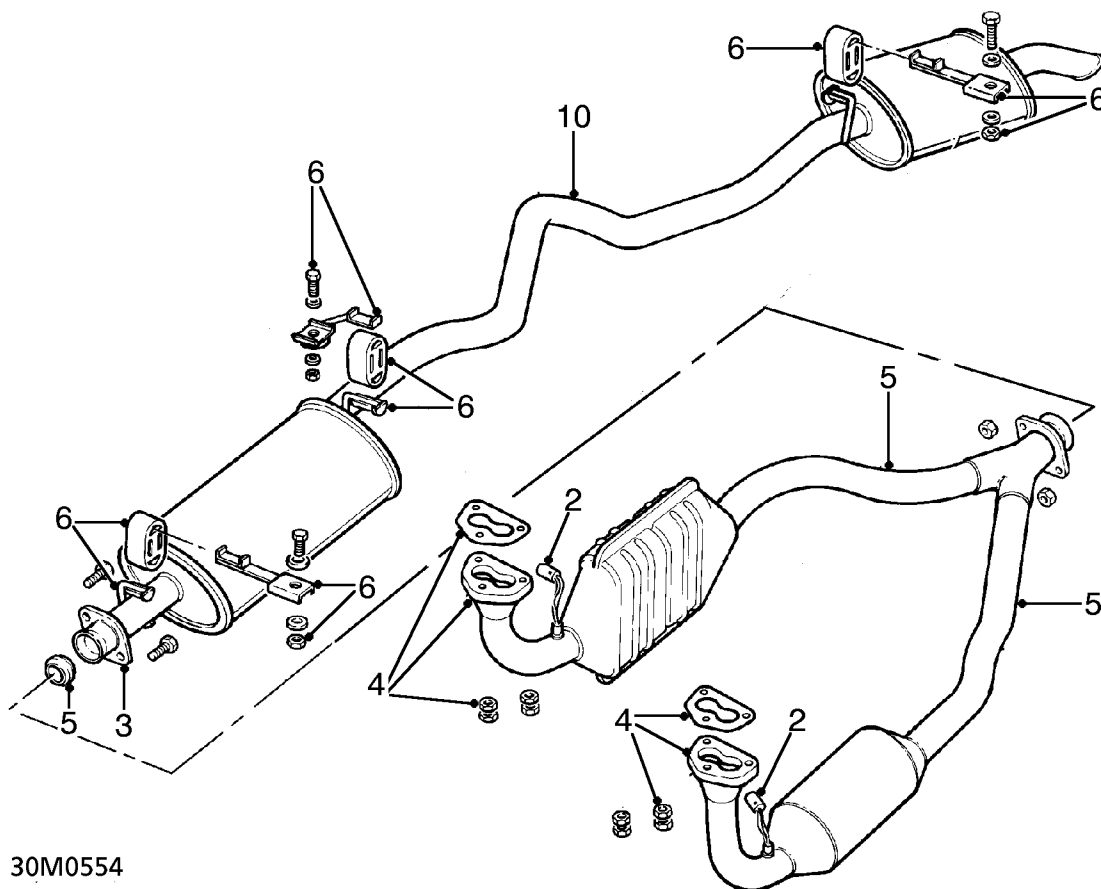


1. Catalysts
2. Lambda oxygen sensors



EXHAUST SYSTEM COMPLETE

Service repair no - 30.11.01



30M0554

To improve sealing and accuracy of assembly, a two piece exhaust system is fitted.



**NOTE:** Ensure no exhaust leaks are evident in either a new or old exhaust system, as this will affect vehicle performance.



**WARNING:** To prevent personal injury occurring from a hot exhaust system, DO NOT attempt to disconnect any components until exhaust system has cooled down.

## Remove

## Catalysts - remove and refit 1 to 5

1. Raise vehicle on a ramp [hoist].
2. **Catalyst vehicles only:** Disconnect two heated oxygen sensor wiring connectors.



**NOTE: NAS models have four heated oxygen sensors fitted.**

3. Remove two nuts securing rear exhaust assembly to front exhaust assembly.
4. Remove nuts and release front downpipes from manifolds. Discard gaskets.
5. Lower front exhaust assembly with catalysts (if fitted), retain olive.



**NOTE: Assistance is required for removing and refitting rear exhaust assembly.**

6. Remove bolts securing three hanger brackets to chassis. Lower exhaust assembly onto rear axle. Detach rubbers from hanging brackets.
7. Place extended axle stands underneath chassis, in front of chassis mounted rear towing brackets.
8. Lower ramp[hoist] until vehicle weight is supported securely on stands.
9. Lower ramp [hoist] until rear shock absorbers are ALMOST fully extended.
10. Move rear exhaust to a diagonal position, centre silencer to right of vehicle.
11. Facing rear of vehicle, twist assembly anti-clockwise clear of rear axle.
12. Remove rear exhaust assembly from vehicle.

## Refit

13. Position rear exhaust assembly over rear axle in a diagonal position, as for removing.
14. Twist assembly clockwise until it is in mounting position.
15. Reverse removal procedure. 1. to 9. using new manifold gaskets and applying exhaust sealer to system joint.
16. Examine system for leaks, ensuring that system does not foul underbody components. Rectify if necessary.

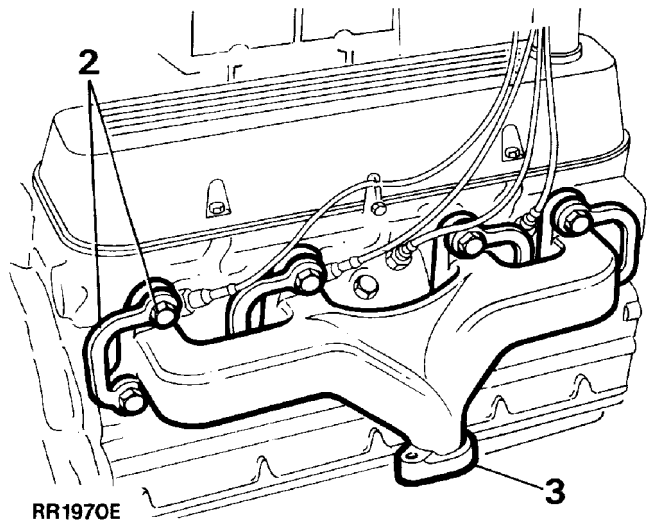
## EXHAUST MANIFOLD - V8i

Service repair no - Left hand - 30.15.10

Service repair no - Right hand - 30.15.11

## Remove

1. Disconnect front exhaust pipe(s) from manifold(s).
2. Tap back bolt locking tabs and remove eight bolts, lock tabs and washers.
3. Remove manifold(s) and old gaskets.

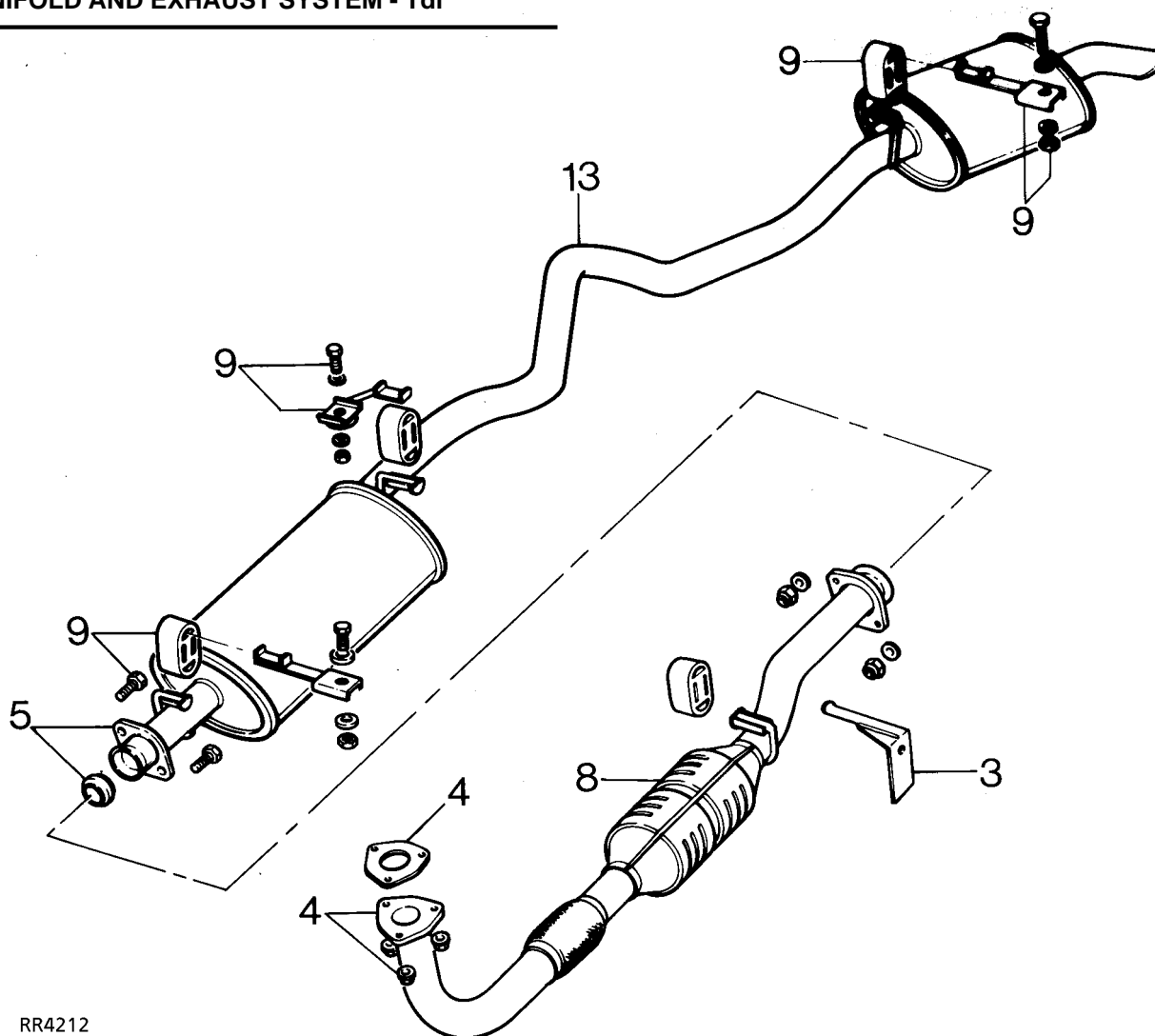


## Refit

4. Ensure that mating surfaces of cylinder head and exhaust manifold are clean and smooth.
5. Coat threads of each bolt with anti-seize compound.
6. Place manifold and new gaskets in position on cylinder head and fit securing bolts, new lockplates and plain washers. Plain washers are fitted between manifold and lockplates.
7. Evenly tighten manifold bolts to **20Nm** bend over lockplate tabs.
8. Reconnect front exhaust pipe, using new exhaust flange gaskets.



MANIFOLD AND EXHAUST SYSTEM - Tdi



RR4212

**Remove**

1. Raise vehicle on a ramp [hoist].
2. Remove anti-roll[sway] bar bolts to chassis and allow to swing down clear of axle. **See REAR SUSPENSION, Repair, Anti-roll [sway] Bar Assembly Rear**
3. Remove exhaust support bracket behind catalyst.
4. Disconnect exhaust at manifold.
5. Disconnect flange between rear and front exhaust.
6. Fit axle stands in suitable place on chassis.
7. Allow hoist to lower until front suspension is fully extended.
8. Manoeuvre front exhaust section from underneath vehicle.
9. Remove bolts securing three hanger brackets to chassis. Lower rear exhaust assembly onto rear axle. Detach rubbers from hanging brackets.
10. Place extended axle stands underneath chassis in front of chassis mounted rear towing brackets.

11. Lower hoist until vehicle weight is supported securely on stands.
12. Lower hoist until rear suspension is almost fully extended.
13. Move rear exhaust to a diagonal position, centre silencer to right of vehicle.
14. Facing rear of vehicle, twist assembly anti-clockwise clear of rear axle.
15. Remove rear exhaust assembly from vehicle.

**Refit**

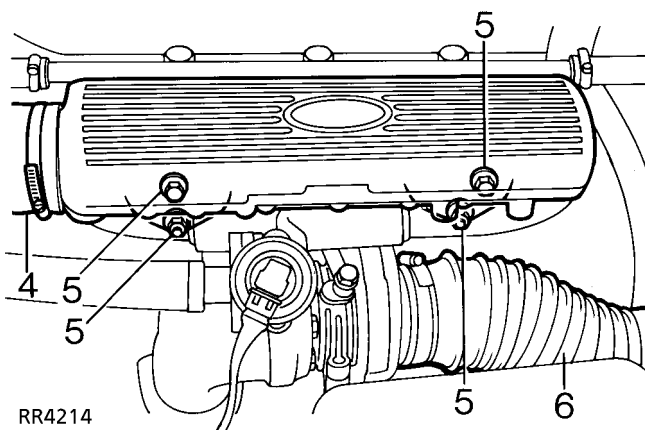
16. Position rear exhaust assembly over rear axle in a diagonal position, as for removing.
17. Twist assembly clockwise until it is in mounting position.
18. Reverse removal procedure instructions 1 to 15 using a new manifold gasket and applying exhaust sealer to system joints.
19. Examine system for leaks, ensuring that system does not foul under body components. Rectify if necessary.

**EXHAUST MANIFOLD - Tdi**

Service repair no - 30.15.10

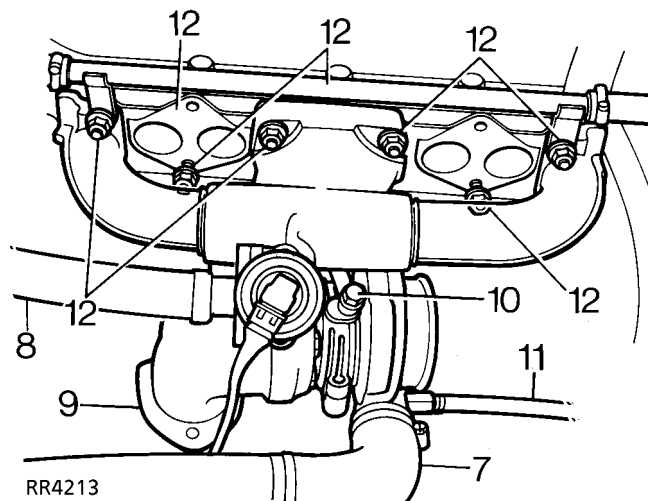
**Remove**

1. Disconnect battery negative lead.
2. Remove heat shield from rear of air intake manifold.
3. Release dip stick tube from cylinder block.
4. Disconnect the intake hose from the manifold.



RR4214

5. Remove the two bolts and two nuts securing the intake manifold to the cylinder head and withdraw the inlet manifold.
6. Remove air filter inlet pipe to turbo unit.
7. Remove intercooler pipe from turbo to intercooler.
8. Disconnect the EGR pipe from the inlet manifold hose.
9. Remove the three fixings at the exhaust pipe flange.
10. Release the turbo charger oil pipes from the cylinder block.
11. Remove the turbo boost pipes.



RR4213

12. Remove seven bolts securing the exhaust manifold, release the heater rail and remove the manifold gasket, complete with turbo unit.
13. Remove four bolts and disconnect diaphragm rod from manifold, and remove turbo charger if necessary.

**Refit**

14. Reverse removal procedure. 1 to 12. Use a new manifold and exhaust flange gaskets.
15. Reconnect battery negative lead. Start engine and check for leaks.





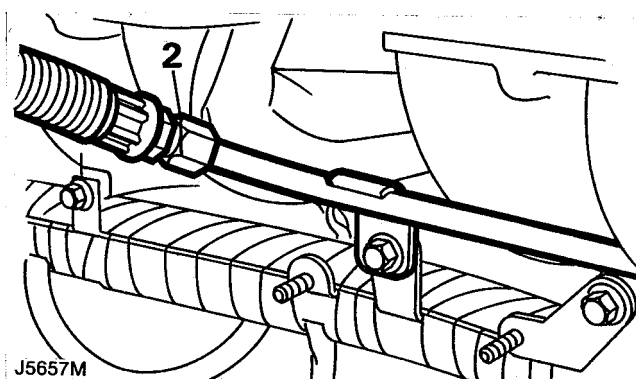
## INLET MANIFOLD GASKET - Mpi

Service repair no - 30.15.08

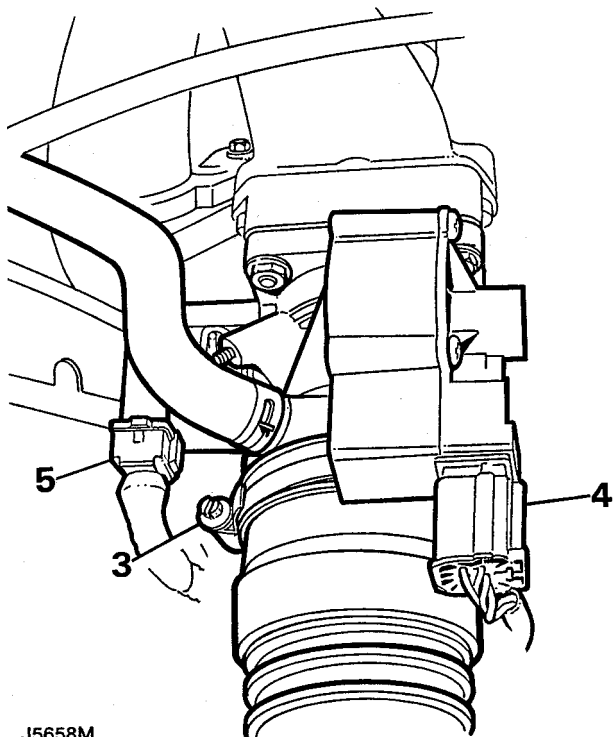
### Remove

1. Disconnect battery negative lead.
2. Position absorbent cloth around fuel pipe to fuel rail union. Unscrew union to relieve fuel pressure. Re-tighten union.

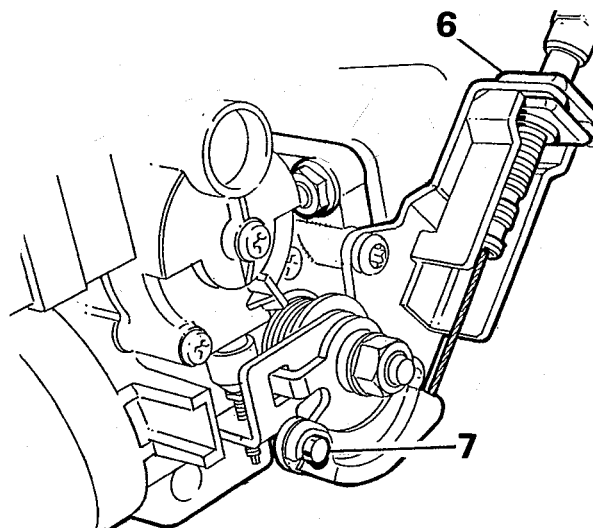
**CAUTION: Plug connections.**



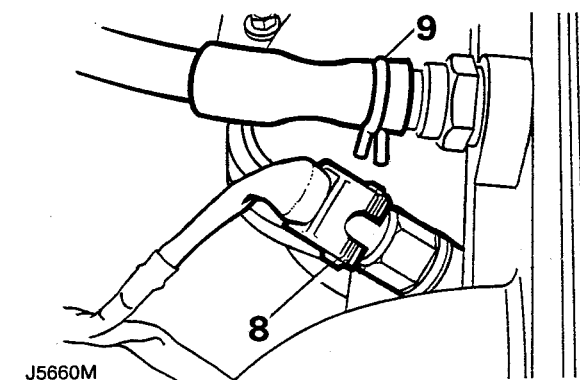
3. Release clip and remove air cleaner to throttle housing hose.
4. Disconnect stepper motor multiplug.
5. Disconnect throttle potentiometer multiplug.



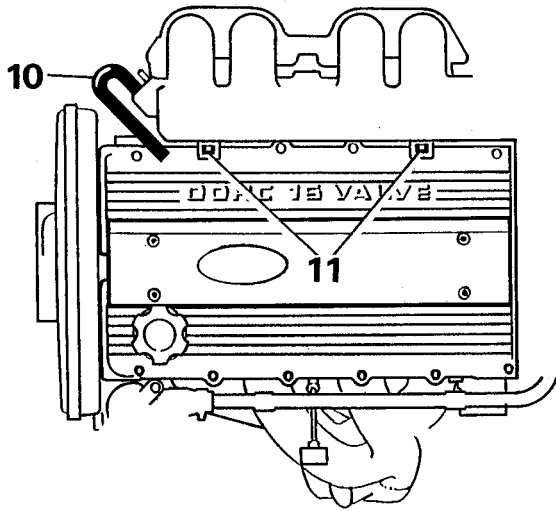
6. Release throttle cable from abutment bracket.
7. Release throttle cable from cam. Remove coolant bypass hose.



8. Disconnect fuel temperature sensor multiplug.
9. Release clip and disconnect brake servo hose from manifold.

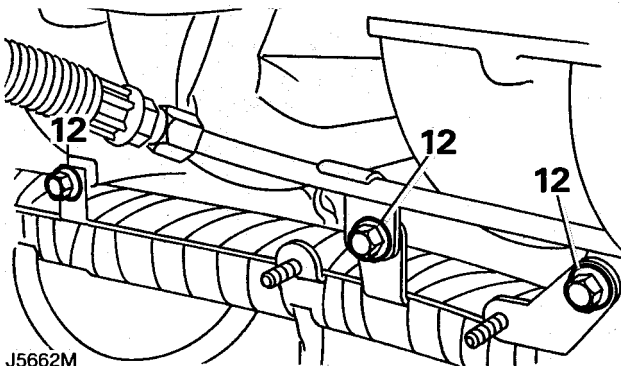


10. Release clip and disconnect breather hose from manifold.
11. Release 2 bolts securing cam cover brackets to manifold.



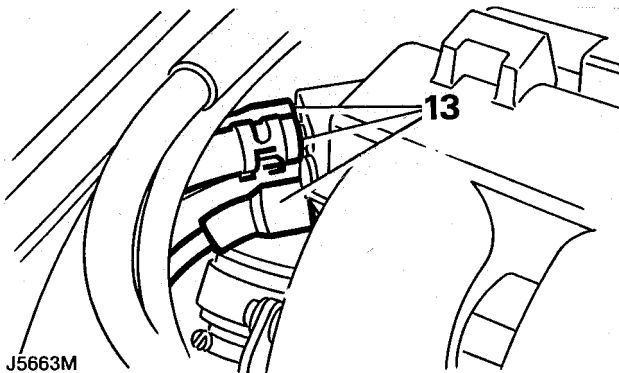
J5661M

12. Remove 3 bolts securing engine harness to manifold.



J5662M

13. Disconnect 3 vacuum hoses from manifold.



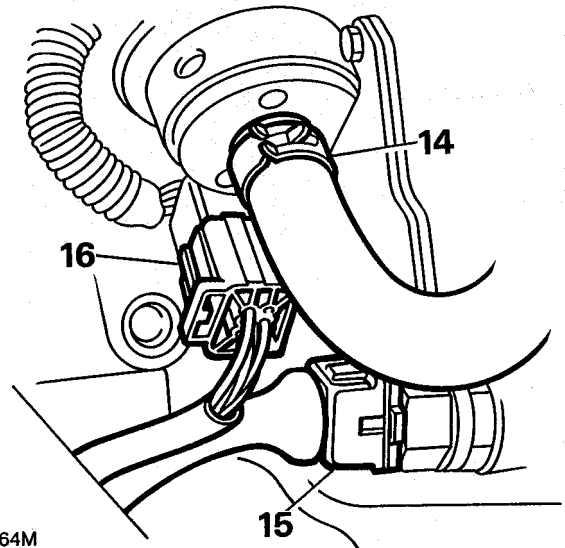
J5663M

14. Release clip and disconnect fuel hose from pressure regulator.



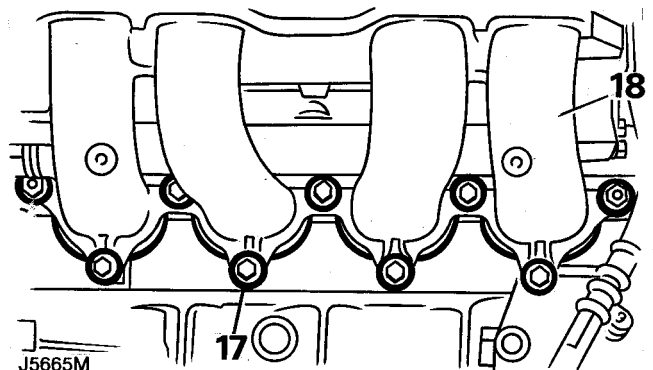
**CAUTION: Plug the connections.**

15. Disconnect intake air temperature sensor multiplug.
16. Disconnect fuel injector harness multiplug.



J5664M

17. Remove 2 nuts and 7 bolts securing manifold to cylinder head.
18. Remove manifold assembly and collect gaskets.

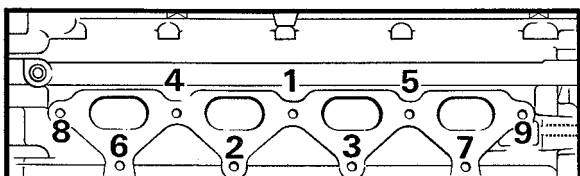


J5665M



**Refit**

19. Ensure mating faces of inlet manifold and cylinder head are clean.
20. Fit a new gasket, position inlet manifold to cylinder head.
21. Fit nuts and bolts, tighten in the order shown to the correct torque **25Nm**



J5666M

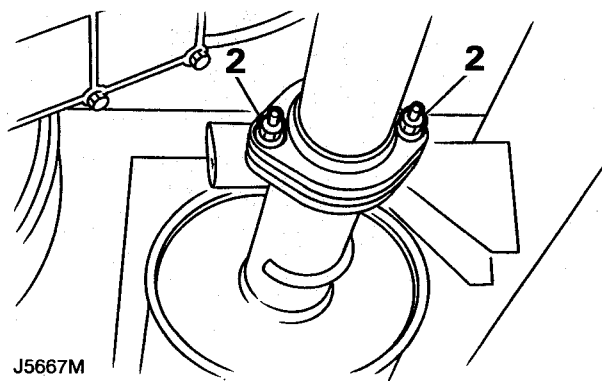
22. Position engine breather hose to manifold and secure with bolts.
23. Connect fuel injector harness and intake air temperature sensor multiplug.
24. Connect fuel hose to pressure regulator and secure with clip.
25. Fit fuel pipe to fuel rail, tighten union to **10Nm**
26. Connect vacuum hoses to manifold.
27. Position engine harness and cam cover brackets to manifold, secure with bolts.
28. Connect breather hose and brake servo hose to manifold, secure with clips.
29. Connect multiplug to fuel temperature sensor.
30. Connect breather hose to throttle housing and secure with clip.
31. Connect throttle cable to cam and secure to abutment bracket.
32. Connect coolant bypass hose to throttle housing.
33. Connect stepper motor and throttle potentiometer multiplugs.
34. Connect air cleaner hose to throttle housing and secure with clip.
35. Connect battery negative lead.
36. Adjust throttle cable.

**EXHAUST MANIFOLD GASKET - Mpi**

**Service repair no - 30.15.12**

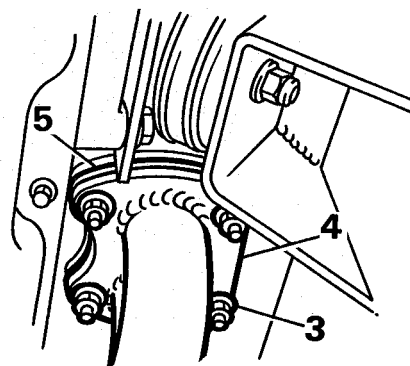
**Remove**

1. Raise vehicle.
2. Loosen 2 nuts securing downpipe to silencer box.



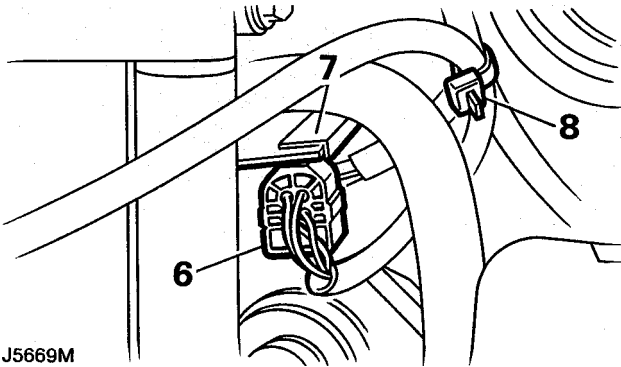
J5667M

3. Remove 4 nuts securing downpipe to exhaust manifold.
4. Release downpipe from exhaust manifold.
5. Discard gasket.



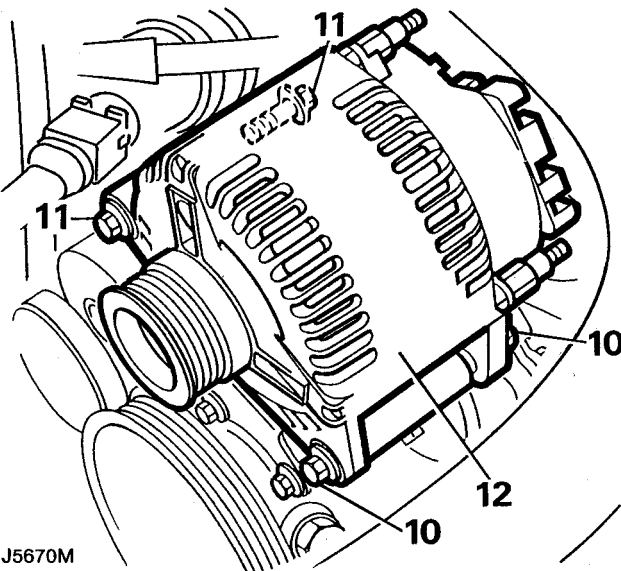
J5668M

6. Disconnect oxygen sensor multiplug.
7. Release multiplug from bracket on thermostat housing.
8. Release harness from cable tie.



J5669M

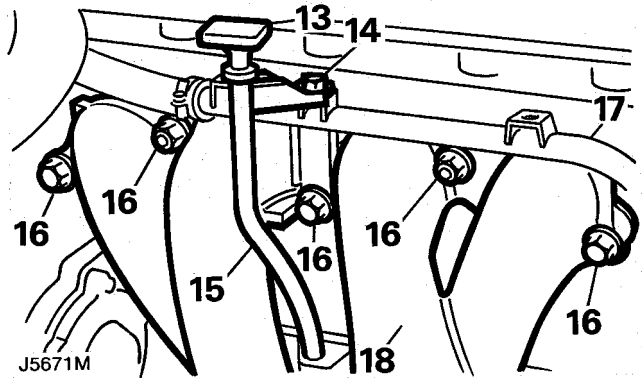
9. Remove drive belt.
10. Remove 2 front bolts securing generator to mounting bracket.
11. Remove 2 rear bolts securing generator to mounting bracket.
12. Move generator from mounting bracket and place aside.



J5670M

13. Remove exhaust manifold heat shield.
14. Remove dipstick and bolt securing dipstick tube to coolant rail.
15. Remove dipstick tube from cylinder block.

16. Remove 3 bolts and 2 nuts securing exhaust manifold to cylinder head.
17. Release coolant rail bracket from manifold studs.
18. Remove exhaust manifold and discard gasket.



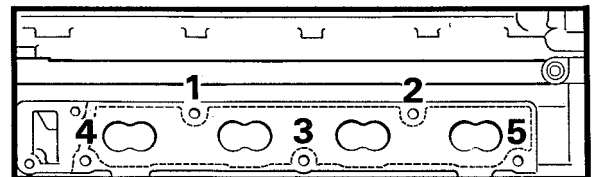
J5671M

### Refit



**NOTE: For torque values. See Specifications, torque, Torque Values**

19. Clean mating faces of exhaust manifold and cylinder head.
20. Fit new manifold gasket and align exhaust manifold to cylinder head.
21. Position coolant rail bracket to manifold studs.
22. Fit manifold nuts and bolts, tighten to the correct torque in the order shown.



J5672M

23. Secure oxygen sensor multiplug to bracket.
24. Connect oxygen sensor multiplug.
25. Fit new manifold flange gasket and align exhaust front pipe to manifold.
26. Fit nuts and tighten diagonally to the correct torque.
27. Tighten exhaust downpipe to silencer box nuts to the correct torque.
28. Position generator to mounting bracket.
29. Fit and tighten 4 generator securing bolts.
30. Refit drive belt.

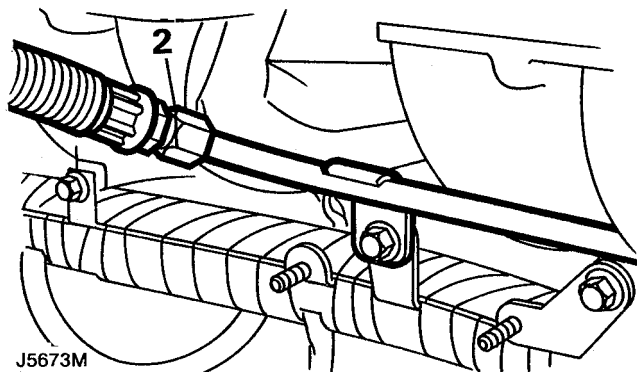


**MANIFOLD CHAMBER GASKET - Mpi**

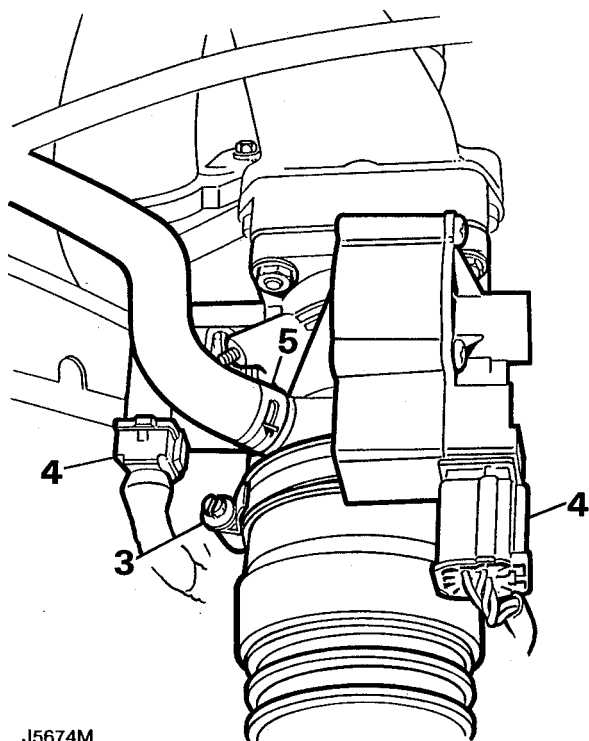
Service repair no - 30.15.37

**Remove**

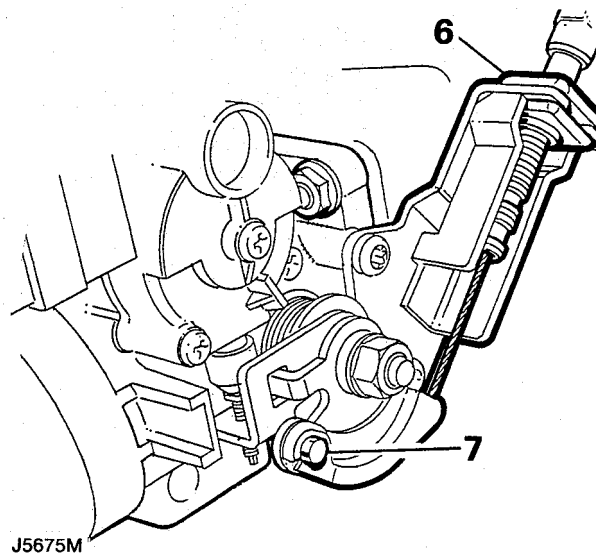
1. Disconnect battery negative lead.
2. Position absorbent cloth around fuel pipe to fuel rail union. Loosen union to relieve pressure. Re-tighten union.



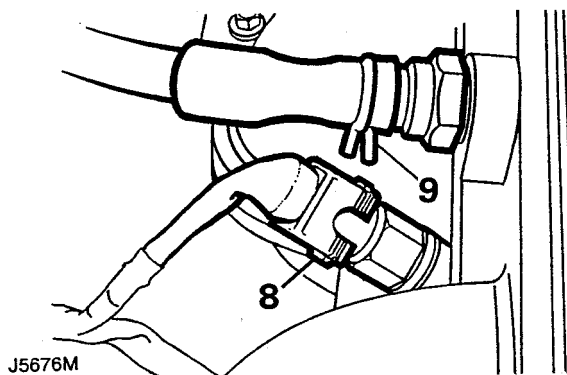
3. Release clip and remove air cleaner to throttle housing hose.
4. Disconnect stepper motor and throttle potentiometer multiplugs.
5. Release clip and disconnect breather hose from throttle housing.



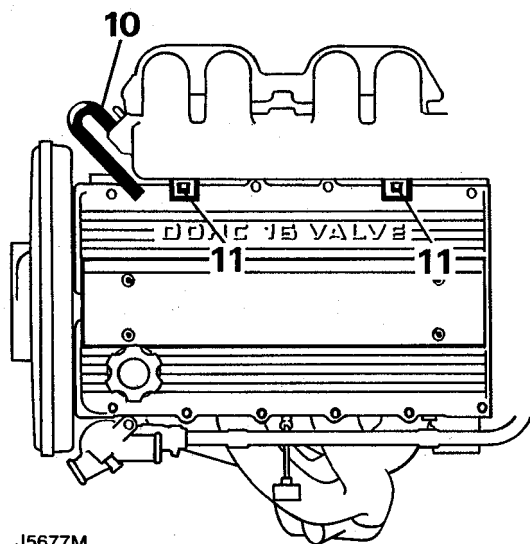
6. Release throttle cable from abutment bracket.
7. Release throttle cable from cam. Remove coolant bypass hose from throttle housing.



8. Disconnect fuel temperature sensor multiplug.
9. Release clip and disconnect brake servo hose from manifold.

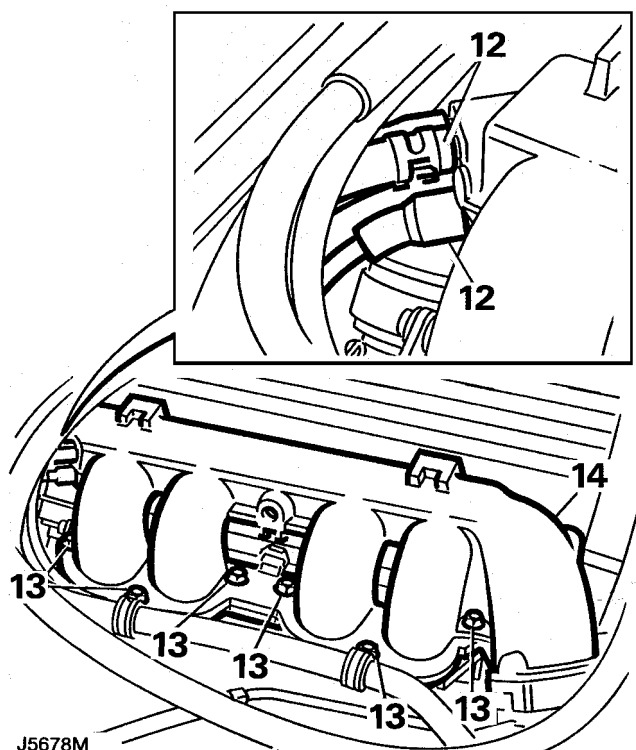


10. Release clip and disconnect breather hose from manifold.
11. Release 2 bolts securing camshaft cover brackets to manifold.



J5677M

12. Disconnect 4 vacuum hoses from manifold.
13. Remove 6 bolts securing manifold chamber to lower manifold.
14. Remove manifold chamber and collect gaskets.



J5678M

## Refit



**NOTE: For torque values. See Specifications, torque, Torque Values**

15. Ensure mating faces of manifold chamber and lower manifold are clean.
16. Fit a new gasket, position manifold chamber to lower manifold.
17. Fit bolts, tighten to the correct torque.
18. Connect vacuum hoses to manifold.
19. Position camshaft cover brackets to manifold, secure with bolts.
20. Connect breather hose and brake servo hose to manifold, secure with clips.
21. Connect multiplug to fuel temperature sensor.
22. Connect breather hose to throttle housing and secure with clip.
23. Connect throttle cable to cam and secure to abutment bracket.
24. Connect coolant bypass hose to throttle housing.
25. Connect stepper motor and throttle potentiometer multiplugs.
26. Connect air cleaner hose to throttle housing and secure with clip.
27. Reconnect battery negative lead.
28. Adjust throttle cable.



**TORQUE VALUES**



**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
<b>MANIFOLDS AND EXHAUSTS - Mpi</b>	
Inlet manifold nuts and bolts .....	25
Fuel pipe to fuel rail .....	10
Exhaust manifold nuts .....	45
Exhaust frontpipe to manifold .....	10
Exhaust downpipe to silencer box .....	30
Manifold chamber gasket .....	10

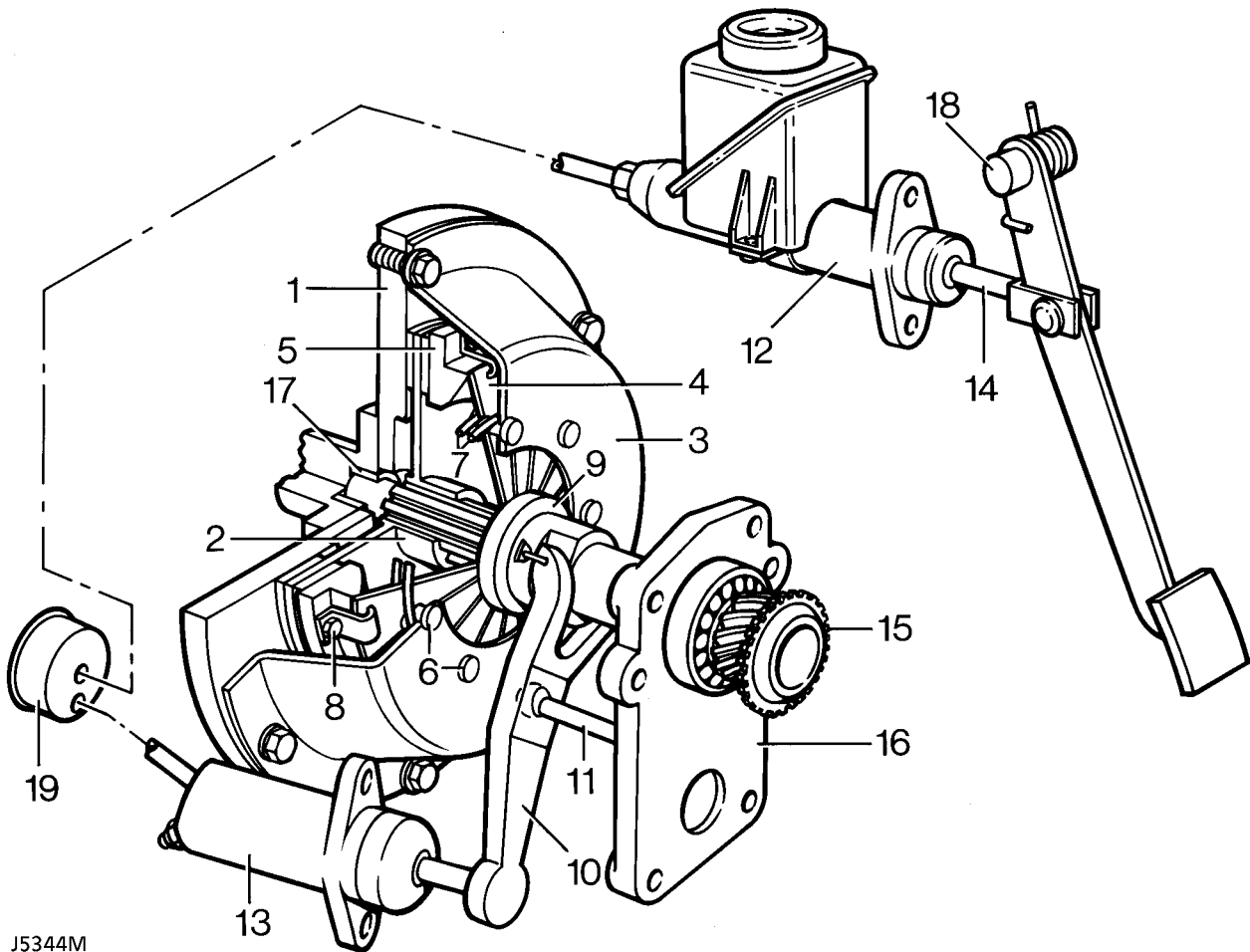


## DESCRIPTION

The clutch unit fitted with the manual transmission, comprises a single dry plate friction disc and diaphragm spring clutch unit, secured to the engine flywheel.

## OPERATION

The unit is operated hydraulically by the clutch master cylinder 12 and a slave cylinder 13 attached to the transmission bell housing.



J5344M

- |  |  |
|--|--|
| 1. Crankshaft and flywheel                           | 11. Release lever pivot post                     |
| 2. Friction plate                                    | 12. Master cylinder                              |
| 3. Clutch cover                                      | 13. Slave cylinder                               |
| 4. Diaphragm spring                                  | 14. Master cylinder pedal pushrod                |
| 5. Pressure plate                                    | 15. Primary shaft and taper bearing (in gearbox) |
| 6. Fulcrum posts (9) for diaphragm spring            | 16. Gearbox front cover                          |
| 7. Bearing rings (2) for diaphragm spring            | 17. Primary shaft flywheel bush                  |
| 8. Retraction links and bolts (3) for pressure plate | 18. Pedal pivot and return spring                |
| 9. Release bearing                                   | 19. Hydraulic damper (Diesel only)               |
| 10. Release lever                                    |  |



# 33 CLUTCH

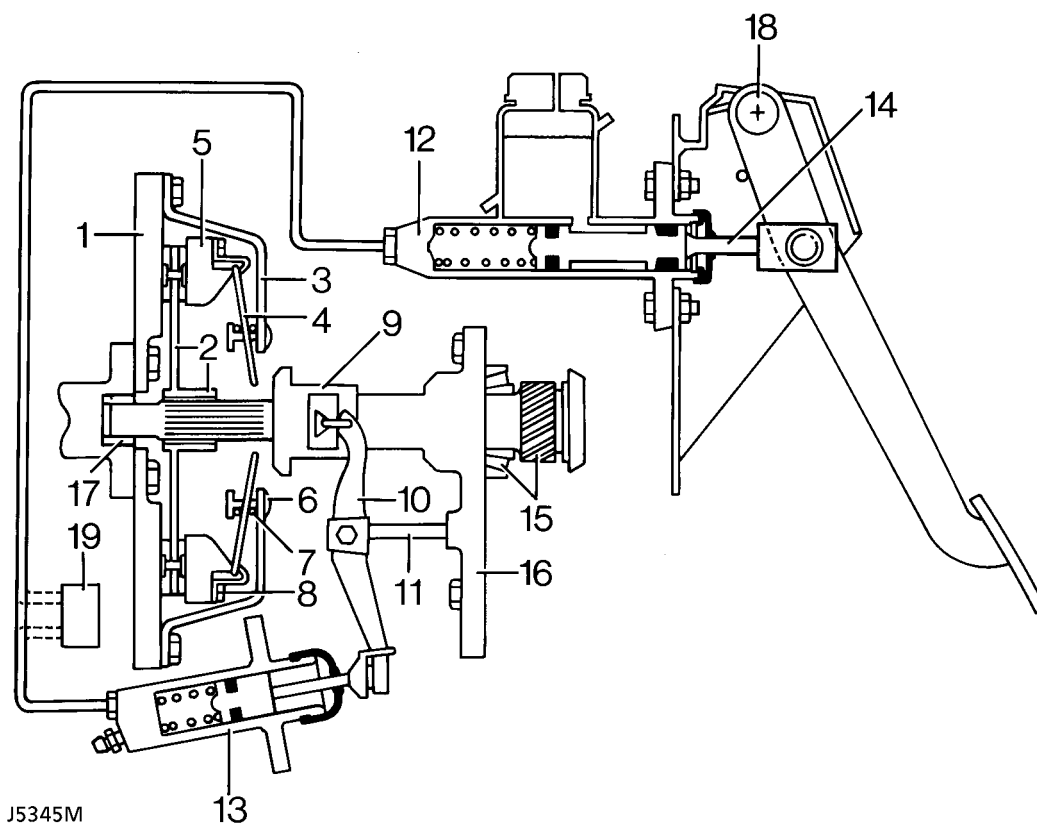
When the clutch pedal is depressed, hydraulic fluid transmits the movement via the slave cylinder, release lever 10, bearing 9, to the inner fingers of the diaphragm spring 4.

The diaphragm spring 4 pivots on the bearing rings 7 and fulcrum posts 6 causing the pressure plate 5 to release the clamping force on the friction plate and linings 2.

As the the clamping force is removed from the friction plate 2, the plate slides on the splines of the primary shaft 15 and takes up a neutral position between the flywheel 1 and the pressure plate 5 , thus breaking the drive between the engine and the gearbox.



**NOTE: Diesel engined vehicles have an hydraulic damper 19 fitted into the system. The damper contains a steel diaphragm which absorbs slight hydraulic pulses caused by cyclic variations of the diesel engine crankshaft at low rpm.**





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### CLUTCH ASSEMBLY CONDITIONS

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For the clutch to operate correctly as described and illustrated in the "Description and Operation", it is important the following conditions are satisfied:-

- A. The primary shaft 15 must be free in the crankshaft spigot bush 17.
- B. The friction plate 2 must be able to slide easily on the splines on the primary shaft 15, to a position where it does not contact either the flywheel or the pressure plate.
- C. The friction plate must not be distorted or the linings contaminated with oil, which may cause it to stick or continue to run in contact with the flywheel or pressure plate.

A number of faults can develop in the operation of the clutch for a variety of reasons and although most faults are due to normal wear at high mileage, problems can also occur if the unit has been renewed by an unskilled operator.

Recognising and diagnosing a particular clutch fault is therefore of paramount importance in ensuring, that the problem is rectified at the first attempt.

Problems which develop in the clutch are as follows:-

- A. Clutch spin/drag
- B. Clutch slip
- C. Clutch judder/fierce

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### CLUTCH SPIN - DRAG

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#### Symptoms

Clutch spin is that, with engine running and clutch pedal depressed, the gears cannot be immediately engaged without making a grinding noise. This indicates the clutch is not making a clean break.

However, if the clutch pedal is held depressed for several seconds the friction plate will eventually break free from the engine and the gear will engage silently.

Clutch spin as it becomes more severe develops into clutch drag, making the silent engagement of a gear impossible, regardless of how long the pedal is held depressed.

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### CLUTCH SLIP

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#### Symptoms

Clutch slip is most evident climbing a hill or when the vehicle is moving off from stationary with a heavy load. As the clutch is released slip occurs between the engine and the transmission, allowing the engine speed to increase without a corresponding increase in vehicle speed.

Clutch slip can develop to the stage where no power is transmitted through the clutch as the pedal is released.

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### CLUTCH JUDDER - FIERCE

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#### Symptoms

Clutch judder or fierce engagement, like slip, is most likely to occur when the vehicle is moving off from stationary. As the clutch pedal is released the vehicle will move rapidly or in a series of jerks, which can not be controlled even by careful operation of the clutch by the driver.

It should be noted that a vehicle may display all the symptoms or any combination of the symptoms described, depending on the driving conditions vehicle load and operating temperatures.

## FAULT/SYMPTOM CHART

Symptoms			Fault	Item
Slip	Spin/Drag	Judder/Fierce		
*	*	*	Worn or oil on clutch linings	2
*	*	*	Mechanical damage	4 5 6 7 8
	*	*	Distorted clutch plate	2
	*		Failed or air in hydraulic system	12 13
	*	*	Primary shaft tight fit in crankshaft bush	15 17
	*		Clutch splines sticking	2 15
		*	Weak clutch plate springs or insecure/worn engine/gearbox mountings	6
		*	Insecure/worn propeller shafts	
		*	Insecure/worn suspension components/rubber bushes	

For items referred to in this chart. **See Description and operation, Description**

### CLUTCH NOISE - MECHANICAL FAULTS

**Noise from clutch or gearbox in neutral, which disappears when clutch is depressed.**

Suspect gearbox input/primary shaft bearings.

**See MANUAL GEARBOX, Fault diagnosis, Manual Gearbox**

- Noise from gearbox in neutral, which disappears when clutch is depressed

**Noise from clutch or gearbox in neutral, which changes tone or becomes worse when the clutch is depressed.**

Suspect worn release bearing.

**Knocking/rattling from clutch or gearbox in neutral, which is reduced or disappears when the clutch is depressed.**

Suspect worn/weak release lever retainer or clutch unit.

**Noise from clutch or gearbox in neutral, which disappears when clutch is depressed.**

Suspect gearbox fault.

**See MANUAL GEARBOX, Fault diagnosis, Manual Gearbox**

- Noise from gearbox in neutral, which disappears when clutch is depressed.

### HYDRAULIC FAULTS

**Unable to dis-engage clutch, little or no pedal resistance.**

1. Check condition, specification and level of fluid.
2. Check pipes and cylinders for leaks.
3. Check that air vent in reservoir lid is clear. Suspect faulty master cylinder if no fluid leaks present. **See Repair, Master Cylinder**

**Spongy pedal operation**

1. Check condition, specification and level of fluid.
2. Check that air vent in reservoir lid is clear. Suspect air in fluid. **See Repair, Bleed Hydraulic System**

**Clutch is difficult to dis-engage and/or does not immediately re-engage when pedal is released.**

1. Check condition, specification and level of fluid.
2. Check that air vent in reservoir lid is clear. Suspect pedal pivot, master cylinder or slave cylinder seizure. **See Repair, Master Cylinder**



## CLUTCH ASSEMBLY

Service repair no - 33.10.01

### Clutch pressure plate

Renew pressure plate if diaphragm spring fingers are worn or if pressure plate shows signs of wear, cracks or burning.

### Clutch driven plate

Renew driven plate if centre hub splines are worn or if lining is contaminated, burned or unevenly worn.

### Service tools:

#### Clutch centralising tool

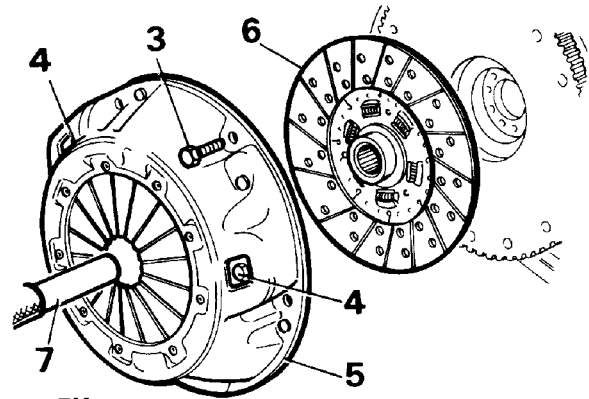
LRT-12-001 - V8

LRT-12-040 - Tdi

LRT-12-057 - Mpi

### Remove

1. Remove gearbox. **See MANUAL GEARBOX, Repair, R380 Manual Gearbox**
2. Mark position of clutch cover to flywheel for reassembly.
3. Remove clutch cover securing bolts, working evenly and diagonally.
4. Do not disturb three bolts in clutch cover.
5. Remove clutch assembly.
6. Withdraw clutch driven plate.



RR817M

### Refit



**NOTE:** To prevent clutch plate sticking, lubricate splines using Rocol MV 3 or Rocol MTS 1000 grease.

7. Renew/refit clutch driver plate and clutch assembly using centralising tool, where applicable, align assembly marks.
8. Secure clutch assembly cover fixings evenly, working in a diagonal sequence. Tighten to **28 Nm**.
9. Fit gearbox to engine.

## BLEED HYDRAULIC SYSTEM

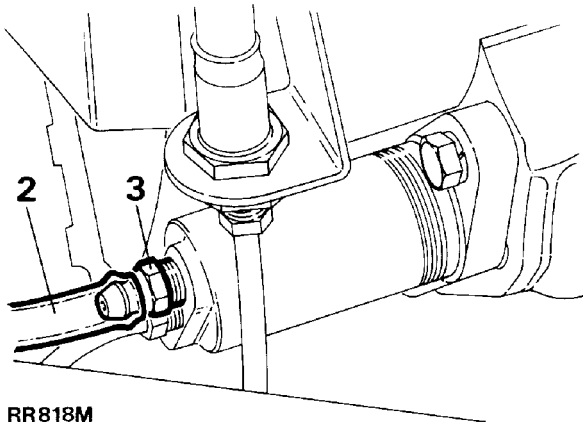
Service repair no - 33.15.01

### Procedure



**NOTE:** During bleed procedure, keep fluid reservoir topped up to avoid introducing air to system. For hydraulic fluid recommendations. See *LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids*

1. Attach suitable tubing to slave cylinder bleed screw.
2. Place free end of tube in a glass jar containing clutch fluid.
3. Loosen bleed screw.



RR818M

4. Pump clutch pedal, pausing at end of each stroke, until fluid from tubing is free of air. Keeping free end of tube below surface of fluid.
5. Hold clutch pedal down, tighten bleed screw.
6. Top up fluid reservoir.

## MASTER CYLINDER

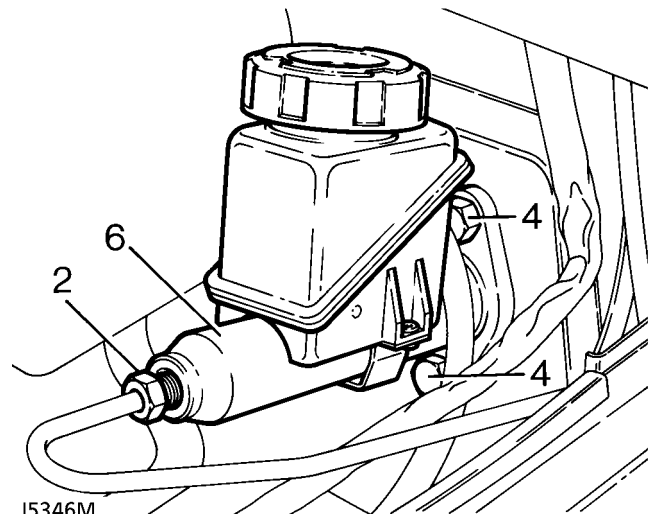
Service repair no - 33.20.01/03



**NOTE:** All flexible and pipe connections and joints should be tightened to 15 Nm.

### Remove

1. Evacuate hydraulic fluid from system.
2. Disconnect fluid pipe at master cylinder. Plug master cylinder fluid port and seal end of hydraulic pipe to prevent ingress of foreign matter.
3. Lower fascia fuse box panel.
4. Remove master cylinder fixings.
5. Remove retaining washer and clevis pin from push rod and clutch pedal.
6. Remove master cylinder.

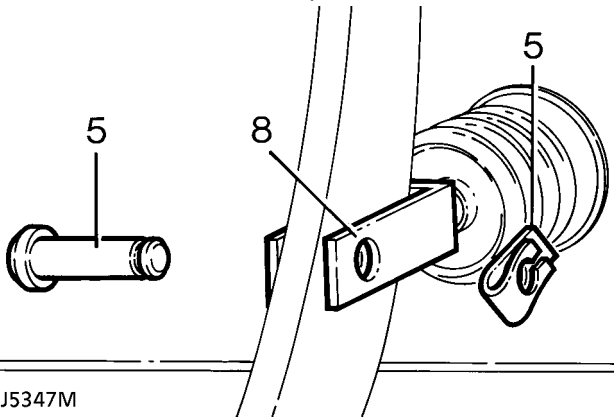


J5346M



### Refit

7. Fit the master cylinder and fixings.
8. Fit push-rod to pedal and retain with clevis pin and washer.
9. Raise fascia fuse box panel.



J5347M

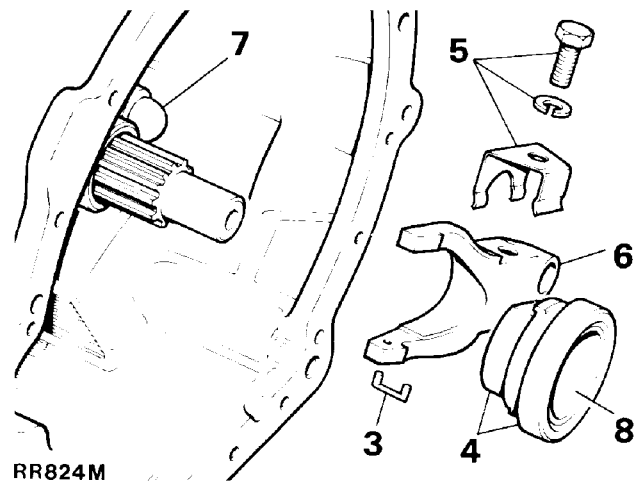
10. Fit fluid pipe to master cylinder.
11. Bleed system. **See *Bleed Hydraulic System***

### RELEASE BEARING ASSEMBLY

Service repair no - 33.10.07

### Remove

1. Remove gearbox. **See *MANUAL GEARBOX, Repair, R380 Manual Gearbox***
2. Remove clutch slave cylinder. **See *Slave Cylinder***
3. Withdraw retainer staple.



RR824M

4. Withdraw bearing and sleeve. If required, press bearing off sleeve. Fit replacement bearing with domed face outwards from sleeve.
5. Remove spring clip and fixings.
6. Withdraw release lever assembly.

### Refit

7. Smear pivot with grease and fit release lever and retain with spring clip and bolt.
8. Smear release bearing sleeve inner diameter with molybdenum disulphide base grease.
9. Reverse removal procedure. 1 to 4.

## SLAVE CYLINDER

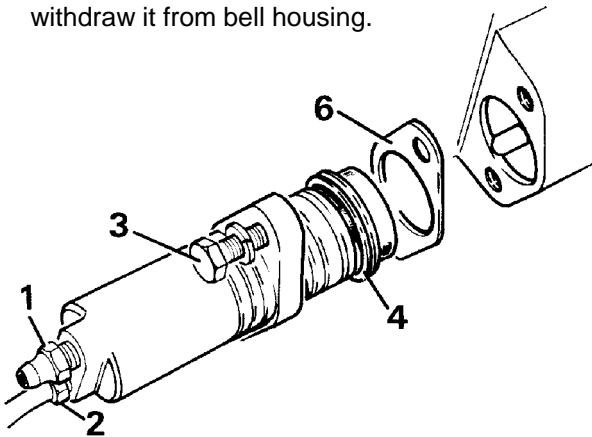
Service repair no - 33.35.01



**NOTE:** All flexible and pipe connections and joints should be tightened to 15 Nm.

### Remove

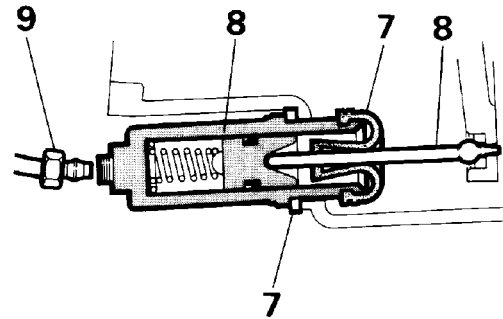
1. Evacuate clutch system fluid at slave cylinder bleed valve.
2. Disconnect fluid pipe.
3. Remove two securing bolts and withdraw slave cylinder and backing plate.
4. If dust cover is not withdrawn with slave cylinder, withdraw it from bell housing.



RR628M

### Refit

5. Withdraw dust cover and backing plate from slave cylinder.
6. Coat both sides of backing plate with Hylomar P232M waterproof jointing compound.
7. Locate backing plate and dust cover in position on slave cylinder.
8. Fit slave cylinder, engaging push-rod through centre of dust cover and with bleed screw uppermost.



RR829M

9. Reconnect fluid pipe.
10. Replenish and bleed clutch hydraulic system.
11. Check for fluid leaks with pedal depressed and also with system at rest.



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**RENEWING HYDRAULIC DAMPER - Tdi**

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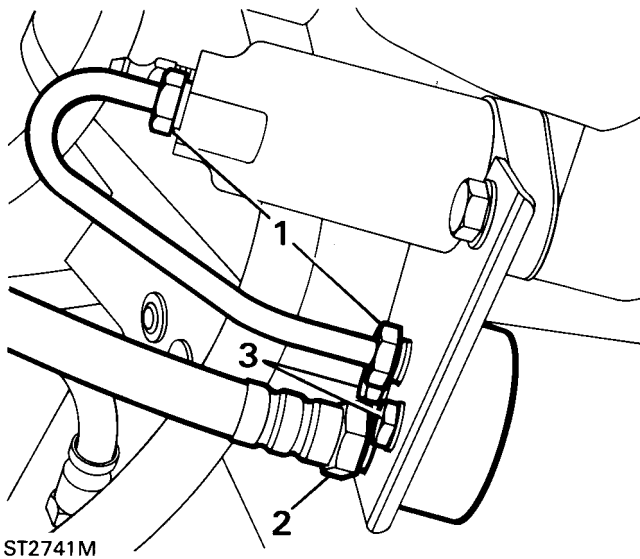
Service repair no - 33.15.05



**NOTE: All flexible and pipe connections and joints should be tightened to 15 Nm.**

**Remove**

1. Remove the pipe between the slave cylinder and damper.
2. Disconnect the hydraulic hose from the damper.
3. Remove the two bolts securing the damper to the bracket and remove the damper.



ST2741M

**Refit**

4. Fit the damper to the bracket and tighten the two bolts.
5. Connect the flexible hose to the damper.
6. Fit the pipe to the slave cylinder and to the damper and tighten the unions.
7. Bleed the hydraulic system.





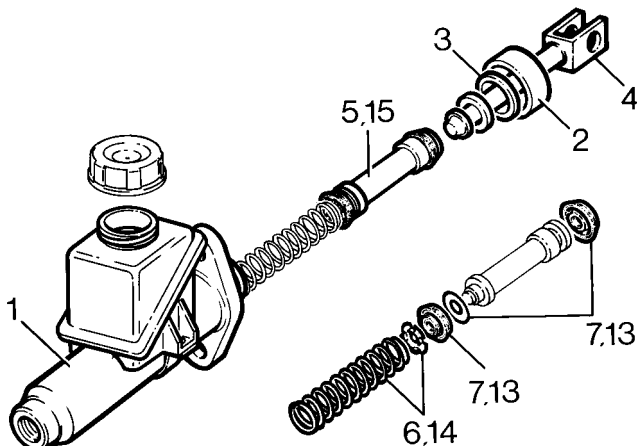
## MASTER CYLINDER

Service repair no - 30.20.07

1. Remove master cylinder. *See Repair, Master Cylinder*

### Disassemble

2. Pull back and remove rubber sealing boot from pushrod.
3. Depress push-rod and extract circlip.
4. Withdraw push-rod assembly.
5. Withdraw piston assembly.
6. Withdraw retainer and spring.

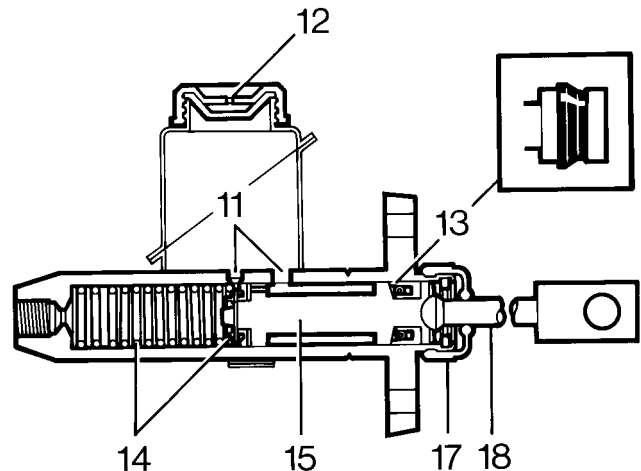


J5348M

7. Remove two piston seals and piston washer.

### Inspecting

8. Clean all components thoroughly using new hydraulic fluid. Dry, using a lint-free cloth.
9. Examine cylinder bore and piston, ensure they are smooth to touch with no corrosion, score marks or ridges. If in doubt, fit new components.
10. Fit new seals and rubber boot. These items are all included in master cylinder overhaul kit.
11. Ensure that feed and by-pass ports are not obstructed.



J5349M

12. Ensure reservoir cap vent is clear.

### Assemble



**NOTE: Cleanliness is essential, ensure hands are free of grease or dirt. Lubricate cylinder bore and rubber seals with new hydraulic fluid before assembly.**

13. Fit a new piston washer and thinner of two piston seals, lip last, over piston nose, up against drilled piston head. Fit thicker seal into piston groove with lip facing towards seal at opposite end.
14. Insert spring and retainer into master cylinder bore.
15. Insert piston and seal assembly, ensuring that seal lips do not bend back.
16. Reverse 3 and 4, correctly locating circlip.
17. Stretch new rubber boot over push-rod, pack with rubber grease. Fit securely into locating groove.
18. Operate push-rod several times to ensure free movement of internal components.
19. Fit master cylinder.

## SLAVE CYLINDER

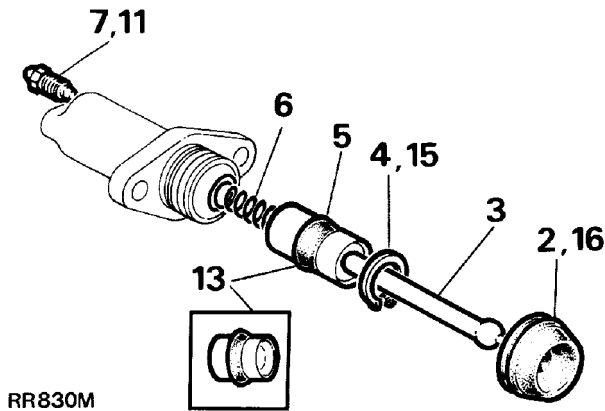
Service repair no - 33.35.07

### Overhaul

1. Remove slave cylinder. *See Repair, Slave Cylinder*

### Disassemble

2. Withdraw rubber boot.
3. Withdraw push-rod.
4. Remove circlip.
5. Extract piston and seal assembly, applying low pressure air to fluid inlet if necessary.
6. Withdraw spring.
7. Remove bleed valve.



### Inspecting

8. Clean all components thoroughly using new hydraulic fluid, and dry using lint-free cloth.
9. Examine cylinder bore and piston which must be free from corrosion, scores and ridges.
10. Replace seal and rubber boot using appropriate repair kit.

### Assemble



**NOTE: Cleanliness is essential, ensure hands are free of grease or dirt.**

11. Fit bleed valve. Do not overtighten.
12. Lubricate seals, piston and bore using new hydraulic fluid.
13. Fit seal into piston groove, lip of seal towards fluid inlet end of cylinder.
14. Enter piston assembly, spring first, into cylinder bore. Ensure that seal lip does not fold back.
15. Secure with circlip.
16. Fill rubber boot with rubber grease.
17. Reverse removal procedure. 1 to 3.



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**TORQUE VALUES**

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**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
<b>Clutch pipes</b>	
Master cylinder union .....	15
Pipe joint .....	15
Pipe to damper .....	15
Pipe out of damper .....	15
Pipe to jump hose .....	15
Jump hose to pipe .....	15
Pipe to slave cylinder .....	15



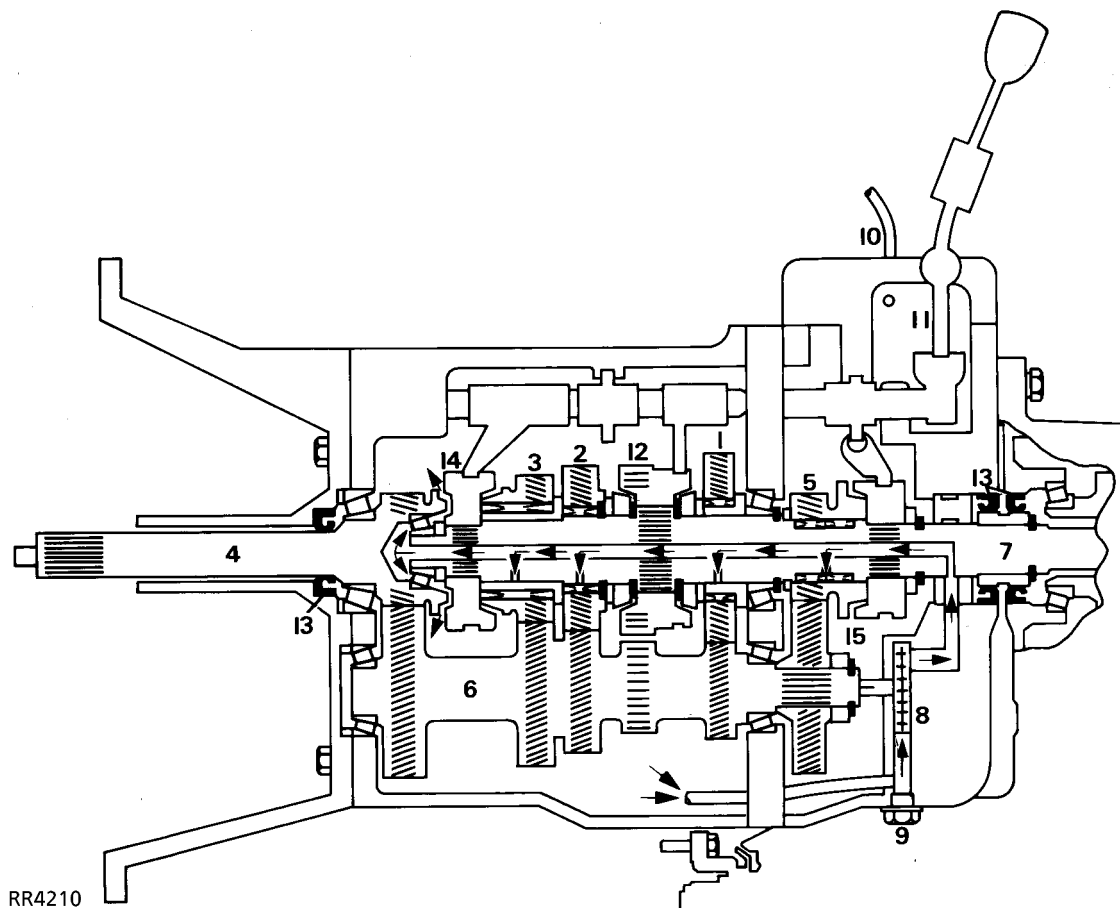
## MANUAL TRANSMISSION

### Description

The all synchromesh five speed manual gearbox unit, is married to a LT230T two speed transfer gearbox.

All the gears including reverse run on needle roller bearings and the main, layshaft and primary shafts are supported by tapered roller bearings.

The whole of the geartrain is lubricated through drillings in the shafts, supplied by a low pressure pump driven from the rear of the layshaft. The gear change has a single rail selector and spool type interlock. The main and transfer gearboxes ventilate through nylon pipes, which terminate high up in the engine compartment to prevent water entry when the vehicle is operating in adverse conditions.



1. Mainshaft 1st gear
2. Mainshaft 2nd gear
3. Mainshaft 3rd gear
4. Primary input shaft
5. Mainshaft 5th gear
6. Layshaft
7. Mainshaft
8. Lubrication pump

9. Drain plug
10. Ventilation pipe
11. Single rail gear shift
12. 1st/2nd synchromesh
13. Oil seals
14. 3rd/4th synchromesh
15. 5th gear synchromesh



## MANUAL GEARBOX

### Symptom - Gear jumps out of engagement (any forward gear)

1. Check condition and security of transmission and engine mountings.
2. Check in situ, gear lever and selector adjustments.
3. In situ, remove gearshift and check selector rail yoke security.  
Also check selector detent spring tension and both spool retainers.  
Suspect internal fault  
See remove and overhaul procedure.
4. Check action/operation of main selector rail and forks.
5. Check condition of synchromesh and gear dog teeth.
6. Check main and layshaft end floats bearings and adjustments.
7. Check condition of all gearbox components, ensure clearances and adjustments are correct on reassembly.

### Symptom - Reverse gear only jumps out of engagement

1. Check condition and security of transmission and engine mountings.
2. Check in situ, gear lever and selector adjustments.
3. In situ, remove gearshift and check selector rail yoke security.  
Also check selector detent spring tension and both spool retainers.  
Suspect internal fault  
See remove and overhaul procedure.
4. Check action/operation of main selector rail and reverse lever.
5. Check condition of reverse gear, angled bearings and shaft.
6. Check condition of all gearbox components, ensure clearances and adjustments are correct on reassembly.

### Symptom - Excessive force required to engage or change gear, vehicle stationary or moving.

1. Check lubricant specification and level, if low do not top up at this stage.
2. In situ, lubricate gear mechanism, and check selector adjustments.
3. In situ, remove gearshift and check selector rail is free and that the yoke is secure. Also check selector detent spring tension and both spool retainers.
4. Drain lubricant and check for contamination or metal particles.  
Suspect worn synchromesh unit or baulk rings on affected gears. See remove and overhaul procedure.

### Symptom - Noisy gear engagement, vehicle stationary. See *CLUTCH, Fault diagnosis, Clutch Noise - Mechanical Faults*

### Symptom - Noisy gear selection, vehicle moving.

1. Confirm that clutch operation is satisfactory.
2. Establish which gear/gears is causing noise.
3. Check lubricant specification and level, if low do not top up at this stage.
4. Drain lubricant and check for contamination or metal particles.  
Suspect worn synchromesh. See remove and overhaul procedure.
5. Check condition of synchromesh unit, springs and cones for distortion and wear. Also check dog teeth for damage and cone mating surface on gear for signs of overheating.
6. Check condition of all gearbox components, ensure clearances and adjustments are correct on reassembly.

### Symptom - Noise from gearbox in neutral, which changes tone or becomes worse when clutch is depressed. See *CLUTCH, Fault diagnosis, Clutch Noise - Mechanical Faults*

**Symptom - Noise from gearbox in neutral, which disappears when clutch is depressed.**

1. Check lubricant specification and level, if low do not top up at this stage.
2. Drain lubricant and check for contamination or metal particles.  
Suspect worn bearings on layshaft, primary shaft or front of main shaft. See remove and overhaul procedure.

**Symptom - Noise from gearbox in one or more gears when being driven.**

1. Check lubricant specification and level, if low do not top up at this stage.
2. Drain lubricant and check for contamination or metal particles.  
Suspect worn roller bearings on particular mainshaft gears. See remove and overhaul procedure.



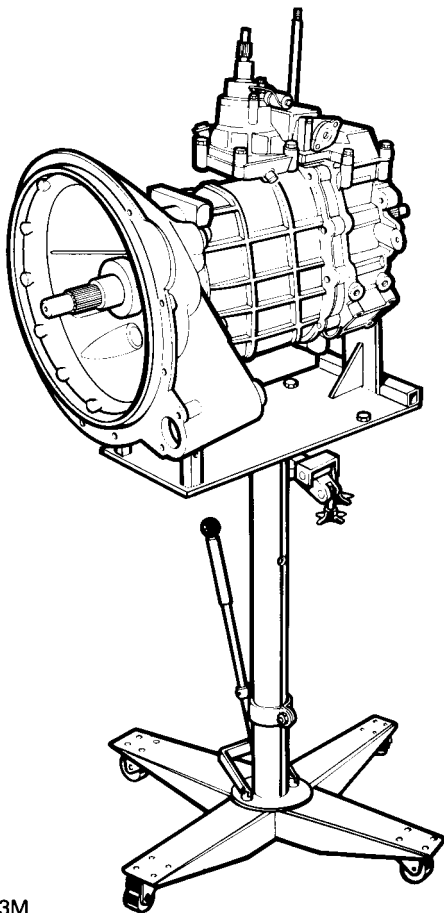
## R380 MANUAL GEARBOX

Service repair no - 37.20.02

### Remove

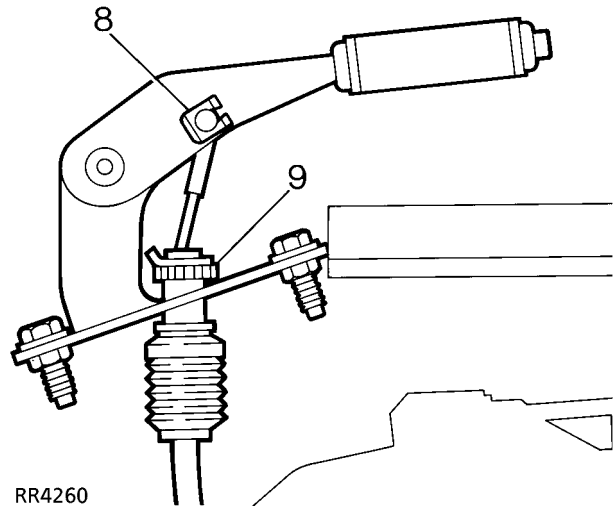


**WARNING:** Where the use of a transmission hoist is necessary, it is absolutely essential to follow the manufacturer's instructions to ensure safe and effective use of equipment.



ST3213M

1. Install vehicle on a ramp [hoist].
2. Disconnect battery earth lead.
3. Remove centre console. **See CHASSIS AND BODY, Repair, Centre Console**
4. Remove sound insulation from top of transmission tunnel.
5. Remove bolt and remove upper gear lever.
6. Remove screws securing gear selector lever and high/low selector lever draft excluders.
7. Remove draft excluder clamp rings.



RR4260

8. Remove handbrake cable clevis pin clip and clevis pin.
9. Remove 'C' clip and cable adjuster.
10. Select low range to prevent gear lever fouling tunnel when removing gearbox.
11. Remove bolt securing gearbox breather pipe clip to cylinder block.
12. Remove bolts securing fan cowl to radiator.
13. Release fan cowl from radiator and lay over fan blades.
14. Raise ramp [hoist].
15. Drain oil from main gearbox and transfer gearbox. **See SECTION 10, Maintenance, Under Vehicle Maintenance**
16. Remove exhaust front pipe(s). **See MANIFOLD AND EXHAUST SYSTEM, Repair, Exhaust System Complete**
17. Release intermediate exhaust pipe(s) from mountings and tie aside.
18. Remove bolts securing clutch slave cylinder.
19. Release slave cylinder from clutch housing and collect spacer.
20. Mark propeller shaft drive flange relationships for reassembly.
21. Disconnect front and rear propeller shafts from transfer gearbox. Tie shafts aside.
22. Remove clamp and disconnect speedometer cable from transfer gearbox.
23. Release handbrake cable from transmission tunnel.
24. Temporarily support transmission in a way which enables the crossmember to be removed and a hoist cradle to be fitted.

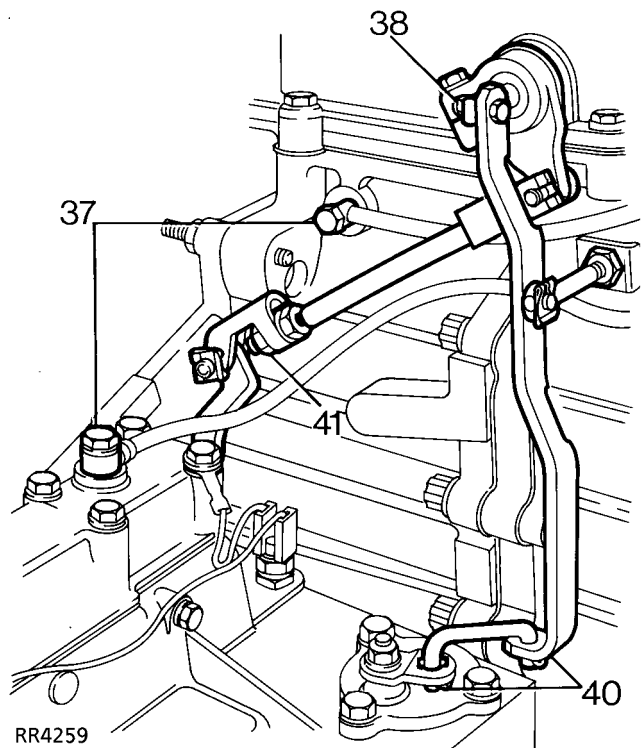
25. Remove nuts and bolts securing transmission cross-member to chassis.
26. Remove nuts and bolts securing cross-member mountings to transmission.
27. Remove cross-member.
28. Manufacture an adapter plate to dimensions given in service tool section and attach it to a transmission hoist. To achieve balance of the transmission unit when mounted to hoist, it is essential that point **A**, is situated over lifting hoist ram. Drill holes **B** to suit hoist table. Secure the transmission unit cradle at point **C** using the lower bolts retaining transfer gearbox rear cover. Raise hoist just enough to take weight of transmission.
29. Lower hoist sufficiently to allow transfer gearbox selector lever to clear transmission tunnel aperture.
30. Disconnect differential lock switch connectors.
31. Disconnect reverse lamp switch connectors.
32. Remove clips securing gearbox breather pipes to harness.
33. Support engine under sump with a jack.



**CAUTION: Use a wooden block to protect sump.**

34. Remove bell housing nuts.
35. Withdraw transmission whilst ensuring all connections to engine and chassis are released.

36. Remove transmission assembly from hoist cradle and position safely on a bench.



37. Remove breather pipes. Discard pipe union sealing washers.
38. Remove 'Nyloc' nut, and remove bolt, securing lever to high/low shaft.
39. Collect spacer washer.
40. Remove 2 clips and remove differential lock lever link.
41. Remove lower locknut from high/low operating rod.
42. Place a sling round transfer box and attach to hoist.
43. Remove nut and 5 bolts securing transfer gearbox to extension housing.
44. Withdraw transfer gearbox.





### Assembling transfer gearbox to main gearbox

45. Clean extension housing and transfer gearbox mating faces.
46. Ensuring loose upper dowel is fitted, hoist transfer gearbox into position.
47. Fit and tighten nut and bolts to **34Nm**.
48. Connect high/low operating rod, fit and tighten locknut.
49. Fit link to differential lock lever and secure with 2 clips
50. Align lever to high/low shaft, position washer, fit bolt and new Nyloc nut. Tighten to **2Nm**.
51. Position breather pipes, secure pipe unions using new sealing washers. Tighten unions to **15Nm**.

### Fitting transfer gearbox and main gearbox assembly to engine

52. Position transmission assembly to hoist cradle.
53. Clean bell housing and engine mating faces.
54. Temporarily fit gear lever and select any gear in main gearbox to facilitate entry of gearbox input shaft.
55. Position and raise hoist, and fit transmission to engine whilst keeping wires and pipes clear to prevent trapping.
56. Fit and tighten nuts securing transmission to engine.
57. Connect reverse lamp switch connectors and differential lock switch connectors.
58. Secure breather pipes to harness with clips.
59. Position temporary support.
60. Remove 2 bolts securing lifting cradle to transmission and remove hoist. Apply Loctite 290 to bolts and refit bolts.
61. Position cross-member, loosely fit nuts and bolts securing cross-member mountings to transmission.
62. Raise transmission, align cross-member and loosely fit nuts and bolts securing cross-member to chassis.
63. Tighten all securing nuts and bolts. Remove supporting jack from under sump.
64. Remove temporary support.
65. Fit handbrake cable through transmission tunnel and secure gaiter.
66. Connect speedometer cable to transfer gearbox.
67. Line up marks and connect front and rear propeller shafts.
68. Clean spacer, clutch slave cylinder and gearbox mating faces.
69. Position spacer and slave cylinder, fit bolts. Tighten to **25Nm**.
70. Untie intermediate exhaust pipe(s) and refit exhaust front pipe(s). **See MANIFOLD AND EXHAUST SYSTEM, Repair, Exhaust System Complete**
71. Refill main gearbox and transfer gearbox with oil. **See SECTION 10, Maintenance, Under Vehicle Maintenance**
72. Lower ramp [hoist].
73. Fit fan cowl, fit and tighten bolts.
74. Align breather pipe clip to cylinder block, fit and tighten bolts.
75. Fit handbrake cable adjuster and secure with 'C' clip.
76. Align cable trunnion to handbrake lever, fit clevis pin and secure with clip.
77. Check handbrake adjustment. **See SECTION 10, Maintenance, Vehicle Interior**
78. Fit upper gear lever, fit and tighten bolt.
79. Fit gear selector lever and high/low selector lever draft excluders.
80. Position draft excluder clamp rings, fit and tighten screws.
81. Refit sound insulation.
82. Refit centre console. **See CHASSIS AND BODY, Repair, Centre Console**
83. Connect battery earth lead.




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**TORQUE VALUES**


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**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
Slave cylinder to bell housing .....	25
Breather .....	15
Bell housing to cylinder block .....	40
High/low level to shaft .....	2
Transfer box to gearbox .....	45



**NOTE:** Torque values below apply to all screws and bolts used unless otherwise specified.

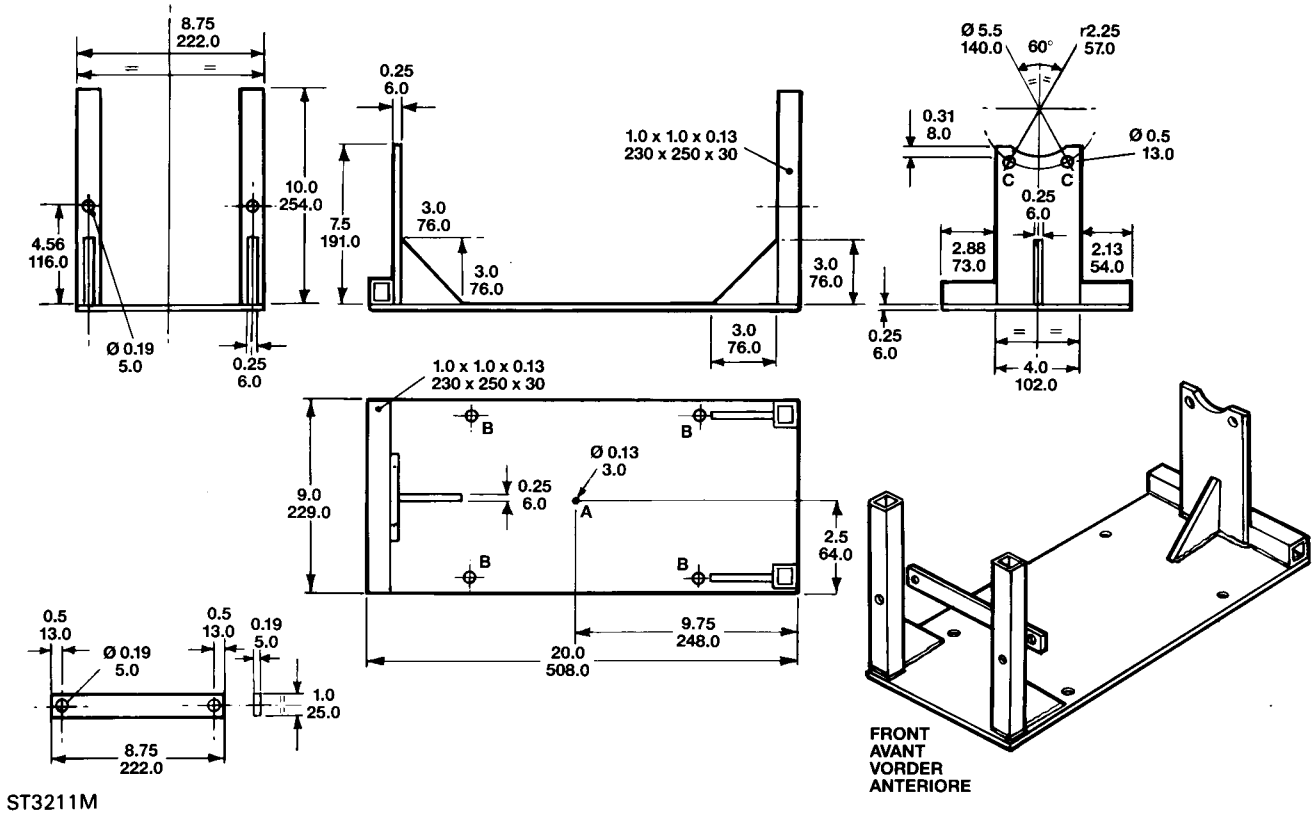
METRIC	Nm
M5 .....	6
M6 .....	9
M8 .....	25
M10 .....	45
M12 .....	90
M14 .....	105
M16 .....	180

UNC / UNF	Nm
1/4 .....	9
5/16 .....	24
3/8 .....	39
7/16 .....	78
1/2 .....	90
5/8 .....	136



## ADAPTER PLATE GEARBOX

Adapter plate for removing gearbox. This can be manufactured locally to drawing shown.



## MATERIAL AND WELDING SPECIFICATION

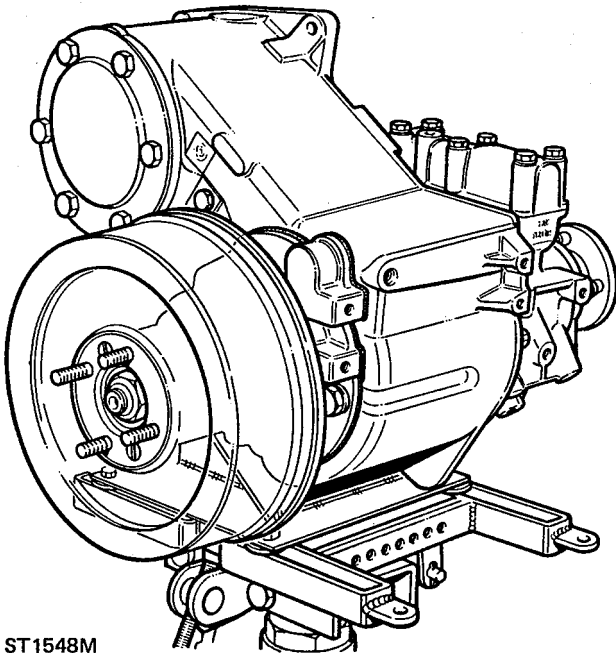
Steel Plate	BS 1449 (Grade 4 or 14)
Tube	BS 4848 (Part 2)
Arc Welding	BS 5135



## LT230T TRANSFER BOX

The LT230T transfer box is a permanent 4 wheel drive, two speed ratio reducing gearbox incorporating high and low range outputs with mechanically lockable centre differential (diff-lock). High/low range and diff-lock selection are made via a single lever located forward of the main gear lever.

A shiftlock device is fitted in some territories, it is used as a park facility and prevents accidental gear disengagement when the ignition is switched off. An audible neutral alarm is also fitted. This alerts the driver when parking to move the gear lever to the high or low position.



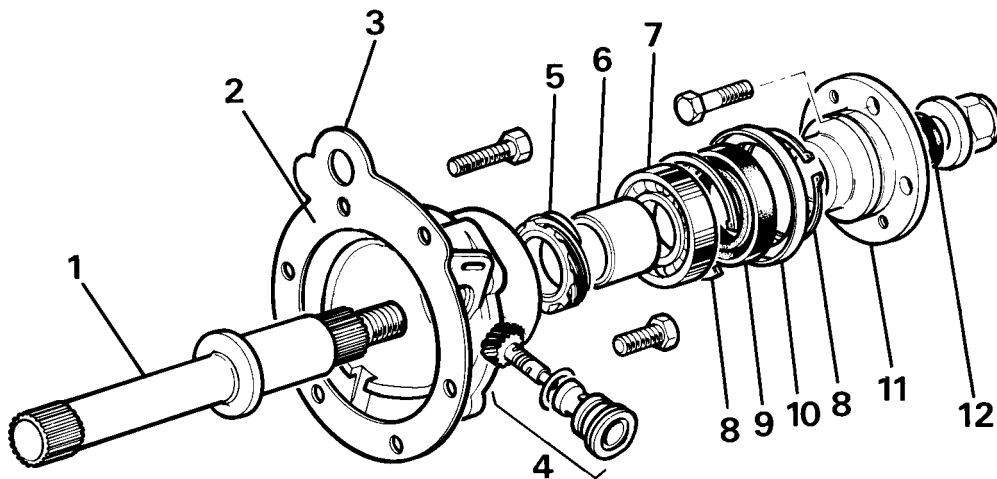
ST1548M

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**REAR OUTPUT DRIVE ASSEMBLY**

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- |                                      |                        |
|--------------------------------------|------------------------|
| 1. Rear output shaft                 | 7. Ball bearing        |
| 2. Joint sealant                     | 8. Circlip             |
| 3. Speedometer drive housing         | 9. Oil seal            |
| 4. Speedometer drive pinion assembly | 10. Oil shield         |
| 5. Speedometer worm drive            | 11. Rear output flange |
| 6. Spacer                            | 12. Sealing washer     |

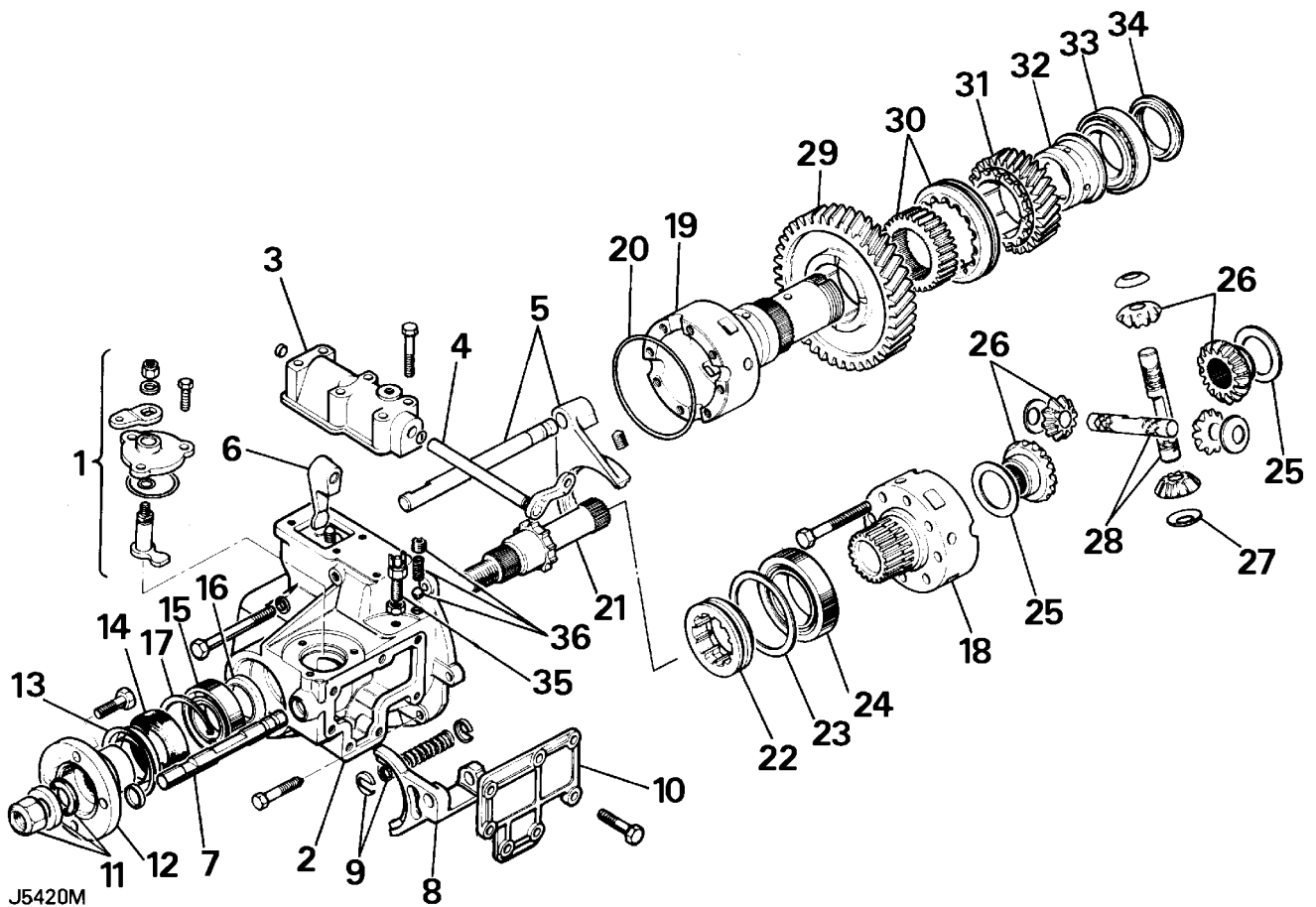


J5415M



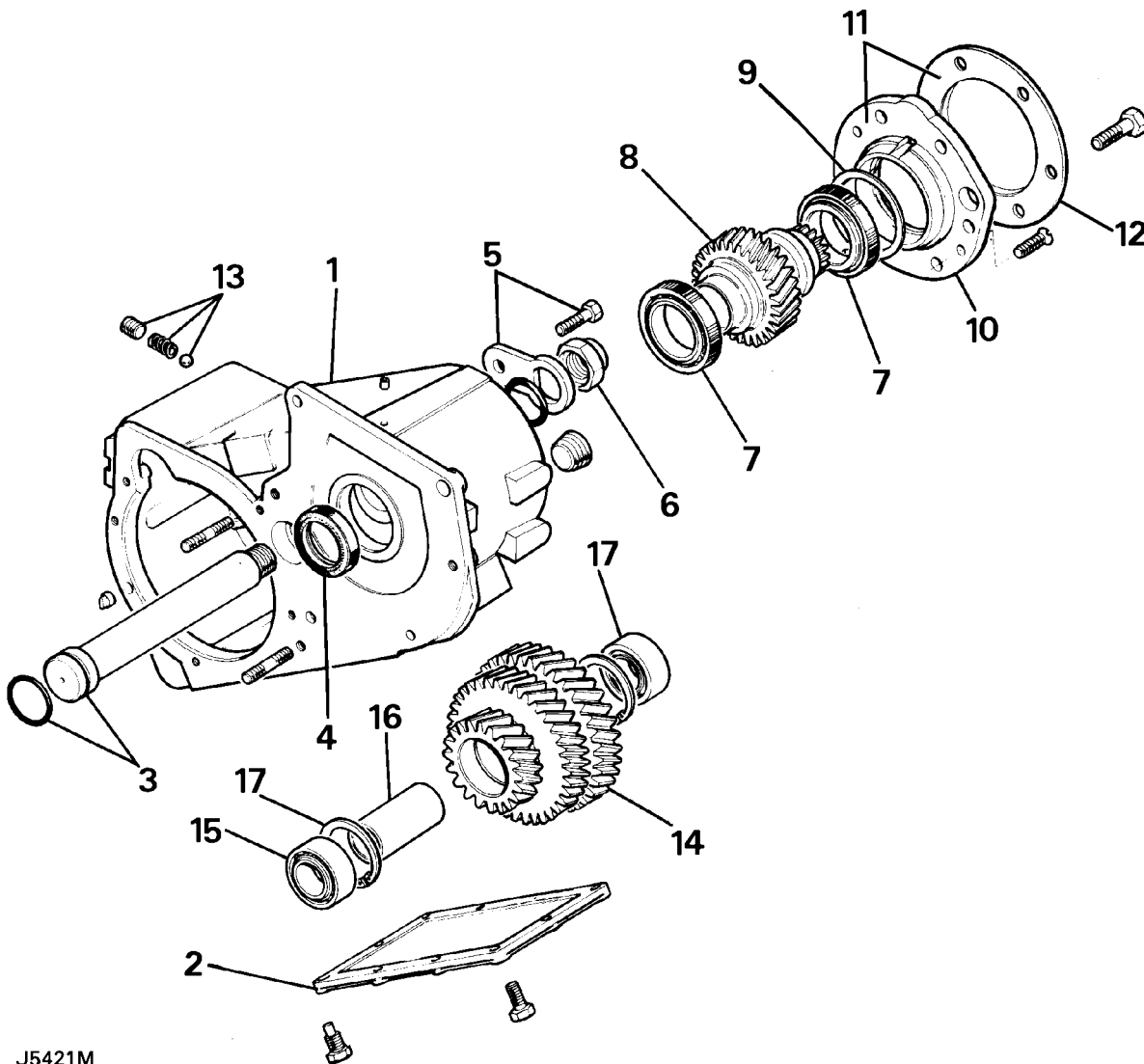
## DIFFERENTIAL AND OUTPUT DRIVE ASSEMBLY

1. Differential selector assembly
2. Front output housing
3. High-low ratio cross shaft assembly
4. High-low selector shaft and lever
5. High-low selector fork and shaft
6. High-low selector finger
7. Differential lock selector shaft
8. Differential lock selector fork
9. Differential lock spring and clips
10. Front output housing cover and housing
11. Felt washer, steel washer and flange nut
12. Front output flange
13. Mud shield
14. Oil seal
15. Bearing
16. Spacer
17. Circlip
18. Differential carrier, front half
19. Differential carrier, rear half
20. Retaining ring
21. Front output shaft
22. Dog clutch, front drive lock-up
23. Selective shim
24. Bearing
25. Selective thrust washers
26. Sun and planet gears
27. Thrust washers
28. Cross shafts
29. Gear low
30. Hub and sleeve assembly
31. High output gear
32. Bush
33. Bearing
34. Bearing retaining nut
35. Differential lock switch
36. Differential lock detent ball and spring



### INTERMEDIATE GEAR AND POWER TAKE OFF ASSEMBLY

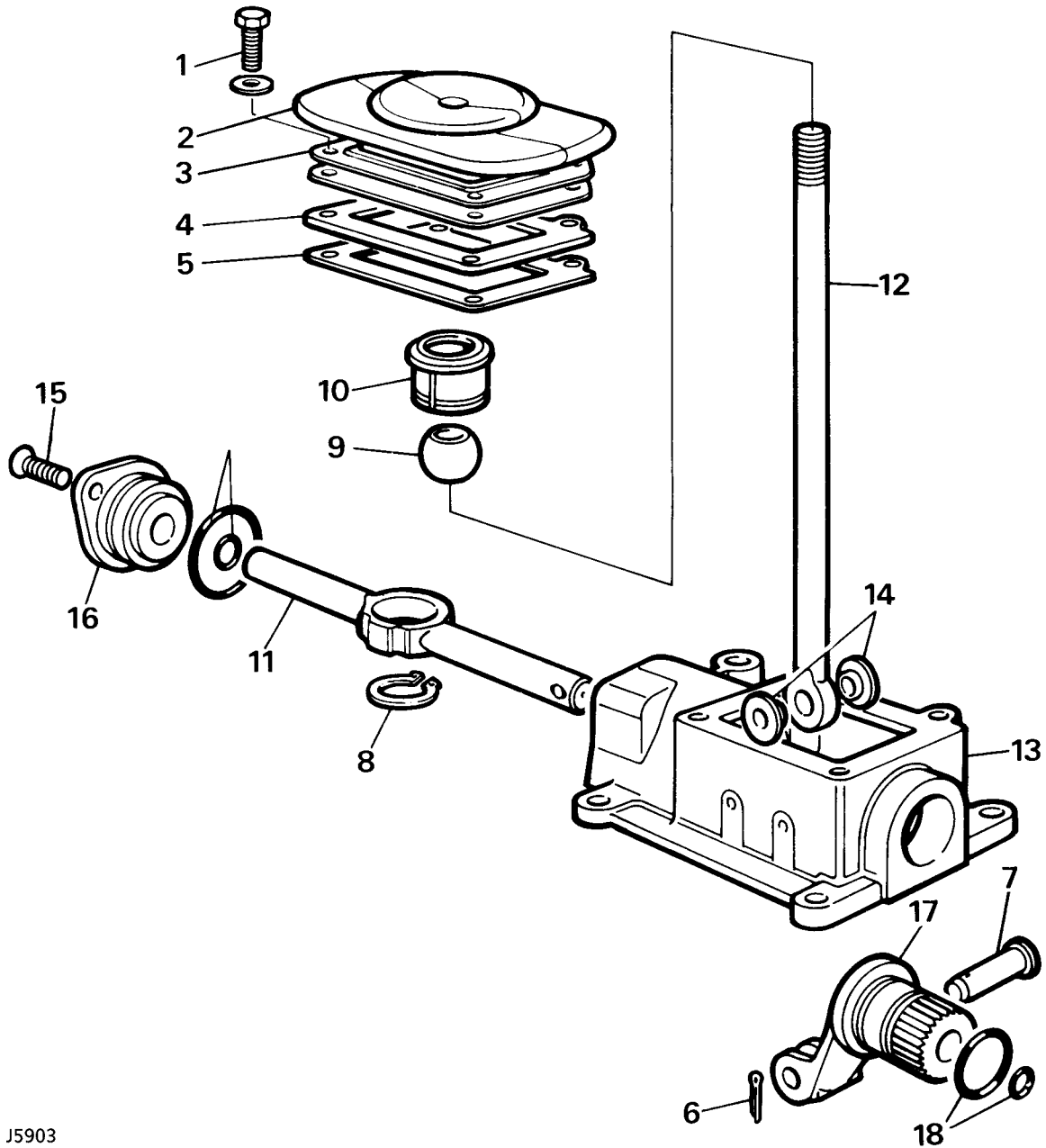
- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. Transfer case assembly</li> <li>2. Transfer case bottom cover</li> <li>3. Intermediate shaft and 'O' ring</li> <li>4. Oil seal</li> <li>5. Retaining plate and anchor screw</li> <li>6. Intermediate shaft nut</li> <li>7. Bearing</li> <li>8. Transfer mainshaft gear</li> <li>9. Selective shim</li> </ol> | <ol style="list-style-type: none"> <li>10. Mainshaft transfer bearing housing</li> <li>11. Joint sealant</li> <li>12. Power take off cover</li> <li>13. High low detent ball and spring</li> <li>14. Intermediate gear cluster</li> <li>15. Bearings</li> <li>16. Collapsible spacer</li> <li>17. Circlip</li> </ol> |
|--|--|



J5421M



TRANSFER GEAR SELECTOR COMPONENTS



J5903

- |                                   |                         |
|-----------------------------------|-------------------------|
| 1. Gaiter retaining screw - 4 off | 10. Nylon seat          |
| 2. Gaiter                         | 11. Cross shaft         |
| 3. Gaiter support plate           | 12. Gear lever          |
| 4. Gate plate                     | 13. Gear change housing |
| 5. Gasket                         | 14. Non-metallic bushes |
| 6. Clip                           | 15. Countersunk screws  |
| 7. Pin                            | 16. End cover           |
| 8. Circlip, retaining nylon seat  | 17. Selector fork       |
| 9. Gear lever ball                | 18. 'O' ring seals      |

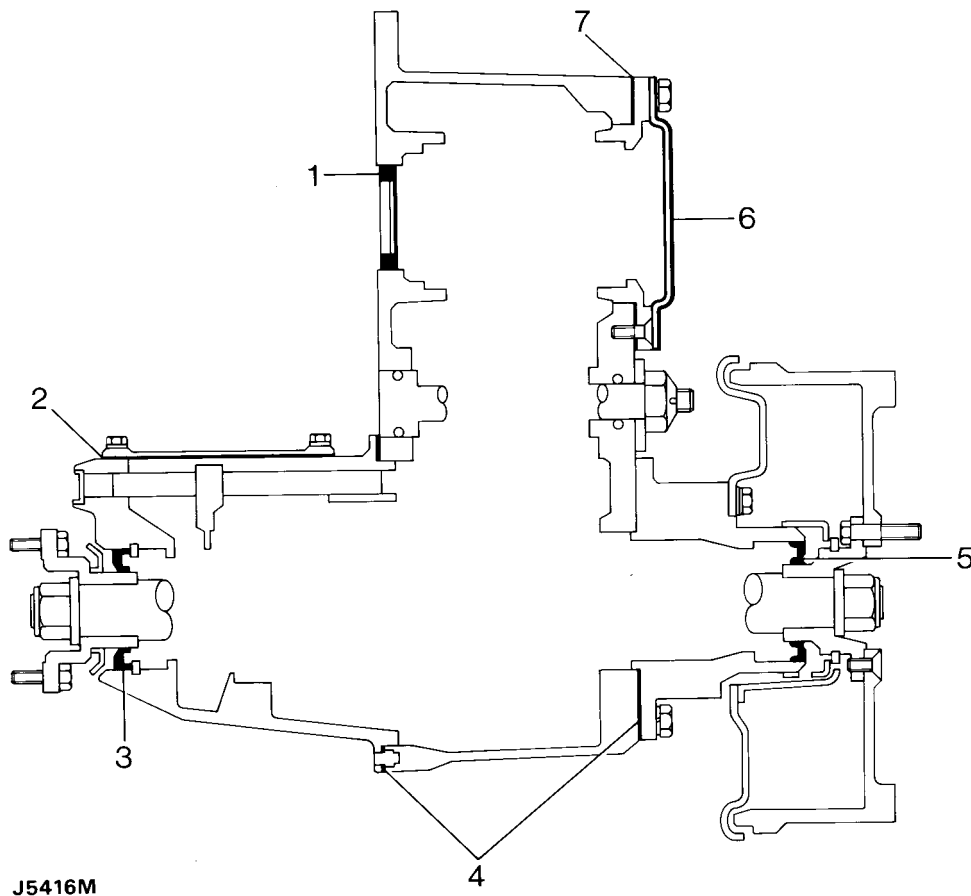




## LT230T TRANSFER BOX - OIL LEAKS

Verify that the leak is from the transfer box and not the gearbox before proceeding.

1. Input seal.
2. Cover plate joints.
3. Front output seal.
4. Front and rear housing joint faces.
5. Rear output seal.
6. Power take off cover plate joint.
7. Bearing plate joint.



**PROCEDURE****Prior to road test**

1. Check oil level in transfer box is correct.
2. Check tightness of level and drain plugs.
3. Check breather system for blockage. To validate the system the pipe must be removed, inspected, rectified as necessary and refitted.
4. Remove all traces of oil from exterior of transfer box.

**Take vehicle for short road test.**

5. Identify source of leaks and rectify as follows.

**Front or rear output seal leaking:-**

1. Drain the oil and remove the leaking output flange.
2. Inspect the seal track on the flange for surface damage. If damaged renew component.
3. Remove and discard the oil seal.
4. Inspect the seal locating bore and remove any sharp edges which may damage the new oil seal.
5. Fit new seal.
6. Fit the output flange and all the other parts.
7. Add oil to correct level into the gearbox. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**

**Cover plate gasket leaking.**

1. Drain the oil and remove the leaking cover plate.
2. Remove all traces of joint sealant from both joint faces.
3. Degrease all components and apply a thin film of Hylomar sealant, to both joint faces.
4. Apply thread sealant to the bolts which come into contact with gearbox oil.
5. Refit cover plate.



**CAUTION: Care must be taken not to overtighten the fixings.**

**Leak between the main and transfer gearboxes.**

1. Site vehicle onto a ramp [hoist].
2. Select neutral in transfer box and select 4th gear in the main gearbox.
3. Run engine at 2000 rpm with the clutch/drive engaged.
4. Observe joint between the main and transfer boxes.
5. If oil leak is found establish if it is gear oil.
6. If so, the leak is originating from the transfer box.
7. Check the two inner (main/transfer) bolts are oil tight, as these holes are tapped through into the main transfer case.
8. Remove the transfer box to inspect the mainshaft collar seal track condition, and the front face of the transfer case for porosity. **See Repair, LT230T Transfer Gearbox**
9. If these areas require servicing, the transfer gearbox input seal must also be renewed.



**CAUTION: Avoid damaging the new seal lip and ensure the seal is fitted flush with the machined face. Also ensure the new seal is not damaged when refitting the transfer gearbox.**

10. If red A.T.F type oil is seen leaking during the workshop test, investigate the main gearbox for cause of leak.

**Detent plug or electrical switch leaks.**

1. Detent plugs and electrical switches do not usually leak. It must be noted that they fit into open tapped holes in the transfer case and therefore should be considered when looking for the source of the leak.



**LT230T TRANSFER GEARBOX**

Service repair no - 41.10.25

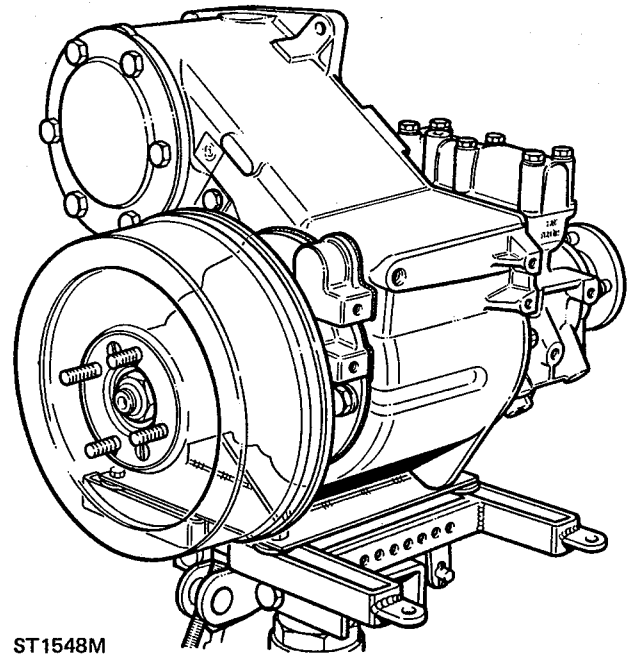
Remove

**Adaptor plate for removing transfer gearbox**

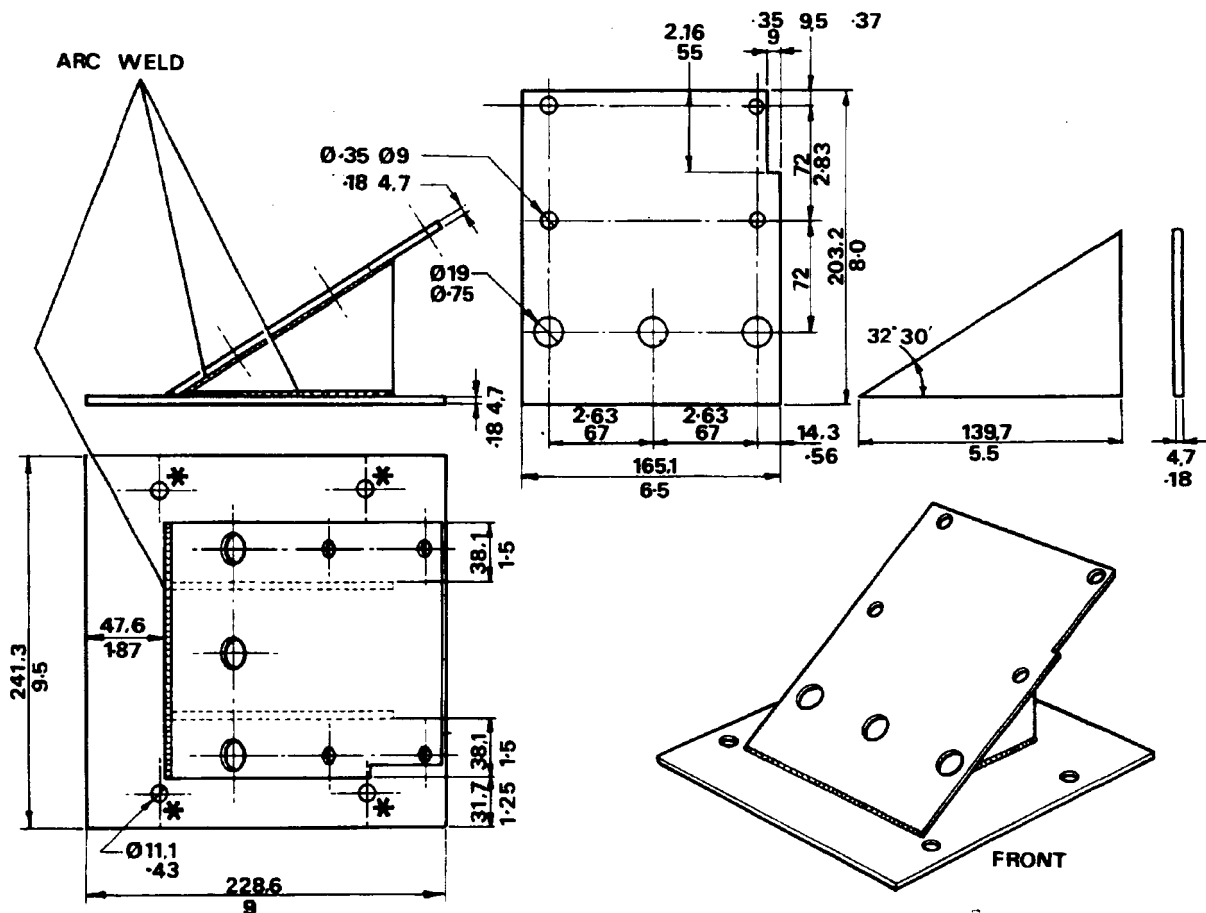
The transfer gearbox is removed from underneath the vehicle. Using a transmission hoist with an adaptor plate for securing the transfer gearbox to the hoist. The adaptor can be manufactured locally to the drawing below.



**WARNING:** When using a transmission hoist it is essential to follow the hoist manufacturer's instructions.



ST1548M



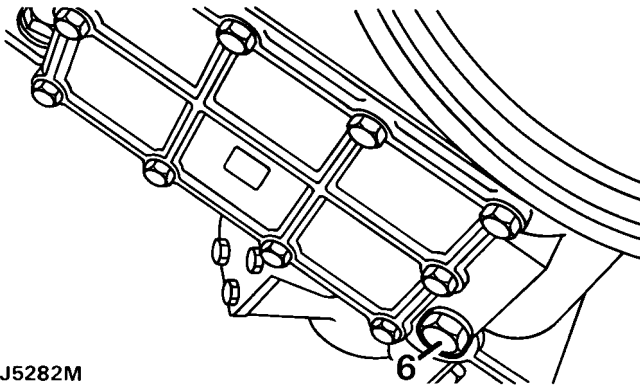
**MATERIAL: STEEL PLATE**

**\*= TO BE DRILLED TO FIT TRANSMISSION JACK BEING USED**

RR2195A

**Remove**

1. Site vehicle on a ramp [hoist].
2. Disconnect battery negative lead.
3. Remove fan cowl from radiator.
4. Remove transfer gear lever knob and gaiter.
5. Raise vehicle on ramp [hoist].
6. Drain oil and refit plug.



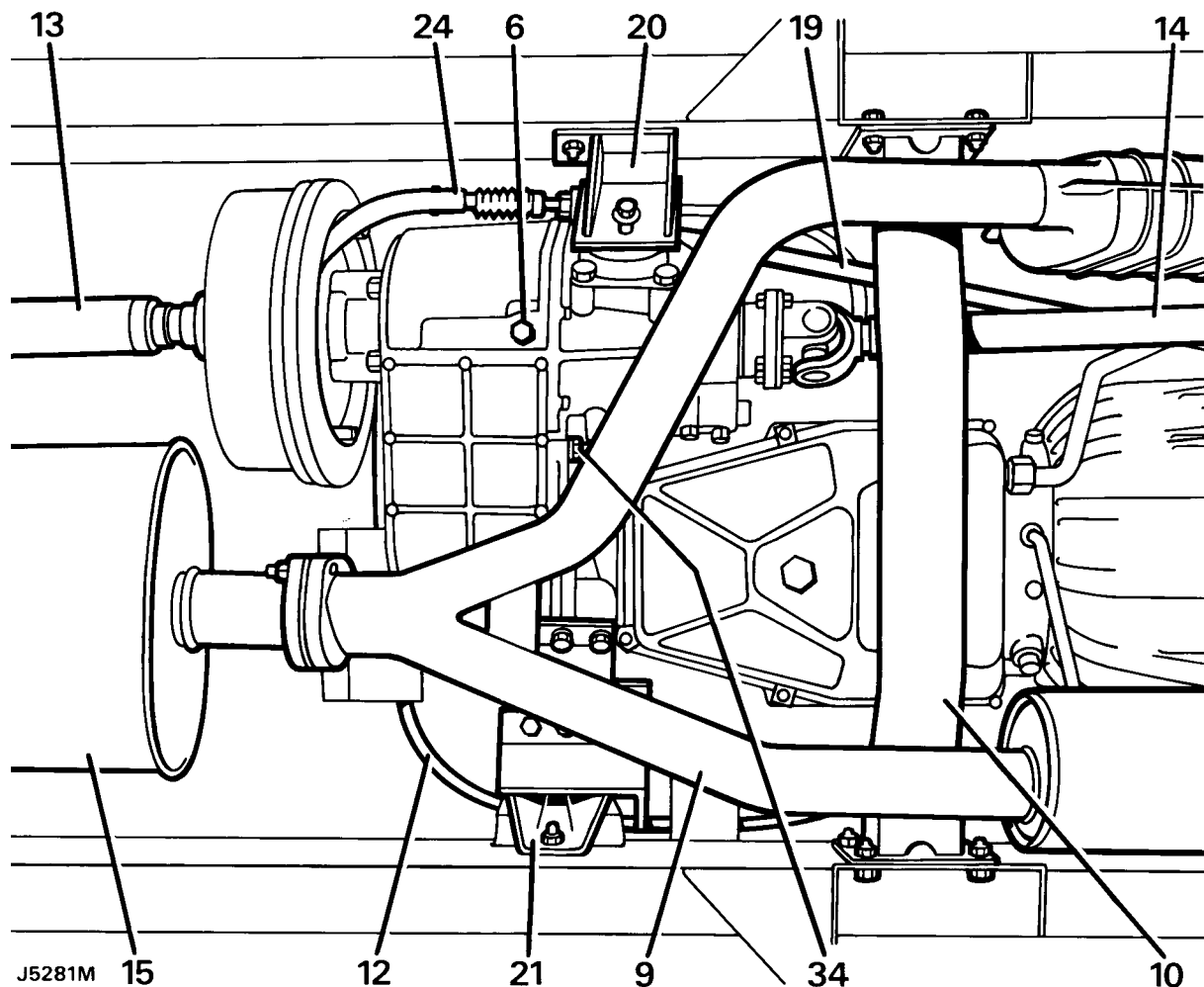
J5282M

7. Detach heat shield at front exhaust pipe to manifold.
8. Disconnect electrics to Lambda sensors.
9. Remove catalytic converter assembly.
10. Remove chassis crossmember from under gearbox.
11. Remove heat shield from speedometer cable at transfer gearbox.
12. Remove clamp and disconnect speedometer cable from transfer gearbox. Tie cable to one side.
13. Mark for reassembly then disconnect propeller shaft to output flange, tie to one side.
14. Repeat on front propeller shaft to output flange.
15. Remove bolts retaining silencer front and rear securing brackets and tie silencer to one side.
16. Place four 30mm long spacers between top of hoist and adaptor plate, at securing points, and secure adaptor plate to hoist.
17. Remove four central bolts from transfer gearbox bottom cover, move hoist into position and secure adaptor plate to transfer gearbox.
18. Adjust hoist to take weight of transfer gearbox.
19. Remove tie bar, transfer gearbox to main gearbox.
20. Remove nuts and bolts securing right transfer gearbox mounting bracket to chassis.
21. Repeat for left mounting bracket. Removal of these fixings will also free speedometer transducer bracket.
22. Remove right side mounting bracket to flexible mounting rubber.
23. Lower hoist until rear brake drum clears passenger footwell. Check engine does not crush any components while lowering.
24. Loosen park brake adjustment nut.
25. Remove park brake drum.
26. Remove park brake assembly complete from rear output flange.
27. Disconnect leads from transfer gearbox temperature sensor and differential lock warning light switch.
28. Remove banjo bolt from breather pipe, retrieve sealing washers and lay pipe aside.
29. Remove split [cotter] pin and washers securing differential lock to connecting rod and disconnect rod from lever.
30. Select low range transfer gearbox position.
31. Remove high/low rod lower lock nut and remove rod from yoke.
32. Position hoist jack channel under bell housing.
33. Using wooden block support the main gearbox and bell housing.
34. Remove upper and lower bolts securing transfer gearbox to main gearbox.
35. Fit guide studs 18G 1425 to main gearbox and move transfer gearbox rearwards to detach.



## Refit

36. Select 'P' in main gearbox, with low range and differential lock selected in transfer gearbox.
37. Secure transfer gearbox to adaptor plate on lifting hoist.
38. Ensure joint faces of transfer and main gearboxes are clean and guide studs 18G 1425 are fitted.
39. Raise hoist until transfer gearbox can be located over guide studs to main gearbox. At the same time locate high/low lower link to yoke.
40. Remove guide studs and secure transfer gearbox to main gearbox.
41. Complete refitting by reversing removal procedure, noting the following important points.
42. After removal of adaptor plate from transfer gearbox, clean threads of four bottom cover bolts, coat threads with Loctite 290 and fit together with spring washers. Tighten to **25Nm**
43. Add correct grade of oil to transfer gearbox to oil level plug hole. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**
44. Check main gearbox oil level.
45. Check operation of parking brake and adjust as necessary. **See SECTION 10, Maintenance, Vehicle Interior**

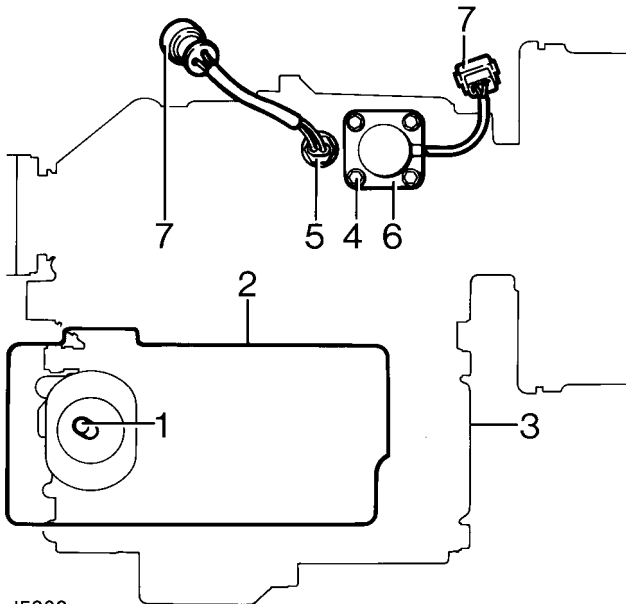


**SHIFTLOCK SOLENOID/NEUTRAL SWITCH****Service repair no - 41.10.63/64**

This is sited on top of the transfer gearbox. Access to the component is gained through the transmission tunnel aperture.

**Remove**

1. Disconnect battery negative lead.
2. Remove centre console. **See CHASSIS AND BODY, Repair, Centre Console**
3. Remove rear passenger heater air ducts.
4. Remove insulation pad.
5. Remove four screws and remove main gear lever assembly.
6. Drill out rivets and remove tunnel blanking plate.
7. Disconnect solenoid multiplug.
8. Remove four retaining bolts and remove shiftlock solenoid cover.
9. Remove solenoid and spring washer.
10. Clean joint sealant from mating faces.



J5908

**KEY**

1. Gearlever
2. Transmission tunnel aperture
3. Transfer gearbox
4. Bolt
5. Switch
6. Solenoid
7. Electrical connections

**Refit**

1. Apply Hylosil or equivalent sealant to mating faces.
2. Ensure solenoid plug lead is located in cover recess.
3. Reverse removal procedure.
4. Fit four solenoid bolts. Tighten to **9Nm**.

**Neutral switch, audible alarm**

1. Disconnect neutral switch electrical plug.
2. Remove neutral switch from transfer box.

**Refit**

3. Apply Hylomar PL32/L20 or SL500 sealant to neutral switch.
4. Reverse removal procedure.
5. Switch - Tighten to **25Nm**.




---

**TORQUE VALUES**


---



**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
<b>LT230T Transfer gearbox</b>	
Pinch bolt - operating arm to crank arm .....	9
End cover gear change housing .....	9
Bottom cover to transfer case .....	25
Front output housing to transfer case .....	25
Cross shaft housing to front output housing .....	25
Gear change housing .....	25
Pivot shaft to link arm .....	25
Connecting rod to adjustable clevis .....	25
Anti-rotation plate intermediate shaft .....	25
Front output housing cover .....	25
Pivot bracket to extension housing .....	25
Finger housing to front output housing .....	25
Bearing housing to transfer case .....	25
Brake drum to coupling flange .....	25
Bearing housing cover to transfer gearbox .....	45
Rear output speedometer housing to transfer gearbox .....	45
Selector finger to cross shaft high/low .....	25
Selector fork, high/low to shaft .....	25
Transmission brake to speedometer housing .....	72
Gate plate to grommet plate .....	9
Gearbox to transfer case .....	45
Oil drain plug .....	30
Oil filler/level plug .....	30
Differential case (front to rear) .....	60
Output flanges .....	162
Differential case rear stake nut .....	72
Transfer breather .....	15
Transfer box front drive flange to drive shaft .....	45
Transfer box rear drive flange to drive shaft .....	45
Transfer gearbox mounting brackets to chassis .....	30
Mounting brackets to transfer gearbox .....	55
Mounting rubbers to mounting brackets .....	21
<b>Shiftlock</b>	
Shiftlock screws .....	9
Neutral switch .....	25

---

**LT230T TRANSFER GEARBOX DATA**

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High range gear end - float .....	0,05 to 0,15 mm
Front differential bearing pre - load .....	0.56 to 1.69 Nm
Input gear bearing pre - load .....	0.56 to 2.25 Nm
Intermediate shaft bearing pre - load .....	0.56 to 1.69 Nm

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**JOINT SEALANT**

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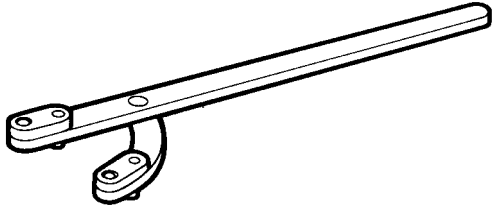
Joint faces use .....	BLS. 22SE03 TYPE 2
Shiftlock solenoid cover .....	HYLOSIL RTV
Neutral switch .....	HYLOMAR





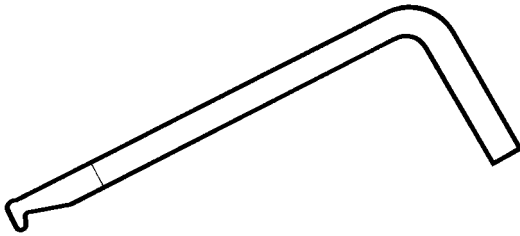
LT230T TRANSFER GEARBOX

LRT-51-003 Drive flange wrench  
18G 1205



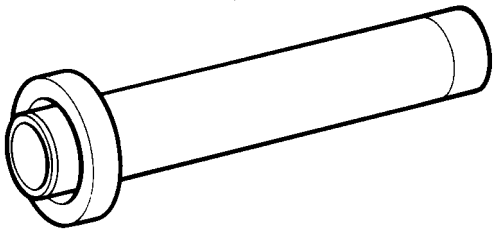
18G1205

18G 1271 Oil seal remover  
18G 1271



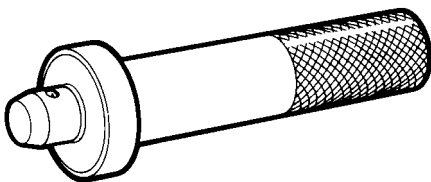
18G1271

LRT-37-014 Mainshaft rear oil seal replacer  
18G 1422



18G1422

LRT-99-003 Oil seal replacer handle  
MS 550 or 18G 134



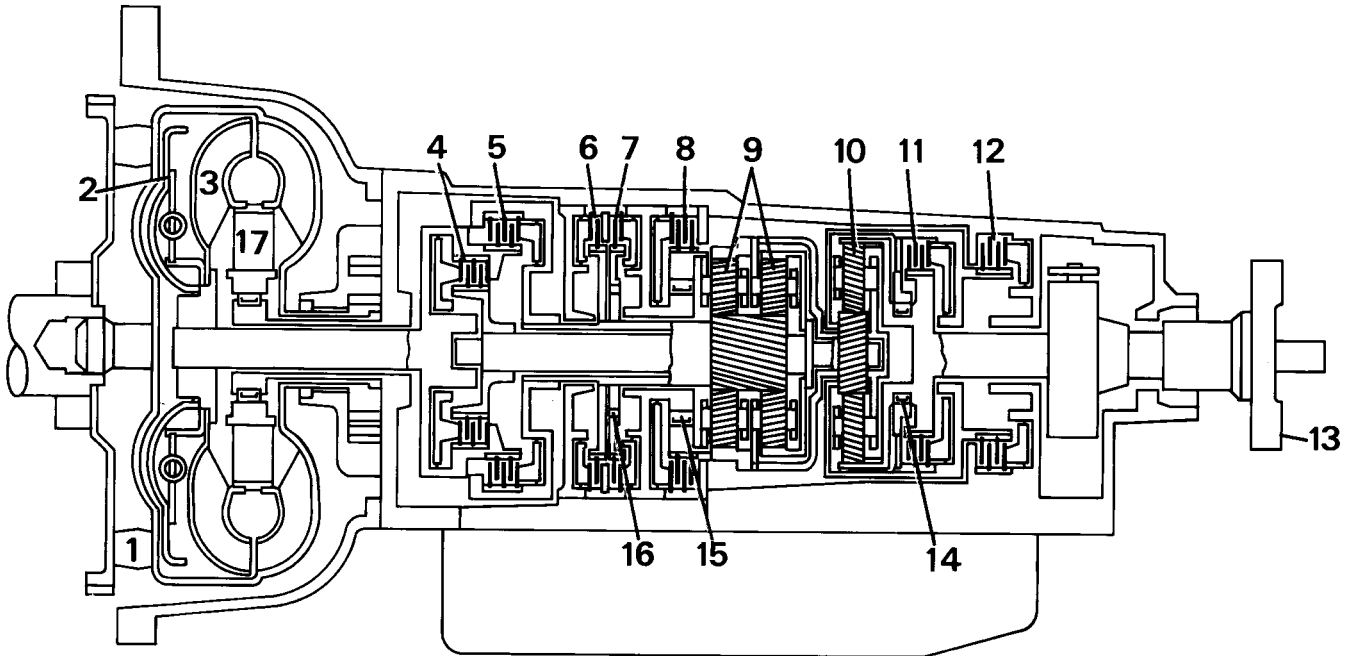
MS550



## DESCRIPTION

The automatic transmission is specially tailored version of the ZF4 HP22, used by many manufacturer's of high performance vehicles.

A three element torque converter delivers the power to a four speed epicyclic transmission. First, second and third gears are reduction ratios but fourth is an overdrive gear for high speed cruising. A direct drive clutch, integral with the torque converter operates to engage fourth gear.



RR3560A

The gear selector has seven positions as follows:

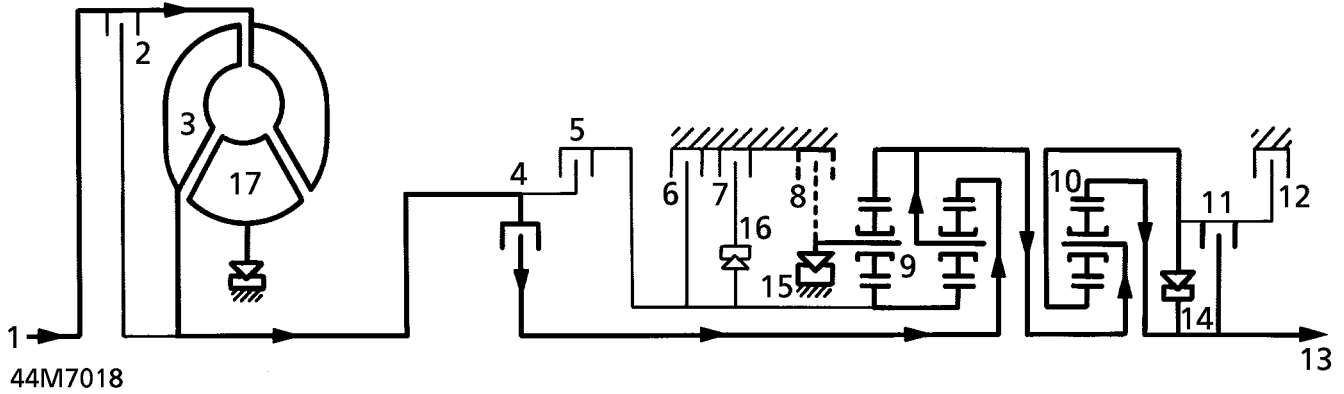
- P = Park provides a mechanical lock on the output shaft.
- R = Reverse gear.
- N = Neutral.
- D = Provides a 1st gear start and automatic shifts 1-2-3-4-3-2-1.
- 3 = Provides a 1st gear start and automatic shifts 1-2-3-2-1.
- 2 = Provides a 1st gear start and automatic shifts 1-2-1 or 3-2-1.
- 1 = Provides a 1st gear start with no up shifts, or 3-2-1.

All automatic shifts are automatically controlled by the valve block and an hydraulic governor driven by the output shaft.

## Power flow

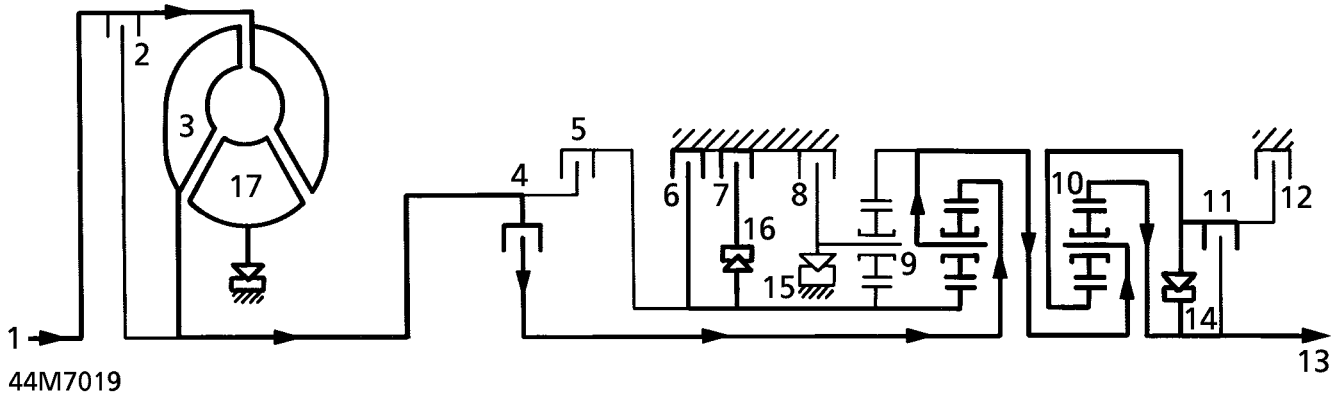
### 1st gear D selected

With D selected 1st gear engaged, clutches 4 and 11 are operative. The front planet gear carrier of gear set 9 is locked against the housing through freewheel 15 when the engine is pulling but freewheels when the vehicle is coasting. Epicyclic gear set 10 rotates as a solid unit with the front planet gear carrier. In selector position 1 with 1st gear engaged, clutch 8 operates to prevent the loss of drive on the overrun through freewheel 15, to provide engine braking.



### 2nd gear D selected

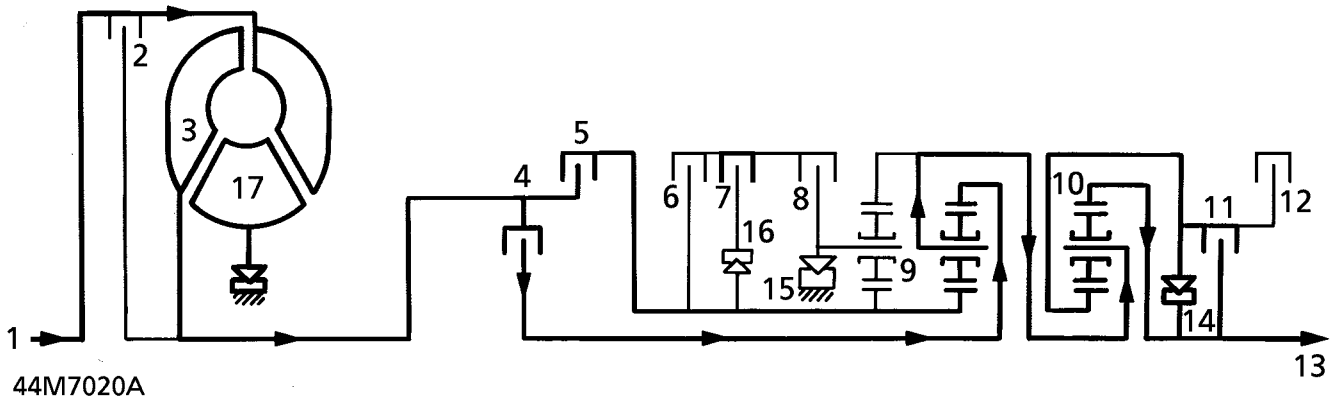
Clutches 4, 6, 7 and 11 are engaged. Freewheel 15 overruns, the hollow shaft with the sun wheel of epicyclic gear set 9 is locked. Epicyclic gear set 10 also rotates as a solid unit.





### 3rd gear D selected

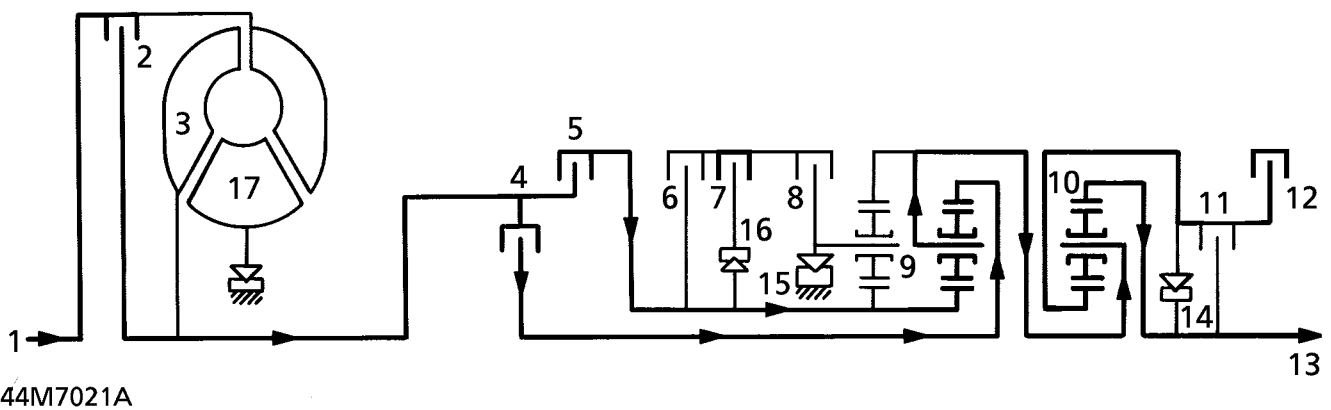
Clutches 4, 5, 7 and 11 are engaged. Freewheel 15 and 16 are overrun. Epicyclic gear set 9 and 10 rotate as a solid unit at a ratio of 1:1.



### 4th gear D selected

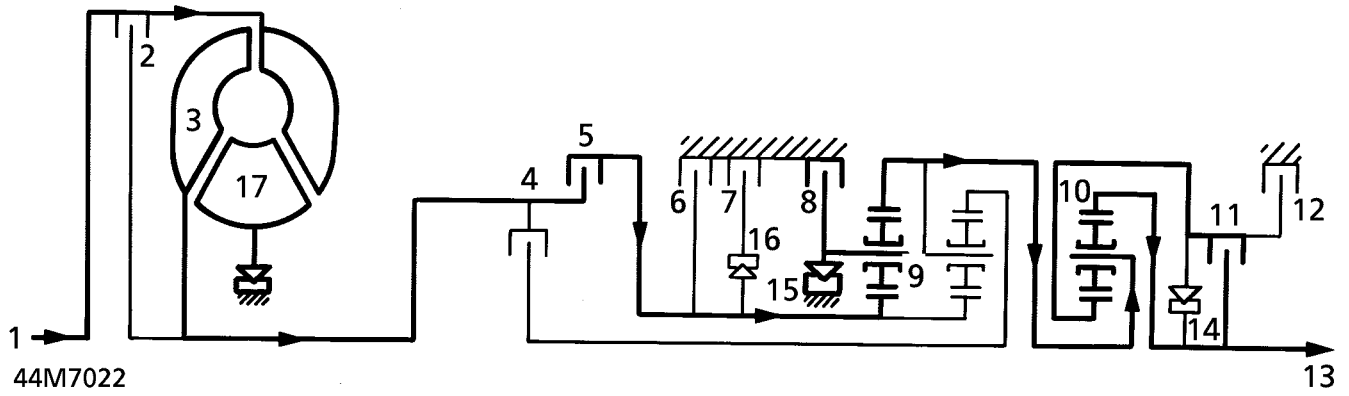
Clutches 4, 5, 7 and 12 are engaged. Freewheel 14, 15 and 16 are overrun. Epicyclic gear set 9 rotates as a solid unit. The hollow shaft with the sun wheel of epicyclic gear set 10 is locked.

Above a predetermined road speed, clutch 2 locks the gearbox power input direct to the engine, by-passing the torque converter.



## Reverse gear

Clutches 5, 8 and 11 are engaged. Since the front planet gear carrier of epicyclic gear set 9 is locked, the direction of output-shaft rotation is reversed. Epicyclic gear set 10 also rotates as a solid block.





## ZF AUTOMATIC GEARBOX

Before referring to fault symptoms, carry out initial static checks first:

### INITIAL STATIC CHECKS

Check start positions .....	'P' & 'N' only
Reverse lights .....	'R' only
Gear engagements .....	N-D,N-3,N-2,N-1,N-R
Full throttle .....	Engine switched off, check full travel at engine and at pedal.
Oil level .....	'N' selected, engine running at normal running temperature.

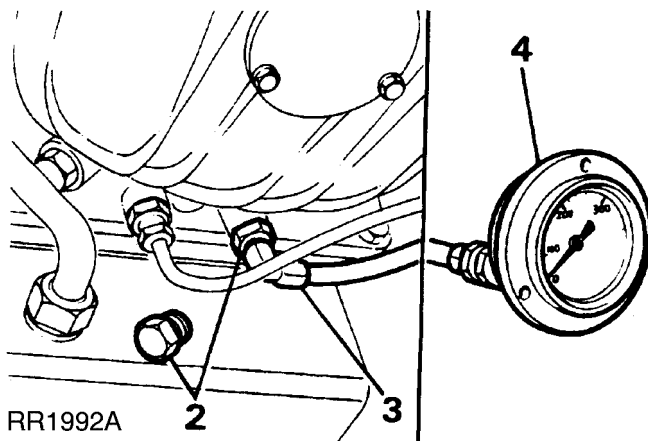
### Pressure test

2000 rev/min .....	10 ± 0.3 bar, 150 ± 5 lbf/in <sup>2</sup>
Idle pressure .....	6.9 ± 0.3 bar, 100 ± 5 lbf/in <sup>2</sup> at 665 to 735 rev/min.

### To fit pressure gauge

**Service tools:** See *Service tools, Automatic Gearbox*

0 to 20 bar, 0 to 300 lbf/in<sup>2</sup> Pressure gauge.  
Flexible hose adaptor.



### Remove pressure gauge

- Reverse removal procedure.

- Site vehicle on a ramp [hoist].
- From under gearbox, remove socket head plug (located 10cm from oil pipe) Fit hose adaptor LST502-1.
- Fit hose to adaptor.
- Fit gauge 18G502A to hose and route into vehicle, ensuring hose is clear of rotating parts and exhaust pipes.
- Carry out road test. See *Road Test Procedure*

**ROAD TEST PROCEDURE**

Follow the procedure given commencing each test, from a standing start, on a level road, in good weather conditions.

**ROADTEST 1 = CHECKS 1-2-3-4-5-6-7-8****D SELECTED KICKDOWN START FROM REST****CHECK 1**

Check for clutch squeal and slip. Check pressure is 150lbf/in<sup>2</sup>

**CHECK 2**

Check 1st to 2nd upshift speed and quality. Pressure should fall to 120 lbf/in<sup>2</sup>.

**CHECK 3**

Check 2nd-3rd upshift speed and quality. Pressure should fall to 100 lbf/in<sup>2</sup>

**CHECK 4**

Release throttle to allow simultaneous engagement 4th + DDC. Check shift quality and engine rpm drop of approximately 500 rpm.

**CHECK 5**

To proceed to Check 5 release throttle and check drop out speed of direct drive clutch to 4th.

**CHECK 6**

Check down shift speed and quality 4th to 3rd.



**NOTE: This shift is usually very smooth and difficult to detect.**

**CHECK 7**

Check downshift speed and quality 3rd to 2nd.

**CHECK 8**

Check downshift speed and quality 2nd to 1st. Also difficult to detect.

**END OF ROADTEST 1****ROADTEST 2 CHECKS = 9-10-11****D SELECTED FROM REST****FULL THROTTLE START****CHECK 9**

Check 1st-2nd upshift speed and quality.

**CHECK 10**

Check 2nd 3rd upshift speed and quality.

**CHECK 11**

Check 3rd 4th and direct drive clutch upshift speed and quality.



**NOTE: 4th and the direct drive clutch engage simultaneously.**

**END OF ROADTEST 2**

**ROADTEST 3 = CHECKS****12-13-14-15-16-17-18-19-20-21-22-23****D SELECTED FROM REST****LIGHT THROTTLE START****CHECK 12**

Check 1st 2nd upshift speed and quality.

**CHECK 13**

Check 2nd 3rd upshift speed and quality.

**CHECK 14**

Check 3rd 4th upshift speed and quality.



**NOTE: This shift is usually very difficult to detect but can be confirmed by a 200 rpm drop in engine speed.**

**CHECK 15**

Check speed and quality of shift into direct drive clutch, confirmed by 300 rpm drop in engine speed.



**NOTE: An intermediate throttle position engagement of 4th and the direct drive clutch, which is indicated by a fall of 500rpm in engine speed.**

**CHECK 16**

At approximately 88 kph (55 mph) depress throttle to kickdown - gearbox should change down to 2nd - release throttle to re-engage 4th direct drive clutch continue to accelerate gently.

**CHECK 17**

At approximately 128 kph (80 mph) depress throttle to kickdown - gearbox should change down to 3rd - release throttle to re-engage 4th direct drive clutch and continue to accelerate gently.

**CHECK 18**

At approximately 138 kph (85 mph) select 3rd, gearbox should change immediately down to 3rd. Release throttle.

**CHECK 19**

De-accelerate to approximately 47 kph (30 mph) depress throttle to kickdown - gearbox should downshift to 1st gear, continue accelerating at full throttle until 3rd gear is attained. To do this you will have repeated check 2 of Test 1.

**CHECK 20**

At 128 kph (80 mph) select 2nd no downshift should occur. Release throttle.

**CHECK 21**

At 104 kph (65 mph) an automatic downshift into 2nd gear should occur. Continue to de-accelerate.

**CHECK 22**

At 88 kph (55 mph) select 1st. No downshift should occur. Continue to de-accelerate.

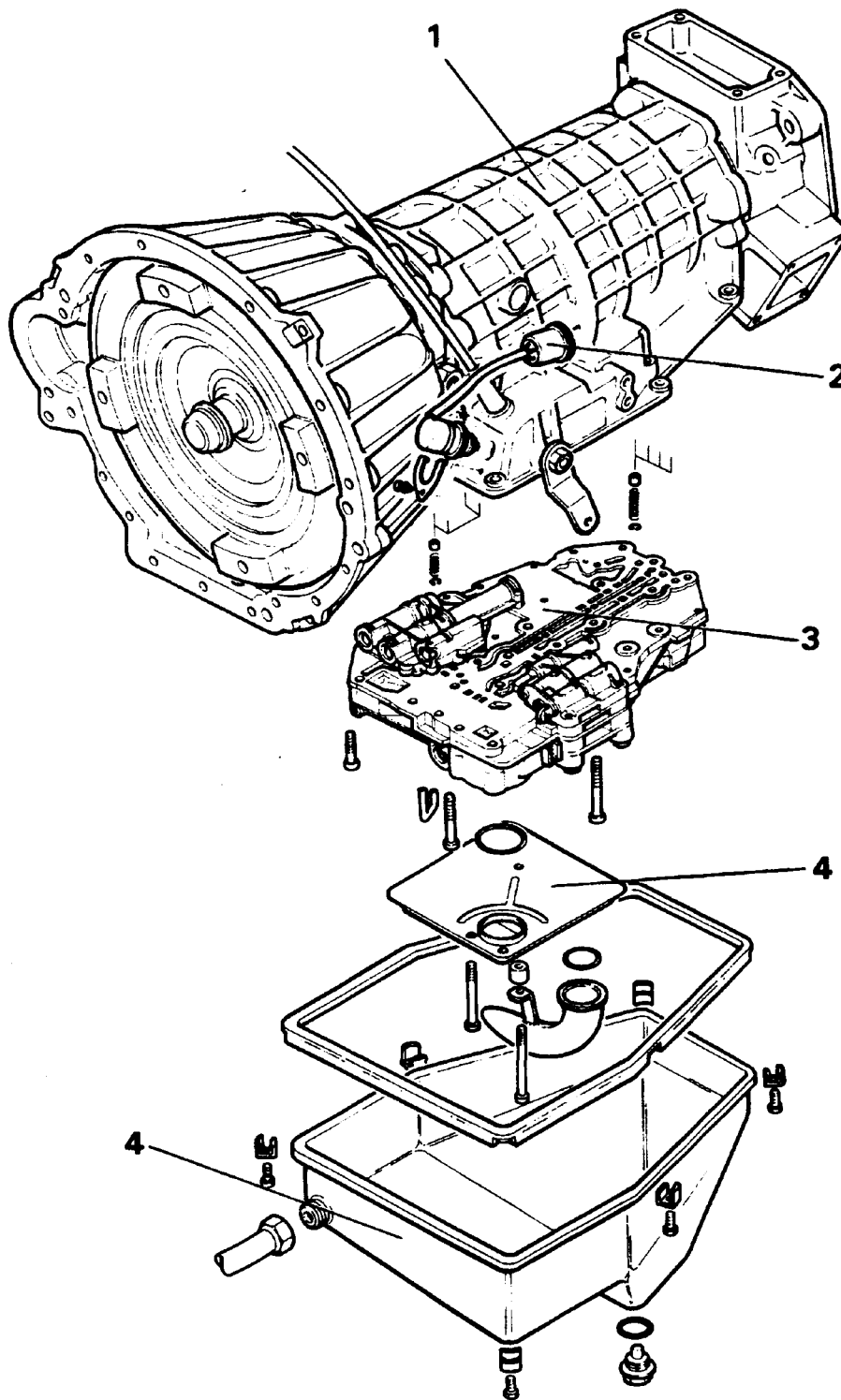
**CHECK 23**

With 1 selected 2nd gear engaged continue to de-accelerate and at 45 kph (28 mph) the box should automatically downshift to 1st gear after which no upshifts will occur in this selector position.

**END OF ROADTEST**



## AUTOMATIC GEARBOX ASSEMBLY ILLUSTRATED

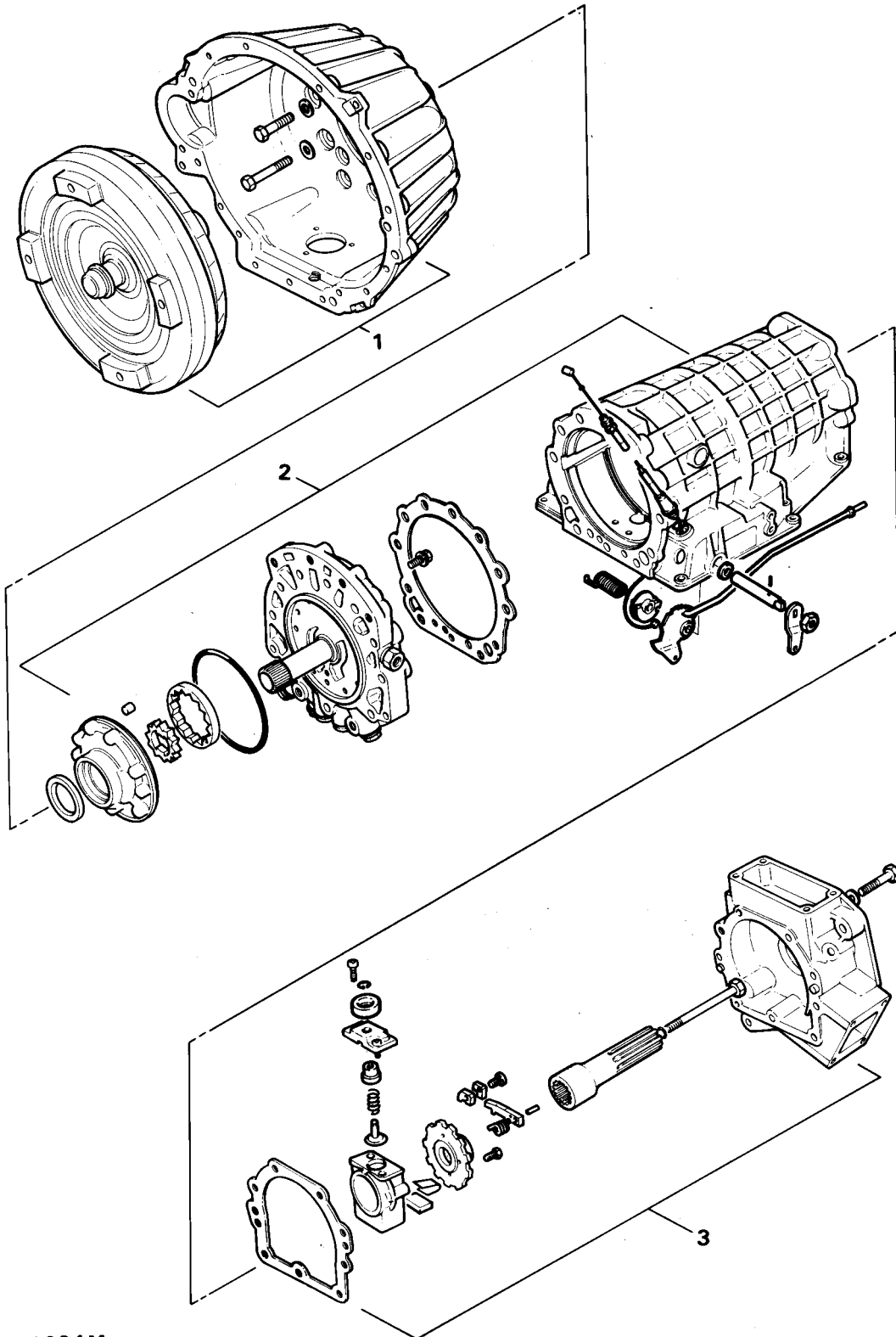


RR0524A

1. Gearbox assembly
2. Inhibitor switch assembly
3. Control unit assembly
4. Filter and sump assembly

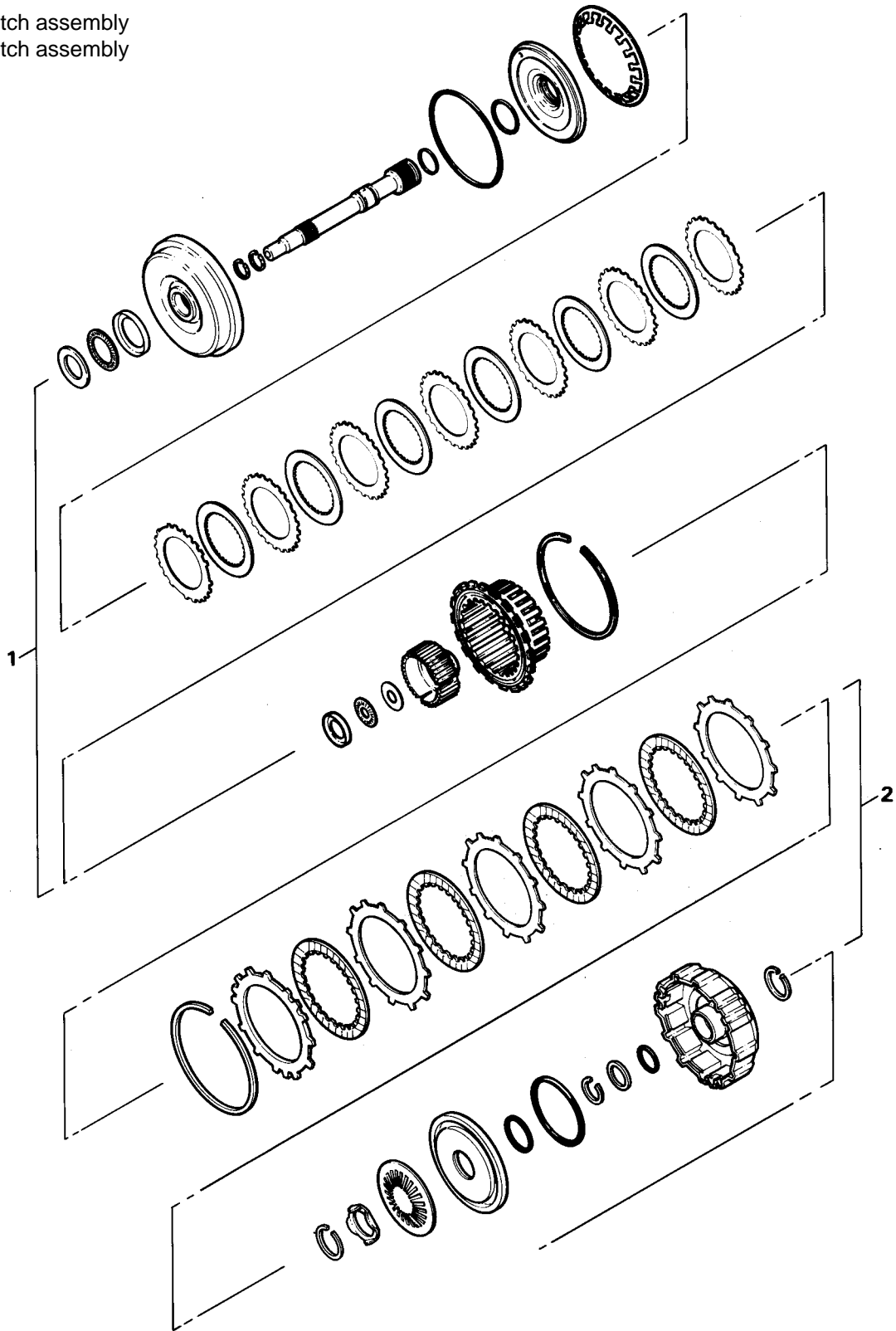


1. Torque converter housing assembly
2. Gearbox pump and casing assembly
3. Governor and adaptor housing assembly



RR 3894M

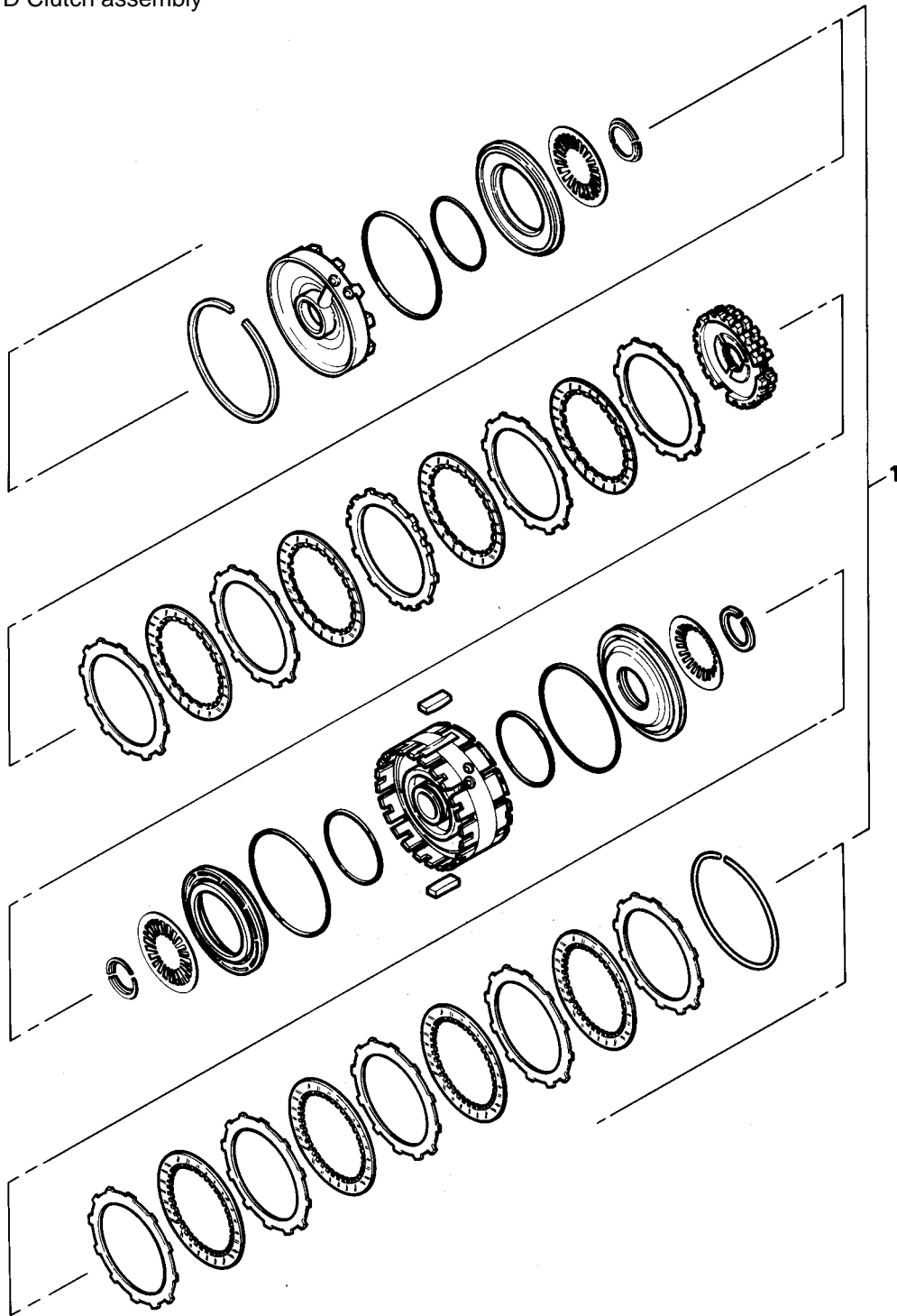
- 1. A Clutch assembly
- 2. B Clutch assembly



RR3895M

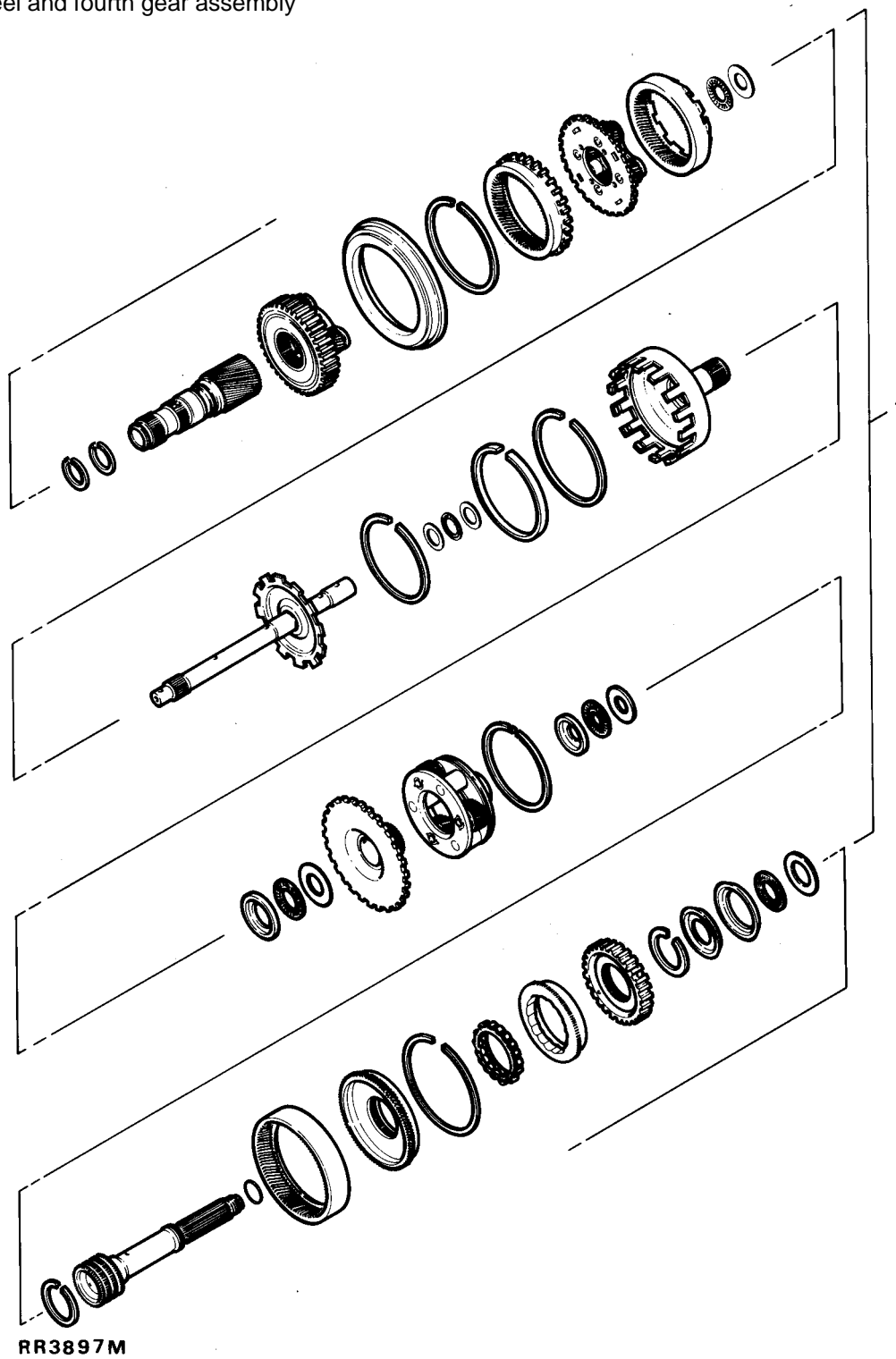


## 1. C,C' and D Clutch assembly



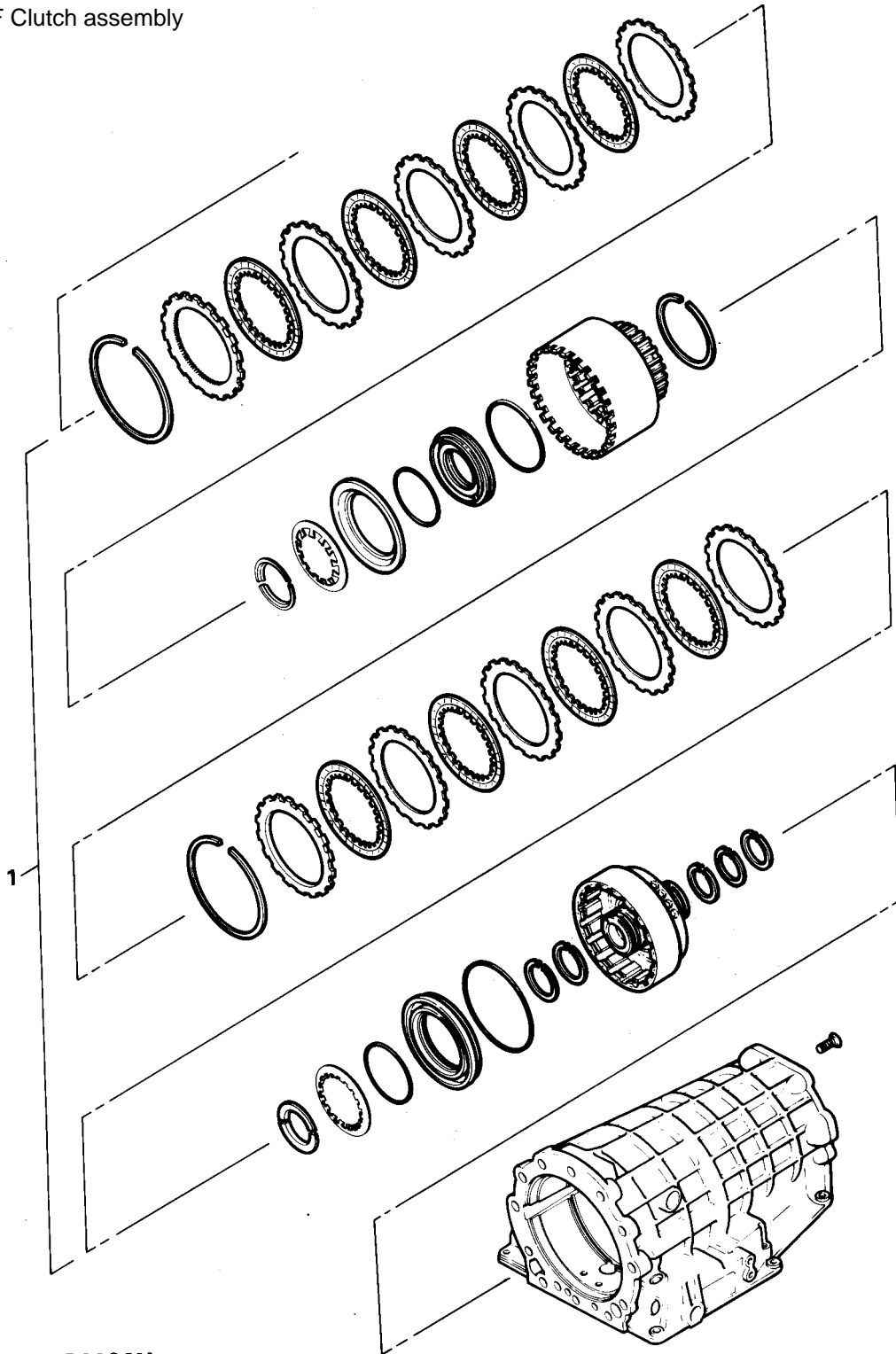
RR3896M

## 1. Freewheel and fourth gear assembly





1. E and F Clutch assembly



RR3898M

**FAULT SYMPTOMS****SYMPTOM 1 - Intermittent drive and high pitched noise**

FAULT - Low fluid level or restricted filter

**SYMPTOM 2 - No drive in reverse**

Select 'D'

œ No drive

FAULT - Continue with Symptom 3

œ Drives forward

FAULT - Reverse gear interlock valve seized

Select '1'

œ No engine braking

FAULT - Clutch brake 3

**SYMPTOM 3 - No drive from rest with 'D' selected**

Select '1'

œ Vehicle drives

FAULT - No 2 freewheel

œ No drive

Carry out main line pressure check

œ Normal pressure

FAULT - Clutch A

œ No pressure

FAULT - Blocked filter or pump failure

œ Low pressure

FAULT - Restricted filter or sticking primary regulator

**SYMPTOM 4 - Slip in all forward gears**

Carry out main line pressure check

œ No pressure

FAULT - Blocked filter or pump failure

œ Low pressure

FAULT - Restricted filter or sticking primary regulator

œ Normal pressure

FAULT - Clutch 'A'

**SYMPTOM 5 - Harsh engagement 'N' to 'D'**

Check engine idle speed

Carry out main line pressure check

œ High pressure

FAULT - Primary regulator stuck

œ Normal pressure

FAULT - Clutch 'A' or damper for clutch 'A'

**SYMPTOM 6 - Fierce shift or flare 1st to 2nd shift**

Check engine idle speed

Carry out mainline pressure check

œ High pressure

FAULT - Continue with symptom 5

œ Normal pressure

FAULT - Modulator valve or dampers for

clutch brake CB1 and/or clutch brake CB2

FAULT - Clutch brake CB1 and/or clutch

brake CB2

**SYMPTOM 7 - Fierce shift or flare 2nd to 3rd**

Carry out mainline pressure check

œ High pressure

FAULT - Continue with symptom 5

œ Normal pressure

FAULT - Modulator valve or clutch 'B' damper

FAULT - Clutch 'B'

**SYMPTOM 8 - No 3rd gear**

FAULT - 2-3 shift valve

FAULT - Clutch 'B'

**SYMPTOM 9 - No 4th gear 'D' selected**

FAULT - 4th to 3rd downshift valve stuck or

3rd to 4th upshift valve stuck

FAULT - Clutch brake 4



**SYMPTOM 10 - None or harsh engagement of direct drive clutch**



**NOTE: The direct drive clutch will only engage if 4th gear is engaged at 40 to 45 mph.**

Carry out road test pressure check with gauge connected to torque converter.

- œ Normal pressure  
FAULT - Failed direct drive clutch
- œ Pressures correct but remains high  
FAULTS POSSIBLE -  
Direct drive clutch and torque converter control valve stuck  
Hysteresis valve stuck  
Direct drive clutch control valve stuck

**SYMPTOM 11 - Direct drive clutch shift point incorrect or at low speed**



**NOTE: Direct drive clutch engagement at low speed will cause vibration in the torque converter**

Carry out mainline and torque converter pressure check

- œ Normal pressure  
FAULT - Governor valve sticking
- œ Low or incorrect pressure  
FAULTS POSSIBLE -  
Direct drive clutch and torque converter control valve sticking.  
Hysteresis valve stuck.  
Direct drive clutch control valve stuck.

