DEFENDER

WORKSHOP MANUAL

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INTRODUCTION

This Workshop Manual covers the Land Rover Defender One Ten vehicles. It is primarily 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, or suspension should be carried out by a Land Rover Dealer. Repairs to such items should NEVER be attempted by untrained individuals.

WARNINGS and **CAUTIONS** 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 to perform.

REFERENCES

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, 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.**

DIMENSIONS

The dimensions quoted are to design engineering specification. Alternative unit equivalents, shown in brackets following the dimensions, have been converted from the original specification.
During the period of running-in from new, certain adjustments may vary from the specification figures given in this Manual. These adjustments will be re-set by the Distributor or Dealer at the After Sales Service, and thereafter should be maintained at the figures specified in the Manual.

REPAIRS AND REPLACEMENTS

When replacement parts are required it is essential that only Land Rover parts are used.
Attention is particularly drawn to the following points concerning repairs and the fitting of replacement parts an 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 wrench setting figures given in the Repair Operation 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 renewed. Owners purchasing accessories while travelling abroad should ensure that the accessory and its fitted location on the vehicle conform to mandatory requirements existing in their country of origin. The terms of the Owners Service Statement may be invalidated by the fitting of other than Land Rover parts.
All Land Rover parts have the full backing of the Owners Service Statement.
Land Rover Distributors and Dealers are obliged to supply only Land Rover service parts.

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.
Fuel vapor is highly flammable and in confined spaces is also very explosive and toxic.
When fuel evaporates it produces 150 times its own volume in vapor, which when diluted with air becomes a readily ignitable mixture. The vapor 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_2 GAS, or POWDER close at hand when handling or draining 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 vapor in the atmosphere. Always disconnect the vehicle battery BEFORE carrying out work on a 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 lead-lamps used must be flameproof and kept clear

NO ONE SHOULD BE PERMITTED TO REPAIR COMPONENTS ASSOCIATED WITH FUEL WITHOUT FIRST HAVING HAD SPECIALIST TRAINING.

HOT FUEL HANDLING PRECAUTIONS

Before commencing any operation requiring fuel drainage from fuel tanks, the following procedures should be adhered to:

1. Allow sufficient time for the fuel to cool, thus avoiding contact with hot fuels.
2. Vent system by removing the fuel cap in a well ventilated area replace cap until commencement of tank drainage.
3. Before disconnecting any part of the fuel system it is vital to remove dirt, dust and debris from around components to prevent ingress of foreign matter into the fuel system. Cover the tank apertures after removal to prevent entry of dirt and escape of fuel vapors.

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 vapor label should be attached to the fuel tank upon removal from vehicle. **ENSURE TANK IS COMPLETELY DRAINED.**

FUEL TANK REPAIR

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

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 one of the following companies for advice and the address of the nearest stockist.

Marston Lubricants Limited
Hylo House
Cale Lane, New Springs
Wigan, WN2 1JR
Tel: 0942 824242
Fax: 0942 826653
Telex: **67230**

Northern Adhesives Limited
Prudhoe
Northumberland
NE42 6NP
Tel: 0661 32014
Fax: 0661 35839

POISONOUS AND DANGEROUS SUBSTANCES

Many liquids and other substances used in motor vehicles are poisonous and should under no circumstances be consumed and should be kept away from open wounds. These substances among others include anti-freeze, brake fluid, fuel, windscreen washer additives, air conditioning refrigerant, lubricants and various adhesives.

Engine oils

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

Health protection precautions

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

Asbestos

Some components on the vehicle, such as gaskets, brake and clutch linings and friction pads contain asbestos. Inhaling asbestos dust is dangerous to health and the following essential precautions must be observed.

1. Work out of doors or in a well ventilated area and wear a protective mask.
2. Dust found on the vehicle or produced during work should be removed by vacuuming and not blowing.
3. Asbestos dust waste should be dampened, placed in a sealed container and labelled with what it contains to ensure safe disposal.
4. **If** any machining, cutting of drilling is attempted on materials containing asbestos the item should be dampened and only hand tools or low speed power tools used.

Synthetic rubber

Many “O” ring seals, flexible pipes and other similar items which appear to be natural rubber, are, in fact, 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 heating, it can break down and produce highly corrosive Hydrofluoric acid which can cause serious bums on contact with skin. Should the material be in a burnt or over heated 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.

DISPOSING OF USED OILS AND FLUIDS

Environmental protection precaution

It is illegal to pour used oil and other fluids onto the ground, down sewers or drains, or into waterways.
Dispose of used oil through authorized waste disposal contractors.

ACCESSORIES AND CONVERSIONS

Land Rover vehicles are designed and constructed for a variety of uses but no alterations or conversions should be carried out to any vehicle produced by Land Rover which could affect the safety of the vehicle or its passengers.

Land Rover has tested and approved a large number of accessories and conversions, suitable for all models. Before fitting any accessory or commencing any conversion work to any Land Rover vehicle, check that the accessory or conversion is approved by Land Rover.

WARNING: DO NOT FIT unapproved accessories or conversions, as they could affect the safety of the vehicle. Land Rover will not accept any liability for death, personal injury or damage to property which may occur as a direct result of fitment of non-approved accessories or the carrying out of non-approved conversions to Land Rover vehicles.

SPECIFICATION

Purchasers are advised that the specification details set out in the Manual apply to a range of vehicles and not to any one. For the specification of a particular vehicle, purchasers should consult their Distributor or Dealer.

The Manufacturers reserve the right to vary their specification 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 nor the Distributor or Dealer, by whom this Manual is supplied, shall in any circumstances be held liable for any inaccuracy or the consequences thereof.

Special Service Tools

The use of approved special 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 they save can be considerable.

Every special tool is designed with the close co-operation of Land Rover Ltd., 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, P.O. Box 3, Daventry, Northamptonshire, 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 under publication number VLC 2561/1/91 or from Land Rover Merchandising Service, P.O. Box 534, Erdington, Birmingham, B24 OQ5.

ABBREVIATIONS AND SYMBOLS

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
Centrigrade (Celsuis) C
Cubic centimetre ..... cm^3
Cubic inch ..... in^3
Degree (angle) ..... deg or °
Degree (temperature) ..... deg or °
Diameter ..... dia.
Direct current ..... d.c.
Electronic Control Module ..... ECM
Fahrenheit ..... F
Feet ..... ft
Feet per minute ..... ft/min
Fifth 5th
First 1st
Fluid ounce ..... fl oz
Foot pounds (torque) ..... ft lb
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^2
Kilogramme per square centimetre ..... kgf/cm^2
Kilogramme metres (torque) ..... kgf.m
Kilometres ..... km
Kilometres per hour ..... km/h
Kilovolts ..... kV
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) ..... -
Multi-port Fuel Injection ..... MFi
Naturally aspirated ..... N.A
Negative (electrical) ..... -
Newton meters (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 pt
Plus (tolerace) ..... +
Positive electrical ..... +
Pound (force) ..... lbf
Pounds inch (torque) ..... in.lbf.
Pound (mass) ..... lb
Pounds per square inch ..... $lbf.in^2$
Ratio ..... :
Reference ..... ref.
Revolution per minute ..... rev/min
Right-hand ..... RH
Second (angle) ..... "
Second (numerical order) 2nd
Specific gravity ..... sp.gr.
Square centimetres ..... cm^2
Square inches ..... in^2
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

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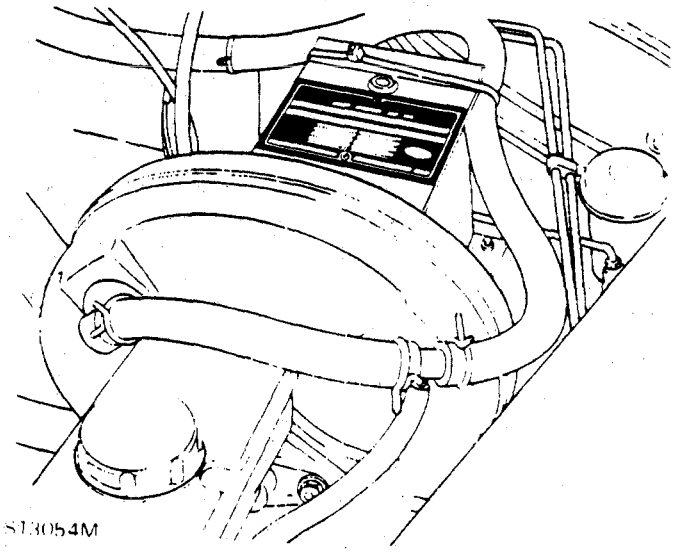
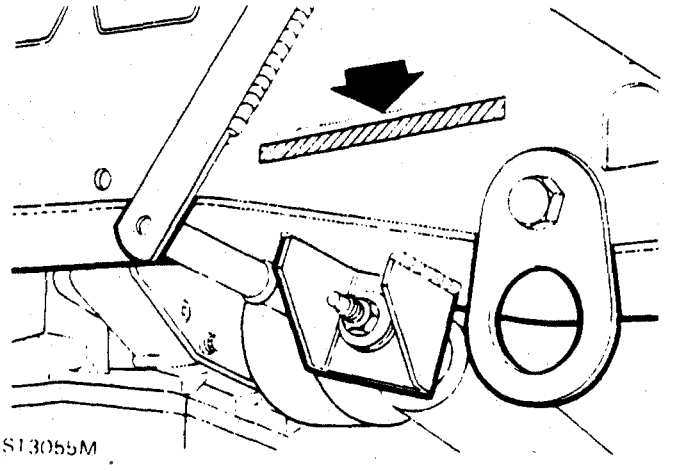
LOCATION OF VEHICLE IDENTIFICATION AND UNIT NUMBERS

VEHICLE IDENTtFICATION NUMBER (VIN)

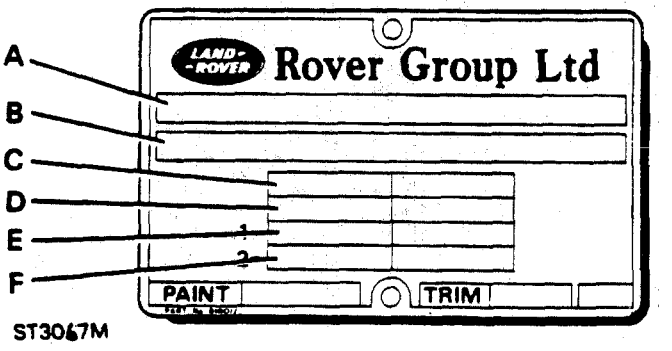
The Vehicle Identification Number and the recommended maximum vehicle weights are stamped on a plate riveted to the top of the brake pedal box in the engine compartment.
The number is also stamped on the right-hand side of the chassis forward of the spring mounting turret.
Always quote this number when writing to Land Rover.


ST3054M


ST3055M

Key to Vehicle Identification Number Plate

A Type approval
B VIN (minimum of 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



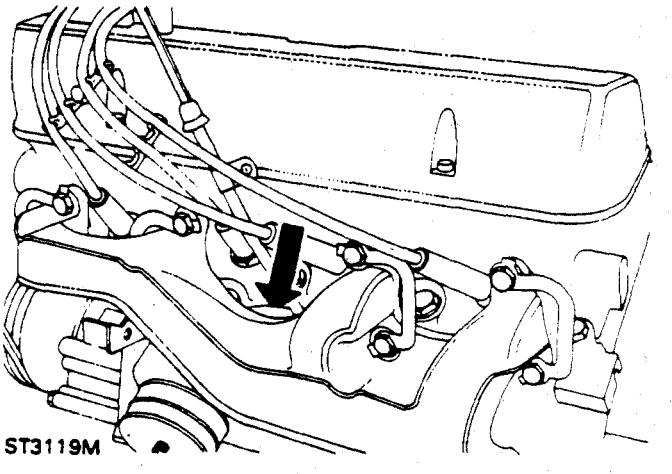
ST3067M

The Vehicle Identification Number identifies the manufacturer, model range, wheel base, body type, engine, steering, transmission, model name and place of manufacture. The following example shows the coding process.

SAL = Land Rover.
LD = Land Rover Ninety and One Ten.
H = One Ten inch. V = Ninety inch.
M = 4 door station wagon. A = pick-up hood cab truck hard top.
V = V8. C = 2.5 Diesel. D = 2.5 Petrol. B = **2.5** Turbo Diesel.
7 = RH stg. with 5 speed gearbox. 8 = LH stg. with 5 speed gearbox.
A = Ninety. B = One Ten. E = Ninety, One Ten 1988 model year.
A = Solihull build. F = Assembled locally from kit.

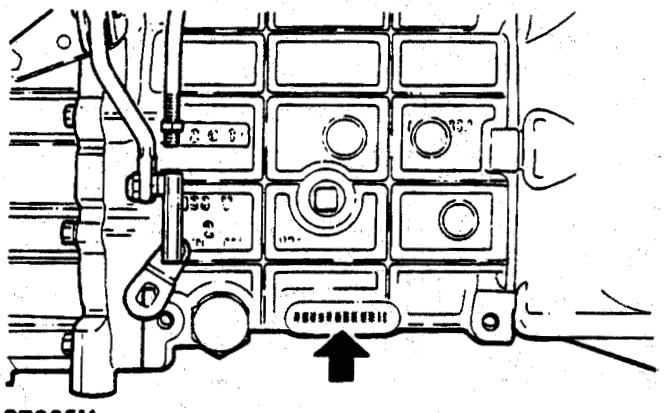
The last six digits identify build sequence number.

The V8 engine serial number is stamped on a cast pad on the cylinder block between numbers 3 and 5 cylinders.


ST3119M

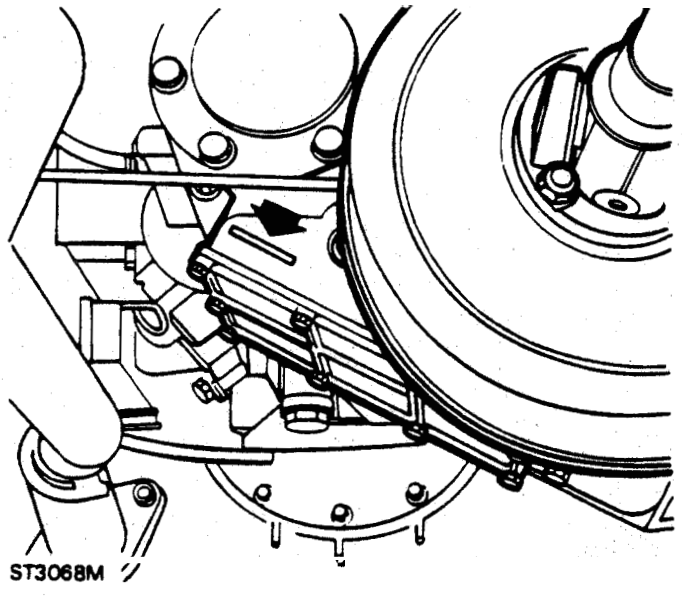
MAIN GEARBOX LT77

Stamped on a pad on the right-hand side of the gearbox immediately below the oil filler level plug.



ST665M

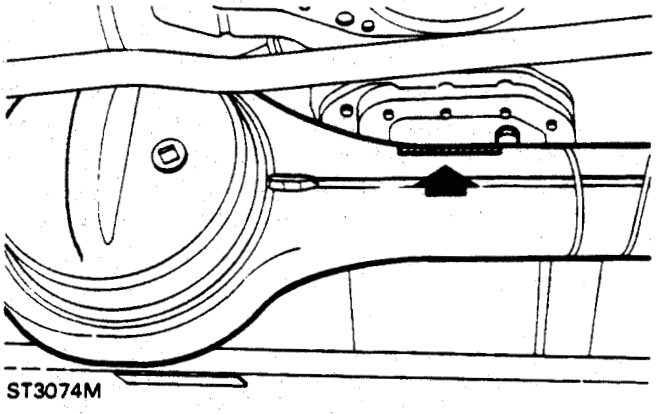
TRANSFER GEARBOX LT230T



ST3068M

FRONT AXLE

Stamped on top of the left-hand axle tube.



ST3074M

REAR AXLE

Stamped **on** rear of left-hand axle tube on 110, and on top of left-hand axle tube for 90 models (110 axle illustrated).

ENGINE 3.9 V8

Type	V8
Number of cylinders	Eight, two banks of four
Bore	94.00 mm
Stroke	71.12 mm
Capacity	3950 cc
Valve operation	Overhead by push-rod
Compression ratio	9.35:1
Maximum power	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 type	5, Vandervell shells
Material	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	Vandervell VP 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	1.478-1.49mm
Compression ring gap	0.40-0.65 mm
Oil control ring type	Hepworth and Grandage
Oil control ring width	3.0 mm
Oil control ring rail gap	0.38-1.40 mm

Camshaft

Location	Central
Bearings	Non serviceable
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 45 112°
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	Gear
Oil pressure	2.11 to 2.81 kg/cm² (30 to 40 p.s.i) at 2400 rev/min with engine warm
Oil filter-internal	Wire screen, pump intake filter in
Oil filter-external	Full flow, self-contained cartridge

TRANSMISSION

Main gearbox

Type - Manual	LT77 5-speed helical constant mesh, with synchromesh on all forward gears
Main gearbox ratios	Fifth (Cruising gear) 0.795:1
	Fourth 1.000:1
	Third 1.436:1
	Second 2.180:1
	First 3.650:1
	Reverse 3.718:1

Transfer gearbox

Type	LT230T. Two-speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential.	
Overall ratio	In high transfer	In low transfer
Fifth (Cruising gear)	3.9663:1	9.3401:1
Fourth	4.9893:1	11.7471:1
Third	7.1656:1	16.8712:1
Second	10.8786:1	25.6134:1
First	18.2094:1	42.3734:1
Reverse	18.9497:1	44.9233:1

Rear Axle - One Ten only

Type	Salisbury 8HA
Ratio	3.538:1
Track	1485,90 mm

Rear Axle - Ninety only

Type	Land Rover spiral bevel
Ratio	3.538:1
Track	1485,90 mm

Front Axle

Type	Land Rover spiral bevel
Ratio	3.538:1
Track	1485,90 mm

PROPELLER SHAFTS

Type: Front and rear — Single Hookes universal needle roller joints.

SUSPENSION

Type	Coil springs controlled by telescopic dampers front and rear
Front	Transverse location of axle by Panhard rod. and fore and aft location by two radius arms
Rear	Fore and aft movement inhibited by two trailing links Lateral location of axle by a centrally positioned 'A' bracket bolted at the apex to a ball joint mounting. Defender 110 has a levelling unit is positioned between the ball joint and upper cross member

BRAKES

System	Direct acting servo assisted dual braking system with Girling tandem master cylinder and G valve

Foot brake

Front	
Type	Lockheed Disc
Disc Diameter	300 mm
Number of pistons per wheel	4
Total lining area	
Lining material	(Asbestos) or Ferodo 3440 (Asbestos free)
Rear disc brakes	
Type	Lockheed Disc
Disc diameter	290 mm
Number of pistons per wheel	2
Lining material	Don 230 (Asbestos) or Ferodo 3440
Rear drum brakes	
Type	Girling single cylinder drum brake
Drum diameter	280 mm
Total lining area	493 cm²
Brake drum width	63.9mm
Lining material	Ferodo 2629

Handbrake	
Type	Transmission drum brake cable operated
Drum diameter	254 mm
Lining material	Don 269

STEERING

Power steering box

Make/type	Adwest Varamatic - worm and roller box
Ratio	Variable: straight ahead 19.3:1 on lock 17.2:1
Steering wheel turns, lock-to-lock	3.75

Steering pump

Make/type	Hoboum-Eaton series 200
Operating pressure - straight ahead position - at idle	7 kgf/cm² (100 p.s.i.) maximum
Full lock (left or right) at idle	28 kgf/cm² (400 p.s.i.) minimum
Full lock (left or right) 1000 rev/min	70-77 kgf/cm² (1000-1100 p.s.i.)

Steering geometry		
Steering wheel diameter	420mm	
Toe-out measurement	0 to 2.0mm	
Toe-out included angle	0° to 0° 16'	
Camber angle	0°	Check with vehicle in static unladen condition. that is. vehicle with water. oil and five gallons of fuel
Castor angle	3°	Rock the vehicle up and down at the front to allow it to take up a static position
Swivel pin inclination static	7°	
Steering damper	Double acting fitted between drag link and pinion housing	
Steering column type	Collapsible coupling	

ELECTRICAL EQUIPMENT

System	12 volt, negative ground	

Battery

Type:		
Lucas - standard 9 plate	B.B.M.S. No.371	Designation
Chloride - standard 9 plate	B.B.M.S. No.2911	90/84/90
Lucas - cold climate 13 plate	B.B.M.S. No.389	Designation
Chloride - cold climate 13 plate	B.B.M.S. No.3693	15/120/92

Alternator

Type	Magnetti Marelli A127-85
Maximum D.C. output at 6000 rev/min	85 amps
Rotor - winding resistance	2.6 ohms at 20°C ± 5%
Stator - winding resistance per phase	0.092 ohms at 20°C ± 5%
New brush length	20 mm
Renew brush at	10 mm
Brush spring pressure	1.3 - 2.7 N
Regulator controlled voltage	13.6 - 14.4 volts measured across battery

Starter motor

Type	Magnetti Marelli M78R pre-engaged
Brush spring tension	120 gms
Brush minimum length	9,5 mm

Distributor & MFI system ..... See **'ENGINE TUNING DATA'**

Wiper motor

Type	Lucas 14W uprated two-speed
Armature end-float	0,1 - 0,20 mm
Minimum brush length	4,8 mm

Fuses

Type ..... Cartridge fuses, located in a box below the facia panel, which protect the electrical components. A complete list of circuits protected is given in Electrical Section.

A second fuse box located in the engine compartment next to the brake servo contains fuses to protect the vehicle harness. For fuse values refer to the Electrical Section.

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

Horns

Make/type	Klamix (Mixo) TR99

Ignition module

Make/type	Lucas 9EM amplifier module, distributor mounted

Spark plugs

Make/type	Champion RN9YC

REPLACEMENT BULBS AND UNITS

Headlamps	***60/55*** **W** halogen sealed beam
Front side lamps	**12V 5W**
Side marker lamps	**12V 3W**
Stop/tail lamps	**12V 21/5W**
High mounted stop light	**12V/5W**
Flasher lamps	**12V 21W**
Number plate lamp	**12V 4W**
Reverse lamp	**12V 21W**
Interior lamp	**12V 21 W**
Warning lights	**12V 1.2W**
Instrument illumination	**12V 2W**
Hazard switch warning light	**12V 1.2W** (red)
Heated rear Screen switch illumination	**12V 1.2W** (green)
Heated front screen switch **illumination**	**12V 1.2W** (green)
Heated front Screen warning light	**12V 1.2W** (amber)
Cigar light illumination	**12V 1.2W**

VEHICLE DIMENSIONS 110

Overall length	4599mm
Overall width	1790mm
Overall height	2035mm
Wheelbase	2794mm
Track: front and rear	1485,90mm
Ground clearance: under differential	215mm
Rear opening height (interior)	1205mm

VEHICLE DIMENSIONS 90

Overall length	4072mm
Overall width	1790mm
Overall height	2035mm
Wheelbase	2360mm
Track: front and rear	1485,90mm
Ground clearance: under differential	229mm
Tailgate aperture width	864mm
Tailgate height	1300mm
Interior width	1450mm
Width between wheelboxes	925mm

VEHICLE WEIGHTS AND PAYLOAD

When loading a vehicle to its maximum (Gross Vehicle Weight), consideration must be taken of the vehicle kerb 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.

Defender 90	Front kg	Rear kg	Total kg
Curb weight			1615
Gross Vehicle Weight			2722
Maximum axle loads	1225	1496	
Unladen weight			1570

Defender 110	Front kg	Rear kg	Total kg
Curb weight			1872
Gross Vehicle Weight			2950
Maximum axle loads	1200	1750	
Unladen weight			1737

NOTE:

CURB WEIGHT equals the minimum unladen vehicle weight plus full fuel tank.

GROSS VEHICLE WEIGHT equals the maximum all up weight, with the driver, passengers. payload equipment and towing attachment load (where applicable)

GROSS VEHICLE WEIGHT CONDITION - the maximum axle weights shown are individual axle loadings which allow for the fitting of optional equipment. The loading of both axles up to their respective maximums **MUST BE AVOIDED,** as the overall maximum vehicle weight would then be exceeded.

WHEELS AND **TIRES**

DEFENDER 90

Wheels
Steel ..... 7.0 X 16
Alloy ..... 7J X 16 X 33

Tires
Type and size ..... **BF** Goodrich LJ265/R16Mud Terrain Radial Ply

DEFENDER 110

Wheels
Steel ..... 139,70mm x 406,40mm

Tires
Type and size ..... 750X 12,8m (tubed) USE RADIAL PLY TIRES ONLY

TIRE PRESSURES

WARNING: Tire pressures must be checked with the tires cold, as the pressure is about 0,21 bar higher at running temperature. If the vehicle has been parked In the sun or high ambient temperatures, Do not reduce the tire pressures, move the vehicle into the shade and wait for the tires to cool before checking the pressures.

Defender 90 Tires- size and type		**Normal** All load conditions		**Emergency soft** Unladen		Laden	
		Front	Rear	Front	Rear	Front	Rear
LJ265/R16 RADIAL	bar	1,9	2,4	1,6	2.0	1,6	2.0
	PSI	28	35	23	23	30	30

Defender 110 Tires- size and type		**Normal** All load conditions		**Emergency soft** Unladen		Laden	
		Front	Rear	Front	Rear	Front	Rear
7 50R16 **RADIAL PLY**	bar	1.9	3.3	1.1	1.1	1.1	1.8
	PSI	28	48	16	16	16	26

General Notes
- Emergency soft pressures should only be **used** in extreme conditions where extra flotation is required Max speed 40 km/h (25 mph). Return pressures to normal immediately firm ground is regained.
- Towing When vehicle is used for towing the reduced rear tire pressures for extra ride comfort are not applicable

WARNING: Do not replace the road wheels with any type other than genuine Land Rover wheels, **as** they 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 tires should be of the size recommended in this manual and all be the same make, ply rating and tread pattern. If in any doubt, consult Land Rover Service department for advice.

ENGINE 3.9 V8

Type	3.9 Litre V8
Firing order	1-8-4-3-6-5-7-2
Cylinder Numbers	
Left bank	1-3-5-7
Right bank	2-4-6-8
No 1 Cylinder location	Pulley end of left bank
Timing marks	On crankshaft vibration damper
Spark plugs	
Gap	0.84-0.96mm
Coil	
Make/type	Bosch 0-221-122-392, (ETC 6574)
Compression ratio	9.35:1
Fuel injection system	Lucas 14 CUX Hot-wire air flow sensor system electronically controlled

Valve Timing	**Inlet**	**Exhaust**
Opens	32° BTDC	70° BBDC
Closes	73° ABDC	35° ATDC
Duration	285°	285°
Valve peak	104° ATDC	114° BTDC

Idle speed - controlled by MFI system	700 ± 25 rev/min
Base idle speed	See setting procedure - 525 ± 25 rev/min.
Ignition Timing - dynamic at idle speed, vacuum disconnected	5° BTDC ± 1°
Exhaust gas	
CO content at idle	0% to 0.05% max.

ENGINE	Nm
Alternator mounting bracket to cylinder head	40
Alternator to mounting bracket	24
Alternator to adjusting link	24
Chainwheel to camshaft	58
Connecting rod bolt	51
Cylinder head:	
Outer row	58
Centre row	92
Inner row	92
Distributor clamp nut	21
Exhaust manifold to cylinder heads	21
Fan to viscous unit	30
Flywheel to crankshaft	78
Inlet manifold to cylinder heads	51
Lifting eye to cylinder heads	24
Main bearing cap bolts	72
Main bearing cap rear bolts	92
Manifold gasket clamp bolt	17
Oil pump cover to timing cover	13
Oil plug	28
Oil relief valve cap	40
Oil sump drain plug	45
Oil sump to cylinder block	10
Oil sump rear to cylinder block	18
Rocker cover to cylinder head	7
Rocker shaft bracket to cylinder head	37
Spark plug	15
Starter motor attachment	44
Damper to crankshaft	271
Timing cover to cylinder block	27
Viscous unit to water pump hub	45
Water pump pulley to water pump hub	10
Water pump timing cover to cylinder block	27

FUEL LINES	
Connections at straight connector	16
Pipe connections at filter	16
Hose clips	2
Connections at vapour separator	16
Connections at Tee-piece	16

CLUTCH	
Clutch cover bolts	27
Slave cylinder bolts	27

MAIN GEARBOX (FIVE-SPEED) LT77S	Nm
Oil pump body to extension case	9
Clip to clutch release lever	9
Attachment plate to gearcase	9
Attachment plate to remote housing	9
Extension case to gearcase	25
Pivot plate	25
Remote selector housing to extension case	25
Gear lever housing to remote housing	25
Guide clutch release sleeve	25
Slave cylinder to clutch housing	25
Front cover to gearcase	25
5th support bracket	25
Plunger housing to remote housing	25
Blanking plug extension case	9
Gear lever retainer	9
Yoke to selector shaft	25
Fixing gear lever assembly nut	44
Reverse pin to centre plate nut	25
Clutch housing to gearbox bolt	72
Plug - detent spring	25
Oil drain plug	51
Oil filter plug	72
Plug oil filler - remote housing	30
Breather	9
Oil level plug	30
Blanking plug - reverse switch hole	24
Fifth gear layshaft nut	217

TRANSFER GEARBOX LT230T	Nm
Fixings securing mounting brackets to gearbox	90
Pinch bolt operating arm	9
Gate plate to grommet plate	9
Bearing housing to transfer case	9
Speedometer cable retainer	9
Speedometer housing	See note
Locating plate to gear change	6
Bottom cover to transfer	**25**
Front output housing to transfer	25
Front output housing to transfer	**25**
Cross shaft housing to front output housing	**25**
Gear change	25
Gear change	25
Cross shaft to high/low lever	25
Pivot shaft to link arm	25
Connecting rod	**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
Mainshaft bearing housing to transfer case	25
Brake drum to coupling flange	25
Gearbox to transfer case	45
End cover bearing housing to transfer case	45
Speedometer housing to transfer	45
Selector finger to cross shaft (high/low)	**25**
Selector fork high/low to shaft	25
Transmission brake to speedometer housing	**72**
Gearbox to transfer case	45
Transfer case assembly	**See** note
Oil drain plug	30
Detent plug	Plug to be coated with Hylomar and peened. Screw plug fully in (spring solid) then turn two complete turns back.
Differential casings	60
Front and rear out flange	162
Differential case rear	**72**
Oil filler and level plug transfer	30
Transfer breather	9
Inner shaft stake nut	135

N0TE: Studs to be assembled into casings with sufficient torque to wind them fully home, but this torque must not exceed the maximum figure quoted for the associated nut on final assembly.

FRONT AXLE	
Hub driving member to hub	65
Stub axle to swivel pin housing	65
Upper swivel pin to swivel pin housing	65
Lower swivel pin to swivel pin housing	25
Oil seal retainer to swivel pin housing	9
Swivel bearing housing to axle case	**72**
Pinion housing to axle case	41
Crown wheel to differential case	58
Differential bearing cap to pinion housing	90
Universal Joint flange to propeller shaft	47
Mudshield to swivel pin housing	9
Bevel pinion nut	**129**

	Nm
REAR AXLE AND FINAL DRIVE	
Crown wheel to differential case	160
Rear cover to axle case	24
Ball joint mounting bracket to axle case	133
Universal Joint flange to propeller shaft	47
Drum to hub	18
Rear brake assembly and stub axle rear to axle	65
Hub driving member to hub	65
PROPELLER SHAFTS	
Coupling flange bolts	46
REAR SUSPENSION	
Bottom link to chassis nut	176
Bottom link to mounting rubber	*64*
Top link bracket to chassis	47
Bump stop rubber bracket nuts	32
Shock absorber bracket to chassis	*64*
Shock absorber upper attachment to bracket	82
Anti roll bar bush to chassis nuts	24
Upper link ball joint to axle castle nut	176
Anti roll bar ball joint castle nut	40
Shock absorber lower attachment nuts	75
STEERING AND FRONT SUSPENSION	
Tie bar to mounting arm nut	81
Mounting arm to chassis nuts	176
Tie bar to steering box nuts	81
Panhard rod to mounting arm nut	88
Panhard rod to anchor bracket nut	88
Panhard rod mounting bracket to chassis bolts	123
Drop arm to drag link castle nut	81
Steering damper to drag link nut	*50*
Drop arm to steering box nut	176
Radius arm to axle nuts	176
Steering box to chassis nuts	81
Radius arms to chassis nuts	176
Track rod clamp bolt nuts	14
Drag link clamp bolt nuts	14
Steering wheel retaining nut	30
Road wheel nuts	108
Ball joint nuts	41
Collapsible coupling nuts	25

POWER ASSISTED STEERING	Nm
Mounting bracket to front cover	25
Mounting bracket to cylinder block	25
Mounting plate to mounting bracket	25
Pulley to PAS pump	9
P.A.S pump to mounting bracket	25
P.A.S box 16 mm thread	20
P.A.S box 14 mm thread	15
P.A.S pump union	20
P.A.S pump Jubilee clips	3

BRAKES	
Brake disc to hub	72
Brake caliper to swivel housing	100
Brake pipe connections to:	
Servo. primary port	13
Servo. secondary port	13
Jump hose - female	15
Wheel cylinders to back plate	11
'G' valve	10
'G' valve to bracket	13
Master cylinder to servo nuts	14
Servo to bulkhead nuts	14

ELECTRICAL EQUIPMENT	
Alternator:	
Shaft nut	60
Through bolts	5
Rectifier bolts	3,5
Starter motor to engine bolts	44
Starter motor:	
Through bolts	10,8
Solenoid fixing stud nut	6
Solenoid upper terminal nut	4
Reverse light switch	24

Lucas 35 DM8 Electronic ignition distributor	
Pick up bearing plate support pillars	1,2
Pick up barrel nuts	1,2

AIR CONDITIONING	
Adaptor plate to front cover	45
Compressor mounting bracket to adaptor plate	45
Mounting plates to compressor	25
Compressor to mounting bracket	45
Adjusting link to mounting bracket & compressor	45
Belt damper to front cover plate	36
Pulley to Torsional Vibration damper	25

PRECAUTIONS AGAINST DAMAGE

1. Always fit covers to protect wings before commencing work in engine compartment.
2. Cover seats and carpets, wear clean overalls and wash hands or wear gloves before working inside car.
3. Avoid spilling hydraulic fluid or battery acid on paint work. Wash off with water immediately if this occurs. Use Polythene sheets in boot to protect carpets.
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 - (See also SECTION 01 - Poisonous Substances)

1. Whenever possible use a ramp or pit when working beneath vehicle, in preference to jacking. Chock wheels as well as applying hand brake.
2. Never rely on a jack alone to support vehicle. Use axle stands or blocks carefully placed at jacking points to provide rigid location.
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. Inspect power leads of any mains electrical equipment for damage and check that it is properly earthed.
6. Disconnect earth (grounded) terminal of vehicle battery.
7. Do not disconnect any pipes in air conditioning refrigeration system, if fitted, unless trained and instructed to do so. A refrigerant is used which can cause blindness if allowed to contact eyes.
8. Ensure that adequate ventilation is provided when volatile degreasing agents are being used.

   WARNING: Fume extraction equipment must be in operation when trachloride, methylene chloride, chloroform or perchlorethylene are used for cleaning purposes.

9. 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 lines from stray heat.
10. Do not leave tools, equipment, spilt oil etc., around or on work area.
11. Wear protective overalls and use barrier creams when necessary.

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

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 ail 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. Mark mating parts to ensure that they are replaced as dismantled. Whenever possible use marking ink, which avoids possibilities of distortion or initiation of cracks, liable if centre punch or scriber are used.
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.

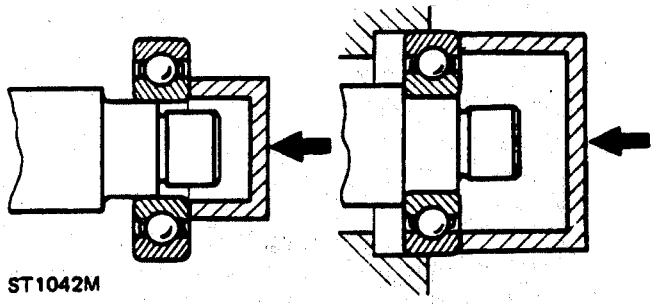
INSPECTION - GENERAL

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 dimesnion is exactly limit size, and is otherwise satisfactory.
4. Use plasti-guage 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.

BALL AND ROLLER BEARINGS

NEVER REPLACE A BALL OR ROLLER BEARING WITHOUT FIRST ENSURING THAT IS IN A FULLY SERVICABLE CONDITION

1. Remove all traces of lubricant from bearing under inspection by washing in petrol or 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 discolouration 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.) If markings are found, use 'Loctite' in installation of replacement bearing.
7. Ensure that shaft and housing are clean and free from burrs before fitting bearing.
8. If one bearing of a pair shows an imperfection it is generally advisable to renew both 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.



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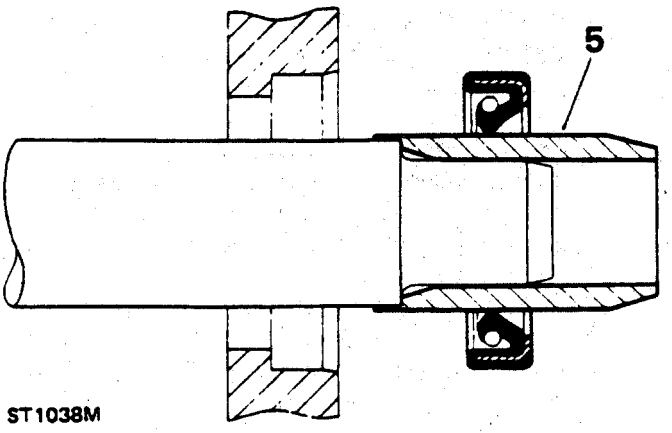
10. In the case of grease-lubricated bearings (e.g. hub bearings) fill space between bearing and outer seal with recommended grade of grease before fitting seal.
11. Always mark components of separable bearings (e.g. taper roller bearings) in dismantling, to ensure Correct reassembly. Never fit new rollers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

OIL SEALS

1. Always fit new oil seals when rebuilding an assembly. It is not physically possible to replace a seal exactly when it has bedded down.
2. Carefully examine seal before fitting to ensure that it is clean and undamaged.
3. Smear 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 adhesive tape to prevent damage to sealing lip.



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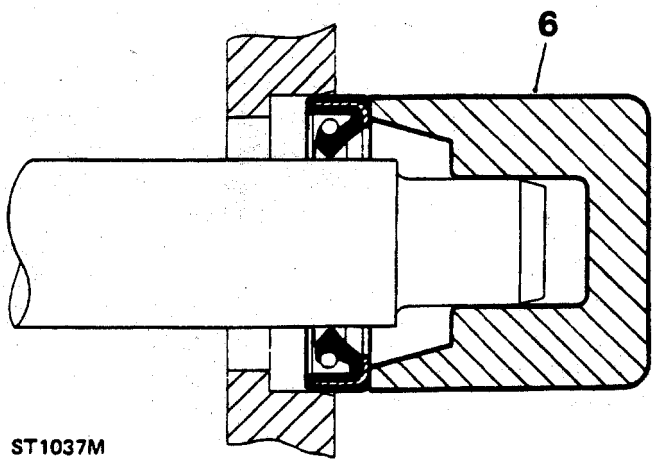
6. Grease outside diameter of seal, place square to housing recess and press into position, using great care and if possible a 'bell piece' to ensure that seal is not tilted. (In some cases it may be preferable to fit seal to housing before fitting to shaft.) Never let weight of unsupported shaft rest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



7. If correct service tool is not available, use a suitable drift approximately 0,4 mm 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.

JOINTS AND JOINT FACES

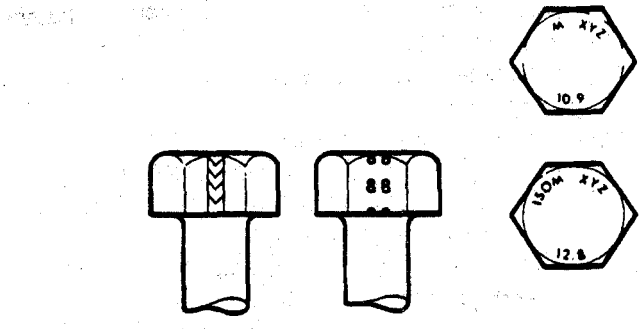
1. Always use correct gaskets where they are specified.
2. Use jointing compound only when recommended. Otherwise fit joints dry.
3. When jointing compound is used, apply in a thin uniform film to metal surfaces; take great care to prevent it from entering oilways, pipes or blind tapped holes.
4. Remove 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 swarf or dirt to enter tapped holes or enclosed parts.
6. Blow out any pipes, channels or crevices with compressed air, renewing any O-rings or seals displaced by air blast.

FLEXIBLE HYDRAULIC PIPES, HOSES

1. Before removing any brake or power steering hose, clean end fittings and area surrounding them as thoroughly as possible.
2. Obtain appropriate blanking 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 hydraulic 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 hydraulic fluid to be contaminated with mineral oil, or use a container which has previously contained mineral oil.
8. Do not re-use fluid bled from system.
9. Always use clean brake fluid to clean hydraulic components.
10. Fit a blanking cap to 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.

METRIC BOLT IDENTIFICATION

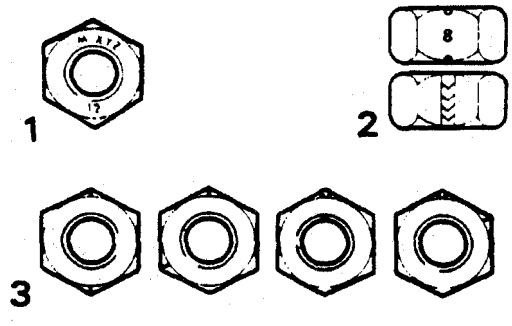
1. An IS0 metric bolt or screw, made of steel and larger than 6 mm in diameter can be identified by either of the symbols IS0 M or M embossed or indented on top of the head.
2. In addition to marks to identify the manufacture, the head is also marked with symbols to indicate the strength grade e.g. 8.8, 10.9, 12.9 or 14.9, where the first figure gives the minimum tensile strength of the bolt material in tns of kg/sq mm.
   Zinc plated IS0 metric bolts and nuts are chromate passivated, a greenish-khaki to gold-bronze colour.



ST1035M

METRIC NUT IDENTIFICATION

1. A nut with an IS0 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.



ST1036M

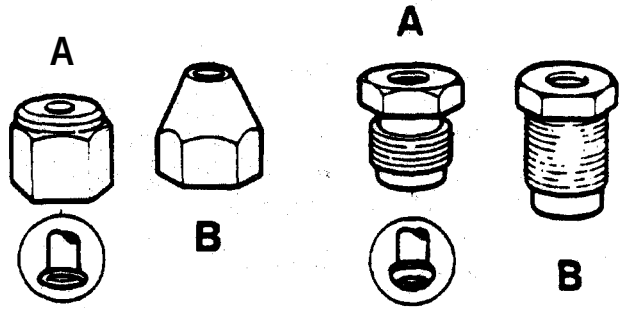
HYDRAULIC FITTINGS-Metrication

WARNING: Metric and Unified threaded hydraulic parts. Although pipe connections to brake system units incorporate threads of metric form, those for power assisted steering are of UNF type. It is vitally important that these two thread forms are not confused, and careful study should be made of the following notes.

Metric threads and metric sizes are being introduced into motor vehicle manufacture and some duplication of parts must be expected. Although standardisation must in the long run be good, it would be wrong not to give warning cf the dangers that exist while UNF and metric threaded hydraulic parts continue together in service. Fitting UNF pipe nuts into metric ports and vice-versa should not happen, but experience of the change from BSF to UNF indicated that there is no certainty in relying upon the difference in thread size when safety is involved.

To provide permanent identification of metric parts is not easy but recognition has been assisted by the following means. (Illustration A Metric, **B** Unified.)

1. All metric pipe nuts, hose ends, unions and bleed screws are coloured black.
2. The hexagon area of pipe nuts is indented with the letter **'M'.**
3. Metric and UNF pipe nuts are slightly different in shape.



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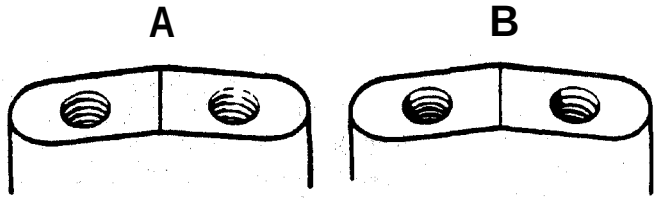


ST1034M

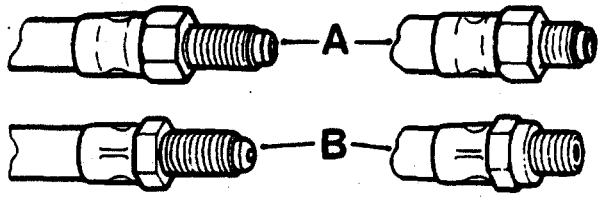
The metric female nut is always used with a trumpet flared pipe and the metric male nut is always used with a convex flared pipe.

4. All metric ports in Cylinders and calipers have no counterbores, but unfortunately a few cylinders with UNF threads also have no counterbore. The situation is, all ports with counterbores are UNF, but ports not counterbored are most likely to be metric.
5. The coulour of the protective plugs in hydraulic ports indicate the size and the type of the threads but the function of the plugs is protective and not designed as positive identification. In production it is difficult to use the wrong plug but human error must be taken into account. The Plug colours and thread sizes are:

	UNF
RED	3/8 in x 24 UNF
GREEN	7/16 in x 20 UNF
YELLOW	1/2 in x 20 UNF
PINK	7/8 in x 18 UNF
	METRIC
BLACK	10 x 1 mm
GREY	12 x 1 mm
BROWN	14 x 1,5 mm

6. Hose ends differ slightly between metric and UNF. Gaskets are not used with metric hoses. The UNF hose is sealed on the cylinder or caliper face by a copper gasket by the metric hose seals against the bottom of the port and there is a gap between faces of the hose and cylinder.

Pipe sizes for UNF are 3/16 in, 1/4 in and 5/16 in outside diameter.
Metric pipe sizes are **4,75** mm, 6 mm and 8 mm. 4,75 mm pipe is exactly the same as 3/16 in pipe. 6 mm pipe is 0.014 in smaller than 1/4 in pipe. 8 mm pipe is 0.002 in larger than 5/16 in pipe.
Convex pipe flares are shaped differently for metric sizes and when making pipes for metric equipment, metric pipe flaring tools must be used.



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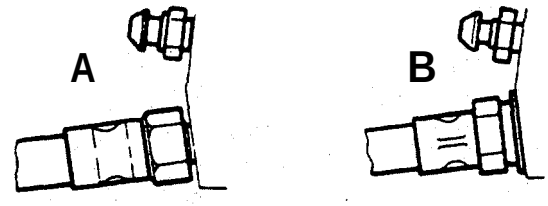

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The greatest danger lies with the confusion of 10 mm and 3/8 in UNF pipe nuts used for 3/16 in (or 4,751 mm) pipe. The 3/8 in UNF pipe nut or hose can be screwed into a 10 mm port but is very slack and easily stripped. The thread engagement is very weak and cannot provide an adequate seal.
The opposite condition, a 10 mm nut in a 3/8 in port, is difficult and unlikely to cause trouble. The 10 mm nut will screw in 1 1/2 or 2 turns and seize. It has a crossed thread 'feel' and it is impossible to force the nut far enough to seal the pipe. With female pipe nuts the position is of course reversed.
The other combinations are so different that there is no danger of confusion.

KEYS AND KEYWAYS

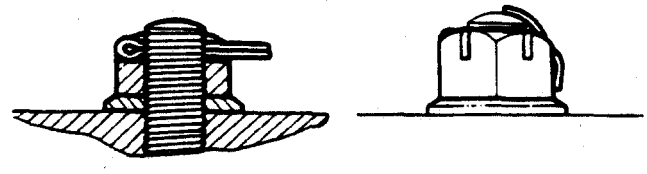
1. Remove burrs from edges of keyways with a fine file and clean' thoroughly before attempting to refit key.
2. Clean and inspect key closely; keys are suitable for refitting only if indistinguishable from new, as any indentation may indicate the onset of wear.

TAB WASHERS

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

SPLIT PINS

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



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NUTS

1. When tightening a slotted or castellated nut never slacken it back to insert split 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

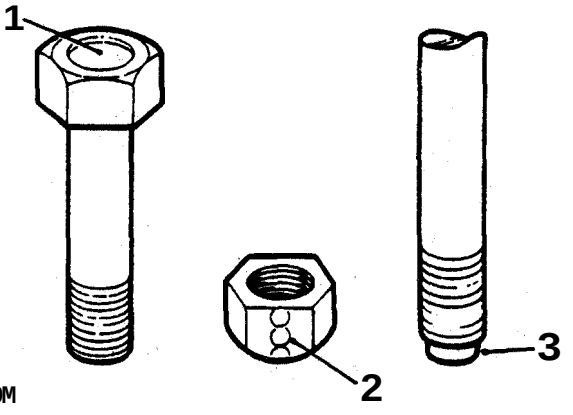
1. Fit new locking wire of the correct type for all assemblies incorporating it.
2. Arrange wire so that its tension tends to tighten the bolt heads, or nuts, to which it is fitted.

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 figure. Damaged or corroded threads can affect the torque reading.
6. To check or re-tighten a bolt or screw to a specified torque figure, first slacken a quarter of a turn, then re-tighten to the correct figure.
7. Always oil thread lightly before tightening to ensure a free running thread, except in the case of 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.



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RECOMMENDED LUBRICANTS AND FLUIDS

COMPONENT	SPECIFICATION		AMBIENT TEMPERATURE
			°C: -30 -20 -10 0 10 20 30 40 50 °F: -22 -4 +14 +32 50 68 86 104 122
Engine	Use oils to API service level S G	Viscosity	
		5W/20) 5W/30) 5W/40)	
		10W/30	
		10W/40) 10W/50)	
		15W/40) 15W/50)	
		20W/40) 20W/50)	
Manual gearbox	ATF TYPE 'F'		
Transfer gearbox(LT230) Final drive units Swivel pin housings	APIGL4 or GL5 MIL-L-2105 or MIL-L-2105B	Viscosity	
		90 EP	
		80W EP	
Power steering	ATF TYPE 'F'		
Brake and clutch reservoirs	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		

Engine cooling system	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). **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.**
Battery lugs, Earthing surfaces where paint has been removed	Petroleum jelly. **NOTE: Do not use Silicone Grease**
Air Conditioning System Refrigerant	**METHYLCHLORIDE REFRIGERANTS MUST NOT BE USED** Use only with refrigerant 12. This includes 'Freon 12' and 'Arcton 12'
Compressor Oil	Shell Clavus 68 BP Energol LPT68 Sunisco 4GS Texaco Capella E Wax/Free 68. Castrol Icematic 99

ANTI-FREEZE

ENGINE TYPE	MIXTURE STRENGTH	PERCENTAGE CONCENTRATION	PROTECTION LOWER TEMPERATURE LIMIT
V8 (aluminium)	One part anti-freeze One part water	50%	
Complete protection Vehicle may be driven away immediately from cold			-33°F -36°C
Safe limit protection Coolant in mushy state. Engine may be started and driven away after warm-up period			-41°C -42°F
Lower protection Prevents frost damage to cylinder head, block and radiator. Thaw out before starting engine			-47°C -53°F

CAPACITIES

The following capacity figures are approximate and are provided as a guide only. All oil levels must be set using the dipstick or level plugs as applicable.

Component	Litres	Imperial units
Engine sump oil	5,10	9.00 pints
Extra when refilling after fitting new filter	OS6	1.00 pint
Main gearbox oil. five-speed **LT77S**	2,20	3.90 pints
LT230T transfer gearbox	2,30	4.00 pints
Front differential	1,70	3.00 pints
Rear differential: Salisbury 8HA	2,30	4.00 pints
Swivel pin housing oil (each)	0,35	0.60 pint
Cooling system	12,80	22.50 pints
Power steering box and reservoir fluid	2,90	5.0 pints

WORKSHOP MAINTENANCE SCHEDULES

The following maintenance should be carried out by trained personnel in a fully equipped workshop. If the vehicle is operating in a remote area where workshop facilities are not available, maintenance and repair work should be carried out by experienced mechanics in safe conditions. Maintenance should normally be carried out at 7,500 miles (12,000 km) intervals or six months, whichever is first, as described in the following schedules, In severe conditions, such as deep mud or sand, or a very dusty atmosphere, the intervals should be reduced to monthly, weekly or even daily for some items. Ask your Dealer for advice.

WARNING: DO NOT use any lubricants solvents or sealants etc, before reading any warnings and instructions supplied with these substances, as they could be harmful if improperly used.

WARNING: Two wheel roller tests (Dynamometer) must be restricted to 5 km/hour (3 miles/hour). DO NOT engage the differential lock or the vehicle will drive off the roller test rig because the Defender 110 is a permanent 4 wheel drive.

WARNING: Use care when draining oil from the engine, gearbox and axles, if it is hot it could cause personal scalding.

WARNING: DO NOT work underneath the vehicle unless it is safely parked and the wheels chocked, or it is supported by heavy duty stands, otherwise the vehicle could move causing personal injury.

ALL NORTH AMERICAN MODELS

First 1000 miles (1600km) service only

Renew engine oil.
Check/top up transfer box oil.
Renew front axle oil.
Renew rear axle oil.
Renew steering swivel housing oil.
Chec/top up power steering fluid.
Check/topup transmission oil.
Check/topup clutch and brake m/c fluid level.
Check for oil/fluid leaks from:
Suspension, dampers and self levelling unit, engine and transmission units, front and rear axles.
Check brake pipes/unionsfor security, chafing leaks and corrosion.
Check power steering system for leaks, hydraulic pipes/unionsfor security, chafing and corrosion.
Check fuel system for leaks.
Check fuel tank for condition and mounting bolts for tightness
Check cooling and heater systems for leaks, hoses for security and condition.
Check security and operation of park brake.
Check foot brake operation.
Check condition and security of steering unit, joints and gaiters.
Checkladjust steering box.
Check front toe.
Check positive crankcase ventilation system for leaks and hoses for security and condition.
Check operation of throttle mechanical linkage.
Check ignition wiring and HT leads for security and fraying.
Checkladjust all drive belts.
Check operation of all instruments, fuel and temperature gauges, warning indicators, lamps, horns and audio unit.
Check operation of front and rear screen wash/wipers.
Check operation and security of rear view mirrors and for cracks and crazing.
Check condition and security of seats, seat belt mountings, belts and buckles.
Check exhaust system for leaks, security and damage.
Check tires comply with manufacturer's specification.
Check tires for cuts, lumps, bulges, uneven wear, tread depth and road wheels for damage.
Checkladjust tire pressures including spare.
Check/tightenroad wheel retaining nuts.
Drain flywheel housing-re-install plug.

CALIFORNIA

Maintenance Intervals: Miles x 1000 / km x 1000	7.5 12	15 (24)	22.5 (36)	30 (48)	37.5 (60)	45 (72)
Renew engine oil	•	•	•	•	•	•
Renew engine oil filter	•	•	•	•	•	•
Renew spark plugs				•		
Check exhause system for leaks, security and damage	•	•	•	•	•	•
Check condition of driving belts - adjust if required	•	•	•	•	•	•

California models - For maintenance after 45,000 miles (72,000 km) we recommend that the U.S.A. Required Maintenance' is carried out in addition to the 'Recommended Maintenance' list.

NOTE: The next service is due in six months if you drive less than 7,500 miles (12,000 km).

Maintenance Intervals: Miles x 1000 / km x 1000	7.5 12	15 24	22.5 36	30 48	37.5 60	45 72	52.5 84	60 96	67.5 108	75 120	82.5 132	90 144	97.5 156	105 168
Renew positive crankcase ventilation (PCV) intake filter, check and clean PCV system							•					•		•
Renew engine oil	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Renew engine oil filter	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Renew fuel filter							•							•
**Renew air cleaner element/check/clean dump valve				•				•				•		
Renew charcoal canister														•
Renew spark plugs				•				•				•		
Renew catalytic converters														•
Renew oxygen sensors											•			
*Check exhaust systems for leaks, security and damage	•	•	•	•	•	•	•	•	•	•	•	•	•	•
*Check condition of driving belts - adjust if required	•	•	•	•	•	•	•	•	•	•	•	•	•	•
**Check/top up cooling system	•	•	•	•	•	•	•	•	•	•	•	•	•	•
*Check ignition wiring and HT leads for fraying, chafing and deterioration							•							•
*Clean distributor cap and rotor arm, check for cracks and tracking. Lubricate rotor spindle with rotor arm removed							•							•
*Check/adjust ignition timing							•							•
*Check engine idle speed							•							•
*Check fuel evaporative loss control systems for leaks							•							•
*Check fuel filler cap seal for leaks							•							•
*Check fuel pipes, filler hoses and connections for leaks and security							•							•
*Check engine emission control system hoses, tubes and vacuum lines for security and condition							•							•
*Check operation of engine control module/systems							•							•
*Check operation of auxiliary emission control devices							•							•
Reset Service Reminder Indicator							•							•

* The owner of the vehicle need not perform the items marked * in order to maintain the emission warranty or manufacturer's recall liability.

** Recommended maintenance in California.

Note: The next service is due in six months if you drive less than 7,500 miles (12,000 km).

Maintenance Intervals: Miles x 1000 / km x 1000	7.5 12	15 24	22.5 36	30 48	37.5 60	45 72	52.5 84	60 96	67.5 108	75 120	82.5 132	90 144	97.5 156	105 168
Check/top up transfer box oil	•	•	•		•	•	•		•	•	•		•	•
Check/top up transmission box oil	•	•	•		•	•	•		•	•	•		•	•
Renew transfer box oil				•				•				•		
Check/top up front and rear axle oil	•	•	•		•	•	•		•	•	•		•	•
Renew front and rear axle oil				•				•				•		
Check/top up steering swivel housing oil	•	•	•		•	•	•		•	•	•		•	•
Renew steering swivel housing oil				•				•				•		
Change transmission oil				•				•				•		
Check clutch fluid level	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check/top up power steering fluid	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check/top up brake fluid	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check for oil/fluid leaks from: Suspension dampers and self levelling unit	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check foot brake and clutch operation	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check condition and security of steering unit, joints and gaiters		•		•		•		•		•		•		•
Check/adjust steering box		•		•		•		•		•		•		•
Check front wheel toe		•		•		•		•		•		•		•
Check positive crankcase ventilation for leaks and hoses for security and condition				•				•				•		
Check and clean positive crankcase ventilation system and breathers				•				•				•		
Check/clean air cleaner dump valve element		•		•		•		•		•		•		•
Check operation of throttle mechanical linkage		•		•		•		•		•		•		•

Note: The next service is due in six months if you drive less than 7,500 miles (12,000 km).

Maintenance Intervals: Miles x 1000 / km x 1000	7.5 12	15 24	22.5 36	30 48	37.5 60	45 72	52.5 84	60 96	67.5 108	75 120	82.5 132	90 144	97.5 156	105 168
Check battery condition		•		•		•		•		•		•		•
Clean and grease battery terminals	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check ignition wiring and HT leads for security, fraying, chafing, deterioration		•		•		•		•		•		•		•
Clean distributor cap and rotor arm, check for cracks and tracking		•		•		•		•		•		•		•
Lubricate distributor rotor spindle with rotor arm removed				•				•				•		
Clean/adjust spark plugs		•				•				•				•
Check/adjust ignition timing			•				•			•				•
Check condition and security of seats, seat belt mountings, belts and buckles	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check tightness of propeller shaft coupling bolts		•		•		•		•		•		•		•
Check exhaust system for leaks, security and damage	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check tires comply with manufacturer's specification	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check tires for cuts, lumps, bulges, uneven wear, tread depth and road wheels for damage	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check/adjust tire pressures including spare	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check security of spare wheel	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check/adjust headlamp alignment		•		•		•		•		•		•		•
Check operation of all instruments, fuel and temperature gauges, warning indicators, lamps, horn and audio unit	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Note: The next service is due in six months if you drive less than 7,500 miles (12,000 km).

Maintenance Intervals: Miles x 1000 / km x 1000	7.5 12	15 24	22.5 36	30 48	37.5 60	45 72	52.5 84	60 96	67.5 108	75 120	82.5 132	90 144	97.5 156	105 168
Check operation of front and rear screen and wash/wipers		•		•		•		•		•		•		•
Check operation of all doors, hood, tailgate locks and window controls	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Lubricate all locks (not steering lock),hinges and door check mechanisms		•		•		•		•		•		•		•
Check operation of heater and air conditioning systems		•		•		•		•		•		•		•
Check brake and clutch pipes/unions for security, chafting leaks and corrosion	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check power steering system for leaks, hydraulic pipes/unions for security, chafting and corrosion	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check fuel pipes for leaks	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check cooling and heater systems for leaks, hoses for security and condition		•		•		•		•		•		•		•
Check/top up cooling system	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Inspect brake pads for wear, calipers for leaks and discs for condition	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Remove road wheel brake drums, inspect brake shoes for wear and drums for condition (rear only)	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Inspect rear wheel cylinders for leaks	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Adjust rear wheel brake shoes	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Check security and operation of park brake	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Lubricate accelerator control linkage and pedal pivot		•		•		•		•		•		•		•
Lubricate park brake mechanical linkage	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Lubricate propeller shaft universal joints	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Lubricate propeller shaft sealed sliding joints			•			•			•			•		
Check applicability/perform annual Corrosion Perforation Limited Warranty	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Note: The next service is due in six months if you drive less than 7,500 miles (12,000 km).

It is recommended that:
At 15,000 mile (24,000 km) intervals or every 18 months, whichever is the sooner, the hydraulic brake and clutch fluid should be completely renewed.

At 37,500 mile (60,000 km) intervals or every 3 years, which ever is the sooner, all hydraulic brake and fluid, seals and flexible hoses should be renewed, all working surfaces of the master cylinder, wheel cylinders and caliper cylinders should be examined and renewed where necessary.

At 37,500 mile (60,000 km) intervals remove all suspension dampers, test for correct operation, refit or renew as necessary.

At two year intervals or at the onset of the second winter, the cooling system should be drained, flushed and refilled with the required water and anti-freeze solution.

The battery electrolyte level should be checked and topped up if required
once a year in tropical and sub-tropical climates
once every three years in temperate climates.

NOTE: Climatic and operating conditions affect maintenance intervals to a large extent: in many cases, therefore, the determination of such intervals must be left to the good judgement of the owner or to advice from an Authorised Dealer but the recommendations will serve as a firm basis for maintenance work.

Vehicles operating under arduous conditions will require more frequent servicing, therefore, at a minimum, the Maintenance intervals should be reduced by half.

For low mileage vehicles it is recommended that the maintenance is carried out at 6 months intervals.

The owner need not perform recommended maintenance in order to maintain the emission warranty or manufacturer recall liability.

SPECIAL OPERATING CONDITIONS

When the vehicle is operated in extremely arduous conditions or on dusty, wet or muddy terrain, more frequent attention should be paid to all servicing requirements.

ADDITIONAL DAILY O R WEEKLY ATTENTION DEPENDING ON OPERATING CONDITIONS:

Check/top-up transfer box oil.
Check steering rubber boots for security and condition. Renew if damaged.
Check brake fluid level: consult your Dealer if any fluid loss is suspected.
Clean brake discs and calipers.
Lubricate front and rear propeller shaft grease points and front sliding joint. Under tropical or severe conditions, particularly where sand is encountered, the sliding joints must be lubricated very frequently to prevent ingress of abrasive material.
Every week and every maintenance inspection check tyre pressures and inspect tyre treads and side walls. Under arduous cross-country conditions the tyre pressures should be checked much more frequently, even to the extent of a daily check.

MONTHLY

Renew gearbox oil.
Renew transfer box oil.
Check air cleaner element and renew every 6 months or as necessary.

LUBRICATION

This first part of the maintenance section covers renewal of lubricating oils for the major units of the vehicle and other components that require lubrication, as detailed in the 'MAINTENANCE SCHEDULES' . Refer to 'SECTION 09' for capacities and recommended lubricants.

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

Draining of used oil should take place after a run when the oil is warm. Always clean the drain and filler-level plugs before removing. In the interests of safety disconnect the vehicle battery to prevent the engine being started and the vehicle moved inadvertently, while oil changing is taking place.

Allow as much time as possible for the oil to drain completely except where blown sand or dirt can enter the drain holes. In these conditions clean and refit the drain plugs immediately the main bulk of oil has drained.

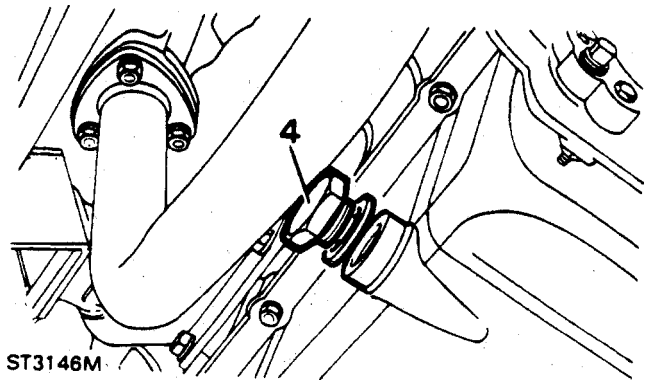
Where possible, always refill with oil of the make and specification recommended in the lubrication charts and from sealed containers.

WARNING: See ENGINE OILS under POISONOUS SUBSTANCES - SECTION 01. INTRODUCTION.

RENEW ENGINE OIL

Drain and refill engine

1. Drive vehicle to level ground.
2. Run the engine to warm the oil; switch off the ignition and disconnect the battery for safety.
3. Place an oil tray under the drain plug.
4. Remove the drain plug in the bottom of the sump. Allow oil to drain away completely and replace the plug and tighten to the correct torque.

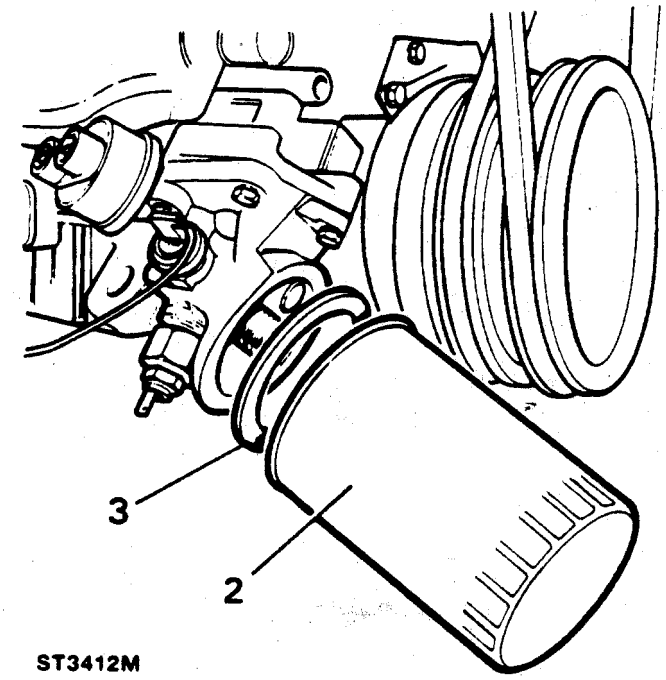


5. Clean the outside of the oil filler cap, remove it from the rocker cover and clean the inside.
6. Pour in the correct quantity of new oil of the correct grade from a sealed container to the high mark on the dipstick and firmly replace the filler cap. Reconnect the battery.

RENEW OIL FILTER

CAUTION: The engine oil filter must not be removed whilst the sump is empty, otherwise the oil pump may have to be primed.

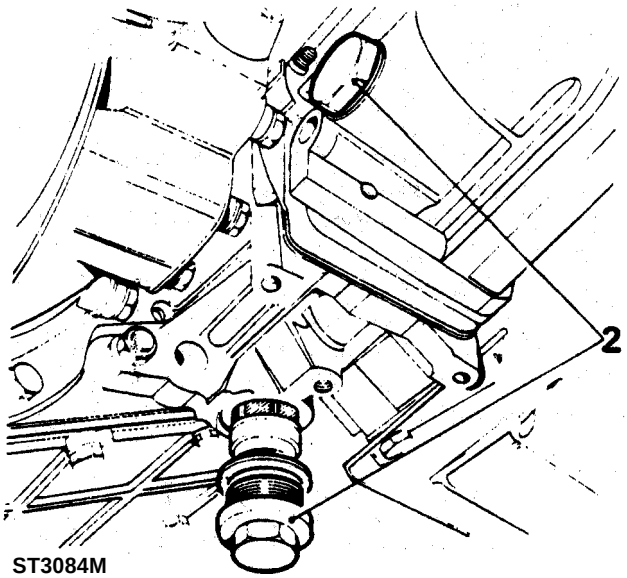
1. Place an oil tray under the engine.
2. Unscrew the filter anti-clockwise, using a strap spanner as necessary.
3. Smear a little clean engine oil on the rubber washer of the new filter, and half fill with fresh oil. Then screw the filter on clockwise until the rubber sealing ring touches the machined face, then tighten a further half turn by hand only. Do not overtighten.
4. Run the engine and check for leaks from the filter. Stop the engine, allow the oil to run back into the sump for a few minutes, then check the oil level again and top up if necessary.



RENEW MAIN AND TRANSFER GEARBOX OILS

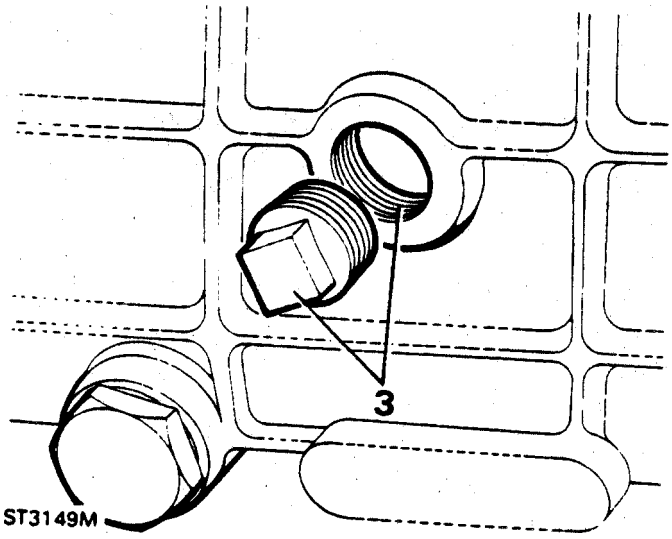
DRAIN AND REFILL LT77S MAIN GEARBOX

1. Drive the vehicle to level ground and place a suitable container under the gearbox to catch the old oil.
2. Remove the gearbox and extension case drain plugs and allow the oil to drain completely. Wash the extension case filter in kerosene and refit the plugs using new washers, if necessary, and tighten to the correct torque.



ST3084M

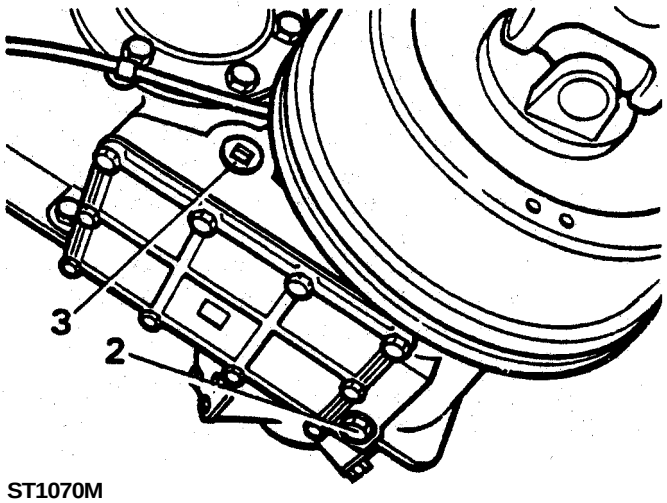
3. Remove the oil filler-level plug and inject the approximate quantity of new oil of the correct make and grade until it begins to run out of the filler-level hole. Fit the plug and tighten to the correct torque. Since the plug has a tapered thread it must not be overtightened. Wipe away any surplus oil.



ST3149M

DRAIN AND RENEW LT230T TRANSFER GEARBOX OIL

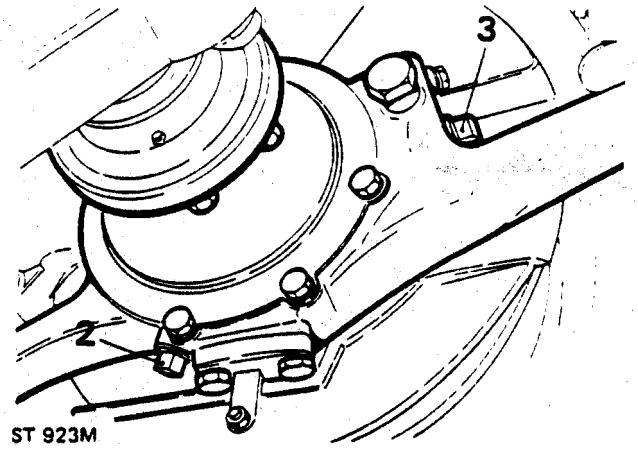
1. Drive the vehicle to level ground and place a container under the gearbox to catch the old oil.
2. Remove the drain plug and allow the oil to drain. Fit the plug using a new washer, if necessary, and tighten to the correct torque.
3. Remove the filler-level plug and inject the approximate quantity of the recommended oil until it begins to run from the plug hole. Fit the level plug and tighten only to the correct torque, do not overtighten, wipe away any surplus oil.



ST1070M

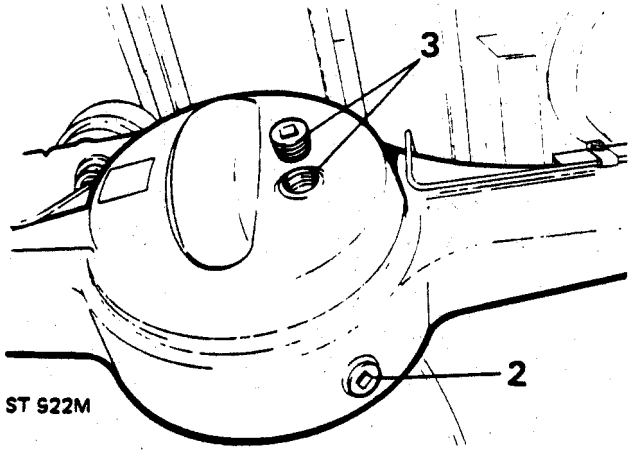
RENEW SWIVEL PIN HOUSING OIL

1. Drive the vehicle to level ground and place a container under each swivel housing to catch the used oil.
2. Remove the drain plug and allow the oil to drain completely and clean and refit the plugs.
3. Remove the oil filler-level plug and inject the recommended make and grade of oil until oil begins to run from the level hole. Clean and fit the level plugs and wipe away any surplus Oil.



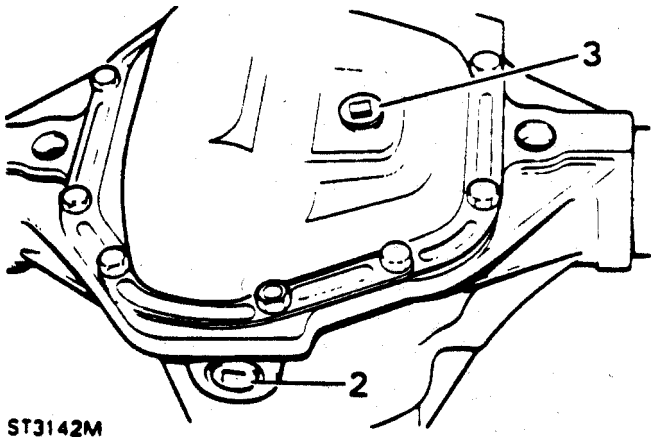
RENEW FRONT AND REAR AXLE OIL

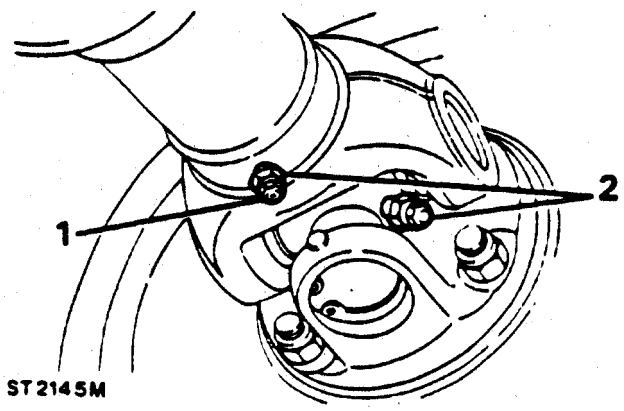
1. Drive the vehicle to level ground and place a container under the axle to be drained.
2. Using a spanner with a 13 mm square drive remove the drain plug and allow the oil to drain completely. Clean and refit the drain plug.
3. Remove the oil filler-level plug and inject new oil of a recommended make and grade until it begins to run from the hole. Clean and fit the filler-level plug and wipe away any surplus oil.



LUBRICATE PROPELLER SHAFTS

1. Clean all the grease nipples on the front and rear propshaft universal joints, and sliding portion of the shaft.
2. Charge a bw pressure hand grease gun with grease of a recommended make and grade and apply to the grease nipple. giving two to three strokes of the gun only to each nipple every 40.000 km (24,000 miles) intervals.





GENERAL MAINTENANCE AND ADJUSTMENT

This second part of the maintenance section covers adjustments and items of general maintenance as dictated by the 'MAINTENANCE SCHEDULES' . However, only maintenance operations that are not included in the OVERHAUL SECTIONS of the manual appear in this section.

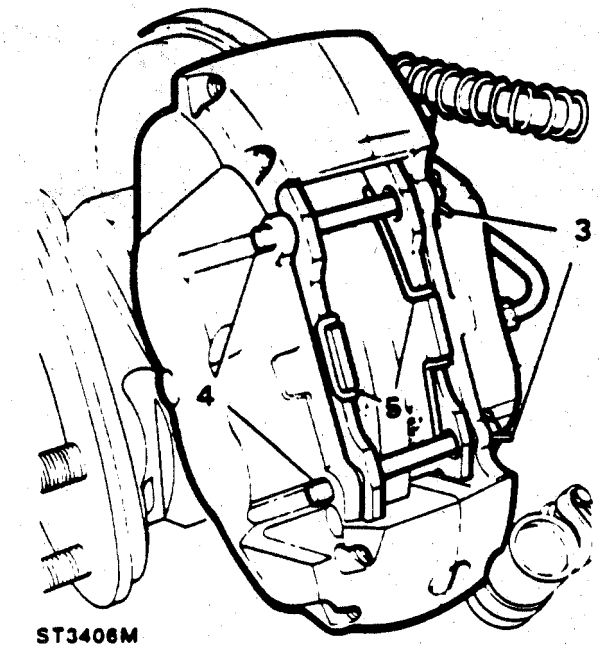
EXAMINE AND RENEW DISC BRAKE FRICTION PADS

NOTE: Defender 90 has disc type brakes fitted to both front and rear axles. Defender 110 is fitted with disc type brakes at the front and drum type brakes at the rear. Front brakes on both vehicle types are fitted with four piston calipers and the rear brakes on Defender 90 are fitted with twin piston calipers, The procedure for renewing friction pads is the same for both types although there may be a variation in the type of anti-rattle spring fitted, see Section 70.

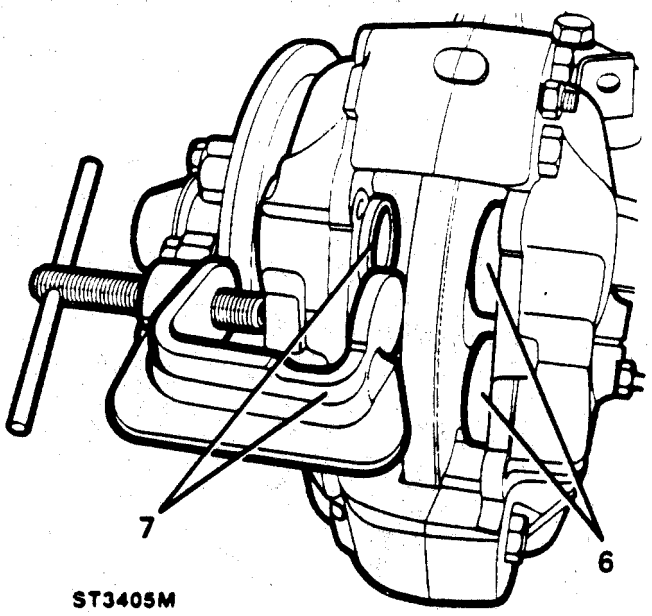
Examine the friction pads for wear, if the friction material is less than 3 mm thick or oil contaminated, they must be renewed as described in the following instructions. Observe precautions in SECTION 01 concerning asbestos:

CAUTION: Friction pads must be changed in axle sets.

1. Loosen wheel nuts, jack-up the vehicle, lower onto axle stands. and remove the wheels.
2. Clean the exterior of me calipers.
3. Remove the split pins, or spring clips, from the pad retaining pins.



4. Withdraw the pad retaining pins.
5. Remove the anti-rattle springs and withdraw the friction pads.
6. Clean the exposed surfaces of the pistons with new hydraulic fluid or brake cleaning fluid.
7. Using piston clamp (18G **672),** press each piston back into its bore, whilst ensuring that the displaced fluid does not overflow from the reservoir.

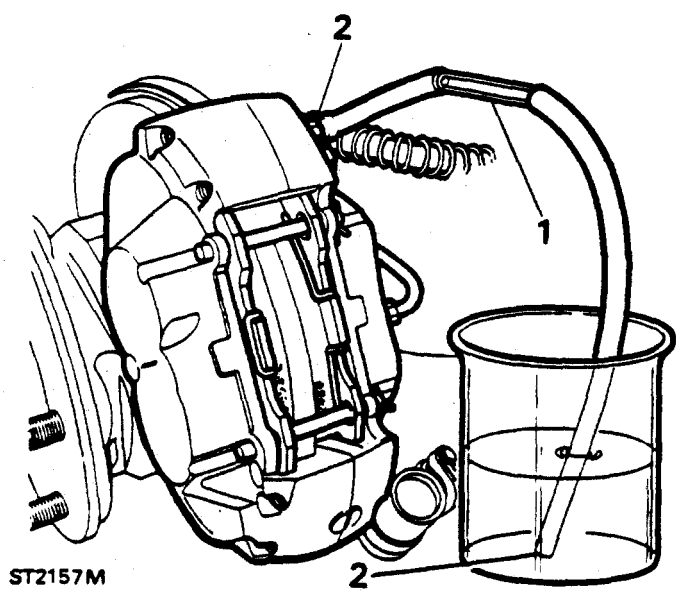


8. Smear the faces of the pistons with disc brake lubricant, taking care not to allow any to reach the pad lining material.
9. Insert the new friction pads.
10. Place the anti-rattle springs in position.
11. Insert the pad retaining pins and secure with new split pins.
12. Apply the foot brake pedal several times to locate the pads.
13. Check the fluid reservoir and top up if necessary
14 Fit the road wheels and secure with the nuts Jack up the vehicle to remove the axle stands and lower me vehicle to me ground Finally. tighten the road wheel securing nuts evenly. to the correct torque.

CHANGING THE HYDRAULIC BRAKE FLUID

In the service schedule it is recommended that the brake fluid is renewed at 18,000 miles (30.000 km) intervals or every eighteen months. If the following procedure is adopted air should not enter the system.

1 Proceed in the same way and order as for bleeding the system, see **SECTION 70** . If a clear plastic bleed tube is not available, interpose a short length of glass tube into the bleed hose being used so that the passage of the fluid can be seen.
2. Attach one end of the bleed hose to the bleed nipple of the wheel cylinder nearest to the master cylinder and immerse the free end into a glass vessel containing a small quantity of brake fluid so that the end of the tube is below the fluid level.
3. Unscrew the bleed nipple screw about half-a-turn, enough to allow fluid to be pumped out. Air could be drawn into the system if the screw is withdrawn too far.



ST2157M

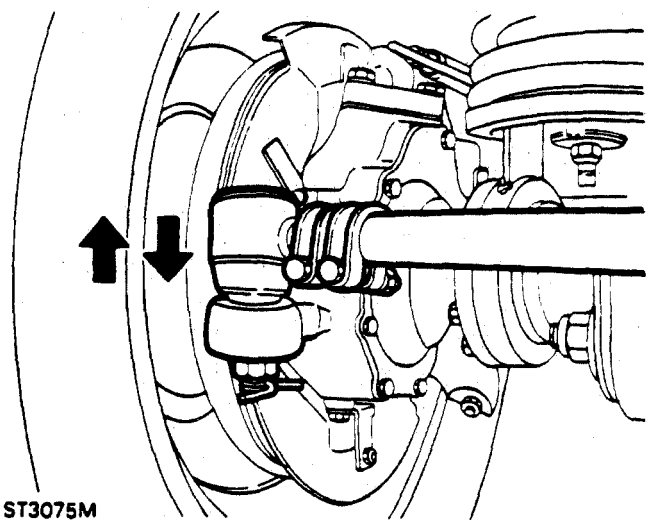
4 Pump-out most, but not all, of the fluid from the reservoir by continuously depressing and releasing the foot pedal. Do not, however, allow the reservoir to empty completely.
5. Top-up the reservoir with new, unused fluid. of the correct specification, from a sealed container. See **SECTION 09** .
6. Ensure that the reservoir is kept topped-up and continue bleeding until the old and discoloured fluid is dispelled and the new fluid is seen passing through the clear bleed hose or glass tube. Continue to bleed for two full strokes of the pedal and then close the bleed nipple whilst the pedal is depressed.
7 Repeat the above procedure at the remaining wheel cylinders in turn.
8. Top-up the reservoir and road test the vehicle.

AXLE BREATHERS

Pipes attached to the breathers on the axles terminate inside the engine compartment. This allows the axles to breath whilst the vehicle is traversing mud and water. No maintenance is required except to ensure that the pipes do not become blocked, kinked, or split, or damaged in any other way to prevent proper breathing.

CHECK STEERING BALL JOINTS

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


ST3075M

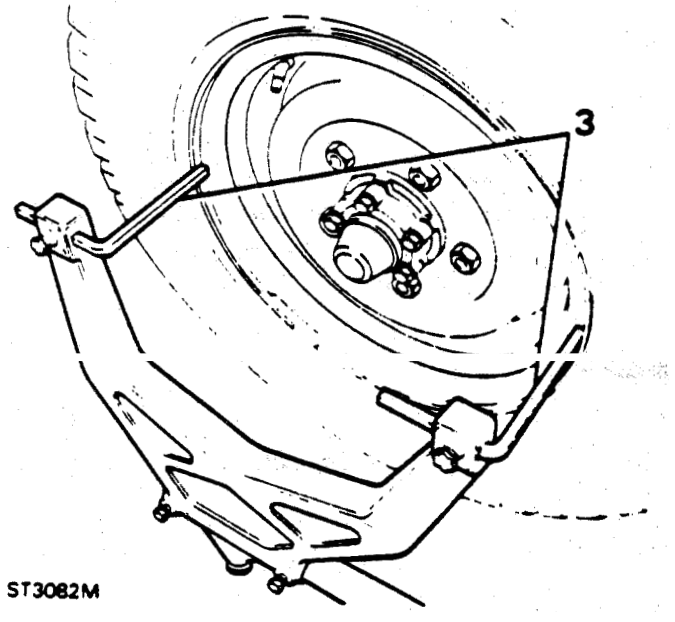
1. Check for wear in the joints by moving the ball joint up and down vigorously. If free movement is apparent renew the complete joint assembly.

CHECK FRONT WHEEL ALIGNMENT

Recognised front wheel alignment tracking equipment should be used to perform this check. See **SECTION 04** for wheel alignment data. Before checking the alignment make the following checks:.

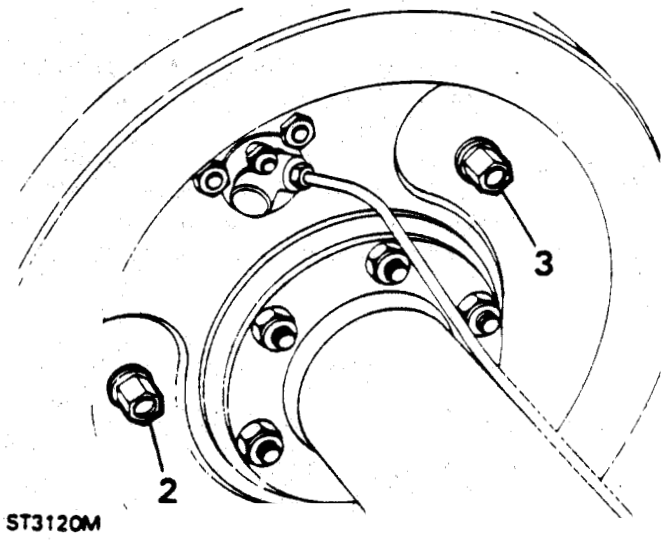
a. The vehicle is on level ground.
b. The vehicle is not loaded.
c. The tire pressures are correct.
d. The wheels run true and are not damaged or buckled.
e. The track rod is not damaged or bent and the ball joints are not worn. Also check that the joints are assembled in the same angular plain and are central in their housings. See **SECTION 57.**

1. Set the road wheels to the straight ahead position and move the vehicle forward a short distance at least two revolutions of the wheels.
2. Set up the tracking equipment to the manufacturers instructions.
3. Position the trammel probes on the inner face of the wheel, not the rims, if the latter are damaged.
4. Check the alignment as instructed by the equipment manufacturers and repeat the check on the opposite wheel. If adjustment is required follow the instructions in steering **SECTION 57.**



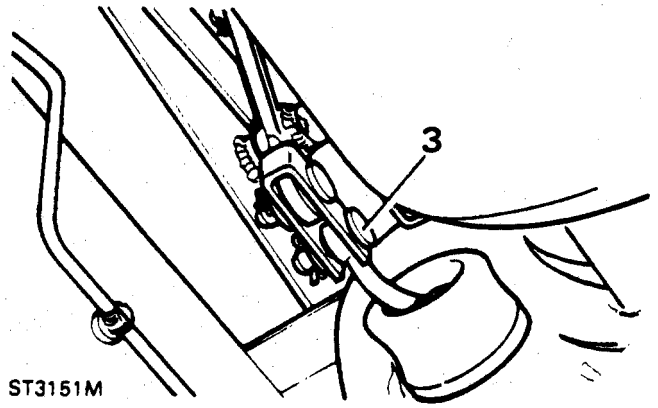
ADJUST REAR BRAKES DEFENDER 110 ONLY

1. Raise up vehicle and lower onto axle stands.
2. Each shoe is independently set by means of a hexagon adjuster. Check that the wheel turns freely and turn one adjuster until the shoe IS locked against the drum. Slacken off the adjuster sufficiently for the wheel to turn freely approximately two serrations on the snail cam.
3. Repeat the above procedure for the second brake shoe and the opposite wheel.
4. Remove the axle stands and road test the vehicle brakes.



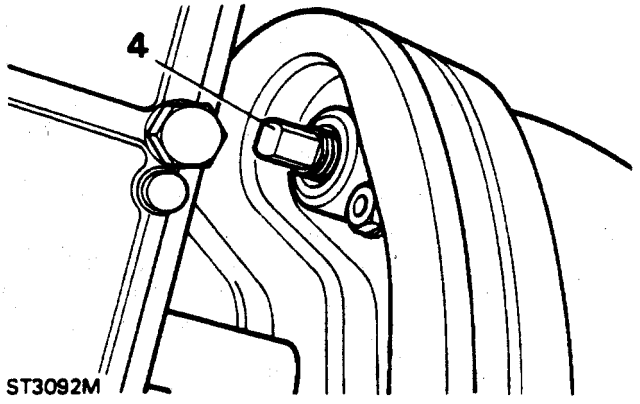
ADJUST TRANSMISSION BRAKE (Handbrake)

1. Set the vehicle on level ground and chock the wheels.
2. Release the handbrake fully.
3. Remove the clevis pin connecting the handbrake lever to the relay at the gearbox end.



ST3151M

4. Turn the adjuster on the back plate clockwise until the shoes are fully expanded against the drum.



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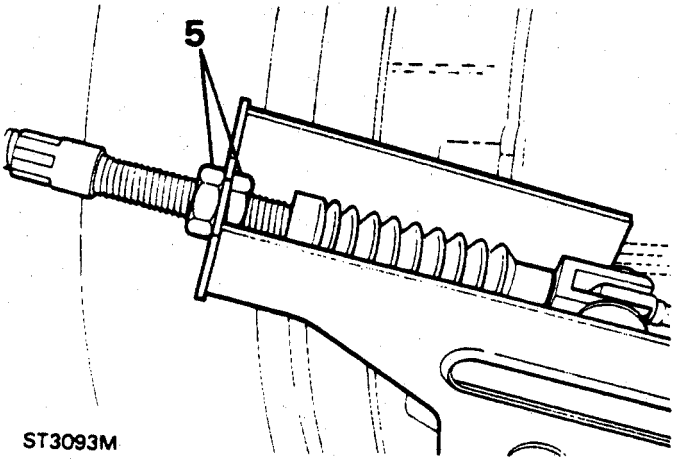
5. Adjust the outer sheath of the handbrake cable by means of the two locknuts at the gearbox end until the holes in the clevis on the inner cable line up with the hole in the relay lever



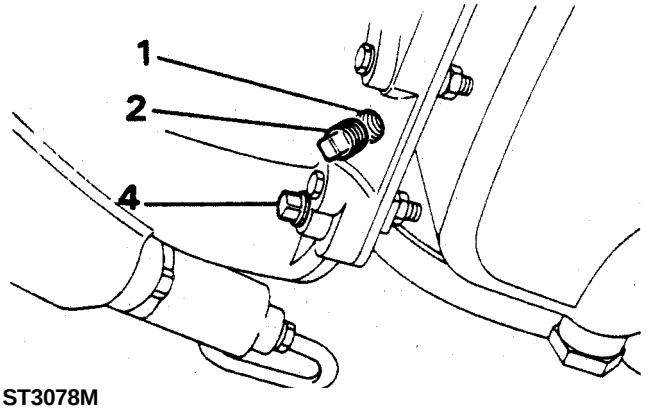
ST3093M

6. Fit the clevis pin, washer and a NEW split pin.
7. Slacken the adjuster 1 or 2 notches until handbrake shoes just clear the drum.
8. Apply the handbrake gradually. The drum should still rotate on the first ratchet and start to come on at the second ratchet.

CAUTION: DO NOT over adjust the handbrake, the drum must be free to rotate when the handbrake is released, otherwise serious damage will result.

DRAIN FLYWHEEL HOUSING

1. The flywheel housing can be completely sealed to exclude mud and water under severe wading conditions, by means of a plug fitted in the bottom of the housing.
2. The plug should only be fitted when the vehicle is expected to do wading or very muddy work.
3. When the plug is in use it must be removed periodically and any oil allowed to drain off before the plug is replaced.
4. When the plug is not in use, it must be stored as shown.



ST3078M

FILTERS

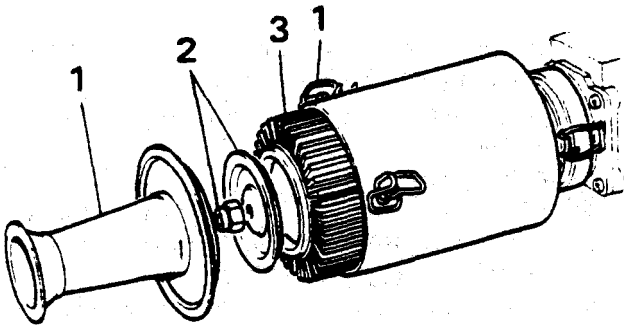
AIR CLEANER ELEMENT

Removing

1. Release the three clips and remove the inlet tube.
2. Remove the nut and end plate.
3. Withdraw element and discard.

Refitting

4. Insert the new element and reassemble the unit in reverse order to removal.



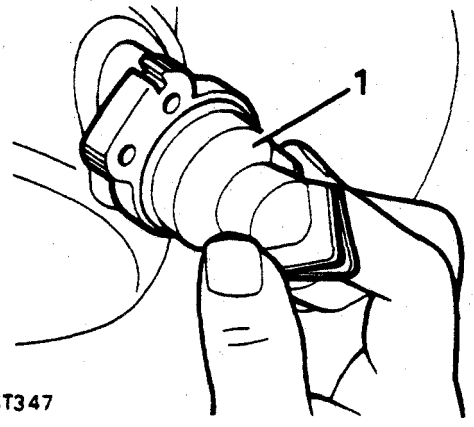
ST3413M

AIR CLEANER DUMP VALVE

The dump valve provides an automatic drain for the air cleaner and is fitted in the base of the air cleaner support bracket.

Checking

1. Squeeze open the dump valve and check that the rubber is flexible and in good condition.
2. If necessary remove the dump valve to clean the interior.
3. Fit a new valve if the original is in a poor condition.



ST347

FUEL FILTER

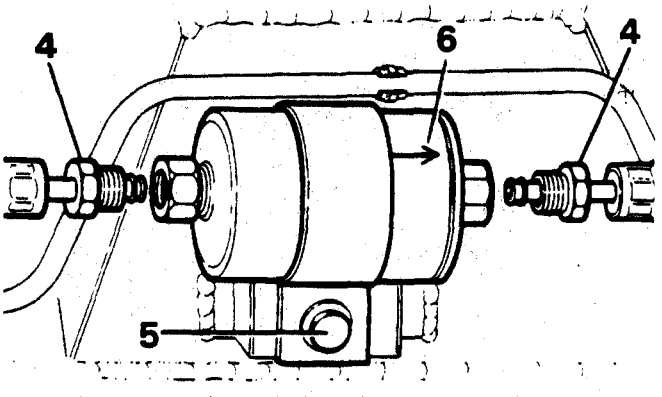
Remove and refit

WARNING: Ensure that the fuel handling precautions given in Section 01 - Introduction regarding fuel handling are strictly adhered to when carrying out the following instructions.

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

Removing

1. Depressurise the fuel system.
2. The fuel filter is located on the right-hand chassis side member forward of the fuel tank filler neck. Access to the filter is gained through the right-hand rear wheel arch.
3. Clamp the inlet and outlet hoses to prevent of fuel spillage when disconnecting the hoses.
4. Loosen the two fuel unions and remove the hoses from the filter canister.
5. Release the single nut and bolt securing the filter and clamp and remove the filter.



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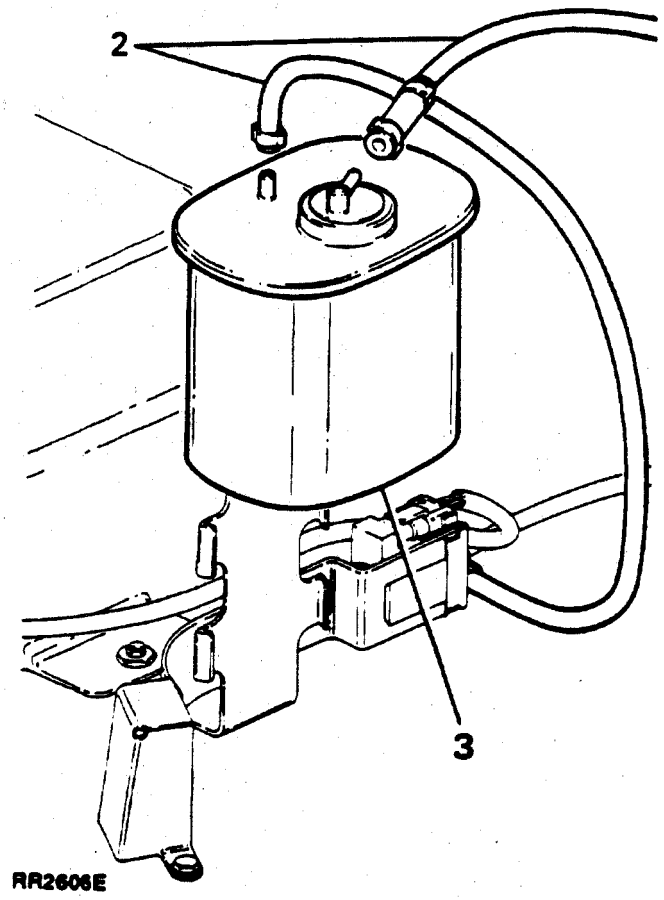
Refitting

6. Fit a new filter observing the direction of flow arrow on the canister.
7. Tighten the single nut and bolt.
8. Fit the inlet and outlet hoses. Tighten the unions to a torque of (27-34Nm).
9. Refit the fuel pump relay. Reconnect the battery and recode the radio.
10. Start the engine and inspect for fuel leaks around the hose connections.

Charcoal canister Defender 110

Remove

1. Disconnect battery negative lead.
2. Disconnect both purge lines.
3. Release canister from its mounting bracket.



Refit

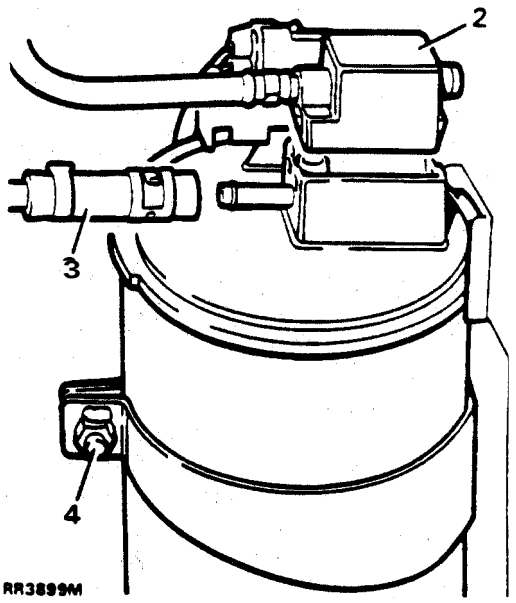
4. Reverse the removal procedure, ensuring that the canister is securely located in its mounting bracket and both purge lines are fitted correctly to the canister.

WARNING: The use of compressed air to clean a charcoal canister or to clear a blockage in the evaporative system is highly dangerous. An explosive gas present in a fully saturated canister may be ignited by the heat generated when compressed air passes through the canister.

Charcoal canister Defender 90

Remove

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

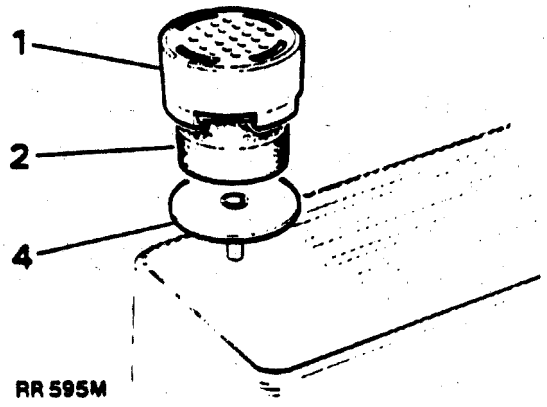


Refitting

5. Reverse the removal procedure.

POSITIVE CRANKCASE VENTILATION INTAKE FILTER

1. Pry the filter holder upwards to release it from the rocker cover.
2. Discard the sponge filter.



Fit new filter

3. Insert a new filter into the plastic body
4. Push the filter holder onto the rocker cover until it clips firmly into place

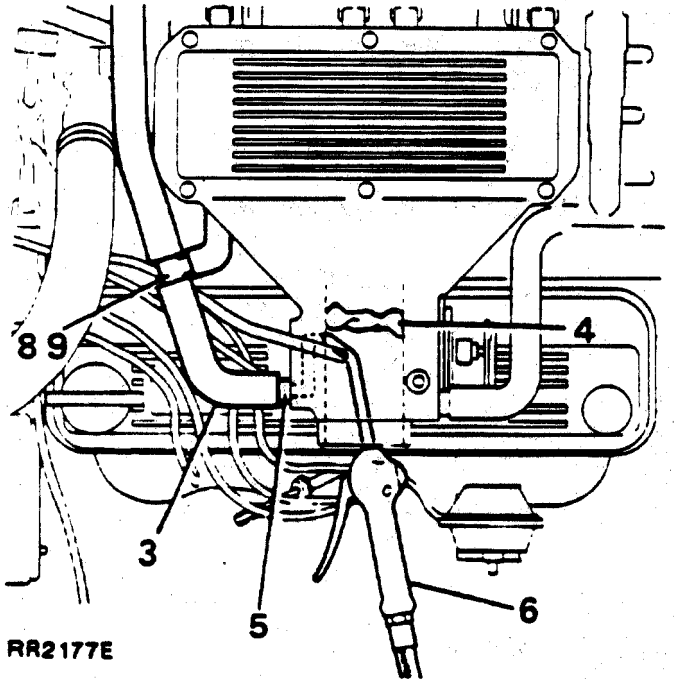
CLEAN PLENUM CHAMBER VENTILATION PASSAGEWAY

The cleaning of the plenum chamber ventilation passageway can be carried out without removing the plenum chamber from the ram housing.

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

WARNING: Safety glasses must be worn when performing this operation. Ensure that debris is not blown into the atmosphere which could be harmful to other personnel within the vicinity.

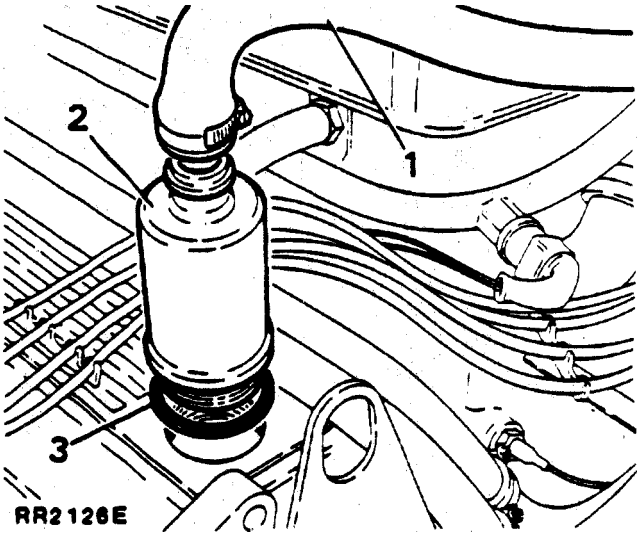
1. Disconnect the battery negative terminal.
2. Release the hose clamp and remove the hose from the plenum chamber inlet neck.
3. Remove the crankcase ventilation hose from the side of the plenum chamber.
4. Insert a piece of lint free cloth down the throttle valve bore to prevent debris passing beyond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



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

CLEAN POSITIVE CRANKCASE VENTILATION BREATHER FILTER

1. Release the hose clamp and pull the hose off the canister.
2. Unscrew the canister and remove if from the rocker cover.
3. Remove the large *'0'* ring from the threaded end of the canister.
4. Visually inspect the condition of the wire screen within the canister, if in poor condition fit a new assembly, if in an acceptable condition clean the screen as follows:



5. Immerse the canister in a small amount of solvent and allow time tor the solvent 10 dissolve and loosen any engine fume debris within the canister.
6. Remove canister from solvent bath and allow to dry out in still air.

WARNING: Do not use a compressed air line to remove any remaining solvent or particles of debris within the canister as this could cause fire or personal injury.

Refitting the breather/filter

7 Fit a new rubber **'O'** ring.
8. Screw the canister into the rocker cover hand tight only.
9. Refit hose and tighten hose clamp securely

GENERAL MAINTENANCE AND ADJUSTMENTS

CHECK/ADJUST OPERATION OF ALL WASHERS AND TOP-UP RESERVOIR

1. Check the operation of windscreen, tailgate and headlamp washers.
2. Adjust jets if necessary by inserting a needle or very fine sharp implement into the jet orifice and maneuvering to alter the jet direction.
3. Unclip the reservoir cap.
4. Top up reservoir to within 25mm (1 in) below the bottom of the filler neck.
   Use a screen washer solvent/anti-freeze in the reservoir, this will assist in removing mud, flies and road film and protect against freezing.

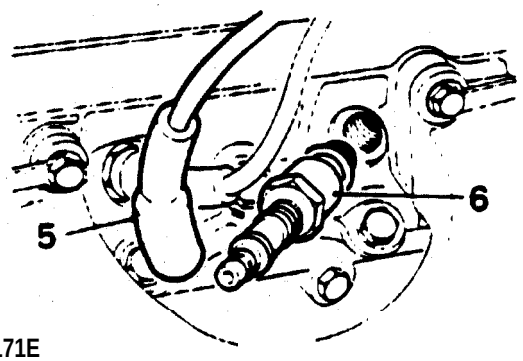
IGNITION

Spark plugs

1. Take great care when fitting spark plugs not to cross-thread the plug, otherwise costly damage to the cylinder head will result.
2. Check or replace the spark plugs as applicable.
3. It is important that only the correct type of spark plugs are used for replacements.
4. Incorrect grades of plugs may lead to piston overheating and engine failure.

To remove spark plugs proceed as follows:

5. Disconnect the battery negative lead and remove the leads from the spark plugs.
6. Remove the' plugs and washers.



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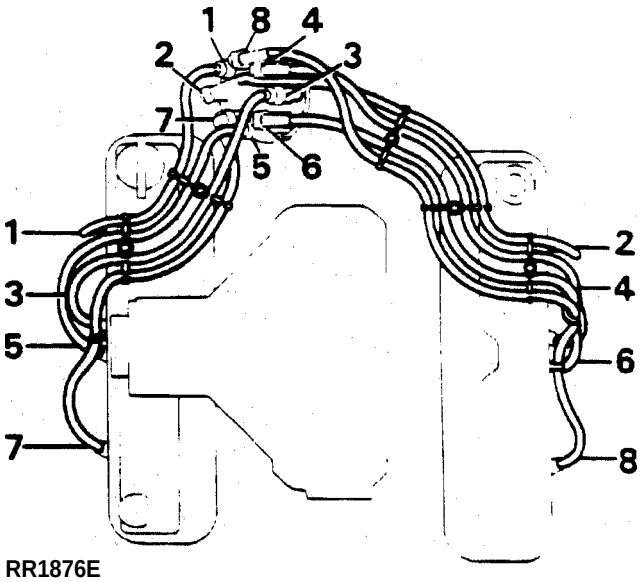
7. Set the electrode gap to the recommended clearance.
8. When pushing the leads onto the plugs, ensure that the shrouds are firmly seated on the plugs.

Fitting H.T. leads

9. Ensure that replacement H.T. leads are refitted in their spacing cleats in accordance with the correct layout illustrated.
   Failure to observe this instruction may result in cross-firing between two closely fitted leads which are consecutive in the firing order.

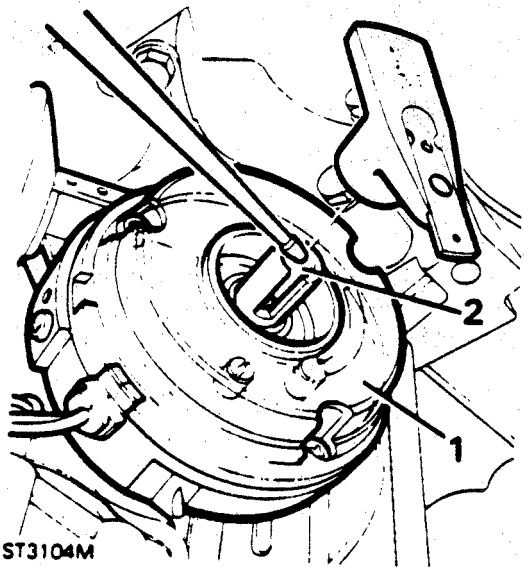


RR1876E

CLEAN AND LUBRICATE V8 ENGINE ELECTRONIC DISTRIBUTOR every 40,000 km (24,000 miles)

WARNING: The electronic ignition System involves very high voltages. Inexperienced personnel and wearers of medical pacemaker devices should not be allowed near any part of the high tension circuit.

1. Remove the distributor cap and rotor arm and wipe inside with a nap-free cloth. Do not disturb the clear plastic insulating cover which protects the magnetic pick-up module.
2. Apply three drops of clean engine oil to the rotor spindle.

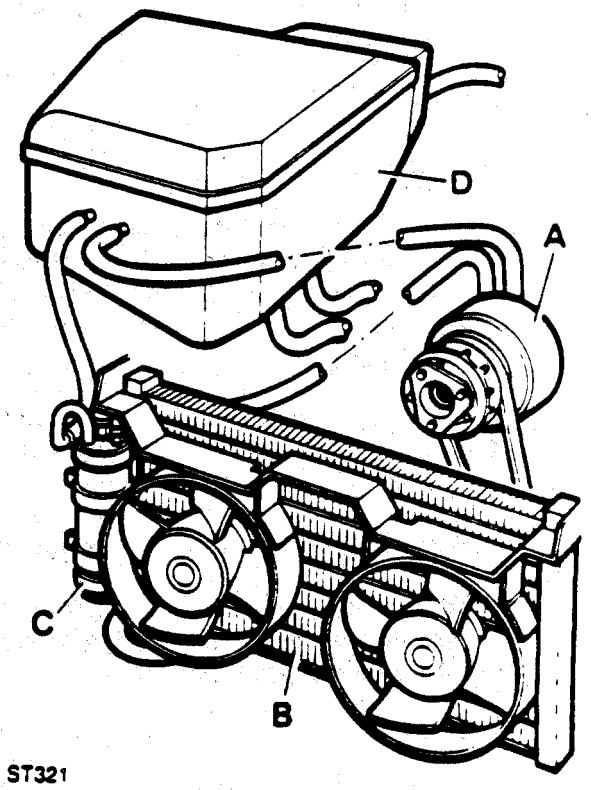


3. Fit the rotor arm and distributor cap and ensure that the cap is property located and secured with the two clips.

AIR CONDITIONING SYSTEM DEFENDER 110

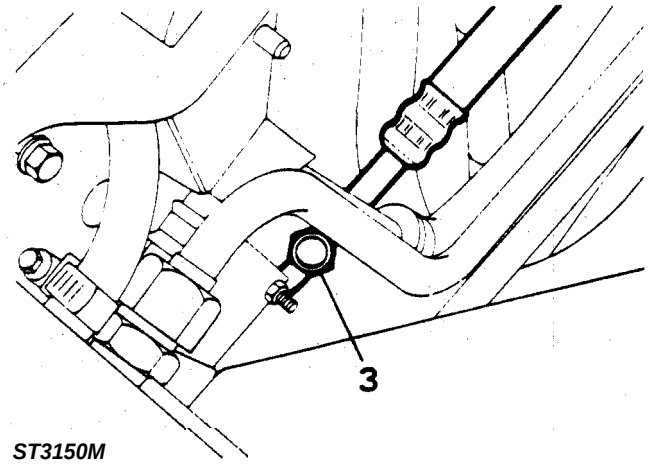
The air conditioning system operates in conjunction with the vehicle heater to provide dried cooled recirculated or fresh air to the vehicle interior
The system consists of the following units which should be examined at the same mileage intervals as the heater system:

A. Engine mounted compressor.
B. Condenser in front of the radiator.
C. A receiver/drier in front of and to the right of the condenser.
D. Evaporator/heater unit in engine compartment



1. Compressor: Check the pipe connections tor leakage and the hoses tor swelling Check that the drive belt is correctly tensioned
2. Condenser: Using an air line. or a water hose, dean the exterior of the condenser matrix. Check the pipe Connections for signs of leakage.

3. Receiver/drier: Check the pipe connections for signs of leakage. Examine the sight glass while the system is operating and if bubbles are present it indicates that the system is contaminated with air or water and will require purging.



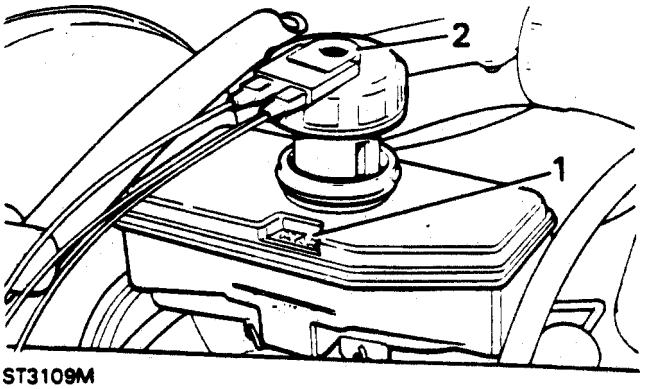
ST3150M

4. Evaporator: Examine the pipe connections for leaks.

WARNING: The air conditioning system is filled at high pressure with a potentially toxic material. If any repair or servicing work is necessary following the above inspections, it must only be carried out by a qualified air conditioning engineer who must wear protective goggles and follow the WARNINGS and CAUTIONS given in **SECTION 82.**

CHECK BRAKE FLUID RESERVOIR

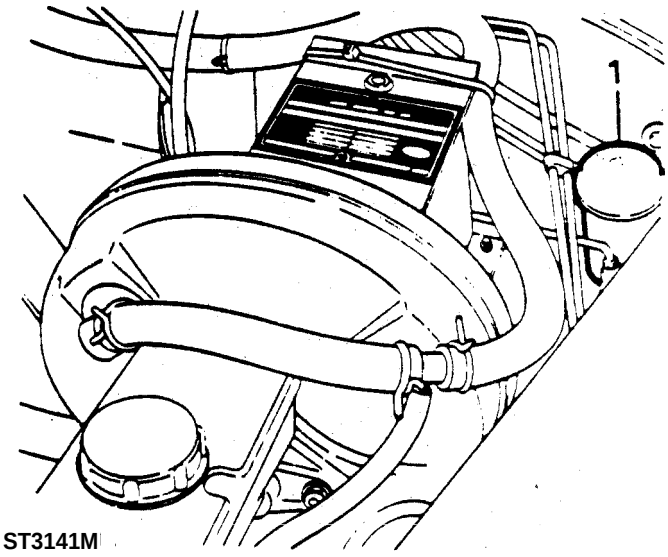
1. Check the fluid level in the fluid reservoir by observing the level in relation to the 'MIN' or 'MAX' marks on the side of the translucent reservoir.
2. If the level is below the 'MAX' mark clean the outside of the filler cap and top-up with new. clean fluid from a sealed container. Use only fluid recommended in **'SECTION 09'.** Refit the cap.



ST3109M

CHECK CLUTCH FLUID RESERVOIR

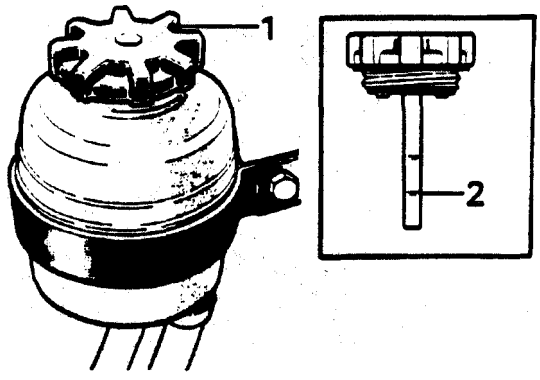
1. Clean and remove the reservoir cap and observe the fluid level in relation to the marks on the side of the reservoir.
2. Top-up if necessary with new, clean fluid from a sealed container and of a recommended specification - **see 'SECTION 09'.** Refit the **cap.**



ST3141M

POWER STEERING FLUID RESERVOIR

1. Clean and remove the reservoir cap.
2. Check that the fluid is up to the lower mark on the dip stick. Top-up if necessary and refit cap.



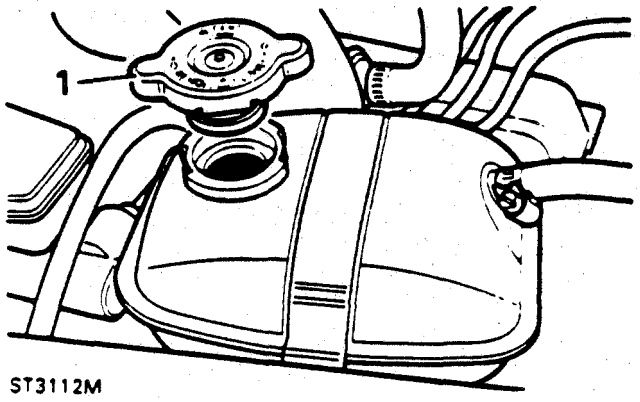
ST445

CHECK COOLING SYSTEM COOLANT

Refer to the 'COOLING SYSTEM' section for details of anti-freeze and to SECTION 09 for anti-freeze protection quantities.
With a cold engine, the expansion tank should be approximately half full.

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

1. To remove the filler cap, first turn it anti-clockwise a quarter of a turn and allow all pressure to escape, before turning further in me same direction to lift it off. When replacing the filler cap it is important that it is tightened down fully, not just to the first stop. Failure to tighten the filler cap properly may result in water loss, with possible damage to the engine through overheating.



ST3112M

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

1. When removing the filler cap, first turn it a little way very gently and gauge any pressure that may be behind it. Allow all pressure to escape slowly before fully releasing the cap.
2. With a cold engine, the coolant level should be just to the top of the level indicator post situated in the expansion tank below the filler hole.

BATTERY

Check Specific Gravity

The specific gravity of the electrolyte should be checked using a battery hydrometer. The readings should be as follows:
Temperate climate below 26.5°C (80°F) as commissioned for service, fully charged 1.270 to 1.290 specific gravity.
As expected during normal sewice, three-quarter charged 1.230 to 1.250 specific gravity.
If the specific gravity should read between 1.190 to 1.210, half-charged, the battery must be bench charged and the electrical equipment in the car should be checked.
Tropical climate above 26.5°C (80°F) as commissioned for service, fully charged 1.210 to 1.230 specific gravity.
As expected during normal sewice, three-quarter charge 1.170 to 1.190 specific gravity.
If the specific gravity should read between 1.130 to 1.150, half-charged, the battery must be bench charged and the electrical equipment on the car should be checked.

Check and Top-Up Electrolyte Level

1. Wipe all dirt and moisture from the battery top.
2. Remove the filler cover, If necessary add sufficient distilled water to raise the level to the top of separators.

Replace the filler plugs or manifold lid.

3. Avoid the use of a naked light when examining the cells.
4. In hot climates it will be necessary to top up the battery at more frequent intervals.
5. In very cold weather it is essential that the vehicle is used immediately after topping up, to ensure that the distilled water is thoroughly mixed with the electrolyte. Neglect of this precaution may result in the distilled water freezing and causing damage to the battery.

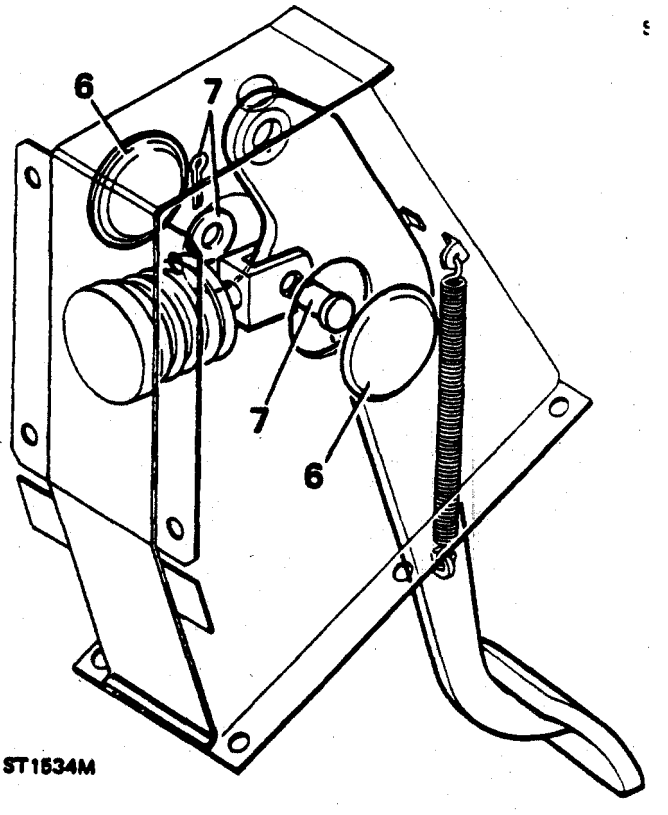
Battery terminals

6. Remove battery terminals, clean, grease and refit.
7. Replace terminal screw: do not overtighten. **Do** not use the screw for pulling down the terminal.
8. Do NOT disconnect the battery cables while the engine is running or damage to alternator semiconductor devices may occur. It is also inadvisable to break or make any connection in the alternator charging and control circuits while the engine is running.
9. It is essential to observe the polarity of connections to the battery, alternator and regulator, as any incorrect connections made when reconnecting cables may cause irreparable damage to the semiconductor devices.

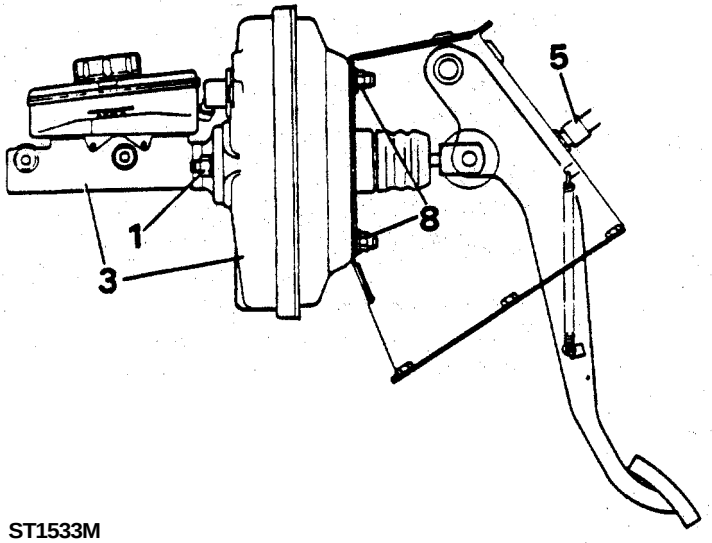
CAUTION: If a new battery is fitted to the vehicle, it should bo the same type as fitted to the vehicle when new. Alternative batteries may vary in sire and terminal positions and this could be a possible fire hazard if the terminals or leads come into contact with the battery clamp assembly. When fitting a new battery ensure that the terminals and leads are clear of the battery clamp assembly.

RENEW BRAKE SERVO FILTER

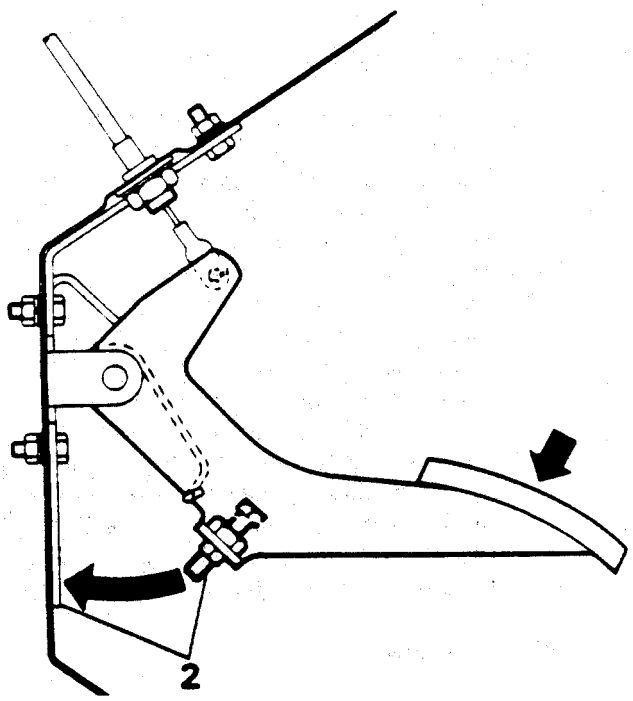
1. Remove the nuts securing the master cylinder to the servo.
2. Release the clip retaining the brake pipe to the clutch pipe.
3. Separate the master cylinder from the servo.
4. Disconnect the vacuum hose from the servo.
5. Disconnect the Lucars from the stop lamp switch at the rear of the pedal box.
6. Remove the blanking grommets from the pedal box.
7. Remove the split pin from the clevis and withdraw the clevis pin and washer



8. Remove the four nuts securing the servo to the pedal box and remove the servo

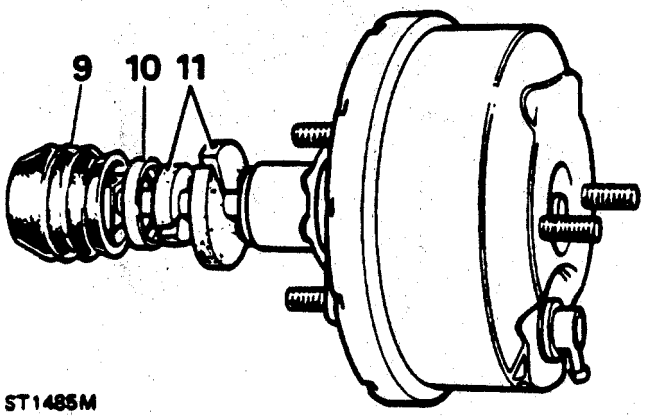


ST1533M



ST1835M

9. Pull back the dust cover.
10. Release the end-cap.
11. Cut the filters to remove them from the shaft.



ST1485M

12. Clean the filter seating and fit the new filters noting that they must be cut to fit over the shaft
13 Fit the end-cap and dust cover and refit the servo and master cylinder to the vehicle reversing the removal procedure. Use a new split pin to secure the clevis.
14 Test the brakes

THROTTLE PEDAL ADJUSTMENT

1. After renewing the throttle cable. remove any slack in the cable by adjustment of the cable adjuster at me engine end.
2. Depress the throttle pedal, by hand, to the full extent of the throttle linkage, and adjust the pedal stop screw to take up all clearance between the screw and scuttle panel. Make sure that no strain is placed upon the throttle linkage.

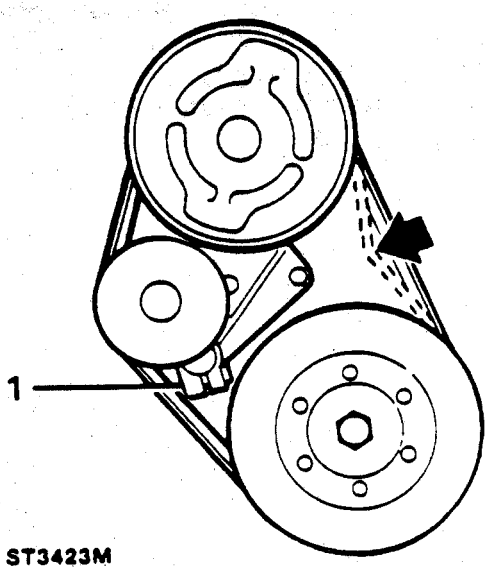
DRIVE BELT TENSIONING

WARNING: Do not attempt to check belt tension or make adjustments with the engine running. Serious injury could result.

Each drive belt should be tight enough to dnve without undue strain on the bearing. Using moderate finger pressure at the point indicated in the illustration, belts should deflect 0.5 mm per 25 mm. Deflection beyond this limit may cause a loud whining or knocking noise and intermittent drive.

FAN/WATER PUMP DRIVE BELT ADJUSTMENT

1. Loosen the jockey wheel securing bolt and adjust the wheel position until the correct tension is obtained.
2. Tighten the securing bolt and recheck the deflection.

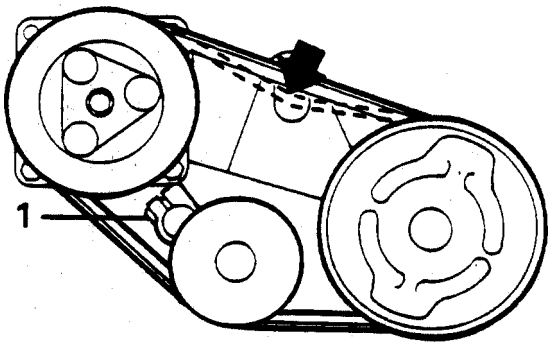


ST3423M

AIR CONDITIONING COMPRESSOR DRIVE BELT DEFENDER 110

ADJUSTMENT

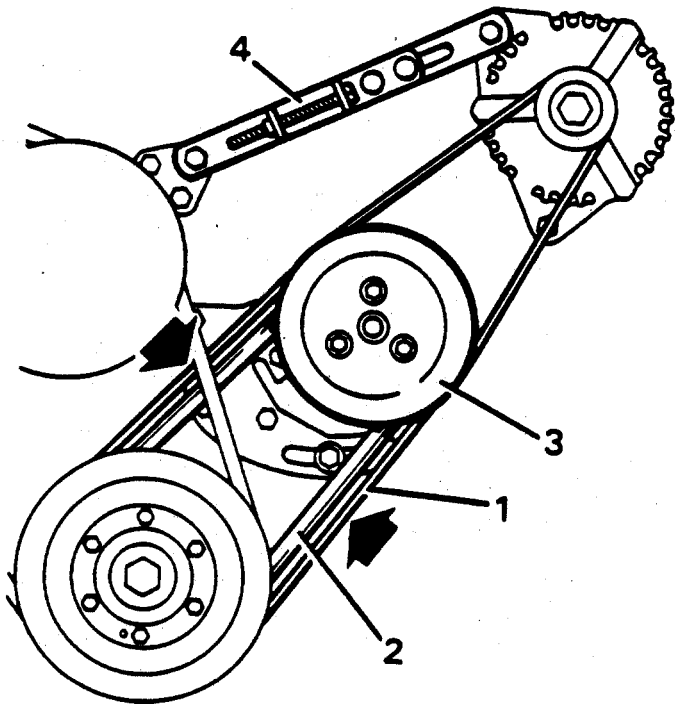
1. Loosen the Jockey wheel securing bolt and adjust the wheel position until the correct tension is obtained. Tighten the securing bolt and recheck the deflection



ST3424M

ALTERNATOR AND POWER STEERING PUMP DRIVE BELT ADJUSTMENT

An additional pulley, bolted to the front of the steering pump pulley is used as a guide for the alternator drive belt. Before adjustment of the steering pump belt is carried out, the alternator belt must be loosened to facilitate accurate adjustment. Before adjusting the alternator drive belt ensure the steering pump belt is correctly adjusted.



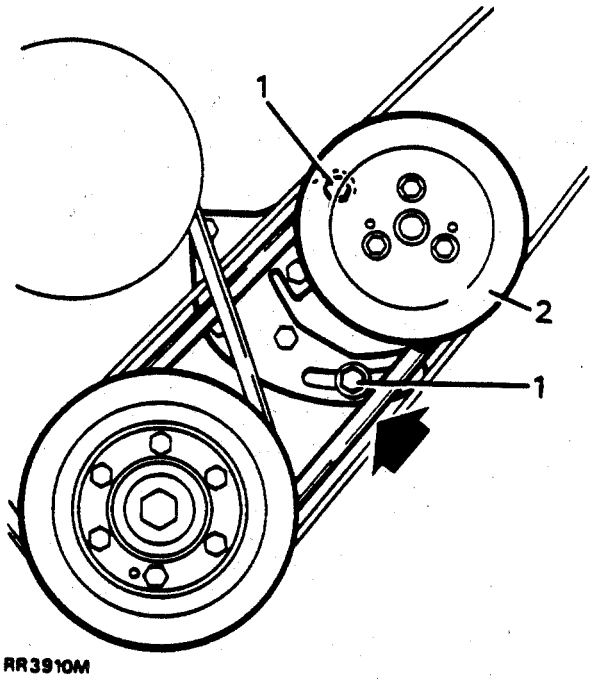
RR3909M

1. Alternator drive belt
2. Steering pump drive belt
3. Steering pump and guide pulley
4 Alternator drive belt tensioner

POWER STEERING PUMP DRIVE BELT

Before adjustment of the steering pump belt is carried out, the alternator drive belt must be loosened to facilitate accurate adjustment.

1. Loosen the steering pump pivot nut and adjustment bolt.
2. Ensure the pump is free to rotate on the mounting. DO NOT lever pump, loosen fixings further if necessary.
3. Carefully lever against the pump bracket to tension the belt. Where access is restricted, a lever with one end cranked 5° to 10° may be fed down between the water pump and distributor. Place the lever against the steering pump bracket, carefully levering from the water pump/front cover



RR3910M

CAUTION: Do not lever against the steering pump casing. Damage to the casing may result in oil leaks.

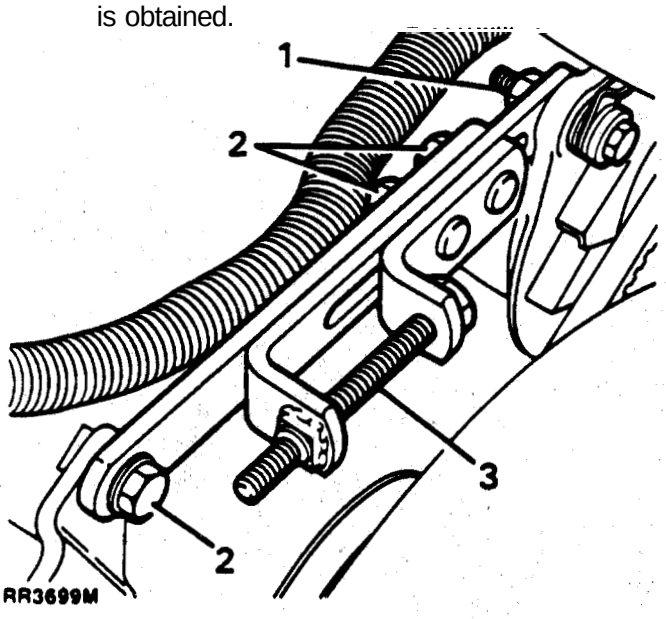
4. Check the belt tension at the mid-point of the longest span, the belt should deflect 0.5 mm per 25 mm of belt run between pulley centres Tighten the steering pump adjustment bolt and pivot nut.
5. Recheck the belt tension.
6. Carry out alternator belt tensioning

ALTERNATOR DRIVE BELT

Before adjusting the alternator drive belt, ensure that the steering pump drive belt is correctly tensioned.

A positive drive tensioner is fitted to provide greater accuracy when setting the alternator belt. The tensioner eliminates the need to lever the alternator when adjusting the belt tension.

1. Loosen the alternator pivot bolt and the bolt securing the alternator to the tensioner.
2. Loosen the two tensioner nuts and the bolt securing the tensloner to the water pump bracket.
3. Rotate the tensionerlead screw either anti-clockwise to slacken or clockwise to tighten the drive belt until the correct tension is obtained.



NOTE: Where possible the belt tension should be checked using a recognised tensioning gauge. The correct tension using a Clavis gauge is 152 to 158 *Hz*.

4 Tighten the alternator pivot bolt. the two bolts securing the tensioner and the two tensioner nuts Recheck the belt tension.

5. If a new drive belt has been fitted. run the engine at fast idle for 3 to 5 minutes, stop engine and recheck belt tension.

RESET EMISSION MAINTENANCE REMINDER

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

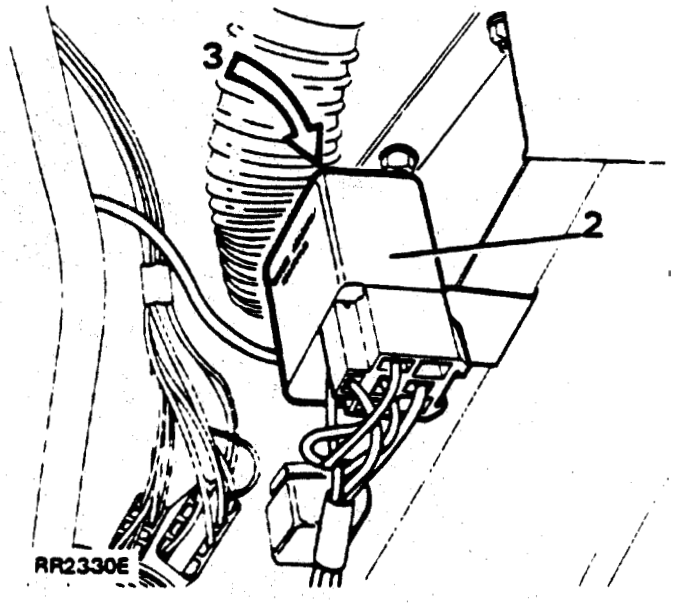
The control unit IS located behind the instrument panel,

The control unit colour is brown, mounted on a brown plug, 'EMISSION MAINTENANCE REMINDER' is embossed in white on the side of the unit. A tamperproof label is attached to the top of the unit.

The emission maintenance reminder must be reset after the 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, refer to section 17.

The unit can be reset as follows:

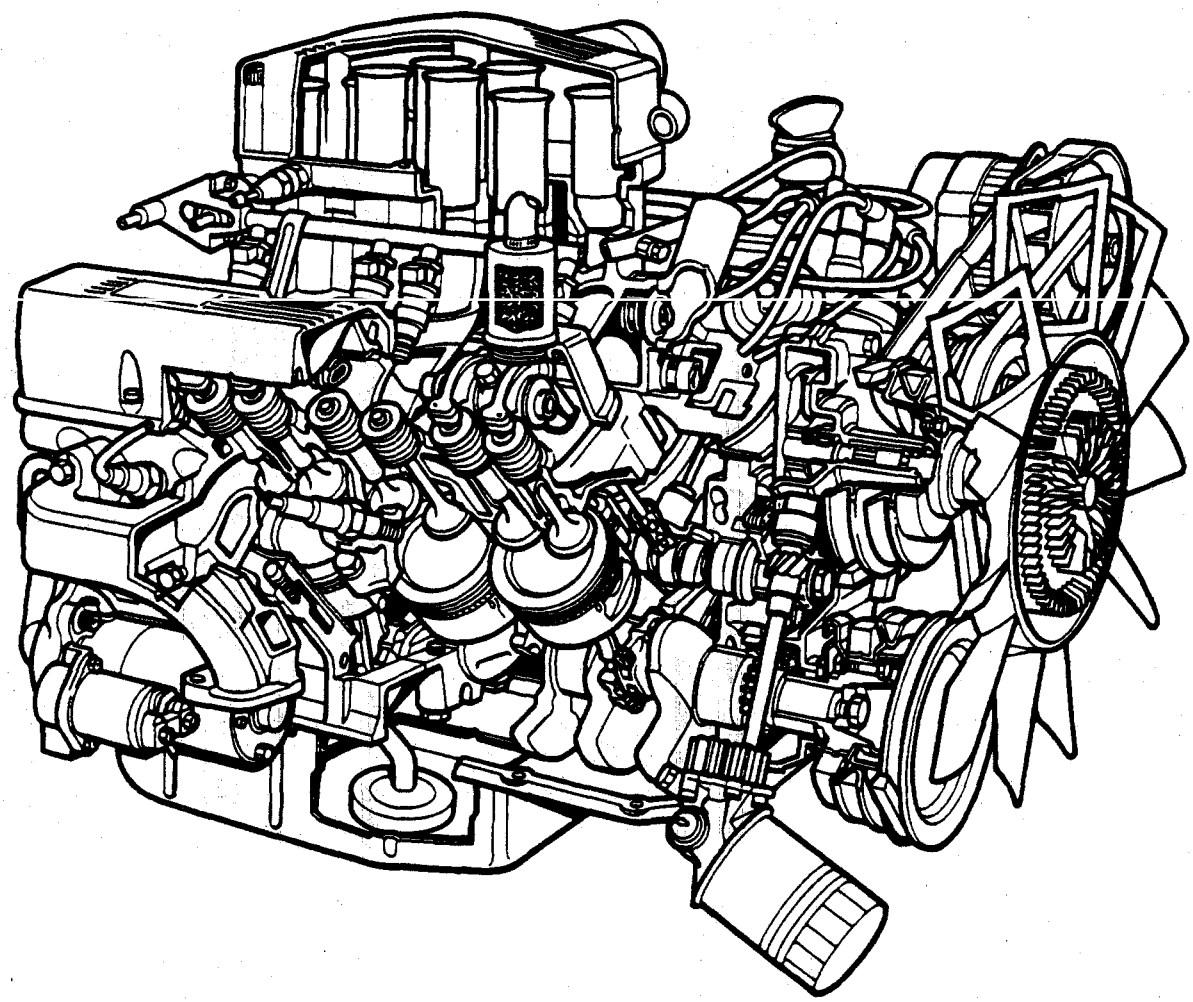
1. Remove the fixings and lower the lower dash panel.
2. Identify the control unit and remove it from the plug.
3. Remove the tamperproof label to reveal the access hole for resetting.



4. Using a small thin metallic probe, place the probe into the access hole and momentarily electrically short between the reset pins within the unit.
5. Refit the control unit to the plug, switch on the ignition, the **'SERVICE ENGINE'** warning light in the instrument panel will initially light up as part of the unit's inbuilt check feature, if the unit has been reset correctly the warning light will go out after a few seconds. Should the warning light remain illuminated, repeat the resetting procedure.
6. Fit a new tamperproof label.
7. Endorse the Passport to service.

DESCRIPTION

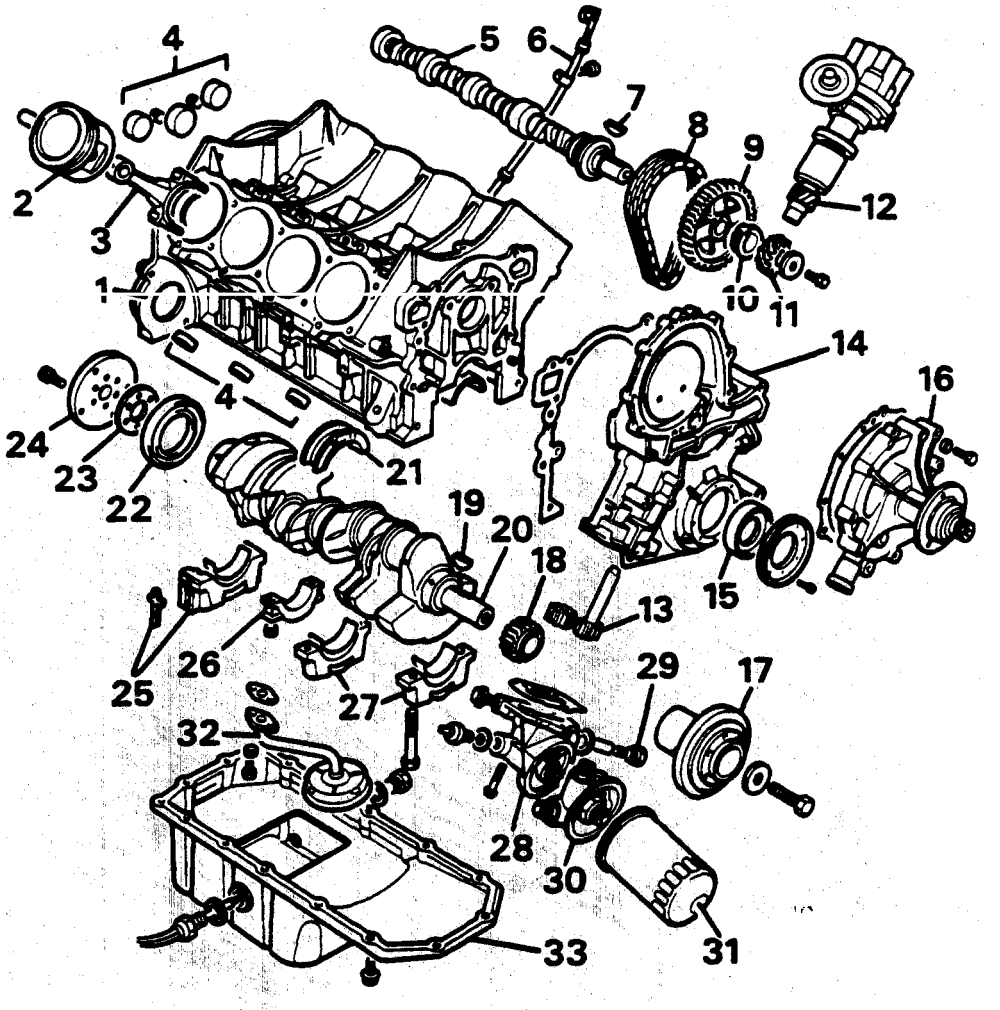
The V8 engine has cast aluminium cylinder heads and cylinder block. The two banks of steel cylinder liners which are pressed down to stops in the block, are set at 90° to one another. The three ringed aluminium pistons transmit the power through the connecting rods to a cast iron five bearing crankshaft, which drives the centrally located camshaft via an inverted tooth chain.



RR3523M

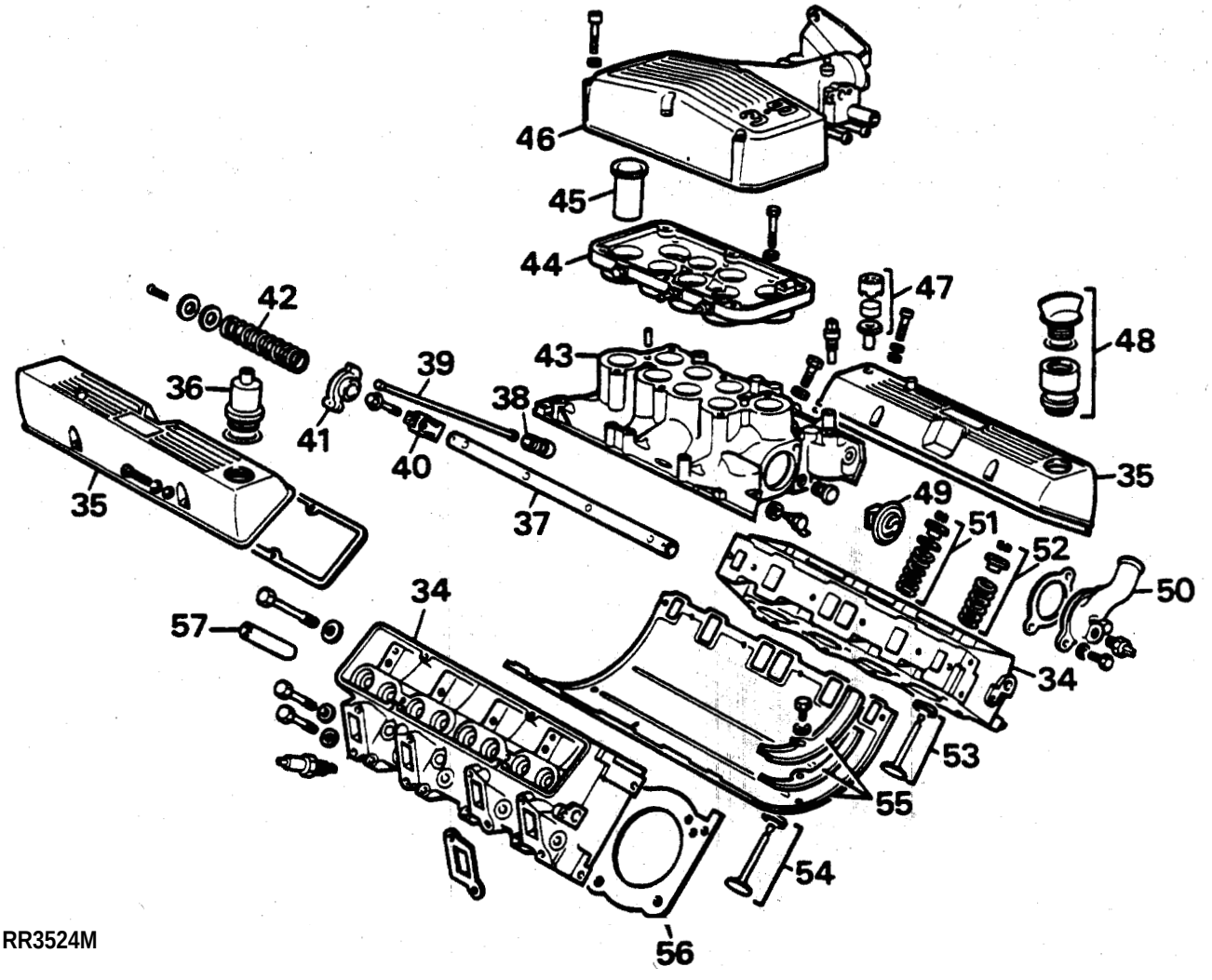
The electronic ignition distributor and lubrication oil pump are driven by a skew gear off the front of the camshaft. The overhead inlet and exhaust valves are operated by rocker shafts, pushrods and self adjusting hydraulic tappets.

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



RR3627M

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



RR3524M

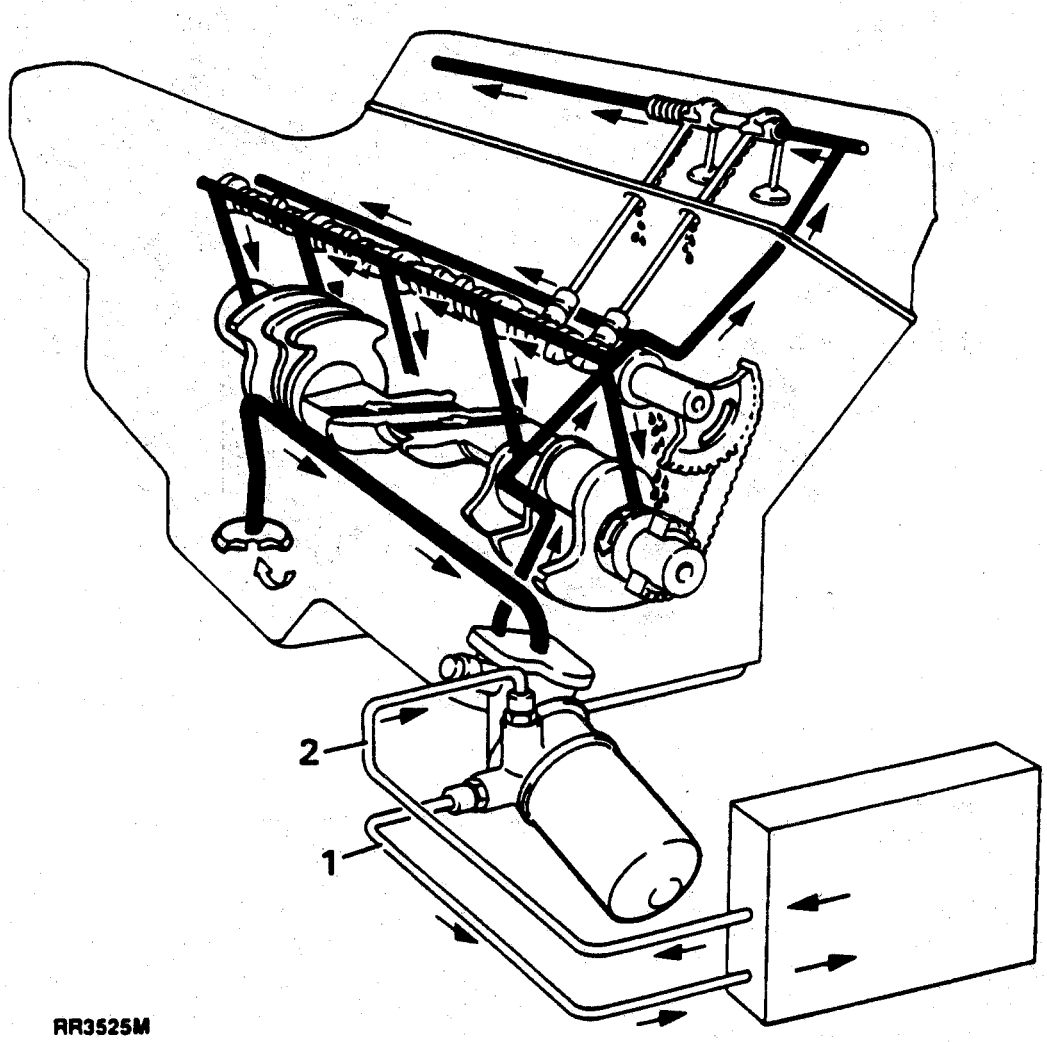
34. Cylinder heads (2)
35. Rocker covers (2)
36. Oil separator
37. Rocker shafts (2)
38. Hydraulic tappets (8)
39. Pushrods (8)
40. Rocker brackets (8)
41. Rocker arms (4) left and (4) right
42. Rocker shaft springs (6)
43. Inlet manifold
44. Plenum chamber lower
45. Ram pipes (8)
46. Plenum chamber upper
47. Air filter
48. Oil filler
49. Thermostat
50. Thermostat cover
51. Inlet valve spring, cap, seal and collets (8)
52. Exhaust valve spring, cap, collets (8)
53. Inlet valve and seat (8)
54. Exhaust valve and seat (8)
55. Tappet cover gasket and seals
56. Cylinder head gaskets (2)
57. Valve guides (16)

Lubrication system

The **V8** full flow lubrication system uses an external gear pump which is driven from the front of the camshaft via the distributor drive shaft. The oil pump gears are housed in the timing cover and the pressure relief valve, warning light switch and filter are fitted to the gear 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 Dower and exhaust strokes.

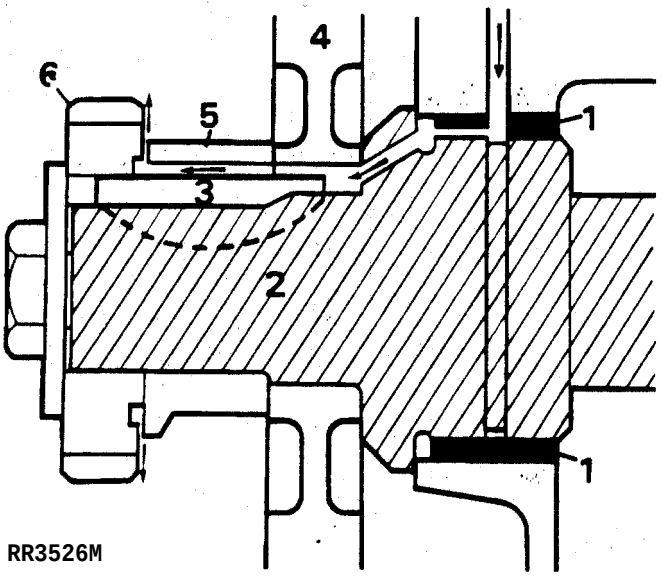


Lubrication system

1 Oil to cooler
2 Oil from cooler

Distributor/oil pump drive and timing chain lubrication

The distributor/oil pump drive, and timing chain 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.

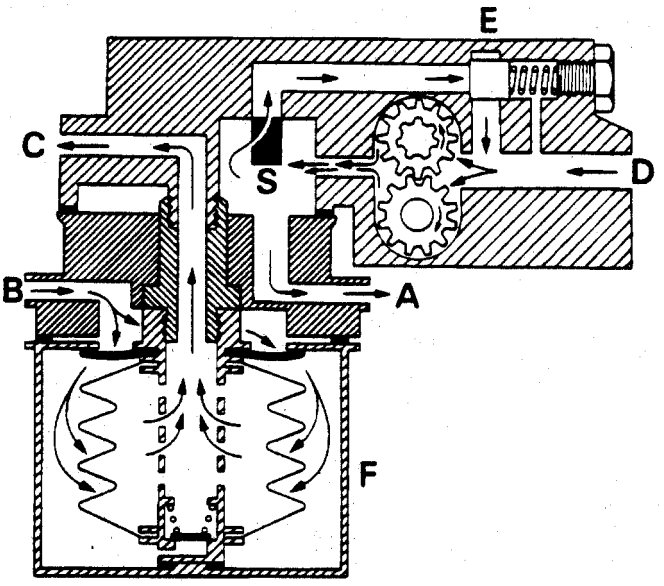


RR3526M

1 Bearing
2 Camshaft
3 Key
4 Camgear
5 Spacer
6 Distributor oil pump drive gear

Filtered oil

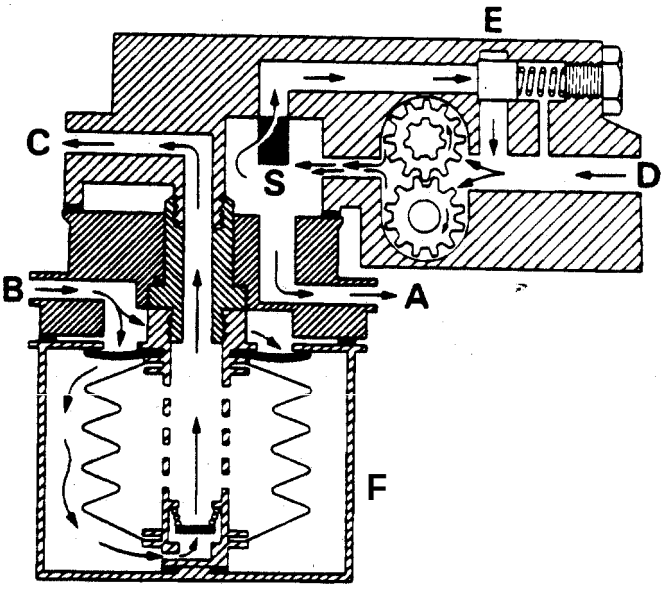
Lubrication pressure is controlled by the pressure relief valve E which allows excess pressure to escape into the pump suction gallery D. The oil is then pumped through the cooler via connections A and **B** before passing through the anti-siphon valve and into the filter. Filtered oil is supplied to the engine bearings by port C.



RR3528M

Unfiltered oil

Any blockage of the filter element will open the by-pass valve and maintain an un-filtered oil supply to the bearings.



RR3529M

Hydraulic tappets

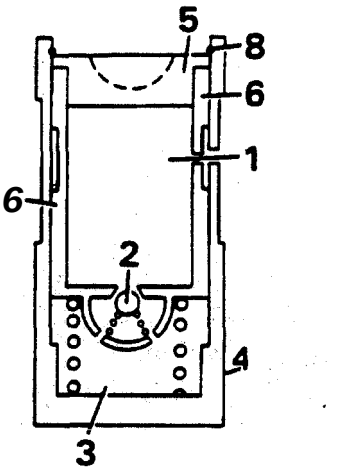
The purpose of the hydraulic tappet is to provide maintenance free and quiet operation of the inlet and exhaust valves. It achieves its designed purpose by utilizing engine oil pressures to eliminate the mechanical clearance between the rockers and the valve stems.

Operation

During normal operation, engine oil pressure present in the upper chamber 1, passes through the non-return ball valve 2 and into the lower (high pressure) chamber 3.

When the cam begins to lift the outer sleeve 4, the resistance of the cylinder valve spring felt through the push rod and seat 5, causes the inner sleeve 6, to move downwards inside the outer. This slight downward movement of the inner sleeve 6, closes the ball valve 2 and increases the hydraulic pressure in the high pressure chamber 3 , sufficient to ensure that the push rod opens the cylinder valve fully.

As the tappet assembly moves off the peak of the cam to the closing side, the ball valve 2 opens to equalize the pressure in both chambers which ensures that the cylinder valve fully closes when the tappet is on the back of the cam.



RR3531M

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

ENGINE FAULT DIAGNOSIS

ENGINE OIL PRESSURE TEST

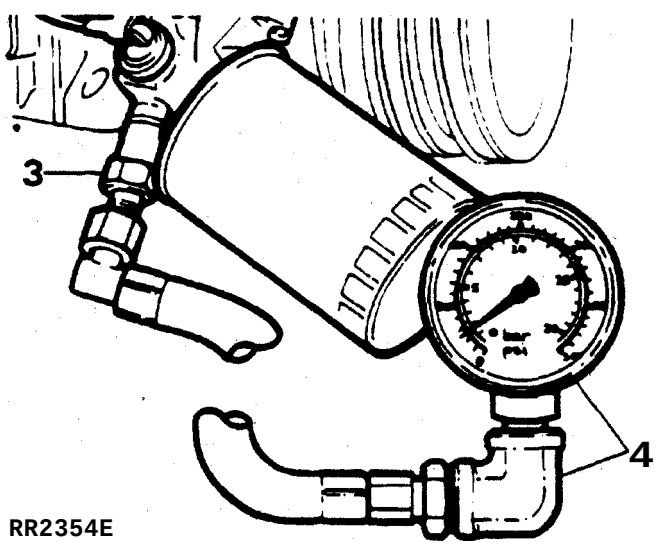
Service tools:
LRT-12-052: Pressure test equipment

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.
3. Disconnect battery negative terminal and remove oil pressure switch.
4. Fit the test gauge.
5. Connect battery terminal.
6. Start and run engine to normal operating temperature.
7. At a steady engine speed of 2400 rev/min - minimum engine oil pressure reading should be - 1.76 kg/cm².
8. If there is no oil pressure check for air lock in system. See Service schedule.
9. If the pressure is low, see Remove and overhaul oil pump.



RR2354E

NOTE: Excessive lubrication pressure can effect engine performance by over-pressurising the hydraulic tappets causing the valves to be held open, see Lubrication system.

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 170 - 180 psi
6. If compression is appreciably less than correct figure, or varies by more than 10%, piston rings or valves may be faulty.
7. Low pressure in adjoining cylinders may indicate a faulty head gasket.

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 disconnecting the appropriate 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 Lubrication system.

1. Is engine oil level correct?
   NO - Top up to correct level.
   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 Rocker shafts and valve gear.

Heavy knocking noise (particularly on load and when engine is hot). See Lubrication system.

1. Is engine oil level correct?
   NO - Top up to correct level.
   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 belts to reduce general noise level and use a stethoscope to locate source of noise.

Heavy rumbling noise (particularly during hard acceleration). See Lubrication system.

1. Is engine oil level correct?
   NO - Top up to correct level.
   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 belts to reduce general noise level and use a stethoscope to locate source of noise.

ENGINE STARTING PROBLEMS

NOTE: References to the Electrical Trouble Shooting Manual (ETM) in the following paragraphs are to the Range Rover ETM. However, only the specific circuits referred to in the following paragraphs are applicable to the Defender.

Engine fails to crank

1. Is battery in good state of charge?
   NO - Charge the battery.
   YES - See ETM B1
   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 - Charge the battery.
   If necessary also **see** ETM B1
   YES - Continue.

2. Is there combustion in any cylinder?
   NO - See Ignition system tests. See ETM A1
   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 or 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 ETM A1.
   Check brake vacuum connections. **See** Brakes.
   If problem is not diagnosed continue.

2. Are HT leads correctly routed and clipped?
   NO - See Electrical.
   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.
   If problem is not diagnosed repeat tests, starting at 1.

Engine lacks power/poorperformance

1. Is accelerator pedal travel restricted or cable incorrectly adjusted?
   YES - Check thickness of carpets. See Fuel System.
   NO - Continue.

2. Is the Ignition and Multiport Fuel Injection systems in order?
   NO - See ETM A1
   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 or Emission Control.
   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 Lubrication system.
   NO - Carry out cylinder compression tests to determine condition of head gaskets and valves. **See** Cylinder compression test.

5. Are cylinder compressions satisfactory?
   NO - For overhaul, see Remove and overhaul cylinder heads.
   YES - Check brake vacuum connections, see Brakes.

If problem is not diagnosed: Continue.

6. Are the brakes binding?
   YES - Investigate cause of binding. See Brakes.
   NO - Continue.

Engine backfires into exhaust system

1. Are there any leaking joints/connections or holes in the exhaust system?
   YES - See Exhaust system.
   NO - Continue.

2. Is distributor fitted correctly, HT leads in correct firing order and routed correctly?
   NO - See Electrical.
   YES - Continue.

3. Is air fuel ratio correct?
   NO - Check multiport fuel injection, see ETM A1.
   Check brake vacuum connections, see Brakes.
   Check the crank case and fuel tank ventilation system. See 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.
   For overhaul, see Remove and overhaul cylinder heads.

   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.
   YES - Continue.

2. Is air fuel ratio correct?
   NO - Check multiport fuel injection, see ETM A1.
   Check brake vacuum connections, see Brakes.
   Check the crank case and fuel tank ventilation system. See 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 overhaul, see Remove and overhaul cylinder heads.

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

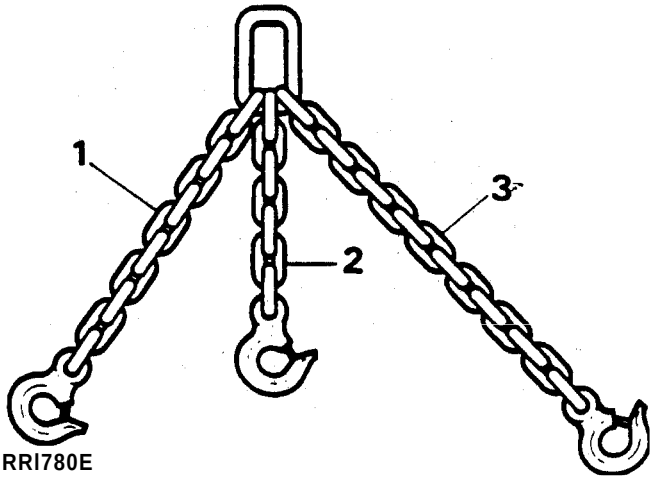
ENGINE REMOVAL

Remove

1. Park vehicle on level ground and apply park brake.
2. Depressurize fuel system, see Depressurise fuel system.
3. Remove bonnet, see CHASSIS AND BODY.
4. Disconnect battery.
5. Remove 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. Disconnect throttle cable from bracket.
10. Remove ram housing.
11. Remove air flow sensor.
12. Remove air cleaner assembly.
13. Remove alternator, See alternator.
14. Release air conditioning compressor from its mounting and lay to one side. DO NOT discharge air conditioning system.

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.
    Disconnect leads from coil.
    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.**



RRI780E

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

Refit

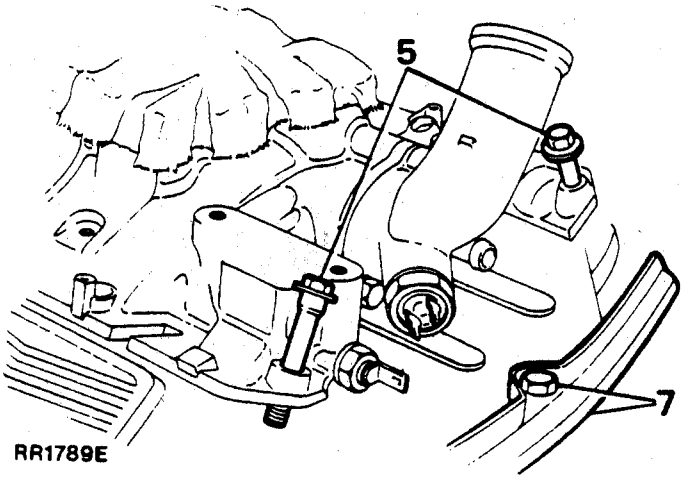
43. Fit lifting chains to engine. Raise engine using hoist.
44. Lower engine into engine compartment. Ensure all components are clear of engine assembly.
45. Lower engine into position. Locate primary pinion into clutch. Engage bell housing dowels.
46. Fit two bolts and partially tighten.
47. Remove jack and lower hoist until engine rests securely on engine mounting brackets.
48. Fit top two bell housing securing bolts. Tighten to 40 Nm.
49. Fit remaining bell housing to cylinder block bolts, and tighten to 40 Nm.
50. Fit new gasket and refit bottom cover, tighten bolts to 9 Nm.
51. Fit new exhaust flange gaskets, fit exhaust to manifold.
52. Refit all harnesses, ground straps breather pipes and hoses at rear of engine.
53. Raise engine and refit engine mounting rubbers, tighten nuts to 20 Nm.
54. Remove temporary lifting eye ETC 5964 and reverse instructions 1 to 23, ensuring that all electrical plugs and harnesses are fitted in correct locations.

ENGINE - DISMANTLE AND OVERHAUL

Remove engine from vehicle, see engine removal and clean exterior. For safe and efficient working secure engine to an approved engine stand. Drain engine oil into a suitable container.

Remove intake manifold

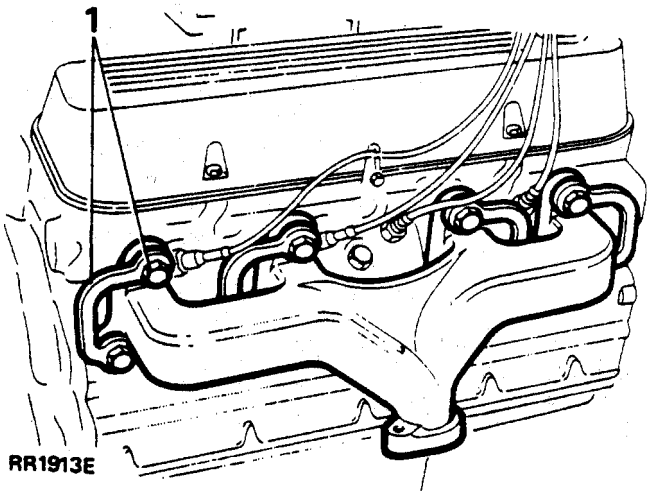
1. Release hose clamp at water pump
2. Detach retaining clips from top of injectors.
3. Remove four bolts securing fuel rail to manifold.
4. Withdraw fuel rail and injectors.
5. Evenly loosen and remove twelve bolts securing intake manifold to cylinder heads.



6. Lift intake manifold from cylinder heads.
7. Remove surplus coolant, remove gasket clamp bolts, remove clamps.
8. Lift off gasket and seals.

Remove exhaust manifolds

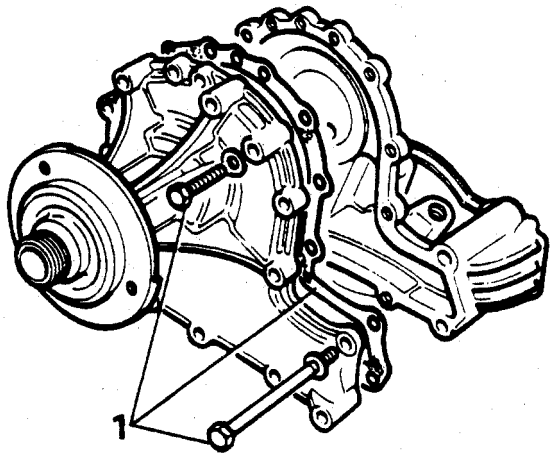
1. Bend back lock tabs, remove eight bolts securing each manifold, and withdraw manifolds and gaskets.



Remove water pump

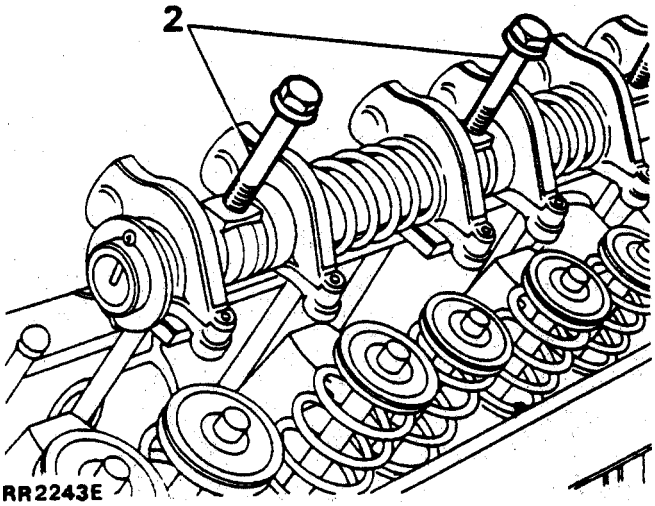
1. Remove fifteen bolts, pump and joint washer.

NOTE: The water pump is not serviceable. In event of failure, fit a new water pump assembly.

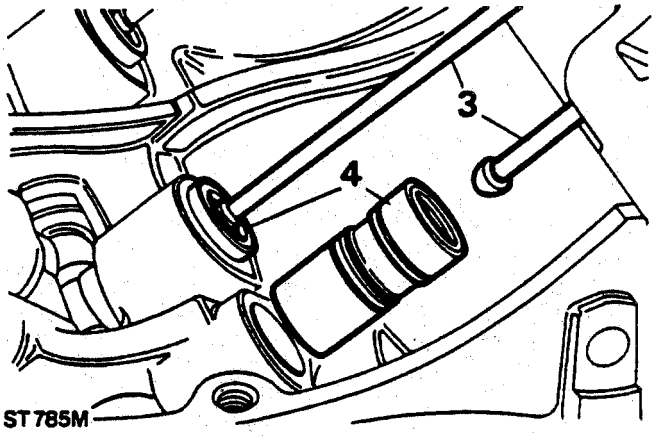


REMOVE AND OVERHAUL ROCKER SHAFTS AND VALVE GEAR

1. Remove spark plug leads from spark plugs and retaining clips. Release four screws and lift off rocker covers.
2. Remove four rocker shaft retaining bolts and lift off assembly.

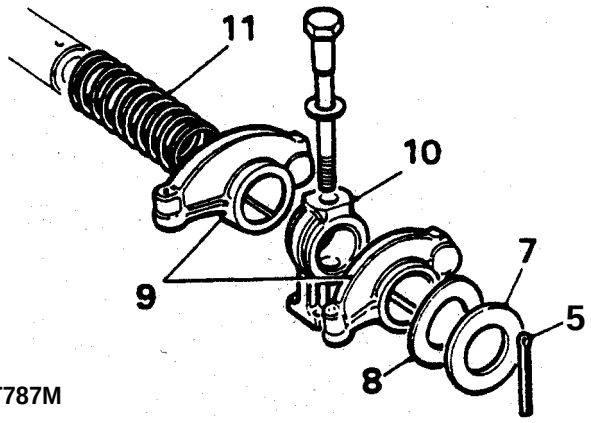


3. Withdraw pushrods and retain in sequence removed.
4. Remove hydraulic tappets. Retain with their respective pushrods. If a tappet cannot be removed leave in position until camshaft is removed.



Dismantle rocker shafts

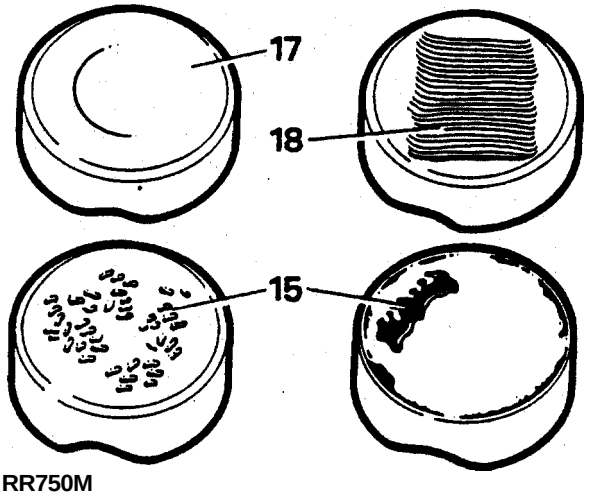
5. Remove split pin from one end of rocker shaft.
6. Withdraw following components and retain in correct sequence for re-assembly:
7. A plain washer.
8. A wave washer.
9. Rocker arms.
10. Brackets.
11. Springs.
12. Examine each component for wear, in particular rockers and shafts. Discard weak or broken springs.



Inspect tappets and pushrods

13. Hydraulic tappet: inspect inner and outer surfaces of body for blow holes and scoring. Fit a new hydraulic tappet if body is roughly scored or grooved, or has a blow hole extending through wall in a position to permit oil leakage from lower chamber.
14. The prominent wear pattern just above lower end of body should not be considered a defect unless it is definitely grooved or scored. It is caused by side thrust of cam against body while tappet is moving vertically in its bore.
15. Inspect cam contact surface of tappets. Fit new tappets if surface is excessively worn or damaged.
16. A hydraulic tappet body that has been rotating will have a round wear pattern. A non-rotatlng tappet body will have a square wear pattern with a very slight depression near centre.

17. Tappets MUST rotate, a circular wear condition is normal. Tappets with this wear pattern can be refitted provided there are no other defects.
18. If a tappet is not rotating check camshaft lobes for wear. Fit new tappet ensuring it rotates freely in cylinder block.

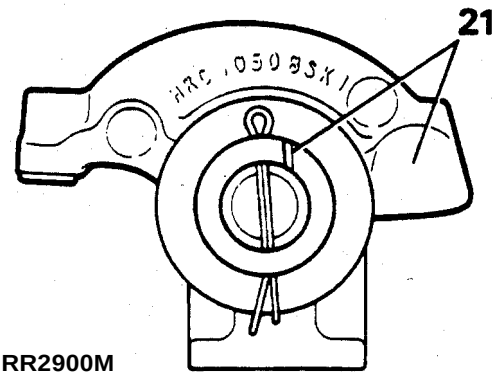


RR750M

19. Fit a new hydraulic tappet if area of pushrod contact is rough or damaged.
20. Fit a new pushrod if it is bent or has a rough or damaged ball end or seat.

Assemble rocker shafts

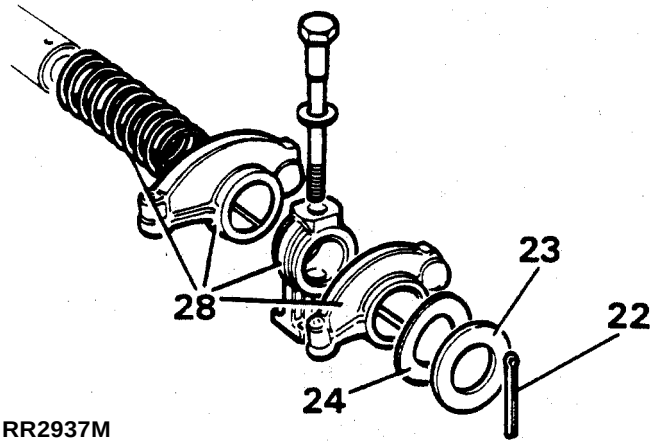
21. Assemble rocker shafts with identification groove at one o'clock position with push rod end of rockers to the right.



RR2900M

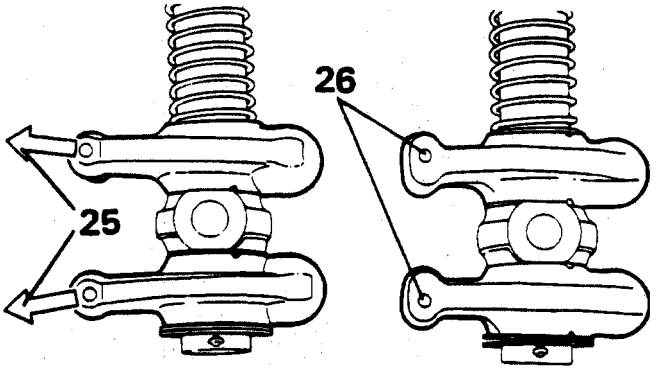
CAUTION: If incorrectly assembled shafts and rockers are fitted to engine, oil supply to rocker shafts will be restricted.

22. Fit new split pin to one end of rocker shaft.
23. Slide a plain washer over the long end of the shaft to contact the split pin.
24. Fit a wave washer to contact plain washer.



RR2937M

25. Early type rocker arms are angled. They must be fitted so that valve end of rocker arms angle away from each other as shown.
26. On later type rocker arms the valve end is offset and must be fitted as shown.
27. Early and late rocker arms are interchangeable provided complete set is changed.

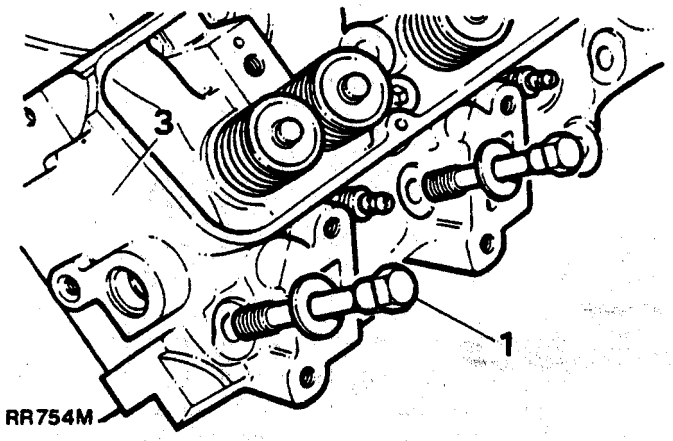


RR2899M

28. Assemble rocker arms, brackets and springs to rocker shaft.
29. Compress the springs, fit wave washer, plain washer and split pin to end of rocker shaft.
30. Fit locating bolts through brackets. Place assemblies to one side.

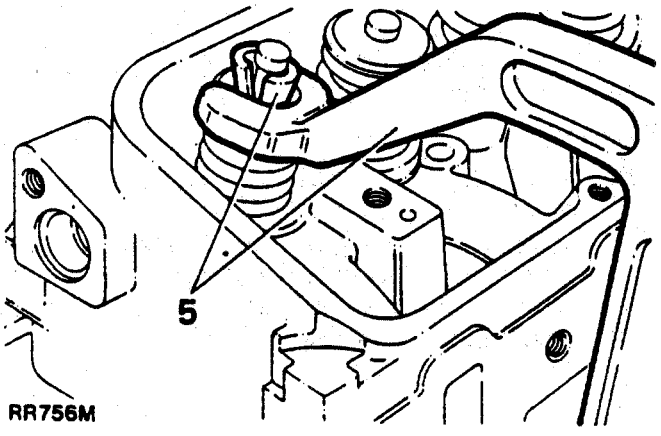
REMOVE AND OVERHAUL CYLINDER HEADS

1. Evenly loosen fourteen cylinder head bolts, reversing tightening order.
2. Mark heads LH and RH for reassembly.
3. Lift off cylinder heads, discard gaskets.

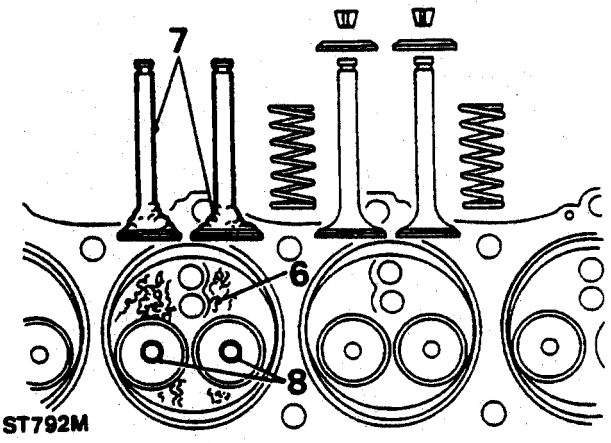


Dismantle cylinder heads

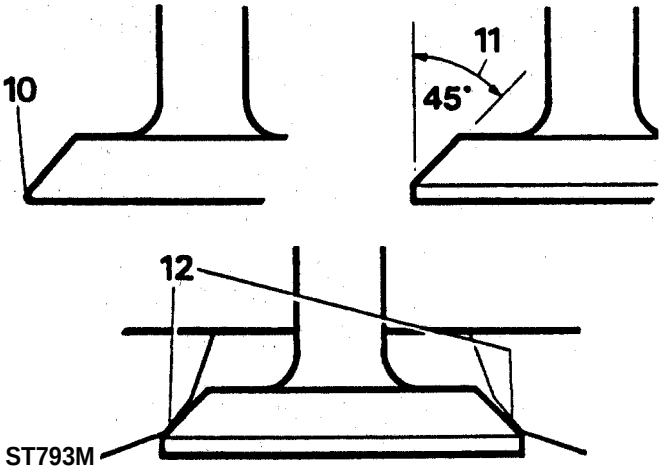
4. Remove spark plugs.
5. Using valve spring compressor 18G 106A or a suitable alternative, remove valves, springs, retain in sequence for refitting. Discard inlet valve stem seals.



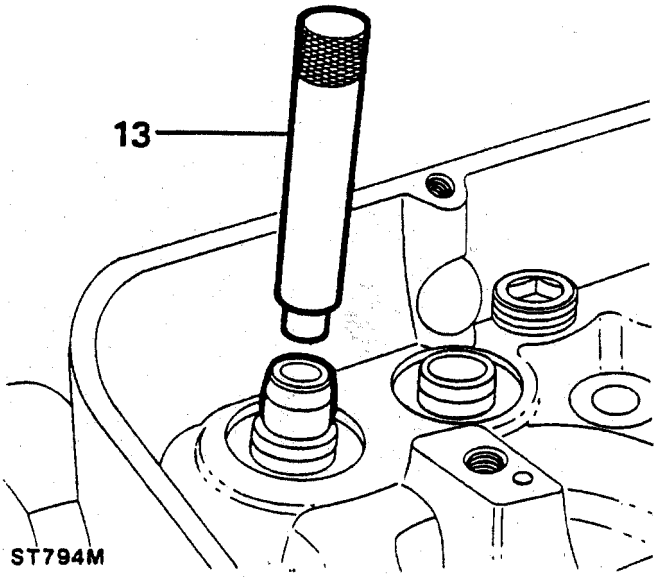
6. Clean combustion chambers using a soft wire brush.
7. Clean valves.
8. Clean valve guide bores.



9. Regrind or fit new valves as necessary.
10. If a valve has to be ground to a knife-edge to obtain a true seat, fit a new valve.
11. Correct angle for valve seating face is 45° ± 1/4.
12. Correct angle for seat is 46° ± 1/4 and seat witness towards outer edge.



13. Check valve guides and fit replacements as necessary. Using valve guide remover 274401, drive out old guides from valve spring seat face of cylinder head.

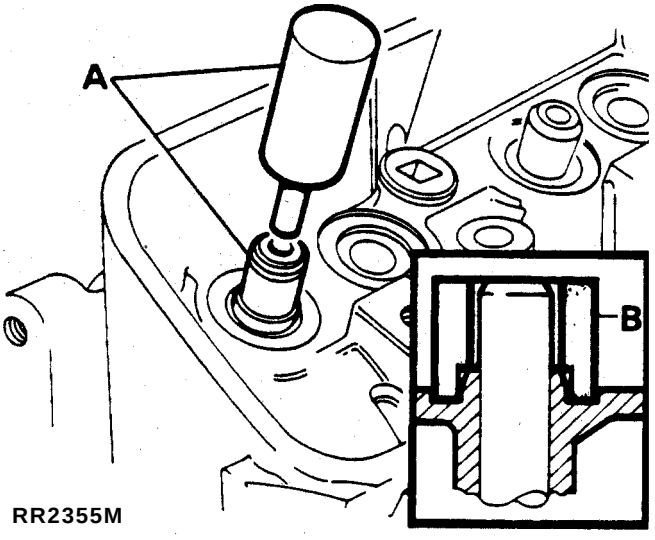


Fit new valve guides

NOTE: Service valve guides are 0,025 mm larger on outside diameter than original equipment to ensure interference fit.

14. Lubricate new valve guide and place in position.

A. Using guide drift LRT-12-038 partially drive guide into cylinder head.
B. Remove drift LRT-12-038 and place distance piece LRT-12-515 over valve guide. Drift guide into head until distance piece contacts spring seat.
C. Alternatively drift guide into cylinder head until it protrudes 19 mm above valve spring recess in head.

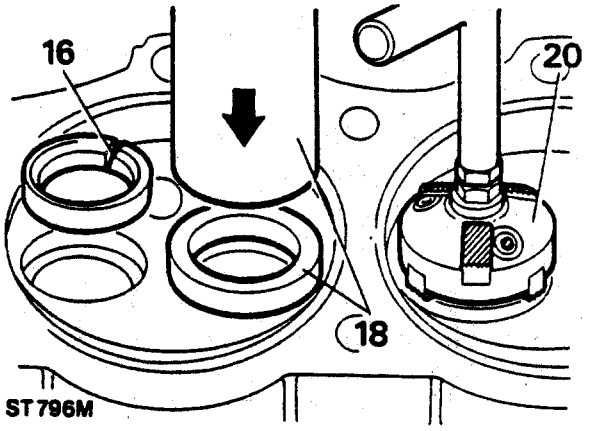


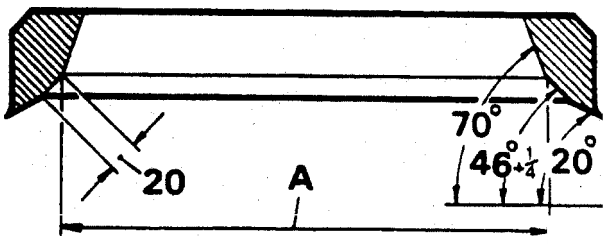
Examine and fit new valve seats

15. Check valve seats for wear, pits and burning. Fit new inserts if necessary.
16. Remove old seat inserts by grinding them until thin enough to be cracked and pried out.
17. Heat cylinder head evenly to approximately 65°C.
18. Press new insert into recess in cylinder head.

NOTE: Service valve seat inserts are available in two over-sizes 0.25 and 0.50 mm larger on outside diameter to ensure interference fit.

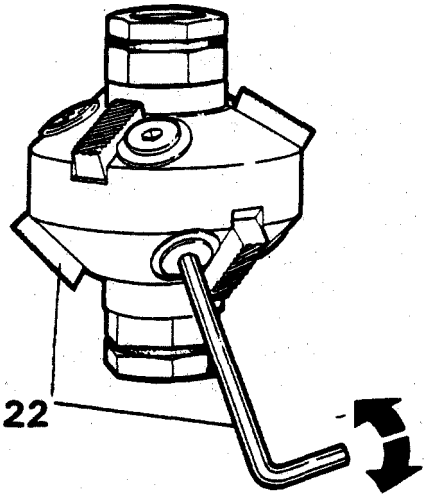
19. Using service tool MS621 if necessary, cut valve seats to 46° ±1/4,
20. Nominal seat width is 1,5 mm. If seat exceeds **2,0** mm it should be reduced to the specified width by the use of 20° and 70° cutters.
21. The inlet valve seat diameter: 'A' is **37,03** mm and exhaust valve seat is **31,510** mm.





ST797M

22. Ensure cutter blades are correctly fitted to cutter head with angled end of blade downwards, facing work, as illustrated.
Check that cutter blades are adjusted so that middle of blade contacts area of material to be cut. Use key provided in hand set MS76. Use light pressure and remove only minimum material necessary.

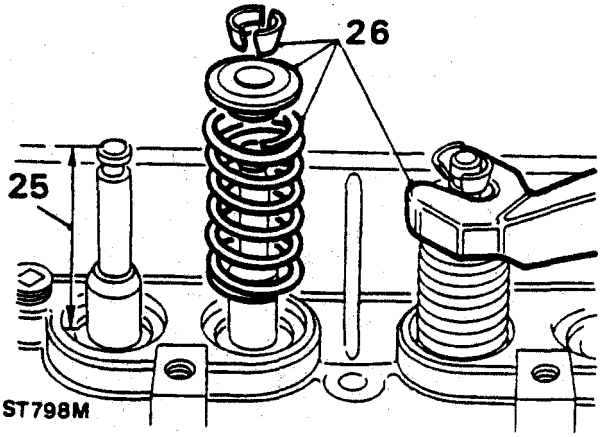


ST1024M

23. Coat valve seat with a small quantity of 'engineers' blue, revolve a properly ground valve against seat. A continuous fine line should appear round valve. If there is a gap of not more than 12 mm it can be corrected by lapping.
24. Alternatively, insert a strip of cellophane between valve and seat, hold valve down by stem, slowly pull out cellophane. If there is a drag, seal is satisfactory in that spot. Repeat in at least eight places. Lapping-in will correct a small open spot.

Re-Assemble valves to cylinder head

25. Before fitting valves and springs, check height of each valve above head. Measure height of stem above valve spring seat surface, holding head firmly against seat. This dimension must not exceed 47.63 mm. If necessary fit a new valve or grind end of valve stem.
26. Lubricate valve stems. Fit new inlet valve stem seals and springs. Fit caps, compress springs using LRT-12-034 and fit collets.



ST798M

Reclaiming cylinder head threads

Damaged or stripped threads in cylinder head can be salvaged by fitting Helicoils as follows:

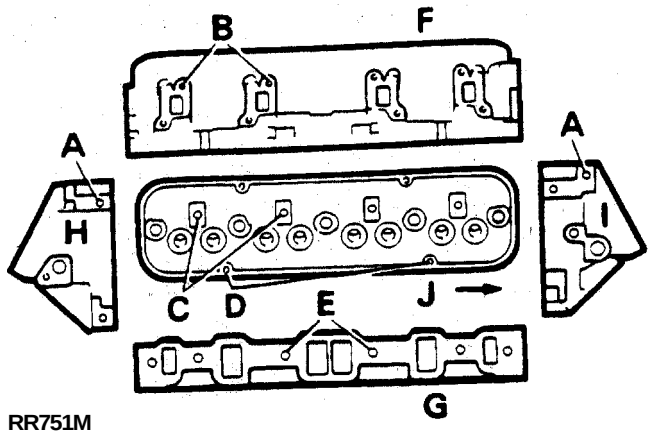
Holes A - These three holes may be drilled 0.3906 in dia. x 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.875 in (min) deep (3/8 UNC 1.5D insert).

Holes B - These eight holes may be drilled 0.3906 in dia. x 0.812 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CBB 0.749 in (min) deep (3/8 UNC 1.5D insert).

Holes C - These four holes may be drilled 0.3906 in dia x 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.875 in (min) deep (3/8 UNC 1.5D insert).

Holes D - These four holes may be drilled 0.261 in dia x 0.675 + 0.040 in deep. Tapped with Helicoil Tap No. 4 CPB or 4CS x 0.625 in (min) deep (1/4 UNC 1.5D insert).

Holes E - These six holes may be drilled 0.3906 in dia x 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.875 in (min) deep (3/8 UNC 1.5D insert).



RR751M

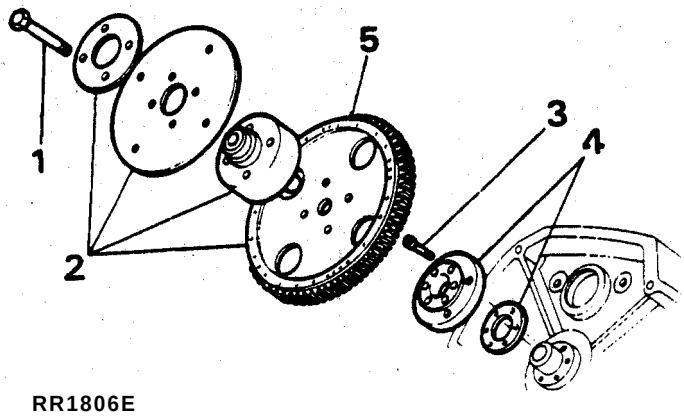
NOTE: Right-hand cylinder head illustrated.

F Exhaust manifold face
G Intake manifold face
H Front face
I Rear face
J Front of engine

REMOVE FLEXIBLE DRIVE PLATE AND RING GEAR ASSEMBLY

NOTE: Scribe each component with an identification line to enable re-assembly in original position.

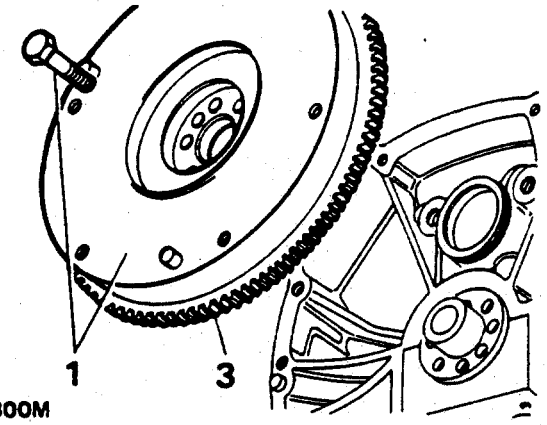
1. Remove four retaining bolts.
2. Withdraw clamp ring, flexible drive plate, hub aligner and ring gear assembly.
3. Remove six socket head bolts securing crankshaft adaptor plate and shim to crankshaft flange.
4. Withdraw crankshaft adaptor plate and shim.
5. Inspect ring gear assembly for distortion, cracks, chipped or badly **worn** teeth. If ring gear is in poor condition fit a new assembly.



RR1806E

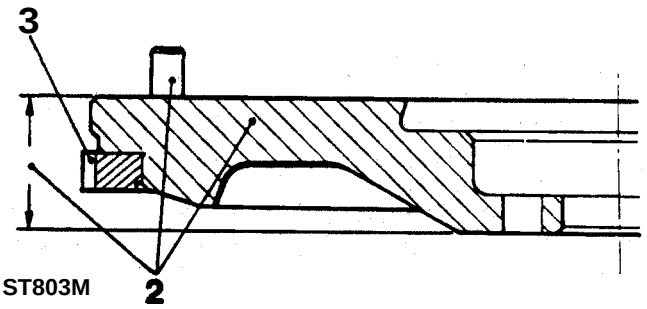
REMOVE AND OVERHAUL FLYWHEEL

1. Remove retaining bolts and withdraw flywheel from crankshaft.



ST800M

2. Examine flywheel clutch face for cracks, scores and overheating. The flywheel can be refaced provided minimum thickness does not go below 39.93 mm (1.572 in). Remove three dowels before machining.
3. Examine ring gear for worn, chipped and broken teeth. Renew as follows:



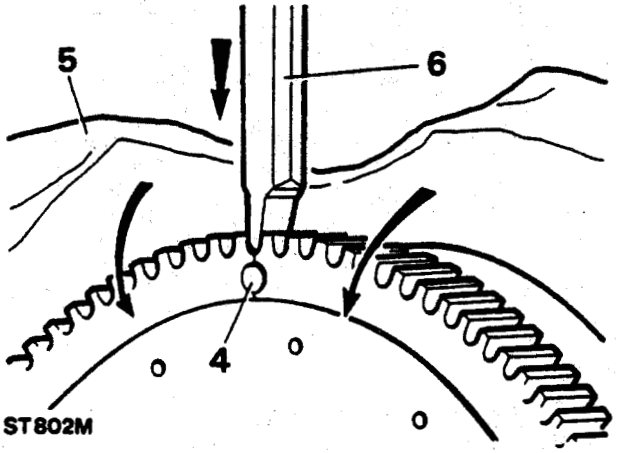
ST803M

4. Drill a 10 mm diameter hole axially between roots of any tooth and inner diameter of starter ring sufficiently deep to weaken ring. DO NOT allow drill to enter flywheel.

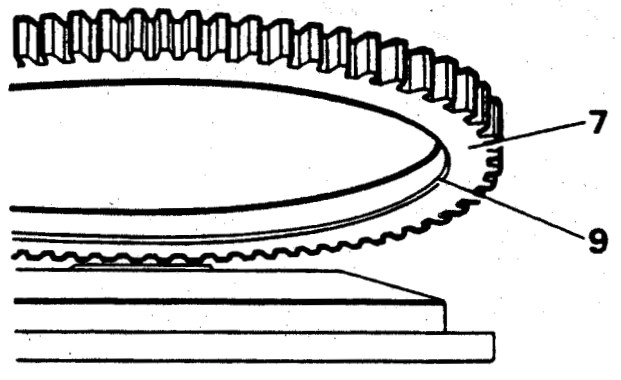
5. Secure flywheel in a vice using soft jaws and place a cloth over flywheel to protect operator from flying fragments.

   WARNING: Take adequate precautions against flying fragments when splitting ring gear.

6. Place a chisel as shown, strike it sharply to split starter ring gear.



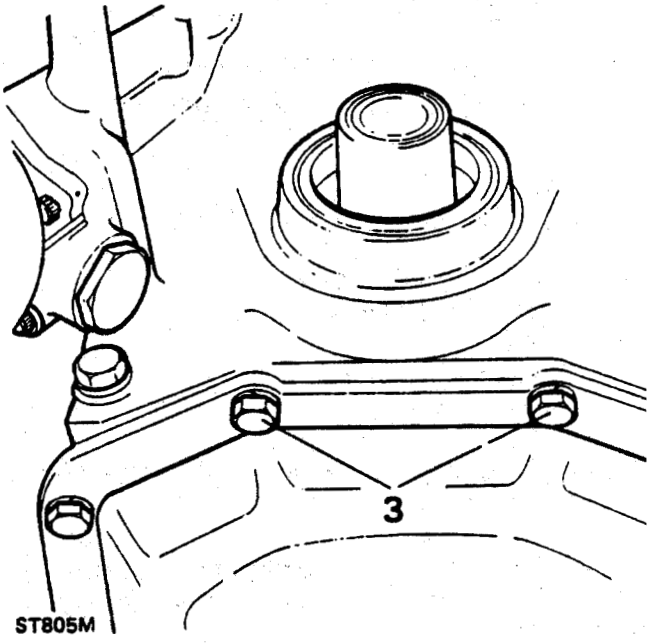
7. Heat new ring gear uniformly to between 170°C and 175°C, DO NOT EXCEED higher temperature.
8. Place flywheel, clutch side down, on flat surface.
9. Locate heated starter ring gear in position on flywheel, with chamfered inner diameter towards flywheel flange. If starter ring gear is chamfered both sides, it can be fitted either way round.
10. Press starter ring gear firmly against flange until ring contracts sufficiently to grip flywheel.
11. Allow flywheel to cool gradually. DO NOT HASTEN cooling in any way, distortion may occur.
12. Fit new clutch assembly location dowels to flywheel.



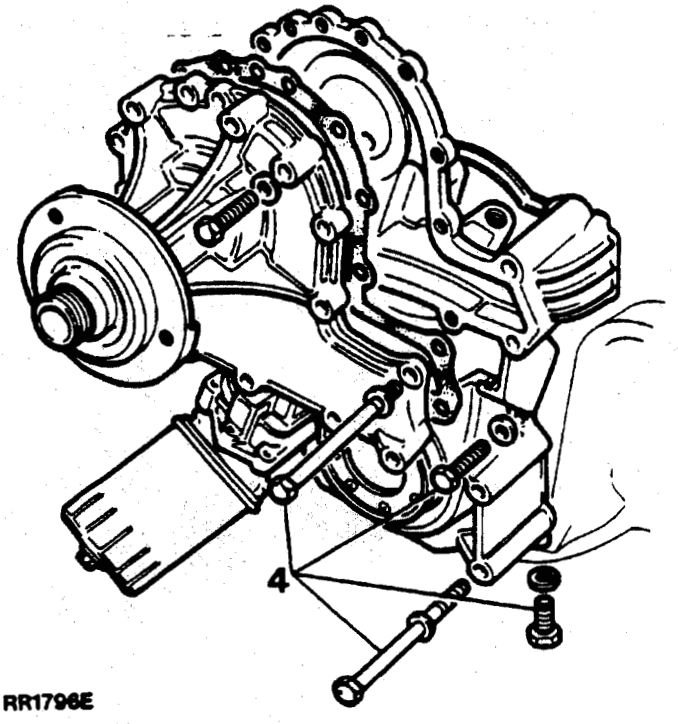
ST804M

REMOVE TIMING GEAR COVER AND WATER PUMP

1. Place an oil drip-tray beneath timing cover, remove oil filter element.
2. Remove crankshaft pulley bolt and special washer, withdraw pulley.

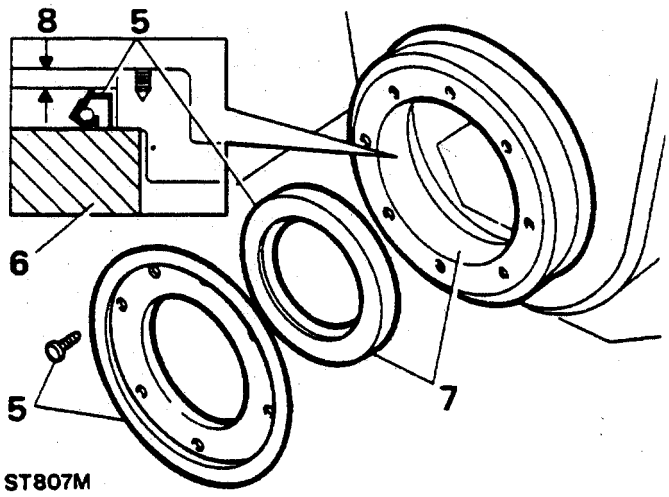


3. Remove two bolts securing sump to bottom of timing cover.
4. Remove timing cover bolts and withdraw cover complete with oil pump.



Fit new timing cover oil seal

5. Remove seven drive screws and withdraw mud shield and oil seal.
6. Position gear cover with front face uppermost and underside supported across oil seal housing bore on a suitable wooden block.
7. Enter oil seal, lip side leading, into housing bore.
8. Press in oil seal until plain face is approximately 1,5 mm below gear cover face.
9. Fit mud shield and securing screws.



ST807M

DISTRIBUTOR REMOVE

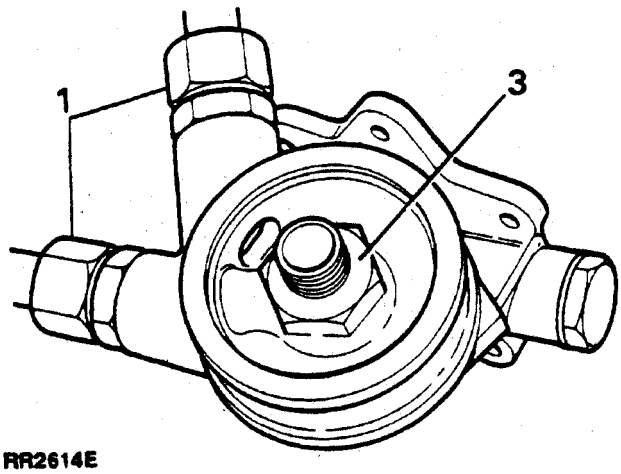
1. Release single nut securing distributor clamp.
2. Remove clamp, withdraw distributor.
3. If necessary overhaul distributor.

REMOVE ENGINE OIL COOLER ADAPTOR PLATE

1. Remove both oil cooler pipes.
2. Mark position of adaptor plate/oil pump cover.
3. Remove centre fixing and withdraw adaptor plate.

Refit

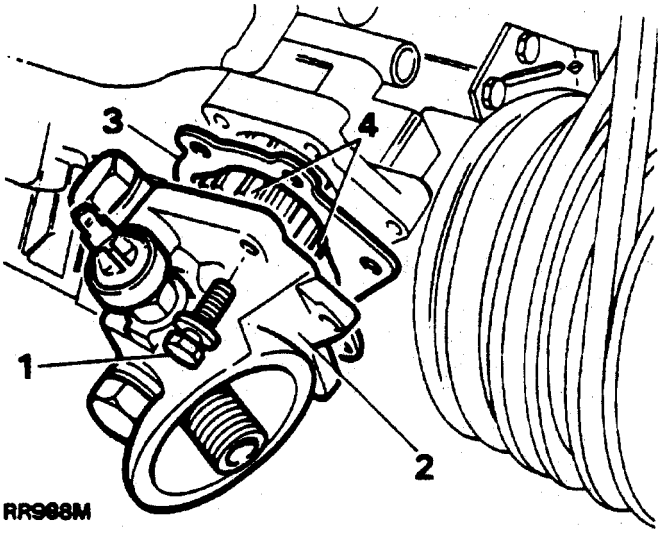
4. Reverse the removal procedure, lining up the location marks to ensure pipe runs are correct. Ensure the pipes and centre fixing are tightened to the specified torque.



RR2614E

REMOVE AND OVERHAUL OIL PUMP

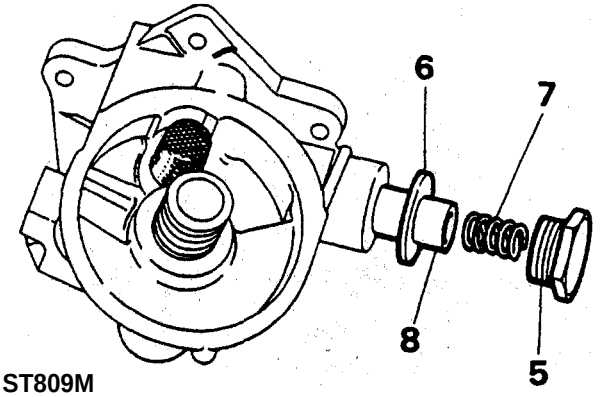
1. Remove bolts from oil pump cover.
2. Withdraw oil pump cover.
3. Lift off cover and remove gasket.
4. Withdraw oil pump gears.



RR968M

Dismantle pump

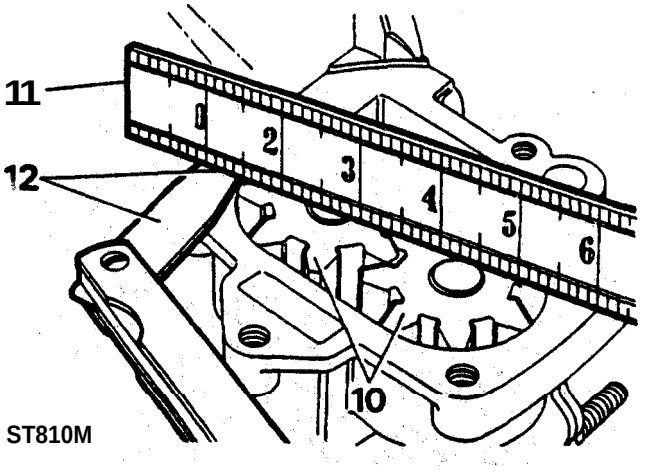
5. Unscrew plug from pressure relief valve.
6. Remove sealing washer from plug.
7. Withdraw spnng from relief valve.
8. Withdraw pressure relief valve.



ST809M

Examine pump

9. Check oil pump gears for wear/scoring.
10. Fit oil pump gears and shaft into front cover.
11. Place a straight edge across gears.
12. Check clearance between straight edge and front cover.If less than 0.05 mm, check front cover gear recess for wear.



ST810M

13. Check oil pressure relief valve for wear/scoring.
14. Check sides of relief valve spring for wear or signs of collapse.
15. Clean wire screen filter for relief valve.
16. Check relief valve is an easy slide fit with no perceptible side movement in its bore.

Assemble pump

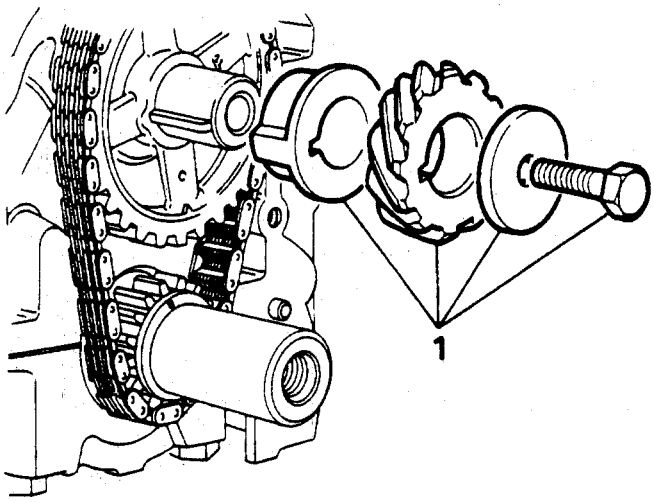
17. Insert relief valve spring.
18. Locate sealing washer on relief valve plug.
19. Fit relief valve plug, tighten to 40 - 47 Nm.
20. Fully pack oil pump gear housing with Petroleum Jelly. No other grease is suitable.
21. Fit oil pump gears ensuring that Petroleum Jelly is forced into every cavity between teeth of gears.

    IMPORTANT: Unless pump is fully packed with Petroleum Jelly it may not prime itself when engine is started.

22. Place new gasket on oil pump cover.
23. Locate oil pump cover in position.
24. Fit special fixing bolts and tighten to 13 Nm.

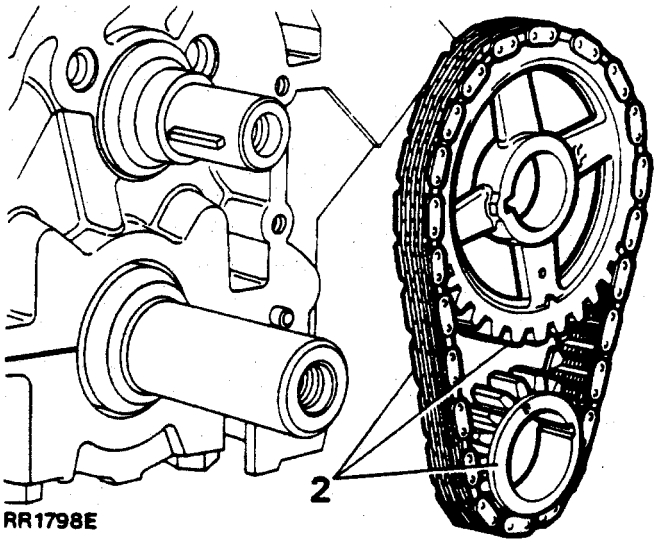
REMOVE TIMING CHAIN SPROCKET AND CAMSHAFT

1. Remove retaining bolt and washer. Withdraw distributor drive gear and spacer.



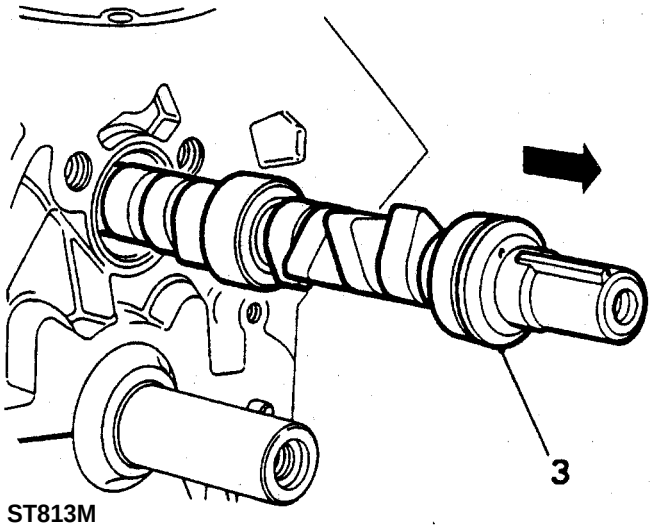
RR1797E

2. Withdraw sprocket complete with timing chain.



RR1798E

3. Withdraw camshaft, taking particular care not to damage bearings in cylinder block.



ST813M

Examine components

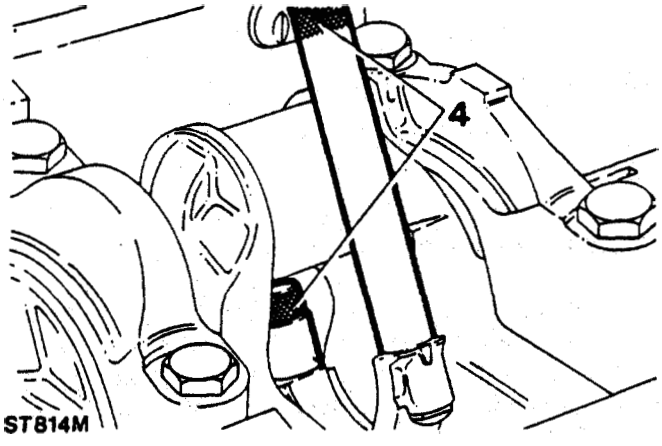
4. Visually examine all parts for wear. Fit a new camshaft if bearing journals and cams show signs of wear, pits, scores and overheating.
5. Examine links and pins of timing chain for wear. Compare its condition with a new chain. Inspect teeth of sprockets, if necessary fit a new sprocket.
6. Measure camshaft journals for overall wear, ovality and taper. Diameters of journals are as follows, from front of shaft:

   Number 1 journal 45,4 to 45,3 mm
   Number 2 journal 44,6 to 44,5 mm
   Number 3 journal 43,84 to 43,81 mm
   Number 4 journal 43,07 to 43,05 mm
   Number 5 journal 42.31 to 42,29 mm

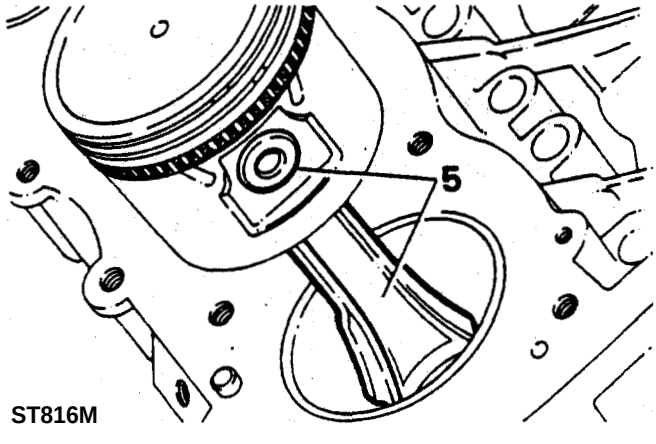
7. To check camshaft for straightness rest two end journals i.e. numbers 1 and 5 on 'V' blocks and mount a dial gauge on centre 'journal. Rotate shatt and note reading. If run out is more than 0.05 mm fit a new camshaft.

REMOVE AND OVERHAUL CONNECTING RODS AND PISTONS

1. Withdraw retaining bolts and remove sump.
2. Remove sump oil strainer.
3. Remove connecting rod caps, retain in sequence for reassembly.
4. Screw guide bolts LRT-12-041 onto connecting rods.



5. Push connecting rod and piston assembly up cylinder bore, withdraw it from top. Retain connecting rod and piston assemblies in sequence with respective caps.
6. Remove guide bolts LRT-12-041 from connecting rod.