**SYMPTOM 12 - Drives in 'D' but immediately upshifts to 3rd**

FAULT - 2nd to 3rd shift valve stuck.

**SYMPTOM 13 - With 'D' selected vehicle starts in 2nd**

FAULTS POSSIBLE -  
1st and 2nd shift valve stuck.  
Governor sleeve sticking.

**SYMPTOM 14 - With 'D' selected vehicle starts in 3rd**

FAULTS POSSIBLE -  
1st to 2nd and 2nd to 3rd shift valves stuck.  
Governor sleeve sticking.

**SYMPTOM 15 - No kickdown 4th to 3rd**

FAULT - 4th to 3rd kickdown valve stuck.

**SYMPTOM 16 - Upshifts/downshifts and kickdown shifts at incorrect road speeds**

Check throttle kickdown cable adjustment  
Carry out main line pressure check

- œ Normal pressure  
FAULT - Governor valve sticking
- œ Incorrect pressure  
FAULTS POSSIBLE -  
Incorrect throttle valve adjustment  
Primary regulator sticking

**SYMPTOM 17 - No upshifts at light throttle**

FAULTS POSSIBLE

- Governor valve sticking
- Shift valves sticking

**SYMPTOM 18 - No engine braking '3' selected 3rd gear**

FAULT - Clutch 'C'

**SYMPTOM 19 - Delayed or no downshift occurs when making a manual selection from '3' to '2'**

FAULTS POSSIBLE -  
2nd and 3rd upshift valve sticking.  
Governor valve sticking.  
'2' Position interlock valve sticking.

**SYMPTOM 20 - At speeds below 28 mph when making a manual selection from '2' to '1', downshift is delayed or does not occur**

FAULTS POSSIBLE -  
Governor sticking.  
1st to 2nd shift valve sticking.  
'1' Position interlock valve sticking.

**SYMPTOM 21 - '1' Selected 1st gear no engine braking**

FAULT - Clutch brake 3

**SYMPTOM 22 - '2' Selected 2nd gear no engine braking**

FAULT - Clutch brake 1

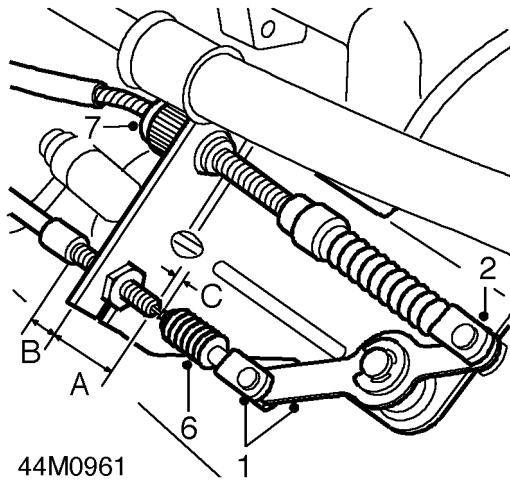
**SYMPTOM 23 - Vehicle drives forward in 'N'**

FAULT - Clutch 'A' stuck





## KICKDOWN CABLE ADJUSTMENT



1. Remove split pin, withdraw clevis pin and disconnect kickdown cable from lever.
2. Remove split pin, withdraw clevis pin and disconnect throttle cable from lever.
3. Adjust the position of the kickdown cable locknuts so that dimension 'A' is 28 mm. With cable held in this position, there should be 6 threads exposed to the rear of the bracket, (dimension 'B').
4. Tighten both locknuts Connect the kickdown cable to the lever and secure with clevis pin and split pin.
5. Connect the throttle cable to the lever and secure with clevis pin and split pin.
6. Pull back the rubber boot on the kickdown cable until the crimped nipple is visible.
7. Rotate the knurled plug on the throttle cable until the crimped nipple is 1 mm from the end of the threads, (dimension 'C').
8. Refit the rubber boot.



## LT230T TRANSFER GEARBOX WITH AUTOMATIC GEARBOX ASSEMBLY - V8i

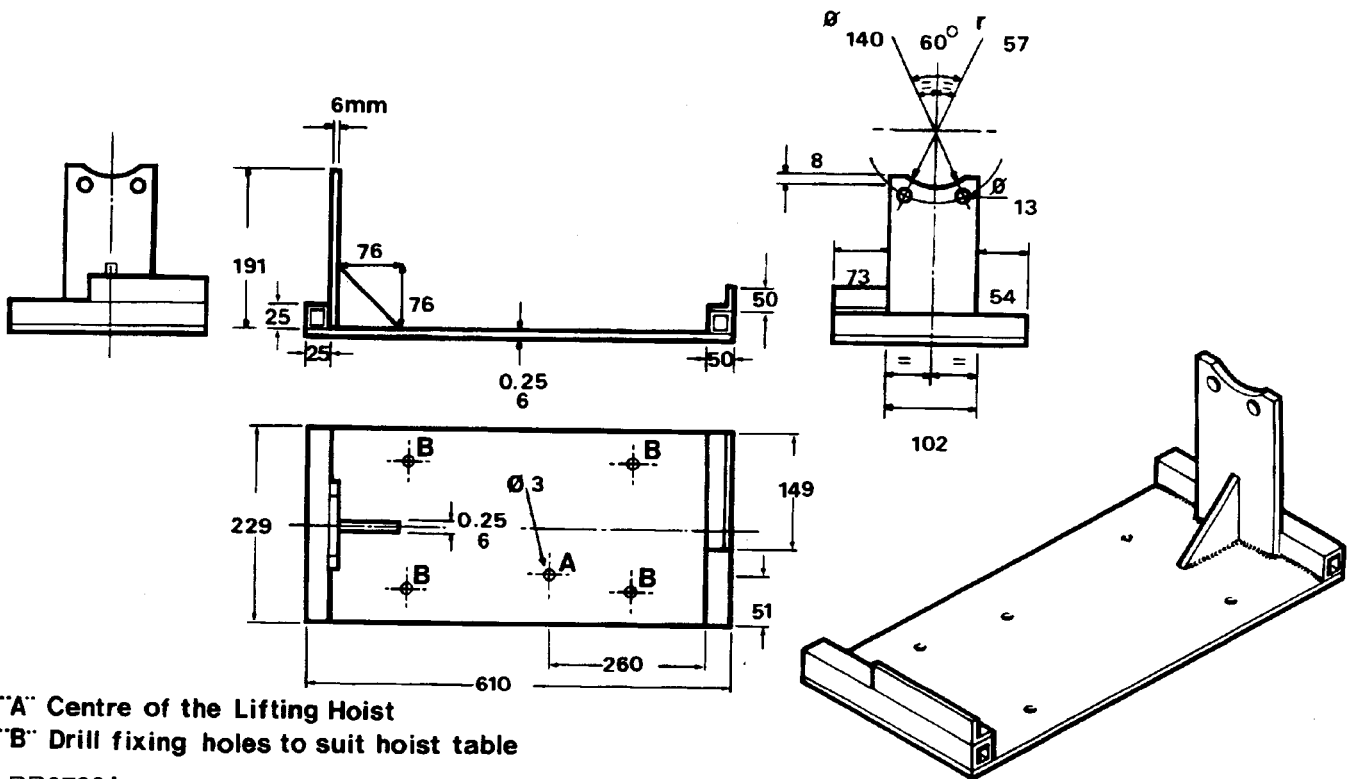
Service repair no - 44.20.04

### Removal from V8i engine

The assembled transfer gearbox, automatic gearbox and torque converter is removed from underneath the vehicle. Use a transmission hoist with an adaptor plate for securing the assembly to the hoist. The adaptor can be manufactured locally to the drawing below or purchased from:- Straight Set Engineering, England. Tel.01909 480055

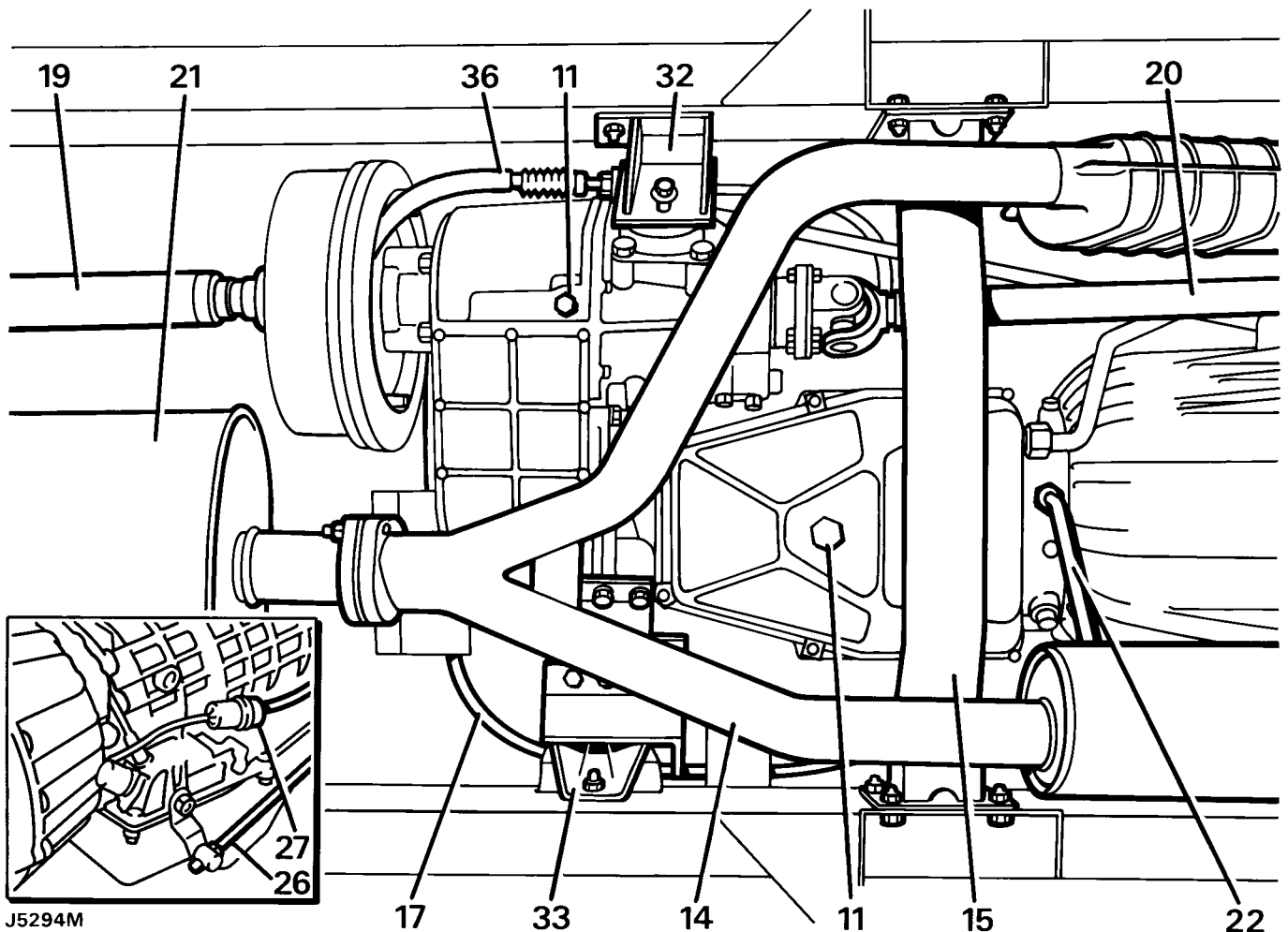


**WARNING:** When using a transmission hoist it is essential to follow the hoist manufacturer's instructions.



## 44 AUTOMATIC GEARBOX

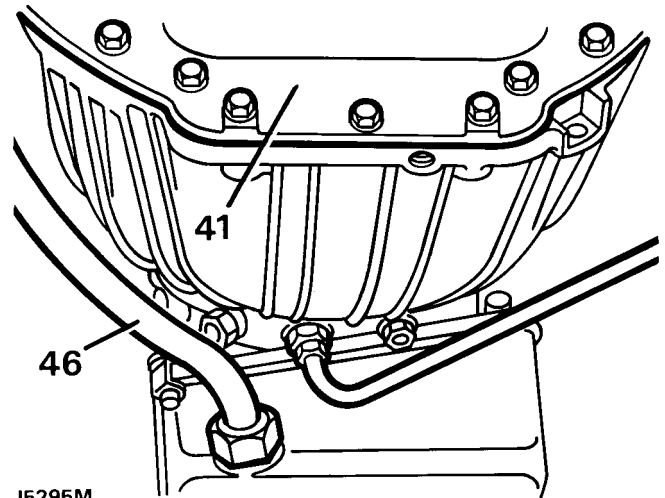
1. Site vehicle on a four post ramp [hoist].
2. Disconnect battery negative lead.
3. Remove fan cowl securing screws and release cowl from radiator.
4. Loosen securing clip and disconnect air flow hose from plenum chamber.
5. Disconnect stepper motor hose from top of plenum chamber.
6. Disconnect kickdown cable from throttle linkage and release from clipping.
7. Release two gearbox breather pipes from clip located on lifting eye at rear of right hand cylinder head.
8. Remove dipstick from main gearbox oil filler tube.
9. Working inside vehicle detach transfer gear lever gaiter from console, unscrew knob and withdraw gaiter and knob.
10. Raise vehicle on ramp [hoist].



11. Remove drain plugs and drain oil from transfer gearbox and main gearbox. Refit plugs.
12. Detach heat shield at front exhaust pipe to manifold.
13. Disconnect electrics to Lambda sensors.
14. Remove catalytic converter assembly.
15. Remove chassis cross-member from under gearbox.
16. Remove heat shield from speedometer cable at transfer gearbox.
17. Remove clamp and disconnect speedometer cable from transfer gearbox. Tie cable to one side.
18. Mark for reassembly propeller shaft to transfer gearbox mating flanges.



19. Disconnect rear propeller shaft to output flange, and tie to one side.
20. Repeat instructions 18 and 19 on front propeller shaft to main gearbox.
21. Remove bolts retaining silencer front and rear securing brackets and tie silencer to one side.
22. Disconnect oil cooler feed and return pipes from bottom and side of main gearbox.
23. Release cooler pipes from clamp at engine sump and remove distance piece.
24. Blank pipe ends and unions.
25. Move oil cooler pipes clear of transmission and tie aside.
26. Disconnect selector cable from operating lever.
27. Disconnect inhibitor switch at multiplug.
28. Attach adaptor plate to hoist.
29. Remove two bolts from transfer gearbox rear cover.
30. Raise hoist to align adaptor plate with transfer gearbox and transmission. Secure to transfer gearbox at rear cover with two bolts removed.
31. Adjust hoist to take weight of transmission.
32. Remove nuts and bolts securing right transfer gearbox mounting bracket to chassis.
33. Repeat for the left mounting bracket. Removal of these fixings will also free speedometer transducer bracket
34. Remove right side mounting bracket to flexible mounting rubber retaining nut.
35. Lower hoist until rear brake drum clears passenger footwell. Check engine does not crush any components while lowering.
36. Remove clip and clevis pin from park brake lever.
37. Remove clip securing outer brake cable
38. The park brake cable is now free.
39. Disconnect leads from transfer gearbox temperature sensor and differential lock warning light switch.
40. Remove ties securing breather pipes to harness.
41. Remove bell housing access plate complete with gasket.
42. Rotate engine, using crankshaft pulley, until two access holes are visible in drive plate/ring gear assembly through bell housing bottom cover opening.
43. Identify an access hole and bolt hole to aid reassembly.
44. Remove bolts securing drive plate to convertor through access holes.



J5295M

45. Rotate crankshaft half turn to access and remove remaining bolts.
46. Disconnect oil dipstick tube at main gearbox.
47. Remove bolt at bell housing and detach dipstick tube. Blank pipe end and union.
48. Position hoist jack channel under engine and support using a wooden block.
49. Remove bell housing to engine securing bolts, also detach harness bracket from bell housing.
50. Ease transmission rearwards to allow access to secure torque converter in bell housing.
51. Lower hoist and complete removal of transmission.

#### Refit

52. Ensure torque converter is retained in bell housing.
53. Secure transmission to adaptor plate on lifting hoist.
54. Raise hoist and locate transmission with engine.
55. Remove torque converter retainer.
56. Complete attachment of transmission to engine and fit bell housing bolts. Fit the dipstick tube bracket and harness bracket to their respective bolts.
57. Complete refitting by reversing removal procedure. Note the following important points.
58. Drive plate to torque converter bolts are to be coated with Loctite 290 prior to assembly.
59. Refill transfer and main gearboxes with correct grade oil. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**
60. Check operation of parking brake and adjust as necessary. **See SECTION 10, Maintenance, Vehicle Interior**

## LT230T TRANSFER GEARBOX WITH AUTOMATIC GEARBOX ASSEMBLY - Tdi

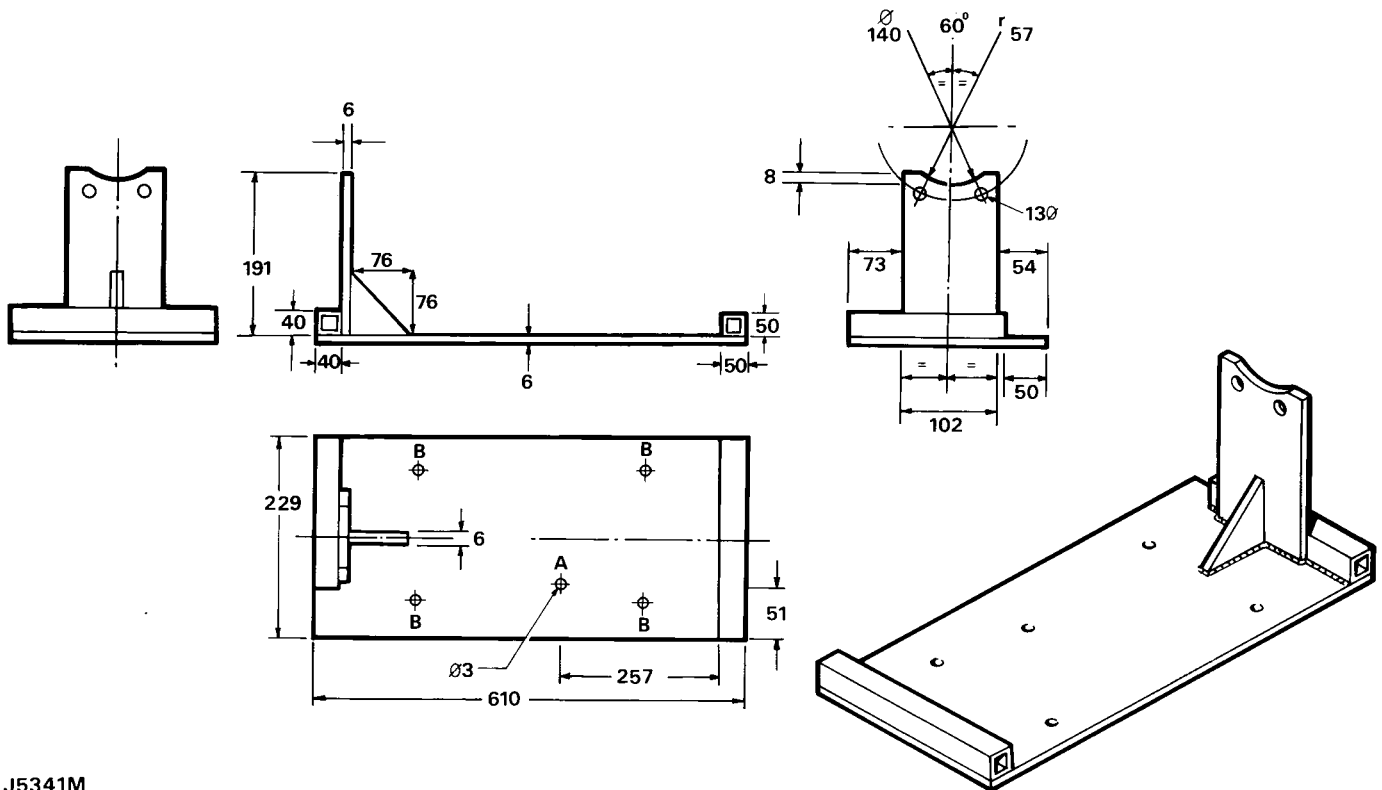
Service repair no - 44.20.04

### Removal from Tdi engine

The assembled transfer gearbox, automatic gearbox and torque converter is removed from underneath the vehicle. Use a transmission hoist with an adaptor plate for securing the assembly to the hoist.



**WARNING:** When using a transmission hoist it is essential to follow the hoist manufacturer's instructions.

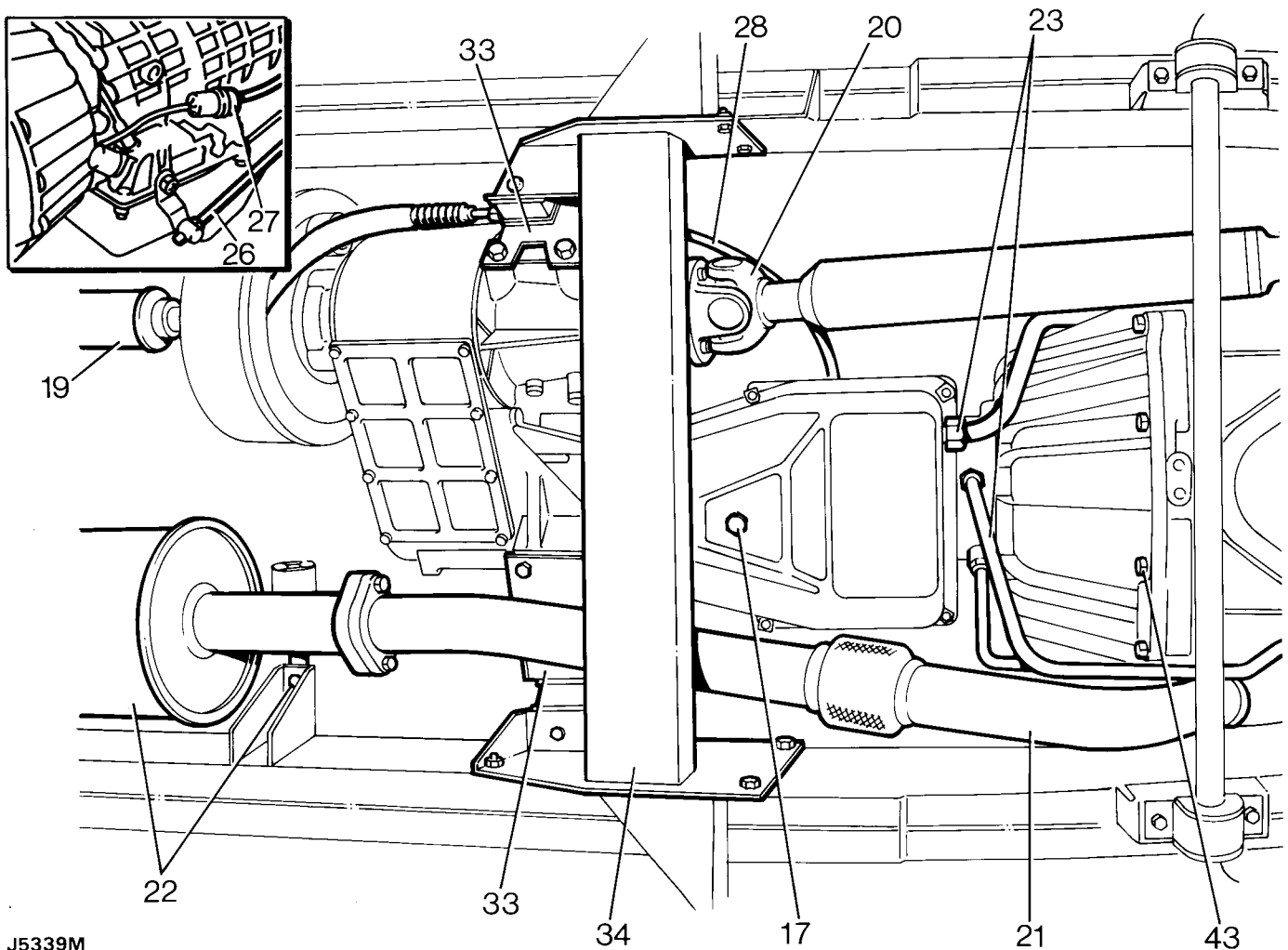


J5341M



## Remove

1. Select low range with transfer gear lever.
2. Remove knob and gaiter from transfer gear lever.
3. Disconnect battery terminals.
4. Remove insulation pad from rocker cover and inlet manifold.
5. On LH drive vehicles only, disconnect multi-plug from top of brake fluid reservoir.
6. Release electrical harness from clips along top of bulkhead and pull over to one side.
7. Remove bolt securing transfer and main gearbox breather pipe clip to rear of cylinder head.
8. Disconnect kick down cable at fuel injection pump.
9. Drain coolant from cooling system.
10. Disconnect top hose from radiator.
11. Disconnect turbo charger hose from inter-cooler.
12. Remove starter heat shield.



J5339M

13. Remove starter.
14. Working through starter aperture note position of torque converter flexible drive plate to facilitate refitting.
15. Remove the four torque converter to flexible drive securing bolts, rotating engine to gain access to each individual bolt.
16. Raise vehicle on four post ramp [hoist].
17. Drain lubrication oil from transfer and main gearboxes.
18. Disconnect speedometer cable from transfer gearbox and disconnect associated clipping.
19. Remove rear propeller shaft. **See PROPELLER SHAFTS, Overhaul, Flexible Coupling**
20. Disconnect front propeller shaft at transfer gearbox and tie to one side.
21. Remove exhaust front pipe.
22. Remove bolts securing front and centre silencer mounting brackets and tie silencer to one side.
23. Disconnect oil cooler pipes from gearbox.
24. Blank off pipes and union connections.
25. Remove bolt securing retaining bracket to sump and move cooler pipes aside.
26. Disconnect selector cable from lever on side of gearbox.
27. Disconnect inhibitor switch multi-plug.
28. Disconnect park brake cable from linkage to park brake lever.
29. Disconnect electrical connections from differential lock switch on transfer gearbox.
30. Remove two lower bolts from transfer gearbox input bearing support plate.
31. Assemble approved support cradle to transmission hoist.
32. Raise hoist and secure cradle to transfer gearbox input bearing support plate using bolts removed.
33. Disconnect gearbox mounting brackets from chassis cross member.
34. Remove chassis cross member.
35. Lower transmission sufficiently to allow access to items attached to top of gearbox.
36. Remove left hand gearbox mounting bracket assembly.
37. Remove ties from breather pipes and harness.
38. Remove nut securing gearbox oil filler/dip stick tube to bell housing.
39. Release union nut at gearbox sump and remove filler/dipstick tube. Fit blanking plugs.
40. Support engine using a wooden block with a suitable ramp [hoist] jack.
41. Remove nut securing kick down cable bracket to bell housing.
42. Remove two bolts securing top of bell housing to flywheel housing.
43. Remove nuts securing bell housing to flywheel housing and withdraw transmission assembly from engine.
44. Fit a suitable torque converter retaining strap to the bell housing.
45. Remove hoist and transmission from under vehicle.
46. Fit lifting eyes to transmission.
47. Using suitable chains and lifting tackle take weight of transmission assembly.
48. Remove bolts securing transmission cradle to transfer box and withdraw hoist complete with cradle.
49. Refit bolts to cover plate.



## Accessories removal/fitting

If fitting a replacement transmission assembly to the vehicle, remove the following items from the existing assembly and fit to the replacement.



**CAUTION: It is important to remove the spacer from the extension shaft and fit onto the replacement unit.**

50. Breather pipe union and washers from main gearbox.
51. Breather pipe, union and washers from transfer gearbox.
52. Main gearbox selector lever.
53. RH mounting bracket assembly.
54. Oil cooler pipe unions.
55. Fit blanks to all apertures where unions have been removed and blank off pipe ends.
21. Secure gearbox mounting brackets to chassis cross member.
22. Remove ramp [hoist] jack.
23. Connect electrical leads to differential lock switch.
24. Connect inhibitor switch multi-plug.
25. Connect selector cable to lever on side of gearbox.
26. Connect oil cooler pipes to gearbox and secure retaining bracket to gearbox sump.
27. Secure silencer to chassis and refit exhaust front pipe.
28. Refit front propeller shaft to transfer gearbox.
29. Refit rear propeller shaft. **See PROPELLER SHAFTS, Overhaul, Flexible Coupling**
30. Connect speedometer cable to transfer gearbox.
31. Refill transfer gearbox with correct grade of lubricating oil. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**

## Refit

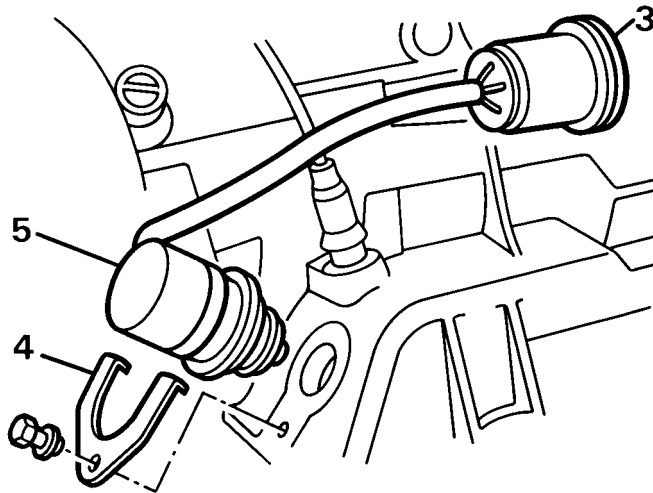
1. Fit transmission to cradle and hoist.
2. Locate hoist under vehicle and remove torque convertor retaining strap.
3. Ensure low range gear is engaged.
4. Apply approved sealant to bell housing face.
5. Carefully raise assembly, align bell housing with flywheel housing and bring mating faces together.
6. Fit nuts and bolts to secure transmission to engine.
7. Locate electrical wiring and breather pipes to position.
8. Secure kick down cable clip to bell housing.
9. Raise hoist sufficiently to take weight.
10. Remove block and jack from engine sump.
11. Fit filler/dipstick tube to gearbox sump and secure bracket to bell housing.
12. Apply Loctite to torque convertor bolts
13. Working through starter aperture refit the four torque convertor to flexible drive securing bolts, rotating crankshaft to gain access to bolt locations.
14. Refit starter and heatshield.
15. Secure breather pipes and harness with ties.
16. Fit left hand mounting bracket assembly to gearbox.
17. Raise transmission and support with a suitable ramp [hoist] jack.
18. Remove two bolts securing transmission to cradle, lower hoist and remove from under vehicle.
19. Apply Loctite to above bolts and fit to transfer gearbox input bearing support plate.
20. Fit chassis cross member.
32. Lower ramp [hoist] to ground level.
33. Reconnect turbo-charger hose to inter-cooler.
34. Reconnect top hose to radiator.
35. Refill cooling system with correct mixture of coolant. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**
36. Reconnect kick down cable to fuel injection pump.
37. Secure breather pipe clip to rear of cylinder head.
38. Engage harness with clips along top of bulkhead.
39. On left hand drive vehicles only, connect multi-plug to top of brake fluid reservoir.
40. Refit insulation pad to rocker cover and inlet manifold, secure with oil filler cap.
41. Refit gaiter and knob to transfer gear lever.
42. Select high range gear.
43. Reconnect battery terminals.
44. Refill main gearbox with correct grade of lubricating oil. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**



## INHIBITOR SWITCH

Service repair no - 44.15.19

### Remove



J5324M

1. Site vehicle on a four post ramp [hoist].
2. Disconnect battery negative lead. Raise vehicle.
3. Disconnect inhibitor switch multi plug.
4. Remove inhibitor switch retaining plate.
5. Remove inhibitor switch.
6. Remove 'O' ring seal.
7. Clean inhibitor switch.

### Refit

8. Clean mating face on casing.
9. Fit and lubricate new 'O' ring seal to switch.
10. Fit switch to casing.
11. Secure with retaining plate and bolt.
12. Connect multiplug to harness.
13. Reconnect battery and remove vehicle from ramp [hoist].

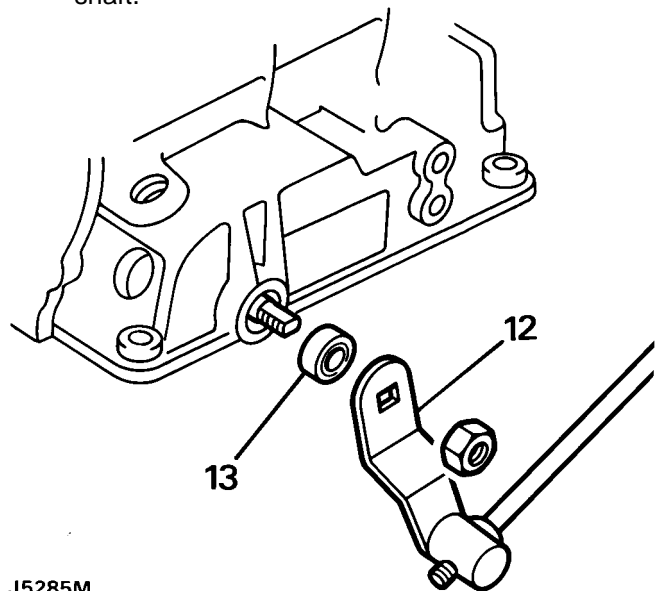
## SELECTOR SHAFT OIL SEAL

Service repair no - 44.15.34

### Renew

1. Site vehicle on a four post ramp [hoist].
2. Disconnect battery negative lead.
3. Raise vehicle.

4. Detach heat shield at front exhaust pipe to manifold.
5. Disconnect electrics from Lambda sensors.
6. Remove catalytic converter assembly.
7. Remove chassis cross-member from under gearbox.
8. Engage low range gear in the transfer gearbox.
9. Support transfer gearbox with a jack or transmission hoist.
10. Remove transfer gearbox chassis mounting bracket nuts and bolts. Note location of speedometer cable bracket for refit.
11. Lower transmission to allow access to selector shaft.



J5285M

12. Remove selector lever from shaft.
13. Remove selector shaft seal from casing.
14. Clean selector shaft and seal mating faces.
15. Fit centre section of special tool LST 114 over selector shaft.
16. Lubricate new oil seal and position seal on tool.
17. Fit tool outer sleeve and screw on nut to drive seal into housing.
18. Remove tool from shaft.
19. Refit selector lever to shaft.
20. Raise transmission and secure mounting brackets to chassis. Ensure speedometer cable bracket is secured. Tighten bolts to **30Nm**.
21. Remove support jack.
22. Refit chassis cross-member.
23. Refit catalytic converter assembly.
24. Connect electrics to Lambda sensors.
25. Connect heat shield front pipe to manifold.
26. Connect battery.
27. Check/top up gearbox oil level.



## OIL SUMP

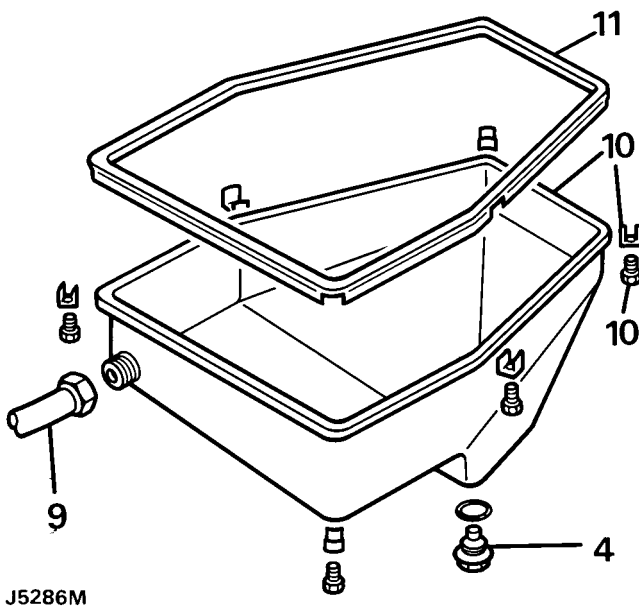
Service repair no - 44.24.05

### Remove

1. Site vehicle on a four post ramp [hoist].
2. Disconnect battery negative lead.
3. Raise vehicle.
4. Drain oil and refit plug with new seal.
5. Detach heat shield at front exhaust pipe to manifold.
6. Disconnect electrics from Lambda sensors.
7. Remove catalytic converter assembly.
8. Remove chassis cross-member from under gearbox.

### Refit

12. Refit oil sump using a new gasket.
13. Connect dipstick tube to oil sump and tighten bolt at bell housing.
14. Refit chassis cross member.
15. Refit catalytic converter assembly
16. Connect electrics to Lambda sensors.
17. Connect heat shield front pipe to manifold.
18. Connect battery.
19. Refill gearbox using correct grade of oil. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**



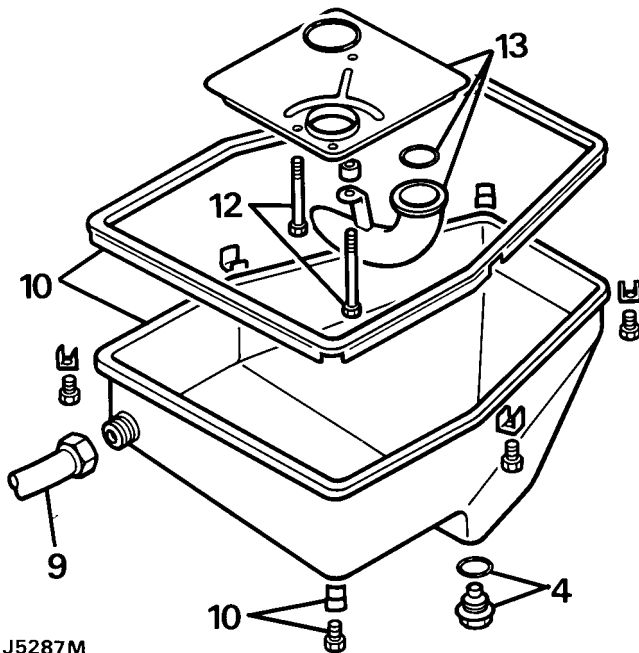
9. Disconnect dipstick tube at oil sump. Loosen securing bolt at bell housing and move dipstick aside.
10. Remove clamps securing oil sump. Note their locations for refit and withdraw sump.
11. Remove gasket and clean gasket mating faces.

## OIL SCREEN

Service repair no - 44.24.07

### Renew

1. Site vehicle on a four post ramp [hoist].
2. Disconnect battery negative lead.
3. Raise vehicle.
4. Drain oil and refit plug with new seal.
5. Detach heat shield at front exhaust pipe to manifold.
6. Disconnect electrics from Lambda sensors.
7. Remove catalytic converter assembly.
8. Remove chassis cross-member from under gearbox.



9. Disconnect dipstick tube at oil sump. Loosen securing bolt at bell housing and move dipstick aside.
10. Remove clamps securing oil sump. Note their locations for refit and withdraw sump.
11. Remove gasket and clean gasket mating faces.
12. Remove securing screws and detach oil screen and suction pipe, taking care to retain suction pipe spacer, discard 'O' ring seal.

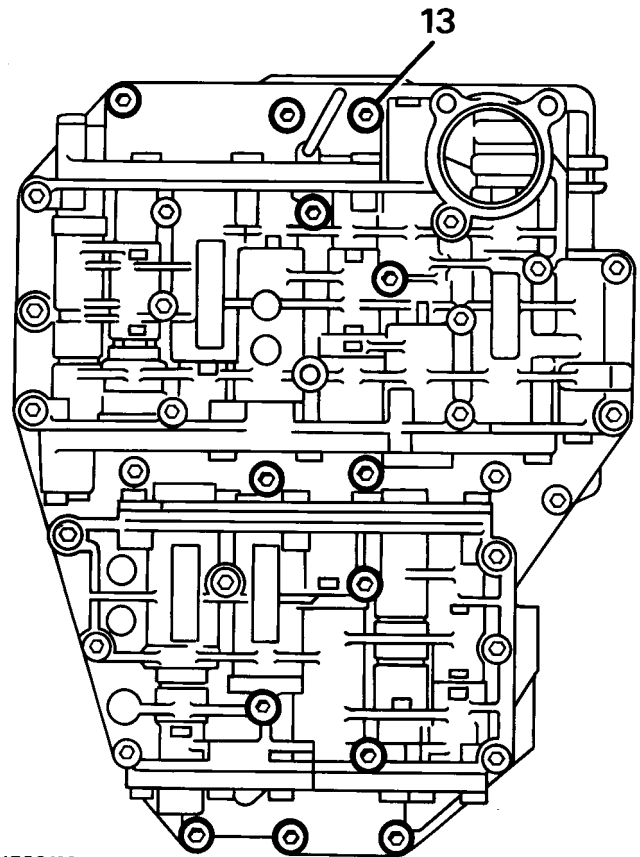
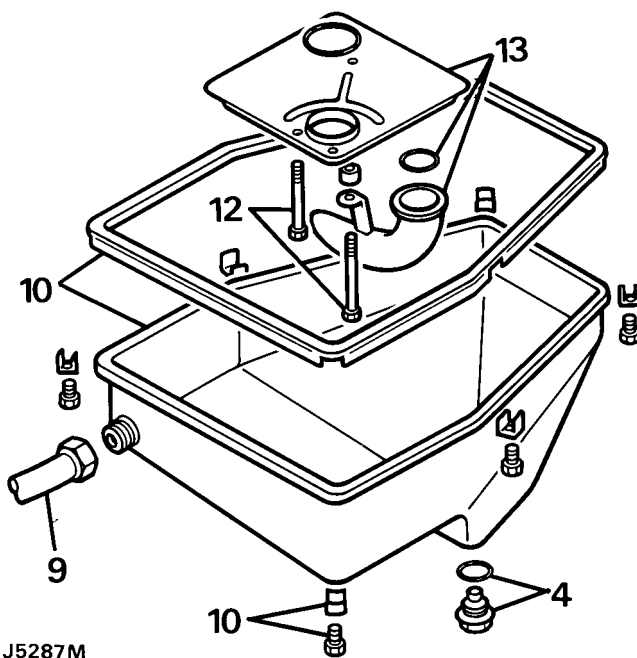
13. Detach suction pipe from oil screen, discard 'O' ring seal.
14. Clean oil screen and blow out with airline.
15. Clean suction pipe.
16. Fit new 'O' ring seals to oil screen using light grease to aid assembly.
17. Fit oil screen and suction pipe with spacer and secure with three bolts.
18. Refit oil sump using a new gasket.
19. Connect dipstick tube to oil sump and tighten bolt at bell housing.
20. Refit chassis cross-member.
21. Refit catalytic converter assembly
22. Connect electrics to Lambda sensors.
23. Connect heat shield front pipe to manifold.
24. Connect battery.
25. Refill gearbox oil system using correct grade of oil. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**



## CONTROL UNIT

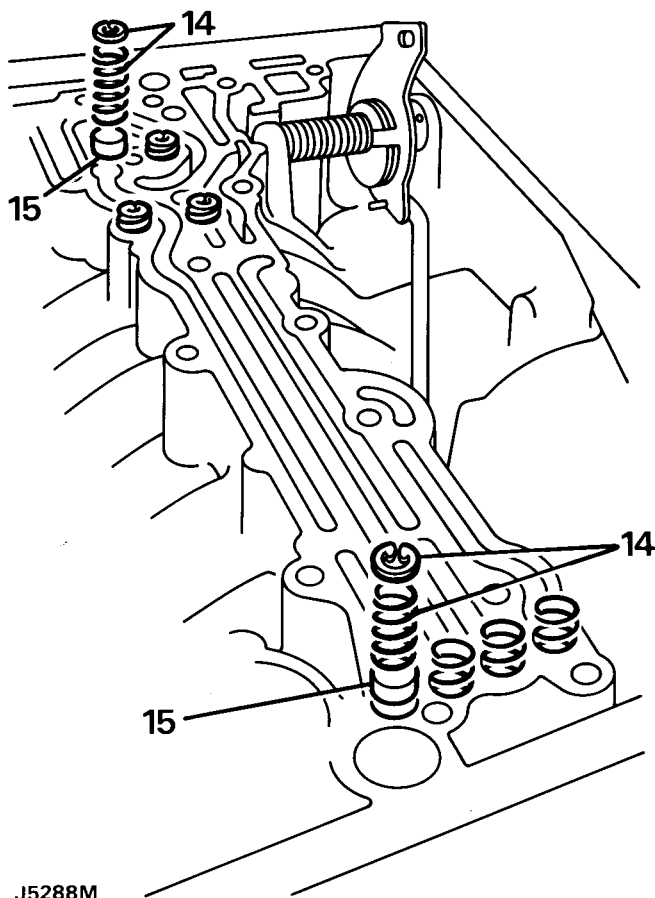
### Remove

1. Site vehicle on a four post ramp [hoist].
2. Disconnect battery negative lead.
3. Raise vehicle.
4. Drain oil and refit plug with new seal.
5. Detach heat shield at front exhaust pipe to manifold.
6. Disconnect electrics from Lambda sensors.
7. Remove catalytic converter assembly.
8. Remove chassis cross-member from under gearbox.
9. Disconnect dipstick tube at oil sump. Loosen securing bolt at bell housing and move dipstick aside.
10. Remove clamps securing oil sump. Note their locations for refit and withdraw sump.
11. Remove gasket and clean gasket mating faces.
12. Remove securing screws and detach oil screen and suction pipe, taking care to retain suction pipe spacer, discard 'O' ring seal.
13. Remove securing screws and detach control unit from casing.



## Oil seal replacement

14. Remove circlips and springs from control unit. Note locations of long and short springs.
15. Using seal replacer/remover LST113 remove and discard seals.

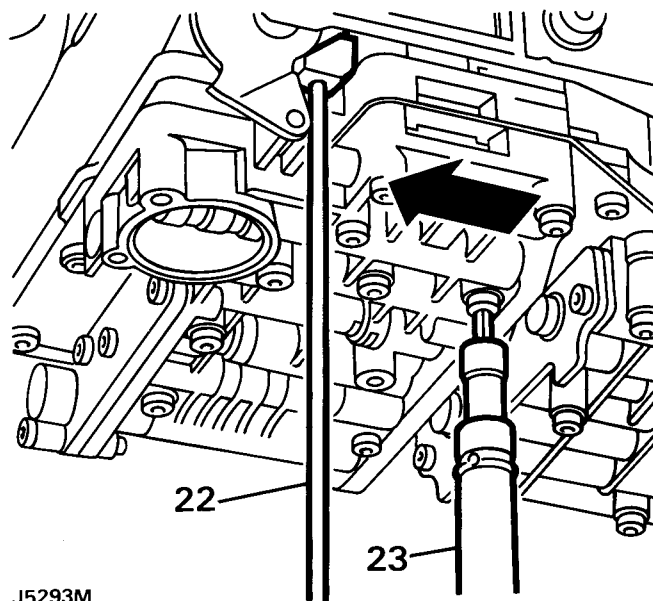


16. Clean control unit, springs and circlips and check that they are satisfactory for further use.
17. Fit new seals to control unit using LST113, ensure seals are fully seated.
18. Fit springs to locations noted during removal and secure with circlips.

## Refit

19. Fit control unit to gearbox, locating throttle valve behind cam and engaging selector quadrant with manual valve.
20. Loosely fit securing screws.

21. Manually open throttle linkage to full throttle position.



22. Engage special tool LST 109 between control unit and throttle valve pin.
23. Set correct distance between control unit and cam.
24. Remove special tool and close throttle.
25. Fit new 'O' ring seals to oil screen using light grease to aid assembly.
26. Fit oil screen and suction pipe with spacer and secure with three bolts.
27. Refit oil pan using a new gasket.
28. Connect dipstick tube to oil sump and tighten bolt at bell housing.
29. Refit chassis cross member.
30. Refit catalytic converter assembly
31. Connect electrics to Lambda sensors.
32. Connect heat shield front pipe to manifold.
33. Connect battery.
34. Refill gearbox oil system using correct grade of oil. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**



## KICKDOWN CABLE

### Service repair no - 44.15.01

#### Remove

1. Site vehicle on a four post ramp [hoist].
2. Select neutral 'N' gear lever.
3. Disconnect battery negative lead.
4. Disconnect kickdown cable at throttle linkage.
5. Release outer cable locknut.
6. Disconnect cable from mounting bracket.
7. Release cable from bracket attached to cylinder head.
8. Feed cable through to underside of vehicle.
9. Raise vehicle on ramp [hoist].
10. Drain oil and refit plug with new seal.
11. Detach heat shield at front exhaust pipe to manifold.
12. Disconnect electrics from Lambda sensors.
13. Remove catalytic converter assembly.
14. Remove chassis cross-member from under gearbox.
15. Disconnect dipstick tube at oil sump. Loosen securing bolt at bell housing and move dipstick aside.
16. Remove clamps securing oil sump. Note their locations for refit, and withdraw sump.
17. Pull kickdown inner cable to fully open valve cam. Wedge cam in this position.
18. Release cable from cam by pushing inner cable into outer casing and detaching cable nipple from cam.
19. Using special tool LST112 compress cable tangs and remove cable from gearbox.
20. If cable is to be refitted remove 'O' ring seal and clean cable assembly.

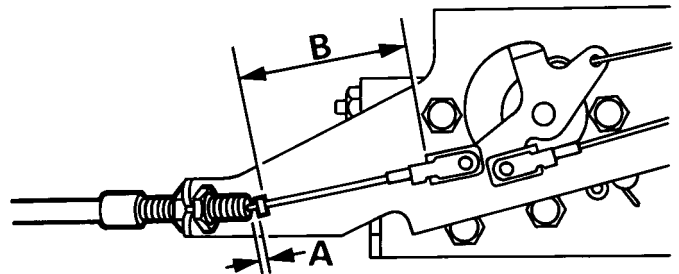
#### Refit

21. Fit new 'O' ring seal to cable and lubricate seal.
22. Fit cable to gearbox casing ensuring it is correctly seated.
23. Fit inner cable nipple to its location on cam.



**NOTE: When a new cable is fitted, to help locate nipple to cam, introduce a curve into the cable. Do not bend or kink cable.**

24. Remove wedge from cam and ensure nipple remains engaged.
25. Feed free end of cable assembly into engine compartment.
26. Refit oil pan using a new gasket.
27. Connect dipstick tube to oil sump and tighten bolt at bell housing.
28. Refit chassis cross-member
29. Refit catalytic converter assembly
30. Connect electrics to Lambda sensors.
31. Connect heat shield front pipe to manifold.
32. Lower vehicle on ramp [hoist].
33. Fit cable to bracket at cylinder head.
34. Locate cable in mounting bracket, do not tighten locknut.
35. Fit cable to throttle linkage.
36. Ensure throttle linkage is fully closed.
37. Adjust outer cable to achieve a gap of 0,25 to 1,25mm (dimension 'A') between end of outer cable and crimped collar on inner cable.
38. Tighten locknuts and recheck gap.



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**NOTE: If fitting a new cable, and collar on inner cable is loose, measure distance 'B' on old cable. Crimp collar on new cable to this dimension.**

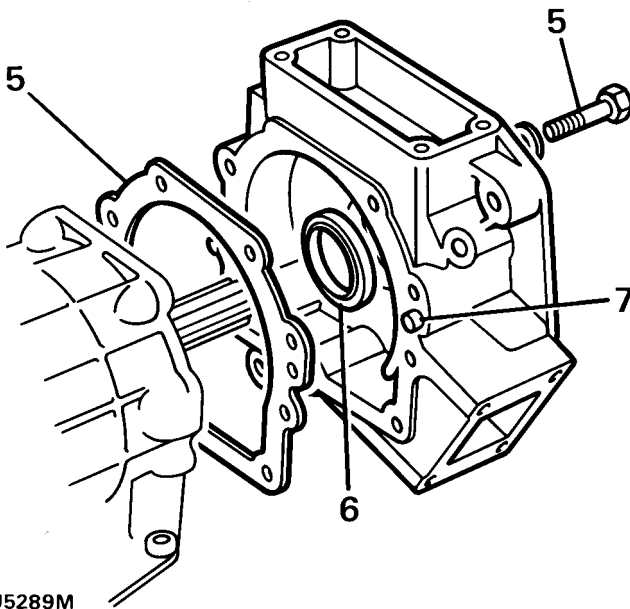
39. Reconnect battery negative lead.
40. Refill gearbox oil using correct grade of oil. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**

## EXTENSION HOUSING

Service repair no - 44.20.18

### Remove

1. Remove transfer gearbox. *See TRANSFER GEARBOX, Repair, LT230T Transfer Gearbox*
2. Drain oil from automatic gearbox.
3. Remove bolts securing left hand mounting bracket to extension housing and withdraw bracket.
4. Remove transfer gear lever housing securing bolts and move housing aside.



J5289M

5. Remove securing bolts and withdraw extension housing from over coupling shaft. Remove and discard gasket.
6. Place extension housing on bench and remove oil seal.
7. Ensure that all surfaces are clean and housing is free from damage. If damage is found and housing has to be renewed remove dowels from face of existing housing and fit to new housing.
8. Using special tool LST108 fit new oil seal to housing.

### Refit

9. Fit extension housing to gearbox, with a new gasket, ensuring oil seal is not damaged by extension shaft.
10. Secure housing with nine bolts. Tighten to **23 Nm**.
11. Refit transfer gear lever housing to top of extension housing. Tighten to **25 Nm**.
12. Refit mounting bracket to extension housing. Tighten to **52 Nm**.
13. Refit transfer gear box. *See TRANSFER GEARBOX, Repair, LT230T Transfer Gearbox*
14. Refill automatic gearbox lubrication system with correct grade of oil. *See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids*



## GOVERNOR ASSEMBLY

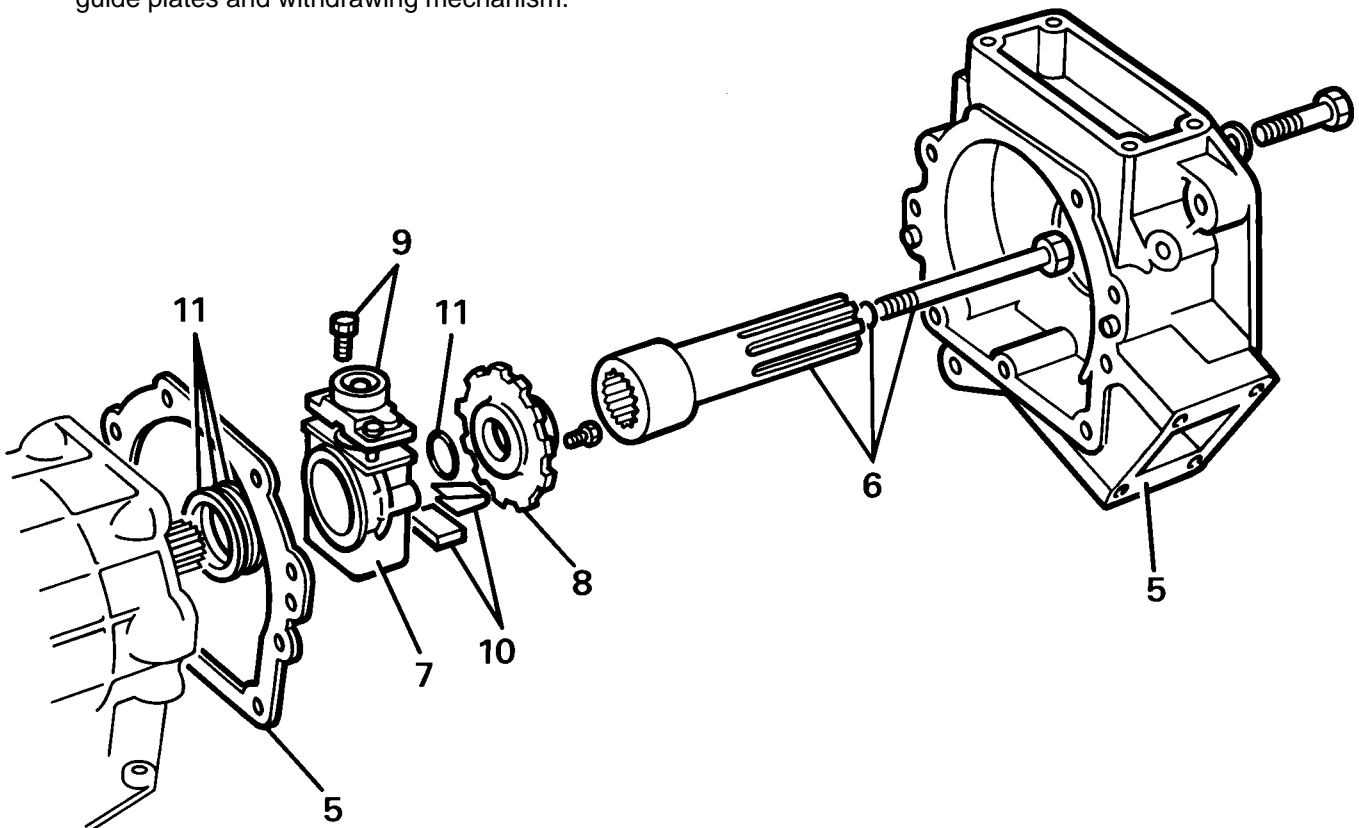
Service repair no - 44.22.01

### Remove

1. Remove transfer gearbox. **See TRANSFER GEARBOX, Repair, LT230T Transfer Gearbox**
2. Drain oil from automatic gearbox.
3. Remove bolts securing left hand mounting bracket to extension housing and withdraw bracket.
4. Remove transfer gear lever housing securing bolts and move housing aside.
5. Remove extension housing ensuring seal is not damaged, remove and discard gasket.
6. Remove extension shaft retaining bolt, withdraw shaft and discard 'O' ring seal. If Tdi vehicle remove spacer.
7. Remove governor assembly.
8. Remove park gear from governor assembly.
9. Detach governor housing.
10. Remove security clip and counter weight.
11. Remove and discard 'O' ring seal from output shaft and three seal rings from 'F' clutch housing.
12. Clean all components.
13. If necessary detach parking pawl by removing guide plates and withdrawing mechanism.

### Refit

14. Refit parking pawl mechanism if removed.
15. Fit and lubricate new seal rings to 'F' clutch housing shaft, ensure they are correctly seated.
16. Apply petroleum jelly to a new 'O' ring seal. Fit to output shaft
17. Fit park gear to governor assembly tightening screws to correct torque.
18. Fit governor assembly to output shaft.
19. Fit extension shaft with spacer if Tdi. Fit new 'O' ring under bolt head.
20. Fit extension housing, avoid damaging seal. Tighten to **23 Nm**.
21. Refit transfer gear lever housing to extension housing.
22. Refit mounting bracket to extension housing. Tighten to **52 Nm**.
23. Refit transfer gearbox. **See TRANSFER GEARBOX, Repair, LT230T Transfer Gearbox**
24. Refill automatic gearbox with correct grade of oil. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**



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## GOVERNOR HUB

Service repair no - 44.22.04

### Remove

1. Remove transfer box. *See TRANSFER GEARBOX, Repair, LT230T Transfer Gearbox*
2. Remove transfer gear selector housing.
3. Loosen nine bolts holding extension housing.
4. Remove extension housing ensuring that seal is not damaged, discard gasket.
5. Remove extension shaft and retaining bolt with 'O' ring. If Tdi vehicle remove spacer.
6. Remove governor assembly with parking wheel.
7. Remove two screws holding governor housing.
8. Remove two bolts, remove parking wheel. Discard governor hub.
9. Remove security clip and counter-weight.
10. Remove 'O' ring from output shaft and discard.
11. Remove three seal rings from 'F' clutch housing shaft.
12. Inspect all parts for damage or wear, replace if necessary.

### Refit

13. Fit counterweight and security clip into new governor hub.

14. Secure governor housing to governor hub. Tighten to **10Nm**.
15. Fit parking wheel to governor hub. Tighten to **10 Nm**.
16. Fit three new seal rings onto F clutch housing shaft, fit 'O' ring onto output shaft.



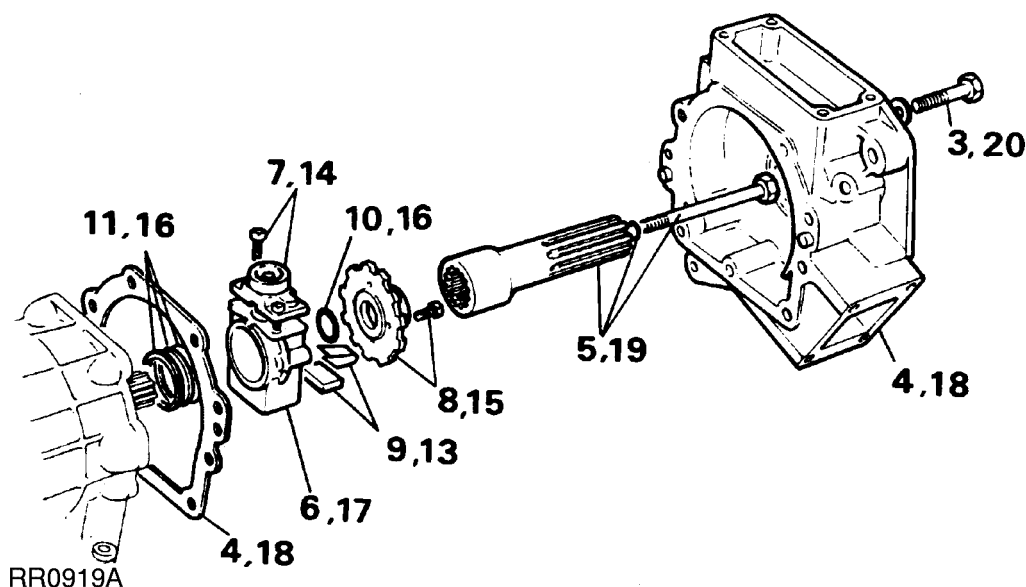
**NOTE: To aid fitting of 'O' ring apply petroleum jelly.**

17. Push governor assembly and parking wheel onto output shaft until seated.



**NOTE: Apply petroleum jelly to 'O' ring. Ensure seal rings are snapped together and seated.**

18. Fit new gasket to rear of gearbox. Fit extension housing, avoid damaging seal.
19. Fit extension shaft, and spacer if Tdi, apply Loctite 270 to retaining bolt. Using a new 'O' ring, tighten bolt to **42 Nm**.
20. Tighten nine extension housing nine bolts to **23 Nm**.
21. Fit transfer gear selector housing, tighten three bolts to **25 Nm**.
22. Refit transfer box.



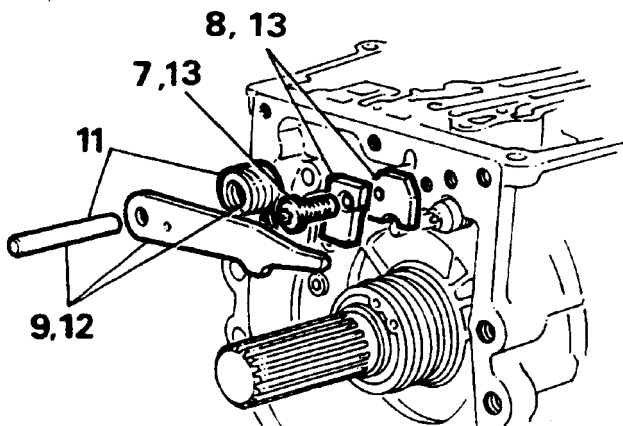


## PARKING PAWL MECHANISM

Service repair no - 44.28.07

### Remove

1. Remove transfer box. *See TRANSFER GEARBOX, Repair, LT230T Transfer Gearbox*
2. Remove transfer gear selector housing.
3. Loosen nine bolts holding extension housing.
4. Remove extension housing ensuring that seal is not damaged, discard gasket.
5. Remove extension shaft and retaining bolt with 'O' ring. If Tdi vehicle, remove spacer.
6. Remove governor assembly with parking wheel.



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7. Remove guide plate bolt.
8. Remove plate and guide plate from gearbox case.
9. Remove pin, pawl and spring.



**CAUTION: When removing assembly. Avoid damaging parts which could weaken spring tension.**

10. Inspect all parts for wear or damage. Replace if necessary.

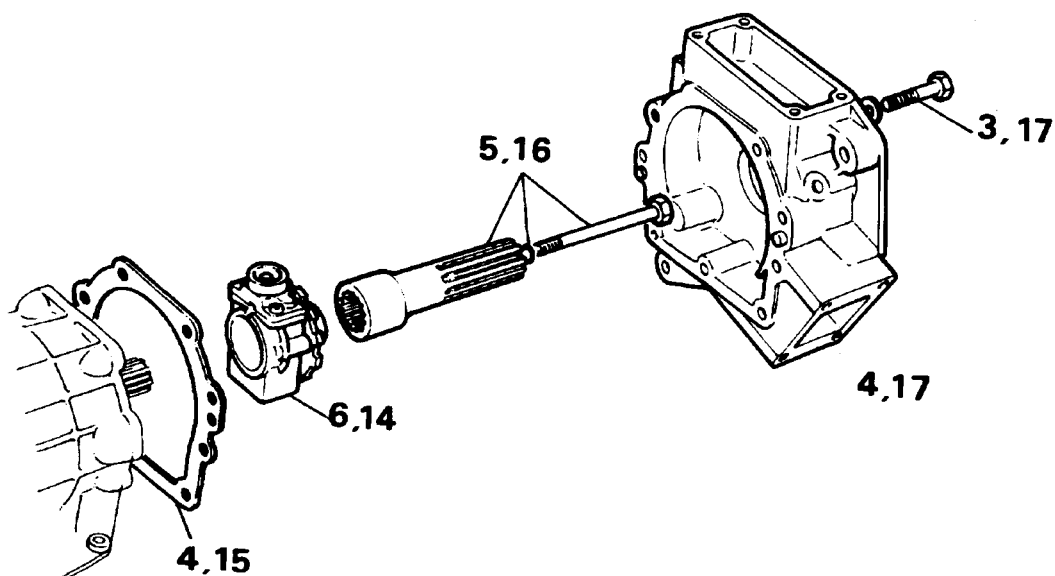
### Refit

11. Fit pin and leg spring, locate spring correctly.
12. Fit pawl to pin. Locate spring leg into hole in pawl to create tension in spring.
13. Fit plate and guide plate. Tighten to **10 Nm**.
14. Push governor assembly with parking wheel onto output shaft until seated.



**NOTE: Apply petroleum jelly to 'O' ring. Ensure seal rings are snapped together and seated.**

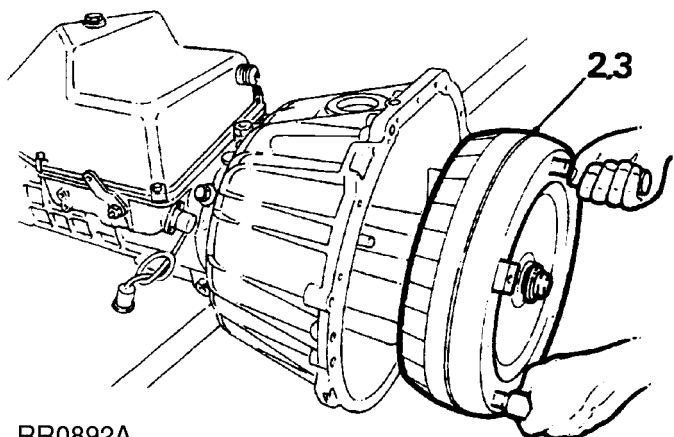
15. Fit new gasket to rear of gearbox. Fit extension housing, taking care not to damage seal or assembly.
16. Fit extension shaft with spacer if Tdi and retaining bolt with new 'O' ring.
17. Fit extension housing, tighten nine bolts to **23Nm**.
18. Fit transfer gear selector housing, tighten three bolts to **25 Nm**.
19. Refit transfer box.



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## REPLACING TORQUE CONVERTER

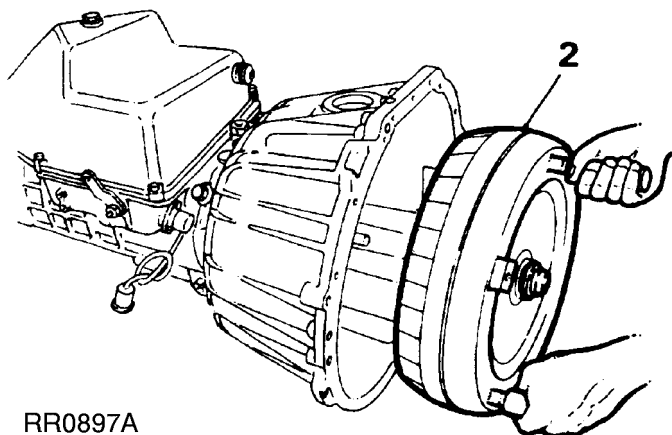
1. Remove gearbox and transfer box assembly. **See LT230T Transfer Gearbox**
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501, taking care not to damage torque converter/oil pump housing oil seal.
3. Fit new torque converter using torque converter handles 18G1501. Check dimension from converter fixing boss to converter housing face is 50 mm. This shows converter is correctly seated in housing.
4. Refit gearbox and transfer box assembly. **See LT230T Transfer Gearbox**



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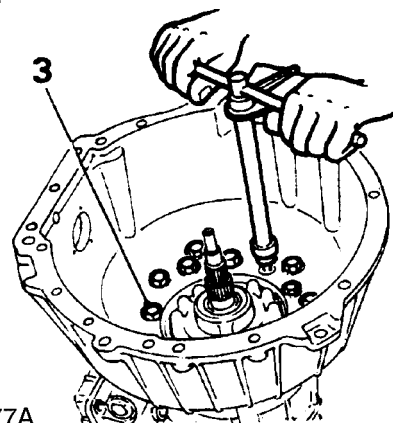
## ELIMINATING LEAKS ON PUMP HOUSING

1. Remove gearbox and transfer box assembly. **See LT230T Transfer Gearbox**
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501, taking care not to damage torque converter/oil pump housing oil seal.



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3. Remove twelve hexagonal bolts (inner ring pattern).

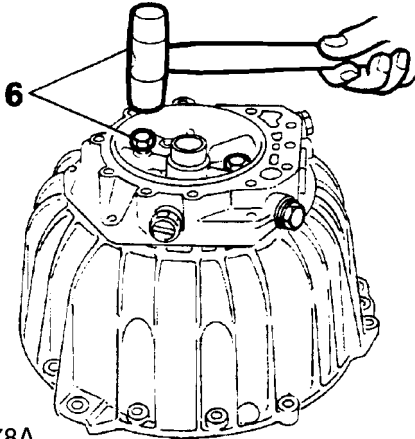


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4. Remove bell housing and pump assembly, discard gasket.
5. Remove eight hexagonal bolts on rear of pump.



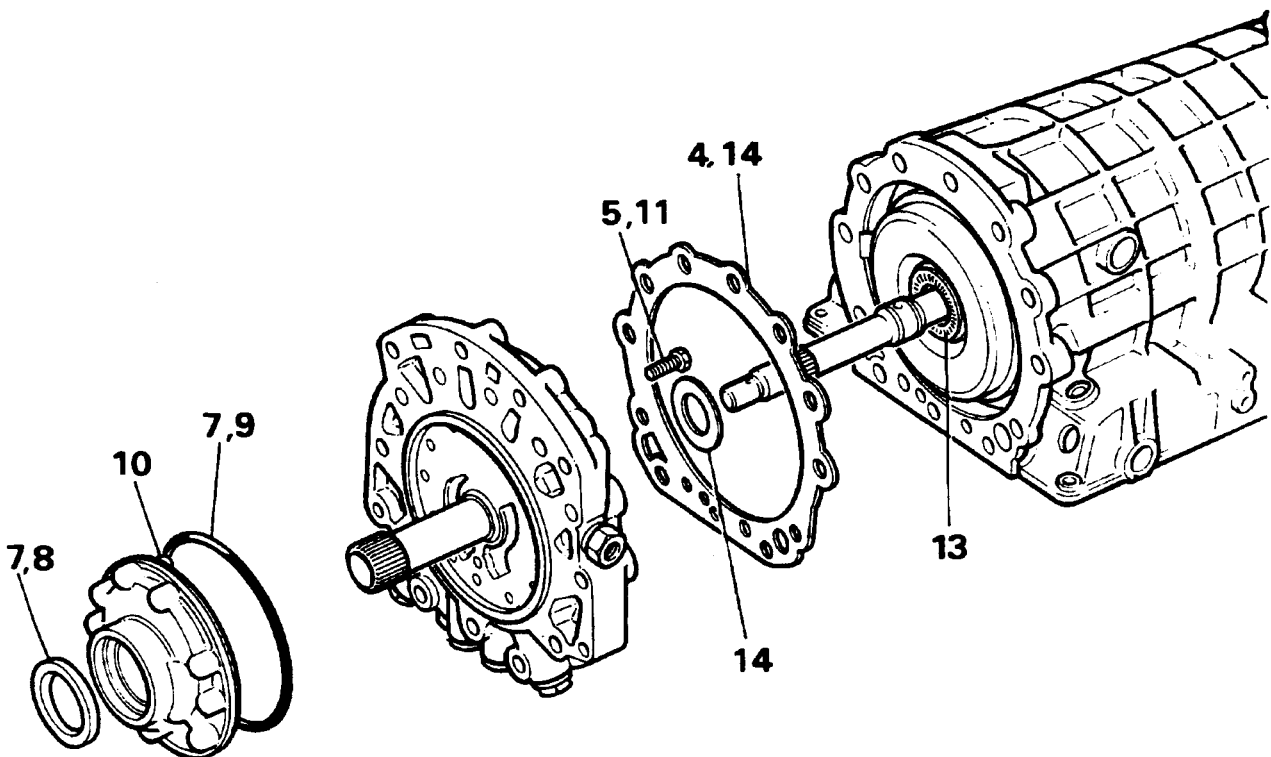
6. Screw in two bolts, diagonally opposite each other. Tap lightly using a soft headed mallet to remove pump assembly from intermediate plate.



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7. Remove shaft sealing ring and 'O' ring from pump housing and discard.
8. Using oil seal replacer LST108 fit shaft seal ring into pump housing.
9. Fit 'O' ring onto circumference of pump housing.
10. Align dowel with hole in intermediate plate and press pump housing home.

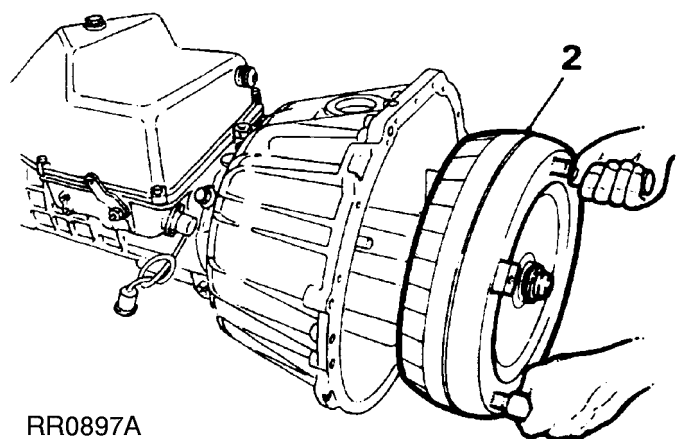
11. Fit pump housing to intermediate plate, tighten eight bolts to **10 Nm**.
12. Place bell housing and intermediate plate assembly on bench, front face up. Using oil pump rotation sleeve LST111, check that pump gears rotate freely.
13. Before fitting intermediate plate and bell housing assembly, check that thrust washer and axial cage are seated on A clutch housing.
14. Place gasket and disc washer onto bell housing and intermediate plate assembly using Petroleum Jelly.
15. Fit bell housing and intermediate plate assembly to gearcase. Tighten twelve bolts to **46 Nm**.
16. Place end float gauge LST111 onto pump housing and check that axial play is between 0.2-0.4 mm. Replace existing washer, situated at rear of intermediate plate, with a suitable washer to give required end float.
17. Refit torque converter into housing using torque converter handles 18G1501, checking that dimension from converter fixing bolt boss to converter housing face is 50 mm. This shows converter is properly seated in housing.
18. Refit gearbox/transfer box assembly. **See LT230T Transfer Gearbox**



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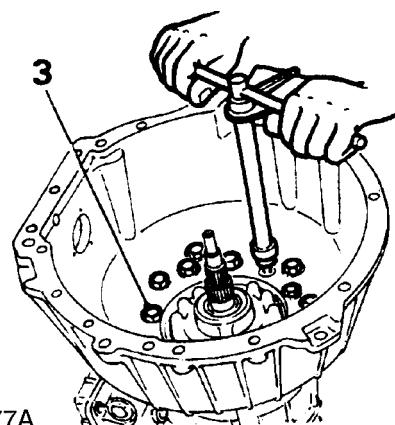
## ELIMINATING LEAKS BETWEEN GEARBOX HOUSING AND INTERMEDIATE PLATE

1. Remove gearbox and transfer box assembly. **See LT230T Transfer Gearbox**
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501, taking care not to damage torque converter/oil pump housing oil seal.



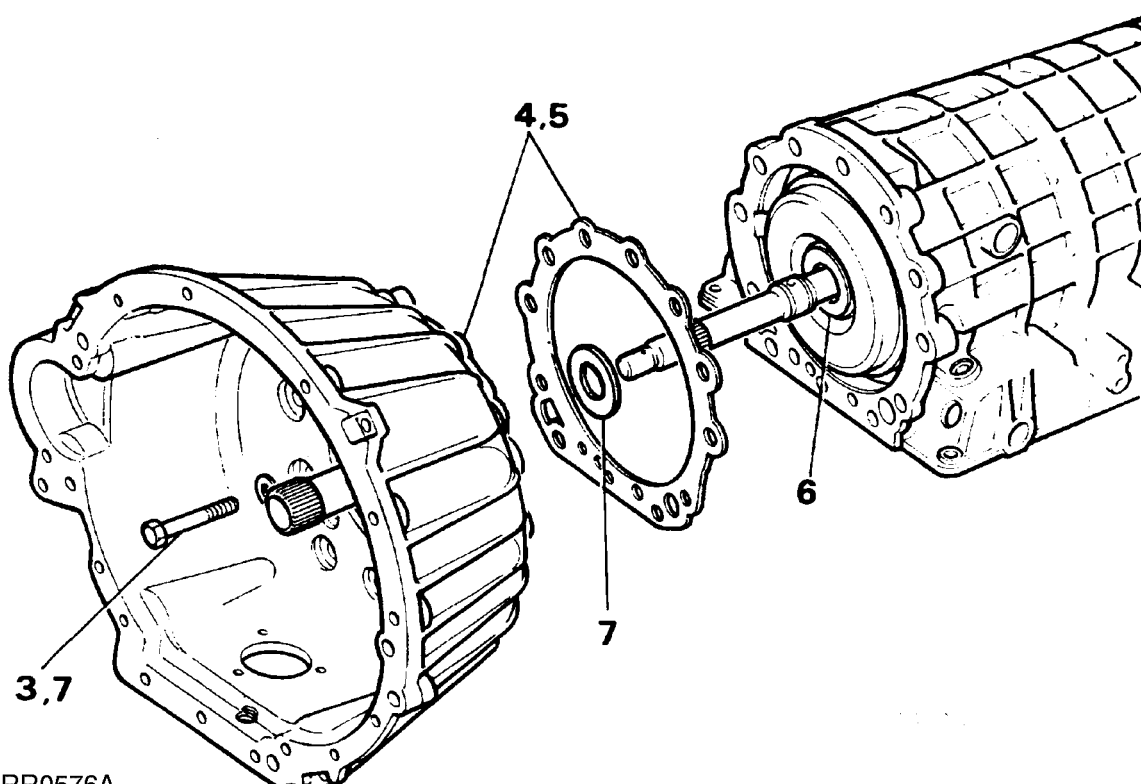
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3. Remove twelve hexagonal bolts (inner ring pattern).
4. Remove bell housing/intermediate plate assembly from gearbox case and discard gasket.
5. Place new gasket onto intermediate plate using Petroleum Jelly.



RR0577A

6. Before fitting bell housing assembly check that thrust washer and axial cage are seated on A clutch housing.
7. Fit bell housing assembly with disc washer to gearcase. Tighten twelve bolts to **46Nm**.
8. Place end-float gauge LST111 onto pump housing and check that axial play is between 0.2-0.4 mm. Replace existing washer, situated at rear of intermediate plate, with a suitable washer to give required end-float.
9. Refit torque converter using torque converter handles 18G1501. Checking that dimension from converter fixing boss to converter housing case is 50mm. This dimension shows converter is properly seated.
10. Refit gearbox/transfer box assembly. **See LT230T Transfer Gearbox**



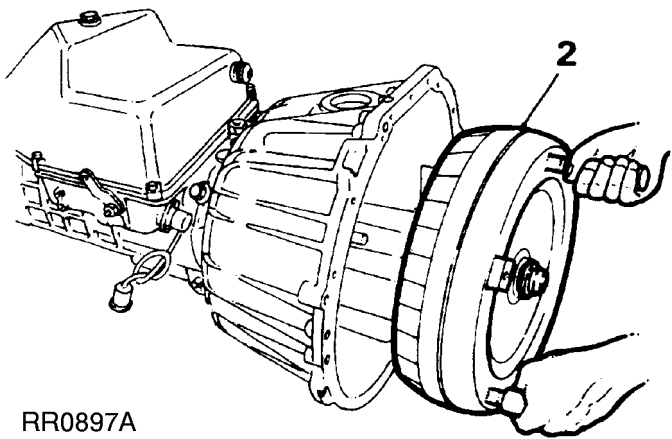
RR0576A



## REPLACING PUMP

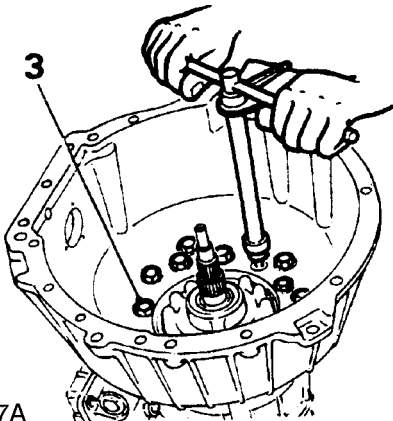
### Service repair no - 44.32.01

1. Remove gearbox and transfer box assembly.  
**See LT230T Transfer Gearbox**
2. Place gearbox on bench. Remove torque converter using torque converter handles 18G1501, taking care not to damage torque converter/oil pump housing oil seal.



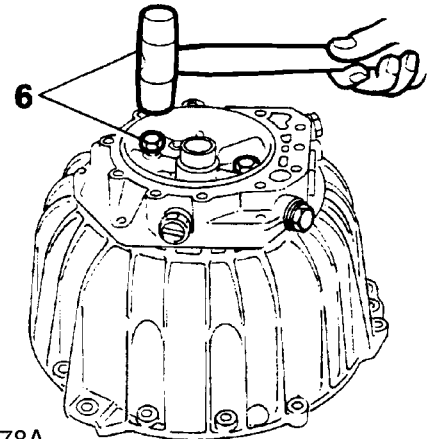
RR0897A

3. Remove twelve bolts (inner ring pattern).



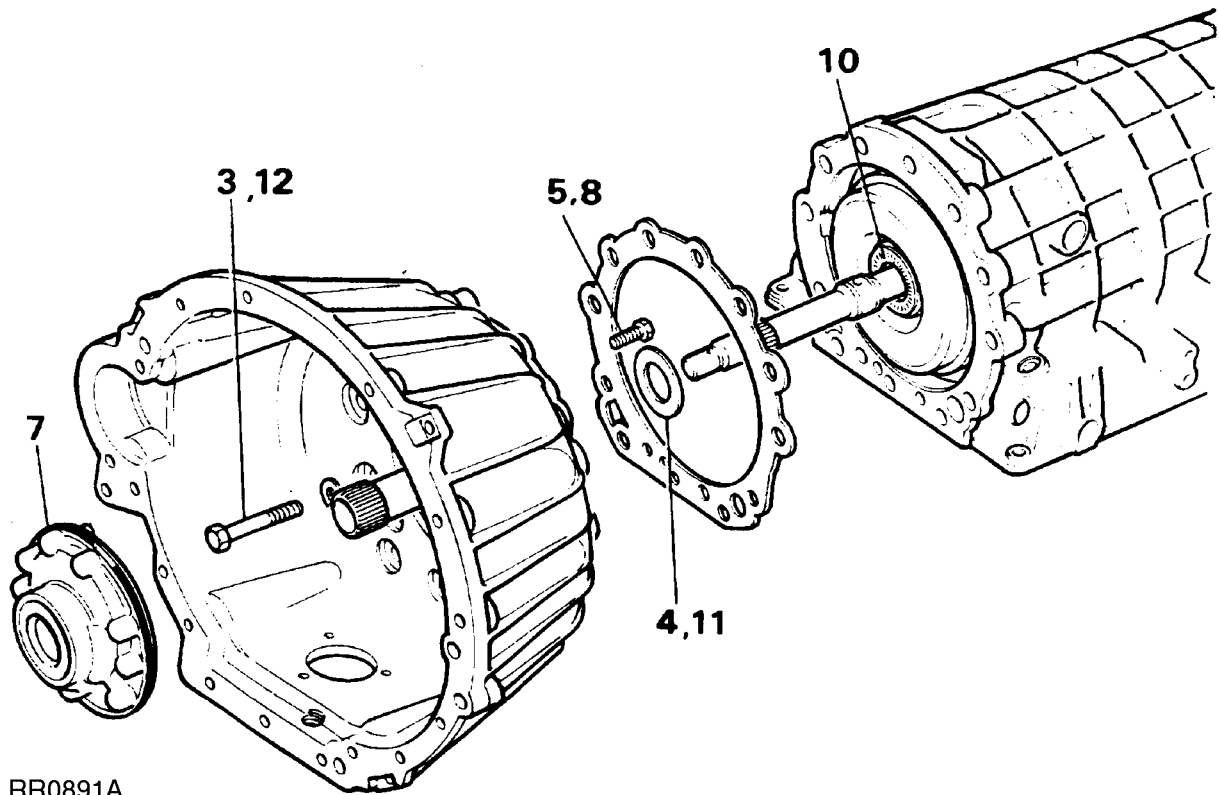
RR0577A

4. Remove bell housing and pump assembly from gearbox case, discard gasket.
5. Remove eight bolts on rear of pump.
6. Screw in two bolts, diagonally opposite each other, tap lightly using a soft headed mallet to free pump assembly from intermediate plate.



RR0578A

7. Fit new pump assembly, aligning dowel with hole in intermediate plate, press pump housing home.
8. Secure pump housing to intermediate plate using eight hexagonal bolts. Tighten to **10 Nm**.
9. Place bell housing and intermediate plate assembly on bench, front face up. Using oil pump rotation sleeve LST111, check that pump gears rotate freely.
10. Before replacing intermediate plate/bell housing assembly check that thrust washer and axial cage are seated on A clutch housing.
11. Place new gasket and disc washer onto bell housing and intermediate plate assembly using a Petroleum Jelly.
12. Fit bell housing and intermediate plate assembly, tighten twelve bolts to **46 Nm**.



RR0891A

13. Place end-float gauge LST111 onto pump housing and check that axial play is between 0.2-0.4 mm. Replace existing washer, situated at rear of intermediate plate, with suitable washer to give required end-float.



**NOTE:** If damage is apparent to bolts they should be replaced.

14. Refit torque converter into housing using torque converter handles 18G1501. Check dimension converter fixing boss to converter housing face is 50 mm. This shows converter is properly seated in housing.
15. Refit gearbox/transfer box assembly. **See** *LT230T Transfer Gearbox*

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## GEAR SELECTOR-INTERLOCK

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For remove and refit of gear selector interlock. **See** *ELECTRICAL, Repair, Gear Selector-Interlock*



## TORQUE VALUES



**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	<b>Nm</b>
Coupling shaft to mainshaft .....	42*
Filler tube to sump .....	68
Gear change lever to gearbox .....	25
Cooler pipe adaptor to gearbox .....	42
Securing screws - clutch F .....	10
Securing screw - parking pawl .....	10
Securing screws - pump .....	10
Intermediate plate plugs (M20) .....	50
Intermediate plate plugs (M14) .....	40
Bell housing mounting bolts .....	46
Governor mounting screws .....	10
Extension housing bolts .....	23
Control unit mounting bolts .....	8
Sump plug .....	10
Mounting screws for sump .....	8
Drive plate to converter .....	39*
Gearbox to engine .....	42
Strut (threaded end) .....	42
Bottom cover to converter housing .....	9
Cover - converter housing .....	9
Drive plates to crankshaft adaptor .....	40*
Adaptor to crankshaft .....	84



**NOTE:** \* These bolts must have threads coated with Loctite 270 prior to assembly.

Torque values below are for all screws and bolts used except for those that are specified otherwise.

<b>METRIC</b>	<b>Nm</b>
M5 .....	6
M6 .....	9
M8 .....	25
M10 .....	45
M12 .....	90
M14 .....	105
M16 .....	180
 <b>UNC / UNF</b>	
1/4 .....	9
5/16 .....	24
3/8 .....	39
7/16 .....	78
1/2 .....	90
5/8 .....	136



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## ZF GEARBOX DATA

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Axial end float 0.2 to 0.4 mm.

From torque converter boss to torque converter housing face 50 mm

Freewheel cage assembly to ring gear; minimum clearance 0.1 mm

Output shaft above cylinder F assembly; dimension 10.00 mm

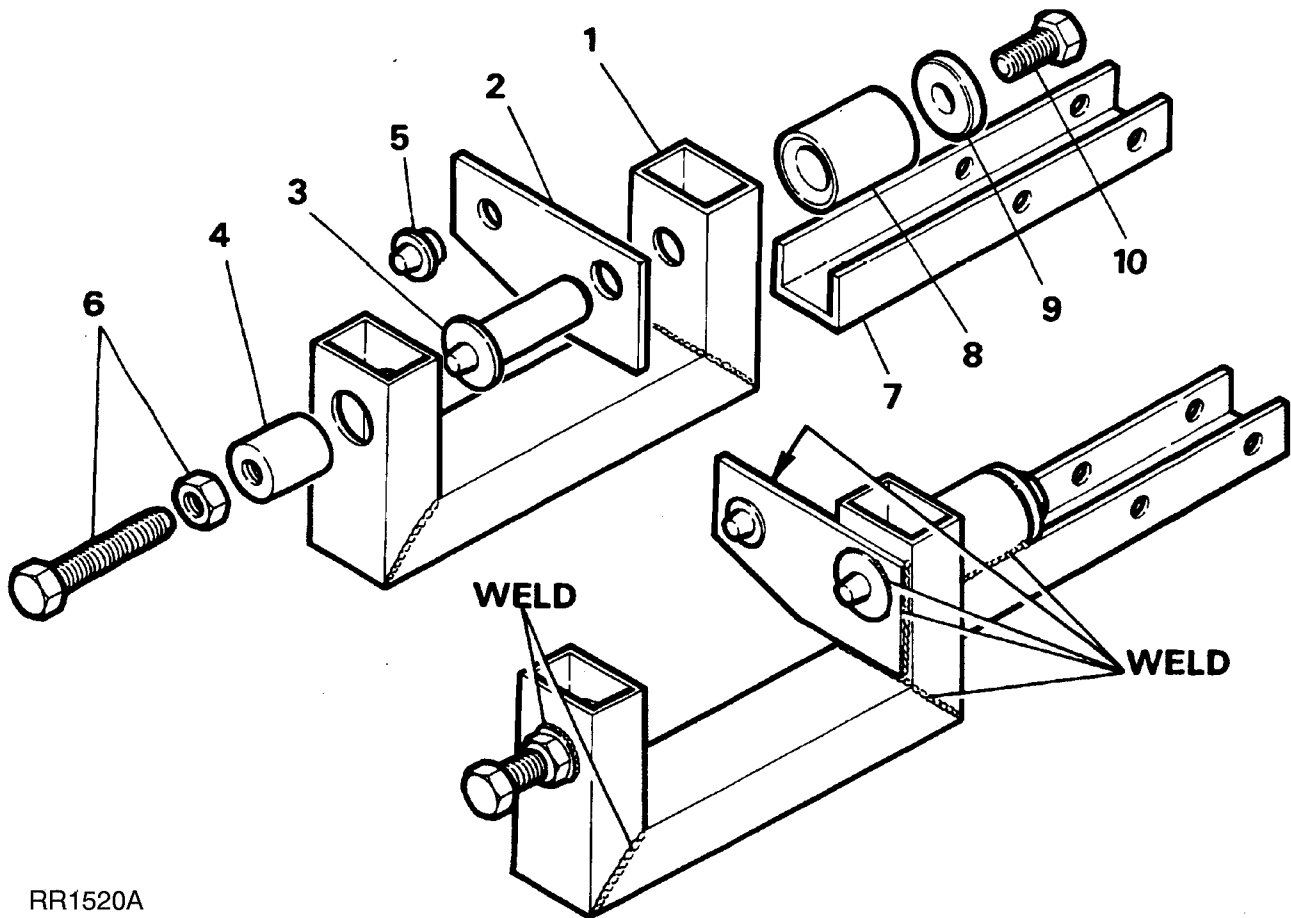
A cylinder protrusion above gearbox front face not more than 8.5 mm



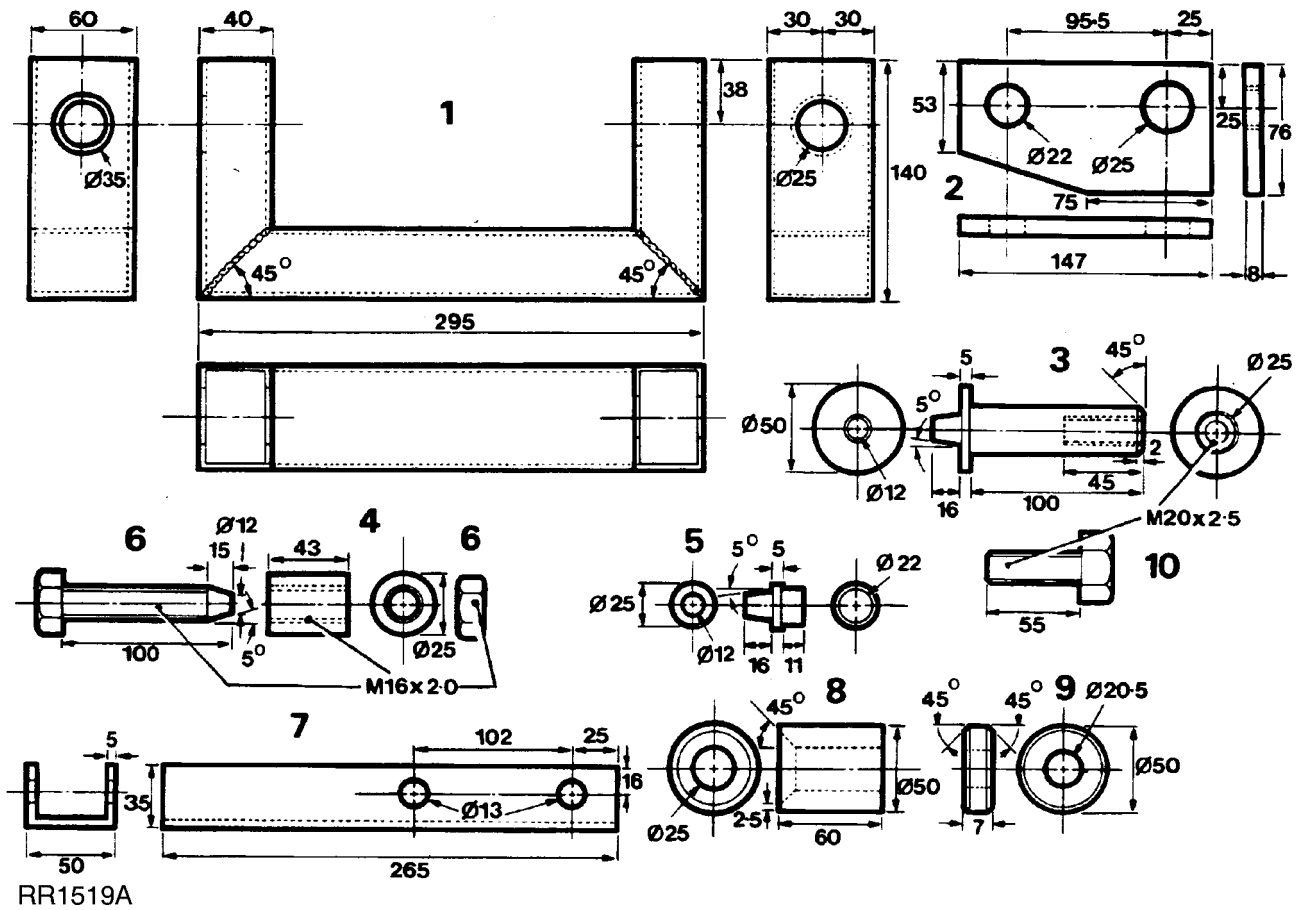
## AUTOMATIC GEARBOX HOLDING FIXTURE



**NOTE:** This fixture enables ZF gearbox to be held securely during bench sited repairs. It can be manufactured to details given, or purchased under service tool number LST 118.



RR1520A



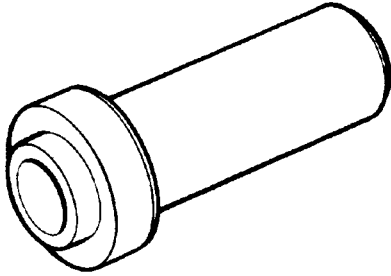


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**AUTOMATIC GEARBOX**

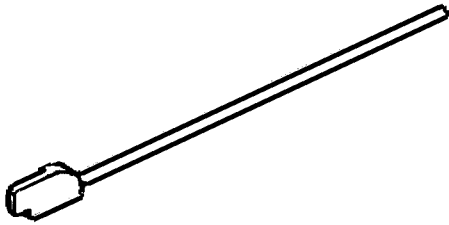
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LRT-44-001 Front and rear oil seal replacer.  
LST 108



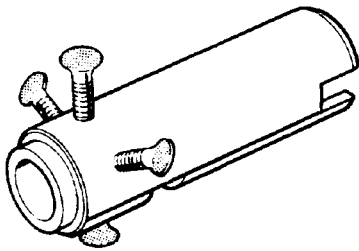
LST108

LRT-44-002 Selector linkage setting gauge.  
LST 109



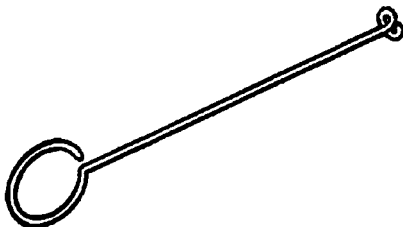
LST109

LRT-44-003 Oil pump rotation sleeve and end float gauge.  
LST 111



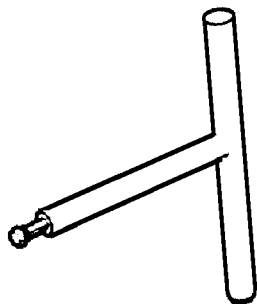
LST111

LRT-44-004 Kickdown cable remover.  
LST 112



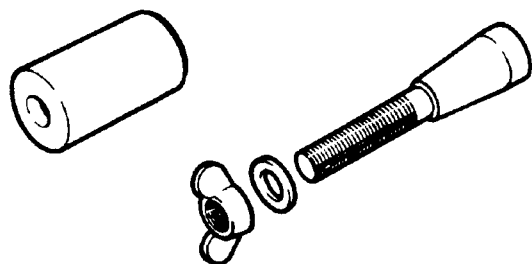
LST112

# 44 AUTOMATIC GEARBOX



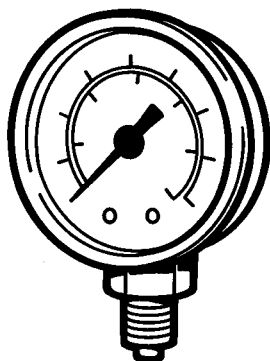
LRT-44-005 Control unit oil seal remover/replacer.  
LST 113

LST113



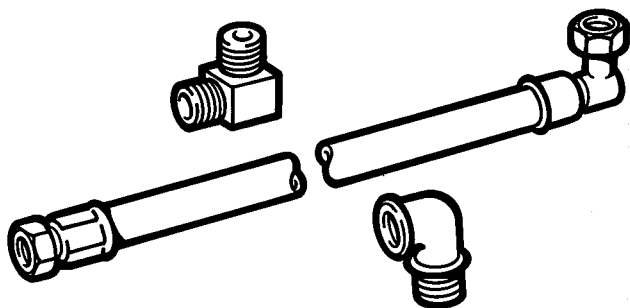
LRT-44-006 Selector shaft oil seal replacer.  
LST 114

LST114



LRT-44-007 Line pressure test gauge.  
18G.502A

18G502A

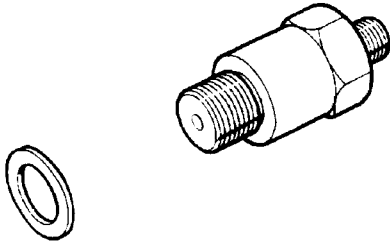


LRT-44-008 Hose and adaptor.  
18G.502K

18G502K

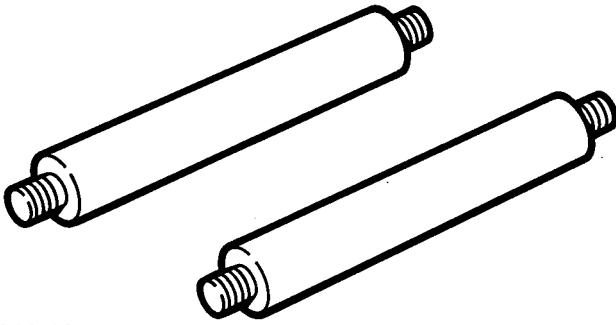


LRT-44-009 Adaptor pressure take off.  
LST 502-1



LST502-1

LRT-44-010 Converter lifting handles.  
18G.1501



18G1501



**PROPELLER SHAFT ALIGNMENT**

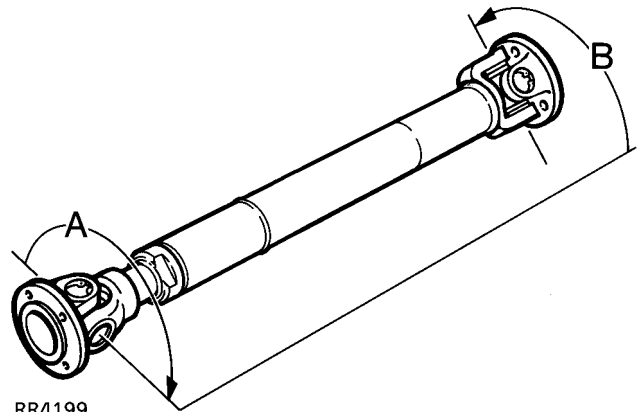
**Description**

The front and rear propeller shafts have non-constant velocity 'Hooks' type universal joints, with needle roller bearings. The bearing cups are pre-packed with lubricant on assembly and a grease nipple is fitted for servicing as specified, in maintenance section.

Both shafts have Rilsan coated sliding splines to accommodate the variation in distance between the axles and transmission. The splines are pre-packed with lubricant and sealed.

The rear shaft is fitted with a conventional joint at gearbox end and the sliding joint sealed with a rubber gaiter. An SGF rubber coupling is fitted at the differential end of the shaft.

The front shaft which is shorter than the rear is 'Phased', with the joints at each end, A and B mis-aligned as shown in RR4199.

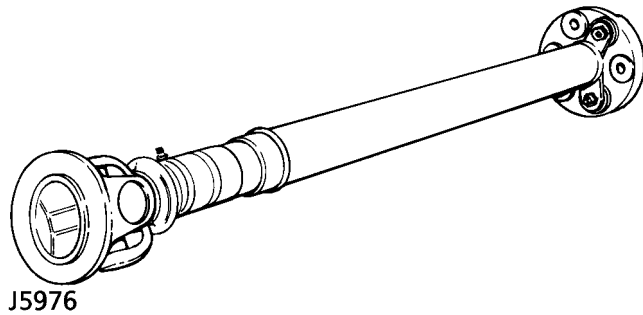


RR4199

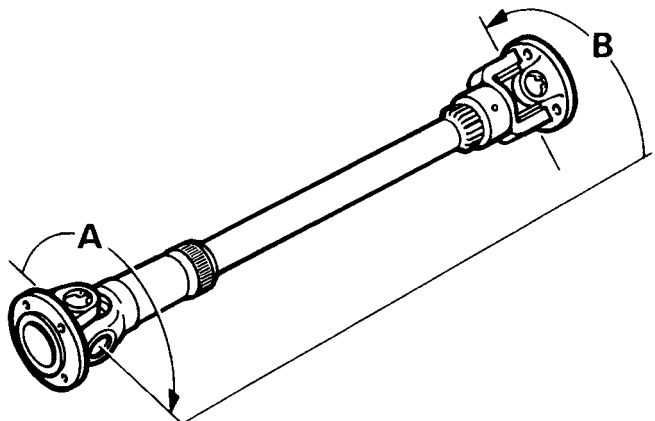
The phasing is necessary on the front shaft only to allow for greater variation in angular changes.

**Catalyst vehicles**

The front shaft is 'phased' as above but is of solid bar construction.



J5976



RR3643A



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## VIBRATION HARSHNESS

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1. Check that the propeller shaft universal joints and sliding splines are not siezed or worn and that the shafts are correctly aligned.



**NOTE:** In the event that both shafts are satisfactory, but the vibration/harshness is still present, the transfer box operation and balance of the road wheels should be checked.

For transfer box operation. **See TRANSFER GEARBOX, Fault diagnosis, LT230T Transfer Box - Oil Leaks**

For balance of road wheels. **See WHEELS AND TYRES, Repair, Wheel Balancing**





**FRONT PROPELLER SHAFT**

Service repair no - 47.15.02 - Front

**Remove**

1. Place vehicle over pit or on a ramp [hoist].
2. Remove nuts from each end of propeller shaft. Remove shaft.
3. Scribe alignment marks on flanges at both ends of propeller shaft to ensure correct refitting.

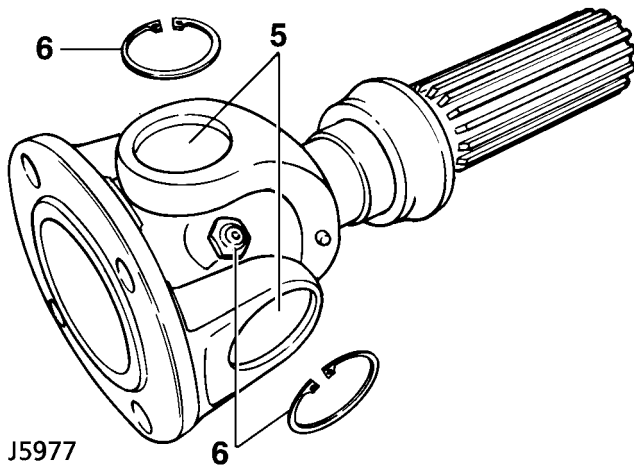
Service repair no - 47.15.11

**Overhaul**

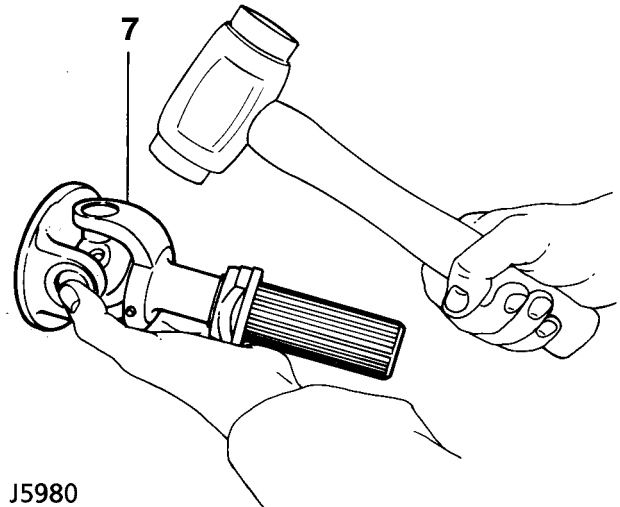
4. Thoroughly examine universal joint for signs of damage or wear. Replace if necessary.
5. Clean universal joint bearing cups and circlips.

**CAUTION:** To ensure correct assembly and reduce possibility of imbalance. Before removing propeller shaft joint. Mark position of spider pin lubricator relative to journal yoke ears.

6. Remove circlips, and grease nipple.



J5977

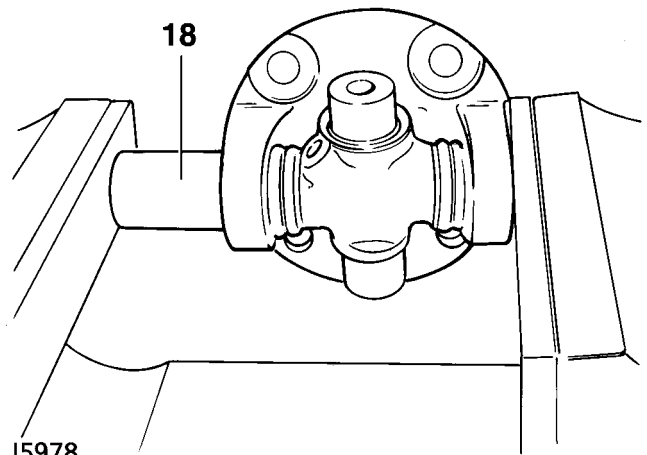


J5980

7. Tap yokes to eject bearing cups.
8. Remove bearing cups and spider.
9. Repeat instructions 4 to 7 for opposite end of propeller shaft if necessary.
10. Clean yokes and bearing cup locations.

**Assemble**

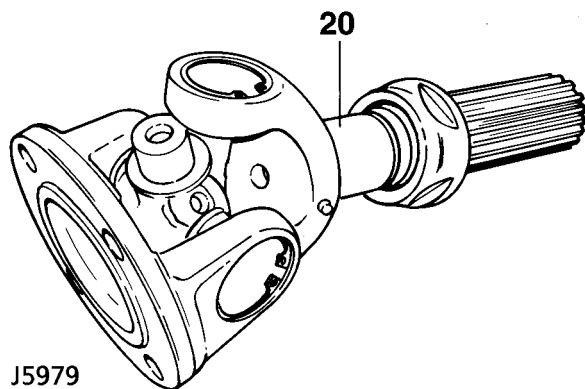
11. Remove bearing cups from new spider.
12. Check all needle rollers are present and positioned in bearing cups.
13. Ensure bearing cups are one-third full of lubricant. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**
14. Enter new spider with seals into yokes of sliding member flange.
15. Partially insert one bearing cup into flange yoke and enter spider trunnion into bearing cup.
16. Insert opposite bearing cup into flange yoke.
17. Press both cups into place.



J5978

## 47 PROPELLER SHAFTS

18. Press each cup into its respective yoke up to lower land of circlip grooves. Damage may be caused to cups and seals if cups pass this point.
19. Fit circlips and check no end float exists.
20. Engage spider in yokes of sliding member. Fit bearing cups and circlips as described in instructions 14 to 19.



21. Fit grease nipples to spider and sliding member.
22. Apply instructions 14 to 19 to opposite end of propeller shaft.
23. Fit grease nipple and lubricate.

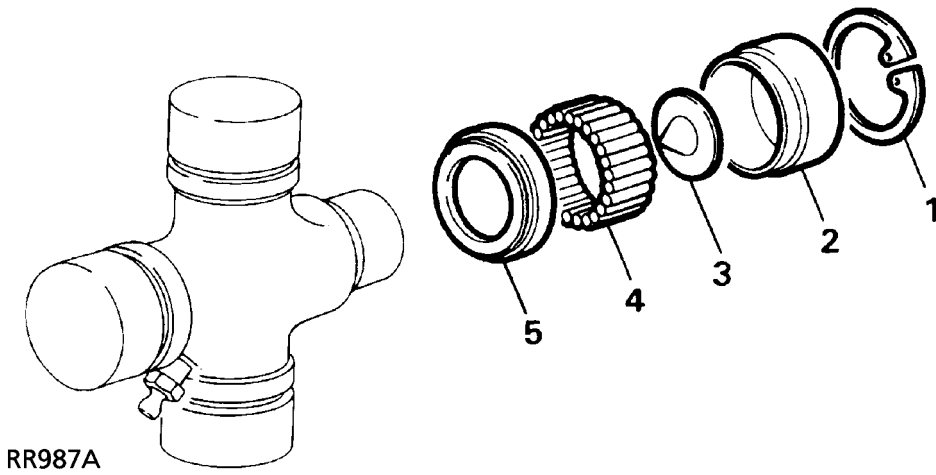
### Refit

24. Fit propeller shafts to vehicle and tighten nuts to **47Nm**  
Refit FRONT propeller shaft so sliding joint end of shaft is fitted to transfer gearbox.



**SPIDER ASSEMBLY COMPONENTS**

1. Circlip
2. Bearing cup
3. Nylatron washer
4. Needle rollers (27 per cup)
5. Seal retainer and seal



**REAR PROPELLER SHAFT**

Service repair no - 47.15.03



**NOTE:** SGF rubber coupling should be left attached to propeller shaft. Only remove coupling from propeller shaft if replacement is required.

**Remove**

1. Scribe alignment marks on flanges at both ends of propeller shaft to ensure correct refitting.
2. Remove three nuts and bolts securing flexible coupling to axle flange.
3. Remove nuts securing propeller shaft flange to transfer gearbox.
4. Raise propeller shaft at gearbox end detach coupling from spigot at differential and withdraw shaft.



**NOTE:** For replacement of spigot (pinion flange centralising peg). See **REAR AXLE AND FINAL DRIVE, Overhaul, Axle Differential Assembly**

**Overhaul**

Service repair no - 47.15.12



**NOTE:** Refer to front propeller shaft overhaul procedure for gearbox end of shaft. The SGF rubber coupling is a non-serviceable item.

**Refit**

5. Locate flexible coupling over spigot, align scribed marks and secure at transfer gearbox. Tighten to **47 Nm**.
6. Secure flexible coupling to axle flange with three nuts and bolts and Tighten to **78 Nm**.

**FLEXIBLE COUPLING**

**NOTE:** Flexible coupling should only be removed if a new coupling is to be fitted.

**Remove**

1. Remove rear propeller shaft. See **Rear Propeller Shaft**.
2. Remove nuts and bolts securing flexible coupling to propeller shaft.

**Refit**

3. Reverse removal procedure. Fit nuts and bolts. Tighten to **78 Nm**.



**DESCRIPTION**

The welded steel rear axle casing houses a separate spiral bevel type differential unit, which is off set to the right of the vehicle centre line. The differential unit drives the rear wheels via the axle shafts and fully floating hubs which are mounted on tapered roller bearings.

**Lubrication**

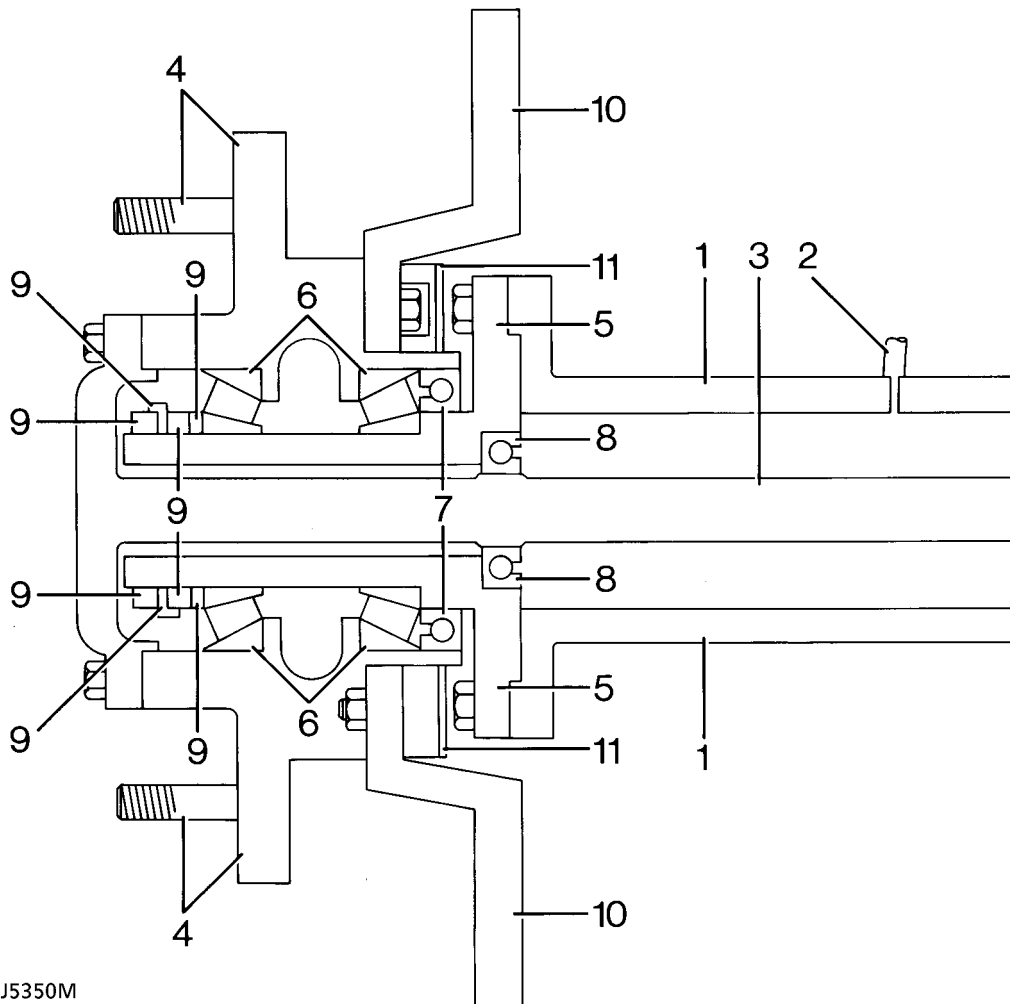
The differential is lubricated with oil and the hub bearings with grease. The hub bearings are fitted

with inner and outer seals. The outer seals prevent the differential oil mixing with the hub grease and the inner seals prevent dirt ingress into the hub.

**Ventilation**

Ventilation of the hub bearings is through the outer oil seals and the differential ventilation pipe, which terminates at a high level.

The wheel hubs on axles with ABS brakes share the same construction to non ABS axles except for the addition of a sensor ring 11 on the brake disc 10.



**Rear axle hub**

- |                            |   |
|----------------------------|---|
| 1. Axle casing             | 7. Inner hub seal                             |
| 2. Ventilation pipe        | 8. Outer hub/axle shaft seal                  |
| 3. Axle shaft              | 9. Hub lock plate, thrust washer and nuts (2) |
| 4. Wheel studs and hub     | 10. Brake disc                                |
| 5. Wheel bearing stub axle | 11. Sensor ring, ABS                          |
| 6. Wheel bearings (2)      |   |



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## FAULT DIAGNOSIS

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### Complaint - Oil leaks

An external leak of lubrication from the hub seals can be caused by a faulty internal seal. For example, if the internal seals which separate the differential from the hubs are faulty and the vehicle is operating or parked on an embankment. Oil from the differential may flood one hub causing a leak and leave the differential lacking lubrication.

When a seal is found to be leaking check the axle ventilation system, as a blockage can cause internal pressure to force oil past the seals.

See 'Description and Operation' for illustrations of oil seal locations.

When investigating hub seal leaks check the grease for dilution with oil. Check also the differential level and oil for metal particles and the condition of internal seals.

If the vehicle is driven in deep water with defective oil seals, water may contaminate the lubricants and raise the differential level giving a false impression that the housing has been overfilled with oil.

**Do not assume that a high oil level in the differential is due to over filling or, that a low level is because of an external leak.**



## REAR AXLE

Service repair no - 51.25.01

### Remove



**WARNING:** Remove and refit of axle requires a further two persons to steady the axle when lowering or repositioning axle.

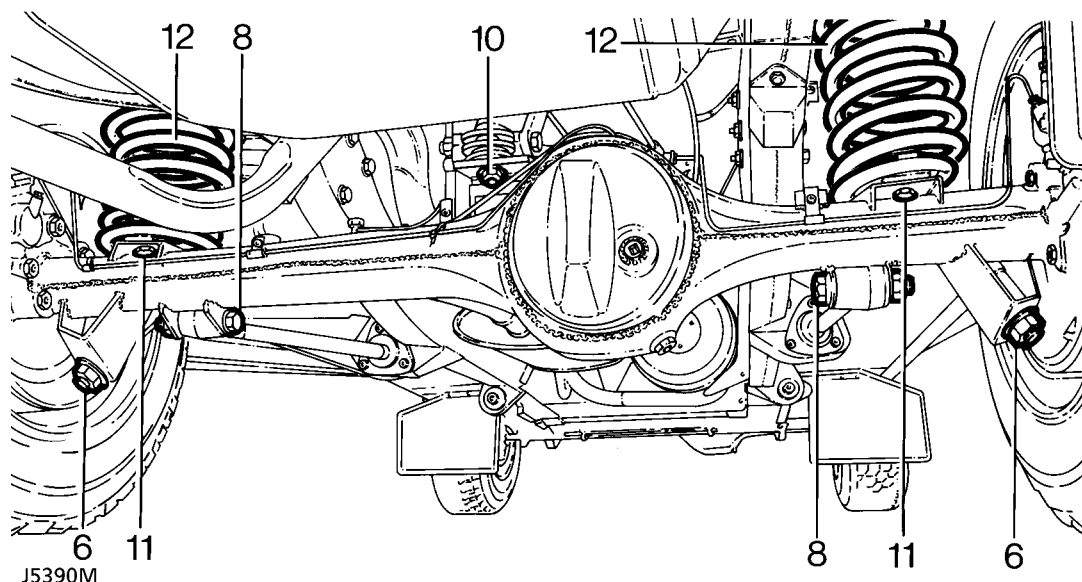
axle.

1. Drain brake system.
2. Support chassis rear.
3. Remove road wheels.
4. Support axle weight with hydraulic jack.
5. Disconnect ABS wiring harness multi-plug at jump hose bracket, if applicable.
6. Disconnect shock absorbers.
7. Disconnect flexible brake hose at connection under floor.
8. Disconnect lower links at axle.
9. Mark differential and propeller shaft flanges with identification marks for assembly. Remove four nuts and bolts. Lower propeller shaft and tie to one side.

10. Disconnect pivot bracket ball joint at axle bracket.
11. Release bolts and remove coil spring retaining plates.
12. Lower axle and remove road springs.
13. Disconnect anti-roll[sway] bar links to axle. **See REAR SUSPENSION, Repair, Anti-Roll[Sway] Bar Ball Joint Links**
14. Remove axle assembly.

### Refit

15. Position axle and fit lower links. Tighten to **176 Nm**
16. Reverse removal procedure.
17. Tighten pivot bracket ball joint to axle to **176 Nm**.
18. Tighten propeller shaft to differential drive flange to **47 Nm**
19. Bleed brake system. **See BRAKES, Repair, Brake System Bleed**



**REAR BRAKE DISC NON ABS**

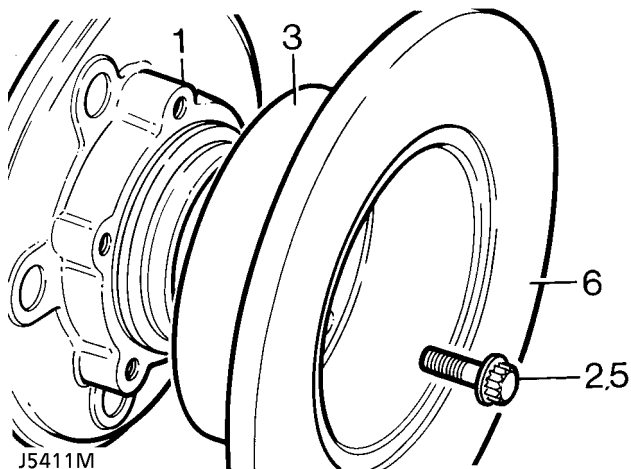
Service repair no - 70.10.11.

**Remove**

1. Remove rear hub assembly. *See Rear Hub Assembly*
2. Remove disc bolts.
3. Remove disc from rear hub.

**Refit**

4. Fit disc to rear hub.
5. Fit disc bolts. Tighten to **73 Nm**.
6. Check total disc run out, this must not exceed 0,15 mm. If necessary reposition disc.



7. Fit rear hub assembly. *See Rear Hub Assembly*

**Disc reclamation**

8. Check disc thickness. This dimension may be reduced to minimum thickness of 12 mm. Machine equal amounts off each face.

**REAR BRAKE DISCS ABS**

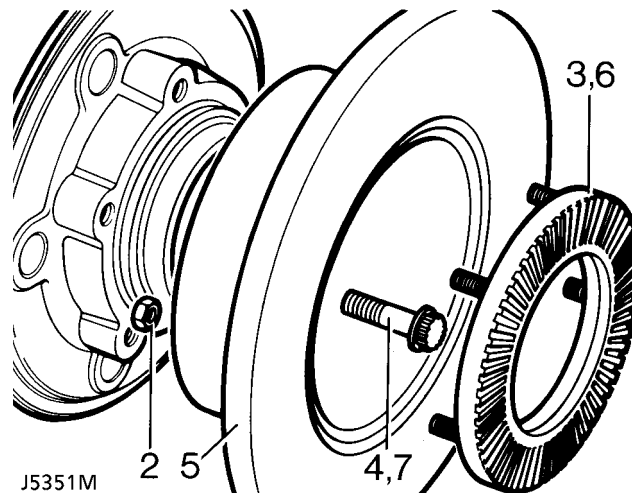
Service repair no - 70.11.11.

**Remove**

1. Remove rear hub assembly. *See Rear Hub Assembly*
2. Remove five nyloc nuts.
3. Remove sensor ring.
4. Remove five hub to disc retaining bolts.
5. Remove disc from hub.

**Refit**

6. Fit disc onto hub.
7. Apply loctite 270 and fit hub to disc retaining bolts. Tighten to **73 Nm**.
8. Using new nyloc nuts fit sensor ring.



9. Check total disc run out, this must not exceed 0,15 mm. If necessary reposition disc.
10. Fit hub assembly. *See Rear Hub Assembly*

**Disc reclamation**

11. Check disc thickness. This dimension may be reduced to a minimum thickness of 12 mm. Machine equal amounts off each face.





**REAR HUB ASSEMBLY**

Service repair no - 64.15.01

**Remove**

1. Place rear axle onto axle stands and remove road wheel.
2. Release brake hose clips and remove brake caliper bolts. Secure to one side.

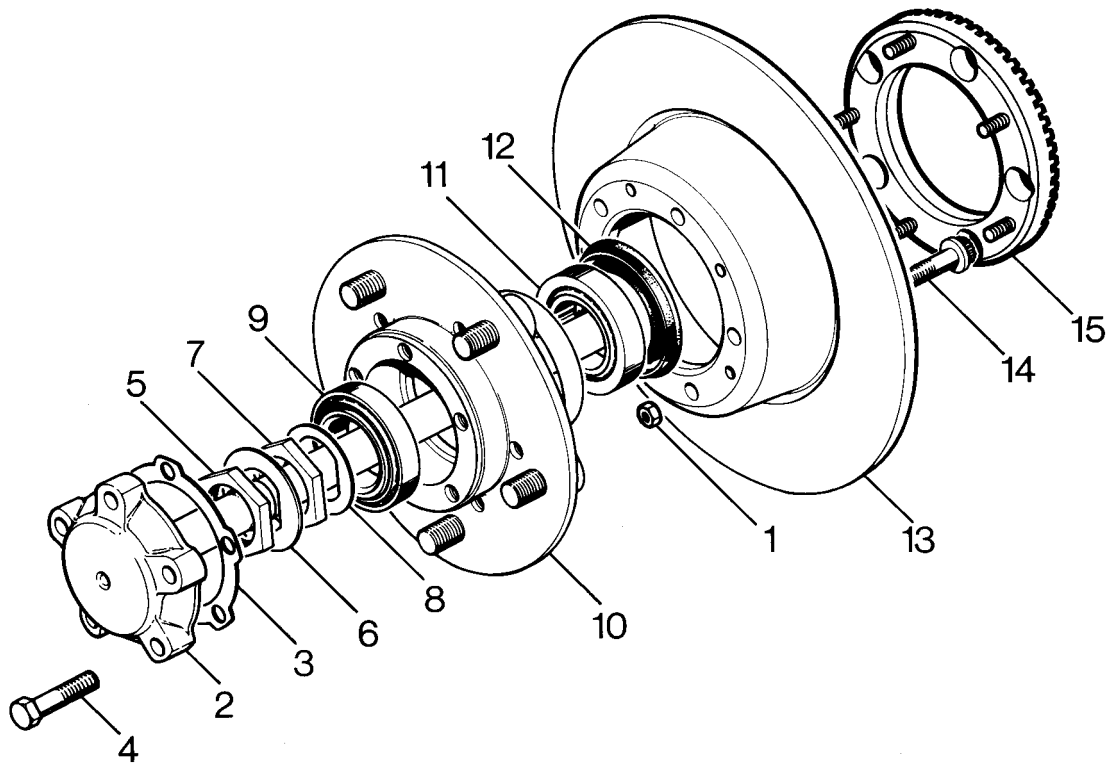


**WARNING: Take care not to kink brake hose.**

3. Remove five bolts and withdraw axle shaft.
4. Remove joint washer.
5. Bend back lock washer tabs.
6. Remove locknut and lock washer.
7. Remove hub adjusting nut.
8. Remove spacing washer.
9. Remove hub and brake disc assembly complete with bearings.

**REAR HUB COMPONENTS**

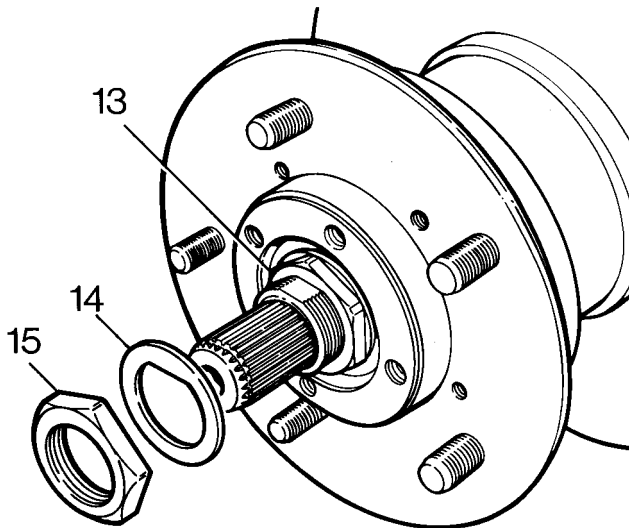
1. Sensor ring retaining nut ABS.
2. Axle shaft.
3. Axle shaft joint washer.
4. Axle shaft retaining bolt (five off).
5. Lock nut.
6. Lock washer.
7. Hub adjusting nut.
8. Spacing washer.
9. Outer bearing.
10. Hub.
11. Inner bearing.
12. Grease seal.
13. Brake disc.
14. Disc retaining bolt (five off).
15. Sensor ring ABS.



J5352M

## Refit

10. Clean stub axle. Retract ABS sensor slightly from sensor sleeve, if applicable
11. Fit hub assembly to stub axle.
12. Fit spacing washer.
13. Fit hub adjusting nut. Tighten to **61 Nm**.  
Back off adjusting nut 90°. Tighten to **4 Nm**.  
This will give the required hub end float of 0,010mm
14. Fit a new lock washer.
18. Fit brake caliper. Tighten to **82 Nm**.  
Secure brake pipes to axle casing.
19. If applicable, set ABS brakes sensor.  
Push sensor in until it touches sensor ring then rotate hub to set sensor.
20. Fit road wheel, remove axle stands and final tighten road wheel nuts to **126 Nm**.
21. Operate footbrake to locate brake pads before driving vehicle.



15. Fit locknut. Tighten to **61 Nm**.
16. Tab over lock washer to secure adjusting nut and locknut.
17. Using a new joint washer fit axle shaft to hub, secure with five bolts. Tighten to **65 Nm**.



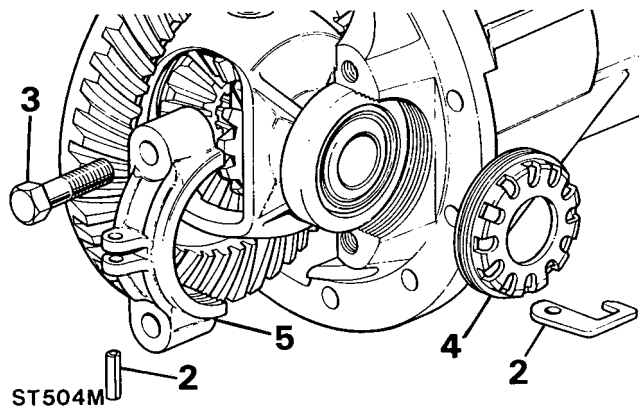
**AXLE DIFFERENTIAL ASSEMBLY**

Service repair no - 51.15.07.

**DISMANTLE**

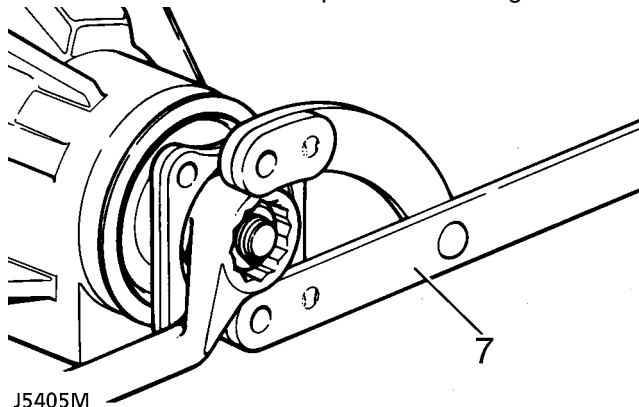
**NOTE:** Mark differential components so their original positions relative to other components is maintained. Bearing caps must not be interchanged.

1. Remove axle shafts then differential assembly from axle.
2. Remove roll pin securing bearing nut locking fingers to bearing caps. Remove locking fingers.
3. Loosen bearing cap bolts and mark caps for assembly.
4. Using service tool LRT-54-508, remove bearing adjusting nuts.
5. Remove bearing cap bolts and bearing caps.
6. Remove crown wheel differential unit and bearings.

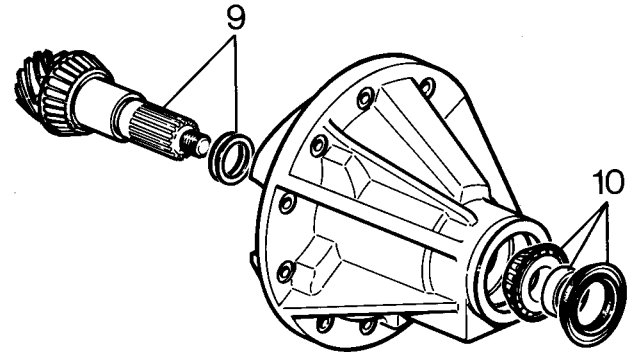


**Remove pinion FRONT AXLE DIFFERENTIAL ONLY**

7. Remove pinion flange nut using service tool LRT-51-003 to restrain flange.
8. Remove washer and pinion drive flange.



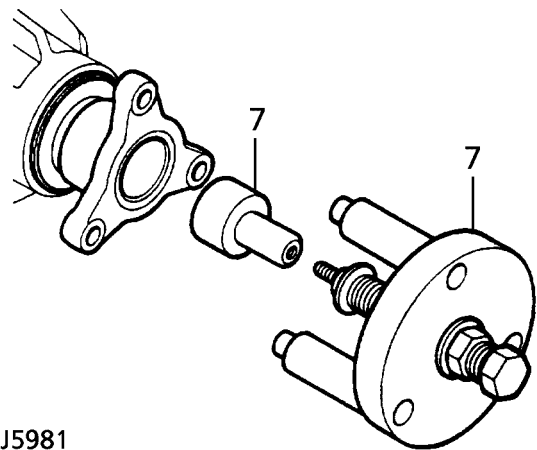
9. Remove pinion complete with bearing and outer bearing shims.
10. Remove pinion flange oil seal, spacer and bearing.



J5354M

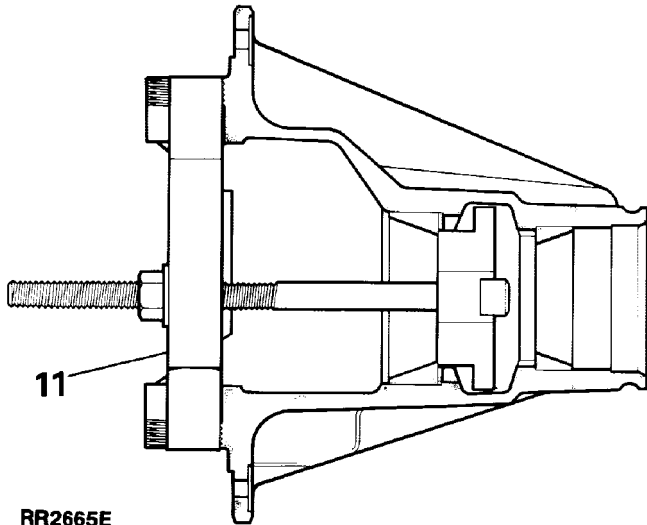
**Remove pinion REAR AXLE DIFFERENTIAL ONLY**

7. Remove pinion flange centralizing peg using service tool LRT-51-008.
8. Remove pinion flange nut using service tool LRT-51-003 to restrain flange.
9. Remove pinion complete with bearing and outer bearing shims.
10. Remove pinion flange oil seal and bearing.



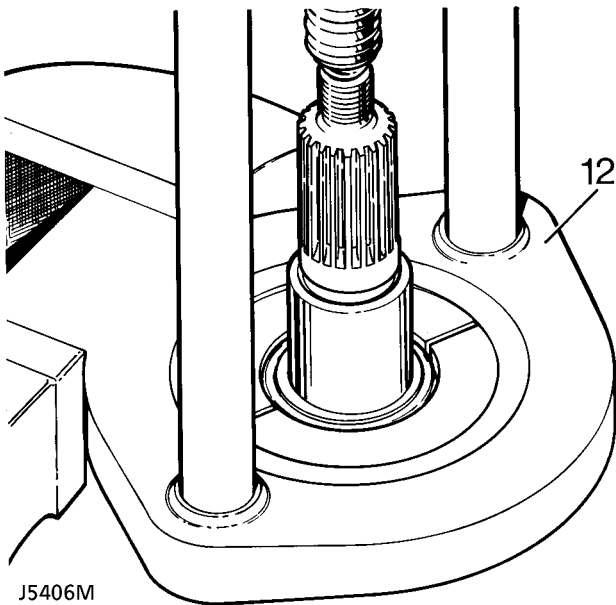
J5981

11. Using service tool LRT-54-505, remove pinion head bearing track and shim and drive out outer bearing of differential housing.



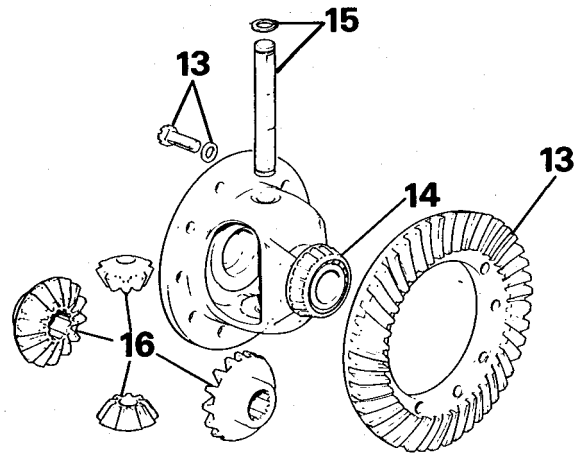
RR2665E

12. Remove pinion head bearing with service tool LRT-99-002.



J5406M

13. Remove bolts and washers securing crown wheel to differential flange. Remove crown wheel.  
 14. Remove differential carrier bearings.  
 15. Remove circlips and extract differential cross shaft.  
 16. Withdraw differential gears and pinions.  
 17. Clean all components.



ST509M

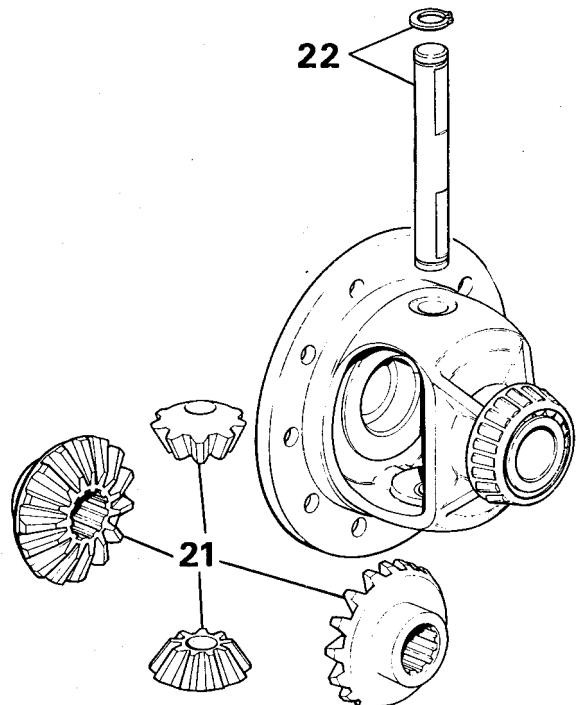
## INSPECTION

18. Check all bearings for wear and pitting.  
 19. Check all gears for wear, scuffing, pitting and damaged teeth.  
 20. Supplied as matched sets are: crown wheel and pinion, pinion housing and bearing caps.

## ASSEMBLE

## Differential gears

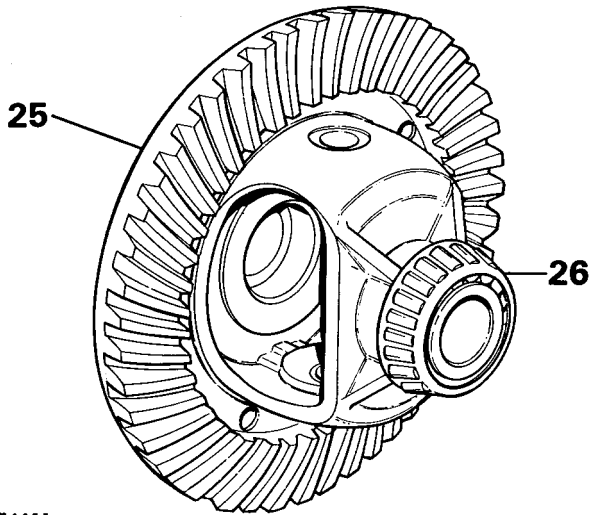
21. Fit differential gears to differential housing.  
 22. Fit differential cross shaft and circlips.



ST510M

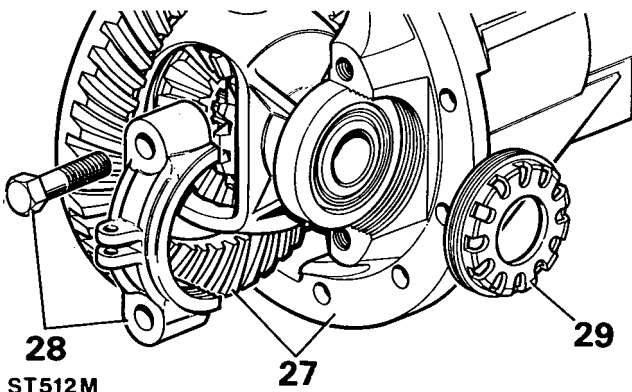


- 23. Check gear for freedom of rotation and backlash. Nominal backlash should be present. Excess backlash necessitates replacement of gears or differential housing.
- 24. Check serial number marked on pinion end face matches that on crown wheel.
- 25. Clean and fit crown wheel.
- 26. Fit carrier bearings and assemble tracks to bearings.



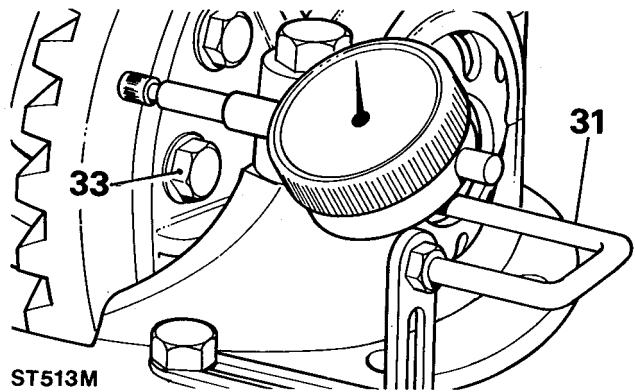
ST511M

- 27. Place differential housing with crown wheel and bearings in pinion housing.
- 28. Fit bearing caps and bolts. Do not tighten bolts.
- 29. Fit bearing adjusting nuts and adjust to obtain zero end float.



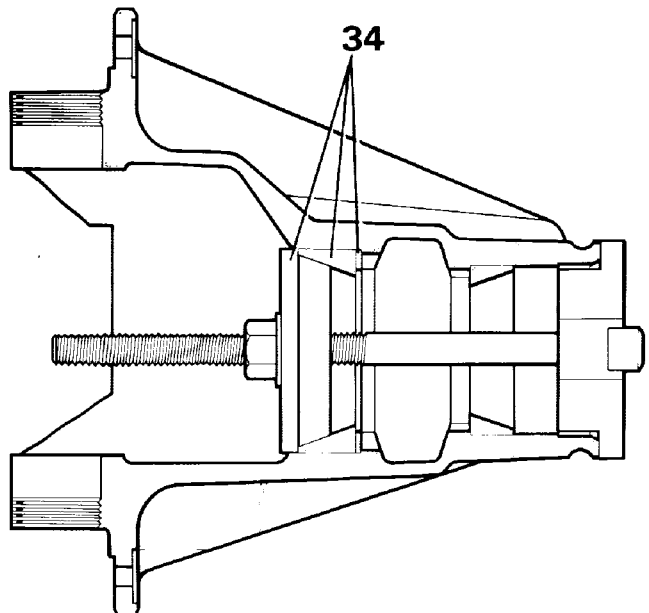
ST512M

- 30. Tighten bearing cap bolts to **90 Nm**.
- 31. Check crown wheel for run-out. This should not exceed 0,10 mm. If exceeded examine crown wheel and mounting flange for burrs, grit, etc. Refit and recheck. A buckled or damaged differential housing flange is corrected by replacing differential gear housing.
- 32. After checking run out remove differential housing from pinion housing.
- 33. Remove crown wheel bolts and refit using Loctite 'Studlock'. Tighten to **58 Nm**.



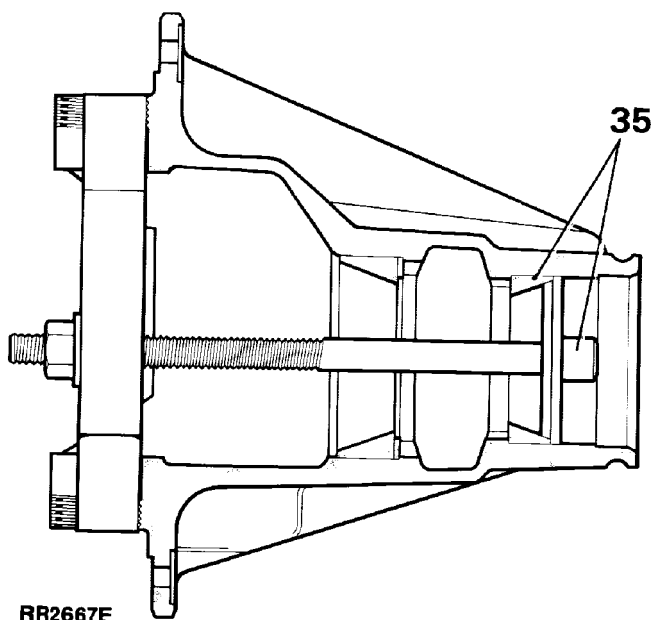
ST513M

- 34. Fit pinion head bearing track and original shim to pinion housing. Use service tools LRT-54-505 and LRT-54-506. If fitting a new shim use minimum 1.27 mm thickness.

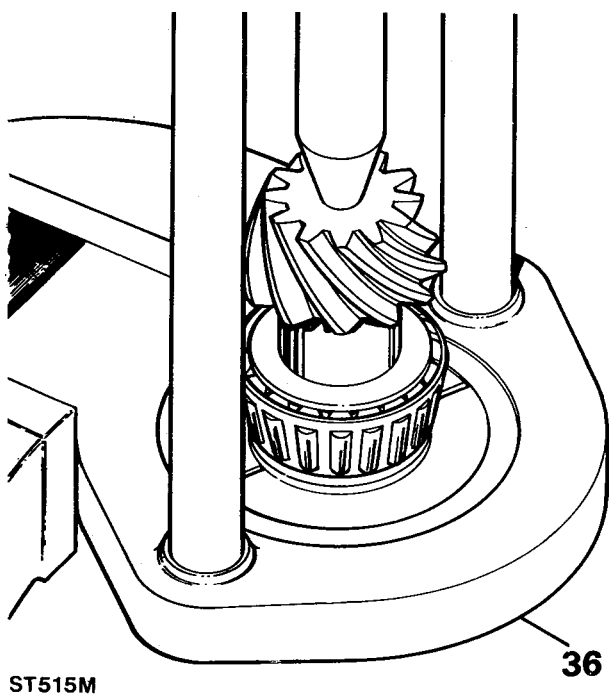


RF2666E

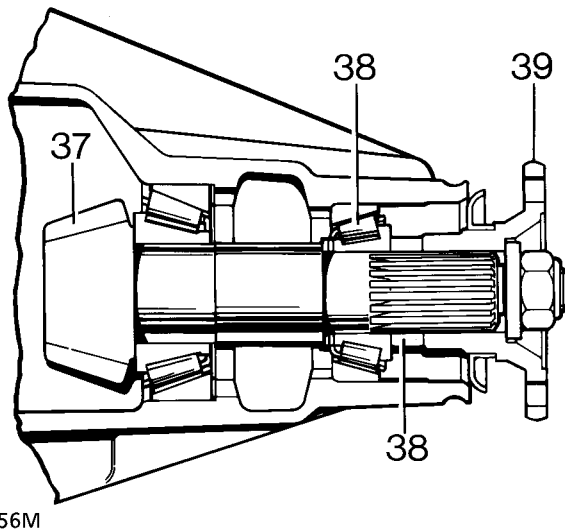
35. Fit pinion outer bearing track to pinion housing.  
Use service tools LRT-54-505 and LRT-54-507.



36. Fit pinion head bearing to pinion. Use service tool LRT-54-502.



37. Fit pinion into its location without shims for bearing pre-load.  
38. Fit outer bearing, and spacer (front axle differential only).  
39. Fit driving flange, washer and nut.



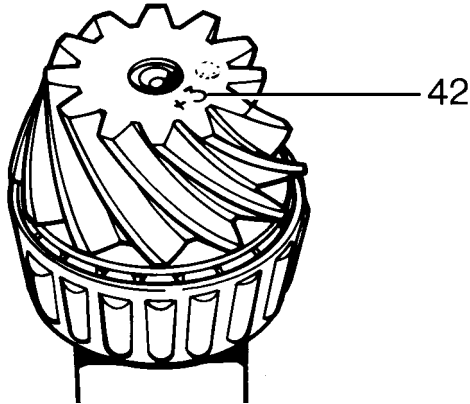
40. Do not fit oil seal at this stage.  
41. Tighten pinion flange nut until force required to rotate pinion is **3 Nm** if new bearings are fitted. This will pre-load bearings to check pinion height dimension.

△ **NOTE:** If using original bearings, pre-load figure is 1.5 Nm.

#### Drive pinion markings

△ **NOTE:** Markings on end face adjacent to serial number are of no relevance to servicing.

42. Figures marked on end face opposite to serial number show in thousandths of an inch, deviation from nominal, required to set pinion. Pinions marked plus (+) must be set below nominal. Pinions marked minus (-) must be set above nominal. Unmarked pinions must be set at nominal.



J5357M

Pinion height shims

PART No.	INCH	MM
FTC3853	.061	1.548
FTC3854	.060	1.523
FTC3855	.059	1.498
FTC3856	.058	1.473
FTC3857	.057	1.448
FTC3858	.056	1.423
FTC3859	.055	1.398
FTC3860	.054	1.373
FTC3861	.053	1.348
FTC3862	.052	1.323
FTC3863	.051	1.298
FTC3864	.050	1.273
FTC3865	.049	1.248
FTC3866	.048	1.223
FTC3867	.047	1.198
FTC3868	.046	1.173

- 43. Nominal setting dimension is represented by setting gauge block LRT-54-503. Referenced from pinion end face to bottom radius of differential bearing bore.

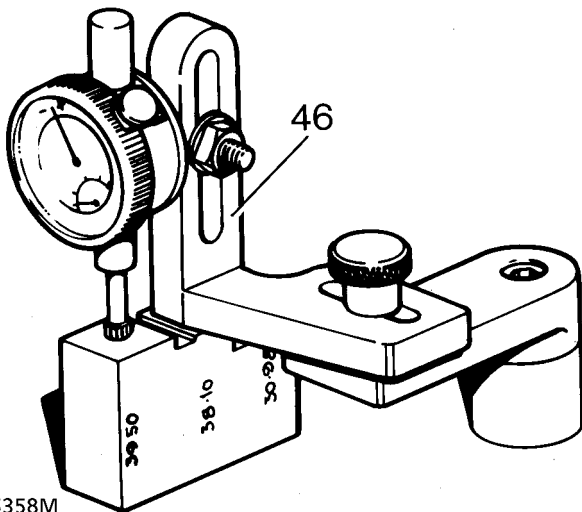
Drive pinion adjustment

- 44. Ensure pinion end face is free of burrs around etched markings.
- 45. Remove keep disc from magnetized base of dial gauge tool.
- 46. Place dial gauge and setting block on surface plate. Zero dial gauge trace pin on setting block.

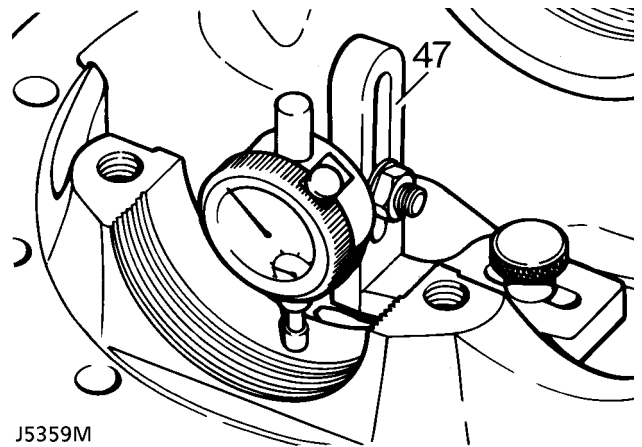
- 47. Position dial gauge centrally on pinion end face, register on lowest point on one differential bearing bore. Note dial gauge measurement from zeroed setting.

**NOTE:** Setting block has three height settings heights.

Use 39.50mm setting mark for this differential.



J5358M



J5359M

48. Repeat on other bearing bore. Add readings then halve sum to obtain mean reading. Note whether trace pin has moved up or down from zero.
- Where trace pin moves down, reading is equal to thickness of shims to remove, to bring pinion to nominal.
  - Where trace pin moves up, reading is equal to thickness of shims to add, to bring pinion to nominal.
49. Before adjusting shim thickness: check pinion face marking. If a plus (+) figure, subtract in thousandths of an inch from shim thickness figure.
50. If pinion has a minus (-) figure, add amount to shim thickness figure. Adjust shim thickness under pinion head bearing track as necessary.

INCH	=	MM
.001	=	.025
.002	=	.05
.003	=	.075
.004	=	.10
.005	=	.125
.006	=	.15
.007	=	.175
.008	=	.20
.009	=	.225
.010	=	.25

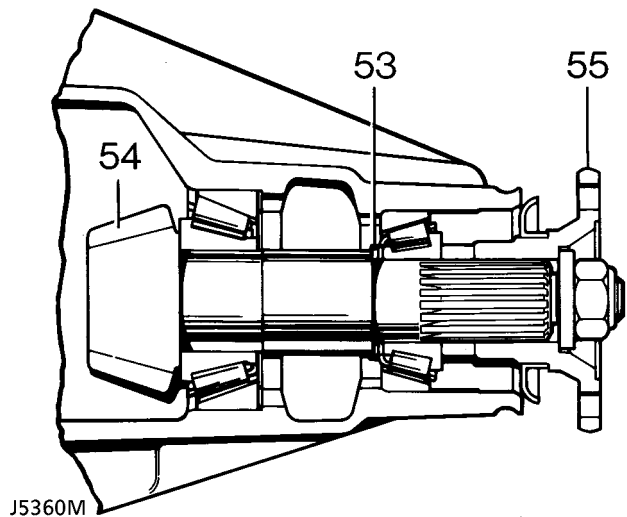


**NOTE: Where dial indicator is metric conversion must be made to inches when measuring and selecting shims.**

51. Recheck pinion height setting. If setting is correct, mean reading of dial gauge will agree with figure marked on pinion end face. For example, with end face marking of +3, dial gauge reading should indicate pinion is +0.003 in.

### Bearing pre-load adjustment

52. Remove the pinion flange, pinion, outer bearing and spacer.
53. Slide new shim, of same thickness as original (bearing pre-load) into position on pinion shaft. If fitting a new shim use thickest shim 2.155 mm.
54. Fit pinion to pinion housing and fit outer bearing and spacer (front differential only).
55. Fit driving flange, washer and nut.
56. Do not fit oil seal at this stage.



57. Tighten pinion flange nut to **130 Nm**. Force to rotate pinion shaft is 3Nm using new bearings. Change shim as necessary to obtain reading. Thicker shim will reduce pre-load. Thinner shim will increase pre-load.



**NOTE: If using original bedded in bearings, pre-load figure is 1.5 Nm.**

58. Remove pinion flange.



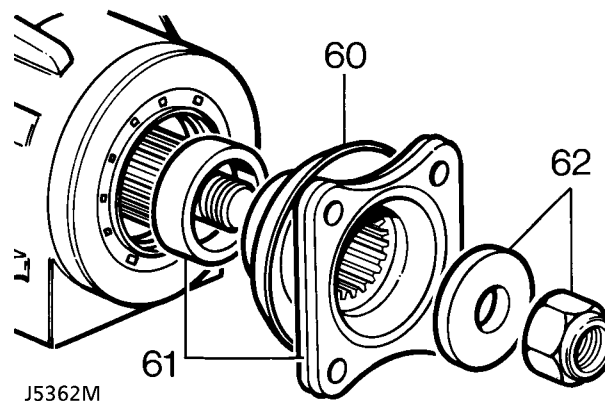


**PINION PRELOAD SHIMS**

PART No.	INCH	MM
FTC3869	.085	2.155
FTC3870	.084	2.130
FTC3871	.083	2.105
FTC3872	.082	2.080
FTC3873	.081	2.055
FTC3874	.080	2.030
FTC3875	.079	2.005
FTC3876	.078	1.980
FTC3877	.077	1.955
FTC3878	.076	1.930
FTC3879	.075	1.905
FTC3880	.074	1.880
FTC3881	.073	1.855
FTC3882	.072	1.830
FTC3883	.071	1.805
FTC3884	.070	1.780
FTC3885	.069	1.755
FTC3886	.068	1.730
FTC3887	.067	1.705
FTC3888	.066	1.680
FTC3889	.065	1.655
FTC3890	.064	1.630
FTC3891	.063	1.605
FTC3892	.062	1.580
FTC3893	.061	1.555
FTC3894	.060	1.530
FTC3895	.059	1.505
FTC3896	.058	1.480

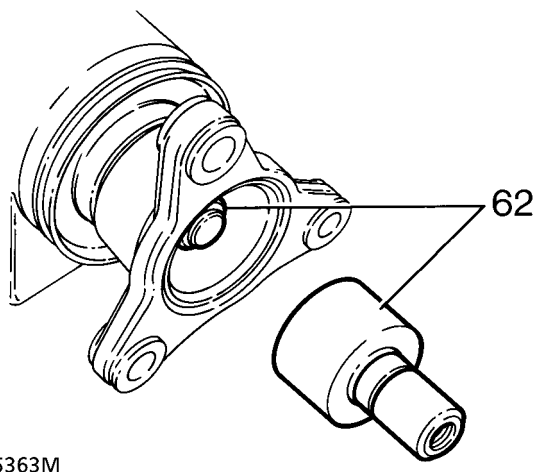
**Fit pinion drive flange - front axle differential**

- 60. Lubricate seal lips with axle oil.
- 61. Fit spacer and pinion drive flange to differential.
- 62. Secure flange with washer and nylon nut. Tighten to **130 Nm**.



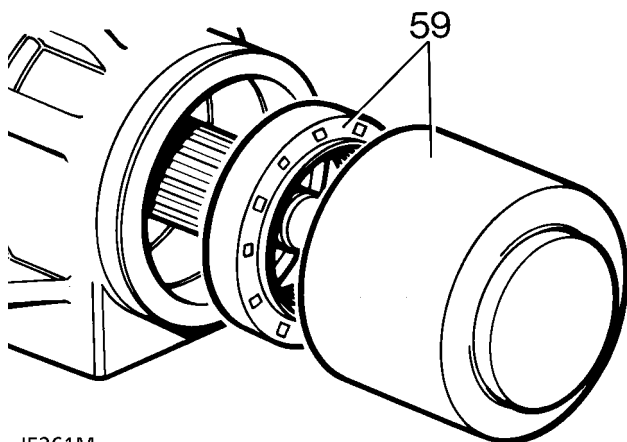
**Fit pinion drive flange - rear axle differential**

- 60. Lubricate seal lips with axle oil.
- 61. Fit pinion drive flange to differential and secure with washer and nylon nut. Tighten to **130 Nm**.
- 62. Coat centralizing peg with Loctite 601 or 638 and fit over pinion retaining nut in drive flange.



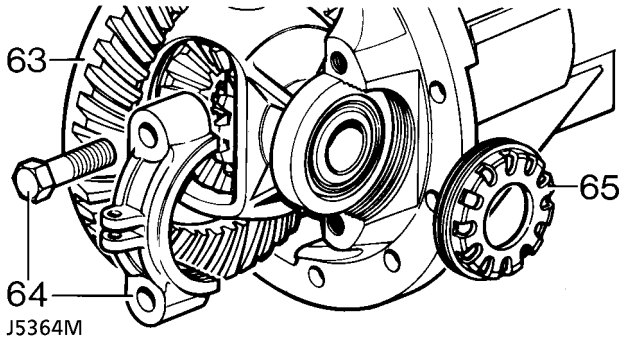
**Fitting Pinion Oil Seal**

- 59. Coat outer diameter of seal with grease. Fit seal lip side leading flush with end face of housing using tool LRT-51-001.

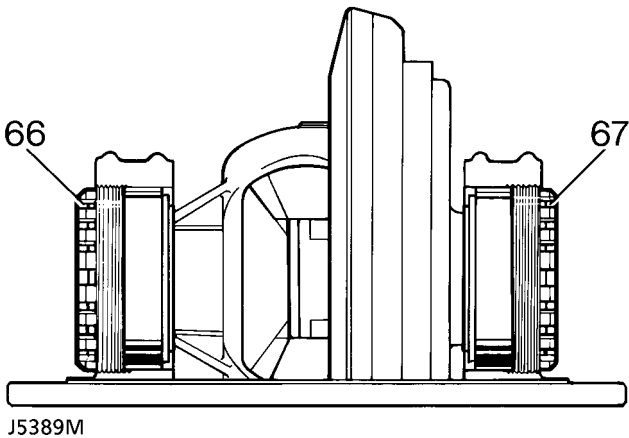
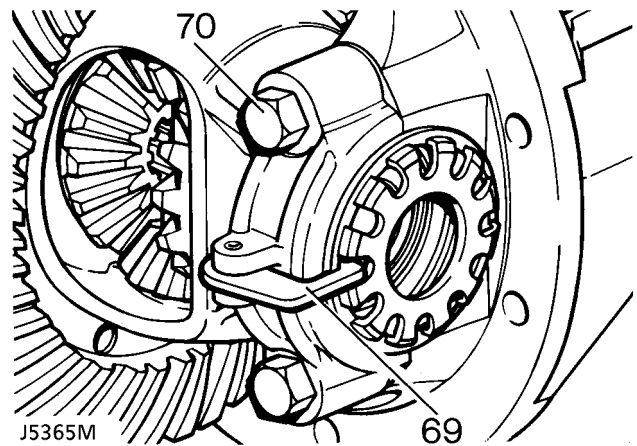


### CROWN WHEEL/PINION BACKLASH ADJUSTMENT

63. Place differential housing in pinion housing.  
64. Fit bearing caps and partly tighten bolts.



68. Tighten left nut until it contacts bearing. Continue turning until a backlash of 0,10 to 0,17 mm is met. **DO NOT** loosen right nut otherwise bearing preload will be affected.  
69. Fit locking fingers and roll pins. Align locking finger with a slot.  
70. Evenly tighten bearing cap bolts to **90 Nm**.



71. Recheck crown wheel/pinion backlash.  
72. Lubricate bearings and gears.

65. Fit bearing adjusting nuts.  
66. Mesh crown wheel to pinion. Using service tool LRT-54-508 loosen left bearing adjuster nut.  
67. Tighten right nut until crown wheel/pinion backlash is just removed.



**REAR HUB ASSEMBLY**

Service repair no - 61.15.13.

**Overhaul**

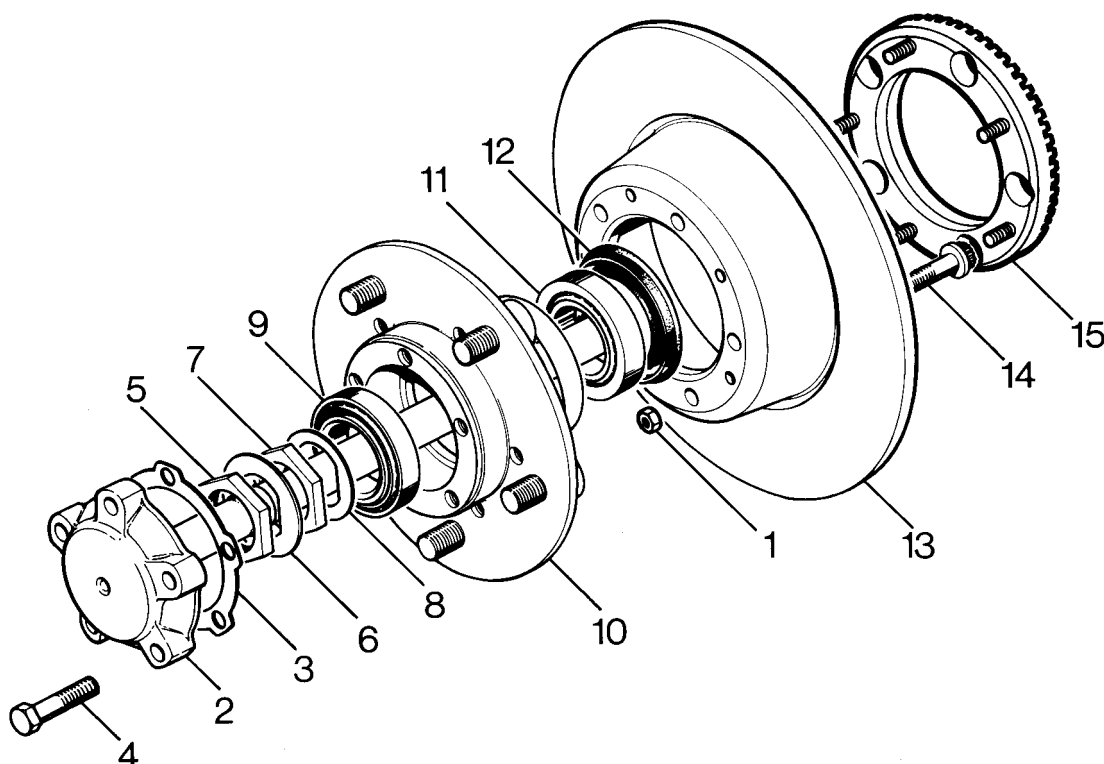
1. Remove rear hub assembly. *See Repair, Rear Hub Assembly*
2. Remove outer bearing.
3. Remove five nyloc nuts and withdraw ABS sensor ring, if applicable.
4. Mark, for reassembly, position of hub to brake disc.

5. Remove five bolts and separate hub from brake disc.



**WARNING: A maximum of two road wheel retaining studs can be renewed. Should more studs be unserviceable fit new hub with studs.**

6. Remove grease seal and inner bearing from hub.
7. Remove inner and outer bearing tracks.



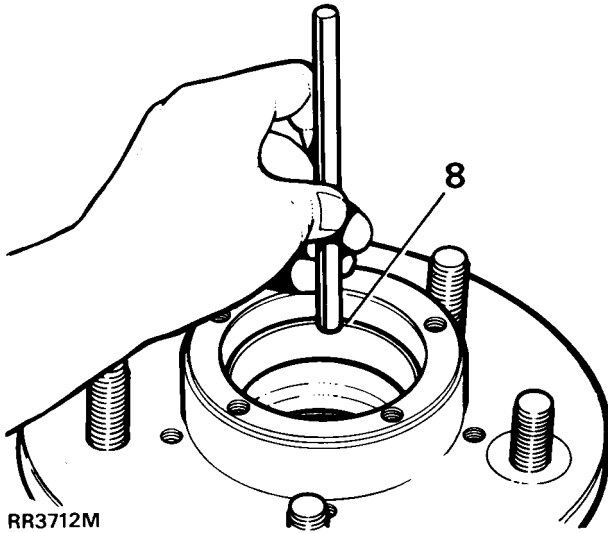
J5352M

**REAR HUB COMPONENTS**

- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1. Sensor ring retaining nut ABS.</li> <li>2. Axle shaft.</li> <li>3. Axle shaft joint washer.</li> <li>4. Axle shaft retaining bolt (five off).</li> <li>5. Lock nut.</li> <li>6. Lock washer.</li> <li>7. Hub adjusting nut.</li> <li>8. Spacing washer.</li> </ol> | <ol style="list-style-type: none"> <li>9. Outer bearing.</li> <li>10. Hub.</li> <li>11. Inner bearing.</li> <li>12. Grease seal.</li> <li>13. Brake disc.</li> <li>14. Disc retaining bolt (five off).</li> <li>15. Sensor ring ABS.</li> </ol> |
|--|---|

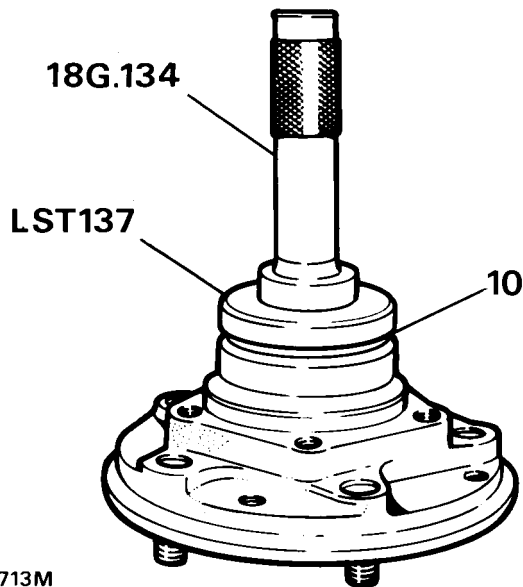
## Refit

8. Clean hub and fit inner and outer bearing tracks.



9. Pack hub inner bearing with grease and fit to hub.

10. With lip side leading fit a new seal flush with rear face of hub. Using service tool LRT-54-003 seal replacer and drift. Apply grease between seal lips.



11. Assemble brake disc to the hub, line up reassembly marks. Applying Loctite 270, fit and tighten retaining bolts to **73 Nm**.
12. If necessary, where applicable, renew sensor ring studs applying Loctite 270 to threads. Fit sensor ring using new nyloc nuts. Tighten to **9 Nm**. Ensuring it is correctly fitted to avoid tooth run out.
13. Pack hub outer bearing with grease and fit to hub.
14. Fit rear hub assembly. *See Repair, Rear Hub Assembly*

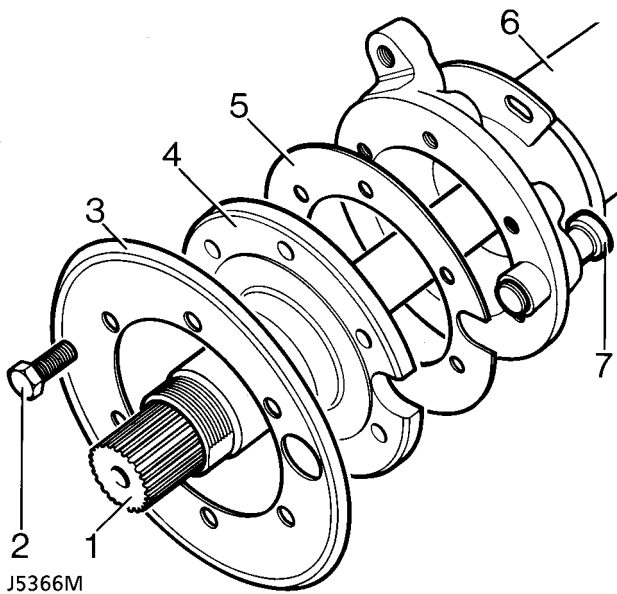


**REAR STUB AXLE**

Service repair no - 64.15.22.

**STUB AXLE COMPONENTS**

1. Rear axle shaft.
2. Stub axle to axle casing bolt.
3. Mudshield.
4. Stub axle.
5. Stub axle joint washer.
6. Axle case.
7. Sensor ABS.

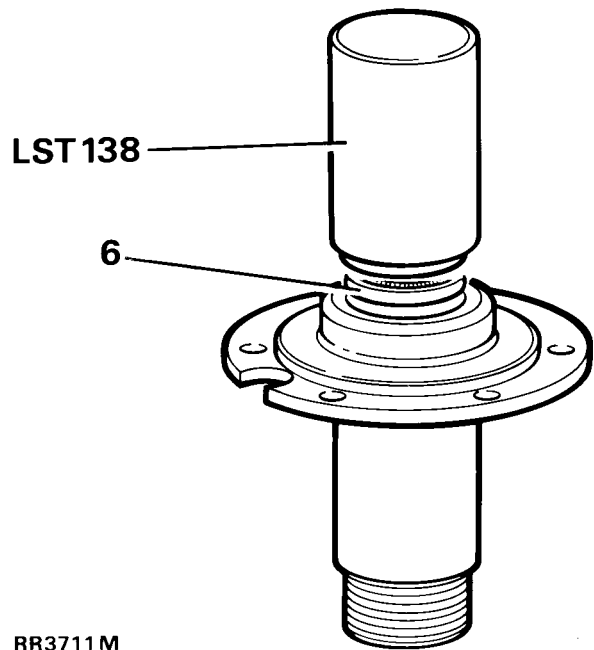


**Overhaul**

1. Remove hub assembly. *See Repair, Rear Hub Assembly*
2. Remove six bolts from stub axle to axle casing.
3. Remove mudshield.
4. Remove stub axle and joint washer.
5. Remove rear axle shaft from axle casing.

**Renew rear stub axle oil seal**

6. Remove and discard oil seal. Lubricate seal and lip with EP90 oil. Using special tool LST 138 fit new oil seal lipside trailing so that seal is flush with rear face of stub axle.



**Refit**

7. Fit new joint washer, stub axle and mudshield with bolts. Tighten to **65 Nm**.
8. Fit rear axle shaft avoid damaging stub axle seal.
9. Refit rear hub assembly. *See Repair, Rear Hub Assembly*



**AXLE DIFFERENTIAL DATA**

Pinion bearing pre-load:	
(new bearings) .....	3 Nm
(bearings bedded in) .....	1,5 Nm
Crown wheel run-out .....	0,10 mm
Crown wheel/pinion backlash .....	0,10 to 0,17 mm

**REAR HUB**

Rear hub end float .....	0,010 mm
--------------------------	----------

**TORQUE VALUES**



**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
<b>REAR AXLE</b>	
Pinion housing to axle case .....	41
Crown wheel to differential case .....	58
Differential bearing cap to pinion housing .....	90
Differential drive flange to drive shaft .....	47
Bevel pinion nut .....	129
Lower link to axle .....	176
Pivot bracket ball joint to axle .....	176
<b>REAR HUB ABS VEHICLES</b>	
Hub driving member to hub .....	65 *
Brake disc to hub .....	73 *
Stub axle rear to axle case .....	65
Brake caliper to axle case .....	82
Disc shield to axle case .....	11
Sensor ring to brake disc ABS .....	9

\* Apply loctite 270 prior to assembly.

Torque values below cover all screws and bolts used, unless specified otherwise.

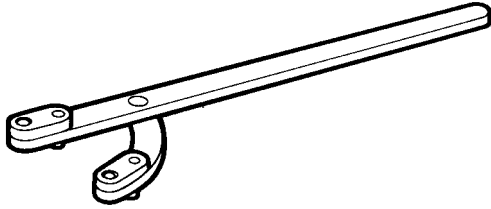
METRIC	Nm
M5 .....	6
M6 .....	9
M8 .....	25
M10 .....	45
M12 .....	90
M14 .....	105
M16 .....	180

UNC / UNF	
1/4 .....	9
5/16 .....	24
3/8 .....	39
7/16 .....	78
1/2 .....	90
5/8 .....	136



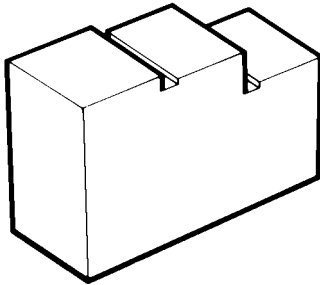
AXLE DIFFERENTIAL

LRT-51-003 Flange holder tool  
18G1205



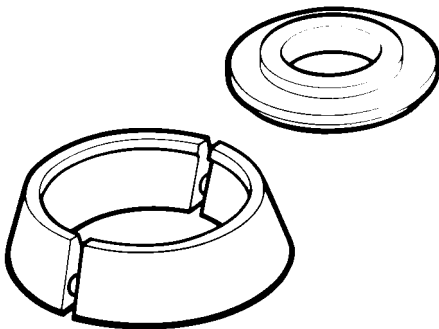
18G1205

LRT-54-504 Universal setting block  
18G1914



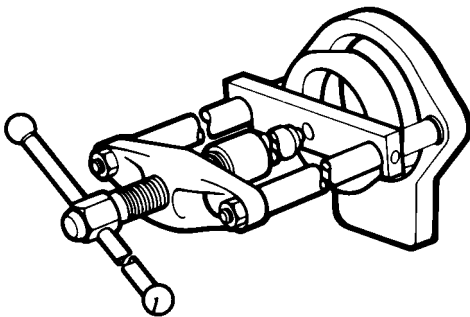
18G1914

LRT-54-502 Pinion head bearing remover/replacer  
18G476



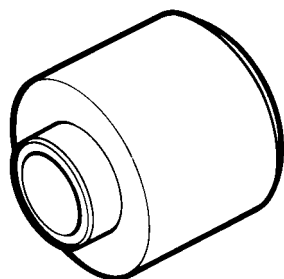
18G476

LRT-99-002 Press  
MS47



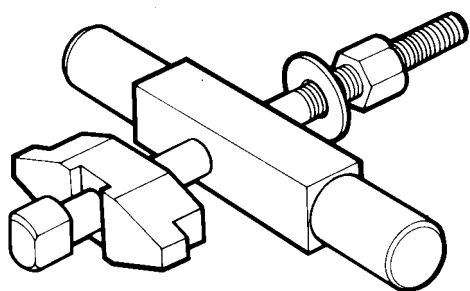
MS47





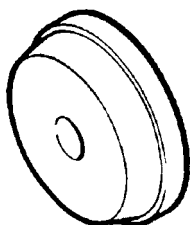
LRT-51-001 Oil seal replacer  
LST106

LST106



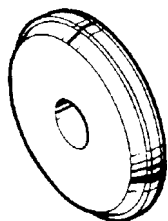
LRT-54-505 Extractor for pinion bearing races  
RO262757A

262757A



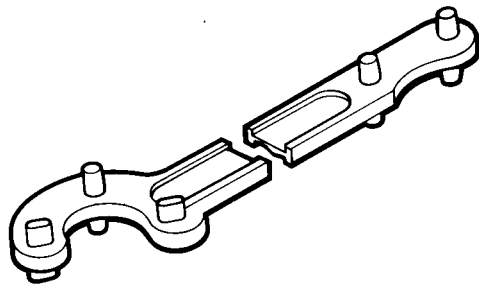
LRT-54-506 Replacer adapter pinion head bearing cup  
RO2627571

2627571



LRT-54-507 Adaptor pinion tail bearing cup replacer  
RO2627572

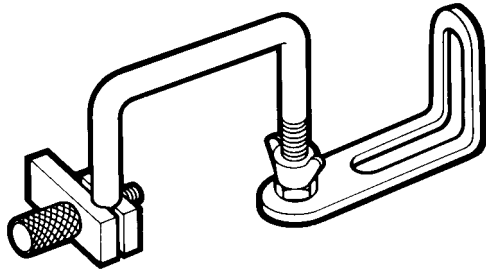
2627572



RO530105

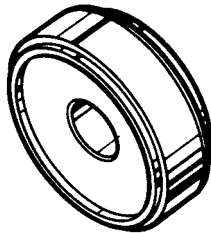
LRT-54-508 Wrench flange and carrier  
RO530105 bearing nuts

REAR HUB



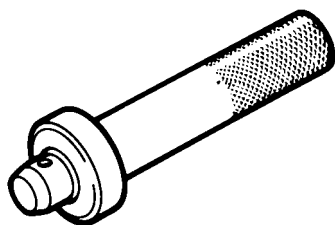
RO530106

LRT-99-503 Bracket for dial gauge and indicator  
RO530106



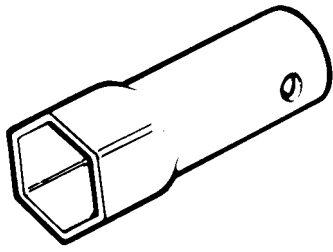
LST 5505

LRT-54-001 Oil seal replacer non ABS  
LST550-5

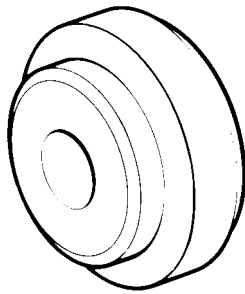


18G134

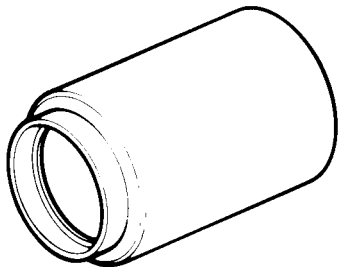
LRT-99-003 Drift  
18G134

**606435A**

LRT-54-002 Hub nut wrench  
RO606435A

**LST137**

LRT-54-003 Hub oil seal replacer ABS  
LST137

**LST138**

LRT-54-004 Oil seal replacer ABS  
LST138



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## DESCRIPTION

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The welded steel front axle casing houses a separate spiral bevel type differential unit, which is off set to the right of the vehicle centre line. The differential unit drives the front wheels via the axle shafts and constant velocity joints which are totally enclosed in the spherical and swivel housings.

The front axles fitted with ABS brakes or non ABS brakes are of the same construction except for different top swivel pins in the swivel housing and a sensor on the constant velocity joint.

### Front axle - ABS

The front wheels are pivoted on taper roller bearings 19 at the bottom of the swivel housing and a 'Rialco bush' 25 at the top. The top swivel pin also houses the ABS pickup (electrical connection) as shown in the main illustration, J5367.

### Front axle - non ABS

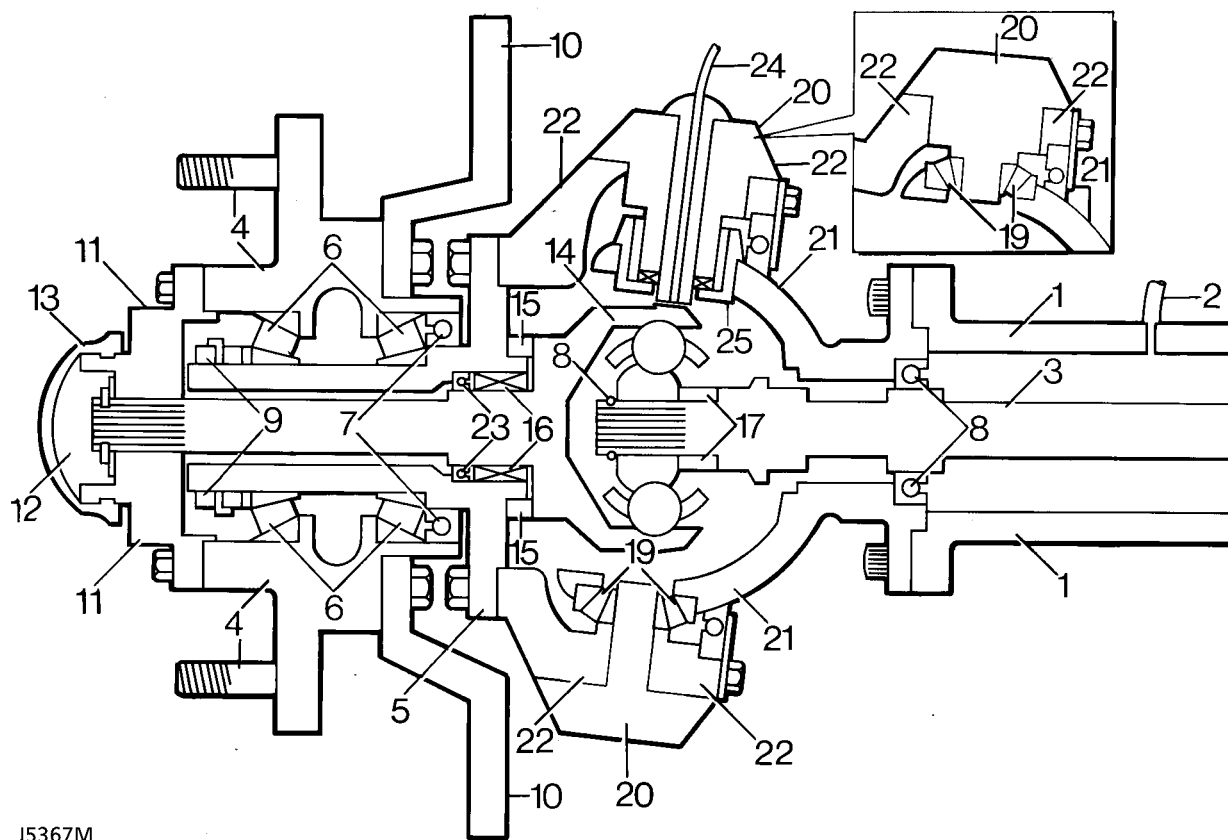
The front wheels are pivoted on taper roller bearings at the top (see insert) and bottom of the swivel housing. The wheel hubs on all axles are supported by two taper bearings and driven by drive flanges which are splined to the one piece, stub shaft/constant velocity joint.

### Lubrication

The differential, swivel pin housing and wheel hubs are individually lubricated and separated by oil seals 7 and 8 to prevent oil transfer across the axle when the vehicle is traversing steep inclines. The wheel bearings are lubricated with grease and the swivel housing and differential with oil.

### Ventilation

Ventilation of the differential is through a plastic pipe 2 which terminates at a high level in the vehicle on both ABS and non ABS axles. The swivel housings ventilate through axle shaft oil seals 8 into the differential and the hub bearings vent via the oil seals into swivel housing.



J5367M

### Front axle

- |   |  |
|---|--|
| 1. Axle casing                                | 14. Constant velocity joint/shaft        |
| 2. Ventilation pipe                           | 15. Thrust collar for CV joint           |
| 3. Axle shaft                                 | 16. Roller bearing                       |
| 4. Wheel studs and hub                        | 17. Spacer                               |
| 5. Stub axle                                  | 18. Circlip                              |
| 6. Wheel bearings (2)                         | 19. Bottom swivel taper bearing          |
| 7. Inner and outer hub seals                  | 20. Top and bottom swivel pins           |
| 8. Axle shaft seal                            | 21. Spherical housing, seal and retainer |
| 9. Hub lock plate, thrust washer and nuts (2) | 22. Swivel housing                       |
| 10. Brake disc                                | 23. Constant velocity shaft seal         |
| 11. Drive flange                              | 24. ABS pickup (electrical connection)   |
| 12. Shim washer and circlip                   | 25. 'Rialco' bush ABS                    |
| 13. Dust cap                                  |  |



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## FAULT DIAGNOSIS

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### Complaint - Oil leaks

An external leak of lubrication can be caused by a faulty internal seal. For example, if the seals which separate the differential from the swivel housings are faulty and the vehicle is operating or parked on an embankment, oil may leak across the axle leaving one swivel with a high level and the other swivel and differential lacking lubrication.

See 'Description and Operation' for illustrations of oil seal locations.

When investigating leaks or checking oil levels, it is essential that all the lubrication is drained from any housing with a high level and that the other levels are checked.

Swivel oil should be checked for signs of grease leaking from the hub bearings and the hub grease should not contain oil.

Check that the axle ventilation system is clear, as a blockage can cause internal pressure to force oil past the seals.

If the vehicle is driven in deep water with defective oil seals, water may contaminate the lubricants and when checked, give a false impression that the housing has been overfilled with oil.

**Do not assume that a high oil level is due to over filling or, that a low level is because of an external leak.**



## FRONT AXLE ASSEMBLY

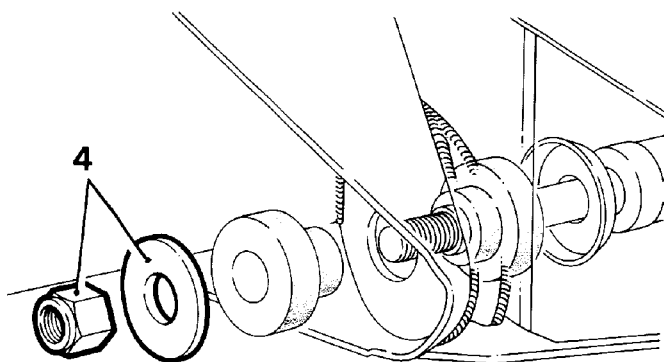
Service repair no - 54.15.01

### Remove



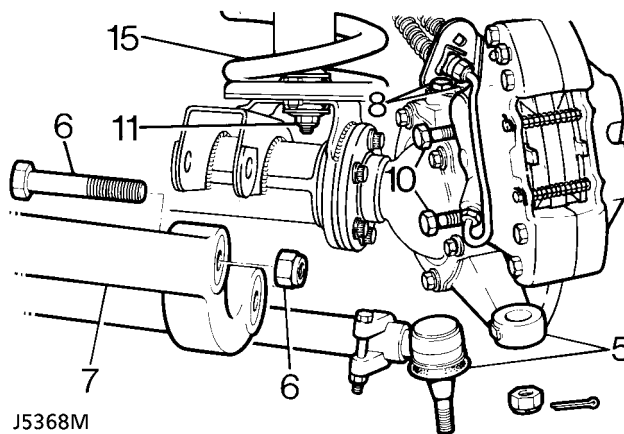
**WARNING:** Remove and refit of axle requires a further two persons to steady axle when lowering or repositioning axle.

1. Support chassis front.
2. Remove road wheels.
3. Support axle weight with hydraulic jack.
4. Remove radius arms to chassis frame nuts.



RR983M

5. Disconnect steering damper from track rod. Using a extractor remove track rod links from swivel pin arms.
6. Remove four nuts and bolts securing radius arms to axle bracket.
7. Remove radius arms.
8. Remove bolts securing brake hose brackets. Refit bolts to prevent oil leakage.
9. Remove ABS sensor, if applicable.
10. Remove bolts from brake calipers and tie to one side.
11. Remove nuts and washers securing shock absorbers to axle.
12. Disconnect drag link from swivel pin housing arm.



J5368M

13. Remove two nuts and bolts securing panhard rod to axle bracket. Lift rod clear of axle.
14. Mark for reassembly drive shaft flanges. Remove four nuts and bolts, tie propeller shaft to one side.
15. Lower axle assembly and remove road springs.
16. Disconnect anti-roll[sway] bar link. **See FRONT SUSPENSION, Repair, Anti-Roll[Sway] Bar Ball Joint Links**
17. Remove axle assembly.

### Refit

18. Position axle under vehicle, supporting left side of axle.
19. Reverse removal procedure.
20. Tighten propeller shaft bolts to **47 Nm**.
21. Tighten panhard rod to axle bracket to **88 Nm**.
22. Tighten drag link to hub arm to **40 Nm**.
23. Tighten upper swivel pin bolts. **See Specifications, torque, Torque Values**
24. Tighten radius arms to axle bolts to **197 Nm**.
25. Tighten radius arms to chassis side member nuts to **197 Nm**.
26. Tighten track rod end to **40 Nm**. **Fit new split [cotter] pin.**

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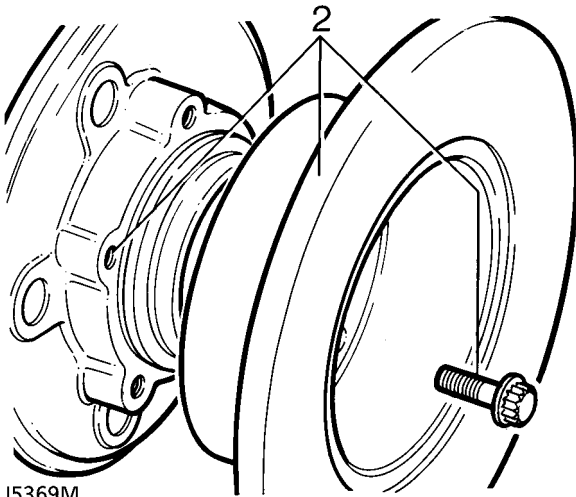
**FRONT BRAKE DISCS**

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Service repair no - 70.10.10.

**Remove**

1. Remove front hub assembly. *See Front Hub Assembly*



2. Remove five hub to disc bolts.
3. Tap disc to separate from hub.

**Refit**

4. Locate disc to hub.
5. Apply Loctite 270 to disc bolts. Tighten to **73 Nm**.
6. Check total disc runout with a dial indicator, this must not exceed 0,15 mm. If necessary reposition disc.
7. Fit hub assembly. *See Front Hub Assembly*

**Disc reclamation**

8. Check disc thickness. This dimension may be reduced to minimum thickness of 12 mm. Machine equal amount off each face.





**FRONT HUB ASSEMBLY**

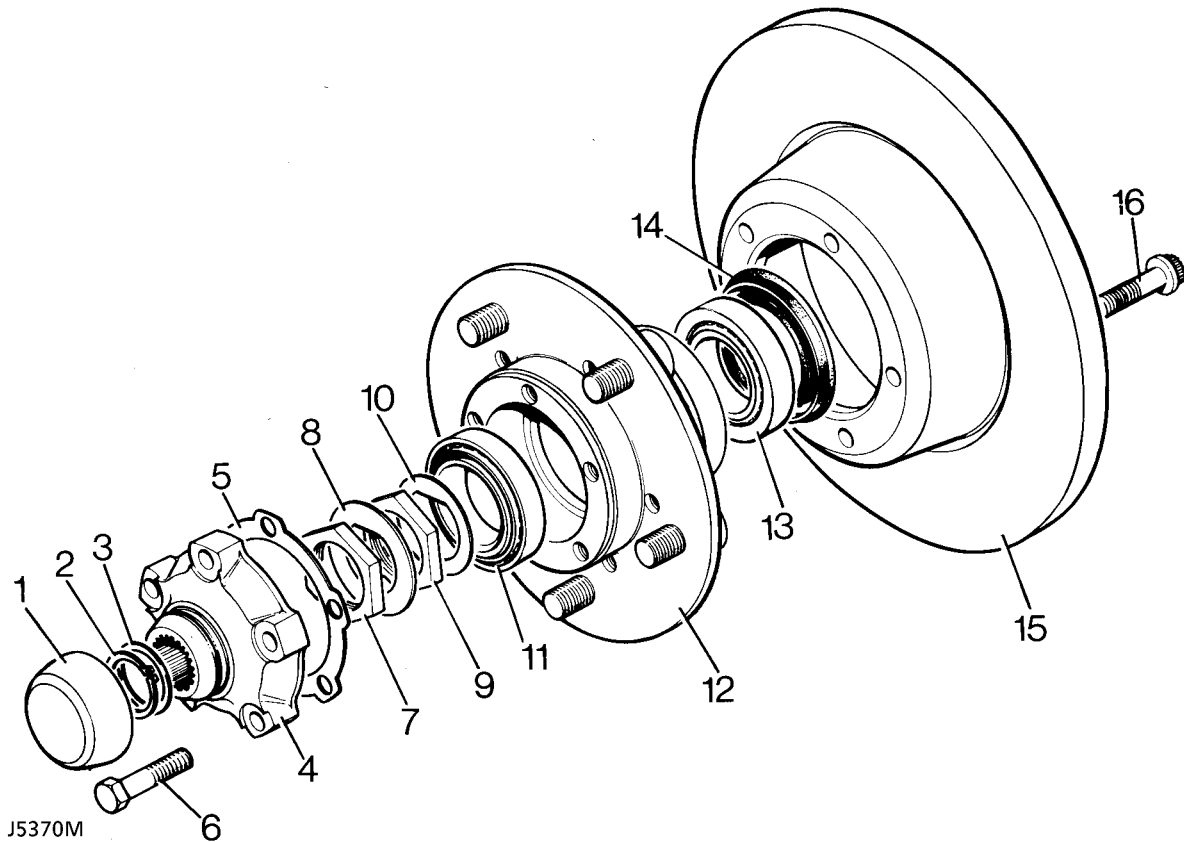
Service repair no - 60.25.01.

**Remove**

1. Loosen front wheel nuts, jack up vehicle and lower onto axle stands and remove road wheel.
2. Release brake hose clips and remove brake caliper. Secure to one side.
3. Lever off dust cap.
4. Remove circlip and drive shaft shim from driveshaft.
5. Remove five bolts and withdraw driving member and joint washer.
6. Bend back lock washer tabs.
7. Remove locknut and lock washer.
8. Remove hub adjusting nut.
9. Remove spacing washer.
10. Remove hub and brake disc assembly complete with bearings.

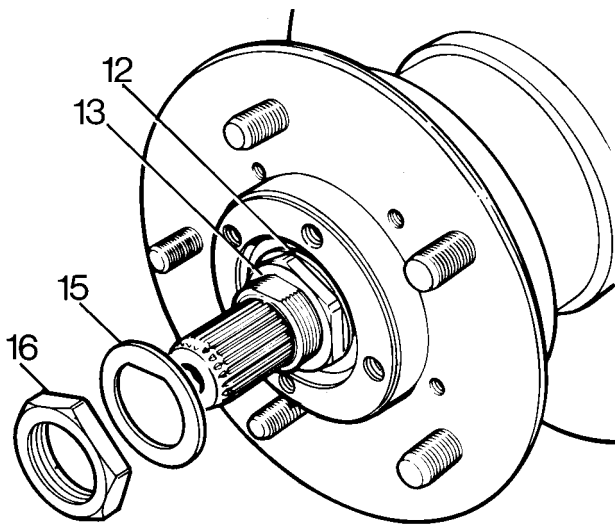
**HUB COMPONENTS**

1. Dust cap.
2. Drive shaft circlip.
3. Drive shaft shim.
4. Drive member.
5. Drive member joint washer.
6. Drive member retaining bolt.
7. Lock nut.
8. Lock washer.
9. Hub adjusting nut.
10. Spacing washer.
11. Outer bearing.
12. Hub.
13. Inner bearing.
14. Grease seal.
15. Brake disc
16. Disc retaining bolt.



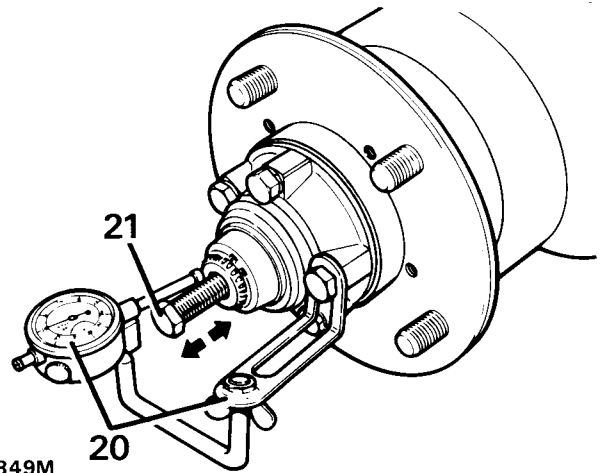
## Refit

11. Clean stub axle and drive shaft and fit hub assembly to axle.
12. Fit spacing washer.
13. Fit hub adjusting nut. Tighten to **61 Nm**.
14. Back off adjusting nut 90°. Tighten to **4 Nm**. This will give the required hub end float of 0,010mm
15. Fit a new lock washer.
19. Fit original drive shaft shim and secure with a circlip.
20. To check drive shaft end play mount a dial gauge using bracket LRT-99-503 and rest pin in a loaded condition on end of drive shaft.
21. Fit a suitable bolt to threaded end of drive shaft. Move drive shaft in and out noting dial gauge reading. End play should be between **0,08 to 0,25 mm**.



J5371M

16. Fit locknut. Tighten to **61 Nm**.
17. Tab over lock washer to secure adjusting nut and locknut.
18. Fit a new joint washer to driving member and fit member to hub and secure with five bolts. Tighten to **65 Nm**.



RR3849M

22. If end play requires adjustment, remove circlip, measure shim thickness and fit an appropriate shim to give required end-play.
23. Remove bolt from drive shaft, fit circlip and dust cap.
24. Fit brake caliper. Tighten to **82 Nm**.
25. Bleed brake system. **See BRAKES, Repair, Brake System Bleed**
26. Fit road wheel, remove axle stands and tighten road wheel nuts to **126 Nm**.
27. Operate footbrake to locate brake pads before taking vehicle on road.



**FRONT DIFFERENTIAL**

Service repair no - 54.10.07.

**Overhaul**

The front and rear differentials are the same. When overhauling front differential. **See REAR AXLE AND FINAL DRIVE, Overhaul, Axle Differential Assembly**

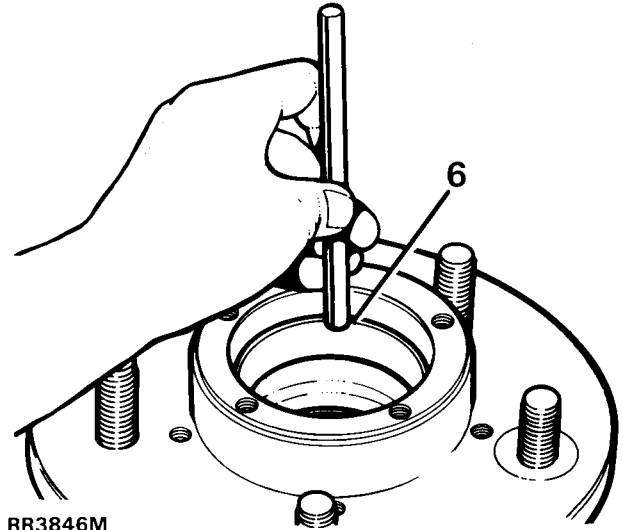
**FRONT HUB**

Service repair no - 60.26.14.

**Overhaul**

1. Remove front hub assembly. **See Repair, Front Hub Assembly**
2. Remove outer bearing.
3. Mark, for reassembly, relationship between hub and brake disc, if original hub is to be refitted.
4. Remove five bolts and separate hub from brake disc.

5. Drift out grease seal and inner bearing from hub and discard seal.
6. Drift out inner and outer bearing tracks.
7. Clean hub and drift in inner and outer bearing tracks.

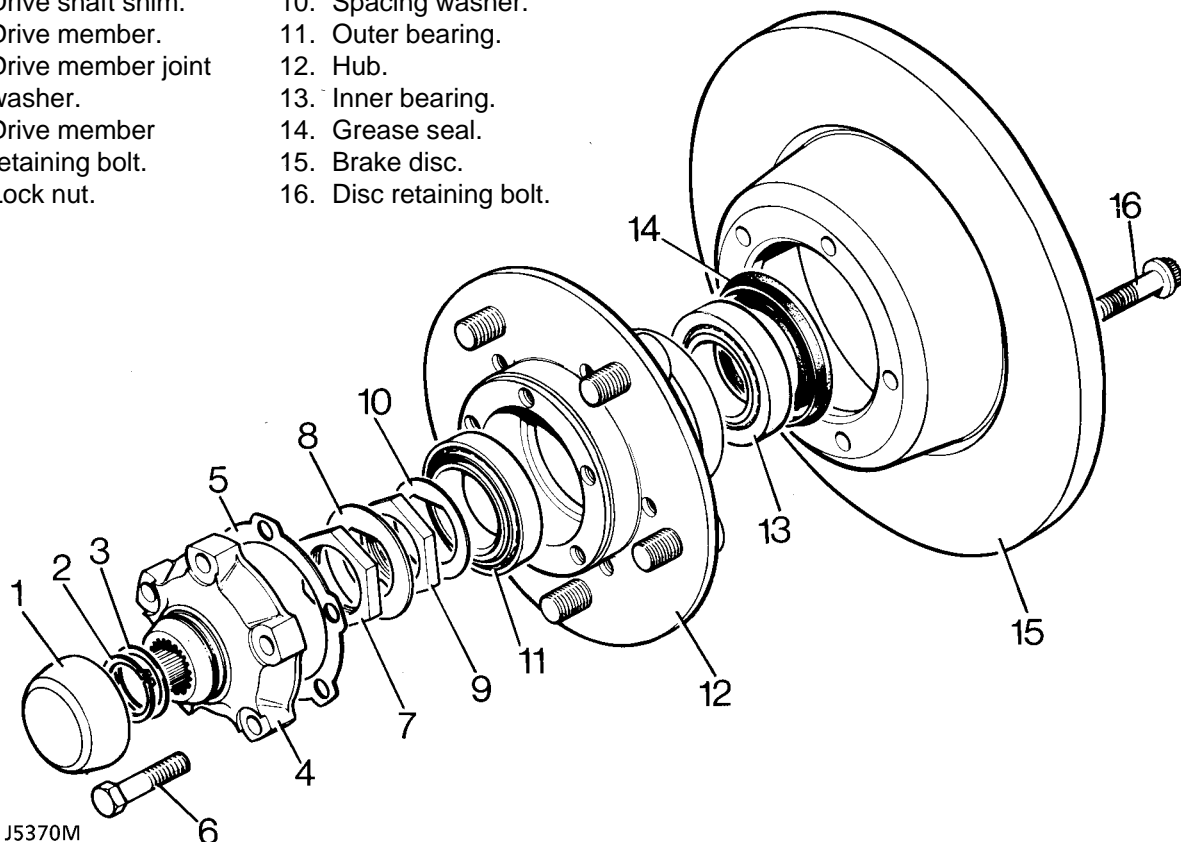


RR3846M

8. Pack hub inner bearing with recommended grease and fit to hub.

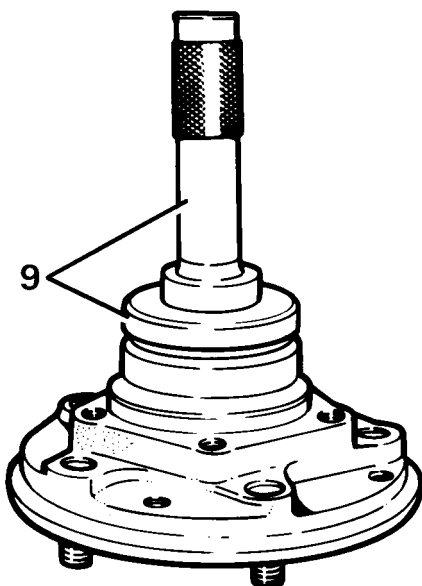
**HUB COMPONENTS**

- |                                 |                          |
|---------------------------------|--------------------------|
| 1. Dust cap.                    | 8. Lock washer.          |
| 2. Drive shaft circlip.         | 9. Hub adjusting nut.    |
| 3. Drive shaft shim.            | 10. Spacing washer.      |
| 4. Drive member.                | 11. Outer bearing.       |
| 5. Drive member joint washer.   | 12. Hub.                 |
| 6. Drive member retaining bolt. | 13. Inner bearing.       |
| 7. Lock nut.                    | 14. Grease seal.         |
|                                 | 15. Brake disc.          |
|                                 | 16. Disc retaining bolt. |



J5370M

9. With lip side leading fit new seal to hub using special tool LST 137 seal replacer and drift 18G 134. Drive in seal flush with rear face of hub. Apply grease between seal lips.
10. Fit brake disc to hub, lining up to marks made during dismantling. applying Loctite 270, fit five retaining bolts. Tighten to **73 Nm**.



RR3845M

11. Grease and fit outer bearing to hub.
12. Fit front hub assembly. **See Repair, Front Hub Assembly**

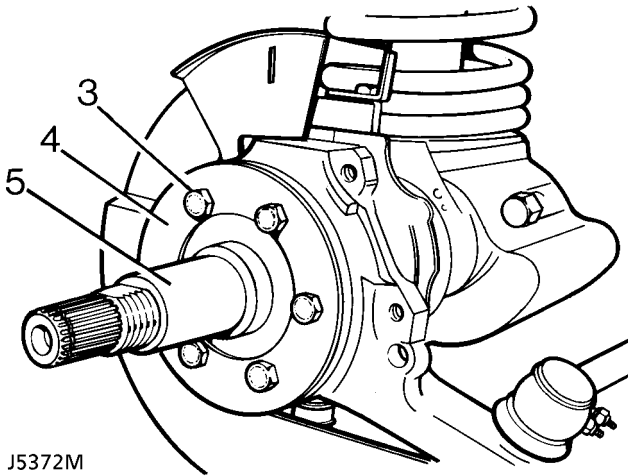


**FRONT STUB AXLE, CONSTANT VELOCITY JOINT AND SWIVEL PIN HOUSING NON ABS**

Service repair no - 60.15.43.

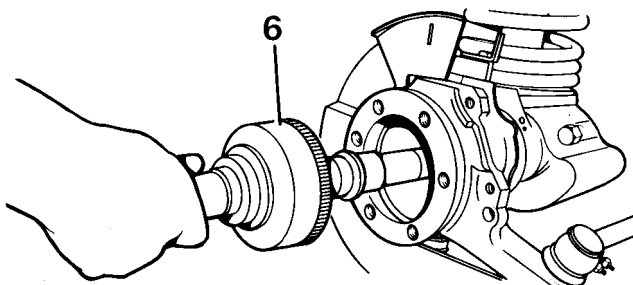
**Remove stub axle, axle shaft and constant velocity joint.**

1. Remove front hub assembly. *See Repair, Front Hub Assembly*
2. Drain swivel pin housing and refit plug.
3. Remove six bolts retaining stub axle to swivel housing.
4. Remove mud shield.
5. Remove stub axle and joint washer.



J5372M

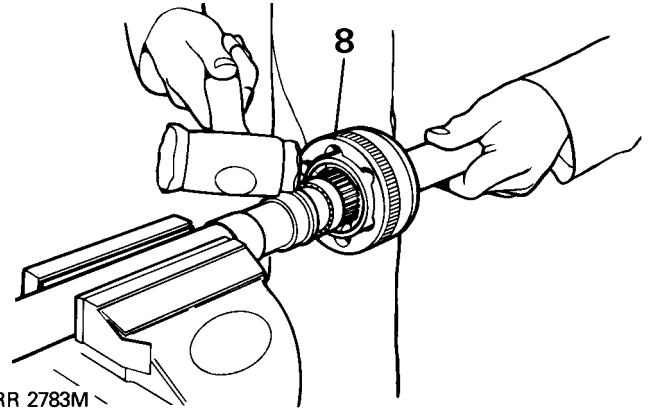
6. Pull out axle shaft and constant velocity joint from axle casing.



RR2782M

**Remove constant velocity joint from axle shaft**

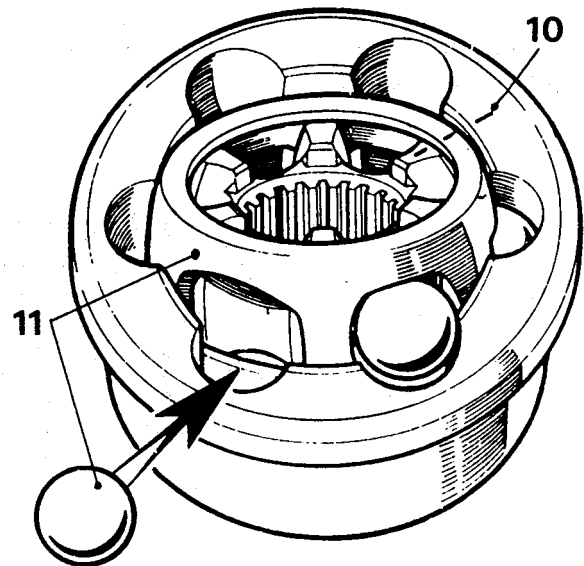
7. Hold axle shaft firmly in a soft jawed vice.
8. Using a soft mallet drive constant velocity joint from shaft.
9. Remove circlip and collar from axle shaft.



RR 2783M

**Constant velocity joint**

10. Mark positions of constant velocity joint, inner and outer race and cage for reassembly.
11. Swivel cage and inner race to remove balls.

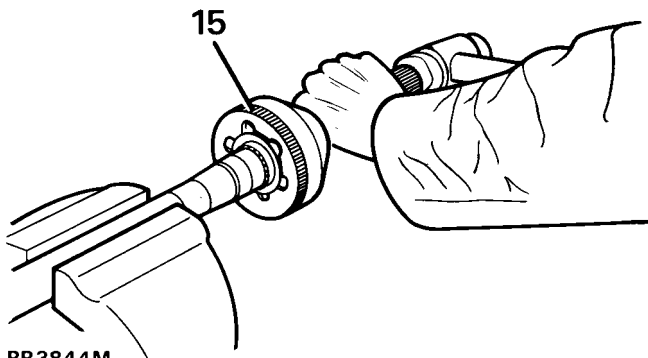


ST1025M

12. Examine all components in particular inner and outer track, cage balls and bearing surfaces for damage and excessive wear.
13. Maximum acceptable end-float on assembled joint 0,64mm. Renew if worn or damaged. Lubricate with a recommended oil during assembly.

#### Fit constant velocity joint to axle

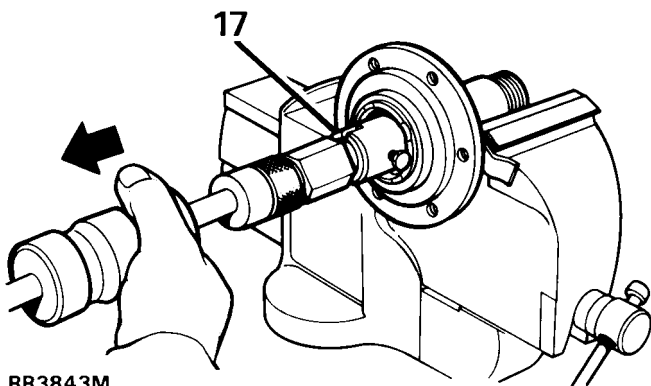
14. Fit collar and a new circlip.
15. Engage constant velocity joint on axle shaft splines and using a soft mallet, drive joint in fully.



RR3844M

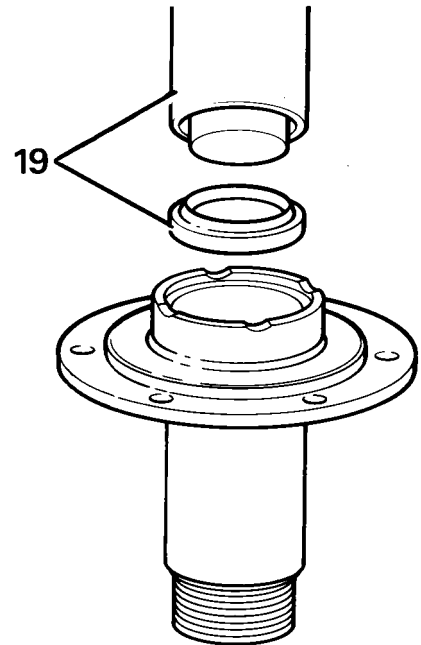
#### Renew stub axle, thrust ring, oil seal and bearing

16. Drill and chisel off thrust ring taking care to avoid damaging stub axle.
17. Remove bearing and oil seal using special tool LRT-37-004 and slide hammer LRT-99-004. Ensure lip of tool locates behind bearing to drive it out.
18. Repeat instruction for removal of oil seal.



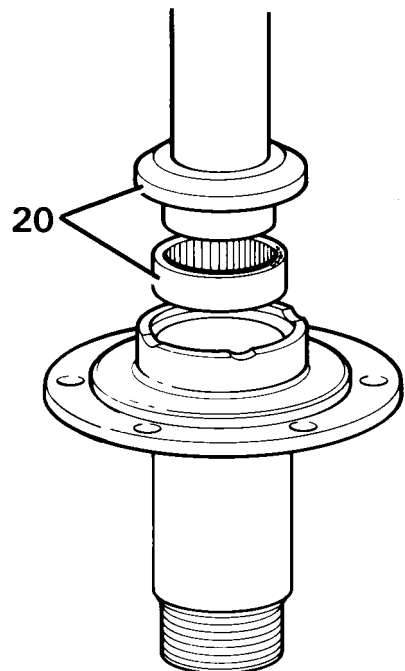
RR3843M

19. Lubricate seal and lip with EP90 oil and with cavity side leading press in a new oil seal using special tool LRT-54-004.



RR3840M

20. Using special tool LRT-54-005, fit bearing with its part number visible when fitted, and flush with end face of stub axle.
21. Press fit a new thrust ring onto stub axle.



RR3839M



### Swivel pin housing

22. Remove bolts securing oil seal retaining plate and joint washer. Release assembly from swivel pin housing.



**NOTE: Removal of oil seal and retaining plate is achieved when swivel bearing housing is removed.**

23. Remove two bolts, retaining lower swivel pin to housing.
24. Remove brake disc shield bracket.
25. Tap lug to remove lower swivel pin and joint washer.
26. Remove two bolts retaining brake hose bracket and top swivel pin.
27. Remove bracket, top swivel pin and shims.
28. Remove swivel pin housing while retrieving lower and upper bearings.

### Swivel bearing housing

29. Remove lower bearing track from swivel bearing housing.



**NOTE: Use upper bearing opening to gain access to lower bearing track.**

30. Remove seven bolts retaining swivel bearing housing to axle case.
31. Remove inner oil seal from back of housing.
32. Remove top bearing track from swivel bearing housing.



**NOTE: Use lower bearing opening to gain access to upper bearing track.**

33. If worn, pitted or damaged, renew housing.
34. Fit upper and lower bearing tracks into swivel bearing housing.



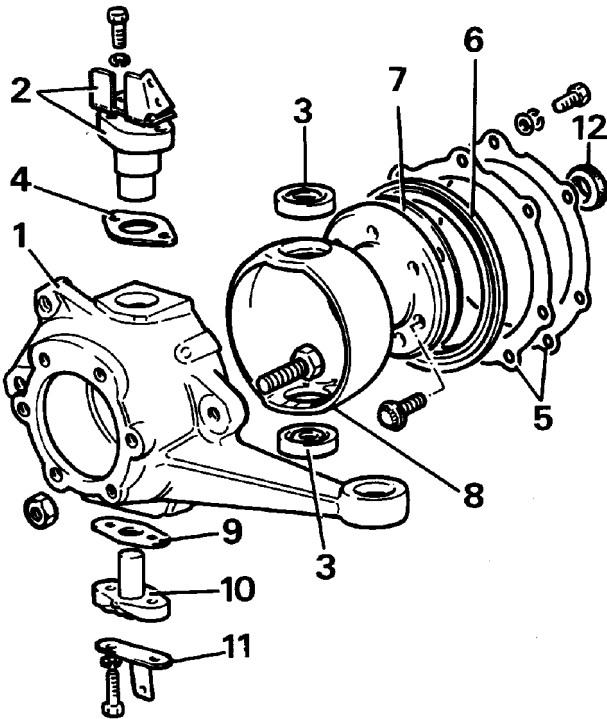
**CAUTION: Ensure bearing tracks are fitted square or damage could occur.**

35. With seal lips trailing, fit swivel housing inner oil seal into rear of housing. Grease seal lips.

### Fit swivel pin housing

36. Coat swivel bearing housing to axle casing bolts with Loctite 270 or equivalent.
37. Coat both sides of joint washer with a sealing compound. Position swivel bearing housing to axle mating face.
38. Place retaining plate, joint washer and oil seal over axle flange ready for assembly.
39. Fit swivel bearing housing to axle flange with seven bolts. Tighten to **73 Nm**.
40. Grease and fit upper and lower swivel pin taper roller bearings.
41. Position swivel pin housing over swivel bearing housing.
42. Coat joint washer both sides with sealing compound and position on lower swivel pin.
43. Loosely fit brake shield bracket plus lower swivel pin with lug outboard to swivel pin housing.
44. Loosely fit top swivel pin plus existing shims and brake hose bracket to swivel pin housing.
45. Apply Loctite 270 or equivalent to lower swivel pin bolts. Tighten to **78 Nm** bend over lock tabs.
46. Tighten top swivel pin bolts to **78 Nm**.

## Swivel assembly components



RR980M

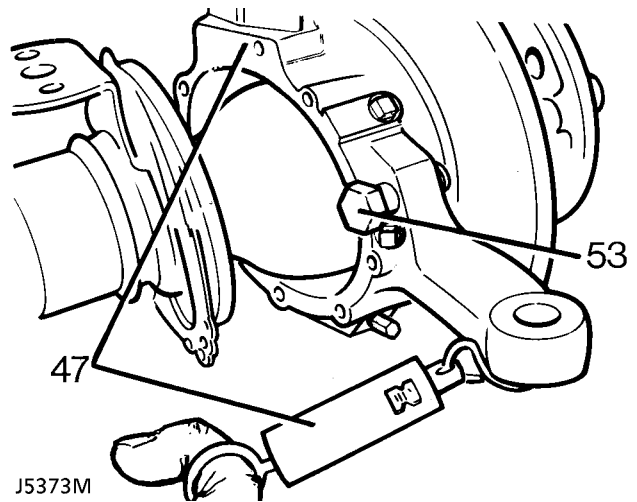
1. Swivel pin housing
2. Top swivel pin and brake hose bracket
3. Upper and lower swivel pin bearings
4. Shim
5. Retaining plate and washer
6. Oil seal
7. Joint washer
8. Swivel bearing housing
9. Joint washer
10. Lower swivel pin
11. Mudshield bracket
12. Swivel housing inner oil seal

## Check and adjust preload on bearings



**NOTE: Swivel housing oil seal and axle should not be fitted.**

47. Attach a spring balance to ball joint bore and pull balance to determine effort required to turn swivel pin housing. Resistance, once initial inertia has been overcome, should be **1.16 to 1.46 kg**. Adjust by removing or adding shims to top swivel pin.



J5373M

48. When setting is correct remove top swivel bolts, apply Loctite 270 or equivalent. Refit to **78 Nm**, and bend over lock tabs.
49. Apply recommended grease between lips of swivel oil seal.
50. Fit oil seal, joint washer and retaining plate with seven bolts and spring washers to **11 Nm**.
51. Fit tie rod and drag link and secure with new cotter pins. Tighten to **40 Nm**.
52. Fit brake disc shield.
53. Loosely fit lock stop bolt and nut.
54. Apply a recommended grease between lips of swivel housing oil seal.
55. Secure oil seal with retaining plate and securing bolts. Tighten to **11 Nm**.
56. Fit track-rod and drag link and secure with new cotter pins.
57. Loosely fit lock stop bolt for later adjustment.
58. Fit brake disc shield.





Fit driveshaft and stub axle

59. Insert axle shaft, and when differential splines are engaged, push assembly in fully.

**CAUTION:** Take care not to damage axle shaft oil seals.

60. Place a new joint washer in position on swivel pin housing to stub axle mating face. Coat threads of stub axle bolts with Loctite 270.
61. Fit stub axle with flat at 12 o'clock position.

**CAUTION:** Ensure that constant velocity joint bearing journal is butted against thrust ring on stub axle. Before stub axle is secured.

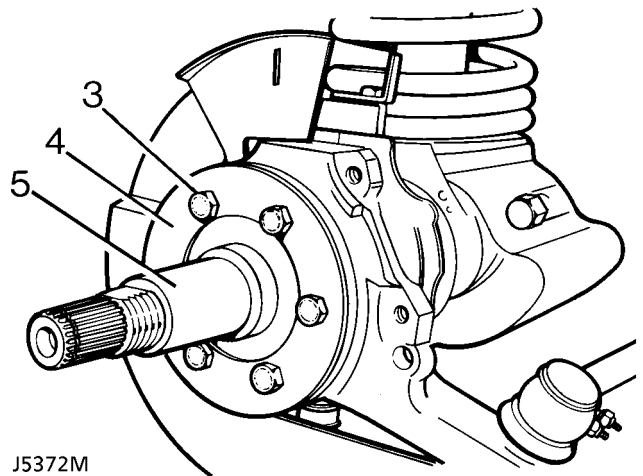
62. Place mud shield in position and secure stub axle to swivel pin housing with six bolts and tighten evenly to **65 Nm**.
63. Fit brake jump hoses to brake jump hose bracket.
64. Fit front hub complete assembly. *See Repair, Front Hub Assembly*
65. Check swivel pin housing oil drain plug is fitted.
66. Fill swivel assembly to correct level, with new oil. *See SECTION 10, Maintenance, Under Vehicle Maintenance*
67. Set steering lock stop bolts to provide a clearance of 20mm. *See STEERING, Adjustment, Steering Lock Stops*

FRONT STUB AXLE, CONSTANT VELOCITY JOINT AND SWIVEL PIN HOUSING ABS

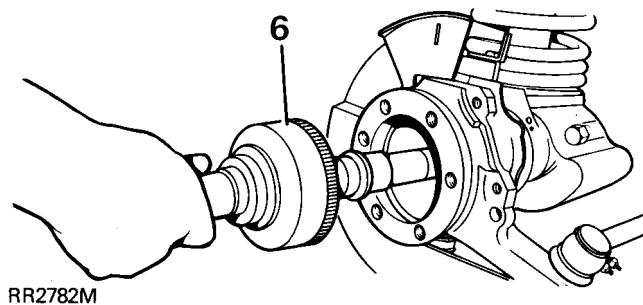
Service repair no - 60.15.43.

Remove stub axle, axle shaft and constant velocity joint.

1. Remove front hub assembly. *See Repair, Front Hub Assembly*
2. Drain swivel pin housing and refit plug.
3. Remove six bolts retaining stub axle to swivel housing.
4. Remove mud shield.
5. Remove stub axle and joint washer.

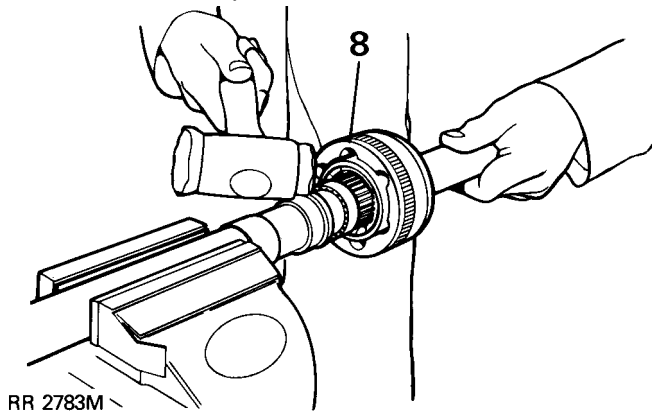


6. Pull out axle shaft and constant velocity joint from axle casing.

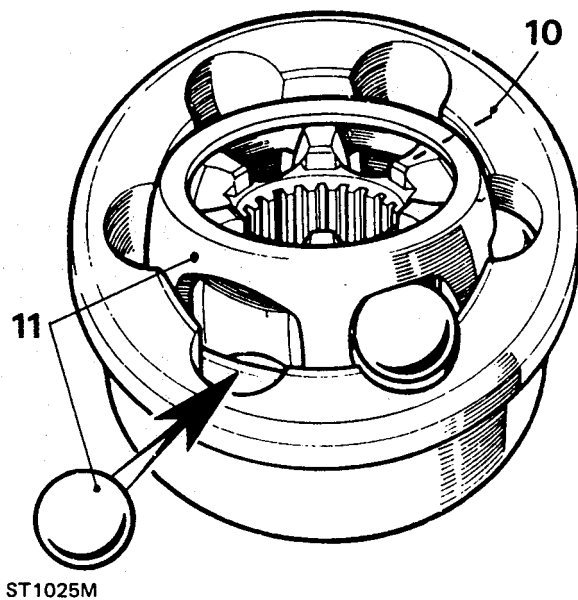


**Remove constant velocity joint from axle shaft**

7. Hold axle shaft firmly in a soft jawed vice.
8. Using a soft mallet drive constant velocity joint from shaft.
9. Remove circlip and collar from axle shaft.

**Constant velocity joint**

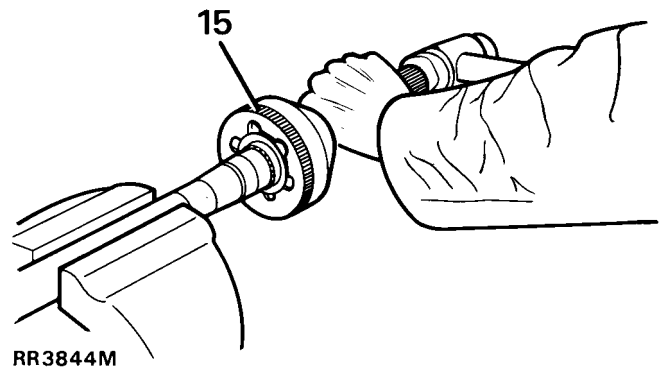
10. Mark positions of constant velocity joint, inner and outer race and cage for reassembly.
11. Swivel cage and inner race to remove balls.



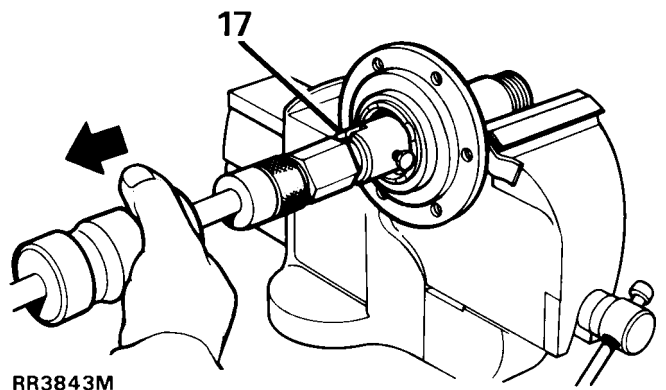
12. Examine all components in particular inner and outer track, cage balls and bearing surfaces for damage and excessive wear.
13. Maximum acceptable end-float on assembled joint 0,64mm. Renew if worn or damaged. Lubricate with a recommended oil during assembly.

**Fit constant velocity joint to axle**

14. Fit collar and a new circlip.
15. Engage constant velocity joint on axle shaft splines and using a soft mallet, drive joint in fully.

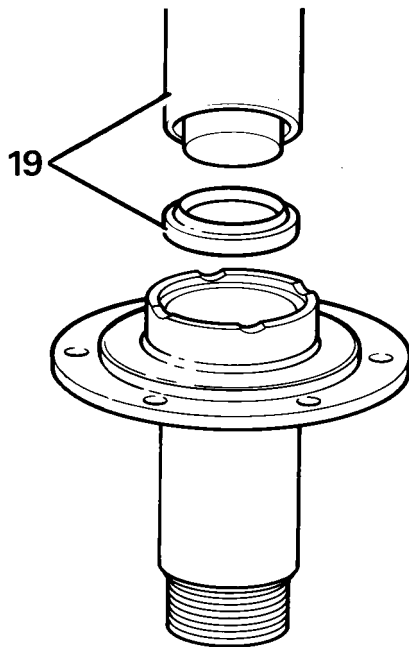
**Renew stub axle, thrust ring, oil seal and bearing**

16. Drill and chisel off thrust ring taking care to avoid damaging stub axle.
17. Remove bearing and oil seal using special tool LRT-37-004 and slide hammer LRT-99-004. Ensure lip of tool locates behind bearing to drive it out.
18. Repeat instruction for removal of oil seal.



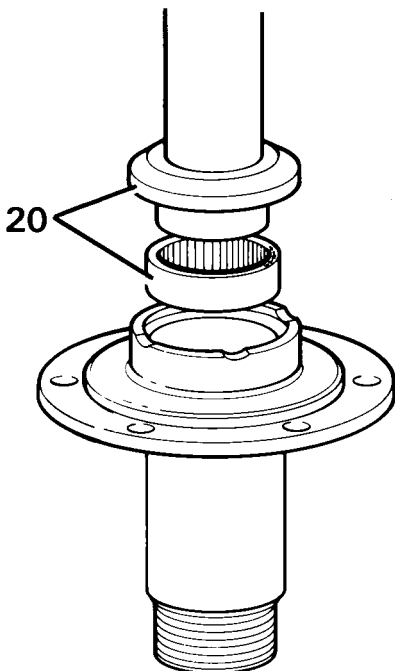


19. Lubricate seal and lip with EP90 oil and with cavity side leading press in a new oil seal using special tool LRT-54-004.



RR3840M

20. Using special tool LRT-54-005, fit bearing with its part number visible when fitted, and flush with end face of stub axle.
21. Press fit a new thrust ring onto stub axle.



RR3839M

### Swivel pin housing assembly

22. Remove brake disc shield bracket.
23. Disconnect track-rod end ball joint from housing.
24. Disconnect drag-link ball joint.
25. Disconnect jump hoses from brake jump hose bracket.
26. Remove ABS brake sensor.
27. Remove six bolts securing oil seal and retaining plate to swivel pin housing. Prise seal from swivel pin housing.

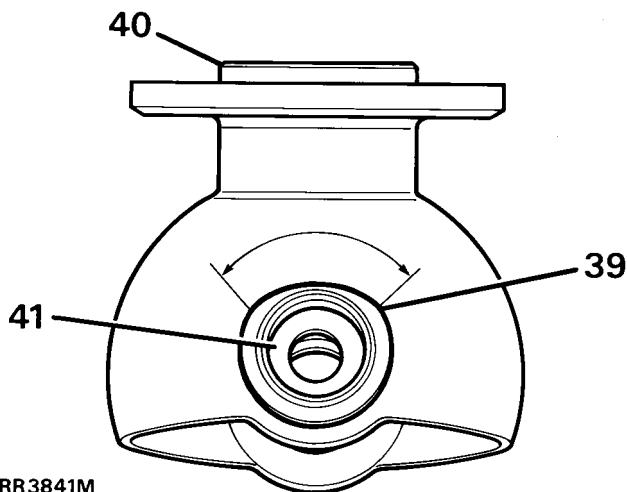


**NOTE: Oil seal and retaining plate cannot be removed until swivel pin bearing housing is removed.**

28. Remove two screws securing brake damper/shield bracket and lower swivel pin to housing.
29. Withdraw lower swivel pin and joint washer by tapping protruding lug.
30. Remove top swivel pin retaining bolts complete with brake jump hose bracket.
31. Remove top swivel pin and shims.
32. Remove swivel pin housing while retrieving lower taper bearing.

### Swivel pin bearing housing

33. Remove seven bolts securing swivel pin bearing housing to axle case.
34. Remove and discard oil seal and joint washer.
35. Remove lower swivel pin bearing track.
36. Remove top swivel pin bush housing assembly. Discard two thrust washers and bearing.
37. If worn, pitted or damaged, renew swivel pin bearing housing.
38. Fit a new lower swivel pin bearing track.
39. Fit a new bush and bush housing. Ensure relieved lip of bush housing faces towards rear, as shown.



RR3841M

40. With seal lips trailing press axle shaft oil seal flush into rear of housing. Grease lips.
41. Fit new thrust washers and bearing into top swivel pin bush.
42. Hang swivel pin bearing housing oil seal and retainer plate over back of housing. Ensure they are in correct assembly order.
43. Fit a new joint washer and secure swivel pin bearing housing to axle. Starting with top fixing dowel bolt. Tighten to **72Nm**.

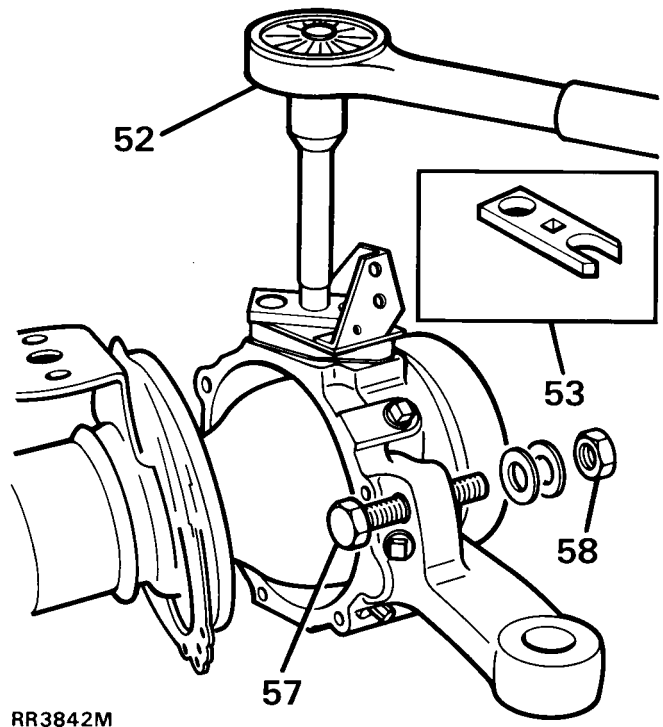
#### Fit swivel pin housing

44. Grease and fit lower swivel pin bearing to bearing housing.
45. Place swivel pin housing in position over swivel pin bearing housing.
46. Using a new joint washer, fit lower swivel pin with lip outboard. Do not secure with screws at this stage.
47. Fit a new sensor bush and new oil seal, lip side leading to top swivel pin.
48. Lubricate with a recommended oil and fit top swivel pin with existing shims.
49. Coat threads of top swivel pin bolts with Loctite 542. Fit bolts and jump hose bracket (do not tighten).

50. Coat threads of lower swivel pin screws with Loctite 270 and fit, together with damper and shield bracket. Tighten to **25 Nm**.
51. Tighten top swivel pin and brake jump hose bracket securing bolts to **65 Nm**.

#### Check and adjust preload on bearings

52. The preload on bearings to be **0,25 to 0,30 mm**, **without** swivel housing oil seal and axle fitted, and reading from centre of swivel pin. The torque required to turn swivel assembly from lock to lock to be **2.0 to 2.8 Nm**. Adjust by removing or adding shims as necessary.
53. To take a reading use special tool LRT-57-024 torque test adaptor, with a torque wrench and extension as shown.



RR3842M

54. Apply a recommended grease between lips of swivel housing oil seal.
55. Secure oil seal with retaining plate and securing bolts. Tighten to **11Nm**.
56. Fit track-rod and drag link and secure with new cotter pins.
57. Loosely fit lock stop bolt for later adjustment.
58. Fit brake disc shield.



### Fit driveshaft and stub axle

59. Insert axle shaft, and when differential splines are engaged, push assembly in fully.



**CAUTION: Take care not to damage axle shaft oil seals.**

60. Place a new joint washer in position on swivel pin housing to stub axle mating face. Coat threads of stub axle bolts with Loctite 270.
61. Fit stub axle with flat at 12 o'clock position.

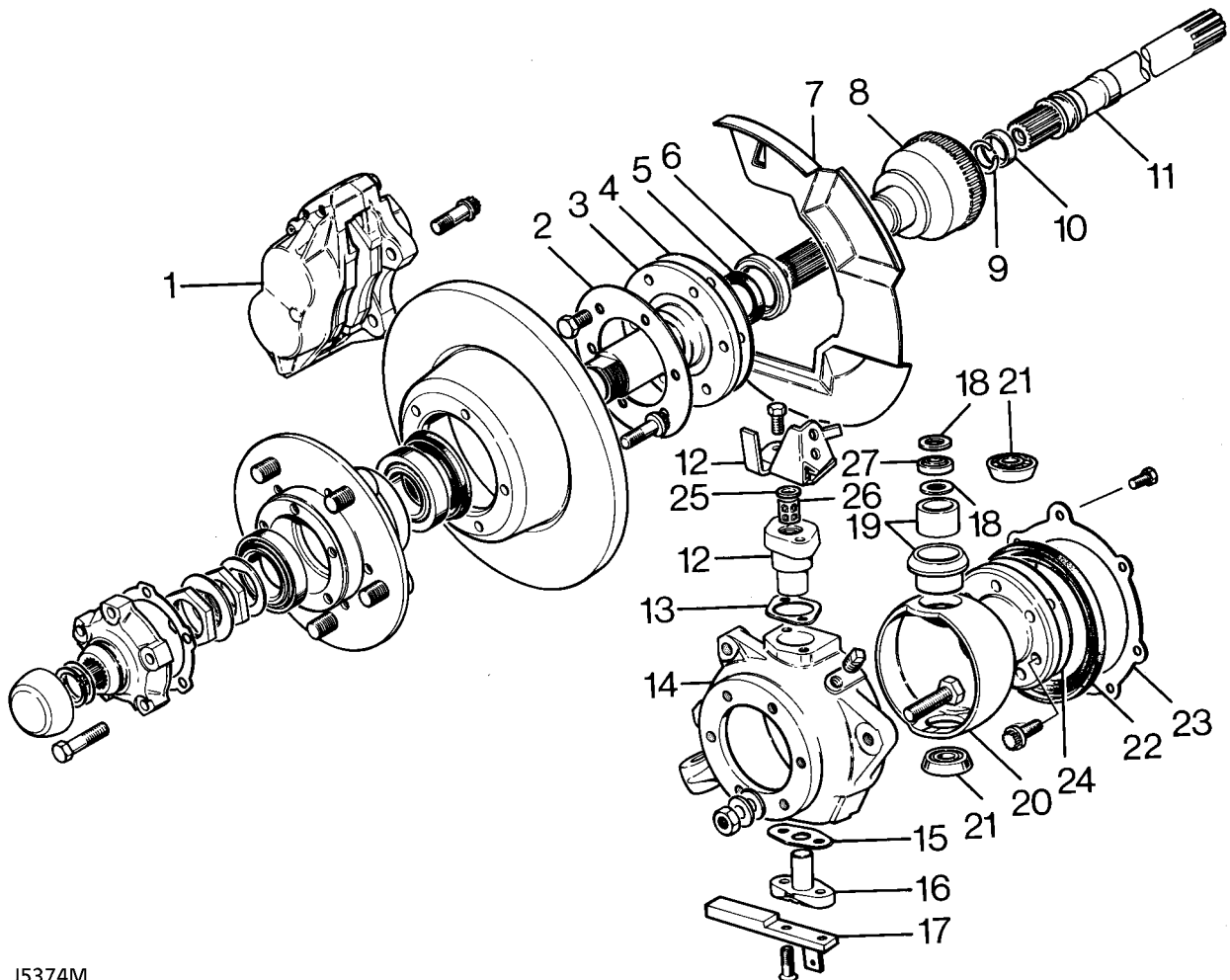


**CAUTION: Ensure that constant velocity joint bearing journal is butted against thrust ring on stub axle. Before stub axle is secured.**

62. Place mud shield in position and secure stub axle to swivel pin housing with six bolts and tighten evenly to **65 Nm**.
63. Fit brake jump hoses to brake jump hose bracket.
64. Fit front hub complete assembly. **See Repair, Front Hub Assembly**
65. Check swivel pin housing oil drain plug is fitted.
66. Fill swivel assembly to correct level, with new oil. **See SECTION 10, Maintenance, Under Vehicle Maintenance**
67. Set steering lock stop bolts to provide a clearance of 20mm. **See STEERING, Adjustment, Steering Lock Stops**
68. Fit ABS brake sensor. **See BRAKES, Repair, Sensors - Front**

## FRONT HUB AND SWIVEL COMPONENTS

1. Brake caliper.
2. Mud shield.
3. Stub axle.
4. Joint washer.
5. Oil seal.
6. Bearing.
7. Brake disc shield.
8. Constant velocity joint.
9. Circlip.
10. Bush.
11. Inner driveshaft.
12. Top swivel pin and jump hose bracket.
13. Shim.
14. Swivel pin housing.
15. Joint washer.
16. Lower swivel pin.
17. Damper and shield bracket.
18. Thrust washer, ABS.
19. Bush and housing, ABS.
20. Swivel pin bearing housing.
21. Lower swivel pin bearing (and upper bearing non ABS).
22. Oil seal.
23. Oil seal retaining plate.
24. Joint washer.
25. Oil seal, ABS.
26. Sensor bush, ABS.
27. Thrust bearing, ABS.



J5374M



**TORQUE VALUES**



**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
<b>FRONT AXLE</b>	
Hub driving member to hub .....	65*
Brake disc to hub .....	73
Stub axle to swivel pin housing .....	65*
Brake caliper to swivel pin housing .....	82
Upper swivel pin to swivel pin housing .....	78*
Upper swivel pin to swivel pin housing ABS .....	65
Lower swivel pin to swivel pin housing .....	78*
Lower swivel pin to swivel pin housing ABS .....	25*
Oil seal retainer to swivel pin housing .....	11
Swivel bearing housing to axle case .....	73*
Pinion housing to axle case .....	41
Crown wheel to differential housing .....	58
Differential bearing cap to pinion housing .....	90
Differential drive flange to drive shaft .....	47
Mudshield to bracket lower swivel pin .....	11
Disc shield to bracket lower ABS .....	9
Bevel pinion nut .....	130
Draglink to hub arm .....	40
Panhard rod to axle bracket .....	88
Radius arm to axle .....	190
Radius arm to chassis side member .....	190



**NOTE:** \* These bolts to be coated with Loctite 270 prior to assembly.

Torque values below cover all screws and bolts used, unless specified otherwise.

METRIC	Nm
M5 .....	6
M6 .....	9
M8 .....	25
M10 .....	45
M12 .....	90
M14 .....	105
M16 .....	180

UNC / UNF	Nm
1/4 .....	9
5/16 .....	24
3/8 .....	39
7/16 .....	78
1/2 .....	90
5/8 .....	136

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#### FRONT HUB AND SWIVEL DATA

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##### Front hub

Front hub end float .....	0,010 mm
Drive shaft end play .....	0,08 to 0,25 mm

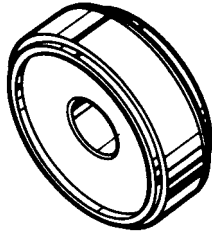
##### Swivel pin bearing preload

ABS vehicles - Torque to turn .....	2. to 3. Nm
Non ABS vehicles - Resistance to turn .....	1,16 to 1,46Kg



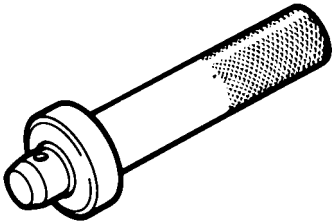


FRONT HUB



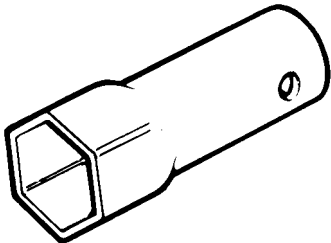
LST 5505

LRT-54-001 Oil seal replacer non ABS  
LST550-5



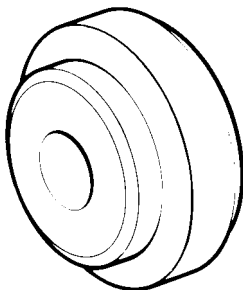
18G134

LRT-99-003 Drift  
18G134



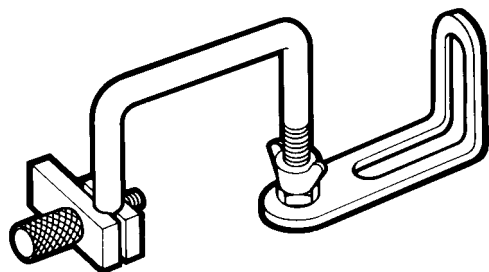
606435A

LRT-54-002 Hub nut wrench  
RO606435A



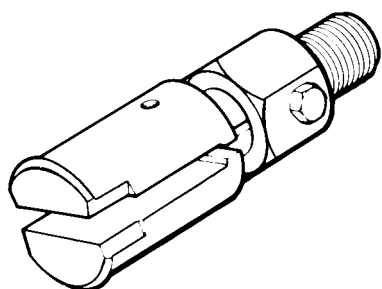
LST137

LRT-54-003 Hub oil seal replacer ABS  
LST137



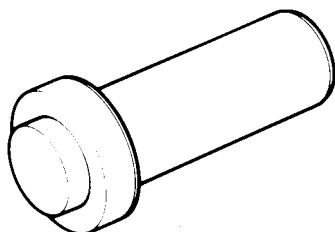
RO530106

LRT-99-503 Dial gauge bracket  
RO530106



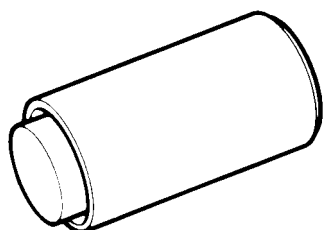
8G284AAH

LRT-37-004 Extractor ABS  
18G284AAH



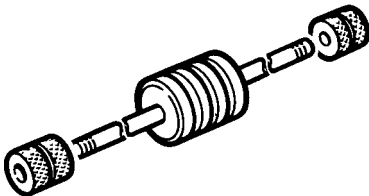
LST132

LRT-54-005 Bearing installer ABS  
LST132



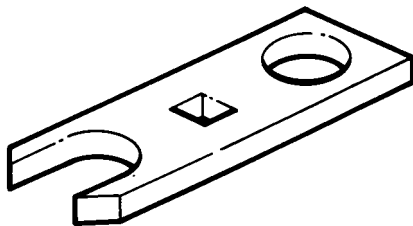
LST133

LRT-54-004 Seal installer ABS  
LST133



LRT-99-004 Impulse extractor  
MS284

MS284



LRT-570-024 Torque test adaptor ABS  
LST141

LST141



**DESCRIPTION**

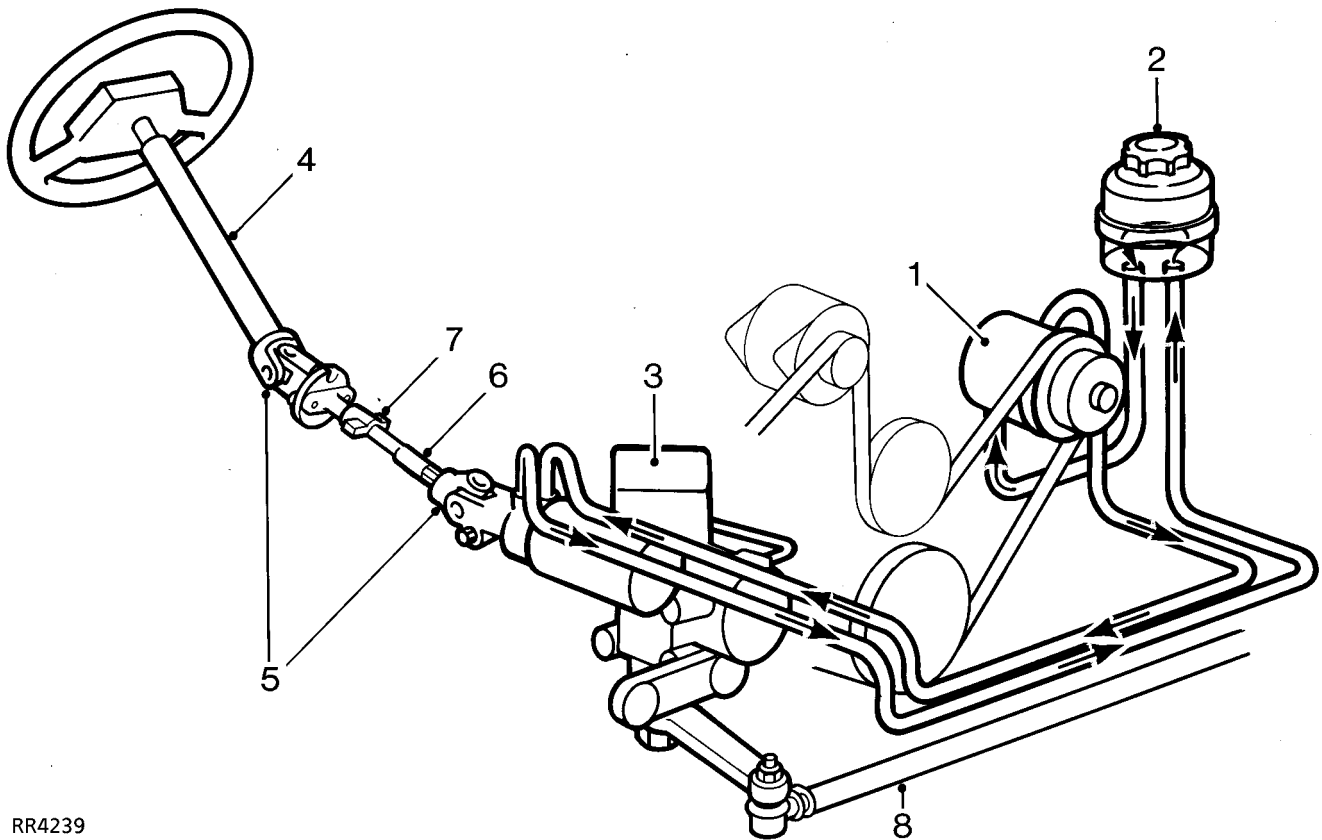
The power assisted steering system incorporates a compression joint in the lower shaft, designed to collapse on impact and for certain countries, an air bag located in the centre of the steering wheel. The mis-alignment of the upper steering column with the steering box and the inclusion of two universal joints and a compression joint in the lower shaft, is also designed to prevent frontal impact moving the column toward the driver. The steering box is located behind the first cross member of the chassis and is connected to the road wheels by the drag link and track rod. An hydraulic damper absorbs shocks in the steering, caused by road wheel deflections when operating on rough terrain.

**Power steering system**

The power steering system comprises a hydraulic pump which is belt driven from the engine and supplied with fluid from a reservoir that also acts as a cooler.

The steering box houses a self neutralizing rotary valve which is part of the worm/valve assy and a hydraulic piston/rack to assist the mechanical operation.

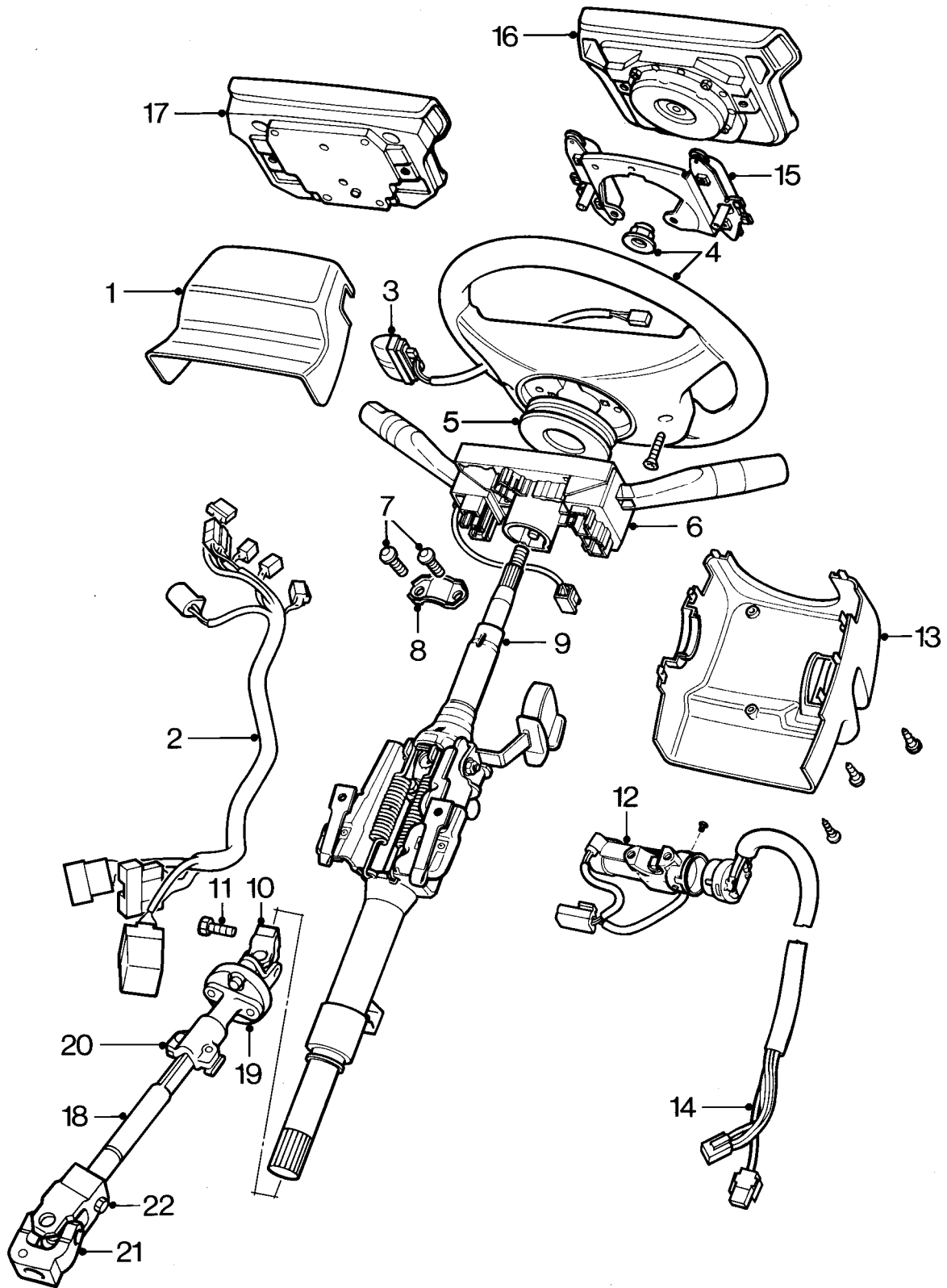
The rotary valve which is operated by movement of the steering wheel, directs fluid pressure to the appropriate side of the hydraulic piston/rack to provide assistance.



RR4239

**Power steering system**

- 1. Hydraulic pump
- 2. Fluid reservoir
- 3. Steering box
- 4. Upper column
- 5. Universal joints
- 6. Lower shaft
- 7. Compression joint
- 8. Drag link

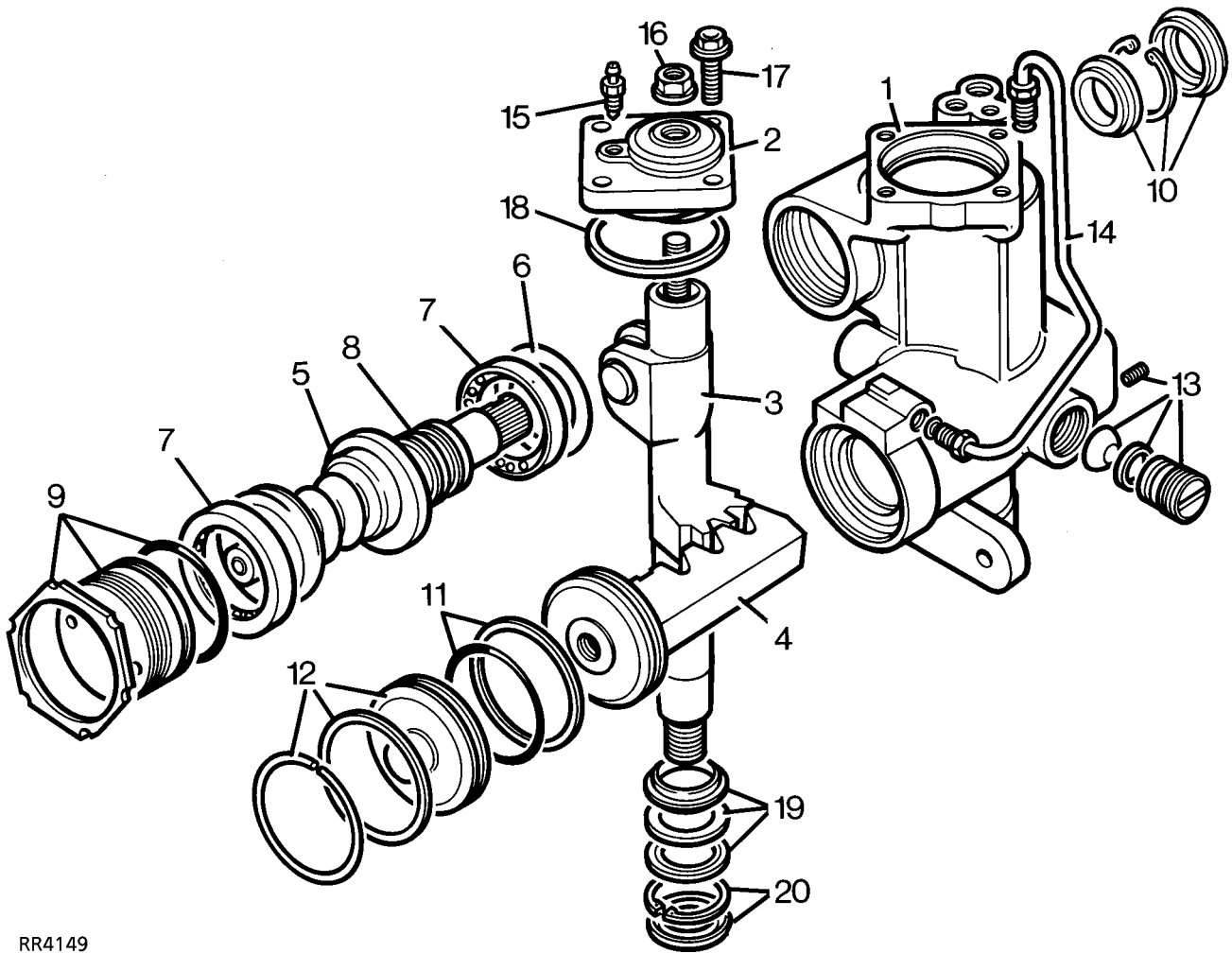


J5950



### Steering column components

1. Upper shroud
2. Column harness
3. Cruise control switch (if fitted)
4. Steering wheel and nut
5. Rotary coupler
6. Column switch
7. Shear bolts
8. Switch saddle
9. Upper steering column
10. Universal joint
11. Universal joint bolt
12. Steering column lock assembly
13. Lower shroud
14. Column lock/ignition
15. Air bag mounting bracket (if fitted)
16. Air bag module
17. Steering pad (non-airbag)
18. Lower shaft
19. Rubber coupling
20. Compression joint
21. Universal joint
22. Universal joint bolt



RR4149

## Power steering box components

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. Housing complete with sector shaft bearings</li> <li>2. Cover plate complete with bearing</li> <li>3. Sector shaft</li> <li>4. Hydraulic piston/rack</li> <li>5. Worm/valve and torsion bar assembly</li> <li>6. Shims for centralizing worm/valve</li> <li>7. Ball race (2)</li> <li>8. 'Teflon' seals for valve sleeve (3)</li> <li>9. Bearing adjuster, locknut and seal</li> <li>10. Worm shaft pressure seal, circlip and dirt excluder</li> </ol> | <ol style="list-style-type: none"> <li>11. 'Teflon' and rubber seal for piston</li> <li>12. End cover seal and snap ring</li> <li>13. Adjustment components for piston/rack</li> <li>14. Hydraulic pipe</li> <li>15. Bleed screw</li> <li>16. Sector shaft adjustment lock nut with seal</li> <li>17. Cover plate bolts (4)</li> <li>18. Cover plate seal</li> <li>19. Seal, washer and backup seal</li> <li>20. Circlip and dust cover</li> </ol> |
|---|--|



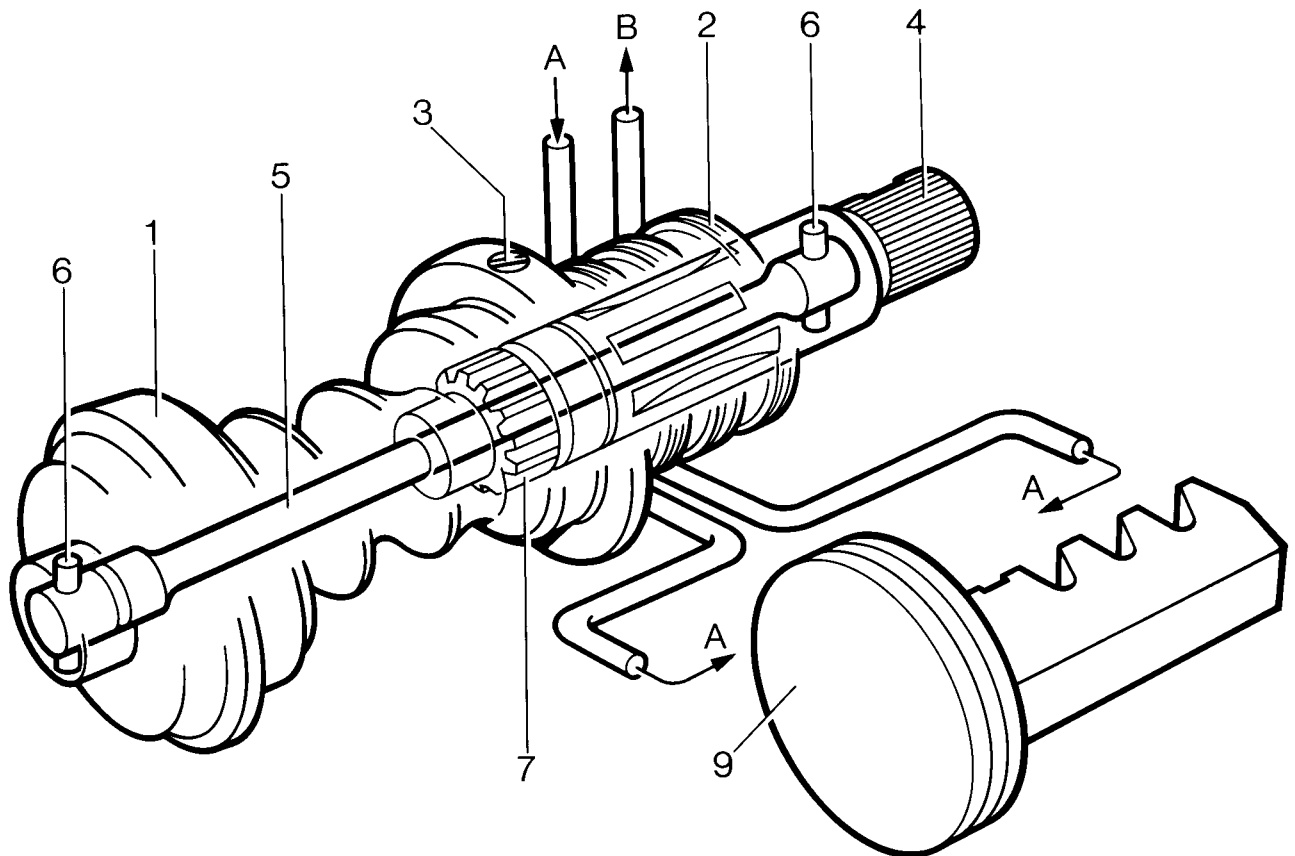
### Rotary valve operation

The rotary valve assembly seen in RR3620M comprises the worm (1), the valve sleeve (2), the input shaft (4) and the torsion bar (5).

The valve sleeve is retained inside the worm by the trim screw (3), and incorporates valve ports in its inner bore. The input shaft is attached to the steering wheel via the steering shaft and steering column and incorporates valve ports in its outer diameter to align with those in the sleeve. The torsion bar which is secured to the worm and input shaft with pins (6) at each end (later models use one pin at input shaft end), holds the valve ports in neutral alignment when there is no demand for assistance.

### No demand for assistance (Valve at neutral)

When there is no demand for assistance as seen in RR3620M, the torsion bar holds the input shaft and sleeve valve ports in neutral relationship to one another, allowing equal pump pressure A to both sides of the piston/rack (9). Any excess fluid flow from the pump returns to the reservoir via B.



RR3620M

### Rotary valve at neutral



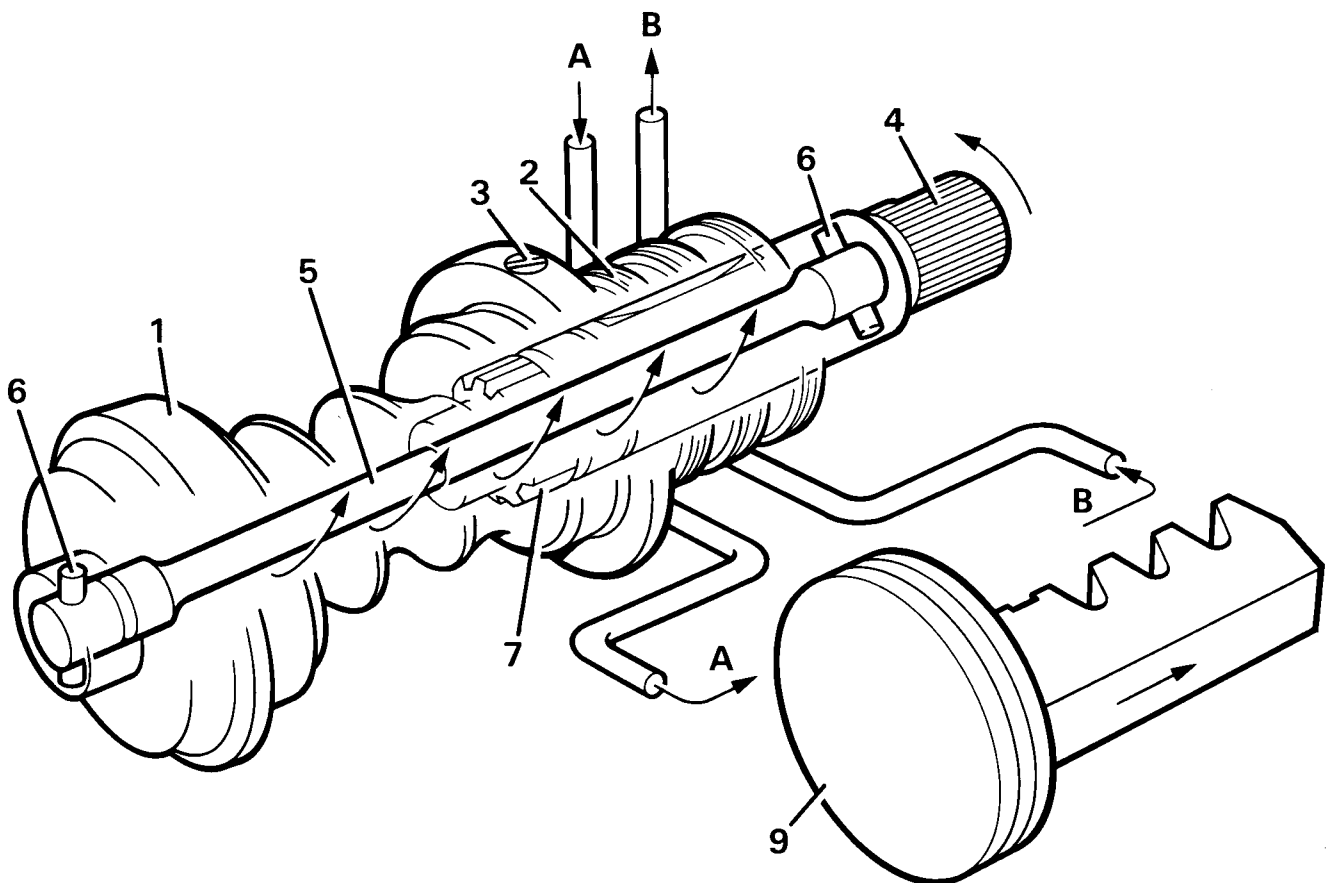
## Demand for assistance (Valve misaligned)

When the steering wheel and input shaft is turned, steering resistance transmitted to the worm causes the torsion bar to be twisted and the valve ports to be misaligned for a right or left turn. The misalignment of the valve ports directs all fluid pressure A to one side of the piston only and allows displaced fluid B on the other side.

When demanding maximum assistance, any excessive fluid output from the pump due to high pump speed, will circulate through the regulator valve located in the pump unit, causing the temperature of the fluid and the pump to rise rapidly. To avoid excessive fluid temperatures which could damage the oil seals, the steering must not be held on full lock for more that 30 seconds in one minute.

Only when the steering wheel and the demand for assistance is released, will the torsion bar return the valve to neutral, allowing the fluid to circulate through the reservoir where it is cooled.

In the unlikely event of mechanical failure of the torsion bar, a coarse splined connection (7) between the input shaft and worm, ensures steering control is maintained sufficient to allow the vehicle to be recovered.



RR3621M

## Rotary valve misaligned

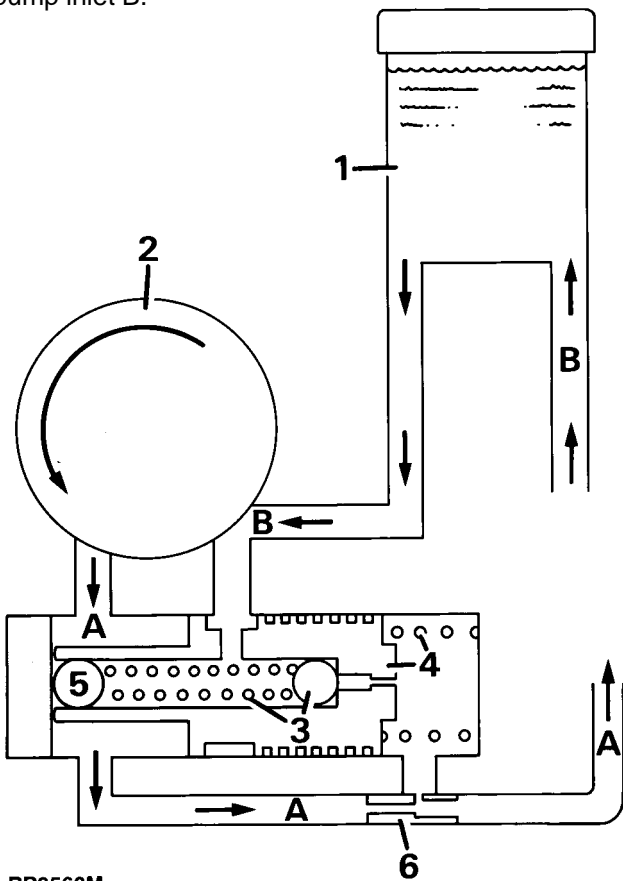


**Pump and regulator valve operation**

The pump which is belt driven from the engine is an eccentric roller type and also houses the pressure regulator and flow control valve. The pressure is controlled by a spring loaded ball valve 3 which is housed inside the flow control valve piston 4.

**No demand for assistance High flow through box - Low pressure**

With no demand for assistance as illustrated in RR3568M the rotary valve in the steering box acts as a pressure relief valve, allowing fluid A to flow freely through the steering box and back to the reservoir and pump inlet B.



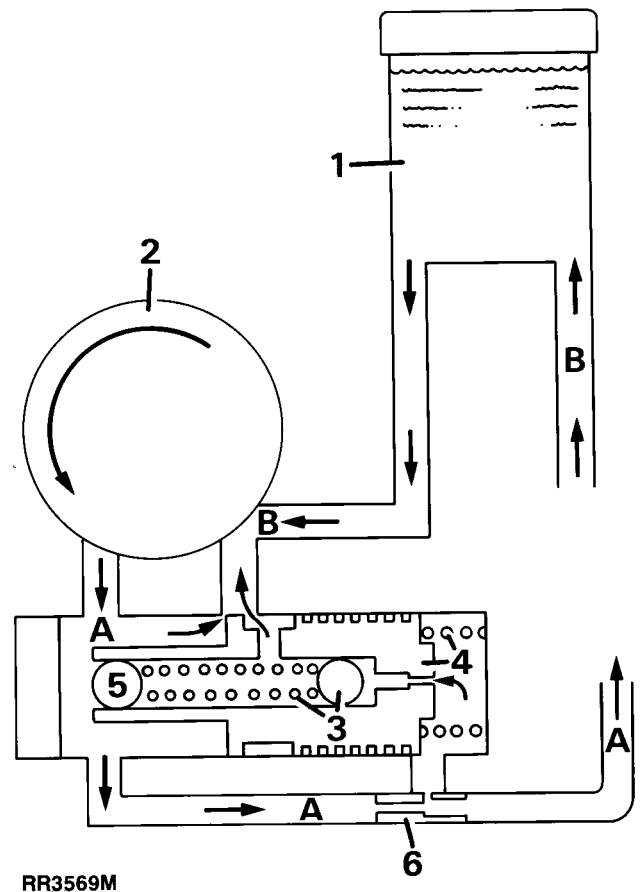
**No demand for assistance**

1. Reservoir
2. Pump
3. Pressure control ball valve and spring
4. Flow control valve and spring
5. Press fit plug (ball bearing)
6. Restrictor

**The ball plug item 5 is pressed into the valve 4 during manufacture and determines the opening pressure of pressure relief valve 3.**

**No flow, through box - High pressure**

When the steering is turned, the rotary valve effectively stops all fluid flow through the steering box, thus causing an increase in pressure A. This increase in pressure is felt in the flow control valve spring chamber where, at a pre-determined pressure the relief valve 3 will open and allow the pressure to escape. The fall in pressure in the flow control spring chamber, allows the flow control valve to move to the right, which in turn allows pump output A to escape directly into the pump inlet B, as seen in RR3569M.



**Assistance demanded**

As soon as the steering wheel is released after making a turn, the system reverts to the condition seen in RR3568M and the road wheels are returned to the straight ahead position by the mechanical steering geometry.

In the event of any hydraulic failure steering control though heavy, will be maintained through the mechanical components in the steering box.



## INSUFFICIENT POWER ASSISTANCE

1. Is fluid level correct?  
YES - go to 3.  
NO - Fill/bleed system
2. Is there a problem with a leak?  
YES - Diagnose. **See Power Steering Fluid Leaks**  
NO - continue
3. Is drive belt tension correct?  
YES - go to 5.  
NO - retension. **See ENGINE, Repair, Drive Belt**
4. Is the problem resolved?  
YES - end  
NO - continue
5. Carry out pressure test at idle and 1000 rev/min.  
**See Power Steering System - Test**
6. Is correct pressure achieved?  
YES - steering box defective  
Not at any speed go to 9.  
Not at idle go to 7.
7. Is idle speed correct?  
YES - Go to 8.  
NO - Correct idle speed -  
If 3.9 **See ENGINE TUNING DATA, Information, Engine 3.9 V8i**  
If Tdi **See ENGINE TUNING DATA, Information, 300 Tdi Engine**  
If Mpi **See ENGINE TUNING DATA, Information, Engine - Mpi - 2.0 Litre**
8. Is the problem resolved?  
YES - end  
NO - go to 9.
9. Bypass steering box using adaptor tap LRT-57-001
10. Is correct pressure obtained?  
YES - defective steering box  
NO - defective steering pump



**CAUTION:** Do not hold steering wheel on full lock for more than 30 seconds in any one minute to avoid overheating fluid and possibly damaging seals.



**NOTE: 1.** Excessive pressure in the system is almost always caused by a faulty relief valve in the PAS pump.

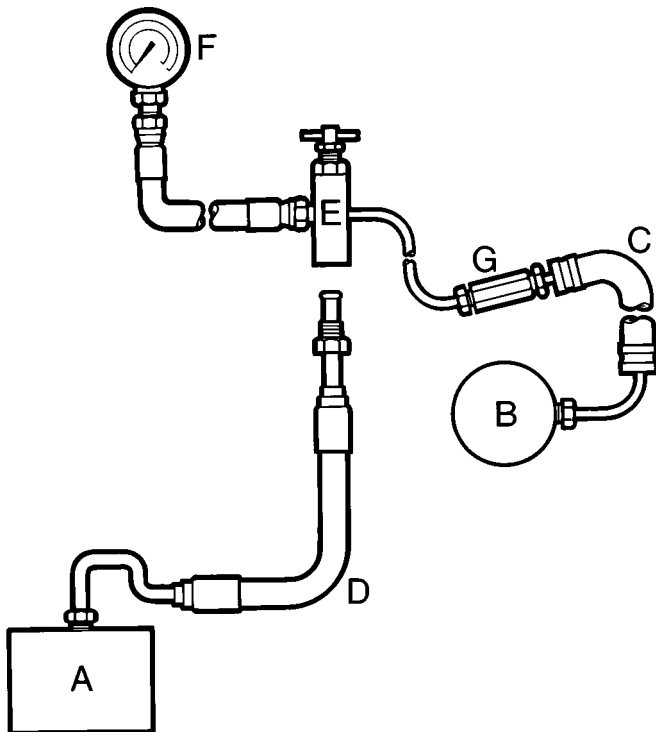


**NOTE: 2.** Insufficient pressure in the system is usually caused by low fluid level or PAS pump drive belt slip, or one of the following: PAS system leaks, faulty PAS pump relief valve, fault in steering box valve and worm assembly, leak at piston in steering box, worn components in PAS pump or box.

## POWER STEERING SYSTEM - TEST



**NOTE:** If steering lacks power assistance. Check pressure of hydraulic pump before fitting new components. Use fault diagnosis chart to assist in tracing faults.



RR3959M

- A. Steering box.
- B. Steering pump.
- C. Existing hose, steering box to pump.
- D. Hose LRT-57-030.
- E. Test adaptor LRT-57-001.
- F. Pressure gauge LRT-57-005.
- G. Thread adaptor LRT-57-004.
- H. Thread adaptor LRT-57-022.

## Procedure

1. A hydraulic pressure gauge and test adaptor is used to test power steering system. This gauge is able to measure 140 kgf/cm<sup>2</sup>. The maximum power steering system pressure is 77 kgf/cm<sup>2</sup>.
2. Some fault conditions of hydraulic pump may obtain pressures up to 105 kgf/cm<sup>2</sup>. Pressure on gauge is same pressure being exerted upon steering wheel. When testing, turn steering wheel gradually while reading pressure gauge.
3. Check and maintain maximum fluid level of reservoir.
4. Examine power steering units and connections for leaks. All leaks must be rectified before attempting to test the system.
5. Check steering pump drive belt tension. **See ENGINE, Repair, Drive Belt**
6. Assemble test equipment and fit to vehicle, as shown in RR3959M.
7. Open tap of adaptor.
8. Bleed system, take care not to overload pressure gauge.
9. With system in good condition, pressures should be:
  - (A) Steering wheel held on full lock and engine running at 1,000 rev/min, 70 to 77 kgf/cm<sup>2</sup>.
  - (B) Steering wheel held on full lock and engine idling, 28 kgf/cm<sup>2</sup>.

Checks should be carried out on both full lock positions.



**CAUTION:** Do not maintain this pressure for more than 30 seconds in any one minute to avoid overheating fluid and possibly damaging seals.

10. Release steering wheel and with engine idling. Pressure should read below 7 kgf/cm<sup>2</sup>.
11. If pressures differ to those given a fault exists.
12. To determine if fault is steering box or pump. Close adaptor tap for a maximum five seconds.
13. If gauge does not register specified pressure, pump is faulty.
14. Fit a new pump, bleed system and repeat test. If low pressure or a substantial imbalance exists, fault is in steering box valve and worm assembly.



## STEERING DAMPER

The power steering system, as well as reducing the effort required to manoeuvre the vehicle when parking, also helps to dampen any deflections of the road wheels, being transmitted back to the steering wheel.

When operating the vehicle off road, the road wheels are often deflected by ruts and boulders causing the steering wheel to turn left and right. This phenomenon is known as 'steering kickback'. To subdue the effects of 'steering kickback', a hydraulic damper is fitted in the steering linkage between the track rod and the differential casing. The damper, which offers the same resistance in extension and compression, is sealed for life.

### Steering damper check

Check the condition operation of the hydraulic steering damper as follows:

#### Check procedure

1. Inspect damper for casing damage or leaks.
2. Clamp one end of the damper horizontally in a vice using soft jaws. Compress and extend the unit by hand. Resistance should be equal in both directions.
3. If it is felt that the unit is outside acceptable limits, fit a new steering damper

## STEERING FAULTS

### Symptom:-

**Excessive kickback through steering wheel - when driven on rough terrain.**

1. Is the steering damper in good working order?  
**See Steering Damper**  
NO - Renew unit. **See Repair, Steering Damper**  
YES - Continue.
2. Is there any looseness or free play in the steering ball joints and linkage?  
YES - **See Steering Linkage Inspect**  
NO - Continue.
3. Is there any looseness or worn bushes in front suspension?  
YES - **See FRONT SUSPENSION, Repair, Radius Arm**



**NOTE: When replacing suspension bushes ALL bushes and fixings must be replaced.**

- NO - Continue.
4. Is the steering exceptionally light/sensitive when driven on good road surface?  
YES - See fault symptom - **Steering excessively light/sensitive and freeplay at steering wheel.**  
NO - Suspect axle swivel resistance.
5. Check the resistance of the axle swivels. **See FRONT AXLE AND FINAL DRIVE, Overhaul, Front Stub Axle, Constant Velocity Joint and Swivel Pin Housing Non ABS See FRONT AXLE AND FINAL DRIVE, Overhaul, Front Stub Axle, Constant Velocity Joint and Swivel Pin Housing ABS**

**Symptom:-**

Fluid leaks from steering box seals.



**CAUTION:** The steering wheel must not be held on full lock for more than 30 seconds in one minute, as this may overheat the fluid and cause damage to the oil seals.

1. Check fluid level. **See Repair, Power Steering Fluid Reservoir**  
Check fluid pressure. **See Power Steering System - Test**
2. Is pressure high?  
YES - Renew pump. **See Repair, Power steering Pump**  
If oil seal leaks persist after renewing the pump. **See Overhaul, Power Steering Box**  
NO - **See Overhaul, Power Steering Box**

**Symptom:-**

**Insufficient power assistance - castor return action normal.**

1. Are tyres correct type and pressure?  
NO - **See GENERAL SPECIFICATION DATA, Information, Wheels and Tyres**  
YES - Continue.
2. Is fluid level correct?  
NO - Check fluid level **See Repair, Power Steering Fluid Reservoir**  
YES - Check system for air locks. **See Repair, Power Steering System - Bleed**
3. Is pressure correct?  
NO - Check fluid pressure. **See Power Steering System - Test**  
If pressure is not correct after bleeding the system, renew pump. **See Repair, Power Steering Pump**  
YES - **See Overhaul, Power Steering Box**

**Symptom:-**

**Steering heavy - stiff, poor castor return action.**

1. Are tyres correct type and pressure?  
NO - **See GENERAL SPECIFICATION DATA, Information, Wheels and Tyres**  
YES - Check universal joints for seizure and correct alignment. **See Repair, Lower Steering Shaft and Universal Joints**  
Check power steering box adjustments. **See Overhaul, Power Steering Box**
2. Is the power assistance satisfactory?  
NO - See fault symptom **Insufficient assistance, (castor return action normal)**.  
YES - Disconnect drag link from drop arm and check steering column and box for stiffness. **See Repair, Drag Link and Drag Link Ends**
3. Is the steering stiff with the drag link disconnected?  
NO - Check steering ball joints for seizure and axle swivels lubrication and resistance. **See Repair, Drag Link and Drag Link Ends See FRONT AXLE AND FINAL DRIVE, Overhaul, Front Stub Axle, Constant Velocity Joint and Swivel Pin Housing Non ABS See FRONT AXLE AND FINAL DRIVE, Overhaul, Front Stub Axle, Constant Velocity Joint and Swivel Pin Housing ABS**  
YES - Disconnect the lower steering shaft and check the column and box for stiffness. **See Repair, Lower Steering Shaft and Universal Joints**
4. Is the steering column stiff to turn when disconnected from the box?  
NO - Remove and overhaul box. **See Overhaul, Power Steering Box**  
YES - Adjust steering column. **See Stiff Steering Checklist**

**Symptom :-**

**Steering excessively light/sensitive. Excessive freeplay at steering wheel.**

1. Are steering box adjustments correct?  
NO - **See Adjustment, Power Steering Box**



**WARNING:** Adjustments of steering box should not be required while in warranty period. If box is within warranty, it must be returned to manufacturer. No attempt must be made to introduce backlash.

- YES - Suspect worn panhard rod or radius arm bushes. Check condition of ball joints and the lower steering column shaft universal joints for wear. **See Repair, Lower Steering Shaft and Universal Joints**

**Symptom :-**

**Steering vibration, road wheel shimmy - wobble.**

Vibration through the steering linkage powerful enough to induce high frequency oscillation of the steering wheel, is generally caused by out of balance road wheels. However there are a number of other possible causes of this symptom which if severe, may be described as shimmy or wobble. Regardless of the terminology used by the owner/driver to describe the symptoms, the following diagnostic checks should be carried out in the order presented.

1. Check the tyres and balance of the road wheels. **See GENERAL SPECIFICATION DATA, Information, Wheels and Tyres See WHEELS AND TYRES, Fault diagnosis, Fault - Symptoms See WHEELS AND TYRES, Repair, Wheel Balancing**
2. Check the steering hydraulic damper function. **See Steering Damper**
3. Check steering column universal joints for wear and correct alignment. **See Repair, Lower Steering Shaft and Universal Joints**

4. Check steering linkage ball joints for wear, correct alignment and security, including steering box and tie rod. **See Steering Linkage Inspect**
5. Check all front suspension rubbers for wear. Check all fixing torques, including radius arm bushes, panhard rod and anti-roll [sway] bar. **See FRONT SUSPENSION, Repair, Panhard Rod See FRONT SUSPENSION, Repair, Radius Arm See FRONT SUSPENSION, Repair, Anti-Roll[Sway] Bar Assembly See FRONT SUSPENSION, Repair, Front Shock Absorber**
6. Fit new radius arm bushes using NTC 6860. Fit harmonic damper if vehicle has air suspension. Fit new nuts, bolts and washers.
7. **Coil spring vehicles only** - If problem persists fit damper kit STC 241 (2 off front) and STC 1474 (2 off rear). Road test vehicle.
8. Check the power steering box adjustments and operation. **See Overhaul, Power Steering Box**
9. Check the hub bearing end floats and determine the condition of the hub bearings. As applicable. **See FRONT AXLE AND FINAL DRIVE, Repair, Front Hub Assembly**
10. Check the resistance and condition of the swivels. **See FRONT AXLE AND FINAL DRIVE, Description and operation, Description**  
If problem is not diagnosed: Repeat checks starting at 1.
11. Carry out a full steering geometry check. **See INTRODUCTION, Information, Steering**

## STEERING STABILITY AND VEER UNDER BRAKING

### Possible cause:

Incorrectly set, swivel pin bearing preload. There are three different settings for these bearings dependant on model year and if fitted with ABS brakes.

### Remedy.

1. Establish model year of vehicle.
2. If fitted with or without antilock brakes.
3. Follow instructions to overhaul front stub axle, constant velocity joint and swivel pin non ABS, or with ABS as appropriate.  
**See FRONT AXLE AND FINAL DRIVE, Overhaul, Front Stub Axle, Constant Velocity Joint and Swivel Pin Housing Non ABS See FRONT AXLE AND FINAL DRIVE, Overhaul, Front Stub Axle, Constant Velocity Joint and Swivel Pin Housing ABS**

## 1. GENERAL STEERING

1. Carry out visual and safety checks. **See Visual and Safety Checks**
2. Road test vehicle. **See Road Test Procedure**
3. Is problem resolved?  
YES - end  
NO - continue
4. Is problem stiff steering?  
YES - **See Stiff Steering Checklist**  
NO - Go to 6.
5. Is problem resolved?  
YES - end  
NO - go to 8.
6. Is problem steering niggles?  
YES - Replace radius arm bushes, arm and axle. **See FRONT SUSPENSION, Repair, Radius Arm**  
NO - go to 8.
7. Is problem resolved?  
YES - end  
NO - continue.
8. Centralise steering box. **See Adjustment, Centralise Steering Box**
9. Is problem resolved?  
YES - end  
NO - continue.
10. Check, adjust if necessary, steering geometry.
11. Is problem resolved?  
YES - end  
NO - continue.
12. Categorise the remaining problems into one or more of the following descriptions:  
**See 2. Steering Veer**  
**See 3. Veer Under Braking**  
**See 4. Directional Stability**





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## 2. STEERING VEER

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From 1. GENERAL STEERING:

1. Vehicle veers, not under braking, swap front tyres side to side.
2. Is problem resolved?  
YES - end  
NO - continue.
3. Does vehicle now veer in other direction?  
YES - fit new tyres  
NO - continue.
4. Recentralise steering box. **See Adjustment, Centralise Steering Box**
5. Is problem resolved?  
YES - end  
NO - contact local technical office.

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## 3. VEER UNDER BRAKING

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From 1. GENERAL STEERING:

1. Vehicle veers under braking, bleed brake system.
2. Is problem resolved?  
YES - end  
NO - continue.
3. Check brake pads for glazing, and discs, axles etc for contamination.
4. Is problem resolved?  
YES - end  
NO - continue.
5. Check brake lines and hoses for deterioration. Replace as necessary.
6. Is problem resolved?  
YES - end  
NO - continue.
7. Contact local technical office.

## 4. DIRECTIONAL STABILITY

From 1. GENERAL STEERING:

1. Is directional stability concern when vehicle is towing?  
YES - Check towing/vehicle loading parameters in Owner's Handbook.  
NO - go to 3.
2. Is problem resolved?  
YES - end  
NO - continue.
3. Check condition of rear trailing link/chassis bushes.
4. Is problem resolved?  
YES - end  
NO - continue.
5. Check condition of front and rear shock absorbers. If in doubt change units in pairs, side to side.
6. Is problem resolved?  
YES - end  
NO - continue.
7. Check steering damper. **See Steering Damper**
8. Is problem resolved?  
YES - end  
NO - continue.
9. Check wheel balance
10. Is problem resolved?  
YES - end  
NO - contact local technical office.

## POWER STEERING FLUID LEAKS

1. Is fluid level correct?  
YES - go to 3.  
NO - Refill or drain to correct level. Bleed system, check for leaks. **See Repair, Power Steering System - Bleed**
2. Is problem resolved?  
YES - end  
NO - continue.
3. Are hoses or joints leaking? Check on full lock with engine at 2000 rev/min.  
YES - loosen and retorque joints.  
NO - go to 6.
4. Does leak remain?  
YES - change PAS pipe.  
NO - end.
5. Does leak remain?  
YES - suspect seal in component. Check and replace as necessary.  
NO - end.
6. Is oil escaping from filler cap?  
YES - bleed system. **See Repair, Power Steering System - Bleed**  
NO - go to 8.
7. Is oil still escaping from filler cap?  
YES - go back to 1.  
NO - end.
8. Is oil leaking from PAS pump?  
YES - go to 10.  
NO - continue.
9. Is oil leaking from PAS box?  
YES - go to 10.  
NO - end.
10. Clean unit, add tracer dye to system. Retest
11. Is oil still leaking?  
YES - establish leak point. Repair or replace unit as necessary.  
NO - end.




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**POWER STEERING SYSTEM - EXCESSIVE NOISE**


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1. Is fluid level correct?  
YES - go to 3.  
NO - Refill or drain to correct level. Bleed system, check for leaks. **See Repair, Power Steering System - Bleed**
2. Is problem resolved?  
YES - end  
NO - continue.
3. Is pressure hose from pump to box touching body in a hard foul condition?  
YES - reroute hose away from body.  
NO - go to 5.
4. Does noise remain?  
YES - continue.  
NO - end.
5. Is noise a whistle or hiss on full lock?  
YES - noise is not a fault unless excessive. Compare with other vehicles  
NO - go to 8.
6. Is noise excessive?  
YES - continue.  
NO - end.
7. Change steering box and/or pump.
8. Is noise a squeal on full lock?  
YES - check/reset drive belt tension. **See ENGINE, Repair, Drive Belt**  
NO - go to 10.
9. Does squeal remain?  
YES - drive belt contaminated, change belt.  
NO - end.
10. Is noise a continuous moan?  
YES - bleed PAS system. **See Repair, Power Steering System - Bleed**  
NO - go to 13.
11. Does moan remain?  
YES - do figure 8 manoeuvres.  
NO - end.
12. Does moan remain?  
YES - continue  
NO - end.

13. Is noise an intermittent "grunt"?  
YES - **See Power Steering System - Grunt**  
NO - continue.
14. Is it a clunking noise?  
YES - reset drive belt tension. **See ENGINE, Repair, Drive Belt**  
NO - contact local technical office.
15. Does noise remain?  
YES - Suspect suspension or drive train.  
NO - end.

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**POWER STEERING SYSTEM - GRUNT**


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**Steering box grunts intermittently when turning from lock to lock:**

1. Is fluid level correct?  
YES - go to 3.  
NO - refill or drain to correct level. Bleed system, check for leaks. **See Repair, Power Steering System - Bleed**
2. Does grunt remain?  
YES - continue  
NO - end.
3. Is correct low pressure hose ANR 3152, steering box to reservoir fitted?  
YES - go to 5.  
NO - Fit correct hose.
4. Does grunt remain?  
YES - continue  
NO - end.
5. Purge box by doing figure 8 manoeuvres e.g. on car park, followed by 10 minutes normal road use.
6. Does grunt remain?  
YES - Contact local technical office  
NO - end.

## VISUAL AND SAFETY CHECKS



**WARNING:** Before taking vehicle out on the public highway for road test, it is important that the following basic visual checks are carried out to ensure that the vehicle complies with legal requirements.

### Tyres and wheel rims

1. Check and adjust tyre pressures. **See GENERAL SPECIFICATION DATA, Information, Tyre Pressures**  
Note that this information refers to standard tyres fitted as original equipment.
2. Check condition of tyres. Inspect for signs of uneven wear, damage and feathering. Check tread depth.
3. Ensure that the tyre make, type and general condition are common across each axle.
4. Check wheel rims for signs of damage and excessive run out.
5. Carry out road test. **See Road Test Procedure**

## ROAD TEST PROCEDURE

General steering/handling problems can usually be classified into one of the categories listed and ARE GENERALLY RELATED TO THE AGE, CONDITION AND USE OF THE VEHICLE.



**WARNING:** Ensure that all road tests are conducted by suitably qualified drivers in a safe and legal manner, and where local traffic conditions allow.

1. Carry out visual and safety checks. **See Visual and Safety Checks**

Confirm general nature of complaint with customer, simulating where possible the conditions under which the problem occurs. Carry out following road test procedure to establish the problem.

2. Steering load assessment - drive at 16 km/h (10 mph). Put 90° turn input into steering wheel, check self centering. The self centering should be equal on each lock BUT not necessarily return to exactly straight ahead without assistance from the driver.
3. Steering assessment - drive at 64 km/h (40 mph) on a straight FLAT road (no camber), check for steering veer. The vehicle should follow a straight path with NO tendency to follow a curved path. If vehicle veers towards the kerb, vehicle may be 'camber sensitive'. A small amount of veer in direction of camber is acceptable.
4. Directional stability assessment - drive at 112 km/h (70 mph) or maximum legal speed on a straight flat road. Carry out a normal lane change. Vehicle should quickly settle into a new straight path.
5. Braking assessment (medium effort) - drive at 96 km/h (60 mph) on a straight flat road. Apply steady medium braking effort, noting any tendency to veer. Carry out brake test three times, if a veer is consistently noted carry out a braking efficiency test on a rolling road.
6. Braking assessment (full effort) - drive at 96 km/h (60 mph) on a straight flat road. Apply full braking effort, noting any tendency to veer. Carry out brake test three times, if a veer is consistently noted carry out a braking efficiency test on a rolling road.

If the symptom described by the customer is stiff steering or steering niggles, carry out stiff steering procedure. **See Stiff Steering Checklist**

If not proceed with basic checks and adjustments. **See Visual Check and Basic Adjustments**



## STIFF STEERING CHECKLIST



**NOTE:** Having completed visual checks and steering assessment and confirmed that vehicle steering load is incorrect carry out the following procedure in order shown.

### Steering wheel 'torque to turn' loads

1. Raise vehicle so both front wheels free.
2. With engine off, centralise steering wheel, and remove air bag, if fitted or steering wheel pad. Using torque wrench on column nut, check torque required to turn the steering wheel one turn in each direction.
3. Record readings obtained in each direction. Compare figures obtained with the specified figures:

Without ABS **4.40 Nm.**

With ABS **4.65 Nm.**



**NOTE:** If figures are in excess of those specified carry out steering box tie bar reset below. If figures are as specified. See *Visual Check and Basic Adjustments*

### Steering box tie bar reset

1. Loosen the three tie bar fixings one complete turn.
2. Drive vehicle carefully a short distance (within the dealership) applying full lock in both directions in order to settle steering components. Drive vehicle over speed bumps and include harsh braking if possible.



**WARNING:** Do not drive on public highway.

3. Near end of 2. ensure vehicle is driven in a straight line on level ground and halted.
4. Tighten panhard rod mounting arm nut, **110 Nm.**
5. Tighten the two fixings tie bar to steering box, **81 Nm.**
6. Recheck steering wheel torque to turn. If torque reading is still greater than specified, carry out steering shaft universal joint lubrication.

### Lower steering shaft universal joint lubrication

1. Check lower steering shaft is correctly phased. See *Repair, Lower Steering Shaft and Universal Joints*
2. Lubricate universal joints with an anti-seizure type penetrating spray. Work the joints to ensure full penetration of the spray by driving vehicle and steering from lock to lock.
3. If steering stiffness still persists carry out swivel pin preload setting.

### Swivel pin preload setting

The swivel pin preload setting must be checked and set following the workshop manual procedure.

1. NON ABS vehicles. See *FRONT AXLE AND FINAL DRIVE, Overhaul, Front Stub Axle, Constant Velocity Joint and Swivel Pin Housing Non ABS*  
Note that a pull load of 1.16 - 1.46 kg is required after the axle shaft and swivel housing seal have been removed.
2. ABS vehicles. See *FRONT AXLE AND FINAL DRIVE, Overhaul, Front Stub Axle, Constant Velocity Joint and Swivel Pin Housing ABS*  
Note that a torque to turn of 2.0 - 2.8 Nm is required after the axle shaft and swivel housing seal have been removed.
3. If steering stiffness still persists carry out steering column alignment.

## Steering column alignment

1. Place vehicle on level ground. Measure the angle of lower steering shaft using a Pernumeter placed on the shaft between the universal joints. The angle should measure a minimum of 12°.
2. If necessary, realign the shaft. Release the five fixings securing the steering column. Position column as required. Tighten the fixings evenly, **27 Nm**.
3. Loosen the three screws securing lower steering column shroud to upper shroud ensure lower shroud is clipped to upper shroud. Reposition shroud, tighten screws.
4. Recheck steering column angle.

## Steering box adjustment

1. Check steering box adjustment. **See Adjustment, Power Steering Box**

## Steering damper check

1. Check condition of steering damper **See Steering Damper**

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## VISUAL CHECK AND BASIC ADJUSTMENTS

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**NOTE: It is important that the following instructions are carried out in the sequence shown and the results recorded.**

1. Road springs - check that road springs are correctly seated and are to correct specification for vehicle. For spring specification. **See GENERAL SPECIFICATION DATA, Information, Road Springs Data**
2. Ride height - measure trim height from wheel centre to wheelarch eyebrow. Record results on data sheet.
3. Check/top up power steering fluid **See Repair, Power Steering Fluid Reservoir**
4. Check tension and condition of drive belt. **See ENGINE, Repair, Drive Belt**
5. Track rod/drag link - check condition of track rod, drag link and ball joints. **See Repair, Drag Link and Drag Link Ends**  
If either component is damaged, check operation of steering damper and steering box for smoothness. Replace all damaged or worn components that impair the operation of the steering system.
6. Suspension bushes - examine all steering and suspension bushes for signs of wear and deterioration. Also check all fixings for torque relaxation. Tighten to correct torque value. **See FRONT SUSPENSION, Specifications, torque, Torque Values**
7. Oil leaks - check front and rear axle hubs for leak and repair as necessary.
8. Brake system - check brake system for leaks, pipe condition, pad wear/contamination, disc wear/condition and ABS sensors for correct fitting.
9. Hub end float - check movement in the hubs by rocking the wheels.
10. Check front wheel alignment. Vehicles displaying a tendency to veer more than considered allowable, it is permissible to set the front track to parallel.
11. Having completed all the above checks and adjustments, road test vehicle. **See Road Test Procedure**  
Attempting to reproduce the symptoms established earlier. If symptoms still exist refer to relevant Diagnostic Chart.



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**STEERING LINKAGE INSPECT**

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**NOTE: When inspecting steering linkages and ball joints for wear the following items must be checked.**

**Steering ball joints**

1. Check ball joint rubber boots for security, signs of cracking or deterioration.
2. Check ball joint assemblies for seizure i.e. no movement on ball joint and associated assemblies.
3. Check for excessive wear. This will be evident as extreme movement on track rod and steering linkages. Renew parts as necessary. **See Repair, Track Rod and Linkage See Repair, Drag Link and Drag Link Ends**

**Steering linkages**

4. Check all linkages for wear, deterioration and damage. Renew parts as necessary. **See Repair, Track Rod and Linkage See Repair, Drag Link and Drag Link Ends**




## POWER STEERING BOX

Service repair no - 57.10.13

**WARNING:** Adjustments of steering box should not be required while in warranty period. If box is stiff or tight and within warranty, it must be returned to manufacturer. No attempt must be made to introduce backlash.

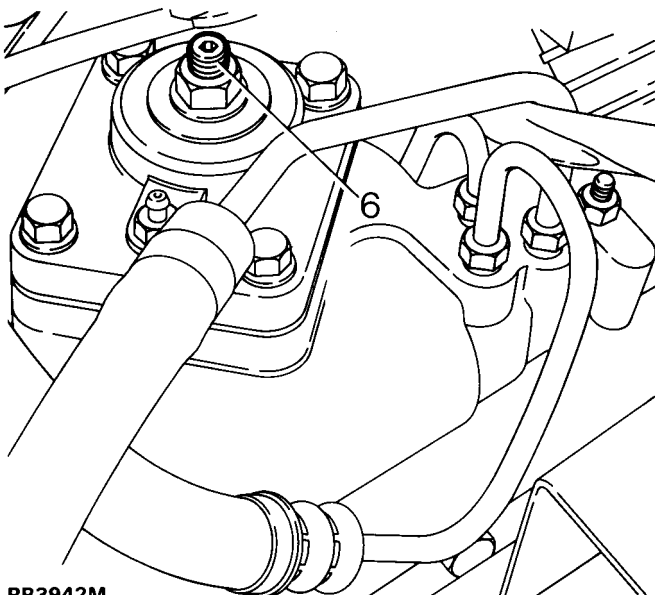
1. Apply park brake, select 'P' in automatic transmission and chock wheels. Support chassis front on axle stands.
2. Remove engine undertray.
3. Disconnect drag link from steering drop arm.
4. Check torque to turn. *See Fault diagnosis, Stiff Steering Checklist*
5. Centralise steering box. *See Centralise Steering Box*

 **NOTE:** Only check for no backlash when steering box is in central position.

 **NOTE:** If steering wheel is not straight, it should be repositioned. *See Repair, Steering Wheel*


The adjustment of the steering box ensures any preload or end float present on centre is removed.

6. The adjustment is obtained by rocking the drop arm about centre whilst an assistant slowly tightens the steering box adjuster screw.



RR3942M

7. Tighten the locknut when all backlash has been removed.
8. Repeat the check for backlash. If backlash exists loosen locknut and repeat adjustment procedure.
9. Turn steering wheel lock to lock and check no tightness exists.
10. Ensure front wheels are aligned and in straight ahead position. *See Front Wheel Alignment*
11. Adjust drag link 924 mm between ball joint centres.
12. Connect drag link. Tighten to **40 Nm**.
13. Lower vehicle to ground level and remove chocks.
14. Road test vehicle. *See Fault diagnosis, Road Test Procedure*

 **NOTE:** If steering wheel is not in straight ahead position when vehicle is travelling in a straight line, drag link length is incorrect and is pushing drop arm away from central position.

### Drag link adjust

15. Right hand drive vehicles - if steering wheel is to right, drag link is too long. If steering wheel is to left drag link is too short.  
Left hand drive vehicles - if steering wheel is to right, drag link is too short. If steering wheel is to left drag link is too long.
16. Adjust drag link until steering wheel points straight ahead when vehicle is travelling in a straight line.

## CENTRALISE STEERING BOX

1. To centralise the box, insert a suitable peg (hole size 8.06 mm) into the rear of the drop arm and into the steering box casing to enable rapid and accurate setting on centre.

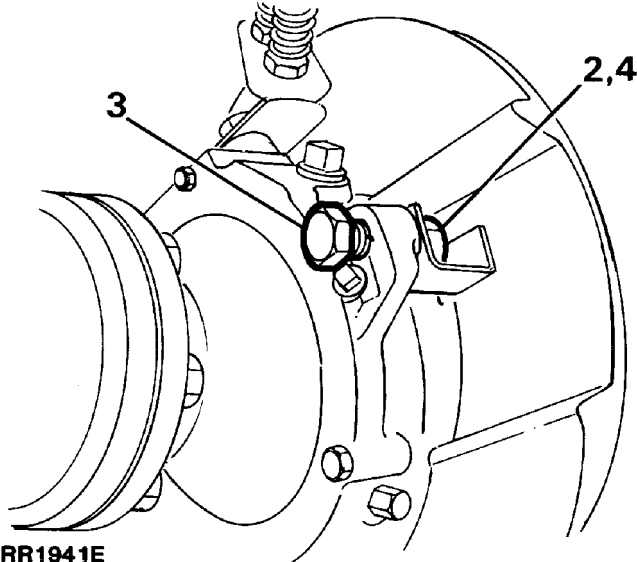


## STEERING LOCK STOPS

Service repair no - 57.65.03

### Check

1. Measure clearance between tyre wall and radius arm at full lock. This must be 20 mm.



### Adjust

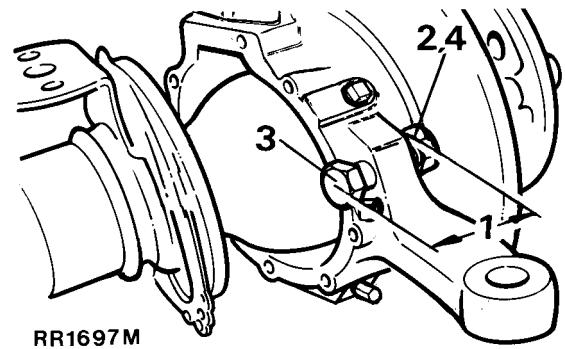
2. Loosen stop bolt locknut.
3. Turn stop bolt as required.
4. Tighten locknut.
5. Check clearance between tyre wall and radius arm on each lock.



**NOTE:** Alternatively lock stop adjustment may be carried out using following procedure.

### Check

1. Measure stop bolt protrusion as shown in RR1697M. This must be 40.5 mm.



### Adjust

2. Loosen stop bolt locknut.
3. Turn stop bolt as required.
4. Tighten locknut.
5. Check wheel position at full lock.



**FRONT WHEEL ALIGNMENT**

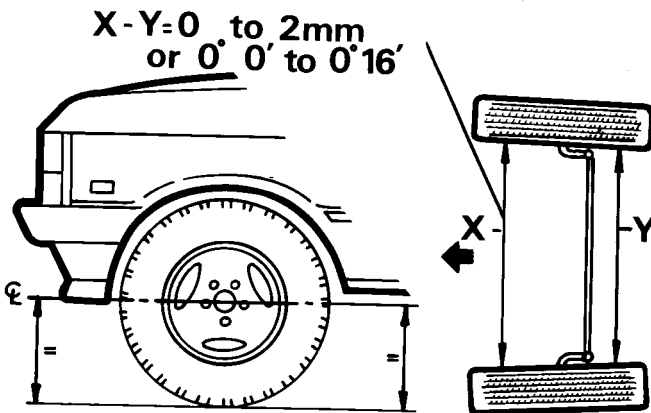
Service repair no - 57.65.01

**Checking Toe-out dimensions**

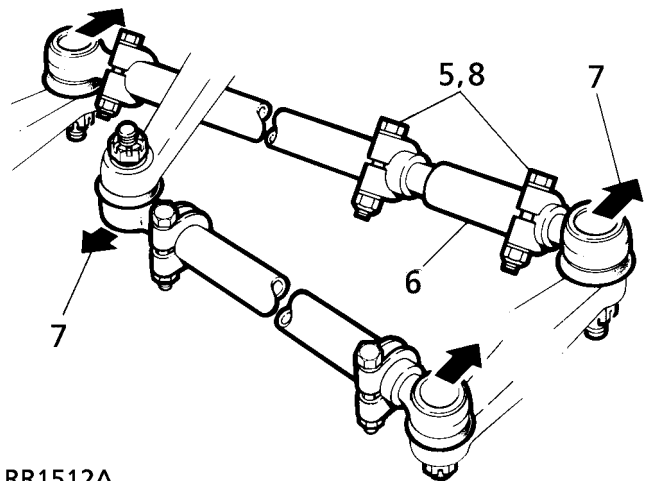


**NOTE: No Adjustment is provided for castor, camber or swivel pin inclinations.**

1. Set vehicle on level ground with road wheels positioned straight ahead.
2. Push vehicle back and forwards to settle linkage.
3. Measure toe-out at horizontal centre-line of wheels.
4. Check tightness of clamp bolt fixings. Tighten to **14 Nm**.



RR2172E



RR1512A

**Adjust**

5. Loosen adjuster sleeve clamp.
6. Rotate adjuster to lengthen or shorten track rod.
7. Check toe-out setting as instructions 1 to 4. When toe-out is correct, tap steering linkage ball joint, in directions of arrows shown, to maximum of their travel. This ensures full unrestricted working travel.
8. Tighten clamp bolts to **14 Nm**.

**POWER STEERING PUMP DRIVE BELT**

Service repair no - 57.20.01

**Adjust**



**NOTE: For details of drive belt adjust procedure See ENGINE, Repair, Drive Belt**



**POWER STEERING FLUID PIPES**

Service repair no - 57.15.21

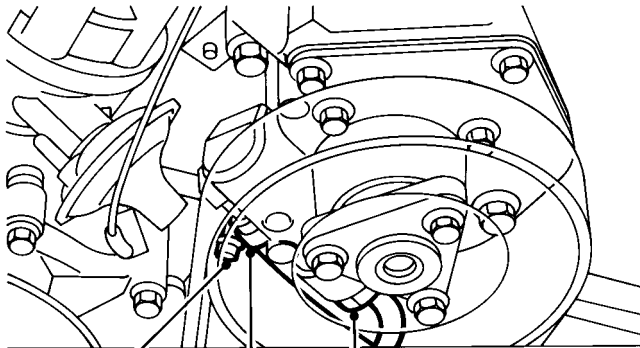


**CAUTION:** If any joints are disconnected, it is essential that open pipe and ports are plugged to prevent ingress of dirt.

The following procedures must be followed when refitting fluid pipes:

**Power steering pump**

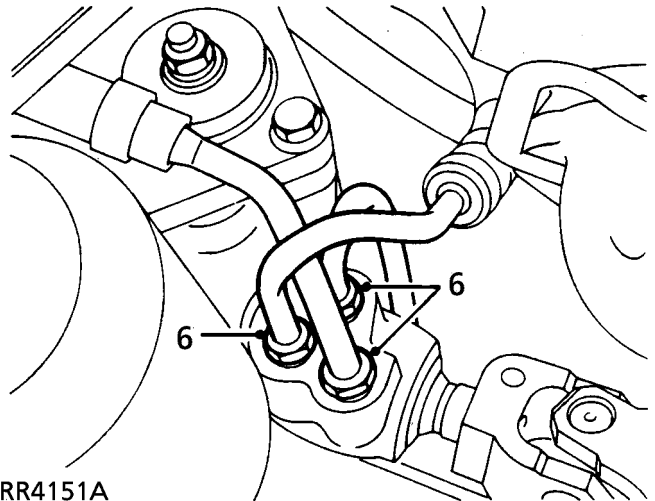
1. Remove plugs, place clamp on feed hose.



RR4150

**V8i Steering pump illustrated**

2. Push hose onto pump.
3. Hold clamp in position, Tighten to **3 Nm**.
4. Fit high pressure union into pump.
5. Hold pipe in correct position. Tighten to **20 Nm**.

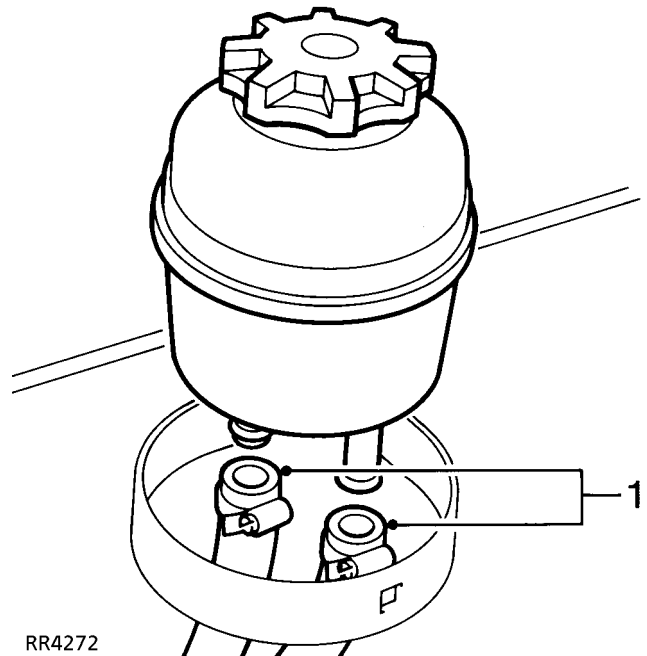


RR4151A

6. Remove plugs and refit pipes to steering box, leave fingertight.
7. Tighten to torque: 16mm thread **20 Nm**.  
14mm thread **15 Nm**.

**Power steering reservoir**

1. Remove plugs and refit pipes and clamps.



RR4272

2. Tighten clamps to **3 Nm**.

## POWER STEERING BOX

Service repair no - 57.10.01

### General precautions

1. Whenever any part of system, is removed or disconnected, utmost cleanliness must be observed.
2. Disconnected ports and hoses must be plugged to prevent ingress of dirt. If metal sediment is found in system, establish cause rectify and flush system.
3. Do not start engine until reservoir is full as pump will be damaged.
4. Metric pipe fittings are used with 'O' ring pipe ends on fittings to steering box.
5. Follow normal 'O' ring replacement procedure whenever pipes are disconnected.
6. Ensure compatible metric components when fitting replacement pipes.



**CAUTION:** Before removing any parts of steering linkage, it is imperative that road wheels are positioned straight ahead.

Then steering wheel removed to prevent rotary coupler being wound up or damaged.



**CAUTION:** After refitting steering linkage parts follow correct procedure to ensure that road wheels, steering box and steering wheel are correctly positioned relative to each other when in straight ahead condition. If steering wheel requires repositioning, ensure that drive pegs on rotary coupler are correctly positioned before steering wheel is replaced.

This ensures drive pegs locate in their holes in rear of steering wheel.

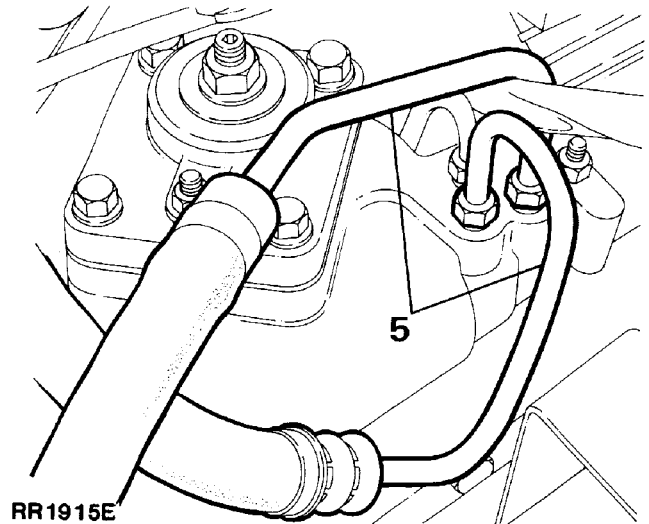
After final alignment connect rotary coupler multiplug, tighten steering wheel securing nut and fit air bag - if fitted or steering wheel trim pad.



**NOTE:** When drag link is disconnected from steering box, travel available at steering wheel to each full lock is not equal.

### Remove

1. Site vehicle on level surface.
2. Open bonnet[hood].
3. Remove filler cap from power steering fluid reservoir.
4. Clean steering box.
5. Disconnect feed and return pipes from steering box.



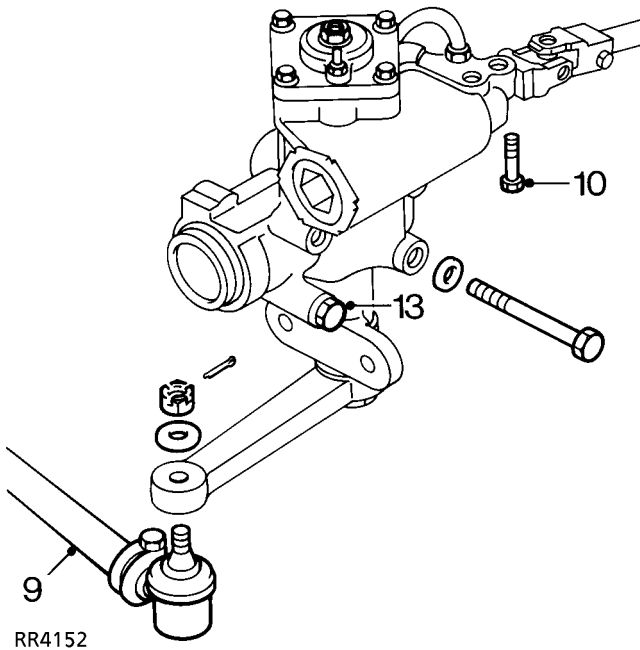
6. Plug open pipes and steering box ports to prevent ingress of dirt.
7. Support chassis front on axle stands. Or raise vehicle on a hoist.



**WARNING:** Ensure wheels are chocked, parking brake is applied, and low range selected.

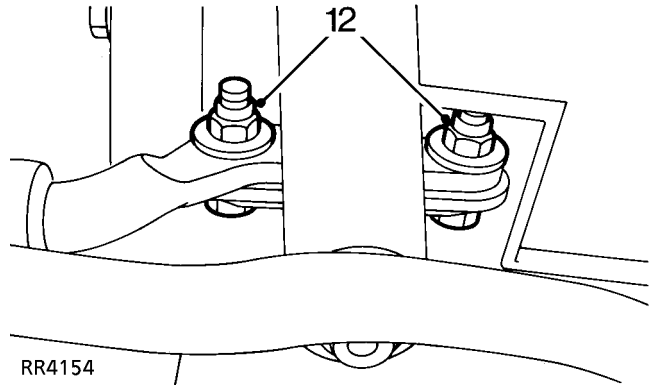


8. Remove undertray



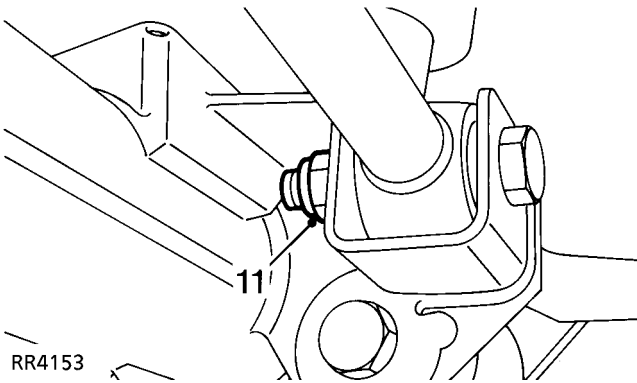
RR4152

- 9. Disconnect drag link from drop arm using a suitable extractor.
- 10. Remove pinch bolt securing lower shaft universal joint to power steering box.



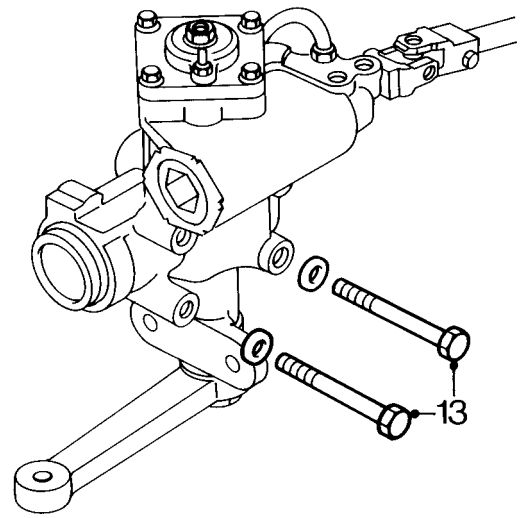
RR4154

- 12. Remove bolts securing tie bar, move tie bar aside.



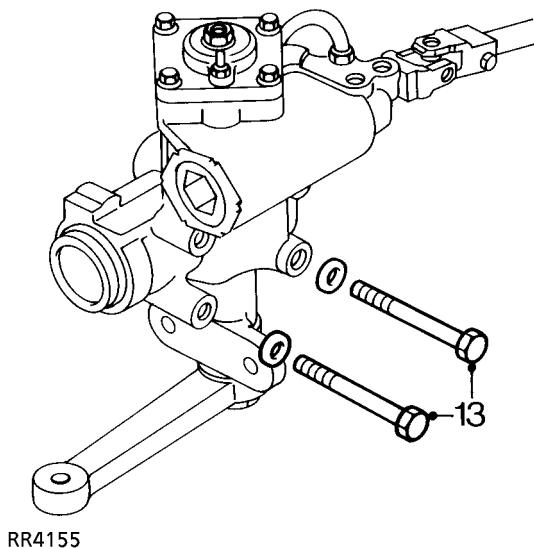
RR4153

- 11. Loosen but do not remove nut securing tie bar to mounting.



RR4155

- 13. Remove bolts securing power steering box to chassis side member.
- 14. Withdraw power steering box.



RR4155



**CAUTION:** Do not maintain this pressure for more than 30 seconds in any one minute, to avoid oil overheating and possible seal damage.

26. Test drive vehicle: using both full lock directions, to settle steering components. If possible, drive vehicle over speed bumps and include harsh braking.



**WARNING:** Do not test drive vehicle on public highway.

27. Drive vehicle in a straight line on level ground and stop.
28. Tighten tie bar to mounting nut to **110 Nm**.
29. Tighten bolts securing tie bar to **81 Nm**.
30. Ensure steering wheel is correctly aligned when wheels are positioned straight ahead.
31. If necessary reposition steering wheel. **See Steering Wheel**
32. Road test vehicle.

## Refit


15. Position steering box to chassis side member, ensuring locating peg is engaged. Tighten bolts to **81 Nm**.
16. Fit pinch bolt and nut securing universal joint to power steering box. Tighten to **25 Nm**.
17. Position tie bar, tighten bolts and nut to **81 Nm, starting with tie bar to mounting nut, then loosen nut and bolts by one complete turn.**
18. Check steering box, adjust if necessary. **See Adjustment, Power Steering Box**
19. Refit drag link to drop arm tighten nut to **40 Nm**.
20. Fit undertray.
21. Lower vehicle to ground.
22. Remove plugs and refit pipes to steering box. Tighten 16mm thread to **20 Nm**.  
14mm thread to **15 Nm**.
23. Remove filler cap. Fill reservoir to oil level mark on dipstick. Use recommended fluid. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids** and bleed power steering system. **See Power Steering System - Bleed**
24. Recheck fluid level and replace cap.
25. With engine running, test steering system for leaks by holding steering in both full lock directions.



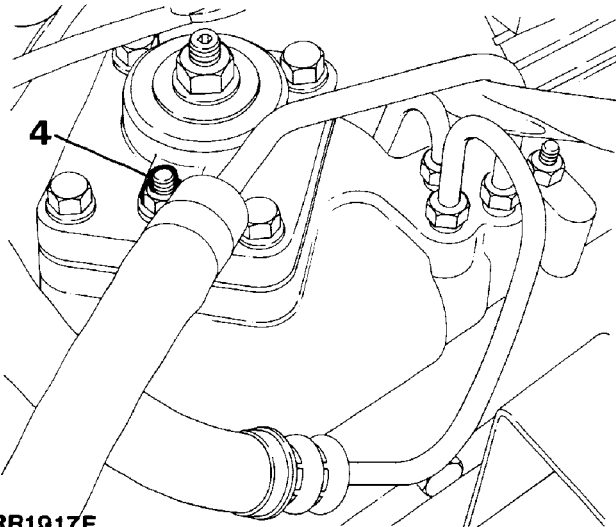
## POWER STEERING SYSTEM - BLEED

Service repair no - 57.15.02

1. Ensure fluid in reservoir reaches dipstick maximum.
2. Run engine to normal operating temperature.
3. Recheck and correct reservoir fluid level.


 **NOTE: During instructions 4 to 6, maintain maximum fluid level in reservoir. Do not increase engine speed or move steering wheel.**

4. With engine at idle speed, loosen bleed screw. When fluid seeps past bleed screw retighten screw.



RR1917E

5. Check fluid level.
6. Clean away fluid around bleed screw.
7. Check hose connections, pump and steering box for fluid leaks by holding steering on full lock in both directions.

 **CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute to avoid overheating fluid and possibly damaging seals.**

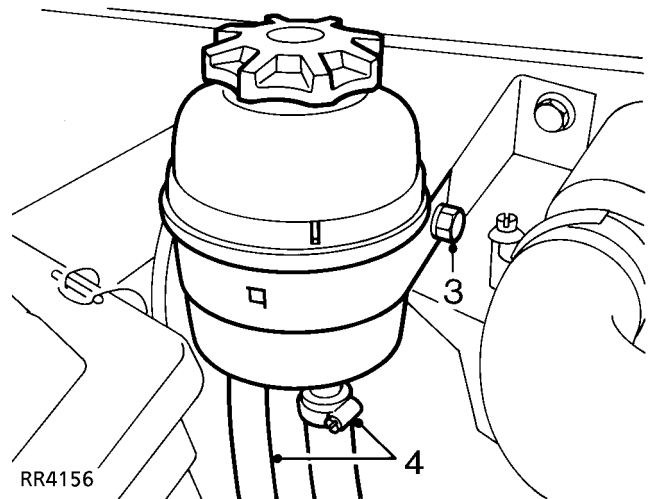
8. Carry out road test.

## POWER STEERING FLUID RESERVOIR

Service repair no - 57.15.08

### Remove


1. Remove undertray.
2. Position drain tin beneath reservoir.



3. Loosen mounting bracket clamp bolt, raise reservoir to gain access to pipe clamps.
4. Loosen clamps, disconnect feed and return hoses from reservoir, allow fluid to drain.

 **CAUTION: Plug the connections.**

5. Remove reservoir.

 **CAUTION: Discard fluid drained from system. Do not allow fluid to contact paintwork, if spilled, remove fluid and clean area with warm water.**

## Refit

6. Position reservoir, connect feed and return hoses and tighten clamps to **3 Nm**.
7. Fit reservoir in clamp, tighten clamp bolt.
8. Fill reservoir to 'MAX' mark on dipstick with power steering fluid. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**
9. Fit undertray.
10. Bleed power steering system. **See Power Steering System - Bleed**

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## POWER STEERING PUMP DRIVE BELT

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Service repair no - 57.20.02



**NOTE:** For details of drive belt remove and refit. **See ENGINE, Repair, Drive Belt**

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## POWER STEERING PUMP - V8i

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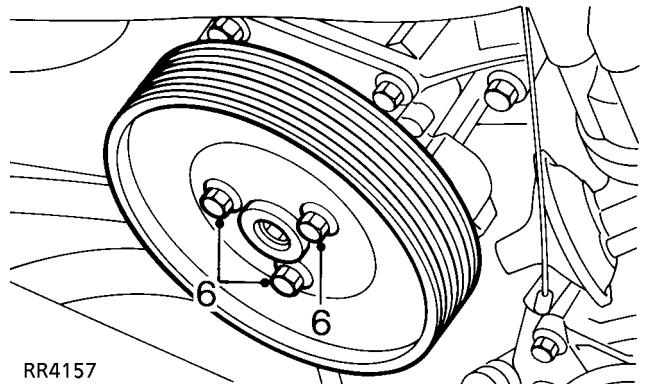
Service repair no - 57.20.14



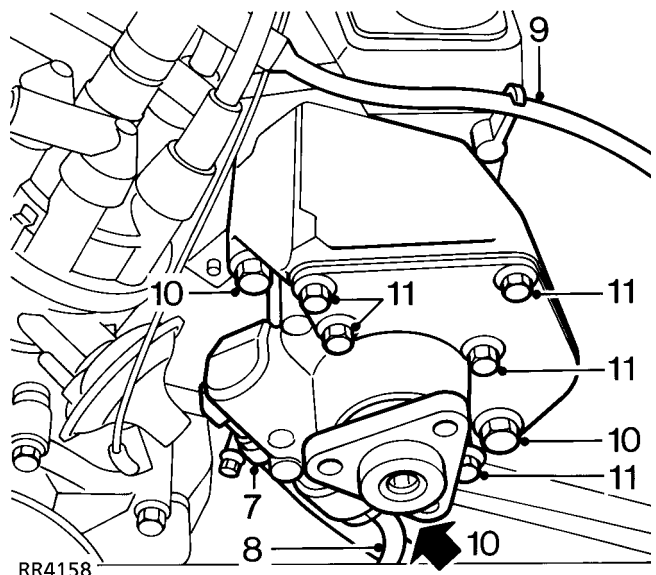
**NOTE:** The power steering pump is not serviceable. Fit new pump if worn or damaged.

## Remove

1. Disconnect battery negative lead.
2. Remove drive belt from steering pump. **See ENGINE, Repair, Drive Belt**
3. Remove undertray.
4. Remove fan blades and viscous coupling. **See COOLING SYSTEM, Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl**
5. Position drain tin beneath steering pump.



6. Using a 9 mm Allen key to restrain steering pump pulley, remove 3 bolts securing pulley to pump; remove pulley.







7. Loosen clamp securing reservoir hose to steering pump; disconnect hose.
8. Disconnect high pressure pipe from steering pump.



**CAUTION: Plug the connections.**

9. Release ht lead from clip
10. Remove 3 bolts securing steering pump. Remove pump and recover engine lifting bracket.



**NOTE: Do not carry out further dismantling if component is removed for access only.**

11. Remove 5 bolts securing front mounting plate.
12. Fit front mounting plate to replacement steering pump. Tighten bolts to **9 Nm**.

#### Refit

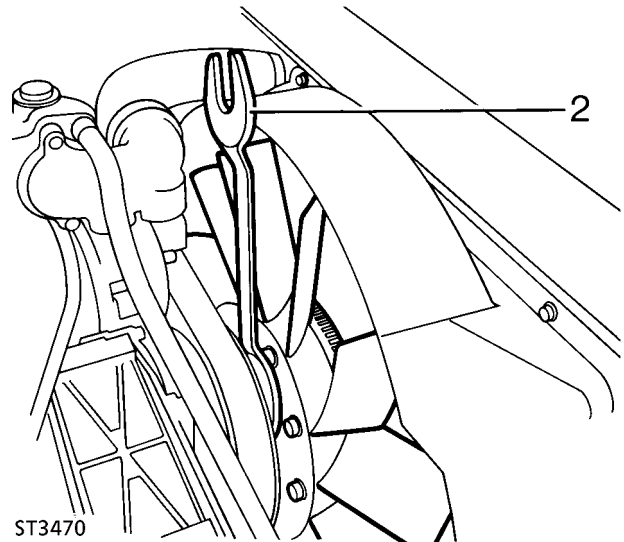
13. Position steering pump and engine lifting plate, fit bolts. Tighten to **35 Nm**. Secure ht lead in clip.
14. Connect high pressure pipe to steering pump, tighten union to **20 Nm**.
15. Connect reservoir hose to steering pump. Tighten clamp to **3 Nm**.
16. Position pulley to pump, coat threads of bolts with Loctite 242.
17. Restrain pulley using a 9 mm Allen key, fit bolts. Tighten to **10 Nm**.
18. Fit drive belt. **See ENGINE, Repair, Drive Belt**
19. Fit fan blades and viscous coupling. **See COOLING SYSTEM, Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl**
20. Fit undertray.
21. Reconnect battery negative lead.
22. Bleed power steering system. **See Power Steering System - Bleed**

#### POWER STEERING PUMP - Tdi

Service repair no - 57.20.14

#### Remove

1. Remove fan blades and viscous coupling. **See COOLING SYSTEM, Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl**



2. Restrain steering pump pulley, loosen but do not remove 3 bolts securing pulley.
3. Remove drive belt. **See ENGINE, Repair, Drive Belt**
4. Remove 3 bolts securing steering pump pulley, remove pulley.
5. Remove undertray.
6. Position drain tin beneath steering pump.

7. Loosen clamp securing reservoir hose to steering pump, disconnect hose.
8. Disconnect high pressure pipe from steering pump.

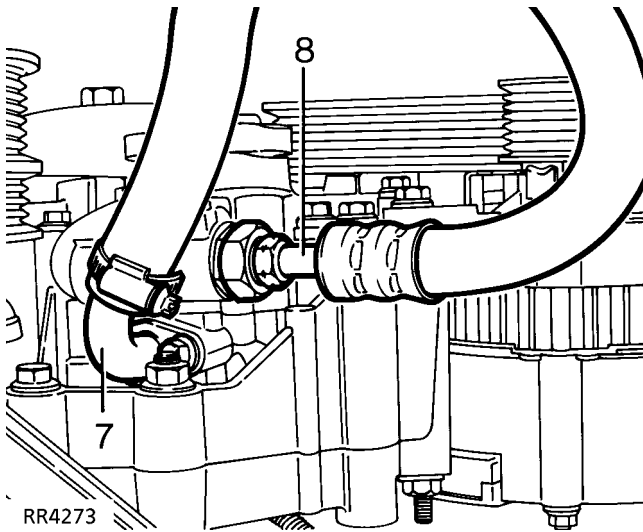


**CAUTION: Plug the connections.**

9. Remove 4 bolts securing steering pump to mounting bracket, remove pump.



**NOTE: Do not carry out further dismantling if component is removed for access only.**



RR4273

10. Remove 3 bolts securing mounting plate to pump, remove plate.
11. Fit mounting plate to replacement steering pump. Tighten bolts to **9 Nm**.

## Refit

12. Position steering pump, fit 3 bolts. Tighten to **35 Nm**.
13. Connect high pressure pipe to steering pump. Tighten to **20 Nm**.
14. Connect reservoir hose to steering pump. Tighten clamp to **3 Nm**.
15. Position pulley to steering pump, coat threads of bolts with Loctite 242; fit but do not fully tighten 3 bolts.
16. Fit drive belt. *See ENGINE, Repair, Drive Belt*
17. Restrain steering pump pulley, tighten bolts to **10 Nm**.
18. Fit fan blades and viscous coupling. *See COOLING SYSTEM, Repair, Viscous Coupling, Fan Blades, Pulley and Fan Cowl*
19. Fit undertray.
20. Bleed power steering system. *See Power Steering System - Bleed*



**LOWER STEERING SHAFT AND UNIVERSAL JOINTS**

Service repair no - 57.40.25



**CAUTION:** Before removing any parts of steering linkage, it is imperative that road wheels are positioned straight ahead.

Then steering wheel removed to prevent rotary coupler being wound up or damaged.



**CAUTION:** After refitting steering linkage parts follow correct procedure to ensure that road wheels, steering box and steering wheel are correctly positioned relative to each other when in straight ahead condition. If steering wheel requires repositioning, ensure that drive pegs on rotary coupler are correctly positioned before steering wheel is replaced.

This ensures drive pegs locate in their holes in rear of steering wheel.

After final alignment connect rotary coupler, tighten steering wheel securing nut and fit air bag module - if fitted or steering wheel trim pad.

**Remove**

1. Ensure road wheels are straight ahead.
2. Remove pinch bolt securing top universal joint to steering column.
3. Remove 2 pinch bolts securing lower universal joint.
4. Move lower shaft up to release lower universal joint from steering box splines. Remove lower shaft.
5. Remove universal joint from lower shaft.



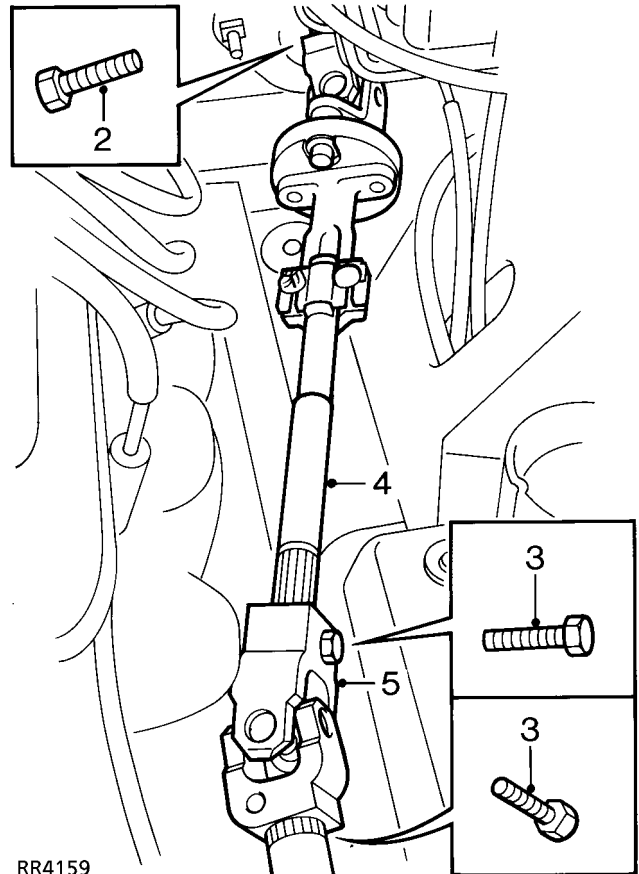
**NOTE:** Do not dismantle upper coupling joint. Steering shaft, rubber coupling and top universal joint is only available as an assembly.

6. Inspect lower universal joint for wear and excessive play, renew if necessary.
7. Inspect top universal joint and rubber coupling, renew lower shaft as an assembly if necessary.
8. Inspect universal joints for stiffness, lubricate if necessary.



**NOTE:** Prior to fitting a replacement steering shaft check the following:

9. Release stud fasteners securing heat shield (if fitted).



10. Check that indicator clip coloured red is fully inserted under head of compression joint bolt.



**WARNING:** If clip is displaced, no attempt must be made to drive clip into engagement, a new shaft assembly must be fitted.

11. Secure heat shield stud fasteners (if fitted).

**Refit**



**NOTE:** Fit universal joints so pinch bolt holes line up with flat on shaft.

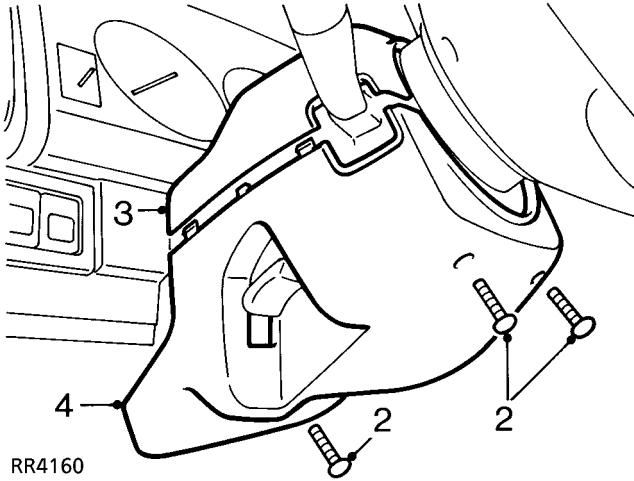
12. Position lower universal joint on shaft.
13. Position shaft assembly onto steering column. Move assembly up spline to enable lower universal joint to fit onto steering box splines.
14. Align bolt holes with grooves in splines. Fit pinch bolts. Tighten to **25 Nm**.

## STEERING COLUMN SHROUD

Service repair no - 57.40.29

### Remove

1. Disconnect battery negative lead.



2. Remove 3 screws securing shroud.
3. Carefully release upper shroud from lower.
4. Manoeuvre lower shroud clear of steering column.

### Refit

5. Position upper and lower shrouds to steering column ensuring plastic tags on lower shroud are correctly located. Clip both halves of shroud together.
6. Fit and tighten 3 screws.

## STEERING WHEEL

Service repair no - 57.60.01



**CAUTION:** Prior to commencing work on vehicles fitted with an air bag, See **SUPPLEMENTARY RESTRAINT SYSTEM, Description and operation,**



**CAUTION:** Before removing any parts of steering linkage, it is imperative that road wheels are positioned straight ahead. Then remove steering wheel to prevent rotary coupler being wound up or damaged.



**CAUTION:** After refitting steering linkage parts follow correct procedure to ensure that road wheels, steering box and steering wheel are correctly positioned relative to each other when in straight ahead condition. If steering wheel requires repositioning, ensure that drive pegs on rotary coupler are correctly positioned before steering wheel is replaced.

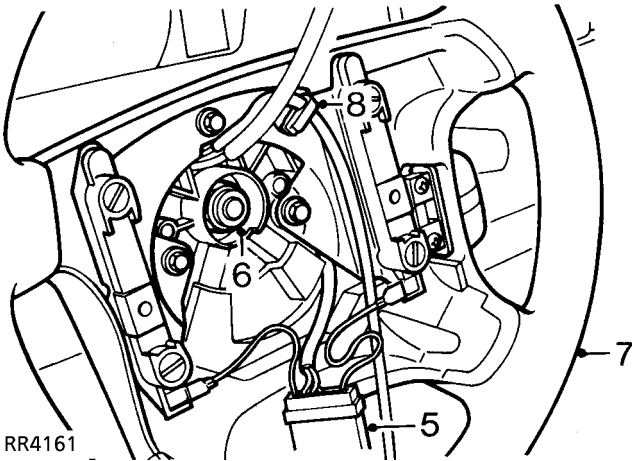
This ensures drive pegs locate in their holes in rear of steering wheel.

After final alignment connect rotary coupler multiplug, tighten steering wheel securing nut and fit air bag - if fitted or steering wheel trim pad.



## Remove

1. Disconnect battery negative lead.
2. Position road wheels straight ahead so steering wheel can be correctly re-assembled.
3. **Airbag fitted:** Remove air bag. **See SUPPLEMENTARY RESTRAINT SYSTEM, Repair, Driver's Airbag Module**
4. Remove trim pad from steering wheel, disconnect Lucars from horn button.



5. Disconnect rotary coupler multiplug.
6. Loosen but do not remove retaining nut.
7. Release steering wheel from taper, remove retaining nut and washer.
8. Release harness from retaining clip.
9. Withdraw steering wheel whilst at the same time feeding harness through wheel hub.



**CAUTION:** Prevent rotation of rotary coupler once steering wheel is removed. Secure in position with adhesive tape.



**NOTE:** Do not carry out further dismantling if component is removed for access only.

## Refit

10. Recheck road wheels are positioned straight ahead.
11. Position steering wheel to column, feed harness through wheel hub.
12. Remove adhesive tape securing rotary coupler.
13. Locate rotary coupler drive pegs and indicator switch self-cancel pegs in steering wheel hub, push wheel fully onto taper.
14. Fit steering wheel nut. Tighten to **50 Nm**.
15. Connect rotary coupler multiplug.
16. Non airbag module: Fit horn push assembly, connect Lucars to horn button, secure harness in clip.
17. Fit airbag module - if fitted. **See SUPPLEMENTARY RESTRAINT SYSTEM, Repair, Driver's Airbag Module**
18. Reconnect battery negative lead.

## UPPER STEERING COLUMN

Service repair no - 57.40.01



**NOTE:** Steering column assembly is not a serviceable component.



**CAUTION:** Before removing any parts of steering linkage, it is imperative that road wheels are positioned straight ahead. then steering wheel removed to prevent rotary coupler being wound up or damaged.



**CAUTION:** After refitting steering linkage parts follow correct procedure to ensure that road wheels, steering box and steering wheel are correctly positioned relative to each other when in straight ahead condition. if steering wheel requires repositioning, ensure that drive pegs on rotary coupler are correctly positioned before steering wheel is replaced.

This ensures drive pegs locate in their holes in rear of steering wheel.

After final alignment, connect rotary coupler multiplug, tighten steering wheel securing nut and fit airbag - if fitted or steering wheel trim pad and horn push assembly.

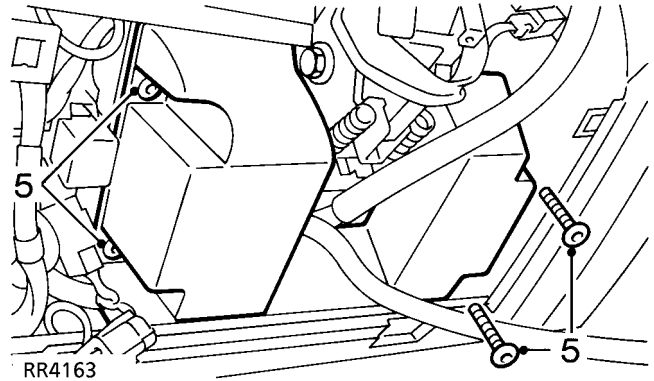
### Remove

1. Remove steering wheel. *See Steering Wheel*

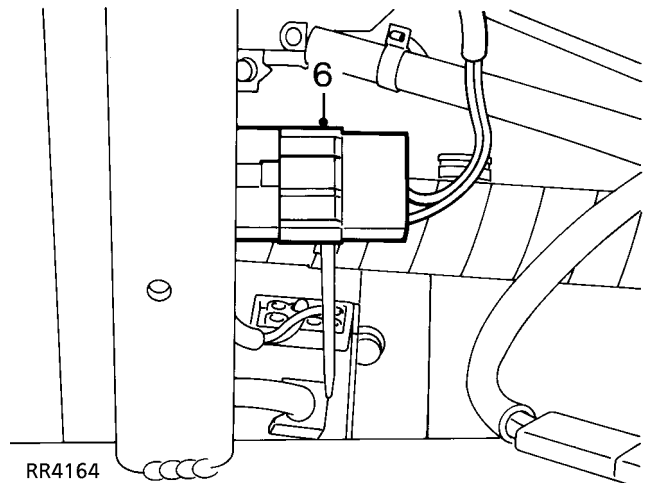


**CAUTION:** Prevent rotation of rotary coupler once steering wheel is removed. Secure in position with adhesive tape.

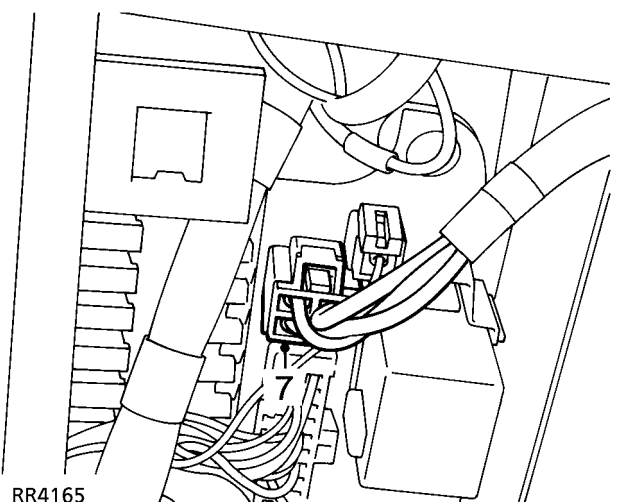
2. Remove driver's access panel.
3. Remove steering column shroud. *See Steering Column Shroud*
4. Remove rotary coupler. *See SUPPLEMENTARY RESTRAINT SYSTEM, Repair, Rotary Coupler*



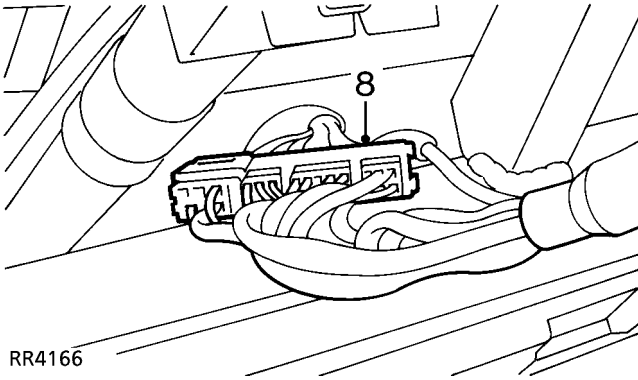
5. If fitted - remove 4 screws securing knee bolster, remove knee bolster.



6. Disconnect column switch multiplug.

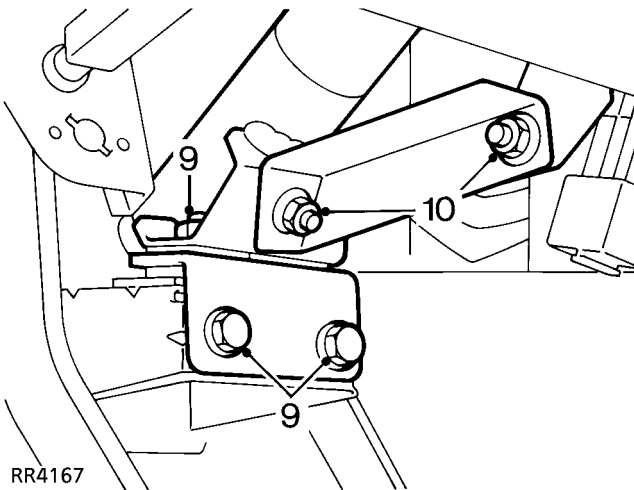


7. Disconnect ignition switch multiplug from fuse box.



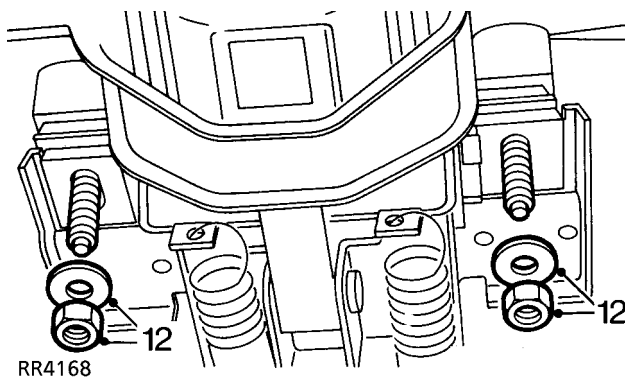
RR4166

8. Disconnect ignition switch main feed multiplug.



RR4167

- 9. Remove 4 nuts securing upper column to lower mounting.
- 10. Remove 2 nuts securing lower mounting steady bracket, remove bracket.
- 11. Remove pinch bolt securing upper column to universal joint.



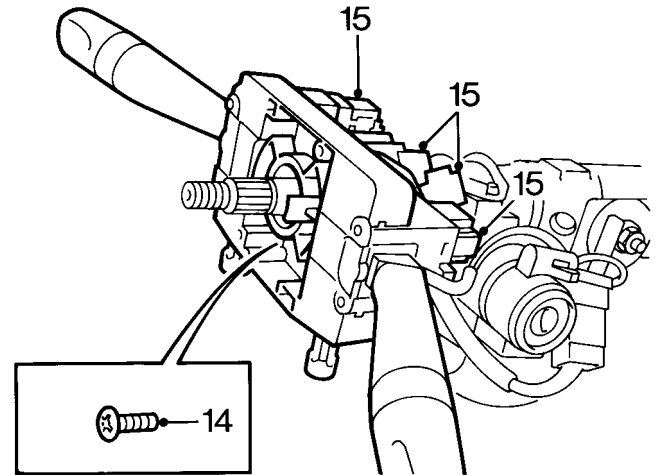
RR4168

12. Remove 2 nuts and washes securing upper column to upper mounting bracket.

13. Carefully manoeuvre upper column out of footwell, recover rubber boot.

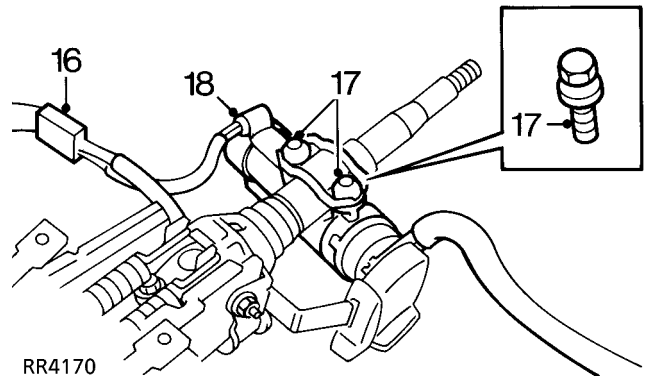


**NOTE: Do not carry out further dismantling if upper column is removed for access only.**



RR4169

- 14. Loosen but, do not remove screw securing column switch assembly, withdraw assembly to gain access to multiplugs.
- 15. Disconnect column switch multiplugs, remove column switch assembly.



RR4170

- 16. Disconnect ignition switch multiplug.
- 17. Remove shear bolts securing steering column lock, remove lock and saddle; discard shear bolts.
- 18. Withdraw bulb holder from column lock shroud.
- 19. Transfer components to new upper column, connect multiplug.



**NOTE: Do not shear column lock bolts at this stage.**

**Refit**

20. Manoeuvre upper column to position in footwell, ensure splines in column and universal joint are correctly engaged and rubber boot is fitted.
21. Fit but do not tighten universal joint pinch bolt.
22. Position upper column to upper mounting, fit washers and nuts, do not tighten nuts.
23. Fit but do not tighten nuts and bolts securing upper column to lower mounting.
24. Fit lower mounting steady bracket, fit but do not tighten nuts and bolts.
25. Ensure upper column is aligned to mountings.
26. Tighten all nuts and bolts to **22 Nm**.
27. Tighten universal joint pinch bolt to **25 Nm**.
28. Connect column switch multiplug.
29. Connect ignition switch multiplugs.
30. Fit rotary coupler. **See SUPPLEMENTARY RESTRAINT SYSTEM, Repair, Rotary Coupler**
31. Fit steering wheel. **See Steering Wheel**
32. Reconnect battery negative lead.
33. Check steering column lock for correct operation, tighten shear bolts until heads shear off.
34. If fitted - position knee bolster, fit and tighten screws.
35. Fit steering column shroud. **See Steering Column Shroud**
36. Fit driver's access panel.





## STEERING COLUMN LOCK ASSEMBLY

Service repair no - 57.40.31

Remove



**CAUTION:** Before removing any parts of steering linkage, it is imperative that road wheels are positioned straight ahead.

Then steering wheel removed to prevent rotary coupler being wound up or damaged.

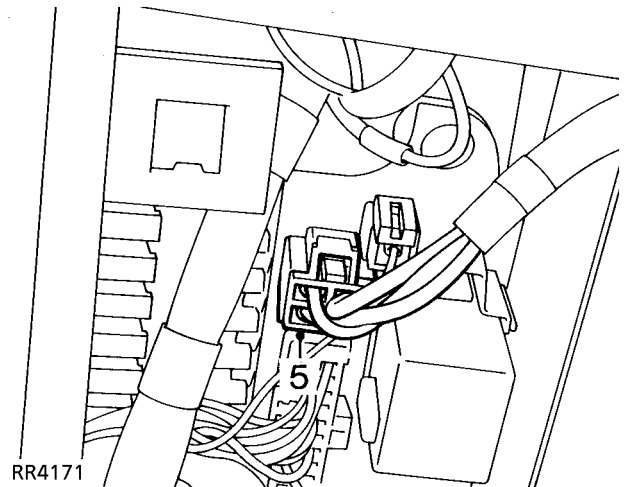


**CAUTION:** After refitting steering linkage parts follow correct procedure to ensure that road wheels, steering box and steering wheel are correctly positioned relative to each other when in straight ahead condition. If steering wheel requires repositioning, ensure that drive pegs on rotary coupler are correctly positioned before steering wheel is replaced.

This ensures drive pegs locate in their holes in rear of steering wheel.

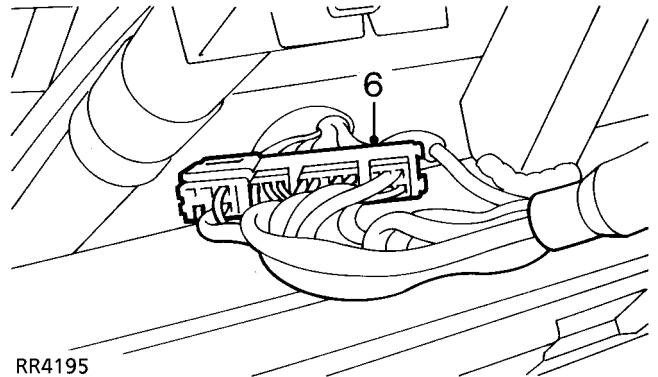
After final alignment connect rotary coupler multiplug, tighten steering wheel securing nut and fit airbag module - if fitted.

1. Disconnect battery negative lead.
2. Remove steering column shroud. *See Steering Column Shroud*
3. Release turnbuckles, lower driver's access panel.
4. If fitted, remove 4 screws securing knee pad, remove bolster.