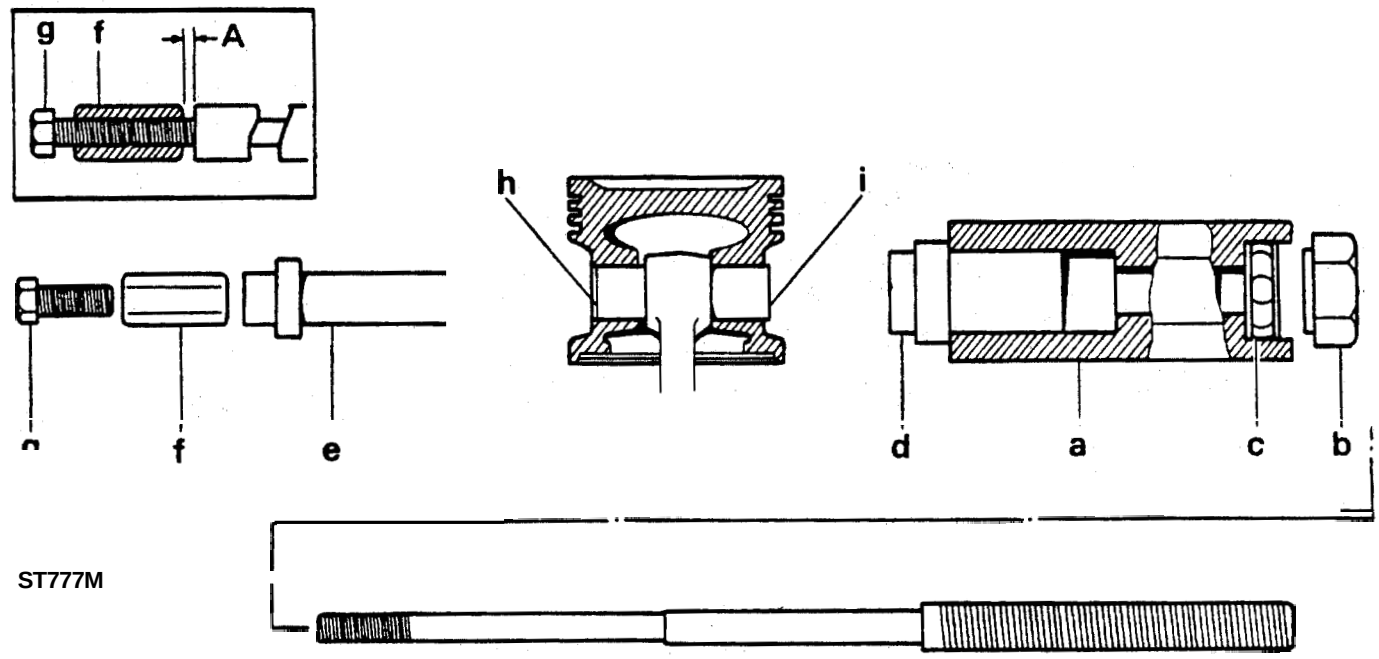


Overhaul

NOTE: Retain connecting rods, caps and bearing shells in **sets, in correct sequence. Remove piston rings over crown of piston. If same piston is to** be **refitted, mark it relative to its connecting rod to ensure that original assembly is maintained.**

7. Withdraw piston pin, using tool LRT-12-013:

   a. Clamp hexagon body of LRT-12-013 in vice.
   b. Position large nut flush with end of centre screw.
   c. Push screw forward until nut contacts thrust race.
   d. Locate piston adaptor LRT-12-013 with its long spigot inside bore of hexagon body.
   e. Fit remover/replacer bush of LRT-12-013 on centre screw with flanged end away from piston pin.
   f. Screw stopnut about half-way onto smaller threaded end of centre screw, leaving a gap 'A' of 3 mm **(1/8** in) between nut and remover/replacer bush.
   g. Lock stop-nut securely with lock screw.
   h. Check that remover/replacerbush is correctly positioned in bore of piston.
   i. Push connecting-rod to right to expose end of piston pin, which must be located in end of adaptor 'd'.
   j. Screw large nut up to thrust race.
   k. Hold lock screw and turn large nut until piston pin has been withdrawn from piston. Dismantle tool.



ST777M

Original pistons

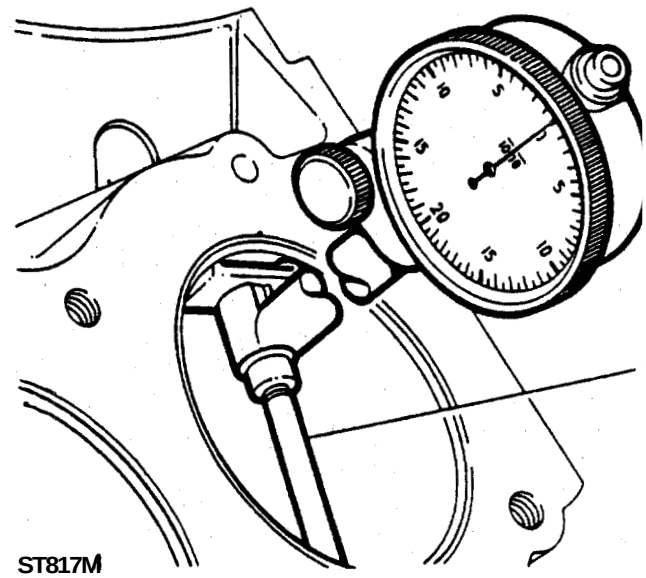
8. Remove carbon deposits, particularly from ring grooves. Examine pistons for signs of damage or excessive wear, refer to new pistons for method of checking running clearance. Fit new pistons if necessary.

New pistons

NOTE: Pistons are available in service standard size pistons supplied 0.0254 mm oversize. Oversize pistons are 0.25 mm and 0.50 mm oversize. When fitting new service standard size pistons to a cylinder block, check for correct piston to bore clearance, honing bore if necessary. Bottom of piston skirt/bore clearance should be 0.018 to 0.033 mm.

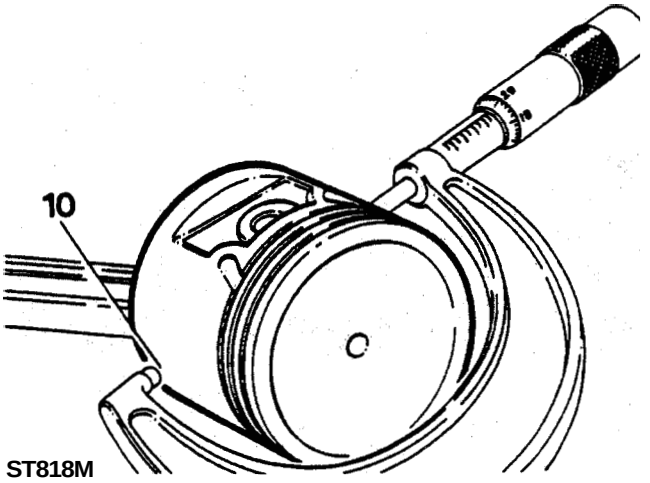
NOTE: Piston and cylinder block temperature must be same to ensure accurate measurement. When reboring cylinder block, crankshaft main bearing caps must be fitted and tightened to 70 Nm.

9. Check cylinder bore dimension at right angles to piston pin 40 to 50 mm from top.



ST817M

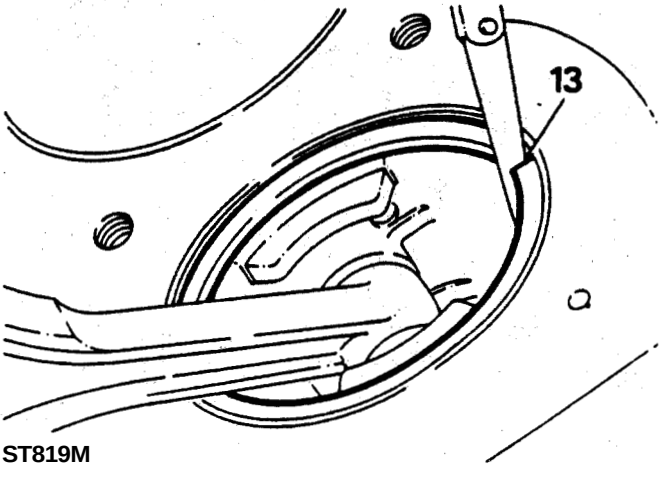
10. Check piston dimension at right angles to piston pin, at bottom of skirt.



ST818M

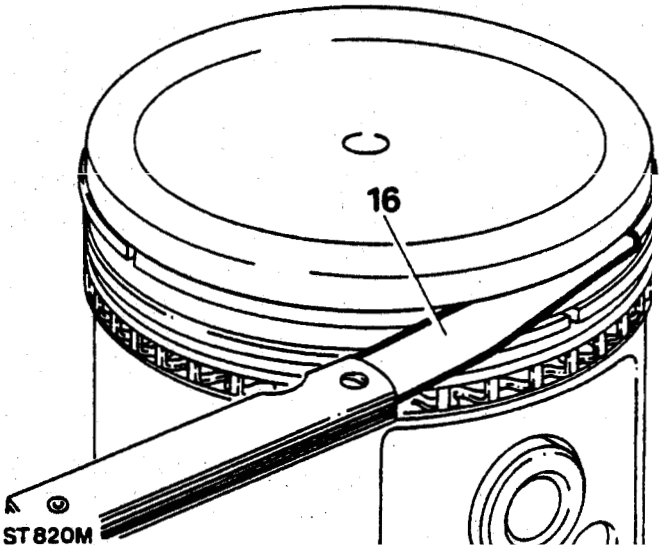
11. The piston dimension must be 0.018 to 0.033 mm smaller than cylinder.
12. If new piston rings are to be fitted without reboring, deglaze cylinder walls with a hone without increasing bore diameter, to provide a cross-hatch finish. After honing, thoroughly clean piston bores to remove all traces of foreign matter.
13. Check compression ring in applicable cylinder, held square to bore with piston. Gap limits: 0.44 to 0.56 mm. Use a fine-cut flat file to increase gap if required. Select a new piston ring if gap exceeds limit.

NOTE: Gapping does not apply to oil control rings.



ST819M

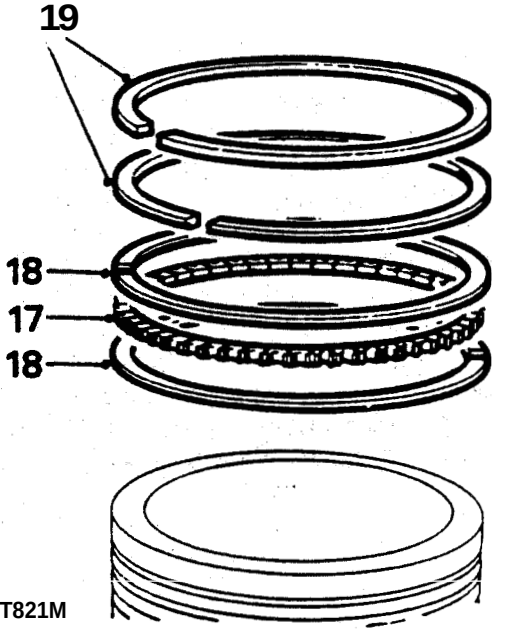
14. Temporarily fit compression rings to piston.
15. The ring marked 'TOP' must be fitted with marking uppermost into second groove. The chrome ring fits top groove and can be fitted either way round.
16. Check compression ring clearance in piston groove. Clearance limits: 0.05 to 0.10 mm.



ST820M

Fit piston rings

17. Fit expander ring into bottom groove making sure that ends butt and do not overlap.
18. Fit two ring rails to bottom groove, one above and one below expander ring.
19. Fit second compression ring with marking 'TOP' uppermost. Fit chrome ring into top groove, either way round.



ST821M

Examine connecting rods

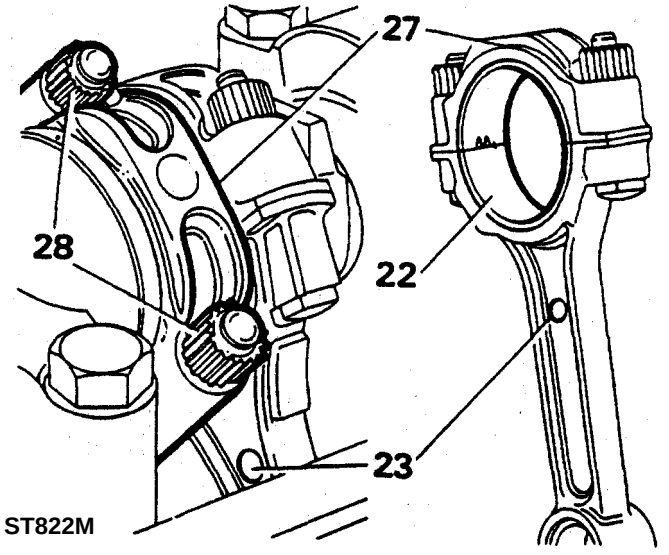
20. Check alignment of connecting rod.
21. Check connecting rod small end, piston pin must be a press fit.

Check crankshaft bearings

22. Locate bearing upper shell into the connecting rod.
23. Locate connecting rod and bearing onto its crankshaft journal.

NOTE: Domed shape boss on connecting rod must face towards front of engine on right hand bank of cylinders and towards rear on left hand bank.

24. When both connecting rods are fitted, bosses will face inwards towards each other.

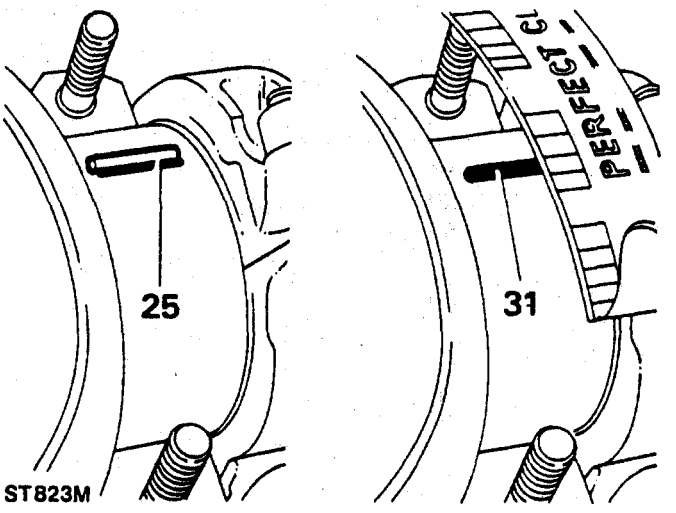


ST822M

25. Place a piece of Plastigauge (P61) across centre of lower half of crankshaft journal.
26. Locate bearing lower shell into connecting rod cap.
27. Locate cap and shell onto connecting rod.

NOTE: Note that rib on edge of cap must be on same side as domed shape boss on connecting rod.

28. Secure connecting rod cap. Tighten to 50 Nm.
29. Do not rotate crankshaft while Plastigauge is in use.



ST823M

30. Remove connecting rod cap and shell.
31. Using scale printed on Plastigauge packet, measure flattened Plastigauge at its widest point.
32. The graduation most closely corresponding to width of Plastigauge indicates bearing clearance.
33. Correct bearing clearance with new or overhauled components is 0.015 to 0.055 mm.
34. If a bearing has been in service, fit a new bearing if clearance exceeds 0.08 mm.
35. If a new bearing is being fitted, use selective assembly to obtain correct clearance.
36. Wipe off Plastigauge with an oily rag. DO NOT scrape it off.

NOTE: It is important that connecting rods, caps and bearing shells be retained in sets, and in correct sequence.

Assembling pistons to connecting rods

37. Using tool LRT-12-013 refit each piston to its connecting rod as follows:

a. Clamp hexagon body of LRT-12-013 in a vice, with adaptor LRT-12-014 positioned as instruction 7d.
b. Remove large nut of LRT-12-013 and push the centre screw approximately 50 mm into body until shoulder is exposed.
C. Slide parallel guide sleeve, grooved end last, onto centre screw and up to shoulder.

d. Lubricate piston pin and bores of connecting rod and piston with graphited oil (Molykote 2). Also lubricate ball race and centre screw of LRT-12-013.

e. Fit connecting rod and piston together onto tool, with markings aligned if fitting original pair, with connecting rod around sleeve up to groove.

f. Fit piston pin into piston bore, up to connecting rod.

g. Fit remover/replacer bush LRT-12-015 with its flanged end towards piston pin.

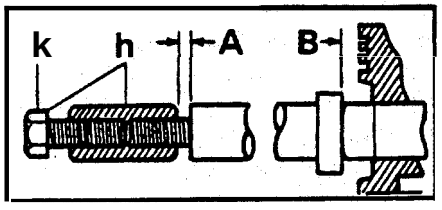
h. Screw stop nut onto centre screw and adjust nut to obtain an 0.8 mm end float **'A'** on whole assembly, and lock nut securely with screw.

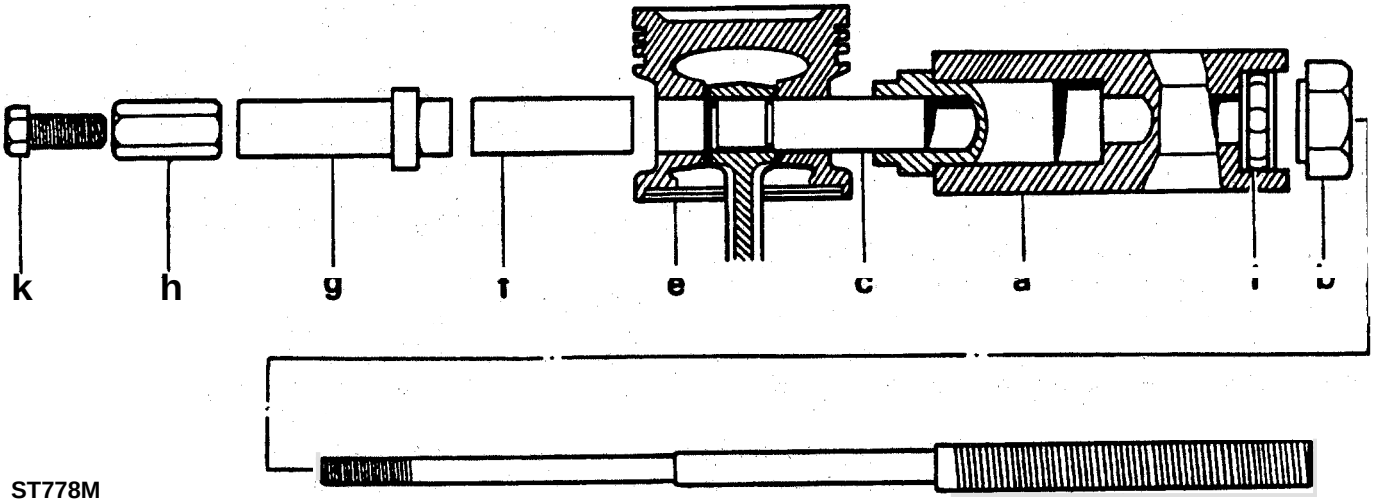
ı. Slide assembly back into hexagon body and screw large nut up to thrust race.

j. Set a torque spanner to 16 Nm. This represents minimum load for an acceptable interference fit of piston pin in connecting rod.

k. Using torque spanner and socket on large nut, and holding lock screw, pull piston pin in until flange of remover/replacer bush is 4mm **'B'** from face of piston. This flange must not be allowed to contact piston.

CAUTION: If torque spanner has not reached at least 16 Nm. throughout pull, fit of piston pin to connecting rod is not acceptable and necessitates fitting new components. The large nut and centre screw of tool must be kept well oiled.



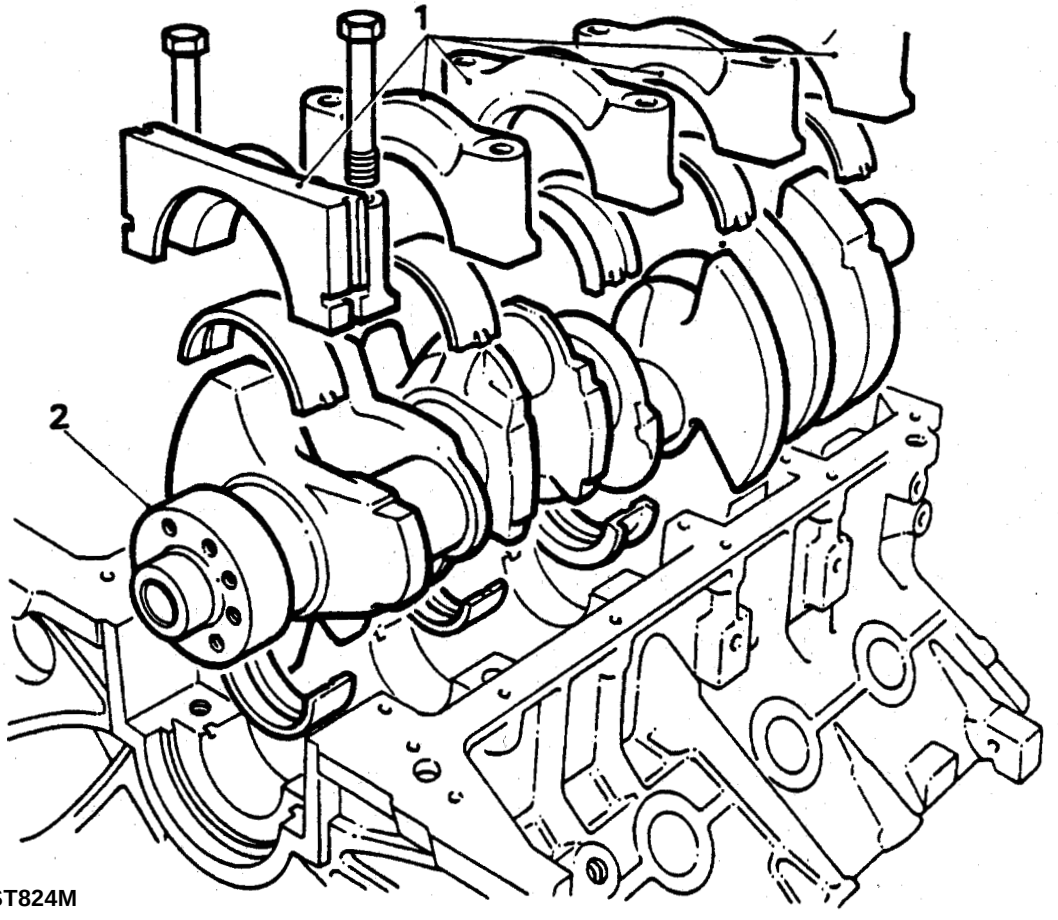


ST778M

38. Remove tool and check that piston moves freely on piston pin and that no damage has occurred during pressing.

REMOVE AND OVERHAUL CRANKSHAFT

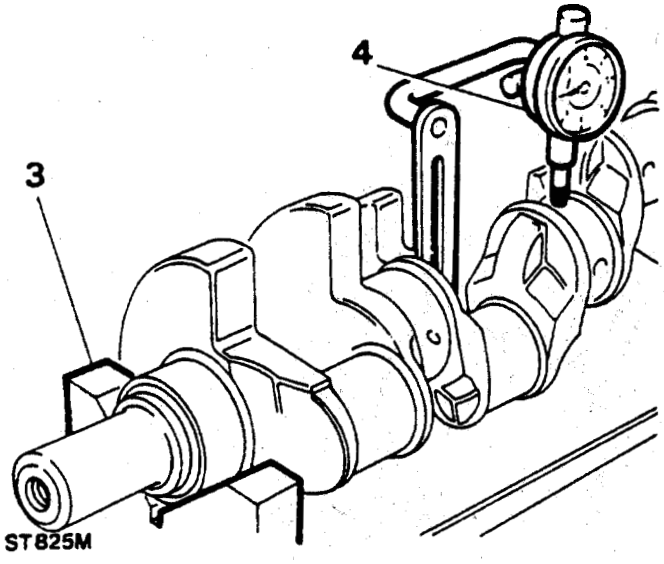
1. Remove main bearing caps and lower bearing shells. Retain in pairs and mark with number of journal until it is decided if bearing shells are to be refitted.
2. Lift out crankshaft and rear oil seal.



ST824M

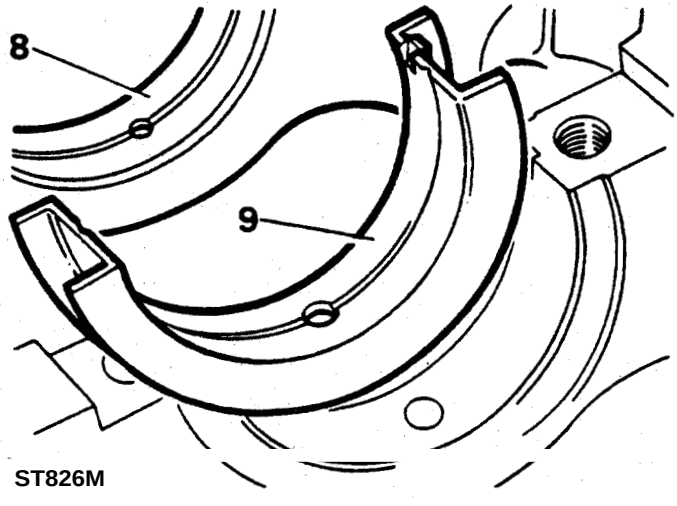
Inspect and overhaul crankshaft

3. To check for straightness, place crankshaft on vee-blocks at numbers one and five main bearing journals.
4. Using a dial indicator, check run-out at centre main bearing journal.



5. Total run-out at each journal should not exceed 0.08 mm.
6. **If** crankshaft is bent it is not suitable for regrinding and should be renewed.
7. Check each crankshaft journal for ovality. **If** ovality exceeds 0.040 mm around crankshaft journal, regrind or fit a new crankshaft.
8. Crankshaft main and connecting rod bearings are available in following undersizes:

   0.25mm
   0.50mm



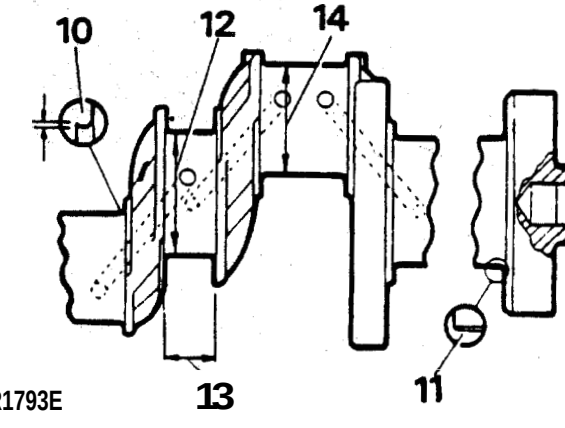
9. The centre main bearing shell, which controls crankshaft thrust, has thrust faces increased in thickness when more than 0.25 mm undersize, as shown in following chart.
10. When a crankshaft is to be reground, thrust faces on either side of centre main journal must be machined in accordance with dimensions in charts that follow.

Main bearing journal size	Thrust face width
Standard	Standard
0.25 mm undersize	Standard
0.50 mm undersize	0.25 mm oversize

11. For example: If fitting a 0.50 mm undersize bearing, 0.125 mm must be machined off each thrust face of centre journal, maintaining correct radius.

Crankshaft dimensions

12. Radius for all journals except rear main bearing is 1.90 to 2.28 mm.
13. Radius for rear main bearing journal is 3.04 mm.
14. Main bearing journal diameter, see following chart.
15. Thrust face width, and connecting rod journal diameter, **see** following chart.

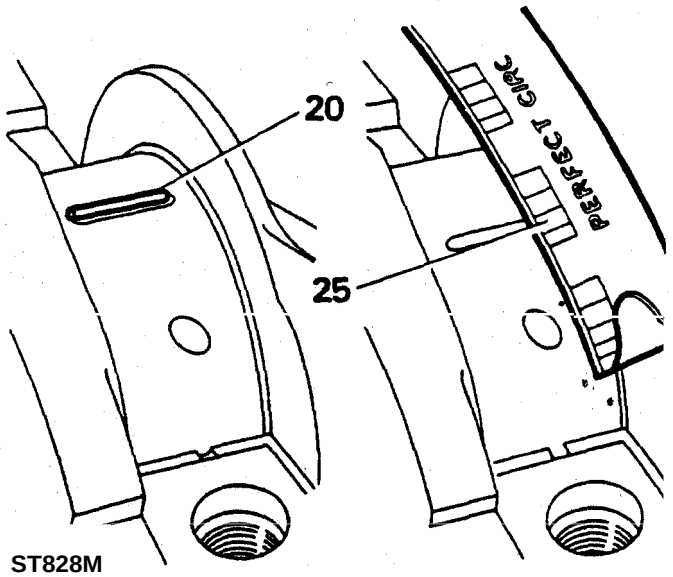


Crankshaft dimensions-millimetre

Crankshaft Grade	Diameter '12'	Width '13'	Diameter '14'
Standard	58.400-58.412	26.975-27.026	50.800-50.812
0.254U/S	58.146-58.158	26.975-27.026	50.546-50.558
0.508 U/S	57.892-57.904	27.229-27.280	50.292-50.304

Check main bearing clearance

16. Remove oil seals from cylinder block and rear main bearing cap.
17. Locate upper main bearing shells (with oil hole and oil grooves) into cylinder block.
18. Locate flanged upper centre main bearing shell.
19. Place crankshaft in position on bearings.
20. Place a piece of Plastigauge across centre of crankshaft main bearing journals.
21. Locate lower shells into main bearing caps.



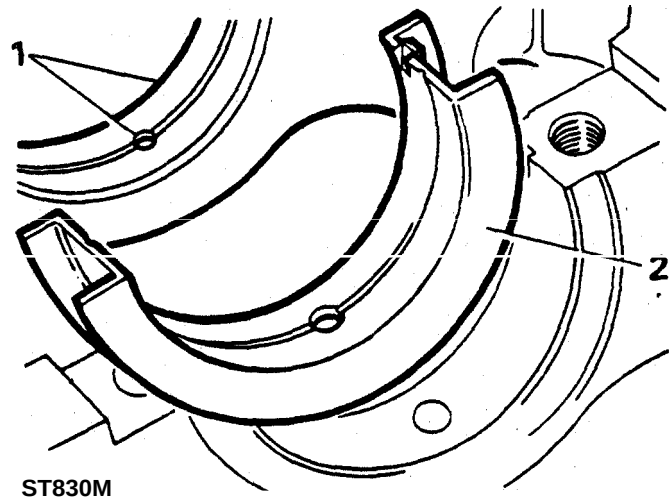
ST828M

22. Fit numbers one to four main bearing caps and shells, tighten to 70 Nm.
23. Fit rear main bearing cap and shell and tighten to 90 Nm. **Do** not allow crankshaft to rotate while Plastigauge is in use.
24. Remove main bearing caps and shells.
25. Using scale printed on Plastigauge packet, measure flattened Plastigauge at widest point.
26. Graduation most closely corresponding to width of Plastigauge indicates bearing clearance.
27. Correct bearing clearance with new or overhauled components is 0.023 to 0.065 mm.
28. **If** correct clearance is not obtained initially, select a suitable bearing to give required clearance.
29. Wipe off Plastigauge with an oily rag. **Do** NOT scrape it off.
30. Maintain bearing shells and caps in sets, in the correct sequence.

ASSEMBLING ENGINE

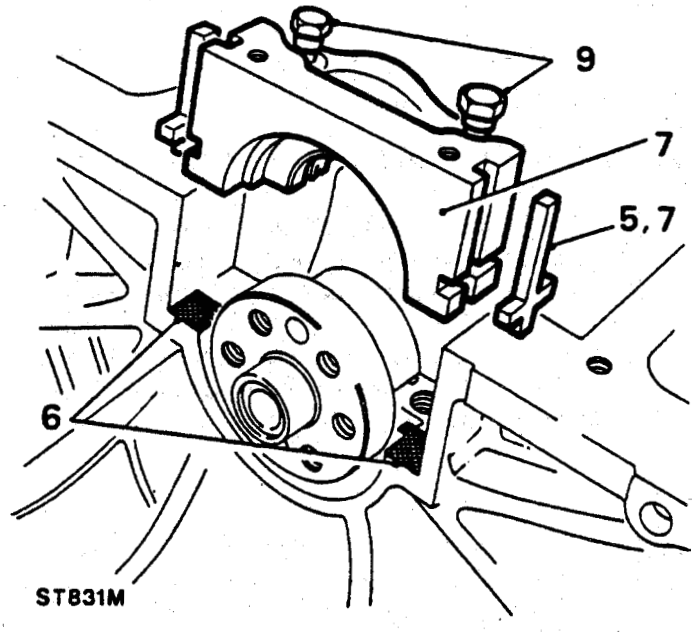
FIT CRANKSHAFT AND MAIN BEARINGS

1. Locate upper main bearing shells (with oil holes and grooves) in cylinder block.
2. Locate the flanged upper centre main bearing shell.
3. Lubricate crankshaft main bearing journals and bearing shells with clean engine oil and lower crankshaft into position.



ST830M

4. Lubricate lower main bearing shells and fit numbers one to four main bearing caps and shells only, leave the fixing bolts finger-tight.
5. Fit cross shaped side seals to grooves each side of rear main bearing cap. Do not cut side seals, they must protrude 1.5 mm approximately above bearing cap parting face.
6. Apply Hylomar SQ32M jointing compound to rearmost half of rear main bearing cap parting face or, if preferred, to equivalent area on cylinder block as illustrated.
7. Lubricate bearing half and bearing cap side seals with clean engine oil.
8. Carefully fit bearing cap assembly.
9. Do not tighten fixings, but ensure that cap is fully home and squarely seated on cylinder block.



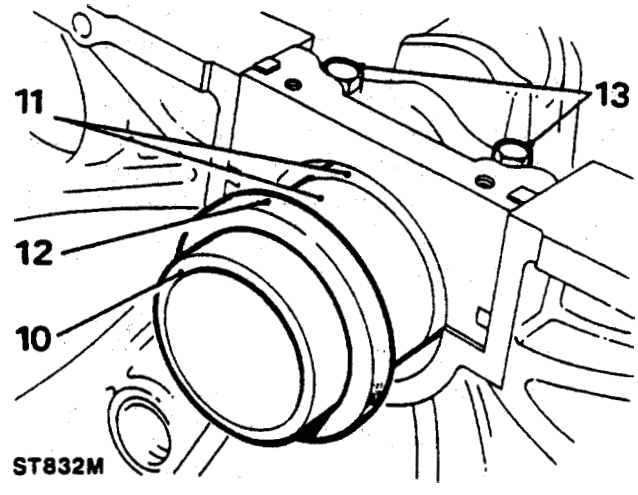
CAUTION: Do not handle oil seal lip, check it is not damaged and ensure that outside diameter remains clean and dry.

10. Position seal guide LRT-12-010 on crankshaft flange.
11. Ensure that oil seal guide and crankshaft journal are scrupulously clean. Coat seal guide and oil seal journal with clean engine oil.

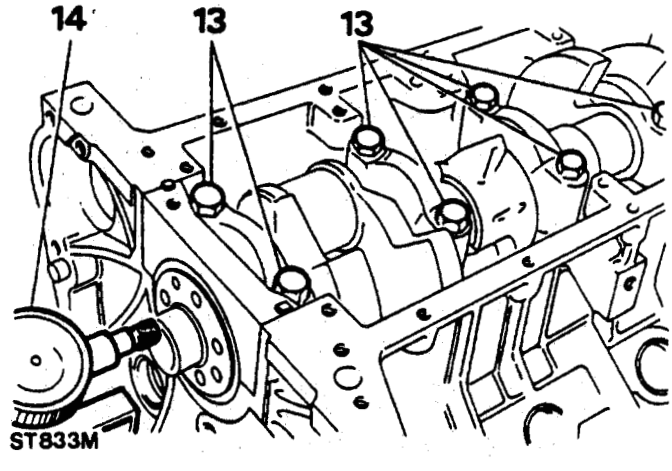
NOTE: Lubricant coating must cover seal guide outer surface completely to ensure that oil seal lip is not turned back during assembly.

Position oil seal, lipped side towards the engine, on to seal guide. Seal outside diameter must be clean and dry.

12. Push oil seal fully and squarely by hand into recess formed in cap and block until it contacts machined step in recess.
Withdraw seal guide.



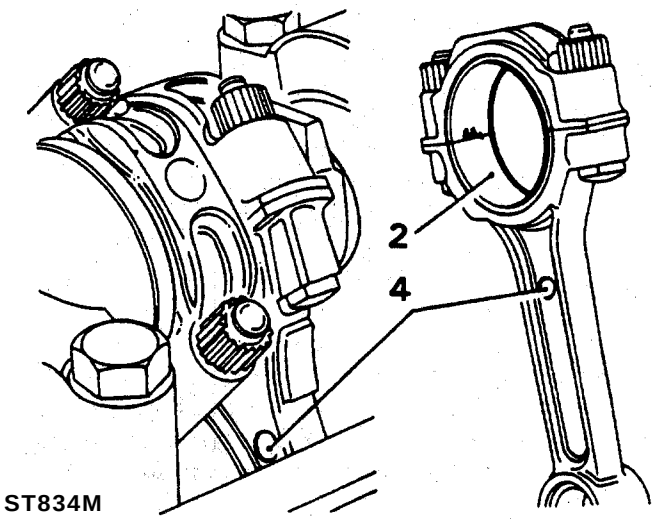
13. Tighten cap bolts to correct torque, numbers one to four bearings 70 Nm, rear main bearing 90 Nm.
14. Check crankshaft end-float, 0.10 to 0.20 mm.



CAUTION: Do not exceed 1,000 engine rev/min for 15 seconds when first starting engine, otherwise crankshaft rear oil seal will be damaged.

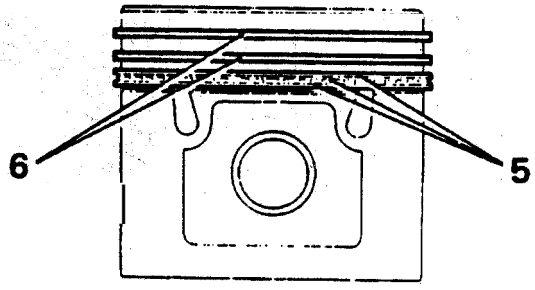
FIT CONNECTING RODS AND PISTONS

1. Locate applicable crankshaft journal at B.D.C.
2. Place bearing upper shell in connecting rod.
3. Retain upper shell by screwing guide bolts 605351 onto connecting rods.
4. Insert connecting rod and piston assembly into respective bore, noting that domed shape boss on connecting rod must face towards front of engine on right hand bank of cylinders and towards rear on left hand bank. When both connecting rods are fitted, bosses will face inwards towards each other.



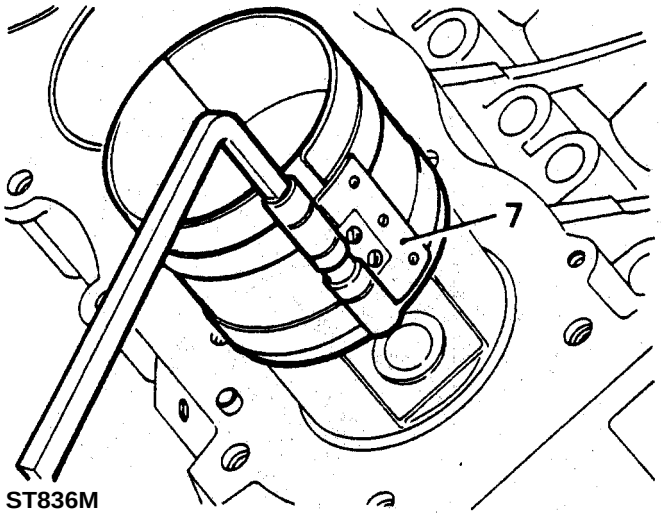
ST834M

5. Position oil control piston rings with ring gaps all at one side, between piston pin and piston thrust face. Space gaps in ring rails approximately 25 mm each side of expander ring joint.
6. Position compression rings with ring gaps on opposite sides of piston between piston pin and piston thrust face.



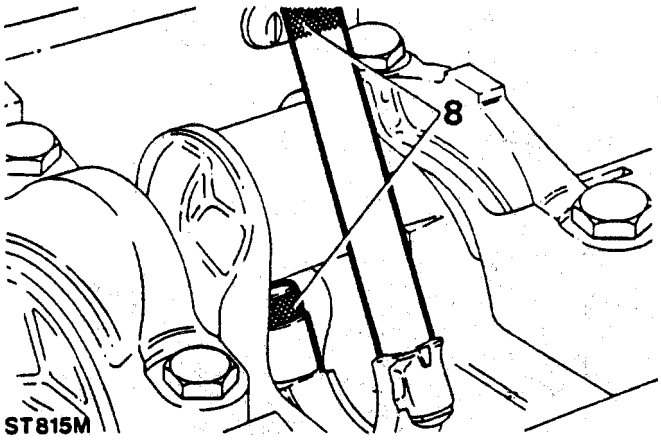
ST835M

7. Using a piston ring compressor, locate piston into cylinder bore, until piston crown is just below cylinder block top face.



ST836M

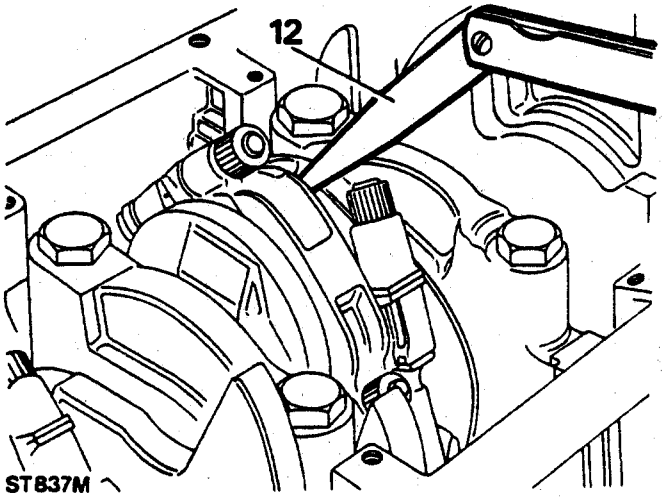
8. Pull connecting rods on to crankpins using the guide bolts. Use extreme care to prevent scratching crank pins.



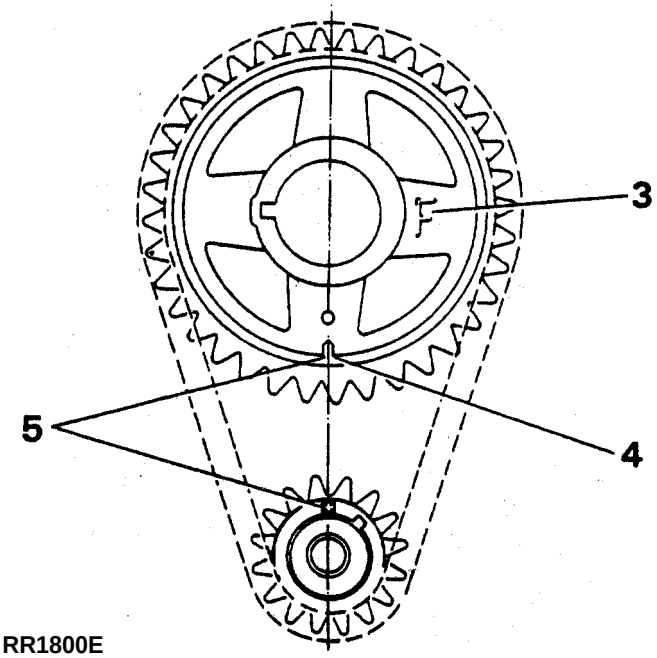
ST815M

9. Place bearing lower shell in connecting rod cap.
10. Locate cap and shell onto connecting rod, noting that rib on edge of cap must be towards front of engine on right hand bank of cylinders and towards rear on left hand bank.
11. Check that connecting rods move freely sideways on the crankshaft. Tightness indicates insufficient bearing clearance or misaligned connecting rod.

12. Check end-float between connecting-rods on each crankshaft journal. Clearance limits: 0.15 to 0.37 mm.
13. Tighten connecting rod nuts to the correct torque, 50 Nm. Fit oil strainer and joint washer.

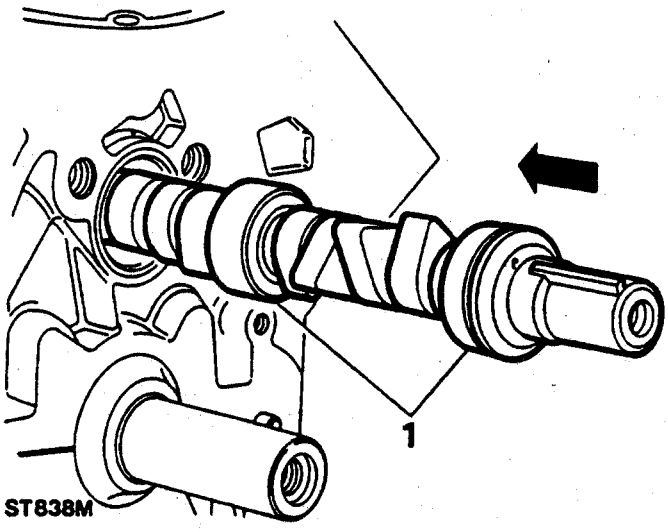


5. Encircle sprockets with chain keeping timing marks aligned.



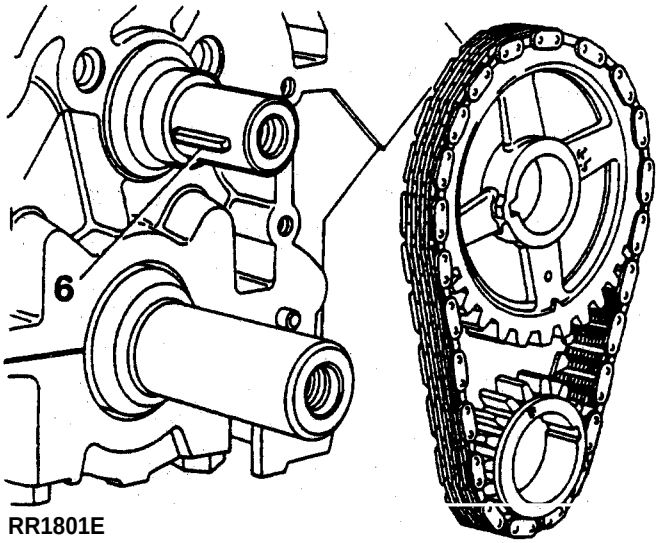
FIT CAMSHAFTTIMING CHAIN AND SPROCKET

1. Lubricate camshaft journals and carefully insert camshaft into cylinder block.

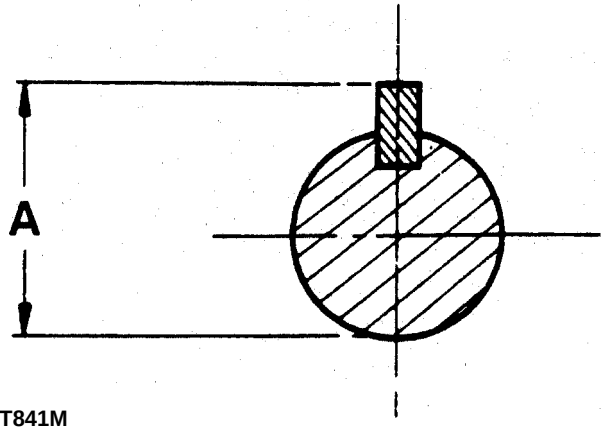


2. Turn crankshaft to bring number one piston to TDC.
3. Temporarily fit camshaft sprocket with marking 'F or 'FRONT' outward.
4. Turn camshaft until mark on camshaft sprocket is at six o'clock position, remove sprocket without disturbing camshaft.

6. Fit sprocket assembly to camshaft and crankshaft key locations. Check that camshaft key is parallel to shaft axis to ensure adequate lubrication of distributor drive gear.

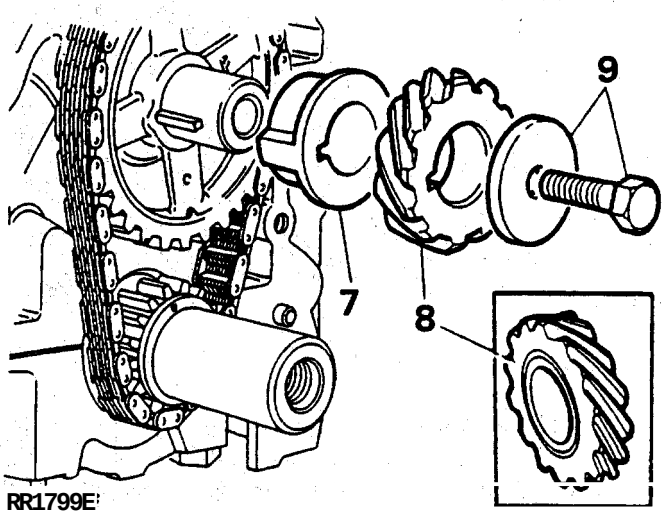


CAUTION: The space between key and keyway acts as an oilway for lubrication of drive gear. Ensure that key is seated to full depth of keyway. Overall dimension of shaft and key must not exceed 30.15 mm, dimension **A** below.



ST841M

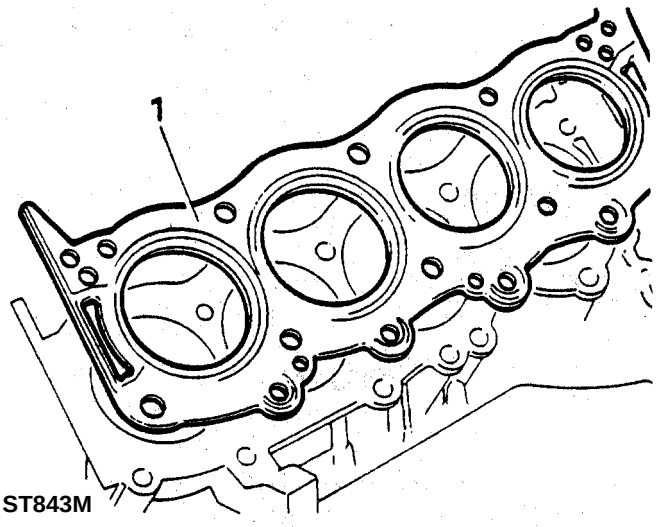
7. Check timing marks line up, fit spacer with flange to front.
8. Fit the distributor drive gear. Ensure that annular grooved side is fitted to rear, towards spacer.
9. Fit bolt and washer, tighten to correct torque, 60 Nm.



RR1799E

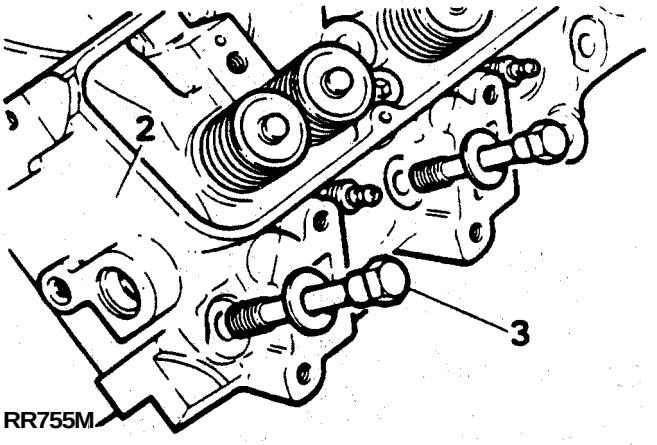
FIT **CYLINDER HEADS**

1. Fit new cylinder head gaskets with word 'TOP' uppermost. **Do** NOT use sealant.



ST843M

2. Locate cylinder heads on dowels.
3. Clean threads of cylinder head bolts and lubricate with engine oil.

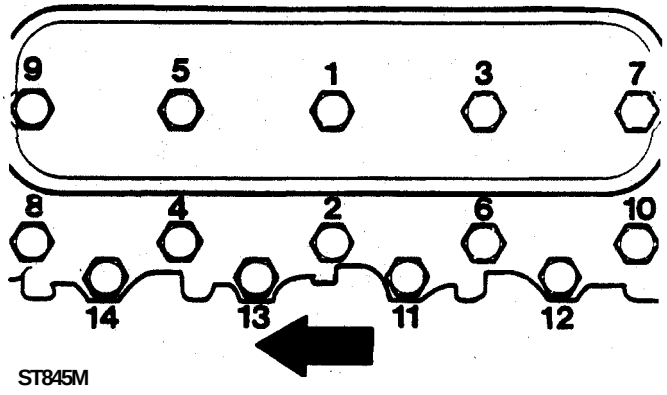


RR755M

4. Locate the cylinder head bolts in position illustrated and fit dipstick tube.

Long bolts - 1, 3 and 5.
Medium bolts - 2,4,6,7,8,9 and 10.
Short bolts - 11,12,13 and 14.

5. Tighten head bolts progressively in sequence shown. Finally tighten to correct torque, outer row 60 Nm centre and inner row 90 Nm.
6. Re-check torques when all bolts have been tightened.



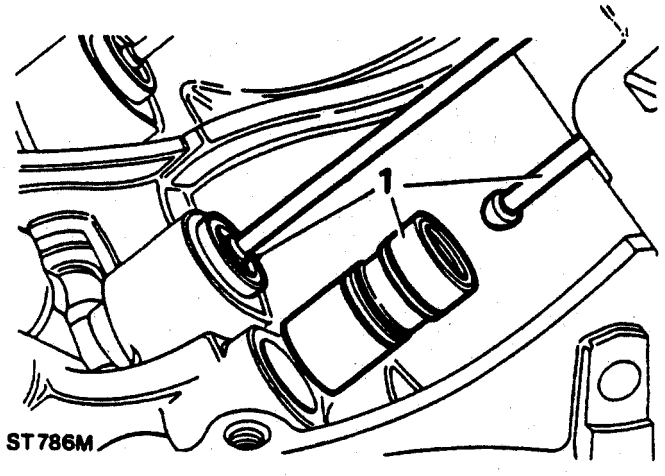
ST845M

NOTE: Left-hand cylinder head illustrated. Arrow points to front of vehicle.

FIT TAPPETS, PUSH RODS AND ROCKER ASSEMBLIES

NOTE: Immerse tappets in clean engine oil. Before fitting, pump inner sleeve of tappet several times using a pushrod, to reduce tappet noise when engine is started.

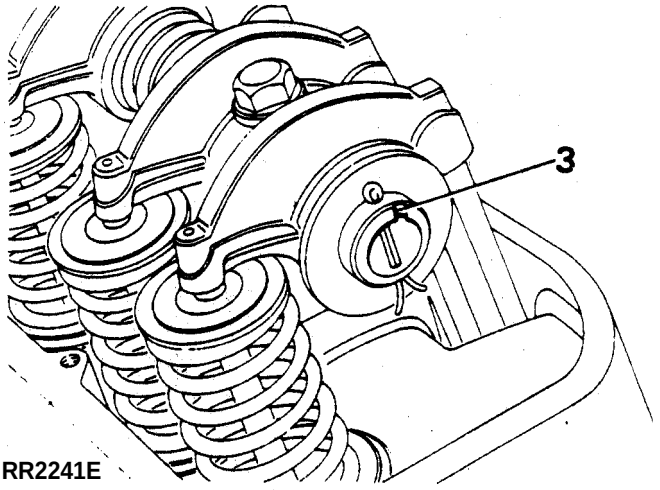
1. Fit tappets and push rods in original positions. Ensure tappets move freely in bores.



ST786M

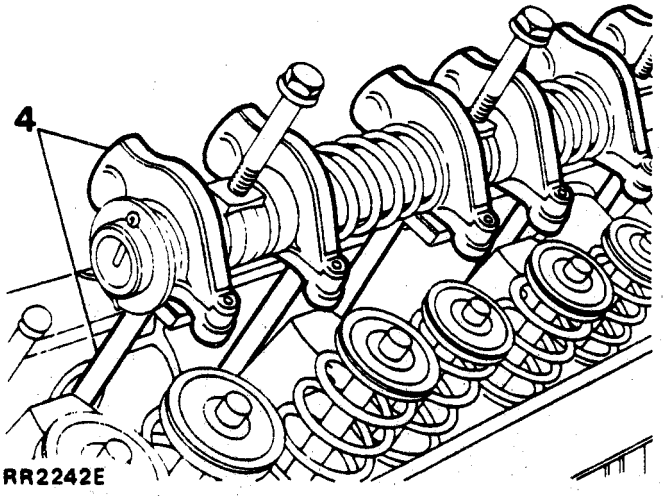
2. Rocker shafts are handed and must be fitted correctly to align oilways.

3. Ensure each rocker shaft is fitted with notch uppermost and towards front of engine on right hand side, towards rear on left hand side.



RR2241E

4. Fit rocker shaft assemblies. Ensure pushrods engage rocker cups. Tighten bolts to correct torque, 38 Nm.



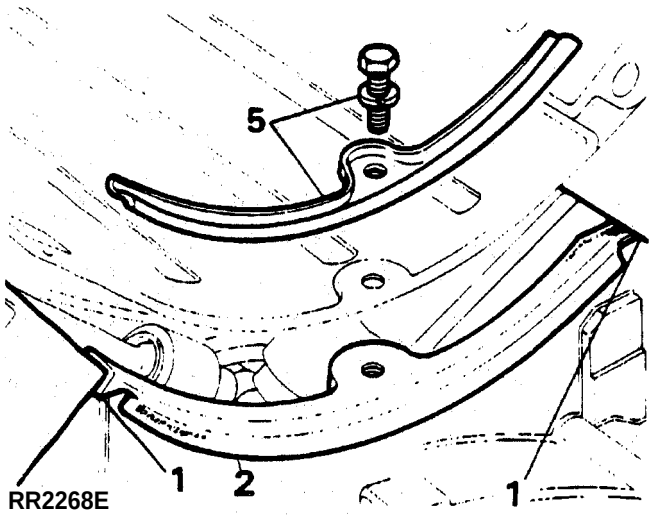
RR2242E

NOTE: Tappet noise can be expected on initial starting after overhaul or if vehicle has been standing a very long period. Run engine at 2,500 rev/min for a few minutes (subject to following caution), when noise should be eliminated.

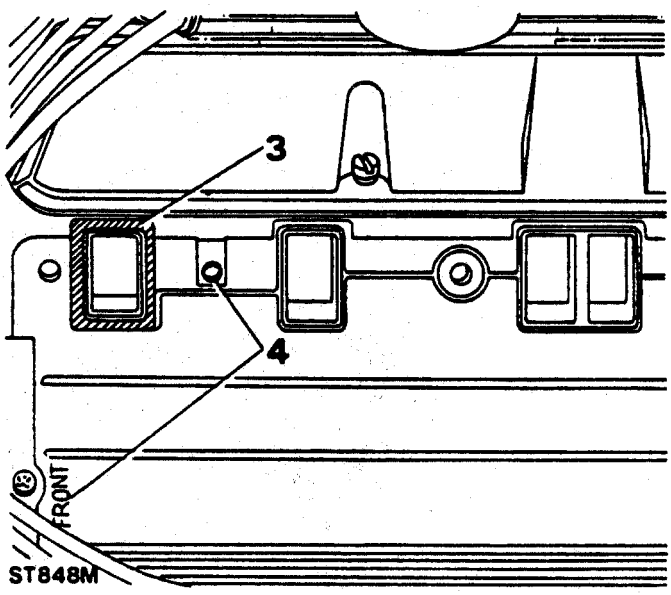
CAUTION: Do not exceed 1,000 engine rev/min for 15 seconds when first starting engine, otherwise crankshaft rear oil seal will be damaged.

FIT INTAKE MANIFOLD

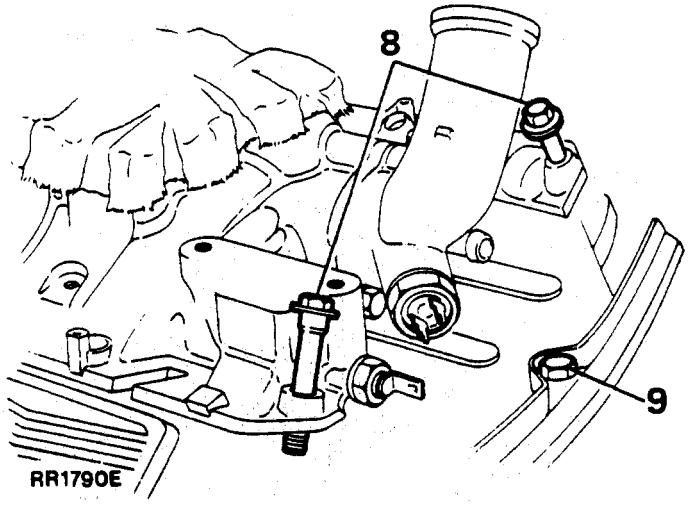
1. Apply globule of Hylomar SQ32M sealing compound to notches between cylinder head and block.
2. Locate NEW seals in position with ends engaged in notches.



3. Apply 'Hylomar' **SQ32M** on corners of cylinder head, manifold gasket and manifold, around water passage joints.
4. Fit manifold gasket with word 'FRONT' to front and open bolt hole at front R.H. side.
5. Fit gasket clamps, do not fully tighten bolts.

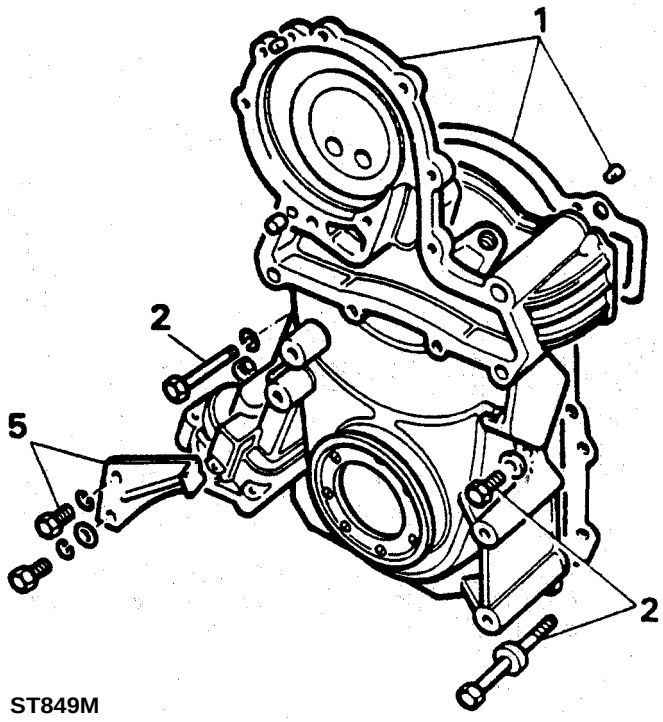


6. Locate manifold on to cylinder head.
7. Clean threads of manifold securing bolts.
8. Fit all manifold bolts, evenly tighten a little at a time, alternate sides working from centre to each end. Finally tighten to correct torque, 40 Nm.
9. Tighten gasket clamp bolts to correct torque, **18** Nm.



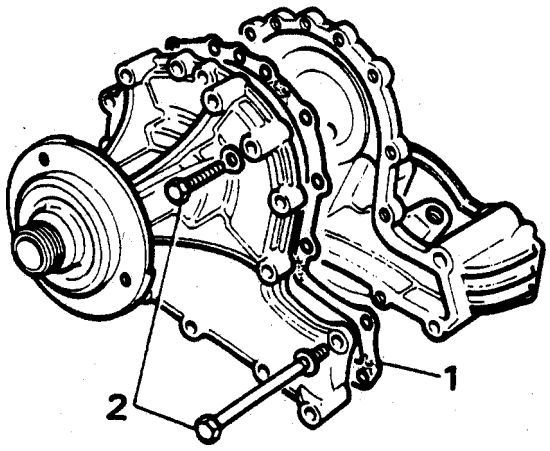
FIT TIMING COVER AND CRANKSHAFT PULLEY

1. Position a new timing cover joint washer, fit timing cover, locating it on two dowels.
2. Clean threads of timing cover securing bolts, coat them with Loctite **572.**
3. Fit and evenly tighten timing cover bolts to correct torque, **28** Nm.
4. Fit crankshaft pulley. Tighten retaining bolt to correct torque, **270** Nm.
5. Fit timing pointer.



FIT WATER PUMP

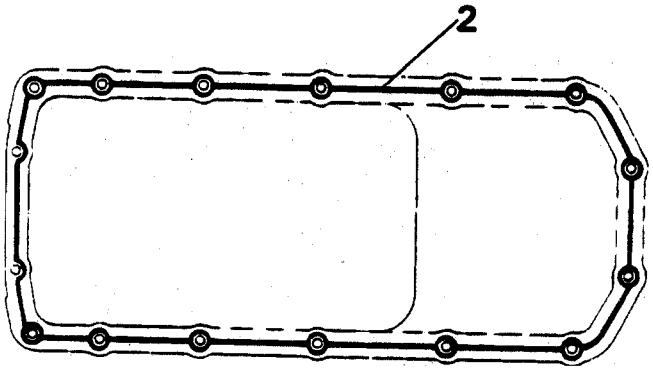
1. Lightly grease a new joint washer and place it in position on timing cover.
2. Clean threads of four long bolts and coat with Loctite572 thread lubricant sealant. Locate water pump in position.
3. Locate alternator adjusting link on water pump.
4. Leaving alternator adjusting link loose, tighten remaining water pump housing bolts evenly to correct torque 28 Nm.



RR1795E

FIT SUMP

1. Remove old sealant from sump and cylinder block joint faces.
2. Apply 2 mm wide bead of Hylosil 102 to joint face of sump as shown in illustration below.

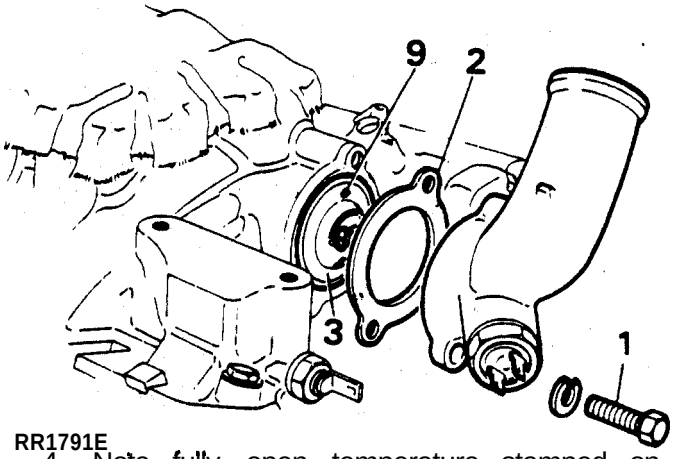


RR1867E

3. Place sump in position, fit sump bolts, evenly tighten bolts to correct torque, 10 Nm, rear bolts 19 Nm.
4. Tighten sump plug to correct torque, 44Nm.
5. Allow thirty minutes sealant curing time before starting engine.

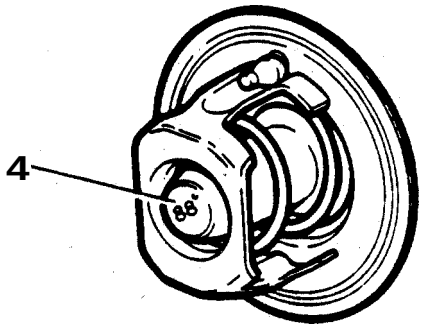
TEST AND FIT THERMOSTAT

1. Remove two bolts securing thermostat housing to intake manifold.
2. Remove housing gasket.
3. Withdraw thermostat.



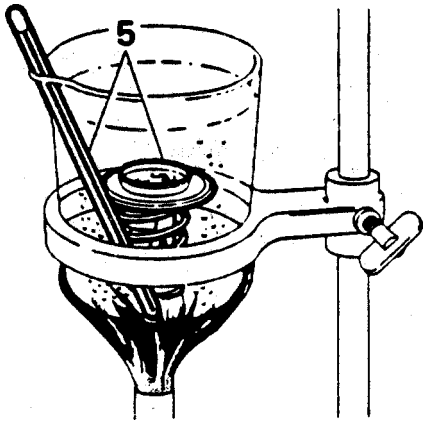
RR1791E

4. Note fully open temperature stamped on thermostat, **88°C.**



RR799M

5. Place thermostat and a thermometer in a suitable container half full of water.



ST858M

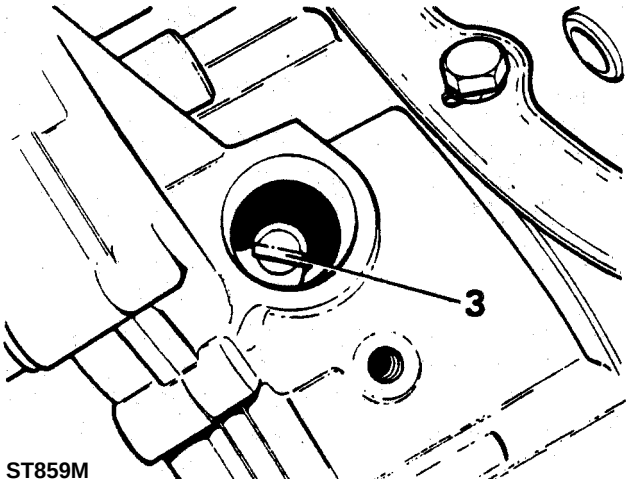
6. Heat water and observe temperature at which thermostat opens.
7. Disard thermostat if faulty.
8. Clean intake and manifold and thermostat housing mating faces.
9. Fit thermostat with jiggle pin uppermost.

NOTE: Airlocks may develop in cooling system if thermostat is incorrectly positioned, with consequent loss of coolant and possible overheating.

10. Fit housing with new gasket, tighten two bolts to correct torque, 28 Nm.

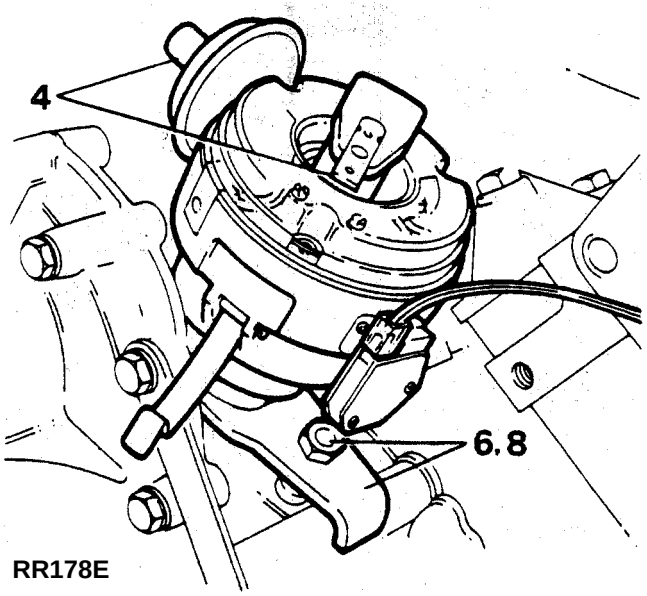
FIT DISTRIBUTOR

1. Turn crankshaft to bring number one piston to **6°** BTDC on compression stroke (both valves closed number one cylinder).
2. Turn distributor drive until rotor arm is approximately 30" anti-clockwise from number one spark plug lead position on cap.
3. Turn oil pump and distributor drive shaft until tongue is in approximate position illustrated.



ST859M

4. Fit distributor to engine, check that centre line of rotor arm is now in line with number one spark plug lead position in distributor cap. Reposition distributor if necessary. The vacuum capsule should be at approximately 90° to camshaft.
5. If distributor does not seat correctly, oil pump drive is not engaged. Remove distributor, reset oil pump drive tongue, repeat operation.



RR178E

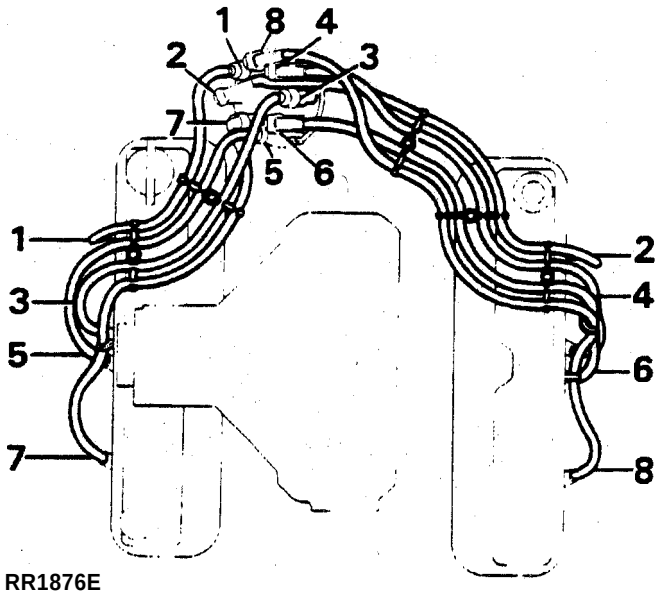
6. Fit clamp and nut, leave loose.
7. Rotate distributor until peak on pick-up lines up with a peak on reluctor ring. Remove rotor arm for better view.

CAUTION: On no account must engine be started before this operation is carried out.

8. Secure distributor in this position by tightening clamp nut.

9. Fit distributor cap and spark plugs. Connect H.T. leads as shown in illustration RR1876E.

NOTE: This distributor setting is to enable engine to be started. When engine is refitted the ignition timing must be set using electronic equipment.

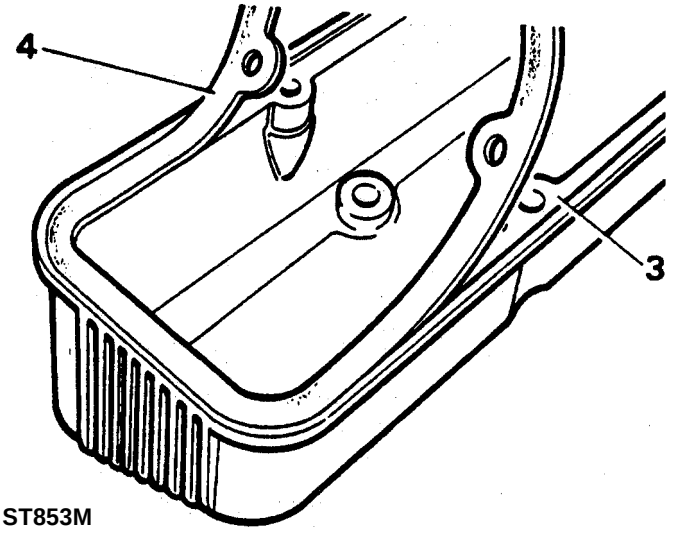


RR1876E

FIT ROCKER COVERS

1. An oil baffle is fitted inside each rocker cover, Remove **two** screws to remove baffle for cleaning.
2. Remove old gasket and sealant from covers and cylinder heads. Clean and dry gasket mounting face, using Bostik cleaner **6001.** Apply Bostik **1775** to seal face and gasket, use a brush to ensure an even film. Allow adhesive to become touch-dry, approximately fifteen minutes.

NOTE: The gasket fits one way only, it must be fitted accurately first time. Subsequent movement would destroy bond.



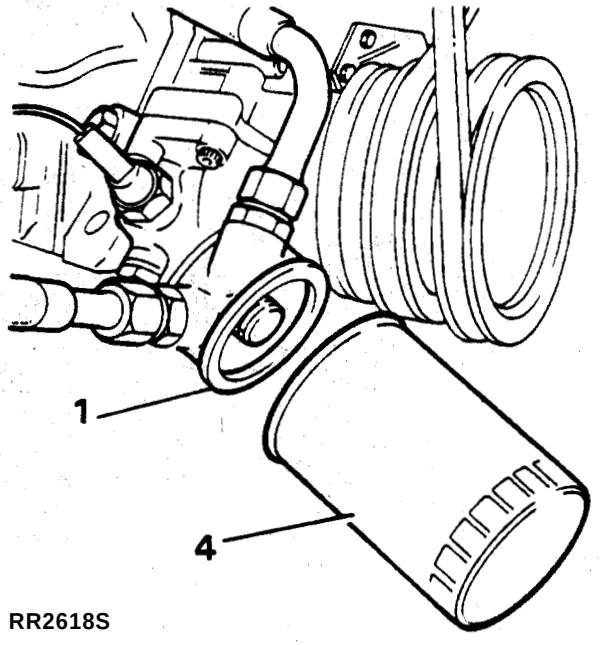
ST853M

3. Fit pilot studs in rocker cover fixing holes to guide gasket onto cover and into recess. Press gasket into place ensuring that outer edge firmly contacts recess wall.

4. Allow covers to stand for thirty minutes before fitting.
5. Secure rocker covers to cylinder heads with short screws inboard, long screws outboard. Tighten to correct torque, 9 Nm.

FIT ENGINE OIL FILTER

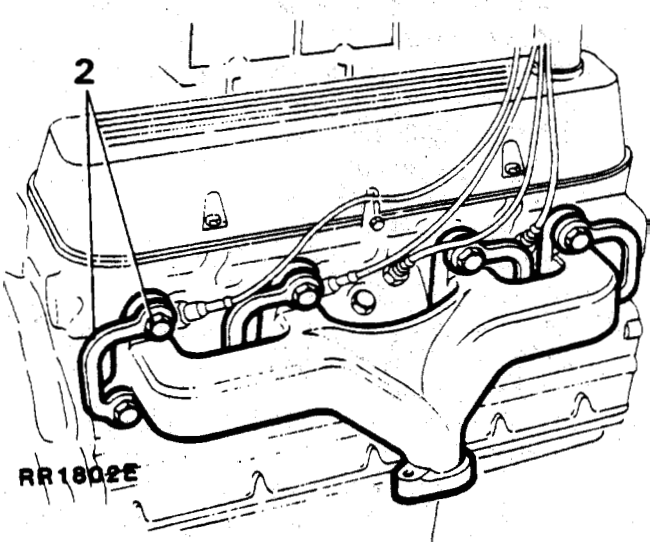
1. Clean oil cooler adaptor mating face.
2. Coat sealing ring of new filter with clean engine oil.
3. Fill filter with new oil as far as possible, noting angle at which filter is to be fitted.
4. Screw on filter until sealing ring touches mating face, then tighten a further half turn by hand only. DO NOT OVERTIGHTEN.
5. Refill engine with specified grade and quantity of oil.



RR2618S

FIT EXHAUST MANIFOLD

1. Ensure mating surfaces of head and exhaust manifold are clean. Fit new gaskets to exhaust manifold. Coat threads of bolts with anti-seize compound.
2. Position manifold on cylinder head and fit new lockplates, securing bolts and plain washers. The plain washers are fitted between manifold and lockplates. Evenly tighten manifold bolts to correct torque. 20 Nm. Bend over lock tabs.

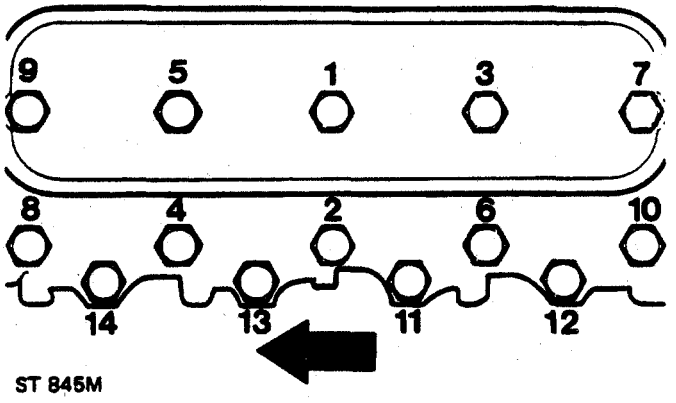


MISCELLANEOUS AND NON-STANDARD ITEMS

Fit remaining items of equipment, miscellaneous hoses, pipes, filters, clips and brackets in position.

CYLINDER HEAD GASKETS - RENEW

1. Drain cooling system.
2. Remove inlet manifold.
3. Remove alternator.
4. Remove rocker shafts.
5. Remove push rods.
6. Remove power steering pump belt.
7. Remove alternator bracket.
8. Remove both exhaust manifolds.
9. Remove air cleaner assembly.
10. Remove air flow meter.
11. Remove earth leads from rear of left hand cylinder head
12. Right hand cylinder head - remove breather pipe from lifting bracket.
13. Loosen cylinder head bolts, reversing tightening sequence.
14. Remove cylinder heads.
15. Remove cylinder head gaskets.
16. Clean exhaust mating faces.
17. Clean head and block faces.
18. Fit new cylinder head gaskets, word TOP uppermost. DO NOT use sealant.
19. Oil cylinder bores.
20. Clean threads of head bolts and coat with Loctite 572.
21. Locate cylinder heads on block.
22. Locate cylinder head bolts in position illustrated.
    Long bolts - 1, 3, and 5.
    Medium bolts - 2, 4, 6, 7, 8, 9 and 10
    Short bolts - 11, 12, 13, and 14



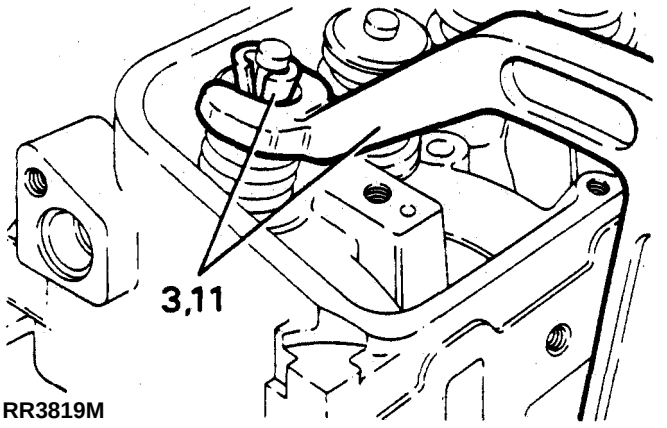
ST 845M

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

23. Tighten bolts progressively in sequence, see illustration number ST845M. Finally tighten to torque:
    Outer row 60 Nm
    Centre row 90 Nm
    Inner row 90 Nm.
24. When all bolts have been tightened, re-check for correct torque.
25. Reverse instructions 12 to 1.

CYLINDER HEADS - RENEW

1. Remove cylinder heads and gaskets.
2. Remove spark plugs.
3. Using spring compressor 18G 106A, remove valves, collets, springs and caps.



RR3819M

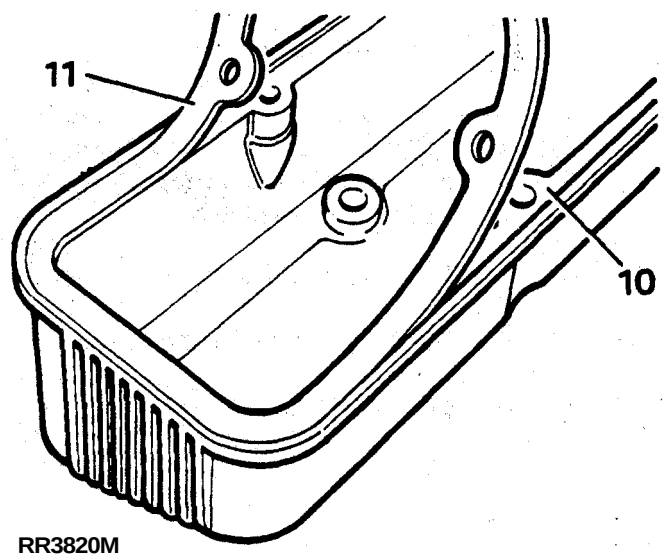
4. From left hand cylinder head, remove earth lead studs.
5. Remove PAS pump pivot stud.
6. Right hand cylinder head, remove rear lifting bracket.
7. Fit lifting bracket to new right hand cylinder head.
8. Fit PAS pump pivot stud, earth lead studs to new left hand cylinder head.
9. Regrind valves.
10. Lubricate valve stems, fit valves, springs, and caps. Fit new seals to inlet valve stems only.
11. Using spring compressor 18G 106A, compress springs, fit collets. Tap valve to check correct collet seating.
10. Fit spark plugs.
11. Fit cylinder heads with new gaskets.

ROCKER COVER - RIGHT HAND - RENEW

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.

8. Remove plug lead retaining clips from rocker cover, fit to new rocker cover.
9. Clean and dry rocker cover and cylinder head matng faces using Bostik cleaner 6001.

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



RR3820M

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 intoplace 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 8 Nm.
14. Position fuel pipes.
15. Fit breather pipe to rocker cover, tighten clip.
16. Fit breather pipe 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.

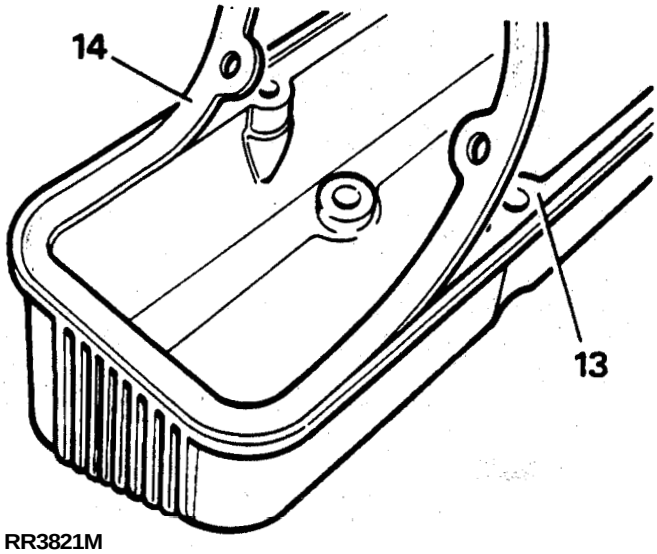
ROCKER COVER - LEFT HAND - RENEW

1. Remove air flow sensor.
2. Remove plenum chamber.
3. Remove dipstick.
4. Remove spark plug leads from plugs and retaining clips.
5. Disconnect HT lead from coil.
6. Remove alternator heat shield from rocker cover.
7. Remove air flow meter harness clip.
8. Remove 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.

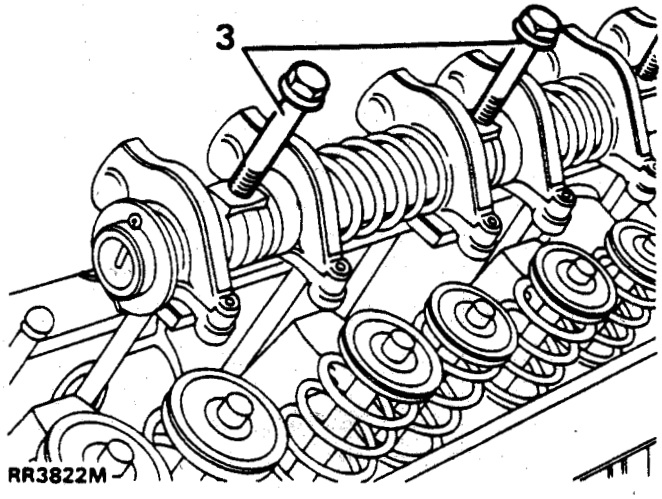


RR3821M

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 8 Nm.
17. Locate and tighten dipstick tube clip.
18. Fit and tighten air flow meter harness clip.
19. Fit alternator 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

1. Remove rocker covers as required,
2. Loosen four rocker shaft fixings



RR3822M

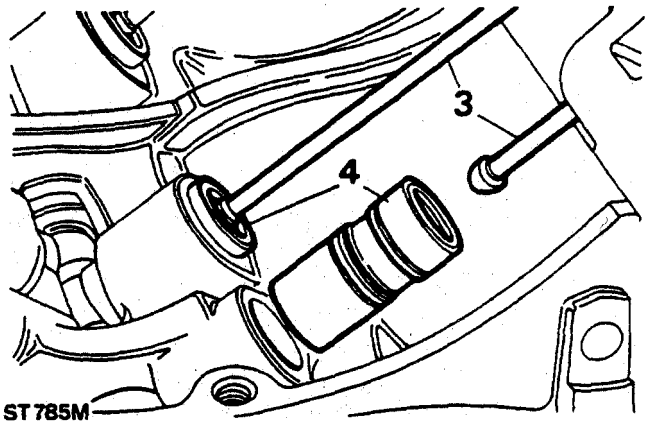
3. Remove rocker shaft assembly.

   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

1. Remove rocker shafts.
2. Remove inlet manifold.
3. Remove push rods, retain in removal sequence.



4. Remove hydraulic tappets
5. Fit tappets, push rods and rocker assemblies.
6. Fit inlet manifold.
7. Reverse remaining removal procedure.

CRANKSHAFT PULLEY ASSEMBLY

1. Remove viscous coupling, see viscous coupling, fan blades, pulley and fan cowl.
2. Remove water pump drive belt.
3. Remove alternator drive belt.
4. Remove power steering pump drive belt.
5. Raise vehicle on ramp.
6. Remove bell housing bottom cover.
7. With assistance to stop flywheel rotation, remove crankshaft pulley assembly retaining bolt.
8. Remove crankshaft pulley assembly.
9. If required: Place assembly in vice and remove pulleys.
10. Fit pulleys to torsional vibration damper.
11. Lubricate seal face of assembly.
12. Fit pulley assembly.
13. With assistance to stop flywheel rotation, fit retaining bolt, tighten to 280 Nm.
14. Reverse instructions 1 to 6.

FRONT COVER OIL SEAL - RENEW

1. Remove crankshaft pulley,
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 18G1291/5to 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

1. Remove crankshaft pulley.
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 alternator 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 alternator tensioner from water pump, move tensioner aside.
18. Mark distributor position to front cover.
19. Remove distributor clamp, remove distributor.
20. Remove fixings sump to front cover.
21. Loosen four adjacent sump fixings.
22. Remove alternator 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 alternator 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 alternator 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 alternator 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.
52. Tension drive belts correctly.
53. Check ignition timing.
54. Refill cooling system.

TIMING CHAIN AND CHAINWHEELS

Remove

1. Remove front cover.
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.

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.

FLYWHEEL

Remove

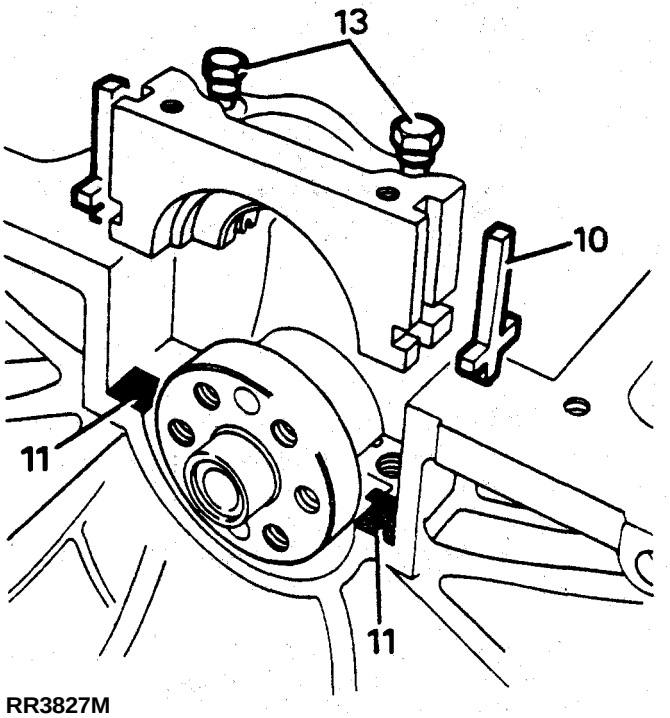
1. Remove gearbox and clutch.
2. Slacken starter motor bolts.
3. Lock flywheel, remove flywheel bolts and flywheel.

Refit

4. Clean components for reassembly.
5. Fit flywheel.
6. Lock flywheel, fit flywheel bolts, tighten to 80 Nm.

CRANKSHAFT REAR OIL SEAL

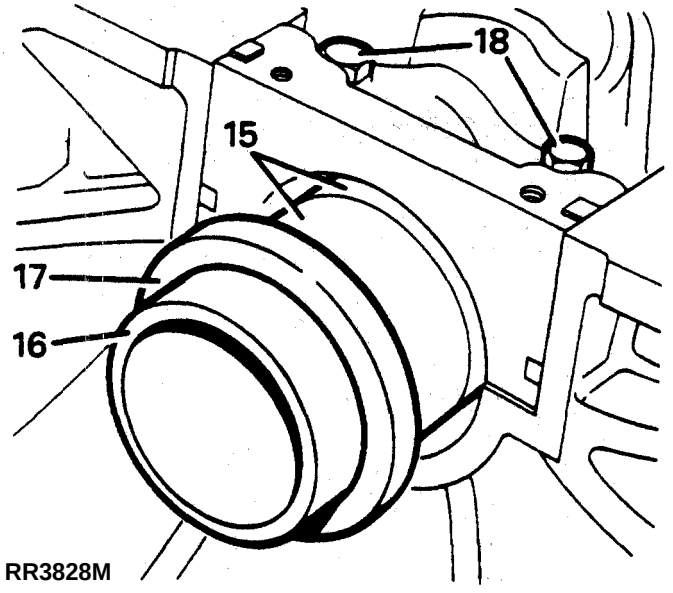
1. Remove engine.
2. Remove flywheel.
3. Remove dipstick.
4. With assistance, invert engine, support on blocks.
5. Remove sump.
6. Remove rear main bearing cap.
7. Remove cross seals from cap.
8. Remove crankshaft rear oil seal.
9. Clean main bearing cap and oil seal area of block.
10. Fit new cross seals to bearing cap.
11. Apply Hylomar SQ32M to block as illustrated.



RR3827M

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

15. Ensure **oil** seal guide RO1014 and crank journal are scrupulously clean. Coat seal guide and oil seal journal with clean engine oil.



RR3828M

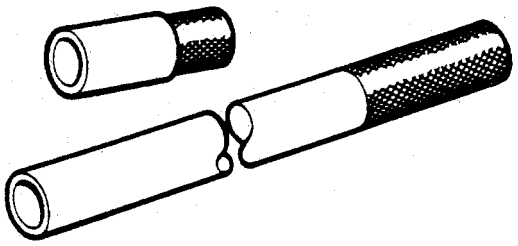
CAUTION: Do not handle oil seal lip, check it is not damaged. Ensure outside diameter remains clean and dry.

16. Position oil seal guide RO1014 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.

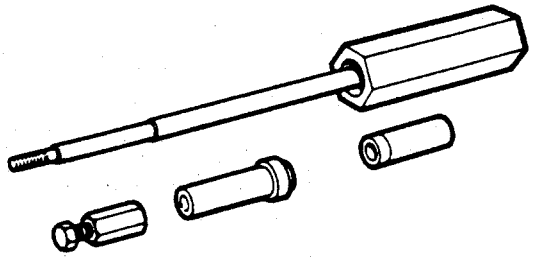
17. Push oil seal fully and squarely by hand into recess in cap and block until it contacts machined step in recess. Remove seal guide.
18. Tighten rear main bearing cap to 90 Nm.
19. Fit sump.
20. Reposition engine, fit dipstick.
21. Fit flywheel.
22. Fit engine to vehicle.

LRT-12-041 Guide bolts
RO605351



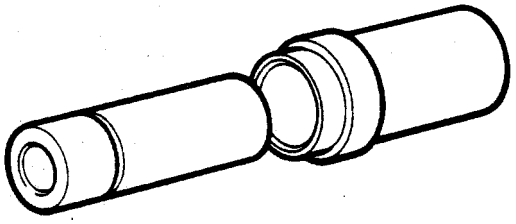
RO605351

LRT-12-013 Piston pin remover/replacer Basic tool
18G1150



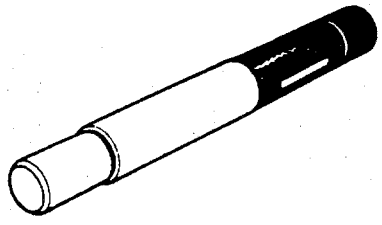
18G1150

LRT-12-014 Adaptor remover/replacer piston pin
18G1150E



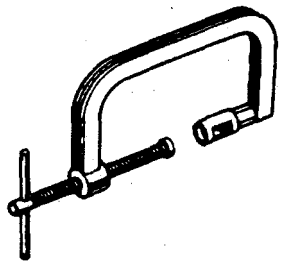
18G1150E

LRT-12-001 Clutch centralising tool.
18G79



18G79

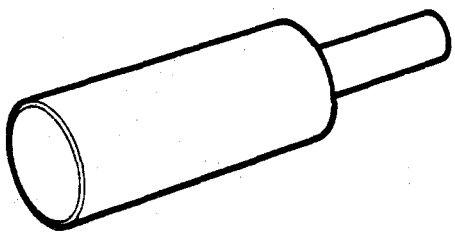
LRT-12-034 Spring compressor
MS1519A



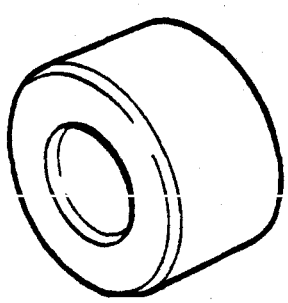
MS1519A

LRT-12-038 Drift - Valve guide replacement - intake and exhaust
RO600959

RO.600959



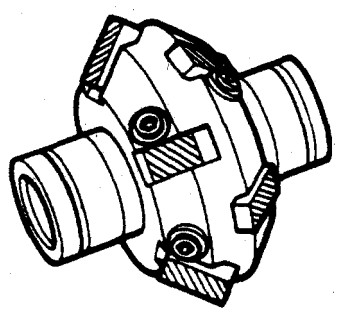
LRT-12-515 Distance piece for valve guide
RO605774A



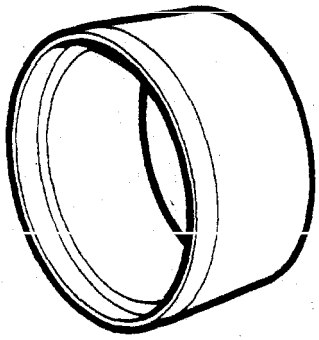
605774A

LRT-12-504 Valve seat cutter
MS621

MS.621

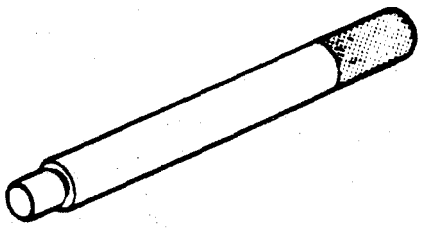


RO.1014



LRT-12-010 **Crankshaft rear seal sleeve**
RO1014

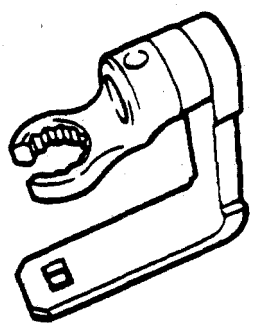
LRT-12-037 **Drift for valve guide removal - intake and exhaust**
RO274401A



RO274401

LRT-12-047 **Torque adaptor lambda sensor**
LST134

LST134



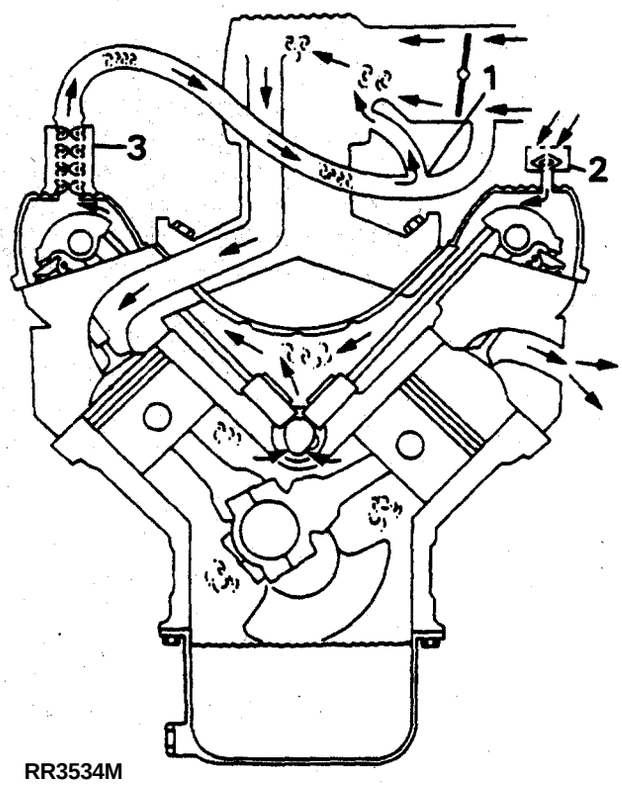
EMISSION CONTROL

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

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.



RR3534M

1 Three way connector
2 Air filter
3 Oil separator

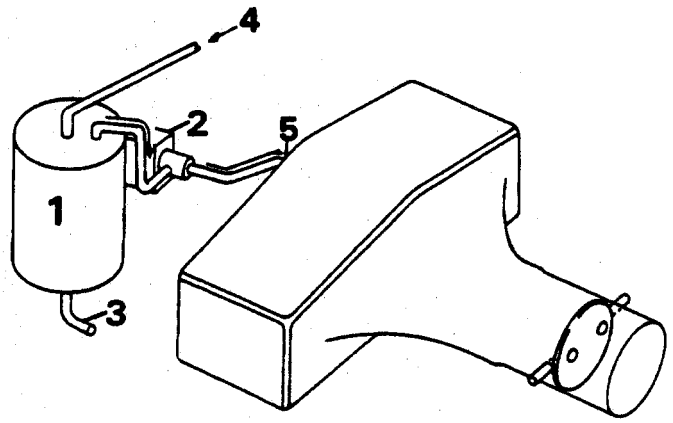
The purpose of the crankcase ventilation system is to ensure that any noxious gas generated in the engine crankcase is rendered harmless by burning in the combustion chambers as follows:
Oil laden noxious gas in the engine crankcase is drawn through an oil separator **3** located on the right cylinder head rocker cover, where the oil is separated and returned to the stump. The gas flows through a restrictor in the three way connection 1 and into the inlet plenum chamber where it 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.

EVAPORATIVE EMISSION CONTROL

Fuel tank evaporative control

The specification for certain countries requires the recycling of petrol evaporation from the fuel tank. For these countries only, a charcoal canister and purge valve are installed in the engine compartment.



RR3546M

Evaporative purge system

1 Charcoal canister
2 Purge valve
3 Charcoal canister air vent
4. Fuel purge connecion from separator/expansion tank
5 Plenum chamber connection

Operation

When the engine is not running, the purge valve (2) seals the plenum chamber connection **(5).** Any vapour entering the canister at (4) from separator/expansiontank, is condensed by the air entering at **(3)** which is then absorbed by the charcoal.

The opening of the purge valve (2), which IS controlled by the MFI ECM occurs when the following conditions prevail:

When the engine is running at speeds above 1700 rev/min and temperatures above 54°C the ECM will hold open the purge valve as necessary.

At speeds below 1700 rev/min the ECM will only pulse the purge valve open for short periods.

While the purge valve (2) is open, engine depression draws air through vent (3) and fuel tank fumes via (4) into the engine combustion chambers, where they are burned. Air entering at (3), passes through the charcoal, where any accumulation of condensed fuel is also extracted and burned in the engine.

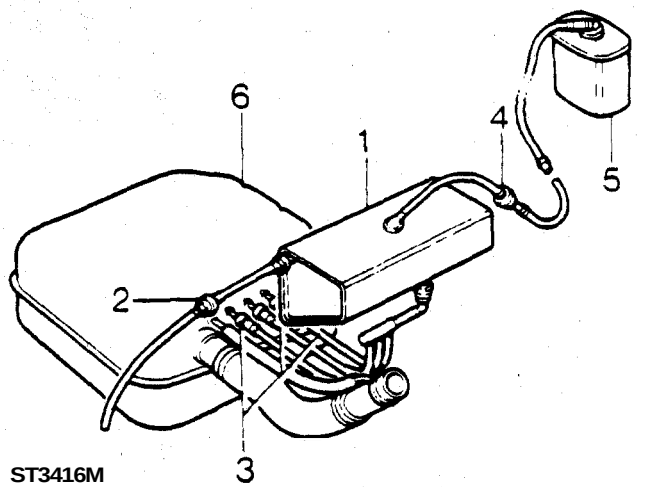
A permanent leakage of air into the plenum chamber through the purge system will effect engine performance.

Fuel tank evaporative control system

The system consists of a fuel separator/expansion tank located at a higher level than the fuel tank, between the inner body side and the right rear fender. The tank is vented to atmosphere through a relief valve and is connected to the fuel tank and the charcoal canister purge system in the engine compartment.

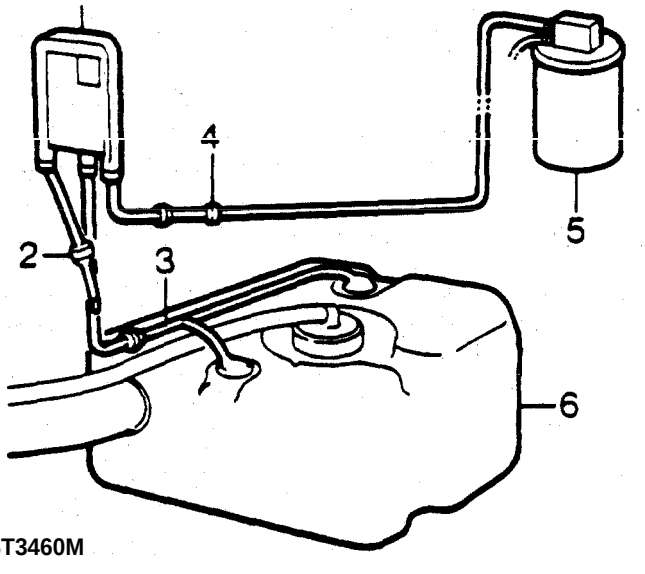
Operation

As the temperature rises, fuel vapour in the fuel tank is allowed to vent into the separator/expansion tank (1) via three pipes and a manifold connector (3). Any vapour which condenses into liquid fuel drains through pipe (6) back into the main fuel tank and residual vapour is dealt with by the purge system connection (4) in the engine compartment.
The atmosphere relief valve (2) will only open if a blockage occurs in the charcoal canister or purge system.



ST3416M

Defender 110



ST3460M

Defender 90

Fuel tank evaporative control system

1 Fuel expansion tank
2 Relief valve to atmosphere
3 Fuel tank vent
4 Relief valve to charcoal canister
5 Charcoal Canister in engine compartment
6 Fuel tank

FUEL EXPANSION TANK

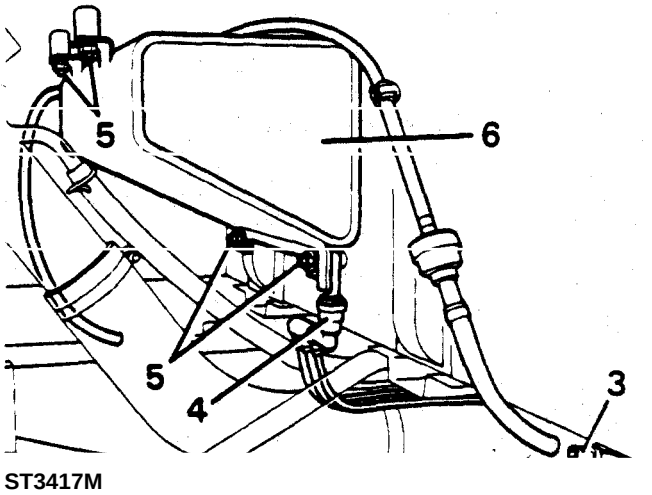
The fuel expansion tank is located under the wheel arch of the right rear fender.

WARNING: Ensure all necessay precautions are taken against spillage of fuel when disconnecting expansion tank hoses.

DEFENDER 110

Remove

1. Loosen fuel tank filler cap to release any pressure in tank.
2. Disconnect battery negative lead.
3. Disconnect pipe connection at joint under chassis member.
4. Disconnect evaporative control pipes. Use LRS-19-002, press down on collet and pull connector.



ST3417M

5. Remove four nuts and remove expansion tank.

Refit

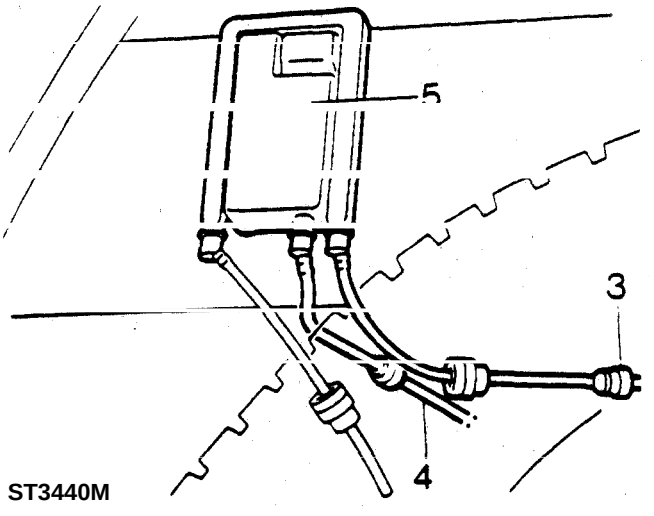
6. Reverse removal instructions.

DEFENDER 90

Remove

1. Loosen filler cap to release any pressure in tank.
2. Disconnect battery negative terminal.
3. Disconnect pipe connection to charcoal canister, using Special Tool LRT-19-002, press down on collet and pull connector.
4. Disconnect pipe to fuel tank using **LRS-19-002.**

5. Remove four nuts and remove expansion tank.



ST3440M

Refit

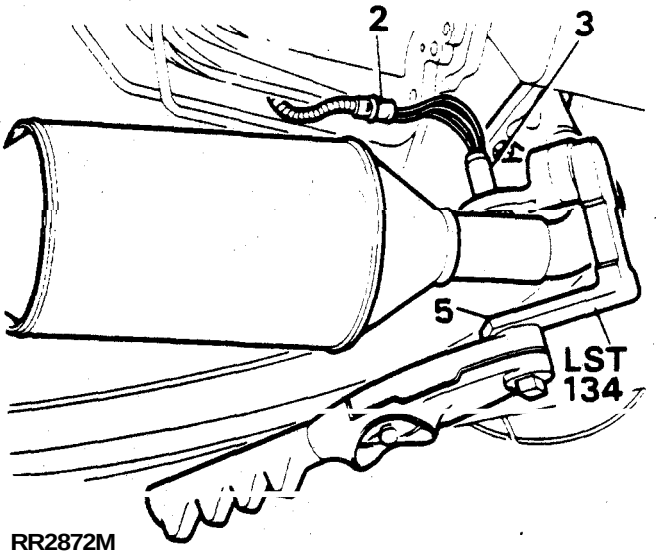
6. Reverse removal instructions.

HEATEDOXYGENSENSOR

Remove sensors from exhaust system **only** when engine is cold.

Remove

1. Disconnect battery negative lead.
2. Disconnectelectrical plugs from sensors.
3. Remove sensors from exhaust downpipes.



RR2872M

Refit

4. Coat threads of sensor with anti-seize compound.

CAUTION: To ensure efficiency of sensor is not impaired, DO NOT allow anti-seize compound to **come into contact with sensor nose.**

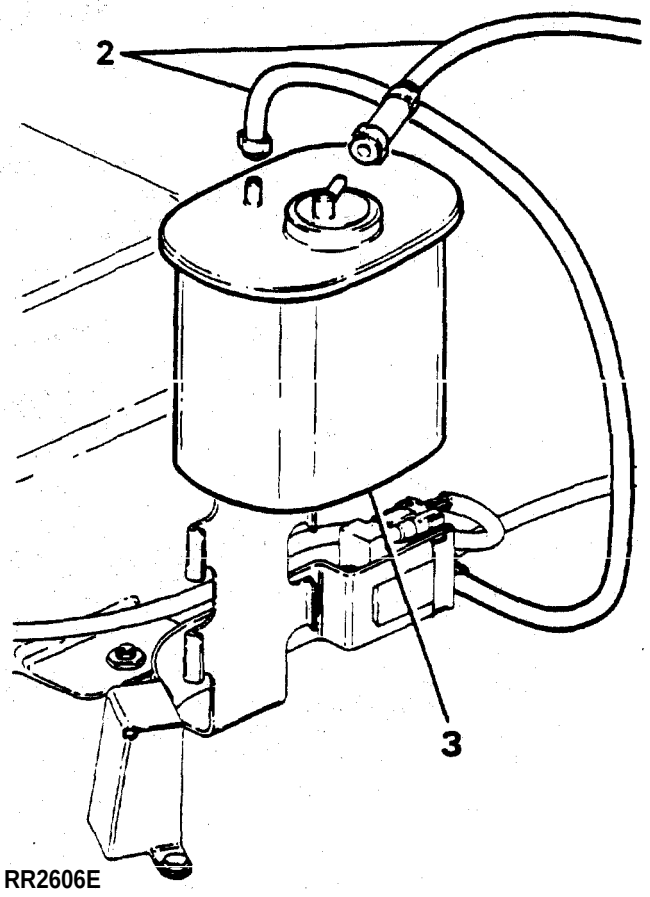
5. Fit sensor and tighten to a torque of 20 Nm. using service tool LST-134.
6. Connect electrical plugs and battery lead.

CHARCOAL CANISTER DEFENDER 110

NOTE: If crimped hoses are removed it is essential that they are recrimped on reassembly to ensure a leak free joint.

Remove

1. Disconnect battery negative lead.
2. Disconnect both purge lines.
3. Release canister from mounting.



RR2606E

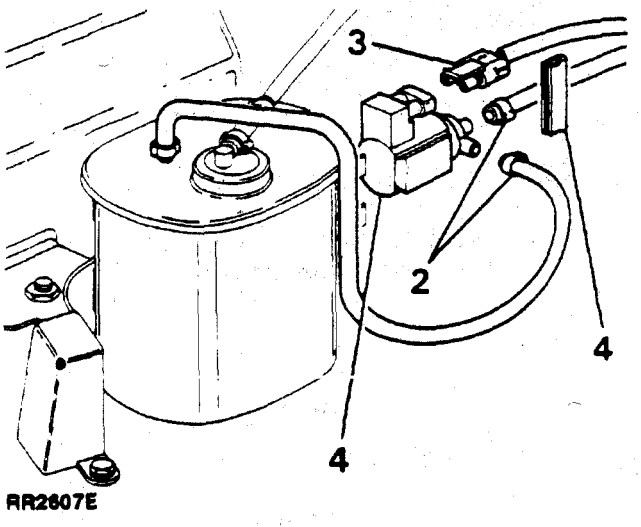
Refit

4. Reverse removal procedure. Ensure that canister is securely located and both purge lines are fitted correctly to canister.

CHARCOAL CANISTER ' PURGE VALVE DEFENDER 110

Remove

1. Disconnect battery negative lead.
2. Disconnect two purge valve pipes.
3 Disconnect electrical connection.
4 Remove edge clip retaining purge valve and withdraw purge valve.



RR2607E

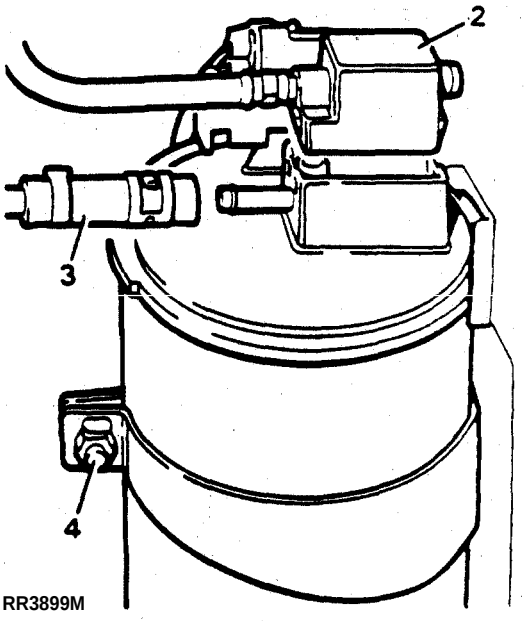
Refit

5. Reverse removal procedure ensuring pipes are securely crimped.

CHARCOAL CANISTER DEFENDER 90

Remove

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



RR3899M

Refit

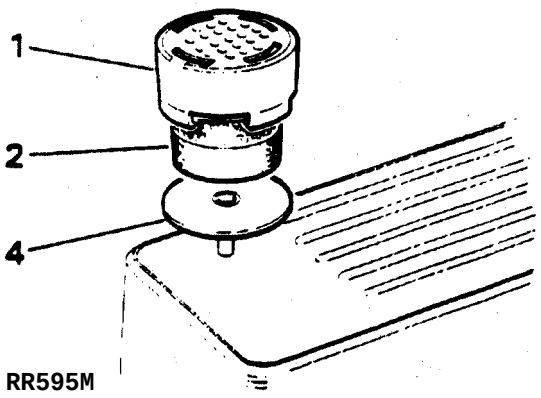
6. Reverse removal procedure

POSITIVE CRANKCASE VENTILATION AIR INTAKE FILTER

The PCV air intake filter is located at rear of left hand rocker cover, beneath throttle linkage bracket.

Remove

1. Pry filter cover upwards to release it.
2. Remove filter from cover and discard.



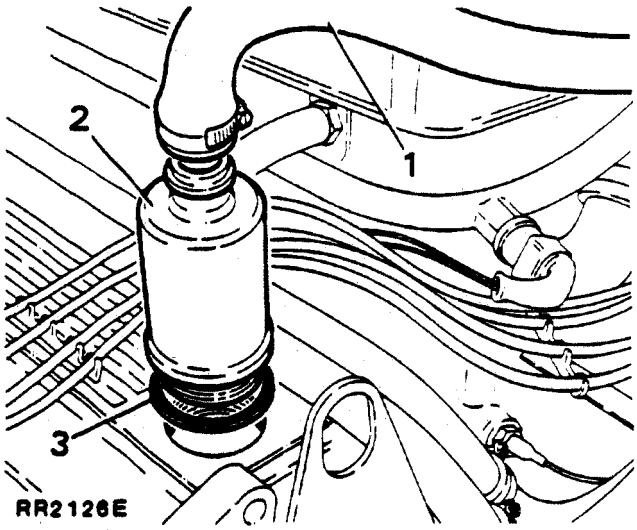
Refit

3. Insert new filter into filter cover.
4. Press filter onto mounting until it clips firmly into position.

POSITIVE CRANKCASE VENTILATION BREATHER FILTER

Remove

1. Release hose clamp, pull hose off canister
2. Unscrew canister and remove.
3. Remove large rubber 'O' ring, inspect for deterioration.



4. Inspect condition of wire screen within canister, if necessary, replace assembly. If filter unit is in acceptable condition, clean as follows.
5. Immerse canister in small amount of solvent (mineral spirits), allow solvent to dissolve or loosen debris.
6. Remove canister from solvent, allow to dry in still air.

WARNING: Do not use compressed air to dry, clean or remove particles of debris within the canister. This could cause fire or personal injury.

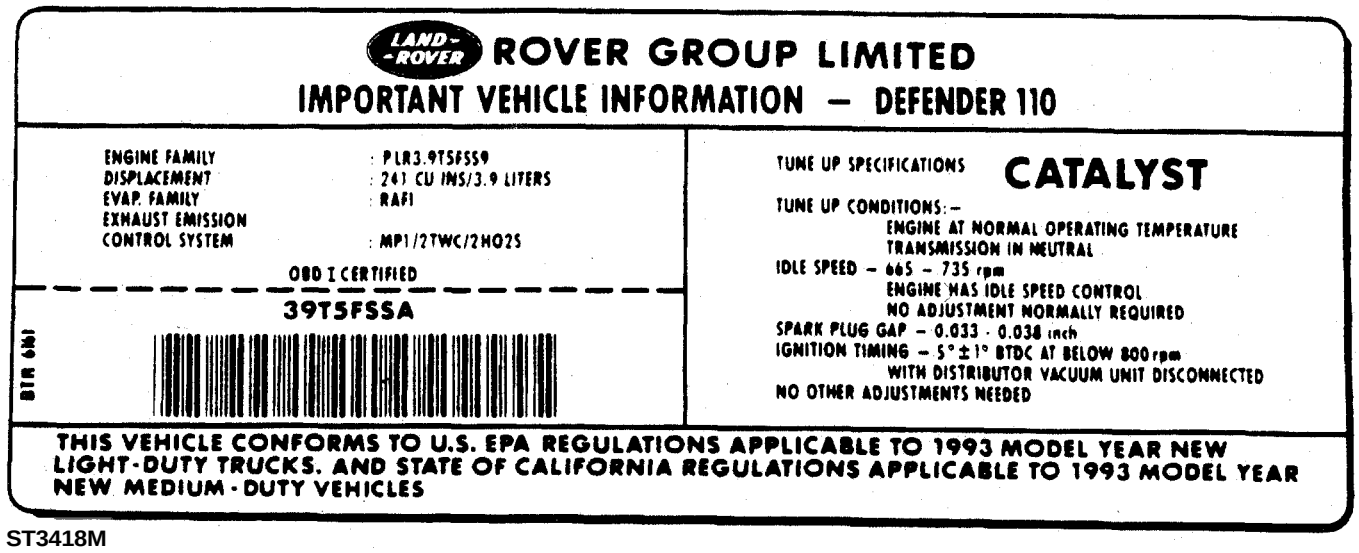
Refit

7. Fit a new '0' ring to original Canister
8 Screw canister into rocker cover securely - hand tight only.
9 Refit hose, tighten hose clamp securely

EMISSION LABEL

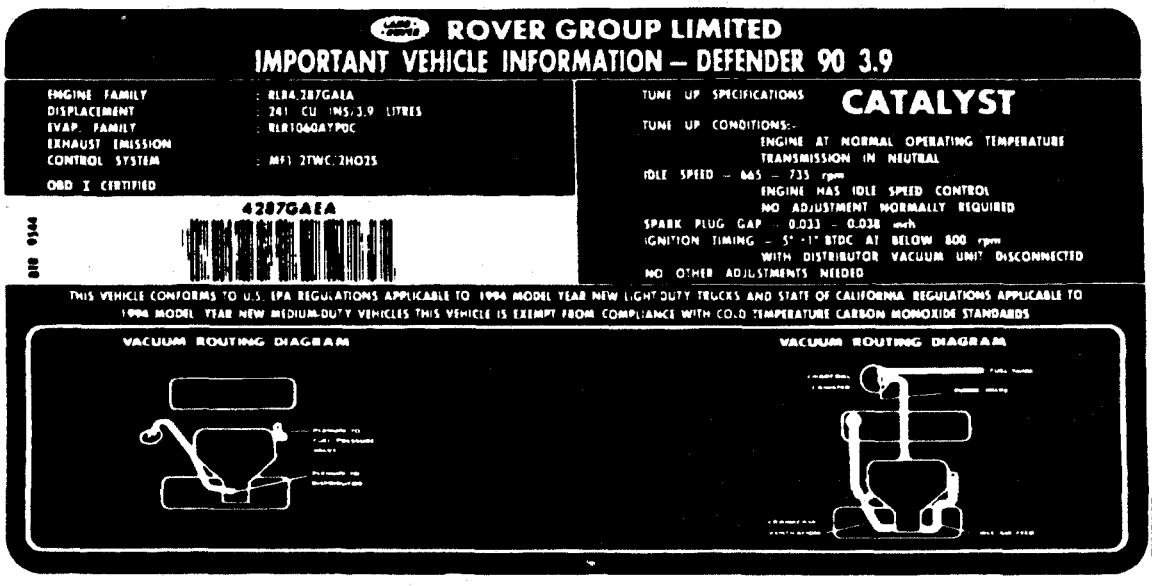
A vehicle Emission Control information label is located in the engine compartment. On Defender 110 vehicles it is attached to the air conditioning unit. On Defender 90 vehicles it is adhered to the underside of the hood. The label gives Engine Tune Details to ensure that correct emission levels are achieved. The label is fitted to comply with U.S Federal and State of California Regulations and should not be removed from its location within the vehicle.

Defender 110 Emissions label - 1993 Model Year



ST3418M

Defender 90 Emissions label - 1994 Model Year

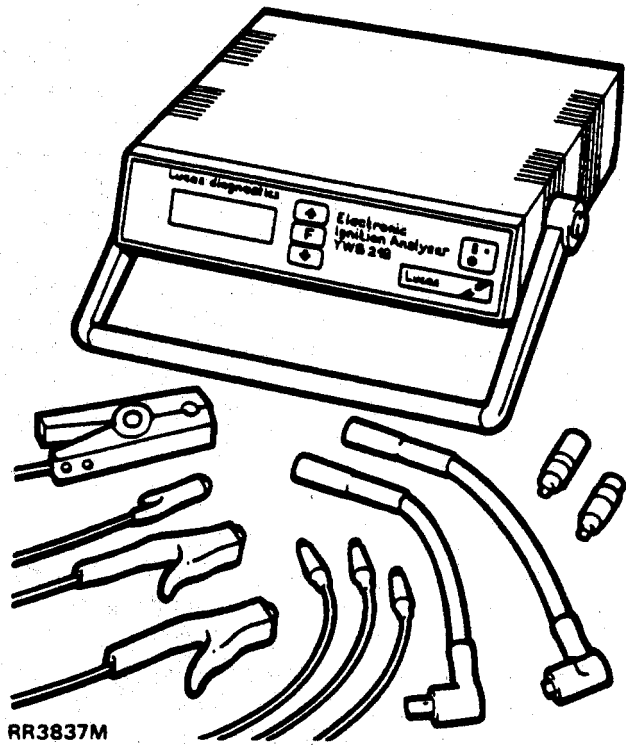


ST3459M

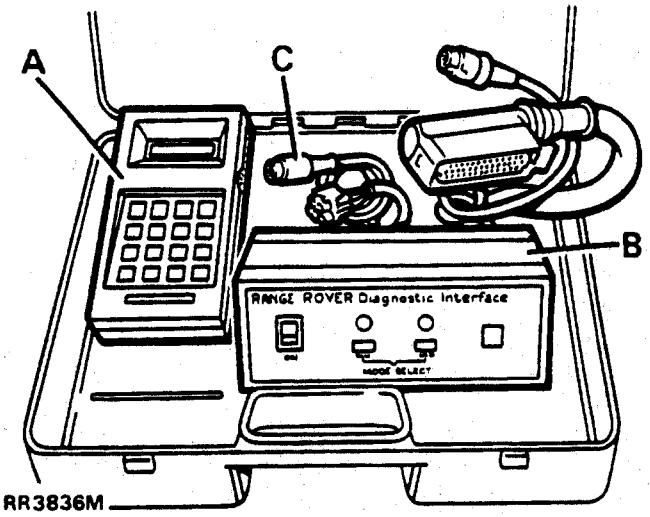
DIAGNOSTIC EQUIPMENT

IGNITION

Electronic Ignition Analsyer
Lucas Part No. - YWB 119
Supplied by Lucas Complete with instruction manual.



RR3837M



RR3836M

MEMORY CARDS

Land Rover Part Numbers include two memory card and instruction manual in appropriate language

Suitable for 14CUX ECU

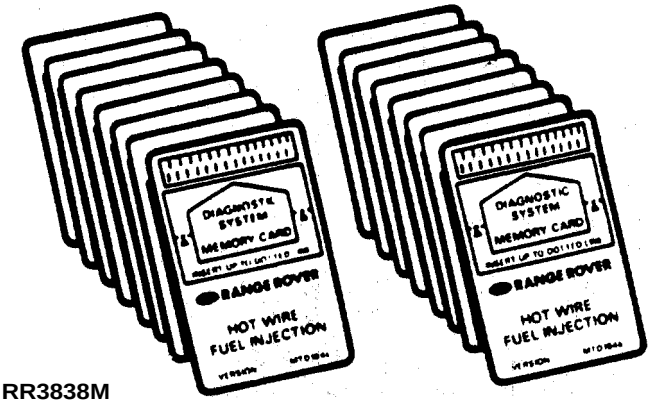
ENGLISH	RTC 6835
USA	RTC 6836
FRENCH	RTC 6837
GERMANY	RTC 6838
ITALIAN	RTC 6839'
SPANISH	RTC 6840
DUTCH	RTC 6842
JAPANESE	STC 127

LUCAS MFI DIAGNOSTIC EQUIPMENT
Complete kit Land Rover Part No. RTC 6834

Kit Comprises:-

- A Hand held tester
- B Interface unit
- C Serial link cable (Spare part Lucas No. 54744753).
- Foam lined carrying case

Memory cards are supplied separately **see** below



RR3838M

HOT WIRE MULTIPORT FUEL INJECTION

Description

The 'Hot Wire' Multiport Fuel Injection system derives its name from the air flow meter 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 inlet 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 Electronic 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.

Electronic control module - ECM

The Multiport Fuel Injection system is controlled by the ECM which is located behind the front passenger's toe board. The control unit is 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 by the front left handbranch of the intake manifold. The engine coolant temperature sensor provides engine coolant information to the ECM. The ECM on receiving the signal from the engine coolant temperature sensor will lengthen slightly the time that the injectors are open, and reducing this time as the engine reaches normal operating temperature.

Engine fuel temperature sensor

The engine fuel temperature sensor is located in the fuel rail forward of the ram housing. The engine fuel temperature 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 idle air control valve as required by the ECM.
The bypass 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

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 heated oxygen 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.

Mass air flow sensor

The hot-wire mass 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 mass 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 throttle pedal causes the throttle butterfly 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 the throttle position sensor setting is not lost, for example, when throttle stop wear occurs.

CAUTION: Do not attempt to adjust throttle position sensor.

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 mounted on a bracket located on the left hand chassis side member adjacent to the rear engine mounting. The vehicle speed sensor provides road speed data to the **ECM.** The ECM in turn detects vehicle movement from the road speed input and ensures that idle speed control mode is disengaged. Should the vehicle speed sensor fail in service the ECM idle speed control would become erratic.

The vehicle speed sensor also provides road speed data to the electric speedometer.

Inertia fuel shut off switch

The inertia fuel shut off switch is a mechanically operated switch that is normally closed and is connected to the fuel pump circuit. In the event of a sudden impact the inertia fuel shut off switch opens, and disconnects the electrical feed to the fuel pump. The inertia fuel shut off switch is reset by pressing down the button.

Relay modules

Two multiport fuel injection relay modules are located behind the front passenger toe board. 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.

ENGINE TUNING

ECM - MFI circuit diagnosis

Circuit fault diagnosis may be carried out on all MFI vehicles, using a good quality Multi Meter or the hand held tester RTC6834. The tester displays the fault code and guides the operator by visual prompts, through a series of diagnostic checks. Full operational and diagnosis instructions are provided with the unit memory card.

Which ever instrument is used to diagnose the problem, the following Preliminary Checks must be carried out first.

Preliminary checks

CAUTION: 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 catalysts. 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 D in main fuse panel and the fuel pump fuse in the auxiliary fusebox.
3. Check for ample fuel in tank.
4. Check air inlet system for possible leaks into the inlet 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.

For diagnosis procedure using a Multi Meter see ETM A1.

The diagnosis procedure using Hand Held Tester is contained in the hand held tester manual.

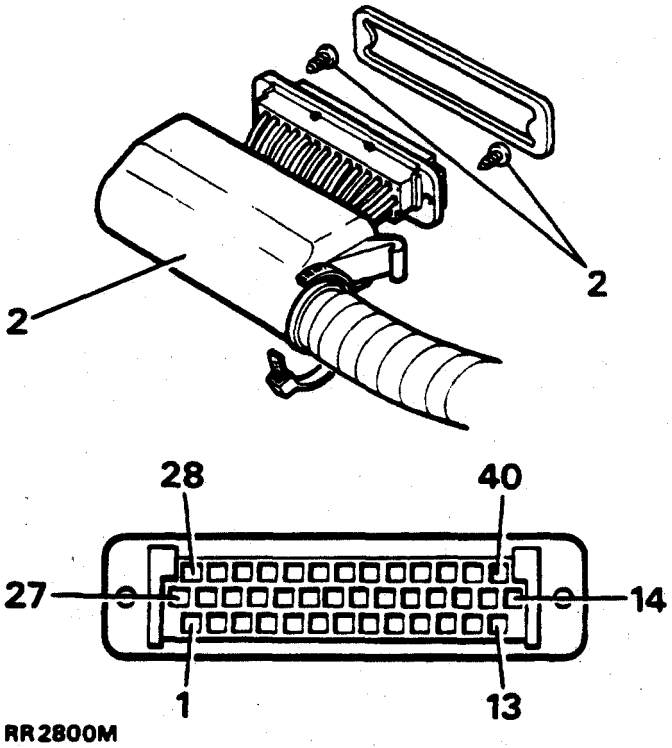
MULTIMETER CHECKS

To carry out tests when 40 way multi-plug is connected to the ECM, it is necessary to remove the two screws securing the shroud to the plug to enable the multi-meter probes to be inserted into the back of the appropriate pin.

CAUTION: Tests requiring plug to be removed from ECM, must have meter probes inserted into back of plug. If probes are inserted into plug sockets, damage will occur to sockets resulting in poor connections when plug is reconnected.

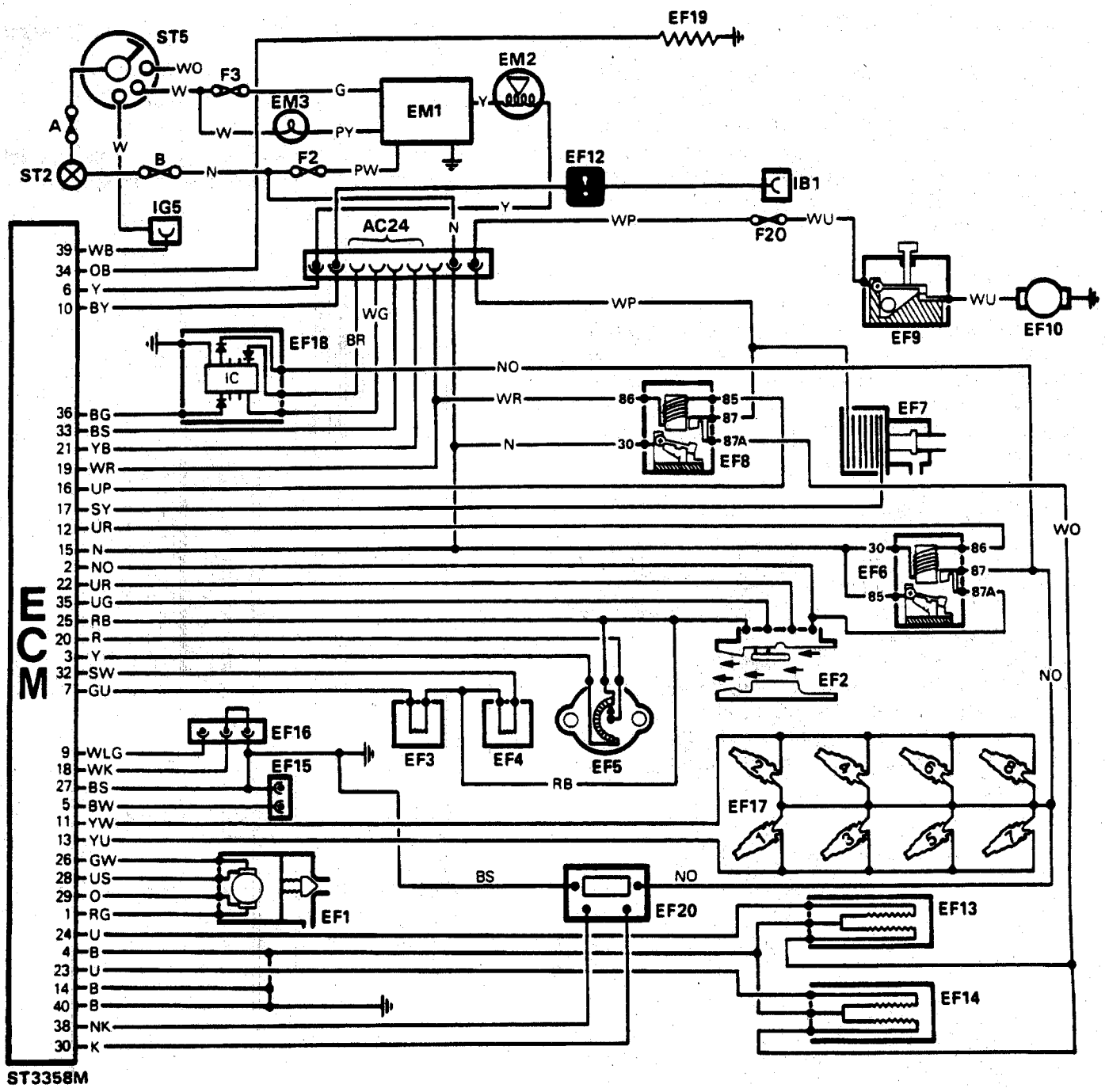
Testing

1. Release harness plug from ECM.
2. Remove plug shroud and manoeuvre it along harness to enable meter probes to be inserted into back of plug.
3. Only pin numbers 1, 13, 14, 27, 28 and 40 are moulded onto rear of plug.



RR2800M

View of plug - cover removed.
Pins 1 to 13 bottom row.
Pins 14 to 27 centre row.
Pins 28 to 40 top row. For clarity electrical leads omitted.
For diagnostics using a multi meter, see ETM A1.



MULTIPORT FUEL INJECTION (MFI) CIRCUIT DIAGRAM ST3358M

EF1 Idle air control valve (IACV)
EF2 Mass air flow sensor (MAFS)
EF3 Engine coolant temperature sensor (ECTS)
EF4 Engine fuel temperature sensor (EFTS)
EF5 Throttle position sensor (TPS)
EF6 Main relay module
EF7 Canister purge valve (CANPV)
EF8 Fuel pump relay module
EF9 Inertia fuel shut-off switch (IFS)
EF10 Fuel pump (FP)
EF12 Malfunction indicator lamp (MIL)
EF13 Heated oxygen sensor (H02S)
EF14 Heated oxygen sensor (H02S)
EF15 Tune resistor connector
EF16 Data link connector (DLC)
EF17 Fuel injectors
EF18 Fan control timer
EF19 Resistor (manual transmission)
EF20 Onboard diagnostic module (OBDM)
EM1 Service reminder indicator unit
EM2 Vehicle speed sensor (VSS)
EM3 Service reminder light (SRI)
IB1 Instrument binnacle
IG5 Ignition coil
ST2 Terminal post starter solenoid
ST5 Starter/ignitionswitch
AC24 Air conditioning connections
F20 20 amp fuse, dash fuse box
F3 15 amp fuse, dash fuse box

BASE IDLE SPEED SETTING

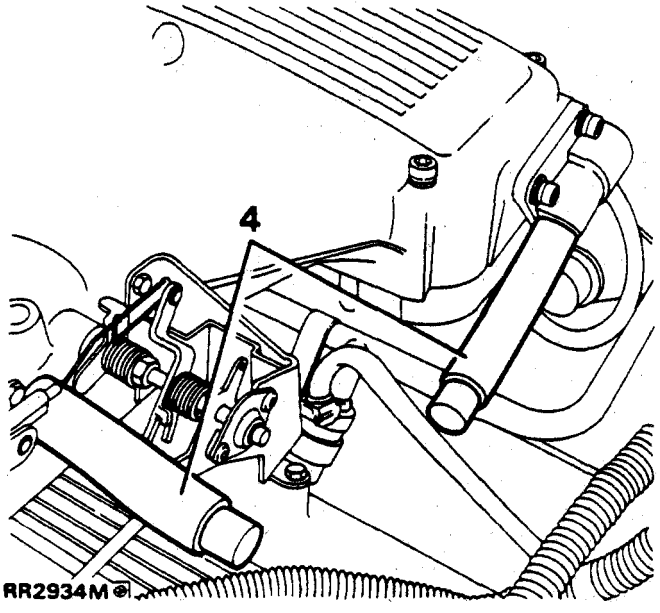
NOTE: Base idle speed is set at factory. It should not require further adjustment unless plenum chamber is changed. The adjustment screw is sealed with a plug to prevent unauthorised alteration. Check ignition timing before attempting following procedure, since this will affect idle speed.

Equipment required

Two blanking hoses. these are manufactured using a new idle air control 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

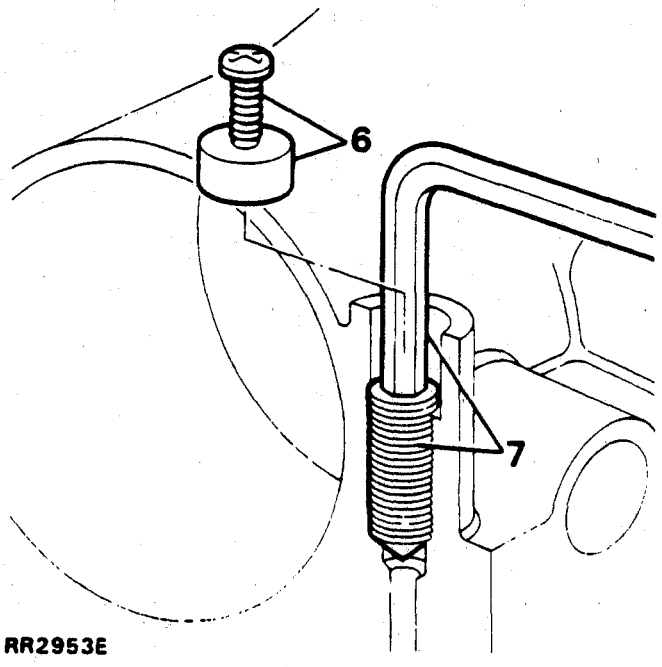
1. Drive vehicle at least two miles until engine and transmission are hot. Switch off engine.
2. Check all electrical loads are OFF, including air conditioning.
3. Remove idle air control valve hose.
4. Fit blanking hoses to both plenum chamber and idle air control valve. Ensure hoses are securely fitted to prevent air leaks. Note throttle cable has been omitted from illustration.



5. Start engine and check idle speed is within limits.

Adjusting base idle speed

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 anti-clockwise to increase idle speed.
8. Stop engine, remove blanking hoses. Reconnect hose to plenum.
9. Fit new tamper proof plug.

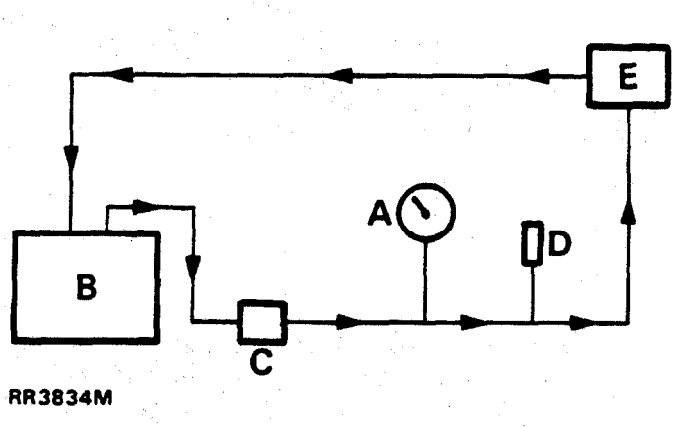
FUEL PRESSURE CHECK

In order to check the fuel pressure it is necessary to first depressurise the fuel system as follows:

WARNING: Under normal operating conditions the fuel injection system is pressurised by a high pressure fuel pump, operating at up to 2.3 to 25 bar. When engine is stationary pressure is maintained within system. To prevent pressurisedfuelescapingandtoavoidpersonal injury it is necessary to depressurise 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 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 ground terminal.

NOTE: Fuel at low pressure will remain in system. To remove low pressure fuel, place absorbent clotharound fuel pipe at the filter during disconnection

5. Connect the pressure gauge on the outlet from the filter, located on the chassis.
6. Reconnect the battery and turn the ignition to posititon II while observing the pressure gauge. Results
   Expected reading 2,39-2,672 kgf/cm²
   Pressure drop-max 0.7 kgf/cm² 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 regutator, see Fuel pressure regulator.

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 Kgf/cm². No injector should leak more than 2 drops of fuel per minute.

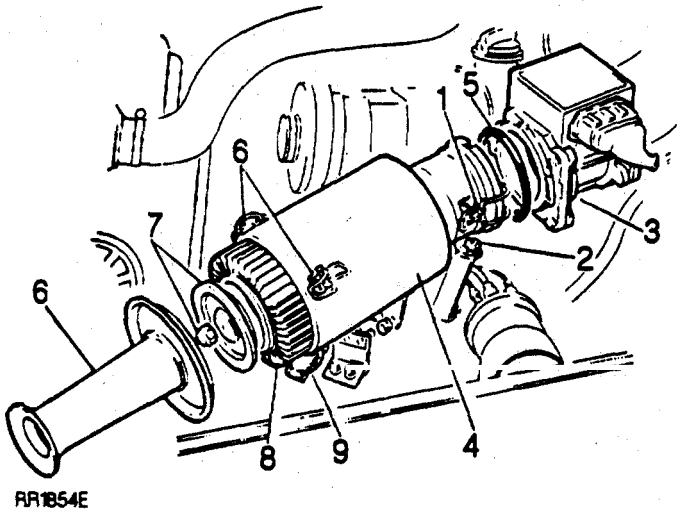
Fuel Delivery Test

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.

REMOVING AIR CLEANER

To Remove

1. Release two clips securing air cleaner to mass airflow sensor.
2. Release two nuts and bolts securing air cleaner to left hand valance mounting bracket.
3. Detach mass airflow sensor from air cleaner, and lay carefully to one side.
4. Detach air cleaner from centre mounting bracket and withdraw from engine compartment.
5. Remove large 'O' ring from outlet tube of air cleaner. Fit a new 'O' ring if in poor condition.
6. Unclip three catches and remove inlet tube.
7. Remove nut and end plate securing air cleaner element in position.
8. Withdraw air cleaner element and discard.
9. Inspect dump valve for condition and free of obstructions.



RR1854E

To Refit

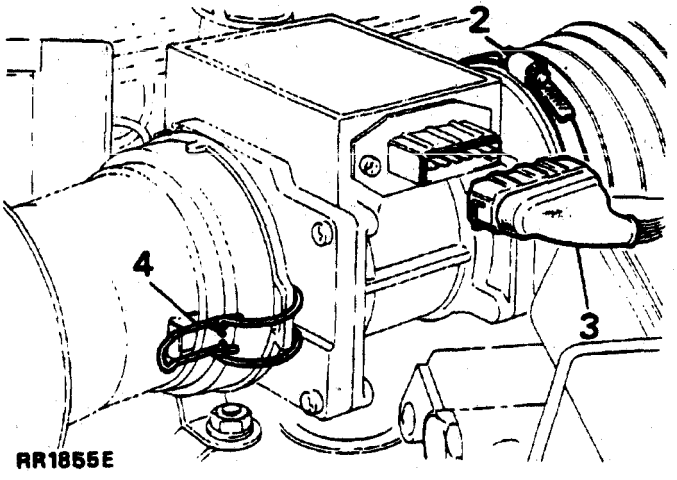
10. Fit new element and secure in position.
11. Refit inlet tube.
12. Refit air cleaner to mounting bracket and secure.
13. Clip air cleaner to mass air flow sensor.

REMOVING MASS AIR FLOW SENSOR

To Remove

NOTE: The air flow sensor is not a serviceable item. In event of failure or damage complete unit must be replaced.

1. Disconnect battery ground terminal .
2. Release intake hose clamp, disconnect from sensor.
3. Disconnect multi-plug.
4. Release two clips securing air cleaner case to air flow sensor. Remove sensor from engine compartment.



RR1855E

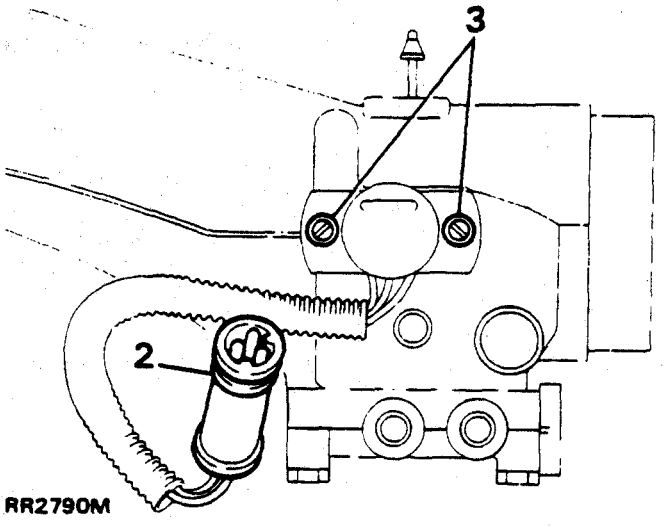
To Refit

5. Reverse removal procedure. Ensure multi-plug is firmly reconnected, and hose clamp at the rear of sensor is securely tightened, to prevent unmetered air entering engine.

REMOVING **THROTTLE** POSITION SENSOR

To Remove

1. Disconnect battery ground terminal.
2. Disconnect electrical plug.
3. Remove two screws securing throttle position sensor to plenum chamber and carefully pull throttle position sensor off throttle shaft.



4. Remove old gasket.

To Refit

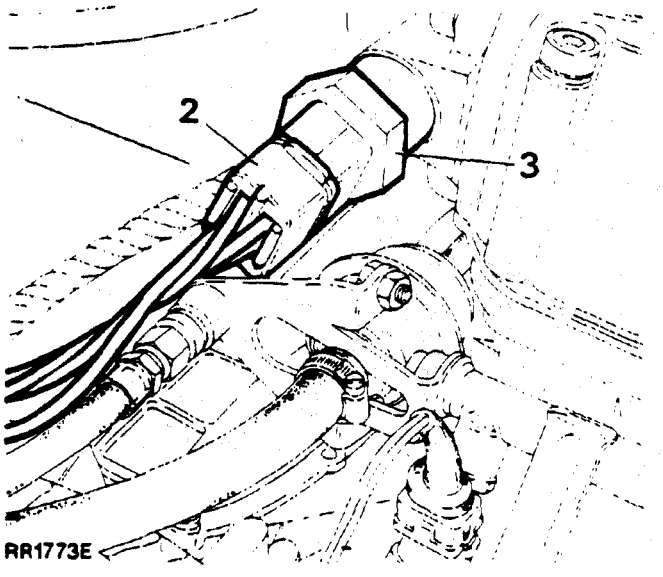
5. Fit new gasket.
6. Align throttle position sensor and shaft fiats, slide switch on to throttle shaft. Secure throttle position sensor to plenum chamber.

CAUTION: D O NOT operate throttle mechanism while throttle position sensor is loosely fitted, damage may be caused to throttle position sensor wiper track.

REMOVING IDLE AIR CONTROL VALVE

To Remove

1. Disconnect battery ground terminal.
2. Remove multi-plug.
3. Unscrew idle air control valve from rear plenum chamber.
4. Remove washer.



To Refit

5. Fit NEW sealing washer.

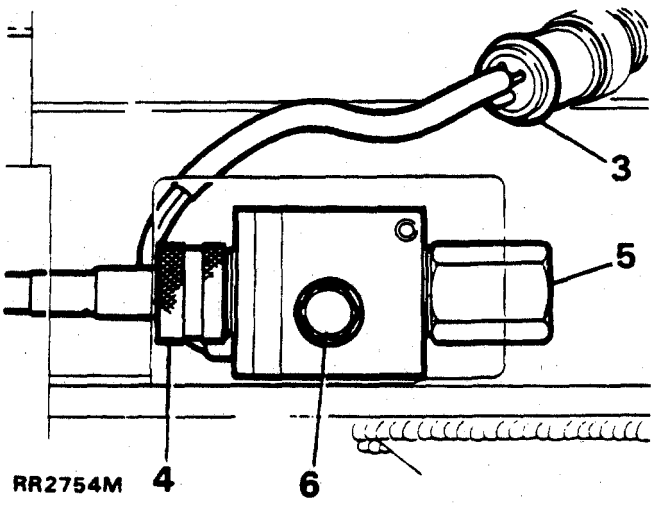
NOTE: If same idle air control valve is being refitted clean sealing compounds from threads. Apply Loctite 241 to threads of idle air control valve before reassembly.

6. Tighten idle air control valve to 20 Nm.
7. Reverse removal instructions.

REMOVING VEHICLE SPEED SENSOR

To Remove

1. Place vehicle on ramp, apply parking brake.
2. Disconnect battery ground terminal .
3. Raise ramp, disconnect electrical plug.
4. Disconnect speedometer cable.
5. Do not remove blanking cap.
6. Remove single bolt. Remove vehicle speed sensor from mounting bracket.



To Refit

7. Reverse the removal instructions.

REMOVING FUEL INJECTION-RELAY MODULES

Incorporated in fuel injection electrical system are two relays modules and a diagnostic plug. Access to the modules and plug is gained by removing the toe board from the front passenger's footwell. For exact location, refer to illustration ST 3362M in Electrical Section 86.

REMOVING ELECTRONIC CONTROL MODULE (ECM) - 14 CUX

NOTE: The ECM is not serviceable, in event of module failure it must be replaced.

To Remove

1. Disconnect battery ground terminal.
2. Remove toe board from front passenger's footwell.
3. Release ECM plug retaining clip.
4. Detach plug from ECM.
5. Remove securing screws and withdraw ECM.

To Refit

6. Refit ECM by reversing the removal procedure.

REMOVING INERTIA FUEL SHUT-OFF SWITCH

The inertia fuel shut off switch is located adjacent to the auxiliary fuse panel. Access is gained by removing the fuse panel cover.

To Remove

1. Disconnect battery ground terminal .
2. Remove two screws securing inertia fuel shut-off switch.
3. Withdraw inertia fuel shut-off switch and disconnect multi-plug.

To Refit

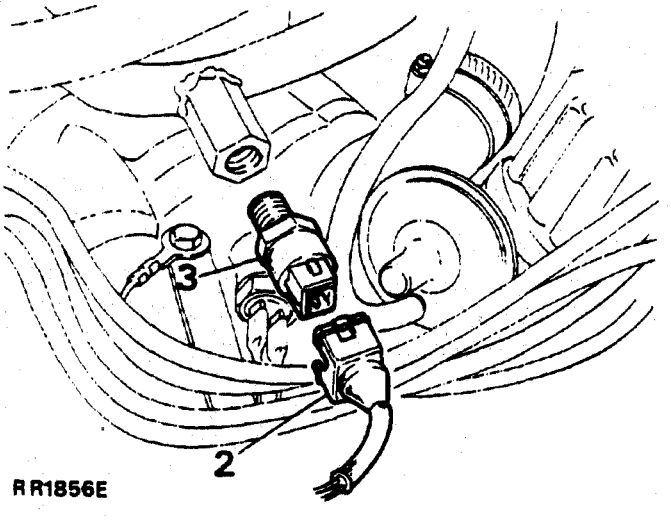
4. Reverse removal procedure. Ensure that switch is reset (plunger in lowest position).

REMOVING ENGINE FUEL TEMPERATURE SENSOR

To Remove

NOTE: Fuel leakage will not occur when engine fuel temperature sensor is removed from fuel rail, therefore it is not necessary to depressurise the fuel system.

1. Disconnect battery ground terminal .
2. Remove multi-plug from engine fuel temperature sensor .
3. Release engine fuel temperature sensor from fuel feed rail.



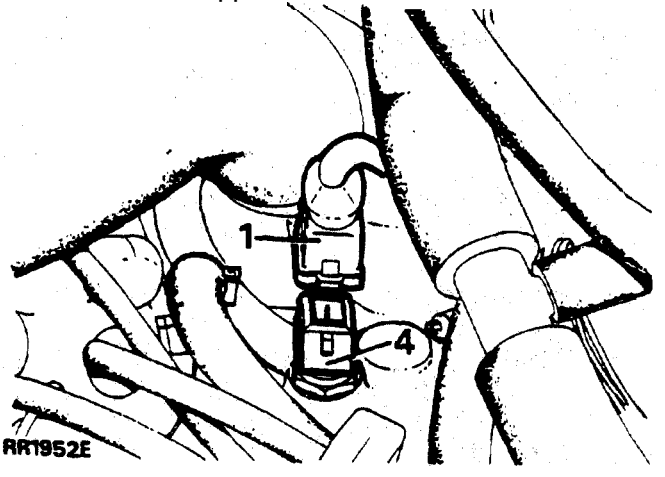
To Refit

4. Reverse removal procedure. Ensure engine fuel temperature sensor is tightened securely in fuel rail.

REMOVING ENGINE COOLANT TEMPERATURE SENSOR

To Remove

1. Disconnect engine coolant temperature sensor multi-plug.
2. Release radiator bottom hose, partially drain cooling system.
3. Refit hose and tighten clamp.
4. Remove engine coolant temperature sensor from left hand front branch of intake manifold.
5. Remove copper washer.



To Refit

6. Fit a NEW copper washer.
7. Fit engine coolant temperature sensor and tighten securely.
8. Refill cooling system.
9. Run engine, check for water leaks around engine coolant temperature sensor .

DEPRESSURISING FUEL SYSTEM

WARNING: Under normal operating conditions the 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 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.
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 ground terminal .

NOTE: Fuel at low pressure will remain in system. To remove low pressure fuel, place absorbent cloth around fuel feed hose at fuel rail.

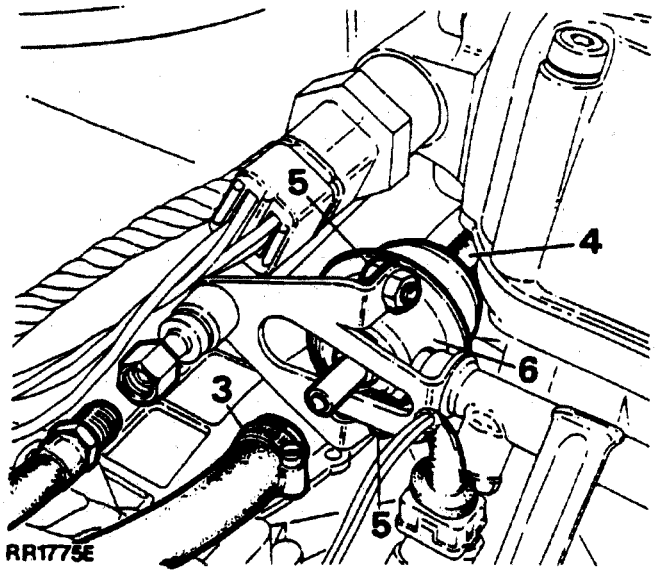
5. Disconnect either:
   a) Nut and olive at fuel rail
   OR
   b) Hose at inlet end of fuel filter.

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).

REMOVING FUEL PRESSURE REGULATOR

To Remove

1. Depressurise fuel system.
2. Disconnect battery ground terminal.
3. Release hose clamp securing fuel return hose to fuel pressure regulator. Remove the hose.
4. Pull vacuum hose from rear of fuel pressure regulator.
5. Remove two nuts and bolts securing fuel pressure regulator to fuel rail, ease regulator fuel inlet pipe out of fuel rail.
6. Withdraw fuel pressure regulator from engine compartment.



NOTE: Fit a NEW 'O' ring to fuel inlet pipe if original fuel pressure regulator is refitted.

To Refit

7. Lightly coat 'O' ring with silicon grease 300 before fitting fuel pressure regulator.
8. Reverse removal procedure.
9. Reconnect battery and pressurise fuel system. Check there are no fuel leaks around fuel pressure regulator connections.

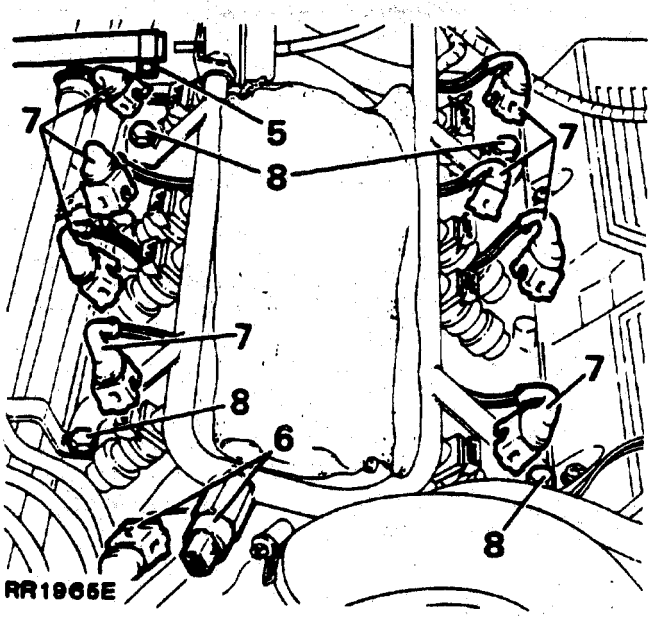
REMOVING FUEL RAIL-INJECTORS R/H AND L/H

To Remove

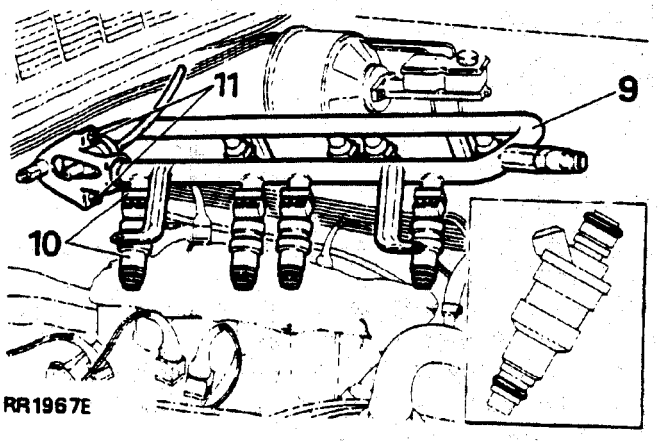
1. Depressurise fuel system.
2. Disconnect battery ground terminal.
3. Remove plenum chamber.
4. Remove ram housing.

NOTE: Place cloth over ram tube openings to prevent ingress of dirt.

5. Release hose clamp and remove fuel return hose from fuel pressure regulator.
6. Disconnect multi-plug from engine fuel temperature sensor.
7. Disconnect multi-plugs from injectors.
8. Remove five bolts securing fuel rail support brackets to intake manifold. Lay heater pipes to one side.



9. Remove fuel rail and injectors.
10. Remove injector retaining clips, ease injectors from rail.
11. Remove fuel pressure regulator if required.



To Refit

12. Fit NEW 'O' rings, to injectors. Lightly coat *'O'* rings with silicon grease 300. Insert injectors into fuel rail, multi-plug connections facing outwards.
13. Refit retaining clips.

CAUTION: Care must be taken when refitting the fuel rail and injectors to intake manifold to prevent damage to 'O' rings.

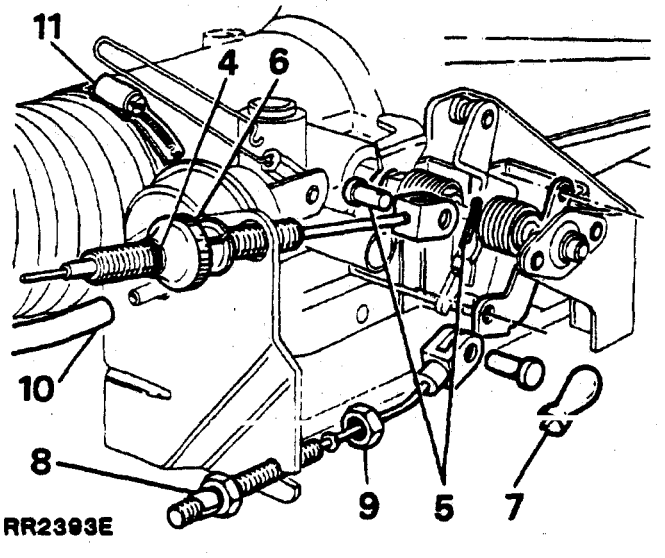
14. Fit a NEW *'O'* ring to fuel pressure regulator lightly coat 'O' ring with silicon grease 300 and secure regulator to the fuel rail.
15. Fit fuel rail and heater pipe assemblies to intake manifold. Secure rail and pipes in position with five bolts.
16. Reverse removal instructions 2 to 7.
17. Pressurise fuel system and check for fuel leaks around injectors and fuel pressure regulator.

REMOVING PLENUM CHAMBER

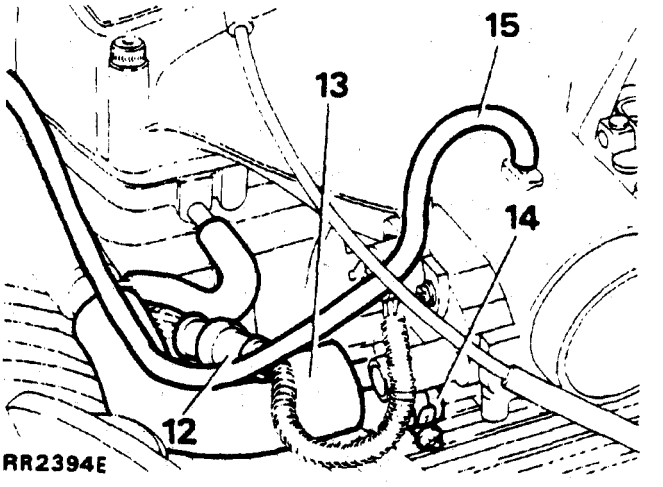
Includes throttle levers and throttle disc

To Remove

1. Disconnect battery ground terminal.
2. Disconnect electrical multi-plug from idle air control valve.
3. Disconnect vacuum hose adjacent to idle air control 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 bin 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 (where fitted).



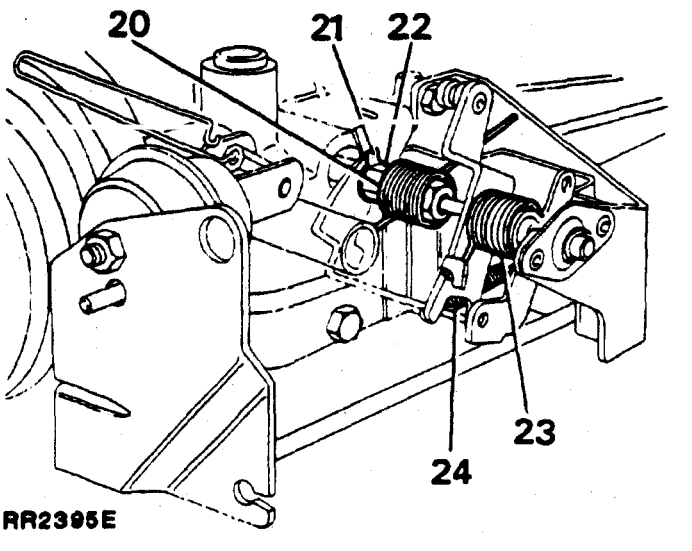
11. Remove intake hose from neck of plenum chamber.
12. Disconnect throttle position sensor multi-plug.
13. Remove PCV breather hose.
14. Disconnect two coolant hoses and plug each hose to prevent excessive loss of coolant. Identify each hose for re-assembly.

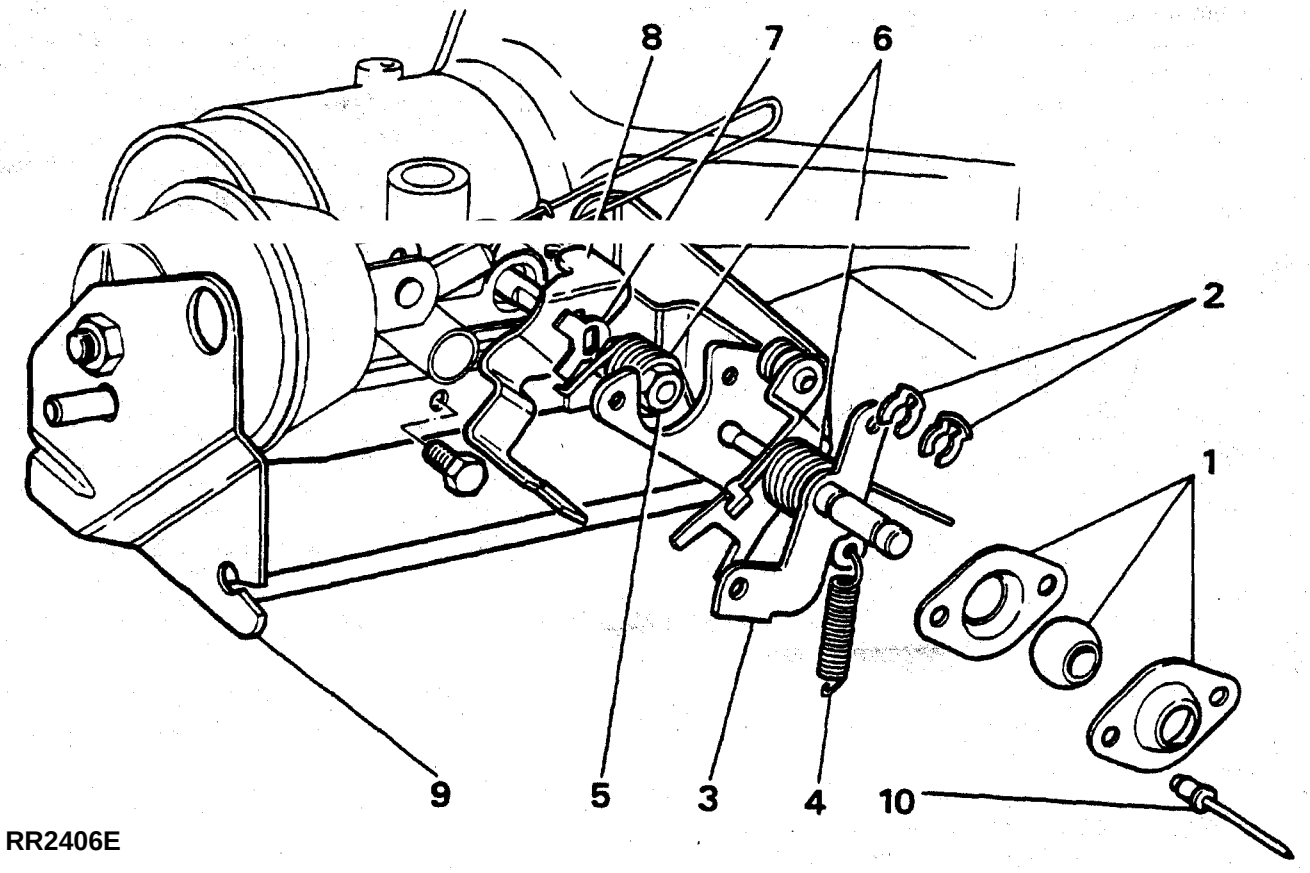


15. Remove distributor vacuum hose.
16. Release two screws and remove throttle position sensor.
17. Remove six screws securing plenum chamber. Remove plenum chamber.
18. Remove idle air control valve hose.

Removing throttle lever assembly

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.



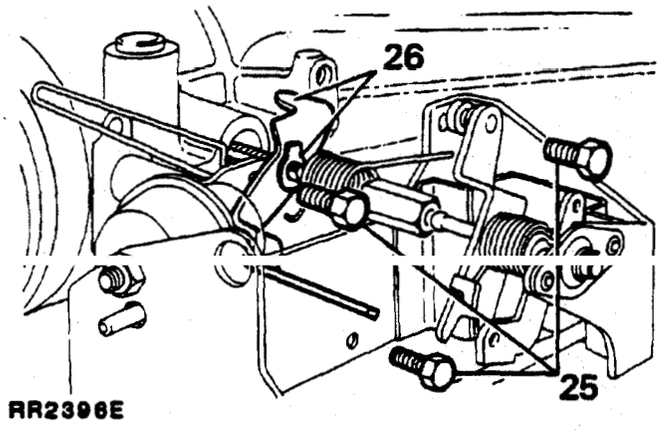


RR2406E

KEY

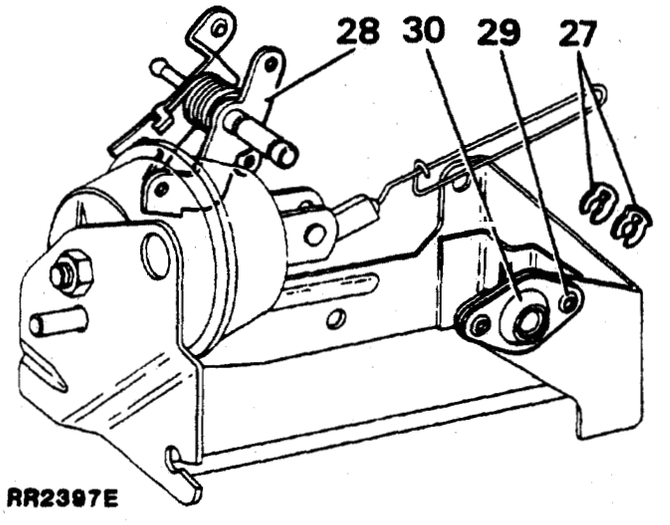
1. Spherical bush/housing
2. Retaining clips (2)
3. Countershaft assembly
4. Overtravelspring
5. Throttle spindle nut
6. Throttle return spring (2)
7. Tab washer
8. Throttle stop lever
9. Throttle bracket assembly
10. Pop rivets (2)

25. Remove three bolts securing throttle bracket to plenum chamber, withdraw bracket assembly.
26. Remove tab washer and throttle stop lever from throttle shaft.

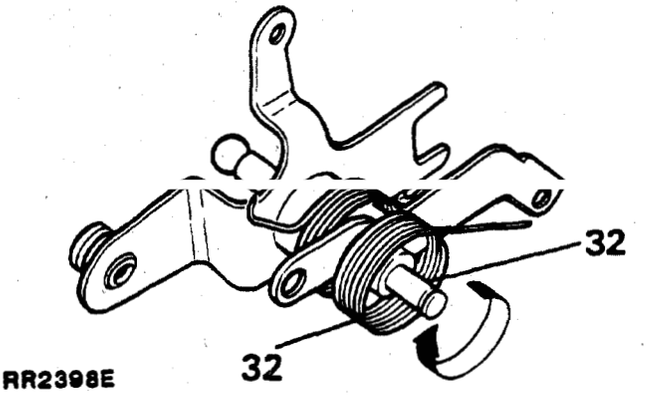


inspect and overhaul throttle lever assembly

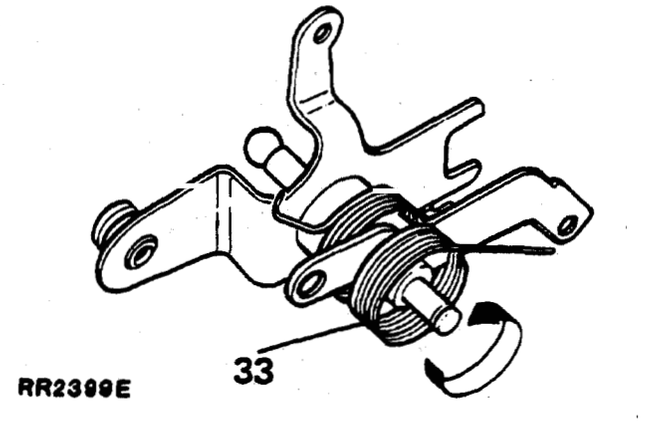
27. Remove two retaining clips from spherical bush.
28. Remove the countershaft assembly.
29. If spherical bush is worn, drill out two securing rivets (4,7 mm, (3/16 in) diameter drill).
30. Split assembly, discard worn bush.



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.



33. Wind new spring onto countershaft assembly, small hooked end of spring is wound on first.

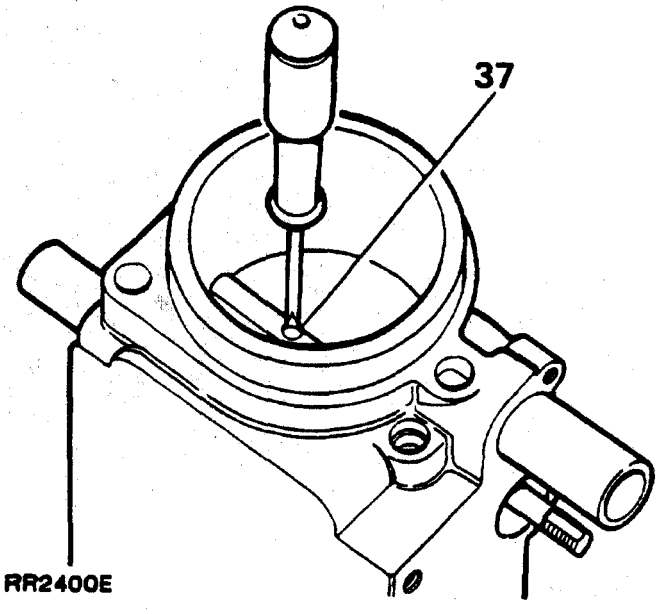


34. Grease shaft with Admax L3 or Energrease LS3, fit countershaft assembly to spherical bearing, secure with two clips.
35. Examine throttle stop lever for wear, fit a new lever if necessary.

Inspect and overhaul throttle disc

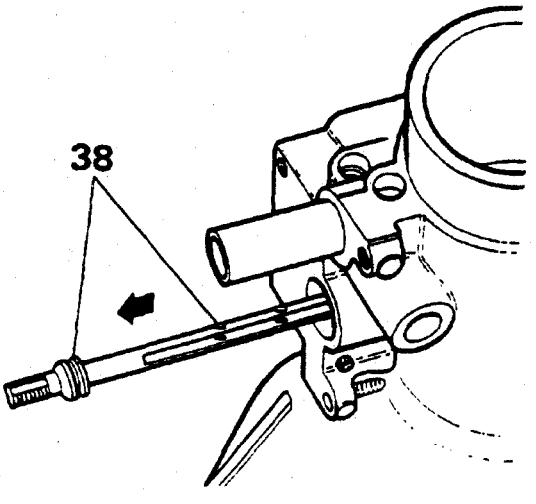
36. Examine throttle shaft for excessive wear between bushes in plenum chamber and shaft. A small amount of clearance is permissible. If excessive wear is evident fit new shaft and bushes as follows.
37. Remove two split screws securing throttle disc and withdraw disc.

CAUTION: Take care not to damage shaft.



RR2400E

38. Remove shaft and air seal from plenum chamber.



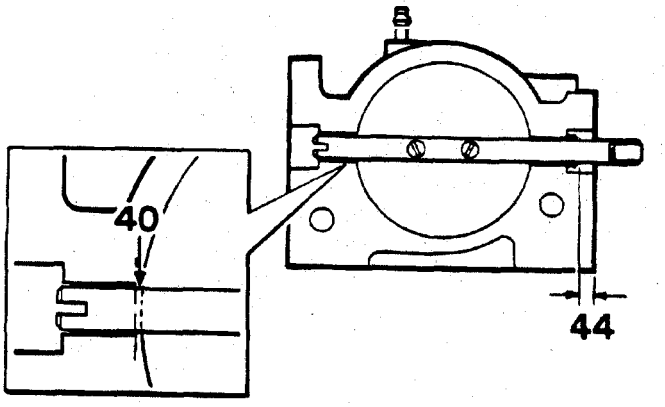
RR2401E

39. Using suitable drift, drive out bushes.

CAUTION: Take care not to damage plenum chamber bores

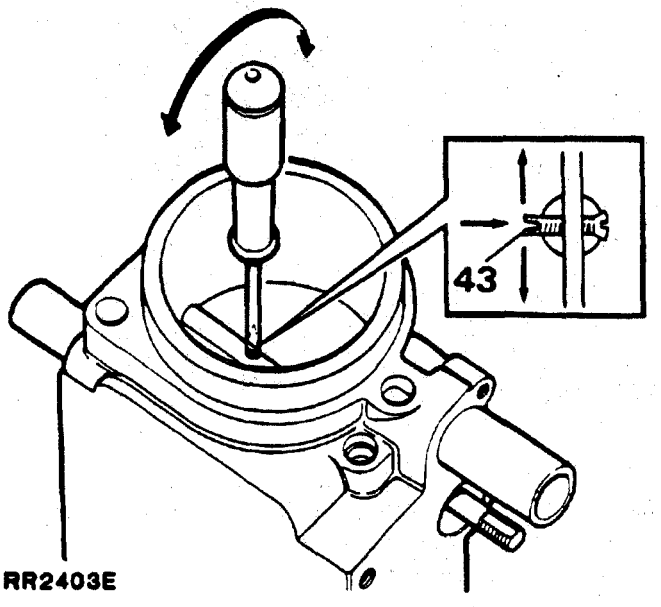
40. Press in new bushes until flush with throttle disc bore.

CAUTION: Ensure that bushes do not protrude into bore, as they will interfere with movement of throttle disc.



RR2402E

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.

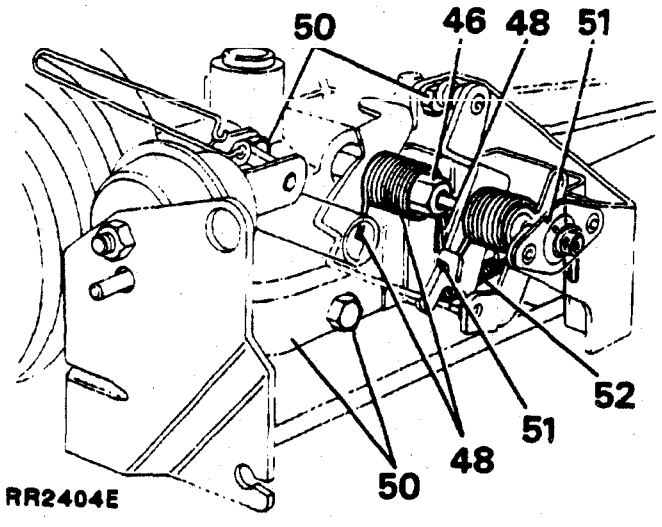


RR2403E

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.

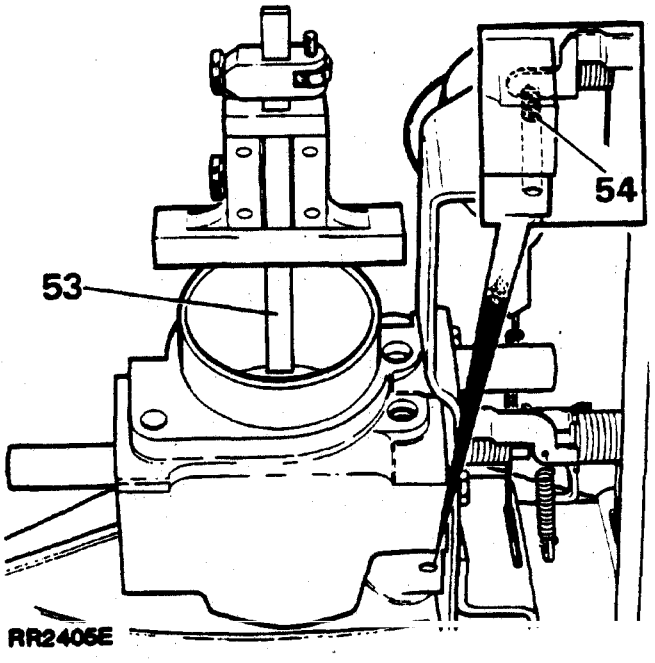
Assemble throttle levers and bracket

45. Fit stop lever to throttle shaft, a new tab washer and secure with throttle spindle nut.
46. Holding stop lever on stop, tighten throttle spindle 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.
highly grease throttle return and overtravel springs with Admax L3 or Energrease LS3.



NOTE: If new throttle levers have been fitted, minimum throttle setting of disc must be checked to ensure it is 90° to bore.

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.



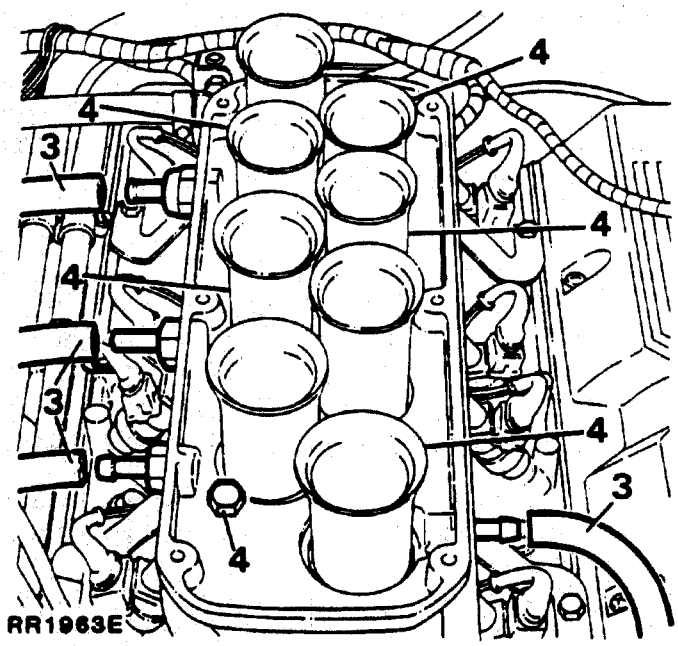
To Refit

55. Where applicable, reconnect and adjust cruise control actuator link.
56. Clean joint faces of plenum and ram housing. Apply 'Hylomar' sealant, refit plenum chamber. Tighten bolts to 26 Nm.
57. Reverse remaining instructions.

REMOVING RAM HOUSING

To **Remove**

1. Disconnect battery ground terminal.
2. Remove 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.

To 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.

REMOVING INTAKE MANIFOLD

To Remove

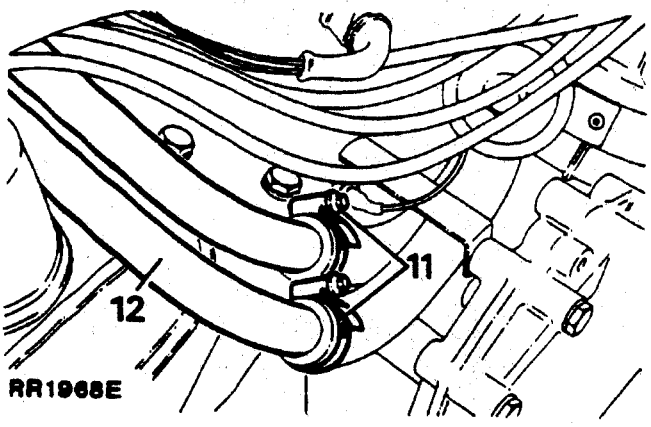
1. Depressurise fuel system.
2. Disconnect battery ground terminal.
3. Remove radiator bottom hose, drain coolant until level is below thermostat housing. Refit hose, tighten clamp.
4. Remove plenum chamber.
5. Remove ram housing.

CAUTION: Place a protective cover over intake manifold openings to prevent ingress of dirt.

6. Disconnect electrical multi-plugs to engine fuel temperature sensor and injectors.
7. Remove two nuts and bolts securing fuel pressure regulator to fuel rail, ease fuel pressure regulator out of rail. Seal end of fuel rail with plastic plugs to prevent ingress of dirt.

NOTE: Intake manifold can be removed from cylinder block without removing fuel rail and injectors.

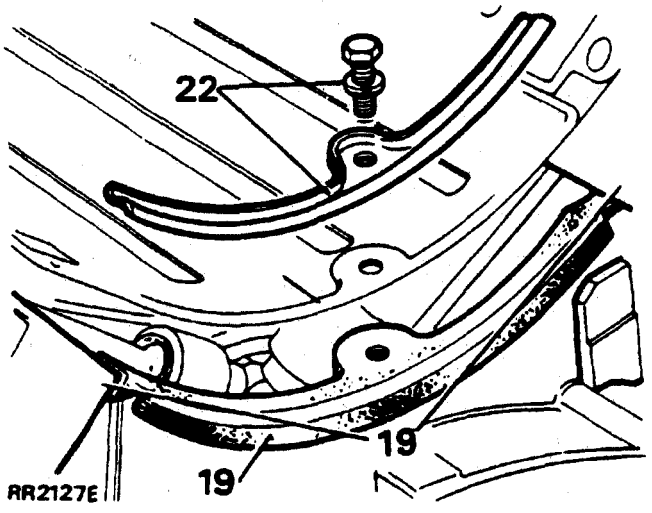
8. Disconnect electrical leads from air-conditioning engine coolant temperature sensor.
9. Disconnect electrical leads to engine coolant temperature sensor located at front of intake manifold.
10. Remove injector harnesses from behind fuel rail, lay to one side.
11. Release hose clamps securing two heater hoses behind water pump.
12. Remove two bolts securing rigid heater pipes to intake manifold and ease pipes out of hoses.



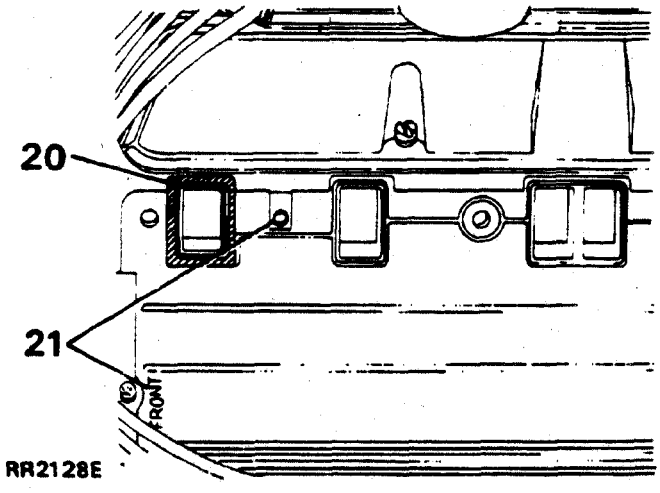
13. Lay heater pipe assembly to one side.
14. Release twelve bolts securing intake manifold.
15. Remove inlet manifold.
16. Remove two gasket clamps from cylinder block.
17. Lift off gasket, remove gasket seals.
18. Remove sealing compound from around water passage openings of cylinder heads.

To Refit

19. Locate NEW seals in position with ends engaged in notches formed between cylinder heads and block.



20. Lightlyapply 'Hylomar' sealant around outside of water passage openings on cylinder heads, manifold gasket and intake manifold.



21. Fit manifold gasket with word 'FRONT' to front and open bolt hole to front right hand side.
22. Fit gasket clamps, DO NOT fully tighten bolts.
23. Locate intake manifold onto cylinder heads, clean threads of manifold securing bolts.
24. Fit manifold bolts. Evenly tighten a little at a time, alternating sides, working from centre outwards.
25. Tighten to 38 Nm.
26. Tighten gasket clamps to 18 Nm.
27. Reverse remaining removal instructions.
28. Replenish cooling system.
29. Start engine, check for coolant and fuel leaks.

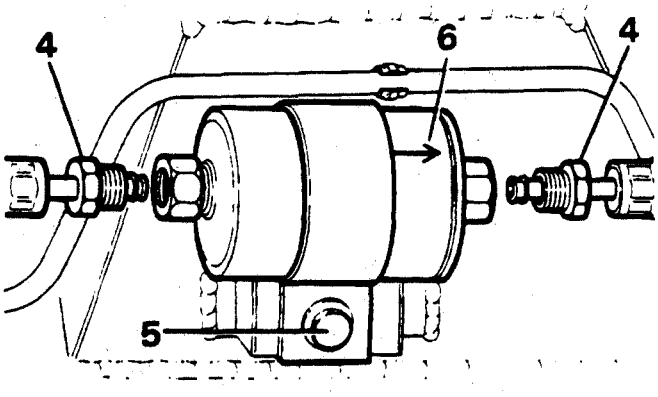
REMOVING FUEL FILTER

To 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 regarding fuel handling are strictly adhered to when carrying out following instructions.

1. Depressurise fuel system.
2. Fuel filter is located on chassis side member below front passenger's door.
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 fuel filter from chassis side member.



To Refit

6. Fit a new fuel filter observing direction of flow arrows stamped on canister.
7. Tighten securing nut and bolt.
8. Fit inlet and outlet hoses. Tighten unions to a of 30Nm.
9. Refit fuel pump relay module, reconnect battery.
10. Start engine and inspect for fuel leaks around hose connections.

REMOVING FUEL TANK AND FUEL PUMP DEFENDER 110

Remove

WARNING: Ensure fuel handling precautions given in section 01 - introduction regarding fuel handling 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.

To renew the pump, it is necessary to remove the fuel tank from the vehicle.

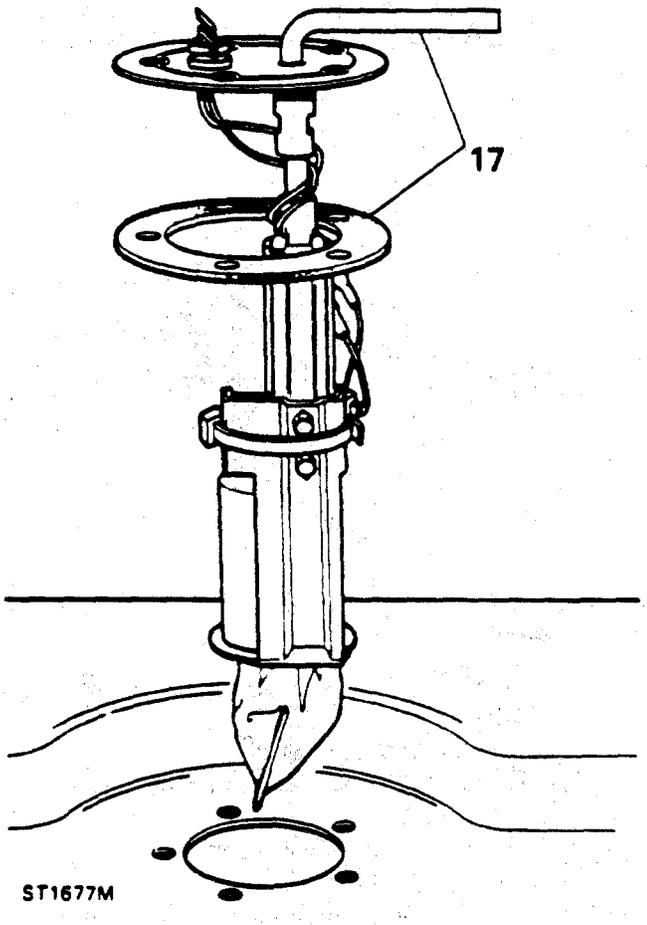
1. Move the vehicle to a well ventilated area and disconnect the battery. Clean the area around the pump.
2. Remove the fuel tank drain plug and allow the fuel to drain into a suitable receptacle that can be sealed afterwards
   ENSURE TANK IS DRAINED COMPLETELY,
   Refit drain plug - refer to WARNING concerning fuel handling at start of procedure.
3. Working from the right hand side of the vehicle, disconnect the fuel feed pipe and the spill return at the rubber connections.
4. Disconnect the fuel filler hose and breather hose from the tank.
5. Whilst noting the cable colours, disconnect the electrical leads from the fuel gauge unit at the left hand side of the vehicle.
6. Disconnect pipes to expansion tank.
7. Remove the eight nuts and bolts securing the anti-roll bar to the chassis and push the anti-roll bar down to provide access to the tank.
8. Remove the left hand lashing eye to facilitate removal of the fuel tank.
9. Place a support under the fuel tank. preferably one which will enable the fuel tank lo be progressively lowered.
10. Remove the two nuts retaining the forward end of the tank.
11. Remove the two nuts retaining the rear end of the tank.
12. Carefully lower the tank sufficiently to enable the electrical leads to the fuel pump to be disconnected.
13. Finally remove the tank from the vehicle together with the fuel pump and rear section of the fuel feed pipe. Place tank in a safe area.

NOTE: A fuel vapour warning label must be attached to vehicle.

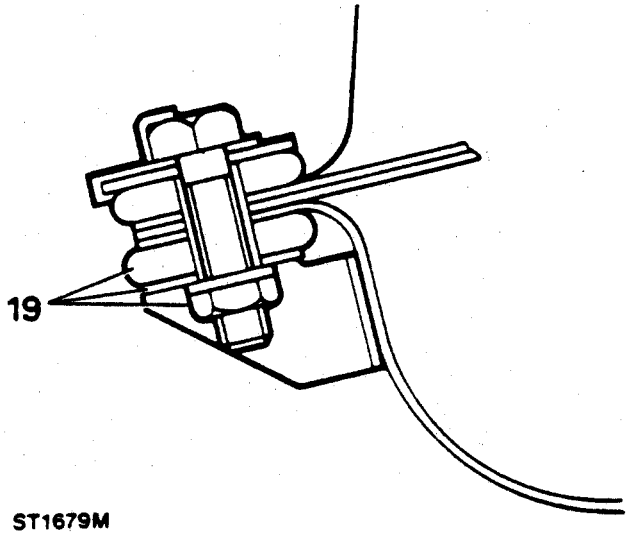
14. Disconnect the rear section of the fuel feed pipe from the pump.
15. Remove the five retaining screws and withdraw the fuel pump and sealing ring from the tank.
16. Cover the pump aperture in the tank to prevent the ingress of foreign matter and escape of fuel vapours.

Refit

17. Fit the pump into the tank with a new sealing ring so that the outlet pipe is directed towards the front of the vehicle and the electrical connections to the rear.

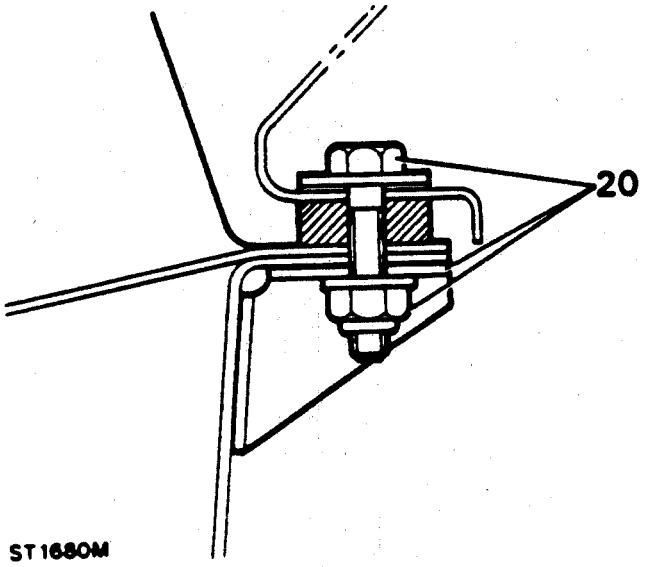


18. Offer up tank to chassis ana connect the electrical leads; black to ground (-) and white to positive (+).
19. Locate front of tank on the two captive bolts and secure with the mounting rubber, flat and spring washers and nut.



ST1679M

20. Secure the rear of the tankwith the **two** captive bolts, plain washer and Nyloc nut.



ST1680M

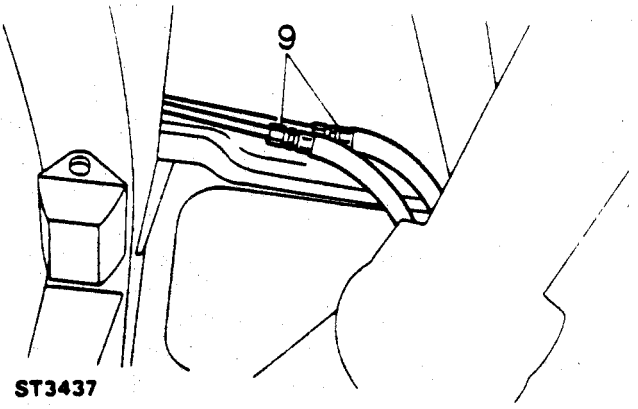
21 Connect the fuel teed and expansion tank pipes.
22. Connect the spill return pipe.
23. Connect the fuel filler hose and breather pipe to me tank.
24. Fit the left hand lashing eye.
25. Fit the anti roll bar.
26. Fit the drop plate support bars - if fitted.
27. Connect the fuel gage unit leads
28. Reconnect battery and check operation of pump and changeover solenoid - if fitted.
29. Run engine check all connection for leaks.

FUEL TANK DEFENDER 90

Remove

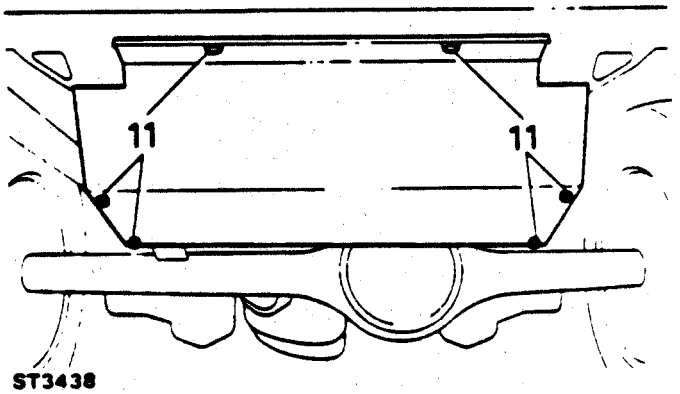
WARNING: During the following operations ensure that the fuel handling precautions and warnings in Section 1 of this manual are being adhered to.

1. Disconnect battery.
2. Raise vehicle onto axle stands.
3. Remove rear step.
4. Remove spare wheel.
5. Remove spare wheel carrier.
6. Drain fuel tank.
7. Disconnect fuel filler pipe at tank.
8. Disconnect breather pipe at filler neck.
9. Disconnect main fuel lines at union connections forward of tank.



ST3437

10. Disconnect pipe to expansion tank using special tool LRT-19-002 on green connector.
11. Loosen protection plate/fuel tank securing **bolts.**



ST3438

12. Support tank and plate, remove securing bolts.
13. Lower tank sufficient to gain access and disconnect multi-plug
14 Complete lowering of tank and withdraw with protectionplate.

Refitting

15. Position protection plate and fuel tank under rear of vehicle.
16. Raise plate and tank sufficient to connect multi-plug.
17. Complete raising and secure plate with bolts.
18. Connect all fuel and breather pipes at their various locations/
19. Refit spare wheel carrier.
20. Refit spare wheel.
21. Refit rear step.
22. Remove vehicle from axle stands.
23. Replenish fuel tank.
24. Reconnect battery.
25. Run engine for short period.
26. Check all disturbed connections for leaks.

FUEL PUMP/SENDER UNIT

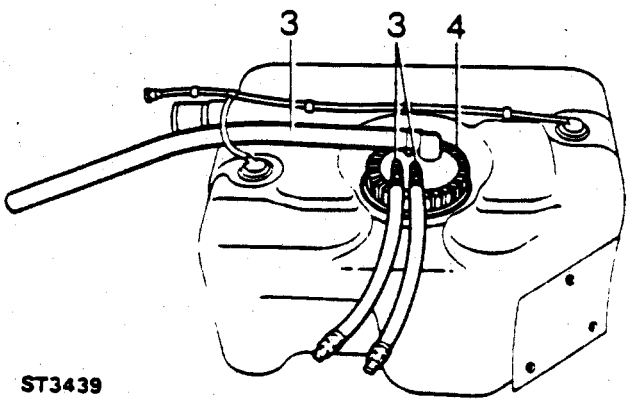
Special tool

LRT-19001 Fuel pump remover

Removal

WARNING:. During the following operations ensure that the fuel handling precautions and warnings in Section 1 of this manual are being adhered to.

1. Disconnect battery.
2. Remove fuel tank.
3. Disconnect fuel and breather pipes from pump/senderunit.



ST3439

4. Using special tool LRT-19-001 remove fuel pump retaining ring.
5. Withdraw pump/sender unit from tank.

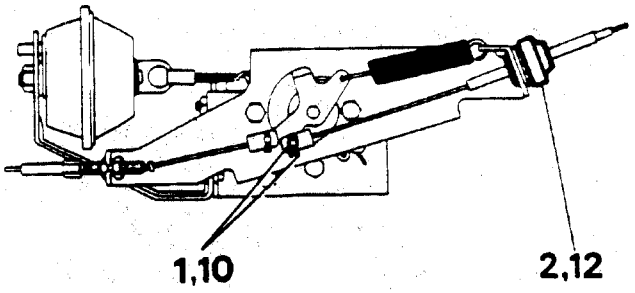
Refitting

6. Refit in reverse order to removal.

REMOVING ACCELERATOR CABLE

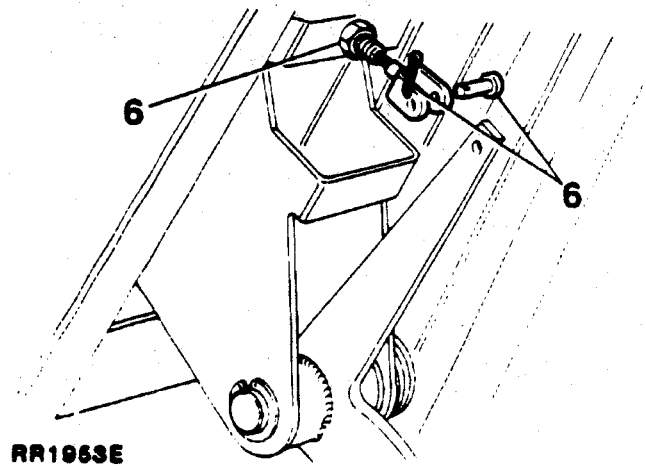
Remove

1. Remove clevis pin securing accelerator cable to lever.
2. Carefully pry accelerator cable adjustment nut out of mounting bracket.
3. Remove accelerator cable from mounting bracket.



RR1964E

4. Release outer cable from retaining clips in engine compartment.
5. Remove toe board from drivers footwell.
6. Disconnect cable from accelerator pedal and release cable locknut.
7. Feed cable through bulkhead grommet into engine compartment.



RR1963E

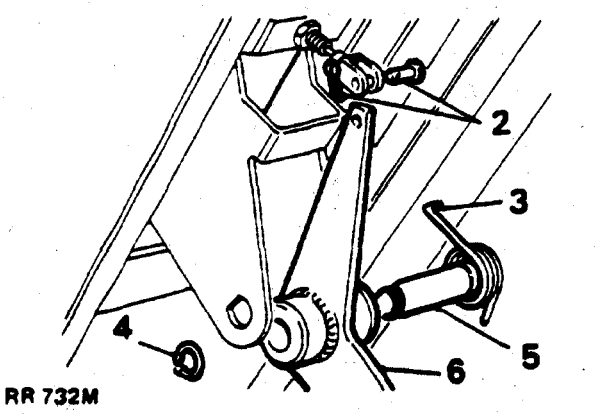
Refit

8. Feed new accelerator cable from engine compartment through bulkhead grommet.
9. Connect cable to accelerator pedal.
10. Connect cable to accelerator linkage, using a new split pin.
11. Clip outer cable adjustment nut into mounting bracket.
12. Adjust outer cable to give 1 57 mm (0 062 in) free play in inner cable Check accelerator operation.

REMOVING ACCELERATOR PEDAL

Remove

1. Remove toe board from driver's footwell.
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.
6. Remove accelerator pedal.



Refit

7. Lightly grease pivot and clevis pins.
8. Fit clevis pin using a new split pin.
9. Reverse remaining removal instructions.

COOLING SYSTEM

Engine Protection

To prevent corrosion of the aluminium engine parts it is vital that the cooling system is filled with a solution of clean water and anti-freeze winter and summer. Never fill or top-up with water only, always add anti-freeze. Never use salt water otherwise corrosion will occur. In certain territories where the only available water supply may have some salt content, use only clean rainwater or distilled water, with anti-freeze added.

Use only Universal anti-freeze or permanent type ethylene base, without methanol containing, a suitable inhibitor for aluminium engine parts. Use one part of anti-freeze to one part water. Anti-freeze should be used even in climates where is it not necessary as a corrosion inhibitor. No other corrosion inhibitor should be used. A concentration of at least 50% should be maintained.

Anti-freeze can remain in the cooling system and will provide adequate protection for two years provided that the specific gravity of the coolant is checked before the onset of the second winter and topped-up with new anti-freeze as required.

The specific gravity can be checked with a hydrometer and a 50% concentration at 68° F (20° C should read 1.075.

Land Rovers leaving the factory have the cooling system filled with a 50% anti-freeze mixture. This gives protection against frost down to minus 47° C (minus 53° F) .

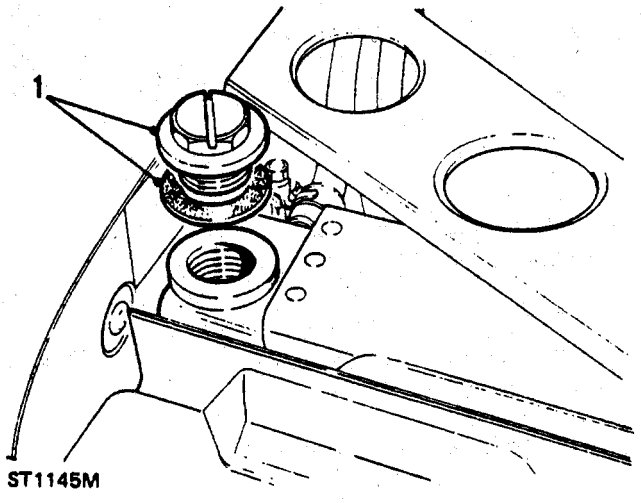
After the second winter the system should be drained and thoroughly flushed. Before adding new anti-freeze examine all joints and renew defective hoses to make sure that the system is leak proof.

See SECTION 09 for protection quantities.

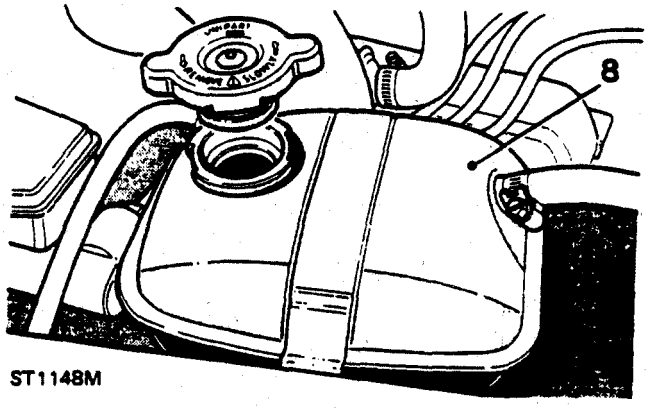
DRAIN AND FILL COOLING SYSTEM

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

1. Remove the radiator filler plug.



2. Disconnect bottom hose and drain cooling system. Connect hose after draining.
3. To drain the expansion tank remove it from the vehicle, empty. flush-out and refit. If necessary renew the expansion tank hose.
4. Make up a solution of anti-freeze and water in a separate container in the concentration required. The cooling system capacity is quoted in the data section. Therefore to allow for topping up and the expansion tank make up a quantity in excess of this quantity.
5. Although anti-freeze may not be required it should be used as an inhibitor see under 'Engine Protection'.
6. Fill the system through the radiator filler plug until the coolant is just below the filler neck.
7. Fit the plug but do not over tighten.
8. Half fill the expansion tank with coolant and secure the cap correctly.



ST1148M

9. Start and run the engine until normal operating temperature is reached. Allow the engine to **cool** and check the levels in the radiator and expansion tank and top up if necessary. Finally check all hose connections for leaks.

REMOVING WATER PUMP

NOTE: The following instructions cover the basic vehicle without air conditioning and power steering. It may therefore be necessary to remove other items in order to gain access to the water pump.

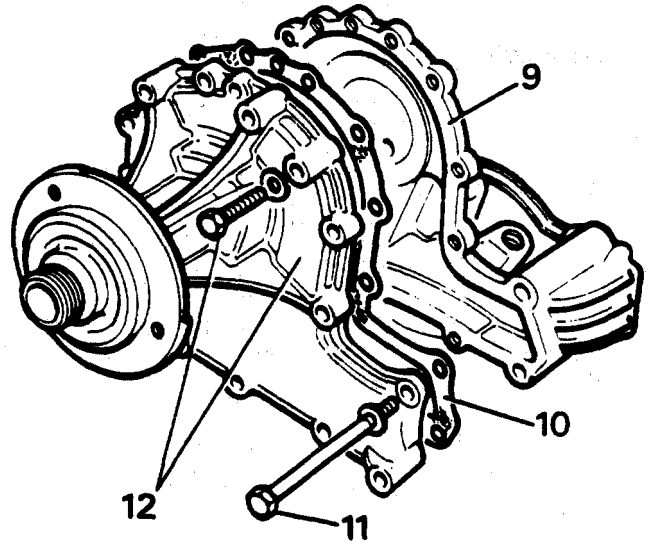
To Remove

1. Disconnect the battery.
2. Disconnect the bottom hose from the radiator to drain the cooling system.
3. Using a cranked open-ended spanner, remove the fan and viscous coupling assembly, noting that it has a left-handed thread.
4. If necessary, remove the fan cowl.
5. Remove the fan drive belt.
6. Remove the bottom hose from the water pump.
7. Release the alternator adjustment strap from the water pump stud.
8. Remove the fourteen bolts and withdraw the water pump and gasket.

NOTE: Information relating to the inspection of the water pump is contained in the engine overhaul section 12.

To Refit

9. Clean the timing cover mating face and ensure all trace of old gasket is removed.
10. Smear a small quantity of grease on both sides of a new gasket and place it in position on the timing cover.
11. Clean the threads of the four long bolts that penetrate the cylinder block and apply Loctite 572 to the threads.
12. Fit the water pump to the engine and secure with the retaining bolts and single stud that also secures the alternator adjustment strap.
13. Fit the bottom hose to the water pump and radiator.
14. Fit the fan cowl, if removed.
15. Fit and tension the drive belt.
16. Fit the fan and viscous coupling.



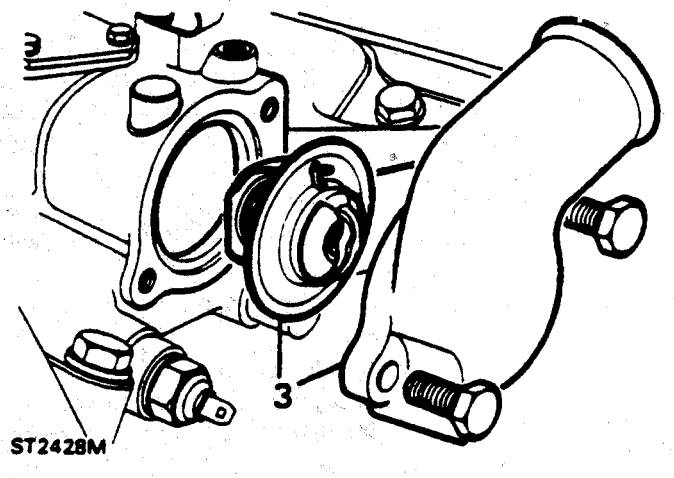
ST3166M

17. Fill the cooling system with the required concentration of recommended anti-freeze in accordance with the instructions in this section.
18. Connect the battery and run the engine while checking for leaks.

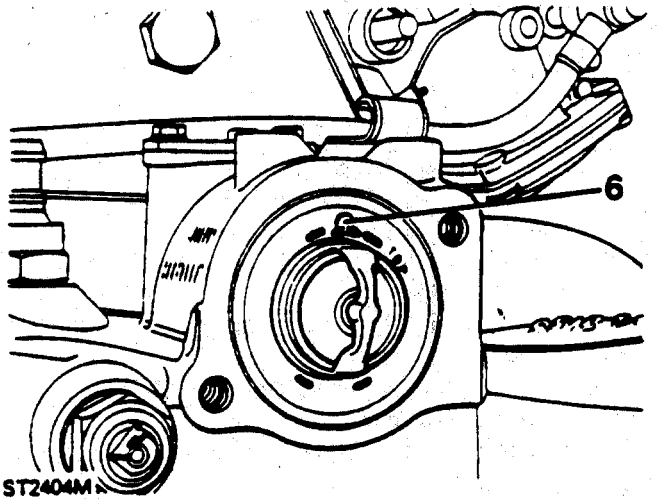
REMOVING THERMOSTAT

To Remove

1. Disconnect the battery and drain the cooling system.
2. Remove any pipes, hoses, or other items that may inhibit access to the thermostat housing.
3. Remove the thermostat cover and withdraw the thermostat. Clean any deposits from the housing and the cover.

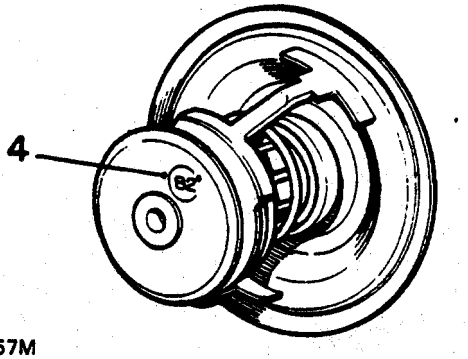


ST2428M



ST2404M

4. The temperature at which the thermostat should be fully open is stamped on the forward end of the thermostat. The following method can be used to determine if the thermostat is satisfactory and suitable for refitting.



ST857M

5. Place the thermostat and a Centigrade thermometer in a laboratory beaker, or a suitable alternative, half full of water. Heat the water and observe the temperature at which the thermostat opens. If faulty, discard the thermostat.

To Refit

6. The thermostat has a small vent hole in which is fitted a 'jiggle' pin to keep the hole clear. Fit the thermostat to the housing ensuring that this vent is uppermost at the 12 o'clock position. If fitted in any other way, an air lock could result in the water passages causing overheating and coolant loss from the system.
7. Fit the thermostat cover using a new gasket. Coat the threads of the retaining screws with Loctite 572 and tighten the screws evenly to the correct torque.
8. Connect all pipes and hoses and refill the cooling system in accordance with the instructions in this section.

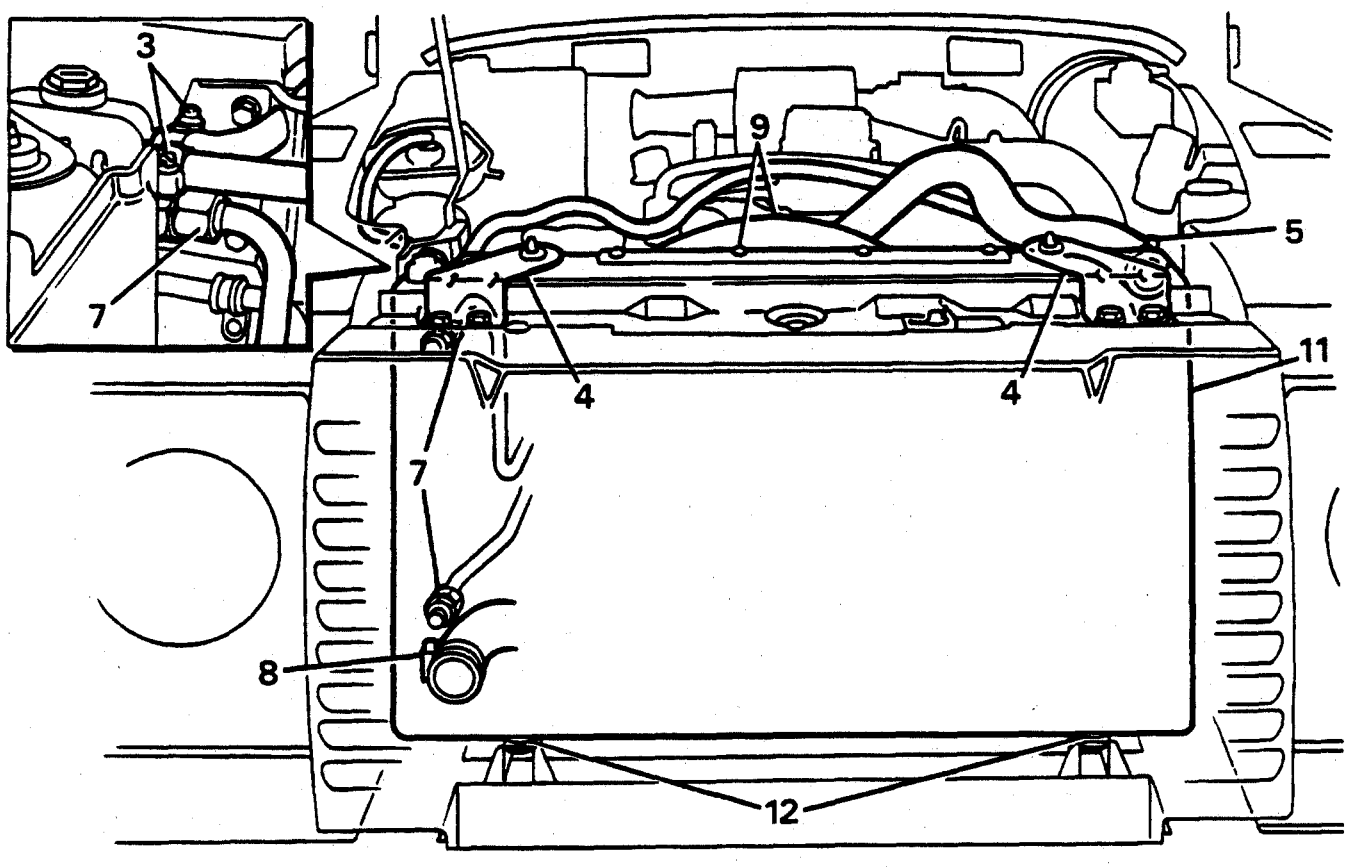
REMOVING RADIATOR

To remove

1. Disconnect the battery.
2. Drain the cooling system.
3. Disconnect the expansion and overflow hoses from the top of the radiator.
4. Release radiator support bracket fixings and detach brackets.
5. Slacken top hose clip, detach hose and place aside.
6. Place a suitable container under the oil cooler hose connections.
7. Disconnect oil cooler hoses at cooler and place aside.
8. Slacken bottom hose clip, detach hose and place aside.
9. Remove the screws securing the cowling to the radiator.
10. Lift the cowling out of the clips at the bottom of the radiator and push it back towards the engine.
11. Carefully lift the radiator out of the engine compartment.

To Refit

12. Lower the radiator into position in the engine compartment, ensuring that the two pegs at the bottom of the radiator locate in the corresponding rubber pads in the cross member brackets.
13. Locate the cowling into the clips at the bottom of the radiator and secure it to the top with the four screws.
14. Secure the top of the radiator with the two brackets and bolts.
15. Secure the top and bottom hoses.
16. Connect the **oil** cooler hoses to the radiator.
17. Connect the expansion tank and overflow hoses. Ensure all hose clips are fully tightened.
18. Refill cooling system with correct coolant mixture.
19. Check and top up engine oil as necessary.