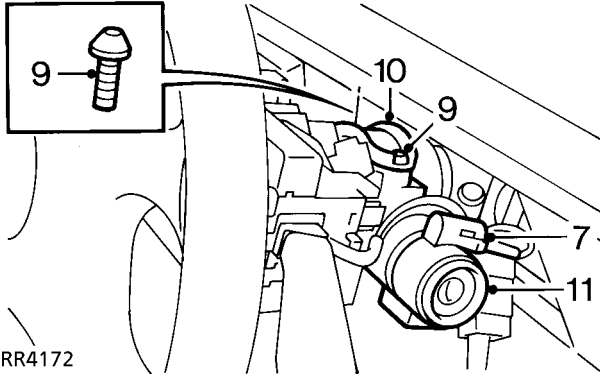
RR4171

5. Disconnect ignition switch multiplug from fuse box.



RR4195

6. Disconnect ignition switch main feed multiplug.



RR4172

7. Remove bulb holder from steering column lock shroud.
8. Tap head of shear bolts anti-clockwise to release them.
9. Remove and discard shear bolts.
10. Detach saddle.
11. Remove steering column lock assembly.

## Refit

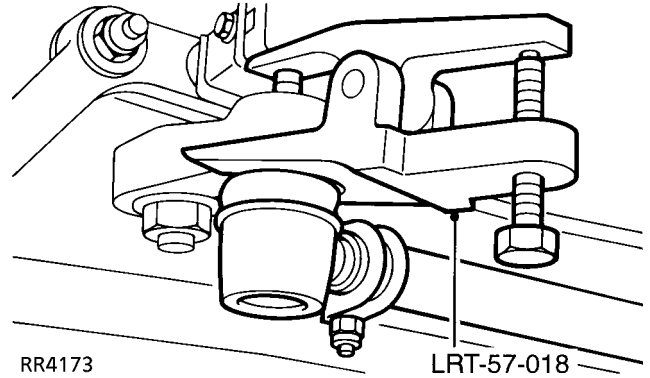
12. Position steering lock saddle on column, locating spigot in hole provided.
13. Place lower lock assembly into column.
14. Fit but do not fully tighten new shear bolts.
15. Connect multiplugs.
16. Insert bulb holder into steering column lock shroud.
17. Reconnect battery negative lead.
18. Check steering column lock for correct operation, tighten shear bolts until heads shear off.
19. Fit steering column shroud. **See Steering Column Shroud**
20. If fitted - fit knee bolster, fit and tighten screws.
21. Raise driver's access panel, secure turnbuckles.

## DROP ARM

Service repair no - 57.50.14

### Remove

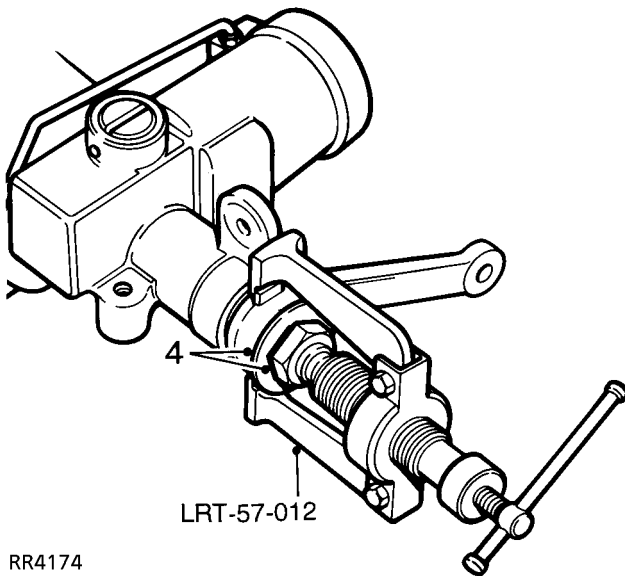
1. Place vehicle on a hoist, or support front axle on axle stands.



2. Disconnect drag link ball joint from drop arm, using extractor LRT-57-018.



3. Bend back tabs on locking washer and remove drop arm using extractor LRT-57-012. Loosen drop arm securing nut, but do not remove before using extractor.
4. Remove nut, discard locking washer.



#### Refit

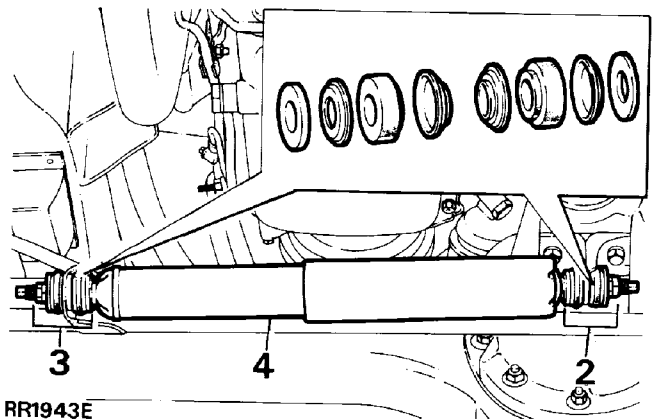
5. Centralise steering box. *See Adjustment, Centralise Steering Box*
6. Fit drop arm, align master splines.
7. Fit a new tab washer and drop arm fixing nut. Tighten to **176 Nm**, bend over tab.
8. Fit drag link. Tighten ball joint nut **40 Nm**.

#### STEERING DAMPER

Service repair no - 57.55.21

#### Remove

1. Site vehicle on a ramp [hoist].
2. Remove fixings at differential case bracket.
3. Remove fixings at track rod bracket.
4. Remove steering damper.



#### Refit

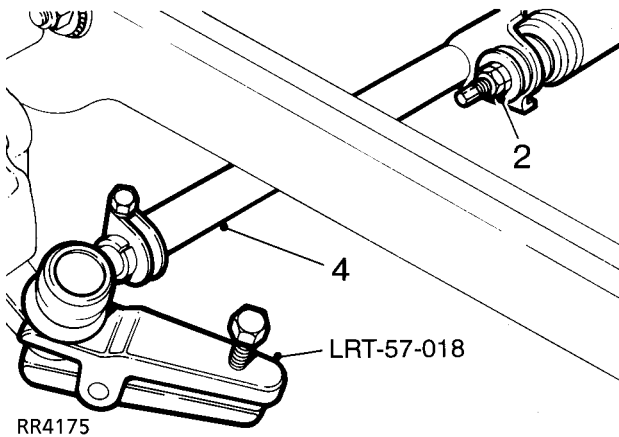
5. Reverse removal procedure. 1 to 4.

## TRACK ROD AND LINKAGE

Service repair no - 57.55.09

### Remove track rod

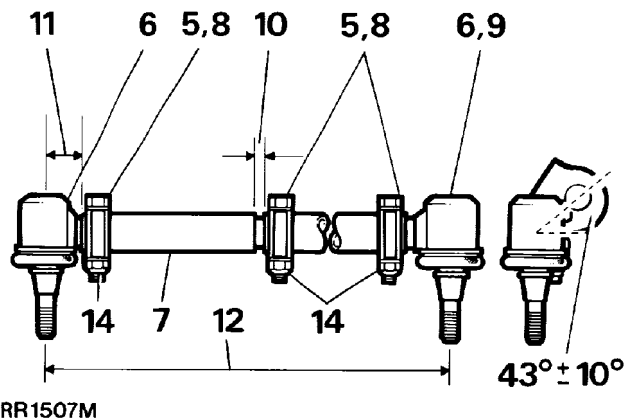
1. Site vehicle on a ramp [hoist].



2. Disconnect steering damper at track rod.
3. Disconnect track rod at ball joints, using extractor LRT-57-018.
4. Remove track rod.

### Remove linkage

5. Loosen clamp bolts.
6. Unscrew ball joints.
7. Unscrew track rod adjuster. (left hand thread).



### Refit linkage

8. Fit replacement parts. Loosely fit clamp pinch bolts.
9. Screw in ball joint to full extent of threads.
10. Set adjuster to track rod distance to 9mm as shown.
11. Set adjuster end ball joint distance to 28.5mm as shown.
12. Track rod effective length of 1230.0mm is subject to adjustment during wheel alignment check.

### Refit track rod



**CAUTION: Fit a new track rod if existing is damaged or bent. No attempt should be made to repair it.**

13. Fit track rod and tighten ball joint nuts to **40 Nm**.
14. Check front wheel alignment. **See Adjustment, Front Wheel Alignment**
15. Connect steering damper to track rod.
16. Remove vehicle from hoist, or axle stands.

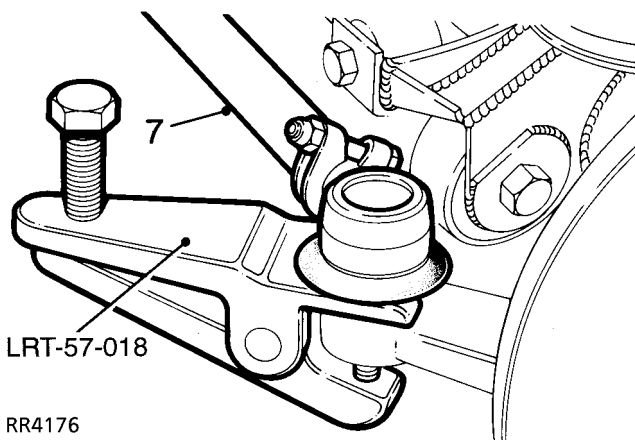


**DRAG LINK AND DRAG LINK ENDS**

Service repair no - 57.55.17

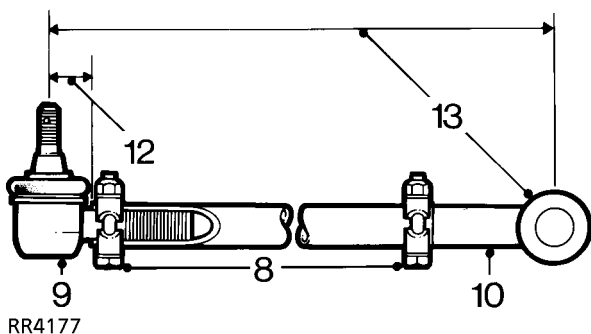
**Remove drag link**

1. Check front wheel alignment. **See Adjustment, Front Wheel Alignment**
2. Ensure wheels are positioned straight ahead during following procedure.
3. Place vehicle on a hoist, or support front axle on axle stands.
4. Remove right front road wheel.



5. Disconnect drag link ball joint at swivel housing arm, using extractor LRT-57-018.
6. Disconnect drag link ball joint at drop arm using LRT-57-018.
7. Remove drag link.

**Remove drag link ends**



8. Loosen clamp bolts.
9. Unscrew ball joints.
10. Clean internal threads in drag link.

**Refit drag link ends**

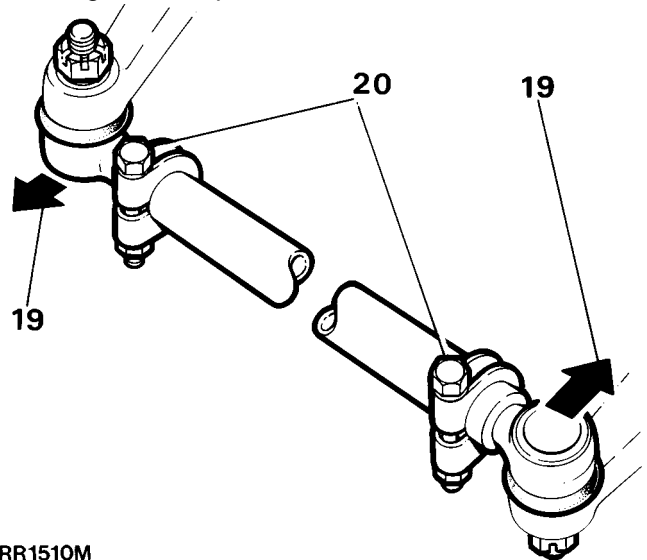
11. Fit replacement ends. Loosely fit clamp bolts.
12. Set ball joints to drag link distance to 28.5mm as shown.
13. Adjust ball pin centres to nominal length of 924.0mm. this length is adjusted during refit.
14. Centralise steering box. **See Adjustment, Centralise Steering Box**
15. Align steering wheel, if necessary. **See Steering Wheel**

**Refit drag link**



**CAUTION: Fit new drag link if existing drag link is damaged or bent. No attempt should be made to repair it.**

16. Fit drag link. Tighten ball-joint nuts to **40 Nm**.
17. Check steering lock stops. **See Adjustment, Steering Lock Stops**
18. Ensure full steering travel is obtained between lock stops. Adjust drag link length to suit.
19. Tap ball joints in direction shown, so both pins are in same angular plane.
20. Tighten clamp bolts to **14 Nm**.



21. Reverse removal procedure. 3 and 4.
22. Road test vehicle.
23. If driving straight ahead and steering wheel is offset by 0° to ± 5° in either direction. Remedy by adjusting drag link length.



**WARNING: To correct steering wheel deviations greater than ± 5°. Remove and reposition steering wheel. See Steering Wheel**



**POWER STEERING BOX**

Service repair no - 57.10.07

**Overhaul**



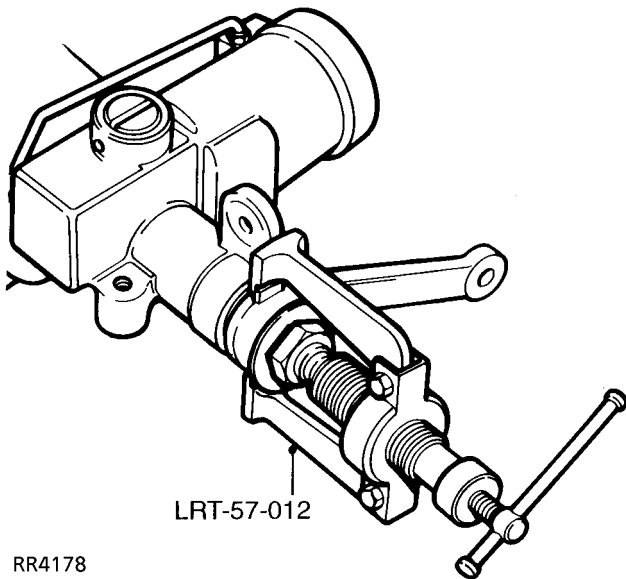
**NOTE:** Overhaul of steering box should not be carried out during the warranty period.



**WARNING:** Wear safety glasses while removing and refitting circlips and retaining ring.



**CAUTION:** Absolute cleanliness is essential when overhauling power steering box.



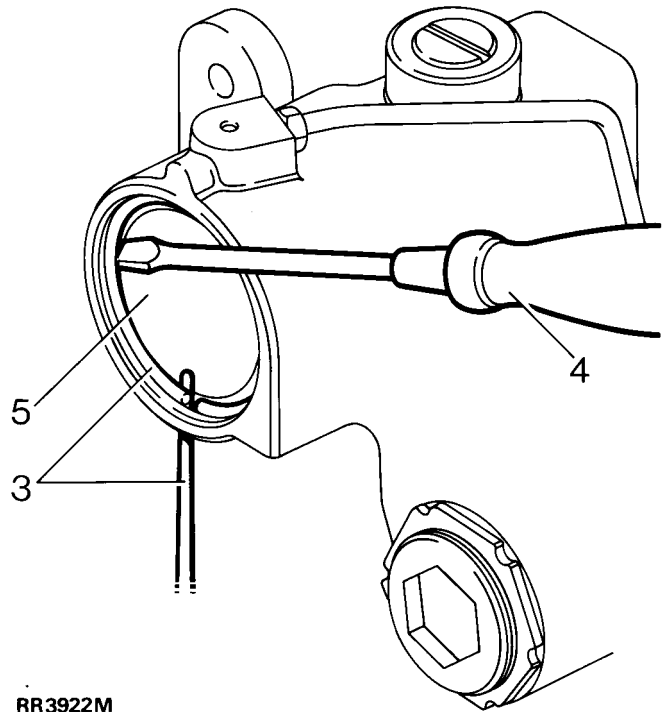
1. Remove steering box from vehicle. **See Repair, Power Steering Box**

Remove drop arm using extractor LRT-57-012. Loosen drop arm securing nut, but do not remove before using extractor. Remove dirt excluder from output shaft.

2. Drain oil, remove blanking plugs and bleed screw. Hold steering box over suitable container, turn input shaft from lock to lock, until oil is drained. Refit bleed screw.

3. Rotate retainer ring until one end is 12 mm from extractor hole. Using a drift through hole in cylinder, lift retaining ring from groove in cylinder bore.

4. Remove retainer ring, using a screwdriver.



RR3922M

5. Turn input shaft (left lock on left hand drive, right lock on right hand drive) until piston pushes out cover. Turn input shaft fully in opposite direction, applying pressure to piston.

6. Remove set screw retaining rack pad adjuster.

7. Remove rack adjuster and pad.

8. Remove sector shaft adjuster locknut.

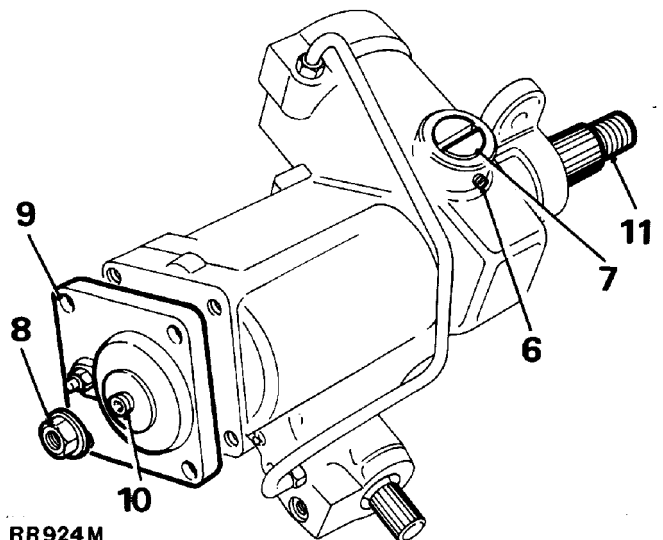
9. Remove four bolts from sector shaft cover.

10. Screw in sector shaft adjuster until cover is removed.



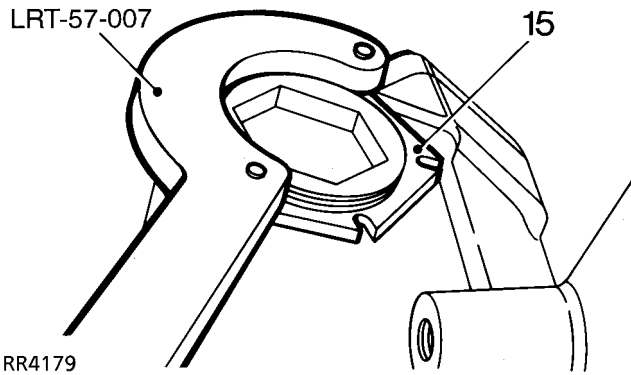
**NOTE:** Sealant is applied to hexagon socket to 'tamperproof' sector shaft adjuster

11. Slide out sector shaft.



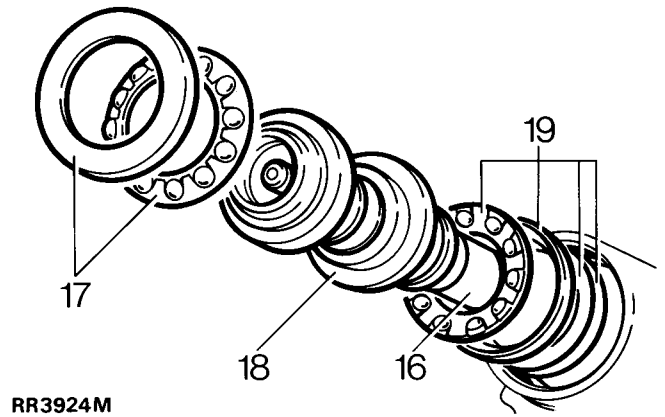
RR924M

12. Remove piston, a bolt screwed into piston will assist removal.
13. Remove input shaft dirt excluder.

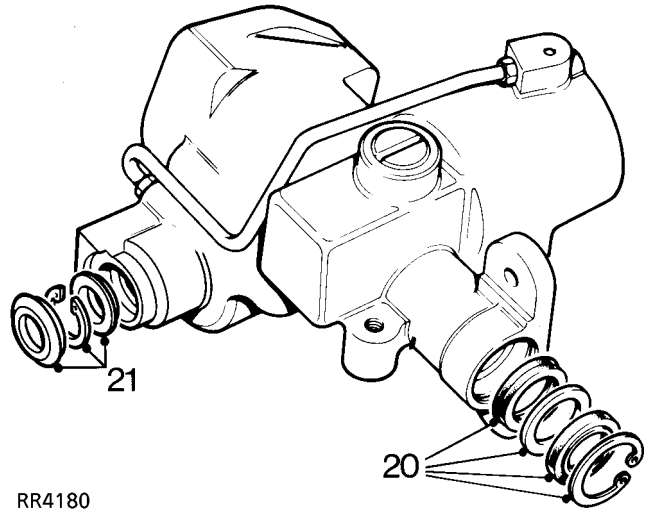


14. Remove worm adjuster locknut using 'C' wrench LRT-57-007.
15. Remove worm adjuster using wrench LRT-57-006.
16. Tap splined end of shaft to free bearing.
17. Remove bearing cup and caged ball bearing assembly.
18. Remove valve and worm assembly.
19. Remove inner bearing cage, cup and shim washers. Retain shims for reassembly.

**NOTE:** Should difficulty be experienced warm casing and bearing assembly. Cool bearing cup using a mandrel and tap steering box on a bench.



### Steering box seals



20. Remove circlip and seal from sector shaft housing bore.



**CAUTION:** Do not remove sector shaft bearings from casing. Replacement parts are not available. If sector shaft bearings are worn fit a new steering box.

21. Remove dirt excluder, circlip and seal from input shaft housing bore.

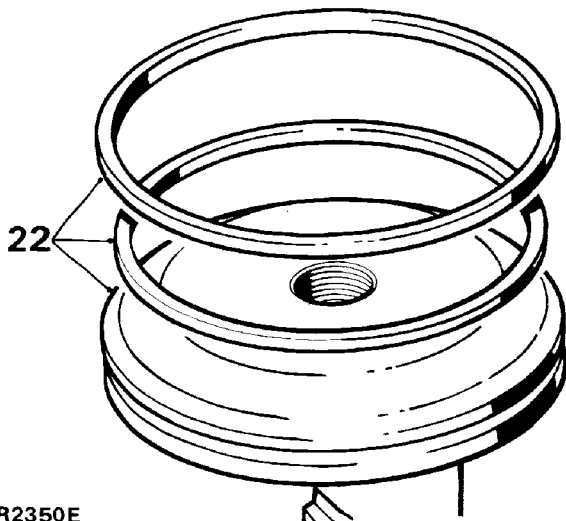
**CAUTION:** The use of a seal puller is recommended to prevent damage to casing, and possible oil leaks.

**INSPECTING**

**Piston**

22. Discard all rubber seals and provide replacements.

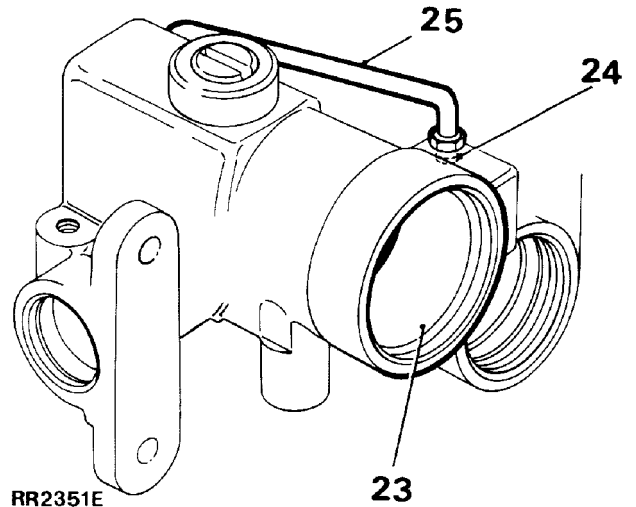
**NOTE:** A rubber seal is fitted behind plastic ring on rack piston. Discard seal and plastic ring.



RR2350E

**Steering box casing**

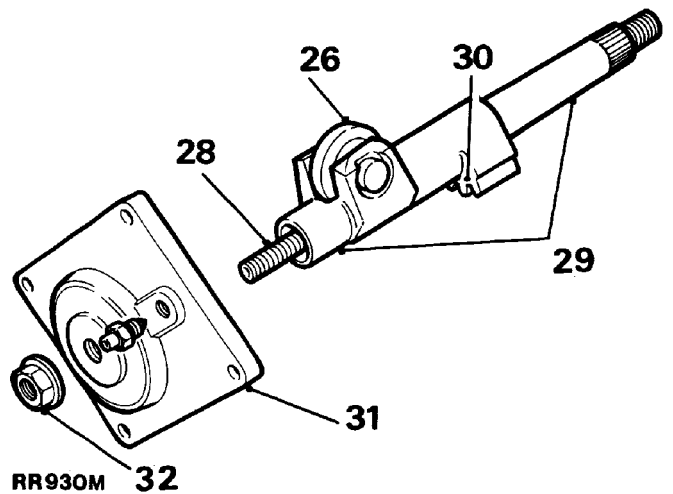
23. Examine piston bore for scoring and wear.
24. Examine feed tube.
25. Fit a new feed tube if damaged. Tighten to **22 Nm**.



RR2351E

**Sector shaft assembly**

26. Check there is no side play on roller.
27. If side play on roller exists fit a new sector shaft.
28. Check condition of adjuster screw threads. Check adjuster end float. Fit new adjuster if end float exceeds 0.15 mm.
29. Examine bearing areas on shaft for excessive wear.
30. Examine gear teeth for uneven or excessive wear.



RR930M 32



## Sector shaft cover assembly

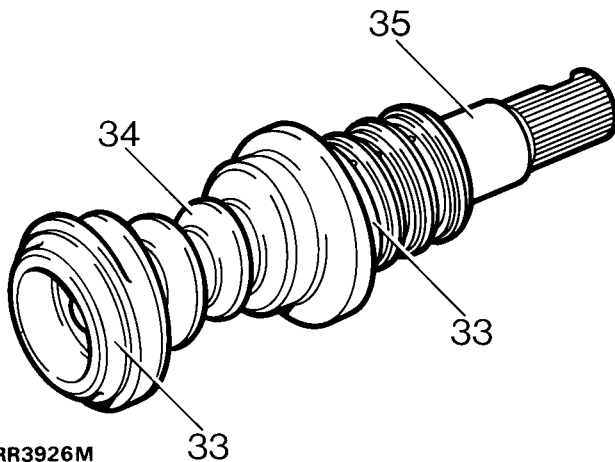
31. Inspect cover and bearing. If worn or damaged, replacement parts are not available, fit a new steering box.

## Sector shaft adjuster locknut

32. The locknut is also a fluid seal. Fit new nut at overhaul.

## Valve and worm assembly

33. Examine bearing areas for wear. The areas must be smooth and not indented.
34. Examine worm track which must be smooth and not indented.



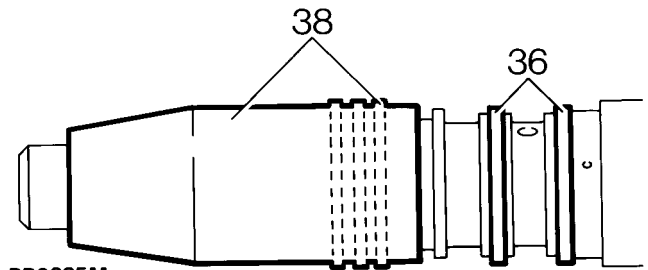
RR3926M

35. Check for wear on torsion bar assembly pin. No free movement should exist between input shaft and torsion bar or between torsion bar and worm.



**NOTE: Any sign of wear makes it essential to fit new valve and worm assembly.**

36. Examine valve rings for cuts, scratches and grooves. The valve rings should be free to rotate in grooves.

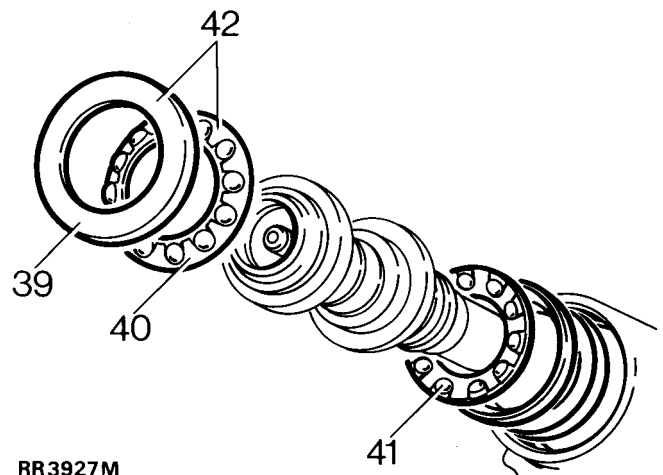


RR3925M

37. If required, replace all three rings, using ring expander LRT-57-019. The expander will not pass over rings already fitted. Remove rings to allow access without damaging seal grooves.
38. Warm rings and expander tool to aid assembly. Fit rings to expander, slide expander over valve and worm assembly. In turn fit rings to their grooves. Remove expander, slide valve and worm assembly into ring compressor LRT-57-020 and allow to cool.

## Ball bearing and cage assemblies

39. Examine ball races and cups for wear and general condition.
40. If ball cage has worn against bearing cup, fit replacements.
41. Bearing balls must be retained by cage.
42. Bearing and cage repair is carried out by complete replacement of assembly.

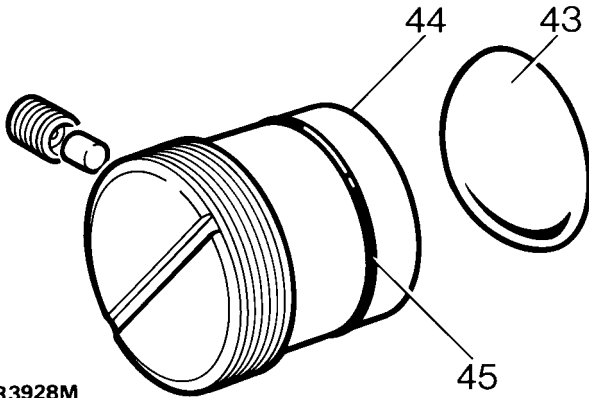


RR3927M



**Rack thrust pad and adjuster**

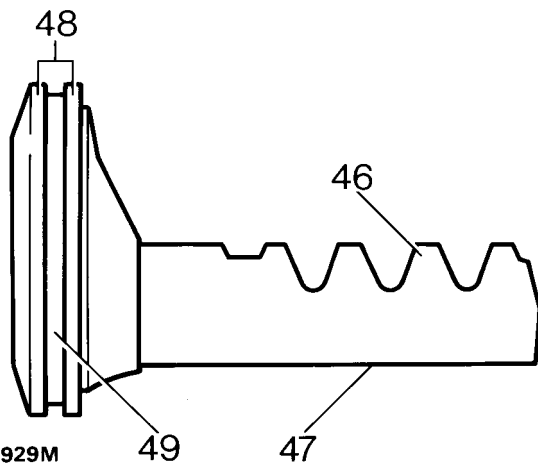
- 43. Examine thrust pad for scores.
- 44. Examine adjuster for wear in pad seat.
- 45. Fit new sealing ring to rack adjuster.



RR3928M

**Rack and piston**

- 46. Examine for excessive wear on rack teeth.
- 47. Ensure thrust pad bearing surface is free from scores and wear.
- 48. Ensure piston outer diameters are free from burrs and damage.



RR3929M

- 49. Examine seal and ring groove for scores and damage.
- 50. Fit new ring to piston. Warm nylon seal and fit to piston.
- 51. Slide piston assembly into cylinder with rack tube outwards.

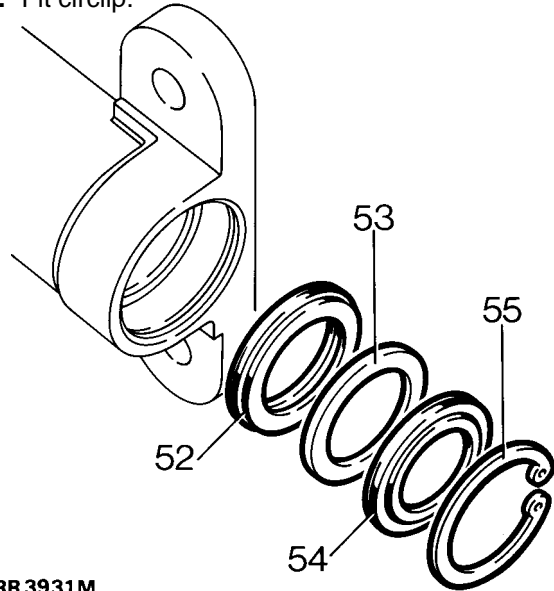
**Reassemble**



**NOTE: When fitting replacement oil seals lubricate with recommended fluid and ensure absolute cleanliness.**

**Sector shaft oil seal**

- 52. Fit oil seal, lip side first.
- 53. Fit extrusion washer.
- 54. Fit dust seal, lipped side last.
- 55. Fit circlip.



RR3931M

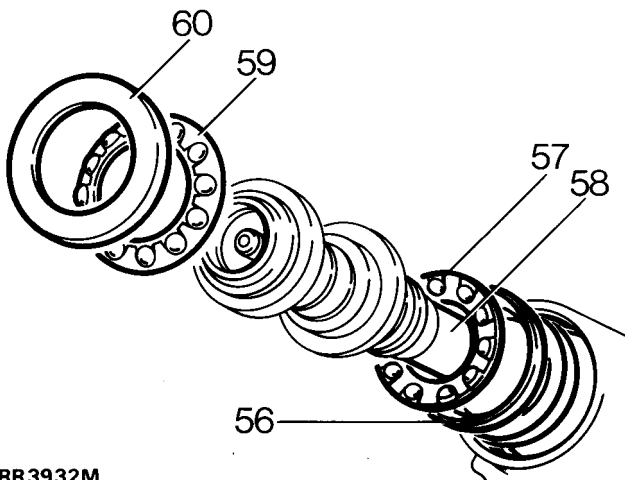
**Fitting valve and worm assembly**

- 56. Refit original shims and inner bearing cup. Use Petroleum Jelly to aid assembly.



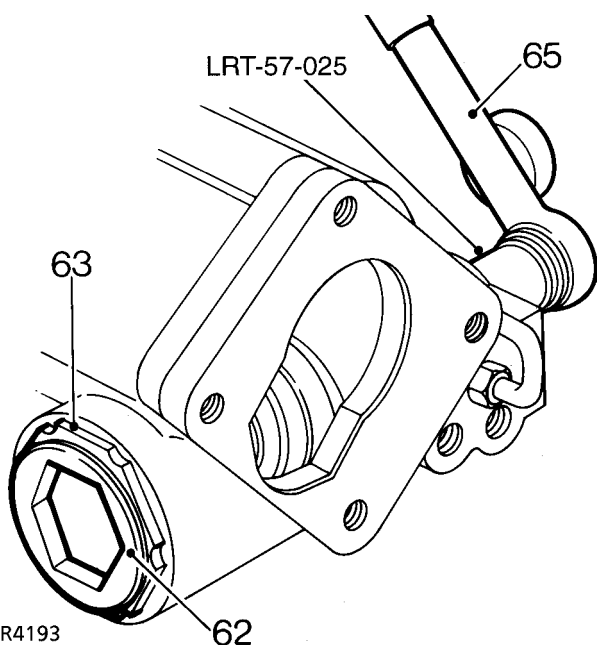
**NOTE: If original shims are not used, fit shims of 0.76 mm thickness.**

- 57. Fit inner cage and bearings assembly.
- 58. Fit valve and worm assembly.
- 59. Fit outer cage and bearings assembly.
- 60. Fit outer bearing cup.



RR3932M

61. Fit new worm adjuster sealing ring.



RR4193

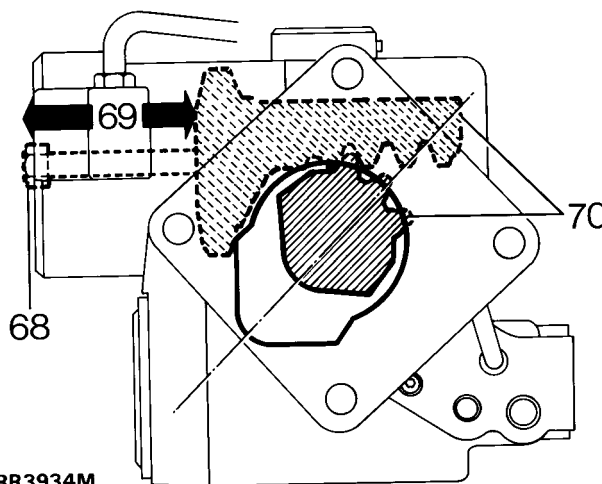
62. Loosely screw adjuster into casing.
63. Fit locknut, do not tighten.
64. Turn in worm adjuster until end float is almost eliminated. Ensure bearing cages are seated correctly.
65. Measure maximum rolling torque of valve and worm assembly, using a torque wrench and spline socket LRT-57-025.
66. Turn in worm adjuster while rotating shaft to increase figure measured in instruction 65. to 0.56 Nm.
67. Back off worm adjuster 1/4 turn. Turn in worm adjuster to increase reading at 65. by 0.21 - 0.34 Nm with locknut tight, **100 Nm**. Use worm adjusting wrench LRT-57-006 and locknut wrench LRT-57-028.

### Fitting rack and piston

68. Screw slave bolt into piston to aid assembly.
69. Fit piston and rack so piston is 70 mm from outer end of bore.

### Fitting sector shaft

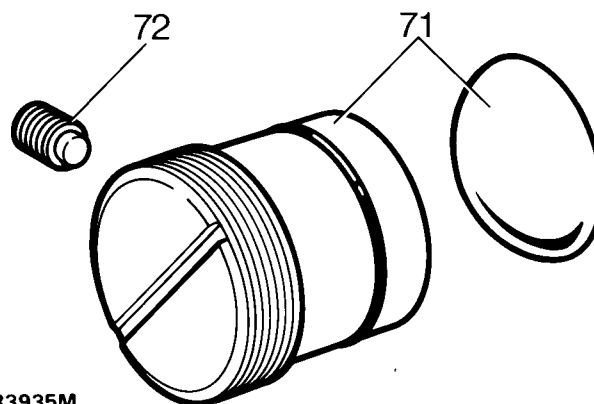
70. Fit sector shaft using seal saver LRT-57-021. Align roller with cut out in casing - see RR3934M. Push in sector shaft while rotating input shaft to allow sector roller to engage worm.



RR3934M

### Fitting rack adjuster

71. Fit rack adjuster and thrust pad to engage rack. Back off half turn on adjuster.
72. Loosely fit new nylon pad and adjuster set screw assembly.

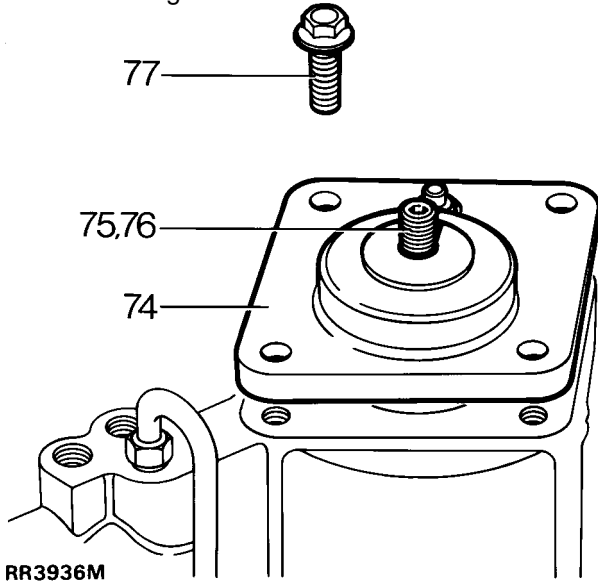


RR3935M



**Fitting sector shaft cover**

- 73. Fit new sealing ring to cover.
- 74. Align cover with casing.
- 75. Screw cover assembly fully on to sector shaft adjuster screw.
- 76. If necessary back off sector shaft adjuster screw. Tap cover in place to allow cover to joint fully with casing.

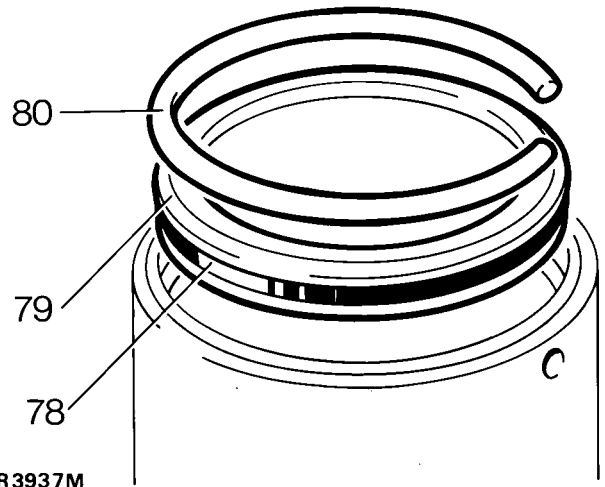


**NOTE:** Before tightening fixings, rotate input shaft to ensure sector shaft roller is free to move in valve worm. If initial resistance is left, turn adjuster screw approximately two turns in a clockwise direction.

77. Fit cover bolts. Tighten to **75 Nm**.

**Fitting cylinder cover**

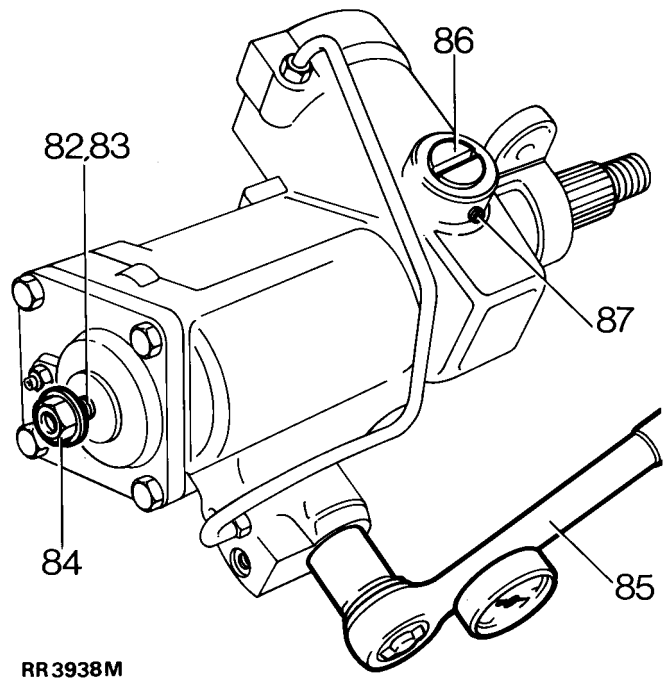
- 78. Fit new square section seal to cover.
- 79. Remove slave bolt fitted at instruction 68. Press cover into cylinder just to clear retainer ring groove.
- 80. Fit retaining ring to groove with one end of ring positioned 12 mm from extractor hole.



**Adjusting sector shaft**

**NOTE:** Refit drop arm and tighten nut sufficiently to ensure that no backlash exists between drop arm and sector shaft.

- 81. To set worm on centre, rotate input shaft to full inner-lock (full right lock for a left hand drive vehicle, full left lock for a right hand drive vehicle). Rotate input shaft back towards centre two full turns.
- 82. The box is now on centre and can be adjusted.



83. Hold input shaft and rock drop arm to establish backlash is present. Continue rocking and slowly turn sector shaft adjusting screw clockwise. Continue rotating adjuster screw until backlash has almost been eliminated.
84. Refit locknut and tighten.



**NOTE: It is important steering box is centralised before any adjustments are made.**

85. Check maximum rolling torque one and a quarter turns either side of centre position, using a torque wrench and spline socket LRT-57-025. Rotate adjuster screw to obtain across centre torque of 0.34 Nm plus torque figure at one and a quarter turns. Tighten adjuster locknut to **60 Nm**.

### Adjusting rack adjuster.

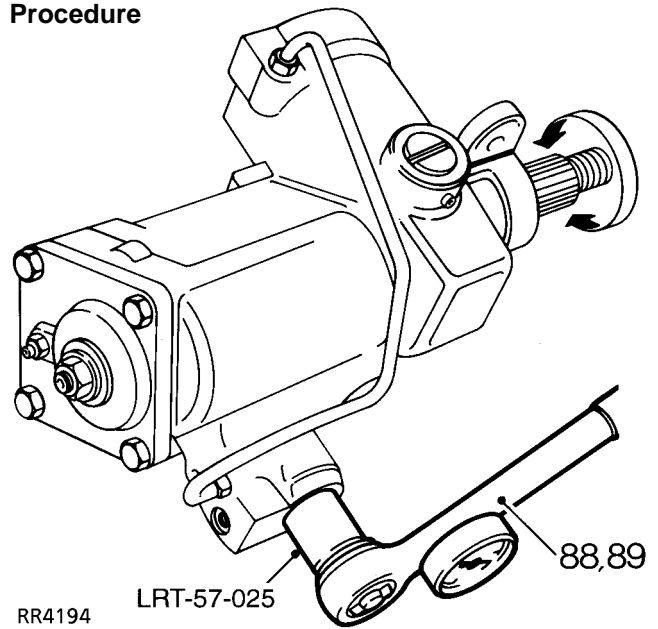
86. Turn in rack adjuster to increase figure measured in instruction 85. by 0.23 - 0.34 Nm. **The final figure may be less, but must not exceed 1.35 Nm.**
87. Lock rack adjuster in position with grub screw. Tighten to **5 Nm**.

### Torque peak check

With input shaft rotated from lock to lock, rolling torque figures should be greatest across centre position and equally disposed about centre position.

The condition depends on value of shimming fitted between valve and worm assembly inner bearing cup and casing. The original shim washer value will give correct torque peak position unless major components have been replaced.

### Procedure



88. With input coupling shaft toward the operator, turn shaft fully counter-clockwise.
89. Check torque figures obtained from lock to lock using torque wrench and spline socket LRT-57-025.
90. Check also for equal engagement either side of centre.

### Adjustments

91. Note where greatest figures are recorded relative to steering position. If greatest figures are not recorded across centre of travel (steering straight-ahead), adjust as follows:

If torque peak occurs **before** centre position, **add** to shim washer value; if torque peak occurs **after** centre position, **subtract** from shim washer value, **refer to fitting valve and worm assembly**.

Shim washers are available as follows:  
0.03mm, 0.07mm, 0.12mm and 0.24mm.



**NOTE: Adjustment of 0.07mm to shim value will move torque peak area by 1/4 turn on the shaft.**

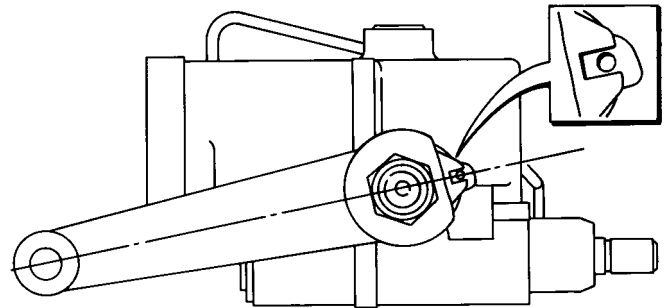


**CAUTION: When reshimming valve and worm, extreme caution must be exercised to prevent seal damage during reassembly.**

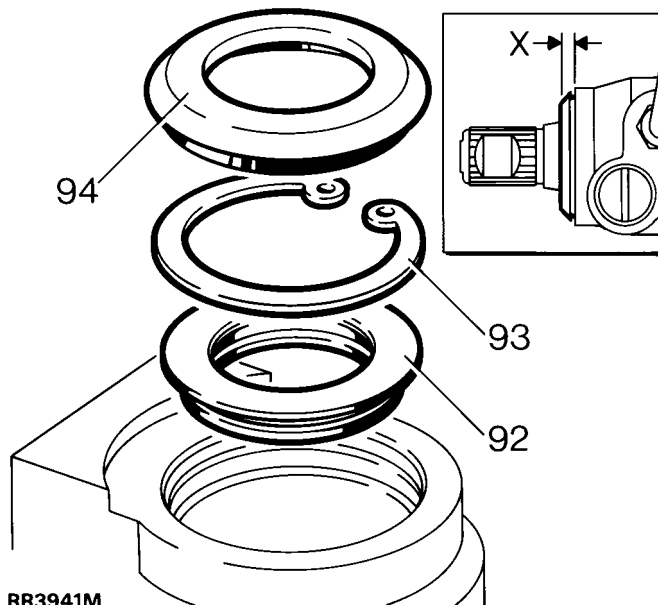


**Input shaft oil seal**

- 92. Fit seal, lip side first, into housing. Use seal saver LRT-57-016 and seal installer LRT-57-026. Note that seal is fitted to a depth of 4.75 - 5.00 mm from face of box.
- 93. Secure seal with circlip.
- 94. Smear inner lip of dirt excluder with PTFE grease. Fit dirt excluder using LRT-57-027. When fitted correctly outer shoulder of excluder is 4.00 - 4.50 mm from face of box, dimension X in RR3941M.



RR3940M



RR3941M

- 97. Fit steering box. *See Repair, Power Steering Box*

- 95. Remove drop arm. Smear inner lip of dirt excluder with PTFE grease and refit, ensuring outer lip is flush with casing.
- 96. With input shaft on centre, line up centralising holes in drop arm and steering box see inset in RR3940M. Fit drop arm to steering box using a new tab washer. Tighten to **176 Nm**, bend over tab.



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**STEERING PUMP**

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Make/type - V8i ..... ZF 'Unicorn'  
Make/type - Tdi ..... Hobourn Eaton 500 series  
Operating pressure - straight ahead position - at idle ..... 7 bar, 100 lbf/in<sup>2</sup> maximum  
Full lock (left or right) at idle ..... 28 bar, 400 lbf/in<sup>2</sup> minimum  
Full lock (left or right) 1000 rev/min ..... 70-77 bar, 1000-1100 lbf/in<sup>2</sup>

## TORQUE VALUES



**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	<b>Nm</b>
Ball joint nuts .....	40
Clamp bolt nuts .....	14
Steering column bracket nuts .....	22
Steering wheel nut .....	50
Tie bar to mounting nut .....	110
Universal joint pinch bolt .....	25
PAS box	
Adjuster locknut .....	60
Drop arm nut .....	176
Sector shaft cover to steering box .....	75
Steering box to chassis .....	81
Steering box fluid pipes 14mm thread .....	15
Steering box fluid pipes 16mm thread .....	20
Tie bar .....	81
PAS pump	
High pressure fluid pipe .....	20
Power steering pump mounting .....	35
Pulley bolts, power steering pump .....	10
Hose clamp .....	3
Front mounting plate bolts .....	9
PAS reservoir	
Hose clamp .....	3

\* Torque values below are for all screws and bolts used except for those that are specified otherwise.

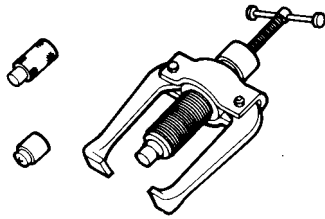
<b>METRIC</b>	<b>Nm</b>
M5 .....	6
M6 .....	9
M8 .....	25
M10 .....	45
M12 .....	90
M14 .....	105
M16 .....	180

<b>UNC / UNF</b>	
1/4 .....	9
5/16 .....	24
3/8 .....	39
7/16 .....	78
1/2 .....	90
5/8 .....	136





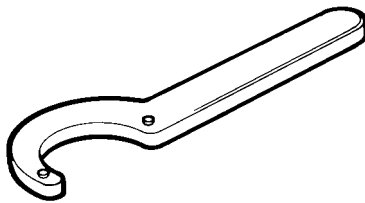
**POWER STEERING BOX**



MS252A

LRT-57-012

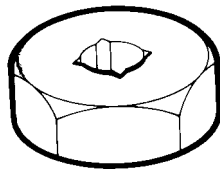
Drop arm extractor



LST120

LRT-57-007

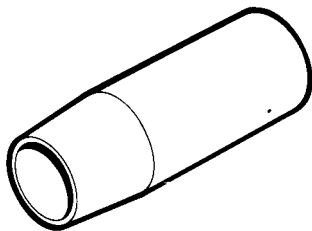
'C' Wrench



LST119

LRT-57-006

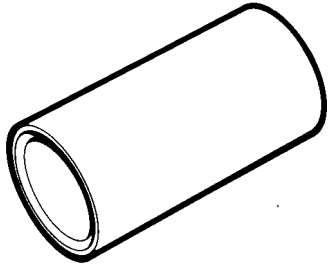
Worm adjusting wrench



RO606602

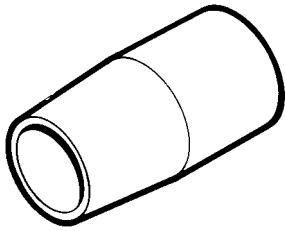
LRT-57-019

Ring expander

**RO606603**

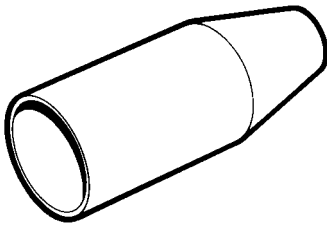
LRT-57-020

Ring compressor

**RO606604**

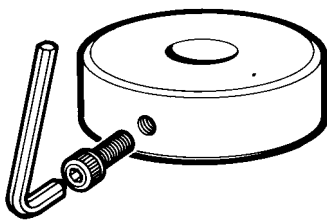
LRT-57-021

Seal saver, sector shaft

**RO1015**

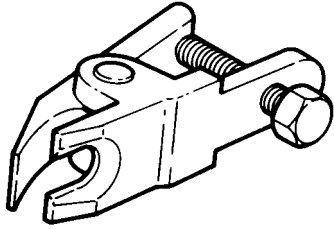
LRT-57-016

Seal saver, valve and worm

**RO1016**

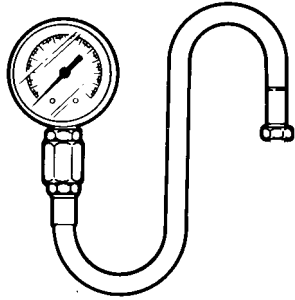
LRT-57-017

Torque setting tool



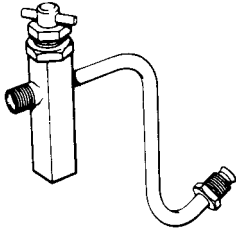
LRT-57-018 Ball joint remover

18G1036A



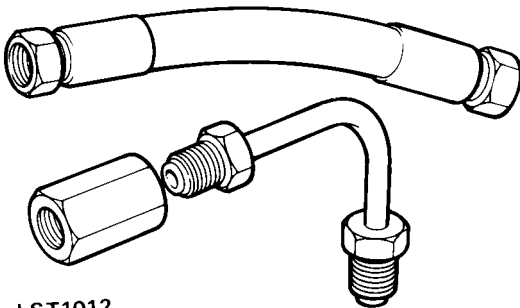
LRT-57-005 Pressure gauge

HY23



LRT-57-001 Test adaptor

JD102



LRT-57-022 Pressure test adaptors

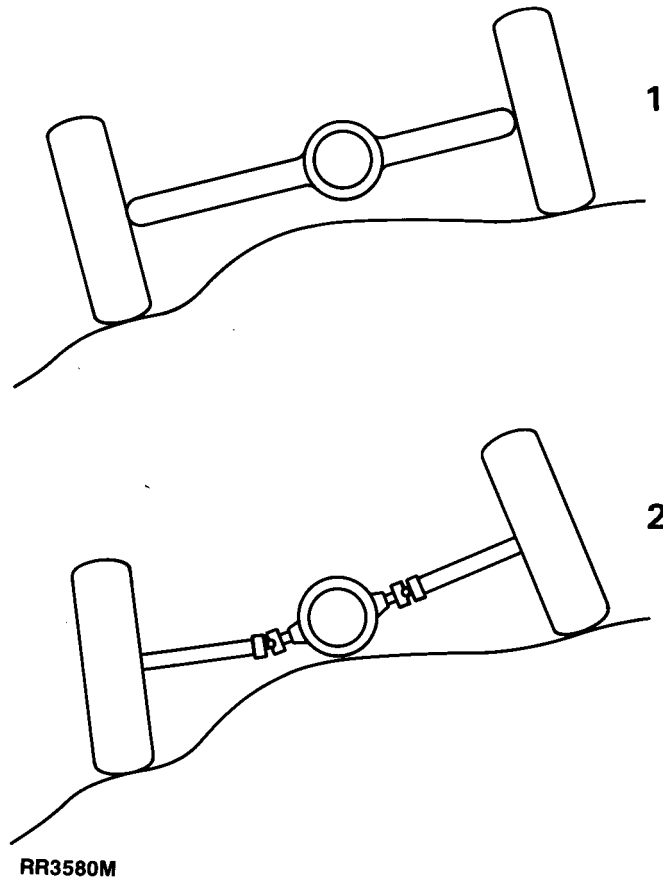
LST1012



## INTRODUCTION

Suspension design is a major factor in determining the comfort, safety and performance of any vehicle, but is particularly significant to 4 wheel drive cross country vehicles. The ideal suspension must allow maximum wheel travel and axle articulation, and provide good ground clearance without loss of traction or directional stability.

A well designed beam axle layout can embrace all of these qualities and also has the inherent advantage (over independent systems) of no variation in wheel track or camber angle.



### Suspension comparison

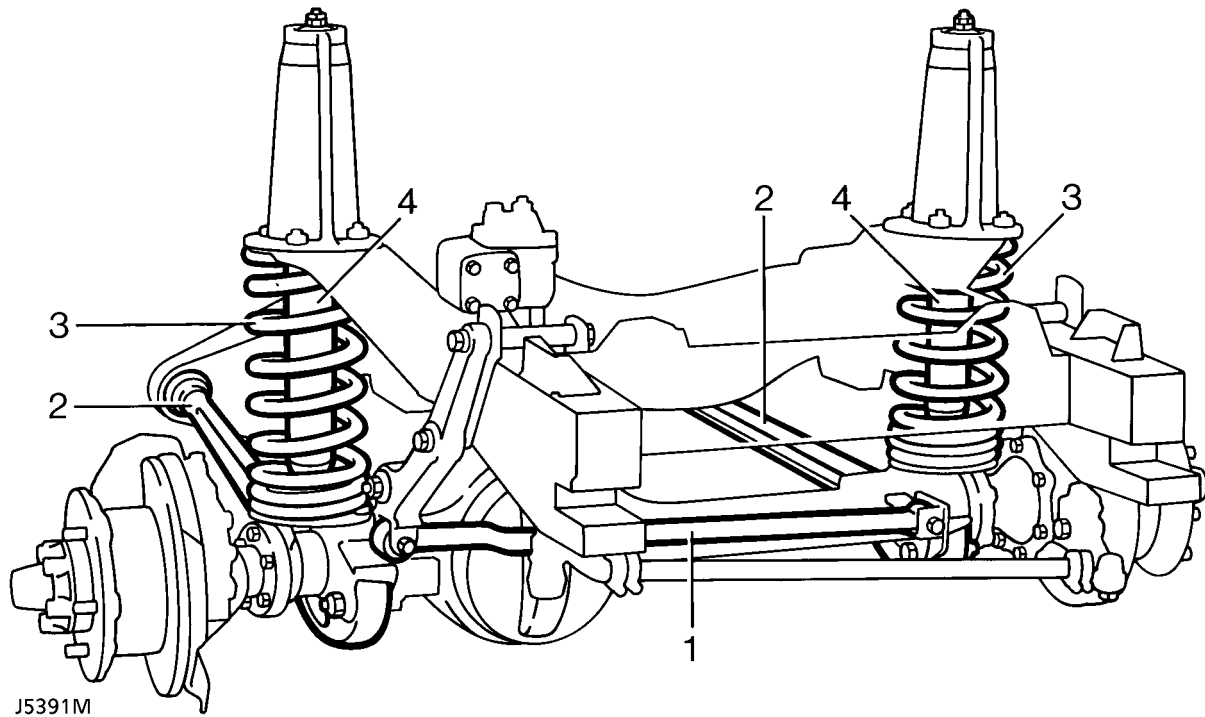
1. Beam axle system
2. Independent system

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**AXLE LOCATION**

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The front axle is controlled longitudinally, by two forged steel radius arms and transversely by a panhard rod.

**Front axle suspension**

1. Panhard rod - transverse location
2. Radius arms - longitudinal location
3. Coil springs
4. Shock absorber

Long travel coil springs and hydraulic shock absorbers, provide the springing for each wheel.



**SELF LOCKING NUTS**



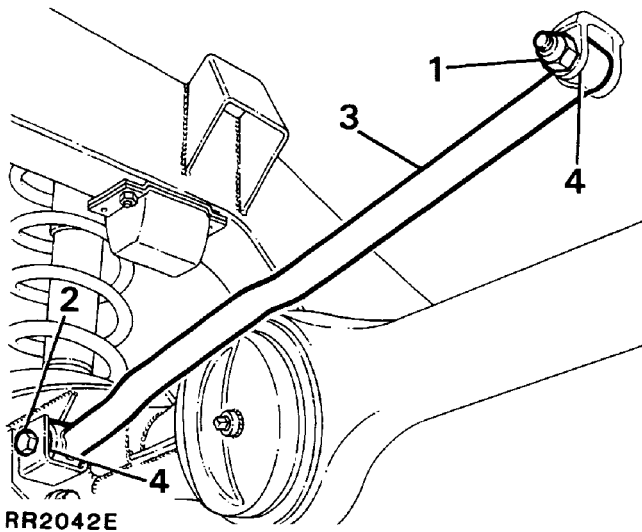
**WARNING:** Where self locking nuts are removed, they must be replaced with new nuts of same specification.

**PANHARD ROD**

Service repair no - 60.10.07.

**Remove**

1. Remove fixings at mounting arm.
2. Remove fixings at axle bracket.
3. Remove Panhard rod.
4. Press out flexible bushes. Ensure the steel tubing locates on the outer edge of the bush and not on the rubber inner.



**Refit**

5. Fit replacement bushes.



**CAUTION:** Apply pressure to outer edge of bush, and not rubber inner.

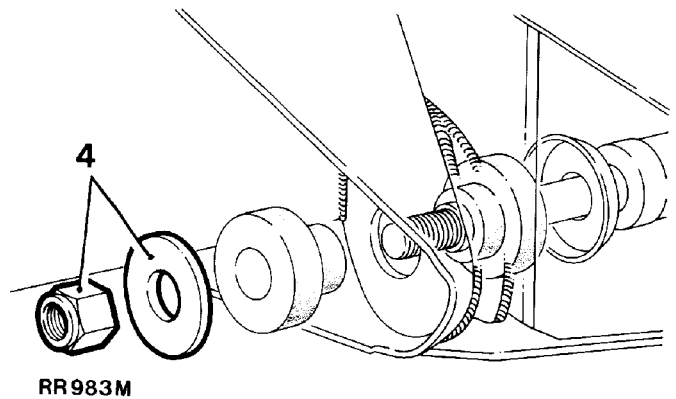
6. Reverse removal procedure. 1 to 4. Tighten to **88Nm**

**RADIUS ARM**

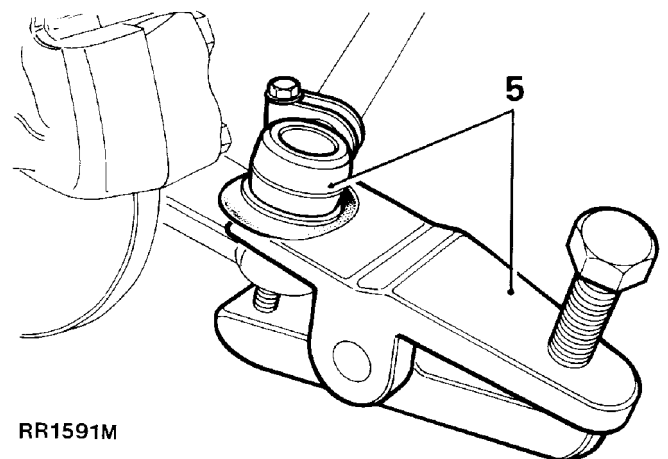
Service repair no - 60.10.16.

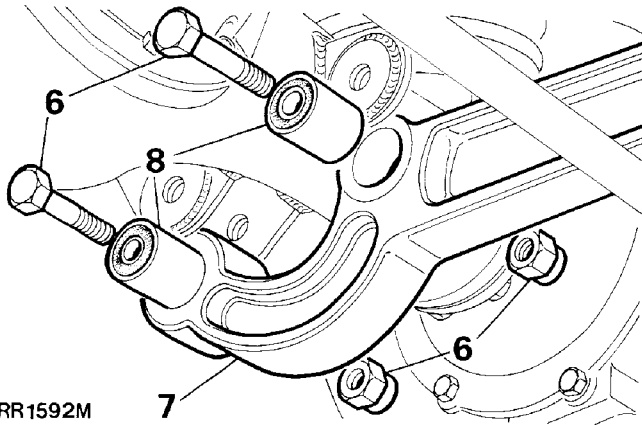
**Remove**

1. Loosen road wheel retaining nuts.
2. Raise front of vehicle. Support chassis on stands and remove wheel.
3. Support front axle weight with jack.
4. Remove radius arm to chassis side member fixings.



5. Disconnect track rod at ball joint.
6. Remove fixings, radius arm to axle.
7. Lower radius arm front end to clear axle and remove from vehicle.





RR1592M

8. Press out flexible bushes.

#### Refit

9. Press in replacement bushes.



**CAUTION:** When pressing in new bushes press on outer edge of bush and not rubber inner.

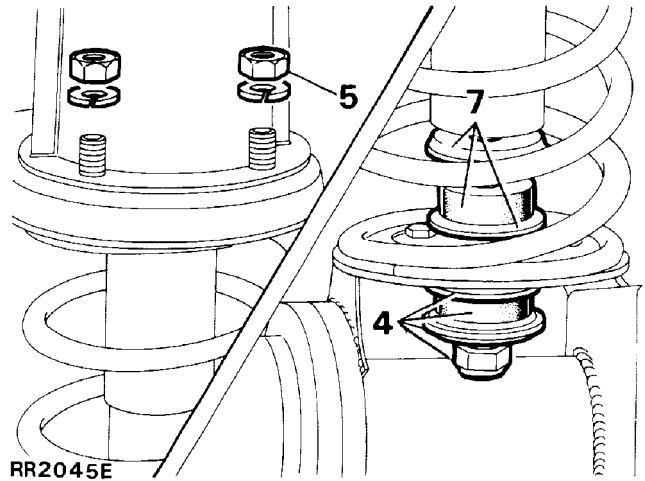
10. Reverse removal procedure. 1 to 8.  
Tighten fixings to following torques:  
Radius arm to chassis **176Nm**  
Radius arm to axle **197Nm**

## FRONT SHOCK ABSORBER

Service repair no - 60.30.02.

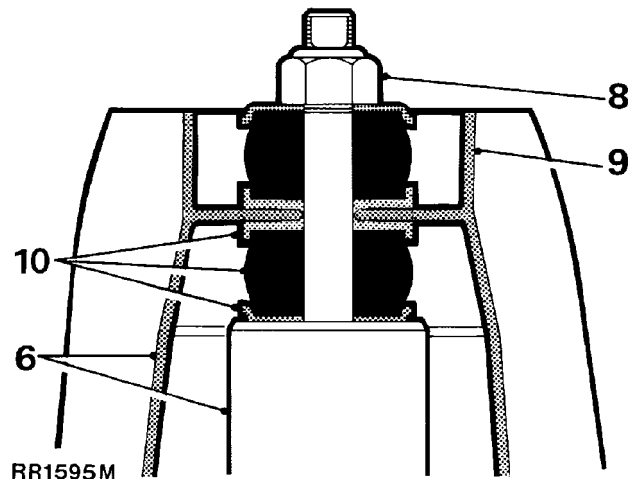
### Remove

1. Loosen road wheel retaining nuts.
2. Support chassis on stands and remove road wheel.
3. Support axle weight with jack.

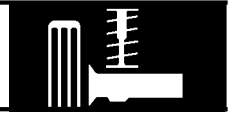


RR2045E

4. Remove shock absorber lower fixing and withdraw cupwasher, rubber bush and seating washer.
5. Remove four shock absorber bracket fixings.
6. Withdraw shock absorber and bracket complete.



RR1595M



7. Withdraw lower seating washer, rubber bush and cupwasher.
8. Remove fixings, shock absorber to mounting bracket.
9. Withdraw mounting bracket.
10. Lift off top seating washer, rubber bush and cupwasher.

#### Refit

11. Reverse removal procedure. 1 to 10.

#### FRONT ROAD SPRING

Service repair no - 60.20.11.

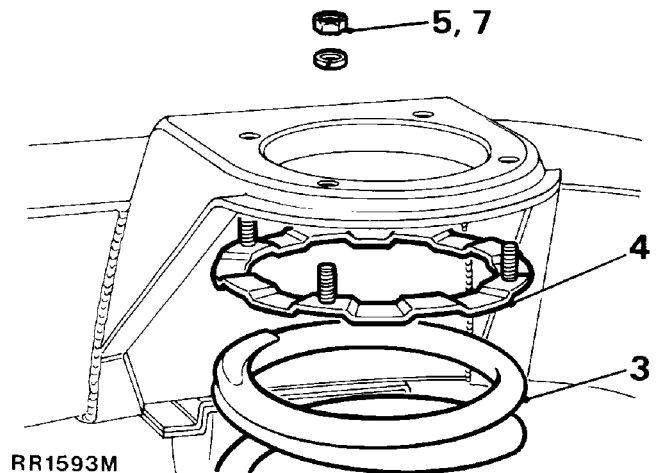
#### Remove

1. Remove front shock absorber. *See Front Shock Absorber*



**CAUTION:** Avoid over stretching brake hoses. If necessary loosen hose connector locknuts to allow hoses to follow axle.

2. Lower axle sufficient to free road spring.
3. Withdraw road spring.
4. Withdraw shock absorber bracket securing ring.



#### Refit

5. Fit shock absorber bracket retaining ring. Retain in position with a nut.
6. Reverse 2 and 3.
7. Remove nut retaining securing ring.
8. Fit front shock absorber.



---

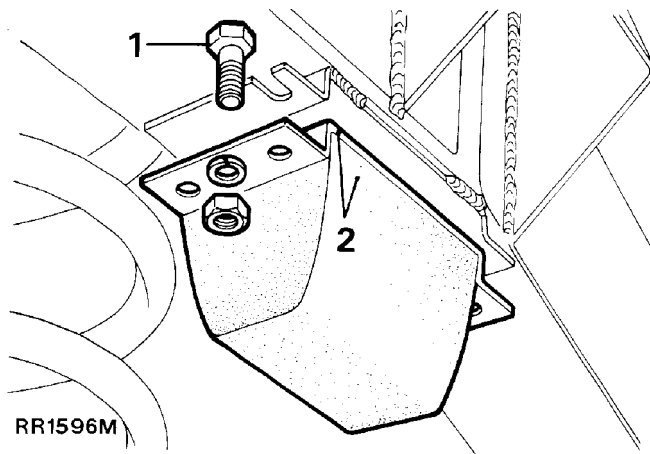
**BUMP STOP**

---

Service repair no - 60.30.10.

**Remove**

1. Remove fixings.
2. Remove bump stop.

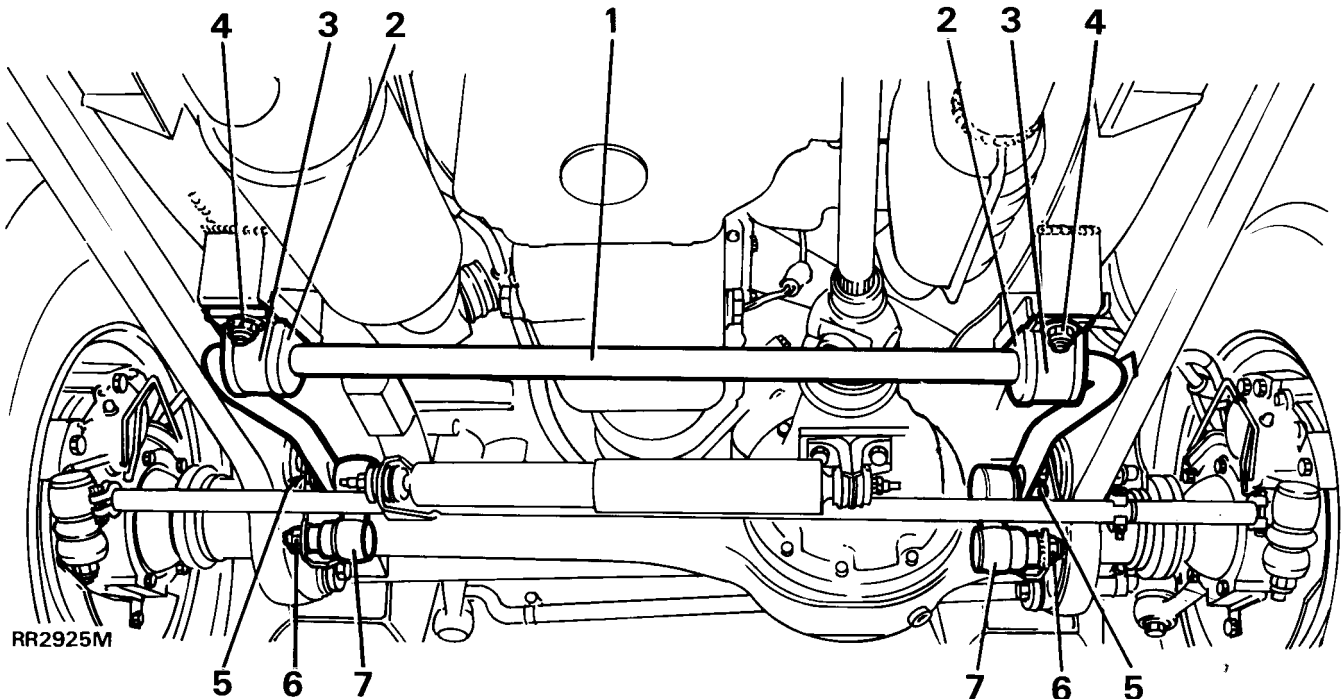
**Refit**

3. Position bolts in slots in chassis brackets.
4. Fit bump stop, secure with washers and nuts.



## ANTI-ROLL[SWAY] BAR ASSEMBLY FRONT

Service repair no - 60.10.01



### KEY

- |                        |                                   |
|------------------------|-----------------------------------|
| 1. Anti-roll[sway] bar | 5. Nut and washer                 |
| 2. Rubber bush         | 6. Castellated nut and cotter pin |
| 3. Strap               | 7. Ball joint link arm            |
| 4. Nut, bolt, washer   |                                   |

### Remove

1. Mark for reassembly position of rubber bushes on anti- roll[sway] bar.
2. Remove four nuts, bolts and washers securing two bush straps.
3. Remove nuts, bolts, washers and rubber bushes from ball joint links and remove anti-roll[sway] bar.

### Refit

4. Position bushes on anti-roll[sway] bar. Ensure split points towards axle on RH bush and away from axle on LH bush.
5. Fit anti-roll[sway] bar with two straps. To ensure correct fit angled sides of bar should point down as shown. Loosely fit the bolts, washers and nyloc nuts.
6. Fit bolt, washers and rubber bushes. Using new nuts fit anti-roll[sway] bar to ball joint links. Tighten to **68Nm**.
7. Tighten nuts securing straps to **30Nm**

---

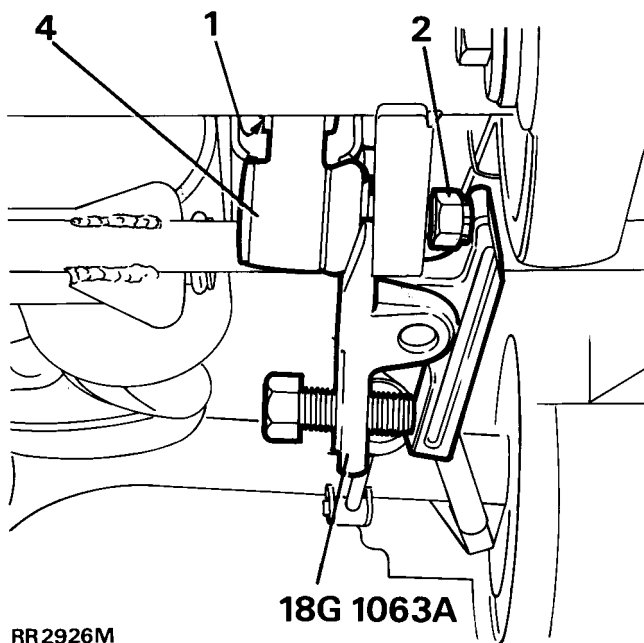
**ANTI-ROLL[SWAY] BAR BALL JOINT LINKS**

---

Service repair no - 60.10.04.

**Remove**

1. Remove two nuts, bolts, washers and rubber bushes from ball joint links.
2. Remove cotter pin and loosen castellated nut a few turns.
3. Release ball joint using special tool 18G 1063A as shown.
4. Remove castellated nut and ball joint link.



**Refit**

5. Fit ball joint link and castellated nut. Ensure ball joint link arm points up. Tighten to **40Nm** and fit new cotter pin.
6. Align anti-roll bar to ball joint links.
7. Fit bolts, washers and rubber bushes using new self locking nuts secure anti-roll[sway] bar to ball joint links. Tighten to **68Nm**.



**TORQUE VALUES**



**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
<b>Anti-roll[sway] bar front</b>	
- Strap nyloc nuts .....	30
- Ball link self lock nut .....	68
- Castellated nut .....	40
Drag link to axle .....	40
Securing ring for mounting turret .....	14
Radius arm to chassis .....	176
Panhard rod mounting arm to chassis .....	88
Panhard rod to axle .....	88
Panhard rod to mounting bracket .....	88
Tie bar to Panhard rod .....	110
Radius arm to axle (front only) .....	197

Torque values below are for all screws and bolts used except for those that are specified otherwise.

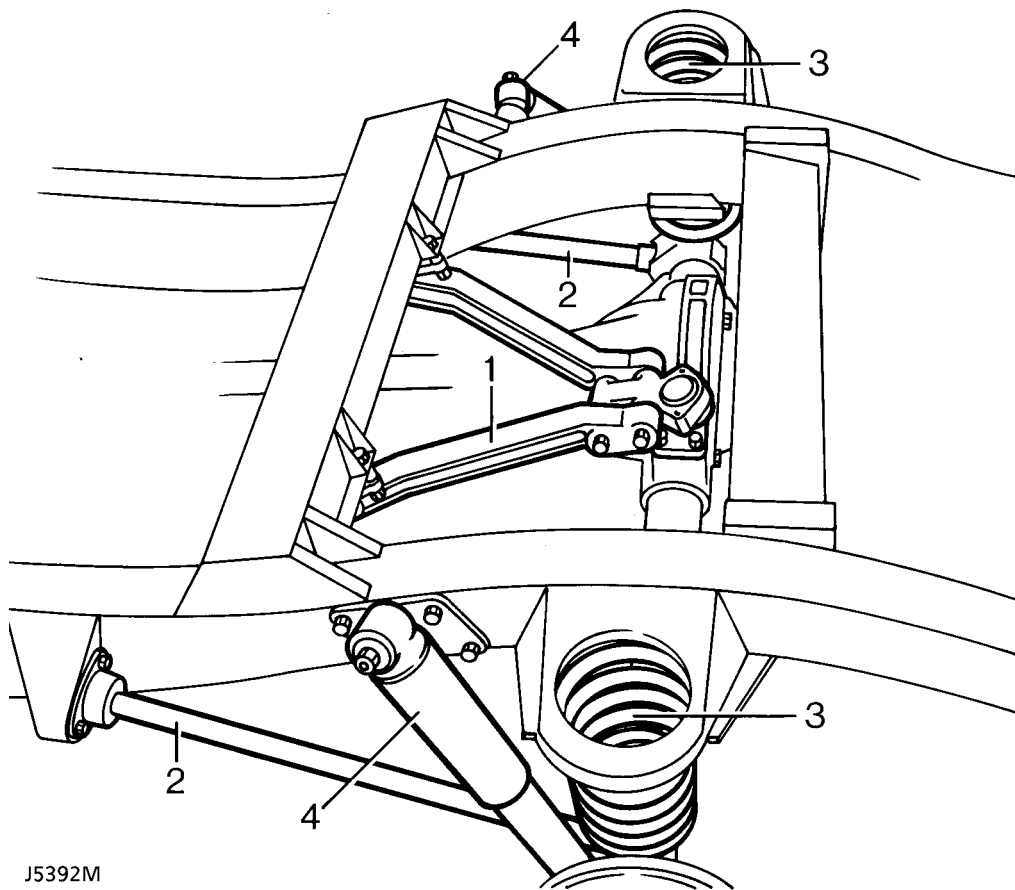
METRIC	Nm
M5 .....	6
M6 .....	9
M8 .....	25
M10 .....	45
M12 .....	90
M14 .....	105
M16 .....	180

UNC / UNF	Nm
1/4 .....	9
5/16 .....	24
3/8 .....	39
7/16 .....	78
1/2 .....	90
5/8 .....	136



## AXLE LOCATION

Longitudinal location of the rear axle is by solid round section steel link arms and a forged "A" frame, upper link assembly, which is secured to a chassis cross member and provides transverse control. Long travel coil springs and hydraulic shock absorbers provide the springing for each wheel.



J5392M

### Rear axle suspension

1. "A" frame, upper link assembly - transverse location
2. Lower link assembly - longitudinal location
3. Coil springs
4. Shock absorber

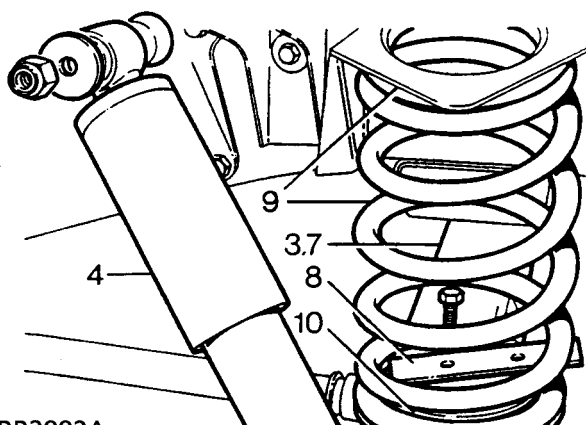


**REAR ROAD SPRING**

Service repair no - 64.20.01

**Remove**

1. Loosen rear road wheel retaining nuts.
2. Support chassis on stands and remove wheels.
3. Support rear axle weight with jack.
4. Disconnect shock absorbers at one end.



RR3882A

5. Position coil spring compressor correctly on road spring.
6. Compress spring evenly to facilitate removal.
7. Lower axle to free road spring from upper seat.



**CAUTION: Avoid lowering axle further than rear brake flexible hose will allow.**

8. Remove spring retainer plate.
9. Withdraw road spring, and spring isolator.
10. Lift off spring seat.

**Refit**

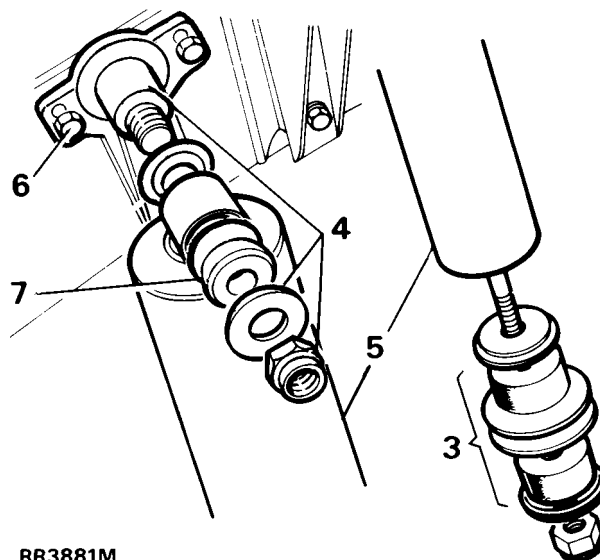
11. Reverse removal procedure.

**REAR SHOCK ABSORBER**

Service repair no - 64.30.02.

**Remove**

1. Loosen road wheel retaining nuts.
2. Support chassis on stands. Remove road wheel and support rear axle weight with jack.
3. Remove fixings and withdraw shock absorber from axle bracket.



RR3881M

4. Remove upper fixings.
5. Withdraw shock absorber.
6. If required remove mounting bracket
7. If required remove mounting rubbers.

**Refit**

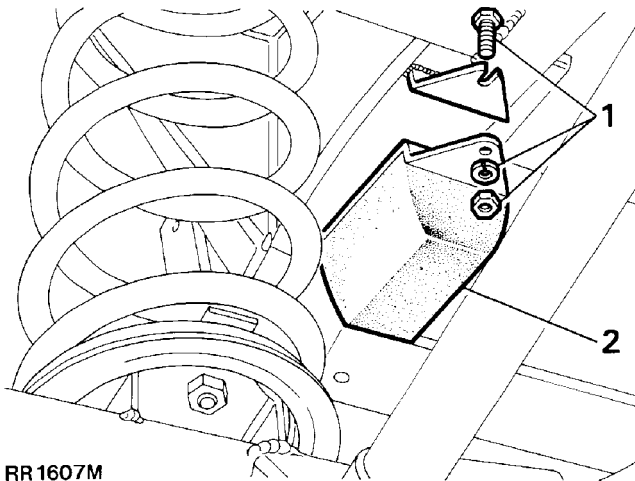
8. Reverse removal procedure.

**BUMP STOP**

Service repair no - 64.30.15.

**Remove**

1. Remove fixings.
2. Remove bump stop.



RR1607M

**Refit**

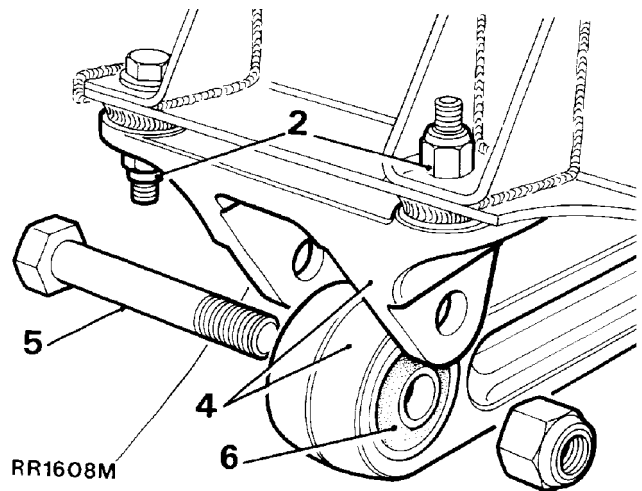
3. Position bolts in slots in bracket.
4. Fit bump stop secure with washer and nuts.

**SUSPENSION LINK UPPER**

Service repair no - 64.35.44.

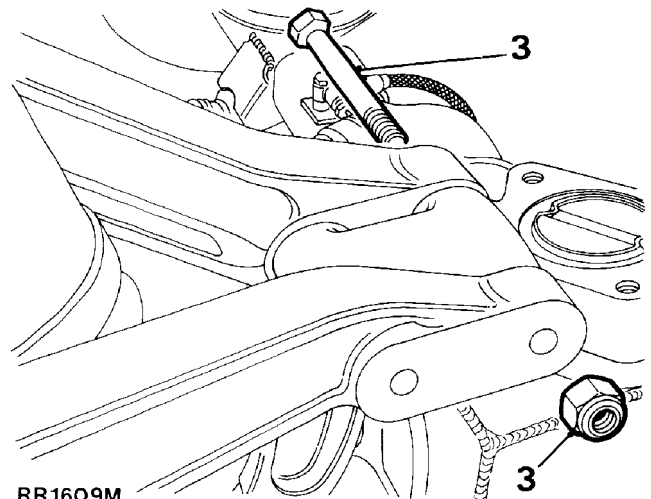
**Remove**

1. Support rear of chassis on stands, allow axle to hang freely.
2. Remove fixings, upper link bracket to frame.
3. Remove fixings, upper links to pivot bracket.
4. Remove upper link complete with frame bracket.



RR1608M

5. Remove bolt.
6. Separate link from bracket.



RR1609M



**Renew bush**

7. Press out rubber bushes.
8. Fit bush centrally in housing.



**CAUTION: Apply pressure to outer edge of bush, and not rubber inner.**

**Refit**

9. Reverse removal procedure. 1 to 6. Do not fully tighten fixings until all components are in position.
10. Tighten fixings to correct torque. **See Specifications, torque, Torque Values**

---

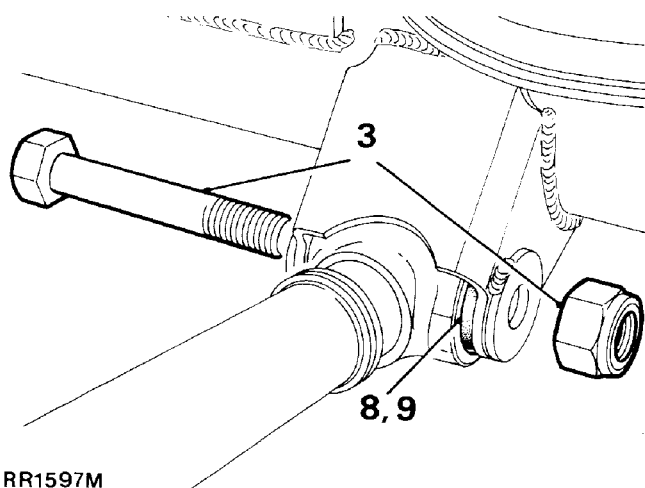
**SUSPENSION LINK LOWER**

---

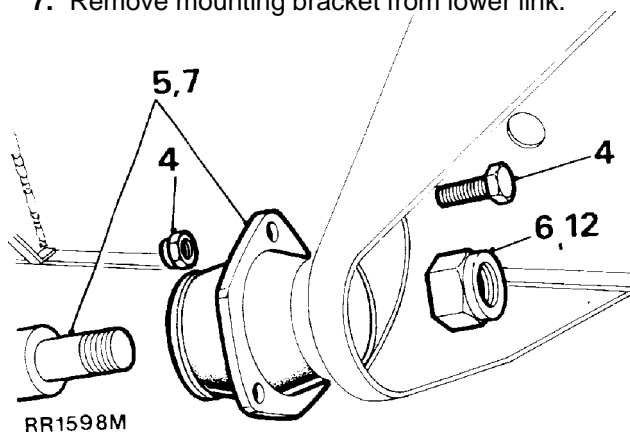
**Service repair no - 64.35.02.**

**Remove**

1. Site vehicle on a ramp [hoist].
2. Alternatively, support vehicle on stands under rear axle.
3. Remove rear fixings.



4. Remove mounting bracket fixings at side member bracket.
5. Remove lower link complete.
6. Remove locknut.
7. Remove mounting bracket from lower link.



**Renew bush**

8. Press out rubber bushes.
9. Fit bush centrally in housing.



**CAUTION: Apply pressure to outer edge of bush, and not rubber inner.**

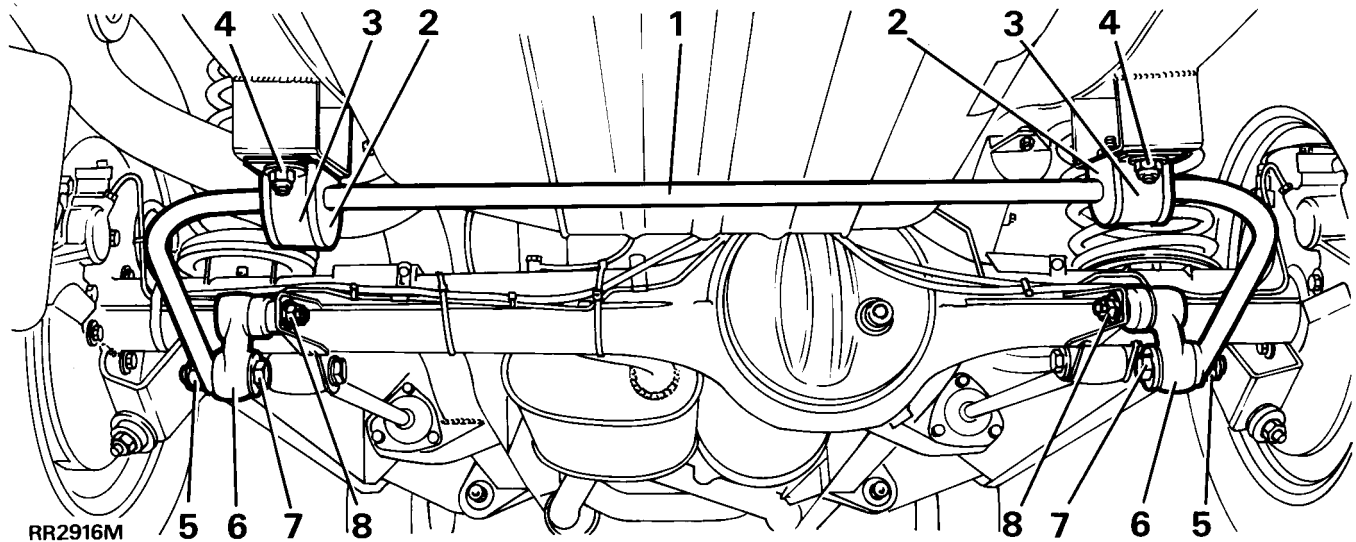
**Refit**

10. Reverse removal procedure. 6 and 7. Do not tighten locknut.
11. Reverse removal procedure. 3 to 5.
12. Lower vehicle, allow axle to take up static laden position. Tighten to **176 Nm**.



## ANTI-ROLL[SWAY] BAR ASSEMBLY REAR

Service repair no - 64.35.08.



### KEY

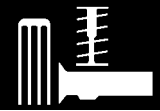
- |                        |                                   |
|------------------------|-----------------------------------|
| 1. Anti-roll[sway] bar | 5. Nut and washer                 |
| 2. Rubber bush         | 6. Ball joint link arm            |
| 3. Strap               | 7. Bolt and washer                |
| 4. Nut, bolt, washer   | 8. Castellated nut and cotter pin |

### Remove

1. Note for reassembly, position of rubber bushes on anti-roll bar.
2. Remove four nuts, bolts and washers securing two bush straps.
3. Remove nuts, bolts, washers and rubber bushes from the ball joint links and remove anti-roll bar.

### Refit

4. Position rubber bushes on anti-roll bar. Fit joint towards axle.
5. Fit anti-roll bar with two straps. Ensure ball joint link arms point down as shown. Loosely fit, bolts, washers and new nyloc nuts.
6. Fit bolt, washers and rubber bushes. Fit anti-roll bar to ball joint links. Tighten to **68Nm**.
7. Tighten nuts securing straps to **30Nm**.

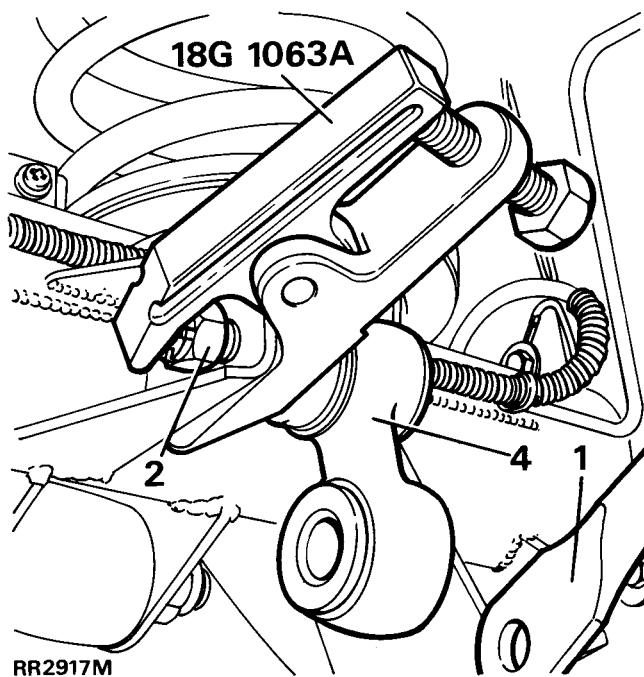


## ANTI-ROLL[SWAY] BAR BALL JOINT LINKS

Service repair no - 64.35.24.

### Remove

1. Remove two nuts, bolts, washers and rubber bushes from ball joint links and lower anti-roll bar to clear links.
2. Remove cotter pin and loosen castellated nut a few turns.
3. Release ball joint using special tool 18G 1063A as shown.
4. Remove castellated nut and ball joint link.



### Refit

5. Fit ball joint link arm and castellated nut. Point ball joint link arm down as shown. Tighten to **40Nm** and fit new cotter pin.
6. Align anti-roll bar to ball joint links.
7. Fit bolts, washers and rubber bushes using new self locking nuts secure anti-roll bar to ball joint links. Tighten to **68Nm**.



**TORQUE VALUES**



**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
<b>Anti-roll[sway] bar rear</b>	
- Strap nyloc nuts .....	30
- Ball link self lock nut .....	68
- Castellated nut .....	40
Top link to mounting bracket .....	176
Bottom link to axle .....	176
Bottom link to chassis .....	176
Top link bracket to rear cross member .....	47
Shock absorber to axle .....	37

Torque values below are for all screws and bolts used except for those that are specified otherwise.

<b>METRIC</b>	Nm
M5 .....	6
M6 .....	9
M8 .....	25
M10 .....	45
M12 .....	90
M14 .....	105
M16 .....	180

<b>UNC / UNF</b>	
1/4 .....	9
5/16 .....	24
3/8 .....	39
7/16 .....	78
1/2 .....	90
5/8 .....	136



## BRAKES

Discovery vehicles have servo assisted brake systems and the option of an anti-lock brake system. Information in this section refers to components relevant to both brake systems. Where the system components are different they are referred to as ABS or NON ABS

### BRAKE SYSTEM NON ABS

#### Description

The servo assisted hydraulic braking system is the dual line type, incorporating primary and secondary hydraulic circuits.



**NOTE: References made to primary or secondary do not imply main service brakes or emergency brakes but denote hydraulic line identification.**

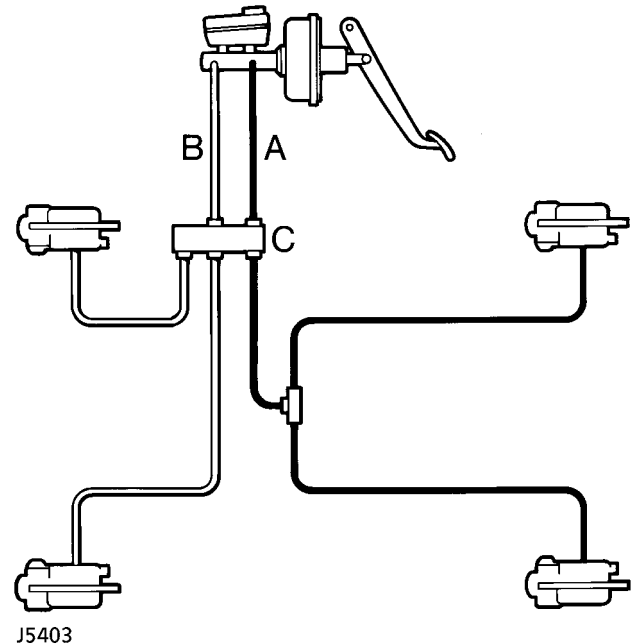
The brake pedal is connected to a vacuum assisted mechanical servo which in turn operates a tandem master cylinder. The front disc brake calipers each house four pistons, these pistons are fed by the secondary hydraulic circuit. The rear disc brake calipers each house two pistons, these are fed by the primary hydraulic circuit via a pressure reducing valve.

A brake fluid level switch is incorporated into the reservoir cap assembly, the switch will immediately illuminate a warning light in the instrument binnacle indicating low fluid or sudden fluid loss.

The brake fluid reservoir is divided, the section closest to the servo feeds the primary circuit and the section furthest from the servo feeds the secondary circuit. Under normal operating conditions both the primary and secondary circuits operate simultaneously on brake pedal application. In the event of a failure in the primary circuit the secondary circuit will still function. If the secondary circuit fails the primary circuit will still function. The brake pedal travel will be longer in the event of a half system failure.

If the servo should fail, both hydraulic circuits will still function but would require greater pedal effort due to the lack of vacuum assistance. The hand operated parking brake acts on a brake drum at the rear of the transfer gearbox and is completely independent of the hydraulic circuits.

#### Hydraulic circuit non ABS

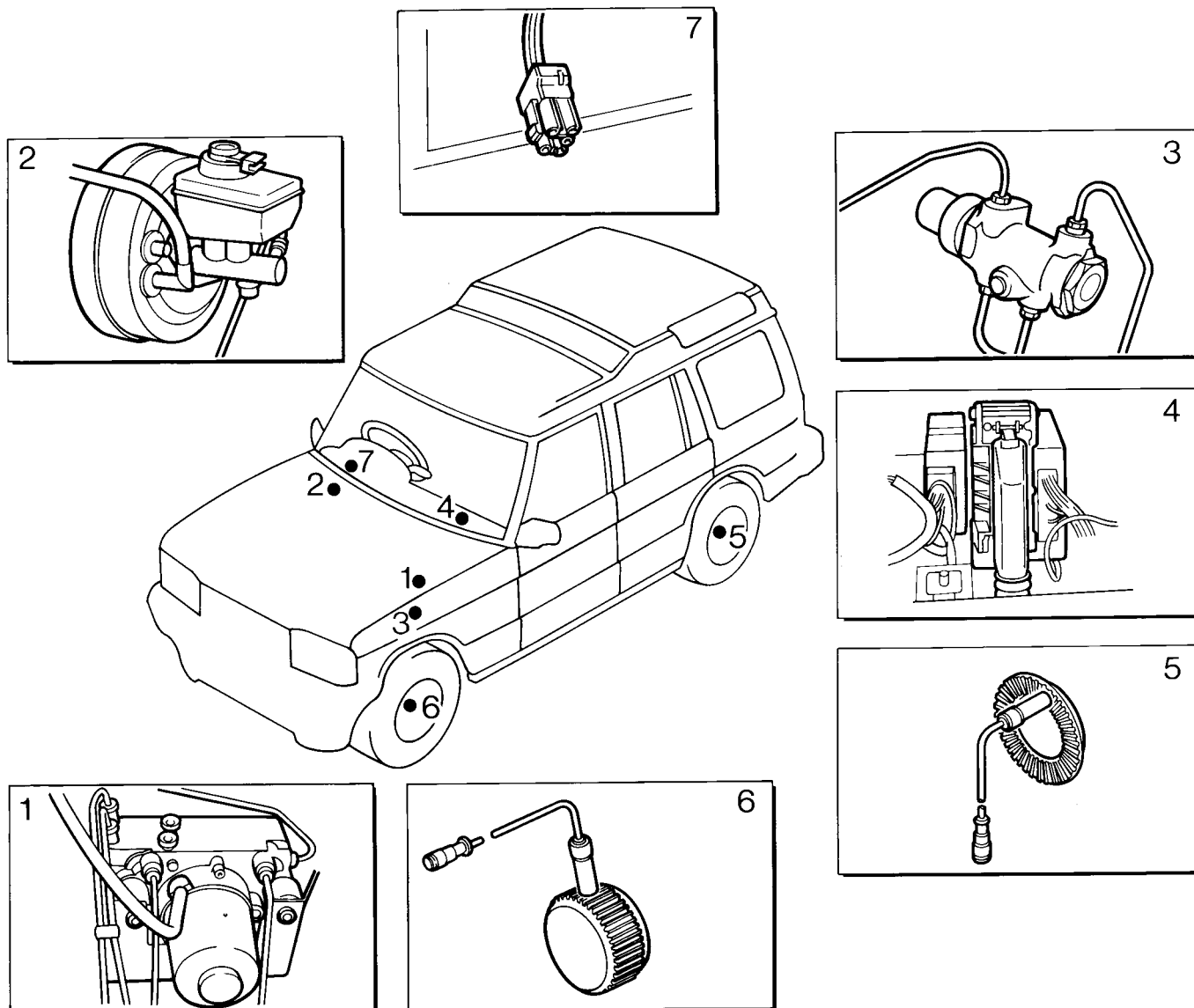


#### Key

- A = Primary hydraulic circuit
- B = Secondary hydraulic circuit
- C = Pressure reducing valve

## ABS COMPONENTS

### Location



J5407M

### Key to diagram

- |                            |                                |
|----------------------------|--------------------------------|
| 1. ABS Modulator unit      | 5. Rear sensors/exciter rings  |
| 2. Servo/Master cylinder   | 6. Front sensors/exciter rings |
| 3. Pressure reducing valve | 7. Diagnostic plug connection  |
| 4. Electronic control unit |                                |



## Description of components

### 1. ABS Modulator unit

To provide the ABS function a Modulator is positioned within the system between the master cylinder and the calipers. On both LHD and RHD vehicles it is sited on the left inner wing [fender]. The Modulator has 8 solenoid valves, 2 for each wheel, 2 expanders and a recirculation pump. It is non serviceable.

### 2. Servo/master cylinder

Actuation of the system is provided by a combined master cylinder and servo assembly attached to the pedal box, this provides pressure to opposed piston calipers at each brake pad Twin piston at the front axle, single piston at the rear.

### 3. Pressure reducing valve

To maintain the braking balance, pressure to the rear axle is regulated by a Pressure Reducing Valve (PRV) This PRV is of the failure bypass type, allowing full system pressure to the rear axle in the event of a front circuit failure. It is sited on the left inner wing [fender].

### 4. Electronic control unit - ECU

ABS control is provided by an electronic control unit which is positioned on the passenger side of the vehicle behind the dash panel/glove box. The ECU, which is non-serviceable, is connected to the ABS harness by a 35 way connector. non serviceable.

The ECU continually monitors the brake system, providing diagnostics in the event of a system malfunction. Details of how to access the ECU diagnostics are provided in the Electrical Troubleshooting Manual.

### 5.& 6. Front and rear sensors/exciter rings - 4 off

A sensor is sited at each wheel, sensing a 60 tooth exciter ring. When vehicle is in motion inductive sensors send signals to ECU. Front exciter ring is fitted to outside diameter of constant velocity joint inside each front hub assembly. The rear exciter ring is bolted to the rear of each brake disc bell.

## 7. Diagnostic plug connection

A diagnostic plug is located behind the dash. To the left of the steering column on LHD vehicles. To the right of the steering column on RHD vehicles. It is a 5 way blue connector.

The location and identification of ABS electrical relays are given in the Electrical Troubleshooting Manual.

For location and identification of ABS electrical fuses. **See ELECTRICAL, Repair, Fuse Box - Interior** or. **See ELECTRICAL, Repair, Fuse Box - Engine Compartment**

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## ANTI-LOCK BRAKE SYSTEM - ABS

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Manufactured by WABCO

### Introduction

The purpose of ABS is to prevent vehicle wheels locking during brake application, thus maintaining vehicle steerability and stability. This allows vehicle to be steered whilst brakes are applied, even under emergency conditions, and to avoid obstacles where there is sufficient space to redirect the vehicle.



**WARNING: ABS is an aid to retaining steering control and stability while braking.**

- **ABS cannot defy the natural laws of physics acting on the vehicle.**
- **ABS will not prevent accidents resulting from excessive cornering speeds, following another vehicle too closely or aquaplaning, i.e. where a layer of water prevents adequate contact between tyre and road surface.**
- **The additional control provided by ABS must never be exploited in a dangerous or reckless manner which could jeopardise the safety of driver or other road users.**
- **The fitting of ABS does not imply that the vehicle will always stop in a shorter stopping distance.**

## System description

The brake system consists of dual hydraulic circuits in a front - rear split. That is individual circuits to front and rear axles.

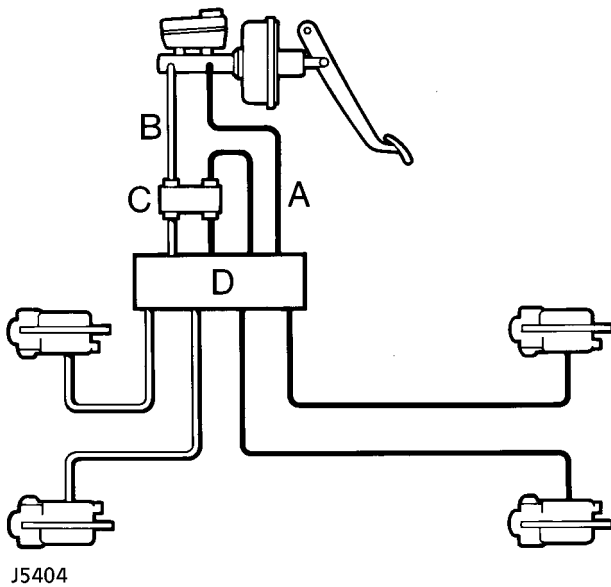
Wheelspeed signals are provided by the fitting of exciter rings to axles and speed sensors.

An ABS stop light switch is fitted to provide a braking signal to the ECU as well as operate the stop lights.

Electrical wiring is provided as necessary with system relays and fuses. Discovery Electrical Troubleshooting Manual gives the location and wiring circuits of these components.

Visual warning of system malfunction is provided via a warning light in the instrument panel.

## Hydraulic circuit ABS



## Key

- A = Primary hydraulic circuit
- B = Secondary hydraulic circuit
- C = Pressure reducing valve
- D = ABS Modulator

## ABS System operation

During normal braking the feel of the brake pedal on vehicles equipped with ABS will be the same as that on non ABS vehicles. During ABS cycling the driver will experience feedback in the form of a pulsating brake pedal and solenoid/pump motor noise from the Modulator.

The system is fully automatic in operation both on and off road, and will only act when the ECU detects that ABS cycling is necessary. The ECU continually monitors the operation of the system.

When starting the ABS system will go through a series of self checks, including a check of the solenoid valves/pump motor.

## WARNING LIGHT

The warning light will be on during the self check (1.3-2 secs). If no faults are stored in the memory the light goes out for 0.5sec, then comes on again. It will then remain on until the vehicle is driven faster than 7 kph/5mph. This is the only time that the light will be on without indicating a problem.

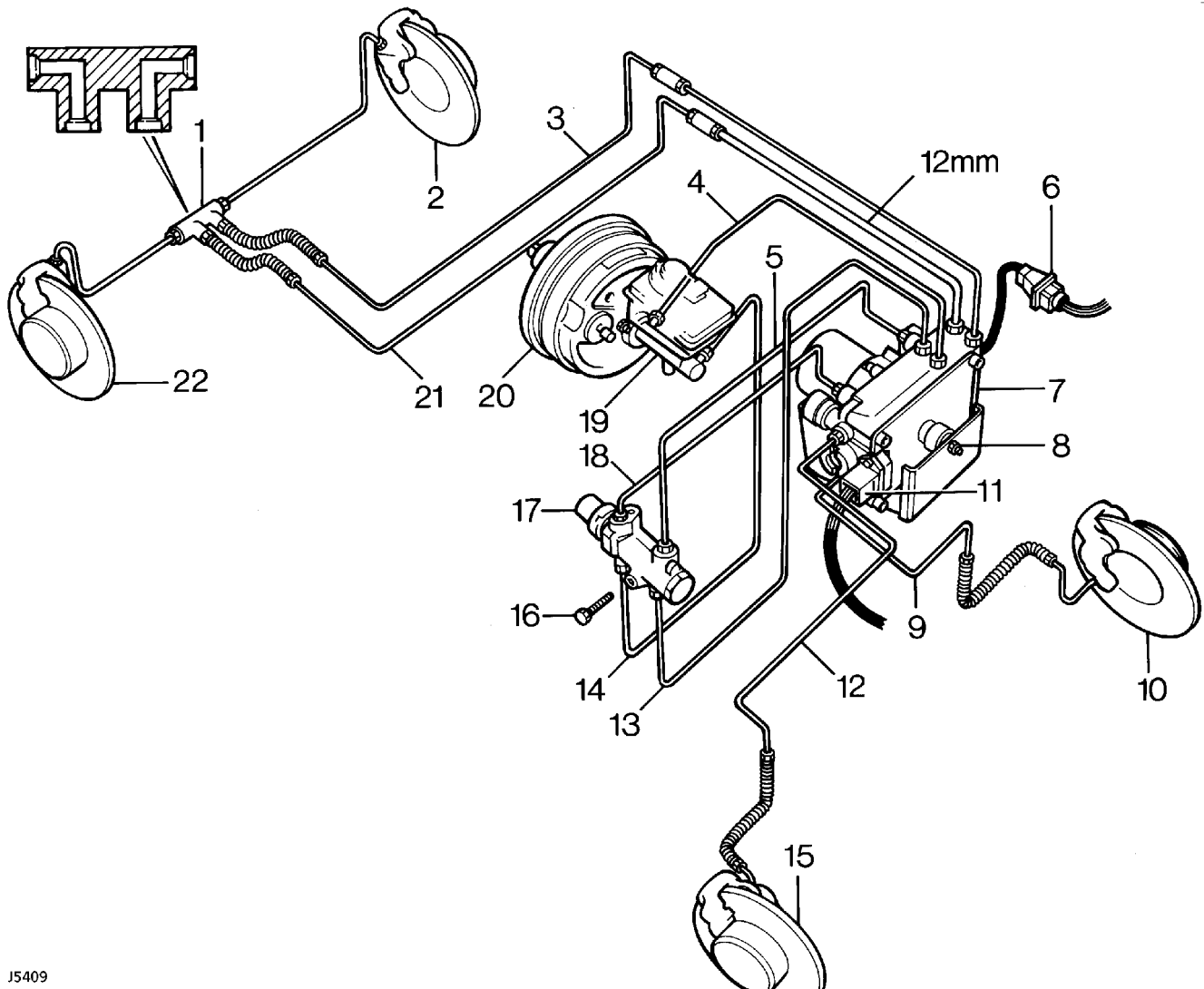


Any faults detected by the ECU will cause the warning light to illuminate indicating that the vehicle may not have full ABS control.



## BRAKE PIPE LAYOUT ABS

Left hand drive shown. On right hand drive vehicles the master cylinder and servo unit only move position.



J5409

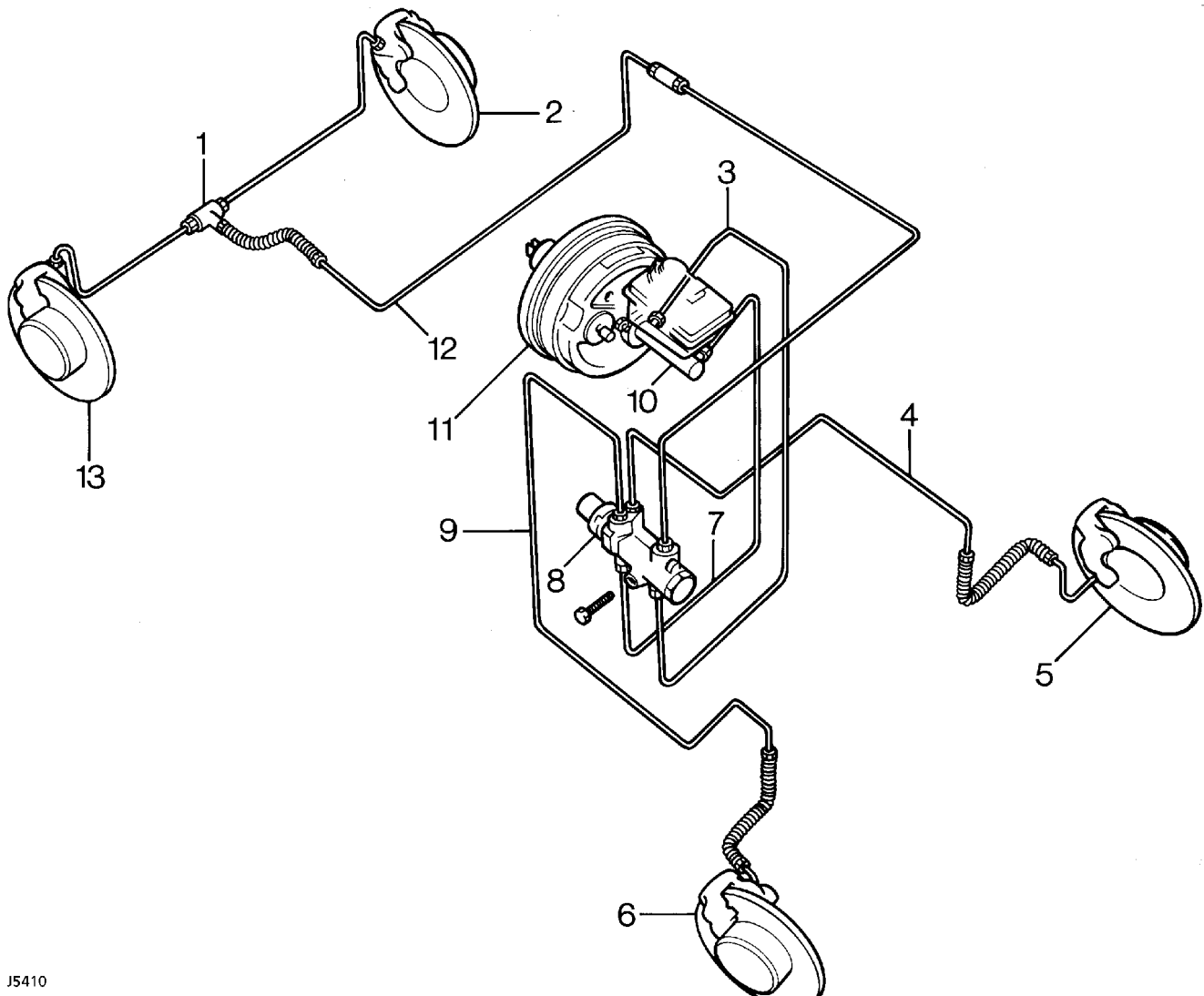
### KEY

- |   |  |
|---|--|
| 1. Connector double elbow                     | 12. Modulator to front right brake                   |
| 2. Rear left brake                            | 13. Modulator to pressure reducing valve lower       |
| 3. Modulator to rear left brake               | 14. Master cylinder to pressure reducing valve lower |
| 4. Modulator to master cylinder               | 15. Front right brake                                |
| 5. Modulator to pressure reducing valve upper | 16. Bolt   |
| 6. Electrical connection                      | 17. Pressure reducing valve                          |
| 7. Modulator unit                             | 18. Modulator to pressure reducing valve upper       |
| 8. Nut, mounting bush and cup                 | 19. Master cylinder                                  |
| 9. Modulator to front left brake              | 20. Servo unit                                       |
| 10. Front left brake                          | 21. Modulator to rear right brake                    |
| 11. Electrical connection                     | 22. Rear right brake                                 |



## BRAKE PIPE LAYOUT NON ABS

Left hand drive shown. On right hand drive vehicles the master cylinder and servo unit only move position.



J5410

### KEY

- |  |   |
|--|---|
| 1. T-Connector                                       | 8. Pressure reducing valve                            |
| 2. Rear left brake                                   | 9. Front right brake to pressure reducing valve upper |
| 3. Master cylinder to pressure reducing valve lower  | 10. Master cylinder                                   |
| 4. Front left brake to pressure reducing valve upper | 11. Servo unit  |
| 5. Front left brake                                  | 12. Pressure reducing valve upper to both rear brakes |
| 6. Front right brake                                 | 13. Rear right brake                                  |
| 7. Master cylinder to pressure reducing valve lower  |   |



## BRAKE SERVO UNIT

### Description

The power assistance for the brake system is provided by a twin diaphragm suspended vacuum servo.

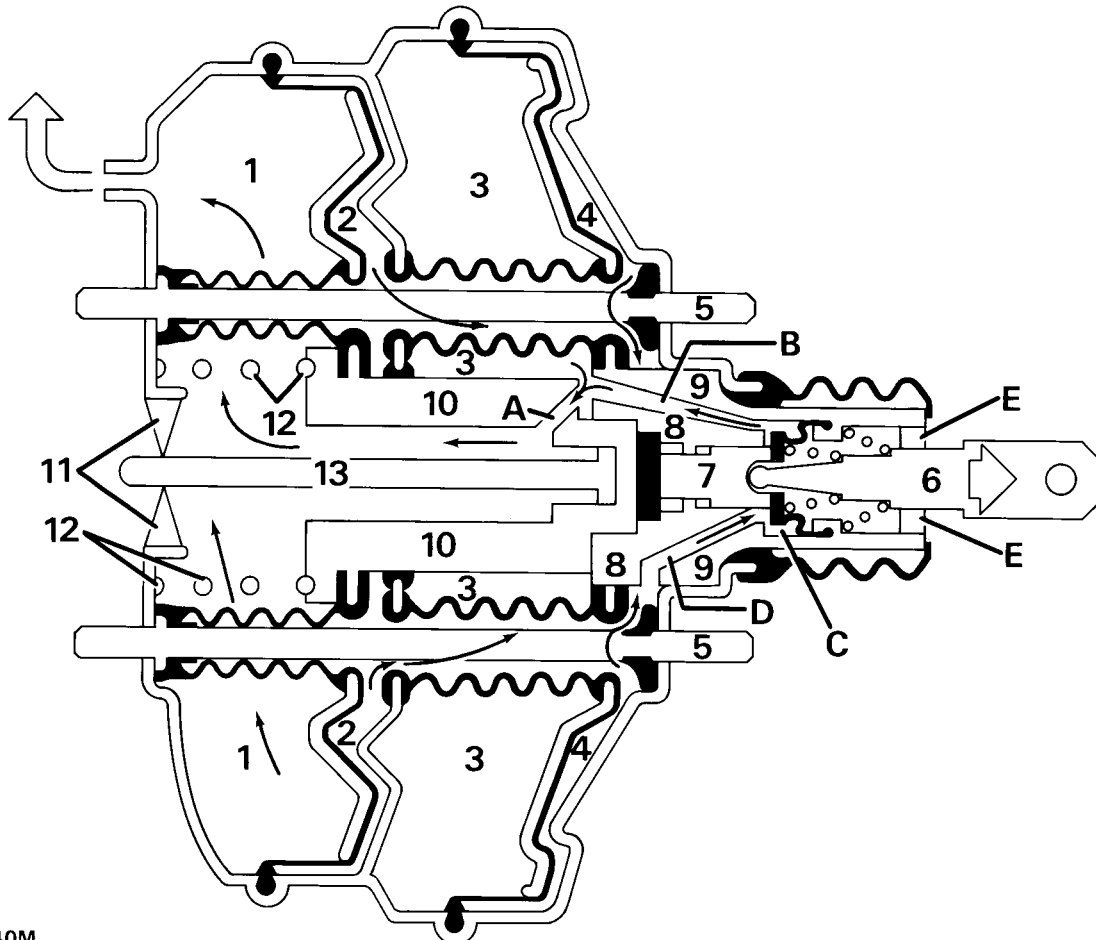
A 'Suspended Vacuum' servo is one where, with the engine running vacuum is present both sides of the diaphragm or diaphragms when the brakes are fully released or partially applied. The principal of having vacuum both sides of the diaphragm has two main advantages. First, it ensures instantaneous servo response to the brake being applied or released and second, it provides very accurate control of the position of the diaphragm and therefore, the degree of partial brake application.

At full pedal depression, vacuum is present in front of the diaphragm with atmospheric pressure on the rear.

### Operation

#### Brakes released

With the brakes released depression is present both sides of the diaphragms, in chambers 1,2,3 and 4. The chambers communicate by ports A, B, D via the valve C which is shown fully released in RR3640M.



RR3640M

## Brakes applied

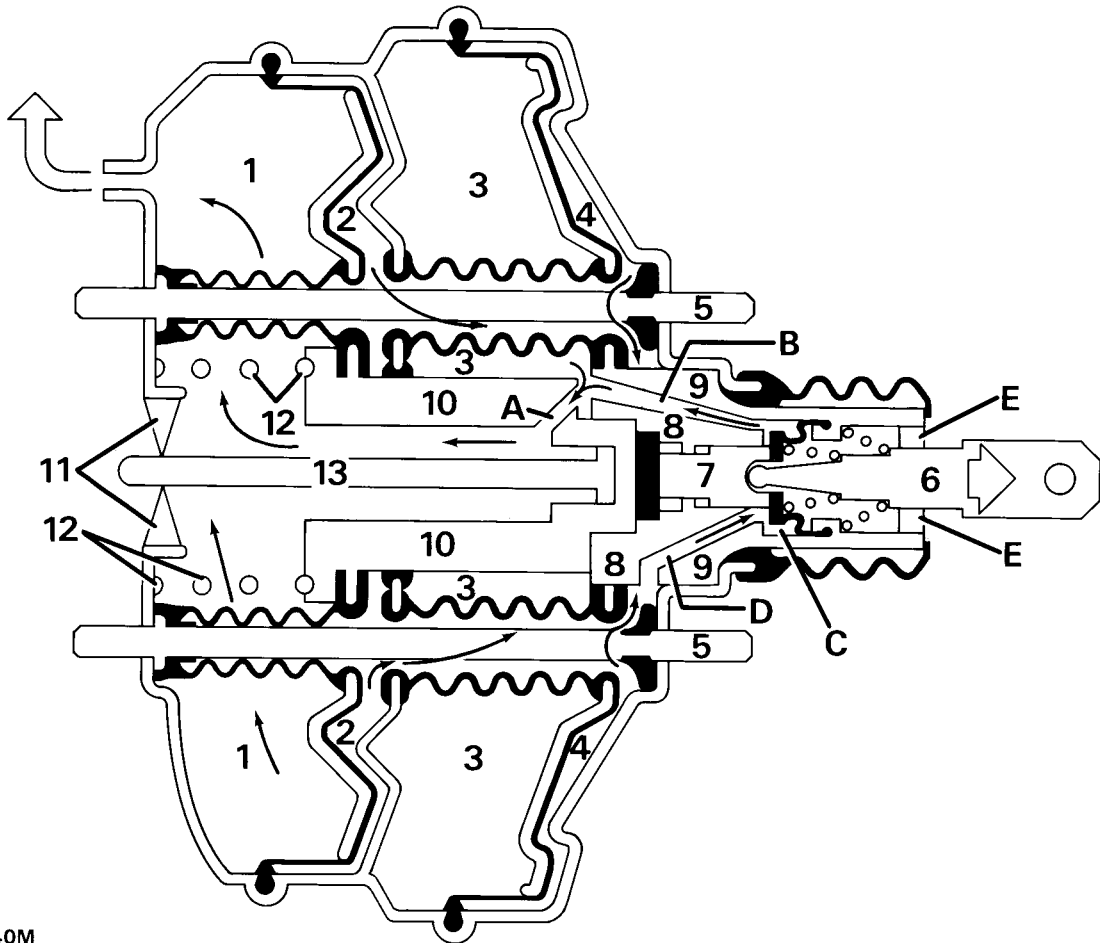
When the brake pedal is depressed the pedal pushrod operates valve C situated in the plastic diaphragm hub 9 and 10. Initial depression of the the brake pedal, push rod 6 and plunger 7 compress a rubber pad 8. This slight movement causes valve C to close port D sealing off the vacuum to chambers 2/4 and allows atmospheric pressure to enter the chambers through the air filter E.

With depression in chambers 1/3 and air pressure in chambers 2/4 the servo hub will apply the brakes via the master cylinder push rod 13.

Atmospheric pressure over the large area of the diaphragms multiples the force applied to the master cylinder piston, to provide the power assistance. If the brake pedal is only partially depressed, the servo hub, diaphragms and master cylinder push rod will stop moving, when valve C comes to rest on the plunger 7. At this point the valve will balance the pressure in all the chambers, to the applied effort at the pedal and provide proportional braking.

It is only when the brakes are fully applied that the valve does not balance the pressures in all the chambers, but ensures that maximum available depression is in chambers 1/3 and full atmospheric pressure enters chambers 2/4.

When the brake pedal is released, the pressure in all chambers is equalised and the servo is returned to the rest position by spring 12.



RR3640M



### **Petrol engine vacuum system**

The vacuum necessary to operate the brake servo on petrol engine vehicles is provided by the engine inlet manifold. During normal operation of the brakes only a small volume of air is drawn from the servo and into the inlet manifold or plenum chamber. However any excessive air leaks due to damage in the brake servo system or manifold hose connection, will effect the mixture strength and ECM fuelling calculations on engines equipped with an MFI system.

### **Diesel engine vacuum system**

As the diesel engine inlet system does not produce depression sufficient to operate the brake servo, it is necessary to install an engine driven vacuum pump.

During normal operation of the brakes only a small volume of air is drawn from the servo by the vacuum pump. However as the pump exhausts air into the engine crankcase atmosphere, an air leak due to damage in the brake servo system or pump hose connection, may cause excessive crankcase pressure.



## ABS FAULT DIAGNOSIS

If a fault has occurred, or has been identified by ECU self diagnostic function and ABS warning light is illuminated. The system and components must be checked to locate and rectify fault, using Testbook diagnostics.



**NOTE: If warning lamp has indicated a fault in system, and no fault code has been stored in memory, cause of fault is:**

- a) Failure in electrical supply
- b) Bad ECU ground
- c) Faulty warning light relay
- d) ECU not connected

Before commencing fault diagnosis procedure following items must be checked:

1. Inspect all exposed cables for damage or abrasion.
2. Check ground on ABS system.
3. Battery - state of charge.
4. Check hub end-float.
5. All ABS fuses and electrical connections.

### Fault rectification

1. Complete harness should be replaced if faults are found in wiring harness.
2. DO NOT use unspecified cables or connectors, as this could jeopardise safe function of ABS.
3. DO NOT attempt to open sealed 35 way connector to ECU.

## FAULT DIAGNOSIS PROCEDURE



**NOTE: If ABS warning light illuminates due to large sensor air gap, fault will be retained by the ECU memory. Where wheel sensors have been pushed fully home prior to test, The ECU will indicate a fault that has been rectified.**



**NOTE: After any steering adjustment, bearing replacement/adjustment, brake disc replacement: Check hub end-float and sensor clearance.**

## RELAYS AND FUSES ABS

The location and identification of ABS electrical relays are given in the Electrical Troubleshooting Manual

For location and identification of ABS electrical fuses. **See ELECTRICAL, Repair, Fuse Box - Interior** or. **See ELECTRICAL, Repair, Fuse Box - Engine Compartment**

## ABS FAULT AND REMEDY CHART

SYMPTOM	POSSIBLE CAUSE	CHECK	REMEDY
ABS warning light on	ABS electrical fault  High sensor air gaps	Check ABS electrical circuit with Testbook diagnostic equipment	Change component if necessary  Push in sensors
Brake fluid warning light ON	Fluid loss  Reservoir fluid level switch malfunction	Check reservoir fluid level and inspect system for leaks Check fluid level switch	Rectify leakage, refill reservoir  Change reservoir cap/switch
Pedal travel increased, foot pressure normal	Air in system  Master cylinder malfunction		Rebleed brake system  Change master cylinder
Pedal can be moved downwards under constant pressure	Seal leaking in master cylinder  Seal leaking in servo unit	Inspect system for leaks	Change master cylinder  Change servo unit



## GENERAL BRAKE SERVICE PRACTICE

### Brake fluid precautions



**WARNING:** Do not allow brake fluid to come into contact with eyes or skin.



**CAUTION:** Brake fluid can damage paintwork, if spilled wash off immediately with plenty of clean water.



**CAUTION:** Use only correct grade of brake fluid. If an assembly fluid is required use **ONLY** brake fluid. Do **NOT** use mineral oil, i.e. engine oil etc.



**CAUTION:** Thoroughly clean all brake calipers, pipes and fittings before commencing work on any part of the brake system. Failure to do so could cause foreign matter to enter the system and cause damage to seals and pistons which will seriously impair the efficiency of the brake system.

- To ensure the brake system efficiency is not impaired the following warnings must be adhered to :-
- **DO NOT** use any petroleum based cleaning fluids or any proprietary fluids containing petrol.
- **DO NOT** use brake fluid previously bled from the system.
- **DO NOT** flush the brake system with any fluid other than the recommended brake fluid.

The brake system should be drained and flushed at the recommended service intervals.

Cover all electrical terminals carefully to make absolutely certain that no fluid enters the terminals and plugs.

## FLUID LEVEL CHECK / TOP UP



**WARNING:** Clean reservoir body and filler cap before removing cap. Use only fluid from a sealed container.

1. Park vehicle on level ground.
2. Check level is between 'MIN' and 'MAX' marks.
3. If level is below 'MIN' mark top up fluid level to 'MAX' mark on reservoir, using correct fluid. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**

Do not fill reservoir above maximum line

## BRAKE SYSTEM BLEED

### Service repair no - 70.25.02

The following method for bleeding the hydraulic brake system applies to both ABS and NON ABS vehicles.

### Preparation



**WARNING:** Before bleeding the brake system refer to general brake service practice. See *General Brake Service Practice*

### Practice

- During bleed procedure, brake fluid level must not be allowed to fall below the MIN level. Keep reservoir topped to the MAX level.
- To bleed the hydraulic circuits four bleed nipples are provided, one at each caliper.
- There are two methods by which air can be removed from the braking system:-

1. MANUAL BLEED PROCEDURE.
2. PRESSURE BLEED PROCEDURE.

### Pressure bleed procedure

Purpose designed equipment for pressure filling and bleeding of hydraulic systems may be used on Land Rover vehicles. The equipment manufacturer's instructions must be followed and the pressure must not exceed 4.5 bar.

### Manual bleed procedure

Equipment required

- Clean glass receptacle
- Bleed hose
- Wrench
- Approx 2 litres brake fluid. See *LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids*

### Master cylinder bleed

1. Disconnect battery negative lead.
2. Depress brake pedal fully and slowly 5 times.
3. Release the pedal and wait for ten seconds.
4. Air bubbles will rise into the reservoir during these instructions.
5. Repeat instructions until a firm resistance is felt at the pedal.

### Complete circuit bleed

1. Disconnect battery negative lead.
2. Fit bleed hose to any caliper bleed screw.
3. Dip free end of bleed hose into brake fluid in bleed bottle.
4. Open bleed screw of caliper.
5. Depress brake pedal fully several times until fluid is clear of air bubbles.
6. Keeping pedal fully depressed, tighten bleed screw, then release pedal.
7. Repeat the above procedure on remaining three calipers.
8. Fit all bleed screw protection caps.
9. Check/top-up fluid level when bleeding is complete. See *Fluid Level Check / Top-Up*





## MASTER CYLINDER ABS

Service repair no - 70.30.08

- Lucas Girling - Type 25.4mm CV/CV

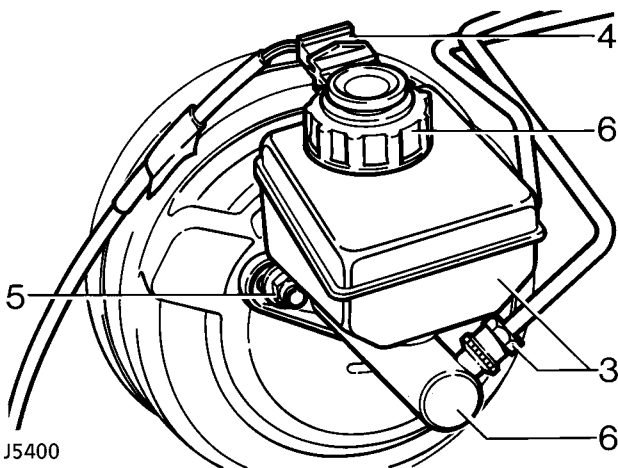


**NOTE: This master cylinder is identified by a 3rd plugged outlet port protruding down from the master cylinder body.**

Before starting repair refer to general brake service practice. **See General Brake Service Practice**

### Remove

1. Disconnect battery negative lead.
2. Place a suitable container under master cylinder to catch brake fluid from cylinder when brake pipes are disconnected.
3. Thoroughly clean immediate area around all outlet ports. Remove each brake pipe, sealing each pipe and outlet port with suitable plugs to prevent ingress of foreign matter.
4. Disconnect electrical plug from low fluid switch on reservoir cap.
5. Remove two nuts securing master cylinder to servo unit remove also spring and plain washers.



6. Detach master cylinder from servo, remove reservoir cap and drain brake fluid into a container.

### Refit



**NOTE: Ensure O ring seal between master cylinder and servo unit is fitted correctly.**

7. Fit master cylinder to servo. Secure in position with two nuts, plain and spring washers. Tighten to **26 Nm**.
8. Fit brake pipes to master cylinder. Tighten to **15Nm**.
9. Top-up master cylinder with correct grade of brake fluid. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**
10. Bleed system. **See Brake System Bleed**
11. Fit cap, reconnect electrical lead to fluid level switch. Reconnect battery negative lead.

## MASTER CYLINDER NON ABS

Service repair no - 70.30.08 - Remove

Service repair no - 70.30.09 - Repair

- Lucas Girling - Type 25.4mm AS/AS

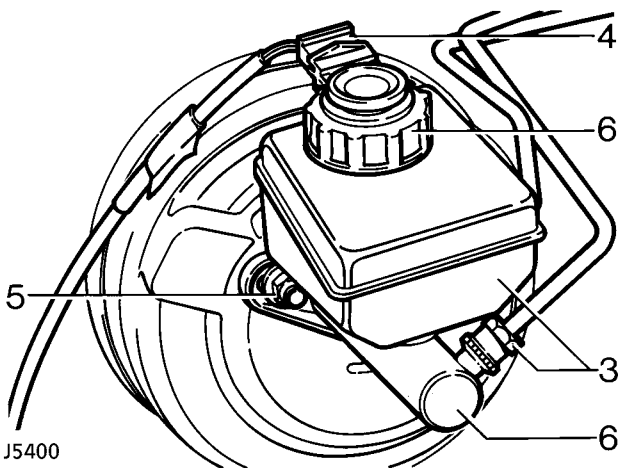


**WARNING:** This master cylinder is not suitable to be fitted on vehicles with antilock brake systems.

Before starting repair refer to general brake service practice. **See General Brake Service Practice**

### Remove

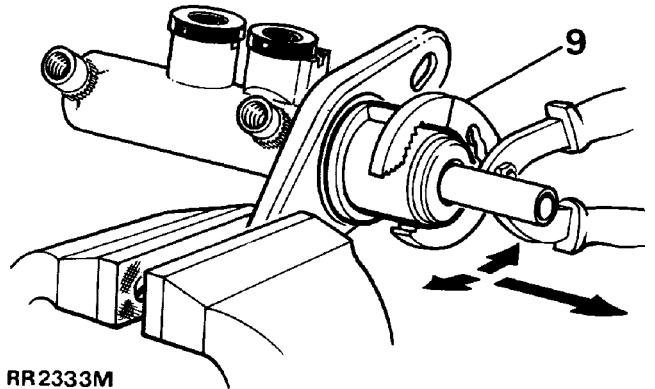
1. Disconnect battery negative lead.
2. Place a suitable container under master cylinder to catch brake fluid from cylinder when brake pipes are disconnected.
3. Thoroughly clean immediate area around all outlet ports. Remove each brake pipe, sealing each pipe and outlet port with suitable plugs to prevent ingress of foreign matter.
4. Disconnect electrical plug from low fluid switch on reservoir cap.
5. Remove two nuts securing master cylinder to servo unit remove also spring and plain washers.



6. Detach master cylinder from servo, remove reservoir cap and drain brake fluid into a suitable container.

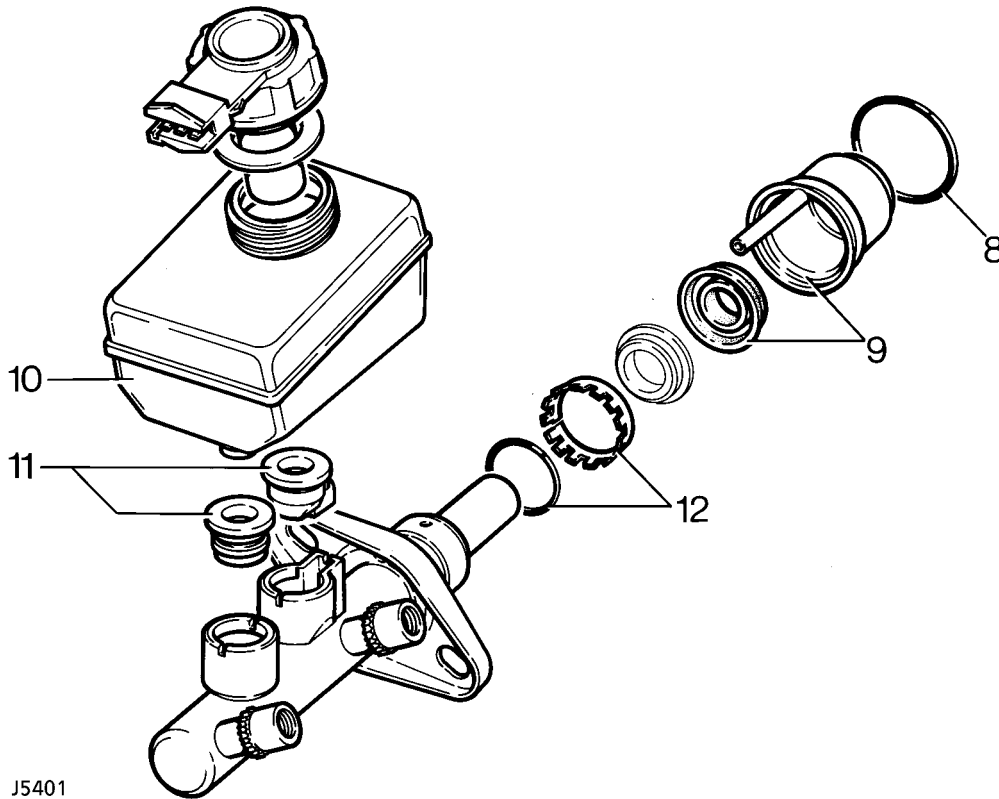
### Repair

7. Thoroughly clean master cylinder and inspect outer surfaces for damage and condition, renew complete assembly if necessary.
8. Using two soft jaws, clamp master cylinder flange in a suitable vice. Remove water ingress 'O' ring seal from master cylinder to servo flange and discard.

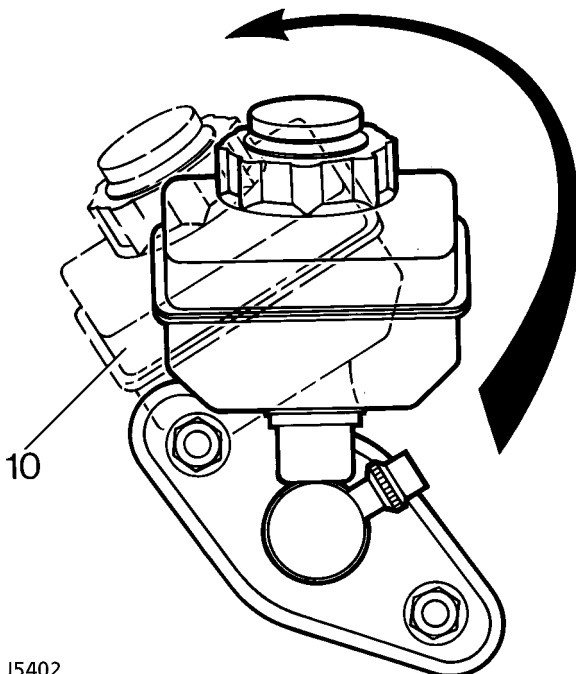


RR2333M

9. Grip outside of transfer housing with a suitable pair of pliers, carefully pull, working pliers in a backwards and forwards rocking motion to ease housing off master cylinder. Discard housing and vacuum seal.



J5401

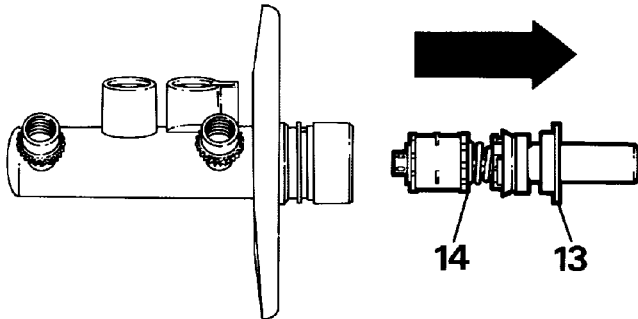


J5402

10. Ease reservoir out of master cylinder taking care to ensure that two outlet ports on bottom of reservoir do not become damaged during this process.
11. Withdraw two reservoir seals from master cylinder inlet ports. Note for reassembly these seals are different. Discard seals.
12. Remove retaining ring and 'O' ring seal from machined outer surface of master cylinder. Discard both seal and retaining ring.
13. Remove guide ring, which supports primary plunger assembly, from mouth of master cylinder. Place to one side for reassembly, note this component is not part of service kit.
14. Pull primary plunger assembly out of master cylinder.

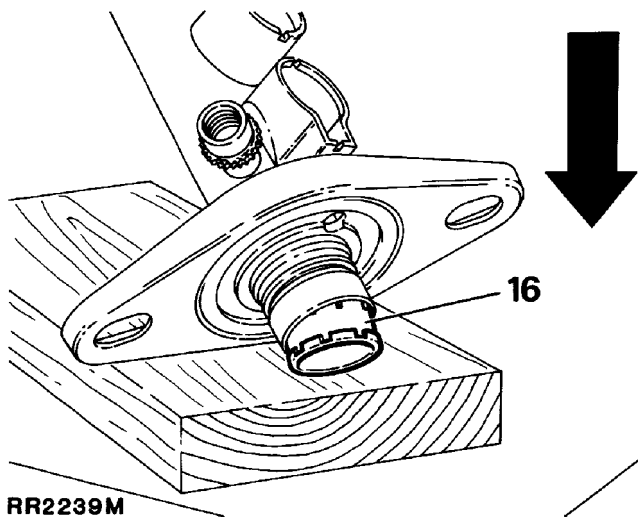


**NOTE:** The primary plunger assembly cannot be broken down any further and is serviced as a complete unit. Discard assembly.



RR2238M

15. The secondary plunger assembly will remain at bottom of master cylinder bore. Remove tapping assembly on a piece of wood until plunger appears at cylinder mouth, carefully pull plunger out of master cylinder.



RR2239M

16. If swirl tube was not expelled at same time as secondary plunger, repeat above operation to remove it from bottom of master cylinder bore and discard.
17. Clean all parts with unused brake fluid. Place cleaned parts onto a clean sheet of paper. Inspect cylinder bore and plungers for signs of corrosion, ridges and score marks. Provided working surfaces are in perfect condition, new seals from a Girling Service repair kit may be used.

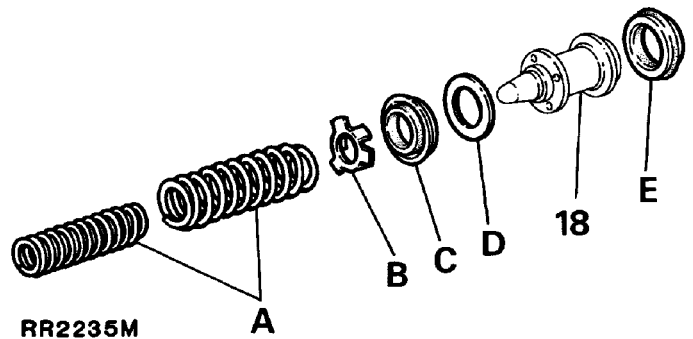
### Renewing secondary plunger seals

18. Remove following components from secondary plunger and discard:



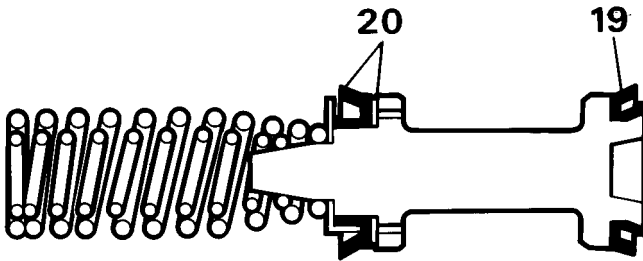
**NOTE:** A small screwdriver with end rounded off and polished is required to remove 'L' seal. **DO NOT** damage secondary plunger.

- (A) Springs
- (B) Seal retainer
- (C) Recuperating seal (primary cup)
- (D) Washer
- (E) 'L' seal





19. Coat new seals in unused brake fluid. Fit 'L' seal to plunger.
20. Fit washer followed by recuperating seal. Fit seal retainer and springs, ensure springs are correctly seated.



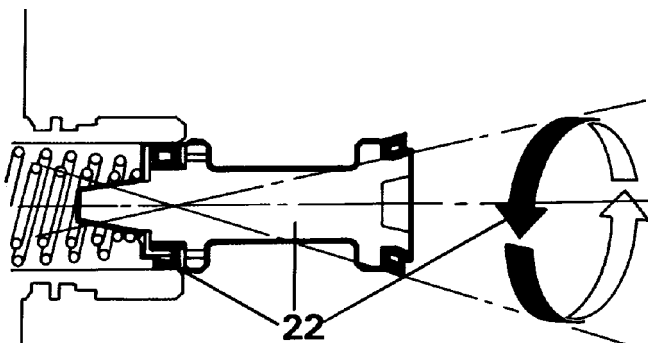
RR2236M

### Assembling master cylinder



**CAUTION:** It is important that following instructions are carried out precisely, otherwise damage could be caused to new seals when inserting plungers into cylinder bore. Generous amounts of new brake fluid should be used to lubricate parts during assembly.

21. Fit new swirl tube to bottom of cylinder bore.
22. Lubricate secondary plunger and cylinder bore. Offer plunger assembly to cylinder until recuperation seal is resting centrally in mouth of bore. Gently introduce plunger with a circular rocking motion, as illustrated. Ensuring that seal does not become trapped, ease seal into bore and slowly push plunger down bore in one continuous movement.



RR2240M

23. Fit new primary plunger assembly using same method as for secondary plunger.
24. Fit original guide ring to support primary plunger.
25. Coat a new 'O' ring with brake fluid and fit to its respective groove on outer location surface of master cylinder.



**CAUTION:** Do not roll 'O' ring down outer location surface of master cylinder. It should be slightly stretched and eased down cylinder and into its groove. Do not over stretch seal.

26. Fit new retaining ring on outer surface of master cylinder ensuring that serrations of ring are facing mounting flange.
27. Fit two new reservoir seals in respective ports.
28. Fit a new vacuum seal to either primary plunger or to bottom of transfer housing bore, open face of seal towards primary plunger.
29. Lubricate vacuum seal with brake fluid. Fit transfer housing to master cylinder, push housing fully up to cylinder mounting flange, Do not adjust transfer housing after fitting.
30. Lubricate new water ingress seal with brake fluid, Slightly stretch seal and ease down housing until it is in position between housing and flange.
31. Roll reservoir into top of master cylinder, reversing procedure described in instruction 10.

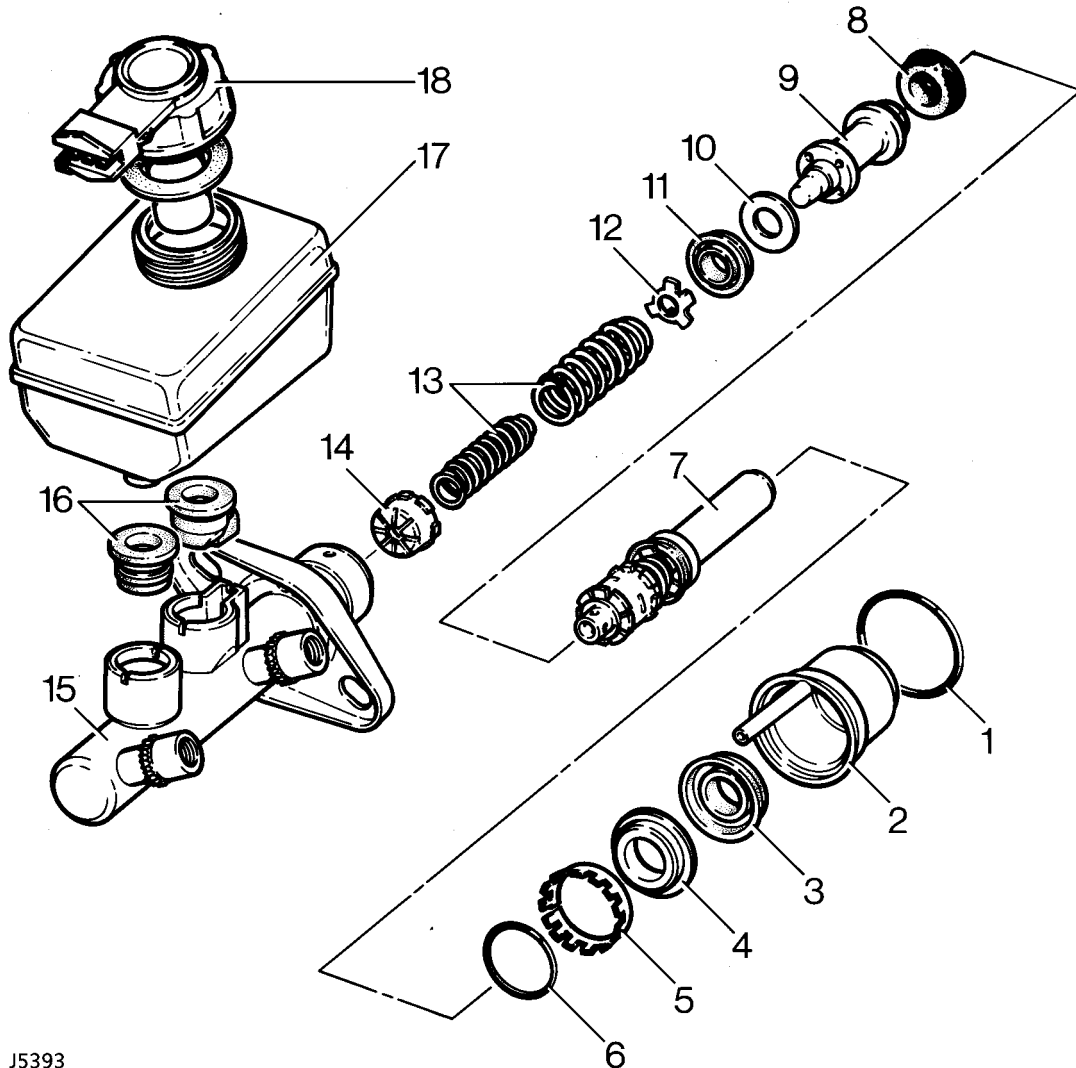
### Refit



**NOTE:** Ensure O ring seal between master cylinder and servo unit is fitted correctly.

32. Fit master cylinder to servo. Secure in position with two nuts, plain and spring washers. Tighten to **26 Nm**.
33. Fit brake pipes to master cylinder. Tighten to **15Nm**.
34. Top-up master cylinder with correct grade of brake fluid. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**
35. Bleed system. **See Brake System Bleed**
36. Fit cap, reconnect electrical lead to fluid level switch. Reconnect battery negative lead.

## MASTER CYLINDER ASSEMBLY NON ABS



J5393

## Key to master cylinder

- |                       |                                     |                                    |
|-----------------------|-------------------------------------|------------------------------------|
| 1. Water ingress seal | 7. Primary plunger assembly         | 13. Springs (2 off)                |
| 2. Transfer housing   | 8. 'L' seal                         | 14. Swirl tube                     |
| 3. Vacuum seal        | 9. Secondary plunger                | 15. Master cylinder body           |
| 4. Guide ring         | 10. Washer                          | 16. Reservoir seals                |
| 5. Retaining ring     | 11. Recuperating seal (primary cup) | 17. Reservoir                      |
| 6. 'O' ring seal      | 12. Seal retainer                   | 18. Low fluid level switch and cap |



**NOTE:** Thoroughly check that no debris is lodged in fluid passageways and drillings. If debris is found, carefully remove, re-clean cylinder and re-check.




## SERVO ASSEMBLY

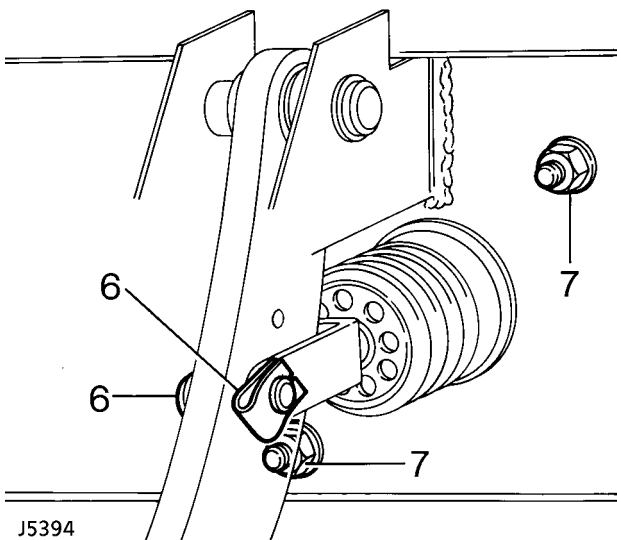
Service repair no - 70.50.01

### Remove

Before starting repair refer to general brake service practice. **See General Brake Service Practice**

 **NOTE: The filter, non-return valve and grommet, are the only serviceable components, in event of failure or damage fit a new unit.**

1. Disconnect battery negative lead.
2. Disconnect electrical plug to low fluid level switch.
3. Thoroughly clean immediate area around all master cylinder outlet ports. Remove each brake pipe, sealing each pipe and outlet port to prevent ingress of foreign matter.
4. Disconnect vacuum supply hose to servo.
5. Remove lower dash panel to gain access to servo push rod to brake pedal.
6. Remove clevis pin securing servo push rod to brake pedal.
7. Remove two nuts and plain washers securing servo.

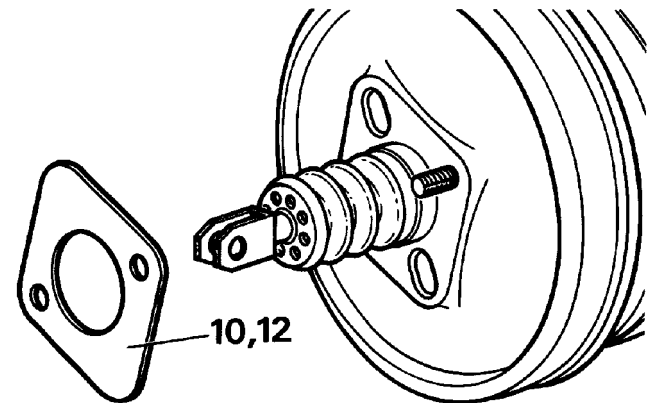


8. Remove servo and master cylinder assembly.
9. Drain brake fluid into a suitable container. (If master cylinder is kept horizontal it is not necessary to drain fluid).

10. Detach spacer from pedal box mounting face of servo.



**NOTE: Retain spacer for reassembly. The spacer ensures stringent pedal to servo operating dimensions are maintained.**



RR2233M

11. Remove master cylinder from existing servo and refit to new servo, if fitting new unit.

### Refit

12. Fit spacer to servo.
13. Fit servo to pedal box.
14. Lightly grease brake pedal around area servo push rod pivots.
15. Fit push rod to lower hole of brake pedal. Fit clevis pin and clip.
16. Secure servo with two nuts and plain washers. Tighten nuts to **26 Nm**.
17. Refit lower dash panel.
18. Fit master cylinder to servo, refit nuts, plain and spring washers. Tighten nuts to **26 Nm**.
19. Remove all sealing plugs. Refit brake pipes to respective ports. Tighten brake pipes to **15 Nm**.
20. Refit vacuum supply hose.
21. Fill master cylinder to correct level using correct grade of brake fluid. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**
22. Bleed brake system. **See Brake System Bleed**

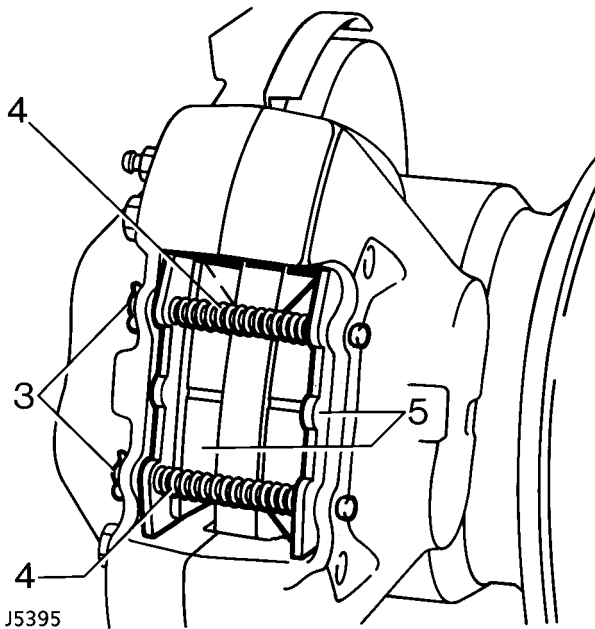
## FRONT BRAKE PADS

Service repair no - 70.40.02

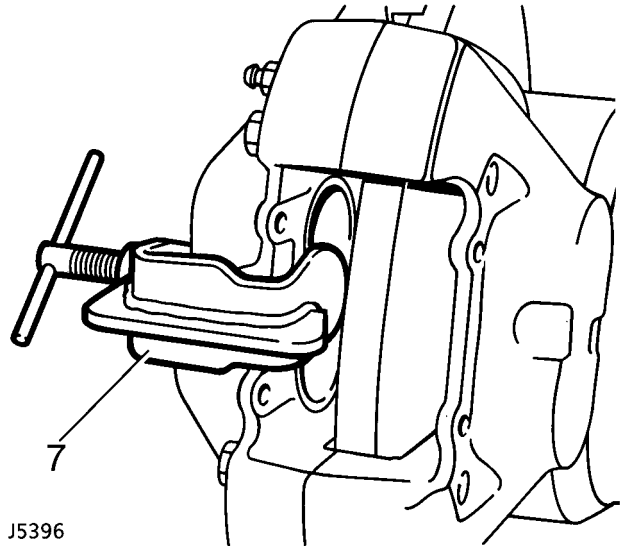
Service tool:  
LRT.70-500 - Piston clamp

### Remove

1. Remove front road wheels. **See WHEELS AND TYRES, Repair, Wheels**
2. Clean exterior of calipers.
3. Remove split [cotter] pin from retaining pins.



4. Remove pad retaining pins and anti-rattle springs.
5. Remove brake pads.



6. Clean exposed parts of pistons, using new brake fluid. Wipe away excess with a lint free cloth.
7. Using piston clamp LRT-70-500 press each piston back into its bore. Ensure that displaced brake fluid does not overflow from reservoir.

### Refit

8. Fit brake pads.
9. Fit pad retaining pins and anti-rattle springs. Secure with new split [cotter] pin.
10. Apply service brake pedal several times to locate pads.
11. Check fluid reservoir. Top up if necessary, using correct grade of fluid. **See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**





## REAR BRAKE PADS

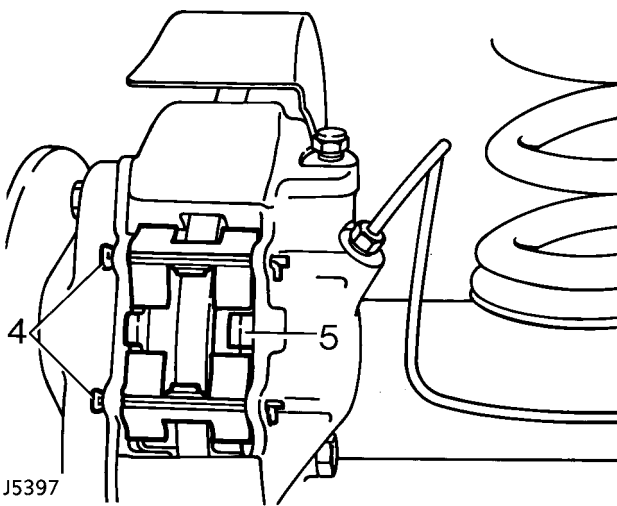
Service repair no - 70.40.03

Service tool:

LRT-70-500 - Piston clamp

### Remove

1. Remove rear road wheels. *See WHEELS AND TYRES, Repair, Wheels*
2. Disconnect battery negative lead.
3. Clean exterior of calipers.
4. Remove pad retaining pins and springs.
5. Remove brake pads.

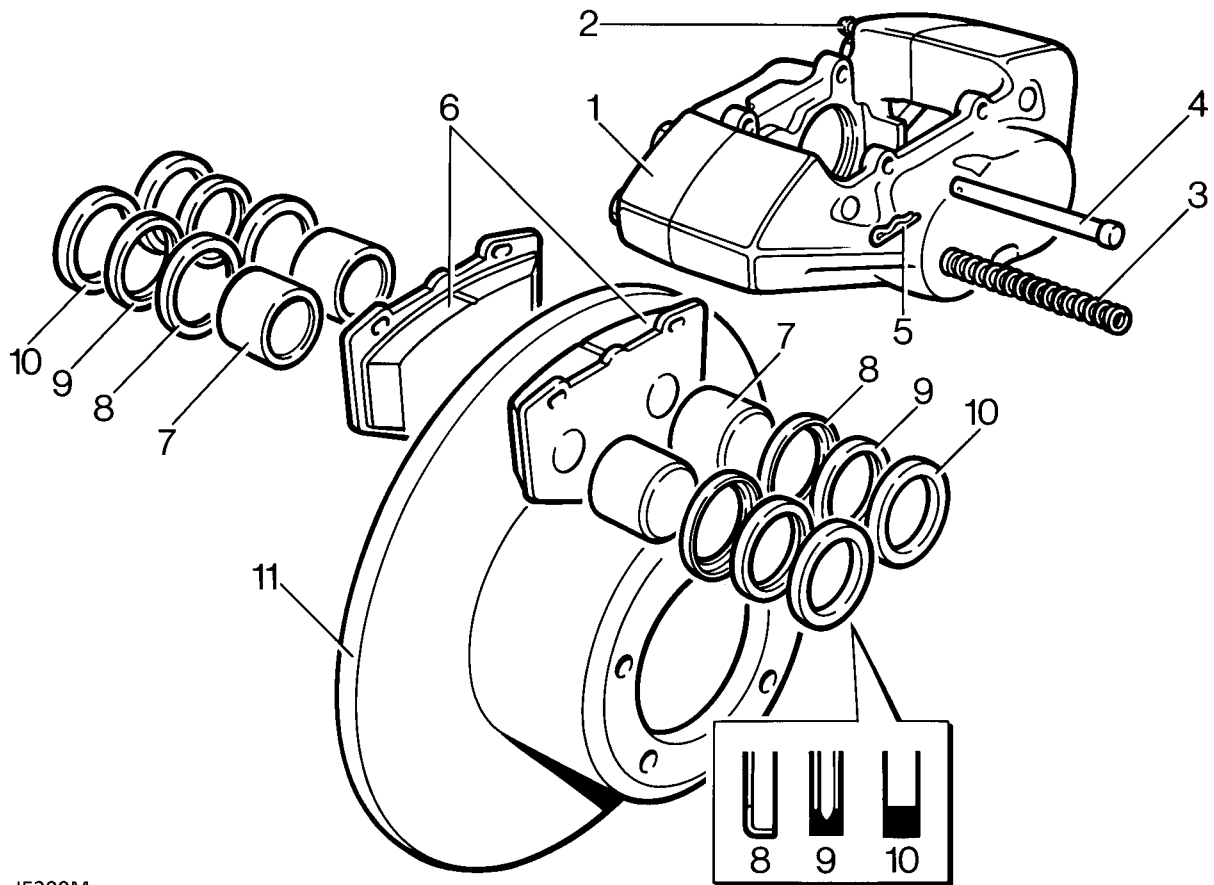


6. Clean exposed parts of pistons, using new brake fluid. Wipe away excess with a lint free cloth.
7. Using piston clamp LRT-70-500 press each piston back into its bore. Ensure that displaced brake fluid does not overflow from reservoir.

### Refit

8. Insert brake pads.
9. Position pad retaining springs, fit new pins and spread ends.
10. Apply service brake pedal several times to locate pads.
11. Check fluid reservoir, top up if necessary, using correct grade of fluid. *See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids*

## FRONT BRAKE CALIPER ASSEMBLY



J5398M

### Key to caliper

1. Caliper
2. Bleedscrew
3. Antirattle springs
4. Pad retaining pins
5. Split [cotter] pin
6. Friction pads
7. Piston
8. Wiper seal retainer
9. Wiper seal
10. Fluid seal
11. Brake disc



## FRONT BRAKE CALIPERS

Service repair no - 70.55.03

Service repair no - 70.55.16

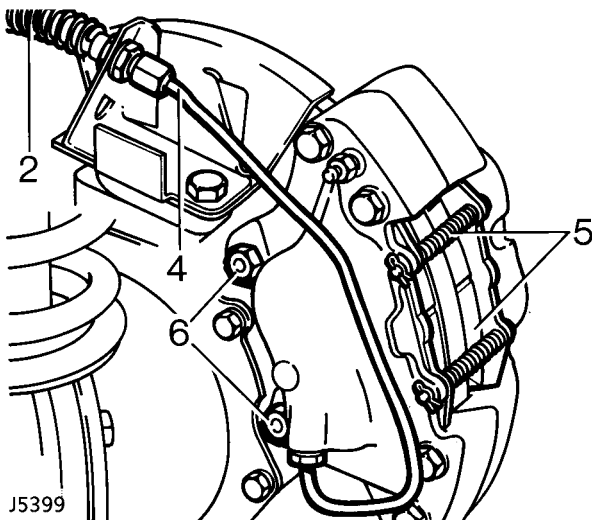
### Service tool:

LRT-70-500 - Piston clamp

Before starting repair refer to general brake service practice. **See General Brake Service Practice**

### Remove caliper

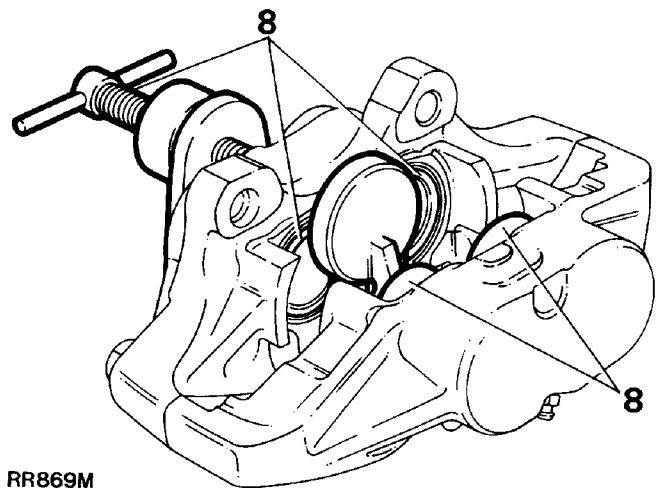
1. Loosen front wheel retaining nuts, raise front of vehicle, lower onto axle stands, remove wheels.
2. Expose flexible brake hose by moving coiled protective covering.
3. Using a recognised hose clamp, clamp hose to prevent loss of brake fluid.
4. Disconnect rigid brake pipe from flexible hose, seal exposed ends to prevent ingress of dirt.
5. Remove split [cotter] pin, retaining pins and springs, withdraw pads. If refitting pads, identify them for assembly to original locations.
6. Loosen bolts and remove caliper.



### Repair

#### Do not separate caliper halves

7. Clean outer surfaces of caliper using aerosol brake cleaner.
8. Using special tool LRT-70-500, clamp pistons in inboard half of caliper. Gently, keeping fingers clear, and with **CAUTION**, apply air pressure to fluid inlet port to expel pistons. It is unlikely that pistons will expel at same time, regulate rate with a suitable piece of wood between appropriate piston and caliper.



9. Finally remove pistons, identifying them with their respective bores.
10. Remove wiper seal retainer by inserting a blunt screwdriver between retainer and seal. Pry retainer carefully from mouth of bore.
11. Taking care not to damage seal grooves, extract wiper seal and fluid seal.
12. Clean bores, pistons and seal grooves using clean brake fluid only. If caliper or pistons are corroded, or their condition is not perfect, new parts must be fitted.

**Assemble outboard pistons**

13. Coat new fluid seal with brake fluid. Ease seal into groove in bore using only fingers, ensuring it is properly seated. Fluid seal and groove are not same in section, so when seal is seated it feels raised to touch at edge furthest away from mouth of bore.
14. Coat appropriate piston with brake fluid. Insert it squarely into bore by hand only. Do not tilt piston during insertion, leave approximately 8mm projecting from bore.
15. Coat new wiper seal with brake fluid and fit to new seal retainer. Slide assembly, seal first, over protruding piston and into bore recess. Use piston clamp to press home seal retainer and piston.

**Mounting inboard pistons**

16. Clamp outboard pistons and carry out same procedure for removing and fitting outboard pistons and seals, instructions 8 to 15.

**Fit calipers and pads**

17. Fit caliper, tighten bolts evenly to **82 Nm**.
18. Connect brake flexible hoses to caliper. Tighten to **15 Nm**.
19. Remove hose clamps.
20. Insert pads. Fit pins and springs, secure using new split [cotter] pin.
21. Bleed brake system. **See Brake System Bleed**
22. Press brake pedal firmly several times to locate friction pads.
23. Fit road wheels, remove axle stands. Finally tighten road wheel nuts to **130 Nm**.
24. Road test vehicle. Note that new friction pads require 'bedding-in', this may take several hundred miles before brakes are at maximum efficiency.



## REAR BRAKE CALIPERS

Service repair no - 70.55.06

Service repair no - 70.55.17

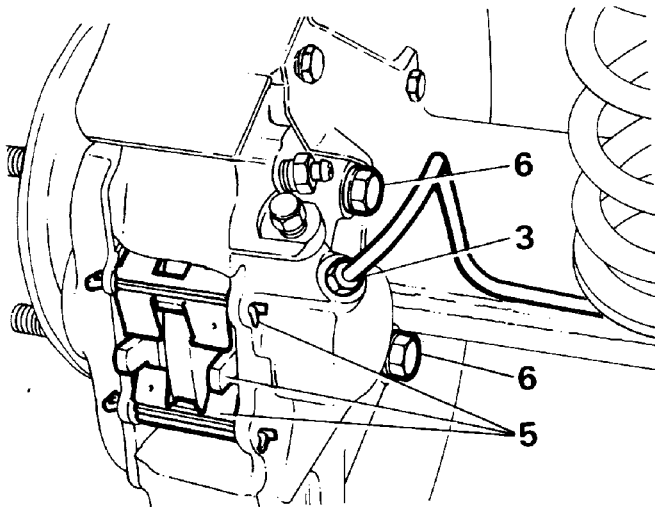
Service tool:

LRT-50-700 - Piston clamp

Before starting repair refer to general brake service practice. **See General Brake Service Practice**

### Remove caliper

1. Loosen rear road wheel nuts. Jack up vehicle, lower onto axle stands, remove wheels.
2. Using a recognised hose clamp, clamp flexible brake hose above rear axle.
3. Remove brake pipe(s) from rear brake caliper(s).
4. Seal pipe ends to prevent ingress of dirt.
5. Remove retaining pins and springs and withdraw pads. If same pads are to be refitted, identify them for assembly in original positions.
6. Remove two bolts, withdraw caliper from axle.

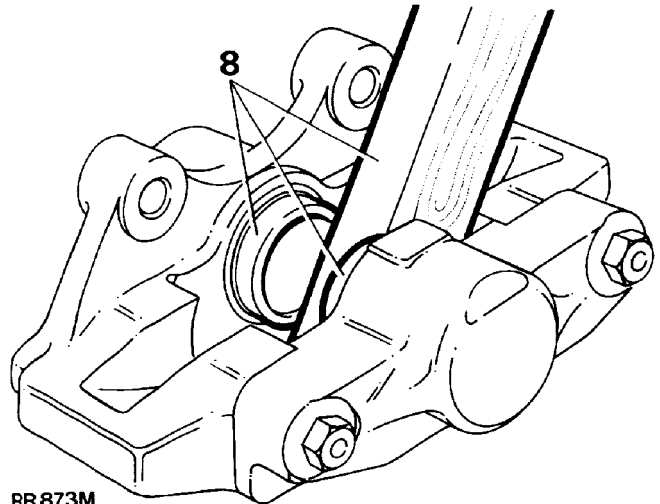


RR2007E

### Repair

#### Do not separate caliper halves

7. Clean outer surfaces of caliper with aerosol brake cleaner.
8. **WITH CAUTION** expel pistons from their bores by applying air pressure to fluid inlet port. It is unlikely both pistons will expel at same time, regulate rate with a suitable piece of wood inserted between two pistons.



RR873M

9. Finally, remove pistons keeping them identified with their respective bores.
10. Remove wiper seal retainer by inserting a blunt screwdriver between retainer and seal and pry retainer carefully from mouth of bore.
11. Taking care not to damage seal grooves, extract wiper seal and fluid seal.
12. Clean bores, pistons and particularly seal grooves using clean brake fluid only. If caliper or pistons are corroded or their condition is not perfect new parts must be fitted.

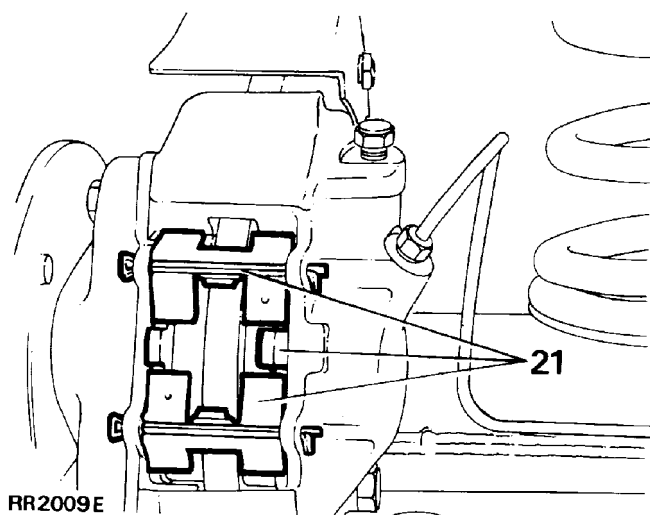
13. Apply brake fluid to new seal. Fit seal into groove in bore. When seal is seated it feels raised to touch at edge furthest away from mouth of bore.
14. Coat piston with brake fluid. Insert it squarely into bore. Do not tilt piston during insertion and leave 8mm projecting from bore.
15. Coat a new wiper seal with brake fluid and fit to new seal retainer. Slide assembly, seal first, over protruding piston into bore recess.
16. Using special tool LRT-70-500 - piston clamp, press home seal retainer and piston.
22. Bleed brake system. **See *Brake System Bleed***
23. Press brake pedal firmly several times to locate pads.
24. Fit road wheels, remove axle stands and finally tighten road wheel nuts,
25. Road test vehicle. Note new brake pads require 'bedding-in', for several hundred miles before brakes are at maximum efficiency.

## Mounting inboard piston

17. Carry out same procedure as for removing and fitting outboard piston and seals, instructions 8 to 16.

## Fit calipers and pads to vehicle

18. Fit caliper to axle, tighten two bolts evenly to **82 Nm**.
19. Connect brake pipe to caliper. Tighten to **15Nm**.
20. Remove clamp from flexible brake hose.
21. Insert pads and retaining springs, secure in position with new retaining pins and spread ends. Note correct position of retaining springs.



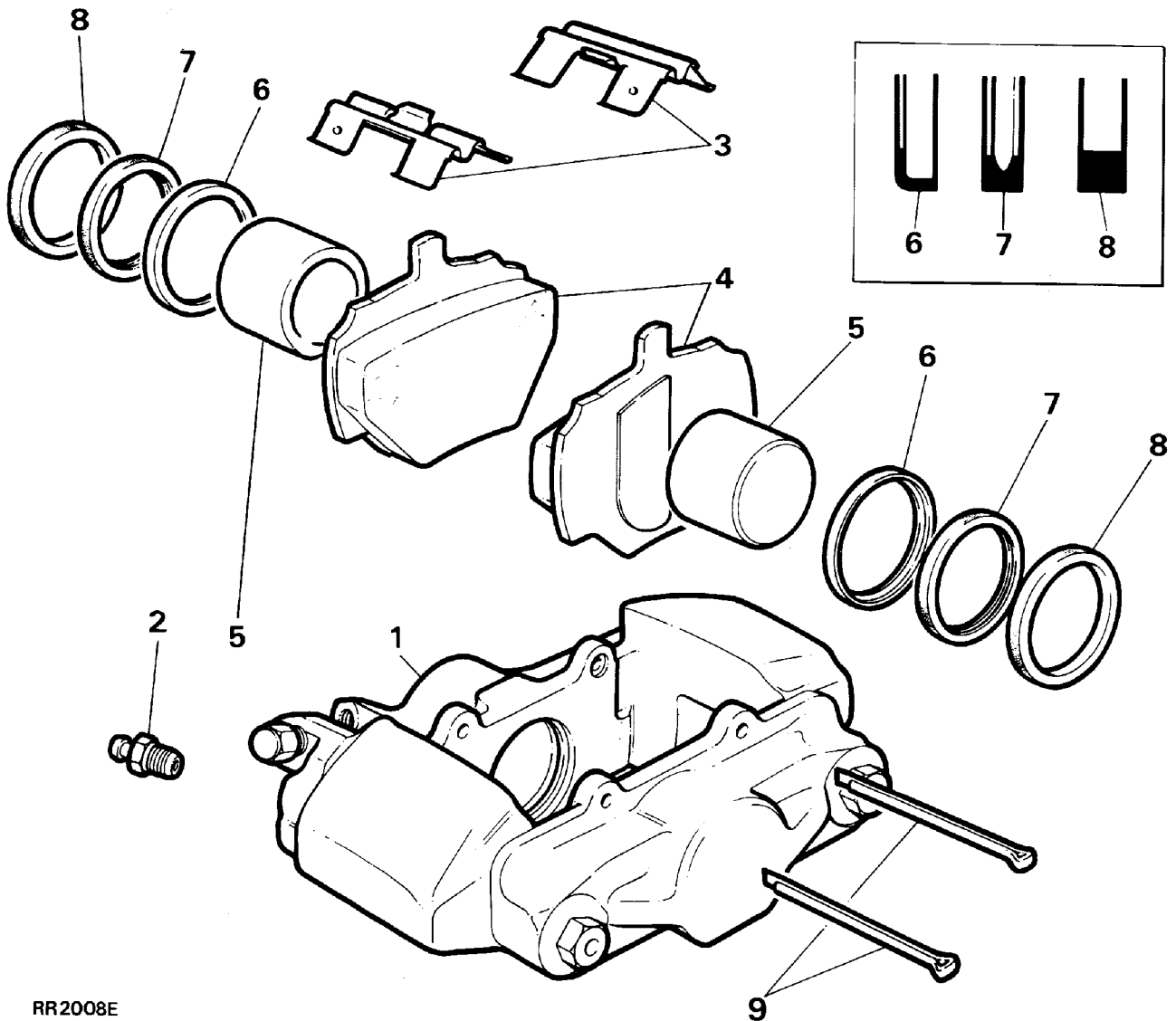
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**PARKING BRAKE ADJUST** *See SECTION 10, Maintenance, Vehicle Interior*

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## REAR BRAKE CALIPER ASSEMBLY



RR2008E

LH Rear Caliper illustrated

### Key to caliper

- |                          |                        |
|--------------------------|------------------------|
| 1. Caliper               | 6. Wiper seal retainer |
| 2. Bleed screw           | 7. Wiper seal          |
| 3. Pad retaining springs | 8. Fluid seal          |
| 4. Brake pads            | 9. Retaining pins      |
| 5. Piston                |                        |

## SENSORS - FRONT

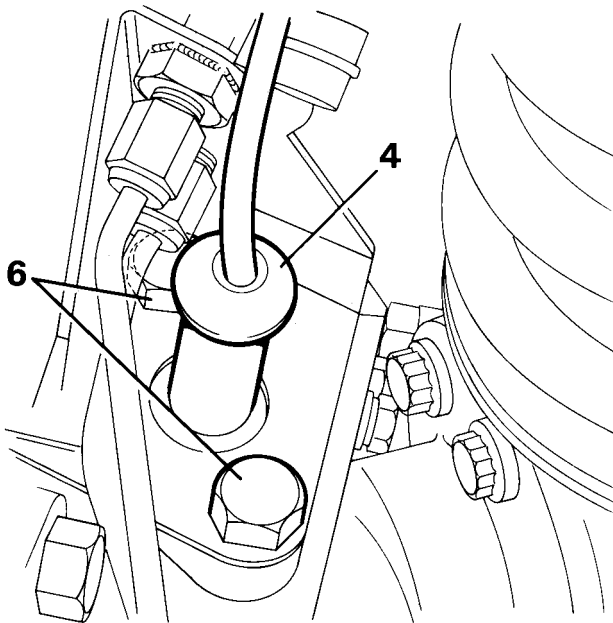
Service repair no - 70.65.32



**CAUTION:** If a sensor is removed for any reason, a **NEW** sensor bush and seal must be fitted.

### Remove

1. Disconnect battery negative lead.
2. Disconnect required sensor electrical connection, located on inner wing [fender] panel.
3. Remove sensor lead from clips.
4. Clean area surrounding sensor to prevent ingress of dirt. Using a suitable lever pry sensor from mounting bush.



RR2752M

5. Release harness cable ties, remove sensor lead from vehicle.
6. Remove top swivel retaining bolts complete with brake jump hose and sensor seal. Remove sensor bush.

### Refit

7. Insert new sensor bush and seal.
8. Refit brake jump hose bracket, coat bolts with Loctite 270.
9. Lightly coat new sensor using EP 90 oil. Push sensor through bush until it contacts exciter ring. Sensor will be 'knocked back' to correct position when vehicle is driven.
10. Secure sensor lead in original position.
11. Reconnect sensor electrical connection.
12. Drive vehicle to ensure ABS warning light is extinguished.

## SENSOR RINGS

The rear sensor ring is assembled to the rear brake disc to form part of the rear hub assembly. **See REAR AXLE AND FINAL DRIVE, Repair, Rear Hub Assembly**

The front sensor ring is a toothed ring on the axle shaft which forms part of the front stub axle assembly. **See FRONT AXLE AND FINAL DRIVE, Overhaul, Front Stub Axle, Constant Velocity Joint and Swivel Pin Housing ABS**





## SENSORS - REAR

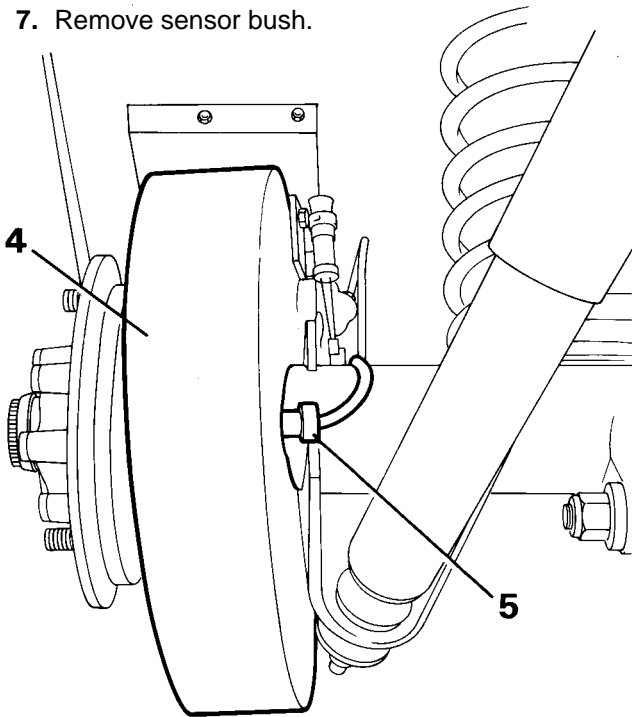
Service repair no - 70.65.31



**CAUTION:** If a sensor is removed for any reason, a **NEW** sensor bush must be fitted.

### Remove

1. Disconnect battery negative lead.
2. Disconnect sensor electrical connections, located above rear axle.
3. Remove sensor from its locating clip.
4. Remove bolts securing mudshield.
5. Using a suitable lever, pry sensor from mounting bush.
6. Release harness cable ties, remove sensor lead from vehicle.
7. Remove sensor bush.



RR2753M

### Refit

8. Fit new sensor bush.
9. Lightly grease new sensor using silicone grease.  
**See LUBRICANTS, FLUIDS AND CAPACITIES, Information, Recommended Lubricants and Fluids**
10. Push sensor through bush until it touches exciter ring. Sensor will be 'knocked back' to correct position when vehicle is driven.
11. Secure harness in position.
12. Reconnect sensor electrical connection.
13. Drive vehicle to ensure ABS warning light is extinguished.

## STOP LIGHT SWITCH ABS

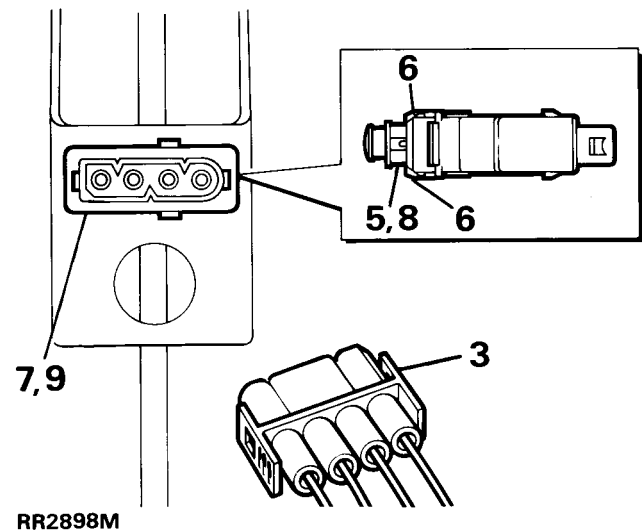
Service repair no - 86.65.51

### Remove

1. Turn ignition off. Disconnect battery negative lead.
2. Remove lower trim panel.
3. Disconnect multiplug to switch.
4. Depress brake pedal access front of switch.
5. Pull sleeve and plunger of switch **FULLY** forward.
6. Remove switch rearwards



**NOTE:** If switch is difficult to release, check sleeve is **FULLY** forward.



RR2898M

### Refit

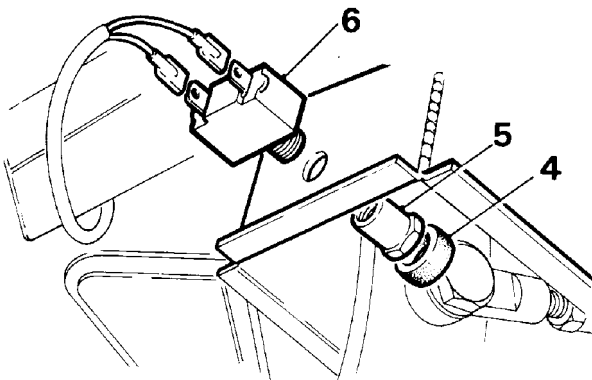
7. Pull sleeve and plunger of switch fully forward.
8. Depress brake pedal, fit switch. Ensure retaining clips are **FULLY** located.
9. Hold switch firmly in place, pull brake pedal back fully to set switch.
10. Reconnect battery and turn ignition on.
11. Check switch operation by slowly depressing brake pedal and checking that the switch clicks twice.
12. Check stop lamps go off when pedal is released.
13. Recheck switch is securely fitted.
14. Operation may be checked using Testbook.

## STOP LIGHT SWITCH - NON ABS

Service repair no - 86.65.51

### Remove

1. Disconnect battery negative lead.
2. Remove lower dash panel.
3. Depress foot brake.
4. Remove rubber protector from switch, if fitted.
5. Remove hexagon nut.
6. Withdraw switch.
7. Disconnect electrical leads.



RR509M

### Adjust

8. With switch still in position and multiplug disconnected, connect an ohmmeter across switch terminals.
9. Screw switch in until open circuit exists across terminals with pedal released and continuity exists as soon as pedal is depressed.
10. Tighten locknut.



**CAUTION:** Ensure switch does not prevent brake pedal returning fully.

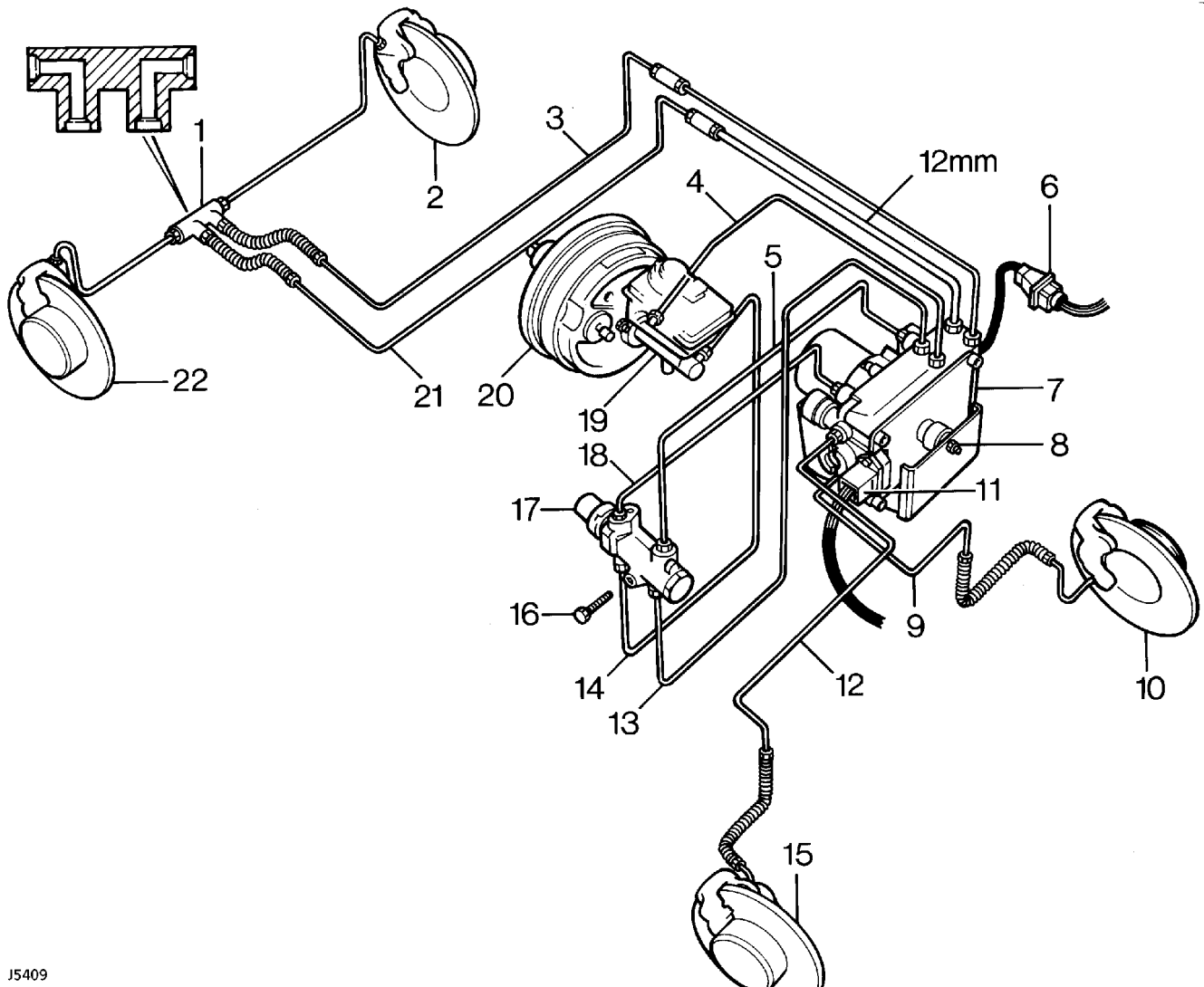
### Refit

11. Reverse removal procedure.



## BRAKE COMPONENTS ABS

Left hand drive shown. On right hand drive vehicles the master cylinder and servo unit only move position.



J5409

### KEY

- |   |  |
|---|--|
| 1. Connector-double elbow                     | 12. Modulator to front right brake                   |
| 2. Rear left brake                            | 13. Modulator to pressure reducing valve lower       |
| 3. Modulator to rear left brake               | 14. Master cylinder to pressure reducing valve lower |
| 4. Modulator to master cylinder               | 15. Front right brake                                |
| 5. Modulator to pressure reducing valve upper | 16. Bolt   |
| 6. Electrical connection                      | 17. Pressure reducing valve                          |
| 7. Modulator unit                             | 18. Modulator to pressure reducing valve upper       |
| 8. Nut, mounting bush and cup                 | 19. Master cylinder                                  |
| 9. Modulator to front left brake              | 20. Servo unit                                       |
| 10. Front left brake                          | 21. Modulator to rear right brake                    |
| 11. Electrical connection                     | 22. Rear right brake                                 |

## MODULATOR UNIT

Service repair no - 70.65.45



**WARNING:** New modulator units are supplied in a shock absorbing pack marked with a use by date. The new modulator will contain hydraulic brake fluid within the valve block and all ports plugged.

Modulator units must be handled with care the following must be avoided:- any impact, use of compressed air on any of the hydraulic ports, removing plugs to connection ports before fitting unit.

### Remove

1. Refer to the illustration of brake components ABS. For details of modulator unit and hydraulic pipe connections to it. **See Brake Components ABS**
2. Refer to general brake service practice. **See General Brake Service Practice**
3. Check new modulator unit is packaged in accordance with the WARNING above.
4. Disconnect battery negative lead.
5. Remove the two electrical plugs.
6. Identify 8 pipe to modulator connections for correct reassembly.
7. Disconnect 8 pipe unions.
8. Remove nuts securing modulator to mounting bracket.
9. Remove modulator unit.
10. Remove mounting bushes and cup.

### Refit

11. Fit mounting bushes and cup to new modulator.
12. Fit modulator unit to mounting bracket.
13. Fit 8 pipes to modulator connections. Pipes **must** be connected to correct port. Tighten to **15Nm**.
14. Bleed the complete hydraulic system. **See Brake System Bleed**
15. Check system function using the 'Testbook' diagnostics
16. Test operation of brakes.

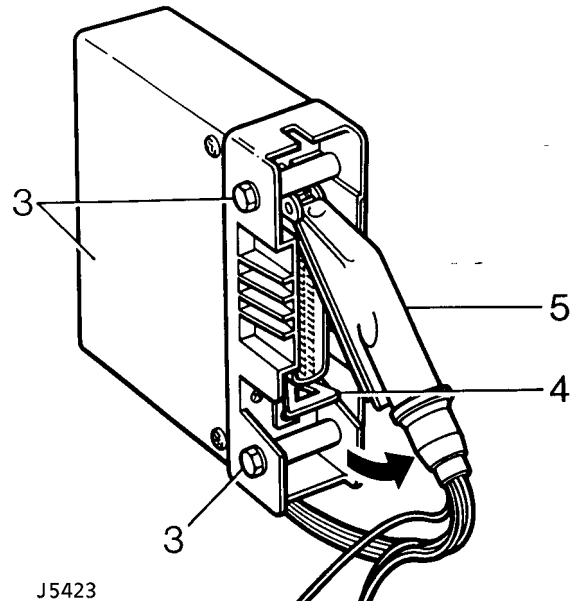
## ELECTRONIC CONTROL UNIT ABS

Service repair no - 70.65.01

### Remove

For location of the ECU. **See Description and operation, ABS Components**

1. Disconnect battery negative lead.
2. Remove retaining bolt and lower alarm system ECU and relay mounting bracket into passenger footwell.
3. Remove two screws and detach ECU complete with harness plug from mounting bracket.
4. Release ECU plug retaining clip.
5. Move plug in direction of arrow and release hooked end of plug from retaining post.



### Refit

6. Reconnect ECU harness plug ensuring that it is firmly located and retaining clip secures plug.
7. Reverse removal procedure.




---

**TORQUE VALUES**


---



**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
<b>Brakes</b>	
Brake pipe connections to:	
- Modulator unit .....	15
- Brake calipers .....	15
- Master cylinder .....	15
Jump hoses to calipers .....	15
Bleed screws .....	15
Brake caliper to swivel pin housing .....	82
Servo assembly to pedal box .....	26
Master cylinder to servo .....	26

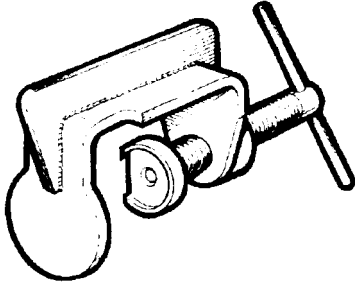


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**BRAKE SERVICE TOOLS**

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**18G 672**



LRT-70-500  
18G 672

Brake piston compressor



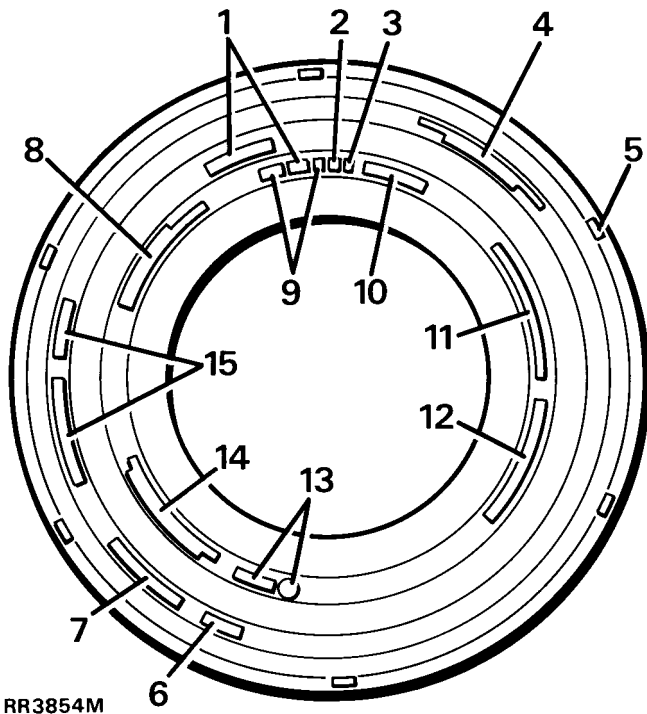
**TYPES OF WHEEL RIMS AND TYRES**

**Description**


Dependent on specification, the vehicle is equipped with alloy or pressed steel wheel rims, both using tubeless radial ply tyres.

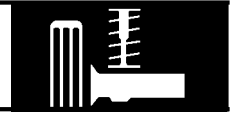
**Tyre codes**

The writing, codes and numbers moulded into the tyre wall vary between tyre manufacturers, however most tyres are marked with the information shown in the illustrated example.

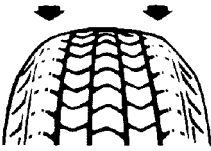
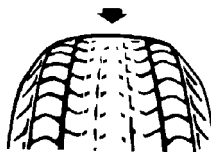
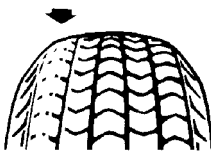




1. Type of tyre construction - **Radial Ply**
2. Load index - **104**
3. Speed symbol - **S or T**
4. USA Tyre quality grading - **Tread wear 160 Traction A temperature B**
5. Tread wear indicators moulded into tread pattern are located at intervals around the tyre and marked by a code - **E66 103S6**
6. Tyres with 'Mud Snow' type tread pattern are marked - **M&S**
7. Tyre reinforcing mark - **Reinforced**
8. USA Load and pressure specification - **900Kg(1984LBS) at 340KA (50PSI) MACS PRESS**
9. Tyre size - **205 16 ot 235/70 R16**
10. Type of tyre - **TUBELESS**
11. Country of manufacture - **MADE IN GREAT BRITAIN**
12. USA Compliance symbol and identification - **DOT AB7C DOFF 267**
13. European type approval identification - **E11 01234**
14. Tyre construction - **SIDE WALL 2 PLYS RAYON. TREAD 2 RAYON 2 STEEL**
15. Manufacturer's brand name/type - **TRACTION PLUS mzx M**

 **NOTE:** The illustration is an example of the type of markings moulded into tyres and is for guidance only. For specific tyre specifications. See *GENERAL SPECIFICATION DATA, Information, Wheels and Tyres*



**TYRE WEAR CHART**

FAULT	CAUSE	REMEDY
<p>Rapid wear at shoulders</p> 	<p>Tyres under-inflated Worn suspension components i.e. ball joints, panhard rod bushes, steering damper</p> <p>Excessive cornering speeds</p>	<p>Inflate to correct pressure Replace worn components</p>
<p>Rapid wear at centre of tread</p> 	<p>Tyres over-inflated</p>	<p>Inflate to correct pressure</p>
<p>Wear at one shoulder</p> 	<p>Track out of adjustment</p> <p>Bent panhard rod</p>	<p>Adjust track to correct figure</p> <p>Check and replace worn or damaged components</p>
<p>Bald spots or tyre cupping</p> 	<p>Wheel out of balance</p> <p>Excessive radial runout</p> <p>Shock absorber worn</p> <p>Excessive braking</p>	<p>Balance wheel and tyre assembly</p> <p>Check runout and replace tyre if necessary</p> <p>Replace shock</p>
<p>Tyre scalloped</p>  <p>RR2136E</p>	<p>Track out of adjustment</p> <p>Worn suspension components</p> <p>Excessive cornering speeds</p>	<p>Adjust toe to correct figure</p> <p>Replace as necessary</p>



**CAUTION:** This diagnosis chart is for general guidance only and does not necessarily include every cause of abnormal tyre wear.



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**FAULT - SYMPTOMS**


---

**Vibration through steering wheel**

1. Check tyre pressures. *See Repair, Tyre Pressures*
2. Check condition of tyres. *See Tyre Wear Chart*
3. Check front wheel alignment. *See STEERING, Adjustment, Front Wheel Alignment*
4. Check wheel balance. *See Repair, Wheel Balancing*



**NOTE:** In the event that any apparent vibration is not eliminated at this stage.

*See PROPELLER SHAFTS, Fault diagnosis, Vibration Harshness*



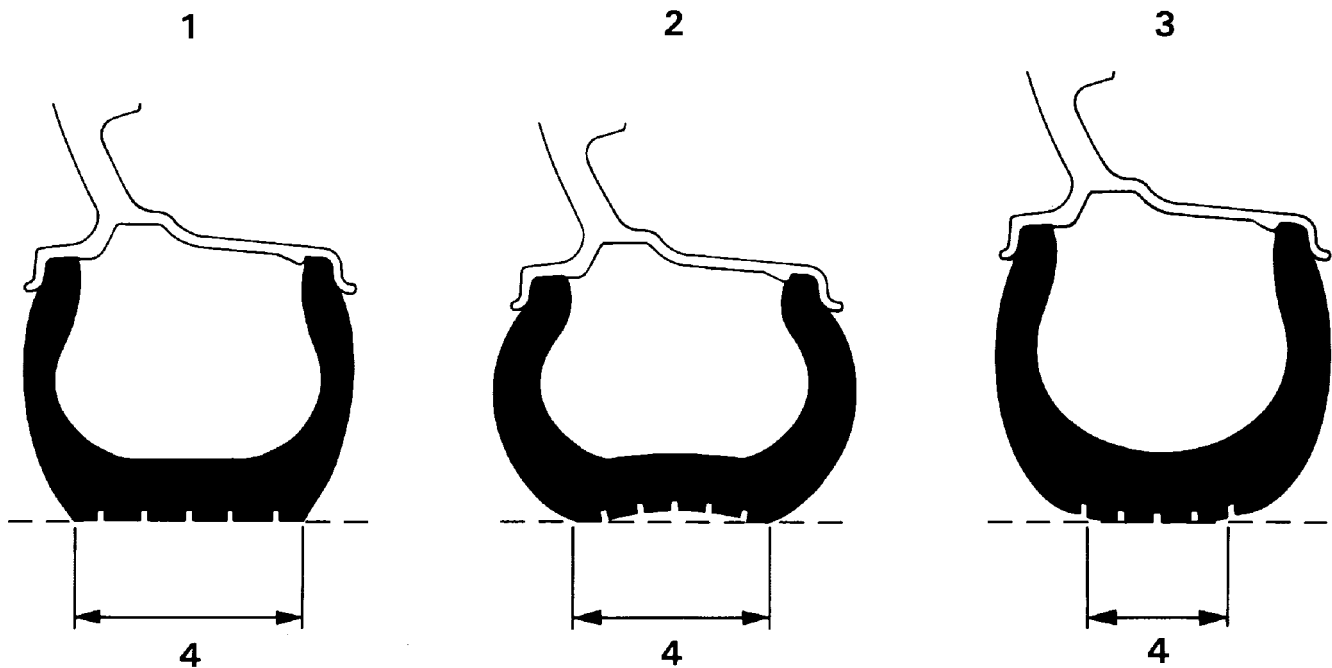
**NOTE:** In the event that any apparent vibration is not eliminated at this stage, go to steering Fault Diagnosis, Fault -

Symptom (Steering vibration, road wheel shimmy/wobble). *See STEERING, Fault diagnosis, Steering Faults*



**NOTE:** Radial ply tyres have a flexible sidewall, which produces a sidewall bulge making the tyre appear under-inflated.

This is a normal condition for radial ply tyres. Do not attempt to reduce this bulge by over-inflating the tyre.



RR2133E

1. Correct inflation.
2. Under-inflation.
3. Over-inflation.
4. Tread contact with road.



**GENERAL INFORMATION**



**WARNING: This is a multi- purpose vehicle with wheels and tyres designed for both on and off road usage. Only use wheels and tyres specified for use on the vehicle.**

The vehicle is equipped with tubeless 'S', 'T' or 'H' rated radial ply tyres as standard equipment. The tyres are of European metric size and must not be confused with the "P" size metric tyres available in North America.

Vehicle wheel sets, including spare wheel, must be fitted with the same make and type of tyre to the correct specification and tread pattern. Under no circumstances must cross-ply or bias-belted tyres be used.

For tyre specification and pressures. **See GENERAL SPECIFICATION DATA, Information, Wheels and Tyres**

**Alloy Wheels**

Tubeless tyres are mounted on 7.0 inch wide by 16 inch diameter cast aluminium alloy wheels. The surface has a paint finish covered with a clear polyurethane lacquer. Care must be taken when handling the wheel to avoid scratching or chipping the finish.

**The alloy wheel rim is of the asymmetric hump type incorporating a safety hump to improve location of the tyre bead in its seat. If difficulty is experienced in fitting tyres to this type of rim. See Tyre Fitting**



**WARNING: Do not fit an inner tube to an alloy wheel.**

**Steel wheels**

Tubeless tyres are mounted on 7.0 inch wide by 16 inch diameter steel wheels.

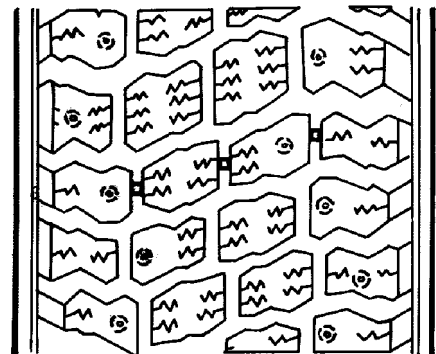
**TYRE INSPECTION**

Inspect tyres at weekly intervals to obtain maximum tyre life and performance and to ensure compliance with legal requirements. Check for signs of incorrect inflation and uneven wear, which may indicate a need for balancing or front wheel alignment. **See Fault diagnosis, Tyre Wear Chart** if the tyres have abnormal or uneven wear patterns.

Check tyres at least weekly for cuts, abrasions, bulges and for objects embedded in the tread. More frequent inspections are recommended when the vehicle is regularly used in off road conditions.

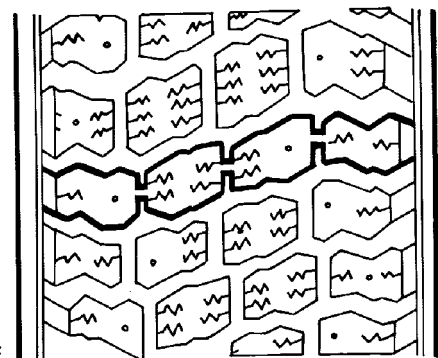
To assist tyre inspection, tread wear indicators are moulded into the bottom of the tread grooves, as shown in the illustration below.

RR2145E



When the tread has worn to a remaining depth of 1.6 mm the indicators appear at the surface as bars which connect the tread pattern across the width of the tread as shown in the illustration below.

RR2146E



When the indicators appear in two or more adjacent grooves, at three locations around the tyre, a new tyre must be fitted.



**NOTE: Do not attempt to interchange tyres, e.g. from front to rear, as tyre wear produces characteristic patterns depending on their position. If tyre position is changed after wear has occurred, the performance of the tyre will be adversely affected.**



**NOTE: Territorial vehicle regulations governing tyre wear MUST be adhered to.**

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## WHEELS INSPECTION

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Regularly check the condition of the wheels. Replace any wheel that is bent, cracked, dented or has excessive runout.

---

## VALVES INSPECTION

---

Check condition of inflation valve. Replace any valve that is worn, cracked, loose, or leaking air.

---

## TYRE PRESSURES

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**Maximum tyre life and performance will be obtained only if tyres are maintained at the correct pressures.**

Tyre pressures must be checked at least once a month and at least once a week, preferably daily, if the vehicle is used off road.

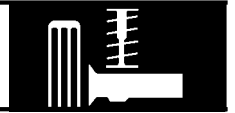
The tyre inflation pressure is calculated to give the vehicle satisfactory ride and steering characteristics without compromising tyre tread life. For recommended tyre pressures in all conditions. **See GENERAL SPECIFICATION DATA, Information, Wheels and Tyres**

American vehicles - A label attached to the inside edge of the driver's door also provides tyre pressure information.

**Always check tyre inflation pressures using an accurate gauge and inflate tyres to the recommended pressures only.**

Check and adjust tyre pressures **ONLY** when the tyres are cold, vehicle parked for three hours or more, or driven for less than 3.2 km (2 miles) at speeds below 64 km/h (40 mph). Do not reduce inflation pressures if the tyres are hot or the vehicle has been driven for more than 3.2 km (2 miles) at speeds over 64 km/h (40 mph), as pressures can increase by 0.41 bars (6 p.s.i) over cold inflation pressures.

Check **ALL** tyre pressures including the spare. Refit the valve caps as they form a positive seal and keep dust out of the valve.



**WHEEL BALANCING**



**CAUTION:** It is essential that all wheel balancing is carried out off the vehicle.

The use of on the vehicle balancing could cause component damage or personal injury and **MUST NOT** be attempted.

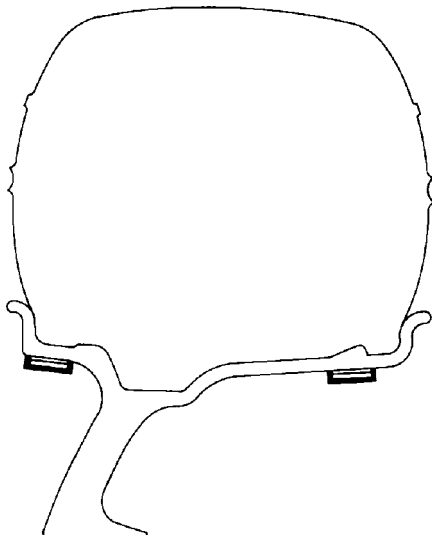


**NOTE:** Before attempting to balance a wheel and tyre assembly clean all mud and dirt deposits from both inside and outside rims and remove existing balance weights.

Remove stones from the tyre tread in order to avoid operator injury during dynamic balancing and to obtain the correct balance.

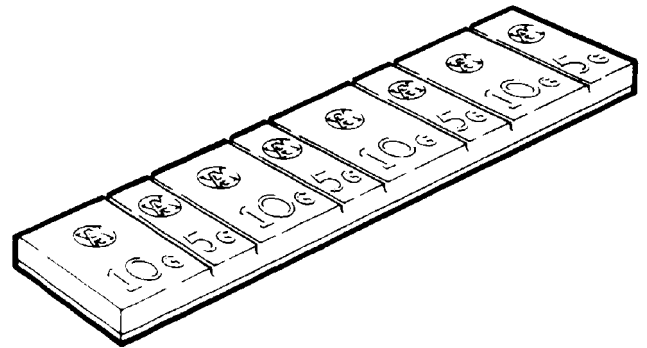
Inspect tyres for damage and correct tyre pressures and balance according to the equipment manufacturer's instructions.

**Alloy wheels**



RR2138E

Clean area of wheel rim and attach adhesive balance weights in position shown. Cut through rear face of weight strip to detach required weights.

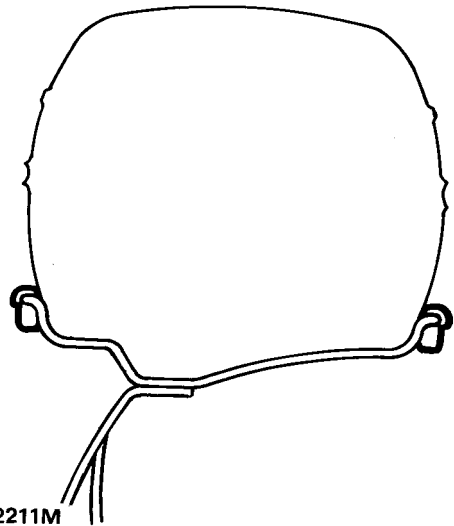


RR2137E



**CAUTION:** Use only correct adhesive balance weights to avoid damage to aluminium wheel rim. **DO NOT** attempt to use a steel wheel weight on an aluminium wheel.

**Steel wheels**

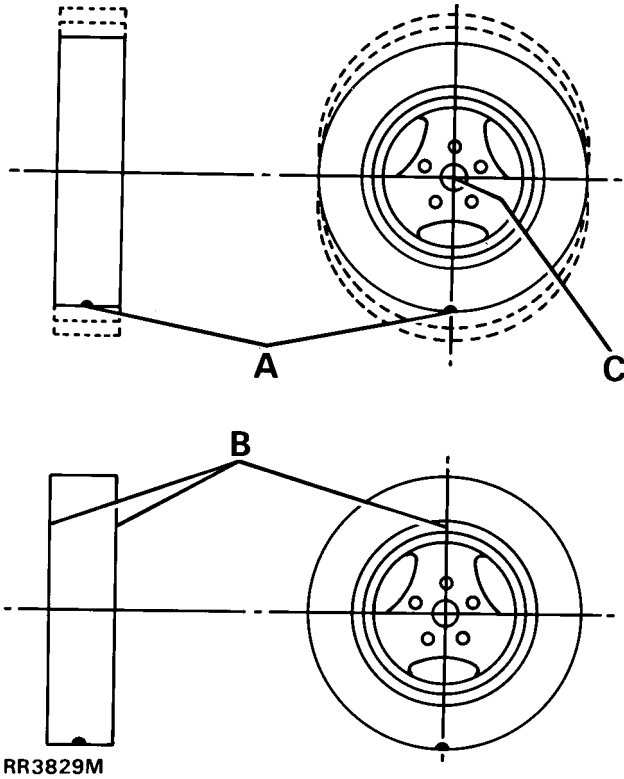


RR2211M

Clean area of wheel rim and attach balance weights in position shown.

### Static balance

Wheel tramp

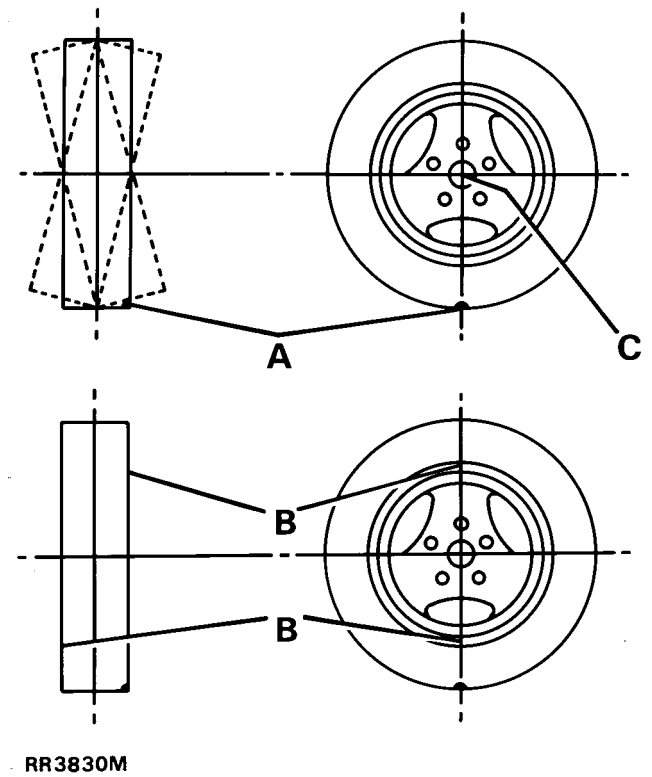


- A. Heavy spot.
- B. Add balance weights here.
- C. Centre line of spindle.

Static balance is the equal distribution of weight around the wheel. A statically unbalanced wheel will cause a bouncing action called wheel tramp. This condition will eventually cause uneven tyre wear.

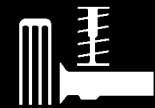
### Dynamic balance

Wheel shimmy



- A. Heavy spot.
- B. Add balance weights here.
- C. Centre line of spindle.

Dynamic balance is the equal distribution of weight on each side of the centre line so that when the wheel spins there is no tendency for side to side movement. A dynamically unbalanced wheel will cause wheel shimmy.



### Off vehicle balancing

Balance wheel assembly referring to equipment manufacturer's instructions.

It is essential that the wheel is located by the centre hole **NOT** the stud holes. To ensure positive wheel location the diameter of the locating collar on the machine shaft must be 112.80 to 112.85 mm (4.441 to 4.443 in). This diameter will ensure that the collar fits correctly within the centre hole of the wheel.

Where possible always use the vehicle wheel retaining nuts to locate the wheel on the balancer, to avoid damaging the wheel. If this is not possible, the locating nuts must be of a similar pattern to the original wheel nuts. The use of conical type wheel nuts for this purpose may damage the aluminium alloy.

### Cleaning

Wash the aluminium wheels using a suitable wash and wax concentrate correctly diluted and rinse with cold clear water. **DO NOT** use abrasives or aluminium wheel cleaners containing acid, as they will destroy the lacquer finish.

### Tyre changing

Use only tyre changing equipment to mount or demount tyres, following the equipment manufacturer's instructions. **DO NOT** use hand tools or tyre levers, as they may damage tyre beads or the aluminium wheel rim.

### Puncture repair

Remove punctured tyre from wheel and repair using a combination service plug and vulcanising patch. Always follow manufacturer's instructions when using a puncture repair kit.

Only punctures in tread area are repairable, **DO NOT** attempt to repair punctures in tyre shoulders or sidewalls.

Do not attempt to repair a tyre that has sustained the following: bulges or blisters, ply separation, broken or cracked beads, wear indicators visible and punctures larger than 6 mm diameter.



**CAUTION: Do not use tyre sealants that are injected through valve stem to repair punctured tyres, they may produce wheel corrosion and tyre imbalance.**

Aluminium wheel rim bead seats should be cleaned using a non-abrasive cleaner to remove the mounting lubricants and old rubber. Before mounting or demounting a tyre, bead area should be well lubricated with a suitable tyre lubricant.

---

## TYRE FITTING

---

Alloy wheels

1. Install a new valve assembly.
2. Ensure wheel and tyre is adequately lubricated.
3. Mount tyre in normal manner. Inflate tyre and at same time apply hand pressure to area around valve to aid seating over valve first.



**NOTE: Stop inflation immediately if tyre seats opposite valve, as this will result in valve being blocked by tyre beading, making further inflation impossible, and carry out following procedure.**

4. Deflate tyre, unseat and rotate it around the rim until valve is in line with that part of tyre which seated initially. This part of beading having seated over hump previously will automatically seat first when tyre is re-inflated.
5. Inflate tyre to seat beads correctly, finally inflate to correct pressure.

---

**WHEELS**


---

**Remove**

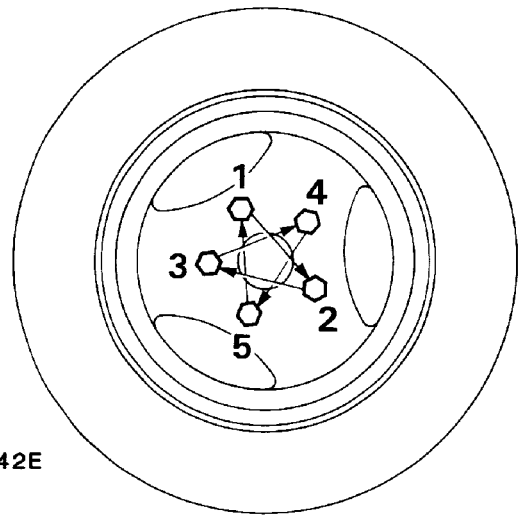
**WARNING:** The parking brake acts on transmission, not rear wheels, and may not hold vehicle when jacking unless following procedure is used. If one front wheel and one rear wheel is raised no vehicle holding or braking effect is possible. Wheels **MUST** be chocked in all circumstances.

Apply parking brake, select 'P' or a gear in main gearbox and engage low gear in transfer box.

1. Loosen five wheel nuts.
2. Using a suitable trolley jack raise vehicle and place on axle stands. **See INTRODUCTION, Information, Jacking**
3. Remove wheel nuts and carefully withdraw wheel over studs.

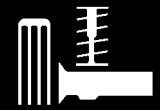
**Refit**

4. Ensure that retaining studs and nuts are clean.
5. Alloy wheels: Lightly coat wheel mounting spigot face with a suitable anti-seize compound to minimise possibility of adhesion between wheel and spigot face.
6. Refit wheel taking care not to damage stud threads. (Do not apply oil)
7. Fit wheel nuts and turn by hand for at least three full threads before using any form of wheel wrench.
8. Tighten nuts as much as possible using a suitable wrench.



RR2142E

9. Lower vehicle and finally tighten nuts to correct torque sequence shown. Alloy wheels and steel wheels: **130Nm**.



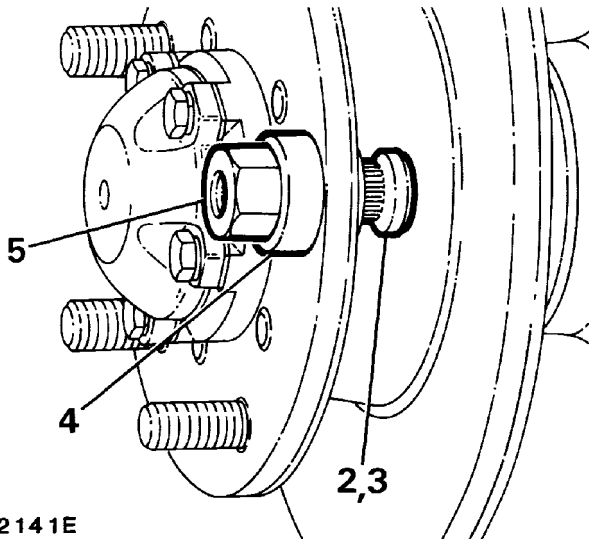
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**WHEEL STUD**

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**Remove**

1. Remove wheel. *See Wheels*
2. Drive stud out of driveshaft flange.



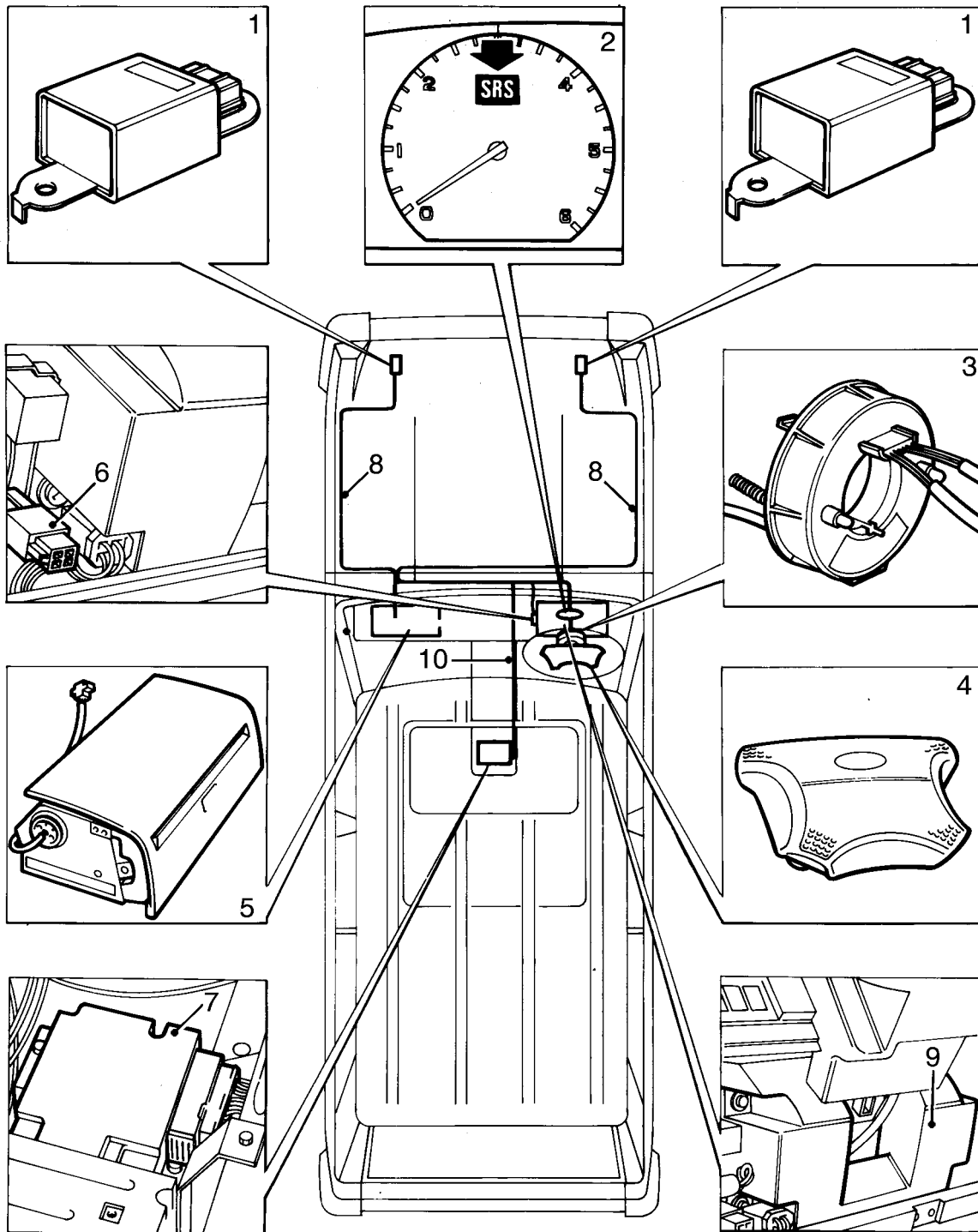
RR2 14 1E

**Refit**

3. Position stud in flange.
4. Install a suitable spacer over stud.
5. Using a M16 x 1.5P nut, a slave wheel nut is suitable, pull stud into flange until shoulder of stud abuts flange.
6. Refit wheel.



SYSTEM COMPONENTS



RR4231A

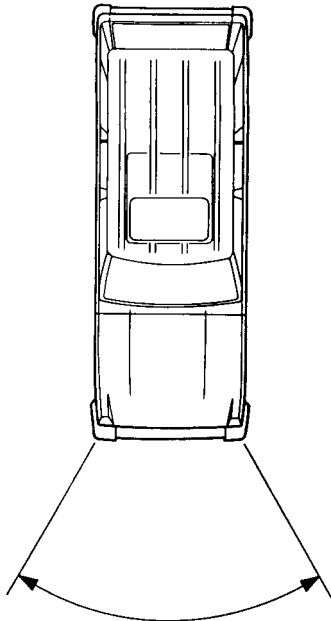
- |   |                                     |
|---|-------------------------------------|
| 1. Airbag crash sensors (distributed SRS) | 6. Airbag diagnostic socket         |
| 2. SRS warning light (airbag)             | 7. Airbag diagnostic control unit   |
| 3. Rotary coupler                         | 8. Airbag harness (distributed SRS) |
| 4. Driver's airbag module                 | 9. Knee bolsters (where fitted)     |
| 5. Passenger's airbag module              | 10. Airbag harness                  |

## OPERATION

The airbag supplementary restraint system (SRS) is a safety device which, when used in conjunction with the seat belt, is designed to protect the driver and front passenger.

Two different SRS systems are fitted to Discovery. The Distributed SRS which has two crash sensors located in the engine compartment on the chassis longitudinals and the Single Point Sensing (SPS) SRS which has a single crash sensor located in the Airbag diagnostic control unit.

The change from distributed SRS to SPS SRS occurred at VINs **198222** and **528977**.



RR4232

### Distributed SRS

In the event of a frontal impact, when the airbag diagnostic control unit and one of the airbag crash sensors senses the impact, the diagnostic control unit fires igniters. This in turn ignites tablets of sodium azide which generate a large amount of Nitrogen gas leading to airbag inflation in approximately 30 milli-seconds.

### SPS SRS

In the event of a frontal impact, when the airbag diagnostic control unit senses the impact, the diagnostic control unit fires igniters. This in turn ignites tablets of sodium azide which generate a large amount of Nitrogen gas leading to airbag inflation in approximately 30 milli-seconds.

### All Models

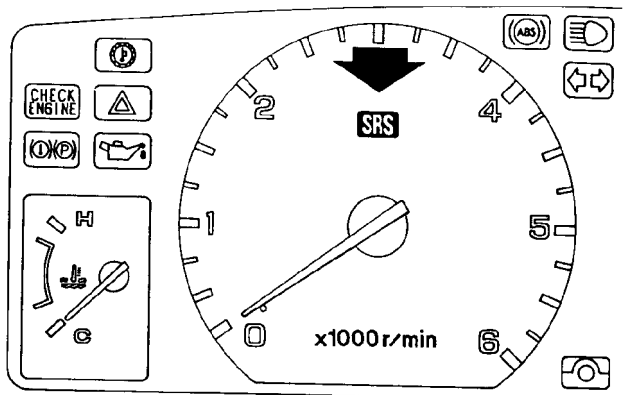
When fully deployed the airbag offers additional protection to the front seat occupant. As an occupant moves into the airbag it immediately discharges the gas to provide progressive occupant deceleration and reduce risk of injuries. The whole process is completed in approximately 0.3 seconds.



**WARNING: All the airbag system components, including the wiring harness, MUST be renewed after the airbags have deployed.**



### SRS warning light (airbag)



RR4233

#### Distributed SRS

The warning light in the instrument pack illuminates after the electrical circuits are switched on whilst a system check is carried out. After about 8 seconds the warning light will go out. The system checks airbag diagnostic control unit, airbag crash sensors, airbag harness, driver and passenger modules.

#### SPS SRS

The warning light in the instrument pack illuminates after the electrical circuits are switched on whilst a system check is carried out. After about 5 seconds the warning light will go out. The system checks airbag diagnostic control unit, airbag harness, driver and passenger modules.

#### All Models

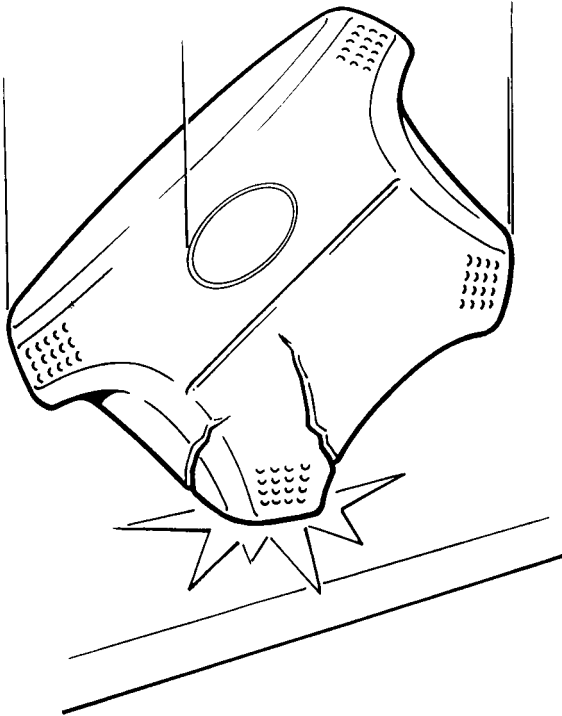
In the event of a fault in the system the warning light will illuminate. The airbag diagnostic control unit logs the fault which can only be accessed using TestBook.

## GENERAL PRECAUTIONS

## Impacts which do not deploy airbags

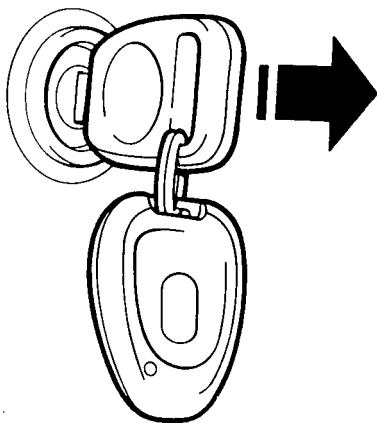


**CAUTION:** Check for structural damage in the area of the impact, paying particular attention to bumper armatures, longitudinals, crash cans and bracketry.



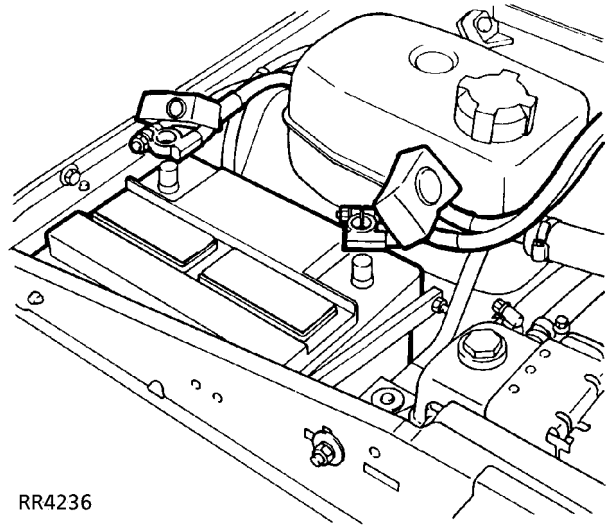
RR4234

1. Carefully inspect any airbag part before installing. Do not install any part that shows signs of being dropped or improperly handled, such as dents, cracks or deformation.



RR4235

2. Always remove the key from the starter switch before beginning work.



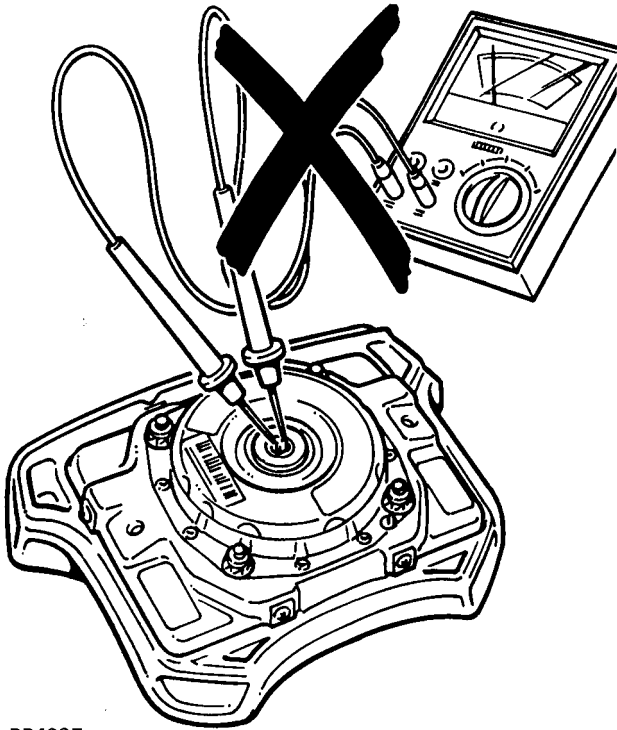
RR4236

3. Always disconnect both the negative '-' cable and positive '+' cable at the battery before removal of driver or passenger airbag modules. Disconnect the negative cable first.



**CAUTION:** The airbag system has sufficient stored energy to deploy airbags for up to 20 minutes.

4. To continue work immediately, disconnect the driver's airbag and passenger's airbag (where fitted).
5. Do not try to dismantle the airbag module. There are NO separately serviceable parts. Once an airbag has been deployed, it cannot be repaired or reused.
6. Do not install used airbag parts from another vehicle. When repairing, use only new airbag parts.



RR4237

7. Do not use electrical test equipment on the airbag harness or connectors. Tampering with or disconnecting the harness could result in accidental firing of the airbag or make the system inoperative, which may result in serious injury.
8. **An airbag system fault can only be diagnosed using TestBook.**
9. The airbag module contains Sodium Azide which is poisonous and extremely flammable. Contact with water, acid or heavy metals may produce harmful or explosive compounds. Do not dismantle, incinerate or bring into contact with electricity.

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## VEHICLE RECOVERY

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### Towing - airbag not deployed

Normal towing procedures are unlikely to cause an airbag to deploy. However, as a precaution switch the ignition off and then disconnect both battery leads. Disconnect the negative '-' lead first.

### Towing - airbag deployed

Once the driver's airbag has been deployed the vehicle must have a front suspended tow. However, as a precaution switch the ignition off and then disconnect both battery leads. Disconnect the negative '-' lead first.

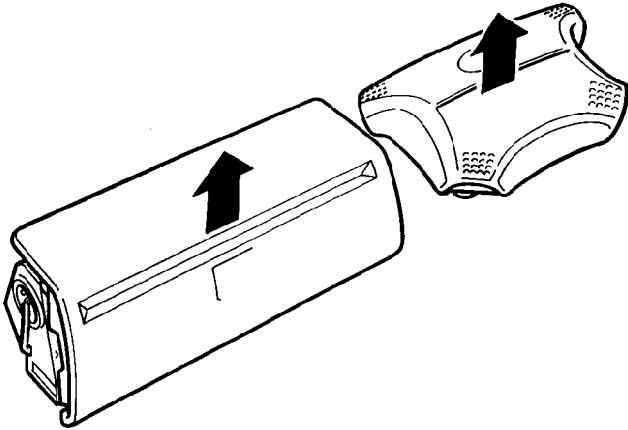
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**AIRBAG STORAGE**

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**Temporary storage**

For temporary storage of the airbag module during service, observe the following precautions:



RR4017

Store the airbag module with the pad surface up. Place the airbag module in designated storage area. If no designated storage area is available, the module may be stored in the boot of the vehicle from which it was removed. Always lock the boot when module is stored in it and inform workshop supervisor.



**WARNING: If the airbag is improperly stored face down, accidental deployment could propel the unit with enough force to cause serious injury.**

Store the removed airbag module on a secure flat surface away from heat, oil, grease, detergent or water.



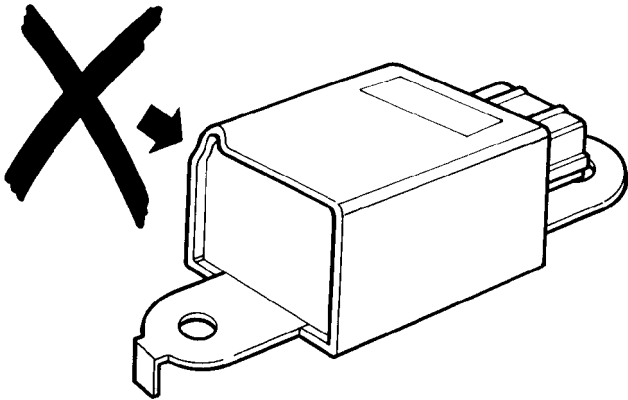
**CAUTION: Improper handling or storage can internally damage the airbag module, making it inoperative. If you suspect the airbag module has been damaged, install a new unit.**

**Overnight storage**

Airbag modules are classed as an explosive article and as such they must be stored in a secure steel cabinet which has been approved by the local authority.

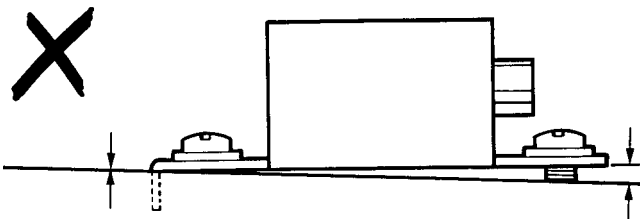
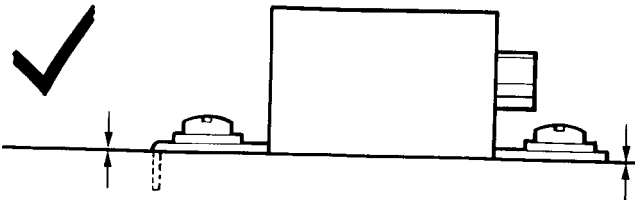


**CRASH SENSOR INSPECTION - DISTRIBUTED SRS**



RR4018

1. After any degree of front body damage, inspect both front crash sensors. Replace a sensor if there are any signs of dents, cracks or deformation.



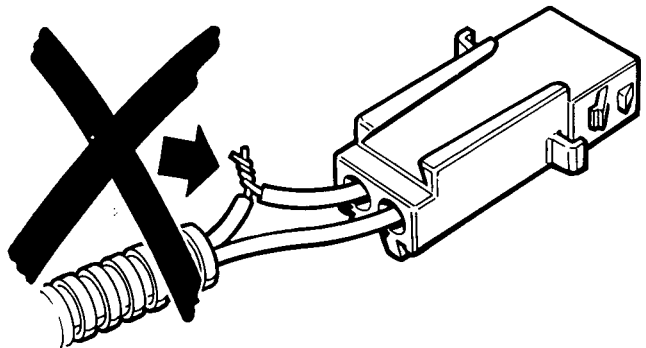
RR4019

2. Ensure the sensors are installed correctly. There must be no gap between the sensor and body of the vehicle. Use the fixing screws supplied with the sensor and tighten to the correct torque. Tighten front sensor fixing before rear sensor fixing.



**CAUTION:** Take extra care when painting or doing body work in the vicinity of the sensors. Avoid direct exposure of the sensors or harness to heat guns, welding or spraying equipment.

**AIRBAG HARNESS**



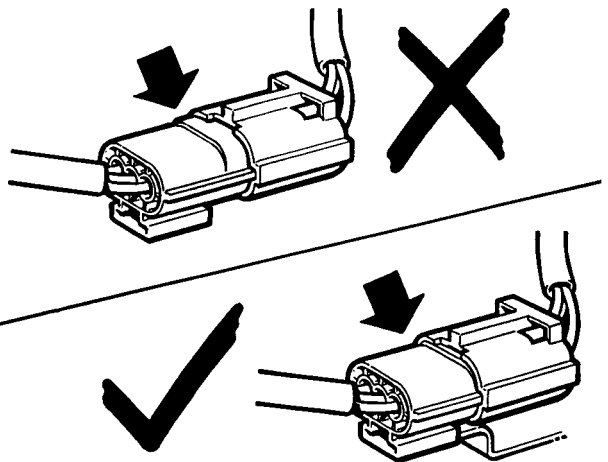
RR4020

1. Never attempt to modify, splice or repair the airbag harness. Never install electronic equipment such as; a mobile telephone, two-way radio or in-car entertainment system in such a way that it interferes electrically with the airbag harness.



**NOTE:** The airbag harness can be identified by a special yellow outer protective covering.

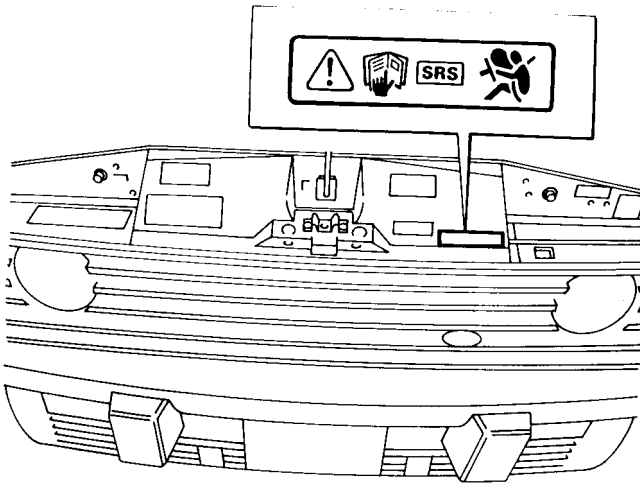
2. Make sure the airbag harness is installed correctly and not pinched or trapped.



RR4022

3. Ensure all airbag harness connectors are mated correctly and securely fastened. Do not leave the connectors hanging loose.

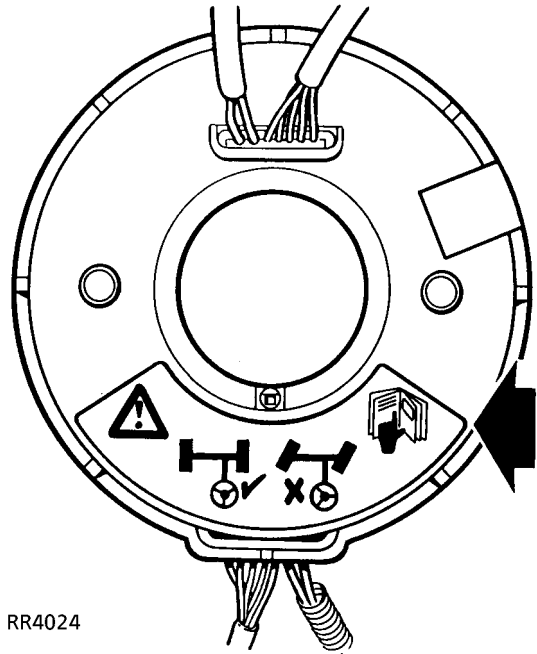
### WARNING LABELS



RR4023

#### 1. Bonnet locking platform

Refer to the Owner's Handbook for information on the airbag system.

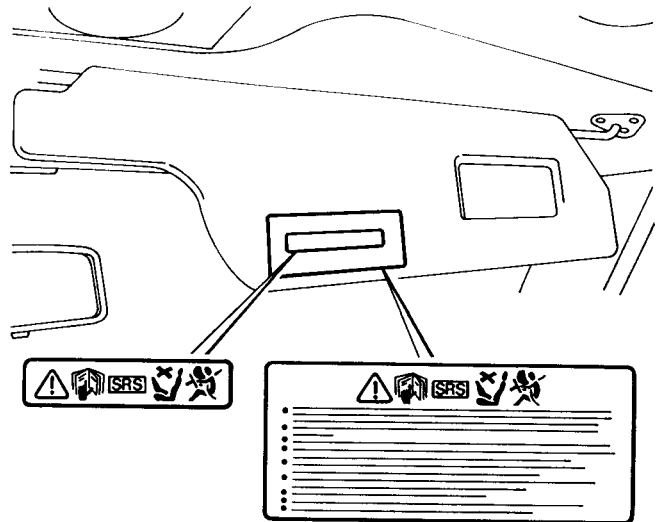


RR4024

#### 2. Rotary coupler



**CAUTION: Ensure wheels are straight ahead before removal and installation.**

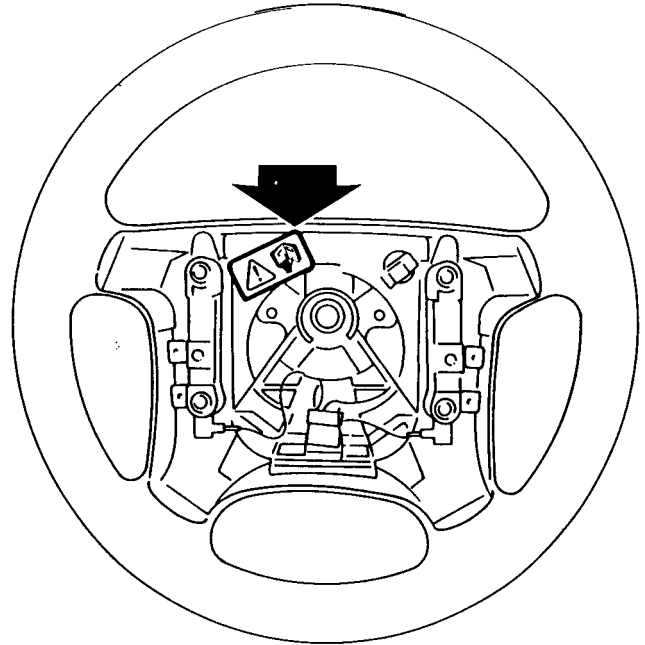
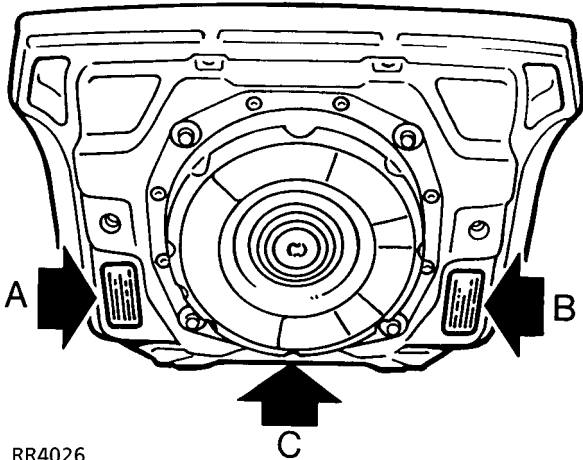


RR4025

#### 3. Driver's sun visor

Refer to the Owner's Handbook for information on the airbag system.





4. Airbag modules

**A** - If defective, replace and dispose of the entire unit as directed in the instructions. Under no circumstances should a diagnosis be performed using electrically powered test equipment or probing devices.

**B** - Tampering or mishandling can result in personal injury. For special handling instruction refer to the Workshop manual. This airbag module cannot be repaired. Use diagnostic instructions to determine if the unit is defective.

**C** - ROVER Bar code - The code number must be recorded if the airbag module is to be replaced.

5. Steering wheel

Refer to the Owner's Handbook for information on the airbag system.



**SYSTEM PRECAUTIONS**



**CAUTION:** Before and during any removal operations within the SRS section, note routing and position of all harnesses to aid correct refitting and to avoid accidentally trapping cables.



**CAUTION:** During refitting of any item within the SRS section, always ensure connectors are fully engaged and latched before proceeding to the next stage of the operation.

**DRIVER'S AIRBAG MODULE**

Service repair no - 76.74.01



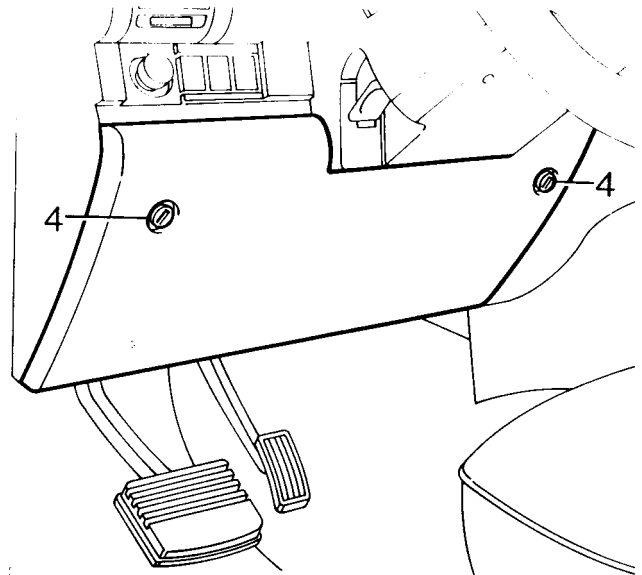
**WARNING:** All the airbag system components, including the wiring harness, **MUST** be renewed after the airbags have deployed.

**Remove**

1. Turn steering wheel 90° from horizontal.
2. Switch off ignition.
3. Disconnect battery negative '-' and then the positive '+' lead.

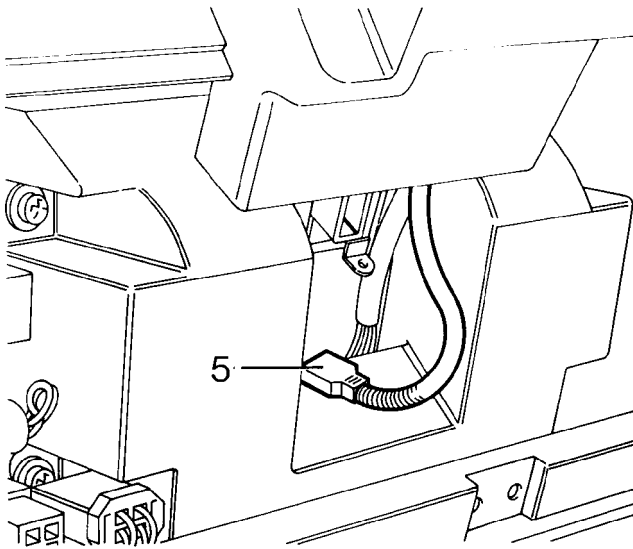


**CAUTION:** Always disconnect both leads.



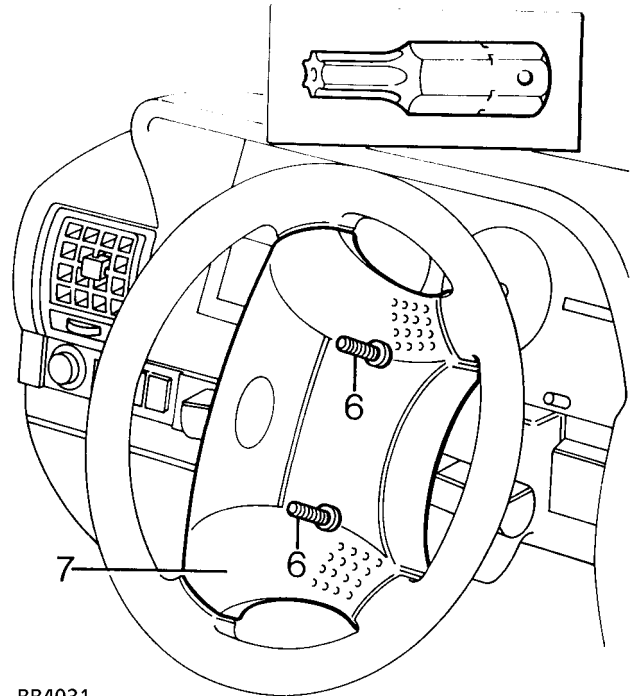
RR4029

4. Release 2 turnbuckles and remove dash lower panel.



RR4030

5. Disconnect airbag harness connector from yellow airbag column harness.

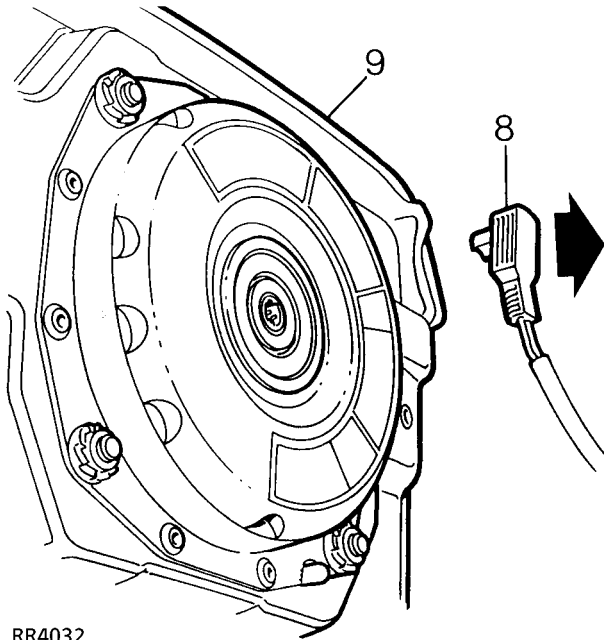


RR4031

6. Use special socket, unscrew 2 tamper-proof Resistorx screws securing airbag module to steering wheel.
7. Release airbag module from steering wheel.



**CAUTION:** Do not allow the airbag module to hang by the airbag harness.



RR4032

8. Disconnect harness connector from airbag module.
9. Remove airbag module.



**CAUTION:** Store the airbag module in accordance with the storage procedures outlined in Description and Operation.



**NOTE:** If airbag module is to be replaced the serial numbers must be recorded in the vehicle service record.

**Refit**

10. Reverse removal procedure.
11. Connect harness connector to airbag module with harness downwards (as shown at 8).
12. Position airbag module on steering wheel and engage retained screws. Use special socket to tighten screws to **8Nm (6 lbf ft)**.



**CAUTION:** Take care not to cross thread screws.

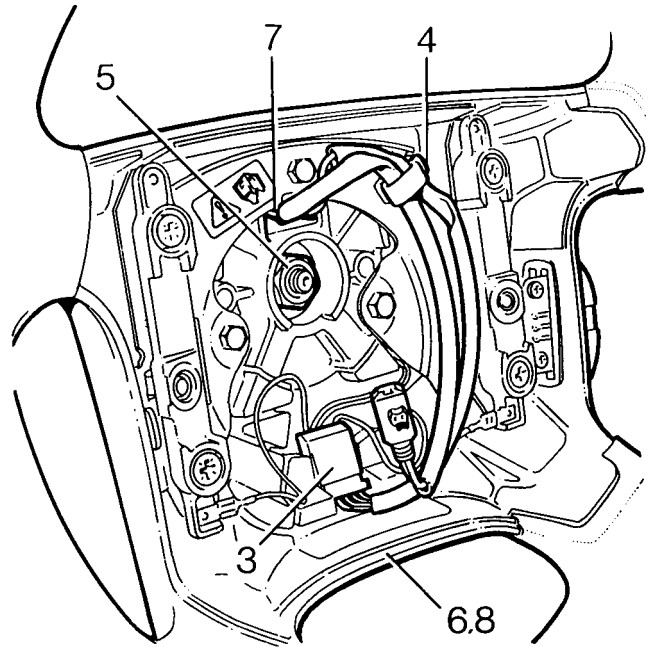
13. Check Supplementary Restraint System using **Testbook**.

**STEERING WHEEL**

Service repair no - 57.60.01

**Remove**

1. Remove driver's airbag module. **See driver's airbag module.**
2. Position steering wheel so the road wheels are in the straight ahead position.



RR4033

3. Disconnect cruise control switch connector (where fitted) from rotary coupler harness.
4. Release harnesses from clip on steering wheel.
5. Remove steering wheel nut.
6. Release steering wheel from column.
7. Feed harnesses through hole in steering wheel.
8. Remove steering wheel.



**CAUTION:** Prevent rotation of rotary coupler once steering wheel is removed. Secure in position with adhesive tape.

## Refit

9. Reverse removal procedure.



**CAUTION:** Ensure road wheels are straight ahead before fitting steering wheel.

10. Fit steering wheel ensuring the rotary coupler lugs are correctly engaged.
11. Fit steering wheel nut. Tighten to **50 Nm (37 lbf ft)**.
12. Refit driver's airbag module. **See driver's airbag module.**

## ROTARY COUPLER

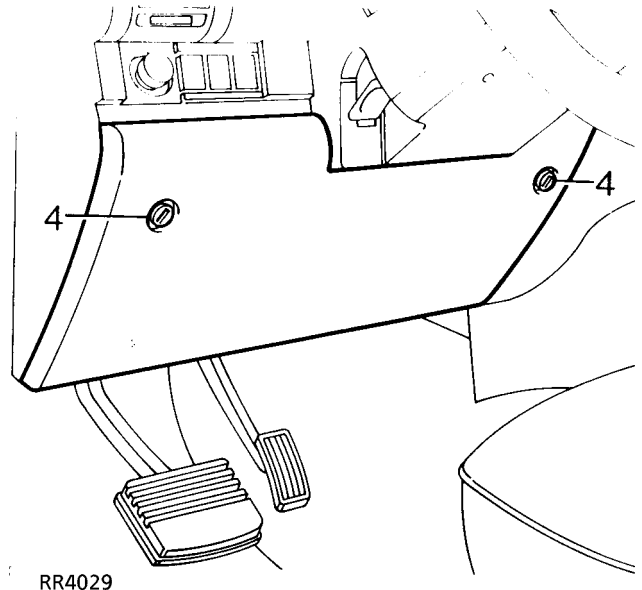
Service repair no - 76.74.07



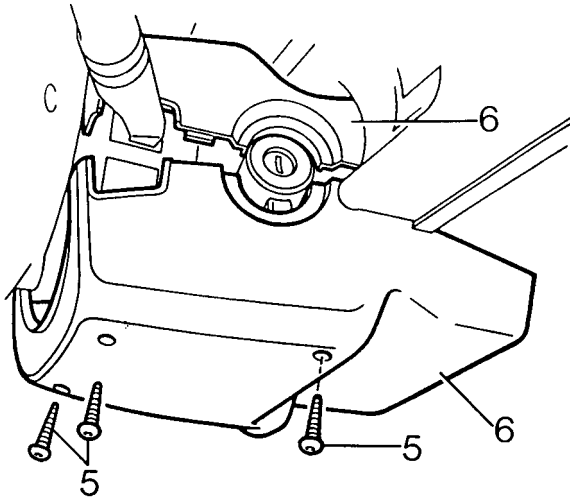
**CAUTION:** Ensure wheels are straight ahead before removal and refitting. Store in plastic bag. **DO NOT** rotate mechanism whilst removing.

## Remove

1. Remove driver's airbag module. **See driver's airbag module.**
2. Remove steering wheel. **See steering wheel.**
3. Release lever and lower steering column.

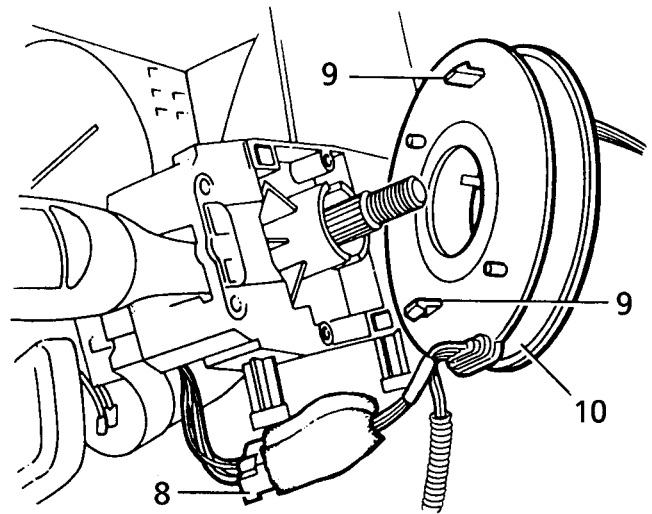


4. Release 2 turnbuckles and remove lower dash panel.



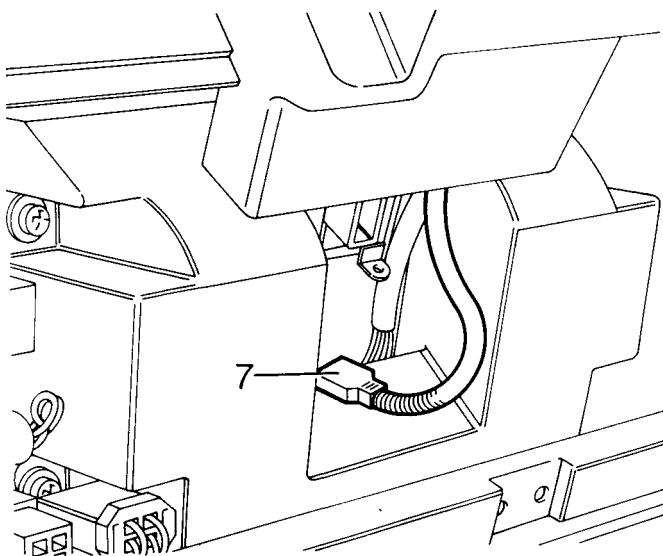
RR4034

5. Remove 3 screws securing lower half of nacelle to steering column.
6. Separate the 2 halves of the nacelle and remove from steering column.



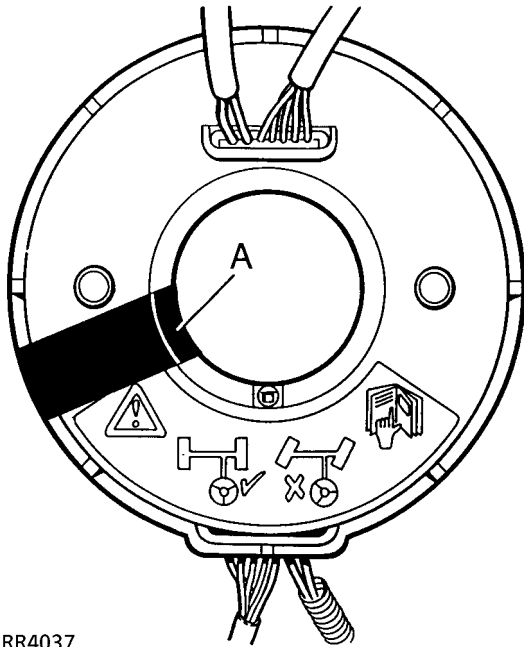
RR4036A

8. Disconnect rotary coupler connector from steering column harness.
9. Release 2 clips securing rotary coupler to column switch assembly.
10. Remove rotary coupler from column switch assembly.



RR4035

7. Release airbag harness connector from bracket and disconnect.



RR4037

11. If rotary coupler is being re-used, place a piece of adhesive tape around moulding in position **A** to prevent rotation.

#### Refit

12. Reverse removal procedure.

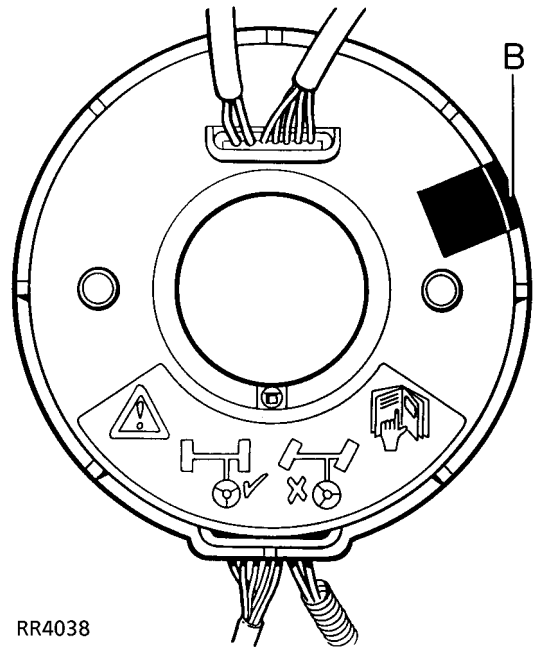


**CAUTION:** Ensure indicator cancellation pegs correctly engage into back of steering wheel.

13. Align direction indicator cancellation bush. If original rotary coupler is being fitted remove adhesive tape and then fit rotary coupler to column switch assembly.



**NOTE:** If original rotary coupler is to be fitted and there is evidence of tampering, it is imperative that the coupler is centralised. *See rotary coupler centralise.*



RR4038

14. If a new rotary coupler is being fitted and the sealing tape at position **B** is broken it **MUST NOT** be used.
15. Refit steering wheel. *See steering wheel.*
16. Turn steering wheel to both LH and RH lock 5 times. If adverse noises can be heard, check alignment of indicator cancellation pegs.
17. Refit driver's airbag module. *See driver's airbag module.*



**ROTARY COUPLER CENTRALISE**

Fitting a rotary coupler which has not been centralised could result in tape breakage. If the tape is broken, a new rotary coupler must be fitted.

Providing the removal procedure has been correctly followed this operation should not be necessary. If however there is evidence of tampering, it is imperative that the coupler is centralised.



**CAUTION: Ensure wheels are positioned straight ahead before fitting the rotary coupler.**

1. Correctly fit rotary coupler to column switch assembly but do not fit steering wheel or make any electrical connections. **See rotary coupler.**
2. Depress rotary coupler locking peg and without using undue force, rotate coupler anti-clockwise as far as inner tape will allow. Releasing peg will lock coupler in its current position.



**NOTE: Do not apply excessive force when limit is reached as this may result in tape breakage. If no limit can be found, tape has already broken and rotary coupler must be replaced.**

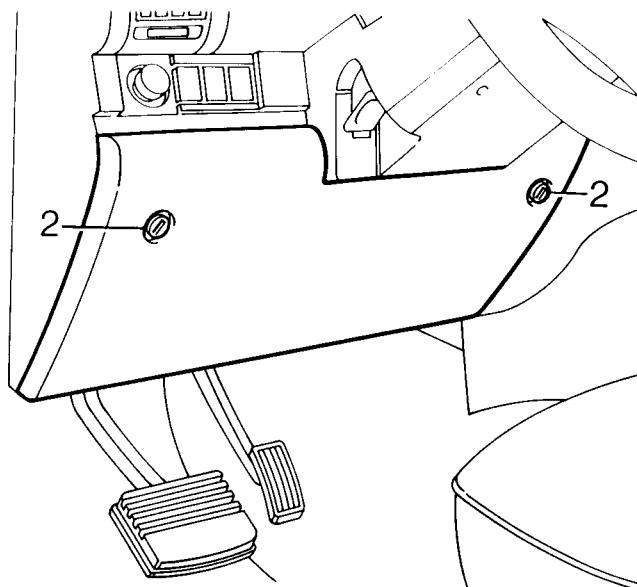
3. Having turned rotary coupler fully anti-clockwise to limit position, proceed to turn coupler 2.5 turns clockwise to obtain central position. (Coupler will normally rotate a full five turns from anti-clockwise limit to clockwise limit).
4. Make necessary electrical connections and refit steering wheel. **See steering wheel.**
5. Refit driver's airbag module. **See driver's airbag module.**

**COLUMN SWITCH ASSEMBLY**

**Service repair no - Indicator/lighting - 86.65.55**  
**Service repair no - Wash/wipe - 84.15.34**

**Remove**

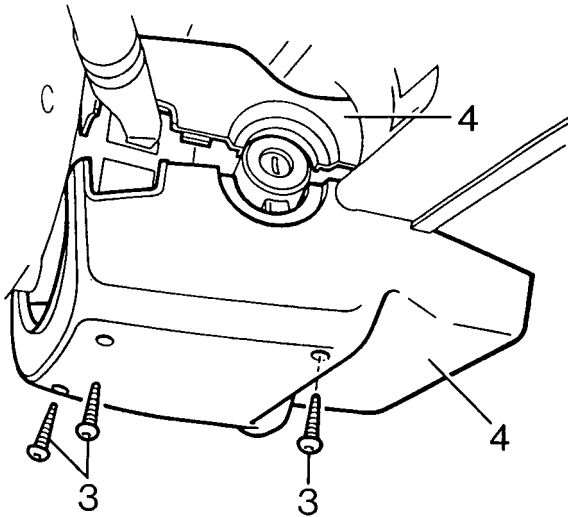
1. Remove steering wheel. **See steering wheel.**



RR4039

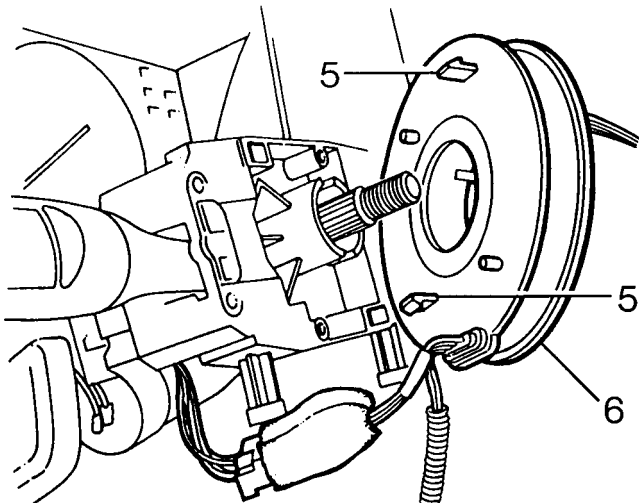
2. Release 2 turnbuckles and remove lower dash panel.





RR4040

3. Remove 3 screws securing lower half of nacelle to steering column.
4. Separate the halves of the nacelle and remove from steering column.

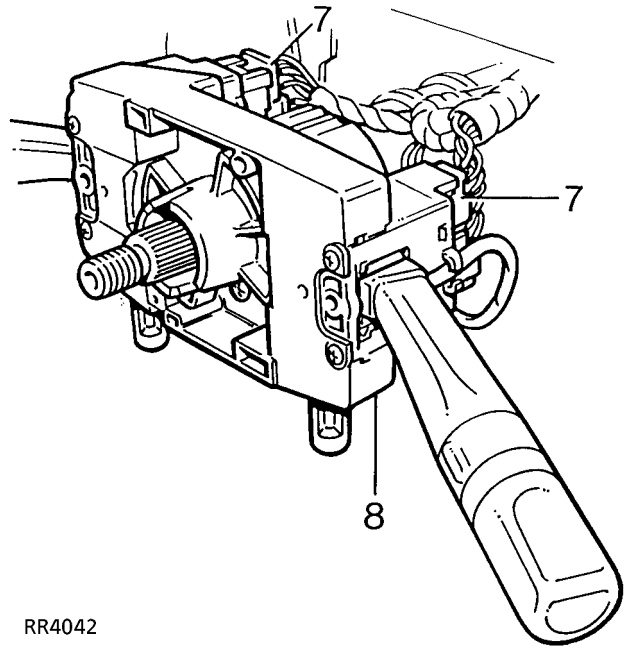


RR4041

5. Release 2 clips securing rotary coupler to column switch assembly.
6. Release rotary coupler.



**CAUTION:** Do not allow rotary coupler to hang on its harness.



RR4042

7. Disconnect 4 connectors from column switch assembly.
8. Remove column switch assembly from steering column.

#### Refit

9. Reverse removal procedure.



**PASSENGER'S AIRBAG MODULE**

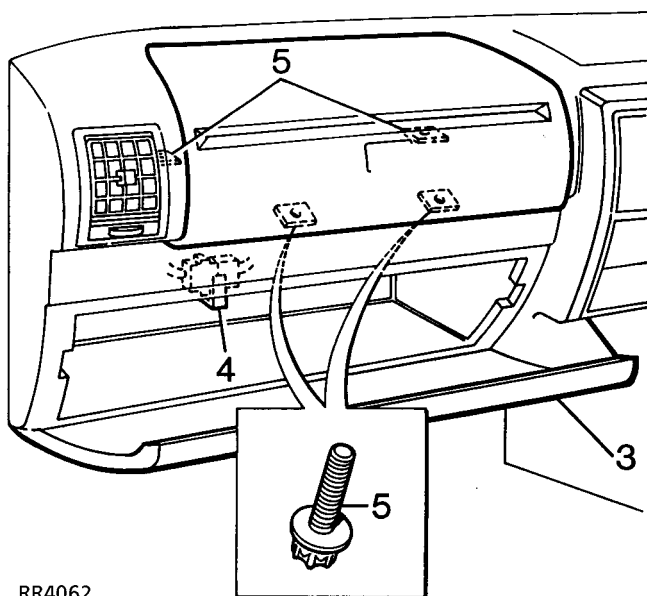
Service repair no - 76.74.02



**WARNING:** All the airbag system components, including the wiring harness, **MUST** be renewed after the airbags have deployed.

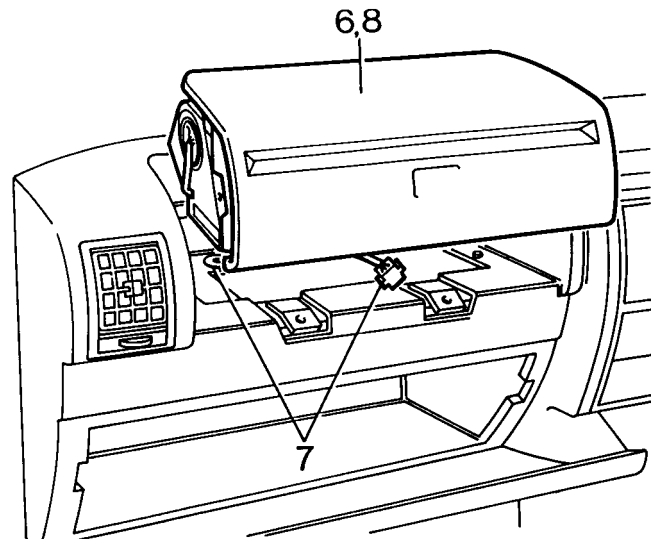
**Remove**

1. Switch off ignition.
2. Disconnect battery negative lead and then positive lead.



RR4062

3. Open glovebox and disconnect harness connector from airbag module.
4. Use special socket and long extension, remove 2 torx head screws securing front of airbag module to fascia panel.
5. Use special socket, remove 2 torx head screws securing rear of airbag module to fascia panel.



RR4043

6. Release airbag module from fascia panel.



**CAUTION:** Do not allow the airbag module to hang by the airbag harness.

7. Carefully and without pulling on connector remove airbag module.



**CAUTION:** Store the airbag module in accordance with the storage procedures described in Description and Operation.



**NOTE:** If airbag module is to be replaced the serial number must be recorded in the vehicle service record.

**Refit**

8. Reverse removal procedure.
9. Tighten airbag module securing screws to **8 Nm (6 lbf ft)**.



**CAUTION:** Take care not to cross thread screws.

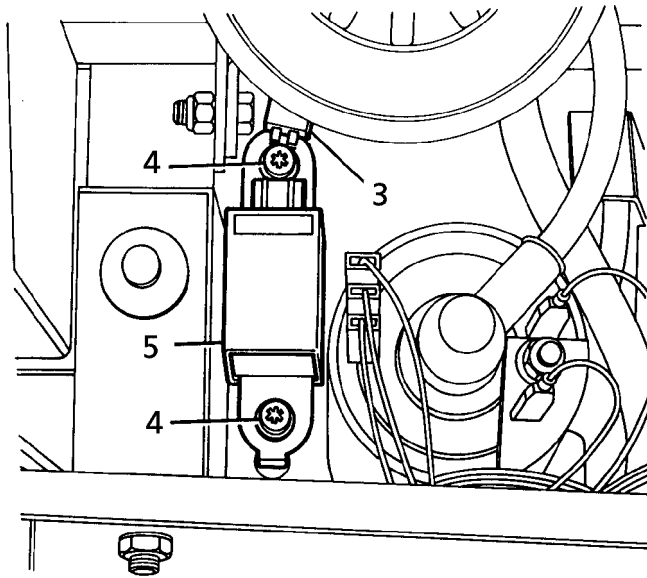
10. Check Supplementary Restraint System using **Testbook**.

**CRASH SENSOR - DISTRIBUTED SRS**

Service repair no - 76.74.04

**Remove**

1. Disconnect battery negative lead.
2. **LH sensor only:** Slacken power steering reservoir clamp and lift reservoir to provide access.  
**Diesel model only:** Remove jack and mounting bracket.



RR4044A

3. Disconnect multiplug from sensor



**CAUTION:** Ensure airbag harness connector seal and anti-backout **DO NOT** come adrift when disconnecting sensor.

4. Use special socket, remove 2 screws securing crash sensor to body.
5. Remove crash sensor.

**Refit**

6. Reverse removal procedure.
7. Tighten crash sensor securing screws to **10 Nm (7 lbf ft)**. Ensure multiplug is fully engaged on sensor and retained by its latch.
8. Check Supplementary Restraint System using **Testbook**.

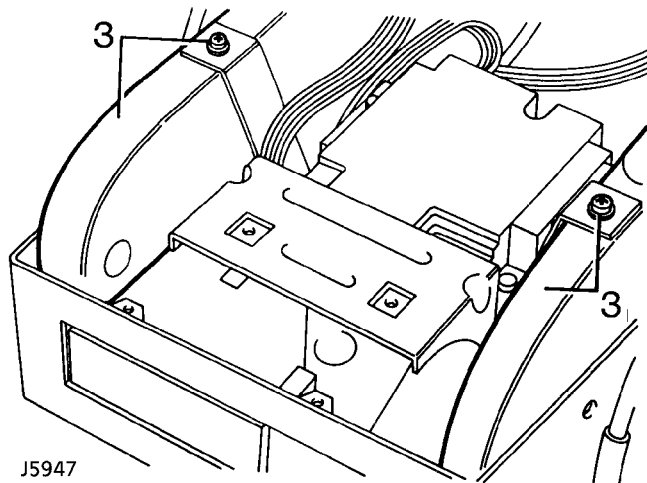


**AIRBAG DIAGNOSTIC CONTROL UNIT -  
DISTRIBUTED SRS**

Service repair no - 76.74.03

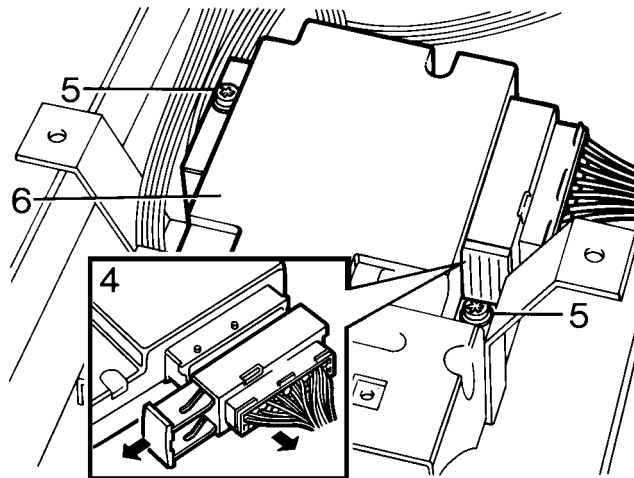
**Remove**

1. Disconnect battery negative lead.
2. Remove centre console assembly. **See CHASSIS AND BODY, Repair, centre console.**



J5947

3. Remove 4 screws and release the 2 rear passenger air ducts from their fitted position and remove centre console mounting bracket.



RR4046

4. Use flat ended screwdriver and release YELLOW retainer, pull retainer 30mm (1 1/8 in) from multiplug and disconnect airbag harness multiplug from airbag control unit.
5. Use special socket, remove 2 screws securing airbag control unit to body bracket.
6. Remove airbag diagnostic control unit.

**Refit**

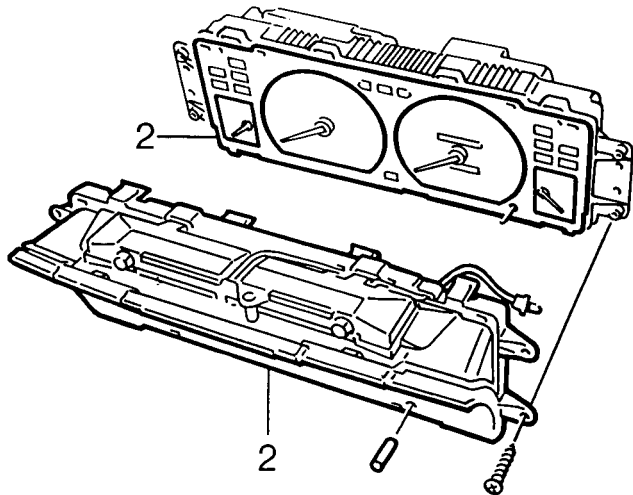
7. Reverse removal procedure.
8. Tighten control unit securing screws to **10Nm (7 lbf ft)**.
9. Check Supplementary Restraint System using **Testbook**.

## SRS WARNING LIGHT BULBS

Service repair no - 76.73.74

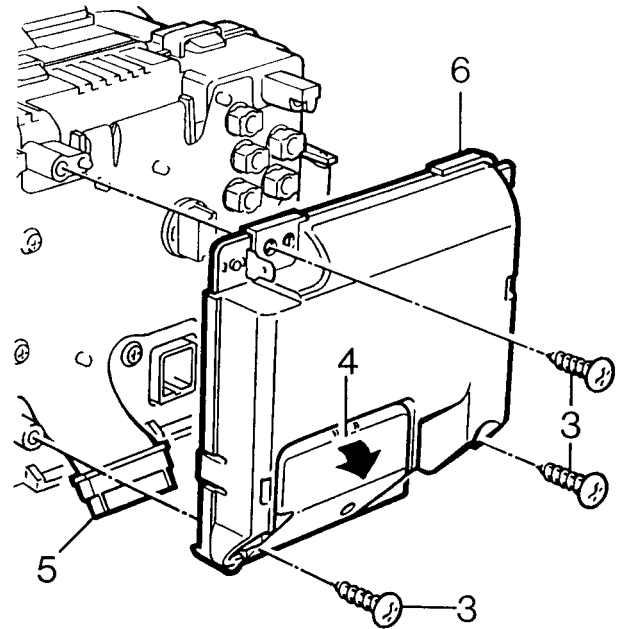
## Remove

1. Remove instrument binnacle. See *ELECTRICAL, Repair, instrument binnacle.*



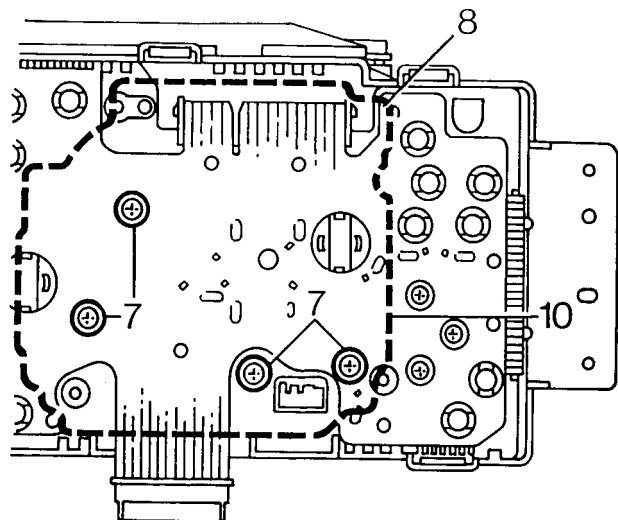
RR4047

2. Remove window and face plate from instrument panel.



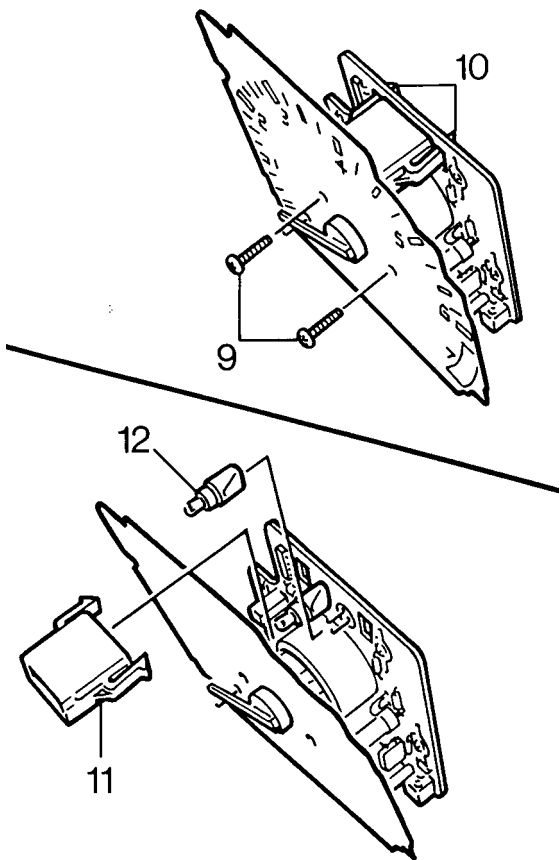
RR4048

3. Remove 3 screws securing ECU to instrument panel.
4. Release and remove small cover from ECU.
5. Disconnect multiplug from ECU.
6. Remove ECU



RR4049

7. Remove 4 screws securing tachometer.
8. Remove tachometer.



RR4050

9. Carefully remove 2 screws securing face plate to tachometer.
10. Release warning light housing from tachometer circuit board.
11. Carefully (to avoid damage to tachometer needle and spindle), tilt and remove warning light housing.
12. Remove 2 warning light bulbs.

**Refit**

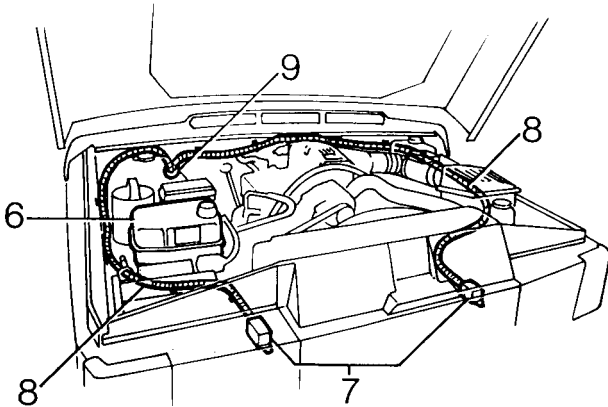
13. Reverse removal procedure.
14. Fit new warning light bulbs.
15. Carefully fit warning light housing, ensuring that locating pegs engage correctly and that retaining clips lock housing into position.
16. Ensure that tachometer needle is on the correct side of its stop.
17. Fit instrument binnacle. **See ELECTRICAL, Repair, instrument binnacle.**

## AIRBAG HARNESS

Service repair no - 86.70.63

### Remove

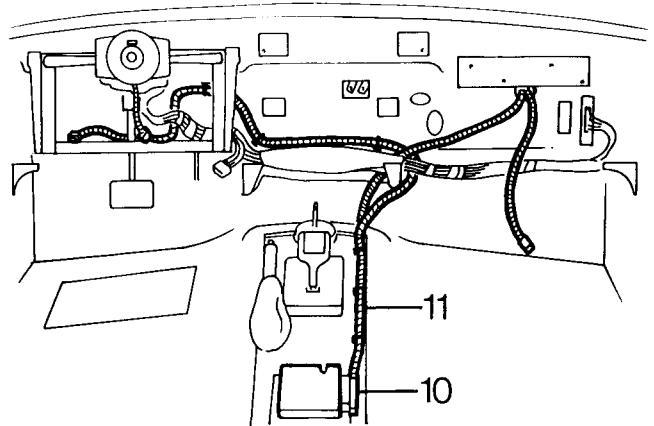
1. Remove driver's airbag. *See driver's airbag module.*
2. Remove passenger's airbag. *See passenger's airbag module.*
3. Remove dash panel assembly. *See CHASSIS AND BODY, Repair, dash panel assembly*
4. Remove heater blower unit. *See HEATING AND VENTILATION, Repair, blower motor unit - heater and air conditioning.*
5. Remove heater and cooler unit. *See AIR CONDITIONING, Repair, heater and cooler unit*



RR4051

### Pre 97 MY

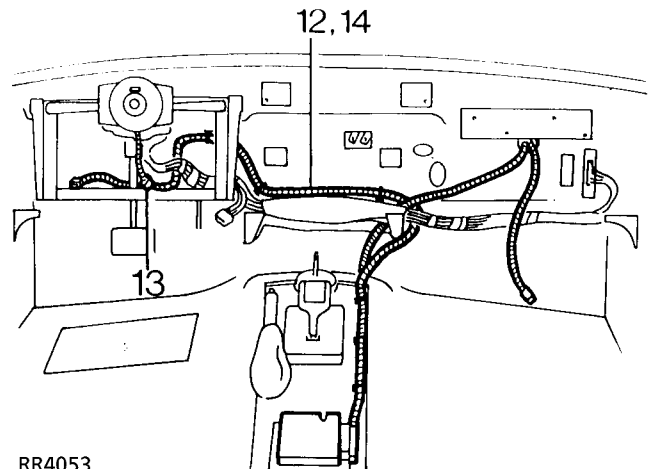
6. Remove 3 screws securing expansion tank and position expansion tank aside.
7. Disconnect multiplug from each crash sensor.
8. Release airbag harness from clips and ties along the bulkhead and each valance.
9. Displace airbag harness grommet to inside of bulkhead and feed harness through bulkhead.



RR4052

### All Models

10. Disconnect multiplug from airbag control unit.
11. Release airbag harness from under carpet.



RR4053

12. Release ties securing harness along toeboard.
13. Disconnect steering wheel airbag multiplug.
14. Release airbag harness from driver's side and remove.

### Refit

15. Reverse removal procedure.



**CAUTION:** Ensure harness is correctly routed in harness protector and that all securing clips and ties are correctly engaged and harness is undamaged. Ensure all connections are fully engaged and retained by their latches.



**AIRBAG MANUAL DEPLOYMENT**

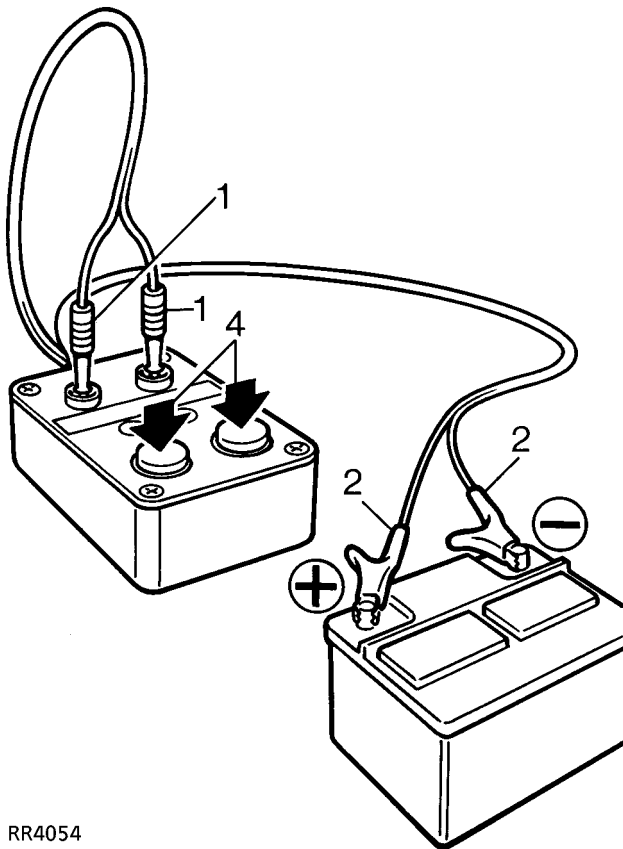


**CAUTION:** Deployment in the vehicle will damage the steering wheel; if the vehicle is not being scrapped deploy the module away from the vehicle in accordance with the separate procedure.

If a vehicle is to be scrapped and contains an undeployed airbag module, the module must be manually deployed. This operation should only be carried out using the following recommended manual deployment procedure.

Before deployment is started the deployment tool self test procedure should be carried out.

**Deployment tool SMD 4082/1 self test procedure**



RR4054

1. Insert BLUE and YELLOW connectors of tool lead into corresponding sockets on face of tool.
2. Connect crocodile clips of second tool lead to battery, RED to positive and BLACK to negative.
3. RED "READY" light should illuminate.
4. Press and hold both operating buttons.

5. GREEN "DEFECTIVE" light should illuminate.
6. Release both operating buttons.
7. RED "READY" light should illuminate.
8. Disconnect tool from battery.
9. Disconnect blue and yellow connectors from tool face sockets.
10. Self test now complete.

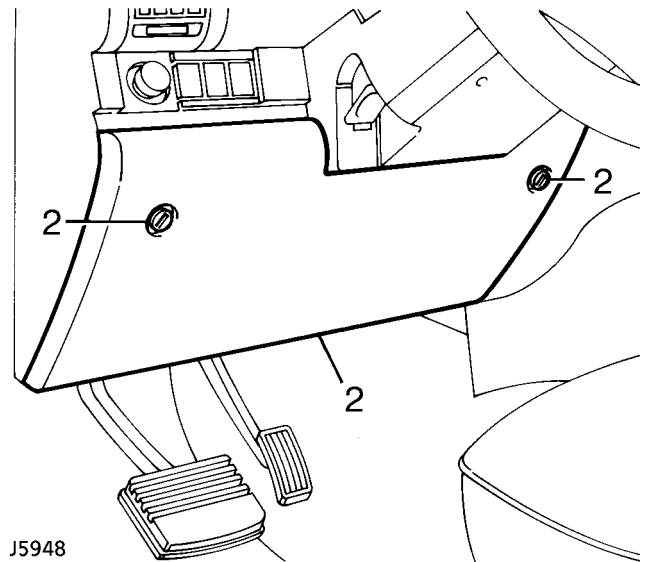
**Deployment with module fitted to vehicle**

These guidelines are written to aid authorised personnel to carry out the safe disposal of the airbag module when fitted to the vehicle.



**WARNING:** Only use the LAND ROVER approved deployment equipment. Deploy airbag module in a well ventilated designated area. Ensure airbag module is not damaged or ruptured before deploying.

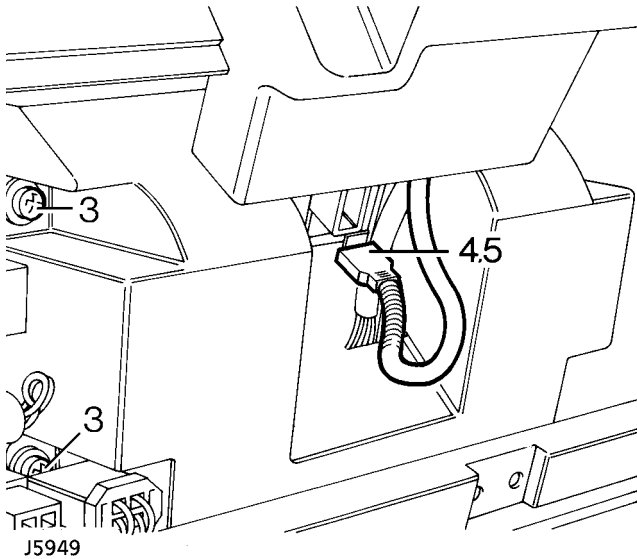
1. Carry out deployment tool self test.



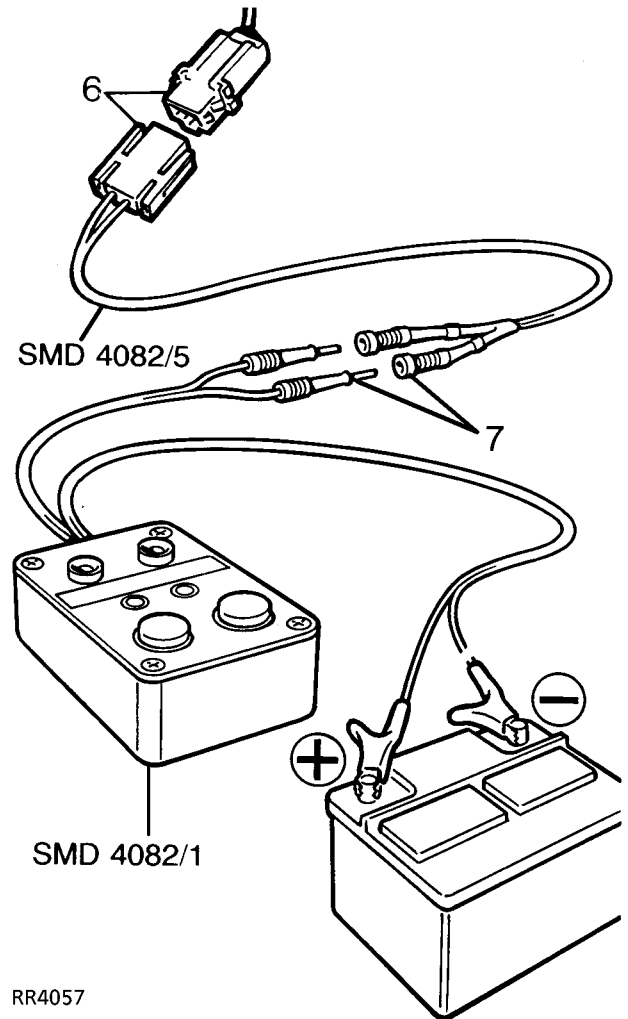
J5948

2. Release 2 turnbuckles securing lower panel to dash, remove lower panel.





3. Knee bolster (where fitted); Remove 4 screws and withdraw kneebolster.
4. Release airbag harness to column harness connector from bracket.
5. Disconnect airbag harness connector from column harness.



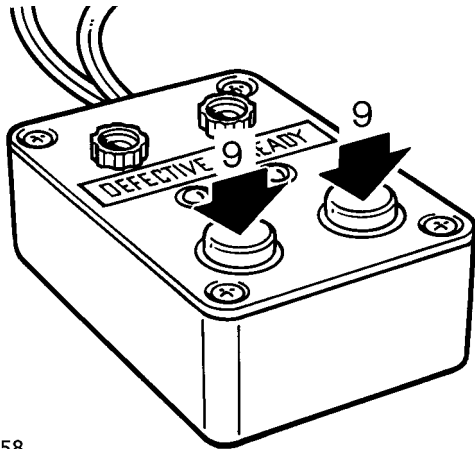
**WARNING:** Ensure tool is not connected to battery.

6. Connect flylead **SMD 4082/5** to column harness connector.
7. Connect flylead **SMD 4082/5** to tool **SMD 4082/1**.

**WARNING:** Ensure airbag module is secure within steering wheel.

8. Connect tool **SMD 4082/1** to battery.

**WARNING:** Ensure all personnel are standing at least 15 metres (50 ft) away from vehicle.



RR4058

9. Press both operating buttons to deploy airbag module.
10. **DO NOT** return to airbag module for 30 minutes.
11. Using gloves and face mask, remove airbag module from steering wheel, place airbag module in plastic bag and seal bag.
12. Transport deployed airbag module to designated area for incineration.


 **NOTE: DO NOT transport airbag module in the vehicle passenger compartment.**

13. Scrap all remaining parts of airbag system. **DO NOT** re-use or salvage any parts of the airbag system including steering wheel.

Deployment with module removed from vehicle.

**Driver's Airbag Module**

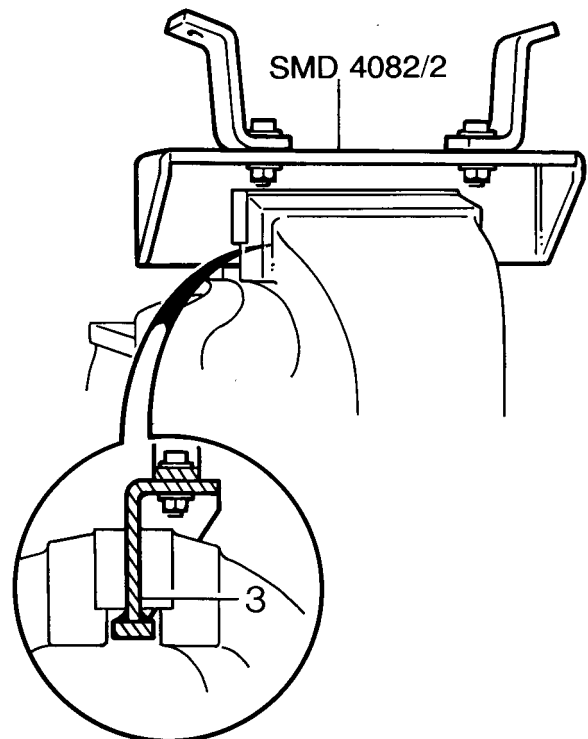
These guidelines are written to aid authorised personnel to carry out the safe disposal of airbag modules when removed from the vehicle.

 **WARNING: Only use the LAND ROVER approved deployment equipment.**

Deploy airbag modules in a well ventilated designated area.

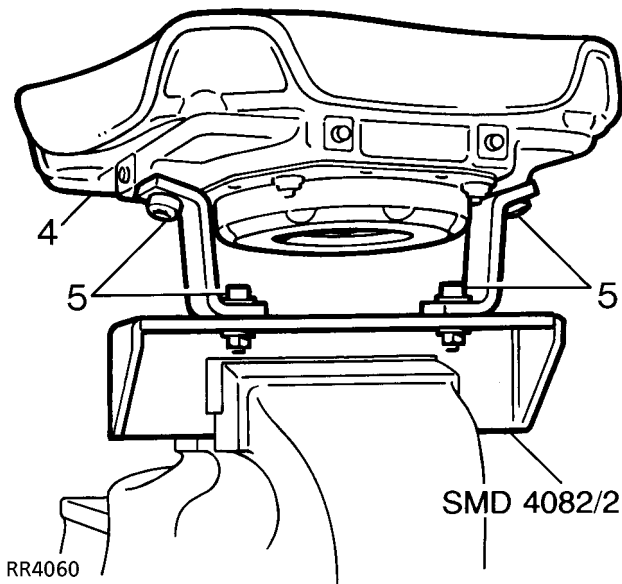
Ensure airbag module is not damaged or ruptured before deploying.

1. Carry out deployment tool self test.
2. Remove airbag module from steering wheel. **See driver's airbag module.**



RR4059

3. Position tool **SMD 4082/2** in vice, ensuring that vice jaws grip tool above bottom flange to prevent possibility of tool being forced upwards from vice. Tighten vice.

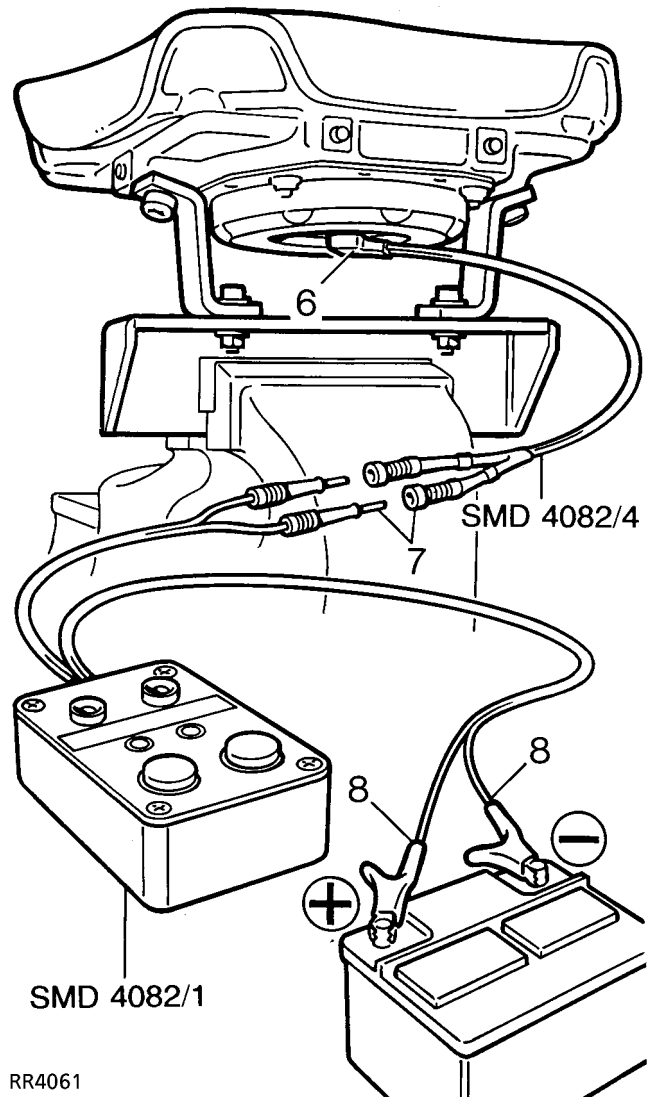


RR4060



**WARNING:** Ensure tool SMD 4082/1 is not connected to battery.

4. Secure airbag module to tool **SMD 4082/2**. Ensure module is correctly secured using both fixings.
5. Ensure airbag module mounting brackets are secure.



RR4061

6. Connect flylead **SMD 4082/4** to airbag module.
7. Connect flylead **SMD 4082/4** to tool **SMD 4082/1**.

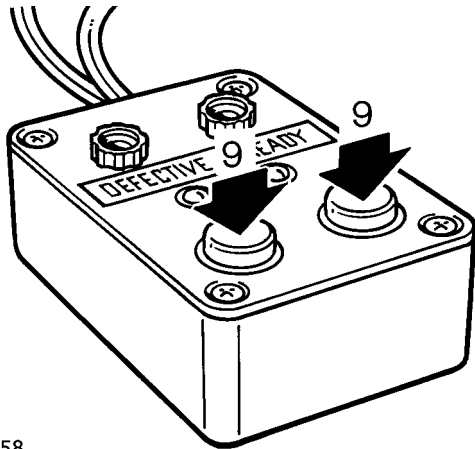


**WARNING:** Do not lean over module whilst connecting.

8. Connect tool **SMD 4082/1** to battery.



**WARNING:** Ensure all personnel are standing at least 15 metres (50 ft) away from module.



RR4058

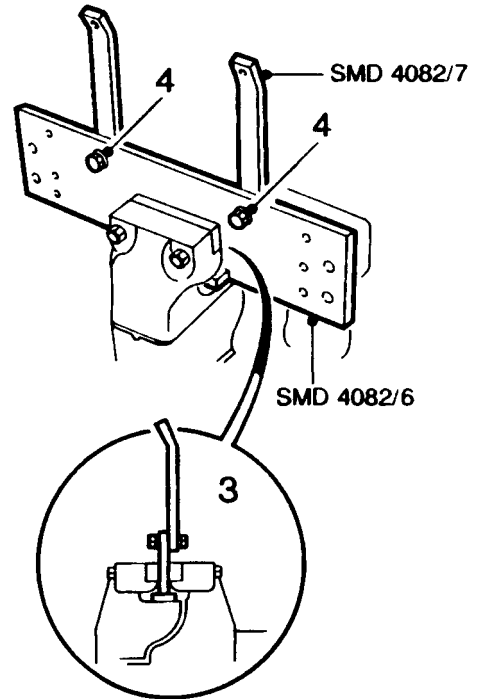
9. Press both operating buttons to deploy airbag module.
10. **DO NOT** return to airbag module for 30 minutes.
11. Using gloves and face mask, remove airbag module from tool, place airbag module in plastic bag and seal bag.
12. Wipe down tool with damp cloth.
13. Transport deployed airbag module to designated area for incineration.



**NOTE: DO NOT transport airbag module in the vehicle passenger compartment. DO NOT re-use or salvage any parts of the airbag system including steering wheel or steering column.**

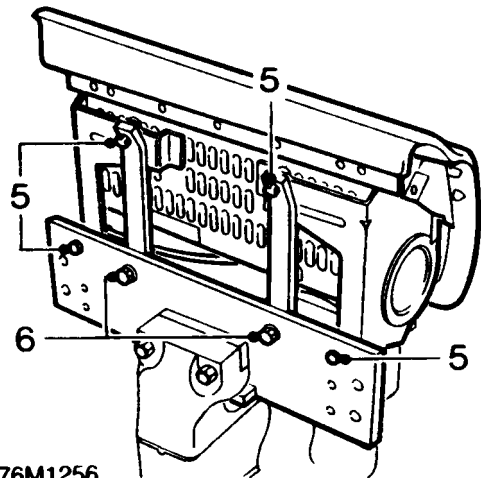
### Passenger's Airbag Module

1. Carry out deployment tool self test.
2. Remove airbag module from fascia. *See passenger's airbag module.*



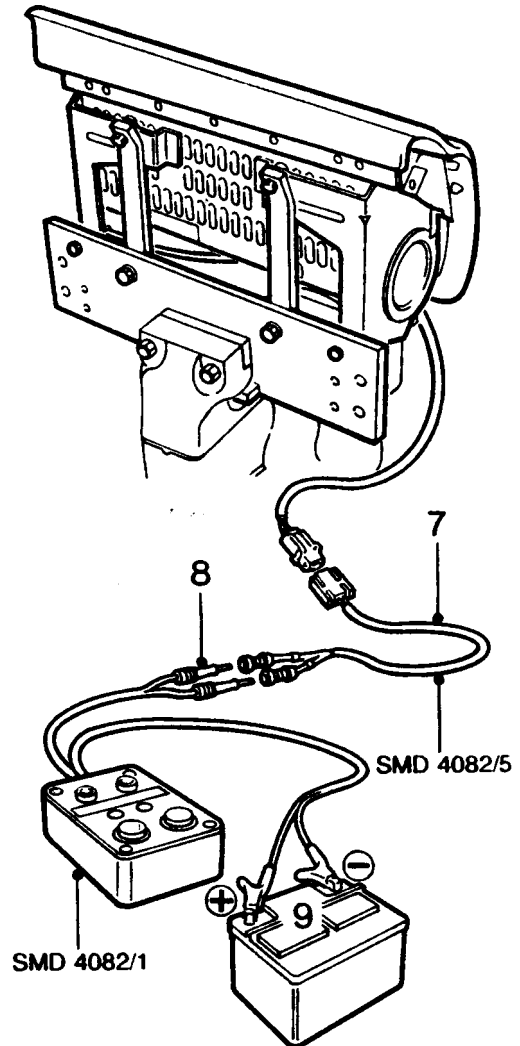
76M1255

3. Position tool **SMD 4082/6** in vice, ensuring that vice jaws grip tool above bottom flange to prevent possibility of tool being forced upwards from vice. Tighten vice.
4. Position brackets **SMD 4082/7** to tool; lightly tighten bolts.



76M1256

5. Position airbag module to tool **SMD 4082/6**. Ensure module is correctly secured using all fixings.
6. Ensure airbag module mounting brackets are secure.



76M1257



**WARNING:** Ensure tool **SMD 4082/1** is not connected to battery.

7. Connect flylead **SMD 4082/5** to airbag module.
8. Connect flylead **Smd 4082/5** to tool **SMD 4082/1**

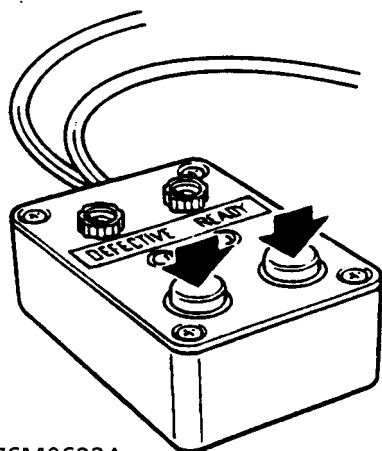


**WARNING:** Do not lean over module whilst connecting.

9. Connect tool **SMD 4082/1** to battery.



**WARNING:** Ensure all personnel are standing at least 15 metres (50 ft) away from module.



76M0623A

10. Press both operating buttons to deploy airbag module.
11. **DO NOT** return to airbag module for 30 minutes.
12. Using gloves and face mask, remove airbag module from tool, place airbag module in plastic bag and seal bag.
13. Wipe down tool with damp cloth.
14. Transport deployed airbag module to designated area for incineration.



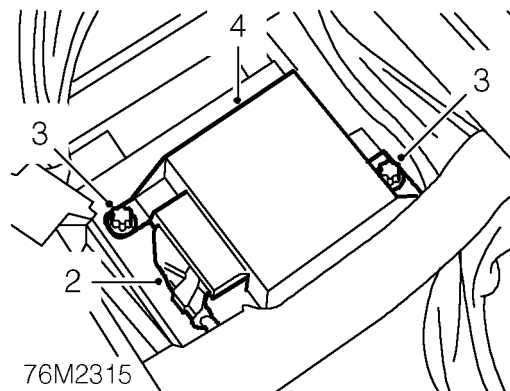
**NOTE: DO NOT transport airbag module in the vehicle passenger compartment. DO NOT re-use or salvage any parts of the airbag system.**

**AIRBAG DIAGNOSTIC CONTROL UNIT - SPS SRS**

Service repair no - 76.74.03

**Remove**

1. Remove centre console. **See CHASSIS AND BODY, Repair, centre console.**



2. Disconnect connector from control unit.
3. Remove 2 Torx bolts securing control unit to body.
4. Remove control unit.

**Refit**

5. Position control unit to body, fit Torx bolts and tighten to **10 Nm (7 lbf ft)**.
6. Connect control unit connector and secure.
7. Fit centre console. **See CHASSIS AND BODY, Repair, centre console.**
8. Check supplementary restraint system using **TestBook**.



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**TORQUE VALUES**

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**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	<b>Nm</b>
Airbag module screws .....	8 (6 lbf ft)
Steering wheel nut .....	50 (37 lbf ft)
Crash sensor screws (Distributed SRS) .....	10 (7 lbf ft)
Control unit .....	10 (7 lbf ft)



## FRONT DOOR

Service repair no - 76.28.01

### Remove

1. Disconnect battery negative lead.
2. Detach the door seal at the lower section of the 'A' post.
3. Carefully remove the two retaining buttons from the trim panel on the side of the footwell and ease out the panel.
4. Disconnect the three multiplugs connecting the door harness and speaker leads.
5. Detach the convoluted grommet from the 'A' post and withdraw the door harness and speaker leads.
6. Set the door in the open position without engaging the check stay; then remove the roll pin securing the check stay at the 'A' post.

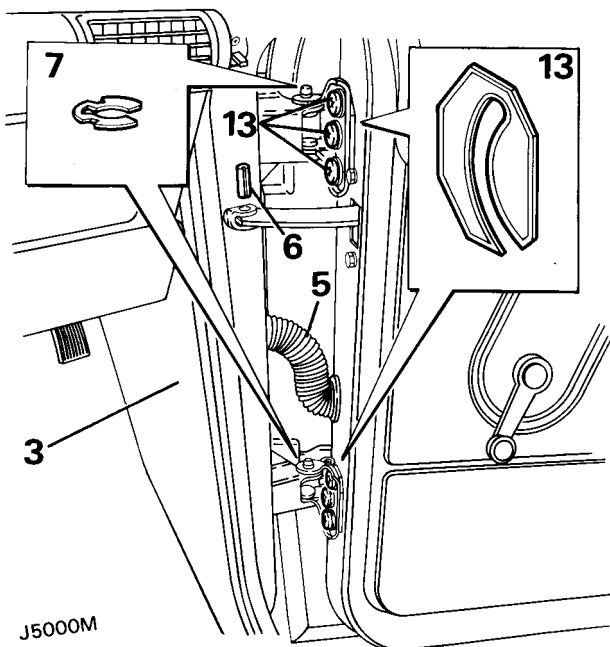


**WARNING: Instruction 7 MUST BE carried out with assistance.**

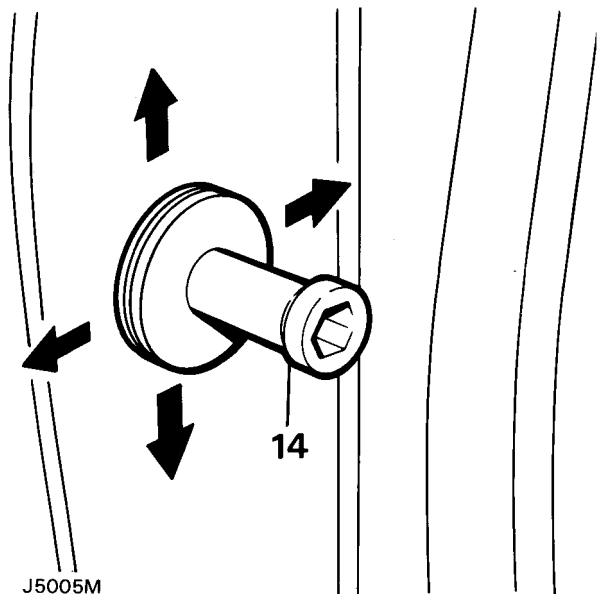
7. Remove the door hinge 'C' clips from the hinge posts and with assistance carefully lift the door from the vehicle.

### Refit

8. Refit the door and secure the hinge posts with the 'C' clips.
9. Locate the check stay to the bracket on the 'A' post and secure with a new roll pin.



10. Feed the door harness and speaker leads through the aperture in the 'A' post, fully open the door and reconnect the multiplugs in the footwell, take up the slack and refit the convoluted grommet to the 'A' post.
11. Refit the footwell side panel.
12. Check the location of the door and the operation of the door lock. If necessary, adjust the door and striker.
13. The door can be adjusted up and down or in and out of the opening by loosening the six screws securing the hinges to the door, and by the addition or removal of shims between the hinge and door.
14. The door lock striker can be adjusted by loosening the striker and moving it in the appropriate direction or by adding and removing spacing washers between the striker and 'B' post.



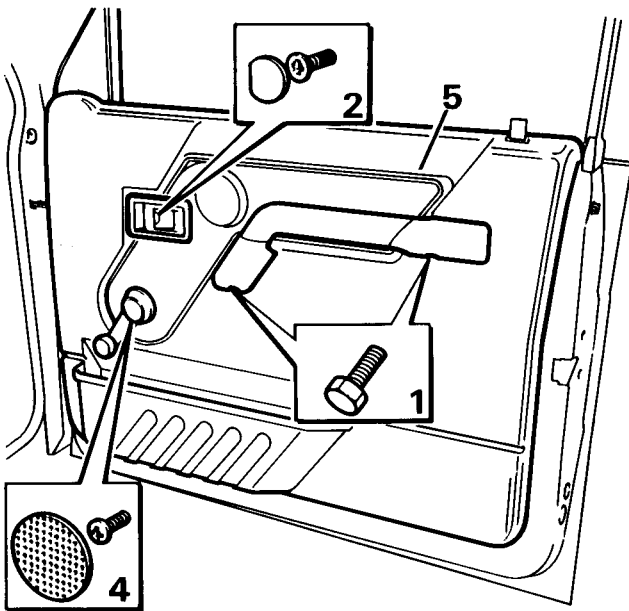


**FRONT DOOR TRIM PANEL**

Service repair no - 76.34.01

**Remove**

1. Remove the two securing screws and detach the door pull from its mounting brackets on the inner door panel.
2. Remove the interior door handle finisher button to reveal the screw retaining the handle surround.
3. Remove the screw and detach the handle surround from the trim panel.
4. Where applicable remove the window winder.
5. Detach the trim panel by inserting a trim panel removing tool between the trim panel and the inner door panel, gently prise out the fourteen plastic securing clips from their respective holes in the inner door panel.
6. Disconnect the two speaker connections from inside the door and remove the trim panel complete with speaker, and door bin.



J5001 A

7. If a new trim panel is to be fitted, remove the speaker, door bin and remote button finisher from the existing trim panel and fit them to the new panel.

**Refit**

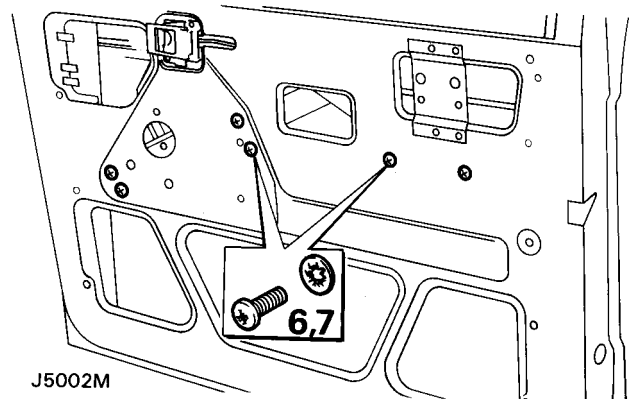
8. Reverse removal procedure.

**FRONT DOOR GLASS AND REGULATOR**

Service repair no - 76.31.45

**Remove**

1. Ensure the window is in the fully closed position and secure with adhesive tape to prevent the window from dropping down.
2. Disconnect battery negative lead.
3. Remove the door trim panel. **See front door trim panel.**
4. Remove the plastic vapour barrier.
5. Where applicable remove the window lift motor. **See ELECTRICAL, Repair, window lift motor - front.**

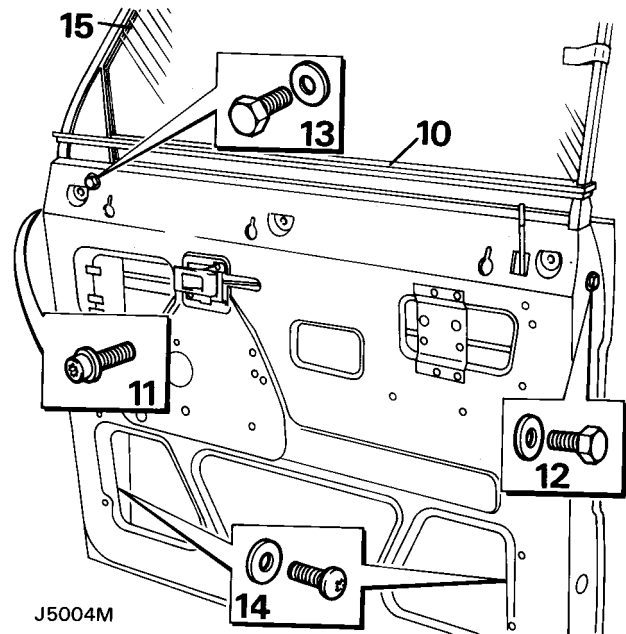
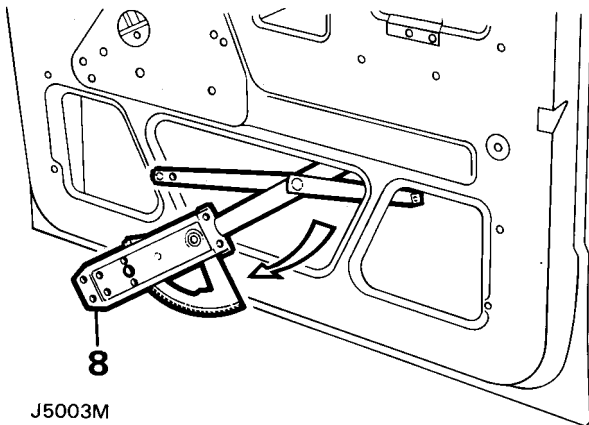


J5002M

6. Remove the four window regulator retaining screws and shakeproof washers from the inner door panel.
7. Remove the two screws and shakeproof washers retaining the lower window lift channel, and slide the channel off the stud.



8. Disengage the lifting arm stud from the upper lifting channel, manoeuvre the window regulator and remove it from the lower centre opening in the inner door panel.



9. Remove the exterior driving mirror. **See *ELECTRICAL, Repair, exterior driving mirrors.***
10. Remove the waist rail seal from the top of the door panel.
11. Remove the 'Torx' bolt from the hinge face of the door which secures the front of the door frame.
12. Remove the bolt and plain washer from the opening edge of the door which secures the rear of the door frame.
13. Remove the bolt and plain washer from the recessed hole in the front of the inner door panel under the exterior driving mirror mounting plate.

14. Remove the screws and plain washers, from inside the door, securing the bottom of the front and rear glass channels.
15. Lift the door glass frame complete with glass out of the door panel and remove to a suitable bench.
16. Remove the adhesive tape securing the glass to the door frame.
17. Slide the glass out of the door frame channel.

#### Refit



**NOTE:** When refitting the door glass frame, ensure it is repositioned to suit the door opening before fully tightening the door frame securing bolts.

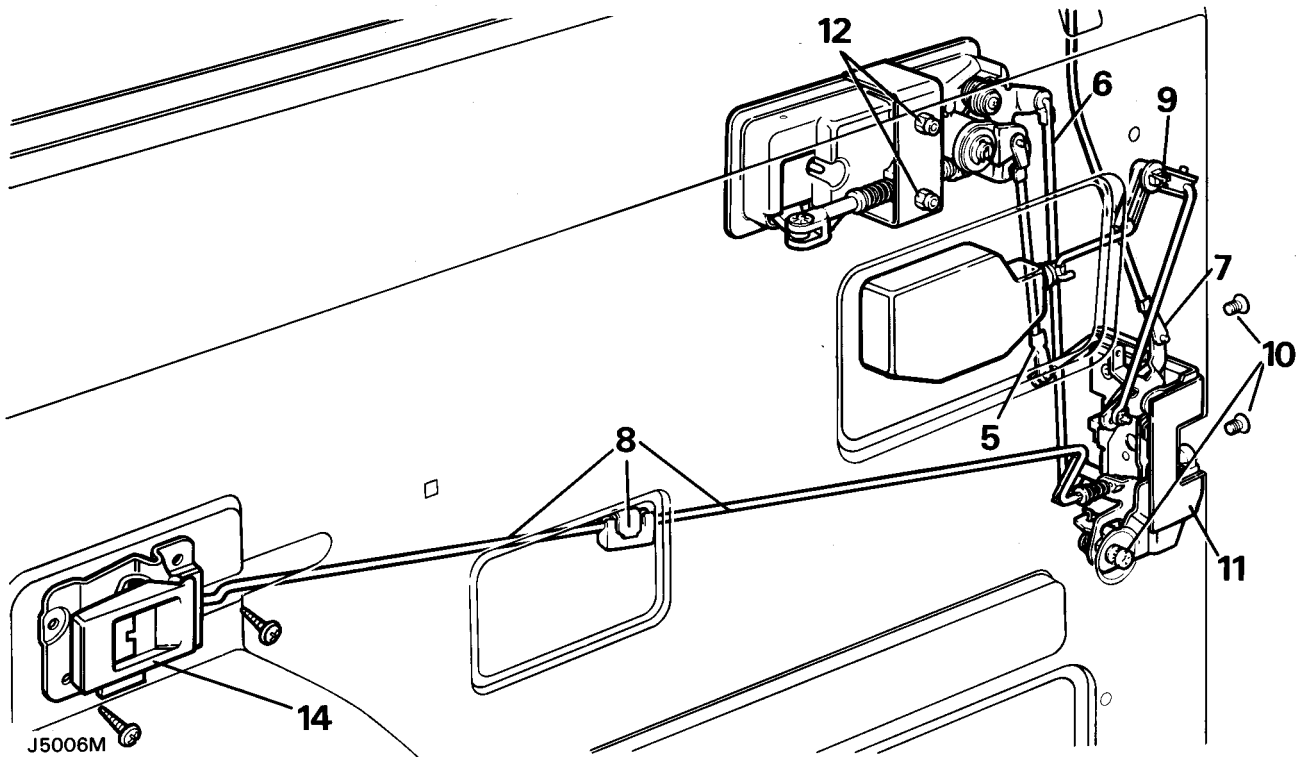
18. Reverse removal procedure.

### FRONT DOOR LOCK, OUTSIDE AND INSIDE DOOR RELEASE HANDLES

Service repair no - 76.37.12/31

#### Remove

1. Disconnect battery negative lead.
2. Remove the door trim panel. *See front door trim panel.*
3. Remove the door glass and regulator. *See front door glass and regulator.*
4. Where applicable remove the door actuator unit. *See ELECTRICAL, Repair, front door actuator unit.*
5. Disconnect the lock barrel control rod from the lock by releasing the metal clip at the bottom of the rod.
6. Disconnect the control rod from the outside door release handle by pulling it out of the plastic ferrule.
7. Disconnect the remote button control rod from the lock by releasing the metal clip at the bottom of the rod and withdraw the rod from the door.
8. Disconnect the control rod connector between the inside door release handle and the door lock by releasing the metal clip and pulling one of the control rods out of the plastic connecting block. This is accessible through the small centre cut-out in the door panel. The control rod also passes through a guide bracket in the inside of the inner door panel.
9. From inside the door panel push out the small pin that secures the quadrant to the inner door panel. Push the quadrant out of the panel.
10. Release the door lock by removing the two counter-sunk screws from the door edge and the single screw and shakeproof washer on the inner door panel.





11. Withdraw the lock through the lower rear cut-out on the inner door panel.
12. Remove the two nuts, shakeproof washers and retaining bracket securing the outer door release handle to the outer door panel, accessible through the upper rear cut-out on the inner door panel.
13. Carefully detach the door release handle from the outer panel.
14. Remove the two screws securing the inside door release handle to the inner panel.
15. Withdraw the handle from its location with the connecting rod half still attached.
16. Unclip the end of the connecting rod from the handle.

#### Refit

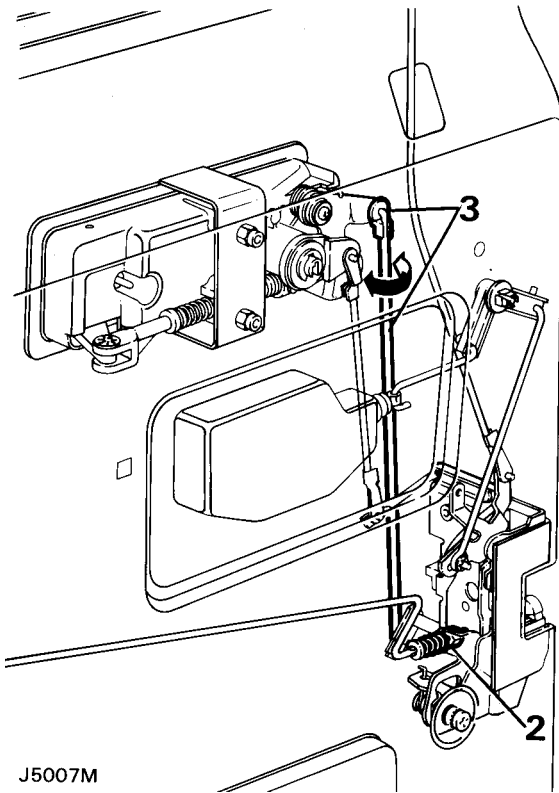
17. Reverse removal procedure.

**ADJUSTMENT-FRONT DOOR LOCK AND HANDLE ASSEMBLY**

Service repair no - 76.37.47

**Inside door release handle to lock**

1. Refit the inside door release handle surround before any adjustment is made, allowing the handle to be set from the correct operating position.



2. At the lock end of the interior handle connecting rod, rotate the spring tensioned nyloc nut clockwise or counter-clockwise, as necessary to shorten or extend the operating length of the rod.

**Outside door release handle to lock**

3. Disconnect the connecting rod from the plastic ferrule at the rear of the outer door release handle. Rotate the rod clockwise or counter-clockwise to shorten or extend the operating length as necessary.



**NOTE:** Door release should be effective before the total handle movement is exhausted to provide a small overthrow movement.



## REAR SIDE DOORS

Service repair no - 76.28.02

### Remove

1. Disconnect battery negative lead.
2. Detach the convoluted grommet from the 'B' post.
3. Withdraw the door harness multiplugs from the 'B' post and disconnect them.
4. Remove the bolts and washers securing the check strap to the 'B' post.



**WARNING: Instruction 5 MUST BE carried out with assistance.**

5. Remove the door hinge 'C' clips from the hinge posts and with assistance carefully lift the door from the vehicle.

### Refit

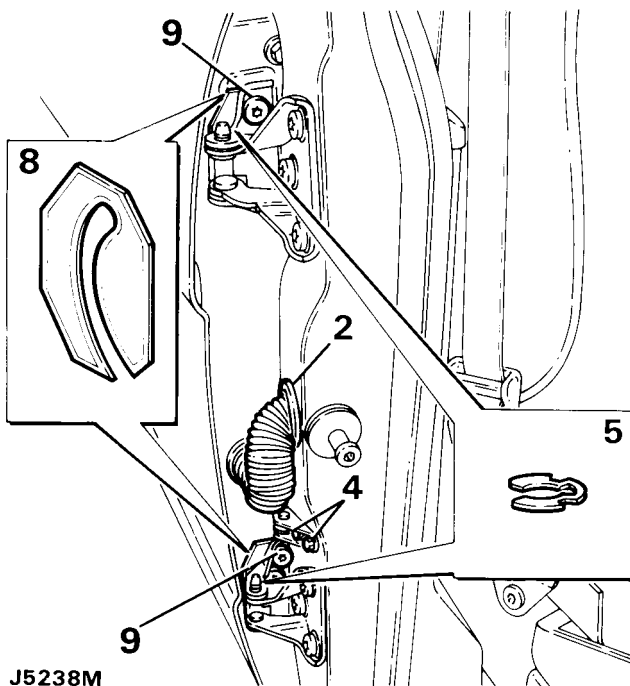
6. Reverse removal procedure. Fitting new 'C' clips if the existing ones are worn or distorted.
7. Check the operation of the door and lock. If necessary, adjust the door and striker.

### Adjust

8. Adjust the door by adding or removing shims between the hinge and the door to move the door forward or rearward in the opening.
9. To adjust the door up, down or in and out of the opening, loosen the screws securing the hinges to the door, adjust as necessary and retighten the screws to the correct torque value.
10. Adjustment of the door striker is identical to the procedure for front doors.



**NOTE: If it is necessary to remove the hinges from the 'B' post they must be refitted in exactly the same position, using an equal thickness of shims to those removed.**



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**REAR SIDE DOOR - TRIM PANEL**


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Service repair no - 76.34.04

**Remove**

1. Disconnect battery negative lead.
2. Remove the two securing screws and detach the door pull from its mounting brackets.
3. Remove the securing screw and detach the interior door release handle surround.
4. Where applicable remove the window winder or release electric switch and disconnect.
5. Detach the trim panel by inserting a trim panel removing tool between the trim panel and the inner door panel, gently prise out the plastic securing clips from their respective holes in the inner panel.
6. Lift the trim panel over the remote button and clear of the door. Where applicable disconnect the electrical plug from the window lift switch and withdraw the panel.

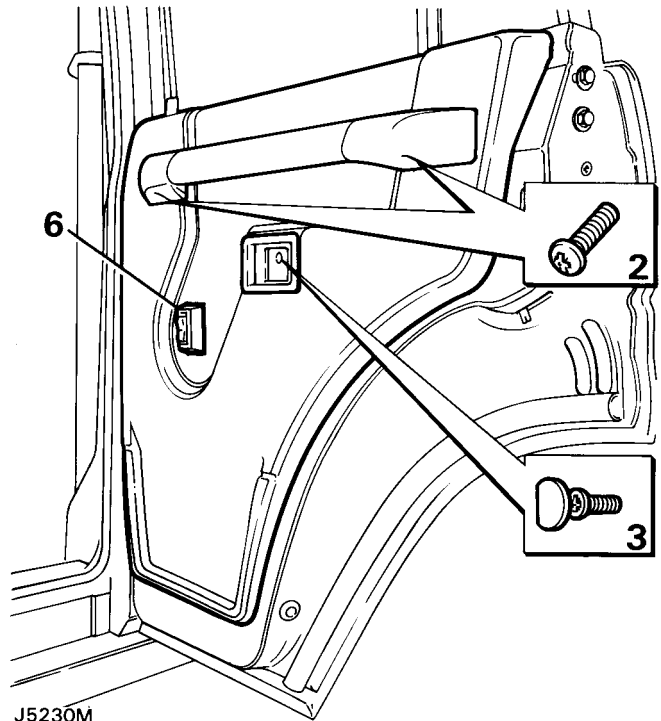


**NOTE: With the trim panel removed the remote button and rod will fall from its location in the bellcrank. Observe its correct location and withdraw from the door panel.**

7. If a new trim panel is to be fitted, remove the window lift switch, door bin and remote button finisher from the existing trim panel and fit them to the new panel.

**Refit**

8. Reverse removal procedure. Ensuring correct fitment of the sill button operating rod.





## REAR SIDE DOOR LOCK, INSIDE AND OUTSIDE RELEASE HANDLES

Service repair no - 76.37.13/32

### Remove

1. Ensure that the window is in the fully closed position.
2. Disconnect battery negative lead.
3. Remove the interior trim panel from the door.  
**See rear side door - trim panel.**
4. Remove the plastic vapour barrier sheet.
5. Disconnect the inside release handle control rod by pulling it from its location in the door lock.
6. Disconnect the sill locking control rod from the lock by releasing the metal clip.
7. Disconnect the outside release handle control rod by pulling it out of the plastic ferrule.
8. Remove the two countersunk screws from the door edge and the single screw and shakeproof washer from the inner door panel. Retrieve any spacing washers which may be fitted between the inner door panel and lock.
9. Withdraw the lock through the upper rear opening in the inner door panel.



**NOTE:** If necessary the following items can be removed.

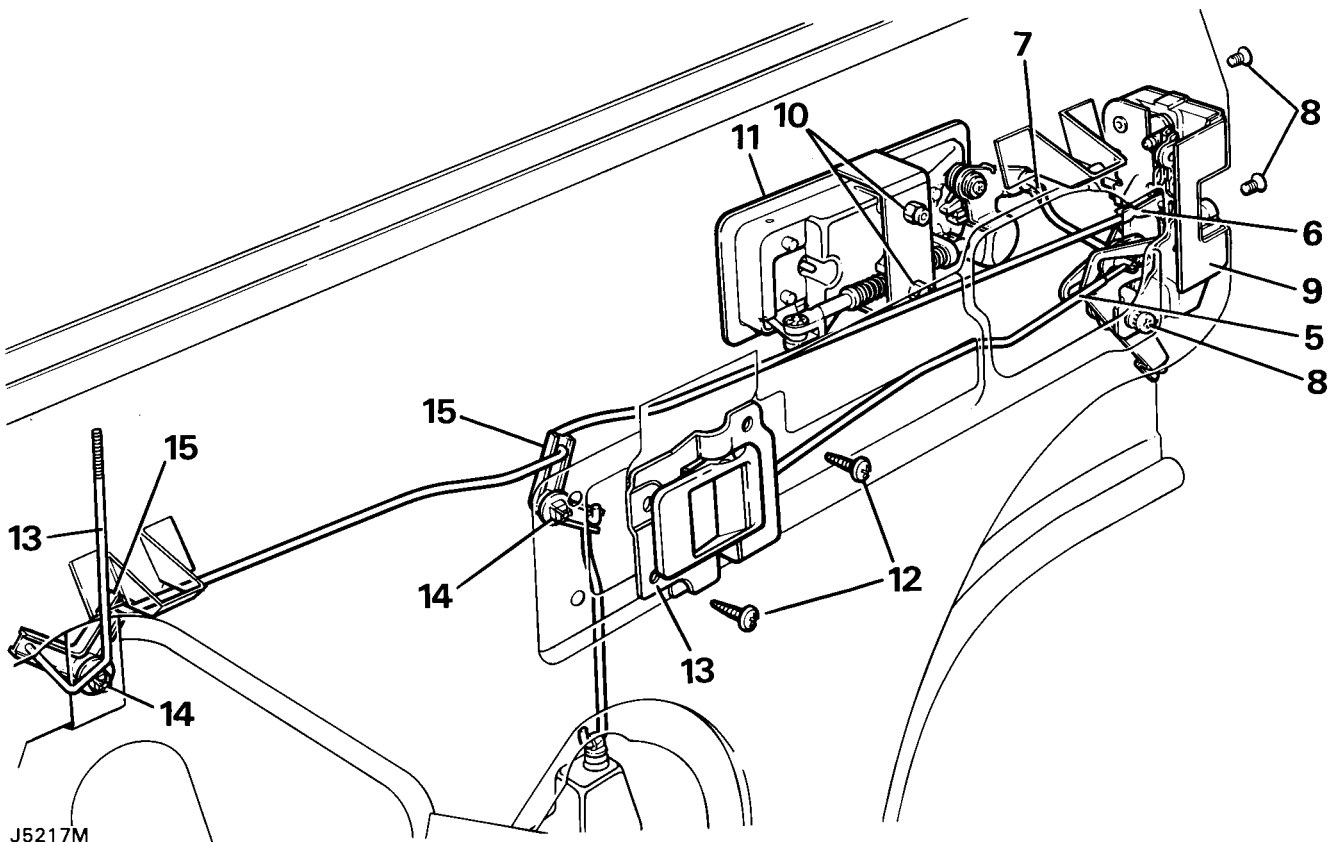
10. Remove the two nuts, shakeproof washers and retaining bracket securing the outer release handle which are accessible through the upper rear cut-out on the inner door panel.
11. Carefully detach the handle from the outer door panel.
12. Remove the two screws and plain washers securing the inside release handle to the inner door panel and withdraw the handle complete with connecting rod.
13. Disconnect the sill button connecting rod from the bellcrank and withdraw the rod complete with sill button.

### Sill locking bellcrank

14. Using a small screwdriver, or length of 3.175 mm (1/8 in) diameter rod, press the plastic locking pins through the respective square inserts in the inner door panel.
15. Release the bellcranks from the inner door panel and unhook the respective connecting rods.
16. Withdraw the bellcranks from inside the door panels.



**NOTE:** When refitting the bellcranks the locking pins are entered into the square insert from outside and pressed in flush.



J5217M



### ADJUSTMENT-REAR SIDE DOOR LOCK AND HANDLE

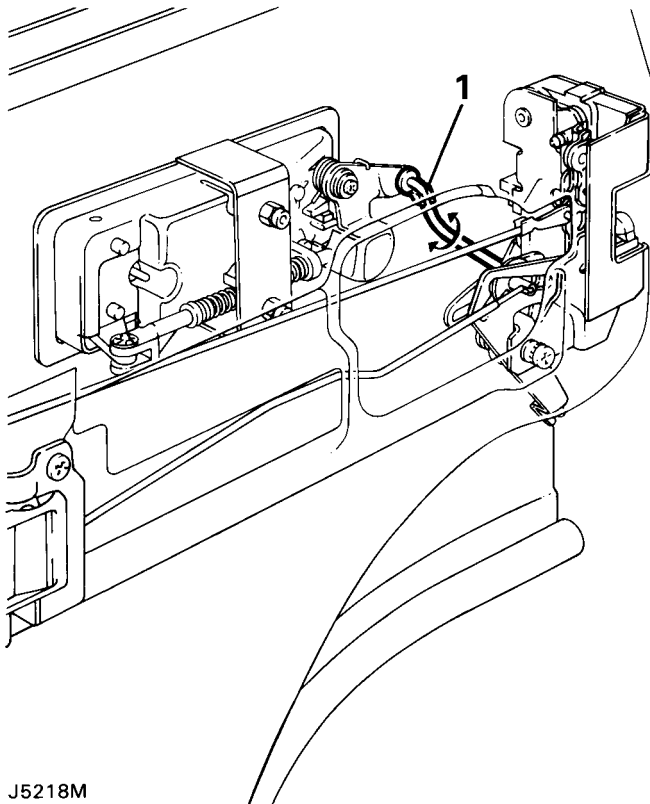
Service repair no - 76.37.47

#### Outside door release handle to lock

1. Disconnect the short off-set connecting rod at the rear of the outer release handle, rotate the rod clockwise or counter clockwise to shorten or extend the operating length of the rod as required.



**NOTE:** Door release should occur before the total handle movement is achieved to provide a small overthrow movement.



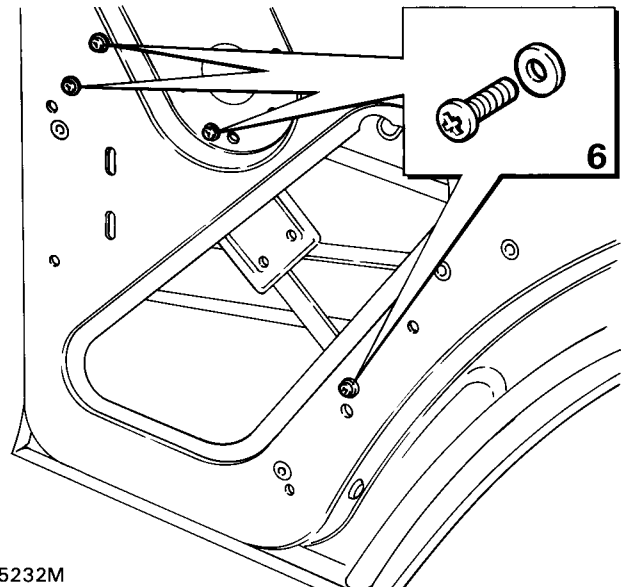
J5218M

### REAR SIDE DOOR GLASS AND REGULATOR

Service repair no - 76.31.45

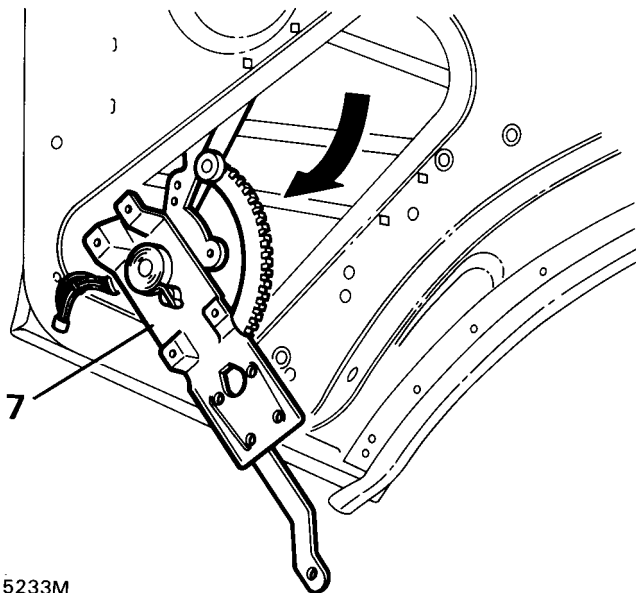
#### Remove

1. Ensure that the window is in the fully closed position and secure it with adhesive tape over the top of the door to prevent the glass from dropping down.
2. Disconnect battery negative lead.
3. Remove the door trim panel. **See rear side door - trim panel.**
4. Remove the plastic vapour barrier.
5. Where applicable remove the door actuator and window lift motor. **See ELECTRICAL, Repair, window lift motor - rear. See ELECTRICAL, Repair, rear side door actuator units.**
6. Remove the four window regulator securing screws and shakeproof washers from the inner door panel.



J5232M

7. Carefully disengage the lifting arm stud from the glass lifting channel and remove the window regulator from the lower opening in the inner door panel.
8. Remove the waist rail seal from the top of the door panel.
9. Remove the single bolt, spring and plain washers from inside the door, securing the bottom of the short glass run channel.
10. Remove the two bolts, spring and plain washers from the hinge face of the door.



J5233M

11. Remove the two bolts, spring and plain washers securing the door frame to the edge of the door.
12. Lift out the door frame complete with glass and remove to a suitable workbench.
13. Remove the tape and slide the glass out of the door frame channel.

#### Refit

14. Reverse removal procedure.



**NOTE:** When refitting the door glass frame ensure that it is adjusted to suit the door opening before fully tightening the securing bolts.

## REAR DOOR

Service repair no - 76.28.19

### Remove

1. Remove the spare wheel from the exterior of the door.
2. Remove the trim panel from inside the rear door. **See rear door trim panel.**
3. Release the convoluted grommet from the door post, expose the door harness connectors and multiplugs and disconnect.
4. Remove the circlip and washer from the check stay pivot on the body.



**WARNING:** Instruction 5 **MUST BE** carried out with assistance.

5. Suitably support the door, remove the four bolts securing the hinges to the door and with assistance slide the door off the hinges.

### Refit

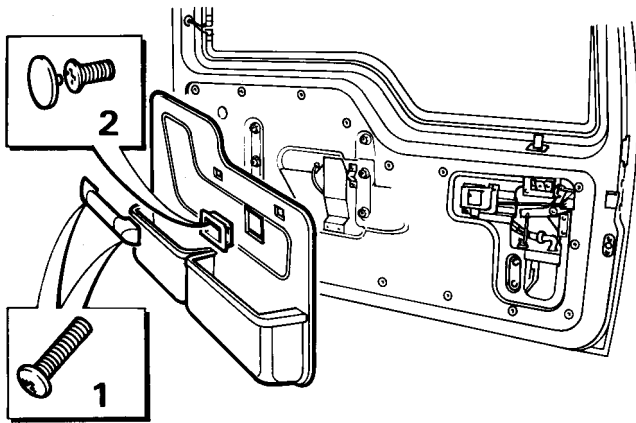
6. Reverse removal procedure.

**REAR DOOR TRIM PANEL**

Service repair no - 76.34.09

**Remove**

1. Remove the two screws securing the door pull and remove it from the door.
2. Remove the finisher from the inner door handle.
3. Using a trim panel removing tool release the seventeen trim panel fasteners and withdraw the panel from the door.



J5010M

4. If necessary remove the sixteen screws securing the storage bins to the trim panel and detach the bins.

**Refit**

5. Reverse removal procedure.

**REAR DOOR LOCK AND INNER AND OUTER RELEASE HANDLES**

Service repair no - 76.37.16/74/77/78

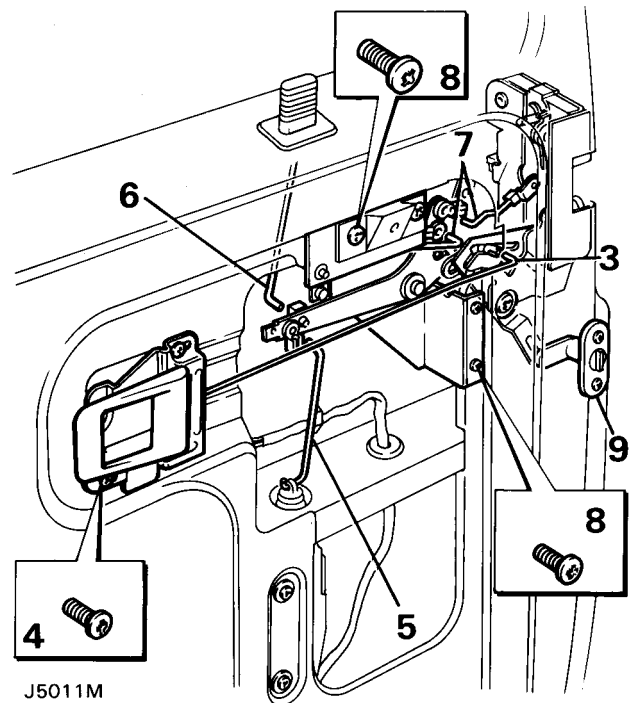
**Remove**

1. Disconnect battery negative lead.
2. Remove the door pull, the trim panel and the vapour protective sheet, to allow access to the door handles and lock mechanisms.
3. Disconnect the inner release handle connecting rod at the lock.
4. Remove the two screws securing the inner handle and withdraw the handle complete with connecting rod.



**NOTE:** Two identical 'Y' shaped levers (bellcranks) are fitted to the rear door lock mechanism and are referred to as inner and outer 'Y' levers; the inner one being the nearest to the inner door panel.

5. If fitted, remove the central locking actuator control rod link from the actuator and from the inner 'Y' lever.

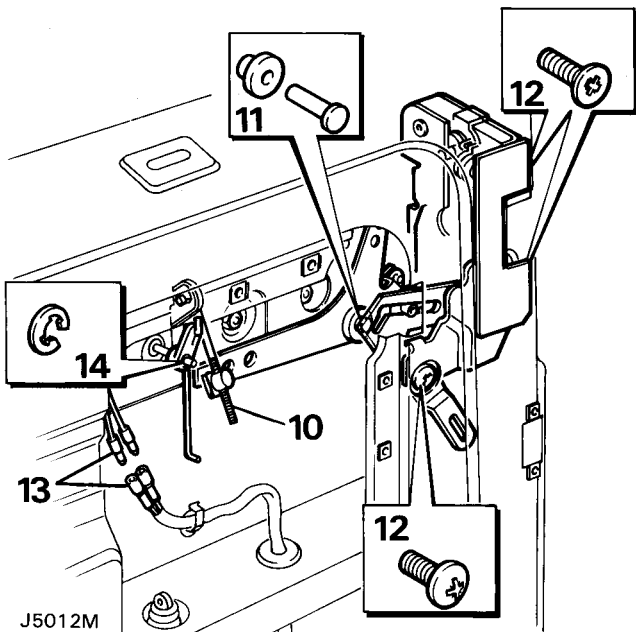


J5011M

6. Detach the remote button connecting rod at the inner 'Y' lever and withdraw from inside the door.
7. Detach the lock and barrel connecting rods from the upper leg of the inner 'Y' lever.

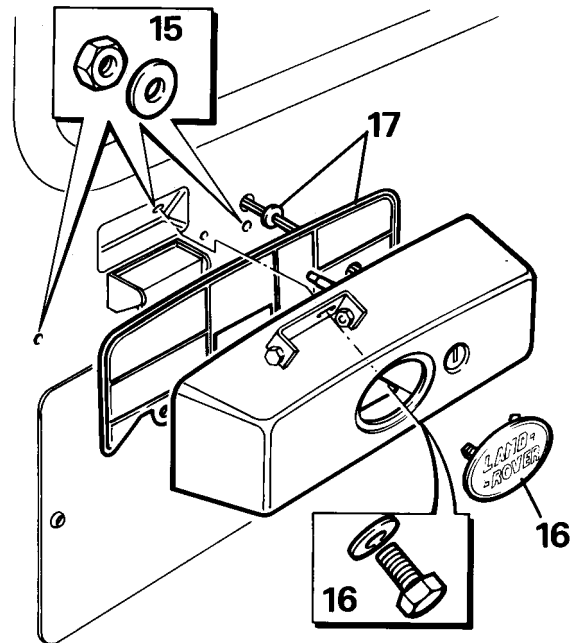


8. Remove the screws securing the lock control mechanism pivot bracket and the door pull mounting bracket, ease the bracket from the lock barrel stem and remove from the door.
9. Remove the two screws and withdraw the childproof lock actuator.



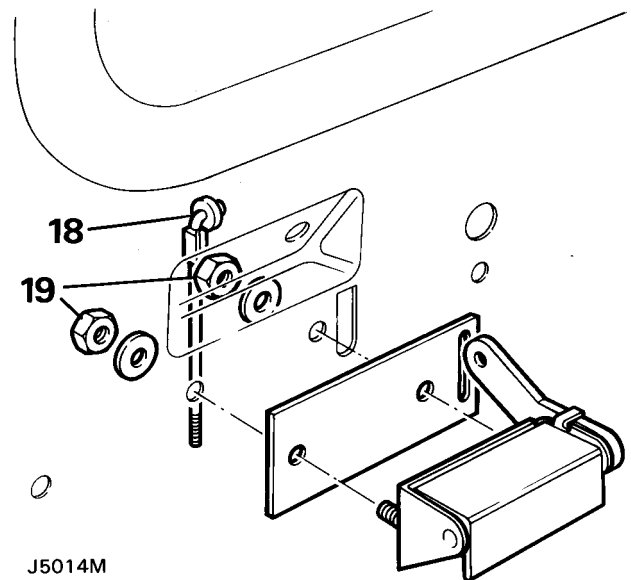
J5012M

10. Disconnect the adjustable lock rod from the outer 'Y' lever.
11. Remove the centre pin from the outer 'Y' lever pivot and release the pivot from the door.
12. Remove the three lock securing screws and manoeuvre the lock and 'Y' lever out of the door panels.
13. Disconnect the number plate light leads from the door harness.
14. Remove the 'E' clip securing the fulcrum to the barrel stem and withdraw the fulcrum and lock rod.
15. From inside the door panel remove the nuts and washers securing the lock barrel and number plate light housing.
16. Remove the logo from the housing and working through the logo aperture, remove the single bolt securing the housing.
17. Partially withdraw the housing and its rubber seal from the door, displace the rubber grommet from the door panel, withdraw the number plate light leads and complete the removal of the housing and seal from the door.