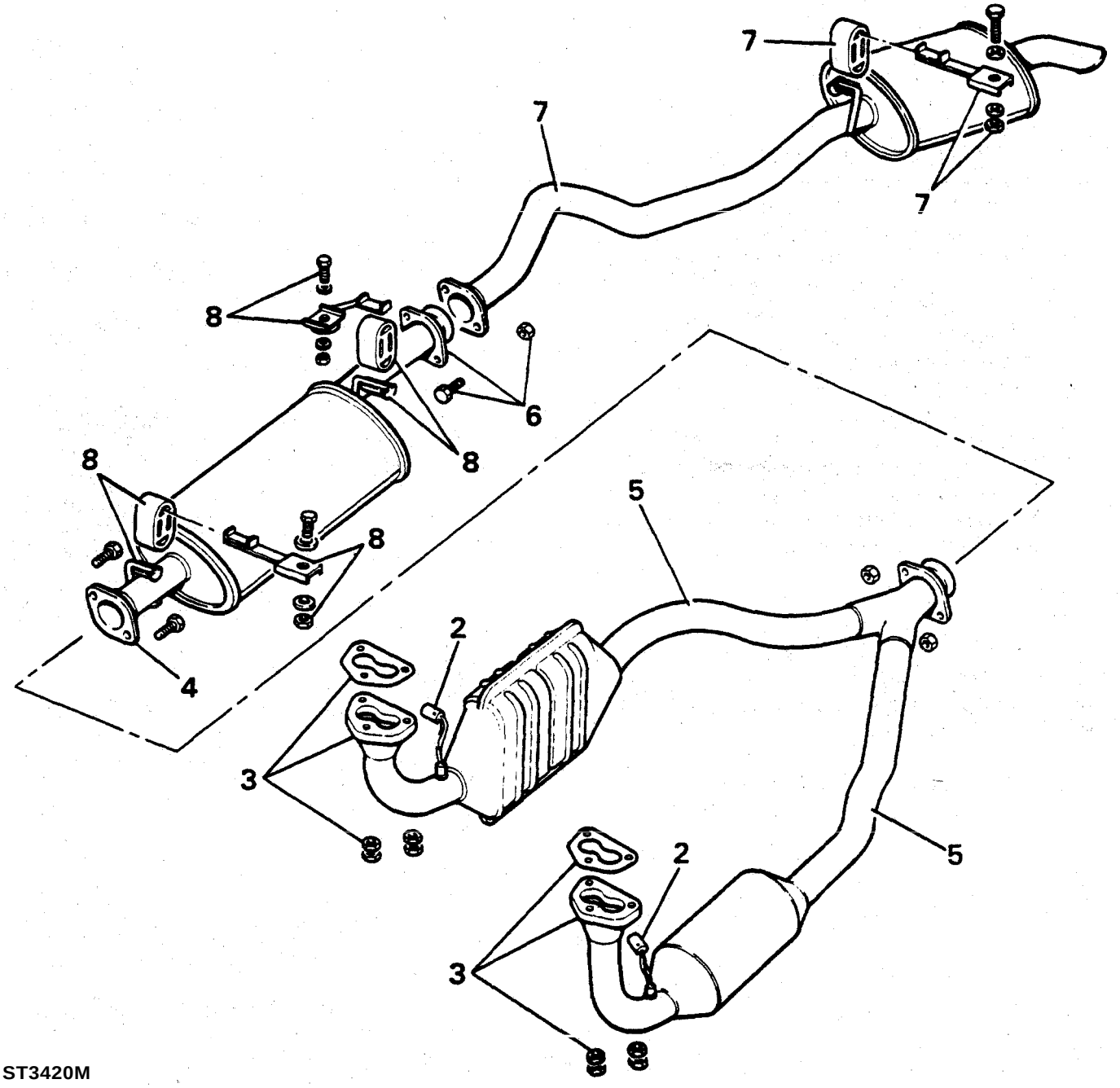
ST3422M

COOLING SYSTEM FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
A-EXTERNAL LEAKAGE	1.Loose hose clips	1.Tighten
	2Defective rubber hose	2.Renew
	3.Damaged radiator seams	3.Rectify
	4.Excessive wear in the water pump	4.Renew
	5.Loose core plugs	5.Renew
	6.Damaged gaskets	6.Renew
	7.Leaksat the heater connections or plugs	7.Rectify
	8.Leak at the water temperature gauge plug	8.Tighten
B-INTERNAL LEAKAGE	1.Defective cylinder head gasket	1.Renew. Check engine oil for contamination and refill as necessary
	2.Cracked cylinder wall	2.Renew cylinder block
	3.Loose cylinder head bolts	3.Tighten. Check engine for oil contamination and refill as necessary
C-WATER LOSS	1.Boiling	1.Ascertain the cause of engine overheating and correct as necessary
	2.Internalor external leakage	2.See items A and B
	3.Restricted radiator or inoperative	3.Flush radiator or renew the thermostat as necessary
F-OVERHEATING	1.Poor circulation	1.See item D
	2.Dirty oil and sludge in engine	2.Refill
	3.Radiator fins choked with chaff, mud, etc	3.Use air pressure from engine side of the radiator and thoroughly clean matrix
	4.Incorrect ignition timing	4.Check using electronic equipment
	5.Insufficientcoolant	5.See item D
	6.Low oil level	6.Replenish
	7.Tight engine	7.New engines are very tight and moderate speeds should be maintained for the first 1,000 miles
	8.Choked or damaged exhaust pipe or silencer	8.Rectify or renew silencer
	9.Dragging brakes	9.Adjust brakes
	10.Overloadingvehicle	10.In the hands of the operator
	11.Driving in heavy sand or mud	11.In the hands of the operator
	12.Engine labouring on gradients	12.In the hands of the operator
	13.Low gear work	13.In the hands of the operator
	14.Excessive engine idling	14.In the hands of the operator
	15.Inaccurate temperature gauge	15.Renew
	16.Defective thermostat	16.Renew
D-POOR CIRCULATION	1. Restriction in system	1. Check hoses for crimps, reverse-flush the radiator, and clear the system of rust and sludge
	2.Insufficient coolant	2.Replenish
	3.Inoperative water pump	3.Renew
	4.Loose fan belt	4.Adjust
	5. Inoperative thermostat	5.Renew

SYMPTOM	POSSIBLE CAUSE	CURE
E-CORROSION	1.Excessive impurity in the water	1.Use only soft, clean water together with correct anti-freeze or inhibitor mixture
	2.Infrequent flushing and draining of system	2.The cooling system should be drained and flushed thoroughly at least once a year
	3.Incorrect anti-freeze mixtures	3.Certain anti-freeze solutions have a corrosive effect on parts of the cooling system. Only recommended solutions should be used.
G-OVERCOOLING	1.Defective thermostat	1.Renew
	2.Inaccurate temperature gauge	2.Renew

EXHAUST SYSTEM COMPLETE



ST3420M

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.

EXHAUST SYSTEM

Remove and refit

Removing

1. Raise the vehicle on a suitable hoist and apply the parking brake.
2. Disconnect the electrical plugs from the heated oxygen sensors.
3. Remove the three nuts securing each front pipe to the manifold. and remove the gaskets.
4. Remove the two nuts and bolts securing the front pipe to the intermediate pipe.
5. Withdraw the front pipes with catalysts.
6. Remove the two nuts and bolts securing the intermediate pipe to the tail pipe.
7. Remove the nut and bolt securing the tail pipe mounting bracket. Withdraw the tail pipe and silencer, and collectthe rubber mounting.
8. Remove the nut and bolt securing intermediate pipe front and rear mountings. Withdraw the intermediate pipe and silencer and collect the rubber mountings.

Refitting

NOTE: Apply Firegum Putty, part no. 15608 to all exhaust system joints with the exception of the exhaust flange to manifold flange, where a new gasket should be fitted.

9. Reverse the removal instructions.

EXHAUST MANIFOLD

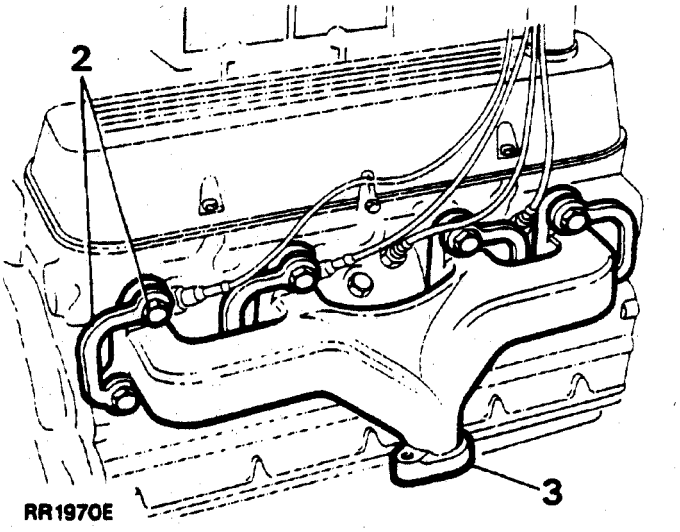
Remove and refit

Left hand

Right hand

Removing

1. Disconnect the front exhaust pipe(s) from the manifold(s).
2. Tap back the bolt locking tabs and remove the eight bolts, lock tabs and washers.
3. Remove the manifold(s)and old gaskets.



Refitting

4. Ensure that the mating surfaces of the cylinder head and exhaust manifold are clean and smooth.
5. Coat the threads of each bolt with anti-seize compound.
6. Place the manifold and new gaskets in position on the cylinder head and fit the securing bolts, new lockplates and plain washers. The plain washers are fitted between the manifold and lockplates.
7. Evenly tighten the manifold bolts to the correct torque, see torque wrench settings section 06, and bend over the lockplate tabs.
8. Reconnect the front exhaust pipe, using new exhaust flange gaskets.

INTAKE MANIFOLD

The removal and refit of the intake manifold is incorporated in the Fuel Injection System, Section 19.

CLUTCH ASSEMBLY RENEWAL

The major part of clutch assembly renewal is the removal of the transmission to gain access to the clutch. Because of the considerable combined weight of the main gearbox and transfer box and the off-set centre of gravity, it is vital that clutch replacement must only be undertaken by organisations or individuals that have the necessary experience and essential equipment to enable the transmission to be removed safely, without the risk of personal injury and damage to the transmission and vehicle. Details of the recommended transmission hoist and special cradles are contained in **SECTION 37.**

Always ascertain the reason for the necessity to renew the clutch before attempting to fit a new assembly. Careful examination of the clutch and the associated components should be carried out. This should also include checking the clutch hydraulic system if the reason for clutch failure is not immediately apparent. See "Clutch Fault Diagnosis".

If oil is present on the clutch lining the source of the oil contamination should be investigated. If necessary, the rear main bearing oil seal should be renewed as described in **SECTION** 12 .

Excessive wear of the clutch due to the vehicle having been used continually for wading without the flywheel housing plug being fitted, would be evident by rust on all parts including the release assembly and splines of the primary shaft.

The clutch cover and friction plate should always be renewed together. Also it would certainly be wise to replace the release bearing and possibly the remainder of the mechanism if any wear is present.

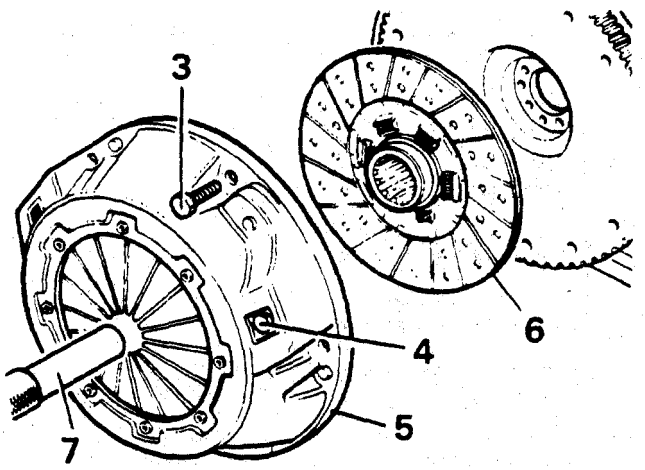
When fitting the clutch it is important that the splines of the primary shaft are smeared with Molybdenum Disulphide grease such as Rocol M.T.S. 1000 to prevent seizure. Also the friction plate must be centralised while the cover bolts are evenly tightened to the correct torque.

SPECIAL TOOLS

LRT-12-001 Clutch centralising tool

Remove

1. Remove the transmission, see **SECTION 37.**
2. Mark the position of the clutch cover to the flywheel to assist with reassembly.
3. Working evenly and diagonally remove the clutch cover securing bolts.
4. Do not disturb the three bolts in the clutch cover.
5. Remove clutch cover assembly.
6. Withdraw the clutch friction plate.



ST3415M

Refitting

7. Reverse items 5 and 6, aligning the assembly marks and using the centralising tool LRT-12-001.
8. Fit the cover securing bolts, working in a diagonal sequence. Finally tightening the bolts to a torque of 28Nm.
9. Refit the transmission.

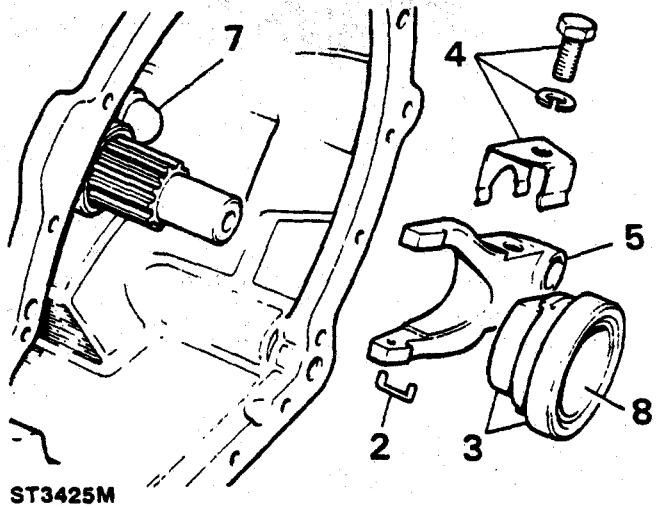
CLUTCH FAULT DIAGNOSIS

CLUTCH DRAGS - Start with check No. 20 and proceed as directed.

	POSSIBLE CAUSES		CHECK AND ACTION
1	Free play at the clutch pedal	Yes No	Check3 Check2
2	Clutch pedal tight on the pivot shaft	Yes No	Free the clutch pedal and lubricate Check3.
3	Clutch release mechanism sticking	Yes No	Free the mechanism Check4
4	Clutch slave or master cylinder pistons seized or sticking	Yes No	Repair or renew the cylinder Check5.
5	Clutch diaphragm cracked	Yes No	Renew the cover plate Check6
6.	Friction plate worn	Yes No	Renew the friction plate Check7
7	Oil on the friction plate linings	Yes No	Renew the friction plate and rectify the oil leak Suspect the friction plate sticking on splines
8.	Engine or gearbox rnountings worn or slack	Yes No	Tighten or renew the mountings Check9
9	Drive shaft joints/propeller shaft joints or splines worn	Yes No	Renew components as necessary Check 10
10.	Clutch release mechanism sticking or detective	Yes No	Free or renew the release mechanism. Check 11
11.	Clutch slave or master cylinder pistons sticking or piston seals leaking	Yes No	Repair or renew the cylinder Check 12
12	Friction plate cushion springs broken or weak	Yes No	Renew the clutch assembly complete. Check 13.
13.	Riven plate sticking on splines	Yes No	Free the driven plate. Check 14.
14	Friction plate distorted or oil on the linings	Yes No	Renew the friction plate and rectify the oil leak Suspect a faulty cover plate or damaged flywheel
15.	Clutch release mechanism or dutch pedal sticking	Yes No	Free as necessary. Check 16.
16.	Clutch slave or master cylinder piston sticking or piston seals leaking	Yes No	Repair or renew the cylinder. Check 17
17.	Friction plate sticking on splines	Yes No	Free the friction plate. Check 18.
18	Friction plate distorted	Yes No	Renew the friction plate. Check 19
19.	Clutch diaphragm detective	Yes No	Renew the cover plate Check20
20	Internal or external clutch fluid leaks	Yes No	Repair or renew as necessary Check21
21	Friction plate sticking on splines	Yes No	Free the friction plate Check22
22.	Oil on the friction plate	Yes No	Renew the friction plate and rectify the oil leak Check23.
23	Friction plate distorted	Yes No	Renew the friction plate Suspect a faulty cover plate

OVERHAUL RELEASE BEARING ASSEMBLY

1. Remove the clutch slave cylinder from the bell housing.
2. Withdraw the retaining staple, if fitted.
3. Remove the release bearing assembly.
4. Remove spring clip retaining bolt and spring.
5. Withdraw the release lever.
6. Discard worn parts.
7. Smear the pivot with grease and fit the release lever and retain with the spring clip and bolt.
8. Smear the release bearing sleeve inner diameter with Molybdenum disulphide base grease.
9. Fit the release bearing assembly and retain with the staple. The staple is to aid assembly and has no other purpose. It may become dislodged in service, without detriment.



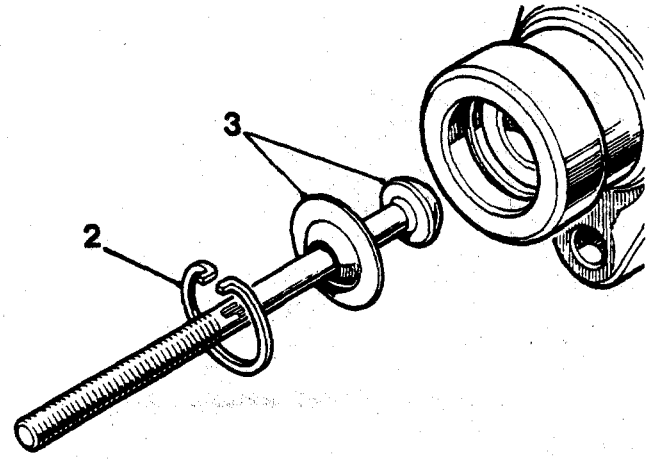
ST3425M

10. Coat both sides of the backing plate with a waterproof joint compound such as Hylomar PL32M and locate the backing plate and dust cover in position on the slave cylinder.
11. Check that the push-rod clip is in position.
12. Fit the slave cylinder, engaging the push-rod through the centre of the dust cover and with the bleed screw uppermost. secure the cylinder with the two bolts, tighten evenly to the correct torque.

OVERHAUL MASTER CYLINDER - All models

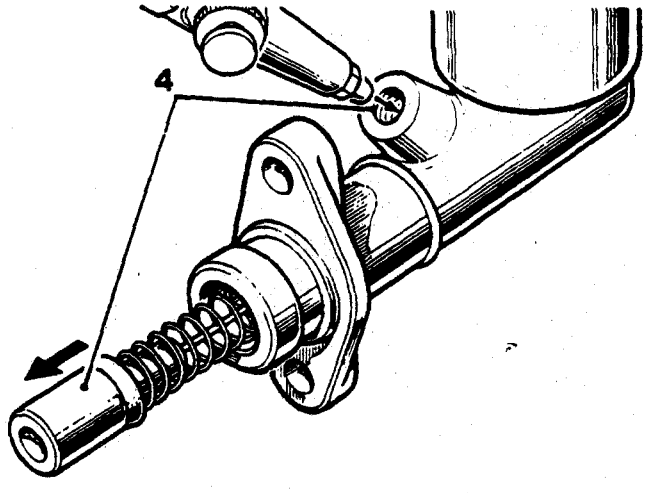
Dismantle

1. Remove the master cylinder from the vehicle.
2. Remove the circlip.
3. Withdraw the push-rod and retaining washer.



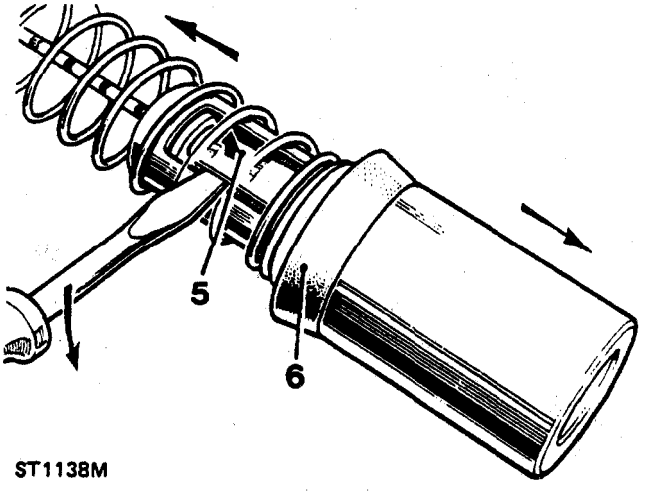
ST1136M

4. Withdraw the piston assembly. If necessary, apply a low air pressure to the outlet port to expel the piston.



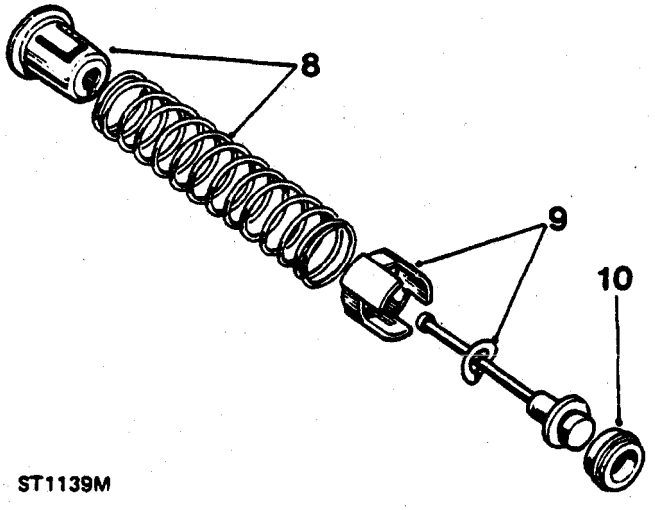
ST1137M

5. Prise the locking prong of the spring retainer clear of the piston shoulder and withdraw the piston.
6. Withdraw the piston seal.
7. Compress the spring and position the valve stem to align with the larger hole in the spring retainer



ST1138M

8. Withdraw the spring and retainer.
9. Withdraw the valve spacer and spring washer from the valve stem.
10. Remove the valve seal.



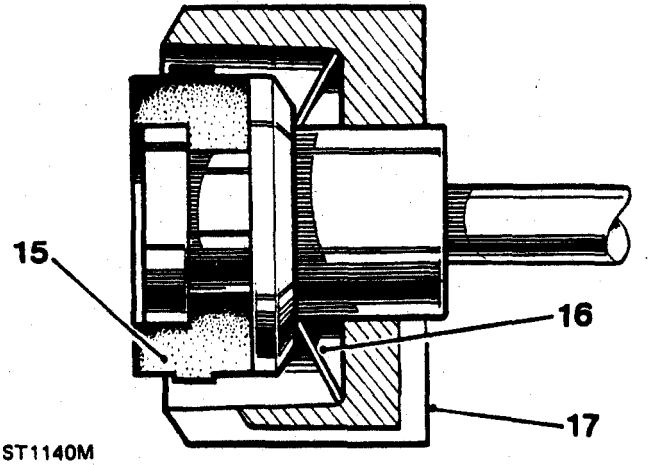
ST1139M

Inspection

11. Clean all components in cleaning fluid and allow to dry.
12. Examine the cylinder bore and piston, ensure that they are smooth to the touch with no corrosion, score marks or ridges. If there is any doubt, fit new replacements.
13. The seals should be replaced with new components.

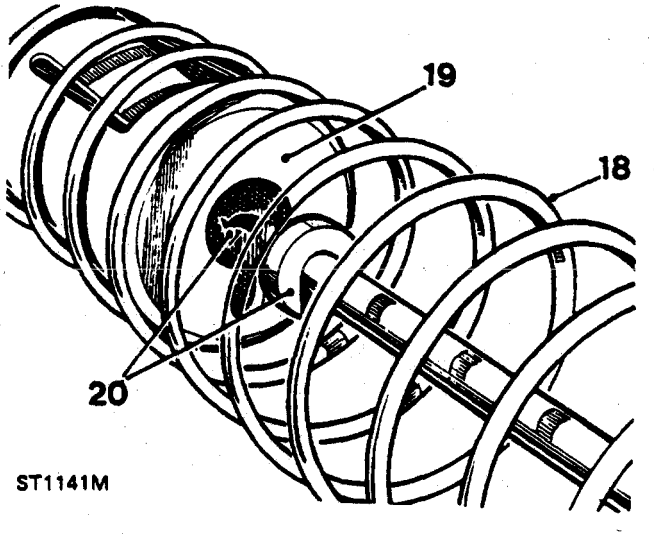
Assemble

14. Smear the seals with rubber grease and the remaining internal items with brake and clutch fluid.
15. Fit the valve seal, flat side first, onto the end of the valve stem.
16. Place the spring washer, domed side first, over the small end of the valve stem.
17. Fit the spacer, legs first.



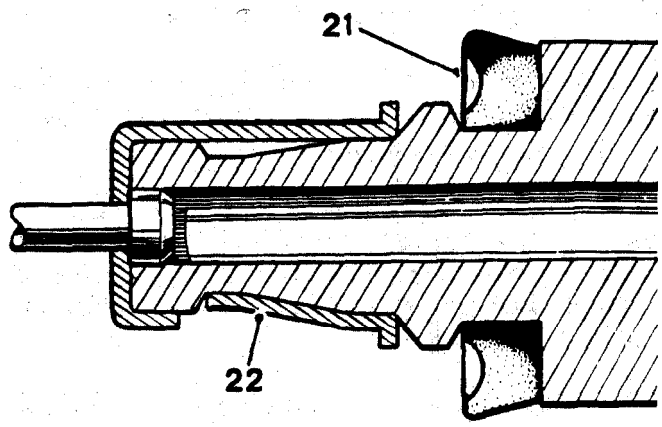
ST1140M

18. Place the coil spring over the valve stem.
19. Insert the retainer into the spring.
20. Compress the spring and engage the valve stem in the keyhole slot in the retainer.



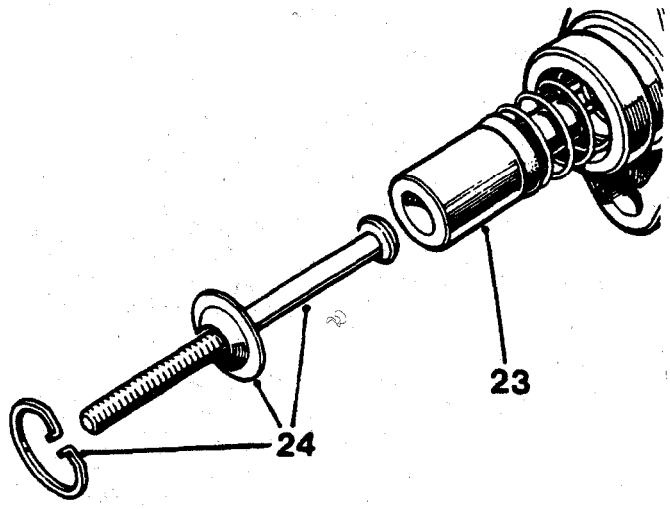
ST1141M

21. Fit the seal, large diameter last, to the piston.
22. Insert the piston into the spring retainer and engage the locking prong.



ST1142M

23. Smear the piston with rubber grease and insert the assembly, valve end first, into the cylinder.
24. Fit the push-rod, retaining washer and circlip.

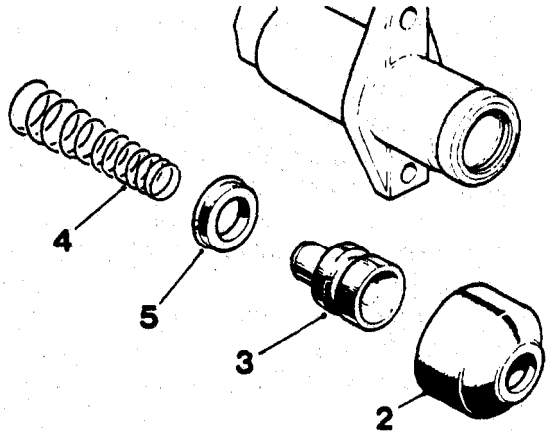


ST1143M

OVERHAUL SLAVE CYLINDER

Dismantle

1. Remove the slave cylinder from the vehicle.
2. Withdraw the dust cover.
3. Expel the piston assembly, applying low pressure air to the fluid inlet.
4. Withdraw the spring.
5. Prise off the seal from the piston.



ST1144M

Inspection

6. Clean all components with cleaning fluid and allow to dry.
7. Examine the cylinder bore and piston, ensure that they are smooth to the touch with no corrosion, score marks or ridges. If there is any doubt, fit new replacement.
8. The seal should be replaced with a new component.

Assemble

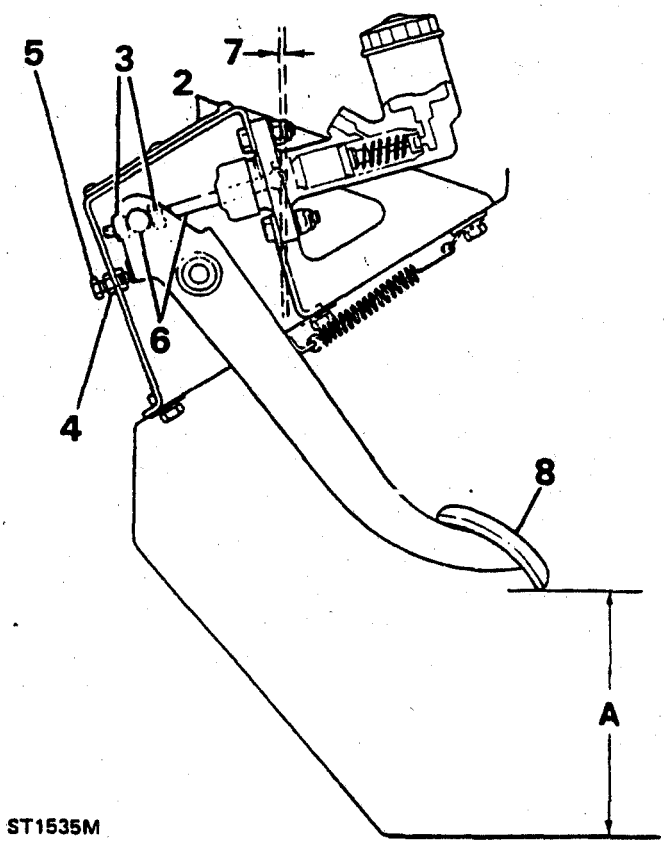
9. Smear the seal with rubber grease and the remaining internal items with brake and clutch fluid.
10. Fit the seal, large diameter last, to the piston.
11. Locate the conical spring, small diameter first, over the front end of the piston.
12. Smear the piston with rubber grease and insert the assembly, spring end first, into the cylinder.
13. Fill the dust cover with rubber grease and fit the cover to the cylinder.

CLUTCH PEDAL AND MASTER CYLINDER ADJUSTMENT

1. The correct height for the clutch pedal from the floor of the footwell, without a mat, to the lower edge of the pedal is 140 mm, dimension A'.

Adjust

2. Withdraw the six screws and remove the top plate.
3. Slacken master cylinder push-rod locknuts to provide free movement of the push-rod through the pedal trunnion.
4. Slacken the adjustment screw locknut.
5. To increase the pedal height, turn the adjustment screw anti-clockwise. To reduce turn clockwise.
   When correct tighten the locknut.
6. To adjust the master cylinder push-rod, check that the push-rod has free-play through the trunnion.
7. Adjust the locknuts until the push-rod has 1,5 mm free-play between the push-rod and master cylinder. When correct tighten the locknuts.
8. Check that there is 6 mm free movement of the pedal at the pad. If necessary re-adjust the push-rod.
9. Refit the top plate.



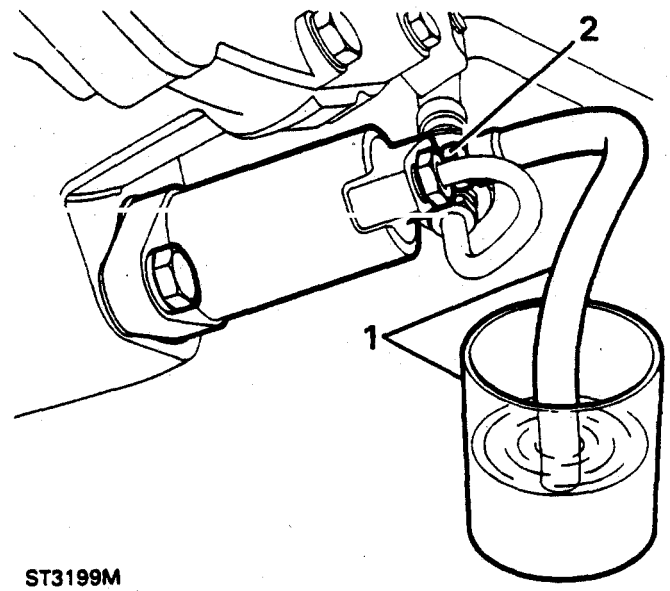
ST1535M

BLEED CLUTCH HYDRAULIC SYSTEM

When the gearbox and bell housing assembly has been fitted to the vehicle the hydraulic clutch release system must be bled to expel air,

NOTE: During the following procedure, keep the fluid reservoir topped-up to avoid introducing air into the system. Use only the fluid recommended in the Lubrication chart. Use only new fluid from a sealed container.

1. Attach a length of suitable tubing to the slave cylinder bleed screw and immerse the free end of the tube in a glass jar containing new clutch fluid.
2. Slacken the bleed screw and depress the clutch pedal, pausing at the end of each stroke, until the fluid issuing from the tubing is free of air with the tube free end below the surface of the fluid in the container. Whilst holding the clutch pedal down and with the free end of the tube below the fluid, tighten the bleed screw.

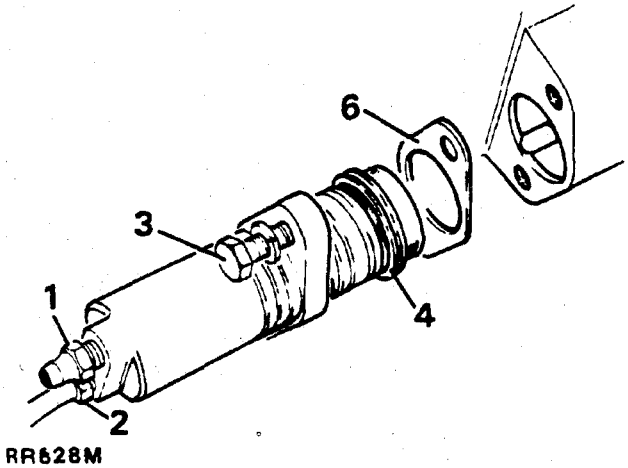


ST3199M

RENEW CLUTCH SLAVE CYLINDER

To Remove

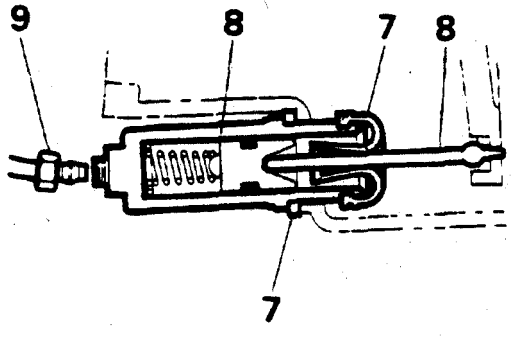
1. Evacuate clutch system fluid at slave cylinder bleed valve.
2. Disconnect fluid pipe.
3. Remove two securing bolts and withdraw slave cylinder and backing plate.
4. If dust cover is not withdrawn with slave cylinder, withdraw it from bell housing.



RR628M

To 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.
9. Reconnect fluid pipe.

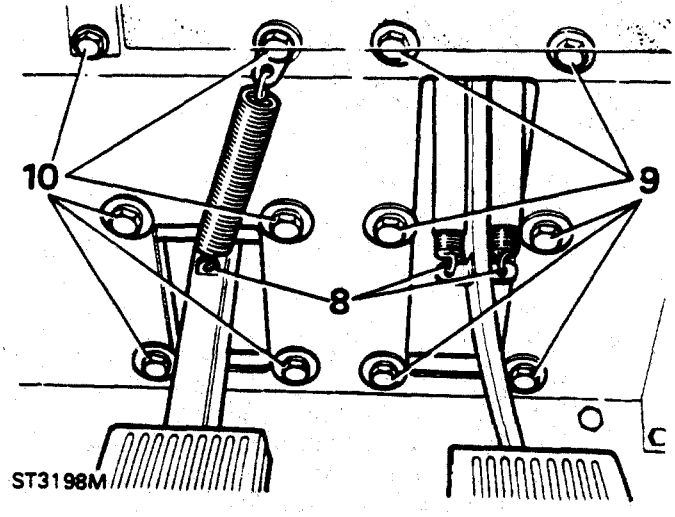


RR829M

10. Replenish and bleed clutch system.
11. Check for fluid leaks with pedal depressed and also with system at rest.

RENEW CLUTCH MASTER CYLINDER
Left hand drive vehicles

1. Disconnect the battery.
2. Remove the bonnet.
3. Remove the two nuts securing the master cylinder to the the servo.
4. Carefully ease the master cylinder away from the servo without imposing any strain upon the brake fluid pipes.
5. Disconnect the vacuum hose from the servo and move aside.
6. Disconnect the two brake lamp lucars.
7. From inside the vehicle, remove the fibre board closing panel above the pedals.
8. Release the two return springs from the brake pedal and single spring from the clutch pedal.
9. Remove the six bolts securing the brake pedal box to the bulkhead and carefully withdraw the pedal box with the servo sufficiently to allow clearance for the clutch master cylinder and pedal box to be withdrawn.
10. Remove the six bolts securing the clutch pedal box to the bulkhead.

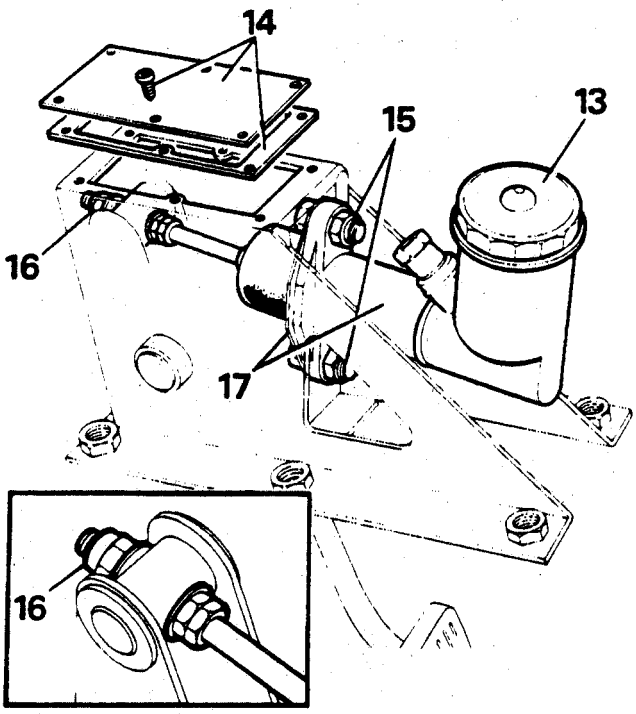


ST3198M

11. Release the hydraulic pipe from the dutch master cylinder and cover the end.
12. Remove the clutch pedal and master cylinder assembly from the vehicle.
13. Remove the reservoir cap and discard the fluid.
14. Remove the six screws and lift-off the pedal box top cover and gasket.
15. Remove the two nuts and bolts that secure. the master cylinder to the pedal box:
16. Remove the nut and washer from the end of the master cylinder push rod.
17. Withdraw the master cylinder and steel gasket.
18. Fit the two locknuts and plain washer to the push-rod.

Refitting

19. Fit the master cylinder and steel gasket to the pedal box and insert the push-rod through the bush and trunnion and loosely fitthe single nut to the end of the push-rod.

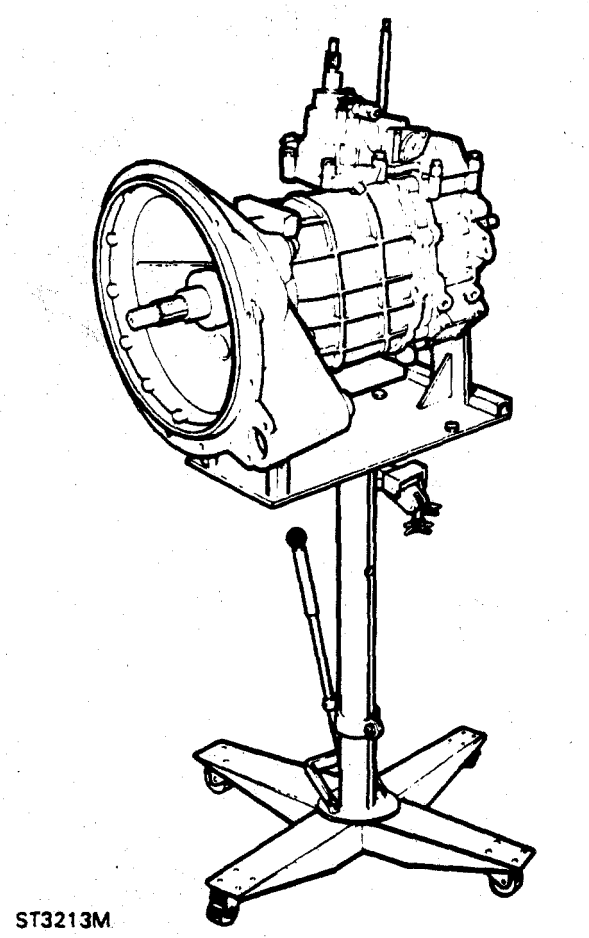


ST3195M

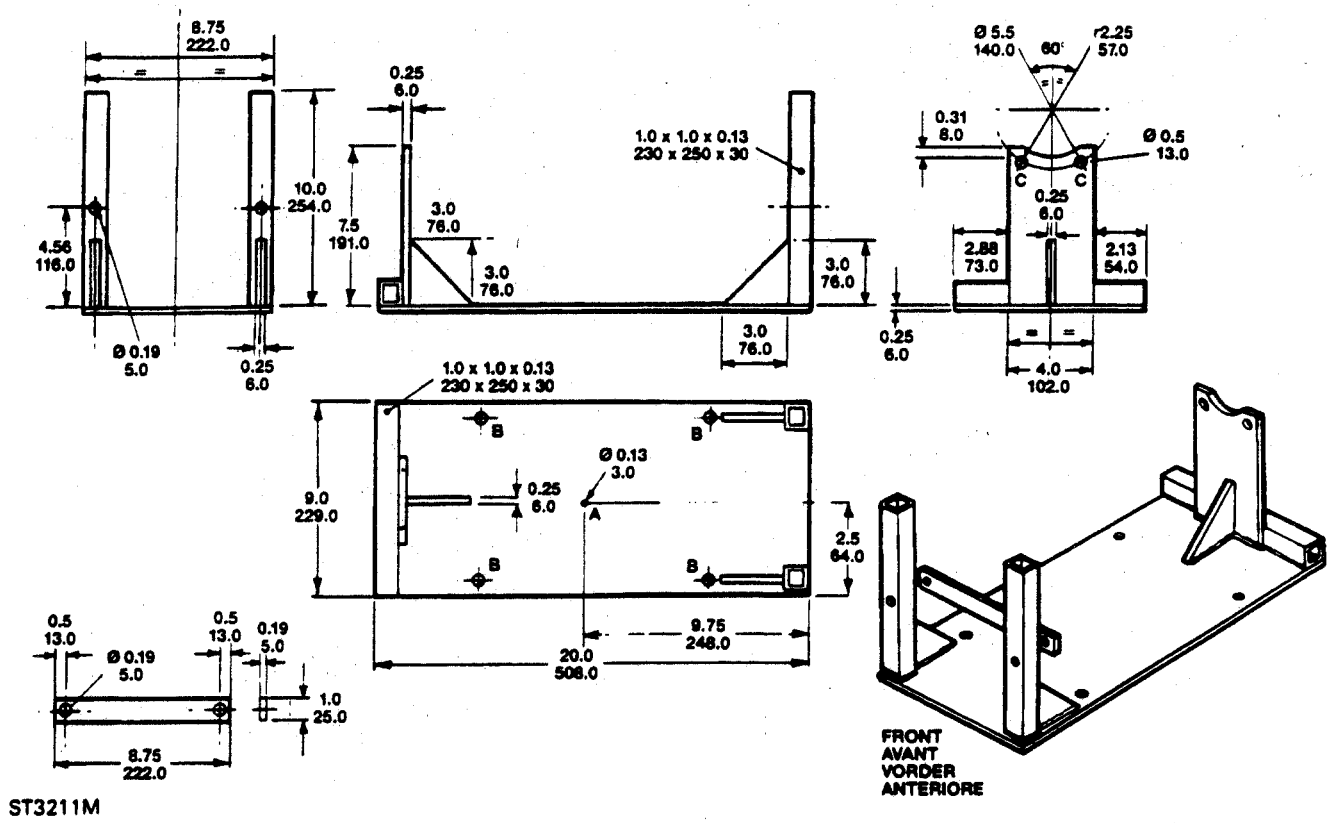
20. Secure the master cylinder with the two nuts and bolts to the pedal box.
21. Fit the pedal box to the bulkhead resealing with Bostic adhesive and secure with the six bolts.
22. Check the clutch pedal height and free-play, adjust if necessary. Tighten the push-rod end nut. Connect the return spring to the pedal.
23. Fit the pedal box top cover with a new gasket and secure with the six screws.
24. Connect the fluid pipe to the master cylinder.
25. Fit the brake servo and pedal box assembly, reseal with Bostic adhesive and secure with the six bolts.
26. Connect the return springs to the pedal.
27. Fit the brake master cylinder to the servo and tighten the two nuts,
28. Fit the fibre board closing panel.
29. Connect the stop lamp lucars.
30. Attach the three way pipe union bracket to the servo ('90' models).
31. Connect the vacuum hose to the servo.
32. Fill the clutch master cylinder with new fluid from a sealed container of the recommmended grade to the level mark on the side of the reservoir.
33. Bleed the clutch hydraulic system and fit the reservoir cap.
34. Connect the battery, fit the bonnet and road test the vehicle.

REMOVE LT77S MANUAL GEARBOX AND LT230 TRANSFER BOX

WARNING: Where the use of a transmission hoist is necessary, it is absolutely essential to follow the manufacturers' instructions to ensure safe and effective use of the equipment.


ST3213M

1. Install the vehicle on a ramp.
2. Disconnect the battery.
3. Remove the gear lever knob.
4. Remove the transfer and differential lock knob.
5. Remove the gear lever cover.
6. Remove the 10 mm Nyloc nut and plain washer. Mark the gear lever spline setting and detach the gear lever and gaiter from the splined lower gear lever.
7. Select high range to prevent the transfer gearbox selector lever fouling the tunnel when removing the gearbox.
8. Remove the bonnet.
9. Remove the nuts and bolts retaining the fan Cowl to the engine and move the cowling forward, clear of the engine.
10. Release the transmission breather pipes, speedometer cable, and starter motor harness from clips at rear of the engine.
11. Release the air filter hose at filter.
12. Raise the ramp.
13. Remove the eight nuts and bolts securing the chassis cross member and using a suitable means of spreading the chassis, remove the cross member.
14. Place a suitable container under the transmission, remove the three drain plugs, allow the oil to drain and refit the plugs. Clean filter on the extension housing plug before refitting.
15. Remove the intermediate exhaust pipe and silencer section as follows:
    (a) Release the connection to the front pipe at the flange.
    (b) Release the connection to the rear section at the flange immediately behind the silencer.
    (c) Remove the 'U' bolt retaining the pipe to the bracket attached to the transfer box.
16. Mark the flanges for reassembly and disconnect the front propeller shaft from the transfer box.
17. Similarly, disconnect the rear propeller shaft.
18. Disconnect the speedometer cable from the rear of the transfer box.
19. Disconnect the handbrake inner cable by removing the split pin and clevis pin.
20. Slacken the retaining nuts and release the handbrake outer cable from the bracket.
21. Remove the two bolts and withdraw the clutch slave cylinder from the bell housing.
22. Manufacture a cradle to the dimensions given in the drawing and attach it to a transmission hoist. To achieve balance of the transmission unit when mounted on the transmission hoist, it is essential that point A is situated over the centre of the lifting hoist ram. Drill fixing holes B to suit hoist table. Secure the transmission unit to the lifting bracket at point C, by means of the lower bolts retaining the transfer gearbox rear cover.
23. Remove the bottom two bolts from the transfer box rear cover and use them to attach the rear end of the cradle to the transfer box. Ensure that the tube in the centre of the cradle locates over the extension housing drain plug.
24. Raise the hoist just enough to take the weight of the transmission.
25. Remove the three nuts and bolts securing the transfer box LH and R H mounting brackets to the chassis.
26. Remove the nuts retaining the brackets to the mounting rubbers and remove the brackets.
27. Lower the hoist sufficiently to allow the transfer lever to clear the transmission tunnel aperture.
28. Disconnect the four-wheel drive indicator electrical lead (bullet connection).



ST3211M

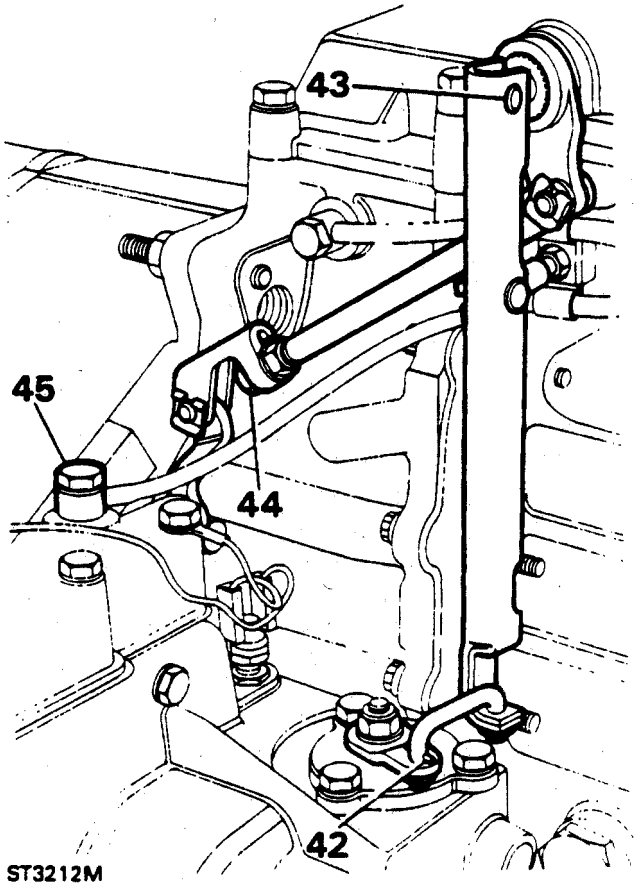
MATERIAL AND WELDING SPECIFICATION

Steel Plate	BS 1449(Grade4 or 14)
Tube	BS 4848(Part2)
Arc Welding	BS 5135

29. Remove the cleat retaining the reverse light switch wires from the RH side of the gearbox.
30. Disconnect the wire from the reverse light switch situated at the top rear of the selector housing and move the harness away from the transmission.
31. Support the engine under the sump with a jack, placing timber between the jack pad and sump.
32. Remove the eleven bell housing nuts.
33. Withdraw the transmission whilst ensuring all connections to the engine and chassis are released.

Separating the transfer box from gearbox

34. Remove the transmission assembly from the hoist and cradle and install it safely on a bench.
35. Remove the four bolts securing the transfer gear change housing to the remote gear change housing.
36. Remove the two bolts retaining the cross shaft lever pivot bracket to the extension housing.
37. Release the connecting link from the differential lock lever.
38. Disconnect the pivot arm from the high/low shaft.
39. Remove the lower lockout from the high/low operating rod.
40. Remove the breather pipes.



ST3212M

41. Hoist the transfer box into position ensuring that the loose upper dowel is fitted, Assemble to the main gearbox extension housing and secure with the four bolts and two nuts.
42. Reverse instructions 37 to 40.

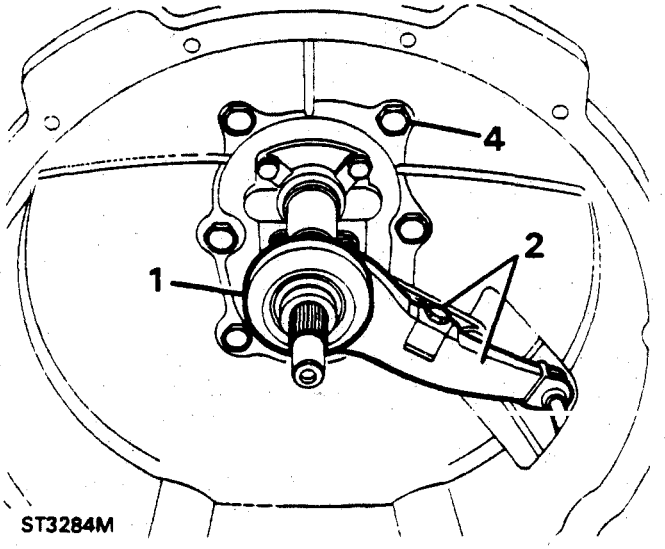
Fitting main gearbox and transfer box to engine

43. Fit the cradle to the transmission hoist and the transmission to the cradle as described in instruction 23. Smear Hylomar on bell housing face mating with engine.
44. Locate the gear lever temporarily and select any gear in the main gearbox to facilitate entry of the primary shaft.
45. Position and raise hoist and fit the transmission to the engine whilst keeping wires and pipes clear to prevent trapping.
46. Secure the transmission to the engine with the eleven nuts, noting that the top RH nut holds a clip for the speedometer cable.
47. Position the reverse light wires to the RH side of the main gearbox and secure with a cleat to the breather pipes.
48. Connect the reverse light wire to the switch at the top rear of the selector housing.
49, Connect the differential lock indicator wires (bullet connection).
50. Raise the transmission to line-up with the engine and ensure that the transfer lever clears the tunnel aperture.
51. Fit the transfer box LH and RH mounting brackets but only partially tighten the securing nuts and bolts.
52. Loosely fit the rubber mounting nuts and lower the transmission onto the mountings. Fully tighten all the securing nuts and bolts.
53. Remove the supporting jack from under the engine sump.
54. Remove the two bolts securing the cradle to the transfer box and remove the cradle and hoist.
55. Refit the two bolts using Loctite 290 on the threads and note that the L H bolt holds a clip for the speedometer cable.
56. Fit the slave cylinder using Hylosil on the gasket and tighten the two bolts evenly to 22 to 28 Nm.
57. Fit the handbrake cable using a new split pin to secure the clevis pin. Grease the clevis and tighten the outer cable lock nuts.
58. Connect the speedometer cable.
59. Check that the three drain plugs are tight and remove the main gearbox and transfer box filler level plugs. Fill the main gearbox with a recommended oil until it begins to run out of the filler level hole. Fit and tighten the filler plug. Similarly remove the transfer filler level plug and inject a recommended oil until it runs out of the filler hole. Apply Hylosil to the threads and fit the plug and wipe away any surplus oil.
60. Line up the marks and fit the front and rear propeller shafts to the transfer box.
61. Fit the exhaust system, and evenly tighten the flange nuts and bolts. Fit the 'U' bolt and secure to the bracket.
62. Expand the chassis side members, fit the cross member and secure with the eight nuts and bolts (four each side).
63. Fit the heater pipe clamp.
64. Clip the breather pipes, speedometer cable and starter motor harness to rear of engine.
65. Fit the fan cowl.
66. Fit the bonnet.
67. Fit main gear lever gaiter and lever, to previously marked spline setting. Secure with the 10 mm 'Nyloc' nut (with plain washer) to the correct torque.
68. Fit the cover to both gear levers and the knobs.

DISMANTLE

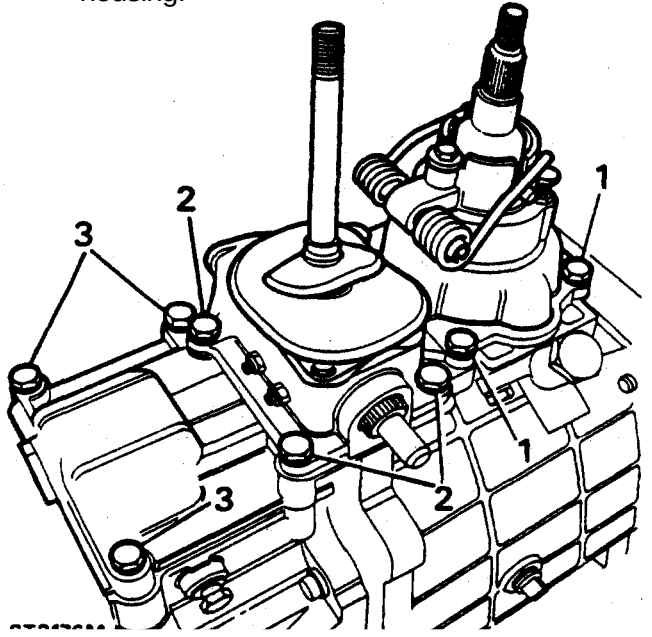
Bell housing

1. Remove clutch release bearing.
2. Remove screw and spring clip and remove release lever.
3. Remove "C" clip from pivot post.
4. Remove six bolts and bell housing.

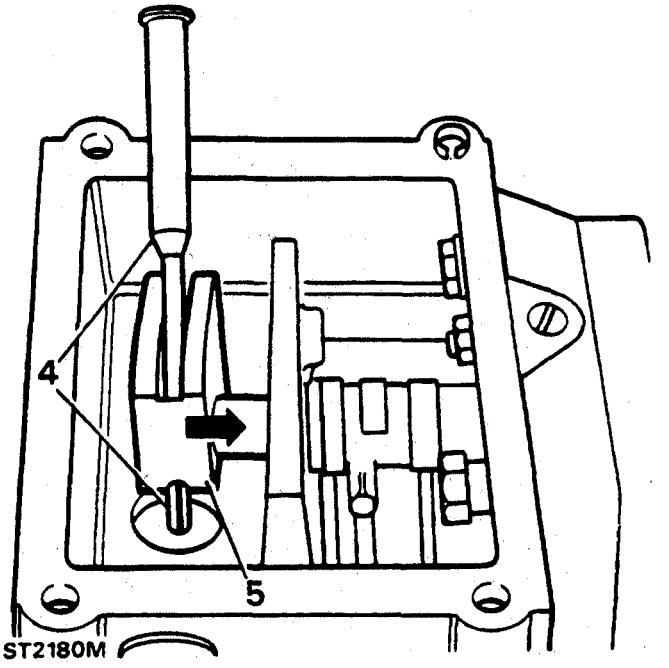


GEAR SELECTOR HOUSING

1. Remove four bolts and remove main gearbox selector housing.
2. Remove transfer box housing.
3. Remove remaining bolts and remove remote housing.

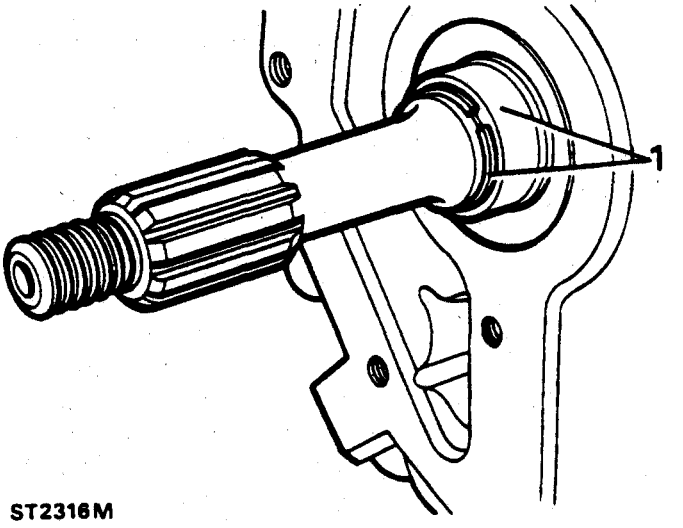


4. Drive out quadrant roll pin.
5. Move selector shaft forward to remove quadrant.

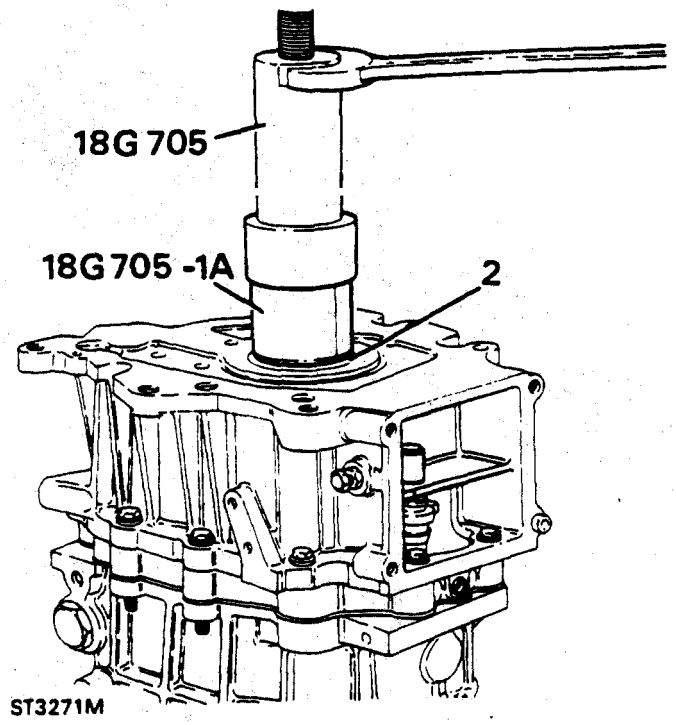


EXTENSION HOUSING

1. Remove snap ring retaining oil seal collar.

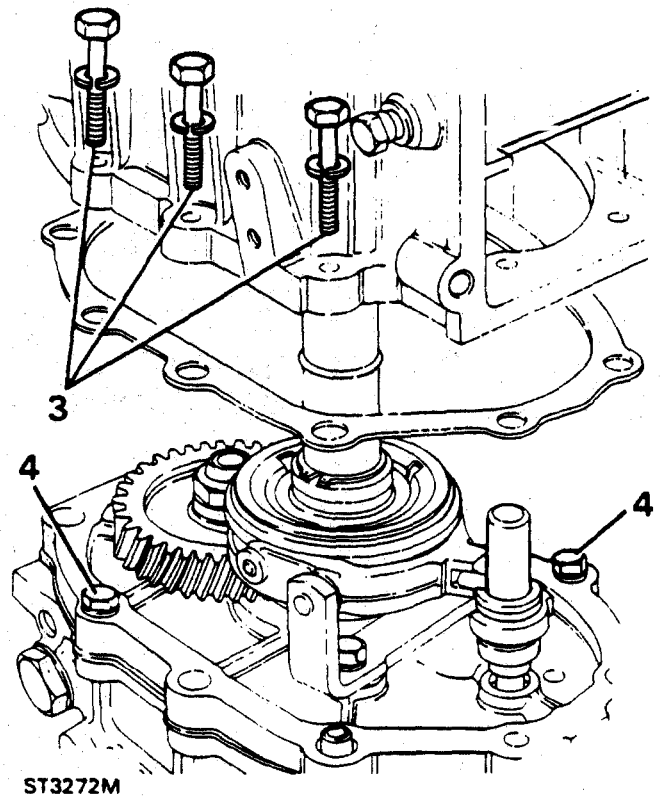


2. Using service tool 18G 705 and 18G 705-1A withdraw the oil seal collar.



ST3271M

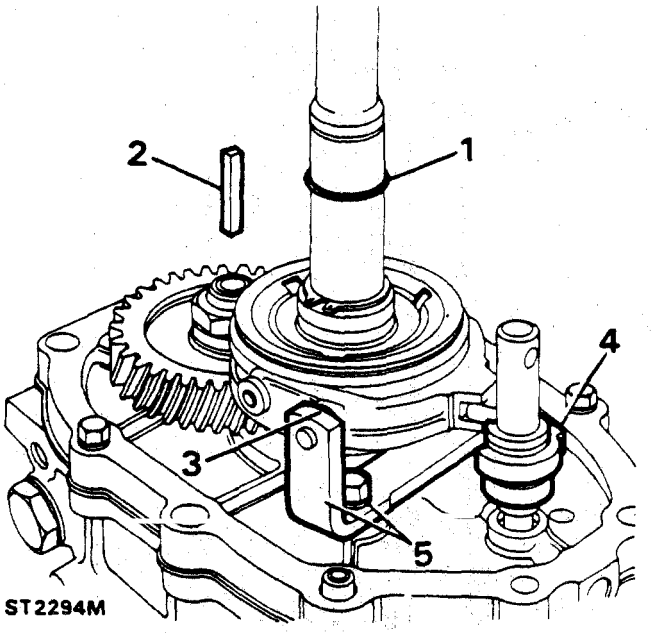
3. Remove the fifth gear extension housing.
4. Secure the centre plate to the gearcase with two 8 x 35mm bolts.



ST3272M

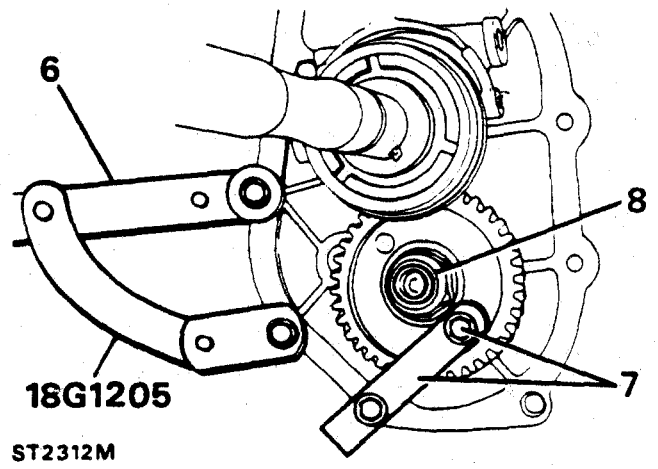
MAINSHAFT AND LAYSHAFT FIFTH GEARS

1. Remove mainshaft "O" ring.
2. Remove oil pump drive shaft.
3. Remove "E" clips from selector fork.
4. Remove fifth gear selector spool.
5. Remove selector fork bracket.



ST2294M

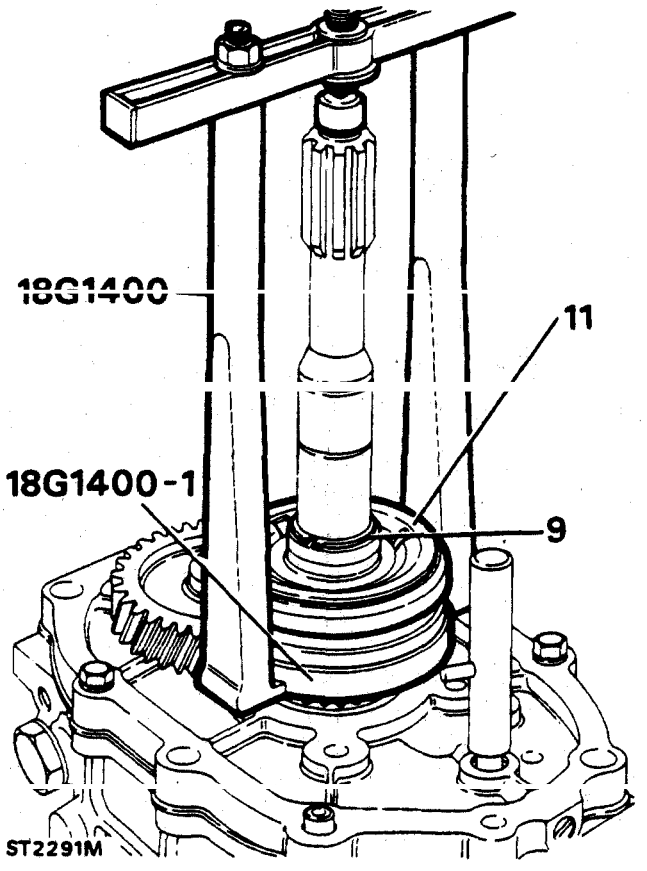
6. Locate flange holder tool 18G 1205.
7. Fit manufactured tool "A" and spacer to restrain layshaft fifth gear.
8. De-stake and remove fifth gear nut.



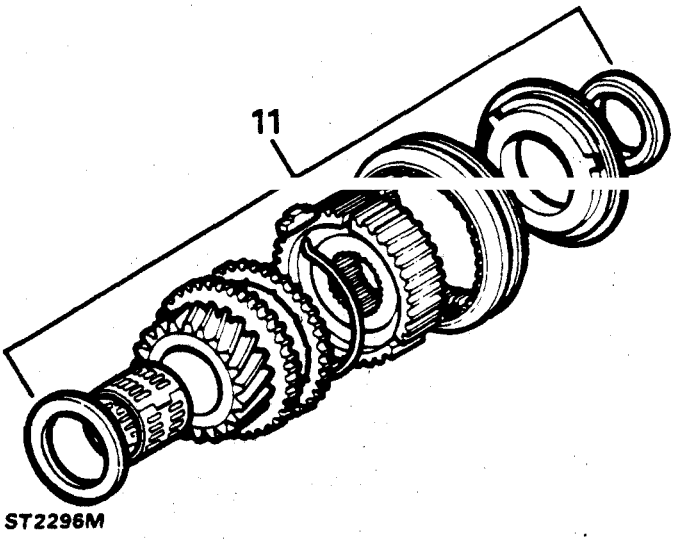
ST2312M

9. Remove circlip retaining mainshaft fifth gear synchromesh.
10. Fit special tool 18G 1400-1 and 18G 1400 as illustrated.

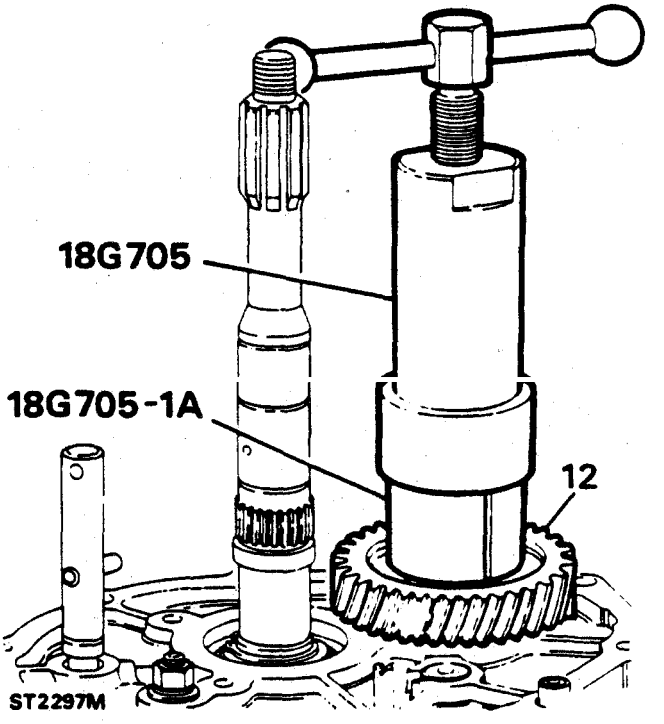
CAUTION: ensure the puller feet locate in the two cut-outs in 18G 1400-1 and between the pins.



11. Remove fifth gear synchromesh.

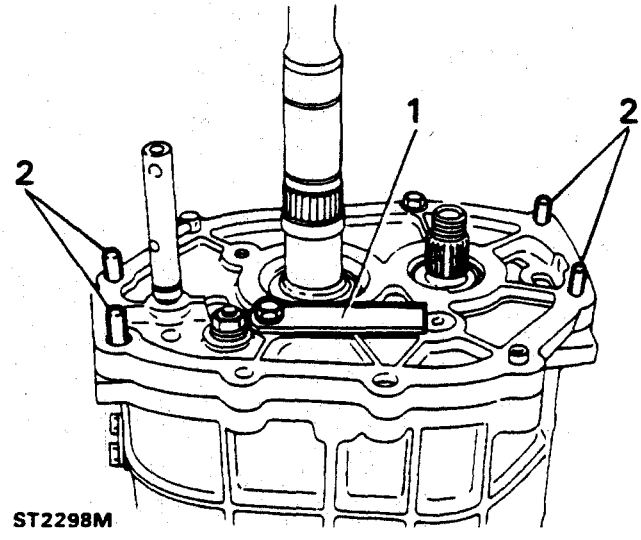


12. Remove layshaft fifth gear using special **tools 18G** 705 and 18G 705-1A.

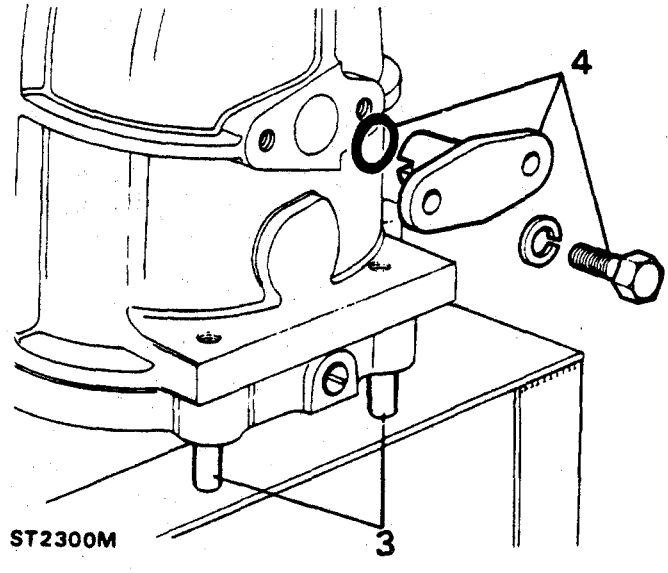


Main gear case.

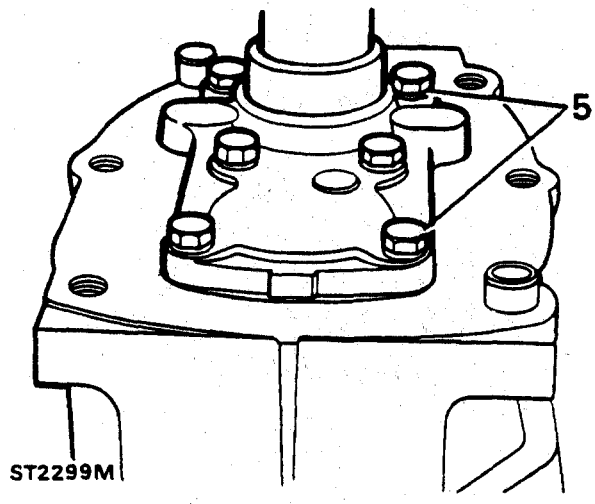
1. Secure reverse shaft retainer, manufactured tool "A, to centre plate
2. Fit studs, manufactured tool "B" to gear case.



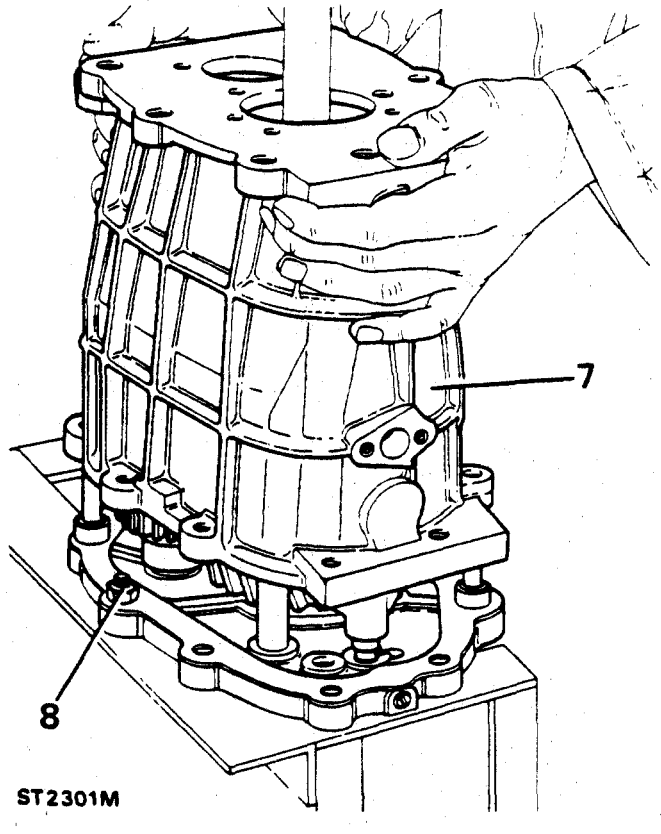
3. **Invert gear case and locate studs** in **workstand holes.**
4. **Remove selector shaft spool retainer.**



5. Remove front cover and gasket.
6. Retrieve selective washers.

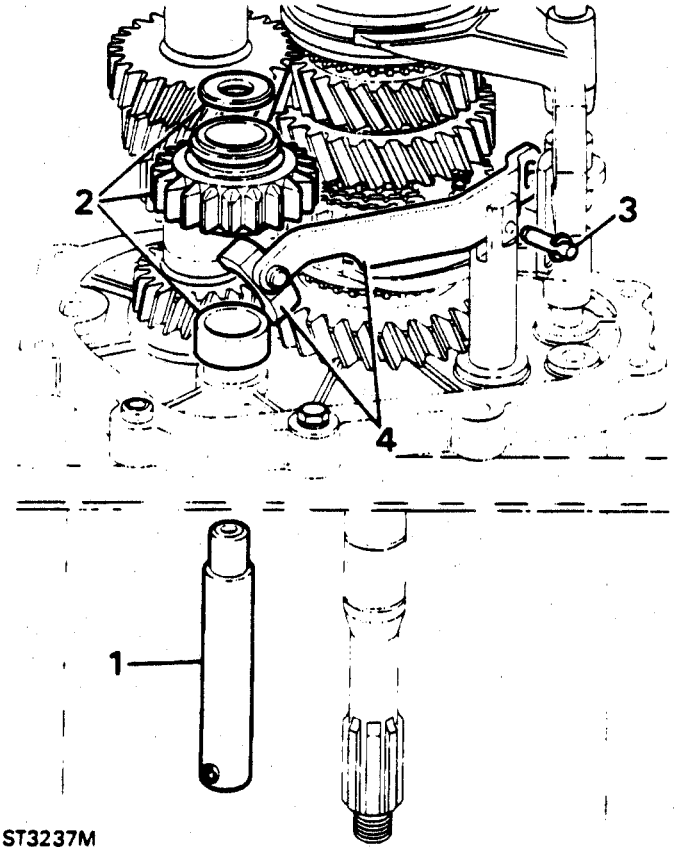


7. **Remove bolts and** lift-off **gear case.**
8. **Secure centre plate with nut and bolt.**



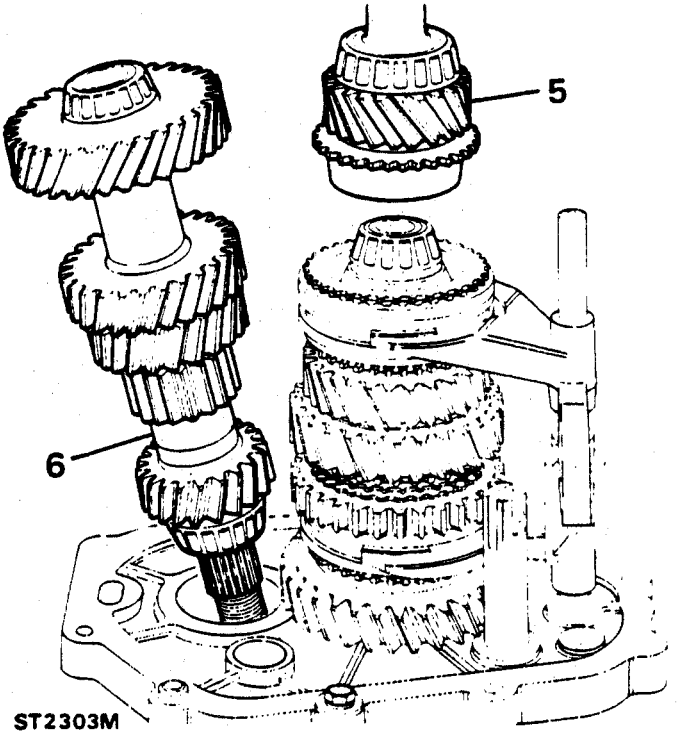
REVERSE SHAFT, LAYSHAFT AND MAINSHAFT

1. Remove retainer (tool "A") and reverse shaft.
2. Remove thrust washer, reverse gear and spacer.
3. Remove reverse lever pin with "E" clip attached.
4. Remove lever and slipper pad.



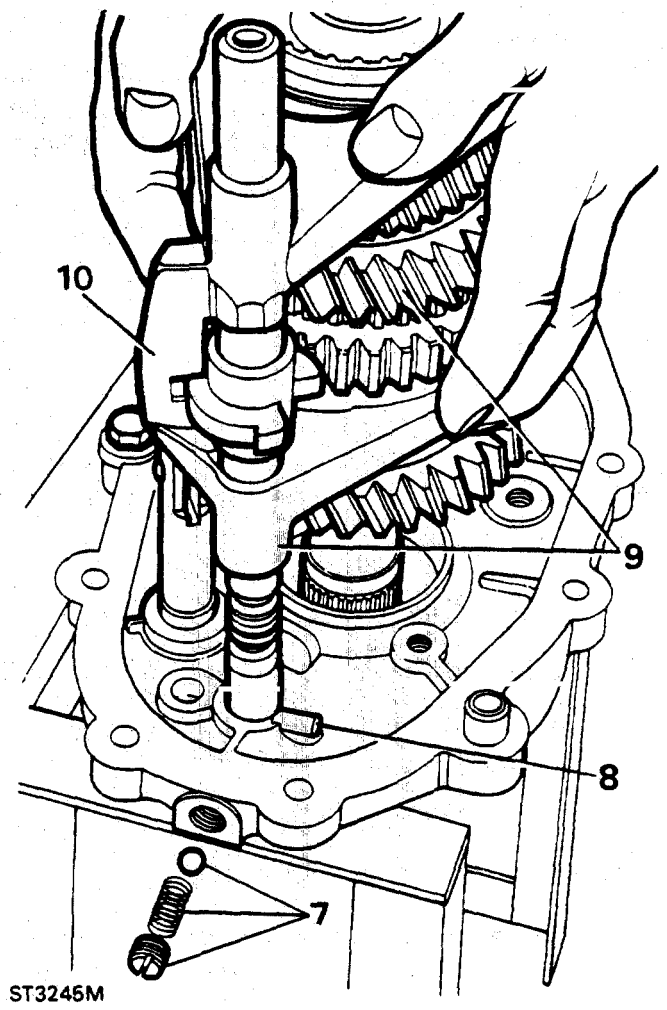
ST3237M

5. Remove input shaft and fourth gear baulk ring.
6. Remove layshaft by tilting, as illustrated and lifting mainshaft.

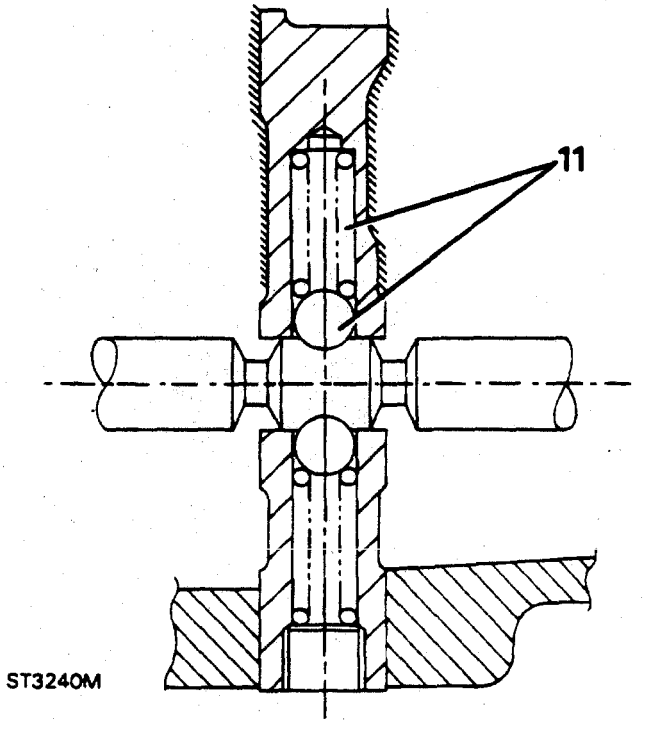


ST2303M

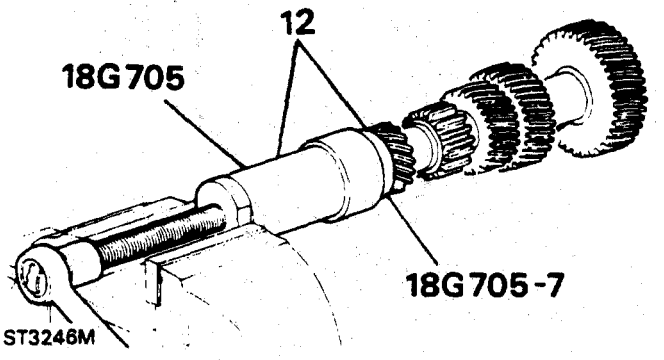
7. Unscrew plug and remove spring and outboard detent ball.
8. Align fifth gear selector pin with centre plate slot.
9. Remove mainshaft, gears, selectors and forks.
10. Remove selector fork assembly from gears.



11. Collect inboard detent ball and spring from centre plate.

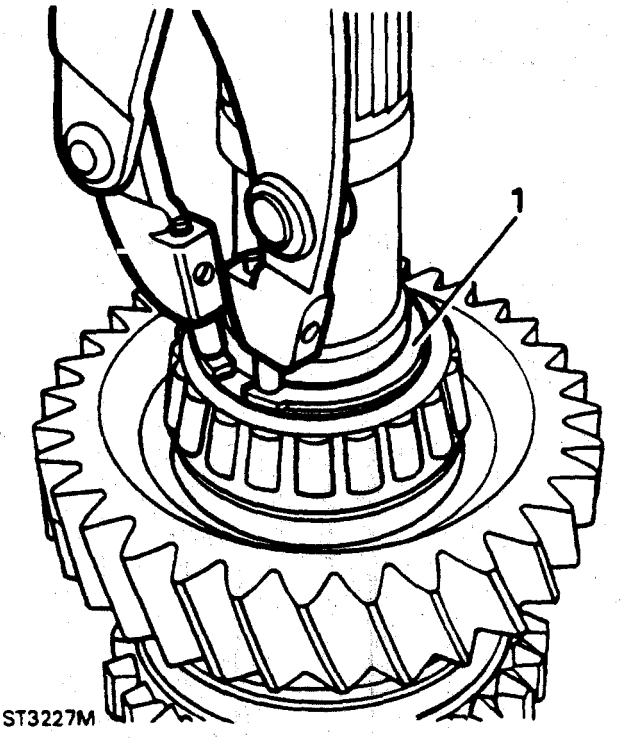


12. Using extractor tool 18G 705 and collets 18G 705-7, withdraw layshaft bearings.

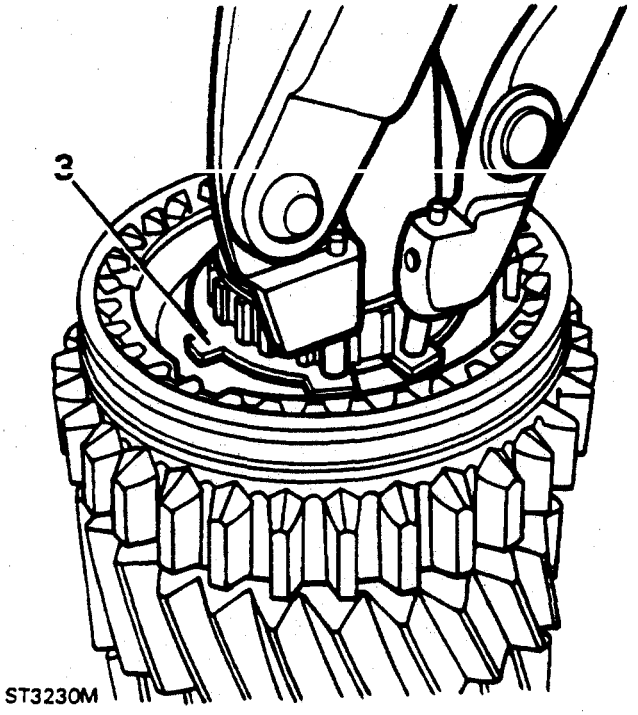


DISMANTLE MAINSHAFT

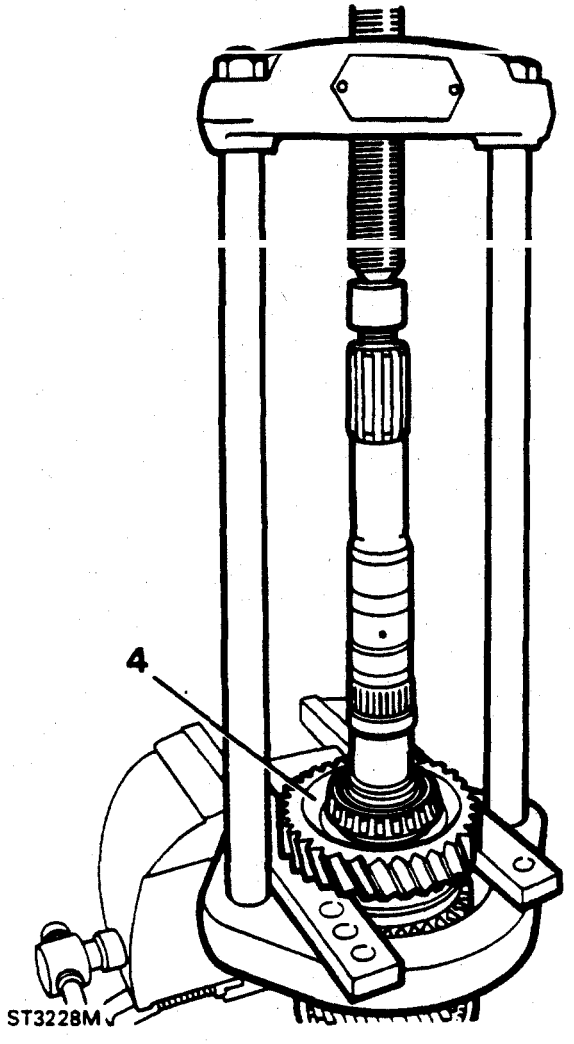
1. Remove circlip retaining first gear assembly.



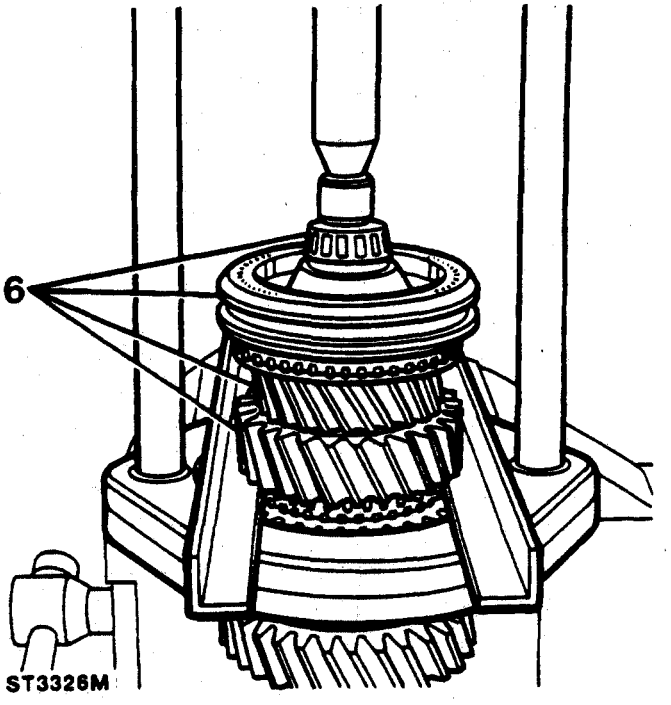
2. Remove taper bearing, bush, needle bearing, first gear spacer, cone, inner and outer baulk rings.
3. Remove circlip to release first and second gear synchromesh assembly.



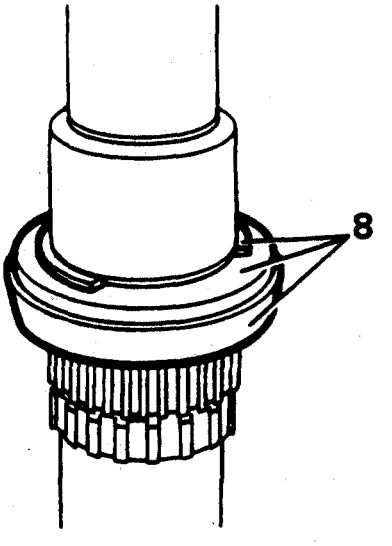
4. With MS 47 press first gear assembly from mainshaft.



5. Remove first and second synchromesh baulk rings.
6. Using MS 47 and support bars under second gear, press off pilot bearing, third, fourth synchromesh second and third gear assembly.



7. Remove washer, third, fourth synchromesh, third gear baulk ring, split needle rollers, bush, needle bearing and second gear.
8. Remove snap ring, spacer, second gear cone and circlip.

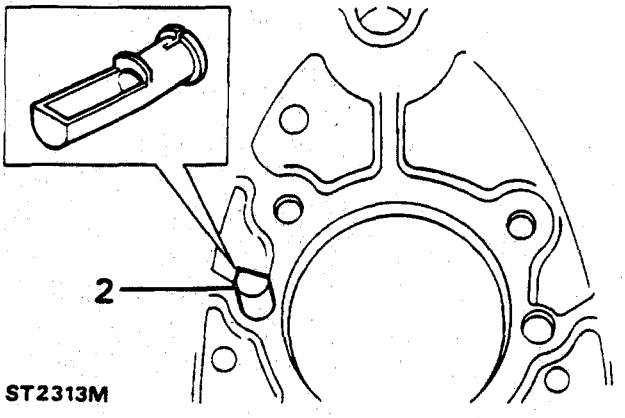


GEARBOX CASINGS AND OIL PUMP

Degrease and clean all components and discard gaskets and seals.

Gearbox casing

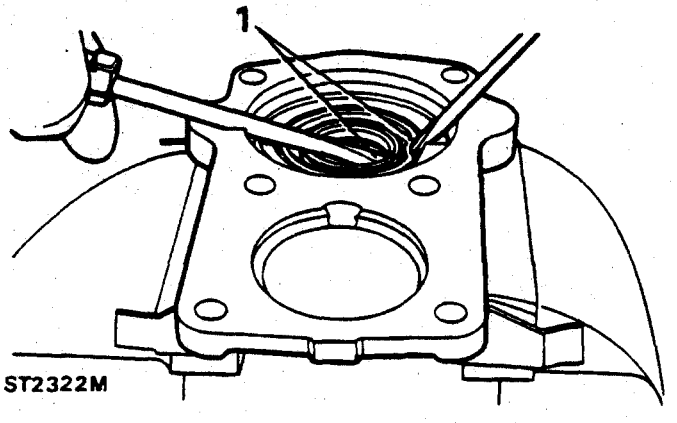
1. Remove mainshaft and layshaft bearing tracks.
2. Remove plastic scoop from inside the casing.



3. Inspect case for damage, cracks and stripped threads.
4. Fit a new scoop with scoop side towards top of casing.

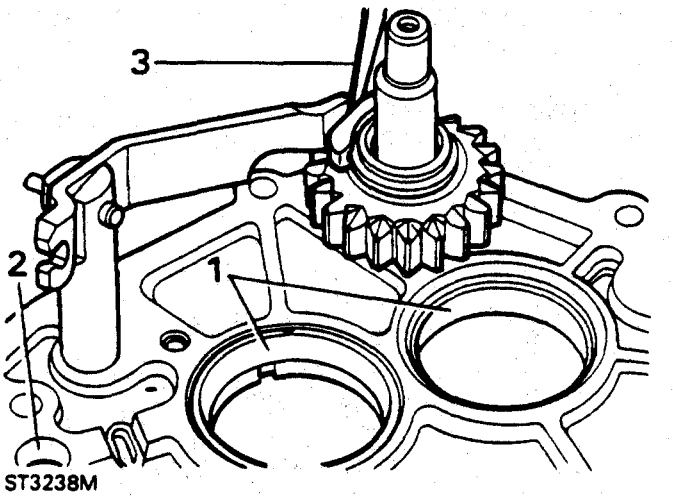
Front cover

1. Remove oil seal from cover. Do not fit a new seal at this stage



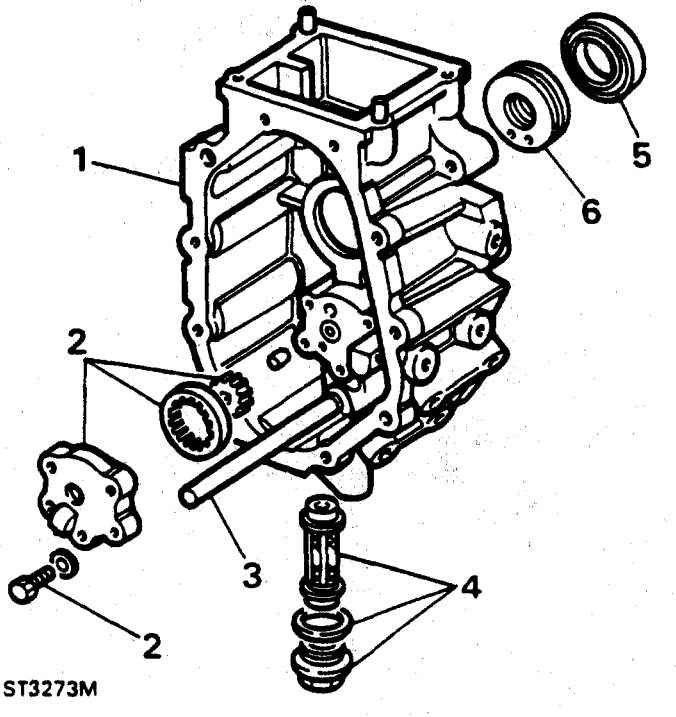
Centre plate

1. Remove bearing tracks.
2. Inspect for damage and selector rail bore for wear.
3. Temporally fit reverse shaft gear and lever and check clearance between slipper and lever does not exceed 0,20mm (0.008 in).



Extension case

1. Examine for damage to threads and machined faces.
2. Remove oil pump cover, inspect gears and housing and renew if required.

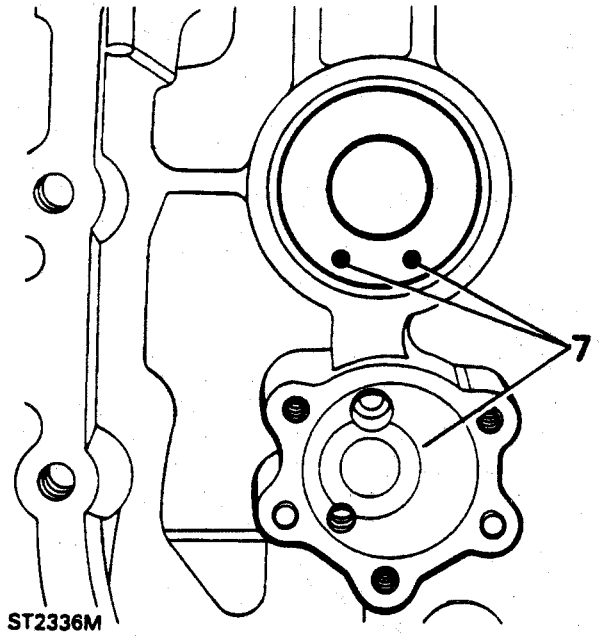


3. Check oil pick up pipe for obstruction but do not remove.
4. Remove drain plug assembly. Clean and renew filter and washers if necessary.
5. Renew oil seal.
6. Renew Ferrobestos bush.

WARNING: This bush contains asbestos. Do not attempt to clean it. Poisonous substances.

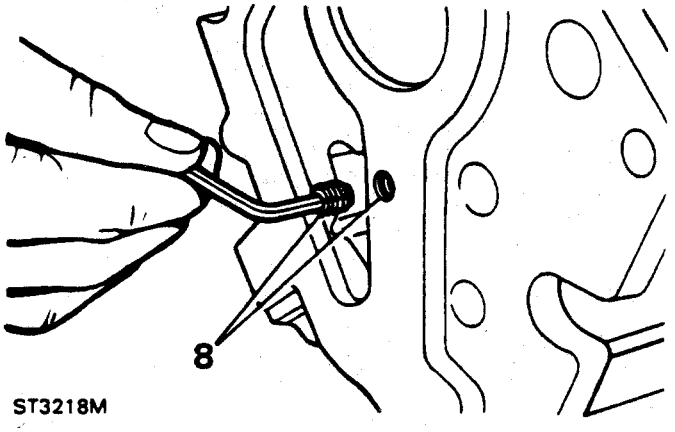
7. Fit new bush with drain holes towards bottom of casing.

CAUTION: If drain holes are not positioned correctly oil may build up behind oil seal and cause a leak.



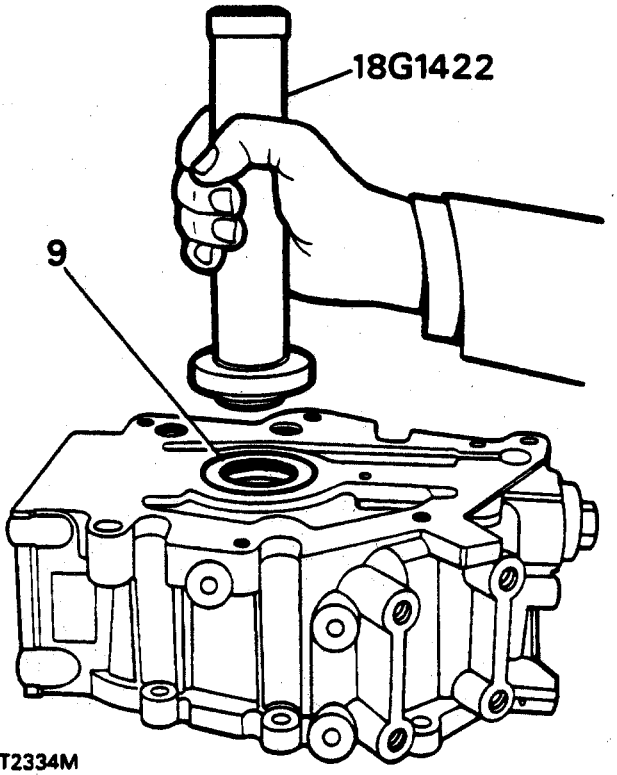
ST2336M

8. If extension housing is being renewed transfer grub screw to new housing. Apply Loctite to threads.



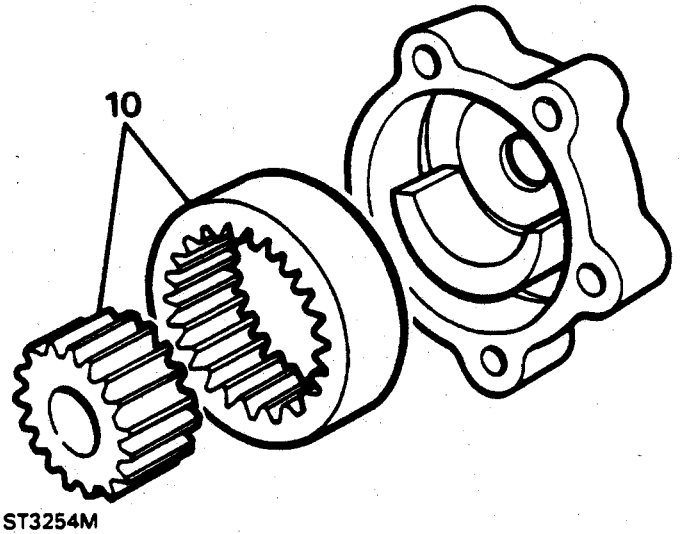
ST3218M

9. Fit oil seal to housing, lip side leading, using 18G 1422. Apply SAE 40 oil to lip.



ST2334M

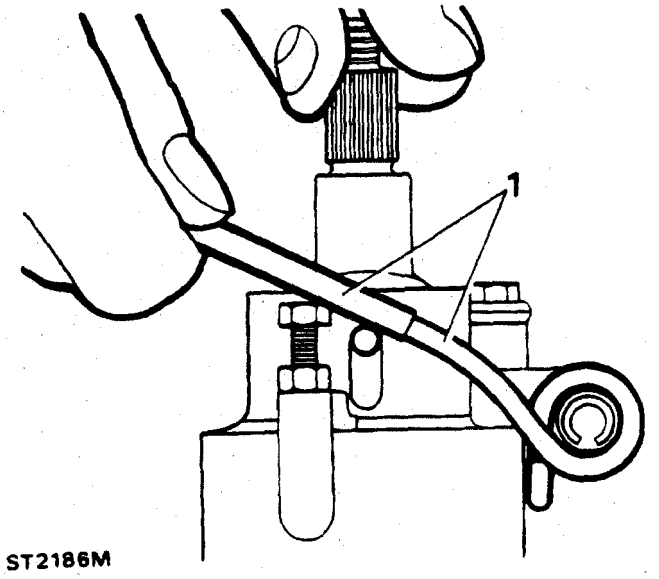
10. Assemble gears to oil pump and fit cover.



ST3254M

GEAR CHANGE HOUSING

1. With a length of tube, release the bias spring from adjusting screws.
2. Remove bias spring adjusting screws.

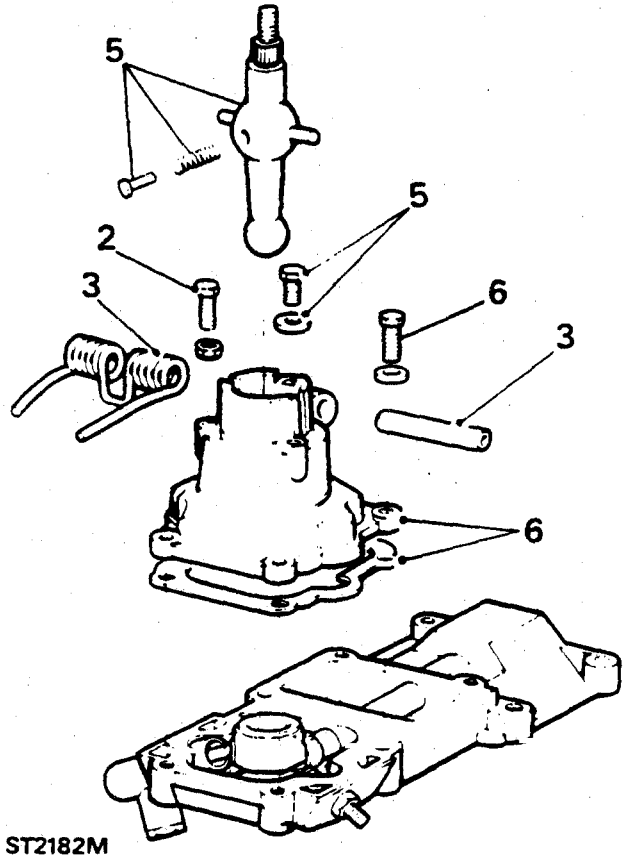


ST2186M

3. Drive-out roll pin to remove bias spring.
4. Remove gear lever extension from lower gear lever.
5. Remove bolt and special washer to remove lower gear lever.

WARNING: Hold the nylon spring loaded pad while removing the lever to prevent it causing personal injury.

6. Remove gear selector housing from remote housing.



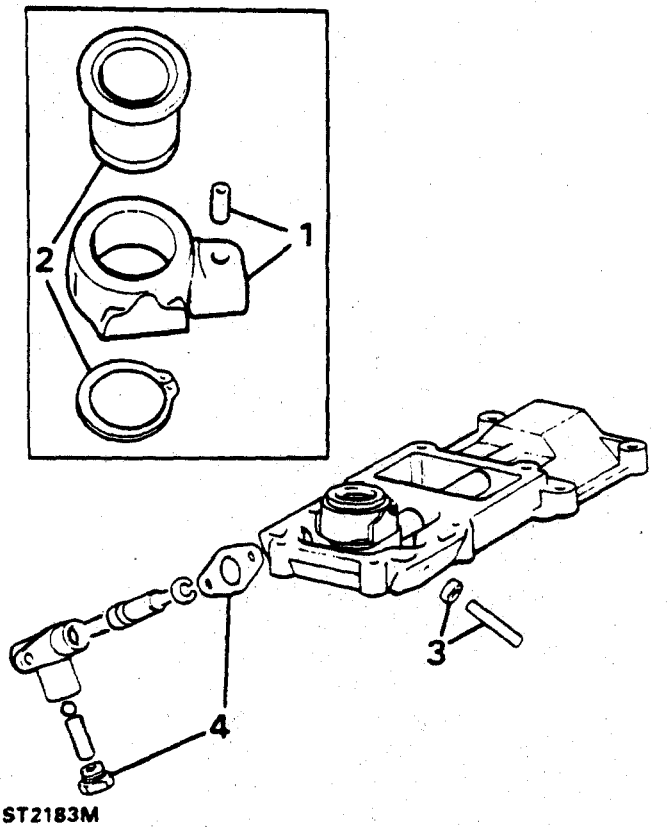
ST2182M

7. Clean and examine all components and renew where necessary.
8. Assemble above parts in reverse order using multi-purpose grease on gear lever.

NOTE: Ensure spring loaded pad is properly located and that the lever is fitted to the housing with the pad on the opposite side to the bias spring. Leave bias spring adjusting screws slack until assembly of gearbox.

Remote gear lever housing.

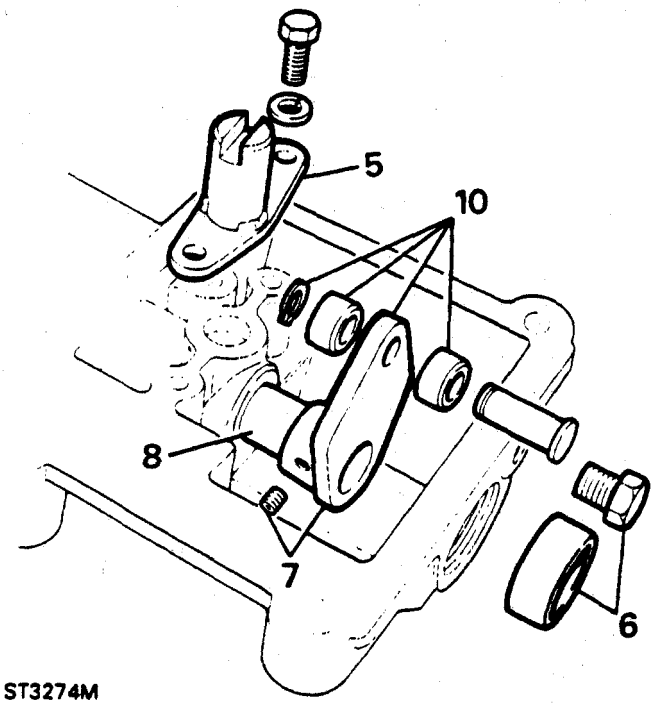
1. Release socket headed screw to remove trunnion.
2. Remove circlip to release seating from trunnion.
3. Remove fifth gear locknut and stud.
4. Remove reverse gear plunger and shim.



ST2183M

5. Remove fifth gear spool guide.
6. Remove blanking plug.
7. Drift-out roll pin securing quadrant to shaft.
8. Withdraw selector shaft through hole.
9. Remove selector shaft *"0"* ring.

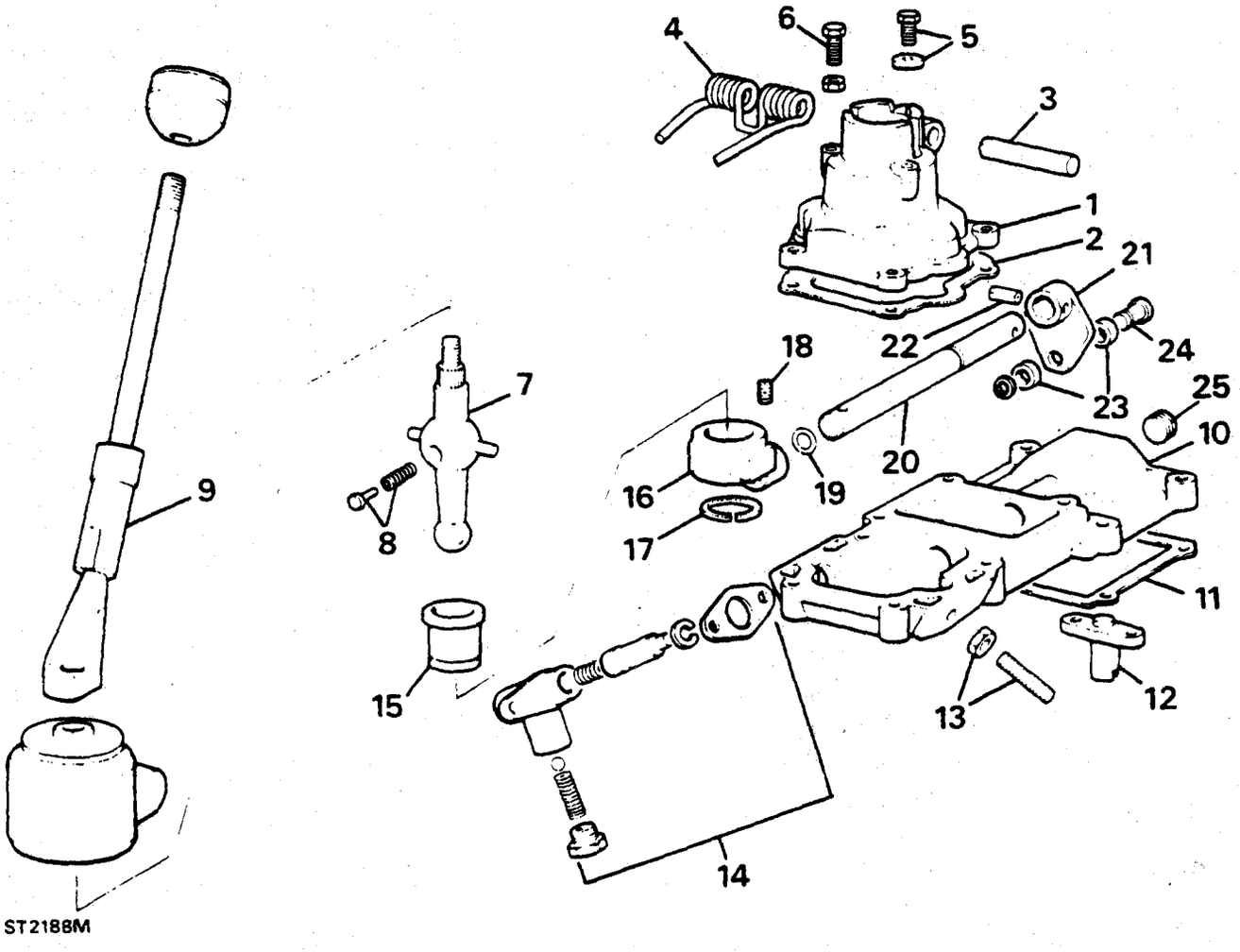
10. Remove circlip to release rollers and pin from quadrant.



ST3274M

11. Clean and examine all components and renew where necessary.
12. Assemble housing by first fitting *"0"* ring to shaft.
13. Fit quadrant and secure with roll pin.
14. Fit rollers and secure with circlip.
15. Fit fifth gear spool retainer and apply Loctite 290 to bolt threads.
16. Apply Loctite 290 to reverse switch threads.
17. Fit seating to trunnion and secure with circlip.
18. Fit trunnion to shaft and apply Loctite to retaining screw threads.
19. Fit reverse gear plunger and original shims.
20. Fit fifth gear stud stop and locknut.
21. Fit new bucker plug with Hylomar PL 32.
22. Fit gear selector housing to remote housing.

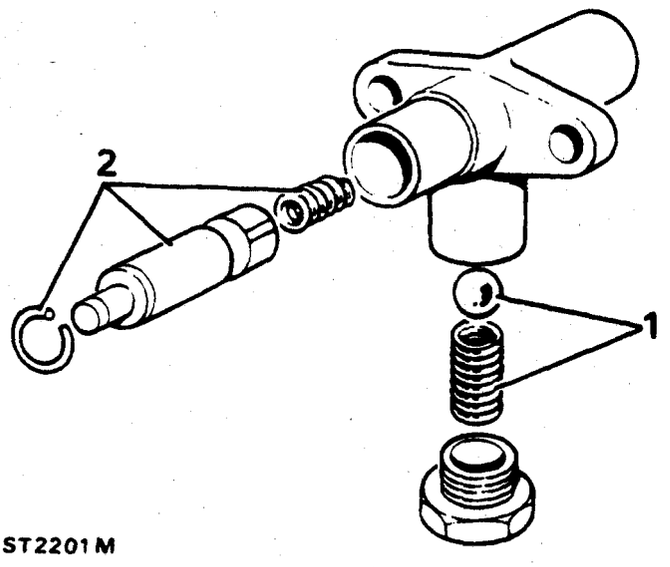
GEAR SELECTOR HOUSING - MAIN GEARBOX



1. Gear selector housing
2. Gasket
3. Roll pin
4. Bias spring
5. Gear lever retaining screw and washer
6. Selector housing screws
7. Gear lever
8. Nylon pad and spring
9. Gear lever extension
10. Remote housing
11. Gasket
12. Fifth gear spool guide
13. Fifth gear stop screw and lock nut
14. Reverse gear plunger
15. Gear lever seating
16. Trunnion
17. Circlip
18. Trunnion retaining screw
19. ' 0 ring
20. Selector shaft
21. Quadrant
22. Roll pin
23. Rollers
24. Pin
25. Blanking plug

Reverse gear plunger assembly.

1. Remove plug spring and ball.
2. Remove circlip to release plunger and spring.
3. Clean and examine components.
4. Assemble plunger and spring with multi-purpose grease and secure with circlip.
5. Lubricate and fit detent ball and spring with light oil. Apply Loctite 290 to plug threads and fit.
6. Check that plunger returns when depressed.



ST2201M

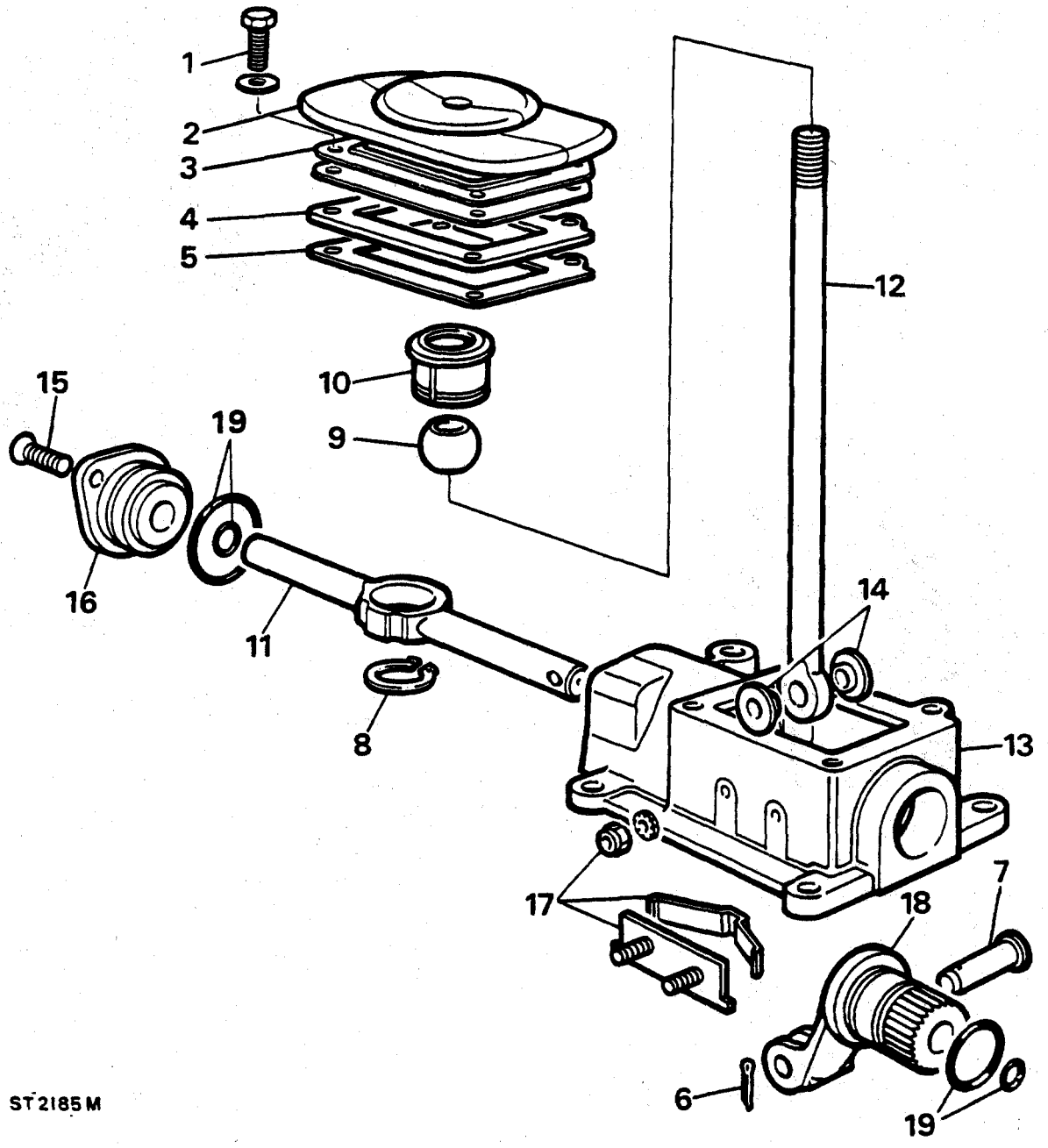
Transfer gear housing.

1. Remove the four screws and remove gaiter assembly.
2. Disconnect the gear lever from selector fork.
3. Retrieve the non metallic bushes.
4. Remove circlip to release ball and seat and withdraw gear lever.
5. Remove screws from end cover to withdraw cover and cross shaft.
6. Remove selector fork.
7. Remove detent spring and plate.
8. Clean and examine all parts and renew where necessary.

NOTE: Assemble the housing using multi-purpose grease on all moving parts.

9. Fit internal and external "O" rings to fork assembly.
10. Fit detent spring.
11. Fit "O" rings to end cover and fit to short end of cross shaft.
12. Insert shaft into fork and secure end cover with screws.
13. Fit Nylon seat, groove downwards, to gear lever.
14. Fit gear lever and seat to cross shaft and secure with circlip.
15. Fit bushes to gear lever and secure with clevis pin and split pin.

GEAR SELECTOR HOUSING - TRANSFER GEARBOX



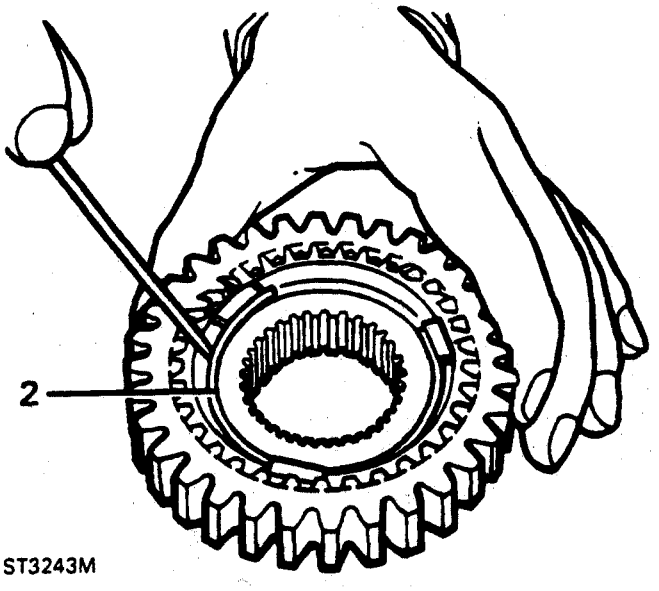
1. Gaiter retaining Screw - 4 off.
2. Gaiter.
3. Gaiter support plate.
4. Gate plate.
5. Gasket.
6. Split pin.
7. Clevis pin.
8. Circlip retaining Nylon seat.
9. Gear lever ball.
10. Nylon seat.
11. Cross shaft.
12. Gear lever.
13. Gear change housing.
14. Non-metallic bushes.
15. Counter sunk screws.
16. End cover.
17. Detent spring and plate.
18. Selector fork.
19. "O" rings.

SYNCHROMESH ASSEMBLIES

Third-fourth and fifth gear synchromesh.

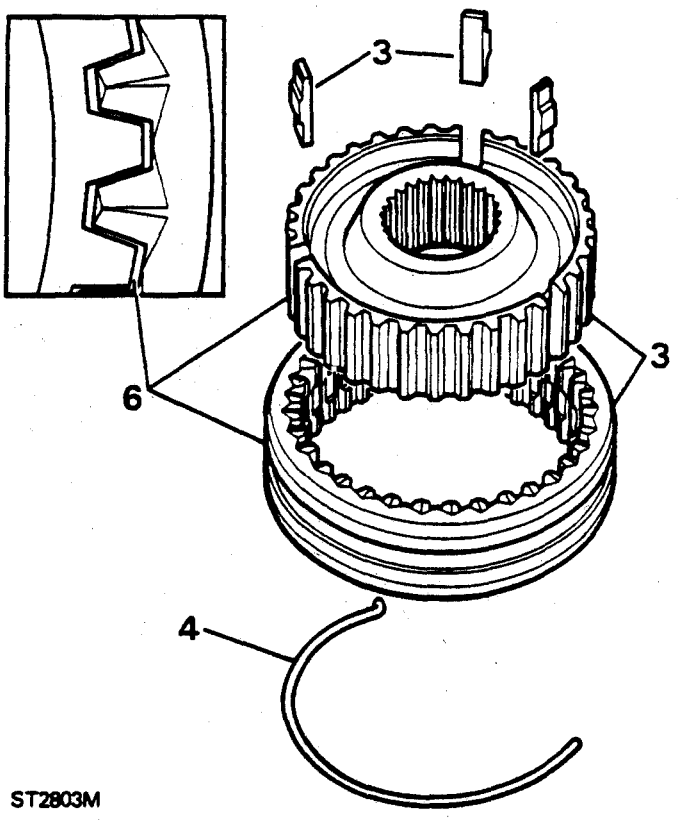
NOTE: The above assemblies are the same except that fifth gear synchromesh has a retainer plate.

1. Mark relationship of inner and outer members.
2. Remove wire clip from both sides of assembly.



ST3243M

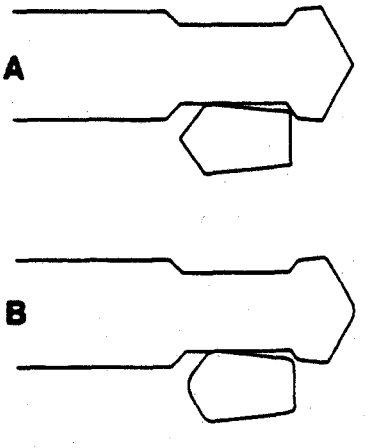
3. Remove slippers and separate the two members.
4. Examine all parts for damage and wear including wire clips for tension.
5. Check no radial movement exists between inner members and mainshaft splines. (except fifth gear synchromesh).
6. Examine inner and outer splines for wear.



ST2803M

7. Examine the dog teeth on all gears for wear and damage.

NOTE: Example "A" shows a tooth in good condition. Example "B" shows the rounded corners of a worn tooth.

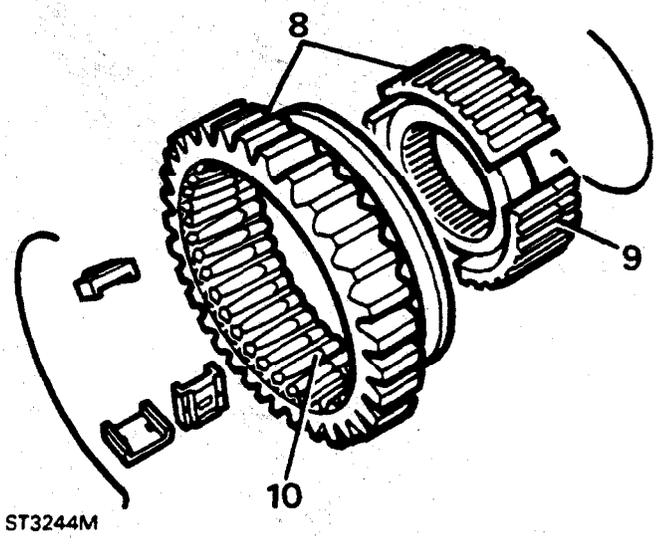


ST2449M

First-second synchromesh

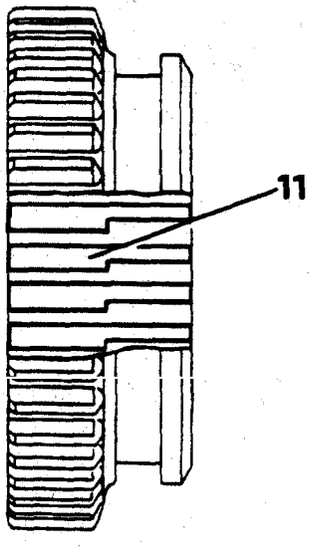
8. Repeat instructions 1 to 6 for third-fourth synchromesh.
9. Examine step in each of outer splines.
10. Check that the step on both sides of the internal splines are sharp not rounded.

NOTE: This applies only to splines on selector groove side of member.



ST3244M

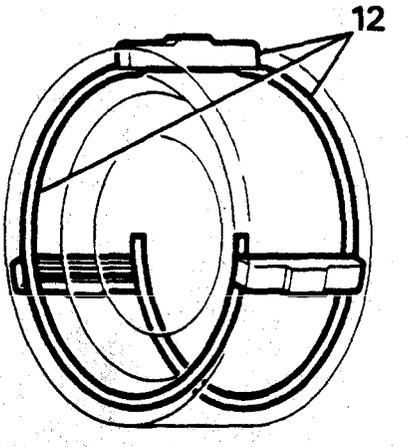
11. Fit inner member to outer so that the wide splines of inner member are under the spur gear teeth.



ST3247M

12. Fit the slippers and secure with a s side of the synchromesh.

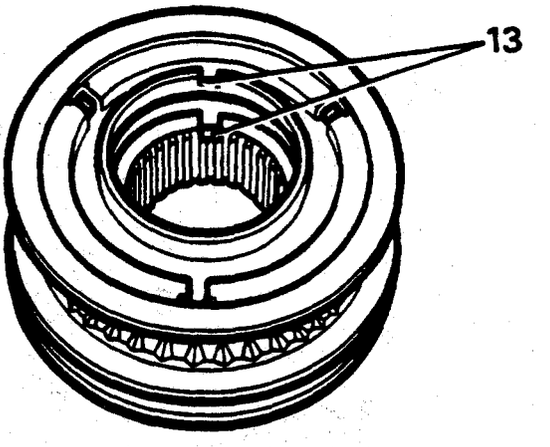
NOTE: The hooked end of each spring must locate in the same slipper with the free ends running in opposite directions and resting against the remaining slippers.



ST2467M

13. Assemble third-fourth and fifth gear synchromesh components as in instruction 12.

NOTE: The back plate for fifth gear is fitted to the rear of the assembly with the single tag locating in a slot in the inner member.

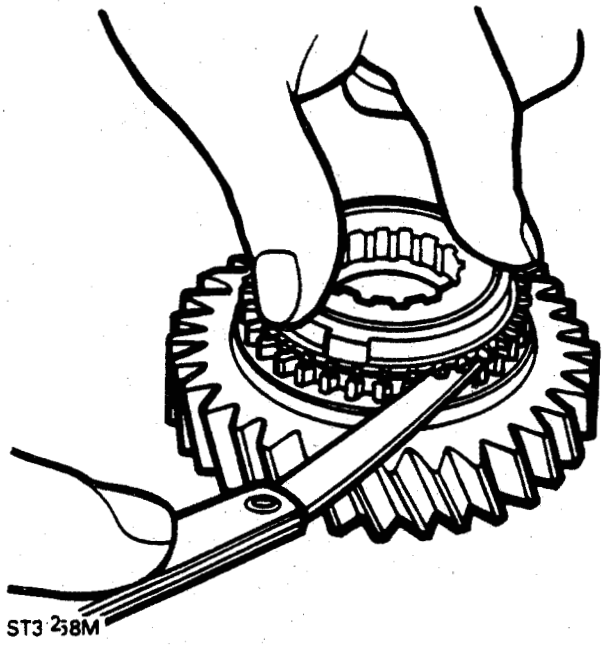


ST3276M

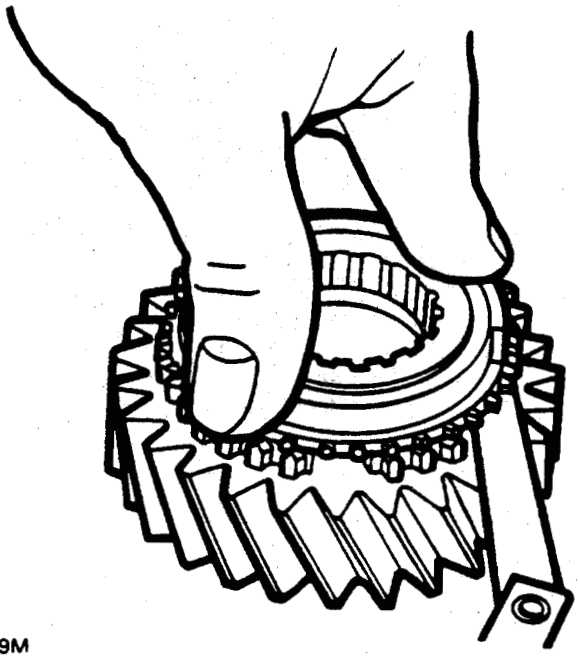
CHECKING BAULK RING CLEARANCES

Check clearance of all baulk rings and gears by pressing the baulk ring against the gear and measuring the gap, The minimum clearance should be 0,38mm (0.015in).

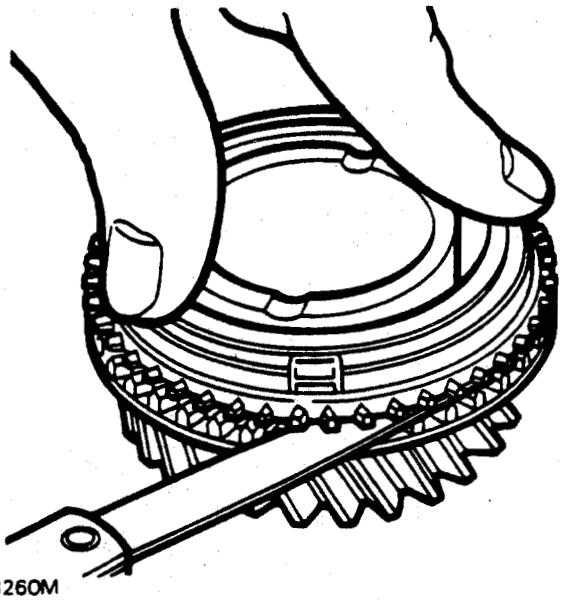
First gear



second gear

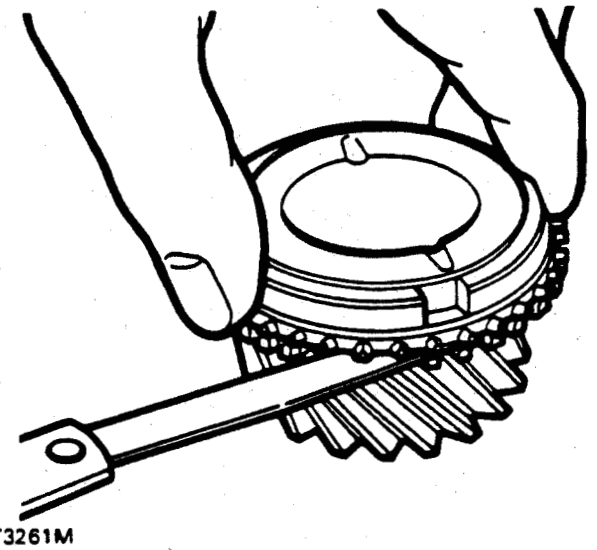


Third gear



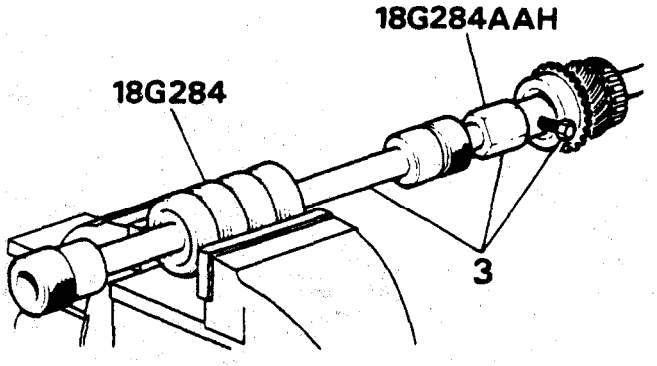
Fourth gear

Fifth gear



INPUT SHAFT

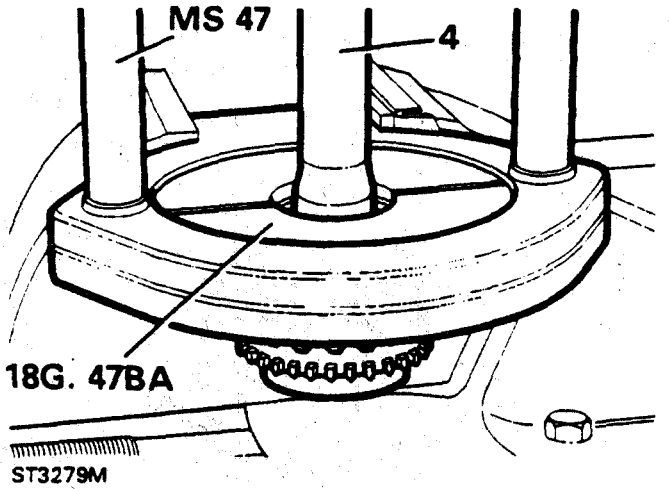
1. Examine the gear and dog teeth for wear and damage.
2. Polish oil seal track if necessary.
3. Using 18G 284 AAH and 18G 284 remove pilot bearing track.



ST3278M

4. Using 18G 47BA and MS 47 remove taper bearing.

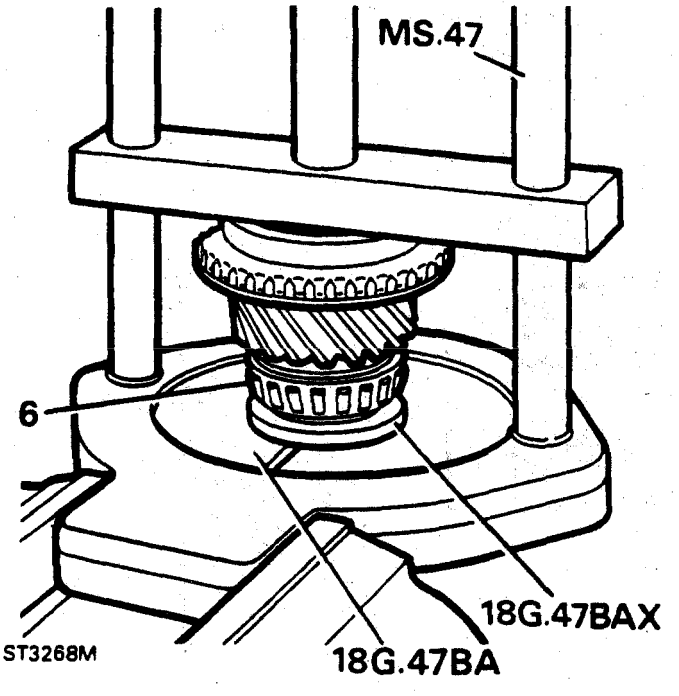
NOTE: Ensure that the bearing is supported by the lip inside 18G 47 BA.



ST3279M

5. Support the shaft under MS 47 and press in a new track.

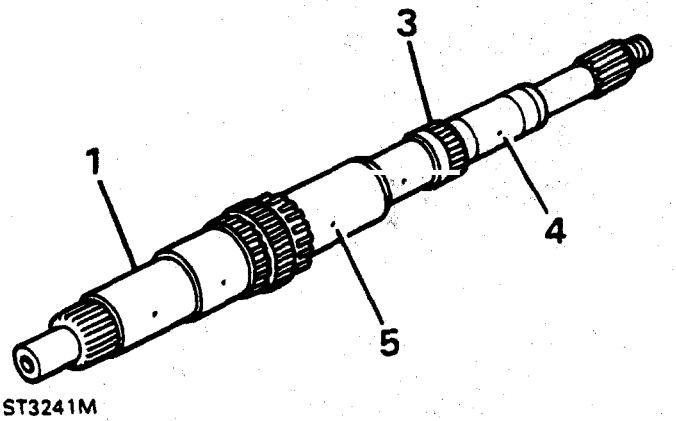
6. Using Press MS 47, Collets 18G 47B and adaptor 18G 47 BAX fit a new taper bearing.



ST3268M

MAINSHAFT

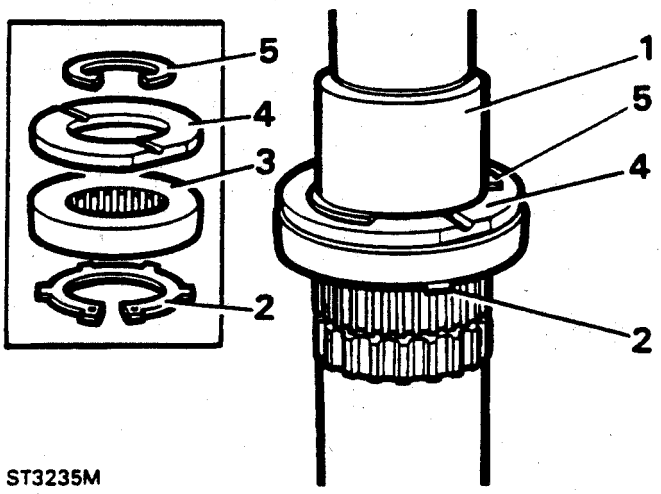
1. Examine bearing journals for wear and scores.
2. Check condition of circlip grooves.
3. Examine splines for wear and damage.
4. Use an air line to check that the main oil feed from the pump is clear and feed to spigot bearing.
5. Check oil feed holes to roller bearings are clear.



ST3241M

MAINSHAFT GEAR END FLOAT CHECKS

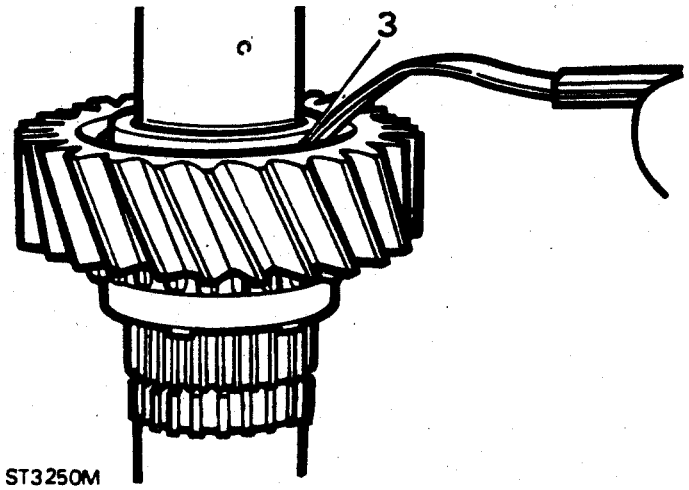
1. Hold mainshaft in vice front end downwards.
2. Fit front circlip for first-second synchromesh.
3. Fit second gear cone.
4. Fit spacer.
5. Fit snap ring.



ST3235M

Second gear end-float.

1. Fit needle roller and second gear.
2. Fit third gear bush.

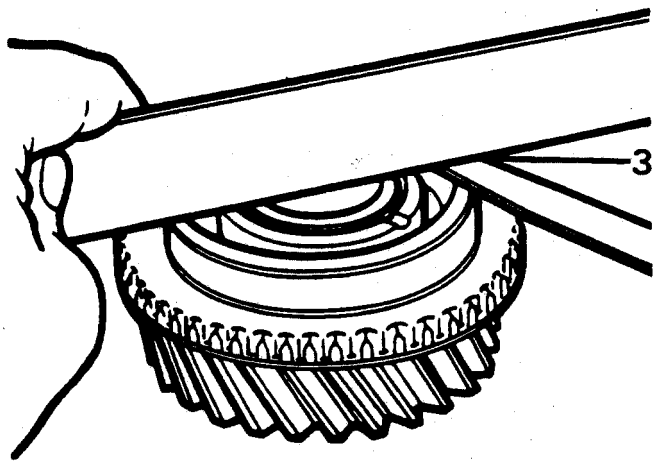


ST3250M

3. Check clearance between second gear and bush flange. Not to exceed **0,20**(0.008in).
4. Remove above components.

Third gear end-float.

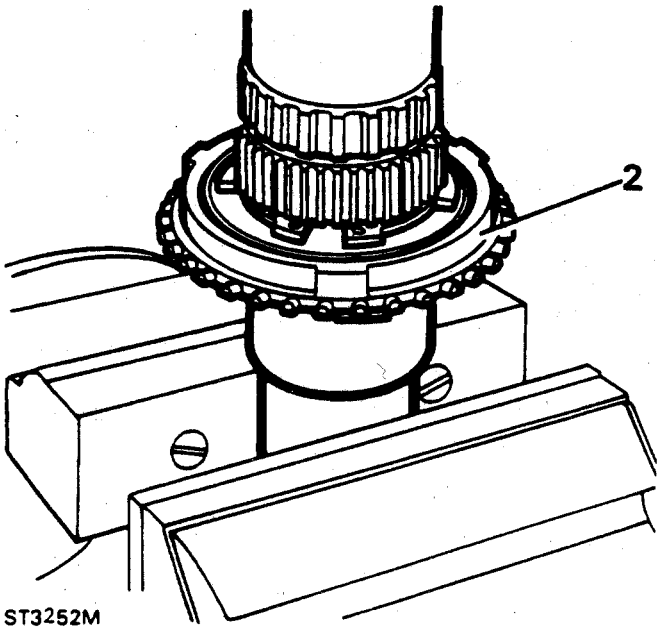
1. Fit needle roller to third gear.
2. Fit third gear bush to third gear.
3. Place gear on flat surface, bush flange downwards, and with a straight edge across gear check clearance between straight edge and gear. Not to exceed **0,20** (0.008in).



ST3251M

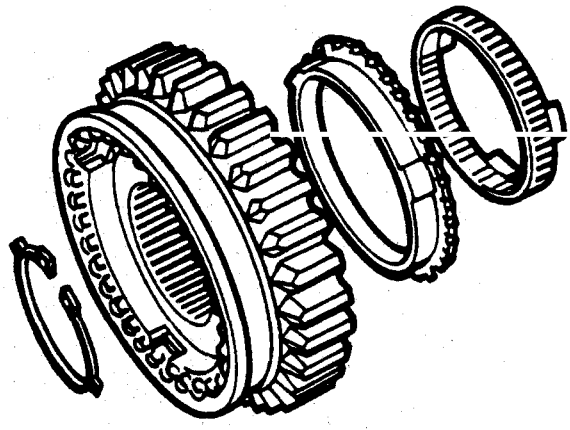
First gear bush end-float.

1. Invert mainshaft rear end uppermost.
2. Fit inner and outer second gear baulk rings.



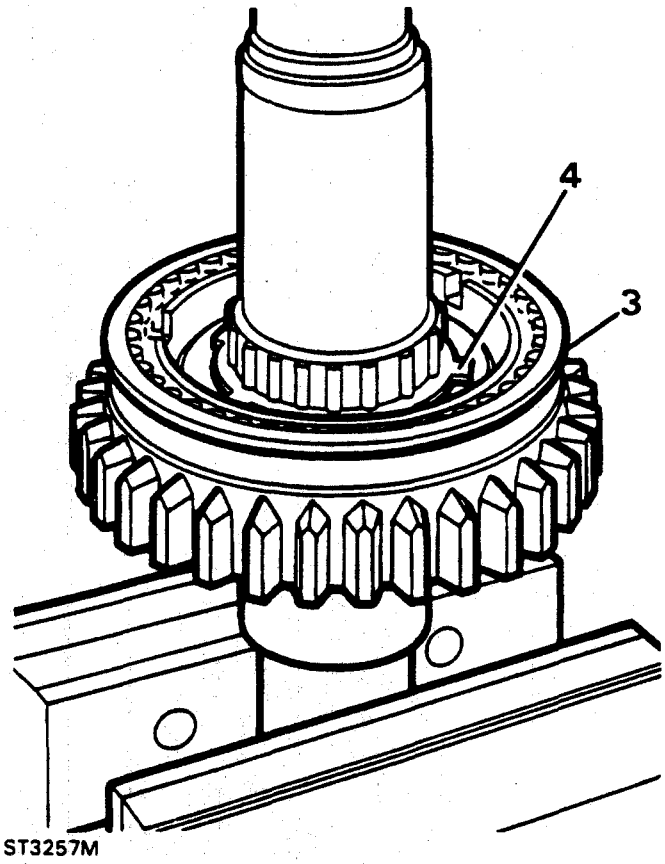
ST3252M

3. Fit first-second synchromesh hub, fork groove uppermost.
4. Fit circlip.



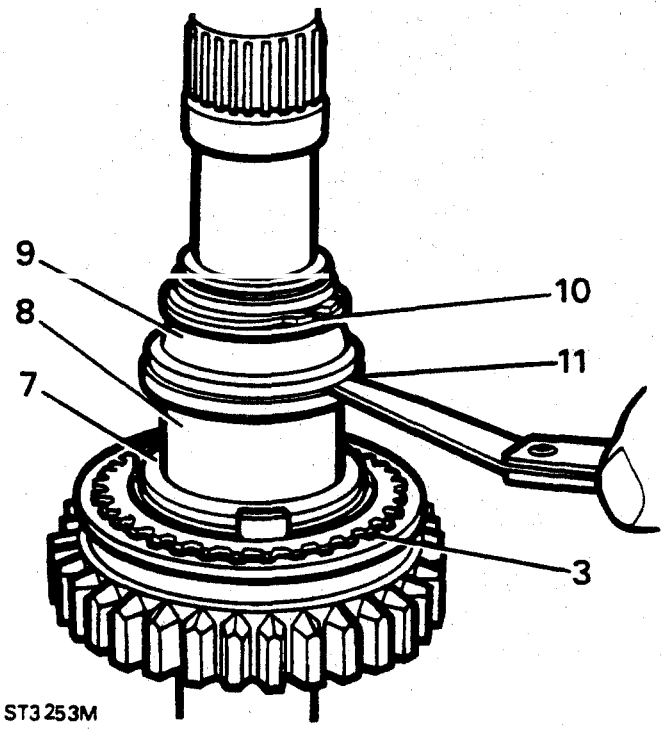
ST3231M

First-second synchromesh assembly



ST3257M

5. Fit first gear inner and outer baulk ring.
6. Fit cone.
7. Fit spacer.
8. Fit first gear bush.
9. Fit dummy bearing.
10. Fit circlip.
11. **Check** clearance between dummy bearing and bush. Not to exceed 0,75mm (0.003in).
12. Remove circlip, dummy bearing and bush.



ST3253M

Selective first gear bush

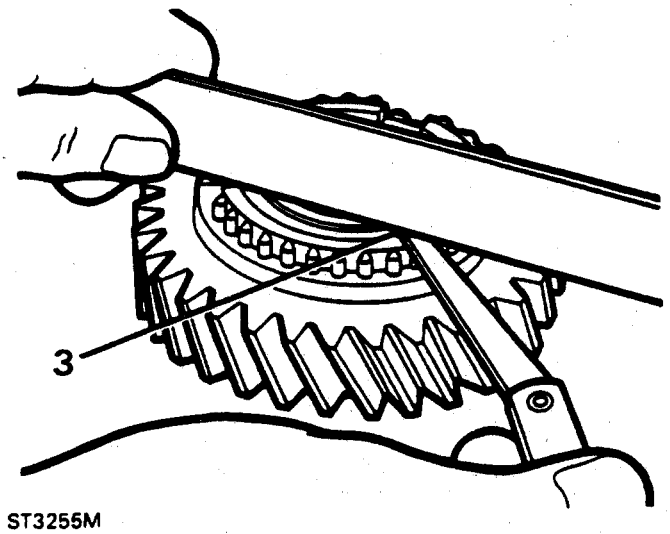
Part number	Thickness
FTC2005	30,905/30,955
FTC2006	30,955/31,005
FTC2007	31,005/31,055
FTC2008	31,055/31,105
FTC2009	31,105/31,155

Check first gear to bush end-float.

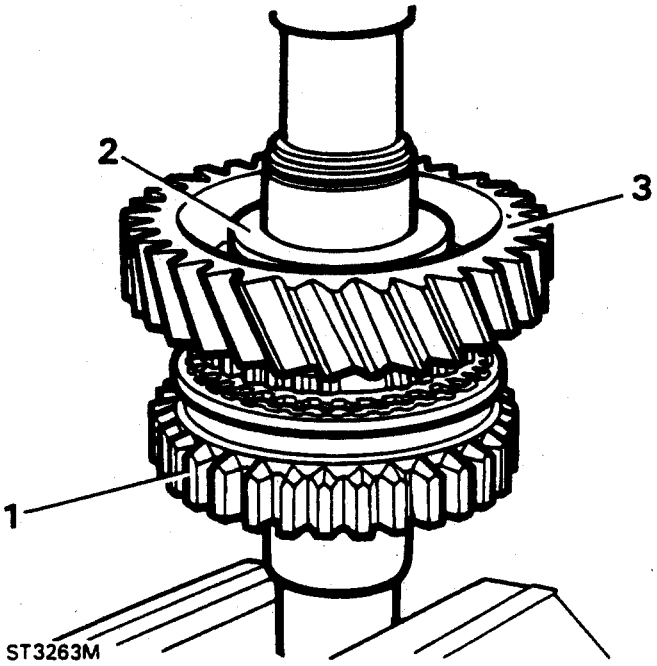
1. Fit roller bearing and bush to first gear.
2. Place bush flange side downwards on a raised block on a flat surface.

NOTE: the block should be approximately the same diameter as the bush flange so that the gear is suspended and does not rest on the flat surface.

3. Place straight edge across gear and check clearance between gear and straight edge.Not to exceed 0,20mm (0.008in).



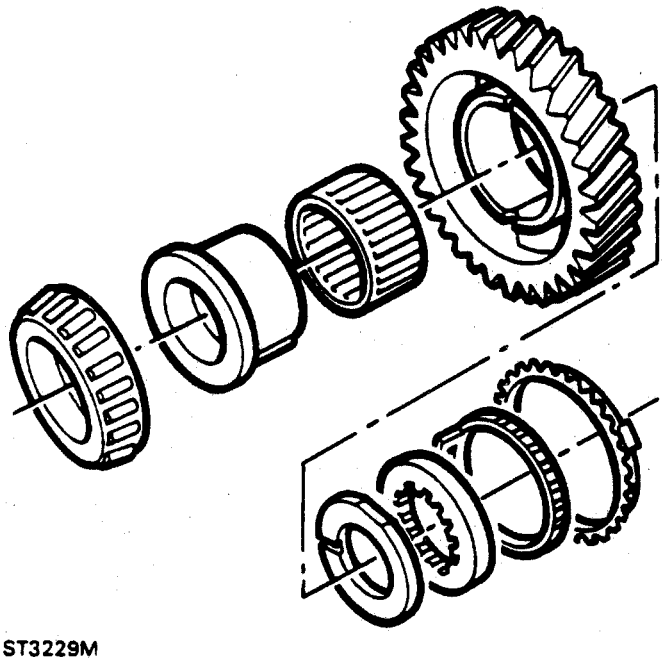
ST3255M



ST3263M

ASSEMBLING MAINSHAFT

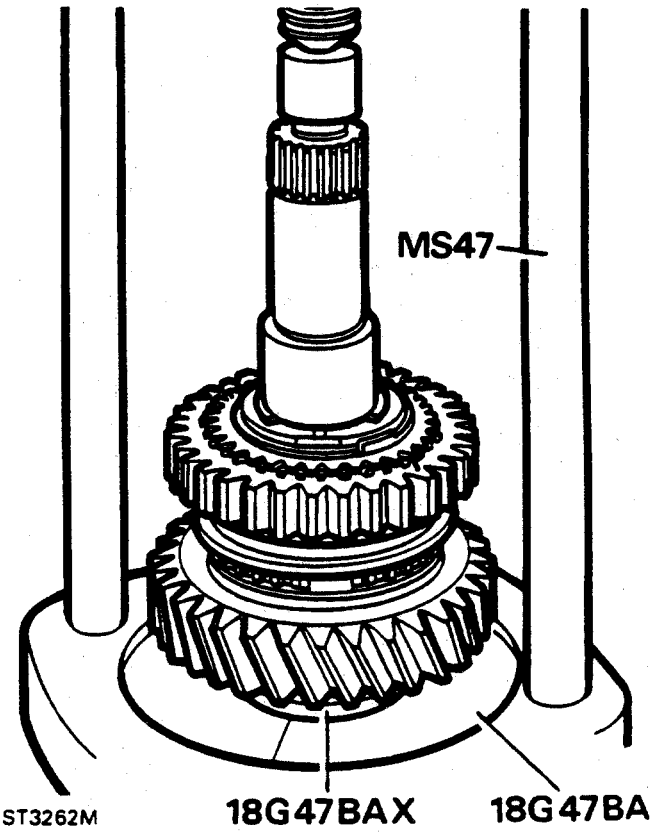
1. With the first-second synchromesh hub and spacer in position, assemble the rear end of the shaft.
2. Fit the roller bearing and bush to first gear.
3. Fit first gear to mainshaft.



ST3229M

First gear assembly

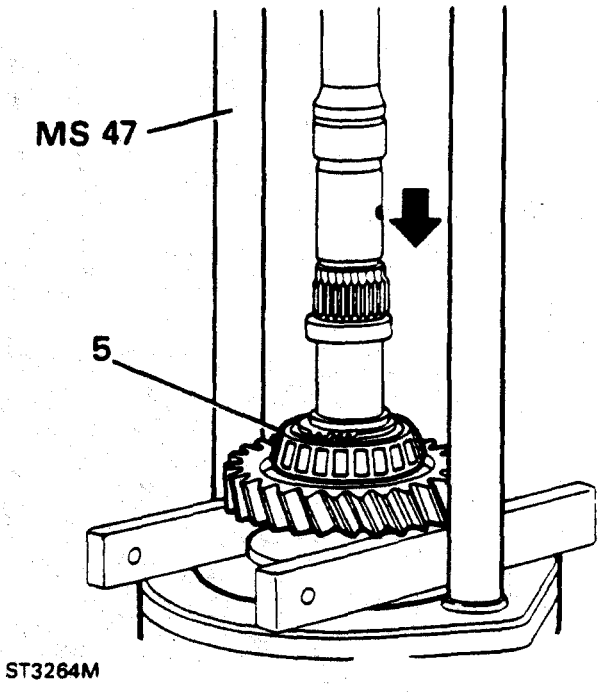
4. Fit the taper bearing to mainshaft using MS 47, collets 18G 47 BA and adaptor 18G 47 BAX.



ST3262M

CAUTION: Ensure that the slots in the baulk ring align with the synchromesh slippers while pressing on the bearing.

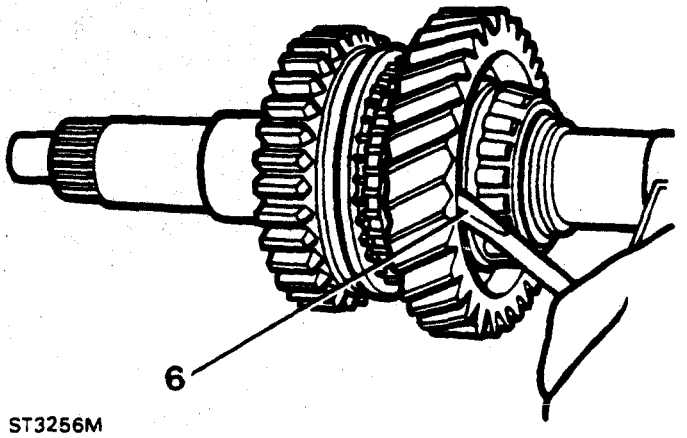
5. Invert mainshaft and press assembly back against circlip.



ST3264M

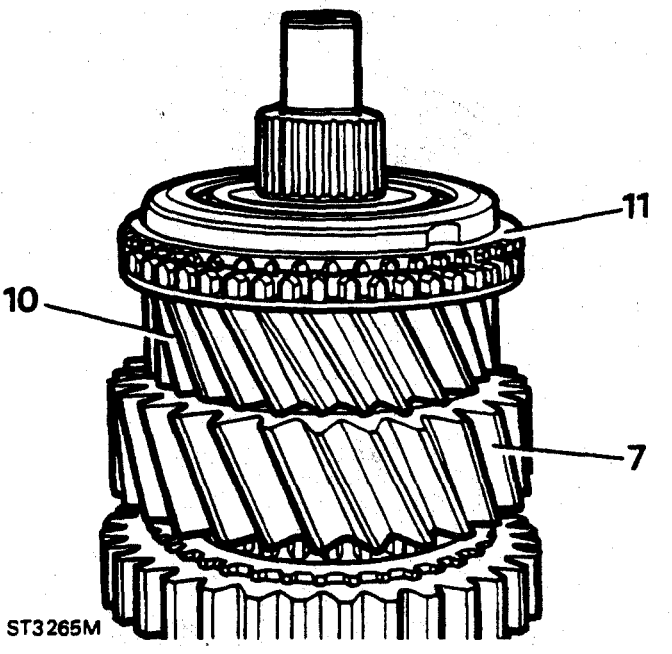
NOTE: Instruction 5 is necessary since it is probable that when pressing on the bearing it will have clamped the first gear bush preventing it from turning.

6. Reposition mainshaft in vice and using a screw driver blade check that the first gear bush is free to turn.

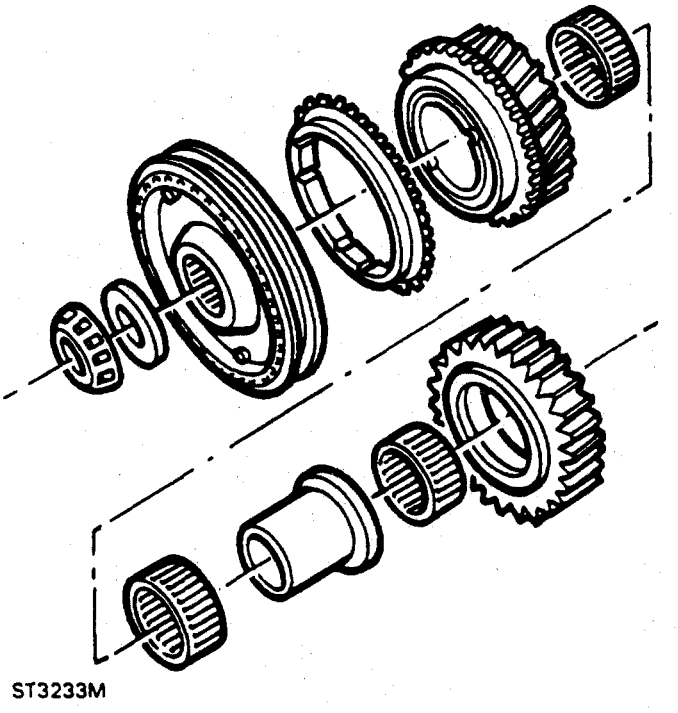


ST3256M

7. Position mainshaft in vice, rear end downwards and fit second gear needle roller, and second gear.
8. Fit third gear bush.
9. Fit third gear needle rollers.
10. Fit third gear.
11. Fit third gear baulk ring.

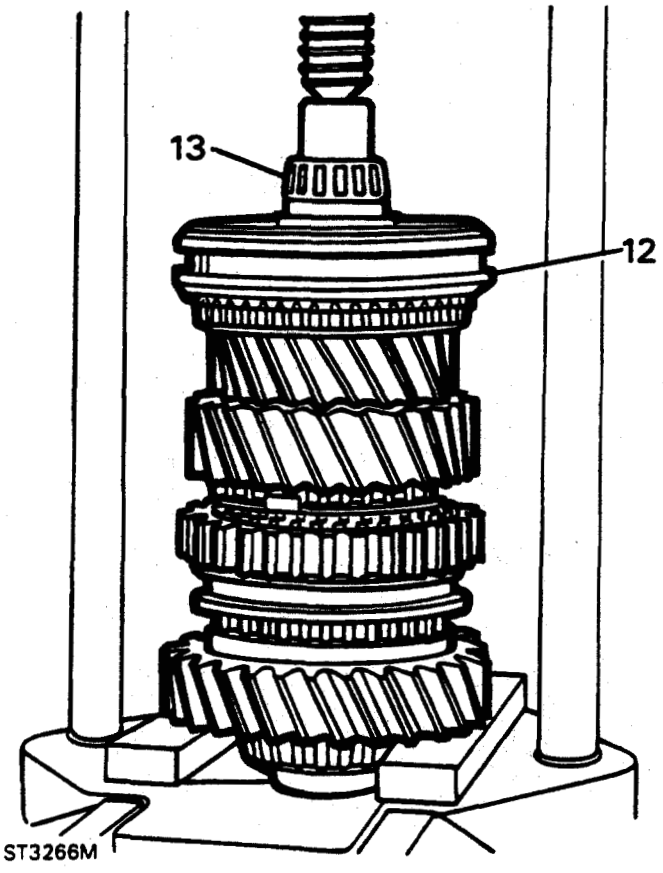


ST3265M


ST3233M

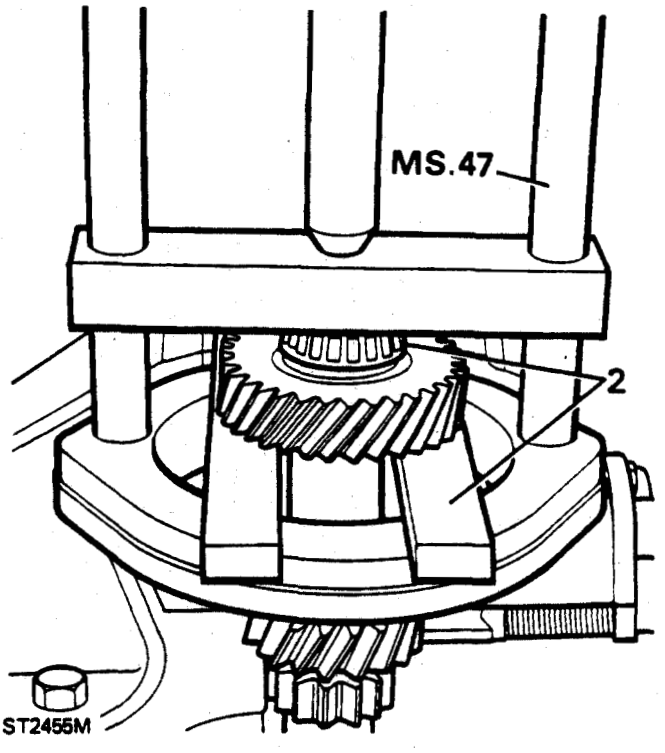
Third-fourth synchomesh assembly

12. Fit third-fourth gear synchromesh hub.
13. Using MS 47 with supports under first gear, press the spigot bearing on to shaft.



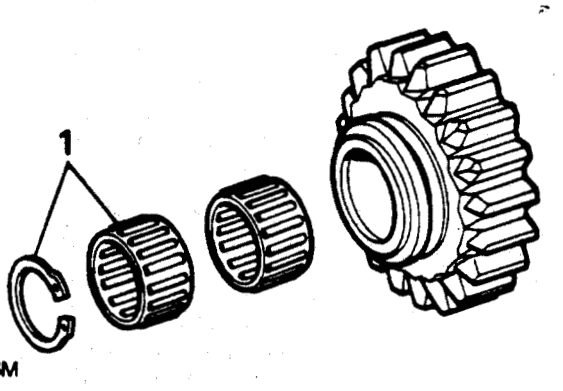
LAYSHAFT

1. Examine the layshaft for wear and damage.
2. Press bearings on to layshaft using MS 47 and supporting bars.

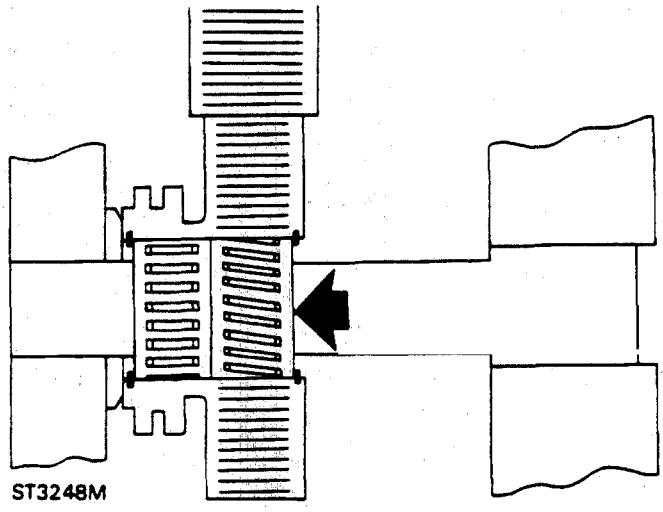


REVERSE GEAR AND SHAFT

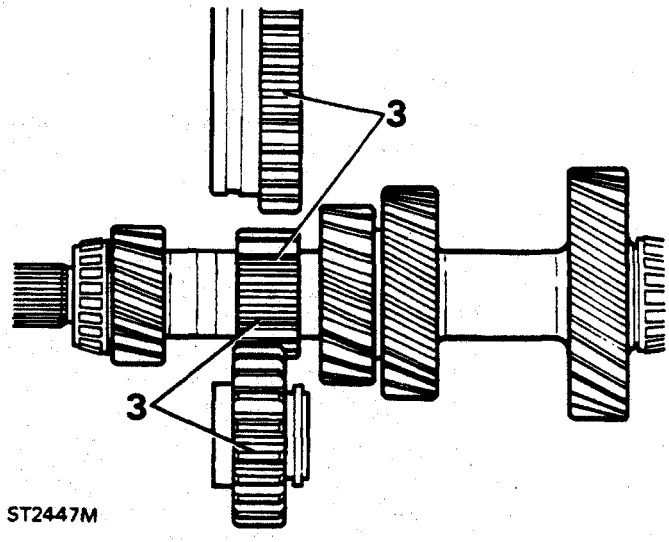
1. Remove one circlip from the idler gear and remove bearings.



NOTE: One bearing cage is twisted in manufacture. The twist causes the gear to tilt on the shaft forcing the gear into engagement. Renew bearings if worn or if the gear jumps out of engagement.


ST3248M

2. Fit the bearings either way round and secure with the circlip.
3. Check condition of idler gear and mating teeth on layshaft and synchromesh outer member.



ST2447M

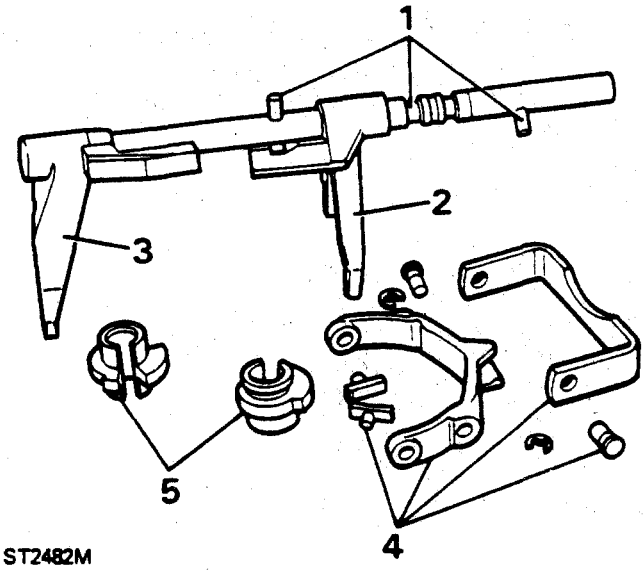
4. Examine idler shaft for wear, scores and pitting.

SELECTORS

1. Examine selector rail and pins for wear and damage.
2. Examine first-second selector fork for wear cracks and damage

NOTE: The selector rail and fork is only supplied as a complete assembly.

3. Examine third-fourth selector fork for wear, cracks and damage.
4. Examine fifth gear selector fork, pads and pivot pins.
5. Examine interlock spools for wear and damage.

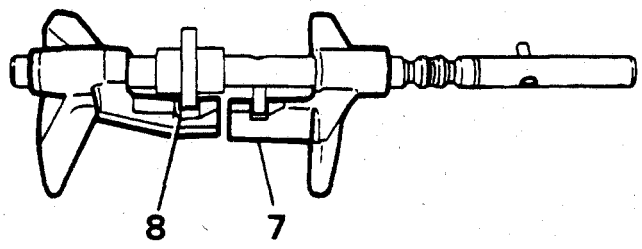


ST2482M

6. Renew retaining circlips if distorted.

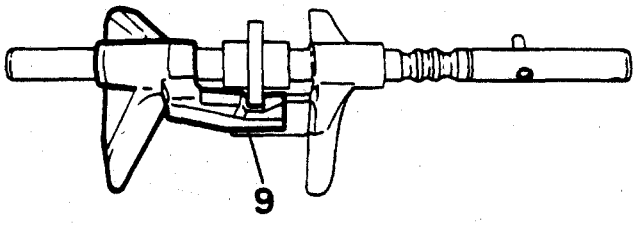
Assembling selectors.

7. Rest first-second fork and shaft assembly on bench and locate pin in jaw of fork.
8. Fit interlock spool and third-fourth fork and engage spool in jaw of fork.



ST2488M

9. Slide spool and fork towards first- second selector until slot in spool locates over pin keeping the spool engaged in third-fourth fork jaw.

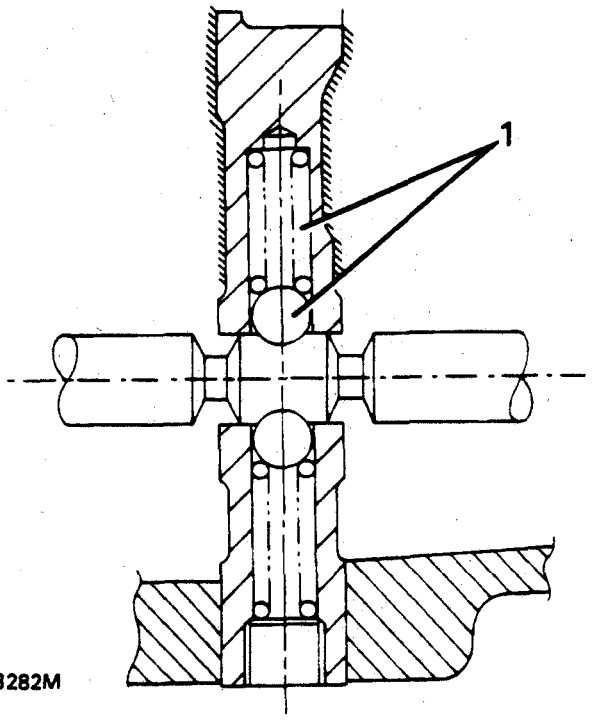


ST2487M

ASSEMBLING GEARBOX SHAFTS TO CENTRE PLATE

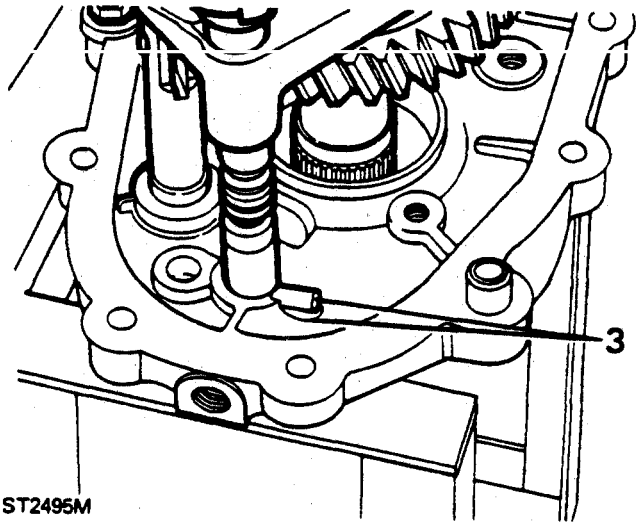
Fitting gears to centre plate

1. Secure centre plate to workstand, fit bearing tracks and inboard detent ball and spring.



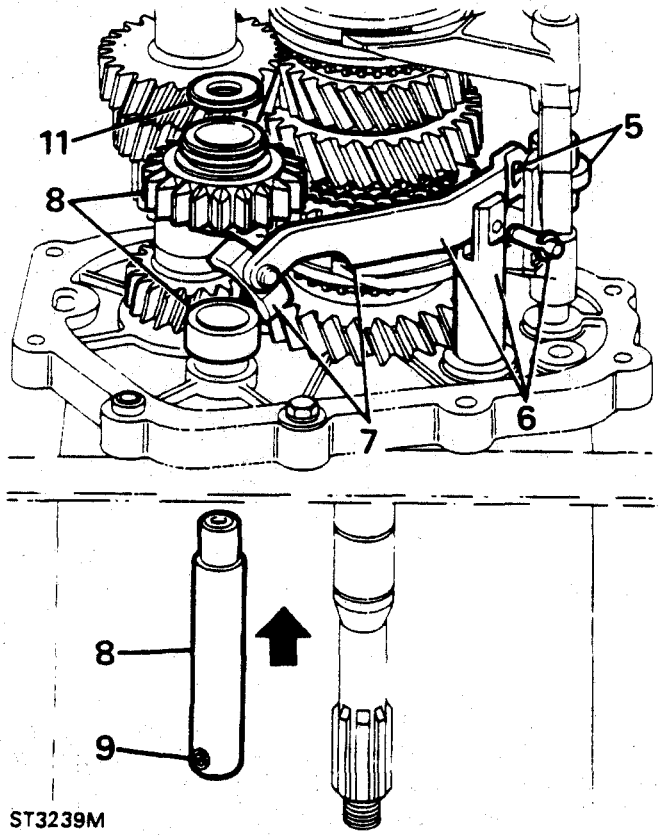
ST3282M

2. Check both synchromesh units are in neutral and fit selector shaft assembly.
3. fit mainshaft and selectors to centre plate and align pin with slot in plate.

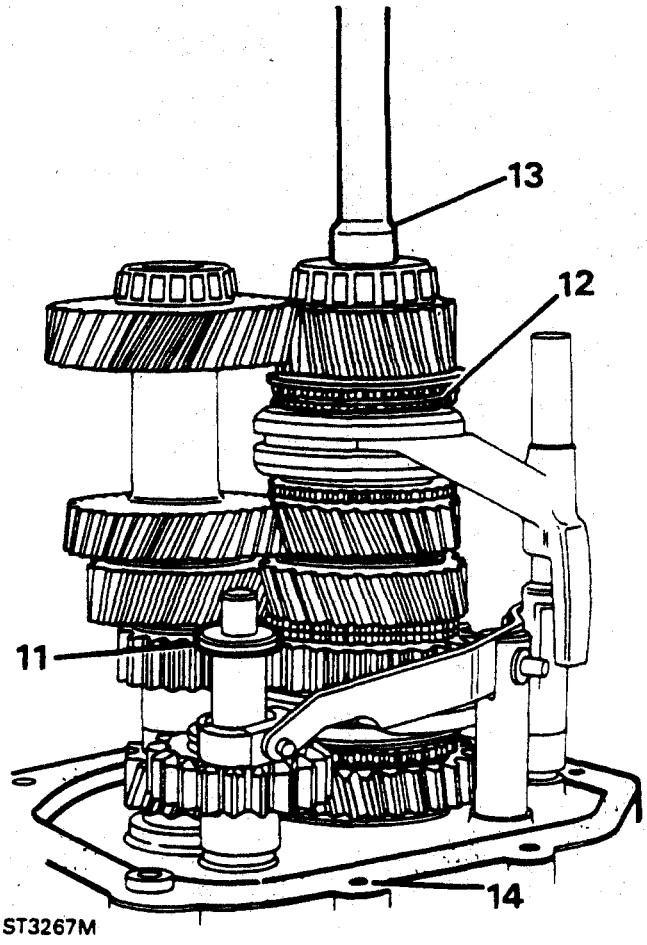


ST2495M

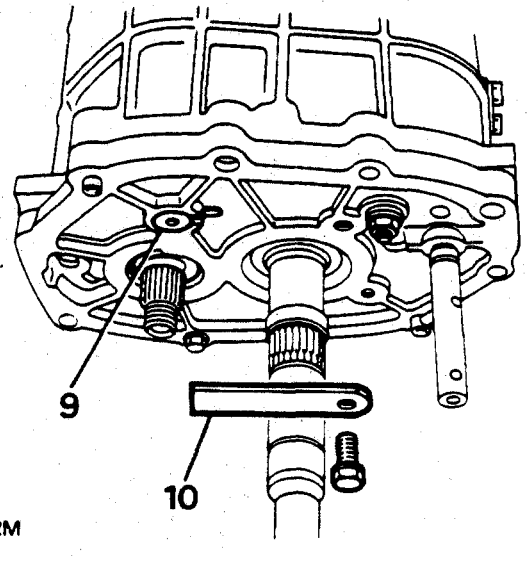
4. Fit layshaft while lifting mainshaft to clear layshaft rear bearing.
5. Turn selector shaft and interlock spool to allow reverse lever to engage spool flange.
6. Fit reverse lever to pivot post and secure with pin and circlip.
7. Fit slipper pad to lever.
8. Fit reverse gear shaft, spacer and gear.
9. Fit slipper to reverse gear and ensure roll pin in shaft engages in slot in centre plate.
10. Secure reverse shaft with manufactured tool "A".
11. Fit reverse gear thrust washer to shaft.
12. Fit fourth gear baulk ring.
13. Lubricate spigot bearing and fit input shaft.
14. Remove centre plate workstand bolt and fit gasket.



ST3239M



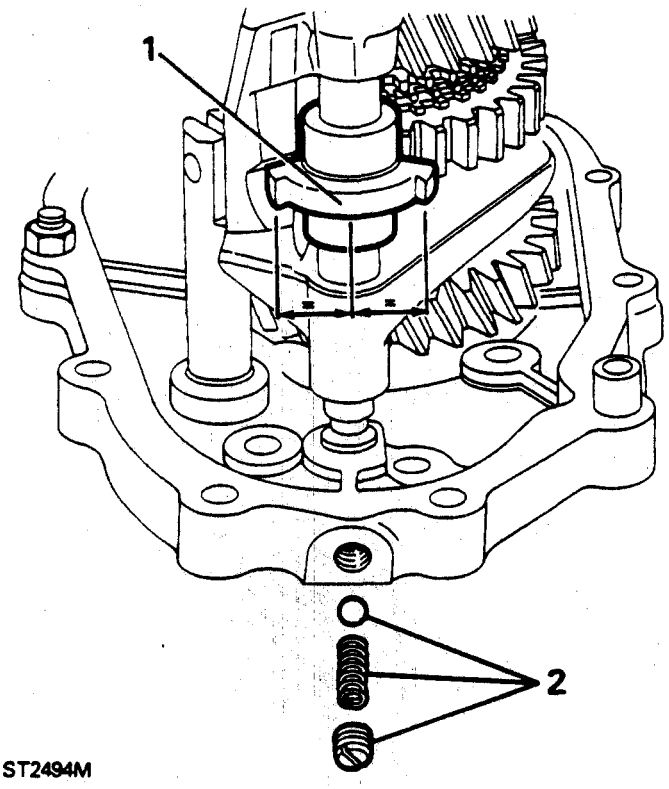
ST3267M



ST2492M

FITTING GEARBOX CASING

1. Turn selector shaft and spool to neutral position.
2. Fit out-board detent ball and spring and secure with plug.

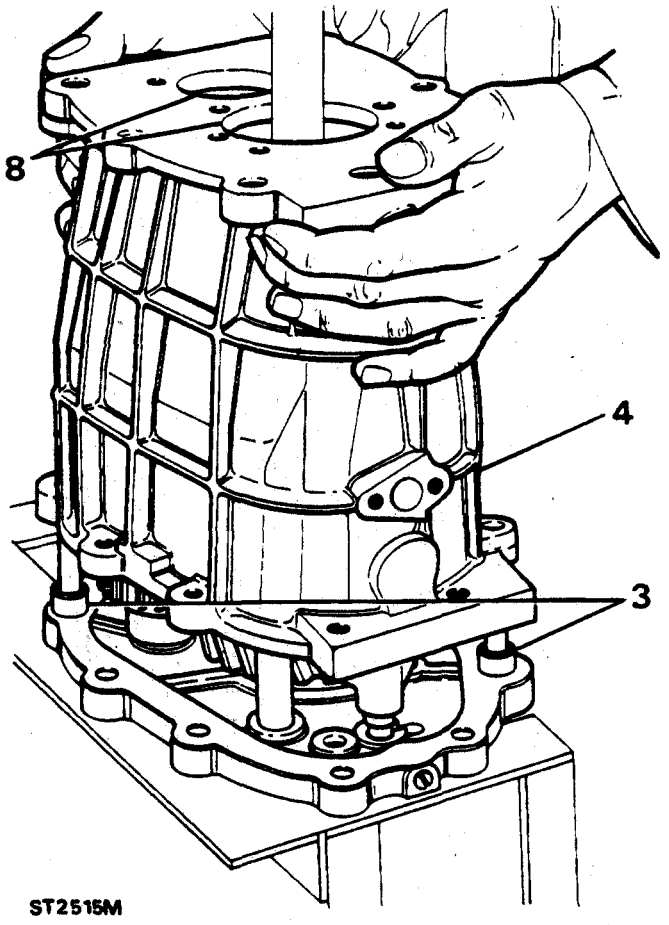


ST2494M

3. Fit guide studs to casing and check oil scoop is correctly fitted.
4. Without using force, fit gearcase.

NOTE: Ensure that the centre plate dowels and selector shaft are properly located.

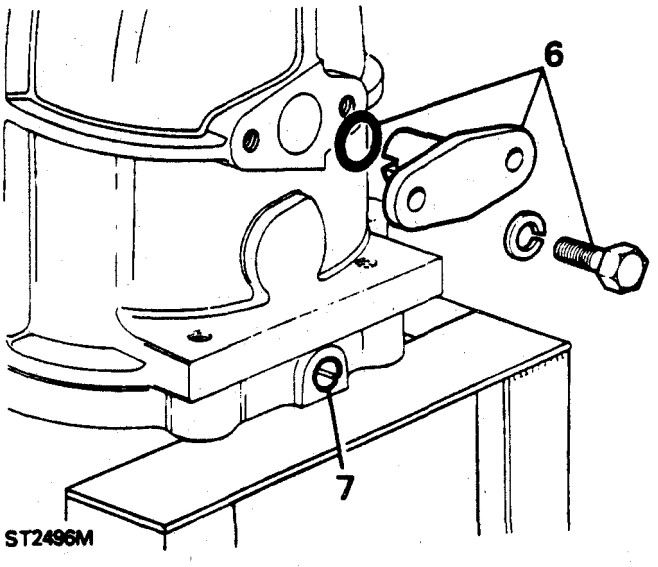
5. Secure centre plate and gearcase to workstand with two 8 x 35mm bolts.
6. Apply PL 32 to joint face and bolt threads and fit spool retainer.



ST2515M

CAUTION: Do not use force to fit retainer. Provided the spool has not been disturbed the retainer will slide into position. If not, remove the gear case and reposition spool or shaft.

7. Remove detent plug, apply Loctite 290 or Hylomar PL 32 to thread, refit and stake.
8 Fit layshaft and input shaft bearing tracks.

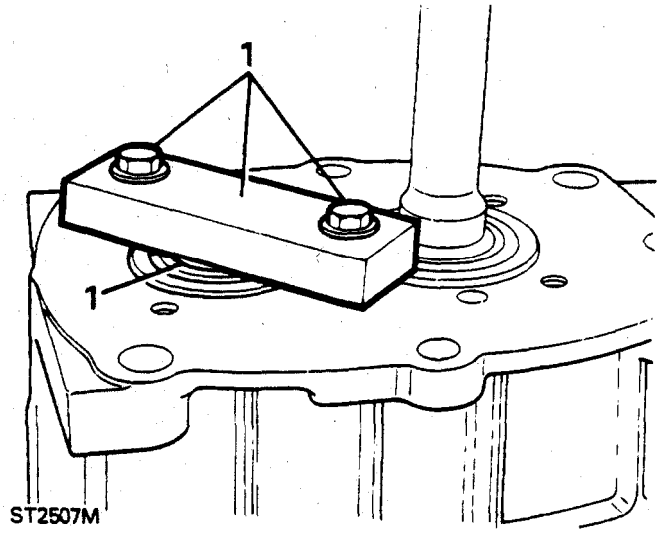


ST2496M

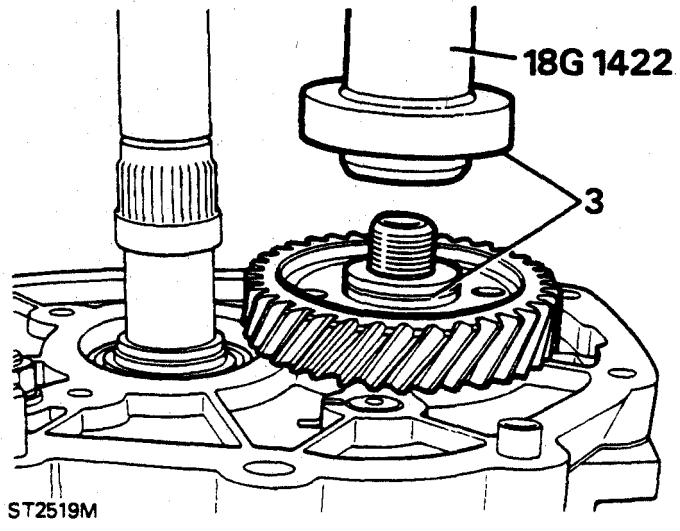
FITTING FIFTH GEAR

CAUTION: Since the fifth gear is a tight fit on the layshaft, the force, when pressing the gear, must not be transferred to the layshaft front bearing. Tool "D" and packing disc should be made to the dimensions given to absorb the force. The plate also retains the input shaft bearing outer track.

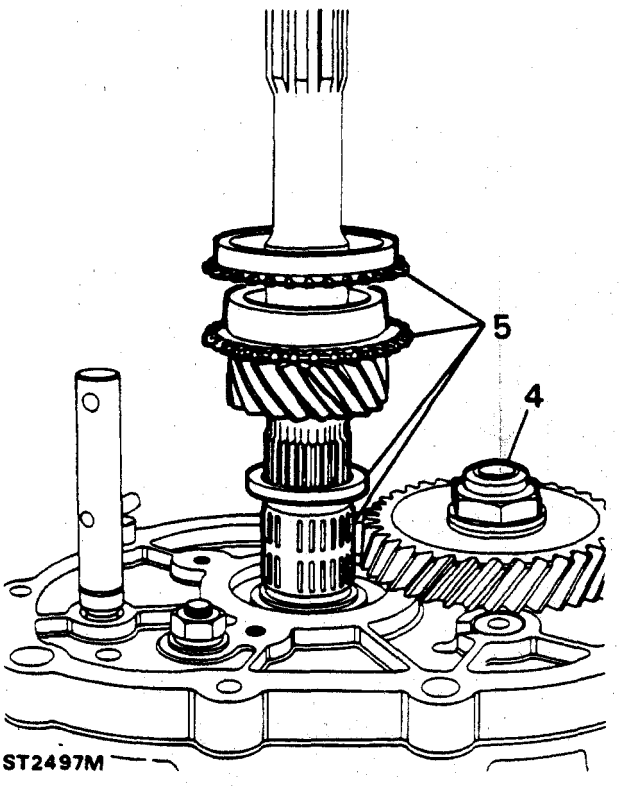
1. Secure Tool "D" with two 8x25mm bolts. Insert disc between Tool "D" and layshaft.



2. Release and invert gearbox and remove reverse shaft retainer plate.
3. With the extraction groove uppermost, drive fifth gear on to layshaft using **18G** 1422.

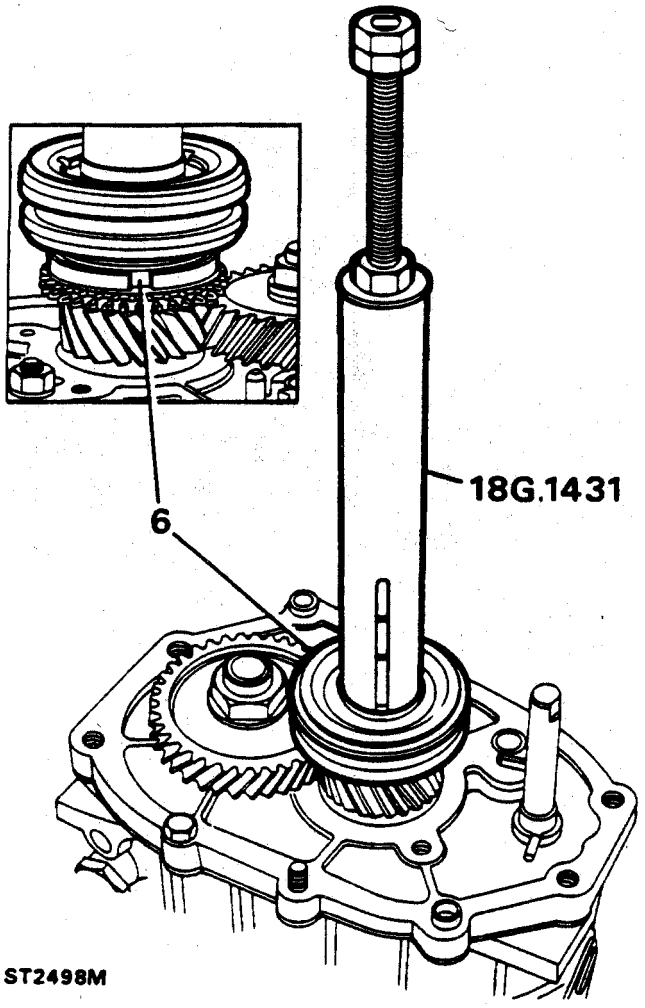


4. Fit a new stake nut but **do** not tighten.
5. Fit fifth gear assembly to mainshaft.



6. Press fifth gear synchromesh assembly to mainshaft using 18G 1431.

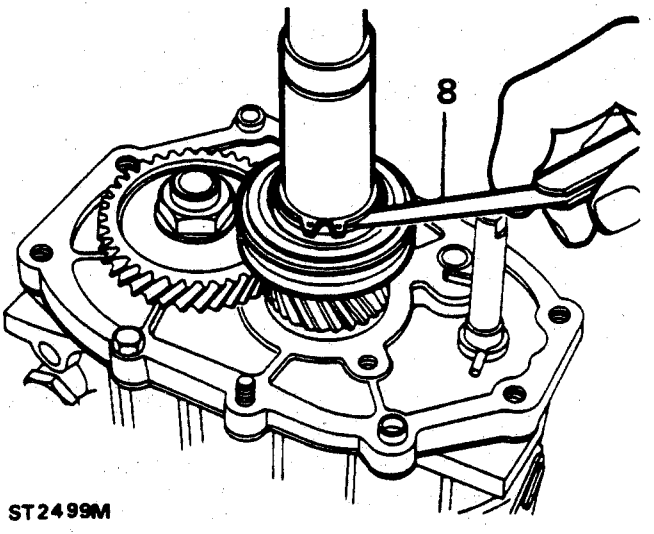
CAUTION: Before pressing the assembly fully home, ensure that the slipper pads locate in the baulk ring slots.



NOTE: Only limited movement of the synchromesh inner member on the main-shaft is permissable. The maximum clearance is 0,005mm to 0,055mm (0.0002in to 0.002in) and to achieve this the following selective washers are available.

Part number	Thickness
FRC 5284	5,10
FRC 5286	5,16
FRC 5288	5,22
FRC 5290	5,38
FRC 5292	5,34
FRC 5294	5,40
FRC 5296	5,46
FRC 5298	5,52
FRC 5300	5,58
FRC 5302	5,64

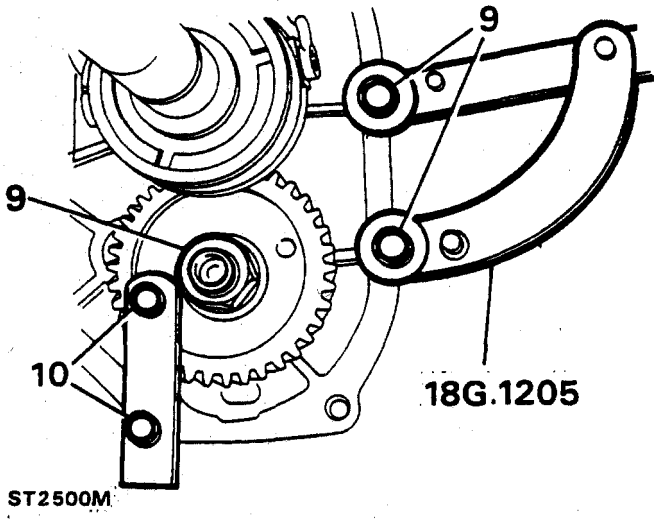
7. Fit the thinnest washer and secure with circlip.
8. Measure clearance between circlip and washer.



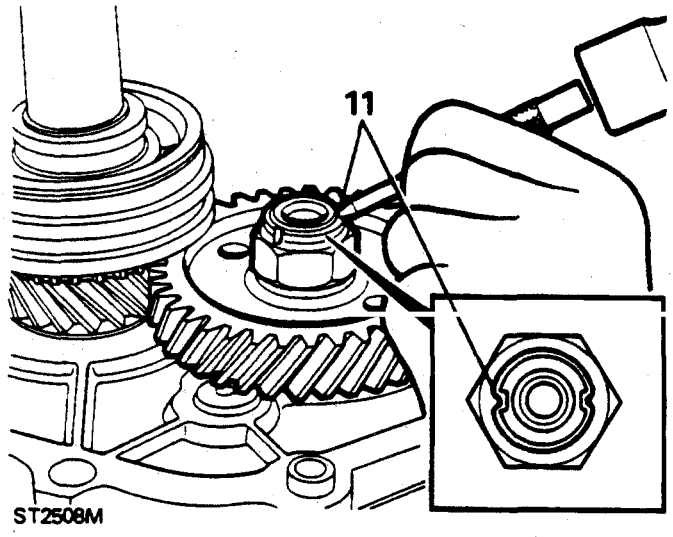
9. Tighten layshaft stake nut using 18G 1205.

CAUTION: The practice of locking gears to provide a restraint to tighten the nut is not acceptable due to high torque figure required.

10. Secure tool "A" to gear and gear case and using a suitable torque wrench tighten the nut to the correct torque.

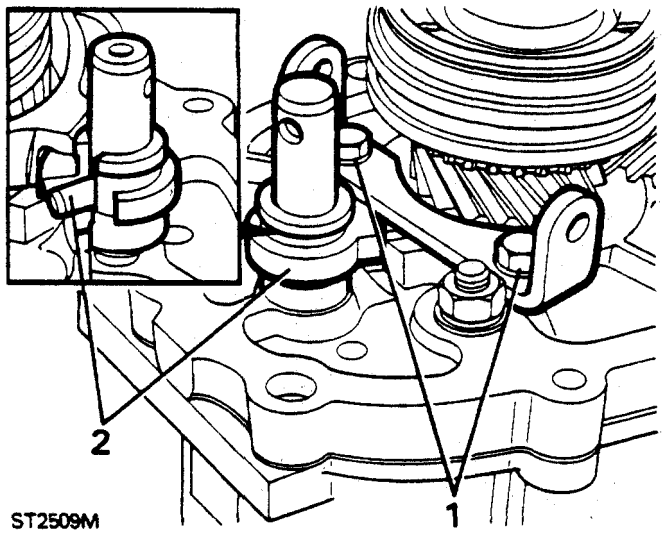


11. Using a round nose punch, form the collar into the layshaft slots.



FIFTH GEAR SELECTOR FORK ASSEMBLY

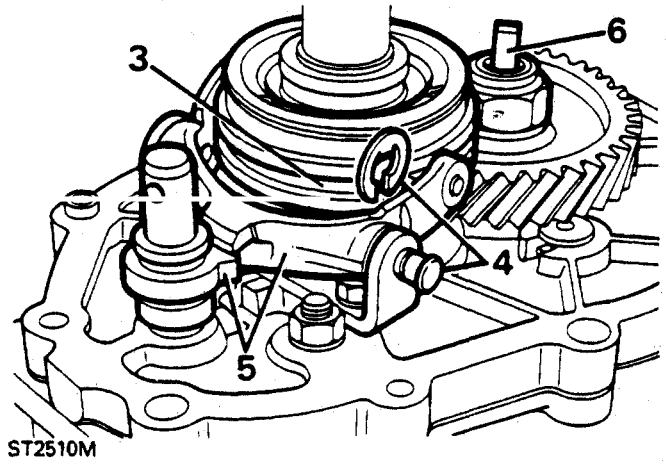
1. Fit fifth gear selector fork bracket.
2. Fit the fifth gear spool long end towards centre plate.



3. Fit slippers to selector fork.
4. Fit fork to synchromesh and secure with pins and "E" clips.

NOTE: Before fitting pins and clips cover holes in centre plate to prevent them falling into casing.

5. Engage tongue of spool in selector fork.
6. Fit oil pump drive to layshaft.



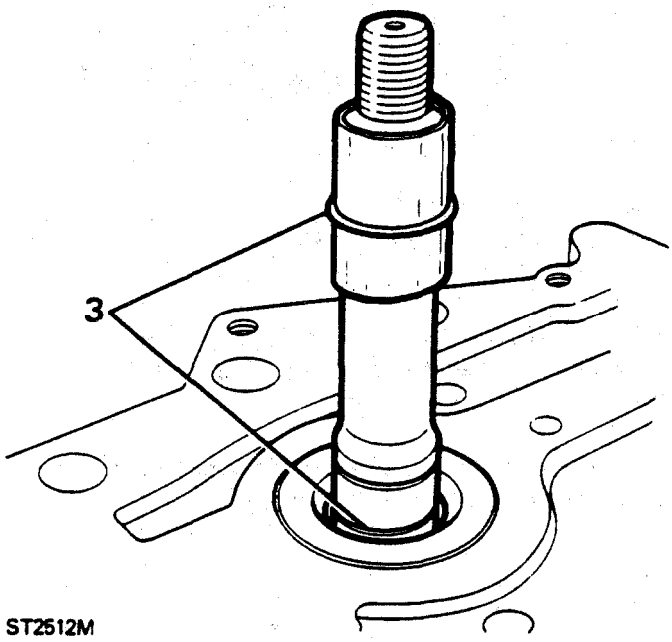
EXTENSION CASE

1. Release centre plate from workstand and fit gasket on joint face.
2. Fit extension case while aligning oil pick-up pipe. Remove guide studs and secure to main case.

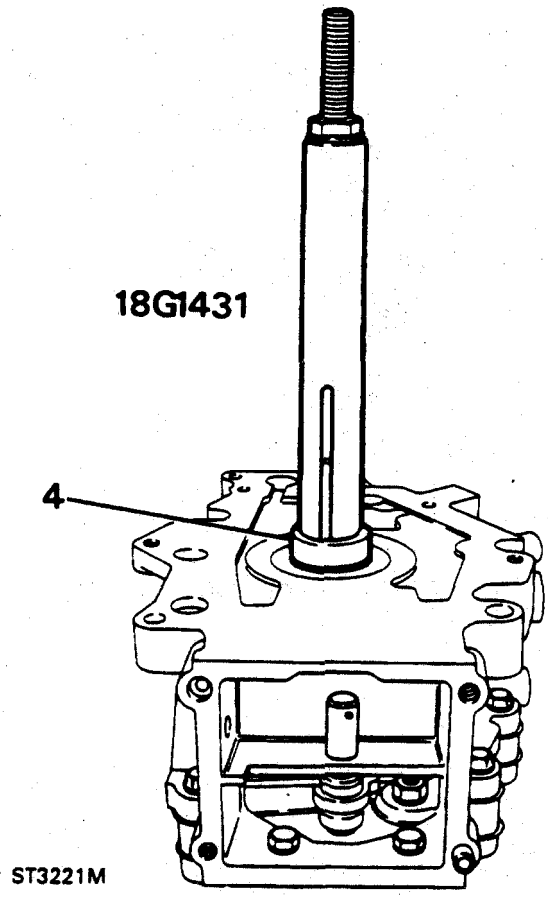
NOTE: Do not use farce, if necessary remove case and re-align oil pump drive if case does not fit first time.

CAUTION: To protect "O" ring while fitting, cover mainshaft splines with smooth tape.

3. Fit " O " ring to mainshaft groove.



4. Fit “O” ring collar to mainshaft using 18G 1431.

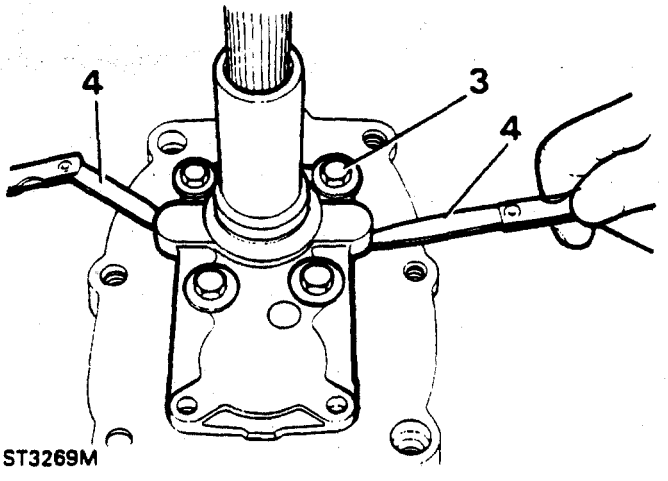


INPUT-MAINSHAFT BEARING ADJUSTMENT

1. Turn gearbox over with input shaft uppermost. Remove layshaft support plate.

NOTE: Correct shimming of the input shaft bearing is vital to ensure that the mainshaft assembly has the design intended end float, and the bearings are not pre-loaded.

2. Measure the thickness of a new front cover gasket.
3. Place the original shim on mainshaft bearing and finger tighten the bolts.
4. Measure the clearance between front cover and gearcase with two feeler gauges.



5. If required, change the selective washer to provide a clearance of 0,35mm to 0,085mm (0.001 to 0.003ins) less than the gasket thickness.

NOTE: This will ensure that when the gasket and cover is fitted to the correct torque, the input and mainshaft bearings will have no pre-load and not more than 0,06mm (0.0025in) end float.

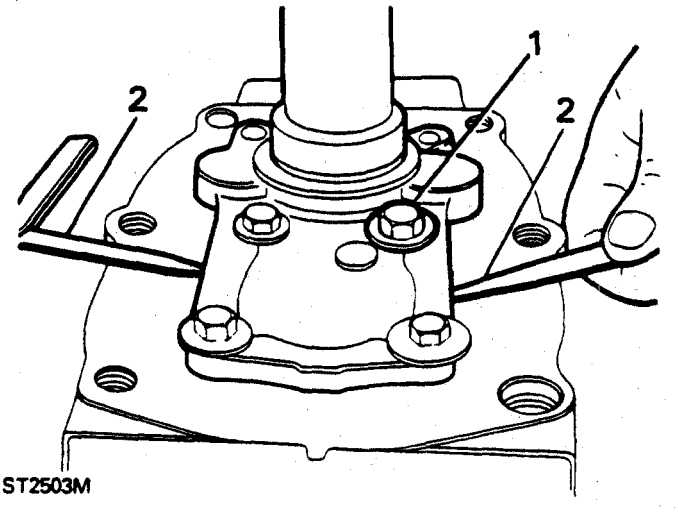
6. Remove front cover and keep gasket and selective washer together.

Mainshaft selective washers

Part number	Thickness(mm)
FRC4327	1,51
FRC4329	1,57
FRC4331	1,63
FRC4333	1,69
FRC 4335	1,75
FRC4337	1,81
FRC4339	1,87
FRC4341	1,93
FRC4343	1,99
FRC4345	2,05
FRC4347	2,11
FRC 4349	2,17
FRC 4351	2,23
FRC4353	2,29
FRC 4355	2,35
FRC4357	2,41
FRC4359	2,47
FRC4361	2,53
FRC4363	2,59
FRC4365	2,65
FRC4367	2,67
FRC4369	2,77

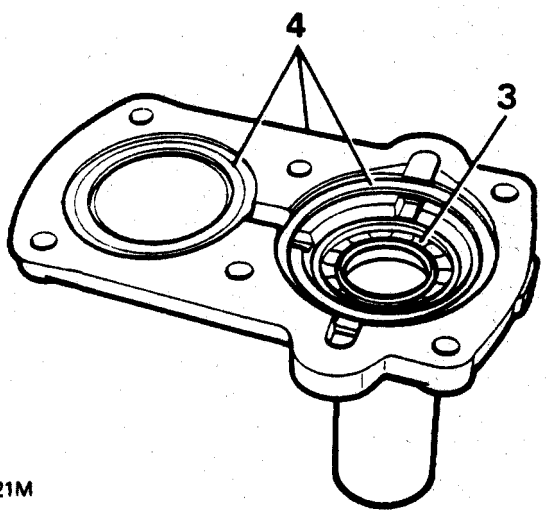
LAYSHAFT BEARING ADJUSTMENT

1. Place original selective washer on layshaft bearing, fit front cover without gasket, and finger tighten bolts.
2. Measure clearance, with two feeler gauges, between cover and gearcase. Select a shim that will provide a clearance equal to the thickness of the gasket that was selected and measured when calculating the adjustment of the input and mainshaft bearing.



NOTE: This will ensure zero layshaft bearing end float and not more than 0,025mm (0.001in) pre-load once the cover and gasket are fitted and bolts correctly torqued.

3. Remove cover and selected washer and fit new oil seal, lip towards gearcase.
4. Fit mainshaft and layshaft selected washers and gasket.



ST2521M

5. Wrap protective tape round input shaft splines.
6. Apply Hylomar **PL** 32 to bolt threads and secure cover.

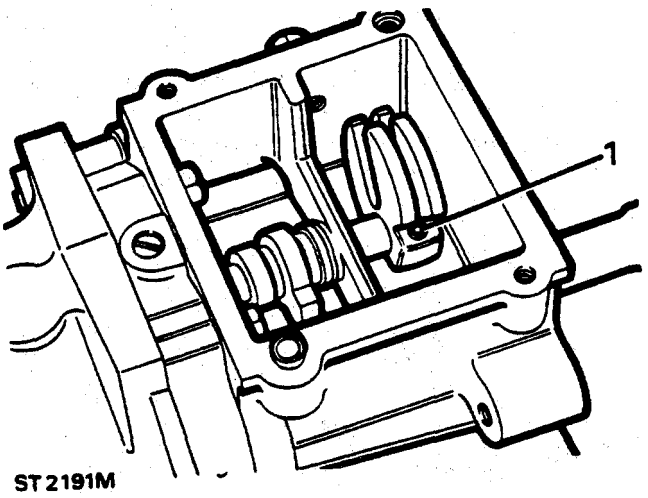
Layshaft selective washers.

Part number	Thickness(mm)
FTC 0262	1,36
FTC 0264	1,42
FTC 0266	1,48
FTC 0268	1.54
FTC 0270	1,60
FTC 0272	1,66
FTC 0274	1,72
FTC 0276	1,78
FTC 0278	1,84
FTC 0280	1,90
FTC 0282	1,96
FTC 0284	2,02
FTC 0286	2,08
FTC 0288	2,14
FTC 0290	2,20
FTC 0292	2,26
FTC 0294	2,32
FTC 0296	2,38

GEAR LEVER AND REMOTE HOUSING ASSEMBLY

1. Fit quadrant to selector shaft with new roll pin,

NOTE: Push shaft forward, fit quadrant so ledge is to the left viewing box from rear. Return shaft to neutral position.



ST2191M

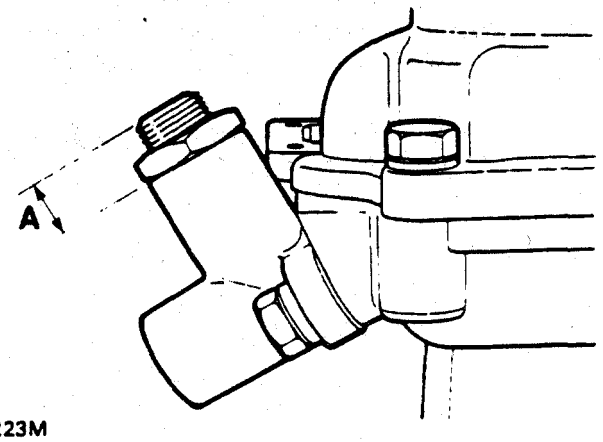
2. With a new gasket, fit remote housing locating over dowels.

NOTE: Ensure rollers locate in quadrant fork.

3. Fit transfer gear change housing.

Reverse gear plunger adjustment.

1. Fit plunger with original shims and tighten bolts.
2. Slacken locknut, turn adjuster screw so that dimension "A" is approximately 12 rnm (0.50 in). Tighten locknut.



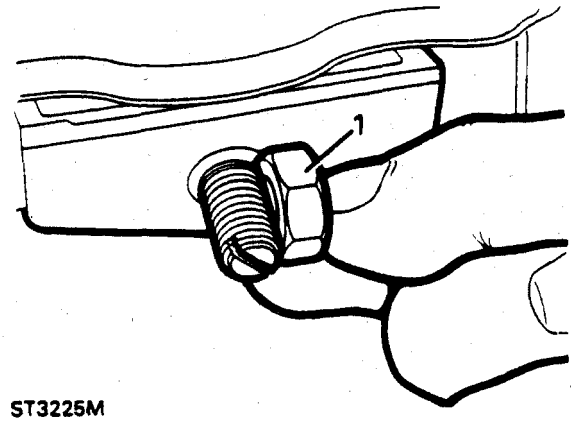
ST3223M

NOTE: If necessary, final adjustment can be made in vehicle. To increase pull-over load turn screw clockwise or anti-clockwise to reduce load.

Fifth gear stop screw adjustment.

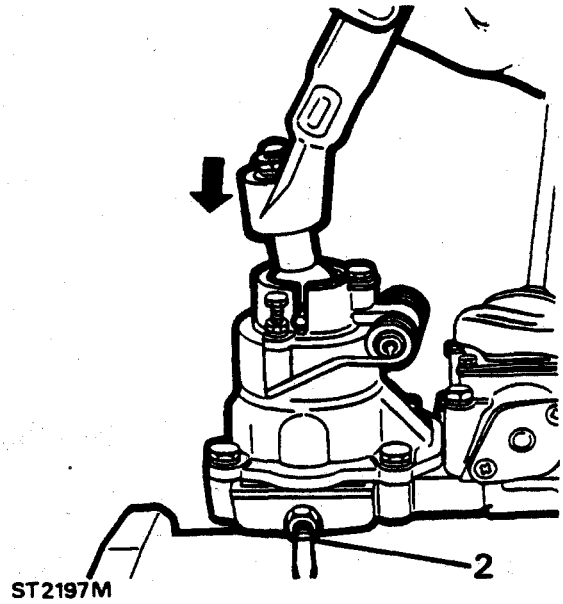
1. Adjust screw to protrude from housing the distance across corners of locknut.

NOTE: This is only an approximate setting which will limit travel of selector yoke but will allow fifth gear to be selected.



ST3225M

2. Select fifth gear. While applying light pressure to gear lever towards right, turn screw clockwise until it contacts yoke. Turn screw half a turn anti- clockwise and tighten nut.



ST2197M

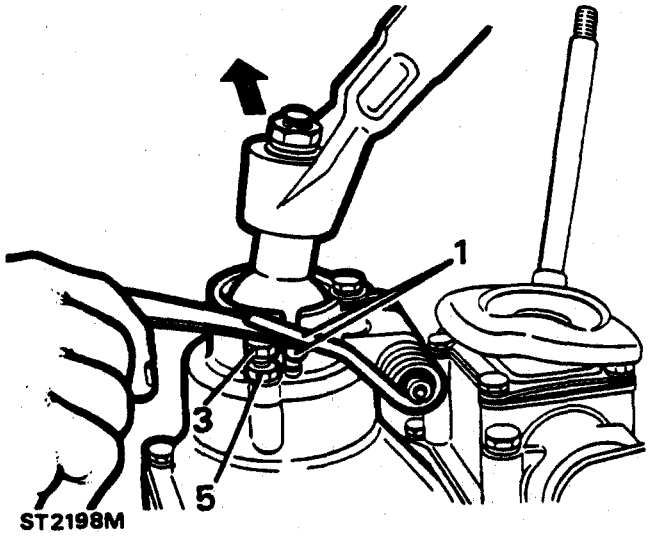
Bias spring adjustment

NOTE: The purpose of this adjustment is to set both bolts so that the bias spring legs apply equal pressure on both ends of the gear lever cross pin when third or fourth gear is engaged. This will ensure that when the lever is in neutral, the gear change mechanism is automatically aligned for third or fourth gear selection.

1. Select fourth gear and lift both spring legs over the cross pins.
2. Turn adjustment bolts until heads touch spring legs.
3. Apply light pressure to gear lever to the right and adjust left hand bolt.

NOTE: Clearance between spring leg and bolt 0,05 mm (0.002 in.) using feeler gauge.

4. Move lever to left and adjust right hand bolt to clearance.
5. Tighten locknuts.



ST2198M

BELL HOUSING

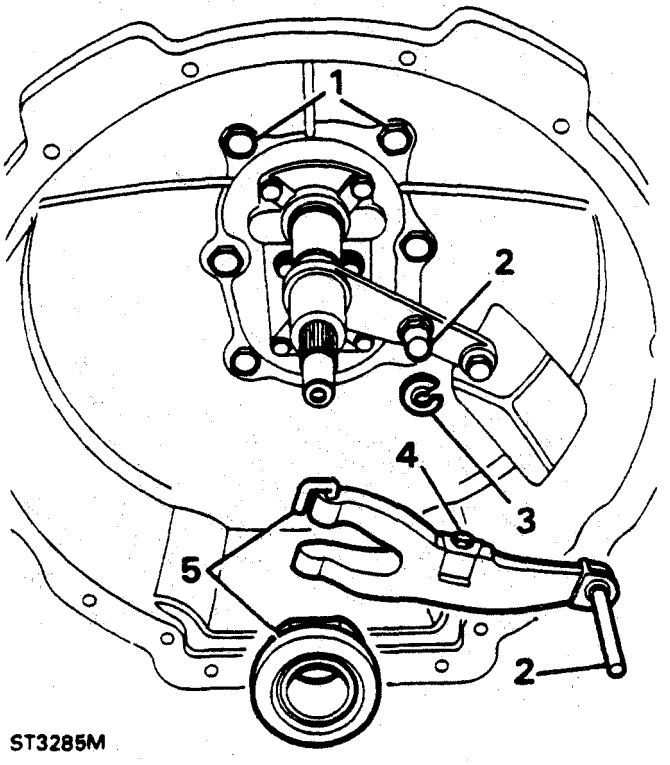
1. Fit bell housing locating on hollow dowels.

NOTE: Fit the 12 x 45mm bolts through dowels and 12 x 30mm bolts in remaining positions.

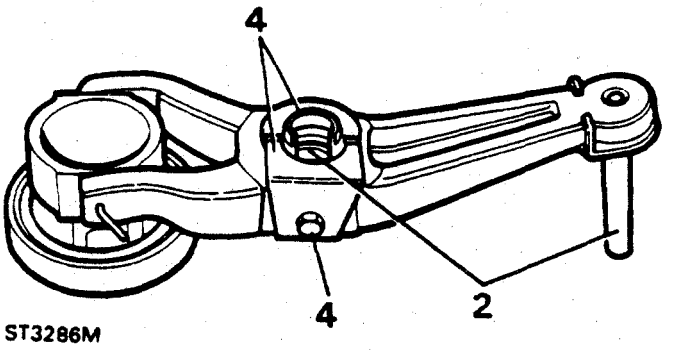
2. Apply molybdenum disulphide grease to pivot post, release lever, socket and push rod. Not the bearing guide.
3. Fit 'C' washer to pivot post.
4. Fit spring clip to lever and fit lever to pivot post.

NOTE: Position spring clip behind 'C' washer and tighten screw.

5. Fit bearing and retain with plastic staple.



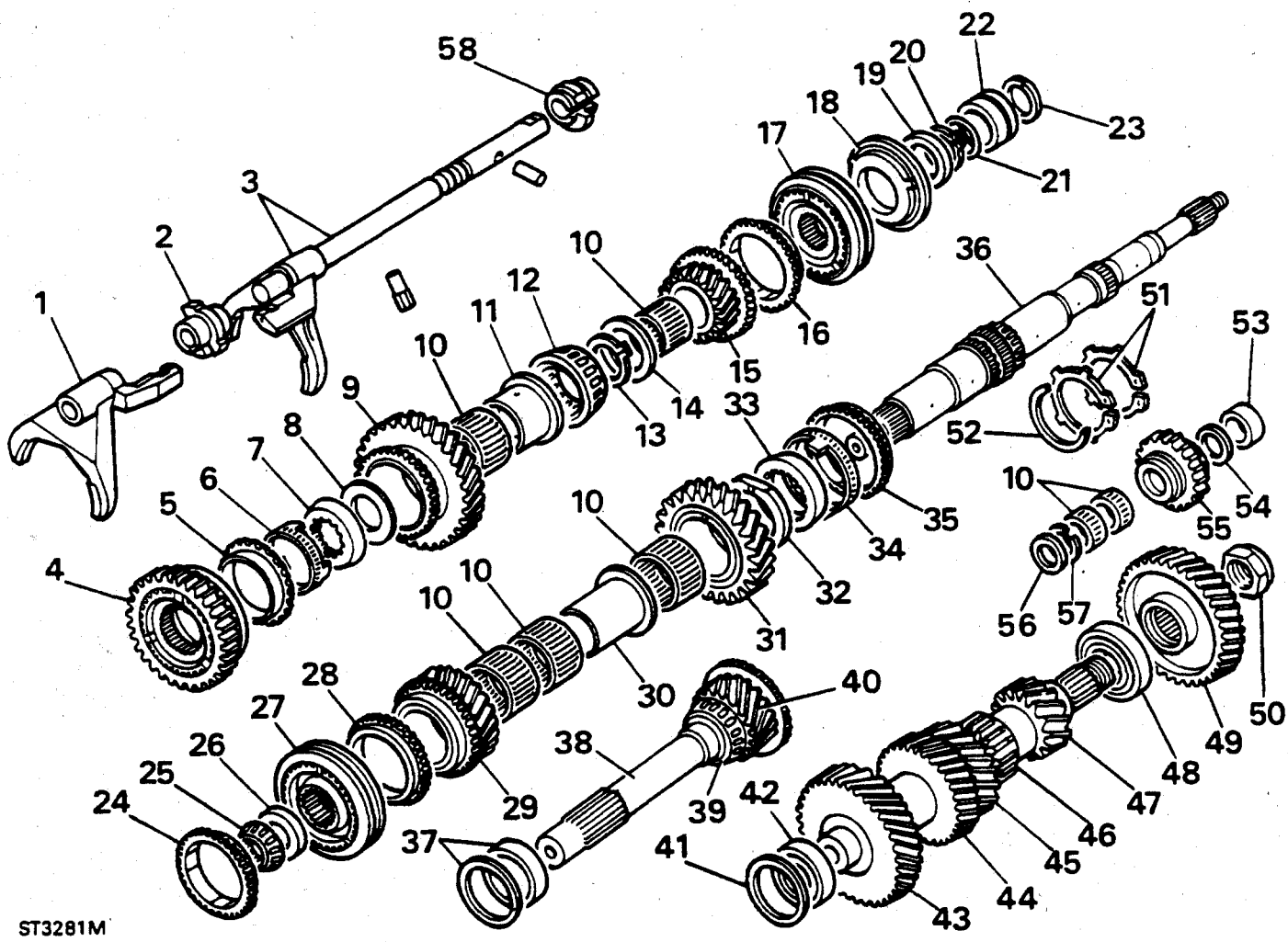
ST3285M



ST3286M

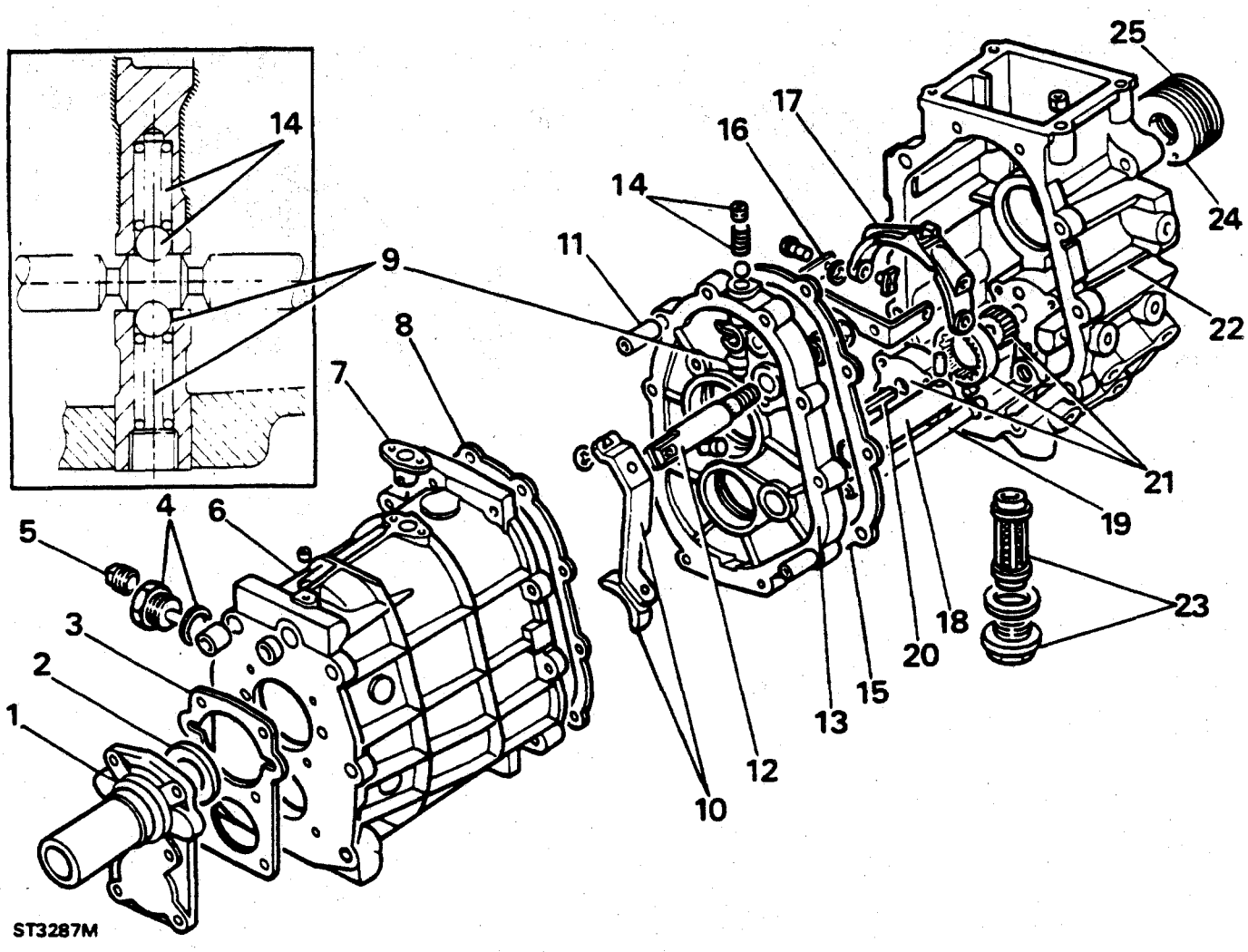
GEARS AND SHAFTS

1. Third - fourth selector fork.
2. Interlock spool.
3. First - second fork and selector rail assembly.
4. First - second synchromesh.
5. First gear synchromesh outer baulk ring.
6. First gear synchromesh inner baulk ring.
7. Cone.
8. Thrust washer.
9. First gear.
10. Needle roller bearings.
11. First gear selective bush.
12. Centre taper roller bearing.
13. Circlip.
14. Thrust washer.
15. Fifth gear.
16. Fifth gear baulk ring.
17. Fifth gear synchromesh.
18. Fifth gear synchromesh back plate.
19. Fifth gear synchromeshselective washer.
20. Circlip.
21. "O" ring.
22. Oil seal collar.
23. Snap ring.
24. Fourth gear baulk ring.
25. Pilot taper bearing.
26. Spacer.
27. Third - fourth synchromesh.
28. Third gear baulk ring.
29. Third gear.
30. Third gear bush.
31. Second gear.
32. Thrust washer.
33. Cone.
34. Second gear synchromesh inner baulk ring.
35. Second gear synchromesh outer baulk ring.
36. Mainshaft.
37. Input shaft bearing track and selective washer.
38. Input shaft.
39. Input shaft taper bearing.
40. Fourth gear.
41. Selective shim.
42. Taper bearing.
43. Layshaft fourth gear.
44. Layshaft third gear.
45. Layshaft second gear.
46. Layshaft reverse gear.
47. Layshaft first gear.
48. Taper bearing.
49. Layshaft fifth gear.
50. Layshaft fifth gear retaining stake nut.
51. Circlips - first gear and first-second synchromesh.
52. Snap ring - second gear cone and spacer.
53. Spacer.
54. Snap ring.
55. Reverse idler gear.
56. Thrust washer.
57. Snap ring.
58. Fifth gear spool.


ST3281M

GEARBOX CASING

1. Front cover.
2. Front cover oil seal.
3. Front cover gasket.
4. Oil drain plug and washer.
5. Oil level plug.
6. Gearbox main casing.
7. Spool retainer.
8. Gasket.
9. Inboard detent ball and spring.
10. Reverse lever and slipper.
11. Locating dowels - centre plate to maincase.
12. Reverse lever pivot post.
13. Centre plate.
14. Selector plug, detent ball and spring.
15. Gasket.
16. Fifth gear selector bracket.
17. Fifth gear selector fork.
18. Reverse gear shaft.
19. Oil pick-up pipe.
20. Oil pump drive shaft.
21. Oil pump gears and cover.
22. Fifth gear extension housing.
23. Fifth gear extension housing drain plug and filter.
24. Ferrobestos bush.
25. Oil seal.



DATA

Reverse lever and slipper pad clearance	0,725 mm
Reverse gear plunger operating load	45 to 55 kg
Synchromesh assemblies push through load	8,2 to 10 kgf
Clearance between baulk rings and gears	0,38 mm
Fifth gear end float	0,020 mm
Third gear end float	0,020 mm
Second gear end float	0,020 mm
First gear bush end float	0,075 mm
First gear end float	0,20 mm
Fifth gear synchromesh end float	0,005 to 0,055 mm

TORQUE VALUES

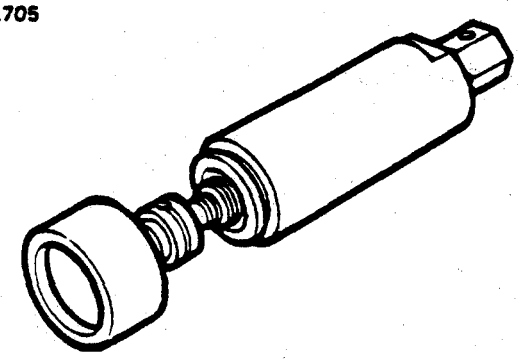
NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	Nm
Oil pump to extension case	7 - 10
Clip clutch release lever	7 - 10
Spool retainer to gearcase	7 - 10
Spool guide to remote housing	7 - 10
Extension case to gearcase	7 - 10
Pivot plate, clutch release	22 - 28
Remote housing to gearcase	22 - 28
Gear lever housing to remote housing	22 - 28
Guide, clutch release sleeve	22 - 28
Slave cylinder to bell housing	22 - 28
Front cover to gearcase	22 - 28
Fifth gear support bracket bolts	22 - 28
Plunger housing to remote housing	22 - 28
Gear lever retainer	7 - 10
Lower gear lever to extension nut	40 - 47
Reverse lever pivot post nut	2 2 - 28
Clutch housing to gearbox bolts	65 - 80
Plug, detent spring and ball	22 - 28
Oil drain plug	47 - 54
Oil filter plug	65 - 80
Oil filler - level plug	25 - 35
Breather	14 - 16
Fifth gear layshaft stake nut	204 - 231
Bottom cover to clutch housing	7 - 10

SERVICE TOOLS

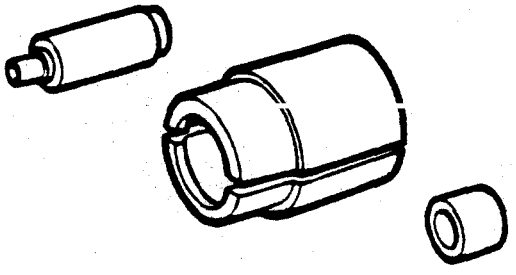
NOTE: Where the use of special tools is specified, only these tools should be used to avoid the possibility of personal injury and or damage to components.

18G.705



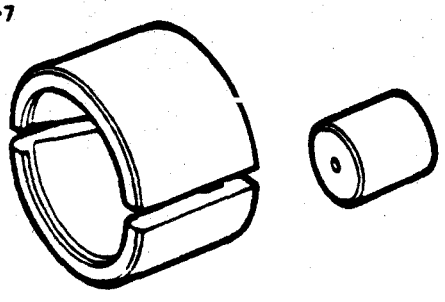
18G705 Puller, bearing remover

18G.705-1A

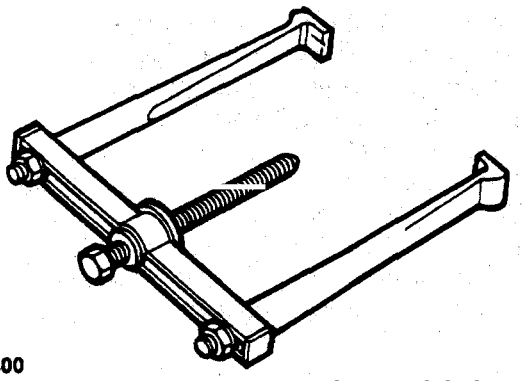


18G705-1A Adaptor for mainshaft oil seal track and layshaft fifth gear

18G.705-7



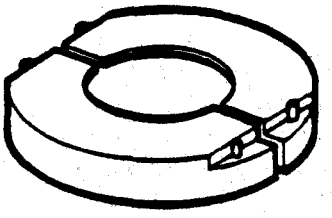
18G705-7 Adaptor for layshaft bearings



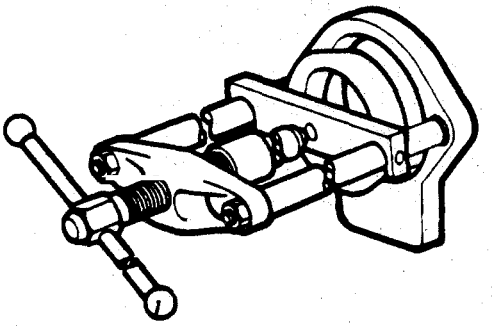
18G1400

18G1400 Remover synchromesh hub and gear cluster

18G.1400-1

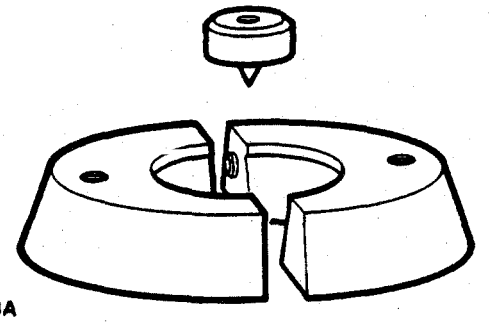


18G1400-1 Adaptor mainshaft fifth gear



MS47

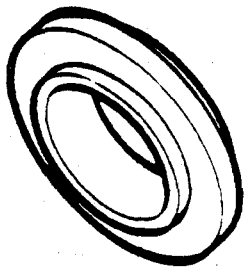
MS47 Hand press



18G47BA

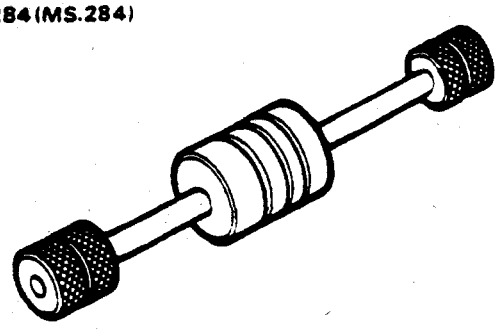
18G47BA Adaptor input shaft bearing

18G.47BAX

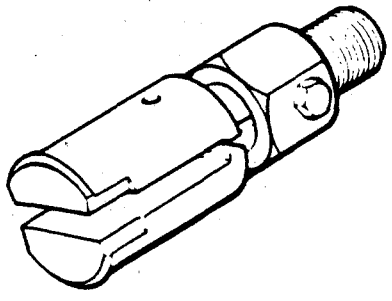


18G47BAX Conversion kit

18G.284 (MS.284)

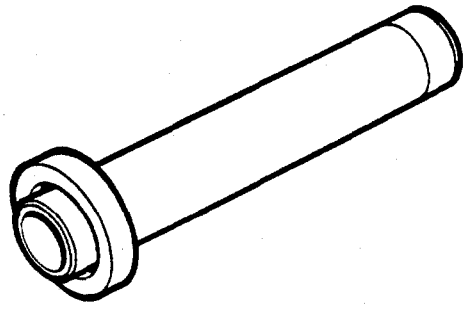


18G 284 Impulse extractor



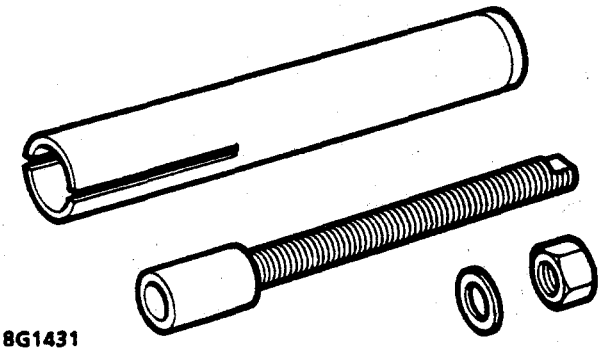
18G284AAH

18G284AAH Adaptor for input shaft pilot bearing track



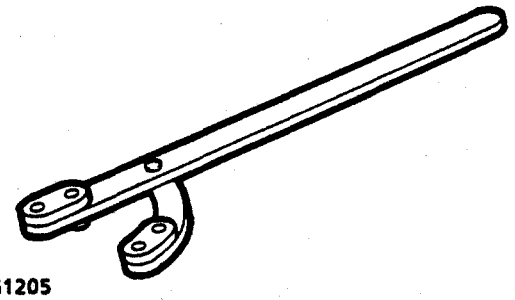
18G1422

18G1422 Mainshaft rear oil seal replacer



18G1431

18G1431 Mainshaft rear oil seal replacer



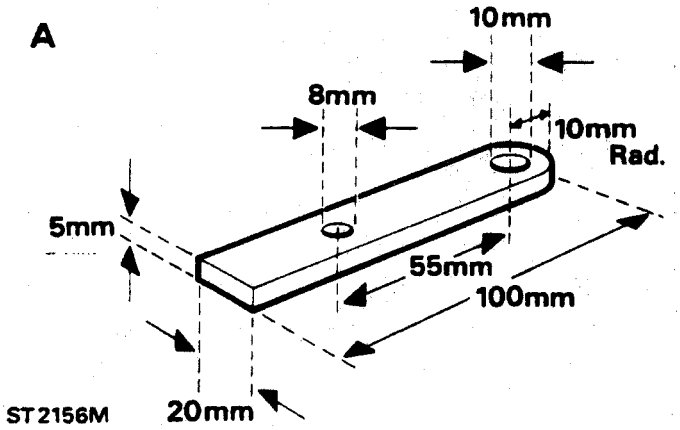
18G1205

18G1205 Flange holder

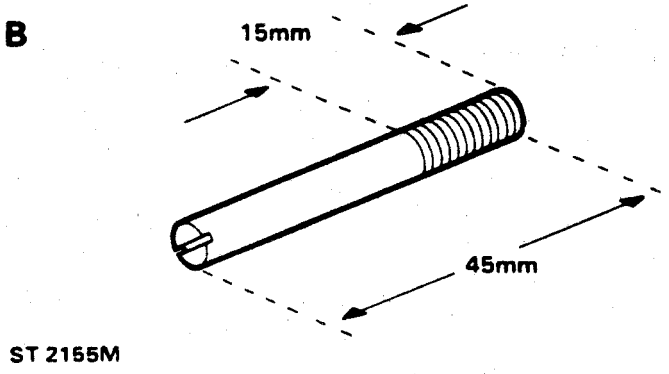
LOCALLY MANUFACTURED TOOLS

In addition to the special service tools, the following tools can be locally made to assist the dismantling and assembly of the gearbox. The overhaul procedure is based upon the assumption that these tools are available.

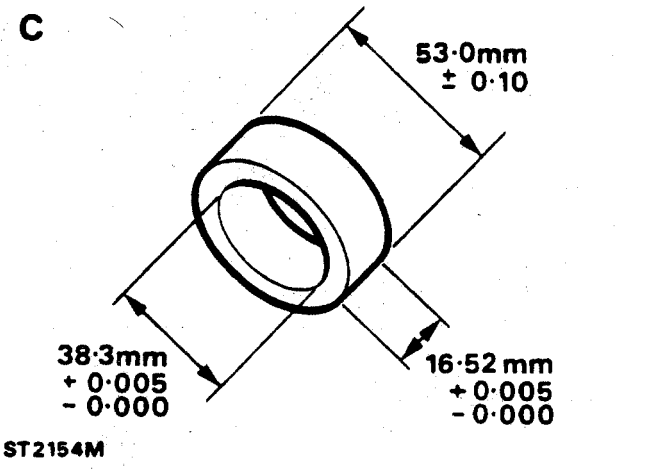
Tool 'A'. Dual purpose tool. Reverse shaft retainer to prevent the shaft falling out when the gearbox in inverted. Also, a layshaft fifth gear retainer to hold the fifth gear whilst releasing stake nut. Use 5mm mild steel to manufacture the tool. When using the tool for the layshaft nut, a suitable spacer is required 20mm diameter 23mm long, with an 8mm diameter clearance hole.



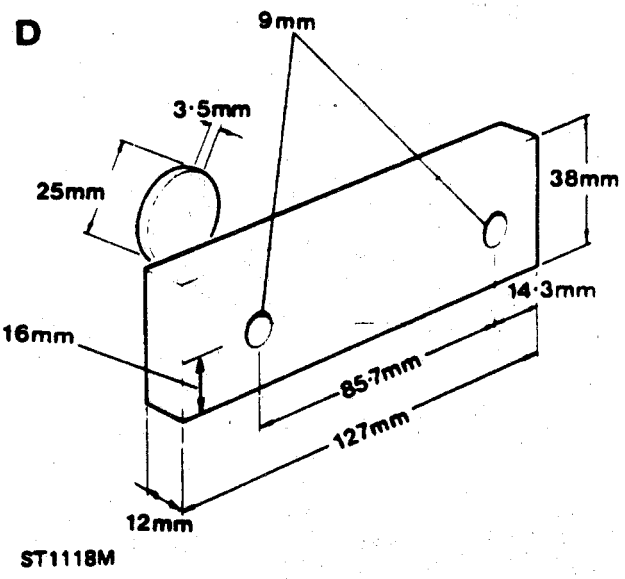
Tool 'B'. Four pilot studs with an 8mm thread for locating in the four counter sunk blind holes in the workstand.



Tool 'C'. Mild steel dummy centre bearing for the selection of first gear bush.

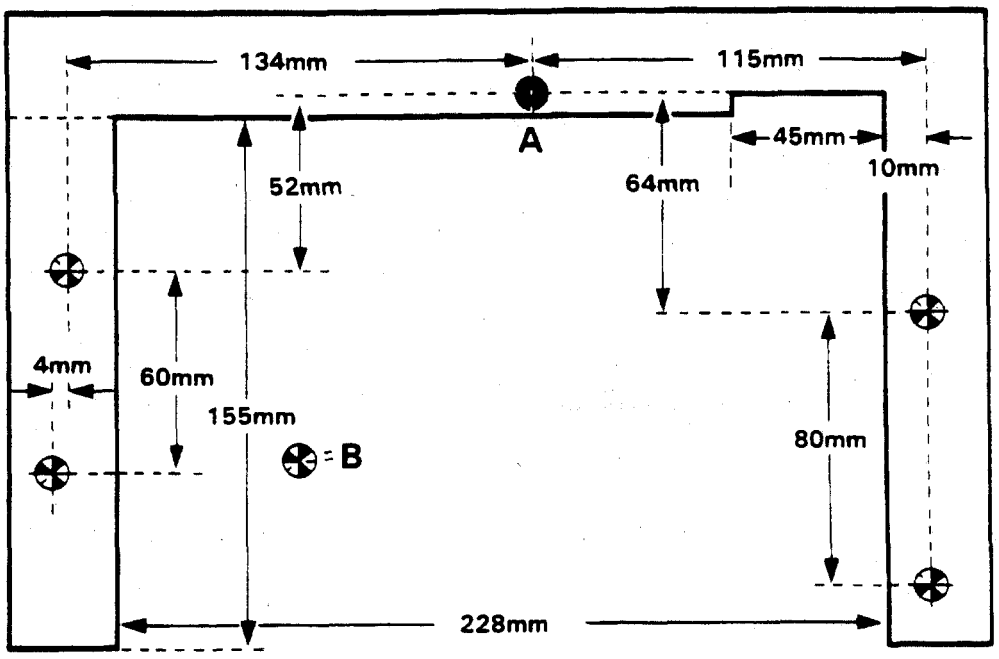


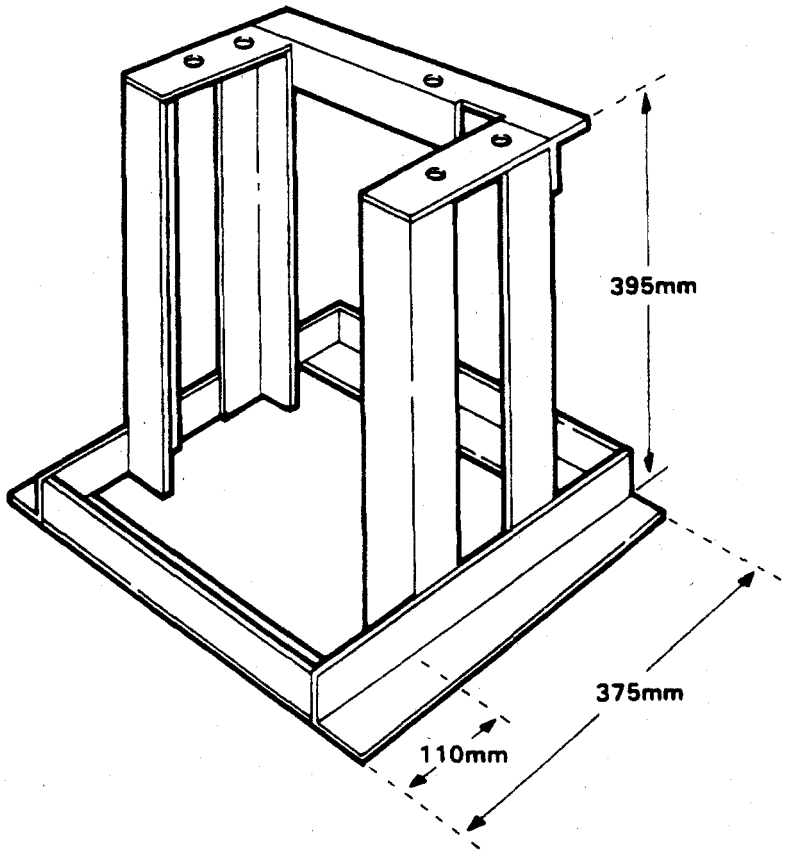
Tool 'D'. Layshaft support plate is fitted with two 8 x 25mm bolts and washers to the front of the gearbox case. It also supports the input shaft bearing outer track.



Tool 'E'. Workstand for securely locating the gearbox during overhaul. Manufacture from 30mm x 30mm angle iron. The single hole marked 'A' should be drilled through the material with a 10mm drill.

The four counter sunk blind holes marked 'B' should also be made with a 10mm drill, but must not be drilled through the material.





ST2153M

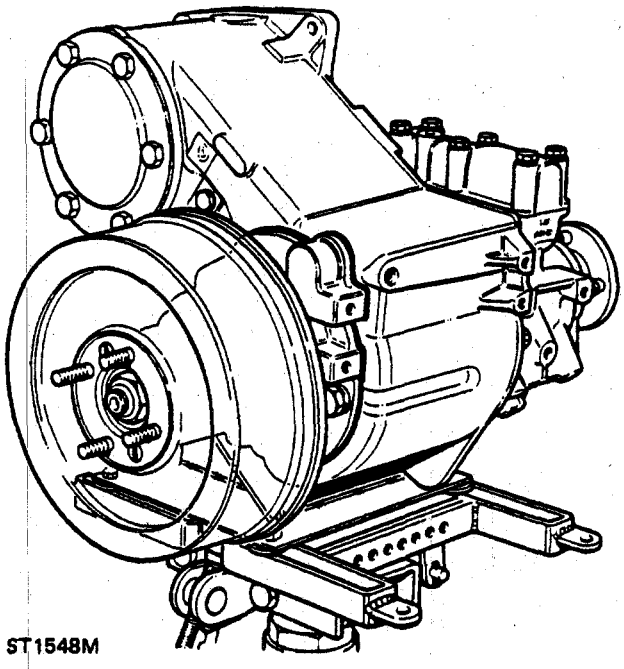
REMOVE LT230T TRANSFER GEARBOX FROM THE LT77S GEARBOX

Special Tool: 18G1425-LRT-41-009 - Guide studs (3) also locally manufactured adaptor plate, see below

Adaptor plate for removing transfer gearbox

The transfer gearbox should be removed from underneath the vehicle, using a hydraulic hoist. An adaptor plate for locating the transfer gearbox onto the hoist can be manufactured locally to the drawing below. If a similar adaptor plate was made for the LT230R transfer gearbox, it can be modified to suit both the LT230R and LT230T gearboxes by making the modifications shown by the large arrows.

WARNING: Where the use of a transmission hoist is necessary, it is absolutely essential to follow the manufacturers' instructions to ensure safe and effective use of the equipment.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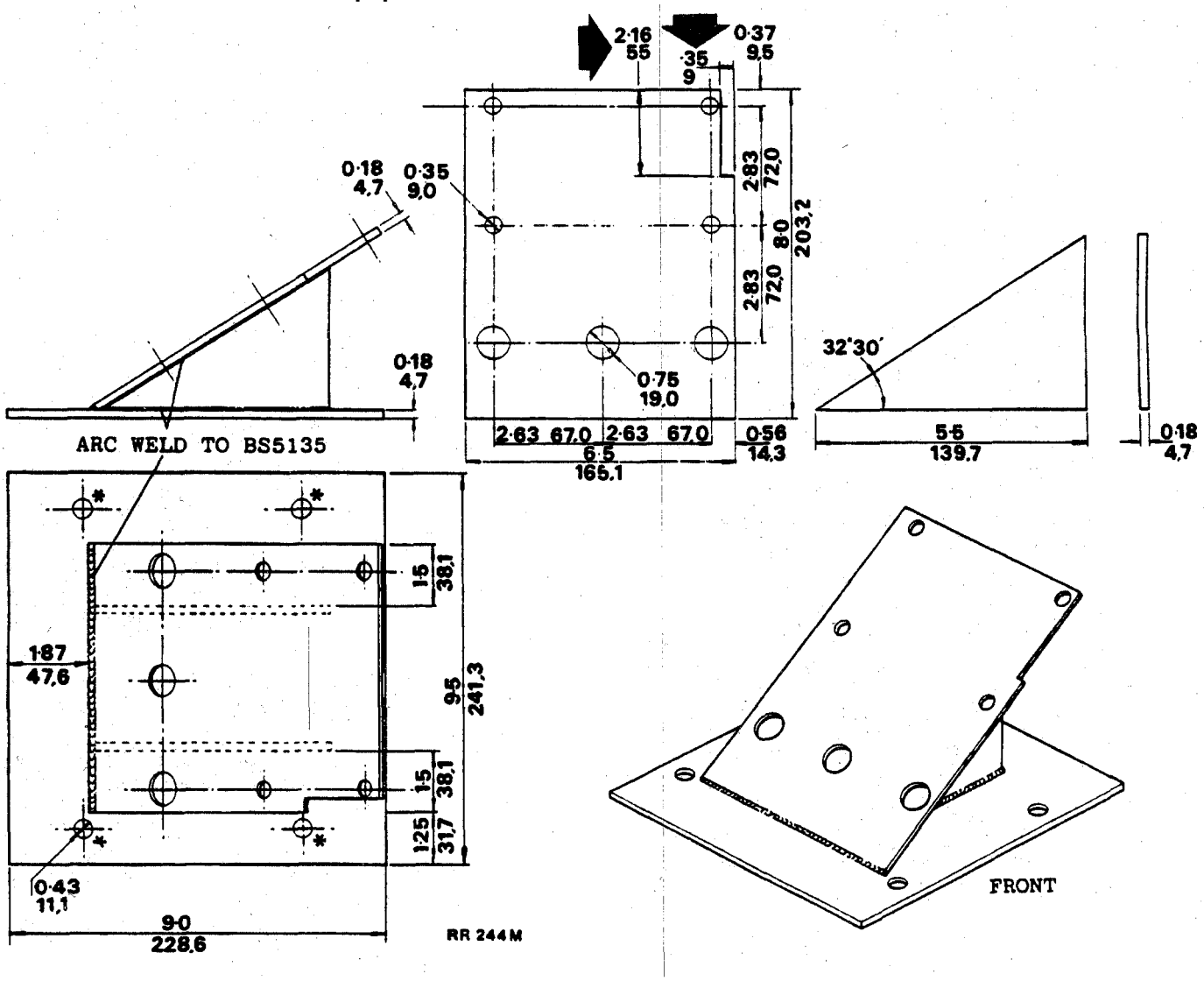
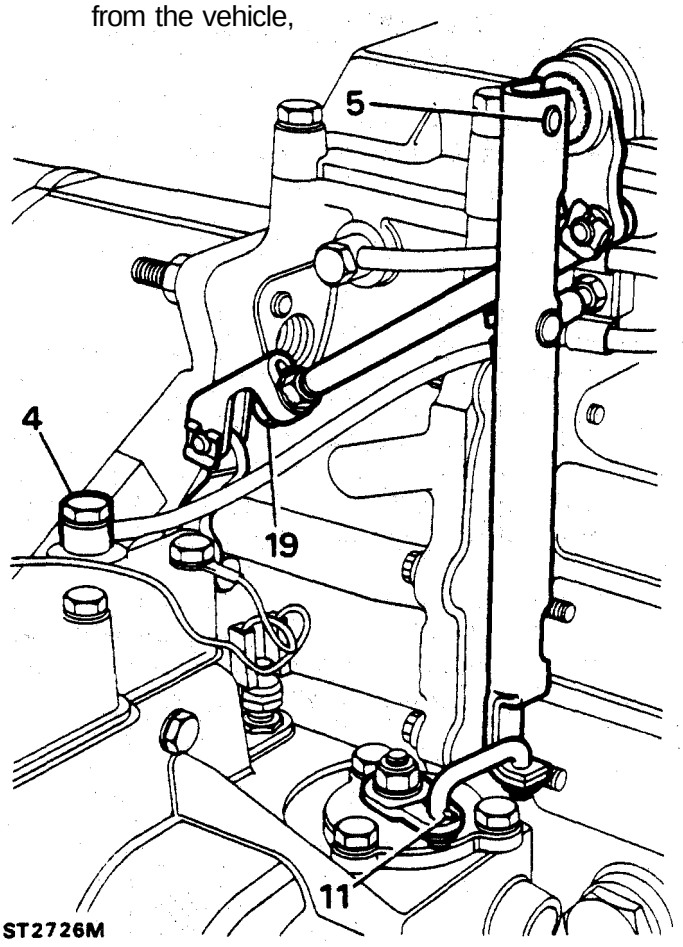


Material. Steel plate BS 1449 Grade 4 or 14
Holes marked thus * to be drilled to fit hoist being used.

Removing

1. Install the vehicle on a ramp.
2. Disconnect the battery.
3. Remove the' cover panel from the right-hand seat base.
4. Remove the breather pipe union from the transfer gearbox high/low cross-shaft housing.
5. Disconnect the high/low lever.
6. Disconnect the transmission brake cable at the clevis joint.
7. Raise the vehicle on the ramp and drain the oil from the transfer box.
8. Remove the centre section of the exhaust system.
9. Disconnect the front and rear propeller shafts from the gearbox and move them aside.
10. Disconnect the speedometer cable from the transfer gearbox.
11. Remove the split pin at the lower end of the pivot arm for the differential lock control. Then, remove the two bolts securing the pivot arm to allow the link to be disconnected. Later models disconnect the connecting link from the differential lock lever.
12. Manufacture an adaptor plate in accordance with the drawing, to attach to the gearbox hoist and transfer box to facilitate removal (RR244M).
13. Place four, 30 mm (1.250 in) long spacers between the top of the hoist and the adaptor plate at the securing points and secure the adaptor plate to the hoist.
14. Remove the four central bolts from the transfer box bottom cover, move the hoist into position and secure the adaptor plate to the transfer box.
15. Adjust the hoist to take the weight of the transfer box.
16. Remove three nuts and bolts securing the right- hand gearbox mounting bracket to the chassis, then remove the nut from the rubber mounting and withdraw the bracket.
17. Place a suitable wooden block between the main gearbox and chassis cross-member, then lower the hoist until the gearbox contacts the wooden block.
18. Disconnect .the electrical lead from the differential lock switch.
19. Move the small crank lever, for the high/low selector, upward to allow access to the adjacent nut securing the transfer box to the main gearbox extension case. Later models remove the lower lock nut from the high-low operating rod.
20. Remove the two nuts and four bolts securing the transfer box to the main gearbox extension case.
21. Fit three guide studs, 18G 1425, through the transfer box bolt holes to support it during removal.
22. Lower the hoist and withdraw the transfer box from the vehicle,



Refitting

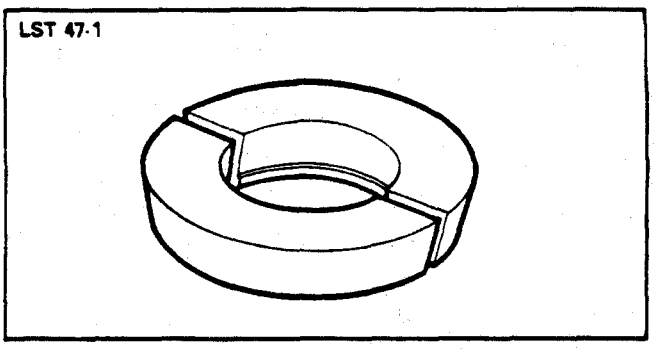
23. Make sure that the joint faces of the transfer box and main gearbox extension case are clean and that the three guide studs, 18G 1425, are fitted to the extension case.
24. Lubricate the oil seal in the joint face of transfer box, secure the transfer box to the adaptor plate on the lifting hoist and raise the hoist until the transfer box can be located over the guide studs.
25. Remove the guide studs and secure the transfer box to me main gearbox extension case. Tighten the nuts and bolts to the correct torque.
26. Complete the refitting procedure by reversing the removal sequence, noting the following important points.
27. After removing the lifting hoist and adaptor plate from the transfer box, clean the threads of the four bolts for the transfer box bottom cover, coat them with Loctite 290, and fit them together with spring washers. Tighten to the correct torque.
28. Refill the transfer box with the correct grade oil to the oil level plug hole.
29. Check, and if necessary top up, the oil level in the main gearbox. Use the correct grade oil.
30. Check the operation of the handbrake and adjust as necessary.

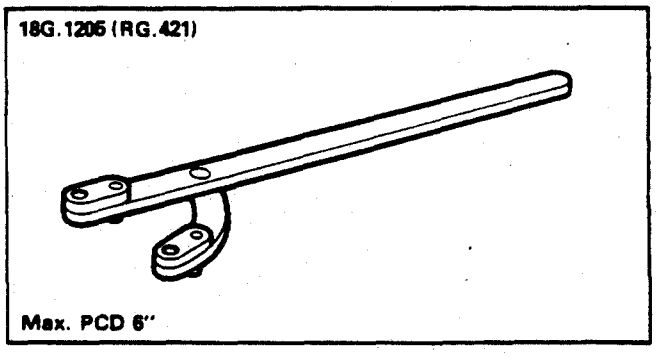
OVERHAUL

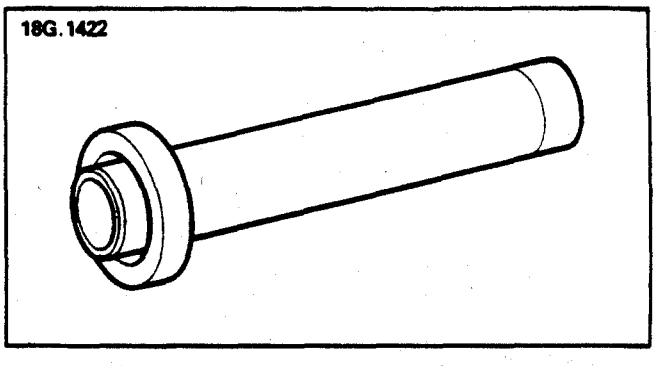
Service Tools:

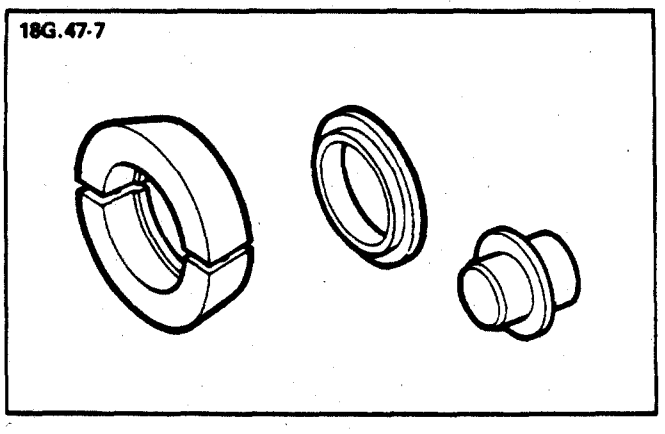
18G47 -7	Input gear cluster bearing cones remover/replacer
18G47BB-1	Adaptor centre differential bearing remover
18G47BB - 3	Adaptor centre differential bearing remover button
18G1205	Drive flange wrench
18G1271	Oil seal remover (optional)
18G1422	Mainshaft rear oil seal replacer
18G1423	Adaptor/socket centre differential Locknut remover/replacer
18G1424	Centre differential bearing replacer
MS47	Hand press
MS550	Bearing and oil seal replacer handle
LST47 -1	Adaptor centre differential bearing remover
LST104	Intermediate gear dummy shaft
LST105	Input gear mandrel
LST550 -4	Intermediate gear bearing replacer

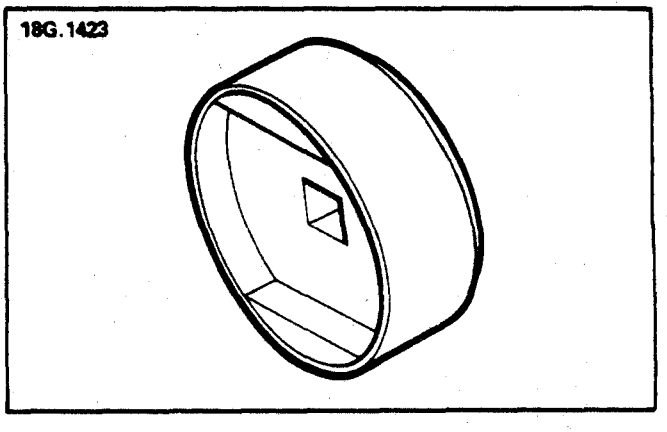
NOTE: Where the use of special service tools is specified, only these tools should be used to avoid the possibility of personal injury and or damage to components.

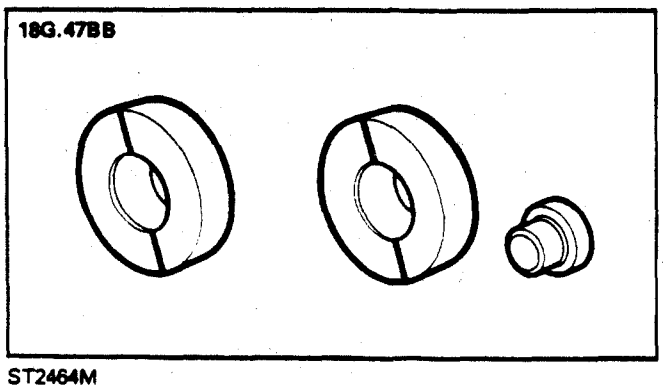


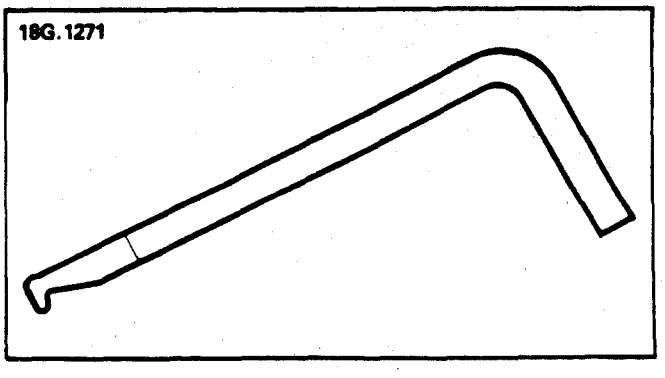




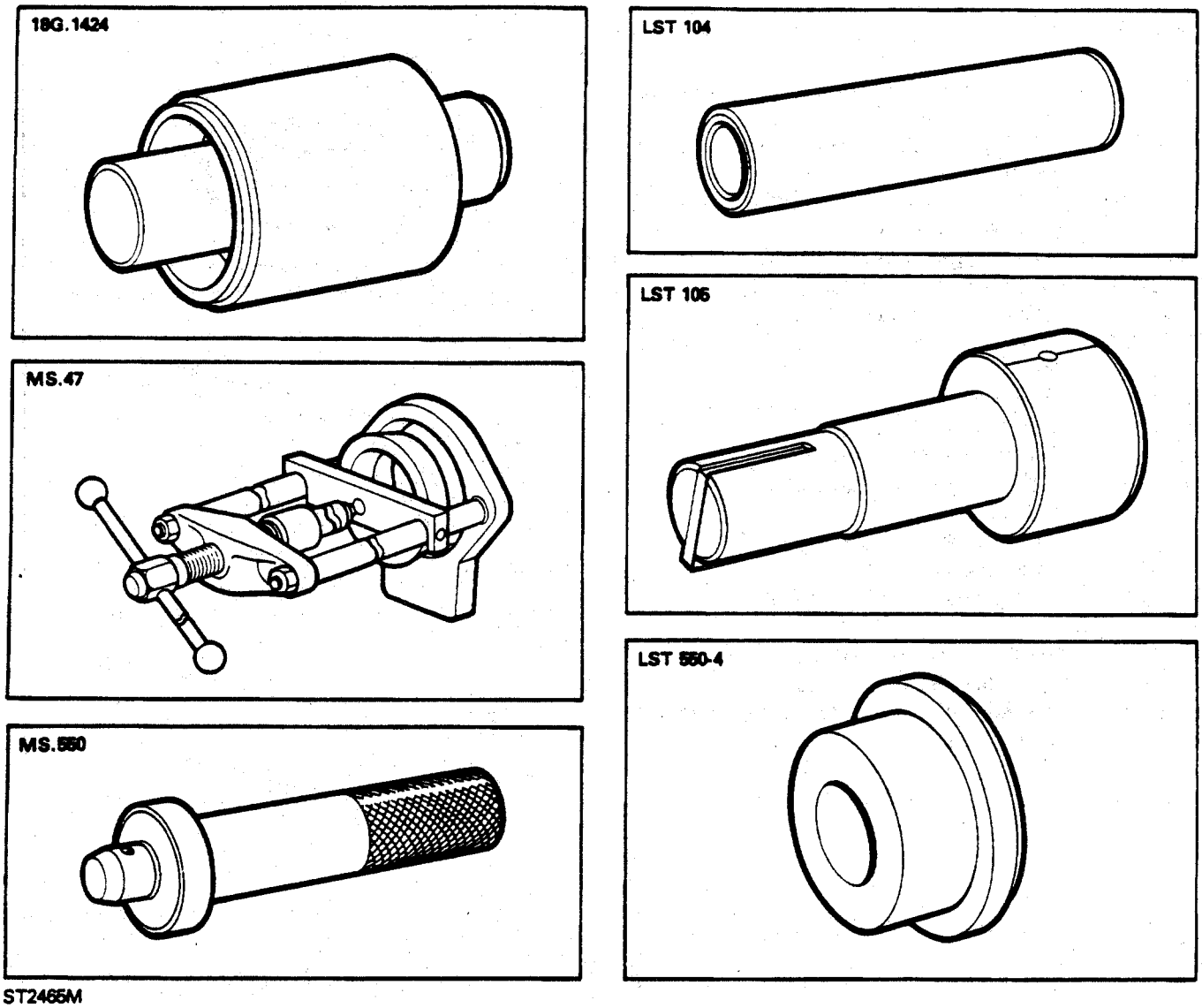








ST2464M



ST2465M

TRANSFER GEARBOX DATA

Front and rear bevel gear pre-load	see text
High range gear end-float	0,05 to 0,15 mm (0.002 to 0.006 in)
Front differential bearing pre-load	0.56 to 1.69 Nm (5 to 15 in lb)
Input gear bearing pre-load	0.56 to 2.25 Nm (5 to 20 in lb)
Intermediate shaft bearing pre-load	0.56 to 1.69 Nm (5 to 15 lb)

TORQUE WRENCH SETTING

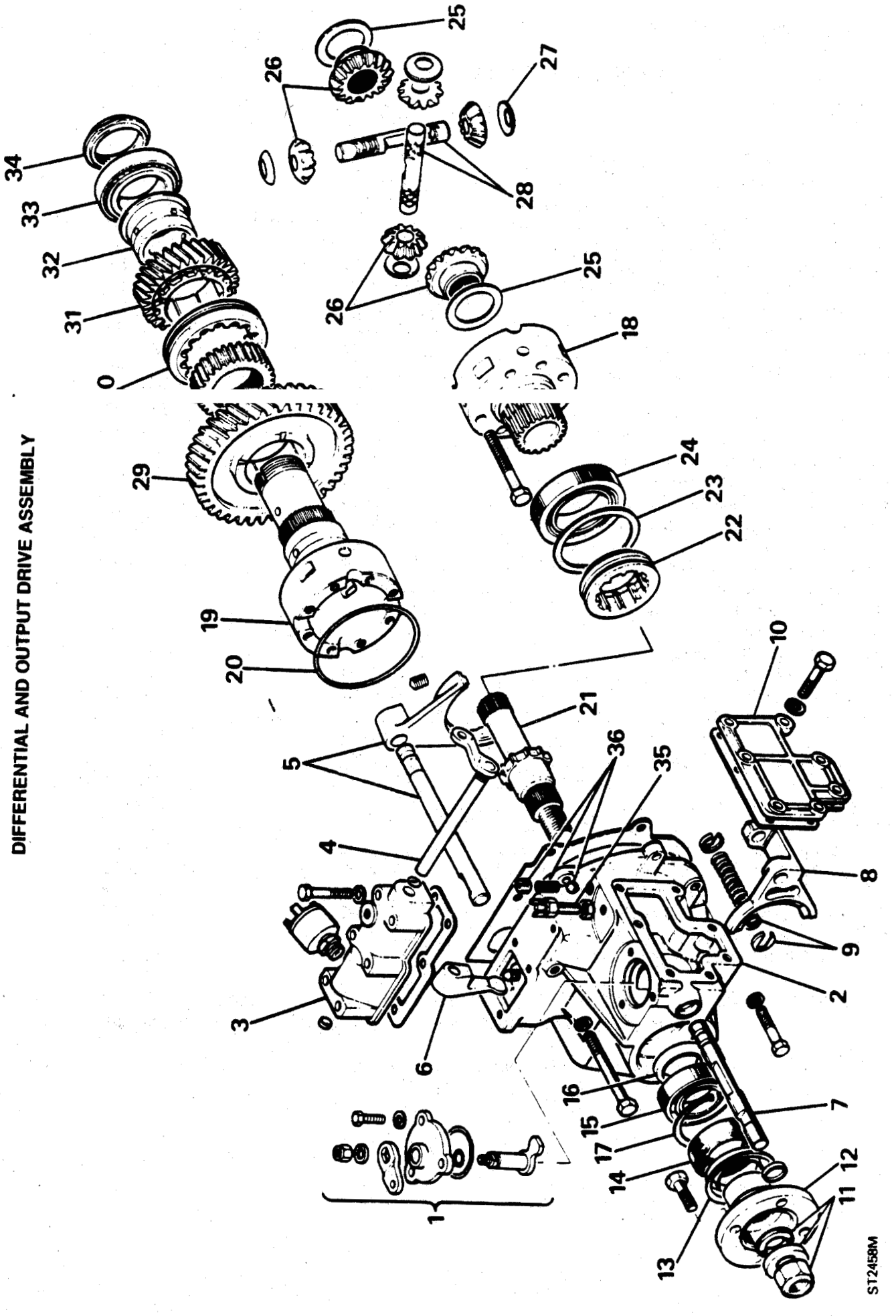
WARNING: Components in bold type must not be re-used

COMPONENT	Nm		ft lb
Pinch bolt - operating arm to crank arm	7 to 10		5 to 7
End cover gear change housing	7 to 10		5 to 7
Speedometer cable retainer	7 to 10		5 to 7
Rear output/speedometer housing		See note	
Bottom cover to transfer case	22 to 28		16 to 21'
Front output housing to transfer case	22 to 28		16 to 21'
Cross shaft housing to front output housing	22 to 28		16 to 21
Gear change housing	22 to 28		16 to 21
Pivot shaft to link arm	22 to 28		16 to 21
Connecting rod to adjustable clevis	22 to 28		16 to 21
Anti-rotation plate intermediate shaft	22 to 28		16 to 21'
Front output housing cover	22 to 28		16 to 21*
Pivot bracket to extension housing	22 to 28		16 to 21*
Finger housing to front output housing	22 to 28		16 to 21'
Bearing housing to transfer case	22 to 28		16 to 21
Brake drum to coupling flange	22 to 28		16 to 21
Bearing housing cover to transfer gearbox	40 to 50		29 to 37'
Rear output speedometer housing to transfer gearbox	40 to 50		29 to 37'
Selector finger to cross shaft high/low	22 to 28		16 to 21'
Selector fork. high/low to shaft	22 to 28		16 to 21'
Transmission brake to speedometer housing	65 to 80		48 to 59
Intermediate shaft stake nut		See text	
Gate plate to grommet plate	**7** to 10		5 to 7
Plunger switch setting	6.75 max		4.82 max
Gearbox to transfer case	40 to 50		9 to 37
Gearbox to transfer case		See note	
Oil drain plug	25 to **35**		19 to 26
Differential case (front to rear)	55 to 64		40 to 47
Output flanges	146 to 179		108 to 132
Differential case rear stake nut	66 to 80		50 to 59
Oil filler/level plug	25 to 35		19 to 26
Transfer breather	14 to 16		10 to 12
Transfer box front drive flange to drive shaft	41 to 52		30 to 38
Transfer box rear drive flange to drive shaft	41 to 52		30 to 38
Transfer gearbox mounting brackets to chassis	**33** to **27**		24 to 20
Mounting brackets to transfer gearbox	52		38
Mounting rubbers to mounting brackets	20 to **22**		13 to 16

NOTE: Studs to be assembled into casting with sufficient torque to wind them fully home, but this torque must not exceed the maximum figure quoted for the associated nut on final assembly.

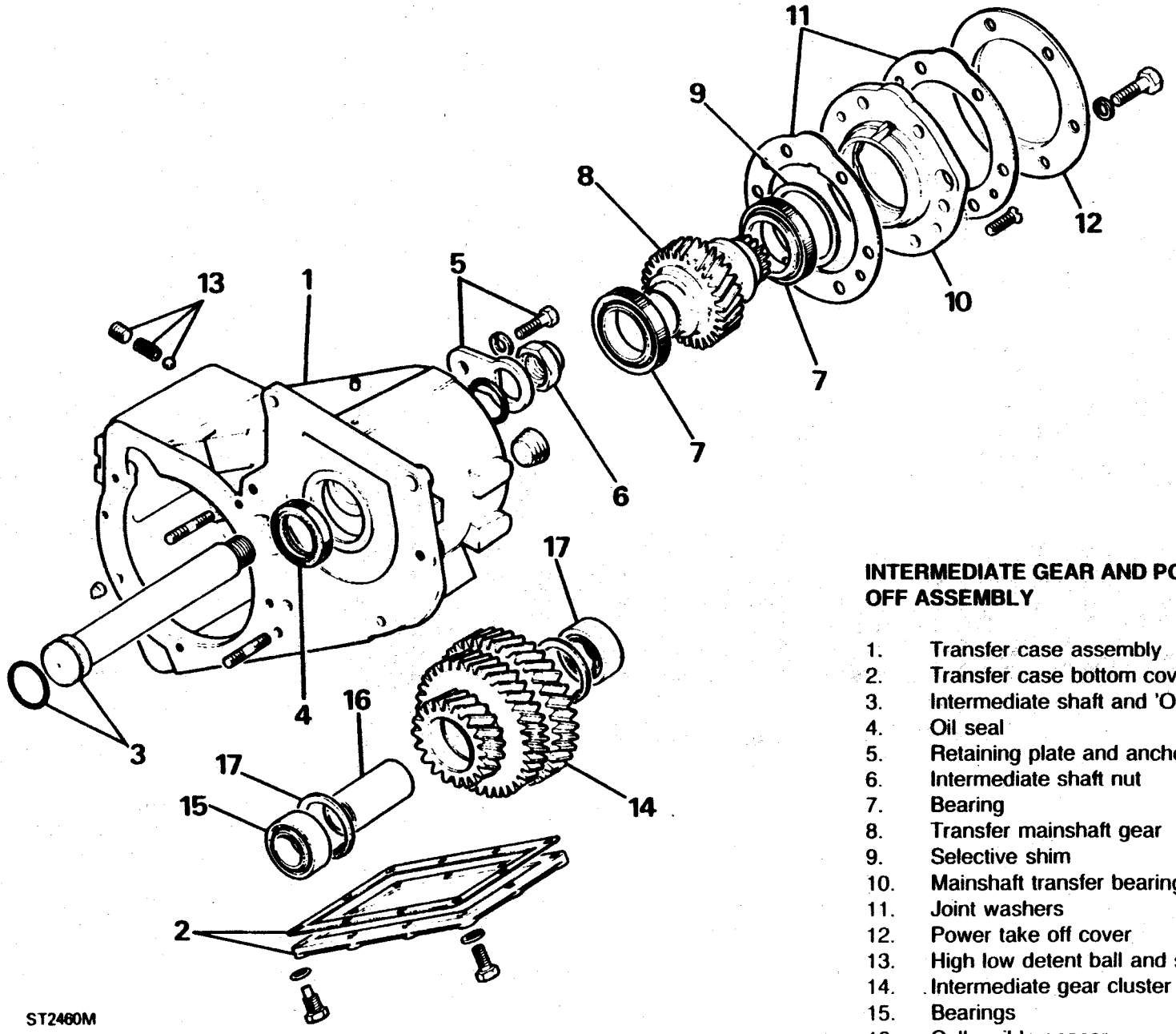
NOTE: * These bolts must have threads coated with Loctite 290 prior to assembly.

DIFFERENTIAL AND OUTPUT DRIVE ASSEMBLY



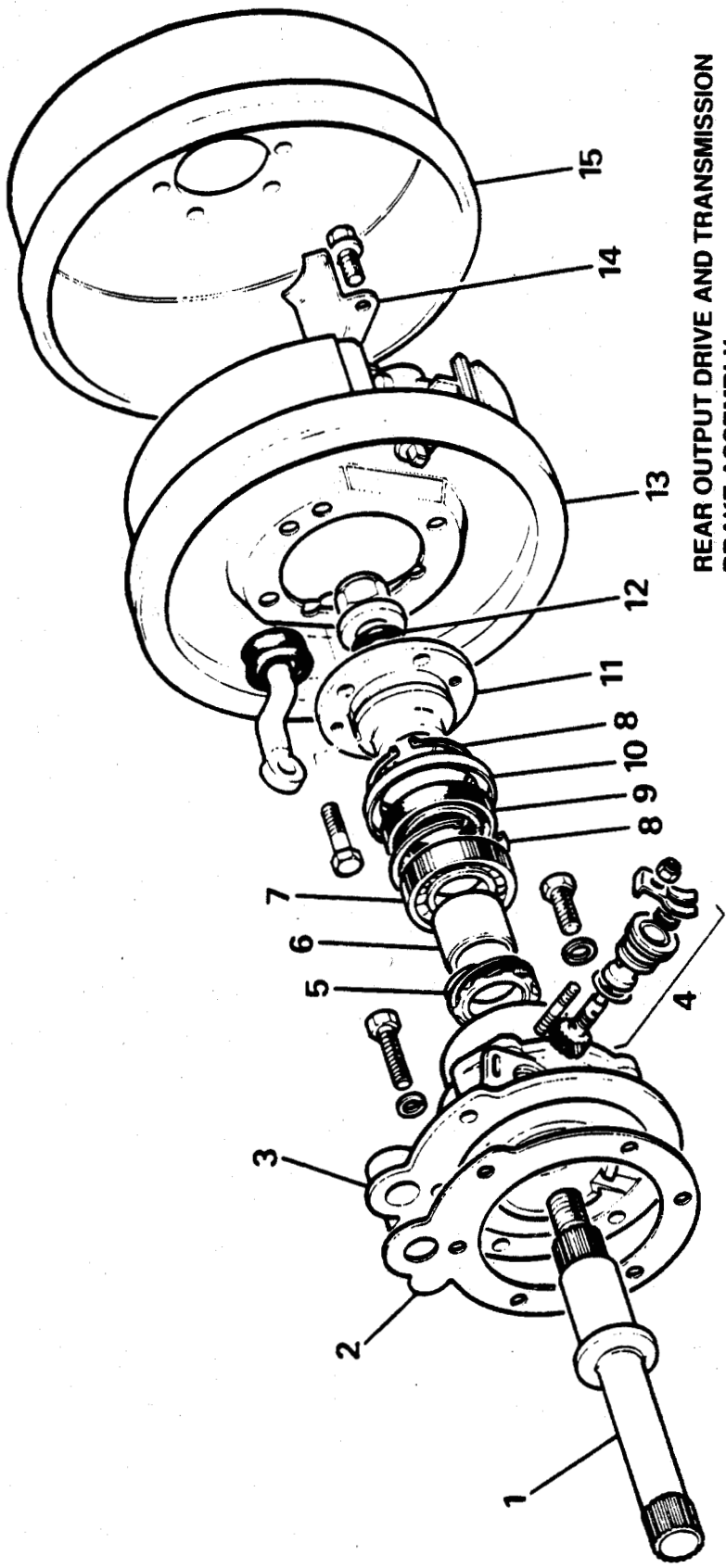
DIFFERENTIAL AND OUTPUT DRIVE ASSEMBLY

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
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

1. Transfer case assembly
2. Transfer case bottom cover and gasket
3. Intermediate shaft and 'O' ring
4. Oil seal
5. Retaining plate and anchor screw
6. Intermediate shaft nut
7. Bearing
8. Transfer mainshaft gear
9. Selective shim
10. Mainshaft transfer bearing housing
11. Joint washers
12. Power take off cover
13. High low detent ball and spring
14. Intermediate gear cluster
15. Bearings
16. Collapsible spacer
17. Circlip



REAR OUTPUT DRIVE AND TRANSMISSION BRAKE ASSEMBLY

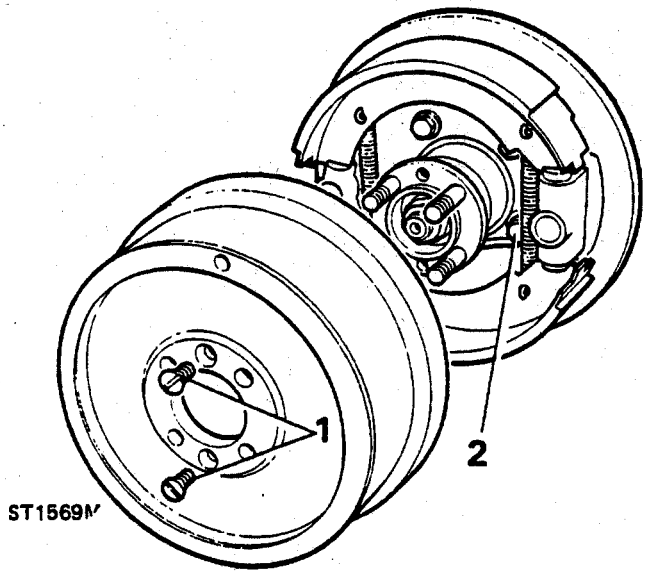
1. Rear output shaft
2. Joint washer
3. Speedometer drive housing
4. Speedometer drive pinion assembly
5. Speedometer worm drive
6. Spacer
7. Ball bearing
8. Circlip
9. Oil seal
10. Oil shield
11. Rear output flange
12. Sealing washer
13. Transmission brake assembly
14. Oil catcher
15. Brake drum

DISMANTLE

Transmission brake removal

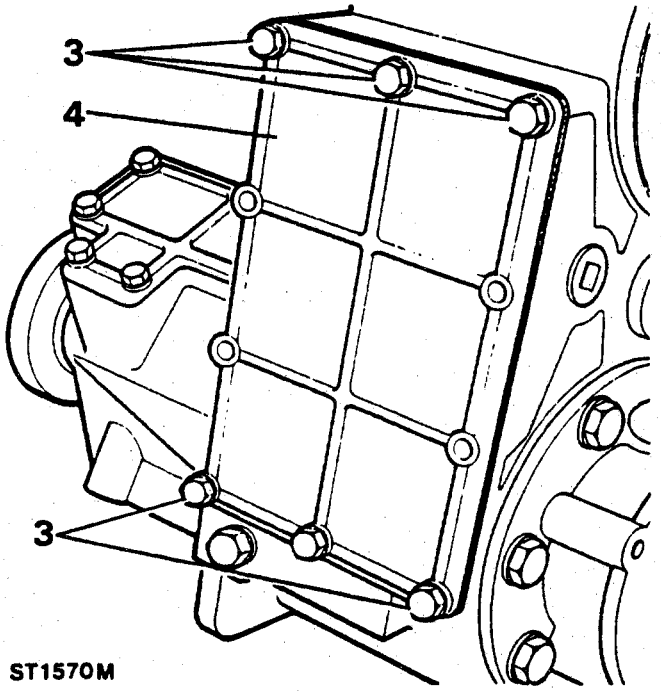
1. Remove two countersunk screws and withdraw brake drum.
2. Remove four bolts securing the brake back plate; the two bottom fixings retain the oil catcher.

NOTE: A hexagonal type socket should be used for these bolts.



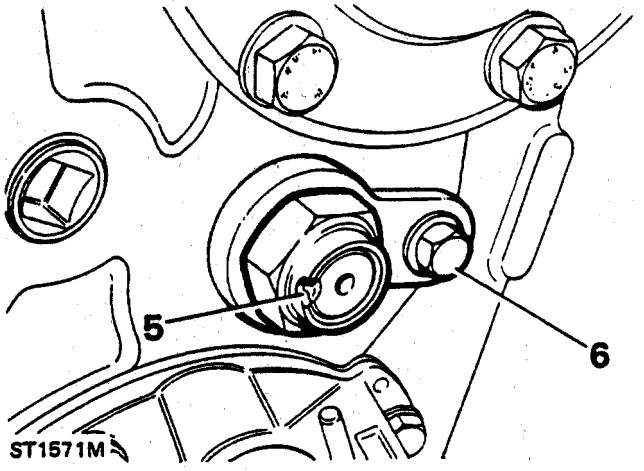
Bottom cover removal

3. Remove the six bolts and washers retaining the bottom cover.
4. Remove the gasket and bottom cover.

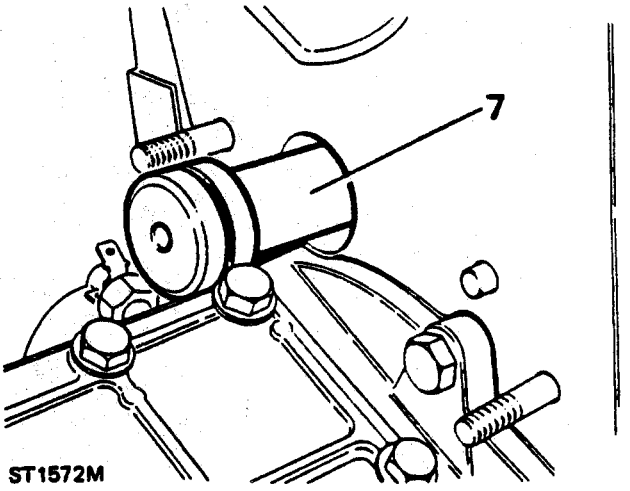


Intermediate shaft and gear cluster removal

5. Release stake nut from recess in intermediate shaft and remove stake nut and discard.
6. Unscrew the single bolt and remove anti-rotation plate at the rear face of the transfer box.

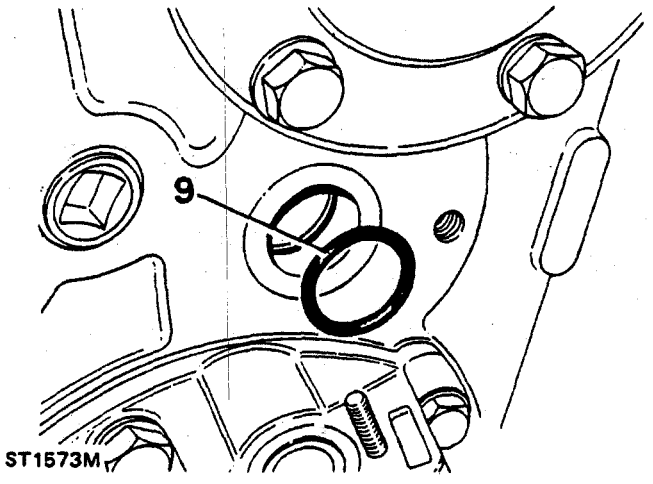


7. Tap the intermediate gear shaft from the transfer box.

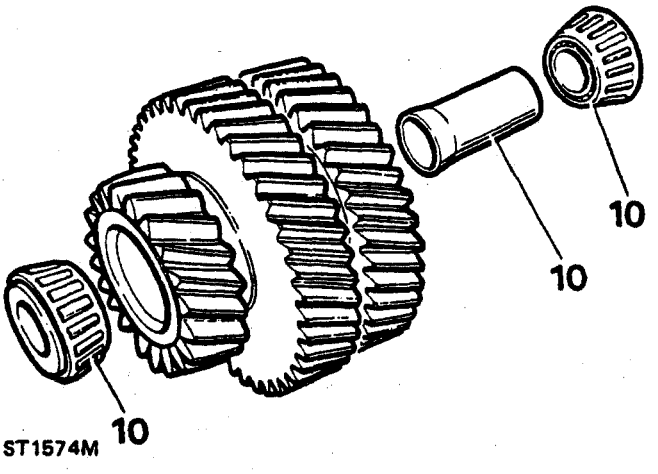


8. Lift out the intermediate gear cluster and bearing assembly.

9. Remove the 'O' rings from the intermediate gear shaft and from inside the transfer box and discard.

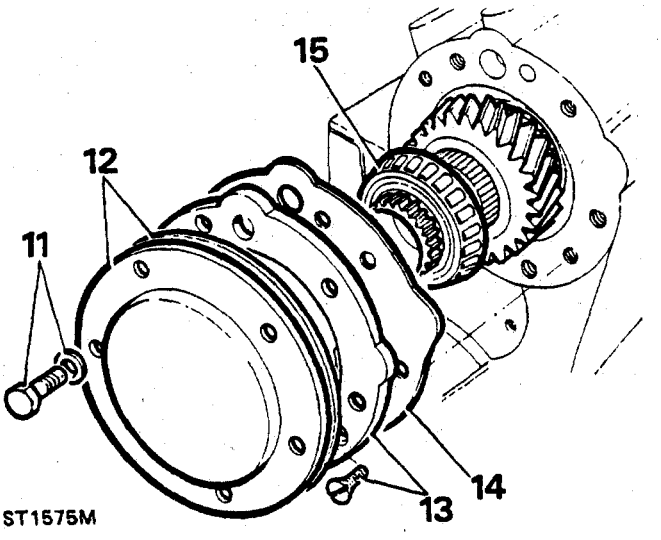


10. Remove taper roller bearings and bearing spacer from the intermediate gear cluster assembly.

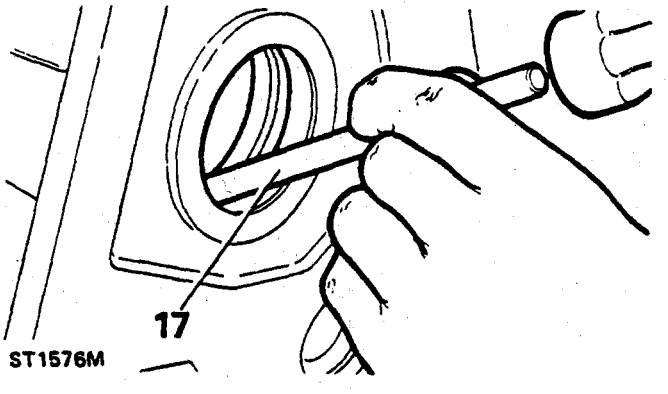


Input gear removal

11. Remove five bolts and washers retaining the take - off cover.
12. Remove the cover and gasket, discard the gasket.
13. Remove the two countersunk screws and detach the main shaft bearing housing.
14. Remove the gasket and discard.
15. Withdraw the input gear assembly.

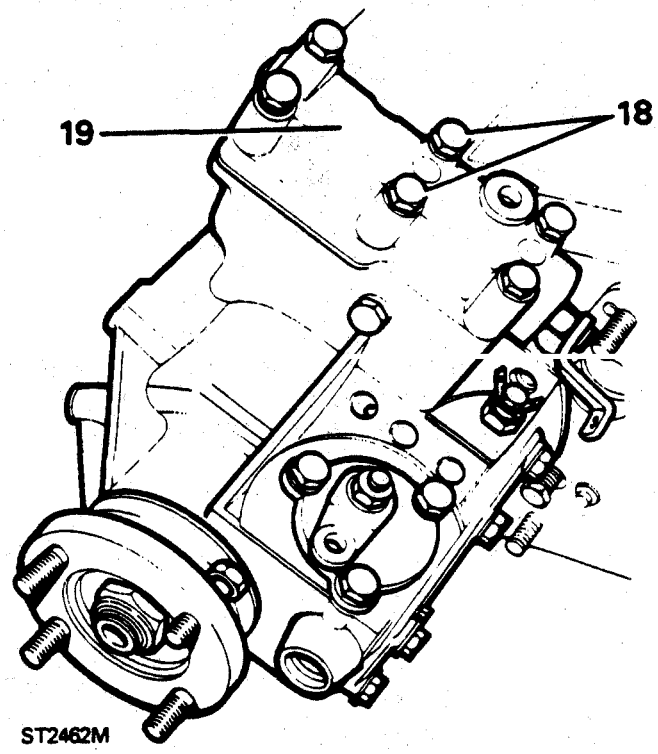


16. Remove and discard the oil seal at the front of the transfer box casing using service tool 18G 1271 to prevent damage to the housing.
17. Drive out the input gear front bearing track.



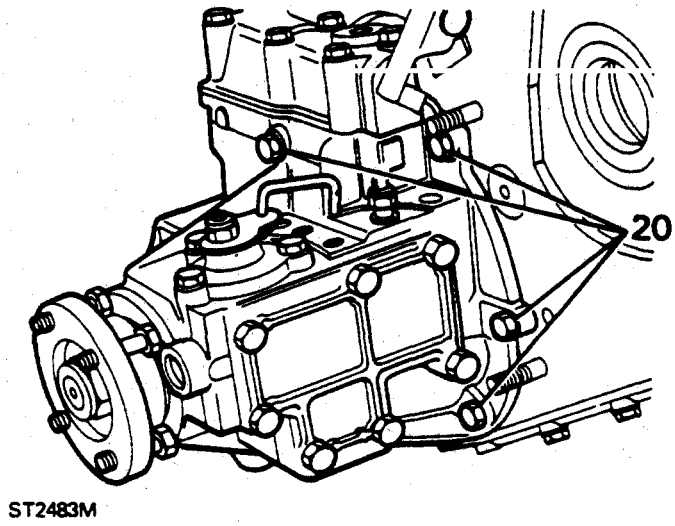
High/low cross - shaft housing removal

18. Remove the six bolts and washers retaining the cross - shaft housing ground lead and retaining clip.
19. Remove the cross - shaft housing and gasket discard the gasket.



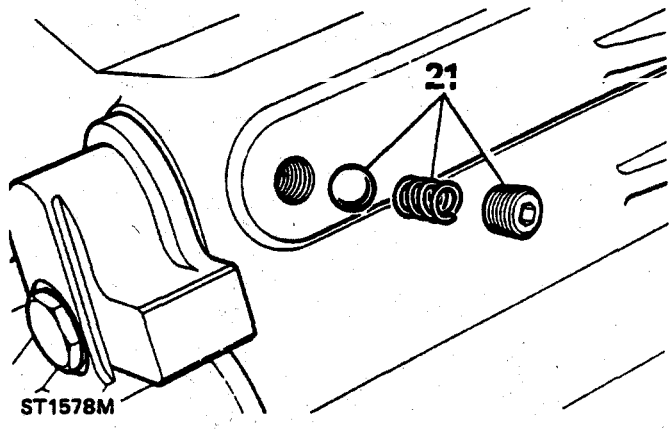
Front output housing removal

20. Remove the eight bolts and washers and detach the output housing from the transfer box casing, taking care not to mislay the dowel. Remove the gasket and discard.

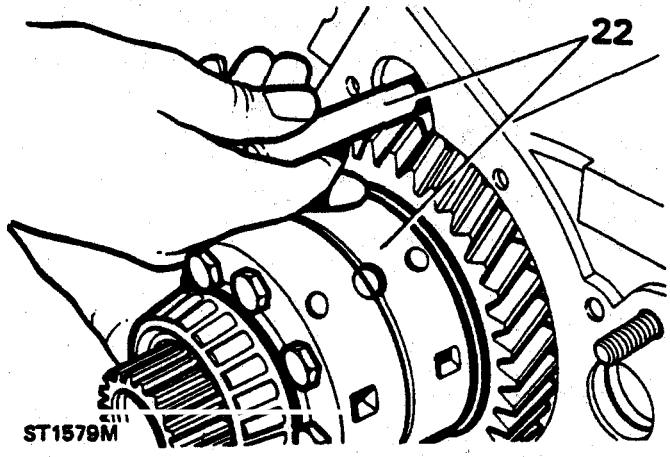


Centre differential removal

21. Remove high/low selector shaft detent plug, spring and retrieve the ball with a suitable magnet.

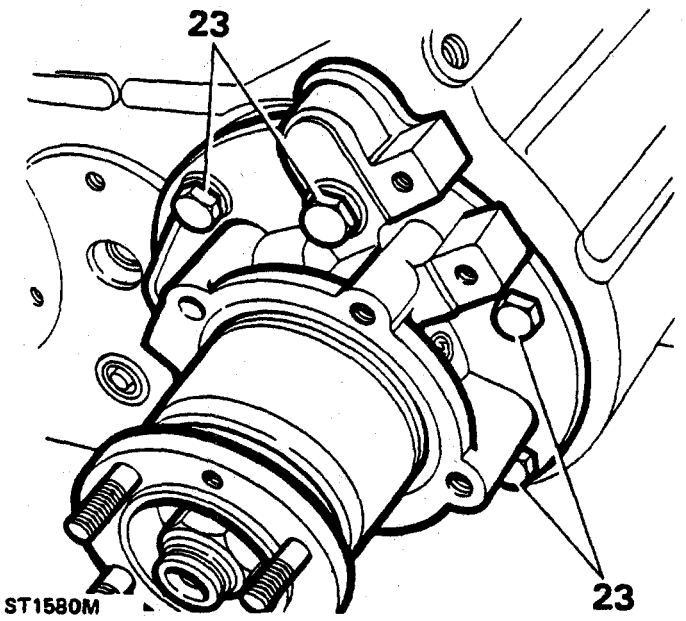


22. Withdraw the centre differential and selector shaft/fork assembly.



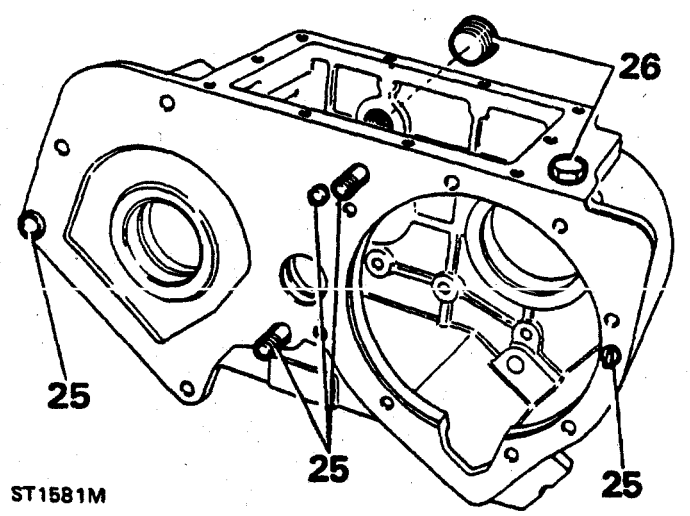
Rear output housing removal

23. Remove six bolts and washers and detach the rear output housing and shaft assembly from the transfer casing.
24. Removethe gasket and discard.

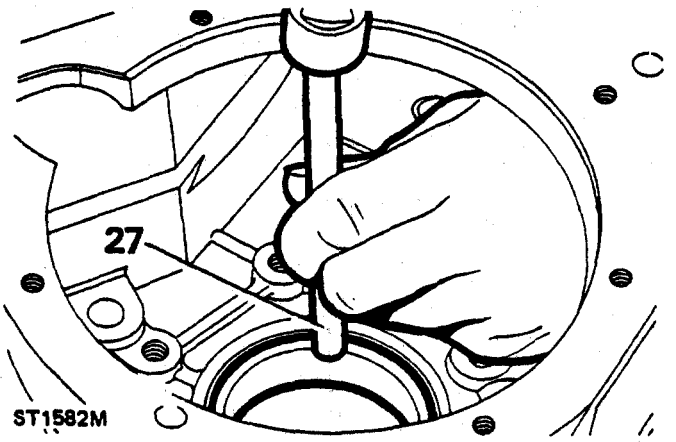


Transfer case, dismantle and overhaul

25. Inspect the studs and dowels for wear or damage. Remove if replacements are required.
26. Remove the magnetic drain plug, copper washer 'and filler/level plug. Discard the washer.



27. Drive out differential rear bearing track.
28. Clean all areas of the transfer casing ensuring all traces of 'Loctite' are removed from faces and threads.

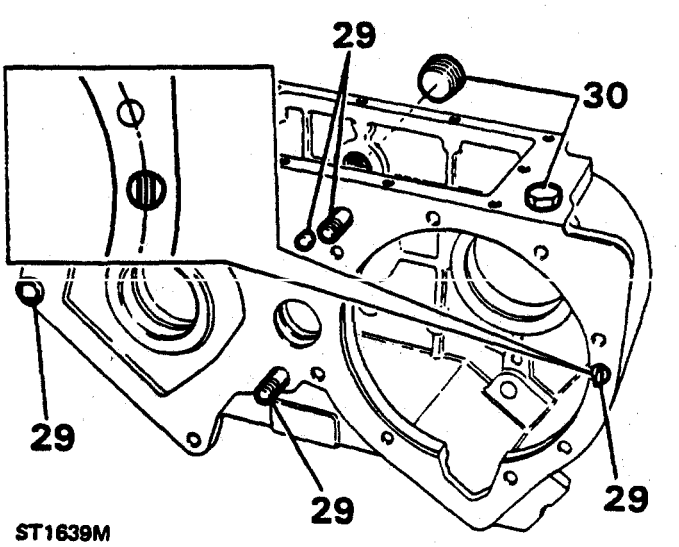


Transfer case overhaul - reassembling

29. If previously removed, fit studs and dowels to front face of the transfer casing. Use new components where necessary.

NOTE: The position of the radial dowel blade is set in line with the circle which is formed by the front output housing fixing holes.

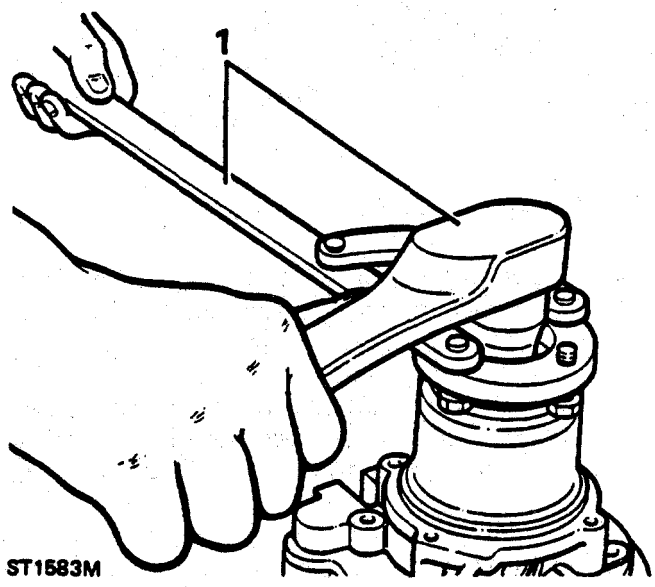
30. Refit magnetic drain plug with new copper washer and tighten to the specified torque, loosely fit the filler/level plug.



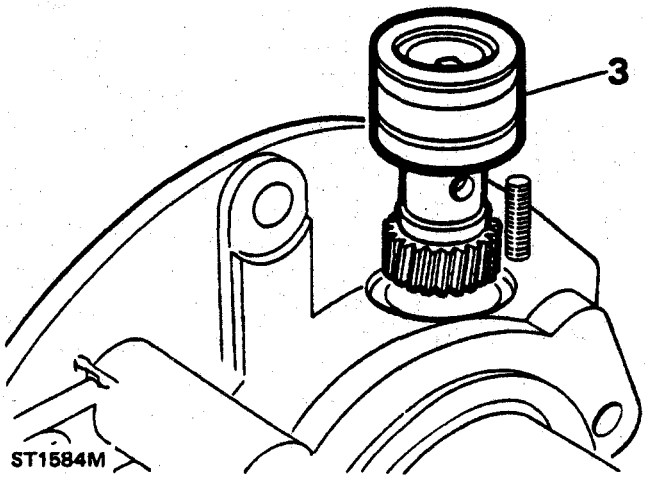
Rear output housing dismantle and overhaul

1. Using flange wrench 18G1205 and socket wrench, remove the flange nut, steel and felt washers, Ensure flange bolts are fully engaged in the wrench.
2. Remove output flange with circlip attached. If necessary, use a two - legged puller.

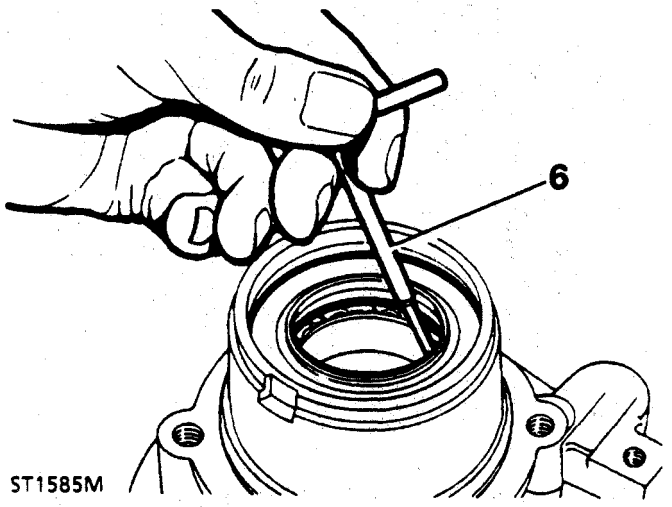
NOTE: The circlip need only be released if the flange bolts are to be replaced.



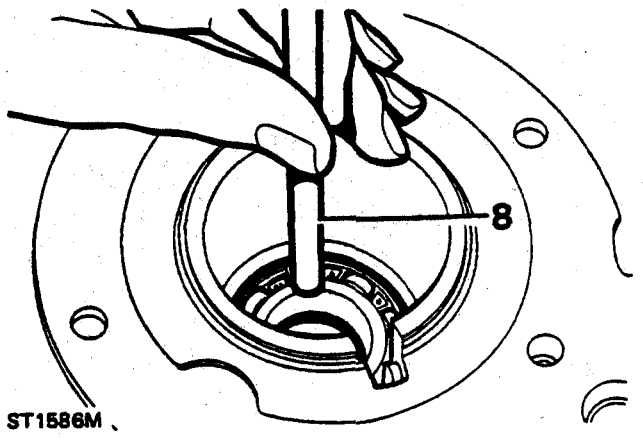
3. Remove speedo - drive housing. This can be eased out with a screwdriver.



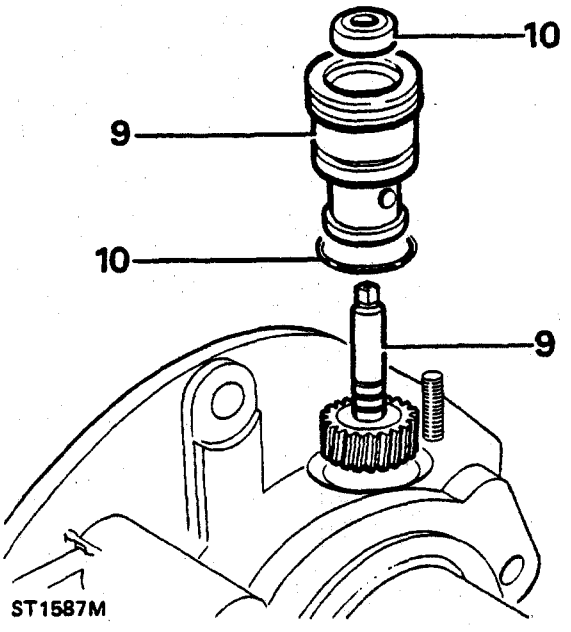
4. Remove housing from the vice and drive out the output-shaft, by striking the flange end of the shaft.
5. Carefully lever off the oil catch ring using a screwdriver in the slot provided.
6. Remove and discard the seal from the output housing using tool 18G 1271 to avoid damaging the housing.



7. Using circlip pliers, remove the circlip retaining the bearing.
8. Drive out the bearing from the rear of the housing.

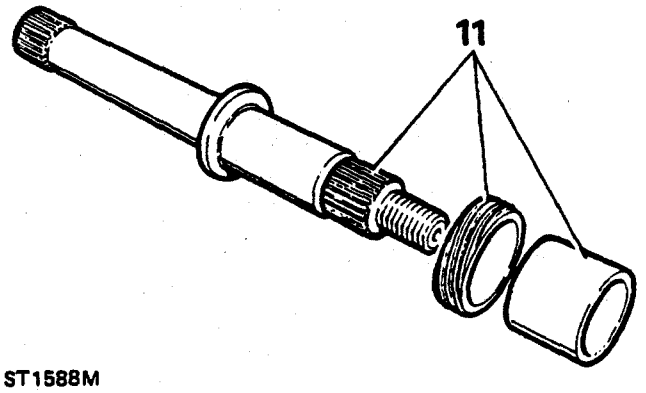


9. Remove speedometer gear (driven) from its housing.
10. Remove the ' O 'ring and oil seal and discard.



ST1587M

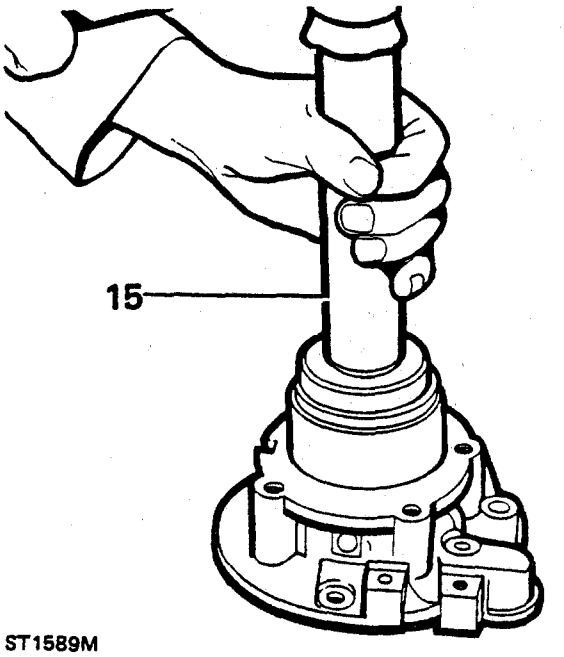
11. Slide off spacer and speedometer drive gear from output shaft.
12. Clean all parts, replace the 'O' ring, oil seals, felt seal and flange nut. Examine all other parts wear or damage and renew, if necessary.



ST1588M

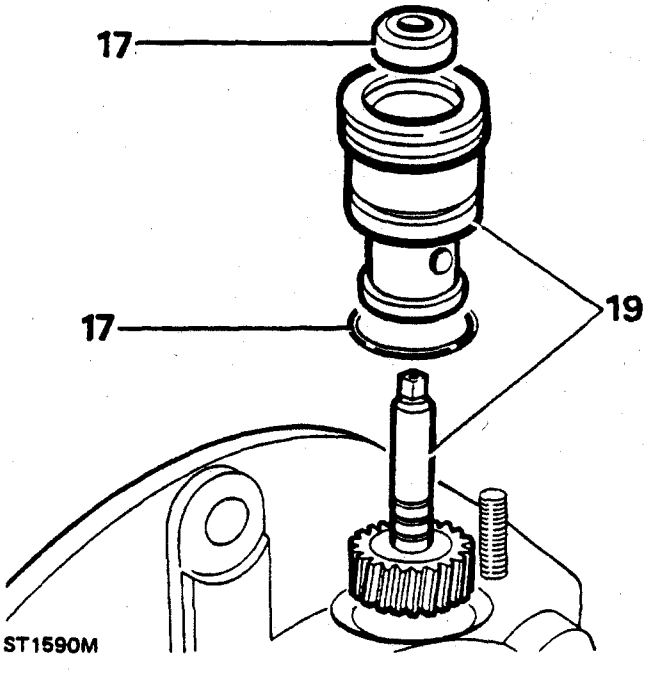
Reassembling rear output housing

13. Press output bearing into the housing. Do not use excessive force. To facilitate fitting the bearing, heat the output housing case. (This is not to exceed 100°C (212°F)).
14. Retain bearing with circlip, using circlip pliers.
15. Pre-grease between the seal lips and fit new seal, lip side leading, using tool 18G1422. The seal should just make contact with the bearing circlip.



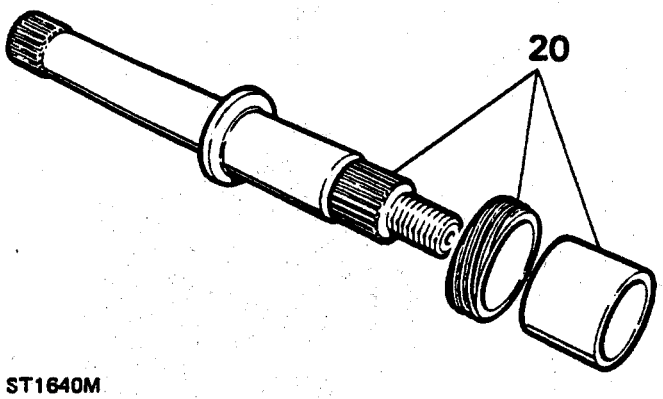
ST1589M

16. Carefully coat the lips of the seal with clean grease and refit oil catch ring onto output housing.
17. Fit the ' O ' ring and oil seal (lip side inwards) to speedometer housing.
18. Lubricate the 'O' ring and seal with oil,
19. Locate speedometer gear (driven) in housing and press into position.



ST1590M

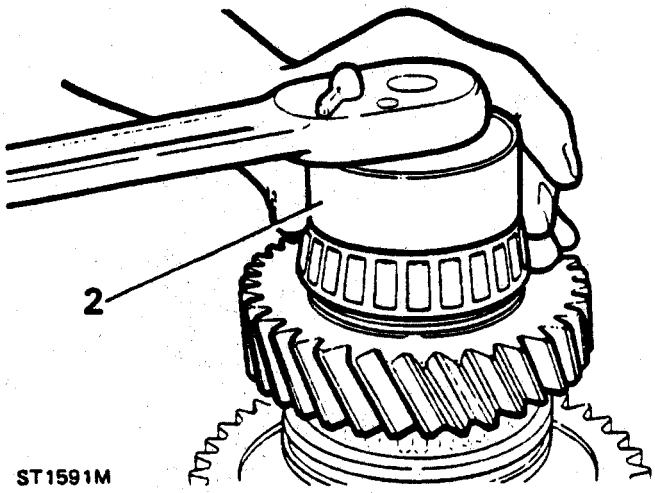
20. Slide drive gear and spacer on to the output shaft.
21. Locate output shaft into the bearing in the housing and drive into position.
22. Locate speedometer gear (driven) housing assembly into the output housing and press in until flush with the housing face.



ST1640M

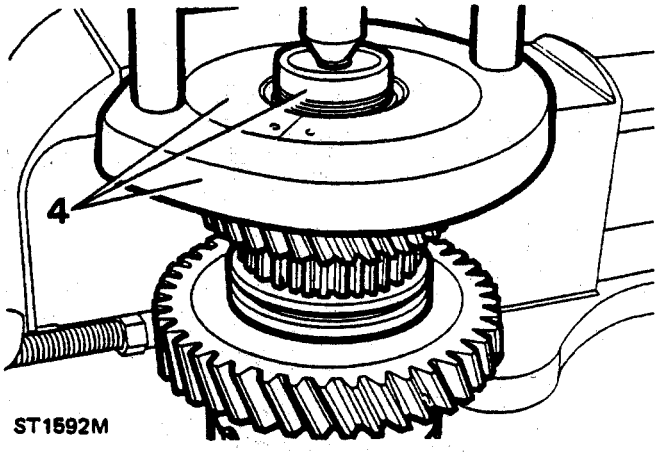
Centre differential unit dismantle and overhaul

1. Secure centre differential unit to a vice fitted with soft jaws, and release stake nut from recess.
2. Remove stake nut using tool 18G1423 and suitable socket wrench and discard stake nut.
3. Remove the differential unit from the vice.



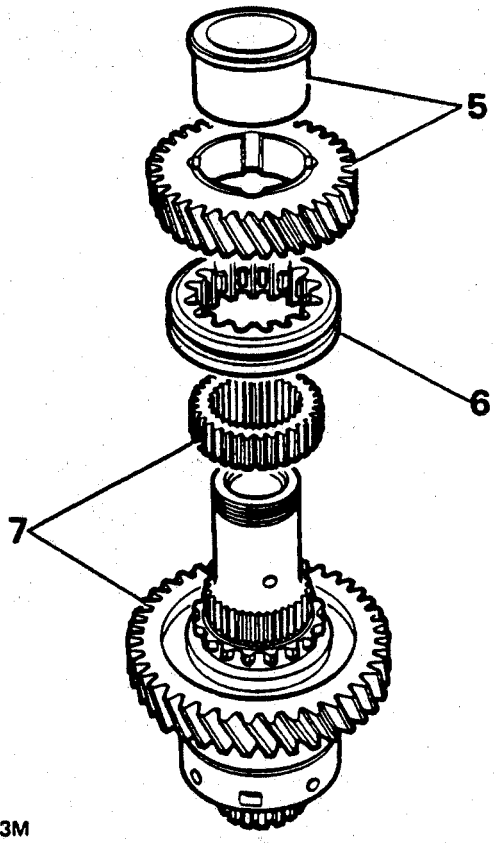
ST1591M

4. Secure hand press MS47 in vice with collars 18G47BB - 1 and using button 18G47BB/3 remove the rear taper bearing and collars.



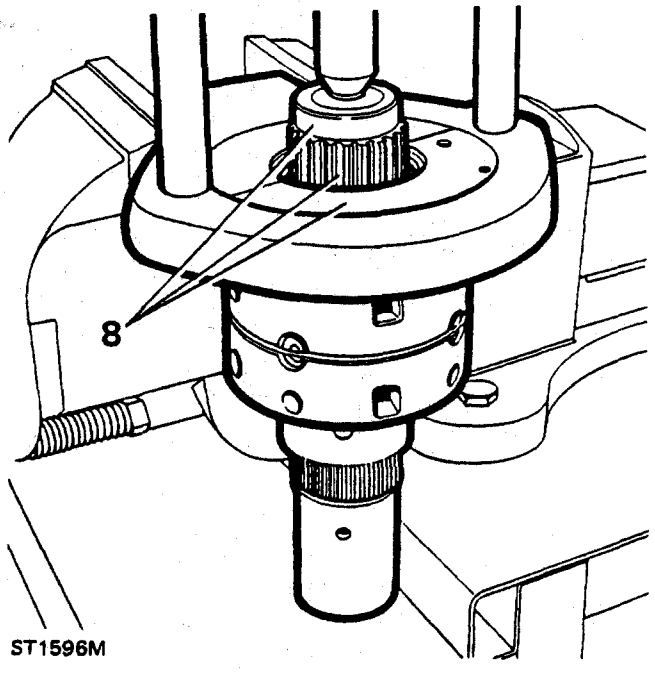
ST1592M

5. Remove the high range gear and bush, taking care not to disturb the high/lowsleeve.
6. Mark the relationship of the high/low sleeve to the hub and then remove the sleeve.
7. Using a suitable press behind the low range gear carefully remove the high/low hub and low range gear.

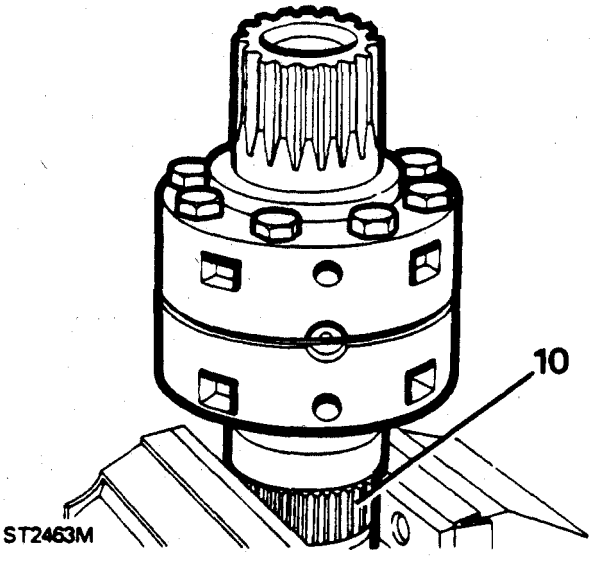


ST1593M

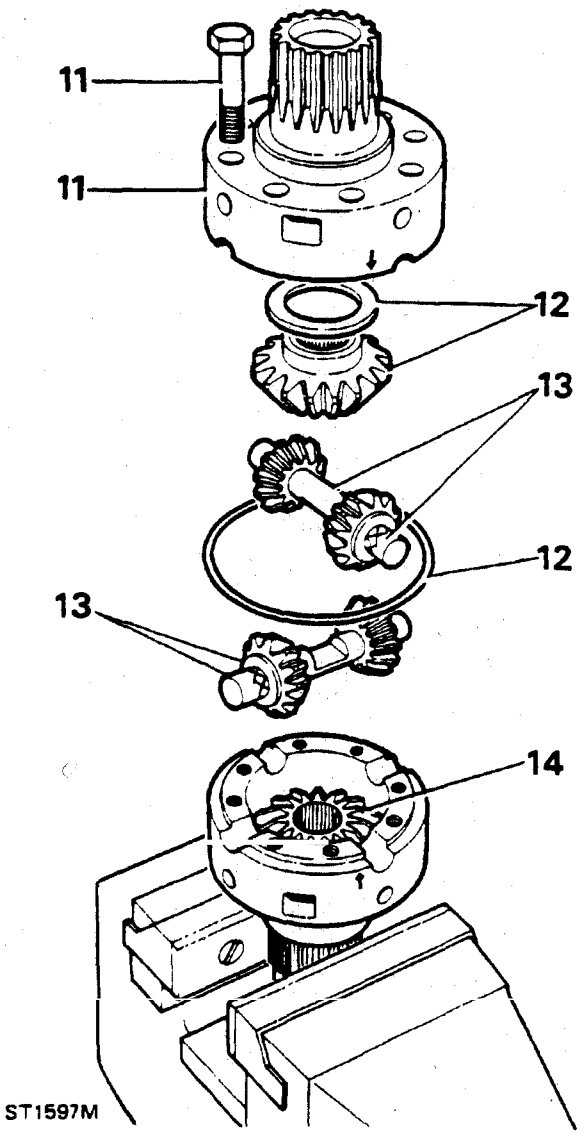
8. Substituting collar LST47 - 1 remove front taper roller bearing from the differential.
9. Remove hand press from the vice.



10. Using soft jaws secure the differential unit in the vice by gripping the hub splines.

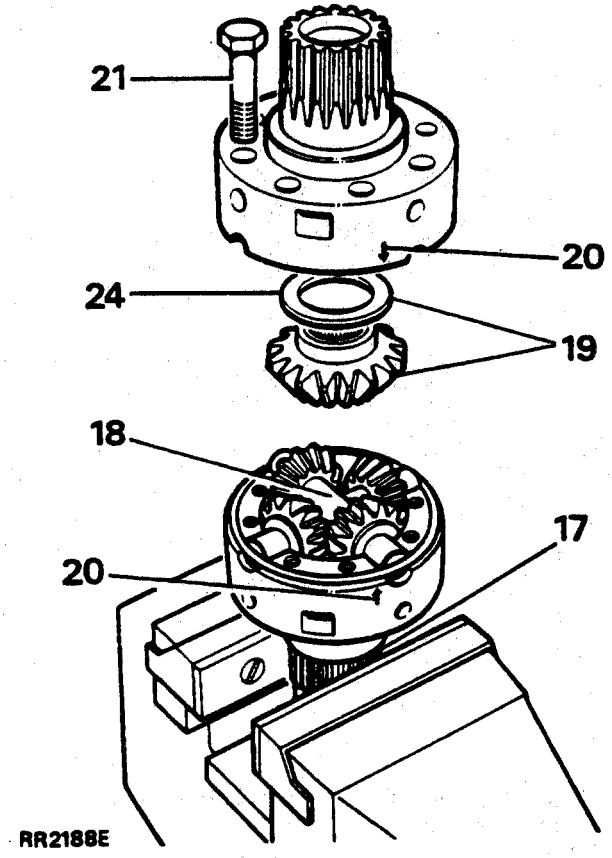


11. Remove the eight retaining bolts and lift off the front part of the differential unit.
12. Release the retaining ring and remove front upper sun gear and thrust washer.
13. Remove the planet gears and dished washers along with the cross shafts.
14. Remove the rear lower sun gear and thrust washer from the rear part of the differential unit.
15. Remove the rear differential unit from the vice and clean all components.



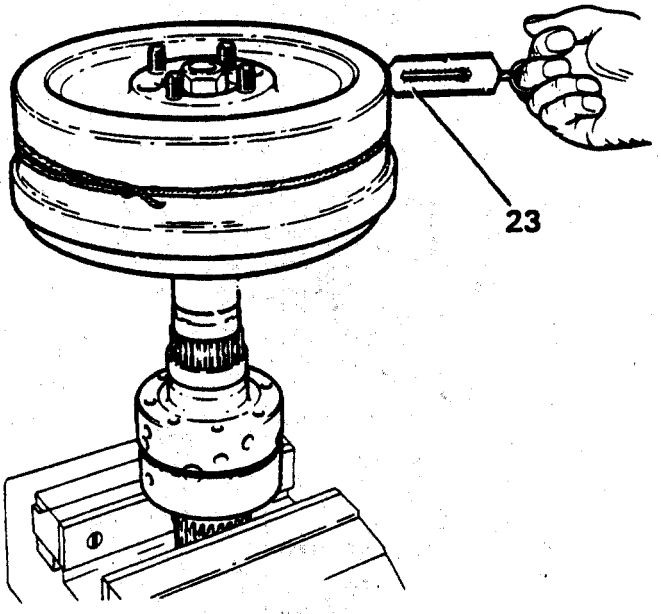
16. Inspect all components for damage or wear, fit new components if necessary.
17. Using soft jaws secure the rear (longest half) of the differential unit in the vice by gripping the hub splines.
18. Lubricate and install the cross shafts and pinion gears with new dished washers DO NOT fit the rear bevel gear at this stage.

19. Lubricate and fit the front bevel gear **and** thinnest thrust washer (FRC6956 1.05mm).
20. Fit the front half of the differential casing ensuring that the two engraved arrows are aligned.
21. Fit securing bolts and tighten to the correct torque (see section 06 - TORQUE VALUES).
22. Lubricate and insert the rear output shaft into the bevel gear and check that the gears are free to rotate.



RR2188E

23. Fit the transmission brake drum to the output drive flange and check the torque required to rotate the gears. Tie a length of string around the brake drum, attach a spring balance to the string and carefully tension the string until a load to turn is obtained, Alternatively use a torque wrench applied to the brake drum flange nut. Rotate the drum slowly by hand to overcome initial load when using either method. Note that the illustration RR2332E shows checking torque at rear bevel gear.



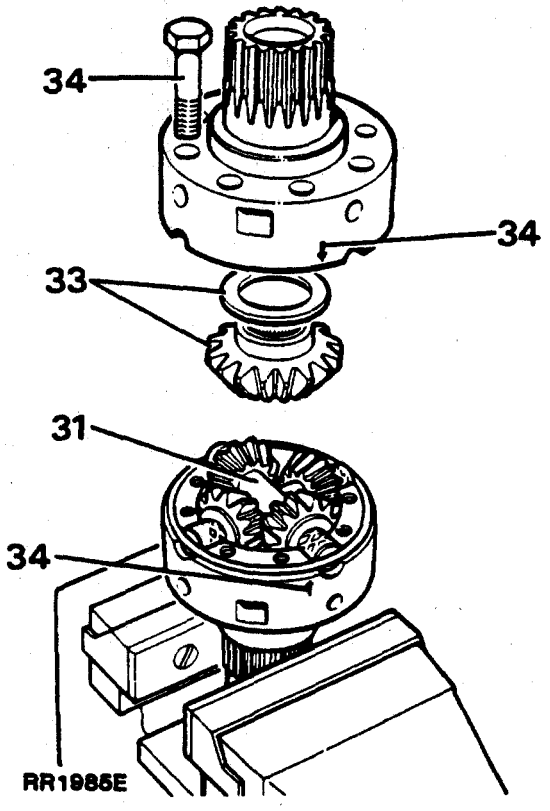
RR2332E

NOTE: Gears that have been run will rotate smoothly and will require a torque of 0.56 Nm (5 in lb). Equivalent force using a spring balance: 0.45 Kg (1 lb).
New **gears will rotate with a "notchy" feel and** will **require a torque of not more than 2.26 Nm (20 in lb). Equivalent force using a spring balance: 1.72 Kg (3.8 lb).**
Keep all components well lubricated when carrying out these adjustments.

24. Change the thrust washer for a thicker one if the torque reading is too low. Five thrust washers are available in 0.10 mm steps ranging from 1.05 to 1,45 mm.
25. Dismantle the unit when the front bevel gear thrust washer is selected.
26. Remove and retain the front bevel and thrust washer combination.
27. Reassemble the unit with the rear bevel gear and thinnest thrust washer in position.
28. Using soft jaws secure the front (shortest half) of the differential unit in the vice by gripping the hub splines.
29. Repeat the above procedure to obtain the correct thrust washer for the rear bevel gear.

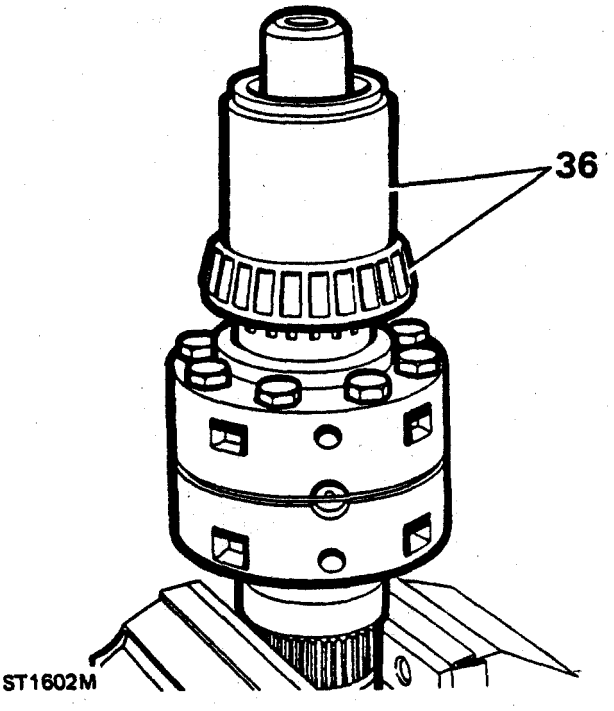
Re-assembling centre differential

30. Fit the selected thrust washer and bevel gear into the rear differential unit.

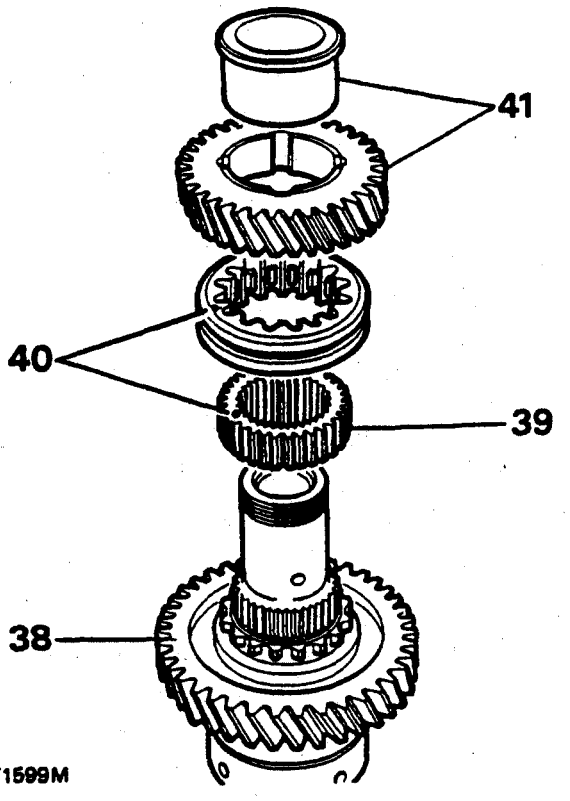


31. Assemble both pinion assemblies and dished washers onto their respective shafts and fit the rear differential unit. Secure the assemblies with the retaining ring.
32. Lubricate all the components.
33. Fit the selected thrust washer and bevel gear into the front upper differential unit.
34. Align both units as previously described and secure with the eight bolts to the specified torque.
35. Check the overall torque required to turn the differential. This should be approximately equal to the resistance of both bevel gears added together.
36. Locate the front differential bearing onto the front, upper differential shaft and press into position using larger end of tool 18G1424 as shown.
37. Invert the differential unit and secure in the vice.

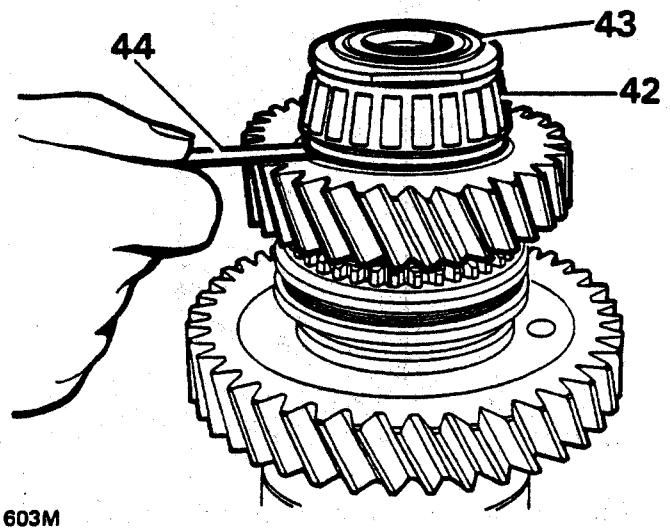
NOTE: During the following sequences all parts should be lubricated as they are fitted.



38. Fit the low range gear, with its dog teeth uppermost to the differential assembly.
39. Press the high/low hub on to the differential splines.
40. Slide the high/low selector sleeve on to the high/low hub ensuring that the alignment marks are opposite each other.
41. Fit the bush into the high range gear so that the flange is fitted on the opposite side of the gear to the dog teeth. Slide the bushed gear on to the differential assembly with the dog teeth down.



42. Locate the rear differential bearing on to the hub and press it into position using the smaller end of tool 18G1424, see instruction 36.
43. Fit the stake nut and tighten to the specified torque using tool 18G1423.
44. Check the end float of the high and low range gears **0,05** to 0,15 mm (0.002 to 0.005 in).

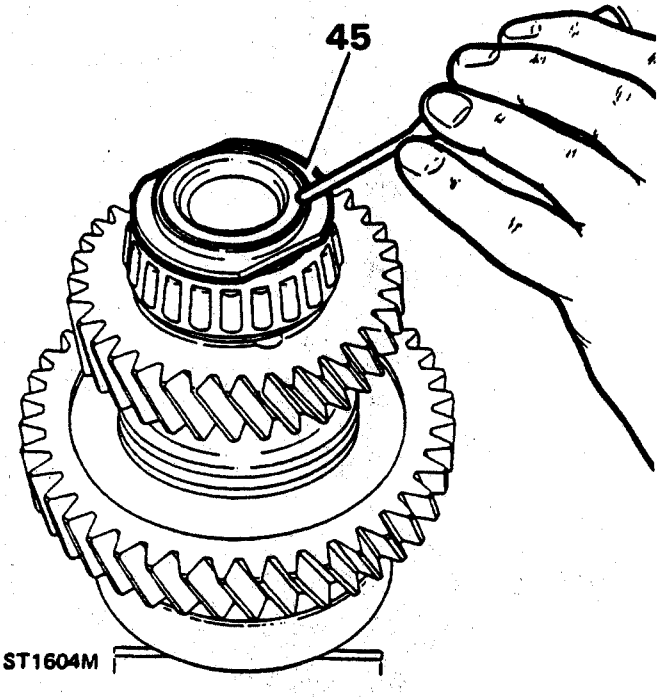


ST1603M

NOTE: If the clearances vary from those specified, the assembly must be rebuilt using the relevant new parts.

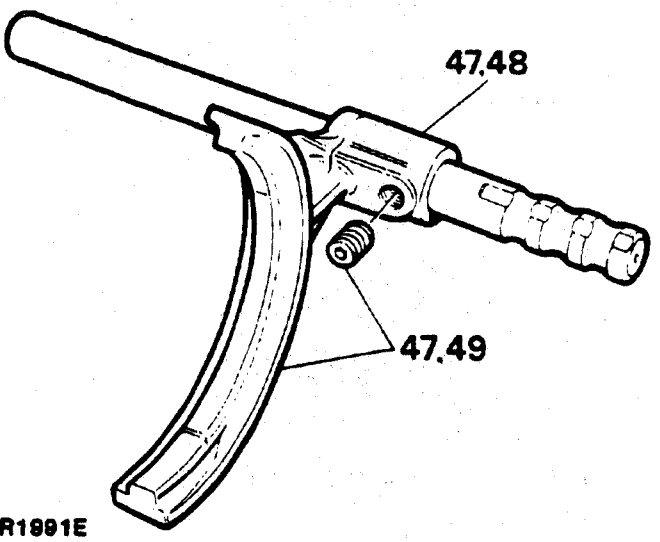
45. Peen the stake nut collar by carefully forming the collar of the nut into the slot as illustrated.

CAUTION: A round nose tool must be used for this operation to avoid splitting the collar of the nut.



ST1604M

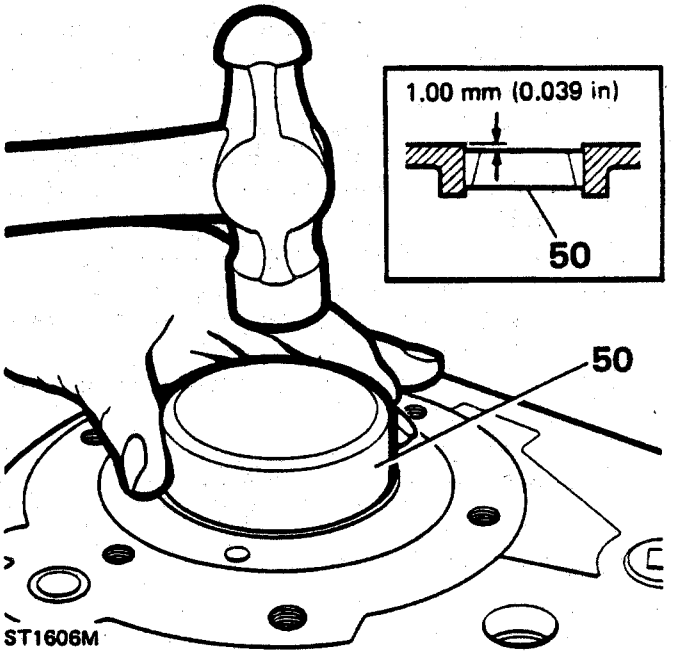
46. Clean and check high/low selector fork assembly for wear and renew if necessary.
47. To renew the selector fork remove the set screw and slide the fork from the shaft.
48. Fit the new selector fork with its boss towards the three detent grooves. Align the tapped hole in the fork boss with the indent in the shaft nearest to the detent grooves.
49. Apply Loctite 290 to the set screw threads and fit the set screw and tighten to the specified torque.



RR1991E

Centre differential rear bearing track

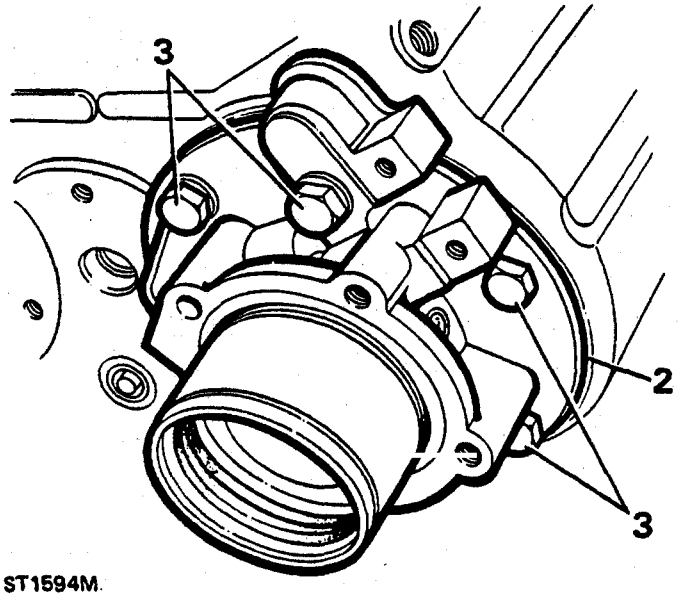
50. Fit the differential rear bearing track 1,00 mm (0.039 in) below the outer face of casing using a suitable tool as shown.



ST1606M

Rear output housing - refit

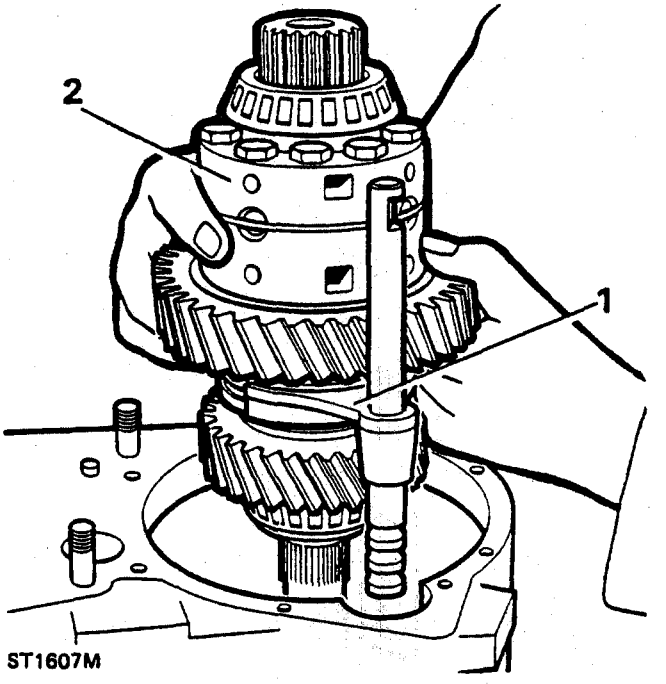
1. Grease output housing gasket and position on to the rear face of the transfer box casing.
2. Fit output housing and ensure clearance of 100 mm (0.039 in) between housing face and gasket.
3. Fit the six output housing bolts with Loctite 290 on the threads, with washers and tighten, evenly to the correct torque, which will pull the rear bearing into position.



ST1594M

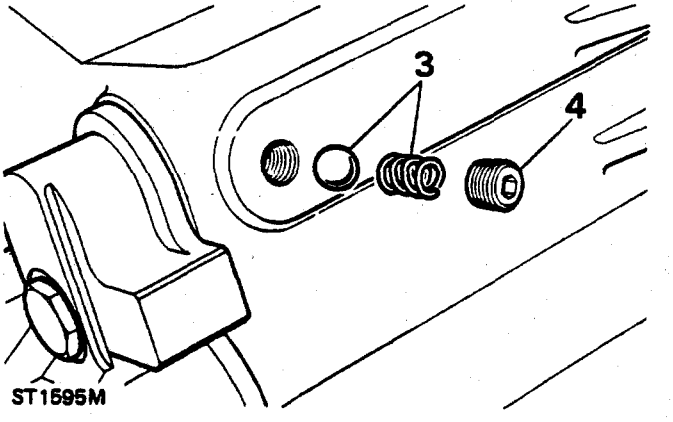
Centre differential unit refit

1. Fit the selector fork/shaft assembly to the high/low selector sleeve on the differential assembly, with detent groove to the rear of the differential assembly.
2. Locate the differential assembly complete with selector fork into the transfer box casing. It may be necessary to **rotate** the output shaft to ease fitment, and engage selector shaft into its hole.



ST1607M

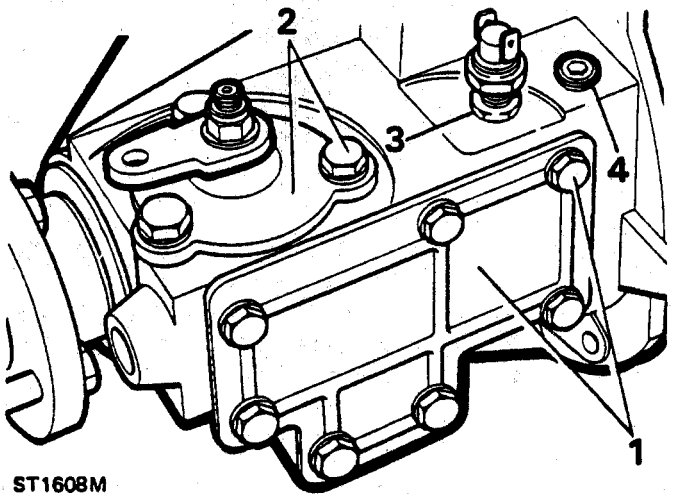
3. Fit selector shaft ball and spring through the side of the transfer box casing.
4. Apply Loctite 290 to detent plug; fit and locate, by screwing gently fully home and then unscrewing two turns.



ST1595M

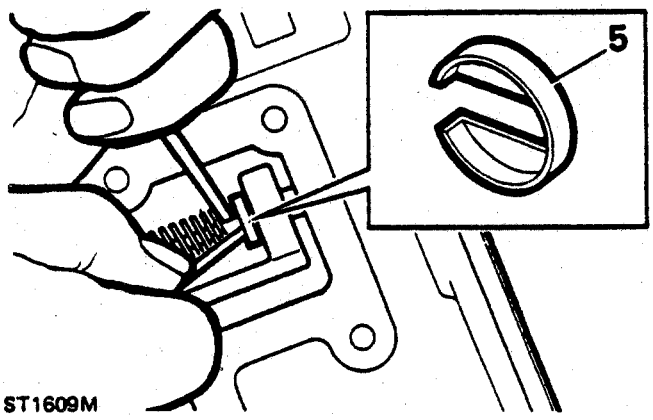
Front output housing dismantle and overhaul

1. Unscrew seven retaining bolts and washers and remove the differential lock selector side cover and gasket.
2. Unscrew three retaining bolts and washers and lift the differential lock finger housing and actuator assembly from the front output housing.
3. Slacken the locknut and unscrew the differential lock warning light switch.
4. Remove slector shaft detent plug, spring and ball using a suitable magnet.



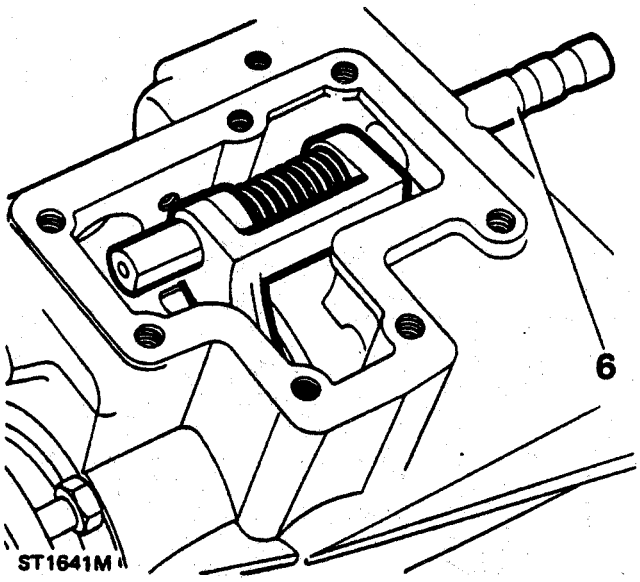
ST1608M

5. Compress the selector fork spring and remove the two spring retaining caps.



ST1609M

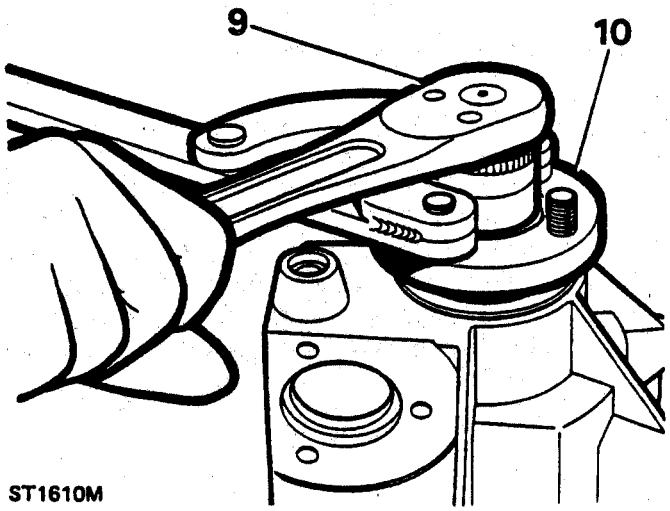
6. Withdraw the selector shaft from the rear of the output housing.
7. Remove the selector fork and spring through the side cover aperture.
8. Remove lock - up sleeve from the rear of the output housing.



ST1641M

9. Using flange wrench 18G1205 and socket wrench, remove the flange nut, steel and felt washers.

NOTE: Ensure that flange bolts are fully engaged in the wrench.

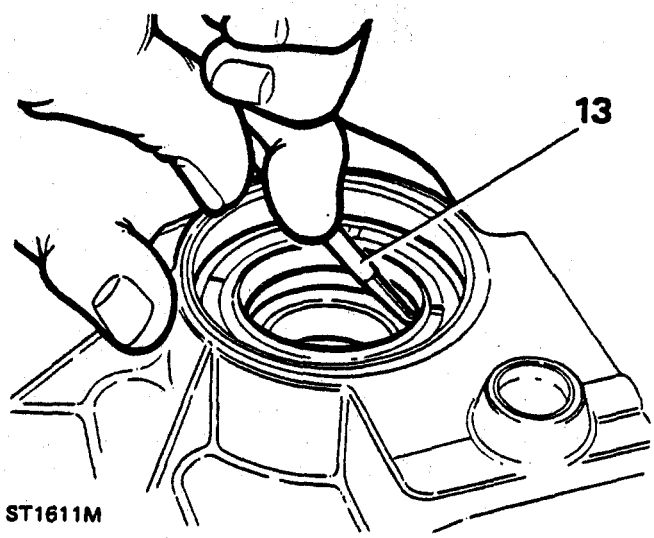


ST1610M

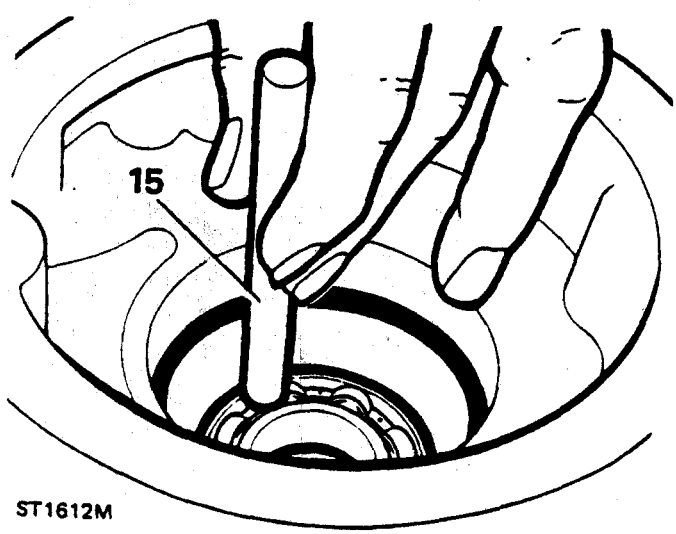
10. Remove the output flange with oil seal shield.

NOTE: These parts need not be separated unless the flange bolts are to be renewed.

11. Drift output shaft rearwards from housing using a soft headed mallet.
12. Slide off the collar from the output shaft.
13. Remove and discard oil seal from output housing using service tool 18G1271 to avoid damaging the housing.
14. Remove circlip with circlip pliers 18G257.

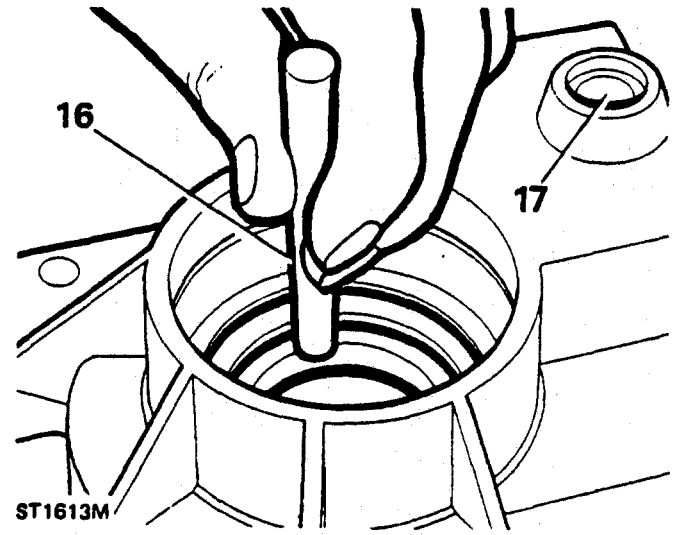


15. Invert housing and drift out bearing from inside the case as shown.



16. Drift out centre differential front taper roller bearing track and shim.
17. Drift out selector shaft cup plug from housing.
18. Clean all components ensuring all traces of 'Loctite' are removed from faces and threads.
19. Examine components for wear or damage and renew if necessary.

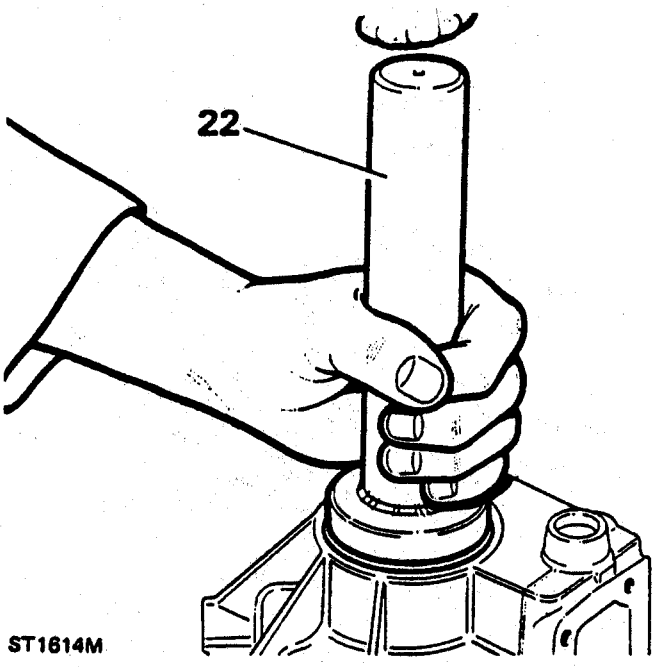
NOTE: Renew oil seal and felt seal and flange nut.



Re-assemblingfront output housing

20. Press the bearing into the housing: do not use excessive force. To facilitate fitting the bearing, heat the front output housing uniformally to a temperature that must not exceed 100°C (212°F).
21. Using circlip pliers, fit the bearing retaining clips.

22. Pre - grease and fit a new oil seal (lip side inwards) using replacer tool **18G1422,** until the seal just makes contact with the circlip.

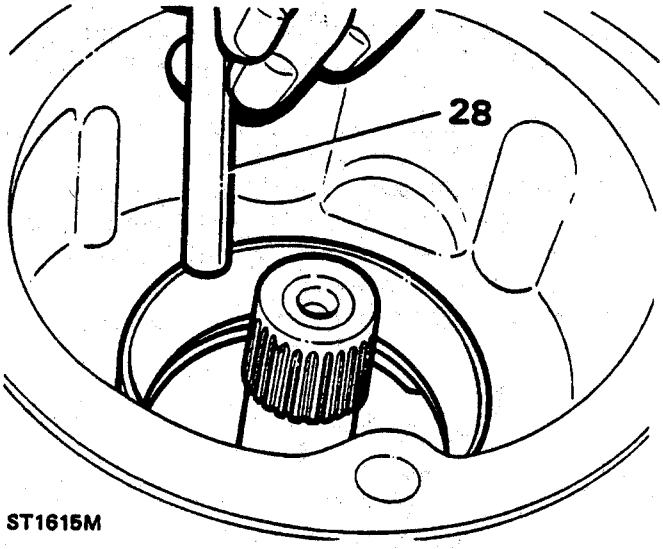


ST1614M

23. Carefully charge the lips of the seal with clean grease.
24. Slide collar on to the output shaft, with its chamfered edge away from the dog teeth.
25. Fit the output shaft through the bearing and drift home.

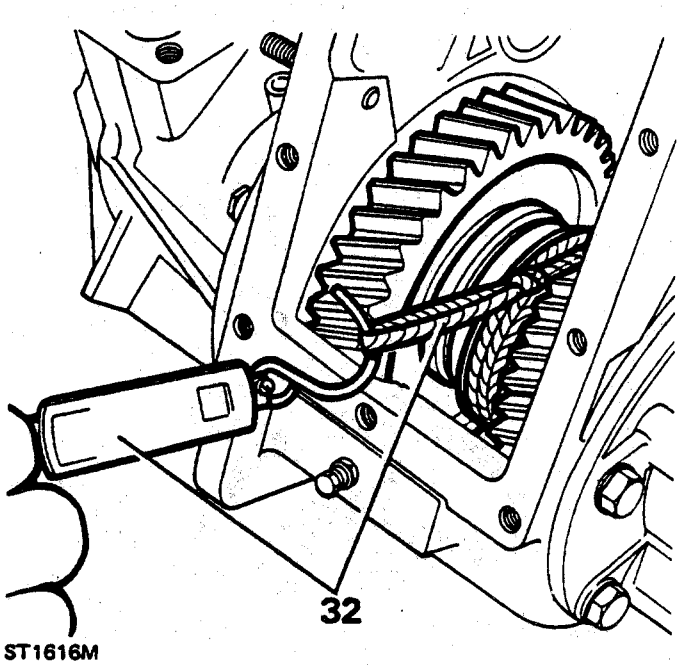
Adjusting front differential bearing pre - load

26. Measure original differential front bearing track shim.
27. Refit original shim into input housing.
28. Drift differential front bearing track into the housing.



ST1615M

29. Grease and fit new gasket and locate the front output housing on the transfer box casing.
30. Secure housing with the eight retaining bolts and washers, the upper middle bolt being longer than the rest. Do not tighten the bolts at this stage.
31. Engage high or low gear.
32. Check the roiling resistance of the differential using a spring balance and a length of string wound around the exposed splines of the high/low hub.



ST1616M

33. With the correct shim fitted the load to turn should be 1,36 kg to 4,53 kg (3 lb to 10 lb).

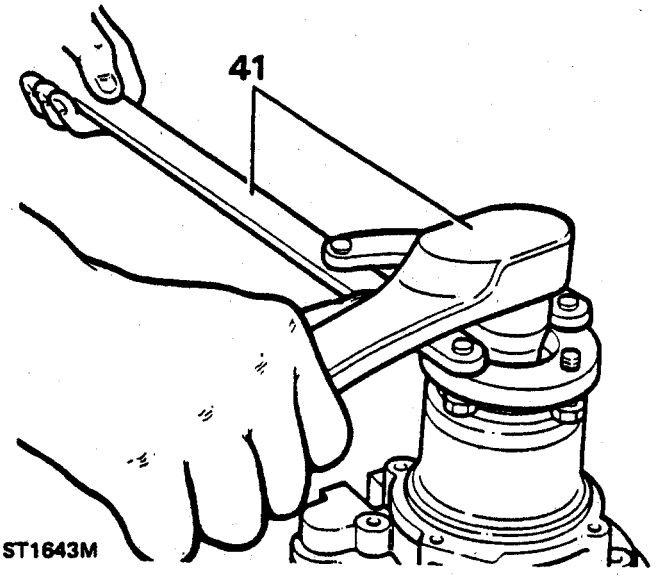
    NOTE: Alternatively, fit the nut to the output flange and use a suitable torque wrench to turn the differential. The readings should be 0.56 to 1.69 Nm (5 to 15 in lb). New bearings will register at the top end of the torque range and used bearings will register at the low end.

    NOTE: Shims are available in 0.001 in increments.

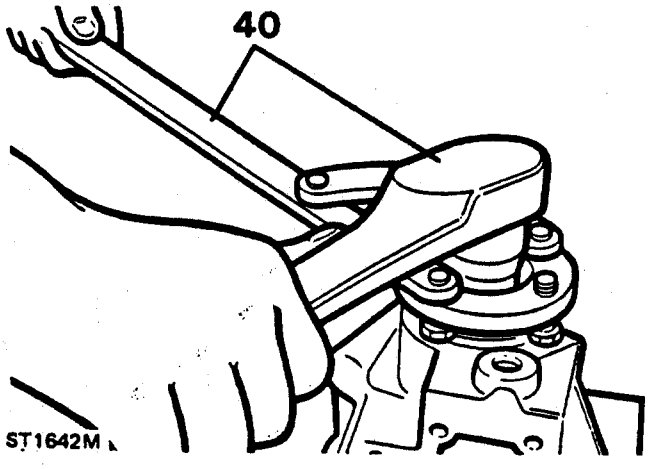
34. If the reading is in excess of the above measurements, remove the front output housing assembly from the transfer box casing.
35. Using a suitable extractor, withdraw the centre differential bearing track and change the shim for one of a suitable thickness. (A thinner shim will reduce the rolling resistance).
36. Fit the new shim and drift the differential bearing track back into its housing until fully home.
37. Having obtained the load to turn, prop up the transfer box casing on the bench with the front face uppermost.
38. Apply Loctite 290 to the threads of the housing retaining bolts and fit the eight bolts and washers into the front output housing and secure to transfer box casing.
39. Fit front output flange, felt washers, steel washers and flange nut.
40. Using flange wrench 18G1205 and torque wrench, pull the output shaft up to the correct position. Check that the oil seal shield does not foul the housing.

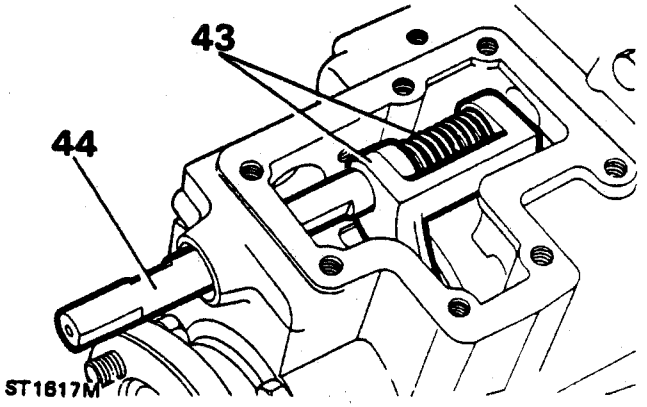
    NOTE: Ensure that the flange bolts are fully engaged in the wrench.

41. Repeat the above operation for the rear output flange.

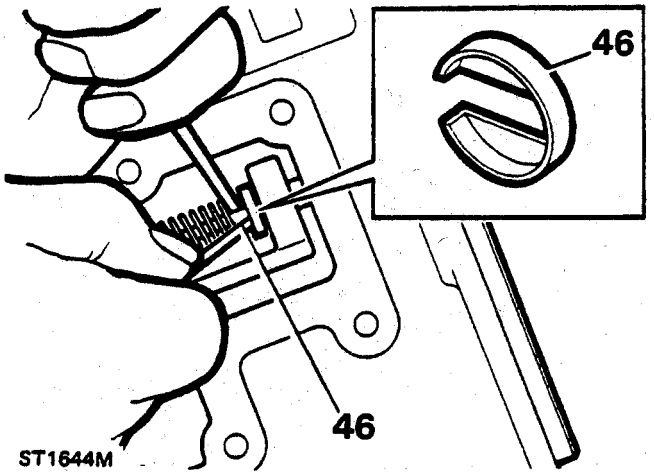


42. Compress the selector shaft spring and fit to the select fork.
43. Locate selector fork through front output housing side cover aperture, ensuring that the fork engages in the groove of the lock up sleeve.
44. Fit selector shaft through the aperture in the front of the output housing and pass it through the selector fork lugs and spring into the rear part of the housing.
45. Rotate the selector shaft until the two flats for the spring retaining caps are at right angles to the side cover plate face.

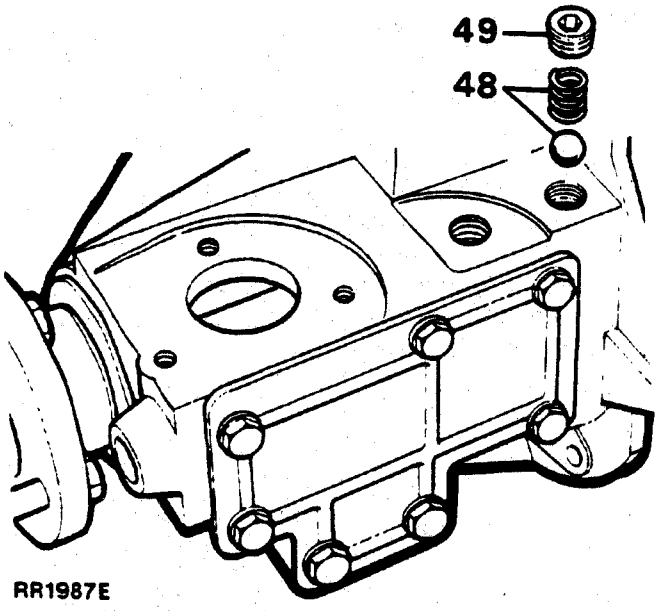




46. Compress the spring between the fork lugs and slide the retaining caps on to the shaft ensuring the spring is captured with the 'cupped' side of the caps.
47. Apply a suitable sealant to a new seal cup and drive the cup into position.



48. Fit selector shaft detent ball and spring in the tapped hole on top of the output housing.
49. Apply Loctite 290 to detent plug threads. Screw detent plug gently home and then unscrew two turns.

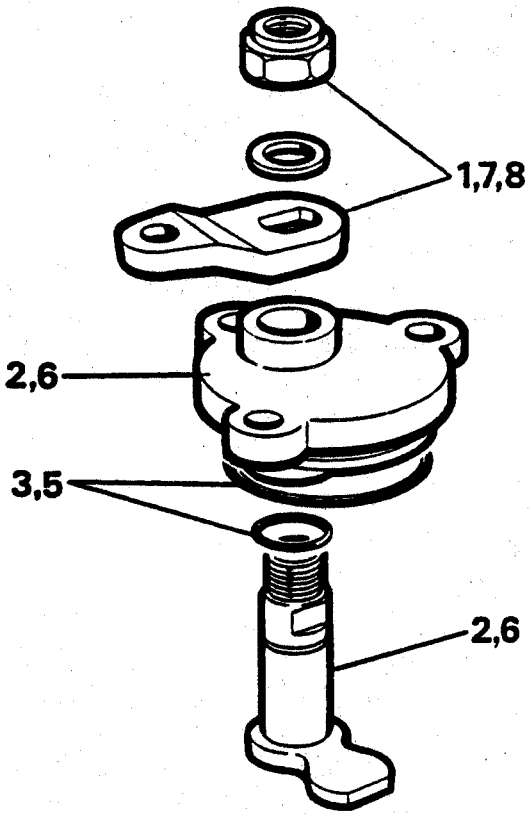


Differential lock finger housing - dismantle and overhaul

1. Unscrew and discard the 'nyloc' nut and remove the operating lever and washer.
2. Remove the pivot shaft from lock finger housing.
3. Remove the 'O' rings from the pivot shaft and housing and discard.
4. Clean all components; examine for wear or damage and renew if necessary.

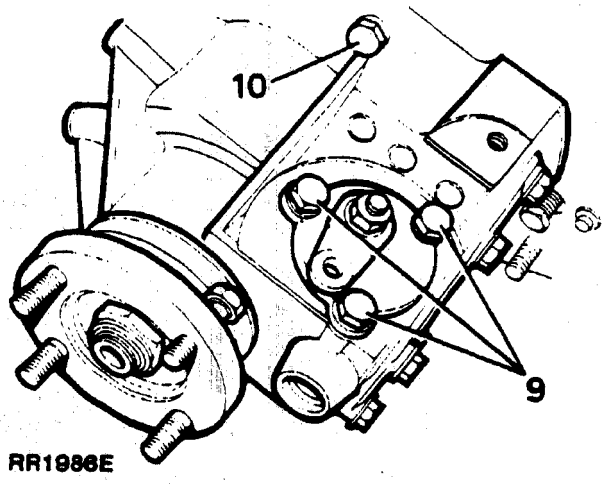
Re-assembling

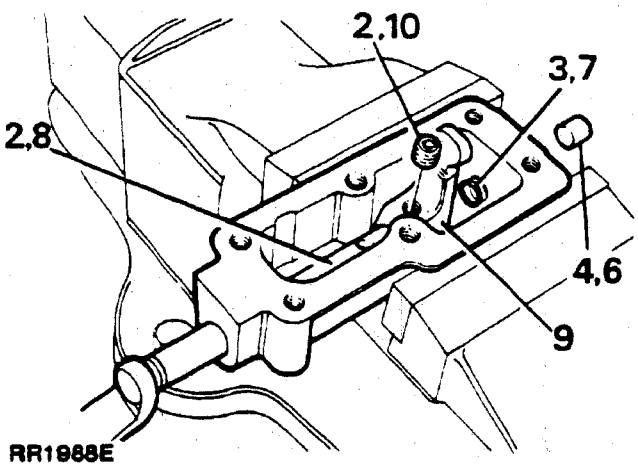
5. Fit new 'O' rings on to pivot shaft and lock finger housing and lubricate with oil.
6. Locate the pivot shaft in the housing.
7. Fit the differential lock lever over the pivot shaft so that the lever will face forward to the bend upwards.
   This lever is then in the correct operating position.
8. Retain the lever with a plain washer and new 'nyloc' nut.



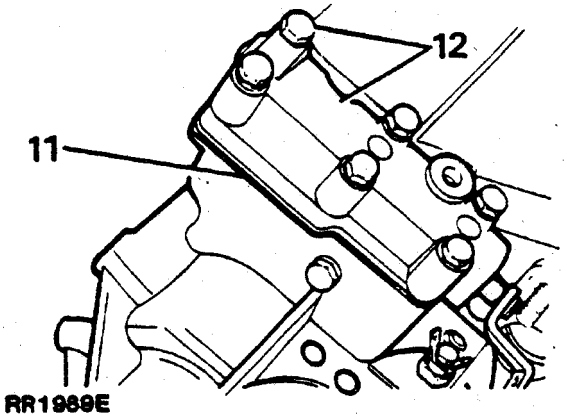
Continued

9. Fit the differential lock finger housing into its seating on the front output housing, ensuring that the selector finger is located in the flat of the selector shaft.
10. Apply Loctite 290 to the bolt threads and retain the lock finger housing with the three bolts and washers to the specified torque.





11. Grease and fit the high/low selector housing gasket on the front output housing.
12. Fit high/low cross - shaft housing, ensuring that the selector finger locates in the slot of the selector shaft, and secure with six bolts and washers to the specified torque.



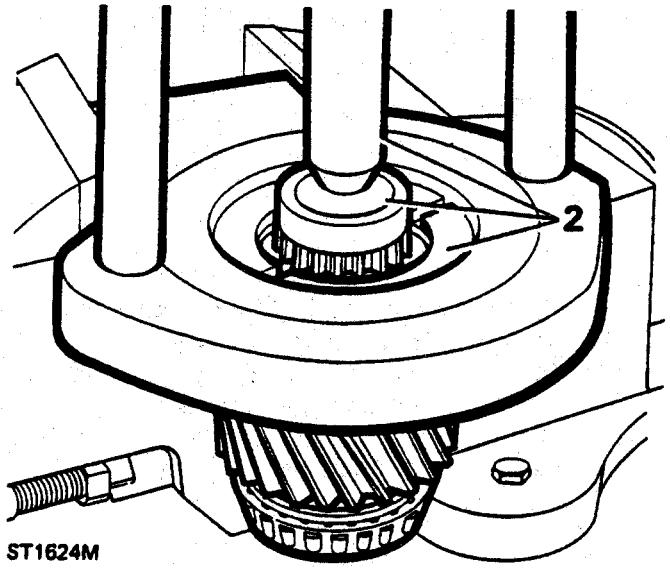
High/low cross - shaft housing overhaul

1. Release the locknut and remove the neutral warning switch.
2. Remove the selector finger set screw and withdraw the cross-shaft from the cross-shaft housing and remove the selector finger.
3. Remove the '0' ring from the cross-shaft.
4. Drive out selector housing cup plug if necessary.
5. Clean all the components and check for damage or wear, replace if necessary.
6. Apply sealant to a new cup plug and fit so that the cup is just below the chamfer for the cross - shaft bore.
7. Fit new 'O' ring to cross - shaft.
8. Lubricate the shaft and insert into the cross - shaft housing.
9. Fit selector finger ensuring that it aligns with the recess in the cross - shaft.
10. Apply Loctite 290 to the grub screw and secure the selector finger to the cross - shaft and fully tighten to the specified torque.

Input gear overhaul - dismantle and overhaul

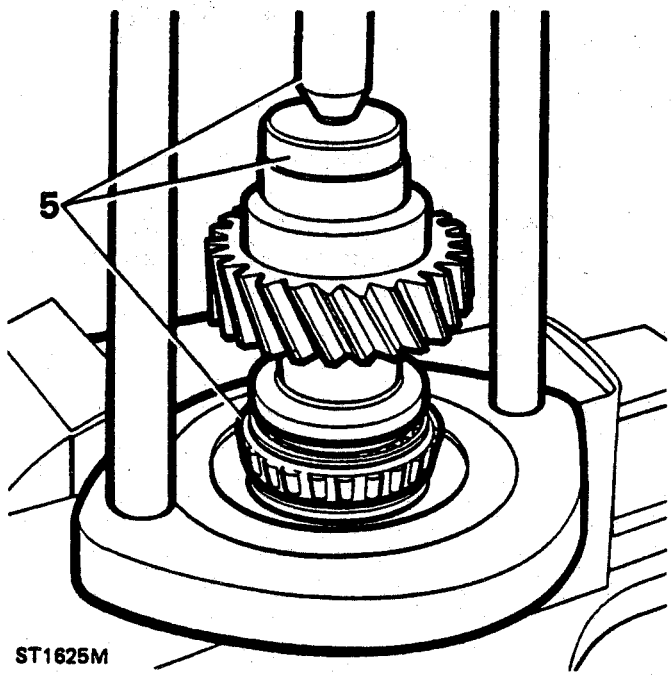
1. Clean the input gear assembly and examine for wear or damage. Remove the bearings only if they are to be renewed.

2. Secure hand press MS47 in the vice and using collars 18G47 - 7 and button 18G47 - BB/3, remove rear taper roller bearing from input gear assembly.
3. Invert input gear assembly in hand press and remove front taper roller bearing.
4. Clean input gear.

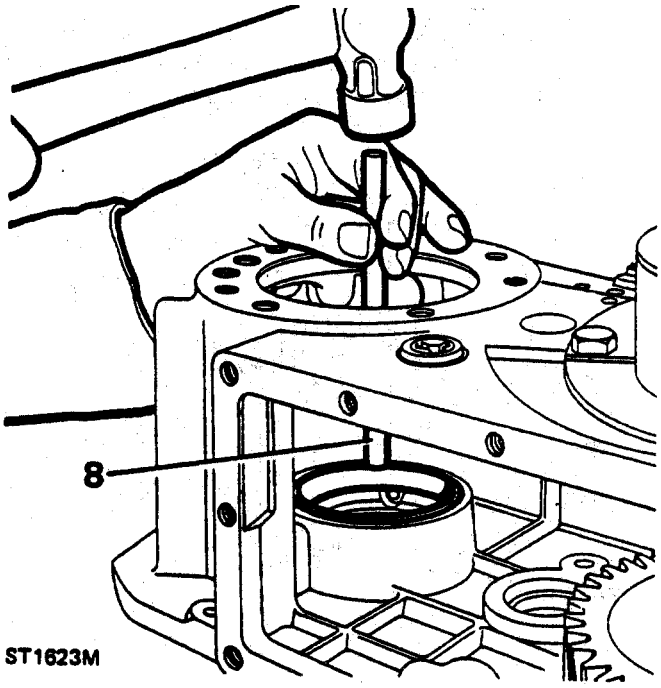


Re-assembling input gear assembly

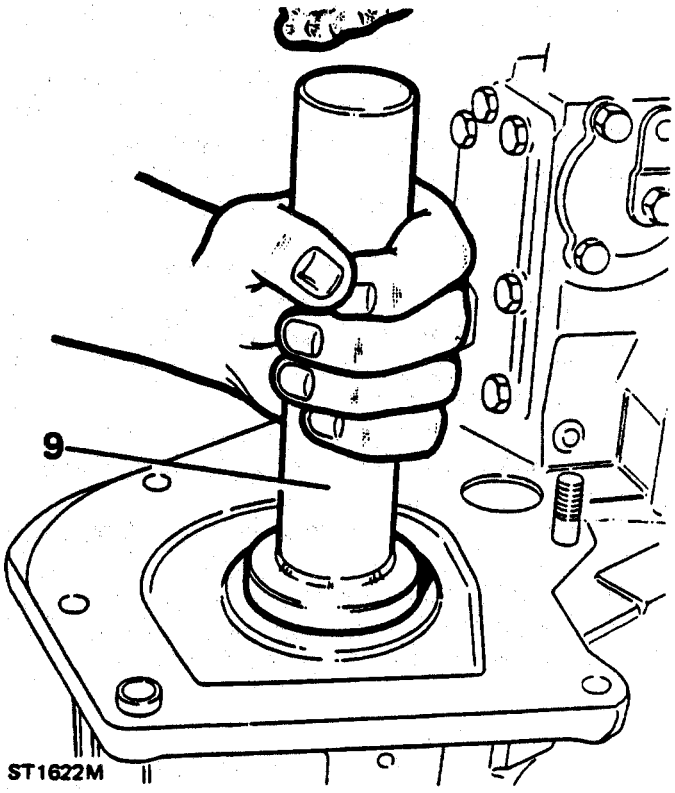
5. Position rear taper roller bearing on input gear and using hand press MS47 and collars 18G47 - 7 press the shaft onto bearing.
6. Invert input gear and fit the front taper roller bearing using the press and collars.



7. Prop up the transfer box casing on the bench with the rear face uppermost.
8. Drift in the front taper bearing track.



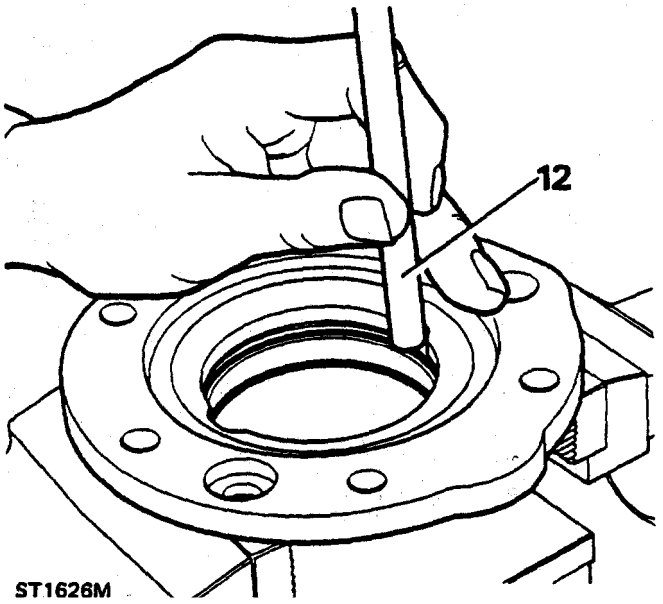
9. Reposition transfer box casing so the front face is uppermost and fit oil seal (lip side inwards) using replacer tool 18G1422.



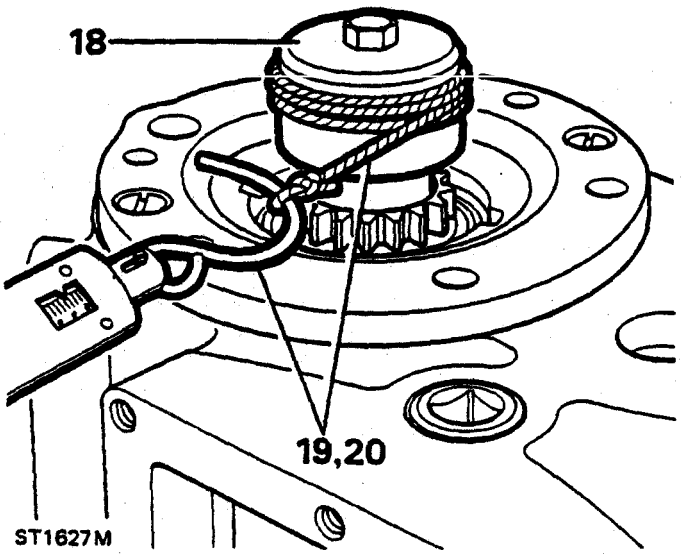
10. Lubricate both bearingswith clean oil.
11. Fit the input gear assembly into the transfer box casing with the dog teeth uppermost.

Checking input gear bearing pre - load

12. Secure bearing support plate in the vice. Drift out input gear bearing track, and remove shim.



13. Clean bearing support plate and shim. Measure original shim and note its thickness.
14. Fit the original shim to the support plate.
15. Locate the bearing track in the support plate and press fully home.
16. Apply grease to the gasket and fit on to the transfer box casing.
17. Fit the bearing support plate on to the transfer box casing and secure with the six bolts, but do not tighten,
18. Fit the service tool LST105 to input gear and engage the spline.

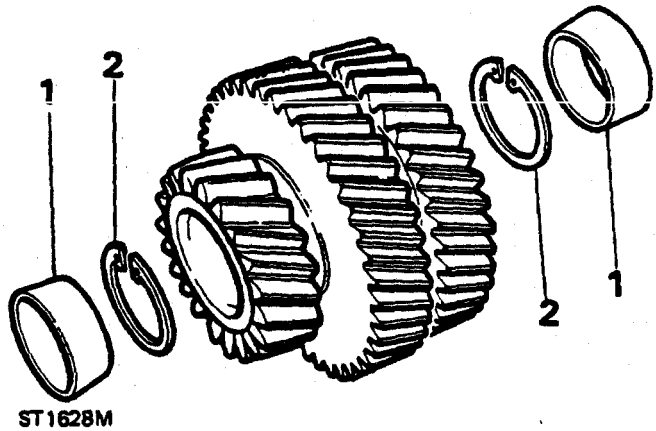


19. Tie a length of string to the split pin and fit it to the service tool as shown.
20. Attach a spring balance to the string and carefully tension the spring until a load to turn the input gear is obtained. A pull of 2,26 kg to 9 kg (5 **lb** to 20 lb) is required.

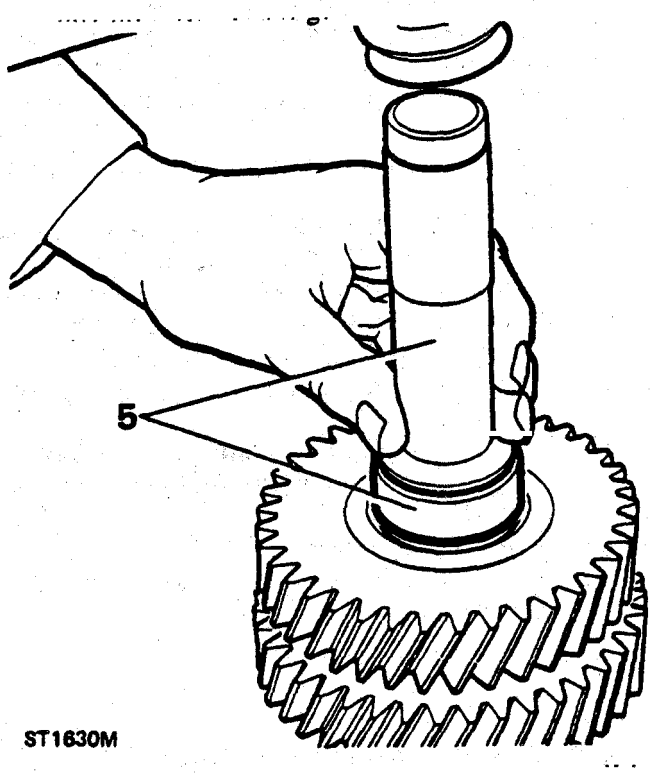
    NOTE: Alternatively using a suitable torque wrench applied to the nut on the service tool, torque to turn the input gear should be 0.56 to 2.25 Nm (5 to 20 in lb).
21. If the reading obtained is outside the above limits, the original shim must be changed.
22. Remove the spring balance, string and service tool.
23. Remove the six bolts and the bearing support plate.
24. Drift out the input gear bearing track from the support plate and discard original shim.
25. Select the correct size shim to obtain a load to turn of 2,26 kg to 9 kg **(5** lb to 20 **lb)** or torque to turn 0.56 to 2.25 Nm (5 to 20 inlb).
26. Fit shim to support plate, locate bearingtrack and press home.
27. Fit bearing support plate and secure to transfer box casing with the six bolts (do not tighten).
28. Repeat the rolling resistance check as previously described, and note the value obtained.

Intermediate gear assembly overhaul

1. Drift out intermediate gear bearing tracks.
2. Remove circlips.

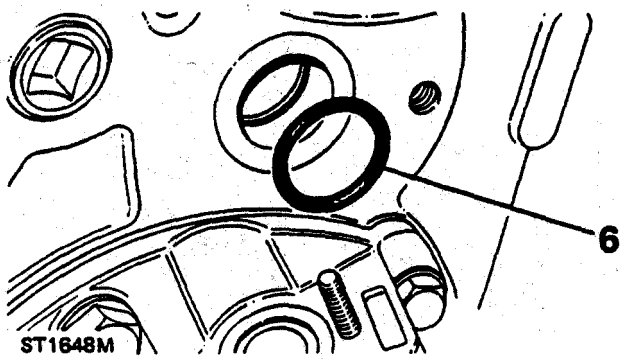


3. Clean all intermediate gear components and lock plate. Check for damage or wear and replace as necessary.
4. Fit new circlips into the intermediate gear cluster,
5. Using tools LST550 - 4 and MS550 fit bearing tracks into the intermediate gear cluster.



ST1630M

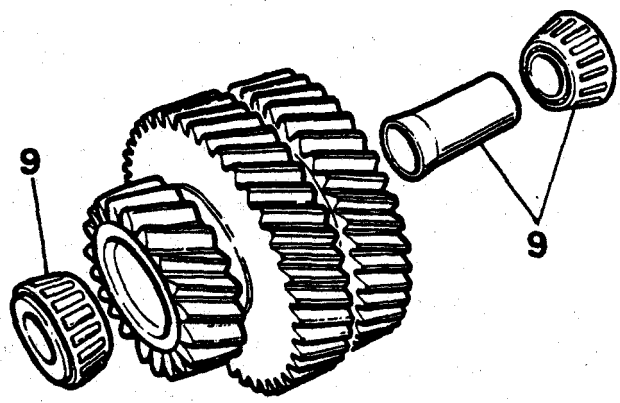
6. Fit the '0' rings to the intermediate shaft and into the intermediate shaft bore at the front of the transfer box casing.



ST1648M

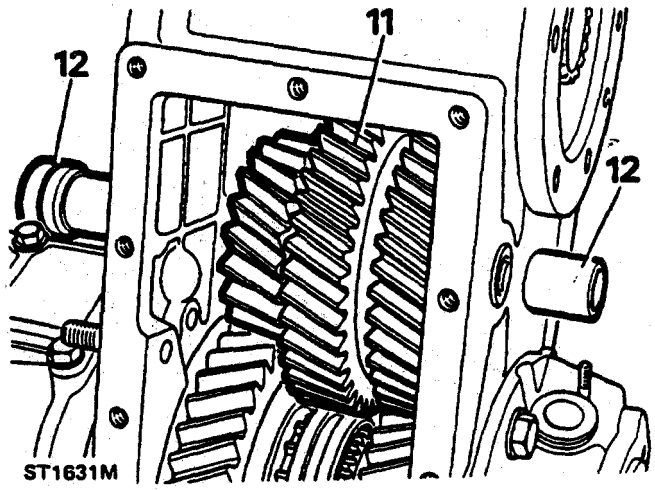
Intermediate gear reassembly

7. Check for damage to the intermediate shaft thread and if necessary clean up with a fine file or stone.
8. Lubricate the taper roller bearing and intermediate gear shaft.
9. Insert new bearing spacer to gear assembly, followed by the taper roller bearings.



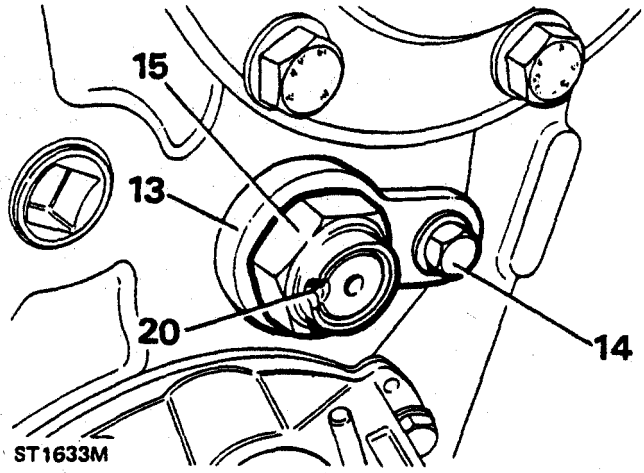
ST1649M

10. Fit dummy shaft LST104 into the intermediate gear cluster.
11. Locate the gear assembly into the transfer box casing from the bottom cover aperture.
12. Insert intermediate shaft from the front of the transfer box casing, pushing the dummy shaft right through as shown and remove. (Making sure that the intermediate gear cluster meshes with the input gear and high range and low range gears.)



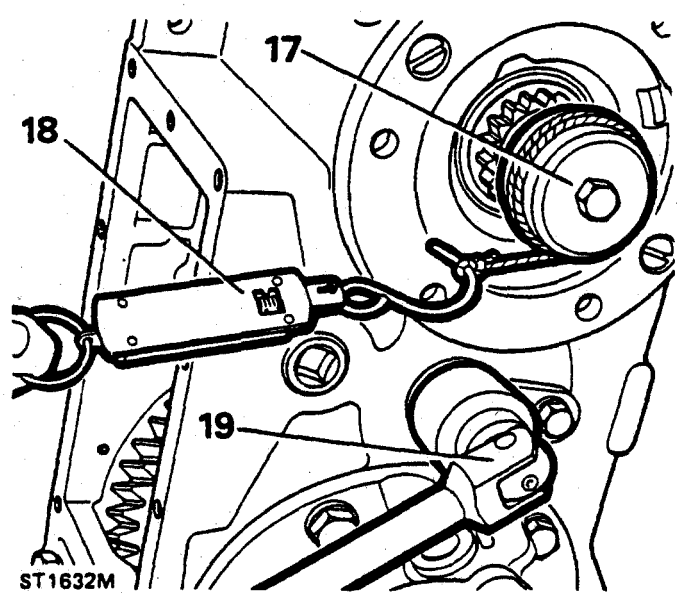
ST1631M

13. Turn the intermediate shaft to allow fitting of retaining plate.
14. Fit retaining plate and secure with retaining bolt and washer.
15. Fit the intermediate gear shaft retaining stake nut.



Adjusting intermediate gear torque - to - turn

16. Select neutral.
17. Fit service tool LST105 to input gear and engage spline.
18. Tie a length of string to a split pin and fit to the service tool as shown. Attach the spring balance to the string.
19. To obtain the correct figures and to collapse the spacer within the intermediate gear cluster, tighten the intermediate shaft nut until the load - to - turn has increased by **3,7**kg (7 lb) ± 1,63 kg (± 3 lb) on that noted when checking input shaft load - to - turn.



20. Peen the stake nut by carefully forming the collar of the nut into the intermediate shaft recess, as illustrated.

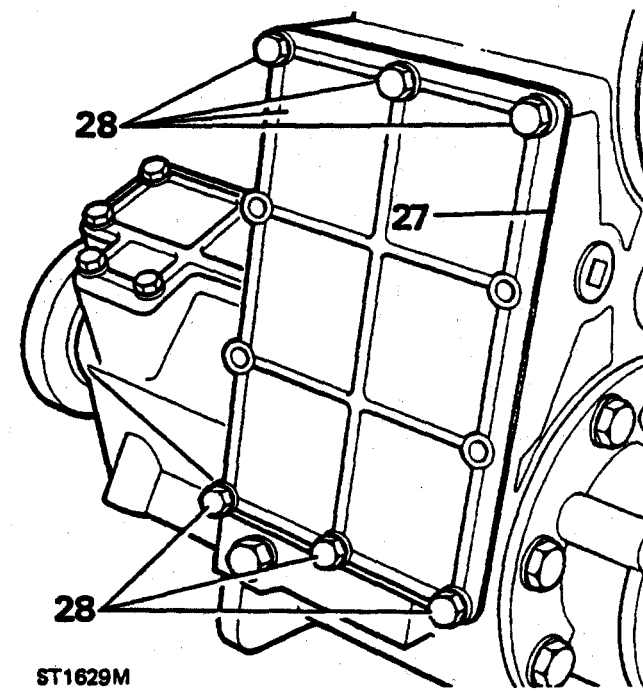
CAUTION: A round nose tool must be used for this operation to avoid splitting the collar of the nut.

Power take - off cover - reassemble

21. Clean power take - off cover and gasket face.
22. Fit the two countersunk screws and tighten.
23. Remove the six bolts from the bearing support plate.
24. Apply sealant to the cover plate gasket and fit it to the bearing support plate.
25. Apply Loctite 290 to bolt threads and secure the power take - off cover with the six bolts and washers.

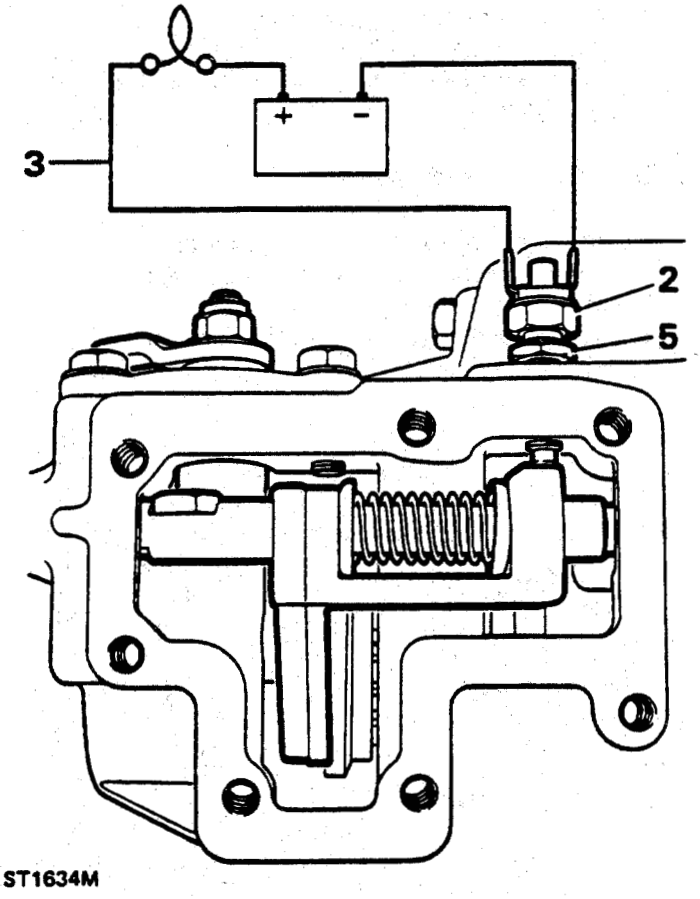
Bottom cover - reassemble

26. Clean bottom cover and gasket face.
27. Apply sealant to cover gasket and fit to transfer box casing.
28. Apply Loctite 290 to bolt threads and secure the bottom cover with six bolts and washers.



Differential lock switch adjustment

1. Select differential locked position by moving the lock taper towards the right side of the transfer box casing.
2. Apply sealant to the differential lock warning light switch and fit to the top of the front output housing.
3. Connect a test lamp circuit to the differential lock switch.
4. Screw in the lock switch until the bulb is illuminated.
5. Turn in the switch another half a turn and tighten with the locknut against the housing.



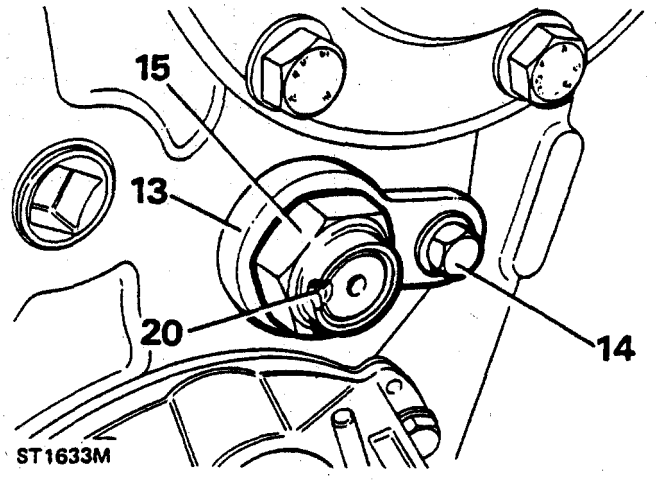
ST1634M

6. Disconnect the battery and move the differential lock lever to the left to disengage differential lock.
7. Clean the front output housing side cover.
8. Grease and fit side cover gasket.
9. Apply Loctite 290 to bolt threads, fit side cover and secure with seven bolts and washers.

Transmission brake drum - re-assemble.

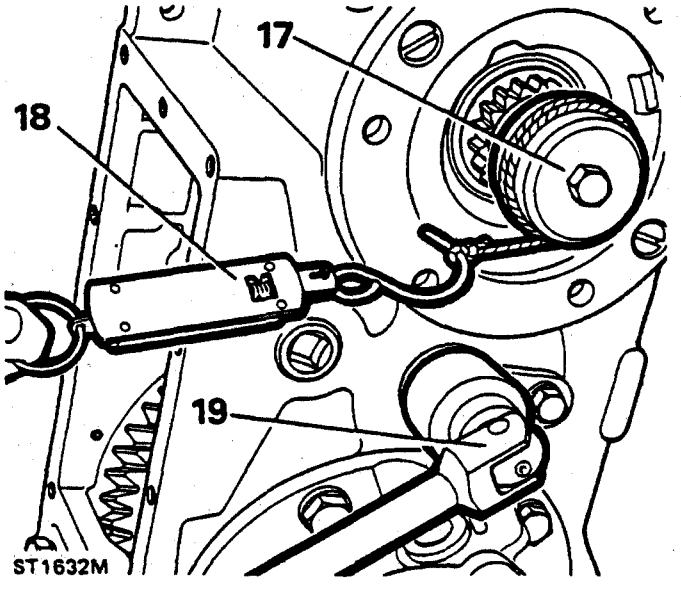
1. Clean brake backplate and oil catcher and apply sealant to the catcher joint face.
2. Locate brake backplate on the rear output housing with the brake operating lever on the right side of the transfer box casing.
3. Secure the backplate (including the oil catcher) with the four special bolts and tighten using a hexagonal socket to the specified torque.
4. Clean and fit brake drum and secure with two countersunk screws.

13. Turn the intermediate shaft to allow fitting of retaining plate.
14. Fit retaining plate and secure with retaining bolt and washer.
15. Fit the intermediate gear shaft retaining stake nut.



Adjusting intermediate gear torque - to - turn

16. Select neutral.
17. Fit service tool LST105 to input gear and engagespline.
18. Tie a length of string to a split pin and fit to the service tool as shown. Attach the spring balance to the string.
19. To obtain the correct figures and to collapse the spacer within the intermediate gear cluster, tighten the intermediate shaft nut until the load - to - turn has increased by 3,7 kg (7 lb) ± 1,63 kg (± 3 lb) on that noted when checking input shaft load - to - turn.



20. Peen the stake nut by carefully forming the collar of the nut into the intermediate shaft recess, as illustrated.

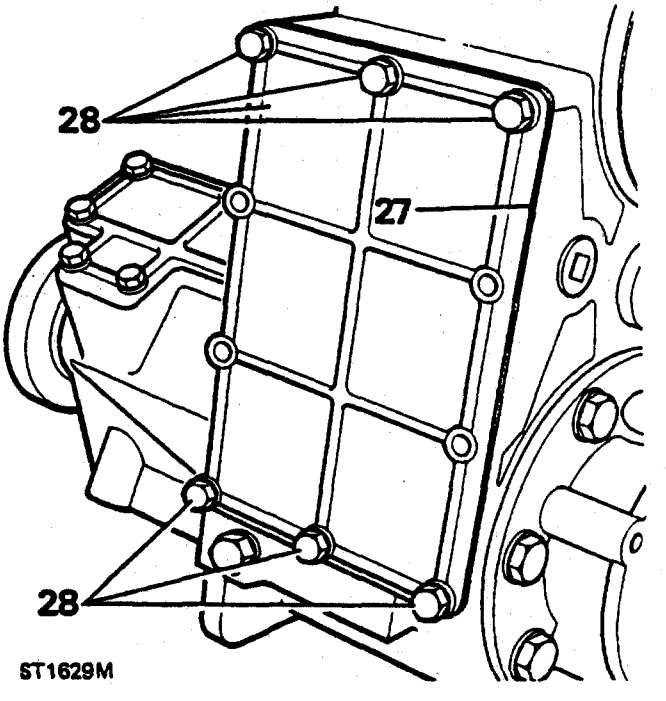
CAUTION: A round nose tool must be used for this operation to avoid splitting the collar of the nut.

Power take - off cover - reassemble

21. Clean power take - off cover and gasket face.
22. Fit the two countersunk screws and tighten.
23. Remove the six bolts from the bearing support plate.
24. Apply sealant to the cover plate gasket and fit it to the bearing support plate.
25. Apply Loctite 290 to bolt threads and secure the power take - off cover with the six bolts and washers.

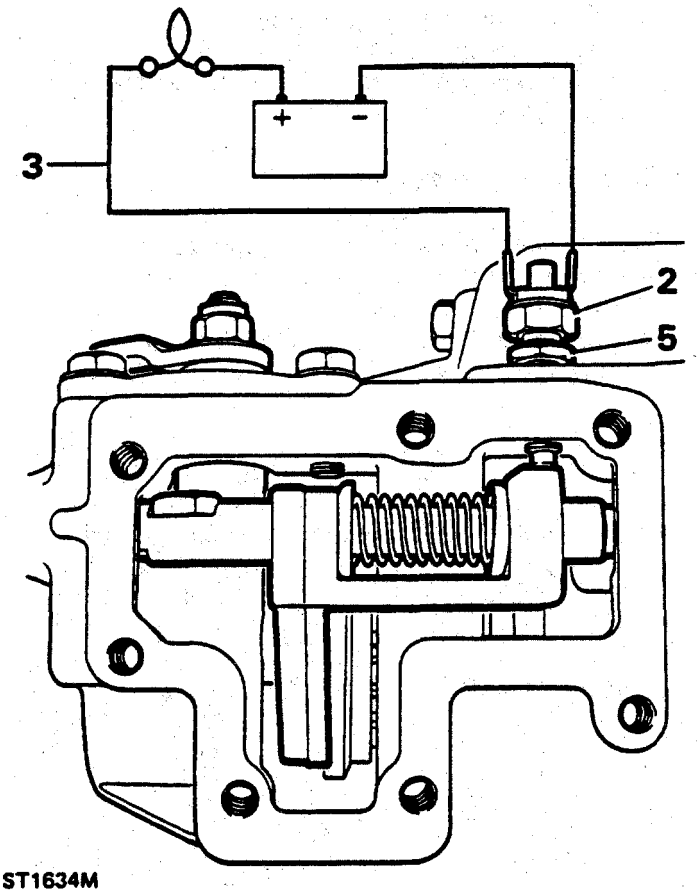
Bottom cover - reassemble

26. Clean bottom cover and gasket face.
27. Apply sealant to cover gasket and fit to transfer box casing.
28. Apply Loctite 290 to bolt threads and secure the bottom cover with six bolts and washers.



Differential lock switch adjustment

1. Select differential locked position by moving the lock taper towards the right side of the transfer box casing.
2. Apply sealant to the differential lock warning light switch and fit to the top of the front output housing.
3. Connect a test lamp circuit to the differential lock switch.
4. Screw in the lock switch until the bulb is illuminated.
5. Turn in the switch another half a turn and tighten with the locknut against the housing.



ST1634M

6. Disconnect the battery and move the differential lock lever to the left to disengage differential lock.
7. Clean the front output housing side cover.
8. Grease and fit side cover gasket.
9. Apply Loctite 290 to bolt threads, fit side cover and secure with seven bolts and washers.

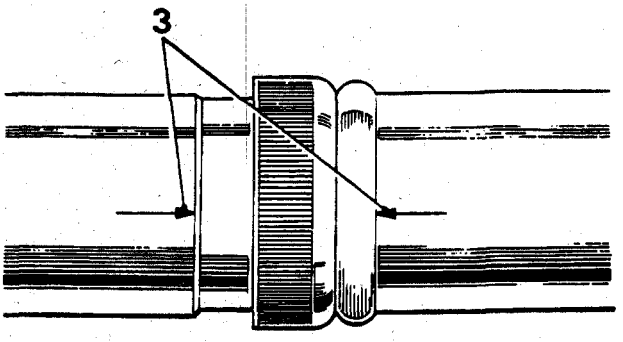
Transmission brake drum - re-assemble.

1. Clean brake backplate and oil catcher and apply sealant to the catcher joint face.
2. Locate brake backplate on the rear output housing with the brake operating lever on the right side of the transfer box casing.
3. Secure the backplate (including the oil catcher) with the four special bolts and tighten using a hexagonal socket to the specified torque.
4. Clean and fit brake drum and secure with two countersunk screws.

OVERHAUL PROPELLER SHAFTS

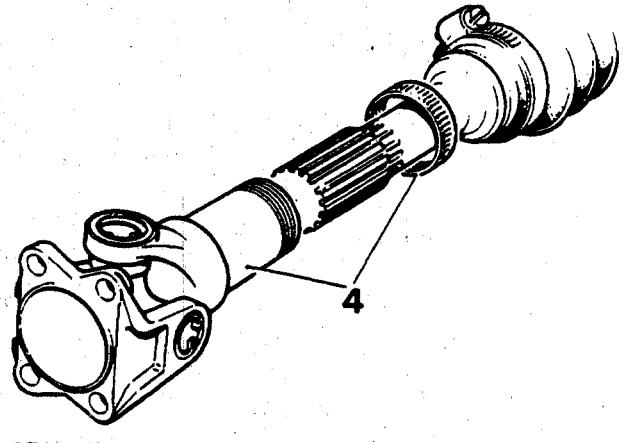
Dismantle

1. Remove the propeller shaft from the vehicle.
2. If a gaiter encloses the sliding member release the two securing clips. Slide the gaiter along the shaft to expose the sliding member.
3. Note the alignment markings on the sliding member and the propeller shaft. See **NOTE** following instruction 22.



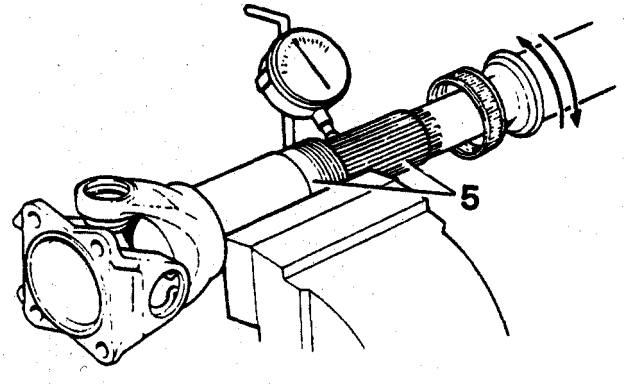
ST1000M

4. Unscrew the dust cap and withdraw the sliding member.



ST1001M

5. Clean and examine the splines for wear. Worn splines or excessive back-lash will necessitate propeller shaft renewal.

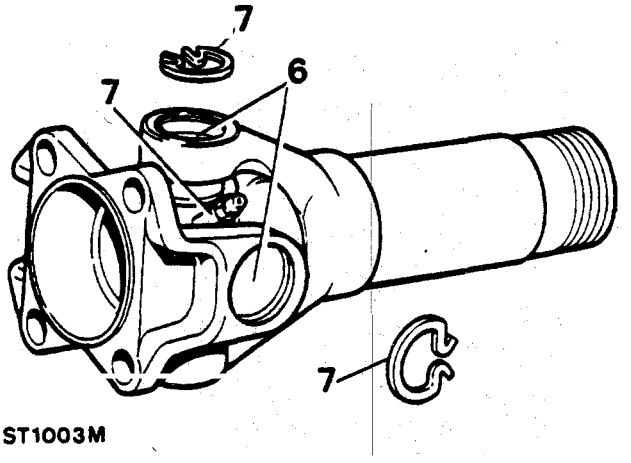


ST1002M

6. Remove paint, rust, etc. from the vicinity of the universal joint bearing cups and circlips.

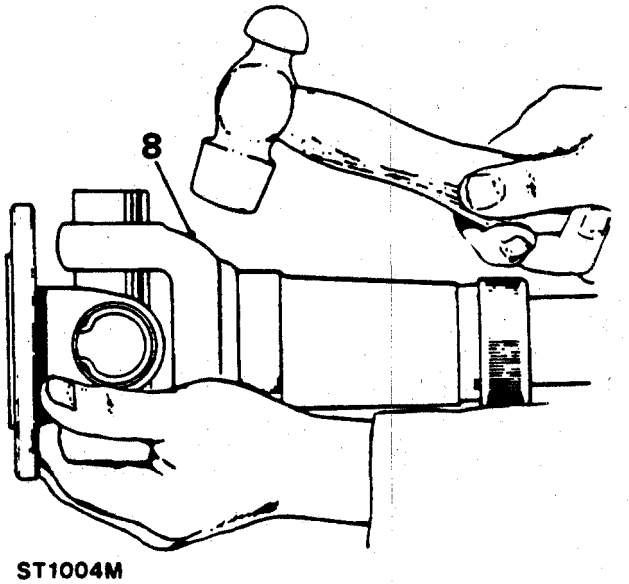
NOTE: Before dismantling the propeller shaft joint, mark the position of the spider pin lubricator relative to the journal yoke ears to ensure that the grease nipple boss is re-assembled in the correct running position to reduce the possibility of imbalance.

7. Remove the circlips, and grease nipple.



ST1003M

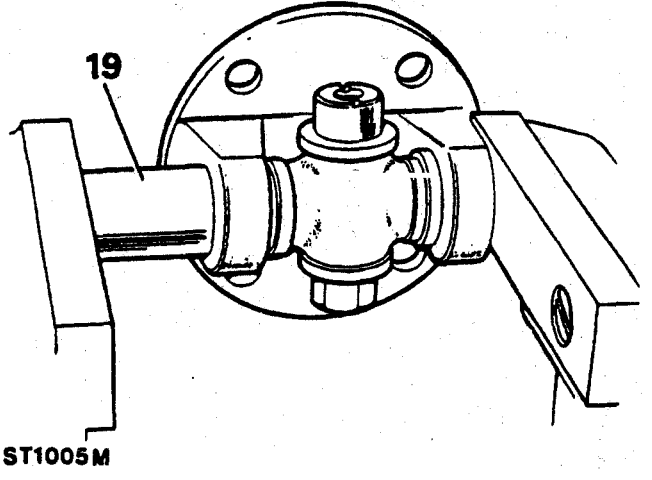
8. Tap the yokes to eject the bearing cups.
9. Withdraw the bearing cups and spider and discard.
10. Repeat instructions 5 to 8 at opposite end of propeller shaft.
11. Thoroughly clean the yokes and bearing cup locations.



ST1004M

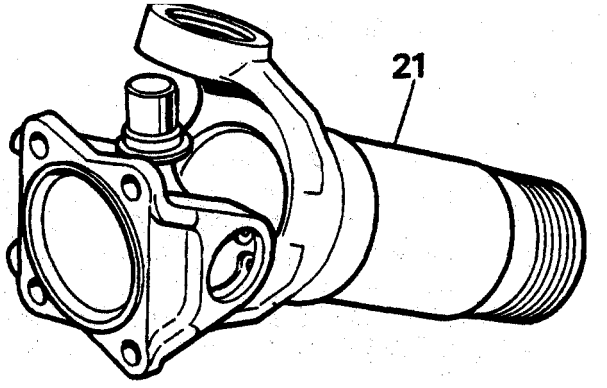
Assemble

12. Remove the bearing cups from the new spider.
13. Check that all needle rollers are present and are properly positioned in the bearing cups.
14. Ensure bearing cups are one third full of fresh lubricant. See **"RECOMMENDED LUBRICANTS".**
15. Enter the new spider complete with seals into the yokes of the sliding member flange. Ensure that the grease nipple hole faces away from the flange.
16. Partially insert one bearing cup into a flange yoke and enter the spider trunnion into the bearing cup taking care not to dislodge the needle rollers.
17. Insert the opposite bearing cup into the flange yoke. Using a vice, carefully press both cups into place taking care to engage the spider trunnion without dislodging the needle rollers.
18. Remove the flange and spider from the vice.
19. Using a flat faced adaptor of slightly smaller diameter than the bearing cups press each cup into its respective yoke until they reach the lower land of the circlip grooves. Do not press the bearing cups below this point or damage may be caused to the cups and seals.



ST1005M

20. Fit the circlips.
21. Engage the spider in the yokes of the sliding member. Fit the bearing cups and circlips as described in instructions 15 to 20.

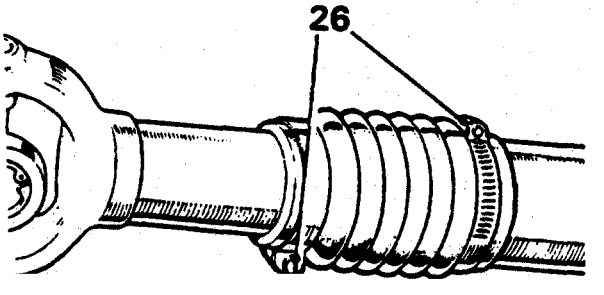


ST1006M

22. Lubricate the sliding member spines and fit the sliding member to the propeller shaft ensuring that the markings on both the sliding member and propeller shaft align.

NOTE: The Universal joints on the front propeller shaft are, by design, not assembled in-line with one another. Nevertheless, the alignment marks on the sliding member and propeller shaft must coincide when assembling.

23. Fit and tighten the dust cap.
24. Fit the grease nipples to the spider and the sliding member and lubricate.
25. Slide the gaiter (if fitted) over the sliding member.
26. Locate the sliding member in the mid-position of its travel and secure the gaiter clips. Note that the gaiter clips must be positioned at 180° to each other so that they will not influence propeller shaft balance.



ST1007M

27. Apply instructions 15 to 20 to the opposite end of the propeller shaft.
28. Fit the grease nipple and lubricate.
29. Fit the propeller shaft to the vehicle.

REAR HUBS

REMOVE AND OVERHAUL

Special tools:

Oil seal replacer L.R.T.-550-5
Drift for seal replacer M.S. 550 or 18G134 L.R.T.-99-003
Hub nut spanner RO 606435A L.R.T.54-002

Remove

1. Jack-up the vehicle, lower onto axle stands and remove the road wheels.
2. Remove the two brake drum retaining screws and withdraw the brake drum. If necessary, slacken the brake adjuster to facilitate removal.
3. Prise-off the hub cap.
4. Remove the circlip.
5. Remove the five bolts and withdraw the hub driving member and joint washer.
6. Prise-up the lock washer and remove the outer locknut and inner adjusting nut.
7. Withdraw the hub complete with with the inner and outer seals, seal track spacer, and inner and outer taper roller bearings.
8. If the stub axle is damaged or scored remove and discard it by removing the six brake back plate retaining nuts and bolts.

Overhaul hub

9. Remove the seal track spacer and outer seal.
10. Remove the outer bearing cone.
11. Remove the inner seal and bearing cone.
12. If new bearings are to be fitted drift or press out the old cups.
13. Degrease and examine the hub for cracks and damage and renew if necessary. Renew hub if wheel studs are faulty.

Assemble

14. If removed, fit the stub axle to the axle casing with a new joint washer and secure with the six nuts and bolts and tighten to the correct torque.
15. Fit new inner and outer bearing cups to the hub, ensuring that they are drifted or pressed squarely into position.
16. Fit the inner bearing cone and pack with one of the recommended hub greases.

Fitting inner oil seal

17. Clean the hub oil seal housing and ensure that the seal locating surface is smooth and the chamfer on the leading edge is also smooth and free from burrs.
18. Examine the new seal and ensure that it is clean, undamaged and that the garter spring is properly located. Even a small scratch on the seal lip could impair its efficiency.
19. Although the new seal is already pre-greased by the manufacturer, apply one of the recommended hub bearing greases to the outside diameter of the seal, before fitting, taking care not to damage the lip.
20. Place the seal, lip side leading, squarely on the hub and using the 76 mm end of seal replacer tool L.S.T.-550-5 and drift 550 or 18G 134 drive the seal into position to the depth determined by the tool.

Fitting outer oil seal

21. Fit the new outer bearing cone and pack with one of the recommended hub greases.
22. Carry out instructions 17 to 19 but insert the seal with the lip side trailing.
23. Place the seal, lip side leading, squarely on the hub and using the 72 mm end of seal replacer tool LS.T. **550-5** and drift 550 or 18 G 134, drive the seal into position to the depth determined by the tool.

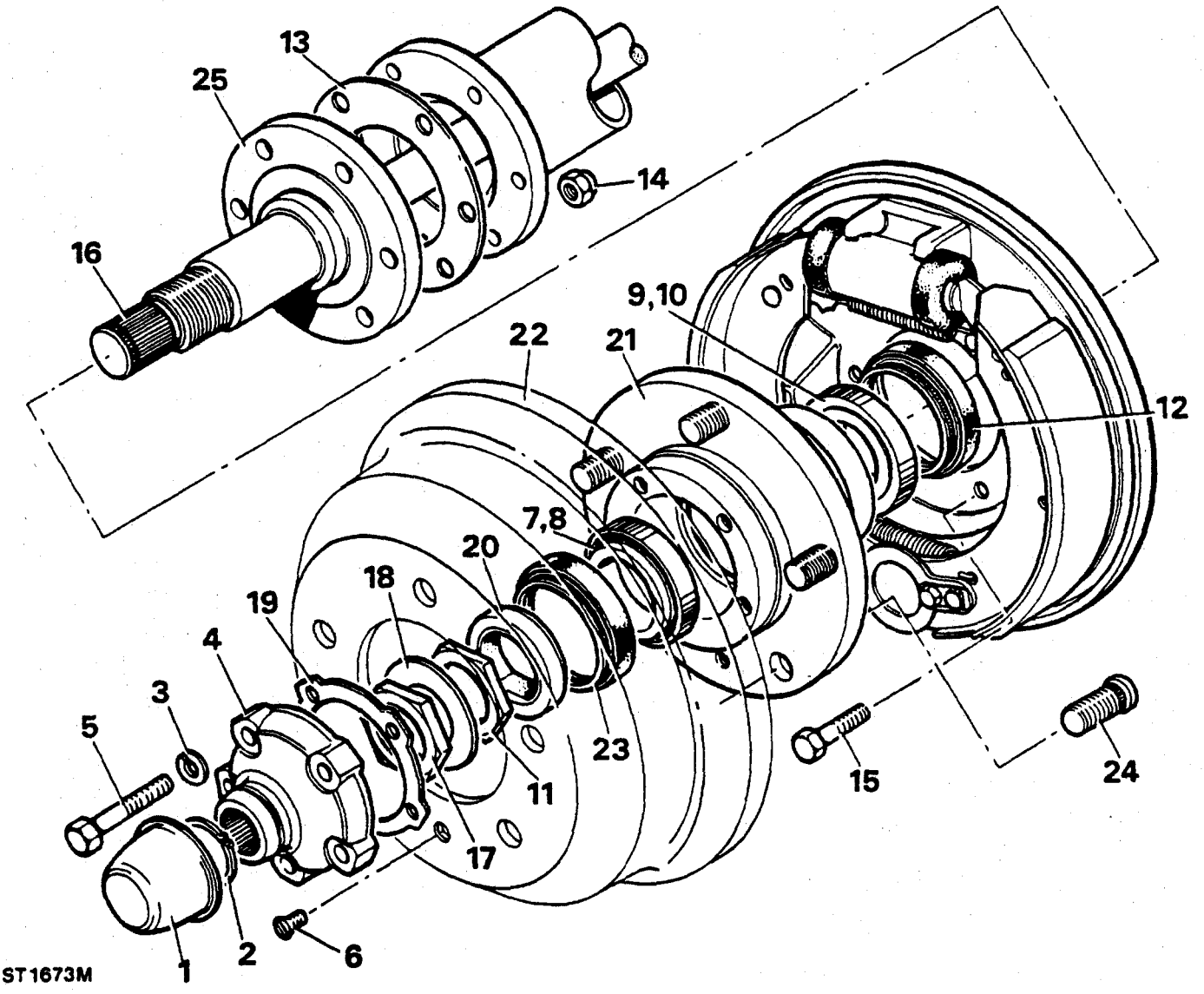
Fitting hub to stub axle

24. Smear the lips of both seals with one of the recommended greases. This is important since a dry seal can be destroyed during the first few revolutions of the hub.
25. Select a new seal track spacer and check that the outer diameter is smooth and free from blemishes and that there are no burrs on the chamfered leading edge.
26. Taking care not to damage the seal lips fit the hub assembly to the stub axle. Do not allow the weight of the hub to rest, even temporarily, on the outer seal otherwise damage and distortion could occur. Therefore hold the hub clear of the stub axle until the seal track spacer is fitted.
27. Carefully fit the seal track spacer, seal lip leading.

NOTE: Instruction 28 is applicable to hubs that have been fitted with new components throughout. If original components are being refitted instruction 29 must be fallowed using the adjustment nut to achieve the required end-float.

28. Fit the hub inner nut and using wrench RO 606435 tighten the adjusting nut while slowly revolving the hub to seat the bearings and to remove all end-float, back-off the nut approximately half a turn and retighten the nut to 13-15 lb in which will automatically allow for compression of the rubber on the new seal track spacer giving the required hub end-float of 0.013 to 0.10 mm.
29. If the rubber on the seal track spacer has previously been compressed the hub end-float can be checked by mounting a dial indicator and bracket on the hub so that the trace pin rests in a preloaded condition on the nut. Rotate the hub to settle the bearings and check the end-float by pushing and pulling the hub. End-float must fall within the limits given in the previous instruction.
30. Fit a new lock washer and locknut. Restraining the inner adjustment nut, tighten the outer lock nut to 95 to 108 Nm.
31. If original components have been refitted rotate the hub several times to settle the bearings then recheck the end-float, refer to previous note and instruction 29.
32. Bend one segment of the locker washer over the adjusting nut and another, diametrically opposite, over the locknut.
33. Using a new joint washer, fit the hub driving member and secure with the five bolts and tighten evenly to the correct torque.
34. Fit the circlip to the axle shaft ensuring that it is properly seated in the groove.
35. Fit the hub cap.
36. Fit the road wheels and secure with the nuts. Jack-up the vehicle, remove axle stands and lower vehicle to ground. Finally tighten the road wheel nuts to the correct torque.

KEY TO REAR HUB COMPONENTS



1. Hubcap.
2. Circlip.
3. Spring washer. hub driving member bolt.
4. Hub driving member.
5. Hub driving member bolts.
6. Brake drum retaining screws.
7. Outer bearing cone.
8. Outer bearing cup.
9. Inner bearing cup.
10. Inner bearing cone.
11. End-float adjusting nut.
12. Inner oil seal.
13. Joint washer,
14. Locknut
15. Bolt.
15. Locknut.
16. Axle shaft
17. Locknut.
18. Lock washer.
19. Joint washer.
20. Seal track spacer.
21. Hub casting.
22. Brake drum.
23. Outer oil seal.
24. Road wheel stud.
25. Stub axle.

OVERHAUL REAR AXLE DIFFERENTIAL ASSEMBLY (SALISBURY) ONE TEN MODELS

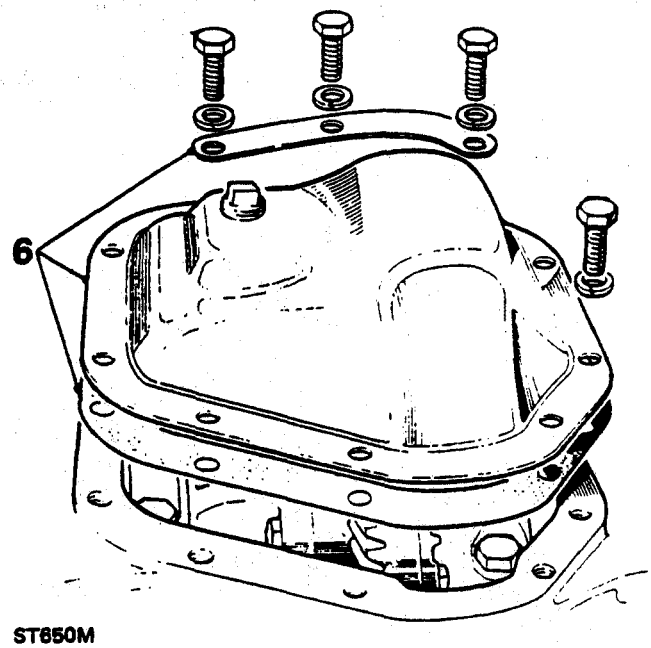
Service tools:

M.S. 47/LRT-99-002 Screw press.
18G 131 C/LRT-51-503 Axle spreader or axle compressor GKN 131.
18G 191 dial gauge, bracket and base.
18G 1122 / LRT-99-502 Screw press.
18G 1205 / LRT-51-003 Spanner for drive coupling.
S 123 A / LRT-51-502 Pinion bearing cup remover.
18G 47 BK / LRT-51-500 pinion bearing cone remover/replacer.
18G 47 BL / LRT-51-5-1 differential bearing remover.
18G 1122 G / LRT-51-502 Pinion bearing cup replacer.
18G 134 DP / LRT-51-504 Differential bearing replacer.
18G 191-4 / LRT-54-503 Universal setting block.
18G 131 F pegs for axle spreader.
RO 1008 / LRT-51-002 Oil seal replacer

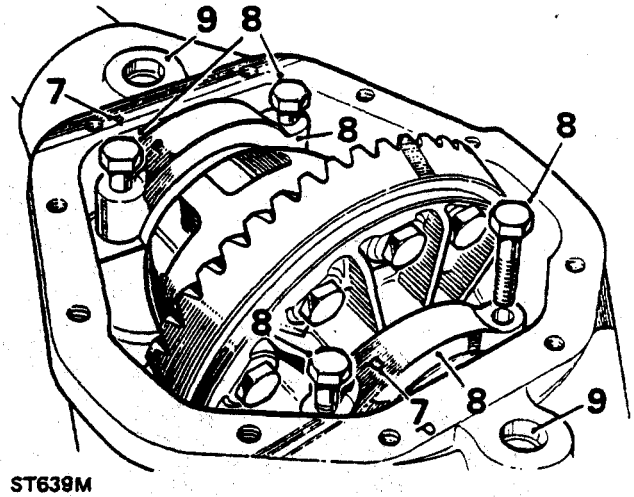
DISMANTLE

NOTE: All fixing bolts used on the differential assembly and differential cover have metric threads.

1. Drain off the differential lubricating oil, and refit plug.
2. Remove the rear axle assembly from the vehicle.
3. Remove the hub driving member fixings.
4. Withdraw the driving member and axle shaft sufficiently to disengage the differential.
5. Repeat instruction 4 for the other axle shaft.
6. Remove the fixings and support strip at the differential cover and withdraw the cover and joint washer.
7. Note the relationship marking on the bearing caps and axle casing to ensure correct refitting.
8. Remove the fixings and withdraw the differential bearing caps.



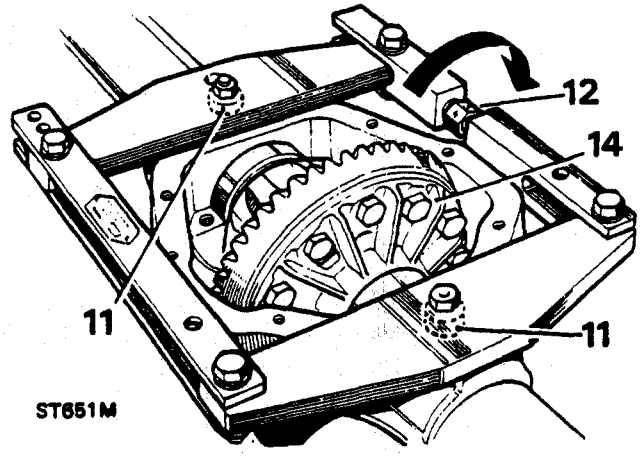
ST650M



ST639M

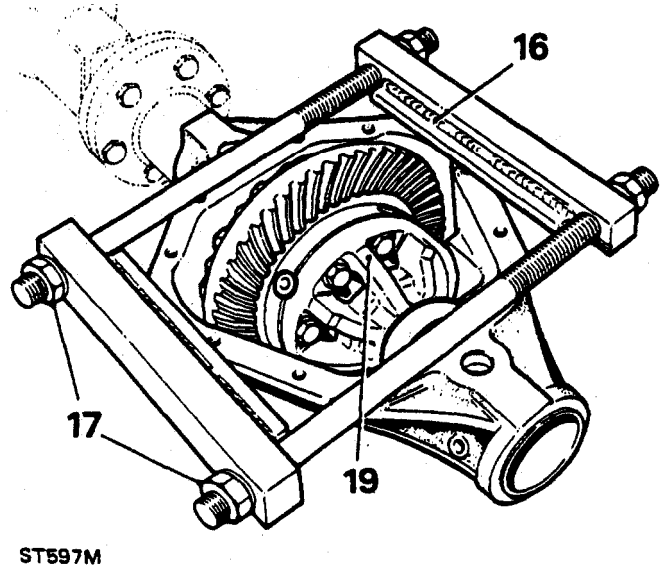
CAUTION: To prevent permanent damage to the gear carrier case, it must not be over-stretched. Each flat on the turnbuckle is numbered to enable a check to be made on the amount turned. The maximum stretch permitted is *0,30* mm, equivalent to three flats.

15. Ease off the adjuster and remove the spreader.



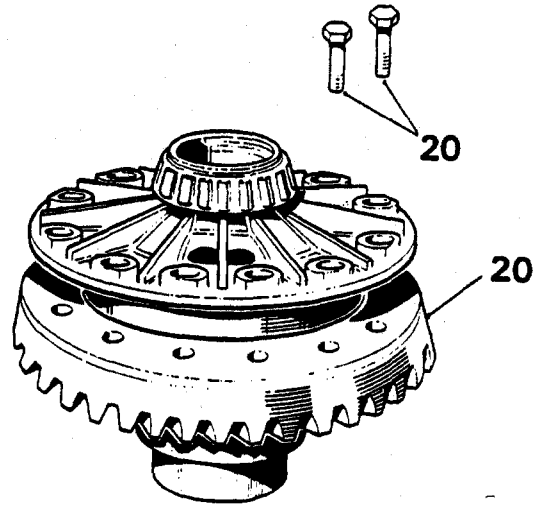
Using axle compressor GKN 131

16. Place the tool on to the differential casing, as illustrated, with the weld seam uppermost. Ensure that the plates rest squarely on the differential machined surface and the end bars butt against the edges of the casing.
17. Tighten the adjusting nuts by hand only, until all slack is taken up.
18. Continue to tighten both nuts alternately with a spanner, one flat at a time, to a maximum of three flats.
19. Carefully lever-out the differential assembly.

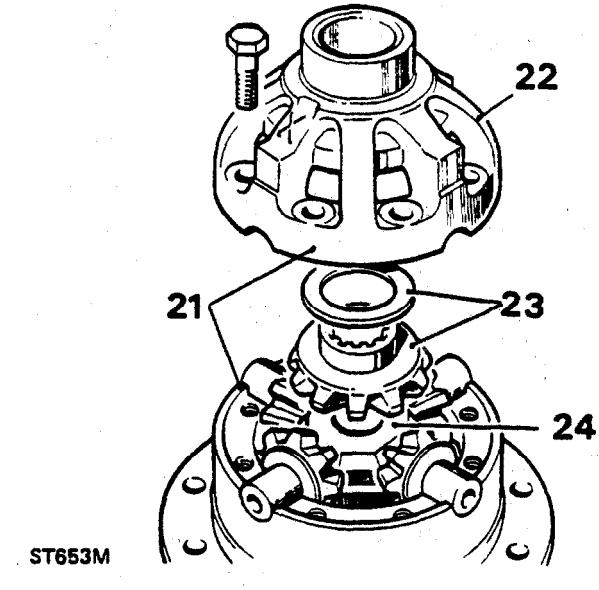


Dismantle differential

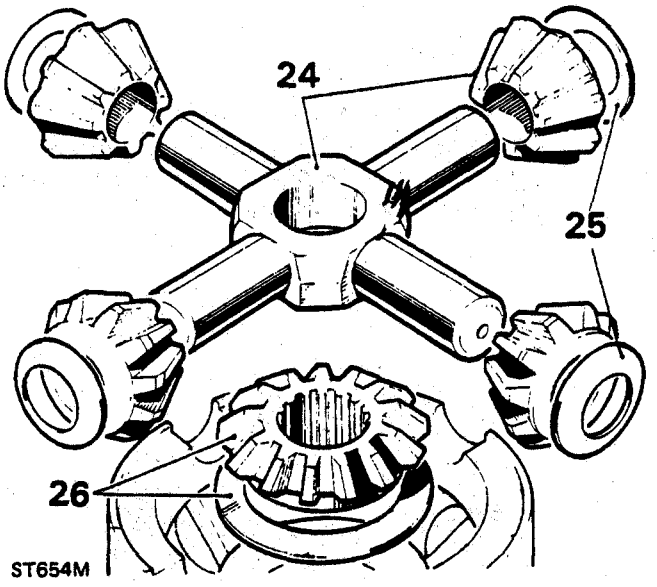
20. Add alignment marks between the crown wheel and the differential case for reassembly purposes, then remove the fixings and withdraw the crown wheel.



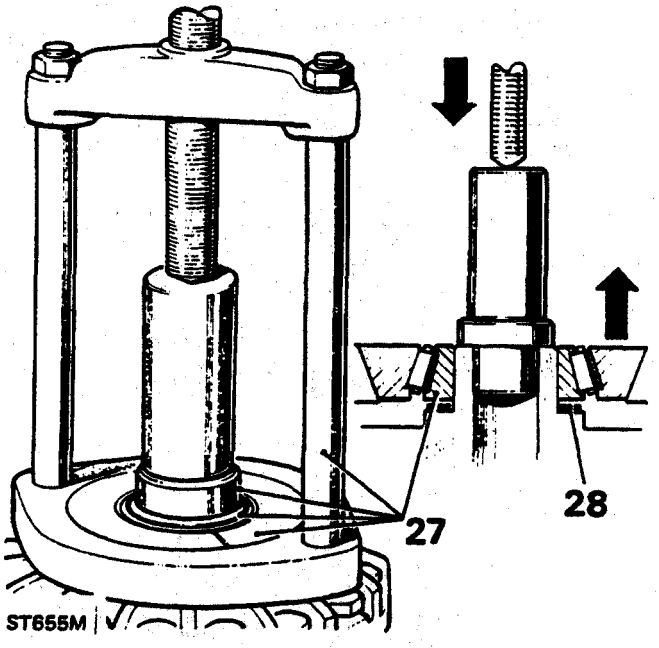
21. Note the alignment markings on the two differential casings to ensure correct refitting, then remove the fixings.
22. Lift off the upper case.
23. Withdraw the upper differential wheel and thrust washer.



24. Lift out the cross-shaft and pinions.
25. Withdraw the four dished thrust washers.
26. Withdraw the lower differential wheel and thrust washer.

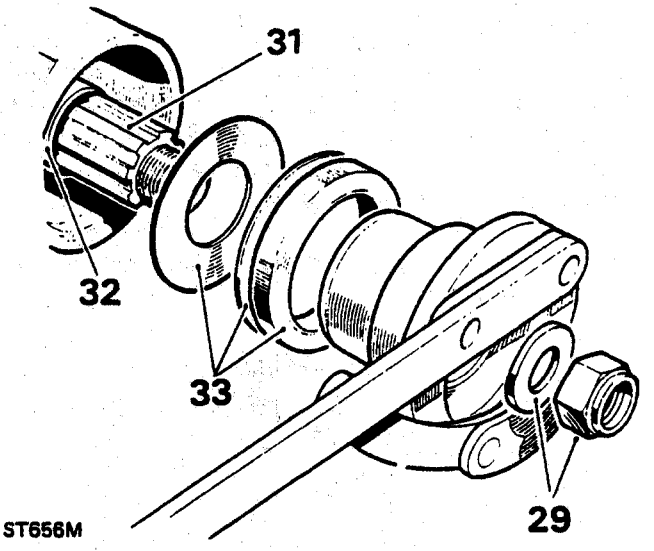


27. Remove the differential bearing cones using remover 18G 47 BL and adaptors 1 and 2 and press M.S. 47.
28. Withdraw the shim washers fitted between the bearing cones and the differential casings.

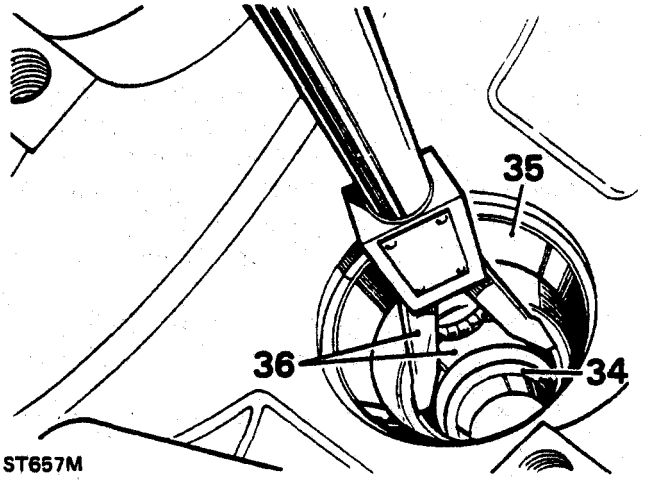


Remove final drive pinion

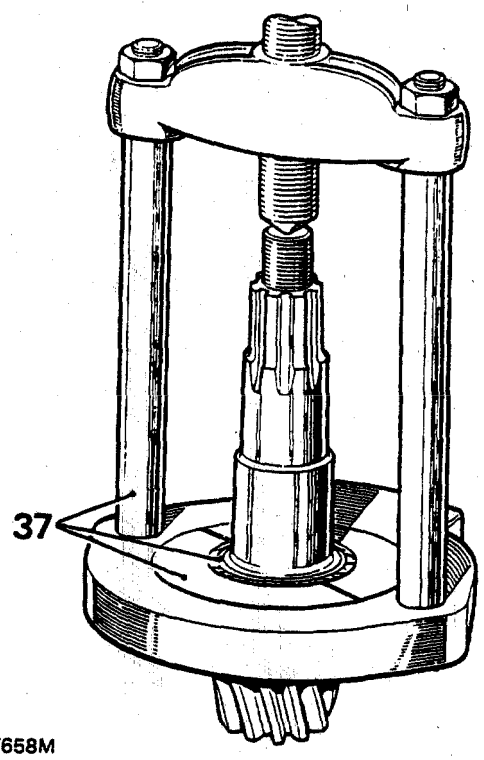
29. Prevent the coupling flange from rotating and remove the flange locknut and plain washer using tool 18G 1205.
30. Support the drive pinion and remove the coupling flange by tapping with a hide hammer.
31. Withdraw the drive pinion together with the inner bearing cone.
32. Withdraw and discard the collapsible bearing spacer.
33. Withdraw the oil seal, gasket and oil thrower.