J5013M

18. Remove the connecting rod from the outer door handle lever.
19. Remove the two nuts and washers securing the outer handle from inside the door panels and detach the handle and seal.



J5014M

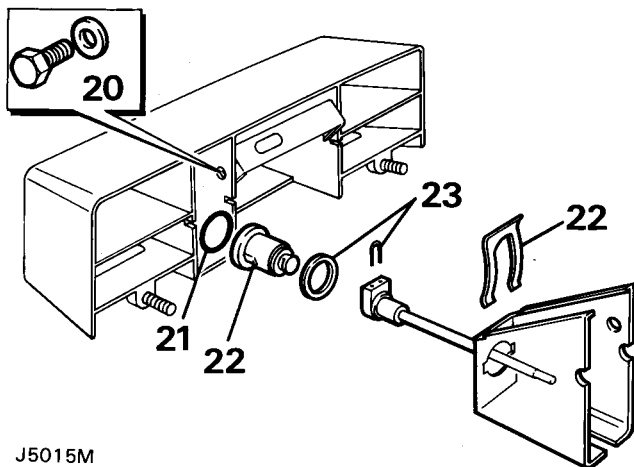
### Lock barrel and number plate light housing

#### Disassemble



**NOTE: The lock barrel can only be removed from its housing when the lock barrel and number plate light housing is removed from the door.**

20. Remove the bolt securing the lock barrel mounting bracket to the housing and withdraw the assembled barrel and bracket.
21. Remove the 'O' ring seal from inside the housing.



22. Remove the spring clip securing the barrel to the bracket and withdraw the barrel and stem assembly from the bracket complete with seal.
23. Remove the 'U' clip securing the stem to the barrel and detach the seal from the inner face of the barrel.
24. If the lock barrel and number plate light housing is being renewed, remove the number plate lights, harness and the housing mounting bracket, from the existing housing and fit them to the new housing.

#### Reassemble

25. Fit the stem to the barrel and secure with the 'U' clip.
26. Position a new seal on the inner face of the barrel, insert the stem and barrel into the mounting bracket and secure with the spring clip.
27. Place a new 'O' ring seal on the inner face of the barrel aperture in the housing.
28. Insert the assembled bracket and barrel into its location in the housing, taking care not to disturb the seal, and secure with the bolt.

#### Refit

29. Fit the outer handle to the door and secure from the inside with the two nuts and washers.
30. Fit the lock barrel and number plate light housing by inserting the number plate light leads through the aperture in the door panel and locating the rubber grommet in the aperture. Insert the barrel stem through the door, locate the housing on the door panel, ensure that the seal seats correctly, and secure with the single bolt and washer through the logo aperture.
31. Connect the number plate light leads to the door harness.
32. Fit the logo to the aperture in the housing.
33. Fit the fulcrum and connecting rod to the barrel stem and secure with the 'E' clip.
34. Fit the lock and assembled outer 'Y' lever, secure the lock with the three screws, locate the 'Y' lever pivot and secure with the pin.
35. Fit the connecting rod from the outer handle lever to the outer 'Y' lever.
36. Fit the childproof lock actuator and check that it is functioning.
37. Insert the remote button and rod to the location in the door.
38. Offer up the assembled inner 'Y' lever and bracket, attach the barrel connecting rod to the top clip of the upper leg and the rod from the lock to the lower clip of the upper leg.
39. Locate the barrel stem in the insert on the bracket.
40. Secure the bracket with the four screws; fitting the door pull mounting bracket under the heads of the top two screws.
41. Attach the remote button and the actuator connecting rods to the 'Y' lever.
42. Fit the inner release handle and attach the connecting rod to the lock.
43. Refit the vapour protective sheet, door trim panel and door pull.

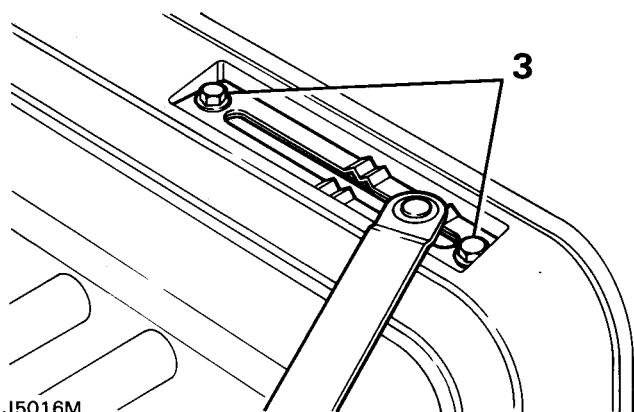


## REAR DOOR CHECK STAY

Service repair no - 76.40.30

### Remove

1. Remove the rear door from the vehicle. **See rear door.**
2. Invert the door on a suitable protected area.
3. Remove the two securing bolts and withdraw the check stay assembly.



J5016M

### Refit

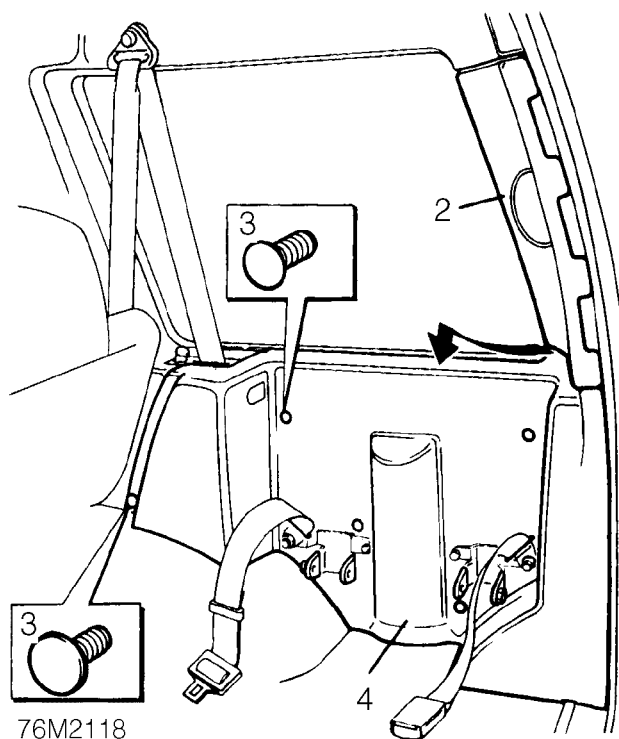
4. Reverse removal procedure.

## REAR COMPARTMENT LOWER TRIM PANELS

Service repair no - 76.13.03

### Remove

1. Remove the fold down seat or pocket side panel, whichever is applicable. **See rear fold down seats.**
2. Remove speaker by releasing screws and disconnecting Lucars. Withdraw rear quarter trim panel.
3. Remove the five trim panel retainers.
4. Ease the trim panel from its location, feed the seat belts through the apertures and withdraw the panel.



76M2118

### Refit

5. Reverse removal procedure.

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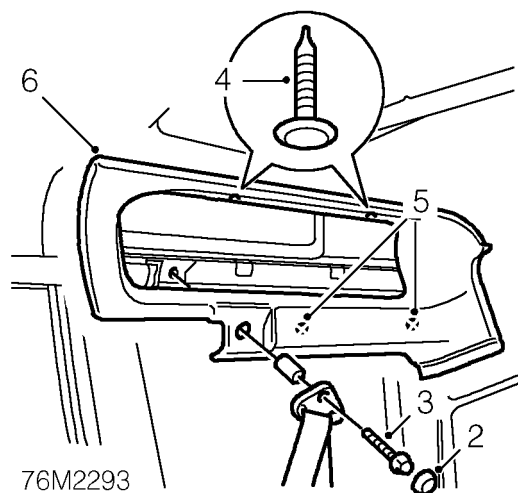
**ALPINE LIGHT TRIM CASING**

---

Service repair no - 76.13.20

**Remove**

1. Remove RH 'E' post trim casing. *See 'E' post trim casing - rh.*



2. Remove rear seat belt anchorage retaining bolt cover.
3. Remove bolt securing rear seat belt anchorage.
4. Remove 2 trim studs securing trim casing.
5. Release trim casing from 2 retaining studs.
6. Remove trim casing.

**Refit**

7. Fit and align trim casing and secure with studs.
8. Fit 2 trim studs securing trim casing.
9. Position seat belt anchorage, fit bolt and tighten to **32 Nm (24 lbf ft)**.
10. Fit cover to seat belt anchorage bolt.
11. Fit 'E' post trim casing. *See 'E' post trim casing - rh.*

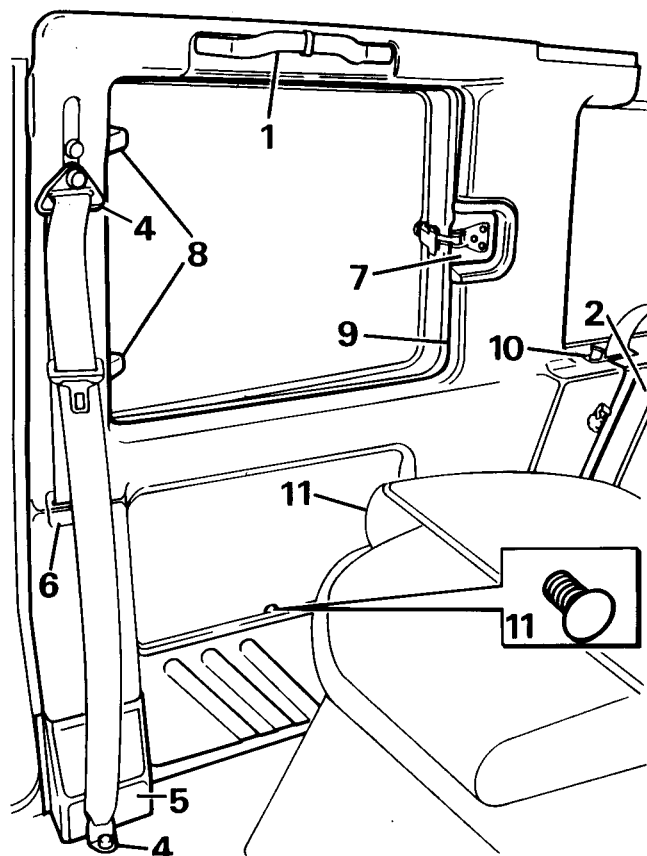


## FRONT BODYSIDE TRIM CASING

Service repair no - 76.13.01

### Remove

1. Remove the grab handle.
2. Remove the rear compartment lower trim panel.  
**See rear compartment lower trim panels.**
3. Remove the alpine light trim casing. **See alpine light trim casing.**
4. Remove the bolts securing the upper and lower seat belt mountings.
5. Remove the finisher from its location over the seat belt inertia reel.
6. Remove the front seat belt guide from the upper aperture in the casing.
7. Open the side window, remove the catch securing screws and withdraw the catch trim.
8. Remove the side window hinge finishers.
9. Release the casing from the window rubber.
10. Release the rear seat belt from the guide attached to the casing.
11. Fold down the rear seats and carefully ease the casing from the fastenings.
12. Pass the front seat belt through the upper aperture and withdraw the casing from the vehicle.



J5028 A

### Refit

13. Reverse removal procedure.



**NOTE:** Ensure that the trim material glued to the door post is not wrinkled when the door seal is fitted.

14. Tighten upper and lower seat belt fixings to **32 Nm (24 lbf ft)**.



## HEADLINING

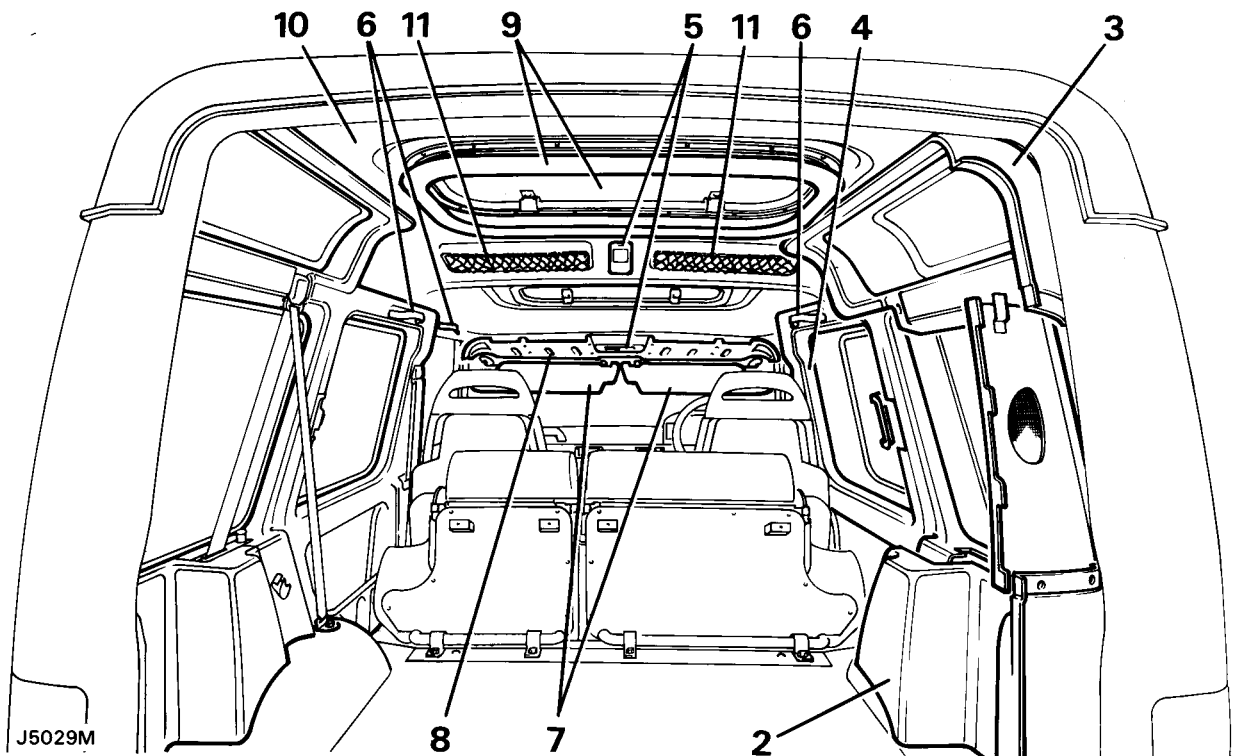
Service repair no - 76.64.01/14

## Remove

1. Disconnect battery negative lead.
2. Remove the lower trim panels from the rear compartment. *See rear compartment lower trim panels.*
3. Remove the alpine light trim casing. *See alpine light trim casing.*
4. Remove the front bodyside trim casing. *See front bodyside trim casing.*
5. Remove the roof lights from the headlining pocket and from the headlining.
6. Remove the front grab handles.
7. Remove the sun visors and their retaining clips.
8. Remove the front headlining pocket.
9. Remove the finishers from the sun roof apertures.
10. Release the headlining from the channel above the rear door and manoeuvre it from the vehicle through the rear door.
11. If the existing headlining is being replaced, if fitted, remove the passenger net pockets and fit them to the new headlining.

## Refit

12. Reverse removal procedure.



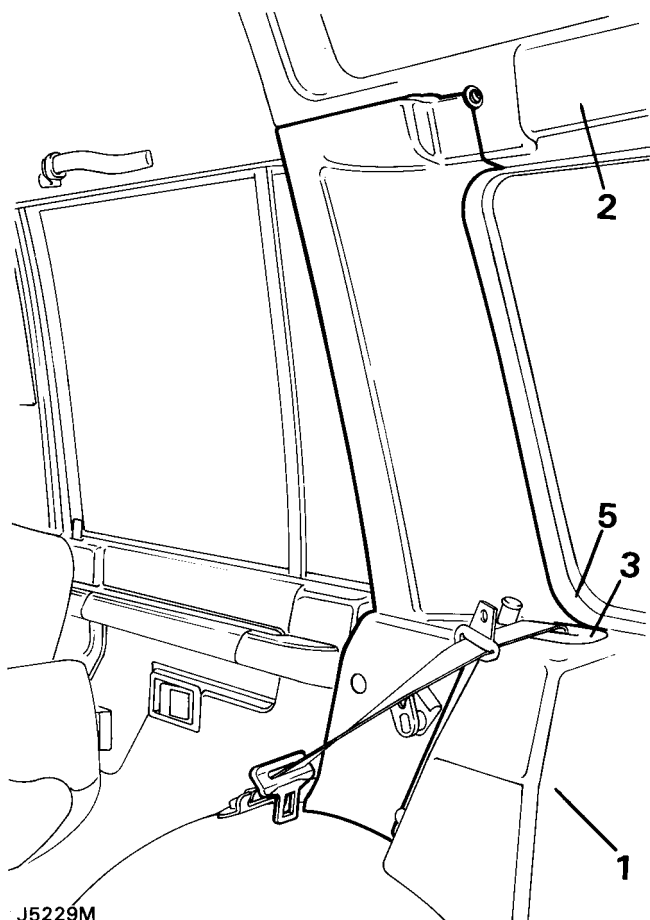


## 'D' POST TRIM CASING

Service repair no - 76.13.73

### Remove

1. Remove the rear compartment lower trim panel. **See rear compartment lower trim panels.**



J5229M

2. Remove the alpine light trim casing. **See alpine light trim casing.**
3. Release the rear seat belt from the guide attached to the casing.
4. Fold down the rear seats.
5. Release the D' post casing from the rear side window seal and carefully ease the casing from the fasteners.

### Refit

6. Reverse removal procedure.

## BODY SIDE OPENING WINDOWS

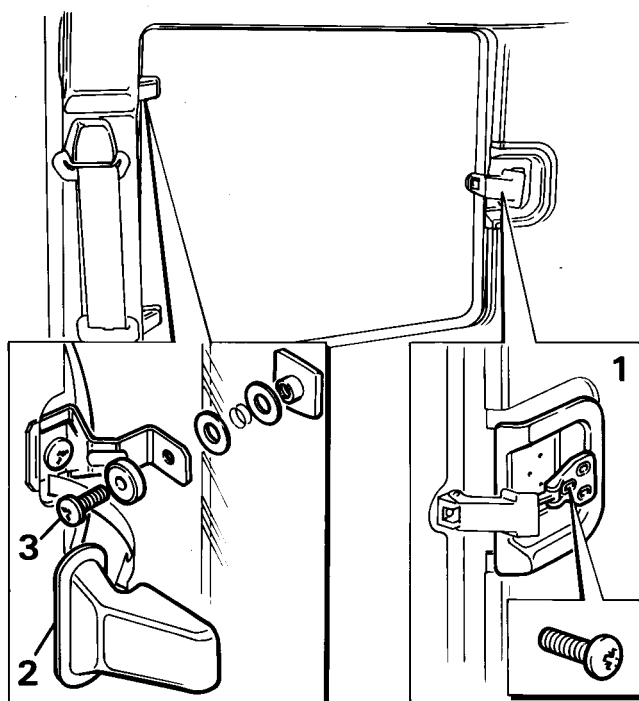
Service repair no - 76.81.18

### Remove

1. Remove the screws securing the catch to the body and detach the catch trim.
2. Remove the hinge finishers from the hinges.
3. Remove the screws securing the glass to the hinges, withdraw the glass and fixings taking care not to lose the joint washers.

### Refit

4. Reverse removal procedure.



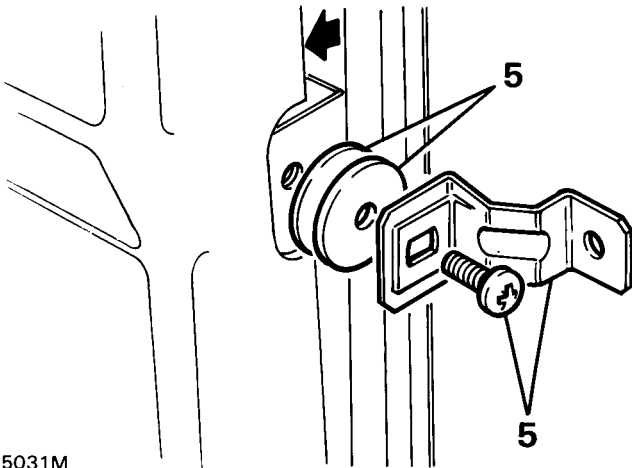
J5030M

**BODY SIDE WINDOW HINGES**

Service repair no - 76.81.47

**Remove**

1. Remove the window. *See body side opening windows.*
2. Remove the passenger grab handle.
3. Detach the front seat belt top mounting from the door post.
4. Ease the trim panel away from the door post to gain access to the window hinges.



J5031M

5. Remove the screws securing the window hinges, taking care not to lose the the packing washers where fitted. Note the thickness and location of any packing washers fitted.

**Refit**

6. Fit the hinges with packing washers fitted to the locations and thickness noted during removal. Do not fully tighten the screws at this stage.
7. Refit the glass to the hinges.
8. Locate the window catch trim and secure the catch to the body.
9. Close the window and secure with the catch.
10. Check the alignment and squareness of the glass, adjust as necessary by adding or deleting washers and using the elongated slots in the hinges for adjustment, finally tighten the screws.
11. Reposition the trim panel and refit the hinge finishers.
12. Refit the top seat belt bracket and the grab handle.

**REAR SIDE FIXED WINDOWS**

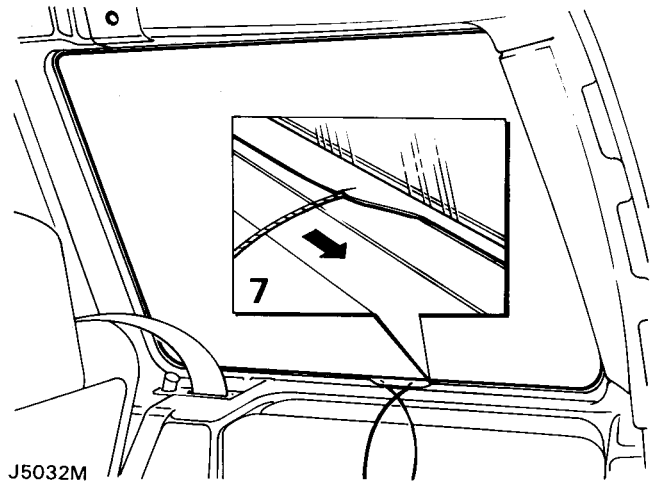
Service repair no - 76.81.18

**Remove**

1. If fitted push out the glass and remove the mounting rubber.
2. Remove the rear seat belt top fixing.

**Refit**

3. Thoroughly clean the opening to be glazed.
4. Clean the glass and fit the mounting rubber, ensuring that the glass sits correctly in the groove.
5. Fit a draw cord around the exterior of the mounting rubber.
6. To aid assembly, coat the flange in the bodyside with liquid soap.
7. Position the assembled glass and rubber mounting to the opening in the body, with the tails of the draw cord fed into the interior of the vehicle.



J5032M

8. With assistance from a second operator, pushing the glass and mounting rubber into the opening, pull the draw cord from the mounting rubber enabling the seal to ride up over the retaining flange.
9. Ease the inner section of the mounting rubber over the interior trim panel.

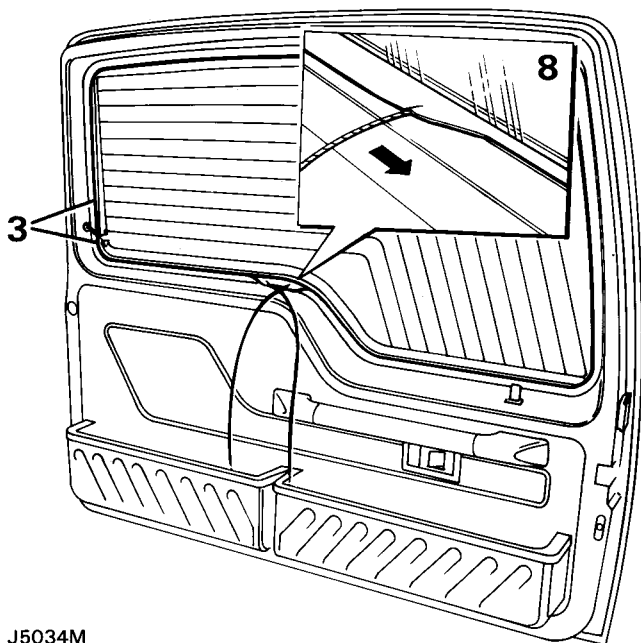


## REAR DOOR GLASS

Service repair no - 76.31.21

### Remove

1. Remove the spare wheel from the rear door.
2. Remove the rear door wiper arm. **See WIPERS AND WASHERS, Repair, wiper arm - rear window.**



J5034M

3. If the glass is fitted, disconnect the heater leads from the terminals, push out the glass and remove the mounting rubber.

### Refit

4. Thoroughly clean the opening to be glazed.
5. Clean the glass and fit the mounting rubber, ensuring that the glass sits correctly in the groove.
6. Fit a draw cord around the exterior of the mounting rubber with the tails of the cord situated on the top corner of the bend at the bottom of the glass.
7. To aid assembly, coat the glass opening in the door with liquid soap.
8. Position the assembled glass and rubber mounting to the opening, with the tails of the draw cord fed into the interior of the vehicle.
9. With assistance from a second operator, pushing the glass and mounting rubber into the opening, pull the draw cord from the mounting rubber enabling the seal to ride up over the retaining flange.
10. Connect the heater leads to the terminals on the glass.

## FRONT FOLDING SEATS 3 DOOR VEHICLES

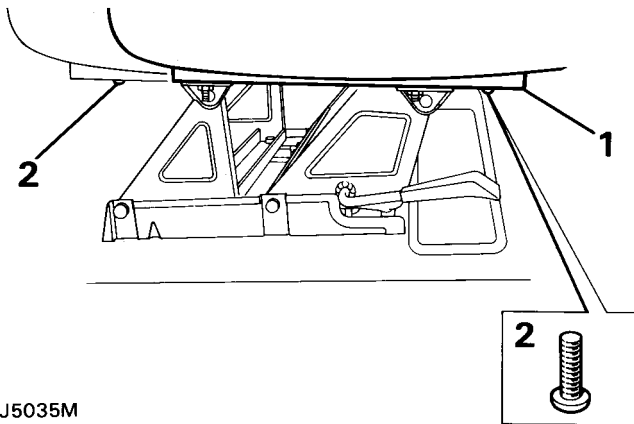
Service repair no - 76.70.01



**WARNING:** Care must be taken if the seat lifting mechanism is operated when the seat is removed from the base otherwise personal injury could occur.

## Remove

1. Slide the seat to the full extent rearwards and remove the rear seat to base securing bolts.
2. Slide the seat forward and remove the front seat to base securing bolts.
3. Lift the seat from the base and withdraw from the vehicle.



## Refit

4. Reverse removal procedure.
5. Tighten all securing bolts to **22 Nm (16 lbf ft)**.



## SEAT BASE

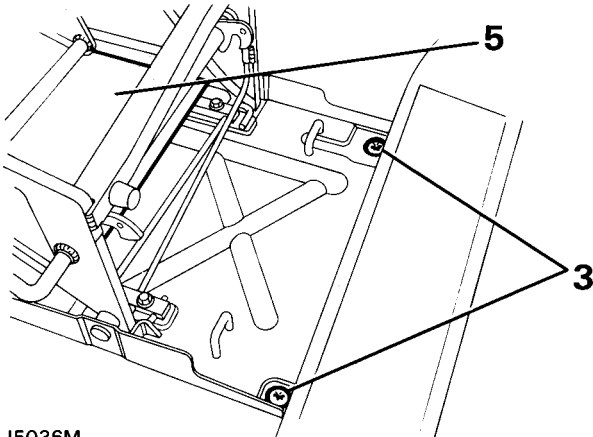
Service repair no - 76.70.06/25



**WARNING:** Care must be taken if the seat lifting mechanism is operated when the seat is removed from the base otherwise personal injury could occur.

### Remove

1. Remove the seat from the base.
2. Carefully operate the seat mechanism to raise it to the tilt position.
3. Remove the two bolts securing the rear of the base to the floor.
4. Return the seat mechanism to the upright position.



J5036M

5. Pull the carpet flap forward to expose the front securing bolts, remove the bolts and lift out the seat base.

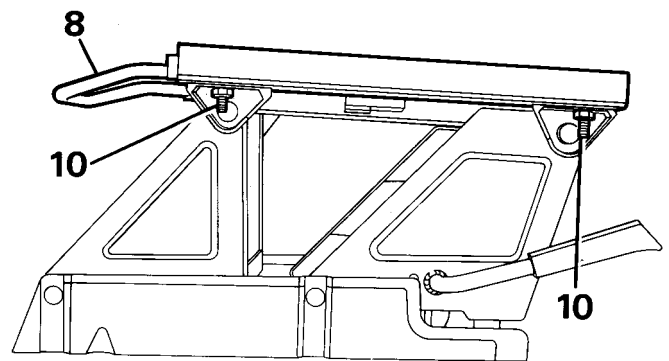
### Refit

6. Reverse removal procedure.

## SEAT BASE RUNNERS

### Remove

7. Remove the seat from the base.
8. Spring the release handle off its locations on the runners.
9. Slide the runners forward sufficient to gain access to the rear securing bolts and rearward for the front bolts.
10. Remove the bolts and withdraw the runners.



J5037M

### Refit

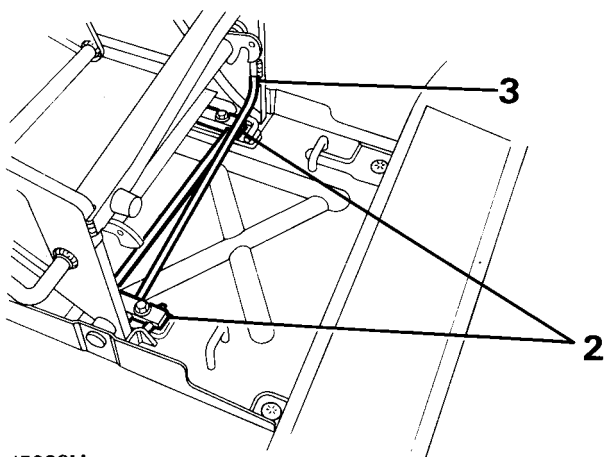
11. Fit the runners and release handle.
12. Reverse removal procedure.
13. Refit the seat to the base.

**SEAT BASE TORSION BARS**

Service repair no - 76.71.34

**Remove**

1. Tilt the seat assembly forward.
2. Remove the torsion bar clamps.
3. Extract the right angled ends of the torsion bars from the brackets on the seat base and withdraw.



J5038M

**Refit**

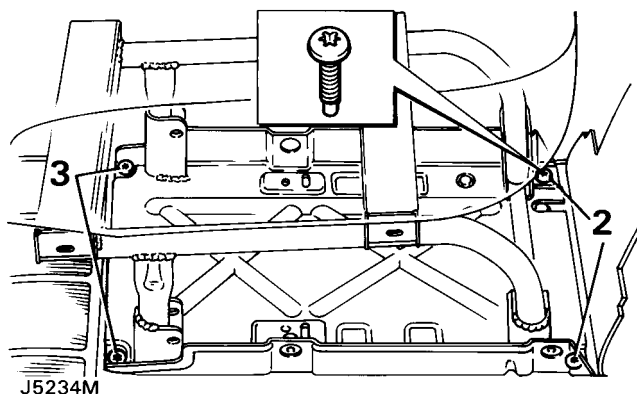
4. Reverse removal procedure.

**FRONT SEATS 5 DOOR VEHICLES**

Service repair no - 76.70.01

**Remove**

1. Remove the finisher from the seat base.
2. Slide the seat to the full extent rearwards and remove the front base to floor securing screws.



J5234M

3. Slide the seat forwards and remove the rear base to floor securing screw.
4. Lift the seat and base assembly and withdraw from the vehicle.

**Refit**

5. Reverse removal procedure.
6. Tighten rear base to floor securing screws to **29 Nm (21 lbf ft)**.
7. Tighten front base to floor securing screws to **22 Nm (16 lbf ft)**.



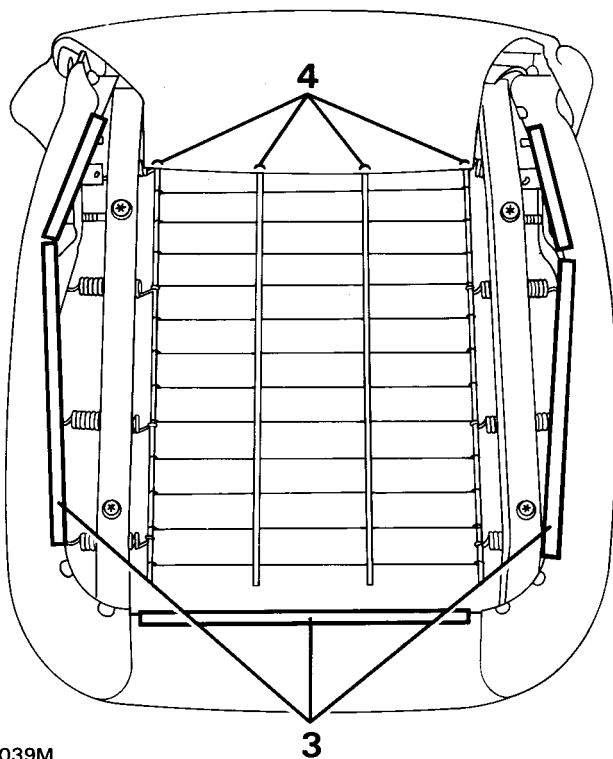
## FRONT SEAT COVERS

Service repair no - 76.70.14

### Cushion

#### Remove

1. Remove the seat from the base.
2. Invert the seat on a suitable clean bench.
3. Detach the seat cover retaining clips from the frame.
4. Release the four wire hooks securing the squab cover to the lower spring frame.
5. Release the cushion rear clip from the frame and detach the cushion complete with cover.
6. Remove the cover from the cushion.



J5039M

#### Refit

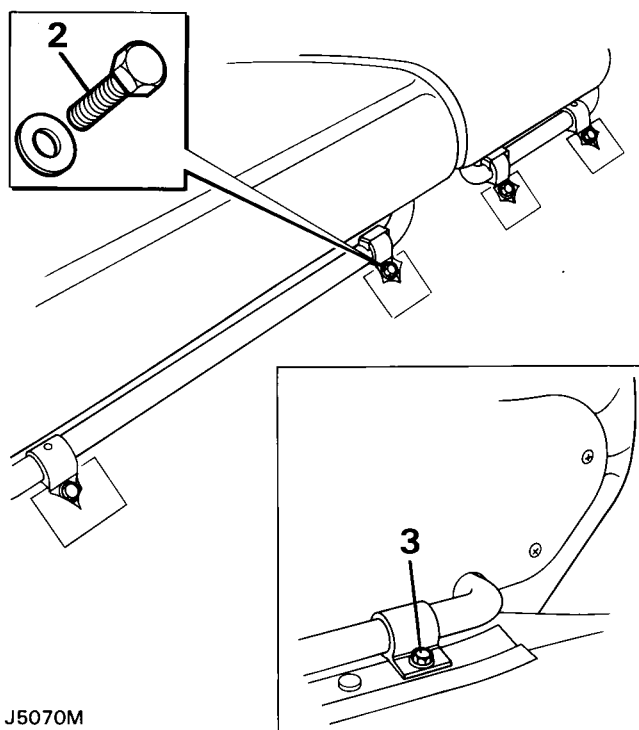
7. Reverse removal procedure.

## REAR PASSENGER SEAT

Service repair no - 76.70.37

### Remove

1. Feed the seat belts through the seats into the rear compartment.
2. With the seats in the upright position, remove the bolts from the front of the hinges.
3. Fold the seats forward, remove the bolts from the rear of the hinges and withdraw the seats from the vehicle.



J5070M

### Refit

4. Reverse removal procedure.
5. Tighten fixing bolts to **8 Nm (6 lbf ft)**.

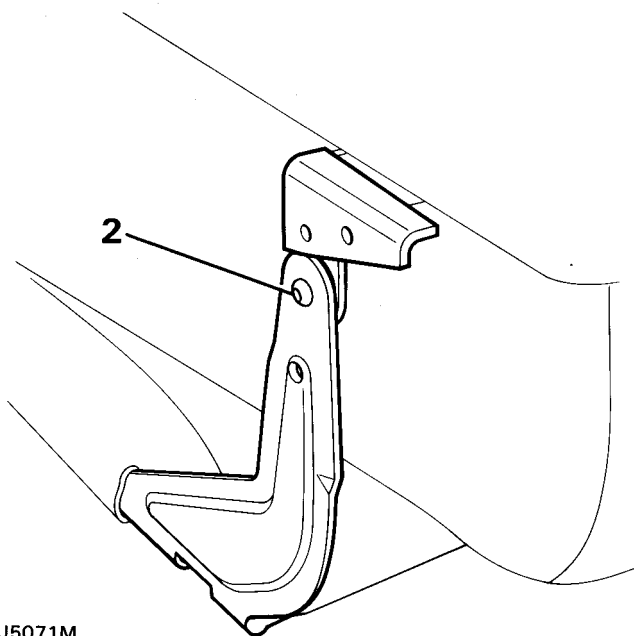


**REAR SEAT SQUAB**

Service repair no - 76.70.38

**Remove**

1. Fold the rear seat down.
2. Remove the two seat squab securing bolts.



J5071M

3. Withdraw the seat squab from the seat assembly.

**Refit**

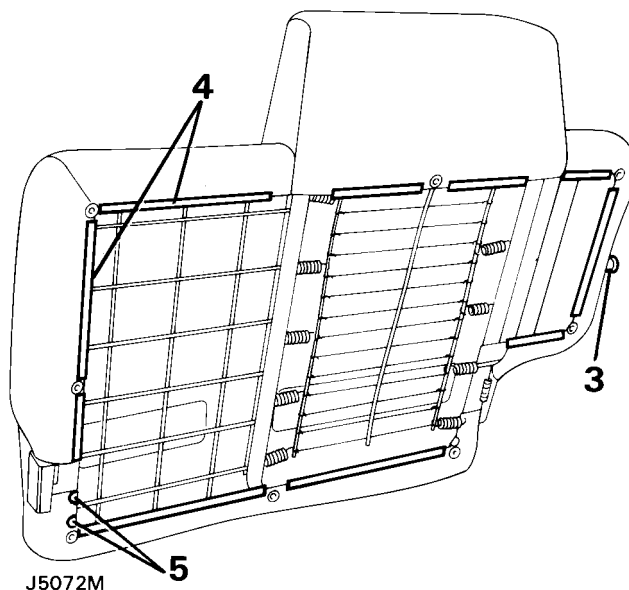
4. Reverse removal procedure.

**REAR SEAT SQUAB COVER**

Service repair no - 76.70.79/80

**Remove**

1. Remove the rear seat squab from the seat assembly and withdraw it from the vehicle. **See rear seat squab.**
2. Remove the rear seat back finisher from the squab.
3. Remove the squab striker plate.
4. Release the squab cover from the frame.
5. Remove the securing clips and remove the cover from the squab.



J5072M

**Refit**

6. Reverse removal procedure.



## REAR SEAT CUSHION COVER

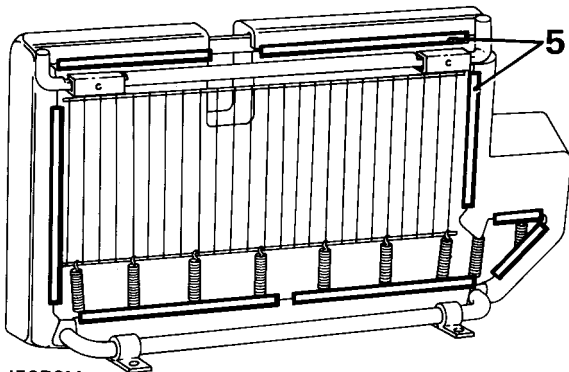
Service repair no - 76.70.88/89

### Remove



**NOTE:** The procedure for removing both left and right hand seat cushions is the same.

1. Remove the rear seat assembly from the vehicle. **See rear passenger seat.**
2. Remove the seat squab.
3. Remove the seat cushion.
4. Remove the cushion base cover retaining screws and withdraw the cover.
5. Release the seat cover securing clips at the frame and at the seat belt aperture.
6. Remove the cover from the cushion.



J5073M

### Refit

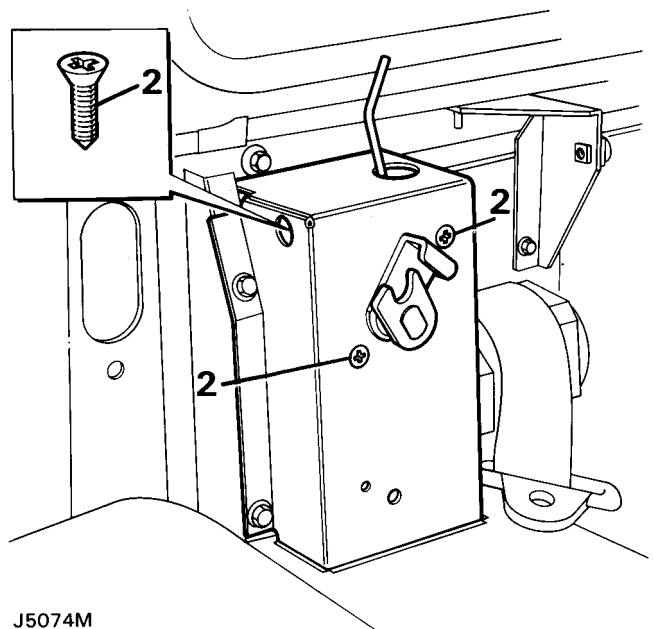
7. Reverse removal procedure.

## SPLIT REAR SEAT LOCKING MECHANISM

Service repair no - 76.70.51

### Remove

1. Remove the front body side trim casing. **See front body side trim casing.**
2. Remove the three screws securing the latch to the tower, noting that access to the single screw is gained through the hole in the front of the tower.
3. Retrieve the latch from the opening at the rear of the tower. If necessary retrieve the single screw.



J5074M

4. The operating rod can be removed from the latch by releasing it at the plastic clip.

### Refit

5. Reverse removal procedure. Setting the release button to achieve a gap of 5 - 8 mm (3/16 - 5/16 in).

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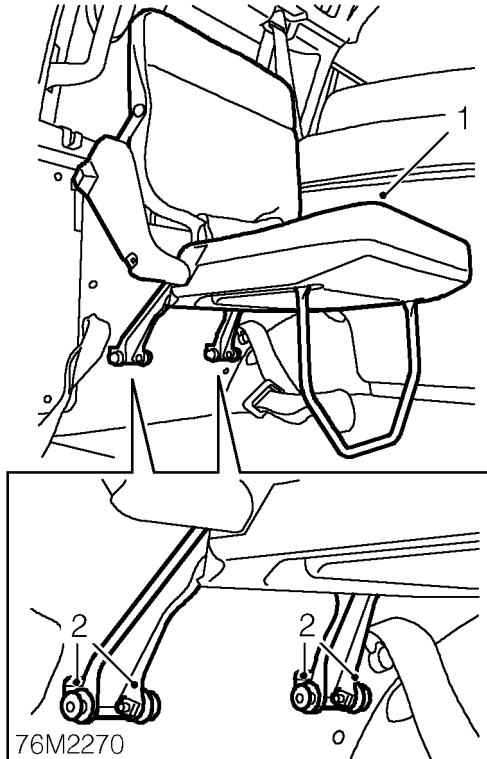
**REAR FOLD DOWN SEATS**


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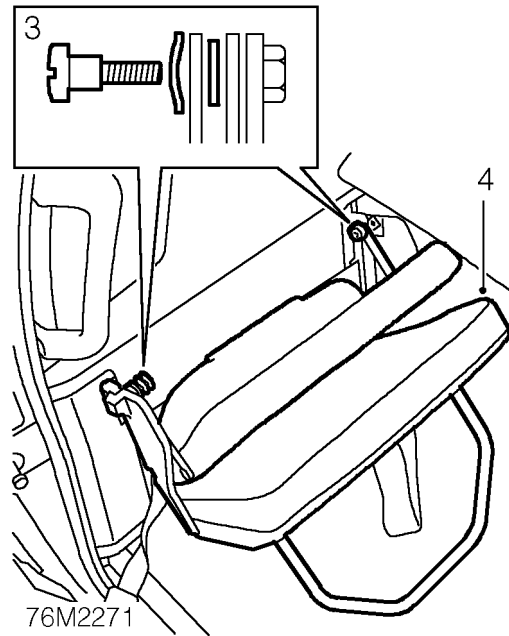
Service repair no - 76.71.23

**Seat and squab**

**Remove**



1. Locate the seat in the down position, release the seat belt strap and buckle from their stowed positions.
2. Remove 4 Torx screws from the lower brackets.



3. Fold the seat up and remove the 2 Torx screws from the upper brackets. Collect 4 washers.
4. Remove seat assembly.

**Refit**

5. Position seat assembly, align upper brackets, and secure with Torx screws tightened to **13 Nm (10 lbf ft)**.



**NOTE: Ensure washers are fitted in their correct positions.**

6. Align lower brackets, fit Torx screws and tighten to **13 Nm (10 lbf ft)**.
7. Secure the seat belt strap and buckle to their stowed positions.

**Seat squab**

**Remove**

8. Remove the seat assembly from the vehicle.
9. Remove the pivot bolts and washers securing the seat squab to the frame.



**NOTE: The pivot bolts, securing the seat squab and cushion, are fitted with a wavy washer under the head and a plain washer between the link or bracket. Ensure that these washers are fitted in the correct locations when reassembling the seat.**



10. Remove the pivot bolts and washers securing the hinge links to the seat squab.
11. If necessary remove the clips securing the cover and detach the cover.

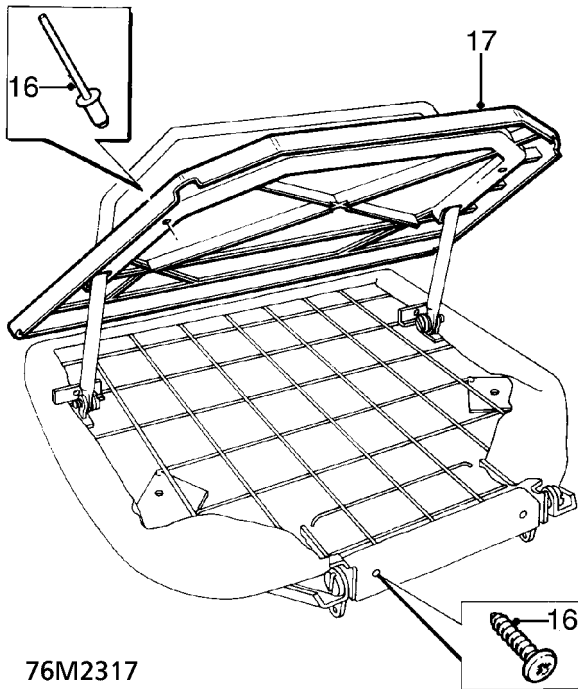
**Refit**

12. Reverse removal procedure.

**Seat cushion**

**Remove**

13. Remove the seat from the vehicle.
14. Remove the seat squab.
15. Remove the pivot bolts and washers securing the hinge bracket and detach the bracket.
16. Invert the seat base and remove the screws and rivets securing the base cover to the base.
17. Raise the seat base cover, to gain access to the stay pivot bolts, remove the bolts and washers and withdraw the stay and seat base cover.
18. If necessary remove the clips and detach the cushion cover.



**FRONT SEAT BELTS**

**Service repair no - 76.73.10**

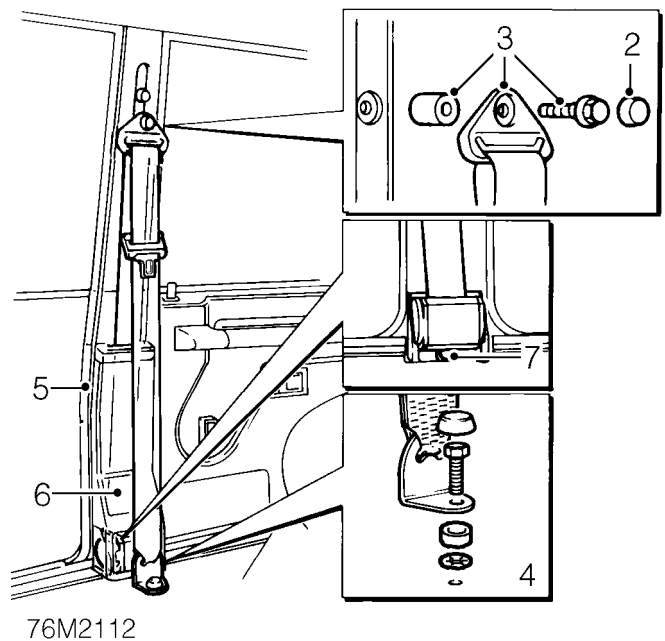
**Remove**

1. Move the front seat to the fully forward position or tilt the seat forward (3 door vehicles).
2. Remove cover to gain access to the seat belt upper mounting bolt.



**NOTE: 3 door models have a non-adjustable, upper mounting.**

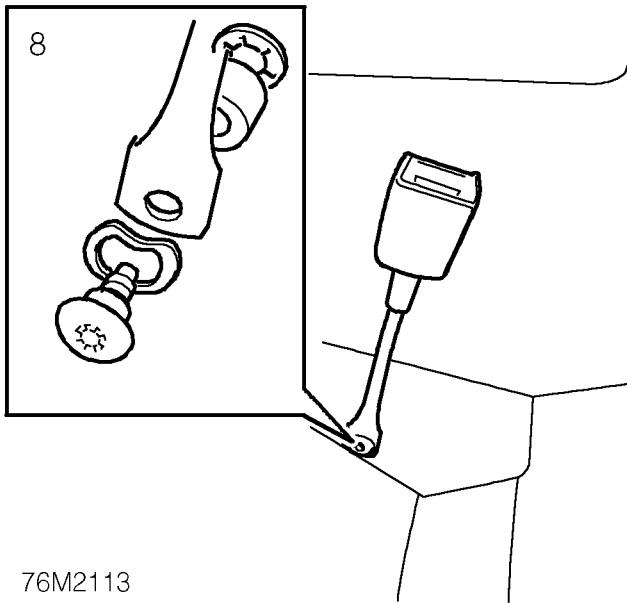
3. Remove the flanged securing bolt to release the upper mounting and spacer.
4. Remove the cover and bolt securing the lower mounting to the floor.
5. Detach the door seals from the 'B' post sufficiently to allow removal of the lower trim panel from the post.
6. Release the seat belt from the split section at the top of the trim panel and withdraw the panel.
7. Remove the securing bolt and detach the inertia reel from the bottom of the 'B' post.



**5 door model illustrated**

**Refit**

19. Reverse removal procedure.



76M2113

8. Release the Torx bolt to allow removal of the seat belt stalk assembly.

#### Refit

9. Reverse removal procedure.



**NOTE: Ensure the seat belt is not twisted.**

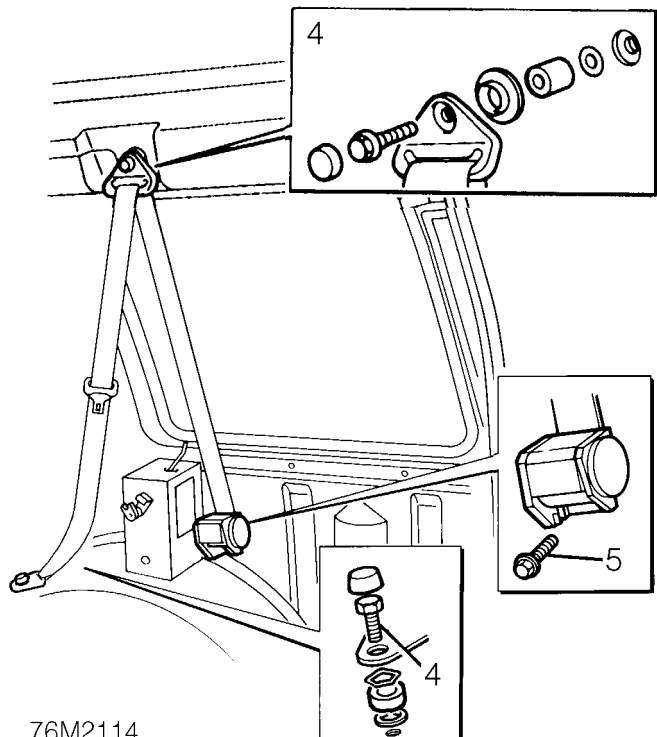
10. Finally, tighten the seat belt bolts to **32 Nm (24 lbf ft)**.

#### REAR OUTER SEATS BELT

Service repair no - 76.73.18

#### Remove

1. Remove the rear fold down seat (if applicable). **See rear fold down seats.**
2. Remove the speaker by releasing the screws and disconnecting the Lucars. Withdraw the rear quarter trim panel.
3. Remove the rear bodyside lower trim panel. **See rear compartment lower trim panels.**
4. Remove the bolts securing the brackets to the wheel arch and upper bodyside.
5. Remove the bolt securing the inertia reel to the bodyside and withdraw the seat belt.
6. Remove the seat belt buckle strap from the floor mounted bracket. **See rear centre seat belt.**



76M2114

#### Refit

7. Reverse removal procedure.
8. Finally, tighten the seat belt bolts to **32 Nm (24 lbf ft)**.

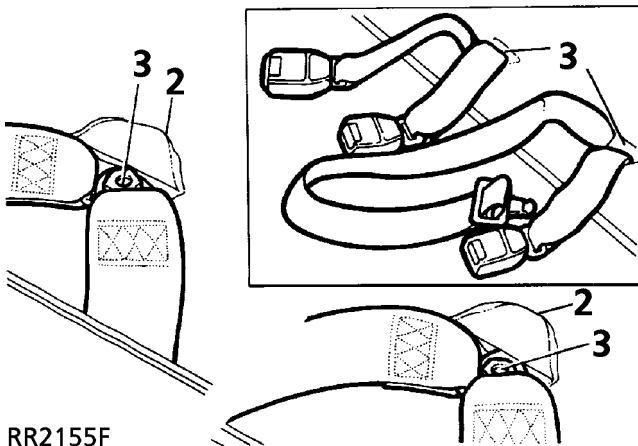


## REAR CENTRE SEAT BELT

Service repair no - 76.73.20

### Remove

1. Pull both halves of the seat belt through to the rear of the seat.



RR2155F

2. Pull back the load space carpet to reveal the Torx bolt heads.
3. Remove the Torx bolt and plain washer securing the belt bracket to load space floor.
4. Remove belt complete with bracket.
5. Repeat steps 2 to 4 for other half of belt.

### Refit

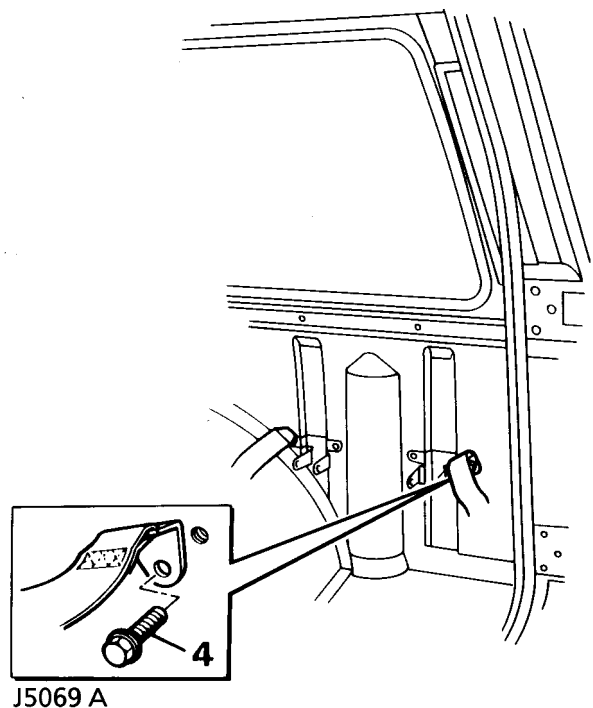
6. Reverse removal procedure.
7. Finally, tighten the seat belt bolts to **32 Nm (24 lbf ft)**.

## REAR FOLD DOWN SEAT BELTS

Service repair no - 76. 73.28

### Remove

1. Remove the fold down seat or pocket side panel, whichever is applicable. **See rear fold down seats.**
2. Remove speaker by releasing screws and disconnecting Lucars. Withdraw rear quarter trim panel.
3. Remove the rear bodyside lower trim panel. **See rear compartment lower trim panels.**
4. Remove the bolts securing the seat belt halves to the body side.



J5069 A

### Refit

5. Reverse removal procedure.
6. Finally, tighten the seat belt bolts to **32 Nm (24 lbf ft)**.

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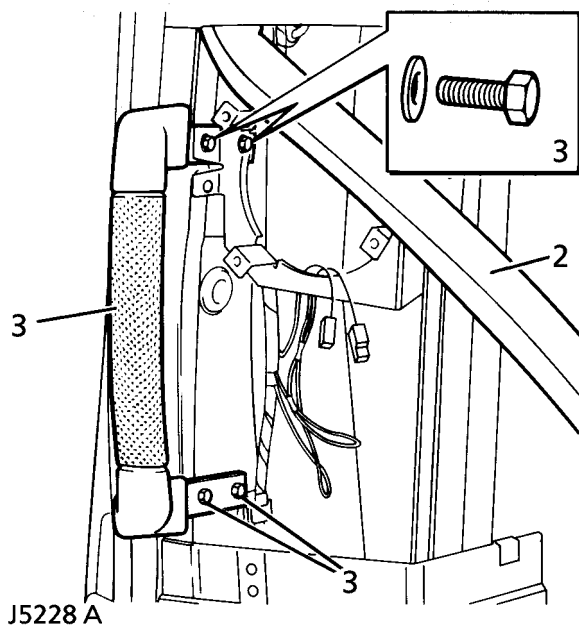
**REAR GRAB HANDLE**

---

Service repair no - 76.58.35

**Remove**

1. Remove speaker and rear quarter trim panel.
2. Detach the foam strip.
3. Remove the four securing bolts and detach the handle.

**Refit**

4. Reverse removal procedure.

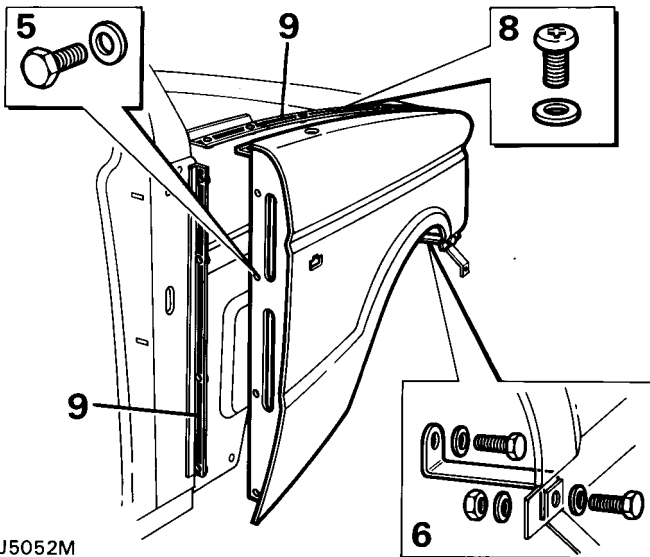


## WINGS [FENDERS]

Service repair no - 76.10.24

### Remove

1. Disconnect battery negative lead.
2. Remove the headlamp surround.
3. Remove the front bumper assembly.
4. Remove the indicator repeater light.
5. Remove the four screws securing the wing [fender] at the 'A' post.
6. Remove the bolts securing the bottom of the wing [fender] at the bumper retaining bracket and at the sill finisher.
7. If removing the RH wing [fender] loosen the radio aerial securing nut.



J5052M

8. Remove the seven bolts from the drain channel in the top of the wing [fender].
9. Break the sealed joints at the valance and 'A' post; then complete the removal of the wing [fender]. If removing a RH wing withdraw the wing [fender] sufficiently to allow removal of the aerial before completing the removal.

### Cleaning/painting

10. Thoroughly clean all traces of existing sealant from the sealing faces of the valance and 'A' post.
11. Paint the cleaned surfaces with etch primer.
12. If the existing wing [fender] is to be refitted repeat the cleaning and painting procedure on the wing [fender] sealing surfaces.

### Refit

13. Apply 3M 8572 Bolted Panel Sealer to the joint faces on the valance and 'A' post and to the bracket face.
14. Refit the wing [fender], on RH wings [fenders] fit the radio aerial, and secure with the bolts and screws ensuring that the wing [fender] correctly aligns with the bonnet [hood].

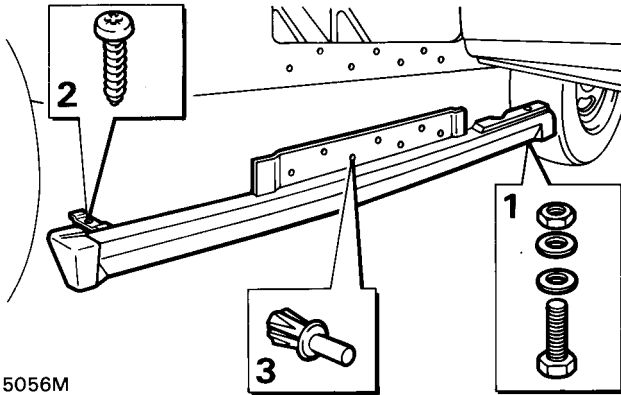


**SILL FINISHER**

Service repair no - 76.76.05

**Remove**

1. Remove the nut, bolt and washer securing the front of the sill finisher to the wing [fender] support bracket.
2. Remove the screw securing the bracket at the rear end of the finisher to the sill.
3. Using a suitable punch, remove the inserts from the seven plastic retainers and withdraw the finisher from the sill.



J5056M

**Refit**

4. Reverse removal procedure. Using new plastic retainers.

**BONNET [HOOD]**

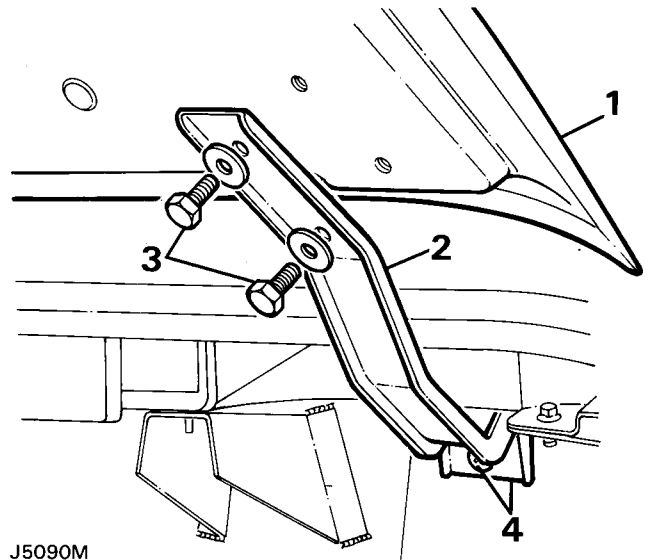
Service repair no - 76.16.01

**Remove**

1. Open the bonnet [hood] and support with the stay.
2. Mark the position of the hinges to the bonnet [hood].
3. With the assistance of a second operator, remove the hinge to bonnet [hood] securing screws, remove the support stay and lift bonnet [hood] from the vehicle. Note the quantity of shims fitted between the hinge and bonnet [hood].

**Refit**

4. Reverse removal procedure. Ensuring that it aligns with the wings [fenders], cowl panel and front grille before fully tightening the securing bolts.



J5090M



## AIR INTAKE PLENUM COWL

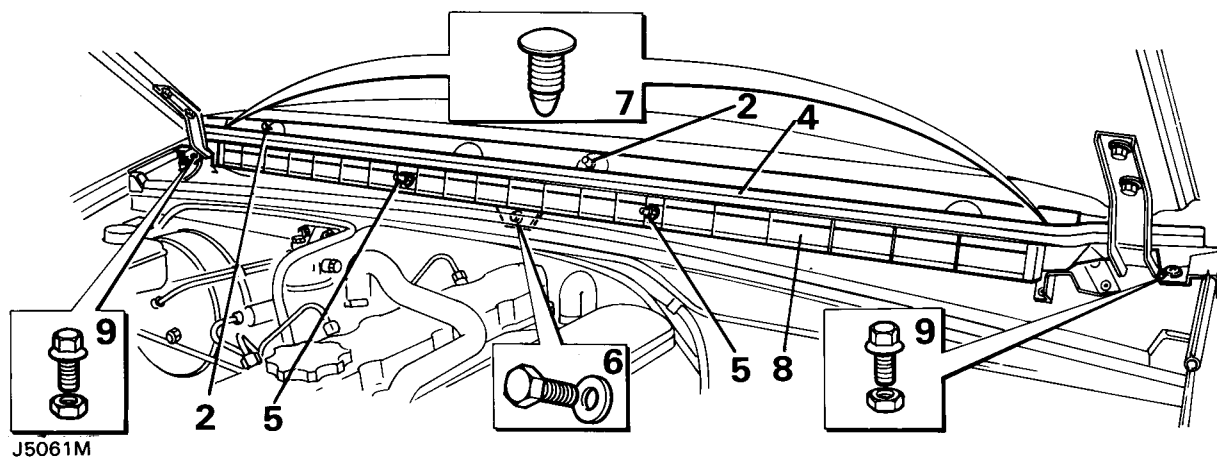
Service repair no - 76.11.08

### Remove

1. Remove the windscreen wiper arms.
2. Remove the securing nuts and the steel and rubber washers from the wiper spindles.
3. Open the vehicle bonnet [hood].
4. Remove the rubber seal from the cowl flange.
5. Release the screen washer tubes from the washer jets on the cowl.
6. Remove the centre bolt securing the cowl centre section.
7. Remove the retainers securing the centre section to the outer section.
8. Detach the centre section from the bulkhead.
9. Remove the nuts and bolts and detach the outer sections of the cowl.

### Refit

10. Reverse removal procedure.



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**SUNROOF ELECTRIC/MANUAL**

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**Introduction**

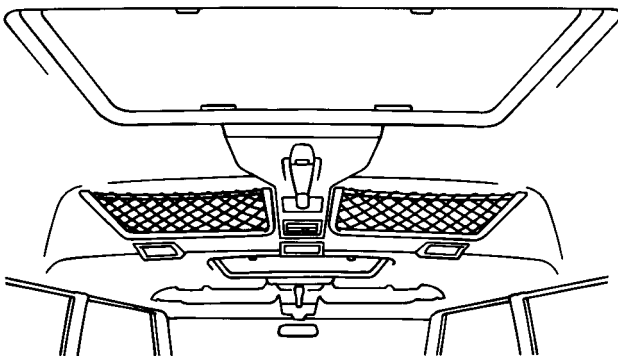
Twin sunroofs are fitted to the vehicle, the open/close sequence for both electric and manual versions sharing the same operation:-

- A Closed position,
- B Tilt position,
- C Fully open position. When fully open the sunroof slides back in a tilt position over the vehicle roof.

The electric front and rear sunroofs, operated by roof mounted switches are controlled by an electronic control unit. A roof mounted isolation switch is also fitted to cut off power to the rear sunroof.

On manual sunroofs a pull down handle is used, incorporating a depress button that locks the handle after each sequence.

Twin sun blinds are installed in the clamping frame of the sunroof and can be drawn forwards independently.



J5913



## SUNROOF GLASS FRONT AND REAR

Service repair no - 76.82.64

### Remove

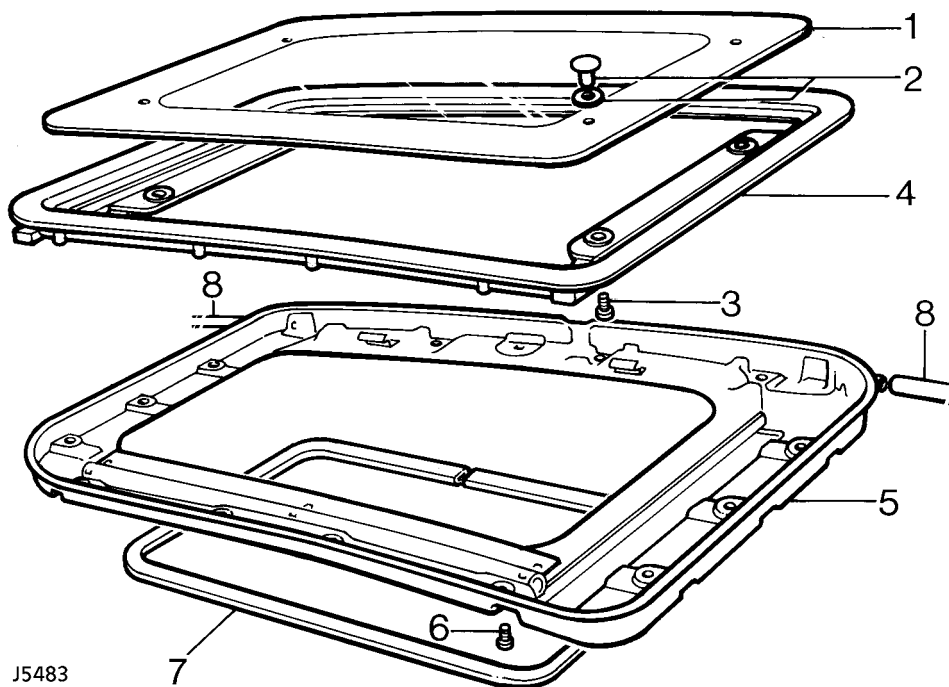
1. Open sunroof to tilt position.
2. Using a right angled screwdriver remove four retaining screws and detach sunroof glass from upper frame. Retain capnuts and washers.

### Refit

3. Locate sunroof glass in upper frame complete with capnuts and loosely fit retaining screws.
4. Close sunroof and move glass centrally in upper frame.
5. Open to tilt position and tighten retaining screws.



**CAUTION:** Ensure washers under capnuts do not twist or spread out when tightening retaining screws.



### Sunroof components

- |                         |                            |
|-------------------------|----------------------------|
| 1. Glass panel          | 5. Clamping frame assembly |
| 2. Capnut and washer    | 6. Screw                   |
| 3. Screw                | 7. Edging trim             |
| 4. Upper frame assembly | 8. Drain tube              |

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**SUNROOF ASSEMBLY - ELECTRICAL, FRONT AND REAR**

---

Service repair no - 76.82.59

**Remove**

Refer to sunroof components illustration J5483

1. Ensure sunroof is in normally closed position.
2. Disconnect battery negative lead.
3. Remove headlining. **See headlining.**
4. Disconnect electric motor wiring plug. **See sunroof electric motors.**
5. Remove screws and detach electric motor from clamping frame.
6. Disconnect drain tubes from each side of clamping frame.
7. Remove 13 fixings and remove clamping frame from upper frame.
8. Remove upper frame assembly.

**Refit**

9. Position upper frame assembly into roof aperture.
10. Locate clamping frame and reconnect drain tubes.
11. Loosely fit screws, centralise upper frame and clamping frame assemblies and then tighten screws.
12. Reverse removal procedure.



## SUNROOF ELECTRIC MOTORS

Service repair no - 76.82.84/85

### FRONT MOTOR

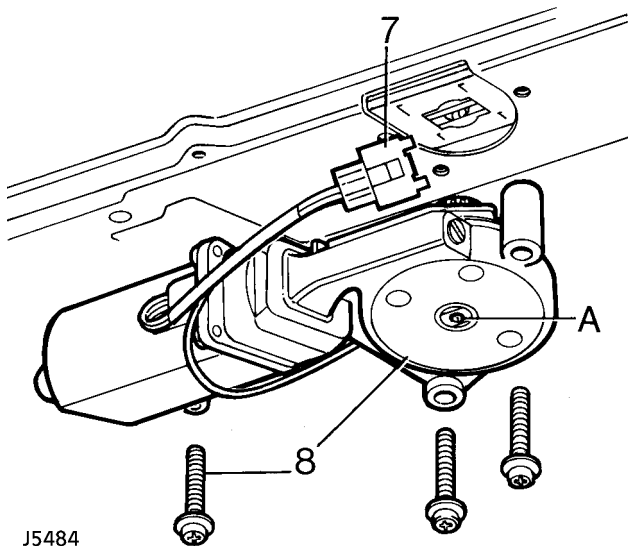
#### Remove

1. Disconnect battery negative lead.
2. Ensure sunroof is in normally closed position



**NOTE:** If the electric motor has failed the sunroof can be closed manually using an allen key to turn motor spindle A.

3. Remove switch panel from stowage pocket panel
4. Remove interior lamp from stowage pocket panel
5. Remove alarm ultrasonic unit.
6. Unscrew ten fixings and remove stowage pocket from headlining.
7. Disconnect motor wiring multiplug.
8. Remove three screws and motor.



#### Refit

9. Reverse removal procedure.



**CAUTION:** Ensure the motor is aligned with fixing holes and the sunroof is in the normally closed position. DO NOT rotate the motor drive spindle in the rack - this may result in incorrect operation of the sunroof.

### REAR MOTOR

#### Remove

1. Disconnect battery negative lead.
2. Ensure sunroof is in normally closed position



**NOTE:** If the electric motor has failed the sunroof can be closed manually using an allen key to turn motor spindle.

3. Remove headlining. *See headlining.*
4. Disconnect motor wiring multiplug.
5. Remove three screws and motor.

#### Refit

6. Reverse removal procedure.



**CAUTION:** Ensure the motor is aligned with fixing holes and the sunroof is in the normally closed position. DO NOT rotate the motor drive spindle in the rack - this may result in incorrect operation of the sunroof.

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**SUNROOF ELECTRIC CONTROL UNIT**

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**Service repair no - 76.82.73**

The control unit serves both front and rear sunroofs and is sited above the front switches behind headlining.

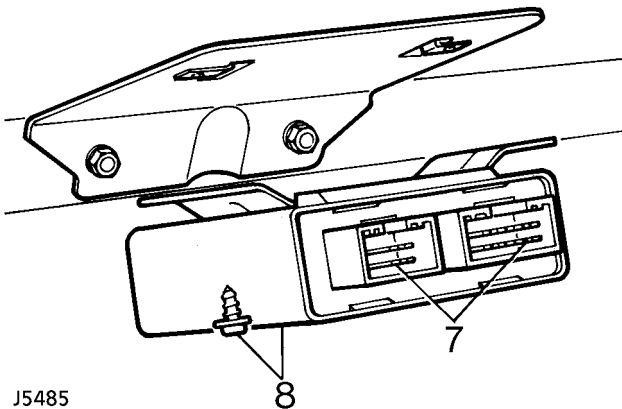
**Remove**

1. Disconnect battery negative lead.
2. Ensure sunroof is in normally closed position.



**NOTE: If the electric motor has failed the sunroof can be closed manually using an allen key to turn motor spindle.**

3. Remove switch panel from stowage pocket panel
4. Remove interior lamp from stowage pocket panel
5. Remove alarm ultrasonic unit.
6. Unscrew ten fixings and remove stowage pocket from headlining.
7. Disconnect electric plugs from control unit.
8. Remove two retaining screws and control unit.

**Refit**

9. Reverse removal procedure.



## SUNROOF ASSEMBLY - MANUAL, FRONT AND REAR

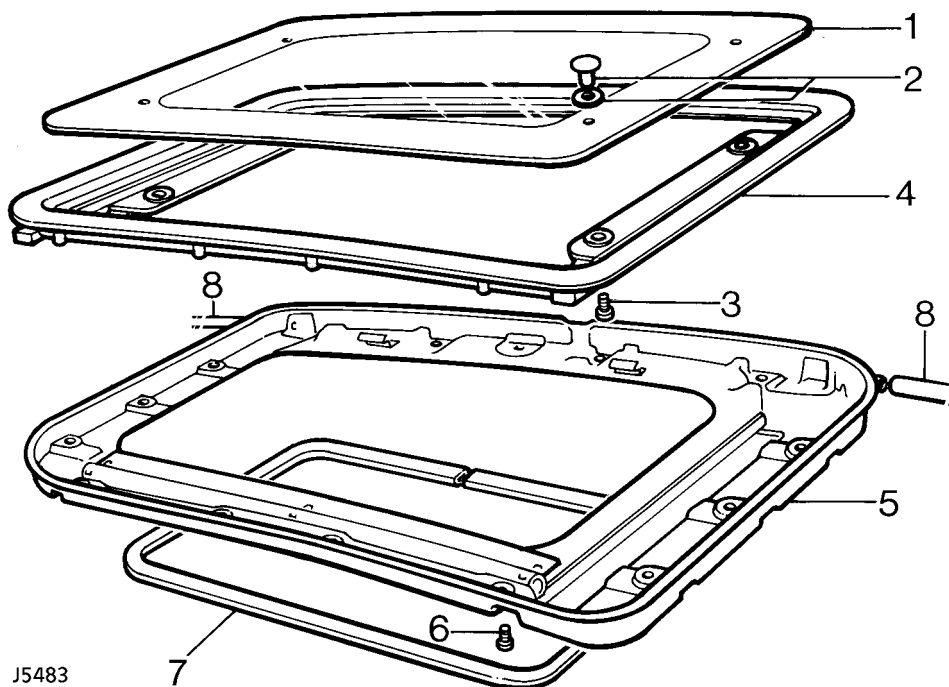
Service repair no - 76.83.01

### Remove

1. Close sunroof.
2. Remove headlining. *See headlining.*
3. Remove screws and manual regulator from clamping frame. *See sunroof regulator manual.*
4. Disconnect drain tubes from each side of clamping frame.
5. Remove 13 screws and clamping frame from upper frame.
6. Remove upper frame assembly from roof aperture.

### Refit

7. Position upper frame assembly into roof aperture.
8. Locate clamping frame and reconnect drain tubes.
9. Loosely fit screws, centralise upper frame and clamping frame assemblies and then tighten screws.
10. Reverse removal procedure.



J5483

### Sunroof components

- |                         |                            |
|-------------------------|----------------------------|
| 1. Glass panel          | 5. Clamping frame assembly |
| 2. Capnut and washer    | 6. Screw                   |
| 3. Screw                | 7. Edging trim             |
| 4. Upper frame assembly | 8. Drain tube              |



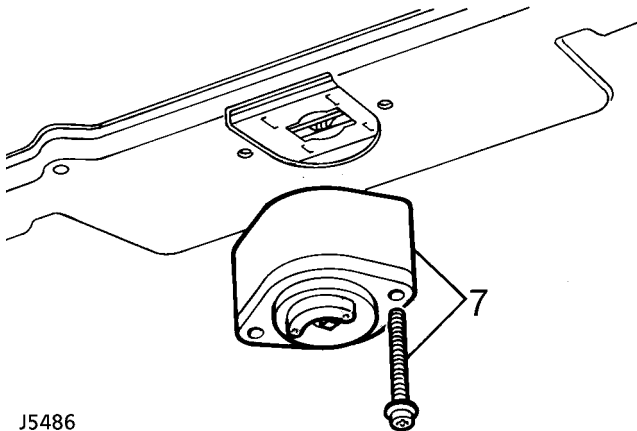
## SUNROOF REGULATOR MANUAL

Service repair no - 76.83.03/04

## FRONT

## Remove

1. Ensure sunroof is in normally closed position.
2. Remove retaining screw and regulator handle.
3. Remove switch panel from stowage pocket panel
4. Remove interior lamp from stowage pocket panel
5. Remove alarm ultra sonic unit.
6. Unscrew ten fixings and remove stowage pocket from headlining.
7. Remove two retaining screws and regulator from clamping frame.



J5486

## REAR

## Remove

1. Ensure sunroof is in normally closed position.
2. Remove retaining screw and regulator handle.
3. Remove headlining. **See headlining.**
4. Remove two retaining screws and regulator from clamping frame.

## Refit

5. Reverse removal procedure.



**CAUTION:** Ensure the regulator is aligned with fixing holes and the sunroof is in the normally closed position. **DO NOT** rotate the regulator spindle in the rack - this may result in incorrect operation of the sunroof.

## Refit

8. Reverse removal procedure.



**CAUTION:** Ensure the regulator is aligned with fixing holes and the sunroof is in the normally closed position. **DO NOT** rotate the regulator spindle in the rack - this may result in incorrect operation of the sunroof.

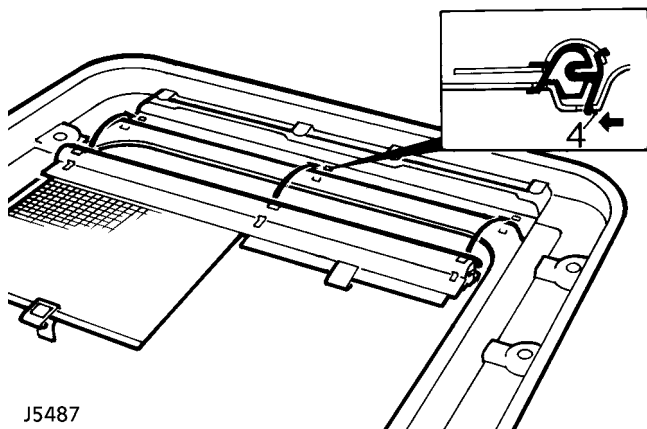


## SUN BLIND ASSEMBLY

Service repair no - 76.82.78

### Remove

1. Open sunroof to the tilt position.
2. Remove the trim finisher from the sunroof surround.
3. Release the headlining locally to access under clamping frame of the sunroof.
4. Lever forward and upward the rear leg of 3 retaining clips to release sun blind roll assembly.



J5487

### Refit

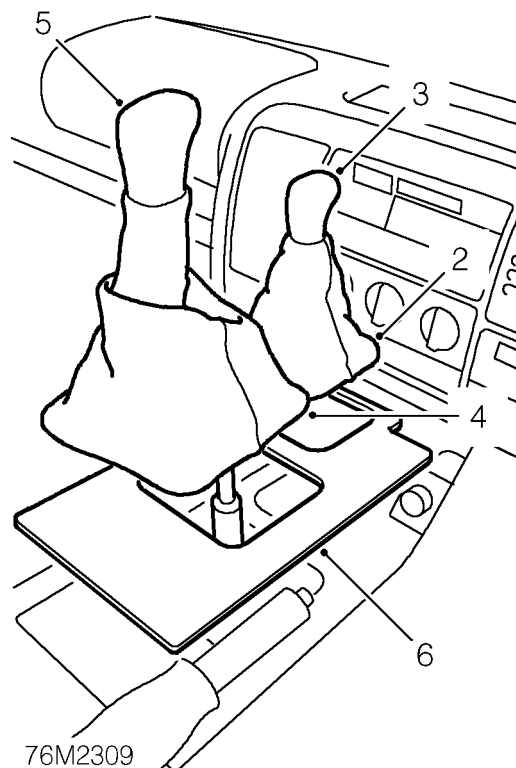
5. Ensure front leg of retaining clips are located.
6. Push in rear leg of retaining clip.
7. Reverse removal procedure.

## CENTRE CONSOLE

Service repair no - 76.52.02

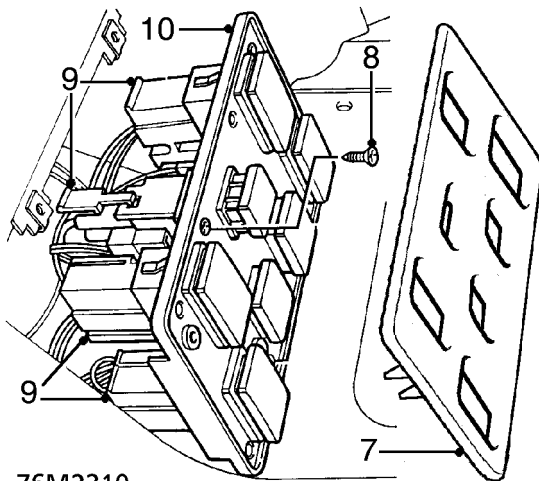
### Remove

1. Disconnect battery earth lead.



76M2309

2. Release transfer gear lever gaiter from console.
3. Remove transfer gear lever gaiter and knob assembly.
4. Release gear selector lever gaiter from centre console.
5. Remove gear selector lever gaiter and knob assembly.
6. Remove centre console rubber mat.



76M2310

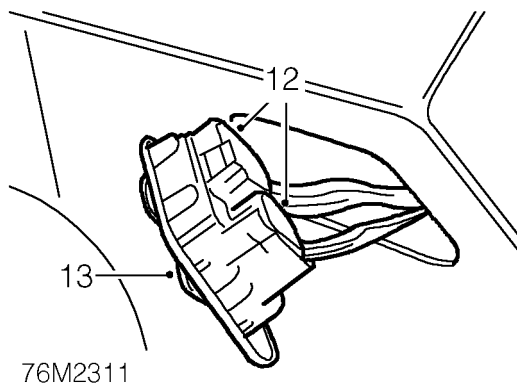
7. Remove centre console switch pack cover.
8. Remove 4 screws securing switch pack to console.
9. Release switch pack from console and disconnect 7 multiplugs.



**NOTE:** If the 'Cold Pack' option is not fitted there will only be 5 switches in pack.

10. Remove switch pack.

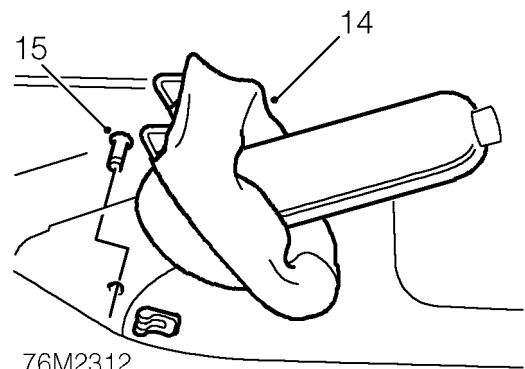
#### Models fitted with electric front seats



76M2311

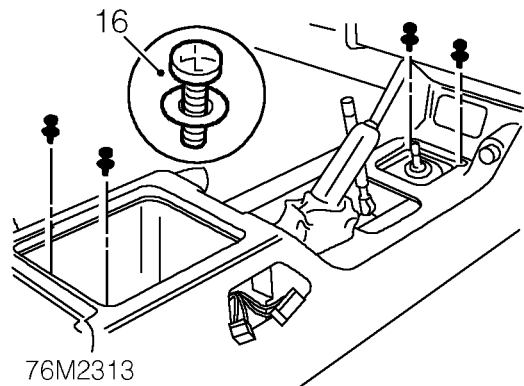
11. Release electric front seat switches from centre console.
12. Disconnect 2 multiplugs from each switch.
13. Remove switches.

#### All models



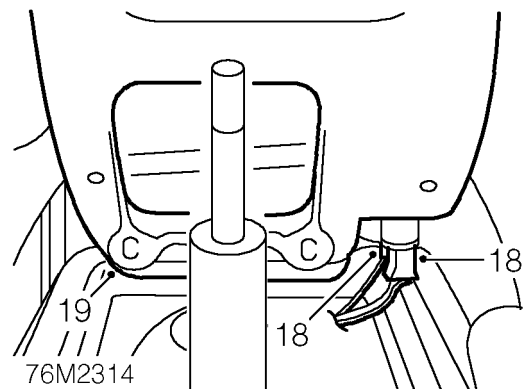
76M2312

14. Release hand brake lever gaiter from centre console.
15. Remove clip and clevis pin securing cable to hand brake lever.



76M2313

16. Remove 4 screws securing centre console to body.
17. Raise hand brake lever, pull centre console rearwards to gain access to cigar lighter multiplug and illumination bulb Lucar.



76M2314

18. Disconnect cigar lighter multiplug and illumination bulb Lucar.
19. Remove centre console assembly.



## Refit

20. Position centre console assembly, ensuring harnesses and connectors are not trapped and are routed to their correct locations.
21. Connect cigar lighter multiplug and illumination bulb Lucar.
22. Align centre console to body fixings and fascia.
23. Fit and tighten screws securing centre console to body.
24. Lubricate hand brake lever to cable clevis pin.
25. Align hand brake cable to lever, fit clevis pin and secure with clip.
26. Secure hand brake lever gaiter to centre console.

## Models fitted with electric front seats

27. Position electric front seat switches, connect multiplugs and secure to centre console.

## All models

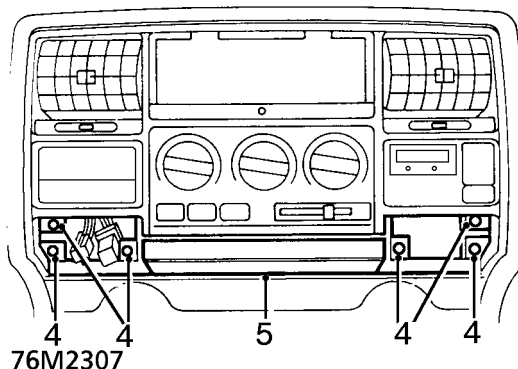
28. Position centre console switch pack and connect multiplugs to switches.
29. Align switch pack to centre console and secure with screws.
30. Fit centre console switch pack cover.
31. Fit centre console rubber mat.
32. Fit gear selector lever knob and secure gaiter.
33. Fit transfer gear lever knob and secure gaiter.
34. Reconnect battery earth lead.

## DRINKS TRAY

Service repair no - 76.46.41

### Remove

1. Disconnect battery negative lead.
2. Remove ash tray. **See ash tray - dash panel central louvre panel.**
3. Remove switch pack. **See switch pack - dash panel central louvre panel.**



4. Remove 6 screws securing drinks tray to dash panel central louvre panel.
5. Remove drinks tray.

### Refit

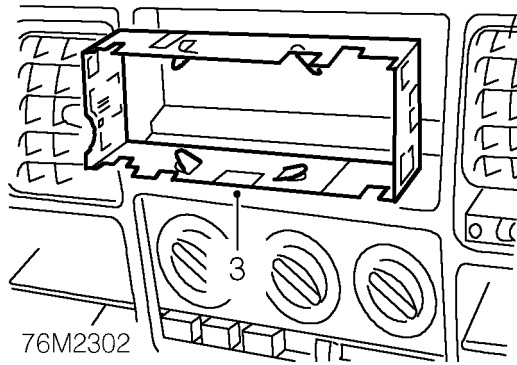
6. Position drinks tray to dash panel central louvre panel and secure with screws.
7. Fit switch pack. **See switch pack - dash panel central louvre panel.**
8. Fit ash tray. **See ash tray - dash panel central louvre panel.**
9. Connect battery negative lead.

## DASH PANEL CENTRAL LOUVRE PANEL

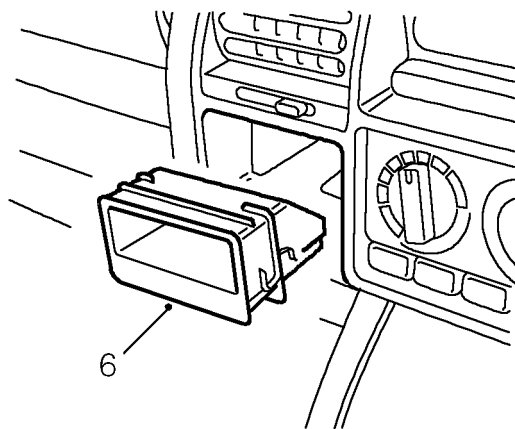
Service repair no - 76.46.42

## Remove

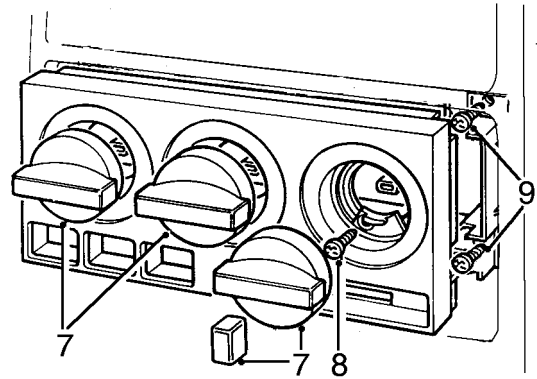
1. Disconnect battery negative lead.
2. Remove radio. *See ELECTRICAL, Repair, radio.*



3. Release tags securing radio cage to louvre panel and remove cage.
4. Remove clock. *See ELECTRICAL, Repair, clock.*
5. Release 4 coin tray securing tags.

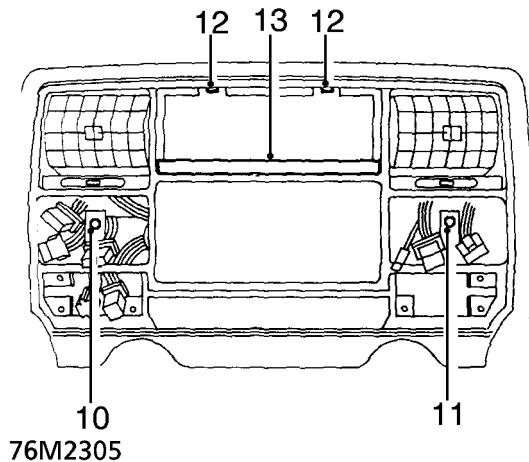


6. Remove coin tray.



76M2304

7. Remove 3 heater control and blower switch knob.
8. Remove 2 screws securing heater graphic display panel and remove panel.
9. Remove 4 screws securing heater control unit to panel.



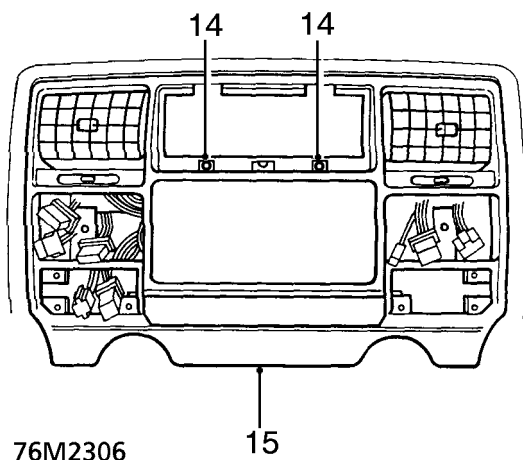
76M2305

10. Working through coin tray aperture, remove screw securing panel.
11. Working through clock aperture, remove screw securing panel.
12. Loosen 2 uppermost panel retaining screws.



**NOTE:** On some models the panel is fitted with an LED. In this case, manoeuvre LED from panel and disconnect.

13. Remove panel retaining screw cover.



14. Remove 2 screws securing louvre panel.
15. Remove louvre panel from dash panel.

#### Refit

16. Position louvre panel, feed harness connectors through their correct apertures, and align to dash panel.



**CAUTION:** When refitting avoid trapping of electrical wiring.

17. Fit and tighten screws securing louvre panel.
18. Fit panel retaining screw cover.
19. Position heater control unit to panel and secure with screws.
20. Fit heater graphic display panel and secure with screws.
21. Fit heater control and blower switch knobs.
22. Fit clock. **See ELECTRICAL, Repair, clock.**
23. Position coin tray and secure to tags.
24. Position radio cage, feed electrical connectors and aerial through cage, and position to panel.
25. Bend back radio cage retaining tags.
26. Fit radio. **See ELECTRICAL, Repair, radio.**
27. Connect battery negative lead.

#### DASH PANEL ASSEMBLY

Service repair no - 76.46.23

#### Remove

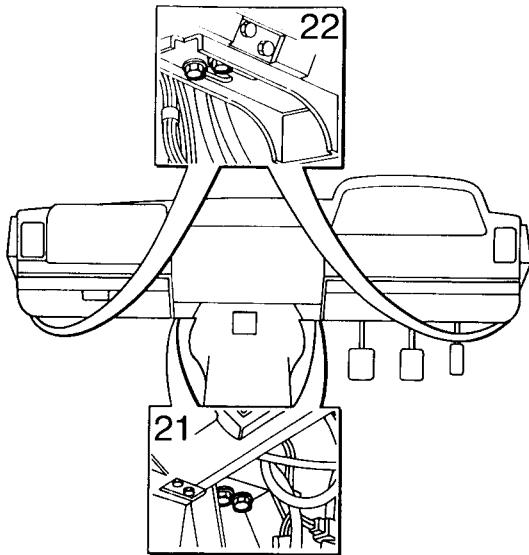
1. Move front seats to rearmost position.
2. Disconnect battery negative lead.
3. Disconnect air bag multiplugs under dash panel.



**CAUTION:** When air bags are fitted, reference must be made to the Airbag Supplementary Restraint System section.

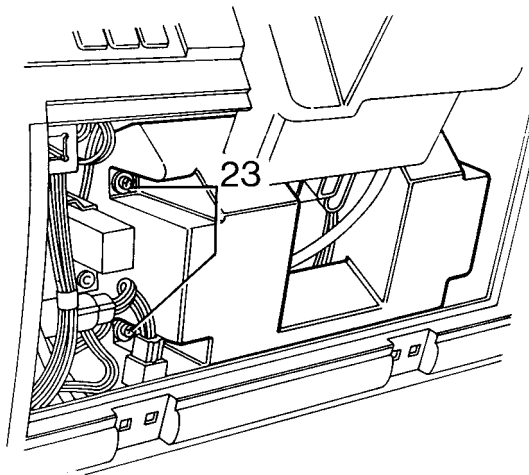
4. Remove passenger glove box.
5. Remove driver's side access panel.
6. Remove centre console assembly. **See centre console.**
7. Remove airbag from steering wheel. **See SUPPLEMENTARY RESTRAINT SYSTEM, Repair, driver's airbag module.**
8. Remove passenger's airbag from dash panel. **See SUPPLEMENTARY RESTRAINT SYSTEM, Repair, passenger's airbag module.**
9. Release clamp and lower steering column.
10. Remove steering wheel. **See STEERING, Repair, steering wheel.**
11. Remove column switch. **See SUPPLEMENTARY RESTRAINT SYSTEM, Repair, column switch assembly.**
12. Remove instrument binnacle. **See ELECTRICAL, Repair, instrument binnacle.**
13. Remove radio. **See ELECTRICAL, Repair, radio.**
14. Remove exterior mirrors switch panel.
15. Remove coin tray.
16. Remove switch panel.
17. Remove clock.
18. Undo screw securing mounting bracket and position passenger's side relay assembly aside.
19. Set heater controls fully clockwise.

20. Note position of levers, disconnect heater control cables from levers and outer cable from retaining clips.



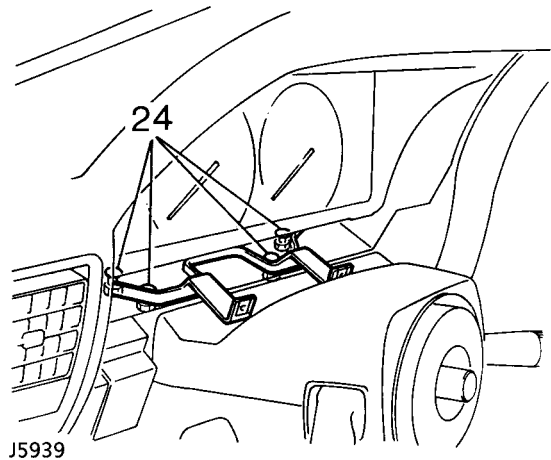
J5937

21. Remove 4 bolts securing dash panel to centre lower mounting brackets.  
22. Remove 4 bolts securing dash panel to side lower mounting brackets.



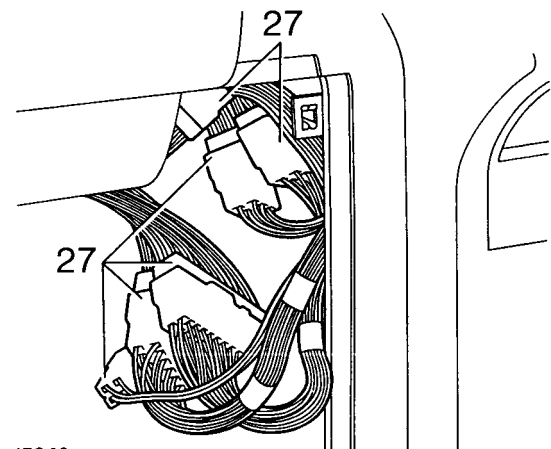
J5938

23. Undo 4 screws and remove 2 driver's knee bolster pads from below steering column.



J5939

24. Remove 4 nuts securing instrument mounting bracket to dash panel.



J5940

25. **With assistance:** Manoeuvre dash panel partially rearward.  
26. Driver's side: Disconnect 6 multiplugs connecting dash harness to main harness.  
27. Disconnect 3 multiplugs connecting dash harness to fusebox.  
28. **With assistance:** Lift dash panel rearward to clear fixings and remove from vehicle.



## Refit



**CAUTION: When refitting avoid trapping electrical wiring.**

29. Reverse removal procedure.
30. With assistance: Position dash panel and connect dash harness multiplugs to fusebox and main harness.
31. Reverse removal procedure. Ensure dash panel upper bracket studs are located before the 4 lower brackets.
32. Reverse removal procedure. Disconnect glovebox switch Lucars to ease fitting of relay bracket.

## WINDSCREEN GLASS

Service repair no - 76.81.01

## Information

The following equipment is required:

- Cutting wire and handles
- Windscreen repair kit (see Technical Bulletin). *See Electrical Trouble Shooting Manual. Windscreen Glass Replacement.*
- Sealant applicator gun.
- Suction cup lifters.

The following materials are included in the windscreen repair kit:

- Glass cleaning solvent - 'Betawipe' Glass activator (yellow cap).
- Cotton buds.
- Glass primer - 'Betaprime'(green cap).
- Body primer - 'Betaprime' paint/plastic primer (red cap).
- Betaseal Adhesive sealant.



**NOTE: The adhesive sealant cures in 6 to 8 hours**



**CAUTION: Once existing sealant is cut, the exposed surfaces oxidises in approximately 90 minutes. The refit procedure must be completed within this time span to prevent the sealant oxidising, to effect a satisfactory joint.**



**CAUTION: If the windscreen aperture body flange shows signs of corrosion it must be treated with anti corrosion primer and repainted. Newly painted areas must then be left for 8 hours or more before applying adhesive sealant.**

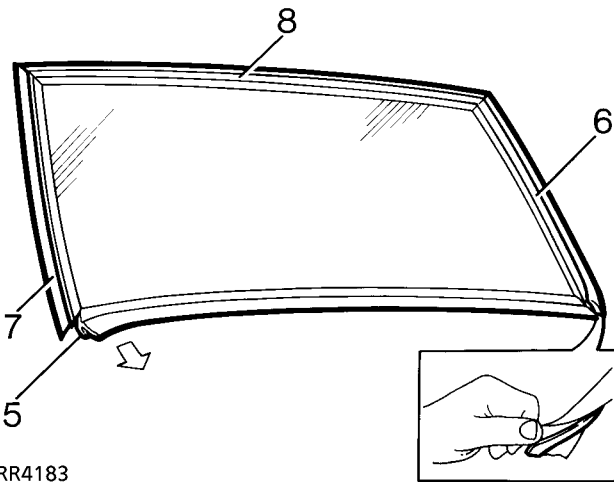




**NOTE:** If heated front screen: 2 electrical multiplug connectors are located under the decker [cowl] panel. To access release decker panel.

### Remove

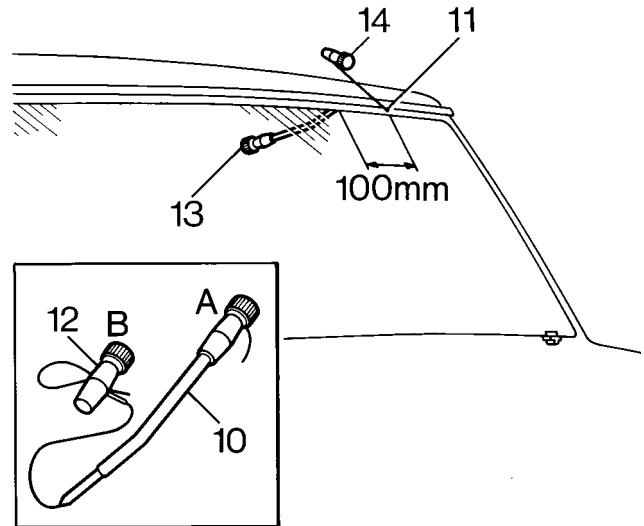
1. Remove windscreen wiper arms. *See WIPERS AND WASHERS, Repair, wiper arms - windscreen.*
2. Remove rear view mirror and stickers from glass.
3. Remove 'A' post finishers.
4. Fit protective cover over dash panel and apply masking tape to protect 'A' posts.



RR4183

5. Ease one end of bottom finisher away from glass, pull to disengage finisher flange and remove.
6. Lift lip of LH 'A' post finisher and release sealing strip along its length, pull to disengage finisher flange from glass and remove.

7. Remove RH 'A' post finisher.
8. Remove header finisher.
9. Apply masking tape to protect paint finish around glass.



RR4184

10. Prepare cutting wire in handle 'A'. Bend end of wire to handle and tape over end.
11. Force cutting wire through sealer from inside and 100mm (3 7/8 in) from a top corner. Use a needle if necessary to make a pilot hole.
12. Attach handle 'B'. Allow 200mm (7 7/8 in) of wire between handles, tape over end of wire.
13. **With an assistant on the inside:** Wedge the tube of the handle 'A' between glass and body flange 100mm (3 7/8 in) ahead of hole in sealer.
14. **From the outside:** Carefully cut sealer from flange using a straight pull away from the glass. Continue in 100mm (3 7/8 in) steps around the glass, use a sawing action at the corners.

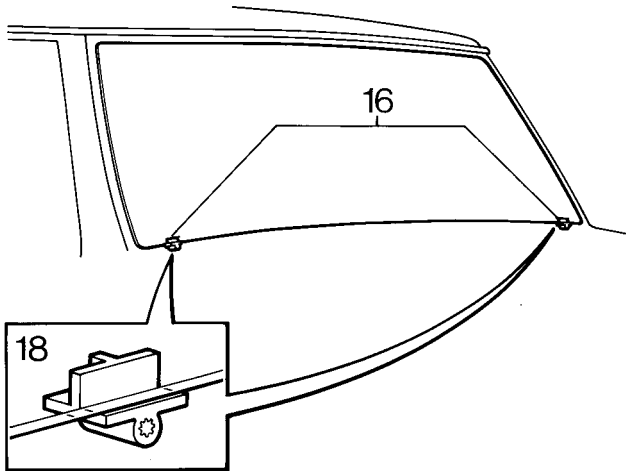


**CAUTION:** Along the bottom edge, great care must be taken to cut up to the 2 supports, positions indicated on the obscuration band (See item 18).

15. Remove handle 'B', withdraw the cutting wire and insert it through the sealer between the supports. Refit handle 'B'.



16. Cut through sealer between the supports.  
If heated front screen: Cut through the 2 wires each side of the supports. Tape cut wires and panels to prevent damage to bodywork when screen is removed.



RR4185

17. Attach suction cups to glass and lift glass from body flange, cut sealer free around supports as necessary.

**WARNING:** If glass has splintered: Protect eyes and operate demister blower at maximum speed to remove any glass from ducts. Use a vacuum cleaner to remove glass particles from inside the vehicle.

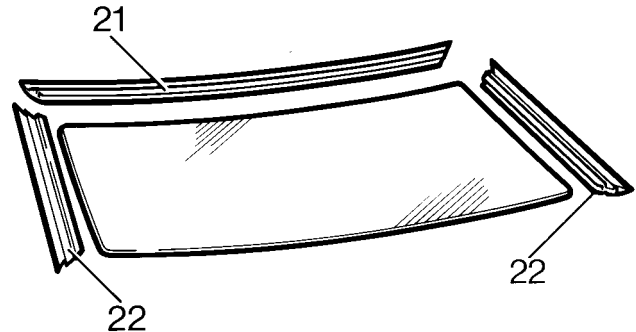
Refit

18. Check condition of supports, renew if necessary. Locating studs must be at right angle to flange.

**NOTE:** The supports were fitted to early vehicles and now replaced with nylon sheaths.

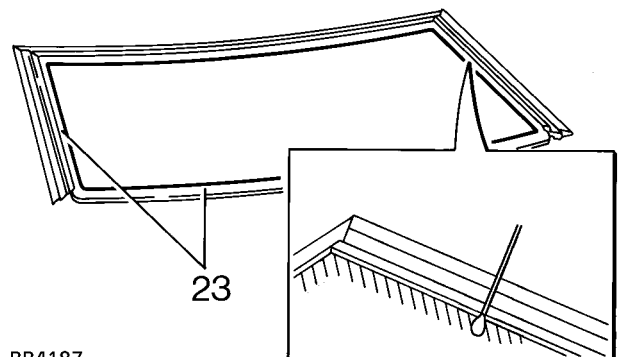
19. Carefully cut back old sealant around body flange to obtain a smooth surface 2mm (1/10in) thick. **DO NOT cut down to flange.**  
20. **If refitting original glass:** It must be free from chips or cracks. Cut back old sealant around glass to obtain a smooth surface 2mm (1/10 in) thick. **DO NOT cut down to glass surface.**

**CAUTION:** Lay glass on felt covered supports, do not stand on edge. Any chipping of glass edge may develop into cracks.



RR4186

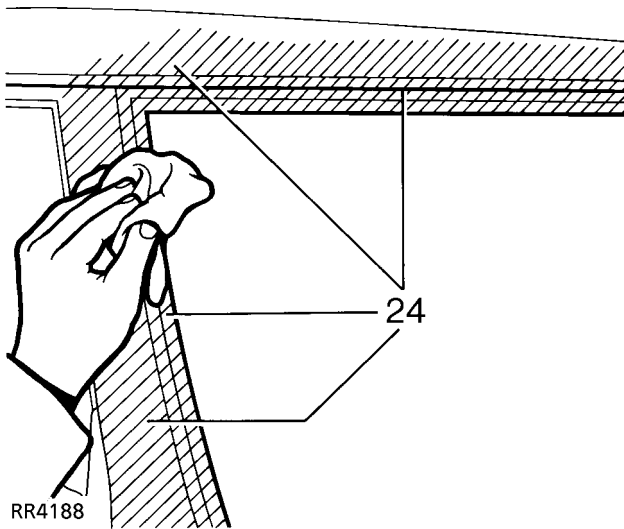
21. Align header finisher on top edge of glass, push flange fully onto glass and use a wooden block and mallet to ensure fit.  
22. Carefully align each side finisher on edge of glass, push flange fully onto glass and use a wooden block and mallet to ensure fit.



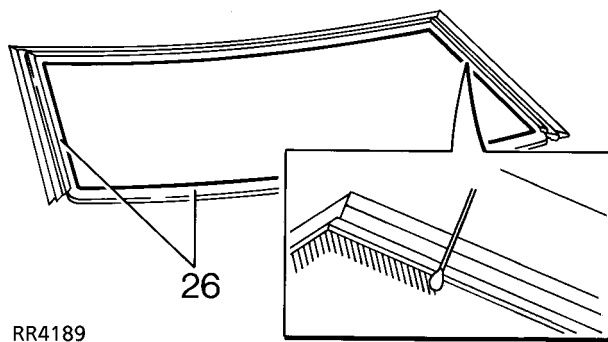
RR4187

23. Using a cotton bud, apply glass cleaning solvent (yellow cap) to inside face of glass, 20mm (13/16 in) strip around inside of finishers and 30mm (1 1/8 in) wide along bottom edge. Immediately wipe off solvent with a clean cloth.

**CAUTION:** Do not touch cleaned or primed surfaces with fingers.

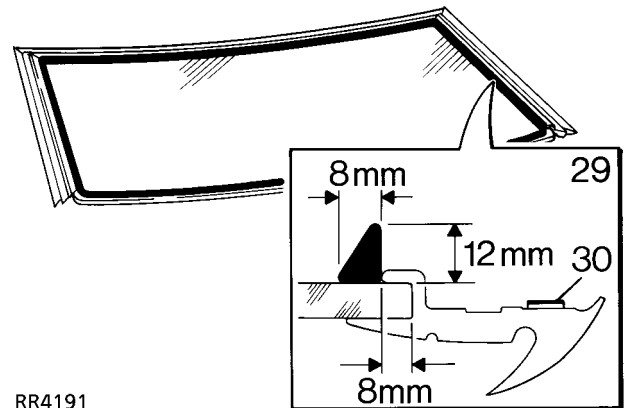


24. Ensure body flanges and surfaces covered by the finishers are clean.



25. Shake the primer container for at least 30 seconds.
26. Using a cotton bud, apply Glass Primer (green cap) to inside face of glass, 20mm (13/16 in) strip around inside of finishers and 30mm (1 1/8 in) wide along bottom edge. This must be touch dry before applying adhesive.

27. Remove protective coverings and tape.



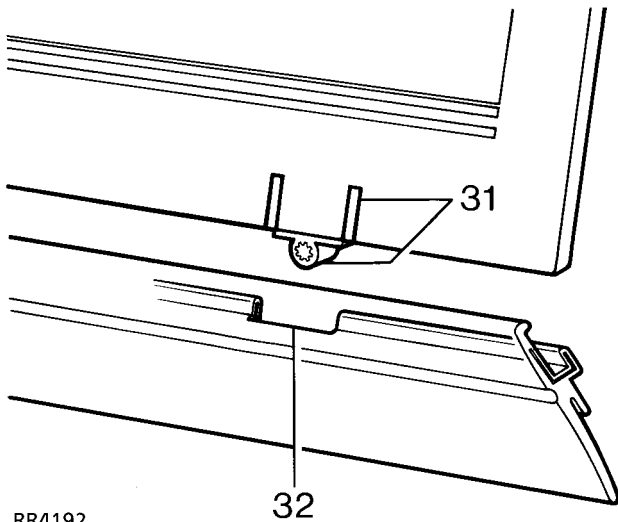
28. Pierce top and pre-cut nozzle to sealer cartridge, remove lid and shake out crystals and install cartridge in applicator gun.
29. Apply a continuous bead of adhesive sealant around the glass as shown. Vertical edge of sealer to abut finishers and to be 8mm (5/16 in) from bottom edge of glass.
30. Remove protective covering (RED) from side finisher sealing strip.



## FRONT SEAT - ELECTRIC

Service repair no - 76.77.01

Remove



RR4192

32

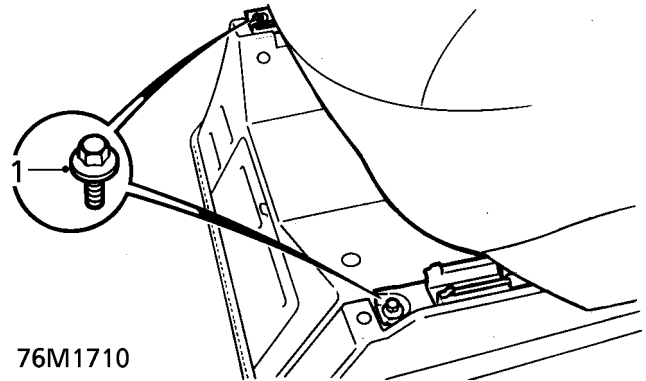
31

- 31. With assistance:** Attach suction cups to glass and lift into position, carefully align the indicators on the obscuration band with the supports. Lower screen onto body flange, check alignment and firmly press to seat glass in the aperture.



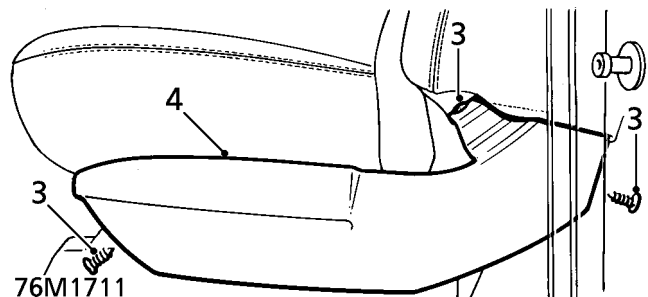
**NOTE:** The finisher on later vehicles will not have cutouts, or supports fitted, as shown.

- 32.** Align cut outs with the supports and push finisher fully onto the glass. Use a wooden block to ensure fit.  
**33.** Refit 'A' post finishers and interior mirror.  
**34.** Refit wiper arms.



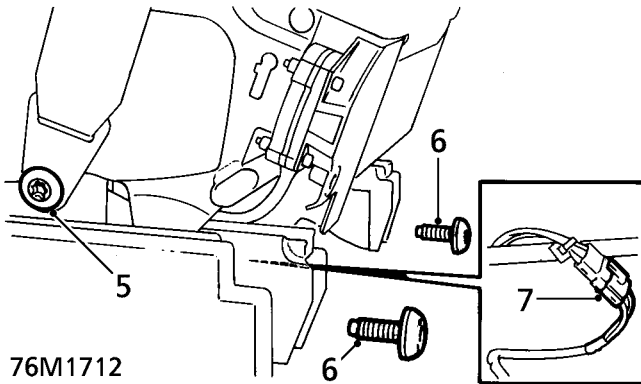
76M1710

1. Operate controls to adjust seat fully backwards and remove 2 bolts securing seat slides.
2. Operate controls to adjust seat fully forwards.



76M1711

3. Remove 3 studs securing seat side valance.
4. Remove side valance.



5. Remove Torx screw securing seat belt.
6. Remove 2 Torx screws securing seat.
7. Disconnect multiplug.
8. Remove seat.

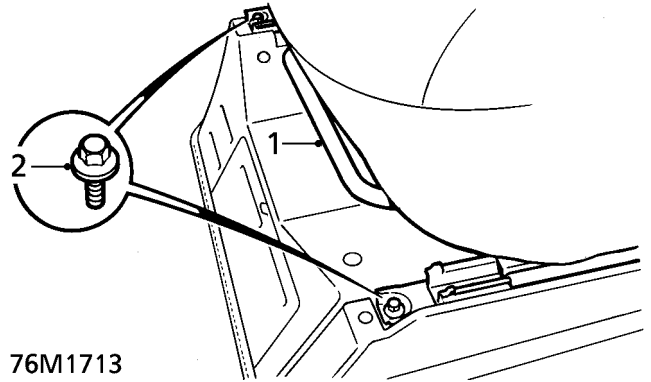
#### Refit

9. Reverse removal procedure.
10. Tighten Torx screws securing seat to **29 Nm (21 lbf ft)**.
11. Tighten bolts securing seat slides to **22 Nm (16 lbf ft)**.
12. Tighten Torx screw securing seat belt to **32 Nm (24 lbf ft)**.

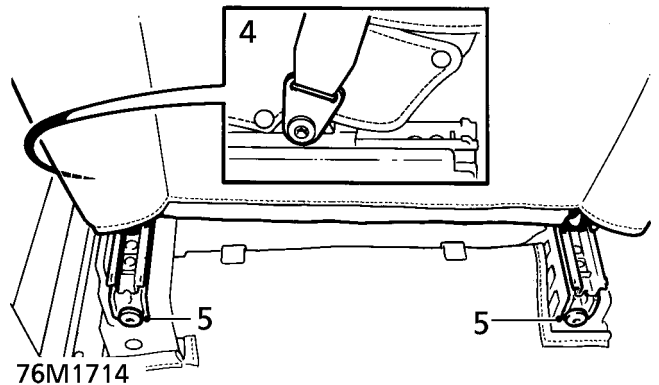
#### FRONT SEAT - MANUAL - 5 DOOR (96 MODELS)

Service repair no - 76.70.01

#### Remove



1. Raise adjusting bar and slide seat fully backwards.
2. Remove 2 bolts securing seat slides.
3. Raise adjusting bar and slide seat fully forwards.



4. Remove Torx screw securing seat belt.
5. Remove 2 Torx screws securing seat.
6. Remove seat.



## Refit

7. Reverse removal procedure.
8. Tighten Torx screws securing seat to **29 Nm (21 lbf ft)**.
9. Tighten bolts securing seat slides to **22 Nm (16 lbf ft)**.
10. Tighten Torx screw securing seat belt to **32 Nm (24 lbf ft)**.

## INTERIOR MIRROR (96 MODELS)

Service repair no - 76.10.51 - Manual

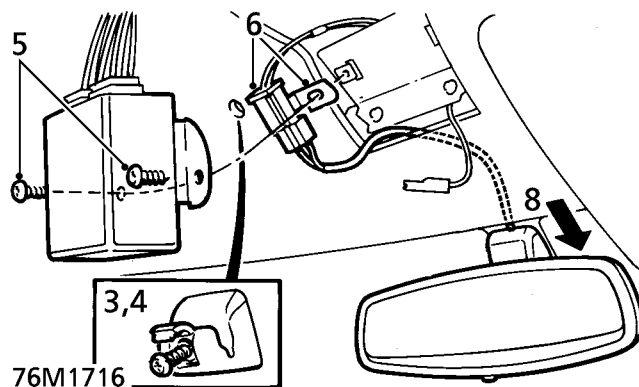
Service repair no - 76.10.54 - Auto dimming

## Remove



**NOTE:** To remove manual mirror, follow step 8 only.

1. Remove headlining front pocket.
2. Release left hand sun visor from clip and move aside.



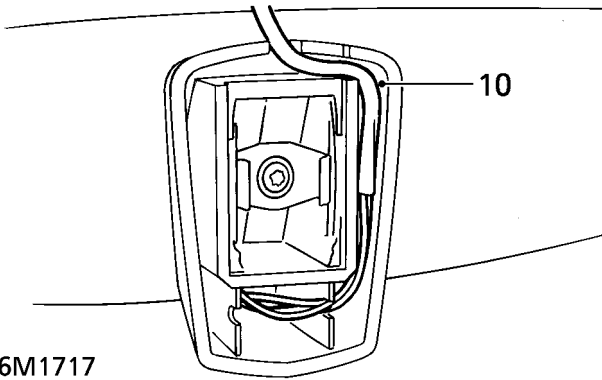
3. Release sun visor clip screw cover.
4. Remove clip securing screw and remove clip.
5. Remove 2 screws securing sunroof ECU and move ECU aside.
6. Locate mirror multiplug, remove clip and disconnect multiplug.
7. Remove tape securing harness (behind headlining).
8. Release mirror from screen by applying sharp downward pressure to the base.



**CAUTION:** Do not use tools to assist removal. Mirror base should be moved in direction of arrow, parallel to windscreen.

9. Release harness from behind headlining and remove mirror.

Refit



76M1717

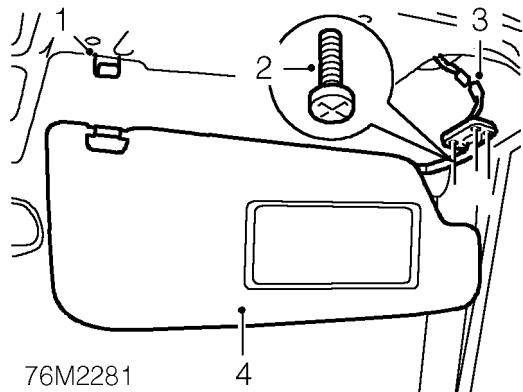
10. Reverse removal procedure. Ensure harness is correctly routed in mirror base so it does not become trapped.



## SUN VISOR

Service repair no - 76.10.47

### Remove



1. Release sun visor from headlining retaining clip.
2. Remove 3 screws securing sun visor to body.
3. Release sun visor and disconnect multiplug.
4. Remove sun visor.

### Refit

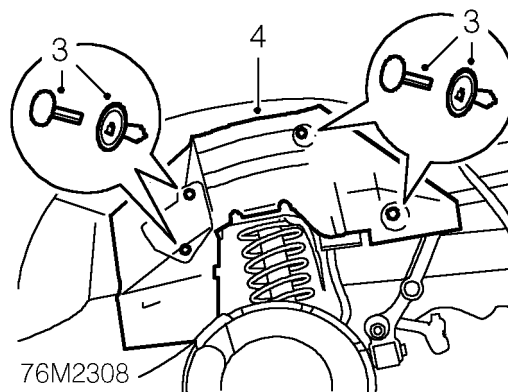
5. Position sun visor and connect multiplug.
6. Position sun visor to headlining and secure with screws.
7. Secure sun visor to headlining clip.

## WHEEL ARCH LINER - FRONT

Service repair no - 76.10.48

### Remove

1. Raise front of vehicle and support on safety stand.
2. Remove front road wheel.



3. Remove 4 wheel arch liner retainers.
4. Remove wheel arch liner.

### Refit

5. Fit wheel arch liner and secure with retainers.
6. Fit front road wheel and tighten nuts to **126 Nm (93 lbf ft)**.
7. Remove stand and lower vehicle.

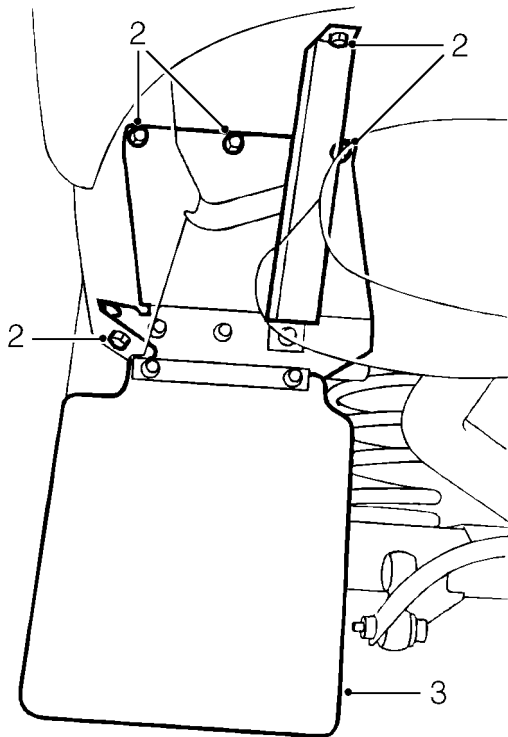


**MUD FLAP - REAR - LH**

Service repair no - 76.10.85

**Remove**

1. Remove rear compartment lower trim panel. **See rear compartment lower trim panel - lh - with rear air conditioning fitted.**



76M2279

2. Remove 5 nuts and bolts securing mud flap to body and bumper valance.
3. Remove mud flap.

**Refit**

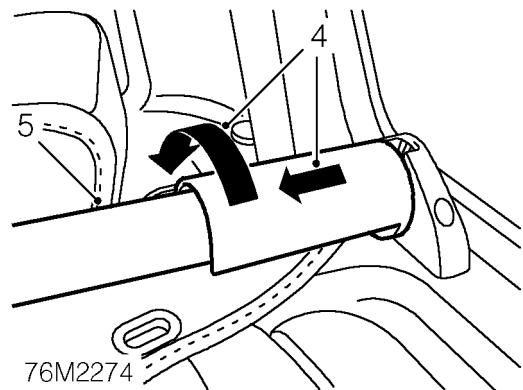
4. Position mud flap to body, fit bolts and tighten nuts to **10 Nm (7 lbf ft)**.
5. Fit rear compartment lower trim panel. **See rear compartment lower trim panel - lh - with rear air conditioning fitted.**

**REAR COMPARTMENT LOWER TRIM PANEL - LH - WITH REAR AIR CONDITIONING FITTED**

Service repair no - 76.13.03/20

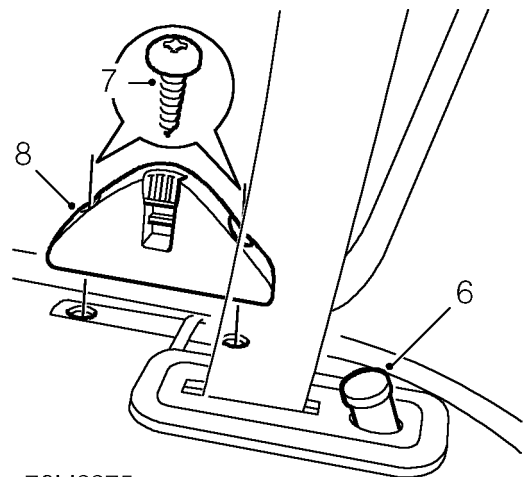
**Remove**

1. Remove rear fold down seat. **See rear fold down seats.**
2. Remove fold down rear seat belts. **See rear fold down seat belts - lh - with rear air conditioning fitted.**
3. Remove 'E' post trim casing. **See 'E' post trim casing - lh - with rear air conditioning fitted.**



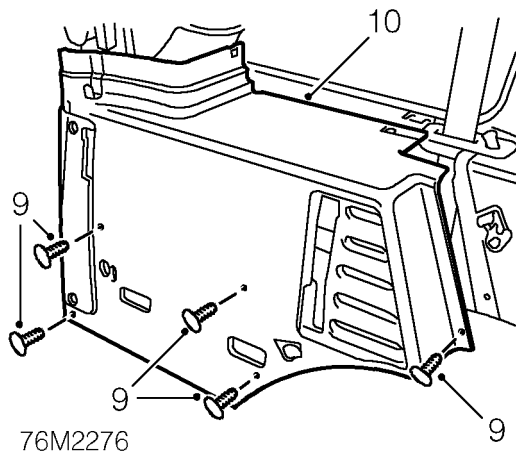
76M2274

4. Release load space cover end sleeve from mounting bracket.
5. Remove load space cover.



76M2275

6. Press rear seat squab release button and fold squab forward.
7. Remove 2 screws securing load space cover mounting bracket.
8. Remove mounting bracket.



9. Remove 5 trim studs securing trim panel.
10. Remove trim panel.

#### Refit

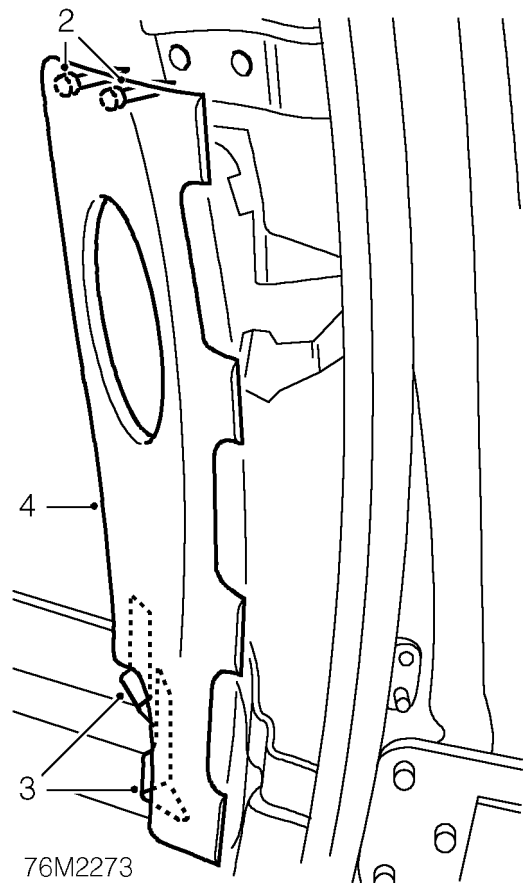
11. Fit and align trim panel.
12. Fit trim panel retaining studs.
13. Position load space cover mounting bracket and secure with screws.
14. Fold rear seat squab back and secure to latch.
15. Position load space cover to mounting brackets and secure.
16. Fit 'E' post trim casing. **See 'E' post trim casing - lh - with rear air conditioning fitted.**
17. Fit fold down rear seat belts. **See rear fold down seat belts - lh - with rear air conditioning fitted.**
18. Fit rear fold down seat. **See rear fold down seats.**

#### 'E' POST TRIM CASING - RH

Service repair no - 76.13.13/03

#### Remove

1. Remove rear speaker. **See ELECTRICAL, Repair, rear speaker.**



2. Release 2 'E' post finisher retaining studs from alpine light trim.
3. Release 2 'E' post finisher retaining clips from lower trim panel.
4. Remove 'E' post finisher.

#### Refit

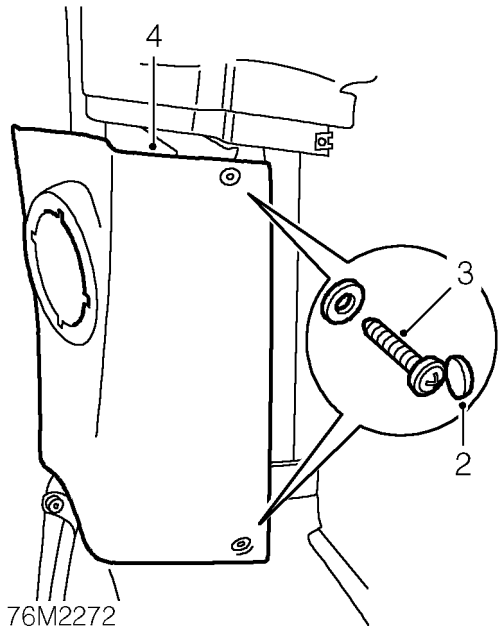
5. Position 'E' post finisher clips to lower trim panel.
6. Secure 'E' post finisher studs to alpine light trim.
7. Fit rear speaker. **See ELECTRICAL, Repair, rear speaker.**

**'E' POST TRIM CASING - LH - WITH REAR AIR CONDITIONING FITTED**

Service repair no - 76.13.13/20

**Remove**

1. Remove rear speaker. *See ELECTRICAL, Repair, rear speaker.*



2. Release 2 trim casing retaining screw covers.
3. Remove 2 screws securing trim casing.
4. Remove trim casing.

**Refit**

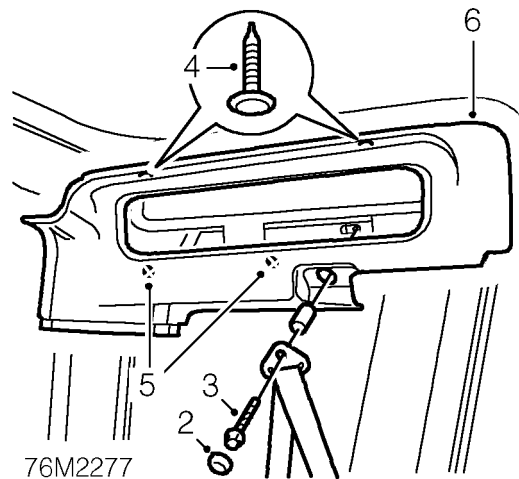
5. Fit and align trim casing.
6. Fit and tighten screws securing trim casing and fit covers.
7. Fit rear speaker. *See ELECTRICAL, Repair, rear speaker.*

**ALPINE LIGHT TRIM CASING - LH - WITH REAR AIR CONDITIONING FITTED**

Service repair no - 76.13.20/20

**Remove**

1. Remove 'E' post trim casing. *See 'E' post trim casing - lh - with rear air conditioning fitted.*



2. Remove rear seat belt anchorage retaining bolt cover.
3. Remove bolt securing rear seat belt anchorage.
4. Remove 2 trim studs securing trim casing.
5. Release trim casing from 2 retaining studs.
6. Remove trim casing.

**Refit**

7. Fit and align trim casing and secure with studs.
8. Fit 2 trim studs securing trim casing.
9. Position seat belt anchorage, fit bolt and tighten to **20 Nm (15 lbf ft)**.
10. Fit cover to seat belt anchorage bolt.
11. Fit 'E' post trim casing. *See 'E' post trim casing - lh - with rear air conditioning fitted.*

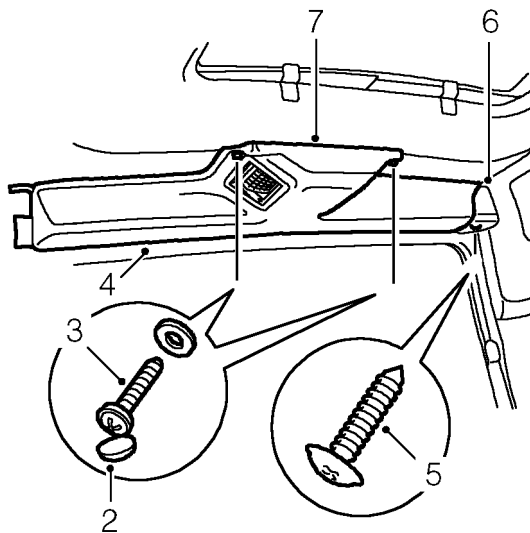


## REAR DOOR UPPER TRIM PANEL - WITH REAR AIR CONDITIONING FITTED

Service repair no - 76.13.72/20

### Remove

1. Remove alpine light trim casing. *See alpine light trim casing - lh - with rear air conditioning fitted.*



76M2278

2. Release 2 trim panel retaining screw covers.
3. Remove 2 trim panel retaining screws.
4. Release rear edge of trim panel from body.
5. Remove screw securing rear header duct to alpine light duct.
6. Release rear header duct from alpine light duct.
7. Remove trim panel assembly.

### Dismantle

8. Remove 2 vents from trim panel.
9. Remove screw securing rear header duct to trim panel.
10. Remove rear header duct.

### Rebuild

11. Fit rear header duct to new trim panel and secure with screw.
12. Fit vents to trim panel.

### Refit

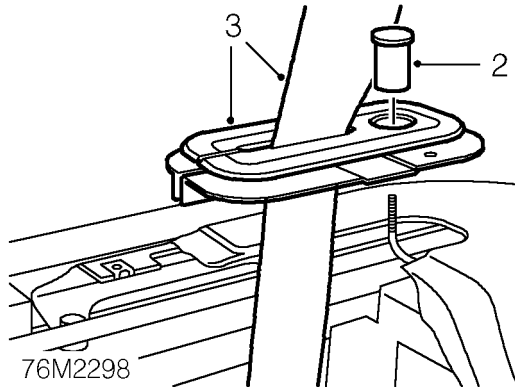
13. Position trim panel and connect rear header duct to alpine light duct.
14. Fit and tighten screw securing rear header duct to alpine light duct.
15. Secure rear edge of trim panel to body.
16. Fit and tighten screws securing trim panel.
17. Secure trim panel retaining screw covers.
18. Fit alpine light trim casing. *See alpine light trim casing - lh - with rear air conditioning fitted.*

**'D' POST TRIM CASING - LH - WITH REAR AIR  
CONDITIONING FITTED - 5 DOOR**

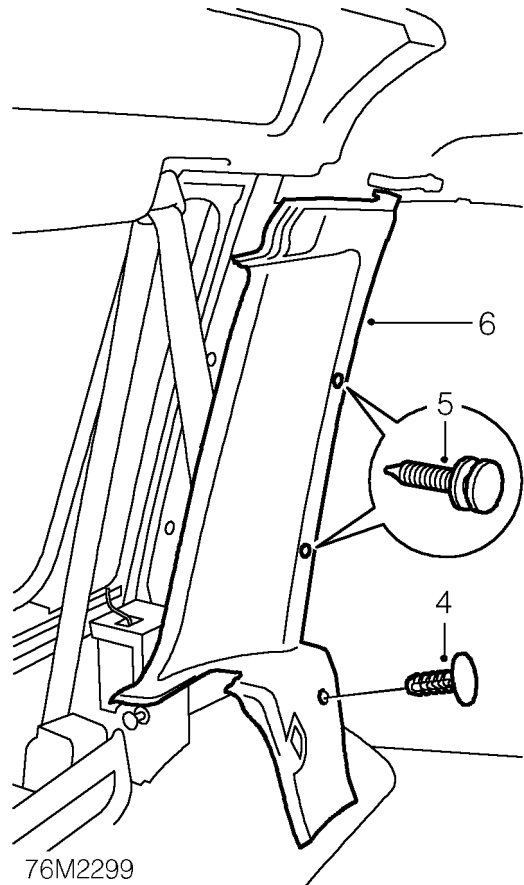
Service repair no - 76.13.73/20

**Remove**

1. Remove rear compartment lower trim panel.  
**See rear compartment lower trim panel - lh -  
with rear air conditioning fitted.**



2. Remove the squab release button from control rod.
3. Release rear seat belt from guide and remove guide.



4. Remove the trim casing retaining stud.
5. Release trim casing from 2 retaining studs.
6. Remove trim casing.

**Refit**

7. Fit trim casing under alpine light trim, align and secure retaining studs.
8. Fit trim casing retaining stud.
9. Position trim casing rear edge beneath sixth light seal flange.
10. Fit seat belt to guide, align squab release control rod and position guide to trim casing.
11. Fit squab release button to control rod.
12. Fit rear compartment lower trim panel. **See rear compartment lower trim panel - lh - with rear air conditioning fitted.**

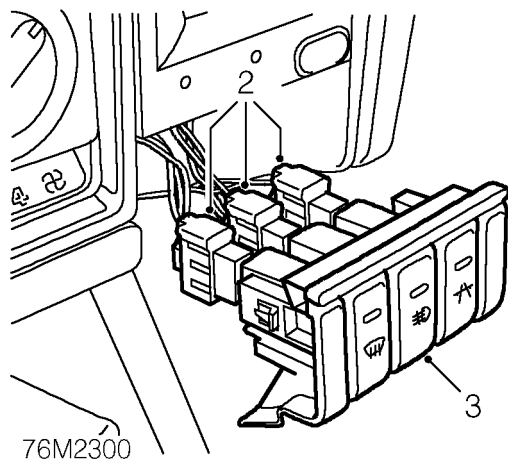


## SWITCH PACK - DASH PANEL CENTRAL LOUVRE PANEL

Service repair no - 76.46.38

### Remove

1. Release switch pack from louvre panel.



2. Disconnect 3 multiplugs from switch pack.
3. Remove switch pack.

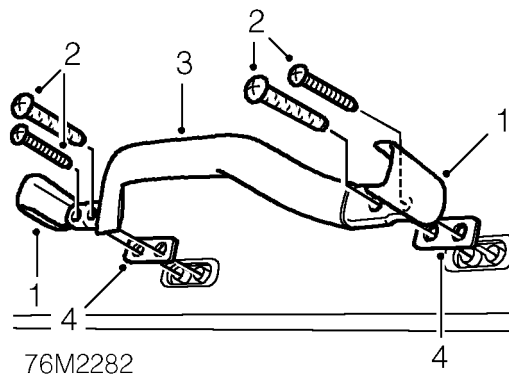
### Refit

4. Position switch pack.
5. Connect multiplugs to switch pack.
6. Secure switch pack to louvre panel.

## GRAB HANDLE

Service repair no - 76.58.30

### Remove



1. Release 2 grab handle retaining screw covers.
2. Remove 4 screws securing grab handle to body.
3. Remove grab handle.
4. Collect 2 washers.

### Refit

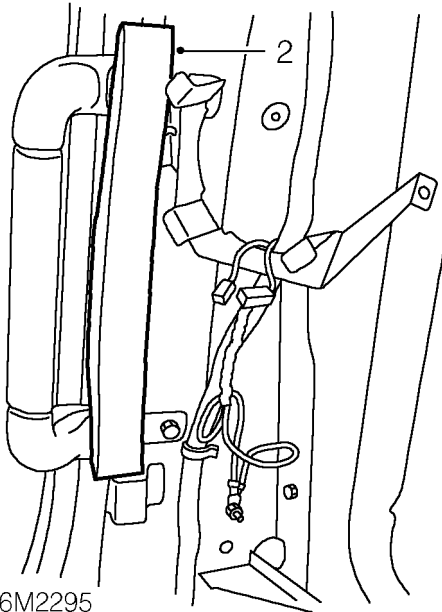
5. Position grab handle and washers.
6. Fit and tighten screws securing grab handle to body.
7. Secure grab handle retaining screw covers.

### GRAB HANDLE - TAIL DOOR - WITH REAR AIR CONDITIONING FITTED

Service repair no - 76.58.35/20

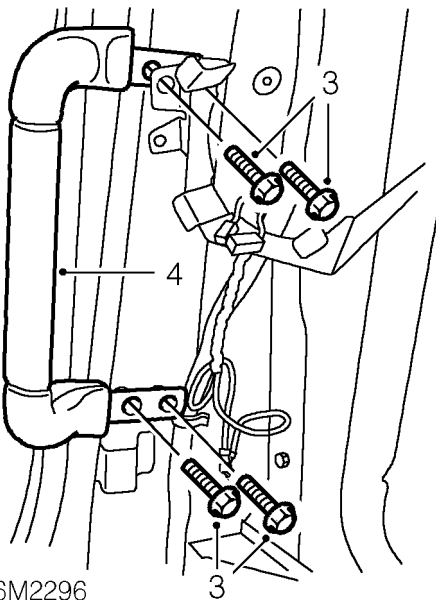
#### Remove

1. Remove 'E' post trim casing. *See 'E' post trim casing - lh - with rear air conditioning fitted.*



76M2295

2. Release foam strip from around grab handle retaining bolts.



76M2296

3. Remove 4 bolts securing grab handle to body.
4. Remove grab handle.

#### Refit

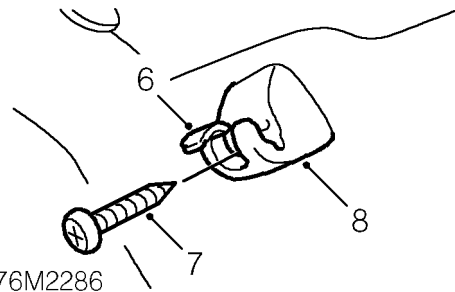
5. Position grab handle, fit bolts and tighten to **10 Nm (7 lbf ft)**.
6. Secure foam strip to body.
7. Fit 'E' post trim casing. *See 'E' post trim casing - lh - with rear air conditioning fitted.*

### HEADLINING - WITH SUN ROOF AND REAR AIR CONDITIONING FITTED - 5 DOOR

Service repair no - 76.64.14/20

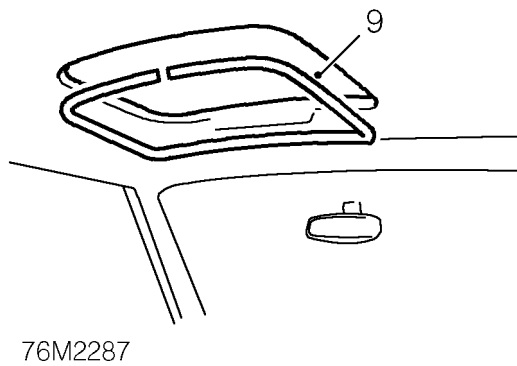
#### Remove

1. Remove both sun visors. *See sun visor.*
2. Remove 4 grab handles. *See grab handle.*
3. Remove front headlining stowage panel. *See headlining stowage panel - front - with sun roof fitted.*
4. Remove LH alpine light trim casing. *See alpine light trim casing - lh - with rear air conditioning fitted.*
5. Remove RH alpine light trim casing. *See alpine light trim casing.*

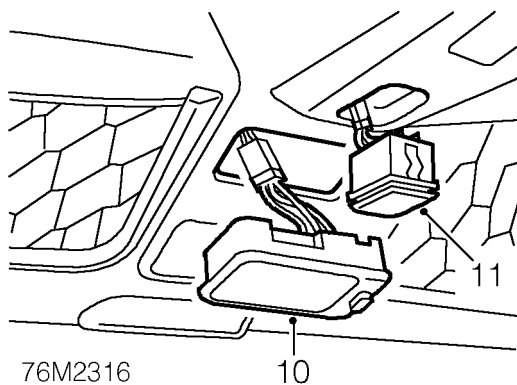


76M2286

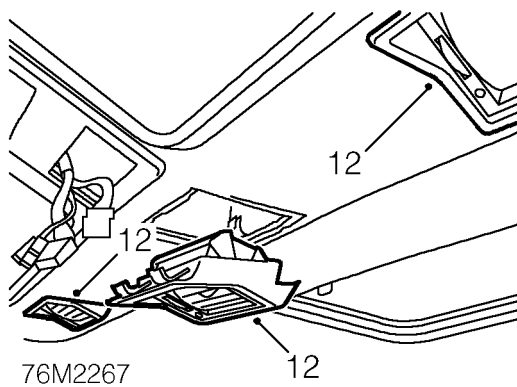
6. Release LH and RH sun visor clip retaining screw covers.
7. Remove LH and RH sun visor clip retaining screws.
8. Remove LH and RH clips.



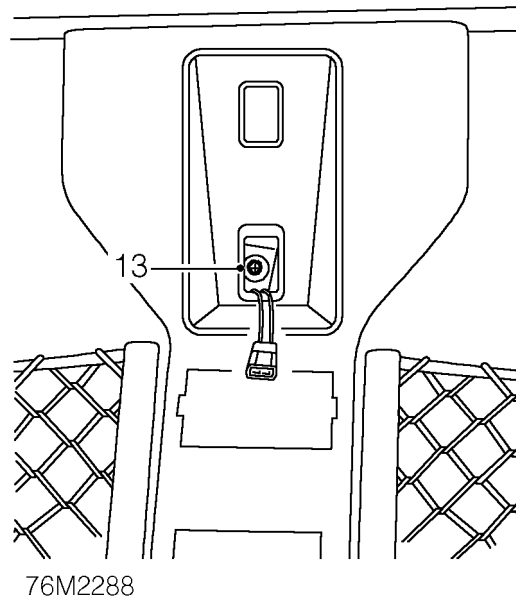
9. Remove front sun roof aperture seal.



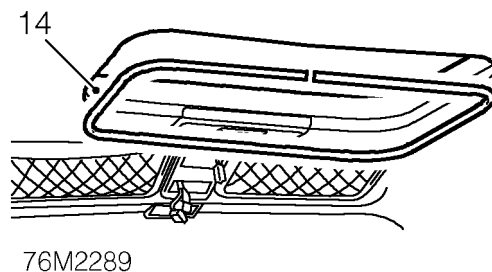
- 10. Release rear passenger interior lamp assembly from headlining panel, disconnect multiplug and remove lamp.
- 11. Release rear sun roof switch from headlining panel, disconnect multiplug and remove switch.



12. Remove 3 vents from headlining.

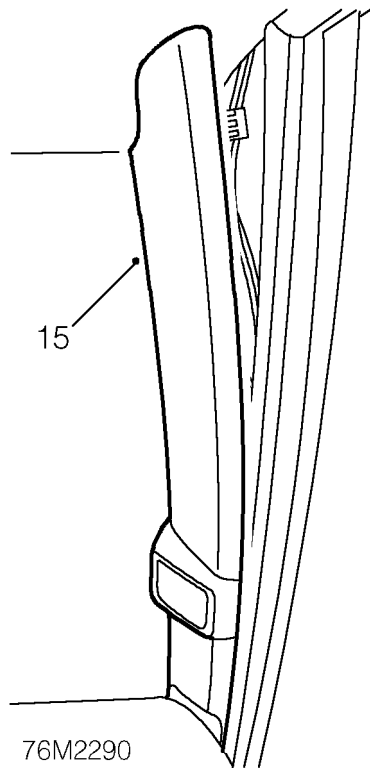


13. Working through sun roof switch housing, remove screw securing headlining panel to body.



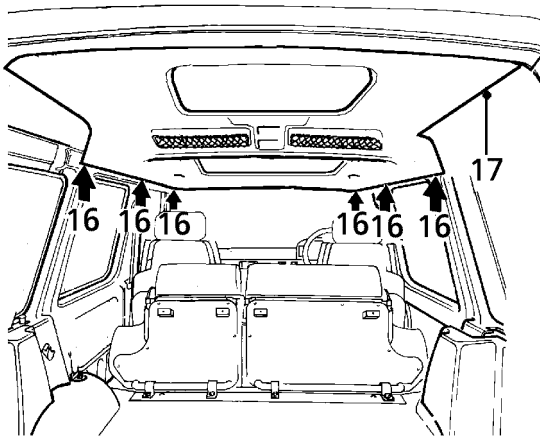
14. Remove rear sun roof aperture seal.





76M2290

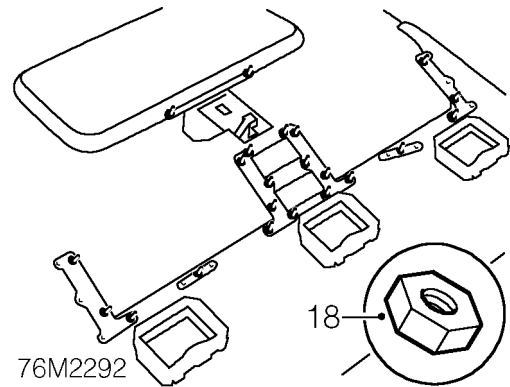
15. Release LH and RH, 'A' post trim finishers from uppermost retaining clips.



76M2291

16. With assistance, release headlining from LH and RH, 'A', 'B' and 'D' post finishers.  
17. Remove headlining assembly.

### Dismantle



18. Remove 22 nuts securing headlining stowage nets and rear headlining panel.  
19. Remove stowage nets and headlining panel.  
20. Collect 7 mounting plates.

### Rebuild

21. Position stowage nets and headlining panel, fit mounting plates to studs and secure with nuts.

### Refit

22. With assistance, fit headlining and position to LH and RH, 'A', 'B' and 'D' post finishers.  
23. Secure LH and RH, 'A' post trim finisher retaining clips.  
24. Fit rear sun roof aperture seal.  
25. Fit and tighten screw securing rear headlining panel to body.  
26. Position vents to headlining, attach clips to vents and secure to headlining.  
27. Position rear sun roof switch, connect multiplug and secure to headlining panel.  
28. Position rear passenger interior lamp, connect multiplug and secure to headlining panel.  
29. Fit front sun roof aperture seal.  
30. Fit LH and RH sun visor retaining clips to body.  
31. Fit and tighten screws securing sun visor retaining clips and secure screw covers.  
32. Fit RH alpine light trim casing. **See alpine light trim casing.**  
33. Fit LH alpine light trim casing. **See alpine light trim casing - lh - with rear air conditioning fitted.**  
34. Fit front headlining stowage panel. **See headlining stowage panel - front - with sun roof fitted.**  
35. Fit grab handles. **See grab handle.**  
36. Fit sun visors. **See sun visor.**

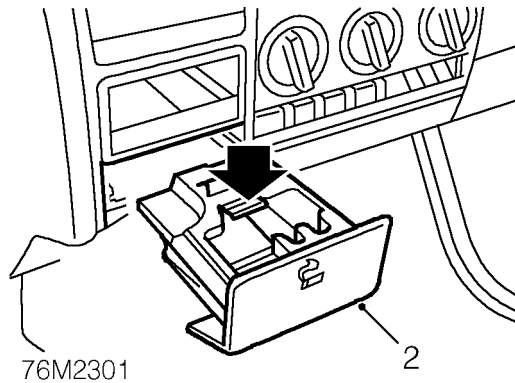


### ASH TRAY - DASH PANEL CENTRAL LOUVRE PANEL

Service repair no - 76.67.26

#### Remove

1. Open ash tray.



2. Press release catch and remove ash tray.

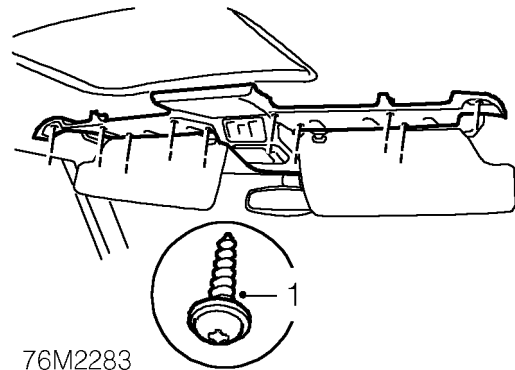
#### Refit

3. Fit ash tray.

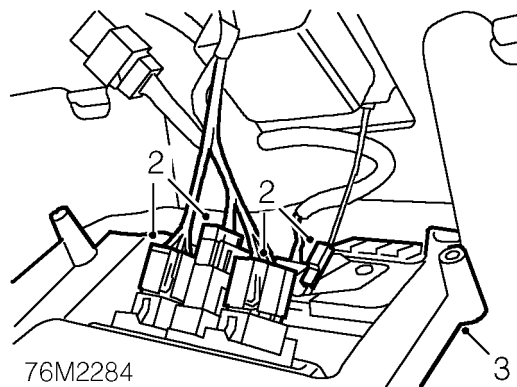
### HEADLINING STOWAGE PANEL - FRONT - WITH SUN ROOF FITTED

Service repair no - 76.67.27

#### Remove

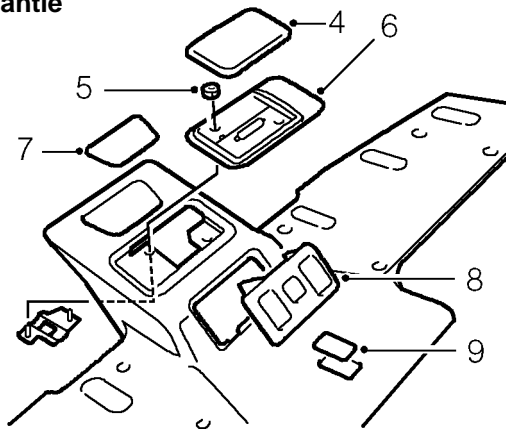


1. Remove 10 screws securing stowage panel to body.



2. Release panel and disconnect Lucar and 4 multiplugs.
3. Remove stowage panel assembly.

## Dismantle



76M2285

4. Remove interior lamp lens.
5. Remove 2 nuts securing lamp to stowage panel.
6. Remove lamp.
7. Remove alarm volumetric sensor/blanking plate.
8. Remove electric sun roof switch pack.
9. Remove electric sun roof manual opening plug.

## Rebuild

10. Fit electric sun roof manual opening plug to panel.
11. Fit alarm volumetric sensor.
12. Fit electric sun roof switch pack to panel.
13. Fit interior lamp to panel and secure with nuts.
14. Fit interior lamp lens.

## Refit

15. Position stowage panel assembly and connect Lucar and multiplugs.
16. Align panel to headlining and secure with screws.

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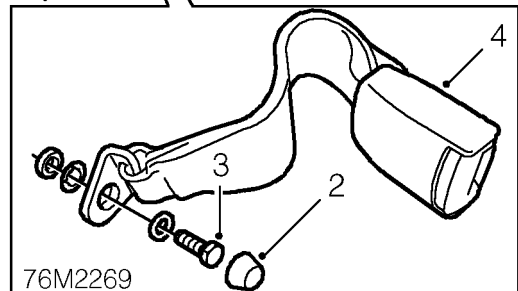
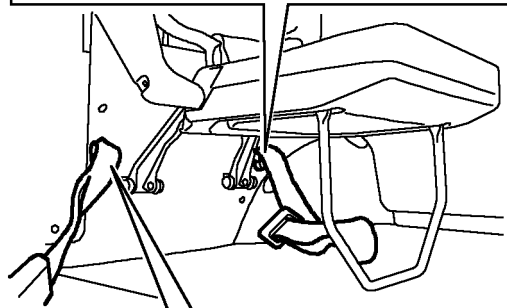
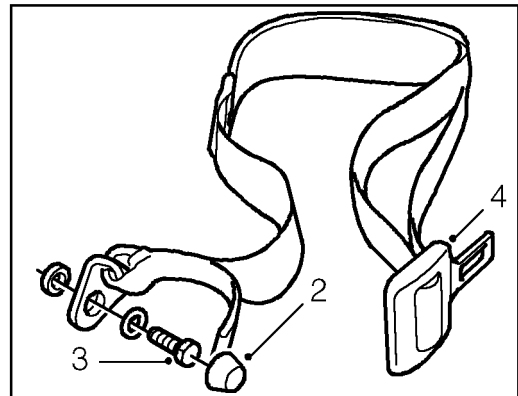
**REAR FOLD DOWN SEAT BELTS - LH WITH REAR AIR CONDITIONING FITTED**


---

Service repair no - 76.73.28/20

## Remove

1. Locate the seat in the down position, remove the seat belt strap and buckle from their stowed positions.



76M2269

2. Remove seat belt strap and buckle retaining bolt covers.
3. Remove bolts securing strap and buckle.
4. Remove seat belts and collect spacers.

## Refit

5. Fit spacers to seat belt retaining bolts, position to fixings and tighten to **32 Nm (24 lbf ft)**.
6. Fit seat belt retaining bolt covers.
7. Secure seat belt strap and buckle to their stowed positions and position seat in the up position.

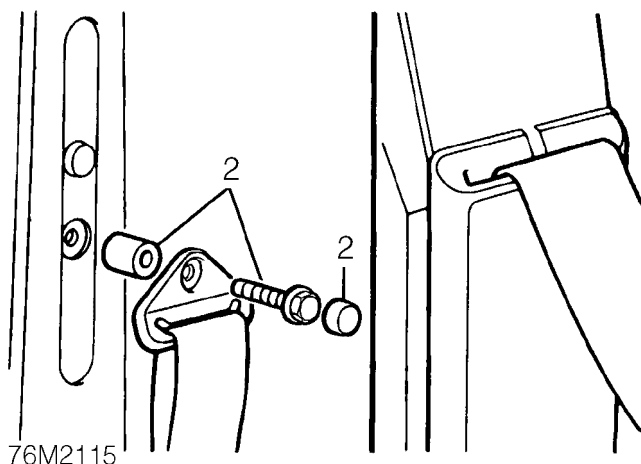


## FRONT SEAT BELTS - 5 DOOR (96 MODELS)

Service repair no - 76.73.10

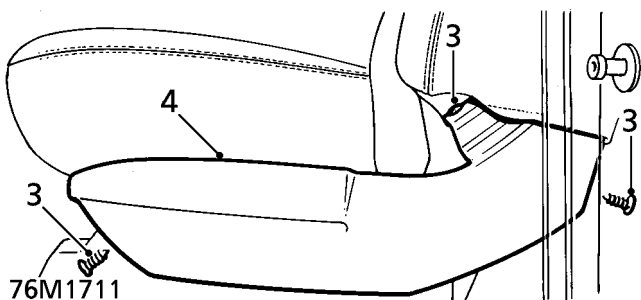
### Remove

1. Move the seat to gain access to the seat belt mountings.



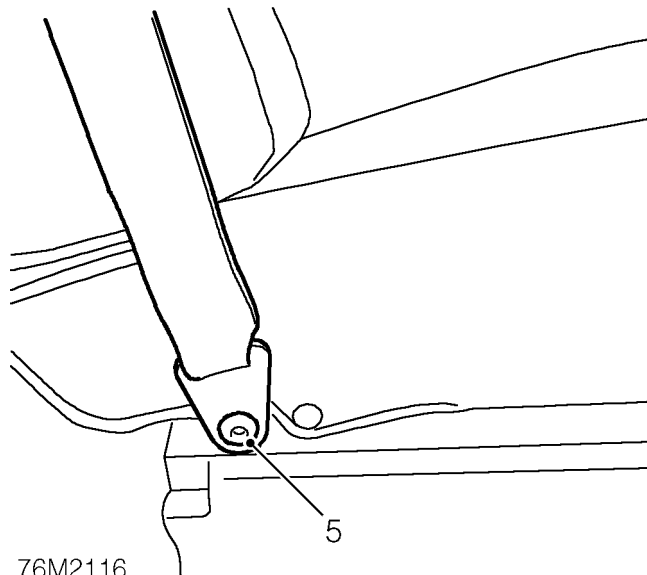
76M2115

2. Remove the cover and securing bolt to release the upper mounting and spacer from the 'B' post adjustable mounting.



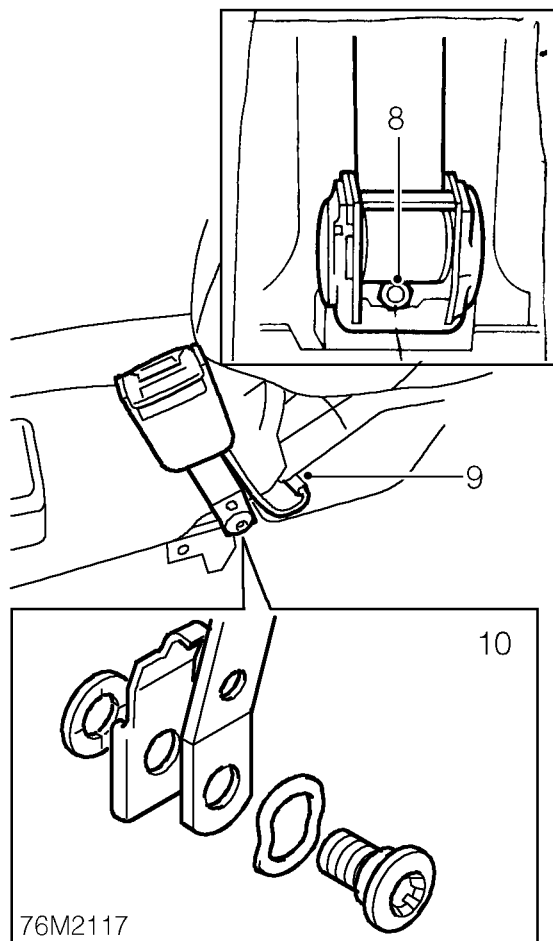
76M1711

3. **Electric seats only:** Release fixings securing the seat side valance.
4. Remove the side valance.



76M2116

5. Remove the Torx bolt securing the lower mounting to the seat.
6. Detach the door seals from the 'B' post sufficiently to allow removal of the lower trim panel from the post.
7. Release the seat belt from the split section at the top of the trim panel and withdraw the panel.



8. Remove the securing bolt and detach the inertia reel from the 'B' post.

9. Release the seat belt sensor connector (if fitted).
10. Release Torx bolt to allow removal of the seat belt stalk assembly.

#### Refit

11. Reverse removal procedure.



**NOTE: Ensure the seat belt is not twisted.**

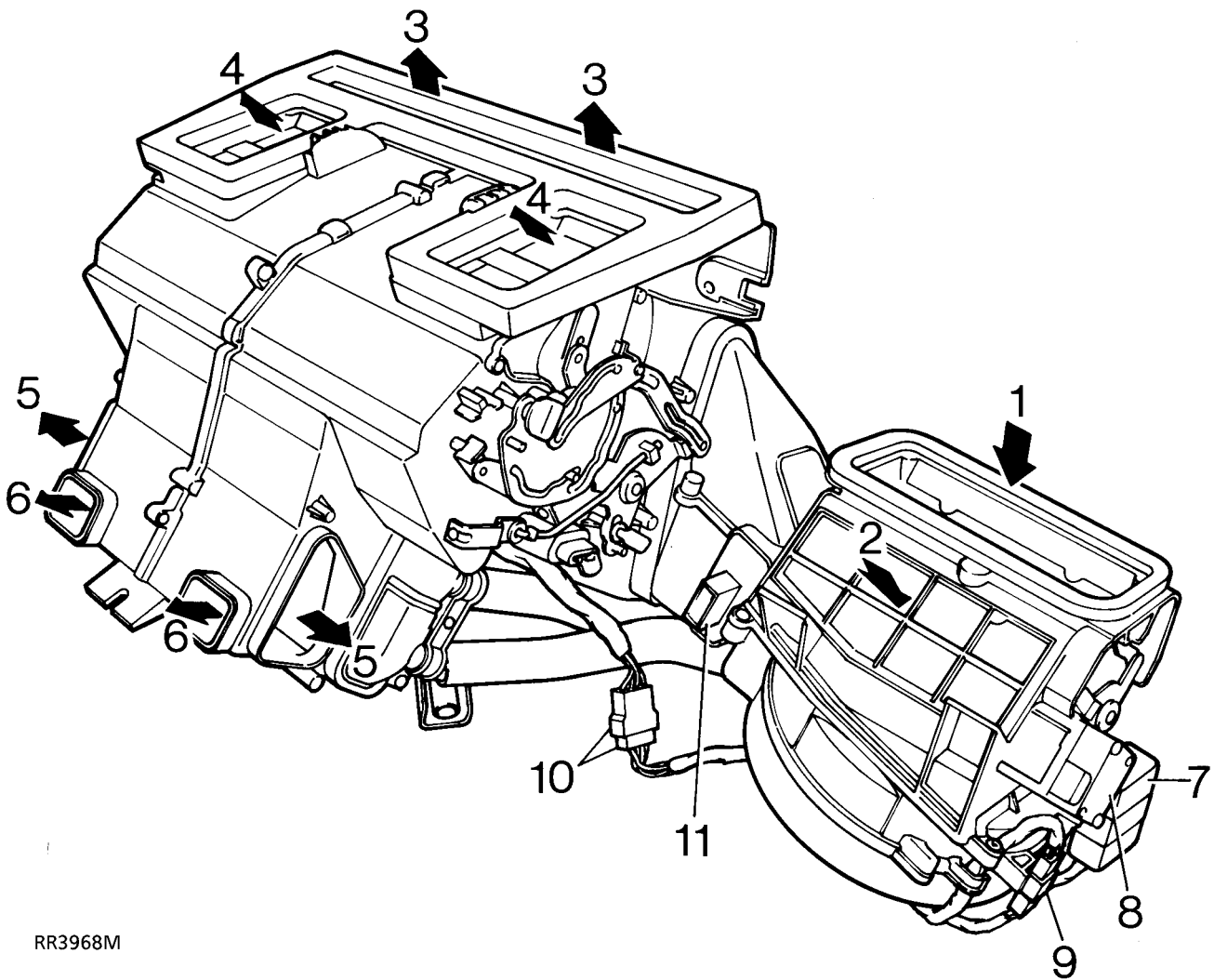
12. Re-connect the seat belt sensor connector (if fitted).
13. Finally, tighten the seat belt fixings to **32 Nm (24 lbf ft)**.



## HEATING AND VENTILATION UNIT

The heating and ventilation and blower units are standard on all models. Air conditioning system is an optional module, which when fitted provides fully integrated climate control for the vehicle interior.

The heating and ventilation unit controls the air distribution and heating to the vehicle interior. The blower unit controls the volume of air supplied, while the air conditioning module (when fitted) provides refrigerated and dehumidified air.



RR3968M

- |                                  |  |
|----------------------------------|--|
| 1. Fresh air inlet               | 7. Fresh/recirculation air flap servo          |
| 2. Recirculation air inlet       | 8. Blower motor relay                          |
| 3. Air outlets screen de-mist    | 9. Multiplug connector to main harness         |
| 4. Air outlet face level vents   | 10. Multiplug connector, blower to heater unit |
| 5. Air outlets front footwells   | 11. Resistor unit - blower speed.              |
| 6. Air outlets to rear footwells |  |

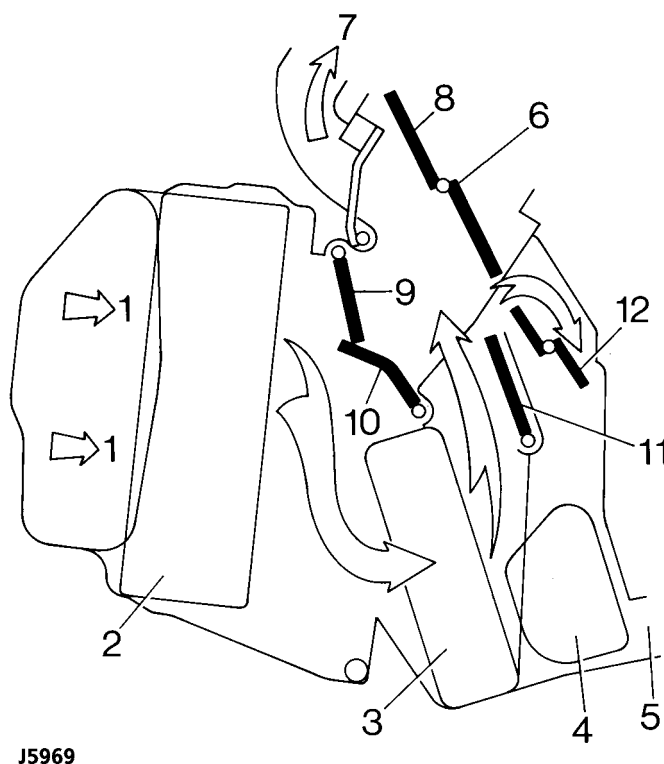
### Through-flow ventilation

Through-flow ventilation is achieved by means of one-way air extraction vents incorporated in both rear quarter body panels. The vents open and close automatically dependent upon the heating and ventilation unit control settings and the volume of air entering the vehicle.

### Heating and ventilation unit, controls

The Heating and Ventilation Unit is centrally located and concealed by the dash assembly. When air conditioning is fitted, an evaporator is mounted in the heater unit forward of the heater matrix.

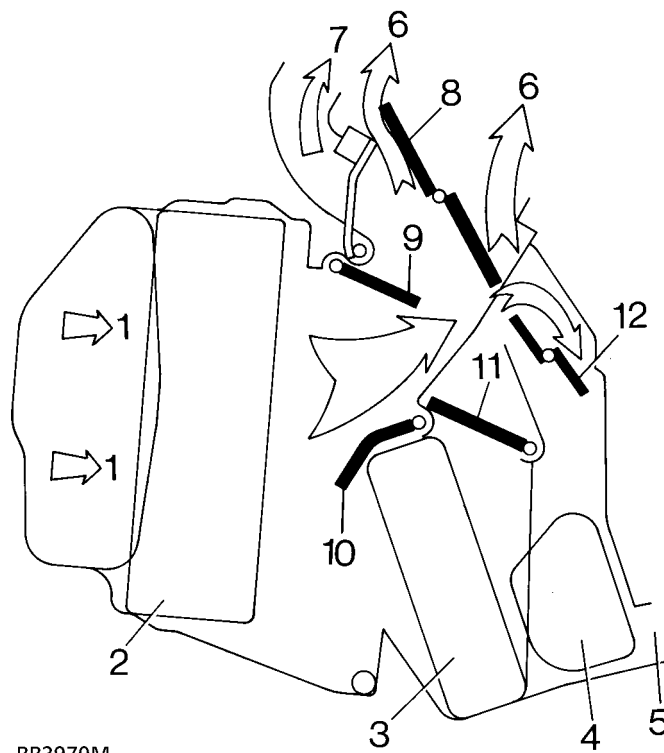
The dash mounted central controls are used to operate both systems. A single switch controls the air conditioning unit when fitted.



### Controls set for maximum heat to footwells and face level vents

#### Heating and ventilation flaps and air flow key

- |   |                                    |
|---|------------------------------------|
| 1. Fresh or recirculated air from blower unit         | 7. Air outlets screen de-mist      |
| 2. Evaporator matrix - air conditioning (when fitted) | 8. Control flap - face level vents |
| 3. Heater matrix                                      | 9. Control flap - demist vents     |
| 4. Air outlet front footwells                         | 10. Control flap - air direction   |
| 5. Air outlet to rear footwells                       | 11. Control flap - air temperature |
| 6. Air outlet face level vents                        | 12. Control flap - air direction   |



### Controls set for unheated air to footwells and face level vents

#### Heater and ventilation operation

The heating and ventilation system contains a heater matrix, which is connected to the engine cooling system, and a 4 speed fan for air distribution. Engine coolant is circulated through the heater matrix continuously, except when the temperature controls are set to COLD.

#### Recirculated air

When the recirculation switch is pressed, an electrical servo operates and fully closes the fresh air intake flap.

#### Fresh air

When the recirculation switch is returned to the OFF position, the electrical servo returns and fully opens the fresh air intake flap.

#### Heated air

Temperature output is controlled by the temperature controls which move the air direction and temperature flaps independently to increase or decrease the volume of air flow through the heater matrix.

**V8 Engine:** When both controls are in the cold position, the coolant valve is turned off.

#### Face level vent flap

Control at face level, flap fully open. All other vents closed.

Control at face and foot level, flaps half open.

Unless an air conditioning unit is fitted, only fresh or re-circulated air is available from the face level vents.

#### Demist vent flap

Control at demist, flap fully open. All other vents closed.

Control at demist and foot level, flaps half open.



**Air direction flap**

Flap moves across mixing chamber to direct the air flow away from the heater matrix.

**Air temperature flap**

Control at HOT, flaps fully closed. All air flow passes through heater matrix. As control is moved towards COLD the flaps progressively open directing air flow away from the heater matrix.

Control at COLD, flaps fully open.

**V8 Engine:** When both controls are at COLD, 2 micro-switches are closed and operate a vacuum valve which closes the coolant valve.

**Air conditioning**

When an air conditioning unit is fitted, the mechanical operation of the heater controls remains unaltered. However the air conditioning evaporator is positioned in front of the mixing chamber through which all air flow passes.



---

**HEATER OUTPUT**

---

**Symptom:-****Heater emits cold air.**

1. Engine running: Check coolant valve opens as a temperature control is moved from COLD.
2. Check for engine running cold. **See COOLING SYSTEM, Fault diagnosis, Engine Runs Cold**
3. Check heater pipes and hoses for blockage or restriction.
4. Check heater matrix for blockage or restriction, flush system.

**Heater emits warm air.**

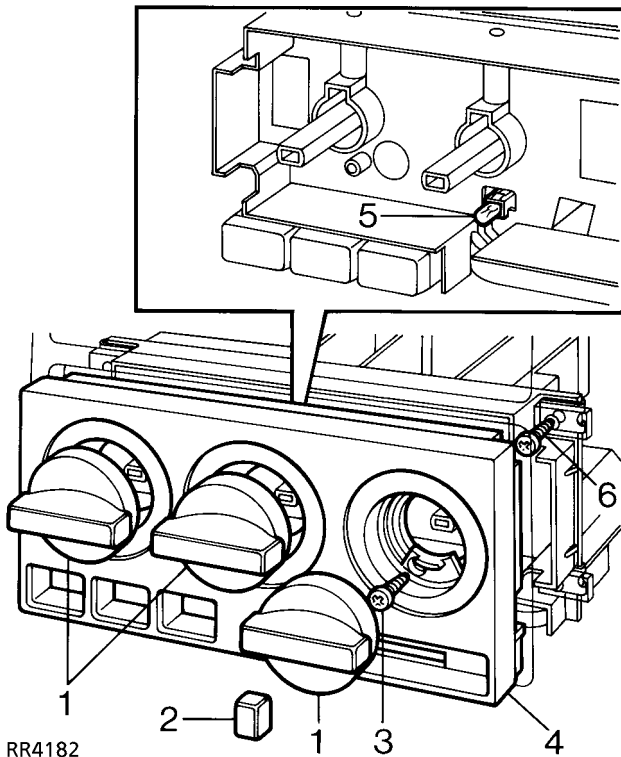
5. **Engine running:** Check coolant valve closes when both temperature controls are moved to COLD.



## HEATER BLOWER SWITCH AND ILLUMINATION BULB

Service repair no - 80.10.22 - Switch  
Service repair no - 86.48.73 - Bulb

### Remove



RR4182

1. Pull 3 knobs from rotary controls.
2. Pull knob from blower switch.
3. Remove 2 screws retaining graphics panel.
4. Remove graphics plate.
5. Remove capless bulb.
6. Remove 4 screws retaining switch.
7. Remove switch panel. Use plastic tube to assist removal.

### Blower switch

8. Pull blower switch from rear of panel.
9. Disconnect multiplug and remove blower switch.

### Refit

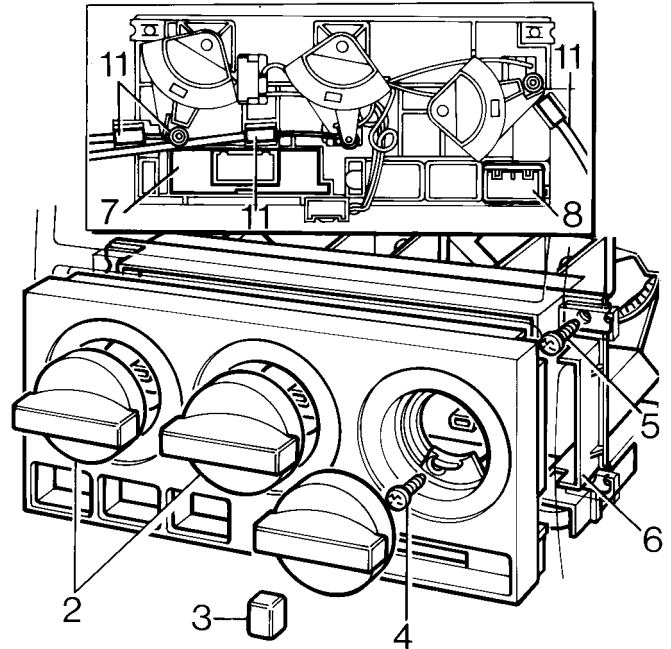
10. Reverse removal procedure.

## HEATER CONTROL UNIT

Service repair no - 80.10.42.

### Remove

1. Disconnect battery negative lead.



RR3971M

2. Pull 3 knobs from rotary controls.
3. Pull knob from blower switch.
4. Remove 2 retaining screws and remove graphics panel.
5. Remove 4 screws retaining switch.
6. Remove switch panel.
7. Release fascia centre louvre vent panel from its fitted position to gain access to rear of panel.  
**See CHASSIS AND BODY, Repair, Dash Panel Central Louvre Panel**

8. Disconnect 4 multiplugs and position harness aside.



**NOTE:** *Do not carry out further dismantling if component is removed for access only.*

9. **Fan speed switch:** remove fan speed switch slide and push out fan speed switch.
10. Pull out light bulb disconnect terminals and remove fan speed light strip.
11. Unclip 3 heater control cables from control unit.
12. **Microswitch:** Unclip 3 micro switches.
13. Cut cable tie and release wiring harness from control unit.
14. Remove heater control unit.