34. Withdraw the outer bearing cone.
35. Extract the pinion inner bearing cup and shim washers from the casing. Note the shim washer thickness using remover S 123 A.
36. Extract the pinion outer bearing cup from the casing using remover S 123 A.



37. Remove the inner bearing cone from the pinion, using remover 18G 47 BK and press M.S. 47.



ST658M

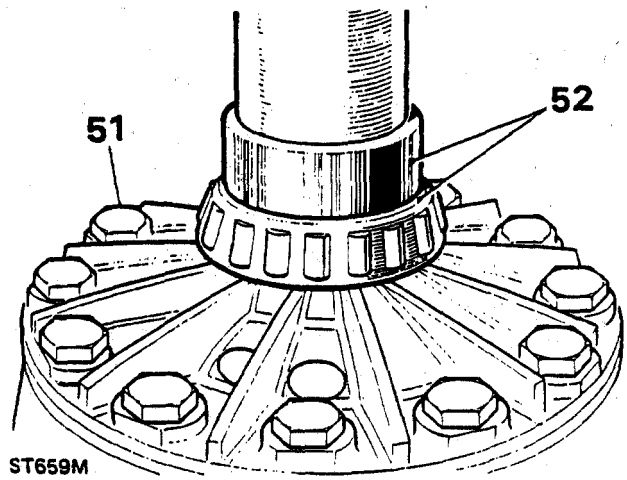
INSPECTION

38. Examine all components for obvious wear or damage.
39. The bearing cones must be a press fit on their locations, except the drive pinion flange and bearing which is a slide fit.
40. The crown wheel and pinion are supplied as a matched pair and must not be interchanged separately.
    A new crown wheel and pinion matched pair may be fitted to an original gear carrier casing if sound. The original crown wheel and pinion, if sound, may be fitted into a replacement casing.
41. The two parts of the differential unit casing are matched and must not be replaced separately.
42. Discard and renew all thrust washers.
43. Differential housings with worn thrust washer seatings must be replaced as a pair.
44. Examine the differential case to crown wheel joint face for burrs and damage which could lead to crown wheel run-out when fitted.

ASSEMBLE

Assemble differential unit

45. Fit the differential lower wheel and thrust washer to the differential case. See illustration following instruction 23.
46. Fit the dished thrust washers.
47. Fit the cross-shaft and pinions.
48. Fit the differential upper wheel and thrust washer.
49. Fit the differential upper case lining-up the
50. Secure the assembly with bolts using Loctite 'Studlock' grade CVX on the threads and tighten evenly and diametrically to 89 to 101 Nm.
51. Fit the crown wheel to the differential casing. Use Loctite 'Studlock' grade CVX on the fixing bolt threads and tighten to the correct torque.
52. Press on the differential roller bearing cones less him washers, using 18G 134 DP, and leave to one side until required for instruction 96.
53. Fit the bearing cups to the differential.
54. Fit the differential unit and bearings to the gear carrier casing, and rotate unit to centralize the bearings. Do not fit the bearing caps.

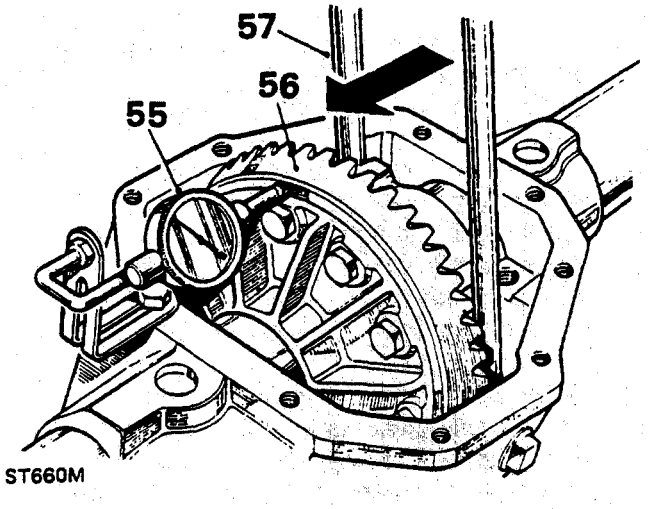


ST659M

55. Position a suitable dial gauge indicator on the casing with the stylus registering on the back face of the crown wheel.
56. Rotate the differential and check the total indicated run-out on the crown wheel back face. This must not exceed 0,05 mm. If run-out is excessive, check the mating faces for dirt and damage: **if** necessary, select a new radial position for the crown wheel. When satisfactory, continue with the following check.

Differential bearing adjustment

57. Insert two levers between the casing and the differential unit at one side.
58. Move the differential unit fully to one side of the casing; do not tilt the unit.
59. Rotate the differential unit to settle the bearings, continue to lever the differential to the side, then zero the dial gauge indicator.
60. Lever the assembly fully to the other side of the casing, rotate the unit to settle the bearings, then note the total indicator reading.

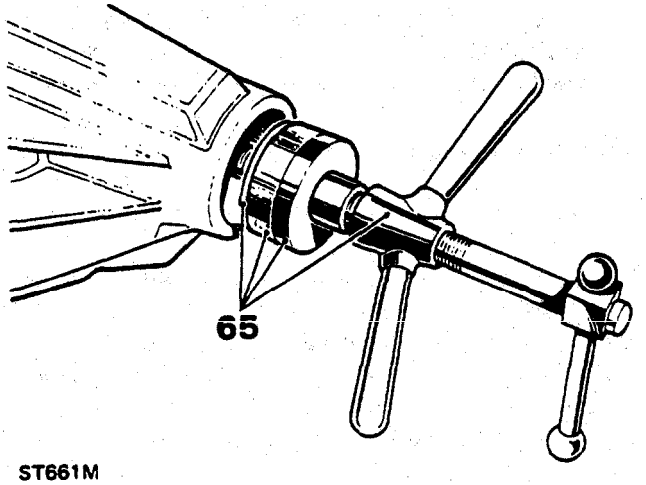


ST660M

61. Add 0,127 mm, for bearing pre-load, to the total noted in the preceding instruction. The sum is then equal to the nominal value of shims required for the differential bearings: Shims are available in the range 0,07 mm, 0,12 mm, 0,25 mm and **0,76**mm. Select the total value of shims required.
62. Remove the differential unit and bearings and place aside. Do not fit the shim washers until the subsequent 'Differential backlash' checks have been made, instructions 96 to 102.

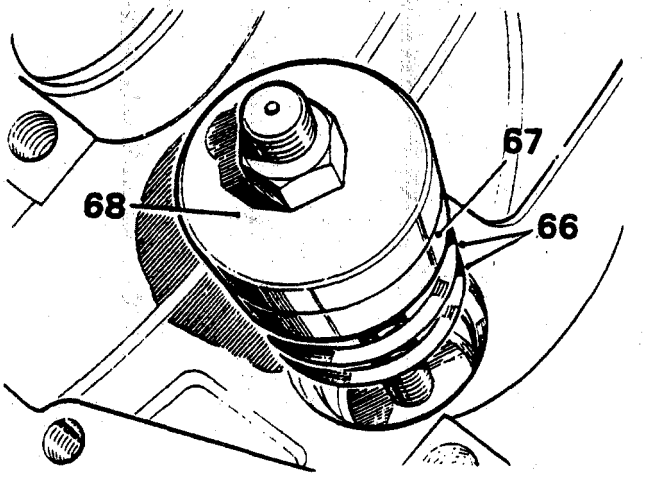
Fit drive pinion

63. Select shim washers of the same thickness value as those removed from under the pinion inner cup, instruction 35, and place ready for fitting,
64. Position the outer bearing replacer 18G 1122 G detail 2, and the outer bearing cup en the press tool 18G 1122.
65. Locate the assembly into the pinion housing nose.



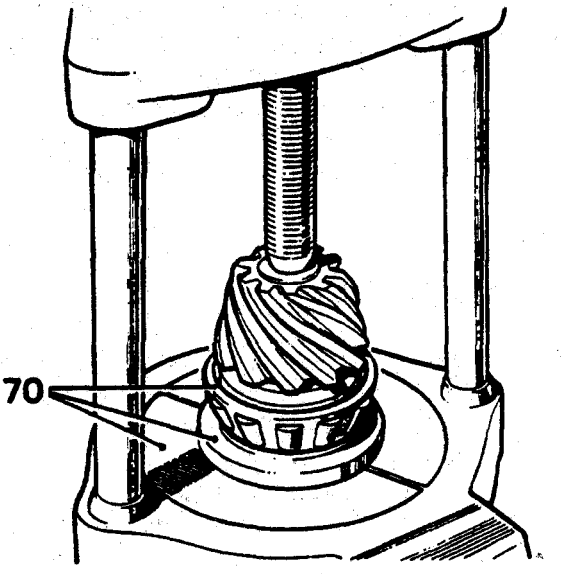
ST661M

66. Place the selected shim washers on to the inner bearing cup seating.
67. Position **the** inner bearing cup in **the** casing.
68. Position the inner bearing replacer 18G 1122 G detail 1, onto 18G 1122 and secure with the fixing nut.
69. Hold still the centre screw and turn the butterfly lever to draw in the bearing cups.



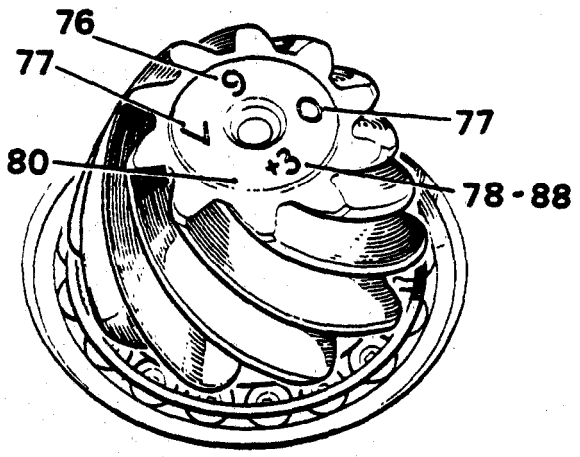
ST662M

70. Press the inner bearing cone onto the drive pinion using 18G 47 BK, details 1 and 2 and press MS 47.
71. Position the pinion and bearing in the casing; omit the collapsible spacer at this stage.
72. Fit the outer bearing cone onto the pinion.
73. Fit the coupling flange and plain washer and loosely fit the flange nut.
74. Tighten the coupling flange locknut to remove end-float from the pinion.
75. Rotate the pinion to settle the bearings and slowly tighten the flange locknut. Use a spring balance to obtain a torque resistance of 9,25 to 13,8 kgf cm. to rotate the pinion.



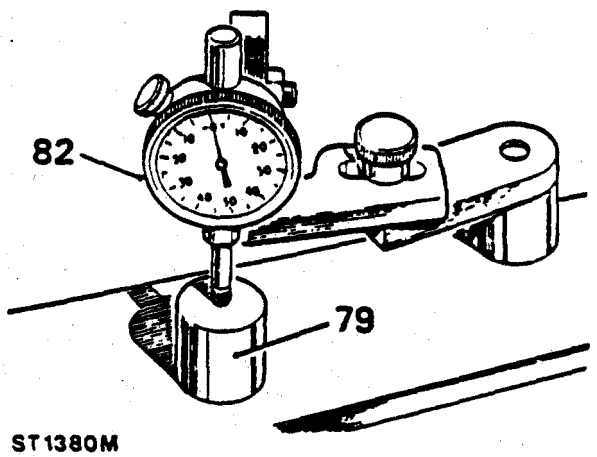
Drive pinion markings

76. Check that the serial number marked on the pinion end face matches that marked on the crown wheel.
77. The markings on the end face adjacent to the serial number are of no significance during servicing.
78. The figure marked on the end face opposite to the serial number indicates, in thousandths of an inch, the deviation from nominal required to correctly set the pinion. A pinion marked plus (+) must be set below nominal, a minus (-) pinion must be set above nominal. An unmarked pinion must be set at nominal.



ST649M

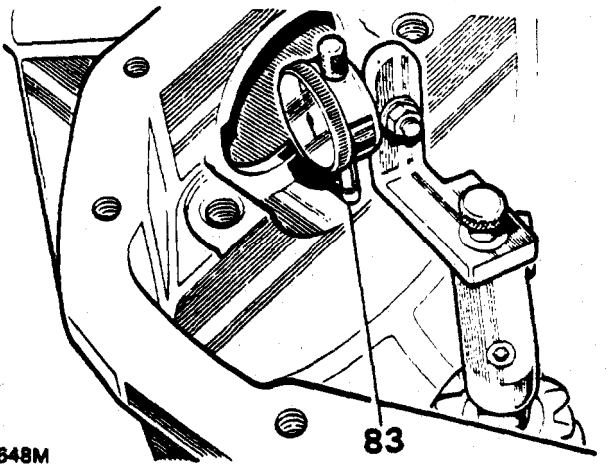
79. The nominal setting dimension is represented by the setting gauge block 18G191P or 18G191-4, which is referenced from the pinion end face to the bottom radius of the differential bearing bore. The latter gauge is illustrated following instruction 85.



ST1380M

Drive pinion adjustment

80. Ensure that the pinion end face is free of raised burrs around the etched markings.
81. Remove the keep disc from the magnetized base of dial gauge tool 18G191
82. Place the dial gauge and setting gauge 18G191P or 18G191-4 on a fiat surface and zero the dial gauge stylus on to the setting gauge.
83. Position the dial gauge centrally on the pinion end face with the stylus registering on the lowest point on one differential bearing bore. Note the dial gauge deviation from the zeroed setting.
84. Repeat on the other bearing bore. Add together the readings, then halve the sum to obtain the mean reading. Note whether the stylus has moved up or down from the zeroed setting.



ST648M

Example 1

Reading obtained L H side	+ 0.006in
Reading obtained R H side	- 0.003in

Add	+ 0.006in
	- 0.003in
	+ 0.003in

Divide by 2 (0.003in divided by 2)= 0.0015in

Therefore subtract 0.0015in from the shim thickness behind the pinion inner bearing track

Example 2

Reading obtained L H side	+ 0.006in
Reading obtained R H side	- 0.008in

Add	+ 0.006in
	- 0.008in
	- 0.002in

Divide by 2 (0.002in divided by **2)=** 0.001in

Therefore add 0.001in from the shim thickness behind the pinion inner bearing track

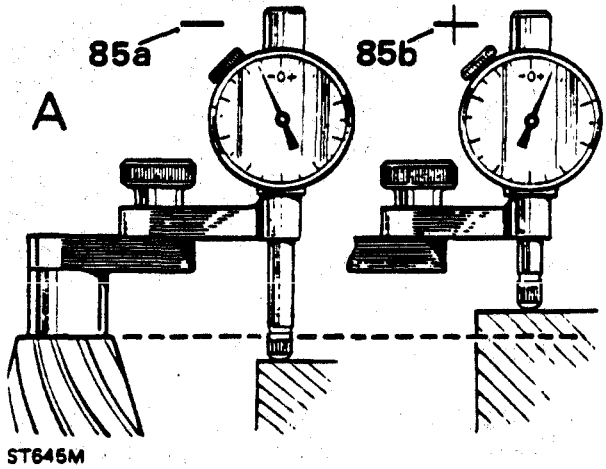
85. Where the stylus has moved down (85a), the amount is equivalent to the thickness of shims that must be removed from under the pinion inner cup to bring the pinion down to the nominal position. Where the stylus has moved up (85b), the amount is equivalent to the additional thickness of shims required to bring the pinion up to the nominal position.

Illustration A. Using setting gauge 18G191P.

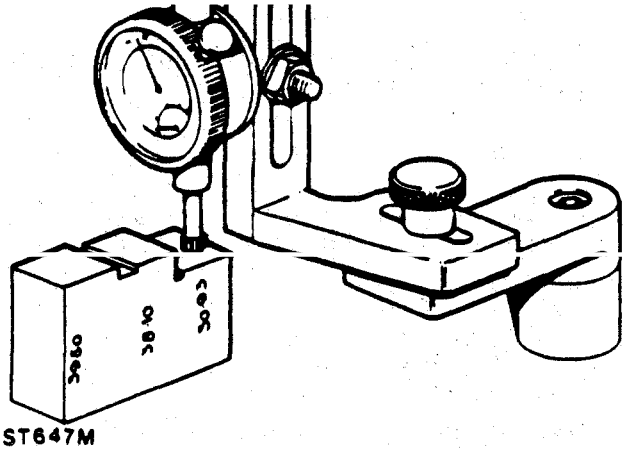
illustration B. Using universal setting block 18G191-4. This setting block has three setting heights as follows:

39.50 mm Rationalised axle
38.10 mm Pre-Rationalised axle
30.93 mm Salisbury axle

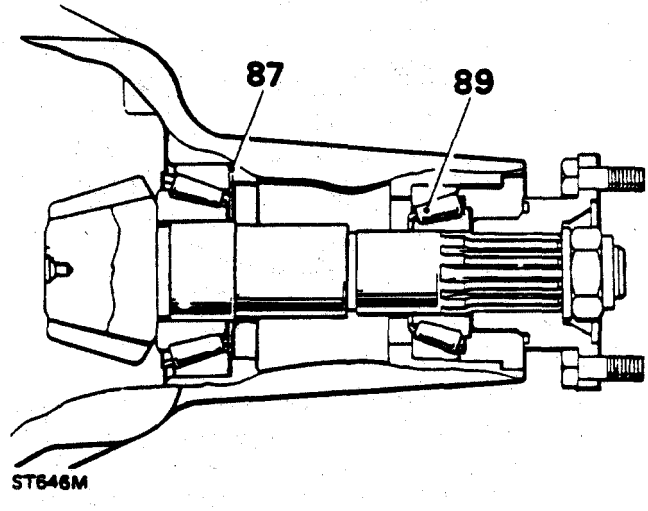
Ensure that the height marked 30.93 mm is used for this differential.



ST645M

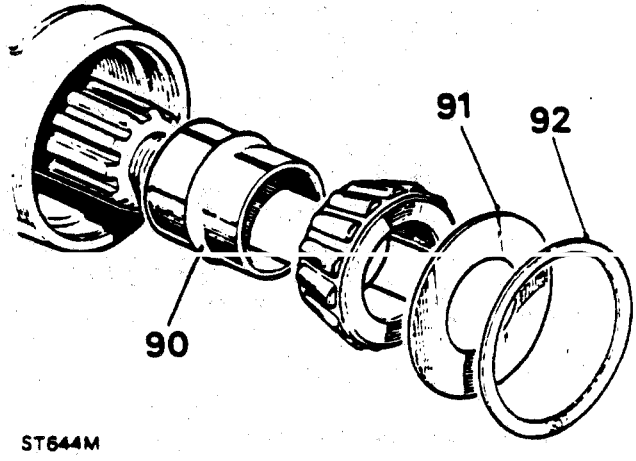

ST647M

86. Before adjusting the shim thickness, check the pinion face marking and if it has a plus (+) figure, subtract that from the shim thickness figure obtained in the previous instruction Alternatively if the pinion has a minus (-) figure, add the amount to the shim thickness figure.
87. Adjust the shim thickness under the pinion inner cup as necessary, by the amount determined in instructions 85 and 86.
88. Recheck the pinion height setting instructions 82 to 84. If the setting is correct, the mean reading on the dial gauge will agree with the figure marked on the pinion end face For example, with an end face marking of +3, the dial gauge reading should indicate that the pinion is 0.003 in (0.0762 mm) below nominal.
89. When the pinion setting is satisfactory, temporarily remove the pinion outer bearing.



ST646M

90. Fit a new collapsible bearing spacer, flared end outward, to the drive pinion and refit the outer bearing.
91. Fit the pinion oil slinger.
92. Fit the oil seal gasket.



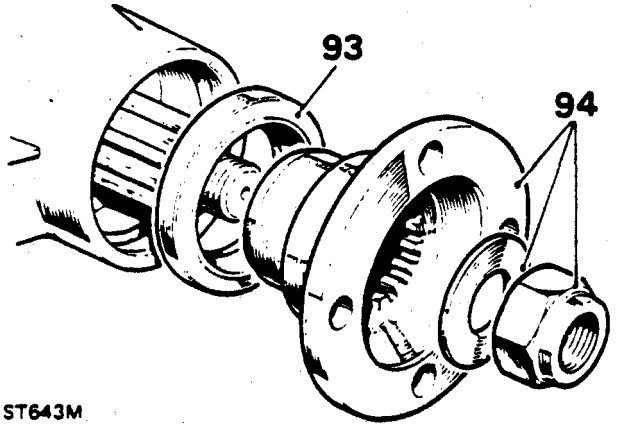
ST644M

93. Fit the pinion oil seal, lipped side first, using general purpose grease or, where available, a molybdenum disulphide based grease on the seal lip, using **RO** 1008 to drift in the seal.

94. Fit the coupling flange and plain washer and loosely fit a new flange nut. Secure **18G 1205** to the coupling flange, using slave fixings.

95. Alternately tighten the flange nut and check the drive pinion resistance to rotation until the following figures are achieved, as applicable:
    a. Assemblies re-using original pinion bearings: **17,3** to **34,3** kgf cm.
    b. Assemblies with new pinion bearings: **34,5** to **46,0** kgf cm.

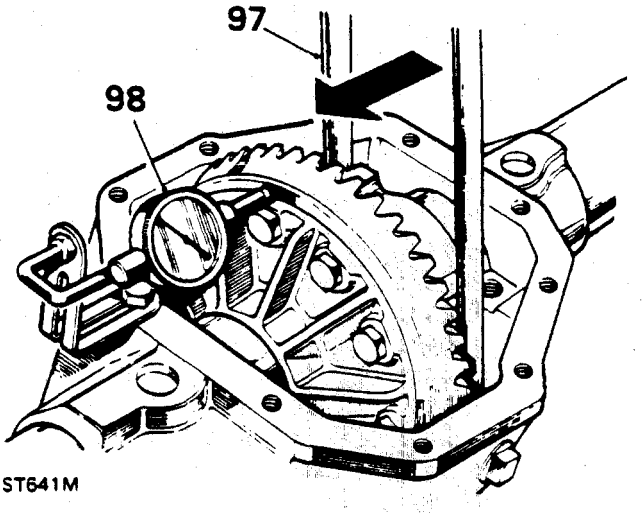
NOTE: Once the bearing spacer has started to collapse the torque resistance build-up is rapid, therefore check frequently, using a spring balance, to ensure the correct figures are not exceeded, otherwise a new collapsible bearing spacer will be required.



ST643M

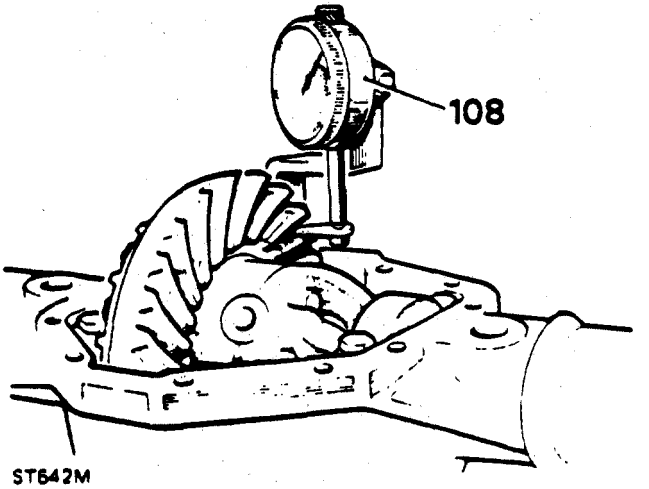
Differential backlash checks

96. Pick up the differential unit as left after instruction 52.
97. Fit the differential unit and lever the unit away from the drive pinion until the opposite bearing cup is seated against the housing. Do not tilt the unit.
98. Install a dial gauge on the casing with its stylus resting on the back face of the crown wheel. Zero the gauge.
99. Lever the differential unit to engage the crown wheel teeth in full mesh with the drive pinion teeth. Do not tilt the unit.
100. Note the total reading obtained on the dial gauge.
101. From this figure subtract 0.010 in to obtain correct crown wheel backlash when fitted. The result indicates the value of shimming to be fitted between the differential case and the bearing cone at the crown wheel side of the differential.



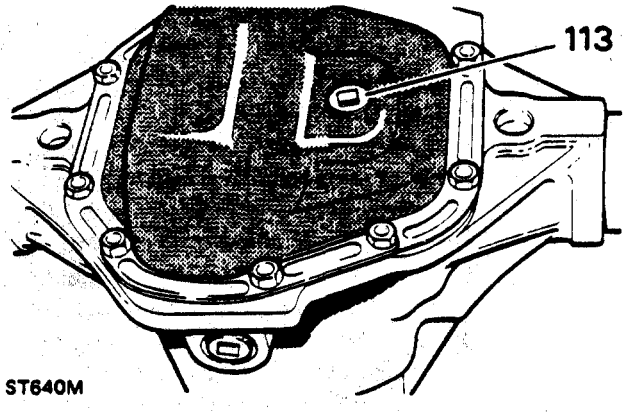
ST641M

102. Fit the shim value determined in instruction 101, taking the shims from the pack previously determined during 'Differential bearing adjustment' checks, instructions 57 to **62** 18G 47 BL details 1 and 2, using press NS 47 and 18G 134 DP.
103. Fit the remaining shims from instruction 101 to the opposite side of the differential, using 18G 47 BL details 1 and 2, press MS 47 and 18G 134DP.
104. Fit the differential unit with shims and bearings to the axle casing, using the axle spreader 18G 131 C with pegs 18G 131 F.
105. Remove the axle spreader.
106. Fit the bearing caps in their correct position, referring to the relationship markings on the caps and on the axle casing.
107. Tighten the bearing caps fixings to 126 to 142 Nm.
108. Mount a dial gauge on the axle casing with the stylus resting on a crown wheel tooth.



ST642M

109. Prevent the drive pinion from rotating and check the crown wheel backlash which must be **0,15** to 0,27 mm. If the backlash is not within the specified limits, repeat the differential backlash checks, instructions 96 to 102 looking for possible errors.
110. Fit the differential cover and new gasket, coating both sides of the gasket with Hylomar PL 32M or an equivalent non-setting sealant. Torque load for fixings is 27 to 33 Nm.
111. Reverse instructions 3 to 5 and coat the threads of the hub driving member bolts with Loctite 'Studlock' grade C.V.X. and fit and tighten the bolts evenly to the correct torque.
112. Fit the rear axle assembly to the vehicle.
113. Replenish the differential lubricating oil, (see Lubrication chart). After the initial axle run, check the oil level and replenish as necessary to the filler/level plug hole.



114. Where major running parts have been replaced during servicing, it is a recommended practice to allow the axle assembly to 'run in' by avoiding, where possible, heavy loads and high speeds during initial running.

DATA

Crown wheel backlash	0,15 to 0,27 mm
Differential bearings pre-load	0,127 mm
Pinion height setting	Set using gauge 18G 191 P or 18G 191-4

Torque resistance initial setting figures

Torque to turn drive pinion and new pinion bearings	34,5 to 46 kgf cm
Torque to turn drive pinion re-using the original bearings	17,3 to 34,5 kgf cm

OVERHAUL REAR AXLE DIFFERENTIAL ASSEMBLY DEFENDER 90

The differential fitted to the rear axle on Defender 90 vehicles is identical to the differential fitted to the front axle. For overhaul instructions refer to Section 54.

REAR DISCS

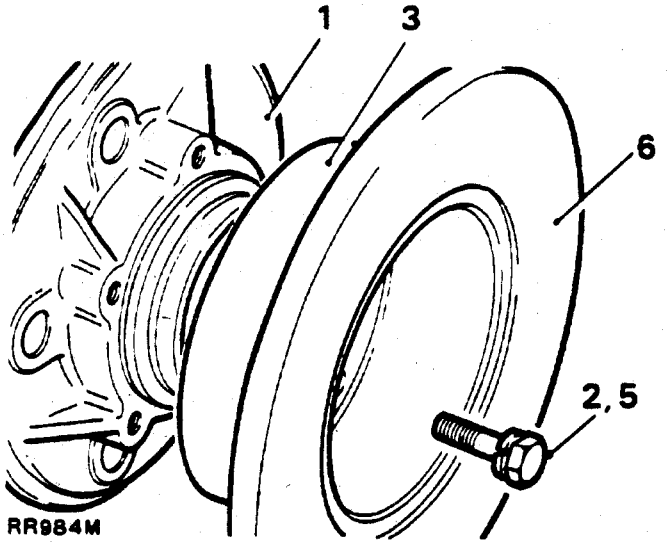
Remove and refit

Removing

1. Remove the rear hub assembly.
2. Remove the rear disc fixing bolts.
3. Tap off the disc from the rear hub.

Refitting

4. Locate the disc onto the rear hub.
5. Fit the disc fixing bolts. See Section 06 **for** tightening torques.
6. Using a dial indicator, check the total disc run out, this must not exceed 0.15 mm (0.006 **in).** If necessary reposition the disc.



7. Fit the rear hub assembly.

Disc Reclamation

Check the disc thickness marked on the disc boss-this dimension may be reduced to a minimum thickness of 13 mm (0.510 in) front and 12 mm (0.460 in) rear. by machining an equal amount off both sides.

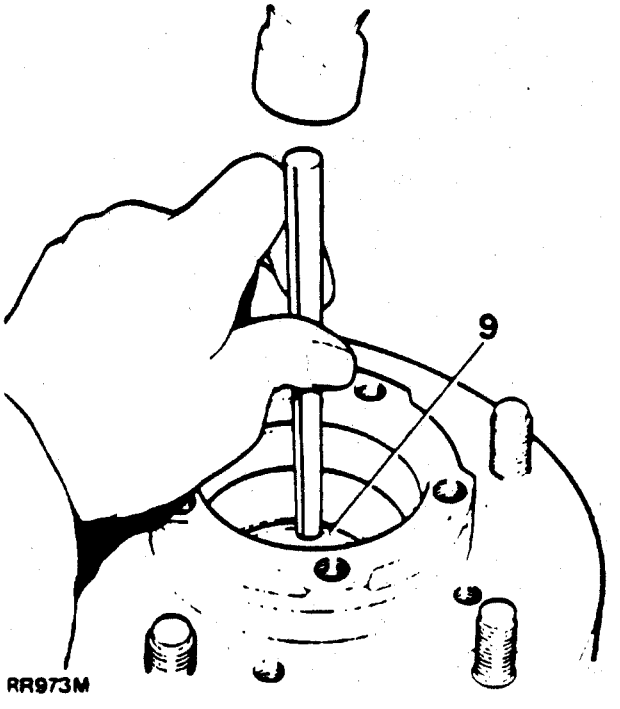
REMOVE AND OVERHAUL REAR HUBS MODELS WITH REAR DISC BRAKES

Service tools:

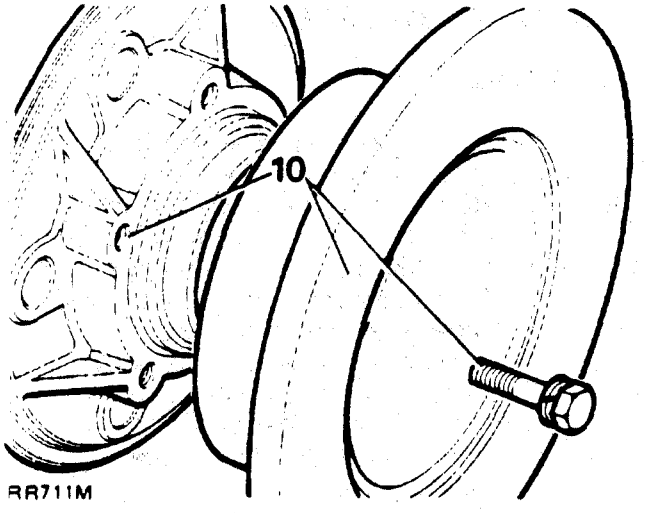
Oil seal replacer LST550-5
Drift for above tool MS550 or 18G134
Hub nut wrench 606435

Remove

1. Jack-up the vehicle, lower on to axle stands and remove the road wheels.
2. Release the brake hose from the axle. casing clips and remove the brake caliper retaining bolts and secure the assembly to one side. Take care not to kink the brake hose
3. Remove the five bolts securing the axle shaft to the hub and withdraw the shaft.
4. Bend back the lock tab and remove the outer nut using box wrench 606435 and remove - remove the lock washer. Likewise remove the inner nut.
5. Remove the seal track spacer.
6. Withdraw the hub complete with bearing oil seals and brake disc.
7. Remove the inner and outer oil seals.
8. Remove the inner and outer bearing cones (races).
9. Drive-out the inner and outer bearing cups.



10. Degrease and examine the hub and brake disc and if necessary replace both or whichever part is unserviceable. The disc is attached to the hub with five bolts. Mark the relationship of the hub to the disc if the original parts are to be re-assembled.

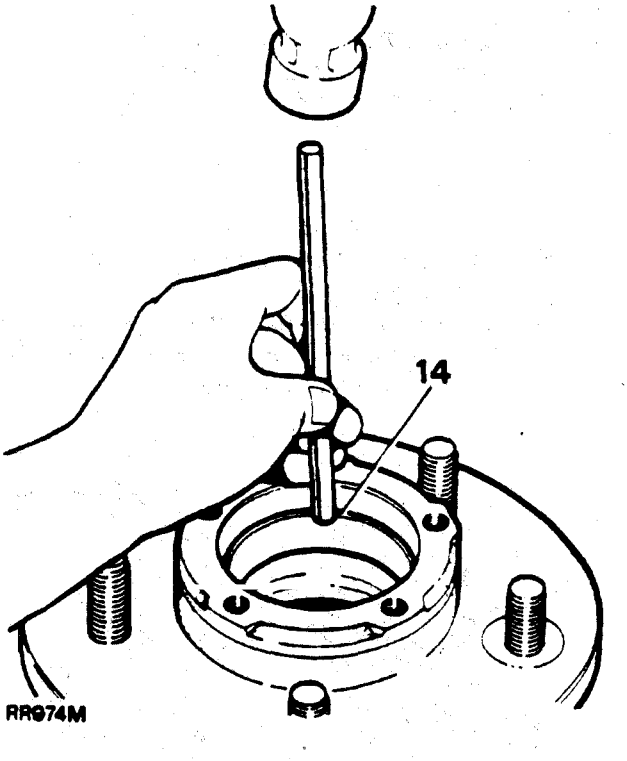


11. Examine the stub axle and in particular check that the inner seal track is smooth and free from blemishes.
12. If necessary remove the six retaining bolts and remove the stub axle complete with the mudshield and joint washer.

Assemble

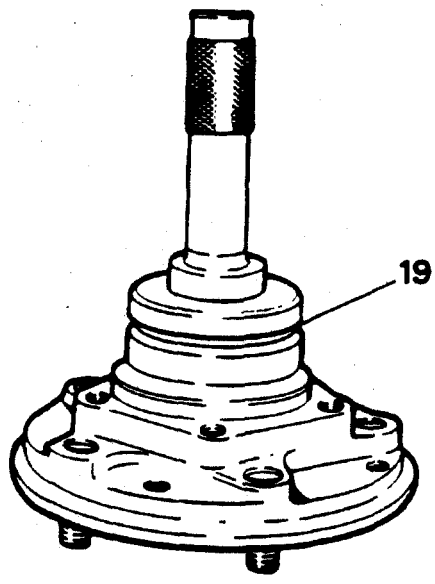
13. Using a new joint washer fit the stub axle and mud shield. Coat the threads of the retaining bolts with Loctite 270 and tighten evenly to me correct torque (see section 06-Torque values).

14. Fit the new inner and outer bearing cups to the hub, using a suitable drift or commercial bearing race driving tool.
15. Fit the new inner bearing cone and pack with one of the recommended hub greases.



Fitting new oil seal-inner

16. Clean the hub oil seal housing and ensure that the seal locating surface is smooth and the chamfer on the leading edge is also smooth and free from burrs.
17. Examine the new seal and ensure that it is clean and undamaged and that the garter spring is properly located. Even a small scratch on the seal lip could impair its efficiency.
18. Although the new seal is already pre-greased by the manufacturer, apply one of the recommended hub bearing greases to the outside diameter of the seal before fitting. taking care not to damage the lip
19 Place the seal, lip side leading. squarely on the hub and using the 76 mm end of seal replacer tool LST550-5 and drift 550 or 18G134. drive the seal into position. flush with the end face of the hub.



Fitting outer oil seal

20. Fit the new outer bearing cone and pack with one of the recommended hub greases. Carry out instructions 16 to **18.**
21. Place the seal, lip side leading, squarely on the hub and using the 72 mm end of seal replacer tool LST550-5 and drift 550 or **18G134,** drive the seal into position to the depth determined by the tool.
22. Coat the lips of both seals with one of the recommended greases. This is important since a dry seal can be destroyed during the first few revolutions of the hub.

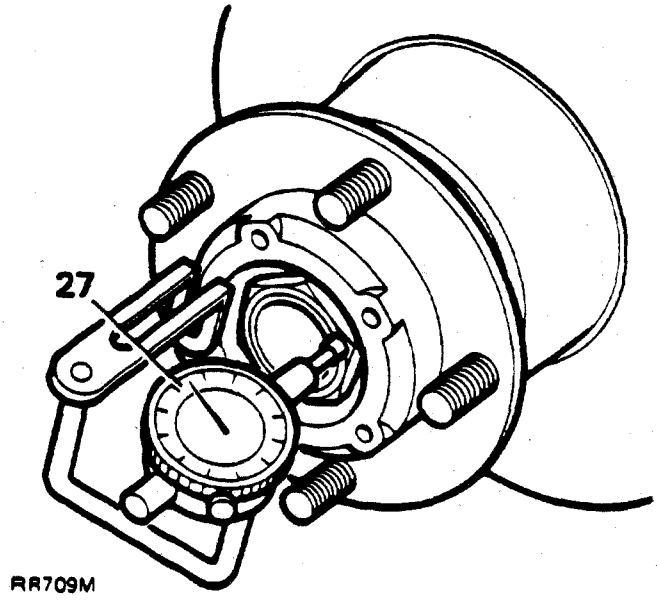
Fitting hub to stub axle

23. Select a new seal track spacer and check that the outer diameter is smooth and free from blemishes and that there are no burrs on me chamfered leading edge.
24 Taking care not to damage the seal lips fit the hub assembly to the stub axle. Do not allow the weight of the hub to rest even temporarily on the outer seal otherwise damage and distortion could occur. Therefore hold the hub clear of the stub axle until the seal track spacer is fitted.
25. Carefully fit the seal track spacer, seal lip leading.

NOTE: Instruction 26 is applicable to hubs that have been fitted with new components throughout. If original components are being refitted instruction 27 must be followed using the adjustment nut to achieve the required end-float.

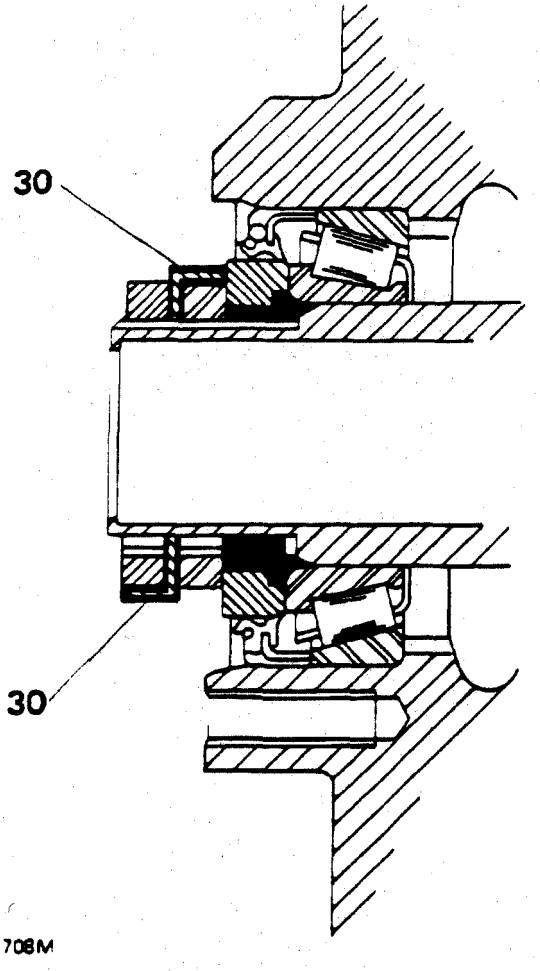
26. Fit the hub inner nut and using wrench 606435 tighten the adjusting nut while slowly revolving the hub until all end-float is removed. then back-off the nut approximately half a turn and retighten the nut to 13-15 in lb which will automatically allow for Compression of the rubber on the new seal track spacer giving the required hub end-float of 0.013 to 0.10 mm (0.0005 to 0.004 in).

27. If the rubber on the seal track spacer has previously been compressed the hub end-float can be checked by mounting a dial indicator and bracket on the hub so that the trace pin rests in a preloaded condition on the nut. Rotate the hub to settle the bearings and check the end-float by pushing and pulling the hub. End-float must fall within the limits given in the previous instruction.
28. Fit a new lock washer and locknut. Restraining the inner adjustment nut, tighten the outer lock nut to 70 to **80** ft lb **(95** to **108** Nm).
29. If original components have been refitted rotate the hub several times to settle the bearings then recheck the end-float, refer to previous note and instruction **27.**



30. Bend one segment of the lock washer over the adjusting nut and another, diametrically opposite, over the locknut taking care not to damage the outer seal.
31. Using a new joint washer, fit the hub driving shaft and evenly tighten the retaining bolts of the correct torque (see section 06-Torque values).

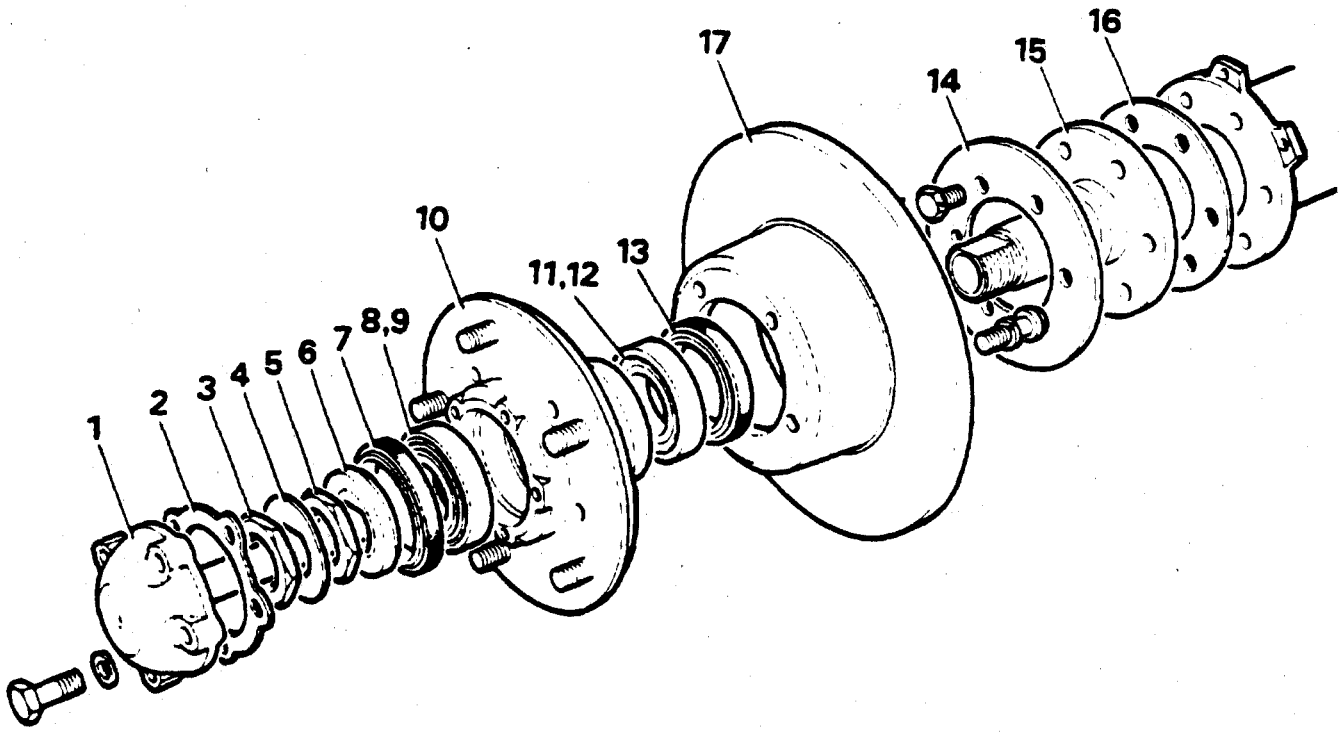
32. **Fit the brake caliper and secure with the retaining bolts and tighten to the correct torque (see section 06-Torque values). Secure the brake pipes to the axle casing.**



33. Fit the road wheels, jack-up the vehicle, remove the axle stands, lower the vehicle to the ground and tighten the road wheel nuts evenly to the correct torque.

KEY TO REAR HUB COMPONENTS

1. Rear axle shaft
2. Joint washer
3. Locknut
4. Lock washer
5. Adjusting nut
6. Seal track spacer
7. Outer oil seal
8. Outer bearing cone
9. Outer bearing cup
10. Hub
11. Inner bearing cup
12. Inner bearing cone
13. Inner oil seal
14. Mudshield
15. Stub axle
16. Stub axle joint washer
17. Brake disc



RR706M

OVERHAUL FRONT HUB ASSEMBLY

Service tools:

18G134/LRT-99-003 Bearing and oil seal replacer
18G1349/LRT-54-501 Hub oil seal replacer
RO530106/LRT-99-503 Dial gauge bracket

DISMANTLE

1. Slacken road wheel nuts.
2. Jack up the vehicle and lower onto axle stand.
3. Remove the road wheel.
4. Slacken the lock nuts securing the jump hose to the retaining bracket.
5. Remove the two bolts securing the brake caliper, see section 70 - brake disc renewal - and whilst withdrawing the caliper from the brake disc release the jump hose from the bracket. Tie the caliper securely to one side.

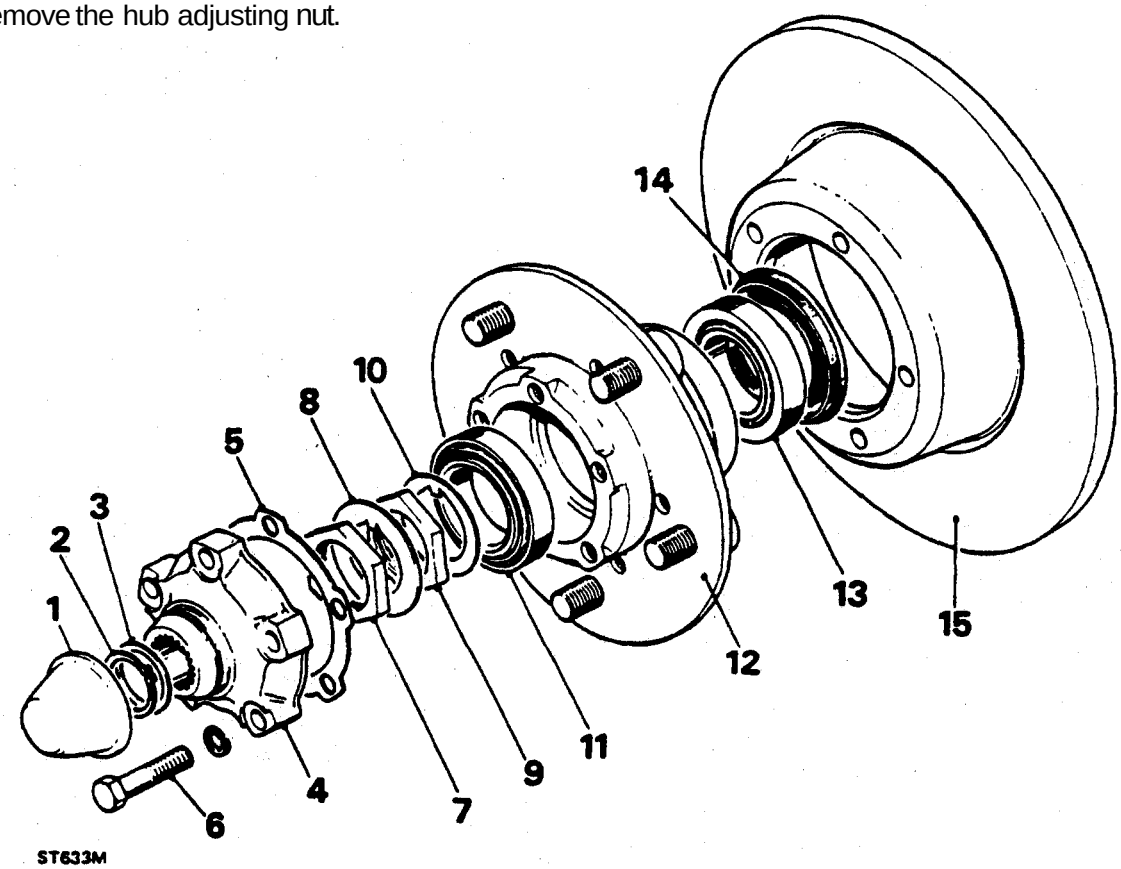
NOTE: Since the bracket on later vehicles is not open-ended, the caliper must be removed completely, which involves disconnecting the jump hose.

6. Lever-off the dust cap.
7. Remove the circlip from the drive shaft.
8. Remove the drive shaft shim.
9. Remove the five bolts and withdraw the driving member and joint washer.
10. Bend back the lock washer tab.
11. Remove the locknut and tab washer.
12. Remove the hub adjusting nut.
13. Remove the key washer.
14. Withdraw the hub and brake disc assembly complete with bearings.
15. Remove the outer bearing.
16. Mark, for reassembly, the relationship between the hub and brake disc, if original hub is to be refitted.
17. Remove the five bolts and separate the hub from the brake disc.

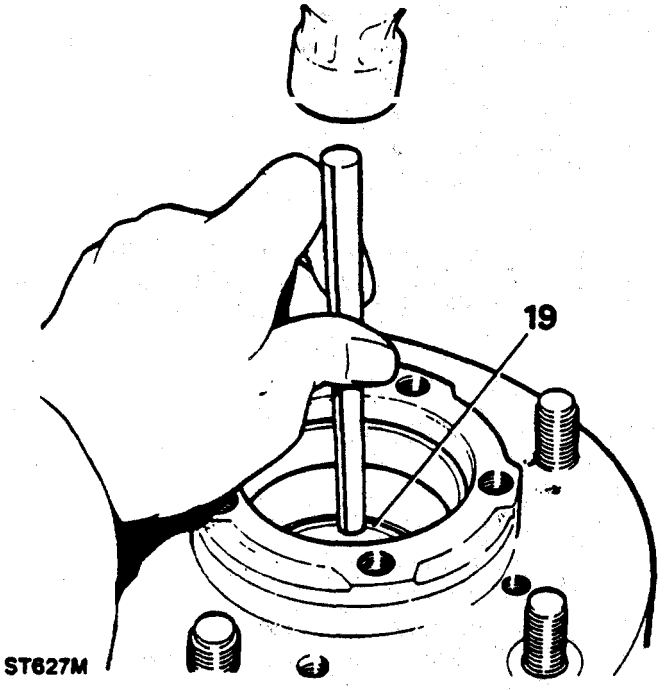
NOTE: The road wheel retaining studs must not be renewed. Should any studs be unserviceable a new hub complete with studs must be obtained.

KEY TO HUB ASSEMBLY

1. Dust cap.
2. Drive shaft circlip.
3. Drive shaft shim
4. Drive member.
5. Drive member joint washer.
6. Drive member retaining bolt (five off).
7. Lock nut.
8. Lock washer.
9. Hub adjusting nut.
10. Keyed washer.
11. Outer bearing.
12. Hub.
13. Inner bearing.
14. Grease seal.
15. Brake disc.



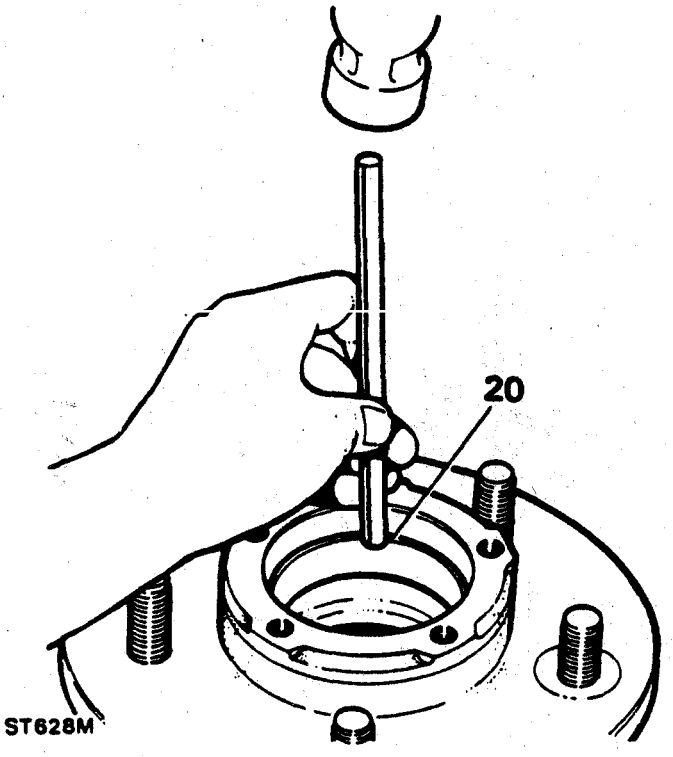
18. Drift-out the grease seal and inner bearing from the hub and discard the seal.
19. Drift-out the inner and outer bearing tracks.



ST627M

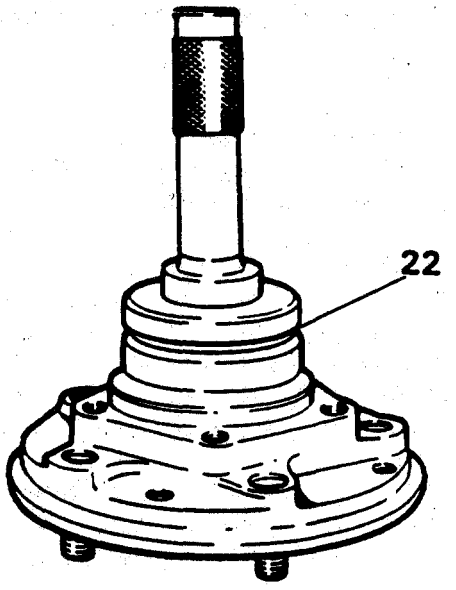
Assemble

20. Clean and degrease the hub and drift-in the inner and outer bearing tracks.



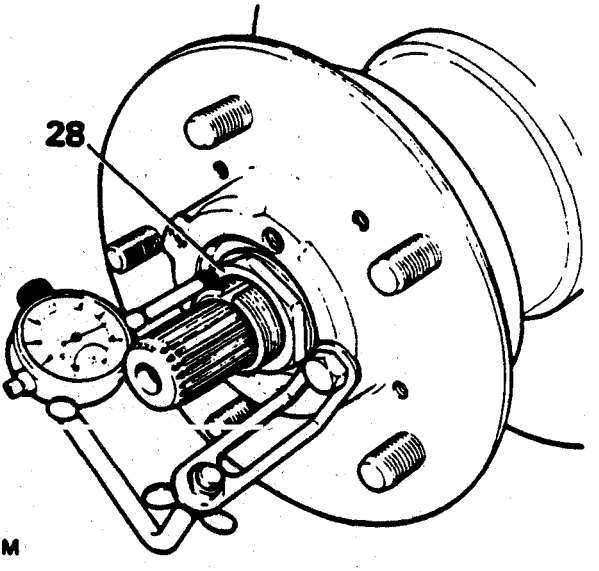
ST628M

21. Pack the hub inner bearing with a grease recommended in the lubrication chart and fit to the hub. Use a minimum of 8,5 grams of grease.
22. With the lip side leading fit a new seal to the hub using special tool 18G1349 grease seal replacer and drift 18G134. Drive-in the seal so that it is recessed 4,83 to **5,33** mm below the rear face of the hub. Apply grease liberally between the seal lips and springs.



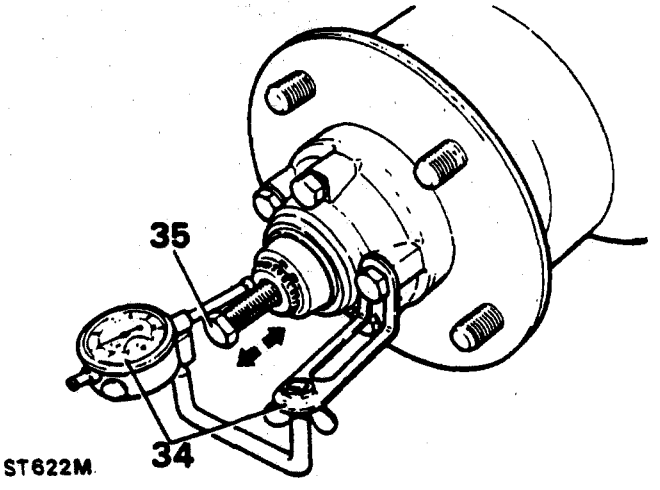
ST631M

23. Assemble the brake disc to the hub lining up the marks made during dismantling. Fit and tighten the five retaining bolts to 65 to 80 Nm.
24. Grease as in instruction 21 and fit the outer bearing to the hub.
25. Clean the stub axle and drive shaft and fit the hub assembly to the axle.
26. Fit the key washer.
27. Fit the hub adjusting nut and tighten by hand whilst rotating the hub until all end-play is taken up.
28. Mount a dial gauge using bracket RO530106 and rest the stylus in a loaded condition on the adjusting nut.



ST621M

29. Slacken off the adjusting nut until an end-play of 0,1270 to 0,1016mm is obtained.
30. Fit a new keyed lock tab washer.
31. Fit and tighten the hub adjusting nut and re-check the end-play before bending the lock tab over.
32. Fit a new joint washer to the driving member and fit the member to the hub and secure with the five bolts tightening evenly to 60 to 70 Nm.
33. Fit the original drive shaft shim and secure with the circlip.
34. To check the drive shaft end-play mount a dial guage using a bracket RO530106 and rest the stylus in a loaded condition on the end of the drive shaft.
35. Fit a suitable bolt to the threaded end of the drive shaft and using a pair of pliers move the drive shaft back and forth noting the dial guage reading. The end-play should be between 0,127 to 0,254 mm.



ST622M

36. If the end-play requires adjustment, remove the circlip, measure the shim thickness and fit an appropriate selective shim to give the required end-play.
37. Remove the bolt from the drive shaft, fit the circlip and dust cap.
38. Fit the brake caliper and tighten the two bolts to the correct torque.
39. Locate the jump hose in the bracket and tighten the locknuts or see caution below.

CAUTION: If the jump nose was disconnected as is necessary on later vehicles the brake hydraulic system must be bled.

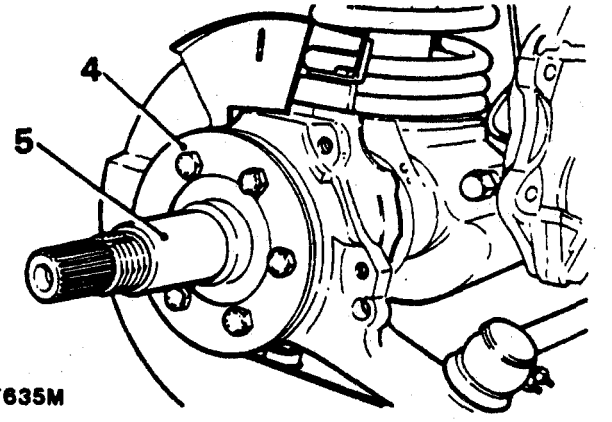
40. Fit the road wheel, remove the axle stand and finally tighten the road wheel nuts.
41. Operate the footbrake several times to locate the brake pads before taking the vehicle on the road.

OVERHAUL STUB AXLE, AXLE SHAFT, CONSTANT VELOCITY JOINT AND SWIVEL ASSEMBLY

Special tool: 18G284AAH/LRT-37-004 bush extractor

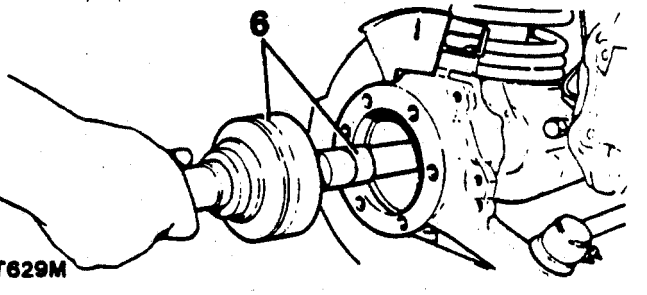
Remove stub axle, axle shaft and constant velocity joint

1. Remove the hub complete as described in the operation to overhaul the hub assembly instructions 1 to 14.
2. Drain the swivel pin housing and refit plug.
3. Remove the six bolts retaining the stub axle to the swivel housing.
4. Remove the mud shield.
5. Remove the stub axle and joint washer.



ST635M

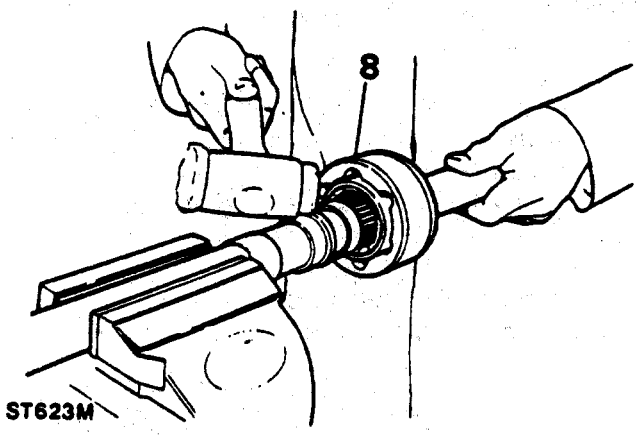
6. Pull-out the axle shaft and constant velocity joint from the axle casing.



ST629M

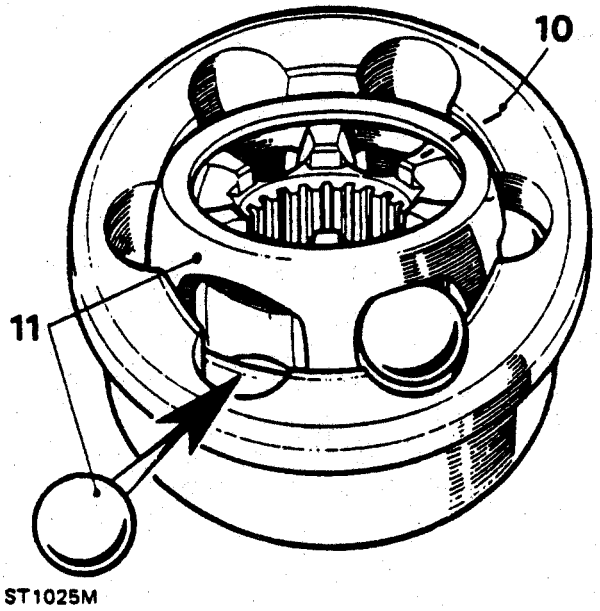
Remove constant velocity joint from axle shaft

7. Hold the axle shaft firmly in a soft jawed vice
8. Using a soft mallet drive the constant velocity joint from the shaft.
9. Remove the circlip and collar from the axle shaft.

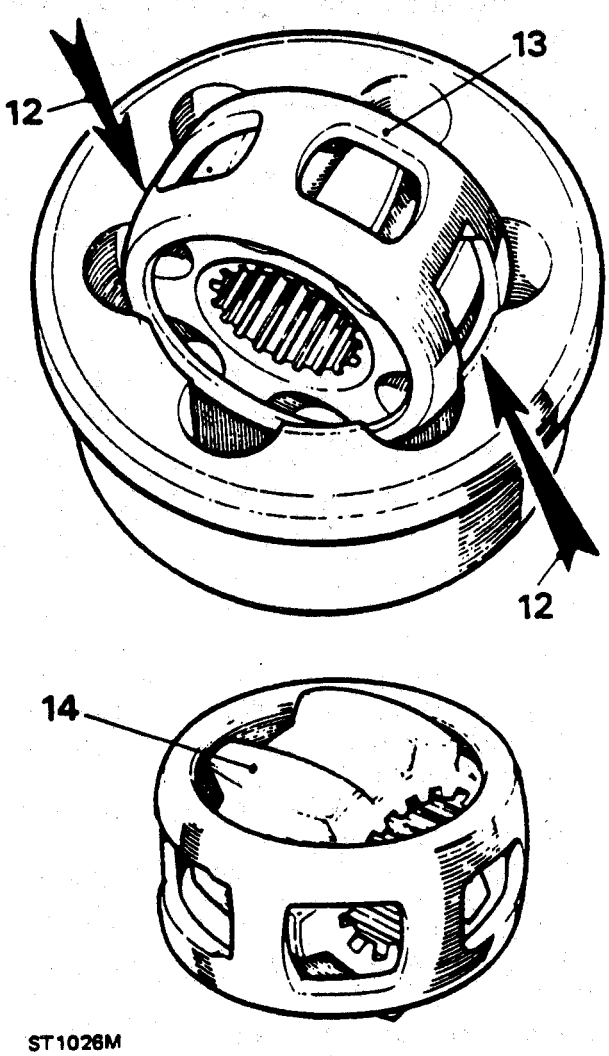


Dismantle the constant velocity joint

10. Mark the relative positions of the constant velocity joint inner and outer race and the cage for correct reassembly.
11. Tilt and swivel the cage and inner race to remove the balls.

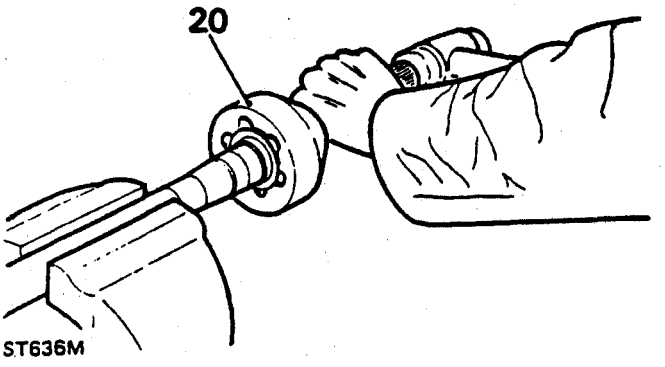


12. Swivel the cage into line with the axis of the joint and turn it until two opposite windows coincide with two lands of the joint housing.
13. Withdraw the cage.
14. Turn the inner track at right angles to the cage with two of the lands opposite the cage openings and withdraw the inner race.
15. Degrease and examine all components for general wear and condition.
16. Examine the inner and outer track, cage balls and bearing surfaces of the constant velocity joint for damage and excessive wear.
17. To assemble the constant velocity joint, reverse the dismantling instructions and lubricate with a recommended EP oil.
18. Check that the end-float of the assembled joint does not exceed 0,64 mm.



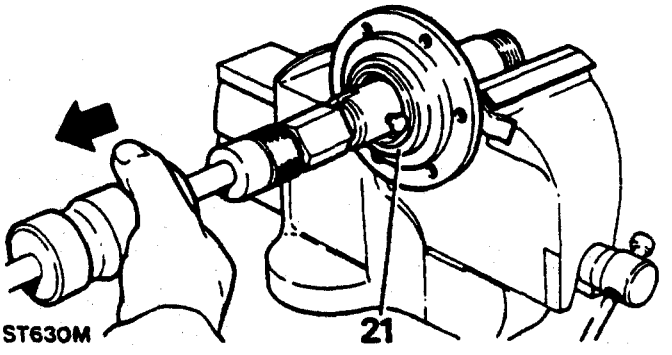
Fit constant velocity joint to axle

19. Fit the collar and a new circlip.
20. Engage the constant velocity joint on the axle shaft splines and using a soft mallet, drive the joint home.



Renew stub axle intermediate oil seal and bush

21. To remove the bronze brush and oil seal use special tool 18G284AAH and a slide hammer. Ensure that the fingers of the tool locate behind the bush, not the oil seal. Drive-out the bush, then extract the oil seal.



22. Lubricate the seal and lip with EP 90 oil and with the cavity side leading press-in a new intermediate oil seal using a suitable tube.
23. Using a suitable block, press or drive-in the bush up to the shoulder.

Remove swivel pin housing

24. Remove the brake disc shield secured by one nut and bolt at the bottom front and one single bolt, behind the shield, in the swivel housing.
25. Disconnect the track-rod end ball joint from the housing.
26. Disconnect the drag-link ball joint.
27. Remove the seven bolts securing the swivel pin housing oil seal and retaining plate and joint washer and release the assembly from the swivel pin housing. Note that whilst the joint washer can be removed at this stage, the oil seal and retaining plate must remain until the swivel pin bearing housing is removed.
28. Remove the two bolts, complete with the brake disc shield bracket, securing the lower swivel pin to the housing.
29. Withdraw the lower swivel pin and joint
30. Remove the top swivel pin retaining bolts complete with the brake jump hose bracket.
31. Withdraw the top swivel pin and shims.
32. Remove the swivel pin housing whilst retrieving the lower taper bearing.
33. If the swivel pin housing is to be renewed, remove the drain and level plugs and lock-stop bolt and nut.

Remove swivel pin bearing housing

34. Remove the seven bolts securing the swivel pin bearing housing to the axle case and remove the housing and joint washer.
35. Remove and discard the swivel pin oil seal and joint washer.

Overhaul swivel pin bearing housing

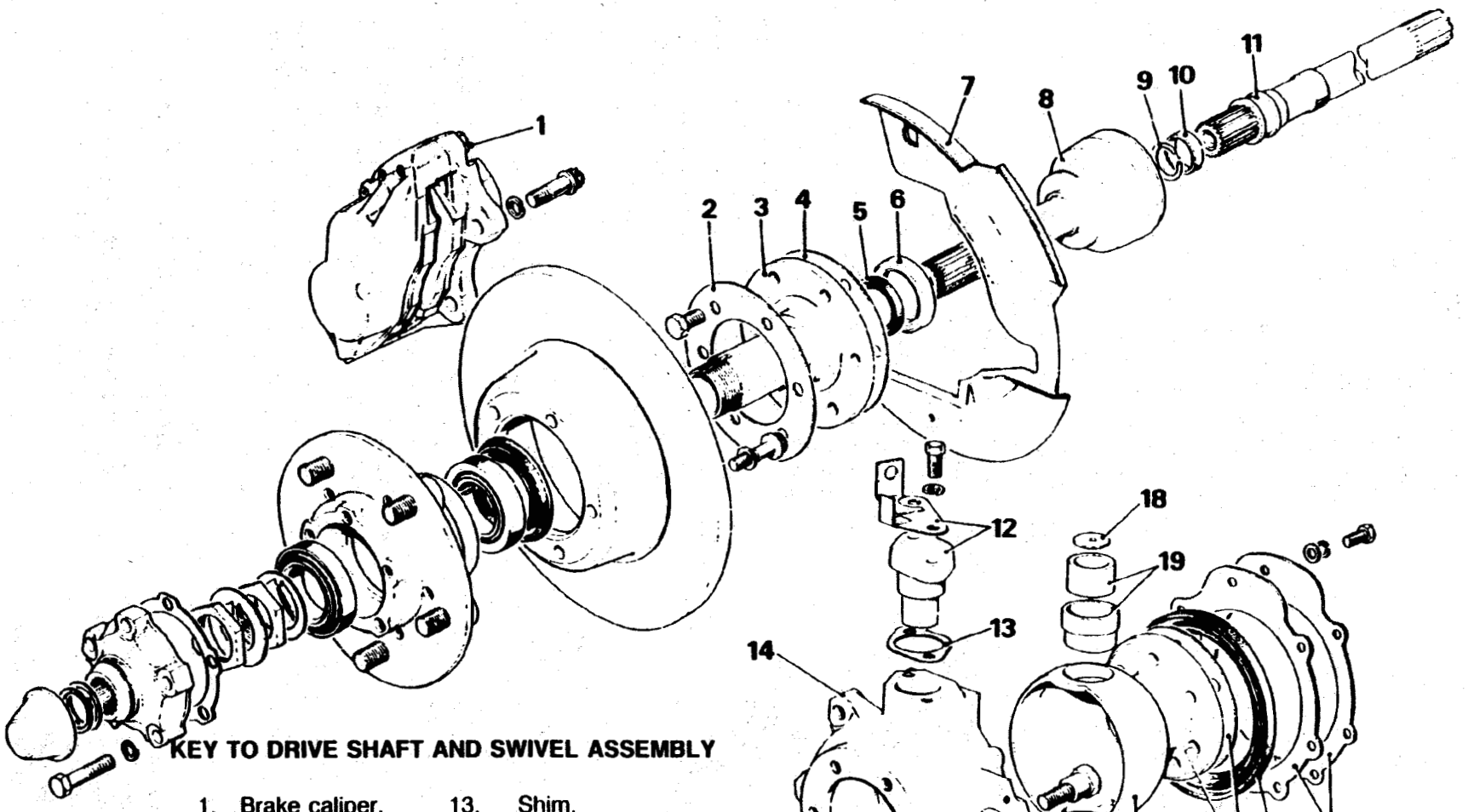
36. Prise-out the oil seal from the back of the housing.
37. Drift-out the lower swivel pin bearing track.
38. Press-out the upper swivel pin in Railko bush housing.
39. If worn, pitted or damaged, renew the housing.
40. Press-in the lower swivel pin bearing track.
41. Press-in the Railko bush housing ensuring that the machined flat is towards the back of the housing, ie when the housing is fitted to the axle, the flat faces inboard.
42. With the cavity side trailing press the axle shaft oil seal into the housing and grease.
43. Fit the thrust disc into the bottom of the Railko bush housing and check that it is still in position when the swivel pin is fitted.

Fit swivel pin bearing housing to axle

44. Coat the swivel pin bearing housing to axle casing bolts with Loctite 270.
45. Coat both sides of a joint washer and place in position on the swivel pin bearing housing to axle mating face.
46. Hang me swivel pin bearing housing oil seal, retainer and joint washer over the back of the housing.
47. Fit and secure the swivel pin bearing housing to the axle with the seven bolts tightening evenly to 65 to 80 Nm.

Fit swivel pin housing

48. Grease and fit the lower swivel pin bearing to the bearing housing.
49. Place the swivel pin housing in position over the swivel in bearinghousing.

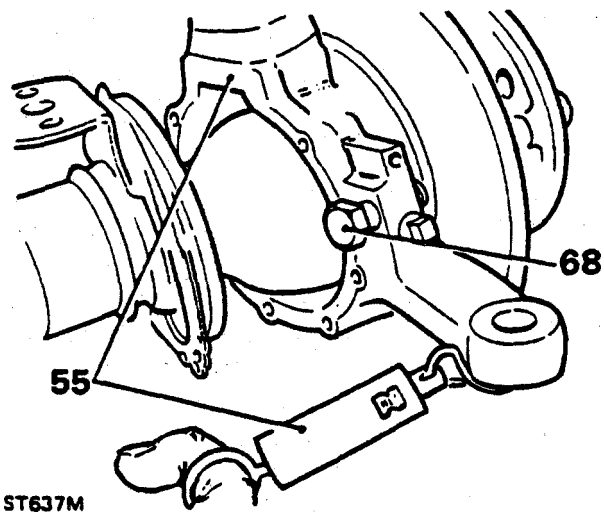


KEY TO DRIVE SHAFT AND SWIVEL ASSEMBLY

1. Brake caliper.
2. Mud shield.
3. Stub axle.
4. Joint washer.
5. Intermediate seal.
6. Bronze bush.
7. Brake disc shield.
8. C.V. joint.
9. Circlip.
10. Bush.
11. Inner drive shaft.
12. Top swivel pin and hose bracket.
13. Shim.
14. Swivel pin housing.
15. Washer.
16. Lower swivel pin.
17. Brake disc shield bracket.
18. Thrust disc.
19. Railko bush and housing.
20. Swivel pin bearing housing.
21. Lower swivel pin bearing.
22. Oil seal.
23. Swivel pin bearing housing - oil seal plate and washer.
24. Joint washer.

ST634M

50. Coat a joint washer both sides with sealing compound and place in position on the lower swivel pin.
51. Fit the lower pin with lip outboard. **Do** not secure with bolts at this stage.
52. Lubricate the Railko bush with an EP oil and Fit the top swivel pin with existing shims and fit the securing bolts and jump hose bracket (do not tighten).
53. Coat the threads of the lower swivel pin bolts with Loctite 270 and fit, together with the brake disc shield bracket, and tighten to 22 to 28 Nm.
54. Tighten the top swivel pin securing bolts to 60 to 70 Nm.
55. To check the top swivel pin pre-load attach a spring balance to the track-rod ball joint bore and pull the balance to determine the effort required to turn the swivel. The resistance, once the initial inertia has been overcome, should be 3,60 to **4,50** Kg. If necessary, adjust by removing or adding shims to the top swivel pin as required.



ST637M

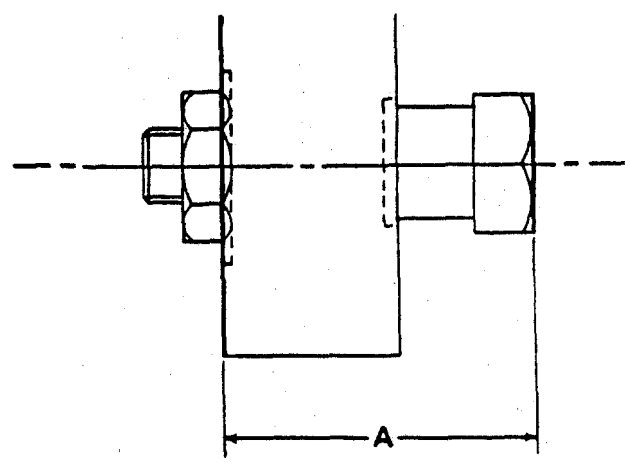
56. Liberally apply - but do not pack - a recommended grease between the lips of the swivel oil seal (2,5 to 4,0 grams).
57. Secure the oil seal and joint washer with the retaining plate and securing bolts tightening evenly to 7 to 10 Nm.
58. Fit the track-rod and drag link and secure with new split pins.
59. Fit the brake disc shield.
60. Loosely fit the lock stop bolt and nut for later adjustment.

Fit drive shaft and stub axle

61. Place a new joint washer in position on the swivel pin housing to stub axle mating face.
62. Taking care not to damage the axle shaft oil seals, insert the axle shaft, and when the differential splines are engaged, push the assembly **home**
63. Fit the stub axle with the keyway uppermost at 12 o'clock. At this stage it is most important to ensure that the constant velocity joint bearing journal engages fully into the bronze bush in the rear of the stub axle before the stub axle is secured with bolts. Damage to the bush can occur if this precaution is not observed. To ensure proper engagement grasp the stub axle with one hand and with the other pull the axle shaft into the bush. The shaft and bush are correctly engaged when the end of the axle shaft splines are flush with the end of the stub axle. This condition must be maintained during all ensuing assembly operations.
64. Place the mud shield in position and secure the stub axle to the swivel pin housing with the six bolts using Loctite 270 and evenly tighten to 60 to 70 Nm.
65. To complete the reassembly, follow instructions 25 to 41 covering front hub overhaul.
66. Check that the swivel pin housing drain plug is tightly fitted and remove the filler level plug.
67. Inject approximately 0,28 litres of recommended EP oil until the oil begins to run out of the filler hole. Fit and tighten the plug and wipe away any surplus oil.
68. Set the steering lock-stop bolts to provide a clearance between the tyre wall and radius arm in accordance with the dimensions below. This dimension however, must be set to 56 mm, irrespective of tyre size and type where steering gaiters are fitted.

Tyre Size	Dim 'A' ± 0,25 mm
750x16 Michelin XS	**54,00** mm
750x16 Avon Rangers	**54,00** mm
750x16(All others)	**51.00** mm

The clearance should be set to a minimum of 20 mm on vehicles fitted with 205R X 16 or 600 X 16 tyres.

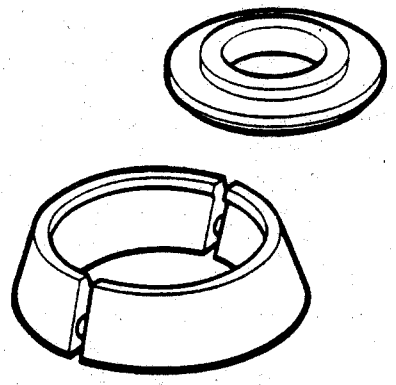


ST1801M

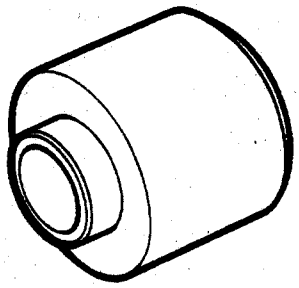
OVERHAUL FRONT AXLE DIFFERENTIAL

Special service tools
18G1205/LRT-51-003 Flange restrainer tool
18G 191 Pinion height setting gauge
18G191-4/LRT-54-503 Universal setting block
18G47-6/LRT-54-502 Pinion head bearing remover/replacer
LST106/L.R.T.-54-504 Oil seal replacer
RO 262757A/LRT-54-505 Extractor for pinion bearing caps
RO 262757-1/LRT-54-506 Replacer, use with RO262757A
RO262757-2/LRT-54-507 Adaptor, tail bearing cap replacer
RO 530105/LRT-54-508 Spanner, diff, flange and carrier bearings
RO 530106/LRT-99-503 Bracket for dial gauge
MS47/LRT-99-002 Press
18G2/L.R.T.-99-500 General purpose puller
MS103 Torque meter

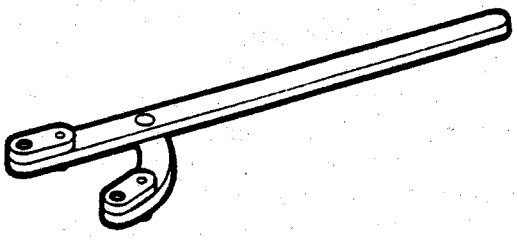
18G.47-6



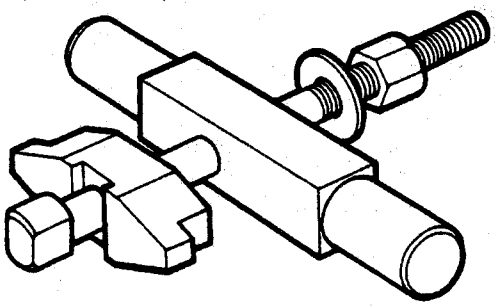
LST.106



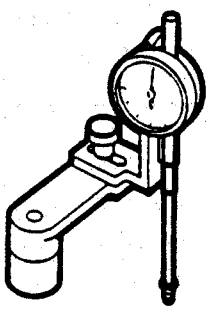
18G.1205



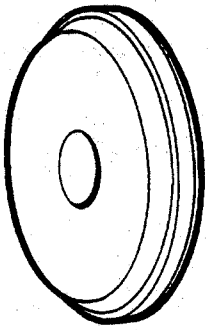
RO.262757A



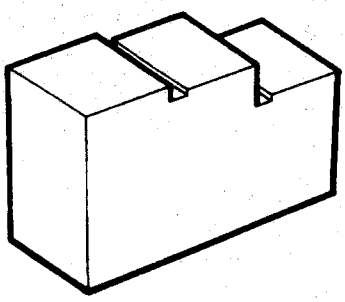
18G.191



RO.262757-2

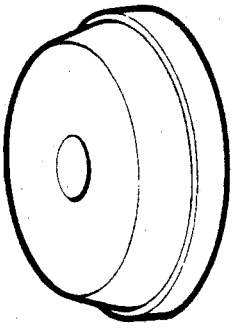


18G.191-4

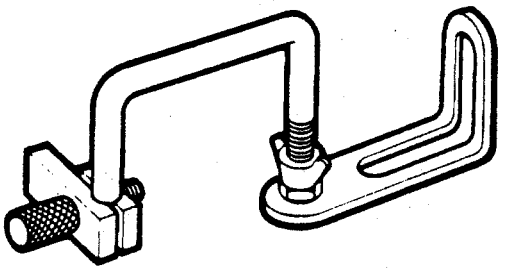


ST2253M

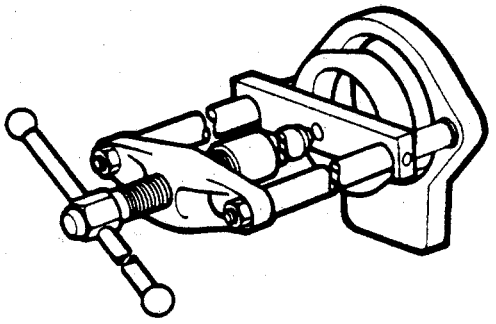
RO.262757-1



RO.530106



MS.47



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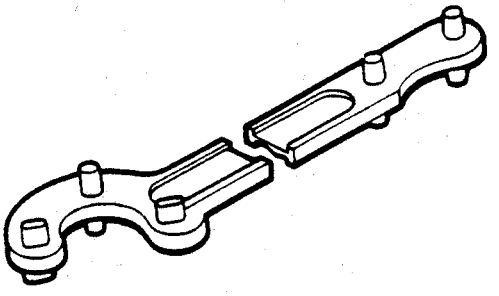
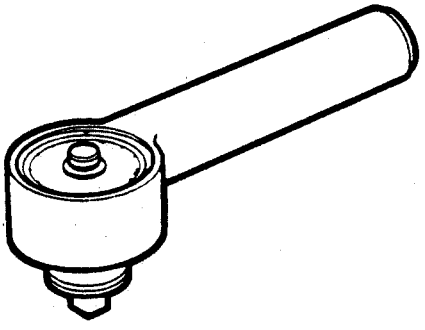
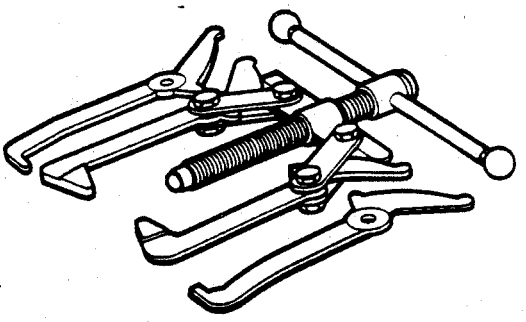


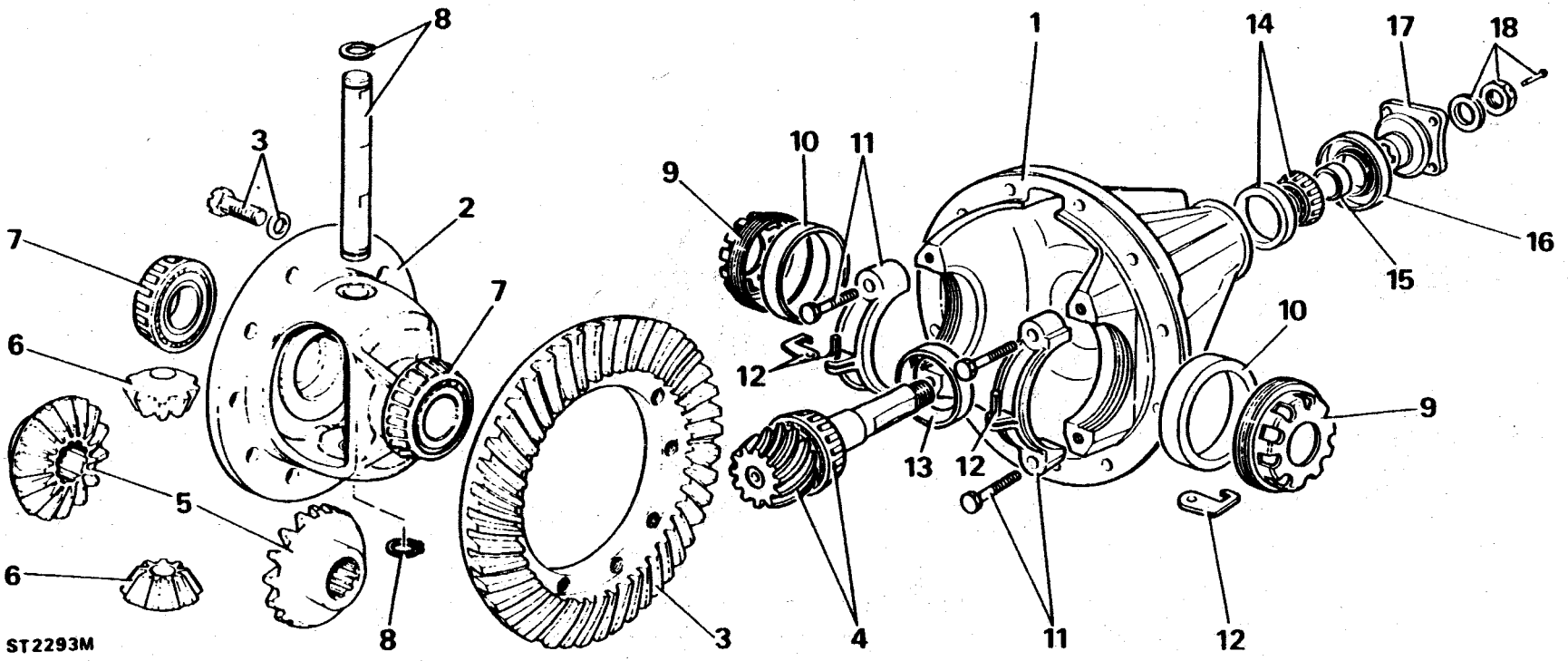
MS.103



18G.2



ST2254M

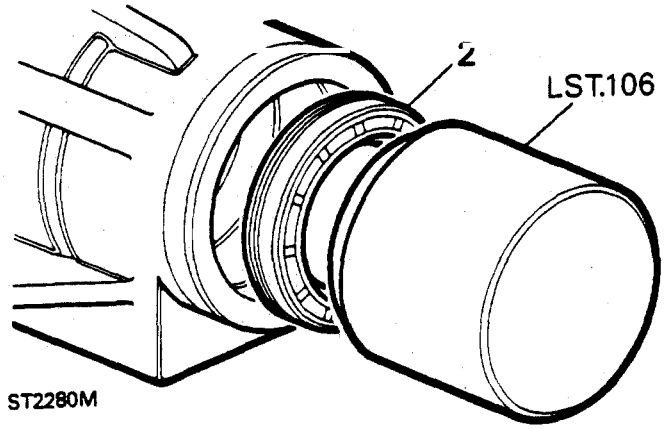


FRONT AXLE DIFFERENTIAL

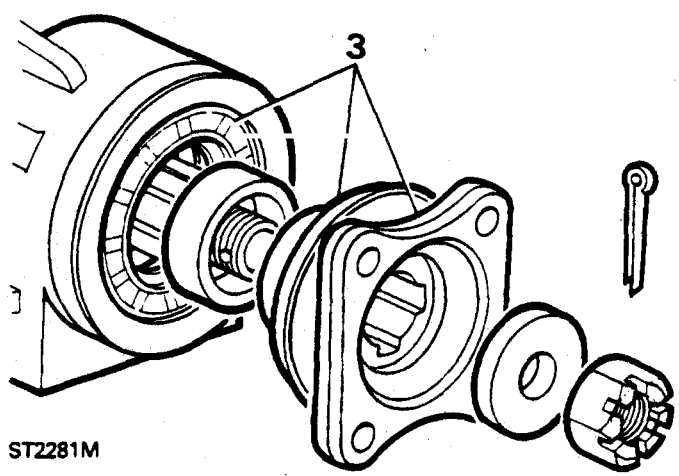
1. Pinion housing
2. Differential carrier
3. Crown wheel and retaining bolts
4. Pinion and head bearing
5. Sun gears
6. Plant gears
7. Carrier bearings
8. Cross shaft and circlips
9. Carrier bearing adjusting nuts
10. Carrier bearing tracks
11. Carrier bearing caps and bolts
12. Locking fingers and roll pins
13. Pinion head bearing track
14. Pinion tail bearing track
15. Spacer
16. Oil seal
17. Drive flange
18. Drive flange washer, nut and split pin

position.

2. Smear the outer diameter of the new seal with a recommended all purpose grease and with the lip side leading, start it squarely into the pinion nose .housing. Using special service tool L.S.T. 106, drive the seal home to the depth determined by the tool.

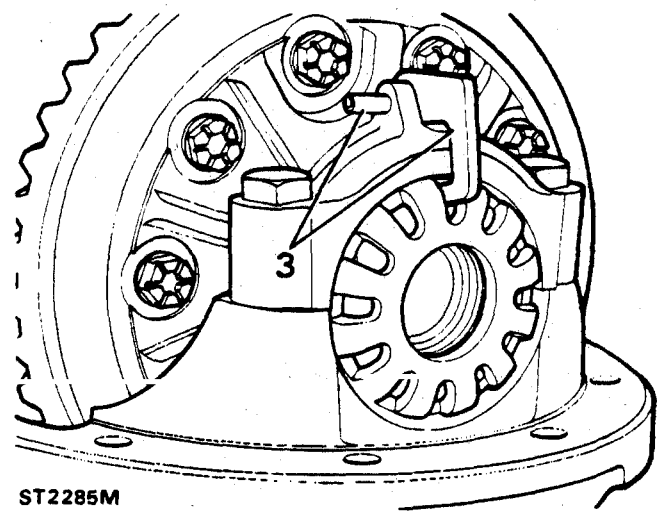


3. Lubricate the seal lips with a recommended axle oil. Check that the flange seal running surface is clean, smooth and free from imperfections that could damage the seal. Carefully fit the drive flange and secure with the washer and nut. Tighten the nut to the correct torque whilst holding the flange with restraining tool 18G 1205. If necessary continue to tighten the nut to line up the split pin hole and fit a new split pin.

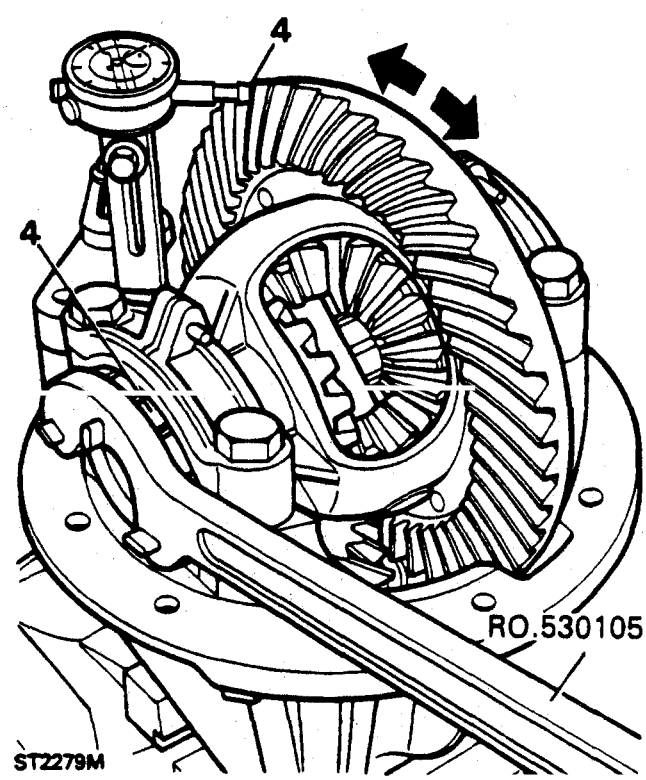


Adjust crown wheel and pinion backlash

1. Return the pinion housing to the vertical position and lower the crown wheel and differential assembly into the pinion housing. Lubricate the carrier bearings and fit the tracks. Fit the bearing caps so that the assembly marks line up and fit the bolts, finger tight only.
2. Move the crown wheel into mesh with the pinion and fit the bearing adjusting nut on the crown wheel side Using wrench RO530105 tighten the nut with just sufficient nip to remove any backlash between the crown wheel and pinion.
3. Line up the centre of the locking finger lug with a slot in the adjusting nut. Fit the locking finger and secure with the roll pin. Fit the opposite nut and tighten, with the above wrench, until resistance is felt.



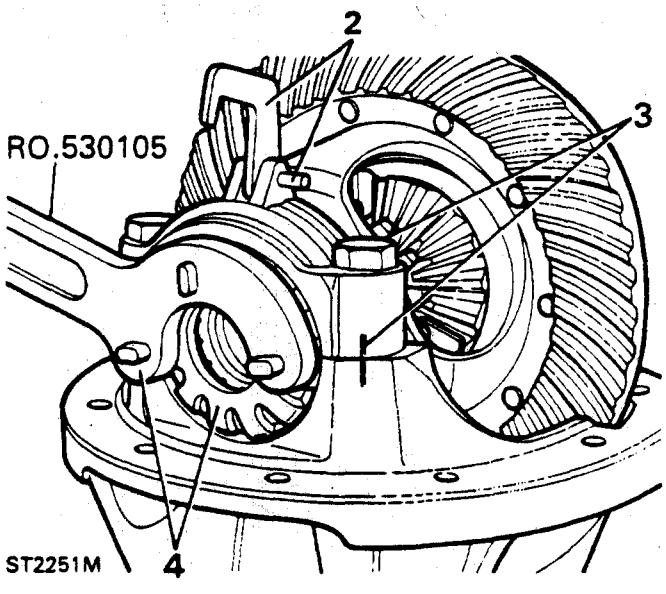
4. Mount the pinion height setting gauge, with the magnetic base on the pinion housing flange and the stylus resting against a crown wheel tooth. Continue to tighten the nut, on the carrier side, until a backlash of 0,10 to 0,17 mm is achieved. Do not slacken the crown wheel side nut otherwise the backlash and bearing pre-load will be lost. Line up the locking finger lug with a slot in the nut.



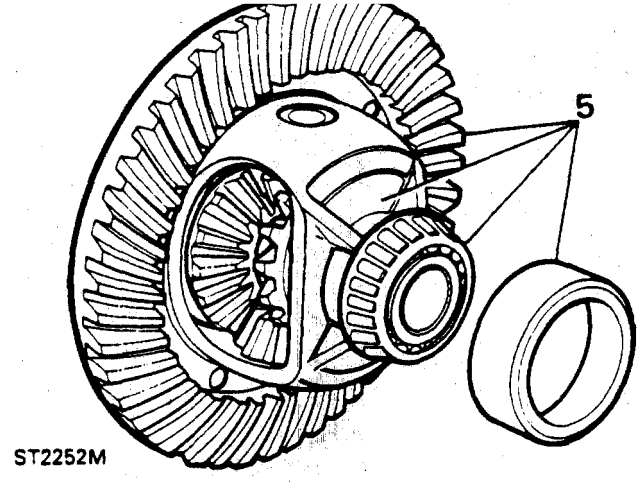
DISMANTLE

It is important that when dismantling the differential the relationship of the components are marked relative to each other and to their position in the pinion housing and differential carrier so that if refitted, the original settings are maintained to avoid the possibility of noise and premature wear of the overhauled axle. In particular bearing caps and gears must not be interchanged and new gears should never be matched with worn ones.

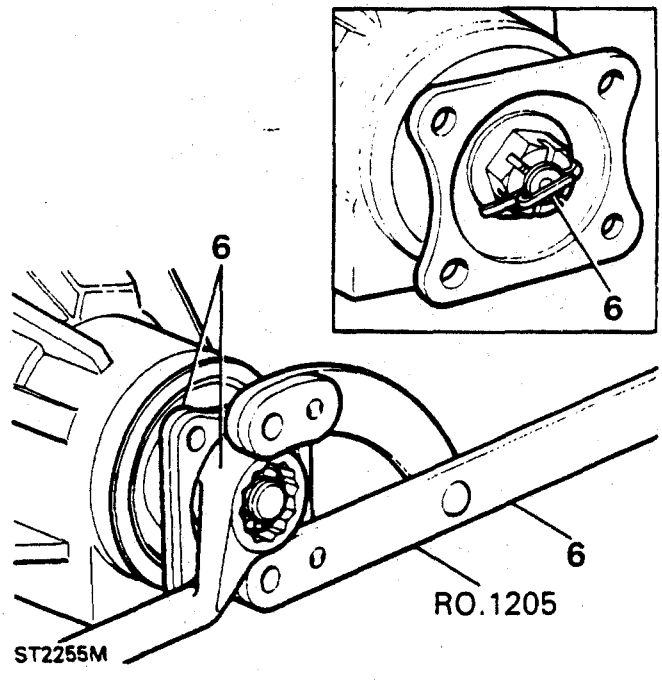
1. Drain the oil from the axle and refit and tighten the drain plug. Withdraw the axle shafts and remove the differential assembly from the vehicle. Clean and degrease the exterior of the pinion housing and secure the assembly in a vice in a vertical position.
2. Remove the two bearing nut locking fingers, by driving out the retaining roll pins from the bearing caps using a suitable punch.
3. Mark the caps in relation to the housing and slacken the four bolts securing the two bearing caps.
4. Using special service tool RO 530105 or a suitable alternative, unscrew the bearing nuts anticlockwise.



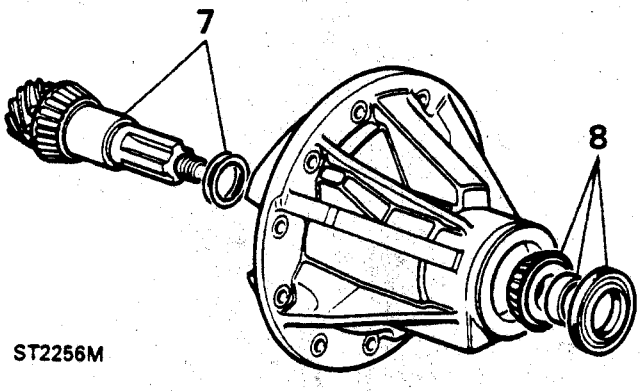
5. Lift-out the crown wheel and differential carrier assembly together with the taper bearings and tracks.



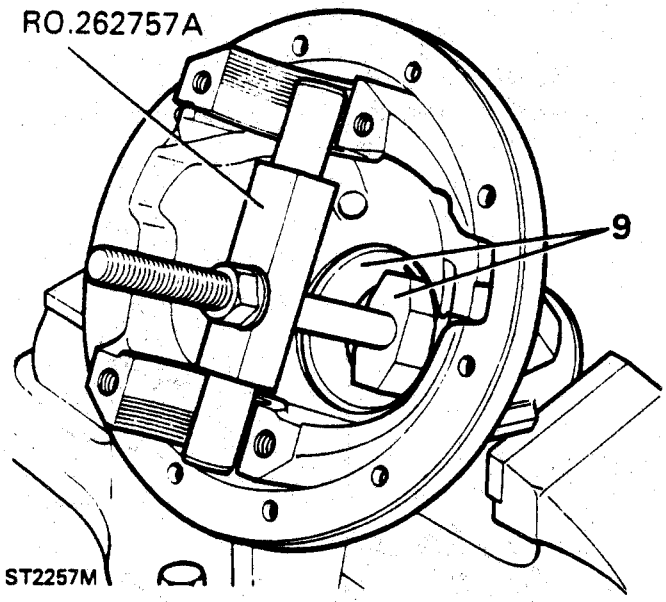
6. Reposition the pinion housing in the vice so that the pinion flange nut is accessible. Remove the split pin from the pinion nut and using special service tool RO 1205 or the reverse end of RO 530105, to restrain the flange, remove the nut anticlockwise using a socket or ring spanner.

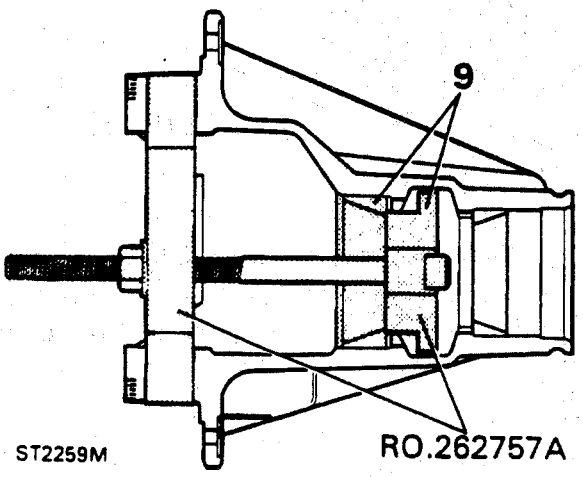


7. Withdraw the pinion complete with the pinion head bearing and shims.
8. Also, remove the oil seal, spacer and pinion tail bearing.

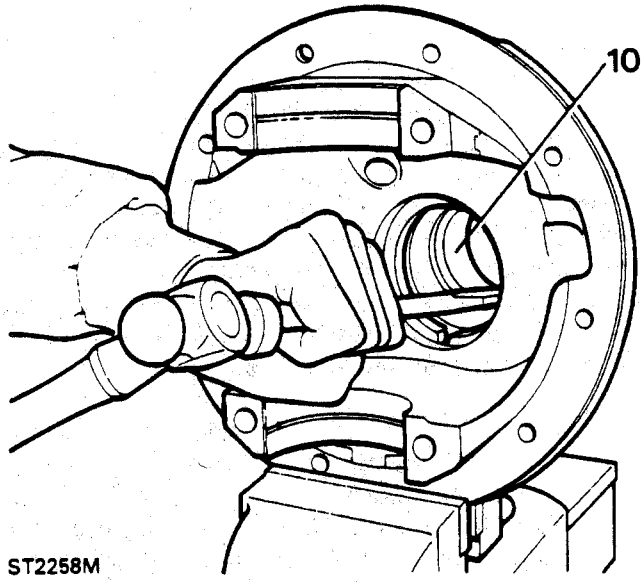


9. To remove the pinion head bearing track use special service tool RO 262757A ensuring that the lower end of the tool locates in the two cut outs in the housing. Using a ring spanner turn the nut clockwise and draw out the track and shim.

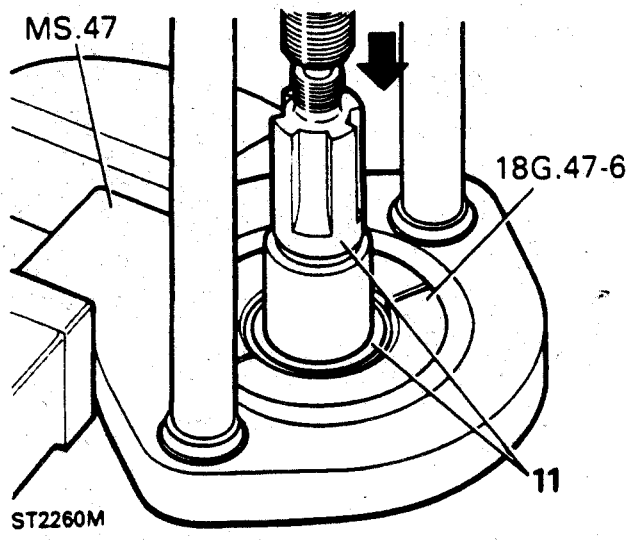




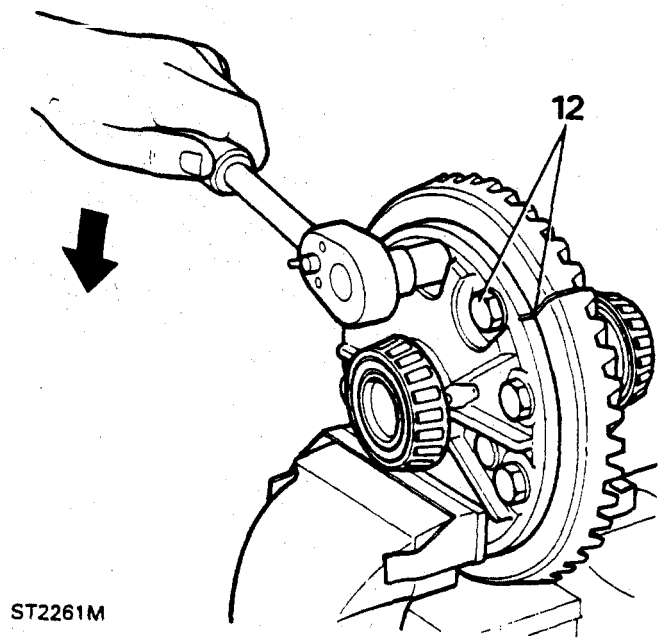
10. Using a suitable drift, drive out the tail bearing track locating the drift in the housing cut outs.



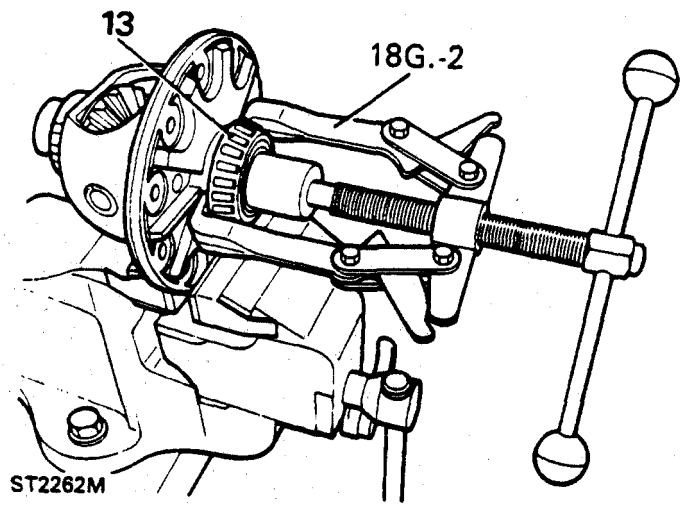
11. Now that all the components have been removed from the pinion housing, the main assemblies can now be dismantled. To remove the pinion head bearing, secure the press tool M.S. 47 in the vice. Encircle the bearing with the adaptor collets 18G 47-6 ensuring that the ends of the bearing rollers locate against the internal shoulder of the tool. Insert the assembly into the press tool and press the pinion from the bearing. Remember to hold the pinion to prevent it falling when released from the bearing.



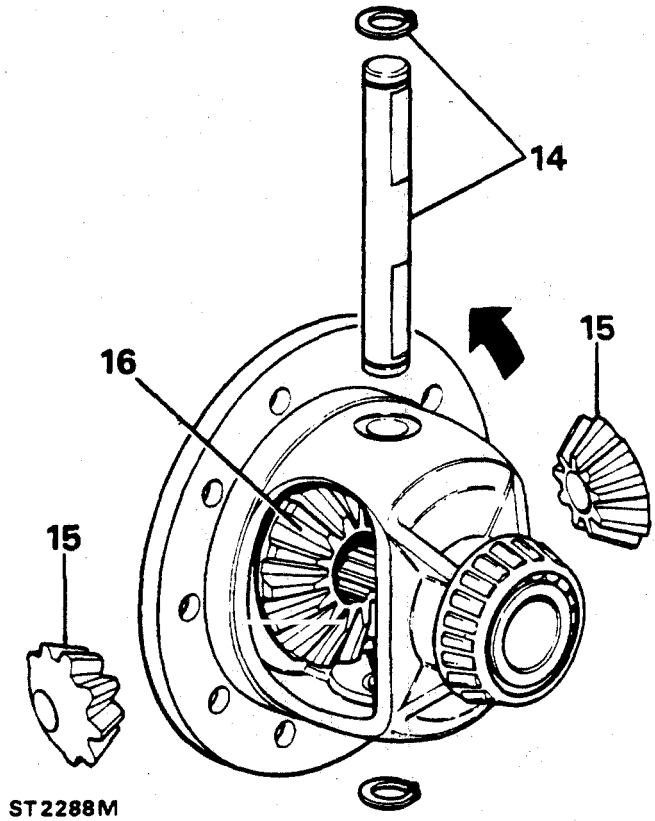
12. Mark the relationship of the crown wheel to the differential carrier and firmly secure the assembly in a soft jawed vice. Remove the ten bolts and washers and withdraw the crown wheel from the carrier. Since the bolt threads are secured with Loctite, it is possible that they will be tight for the entire length.



13. Remove the carrier bearings with the general purpose tool 18G 2 or a suitable alternative. It is possible, however, to drift-off the bearing from the gear housing side of the carrier by positioning a drift in the two cast indentations behind the bearing. The bearing on the crown wheel side can only by withdrawn with a puller.



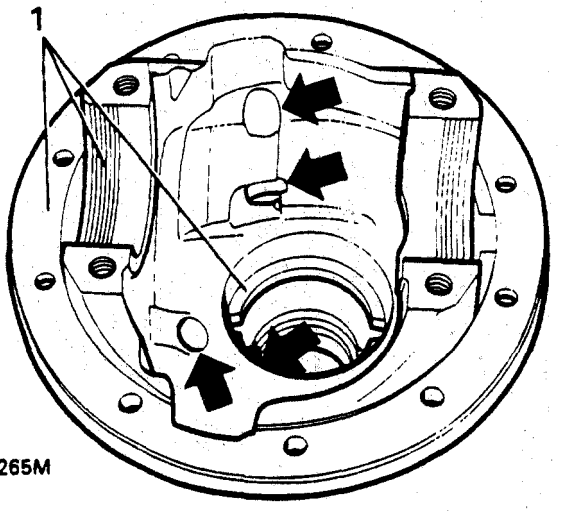
14. To remove the differential gears, release one of the two circlips securing the cross shaft and push out the shaft.
15. Turn the gear assembly 90 degrees to enable the two planet gears to be withdrawn through the carrier aperture.
16. Finally, remove the two sun gears.



17. Clean and degrease all components ready for inspection. Clean the threads of the crown wheel bolts with a wire brush to remove the old locking compound.

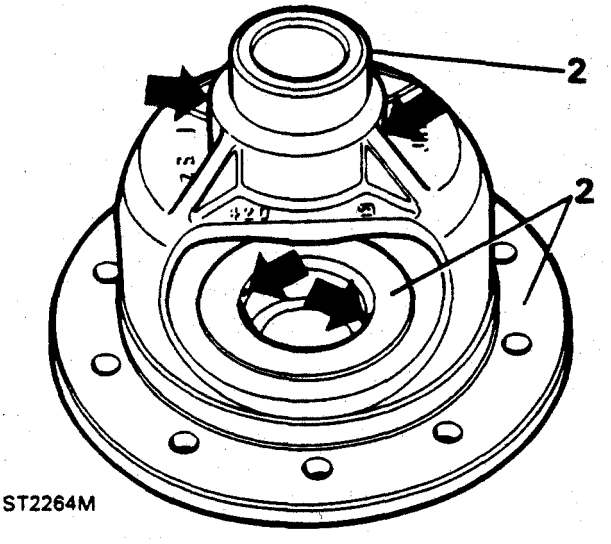
INSPECTION

1. Examine the pinion housing for damage. Check the machined surfaces and remove any burrs. Check the carrier bearing nut threads in the housing and caps and adjusting nuts for damage and repair as necessary. Make sure that the cast-in lubrication passages (arrowed) including the passage to the tail bearing, are completely clear of any obstruction.



ST2265M

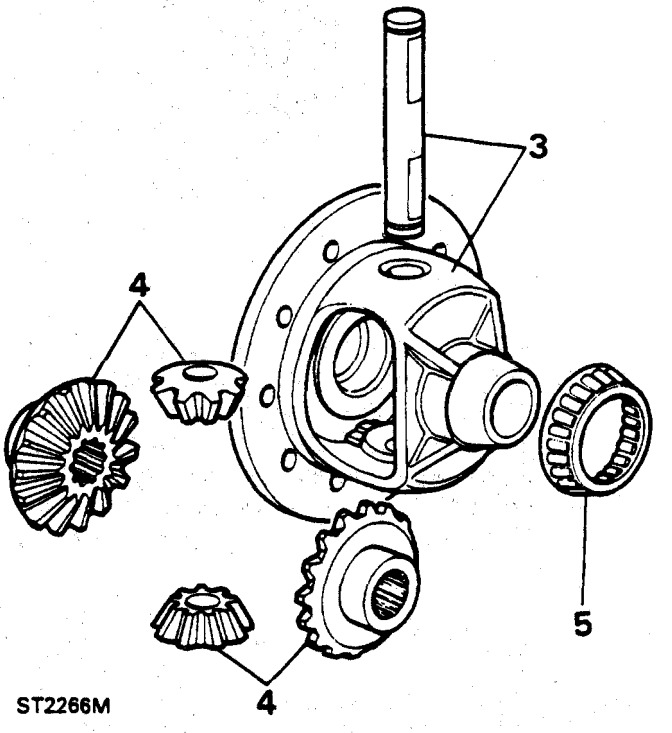
2. Examine the machined surfaces of the differential carrier for damage, pitting, scores and wear and in particular the surfaces on which the sun and planet gears run. Also, ensure that the four lubrication holes (arrowed) are clear. Any obstruction here could cause future bearing failure.



ST2264M

3. Check the cross shaft for scores and pitting. Insert the shaft in the carrier to check for excessive wear.

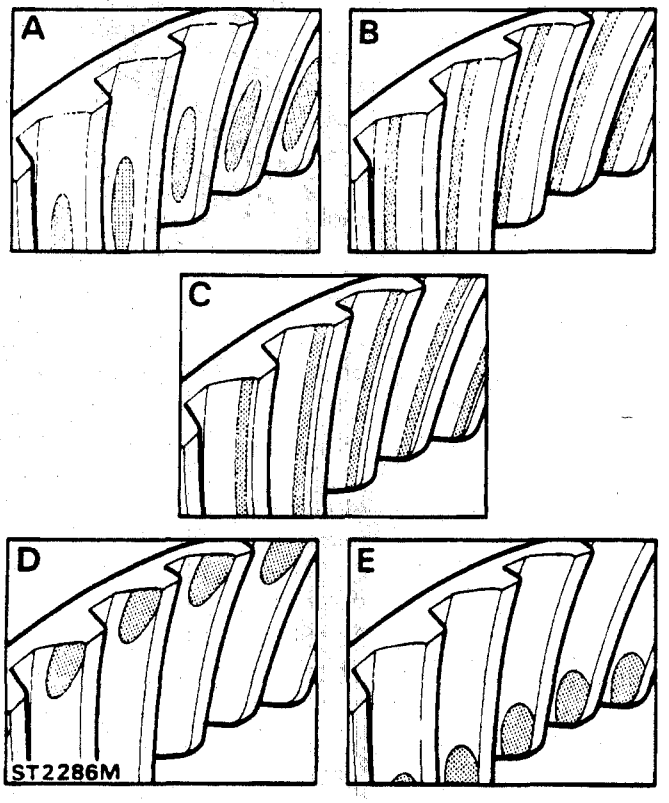
4. Carefully examine the sun and planet gears for wear on the teeth and the running surfaces in contact with the carrier. Check also for signs of over heating.
5. Inspect all the bearings for wear, pitting, flats on the rollers and overheating. If the bearings are serviceable they can be refitted but if new ones are available they must be renewed together with the tracks.



ST2266M

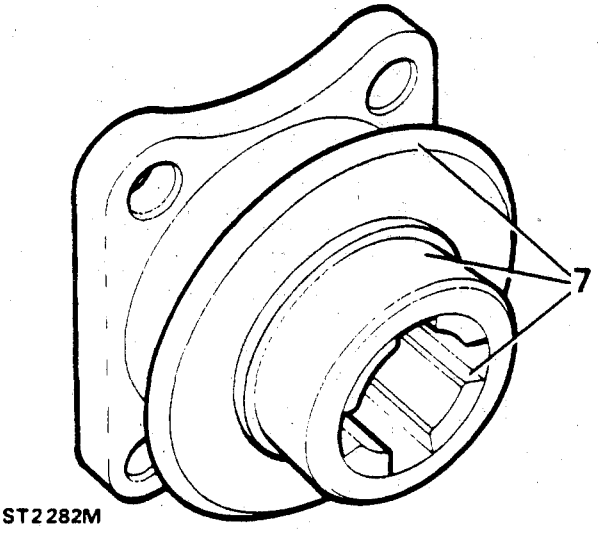
6. Examine the crown wheel and pinion for excessive and abnormal wear and signs of over-heating. Compare the tooth contact on the crown wheel driving side with the examples illustrated below. These examples, however, are for the rear axle crown wheel where the pinion is driven clockwise. Tooth contact for the front axle crown wheel, where the pinion is driven anticlockwise, is the same but on the opposite side of the tooth. The first example " A " shows the marks that should be made by a correctly meshed crown wheel and pinion. The remaining examples show incorrect tooth contact.

A. Correct contact.
B. Root contact - Pinion too far in mesh.
C. Peak contact - Pinion too far out of mesh.
D. Toe contact - Excessive backlash.
E. Heel contact - Insufficient backlash.



NOTE: The crown wheel and pinion are only supplied as a matched set likewise the sun and planet differential gears.

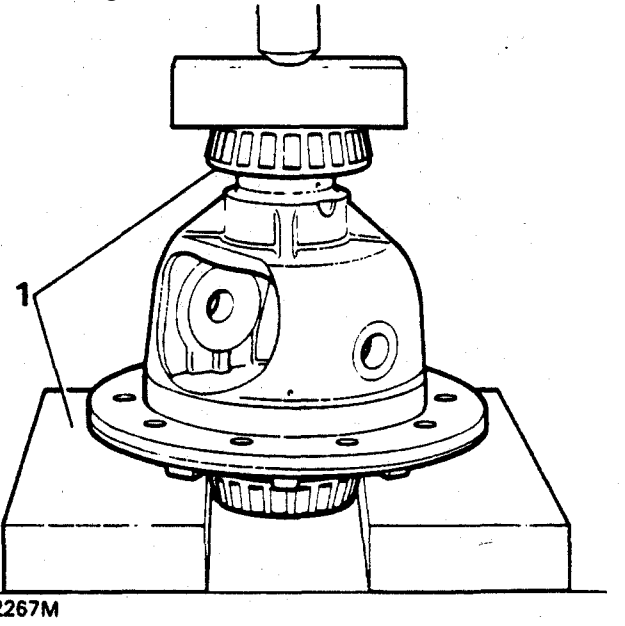
7. Finally, check the condition of the pinion and driving flange splines and ensure that the machined outer diameter of the flange is free from any damage that could destroy a new oil seal. Check that the mud deflector is not damaged or buckled to the extent that it cannot deflect mud and water away from the oil seal.



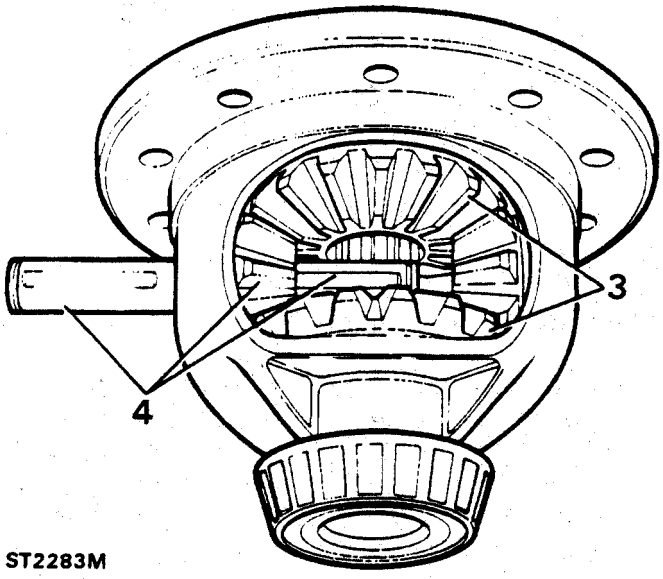
ASSEMBLE

Differential carrier and crown wheel

1. Lubricate the carrier bearing journals with clean oil and start the bearing squarely on to one side of the carrier, largest diameter towards the carrier. It does not matter which bearing is fitted first. Mount the carrier squarely under a suitable press, supporting it under the flange, as close as possible to the journals. Slowly press the bearing fully home against the carrier shoulder.
2. Repeat the above procedure to fit the second bearing.

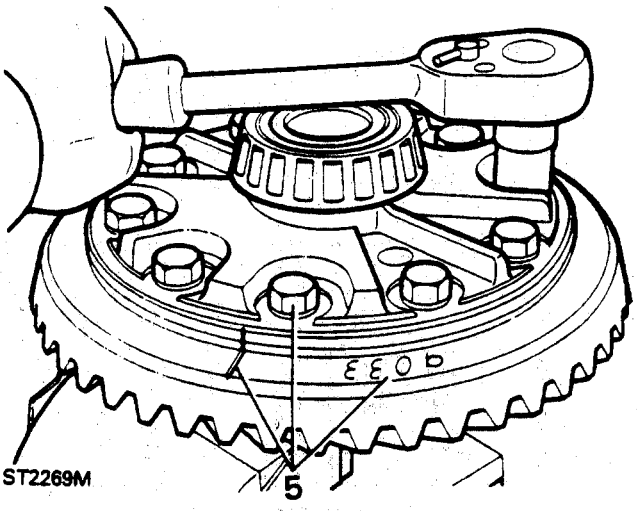


3. Lubricate and fit the two sun gears followed by the planet gears.
4. Align the planet gears with the carrier holes and fit the cross shaft. Secure the shaft with new circlips. Check the gears for freedom of rotation and that there are not tight spots. Only nominal backlash should be present but if excessive, the gears or the carrier or both should be changed since there is no provision for adjustment.



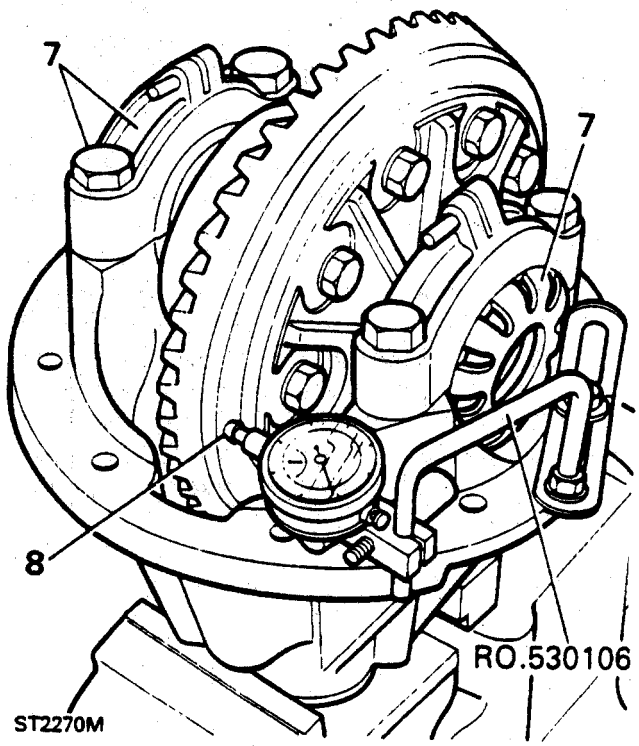
ST2283M

5. Check that the serial number etched on the pinion end face is the same as that marked on the crown wheel. Clean the crown wheel and carrier mating faces and check that there are no burrs or any other damage that could cause excessive run-out of the crown wheel. If the original crown wheel and pinion is being refitted ensure that the marks made when dismantling line up. Since the crown wheel is a fairly tight fit on the carrier, the bolt holes should be lined up first while locating the crown wheel squarely on the carrier. Fit and tighten the bolts evenly, a little at a time, until the crown wheel has pulled down on to the carrier flange. Tighten the bolts temporarily to the correct torque.



ST2269M

6. To check the crown wheel for run out, secure the pinion housing in the vice in a vertical position. Fit the tracks to the carrier bearings and lower the assembly into the pinion housing.
7. Fit the bearing caps, lining up the marks and just nip the bolts. Do not fully tighten. Fit the bearing adjuster nuts and tighten using service tool RO 530105 until there is no end float between the bearings. Now, tighten the bearing cap bolts evenly to the correct torque.

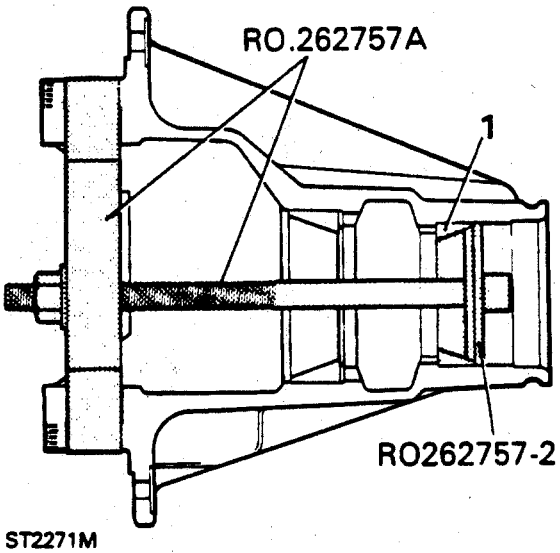


ST2270M

8. Mount a dial test indicator on the flange of the pinion housing using bracket RO 530106 so that the stylus rests on the back of the crown wheel. Turn the crown wheel and if the run out exceeds 0,10mm remove the crown wheel from the carrier and check again that there are no burrs, dirt or damage of any kind that could account for excessive run out. Fit the crown wheel again to the carrier and should the run out still persist, the crown wheel and carrier should be individually checked for run out on a lathe or similar equipment where the parts can be accurately turned and measured.
9. When satisfied that the run out is within the specified limit, remove the crown wheel bolts, one stud at a time, coat the theads with Loctite Studlock and refit the bolts tightening evenly to the correct torque.

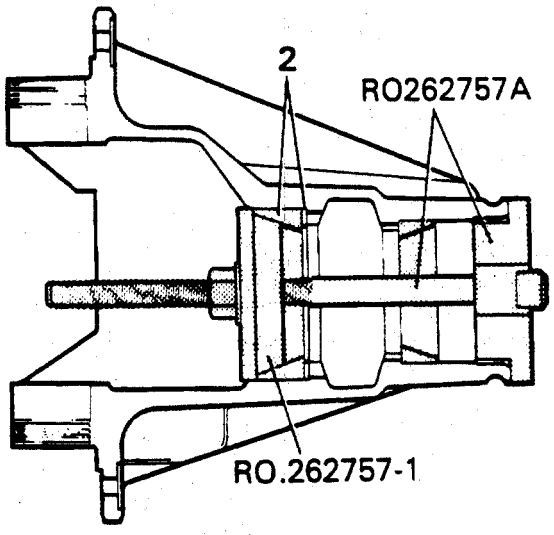
Fitting pinion bearing tracks

1. To fit the pinion tail bearing track, lubricate and start the track squarely in the pinion housing. Assemble the special tool RO 262757A and adaptor RO 262757-2 as illustrated below. Slowly turn the nut clockwise until the track is fully home against the housing shoulder.



ST2271M

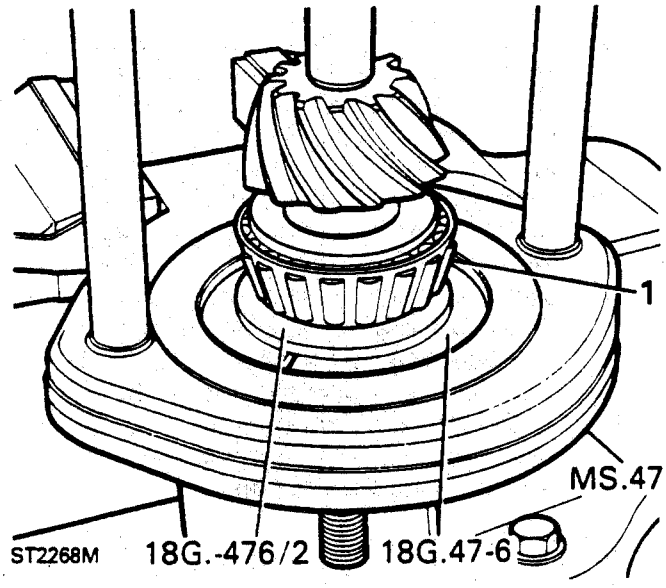
2. Fit the bearing head track and the original shim using main tool RO 262757A and adaptor RO 262757-1. Lubricate and start the track squarely in the housing and assemble the tool as shown below. If the shim was damaged during removal fit a new one of the same thickness. If the shim was lost before the size was measured, fit a replacement shim at least 1,27mm thick. Turn the nut slowly, using a box spanner, until the track is fully home against the housing shoulder. It is vital to the successful assembly of the differential and in particular the following pinion height setting, that the track and shim is indeed pressed fully home.



ST2272M

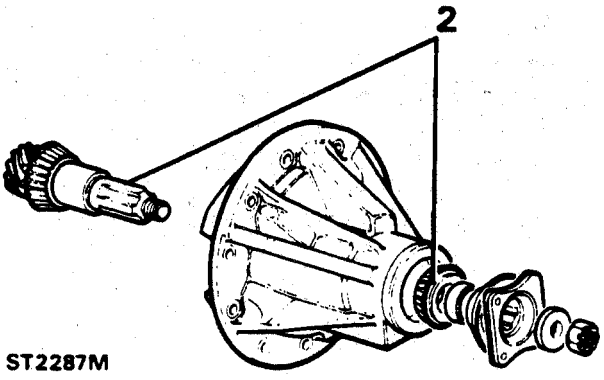
Pinion height setting

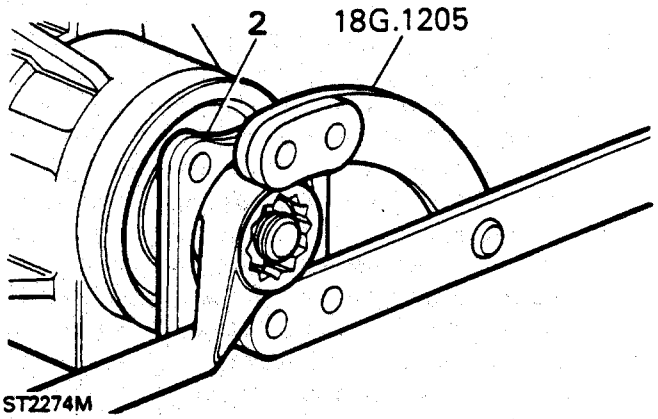
1. Fit the pinion head bearing to the pinion with press M.S. 47 and collets 18G 47-6 and 18G 47-6/2. Note that the smaller register on 18G 47-6/2 must be uppermost against the bearing. Ensure that the larger diameter of the bearing is towards the gear. Lubricate the pinion and press it slowly on to the bearing.



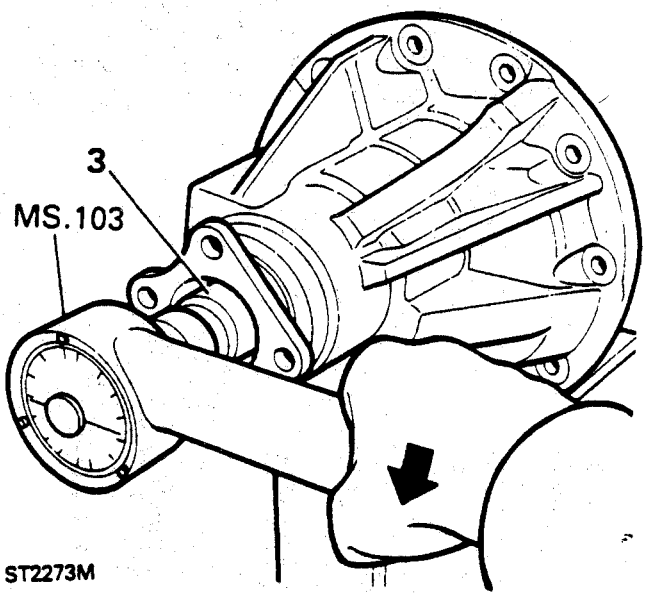
The object of the following instructions is to establish the correct height of the pinion, in the pinion housing, so that it will mesh correctly with the crown wheel. This may entail raising or lowering the pinion by adjusting the value of the shims behind the pinion head bearing track. In order to achieve this, the pinion bearings must be temporarily pre-loaded to the same figure as they will be when the differential is finally assembled.

2. Insert the pinion into the housing and fit the tail bearing without any pre-load shims. Fit the spacer and drive flange, omit the oil seal, and secure the assembly with the washer and nut. Restrain the flange with service tool 18G 1205 or the reverse end of RO 530105, and slowly tighten the nut a little at a time and remove the flange restrainer.

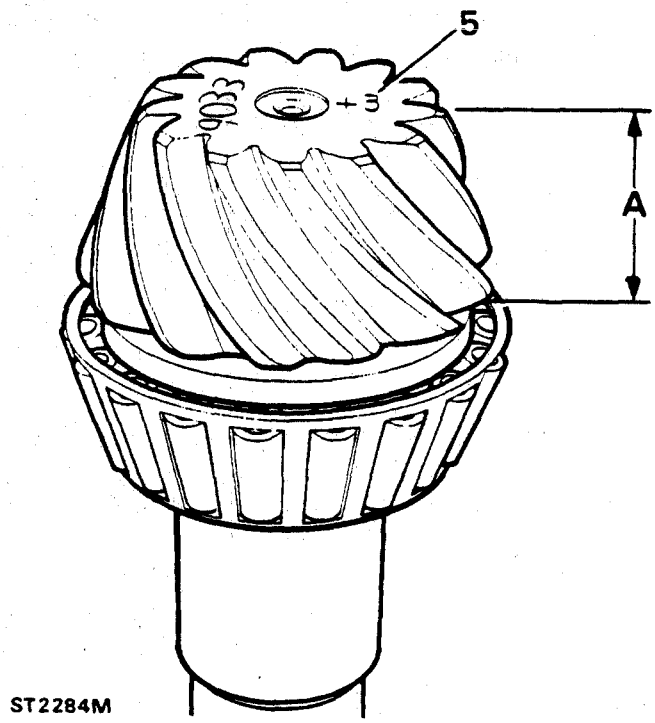




3. Fit a suitable socket to the torque pre-load meter M.S. 103 or a suitable alternative, and check the pre-load figure by turning the pinion, with the meter, in a clockwise direction. Continue to tighten the nut until the gauge reads 2 to 4 Nm.
4. Note that if the original, bedded-in, bearings are being refitted the pre-load figure should be 1.2 to 1.7 Nm.

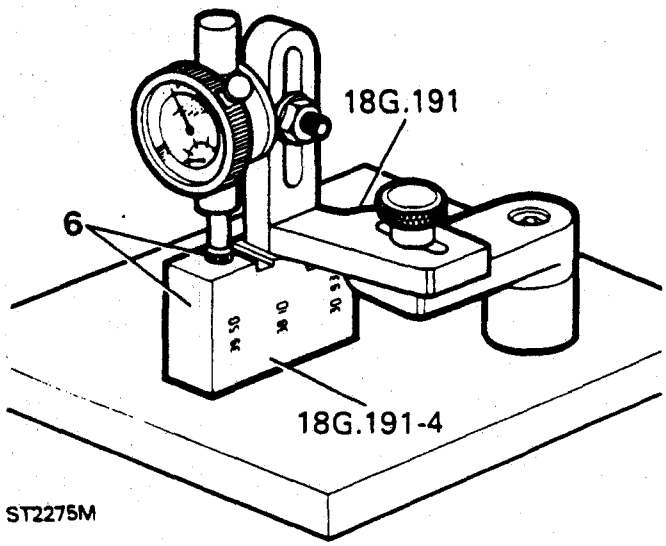


5. Secure the pinion housing vertically in the vice so that the pinion is uppermost. It will be noted that in addition to the serial number etched on the pinion end face there may be a figure with a minus (-) or a plus (+) sign before it. This figure indicates, in thousandths of an inch, whether the depth of the pinion head, (dimension A), is under or oversize from the designed dimension. A pinion without these figures must be set in the pinion housing at the nominal height dimension. The nominal height dimension is represented by the pinion height setting block 18G191-4. The dimension is taken from the pinion end face to the lowest point in the differential carrier bearing saddle in the pinion housing.

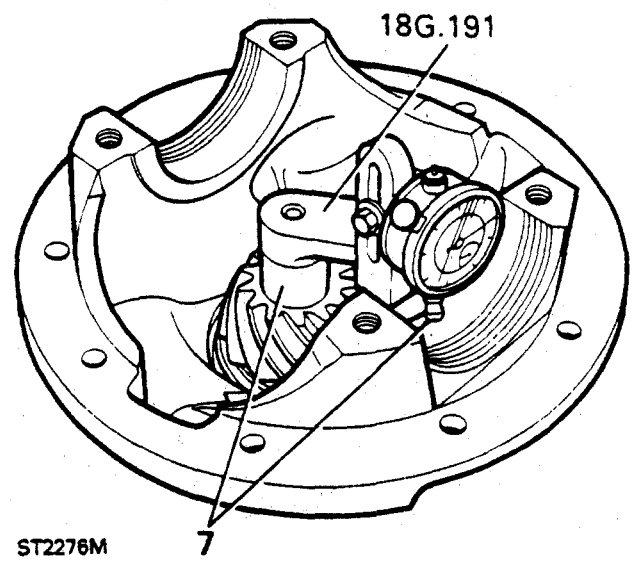


6. Remove the keep disc from the magnetic base of the pinion height setting dial gauge 18G 191 and position the setting block 18G 191-4 and gauge on a surface plate as illustrated. It will be noted that the setting block has three setting heights. It is essential that the correct setting is used for the differential concerned. Rest the stylus on the setting and load the gauge to read approximately 0,40 mm and zero the gauge.

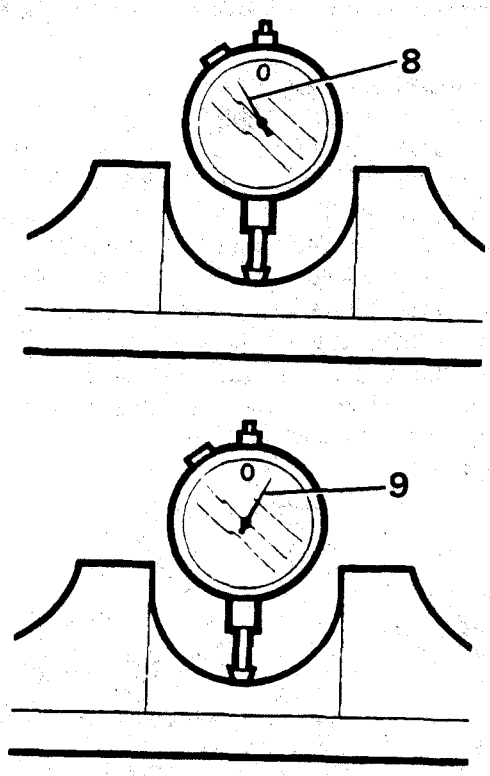
NOTE: The setting block dimensions are as follows: 39,50 mm Rationalised axle - Latest current axle metric threaded bearing cap bolts. 38,10 mm Pre-Rationalised axle recognized by the A/F threaded bearing cap bolts. 30,93 mm Salisbury axle only.



7. Ensure that the pinion head is clean and smooth. Transfer the gauge to the pinion housing so that the magnetic base sits centrally on the pinion end face and the stylus rests on the lowest point in one of the carrier bearing saddles. Make a note of the dial gauge reading from the zeroed setting and whether the gauge needle moved up or down. Now move the dial gauge across to the other saddle and again note the reading from the zeroed setting. Now add the two readings together and divide by two to obtain a mean reading.



8. If the dial indicator needle did not reach the zeroed setting, the difference between this setting and the position of the needle is the thickness of shims that must be removed from behind the pinion head bearing track to lower the pinion to the nominal dimension.
9. If the indicator needle moved beyond the zeroed setting, the difference between this setting and the position of the needle is the thickness of shims that must be added to those behind the pinion head bearing track to raise the pinion to the nominal dimension.



ST2277M

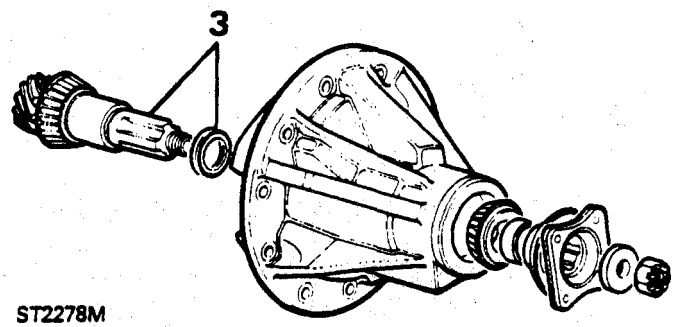
10. Before actually adjusting the shim thickness, the plus or minus figure, if any, on the pinion face must be taken into consideration when calculating the final thickness of shims that **must** be removed or added.
If the pinion has a plus (+) figure etched **on** the pinion face, subtract this figure, in thousandths of an inch, from the figure obtained in instruction 8 or 9. If the pinion has a minus (-) figure on the pinion face add this to that obtained in instructions - or 9. A pinion without a plus or minus figure must be adjusted to the nominal dimension and shims to the value indicated by the dial test indicator in instruction - or 9 should be added or removed.
11. Remove the pinion from the housing and withdraw the pinion head bearing track as previously described. Adjust the shim thickness as required by the above calculations. Refit the bearing track and shims and ensure that once again the track is pressed fully home,

12. Having made the necessary adjustments the pinion height setting must be checked again to ensure that the calculations and adjustments are correct. Refit the pinion to the housing and pre-load the bearings, as before, repeating instructions 2 and **3** above. Now set up the dial gauge and carry out the pinion height check again exactly as described in instructions 6 and **7.** If the pinion height setting is correct, the mean reading obtained will agree with the figure etched on the pinion face figure of +3 the dial gauge reading should indicate that the pinion head depth is indeed 0.003 in (0.0762 mm) oversize.

Pinion bearing pre-load adjustment

1. Position the pinion housing horizontally in the vice. From the pinion housing remove the drive flange, spacer, tail bearing and pinion.
2. Fit a new shim or shims of the same thickness as the originals to the pinion. If these are lost and the thickness is unknown fit shims to the value of at least 4,06 mm.

3. Fit the pinion, with the shims, to the housing, then the tail bearing followed by the spacer and driving flange. Omit the oil seal at this stage and secure the assembly with the washer and castellated nut.



ST2278M

4. Tighten the flange nut to the specified torque whilst holding the flange with service tool 18G 1205, as before. The torque now required to turn the pinion, if new bearings have been fitted, should be between 2 to 40 Nm once the initial inertia has been overcome. If the original, bedded-in, bearings have been refitted, the figure should be between 1.2 to 1.7 Nm. To check the torque or pre-load, use the Torque meter M.S. 103 and a socket and turn the pinion whilst noting the meter reading. If necessary, dismantle the pinion assembly and change the bearing pre-load shims in order to achieve the correct torque figure. As a guide, thicker shims will reduce the torque or pre-load and thinner shims will increase the torque. Reassemble the pinion again and recheck the torque.

Fitting pinion oil seal

1 Having established the correct thickness of shims the pinion drive flange must be removed to fit the oil seal. Examine the seal before fitting to ensure that it is clean and undamaged, since even a small scratch **on** the seal lips could impair its ability to prevent oil leaking. Also check that the garter spring is properly located. Whilst the distance piece can be inserted after the seal has been fitted, the tail bearing will not pass through the seal, so it is important to check that the bearing is in

5. After evenly tightening the bearing cap bolts to the correct torque, check the backlash again to ensure that it has not altered the setting. Fit the locking finger and secure with the roll pin.
6. Locate a new joint washer over the axle casing studs, liberally lubricate the bearings and gears and refit the differential assembly to the axle. Fit and tighten the retaining nuts evenly to the correct torque.
7. Check that the drain plug is tight and remove the axle oil filler level plug. Inject approximately 1,70 litres of a recommended axle oil until it begins to run from the level hole. Fit and tighten the plug and wipe away any surplus oil.

PINION HEIGHT SHIMS.

PART No.	MM
549230	0.97
549232	1.02
549234	1.07
549236	1.12
549238	1.17
549240	1.22
549242	1.27
549244	1.32
549246	1.37
549248	1.42
549250	1.47
549252	1.52
576236	1.57
576237	1.60
576238	1.63
576239	1.65

PINION PRE-LOAD SHIMS.

PART No.	MM
FRC1193	1.52
FRC1195	1.57
FRC1197	1.63
FRC1199	1.68
FRC1201	1.73
FRC1203	1.78
539718	1.83
539720	1.88
539722	1.93
539724	2.03

DATA

Pinion bearing pre-load:	
New bearings	2.0 - 4.0 Nm
Bedded-in bearings	1.2 - 1.7 Nm
Crown wheel run-out	0,10 mm
Crown wheel and pinion backlash	0,10 - 0,17 mm

TORQUE FIGURES	**Nm**
Pinion housing to axle case	36 - 46
Crown wheel to differential case	55 - 61
Bearing cap to pinion housing	80 - 100
Drive flange to **propeller shaft**	41 - 52
Bevel pinion nut	95 - 163

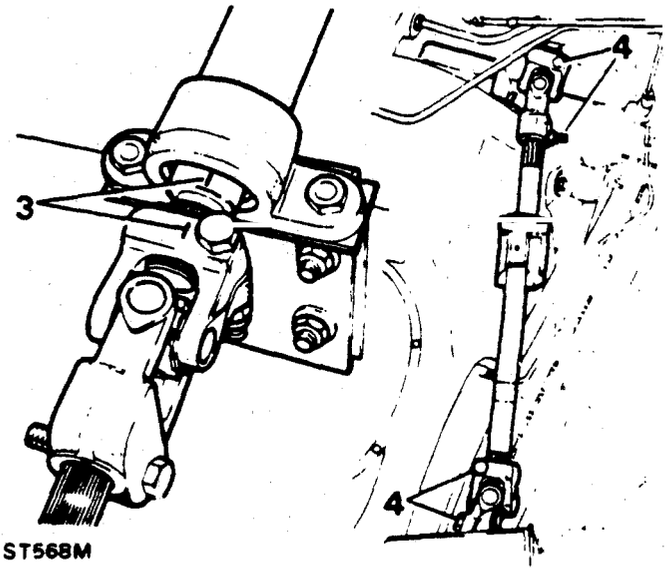
REMOVE AND OVERHAUL STEERING COLUMN

Remove the collapsible shaft

1. Remove the bonnet.
2. Set the road wheels and steering wheel in the straight ahead position.
3. Mark the relationship of the steering column inner shaft to the top universal joint.

NOTE: The Collapsible shaft can be disconnected from the steering column only, if required, by removing the bolts from the top universal joint and slackening the top bolt of the lower universal joint.

4. Remove the two bolts from the top universal joint and the lower bolt of the bottom universal joint. Slacken the top bolt of the lower universal joint and withdraw the shaft

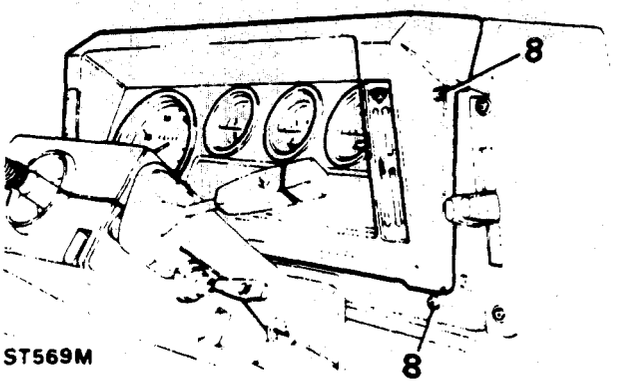


Remove the steering wheel

5. Remove the single screw retaining steering wheel finisher and remove the finisher.
6. Remove the steering wheel retaining nut and if necessary, use a suitable puller to remove the wheel.

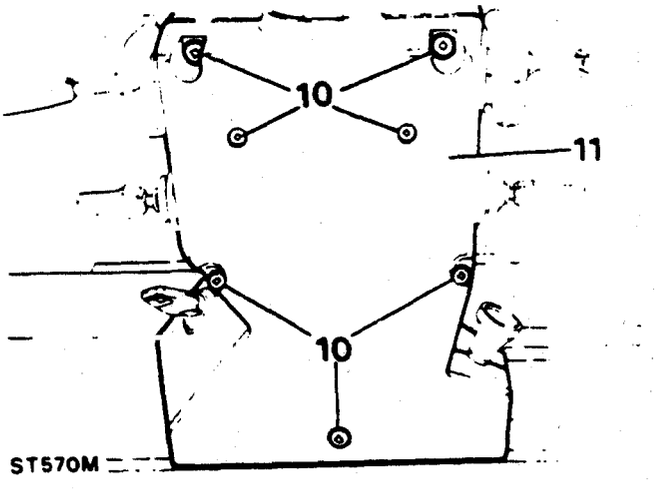
Remove the instrument panel

7. Disconnect the battery.
8. Remove the four screws securing the instrument panel and pull panel away from facia to enable the speedometer cable to be disconnected.
9. Also disconnect two block connectors, one multi-plug connector and one white wire and withdraw the panel complete with instruments

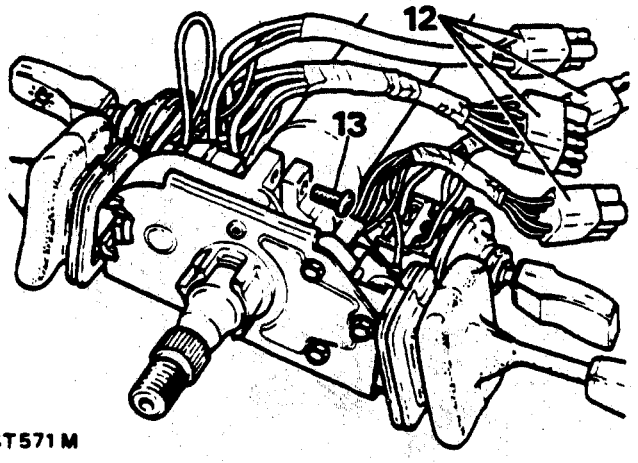


Remove the steering column switches

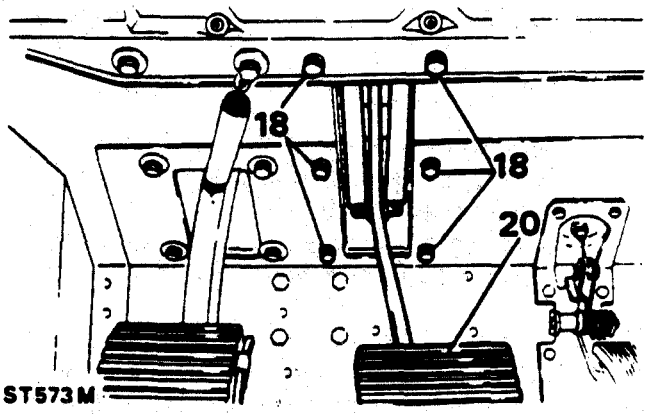
10. Remove five screws and two self-tapping screws to remove the top half of the nacelle.
11. Ease the bottom half of the nacelle from the four switch grommets and remove the lower nacelle.



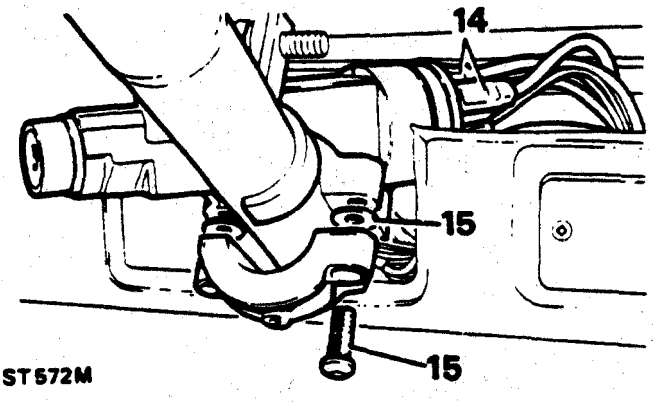
12. Disconnect the four multi-plugs, one for each switch making note of their positions.
13. Remove one clamp screw on top of the switch cluster and withdraw the switches.



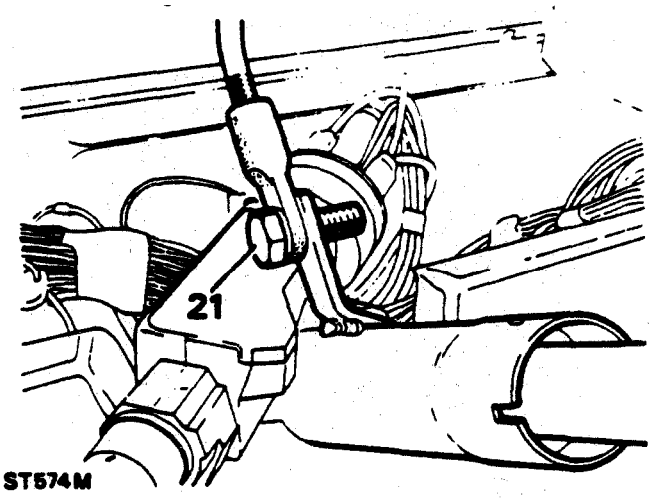
ST571M



ST573M



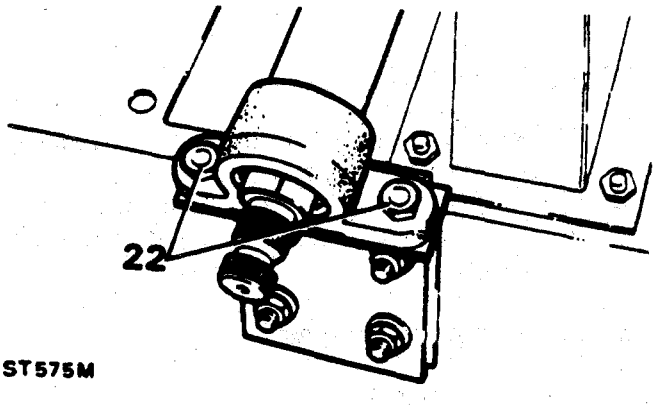
ST572M



ST574M

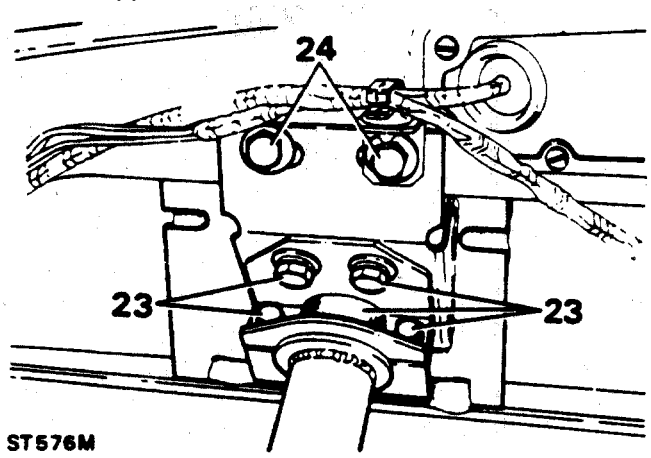
Remove the brake pedal box

16. Remove the vent cover and the strip retaining the mill board trim covering the brake pedal mechanism and remove the trim, to expose the pedal box bolts.
17. Remove the two nuts securing the brake master cylinder to the servo and disconnect the vacuum hose from me servo.
18. Remove the six bolts retaining the pedal box to the bulk head.
19. Disconnect the wires from the stop lamp



ST575M

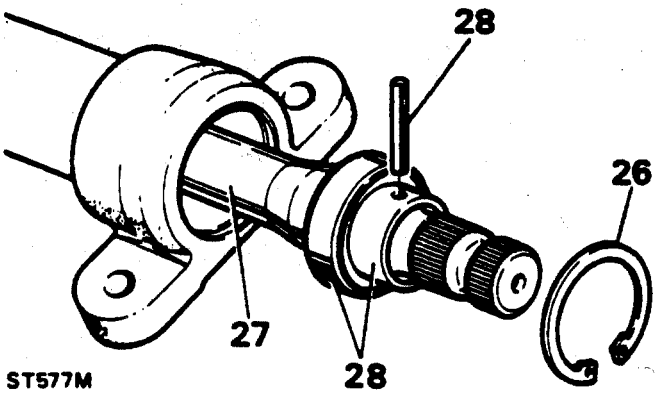
23. Remove the two bolts securing the two halves of the top clamp and the two bolts that secure the top half of the clamp to the bulkhead and remove the clamp and rubber packing.
24. Remove the two bolts securing the column main support bracket to the bulkhead.
25. Remove the steering column and main support bracket from the vehicle.



ST576M

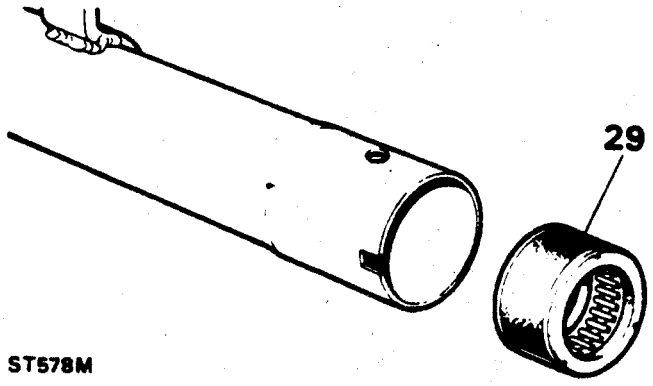
Overhaul the steering column

26. Remove the circlip from the lower end of the steering column.
27. Drift out the inner shaft complete with bearing from the top end of the column.
28. Remove the roll pin from the bearing retaining collar and drive the collar and bearing from the inner shaft



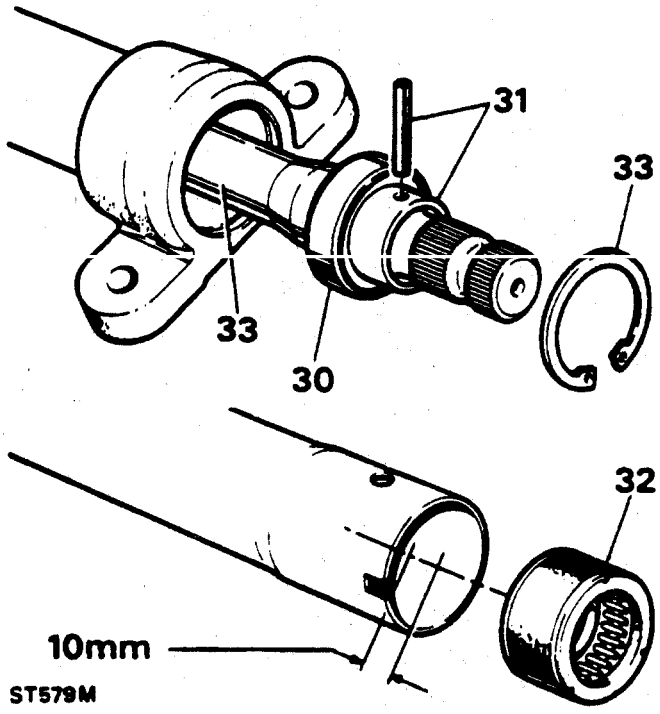
ST577M

29. Drive the needle bearing from the outer column.



ST578M

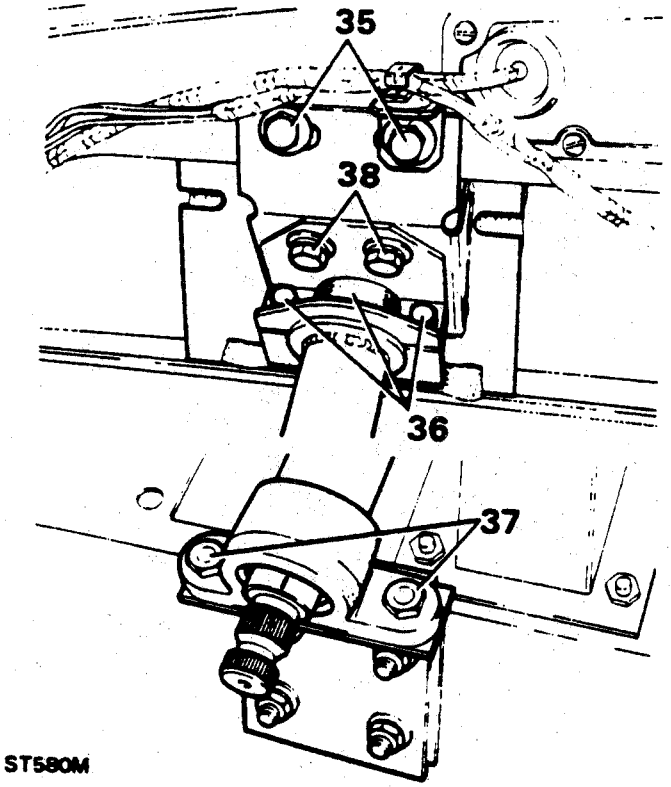
30. Fit a new bearing to the lower end of the inner shaft.
31. Fit the retaining collar, ensuring that it butts against the bearing and that the roll pin holes line up. Secure with the roll pin.
32. Fit a new roller bearing to the top end of the outer column to a depth of 10 mm.
33. Fit the inner shaft and bearing assembly to the outer column and secure with the circlip.



ST579M

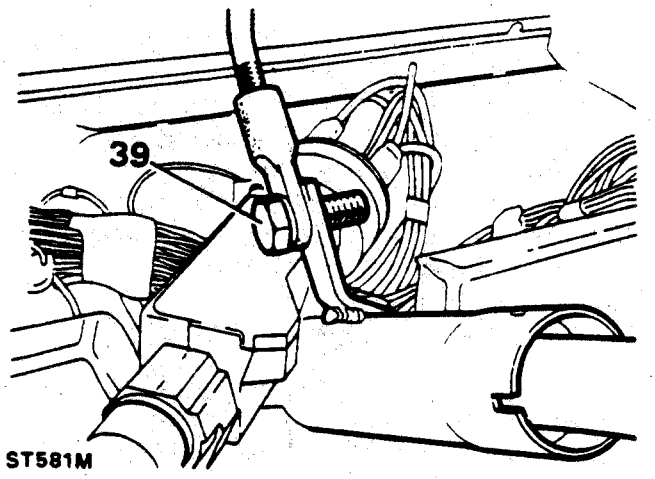
Fitting steering column

34. Fit the main support bracket and padding to the steering column and manoeuvre the column into position in the vehicle.
35. Loosely secure the main support bracket and harness bracket to the bulkhead with two bolts.
36. Loosely fit the clamp and rubber packing strip to the column and retain with two bolts.
37. Loosely secure the lower end of the column to the lower support bracket with two nuts and bolts.
38. Loosely secure the clamp bracket to the main support bracket with two bolts.



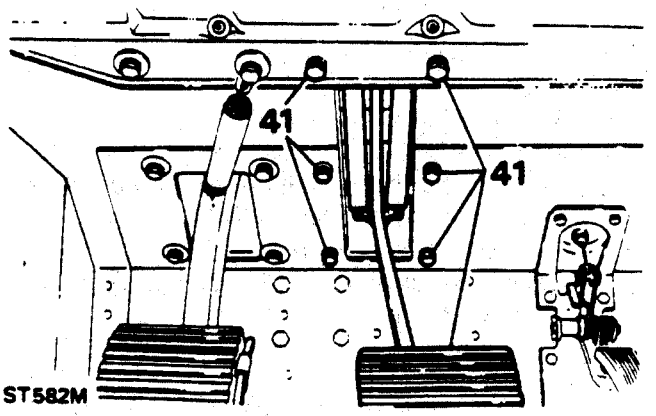
ST580M

39. Working inside the vehicle cab, fit the tie-bar to the column bracket and secure with the single bolt.
40. Finally tighten the main support bracket bolts, clamp bracket bolts, upper clamp bolts and the lower support bracket nuts and bolts.



ST581M

41. Fit the pedal box and secure with the six bolts. Fit the pedal assembly mill board trim and secure with retaining strip, vent cover and screws.
42. Fit the master cylinder to the servo and connect the servo vacuum hose.
43. Connect the stop lamp switch leads.

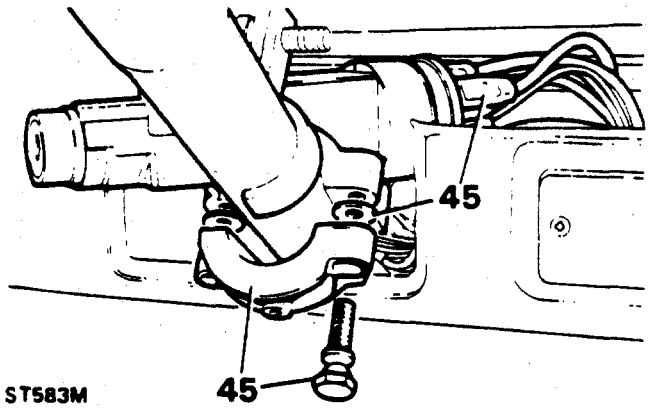


ST582M

Fit steering column lock switch

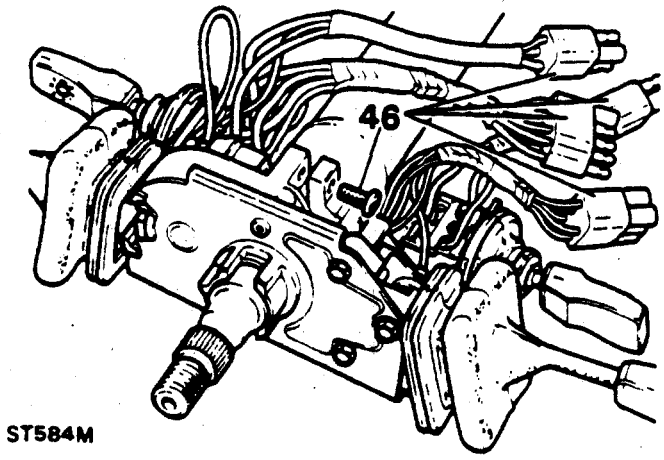
44. Place lock switch in position and rotate the steering column inner shaft to line up the slot with the switch plunger.

45. Secure the lock to the column with the clamp and shear bolts, whilst inserting two plain washers between the switch and clamp. Tighten the bolts but not enough to shear them. Temporarily fit the steering wheel and operate the switch and lock mechanism several times to ensure it functions properly before finally tightening the bolts until the heads shear. Connect the electrical leads to the rear of the switch



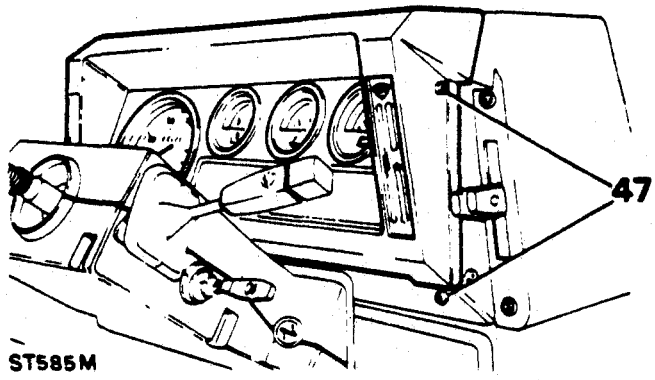
Fit steering column switch assembly

46. Fit the steering column switch assembly and secure with the single screw. Connect the four multi-plugs to the main harness.

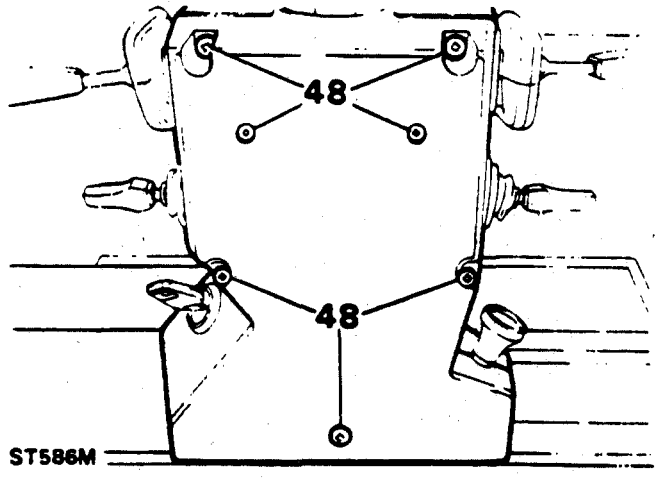


Fit instrument panel and nacelle

47. Offer up the instrument panel and connect the speedometer cable, two block connectors one multi-plug and single white wire. Secure the panel with the four screws.

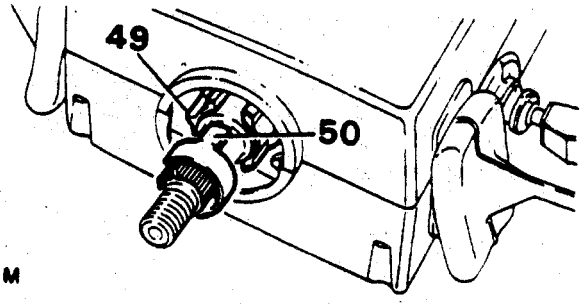


48. Locate the top half of the nacelle in position. Locate the switch grommets and secure the two halves together with the four long screws one short and two self-tapping screws.



Fit the steering wheel

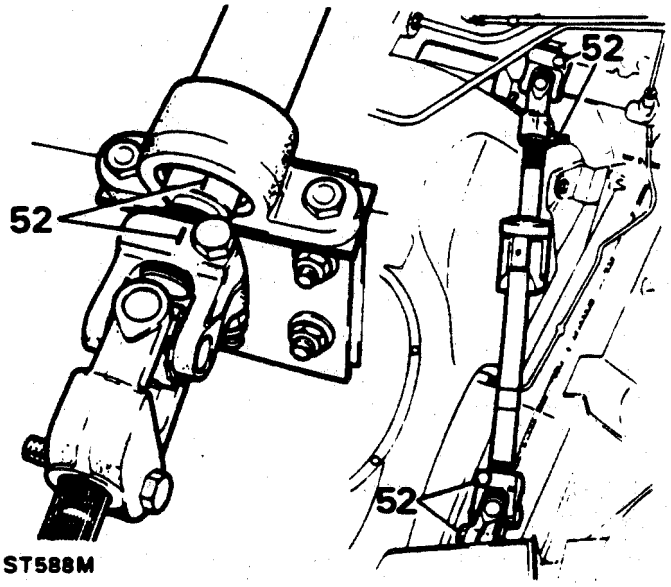
49. Turn the cancelling ring so that the slots are vertical and the lug with the arrow points to the left, in the direction of the indicator switch. Engage the steering lock.
50. Fit the steering wheel with the finisher attachment lug at the bottom. Ensure that the indicator cancelling forks locate in the cancelling ring slots. Secure the wheel with the shake-proof washer and nut and tighten to the correct torque. Fit the finisher and secure with the single screw.



ST587M

Fit collapsible steering shaft

51. If necessary, fit new universal joints to the support. Note that the long joint is fitted to the short length of shaft and short joint to the long end. The joints can only be fitted one way to the shaft.
52. With the steering lock engaged and the road wheels in the straight ahead position line-up the marks made in instruction 2 and fit the collapsible shaft assembly with the long leg of the shaft to the steering box. Fit the pinch bolts and tighten to the correct torque figure 22 - 28 Nm.



ST588M

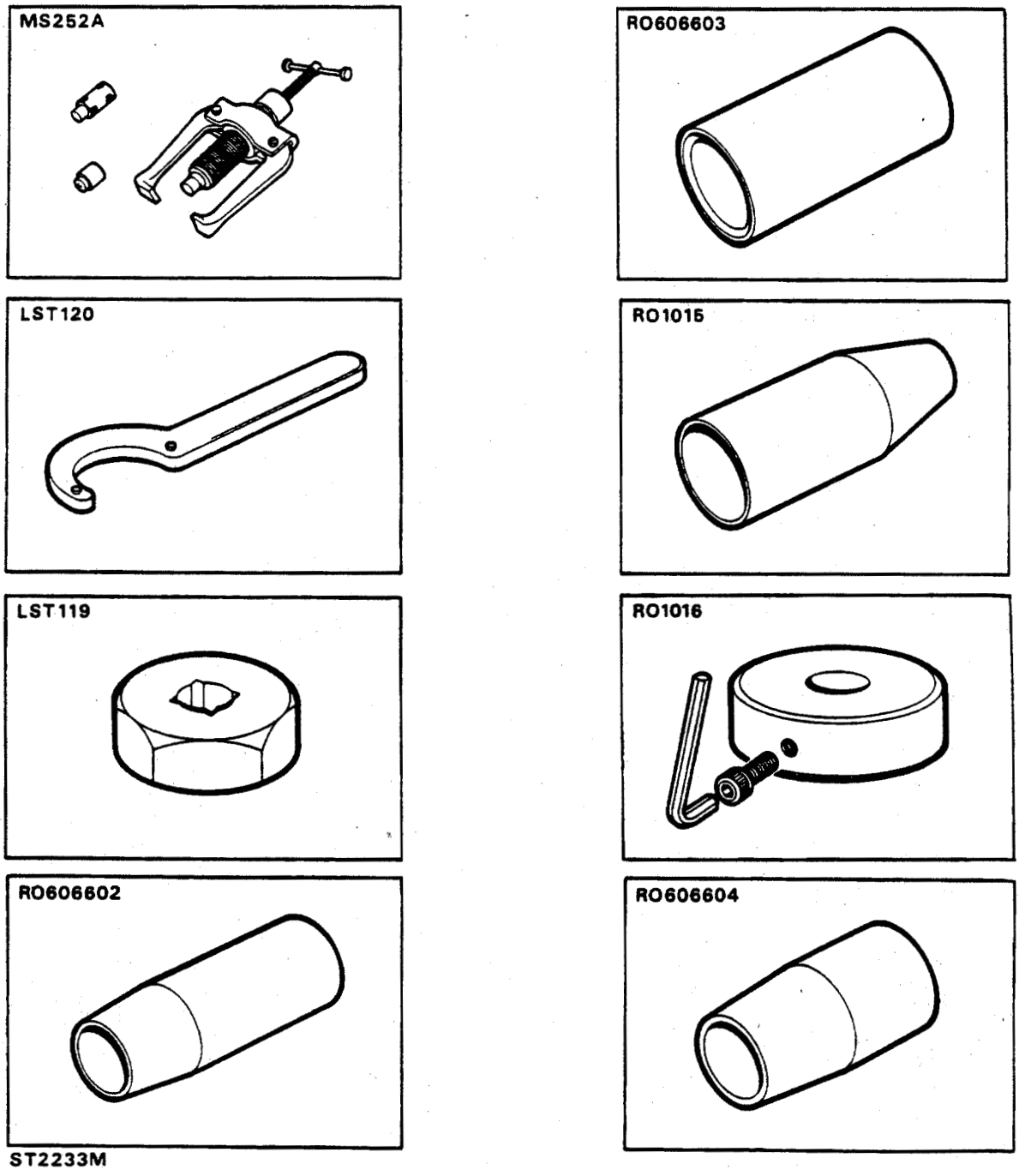
TORQUE FIGURES	Nm
Drop arm nut	176
Steering wheel nut	38
Sector shaft cover to steering box	22
Top cover bolts	50
Top cover bolts from serial No: lJ0001	75

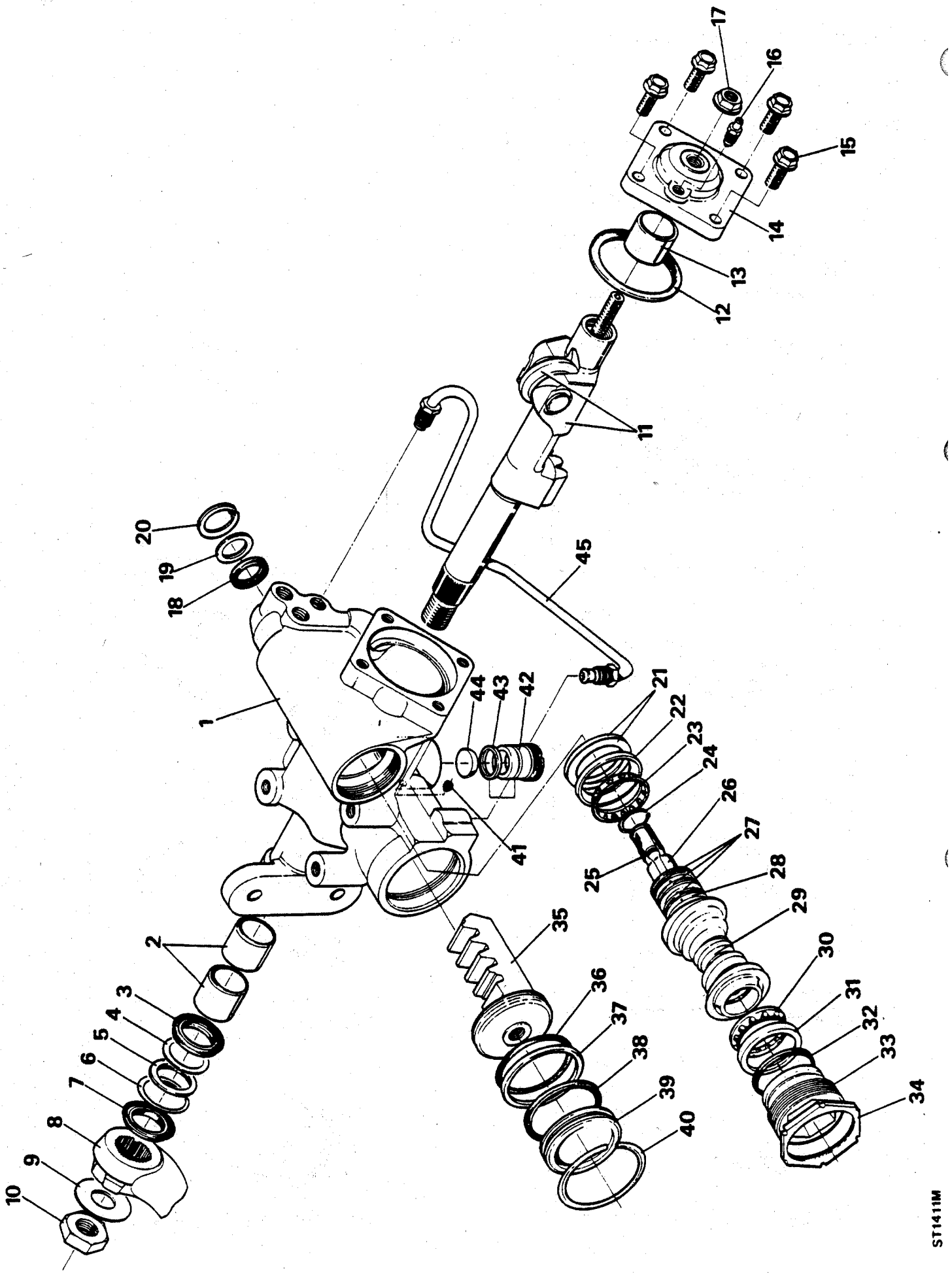
POWER STEERING BOX OVERHAUL

Adwest Lightweight

Special service tools

Drop arm extractor	M S 252A / LRT-57-012
'C' spanner	LST 120 / LRT-57-007
Worm adjusting socket	LST 119 / LRT-57-006
Ring expander	RO 606602 / LRT-57-019
Ring compressor	RO 606603 / LRT-57-020
Seal saver, valve and worm	RO 1015 / LRT-57-016
Torque setting tool	RO 1016 / LRT-57-017
Seal saver, sector shaft	RO 606604 / LRT-57-021

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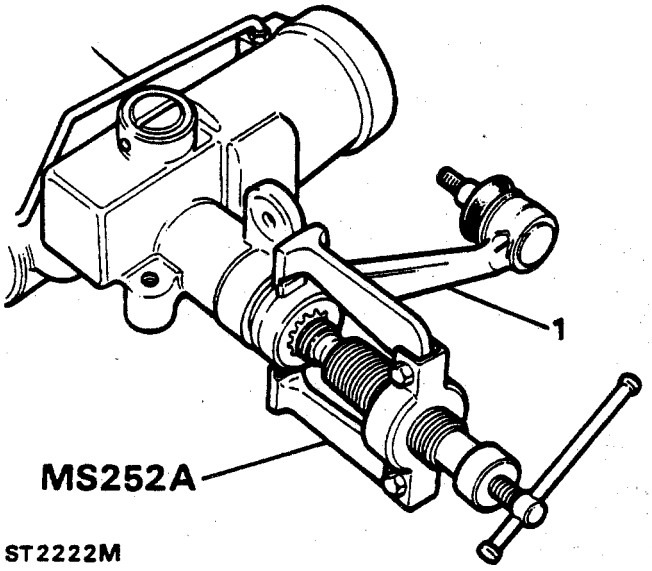
ST1411M

KEY TO LIGHTWEIGHT POWER STEERING BOX

1. Housing.
2. Housing bushes.
3. Seal.
4. Back-up washer.
5. Back-up seal.
6. Circlip.
7. Dust seal.
8. Drop-arm.
9. Tab washers.
10. Sector shaft nut.
11. Sector shaft and follower assembly.
12. Seal.
13. Bush.
14. Cover plate.
15. Self locking screws - 4 off.
16. Bleed screw.
17. Lock nut.
18. Rotor seal.
19. Seal washer.
20. Circlip.
21. Shims.
22. Bearing track.
23. Bearing cage.
24. Circlip.
25. Seal torsion bar.
26. Rotor.
27. Teflon rings - 3 off.
28. Stop-off rings.
29. Worm.
30. Bearing cage and balls.
31. Bearing track.
32. Seal.
33. Worm adjusting screw.
34. Lock nut.
35. Piston.
36. Piston 'O' ring.
37. Piston Teflon seal.
38. Cylinder cover seal.
39. Cylinder cover.
40. Cylinder cover retainer.
41. Screw.
42. Rack adjusting screw.
43. Rack adjusting screw seal.
44. Rack pad.
45. Fluid line.

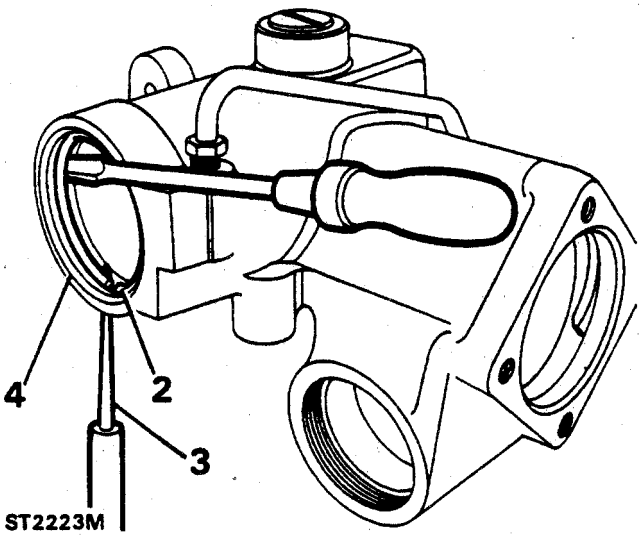
Dismantle

1. To assist assembly, turn the input shaft to bring the steering to the straight ahead position and mark the relationship of the drop arm to the casing. Using special service tool MS 252A withdraw the drop arm and remove the outer dust seal.



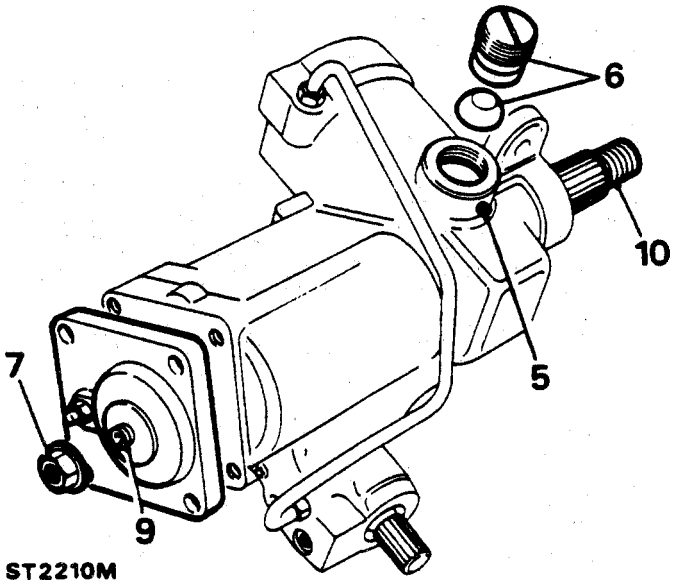
ST2222M

2. Rotate the piston cover retaining ring until one end is about 12 mm from the extractor hole in the side of the cylinder housing.
3. Lever the retaining ring from its locating groove by inserting a suitable pointed drift through the extractor hole. Complete the removal of the ring using a screw driver.



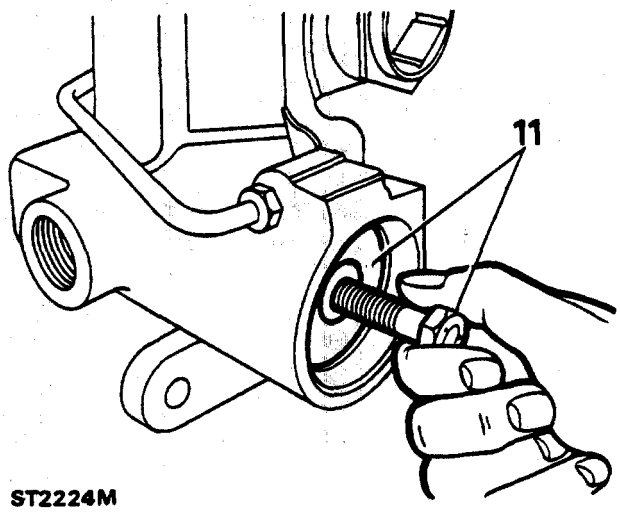
ST2223M

4. To remove the cover, turn the input shaft, in the appropriate direction, until the piston pushes out the cover. For a left-hand steering box, position the sector shaft on the left-hand lock and for a right-hand box on the right-hand lock.
5. Slacken the grub screw locking the rack pad adjuster.
6. Remove the rack pad adjuster clockwise and withdraw the pad.
7. Remove the sector shaft lock nut. The nut, which has a seal moulded inside it, also acts as a fluid seal. The nut should therefore be discarded and a replacement new nut obtained for reassembly.
8. Remove the sector shaft cover bolts.
9. Turn the sector shaft adjuster clockwise with a 6 mm Allen key whilst holding the cover, to prevent it turning, until the cover is removed.
10. The sector shaft can now be removed from the casing.



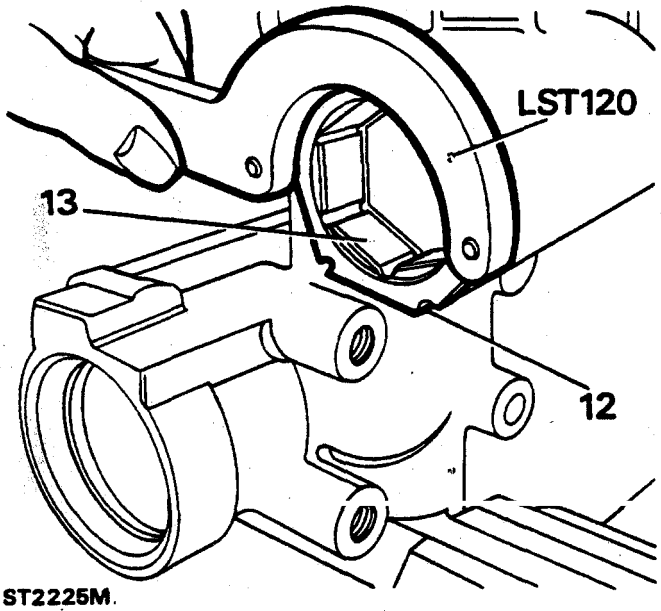
ST2210M

11. To remove the piston, screw a suitable bolt into the piston crown and use it to pull the piston from the casing.



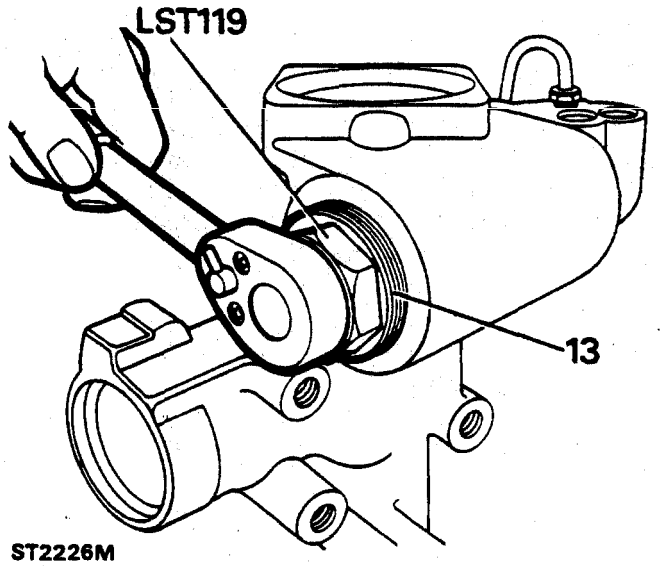
ST2224M

12. Remove the worm shaft adjuster lock nut using special service tool LST 120.

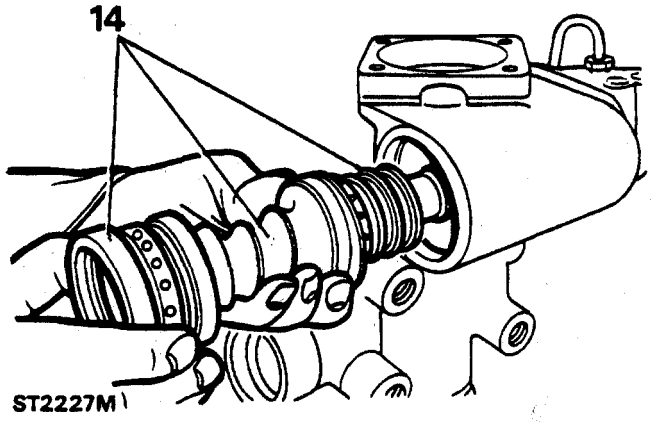


ST2225M

13. Using service tool LST 119 remove the worm shaft adjuster.
14. To withdraw the shaft and bearings tap the splined end of the shaft and lift-out the assembly.

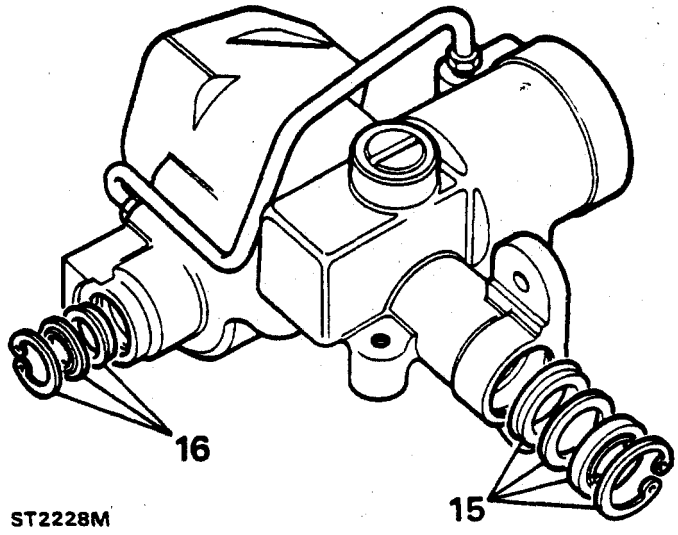


ST2226M



ST2227M

15. Remove the circlip from the sector shaft bore to enable the seal assembly to be withdrawn.
16. Similarly, remove the circlip from the input shaft (worm shaft) bore and remove and discard the seals.



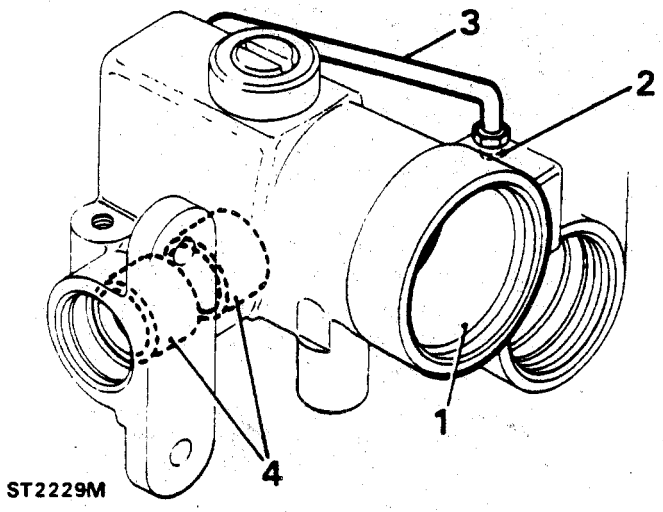
ST2228M

NOTE: The steering box has now been dismantled except for the sector shaft bushes, shown dotted. Since replacement bushes are not available, they should not be **removed. The input shaft inner bearing cup and shims may also still** be **in position if jarring of the box has not already dislodged them and instructions for removing these appear later.**

INSPECTION

Steering box casing

1. Examine the piston bore for wear, scores and pitting.
2. Examine the inlet pipe thread in the side of the cylinder tube for damage and if necessary repair using a suitable tap.
3. Check the feed pipe for damage especially for cracks and dents and renew if in any way faulty.
4. Since it is very unusual for the sector shaft bushes to wear they are not available as replacements. However, they should nevertheless be checked for damage.



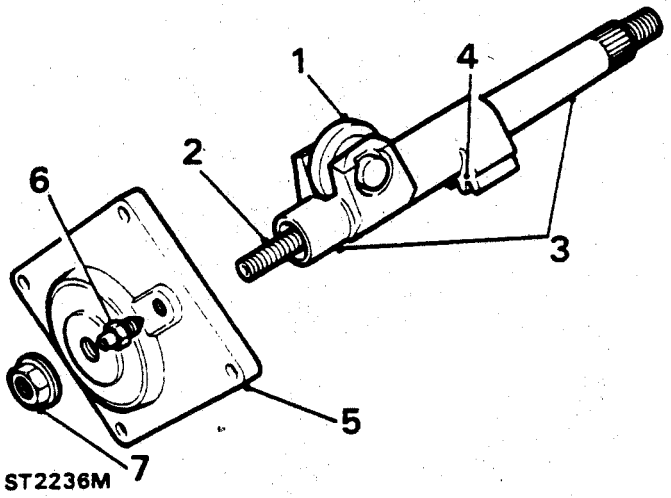
ST2229M

Sector shaft and cover assembly

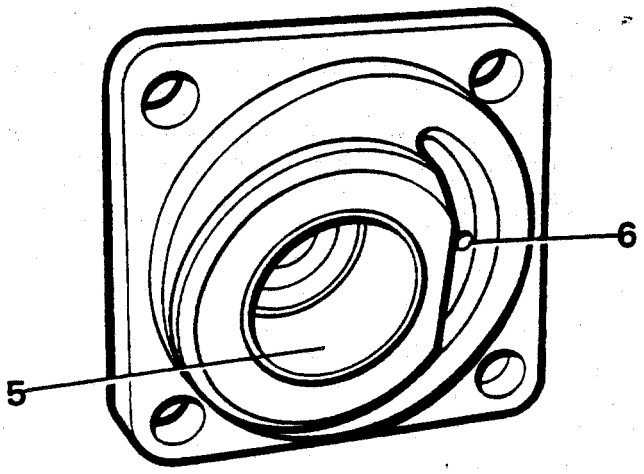
1. Check that there is no side play on the roller. If excessive play **does** exist the sector shaft should be renewed likewise if any of the following checks are unsatisfactory.
2. Check the condition of the adjuster thread and that there is no excessive vertical play. A movement of 2 mm is acceptable. Side play, however, is of no significance.
3. Examine the bearing surfaces of the shaft for wear, scores and pitting.
4. Check the gear teeth for excessive or uneven wear, scores and pitting.
5. Examine the cover for damage and burrs. Remove and discard the seal. Check the bush for wear and scores. Also check the adjuster thread for damage
6. Check the bleed nipple and threads and that the bleed whole in the inside of the cover is clear.

NOTE: For replacement purposes, the cover, bush and seal are supplied as a complete assembly.

7. The locknut, which should be discarded, also acts as a fluid seal and a new one should be fitted on assembly.



ST2236M



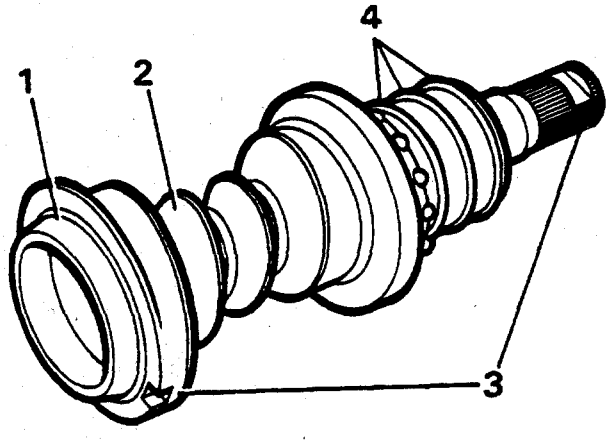
ST2241M

Valve and worm assembly

1. Examine the bearing areas for wear. The surfaces must be smooth and free from indentations, scores and pitting.
2. Examine the worm for wear which must also be smooth and free of scores and indentations.
3. Check for any wear on the torsion bar assembly pins. Grip the splined end of the input shaft in a soft jawed vice and by hand twist the worm end. No free movement should exist between the input shaft and worm.

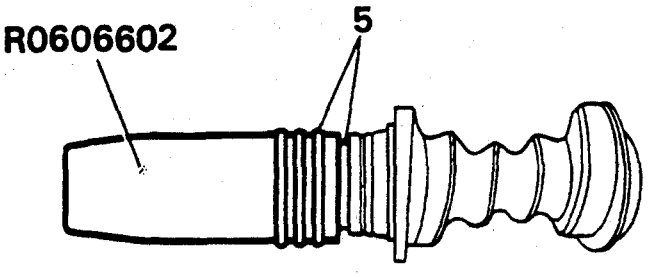
NOTE: If any wear does appear in the above areas it is essential that a new valve and worm assembly is fitted.

4. Examine the valve rings which must be free from cuts, scratches and grooves. The valve rings must be a loose fit in the valve grooves. If any one of the rings is faulty, all the rings must be renewed. Take care not to damage the ring grooves when removing the rings.



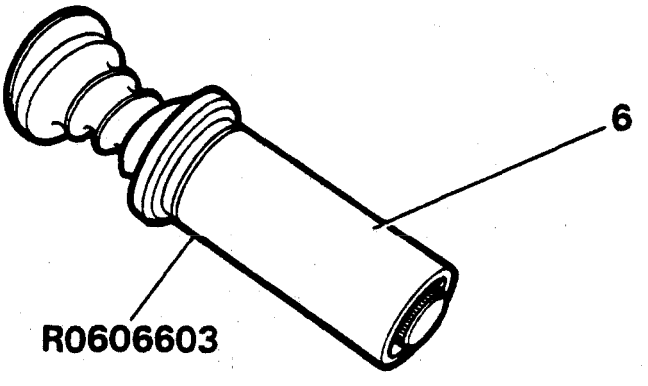
ST2219M

5. Fit replacement rings using expander tool RO 606602. Expand the rings by immersing them in hot water until pliable then carefully slide the rings over the tool, from the chamfered end. Place the tool over the ring grooves and slide the first ring into the groove nearest to the worm and so on until the third ring is in place. It is important to fit the rings in this sequence since the tool will not pass over the rings.



ST2220M

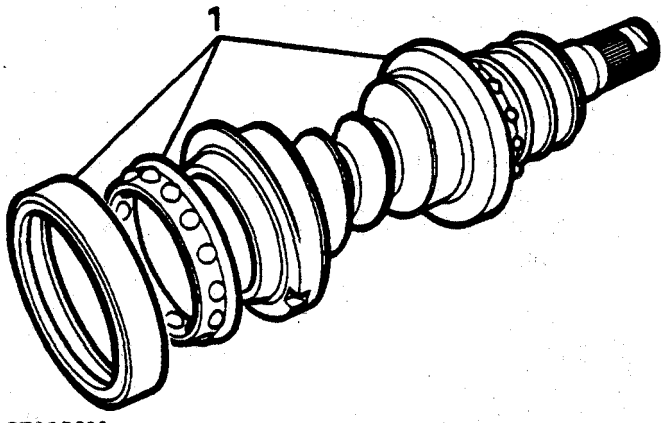
6. Remove the expander tool and slide the compressor tool RO 606603 over the rings, internal chamfered end leading and leave until cool.



ST2217M

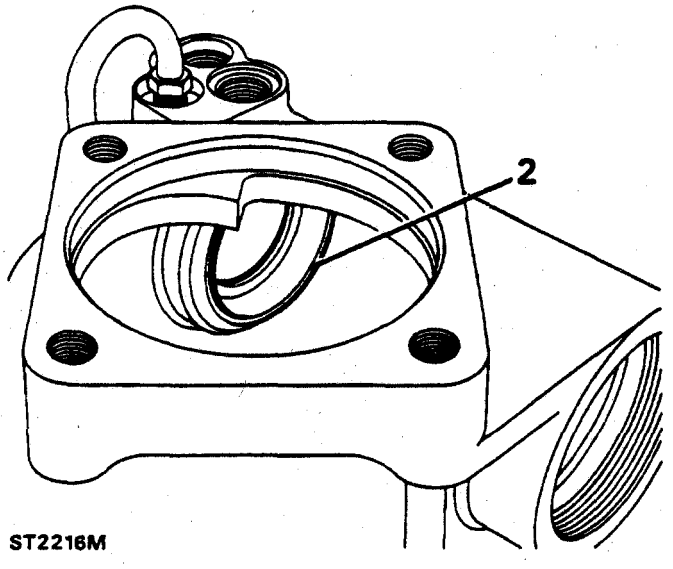
Ball bearing and cage assemblies

1. Examine the valve and worm inner and outer ball races and cups and if either is worn, pitted or damaged in any way, both the cups and the ball races must be renewed.



ST2230M

2. To remove the inner bearing cup and shims jar the casing on the work bench or use a suitable extractor. Alternatively, if difficulty is being experienced, warm the casing universally in an oven or in boiling water. Do not, however, attempt to apply local heat since distortion of the casing may result. Whilst the casing is being heated, cool a suitable mandrel or round bar to fit inside the bearing cup. Insert the cooled bar in the heated casing to retract the cup to enable it to be withdrawn together with the shims which must be retained for reassembly.

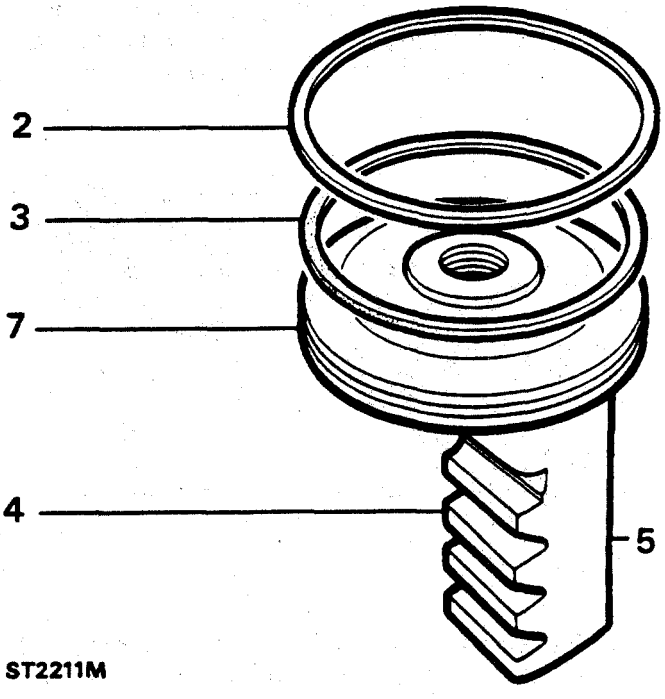


ST2216M

Rack and piston

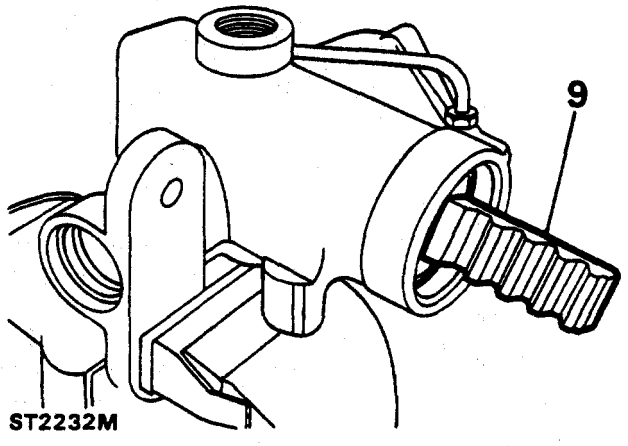
NOTE: That beneath the visible white Nylon ring in the piston groove, there is a rubber seal.

1. Examine the outer seal and if worn or damaged in any way it must be renewed along with the rubber ring.
2. Taking care not to damage the piston outer diameter remove the plastic seal.
3. Likewise, carefully remove the rubber ring.
4. Examine the rack teeth for wear and damage.
5. Check that the thrust pad bearing surface is free from wear and scores.
6. Check the piston outer diameters for burrs and damage and repair as necessary using a fine file and emery cloth.
7. Ensure that the bottom of the groove and the inside walls are not damaged or burred. Repair where necessary in the same way as above



ST2211M

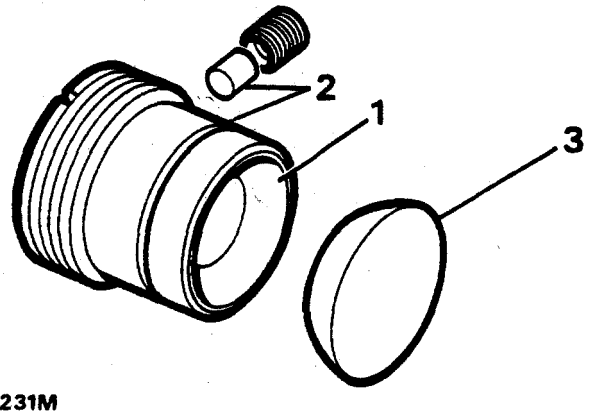
8. Fit a new rubber ring to the piston groove. Warm a new white Nylon seal in hot water and fit to the piston.
9. Immediately, whilst still warm, carefully insert the piston squarely into the casing bore with the rack outwards, as illustrated, and leave until cool.



ST2232M

Rack thrust pad and adjuster

1. Examine the rack pad adjuster for general condition particularly the pad bearing surface.
2. Renew the seal and if necessary the nylon thrust pad behind the grub screw.
3. Check the thrust pad for wear in particular the flat side which slides on the reverse side of the piston rack.



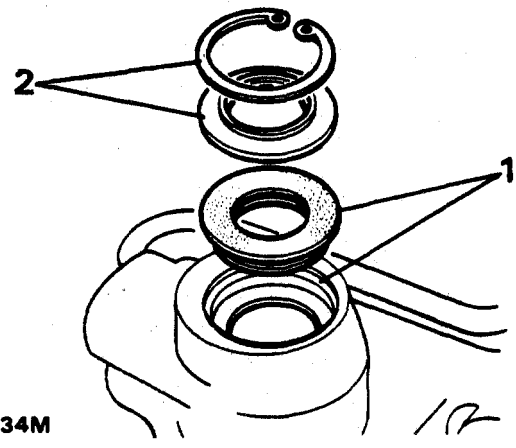
ST2231M

ASSEMBLE

NOTE: When fitting replacement oil seals, these must be **lubricated, before fitting, with the recommended steering** box **fluid. Also ensure that absolute cleanliness is observed throughout the following assembly instructions.**

Fitting input shaft oil seal

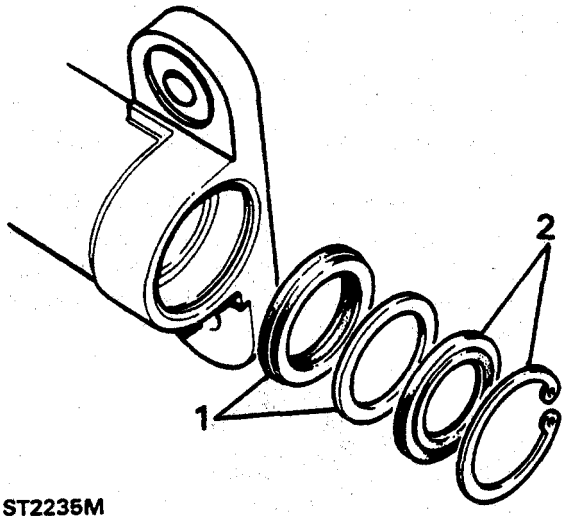
1. Fit a new seal, lipped side first, into the housing noting that when correctly fitted the seal backing will seat on the first shoulder in the bore.
2. Insert the extrusion washer **with** the flat side downwards facing the seal. Secure the assembly with the circlip and to ensure that it is properly located, tap the circlip into the groove with a punch.



ST2234M

Fitting sector shaft seal

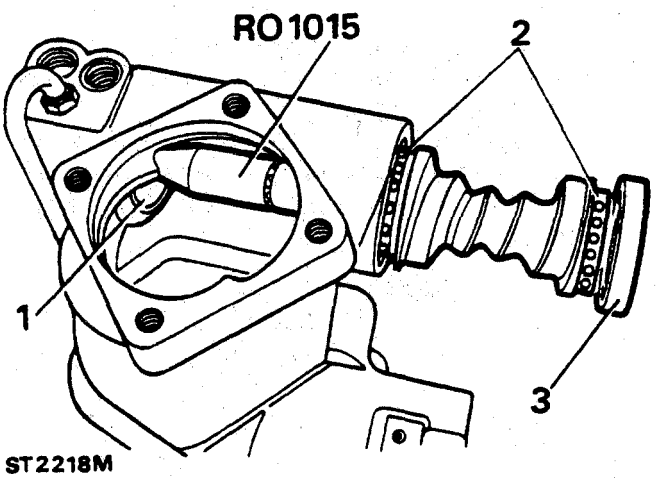
1. With the lipped side leading, fit the oil seal to the casing followed by a plain fibre washer.
2. Fit the steel backed dust seal, flat side downwards towards the oil seal. Secure with the circlip ensuring that it is properly located in the groove.



ST2235M

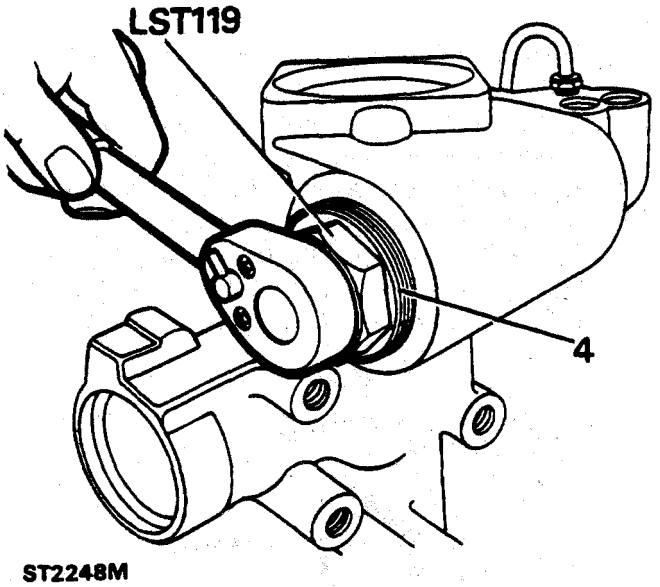
Fitting valve and worm assembly

1. Fit the inner bearing cup and the original shims to the casing. Use a suitable bar approximately 57 mm diameter to tap the cup squarely into position. If the original shims are not available fit shims to the value of 0,76 mm to provide a nominal thickness.
2. Fit the inner and outer bearing cages to the worm using petroleum jelly only to hold the cages in position. Do not use grease for this purpose since it does not dissolve in the steering box lubricating fluid and could block the fluid passages in the valve assembly.
3. Cover the input shaft splined area with seal saver RO 1015 and carefully insert the shaft into the casing followed by the outer bearing cup.



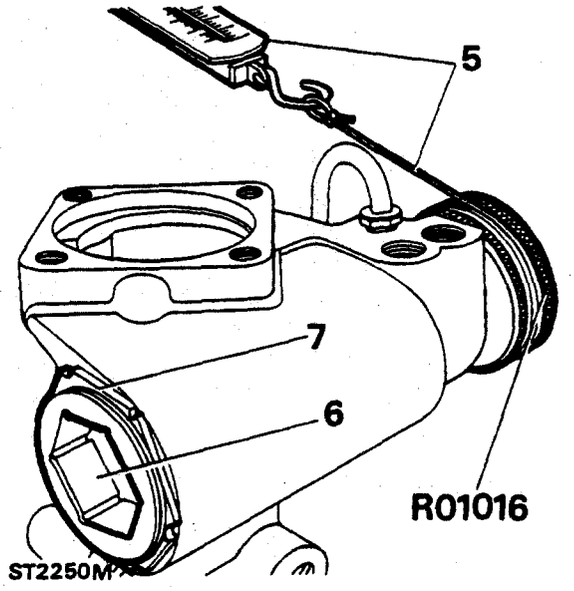
ST2218M

4 Fit a new sealing ring to the worm adjuster screw and turn the adjuster clockwise into the housing using special tool LST 119 until the end float in the input shaft is almost eliminated. Fit the lock-nut but do not tighten until the following instructions for setting the input shaft preload are completed.



ST2248M

5. Fit the torque setting tool RO 1016 to the input shaft and secure with the grub screw. Coil a length of cord round the tool and attach a spring balance to the free end. Measure and record the rolling resistance of the shaft as the spring balance is pulled.



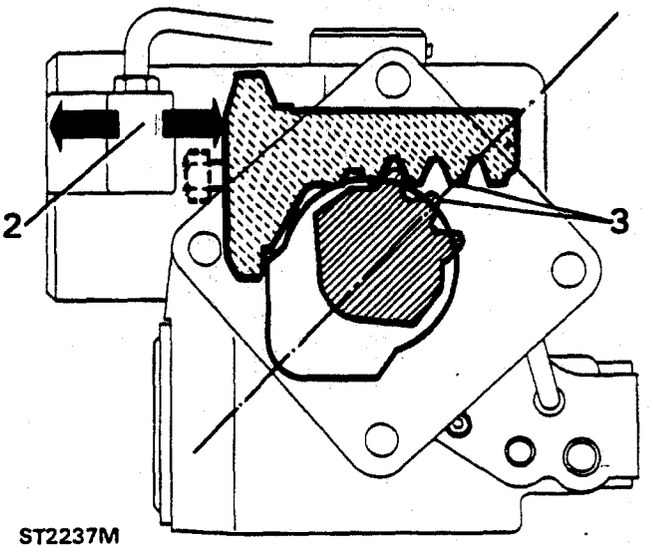
6, To settle the bearings, turn the worm adjuster again, clockwise, to increase the resistance over that recorded in the previous instruction by 1.8 to 2,2 kg (at a radius of 31,7 mm which is determined by the setting tool).

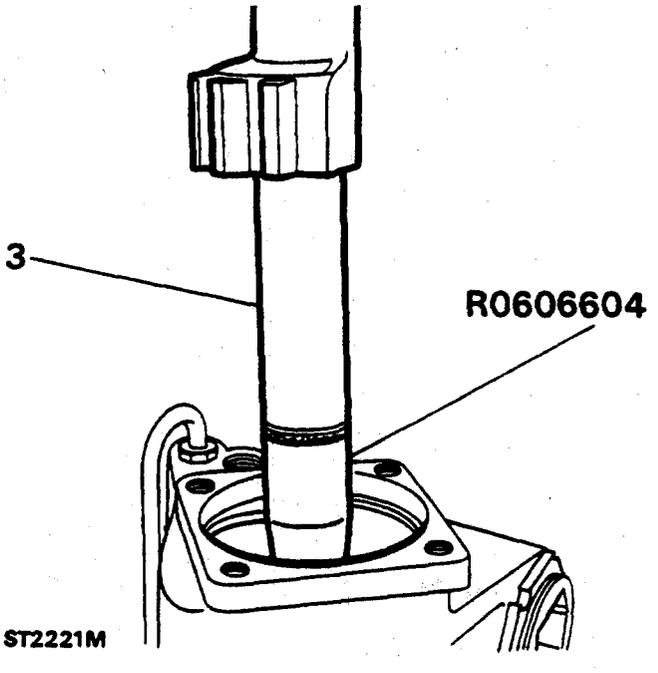
7. Now, back-off the worm adjuster anti-clockwise so that the rolling resistance recorded in instruction 5 is only 0,9 to 1,3 kg Tighten the locknut using special tool LST 119. Check the rolling resistance again in case tightening the lock-nut has altered the setting.

Fitting rack, piston and sector shaft

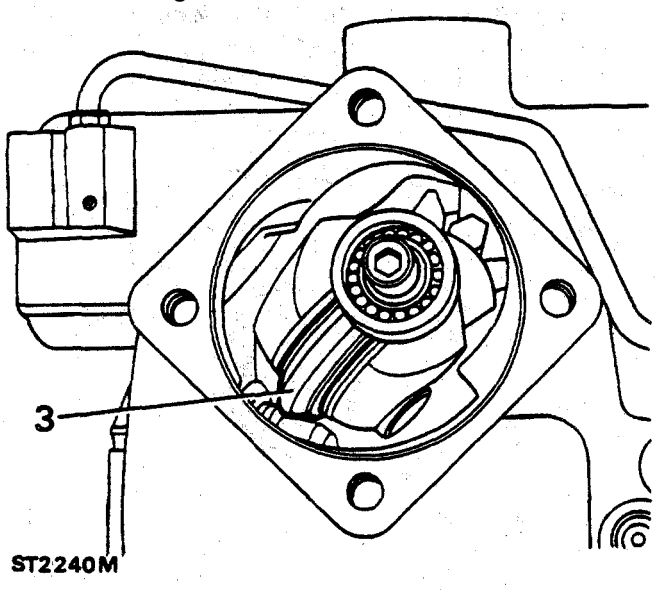
1. Screw a suitable bolt into the piston crown to assist the fitting and positioning of the piston as was recommended for removing the piston.
2. insert the piston, rack end first, into the casing so that the piston crown is approximately **63,5** mm from the outer end of the bore.

3. Fit seal saver R O 606604 over the thread and splines of the sector shaft and carefully insert the shaft into the casing. Align the centre gear pitch on the rack with the centre gear tooth on the sector shaft and at the same time rotate the input shaft about a small arc to allow the sector roller to engage the worm.



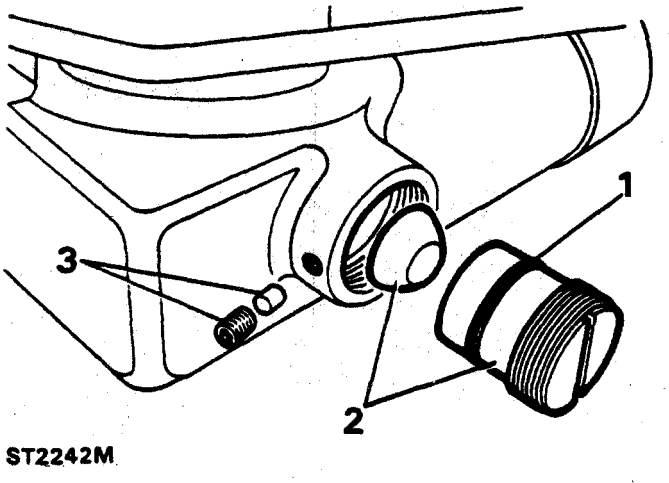


4. The illustration below shows the position in which the sector shaft and roller should be in relation to the casing aperature when the shaft is being inserted.



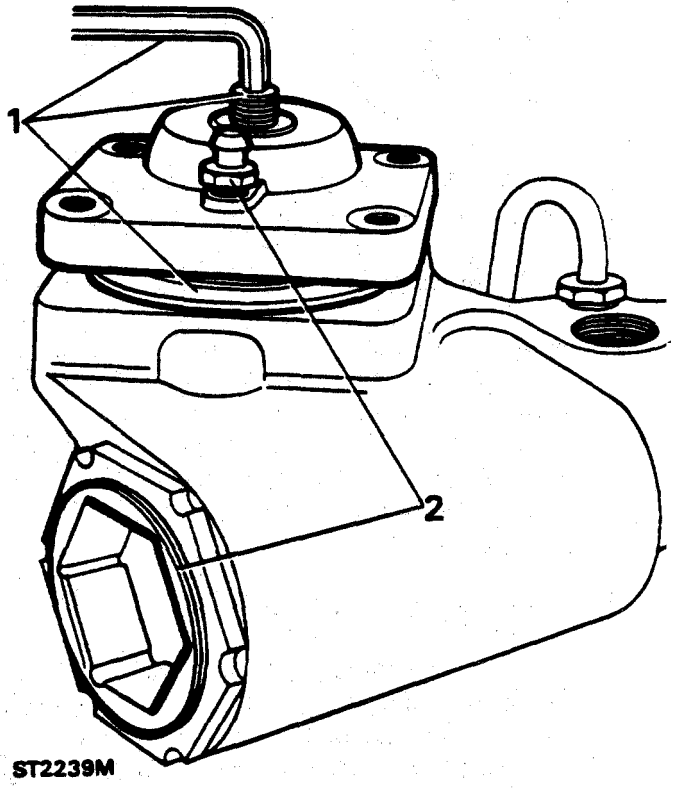
Fitting rack adjuster

1. Fit a new sealing ring to the rack adjuster.
2. Fit the adjuster pad with the flat side towards the rack and screw in the adjuster until solid contact is made with the rack. Now back-off the adjuster half a turn.
3. Insert the Nylon locking pad and fit the grub screw, leaving it slack at this stage.



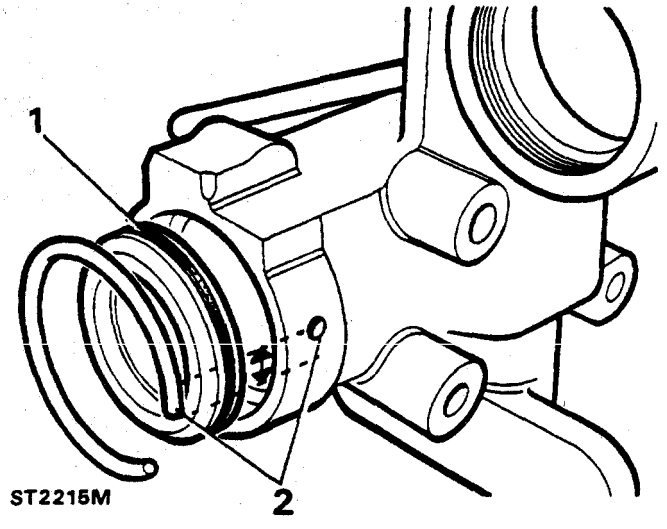
Fitting sector shaft cover

1. Fit and lubricate a new sealing ring to the inside of the cover and screw the cover fully on to the sector shaft adjuster screw. If necessary, use an Allen key to hold the screw to prevent it turning.
2. Locate the cover on the casing noting that it can only be fitted one way, that is, with the bleed nipple towards the worm adjuster. Tap the cover into place and if necessary, back off the adjuster screw a few turns to allow the cover to seat properly on the casing. Fit the cover retaing screws but do not tighten.
3. Using the torque setting tool RO 1016 for convenience, rotate the input shaft through a small arc, in both directions, to ensure that the sector roller is free to move in the worm. Tighten the four screws evenly to the correct torque.

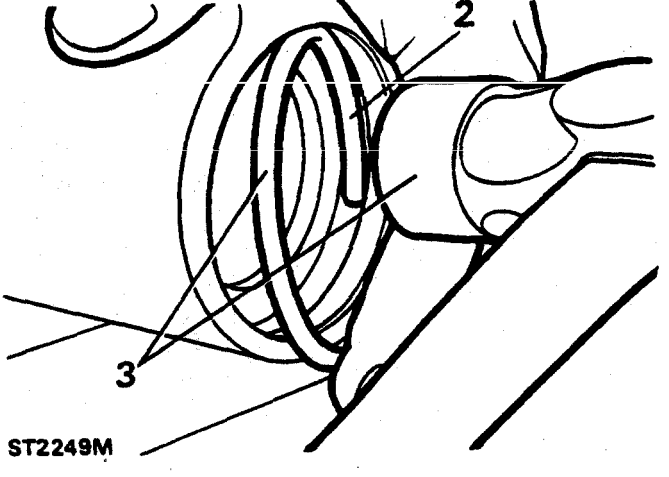


Fitting cylinder cover

1. Fit and lubricate a new seal to the cylinder cover and press the cover squarely into the cylinder just far enough to clear the retaining ring groove.
2. Secure the cover with the retaining ring by inserting one end of the ring into the cylinder groove so that it is positioned 12 mm beyond the ring extractor hole in the side of the cylinder.

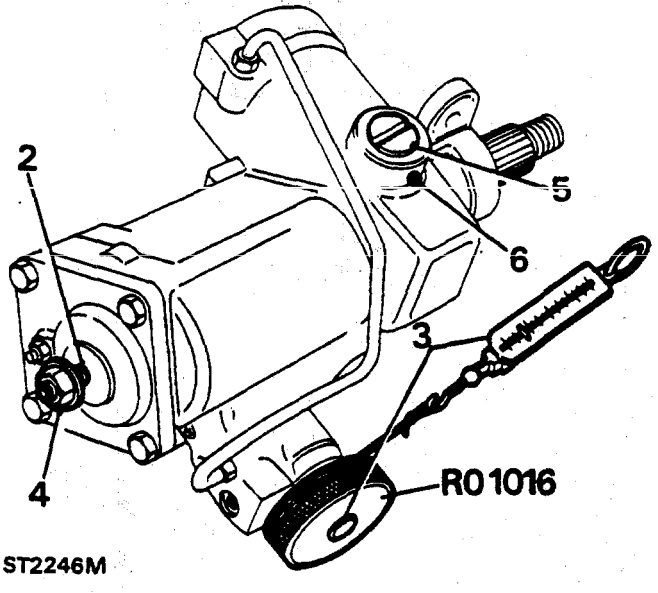


3. Now, compress the ring by hand, whilst feeding the ring into the groove by striking it with a hammer until the ring finally springs into position in the groove. Ensure that the ring is fully seated by tapping it round with a punch.



Setting the sector shaft and rack adjuster pre-loads

1. Turn the input shaft to set the sector shaft roller at the mid point of its travel between the left and right hand locks.
2. Using a 6 mm Allen key, turn the sector shaft adjusting screw anti-clockwise to obtain backlash between the input shaft and sector shaft. Now, turn the adjusting screw clockwise until the backlash is just eliminated.
3. Using the tool R O 1016 and spring balance, measure and record the maximum rolling resistance at the input shaft.
4. Fit a new locknut to the adjuster screw but do not tighten. Continue to rotate the input shaft, with the spring balance, whilst turning the adjuster screw until the figure recorded in instruction 3 is increased by 0,9 to 1,3 kg. Tighten the locknut and check the above figures again.
5. Turn the rack adjuster clockwise to impart Pressure upon the rack and back-off half a turn. Again, using special tool R O 1016 and the spring balance, rotate the input shaft whilst turning the rack adjuster until the figure recorded in instruction 4 is increased by a further 0,9 to 1,3 kg. Note that the final rolling resistance figure, recorded on the spring balance, must not exceed 7,25 kg.



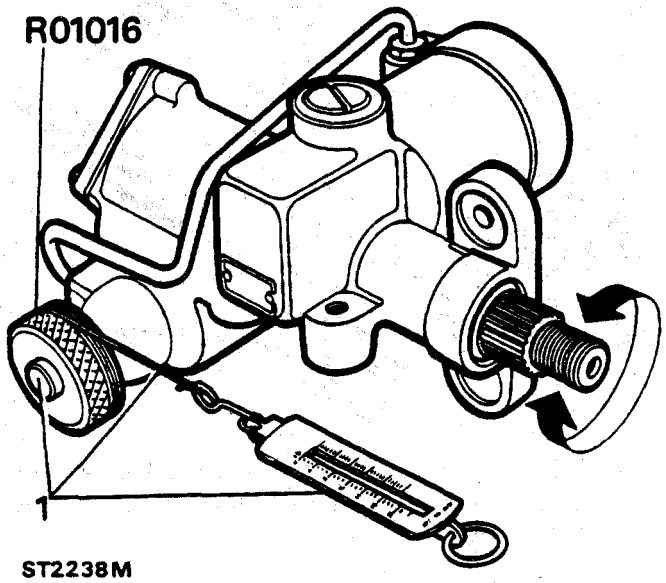
6. When satisfied that the pre-load figures are satisfactory, lock the rack adjuster in position with the grub screw.

Torque peak check

The purpose of this check is to determine the point at which the rolling resistance is the greatest when the steering is turned from lock to lock. This resistance, which must be equally distributed, should be when the sector shaft roller is positioned along the centre portion of the worm approximately two revolutions of the input shaft from either the left or right hand lock.

The correct position of the resistance depends upon the amount of shimming behind the input shaft inner bearing cup. Provided that the original shim pack has been refitted, the torque peak position should be correct unless major components have been renewed. The procedure for checking and adjusting the torque peak is contained in the following instructions.

1. Attach the torque setting tool RO 1016 to the input shaft and turn it fully anti-clockwise. Wind cord round the tool and fasten a spring balance to the free end as before. Turn the input shaft by pulling the spring balance and note the position where the highest figure is obtained. If the highest figures are not recorded along the middle portion of the travel as explained above adjustment is necessary.
2. Adjustment involves the dismantling of the steering box and removal of the input shaft inner bearing cup and shims. If the torque peak (highest figure) occured before the centre position, add shims to the pack. Remove shims if the torque peak occurs after the centre Position.

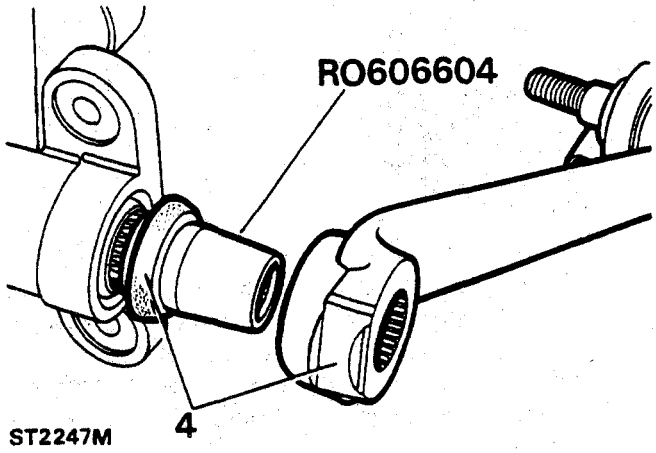


ST2238M

NOTE: That the addition or subtraction of a 0,07 mm shim will move the torque peak area by approximately one quarter of a turn of the input shaft.

Shim washers are available from Land Rover Parts and Equipment in the following sizes: 0,03 mm, 0,07 mm, 0,12 mm and 0,24 mm.

3. Having added or subtracted shims as necessary, reassemble the steering box and check that the torque peak position is now correct.
4. Using seal saver RO 606604, fit a new outer dust seal over the sector shaft. Fit the drop arm to the sector shaft and a new lock washer. Fit and tighten the retaining nut to the correct torque and bend the lock tab over a flat of the nut.



ST2247M

Fitting steering box to vehicle and testing

1. Fit the steering box to the vehicle and replenish the system with the correct make and grade of fluid, For this information refer to **'RECOMMENDED LUBRICANTS AND FLUIDS'** and bleeding the power steering system.
2. To test the effectiveness of the steering box overhaul and the system for leaks, run the engine and hold the steering hard on full lock in both directions whilst a second person checks for fluid leaks.

CAUTION: Do not hold the steering on full lock for more than thirty seconds in any one minute to avoid overheating the fluid and possibly damaging the seals.

3. Finally road test the vehicle.

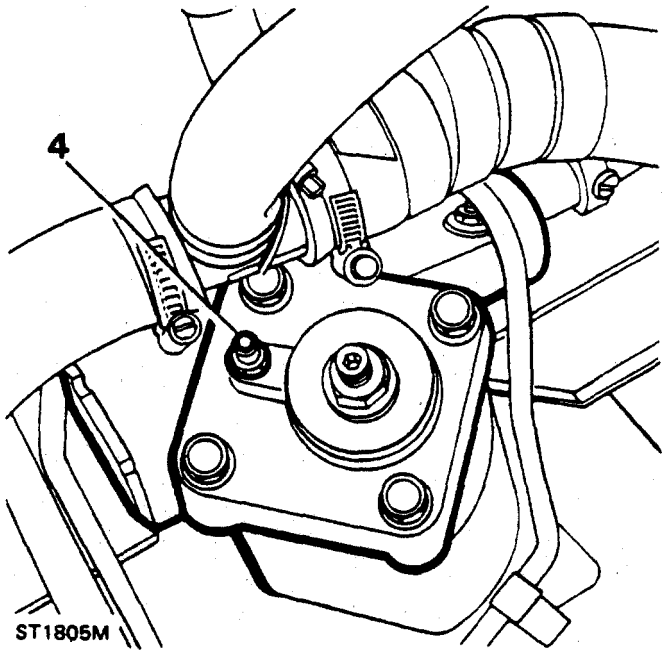
POWER STEERING SYSTEM - Adwest Lightweight box

Bleed

1. Fill the steering fluid reservoir to the mark on the side of the reservoir with one of the recommended fluids.
2. Start and run the engine until it attains normal operating temperature.
3. Check and correct the reservoir fluid level.

NOTE: During the carrying out of items 4, 5 and 6, ensure that the steering reservoir is kept full. Do not increase the engine speed or move the steering wheel.

4. Run the engine at idle speed, slacken the bleed screw. When fluid seepage past the bleed screw is observed, retighten the screw.



5. Ensure that the fluid level is in alignment with the mark on the reservoir dipstick.
6. Wipe off all fluid released during bleeding.
7. Check all hose joints, pump and steering box for fluid leaks under pressure by holding the steering hard on full lock in both directions.

CAUTION: Do not maintain this pressure for **more than 30 seconds in any one minute, to avoid causing the oil to overheat and possible damage to the seals, The steering should be smooth lock-to-lock in both directions, that is, no heavy** or **light spots when changing direction when the vehicle is stationary.**

8. Carry out a short road test. If necessary, repeat the complete foregoing procedure.

Test

If there is a lack of power assistance for the steering the pressure of the hydraulic pump should be checked first before renewing any components of the system. The fault diagnosis chart should also be used to assist in tracing faults in the power steering.

Procedure

1. The hydraulic pressure test gauge is used for testing the power steering system. This gauge is calibrated to read up to 140 kgf/cm² and the normal pressure which may be expected in the power steering system is 77 kgflcm².
2. Under certain fault conditions of the hydraulic pump it is possible to obtain pressures up to 105 kgf/cm². Therefore, it is important to realise that the pressure upon the gauge is in direct proportion to the pressure being exerted upon the steering wheel. When testing, apply pressure to the steering wheel very gradually while carefully observing the pressure gauge.
3. Check, and if necessary replenish, the fluid reservoir.
4. Examine the power steering units and connections for leaks. All leaks must be rectified before attempting to test the system.
5. Check the steering pump drive belt for condition and tension, rectify as necessary.
6. Assemble the test equipment and fit to the vehicle as illustrated.
7. Open the tap in the adaptor.
8. Bleed the system but exercise extreme care when carrying out this operation so as not to overload the pressure gauge.
9. With the system in good condition, the pressures should be as follows:
   a. Steering wheel held hard on full lock and engine running at 1,000 rev/min, the pressure should be 70 to **77** kgf/cm².
   b. With the engine idling and the steering wheel held hard on full lock, the pressure should be 28 kgf/cm² minimum.

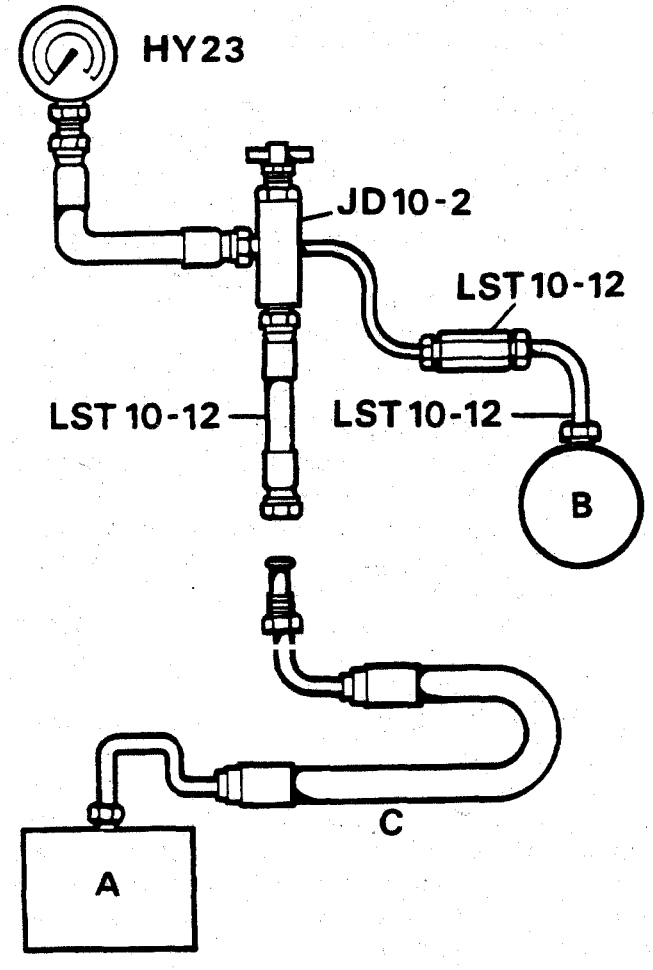
These checks should be carried out first on one lock, then on the other.

CAUTION: Under no circumstances must the steering wheel be held on full lock for more than 30 seconds in any one minute, otherwise there will be a tendency for the oil to overheat and possible damage to the seals may result.

10. Release the steering wheel and allow the engine to idle. The pressure should be below 7 kgflcm².

11. If the pressures recorded during the foregoing test are outside the specified range, or pressure imbalance is recorded, a fault exists in the system. To determine if the fault is in the steering box or the pump, close the adaptor tap for a period not exceeding five seconds.
12. If the gauge fails to register the specified pressures, the pump is inefficient and the pump relief valve should be examined and renewed as necessary.
13. Repeat the foregoing test after renewing the relief valve and bleeding the system. If the pump still fails to achieve the specified pressures, the pump should be overhauled or a new unit fitted.
14. If pump delivery is satisfactory and low pressure or marked imbalance exists, the fault must be in the steering box valve and worm assembly.

TEST EQUIPMENT



A. Steering box
B. Steering pump
C. Existing hose from steering box

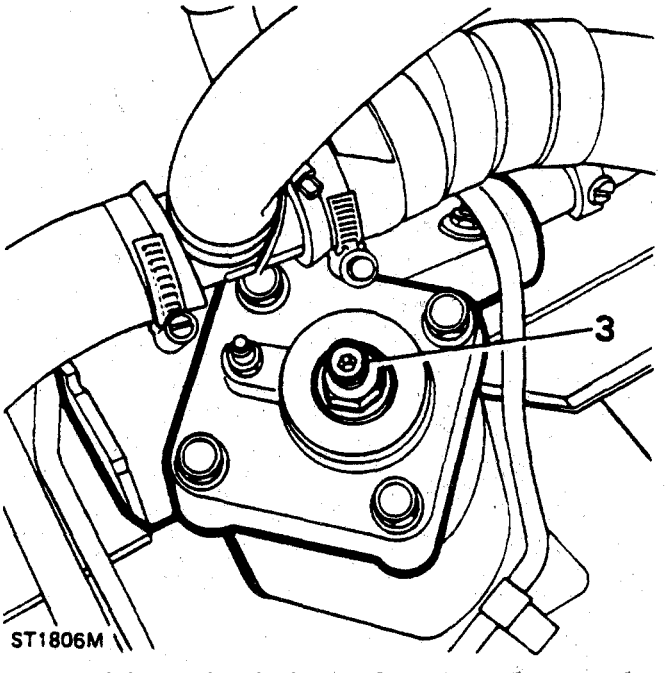
ADJUST POWER STEERING BOX - Adwest Lightweight box

NOTE: The condition of adjustment which must be **checked** is **one of minimum backlash without overtightness when the wheels are in the straight-ahead position.**

1. Jack up the front of the vehicle until the wheels are clear of the ground.

WARNING: Wheels must be chocked in all **circumstances.**

2. Gently rock the steering wheel about the straight-ahead position to obtain the 'feel' of the backlash present. This backlash must not be more than **9,5** mm.
3. Continue the rocking action whilst an assistant slowly tightens the steering box adjuster screw after slackening the locknut until the rim movement is reduced to 9,5 mm maximum.



4. Tighten the locknut, then turn the steering wheel from lock to lock and check that no excessive tightness exists at any point.
5. Lower the vehicle to ground level and remove the wheel chocks.
6. Road test the vehicle.

PIPE CONNECTIONS TO STEERING BOX

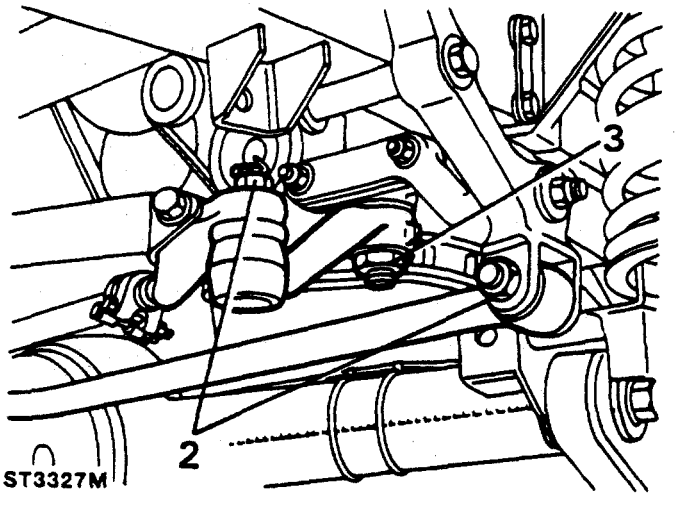
When fitting a new or overhauled steering box observe the following procedure.

1. Remove dust caps from ports.
2. Immediately fit pipes finger tight.
3. Tighten the 16 mm union nut to 20 Nm.
4. Tighten the 14 mm union nut to 15 Nm.

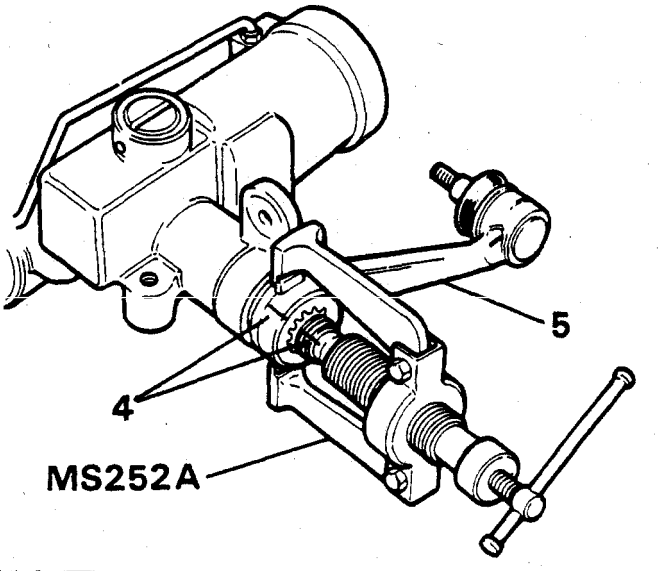
STEERING BOX SECTOR SHAFT SEAL - renew with steering box fitted to vehicle

Special tools
Drop arm puller MS 252A / LRT-57-012
Seal replacer LST 125A / LRT-57-010

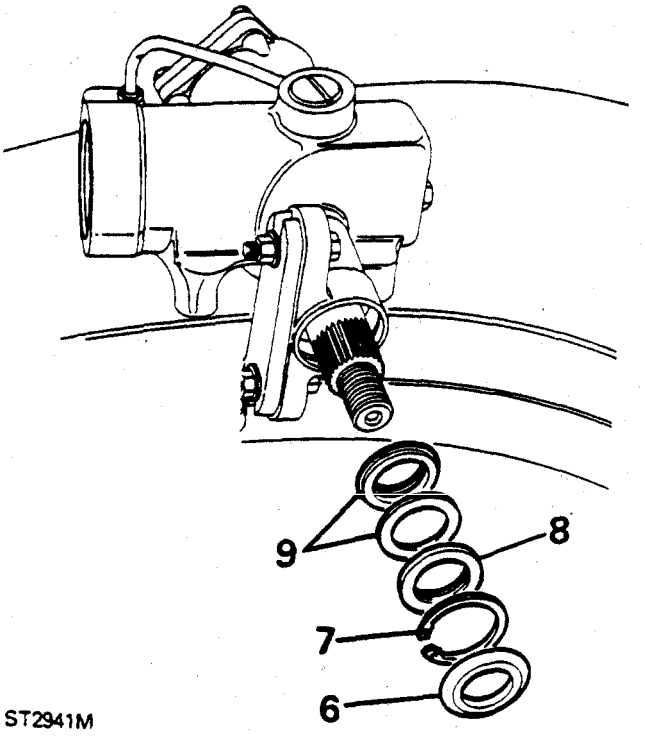
1. Working from beneath the vehicle set the steering in approximately the straight ahead position.
2. Release the ball pin from the drag link, and one end of Panard rod.
3. Release the lock tab from the drop arm retaining nut and remove the nut



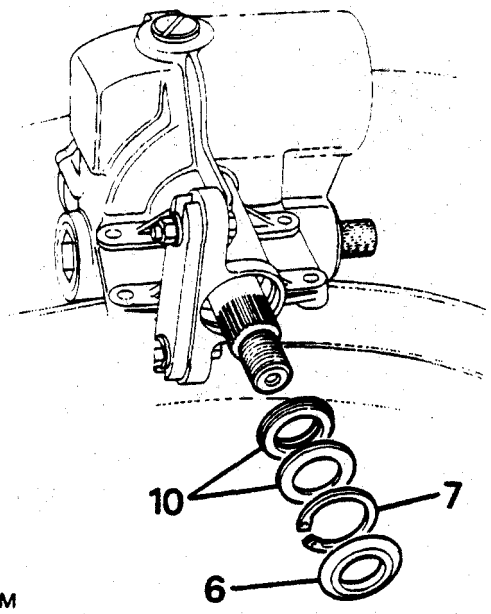
4. Before removing the drop arm, mark its relationship to the sector shaft to assist assembly.
5. Using pulley MS 252A or a suitable alternative, withdraw the drop arm.



6. Remove the dust seal, if fitted, and clean the area around the sector shaft seal.
7. Remove the circlip.
8. To remove the seal pack, drill two 3,0 mm holes diametrically opposite into the metal dirt seal. Insert a 4 mm self tapping screw in each hole then, with pliars pull the seal from the box.
9. Remove the extrusion washer and inner seal.



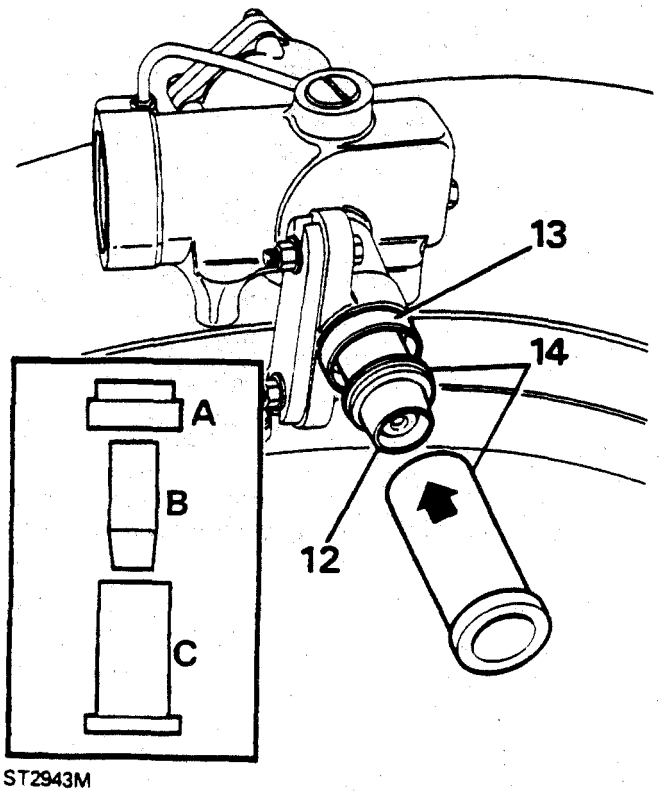
10. With a suitable probe, remove the anti-extrusion washer and inner seal.



ST2942M

Fitting new seals

11. Clean the seal housing and around the sector shaft.
12. Lubricate, and place the seal saver part 'B' of the tool over the shaft.
13. Lubricate and fit part 'A' of the tool with the shoulder against the face of the box.
14. Lubricate and slide the seal, lip side leading, over the seal saver and with part 'C' of the tool, drive the seal into position.
15. Fit the anti extrusion washer, dirt seal, and secure with the circlip. Finally fit the dust seal so the the lip is flat against the face of the box.

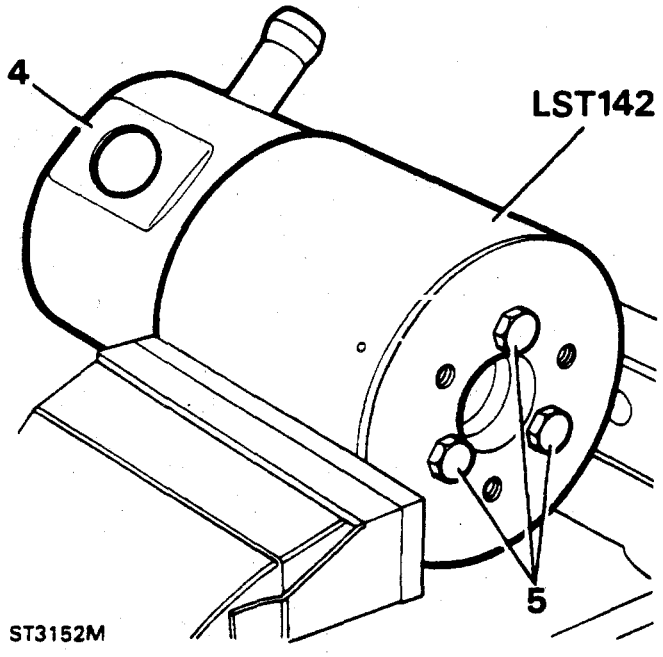


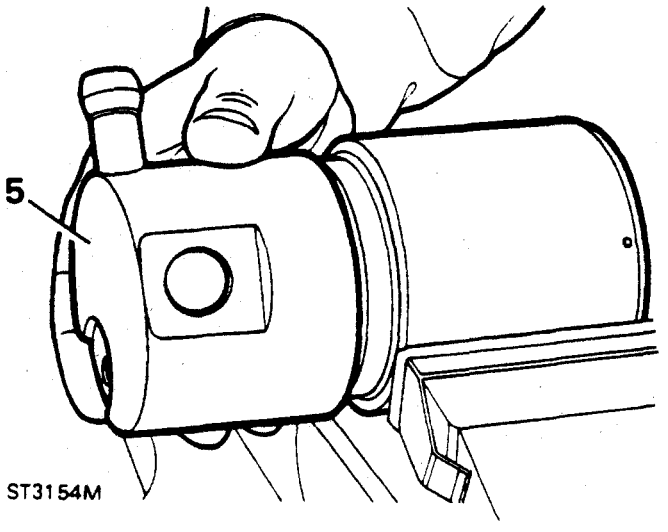
ST2943M

16. Fit the drop arm, aligning the assembly marks.
17. Fit the tab washer and drop arm nut and tighten to the correct torque using a suitable restraining bar between the chassis and drop arm.
18. Bend the tab of the washer over a convenient flat.
19. Fit the ball pin to the drag link, tighten the nut and secure with a new split pin.

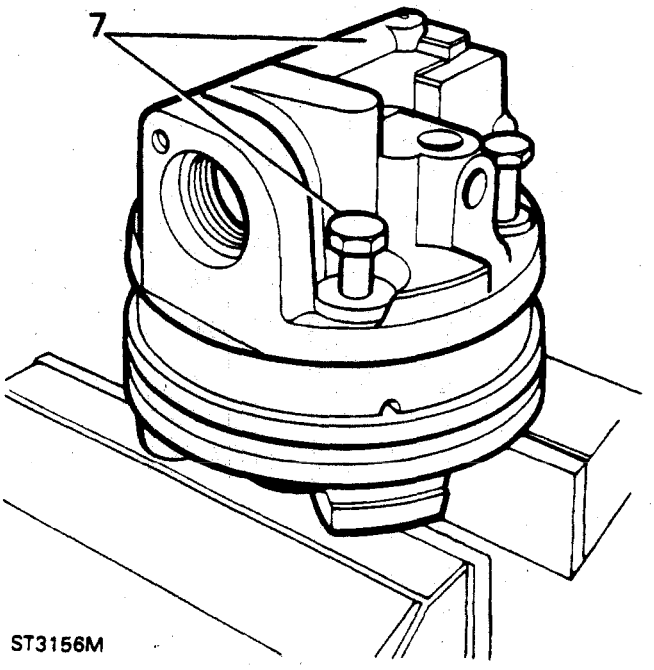
POWER ASSISTED STEERING PUMP - OVERHAUL

1. Disconnect the battery and remove the pump from the vehicle.
2. Clean the exterior of the pump and remove the drive pulley.
3. Remove, from the outlet port, the union nut, two 'O' rings, spring and valve.
4. Secure the pump cover removal tool LST 142 in a vice and insert the pump in the tool.
5. Fit the three 6 mm bolts through the tool into the pump hub. Tighten the bolts evenly until the cover is released from the sealing ring and can be removed from the pump.

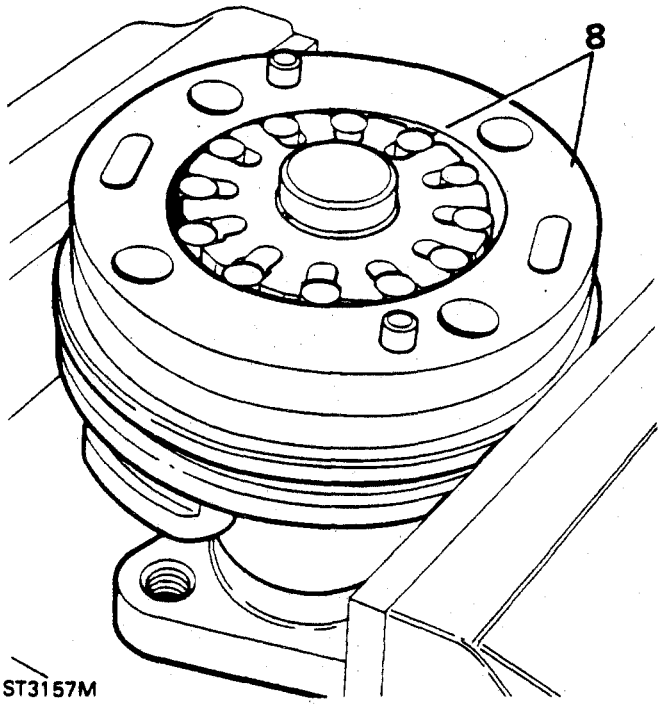




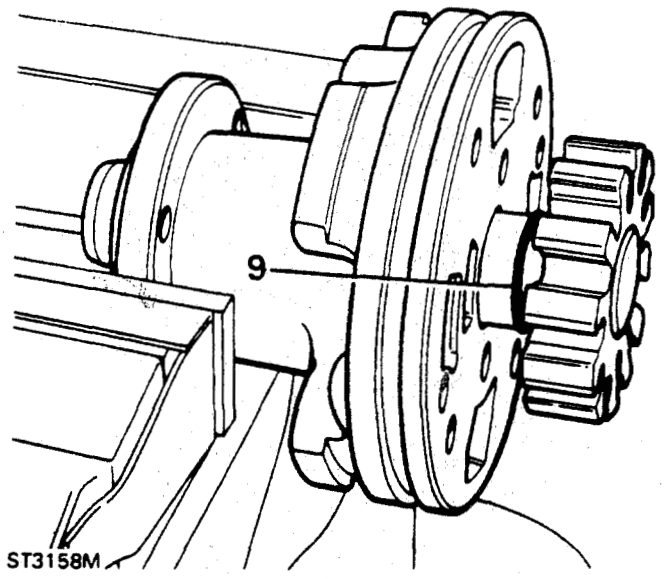
6. Remove the large 'O' ring and secure the pump in a vice.
7. Remove the swarf collection magnet and the four bolts and lift off the valve housing.



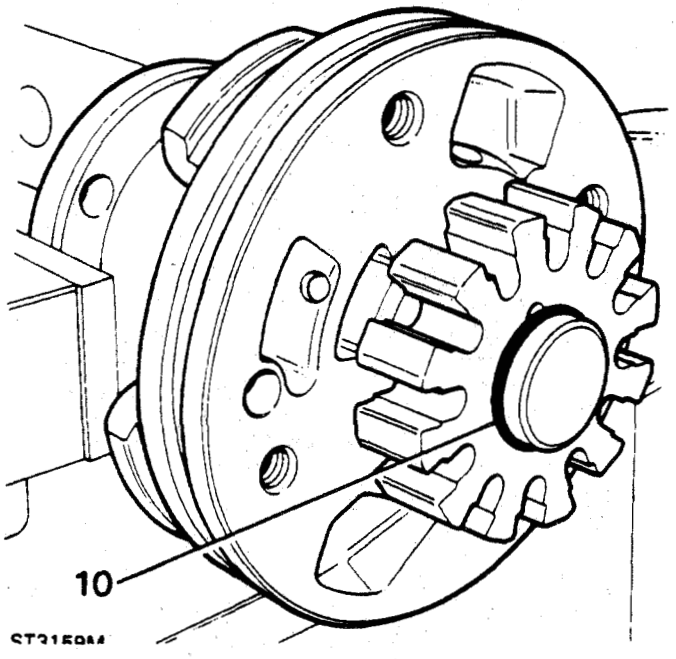
8. Remove the pump outer member and the rollers.



9. Release the spring ring from the groove behind the vane and push it back towards the drive shaft housing.



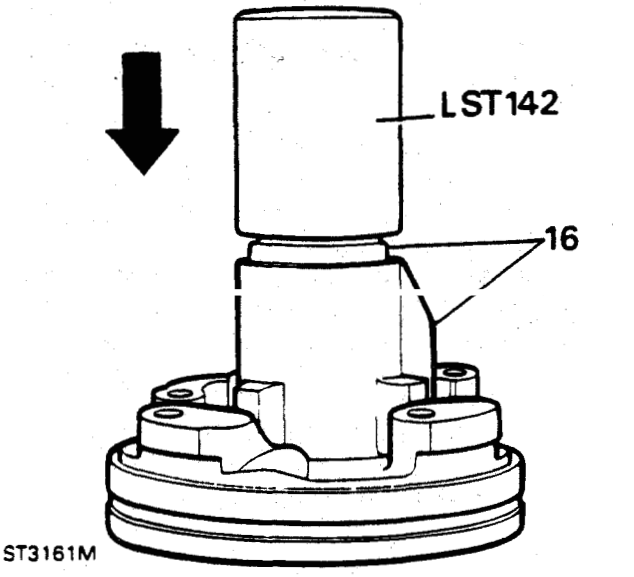
10. Move the vane back to reveal ana remove me spring ring from the front of the vane.



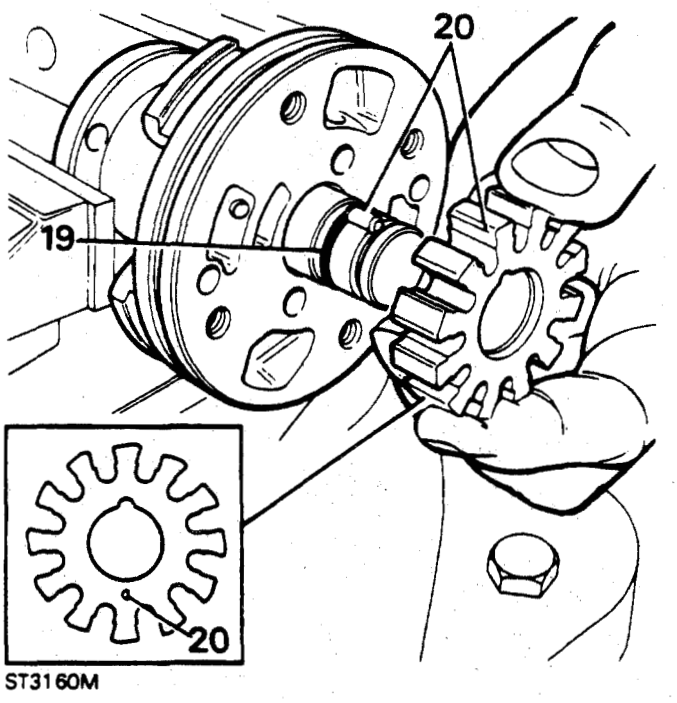
11. Remove the vane and drive key and rear spring ring.
12. Withdraw the drive shaft.
13. Prise-out the oil seal and if necessary press-out the bush from the drive shaft housing.
14. Clean and examine all parts for wear.

Assemble

15. If removed, press-in a new bush in the drive shaft housing to 5 mm below the machined face.
16. Using the seal replacer part of tool number LST 142, drive-in a new seal, lip side leading, into the drive shaft housing.

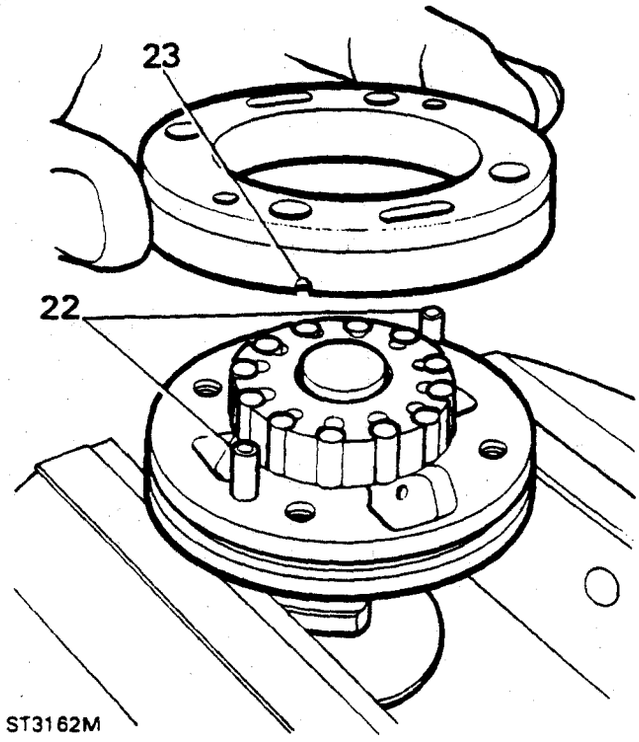


17. Wrap a smooth surface tape round the end of the drive shaft to protect the seal lip.
18. Lubricate the seal lip with power steering fluid and insert the drive shaft.
19. Fit the inner spring ring to the shaft but not into the groove at this stage.
20. Fit the drive key and the vane with the arrow towards the drive shaft housing and with the raised leading edge of the vanes facing left.



21. Fit the outer spring ring to the groove then slide the inner spring ring into the rear groove.

22. Fit the two dowels to the drive shaft housing.
23. Insert the twelve rollers in the vane and fit the pump outer member with the milled cut towards the drive shaft housing.

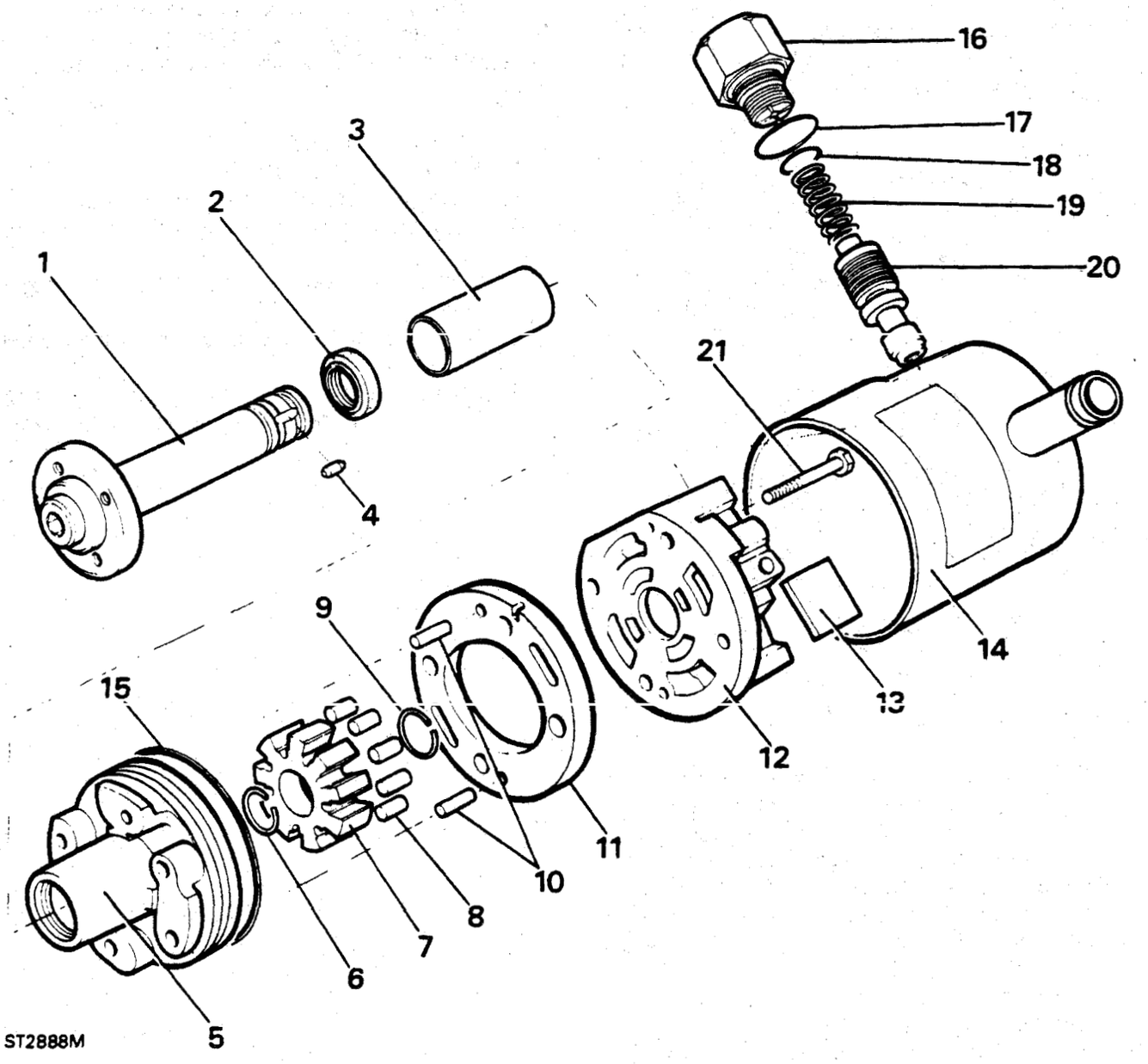


24. Fit the valve housing and secure with the four bolts. Check that the pump revolves freely.
25. Insert the magnet into the slot provided.
26. Lubricate and fit the large 'O' ring and fit the cover ensuring that the hole for the valve is aligned with the outlet port in the valve housing before the cover is finally pushed home over the seal.
27. Lubricate and fit the valve, spring, large and small 'O' rings and the union nut.
28. Finally, fit the drive pulley with the three bolts and washers.
29. Fit dust caps to inlet and outlet connections.

Power assisted steering pump connections

It is important that the following procedure is observed when fitting a new or overhauled pump to the vehicle

1. Remove dust caps.
2. Fit clip to large feed hose.
3. Push hose fully on to pump connection.
4. Hold clip in position and tighten clip screw to 3 Nm.
5. Screw high pressure union into pump, finger tight.
6. Hold pipe in correct position and tighten union to 20 Nm.
7. Check that the hose clip screws securing hoses to fluid reservoir are tightened to 3 Nm.



KEY TO PAS PUMP

1. Drive shaft and flange assembly.
2. Oil seal.
3. Drive shaft bush.
4. Drive shaft key.
5. Drive shaft housing.
6. Inner spring ring.
7. Vane.
8. Vane rollers.
9. Outer spring ring.
10. Locating dowels.
11. Pump outer member.
12. Valve housing.
13. Magnet.
14. Pump cover.
15. Pump cover 'O' ring seal.
16. Outlet pipe union pipe.
17. Large 'O' ring.
18. Small 'O' ring.
19. Spring
20. Valve assembly.
21. Pump assembly bolts (4 off).

POWER STEERING FAULT DIAGNOSIS

SYMPTOM	CAUSE	TEST ACTION	CURE
INSUFFICIENT POWER ASSISTANCE WHEN PARKING	(1) Lack of fluid	Check hydraulic fluid tank level	If low, fill and bleed the system
	(2) Engine idling speed too low	Try assistance at fast idle	If necessary. reset idle speed.
	(3) Driving belt slipping.	Check belt tension.	Adjust the driving belt.
	(4) Defective hydraulic pump and/ or pressure relief valve	(a) Fit pressure gauge between high pressure hose and steering pump. with steering held hard on full lock, see Note 1 below, and Power steering pump test	If pressure is outside limits (high or low) after checking items 1 and 3, see Note 2 below
		(b) Release steering wheel and allow engine to idle. See 'Power steering pump test.	If pressure is greater, check steering box for freedom and self-centring action
POOR HANDLING WHEN VEHICLE IS IN MOTION	Lack of castor action	This is caused by over-tightening the rocker shaft backlash adjusting screw on top of steering box.	It is most important that this screw is correctly adjusted See instructions governing adjustment
	Steering too light and /or over sensitive	Check for loose torsion bar fixings on steering box valve and worm assembly.	Fit new valve and worm assembly
HYDRAULIC FLUID LEAKS	Damaged pipework, loose connecting unions, etc	Check by visual inspection, leaks from the high pressure pipe lines are best found while holding the steering on full lock with engine running at fast idle speed (see Note 1 below). Leaks from the steering box tend to show up under low pressure conditions, that is engine idling and no pressure on steering wheel.	Tighten or renew as necessary
EXCESSIVE NOISE	(1) If the high pressure hose is allowed to come into contact with the body shell, or any component not insulated by the body mounting, noise will be transmitted lo the car interior.	Check the loose runs of the hoses.	Alter hose route or insulate as necessary
	(2) Noise from hydraulic pump.	Check oil level and bleed system.	If no cure, change hydraulic pump.
CRACKED STEERING	Excessive pressure due to faulty relief valve in hydraulic pump	Check by visual inspection	Fit new steering box and rectify hydraulic pump or replace as necessary.

Note 1 Never hold the steering wheel on full lock for more than 30 seconds in any one minute, to avoid causing the oil to overheat and possible damage to the seals.

Note 2 High pressure - In general it may be assumed that excessive pressure is due to a faulty relief valve in the hydraulic pump.
Low pressure - Insufficient pressure may be caused by one of the following:

1 Low fluid level in reservoir — Most usual cause of
2. Pump belt slip — insufficient pressure
3 Leaks in the power steering system
4 Faulty relief valve in the hydraulic pump
5 Fault in steering box valve and worm assembly
6 Leak at piston sealing in steering box
7 Worn components in either steering box or hydraulic pump

OVERHAUL DROP ARM BALL JOINT

The drop arm ball joint can be overhauled and there is a repair kit available which consists of the following items.

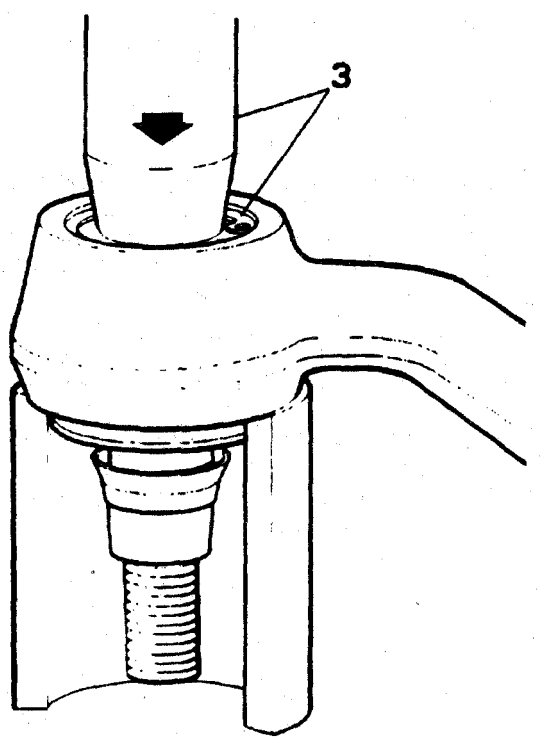
Ball Pin	**Ball lower socket**
Retainer	**Spring**
Spring rings	**'O'ring**
Dust cover	**Cover plate**
Ball top socket	**Circlip**

Dismantle

1. Remove the drop arm from the vehicle and clean the exterior.
2. Remove the spring rings and prise-off the dust cover.
3. In the interests of safety, position the ball joint under a press to relieve the spring tension and support the housing both sides of the ball pin, as illustrated. Apply pressure to the cover plate and remove the circlip and slowly release the pressure.

WARNING: Personal injury could result if the circlip is removed without pressure being applied and maintained to the cover plate.

4. Remove the spring, top socket, and ' O 'ring.



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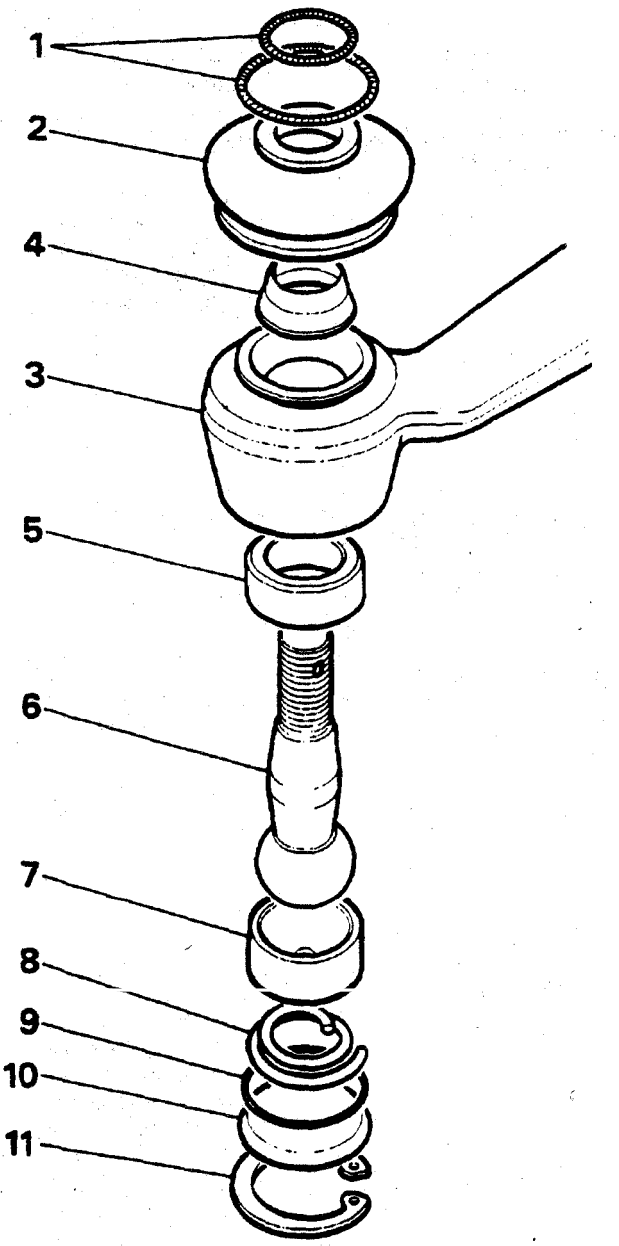
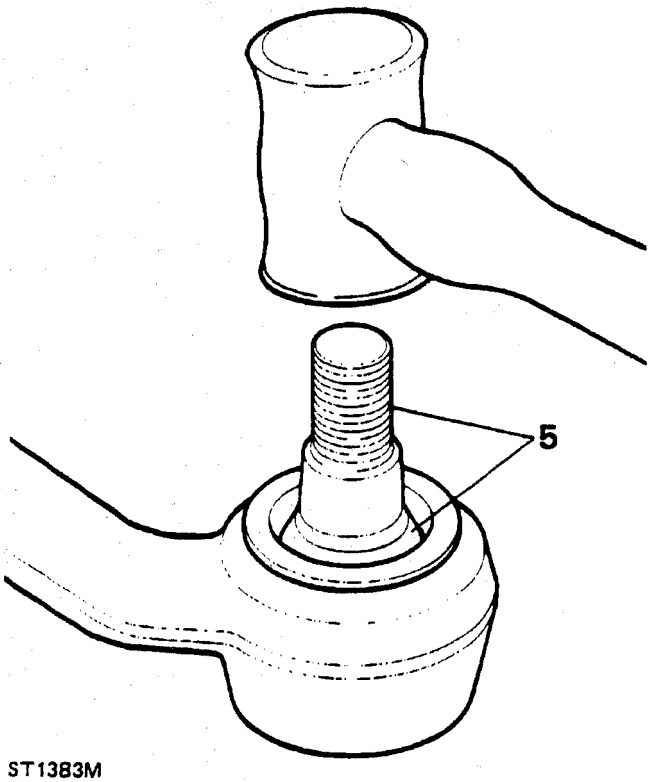


ST1381M

KEY TO BALL JOINT

1. Spring rings.
2. Dust cover.
3. Ball housing.
4. Retainer.
5. Bottom socket.
6. Ball pin.
7. Top socket
8. Spring.
9. 'O' ring.
10. Cover plate
11. Circlip.

5. Since the ball pin cannot be removed with the retainer in position, tap the threaded end of the ball pin to release the retainer and to remove the pin from the housing.



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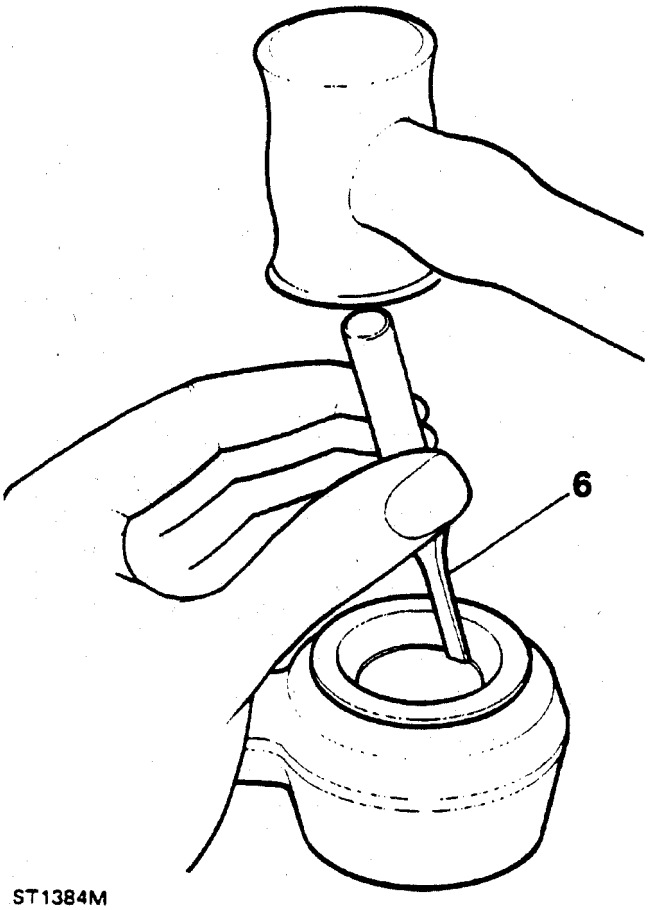
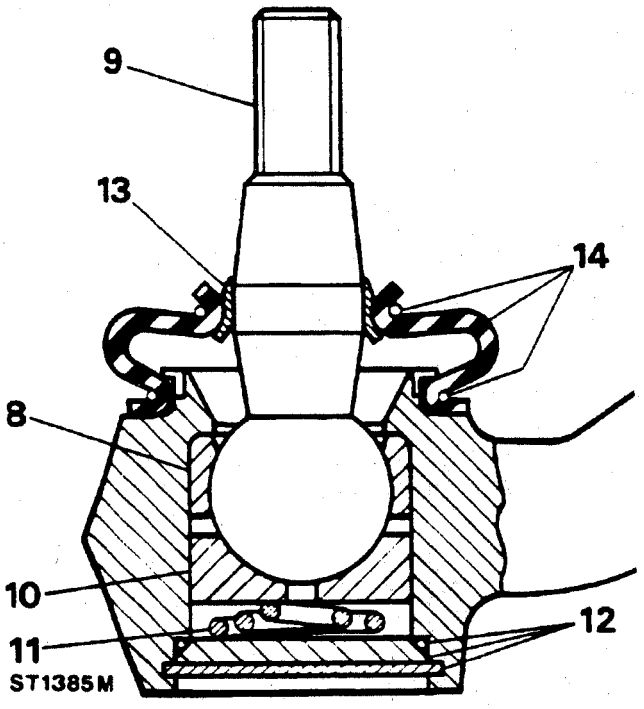


ST1384M

6. Using a sharp-edged punch or chisel, drive the ball lower socket from the housing. Should difficulty be experienced, apply gentle heat to the housing and then continue to drive the socket from the housing.
7. Clean the housing and remove any burrs.

Assemble

8. Press-in the lower socket squarely up to the shoulder.
9. Dip the ball in Duckhams LB 10 grease, or equivalent and fit to the housing and pack with grease.
10. Fit the top socket.
11. Fit the spring, small diameter towards the ball.
12. Fit the 'O' ring and using the same method as for removing the circlip and compress the cover plate and secure with the circlip. Ensure that the circlip is fully seated in the machined groove.
13. Press the retainer on to the ball pin so that the top edge is level with the edge of the taper.
14. Fit the dust cover and retain with the two spring rings.



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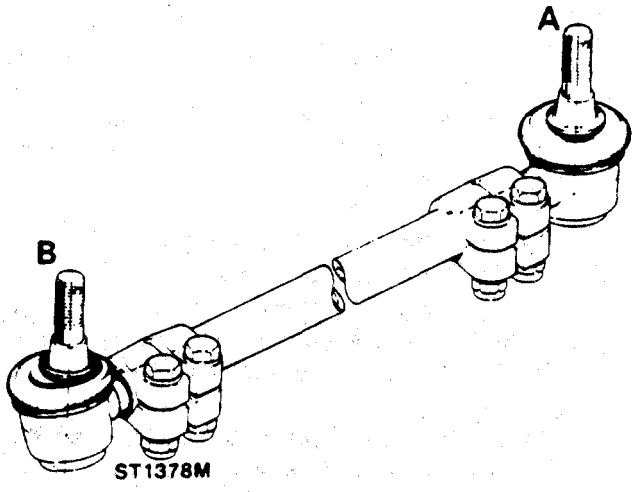
15. Fit the drop arm to the steering box using a new lock washer. Tighten the retaining nut to the correct torque and bend over the lock washer.
16. Assemble the ball pin to the drag link, see instructions for fitting drag link and track rod, and tighten the castle nut to the correct torque and secure with a new split pin.

TRACK ROD AND DRAGLINK

When adjusting or renewing a track rod or draglink it is important to ensure that the ball joints are assembled in the same angular plane and that the ball joint pins are central in their respective housings, as example 'A' illustrated below. Premature wear could result if the pins are inclined to one-side as illustration 'B'.



CAUTION: A track rod or draglink that is damaged or bent must be renewed. No attempt should be made to repair or straighten it.

FRONT WHEEL ALIGNMENT - Check and adjust

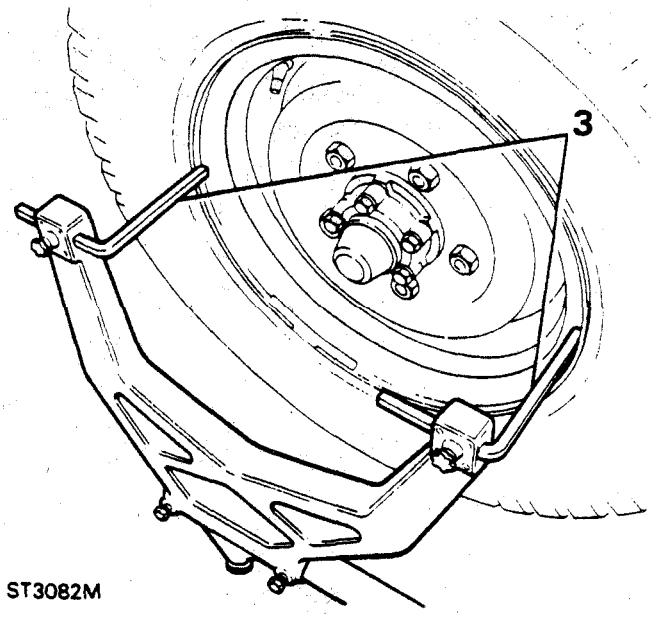
Checking

NOTE: Recognised front wheel alignment tracking equipment should be used to perform this operation. Only the use of basic equipment is described below. See section 04 for alignment data.

Make the following checks before commencing:

- The vehicle is on level ground.
- The vehicle is not loaded.
- The wheels run true and are not damaged or buckled.
- The track rod is not damaged or bent.
- The ball joints are not worn and boots are not split.
- The joints are Set in the same angular plane and central in their housings. See 'Track rod and drag link'.

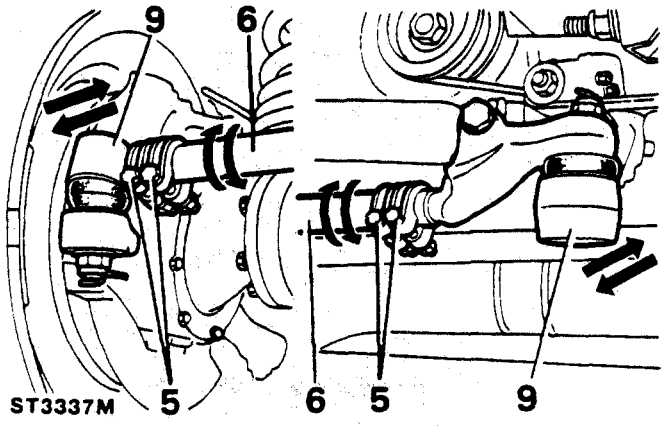
1. Set the road wheels in the straight ahead position and move the vehicle forward a short distance for at least two revolutions of the wheels.
2. Set up the equipment to the manufacturers instructions.
3. Position the trammel probes on the inner face of the wheel, not the rims, if the latter are damaged.



4. Check the alignment as advised by the equipment supplier.

Adjusting

5. Slacken the clamps at both ends of the track rod.
6. Turn the track rod to increase or decrease its effective length until the toe-out is correct.
7. Push the vehicle rearwards turning the steering wheel from side to side to settle the ball joints. Then, with the road wheels in the straight ahead position, push the vehicle forward a short distance.
8. Re-check the track and if required, adjust as necessary.
9. When the alignment is correct, tap the ball joints in direction of the arrows to the maximum of their travel to ensure full unrestricted movement of the track rod. Then return the joints to a central position and in line.



10. Finally, tighten the ball joint clamp nuts and bolts to the correct torque.

OVERHAULREARSUSPENSION

Remove the lower links

1. Jack up the rear of the vehicle and lower on to axle stands.
2. Remove the nut and bolt retaining the lower link to the axle bracket.
3. Remove the three nuts and bolts retaining the foward end of the link to the chassis bracket.
4. Withdraw the lower link from the vehicle.
5. Remove the locknut and washer and remove the flexible mounting from the link.

Renew the bushes

6. Press out the bush from the rear end of the lower link.
7. Press a new bush squarely into the link.

Fit the lower link

8. Assemble the flexible mounting to the link and secure with the locknut but do not tighten at this stage.
9. Fit the link to the vehicle, securing the front end of the link to the chassis bracket with the three nuts and bolts.
10. Assemble the rear end of the link to the axle bracket and retain with the nut and bolt, but do not tighten at this stage.
11. Lower the vehicle to the ground and allow the suspension to settle.
12. Tighten the nut and bolt at the rear end of the link.
13. Tighten the forward locknut to 176 Nm.

Remove upper links

14. Jack up the vehicle under the chassis so that the rear axle is freely suspended.
15. Remove nuts and bolts retaining the upper link bracket to the chassis frame.
16. Remove the two nuts and bolts securing the upper links to the pivot bracket.
17. Withdraw the upper links complete with the chassis attachment brackets from vehicle.
18. Remove the nut and bolt retaining forward end of the link to the chassis bracket and separate the two parts.
19. Press out the bush from the forward end of the links and squarely press in new bushes.

Renew pivot bracket ball joint

20. Remove the levelling unit - if fitted.
21. Remove the split pin, castle nut and plain washer securing the ball joint to the pivot bracket.
22. Using ball joint extractor tool R01006 or a suitable proprietary tool remove the ball joint from the axle bracket.
23. Remove the pivot bracket complete with the ball joint and if fitted, the lower ball joint of the levelling unit.
24. Remove the two bolts securing the ball joint to the pivot bracket and press the ball joint from the bracket.

NOTE: Replacement ball joints are supplied as complete assemblies packed with grease.

25. Using two bolts as a guide to ensure correct alignment press the knurled ball joint into the pivot bracket and secure with the two nuts and bolts.

Assemble upper links and ball joints

26. Fit the pivot bracket ball joint and bracket to the axle and secure with the plain washer castle nut and split pin. Tighten the nut to 176 Nm.
27. Fit the levelling unit, if used.
28. Assemble the upper links to the chassis attachment brackets but do not at this stage fully tighten the pivot nut and bolt.
29. Fit the upper link assemblies to the chassis with the six nuts and bolts, (three each side). Note the positions of the bolt heads. Tighten the nuts to 47 Nm.
30. Secure the rear ends of the upper links to the pivot bracket and tighten the two nuts and bolts and tighten to 115 Nm.
31. Remove the jack from the chassis, allow the suspension to settle and tighten upper link pivot bolts.

Renew anti-roll bar bushes and ball joints

32. Remove the two nuts and bolts securing the anti-roll bar to the axle link.
33. Remove the eight nuts and bolts (four each side) retaining the anti-roll bar to the chassis and remove the bar from the vehicle.
34. Remove the split pin and castle nut and remove the ball joint and link from the axle location.
    If the ball joint requires replacement the complete link must be renewed.
35. Renew the rubbers and fit the anti-roll bar to the chassis and secure with the eight bolts and nuts tightening to 24 Nm.
36. Fit the ball joint and link to the axle location and tighten the castle nut to 40 Nrn and fit a new split pin.
37. Fit the anti-roll bar to the ball joint link and fit new bushes in the sequence illustrated and tighten the nuts and bolts, to the correct

LEVELLING UNIT

Functional check

A Boge Hydromat levelling unit is located in the centre of the rear axle.

When the vehicle is unladen the levelling unit has little effect. The unit is self-energising and hence the vehicle has to be driven before the unit becomes effective, the time taken for this to happen being dependant upon the vehicle load, the speed at which it is driven and the roughness of the terrain being crossed.

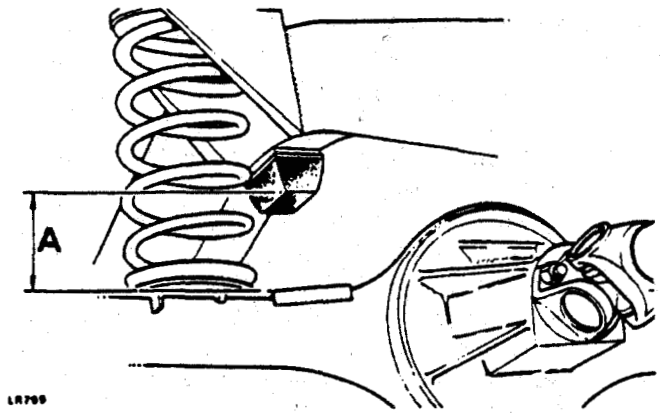
If the vehicle is overloaded the unit will fail to level fully and more frequent bump stop contact will be noticed.

Should the vehicle be left for a lengthy period e.g. overnight, in a laden condition, it may settle. This is due to normal internal fluid movement in the unit and is not detrimental to the unit performance.

Before carrying out the checks below, verity that the vehicle is being operated within the specified maximum loading capabilities. If the levelling unit is then believed to be at fault, the procedure below should be followed.

Whilst slight oil seepage is permissible, the unit should be renewed if there is an excessive oil leak.

1. Remove excessive mud deposits from underneath the vehicle and any heavy items from inside the vehicle that are not part of the original equipment.
2. Measure the clearance between the rear axle bump pad and the bump stop rubber at the front outer corner on both sides of the vehicle, dimension A. The average clearance should be in excess of 67 mm.
3. If the bump stop clearance is less than the above figure remove the rear springs and check the free length against the following data in the chart.
4. Renew any spring where the free length is more than 20 mm shorter than the figures in the chart.
5. Having refitted or renewed any springs repeat the clearance check as described above. If the average bump clearance is still less than 67 mm renew the levelling unit.



6. Load weights to the value of 650 kg evenly over the rear load area of the vehicle and leave it to settle undisturbed for minimum period of thirty minutes.
7. With the driving seat occupied or with an approximate equivalent weight of 75 kg check the bump stop clearance and note the measurement.
8. Drive the vehicle on a test route approximately 5 km in length over undulating roads or graded tracks. At the completion of the drive bring the vehicle to rest by light brake application so as not to disturb the vehicle loading.
9. Without disturbing the vehicle load and with the driving seat occupied, check the bump stop clearance and note the reading, which must be in excess of 45 mm (average).
10. Subtract the reading obtained under Instruction 7 from that obtained under Instruction 9. If the change in clearance is in excess of 10 mm the levelling unit is functioning correctly.
11. If the figures obtained in instructions 9 and 10 do not exceed 45 mm and 10 mm respectively unload the vehicle and renew the levelling unit.

LAND ROVER COIL SPRING SPECIFICATION

PART NO.	DESCRIPTION	COLOUR CODE	LOCATION	SPECIFICATION	FREE LENGTH
NRC 6388	Drivers Levelled	Blue Stripe	Rear	Suspension Levelled	420 mm
NRC 7000	Passengers Levelled	Green & White Stripes	Rear	Suspension Levelled	400 mm

REMOVE LEVELLING UNIT

WARNING: The levelling unit contains pressurised gas and must not be dismantled nor the casing screws removed. Repair is by replacement of complete unit only.

1. Raise and support the vehicle under the chassis and use a jack to support the weight of the axle.
2. Disconnect the upper links at the pivot bracket.
3. Ease up the levelling unit lower gaiter and unscrew the lower ball joint at the push rod using thin jawed spanners.
4. Release the webbing strap from the chassis.
5. Remove the four nuts securing the top bracket to the chassis and withdraw the levelling unit complete with bracket.

Renew levelling unit ball joints

The ball joints for the levelling unit may be dismantled for cleaning and examination.

6. Unscrew the lower ball joint from the pivot bracket.
7. Unscrew the ball joint from the top bracket.
8. Reassemble the ball joints, packing with Dextagrease G.P. or equivalent or if necessary renew the joints if worn.
9. Check the condition of the gaiters and renew if necessary.

Fit levelling unit

10. Ensure the ball pin threads are clean and smear Loctite grade CVX on the ball pin threads.
11. Fit the upper ball joint to the levelling unit and secure the gaiter.
12. Fit the top bracket complete with levelling unit to the chassis and secure with the four nuts and tighten to 47 Nm.
13. Fit the levelling unit to the lower ball joint and secure the gaiter.
14. Attach the webbing strap to the chassis cross member.
15. Fit the upper links to the pivot bracket and retain with the two bolts and nuts but do not tighten at this stage.
16. Remove the jack in support of the axle and the support from under the chassis.
17. Allow the suspension to settle and then tighten the two bolts and nuts retaining the upper links to the pivot bracket to the correct torque.

SPRINGS AND SHOCK ABSORBERS

Remove rear springs

1. Slacken the rear road wheel nuts and raise the rear of the vehicle and lower the chassis on the axle stands or similar supports and remove the road wheels.
2. Support the weight of the axle with a jack.
3. Disconnect the shock absorbers at the lower end.
4. Remove the spring retainer plate.
5. Lower the axle sufficiently to withdraw the spring, but take care not to stretch the flexible brake hose by lowering the axle too far.
6. Remove the spring pan.

Fit rear springs

7. Fit the spring pan and retainer plate.
8. Fit the spring into the chassis top location and using a turning motion fit the spring to the axle pan.
9. Secure the shock absorbers with the rubbers correctly located.
10. Remove the axle support, fit the road wheels and lower the vehicle to ground.
11. Finally tighten the road wheel nuts.

Remove shock absorbers

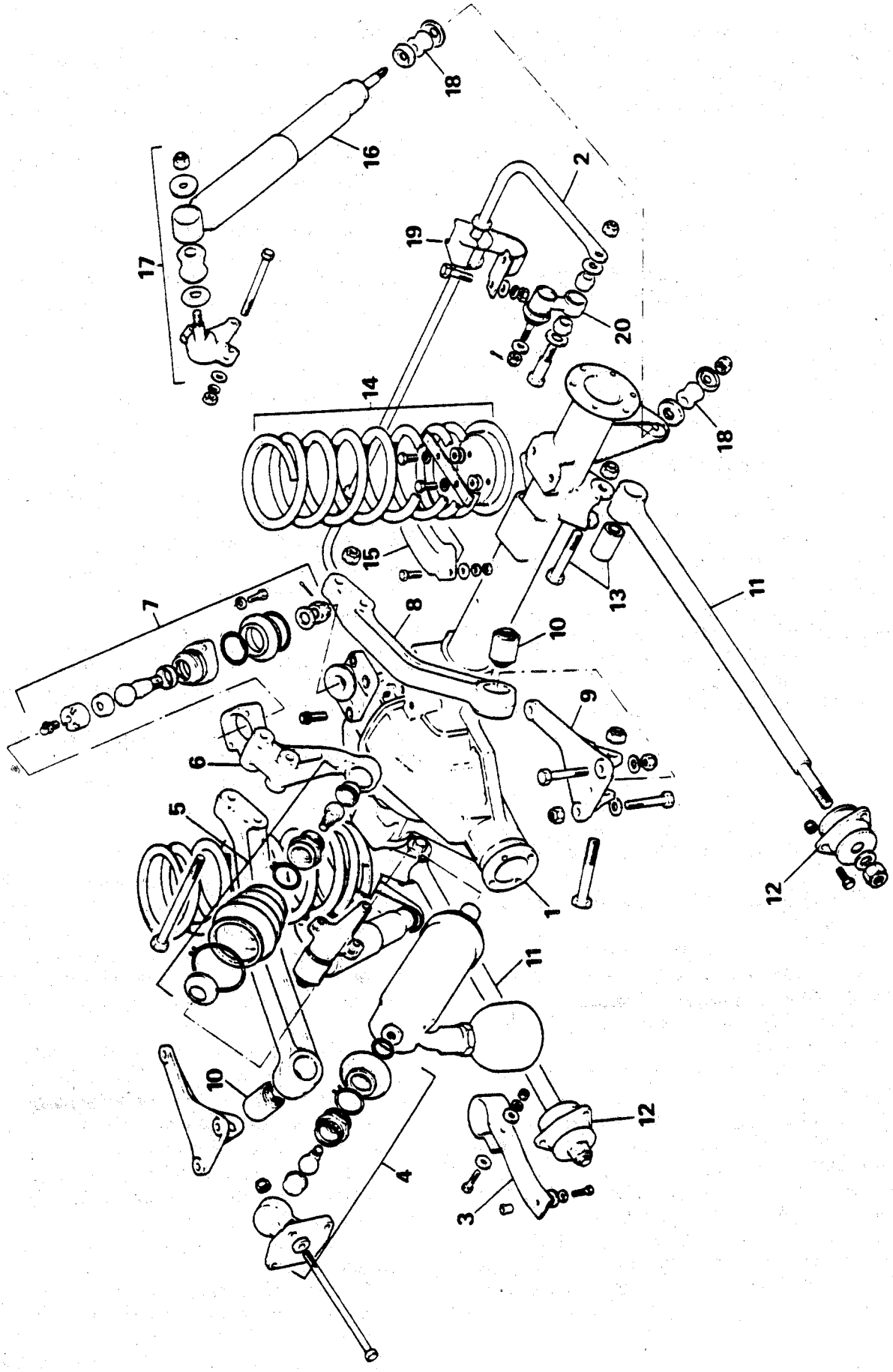
12. Slacken the road wheel nuts, raise the rear of the vehicle and support it under the axle and remove the road wheels.
13. Remove the shock absorber upper and lower retaining nuts and rubbers.
14. Remove the shock absorber from the top locating shaft and withdraw it from the vehicle.

Test shock absorbers

15. Hold the shock absorber vertically in a vice, being careful not to damage the threads.
16. The shock absorber employs differential damping having greater resistance on the extension stroke. Check operation by extending and compressing the shock absorber.
    Resistance should be uniform throughout the length of each stroke. If resistance is erratic or weak, renew the shock absorber. When checking resistance a new shock absorber may be used for comparison. To ensure that the new shock absorber is primed, fully extend and compress the unit several times before testing begins.

Fit shock absorbers

17. Fit the shock absorbers using new rubbers and fit the lower rubbers and caps in the order illustrated.
18. Fit the road wheels, lower the vehicle and finally tighten the road wheel nuts.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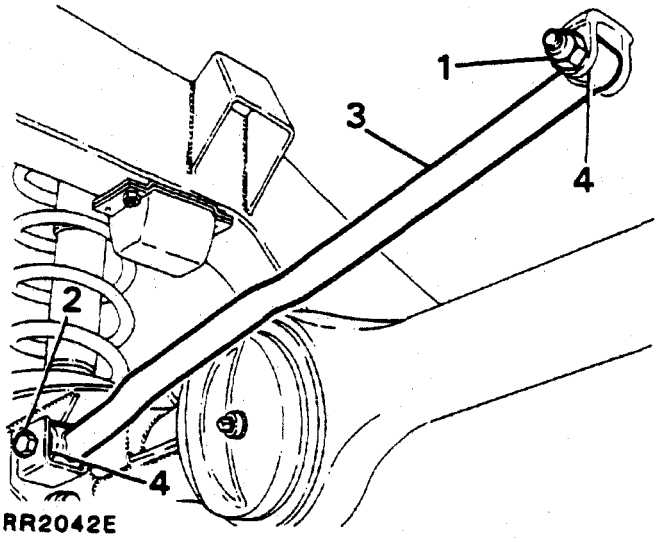
LAND ROVER 110 REAR SUSPENSION

1. Salisbury axle casing
2. Anti-roll bar
3. Boge self levelling unit
4. Levelling unit upper ball joint assembly
5. Levelling unit lower ball joint assembly
6. Fulcrum bracket
7. Fulcrum bracket ball joint assembly
8. Suspension top links
9. Top link mounting brackets
10. Top link bushes
11. Lower links
12. Lower link flexible bush assembly
13. Lower link bush and bolt assembly
14. Coil spring assembly
15. Bump stop
16. Shock absorber
17. Shock absorber top bush assembly
18. Shock absorber lower bush assembly
19. Anti-roll bar bush and strap assembly
20. Anti-roll bar ball joint and link assembly

PAN HARD ROD

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.



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Refit

5. Fit replacement bushes.

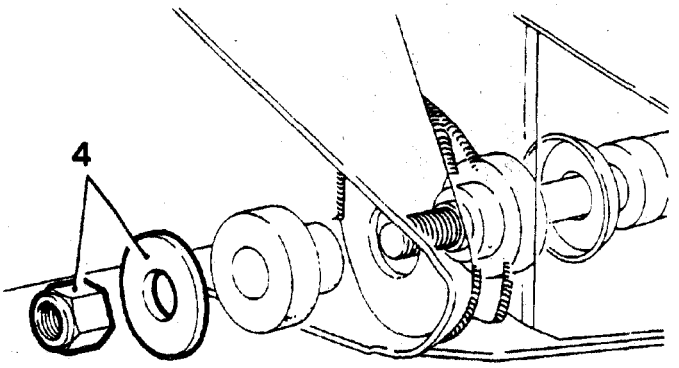
CAUTION: Apply pressure to outer edge of bush, and not rubber inner.

6. Reverse 1 to 4. Tighten fixings to 88Nm.

RADIUS ARM

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.



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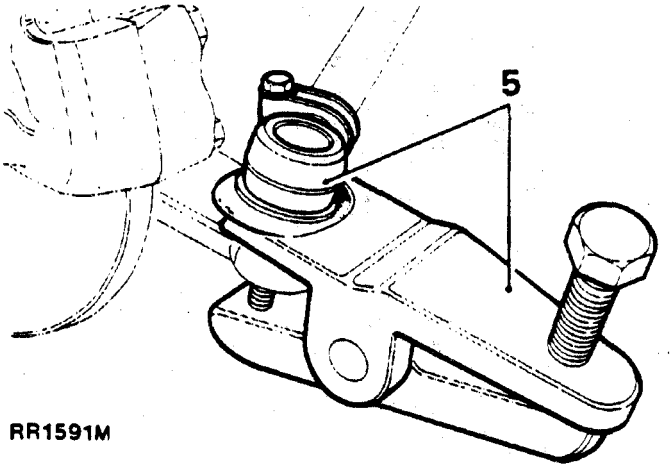
5. Disconnect track rod at ball joint.
6. Remove fixings, radius arm to axle.
7. Lower radius arm front end to clear axle and remove from vehicle.



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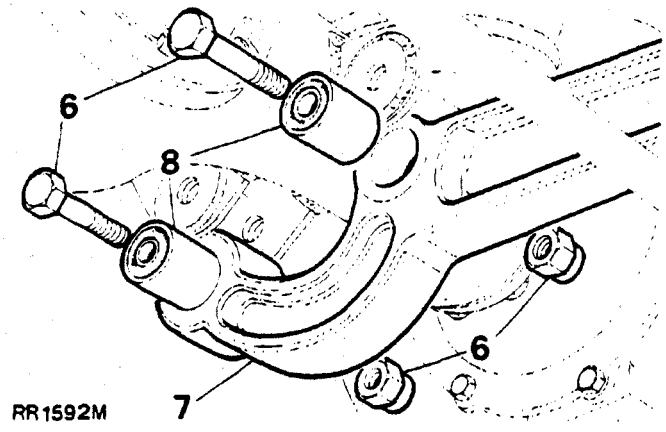


8. Press out flexible bushes.

Refit

9. Press in replacement bushes.

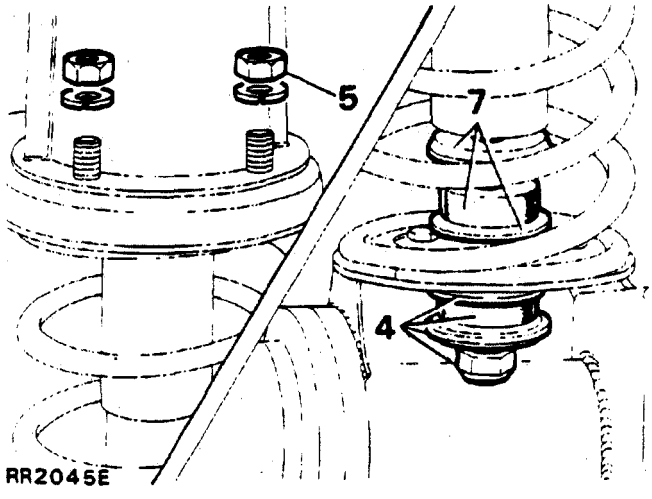
CAUTION: When pressing in new bushes press on outer edge of bush and not rubber inner.

10. Reverse 1 to 7. Tighten fixings to following torques:
    Radius arm to chassis 176Nm.
    Radius arm to axle 197Nm.

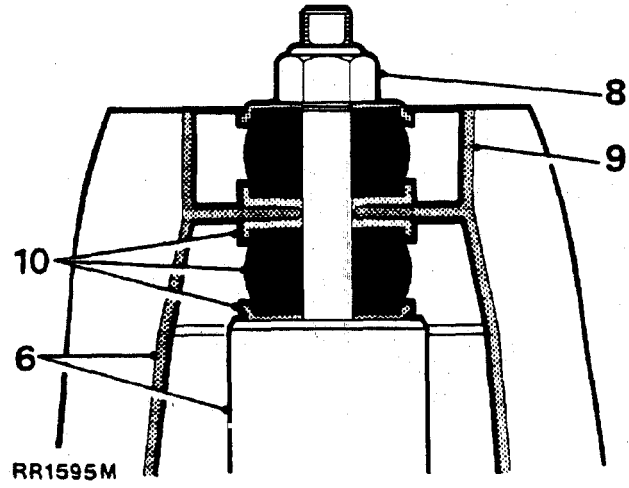
FRONT SHOCK ABSORBER

Remove

1. Loosen road wheel retaining **nuts.**
2. Support chassis on stands and remove road wheel.
3. Support axle weight with jack.



4. Remove shock absorber lower fixing and withdraw e cupwasher, rubber bush and seating washer.
5. Remove four shock absorber bracket fixings.
6. Withdraw shock absorber and bracket complete.



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 instructions 1 to 10.

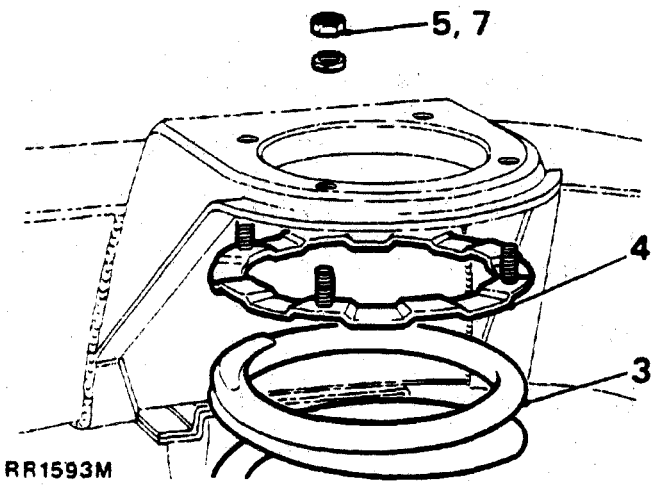
FRONT ROAD SPRING

Remove

1. Remove 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.



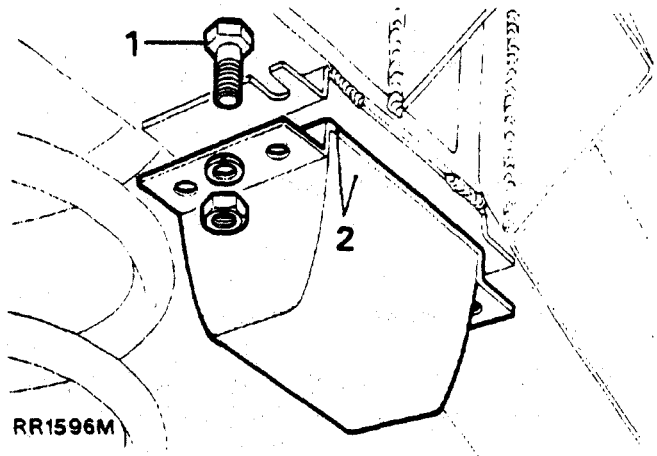
Refit

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

Remove

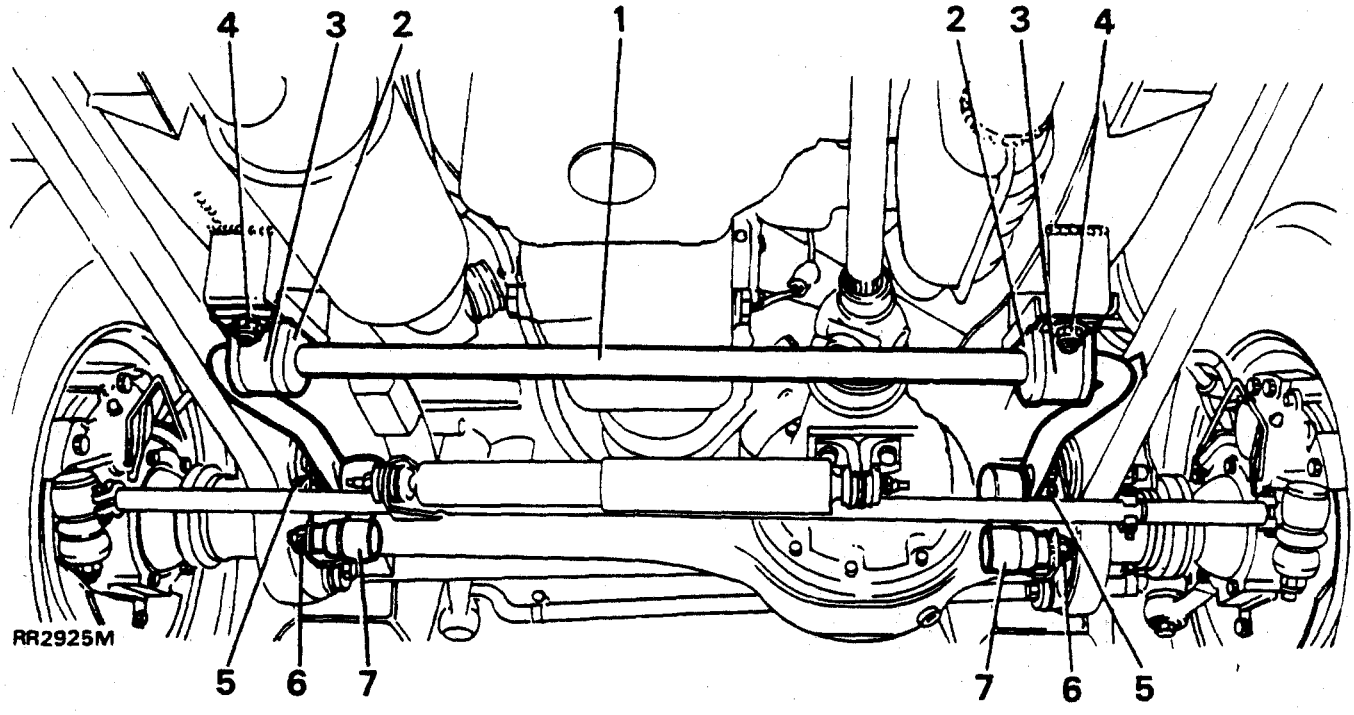
1. Remove fixings.
2. Remove bump stop.



Refit

3. Position bolts in slots in chassis brackets.
4. Fit bump stop, secure with washers and nuts.

ANTI-ROLL BAR ASSEMBLY



KEY

1. Anti-roll bar
2. Rubber bush
3. Strap
4. Nut, bolt, washer
5. Nut and washer
6. Castellated nut and cotter pin
7. Ball joint link arm

ANTI-ROLL BAR FRONT

Remove

1. Mark 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 ball joint links and remove anti-roll bar.

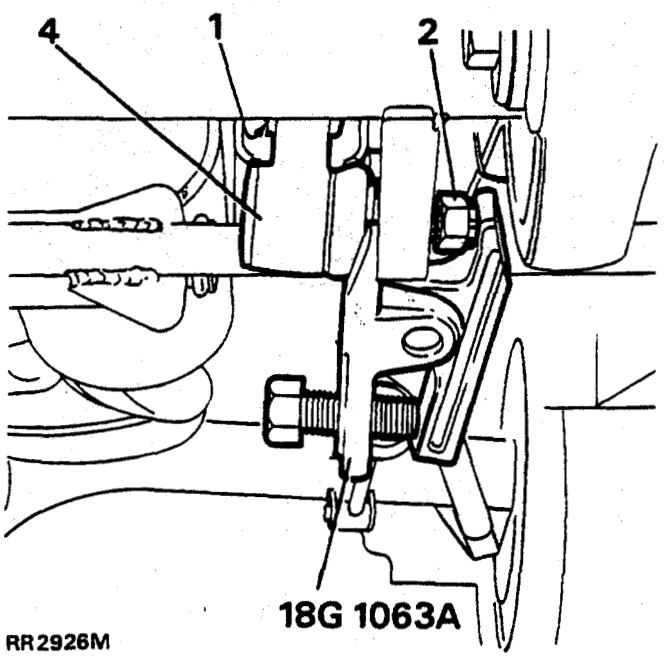
Refit

4. Position bushes on anti-roll bar. Ensure split points towards axle.
5. Fit anti-roll 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 bar to ball joint links. Tighten to 68Nm.
7. Tighten nuts securing straps to 30Nm

ANTI-ROLL BAR BALL JOINT **LINKS**

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 bar to ball joint links. Tighten to 68Nm.

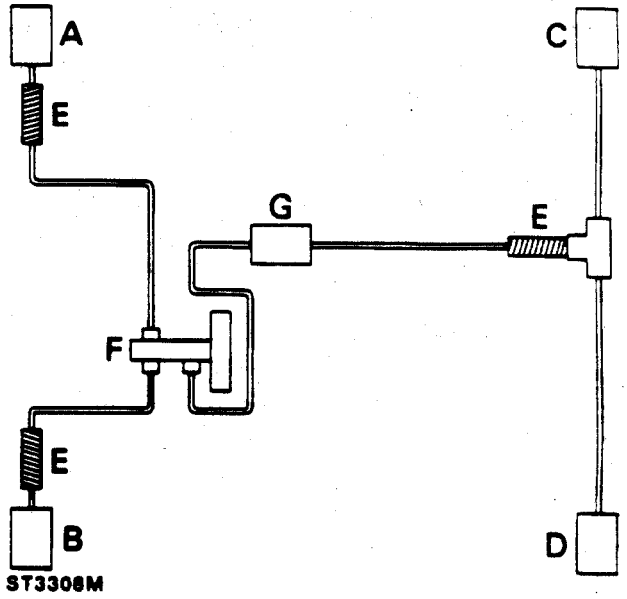
BRAKES

DESCRIPTION

The mechanical components of the Defender 90 braking system consists of four piston caliper disc brakes at the front and twin piston caliper disc brakes at the rear. The Defender 110 system consists of single cylinder drum brakes at the rear and four piston caliper disc brakes at the front. The cable controlled handbrake, common to both vehicles, is a mechanically operated single drum type brake mounted on the output shaft of the transfer box and is completely independent of the main braking system. Adjustment of all drum brakes is by a snail cam turned by a square peg on the back-plates. Caliper disc brakes are self adjusting.
The basic hydraulic system involves two separate and independent primary and secondary circuits which permit a degree of braking should a fault occur in one of the circuits, The primary circuit operates the rear brakes and the secondary circuit controls the front brakes. The tandem master cylinder, which is assisted by a type 80 direct acting servo, is fed by a divided fluid reservoir. The rear section contains fluid for the primary circuit and the front portion supplies fluid for the secondary circuit.

A brake fluid loss switch is fitted to the master cylinder filler cap. The switch is wired to a warning lamp bulb on the drivers control panel and the bulb will illuminate momentarily when the starter motor is actuated, indicating that the brake warning circuit is functioning correctly. A hydraulic failure in the primary or secondary circuits will result in fluid loss and cause the warning bulb to illuminate, in such an event, the driver must stop the vehicle immediately and investigate the cause.

The "G" valve allows fluid to the rear brakes until a predetermined pressure is reached when the valve closes. The valve, from this point on, will only permit a proportion of any increase in fluid pressure to reach the rear brakes to prevent premature locking of the rear wheels. Should a failure occur in the front brake secondary circuit the design of the valve will ensure that the fluid to the rear brakes will by-pass the valve and allow full circuit pressure to the rear wheel cylinder.



A Right hand front brake
B Left hand front brake
C Right hand rear brake
D Left hand rear brake
E Jump hose
F L.S.C. 80 servo and master cylinder assembly
G 'G' valve

REMOVE AND OVERHAUL BRAKE CALIPERS

Special tool:
18G672 - LRT-70-500 - Piston clamp

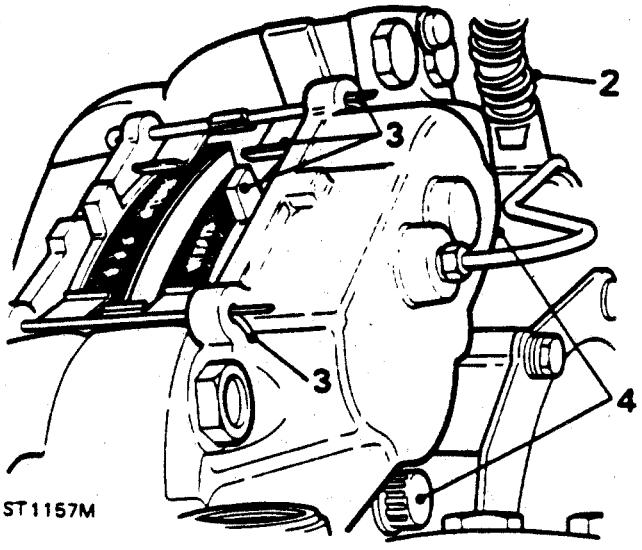
Remove caliper

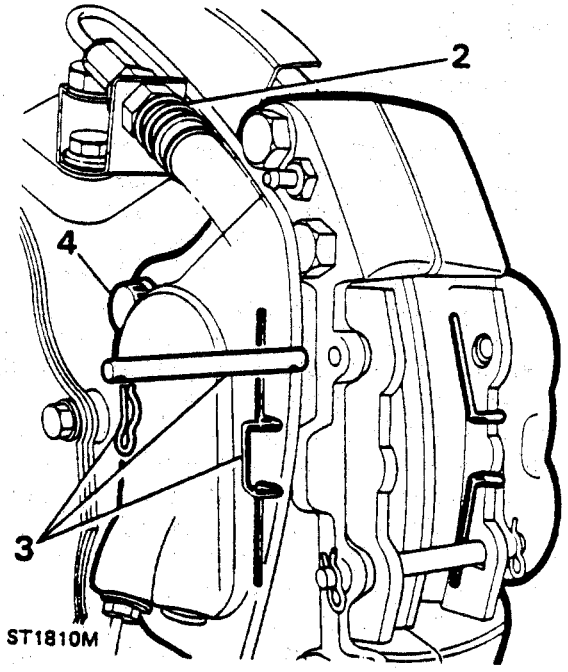
1. Slacken the wheel retaining nuts, jack-up the vehicle, lower onto axle stands and remove the wheels.
2. Expose the brake flexible hose by moving the coiled protective covering and clamp the hose. Disconnect the hose from the caliper.

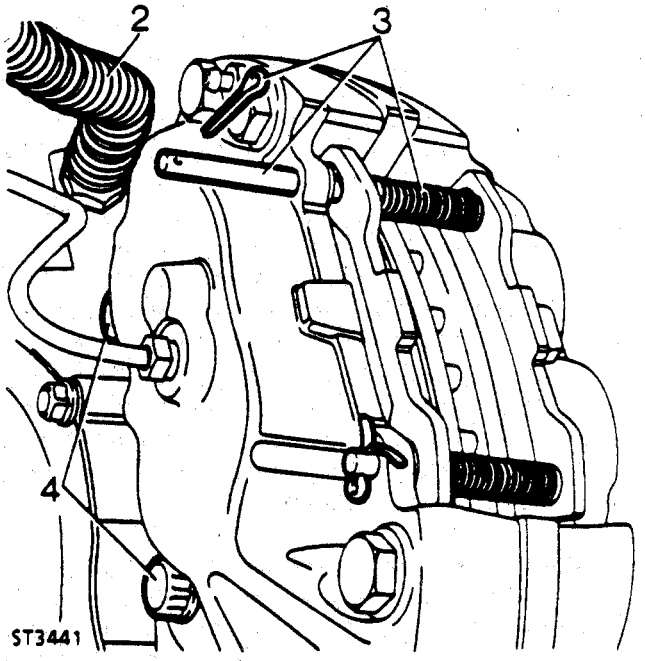
NOTE: Three different methods of retaining the brake pads are used. Each type is listed below and shown in the illustrations referred to:

Type A - Plate anti-rattle springs - Fig. ST1157M.
Type B - Wire anti-rattle springs - Fig. ST1810M.
Type C - Coil anti-rattle springs - Fig. ST3441

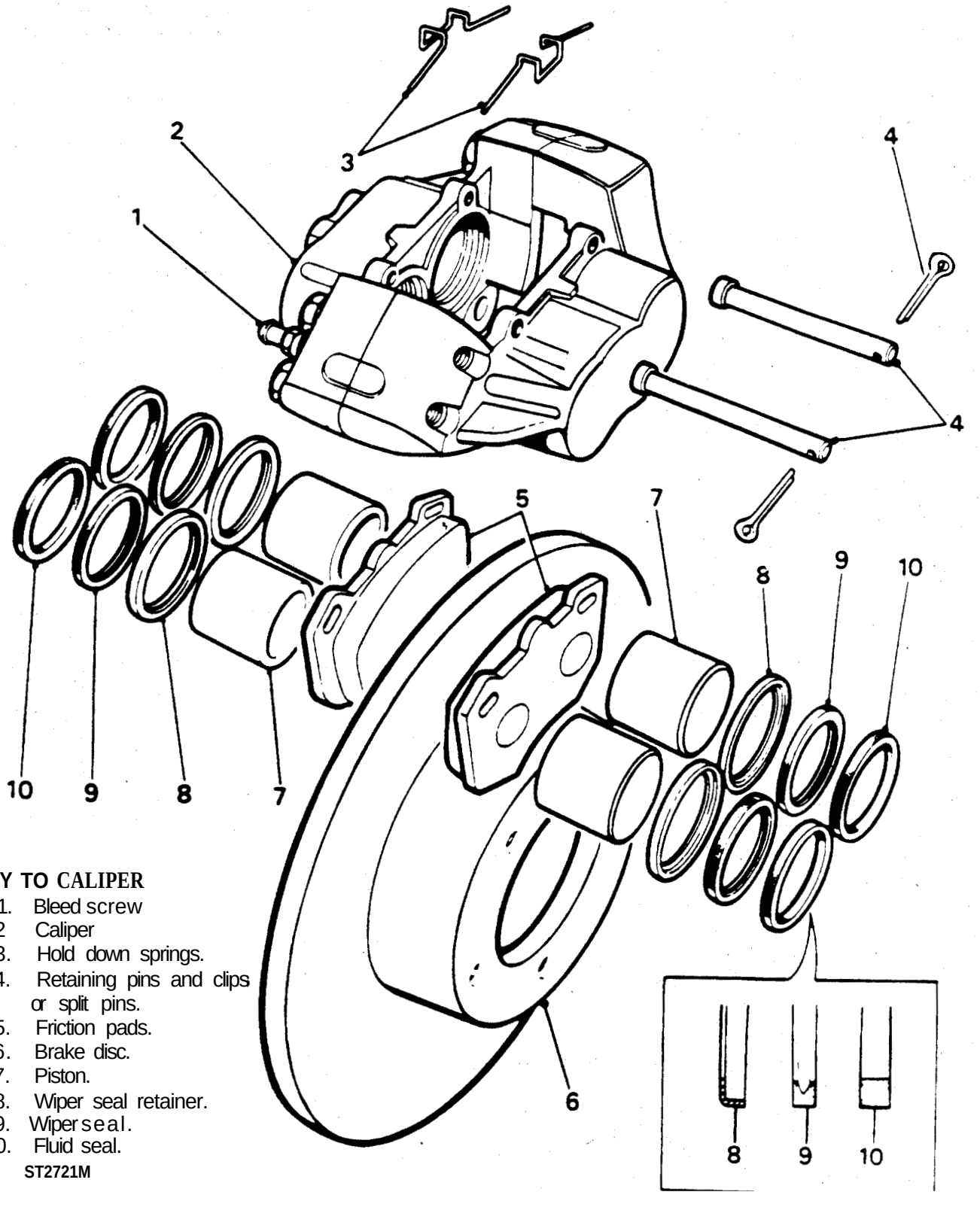
3. Removing friction pads - plate type anti-rattle springs
   Straighten the splayed ends of the pad retaining pins and withdraw the pins. Collect the anti-rattle springs and withdraw the pads. If the same pads are to be refitted, identify them for assembly to their original locations.
   Removing friction pads - wire or coil anti-rattle springs
   Remove the four spring clips or split cotters and remove the retaining pins. Withdraw me friction pads. If the same pads are to be refitted, identify them for assembly to their original locations.
4. Remove the two bolts and withdraw the caliper from the vehicle.







TYPICAL BRAKE CALIPER ASSEMBLY



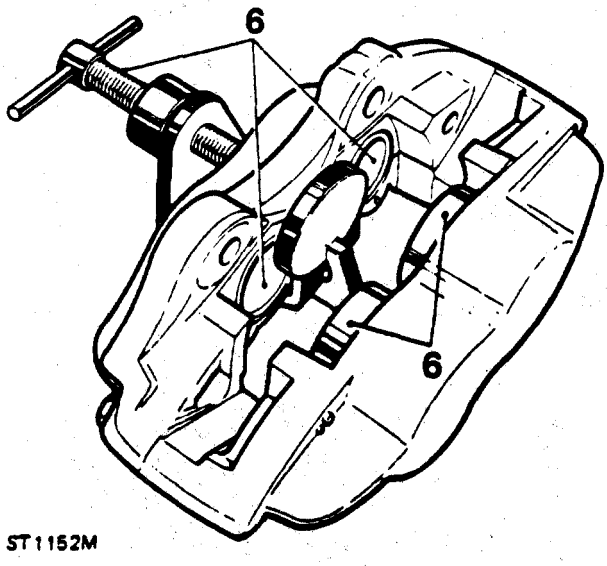
KEY TO CALIPER

1. Bleed screw
2. Caliper
3. Hold down springs.
4. Retaining pins and clips or split pins.
5. Friction pads.
6. Brake disc.
7. Piston.
8. Wiper seal retainer.
9. Wiper seal.
10. Fluid seal.

ST2721M

Do not separate the caliper halves.

5. Clean the outer surfaces of the caliper with methylated spirit.
6. Using special tool 18G672, clamp the pistons in the mounting half of the caliper and gently, keeping fingers clear, and with CAUTION, apply air pressure to the fluid inlet port to expel the rim half pistons. Since it is unlikely that both pistons will expel at the same time, regulate the rate with a suitable piece of timber between the appropriate piston and caliper.
7. Finally, remove the pistons keeping them identified with their respective bores.
8. Remove the wiper seal retainer by inserting a blunt screw driver between the retainer and the seal and prise the retainer carefully from the mouth of the bore.
9. Taking care not to damage the seal grooves, extract the wiper seal and fluid seal.
10. Clean the bores, pistons and particularly the seal grooves with clean brake fluid or methylated spirit only. If the caliper or pistons are corroded or if their condition is not perfect the parts **must** ***be*** renewed.



ST1152M

Assemble rim-half pistons

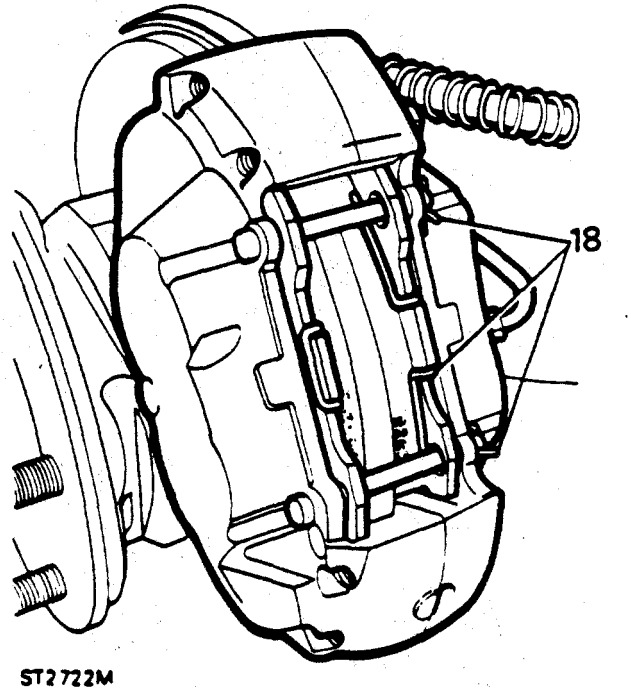
11. Coat a new fluid seal with Lockheed disc brake lubricant. Ease the seal into the groove in the bore using only the fingers and ensure that it is properly seated. The fluid seal and the groove are not the same in section **S0** that when the seal is seated it feels proud to the touch at the edge furthest away from the mouth of me bore.
12. Smear the appropriate piston with hydraulic brake lubricant and insert it squarely into the bore by hand only. Do not tilt the piston during insertion and leave approximately · mm projecting from the bore.
13. Coat a new wiper seal with hydraulic brake lubricant and fit it to a new seal retainer. Slide the assembly, seal first, over the protruding piston and into the bore recess Remove the piston clamp from the mounting half and use the clamp to press home the seal retainer and piston.

Mounting-half pistons

14. Clamp the rim-half pistons and carry out the same procedure as for removing and fitting the rim half pistons and seals, instructions 6 to 13.

Fit calipers and pads to vehicle

15. Fit the caliper to the axle and secure with the two bolts tightening evenly to the correct torque, **see** data.
16. Connect the brake flexible hose to the caliper and remove the hose clamp.
17. Lightly Smear the back and edges of the pads with disc brake lubricant carefully avoiding the friction material.
18. Fit the friction pads and secure using new pins and split pins and anti-rattle springs. Splay the ends of the early type retaining pins.



ST2722M

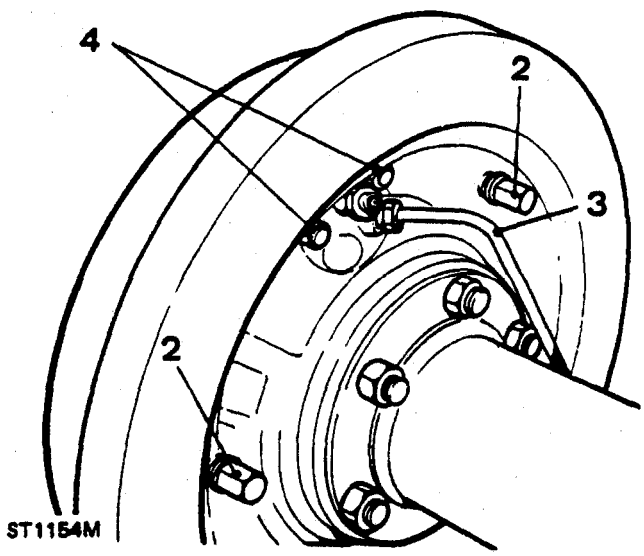
19. Bleed the brake hydraulic system as described later in this section.
28. When the foregoing instructions have been completed on both calipers, depress the brake pedal firmly several times to locate the friction pads.
21. Fit the road wheels, remove the axle stands and finally tighten the road wheel nuts, see data.
22. Road test the vehicle. remembering that if new friction pads have been fitted they are not 'bedded- in' and may take several hundred miles before the brakes are at maximum efficiency.

OVERHAUL REAR BRAKES - 110 models

DISMANTLING

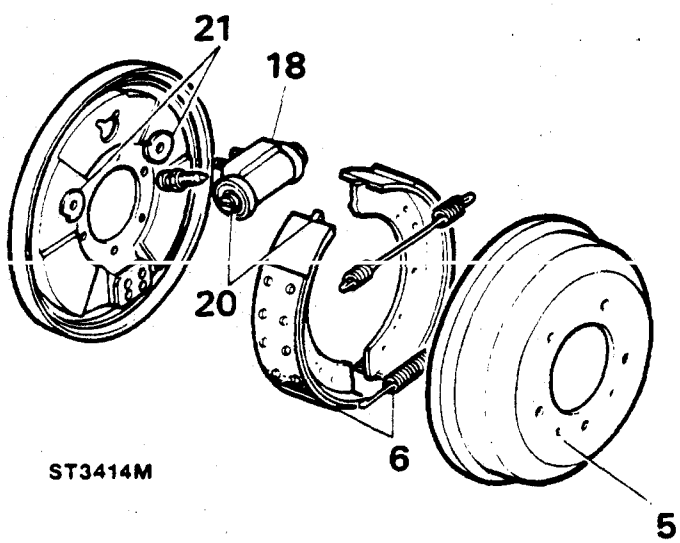
WARNING: Do not use an air line to blow dust from the brake assemblies - asbestos dust from brake linings can be a serious health risk if inhaled.

1. Slacken the road wheel nuts, jack-up the vehicle, lower onto axle stands and remove the road wheels.
2. Slacken the two brake shoe adjusters on the rear of the back-plate to assist removal of brake drum.
3. Disconnect the brake fluid pipe to the wheel cylinder and cover the pipe end to prevent ingress of dirt.
4. Remove the two retaining nuts and withdraw the wheel cylinder from the back-plate.



ST1154M

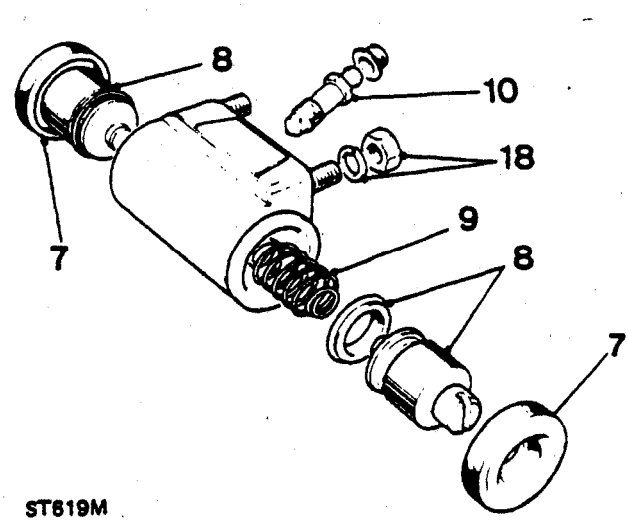
5. Remove the single retaining screw and withdraw the brake drum.
6. Lever off the brake shoes whilst noting the position of the pull-off springs.



ST3414M

Dismantle and overhaul wheel cylinder

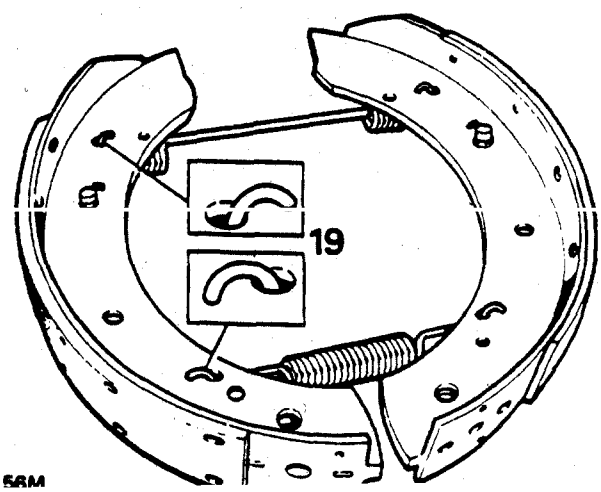
7. Remove the two dust covers.
8. Withdraw the pistons and discard seals.
9. Remove the spring.
10. Remove the bleed screw.
11. Clean components with Girling cleaning fluid and allow to dry.
12. Examine the cylinder and pistons for corrosion, scores and wear. Renew any component that is not satisfactory or replace complete cylinder assembly.
13. Fit new seals to the pistons noting that the seal lip is towards the cylinder.
14. Lubricate the pistons with new clean Girling brake fluid.
15. Fit the spring between the two pistons.
16. Fit the dust covers.
17. Fit the bleed screw and tighten to 0,5 to 0,8 kgf m.



ST619M

Assembling rear brake

18. Fit the wheel cylinder to the back-plate and secure with the two nuts and spring washers.
19. Assemble new brake shoe pull-off springs to relined brake shoes as illustrated.



ST1156M

20. The shoes in the wheel cylinder piston slots and lever the opposite ends into the pivot block.
21. Operate the snail cams to check that the shoes respond.
22. Connect the brake fluid pipe to the wheel cylinder.
23. Fit the brake drum and secure with the single screw.
24. Adjust each brake shoe independently as follows: turn one adjuster until the shoe is locked against the drum. Back off approximately two serrations of the snail cam so that the drum revolves freely.
25. Repeat instruction 24 on the second shoe and carry out the same procedure for the opposite brake.
26. Bleed the brakes.
27. Fit the road wheels, remove the axle stands and finally tighten the road wheel nuts to the correct torque.

OVERHAUL TRANSMISSION BRAKE

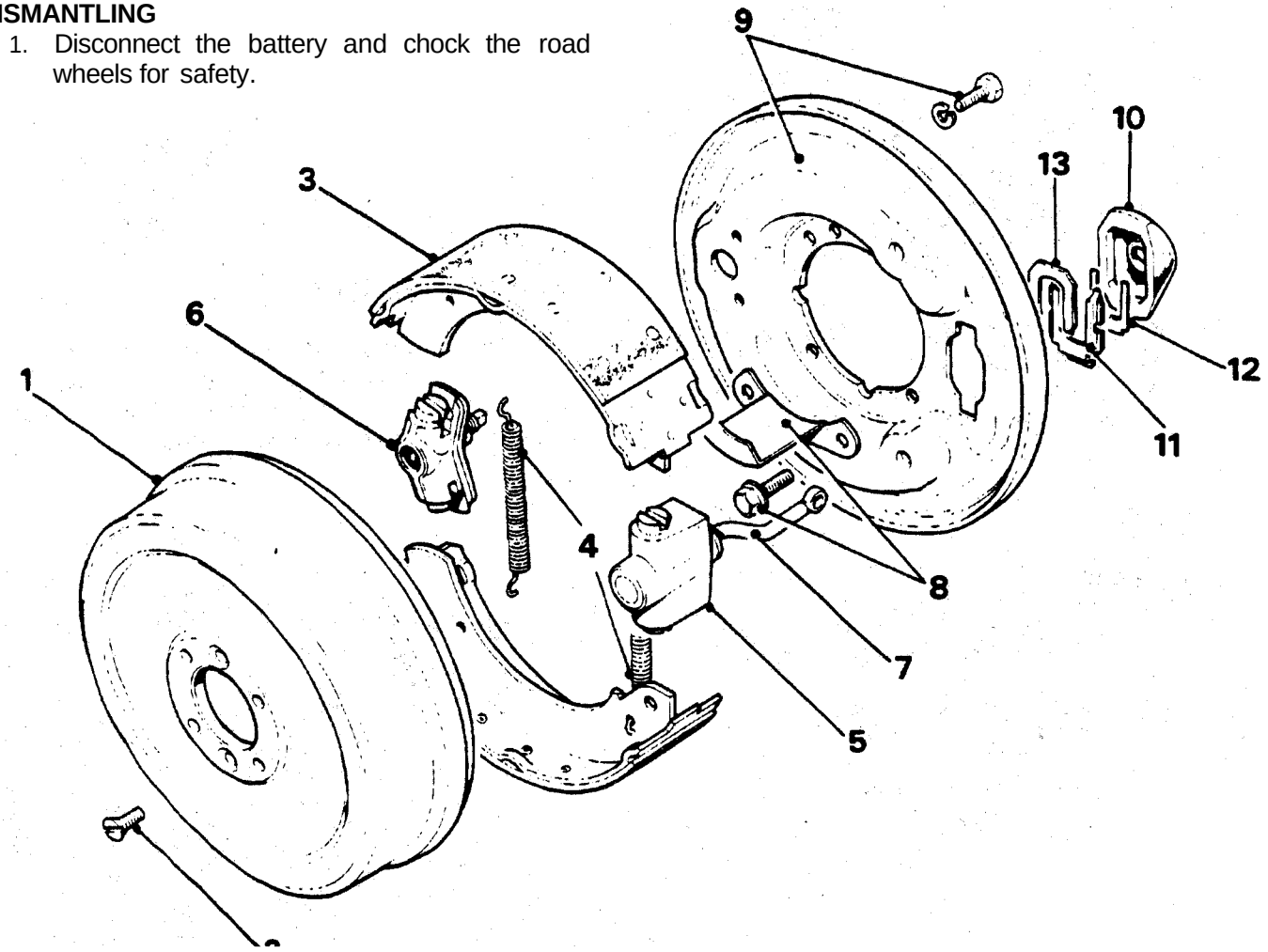
WARNING: Do not use an air line to remove dust from the brake assembly. Asbestos dust from the brake linings can be a serious health risk, if inhaled.

DISMANTLING

1. Disconnect the battery and chock the road wheels for safety.
2. Disconnect the propeller shaft from the output flange.
3. Remove the two screws and withdraw the brake drum. Skim if excessively scored or oval.
4. Remove the split pin and clevis pin connecting the drawlink to the actuating lever.
5. Remove the brake shoes complete with pull-off springs. Note position of springs in relation to the shoes.
6. Remove the four bolts securing back-plate to transfer box and withdraw the back-plate complete with oil catcher.

KEY TO TRANSMISSION BRAKE

1. Brake drum.
2. Brake drum retaining screws
3. Brake shoes.
4. Brake shoes pull-off springs.
5. Expander assembly.
6. Adjuster assembly.
7. Draw link.
8. Oil catcher.
9. Back plate and retaining bolts.
10. Dust cover.
11. Locking plate.
12. Packing plate.
13. Spring plate.

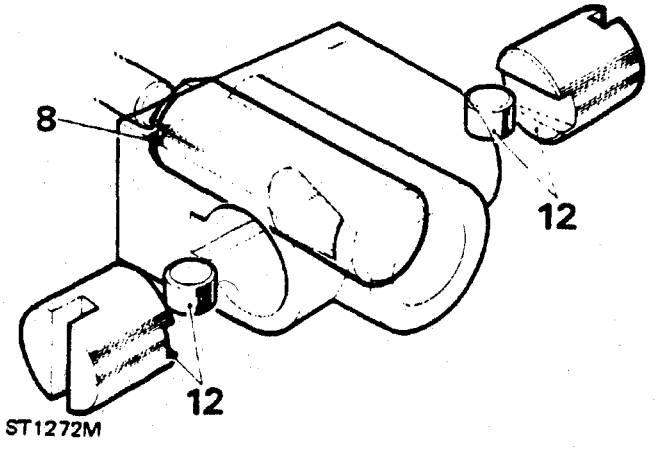


Remove and overhaul expander assembly

7. Remove the rubber dust cover.
8. Remove the expander and draw link.
9. Remove the retainer spring plate.
10. TDO106,254,254 Remove the locking plate.
11. Remove the packing plate and withdraw the expander assembly from the back-plate.
12. Remove the two plungers and rollers.
13. Clean all parts in Girling cleaning fluid and allow to dry. Examine the components for wear and discard **if** unsatisfactory.

Assemble expander assembly

14. Grease and fit the expander and drawlink.
15. Grease and fit the plungers and rollers noting that the highest end of the ramp on the plungers is fitted towards the back-plate. Secure the assembly band to prevent the plungers falling out and place to one side for assembly to back-plate.

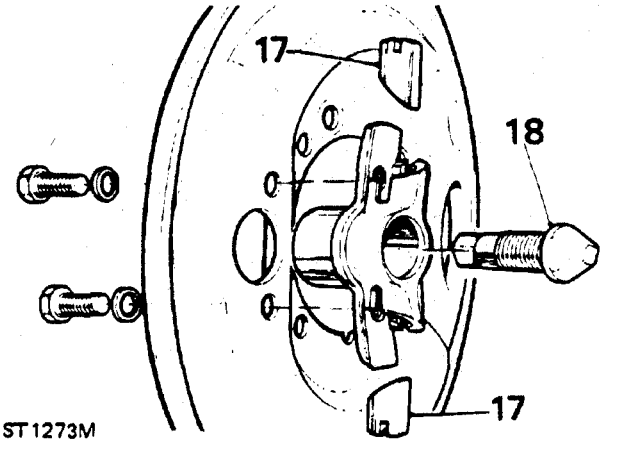


Remove and overhaul adjuster assembly

16. Remove the two bolts and withdraw the adjuster assembly from the back-plate.
17. Remove the plungers.
18. Screw the adjuster cone inwards to remove from the housing.
19. Clean the parts in Girling cleaning fluid and discard any unsatisfactory components.

Assemble adjuster assembly

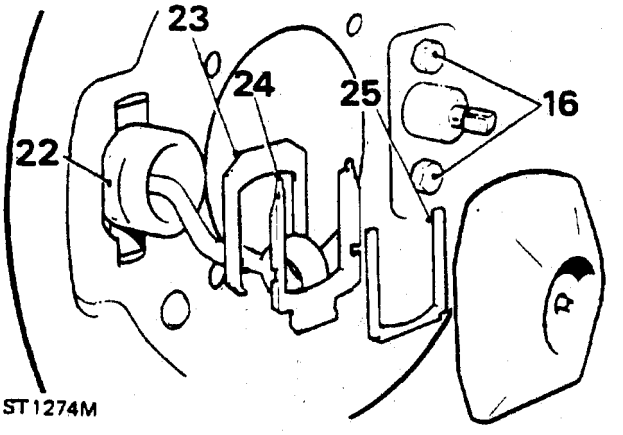
20. Grease and screw in the adjuster cone.
21. Grease and **fit** the adjuster plungers and align the chamfered ends with the adjuster cone. Note that the two plungers are identical and can be fitted to either bore. Secure the assembly with a rubber band to prevent the plungers falling out.



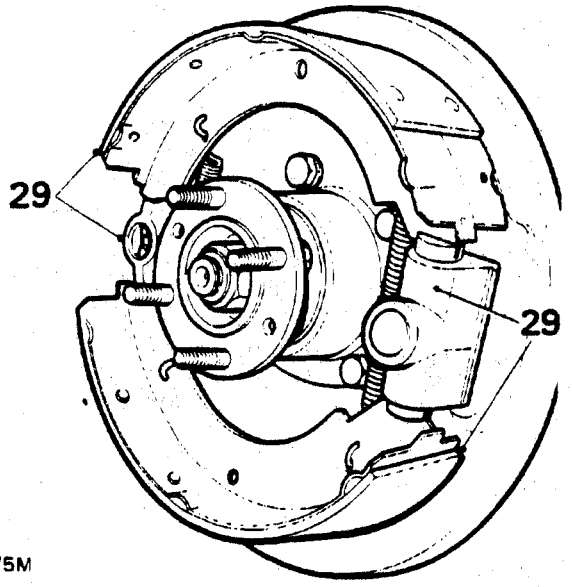
ASSEMBLE

NOTE: If the brake linings are oil-soaked check and if necessary renew the output shaftoil seal.

22. Position the expander assembly on the inside of the back-plate and secure with the following plates at the rear of the back-plate.
23. Locking plate.
24. Retaining plate.
25. Packing plate.
26. Fit the rubber dust cover.

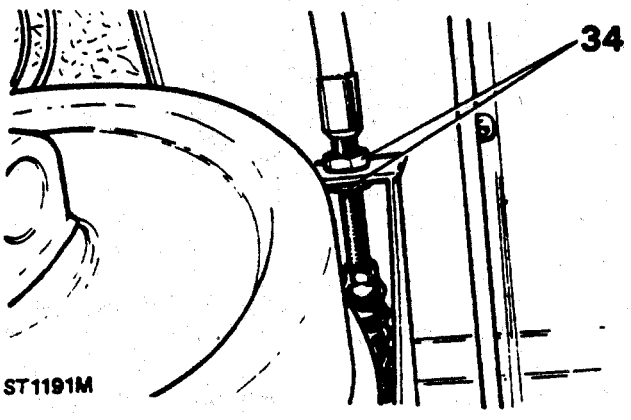


27. Fit the adjuster assembly to the back-plate with the two bolts but do not fully tighten at this stage.
28. Fit the back-plate assembly and mud shield to the transfer box with the four bolts and tighten to the correct torque.
29. Fit new pull-off springs to relined brake shoes and fit to the back-plate. Note that the fully lined end of the lower shoe must be toward the expander assembly and the fully lined end of the upper shoe towards the adjuster assembly.



ST1275M

30. Fit the brake drum and secure with the two screws.
31. Connect the expander drawlink to the actuating lever with a new clevis pin, washer and split pin.
32. Turn the adjuster cone fully in and tighten the two retaining bolts left slack in instruction 27.
33. Slacken off the adjuster two 'clicks' and firmly apply the hand lever to centralise the shoes. The drum should then rotate freely after releasing the hand lever.
34. Adjust the handbrake cable to give the pawl two 'clicks' free movement on the ratchet before the third 'click' fully expands the shoes against the drum.
35. Connect the propeller shaft and evenly tighten the retaining nuts to the correct torque.
36. Remove chocks from wheels and connect the battery.



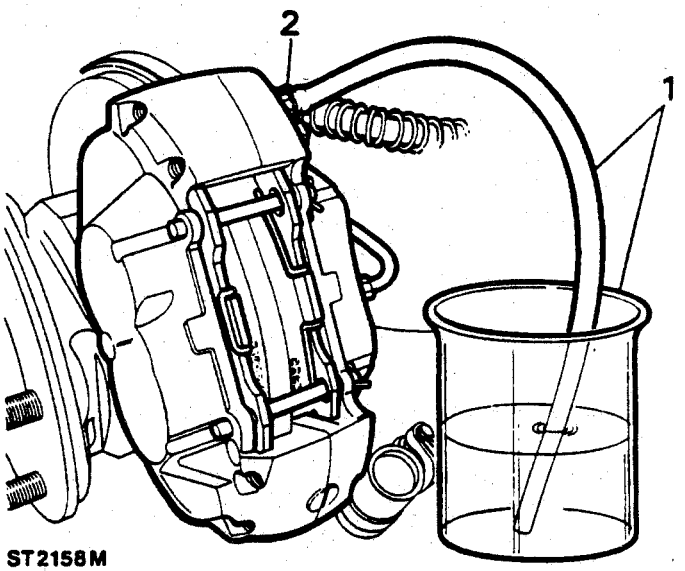
ST1191M

BLEEDING THE BRAKES

Primed System

Bleed the front brakes first starting with the wheel nearest to the master cylinder.

1. Attach a rubber tube to the bleed screw and immerse the other end in a glass jar containing a quantity of clean, new recommended brake fluid.
2. Check that the fluid reservoir is full to the maximum mark.
3. Unscrew the bleed screw approximately half-a-turn, enough to allow fluid to be pumped out. **Do** not open the screw too far or air will be drawn back into the system around the threads.
4. Smartly depress the foot pedal, pause and then allow the pedal to rapidly return, pause again before repeating the procedure.
5. Continue with the above sequence until all air bubbles cease whilst ensuring that the reservoir is kept topped-up.
6. Close the bleed screw immediately after the last down stroke, whilst the pedal is depressed.



ST2158M

Unprimed System

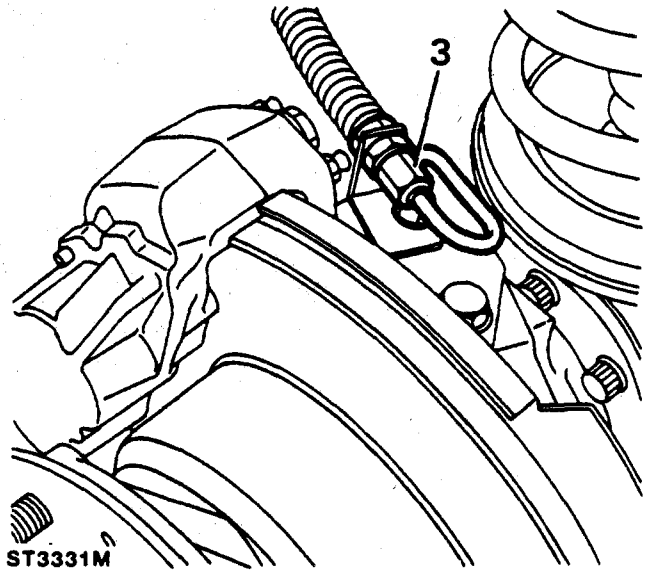
To bleed a replacement master cylinder or a fully drained system.

7. Top up the fluid reservoir to the maximum mark.
8. Open a bleed screw in both circuits and allow fluid to prime both circuits of the master cylinder by gravity for approximately five minutes, then bleed as for a primed system.

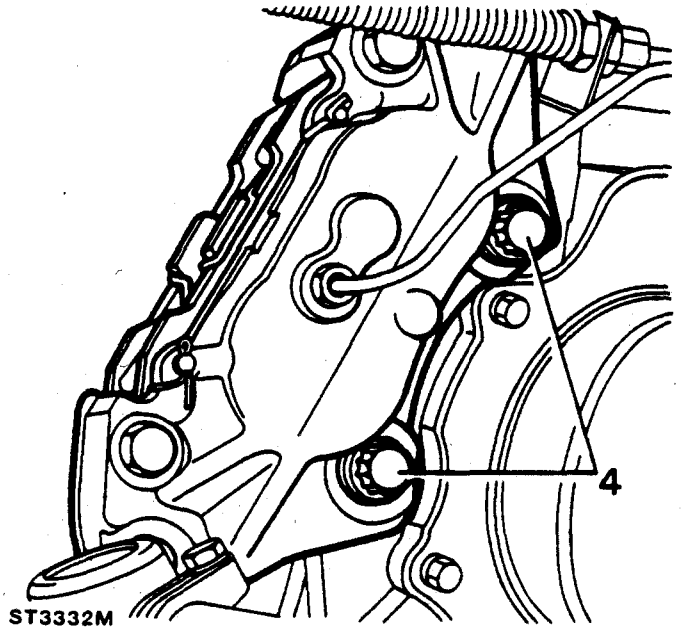
RENEWING FRONT BRAKE DISCS

Removing

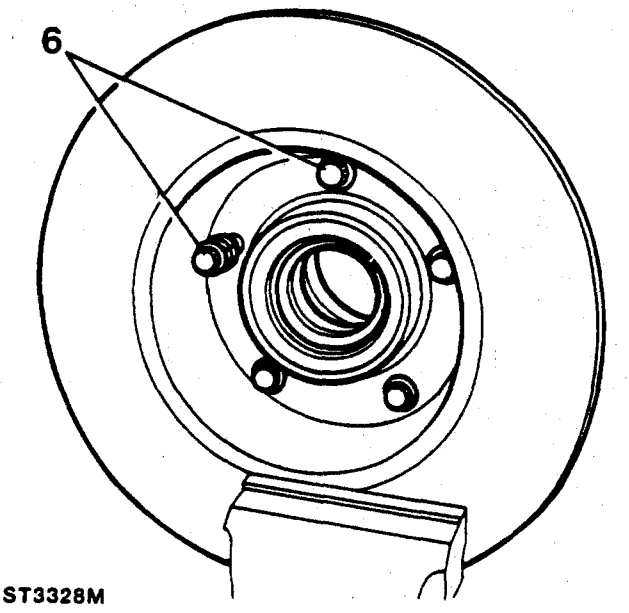
1. Disconnect the battery.
2. Jack-up vehicle, lower on to axle stands and remove road wheels.
3. Disconnect the brake pipe union from the jump hose at the swivel housing bracket. Cover pipe to prevent entry of dirt.



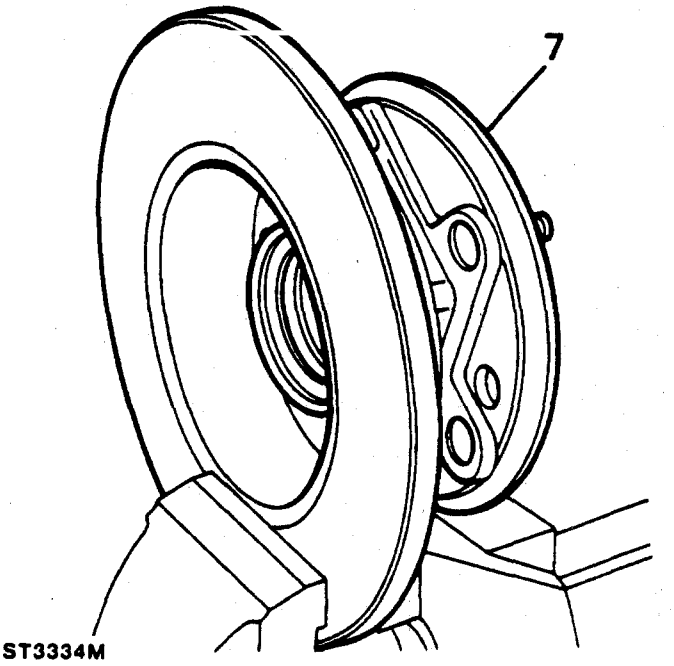
4. Remove the two bolts securing brake caliper to the swivel housing and withdraw the caliper.



5. Remove the front hub complete with brake disc by following instructions 6 to 14 in SECTION 54 for front hub overhaul.
6. Remove the five bolts to separate the disc from the hub.

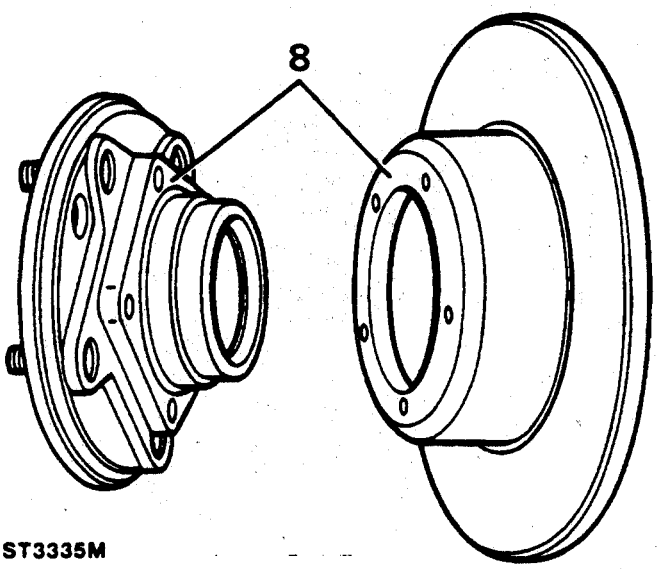


7. The hub will require tapping with a mallet to finally release it from the disc.



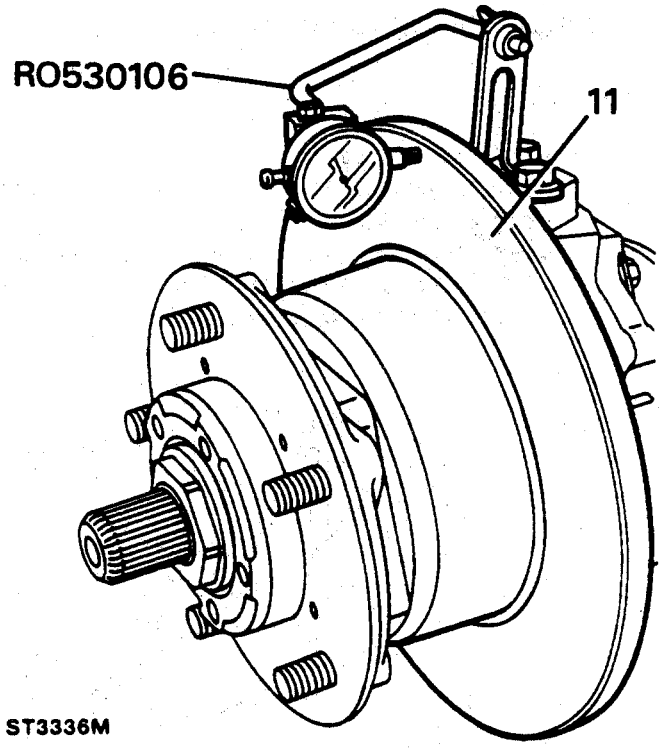
Fitting

8. Make sure that disc and hub mating faces are clean and free from burrs or any other irregularities that could cause the disc to run out excessively.
9. Assemble the disc to the hub with the five bolts and tighten evenly to the correct torque.



ST3335M

10. Fit the hub and disc assembly to the axle by following instructions 24 to 31, **SECTION 54.**
11. Mount the dial test indicator bracket RO 530106 or a suitable alternative on the top swivel and rest the stylus of the dial indicator on the disc face near to the periphery. The maximum run out must not exceed 0,151 mm.



ST3336M

12. Continue with instructions 32 to 41, **SECTION 54.**

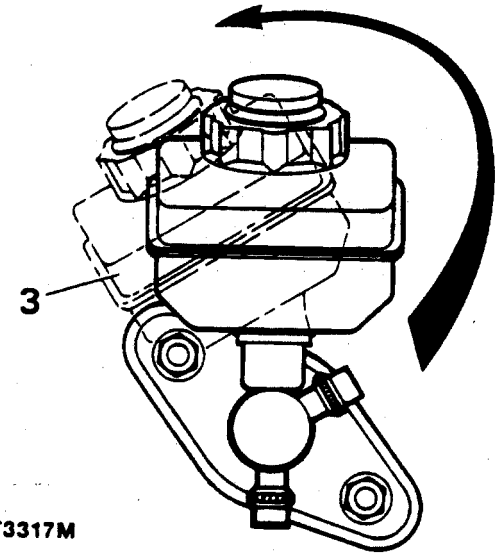
OVERHAUL MASTER CYLINDER - Lucas Girling - Type 25.4 mm AS/AS

Dismantling master cylinder

1. Disconnect the battery and remove the master cylinder from the servo.

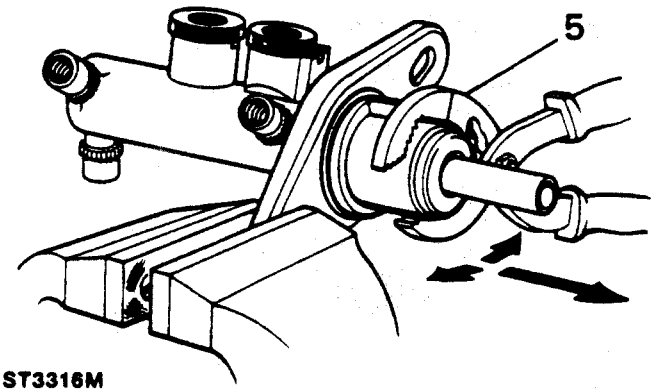
WARNING: Use only clear methylated spirit or unused brake fluid to clean all parts of the brake system. DO NOT use petrol, kerosene or other mineral based fluids.

2. Before commencing the overhaul procedure thoroughly clean the master cylinder and inspect the outer surfaces for damage and condition, renew the complete assembly **if** necessary.
3. The reservoir is a push fit in the master cylinder and secured by seals. Carefully ease the reservoir from the master cylinder by rolling it from the seals as illustrated.



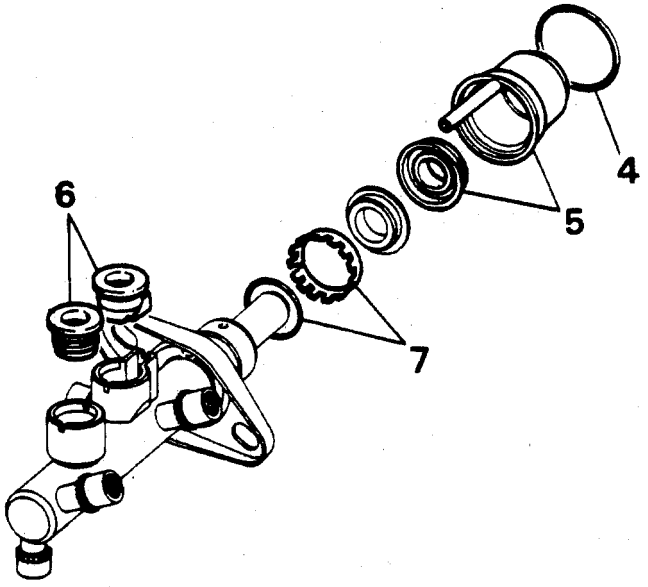
ST3317M

4. Using soft jaws, one either side of the master cylinder flange and clamp the flange in a suitable vice. Remove the water ingress 'O' ring seal from the master cylinder to servo flange and discard.
5. Hold the outside of the transfer housing with a suitable pair of grips, carefully pull, while working the pliers in a backwards and forwards rocking motion to ease the housing off the master cylinder, discard the housing and vacuum seal.

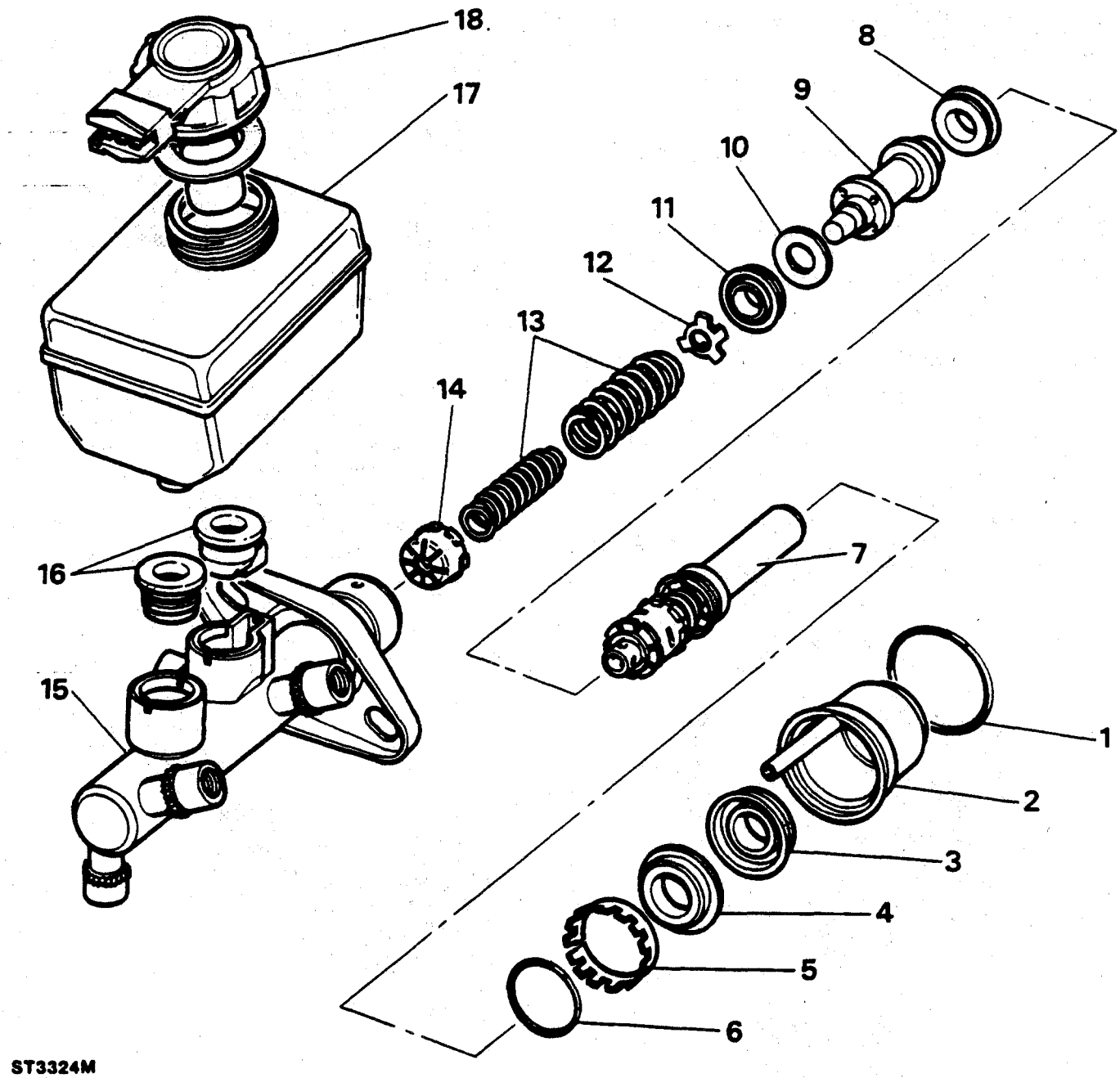


ST3316M

6. Withdraw the two reservoir seals from the master cylinder inlet ports the seals are different and should be noted for assembly, discard both of the seals.
7. Remove the retaining ring and 'O' ring seal from the machined outer surface of the master cylinder, discard both the seal and retaining ring.



ST3318M



ST3324M

KEY TO MASTER CYLINDER

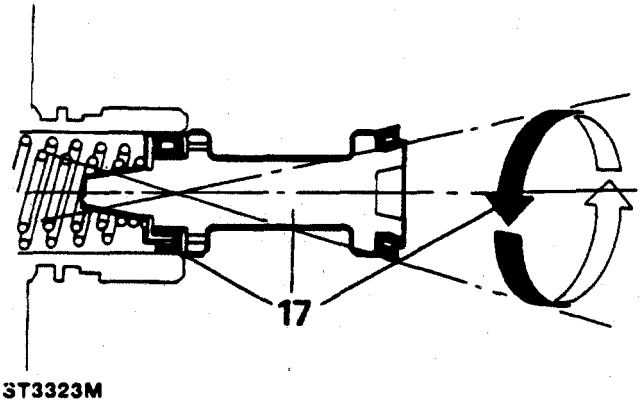
1. Water ingress seal
2. Transfer housing
3. Vacuum seal
4. Guide ring
5. Retaining ring
6. 'O' ring seal
7. Primary plunger assembly
8. 'L' seal
9. Secondary plunger
10. Washer
11. Recuperating seal (primary cup)
12. Seal retainer
13. Springs (2 off)
14. Swirl tube
15. Master cylinder body
16. Reservoir seals
17. Reservoir
18. Low fluid level switch and cap

Assembling master cylinder

CAUTION: It is important that the following instructions are carried out precisely, otherwise damage could be caused to the new seals when inderting the plungers into the cylinder bore. Generous amounts of new brake fluid should be used to lubricate the parts during assembly. Never use old fluid or any other form of cleaning and lubricating material. Cleanliness throughout is essential.

Also thoroughly check that no debris of any description is lodged in any of the fluid passageways and drillings. If debris is found, carefully remove, clean the cylinder and re-check.

16. Fit the new swirl tube to the bottom of the cylinder bore.
17. Lubricate the secondary plunger and cylinder bore. Offer the plunger assembly to the cylinder until the recuperation seal is resting centrally in the mouth of the bore. Gently introduce the plunger with a circular rocking motion, as illustrated. Ensuring that the seal does not become trapped, ease the seal into the bore and slowly push the plunger down the bore in one continuous movement.



3T3323M

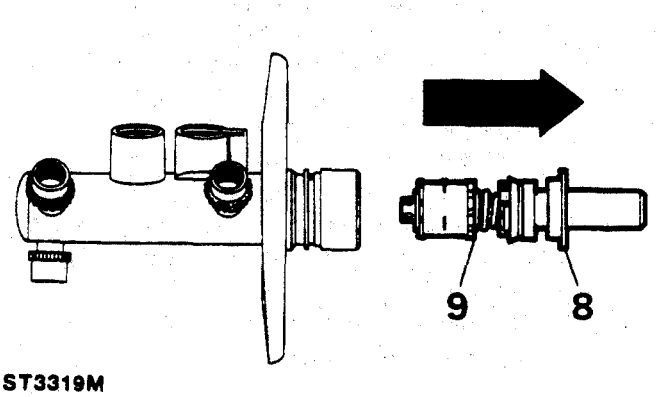
18. Fit the primary plunger assembly using the same method as for the secondary plunger, push the plunger down the bore.
19. Fit the original guide ring to support the primary plunger.
20. Coat a new 'O' ring with brake fluid and fit to its respective groove on the outer location surface of the master cylinder.

NOTE: The 'O' ring should not be rolled down the outer location surface of the master cylinder but should be slightly stretched and eased down the cylinder and into its groove. Do not over stretch the seal.

21. Fit a new retaining ring on the outer surface of the master cylinder ensuring that the serrations of the ring are facing the mounting flange.
22. Fit the two new reservoir seals in their respective ports.
23. Fit a new vacuum seal to either the primary plunger or to the bottom of the transfer housing bore, open face of the seal towards the primary plunger guide ring.
24. Lubricate the vacuum seal with brake fluid, fit the transfer housing to the master cylinder, push the housing fully up to the cylinder mounting flange. DO NOT ADJUST THE TRANSFER HOUSING AFTER FITTING.
25. Lubricate a new water ingress seal with brake fluid, slightly stretch the seal and ease it down the housing until the seal is in the correct position between the housing and flange.
26. Roll the reservoir into the top of the master cylinder, reversing the procedure described in instruction 3.
27. Fit the master cylinder to the servo, connect the battery, and road test the vehicle.

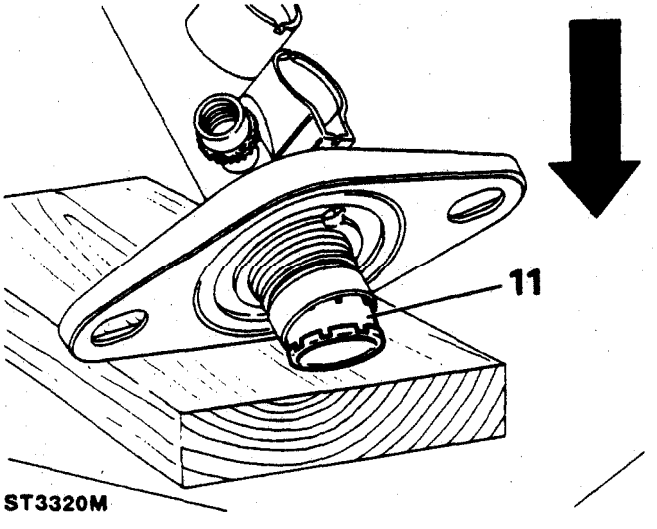
8. Remove the guide ring from the mouth of the master cylinder which supports the primary plunger assembly and place to one side, this component is not part of the master cylinder service kit and is to be refitted on assembly of the unit.
9. Pull the primary plunger assembly out of the master cylinder.

NOTE: The primary plunger assembly cannot be broken down any further and is serviced as a complete unit. Discard the **assembly.**



ST3319M

10. The secondary plunger assembly will remain at the bottom of the master cylinder bore, the plunger can be easily expelled by tapping the assembly on a piece of timber until the plunger appears at the cylinder mouth, carefully pull the plunger out of the master cylinder.
11. **If** the swirl tube was not expelled at the same time as the secondary plunger, repeat the above operation to expel it from the bottom of the master cylinder bore and discard.



ST3320M

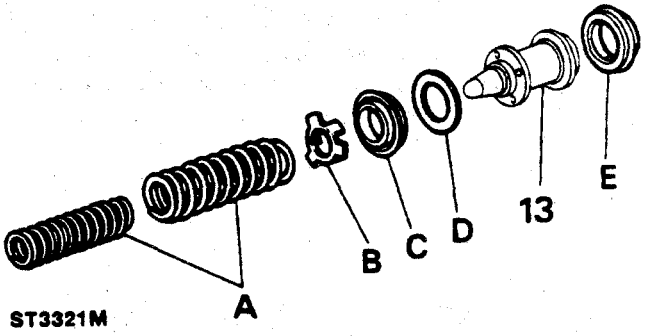
12. Clean all parts with Girling cleaning fluid or unused brake fluid and place the cleaned parts on to a clean sheet of paper. Inspect the cylinder bore and plungers for signs of corrosion, ridges and score marks. Provided the working surfaces are in perfect condition, new seals from a Girling Service repair kit may be used.

Renewing secondary plunger seals

13. Remove the following components from the secondary plunger and discard:

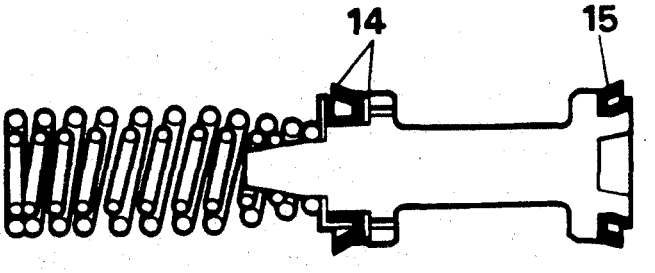
NOTE: A small screwdriver with the end rounded and polished is required to remove the 'L' seal. DO NOT damage the secondary plunger.

A. Springs
B. Seal retainer
C. Recuperating seal (primary cup)
D. Washer
E. 'L' seal



ST3321M

14. Coat the new seals in unused brake fluid and firstly fit the 'L' seal to the plunger.
15. Fit the washer followed by the recuperating seal. Fit the seal retainer and springs, ensure the springs are correctly seated.

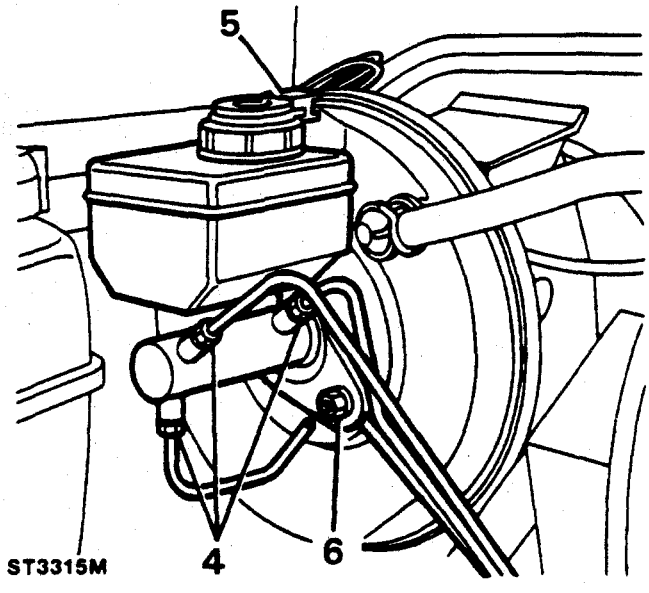


ST3322M

RENEW BRAKE MASTER CYLINDER - Lucas Girling type 25,4 mm AS/AS

Removing

1. Disconnect the battery.
2. Place a container under the master cylinder to catch escaping brake fluid.
3. Clean area round master cylinder ports.
4. Disconnect the pipes from master cylinder ports. Cover, not plug, the pipe ends to prevent entry of dirt.
5. Disconnect electrical leads from reservoir cap.
6. Remove the two nuts securing master cylinder to servo and withdraw cylinder.



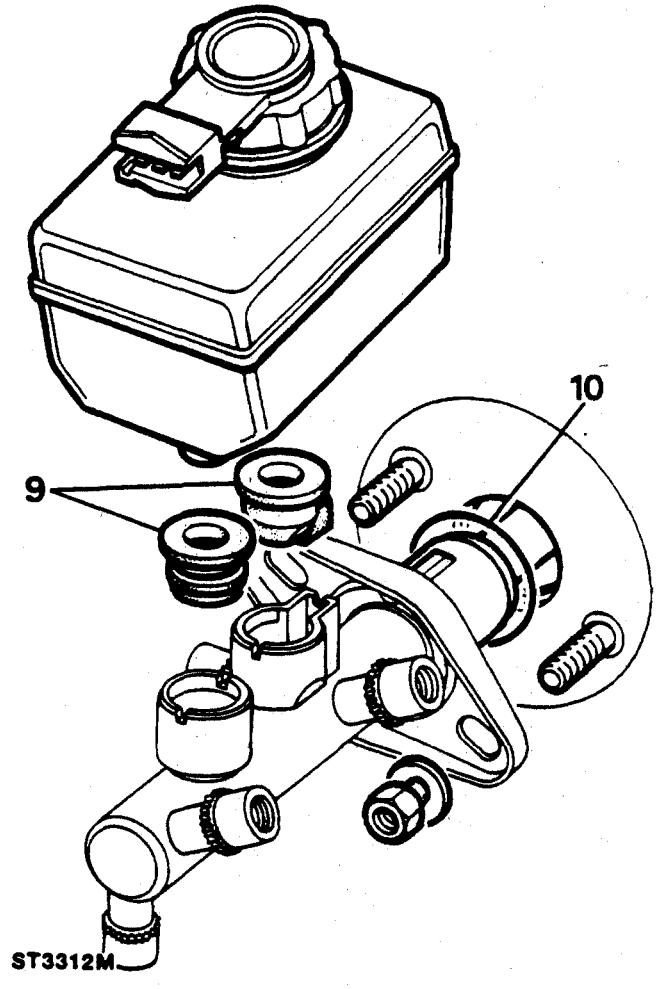
7. Remove reservoir cap and drain fluid into container for disposal.

WARNING: Do not use fluid drained or bled from the system. Dispose of fluid as instructed in SECTION 01 in a container marked "Used brake fluid".

8. The reservoir is a push fit in the master cylinder and secured by seals. Carefully ease the reservoir from the master cylinder by rolling it from the seals, as illustrated in Master Cylinder Overhaul. Note that the two seals are different in size.

Fitting new master cylinder

9. Insert new reservoir seals in the master cylinder ports and fit the reservoir by reversing the removal method.
10. Ensure that the water ingress seal is in position between master cylinder flange and servo and fit master cylinder to servo and secure with the two nuts tightening evenly to the correct torque 11 to 17 Nm.



11. Connect the brake pipes to the master cylinder ports and tighten to 16 Nm.
12. Fill the reservoir with the Correct grade of new fluid, see SECTION 09, taken from a sealed container.
13. Bleed the brake system.
14. Connect the battery and road test vehicle.

RENEW 'G' VALVE - where fitted

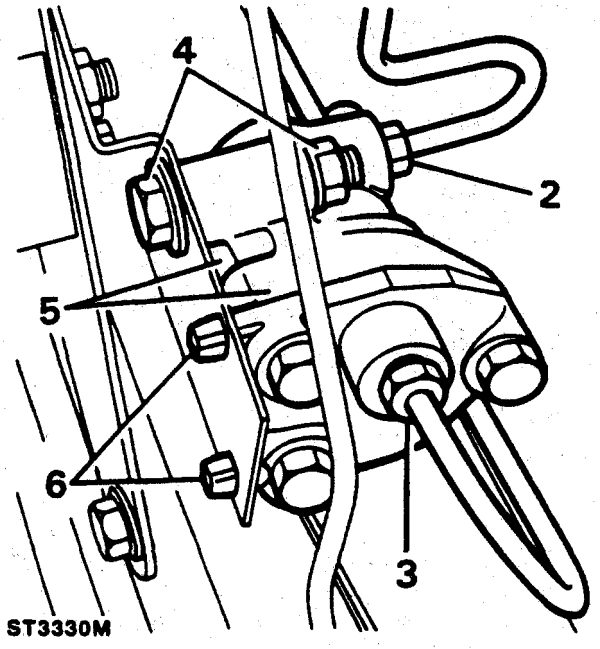
The 'G' valve on both right-hand and left-hand drive vehicles is situated on the right-hand side of the chassis, within the engine compartment, attached to a bracket, at the commencement of the front axle arch.

Removing

1. Disconnect the battery.
2. Disconnect from the 'G' valve the pipe union from the master cylinder.
3. Disconnect from the 'G' valve the pipe union to the rear wheel cylinders.
4. Remove the nut and bolt securing the 'G' valve to the bracket.
5. Release the valve from the bracket.

Fitting

6. Fit the 'G' valve to the bracket locating the lugs in the holes which are to ensure that the valve is installed at the correct angle.



7. Secure the valve to the bracket with the single bolt and nut.
8. Connect the two pipes to the valve and tighten to 16 Nm.
9. Bleed the brake hydraulic system and road test the vehicle.

RENEW SERVO NON RETURN VALVE

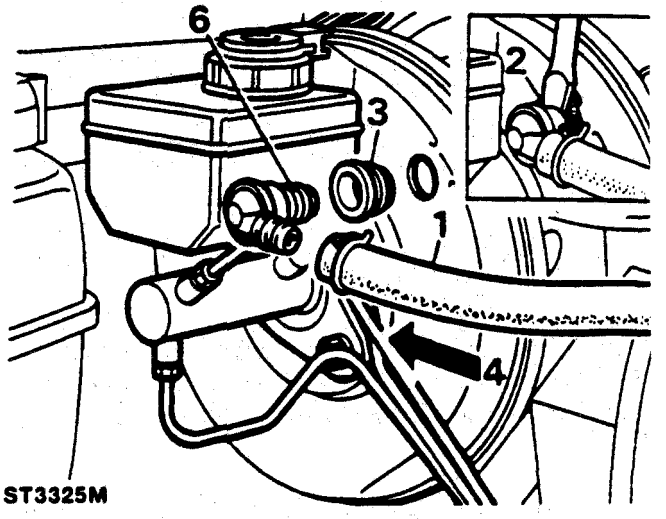
Remove

1. Disconnect the brake vacuum hose from the servo non return valve.
2. The valve is a push fit in the servo and to remove it, carefully prise the valve out with a screwdriver blade between the valve and grommet. Take care not to exert too much pressure on the vacuum chamber.
3. Remove the rubber grommet but be careful not to allow it to fall into the vacuum chamber.
4. Check the valve for correct operation; it should not be possible to pass air through into the servo in direction of arrow. Do not use compressed air.

NOTE: The illustration shows the latest valve fitted to the L.S.C. 80 servo but the principle of removal and fitting is the same for earlier types.

Fitting new valve

5. Fit the rubber grommet.
6. Smear the ribs of the valve with Lucas Girling grease to assist assembly, and push valve fully home.



7. Connect the vacuum hose to the valve.
8. Road test vehicle.

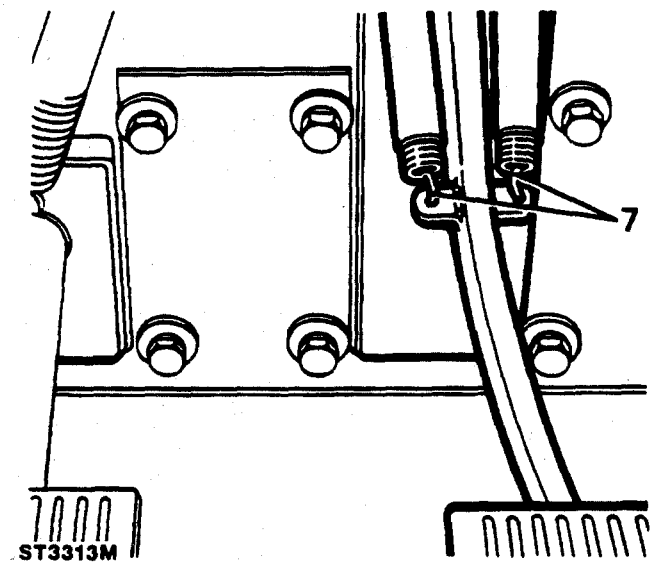
RENEW BRAKE SERVO - L.S.C. 80

Removing

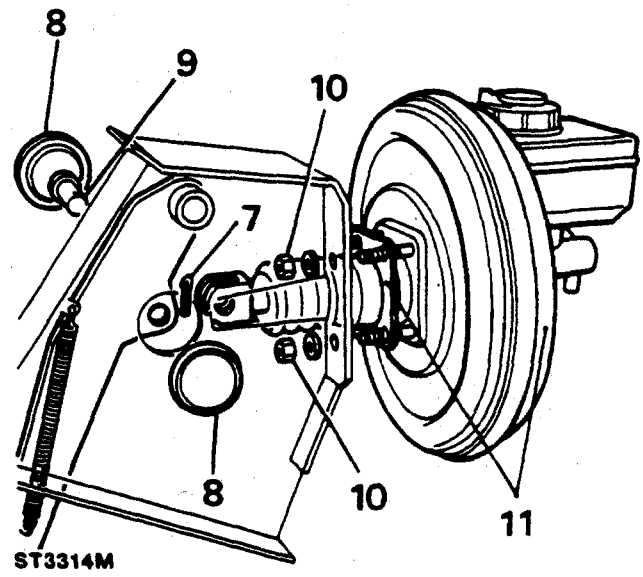
1. Disconnect the battery.
2. Disconnect the electrical leads from reservoir cap.

NOTE: See operation for renewing the master cylinder for the following instructions 3 to 6.

3. Disconnect the vacuum hose from servo.
4. Clean the master cylinder round the area of the outlet ports.
5. Remove the brake pipes from the master cylinder and cover, not plug, each pipe as it is released to prevent entry of dirt.
6. Remove the two nuts securing the master cylinder to the servo and carefully remove the master cylinder. Cover the ports to prevent fluid loss and entry of dirt.
7. From inside the vehicle, release the two brake pedal return springs.



8. Remove the two plugs from each side of the pedal box.
9. Remove the split pin, washer and clevis pin securing the servo push rod to the brake pedal.
10. Remove the four nuts (two each side) retaining the servo to the pedal box and remove the servo and rubber washer from vehicle.



Fitting servo

11. Fit the servo and rubber washer to the pedal box and secure with the four nuts. Tighten evenly to the correct torque.
12. Connect the brake pedal to the servo with the clevis pin and a new split pin. A washer was fitted on earlier installations.
13. Fit plugs to each side of pedal box.
14. Attach the pedal return springs.
15. Connect the vacuum hose to the servo non return valve. Ensure that the hose is in good condition.
16. Fit the master cylinder to the servo and secure with the two nuts. Tighten to the correct torque.
17. Fit the fluid pipes to the master cylinder and tighten to 16 Nm.
18. Top-up the reservoir with new fluid from a sealed container and bleed the brake system.
19. Connect the electrical leads to the reservoir cap.
20. Connect the battery and road test the vehicle.

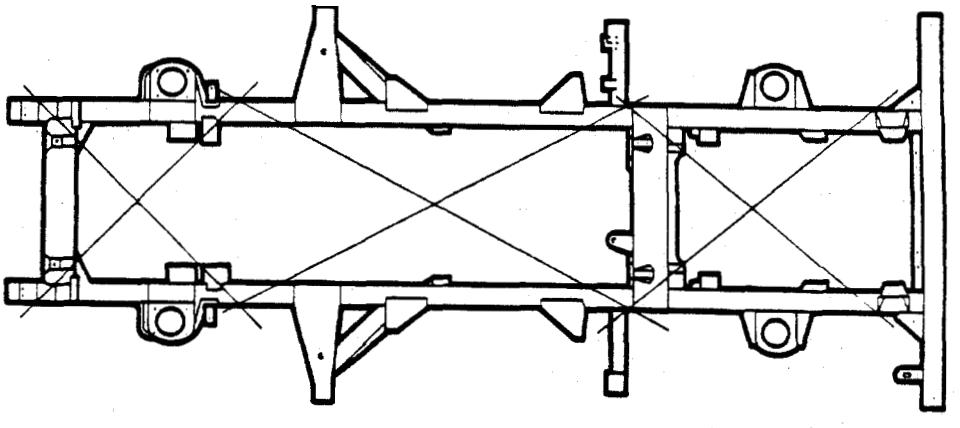
FAULT	CAUSE	REMEDY
FADE	Incorrect linings Badly lined shoes Distorted shoes. Overloaded vehicle Excessive braking Old hydraulic fluid	Replace the shoes, decrease vehicle load or renew hydraulic fluid as necessary
SPONGY PEDAL	Air in system. Badly *lined* shoes. Shoes distorted or incorrectly set. Faulty drums. Weak master cylinder mounting.	Check for air in the system using a Hose Clamp and bleed if necessary Check the master cylinder mounting, lined shoes and drums and replace as necessary. Renew the hydraulic fluid if applicable.
LONG PEDAL	A Disc Brakes Misplaced dust covers. B. Drum Brakes Brakes need adiustment. Fluid leak. *Fluid contamination.* Worn or swollen seals in master cylinder. Blocked filler cap vent.	A Check the disc run out does not exceed
BRAKES BINDING	Brakes maladjusted. No clearance at master cylinder push rod. Seals swollen. Siezed pistons. Shoe springs weak or broken. Servo faulty.	Check the brake adjustment. Check for clearance at the master cylinder, siezed pistons or weak shoe springs. Repair or replace parts as necessary.
HARD PEDAL - POOR BRAKING	Incorrect linings. Glazed linings. Linings wet, greasy or not bedded correctly. Servo unit inoperative. Siezed caliper pistons. Worn shock aborbers causing wheel bounce.	Replace the shoes, or if glazed, use a proprietary brake lining cleaner. Check caliper for damage and repair as necessary. Check servo. Fit new shock absorbers.
BRAKES PULLING	Seized pistons. Variation in linings. Unsuitable tyres or pressures. Worn shock absorbers. Loose brakes. Greasy linings. Faulty drums, suspension or steering. Contaminated seals.	Check the tyres and pressures, seized pistons, greasy linings, or loose brakes; then check suspension, steering and drums. Repair or replace as necessary. Fit new shock absorbers. Rectify contamination, fit new seals and hoses.
FALL IN FLUID LEVEL	Worn disc pads. External leak. Leak in Servo Unit.	Check the pads for wear and for hydraulic fluid leakage.
DISC BRAKE SQUEAL - PAD RATTLE	Worn retaining pins. Worn discs.	Renew the retaining pins, or discs. Apply disc brake lubricant to back of pads.
UNEVEN OR EXCESSIVE - PAD WEAR	Disc corroded (by salt). Disc badly scored. Pads scored. Pads require interchanging. Incorrect friction material.	Check the disc for corrosion, or scoring and replace if necessary. Alternatively, interchange pads. Fit new pads with correct friction material.

CHASSIS ALIGNMENT AND SQUARENESS

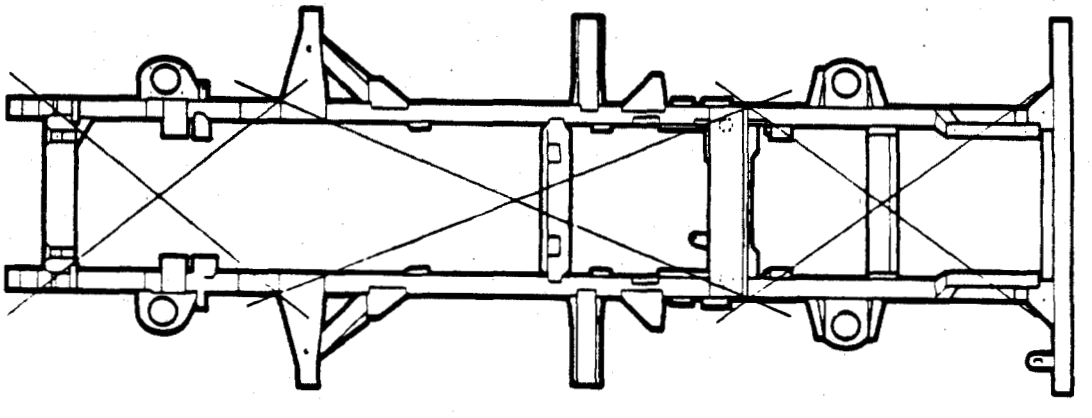
Frame alignment

With the vehicle assembled **a** check for chassis squareness can be made as follows:

1 Place the vehicle on **a** level floor.
2. Mark measuring points at approximately the locations shown in Fig. 1 ensuring that the marks are exactly opposite on each side of the chassis frame.
3. Hold a plumb line against each of the measuring points in turn and mark the floor directly beneath the plumb-bob
4 Move the vehicle and measure diagonally between the marks made on the floor, if the chassis is square the diagonals between the related measuring points should agree within 9,50 mm
5. Chassis frame dimensional checks can be made, with the vehicle upper structure removed, referring to the applicable illustration and associated key.



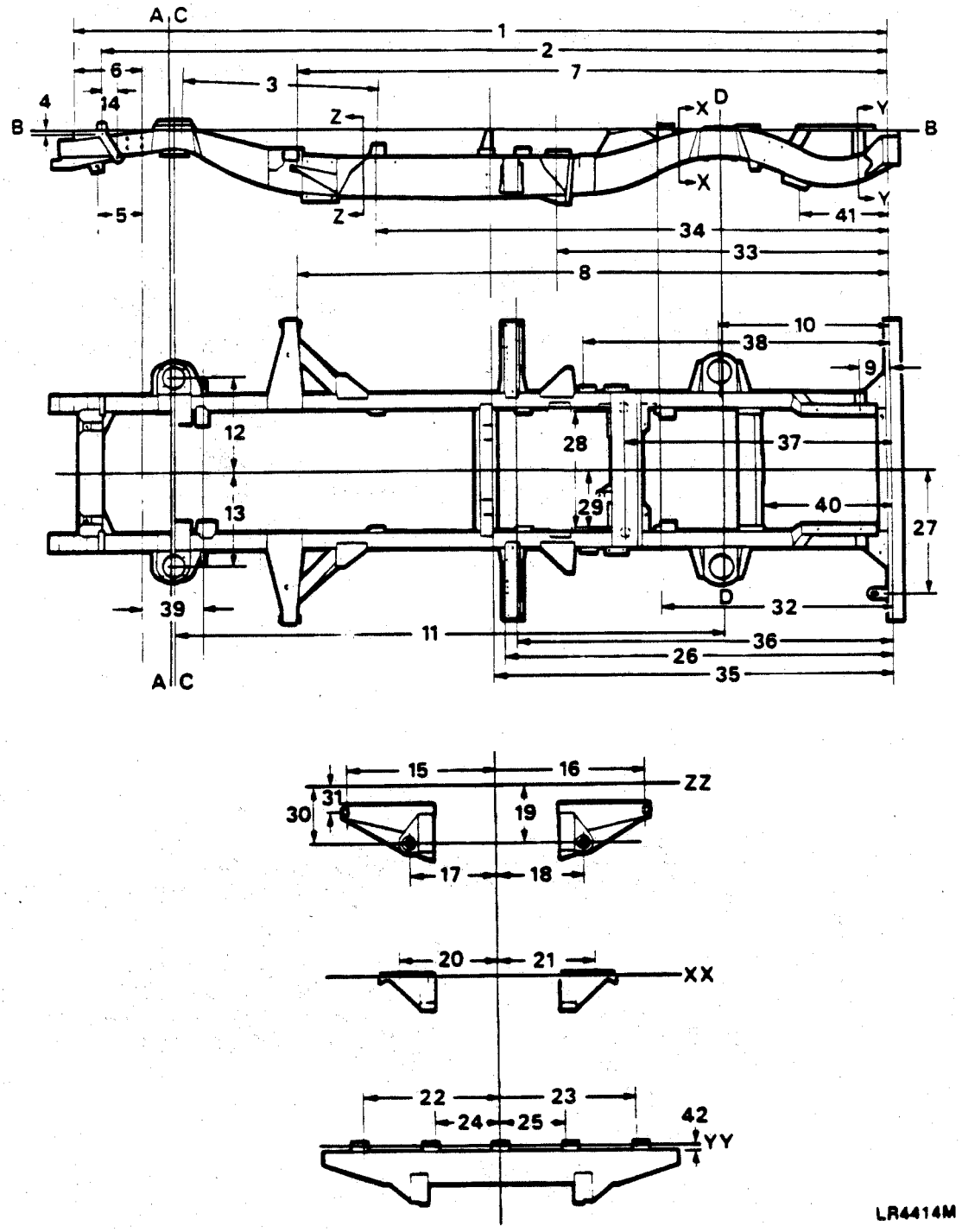
LAND ROVER 90



LAND ROVER 110

LR4412M

DEFENDER 110



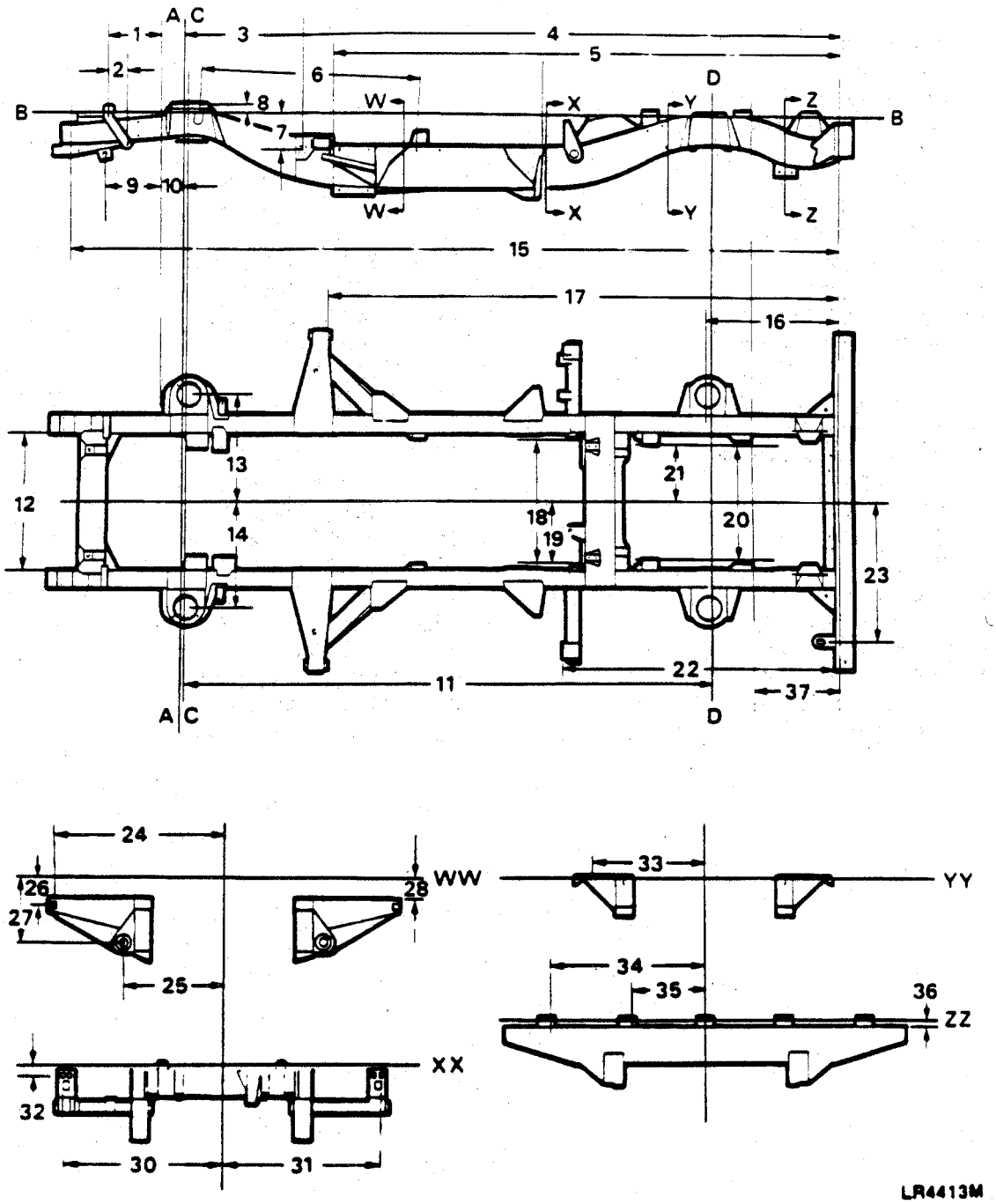
DEFENDER 110

CHASSIS ALIGNMENT DIMENSIONS

A - Front Datum
B - Chassis Datum
C - Front axle centre line
D - Rear axle centre line

1. 4148 - 4143 mm
2. 4009,5 - 4005 mm
3. 978,7 - 981,2 mm
4. 22 - 20 mm
5. 252 - 250 mm
6. 239 - 236,5 mm
7. 3023,3 - 3022,3 mm
8. 3030,7 - 3028,7 mm
9. 155 - 153mm
10. 871,2 - 869,2 mm
11. 2794 mm - wheelbase
12. 488 - 433 mm
13. 488 - 433 mm
14. 82 - 79,5 mm
15. 750,9 mm
16. 750.9 mm
17. 439,5 - 436,5 mm
18. 439,5 - 436,5 mm
19. 299,5 - 295,5 mm
20. 500 - 495 mm
21. 500 - 495 mm
22. 594,2 - 593,4 mm
23. 594,2 - 593,4 mm
24. 283 - 282,2 mm
25. 283 - 282,2 mm
26. 1970 - 1968 mm
27. 642,9 - 639,5 mm
28. 590,5 mm
29. 295,25 mm
30. 299,5 - 295,5 mm
31. 103 - 100 mm
32. 1177,5 - 1175,5 mm
33. 1692,5 - 1689,5 mm
34. 2610 - 2606 mm
35. 2040,5 - 2037,5 mm
36. 1912,5 - 1909,5 mm
37. 1359 - 1357 mm
38. 1573 - 1571 mm
39. 270 - 268 mm
40. 665,5 - 633,5 mm
41. 440-438mm
42. 32,25 - 31,25 mm

DEFENDER 90


A C
1
3
4
5
2
6
D
B
8
W
X
Y
Z
B
7
9
10
W
X
Y
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15
17
16
13
21
12
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20
14
19
23
22
11
37
A C
D
24
WW
26
28
27
33
YY
25
34
35
36
ZZ
XX
32
30
31
LR4413M

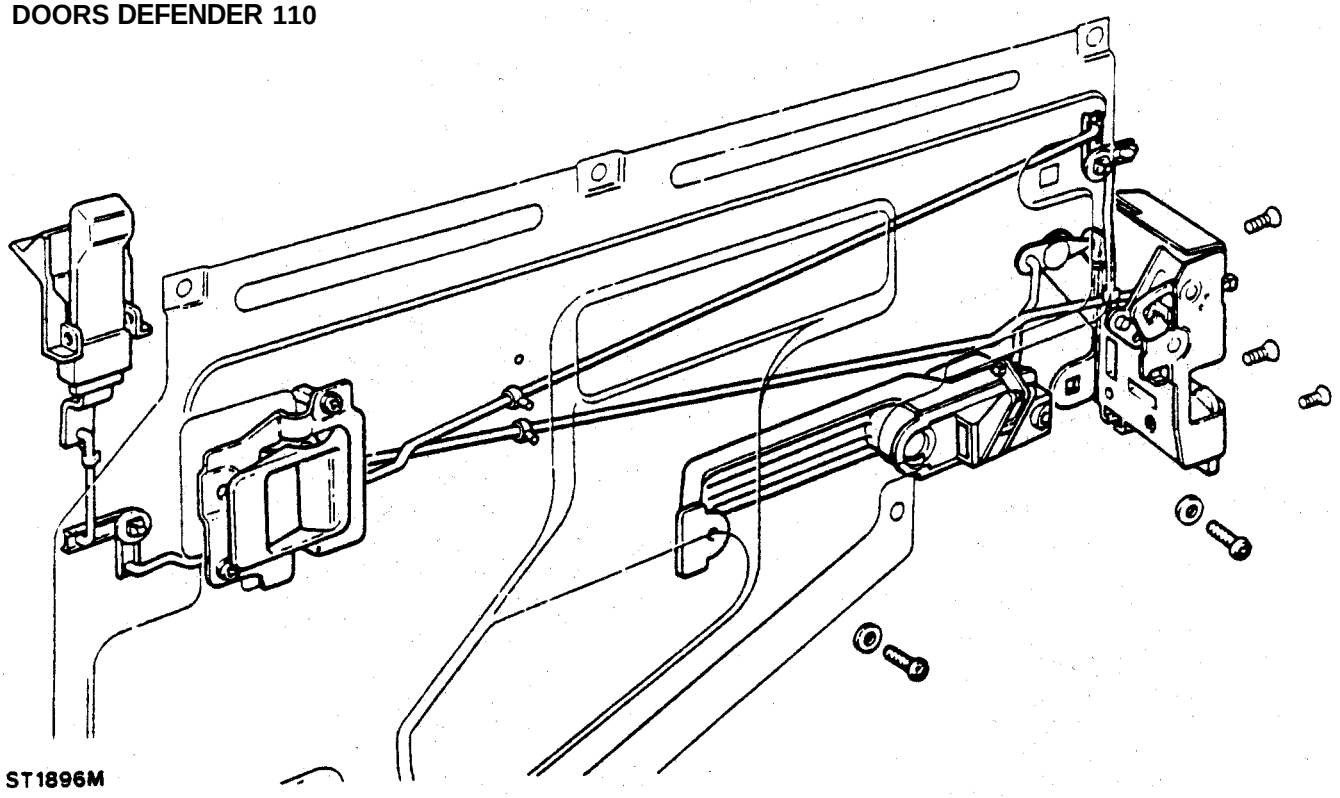
DEFENDER 90

CHASSIS ALIGNMENT DIMENSIONS

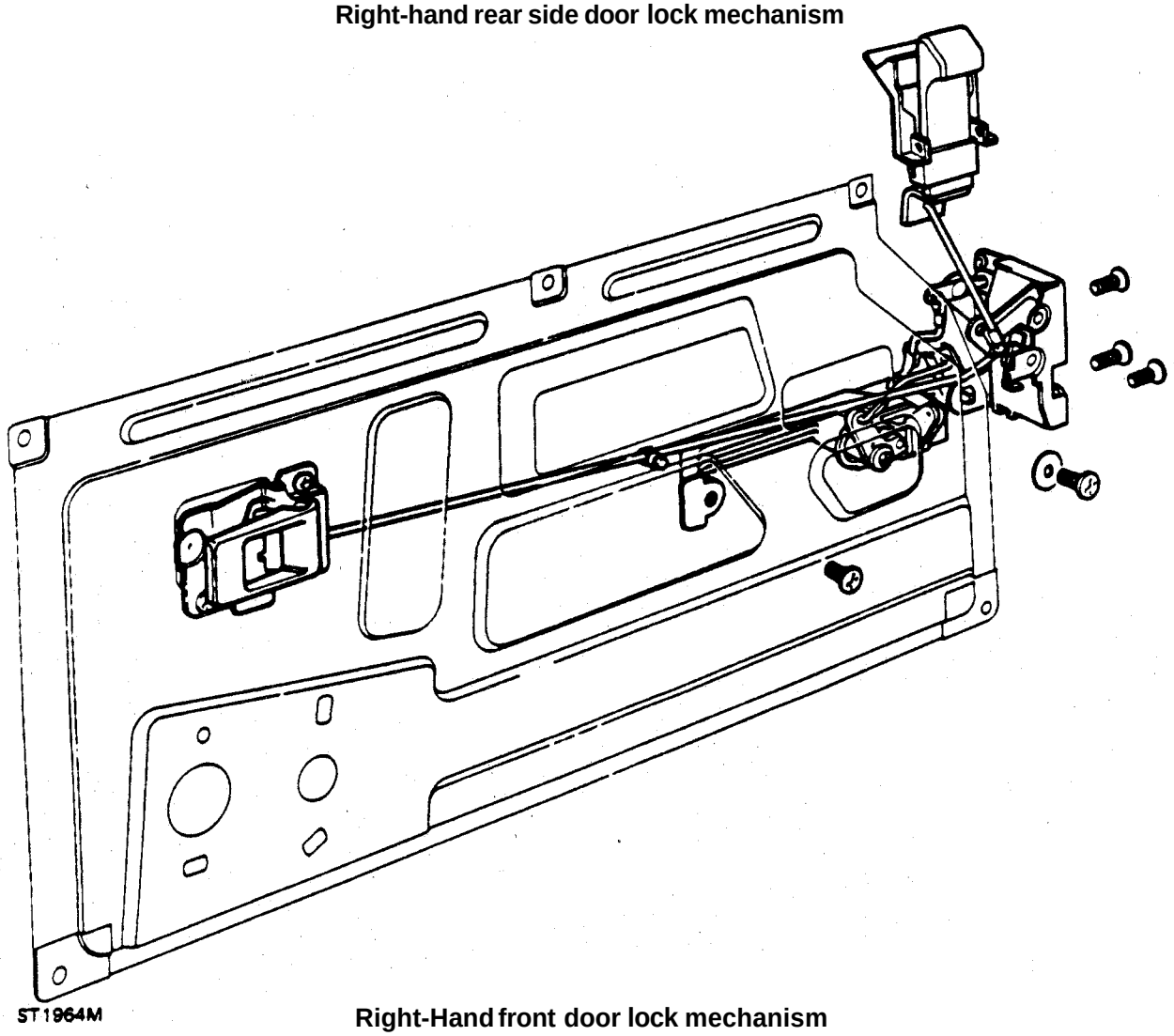
A - Front Datum
B - Chassis Datum
C - Front axle centre line
D - Rear axle centre line

1. 239,00 - 236,50 mm
2. 82,00 - 79,50mm
3. 633,00 mm
4. 2420,60 - 2418,60
5. 2306,40 - 2305,40 mm
6. 981,20 - 978,70 mm
7. 182,70
8. 41,50 - 37,00 mm
9. 252,00 - 250,00 mm
10. 110,00 mm
11. 2360,00 mm - wheelbase
12. 636,00 - 654,00 mm
13. 488 - 483 mm
14. 488 - 483 mm
15. 3431,10 - 3426,10 mm
16. 588,30 - 586,30 mm
17. 2313,80 - 2311,80 mm
18. 590,50 mm
19. 295,25
20. 519,60 - 517,00 mm
21. 259,80 - 258,50 mm
22. 1242,60 - 1240,60 mm
23. 642,50 - 639,50 mm
24. 750,90 mm
25. 439,50 - 436,50 mm
26. 136,50 mm
27. 299,50 - 295,50 mm
28. 103,00 - 100,00 mm
29. 131,50 - 126,50 mm
30. 705,50 - 704,50 mm
31. 705,50 - 704,50 mm
32. 42,20 - 40,20 mm
33. 491,00 - 486,00 mm
34. 594,20 - 593,40 mm
35. 283,00 - 282,20 mm
36. 32,25 - 31,25 mm
37. 397,00 - 395,00 mm

DOORS DEFENDER 110



Right-hand rear side door lock mechanism

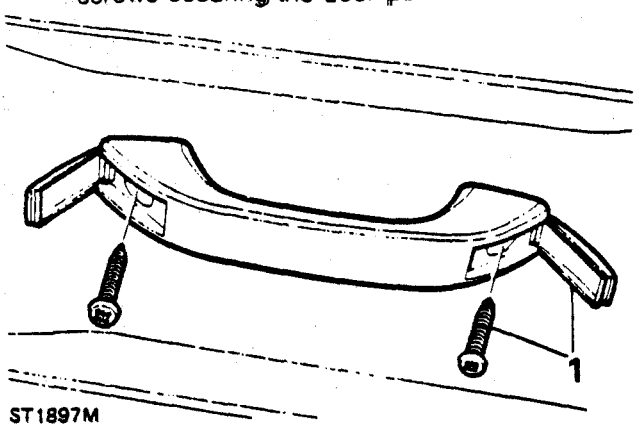


Right-Hand front door lock mechanism

REMOVING THE DOOR TRIM - DEFENDER 110

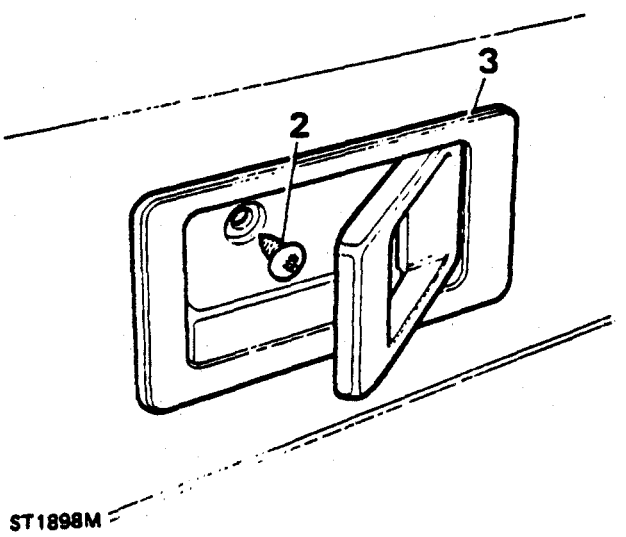
Front and rear doors

1. Prise off the two finishers and remove the two screws securing the door pull.



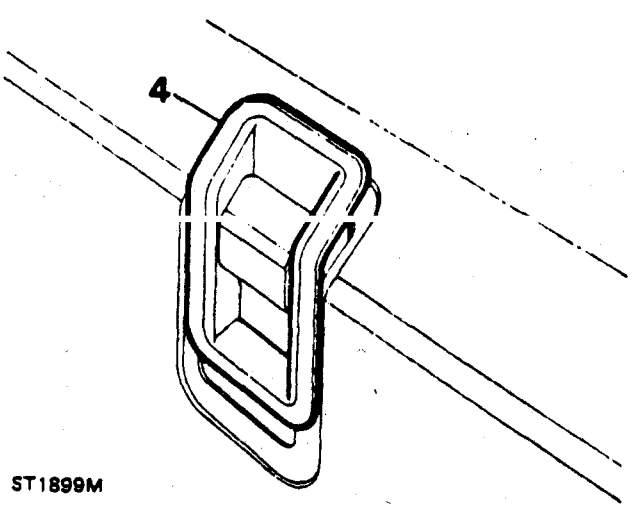
ST1897M

2. Remove the single screw behind the remote control lever.
3. Prise off the remote control lever bezel.



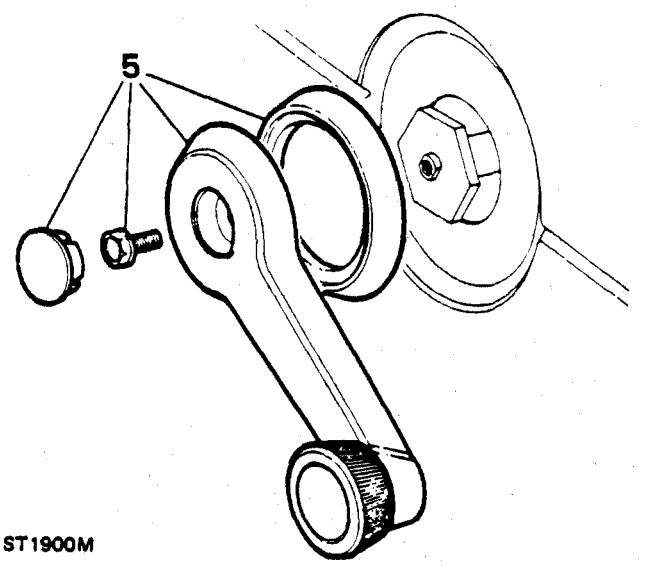
ST1898M

4. Prise off the door locking button bezel.



ST1899M

5. Lever off the window regulator center finisher and remove the retaining screw and withdraw the handle and bezel.

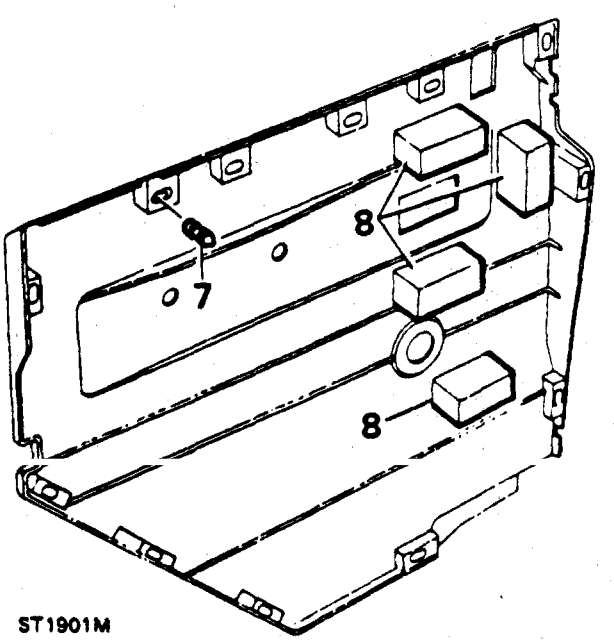


ST1900M

6. Using a screwdriver, carefully ease the trim away from the door.

Fitting door trim

7. Remove any trim fasteners held in the door panel and insert them into the back of the trim or use new ones.
8. Ensure that the anti-vibration pads are in position and offer-up the trim to the door, lining-up the fasteners with the holes in the door and push the trim into position.



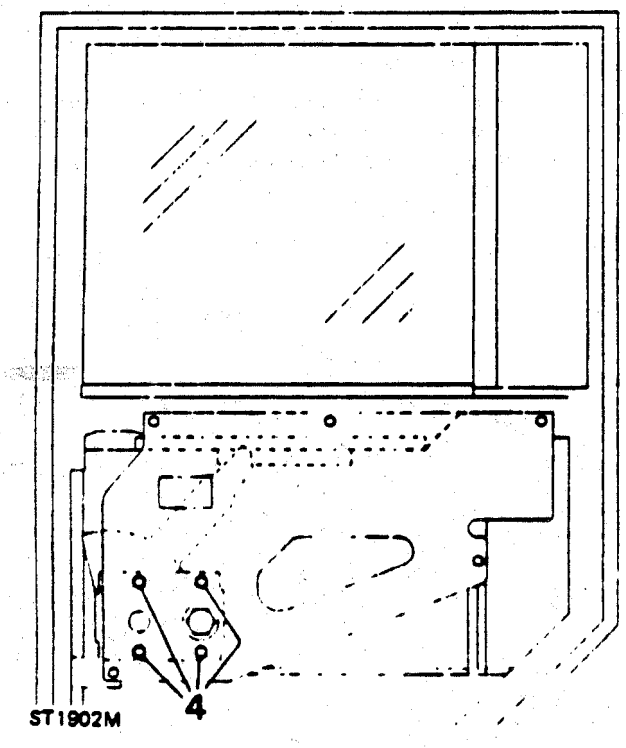
ST1901M

9. Fit the bezels to the locking button and remote control lever.
10. Fit the single screw behind the remote control lever.
11. Fit the door pull and secure with two screws and finishers.
12. Fit the window regulator handle and retain with the single screw and finisher.

REMOVING WINDOW REGULATORS
DEFENDER 110 - Rear side door

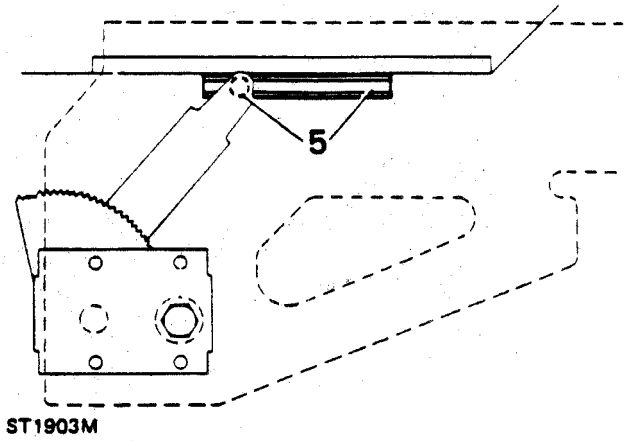
Remove

1. Remove the door trim.
2. Remove the protective weather sheet.
3. Temporarily fit the handle and wind the window up to its fullest extent and support the glass in this position, with a length of timber, to prevent it falling when removing the regulator.
4. Remove the four screws retaining the regulator to the mounting panel and withdraw the regulator whilst sliding the lifting arm button from the lifting channel. To assist this operation, remove the timber and lower the glass.



Fitting regulator

5. Insert the lifting arm button into the lifting channel.



6. Position the regulator so that the fixing holes line-up with the holes in the mounting panel.
7. Secure with the four screws and tighten evenly.
8. Temporarily fit the handle and check that glass can be raised and lowered smoothly without tight spots.
9. Fit the weather protection sheet with adhesive
10. Fit the door trim, regulator handle, door pull, and bezels.

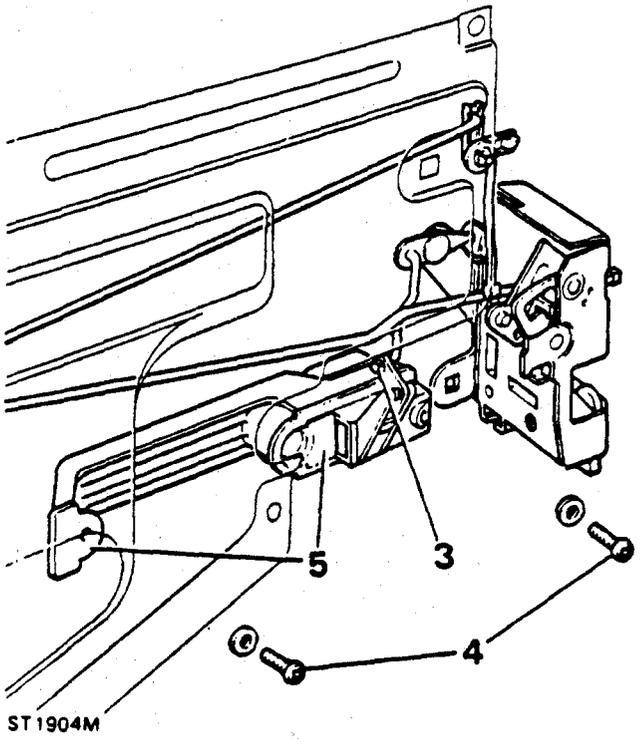
REMOVING EXTERIOR HANDLE
DEFENDER 110 - rear side door

Remove

1. Remove the door trim, regulator handle, door pull and bezels.
2. Peel back sufficient of the weather protection sheet to gain access to the handle mechanism.
3. Disconnect the actuating rod from the handle operating lever.
4. Remove the two screws and withdraw the handle and bezels.

Fitting handle

5. Fit the handle to the door ensuring that the two bezels are in position - flat faces towards the door and secure with the two screws.

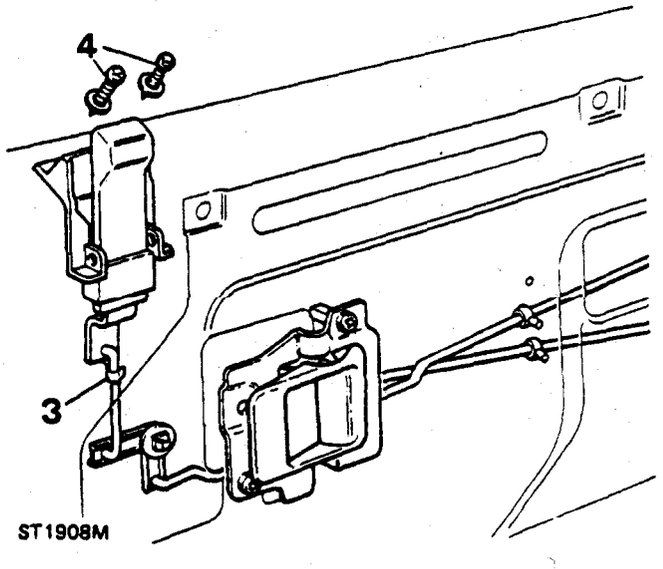


6. Connect the actuating rod to the handle operating lever and secure with spring clip.
7. Re-seal the weather protection sheet.
8. Fit the door trim. regulator handle, door pull and bezels.

REMOVING DOOR LOCKING BUTTON
DEFENDER 110 - Rear side door

Remove

1. Remove the door trim, regulator handle, door pull and bezels.
2. Peel back sufficient of the weather protection sheet to reveal the mechanism
3. Release the spring clip securing the button to the operating rod and withdraw the rod from the button.
4. Remove the two screws securing the button to the door panel and remove the button



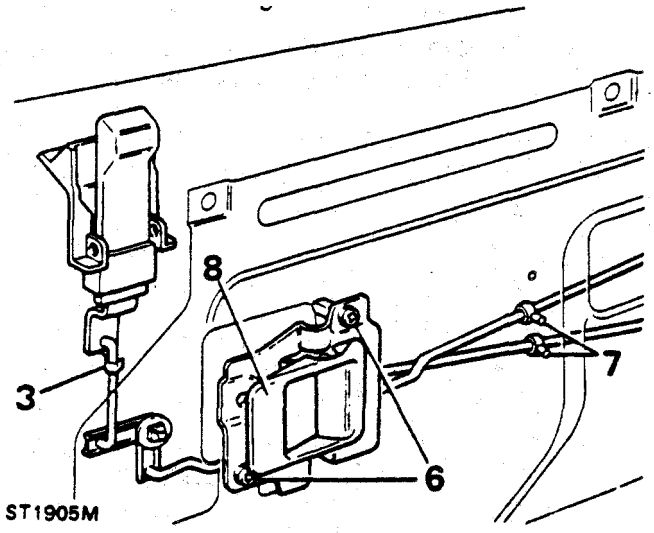
Fitting locking button

5. Secure the locking button assembly to the door panel with the two screws.
6. Fit the operating rod to the button assembly and secure with the spring clip
7. Re-seal the weather protection sheet and fit the door trim, door pull, regulator handle and bezels.

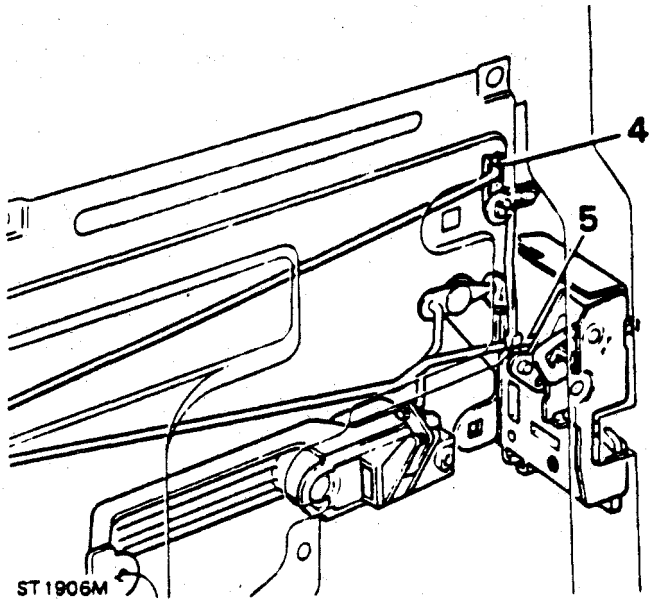
REMOVING REMOTE CONTROL LEVER DEFENDER 110 - Rear side door

Remove

1. Remove the door trim, door pull, regulator handle and bezels.
2. Peel-back sufficient of the weather protection sheet to gain access to the remote lever.
3. Remove the spring clip and disconnect the control rod from the locking button.



4. Release the spring clip and disconnect the short locking button control rod from the latch mechanism.
5. Disconnect the long remote control rod from the latch assembly.
6. Remove the two screws securing the remote control lever to the mounting panel.
7. Release the control rods from the plastic retaining clips located in the mounting panel.
8. Withdraw the remote control lever and rods from the door.



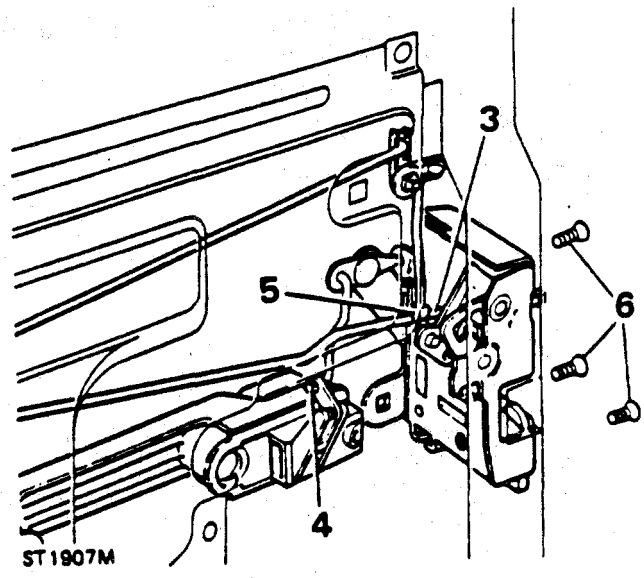
Fitting control lever

9. Fit the plastic retaining clips to the rod assembly into position and secure with the two screws.
10. Connect the control rods to the latch assembly and secure with the clips
11. Fit the plastic retaining rod clips to the mounting panel.
12. Connect the control rod to the locking button and secure with the clip.
13. Re-seal the weather protection sheet and fit the trim panel, regulator handle, door pull and bezels.

REMOVING DOOR LATCH ASSEMBLY DEFENDER 110 - Rear side door

Remove

1. Remove the door pull. regulator handle, bezels and door trim.
2. Peel-back sufficient of the weather protection sheet to reveal the latch.
3. Release the remote control lever rod from the latch assembly.
4. Disconnect the door outer handle control rod from the latch assembly.
5. Disconnect the door locking button remote control rod from the latch mechanism.
6. Remove the three retaining screws and withdraw the latch assembly from the door



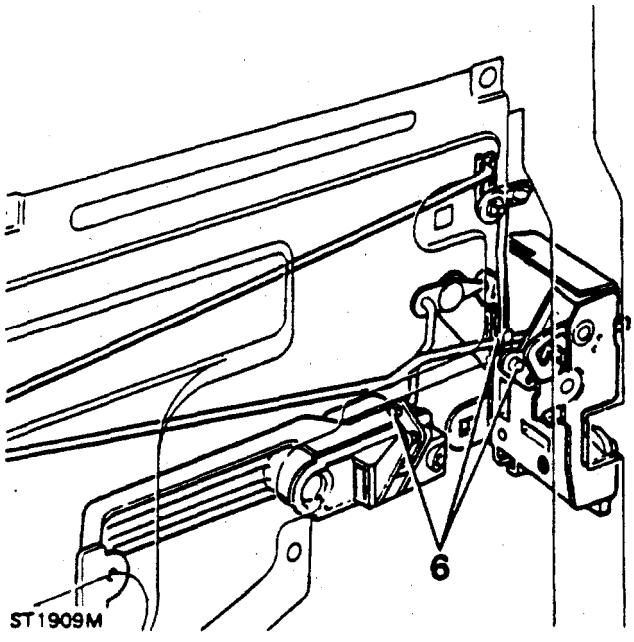
Fitting the latch

7. Fit the latch assembly to the door and secure with the three screws, noting that the uppermost screw is longer.
8. Connect the remote control levers to the latch mechanism reversing instructions 3, 4 and 5.
9. Re-seal the weather protection sheet and fit the regulator handle, door pull, door trim and bezels.