#### Refit

15. Reverse removal procedure. Check the satisfactory function of the controls before fitting louvre vent panel.

#### CONTROL CABLES

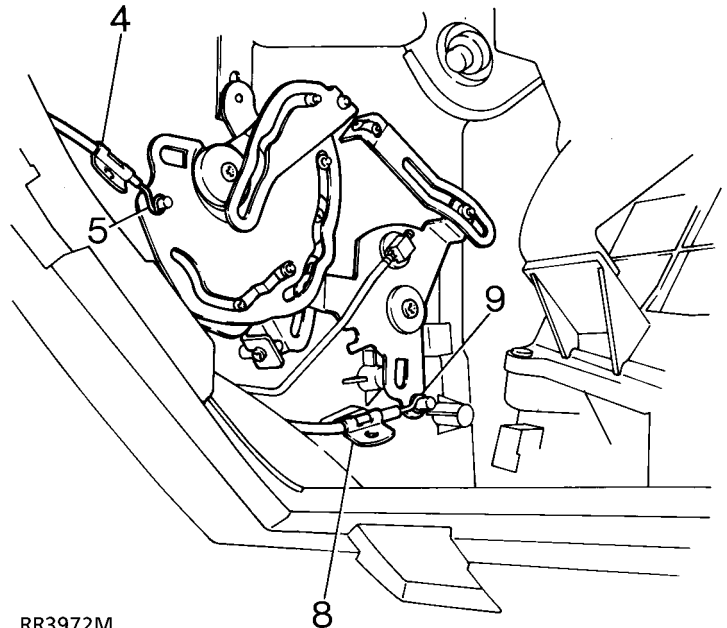
Service repair no - 80.10.06 - Air flow

Service repair no - 80.10.25 - Temperature control RH

Service repair no - 80.10.26 - Temperature control LH

#### Remove

1. Release fascia centre louvre vent panel from its fitted position to gain access to rear of panel.  
**See CHASSIS AND BODY, Repair, Dash Panel Central Louvre Panel**
2. Open glove box, manoeuvre side springs through cut-outs and lower lid.

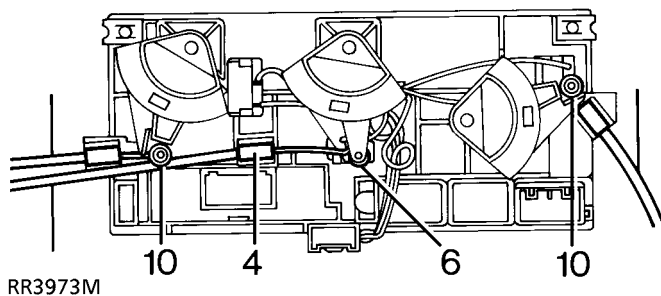


RR3972M



### Air direction

3. Set control fully clockwise
4. Release outer cable from 2 clips on unit.
5. Release cable from stud on flap lever.
6. Remove control cable from control lever.



RR3973M

### Temperature

7. Set RH control fully clockwise, LH control fully anti-clockwise
8. Release outer cable from 2 clips on unit.
9. Release cable from stud on flap lever.
10. Remove control cable from control lever.

### Refit

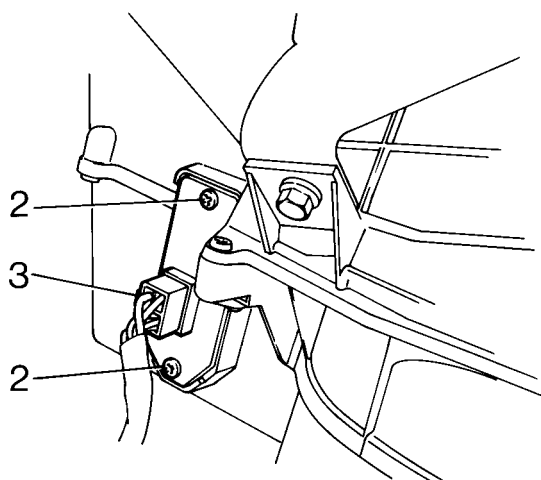
11. Reverse removal procedure. Check the satisfactory function of the controls before fitting louvre vent panel.

### RESISTOR UNIT

Service repair no - 80.20.17

### Remove

1. Open glove box, manoeuvre side springs through cut-outs and lower lid.



RR3974M

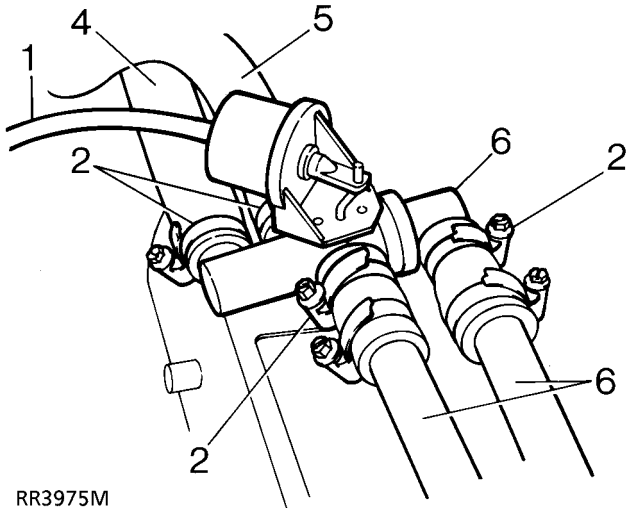
2. Remove 2 screws securing resistor unit to trunking.
3. Disconnect multiplug and remove resistor unit.

### Refit

4. Reverse removal procedure.

**WATER VALVE**

Service repair no - 80.10.16

**Remove**

RR3975M

1. Disconnect vacuum pipe from water valve.
2. Slacken 4 clips securing hoses to water valve.
3. Use a thin blade to break seal between hoses and nozzles
4. Disconnect heater inlet hose from valve.



**NOTE: A quantity of coolant will be released.**

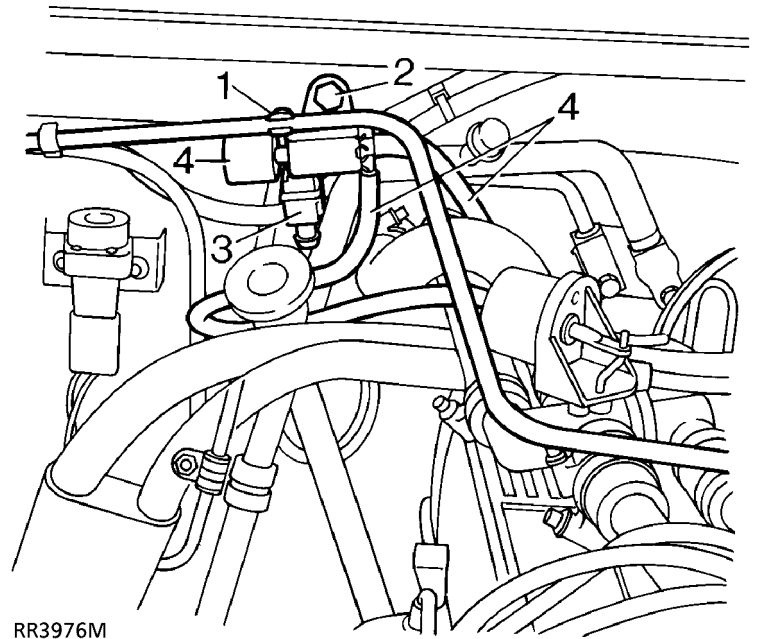
5. Disconnect heater outlet hose from valve.
6. Lever valve from coolant pipe hoses.

**Refit**

7. Reverse removal procedure. Lightly lubricate water valve nozzles with petroleum jelly.
8. Reverse removal procedure. Top-up engine coolant

**VACUUM SWITCH - WATER VALVE**

Service repair no - 80.10.36

**Remove**

RR3976M

1. Release emission pipe from retaining clip.
2. Remove bolt securing switch to bulkhead.
3. Disconnect multiplug from switch.
4. Disconnect 2 vacuum pipes and remove vacuum switch.

**Refit**

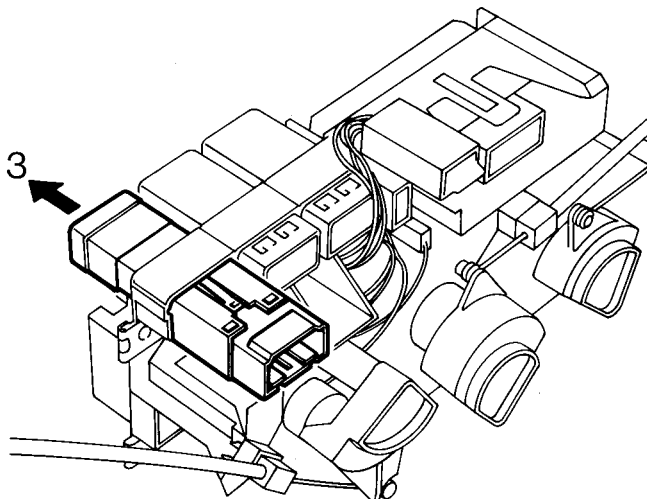
5. Reverse removal procedure.



### RECIRCULATION SWITCH

Service repair no - 80.10.27

#### Remove



RR3977M

1. Release fascia centre louvre vent panel from its fitted position to gain access to rear of panel.  
**See CHASSIS AND BODY, Repair, Dash Panel Central Louvre Panel**
2. Disconnect multiplug from switch
3. From the rear, push switch out of panel.

#### Refit

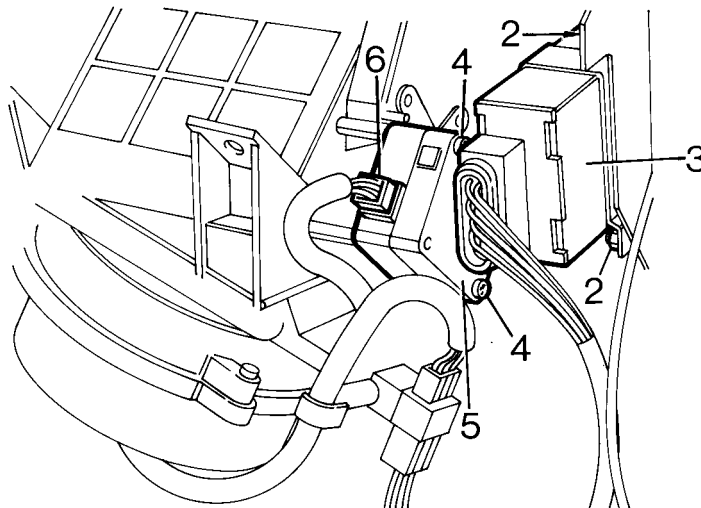
4. Reverse removal procedure.

### RECIRCULATION FLAP SOLENOID

Service repair no - 80.10.43

#### Remove

1. Open glove box, manoeuvre side springs through cut-outs and lower lid.



RR3978M

2. Remove 2 locknuts securing cruise control ECU to bracket.
3. Position cruise control ECU aside.
4. Remove 2 screws securing recirculation solenoid to casing.
5. Release solenoid from lever.
6. Disconnect multiplug and remove solenoid.

#### Refit

7. Reverse removal procedure.

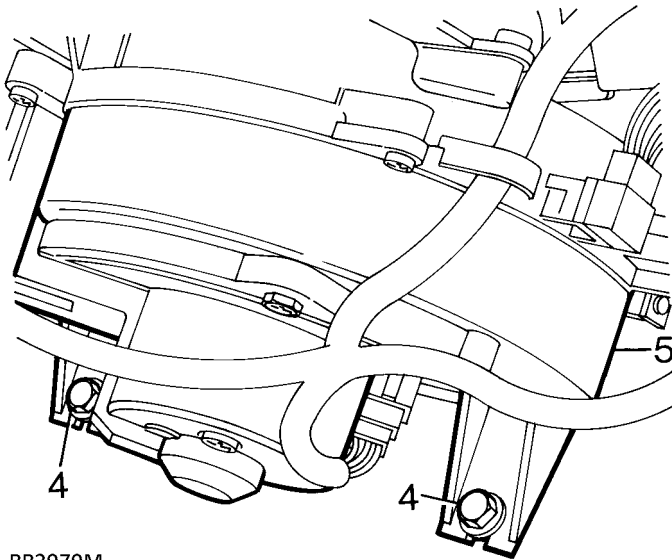
**BLOWER MOTOR UNIT - HEATER AND AIR CONDITIONING**

Service repair no - 80.20.17

Service repair no - 82.25.54.

**Remove**

1. Move seats to rear most position.
2. Disconnect battery negative lead.
3. Remove fascia panel assembly. **See CHASSIS AND BODY, Repair, Dash Panel Assembly**



RR3979M

4. Remove 2 nuts securing lower brackets to toeboard.
5. Manoeuvre blower unit from heater unit and remove.

**Refit**

6. Reverse removal procedure. Ensure seal between blower and heater unit is tight.

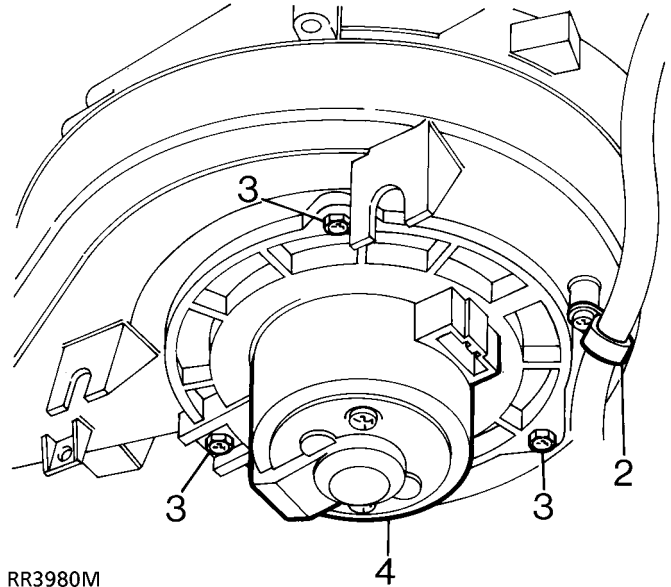
**BLOWER MOTOR**

Service repair no - 80.20.17

Service repair no - 82.25.33.

**Remove**

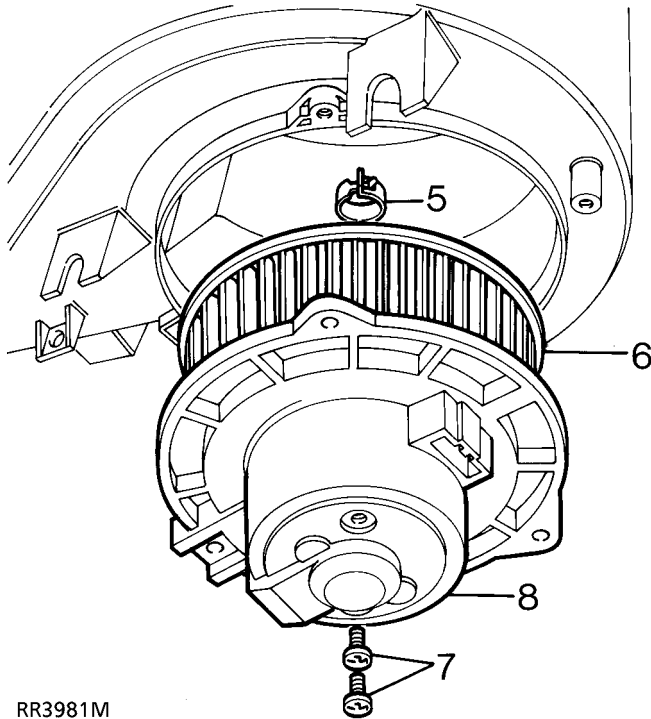
1. Remove blower motor unit. **See Blower Motor Unit - Heater and Air Conditioning**



RR3980M

2. Release wiring harness retaining clip.
3. Remove 3 screws securing casing.
4. Remove blower motor assembly.





RR3981M

5. Remove fan retaining clip.
6. Remove fan.
7. Remove 2 screws securing motor to casing.
8. Remove blower motor.

**Refit**

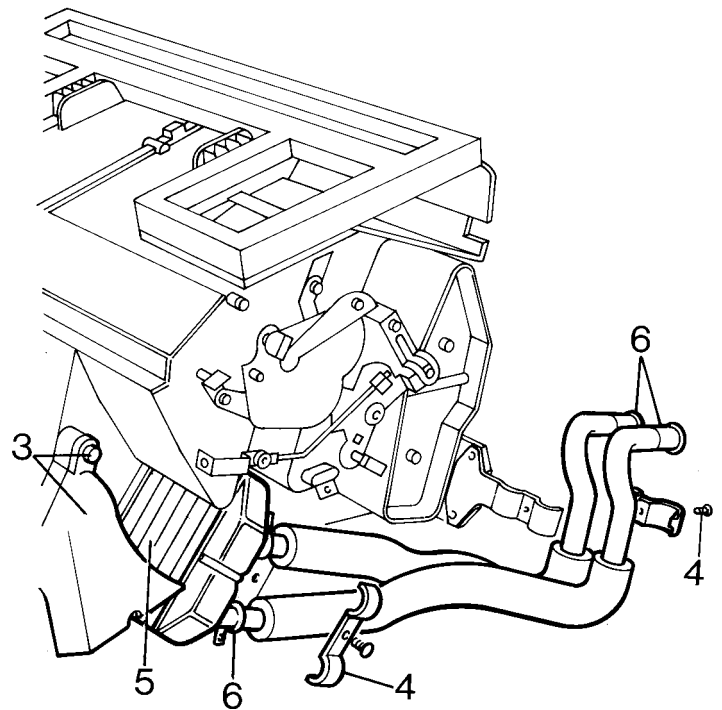
9. Reverse removal procedure.

**HEATER MATRIX**

Service repair no - 80.20.29

**Remove**

1. Remove heater unit. *See AIR CONDITIONING, Repair, Heater and Cooler Unit*
2. Remove evaporator. *See AIR CONDITIONING, Repair, Evaporator and Expansion Valve*



RR3982M

3. Remove 2 screws and remove RH side footwell outlet.
4. Remove heater pipe clips.
5. Slide heater matrix from casing.
6. Release 2 clips and remove 2 heater pipes from matrix.

**Refit**

7. Reverse removal procedure.



**TORQUE VALUES**



**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

Nm

**METRIC**

M5 .....	6
M6 .....	9
M8 .....	25
M10 .....	45
M12 .....	90
M14 .....	105
M16 .....	180

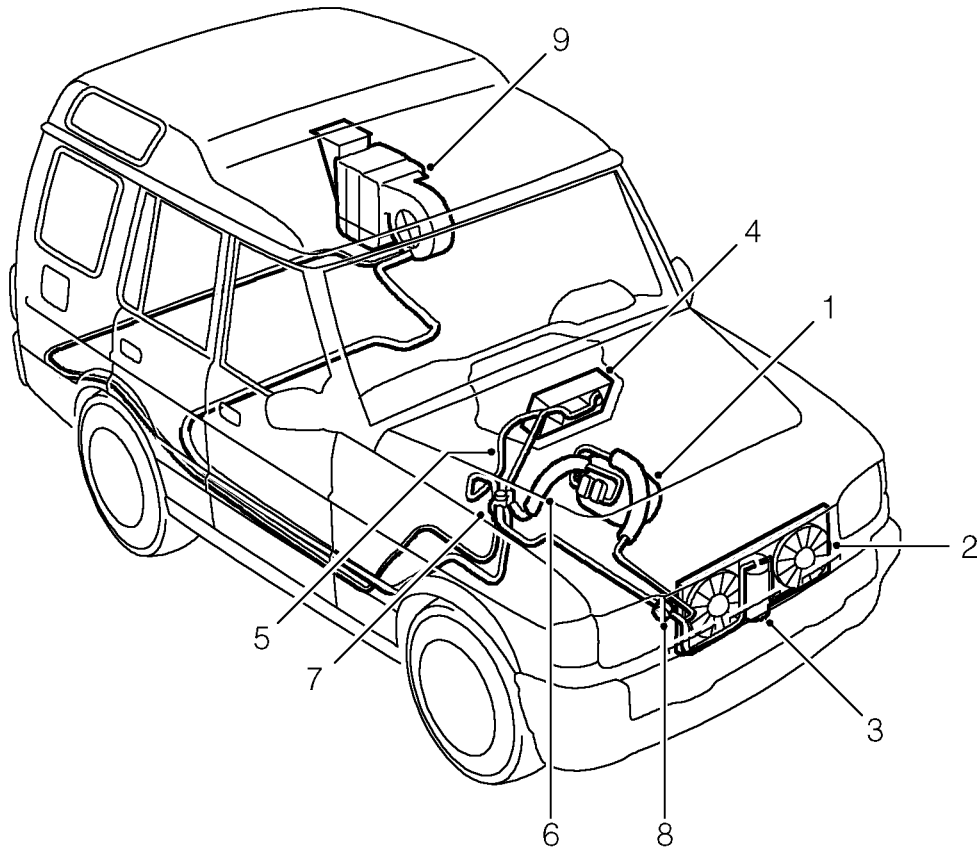
**UNC / UNF**

1/4 .....	9
5/16 .....	24
3/8 .....	39
7/16 .....	78
1/2 .....	90
5/8 .....	136

Torque values above apply to all screws and bolts used unless otherwise specified.

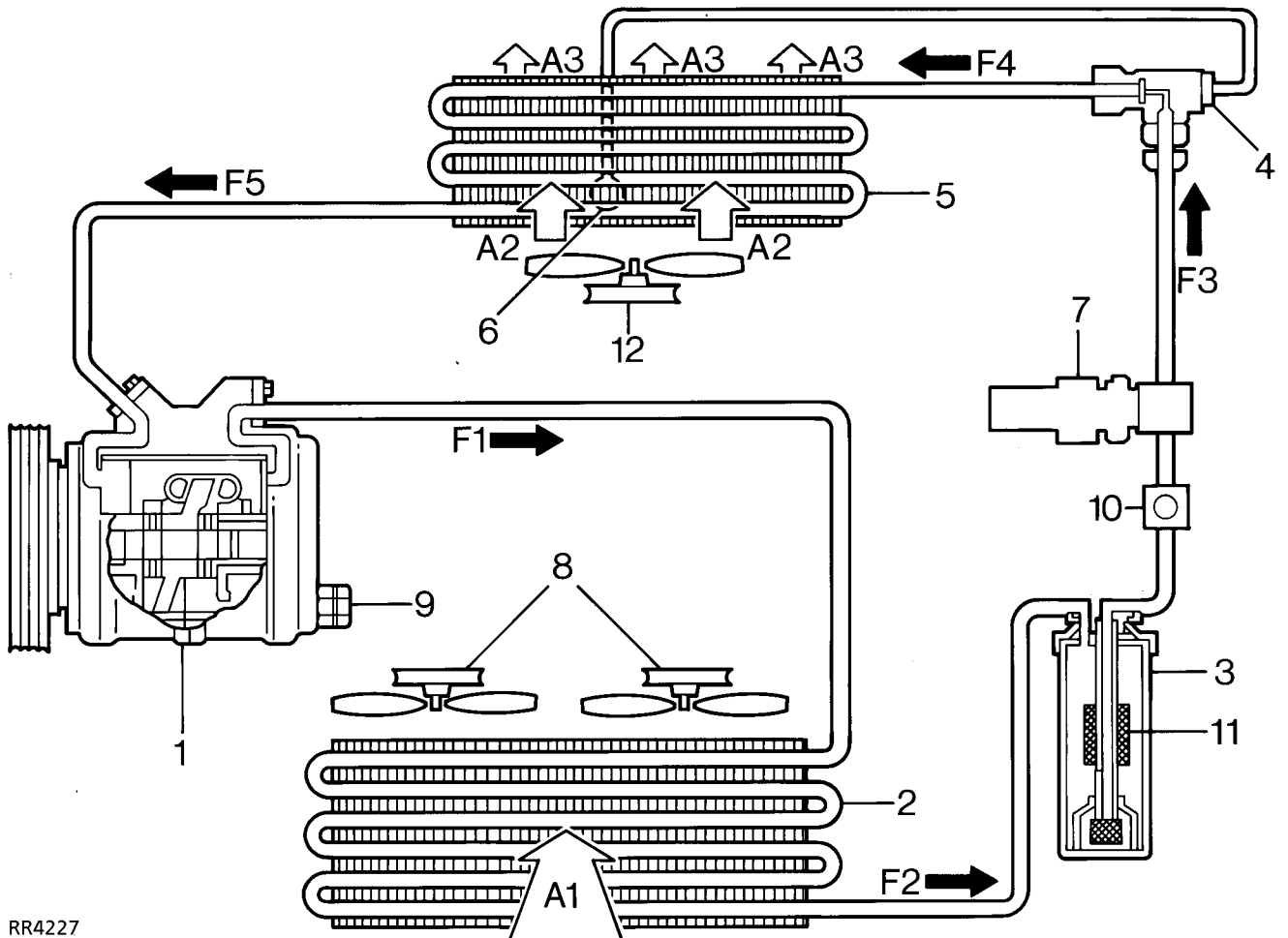


**AIR CONDITIONING SYSTEM COMPONENTS**



82M0416

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>1. Compressor</li> <li>2. Condenser</li> <li>3. Receiver/drier</li> <li>4. Evaporator</li> <li>5. High pressure servicing connection</li> </ul> | <ul style="list-style-type: none"> <li>6. Low pressure servicing connection</li> <li>7. Dual pressure switch</li> <li>8. Sight glass</li> <li>9. Rear evaporator/blower motor assembly</li> </ul> |
|--|---|

**SCHEMATIC LAYOUT OF THE AIR CONDITIONING SYSTEM**


RR4227

- |  |   |
|--|---|
| 1. Compressor                            | A1 Ambient air flow through condenser   |
| 2. Condenser                             | A2 Ambient air flow through fan and evaporator  |
| 3. Receiver/drier                        | A3 Cooled air flow to vehicle interior  |
| 4. Thermostatic expansion valve          | F1 High pressure high temperature refrigerant vapour  |
| 5. Evaporator                            | F2 High pressure slightly subcooled refrigerant liquid  |
| 6. Capillary tube                        | F3 High pressure slightly subcooled refrigerant liquid with moisture, vapour bubbles and foreign matter removed |
| 7. Dual pressure switch                  | F4 Low pressure low temperature mixed liquid and vapour   |
| 8. Cooling fans to maintain air flow     | F5 Low pressure slightly super heated refrigerant vapour  |
| 9. Compressor high pressure relief valve |   |
| 10. Sight glass - refrigerant            |   |
| 11. Drying agent - receiver/drier        |   |
| 12. Blower motor                         |   |



## AIR CONDITIONING SYSTEM OPERATION

The air conditioning system provides the means of supplying cooled and dehumidified, fresh or recirculated air to the interior of the vehicle. The cooling effect is obtained by blowing air through the matrix of an evaporator unit and when required, mixing that air with heated air by means of the heater distribution and blend unit, to provide the conditions required inside the vehicle. The volume of conditioned air being supplied is controlled by a variable speed blower.

A sealed system, charged with Refrigerant R134a, together with a blower unit, blend unit and control system combine to achieve the cooled air condition.

For air conditioning air distribution system. **See HEATING AND VENTILATION, Description and operation, Heating and ventilation unit**

The air conditioning system comprises five major units:

1. An engine-mounted compressor.
2. A condenser mounted in front of the radiator.
3. A receiver/drier unit located in front of the condenser.
4. Thermostatic expansion valve mounted above the evaporator.
5. An evaporator unit mounted in front of the heater matrix.



**NOTE: Vehicles fitted with rear air conditioning have an additional evaporator/blower motor assembly located behind the LH rear compartment lower trim panel.**

These units are interconnected by hoses and pipes carrying Refrigerant R134a, the evaporator is linked into the vehicle ventilation system.

### Refrigeration cycle

#### 1. Compressor

The compressor (1), belt driven from the crankshaft pulley, pressurises and circulates the refrigerant through the system. Mounted on the compressor, an electro-mechanical clutch maintains the correct temperature and pressure by engaging or disengaging to support the system's requirements. The clutch action is normally controlled by a thermostat located at the evaporator (5). The compressor is of the swashplate type having fixed displacement.

Should the temperature at the evaporator (5) fall low enough for ice to begin to form on the fins, the thermostat disengages the clutch and also isolates the cooling fans relays. When the temperature at the evaporator (5) rises to the control temperature, the clutch is re-engaged.

Should the system pressure become excessive or drop sufficiently to cause damage to the compressor (1) a dual pressure switch (7), located in the high pressure line, signals the relay unit to disengage the clutch. The compressor also has an emergency high pressure relief valve (9) fitted.

The cooling fans are controlled by engine temperature when the air conditioning is not switched on.

#### 2. Condenser

From the compressor, hot high pressure vaporised refrigerant (F1) passes to the condenser (2), which is mounted in front of the engine coolant radiator. Ram air(A1) passing through the condenser (2), supplemented by 2 cooling fans (8) mounted in front of the condenser, cools the refrigerant vapour sufficiently to form a high pressure slightly subcooled liquid (F2).

#### 3. Receiver/drier

This liquid then passes to a receiver/drier (3) which fulfils two functions. It acts as a reservoir and moisture extractor (11).

A sight glass (10), in the high pressure line, provides a method of determining the state of the refrigerant without breaking into the system.

#### 4. Expansion valve

From the receiver/drier (3) the moisture free high pressure liquid refrigerant (F3) passes through a thermostatic expansion valve (4). A severe pressure drop occurs across the valve and as the refrigerant enters the evaporator space at a temperature of approximately -5°C it boils and vaporises.

## 5. Evaporator

As this change of state occurs, a large amount of latent heat is absorbed. The evaporator is therefore cooled and as a result heat is extracted from the air flowing across the evaporator. The air flow is controlled by the ventilation fan which can be operated at anyone of four speeds.

To prevent liquid passing through to the compressor, a capillary tube (6), attached to the outlet pipe of the evaporator (5) and connected to the thermostatic expansion valve (4), controls the amount that the valve opens and closes in relation to the temperature of the low pressure high temperature refrigerant vapour (F4) at the outlet. The atomised refrigerant then passes through the evaporator (5). Fan blown air (A2) passes through the matrix (A3) of the evaporator and is cooled by absorption due to the low temperature refrigerant passing through the evaporator.

A thermostat is fitted in the airflow out of the evaporator to sense the temperature of the exterior fins. Should ice begin to form, due to a too cold condition, it will signal to disengage the electro-mechanical clutch on the compressor (1).

From the evaporator, low pressure slightly superheated refrigerant (F5) passes to the compressor to complete the cycle.

## AIR CONDITIONING CONTROL SYSTEM

The air conditioning control system comprises relays, thermostat, pressure switches, and a control panel. Inputs from outside the air conditioning system comprise temperature information from the engine cooling system. Together these controls, in conjunction with the cooling fans, compressor clutch, blower and heater distribution and blend unit enable minimal input to maintain the required environment inside the vehicle.

When air conditioning is not selected, air is supplied by ram effect or blower to the areas selected by the controls. The air mix flap on the blend unit controls the temperature of the air being supplied. No cooled air is available.

Selecting air conditioning provides the added facility of cooled air available to be mixed as before. When required a fully cold condition can be selected by turning the temperature controls to cold, which automatically closes the heated coolant access to the heater matrix. Mixtures of cooled, fresh, and hot air can be selected to give required interior environmental conditions by selection at the control panel.

### Dual pressure switch

This switch, located in the high pressure line between the receiver drier and the expansion valve, monitors refrigerant pressure and by means of the relay module controls the following system functions:

1. Refrigerant pressure drops below 2.0 bar, 29 lbf/in<sup>2</sup> (due to possible leakage), the compressor's electro-mechanical clutch is dis-engaged.  
When pressure rises above 2.0 bar, 29 lbf/in<sup>2</sup> the compressor's clutch is re-engaged.
2. Refrigerant pressure rises above 32 bar, 455 lbf/in<sup>2</sup> (due to possible blockage), even with cooling fan operation, the compressor's electro-mechanical clutch is dis-engaged.  
When the pressure drops below 26 bar, 375 lbf/in<sup>2</sup> the compressor clutch is re-engaged.

**Condenser cooling fans**

The condenser cooling fans operate automatically whenever the air conditioning system is switched on.

**Fan timer unit**

The thermostatically controlled timer will continue to operate the cooling fans after the air conditioning or ignition is switched off. When the system temperature is excessive, the fans will operate for 10 minutes to reduce condenser and underbonnet temperature.

**Blower control**

The blower can be operated at any one of four speeds by sliding the blower switch to the required position. When the blower is switched off the air conditioning system will not operate.

The fresh air/recirculation flaps can move between two positions. One position covers the outside air inlet, leaving open an inlet from the inside of the vehicle clear, when recirculated air is required. In the other position they will cover the inlet from the inside of the vehicle leaving open the outside air inlet when fresh air is required.

**Heater distribution and blend unit control**

Blower unit air flow, having passed through the evaporator passes into the heater blend unit to be heated, if required. It is then directed into the vehicle interior in accordance with the flap positions designated by the air distribution control. Heater flaps control the amount of air flowing through the heater matrix. These flaps are controlled individually by the driver's and passenger's temperature controls.

When the temperature control is in the cold position, a micro switch actuates a vacuum control to close the coolant valve on the engine. As the temperature control is moved away from cold, the coolant valve is opened allowing heated engine coolant to flow through the heater matrix. The temperature of the heated air flow into the vehicle interior is controlled by the blend flaps.

The distribution control moves the flaps which control the direction of the air flow into the interior of the vehicle.



**AIR CONDITIONING FAULTS**

FAULT	CAUSE	REMEDY
<p><b>A. BLOWER MOTOR INOPERATIVE OR SLOW RUNNING</b></p>	<ol style="list-style-type: none"> <li>1. Incorrect voltage.</li> <li>2. Open or defective fuse or relay.</li> <li>3. Loose wire connection including ground.</li> <li>4. Switch open or defective.</li> <li>5. Tight, worn, or burnt motor bearings.</li> <li>6. Open rotor windings.</li> <li>7. Worn motor brushes.</li> <li>8. Shaft binding-blade misaligned.</li> <li>9. Defective resistors</li> </ol>	<ol style="list-style-type: none"> <li>1. Check voltage.</li> <li>2. Check and replace as necessary.</li> <li>3. Check system wires; tighten all connections.</li> <li>4. Replace switch.</li> <li>5. Replace motor.</li> <li>6. Replace motor.</li> <li>7. Replace motor.</li> <li>8. Check alignment. Repair or replace as necessary.</li> <li>9. Rectify or replace.</li> </ol>
<p><b>B. COMPRESSOR CLUTCH INOPERATIVE</b></p>	<ol style="list-style-type: none"> <li>1. Incorrect voltage.</li> <li>2. Open or defective fuse or relay.</li> <li>3. Defective thermostat control or pressure switch.</li> <li>4. Shorted or open field coil.</li> <li>5. Bearing seized (clutch will not disengage).</li> <li>6. Refrigeration circuit problem causing heavy load and excessive drive torque.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check voltage.</li> <li>2. Check and replace as necessary.</li> <li>3. Replace thermostat or pressure switch.</li> <li>4. Replace coil.</li> <li>5. Replace clutch pulley assembly.</li> <li>6. Check and rectify.</li> </ol>
<p><b>C. COMPRESSOR CLUTCH NOISY</b></p>	<ol style="list-style-type: none"> <li>1. Incorrect alignment.</li> <li>2. Loose belt.</li> <li>3. Compressor not mounted securely.</li> <li>4. Bearing in clutch-pulley assembly not pressed in.</li> <li>5. Low voltage to clutch.</li> <li>6. Clutch will not spin freely.</li> <li>7. Oil on clutch face.</li> <li>8. Slipping clutch.</li> <li>9. Overloaded or locked compressor.</li> <li>10. Icing.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check alignment; repair as necessary.</li> <li>2. Adjust to proper tension.</li> <li>3. Repair as necessary.</li> <li>4. Remove clutch and replace clutch pulley assembly.</li> <li>5. Check connections and voltage.</li> <li>6. Refer to B5 above.</li> <li>7. Check compressor seals for leaks.</li> <li>8. Refer to C5 above. Then check air gap.</li> <li>9. Repair or replace compressor.</li> <li>10. Check for suction line frosting. Replace expansion valve if necessary. Replace receiver/drier if necessary.</li> </ol>
<p><b>D. CONDENSER VIBRATION</b></p>	<ol style="list-style-type: none"> <li>1. Motor and/or blades improperly mounted.</li> <li>2. Foreign matter build-up on blades.</li> <li>3. Excessive wear of motor bearings.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check mountings, adjust as necessary.</li> <li>2. Clean blades with a suitable non-inflammable cleaner.</li> <li>3. Replace motor.</li> </ol>



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**REFRIGERATION SYSTEM FAULTS**

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For any refrigeration system to function properly all components must be in good working order. The unit cooling cycle and the relationship between air discharge temperature and ambient temperature and the pressures at the compressor can help to determine proper operation of the system.

The length of any cooling cycle is determined by such factors as ambient temperature and humidity, thermostat setting, compressor speed and air leakage into the cooled area, etc. With these factors constant, any sudden increase in the length of the cooling cycle would be indicative of abnormal operation of the air conditioner.

The low and high side pressures at the compressor will vary with changing ambient temperature, humidity, in-car temperature and altitude.

The following items should be checked before operating the system:

1. Compressor drive belt tension.
2. Compressor magnetic clutch operation.
3. Condenser fan operation.
4. Condenser fins, dirt will cause poor cooling and higher operating temperatures.

The following conditions should be checked after operating the system for several minutes:

1. All high pressure lines and components should be hot to the touch.
2. All low pressure lines should be cool to the touch.
3. Inlet and outlet temperatures at the receiver/drier should be at the same temperature (warm). Any very noticeable temperature difference indicates a blocked receiver/drier.
4. Heavy frost on the inlet to the expansion valve may indicate a defective valve or moisture in the system.
5. Evaporation air temperature will vary with ambient temperature and humidity. As humidity increases the outlet temperature will be higher.



FAULT	CAUSE	REMEDY
<p><b>A.</b> <b>HIGH HEAD PRESSURE</b></p>	<ol style="list-style-type: none"> <li>1. Overcharge of refrigerant.</li> <li>2. Air in system.</li> <li>3. Condenser air passage clogged with dirt or other foreign matter.</li> <li>4. Condenser fan motor defective.</li> <li>5. Incorrect voltage to fan motor.</li> </ol>	<ol style="list-style-type: none"> <li>1. Discharge, evacuate and charge system.</li> <li>2. Discharge system, fit new drier, evacuate and charge system.</li> <li>3. Clean condenser of debris.</li> <li>4. Replace motor.</li> <li>5. Check voltage.</li> </ol>
<p><b>B.</b> <b>LOW HEAD PRESSURE</b></p>	<ol style="list-style-type: none"> <li>1. Undercharge of refrigerant; evident by bubbles in sight glass while system is operating</li> <li>2. Split compressor gasket or leaking valves.</li> <li>3. Defective compressor.</li> </ol>	<ol style="list-style-type: none"> <li>1. Evacuate and charge system. Check for leakage.</li> <li>2. Replace gasket and/or reed valve. Fit new drier, evacuate and charge system.</li> <li>3. Repair or replace compressor.</li> </ol>
<p><b>C.</b> <b>HIGH SUCTION PRESSURE</b></p>	<ol style="list-style-type: none"> <li>1. Loose drive belt</li> <li>2. Refrigerant flooding through evaporator into suction line; evident by ice on suction line and suction service valve.</li> <li>3. Expansion valve stuck open.</li> <li>4. Leaking compressor valves, valve gaskets and/or service valves.</li> <li>5. Receiver/drier blocked; evident by temperature difference between input and output lines.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check belt tension.</li> <li>2. Check thermobulb. Bulb should be securely clamped to clean horizontal section of copper suction pipe.</li> <li>3. Replace expansion valve.</li> <li>4. Replace valves and/or gaskets. Fit new drier evacuate and charge system.</li> <li>5. Fit new drier, evacuate and charge system.</li> </ol>
<p><b>D.</b> <b>LOW SUCTION</b></p>	<ol style="list-style-type: none"> <li>1. Expansion valve thermobulb not operating.</li> <li>2. Expansion valve sticking closed.</li> <li>3. Moisture freezing in expansion valve orifice. Valve outlet tube will frost while inlet hose tube will have little or no frost. System operates periodically.</li> <li>4. Dust, paper scraps, or other debris restricting evaporator blower grille</li> <li>5. Defective evaporator blower motor, wiring, or blower switch.</li> </ol>	<ol style="list-style-type: none"> <li>1. Warm thermobulb with hand. Suction should rise rapidly to 1.4 bar 20 lb/in<sup>2</sup> or more. If not replace expansion valve.</li> <li>2. Check inlet side screen. Clean if clogged. Refer to C-2 and C-3.</li> <li>3. Fit new drier, evacuate and charge system.</li> <li>4. Clean grilles as required.</li> <li>5. Refer to Fault Diagnosis Chart for blower motor.</li> </ol>

FAULT	CAUSE	REMEDY
<b>E.</b> <b>NOISY</b> <b>EXPANSION</b> <b>VALVE</b> <b>(steady hissing)</b>	1. Low refrigerant charge; evident by bubbles in sight glass.	1. Leak test. Repair or replace components as required.
<b>F.</b> <b>INSUFFICIENT</b> <b>COOLING</b>	1. Expansion valve not operating properly. 2. Low refrigerant charge-evident by bubbles in sight glass. 3. Compressor not pumping.	1. Refer to C-2, C-3, D-1 and E. 2. Refer to B-1 and E. 3. Refer to B-2 and B-3
<b>G.</b> <b>COMPRESSOR</b> <b>BELT</b> <b>SLIPPING</b>	1. Belt tension. 2. Excessive head pressure. 3. Incorrect alignment of pulleys or worn belt not riding properly. 4. Nicked or broken pulley. 5. Seized compressor.	1. Adjust belt tension. 2. Refer to A-1 through A-4 and C-6. 3. Repair as needed. 4. Replace as needed. 5. Replace compressor.
<b>H.</b> <b>ENGINE</b> <b>NOISE</b> <b>AND/OR</b> <b>VIBRATION</b>	1. Loose or missing mounting bolts. 2. Broken mounting bracket. 3. Loose flywheel or clutch retaining bolt. 4. Rough idler pulley bearing. 5. Bent, loose, or improperly mounted engine drive pulley. 6. Defective compressor bearing. 7. Insecure mountings of accessories; generator, power steering, air filter, etc. 8. Excessive head pressure. 9. Incorrect compressor oil level.	1. Repair as necessary. 2. Replace bracket. 3. Repair as necessary. 4. Replace bearing. 5. Repair as necessary. 6. Replace bearing. 7. Repair as necessary. 8. Refer to A-1, A-2, A-3 A-4 and C-6. 9. Refer to compressor Oil Level Check.

#### HEATER AND AIR CONDITIONING - CIRCUIT DIAGRAMS

1. For details of heating and air conditioning electrics **See *Electrical Trouble Shooting Manual.***



## GENERAL PRECAUTIONS

The refrigerant used in the air conditioning system is HFC (Hydrofluorocarbon) R134a.



**WARNING: R134a is a hazardous liquid and when handled incorrectly can cause serious injury. Suitable protective clothing must be worn when carrying out servicing operations on the air conditioning system.**



**WARNING: R134a is odourless and colourless. Do not handle or discharge in an enclosed area, or in any area where the vapour or liquid can come in contact with naked flame or hot metal. R134a is not flammable but can form a highly toxic gas.**



**WARNING: Do not smoke or weld in areas where R134a is in use. Inhalation of concentrations of the vapour can cause dizziness, disorientation, uncoordination, narcosis, nausea or vomiting.**



**WARNING: Do not allow fluids other than R134a or compressor lubricant to enter the air conditioning system. Spontaneous combustion may occur.**



**WARNING: R134a splashed on any part of the body will cause immediate freezing of that area. Also refrigerant cylinders and replenishment trolleys when discharging will freeze skin to them if contact is made.**



**WARNING: The refrigerant used in an air conditioning system must be reclaimed in accordance with the recommendations given with a Refrigerant Recovery Recycling Recharging Station.**



**NOTE: Suitable protective clothing comprises: Wrap around safety glasses or helmet, heatproof gloves, rubber apron or waterproof overalls and rubber boots.**

## REMEDIAL ACTIONS

1. If liquid R134a strikes the eye, do not rub it. Gently run large quantities of eyewash over the eye to raise the temperature. If eyewash is not available cool, clean water may be used. Cover eye with clean pad and seek immediate medical attention.
2. If liquid R134a is splashed on the skin run large quantities of water over the area as soon as possible to raise the temperature. Carry out the same actions if skin comes into contact with discharging cylinders. Wrap affected parts in blankets or similar material and seek immediate medical attention.
3. If suspected of being overcome by inhalation of R134a vapour seek fresh air. If unconscious remove to fresh air. Apply artificial respiration and/or oxygen and seek immediate medical attention.



**NOTE: Due to its low evaporating temperature of -30°C, R134a should be handled with care.**



**WARNING: Do not allow a refrigerant container to be heated by a direct flame or to be placed near any heating appliance. A refrigerant container must not be heated above 50°C.**



**WARNING: Do not leave a container of refrigerant without its cap fitted. Do not transport a container of refrigerant that is unrestrained, especially in the boot of a car.**

## SERVICING PRECAUTIONS

Care must be taken when handling refrigeration system components. Units must not be lifted by their hoses, pipes or capillary lines. Hoses and lines must not be subjected to any twist or stress. Ensure that hoses are positioned in their correct run before fully tightening the couplings, and ensure that all clips and supports are used. Torque wrenches of the correct type must be used when tightening refrigerant connections to the stated value. An additional wrench must be used to hold the union to prevent twisting of the pipe.

Before connecting any hose or pipe ensure that refrigerant oil is applied to the seat of the new 'O' ring but not to the threads.

Check the oil trap for the amount of oil lost.

All protective plugs on components must be left in place until immediately prior to connection.

The receiver/drier contains desiccant which absorbs moisture. It must be positively sealed at all times.



**CAUTION: Whenever the refrigerant system is opened, the receiver/drier must be renewed immediately before evacuating and recharging the system.**

Use alcohol and a clean cloth to clean dirty connections.

Ensure that all new parts fitted are marked for use with **R134a**.

### Refrigerant oil

Use the approved refrigerant lubricating oil:

Nippon Denso ND-OIL 8

Unipart R134a ND-OIL8



**CAUTION: Do not use any other type of refrigerant oil.**

Refrigerant oil easily absorbs water and must not be stored for long periods. Do not pour unused oil back into the container.

When renewing system components, add the following quantities of refrigerant oil:

Condenser .....	40ml
Evaporator .....	80ml
Pipe or hose .....	20ml
Receiver/drier .....	20ml

**Total of refrigerant oil in system = 180ml = 6.3 Fl oz**

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



**NOTE: A new compressor should always have its sealing caps in place and must not be removed until immediately prior to fitting**

### Fitting a new compressor

A new compressor is supplied with an oil fill (X) of: 180ml

A calculated quantity of oil must be drained from a new compressor before fitting.

To calculate the quantity of oil to be drained:

1. Remove sealing plugs from the OLD compressor
2. Invert compressor and gravity drain oil into measuring cylinder. Rotating the compressor clutch plate will assist complete draining.
3. Note the quantity of oil drained (Y).
4. Calculate the quantity (Q) of oil to be drained from the NEW compressor using the following formula:

$$X - (Y + 20\text{ml}) = Q$$

### Rapid refrigerant discharge

When the air conditioning system is involved in accident damage and the circuit is punctured, the refrigerant is discharged rapidly. The rapid discharged of refrigerant will also result in the loss of most of the oil from the system. The compressor must be removed and all the remaining oil in the compressor drained and refilled as follows:

1. Gravity drain all the oil, assist by rotating the clutch plate (not the pulley).
2. Refill the compressor with the following amount of new refrigerant oil:

130ml

3. Plug the inlet and outlet ports.



**SERVICING EQUIPMENT**

The following equipment is required for full servicing of the air conditioning system.

- Recovery, recycling and charging station
- Leak detector
- Thermometer +20°C to -60°C
- Safety goggles and gloves

**REFRIGERANT RECOVERY RECYCLING RECHARGING**



**WARNING:** The air conditioning system is charged with a high pressure, potentially toxic refrigerant. Repairs or servicing must only be carried out by an operator familiar with both the vehicle system and the charging and testing equipment.

All operations must be carried out in a well-ventilated area away from open flame and heat sources.

Always wear safety goggles and gloves when opening refrigerant connections.



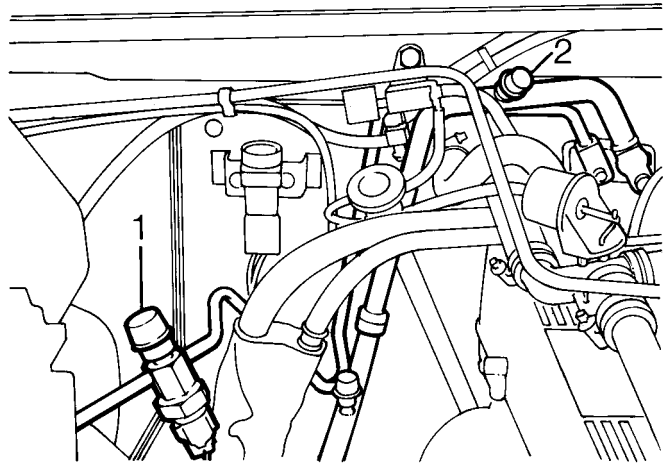
**WARNING:** Wear eye and hand safety protection. Open connections slowly in case liquid or pressure is present. Allow to bleed off slowly.



**CAUTION:** Overcharging air conditioning system will cause excessive head pressure.

An air conditioning portable Refrigerant Recovery Recycling Recharging Station for use with R134a refrigerant incorporates all the features necessary to recover refrigerant R134a from the air conditioning system, to filter and remove moisture, to evacuate and recharge with the reclaimed refrigerant. The unit can also be used for performance testing and air conditioning system analysis. The operator must adhere to the equipment manufacturer's instructions.

**Recovery and recycling**



RR3963M

1. High pressure servicing connection
2. Low pressure servicing connection

1. Connect a Refrigerant Station to the high and low pressure servicing connections.
2. Operate the refrigerant recovery system according to the manufacturer's instructions.
3. Measure the amount of oil discharged from the system. Add an equal amount of new refrigerant oil to compressor before evacuation sequence.



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

**A R134a Refrigerant Recovery Recycling Recharging Station must not be used with any other type of refrigerant.**

Refrigerant R134a from domestic and commercial sources must not be used in motor vehicle air conditioning systems.

**Evacuation and recharging**

1. Add refrigerant oil to compressor if necessary.
2. Renew the receiver/drier.



**CAUTION: When a major repair has been carried out, a leak test should be carried out using inert gas.**

3. Connect a Refrigerant Station to the high and low pressure servicing connections.



**CAUTION: Whenever the refrigerant system is opened, the receiver/drier must be renewed immediately before evacuating and recharging the system.**

4. Operate the refrigerant evacuation system according to the manufacturer's instructions.



**NOTE: If the vacuum reading is below 700mmHg after 15 minutes, suspect a leak in the system. Partially recharge the system and check for leaks using an electronic leak tester. Check suction lines first, then run the compressor for 5 minutes and then check the high pressure lines.**



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

5. Operate the refrigerant recharging system according to the manufacturer's instructions:-

**Refrigerant required to charge system:  
Without rear air conditioning = 0.90kg (32 fl/oz)  
With rear air conditioning = 1.15kg (40 fl/oz)**

6. If the full charge has not been accepted by the system, start the engine and run it at 1500 rev/min for a minimum of 2 minutes.  
Switch on the air conditioning system, open the car windows, set the temperature control to cold and switch the blower to maximum speed.
7. Consult Refrigerant Station Manual for correct procedure to complete the charge.
8. Carry out the air conditioning system performance test.

**LEAK TEST SYSTEM**

The following instructions refer to an electronic type Refrigerant Leak Detector for use with R134a, which are the safest and most sensitive.



**CAUTION: When a major repair has been carried out, a leak test should be carried out using an inert gas (see below).**

1. Place the vehicle in a well ventilated area but free from draughts, as leakage from the system could be dissipated without detection.
2. Follow the instructions issued by the manufacturer of the particular leak detector being used.
3. Commence searching for leaks by passing the detector probe around all joints and components, refrigerant gas is heavier than air.
4. Insert the probe into an air outlet of the evaporator or into the evaporator drain tube. Switch the air conditioning blower on and off at intervals of ten seconds. Any leaking refrigerant will be gathered in by the blower and detected.
5. Insert the probe between the magnetic clutch and compressor to check the shaft seal for leaks.
6. Check all service valve connections, valve plate, head and base plate joints and back seal plate.
7. Check the condenser for leaks at the pipe unions.
8. If any leaks are found, the system must be discharged before rectification.
9. Rectify any leaks and recheck for leaks during evacuation prior to charging.

**Leak test using inert gas**

Use Nitrogen or Helium gas.

1. Connect gas line to recharging station.
2. Pressurise system to 3 bar.
3. Carry out leak test as above.



**AIR CONDITIONING SYSTEM - PERFORMANCE TEST**



**WARNING: R134a is hazardous, refer to the GENERAL PRECAUTIONS given at the beginning of this section.**

Carry out this test with bonnet and doors or windows open, air conditioning switched on, temperature control set to cold and blower at maximum speed. Set the air supply control to supply fresh air.

1. Close low pressure valve on refrigerant station.
2. Close high pressure valve on refrigerant station.
3. Connect a Refrigerant Station to the high and low pressure servicing connections.

4. Insert dry bulb thermometer into cold air outlet and position dry and wet bulb thermometer close to outside air inlet.  
Do not spill water from the wet thermometer (psychrometer).
5. Start engine and run it at 1500 rev/min for 10 minutes with air conditioning switched on.
6. Check that sight glass is free of bubbles.
7. Read both pressure gauges and thermometers. Check readings against table below with humidity between 60% and 80%. If readings are incorrect. **See Fault diagnosis, Refrigeration System Faults.**
8. Switch off air conditioning, stop engine, disconnect test equipment.

**Performance range**


Intake temperature	Outlet temperature	Low pressure	High pressure
20 - 24°C	4 - 10°C	18 - 28 lbf/in <sup>2</sup> 1.2 - 1.9 bar	213 - 299 lbf/in <sup>2</sup> 14.7 - 20.6 bar
25 - 29°C	9 - 19°C	27 - 37 lbf/in <sup>2</sup> 1.9 - 2.6 bar	256 - 341 lbf/in <sup>2</sup> 17.6 - 23.5 bar
30 - 35°C	20 - 27°C	33 - 47 lbf/in <sup>2</sup> 2.3 - 3.2 bar	299 - 384 lbf/in <sup>2</sup> 20.6 - 26.5 bar

**Table 1**

Ambient Temperature		Compound Gauge Readings		High Pressure Gauge Readings	
°C	°F	bar	lbf/in <sup>2</sup>	bar	lbf/in <sup>2</sup>
16	60	1,03-1,4	15-20	6,9-10,3	100-150
26,7	80	1,4-1,72	20-25	9,6-13,1	140-190
38	100	1,72-2,1	25-30	12,4-15,5	180-225
43,5	110	2,1-2,4	30-35	14,8-17,2	215-250



**SYSTEM TEST**

1. Place the vehicle in a ventilated, shaded area free from excessive draught, with the doors and windows open.
  2. Check that the surface of the condenser is not restricted with dirt, leaves, flies, etc. Do not neglect to check the surface between the condenser and the radiator. Clean as necessary.
  3. Switch on the ignition and the air conditioner air flow control. Check that the blower is operating efficiently at low, medium and high speeds. Switch off the blower and the ignition.
  4. Check that the evaporator condensate drain tubes are open and clear.
  5. Check the tension of the compressor driving belt, and adjust if necessary.
  6. Inspect all connections for the presence of refrigerant oil. If oil is evident, check for leaks, and repair as necessary.
-  **NOTE: The compressor oil is soluble in Refrigerant R134a and is deposited when the refrigerant evaporates from a leak.**
7. Start the engine.
  8. Set the temperature controls to cold and switch the air conditioner blower control on and off several times, checking that the magnetic clutch on the compressor engages and releases each time.
  9. With the temperature control at maximum cooling and the blower control at high speed, warm up the engine and fast idle at 1000 rev/min. Check the sight glass for bubbles or foam. The sight glass should be generally clear after five minutes running, occasional bubbles being acceptable. Continuous bubbles may appear in a serviceable system on a cool day, or if there is insufficient air flow over the condenser at a high ambient temperature.
  10. Repeat at 1800 rev/min.
  11. Gradually increase the engine speed to the high range, and check the sight glass at intervals.
  12. Check for frosting on the service valves.
  13. Check the high pressure hoses and connections by hand for varying temperature. Low temperature indicates a restriction or blockage at that point.
  14. Switch off the air conditioning blower and stop the engine.
  15. If the air conditioning equipment is still not satisfactory, carry out a pressure test as previously described in this section.

**COMPRESSOR DRIVE BELT**

**Service repair no - 82.10.01.**

**Tdi - See ENGINE, Repair, Compressor drive belt**  
**V8i and Mpi See ENGINE, Repair, Drive belt**



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**PRECAUTIONS IN HANDLING REFRIGERANT LINES**

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**WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.**

1. When disconnecting any hose or pipe connection the system must be discharged of all pressure. Proceed cautiously, regardless of gauge readings. Open connections slowly, keeping hands and face well clear, so that no injury occurs if there is liquid in the line. If pressure is noticed, allow it to bleed off slowly.
2. Lines, flexible end connections and components must be capped immediately they are opened to prevent the entrance of moisture and dirt.
3. Any dirt or grease on fittings must be wiped off with a clean alcohol dampened cloth. Do not use chlorinated solvents such as trichloroethylene. If dirt, grease or moisture cannot be removed from inside the hoses, they must be replaced with new hoses.
4. All replacement components and flexible end connections must be sealed, and only opened immediately prior to making the connection.
5. Ensure the components are at room temperature before uncapping, to prevent condensation of moisture from the air that enters.
6. Components must not remain uncapped for longer than fifteen minutes. In the event of delay, the caps must be fitted.
7. Receiver/driers must never be left uncapped as they contain Silica Gel crystals which will absorb moisture from the atmosphere. A receiver/ drier left uncapped must not be used, fit a new unit.
8. The compressor shaft must not be rotated until the system is entirely assembled and contains a charge of refrigerant.
9. A new compressor contains an initial charge of of refrigerant oil. The compressor also contains a holding charge of gas when received which should be retained by leaving the seals in place until the pipes are re-connected.
10. The receiver/drier should be the last component connected to the system to ensure optimum dehydration and maximum moisture protection of the system.
11. All precautions must be taken to prevent damage to fittings and connections. Slight damage could cause a leak with the high pressures used in the system.
12. Always use two wrenches of the correct size, one on each fitting when releasing and tightening refrigeration unions.
13. Joints and 'O' rings should be coated with refrigeration oil to aid correct seating. Fittings which are not lubricated with refrigerant oil are almost certain to leak.
14. All lines must be free of kinks. The efficiency of the system is reduced by a single kink or restriction.
15. Flexible hoses should not be bent to a radius less than 90mm.
16. Flexible hoses should not be within 100mm of the exhaust manifold.
17. Completed assemblies must be checked for refrigeration lines touching metal panels. Any direct contact of lines and panels transmits noise and must be eliminated.

## PERIODIC MAINTENANCE

Routine servicing, apart from visual checks, is not necessary. The visual inspections are as follows:

### Condenser

With a water hose or air line, clean the fins of the condenser to remove flies, leaves, etc. Check the pipe connections for signs of oil leakage.

### Compressor

Check pipe connections for signs of oil leakage. Check flexible hoses for swelling. Examine the compressor belt for tightness and condition.

### Sight glass and Receiver/Drier

Examine the sight glass for bubbles with the system operating. Check connections for leakage.

### Evaporator

Examine the refrigeration connections at the unit. If the system should develop a fault, or if erratic operation is noticed, **See Fault diagnosis, Refrigeration System Faults**

## RECEIVER DRIER

Service repair no - 82.17.01

### Remove



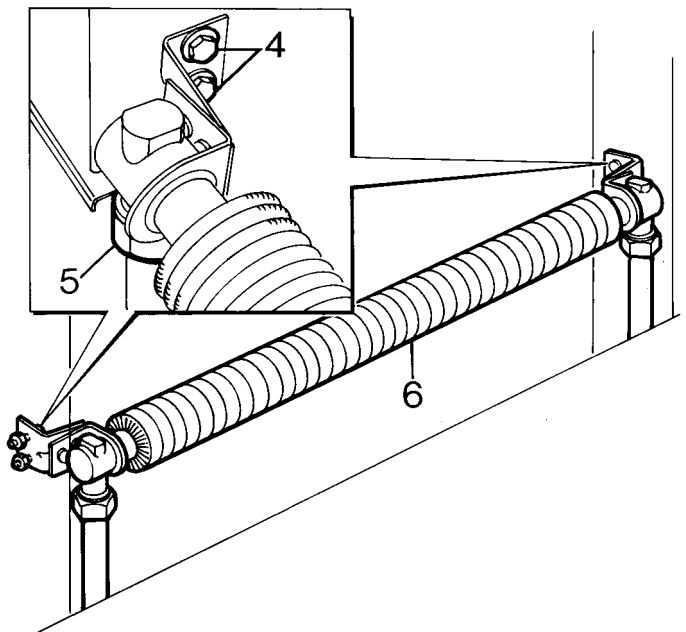
**CAUTION:** If receiver/drier is to be refitted, the ports must be blanked off immediately on disconnection. Exposed life of unit is only 15 minutes.

1. Disconnect battery negative lead.
2. Recover refrigerant from system. **See Adjustment, Refrigerant Recovery Recycling Recharging**



**WARNING:** Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

3. Remove 3 screws from bonnet locking platform and remove radiator grille.



RR3964M

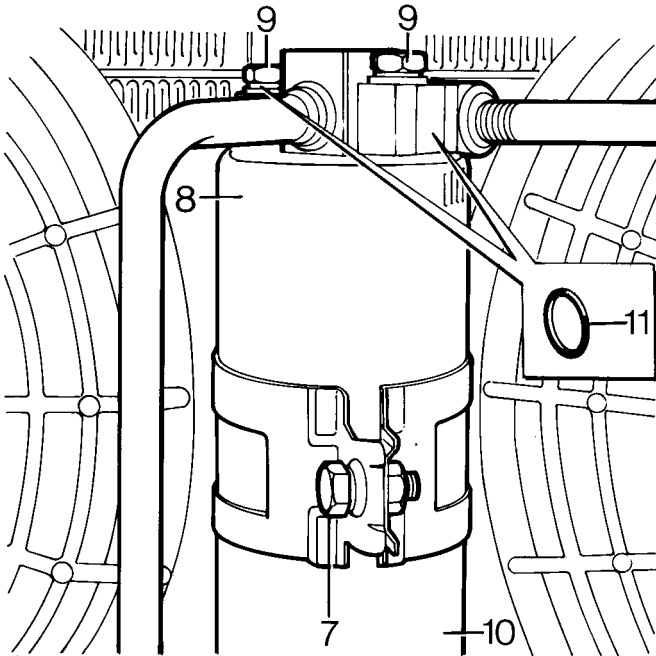
### Automatic gearbox

4. Remove 4 bolts securing transmission oil cooler to body.



5. Disconnect 2 pipe unions from oil cooler. Use a second wrench to support hose adapter.
6. Remove transmission oil cooler. Seal connections.

#### All models



RR3965M

7. Remove bolt securing receiver/drier clamp.



**WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.**

8. Move receiver/drier just sufficiently to gain access to pipe flange bolts without distorting the pipes.
9. Remove bolt securing each pipe flange to receiver/drier.
10. Disengage pipe flanges and withdraw receiver/drier from mounting bracket.
11. Remove 'O' ring from each pipe flange.

#### Refit

12. Fit new 'O' ring to each pipe flange, lubricate with refrigerant oil.
13. Position receiver/drier in mounting bracket with inlet and outlet connections correctly aligned.
14. Engage pipe flanges, fit bolts in turn and tighten.
15. Fit clamp bolt.

#### Automatic gearbox

16. Refit transmission oil cooler. Use a second wrench to support pipe unions.
17. Check gearbox fluid level, top-up if necessary.

#### All models

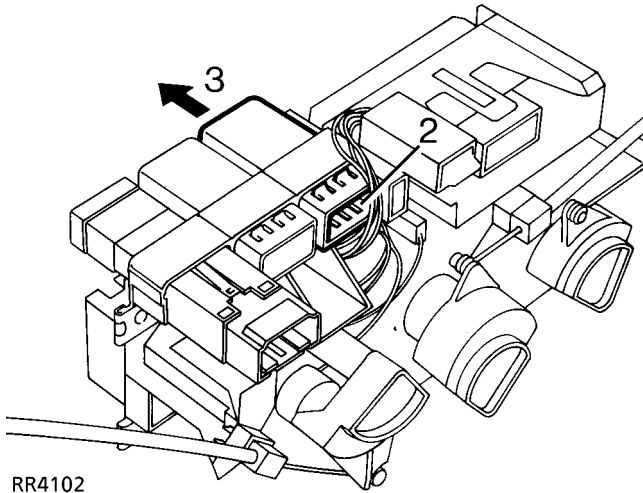
18. Evacuate and recharge air conditioning system.  
**See Adjustment, Refrigerant Recovery Recycling Recharging**
19. Perform a leak test on disturbed joints.
20. Carry out a functional check.

**AIR CONDITIONING SWITCH**

Service repair no - 82.20.29

**Remove**

1. Remove fascia centre louvre vent panel. **See CHASSIS AND BODY, Repair, Dash Panel Central Louvre Panel**



RR4102

2. Disconnect multiplug from switch
3. From the rear, push switch out of panel.

**Refit**

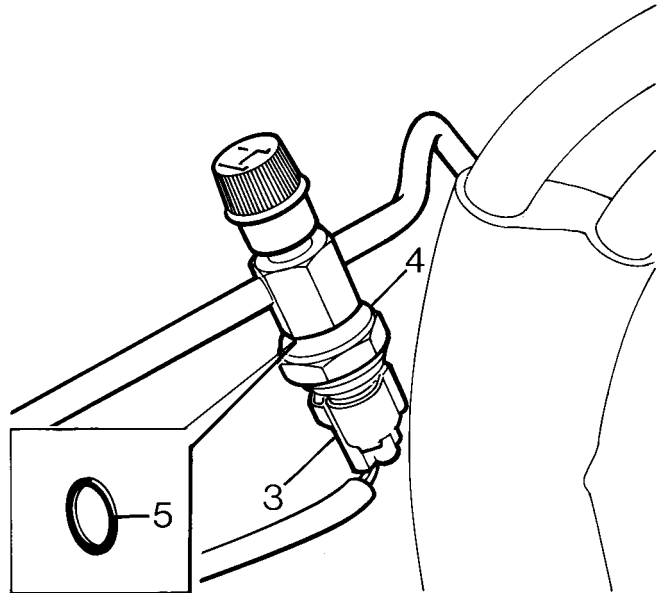
4. Reverse removal procedure.

**DUAL PRESSURE SWITCH**

Service repair no - 82.20.20

**Remove**

1. Disconnect battery negative lead.
2. Recover refrigerant from system. **See Adjustment, Refrigerant Recovery Recycling Recharging**



RR3966M

3. Disconnect multiplug from switch.
4. Unscrew switch from adapter. Use a second wrench to support adapter.

**WARNING:** Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

5. Remove 'O' ring from switch.

**Refit**

6. Reverse removal procedure. Lubricate new 'O' ring with refrigerant oil and fit to switch.
7. Screw switch into adapter and tighten to **11 Nm**.
8. Evacuate and recharge air conditioning system. **See Adjustment, Refrigerant Recovery Recycling Recharging**

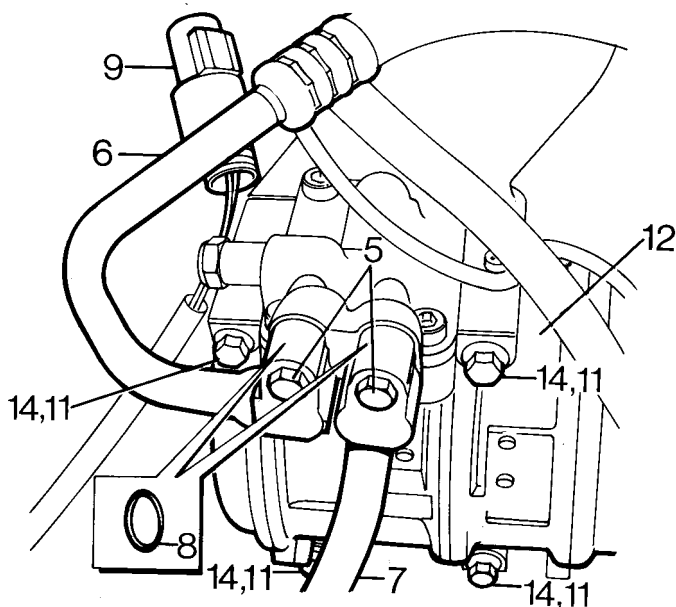


## COMPRESSOR

Service repair no - 82.10.20

### Remove

1. Disconnect battery negative lead.
2. Recover refrigerant from air conditioning system.  
**See Adjustment, Refrigerant Recovery Recycling Recharging**
3. Remove screws retaining centre panel to fan cowl
4. Remove centre panel.



RR3967M

### V8i engine illustrated

5. Remove 2 bolts securing hose flanges to compressor.



**WARNING:** Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

6. Disconnect high pressure hose from compressor.
7. Disconnect low pressure hose from compressor.
8. Remove 'O' ring from each flange.
9. Disconnect electrical lead from compressor clutch.
10. Release drive belt from compressor pulley. **See ENGINE, Repair, Drive Belt**
11. Remove 4 bolts securing compressor to mounting bracket.
12. Remove compressor from mounting bracket.

### Refit

13. New compressor to be fitted: Drain oil from new compressor outlet port. Drain and measure oil from old compressor. Measure new oil equal to amount drained from old compressor, add 30 ml extra to this amount and refill new compressor through outlet port.
14. Locate compressor in mounting bracket, fit bolts. Tighten to **25 Nm**.
15. Connect electrical lead to compressor clutch.
16. Fit new 'O' rings to high and low pressure hose flanges, lubricate with refrigerant oil.
17. Engage hose flanges, fit bolts. Tighten to **10 Nm**.
18. Fit compressor drive belt. **See ENGINE, Repair, Drive Belt**
19. Fit centre panel to fan cowl.
20. Evacuate and recharge air conditioning system.  
**See Adjustment, Refrigerant Recovery Recycling Recharging**
21. Perform a leak test on disturbed joints.
22. Carry out a functional check.

**CONDENSER**

Service repair no - 82.15.07

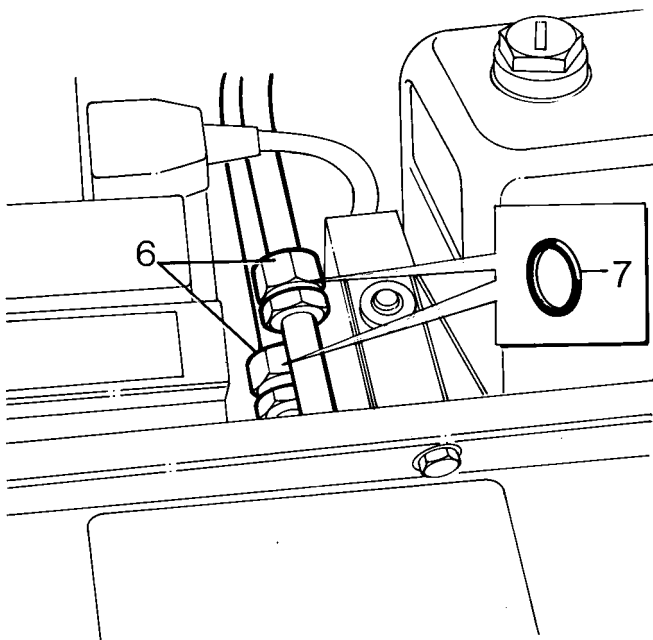
**Remove**

1. Disconnect battery negative lead.



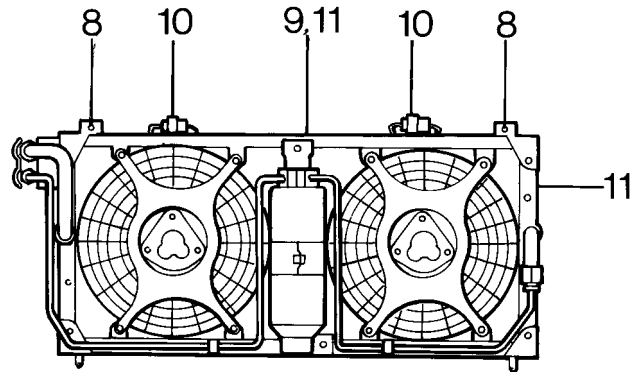
**WARNING:** Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

2. Recover refrigerant from system. *See Adjustment, Refrigerant Recovery Recycling Recharging*
3. Remove front grille panel.
4. Remove battery. *See ELECTRICAL, Repair, Battery*
5. Remove radiator and oil coolers assembly. *See COOLING SYSTEM, Repair, Radiator*



RR3988M

6. Disconnect high and low pressure pipes at condenser unions.
7. Discard 'O' ring seal from each union.



RR3989M

8. Remove 2 bolts securing condenser to body.
9. Pull condenser into radiator area.
10. Disconnect multiplug from each fan lead.
11. Remove condenser assembly. **Do not carry out further dismantling if component is removed for access only.** Blank off inlet and outlet ports.



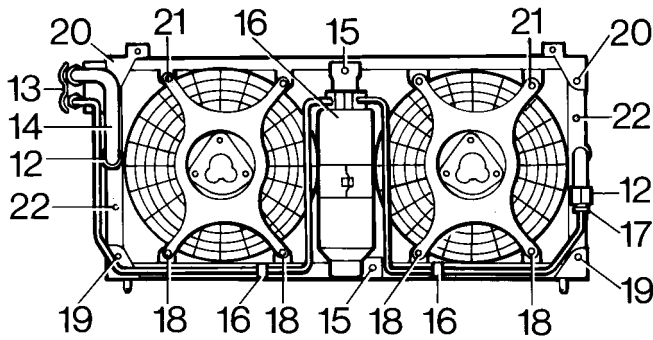
**CONDENSER FANS AND MOTORS**

Service repair no - 82.15.01 - Motor

Service repair no - 82.15.03 - Fan

**Remove**

1. Remove condenser assembly. **See Condenser**

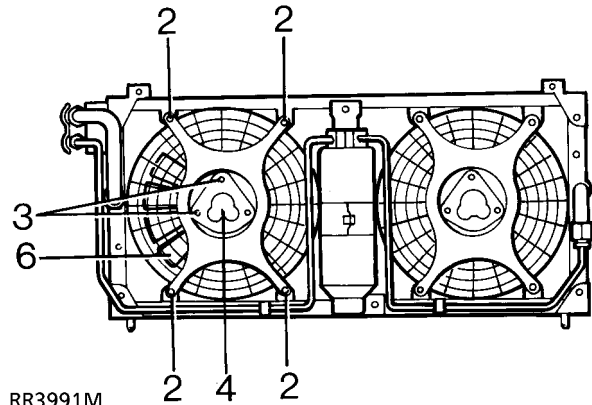


RR3990M

12. Disconnect receiver/drier pipes at condenser unions.
13. Remove retaining bracket from side pipe.
14. Remove LH pipe from condenser and discard 'O' ring.
15. Remove 2 screws securing receiver/drier bracket.
16. Release pipes from lower clips and remove receiver/drier assembly.
17. Remove 'O' ring from RH pipe
18. Remove 2 screws securing lower end of each fan motor.
19. Remove 2 bolts and remove condenser lower mounting bracket.
20. Remove 2 bolts and securing condenser upper mounting bracket.
21. Remove upper mounting bracket and fan motor assembly.
22. Remove 2 screws securing each side mounting bracket and remove the brackets.
23. Transfer parts removed to new condenser.
24. Add 40 ml of refrigerant oil to new compressor to compensate for oil loss.

**Refit**

25. Reverse removal procedure. 3 to 11.
26. Evacuate and recharge air conditioning system. **See Adjustment, Refrigerant Recovery Recycling Recharging**
27. Carry out leak test on disturbed joints. **See Adjustment, Leak Test System**
28. Check air conditioning operation by carrying out a System Test. **See Adjustment, System Test**



RR3991M

2. Remove 4 bolts securing fan cowl to condenser.
3. Remove 3 bolts securing fan motor to cowl.
4. Remove fan motor assembly.
5. Remove 3 screws securing fan blades to motor.
6. Remove fan blades.

**Refit**

7. Reverse removal procedure. Ensuring that wiring is clipped and no fouling of fan blade can occur.



## HEATER AND COOLER UNIT

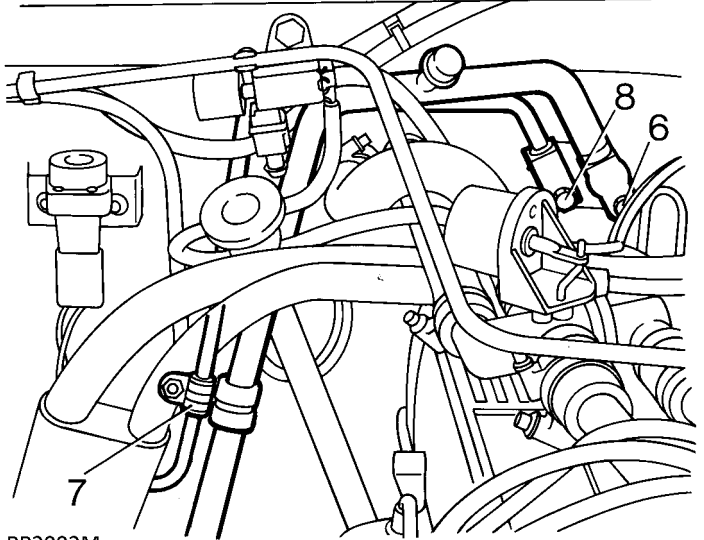
Service repair no - 86.25.21



**WARNING:** All work involving the service and maintenance of air conditioning requires special equipment, knowledge, experience and a full awareness and adherence to safety precautions.

## Remove

1. Disconnect battery negative lead.
2. Drain engine coolant. *See COOLING SYSTEM, Adjustment, Coolant*
3. Recover refrigerant from air conditioning system. *See Adjustment, Refrigerant Recovery Recycling Recharging*
4. Remove fascia panel assembly. *See CHASSIS AND BODY, Repair, Dash Panel Assembly*



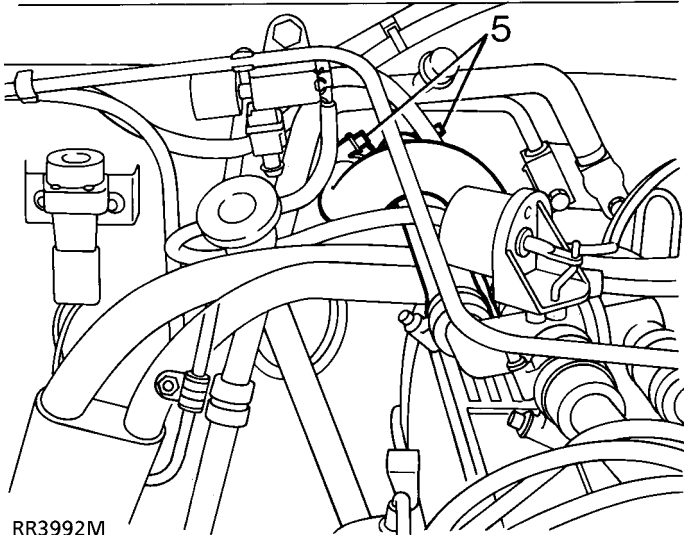
RR3993M

6. Remove securing bolt and disconnect low pressure pipe from evaporator.



**WARNING:** Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

7. Release 'P' clip retaining high and low pressure pipes.
8. Remove securing bolt and disconnect high pressure pipe from evaporator.
9. Discard 'O' ring seals.



RR3992M

5. Release clips and disconnect coolant hoses from heater pipes.



**EVAPORATOR AND EXPANSION VALVE**

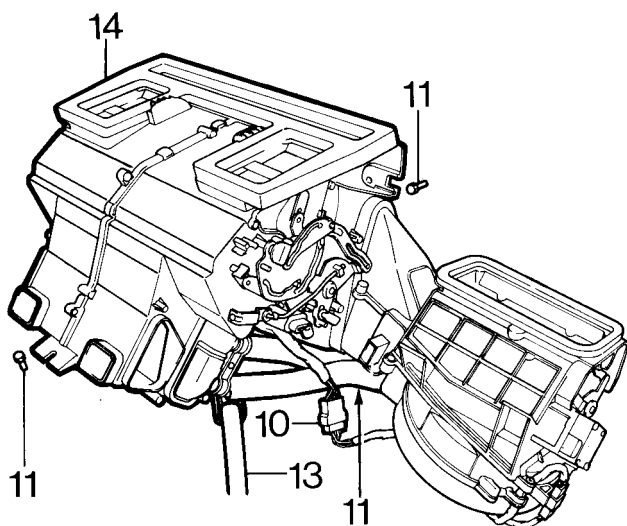
Service repair no - 86.25.20 - Evaporator  
 Service repair no - 86.25.01 - Expansion valve

**Remove**



**WARNING:** Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

1. Remove heater and cooler unit. *See Heater and Cooler Unit*

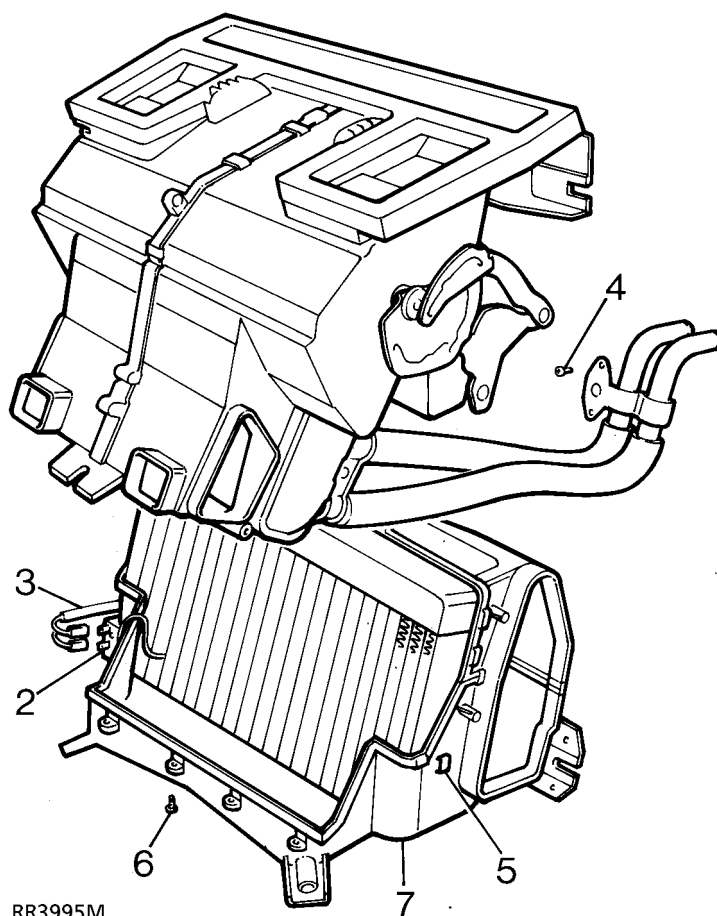


RR3994M

10. Disconnect multiplug connecting heater to blower unit, remove 3 screws and remove blower unit.
11. Remove 5 screws securing casing to bulkhead and tunnel.
12. Remove 2 securing bolts and remove centre console front mounting bracket.
13. Disconnect 2 drain tubes..
14. Ease heater and cooler unit from its location and remove from vehicle.

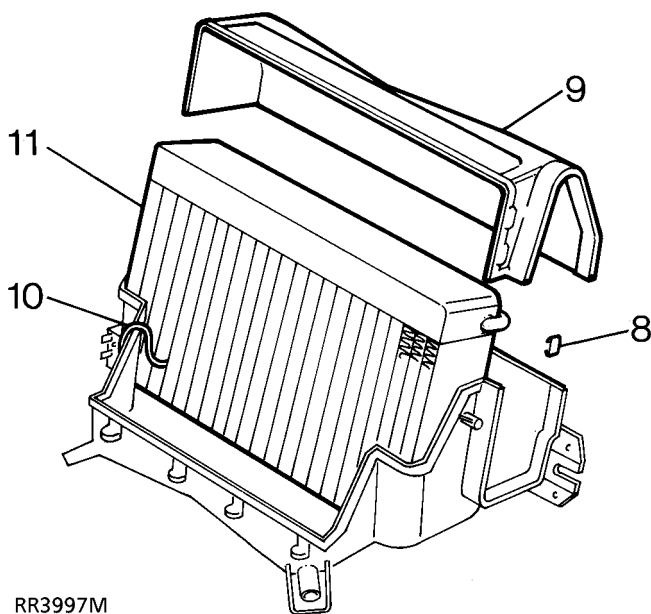
**Refit**

15. Ease heater and cooler unit into position.
16. Fit retaining bolts finger tight. Tighten in sequence, centre and top bolts and then the bottom bolt.
17. Reverse removal procedure.
18. Use new 'O' rings and lubricate with refrigerant oil.
19. Evacuate and recharge system. *See Adjustment, Refrigerant Recovery Recycling Recharging*
20. Leak test any disturbed joints. *See Adjustment, Leak Test System*
21. Perform a functional check.



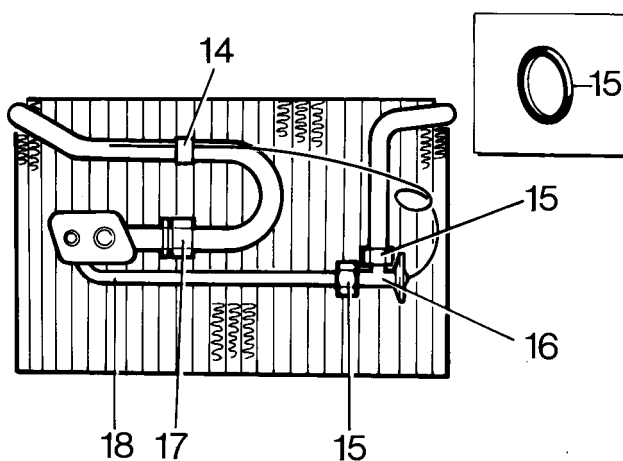
RR3995M

2. Disconnect 2 Lucar connectors from thermostat.
3. Position wiring aside.
4. Remove 2 screws securing heater pipe bracket and position pipes aside.
5. Remove 10 clips retaining upper and lower casings.
6. Remove 5 screws retaining upper casing.
7. Remove lower casing and evaporator.



RR3997M

8. Remove 4 clips securing evaporator top cover.
9. Remove evaporator top cover.
10. Remove thermostat sensor from evaporator matrix.
11. Remove evaporator assembly from lower casing.
12. Remove bulkhead seal from case.



RR3996M

### Expansion valve

13. Remove insulation from evaporator and expansion valve connections.
14. Remove expansion valve sensor retaining clip.
15. Unscrew 2 pipe unions. Discard 'O' ring seals.



**CAUTION:** Use a second wrench to support pipe adapters and plug connections.

16. Remove expansion valve.
17. Unscrew pipe union. Discard 'O' ring seal.
18. Remove evaporator pipe.

### Refit

19. Reverse removal procedure. Use new 'O' rings, insulation and bulkhead seal.



**NOTE:** Use refrigerant oil on all 'O' rings and mating surfaces. Tighten connection  
*See Specifications, torque, Torque Values*

20. Wrap all exposed metal at hose connections with prestite tape.
21. Evacuate and recharge system. *See Adjustment, Refrigerant Recovery Recycling Recharging*
22. Leak test any disturbed joints. *See Adjustment, Leak Test System*
23. Perform a functional check.
24. Disconnect service unit.

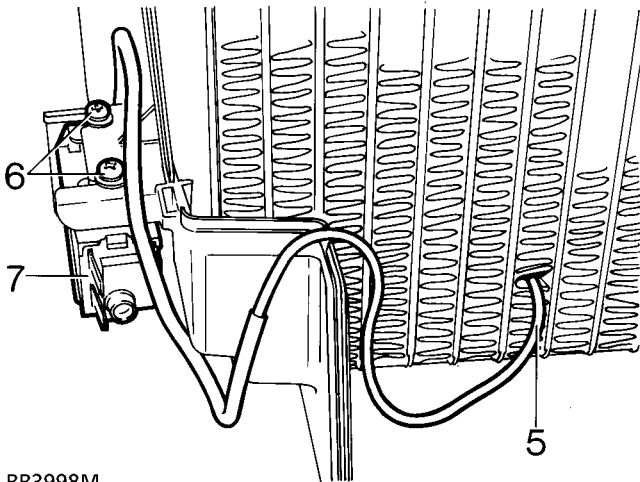


**THERMOSTAT**

Service repair no - 86.25.50

**Remove**

1. Remove heater and cooler unit. **See Heater and Cooler Unit**
2. Remove lower cover and evaporator. **See Evaporator and Expansion Valve**
3. Remove 5 clips and screw securing evaporator top cover.
4. Remove evaporator top cover.



RR3998M

5. Remove thermostat sensor from evaporator matrix.
6. Remove 2 screws securing sensor unit.
7. Remove thermostat and insulation.

**Refit**

8. Reverse removal procedure.

**CAUTION:** The thermostat insulation must be installed in the ORIGINAL POSITION in the evaporator.



**EVAPORATOR/BLOWER MOTOR ASSEMBLY - REAR**

Service repair no - 82.26.01

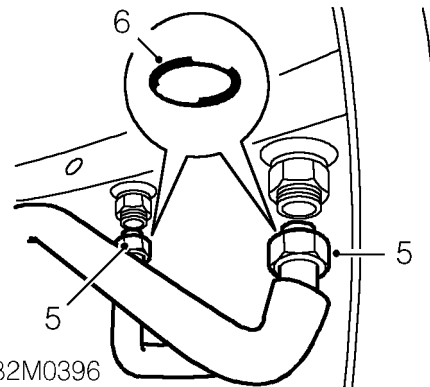
**Remove**

1. Recover refrigerant from system. **See Adjustment, refrigerant recovery recycling recharging**



**WARNING:** Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

2. Remove evaporator to alpine light duct. **See evaporator to alpine light duct**
3. Remove LH rear mud flap. **See CHASSIS AND BODY, Repair, mud flap - rear - lh**
4. Clean area around low and high pressure air conditioning pipe unions, beneath rear wheel arch, to prevent any risk of dirt entering the system.



82M0396

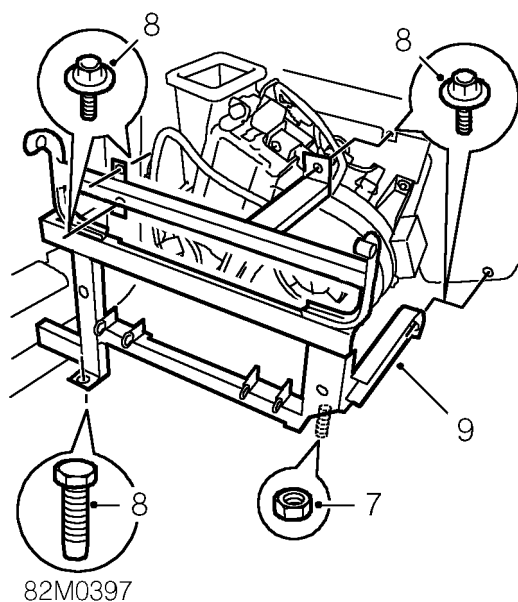
5. Loosen and disconnect high and low pressure air conditioning pipe unions beneath rear wheel arch.
6. Remove and discard 'O' rings from pipe unions.



**CAUTION:** Use 2 spanners when loosening or tightening air conditioning pipe unions.



**CAUTION:** Plug exposed connections immediately.

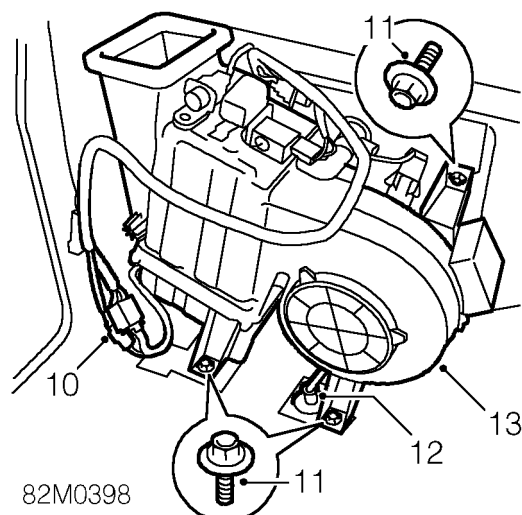


7. Remove nut securing rear fold down seat mounting frame to wheel arch.
8. Remove 5 bolts securing rear fold down seat mounting frame.



**NOTE:** The rear fold down seat mounting frame retaining nut is located in the LH rear wheel arch.

9. Remove mounting frame.



10. Disconnect 2, main to rear air conditioning unit harness multiplugs.
11. Remove 3 bolts securing evaporator/blower motor assembly to body.
12. Release evaporator/blower motor assembly pipes from body grommets.
13. Remove evaporator/blower motor assembly.

### Refit

14. Lubricate body grommets to aid fitment of evaporator/blower motor assembly pipe unions.
15. Fit evaporator/blower motor assembly, feed pipe unions through grommets and align to fittings.
16. Fit bolts securing evaporator/blower motor assembly to body and tighten to **25 Nm**.
17. Connect, main to rear air conditioning unit, harness multiplugs.
18. Position and align rear fold down seat mounting frame to fittings, fit nut and bolts and tighten to **25 Nm**.
19. Lubricate NEW 'O' rings with refrigerant oil, and fit to pipe unions.
20. Remove plugs, align unions, and tighten to; High pressure pipe: **14 Nm**  
Low pressure pipe: **22 Nm**.



**CAUTION:** Use 2 spanners when loosening or tightening air conditioning pipe unions.

21. Fit LH rear mud flap. *See CHASSIS AND BODY, Repair, mud flap - rear - lh; Refit*
22. Fit evaporator to alpine light duct. *See evaporator to alpine light duct; Refit*
23. Evacuate and recharge air conditioning system. *See Adjustment, refrigerant recovery recycling recharging*

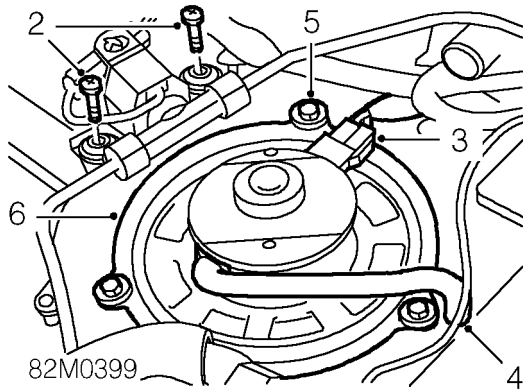


**BLOWER MOTOR - REAR**

Service repair no - 82.26.02

**Remove**

1. Remove evaporator/blower motor assembly. **See evaporator/blower motor assembly - rear**



2. Loosen 2 screws securing high pressure control valve solenoid to blower motor housing.
3. Disconnect multiplug from blower motor.
4. Release blower motor cooling tube from evaporator/blower motor housing.
5. Remove 3 screws securing blower motor.
6. Remove blower motor .

**Refit**

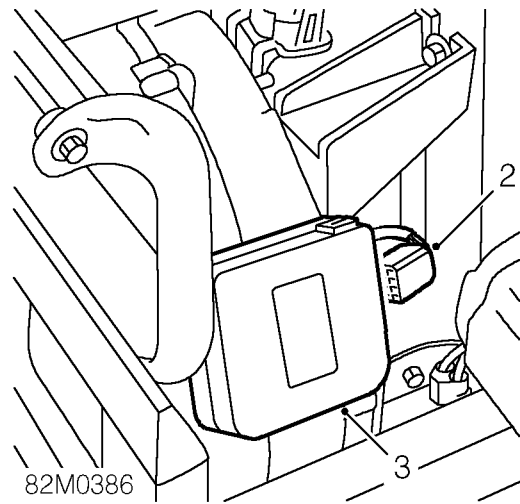
7. Position blower motor to housing and secure with screws.
8. Secure blower motor cooling tube from evaporator/blower motor housing.
9. Connect multiplug to blower motor.
10. Tighten screws securing control valve solenoid.
11. Fit evaporator/blower motor assembly. **See evaporator/blower motor assembly - rear; Refit**

**ELECTRONIC CONTROL UNIT - REAR AIR CONDITIONING**

Service repair no - 82.26.03

**Remove**

1. Remove rear compartment lower trim panel. **See CHASSIS AND BODY, Repair, rear compartment lower trim panel - lh - with rear air conditioning fitted**



2. Disconnect multiplug from ECU.
3. Remove ECU from mounting bracket.

**Refit**

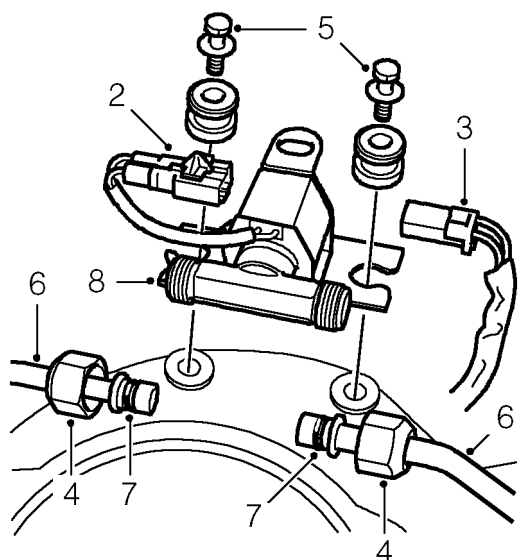
4. Fit ECU to mounting bracket and connect multiplug.
5. Fit rear compartment lower trim panel. **See CHASSIS AND BODY, Repair, rear compartment lower trim panel - lh - with rear air conditioning fitted; Refit**

### SOLENOID - HIGH PRESSURE PIPE CONTROL VALVE - REAR

Service repair no - 82.26.05

#### Remove

1. Remove evaporator/blower motor assembly.  
*See evaporator/blower motor assembly - rear*



82M0414

2. Release multiplug clip from solenoid bracket.
3. Disconnect solenoid multiplug.
4. Loosen 2 control valve unions.



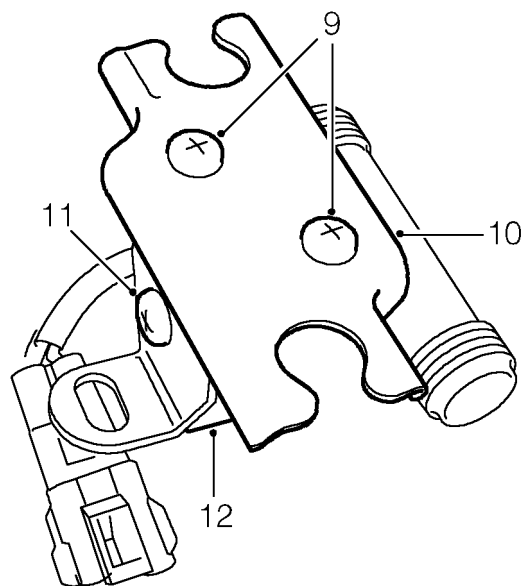
**CAUTION: Use 2 spanners when loosening or tightening air conditioning pipe unions.**

5. Remove 2 screws securing control valve to blower motor housing.
6. Release unions from control valve.
7. Remove and discard 2 'O' ring seals from control valve.



**CAUTION: Immediately plug air conditioning connections.**

8. Remove control valve assembly.



82M0415

9. Remove 2 screws securing mounting bracket to control valve.
10. Remove mounting bracket.
11. Noting the direction arrow on control valve, remove screw securing solenoid to valve.
12. Remove solenoid from valve.



Refit

13. Fit solenoid to valve.
14. Fit but do not tighten screw securing solenoid to control valve.



**NOTE:** Ensure arrow on control valve is pointing in the correct recorded direction.

15. Position mounting bracket to control valve solenoid and secure with screws.
16. Remove plugs from unions and control valve connections.
17. Lubricate NEW 'O' rings with refrigerant oil and fit to valve.
18. Fit control valve to pipes, connect unions, but do not tighten.
19. Fit and tighten screws securing control valve mounting bracket to blower motor housing.
20. Tighten control valve unions to **14 Nm**.



**CAUTION:** Use 2 spanners when loosening or tightening air conditioning pipe unions.

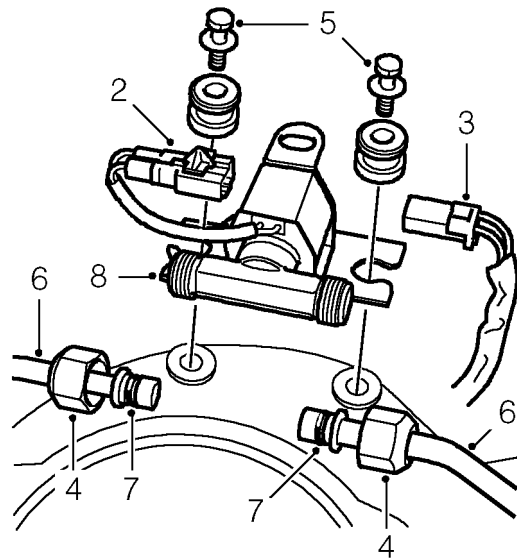
21. Tighten screw securing solenoid to control valve.
22. Connect solenoid multiplug and secure to solenoid bracket.
23. Fit evaporator/blower motor assembly. **See evaporator/blower motor assembly - rear; Refit**

**CONTROL VALVE - HIGH PRESSURE PIPE - REAR**

Service repair no - 82.26.05

Remove

1. Remove evaporator/blower motor assembly. **See evaporator/blower motor assembly - rear**



82M0414

2. Release multiplug clip from solenoid bracket.
3. Disconnect solenoid multiplug.
4. Loosen 2 control valve unions.



**CAUTION:** Use 2 spanners when loosening or tightening air conditioning pipe unions.

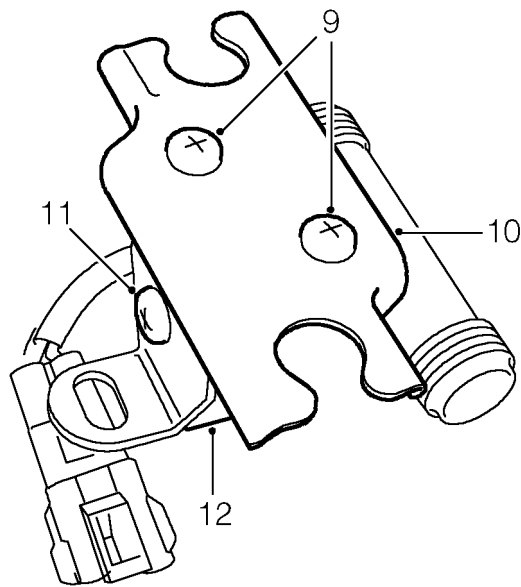
5. Remove 2 screws securing control valve to blower motor housing.
6. Release unions from control valve.
7. Remove and discard 2 'O' ring seals from control valve.



**CAUTION:** Immediately plug air conditioning connections.

8. Remove control valve assembly.





82M0415

9. Remove 2 screws securing mounting bracket to control valve.
10. Remove mounting bracket.
11. Noting the direction arrow on control valve, remove screw securing solenoid to valve.
12. Remove solenoid from valve.

### Refit

13. Fit solenoid to valve.
14. Fit but do not tighten screw securing solenoid to control valve.



**NOTE: Ensure arrow on control valve is pointing in the correct recorded direction.**

15. Position mounting bracket to control valve solenoid and secure with screws.
16. Remove plugs from unions and control valve connections.
17. Lubricate NEW 'O' rings with refrigerant oil and fit to valve.
18. Fit control valve to pipes, connect unions, but do not tighten.
19. Fit and tighten screws securing control valve mounting bracket to blower motor housing.
20. Tighten control valve unions to **14 Nm**.



**CAUTION: Use 2 spanners when loosening or tightening air conditioning pipe unions.**

21. Tighten screw securing solenoid to control valve.
22. Connect solenoid multiplug and secure to solenoid bracket.
23. Fit evaporator/blower motor assembly. **See evaporator/blower motor assembly - rear; Refit**

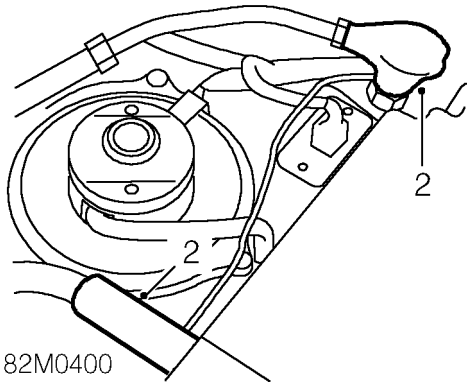


**EXPANSION VALVE - REAR**

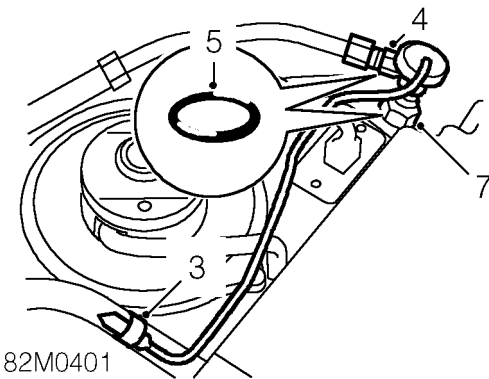
Service repair no - 82.26.07

**Remove**

1. Remove evaporator/blower motor assembly. **See evaporator/blower motor assembly - rear**



2. Remove foam insulation from expansion valve and expansion valve probe.



3. Remove expansion valve probe retaining clip.
4. Loosen expansion valve unions.



**CAUTION: Use 2 spanners when loosening or tightening air conditioning pipe unions.**

5. Remove and discard 'O' rings from evaporator and air conditioning pipes.
6. Plug expansion valve and connections.
7. Remove expansion valve.

**Refit**

8. Position expansion valve probe to evaporator pipe and secure with clip.
9. Remove plugs from expansion valve and connections.
10. Lubricate NEW 'O' rings and fit to pipes.
11. Position expansion valve to pressure pipe and tighten union to **14 Nm**.
12. Position expansion valve to evaporator pipe and tighten union to **22 Nm**.



**CAUTION: Use 2 spanners when loosening or tightening air conditioning pipe unions.**

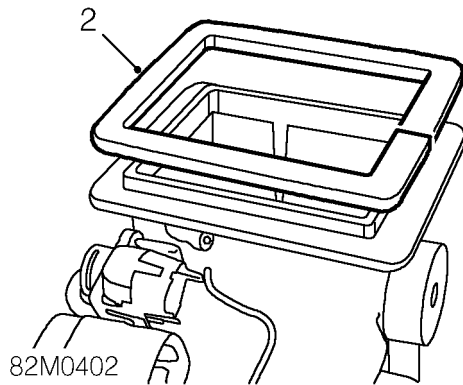
13. Remove backing paper from NEW foam insulation.
14. Fit foam insulation to expansion valve and expansion valve probe.
15. Fit evaporator/blower motor assembly. **See evaporator/blower motor assembly - rear; Refit**

## EVAPORATOR - REAR

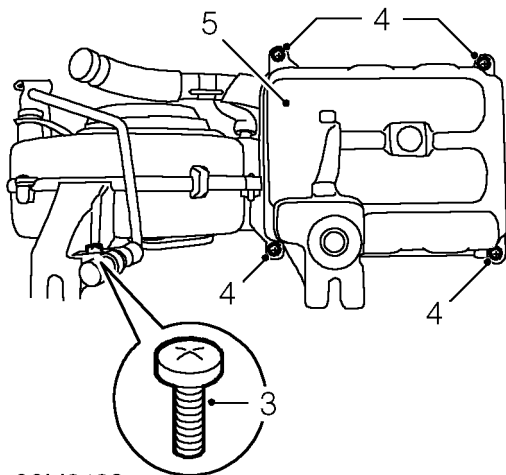
Service repair no - 82.26.08

## Remove

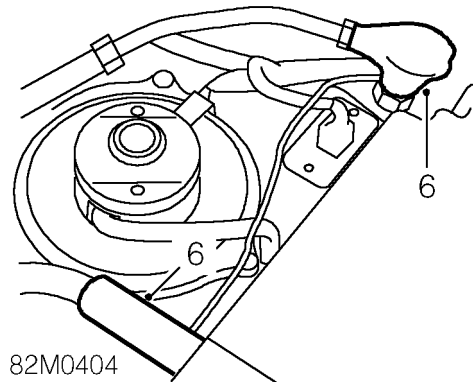
1. Remove evaporator/blower motor assembly harness. **See harness - evaporator/blower motor assembly - rear**



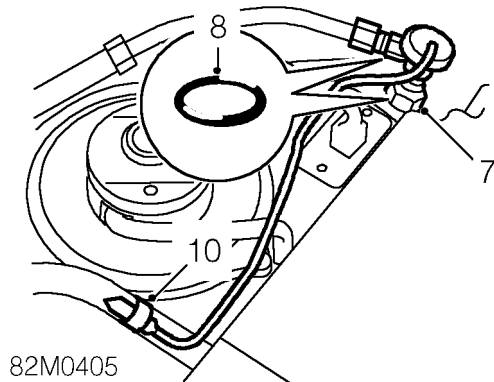
2. Remove foam seal from evaporator to alpine light duct flange.



3. Remove screw securing air conditioning pressure pipe 'P' clip to casing.
4. Remove 4 screws securing evaporator/blower motor lower casing.
5. Remove lower casing.



6. Remove foam insulation from expansion valve and expansion valve probe.

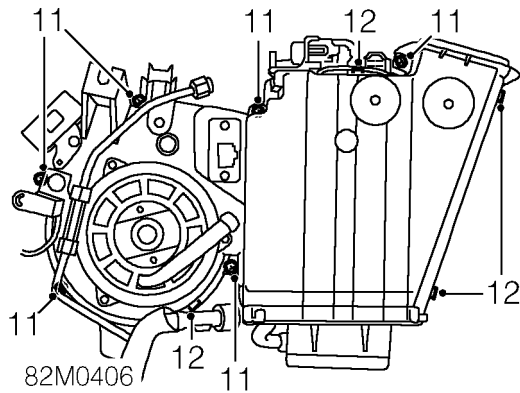


7. Loosen expansion valve to evaporator union.

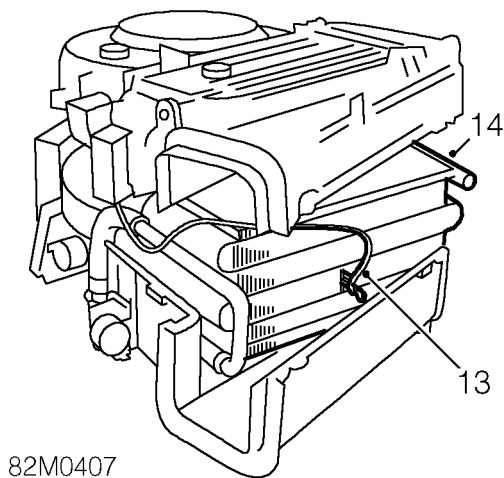


**CAUTION: Use 2 spanners when loosening or tightening air conditioning pipe unions.**

8. Remove and discard 'O' ring from evaporator pipe.
9. Plug expansion valve to evaporator connections.
10. Remove expansion valve probe retaining clip.



- 11. Remove 6 screws securing evaporator/blower motor casing halves.
- 12. Remove 4 clips securing evaporator/blower motor casing halves.



- 13. Separate evaporator/blower motor casing whilst extracting the thermostat probe from evaporator matrix.
- 14. Remove evaporator.

**Refit**

- 15. Position evaporator and align to casing.
- 16. Position casing halves together whilst inserting thermostat probe into evaporator matrix.



**NOTE: Ensure thermostat probe is positioned correctly through casing.**

- 17. Fit clips securing evaporator/blower motor casing halves.
- 18. Fit and tighten screws securing evaporator/blower motor casing halves.
- 19. Position expansion valve probe to evaporator pipe and secure with clip.
- 20. Remove plugs from expansion valve and evaporator pipe connections.
- 21. Lubricate NEW 'O' ring and fit to evaporator pipe.
- 22. Position expansion valve to evaporator pipe and tighten union to **22 Nm**.



**CAUTION: Use 2 spanners when loosening or tightening air conditioning pipe unions.**

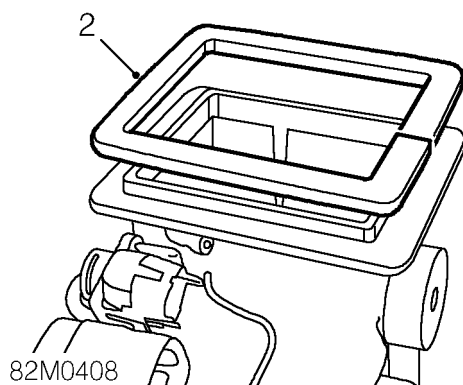
- 23. Remove backing paper from NEW foam insulation.
- 24. Fit foam insulation to expansion valve and expansion valve probe.
- 25. Position evaporator/blower motor lower casing and secure with screws.
- 26. Position air conditioning pressure pipe 'P' clip to evaporator/ blower motor casing and secure with screw.
- 27. Remove backing paper from NEW foam, evaporator to alpine light duct, flange seal.
- 28. Fit foam seal to evaporator/blower motor casing flange.
- 29. Fit evaporator/blower motor assembly harness. **See harness - evaporator/blower motor assembly - rear; Refit**

## THERMOSTAT - REAR

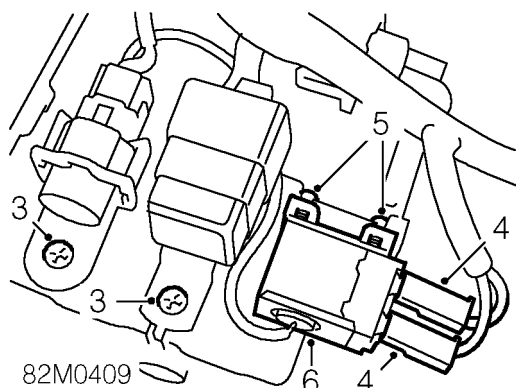
Service repair no - 82.26.09

## Remove

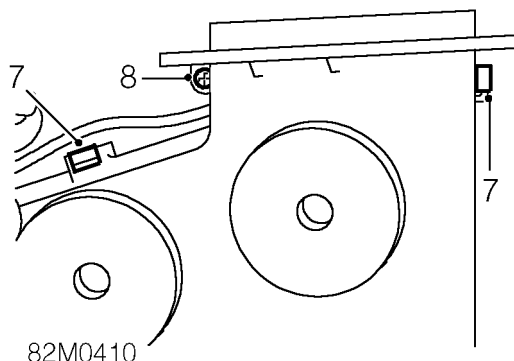
1. Remove evaporator/blower motor assembly harness. **See harness - evaporator/blower motor assembly - rear**



2. Remove foam seal from evaporator to alpine light duct flange.



3. Remove screws securing 2 relay mounting brackets to evaporator/blower motor casing and position aside.
4. Disconnect 2 Lucars from thermostat.
5. Loosen 2 screws securing thermostat.
6. Release thermostat from bracket.



7. Remove 2 clips securing evaporator/blower motor casing halves.
8. Remove screw securing evaporator/blower motor casing halves.
9. Separate casing sufficiently to enable removal of thermostat probe from casing.
10. Remove thermostat.

## Refit

11. Position thermostat fixings to casing and tighten screws.
12. Connect Lucars to thermostat.
13. Separate casing sufficiently to enable fitment of thermostat probe to casing.
14. Fit and tighten screw securing casing halves.
15. Fit clips securing casing halves.
16. Remove backing paper from NEW foam, evaporator to alpine light duct, flange seal.
17. Fit foam seal to evaporator/blower motor casing flange.
18. Fit evaporator/blower motor assembly harness. **See harness - evaporator/blower motor assembly - rear; Refit**

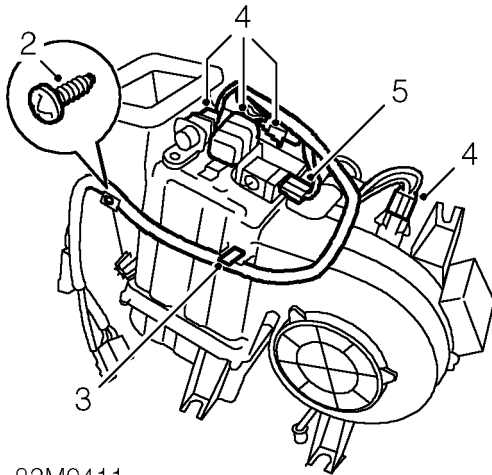


## HARNESS - EVAPORATOR/BLOWER MOTOR ASSEMBLY - REAR

Service repair no - 82.26.12

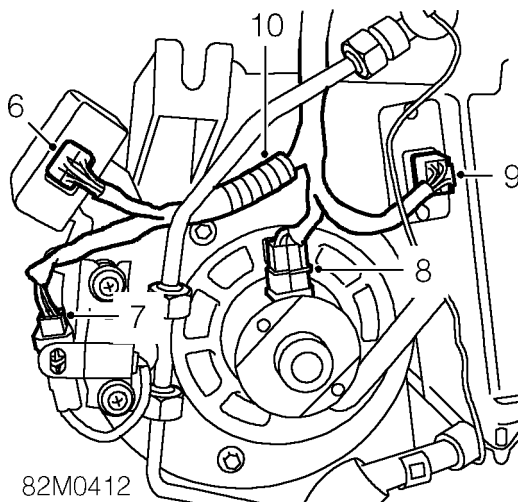
### Remove

1. Remove evaporator/blower motor assembly. **See evaporator/blower motor assembly - rear**



82M0411

2. Remove screw securing harness retaining clip to casing.
3. Release harness clip from casing tag.
4. Disconnect 4 relay multiplugs.
5. Disconnect 2 Lucars from thermostat.



82M0412

6. Disconnect multiplug from ECU.
7. Release control valve solenoid multiplug from mounting bracket and disconnect multiplug.
8. Disconnect multiplug from blower motor.
9. Disconnect multiplug from resistor.
10. Remove harness.

### Refit

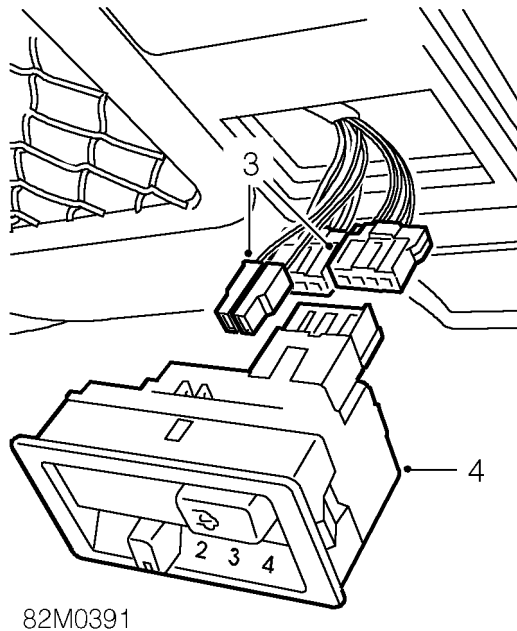
11. Fit harness and route into position.
12. Connect multiplug to resistor.
13. Connect multiplug to blower motor.
14. Connect control valve solenoid multiplug and secure multiplug to mounting bracket.
15. Connect multiplug to ECU.
16. Connect Lucars to thermostat.
17. Connect multiplugs to relays.
18. Secure harness clip to casing tag.
19. Fit screw securing harness retaining clip to casing.
20. Fit evaporator/blower motor assembly. **See evaporator/blower motor assembly - rear; Refit**

## REAR AIR CONDITIONING SWITCH

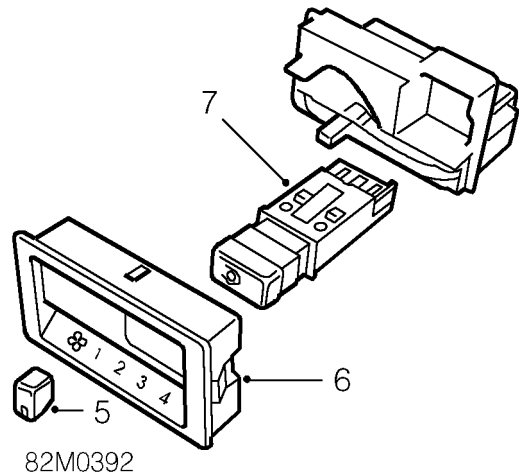
Service repair no - 82.26.14

### Remove

1. Open rear door.
2. Release switch pack from headlining panel.



3. Disconnect 2 multiplugs and 2 Lucars from switch pack.
4. Remove switch pack assembly.



5. Remove blower motor control knob.
6. Release 3 tags securing switch pack display panel and remove panel.
7. Remove switch from switch pack.

### Refit

8. Fit switch to switch pack.
9. Fit display panel and secure to tags.
10. Fit blower motor control knob.
11. Position switch pack assembly, connect multiplugs and Lucars and secure to headlining panel.
12. Close rear door.

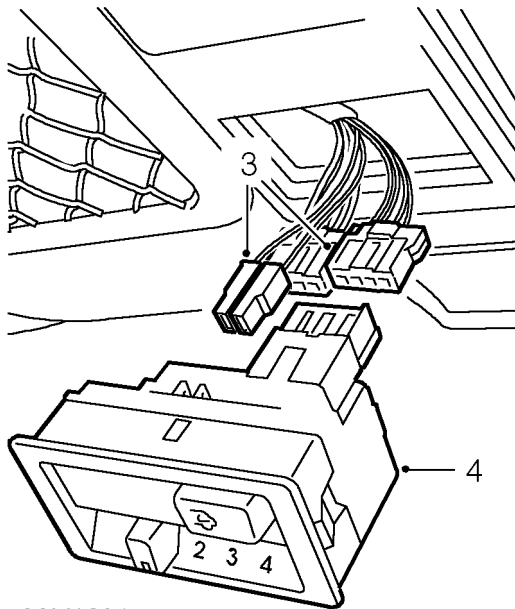


**REAR BLOWER MOTOR SWITCH**

Service repair no - 82.26.15

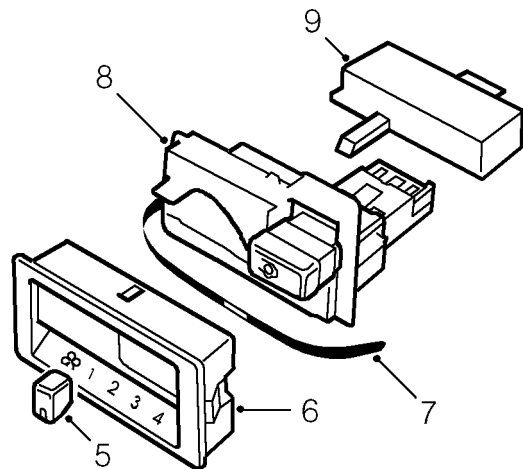
**Remove**

1. Open rear door.
2. Release switch pack from headlining panel.



82M0391

3. Disconnect 2 multiplugs and 2 Lucars from switch pack.
4. Remove switch pack assembly.



82M0393

5. Remove blower motor control knob.
6. Release 3 tags securing switch pack display panel and remove panel.
7. Remove switch position illumination mask.
8. Release 3 tags securing blower motor switch to switch pack.
9. Remove blower motor switch.

**Refit**

10. Fit blower motor switch and secure to tags.
11. Fit switch position illumination mask.
12. Fit display panel and secure to tags.
13. Fit blower motor control knob.
14. Position switch pack assembly, connect multiplugs and Lucars and secure to headlining panel.
15. Close rear door.

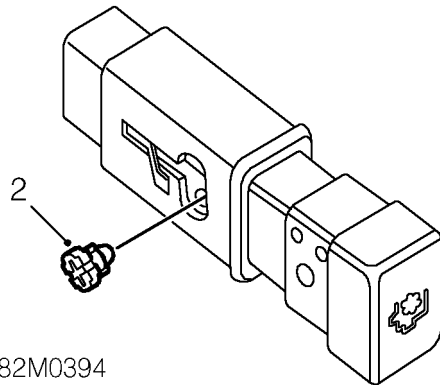


**BULB - REAR AIR CONDITIONING SWITCH**

Service repair no - 82.26.16

**Remove**

1. Remove rear air conditioning switch. **See rear air conditioning switch**



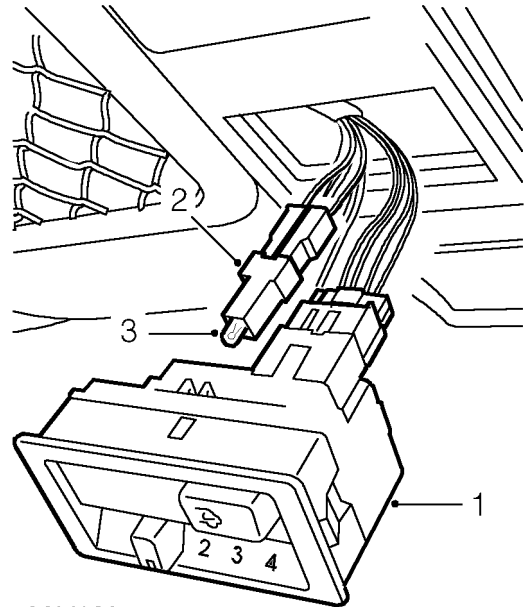
2. Remove bulb from switch.

**Refit**

3. Fit NEW bulb to switch and secure.
4. Fit rear air conditioning switch. **See rear air conditioning switch; Refit**

**BULB - REAR AIR CONDITIONING SWITCH PACK**

Service repair no - 82.26.17

**Remove**

1. Release rear air conditioning switch pack from headlining panel.
2. Release bulb holder from switch pack.
3. Remove bulb from bulb holder.

**Refit**

4. Fit NEW bulb to holder.
5. Secure bulb holder to switch pack.
6. Secure switch pack to headlining panel.

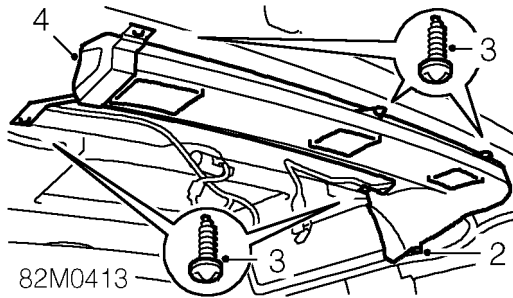


**AIR DUCT - CENTRE - WITH REAR AIR CONDITIONING FITTED - 5 DOOR**

Service repair no - 82.26.18

**Remove**

1. Remove headlining. **See CHASSIS AND BODY, Repair, headlining - with sun roof and rear air conditioning fitted - 5 door**



2. Release harness clip from centre air duct.
3. Remove 5 screws securing centre air duct to body.
4. Remove centre air duct.

**Refit**

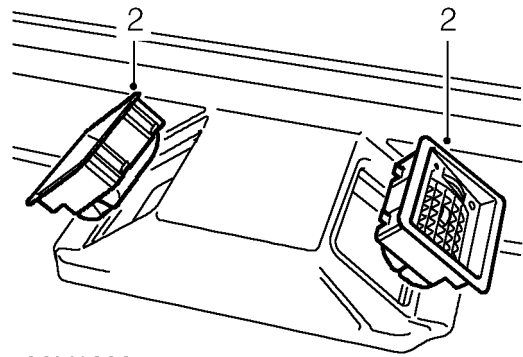
5. Position centre duct, fit screws and tighten.
6. Secure harness clip to centre air duct.
7. Fit headlining. **See CHASSIS AND BODY, Repair, headlining - with sun roof and rear air conditioning fitted - 5 door; Refit**

**UPPER TAIL DOOR AIR DUCT**

Service repair no - 82.26.19

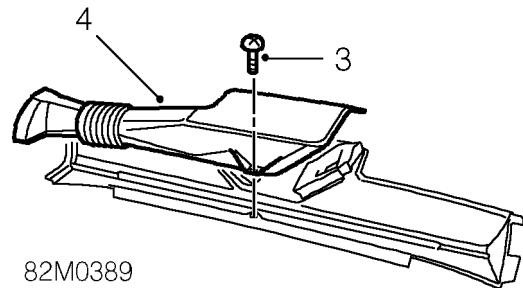
**Remove**

1. Remove rear door upper trim panel. **See CHASSIS AND BODY, Repair, rear door upper trim panel - with rear air conditioning fitted**



82M0388

2. Remove 2 vents from trim panel.



82M0389

3. Remove screw securing rear header duct to trim panel.
4. Remove rear header duct.

**Refit**

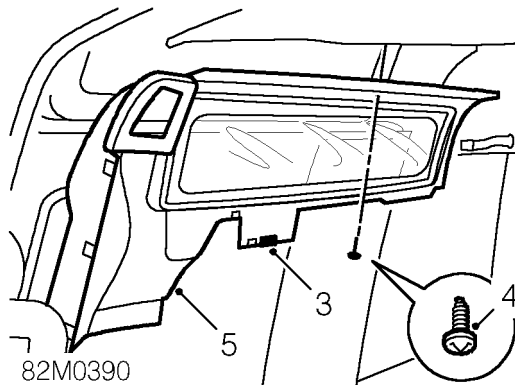
5. Fit rear header duct to new trim panel and secure with screw.
6. Fit vents to trim panel.
7. Fit rear door upper trim panel. **See CHASSIS AND BODY, Repair, rear door upper trim panel - with rear air conditioning fitted; Refit**

**ALPINE LIGHT DUCT**

Service repair no - 82.26.21

**Remove**

1. Remove evaporator to alpine light duct. *See evaporator to alpine light duct*
2. Remove rear door upper trim panel. *See CHASSIS AND BODY, Repair, rear door upper trim panel - with rear air conditioning fitted*



3. Remove clip securing alpine light duct to body flange.
4. Remove screw securing alpine light duct.
5. Manoeuvre alpine light duct from headlining and 'D' post finishers and remove duct.

**Refit**

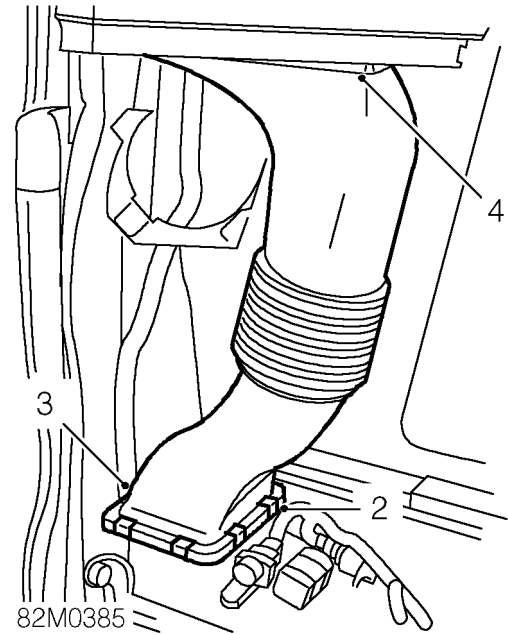
6. Position alpine duct and manoeuvre into position.
7. Fit and tighten screw securing alpine duct to body.
8. Fit clip securing alpine duct to body flange.
9. Fit rear door upper trim panel. *See CHASSIS AND BODY, Repair, rear door upper trim panel - with rear air conditioning fitted; Refit*
10. Fit evaporator to alpine light duct. *See evaporator to alpine light duct; Refit*

**EVAPORATOR TO ALPINE LIGHT DUCT**

Service repair no - 82.26.22

**Remove**

1. Remove rear compartment lower trim panel. *See CHASSIS AND BODY, Repair, rear compartment lower trim panel - lh - with rear air conditioning fitted*



2. Remove 4 clips securing duct to evaporator.
3. Release duct from evaporator.
4. Remove duct from alpine light.

**Refit**

5. Fit duct to alpine light.
6. Position duct to evaporator ensuring rear of duct flange is positioned beneath body panel flange.
7. Fit clips securing duct to evaporator.
8. Fit rear compartment lower trim panel. *See CHASSIS AND BODY, Repair, rear compartment lower trim panel - lh - with rear air conditioning fitted; Refit*



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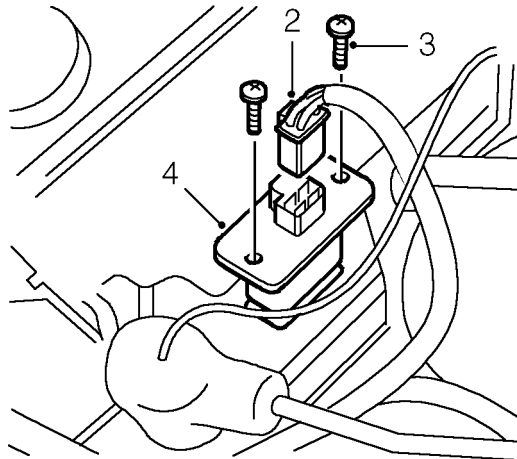
**BLOWER MOTOR RESISTOR - REAR**

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Service repair no - 82.26.23

**Remove**

1. Remove evaporator/blower motor assembly. **See evaporator/blower motor assembly - rear**



82M0387

2. Disconnect multiplug from resistor.
3. Remove 2 screws securing resistor to blower motor casing.
4. Remove resistor.

**Refit**

5. Fit resistor to blower motor casing and secure with screws.
6. Connect multiplug to resistor.
7. Fit evaporator/blower motor assembly. **See evaporator/blower motor assembly - rear; Refit**



**TORQUE VALUES**



**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
<b>Air conditioning</b>	
Compressor flange bolts .....	10
Receiver drier union bolts .....	6
Dual pressure switch .....	11
Pressure pipe union nuts - M16 .....	14
Discharge pipe union nuts - M22 .....	22
Suction pipe union nuts - M24 .....	33

**AIR CONDITIONING CHARGE DATA**

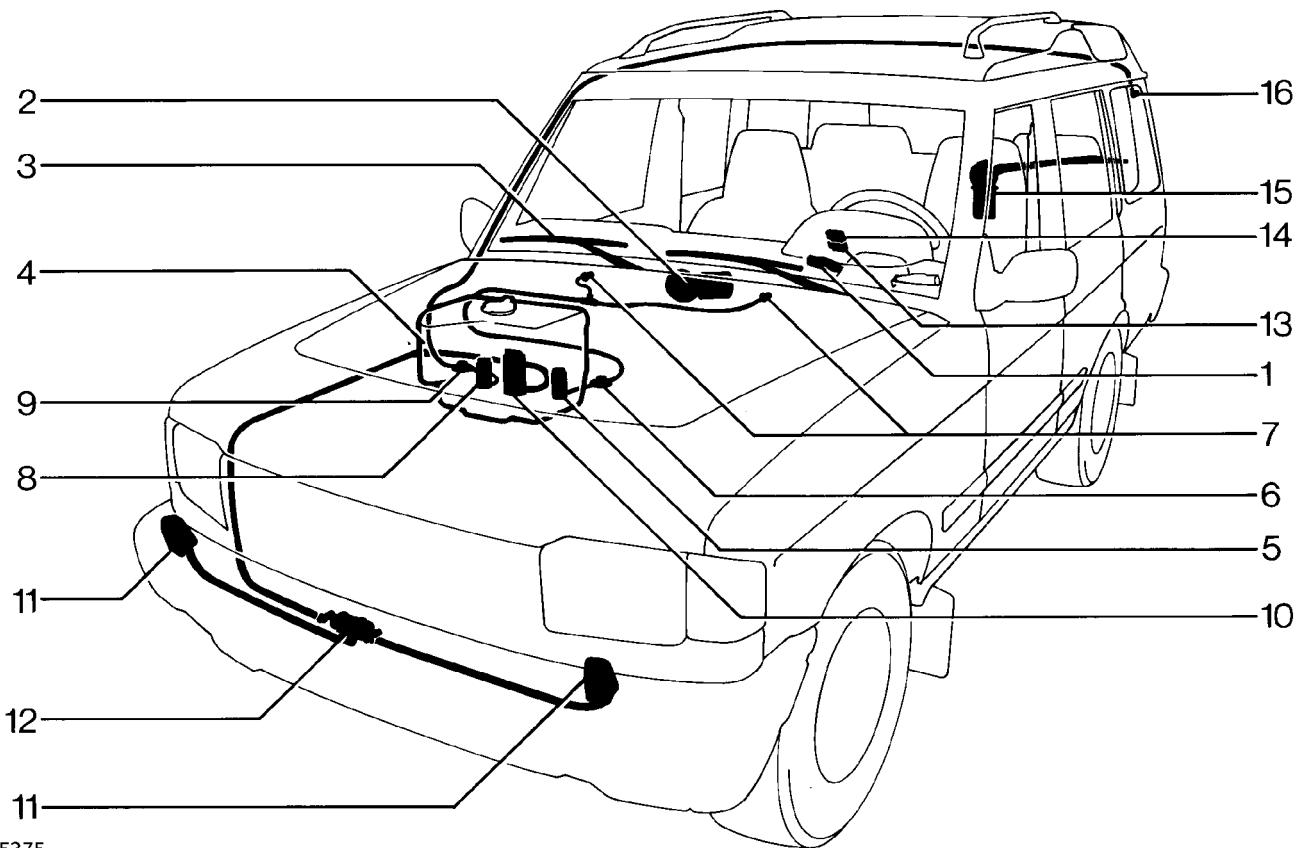
Total oil in system .....	180ml - 6.3Fl oz
Total refrigerant in system .....	0,90kg - 32Fl oz
Total refrigerant in system with rear air conditioning .....	1,15kg - 40Fl oz



**WINDSCREEN WIPER AND WASHER OPERATION**

The illustration below locates and identifies the main components of the windscreen and washer system which is operated by a multi-switch on the right hand side of the steering column.

All functions of the system are described in the following paragraphs.



J5375

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>1. Multi-switch</li> <li>2. Wiper motor</li> <li>3. Wiper arm/blade</li> <li>4. Washer reservoir</li> <li>5. Windscreen washer motor/pump</li> <li>6. Non return valve</li> <li>7. Washer jet</li> <li>8. Rear window washer motor pump</li> <li>9. Non return valve</li> </ul> | <ul style="list-style-type: none"> <li>10. Headlamp power wash motor/pump</li> <li>11. Headlamp power washer jet</li> <li>12. Non return valve</li> <li>13. Rear window wiper switch</li> <li>14. Rear window washer switch</li> <li>15. Rear window wiper motor, arm and blade</li> <li>16. Washer jet</li> </ul> |
|--|--|

### Wash wipe function

With the ignition switched on, power is supplied via a fuse to the multi-switch, a control unit and a park switch which is driven by the wiper motor.

#### Single wipe A

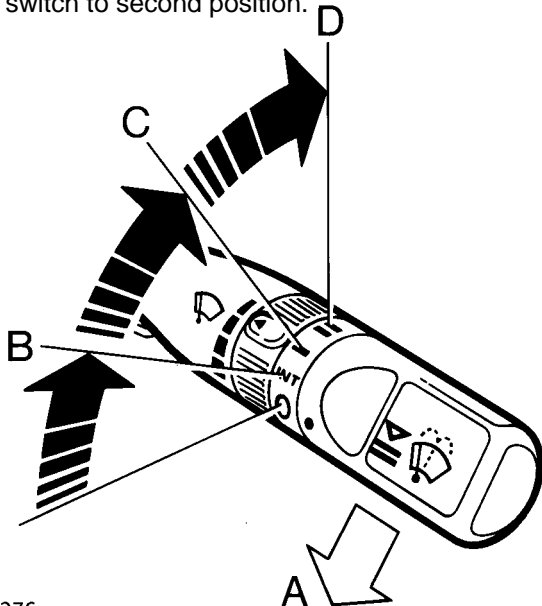
Pull the lever down and release immediately.



**NOTE:** With the lever held down, the wipers will continue operating at high speed until it is released.

#### Intermittent wipe B

Turn switch to second position.



J5376

#### Normal speed wipe C

Turn switch to second position.

#### Fast speed wide D

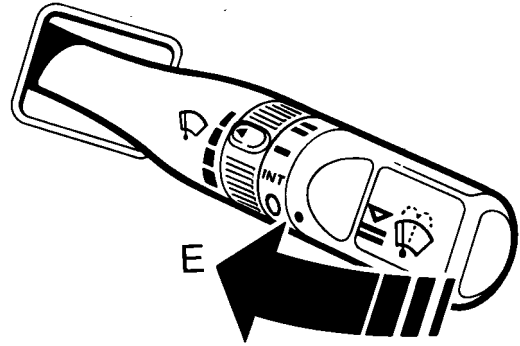
Turn switch to third position.

#### Variable delay (intermittent wipe)

Rotate the switch to vary the delay between wipes.

#### Windscreen washer E

Pull the lever towards the steering wheel. The windscreen washers will operate in conjunction with the wipers for as long as the lever is held in this position.



J5377

### Headlamp washers

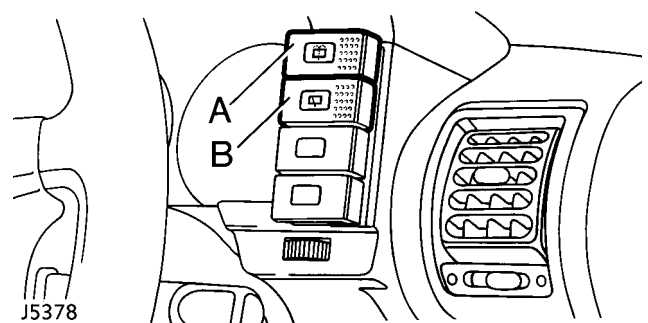
The headlamp washers operate automatically whenever the windscreen washers are operated, provided the headlamps are illuminated and switched to dipped beam. For continuous washing, hold the windscreen washer control in the wash position E.

### REAR WINDOW WIPER AND WASHER OPERATION

The illustration J5375 also locates and identifies the main components of the rear window wiper and washer system which is operated by two switches mounted on the right hand side of the instrument binnacle.

#### Rear window wipe A

Press the switch to operate: after continuously wiping 3 or 4 times, the wiper operates intermittently (approx once every 6 seconds) until switched off.



J5378

#### Rear window washer B

Press and hold the switch for the required duration of rear screen washing. The wiper operates automatically during washing and continues for a further 3 wipes after the switch is released.



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**WIPER MOTOR CHECKING**

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**NOTE: These instructions apply to windscreen and rear window wiper motor.**

If unsatisfactory operation of wiping equipment is experienced, a systematic check to determine fault should be carried out:

1. Check blades for signs of excessive friction. This reduces wiping speed of motor and cause increased current draw which may damage armature. Check by substitution.
2. Check windscreen wiper motor light running current and speed with motor coupling link disconnected from wiper shaft transmission linkage.

Check rear window glass wiper motor with wiper connected and glass wet. Connect an ammeter in series with motor supply. Measure current consumption when motor is switched on. Check operating speed by timing speed of rotation of motor coupling link. The results should compare with figures given in 'General Specification Data'.



**NOTE: If vehicle wiring connections are disconnected and an alternative supply source is applied it is essential that correct polarity is observed. Failure to observe this will cause motor to rotate in reverse direction, which may result in limit switch contacts being damaged.**

3. If motor does not run satisfactorily or takes higher than normal current, a fault exists and must be remedied.
4. If current consumption and speed of motor are satisfactory. A check should be carried out for proper functioning of transmission linkage and wiper arm shafts.



**NOTE: Service parts are not available for windscreen and rear window wiper motors with exception of windscreen wiper rotary connecting link.**

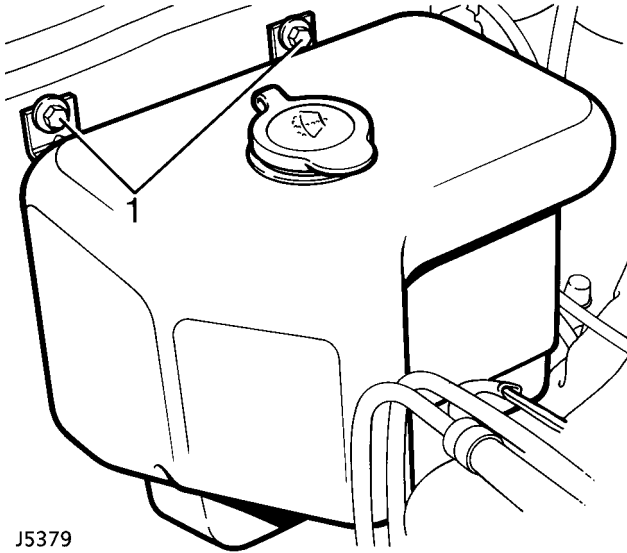




**WASHER RESERVOIR**

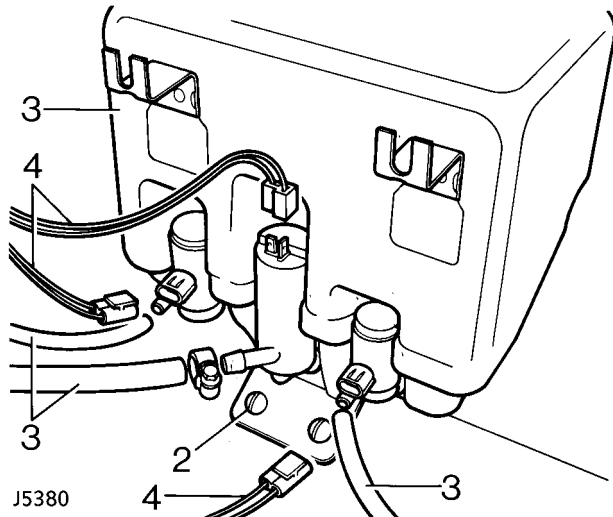
Service repair no - 84.10.03.

Remove



J5379

1. Remove two bolts securing top of reservoir.



J5380

2. From underneath the wheelarch remove two bolts securing base of reservoir.
3. Withdraw reservoir and disconnect tubing from washer pumps and power wash.
4. Disconnect electrical leads from pumps.

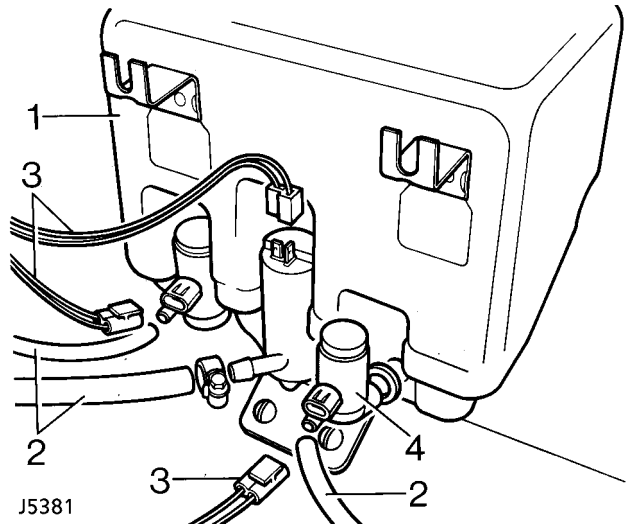
Refit

5. Reverse removal procedure. 1 to 4.

**WASHER PUMP - WINDSCREEN, REAR WINDOW OR POWER WASH**

Service repair no - 84.20.21.

Remove



J5381

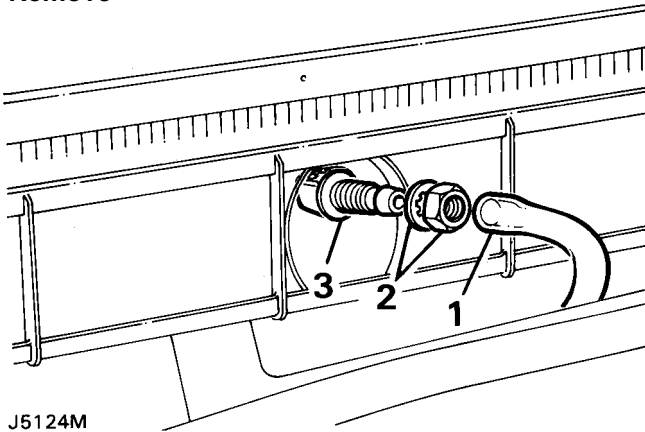
1. Remove washer reservoir. **See Washer reservoir**
2. Disconnect washer tubing from pump.
3. Disconnect electrical leads from pump.
4. Pull top of pump away from its location in reservoir and remove pump.  
Note position of sealing gasket in reservoir.

Refit

5. Reverse removal procedure. 1 to 4.

**WINDSCREEN WASHER JETS**

Service repair no - 84.10.09.

**Remove**

J5124M

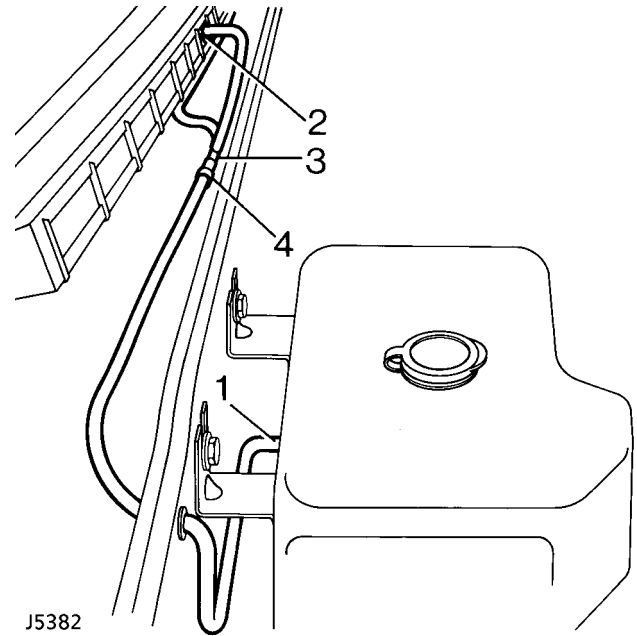
1. Disconnect washer tube from jet.
2. Remove nut and washer securing washer jet to air intake cowl.
3. Remove jet.

**Refit**

4. Reverse removal procedure. 1 to 3.

**WINDSCREEN WASHER TUBES**

Service repair no - 84.10.15.

**Remove**

J5382

1. Disconnect tubing from reservoir pump.
2. Disconnect tubing from washer jets.
3. Disconnect tubing from three-way tee piece.
4. Release tubing from retaining clip and withdraw.

**Refit**

5. Reverse removal procedure. 1 to 4. Ensuring the tubing is not pinched or restricted.

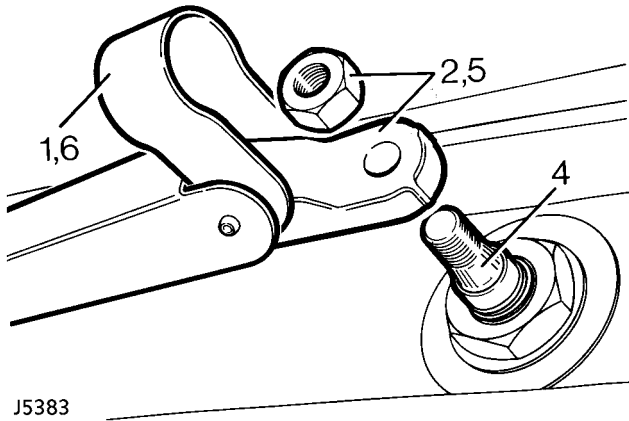


**WIPER ARMS - WINDSCREEN**

Service repair no - 85.15.01.

**Remove**

1. Lift wiper arm end cap to gain access to securing nut.
2. Remove nut and withdraw wiper arm from splined boss.



J5383

**Refit**

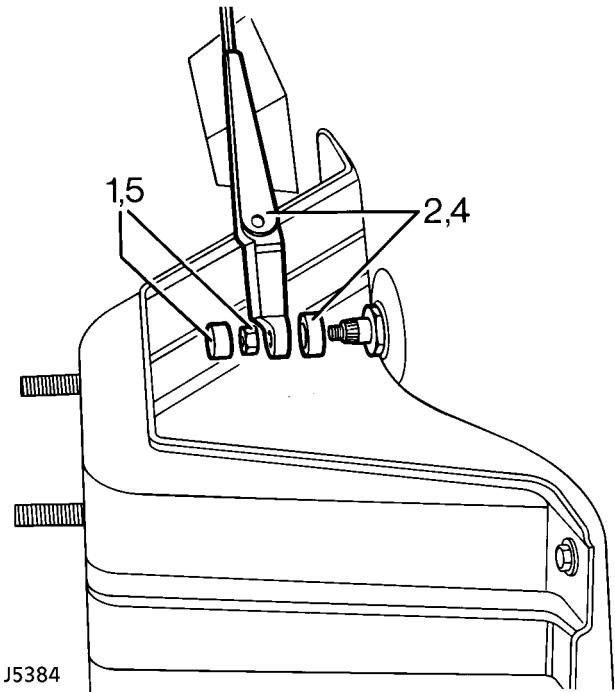
3. Allow wiper motor to move to 'park' position.
4. Push arm onto splined boss, locating it so that wiper blades are clear of windscreen rail.
5. Fit and tighten securing nut.
6. Push end cap over securing nut.
7. Operate wiper on a wet windscreen to ensure blades do not over travel.

**WIPER ARM - REAR WINDOW**

Service repair no - 84.35.01.

**Remove**

1. Remove plastic nut cover and wiper arm securing nut.
2. Withdraw wiper arm and grommet from splined boss.



J5384

**Refit**

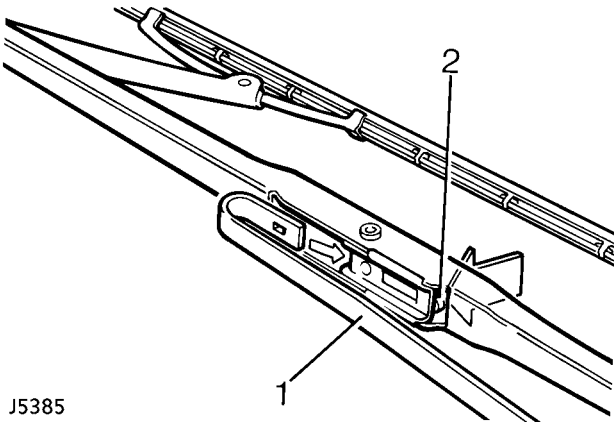
3. Allow wiper motor to move to 'park' position.
4. Fit spacer and wiper arm to splined boss so that the wiper blade is clear of rear window surround.
5. Fit and tighten securing nut.
6. Push plastic nut cover into position.
7. Check operation of wiper.

**WIPER BLADES**

Service repair no - 84.15.05

**Remove**

1. Pull wiper blade away from screen.
2. Depress spring clip and withdraw blade from hooked end of wiper arm.



J5385

**Refit**

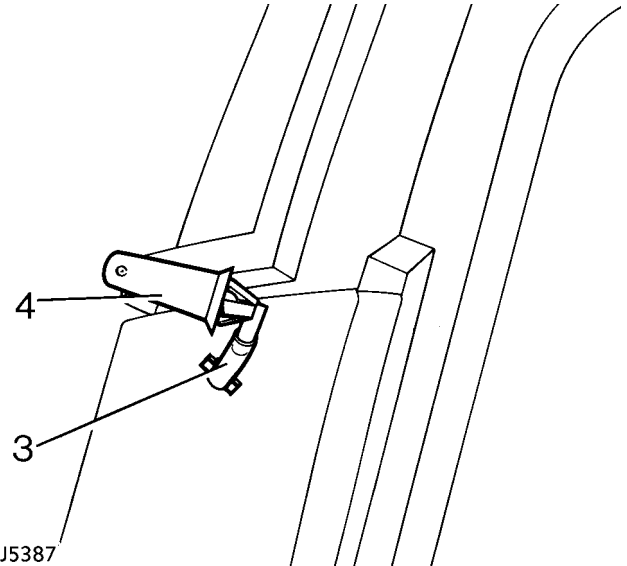
3. Reverse removal procedure. 1 and 2.

**REAR WINDOW WASHER JET**

Service repair no - 84.30.09

**Remove**

1. Turn washer jet in a clockwise direction to release it from the rear quarter panel.
2. Remove rear quarter/speaker trim panel.



J5387

3. Feed washer tubing through rear quarter panel to allow removal of washer jet.
4. Remove washer jet from tubing.

**Refit**

5. Reverse removal procedure. 1 to 4.



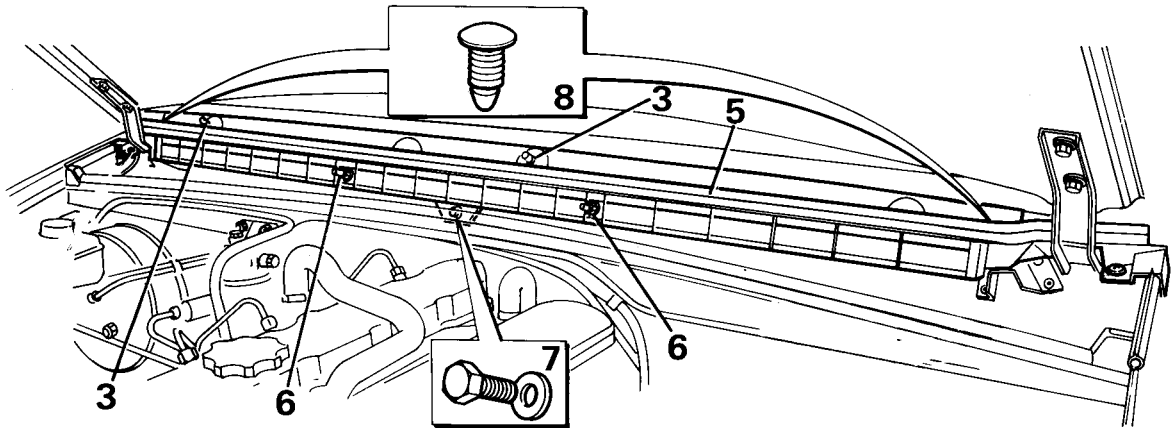
**NOTE:** The tubing run from the reservoir to rear door washer jet differs between left and right hand drive vehicles. On right hand vehicles the tubing run is on the left hand side of the roof. On left hand drive vehicles, the right side. See *Description and operation, Windscreen Wiper and Washer Operation*



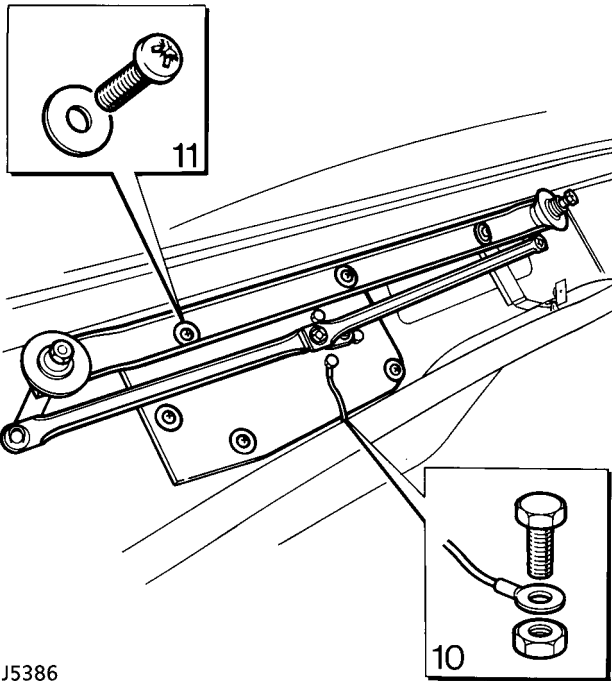
**WINDSCREEN WIPER MOTOR AND LINKAGE**

Service repair no - 84.15.12.

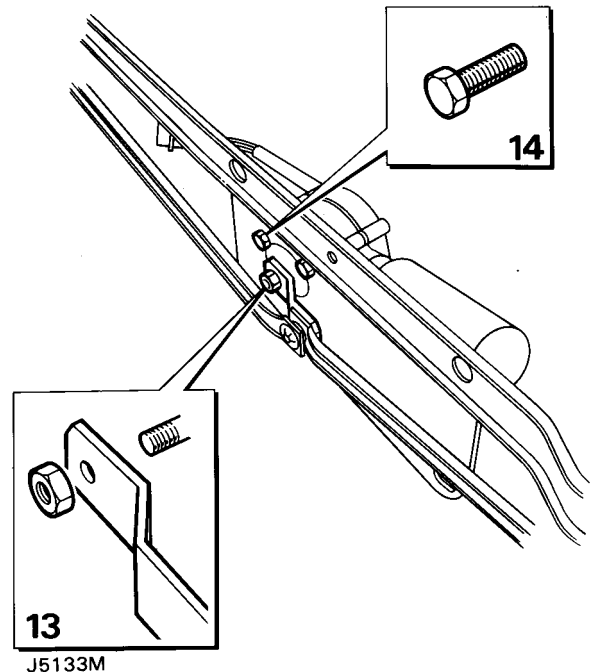
Remove



J5131M



J5386



J5133M

1. Disconnect battery negative lead.
2. Remove windscreen wiper arms. *See Wiper arms - Windscreen*
3. Remove securing nuts and steel and rubber washer from wiper spindles.
4. Open the bonnet [hood].
5. Remove rubber seal from cowl flange.
6. Disconnect tubing from windscreen washer jets.
7. Remove centre bolt from cowl.
8. Remove retainers securing centre section of cowl to outer sections.
9. Detach centre section of cowl.
10. Remove nut and bolt securing wiper motor negative lead to body.
11. Remove five screws securing wiper motor/linkage support plate.
12. Lift assembly clear of bulkhead, disconnect wiper motor multi-plug and withdraw assembly.
13. Remove wiper motor spindle nut and release rotary connecting link from spindle.
14. Remove wiper motor retaining bolts and withdraw negative lead and wiper motor from support plate.
15. The linkage arms can be detached by removing the retaining clips and withdrawing the arms and washers.  
Note location of plain and wavy washers for reassembly purposes.

## Refit

16. Reverse removal procedure.
17. Fit wiper motor to support plate using new sealing bushes at the motor spindle as necessary.
18. When positioning assembled motor and support plate use a new seal and bushes, if necessary.

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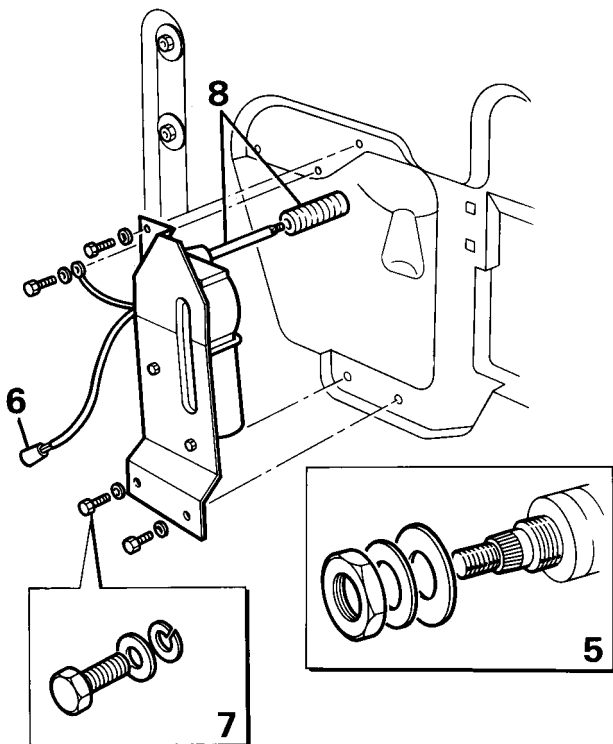
**REAR DOOR WIPER MOTOR**


---

Service repair no - 84.35.12.

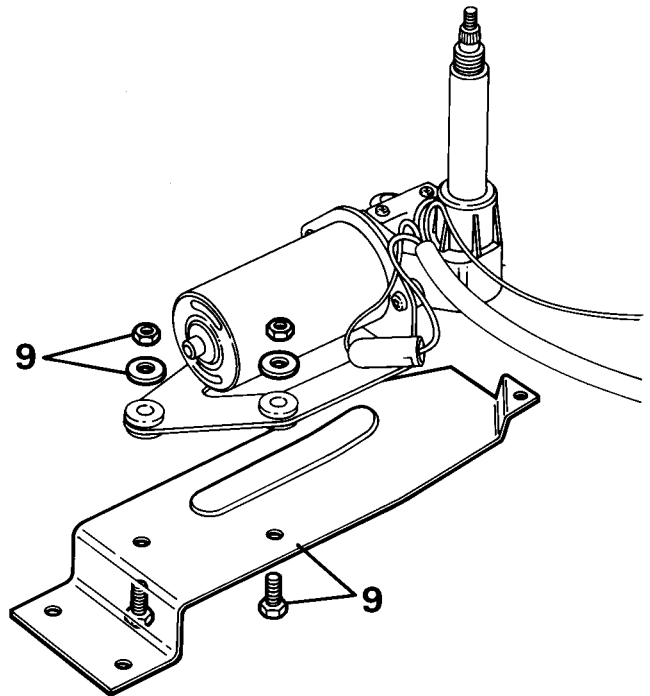
## Remove

1. Disconnect battery negative lead.
2. Remove rear door trim panel.
3. Remove spare wheel.



J5134M

4. Remove wiper arm and grommet.
5. Remove nut, plain washer and seal from drive spindle.
6. From inside the door, disconnect wiper motor leads from door harness at multi-plug.
7. Remove bolts securing wiper motor mounting bracket and negative lead to inner door panel.
8. Withdraw motor spindle from outer door panel and manoeuvre wiper motor from door casing complete with the spindle spacer.
9. Remove two rubber mounted nuts securing mounting bracket to motor and detach bracket.



J5135M

## Refit

10. Reverse removal procedure. 1 to 9.



**NOTE:** If a new wiper motor assembly has been fitted, before fitting the wiper arm. Reconnect battery negative lead. Operate wiper motor to ensure that motor spindle is in park position.



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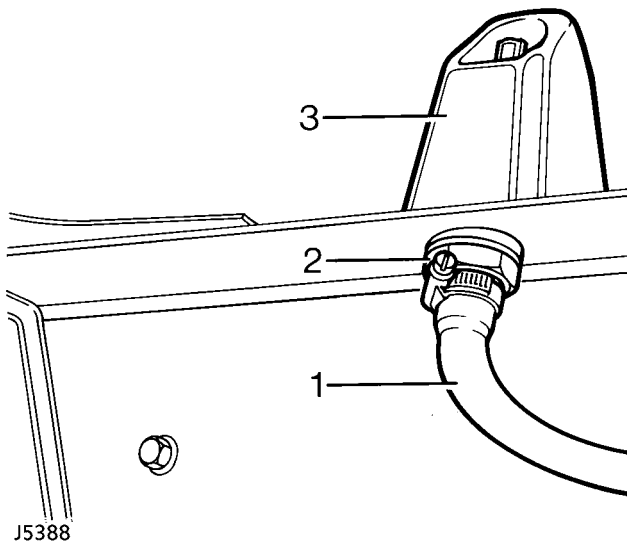
**HEADLAMP POWER WASH JET**

---

Service repair no - 84.20.08

**Remove**

1. Disconnect hose from power wash jet.
2. Remove nut securing jet to bumper.
3. Remove power wash jet.

**Refit**

4. Reverse removal procedure. 1 to 3.

---

**POWER WASH HOSE**

---

Service repair no - 84.20.14

**Remove**

1. Disconnect power wash hoses from jets and washer pump.
2. Release clamps securing hose.
3. Remove power wash hose.

**Refit**

4. Reverse removal procedure. 1 to 3, locating hose in original position.



## ELECTRICAL EQUIPMENT

### DESCRIPTION

The electrical system is Negative ground, and it is most important to ensure correct polarity of the electrical connections at all times. Any incorrect connections made when reconnecting cables may cause irreparable damage to the semi-conductor devices used in the generator and regulator. Incorrect polarity would also seriously damage any transistorized equipment such as radio and tachometer etc.



**WARNING: During battery removal or before carrying out any repairs or maintenance to electrical components always disconnect the battery negative lead first. If the positive lead is disconnected with the negative lead in place, accidental contact of the wrench to any grounded metal part could cause a severe spark, possibly resulting in personal injury. Upon installation of the battery the positive lead should be connected first.**

### GENERATOR

The generator is a three phase, field sensed unit. The rotor and stator windings produce three phase alternating current, AC, which is rectified to direct current, DC. The electronic voltage regulator unit controls the generator output voltage by high frequency switching of the rotor field circuit. Use only the correct Vehicle replacement fan belt. Occasionally check that the engine and generator pulleys are accurately aligned.

It is essential that good electrical connections are maintained at all times. Of particular importance are those in the charging circuit (including those at the battery) which should be occasionally inspected to see that they are clean and tight. In this way any significant increase in circuit resistance can be prevented.

Do not disconnect battery cables while the engine is running or damage to the semi-conductor devices may occur. It is also inadvisable to break or make any connections in the generator charging and control circuits while the engine is running.

The electronic voltage regulator employs micro-circuit techniques resulting in improved performance under difficult service conditions. The whole assembly is encapsulated in silicone rubber and housed in an aluminium heat sink, ensuring complete protection against the adverse effects of temperature, dust, and moisture etc.

The regulating voltage is set during manufacture to give the required regulating voltage range of  $14.2 \pm 0.2$  volts, and no adjustment is necessary. The only maintenance needed is the occasional check on terminal connections and wiping with a clean dry cloth.

The generator system provides for direct connection of a charge (ignition) indicator warning light, and eliminates the need for a field switching relay or warning light control unit. As the warning lamp is connected in the charging circuit, lamp failure will cause loss of charge. Lamp should be checked regularly and spare carried.

When using rapid charge equipment to re-charge the battery, the battery must be disconnected from the vehicle.



**NOTE: For description and operation of electrical circuits see separate publication: Electrical Troubleshooting Manual.**



## ANTI-THEFT SYSTEM FUNCTION

### Perimetric protection

Using the key in the correct sequence will turn on and off perimetric protection only. When fully perimetrically armed, all doors, and bonnet [hood] are protected against unauthorised access. If the door key is used in the normal manner the driver will be unaware of the door key sequence. The time taken to lock or unlock with the key must be less than 5 seconds. To prevent unauthorised tampering, the alarm will sound if the key is held in the unlocked position for longer than 5 seconds when armed. Cranking is disabled when perimetric protection is armed.



**NOTE: When key is turned left or right the keyswitch input will be activated, in conjunction with the sill button switch when links are operated.**

### Volumetric protection

Using the handset transmitter will turn on and off volumetric protection. In volumetric mode the vehicle interior is protected using the ultrasonic sensor. Using the handset also arms and disarms the vehicle perimetrically. Cranking is disabled when volumetric and perimetric protection is armed.



**NOTE: If armed volumetrically the vehicle CANNOT be disarmed using the key.**

### Alarm horn

When an intrusion is detected the alarm horn will sound intermittently (Switzerland and Denmark continuous horn sound) and the hazard lights flash (where territorial regulations allow) for 30 seconds. The alarm must be retriggered before alarm horn will sound again.

### Vehicle status indication

Vehicle status is indicated by up to three devices: (a) alarm horn, (b) hazard lights, (c) dash board LED. When the vehicle arms in either mode the hazard lights will flash three times and the LED will flash rapidly for 10 seconds. LED will then flash at a slower rate while vehicle is armed. When the vehicle disarms, hazard lights will flash once and LED will extinguish. If LED remains lit, it indicates that the alarm has been triggered. Turning on ignition or arming the alarm will extinguish LED. The LED will give a long pulse flash to indicate the ultrasonic unit being activated.

### Central locking

Central locking is controlled by the alarm ECU and may be operated by the key, sill button(s) or handset. The system works on both front doors on four door vehicles or driver's door on two door vehicles.



**NOTE: The central door locking system will shut down for a short period after more than 15 consecutive operations.**

### Inertia switch

An inertia switch is incorporated in the alarm system ECU. If ignition is on and the vehicle receives an impact sufficient to activate the inertia switch, the ECU will signal to unlock central locking actuators and flash hazard lights. Central locking will remain disabled for 30 seconds. To reset turn ignition off and then on after the 30 second period has elapsed.

### Ultrasonic unit

The unit operates by emitting an air pressure carrier wave and receiving the wave back. Any disturbance within the vehicle which disturbs the wave will be detected, triggering the alarm.

When the volumetric sensor is activated it monitors movement within the vehicle for 15 seconds before detecting and responding to intrusions. If the sensor detects movement within the vehicle it delays arming until a 15 seconds quiet period has elapsed. If continuous movement is detected the alarm will not arm volumetrically.



## Radio frequency system

The RF system uses four frequencies according to market. If the coaxial aerial is not fitted system performance will be impaired. Both ECU and handset have a colour coded label.

Frequency	Colour ECU/Handset	Territory
433.92 MHz .....	Blue/black .....	UK, Ireland
224.5 MHz, .....	Yellow/yellow .....	France
433.92 MHz .....	Blue/Purple .....	Germany
433.92 MHz .....	Blue/blue .....	Europe, not France, Switzerland, Italy, Denmark, Germany
433.92 MHz .....	White/Blue .....	Switzerland, Denmark
315.0 MHz .....	Green/green .....	Rest of world, Italy, Australia
315.0 MHz .....	Orange/Green .....	Gulf, Japan

## Partially armed mode

If a door, tailgate or bonnet [hood] is left open when the system is armed, the LED will not light for 10 seconds indicating a mislock condition. Hazard lights will not flash. If an open door or tailgate is causing the mislock, the starter motor is disabled. The alarm will sound if ignition is turned to start position. If an open bonnet [hood] is causing the mislock the starter motor is disabled. The alarm will arm the volumetric part of the system. If the door tailgate or bonnet [hood] is subsequently closed, after a 5 second delay, the doors will unlock and immediately lock and the system will fully arm.

## Handset transmitter

The handset LED will give one short flash when button is pressed momentarily. If button is held down the LED will light again after 2 seconds for 2 seconds, and extinguish until button is released and repressed. The handset contains unique information distinguishing it from other transmitters. It also contains a set of 'random' rolling codes programmed into the ECU before leaving the factory. Each time the handset is pressed a different code is transmitted to the ECU. If handset is operated more than four times outside the vehicle range (6 metres) or power supply is removed, it will be necessary to re-synchronise handset and the ECU by pressing the handset three times within range and within 5 seconds.



**NOTE: If both handsets are lost or damaged when system is armed it will be necessary to fit a new ECU with two matching handsets.**

## Handset batteries

If handset LED flashes continuously when button is pressed, the batteries need replacing. The hazard lights will flash one 3 second pulse, instead of three times upon arming vehicle.

## Power up mode

The alarm system always remembers the state it was left in when power was removed. If the alarm powers up in an armed state and is subsequently triggered it will give a warning that it will fully trigger unless disarmed. This warning consists of short horn pulses every two seconds for 15 seconds.

## New born mode

When the ECU is first produced, it will be in its 'new born' mode. In this mode it will respond to any remote of the right frequency. This mode will be cancelled when the ECU has received ten valid handset signals without power interruption.

## Engine cranking

It is only possible to crank the engine when ignition is ON and alarm disabled.

---

**BUILT IN TEST PROCEDURE**

---

The built in test procedure is accessed as follows:

1. Starting conditions: ignition off, doors unlocked, bonnet [hood] switch depressed.
2. Carry out instructions 3 to 7 within 8 seconds.
3. Release bonnet [hood] switch.
4. Switch ignition ON.
5. Lock doors.
6. Switch ignition OFF.
7. Switch ignition ON.

If alarm is correctly accessed, horn will sound and LED will flash. The following checks can be made:

8. Open and close any door or tailgate - LED will light.
9. Depress bonnet [hood] switch - hazards will flash.
10. Check engine cranking is disabled. Do not turn off ignition.
11. Check ultrasonic by operating handset, LED will emit one 5 second flash, and will flash if interior is disturbed.



**NOTE: If ECU is new born mode any handset of the right frequency will work. If not an initialised handset is required see**

**Handset Initialisation.**

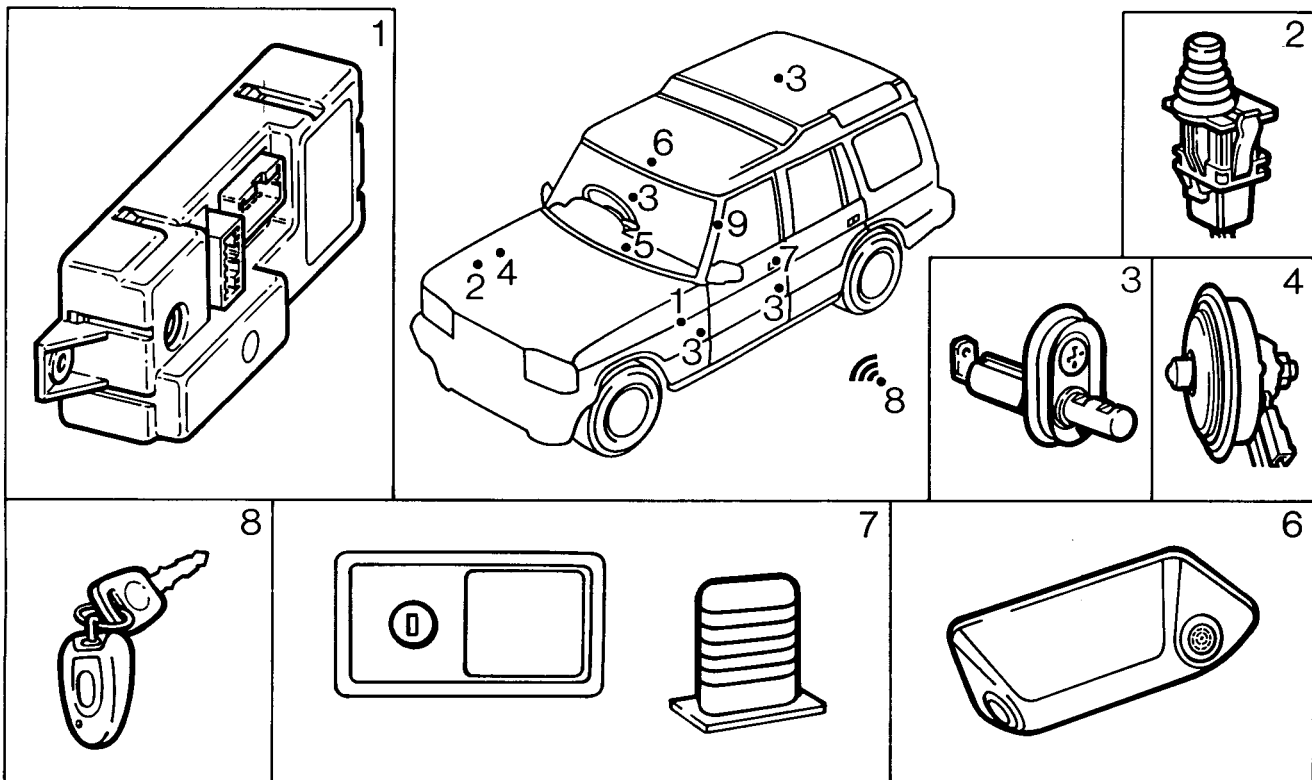
12. Turn OFF ignition or press handset to end test procedure. Horn will sound as before to indicate end of test mode.



**ANTI THEFT ALARM SYSTEM**

The main function of the system is to offer easy to use remote locking and unlocking of the vehicle without having to actively select the alarm function.