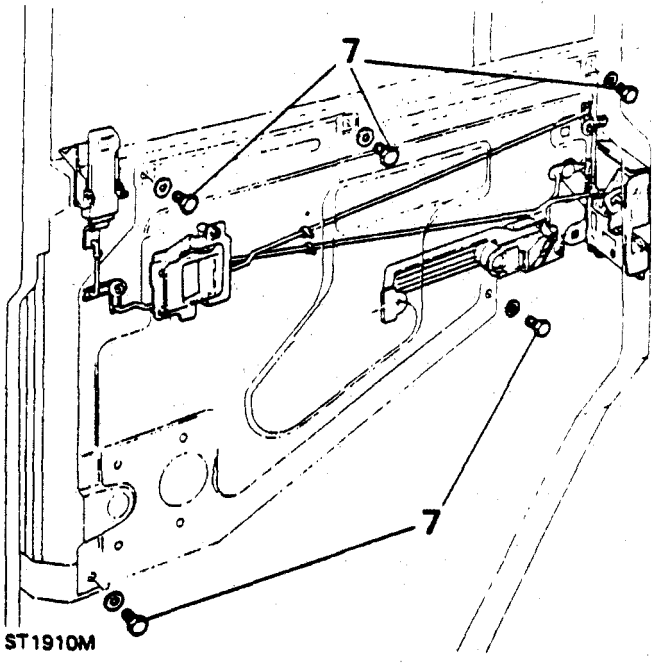
REMOVING DOOR GLASS DEFENDER 110
Rear side door

Remove

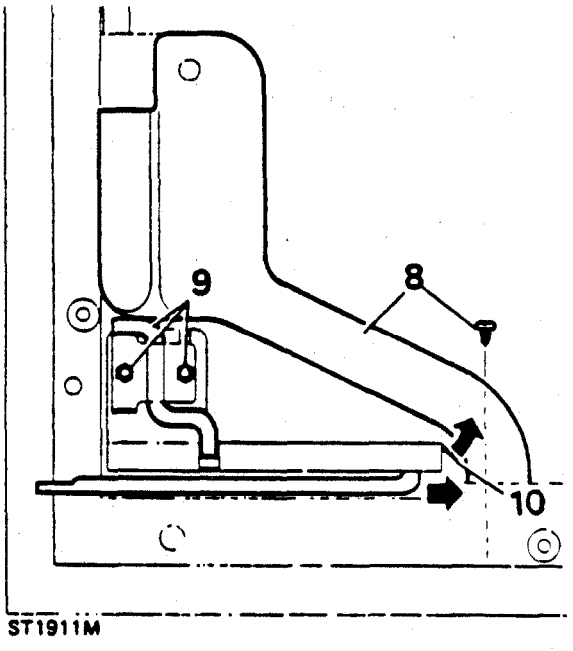
1. Disconnect the door check rod from the door post.
2. Remove the regulator handle, door pull, bezels and door trim.
3. Remove the weather protection sheet.
4. Remove the window regulator assembly.
5. Disconnect and remove the door locking button.
6. Disconnect the control rods from the latch and door outer handle mechanism.



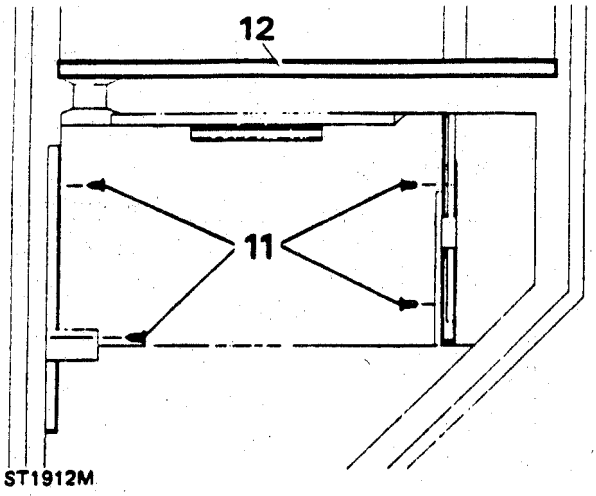
7. Remove the four screws retaining the mounting panel to the door and remove the panel complete with rods and control lever



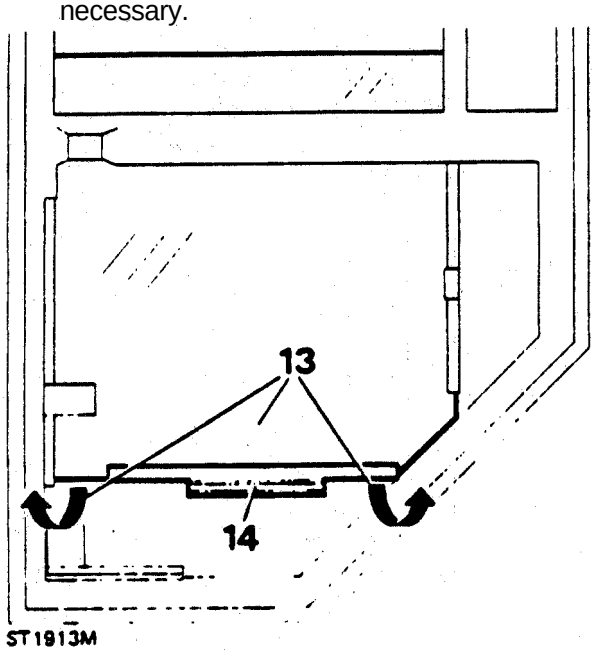
8. Remove the single self tapping screw to remove the water channel.
9. Remove the door check torsion bar
10. Remove the door check rod by bending back the end stop to enable the rod to be withdrawn.



11. Remove the four self-tapping screws - two each side - securing the glass lower channel.
12. Remove the inner and outer weather strips from the door sill



13. Lower the glass down to the bottom of the door, lift the glass over the lower edge and withdraw from the door
14. Remove the lift channel from the glass, if necessary.



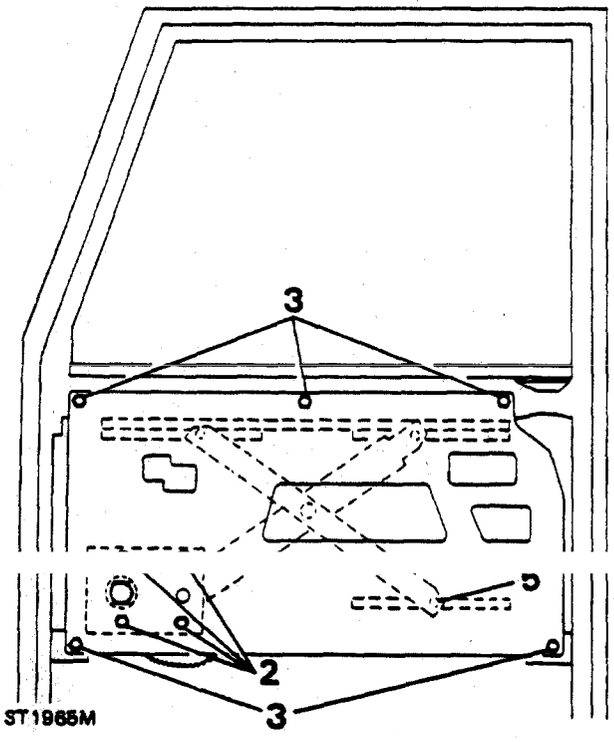
Fitting glass

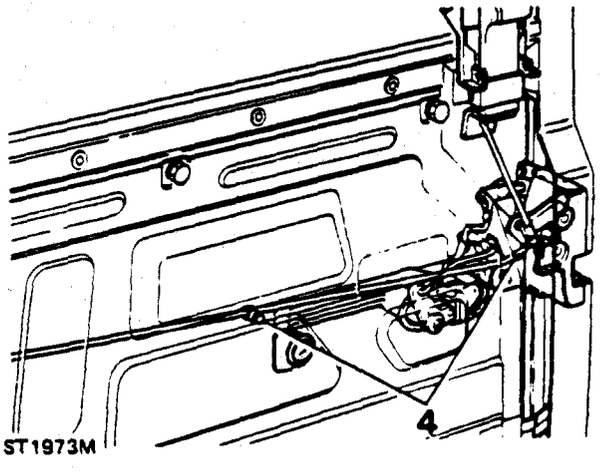
15. Fit the lift channel to the new glass if not supplied already fitted.
16. Insert the glass into the lower channels and carefully push the glass up to the top of the frame.
17. Secure the lower channels with the four self-tapping screws. Ensure that the screw heads are screwed down firmly below the bottom of the channels to prevent damage to the glass.
18. Fit the door check rod and bend the end stop back to the closed position.
19. Fit check stop torsion bar and secure with the two nuts and bolts.
20. Fit the water channel and secure with the single self-tapping screw.
21. Fit the mounting panel complete with rods and remote control lever.
22. Connect the control rods to the latch and door outer handle mechanism.
23. Fit the door locking button and connect the control rad.
24. Fit the window regulator.
25. Fit the door inner and outer sill weather strips
26. Fit and re-seal the weather protection sheet.
27. Fit the door trim, regulator handle, door pull and bezels.
28. Connect the door check rod to the door post.

REMOVING MOUNTING PANEL DEFENDER 110 Front doors

Remove

1. Remove the door trim, window regulator, door pull, bezels and weather protection sheet.
2. Remove the four screws securing the window regulator to the mounting panel.
3. Remove the five screws securing the mounting panel *to* the door frame.
4. Release the remote control lever rod from the latch mechanism and from the plastic clip in the mounting panel.





5 Slide the window regulator arm from the mounting panel channel and remove the panel with the remote control lever and rod

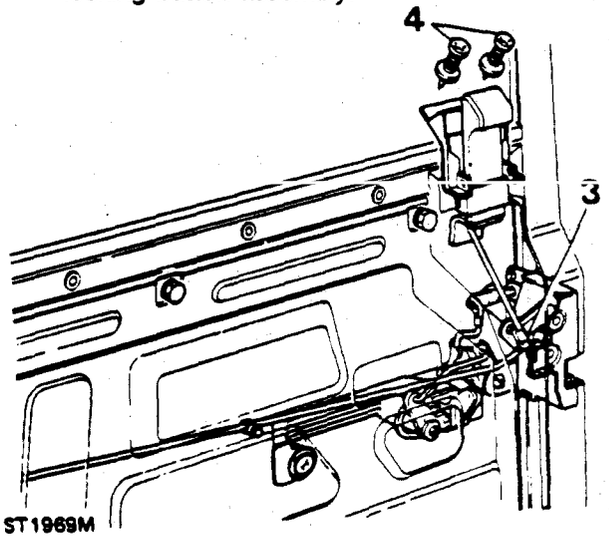
Fitting mounting panel

6. Engage the window regulator arm in the mounting panel channel.
7 Connect the remote control rod to the latch mechanism and secure with the clip
8. .Fit the mounting panel and retain with the five screws.
9. Secure the window regulator to the mounting panel with the four screws.
10. Raise and lower the window to check for free movement.
11. Fit the weather protection sheet, door trim. window regulator handle, door pull and bezels.

REMOVING DOOR LOCKING BUTTON DEFENDER 110 - Front doors

Remove

1. Remove the door trim regulator handle, door pull and bezels.
2. Peel back sufficient of the weather protection sheet to expose the mechanism.
3. Release the spring clip and disconnect the operating rod from the latch mechanism.
4. Remove the two screws and withdraw the locking button assembly.



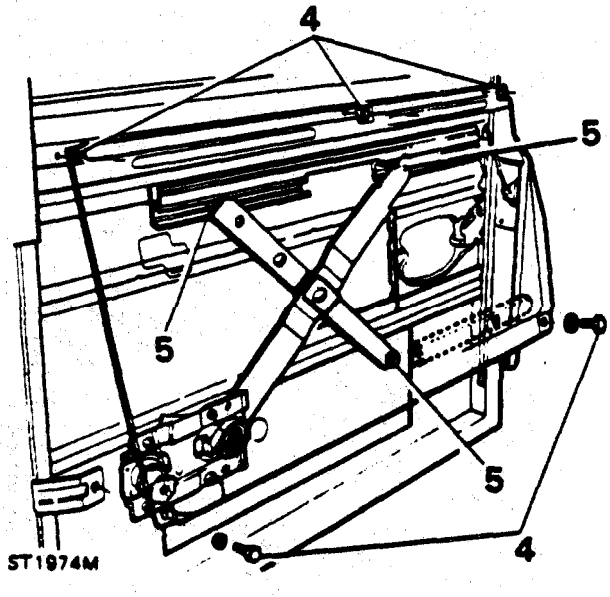
Fitting locking button

5. Secure the locking button assembly to the door with the two screws.
6 Connect the operating rod to the latch mechanism and secure with the spring clip
7. Re-seal the weather protection sheet and fit the door trim, door pull. regulator handle, and bezels.

REMOVING WINDOW REGULATOR
DEFENDER 110 - Front doors

Remove

1. Remove the door trim.
2. Remove the weather protection sheet.
3. Temporarily fit the handle and position the window half open and support with a length of timber.
4. Remove the two lower screws securing the mounting panel to the door and slacken the three upper screws.
5. Remove the four screws retaining the window regulator to the mounting panel and slide the operating arms from the channels attached to the glass and mounting panel and remove the regulator.



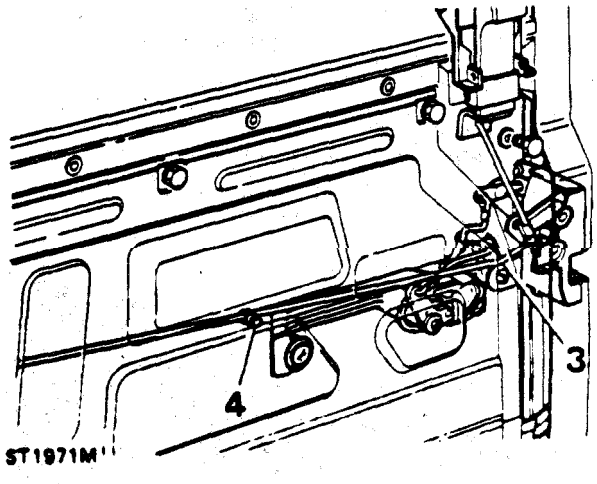
Fitting regulator

6. Insert the regulator operating arms into the channels.
7 Fit and tighten the mounting panel lower screws and tighten the upper screws.
8. Position the holes in the regulator to line-up with the holes in the mounting panel and secure with the four screws.
9. Temporally fit the regulator handle and check that the glass can be raised and lowered without tight spots.
10. Secure the weather protection sheet with adhesive.
11. Fit the door trim, regulator handle, door pull and bezels.

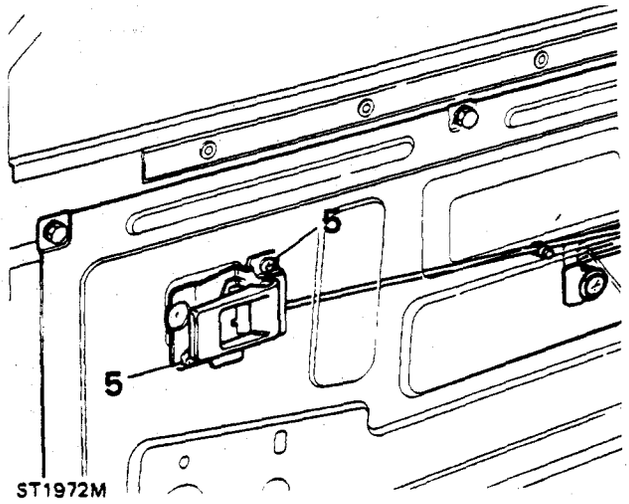
REMOVING REMOTE CONTROL LEVER
DEFENDER 110 - Front doors

Remove

1. Remove the door pull, regulator handle, bezels and door trim.
2. Peel back sufficient of the weather protection sheet to gain access to the remote lever.
3. Release the spring clip and disconnect the control rod from the latch mechanism.
4. Release the control rod from the plastic clip in the mounting panel.



5. Remove the two screws securing the remote control lever to the mounting panel and withdraw the lever and control rod.



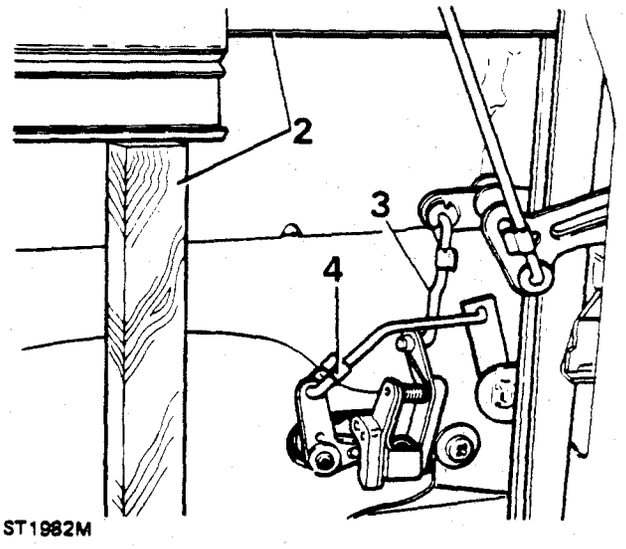
Fitting remote control lever

6. Feed the control rod into position and loosely secure the lever to the mounting panel with the two screws.
7. Connect the control **rod** to the latch mechanism and secure with the spring clip
8. Tighten the control lever retaining screws.
9. Secure the control rod to the plastic clip in the mounting panel.
10. Secure the weather protection sheet with adhesive.
11. Fit the door trim, regulator handle, door pull and bezels.

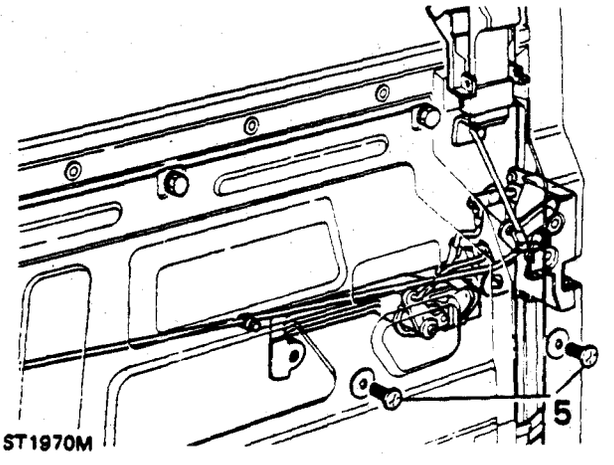
REMOVING EXTERIOR DOOR HANDLE
DEFENDER 110 - Front doors

Remove

1 Remove the regulator handle, door pull, bezels and door trim.
2. To gain access to the handle mechanism, remove the mounting panel and support the glass with timber.
3. Disconnect the operating rod from the handle mechanism.
4 Disconnect the rod from the locking barrel lever.



5. Remove the two screws **and** withdraw the handle assembly.



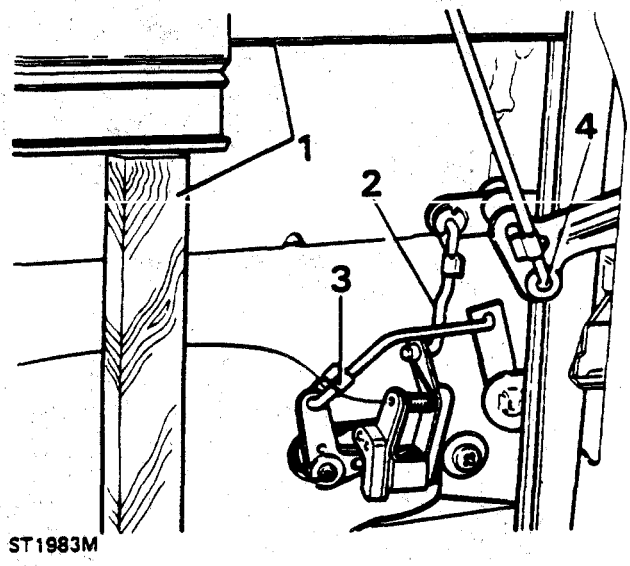
Fitting the handle

6. Fit the handle to the door ensuring that the two bezels are in position - flat faces towards the door, and secure with the two screws
7. Connect the rod to the handle operating lever and secure with the spring clip.
8. Connect the rod to the locking barrel lever and retain with the spring **clip.**
9. Carry-out instructions for fitting the mounting panel and door trim and fittings.

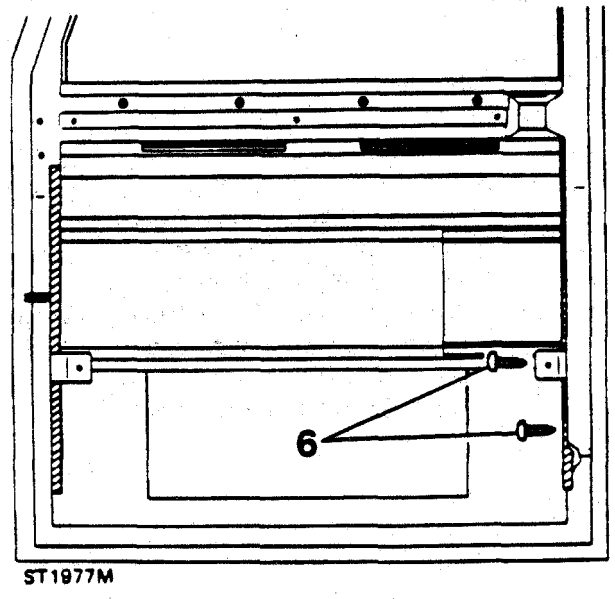
REMOVING THE DOOR LATCH ASSEMBLY
DEFENDER 110 - Front doors

Remove

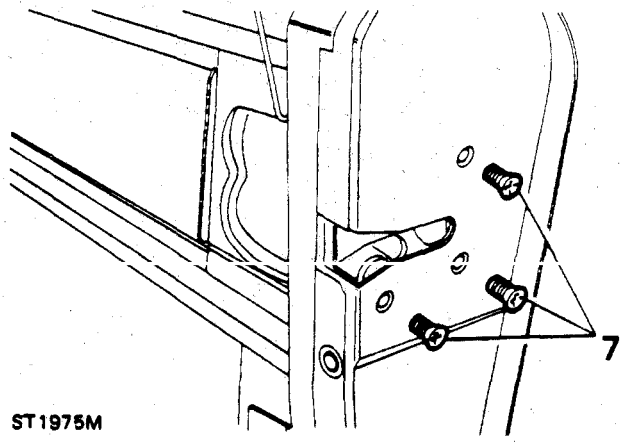
1. Carry out the instructions to remove the mounting panel and support the glass with timber.
2. Disconnect the control rod from the handle operating lever.
3. Disconnect the control rod from the locking lever on the handle.
4. Disconnect the locking button control rod from the latch mechanism.



5. Remove the two screws and remove the handle assembly from the door. See Exterior door handle.
6. Remove the two self-tapping Screws retaining the lower end of the window glass runner.



7. Remove the three screws securing the latch assembly to the door.
8. Whilst taking care not to damage the runner, ease it away from the latch and manoeuvre the latch assembly from the door



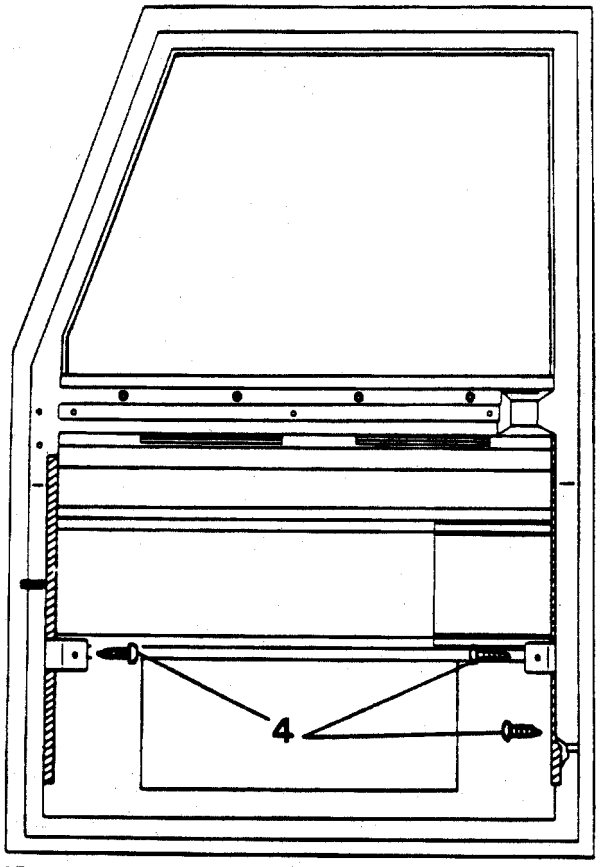
Fitting latch assembly

9. Carefully ease the window runner away, sufficiently to enable the latch to be located into position.
10. Secure the latch to the door with the three screws.
11. Secure the window runner with the two screws ensuring that the packing strip is in position and that the screw heads are below the bottom of the runner to prevent damage to the glass.
12. Fit the handle with the two screws, ensuring that the bezels are in position.
13. Connect the control rod to the handle operating lever and secure with the spring clip.
14. Connect the control rod to the locking lever and retain with the spring clip.
15. Connect the locking button control rod to the latch lever and secure with the spring clip
16. Carry-out the instructions to fit the mounting Panel.
17. Fit the door trim. regulator handle, door pull. and bezels.

REMOVING GLASS DEFENDER 110 - Front doors

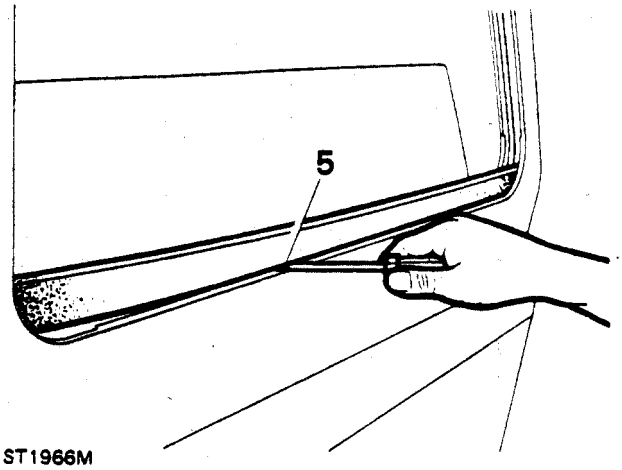
Remove

1 Carry-out the instructions to remove the mounting panel.
2. Remove the window regulator.
3. Push the glass up to the top of its travel and support with a suitable length of timber.
4. Remove the two self tapping screws securing the window glass runner on the latch side of the door and the single screw from the hinge side.



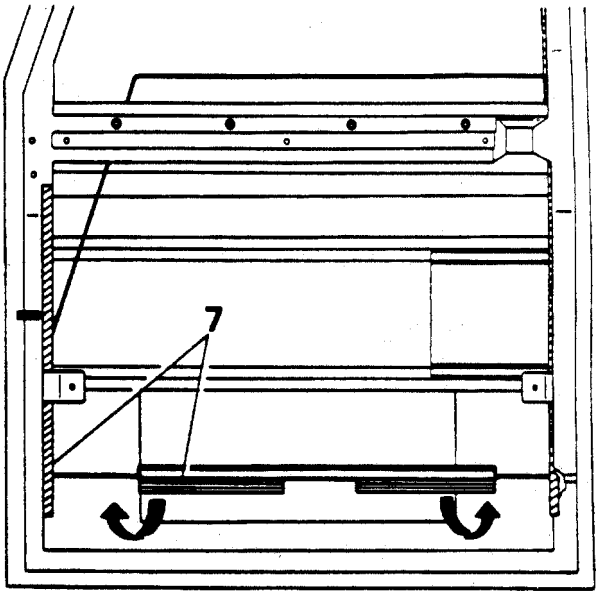
ST1976M

5 Taking care not to damage the paint work. prise the exterior waist weather strip from the door
6. Remove the timber support and lower the glass to the bottom of the door.



ST1966M

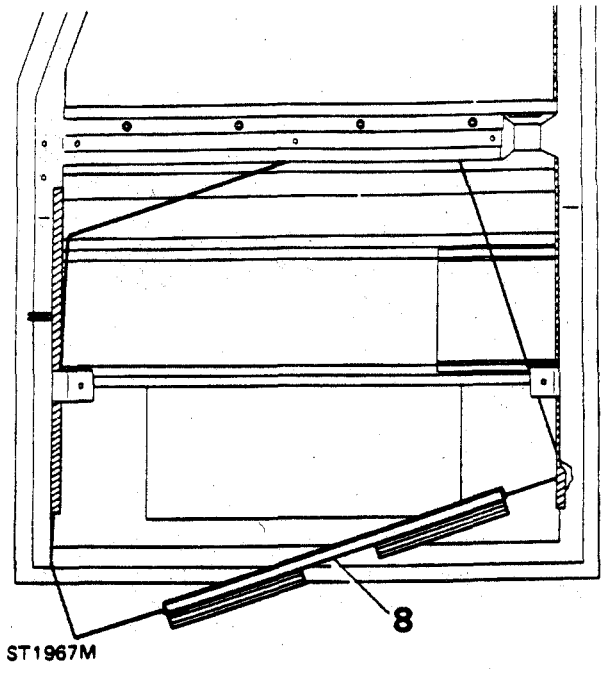
7. Ease the runner from the glass at the hinge side of the door, lift the glass over the bottom edge of the door and withdraw.



ST1968M

Fitting glass

8. Insert the glass into the runners at an angle as illustrated.
9. Whilst lifting me glass, position it squarely in the runners and raise it to the top of its travel and insert the timber support.
10. Secure the hinge side runner with the single screw ensuring that the packing strip is in position.



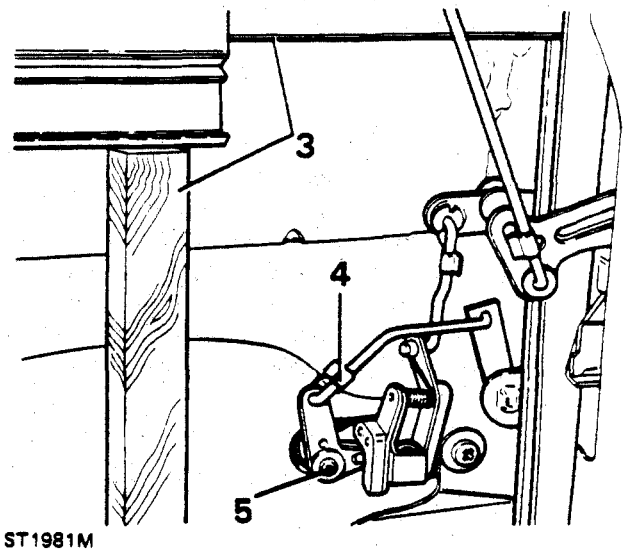
ST1967M

11. Locate the packing strip and secure the opposite runner with the two screws. Ensure that all three screw heads are well below the bottom of the runners to prevent damage to the glass.
12. Locate the regulator in the window lift channels.
13. Carry-out the instructions to fit the mounting panel.
14. Fit the door trim, window regulator, door pull and bezels.

REMOVING LOCKING BARREL DEFENDER 110 - Front doors

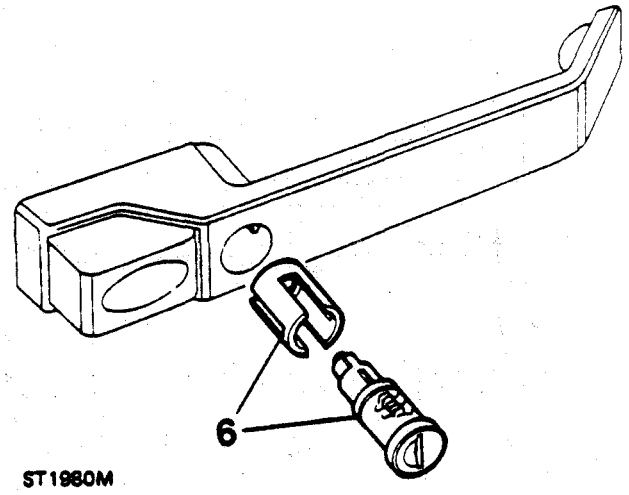
Remove

1. Remove me regulator handle, door pull, bezels, door trim and weather protection sheet.
2. Carry-out the instructions to remove the mounting panel.
3. Raise and support the glass to gain access to me latch mechanism
4. Release the spring clip and disconnect the rod from the lock operating lever.
5. Remove the single screw and withdraw the lock lever assembly.



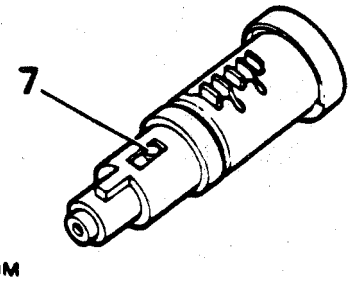
ST1981M

6. Withdraw the lock barrel from the exterior door handle complete with the locking sleeve



ST1980M

7. To remove the barrel from the plastic retaining sleeve, depress the spring loaded button and withdraw the sleeve.

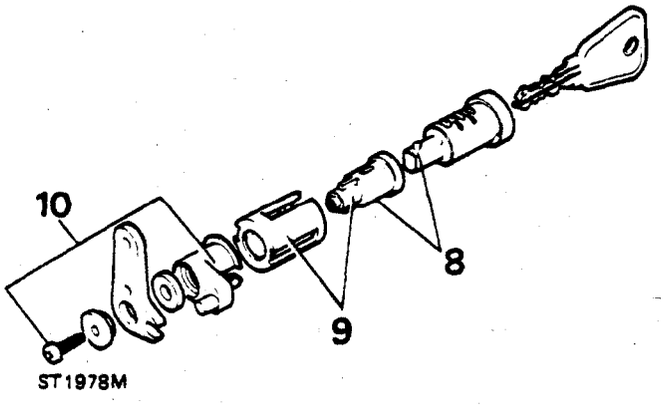


ST1979M

Refit the lock barrel

NOTE: If a new barrel is being fitted, check that the number on the barrel coincides with the number on the accompanyingkey.

8. Push the plastic retaining sleeve over the barrel until the spring loaded peg locks it into **position.**
9. Fit the barrel and plastic sleeve assembly to the locking sleeve and insert into the exterior handle reversing instruction 6.
10. Assemble the lock lever components as illustrated and from the inside of the door panel, fit them to the barrel assembly with the single screw.



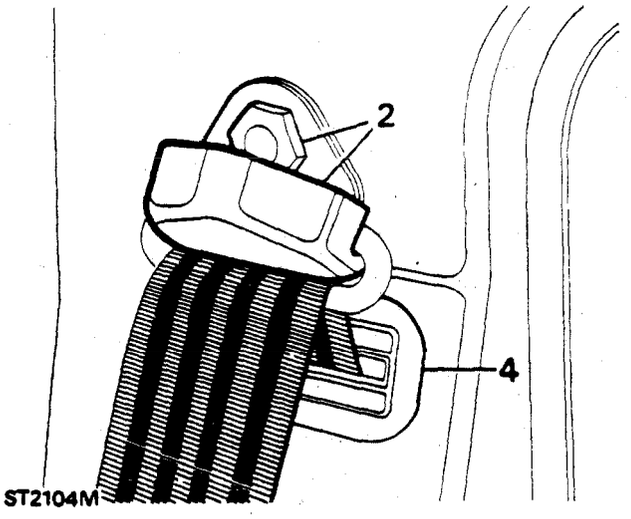
ST1978M

11. Connect the operating rod to the lock lever and secure with the spring clip, reversing instruction 4.
12. Fit the mounting panel and weather protection sheet. Fit the door trim, regulator handle, door pull and bezels.

REMOVING REAR SIDE WINDOW TRIM DEFENDER 110

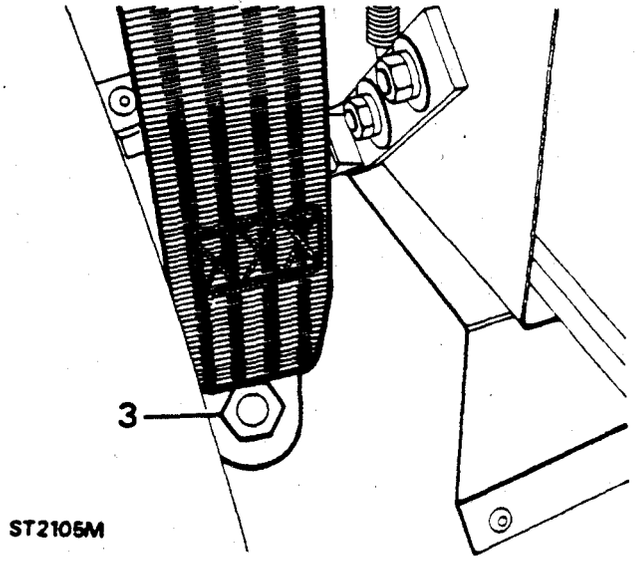
Remove

1. To gain access to the trim lower fixings remove the rear seat and **squab** frame complete.
2. Remove the plastic cover and the seat belt anchorage bolt from the 'C' post.



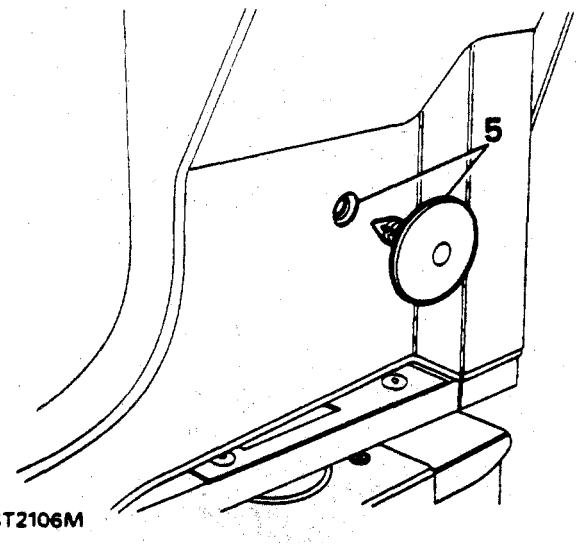
ST2104M

3. Remove the lower anchorage bolt for the same seat belt.
4. Remove the seat belt aperture finisher from the trim panel and remove the rear quarter light trim from the side concerned.



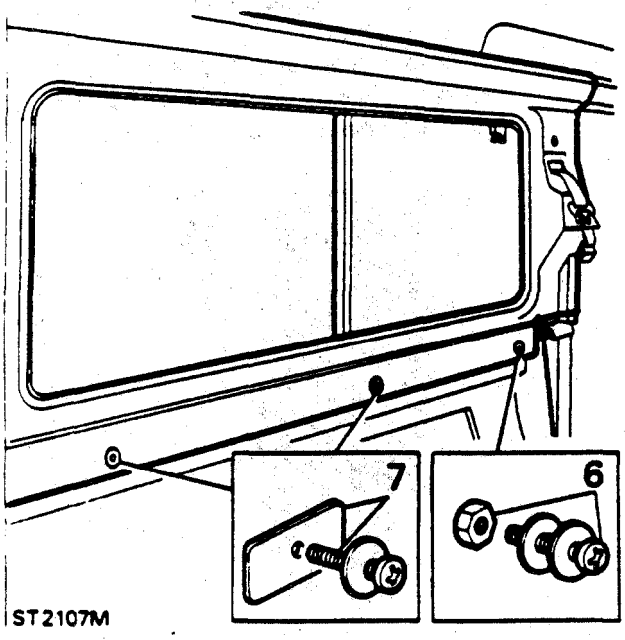
ST2105M

5. Using a screwdriver, carefully lever the trim retaining button from the 'C' post. The button is held by a 'fir-tree' type peg.



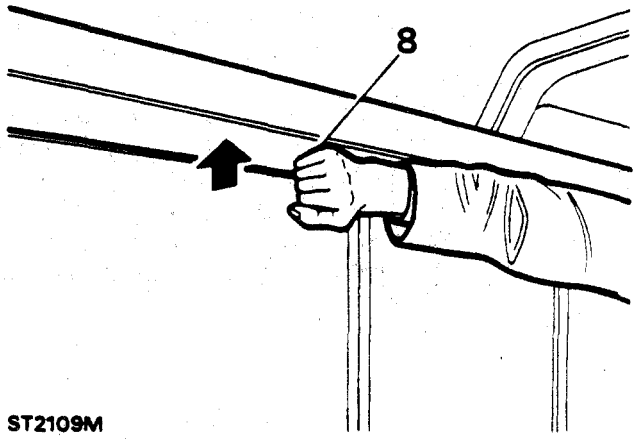
ST2106M

6. Remove the trim lower three fixings. The forward fixing is a screw, two washers and a nut.
7. The rear and center fixings are a screw, washerandanut welded to a plate. When the screw is removed, the plate will fall into the boxed section of the attachment side member.



ST2107M

8. The top edge of the trim is held to the inner cant rail by three spring clips. Strike upwards with the hand, as illustrated, to release the trim.

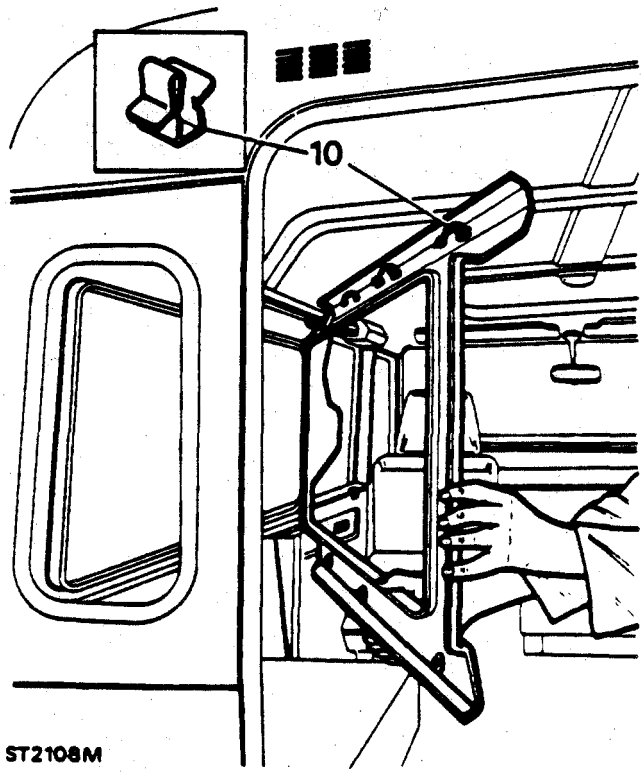


ST2109M

9 Feed the seat belt through the aperture and remove the trim from the vehicle.

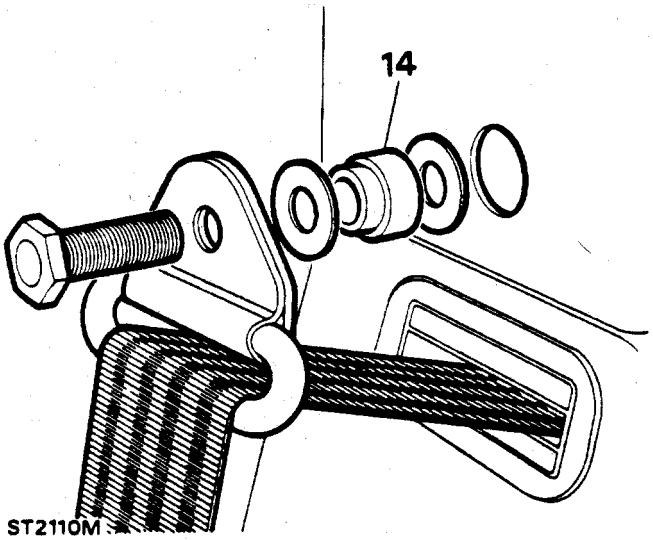
To refit

10. Feed the seat belt through the trim aperture fasten the **top** edge of the trim to the inner cant rail with the three spring clips.



ST2108M

11. Secure the lower edge of the trim with the three screws by reversing the removal process. Secure the rear and centre screws first and note that the nut is to the rear, the plate towards the trim.
12. Fit the plastic retaining button.
13. Fit the seat belt lower anchorage and secure with the special bolt, spacer and washers, as illustrated. tighten the bolt to 20,3 Nm.
14. Similarly, fit the seat belt upper anchorage and tighten the special bolt to 20,3 Nm. Fit the finisher to the seat belt aperture in the trim panel and the plastic cover to the anchorage bolt.



15. Fit the seat and squab frame and secure the seat cushion to the frame with the tapes.
16. Fit the rear quarter light trim.

REMOVING 'B' POST TRIM DEFENDER 110

Remove

1. Remove the plastic cover from the seat belt upper anchorage.
2. Remove the upper anchorage bolt and fittings
3. Carefully lever-out the plastic button and remove the trim.

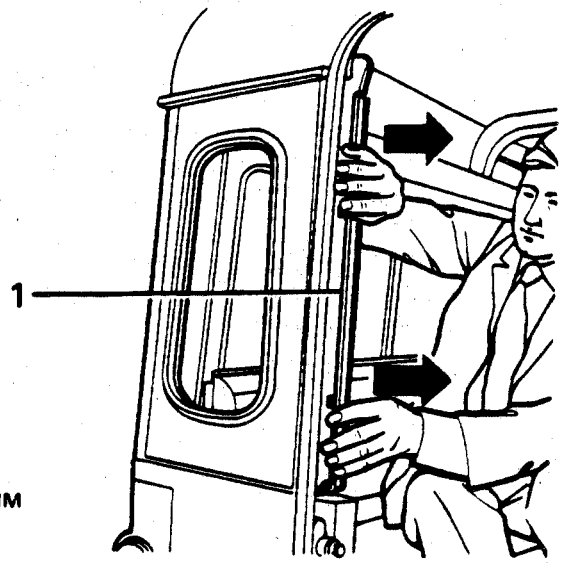
Refit

4. Reverse the removal procedure ensuring that the upper anchorage bolt and fittings are correctly fitted and tightened to the specified torque as described in instruction 14 for refitting the rear side trim.
5. Fit the plastic cover over the anchorage bolt and secure the lower end of the trim with the retaining button.

REMOVING REAR QUARTER LIGHT TRIM DEFENDER 110

Remove

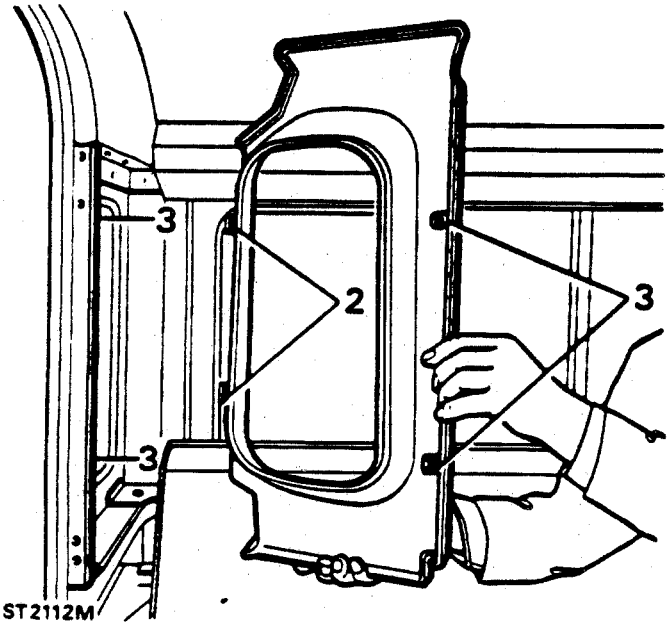
1. Pull the trim panel away from the quarter light with fingers thereby releasing the retaining spring clips from the vertical rail and withdraw the panel.



ST2111M

Refit

2. Reverse the removal procedure whilst ensuring that the two metal lugs locate behind the side trim.
3. Align the two spring clips with the vertical rail and **tap** the panel into position with the hand.

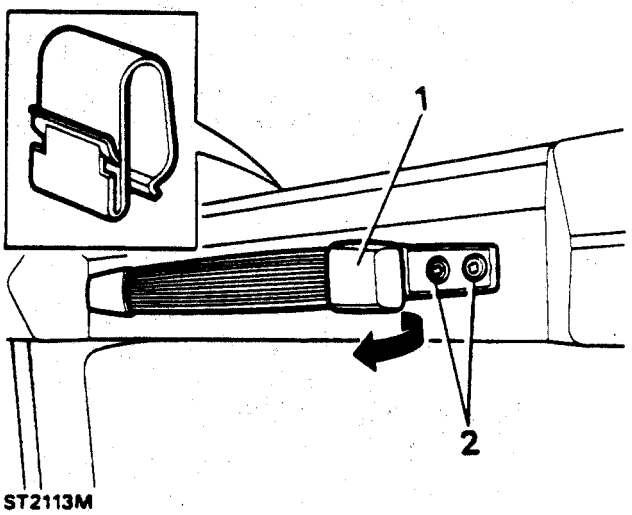


ST2112M

REMOVING GRAB HANDLES DEFENDER 110

Remove

1. Lift the plastic finishers to expose the securing screws.
2. Remove the four screws to release the grab handle.



ST2113M

NOTE: In order to remove the trim above the door between the 'B' and 'C' post on **'110' Station Wagons, the 'B' post trim as well as the grab handle must be removed. The trim above the door is held by clips, the same as used for the side trim**

Refit

3. Reverse instructions 1 and 2.

DOOR LOCK, REAR DOOR DEFENDER 110 FRONT AND REAR DOORS DEFENDER 90

Removal, Defender 110

1. Remove the grab handle from the rear door
2. Remove the rear wiper motor cover.
3. Remove the harness cover from the rear door
4. Remove the rear door trim pad.
5. Remove the screws, washers and nut retainer securing the top of the lock to the door.
6. Remove the nuts, washers and screw retainer securing the bottom of the lock to the door.
7. Withdraw the lock complete with trim.
8. Remove the trim from lock.
9. Remove the door lock gasket.
10. Clean sealant from the retainer plates.

Barrel removal

11. Insert the key in the barrel.
12. Depress the lock barrel plunger.
13. Withdraw the barrel from the lock.

Barrel refitting.

14. Refit the barrel in reverse of removal.

Refitting

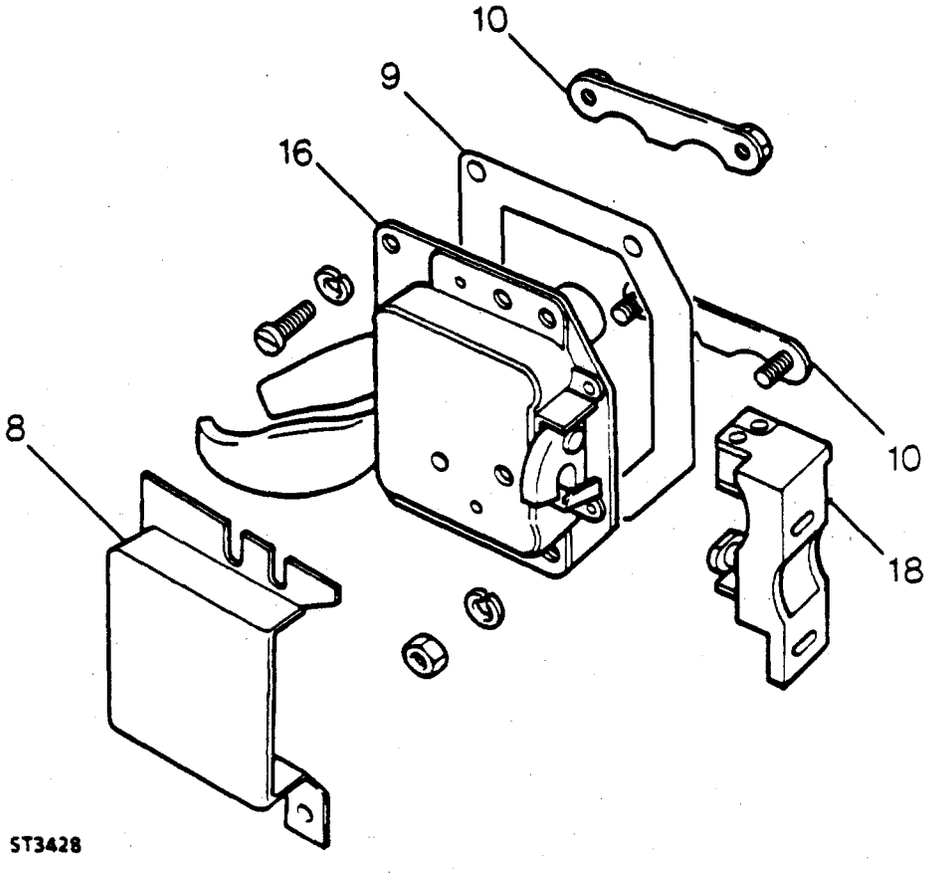
15. Apply sealant to the lock retainer plates
16. Fit the lock to the door with a new gasket and complete with the lock trim
17. Secure with the retainer plates screws. washers and nuts.
18. Close the door and check for correct latching with the striker. Adjust the striker as necessary.
19. Refit the trim pad, the harness and wiper motor covers and the grab handle.

Removal, Defender 90

1. Remove the screws, washers and nut retainer (10) securing the top of the lock to the door
2. Remove the nuts, washers and screw retainer (10) securing the bottom of the lock to the door.
3. Withdraw the lock.

Refitting

4. Apply sealant to the lock retainer plates.
5. Fit the lock to the door with a new gasket.
6. Secure with the retainer plates, screws, washers and nuts.
7. Close the door and check for correct latching with the striker.
8. Adjust the striker as necessary



Striker adjustment

NOTE: Before carrying out adjustment to the striker ensure that the dovetail is correctly adjusted.

1. Loosen the striker securing screws.
2. Adjust the striker and retighten screws.
3. Close the door and check for correct latching with the door lock.
4. Carry out further adjustment as necessary. If full adjustment cannot be achieved carry out the following:
5. Remove the striker and nut plate.
6. Elongate the holes in the body metal which is sandwiched between the striker and nut plate.
7. If interference between the striker and the dovetail is evident it is permissible to lightly grind the bottom of the striker casting.
8. Refit the striker and adjust as necessary.

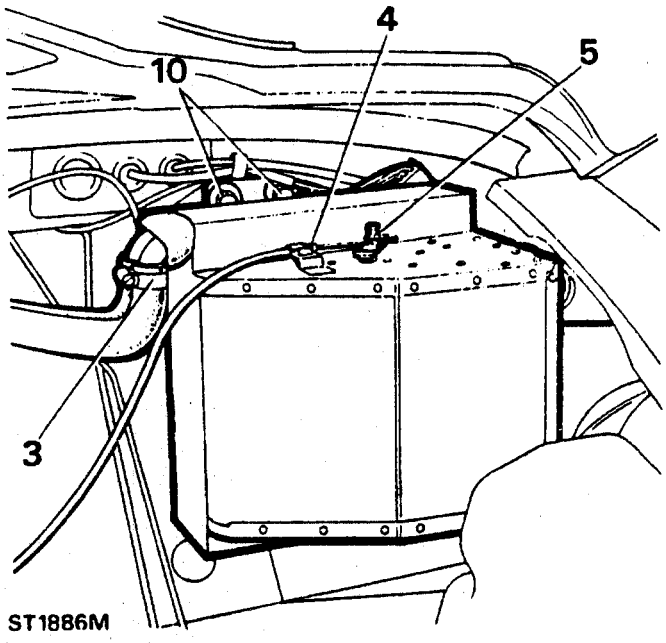
Dovetail adjustment

1. Lift and hold the lock handle in the open position while opening and closing the door.
2. Adjust the dovetail guide as necessary to eliminate lifting, dragging or binding as the dovetail enters the guide.
3. Grease can be used as an aid to adjustment.

HEATER/FAN UNIT
Remove, Overhaul and refit

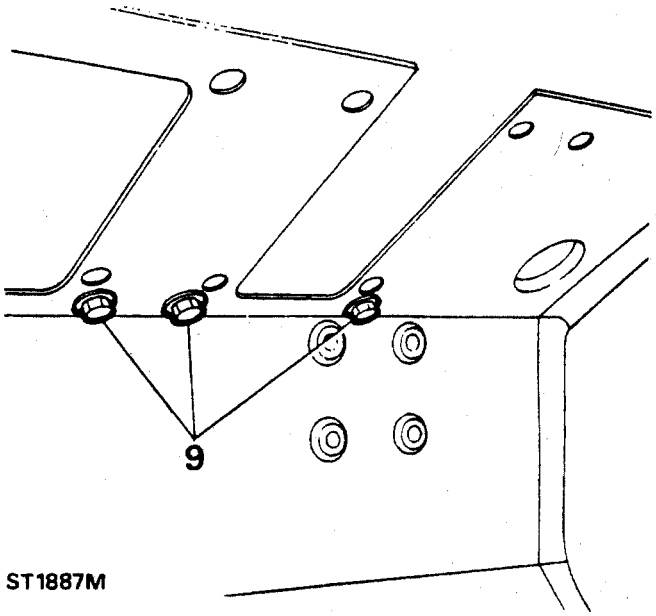
REMOVE FROM VEHICLE

1. Remove bonnet and disconnect battery.
2. Remove radiator bottom hose at radiator union and drain cooling system.
3. Slacken and remove the heater hoses at heater box unions.
4. Remove outer cable securing clips.
5. Slacken and remove control cables at the heater box.
6. Remove heater wiring harness securing loop.
7. Disconnect harness multi-plug.
8. Remove interior bulkhead trim.



ST1886M

9. Remove lower nuts and bolts securing the heater unit *to* the bulkhead.
10. Slacken heater unit upper retaining bolts.
11. Manoeuvre heater unit clear of engine bay.

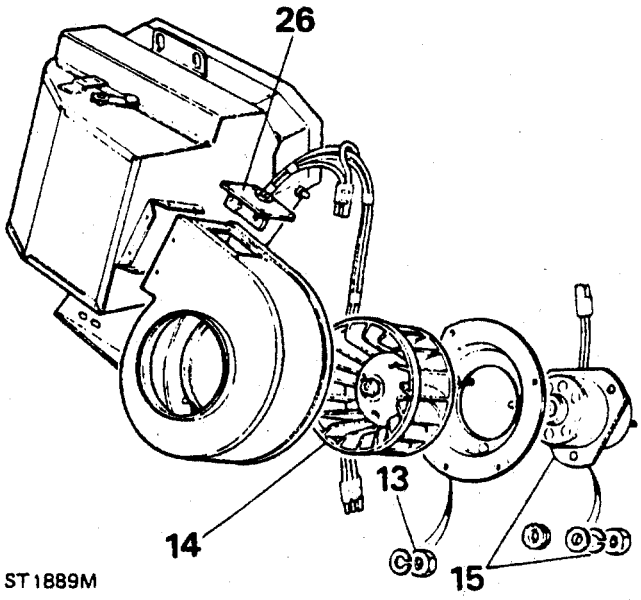


ST1887M

OVERHAUL

Fan Motor Assembly

12. Remove the nuts securing the angled bracket to the heater unit, and remove the bracket.
13. Remove the five nuts securing the fan assembly to the heater unit. Unplug the connector and remove the fan assembly from the heater unit.
14. Remove circlip holding the impeller to the drive shaft and remove the impeller.
15. Remove the three nuts securing the fan motor to the mounting plate and release the motor from the plate.

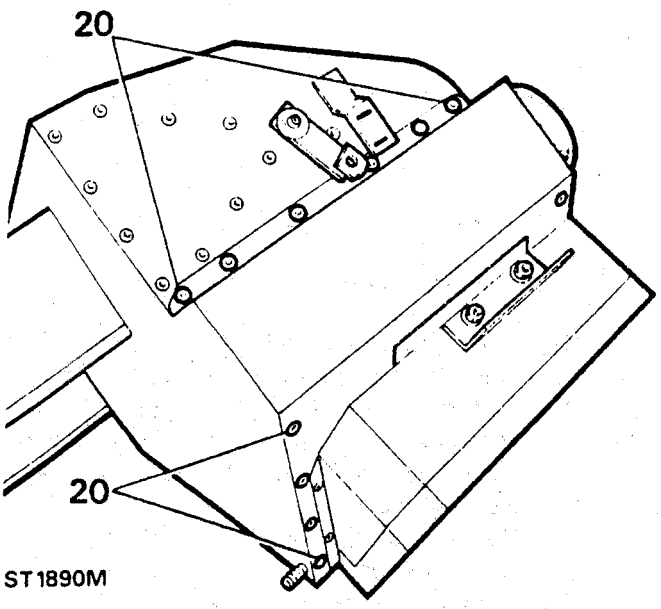


ST1889M

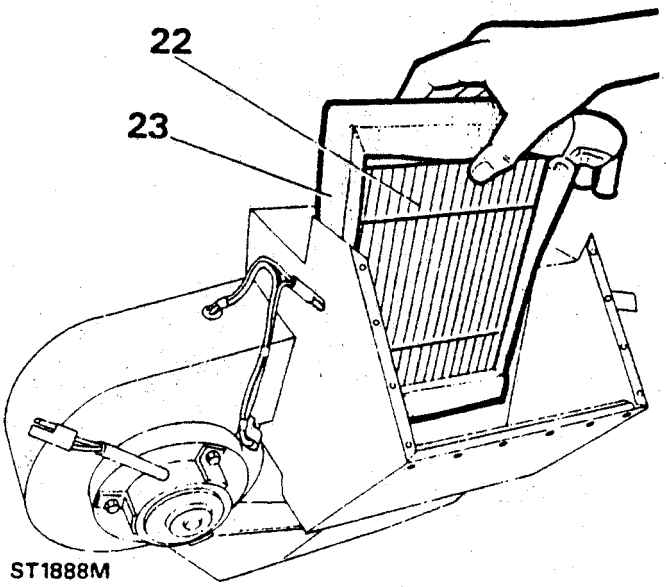
16. Fit fan motor into mounting plate, apply Bostik 1261 adhesive to mating faces, and secure with the three nuts.
17. Refit impeller to fan drive shaft and fit circlip.
18. Refit fan assembly to casing and secure with the five nuts.
19. Plug in connector to resistor harness and refit angled bracket.

Heater Matrix

20. Drill out rivets holding the air duct and top cover to the casing. (Three of the rivets are concealed by the rubber seal).



21. Lift off cover, air duct and seal.
22. Lift heater matrix out of casing.
23. Fit foam rubber to heater matrix casing and position matrix in casing.



24. Check that flap valves operate correctly and without sticking.
25. Refit top cover and rivet into place.

Resistor Unit

26. Drill out the four rivets retaining the resistor mounting plate, and lift out plate with resistor.
27. Apply Bostik adhesive to resistor plate and secure in position with rivets.

REFIT TO VEHICLE

28. Smear heater unit sealing rubber with a suitable impact adhesive, and locate to heater.
29. Place heater unit into engine bay and manoeuvre into position on bulkhead.
30. Loosely fit lower heater unit nuts and bolts.
31. Tighten heater unit upper securing bolts.
32. Tighten lower nuts and bolts.

33. Refit interior bulkhead trim.
34. Locate heater wiring harness into securing **loop,** and tighten nut.
35. Connect harness multi-plug.
36. Refit control cable outer clip and inner cable pinch bolts.
37. If necessary, prime heater matrix with coolant mixture.

38. Connect hoses to heater unit and tighten hose clips.
39. Refit radiator bottom hose and refill cooling system with the required anti-freeze concentration or corrosion inhibitor.
40. Refit bonnet.
41. Connect battery, start engine, and check for leaks.
42. After engine has cooled check coolant level in the expansion tank and radiator. Top up if necessary.

AIR CONDITIONING DEFENDER 110

General Service Information

INTRODUCTION

Before any component of the air conditioning system is removed, the system must be depressurised. When the component is replaced, the system must be evacuated to remove all traces of old refrigerant and moisture. Then the system must be recharged with new refrigerant.

Any service operation that requires the loosening of a refrigerant line connection should be performed only by qualified service personnel. Refrigerant and/or oil will escape whenever a hose or pipe is disconnected.

All work involving the handling of refrigerant requires special equipment, a knowledge of its proper use and attention to safety measures.

Servicing equipment

The following equipment is required for full servicing of the air conditioning system.

Charging trolley
Leak detector
Tachometer
Safety goggles
Refrigerant charging line gaskets
Thermometer -20°C to -60°C
Valve Core Removers

SERVICING MATERIALS

Refrigerant: Refrigerant 12, which includes Freon 12 or Arcton 12.

CAUTION: Methychloride refridgerants **must** not be used.

Nominal charge weight: 1.09 kg (38ozs).
Compressor oil: See Recommended Lubricants.

PRECAUTIONS IN HANDLING REFRIGERANT

The refrigerant used in the air conditioning system is Refrigerant 12. and is transparent and colourless in both the gaseous and liquid state It has a boiling point of -29.8°C (-21.7°F) at atmospheric pressure and at all normal pressures and temperatures it becomes a vapour. The vapour is heavier than air, non-flammable, and non-explosive. It is non-poisonous except when in contact with an open flame, and non-corrosive until it comes in contact with water.

The following precautions in handling Refrigerant 12 should be observed at all times.

DO NOT
- leave refrigerant drum without its heavy cap fitted.
- carry refrigerant drum inside a vehicle.
- subject refrigerant drums to high temperature.
- weld or steam clean near an air conditioning system.
- expose eyes to liquid refrigerant ALWAYS wear goggles
- discharge refrigerant vapour into an area with an exposed flame or into an engine intake. Heavy Concentrations of refrigerant in contact with naked flame produces a toxic gas.
- allow liquid refrigerant to contact bright metal, it will tarnish metal and chrome surfaces, and combined with moisture can seriously corrode all metal surfaces.

PRECAUTIONS IN HANDLING REFRIGERANT LINES

WARNING: Always wear safety goggles when opening refridgerantconnections.

(a) When disconnecting any pipe or flexible 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.

(b) Lines, flexible end connections and components must be capped immediately they are opened to prevent the entrance of moisture and dirt.

(c) 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 pipes. they must be replaced with new pipes.

(d) All replacement components and flexible end connections are sealed. and should only be opened immediately prior to making the connection.

(e) Ensure the components are at room temperature before uncapping, to prevent condensation of moisture from the air that enters.

(f) Components must not remain uncapped for longer than fifteen minutes In the event of delay. the caps must be replaced

(g) 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 be replaced and not used

(h) The compressor shaft must not be rotated until the system is entirely assembled and contains a charge of refrigerant.

(j) A new compressor contains an initial charge of 312,5 ml (11 UK fluid ozs) of oil when received, part of which is distributed throughout the system when it has been run. The compressor contains a holding charge of gas when received which should be retained until the hoses are connected.

(k) The receiver/drier should be the last component connected to the system to ensure optimum dehydration and maximum moisture protection of the system.

(l) 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.

(m) Always use two spanners of the correct size, one on each hexagon, when releasing and tightening refrigeration unions.

(n) 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.

(o) All lines must be free of kinks. The efficiency of the system is reduced by a single kink or restriction.

(p) Flexible hoses should not be bent to a radius less than ten times the diameter of the hoses.

(q) Flexible connections should not be within 50 mm of the exhaust manifold.

(r) Completed assemblies must be checked tor refrigeration lines touching sheet metal panels. Any direct contact of lines and sheet 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 hose pipe or air line. clean the face of the condenser to remove flies. leaves etc. Check the pipe connections for signs of oil leakage.

Compressor

Check hose connections for signs of oil leakage. Check flexible hoses for swelling. Examine the compressor belt for tightness and condition. Checking the compressor oil level and topping-up is only necessary after charging the system or in the event of a malfunction of the system.

Receiver/Drier

Examine the sight glass for bubbles with the system operating. Check connections for leakage.

Evaporator

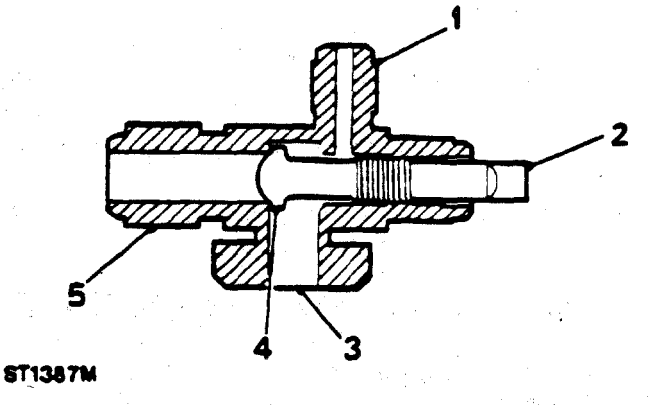
Examine the refrigeration connections at the unit. If the system should develop a fault, or if erratic operation is noticed, refer to the fault diagnosis chart.

Service valves

There are two types of service valves in operation: 'Stem' and 'Schrader'. To identify where the different operations occur, stem type will be boxed.

Stem type

Stem type Service valves allow for the isolation of the compressor from other parts of the system, When these valves are used in conjunction with the liquid line quick-disconnect fittings, the three major assemblies of the system can be removed from the vehicle with a minimal loss of refrigerant. In addition, it is possible to remove major assemblies for repair of components which are not part of the refrigeration system, or provide access to parts of the vehicle which are obstructed by the air conditioning system, without fully discharging the system. A thorough understanding of the stem type service valve is necessary before undertaking servicing or repair involving the air conditioning system.

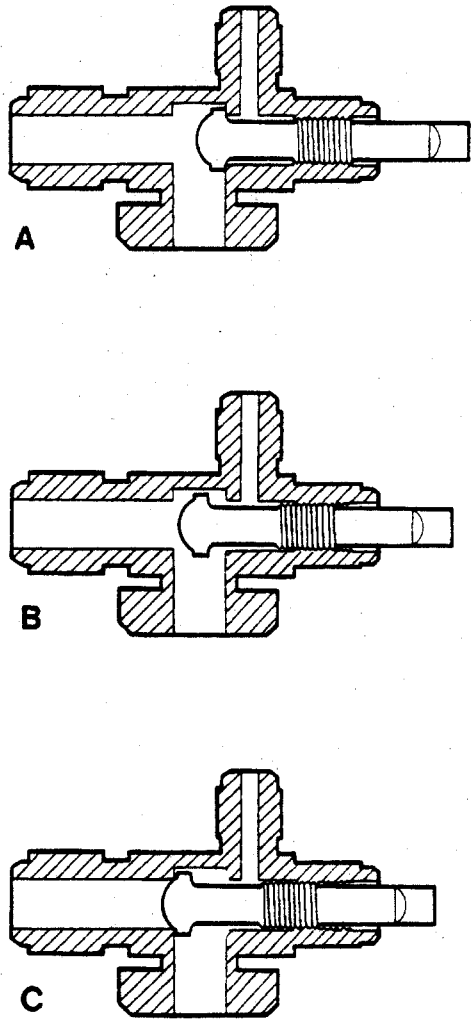


Stem type service valve

1 servlce port
2. Valve stem
3. Compressor port
4. Valve seat
5. Hoseconnector

NOTE: A special wrench should be used to adjust the valve to prevent damage to the stem.

The stem type service valve has three positions, the operation of which is explained as follows.



ST1386M

A. **ON: FULLY ANTICLOCKWISE -** Normal operating position, and the position which is used for connecting and disconnecting the manifold gauge set, is the on position. The stem is turned fully anticlockwise. This seals the service gauge port from receiving any refrigerant flow.

B. **MID (Test) POSITION -** After the service gauge manifold has been installed (the valve stem is in the on position), turn the valve stem the required number of turns clockwise. This will put the valve stem seat midway in the service valve and allow full system operation while permitting refrigerant pressure to reach the gauges.

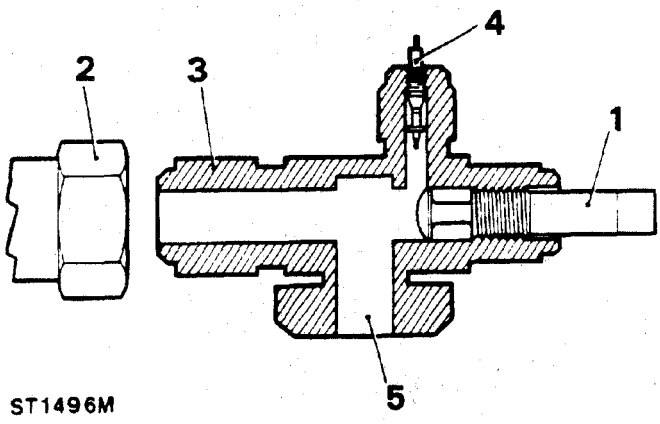
C. **OFF: FULLY CLOCKWISE -** With the service valve stem turned fully clockwise, the valve will block passage of refrigerant flow through the system. As illustrated, the refrigerant flow to or from the compressor (depending on whether it is high side or low side) is blocked.

WARNING: NEVER operate the air conditioning system with the service valves in the OFF POSITION, it will cause severe damage to the compressor.

Schrader Type

These are secured to the head of the compressor, and the suction and discharge flexible end connections are secured to them by unions.
The service valves are identified as suction or low pressure, and discharge or high pressure. Whilst they are identical in operation they are not interchangeable, as the connections are of different sizes.
The valve with the larger connections fits the suction side.
As the name suggests, these valves are for service purposes, providing connections to external pressure/vacuum gauges for test purposes. In combination with charging and testing equipment they are used to charge the system with refrigerant.

Schrader service valve



1. Valve stem
2. Hose connection
3. Service valve
4. Schrader valve core
5. Compressor port

NOTE: A special wrench should be used to adjust the valve to prevent damage to the stem.

The Schrader type service valve has two positions, the operation of which is explained as follows

A. ON: FULLY ANTICLOCKWISE - Normal operating position, and the position which is used for connecting and disconnecting the manifold gauge set, is the on position. The stem is turned fully anticlockwise. This seals the service gauge port from receiving any refrigerant flow.

B. OFF: FULLY CLOCKWISE - With the service valve stem turned fully clockwise, the valve will block passage of refrigerant flow through the system. As illustrated, the refrigerant flow to or from the compressor (depending on whether it is high side or low side) is blocked.

WARNING: NEVER operate the air conditioning system with the service valves in the OFF POSITION, it will cause severe damage *to* the compressor.

Valve Core Remover

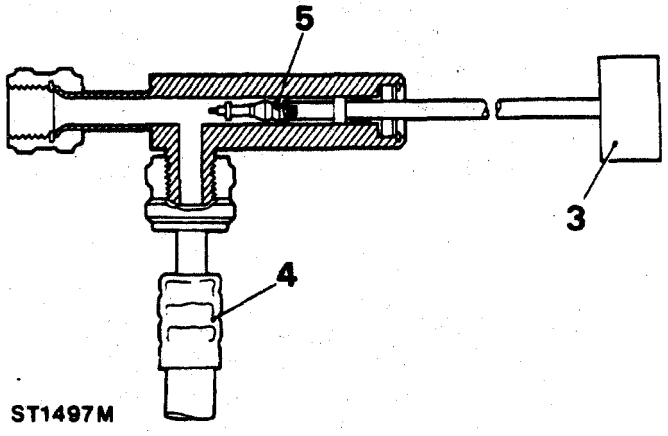
Where Schrader Valve depressors are not fitted to the Testing equipment lines Valve core removers can be used.

Valve Core Removal

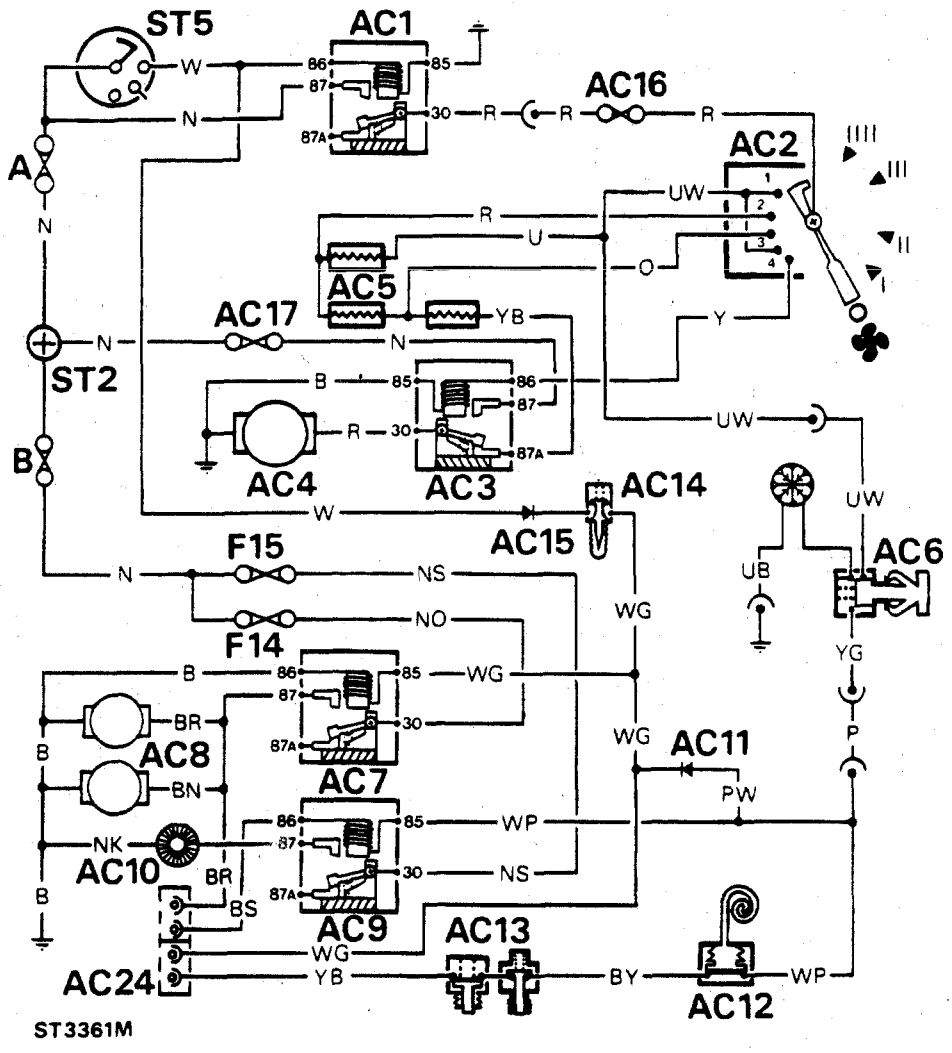
The use of valve core removers will facilitate servicing operations and should be used as follows:

1. Close all valves on the charging trolley.
2. Remove the service valve cap and seals from the valve core remover.
3. Withdraw the plunger as far as possible and connect the core remover to the service valve.
4. Connect the hose to the core remover.
5. Depress the plunger until it contacts the valve core. Unscrew the valve until it is free. Withdraw the plunger to its full extent.

Service valve caps must be replaced when service operations are completed. Failure to replace caps could result in refrigerant loss and system failure.



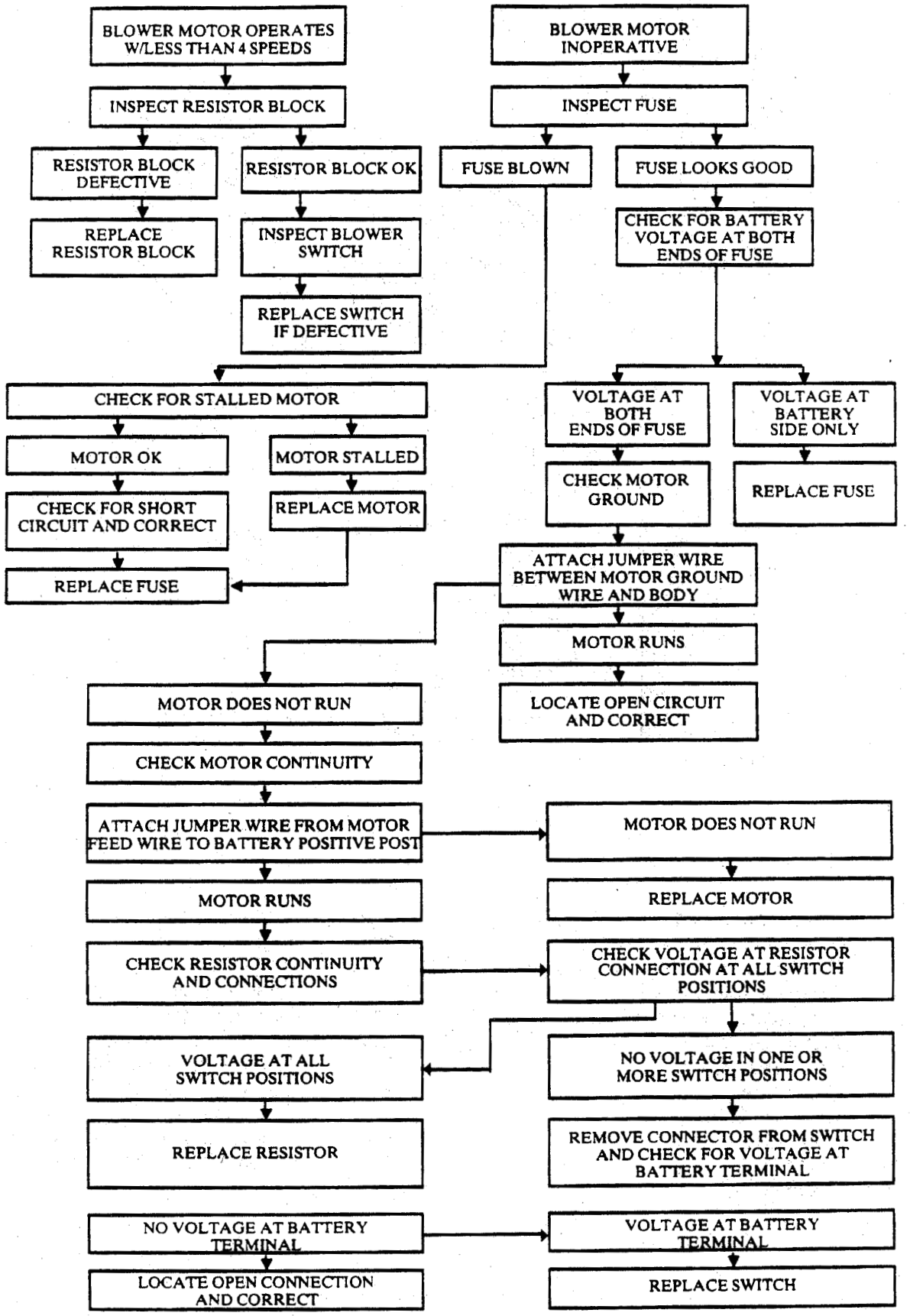
AIR CONDITIONING CIRCUIT DIAGRAM



Key to Circuit Diagram

AC1.	System relay module	AC13.	Refrigerant pressure switches
AC2.	Evaporator/heater fan switch	AC14.	Engine coolant temperature switch
AC3.	Evaporator/heater fan relay module	AC15.	Diode
AC4.	Evaporator/heater fan	AC16.	Fuse in holder - 30 amp
AC5.	Evap/heater fan speed resistor	AC17.	Fuse in holder - 30 amp
AC6.	A/C on/off switch	AC24.	Connectors to MFI ECM
AC7.	Condenser fan relay	ST2.	Terminal post starter solenoid
AC8.	Condenser fans	ST5.	Starter/ignition switch
AC9.	Compressor relay module	B.	60 amp fuse, main fuse box
AC10.	Compressor	F14	20 amp fuse, main fuse box
AC11.	Diode	F15	**5** amp fuse, dash fuse box
AC12.	Thermostat		

AIR CONDITIONING BLOWER MOTOR AND CONTROL SYSTEM DIAGNOSIS



Refrigeration System Fault Diagnosis

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 settng, 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, cab temperature and altitude.

The following conditions should be checked after operating the system for several minutes:

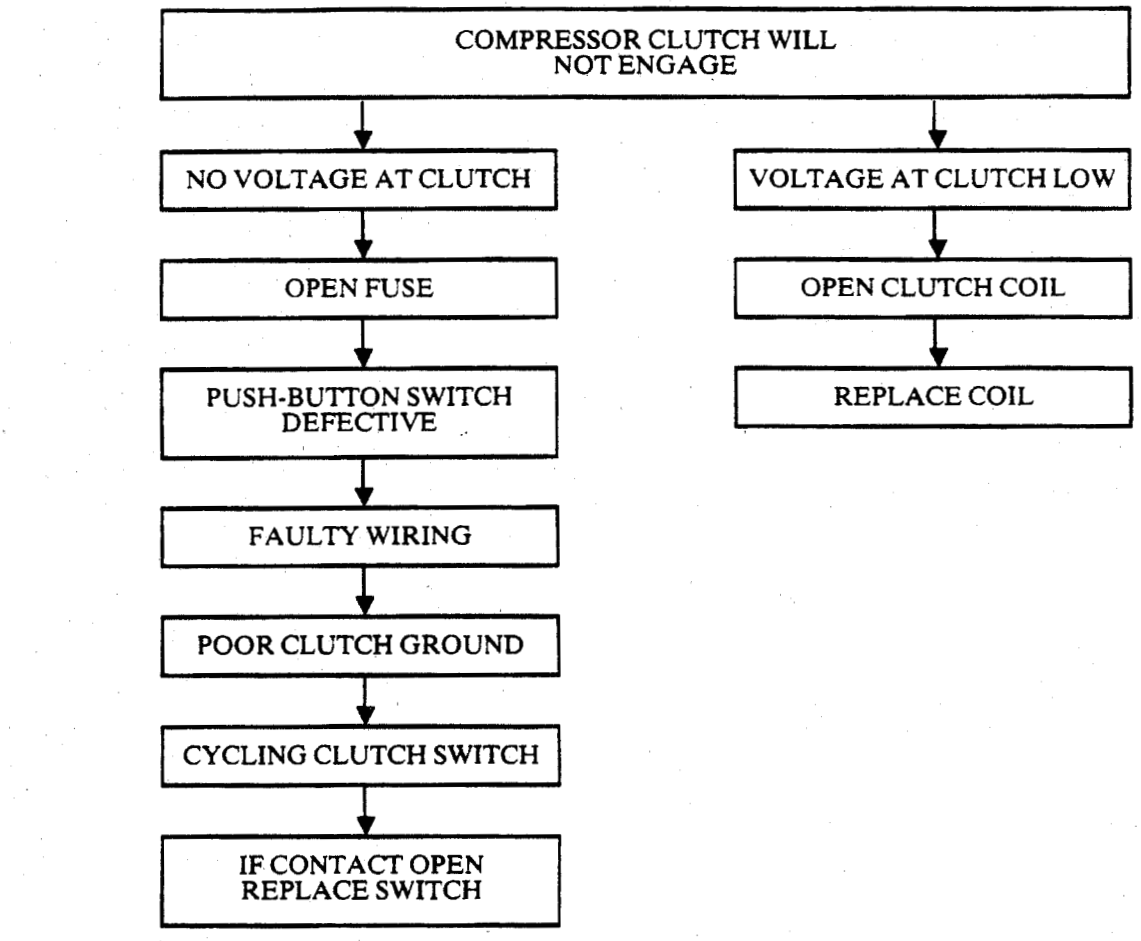
1. All high side lines and components should be warm to the touch.
2. All low side lines should be cool to the touch.
3. Inlet and outlet temperatures at the receiver/drier should be at the same temperature (warm). Any very noticeable temperature difference indicates a blocked receiver/drier.
4. Heavy frost on the inlet to the expansion valve may indicate a defective valve or moisture in the system.
5. With ambient humidity between 30% and 60%, compressor pressures and evaporator air discharge temperature should fall within the general limits given in the table below.

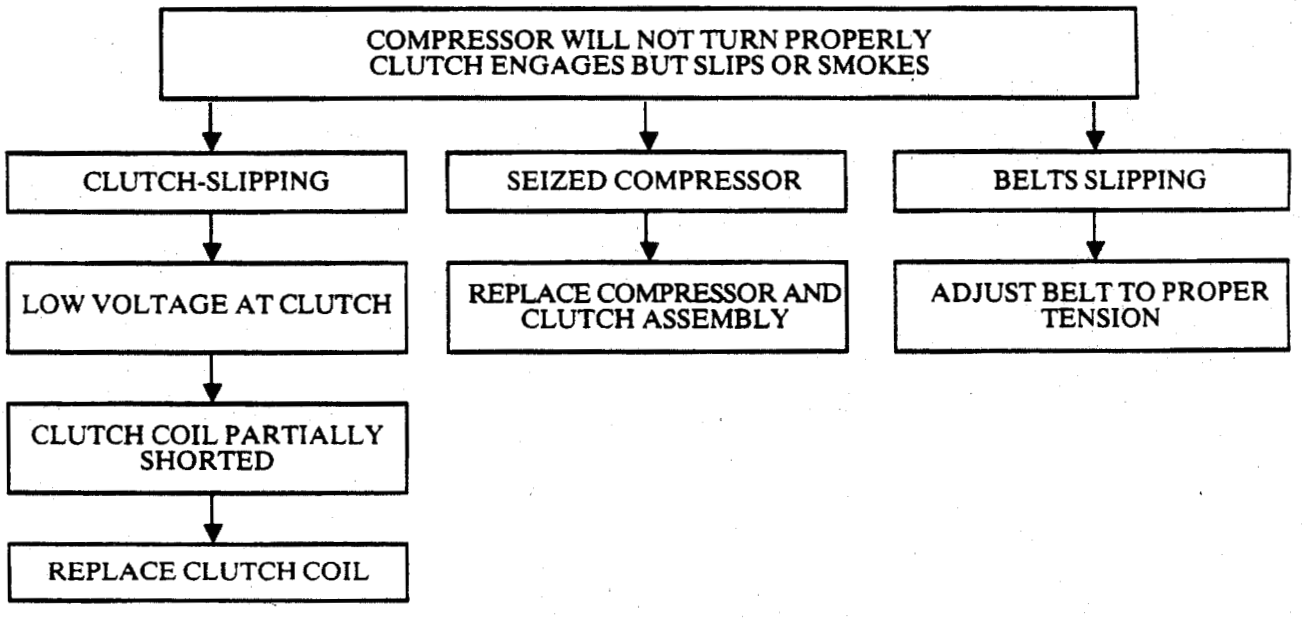
Type of Weather	Evaporator Air Temp °F (°C)	Low Side Pressure Lb/in² (Kg/cm²)	High Side Pressure Lb/in² (Kg/cm²)
Cool Day 70°F - 80°F (21°F - 27°C	35-45°F (1.7-7.2°C)	15-20 1.1-1.4	160-200 11.2-14
Warm Day 80°F - 90°F (27°F - 32°C	40-50F (4.4-10°C)	20-25 (1.4-1.8)	190-240 (13.4-16.9)
Hot Day Over 90°F Over 32°C	45-60°F (7.2-15.6°C)	25-30 (1.8-2.1)	220-270 15.5-19

NOTE
1. Low and high side pressures are guides not specific limits.
2. Evap. air temperatures will be lower on dry days, higher on humid days.

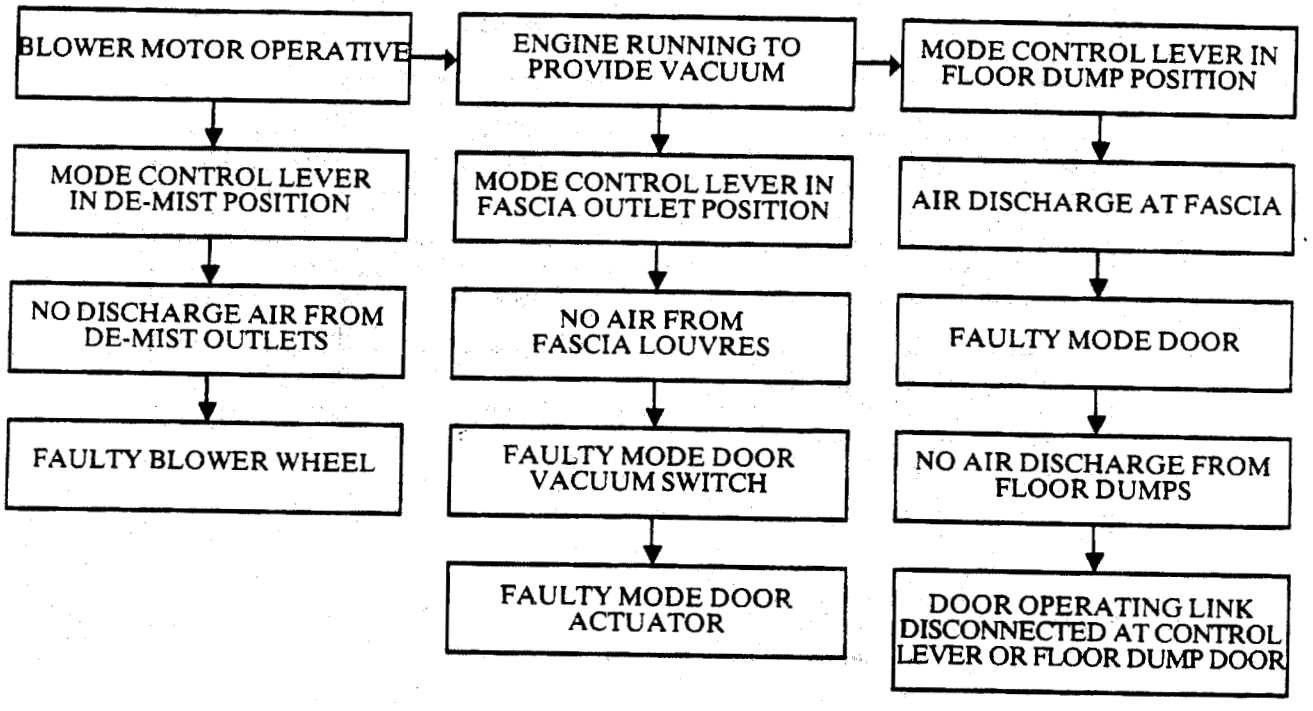
	FAULT	CAUSE	REMEDY
A.	HIGH HEAD PRESSURE	1. Overcharge of refrigerant. 2. Air in system. 3. Condenser air passage clogged with dirt or other foreign matter. 4. Condenser fan motor defective.	1. Purge with bleed hose until bubbles start to appear in sight glass; then, add sufficient refrigerant gas to clear sight glass. 2. Slowly blow charge to atmosphere. Install new drier; evacuate and charge system. 3. Clean condenser of debris. 4. Replace motor.
B.	LOW HEAD PRESSURE	1. Undercharge of refrigerant; evident by bubbles in sight glass while system is operating. 2. Split compressor gasket or leaking valves. 3. Defective compressor.	1. Evacuate and recharge the system. Check for leakage. 2. Replace gasket and install new drier, evacuate, and charge the system. 3. Replace compressor.
C.	HIGH SUCTION PRESSURE	1. Slack compressor belt. 2. Refrigerant flooding through evaporator into suction line; evident by ice on suction line and suction service valve. 3. Expansion valve stuck open. 4. Compressor suction valve strainer restricted. 5. Leaking compressor valves, valve gaskets and/or service valves. 6. Receiver/drier stopped; evident by temperature difference between input and output lines.	1. Adjust belt tension. 2. Check thermobulb. Bulb should be securely clamped to clean horizontal section of copper suction pipe. 3. Replace expansion valve. 4. Replace compressor. 5. Replace valves and/or gaskets. Install new drier, evacuate, and charge the system. 6. Install new drier, evacuate and charge the system.
D.	LOW SUCTION	1. Expansion valve thermobulb not operating. 2. Expansion valve sticking closed. 3. Moisture freezing in expansion valve orifice. Valve outlet tube will frost while inlet hose tube will have little or no frost. System operates 4. Dust, paper scraps, or other debris restricting evaporator blower grille. 5. Defective evaporator blower motor, wiring, or blower switch.	1. Warm thermobulb with hand. Suction should rise rapidly to 20 lbs. or more. If not, replace expansion valve. 2. Check inlet side screen. Clean if clogged. Refer to C-2 and C-3. 3. Install new drier, evacuate and charge the system periodically. 4. Clean grilles as required. 5. Refer to Fault Diagnosis for Electrical System.
E.	NOISY EXPANSION VALVE (steady hissing)	1. Low refrigerant charge; evident by bubbles in sight glass.	1. Leak test. Repair or replace components as required.
F	INSUFFICIENT COOLING	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-2, D-3 and E. 2. Refer to B-1 and E. 3. Refer to B-2 and B-3.
G.	COMPRESSOR BELT	1. Belt tension. 2. Excessive head pressure. 3. Incorrect alignment of pulleys or worn belt not riding properly. 4. Nicked or broken pulley. 5. Frozen compressor.	1. With tension gauge adjust to 100 lbs. (45 kg); tighten until depression of about ½ inch (1,25 cm) occurs across longest span. 2. Refer to A-1 through A-4 and C-6. 3. Repair as needed. 4. Replace pulley. 5. Replace compressor.
H.	ENGINE NOISE AND/OR VIBRATION	1. Loose or missing mounting bolts. 2. Broken mounting bracket, idler bracket, or brace. 3. Loose flywheel or clutch retaining bolt. 4. Rough idler pulley bearing. 5. Bent, loose, or improperly mounted engine drive pulley. 6. Incorrect installation of clutch bearing seal. 7. Insecure mountings of accessories: generator, power steering, air filter, etc. 8. Excessive head pressure. 9. Incorrect compressor oil.	1. Repair as necessary. 2. Replace defective part. 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.

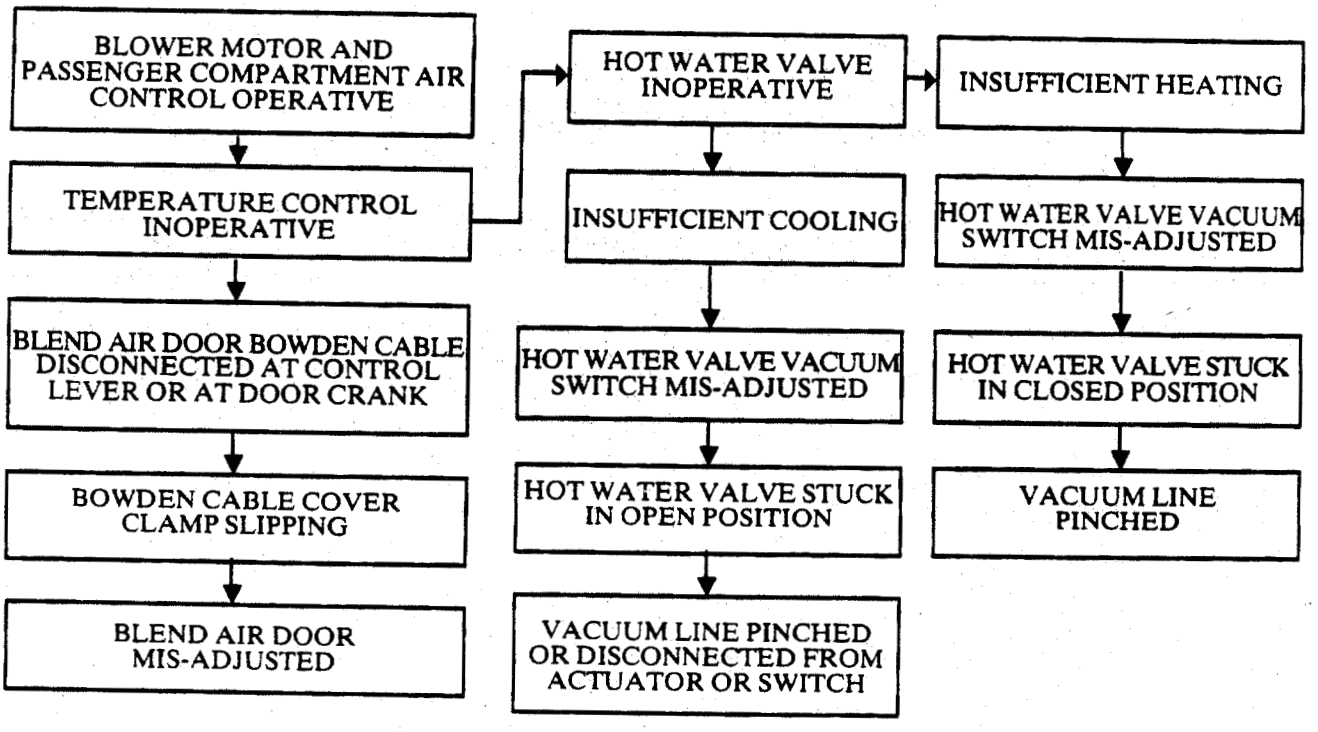
COMPRESSOR CLUTCH DIAGNOSIS





MECHANICAL
AIR CONDITIONER BLOWER MOTOR AND CONTROL SYSTEM DIAGNOSIS





CHARGING AND TESTING EQUIPMENT

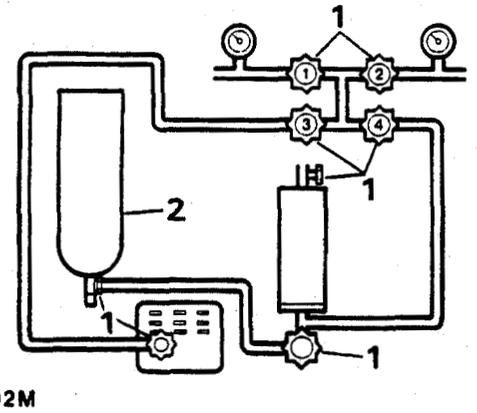
Connecting the gauge set

NOTE: 1: There are two methods of connecting the charging and testing equipment, depending on the operation to be carried out. The method described for 'evacuating or charging with liquid refrigerant' also applies to 'pressure test' and 'compressor oil level check' operations.

NOTE: 2: Various types of charge and test equipment are available depending upon the manufacturer chosen by the user. The equipment illustrated may differ slightly in layout to that possessed by the user, however, it is recommended that the user adheres to the appropriate manufacturer's instructions for the charge and test equipment used in their workshop.

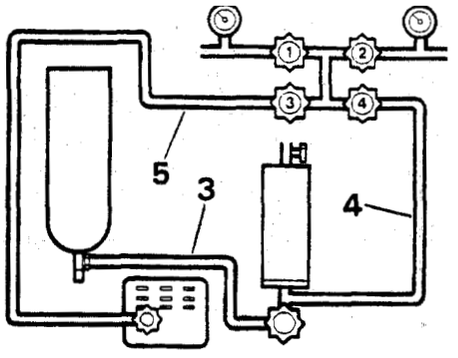
Fitting

1. Ensure that all the valves on the charging and testing equipment are closed. Control valves on the particular equipment selected are numbered 1 to 4 as illustrated. The sequence may vary on other proprietary equipment.
2. Mount a 11,3 kg drum of refrigerant upside down on the support at the rear of the charging equipment, and secure with the strap.



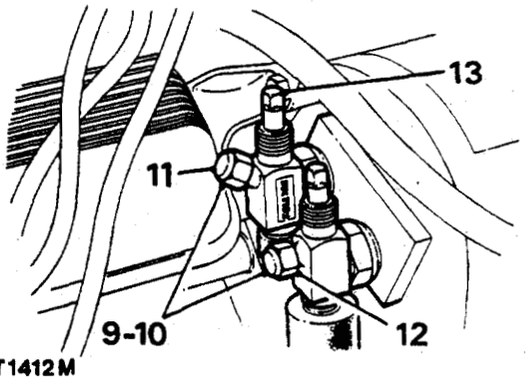
ST 1392M

3. Connect the hose from the bottom of the 'charging cylinder to the refrigerant drum valve.
4. Connect the hose between the bottom of the charging cylinder and the refrigerant control valve (No. 4).
5. Connect the hose between the vacuum pump valve and the vacuum control valve (No.3).



ST 1393M

6. Place the vehicle in a ventilated area away from open flames and heat sources. Stop the engine, open and secure the bonnet.
7. Check that both service valves are fully open (turned anti-clockwise).
8. Put on the safety goggles.
9. Remove the caps from the gauge connections on the service ports.
10. Coat the threads and flares with refrigerant oil.
11. Connect the low pressure charging line (blue) from valve No. 1 to the compressor suction service port.
12. Connect the high pressure charging line (red) from valve No. 2 to the compressor discharge service port.
13. Using the service wrench, turn the suction service valve stem 'clockwise' counting the number of turns necessary to close the valve.



ST1412M

14. After the valve is fully closed, turn the stem out (anti-clockwise) half the number of turns counted, this should position the valve seat in the mid {test) position.

15. Turn the stem on the discharge valve clockwise until the pressure rises on the discharge pressure gauge, If the system is to be evacuated, the discharge service valve seat must be in the mid (test) position.
16. The charging and testing equipment is now connected and ready for proceeding with the required operation.

Removing

17. If the engine has been operated, it must be stopped prior to disconnecting the charging and testing equipment.
18. Close both service ports (turn fully anti-clockwise) until fully closed.
19. Close all valves on the charging and testing equipment.
20. Disconnect the charging lines from the service ports.
21. Refit the blanking caps to the compressor valve stems and service ports, and to the charging lines.
22. Close the bonnet.

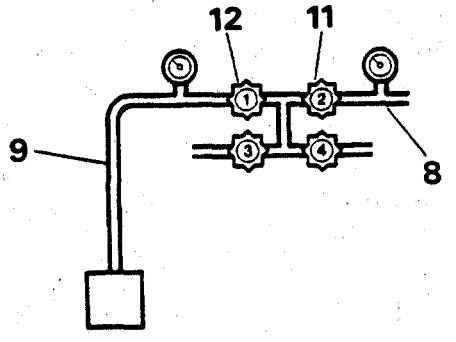
AIR CONDITIONING SYSTEM OPERATIONS

Depressurising

NOTE: The air conditioning refrigeration system contains 'Refrigerant 12' under pressure, and before any component is disconnected or removed, the system must be discharged of all pressure.
Refrigerant 12 evaporates so rapidly at normal atmospheric pressures and temperatures that it tends to freeze anything it contacts. Extreme care must be taken to prevent any liquid refrigerant from contacting the skin and especially the eyes. Should any liquid refrigerant get into the eyes, use a few drops of sterile mineral oil to wash them out and then wash the eyes with a weak solution of boric acid. Seek medical attention immediately even though the initial irritation has ceased after first aid treatment. Always wear safety goggles when opening refrigerant connections.

WARNING: Open connections slowly, keeping the 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.

1. Place the vehicle in a ventilated area away from open flames and heat sources.
2. Stop the engine.
3. Open and secure the bonnet.
4. Remove the caps from the compressor service ports.
5. Check that both compressor service valves are fully opened (turned anti-clockwise).
6. Close all valves on the charging and testing equipment.
7. Put on safety goggles.
8. Connect the high pressure charging line (red) from valve No. 2 to the compressor discharge service port.
9. Run the (blue) hose to an open tapped container of approximately one litre capacity. Attach the hose to the container so that it will not blow out of the container. The purpose of the container is to collect any oil carried by the refrigerant.
10. Open the compressor discharge service port a quarter of a turn.
11. Open valve No. 2 fully.
12. Slowly open the valve No. 1 one turn to allow the refrigerant to escape, if necessary, adjust the refrigerant flow so that the oil captured in the container is not blown out of the container.

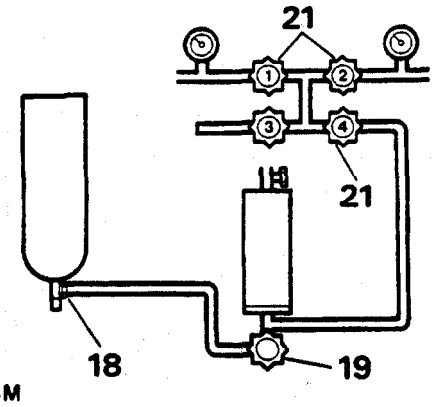


ST 1413M

13. Measure the amount of oil discharged from the system so that an equal amount of new oil can be returned to the system during the charging operation. Discard the old oil.
14. When the gauge pressure is below 50 psi, slowly open the valve No. 1 to maintain refrigerant flow.
15. When the pressure has been reduced, and the system has been completely discharged, close the valves Nos. 1 and 2 on the charging and testing equipment.
16. Close the compressor discharge service port (turn anti-clockwise).
17. Disconnect the high pressure charging line from the compressor service port.

NOTE: If it is necessary to disconnect the compressor hoses, the compressor should be sealed by fully closing the relevant service valve (turn fully clockwise). It is essential to ensure that both service valves are open before operating the compressor. Similarly any other component of the refrigeration system should be capped immediately when disconnected.

18. Open the refrigeration drum valve.
19. Open the valve at the base of the charging cylinder and allow approximately 0,25 kg of refrigerant to enter the cylinder.
20. Close the refrigeration drum valve and the valve at the base of the charging cylinder.
21. Open the refrigerant control valve (valve No. 4) and flush out the high and low pressure lines by opening valves Nos. 1 and 2 momentarily until a white stream of refrigerant is observed.



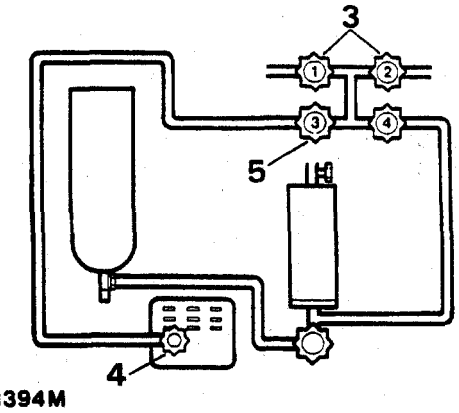
ST 1414M

22. Close all valves on the charging and testing equipment, and fit the blanking caps.
23. The air conditioning system is now depressurised.

Evacuating

Whenever the system has been opened to the atmosphere it is necessary that the system be evacuated to remove all air and moisture. It is also an essential preliminary operation to charging the system with Refrigerant 12. The evacuate operation also provides a check for leaks due to faulty connections.

1. Depressurise the air conditioning system as previously described, then connect the gauge set as detailed under 'Charging and Testing Equipment'.
2. Adjust both service valve seats to the mid (Test) position.
3. Open the low and high pressure valves Nos. 1 and 2.
4. Start the vacuum pump and check that the vacuum pump valve is open.
5. Slowly open the vacuum control valve No. 3. If the vacuum is applied to the system too quickly, the residual oil may be drawn out.

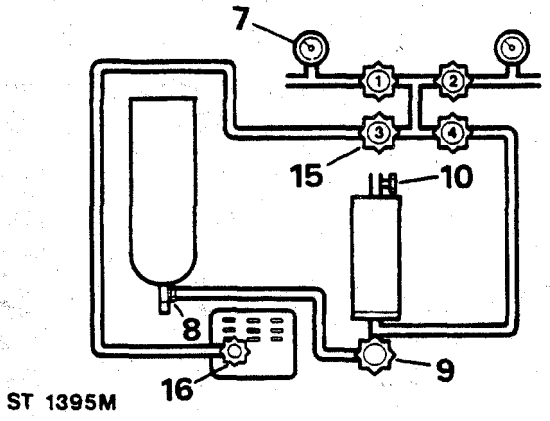


ST 1394M

6. In evacuating the system it is necessary to lower the pressure so that the boiling point of water in the system is lower than the surrounding air temperature. At an ambient temperature of 23.8°C (75°F), it is necessary to lower the system pressure to 29.5 in Hg vacuum to bring the boiling point of water to 22°C (72°F). Atmospheric pressure (and vacuum gauge readings) decrease as altitude increases by approximately 25 mm Hg per 300 m. The following chart provides a guide to the various gauge readings at differing altitudes, for the same 10 mm Hg absolute pressure.

Altitude, ft	m	Vacuum Reading in Hg	mm
0	0	29.5	750
1,000	300	28.5	725
2,000	600	27.4	695
3,000	900	26.4	670
4,000	1200	25.4	645
5,000	1500	24.5	622
6,000	1800	23.5	596
7,000	2100	22.6	574
8,000	2400	21.8	554
9,000	**2700**	20.9	**530**
10,000	3000	20.1	510

7. The low side gauge should indicate a vacuum of 660 mm Hg within five minutes.
8. Whilst the system is evacuating, fill the charging cylinder by opening the refrigerant drum valve.
9. Open the valve at the base of the charging cylinder and fill the cylinder with 10 kg of refrigerant. Liquid refrigerant will be observed rising in the sight glass.
10. As the refrigerant stops filling the cylinder, open the valve at the top of the cylinder (behind the control panel) intermittently, to relieve the head pressure and allow the refrigerant to continue filling the cylinder.
11. When the refrigerant reaches the desired level in the sight glass, close both the valve at the base of the cylinder and the valve at the bottom of the refrigerant tank.
12. Ensure the top cylinder valve is fully closed. If bubbling is present in the sight glass, reopen the cylinder base valve momentarily to equalise the drum and cylinder pressures.
13. If 660 mm Hg of vacuum is not achieved within five minutes, it signifies either the system has a leak or the vacuum pump is defective. Initially check the vacuum pump, if the pump proves to be functioning properly then investigate for a leak in the air conditioning system.
14. Close the vacuum control valve No. 3.
15. Stop the vacuum pump and allow the vacuum to hold for fifteen minutes, then check that there is no pressure rise (a loss of vacuum) evident on the compound gauge. Any pressure rise denotes a leak which must be rectified before proceeding further. Refer to the heading titled 'Leak Detection' later in this section.
16. With the system satisfactorily evacuated, the system is ready for charging with refrigerant.

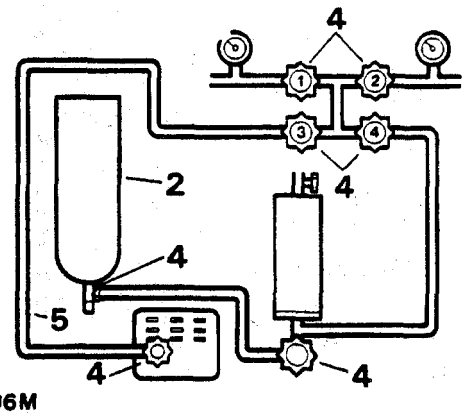


ST 1395M

Sweeping

NOTE: This operation is in addition to evacuating, and is to remove moisture from systems that have been open to atmosphere for a long period, or that are known to contain excessive moisture.

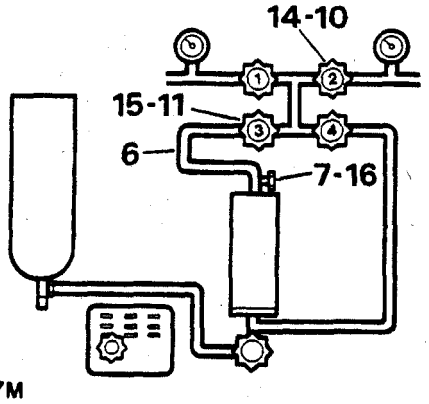
1. Fit a new liquid receiver/drier, as detailed under the heading "Receiver/Drier".
2. Ensure that a full drum of refrigerant is fitted on the charging and testing equipment.
3. Fit the charging and testing equipment as previously described for evacuating and evacuate the air conditioning system, allowing 0,25 to 0,45 kg of refrigerant to enter the charging cylinder.
4. Close all valves on the charging and testing equipment.
5. Disconnect the intake hose from the vacuum pump.



ST 1396M

6. Connect the intake hose to the valve at the top of the charging cylinder.
7. Open the valve at the top of the charging cylinder.
8. Put on safety goggles.
9. Crack open the hose connection at valve No. 3 and allow some refrigerant to purge the hose, then close the connection.
10. Open the high pressure valve (No.2).
11. Slowly open valve No. 3, which is now connected to the top valve of the charging cylinder, and allow gas to flow into the system until the reading on the compound gauge remains steady, Between 0,25 and 0,45 kg of refrigerant will enter the system.
12. Allow the dry refrigerant introduced into the system to remain for 10 minutes.

13. Crack the suction valve charging line at the service port on the compressor to allow an escape of refrigerant, at the same time observing the sight glass in the charging cylinder, A slight drop in the level should be allowed before closing the connection at the compressor.
14. Close the high pressure valve (No.2).
15. Close valve No.3.
16. Close the valve at the top of the charging cylinder.



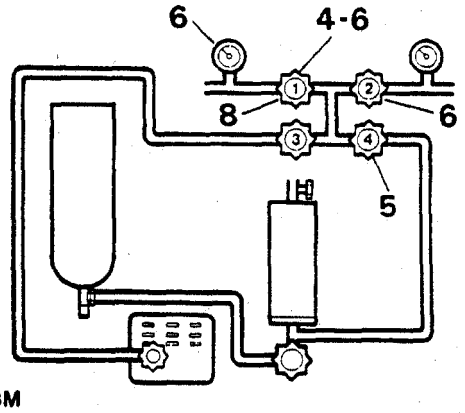
ST 1397M

17. Reconnect the charging and testing equipment, as described for evacuating and evacuate the air conditioning system.
18. Maintain the vacuum for twenty minutes. The air conditioning system is now ready for charging with refrigerant.

Charging

CAUTION: Do not charge liquid refrigerant into the compressor. Liquid cannot be compressed; and if liquid refrigerant enters the compressor inlet valve, severe damage is possible; in addition, the oil charge may be absorbed into the refrigerant, causing damage when the compressor is operated.

1. Fit the charging and testing equipment as previously described for evacuating.
2. Evacuate the air conditioning system allowing 1,09 kg of refrigerant to enter the charging cylinder.
3. Put on safety goggles.
4. Close the low pressure valve (No.1).
5. Open the refrigerant control valve (No. 4) and release liquid refrigerant into the system through the compressor discharge valve port (High pressure). The pressure in the system will eventually balance.
6. If the full charge of 1,09 kg of liquid refrigerant will not enter the system, then close the high pressure valve (No.2) and open the low pressure valve No.1), ensuring that the low pressure gauge does not exceed 18.14 kgf².
7. Start and run the engine at 1,000-1,500 rev/min and allow refrigerant to be drawn though the low pressure valve (No. 1) until the full charge has been drawn into the system.
8. Close valve No.1.



ST 1398M

9. Check the air conditioning system is operating satisfactorily by carrying out a pressure test, as described later in the Section

CAUTION: Do not overcharge the air conditioning system as this will cause excessive head pressure.

Leak test

The following instructions refer to an electronic type refrigerant leak detector which is the safest, most sensitive and widely used.

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. Certain detectors have visual and audible indicators.
3. Commence searching for leaks by passing the detector probe around all joints and components, particularly on the underside, as the refrigerant gas is heavier than air.
4. Insert the probe into an air outlet of the evaporator. 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 connections.
8. If any leaks are found, the system must be depressurised before attempting rectification. If repairs by brazing are necessary, the component must be removed from the vehicle and all traces of refrigerant expelled before heat is applied.
9. After repairs check the system for leaks and evacuate prior to charging.

Pressure test

1. Fit the charging and test equipment as previously described.
2. Start the engine.
3. Run the engine at 1,000 to 1,200 rev/min with the heat control set to cold (blue) zone, air distribution to the central position, recirculation control to recirculation and the air conditioning control 'ON' with fan speed to maximum.
4. Note the ambient air temperature control in the immediate test area in front of the vehicle, and check the high pressure gauge readings - discharge side - against table 1.

Table 1

Ambient Temperature		Compound Gauge Readings		High Pressure Gauge Readings	
°C	°F	kgf/cm²	lbf/in²	kgf/cm²	lbf/in²
16	60	1,05-1,4	15-20	7,0-10,2	100-150
26,7	80	1,4-1,75	20-25	9,8-13,3	140-190
38	100	1,75-2,1	25-30	11,6-15,8	180-225
43,5	110	2,1-2,45	30-35	15,1-17,5	215-250

The pressure gauge readings will vary within the range quoted with the rate of flow of air over the condenser, the higher readings resulting from a low air flow. It is recommended that a fan is used for additional air flow over the condenser if the system is to be operated for a long time. Always use a fan if temperatures are over 26.7°C (80°F) so that a consistent analysis can be made of readings.

5. If the pressure readings are outside the limits quoted, refer to the fault diagnosis chart at the beginning of this section.
6. Stop the engine.
7. Close both service ports (turn fully anti-clockwise) and close all valves on the charging and test equipment. Disconnect the charging lines from the compressor. Refit the blanking caps to the compressor valve stems, port connections and charging lines.
8. Close the bonnet.

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 drains 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 rectify as necessary.

NOTE: The compressor oil is soluble in Refrigerant 12 and is deposited when the refrigerant evaporates from a leak.

7. Start the engine.
8. Set the temperature control switch to maximum cooling 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 1,000 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 1,800 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 and evaporator fins.
13. Check the high pressure pipes 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, proceed with the pressure test as previously described in this section.

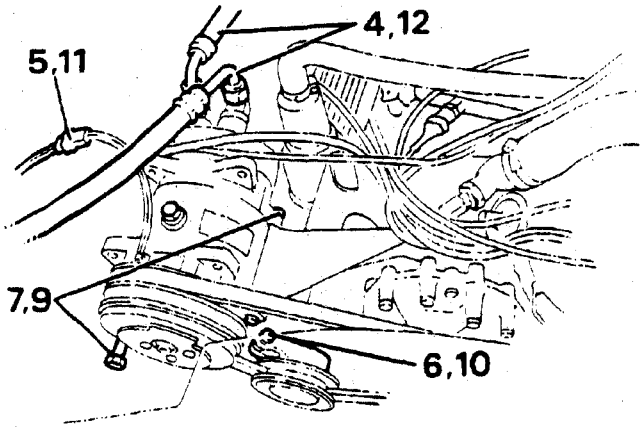
COMPRESSOR

Remove

1. Site vehicle in a ventilated area.
2. Disconnect the battery negative lead.
3. Discharge the air conditioning system, see Discharging system

WARNING: Wear eye and hand protection when disconnecting components containing refrigerant. Plug all exposed connections immediately.

4. Disconnect suction and discharge unions from compressor.
5. Disconnect electrical lead to compressor clutch.
6. Slacken idler pulley and release drive belt.
7. Remove the two compressor mounting bolts and lift compressor clear.



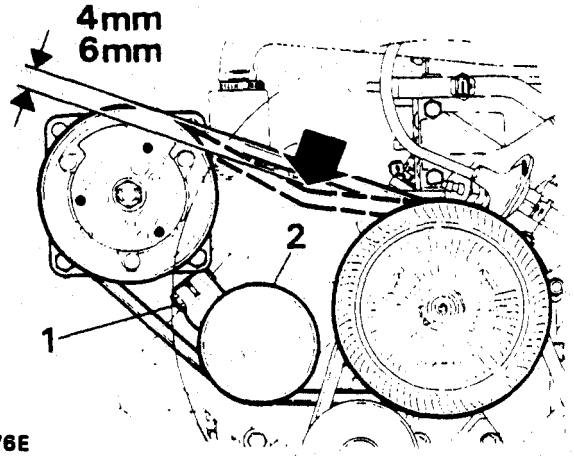
Refit

8. If a new compressor is being fitted, drain oil from new compressor. Drain and measure oil from old compressor. Add 30 ml of new oil to this amount and refill new compressor.
9. Locate compressor in position, fit and tighten mounting bolts.
10. Fit compressor drive belt, see Adjustment, Compressor drive belt
11. Connect electrical lead to compressor clutch at the connector.
12. Evacuate air conditioning system. See Evacuate system.
13. Charge air conditioning system. See Charging system.

COMPRESSOR DRIVE BELT

Adjust

1. Slacken idler pulley securing bolt.

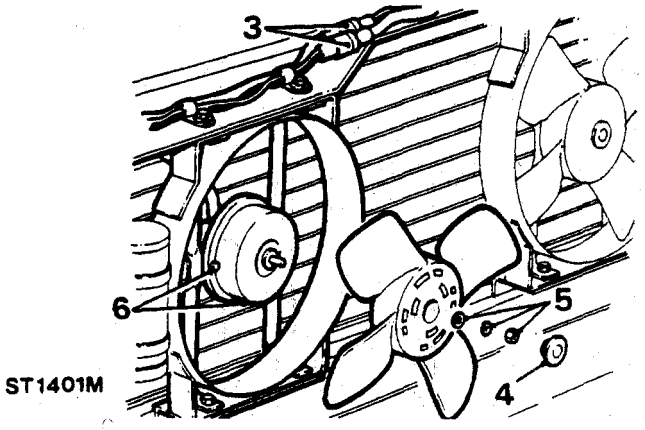


2. Adjust positron of idler pulley until correct tension is obtained. The belt must be tight with 4 to 6 mm total deflection when checked by hand midway between pulleys on the longest run.
3. Tighten securing bolt and recheck tension.

CONDENSER FAN MOTORS

Removal

1. Open and secure the bonnet.
2. Release the six self tapping screws securing the front nose and grille assembly, lift clear.
3. Disconnect the electrical leads to the fans.
4. Remove the blanking caps from the fan centres.
5. Remove the 8 mm securing nuts, star and spring washers from the fan blade centres, pull blade from its respective fan motor shaft.
6. Release the two fan motor retaining bolts and remove the motor whilst feeding the fan motor through the appropriate aperture.



7. Reverse procedures 1 to 6 ensuring the fan supply wiring is routed and securely clipped so that the wiring does not foul the fan blades

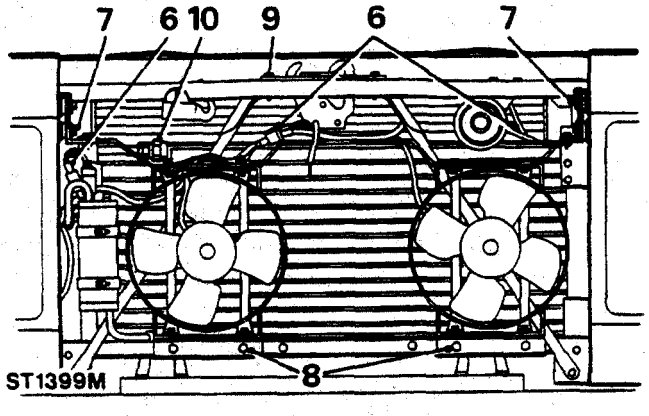
CONDENSER AND RECEIVER/DRIER

Removal

1. Place the vehicle in a well ventilated area.
2. Stop the engine, open and secure the bonnet.
3. Remove the caps from the compressor service valves. Connect the gauge set for evacuation, and evacuate as detailed earlier.
4. Having evacuated the air conditioning system, open fully (turn anti-clockwise) the compressor service valves and disconnect the gauge set. Replace all caps to valve connections.
5. Release the four top and two side fixings securing the grille and nose assembly and remove.
6. Disconnect the wires at the rear of the horn, the air conditioning fan leads located across the top of the fan cowling frame and the electrical connector to the receiver/drier.
7. Release the four bolts and large packing washers securing the cowling to the wing sides.
8. Remove the four nuts securing the fan cowling to the bottom bracket and lift clear.
9. Remove the two bolts securing the bonnet striker support plate.

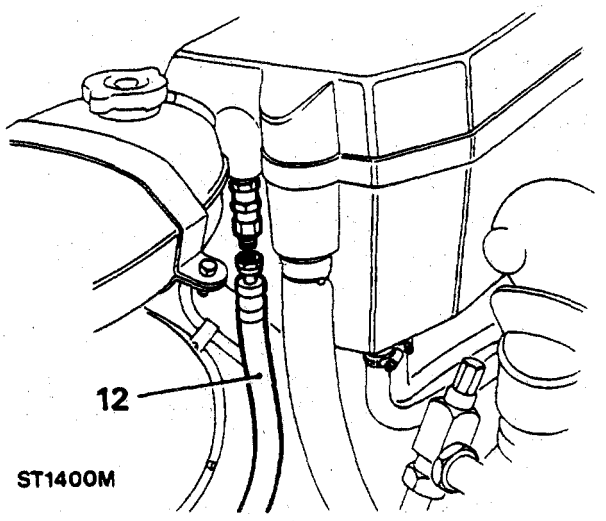
Condenser removal only

10. Release the top air conditioning hose and cap the ends to prevent moisture and dirt entering the system.

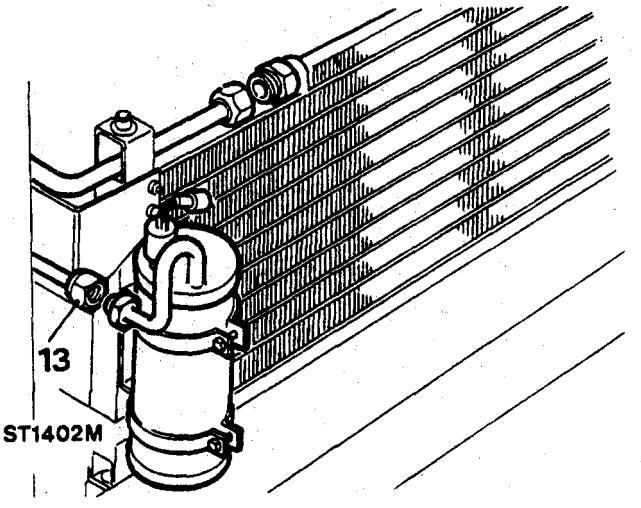


11. Lift the condenser from the bottom mounting lugs and carefully ease the condenser forwards as far as possible.

12. Release the high pressure air conditioning hose complete with the sight glass, at the evaporator connection. Cap the ends to prevent dirt or moisture entering the system.



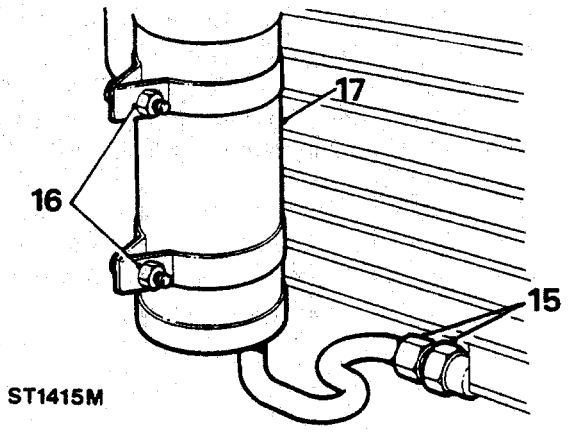
13. Release the high pressure pipe from the receiver/drier, cap the pipe end connections.



14. Release both air conditioning pipes from the condenser extension plate. Lift the condenser clear.

Receiver/drier removal

15. Whilst supporting with suitable spanners, unscrew the bottom union to the receiver/drier. Cap the pipe ends to prevent dirt or moisture entering the system.
16. Release the receiver/drier clamp bolts and allow me assembly to drop clear of the condenser.
17. Lift the receiver/drier from the condenser and discard. It is NOT recommended to refit the old unit.



Refitting

18. Reverse procedures 15 to 17 using a new receiver/drier unit.
19. Connect the high pressure pipe to the receiver/drier. Using two spanners on each union, tighten the union noting that the sight glass remains in the vertical position.
20. Carefully locate the condenser into position, refit the fixings securing the condenser to the extension plate.
21. Connect and tighten the air conditioning hose to the top of the condenser. Use two spanners on each union.
22. Refit the condenser to the bottom bracket.
23. Place the bonnet striker support plate into position, do not secure at this stage.
24. Fit the fan cowling support brackets. It will be necessary to lift the bonnet 'striker support plate to permit the positioning of the fan cowling assembly to the condenser mounting lugs.
25. Secure the steady rods and the lower condenser mounting bracket. Do not tighten the bolts at this stage. Reconnect the top horn electrical leads.
26. Loosely fit the four bolts and distance washers which support the bonnet striker support plate and fan cowling to the wing sides.
27. Tighten the lower condenser bracket bolts.
28. Adjust the condenser position with the bonnet striker support bracket assembly to obtain an equal distance. from the radiator. Tighten the four side mounting bolts.
29. Tighten the four nuts and washers which secure the fan cowling mounting.
30. Reconnect the electrical wiring for the fan assemblies, horn and receiver/drier.
31. Recheck the security of all fixings.
32. Refit the front nose and grille assembly and secure.
33. Evacuate, sweep and charge the air conditioning system as previously described.

EVAPORATOR

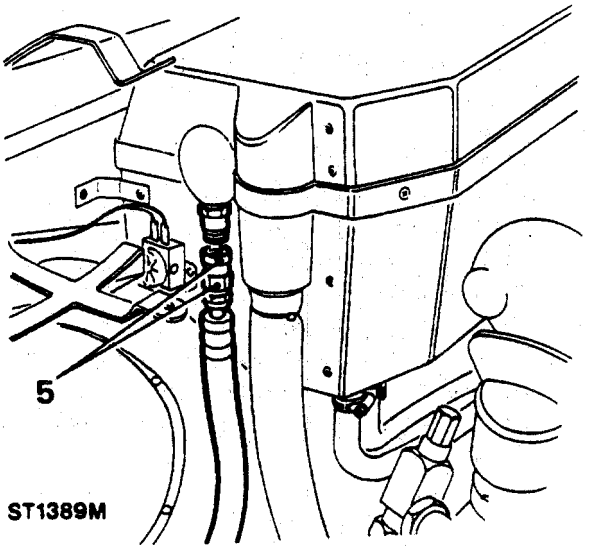
NOTE: It is only necessary to evacuate the air conditioning system when removing the evaporator matrix or to change the expansion valve.

Removal

1. Place the vehicle in a ventilated area away from open flames and heat sources.
2. Stop the engine and secure the bonnet in an open position.

Heater matrix and blower motor only

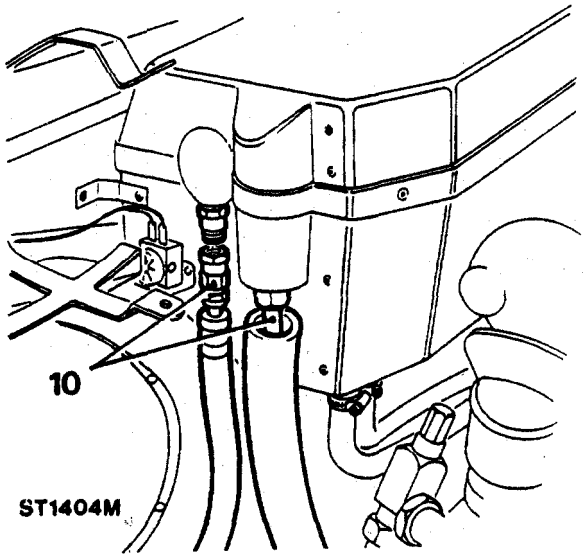
3. Remove the caps from the compressor service valves and close (turn clockwise) fully.
4. Disconnect the low pressure valve from the compressor and cap both ends to prevent dirt or moisture entering the system.
5. Using two suitable spanners remove the high pressure pipe from the evaporator side. Cap both ends to prevent dirt or moisture entering the system.



Evaporator matrix and expansion valve only

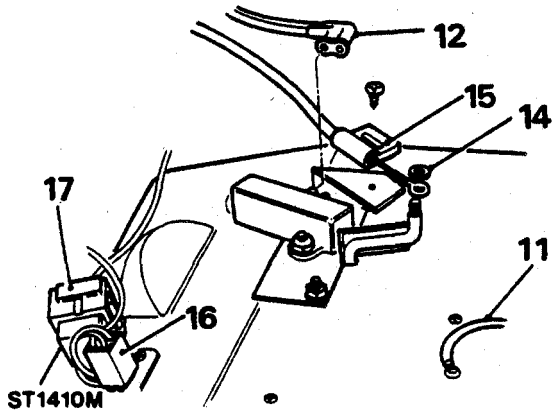
6. Remove the caps from the compressor service valves and connect the gauge set for evacuating.
7. Evacuate the air conditioning system as previously described.
8. Open the compressor service valves and disconnect the gauge set. Cap all pipes and gauge connections to prevent dirt or moisture entering the system.
9. Release the fixings and remove the expansion tank to provide access to the air conditioning high and low pressure pipes.

10, Whilst supporting both unions with suitable spanners unscrew the high and low pressure air conditioning pipes to the evaporator. Cap the pipe ends and evaporator inlets to prevent dirt or moisture entering the system.

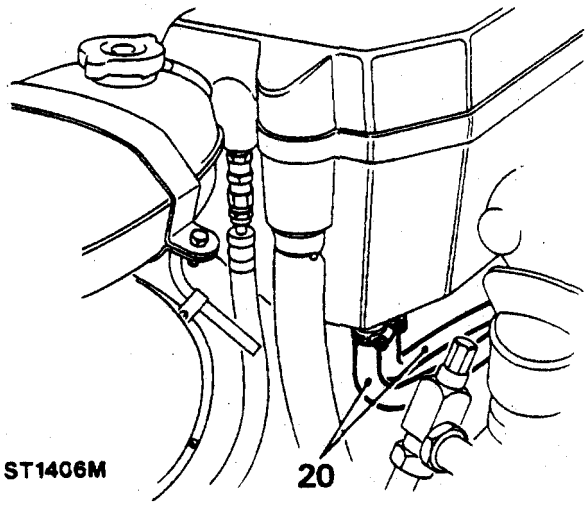


Evaporator unit

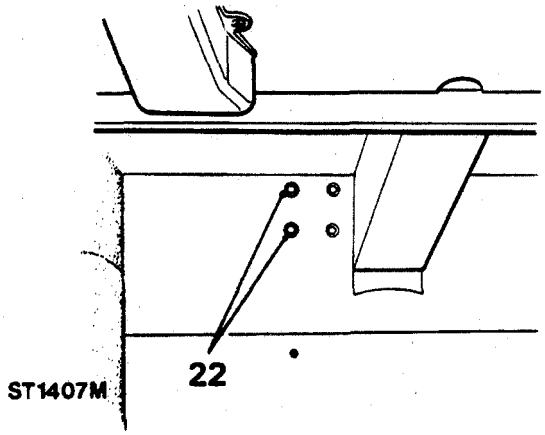
11. Disconnect the electrical leads feeding the compressor clutch cycling switch.
12. Detach the vacuum pipes from the water valve switch.
13. Remove the fixings securing the water valve switch and withdraw it.
14. Remove the clip and cable connection from the evaporator heater Rap rod. Use a new clip on reassembly.
15. Release the nylon cable retainer.
16. Detach the resistor block electrical connector.
17. Remove the relay module from its socket and remove the self tapping screw to release the socket.



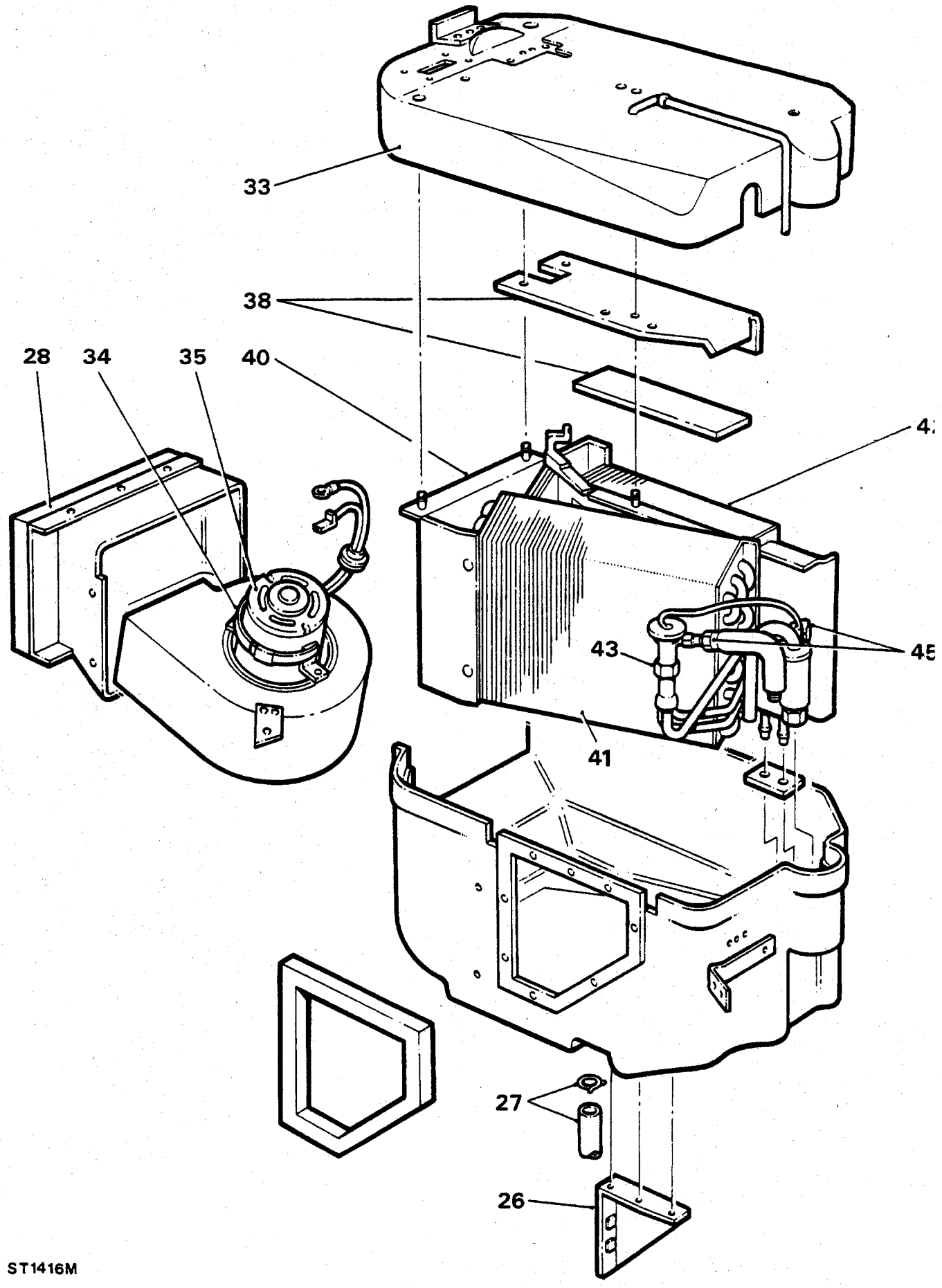
18. Remove the screw securing the fuse holder, then refit both screws to retain the resistor block in the evaporator case.
19. All wiring on the top of the evaporator is now disconnected with the exception of the ground lead, this is disconnected when the evaporator top fixings are removed.
20. Using suitable pipe clamps, clamp the inlet and outlet coolant pipes at the base of the evaporator and release the two jubilee clips and detach, or drain the radiator.



21. From inside the vehicle remove the front passenger carpet and self tapping screws which retain the toe-board. Remove the toe-board.
22. Release the two bolts.



23. From inside the engine compartment remove the two bolts from behind the relay module securing the evaporator to the bulkhead. This also releases the ground leads.
24. Remove the bolt securing the front of the evaporator casing.
25. Lift the evaporator clear of the vehicle and place on a bench with a suitable support underneath the case to ensure the heater pipes are not damaged.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ST1416M

26. Release the nuts and remove the bracket from underneath the evaporator casing.
27. Remove the wire clip and detach the dump valve located underneath.
28. Release the seven self tapping screws securing the outlet duct and carefully break the sealing compound around the edge of the duct and pull ducting plate away from evaporator body.
29. Remove the fifteen screws located around the cover seam. Remove the old sealing compound from the body and top cover.
30. Remove the four screws and four nuts from the top of the cover.
31. From the front of the unit remove the two screws adjacent to the low pressure pipe moulding.
32. At the side of the unit remove the two screws adjacent to the air intake aperture.
33. Lift the top cover off whilst feeding the blower motor wiring and air control flap rod through their respective apertures, thus exposing the blower motor, heater matrix and air conditioning evaporator matrix.

Blower motor unit removal only

34. Remove the screws retaining the motor unit to the casing.
35. Release the three bracket retaining screws and withdraw motor and impeller.
36. Detach the star washer. spring clip and impeller.
37. Remove the two nuts from the motor shroud and lift clear.

Heater/Evaporator matrices removal only

38. Lift the support plate and insulation pad from the matrix.
39. From the bottom of the casing, remove the three screws adjacent to the dump valve outlet, in addition to the screws next to the heater pipes.
40. Lift the evaporator and heater matrices together with the supporting frame containing the air direction flap clear of the casing.
41. Detach the evaporator matrix by releasing the four screws, two at both ends of the support bracket.
42. Detach the heater matrix by removing the self-tapping screw.

Expansion valve removal

43. Support the suction pipe union with suitable spanners and release.
44. Remove the bleed pipe retaining nut from the suction pipe.
45. Remove the spring clip retaining the expansion valve sensor pipe to the main suction pipe which now releases the expansion valve and high pressure pipe Place valve on bench and unscrew the high pressure pipe from the expansion valve.
46. Seal and cap all apertures; discard all 'O' rings which are renewed on assembly.

Refitting

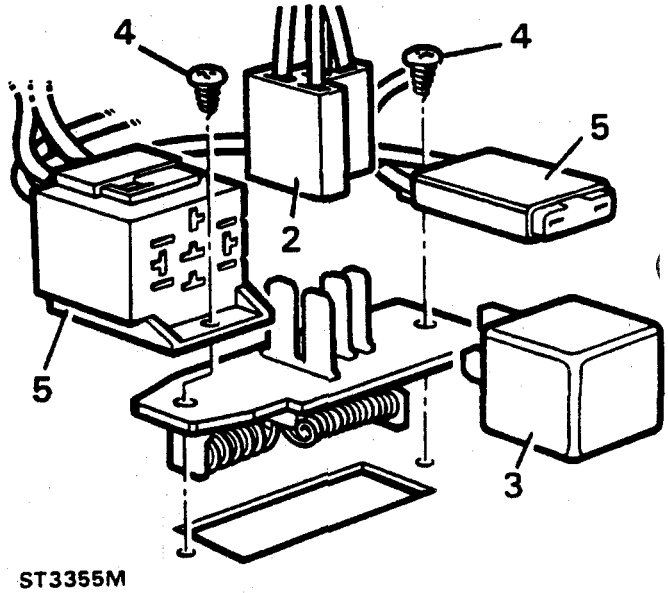
47. Reverse procedures 11 to 46 noting that all threads, unions, 'O' rings are coated with refrigerant oil prior to fitting.

NOTE: Depending upon which unit has been refitted reverse the appropriate procedures:
Heater Matrix or Blower Motor **3** to 5
Evaporator Matrix or Expansion Valve 6 to 10
and then charge the air conditioning system as previously described with Refrigerant 12.

RESISTOR BLOCK

Removal

1. Disconnect the battery.
2. Detach the electrical connector from the. resistor block.
3. Withdraw the relay module from it's socket.
4. Remove the screws securing relay module socket, fuse holder and resistor block.
5. Move fuse holder and relay module socket aside and lift resistor block clear of the evaporator.



ST3355M

Refitting

6. To refit the resistor block, reverse the removal procedure.

ELECTRICAL PRECAUTIONS

The following guidelines are intended to ensure the safety of the operator whilst preventing damage to electrical and any electronic components fitted to the vehicle.
Before commencing any test procedure on a vehicle ensure that the test equipment is working correctly and any harness or connectors are in good condition, this particularly applies to mains leads and plugs.

WARNING: Before commencing work on an ignition system, all high tension terminals, adaptors and diagnostic equipment for **testing should be inspected to ensure that they are adequately insulated and shielded to prevent accidental personal contacts and minimize the risk of shock. Wearers** of **surgically implanted pacemaker devices should not be in close proximity to ignition circuits or diagnostic equipment.**

Polarity

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

High voltage circuits

Whenever disconnecting live high tension circuits always use insulated pliers and never allow the open end of a high tension lead to come into contact with other components particularly electronic control units. Exercise caution when measuring the voltage on the coil terminals while the engine is running, since, high voltage spikes can occur on these terminals.

Connectors and harness

Always ensure that these items are dry and oil free before disconnecting and connecting test equipment. Never force connectors apart either by using tools or by pulling on the wiring harness. Always ensure locking tabs are disengaged before removal and note orientation to enable correct reconnection. Ensure that any protective covers and substances are replaced if disturbed. Having confirmed a component to be faulty switch-off the ignition and disconnect the battery. Remove the component and support the disconnected harness. When replacing the component keep oily hands away from electrical connection areas and push connectors home until any locking tabs fully engage.

Battery disconnecting

Before disconnecting the battery, switch off all electrical equipment.

Battery charging

Recharge the battery out of the vehicle and keep the top well ventilated. While being charged or discharged, and for approximately fifteen minutes afterwards, batteries emit hydrogen gas which is flammable. Always ensure any battery charging area is well ventilated and that every precaution is taken to avoid naked flames and sparks. See SECTION 10 for battery maintenance.

GENERAL PRECAUTIONS

Switch-off ignition prior to making any connection or disconnection in the system as electrical surge caused by disconnecting 'live' connections can damage electronic components.

Ensure hands and work surfaces are clean and free of grease, swarf, etc. as grease collects dirt which can cause tracking or high-resistance contacts.
When handling printed circuit boards, treat them as you would a hi-fi record - hold by the edges only.
Prior to commencing a test, and periodically during a test, touch a good earth, for instance, a cigar lighter socket, to discharge body static as some electronic components are vulnerable to static electricity.

DISTRIBUTOR - 35DLM8

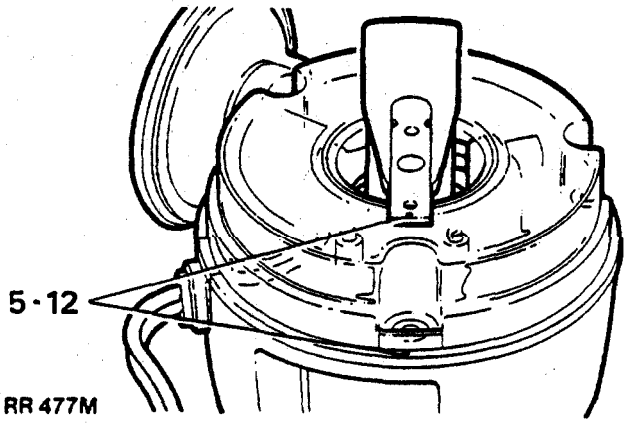
The Lucas 35DLM8 distributor has a conventional advance/retard unit and centrifugal automatic advance mechanism.
A pick-up module, in conjunction with a rotating timing reluctor inside the distributor body, generates timing signals. These are applied to an electronic ignition amplifier module mounted on the side of the distributor body.

NOTE: The pick-up air gap is factory set. Do not adjust the gap unless the pick-up is being changed or the base plate has been moved. Use a non-ferrous feeler gauge to set the air gap.

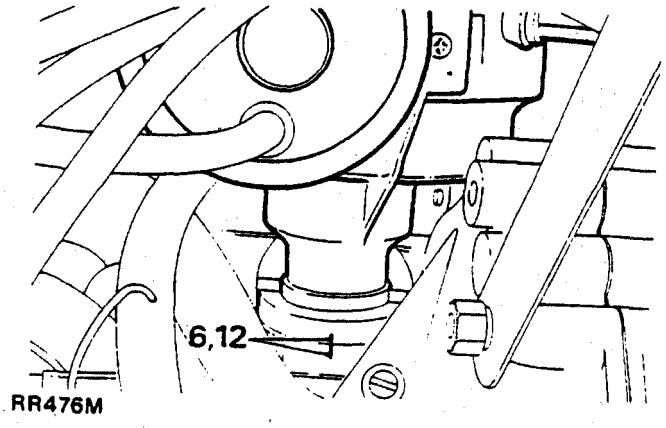
Remove and refit

Removing

1. Disconnect battery.
2. Disconnect vacuum pipe(s).
3. Remove distributor cap.
4. Disconnect low tension lead from coil.
5. Mark distributor body in relation to centre line of rotor arm.



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 the distributor clamp and remove the distributor.

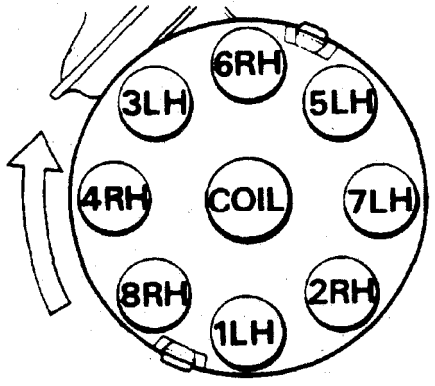
Refitting

NOTE: If a new distributor is being fitted, mark body in same relative position as distributor removed.

8. Leads for distributor cap should be connected as illustrated.

Figures 1 to 8 inclusive indicate plug lead numbers.

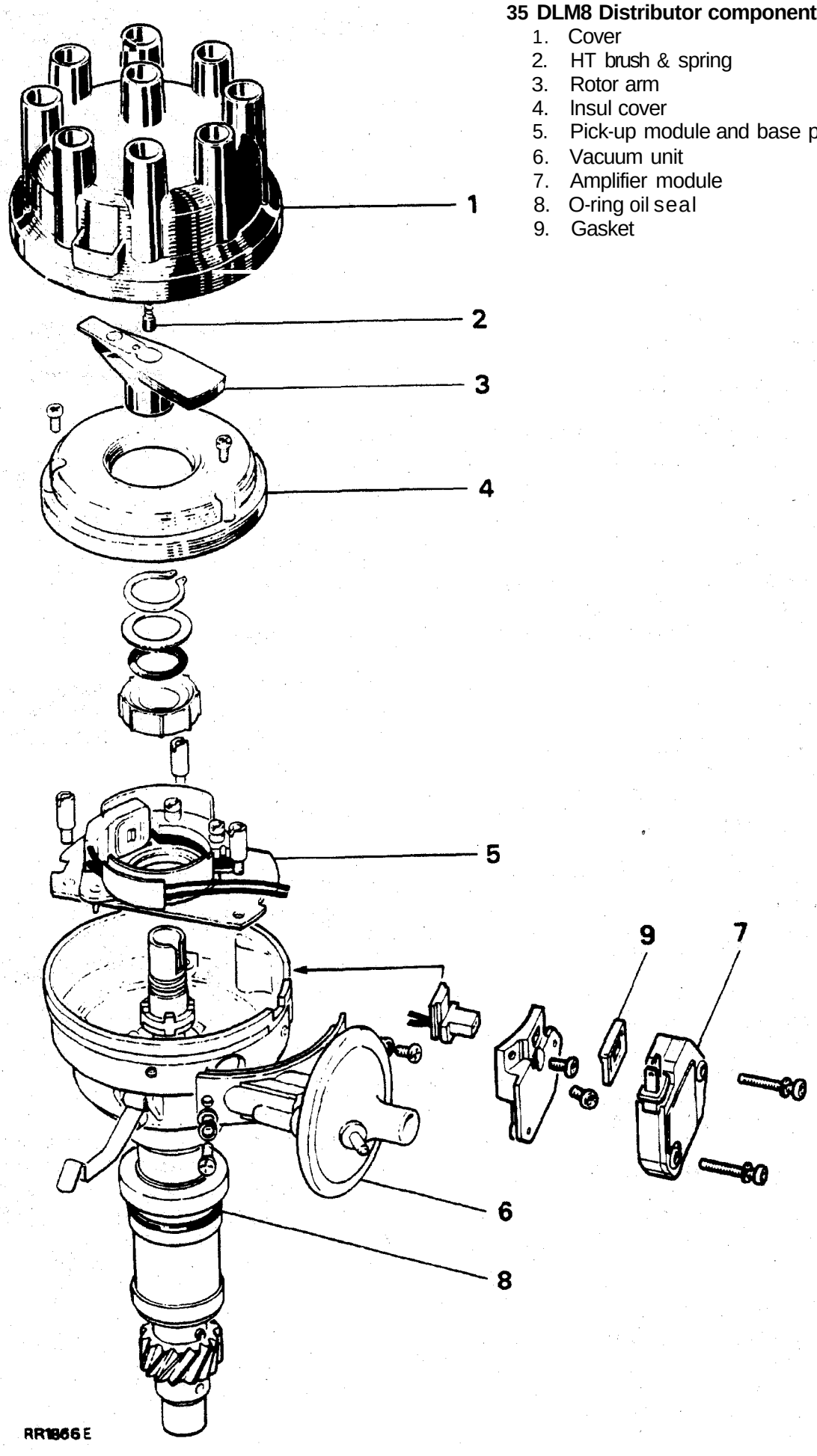
RH - Right-hand side of engine, when viewed from the rear.
LH - Left-hand side of engine, when viewed from the rear.



9. If engine has not been turned whilst distributor has been removed, proceed as follows (items 10 to 17).
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 orginal position.
14. Connect vacuum pipe to distributor and low tension lead to coil.
15. Fit distributor cap.
16. Reconnect battery.
17. Using suitable electronic equipment, set the ignition timing, See IGNITION TIMING ADJUSTMENT



35 DLM8 Distributor components

1. Cover
2. HT brush & spring
3. Rotor arm
4. Insul cover
5. Pick-up module and base plate assembly
6. Vacuum unit
7. Amplifier module
8. O-ring oil seal
9. Gasket

DISTRIBUTOR - LUCAS 35DLM8

Overhaul

DISTRIBUTOR COVER

1. Unclip and remove the cover.
2. Renew the cover if known to be faulty.
3. Clean the cover and HT brush with a nap free cloth.

ROTOR ARM

4. Pull rotor arm from keyed shaft.
5. Renew rotor arm if known to be faulty.

INSULATION COVER (Flash shield)

6. Remove cover, secured by three screws.
7. Renew cover if known to be faulty.

VACUUM UNIT

8. Remove two screws from vacuum unit securing bracket, disengage vacuum unit connecting rod from pick-up base plate connecting peg, and withdraw vacuum unit from distributor body.

AMPLIFIER MODULE

9. Remove two screws and withdraw the module.
10. Remove the gasket.
11. Remove two screws securing the cast heatsink and remove the heatsink.

WARNING: The amplifier contains Beryllia. Do not open or crush.

PICK-UP AND BASE PLATE ASSEMBLY

12. Use circlip pliers to remove the circlip retaining the reluctor on rotor shaft.
13. Remove the flat washer and then the 'O' ring recessed in the top of the reluctor.
14. Gently withdraw the reluctor from the shaft, taking care not to damage the teeth.

NOTE: Coupling ring fitted beneath reluctor.

15. Remove three support pillars and cable grommet. Lift out the pick-up and base plate assembly.

NOTE: Do not disturb the two barrel nuts securing the pick-up module, otherwise the air gap will need re-adjustment.

16. Renew pick-up and base plate assembly if module is known to be faulty, otherwise check pick-up winding resistance (2k-5k ohm).

RE-ASSEMBLY

17. This is mainly a reversal of the dismantling procedure, noting the following points:

LUBRICATION

Apply clean engine oil:

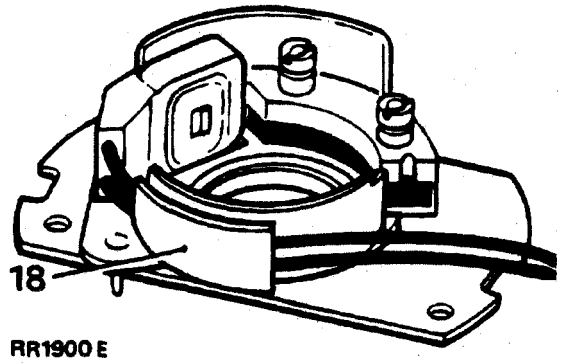
a. Three drops to felt pad reservoir in rotor shaft.

Apply Chevron SR1 (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 assy).
e. Vacuum unit connecting peg (pick-up and base plate assy) and
f. the connecting peg hole in vacuum unit connecting rod.

FITTING PICK-UP AND BASE PLATE ASSEMBLY

18. Pick-up leads must be prevented from fouling the rotating reluctor. Both leads should be located in plastic carrier as illustrated. Check during re-assembly.

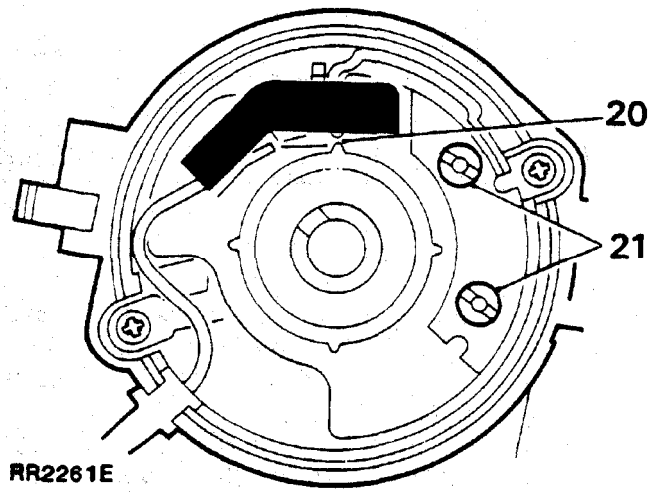


REFITTING RELUCTOR

19. Slide reluctor as far as it will go on rotor shaft, then rotate reluctor until it engages with the coupling ring beneath the pick-up base plate. The distributor shaft, coupling ring and reluctor are 'keyed' and rotate together. Fit the 'O' ring, flat washer and retaining circlip.

PICK-UP AIR GAP ADJUSTMENT

20. The air gap between the pick-up limb and reluctor teeth must be set within the specified limits, using a non-ferrous feeler gauge.
21. If adjustment is necessary, slacken the two barrel nuts to set the air gap. See Engine Tuning Data.



NOTE: When the original pick-up and base plate assembly has been refitted the air gap should be checked, and adjusted if necessary.

When renewing the assembly the air gap will require adjusting to within the specified limits.

AMPLIFIER MODULE

22. Before fitting the module, apply MS4 Silicone grease or equivalent heat - conducting compound to the amplifier module backplate, the seating face on distributor body and both faces of the heatsink casting.

IGNITION TIMING ADJUSTMENT

1. It is essential that the following procedures are adhered to. Inaccurate timing can lead to serious engine damage and additionally create failure to comply with the emission regulations applying to the country of destination. If the engine is being checked in the vehicle and is fitted with an air conditioning unit the compressor must be isolated.
2. On initial engine build, or if the distributor has been disturbed for any reason, the ignition timing must be set statically to 6° B.T.D.C.

(This sequence is to give only an approximation in order that the engine may be started) **ON NO ACCOUNT MUST THE ENGINE BE STARTED BEFORE THIS OPERATION IS CARRIED OUT**

Static ignition timing

1. Set engine - No. 1 piston to 6° B.T.D.C. on compression stroke.
2. Turn distributor drive until rotor arm is approximately 30° anti-clockwise from number one sparking plug lead position on cap.
3. Fit distributor to engine.
4. Check that centre line of rotor arm is now in line with number one sparking plug lead on cap. Reposition distributor if necessary.
5. If distributor does not seat correctly in front cover, oil pump drive is not engaged. Engage by lightly pressing down distributor while turning engine.
6. Fit clamp and bolt leaving both loose at this stage.
7. Connect the vacuum pipe to the distributor.
8. Fit low tension lead to coil.
9. Fit distributor cap.
10. Reconnect the battery.
11. Using suitable electronic equipment set the ignition timing dynamically.

Dynamic ignition timing

Equipment required

Calibrated Tachometer
Stroboscopic lamp

1. Couple stroboscopic timing lamp and tachometer to engine following the manufacturers instructions.
2. Disconnect the vacuum pipes from the distributor.
3. Start engine, with no load and not exceeding 3,000 rev/min, run engine until normal operating temperature is reached. (Thermostat open). Check that the normal idling speed falls within the tolerance specified in the data section.
4. Idle speed for timing purposes must not exceed 750 rpm, and this speed should be achieved by removing a breather hose **NOT BY ADJUSTING IDLE SETTING SCREWS**
5. With the distributor clamping bolt slackened turn distributor until the timing flash coincides with the timing pointer and the correct timing mark on the rim of the torsional vibration damper as shown in the engine tuning section.
6. Retighten the distributor clamping bolt securely. Recheck timing in the event that retightening has disturbed the distributor position.
7. Refit vacuum pipes.
8. Disconnect stroboscopic timing lamp and tachometer from engine.

ELECTRONIC IGNITION - PRELIMINARY CHECKS

Inspect battery cables and connections to ensure they are clean and tight. Check battery state of charge if in doubt as to its condition.
Inspect all LT connections to ensure that they are clean and tight. Check the HT leads are correctly positioned and not shorting to earth against any engine components. The wiring harness and individual cables should be firmly fastened to prevent chafing.

PICK-UP AIR GAP

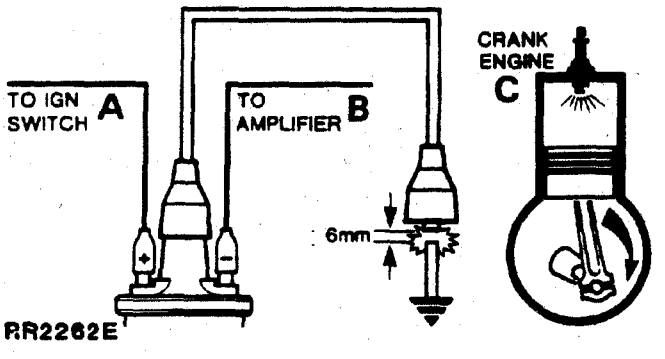
Check air gap with a non-ferrous feeler gauge.

NOTE: The gap is set initially at the factory and will only require adjusting if tampered with or when the pick-up module is replaced.

TEST 1:

Check HT Sparking

Remove coil/distributor HT lead from distributor cover and hold approximately 6 mm from the engine block. Switch the ignition 'on' and operate the starter.
If regular sparking occurs, proceed to Test 6. If no sparking proceed to Test 2.



TEST 2:

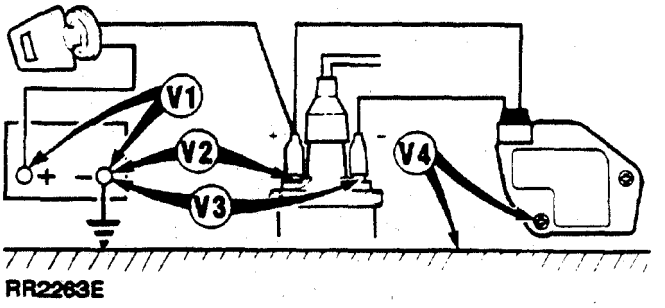
L.T. Voltage

Switch the ignition 'ON'

(a) Connect voltmeter to points in the circuit indicated by the arrow heads and make a note of the voltage readings.
(b) Compare voltages obtained with the specified values listed below:

EXPECTED READINGS

V1. More than 11.5 volts
V2. 1 volt max below volts at point 1 in test circuit
V3. 1 volt max below volts at point 1 in test circuit
V4. 0 volt 0.1 volt



(c) If all readings are correct proceed to Test 3.
(d) Check incorrect reading(s) with chart to identify area of possible faults, i.e. faults listed under heading 'Suspect'.
(e) If coil or amplifier is suspected, disconnect LT lead at coil, repeat V3. If voltage is still incorrect, fit new coil. If voltage is now correct, check LT lead, if satisfactory fit new amplifier.
(f) If engine will not start proceed to Test 3.

1	2	3	4	SUSPECT
L	OK	OK	OK	Discharged battery
OK	L	L	OK	Ign. switch and/or wiring
OK	OK	L	OK	coil or amplifier
OK	OK	OK	H	Amplifier earth

KEY

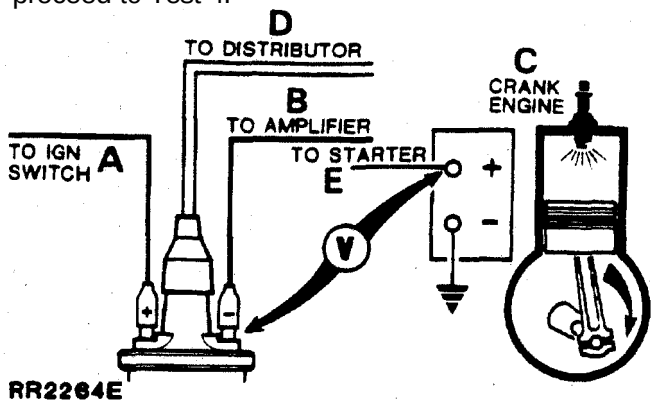
O K Expected Voltage.
H Voltage higher than expected.
L Voltage lower than expected.

TEST 3:

Check Amplifier Switching

Connect the voltmeter between battery positive (-ve) terminal and HT coil negative (- ve) terminal: the voltmeter should register zero volts.
Switch the ignition 'on' and crank the engine. The voltmeter reading should increase just above zero, in which case proceed with Test **5.**

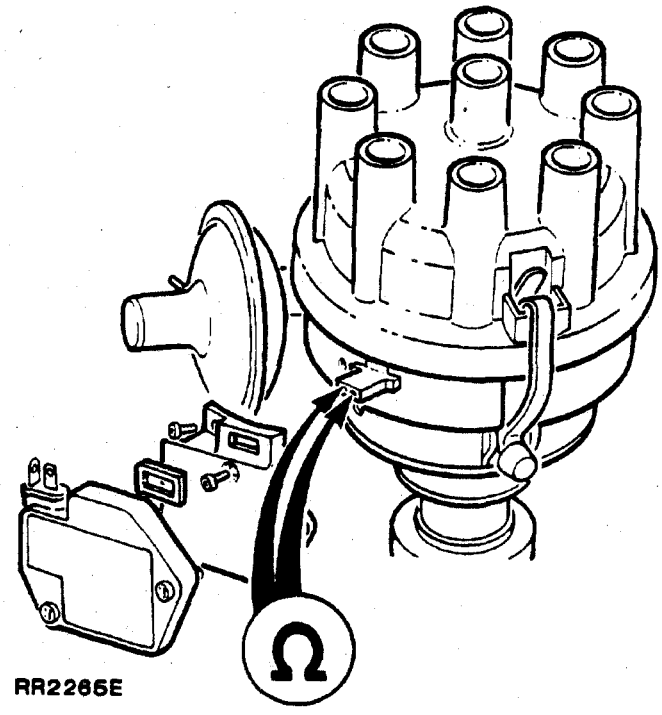
If there is no increase in voltage during cranking proceed to Test 4.



TEST 4:

Pick-Up Coil Resistance.

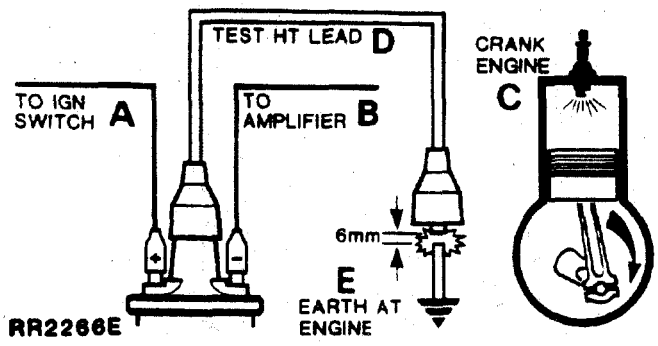
Disconnect the pick-up leads at the harness connector. Connect the ohmmeter leads to the two pick-up leads in the plug.
The ohmmeter should register between 2k and **5k** ohms if pick-up is satisfactory. If the ohmmeter reading is correct, check all connections between pick-up and amplifier, if satisfactory, fit new amplifier.
If the engine still does not start carry out Test 5.
Change the pick-up if ohmmeter reading is incorrect.
If the engine still does not start proceed to Test 5.



TEST 5:

Coil HT Sparking

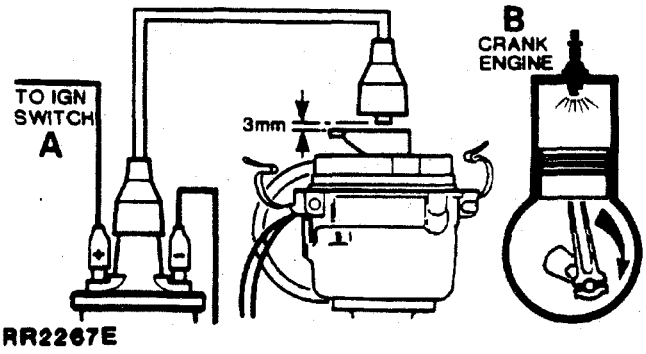
Remove existing coil/distributor HT lead and fit test HT lead to coil tower. Using suitable insulated pliers, hold free end about 6 mm from the engine block and crank the engine. There should be a good HT spark.
If weak or no sparking, fit new coil, repeat test.
HT sparking good, repeat test with original HT lead.
If sparking is good, carry out Test 6.
If weak or no sparking, fit new HT lead, if engine will not start carry out Test 6.



TEST 6:

Rotor Arm

Remove distributor cover. Disconnect coil HT lead from cover and using insulated pliers, hold about 3 mm above rotor arm electrode and crank the engine. There should be no HT sparking between rotor and HT lead. If satisfactory carry out Test 7.
If HT sparking occurs, an earth fault on the rotor arm is indicated. Fit new rotor arm.
If engine will not start carry out Test 7.



TEST *7:*

Visual and HT Cable Checks

Examine:		**Should be:**
1.	Distributor Cover	Clean, dry, no tracking marks
2.	Coil Top	Clean, dry, no tracking marks
3.	HT Cable Insulation	Must not be cracked chafed or perished
4.	HT Cable Continuity	Must not be open circuit
5.	Sparking Plugs	Clean, dry, and set to correct gap.

NOTE:

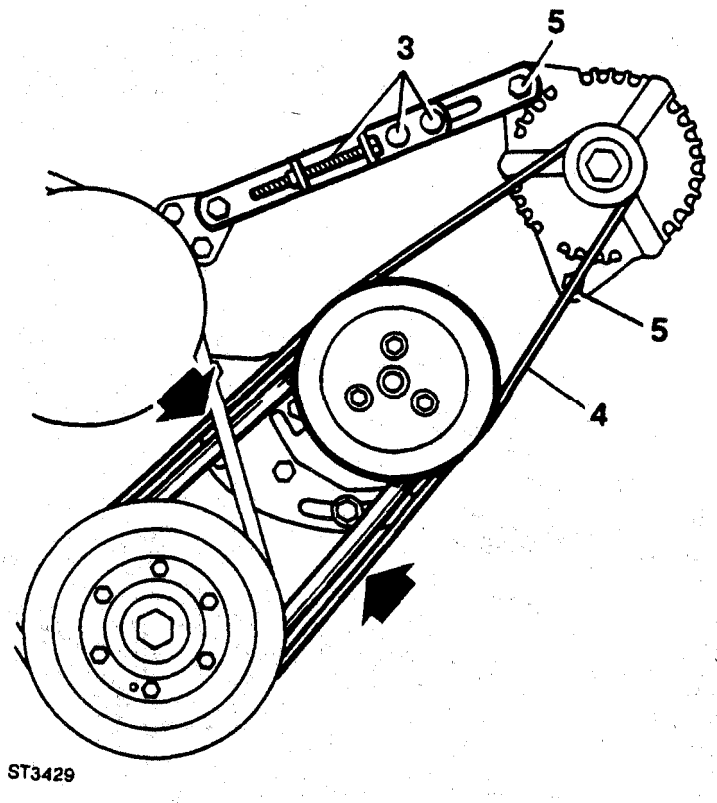
1.	Reluctor	Must not foul pick-up or leads
2.	Rotor and Flash	Must not be cracked or show signs of tracking marks.

ALTERNATOR - TYPE A127

Remove and refit

Removal

1. Disconnect battery ground lead.
2. Disconnect the electrical leads from the alternator.
3. Slacken the two tensioner nuts and rotate the tensioner screw anti-clockwise to slacken the belt tension.
4. Remove the belt.
5. Remove the two securing bolts and withdraw the alternator from the engine.



ST3429

Refit

6. Position n the alternator on the engine and fit the securing bolts.
7. Adjust the drive belt tension, see **MAINTENANCE.**
8. Connect the electrical leads to the alternator and connect the battery.

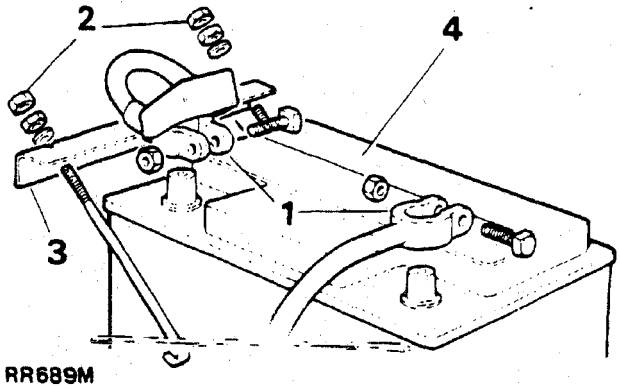
BATTERY

Remove and refit

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.

Removing

1. Disconnect battery ground lead followed by the disconnection of the positive lead.
2. Release the four nuts securing the battery bracket in position.
3. Remove the bracket from the studs.
4. Remove the battery



RR689M

Refitting

5. Reverse the removal procedure.

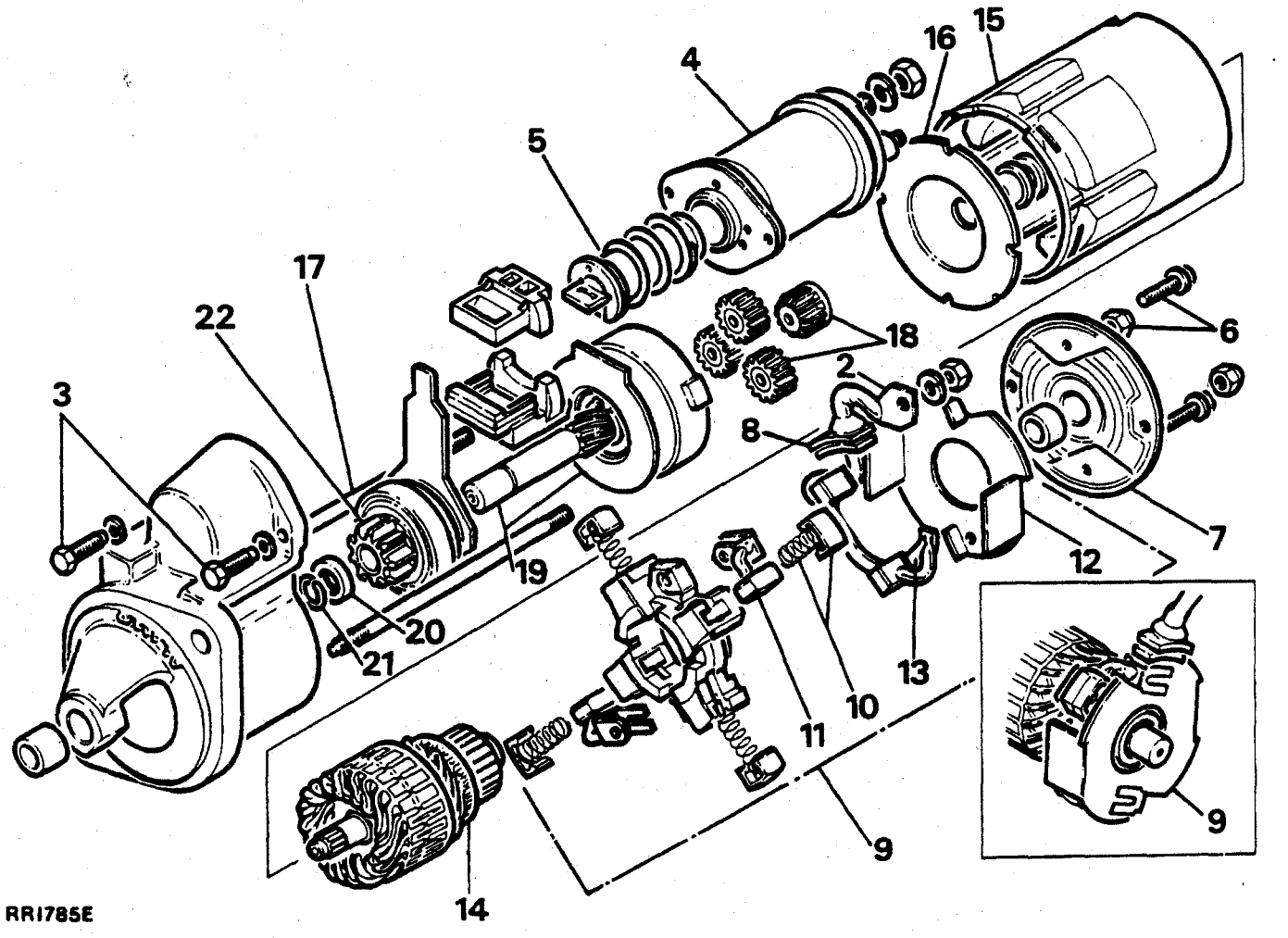
NOTE: Coat the battery clamps and terminals with petroleum jelly before refitting.

STARTER MOTOR - Type M78R

Overhaul

Dismantling

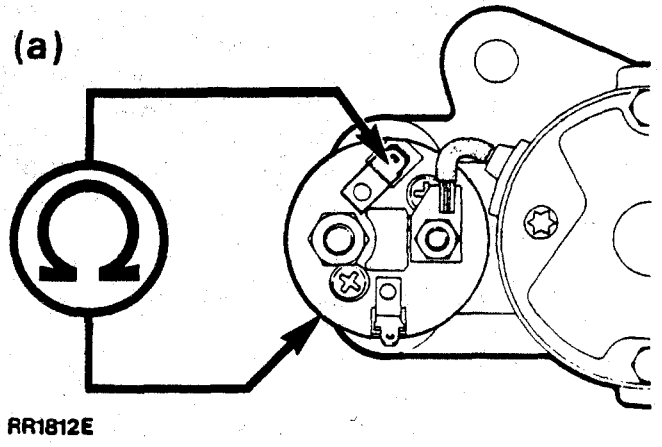
1. Remove the starter motor.
2. Remove the braid between the starter and the solenoid terminal.
3. Remove the solenoid fixing screws.
4. Withdraw the solenoid body.
5. Lift and remove the solenoid plunger.
6. Remove two nuts and two screws from the commutator end bracket.
7. Remove the commutator end bracket.
8. Remove the grommet from the yoke.
9. Lift the brushbox assembly clear of the armature.
10. Remove the brush springs.
11. Unclip and remove the earth brushes.
12. Remove the insulating plate.
13. Withdraw the brushes and bus bar.
14. Remove the armature from the yoke.
15. Remove the yoke.
16. Remove the intermediate bracket.
17. Loosen and remove the through bolts from the drive end bracket.
18. Remove the sun and planet gears.
19. Push out the drive shaft sprocket assembly from the drive end bracket.
20. Carefully tap the thrust collar from over the jump ring back towards the drive.
21. Prise the jump ring from its locating groove.
22. Remove the drive assembly from the drive shaft.



Inspecting

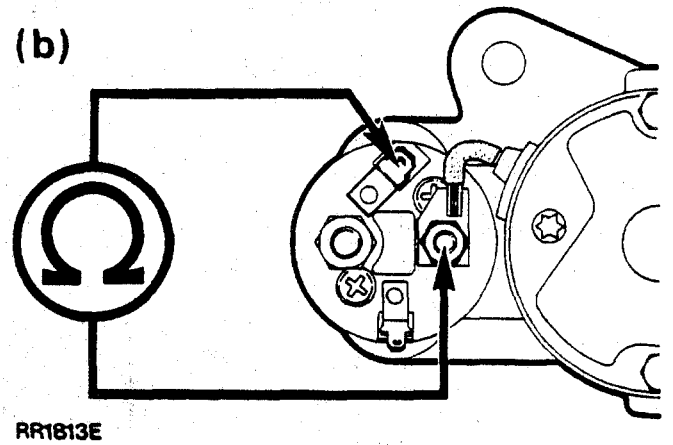
Solenoid

23. Check the continuity and resistance value of windings by connecting an ohmmeter as shown.



RR1812E

(a) Resistance value should be: 1.074 ± 0.035 ohms



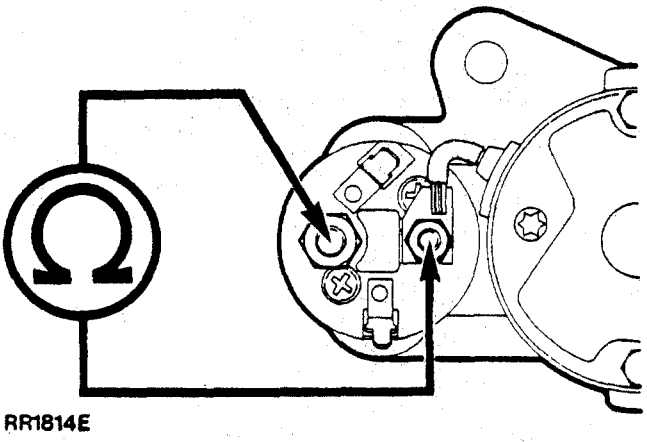
RR1813E

(b) Resistance value should be: 0.298 ± 0.015 ohms

If test results are unsatisfactory replace the solenoid. If results are correct proceed to 24.

24. Check the contacts by connecting an ohmmeter as shown.

Solenoid plunger removed, ohmmeter should read infinity.



RR1814E

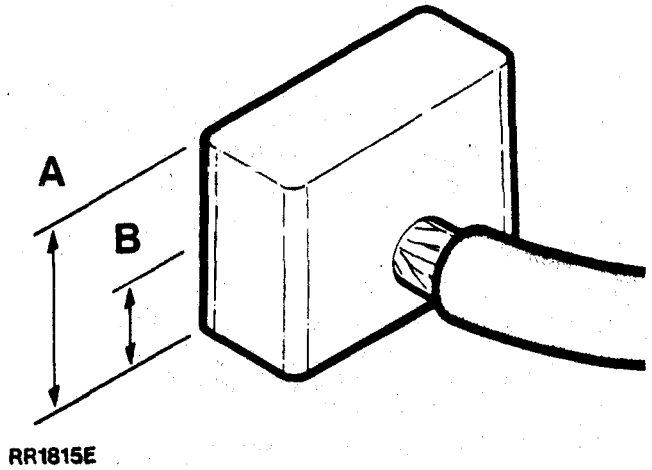
Solenoid plunger operated by hand, ohmmeter should read zero.
If test results are unsatisfactory, replace the solenoid.
If results are correct proceed to 25.

25. Check operation of spring for freedom of movement.

Brush gear

26. Check brush springs and ensure that the brushes move freely in their holders.

Clean the brushes with a petrol moistened cloth, if required.

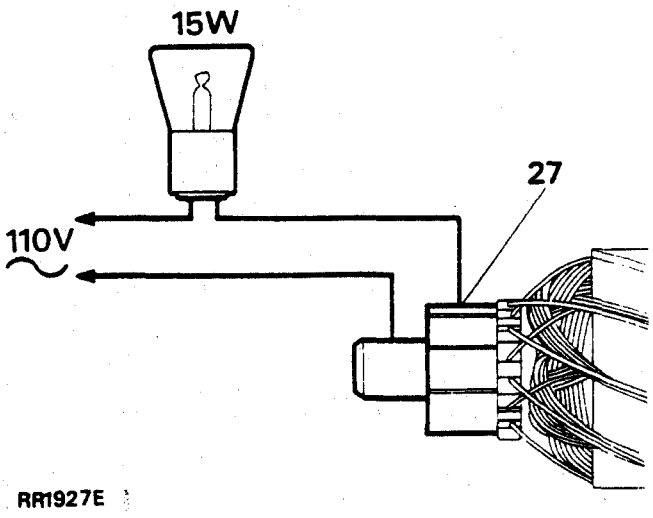


RR1815E

Brush length new, Dimension **A** is 9 mm.
Minimum brush length, Dimension B is 3.5 mm.

Armature

27. Check the armature insulation using suitable test equipment. Connect the tester between any one commutator segment and the shaft. The method illustrated uses a 110 V, 15 W test lamp. If the lamp illuminates the armature is faulty, and a replacement component is required.



28. If necessary, the commutator may be machined, providing a finished surface can be obtained without reducing the diameter below 28.8 mm otherwise a new commutator must be fitted. Finish the surface with fine emery cloth. Do not undercut the insulation slots.

Drive assembly

29. Test the roller clutch. The pinion should rotate in one direction only, independent of the clutch body. Replace the unit if unsatisfactory or if teeth are damaged or worn.

Bearings

30. Renew the bearing bushes if there is evidence of armature fouling magnets or if there is perceptible side play between the shaft and bush.
31. Drive end/intermediate end bracket: press out the bush using a suitable press and mandrel.
32. Press the new bush in, ensuring that on the drive end bracket, the bush is flush with the casting.
33. Commutator end bracket: thread a 9/16 Whitworth or suitable similar tap firmly into the bush. Extract the bush with the tap using a power press in reverse.

NOTE: Soak new bushes in engine oil for thirty minutes before fitting.

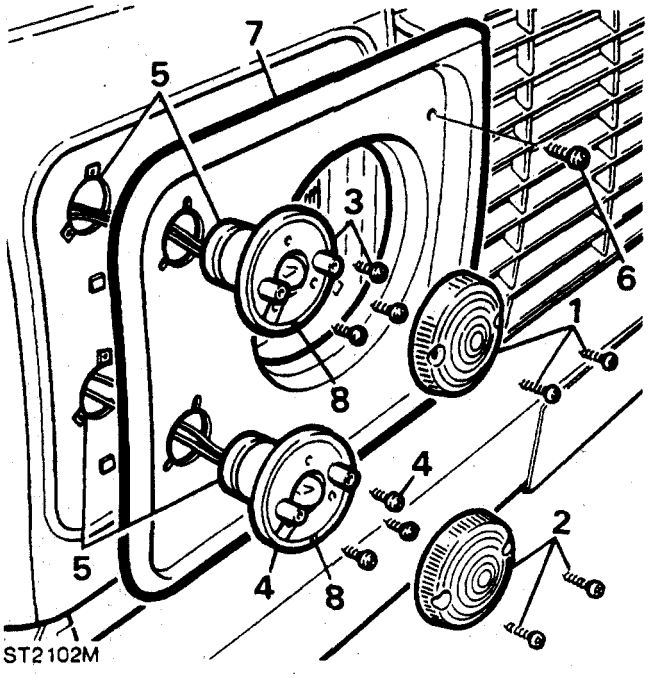
Reassembly

34. Reverse the instructions 1 to 22. Smear the teeth and operating collar of the roller clutch with Shell Retinax 'A' grease. Smear the pivot lever of the drive assembly with Mobil 22 grease. Smear the drive shaft sun and planet gears with Rocol ERE1200 grease.
35. Tighten all the fixings to the correct torque - see Torque Wrench Settings, SECTION 06 .

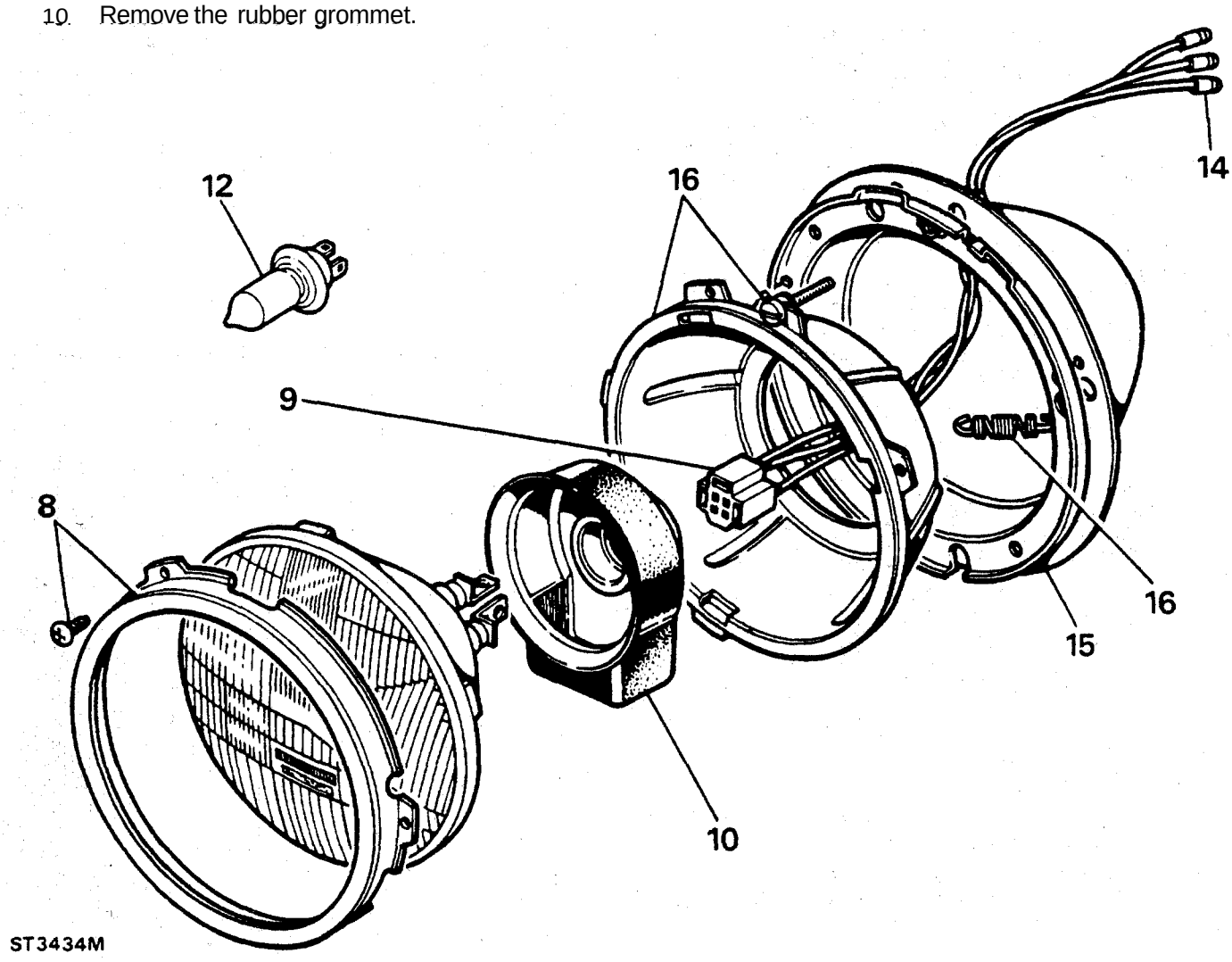
HEADLAMPS

To remove or renew bulb or light unit

1. Remove the two screws and withdraw the front side lamp lens.
2. Remove the two screws and withdraw the front flasher lens.
3. Remove the three screws retaining the side lamp to the wing.
4. Remove the three screws securing the flasher lamp.
5. Ease the side and flasher lamps from their locations in the wing and pull them out as far as the leads will allow.
6. Remove the screws retaining the plastic bezel to the wing.
7. Withdraw the bezel sufficiently to gain access to the headlamp retaining screws.



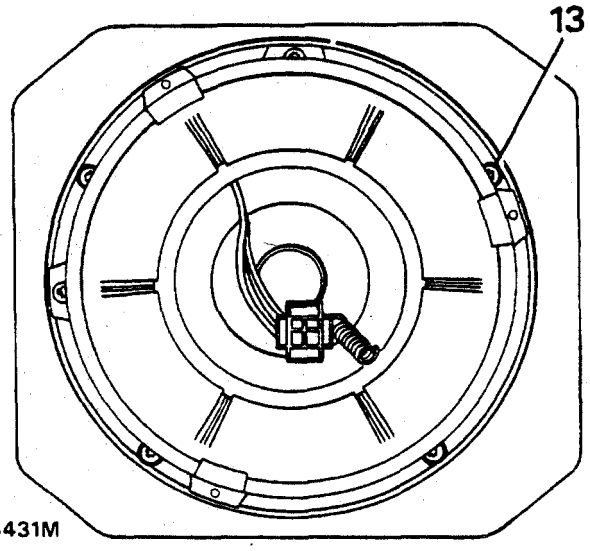
8. Remove the three screws retaining the rim and light unit, and remove the rim.
9. Withdraw the light unit or reflector and disconnect the electrical connector.
10. Remove the rubber grommet.
11. Discard the light unit, or release the spring clip and discard the bulb if faulty.
12. If required, fit a new bulb of the correct wattage and secure with the spring clip, or fit a new light unit.



ST3434M

To remove or renew headlamp assembly

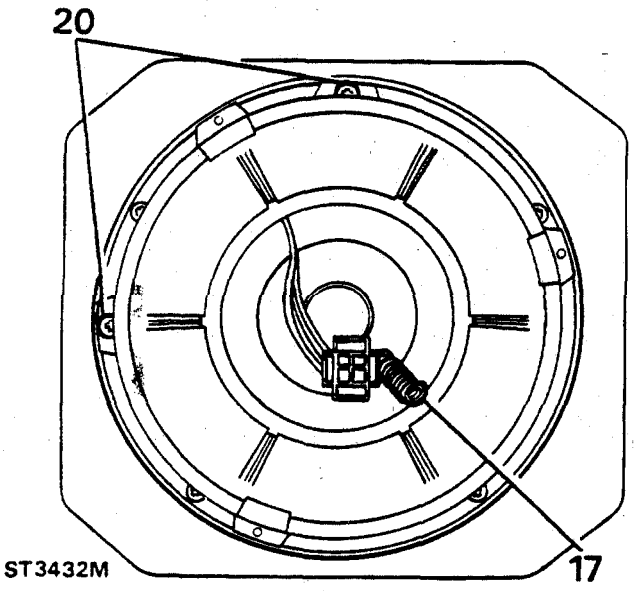
13. Remove the four screws and release the headlamp shell from the front wing.
14. Disconnect the electrical leads from the bullet connectors and remove the headlamp shell.
15. Remove the rubber seal.
16. Release the two trimmer screws and coil spring and detach the rim seating from the headlamp shell.



ST3431M

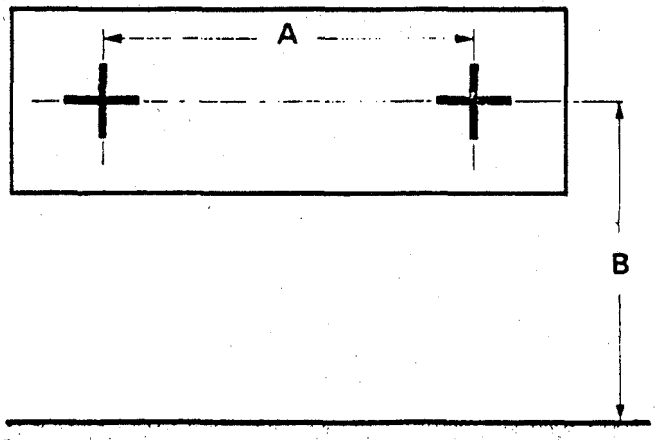
Assemble and refit

17. Fit the rim seating to the headlamp shell with the two trimmer screws and coil spring.
18. Fit the rubber seal to the headlamp shell.
19. Connect the leads to the bullet connectors.
20. Fit the headlamp shell into the front wing locating the trimmer screws into the two holes in the wing. Ensure that the assembly is located, as illustrated, with one trimmer screw at the 12 o'clock position and the other 90° to the left.



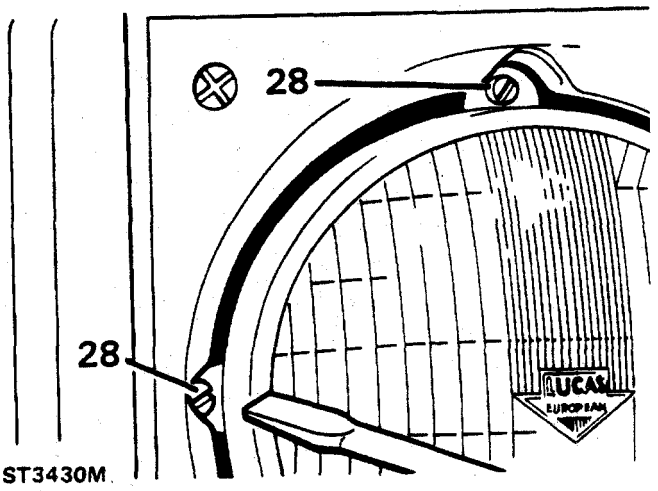
ST3432M

21. Secure the shell assembly to the wing with the four screws.
22. Offer-up the light or reflector unit to the rim seating and connect the electrical connector.
23. Secure the assembly with the rim and three screws.
24. Refitting of the plastic bezel and lamps **is** a reversal of instructions 1 to 7. Ensure, however, that when fitting the side and flasher lamps the gap in the seal surround is located at the bottom to provide for drainage and ventilation.
25. Remember to replace or renew the rubber sealing washers over the screws inside each lens. Also check that the fibre washers are in place under the screw heads on the outside of the lens.
25. Check the main beam setting using beam setting equipment. Should this not be available the beam can be temporarily checked and adjusted in the following way:-
26. Position the vehicle on level ground with the tyres correctly inflated, approximately four meters from a wall or screen, marked as illustrated.
27. The beam centres 'A' are measured horizontally on the vehicle and the dimension 'B' vertically from the ground.



ST1719M

28. Switch-on the main beam and adjust the setting as necessary with the trimmer screws.

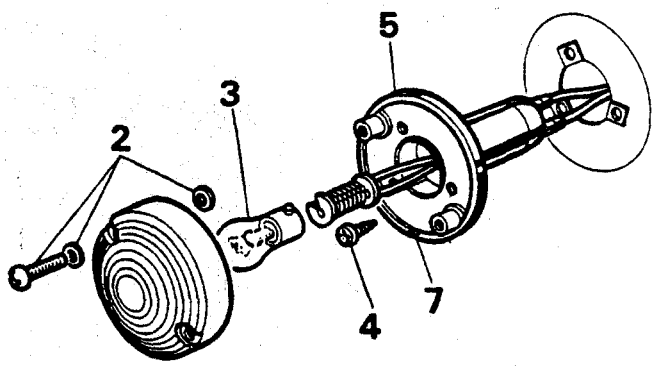


ST3430M

SIDE, TAIL AND FLASHER LAMPS

Renew bulbs and lamps

1. Disconnect the battery.
2. Remove the two screws and fibre washers and withdraw the lens and collect the two rubber washers inside the lens.
3. Push the bulb inwards, twist and withdraw.
4. Remove the three screws and withdraw the lamp holder complete. Disconnect the electrical leads from the bullet connectors inside the vehicle wing for the front lamps. For rear lamps remove the cover inside the body for access to the connectors.
5. If necessary remove the rubber bulb holder cover.



ST1841M

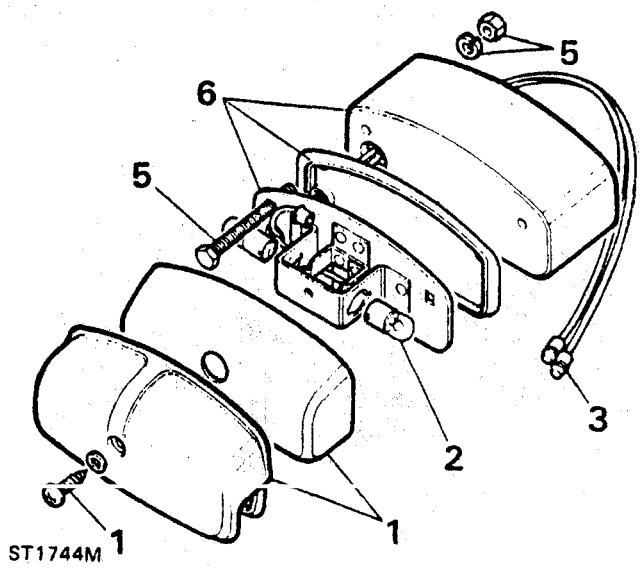
Refitting lamp and bulbs

6. Fit the rubber cover to the lamp holder.
7. Ensure that the drain gap in the cover is at the bottom.
8. Connect the electrical leads to the bullet connectors.
9. Fit the lamp to the vehicle, observing instruction *7*, and secure with the three screws.
10. Fit the bulb of the same wattage, if renewed.
11. Fit the lens ensuring that the rubber and fibre washers are correctly positioned. Evenly tighten the two screws. Overtightening could crack the lens.

REAR NUMBER PLATE LAMP

Remove and renew bulbs

1. Disconnect the battery and remove the single screw securing the lamp cover and lens.
2. At this stage the bulbs only can be renewed.
3. Disconnect the electrical leads.
4. Remove the cover from inside the vehicle body.
5. Remove the two nuts and washers securing the lamp to the vehicle body.
6. Remove the bulb holder complete with rubber seal and mounting block.



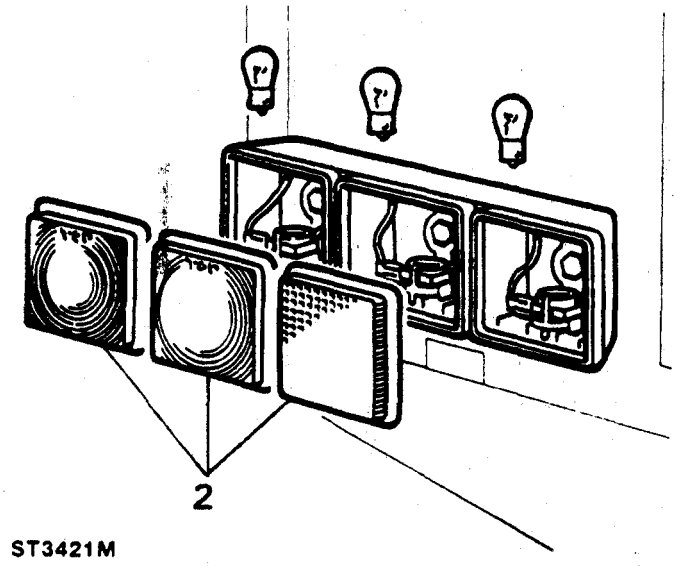
ST1744M

Refitting lamp and bulbs

7. Assemble the bulb holder and rubber seal to the mounting block, connect the leads and fit to the vehicle body with the two screws and nuts.
8. Fit the bulbs.
9. Fit the lens and lamp cover and secure with the single screw. Connect the battery and test the lamp.

REAR LAMPS

1. The rear lamp cluster on the left side comprises a rear/stop lamp an amber flasher lamp and a white reverse lamp.
   On the right side the lamp cluster comprises only rear/stop lamp and flasher.
2. The lenses are easily levered out of the rubber using a flat screwdriver to gain access to the bulbs.
   The lenses are marked "Top" to ensure correct re-assembly.
3. The lamp units are secured by nuts, accessable under the rear fender. Three nuts and bolts retain the left lamp cluster and two nuts and bolts secure the right lamp cluster.



ST3421M

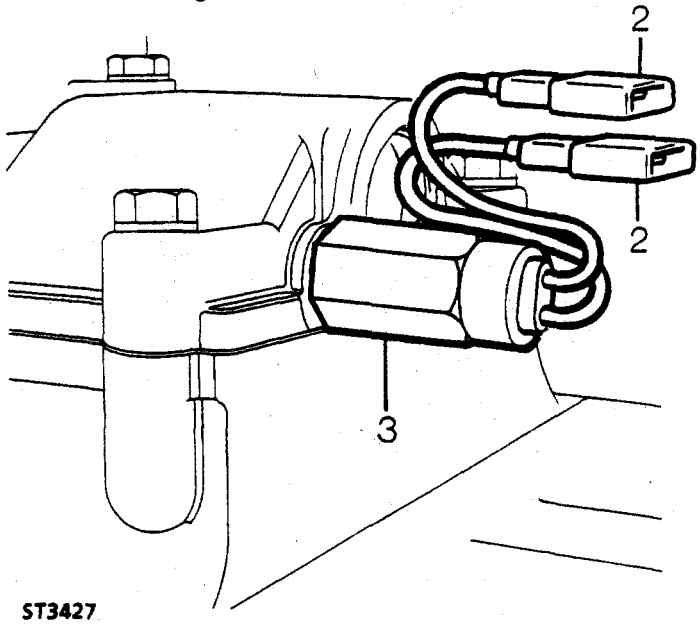
REVERSE LIGHT SWITCH

Remove and refit

The reverse light switch is located at the rear of the gear change housing and is accessible from underneath the vehicle. Loctite thread locking fluid should be used when fitting this switch.

Removal

1. Disconnect the battery negative lead.
2. Disconnect the electrical leads from the reverse light, switch.
3. Unscrew the switch from the gear change housing.



ST3427

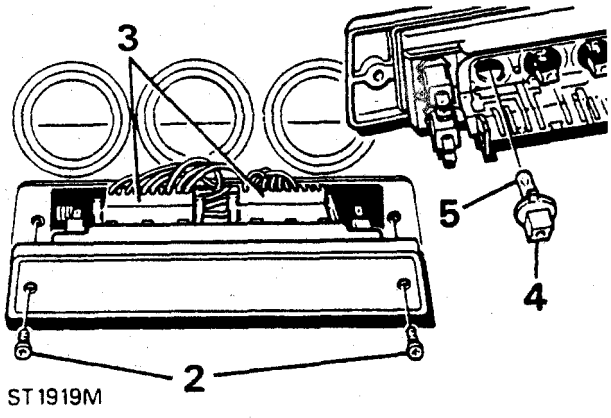
Refitting

4. Coat the switch threads with Loctite 290.
5. Fit the reverse light switch to the gear change housing and tighten to 12 Nm.
6. Connect the electrical leads to the switch.
7. Connect the battery negative lead.

WARNING LAMPS

Renew the bulbs

1. Disconnect the battery.
2. Remove two screws and withdraw the warning light module from the front of the instrument panel.
3. Pull off the plug connector to give access to warning light bulbs,
4. Twist the bulb holder and pull it from its socket.
5. Pull the bulb from the holder.
6. Fit a new bulb and refit the holder and plug connector.
7. Refit the module.
8 Connect the battery.



ST 1919M

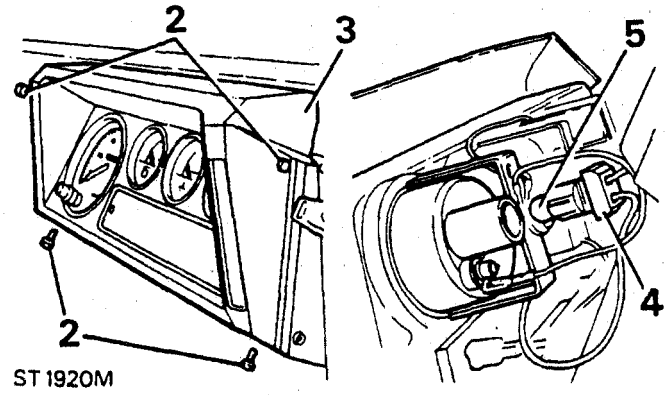
INSTRUMENT ILLUMINATION

Renew bulbs

1 Disconnect the battery.
2. Remove the four screws retaining the instrument panel.
3. Ease forward the panel to gain access to the bulbs.

If necessary, disconnect the drive cable from the back of the speedometer.

4. Twist the bulb holder and pull it from its socket.
5. Pull the bulb from its holder.
6. Fit a new bulb and refit the holder.
7. Replace the instrument panel.
8. Connect the battery.



ST 1920M

WIPER MOTOR - OVERHAUL

DISMANTLE

1. Remove the wiper motor and drive from the vehicle.
2. Remove the wiper motor gearbox cover.
3. Remove the circlip and plain washer securing the connecting rod.
4. Withdraw the connecting rod.
5. Withdraw the flat washer.
6. Remove the circlip and washer securing the shaft and gear.
7. Clean any burrs from the gear shaft and withdraw the gear.
8. Withdraw the dished washer.
9. Add alignment marks to the yoke and gearbox for reassembly.
10. Remove the yoke securing bolts.
11. Withdraw the yoke and armature.
12. Remove the brush gear assembly.
13. Remove the limit switch.

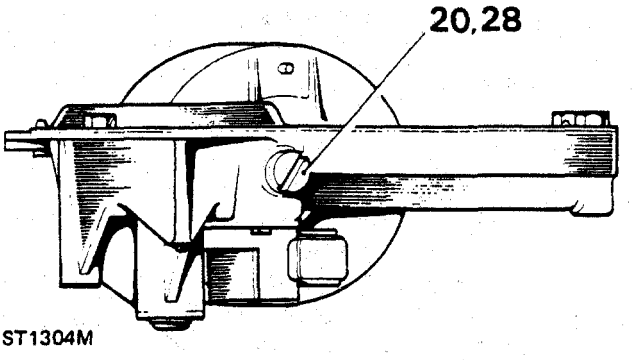
INSPECTION AND TEST

14. Check the brushes for excessive wear, if they are worn to 4,8 mm in length, fit a new brush gear assembly.
15. Using a push type gauge, check that the brush spring pressure is 140 to 200 g when the bottom of the brush is level with the bottom of the slot in the brush box. Fit a new brush gear assembly if the springs are not satisfactory.
16. Test the armature for insulation and open or short-circuits. Use a 110 V 15 W test lamp. Fit a new armature if faulty.
17. Examine the gear wheel for damage or excessive wear.

ASSEMBLE

Use Ragosine Listate Grease to lubricate the gear wheel teeth, armature shaft worm gear, Connecting rod and pin, cable rack and wheelbox gear wheels. Use Shell Turbo 41 oil sparingly to lubricate the bearing bushes, armature shaft bearing journals, gear wheel shaft and wheelbox spindles. Thoroughly soak the felt washer in the yoke bearing with oil.

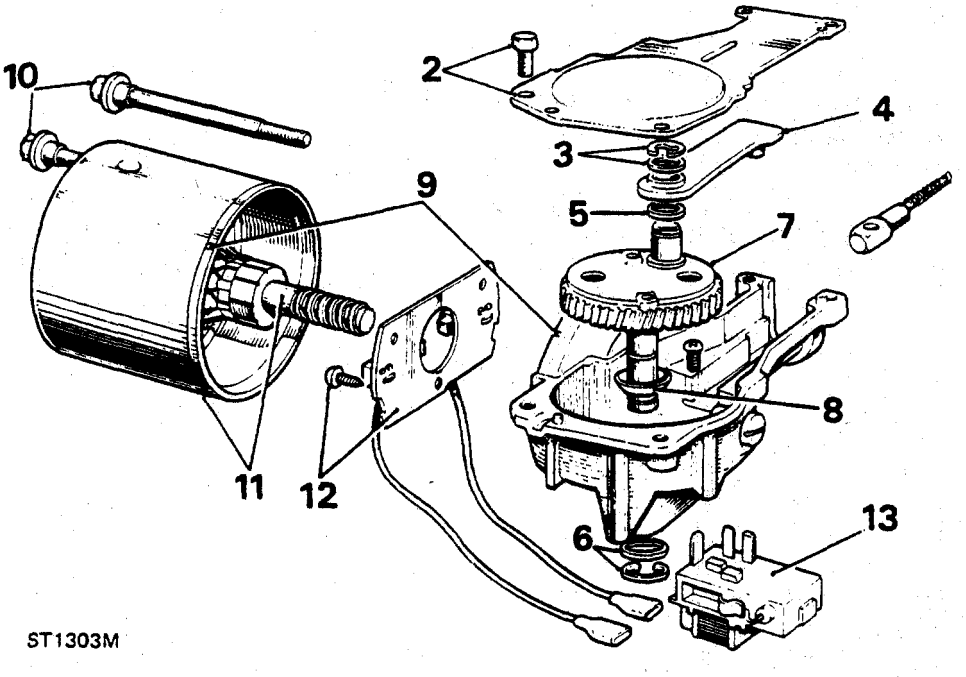
18. Fit the limit switch.
19. Fit the brush gear assembly.
20. Fit the armature to gearbox using alignment marks, secure with the yoke retaining bolts tightening to 23 Kg f cm. If a replacement armature is being fitted slacken the thrust screw *to* provide end-float for fitting the yoke.
21. Fit the dished washer beneath the gear wheel with the concave side towards the gear wheel.
22. Fit the gear wheel to the gearbox.
23. Secure the gear wheel shaft with the plain washer and circlip.
24. Fit the larger flat washer over the crankpin.
25. Fit the connecting rod and secure with the smaller plain washer and circlip.
26. Fit the gearbox cover and secure with the retaining screws.
27. Connect the electrical leads between the wiper motor and limit switch.
28. To adjust the armature shaft end-float, hold the yoke vertically with the adjuster screw uppermost. Carefully screw-in the adjuster until resistance is felt, then back-off one quarter turn.



ST1304M

KEY TO WIPER MOTOR COMPONENTS

1. Flexible drive
2. Gearbox cover
3. Connecting-rod retaining washer and circlip
4. Connecting-rod
5. Fiat washer
6. Gear shaft retaining washer and circlip
7. Drive gear
8. Dished washer
9. Alignment marks - yoke to body
10. Yoke securing bolts
11. Armature and yolk
12. Brush gear assembly
13. Limit switch

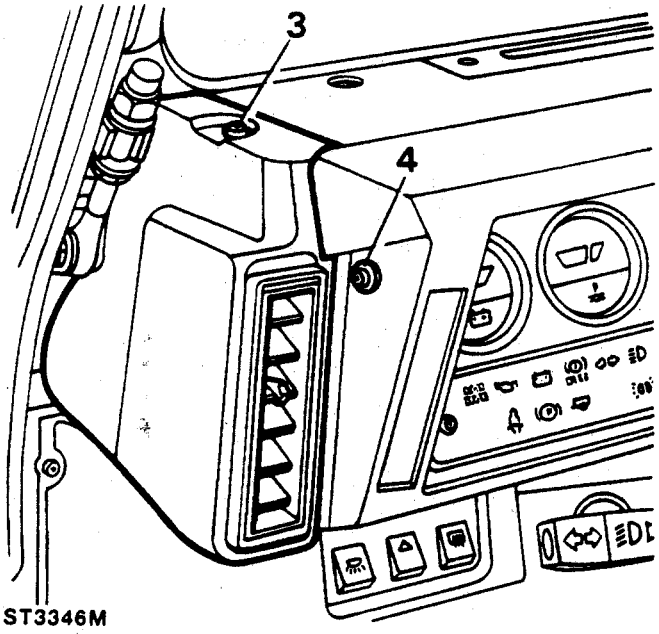


ST1303M

RENEW WIPER MOTOR AND DRIVE RACK

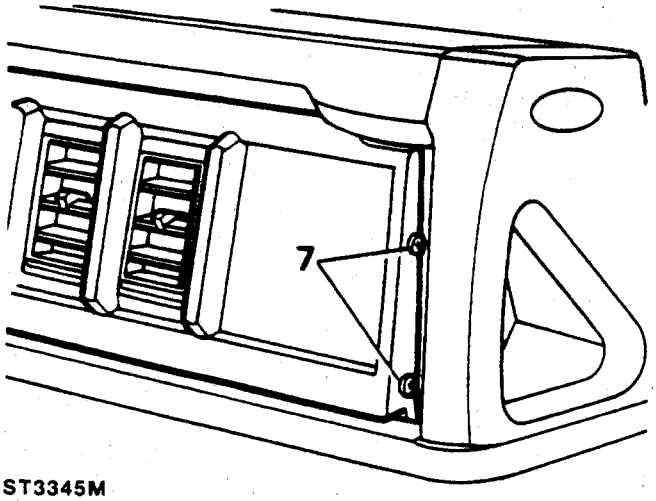
Removing wiper motor

1. Disconnect the battery.
2. Remove the wiper arms.
3. Remove the single screw and remove the fascia side panel.
4. Remove the five screws and withdraw the instrument panel as far as possible without straining the wires and cables.

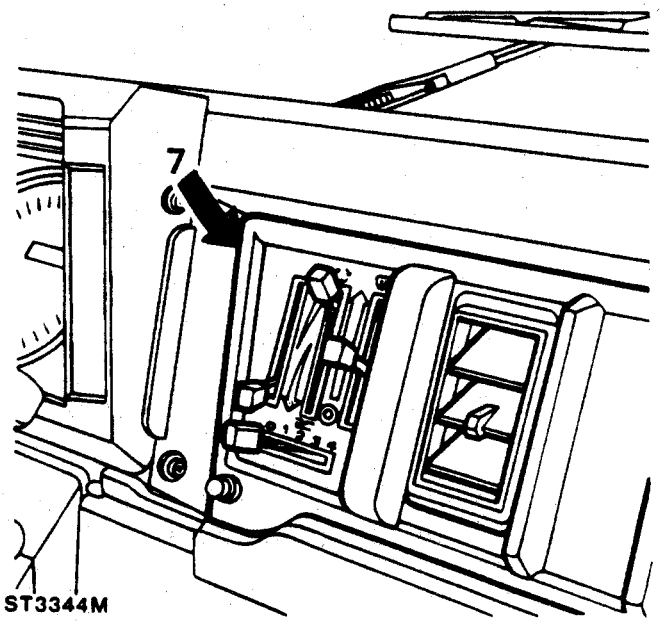


ST3346M

5. Remove the single screw securing steering wheel centre pad.
6. Turn steering wheel to straight ahead position and mark the relationship of the steering wheel to the column and remove the nut. Withdraw the wheel using special tool 18G 1014 or a suitable alternative puller.
7. To remove the air conditioning panel and controls, remove the two screws at the right hand side of the panel and the single screw at the left-hand side, inside the instrument cowl.

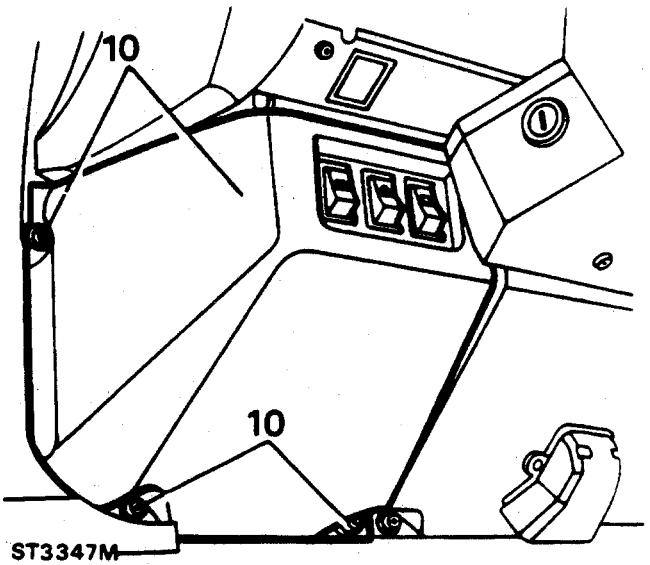


ST3345M



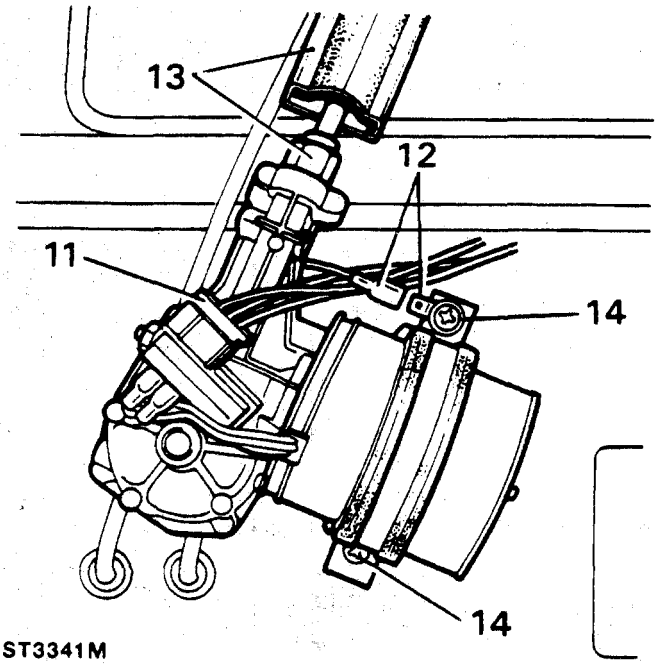
ST3344M

8. Release the fascia panel left-hand support bracket.
9. Remove fascia lower panel finisher.
10. Remove fascia lower panel.



ST3347M

11. Disconnect the wiper motor wiring multiplug.
12. Remove earth lead.
13. Lift rubber sleeve from wiper motor and slacken wiper motor to drive tube nut.
14. Remove the wiper motor retaining strap screws and remove strap together with mounting pad and earth tag.
15. Pull the wiper motor and drive rack clear of the drive tubes.



ST3341M

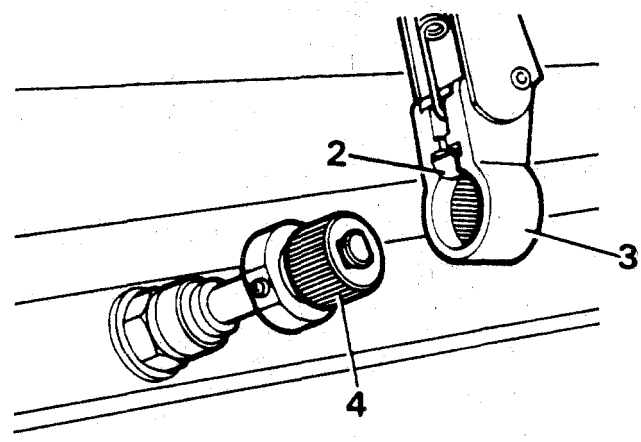
Fitting wiper motor

16. Feed the drive rack into the drive tube until fully located in the wheel boxes.
17. Finger tighten the drive tube nut.
18. Position the motor mounting pad and secure the assembly with the strap and screws not forgetting the earth tag.
19. Tighten the drive tube nut and position the rubber sleeve over the nut.
20. Connect the multiplug to the motor and the earth lead to the tag on motor retaining strap.
21. Before fitting the fascia panels, fit the wiper blades, connect the battery and test the wiper operation.
22. Refit the fascia panels noting that the air conditioning panel must be located and secured, on the left side, with the single screw, before the instrument panel is fitted.
23. Fit the steering wheel ensuring that the marks made during removal coincide. Fit and tighten the securing nut to the correct torque.
24. Fit the steering wheel centre pad with the single screw.

RENEW WINDSCREEN WIPER ARMS

Remove

1. Pull the wiper arm away from the windscreen.
2. Using a small screwdriver, hold back the spring clip which retains the arm to the spindle adaptor.
3. Pull the wiper arm from the splined adaptor.



ST3340M

Fitting new arm

4. Switch the wiper motor to the "park" position with the grub screw, retaining the adaptor, uppermost.
5. Push the arm on to the adaptor so that the wiper blade is just clear of the windscreen surround rubber.
6. Operate the wipers and if necessary adjust the position of the arms.

RENEW WINDSCREEN WIPER WHEELBOXES

Remove

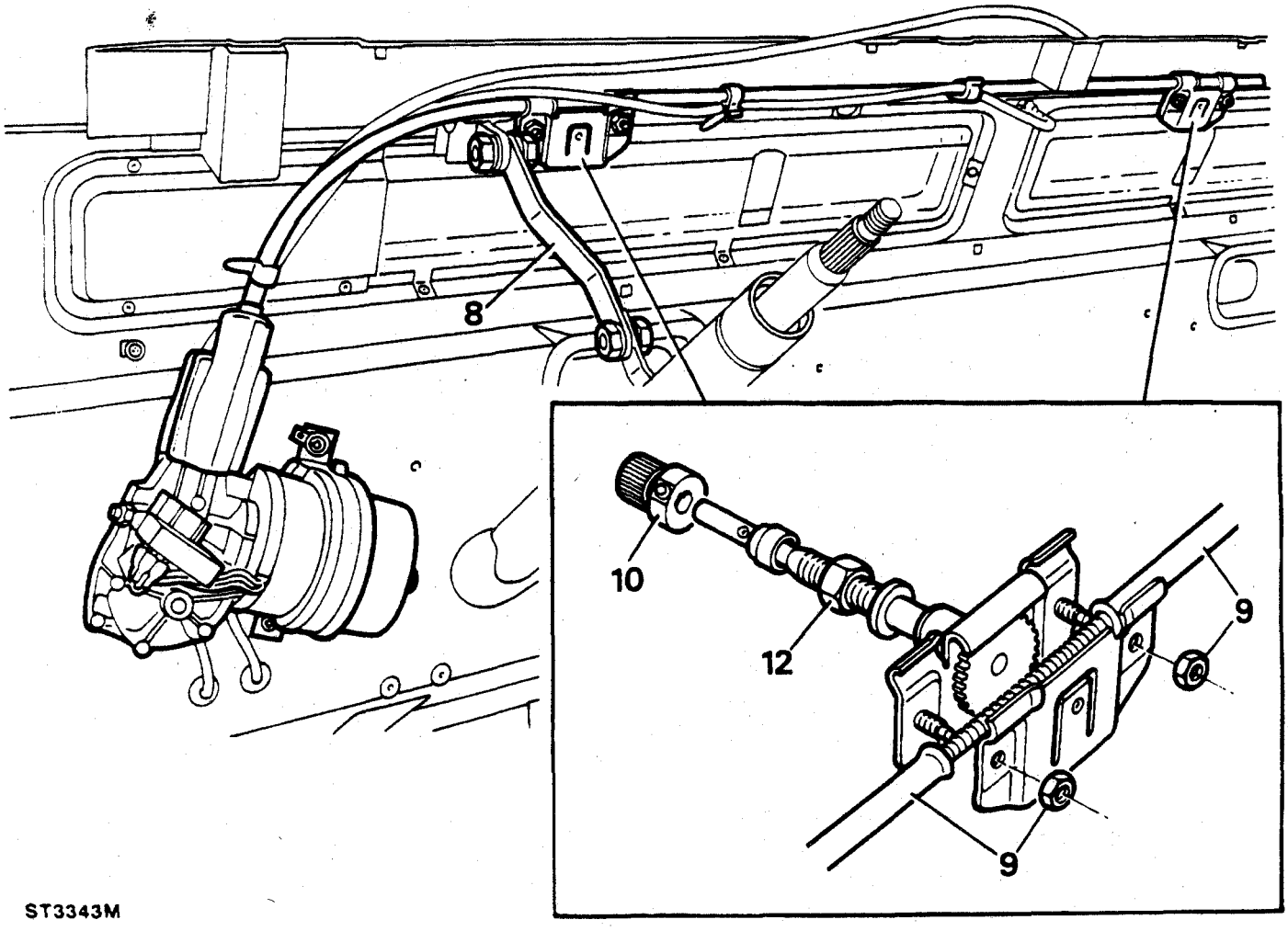
1. Disconnect the battery.
2. Carry-out the instructions to remove the wiper motor and drive rack for air conditioned vehicles, that is:
   Wiper arms
   Fascia side panel
   Instrument housing
   Fascia top crash rail
   Steering wheel
   Fascia panel air conditioning controls

Wiper motor and drive rack

3. Remove centre and left-hand fascia top crash rail support bracket fixings.
4. Remove left and right-hand demister vents from ducts.
5. Remove right-hand demister vent hose from duct.
6. Remove right-hand vent demister vent fixing and pivot vent and hose aside.
7. Remove demister vent top duct.
8. Release the steering column upper and lower support rods.
9. Slacken the left and right-hand wheelbox nuts and remove drive tubes from wheelboxes.
10. Remove wiper arm splined adaptor.
11. Remove spacer, where fitted, early vehicles only.
12. Remove nuts securing left and right-hand wheel boxes and withdraw wheelboxes from bulkhead.

Fitting wheelboxes

NOTE: It is important that during the following assembly the fixings related to the wiper motor and wheelboxes are finger tightened only until all the components are correctly aligned.



ST3343M

13. Fit the wheelboxes to the bulkhead and loosely secure with the nut and washer.
14. Loosely fit the drive tubes to the wheelboxes
15. Feed the drive rack through the tubes until fully seated in both wheelboxes.
16. Loosely secure drive tube nut to wiper motor.
17 Loosely fit the wiper motor strap and earth lead.
18. When all components are correctly aligned, tighten the wheelbox nuts to secure the drive tubes. Tighten the wheelbox to bulkhead nuts.
19. Finally tighten the dnve tube nut to wiper motor and motor strap screws.
20. Connect the multiplug to wiper motor and earth lead to strap tag.
21. Fit the spacer, where used, early vehicles only.
22. Fit the wiper arm adaptors.
23. Connect the battery and check the operation of the motor and drive assembly and wheelboxes.
24. Disconnect the battery and reverse instructions 2 to 10. Ensure that the steering column upper and lower support rod fixings are tightened to the correct torque.
25. Reconnect the battery and check wiper operation again and adjust arms if necessary.

ELECTRICAL SYSTEMS

The electrical systems on the vehicle are made up of separate harnesses of which the Engine Harness, Chassis Harness and Main Harness Assembly are the main components. These three harnesses connect together and to smaller individual component harnesses to form the vehicle harness. Each harness can be separated and replaced individually The harnesses are shown in situ in the vehicle.

The following harness descriptions include listings of the items connected onto each harness and the colour coding of the relevant cables For information on the individual circuits which form the vehicle electrical system, refer to the Circuit Diagrams.

For information on the location and identification of relays. timers and control units, refer to the table and illustration in this section.

ENGINE HARNESS

This harness connects various electrical items fined to the engine and associated systems with the vehicle electrics via the main cable assembly. On Defender 110 the air conditioning fans harness is attached to the engine harness.

The items making up the harness and cable colours are:

Oil pressure switch and sensor
Colours: light green/white, white/brown

Coil
Colours: black/white

Alternator leads
Colours: brown/yellow, brown, white/slate (grey)

Fan temperature switch, 110 only
Colours: white/green, white, white

Air conditioning compressor lead, 110 only
Colours: black, brown/pink

Water temperature transmitter
Colours: green/blue

Starter solenoid
Colours: brown/red, brown

Air conditioning cable connections, 110 only
Colours: black, brown/pink, white/green

Dash ground connection
Colour: black

Main harness connection
Colours: brown/red, green/blue, white/slate, light green/white, white/brown. brown/yellow, white

AIR CONDITIONING FANS HARNESS ASSEMBLY DEFENDER 110 ONLY

This harness connects air conditioning fans and associated switches to the electrical system through a Connection onto the main harness assembly

The items making up the harness and the cable colours are:

Left hand fan motor
Colours: black/red, black

Right hand fan motor
Colours: black/red, black

High pressure switch
Colours: black/yellow, yellow/black

Ranco thermostat
Colours: black/yellow, white/purple, white/purple

Toe box ground connection
Colours: black x 3

Single lead to auxiliary connection on main harness
Colour: white

Main harness connections
Colours: brown, brown/slate, brownlorange

Condenser fan relay module
Colours: black/red, black/red, black, brown/orange, white/green

Compressor clutch relay module
Colours: black/slate, brown/slate, whitelpurple, brown/pink

'In dash' control unit
Colours: white/purple

Blower fan relay module connections
Colours: black, brown, white

Air conditioning harness connections
Colours: brown/pink. black, white/green

CHASSIS HARNESS

This harness connects the rear lights and fuel tank electrics with the main harness: various individual items are also connected to the chassis harness Including the hi-mount stop lamp cable

The items making up the harness and the cable colours are:

Right hand rear lights connections to the following
Ground connection
Colour: black

Tail light
Colours: red/orange

Indicator lamp
Colours: green/white

Reverse lamp
Colours: green/brown, green/brown

Stop lamp
Colours: green/purple, green/purple

Trailer feed (both sides) Defender 110
Colours: purple, purple

Rear lamp connections
Colours: black/brown, black/white

Heated rear window
Colours: white/black, black

Rear wash wipe
Colours: green, white/light green, black/light green

Rear tank connections
Colours: black, whiter/purple, green/black, black

Left hand rear lights connections to the following:
Rear lamp connection
Colours' black/green, green/blue

Ground connection
Colours: black

Indicator lamp
Colours: green/red

Reverse lamp
Colours: green/brown

Stop lamp
Colours: green/purple

Tail light
Colours: red/black

Vehicle speed sensor
Colours: green/yellow

Centre differential locked switch connection
Colours: black/purple. slate/red

Vehicle speed sensor MFI connection
Colour: yellow

Reverse light switch connection
Colour: green

Transmission oil temperature connection
Colour: black/purple

Main harness assembly connections
Colours: red/light green, green, brown/light green, black/blue, green/red, red/orange, green/purple. red/yellow, purple, red/black, green/white

MAIN HARNESS

This harness, fitted through the bulkhead, connects to the front lights, engine and chassis harnesses. main and dash fuse boxes and internal controls and instruments. The MFI harness and Radio harness are also connected into the main harness.

The items making up the main harness assembly and cable colours are:

Dash fuse box - terminals 1-20 (outer), Colours:

1	purple
2	purple/white,purple
3	green
4	green
5	green
6	blue/purple
7	blue/black
8	blue/pink
9	blue/orange
10	blue/slate
11	red
12	red
13	brown/purple
14	brown
15	brown
16	white
17	brown/white
18	white
19	whitelorange
20	white/blue

Dash fuse box - terminals 14-2OU (inner), Colours:

1	brown
2	brown
3	white
4	white/orange
5	white
6	blue
7	blue/red
8	blue/red
9	blue/white
10	blue/white
11	red/black
12	red/orange
13	white/blue
14	brown/orange
15	brown/slate
16	green
17	white/black
18	green
19	white/orange
20	white/purple

Inertia fuel shut-off switch connection
Colours: white/purple,white/blue

Front wiper delay unit
Colours. white/green, yellow/light green. black, light green, light green/brown

MFI connection
Colours: light green/purple, black, light green, light green/blue

Headlamp relay module
Colours: blue, white, black, blue

Start relay module
Colours: white/red, white/red, black, brown

Heated front screen timer, 110 only
Colours: black, green, black/purple, white/brown, purple/yellow

Heated front screen relay module, 110 only
Colours: brown/purple, purple/yellow, white/purple, orange/slate

Audible warning unit
Colours: brown, white/black, purple/orange, white, slate/black, black, white/purple, purple, red

Heated front screen connector, 110 only
Colour: black

Dimming mirror, 110 only
Colours: green, black

Wiper motor ground connection
Colour: black

Wiper motor connector
Colours: black, brown/light green, blue/light green, green, red/light green

Cigar lighter connector
Colours red/white

Rear washer switch, 110 only
Colours black/light green

Auxiliary instruments connection
Colours: light green/green, purple, green, light green/white

Spare connectors 1 - 4
Colours:
No 1 white
No 2 brown
No 3 black
No 4 red/white, red/white

Heated rear window switch. 110 only
Colours: white/light green, white. black. white/light green

Hazard warning switch
Colours. light green, purple, green/white. green light green/brown, greed/red, black/red. red/white black, black, black/red

Heated front screen switch. 110 only
Colours: black/purple, black, black, red/white, orange/slate,black

Heated rear window connector, 110 only
Colours: white/light green, white

Stop lamp switch 2
Colours: green/purple

Stop lamp switch 1
Colour: green

Ignition switch
Colours:
Position 1 - brown
Position 2 (key-in) - white/purple, brown
Position 3 - white/orange
Position 4 - white/red
Position 5 - white

Service reminder unit
Colours: black, purple/yellow, yellow, green, purple/white

Warning light check unit
Colours: black/yellow, white/yellow. white. black

Instruments connector
Colours: red/brown, brown, black, white. purple. green/black, green/blue, green, white/slate, light green/green

Instruments lead 1
Colour: white

Heater illumination
Colours: red/white, black. black

Tachometer
Colours: black, black, green, white/slate. red/white. red/white

Air conditioning connector 1, 110 only
Colours: brown. brown/slate. brown/orange

Right front speaker
Colours: black/green. black/blue

Left front speaker
Colours: black/white. black/brown

Illumination dimmer switch
Colours: red, red/white

Interior light
Colours. purple, purple/blue

Voltage sensitive switch connector
Colours: black/slate

Lighting connector
Colours: brown, red, blue

Horn, direction indicators, dip switch
Colours: blue, green/white, light green/brown, green/red, blue/white, blue/red, purple, purple/black

Wash wipe switch
Colours: blue/light green, light green/black, white/green, yellow/light green, red/light green, green

Warning lamps 1
Colours: slate/black, white/brown, white, brown/yellow, white/yellow, green/white, green/red, purple/yellow

Warning lamps 2
Colours: light green/purple. black, red, red/yellow, blue/brown, white/slate, black/blue, white, btack/yellow,black/yellow

MFI HARNESS

This harness connects the engine mounted items of the fuel injection system with the electronic control module and with the main cable assembly.

The items making up the harness and the cable colours are

Injectors (cyls 2, 4, 6, 8)
Colours: brown/orange, yellow/white

Injectors (cyls 1, 3, 5, 7)
Colours: brownl/orange, yellow/blue

Fuel temperature sensor
Colours: slate/white, red/black

Water temperature sensor
Colours: green/blue, red/black

Heated oxygen Sensors (2)
Colours: white/orange, black, core

Idle air conditioning valve, 110 only
Colours: green/white, blue/slate, orange, red/green

Purge valve
Colours: slate/yellow, white/purple

Coil connection
Colours: white/black

Mass air flow sensor connection
Colours: red/black. blue/green, brown/orange, brown/red

Vehicle speed sensor chassis harness connection
Colours: yellow, yellow

Main harness connector
Colours: white/purple, black/yellow. brown, white/green, white/red

Fault display unit
Colours. brom/orange, black/slate, pink, brown/pink

Fan timer relay module
Colours: black, white/green, black/green, black/red, brown/orange

Fuel pump relay module
Colours: white/purple x 2, white/orange x 2, white/red x 2, white

Main relay module
Colours: brownlorange x 3. brown x 2, blue red

Diagnostic plug
Colours: white/light green. white/pink.
black/slate x 2

RADIO HARNESS

This harness interconnects the radio equipment and the main harness. Two in-line fuses are provided within the harness.

The items connected to the harness and the cable colours are.

Power amplifier connector, 110 only
Colours: red, white, white/black, black/blue, black/brown, black/white, black/green, white/orange, black

Fuse holder (5A), 110 only
Colours: white/orange, white/orange

Rear speaker connector
Colours: black/white, black/green, black/blue, black/brown

RH front speaker OUT
Colours: black/green, black/blue

RH rear speaker OUT
Colours: red, red/black

LH front speaker OUT
Colours: black/white, black/brown

LH rear speaker OUT
Colours: white, white/black

Radio connector 1
Colours: black, red

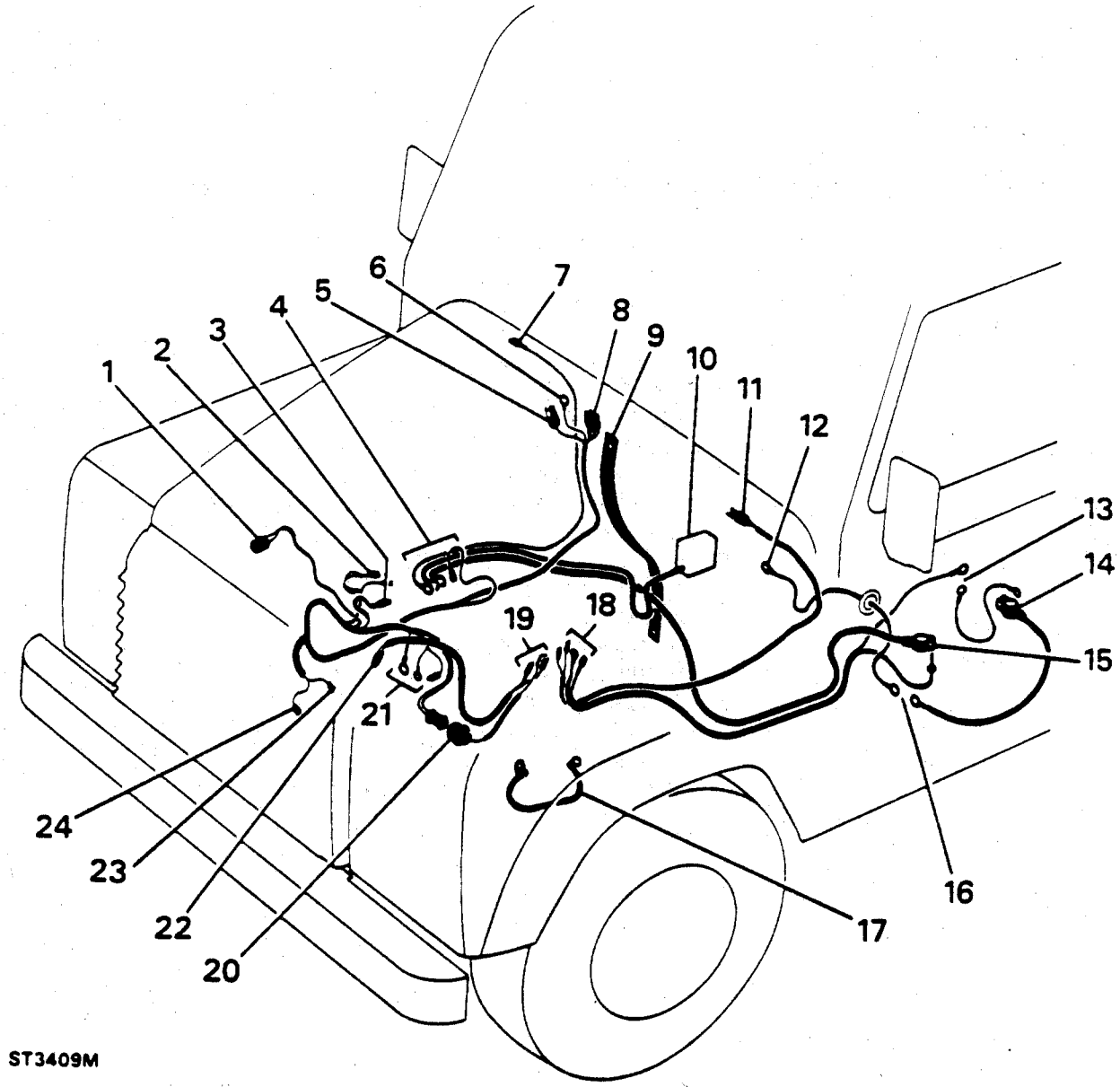
Radio connector 2
Colours: purple, red/white

Fuse holder (2A)
Colours: brown, brown

Main harness connector
Colours: purple, red/white, black/green. black/white, black/brown. black/blue, black. white/orange

ENGINE HARNESS CONNECTORS ST3409M

1. Air conditioning compressor connector, 110 only
2. Fan temperature transmitter, 110 only
3. Water temperature sensor
4. Starter motor connector
5. Air conditioning connection, 110 only
6. Ground
7. Air conditioning connection, 110 only
8. Main cable assembly connection
9. Ground braid
10. Main fuse box
11. Main cable assembly split charge connection, 110 only
12. Gearbox ground
13. Split charge terminals, 110 only
14. Battery terminal Ground -
15. Battery terminal Positive +
16. Isolation switch terminals
17. Engine ground strap
18. Split charge unit terminals
19. Coil connections
20. Low tension connection, 110 only
21. Alternator connection
22. Ignition module connection
23. Oil temperature sensor connection, 110 only
24. Oil pressure switch connections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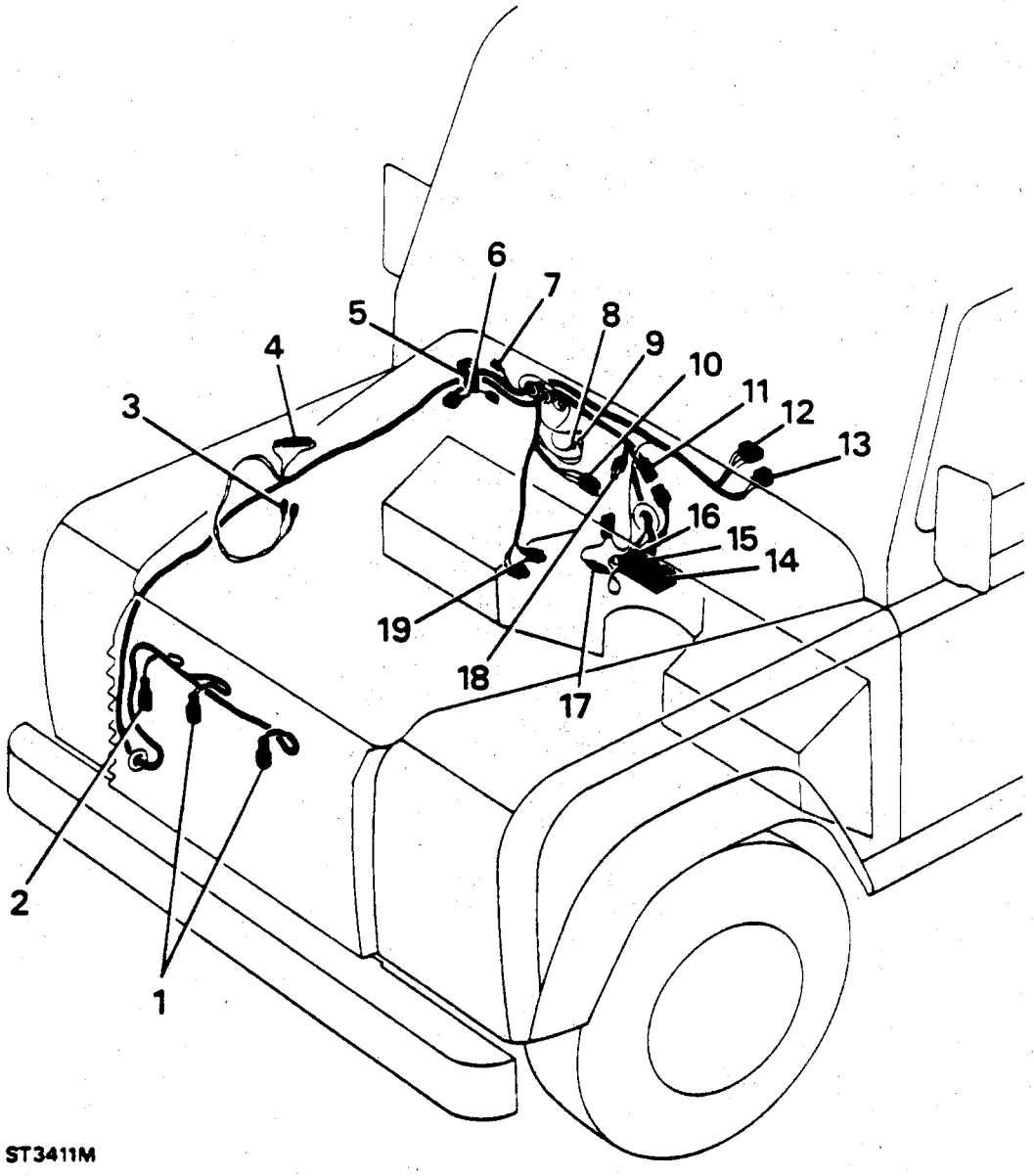
ST3409M

AIR CONDITIONING HARNESS CONNECTORS ST3411M

DEFENDER 110 ONLY

1. Condenser fan connectors
2. Fan switch connector
3. Thermostat connections
4. Diode connections
5. Resistor block connections
6. 30 amp fuse in holder
7. Evaporator connector
8. Auxiliary connection to main cable assembly
9. Ground
10. Engine harness connector
11. System relay module connector
12. Fan switch connector
13. A/C ON/OFF switch connector
14. Evaporator fan relay module connector
15. Compressor relay module connector
16. A/C main relay module
17. 30 amp auxiliary fuse connection
18. Main cable assembly connection
19. MFI cable assembly connection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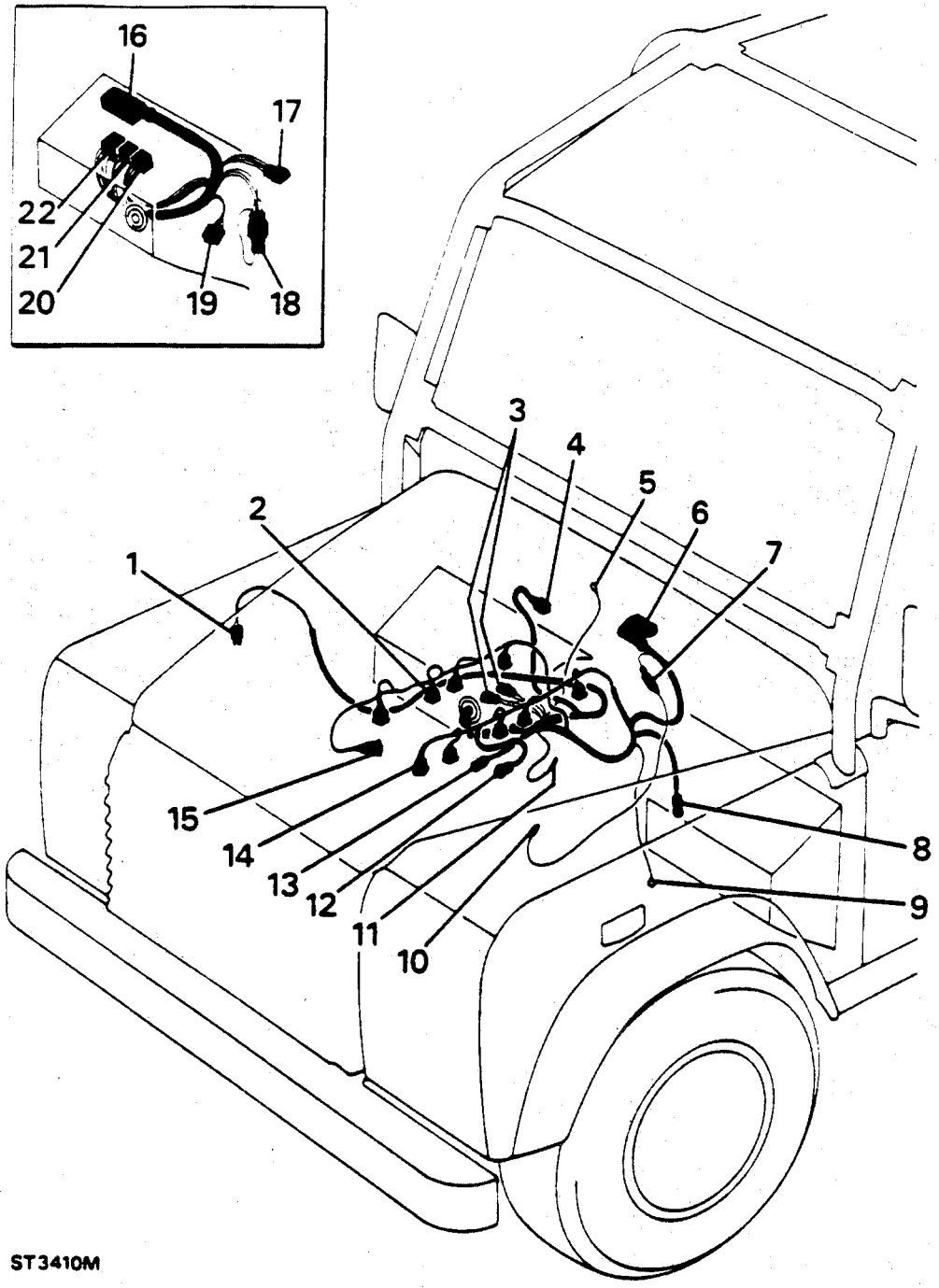
ST3411M

MULTIPORT FUEL INJECTION HARNESS CONNECTORS ST3410M

1. Purge valve connection
2. Injectors
3. A/C connection
4. Idle air control valve connection
5. Ground
6. Mass air flow sensor connector
7. Resistor
8. LH HO2S connector
9. Engine ground
10. Coil connection
11. Chassis harness speed sensor connector
12. Throttle position sensor connector
13. RH HO2S connector
14. Coolant temperature sensor connector
15. Fuel temperature sensor connector
16. MFI connection
17. Main harness connection
18. Diagnostics plug
19. Fault display unit connection
20. Fuel pump relay module
21. Main relay module
22. Fan timer relay module. 110 only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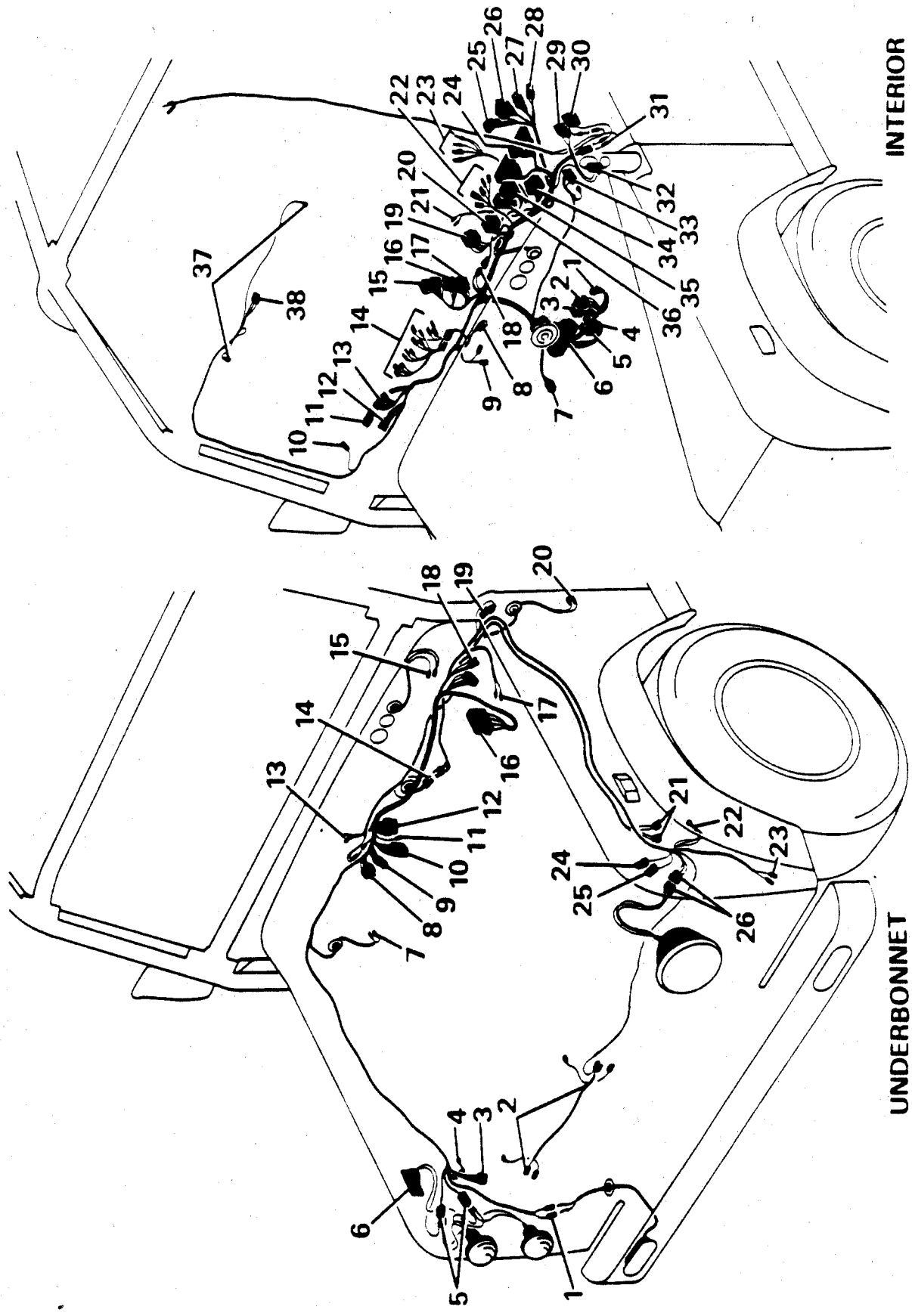
ST3410M

MAIN CABLE ASSEMBLY CONNECTORS UNDER BONNET ST3407M

1. Indicator connections RH side
2. Horn connections
3. Headlight connection RH side
4. Ground
5. Side marker light connection
6. Side marker light connection
7. RH Door switch
8. Spare
9. Heated rear window connection, 110 only
10. Engine harness connection
11. Air conditioning harness connection, 110 only
12. Chassis harness connection
13. Ground
14. Washer pumps connection
15. Brake switch connection
16. Main fuse box connection
17. Radio connection
18. Split charge connection, 110 only
19. Park/Neutral position switch connection
20. LH Door switch
21. Washer pumps connection
22. Ground
23. Indicator connections LH side
24. Side light Ground -
25. Side light Positive +
26. Headlamp connection LH side

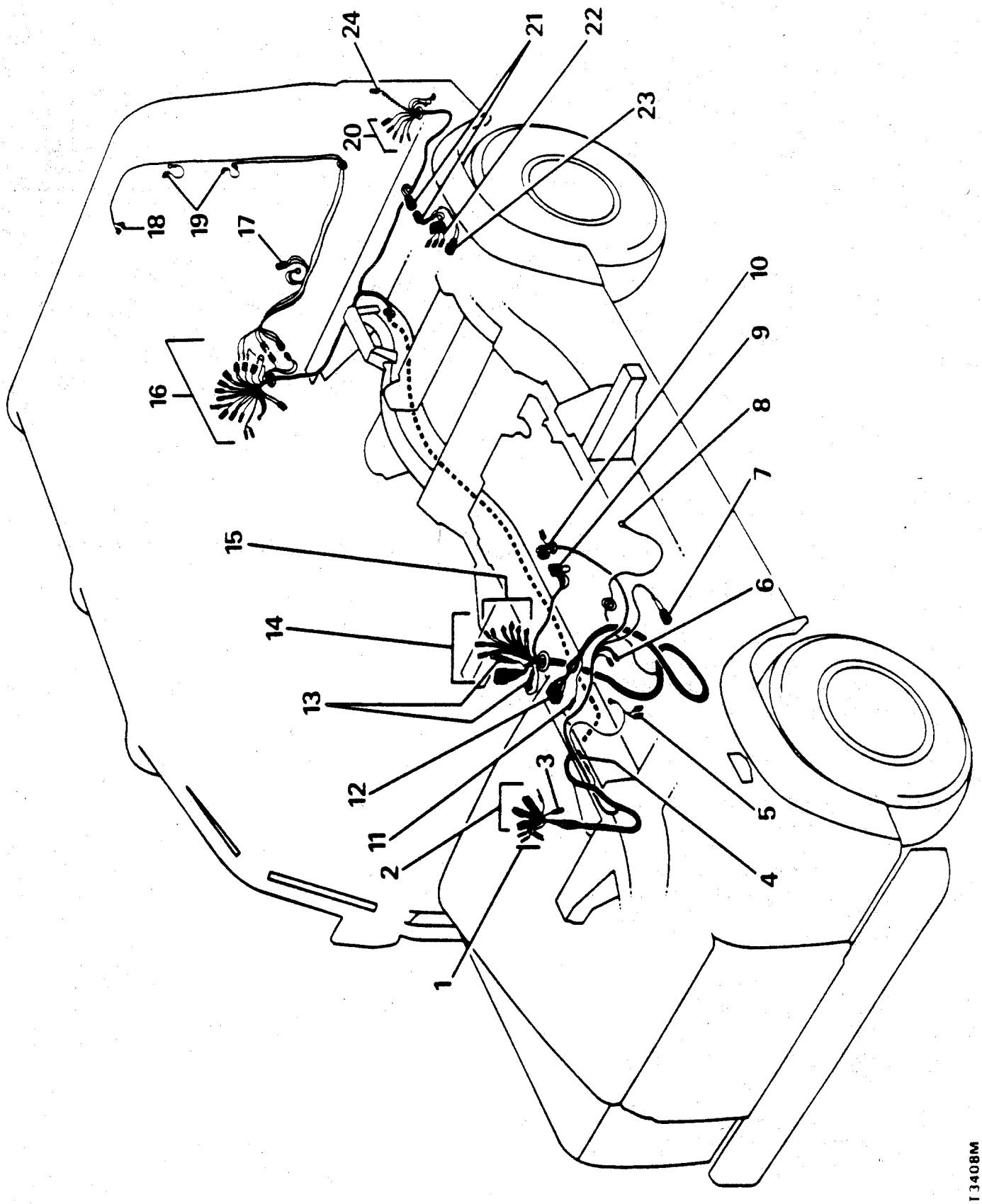
MAIN CABLE ASSEMBLY CONNECTORS VEHICLE INTERIOR ST3407M

1. Inertia switch connection
2. Hazard flasher relay module connection
3. Wiper delay unit connection
4. Starter relay module connection
5. Lighting relay module connection
6. Fuse box
7. MFI Connection
8. Air conditioning harness connection, 110 only
9. Speaker connections
10. Windshield Ground -, 110 only
11. Windshield relay module connection, 110 only
12. Windshield timer unit connection, 110 only
13. Audible warning unit connection
14. Auxiliary instrument connections
15. Heated rear window switch connection, 110 only
16. Heated Windshield switch connection, 110 only
17. Hazard warning connection
18. Heated rear window
19. Service reminder indicator unit
20. Engine/brake warning lamp check unit
21. Air conditioning illumination connection, 110 only
22. Starter/ignition switch connections
23. Tachometer connections
24. Instrument panel connections
25. Wash/wipe switch connection
26. Horn/indicators/dip switch connection
27. Lighting switch connection
28. Not used
29. Panel light dimmer connection
30. Interior light connection
31. Interior light connection
32. Panel light ON resistor
33. Wiper connections
34. Instrument connections
35. Heated rear window relay module, 110 only
36. Voltage sensitive switch
37. Heated front screen connections, 110 only
38. Mirror connections, 110 only


INTERIOR
UNDERBONNET
ST3407M

CHASSIS AND RADIO HARNESS CONNECTORS ST3408M

1. Gearbox over temperature switch connection
2. Main harness connection
3. Transmission low oil connections
4. Centre differential lock connections
5. Centre differential lock switch
6. Reverse light connection
7. Speed sensor connection
8. Radio supply lead
9. Rear speaker connection
10. Rear speaker and seat belt connections
11. Supply to split charge circuit, 110 only
12. Main harness connection
13. Radio fuses
14. Radio connections
15. Speaker connections
16. Rear light connections
17. Rear wiper motor connections, 110 only
18. High level brake light
19. Heated rear window connections, 110 only
20. Rear tank Connections, 110 only
21. Fuel tank cable connections
22. Fuel level indicator connections, 110 only
23. Fuel pump connection
24. Speaker connection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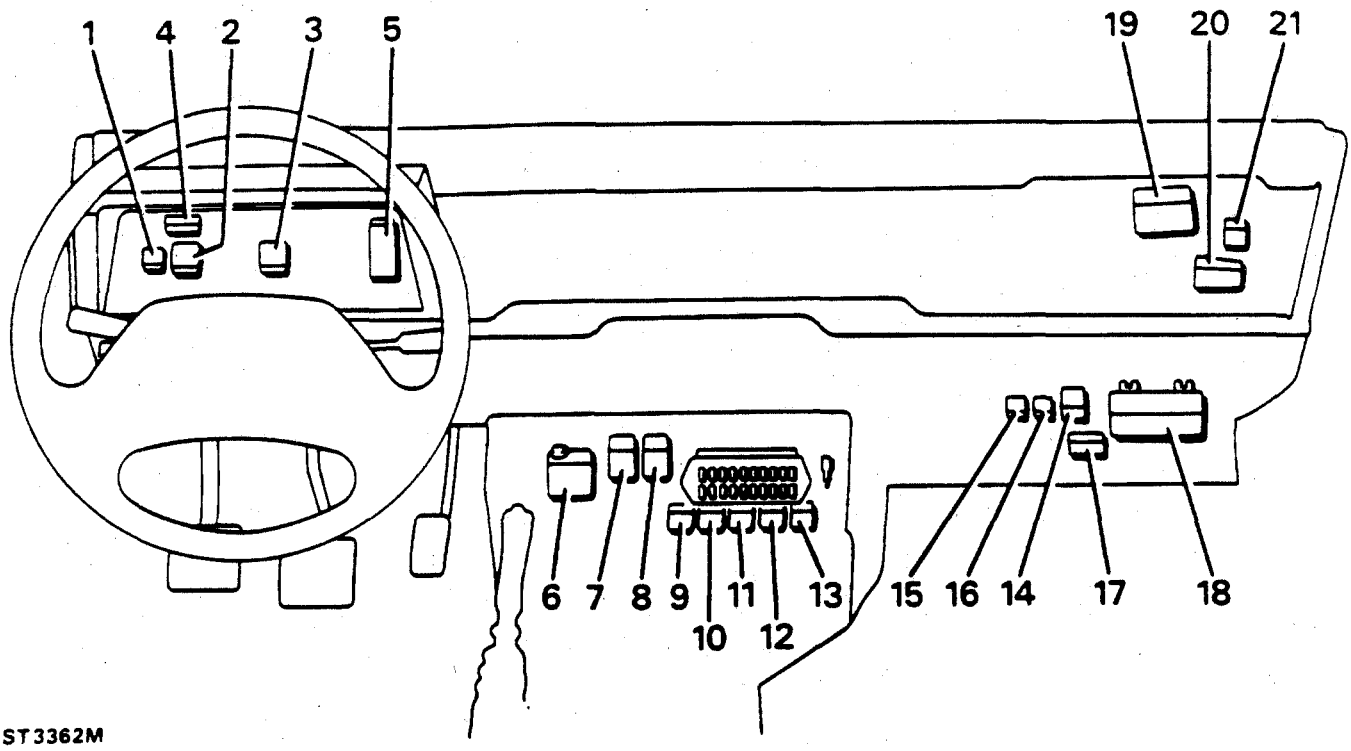
ST3408M

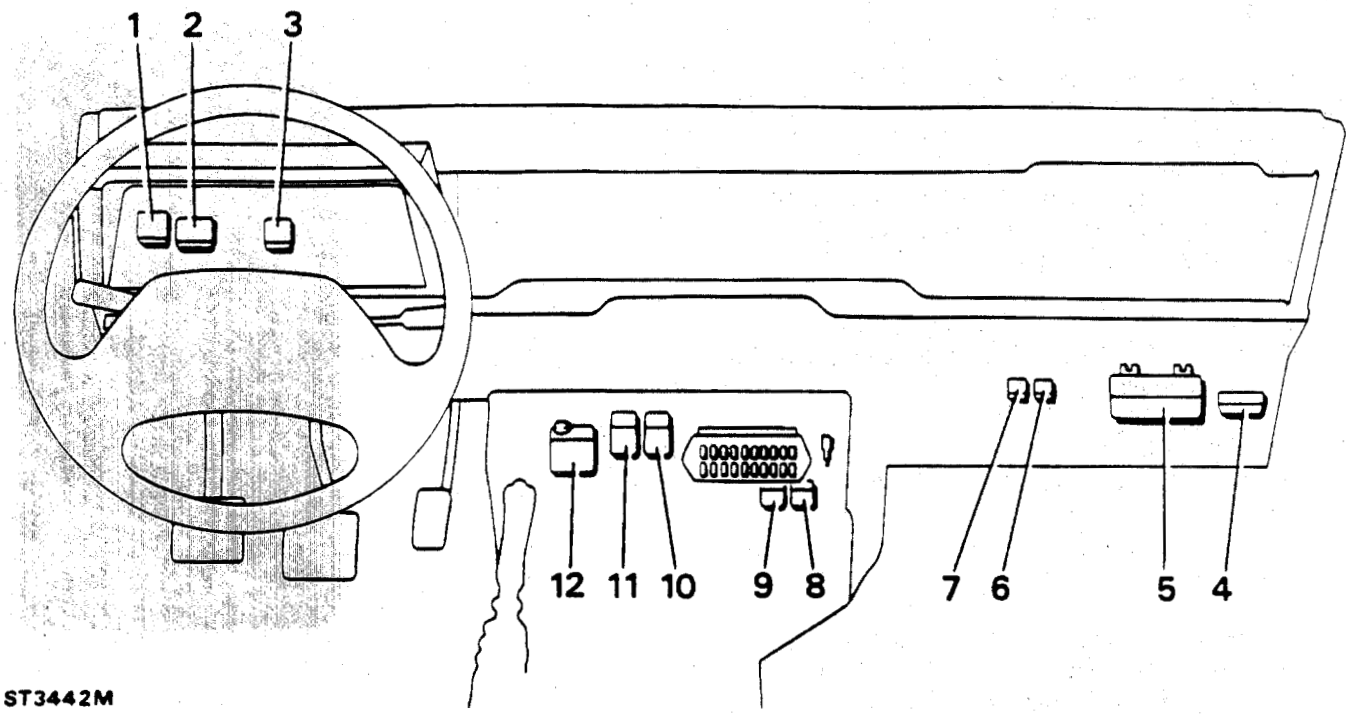


ST3362M

LOCATION O F RELAYS, TIMERS AND C O N T R O L UNITS DEFENDER 110 (ST3362M)

	Relay etc 8 circuit symbol	Location
1	Rear screen relay module HR4	behind instrument binnacle
2	Voltage sensitive switch relay module SC2	
3	Engine/brake warn light check unit WL1	
4	Water temperature signal conditioner WT2	
5	Service reminder unit EM1	
6	Inertia switch EF9	
7	Flasher/hazard unit DF5	adjacent dash f u s e box
8	Wiper delay unit FW3	
9	Starter relay module ST6	
10	Lighting relay module LS2	
11	Evaporator relay module AC3	
12	Compressor relay moduler AC9	
13	Main relay module AC1	
14	Condenser fan timer AC7	RH toe box area
15	Fuel pump relay module EF8	
16	Main MFI relay module EF6	
17	Diagnostic relay module MF16	
18	MFI E C M unit ECM	
19	Warning buzzer unit AW6	RH upper dash area
20	Front screen timer HF4	
21	Front screen relay module HF3	

See relevant circuit diagram



ST3442M

LOCATION OF RELAYS, TIMERS AND CONTROL UNITS DEFENDER 90 (ST3442M)

	Unit and circuit symbol	Location
1	Warning buzzer unit AW6	behind instrument binnacle
2.	Service reminder unit EM1	
3.	Engine/brake warn light check unit WL 1	
4	Diagnostic relay module MF16	RH toe box area
5.	MFI ECM unit ECM	
6.	Main MFI relay module EF6	
7	Fuel pump relay module EF8	
8	Lighting relay module LS2	adjacent dash fuse box
9	Starter relay module ST6	
10	Wiper delay unit FW3	
11	Flasher/hazard unit DF5	
12	Inertia switch EF9	

CIRCUIT DIAGRAMS

The circuits which comprise the electrical system are presented as a series of individual circuit diagrams covering a specific function, eg starter circuit, lighting circuit, audible warning circuit etc. To ensure continuity of terminology throughout the circuits, circuit symbols and abbreviations are consistent.
Wire colour is as follows:

B=black G=green K=pink L=light N=brown O=orange P=purple R=red S=slate(grey) U=blue W=white Y=yellow

The first letter of the code identifies the wire main colour and the second letter identifies the tracer colour.

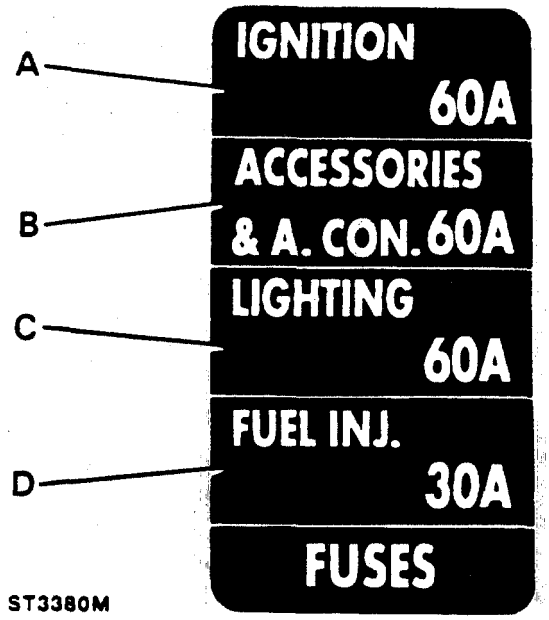
FUSES

The main fuse box is located within the engine bay, attached to the left hand side of the bulkhead. The fuse box has four fuses, designated A,B,C and D for the purpose of these circuit diagrams; see illustration for details of the fuses. All wires from the fuse box are coloured brown.
The auxiliary fuse box is located below the centre of the dash. The fuse box has 20 fuses, designated 1 to 20; these are identified as F1,F2 etc in the circuit diagrams. The illustration and associated table details the circuits protected by the different fuses and the colours of the wires linked to the terminals.
In addition to the main and auxiliary fuse boxes, in-line fuses are protected in the following circuits:

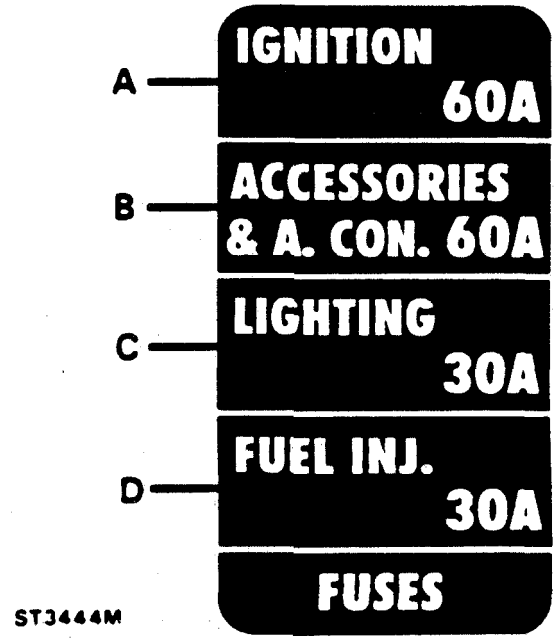
R1-Radio amplifier feed-5A
C16-Air conditioning fan-30A
R2-Radio trigger circuit-2A
AC 17-Air conditioning heater relay-30A

MAIN FUSE BOX SCHEMATIC

FUSE	CIRCUITS OR DASH FUSE SERVED
A	ALL IGNITION FED CIRCUITS inc dash fuses 3-4-5-16-17-18-19
B	BATTERY FEED CIRCUITS inc. dash fuses 1-2-13-14-15
C	LIGHTING CIRCUITS inc. dash fuses 6-7-8-9-10-11-12
D	MFI-FUEL INJ. inc. dash fuse 20

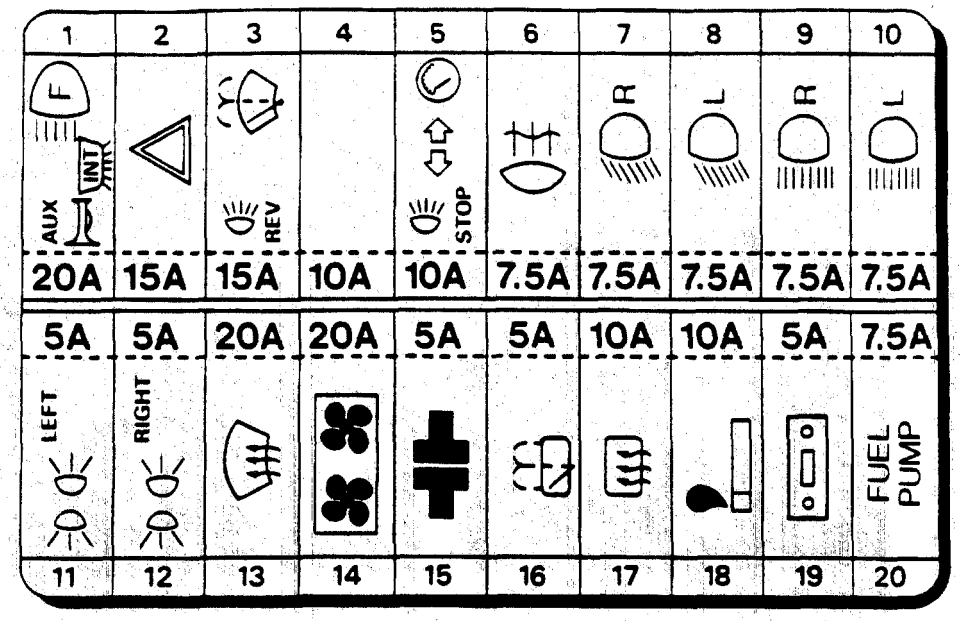


DEFENDER 110



DEFENDER 90

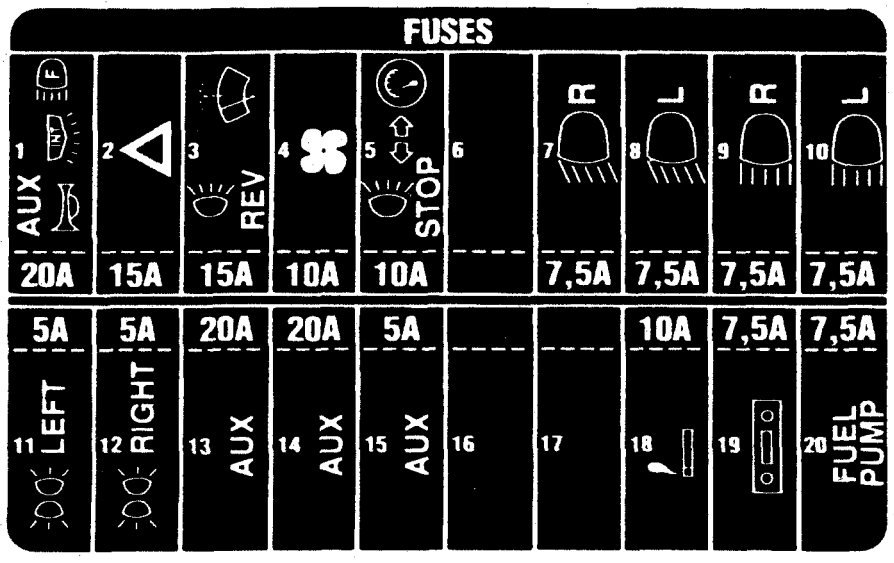
DASH FUSE BOX SCHEMATIC DEFENDER 110 ST3385M



ST3385M

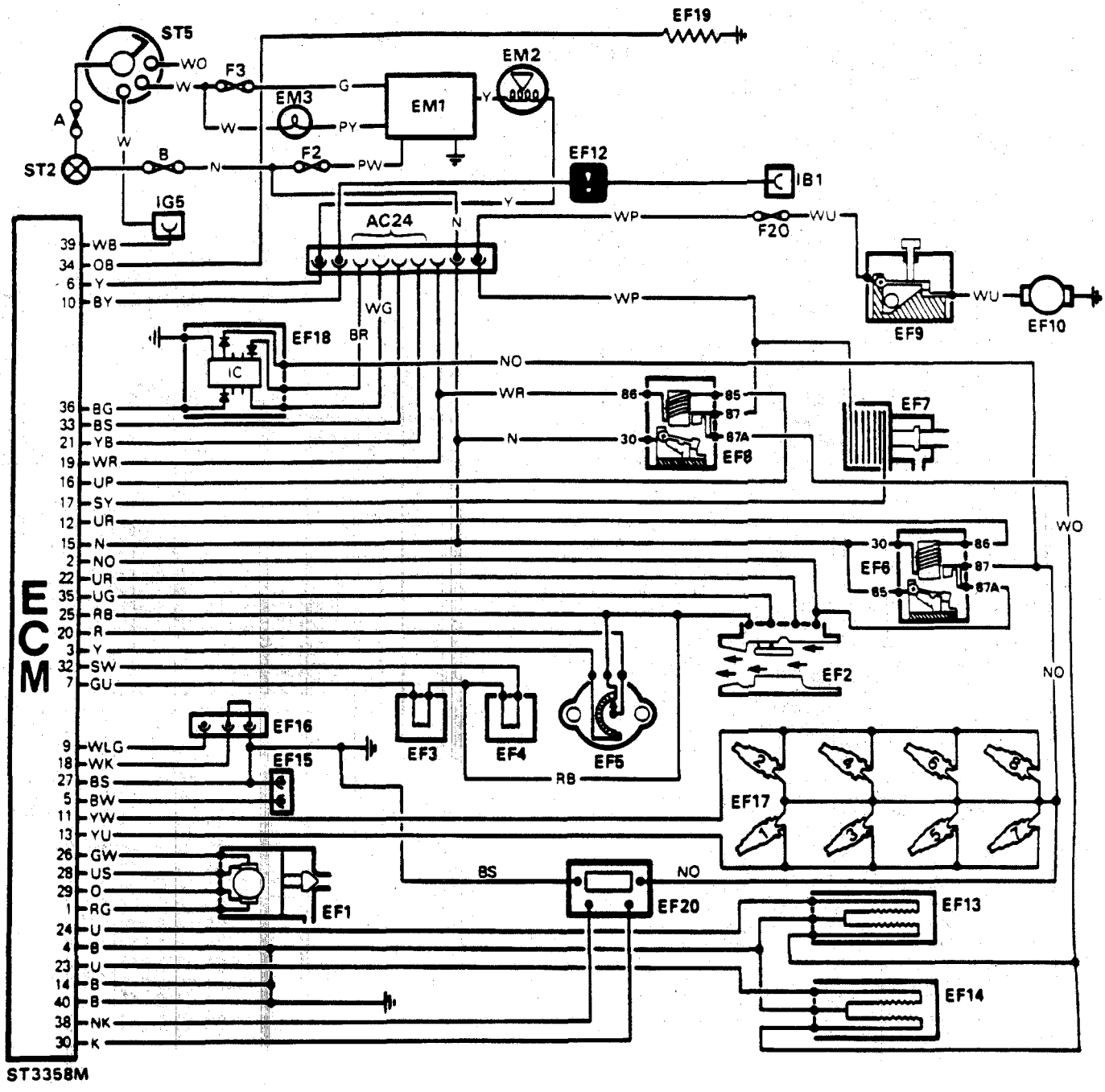
MAIN FUSE	DASH FUSE	VALUE	CABLE COLOUR IN	CABLE COLOUR OUT	CIRCUITSERVED BY FUSE
B	1	20A	N	P	Aux. instrument; fog lights; horn: int. lights
B	2	15A	N	P,PW	Hazard lights; SRI light
A	3	15A	W	G	Reverse light: electric screen wash
A	4	10A	W	G	Dimming mirror
A	5	10A	W	G	Stop lights, direction indicators
C	6	7.5A	U	UP	Not used
C	7	7.5A	UR	UB	Right head lamp dipped beam
C	8	7.5A	UR	UK	Left head lamp dipped beam
C	9	7.5A	UW	UO	Right head lamp main beam
C	10	7.5A	u w	u s	Left head lamp main beam
C	11	5 A	U	R	Left side lights
C	12	5 A	R	RO	Right side lights
B	13	20A	N	NP	Heated Windshield
B	14	20A	N	NO	Air conditioning
B	15	5 A	N	NS	Air conditioning
A	16	5 A	W	G	Rear screen wash/wipe
A	17	10A	WB	NW	Heated rear window
A	18	10A	W	G	Cigar lighter
A	19	5 A	WO	w o	Radio
D	20	7.5A	WP	WU	Fuel pump

DASH FUSE BOX SCHEMATIC DEFENDER 90 ST3443



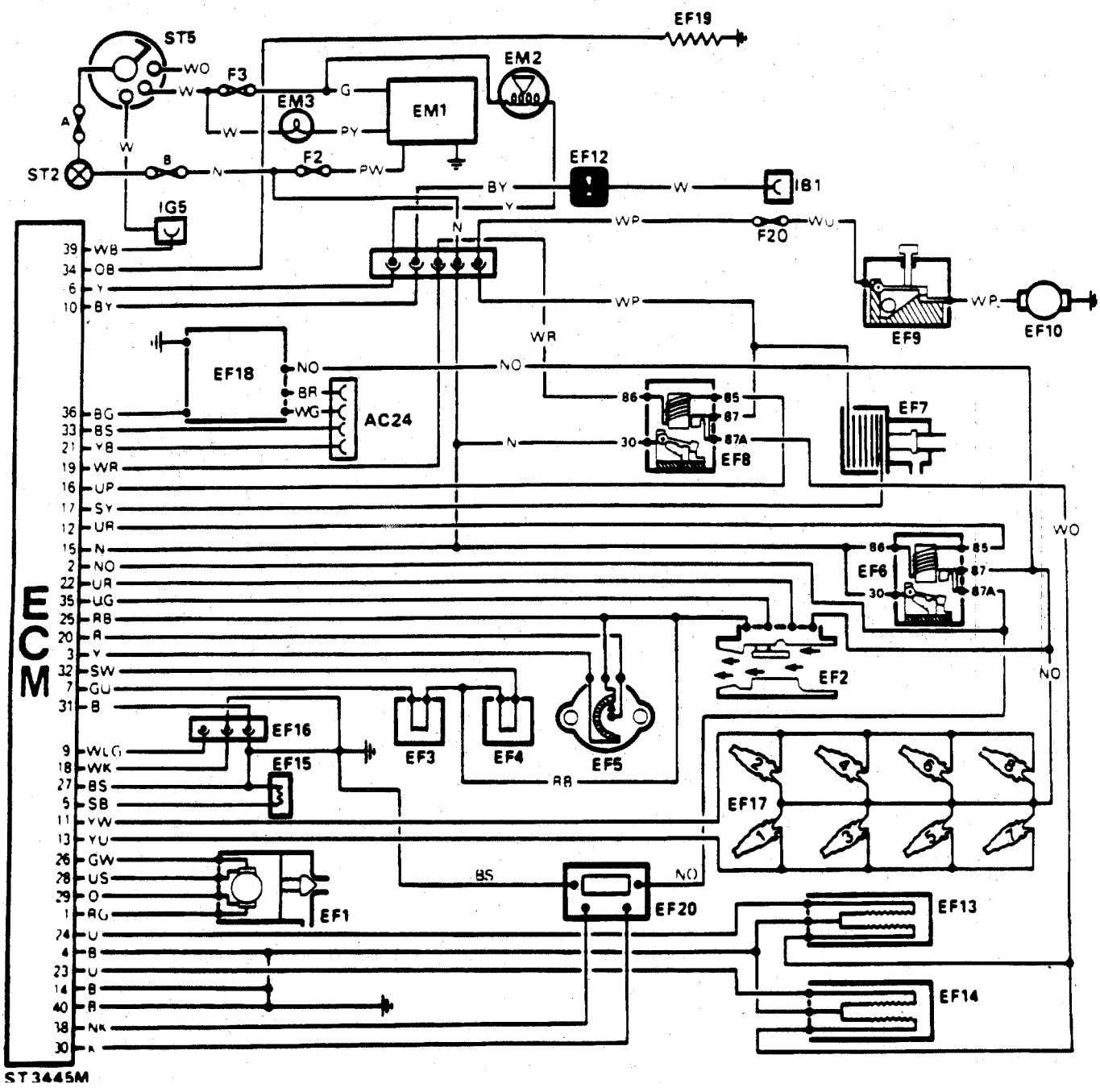
ST3443M

MAIN FUSE	DASH FUSE	VALUE	CIRCUIT SERVED
B	1	20A	Aux. instrument; fog lights; horn; int. lights
B	2	15A	Hazard warning lights
A	3	15A	Reverse light: electric screen wash
A	4	10A	Heater blower motor
A	S	10A	Stop lights, direction indicators
	6		Not used
C	7	7.5A	Right head light dipped beam
C	8	7.5A	Left head light dipped beam
C	9	7.5A	Right head light main beam
C	10	7.5A	Left head light main beam
C	11	5A	Left side lights
C	12	5A	Right side lights
B	13	20A	Auxiliary
B	14	20A	Auxiliary
B	1s	5A	Auxiliary
	16		Not used
	17		Not used
A	18	10A	Cigar lighter
A	19	5A	Radio
D	20	7.5A	Fuel pump



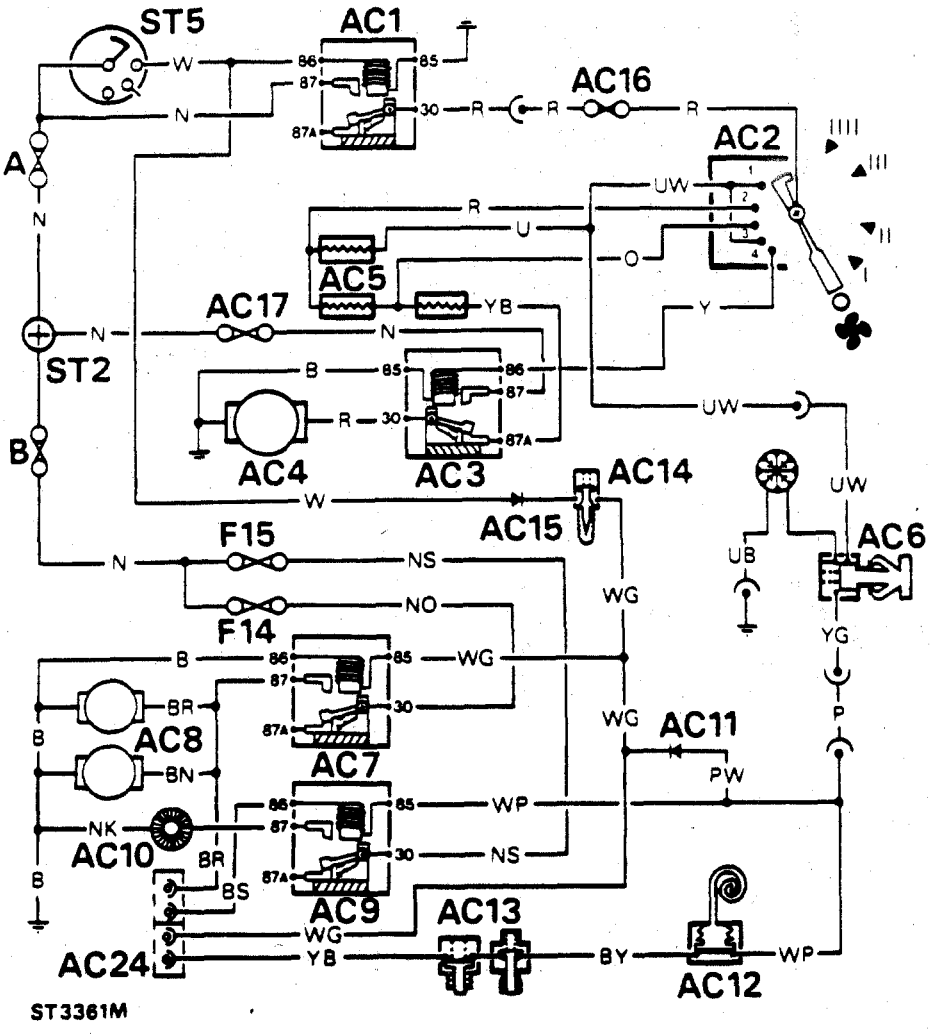
MULTIPORT FUEL INJECTION (MFI) CIRCUIT DEFENDER 110 (ST3358M)

EF1 Idle air control valve
EF2 Mass air flow sensor
EF3 Engine coolant temperature sensor
EF4 Engine fuel temperature sensor
EF5 Throttle position sensor
EF6 Main relay module
EF7 Canister purge valve
EF8 Fuel pump relay module
EF9 Inertia fuel shut-off switch
EF10 Fuel pump
EF12 Malfunction indicator lamp
EF13 Heated oxygen sensor
EF14 Heated oxygen sensor
EF15 Tune resistor connector
EF16 Data link connector
EF17 Fuel injectors
EF18 Fan control timer
EF19 Resistor (manual transmission)
EF20 Onboard diagnostic module
EM1 Service reminder indicator unit
EM2 Vehicle speed sensor
EM3 Service reminder light
IB1 Instrument binnacle
IG5 Ignition coil
ST2 Terminal post starter solenoid
ST5 Starter/ignition switch
AC24 Air conditioning connections
F2 15 amp fuse, dash fuse box
F3 15 amp fuse. dash fuse box
F20 20 amp fuse. dash fuse box



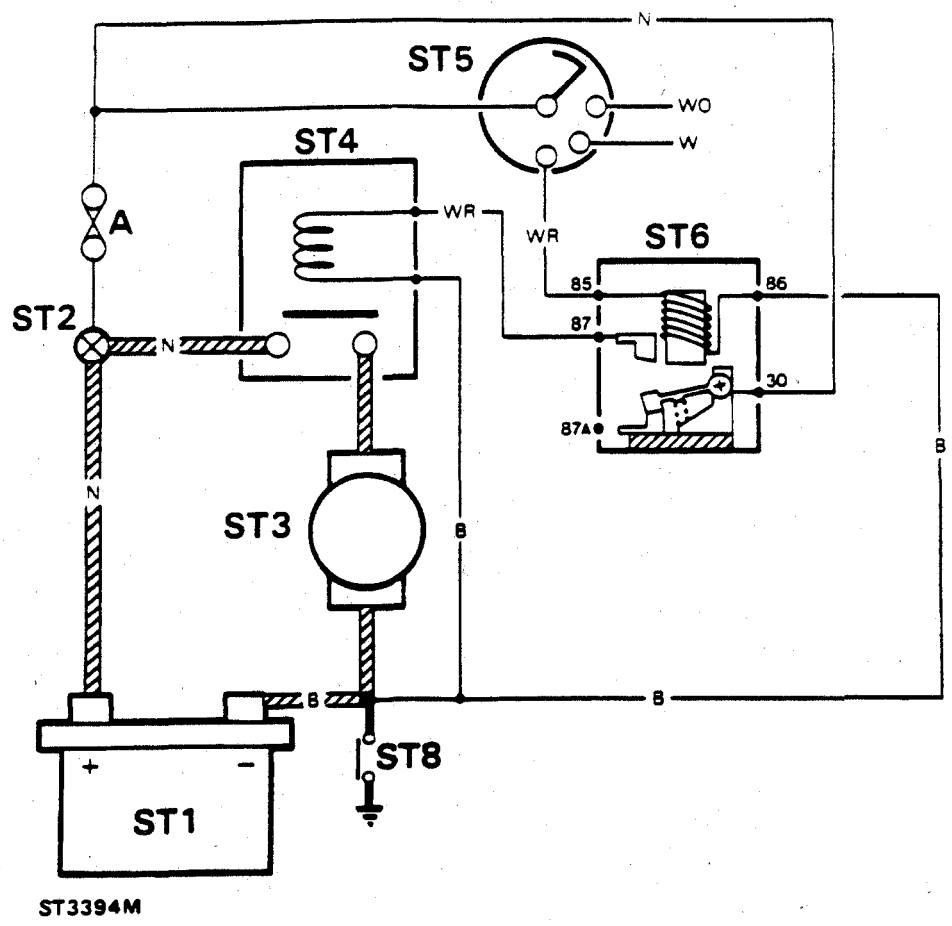
MULTIPORT FUEL INJECTION (MFI) CIRCUIT DEFENDER 90 (ST3445M)

EF1 Idle air control valve
EF2 Mass air flow sensor
EF3 Engine coolant temperature sensor
EF4 Engine fuel temperature sensor
EF5 Throttle position sensor
EF6 Main relay module
EF7 Canister purge valve
EF8 Fuel pump relay module
EF9 Inertia fuel shut-off switch
EF10 Fuel pump
EF12 Malfunction indicator lamp
EF13 Heated oxygen sensor
EF14 Heated oxygen sensor
EF15 Tune resistor
EF16 Data link connector
EF17 Fuel injectors
EF18 Fan control timer (not fitted)
EF19 Resistor (manual transmission)
EF20 Onboard diagnostic module
EM1 Service reminder indicator unit
EM2 Vehicle speed sensor
EM3 Service reminder light
IB1 Instrument binnacle
IG5 Ignition coil
ST2 Terminal post starter solenoid
ST5 Starter/ignition switch
AC24 Not used
F2 15 amp fuse. dash fuse box
F3 15 amp fuse, dash fuse box
F20 20 amp fuse, dash fuse box



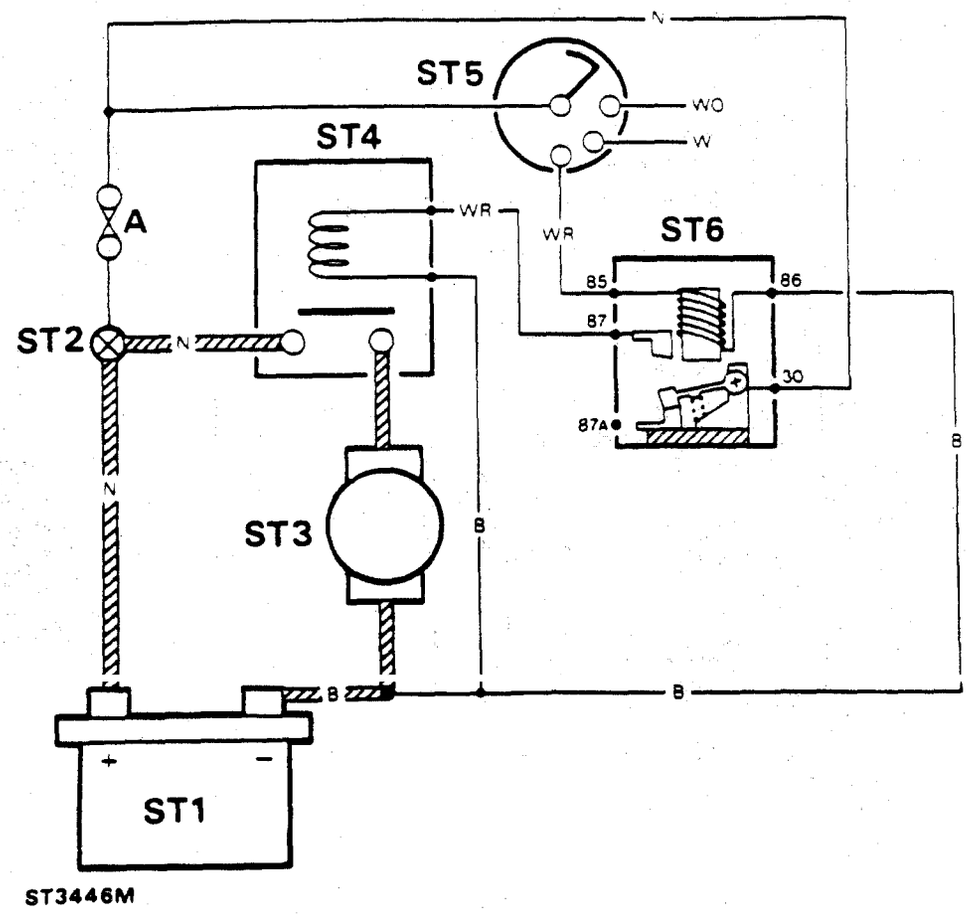
AIR CONDITIONING CIRCUIT DEFENDER 110 (ST3361M)

AC1 System relay module
AC2 Evaporator/heater fan switch
AC3 Evaporator/heater fan relay module
AC4 Evaporator/heaterfan
AC5 Evap/heater fan speed resistor
AC6 A/C on/off switch
AC7 Condenser fan relay
AC8 Condenser fans
AC9 Compressor relay module
AC10 Compressor
AC11 Diode
AC12 Thermostat
AC13 Refridgerant pressure switches
AC14 Engine coolant temperature switch
AC15 Diode
AC16 Fuse in holder - 30 amp
AC17 Fuse in holder - 30 amp
AC24 Connectors to MFI ECM
ST2 Terminal post starter solenoid
ST5 Starter/ignition switch
B 60 amp fuse, main fuse box
F14 20 amp fuse, main fuse box
F15 5 amp fuse, dash fuse box



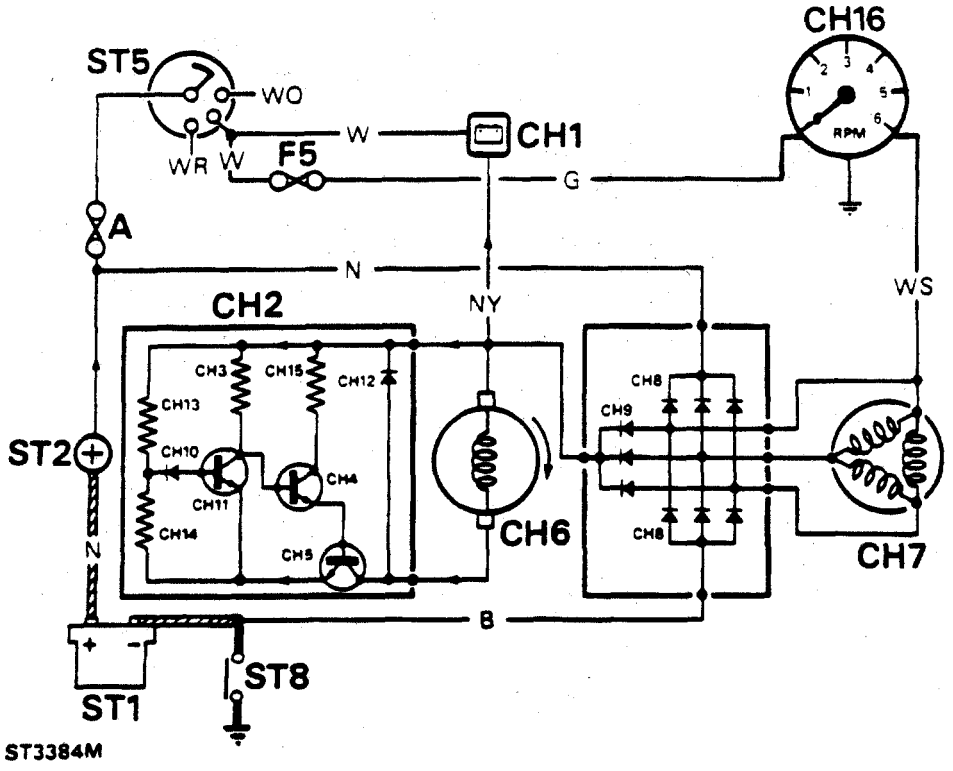
STARTING SYSTEM CIRCUIT DEFENDER 110 (ST3394M)

ST1	Battery
ST2	Terminal post starter solenoid
ST3	Starter motor
ST4	Starter solenoid
ST5	Starter ignition switch
ST6	Stan relay module
ST8	Battery isolator switch
A	60 amp fuse, main fuse box



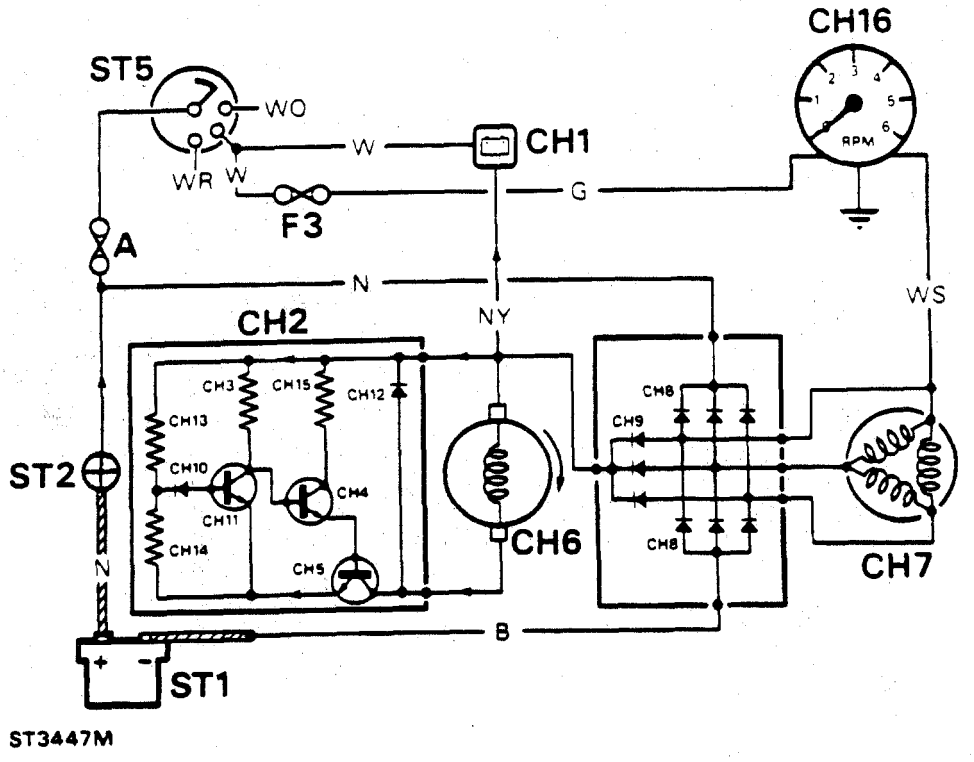
STARTING SYSTEM CIRCUIT DEFENDER 90 (ST3446M)

ST1	Battery
ST2	Terminal post starter solenoid
ST3	Starter motor
ST4	Starter solenoid
ST5	Starter ignition switch
ST6	Start relay module
A	60 amp fuse, main fuse box



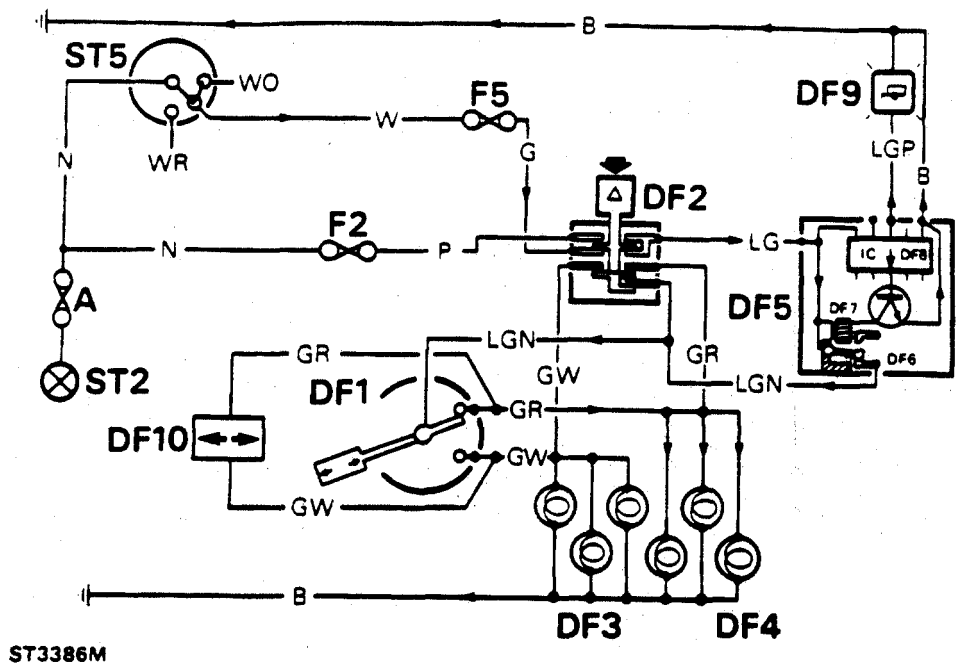
CHARGING AND TACHOMETER CIRCUIT DEFENDER 110 (ST3384M)

CH1 Charge/ignitionwarning light
CH2 Voltage regulator (solid state)
CH3 Resistor
CH4 Transistor
CH5 Transistor
CH6 Alternator rotor field windings
CH7 Alternator stator windings
CH8 Rectifier diodes
CH9 Auxiliary diodes
CH10 Zener diode
CH11 Transistor
CH12 Field **protection** diode
CH13 Resistor
CH14 Resistor
CH15 Resistor
CH16 Tachometer
ST1 Battery
ST2 Terminal post starter solenoid
ST5 Starter/ignitionswitch
ST8 Battery isolating switch
A 60 amp fuse, main fuse box
F5 10 amp fuse, dash fuse box



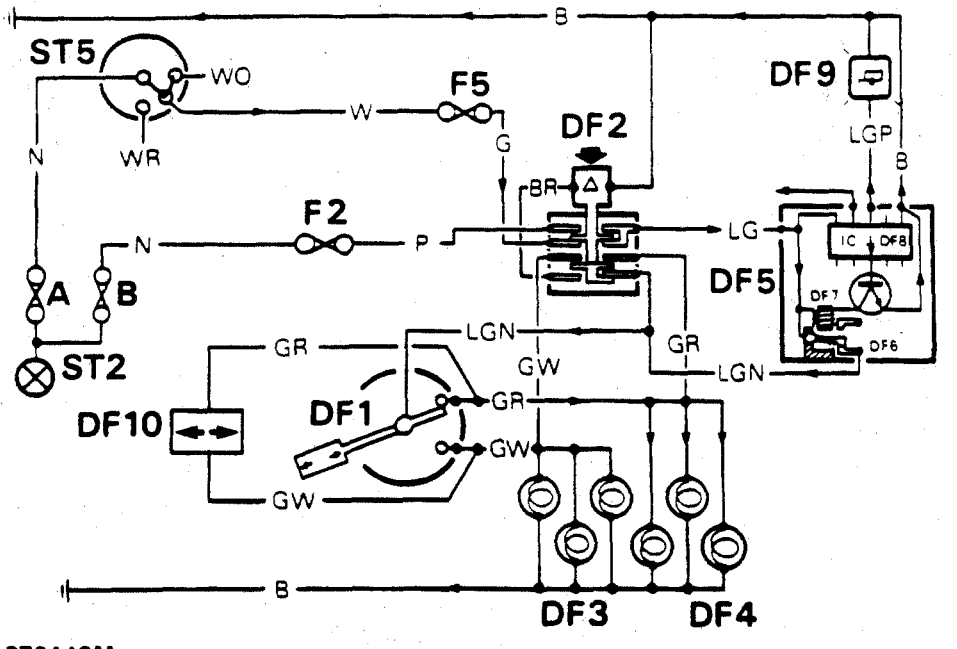
CHARGING AND TACHOMETER CIRCUIT DEFENDER 110 (ST3447M)

CH1 Charge/ignition warning light
CH2 Voltage regulator (solid state)
CH3 Resistor
CH4 Transistor
CH5 Transistor
CH6 Alternator rotor field windings
CH7 Alternator stator windings
CH8 Rectifier diodes
CH9 Auxiliary diodes
CH10 Zener diode
CH11 Transistor
CH12 Field protection diode
CH13 Resistor
CH14 Resistor
CH15 Resistor
CH16 Tachometer
ST1 Battery
ST2 Terminal post starter solenoid
ST5 Starter/ignition switch
A 60 amp fuse, main fuse box
F5 10 amp fuse, dash fuse box



HAZARD FLASHER CIRCUIT DEFENDER 110 (ST3386M)

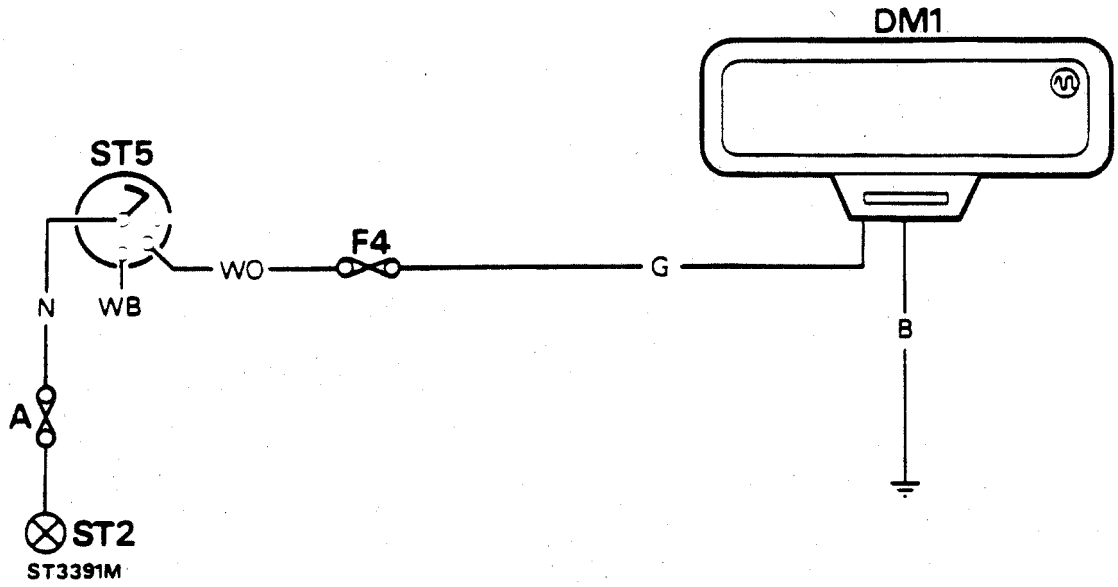
DF1 Direction indicator switch
DF2 Flasher switch and warning light
DF3 Right side indicator lamps including trailer
DF4 Left side indicator lamps including trailer
DF5 Flasher unit
DF6 Flasher unit internal relay module
DF7 Flasher unit internal IC timer
DF6 Integrated circuit
DF9 Indicator warning light, trailer
DF10 Indicator warning light, vehicle
ST2 Terminal post starter solenoid
A 60 amp fuse, main fuse box
F2 15 amp fuse, dash fuse box
F5 10 amp fuse, dash fuse box



ST3448M

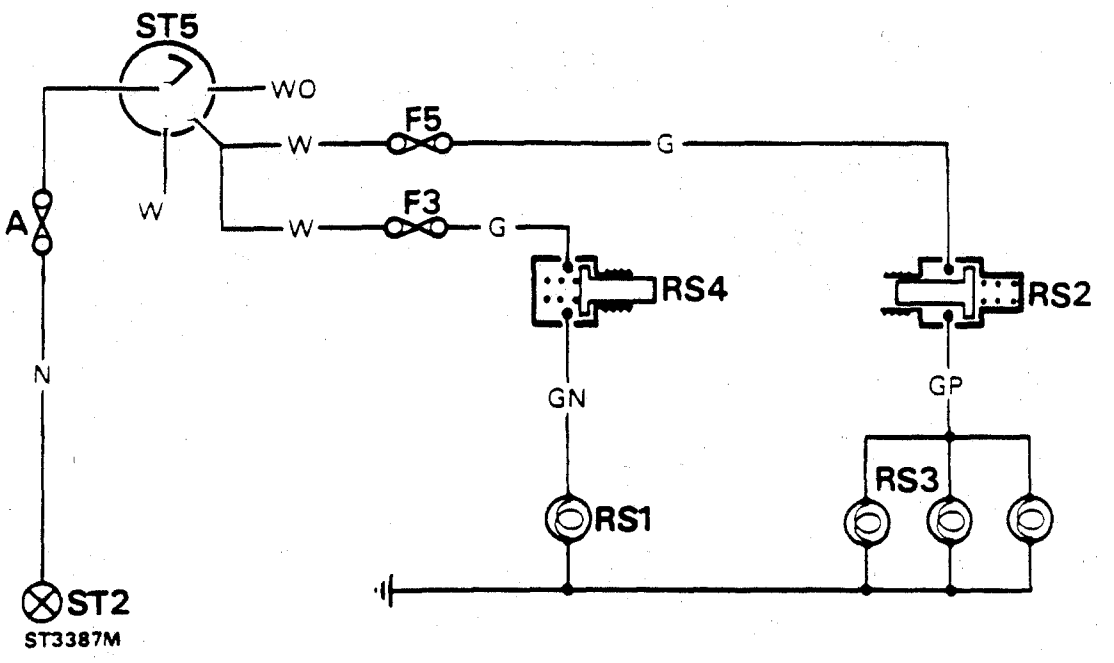
HAZARD FLASHER CIRCUIT DEFENDER 90 (ST3448M)

DF1 Direction indicator switch
DF2 Flasher switch and warning light
DF3 Right side indicator lamps including trailer
DF4 Left side indicator lamps including trailer
DF5 Flasher unit
DF6 Flasher unit internal relay module
DF7 Flasher unit internal IC timer
DF8 Integrated circuit
DF9 Indicator warning light. trailer
DF10 Indicator warning light. vehicle
ST2 Terminal post strater solenoid
A 60 amp fuse, main fuse box
B 60 amp fuse, main fuse box
F2 15 amp fuse. dash fuse box
F5 10 amp fuse, dash fuse box



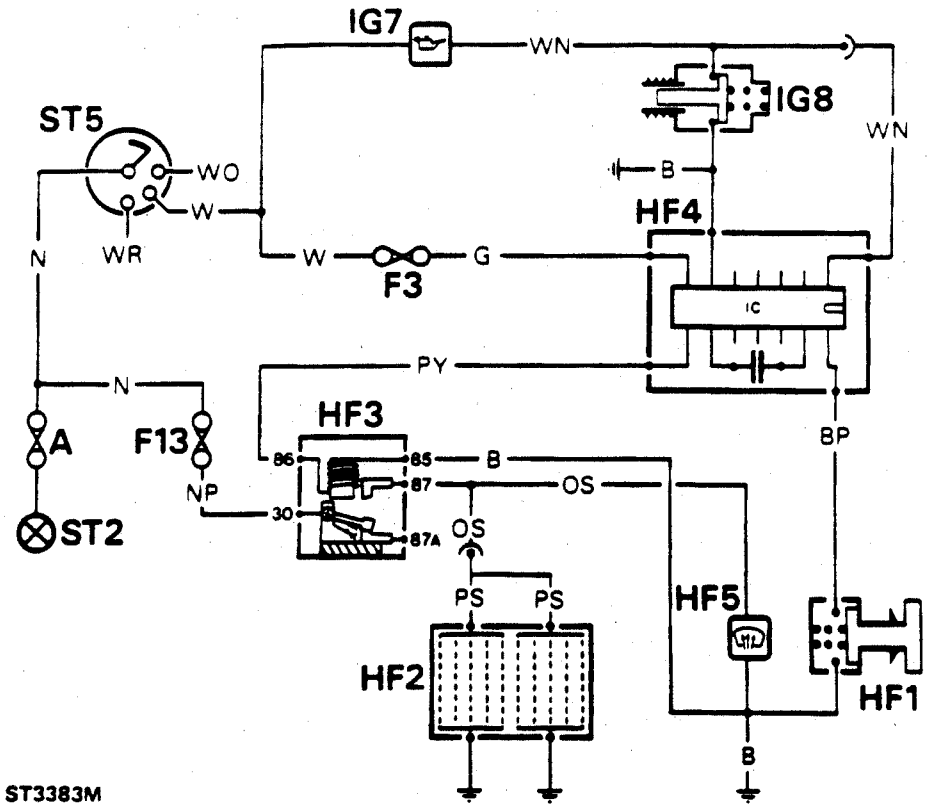
DIMMING MIRROR CIRCUIT DEFENDER 110 (ST3391M)

DM1	Dimming mirror
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse, main fuse box
F4	10 amp fuse, dash fuse box



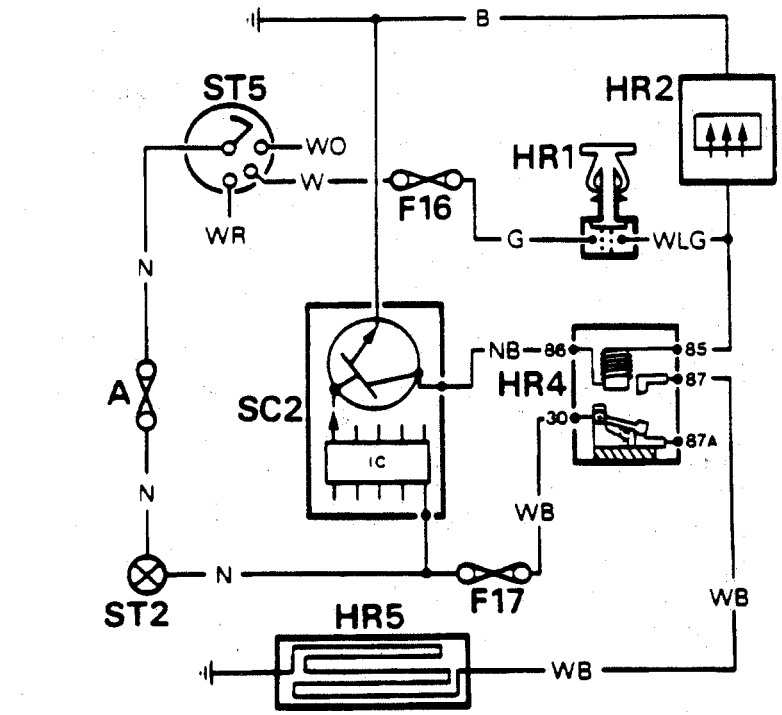
REVERSE ANDSTOP LAMP CIRCUIT DEFENDER 90 AND 110 (ST3387M)

RS1	Reverse lamp
RS2	Stop lamp switch
RS3	Stop lamps
RS4	Reverse lamp switch
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse, main fuse box
F3	15 amp fuse, dash fuse box
F5	10 amp fuse, dash fuse box



HEATED FRONT SCREEN CIRCUIT DEFENDER 110 (ST3383)

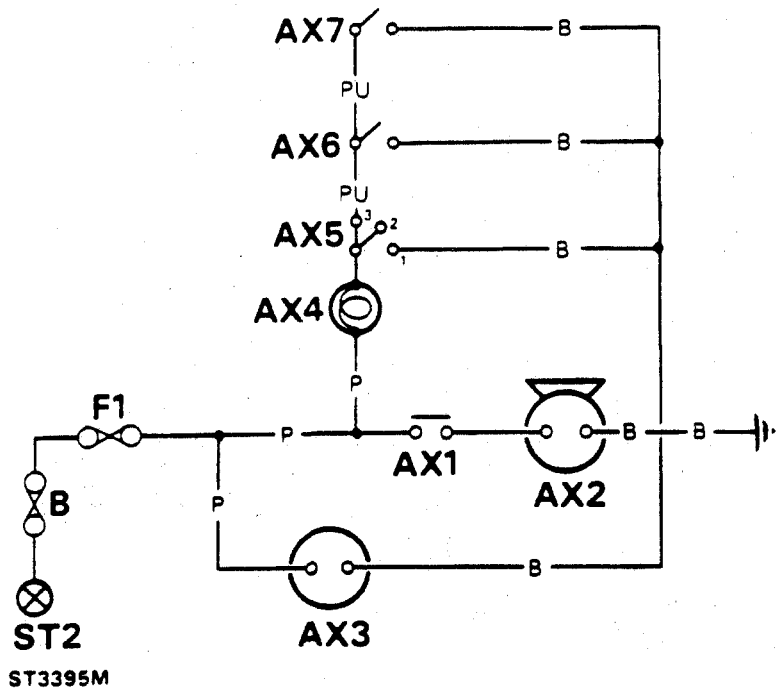
HF1	Heated front screen switch
HF2	Screenelement
HF3	Relay module
HF4	Timer unit
HF5	Indicator light
IG7	Engine oil pressure light
IG8	Engine oil pressure switch
ST2	Terminal *post* Starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse, main fuse box
F3	15 amp fuse. main fuse box
F13	20 amp fuse, main fuse box



ST3381M

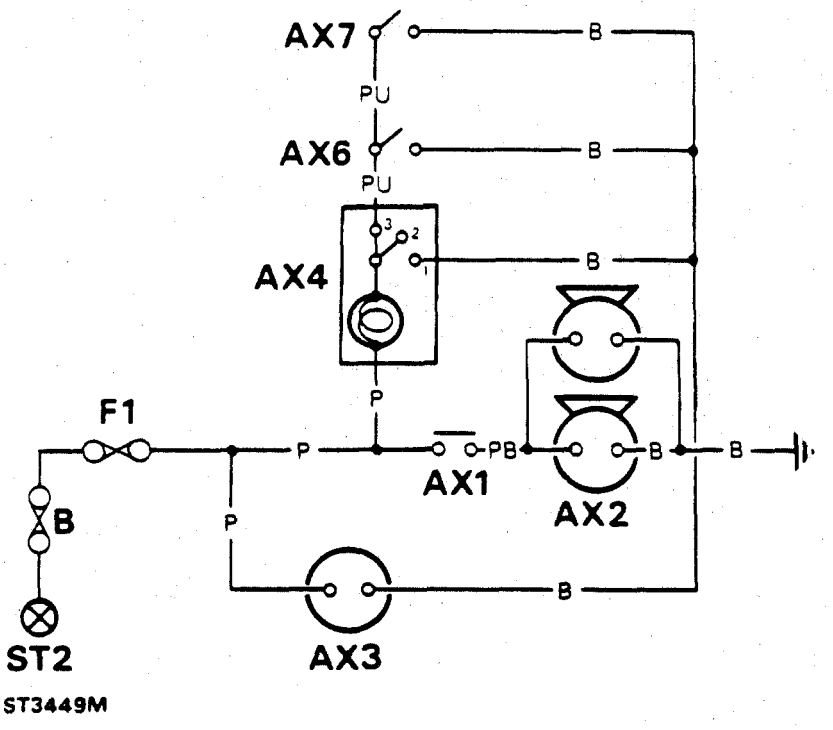
REAR WINDOW DEMIST CIRCUIT DEFENDER 110 (ST3381M)

HR1	ON/OFF Switch
HR2	Indicator light
HR4	Relay module
HR5	Rear window element
SC2	Voltage sensitive switch
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse, main fuse box
F16	5 amp fuse, dash fuse box
F17	10 amp fuse, dash fuse box



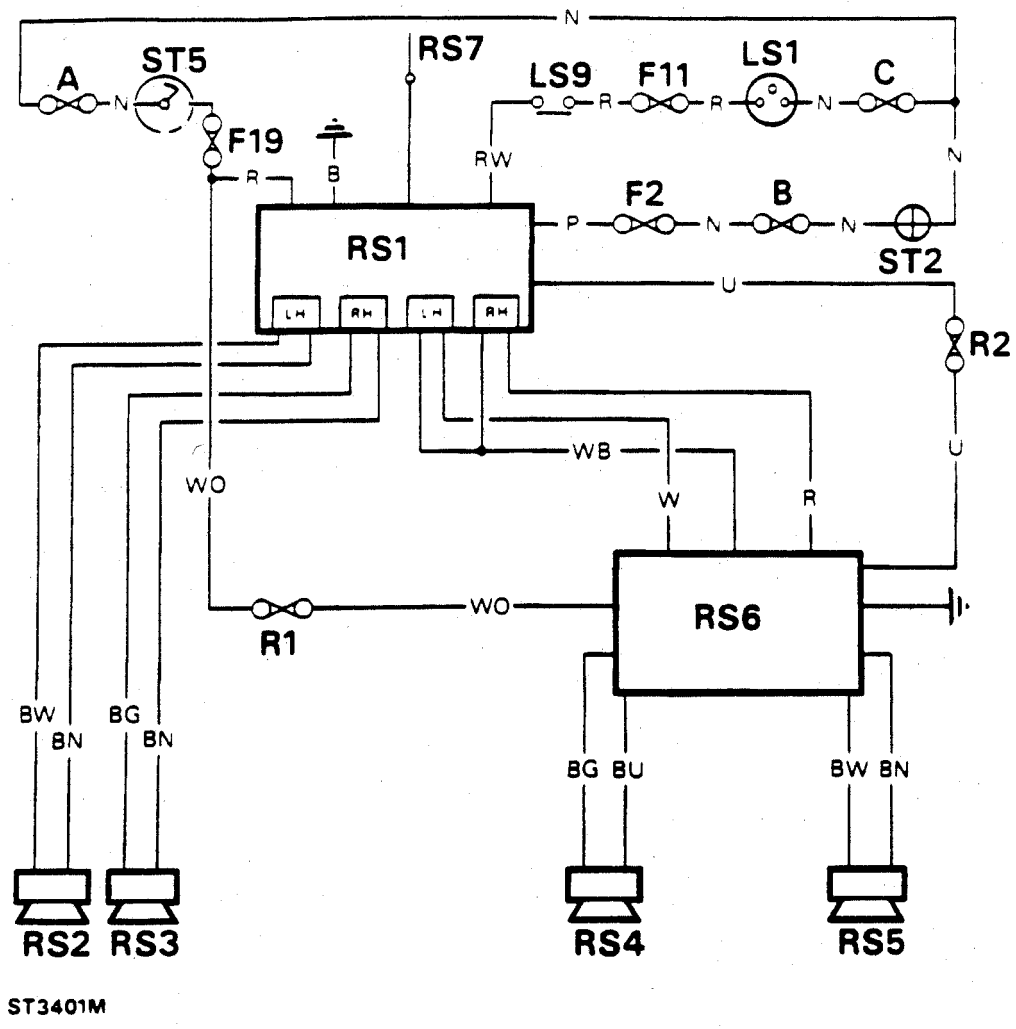
HORN, CLOCK, INTERIOR LIGHT AND AUXILIARY CIRCUITS DEFENDER 110 (ST3395M)

AX1 Horn push
AX2 Horn
AX3 Clock
AX4 Interior light
AX5 Interior light switch, 3 position
Position 1: Light on
Position 2: Light off
Position 3: Door switch operation
AX6 Drivers door switch
AX7 Passenger door switch
ST2 Terminal post starter solenoid
B 60 amp fuse, main fuse box
F1 20 amp fuse, dash fuse box



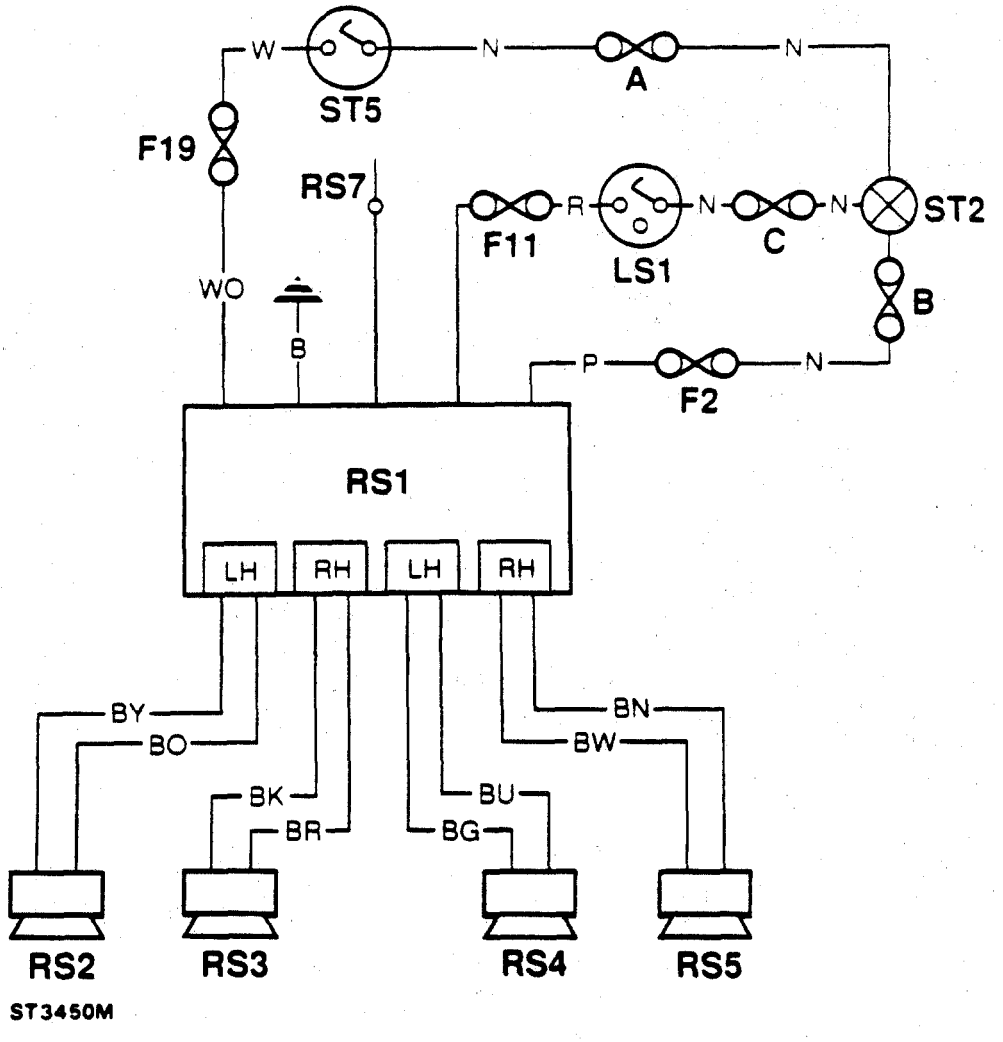
HORN, CLOCK, INTERIOR LIGHT AND AUXILIARY CIRCUITS DEFENDER 90 (ST3449M)

AX1	Horn push
AX2	Horns
AX3	Clock
AX4	interior light and 3 position switch
	Position 1: Light on
	Position 2: Light off
	Position 3: Door switch operation
AX6	Drivers door switch
AX7	Passenger door switch
ST2	Terminal post starter solenoid
B	60 amp fuse, main fuse box
F1	20 amp fuse, dash fuse box



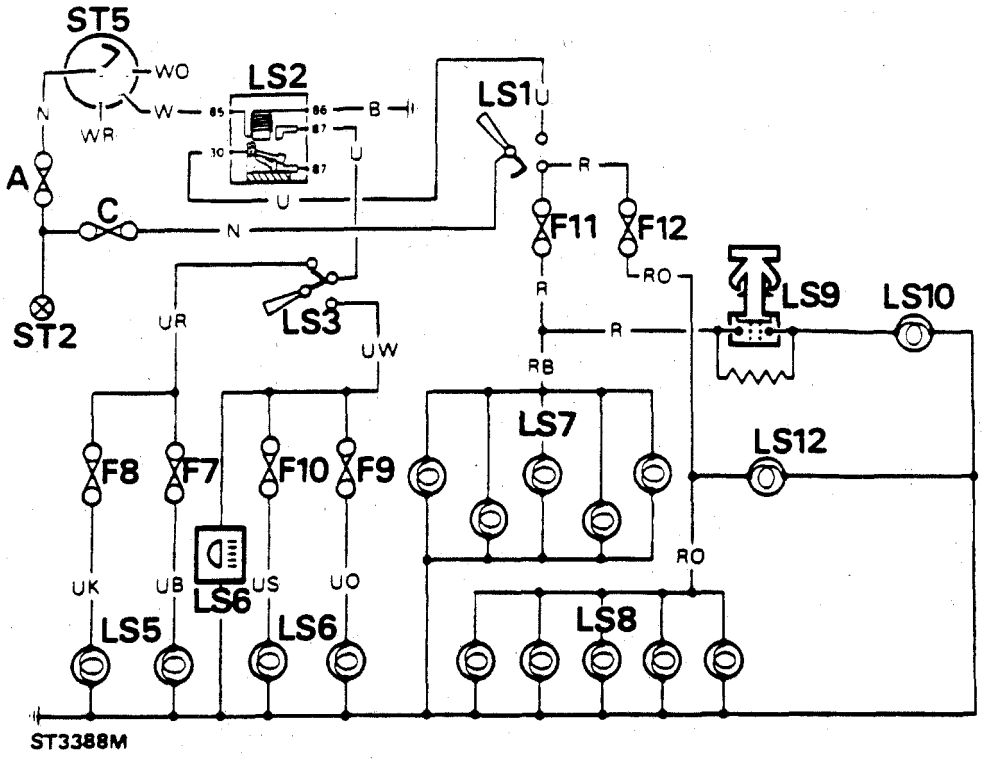
RADIO SYSTEM CIRCUIT DEFENDER 110 (ST3401)

RS1 Radio
RS2 LH front speaker
RS3 RH front speaker
RS4 LH rear speaker
RS5 RH rear speaker
RS6 Amplifier
RS7 Aerial
R1 S amp amplifier feed fuse
R2 2 amp trigger fuse
LS1 Main lighting switch
LS9 Lighting dimmer switch
ST2 Terminal post starter solenoid
ST5 Starter/ignitionswitch
A 60 amp fuse, main fuse box
B 60 amp fuse. main fuse box
C 60 amp fuse, main fuse box
F2 15 amp fuse. dash fuse box
F11 5 amp fuse, dash fuse box
F19 5 amp fuse, dash fuse box



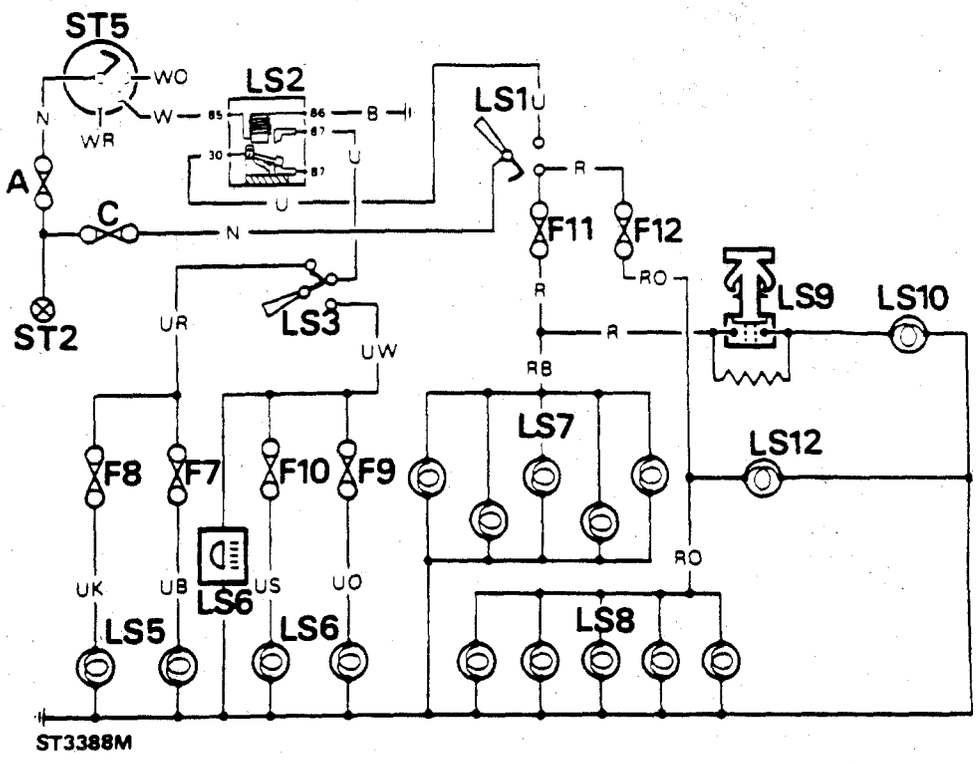
RADIO SYSTEM CIRCUIT DEFENDER 90 (ST3450M)

RS1	Radio
RS2	LH front speaker
RS3	RH front speaker
RS4	LH rear speaker
RS5	RH rear speaker
RS7	Aerial
LS1	Main lighting switch
ST2	Terminal post Starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse, main fuse box
B	60 amp fuse, main fuse box
C	30 amp fuse, main fuse box
F2	15 amp fuse, dash fuse box
F11	5 amp fuse, dash fuse box
F19	7.5 amp fuse, dash fuse box



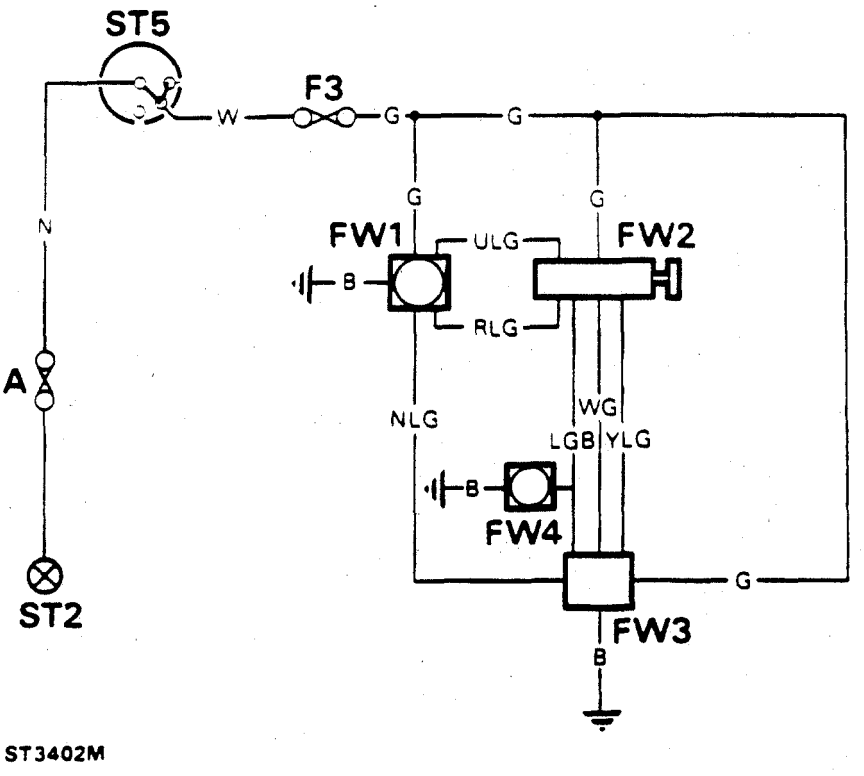
LIGHTING CIRCUIT DEFENDER 110 (ST3388M)

LS1	Main lighting switch
LS2	Main lighting relay module
LS3	High/low beam switch
LS5	Headlights low beam
LS6	Headlights high beam and instrument warning light
LS7	Five lights on left side of vehicle Front and rear side lights Front and rear marker lights
LS8	Five lights on right side of vehicle Front and rear side lights Front and rear markers lights
LS9	Instrument dimmer switch
LS10	Instrument panel lights (12 lights)
LS12	Lights ON warning light
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse. main fuse box
C	60 amp fuse, main fuse box
F7	7.5 amp fuse, dash fuse box
F8	7.5 amp fuse, dash fuse box
F9	7.5 amp fuse, dash fuse box
F10	7.5 amp fuse, dash fuse box
F11	5 amp fuse, dash fuse box
F12	5 amp fuse, dash fuse box



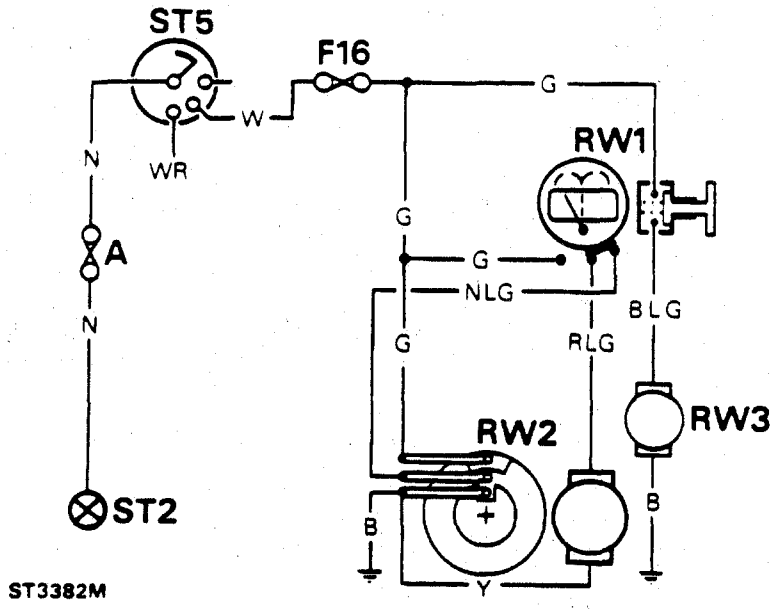
LIGHTING CIRCUIT DEFENDER 90 (ST3388M)

LS1	Main lighting switch
LS2	Main lighting relay module
LS3	High/lowbeamswitch
LS5	Headlights low beam
LS6	Headlights high beam and instrument warning light
LS7	Five lights on ten side of vehicle
	Front and rear side lights
	Front and rear marker lights
LS8	Five lights on right side of vehicle
	Front and rear side lights
	Front and rear markers lights
LS9	Instrument dimmer switch
LS10	Instrument panel lights (10 lights)
LS12	Lights ON warning light
ST2	Terminal post starter solenoid
ST5	Staner/ignitionswitch
A	60 amp fuse, main fuse box
C	30 amp fuse, main fuse box
F7	7.5 amp fuse. dash fuse box
F8	7.5 amp fuse, dash fuse box
F9	7.5 amp fuse, dash fuse box
F10	7.5 amp fuse, dash fuse box
F11	5 amp fuse, dash fuse box
F12	5 amp fuse, dash fuse box



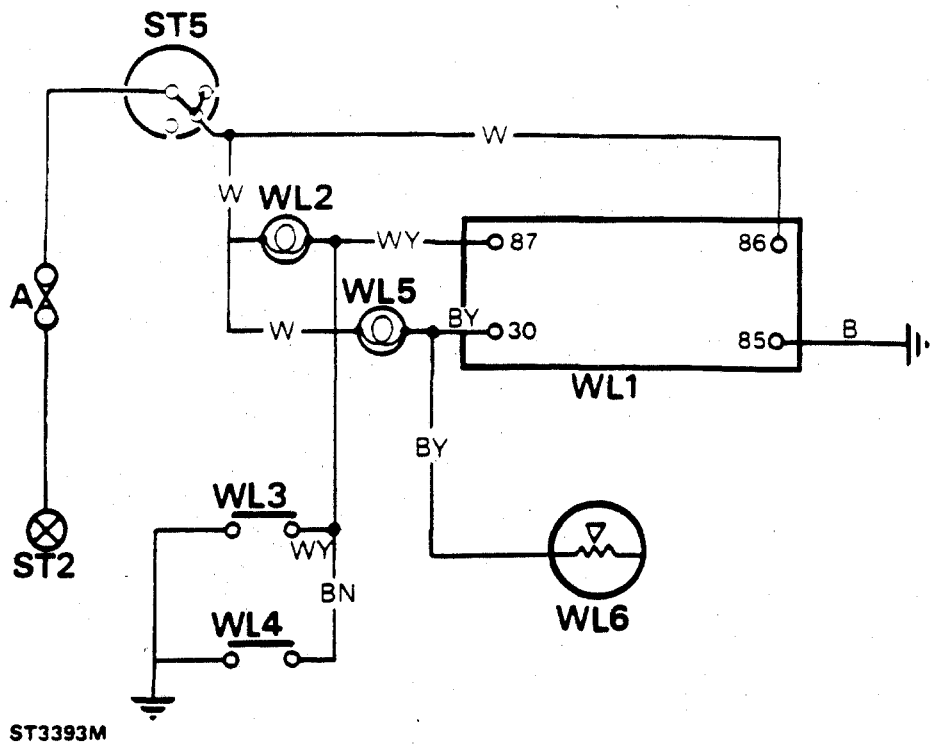
FRONT WASH/WIPE SYSTEM CIRCUIT DEFENDER 90 AND 110 (ST3402M)

FW1	Wiper motor
FW2	Wash/wipe switch
FW3	Wiper delay unit
FW4	Wash pump
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
B	60 amp fuse, main fuse box
F3	15 amp fuse, main fuse box



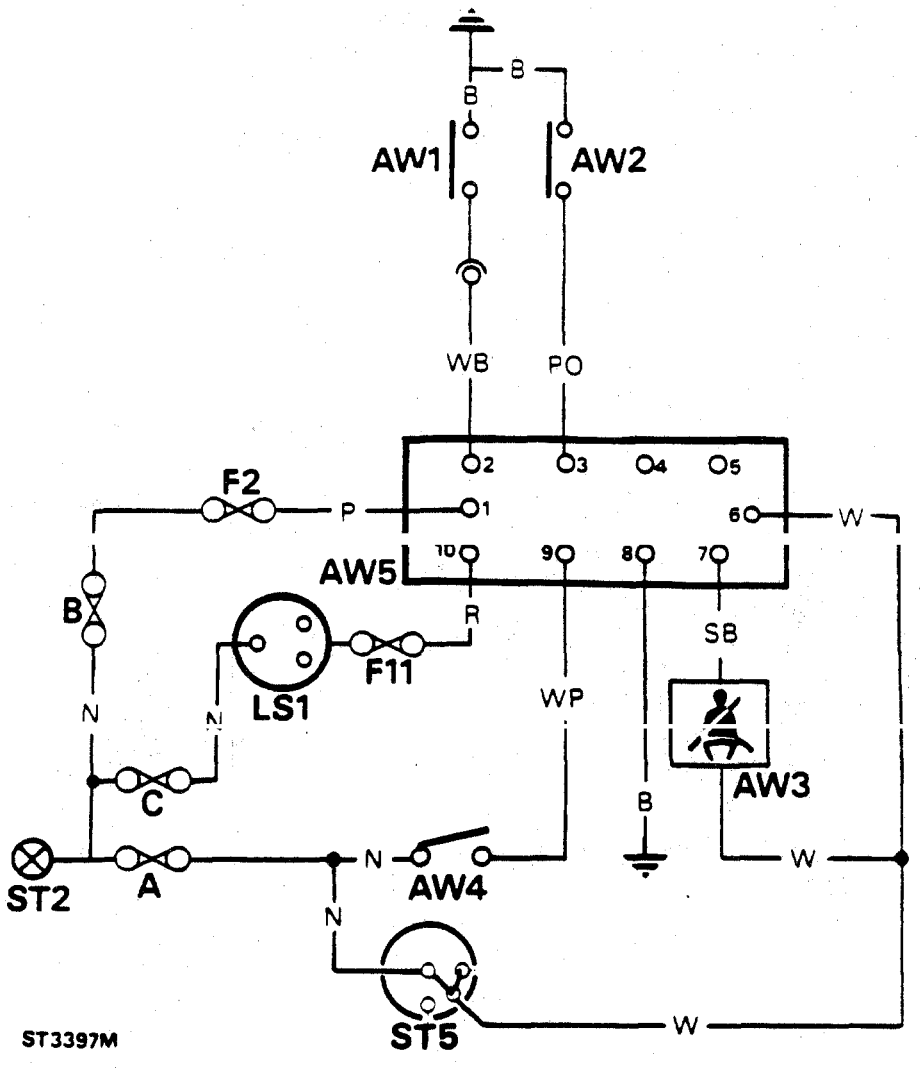
REAR WASH/WIPECIRCUIT DEFENDER 110 (ST3382M)

RW1	Wash/wipe switch
RW2	Wiper motor and park switch
RW3	Wash motor
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse, main fuse box
F16	5 amp fuse, dash fuse box



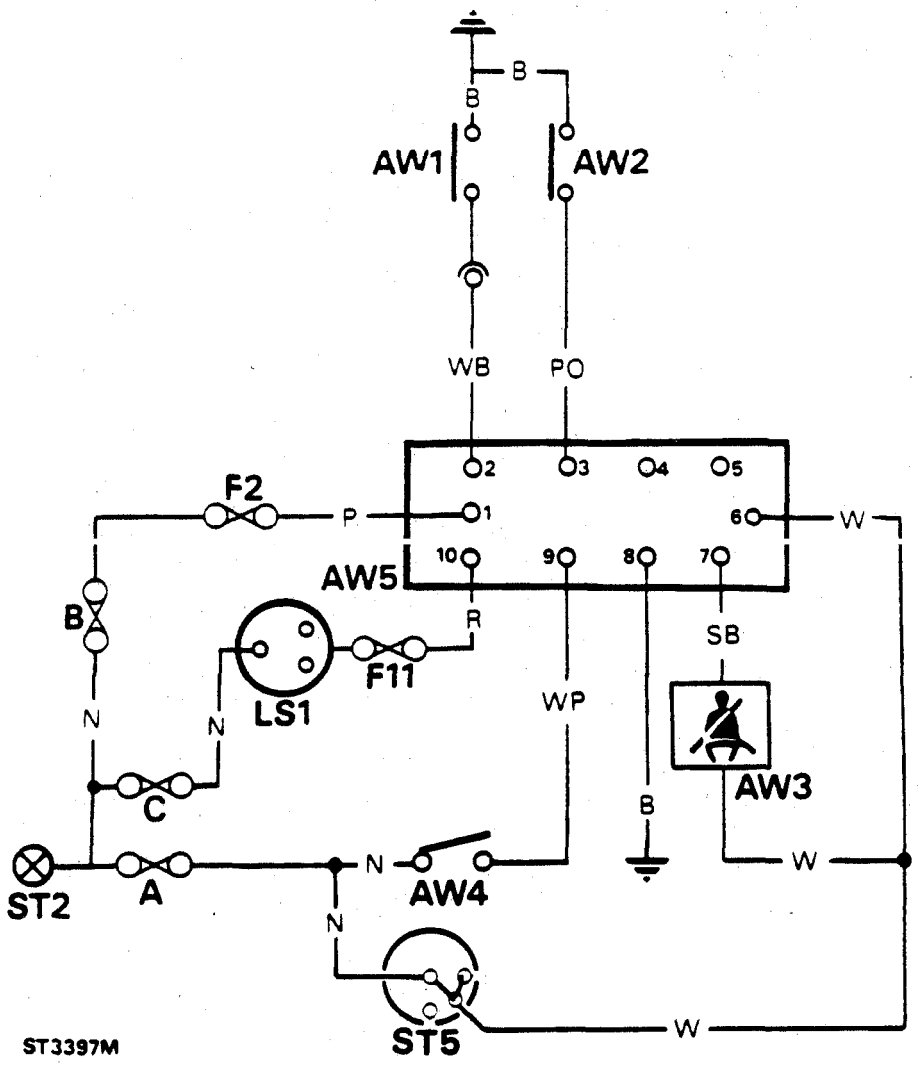
WARNING LIGHTS/CHECK CIRCUIT DEFENDER 90 AND 110 (ST3393M)

WL1	Warning light check unit
WL2	Brake warning light
WL3	Brake fluid level switch
WL4	Park brake switch
WL5	Engine check warning light
WL6	Vehicle speed sensor and MFI ECM connection
ST2	Terminal post starter solenoid
ST5	Starter/ignition Switch
A	60 amp fuse main fuse box



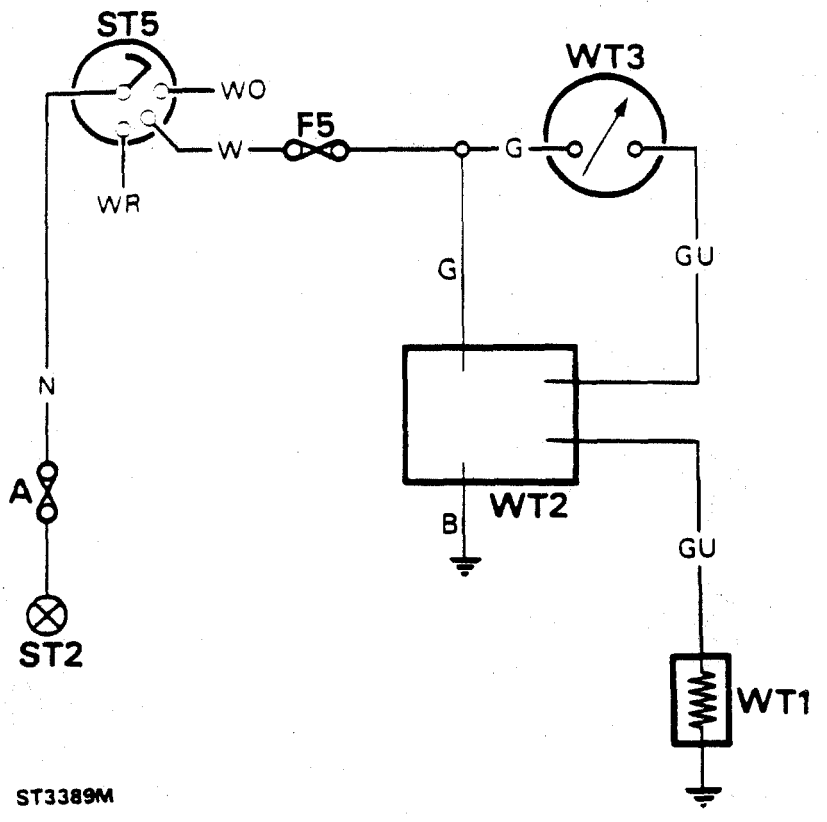
AUDIBLE WARNING SYSTEM CIRCUIT DEFENDER 110 (ST3397M)

AW1	Seat belt switch
AW2	Door switch
AW3	Seat belt warning lamp
AW4	Key-in switch
LS1	Main lighting switch
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse. main fuse box
B	60 amp fuse, main fuse box
C	60 amp fuse, main fuse box
F2	15 amp fuse, dash fuse box
F11	5 amp fuse, dash fuse box



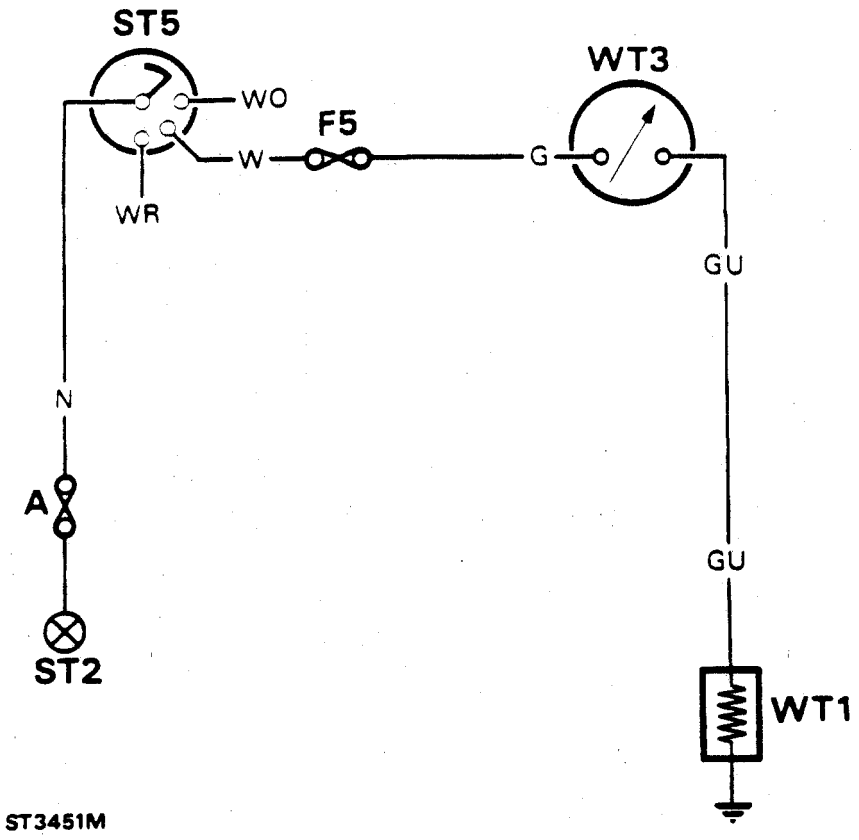
AUDIBLE WARNING SYSTEM CIRCUIT DEFENDER 90 (ST3397M)

AW1	Seat belt switch
AW2	Door switch
AW3	Seat belt warning lamp
AW4	Key-in switch
LS1	Main lighting switch
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse. main fuse box
B	60 amp fuse, main fuse box
C	30 amp fuse, main fuse box
F2	15 amp fuse, dash fuse box
F11	5 amp fuse. dash fuse box



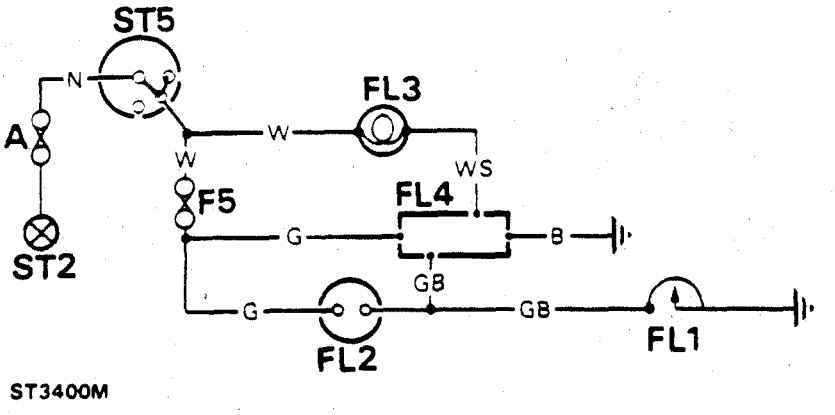
COOLANT TEMPERATURE GAUGE CIRCUIT DEFENDER 110 (ST3389M)

WT1	Coolant temperature sensor
WT2	Signal conditioner
WT3	Water temperature gauge
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse, main fuse box
F5	10 amp fuse, dash fuse box



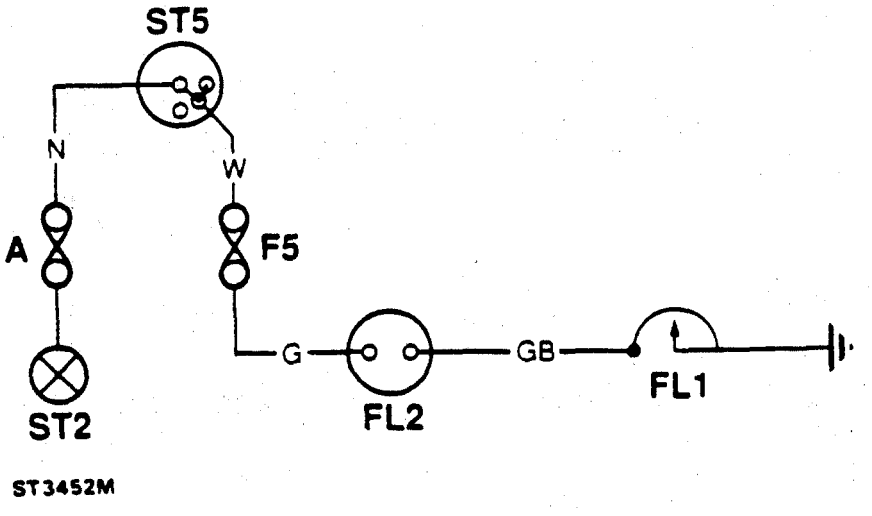
COOLANT TEMPERATURE GAUGE CIRCUIT DEFENDER 90 (ST3451M)

WT1	Coolant temperature sensor
WT3	Water temperature gauge
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse, main fuse box
F5	10 amp fuse, dash fuse box



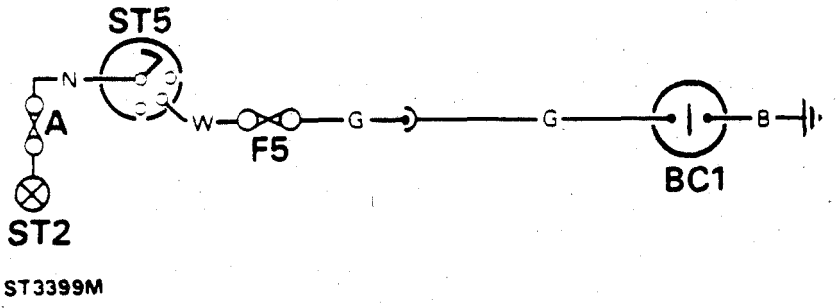
FUEL TANK LEVEL INDICATOR CIRCUIT DEFENDER 110 (ST3400M)

FL1	Fuel tank sensor
FL2	Fuel level gauge
FL3	Low fuel level warning light
FL4	Low fuel unit
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse, main fuse box
F5	10 amp fuse, dash fuse box



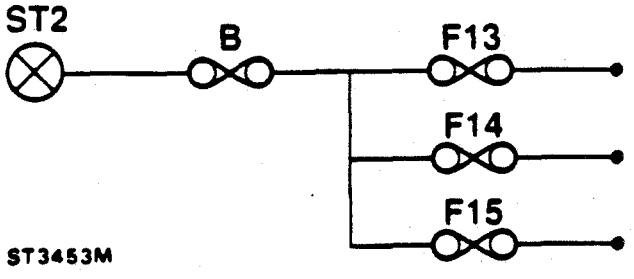
FUEL TANK LEVEL INDICATOR CIRCUIT DEFENDER 90 (ST3452M)

FL1	Fuel tank sensor
FL2	Fuel level gauge
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse, main fuse box
F5	10 amp fuse, dash fuse box



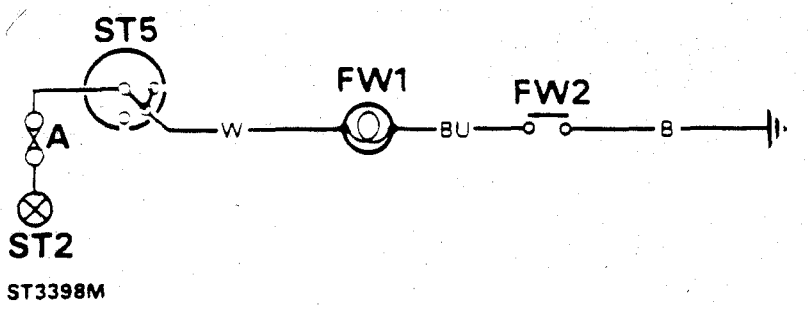
BATTERY CONDITION INDICATOR CIRCUIT DEFENDER 110 (ST3399M)

BC1	Battery condition indicator (voltmeter)
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse, main fuse box
F5	10 amp fuse, dash fuse box



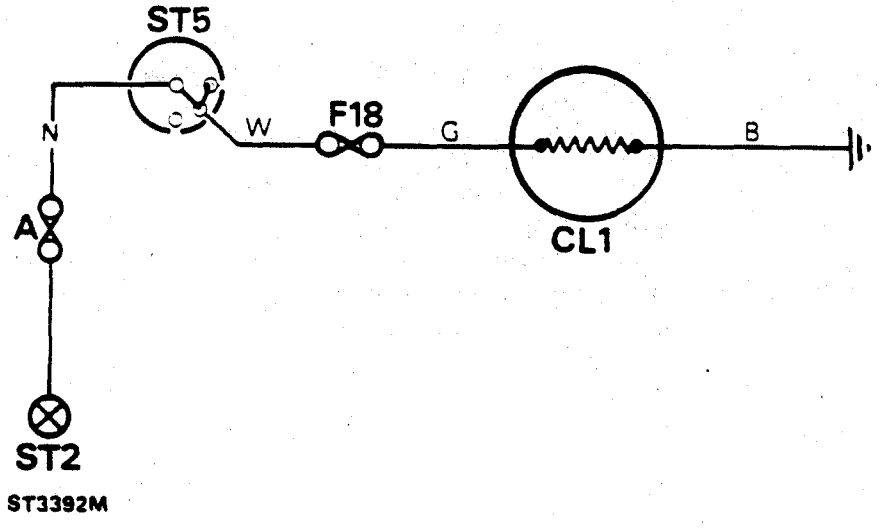
AUXILIARY FEED CIRCUIT DEFENDER 90 (ST3453)

ST2	Terminal post. starter solenoid
B	60 Amp fuse, main fuse box
F13	20 Amp fuse. dash fuse box
F14	20 Amp fuse. dash fuse box
F15	5 Amp fuse. dash fuse box



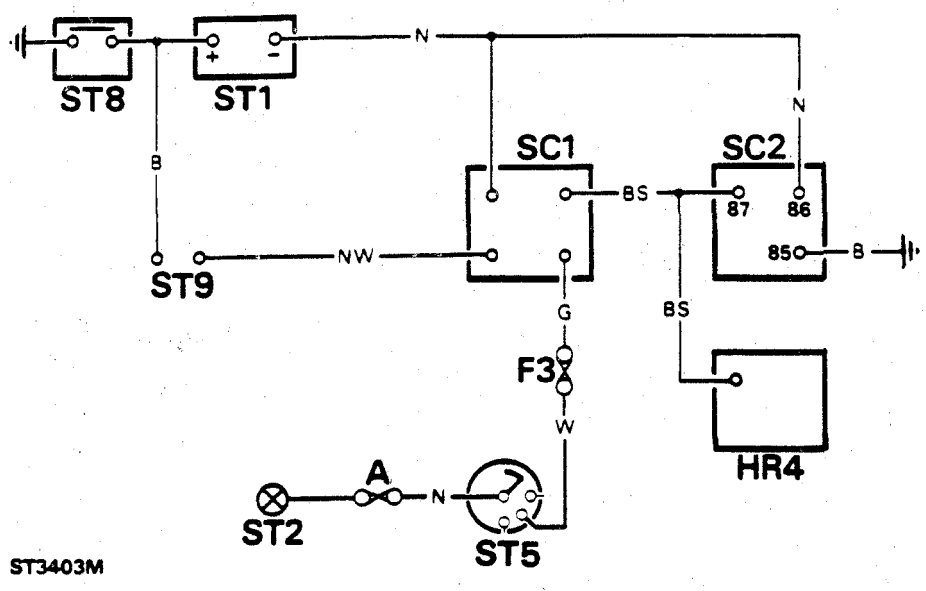
CENTRE DIFFERENTIAL LOCKED CIRCUIT DEFENDER 90 AND 110 (ST3398M)

FW1	Warning light, centre differential locked
FW2	Switch, centre differential locked
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse, main fuse box



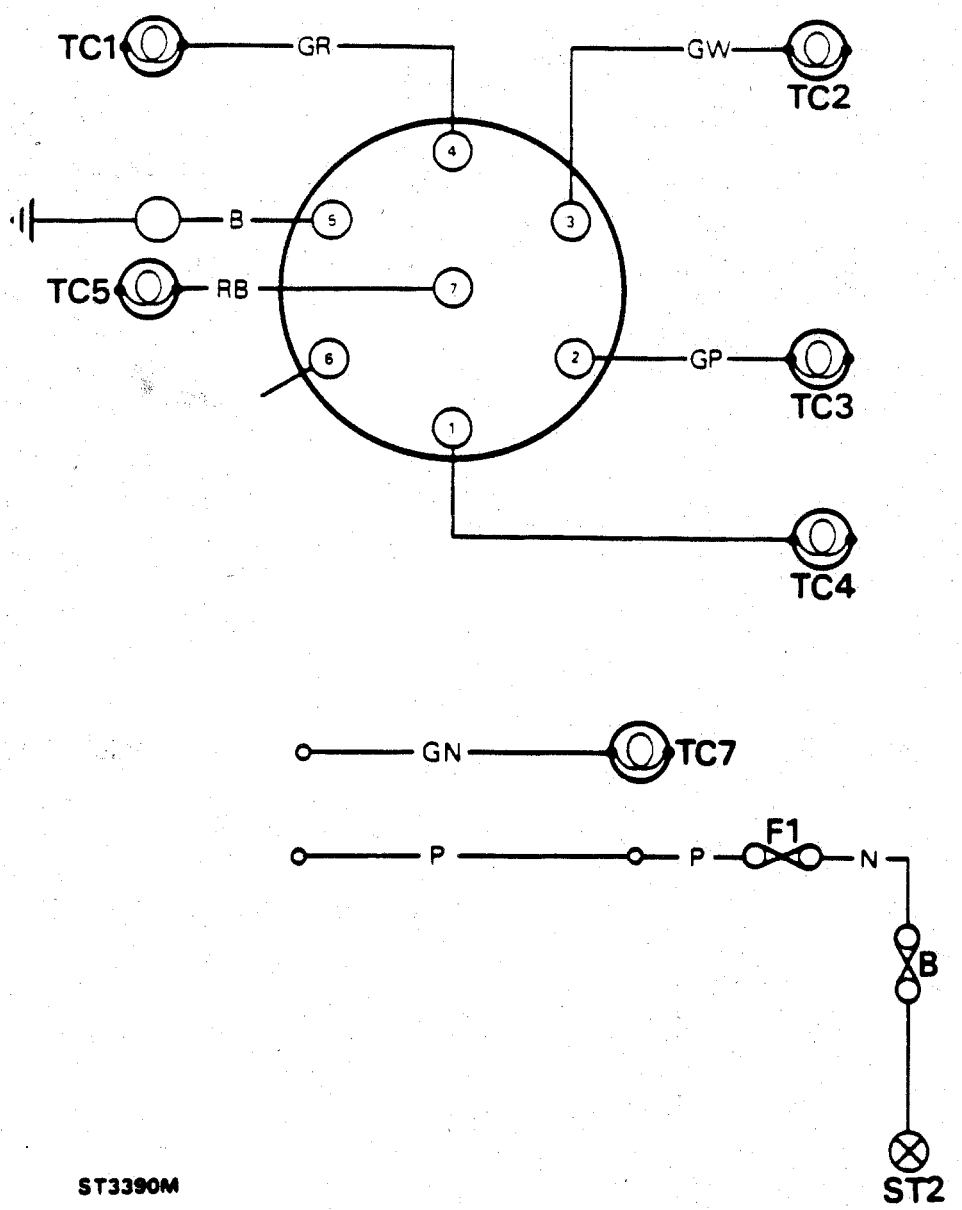
CIGAR LIGHTER CIRCUIT DEFENDER 90 AND 110 (ST3392M)

CL1	Cigar lighter switch and element
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
A	60 amp fuse, main fuse box
F18	10 amp fuse, dash fuse box



SPLIT CHARGE AND VOLTAGE SENSITIVE SWITCH CIRCUIT DEFENDER 110 (ST3403M)

SC1	Split charge unit
SC2	Voltage sensitive switch relay module
ST1	Battery
ST2	Terminal post starter solenoid
ST5	Starter/ignition switch
ST8	Battery isolator switch
ST9	Terminal posts battery box
HR4	Heated rear window relay
A	60 amp fuse, main fuse box
F3	15 amp fuse, dash fuse box



TRAILER CIRCUIT DEFENDER 110 (ST3390M)

TC1	Direction indicator lamp LH
TC2	Direction indicator lamp RH
TC3	Stop lamp
TC4	Tail lamp RH
TC5	Tail lamp LH
TC7	Reverse lamp
ST2	Terminal post starter solenoid
B	60 amp fuse, main fuse box
F1	20 amp fuse, dash fuse box

DEFENDER

NAS 90 HARD TOP
WORKSHOP MANUAL SUPPLEMENT

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BODY AND ELECTRICAL CONTENTS

Section Number **Page**

76 BODY

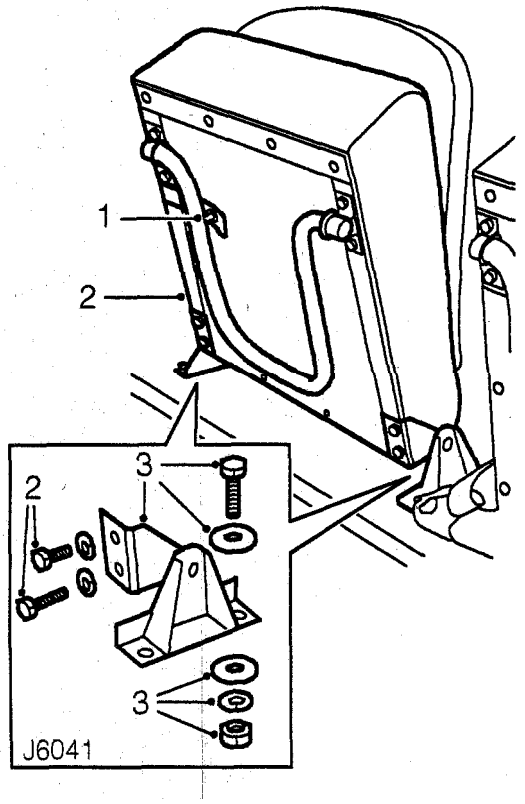
86 ELECTRICAL

REAR SEAT CUSHION

Service repair no - 76.71.24

Remove

1. Release seat cushion stowage strap.
2. Remove four bolts and spring washers and lift seat cushion from pivot brackets.
3. Remove four bolts, plain washers, spring washers and nuts. Detach both pivot brackets from wheel arch.



Refit

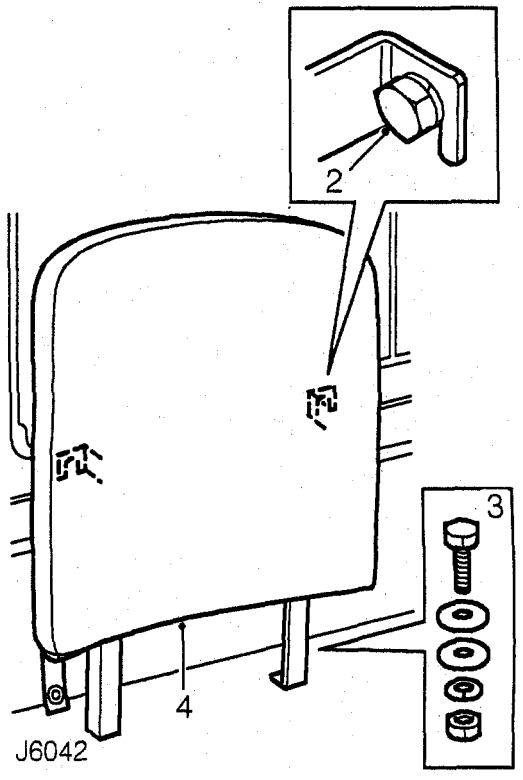
4. Secure pivot brackets to wheel arch and tighten bolts to 10 Nm (7 lbf.ft).
5. Position seat cushion in pivot brackets and secure with four bolts and spring washers.
6. Fit stowage strap.

REAR SEAT SQUAB

Service repair no - 76.71.26

Remove

1. Release seat cushion stowage strap and lower seat cushion.
2. Slacken two bolts securing seat squab brackets to body side.
3. Remove two bolts, plain washers, spring washers and nuts securing seat squab to wheel arch.
4. Lift seat squab and release brackets from retaining bolts.



Refit

5. Lower seat squab brackets over retaining bolts, tighten bolts to 10 Nm (7 lbf.ft).
6. Secure seat squab to wheel arch, tighten bolts to 10 Nm (7 lbf.ft).
7. Raise seat cushion and fit stowage strap.

REAR SEAT BELTS

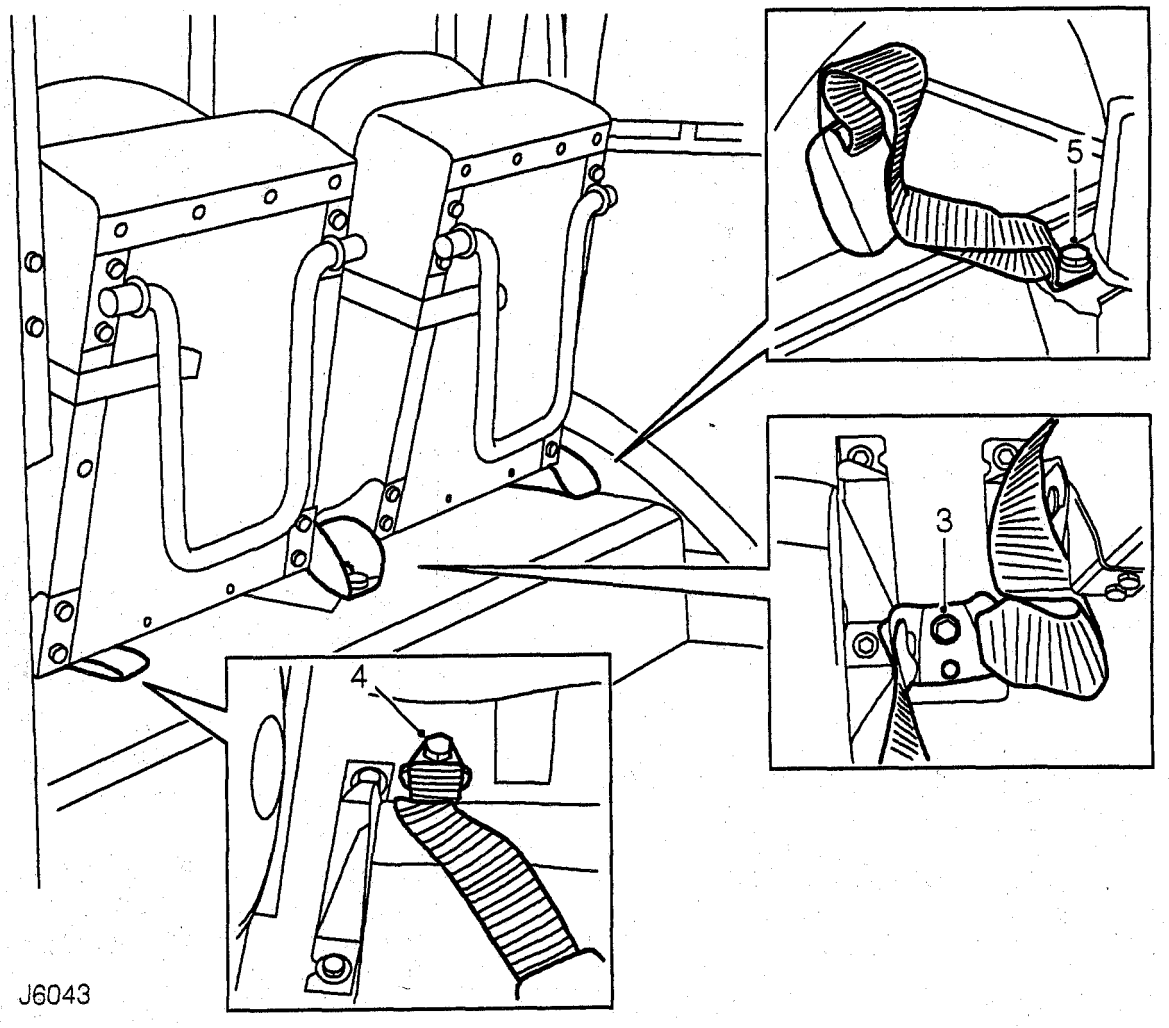
Service repair no - 76.73.18

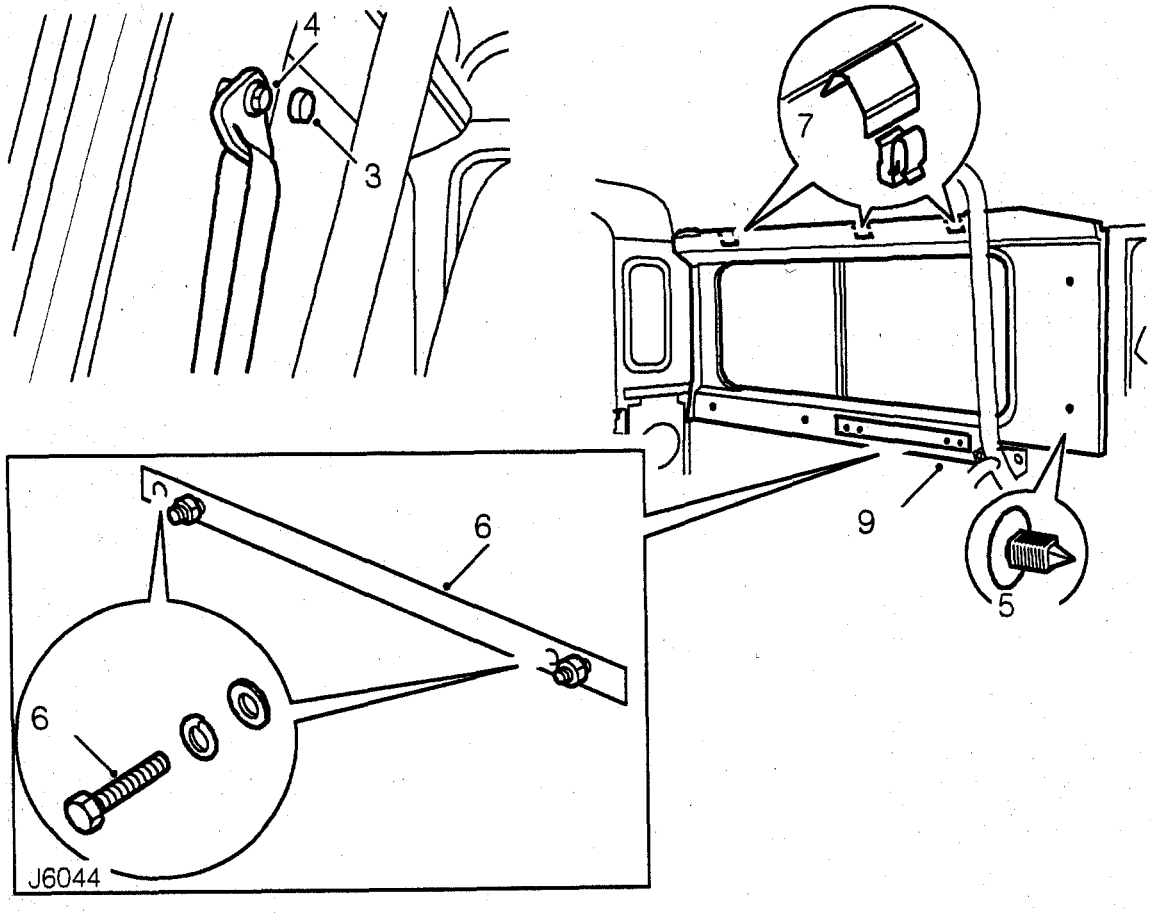
Remove

1. Release belt straps from buckles on both seats.
2. Raise both seat cushions and secure with stowage straps.
3. Unscrew bolt and remove bracket and inner seat belt straps.
4. Unscrew bolt and remove rear seat buckle strap from wheel arch.
5. Unscrew bolt and remove front seat buckle strap from interior roll-over bar mounting.

Refit

6. Reverse removal procedure, ensuring seat belt fixing bolts are tightened to 32 Nm (24 lbf.ft).





SIDE TRIM PANEL

Service repair no - 76.13.70

Remove

1. Remove rear seat squabs. See this Section.
2. Remove rear end trim panel. See this Section.
3. Prise cap from front seat belt upper guide retaining bolt.
4. Unscrew retaining bolt and remove seat belt from 'B/C' post.
5. Carefully prise trim stud from 'B/C' post.
6. Remove four bolts securing side trim panel and forward seat support bracket to body side. Collect support bracket.
7. Release top edge of side trim panel by striking upwards with the hand to disengage three spring clips.
8. Carefully pull trim panel rearwards to clear interior roll- over bar.
9. Remove side trim panel from vehicle.

Refit

10. Fit new spring clips to the three brackets on top edge of side trim panel.
11. Carefully pull trim panel behind interior roll-over bar.
12. Align trim panel, ensuring it is correctly positioned around side window.
13. Locate trim panel spring clips on inner cant rail and press firmly down to secure top edge of trim panel.
14. Align bosses of trim panel and forward seat support bracket with body side fixing holes and secure with four bolts and washers. Do not fully tighten at this stage.
15. Fit trim stud to secure bottom edge of trim panel to 'B/C' post.
16. Secure seat belt guide to 'B/C' post, tighten bolt to 32 Nm (24 lbf.ft) and fit cap.
17. Fit rear end trim panel. See this Section
18. Fit rear seat squab. See this Section.

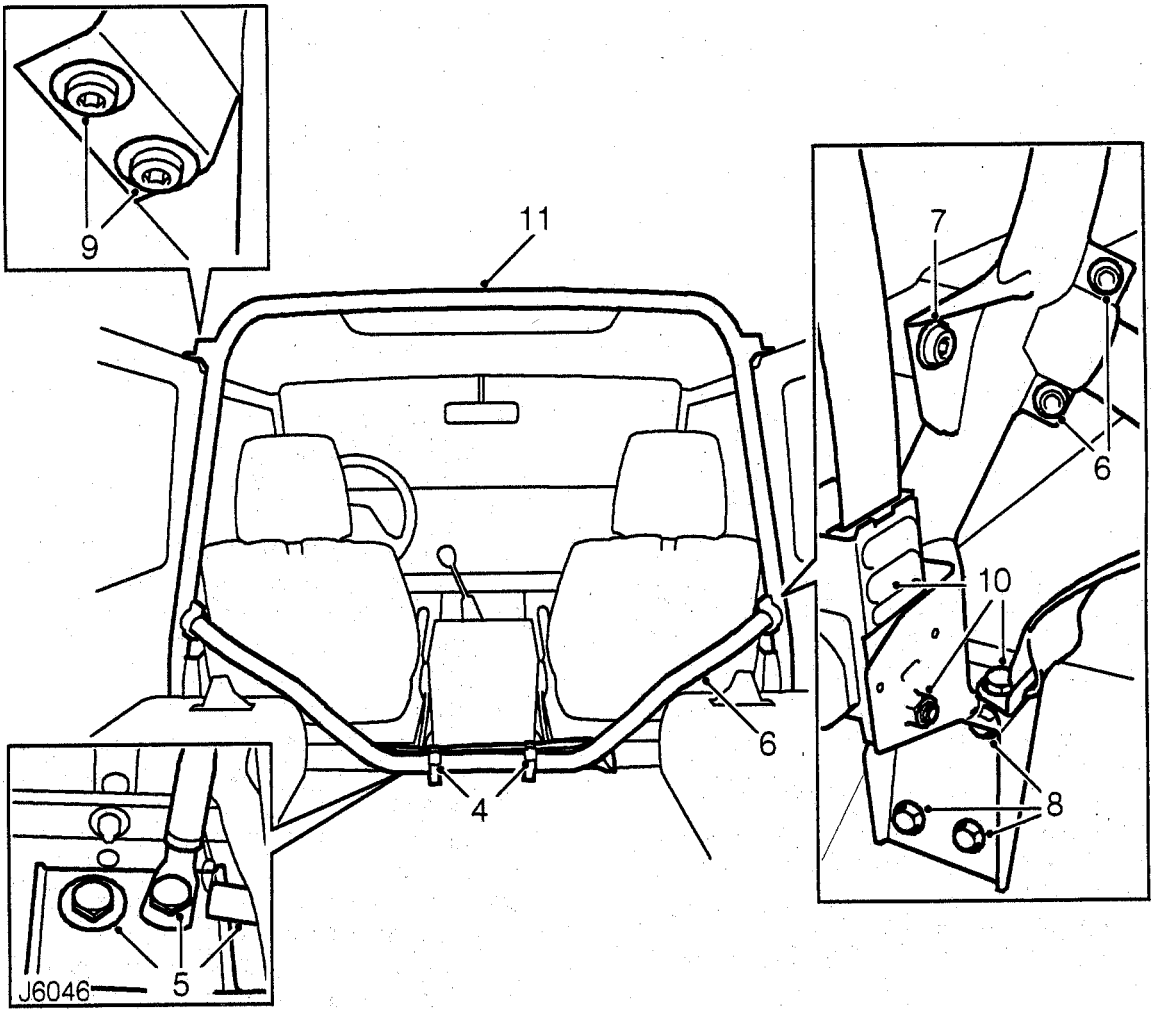
INTERIOR ROLL-OVER BAR

Service repair no - 76.11.40

Remove

1. Remove rear seat squabs. See this Section.
2. Remove rear end trim panels. See this Section.
3. Remove side trim panels. See this Section.
4. Release retaining straps and remove tool bag from roll-over bar.
5. Remove 4 bolts securing centre section of roll-over bar and seat belt stalks to floor. On the driver's side, disconnect harness plug Connector of audible warning circuit at belt stalk.
6. Remove 2 tom bolts and nuts from both sides and detach centre section of roll-over bar assembly.
7. Remove torx bolt, from both sides, securing roll-over bar to body side mounting brackets.
8. Remove 3 bolts and washers, from both sides, securing lower roll-over bar brackets to front of wheelarch.
9. Remove 2 tom bolts and washers, from both sides, securing roll-over bar upper mountings to roof fixing brackets and carefully lower complete assembly to the floor.
10. Unscrew retaining bolts, from both sides, and remove front seat belt inertia reels and rear seat belts from roll-over bar mounting.
11. Supporting from both sides, raise and tilt roll-over bar rearwards to clear wheelarches.
12. Remove roll-over bar from vehicle.

NOTE: Assistance may be required to remove the roll-over bar.



Refit

13. Supporting from both sides, position roll-over bar on the floor in front of wheelarches.
14. Secure front seat belt inertia reels and rear seat belts to roll-over bar mountings. Tighten bolts to 32Nm (24 lbf.ft).
15. Raise roll-over bar assembly and secure to roof mounting brackets. Tighten bolts to 45 Nm (33 lbf.ft).
16. Secure roll-over bar to wheelarches. Tighten bolts to 45 Nm (33 lbf.ft).
17. Secure roll-over bar to body side mounting brackets, tightening bolts to 45 Nm (33 lbf.ft).
18. Secure centre section to main roll-over bar, but do not fully tighten fixing bolts at this stage.
19. Reconnect driver's seat belt audible warning harness plug.
20. Secure seat belt stalks and roll-over bar floor. mounting brackets to chassis. Tighten bolts to 32 Nm (24 lbf.ft).
21. Fully tighten roll-over bar centre section retaining bolts to 45 Nm (33 lbf.ft).
22. Position tool bag and secure to roll-over bar.
23. Fit side trim panels. See this Section.
24. Fit rear and end trim panels. See this Section.
25. Fit rear seat squabs. See this Section.

REAR END TRIM PANEL

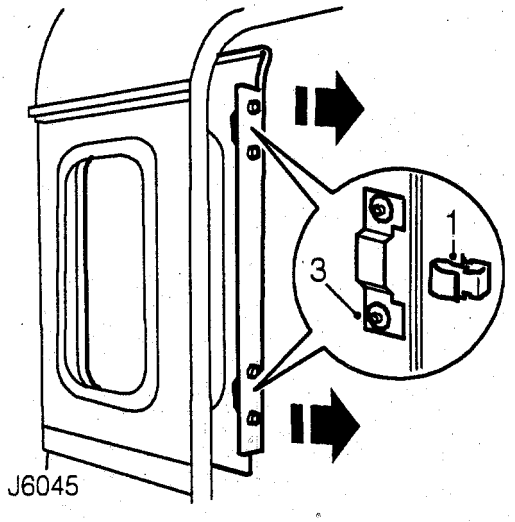
Service repair no - 76.13.71

Remove

1. Pull edge of rear end trim panel firmly to release the two spring retaining clips from vertical rail at door aperture.
2. Remove rear end trim panel.

Refit

3. Fit new spring clips to the two brackets on side of trim panel.



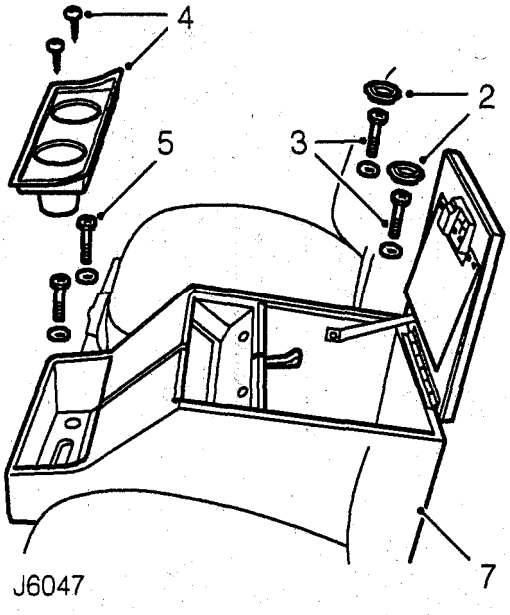
4. Position outboard edge of trim panel in corner to abut side trim panel and locate spring clips on vertical rail.
5. Press edge of trim panel firmly to secure in position.

CUBBY BOX

Service repair no - 76.25.04

Remove

1. Remove radio/cassette player.
2. Open cubby box lid and remove two caps concealing fixing bolts.
3. Remove fixing bolts and washers.
4. Remove 2 screws and lift cup holder from cubby box.
5. Unscrew two bolts securing front of cubby box to floor mounting.
6. Lift cubby box and unthread radio/cassette player leads through cubby box base.
7. Remove cubby box.



Refit

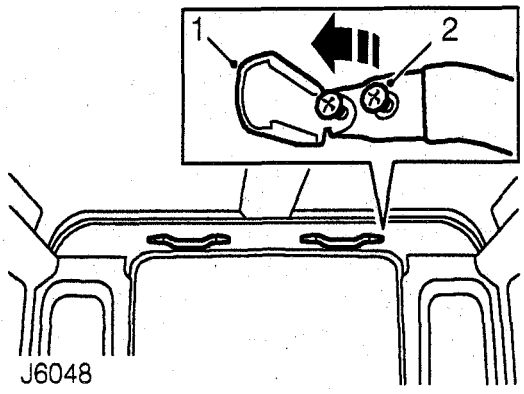
8. Position cubby box to mounting and insert radio/ cassette player leads.
9. Secure front of cubby box to floor and fit cup holder.
10. Open cubby box lid, secure in position and fit bolt caps
11. Fit radio/cassette player.

REAR GRAB HANDLE

Service repair no - 76.58.35

Remove

1. Carefully prise top and bottom edges of finisher caps from grab handle and then hinge outwards to gain access to fixing screws.
2. Remove 4 fixing screws and detach grab handle from rear.end trim panel.



Refit

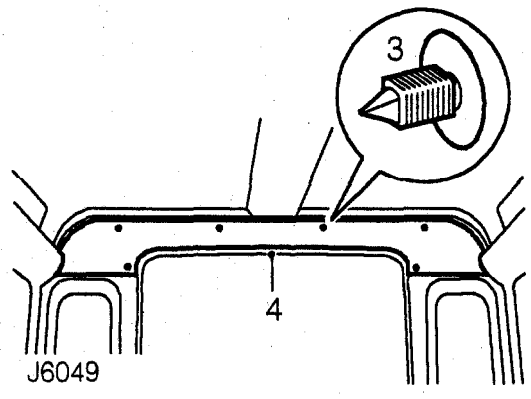
3. Position grab handle on rear end trim panel and secure with 4 fixing screws.
4. Press finisher caps over screws.

REAR END LINING

Service repair no - 76.64.12

Remove

1. Remove rear end trim panel. See this Section.
2. Remove rear grab handles. See this Section.
3. Carefully prise out 6 trim studs securing rear end lining to mounting brackets.
4. Remove rear end lining.



Refit

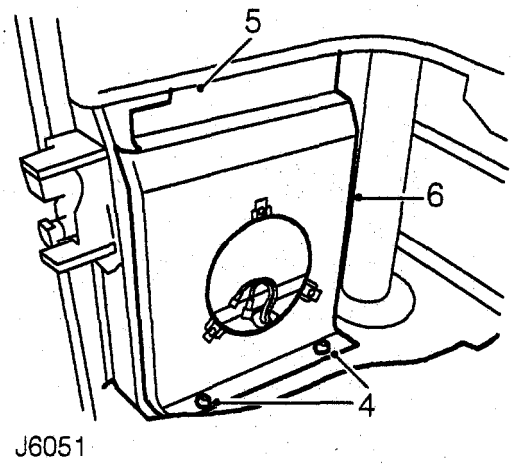
5. Position rear end lining on mounting brackets and secure with 6 trim studs.
6. Fit rear grab handles See this Section.
7. Fit rear end trim panel See this Section.

REAR SPEAKER PANEL

Service repair no - 76.13.13

Remove

1. Raise seat cushion and fit stowage strap.
2. Remove rear end trim panel. See this Section.
3. Remove rear speaker. See Electrical.
4. Peel back carpet and remove two screws securing speaker panel to wheelarch.
5. Prise top edge of panel down to release from body channel.
6. Remove speaker panel.



Refit

7. Position speaker panel on wheel arch.
8. Press top edge of panel down firmly and locate under body channel.
9. Secure speaker panel to wheel arch with 2 screws and reposition carpet.
10. Fit rear speaker. See Electrical.
11. Fit rear end trim panel. See this Section .

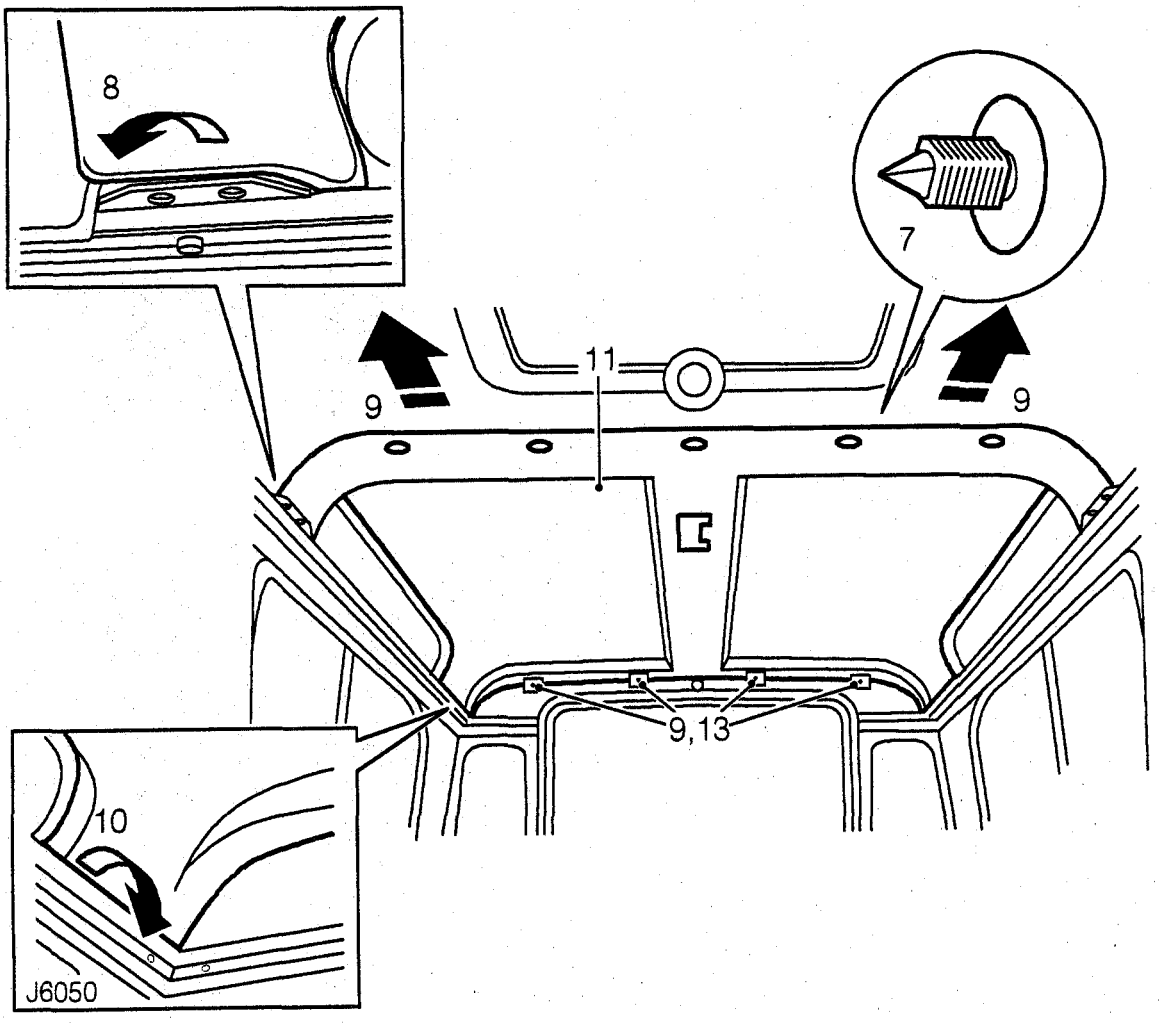
REAR HEADLINING

Servicerepairno-76.64.11

Remove

1. Remove rear end trim panel. See this Section.
2. Remove side trim panels. See this Section.
3. Remove rear grab handles. See this Section.
4. Remove rear end lining. See this Section
5. Remove rear interior lamp. See Electrical
6. Remove interior roll-over bar. See this Section
7. Carefully prise out 5 trim studs securing rear and front headlining to roof mounting brackets.
8. Release front comers of headlining from cant rail, on both sides.
9. Pull headlining forwards sufficiently to clear rear end lining mounting brackets.
10. Release rear corners of headlining from cant rail, on both sides.
11. Lower rear headlining from roof and remove from vehicle.

NOTE: Take care not to bend headlining on removal and refitting.



Refit

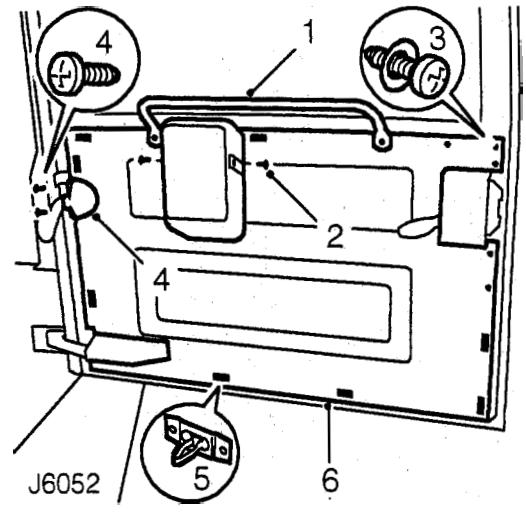
12. With assistance, position rear headlining to roof and locate rear corners in cant rail.
13. Push headlining rearwards and position over rear end lining mounting brackets.
14. Locate front corners of headlining in cant rail.
15. Position front edge of rear headlining over front headlining and secure with trim studs.
16. Adjust rear headlining to achieve good fit at all corners.
17. Fit rear interior lamp. See Electrical.
18. Fit interior roll-over bar. See this Section .
19. Fit rear end lining. See this Section .
20. Fit rear grab handles. See this Section.
21. Fit side trim panels. See this Section.
22. Fit rear end trim panels. See this Section.

REAR DOOR TRIM CASING

Service repair no - 76.34.09

Remove

1. Unscrew 2 bolts and remove grab handle from rear door.
2. Remove 2 screws and detach wiper motor cover.
3. Remove 7 screws securing trim casing to door.
4. Remove two screws and lift wiper motor harness cover from harness support bracket.
5. Carefully release 8 clips securing trim casing to door.
6. Remove trim casing and collect door lock cover.



Refit

7. Position door lock cover, fit trim casing and secure with clips.
8. Fit harness cover and secure with two screws.
9. Secure door panel with retaining screws.
10. Position wiper motor cover and secure with 2 screws.
11. Position grab handle and secure with 2 bolts.

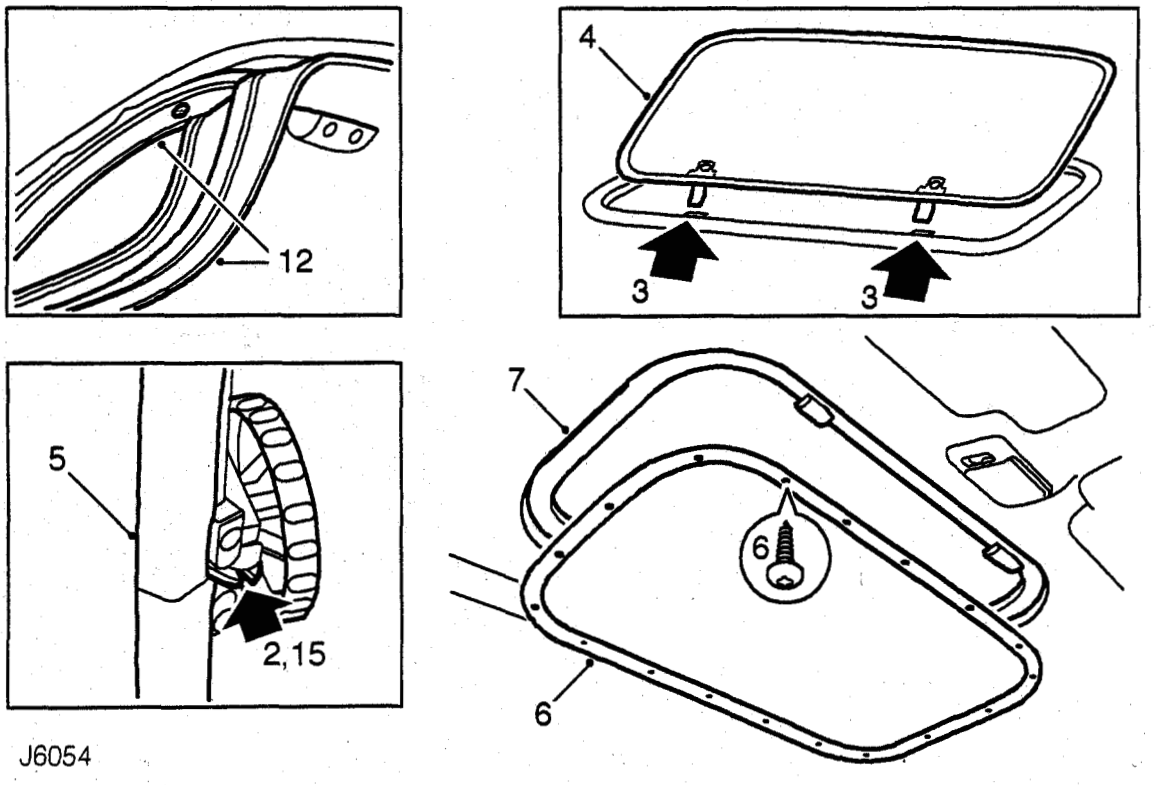
SUN ROOF

Service repair no - 76.82.15

Remove

1. Open sun roof fully.
2. Disengage spring lock from operating handle catch.
3. Holding sun roof at both sides, release hinges from locating brackets at front of outer frame.
4. Remove sun roof.
5. Starting from centre rear, peel headlining finisher from inner frame.
6. Remove 18 screws securing inner frame to outer frame and detach inner frame.
7. Lift outer frame from roof.

NOTE: Assistance may be required to remove the sun roof assembly.



Refit

8. Clean roof area around outer frame seating.
9. Position outer frame on roof.
10. Fit inner frame to headlining and secure to outer frame with 18 screws but do not fully tighten.
11. Check alignment of inner and outer frames with roof mounting and headlining, adjust as necessary, and fully tighten fixing screws to 10 Nm (7 lbf.ft).
12. Starting from centre rear, fit headlining finisher lip into locating channel of inner frame.
13. Press finisher firmly over inner frame and continue around complete frame, ensuring finisher lies flat on headlining.
14. Fit sun roof hinges fully into locating brackets on outer frame, and lower the glass panel.
15. Engage operating handle catch with spring lock of outer frame and close sunroof.

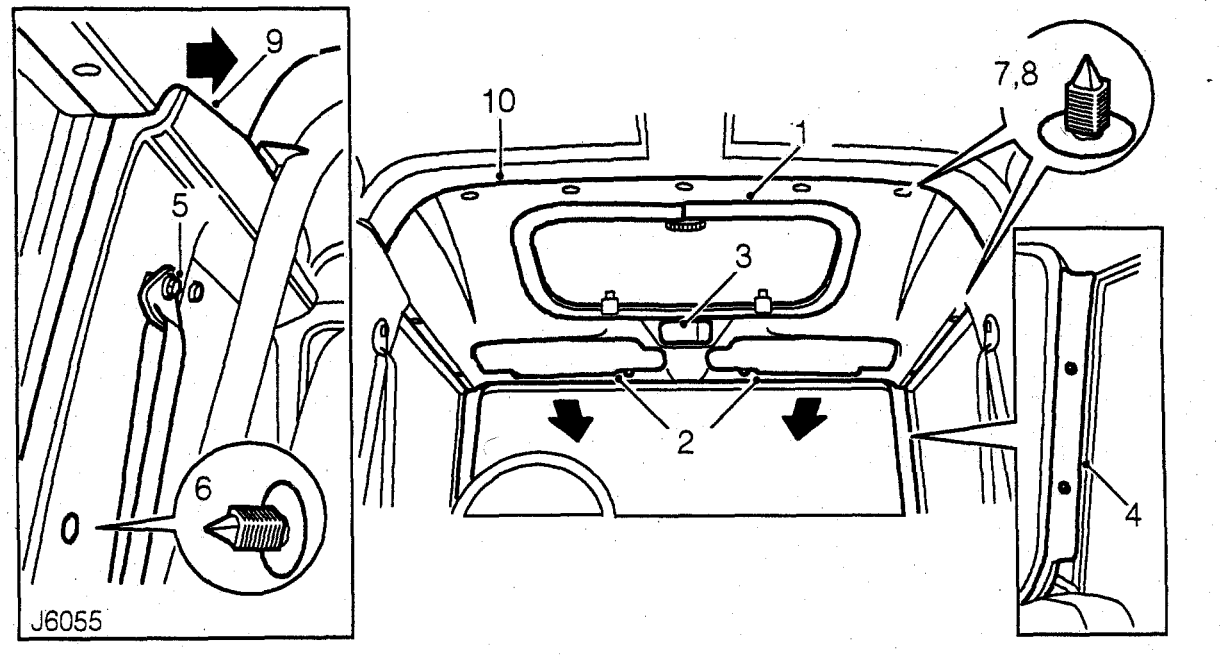
FRONT HEADLINING

Service repair no - 76.64.10

Remove

1. Remove sun roof headlining finisher.
2. Remove sun visors. See this Section.
3. Remove interior lamp. See Electrical.
4. Remove 4 retaining screws and detach both 'A' post trims.
5. Remove caps and unscrew front seat belt fixing bolts from 'B/C' posts.
6. Carefully prise side trim panel cap fastener from 'B/C' posts.
7. Carefully prise 2 trim studs, from both sides, securing headlining to body at door aperture.
8. Carefully prise out 5 trim studs securing front and rear headlinings to roof.
9. From both sides, pull side trim panel inwards enough to release rear corners of front headlining.
10. Lower headlining and remove from vehicle.

NOTE: Take care not to bend the headlining on removal and refitting.



Refit

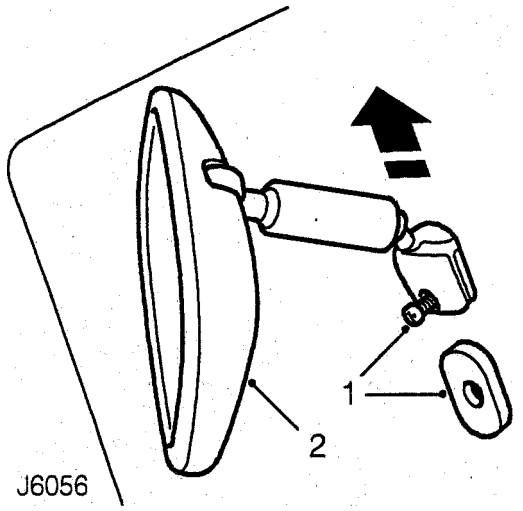
11. With assistance, raise headlining to roof.
12. Carefully pull side trim panel inwards, on both sides, and slide headlining behind trim panel.
13. Position front headlining into recess of rear headlining and secure both to roof mounting brackets with 5 trim studs.
14. Secure both sides of front headlining to body at door apertures with trim studs.
15. Fit side trim trim studs at 'B/C' posts.
16. Secure seat belts to 'B/C' posts and tighten bolts to **32** Nm (24 lbf.ft). Fit caps to bolts.
17. Fit 'A post trims.
18. Fit interior lamp. See Electrical,
19. Fit sun visors. See this Section.
20. Fit sun roof headlining finisher.

INTERIOR REAR VIEW MIRROR

Service repair no - 76.10.51

Remove

1. Remove retaining screw securing mirror adjustment ann to mounting slug.
2. Slide adjustment arm up from mounting slug and remove rear view mirror.



Refit

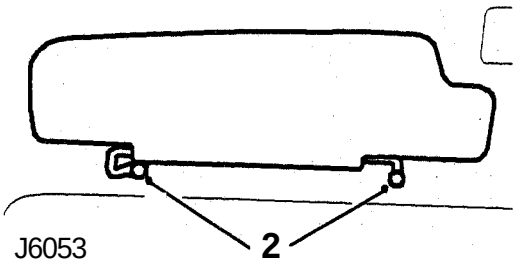
3. Slide mirror adjustment arm over mounting slug.
4. Secure mirror with retaining screw.

SUN VISORS

Service repair no - 76.10.17.

Remove

1. Raise sun visor.
2. Remove 2 screws and collect sun visor.



Refit

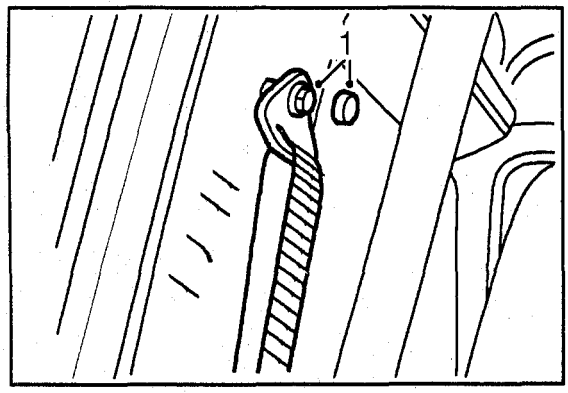
3. Position sun visor and secure with 2 screws.

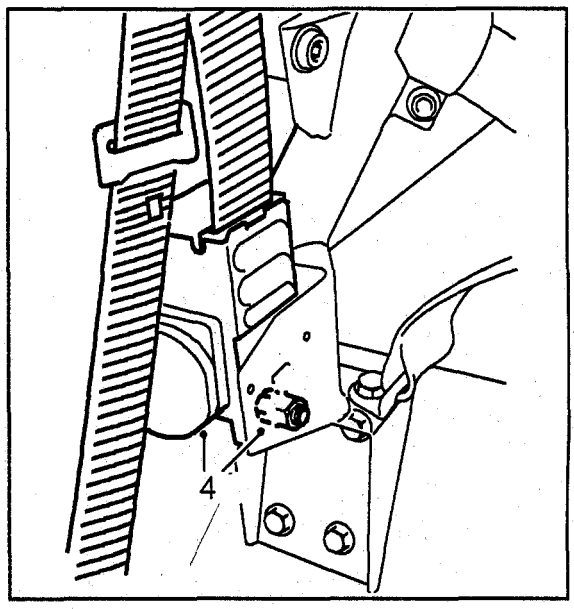
FRONT SEAT BELTS

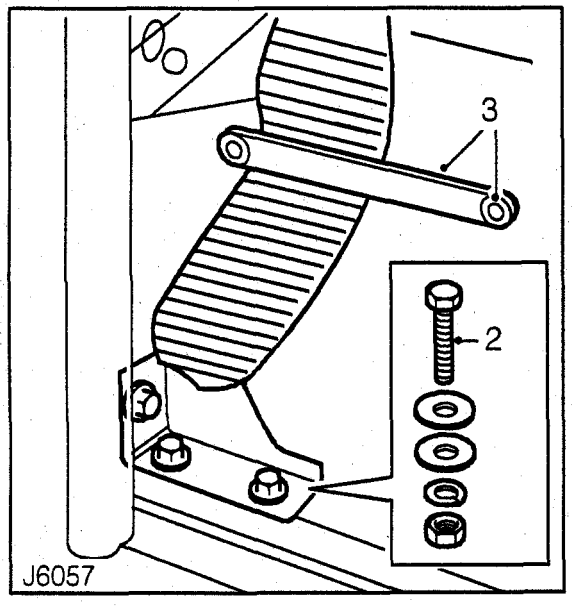
Service repair no - 76.73.13

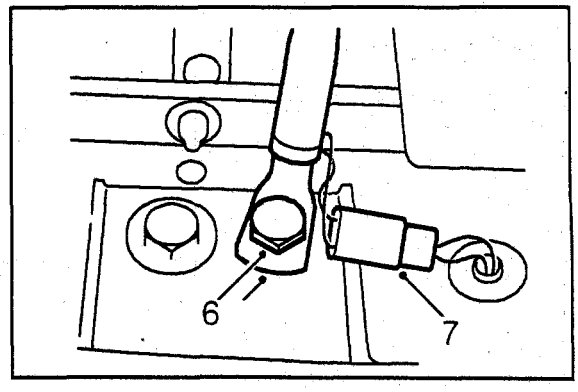
Remove

1. Remove cap and unscrew seat belt guide bracket fixing bolt from 'B/C' post.
2. Remove 3 bolts and plain washers securing seat belt mounting bracket to body on outside of seat base.
3. Prise seat belt retaining clip from side of seat mounting and remove trim studs.
4. Unscrew bolt and remove seat belt inertia reel from roll-over bar mounting bracket.
5. Remove seat belt and inertia reel assembly.
6. Unscrew bolt and washer and remove seat belt buckle stalk from roll-over mounting bracket.
7. On the driver's side, disconnect harness plug connector of audible warning circuit at buckle stalk.









Refit

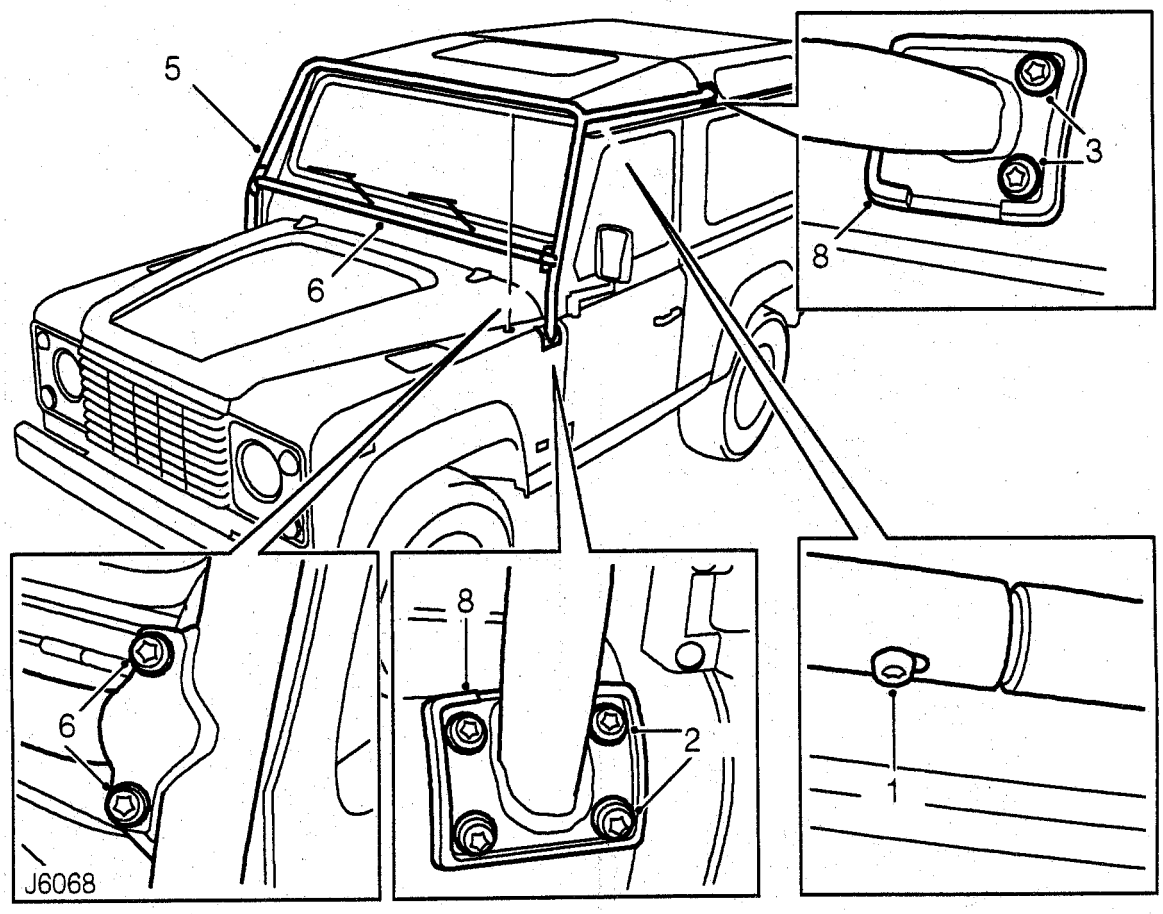
8. Reconnect harness plug of audible warning circuit.
9. Position stalk on roll-over bar mounting bracket and tighten fixing bolt to 32 Nm (24 lbf.ft).
10. Secure seat belt inertia reel to roll-over bar mounting and tighten bolt to 32 Nm (24 lbf.ft).
11. Secure seat belt bracket to floor on outside of seat base and tighten bolts to 23 Nm (17 lbf.ft).
12. Fit seat belt retaining clip to side of seat base and secure with trim studs.
13. Extend belt from inertia reel, secure slide bracket to 'B/C' post and tighten bolt to 32 Nm (24 lbf.ft).
14. Refit fixing bolt cap.

EXTERIOR ROLL-OVER BAR

Service repair no - 76.11.39

Remove

1. Remove tom bolt, from both sides, securing top of roll-over bar to roof mounted bar.
2. With assistance to support roll-over bar at windscreen, remove 4 torx bolts, from both sides, securing roll-over bar to fender mounting.
3. Remove two torx bolts, from both sides, securing top bar to roof mounting.
4. Slide top bars rearwards to disengage from main roll-over bar assembly.
5. Lift main roll-over bar assembly from vehicle
6. If necessary, remove 2 torx bolts and nuts, from both sides, and detach lower cross bar from main roll-over bar.



Refit

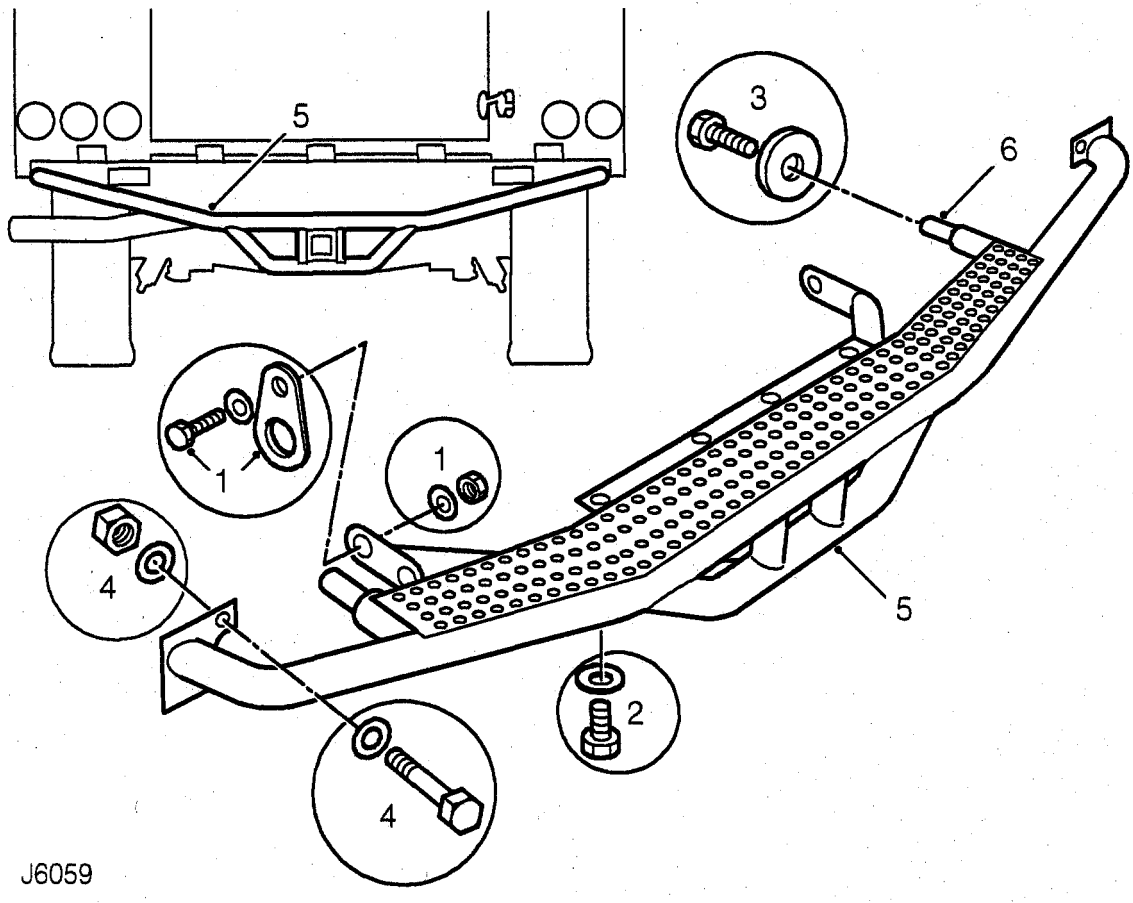
7. Locate lower cross bar into main roll-over bar mounting brackets and secure with torx bolts and nuts to 25 Nm (18lbf.ft).
8. Ensure rubber gaskets are fitted correctly to roll-over bar mounting brackets.
9. With assistance, lift roll-over bar assembly and position on fenders.
10. Slide top bars into main roll-overbar, position on roof mounting and secure with torx bolts to 25 Nm (18lbf.ft)
11. Secure roll-over bar to both fender mountings with torx bolts, Tighten to 25 Nm (18lbf.ft).
12. Secure top bars to main roll-over bar and tighten fixing bolts to 25 Nm (18lbf.ft).

REAR TOW BAR

Service repair no - 76.11.41

Remove

1. Remove bolt, washer and nut from both sides, securing tow bar lower mounting brackets and towing eyes to chassis.
2. Remove 4 bolts and spring washers securing tow bar centre mounting bracket to chassis.
3. Remove both bolts securing the two tow bar locating tubes in rear chassis cross member.
4. Remove 2 bolts securing tow bar top mounting brackets to chassis.
5. With assistance, withdraw tow bar assembly from chassis.



Refit

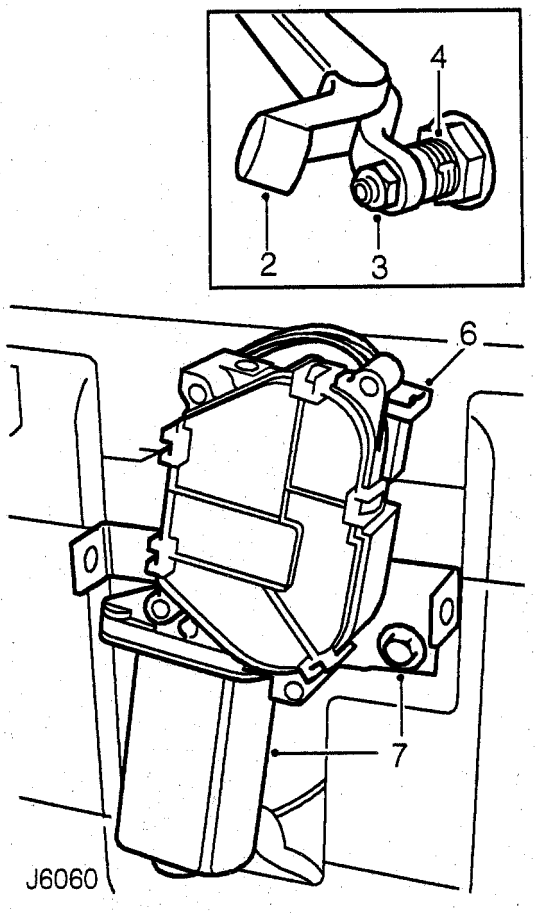
6. With assistance, lift the tow bar assembly and locate both tubes in the chassis crossmember.
7. Secure top tow bar mounting brackets to chassis but do not fully tighten fixings.
8. Secure tow bar locating tubes to rear of chassis and tighten bolts to 25 Nm (18lbf.ft).
9. Secure tow bar centre mounting bracket to underside of chassis and tighten bolts to 25 Nm (18lbf.ft).
10. Position towing eyes to lower mounting brackets and secure to chassis and tighten bolts to 25 Nm (18lbf.ft).
11. Fully tighten tow bar top mounting bracket bolts to 25 Nm (18lbf.ft).

REAR WIPER MOTOR

Service repair no - 84.35.12

Remove

1. With assistance, unscrew 3 retaining nuts and remove spare wheel from rear door mounting studs.
2. Lift wiper arm end cap to gain access to securing nut.
3. Remove nut and withdraw wiper arm from drive spindle.
4. Remove retaining nut, plain washer and rubber washer securing wiper motor drive spindle to door.
5. Remove two screws and remove cover from wiper motor mounting bracket.
6. Disconnect wiper motor harness multi-plug.
7. Remove bolt, with rubber washer, and detach wiper motor, complete with mounting bracket, from rear door.



Refit

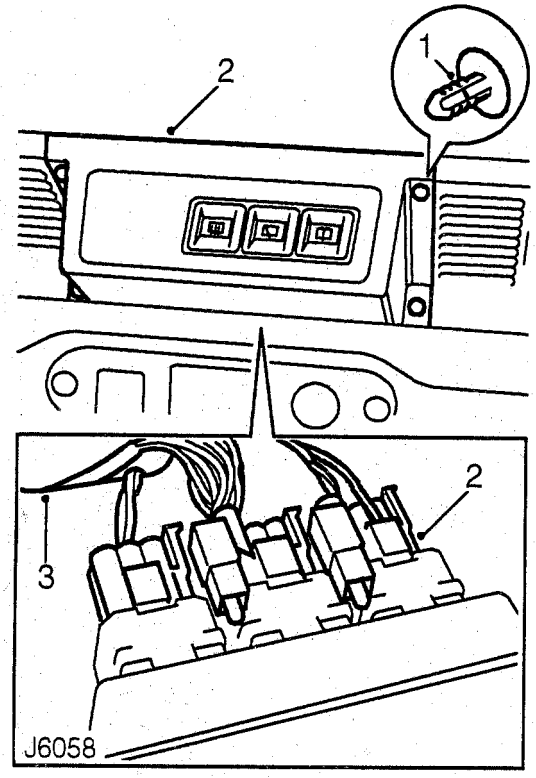
8. Locate wiper motor drive spindle through aperture in rear door.
9. Position wiper motor mounting bracket and secure to rear door. Tighten bolt to 23 Nm (17 lbf.ft).
10. Reconnect harness multi-plug.
11. Secure drive spindle to door.
12. Fit wiper motor cover.
13. Fit rear wiper arm.
14. Fit spare wheel. Tighten retaining nuts to 130Nm (96 lbf.ft).

SWITCH PANEL-REAR DOOR SERVICES

Service repair no - 86.65.78

Remove

1. Carefully prise out 4 trim studs securing switch panel to centre of fascia.
2. Withdraw switch panel and disconnect multi-plugs from the three switches.
3. Pull harness multi-plugs through aperture in base of panel.



4. Remove switch panel.

Refit

5. Feed harness into switch panel and reconnect switch multi- plugs.
6. Position switch panel on fascia and secure with trim studs.

SWITCHES -TAILGATE FUNCTIONS

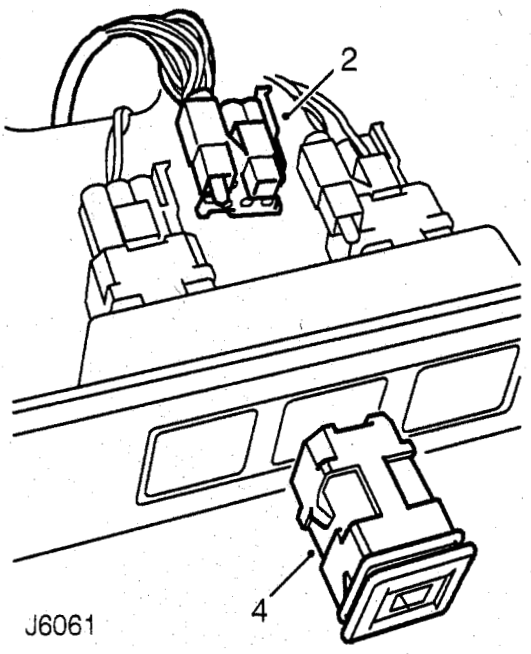
Service repair no - 84.35.33 Rear wiper switch

Service repair no - 84.30.27 Rear wash switch

Service repair no - 86.65.36 Heated rear screen switch

Remove

1. Carefully prise out 4 trim studs securing rear door services switch panel to centre of fascia.
2. Withdraw switch panel from fascia and disconnect multi-plug from rear wiper switch.
3. Press in switch retaining lugs and push switch through panel aperture.
4. Remove rear wiper switch.



Refit

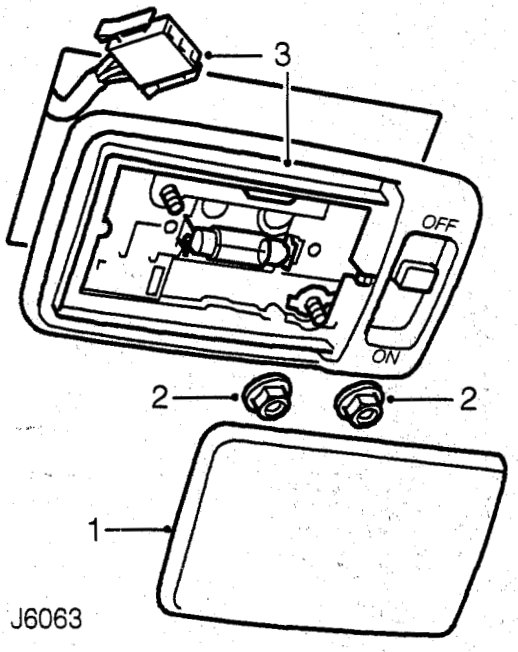
5. Position switch, reconnect multi-plug and refit rear door services switch panel

INTERIOR LAMP

Service repair no - 86.45.02

Remove

1. Carefully prise lens cover from lamp unit.
2. Remove 2 nuts securing lamp unit to headlining and roof mounting bracket.
3. Release lamp from bracket studs and disconnect harness plug.



4. Remove interior lamp.

Refit

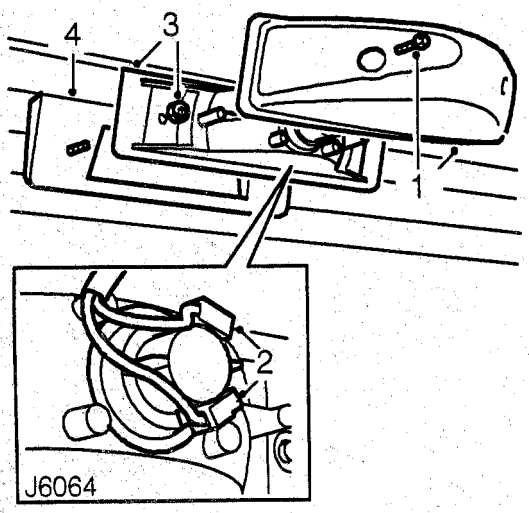
5. Connect harness plug and locate lamp unit. Ensure lamp switch eyelet is correctly seated on lamp unit base.
6. Secure lamp unit to mounting bracket with 2 nuts and refit lamp lens.

HIGH LEVEL STOP LAMP

Service repair no - 86.41.32

Remove

1. Remove 2 screws and remove stop lamp cover.
2. Disconnect Lucarsfrom bulb holder.
3. Unscrew 2 nuts and remove lamp unit from fixing studs and rubber gasket.
4. Remove gasket.



Refit

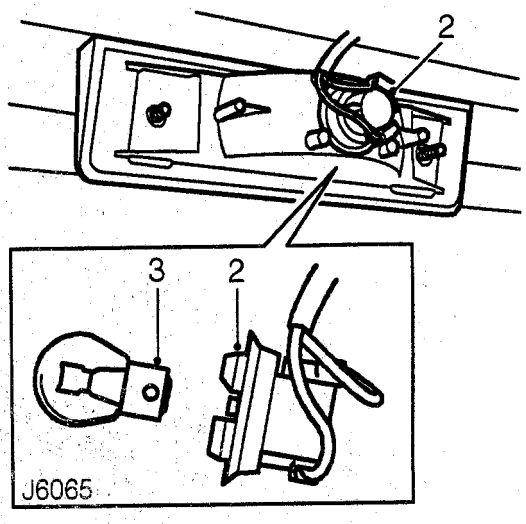
5. Position gasket and stop lamp. Secure with two nuts.
6. Connect Lucars to bulb holder.
7. Position cover and secure with screws.

HIGH LEVEL STOP LAMP BULB

Service repair no - 86.41.31

Remove

1. Remove 2 screws and remove stop lamp cover.
2. Twist bulb holder from lamp unit.
3. Remove bulb.



Refit

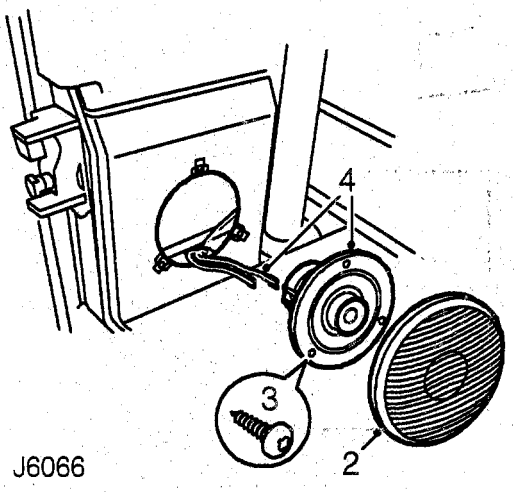
4. Fit bulb and secure holder to lamp unit.
5. Fit cover to lamp unit and secure with screws.

RADIO SPEAKER - REAR

Service repair no - 86.50.13.

Remove

1. Raise rear seat cushion and fit stowage strap.
2. Carefully prise grille from speaker.
3. Remove 3 screws and withdraw speaker from trim panel.
4. Disconnect two Lucars and remove speaker.



Refit

5. Connect Lucars, position speaker and secure with screws.
6. Position grille and press firmly to secure.