**ALARM COMPONENTS**



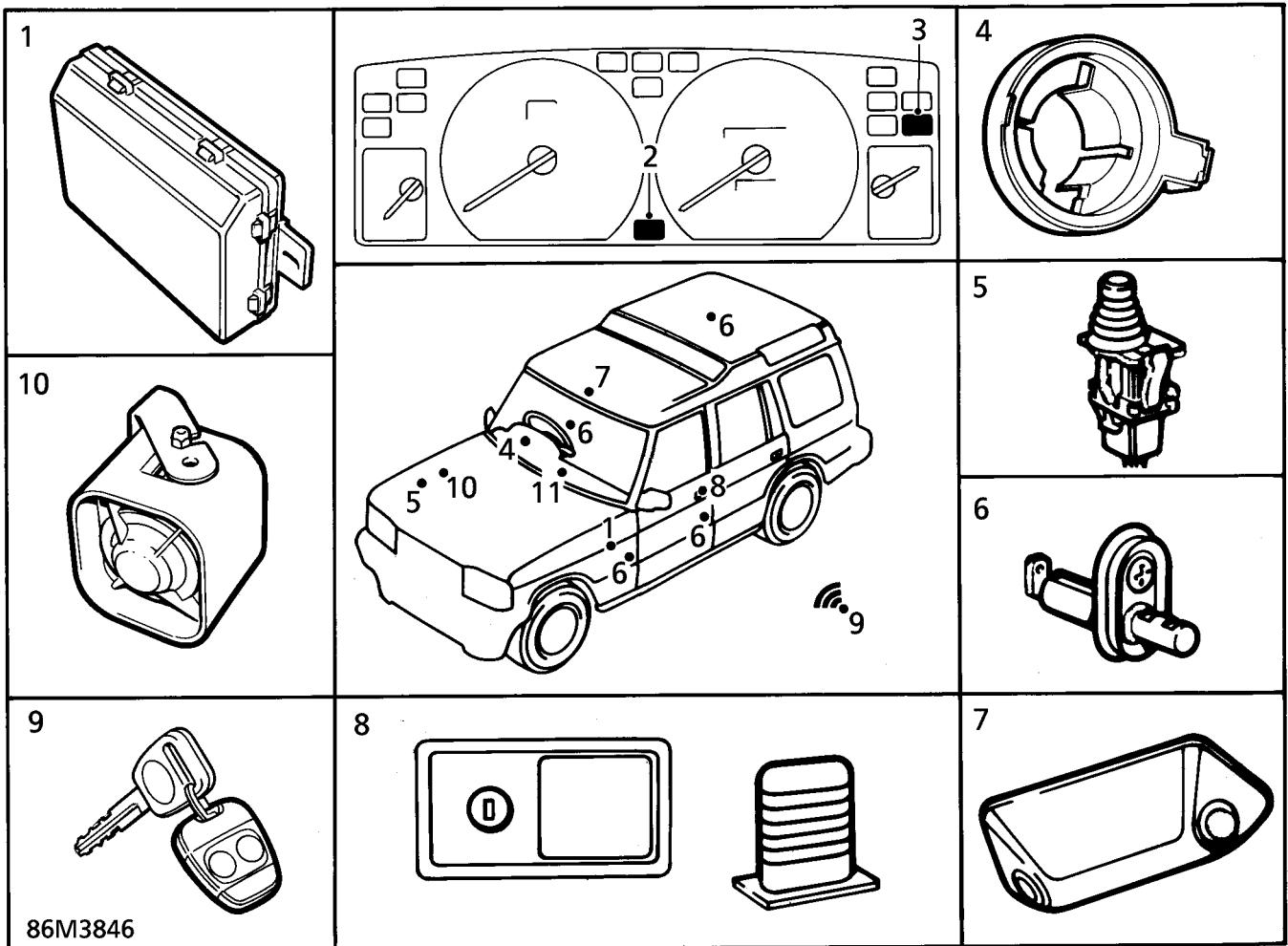
J5422

**COMPONENT**

**LOCATION**

- |    |  |                           |
|----|--|---------------------------|
| 1. | Electronic control unit (ECU) and relays ..... | Passenger footwell        |
| 2. | Bonnet switch .....                            | RH engine bay             |
| 3. | Door switches                                  |                           |
| 4. | Alarm sounder .....                            | RH engine bay             |
| 5. | Light emitting diode (LED) .....               | Dash panel                |
| 6. | Ultrasonic unit .....                          | Roof map pocket           |
| 7. | Lock barrel, sill buttons                      |                           |
| 8. | Handset transmitter                            |                           |
| 9. | Aerial .....                                   | 'A' post, passenger side. |

ALARM COMPONENT LOCATIONS (96 MODELS)



COMPONENT

LOCATION

- 1. Electronic control unit (ECU) and relays ..... Under dash (passenger side)
- 2. Anti-theft alarm indicator light ..... Instrument panel
- 3. Engine immobilisation warning light (EIWL) \* ..... Instrument panel
- 4. Passive coil ..... Over starter switch barrel
- 5. Bonnet switch ..... RH engine compartment
- 6. Door switches
- 7. Ultrasonic sensor ..... Interior light switch panel
- 8. Lock barrel, sill buttons
- 9. Handset and key
- 10. Battery backed-up sounder or horn \* ..... RH engine compartment
- 11. Immobilisation unit (spider) \* ..... Above heater
- 12. Aerial ..... Part of fascia harness

\* where applicable



## ANTI-THEFT ALARM DESCRIPTION (96 MODELS)



**NOTE: The alarm system provides security protection under wide ranging circumstances and is fully programmable to meet market requirements; consequently some of the features listed will vary dependent on vehicle model or territory.**

The handset is intended to be the primary source of control for the alarm system. The key should only be used in the event of handset failure or if perimeter arming only is required.

### Immobilisation

After a time period the vehicle is automatically immobilised regardless of whether or not the alarm is armed.

### Mobilisation

The handset provides the normal means of mobilisation. In the event of handset failure, the key may be used to enter the emergency key access code.

### Perimetric arming

Provides protection whilst the vehicle is still occupied.

### Volumetric arming

If movement within the vehicle is detected the alarm will be triggered.



**NOTE: Perimetric arming always accompanies volumetric arming.**

### Built-in test

The alarm system has a built-in test procedure, but if possible any fault finding should normally be undertaken using TestBook.

### Emergency key access (EKA)

In the event of handset failure the alarm can be disarmed by entry of the EKA code which is unique to each vehicle.

## CONTROL SYSTEM

### Electronic control unit (ECU) and relays

The ECU is the alarm system 'brain' and controls all alarm functions. It responds to inputs received, by supplying suitable outputs to indicate the status of the alarm system or activating the relevant warning devices.

### Handset

The handset is the primary source of control for the alarm system i.e. it locks and unlocks the vehicle, arms and disarms the alarm.

### Door key

The vehicle may be locked using the key (perimetric arming only).



**NOTE: The vehicle MUST be unlocked using the handset. The key may be used to unlock the vehicle if the handset fails to operate, see operation, Emergency key access.**

### Passive coil

The passive coil is located around the starter switch and triggers the handset (usually located on the keyring) if it is within close proximity.

### Aerial

The aerial is a floating connection which supplies the alarm ECU with the signal received from the handset.

### Immobilisation unit (spider)

Dependent on model or territory, the system may be fitted with an immobilisation unit which is discreetly located and provides an interface between the ECU and immobilised areas of the vehicle.

## DETECTION COMPONENTS

### Switches

Perimetric protection for the vehicle is provided by ECU inputs connected to the following:

Key switches (including starter)  
Sill buttons  
Bonnet switch  
Door switches

### Ultrasonic sensor

The ultrasonic sensor is located on the interior light switch panel and triggers the alarm if movement is detected.

## WARNING INDICATORS

### Battery backed-up sounder

The battery backed-up sounder is located in the engine compartment and provides an audible warning whenever the alarm is triggered.



**NOTE: Disconnecting the vehicle battery will result in the alarm sounding if the correct procedure has not been followed.**

*See Repair, Battery.*

### Engine immobilisation warning light (EIWL)

The engine immobilisation warning light is located in the instrument pack and provides a visual indication that the engine is immobilised.

### Anti-theft alarm indicator light

The anti-theft alarm indicator light is located in the instrument pack and provides a visual indication of the alarm status.

### Inertia switch and central door locking

As a safety feature, the alarm system is designed to recognise the inertia switch and via the ECU, unlock the doors in the event of a collision.



**NOTE: This feature only applies when the starter switch is in the on position.**

## ANTI-THEFT ALARM OPERATION (96 MODELS)

### Full arming and immobilisation

Locking the vehicle using the handset immobilises the engine and initializes both volumetric and perimetric protection, providing:

1. After a lock signal has been received, a period of 15 seconds has elapsed during which no movement is detected inside the vehicle;
2. No door or bonnet is open.



**NOTE: If either of the above conditions are not satisfied, the alarm will only be partially armed. This is a mislock condition which will be made apparent by a delay of 10 seconds before the anti-theft alarm indicator begins to flash.**

### Disarming the alarm



**NOTE: ALWAYS disarm the alarm using the handset.**

Unlocking with the key will not disarm the alarm or mobilise the vehicle. If the handset fails to unlock the vehicle *See Repair, Handset.*

### Partial arming and immobilisation

The alarm will be partially armed and the engine immobilised if the vehicle is locked with the handset or key, if:

1. After a lock signal has been received, a period of 15 seconds has elapsed during which movement is detected inside the vehicle;
2. A door or bonnet is open.



**NOTE: This is a mislock condition which will be made apparent by a delay of 10 seconds before the anti-theft alarm indicator begins to flash. Subsequent closure of the offending aperture will cause the alarm to attempt full arming as previously described.**

### Immobilisation

The vehicle will be automatically immobilised whenever any of the following conditions occur:

1. The vehicle is locked using the handset.
2. The vehicle is locked using the key.
3. Thirty seconds after the starter switch has been turned off AND the driver's door opened.
4. Five minutes after the starter switch is turned off or the alarm disarmed.



## Mobilisation

The vehicle can be mobilised using any one of the following processes:

1. Placing the handset in close proximity to the starter switch with the starter switch turned on (normally achieved by placing the key in the starter switch, providing the key and handset are attached).



**NOTE: Under normal circumstances the remobilisation of the vehicle will not be apparent.**

2. Pressing unlock button on handset.
3. Pressing lock button on handset with starter switch turned on.
4. Entry of EKA code using the key.



**NOTE: Any attempt to start the vehicle using the key (detached from the handset) will be unsuccessful. Use one of the above methods. See *Warning indicators*.**

## Volumetric protection

When the vehicle is locked using the handset both perimetric and volumetric protection are activated providing there is no mislock condition.

## Perimetric protection

The vehicle is always perimetrically protected when the alarm is armed using the handset. Perimetric protection only, can be achieved if the vehicle is locked using the key.



**NOTE: The handset should ALWAYS be used for unlocking the vehicle. If the handset fails to unlock the vehicle See *Repair, Handset*.**

## Battery backed-up sounder (BBUS)

The sounder provides audible indication of alarm status including:

Anti-theft warnings;  
Confirmation of access to built-in test.



**NOTE: Disconnecting the vehicle battery will result in the alarm sounding if the correct procedure has not been followed. See *Repair, Battery*.**

## Alarm horn

The horn provides audible indication (as BBUS) of alarm status.



**NOTE: Disconnecting the vehicle battery will have no effect on the horn.**

## Engine immobilisation warning light (EIWL)



**NOTE: Under normal circumstances the light will not illuminate.**

The light will only illuminate (after 2 seconds) if the handset is detached from the key (or the handset fails) and an attempt is made to start the vehicle.

## Anti-theft alarm indicator light

The light flashes to indicate the alarm status.

If the alarm system is fully armed, the light will flash rapidly for 10 seconds and then settle to the slow (anti-theft deterrent) flash.

If the alarm system is perimetrically armed, the light will intermittently flash rapidly for 10 seconds and then settle to the slow (anti-theft deterrent) flash.

If the alarm system is partially armed, the light will NOT emit the slow flash until 10 seconds after arming (to allow the cause to be investigated).

If the vehicle has been left unlocked, providing the driver's door is closed, the light will flash slowly indicating immobilisation. If the driver's door is open, the light will remain illuminated.

## Emergency key access (EKA)

The emergency key access code should be entered in accordance with the instructions in the Owner's Handbook.



### Radio frequency system

The RF system uses frequencies according to market and both ECU and handset are colour coded:

Territory .....	ECU/Handset .....	Frequency
Europe .....	Blue/Blue .....	433.92 MHz
NAS .....	Green/Green .....	315.00 MHz
Japan .....	Green/Green .....	315.00 MHz
Gulf .....	Green/Green .....	315.00 MHz
Rest of World .....	Green/Brown .....	315.00 MHz



**NOTE: In service NAS, Japan and Gulf will have the handset changed to brown.**

### Passive coil

The passive coil excites a receiving coil in the handset causing it to automatically transmit a remobilisation signal to the ECU.

### Inertia switch and central door locking

Actuation of the inertia switch will cause the doors to be unlocked. A time-out period (programmable between 0-5 minutes) will ensue, during which all CDL and alarm activity is disabled.



**NOTE: This feature only applies when the starter switch is in the on position.**

### Handset

Under normal circumstances pressing the respective buttons on the handset once, will unlock or lock the vehicle. If operating the handset does not achieve the desired effect **See Repair, Handset.**

### Functional detail

For full functional details and circuit diagrams **See Electrical Trouble Shooting Manual..**

### Vehicle traceability

All Land Rover vehicles are fitted with a multitude of discreet security features to prevent theft or assist recovery in the event of a vehicle being stolen. All vehicles are traceable, since it is impossible to remove all security identification.



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**ANTI-THEFT ALARM BUILT-IN TEST (96 MODELS)**

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**NOTE: The handset should be detached from the key to allow perimetric testing of the alarm system. The system will automatically switch to volumetric testing if the handset is in close proximity to the starter switch.**

The built-in test procedure can be accessed providing the following conditions exist:

**Alarm disarmed.  
Ignition off.  
Doors unlocked.  
Bonnet[hood] closed.**

The test mode can be entered by completing the following instructions within 5 seconds:

1. Open bonnet.
2. Turn starter switch on.
3. Open driver's door (far enough to activate switch).
4. Turn starter switch off.
5. Turn starter switch on.

If the test mode has been correctly accessed, the sounder/horn will operate briefly and the anti-theft alarm indicator and hazard warning lights will flash.

**Perimetric tests**

The anti-theft alarm indicator light and the hazard warning lights will flash when:

1. Door switches are activated;
2. The bonnet is opened;
3. Sill switches are activated;
4. Key switches are activated.



**NOTE: Operation of key switches can be verified by turning the key in the relevant direction so as not to simultaneously activate the sill switch. If the key switch changes state, the change should be detected but the sill switch will not be activated.**

**Volumetric tests**

Press the unlock button or move the handset close to the starter switch to disable perimetric testing and enable volumetric testing. If movement is detected within the vehicle by the ultrasonic sensor it will be indicated by flashing the anti-theft alarm indicator and hazard warning lights.



**NOTE: Exit anti-theft alarm built-in test by turning starter switch to the off position.**



## GENERAL INFORMATION

The electrical fault diagnostic tool on Discovery vehicles is Testbook. Detailed information of electrical systems, component locations and circuit diagrams are covered in the Discovery Electrical Troubleshooting Manual. **See INTRODUCTION, Information, Fault Diagnostic Equipment**  
*This section covers checks of the charging and ignition system.*

## GENERATOR TESTING

Service repair no - 86.10.01

### Charging system check

1. Check battery is in good condition, with an open circuit voltage of at least 12.6 V. Recharge or substitute battery to carry out test.
2. Check drive belt condition. **See SECTION 10, Maintenance, Under Bonnet [Hood] Maintenance**
3. Check battery connections are clean and tight.
4. Check generator connections are clean and tight.
5. Ensure there is no drain on battery from, for example, interior, under bonnet [hood] or door edge lamps.

### Generator test

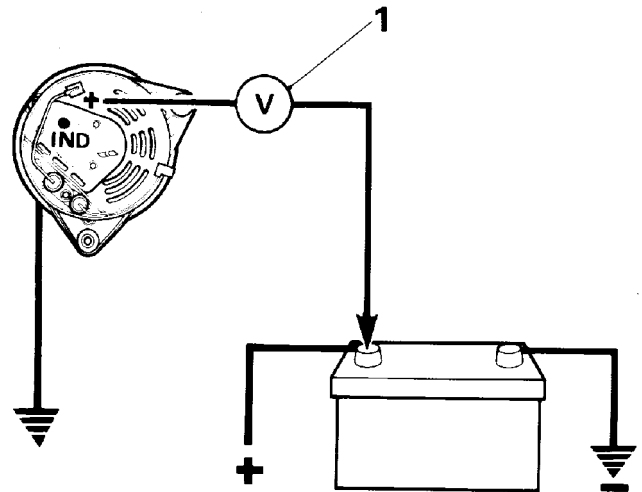
Following instructions refer to use of suitable test equipment using a carbon pile rheostat.

6. Connect test equipment referring to manufacturer's instructions.
7. Start engine and run at 3000 rev/min without accessory load.
8. Rotate carbon pile load control to achieve greatest output (amps) without allowing voltage to fall below 12.0 V. A reading in amps, of generator output, minus 10% to allow for EFI and Ignition loss, should be obtained.
9. Run engine at 3000 rev/min, switch selector to regulator test, read voltmeter. A reading of 13.6 to 14.4 V should be obtained.
10. Switch selector to diode/stator test, switch on headlamps to load generator. Raise engine speed to 3000 rev/min, read voltmeter, needle must be within 'OK' range.

## TESTING IN POSITION

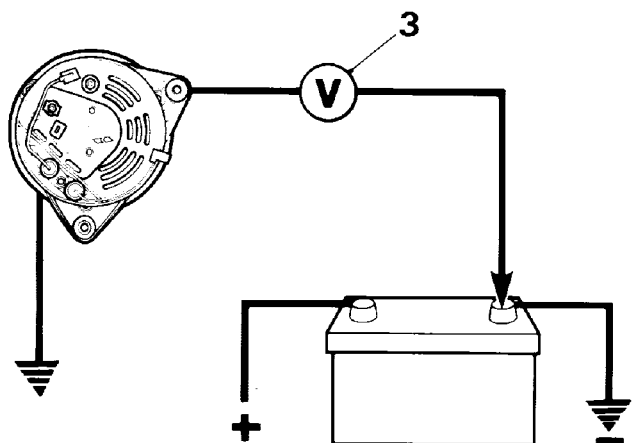
### Charging circuit resistance test.

1. Connect a low range voltmeter between generator terminal marked B+ and positive terminal of battery.



RR2317E

2. Switch on headlamps, start engine. Run engine at approximately 3000 rev/min. Note voltmeter reading.
3. Transfer voltmeter connections to frame of generator and negative terminal of battery, and again note voltmeter reading.



RR2318E

4. If reading exceeds 0.5 volt on positive side or 0.25 volt on negative side, there is a high resistance in charging circuit which must be traced and remedied.

## LUCAS CONSTANT ENERGY IGNITION SYSTEM - V8i

### Preliminary checks

Inspect battery cables and connections to ensure they are clean and tight. Check electrical condition of battery.

Inspect all L.T. connections, ensure they are clean and tight. Check H.T. leads are correctly positioned and not shorting to ground against any engine components. Wiring harness and individual cables should be firmly fastened to prevent chaffing.

### Pick-up air gap

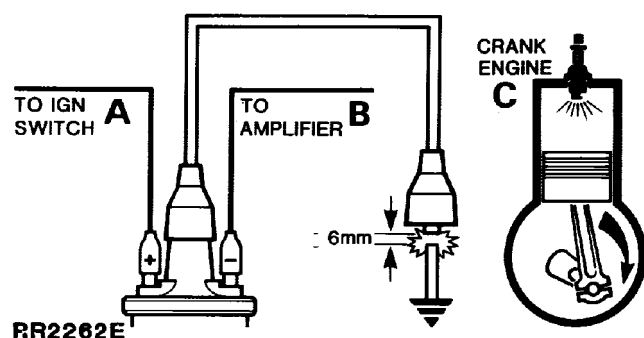
Check air gap between pick-up limb and reluctor teeth is 0.20 - 0.35 mm, using a non-ferrous gauge.



**NOTE:** Air gap is set initially at factory and will only require adjusting if tampered with or when pick-up module is replaced.

### TEST 1:

#### H.T. Sparking

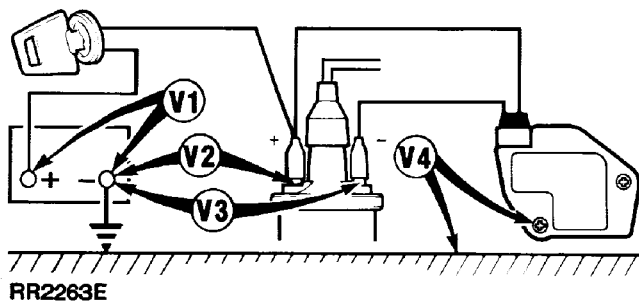


Remove coil/distributor H.T. lead from distributor cover and hold approximately 6mm from engine block, using suitable insulated pliers. Switch ignition 'On' and operate starter.

Regular sparking indicates fault in H.T. distribution, plugs, timing or fuelling, proceed to Test 6. If no spark or weak spark occurs proceed to Test 2.

### TEST 2:

#### L.T. Voltage



Switch ignition 'On' - engine stationary.

- Connect voltmeter to points in circuit indicated by V1 to V4 and make a note of voltage readings.
- Compare voltages obtained with specified values listed below:

#### Expected readings

- V1 More than 12 volts.  
 V2 1 volt maximum below volts at V1.  
 V3 1 volt maximum below volts at V1.  
 V4 0 volt - 0.1 volt.
- If all readings are correct proceed to Test 3.
  - Check incorrect reading(s) with chart to identify area of possible faults, i.e. faults listed under heading SUSPECT and rectify.
  - If coil and amplifier is suspected, disconnect L.T. lead at coil, repeat V3. If voltage is still incorrect, fit new coil. If voltage is now correct, check L.T. lead, if satisfactory fit new amplifier.
  - If engine will not start proceed to Test 3.



1	2	3	4	SUSPECT
L	*	*	*	DISCHARGED BATTERY
*	L	L	*	IGN. SWITCH AND/OR WIRING
*	*	L	*	COIL OR AMPLIFIER
*	*	*	H	AMPLIFIER GROUND

**Key**

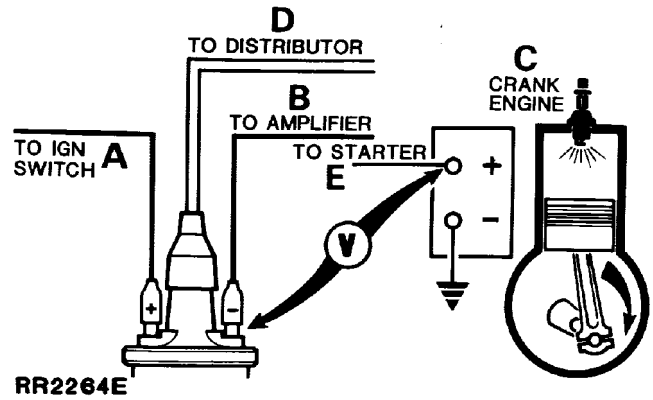
\* Expected Voltage

H Voltage higher than expected

L Voltage lower than expected

**TEST 3:**

**Amplifier Switching**

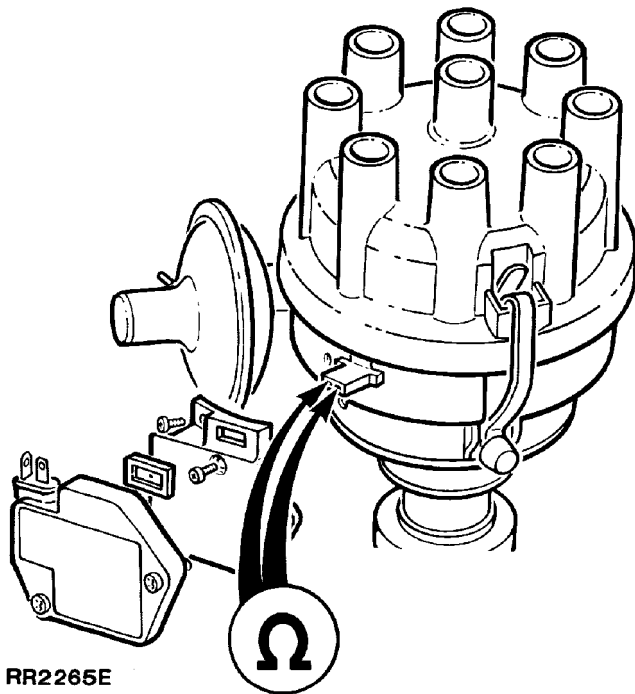


Connect voltmeter between battery positive (+ve) terminal and H.T. coil negative (-ve) terminal. Voltmeter should register 0 volts.

Switch ignition 'On', voltmeter should still register 0 volts.

Crank engine, voltmeter reading should increase when cranking, in which case proceed to Test 5.

If no increase in voltage during cranking proceed to Test 4.

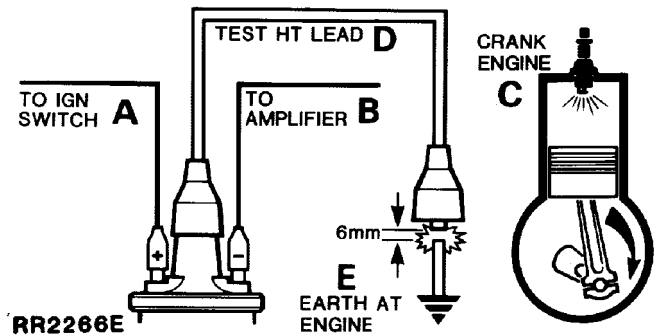
**TEST 4:****Pick-up Coil Resistance**

Remove amplifier.

Connect ohmmeter leads to two pick-up terminals in body of distributor.

The ohmmeter should register between 2k and 5k ohm if pick-up is satisfactory. If ohmmeter reading is correct, check all connections between pick-up and amplifier, if satisfactory, fit new amplifier. If engine still does not start carry out Test 5.

Change pick-up if ohmmeter reading is incorrect. If engine still does not start proceed to Test 5.

**TEST 5:****Coil H.T. Sparking**

Remove existing coil/distributor H.T. lead and fit test H.T. lead to coil tower. Using suitable insulated pliers, hold free end about 6mm from engine block and crank engine. There should be good H.T. sparking.

If weak or no sparking, fit new coil, repeat test.

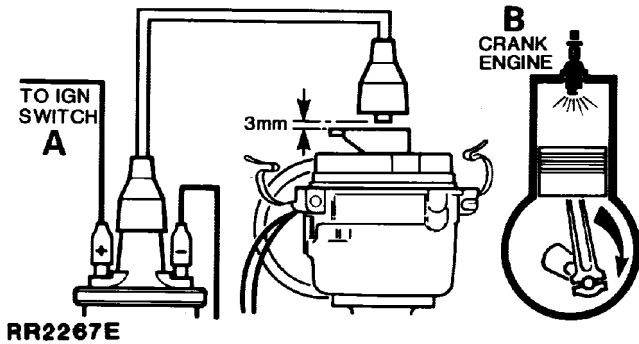
H.T. sparking good, repeat test with original H.T. lead. If sparking is good carry out Test 6.

If weak or no sparking, fit new H.T. lead, if engine will not start carry out Test 6.



**TEST 6:**

**Rotor Arm**



Remove distributor cover. Disconnect coil H.T. lead from cover, using insulated pliers hold about 3mm above rotor arm electrode and crank the engine.

There should be no H.T. sparking between rotor and H.T. lead. If satisfactory carry out Test 7.

If H.T. sparking occurs, an earth fault on rotor arm is indicated. Fit new rotor arm. If engine will not start carry out Test 7.

**TEST 7:**

**Visual and H.T. Cable Checks**

**Examine:**

**Should be:**

- |                                |   |
|--------------------------------|---|
| 1. Distributor Cover .....     | Clean, dry, no tracking marks           |
| 2. Coil Top .....              | Clean, dry, no tracking marks.          |
| 3. H.T. Cable Insulation ..... | Must not be cracked, chafed or perished |
| 4. H.T. Cable Continuity ..... | Must not be open circuit                |
| 5. Sparking Plugs .....        | Clean, dry, and set to correct gap      |

**NOTE:**

- |                                     |   |
|-------------------------------------|---|
| 1. Reluctor .....                   | Must not foul pick-up or leads                      |
| 2. Rotor and Insulation Cover ..... | Must not be cracked or show signs of tracking marks |



## IGNITION TIMING

Service repair no - 86.35.15

### Adjust

1. It is essential that following procedures are adhered to. Inaccurate timing can lead to serious engine damage and additionally create failure to comply with emission regulations. If timing is being checked in vehicle, air conditioning compressor must be disengaged.
2. On initial engine build, or if distributor has been disturbed for any reason, ignition timing must be set statically to 6°B.T.D.C.



**NOTE:** This approximate setting is made only to ensure that engine may be started.



**CAUTION:** On no account must engine be started before this operation is carried out.

### Equipment required :-

Calibrated Tachometer  
Stroboscopic lamp

3. Couple stroboscopic timing lamp and tachometer to engine following manufacturer's instructions.
4. Disconnect vacuum hose from distributor.
5. Start engine. With no load, and without exceeding 3,000 rev/min run engine until normal operating temperature is reached. (Thermostat open). Check that engine idles within tolerance specified in data section.
6. Idle speed for timing purposes must not exceed 800 rev/min.
7. Run engine at idle speed and check timing using stroboscope light on timing marker and pointer.



**WARNING:** Keep hands and equipment away from belt.

8. If timing is not as specified, switch off engine. Loosen distributor clamp bolt and turn distributor to advance or retard ignition as necessary. Tighten clamp bolt, start engine and recheck timing.



**WARNING:** Personal injury may result if an attempt is made to adjust distributor whilst engine is running.

9. Upon completion, switch off engine and retighten distributor clamping bolt securely. Recheck timing, to ensure retightening has not disturbed distributor position.
10. Refit vacuum hose.
11. Disconnect stroboscopic timing lamp and tachometer from engine.



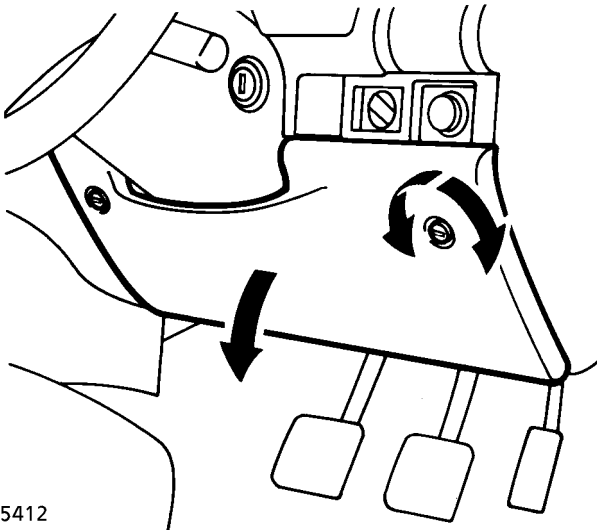


## FUSE BOX - INTERIOR

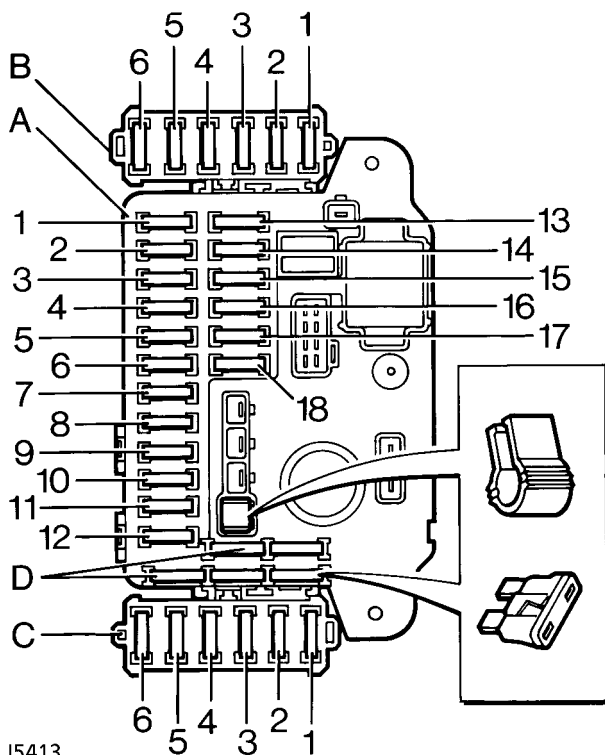
### Right Hand Drive shown

The interior fusebox is fitted below the steering column, behind the trim panel. It comprises of three integral units. 'A' Main fusebox, 'B' Satellite 2, 'C' Satellite 1.

A label in the fusebox cover shows the circuits protected, the fuse rating and their locations. Access is by releasing the fixing screws and lowering the panel.



J5412



J5413

### 'A' Main fusebox

1. Stop lights, direction indicators
2. LH side light
3. Radio/cassette/CD player
4. RH headlight main beam
5. LH headlight main beam
6. Cigar lighter
7. Airbag SRS
8. RH side lights
9. Rear fog guard lights
10. RH headlight dipped beam
11. LH headlight dipped beam
12. Multi-function unit
13. Ignition feed for Multi-function unit
14. Instruments, reversing lights
15. Air conditioning, windows
16. Washers & wipers - front
17. Starter, glow plug
18. Wash/wipe - rear, mirrors, cruise control

### 'B' Satellite 2

1. Electric windows - front
2. Electric windows - rear
3. Anti-lock braking
4. Central door locking
5. Electric sun roof
6. Trailer lights

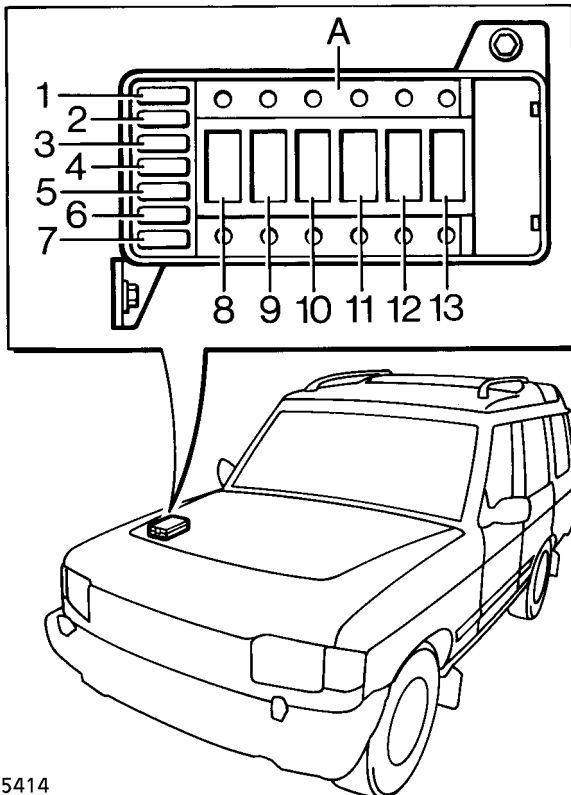
### 'C' Satellite 1

1. Anti-theft alarm
2. Headlight washers
3. Engine management
4. Anti-lock brakes
5. Anti-theft alarm
6. Rear air conditioning, heater

### 'D' Spare fuses (5 off)

## FUSE BOX - ENGINE COMPARTMENT

The fusebox is located on the right side of the engine compartment. The circuits protected and their locations are shown on the inside of the fusebox cover. To change a main circuit fuse prise off protective cover A and remove retaining screws.



### Fuses

1. Heated rear window
2. Sidelights
3. Air conditioning
4. Hazard warning lights, horn
5. ABS valve
6. Fuel pump
7. Fuel injectors

### A Main circuit fuses

8. ABS pump
9. Ignition circuits
10. Lighting
11. Window lift, central door locking, rear blower
12. Heater, air conditioning
13. Generator

J5414



## BATTERY

Service repair no - 86.15.01



**NOTE: Some vehicles are fitted with a battery backed-up sounder. Disconnecting the vehicle battery will cause the alarm to sound unless the following procedure is followed:**

1. Turn starter switch 'ON' then 'OFF'.
2. Disconnect battery WITHIN 15 SECONDS (see WARNING).

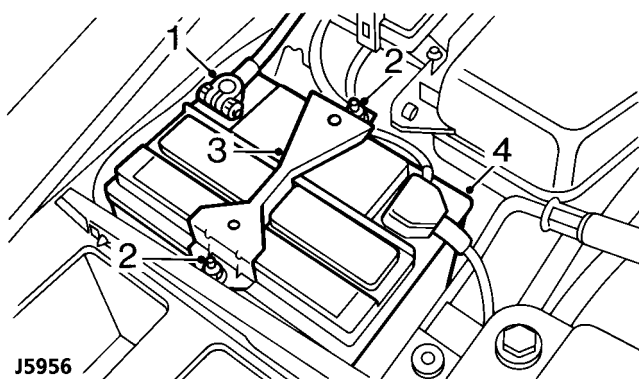
If alarm is accidentally activated, ensure sounder is connected and silence by turning the starter switch to position II.

### Remove



**WARNING: During battery removal or before carrying out any repairs or maintenance to electrical components always disconnect battery negative lead first. If positive lead is disconnected with negative lead in place, accidental contact of wrench to any grounded metal part could cause a severe spark, possibly resulting in personal injury. Upon installation of battery connect positive lead first.**

3. Disconnect both battery leads, negative first.
4. Release four nuts securing battery bracket in position.
5. Remove bracket.
6. Remove battery.



### Refit

7. Reverse removal procedure.

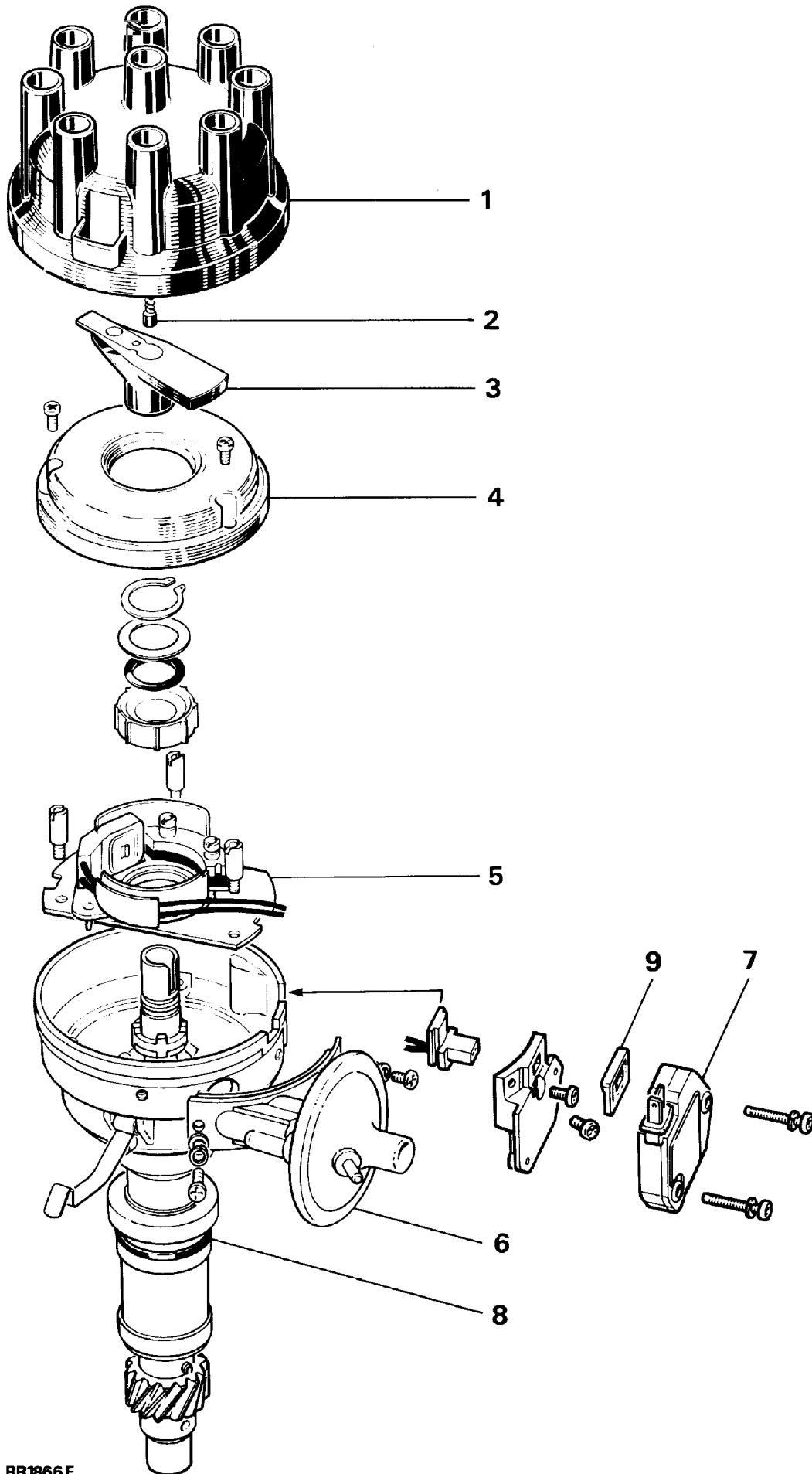


**NOTE: Coat battery clamps and terminals with petroleum jelly before refitting.**

## DISTRIBUTOR-LUCAS 35 DLM8 - V8i

### Service parts

1. Cap
2. HT brush and spring
3. Rotor arm
4. Insulation cover
5. Pick-up module and base plate assembly
6. Vacuum unit
7. Amplifier module
8. 'O'-ring oil seal
9. Gasket



RR1866E



## ELECTRONIC IGNITION - V8i

A Lucas 35DLM8 distributor is employed. This has a conventional vacuum advance unit and centrifugal automatic advance mechanism.

A pick-up module, in conjunction with a rotating timing retractor inside distributor body, generates timing signals. These are applied to an electronic ignition amplifier module mounted on side of distributor body.



**NOTE:** Pick-up air gap is factory set. Do not adjust gap unless pick-up is being changed or base plate has been moved.

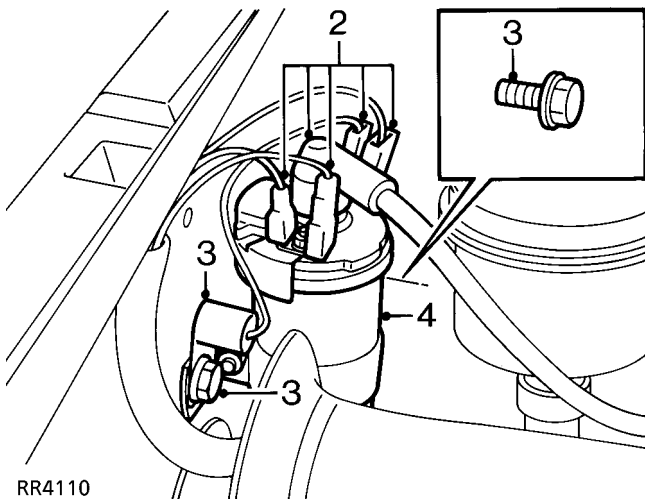
Use a non-ferrous feeler gauge to set air gap.

## IGNITION COIL

Service repair no - 86.35.32

### Remove

1. Disconnect battery negative lead.



RR4110

2. Noting their fitted positions, disconnect electrical leads from ignition coil.
3. Remove two bolts securing ignition coil clamp, recover suppressor.
4. Remove coil.

### Refit

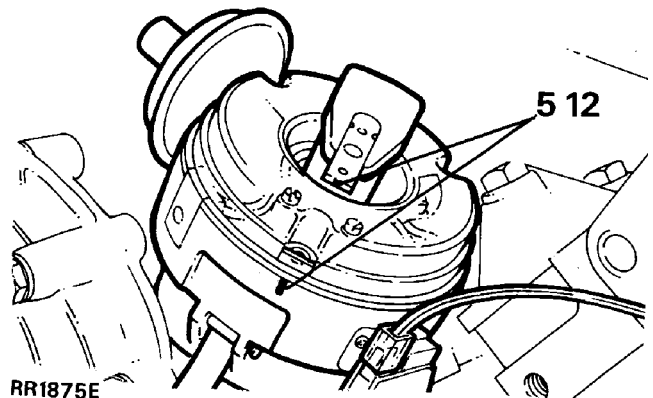
5. Reverse removal procedure.

## DISTRIBUTOR - V8i

Service repair no - 86.35.20

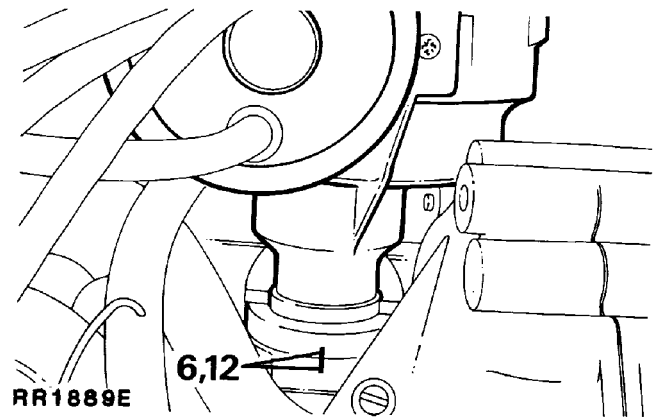
### Remove

1. Disconnect battery negative lead.
2. Disconnect vacuum hose.
3. Remove distributor cap.
4. Disconnect low tension lead from coil.



RR1875E

5. Mark distributor body and centre line of rotor arm.



RR1889E

6. Add alignment marks to distributor and front cover.



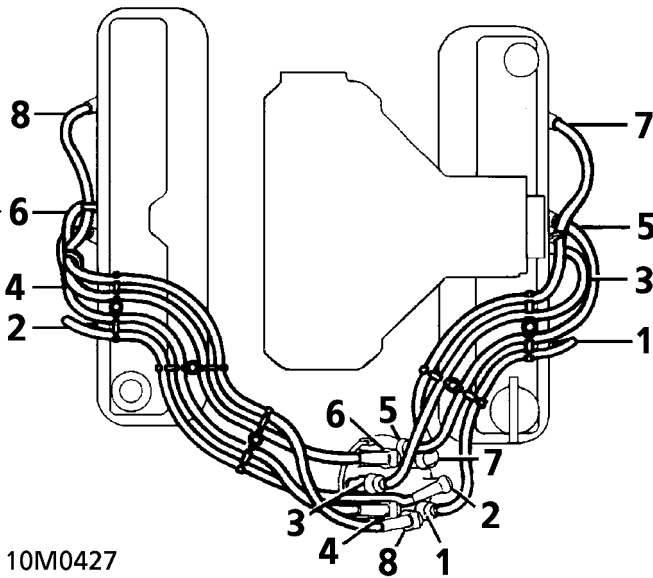
**NOTE:** Marking distributor enables refitting in exact original position, but if engine is turned while distributor is removed, complete ignition timing procedure must be followed.

7. Release distributor clamp and remove distributor.

## Refit



**NOTE:** If a new distributor is being fitted, mark body in same relative position as distributor removed.



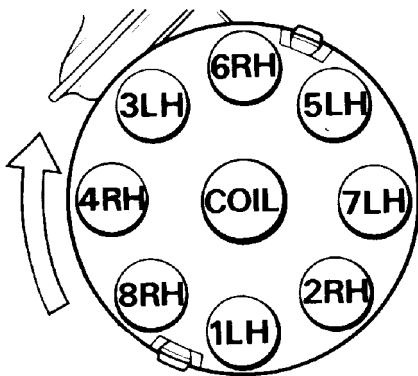
10M0427

8. Leads for distributor cap should be connected as illustrated.

Figures 1 to 8 inclusive indicate plug lead numbers.

RH-Right hand side of engine, when viewed from rear.

LH-Left hand side of engine, when viewed from rear.



RR616M

9. If engine has not been turned while distributor has been removed, carry out instructions 10. to 17. Alternatively proceed to instruction 18.
10. Fit new 'O' ring seal to distributor housing.
11. Turn distributor drive until centre line of rotor arm is 30° anti-clockwise from mark made on top edge of distributor body.
12. Fit distributor in accordance with alignment markings.



**NOTE:** It may be necessary to align oil pump drive shaft to enable distributor drive shaft to engage in slot.

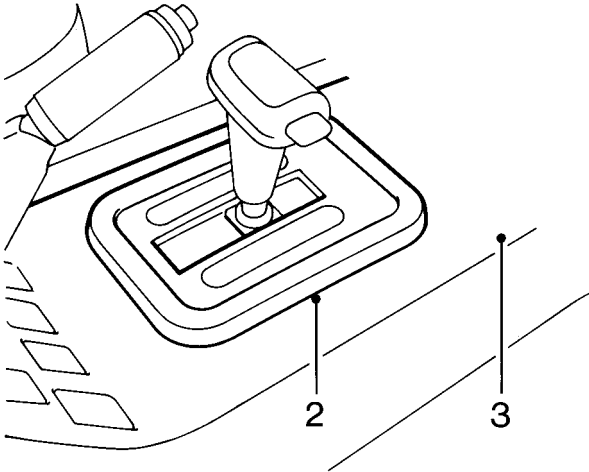
13. Fit clamp and bolt. Secure distributor in exact original position.
14. Connect vacuum hose to distributor and low tension lead to coil.
15. Fit distributor cap.
16. Reconnect battery.
17. Using suitable electronic equipment, set ignition timing. **See Adjustment, Ignition timing**
18. If engine has been turned with distributor removed, carry out instructions 19 to 30.
19. Set engine-No. 1 piston to static ignition timing figure **See ENGINE TUNING DATA, Information, Engine 3.9 V8i**
20. Turn distributor drive until rotor arm is approximately 30° anti-clockwise from number one sparking plug lead position on cap.
21. Fit distributor to engine.
22. Check that centre line of rotor arm is now in line with number one sparking plug lead on cap. Reposition distributor if necessary.
23. If distributor does not seat correctly in front cover, oil pump drive is not engaged. Engage by lightly pressing down distributor while turning engine.
24. Fit clamp and bolt, do not tighten.
25. Set ignition timing statically to 6° B.T.D.C.
26. Connect vacuum hose to distributor.
27. Fit low tension lead to coil.
28. Fit distributor cap.
29. Reconnect battery.
30. Using suitable electronic equipment set the ignition timing. **See Adjustment, Ignition timing**



## AUTOMATIC GEAR SELECTOR-PANEL BULB

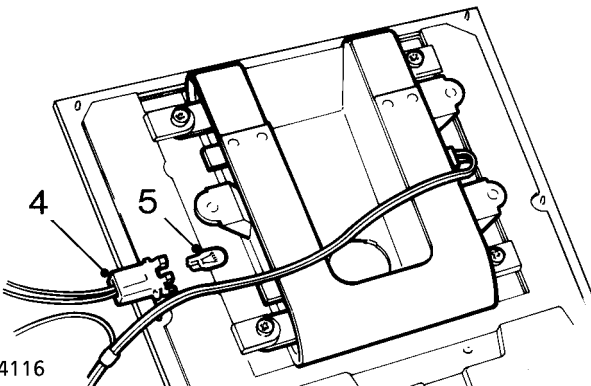
Service repair no - 86.45.40

1. Disconnect battery negative lead.



RR4115

2. Carefully prise quadrant finisher out of surround.
3. Carefully prise rear of surround away from centre console.



RR4116

4. Pull appropriate bulb holder from fitted position.
5. Remove bulb from holder.

### Refit

6. Reverse removal procedure

## START INHIBIT / REVERSE LIGHT SWITCH

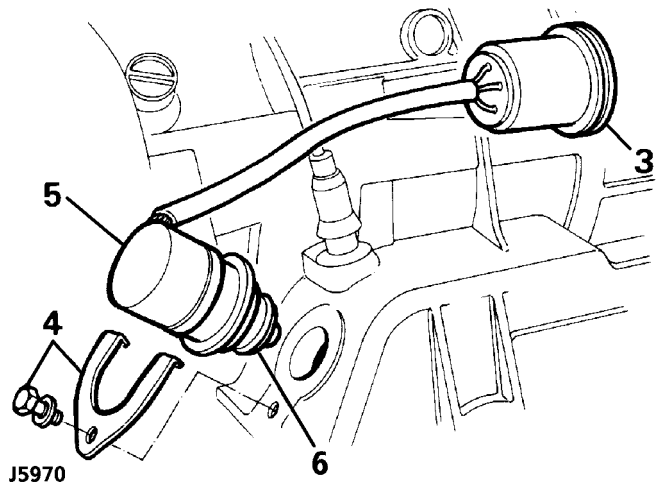
Service repair no - 44.15.19

### Automatic gearbox

#### Remove

Reverse light switch is an integral part of start inhibitor switch. It is located on left hand side of gearbox, accessible from beneath vehicle.

1. Place vehicle on suitable ramp [hoist].
2. Disconnect battery negative lead.
3. Disconnect multi-plug.
4. Release clamp bolt, remove clamp.
5. Remove switch.



J5970

#### Refit

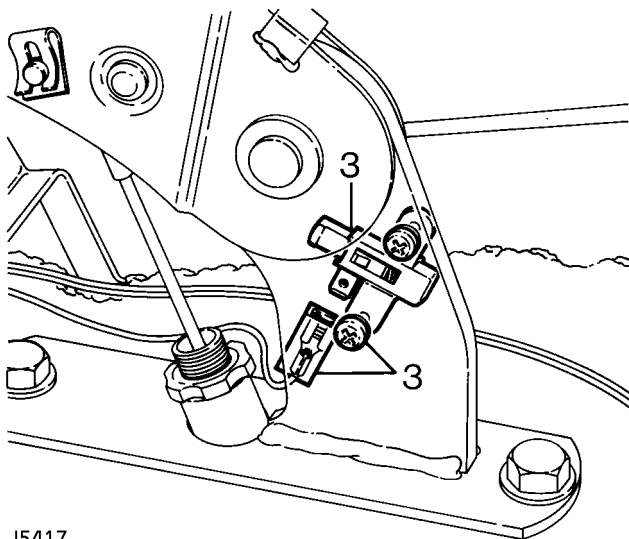
6. Fit a NEW 'O' ring to switch.
7. Reverse removal procedure.

**PARK BRAKE WARNING SWITCH**

Service repair no - 86.65.45

**Remove**

1. Disconnect battery negative lead.
2. Remove four screws and move aside window lift switch panel.
3. Remove two screws, manoeuvre switch from park brake and disconnect electrical lead.



J5417

**Refit**

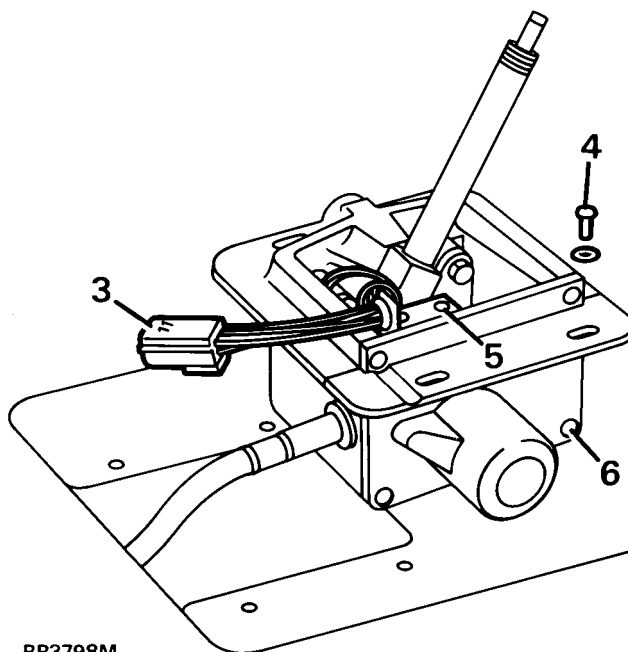
4. Reverse removal procedure.

**GEAR SELECTOR-INTERLOCK**

Interlock solenoid

**Remove**

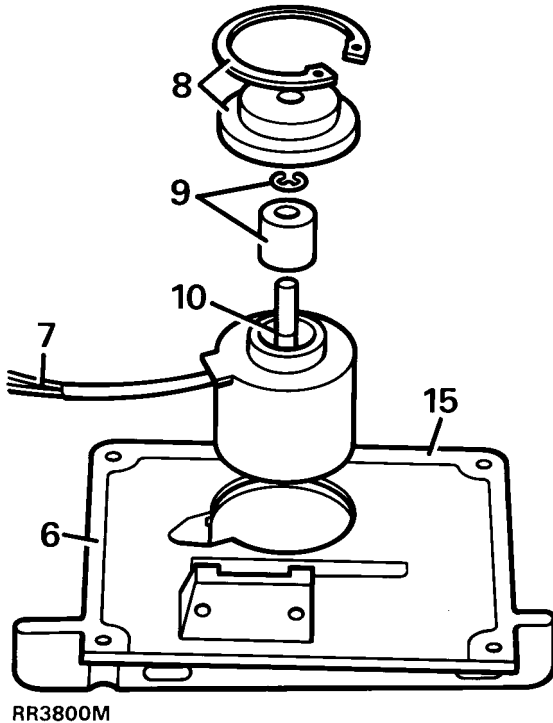
1. Disconnect battery negative lead.
2. Remove gear selector head and illumination panel. *See CHASSIS AND BODY, Repair, Centre console*



RR3798M

3. Disconnect electrical multiplug.
4. Remove screws and lift gear selector mechanism above housing.
5. Remove screws from microswitch support bracket.
6. Remove screws and separate side cover from housing.





RR3800M

7. Disconnect wiring solenoid to multiplug.
8. Remove circlip and retainer plate.
9. Remove clip and centre sleeve.
10. Refit clip into groove on spindle and lever against it to remove solenoid from housing.

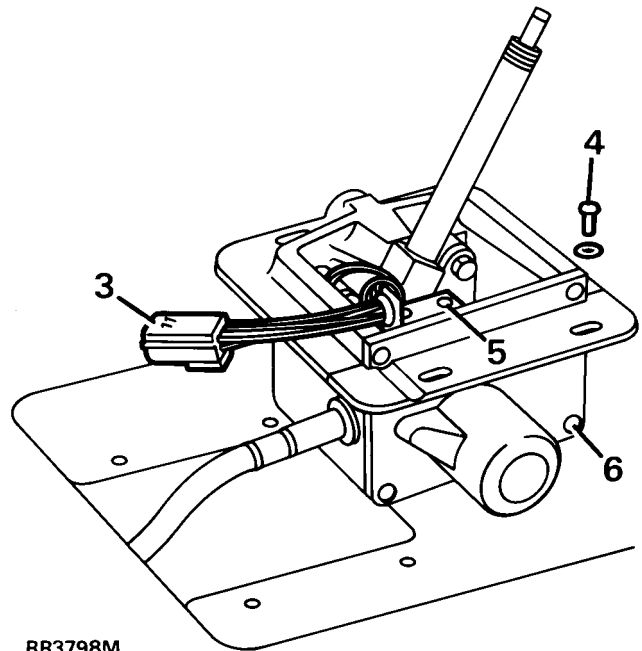
#### Refit

11. Fit solenoid with wiring positioned into side cover recess.
12. Fit sleeve and new clip.
13. Fit retaining plate and circlip.
14. Connect wiring to multiplug.
15. Apply sealant and fit side cover to housing. Use Silcoset 152 sealant or equivalent.
16. Grease all moving parts of gear selector mechanism. Use Rocol E1A or equivalent grease.
17. Reverse removal procedure. 1 to 5.

#### Interlock microswitch onto castellated plate.

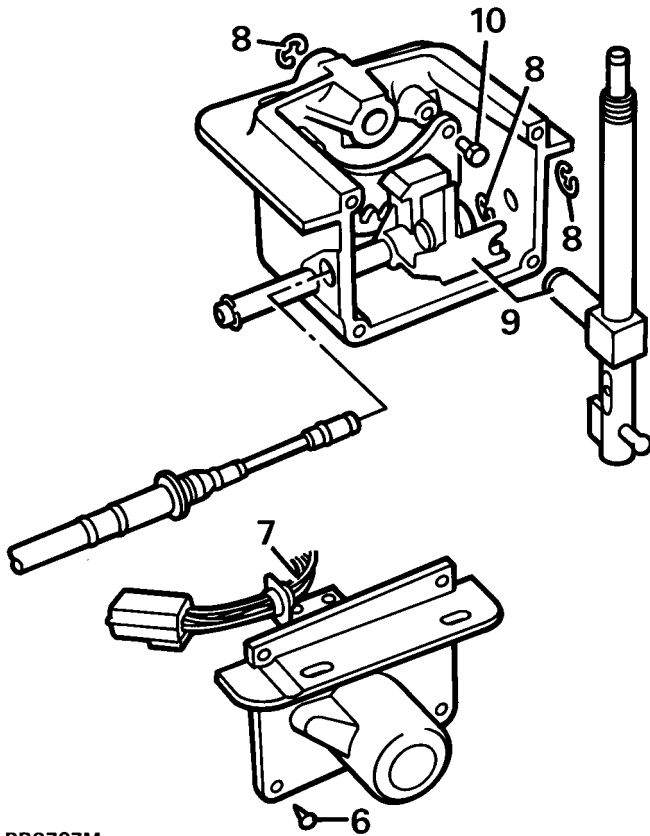
#### Remove

1. Disconnect battery negative lead.
2. Remove gear selector head and illumination panel *See CHASSIS AND BODY, Repair, Centre console*



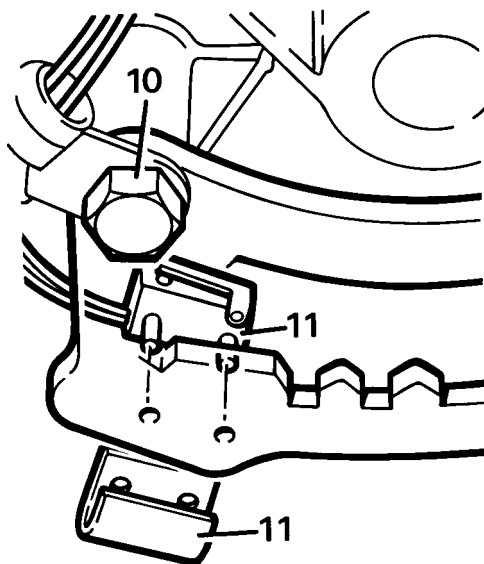
RR3798M

3. Disconnect electrical multiplug.
4. Remove screws and lift gear selector mechanism above housing.
5. Remove screws from microswitch support bracket.
6. Remove screws and separate side cover from housing.
7. Disconnect wiring microswitch to multiplug.



RR3797M

8. Remove 3 clips as shown.
9. Slide trunnion forward and remove gear selector arm.



RR3799M

10. Remove bolts securing coxcomb.
11. Remove microswitch retaining clip and microswitch.

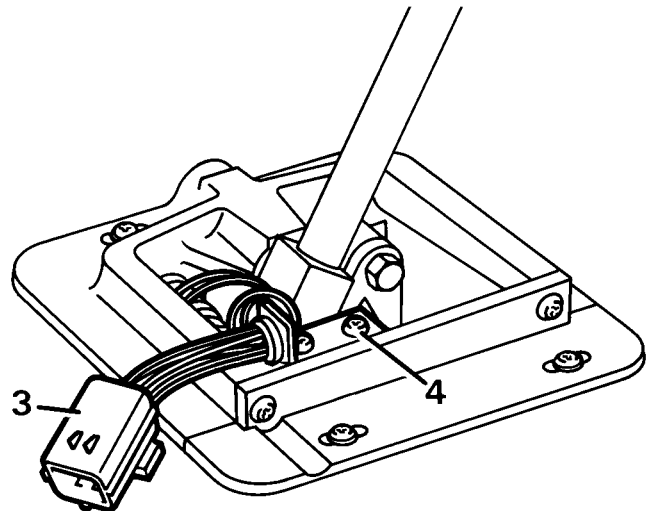
### Refit

12. Reverse removal procedure, correctly positioning microswitch.
13. Apply Loctite 242E to castellated plate bolts. Tighten to **9Nm**.
14. Grease all moving parts of gear selector mechanism. Use Rocol E1A or equivalent grease.
15. Apply Silcoset 152 sealant or equivalent and fit side cover to housing.

### Interlock microswitch onto side cover

### Remove

1. Disconnect battery negative lead.
2. Remove gear selector head and illumination panel **See CHASSIS AND BODY, Repair, Centre console**



J5957

3. Disconnect electrical multiplug.
4. Remove screws from microswitch support bracket.
5. Disconnect wiring microswitch to multiplug.

### Refit

6. Reverse removal procedure. Correctly positioning microswitch.
7. Grease all moving parts of gear selector mechanism. Use Rocol E1A or equivalent grease.



## HANDSET INITIALISATION



**NOTE: New handsets are supplied in pairs. If a new handset is required, it will require initialisation to the ECU using the following procedure:**

following procedure:

1. Starting conditions: ignition off, doors unlocked, bonnet switch depressed.
2. Carry out instructions 3. to 9. within 8 seconds.
3. Switch ignition ON.
4. Switch ignition OFF.
5. Lock doors.
6. Unlock doors.
7. Release bonnet switch.
8. Switch ignition ON.
9. Switch ignition OFF.

If alarm is correctly accessed, horn will sound and LED will light. It is now possible to programme two handsets of correct frequency to vehicle alarm ECU. This must be carried out within two minutes.

10. Press and hold down button on first handset until dash LED flashes.
11. Repeat instruction 10. for second handset.
12. The LED will extinguish if both handsets have been initialised correctly.

## CENTRAL DOOR LOCKING

Where electrically operated central door locking is fitted, locking or unlocking the drivers door from outside by key operation, or from the inside with the sill knob automatically locks or unlocks the passenger and rear doors.

Front and rear passenger doors can be independently locked or unlocked from inside the vehicle by sill knob operation but can be overridden by further operation of the driver's door locking control.

On rear doors, where side facing fold down seats are fitted, a child safety lock is provided which can be mechanically pre-set to render the interior door handles inoperative.

Failure of a door actuator will not affect the operation of the remaining doors and the door with the inoperative actuator can still be locked or unlocked manually.

The actuator unit fitted to the driver's door is the master actuator and is identified from the actuators fitted to the passenger and rear doors by having a white connecting link, whereas the passenger and rear door actuators have grey coloured connecting links.




**NOTE: Actuator units are non-servicable, if a fault should occur replace the unit with a new one.**

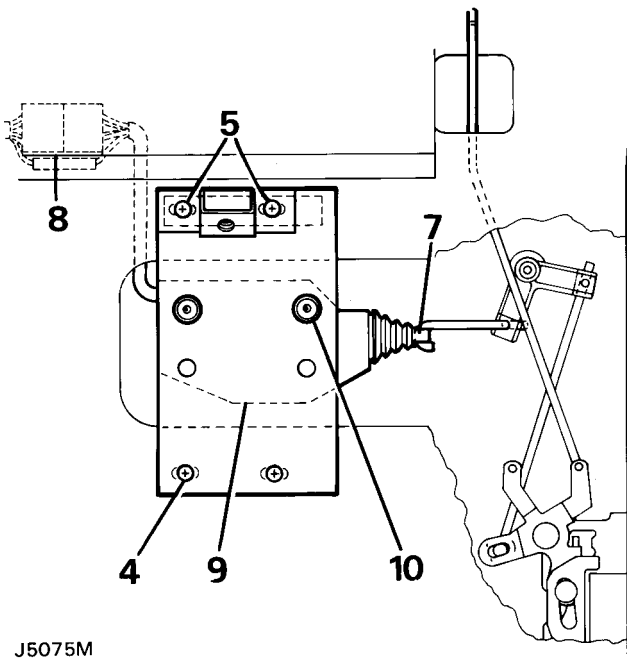
## FRONT DOOR ACTUATOR UNIT

Service repair no - 86.26.08

## Remove

1. Ensure that the window glass is in its fully closed position.
2. Disconnect battery negative lead.
3. Remove the door pull, trim panel and plastic vapour barrier. **See CHASSIS AND BODY, Repair, Front Door Trim Panel**
4. Remove the lower two screws and plain washers securing the actuator mounting plate to the inner door panel.

 **NOTE: The upper two actuator mounting plate securing screws also secure one of the door pull mounting brackets and locate with a nut retainer strip fitted on the inside face of the inner door panel.**



J5075M

5. Remove the upper two screws, the door pull mounting bracket and retrieve the nut retaining strip from inside the door.
6. Release the window lift motor leads from the three clips at the front of the door to allow sufficient slack in the harness for actuator assembly removal.
7. Detach actuator assembly operating rod from the actuator link on the door lock.

8. Withdraw the actuator assembly from the door until the electrical cable is pulled out of its channel sufficiently to expose the connector.
9. Detach the connector and remove the actuator from the door.
10. The actuator unit may be changed by removing the two rubber mounted screws that secure it to the mounting plate.

## Refit

11. Attach the actuator assembly connector to its mating half on the door harness.
12. Engage the actuator assembly operating rod with the hooked end of the actuator link.
13. Pull the door harness back into its channel from the front end and secure the window lift motor leads with the three clips.
14. Fit the actuator assembly to the inner door panel and loosely secure with the two lower screws and plain washers.
15. Position the nut retainer on the inside face of the inner door panel, locate the door pull mounting bracket and loosely secure with the two upper screws.
16. Set the actuator mounting plate with the screws in the centre of the slotted holes, then tighten the screws sufficiently to retain the assembly.
17. Ensure that manual operation of the sill locking control is not restricted by the operation of the actuator operating rod and vice versa, resetting the mounting plate as necessary.
18. Reconnect battery negative lead.
19. Check that electrical operation of the door lock occurs when the sill locking control is moved through half of its total movement. Reset the mounting plate as necessary and fully tighten the four screws.



**NOTE: The above adjustment ensures that the full tolerance on the switching operation is utilised.**

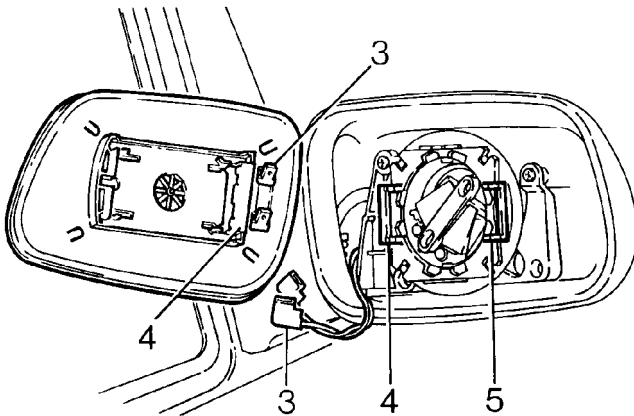


## EXTERIOR DRIVING MIRRORS

Service repair no - 76.11.10

### Replacing the mirror glass

1. Press the outer end of the glass inwards to its full extent.
2. Insert the fingers under the inner end of the glass and pull outwards until the glass is released from its two retaining clips.



J5418

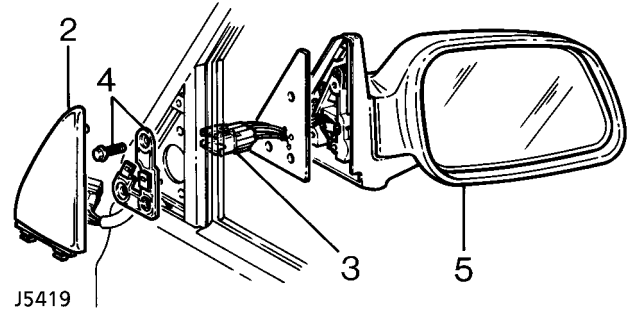
3. Disconnect the two demister leads attached to the back of the glass unit.
4. To replace the glass, locate the inner end of the glass in the retaining clip of the housing first.
5. Carefully press the outer end of the glass inwards until it securely locates in the front retaining clip.
6. Reset the fine adjustment as required.

### Complete assembly

Service repair no - 76.11.10

### Remove

1. Disconnect battery negative lead.



J5419

2. Carefully prise off interior finisher to reveal retaining plate and securing screws.
3. Disconnect electrical plug.
4. Supporting the mirror assembly remove three securing screws and retaining plate.
5. Detach mirror assembly from outer door frame.

### Refit

6. Reverse removal procedure.



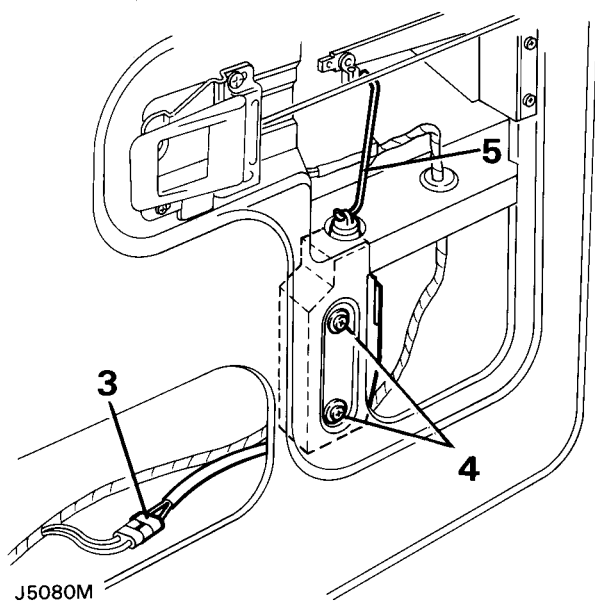
**NOTE:** To prevent damage to the electrical lead ensure that it is not pushed down inside the door casing.

**REAR DOOR ACTUATOR**

Service repair no - 86.26.09

**Remove**

1. Disconnect battery negative lead.



2. Remove the door pull, trim panel and vapour protective sheet from the inner door panel. **See CHASSIS AND BODY, Repair, Rear Door Trim Panel**
3. Disconnect the actuator leads from the door electrical harness.
4. Remove the two screws securing the actuator door panel.
5. Manoeuvre the actuator, disconnect the rod from the link and withdraw the actuator from the door.

**Refit**

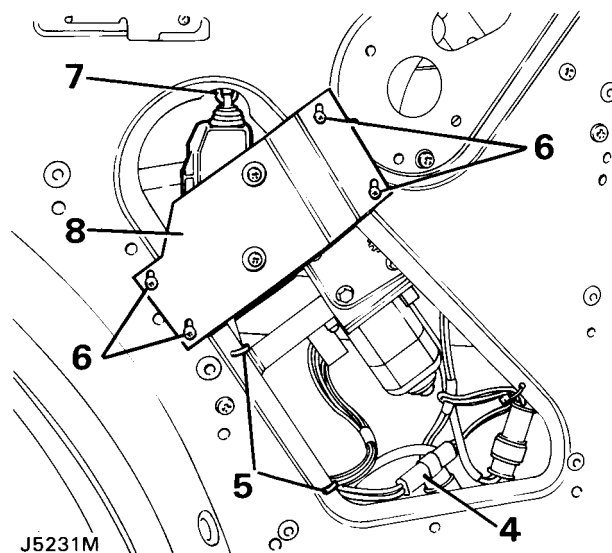
6. Reverse removal procedure.

**REAR SIDE DOOR ACTUATOR UNITS**

Service repair no - 86.26.09

**Remove**

1. Ensure that the window glass is in the fully closed position.
2. Disconnect battery negative lead.
3. Remove the door pull, trim panel and plastic vapour proof barrier. **See CHASSIS AND BODY, Repair, Rear Side Door - Trim Panel**
4. Disconnect the actuator lead from the door harness at the connector.
5. Note the locations and release the straps securing the actuator lead to the door casing.
6. Remove the four screws securing the actuator mounting plate to the door casing.
7. Unhook the operating rod from the actuator link and withdraw the actuator and mounting plate from the door.
8. If a new actuator is being fitted remove the mounting plate from the existing actuator.





### Refit

9. If removed fit the mounting plate to the actuator.
10. Engage the actuator operating rod with hooked end of the actuator link.
11. Fit the actuator and mounting plate to the door and loosely secure with the four screws.
12. Set the mounting plate with the screws in the centre of the slotted holes, then tighten the screws.
13. Connect the actuator lead to the door harness.
14. Reconnect battery negative lead.
15. With the sill locking button held in position, set the bellcrank to approximately the position it would be in if the sill button was depressed to half of its total movement.
16. At this setting check the electrical operation of the door lock. Adjust the mounting plate as necessary to achieve the correct setting. Fully tighten the securing screws on completion.
17. Refit the vapour barrier.
18. Connect the sill button operating rod to the bellcrank, hold in position, fit the door trim panel and the door pull.

### BULB REPLACEMENT

For bulb type and rating refer to rating shown on the bulb or bulb replacement list. **See GENERAL SPECIFICATION DATA, Information, Bulbs**

### HEADLIGHT

Service repair no - 86.40.02/13

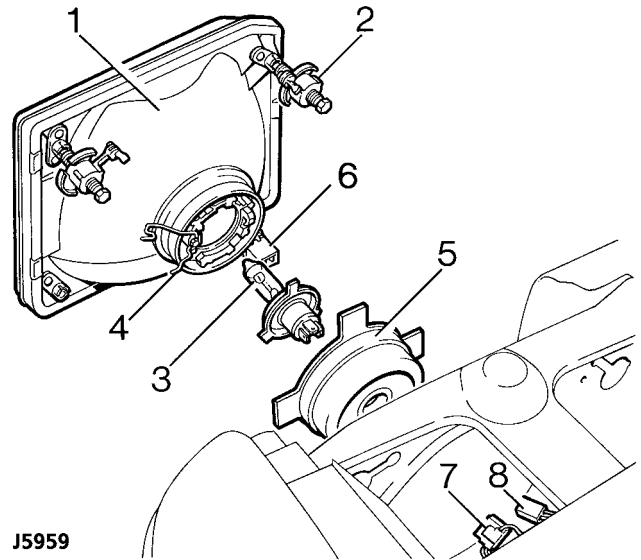
#### Remove

1. Rotate three retaining clips 10 degrees, to align with slots in headlight mounting plate.
2. Withdraw light unit



**NOTE: Detach adjustment operating rod on vehicles fitted with headlight levelling.**

3. Disconnect electrical multiplugs and remove headlight unit.
4. Release spring clips and withdraw headlight bulb.



J5959

#### Key

1. Headlight
2. Retaining clips
3. Bulb
4. Spring clip
5. Cover
6. Bulb sidelight
7. Plug
8. Plug sidelight

#### Refit

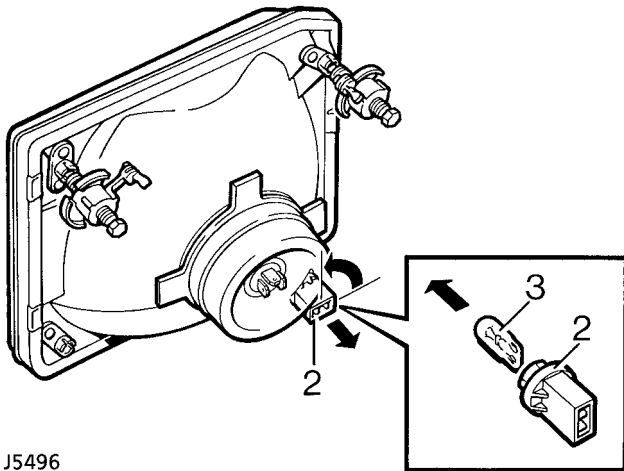
5. Reverse removal procedure.

**SIDELIGHT BULB**

Service repair no - 86.40.33

**Remove**

1. Remove headlight, *See Headlight*
2. Disengage bulb holder by twisting a quarter turn anti-clockwise.
3. Withdraw bulb from holder.



J5496

**Refit**

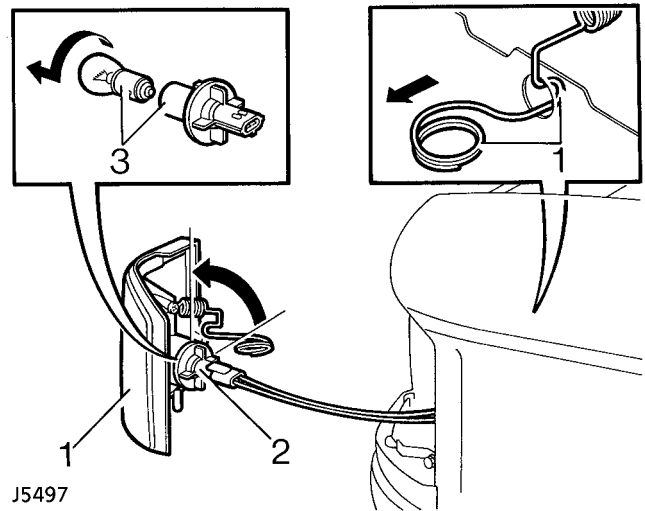
4. Reverse removal procedure.

**FRONT DIRECTION INDICATORS**

Service repair no - 86.40.41

**Remove**

1. Pull spring clips, release from location and lift out direction indicator unit.
2. Turn bulb holder anti-clockwise to release from indicator unit.
3. Push and twist the bulb to remove.



J5497

**Refit**

4. Reverse removal procedure. When replacing light unit, locate the two lugs at the bottom of the lens before re-engaging spring clips.



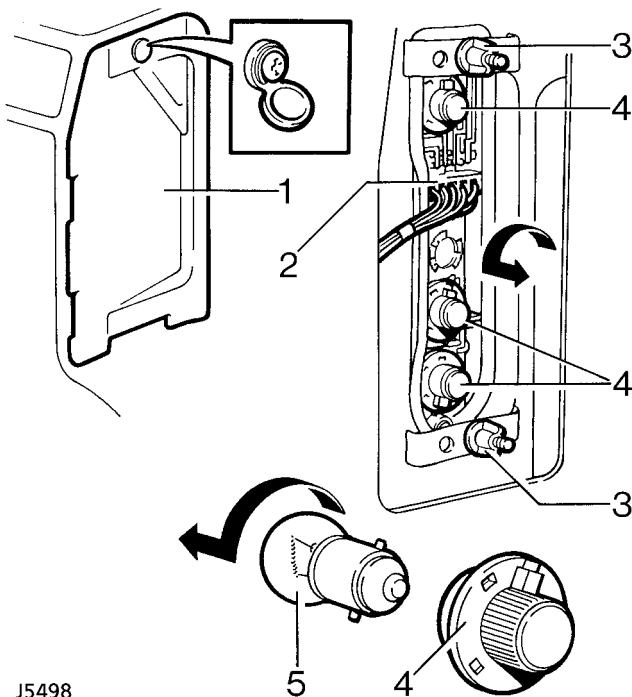


## REAR LIGHT UNIT

Service repair no - 86.40.74

### Remove

1. Pull out side facing seat or pocket cover.
2. Unscrew fastener and remove access panel.
3. Disconnect wiring harness multi-plug from light unit.
4. Remove retaining nuts and withdraw light unit from rear of vehicle.



J5498

### Key

1. Access panel
2. Multiplug
3. Retaining nut
4. Bulb holder
5. Bulb

### Refit

5. Reverse removal procedure. Ensure that the rubber seal is seated correctly.

## STOP, REVERSING, FOG GUARD BULBS

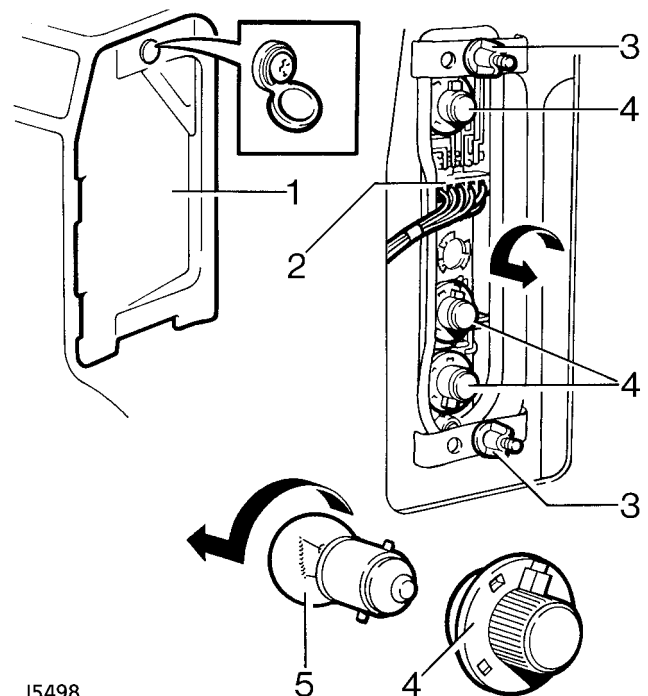
Service repair no - 86.40.74

### Remove

1. Pull out side facing seat or pocket cover.
2. Unscrew fastener and remove access panel.
3. Turn bulb holder anti-clockwise to release.
4. Remove bulb.



**NOTE:** On vehicles fitted with rear air conditioning remove access panel housing rear loadspace light to gain access.



J5498

### Key

1. Access panel
2. Multiplug
3. Retaining nut
4. Bulb holder
5. Bulb

### Refit

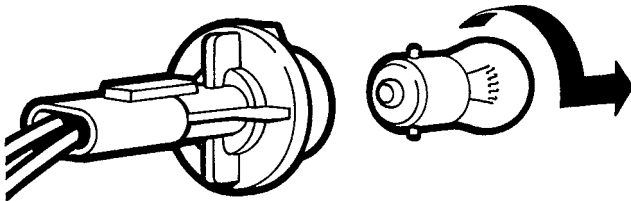
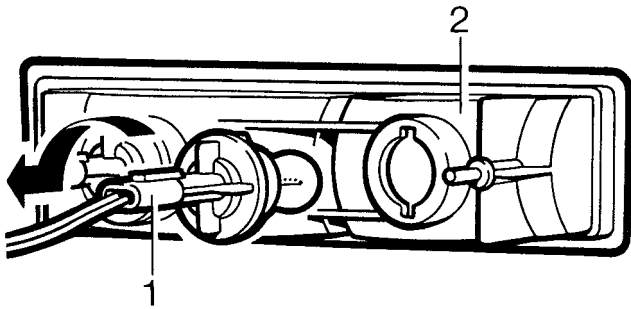
5. Reverse removal procedure.

**REAR LIGHTS, BUMPER MOUNTED**

Service repair no - 86.41.42

**Remove**

1. From behind bumper disconnect light plugs.
2. Unscrew two retaining nuts and remove light unit from bumper.



J5499

**Refit**

3. Reverse removal procedure.



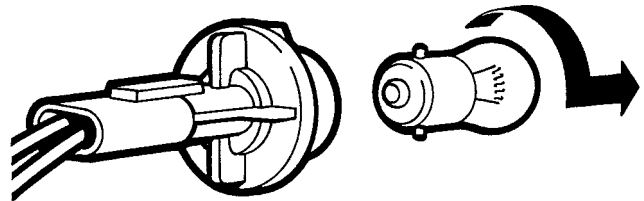
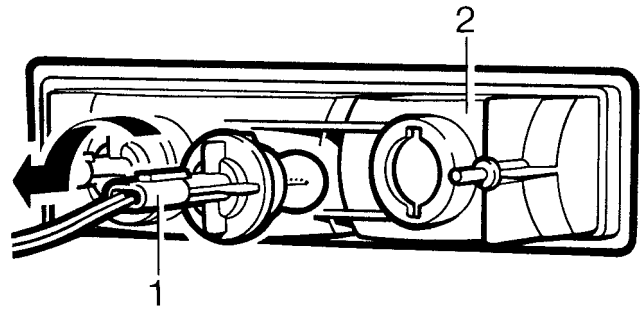
**NOTE:** The black lead plug fits into the direction indication light, the white lead plugs into the tail light, the bulb holder being colour coded red.

**DIRECTION INDICATOR, TAIL LIGHT BULBS**

Service repair no - 86.41.43

**Remove**

1. Turn bulb holder anti-clockwise to release from light unit.
2. Push and twist the bulb to remove.



J5499

**Refit**

3. Reverse removal procedure.

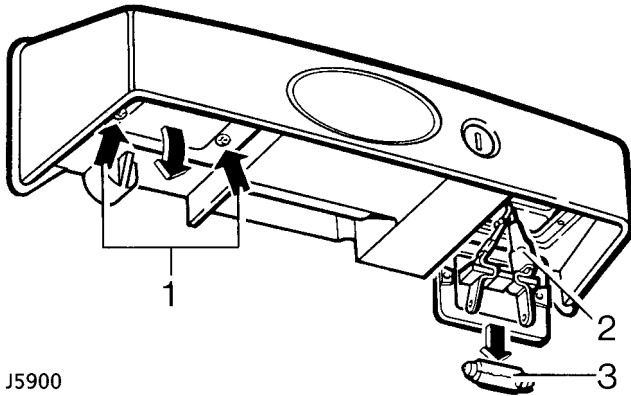


## NUMBER PLATE LIGHTS

Service repair no - 86.40.86

### Remove

1. Remove two screws and withdraw light unit.
2. Disconnect wiring leads and remove light unit.
3. Remove bulb.



J5900

### Refit

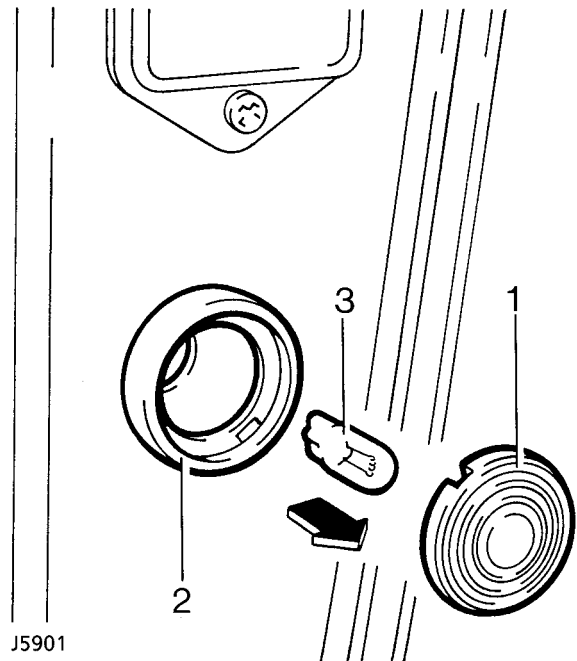
4. Reverse removal procedure.

## DOOR EDGE LIGHT

Service repair no - 86.40.35

### Remove

1. Pry lens from housing.
2. Disconnect wiring leads and remove light unit.
3. Remove bulb.



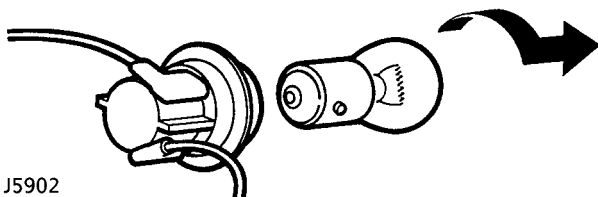
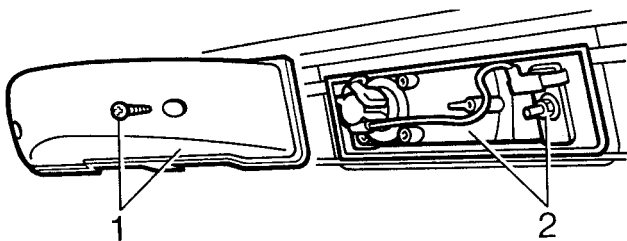
J5901

### Refit

4. Reverse removal procedure.

**HIGH MOUNTED STOP LIGHT**

Service repair no - 86.41.35

**Remove**

1. Remove two screws and lift off light reflector body.
2. Unscrew retaining nut and remove lens unit from rear door glass.

**Refit**

3. Reverse removal procedure.

**STOP LIGHT BULB**

Service repair no - 86.40.87

**Remove**

1. Remove reflector body.
2. Turn bulb holder anti-clockwise to release from light unit.
3. Push and twist the bulb to remove.

**Refit**

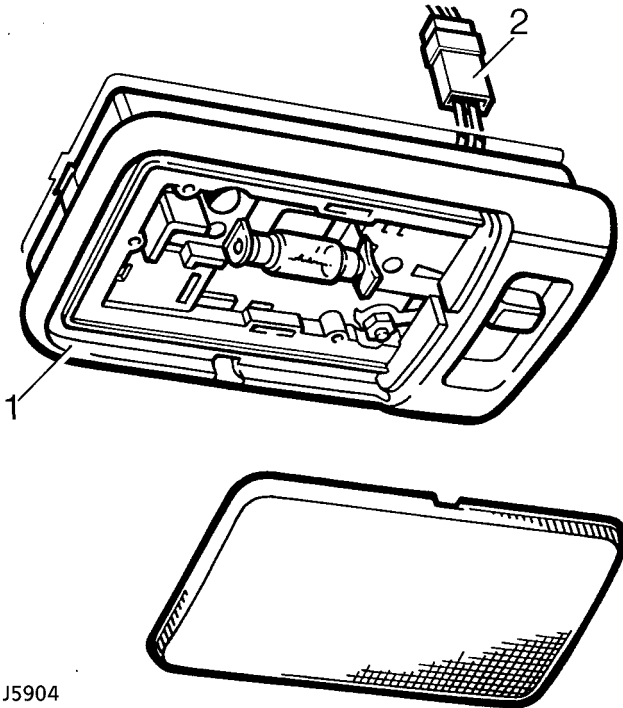
4. Reverse removal procedure.



## INTERIOR LIGHT

Service repair no - 86.35.14

Remove



1. Pry out light unit from roof location.
2. Disconnect light switch plug.

Refit

3. Reverse removal procedure.

**Bulb Removal.**

1. Pry out interior light lens.
2. Remove bulb.

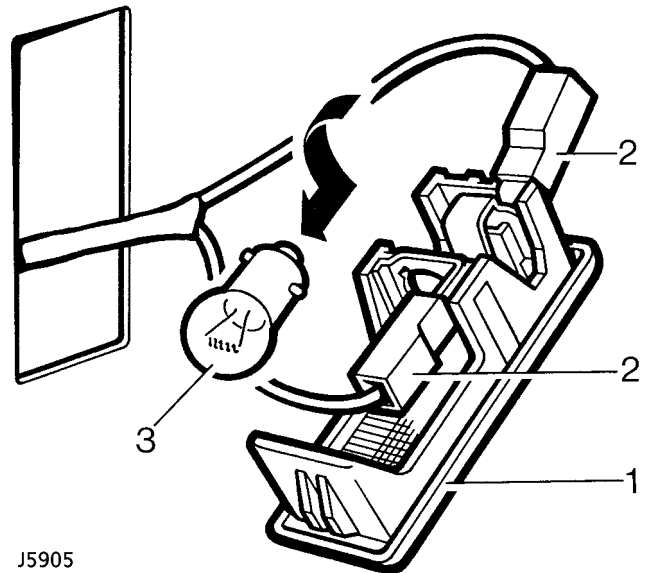
Refit

3. Reverse removal procedure.

## REAR LOADSPACE LIGHT

Service repair no - 86.41.40

Remove



J5905

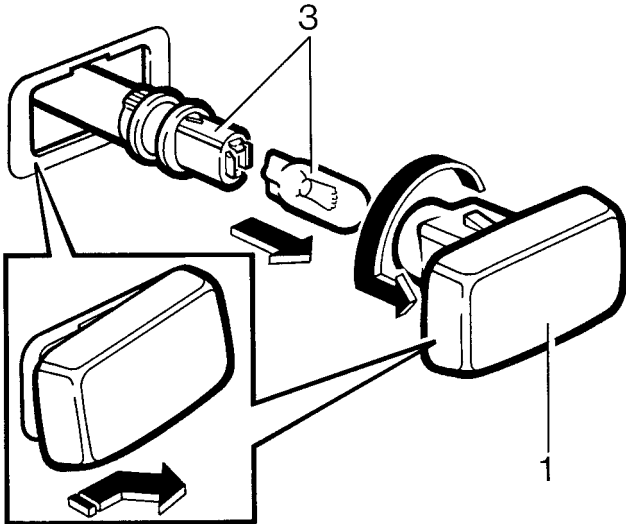
1. Pry light unit from trim panel.
2. Disconnect wiring leads.
3. Remove bulb.

Refit

4. Reverse removal procedure.

**SIDE REPEATER LIGHT**

Service repair no - 86.50.59

**Remove**

J5906

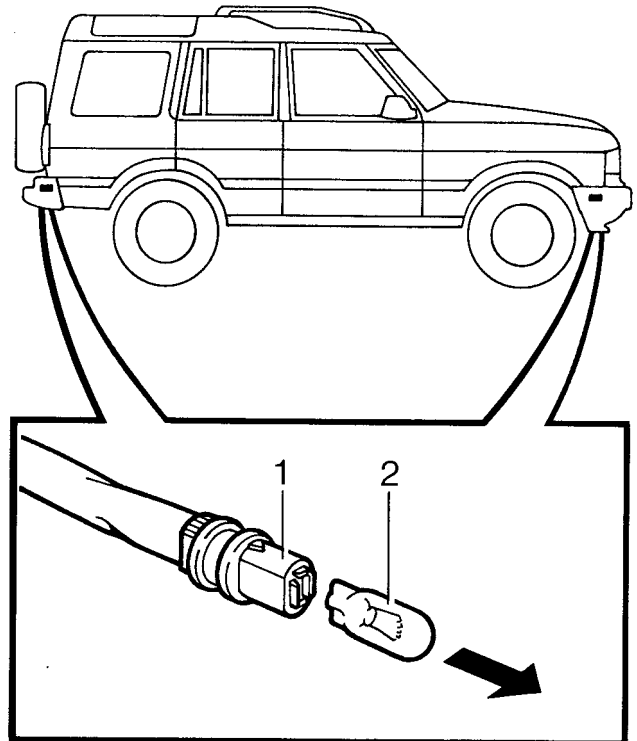
1. Push the lens to the right and then pull outward to detach lens and bulb holder from the panel.
2. Turn lens anti-clockwise and remove from bulb holder.
3. Pull bulb from holder.

**Refit**

4. Reverse removal procedure.

**BUMPER MOUNTED SIDE LIGHT**

Service repair no - 86.50.59

**Remove**

J5907

1. From behind bumper turn holder anti-clockwise and release from light unit.
2. Pull bulb from holder.

**Refit**

3. Reverse removal procedure.

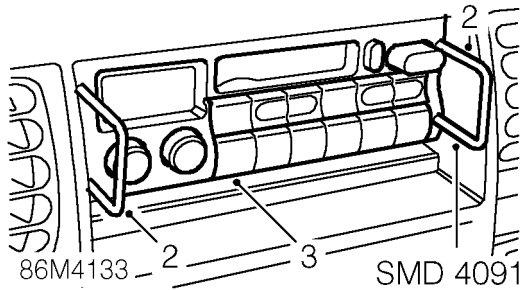


## RADIO

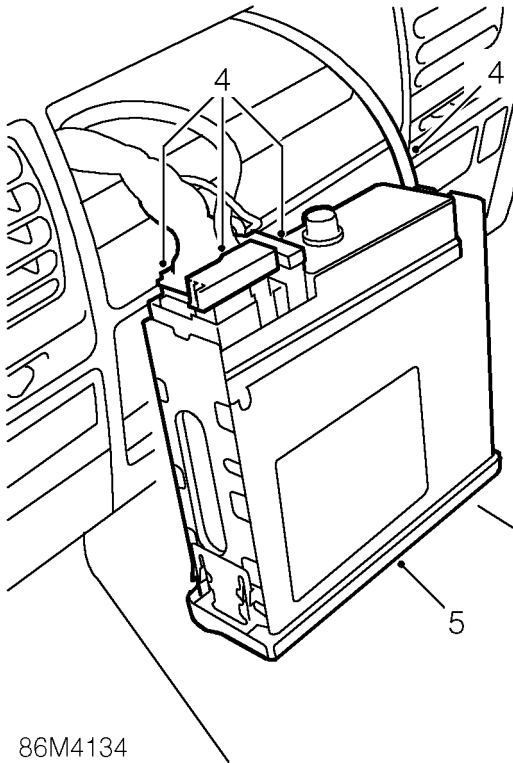
Service repair no - 86.50.03

### Remove

1. Disconnect battery earth lead.



2. Insert removal tools SMD 4091 to radio.
3. Release radio and remove tools.



4. Disconnect aerial and multiplugs from radio.
5. Remove radio.

### Refit

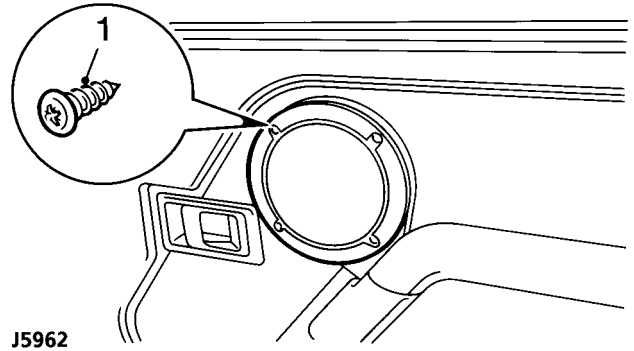
6. Position radio, connect multiplugs and aerial, and secure radio to fascia.
7. Connect battery earth lead.
8. Set radio code.

## SPEAKERS

Service repair no - 86.50.13

### Door speakers

#### Remove



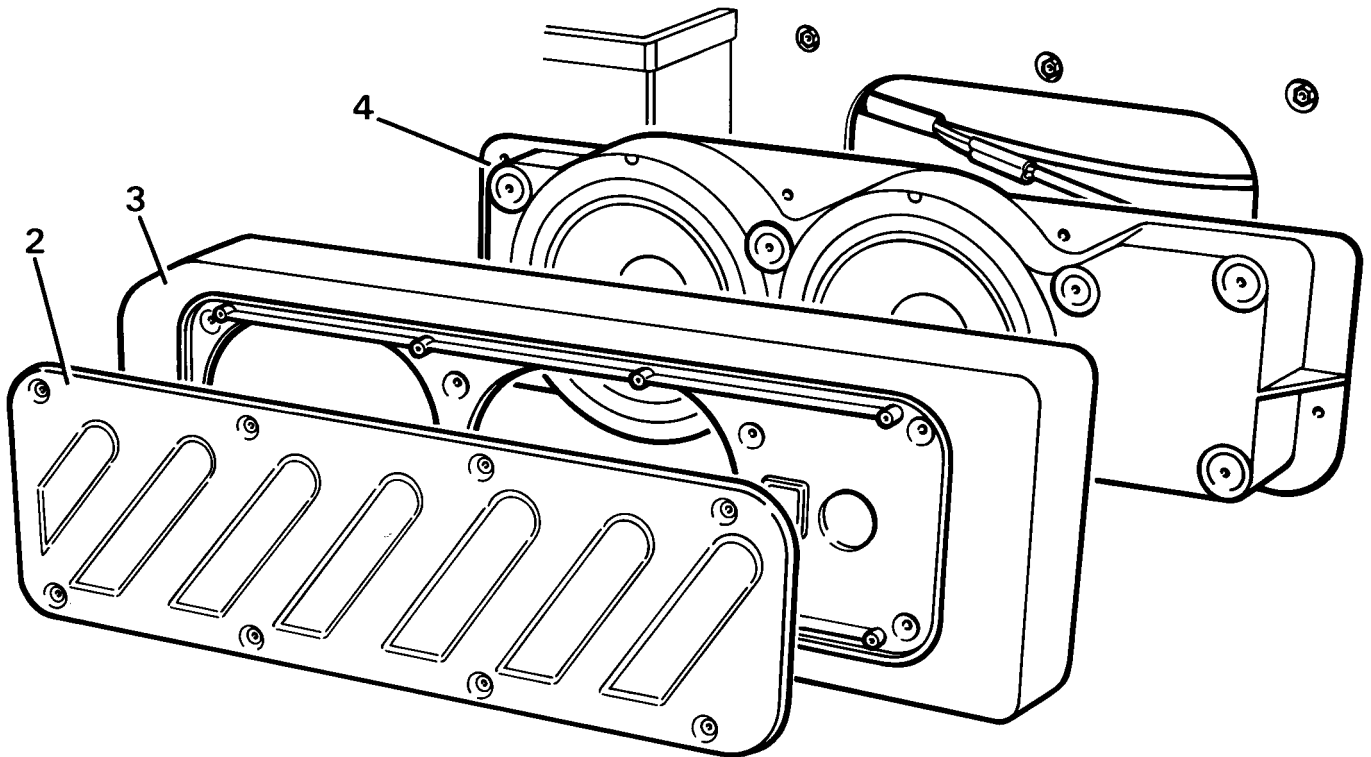
1. Remove the securing screws and withdraw the speaker from the trim panel.
2. Disconnect the speakers leads.

#### Refit

3. Reverse removal procedure.

**SPEAKERS AND AMPLIFIER PACK, REAR DOOR**

Service repair no - 86.50.36



J5283M

**Remove**

1. Disconnect battery negative lead.
2. Remove securing screws and withdraw speaker grille.
3. Remove securing screws and withdraw speaker trim.
4. Remove securing screws ease speaker and amplifier pack away from door panel, disconnect multiplug and withdraw assembly.
5. Disconnect speaker plug from amplifier remove securing screws and detach amplifier.

**Refit**

6. Reverse removal procedure.



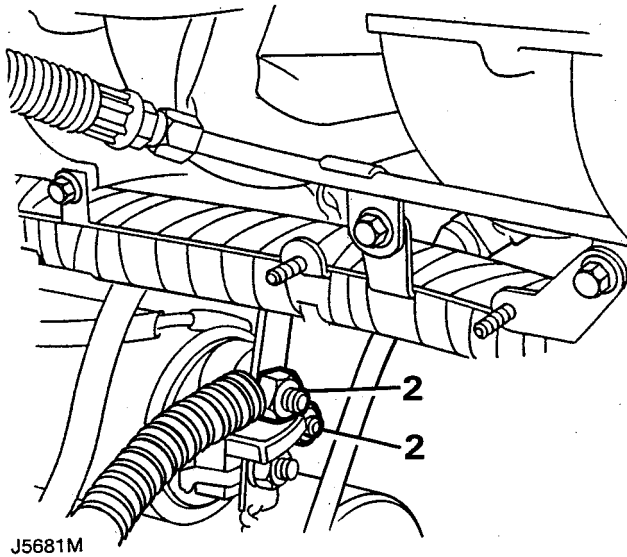


## STARTER MOTOR - Mpi

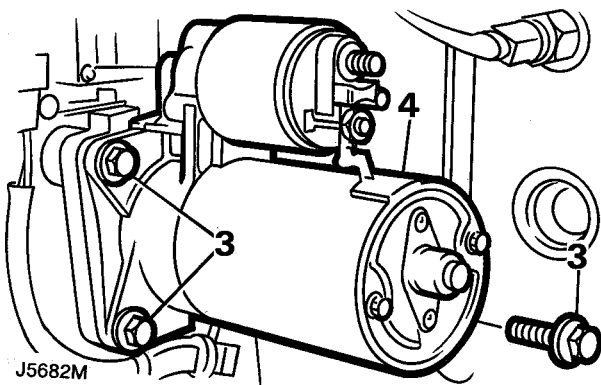
Service repair no - 86.60.01

### Remove

1. Disconnect battery negative lead.



2. Remove 2 nuts securing cables to starter solenoid; release cables.



3. Remove 3 bolts securing starter motor.
4. Manoeuvre starter motor clear of bell housing.
5. Remove starter motor.

### Refit

6. Clean mating faces of starter motor and differential housing.
7. Manoeuvre starter motor into position.
8. Fit mounting bolts and Tighten to **45 Nm**.
9. Connect battery cables to starter solenoid; fit nuts and tighten to the correct torque.
10. Reconnect battery negative lead.

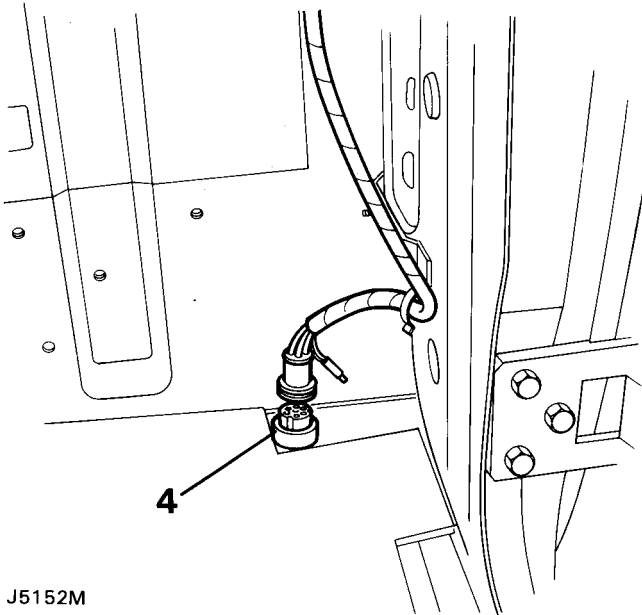
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**TRAILER SOCKET**


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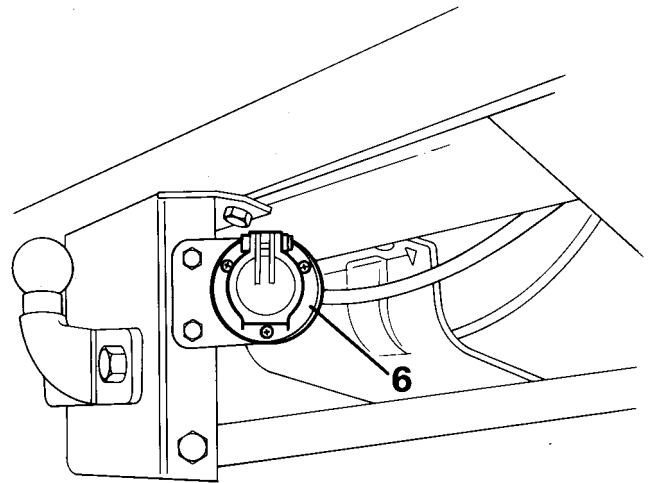
**Remove**

1. If fitted remove the RH side facing seat **See CHASSIS AND BODY, Repair, Rear Fold Down Seats**
2. Remove the rear lower side trim panel **See CHASSIS AND BODY, Repair, Rear Compartment Lower Trim Panels**
3. Raise the carpet adjacent to the RH rear quarter panel.
4. Disconnect the trailer socket lead multi-plug from the RH body harness.



J5152M

5. Displace the rubber grommet in the floor and pass the socket lead through to the underside of the vehicle.
6. Remove the securing screws and withdraw the trailer socket from the towing hook mounting bracket.



J5153M

**Refit**

7. Reverse removal procedure.

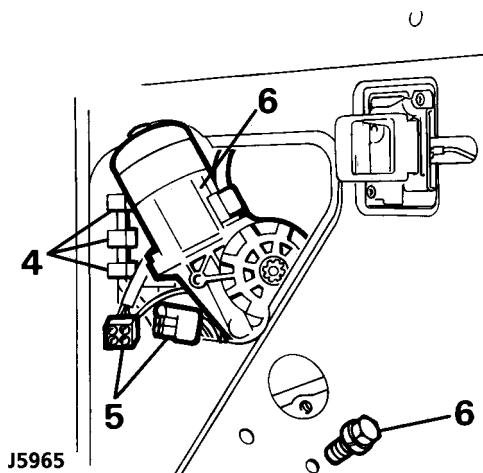


## WINDOW LIFT MOTOR - FRONT

Service repair no - 86.25.04

### Remove

1. Ensure that the window glass is in its fully closed position and secure it with adhesive tape.
2. Disconnect battery negative lead.
3. Remove the door pull, trim panel, and plastic vapour barrier. **See CHASSIS AND BODY, Repair, Front Door Trim Panel**
4. Release the window lift motor wiring harness from the three retaining clips to allow the harness to be pulled out of the opening at the front of the inner door panel.
5. Disconnect the window lift motor harness multi-plug from the main door harness.
6. Support the motor, remove the three securing bolts and withdraw the motor through the top front opening of the door panel.



### Refit

7. Reverse removal procedure.



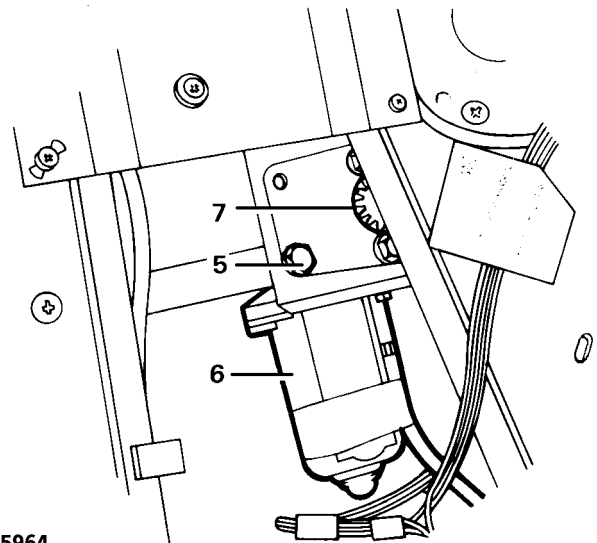
**NOTE:** Ensure drive gear is engaged and correctly aligned with window lift linkage before fitting securing bolts.

## WINDOW LIFT MOTOR - REAR

Service repair no - 86.25.09

### Remove

1. Ensure that the side door glass is in the fully closed position and secure with adhesive tape.
2. Disconnect battery negative lead.
3. Remove the door pull, trim panel and plastic vapour barrier. **See CHASSIS AND BODY, Repair, Rear Side Door Trim - Panel**
4. Disconnect the lift motor harness multi-plug from the door harness.
5. Support the motor and remove the three securing screws.
6. Withdraw the motor through the lower opening in the inner door panel.



### Refit

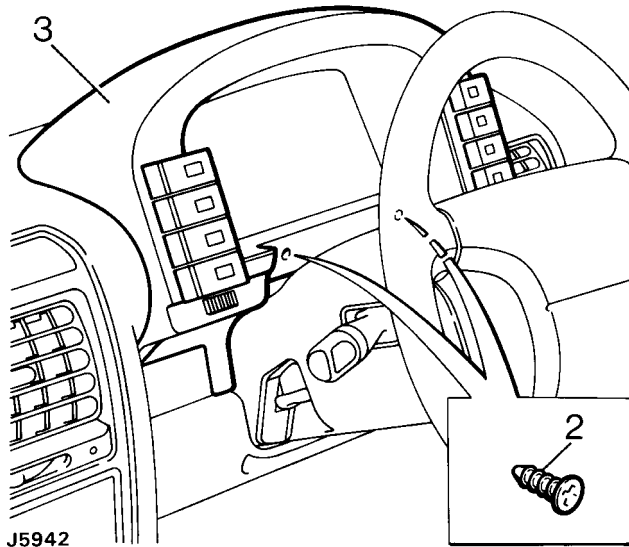
7. Reverse removal procedure.



**NOTE:** Ensure drive gear is engaged and correctly aligned with window lift linkage, before fitting securing bolts.

**INSTRUMENT PANEL FINISHER****Service repair no - 88.20.03****Remove**

1. Position steering wheel for access.



2. Remove 2 screws securing panel.
3. Lift panel clear, disconnect multiplug connections.

**Refit**

4. Reverse removal procedure.

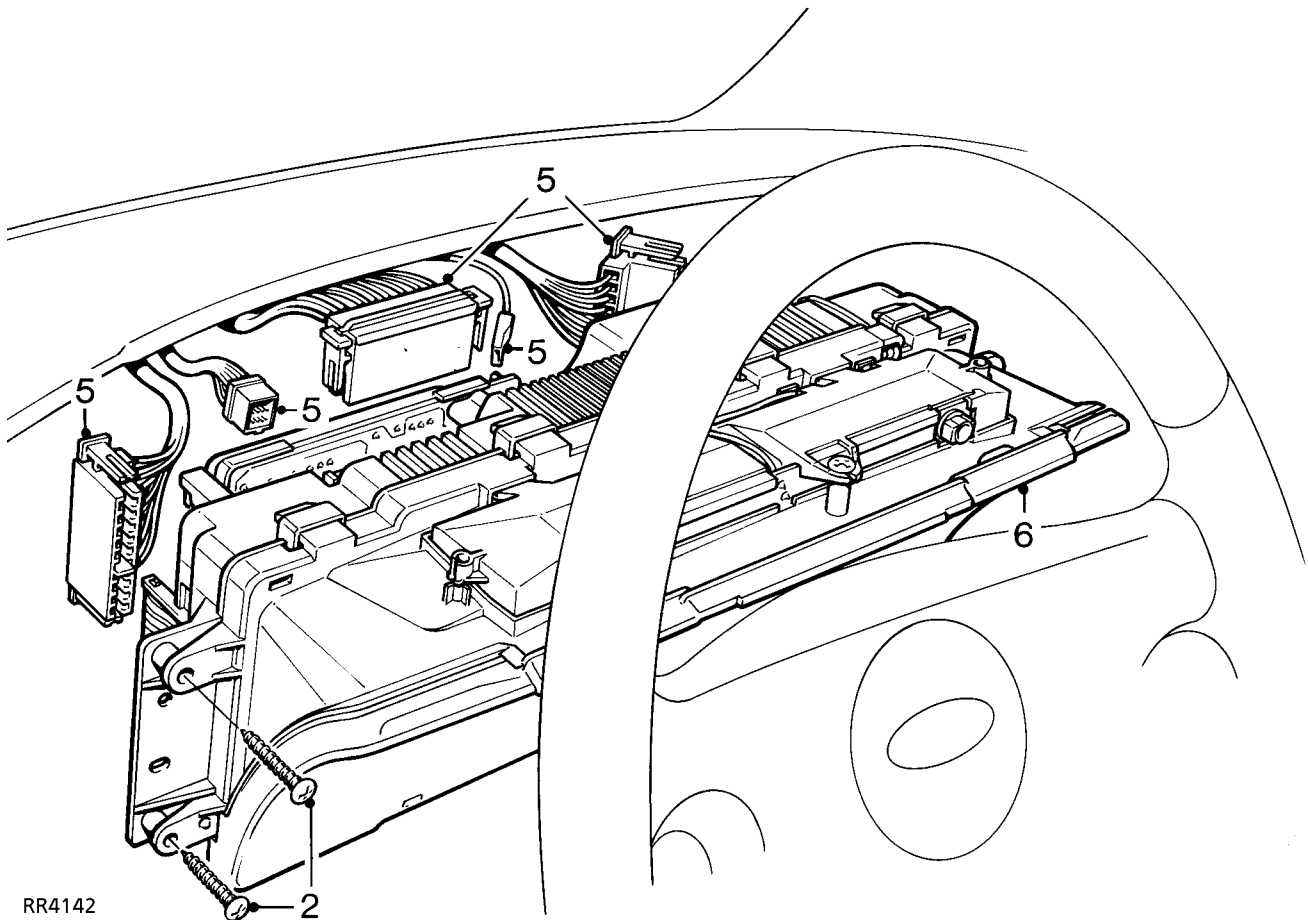


## INSTRUMENT BINNACLE

Service repair no - 88.20.13

### Remove

1. Remove instrument panel finisher. **See**  
*Instrument panel finisher*



2. Remove 4 screws securing binnacle to fascia.
3. Carefully ease 2 lower panel finisher brackets downwards.
4. Withdraw binnacle to gain access to multiplugs.
5. Noting their fitted positions, disconnect multiplugs.
6. Remove binnacle.

### Refit

7. Reverse removal procedure.

**INSTRUMENT ILLUMINATION AND WARNING LIGHT BULBS**

Service repair no - 86.45.48 - Instrument

Service repair no - 86.45.61 - Warning light

**Remove**

1. Remove binnacle. *See Instrument binnacle*
2. Identify bulb to be replaced.



**NOTE:** If faulty bulb is not accessible, remove screws securing circuit board and carefully ease circuit board aside.

3. Rotate bulb holder anti-clockwise, withdraw bulb holder and remove bulb.

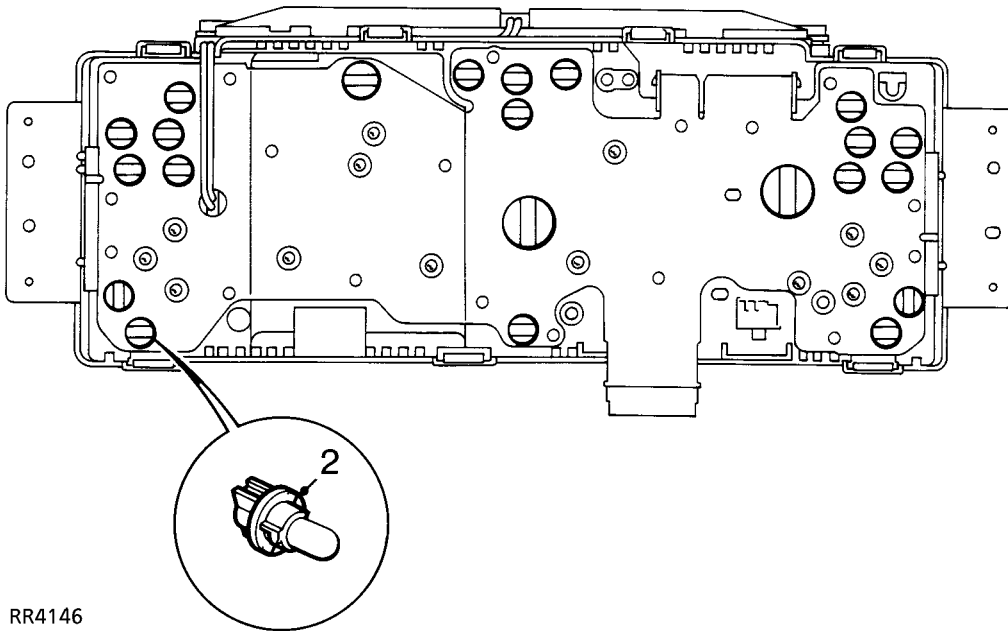
**Refit**

4. Fit new bulb to holder.



**CAUTION:** Ensure bulb of correct wattage and type is fitted.

5. Reverse removal procedure.



RR4146

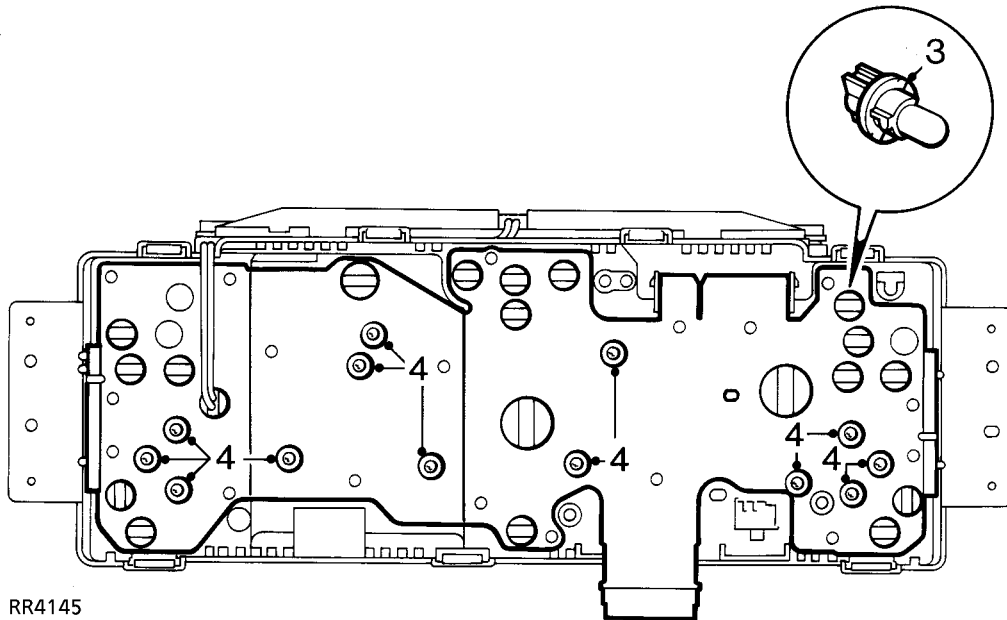


## MAIN PRINTED CIRCUIT

Service repair no - 88.20.19

### Remove

1. Remove instrument cowl. *See Instrument cowl and illumination board*
2. Remove circuit board. *See Circuit board*



3. Remove illumination and warning lamp bulbs.
4. Remove 13 screws securing main printed circuit, remove circuit.

### Refit

5. Position main printed circuit to binnacle.
6. Ensure screw holes in instruments are aligned with holes in binnacle, fit and tighten screws.
7. Reverse removal procedure. 1 and 2.

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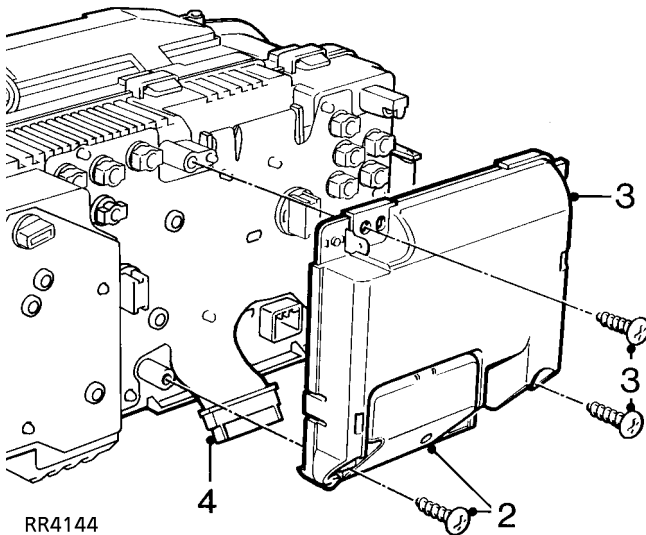
**CIRCUIT BOARD**

---

Service repair no - 88.20.25

**Remove**

1. Remove binnacle. *See Instrument binnacle*



2. Remove screw, release lower cover from circuit board.
3. Remove 2 screws securing circuit board to binnacle, release board.
4. Disconnect multiplug.

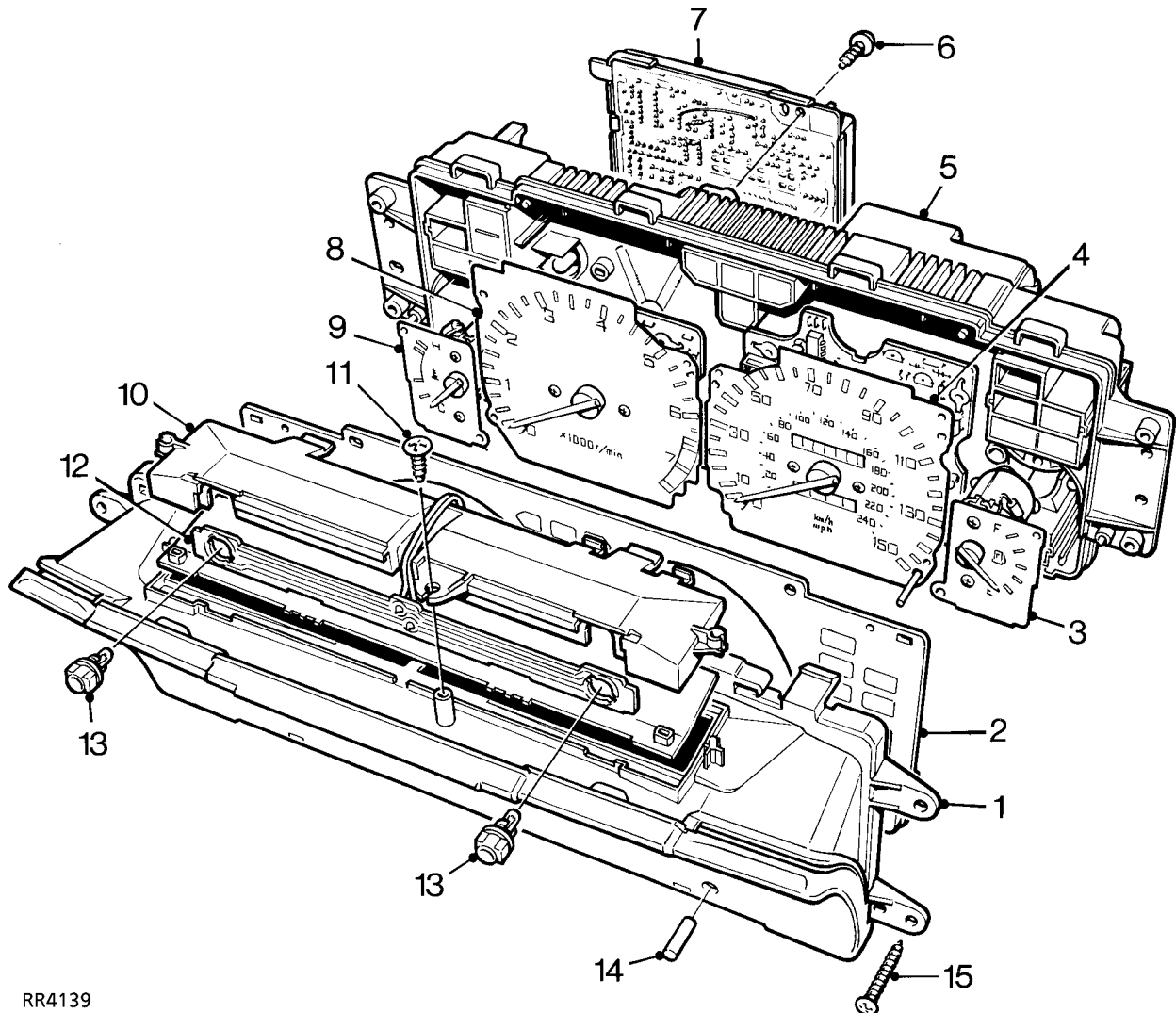
**Refit**

5. Reverse removal procedure.





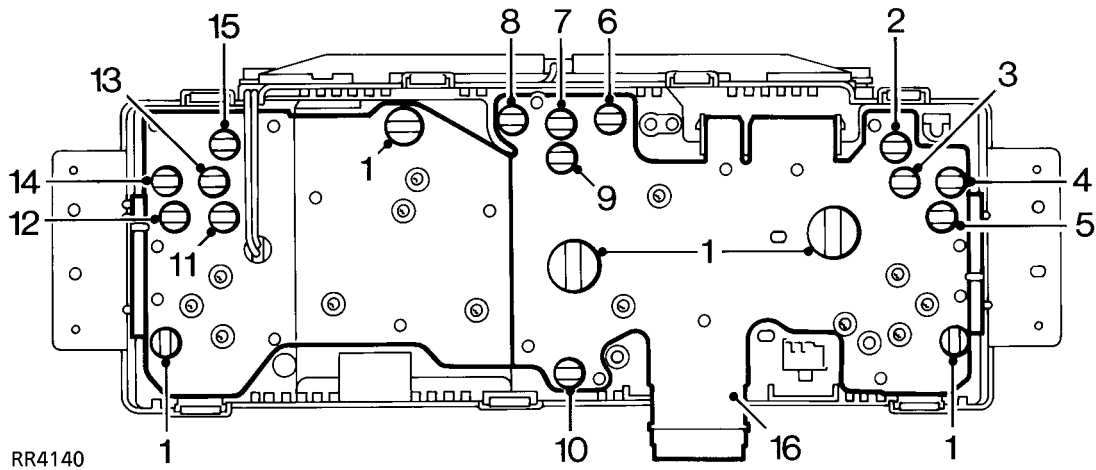
## INSTRUMENT BINNACLE COMPONENTS



RR4139

- |                                   |  |
|-----------------------------------|--|
| 1. Instrument cowl                | 8. Tachometer                                    |
| 2. Face plate                     | 9. Temperature gauge                             |
| 3. Fuel gauge                     | 10. Illumination board                           |
| 4. Speedometer                    | 11. Screw securing illumination board            |
| 5. Instrument binnacle            | 12. Circuit board - instrument illumination      |
| 6. Screw - securing circuit board | 13. Instrument illumination bulb holder and bulb |
| 7. Circuit board                  | 14. Speedometer trip reset button sleeve         |
|                                   | 15. Screw - cowl and binnacle                    |

## PRINTED CIRCUIT AND WARNING LIGHTS



- |   |  |
|---|--|
| 1. Panel illumination bulbs                       | 9. Direction indicator warning lamp bulb             |
| 2. Transmission oil temperature warning lamp bulb | 10. Air suspension warning lamp bulb                 |
| 3. Hazard warning lamp bulb                       | 11. Ignition/no charge warning lamp bulb             |
| 4. Check engine warning lamp bulb                 | 12. Seat belt warning lamp bulb                      |
| 5. Handbrake/brake fluid warning lamp bulb        | 13. Not used   |
| 6. ABS warning lamp bulb                          | 14. Traction control warning lamp bulb               |
| 7. Headlamp main beam warning lamp bulb           | 15. Diesel heater plug warning lamp bulb (if fitted) |
| 8. Trailer direction warning lamp bulb            | 16. Main printed circuit                             |



## INSTRUMENT COWL AND ILLUMINATION BOARD

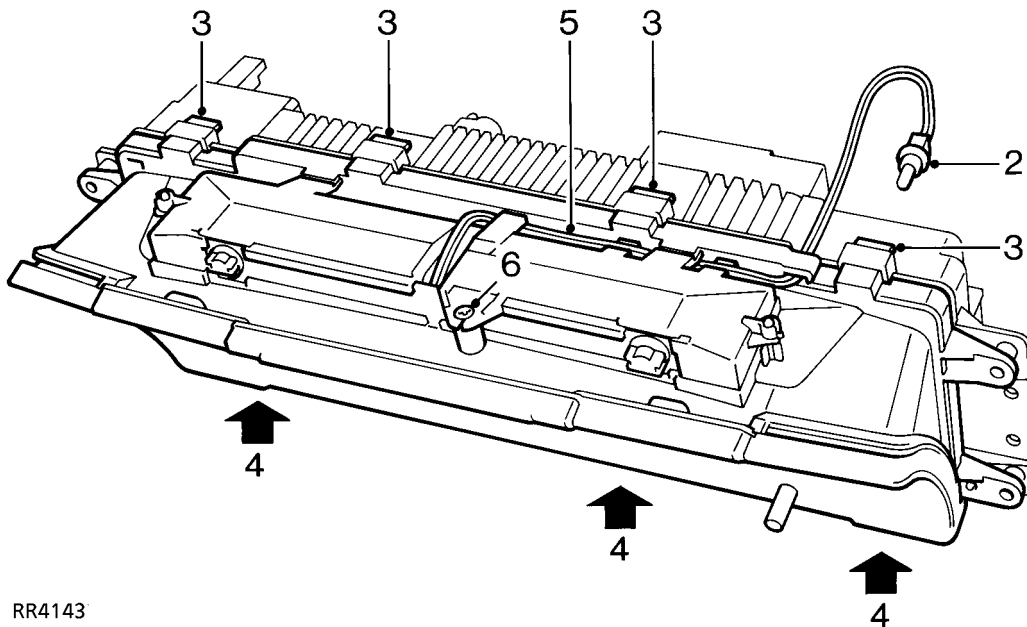
Service repair no - 88.20.06 - Instrument cowl

Service repair no - 88.20.22 - Illumination board

### Remove

1. Remove binnacle, *See Instrument binnacle*

#### *Instrument cowl*



RR4143

2. Remove bulb holder from binnacle.
3. Release 4 clips securing top of cowl to binnacle.
4. Release 3 clips securing bottom of cowl to binnacle, remove cowl.

#### *Illumination board*

5. Release bulb holder wires from clip.
6. Remove screw securing illumination board to cowl, remove board.

### Refit

#### *Illumination board*

7. Position illumination board to cowl, fit and tighten screw.
8. Secure bulb holder wires in clip.

#### *Instrument cowl*

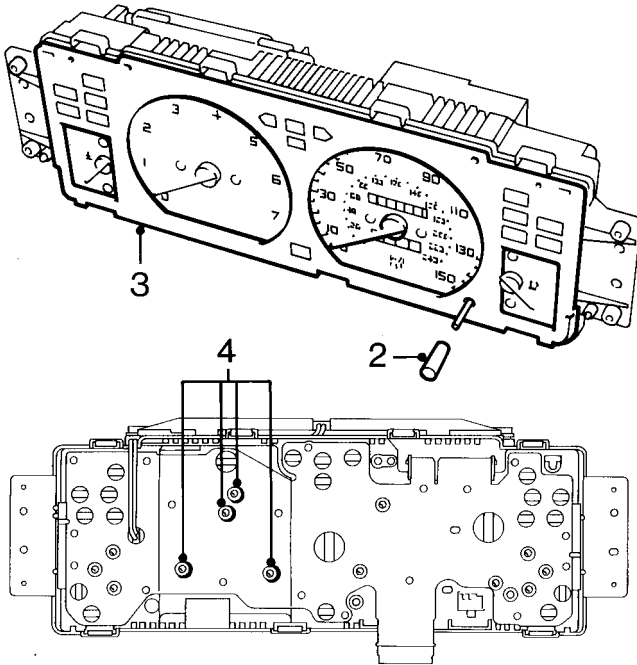
9. Ensure instrument face plate is correctly positioned.
10. Position cowl to binnacle ensuring speedometer trip passes through hole in cowl.
11. Secure cowl retaining clips.
12. Fit bulb holder in binnacle.
13. Fit binnacle. *See Instrument binnacle*

**SPEEDOMETER**

Service repair no - 88.30.01

**Remove**

1. Remove instrument cowl. *See Instrument cowl and illumination board*



RR4131

2. Remove speedometer trip reset button sleeve.
3. Remove instrument face plate.
4. Remove 4 screws securing speedometer, remove speedometer.

**Refit**

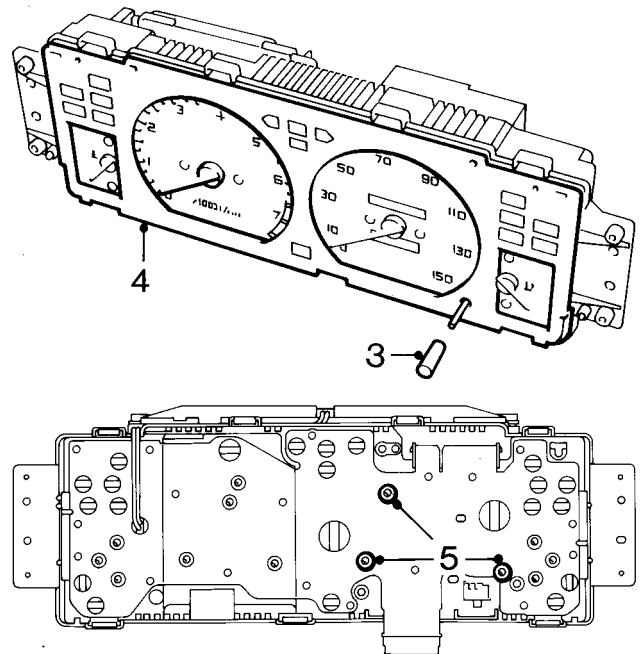
5. Reverse removal procedure.

**TACHOMETER**

Service repair no - 88.30.21

**Remove**

1. Remove circuit board. *See Circuit board*
2. Remove instrument cowl. *See Instrument cowl and illumination board*



RR4124

3. Remove speedometer trip reset button sleeve.
4. Remove instrument face plate.
5. Remove 3 screws securing tachometer to binnacle, remove tachometer.

**Refit**

6. Reverse removal procedure.



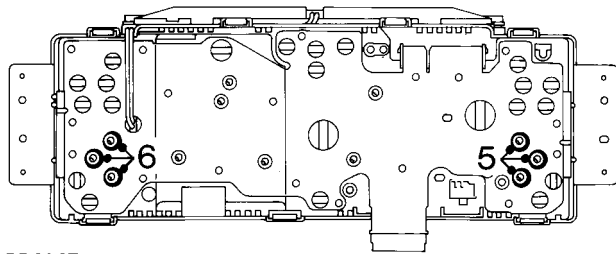
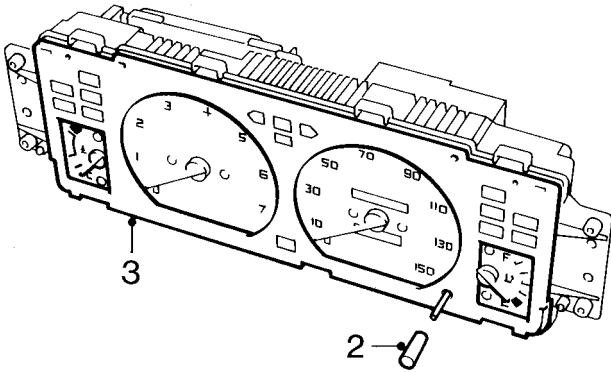
## COOLANT TEMPERATURE AND FUEL GAUGES

Service repair no - 88.25.14 - Coolant temperature gauge

Service repair no - 88.25.26 - Fuel gauge

### Remove

1. Remove instrument cowl. *See Instrument cowl and illumination board*



RR4147

2. Remove speedometer trip reset button sleeve.
3. Remove instrument face plate.

### Coolant temperature gauge

4. Remove circuit board, *See Circuit board*
5. Remove 3 screws securing coolant temperature gauge to binnacle, remove gauge.

### Fuel gauge

6. Remove 3 screws securing fuel gauge to binnacle, remove gauge.

### Refit

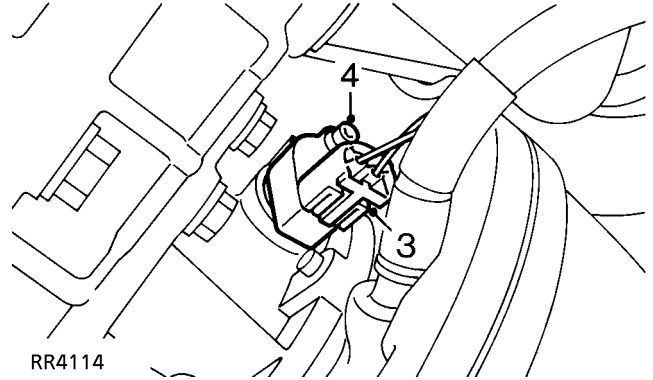
7. Reverse removal procedure.

## SPEEDOMETER TRANSDUCER

Service repair no - 88.30.14

### Remove

1. Position vehicle on ramp and chock wheels.
2. Raise ramp.



RR4114

3. Disconnect multiplug from transducer.
4. Remove bolt securing transducer, remove transducer.

### Refit

5. Reverse removal procedure.

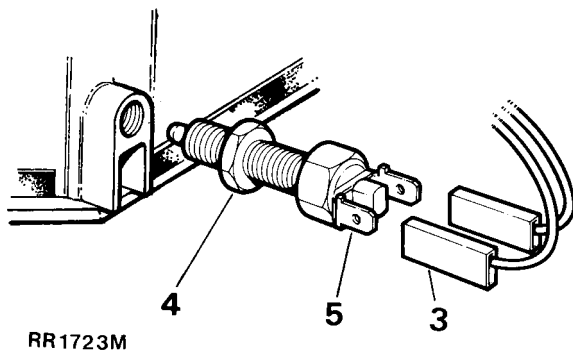
**REVERSE LIGHT SWITCH**

Service repair no - 37.27.01

**Manual Gearbox****Remove**

Reverse light switch is located at rear of selector housing, accessible from beneath vehicle.

1. Place vehicle on suitable ramp.
2. Disconnect the battery negative lead.
3. Disconnect electrical leads.
4. Release lock-nut.
5. Remove switch.

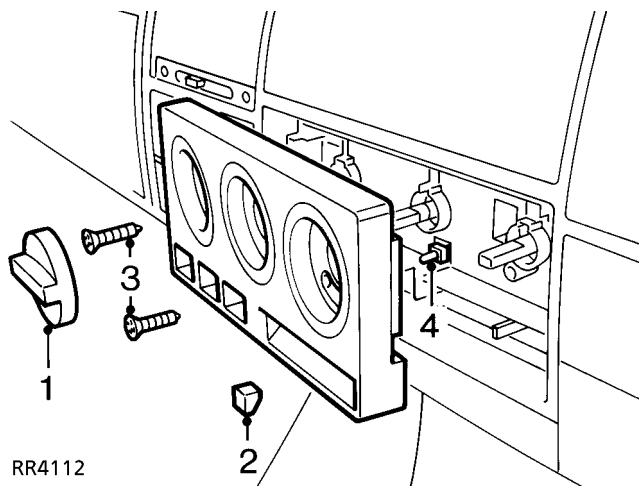


**NOTE:** Reverse light switch requires re-setting on reassembly.

6. Select reverse gear.
7. Connect 12 volt supply and test lamp across switch terminals.
8. Screw switch into housing until test lamp is illuminated. Screw switch in a further half turn, tighten locknut.
9. Connect electrical leads.
10. Reconnect the battery negative lead.

**HEATER/VENTILATION AND AIR CONDITIONING CONTROL PANEL BULB**

Service repair no - 86.45.73

**Remove**

1. Carefully pull 3 rotary knobs off switches.
2. Prise blower speed control knob off lever.
3. Remove 2 screws securing panel, ease panel away from fascia.
4. Pull bulb from holder.
5. Insert new bulb in holder.

**Refit**

6. Reverse removal procedure.



## CIGAR LIGHTER AND BULB

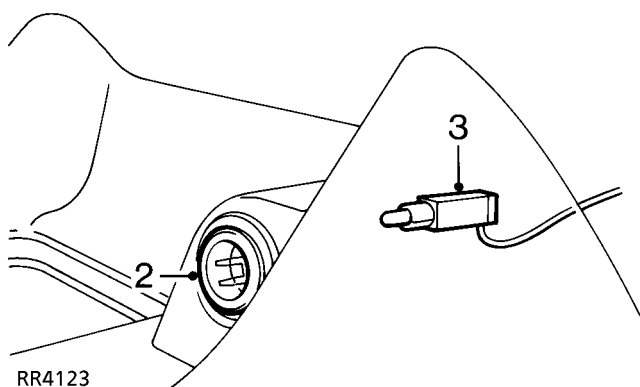
Service repair no - 86.65.60

Service repair no - 86.45.55

### Cigar Lighter

#### Remove

1. Remove centre console. *See CHASSIS AND BODY, Repair, Centre Console*



2. Depress lugs securing cigar lighter, withdraw lighter from centre console.

#### Bulb replacement

3. Remove bulb from holder.

#### Refit

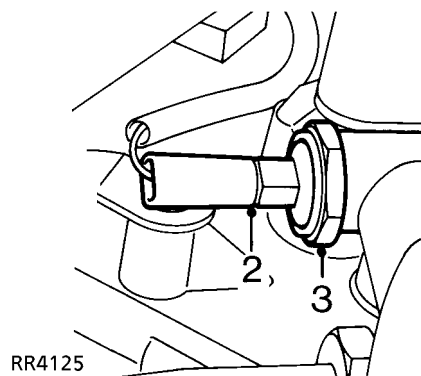
4. Reverse removal procedure.

## OIL PRESSURE WARNING SWITCH - V8i

Service repair no - 86.65.30

#### Remove

1. Disconnect the battery negative lead.
2. Disconnect electrical lead.
3. Unscrew switch unit.
4. Remove switch and sealing washer.



#### Refit

5. Reverse removal procedure. Using a NEW sealing washer.

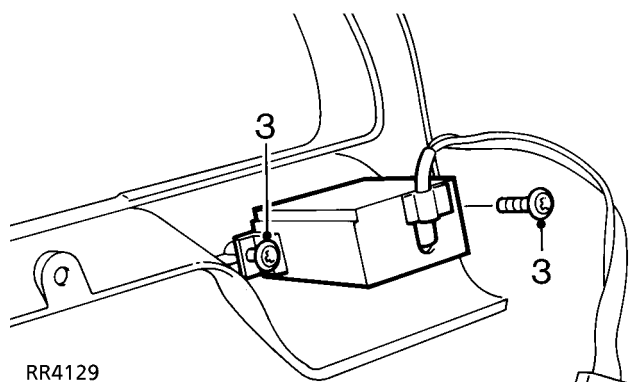
### INSTRUMENT ILLUMINATION ELECTRONIC DIMMER/RHEOSTAT

Service repair no - 86.65.07

Electronic dimming control switch is located in instrument panel finisher. Rotate control to vary intensity of illumination.

#### Remove

1. Disconnect the battery negative lead.
2. Remove instrument panel finisher. **See CHASSIS AND BODY, Repair, Instrument Panel Finisher**



RR4129

3. Remove 2 screws securing rheostat, remove rheostat.

#### Refit

4. Reverse removal procedure.

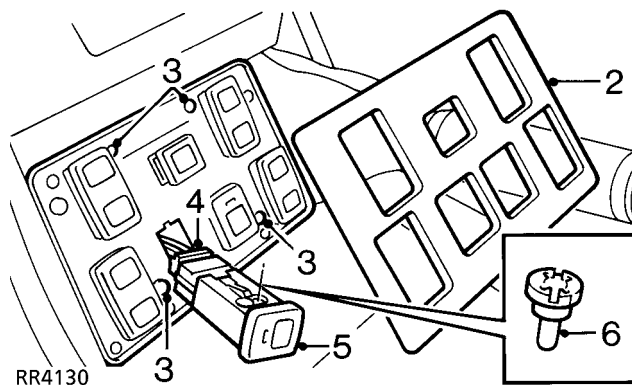
### WINDOW LIFT/HEATED SEAT CUSHION SWITCHES AND BULBS

Service repair no - 86.25.16 - Switches

Service repair no - 86.45.29 - Bulb

#### Switch Replacement

1. Disconnect the battery negative lead.



RR4130

2. Carefully release rear of surround from centre console.
3. Remove screws, pry window lift switch surround from glove box.
4. Disconnect multi-plug(s) at rear of switch(es).
5. Apply pressure to rear of switch, push it through surround.

#### Bulb replacement

6. Identify bulb to be replaced and remove appropriate switch.
7. Rotate bulb holder 90° and withdraw it from switch; discard bulb and holder.

#### Refit

8. Reverse removal procedure.



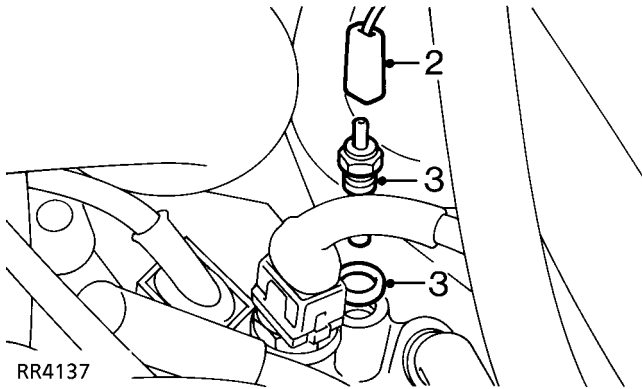


## COOLANT TEMPERATURE TRANSMITTER - V8i

Service repair no - 26.10.02

### Remove

1. Disconnect battery negative lead.



2. Disconnect lead from transmitter.
3. Remove transmitter, discard sealing washer if fitted.

### Refit

4. Coat threads of replacement transmitter with Loctite 572.
5. Fit a new sealing washer to transmitter.
6. Fit transmitter, connect lead.
7. Top-up cooling system.

## HEATED FRONT SCREEN

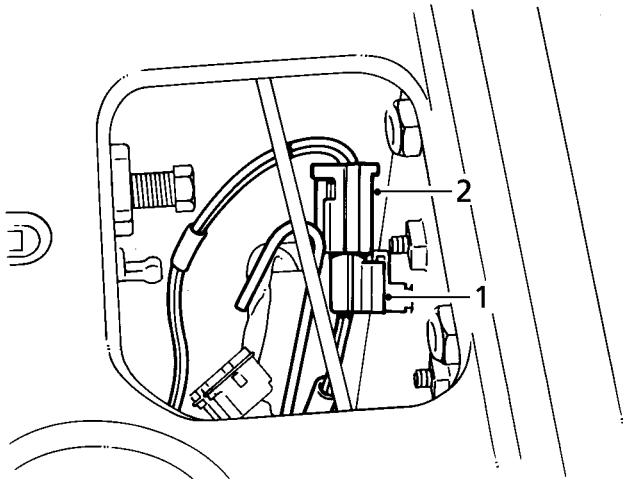
Heated front screen will operate when switch is operated, with engine running. Timer unit will provide a preset time cycle of 7« minutes  $\pm$  20%.

To identify timer unit. **See Electrical Trouble Shooting Manual. Electrical Troubleshooting Manual**

Switching OFF ignition, or further operation of heated front screen switch during cycle will switch off screen and cancel, reset and switch off timer unit.

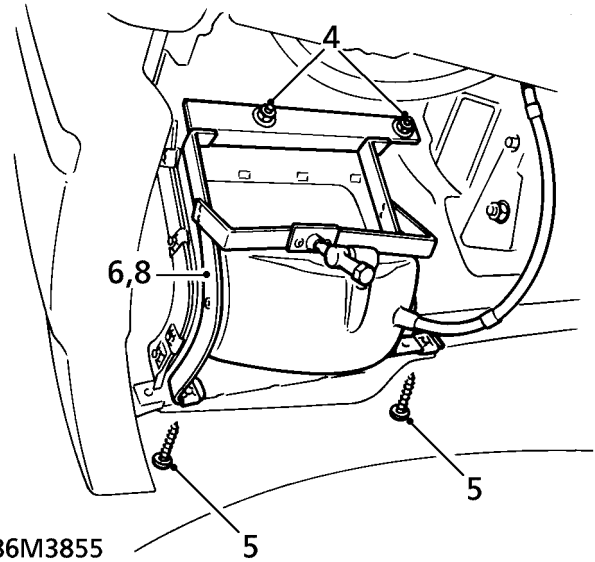
**FOG LAMP - FRONT**

Service repair no - 86.40.96

**Remove**

86M3854

1. Locate and release lamp harness multiplug from clip behind headlamp.
2. Disconnect multiplug.
3. Attach a draw string to harness.



86M3855

4. Remove 2 nuts securing lamp bracket to bumper studs.
5. Remove 2 screws securing lamp bracket to spoiler.
6. Release lamp assembly and pull lamp harness through front panel.
7. Detach draw string from harness.
8. Remove lamp/bracket assembly.
9. Remove 2 spire nuts from lamp bracket.

**Refit**

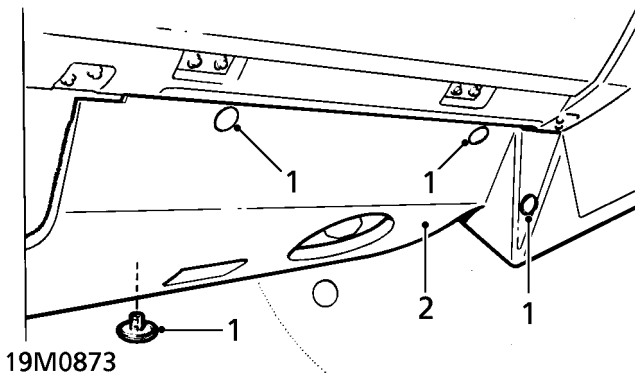
10. Reverse removal procedure.



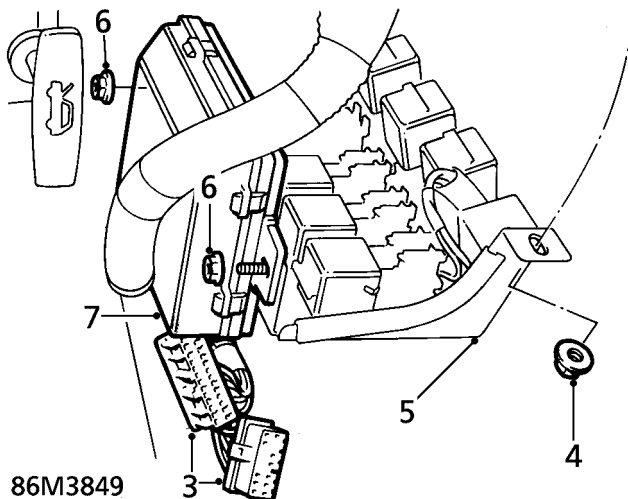
### ANTI-THEFT ALARM ECU (96 MODELS)

Service repair no - 86.55.85

#### Remove



1. Remove 4 studs securing fascia left hand closing panel.
2. Remove closing panel.



3. Disconnect 2 multiplugs from ECU.
4. Remove nut securing ECU/relay bracket.
5. Lower bracket.
6. Remove 2 nuts securing ECU to bracket.
7. Remove ECU.



**NOTE: A new ECU must be initialised using TestBook.**

#### Refit

8. Reverse removal procedure.

### HANDSET (96 MODELS)

If vehicle does not respond to handset immediately, it may have lost synchronisation. To re-synchronise, press either button, 4 times in quick succession. If handset still fails to respond, check batteries, refer to Owner's handbook. If batteries are okay, it may be necessary to use emergency key access, refer to Owner's handbook.



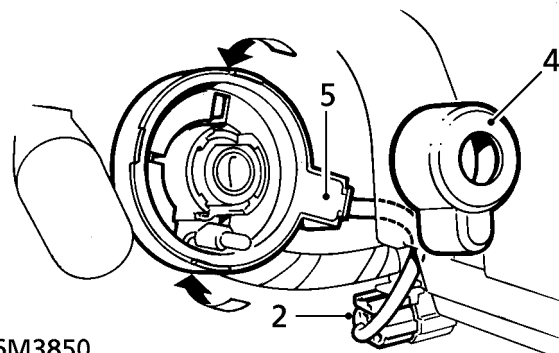
**NOTE: New handsets must be initialised using TestBook.**

### PASSIVE COIL (96 MODELS)

Service repair no - 86.77.35

#### Remove

1. Remove steering column shroud. *See STEERING, Repair, Steering column shroud*



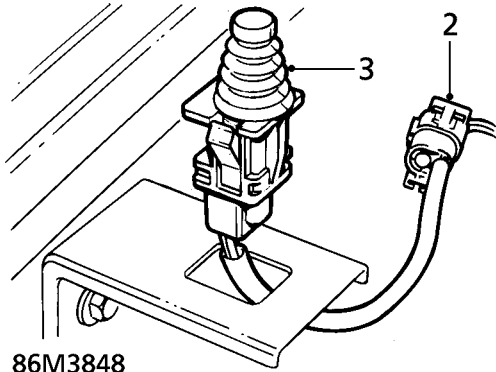
2. Release multiplug from harness clip and disconnect.
3. Release passive coil from starter switch.
4. Remove bulb holder/starter switch shroud.
5. Remove coil.

#### Refit

6. Fit coil, ensuring switch illumination bulb harness passes through large cut-out.
7. Secure coil with cable tie.
8. Position bulb holder/starter switch shroud and locate bulb.
9. Locate bulb holder/starter switch shroud, ensuring cut-out in shroud aligns with lug on starter switch.
10. Connect multiplug and secure to clip.
11. Fit column shroud.

**BONNET SWITCH**

Service repair no - 86.55.89

**Remove**

86M3848

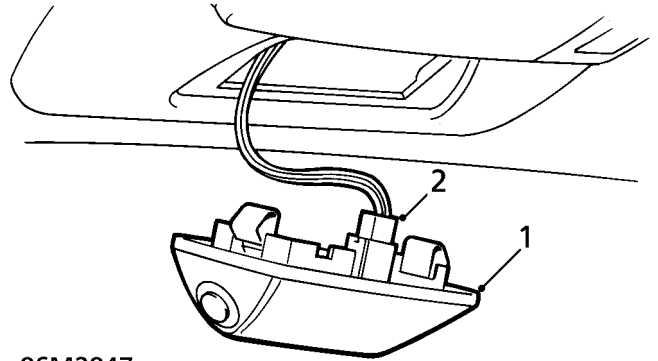
1. Remove 2 bolts securing sounder, move sounder aside.
2. Locate and disconnect bonnet switch multiplug.
3. Release and remove switch.

**Refit**

4. Reverse removal procedure.

**ULTRASONIC SENSOR**

Service repair no - 86.77.32

**Remove**

86M3847

1. Release sensor from switch panel.
2. Disconnect multiplug and remove sensor.

**Refit**

3. Reverse removal procedure.

**ANTI-THEFT ALARM INDICATOR LIGHT (96 MODELS)**

Service repair no - 86.45.61

*See Instrument illumination and warning light bulbs*

**ENGINE IMMOBILISATION WARNING LIGHT (96 MODELS)**

Service repair no - 86.45.61

*See Instrument illumination and warning light bulbs*



## SOUNDER (96 MODELS)

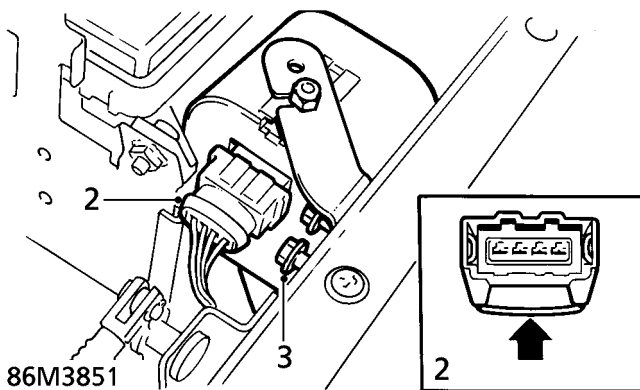
Service repair no - 86.55.87

### Remove



**NOTE:** Failure to follow steps 1 and 2 will result in sounder being activated.

1. Turn starter switch 'ON' then 'OFF'.



2. WITHIN 15 SECONDS, depress release clip on multiplug and detach from sounder.
3. Remove 2 securing bolts and remove sounder complete with bracket.

### Refit

4. Reverse removal procedure.

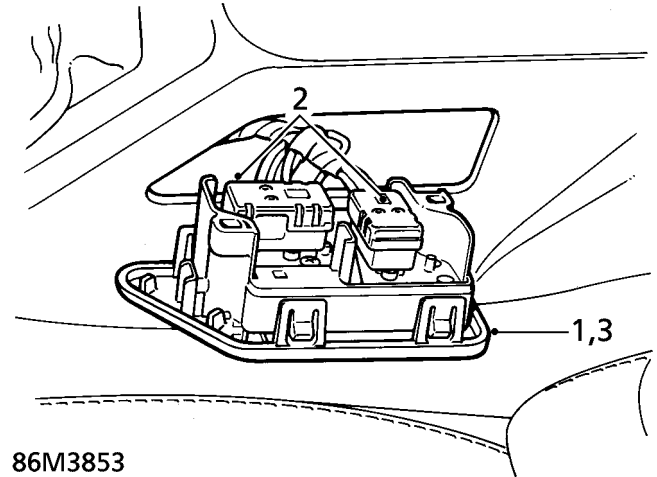


**NOTE:** If sounder is accidentally activated, it can be silenced, provided it is reconnected, by turning starter switch to position II.

## SWITCH - ELECTRIC SEAT

Service repair no - 86.75.03

### Remove



86M3853

1. Release switch panel from centre console.
2. Disconnect 2 switch multiplugs
3. Remove switch panel.

### Refit

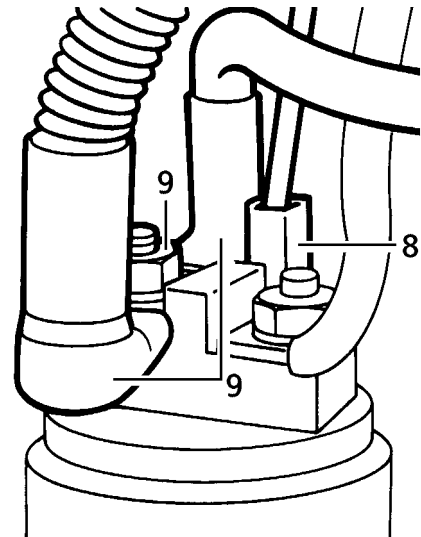
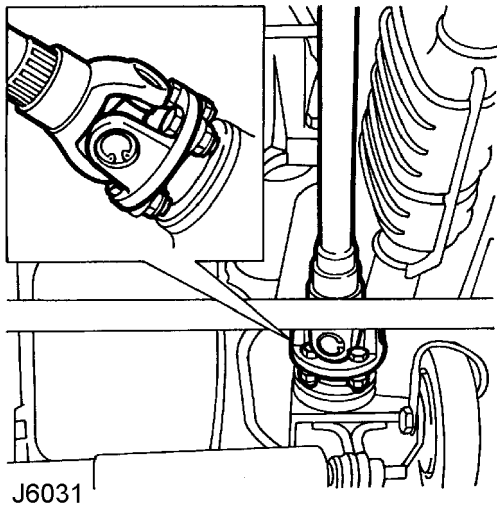
4. Reverse removal procedure.

**STARTER MOTOR - 4.0 V8**

Service repair no - 86.60.01

**Remove**

1. Disconnect battery negative lead.
2. Raise vehicle on ramp.
3. Remove heated oxygen sensor from RH front exhaust pipe. **See EMISSION CONTROL, Repair, Heated Oxygen Sensor (HO2S) - 4.0 V8**



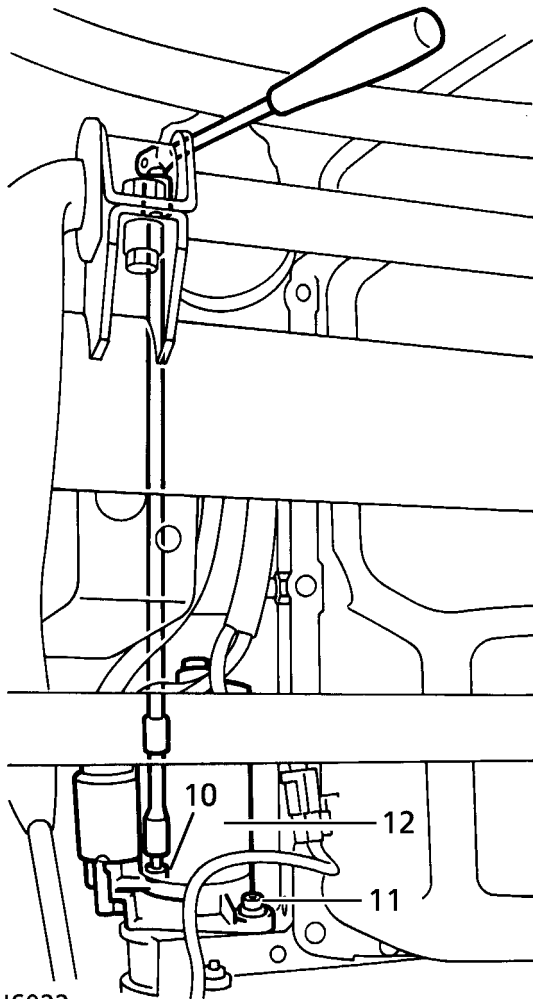
8. Disconnect Lucar from solenoid.
9. Remove nut securing feed wires to starter solenoid and disconnect from terminal.

4. Mark front propeller shaft and drive flanges for assembly reference.
5. Remove 4 nuts and bolts securing propeller shaft flange.



**NOTE:** Raise 1 front road wheel and rotate propeller shaft to gain access to all fixings.

6. Tie propeller shaft aside.
7. Position starter motor heat shield above motor. **See Starter Motor Heat Shield - 4.0 V8**



J6033

## Refit

13. Ensure mating faces are clean.
14. Locate starter motor in fitted position and fit bottom bolt finger tight.
15. Fit top bolt. Tighten to **42 Nm**.
16. Bottom bolt. Tighten to **42 Nm**.
17. Connect feed wires to solenoid terminal. Secure with nut.
18. Connect Lucar to starter solenoid.
19. Manoeuvre heat shield down and forward to position bracket against engine mounting. Engage clip on solenoid.
20. Align bracket to hole using suitable tool and fit retaining bolt.
21. Clean flange mating surfaces, locate propeller shaft and align reference marks.
22. Fit bolts and NEW nyloc nuts. Tighten to **48 Nm**.



**NOTE: Fit bolts with head towards transfer box and away from differential.**

23. Lower vehicle.
24. Reconnect battery negative lead.

10. From above, remove top bolt securing starter motor and position earth lead aside.



**NOTE: To assist removal, use 230 mm extension bar positioned between engine mounting bracket and exhaust manifold.**

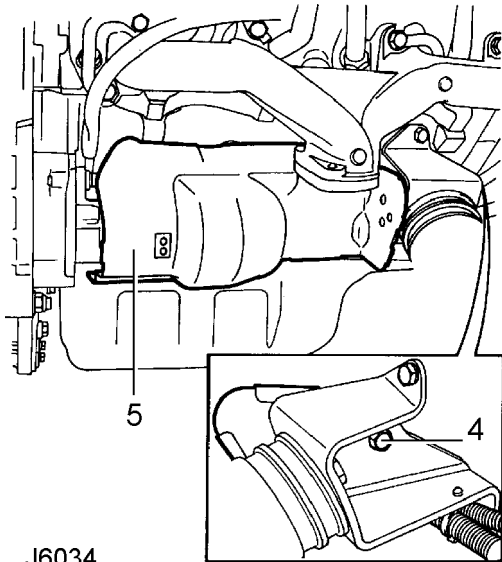
11. Remove bottom bolt securing starter motor.
12. Remove starter motor.

**STARTER MOTOR HEAT SHIELD - 4.0 V8**

Service repair no - 86.60.12

**Remove**

1. Disconnect battery negative lead.
2. Raise vehicle on ramp.
3. Remove heated oxygen sensor from RH exhaust front pipe. **See EMISSION CONTROL, Repair, Heated Oxygen Sensor (HO2S) - 4.0 V8**



4. Remove bolt securing heat shield to RH engine mounting bracket.
5. Release heat shield clip from starter solenoid.
6. Manoeuvre heat shield rearwards and around starter motor.

**Refit**

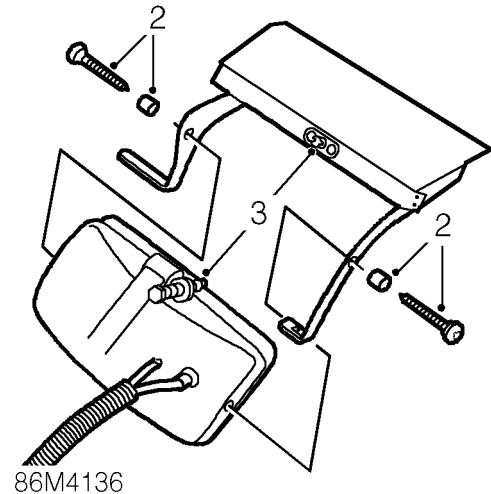
7. Reverse removal procedure.

**BULB - FRONT FOG LAMP**

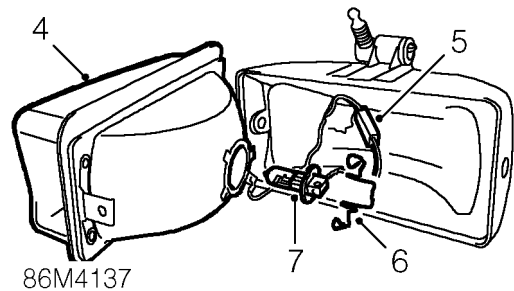
Service repair no - 86.40.94

**Remove**

1. Remove front fog lamp. **See fog lamp - front**



2. Remove 2 Torx screws securing fog lamp to bracket and collect 2 spacers.
3. Release fog lamp adjustment ball joint from bracket and remove lamp.



4. Release lamp lens from shroud.
5. Disconnect 2 Lucars from bulb.
6. Release bulb retaining clip.
7. Remove bulb from lens.





### Refit

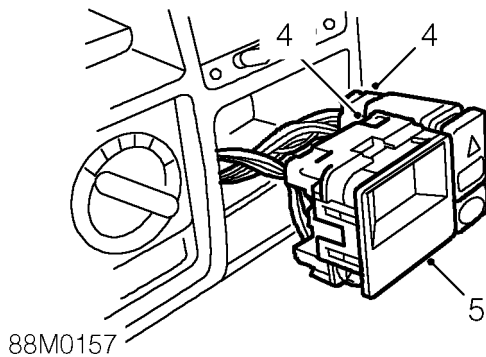
8. Fit bulb to lens.
9. Secure bulb retaining clip.
10. Connect 2 Lucars to bulb.
11. Position lamp lens to shroud.
12. Position lamp to bracket and secure fog lamp adjustment ball joint to bracket.
13. Position spacers, align lamp to bracket and secure with Torx screws.
14. Fit front fog lamp. *See fog lamp - front; Refit*

### CLOCK

Service repair no - 88.15.07

#### Remove

1. Remove drinks tray. *See CHASSIS AND BODY, Repair, drinks tray*
2. Release 4 clock panel securing tags.
3. Release clock panel from louvre panel.



4. Disconnect 2 multiplugs from clock.
5. Remove clock.

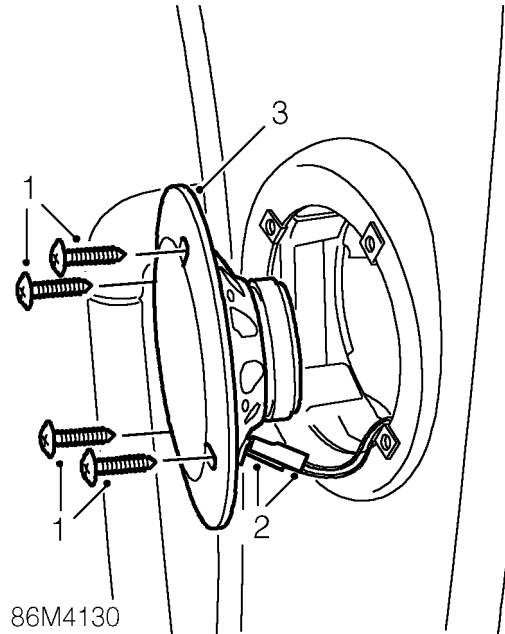
#### Refit

6. Position clock.
7. Connect multiplugs to clock and secure clock to louvre panel.
8. Fit drinks tray. *See CHASSIS AND BODY, Repair, drinks tray; Refit*

### REAR SPEAKER

Service repair no - 88.15.12

#### Remove



1. Remove 4 screws securing speaker.
2. Release speaker and disconnect 2 Lucars.
3. Remove speaker.

#### Refit

4. Position speaker, connect Lucars and secure with screws.

**DIGITAL DIESEL SHUT-OFF VALVE (DDS) - 97 MY**

Service repair no - 86.77.00

**Remove**

1. Remove fuel injection pump. *See FUEL SYSTEM, Repair, fuel injection pump and timing*
2. Drill into 2 break-off screws to a depth of approximately 5 mm using a 3.2 mm drill.



**CAUTION:** Use a drill bushing to guide the drill during the above.

3. Using an 'Easy-out' remove 2 valve retaining screws and discard.
4. Release DDS valve from fuel shut-off solenoid.
5. Remove protective cap from fuel shut-off solenoid electrical connection.
6. Remove fuel shut-off solenoid terminal nut and remove DDS valve.

**Refit**

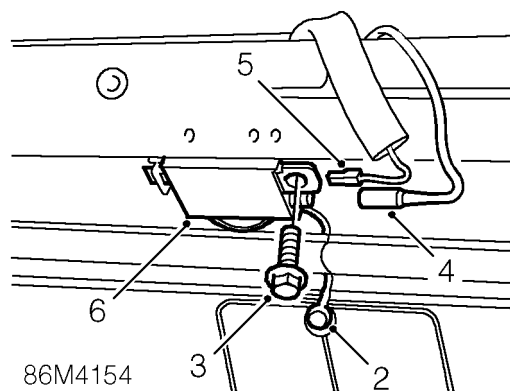
7. Position DDS terminal lead to fuel shut-off solenoid and secure with nut tightened to **2 Nm**.
8. Position DDS valve to fuel shut-off solenoid.
9. Position clamping plate to DDS valve and tighten shear bolts simultaneously until heads shear.
10. Fit fuel injection pump. *See FUEL SYSTEM, Repair, fuel injection pump and timing; Refit*

**ANTENNA AMPLIFIER - 97 MY**

Service repair no - 86.50.29

**Remove**

1. Remove RH alpine light trim casing. *See CHASSIS AND BODY, Repair, alpine light trim casing*



2. Release amplifier to sixth light connector and seal finisher.
3. Remove screw securing amplifier to body and release from location.
4. Disconnect co-axial cable from amplifier.
5. Disconnect Lucar from amplifier.
6. Remove amplifier.

**Refit**

7. Fit amplifier, connect co-axial cable and Lucar to amplifier.
8. Position amplifier to location and secure with screw.
9. Secure amplifier lead through seal finisher and connect to sixth light.
10. Fit RH alpine light trim casing. *See CHASSIS AND BODY, Repair, alpine light trim casing; Refit*




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**DISTRIBUTOR-LUCAS 35DLM8**


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**Overhaul**


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**DISTRIBUTOR CAP**


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**Service repair no - 86.35.10**

1. Unclip and remove cap
2. Fit a new cap if faulty.
3. Clean cap and HT brush with a lint free cloth.

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**ROTOR ARM**


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**Service repair no - 86.35.16**

1. Pull rotor arm from shaft.
2. Fit a new rotor arm if faulty.

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**INSULATION COVER (FLASH SHIELD)**


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**Service repair no - 86.35.40**

1. Remove cover secured by three screws.
2. Fit a new cover if faulty.

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**VACUUM UNIT**


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**Service repair no - 86.35.21**

1. Remove two screws from vacuum unit securing bracket. Disengage vacuum unit connecting rod from pick-up base plate connecting peg. Withdraw vacuum unit from distributor body.

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**AMPLIFIER MODULE**


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**Service repair no - 86.35.30**

1. Remove two screws and withdraw module.
2. Remove gasket.
3. Remove two screws and cast heatsink.



**WARNING: Amplifier module is a sealed unit containing Beryllia. This substance is extremely dangerous if handled. DO NOT attempt to open or crush module.**

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**PICK-UP AND BASE PLATE ASSEMBLY**


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**Service repair no - 86.35.42**

1. Use circlip pliers to remove circlip retaining reductor on rotor shaft.
2. Remove flat washer, and 'O' ring recessed in top of reductor.
3. Gently withdraw reductor from shaft, taking care not to damage teeth.



**NOTE: Coupling ring fitted beneath reductor.**

4. Remove three support pillars and cable grommet. Lift out pick-up and base plate assembly.



**NOTE: Do not disturb two barrel nuts securing pick-up module, otherwise air gap will need re-adjustment.**

5. Fit a new pick-up and base plate assembly if module is known to be faulty, otherwise check pick-up winding resistance (2k-5k ohm).

**Reassemble**

6. This is mainly a reversal of dismantling procedure, noting following points:

**LUBRICATION****Apply clean engine oil:**

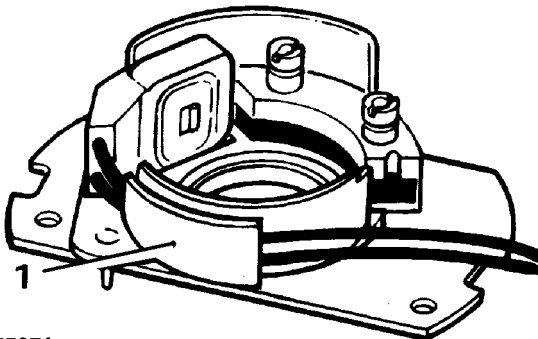
- a. A spot into rotor spindle before fitting rotor arm.

**Apply Omnilube 2 (or equivalent) grease.**

- b. Auto advance mechanism.
- c. Pick-up plate centre bearing.
- d. Pre tilt spring and its rubbing area (pick-up and base plate assembly).
- e. Vacuum unit connecting peg (pick-up and base plate assembly).
- f. Connecting peg hole in vacuum unit connecting rod.

**Fitting pick-up and base plate assembly**

1. Pick-up leads must be prevented from fouling rotating reluctor. Both leads should be located in plastic guide as illustrated. Check during re-assembly.



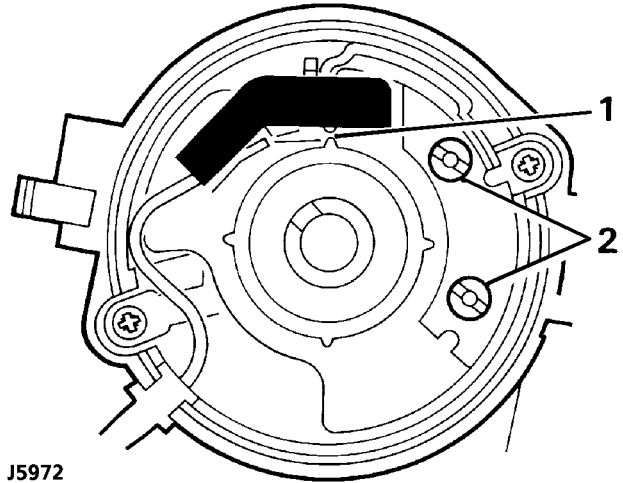
J5971

**Fitting reluctor**

2. Slide reluctor as far as it will go on rotor shaft, rotate reluctor until it engages with coupling ring beneath pick-up base plate. Distributor shaft, coupling ring and reluctor are 'keyed' and rotate together. Fit 'O' ring, flat washer and retaining circlip.

**Pick-up air gap adjustment**

1. Air gap between pick-up limb and reluctor teeth must be set within specified limits, using a non-ferrous feeler gauge.



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2. If adjustment is necessary, loosen two barrel nuts to set the air gap. **See ENGINE TUNING DATA, Information, Engine 3.9 V8i**



**NOTE:** When original pick-up and base plate assembly has been refitted, air gap should be checked, and adjusted if necessary.

**When fitting a new assembly air gap will require adjusting to within specified limits.**

**Amplifier module**

1. Before fitting module, apply MS4 Silicone grease or equivalent heat-conducting compound to amplifier module backplate, seating face on distributor body and both faces of heatsink casting.




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**TORQUE VALUES**


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**NOTE:** Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	<b>Nm</b>
<b>Generator</b>	
Generator mounting bracket to cylinder head .....	34
Generator to mounting bracket .....	24
Generator shaft nut .....	35
Generator through bolts .....	5
Generator rectifier bolts .....	3,5
Amplifier module screws .....	1,2
Amplifier heat sink screws .....	1,2
Auxiliary driving lamp mounting bolts .....	15
Distributor clampbolt .....	20
Distributor pick-up bearing plate support pillars .....	1,2
Distributor pick-up barrel nuts .....	1,2
Distributor vacuum unit .....	2

Torque values below cover all screws and bolts used, unless specified otherwise.

<b>METRIC</b>	<b>Nm</b>
M5 .....	6
M6 .....	9
M8 .....	25
M10 .....	45
M12 .....	90
M14 .....	105
M16 .....	180

<b>UNC / UNF</b>	
1/4 .....	9
5/16 .....	24
3/8 .....	39
7/16 .....	78
1/2 .....	90
5/8 .....	136