WORKSHOP MANUAL

NINETY

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INTRODUCTION

This Workshop Manual covers the Land Rover Ninety and One Ten range of vehicles. It is primarily designed to assist skilled technicians in the efficient repair and maintenance of Land Rover vehicles.

Using the appropriate service tools and carrying out the procedures as detailed will enable the operations to be completed within the time stated in the 'Repair Operation Times'.

The Manual has been produced in separate books; this allows the information to be distributed throughout the specialist areas of the modern service facility.

A table of contents in Book 1 lists the major components and systems together with the section and book numbers. The cover of each book details the sections contained within that book.

The title page of each book carries the part numbers required to order replacement books, binders or complete Service Manuals. This can be done through the normal channels.

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 and accessories:
Safety features embodied in the vehicle may be impaired if other than Land Rover parts are fitted. In certain territories, legislation prohibits the fitting of parts not to the vehicle manufacturer's specification. Torque 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.

POISONOUS SUBSTANCES

Many liquids and other substances used in motor vehicles are poisonous and should under no circumstances be consumed and should as far as possible be kept away from open wounds. These substances among others include antifreeze, brake fluid, fuel, windscreen washer additives, lubricants and various adhesives.

FUEL HANDLING PRECAUTIONS

The following information provides basic precautions which must be observed if petrol (gasoline) 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.

GENERAL

Petrol/gasoline vapour is highly flammable and in confined spaces is also very explosive and toxic.
When petrol/gasoline evaporates it produces 150 times its own volume in vapour, which when diluted with air becomes a readily ignitable mixture. The vapour is heavier than air and will always fall to the lowest level. It can readily be distributed throughout a workshop by air current, consequently, even a small spillage of petrol/gasoline is potentially 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.
Always disconnect the vehicle battery BEFORE carrying out dismantling or draining work on a fuel system.
Whenever petrol/gasoline is being handled, drained or stored, or when fuel systems are being dismantled all forms of ignition must be extinguished or removed, any head-lamps used must be flameproof and kept clear of spillage.

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

FUEL TANK DRAINING

WARNING: PETROL/GASOLINE MUST NOT BE EXTRACTED OR DRAINED FROM ANY VEHICLE WHILST IT IS STANDING OVER A PIT.

Draining or extracting petrol/gasoline from vehicle fuel tank must be carried out in a well ventilated area.
The receptacle used to contain the petrol/gasoline must be more than adequate for the full amount of fuel to be extracted or drained. The receptacle should be clearly marked with its contents, and placed in a safe storage area which meets the requirements of local authority regulations.
WHEN PETROL/GASOLINE HAS BEEN EXTRACTED OR DRAINED FROM A FUEL TANK THE PRECAUTIONS GOVERNING NAKED LIGHTS AND IGNITION SOURCES SHOULD BE MAINTAINED.

FUEL TANK REMOVAL

On vehicles where the fuel line is secured to the fuel tank outlet by a spring steel clip, it is recommended that such clips are released before the fuel line is disconnected or the fuel tank unit is removed. This procedure will avoid the possibility of residual petrol fumes in the fuel tank being ignited when the clips are released.
As an added precaution fuel tanks should have a PETROL/GASOLINE VAPOUR warning label attached to them as soon as they are removed from the vehicle.

FUEL TANK REPAIR

Under no circumstances should a repair to any tank involving heat treatment be carried out without first rendering the tank SAFE, by using one of the following methods:

STEAMING: With the filler cap and tank unit removed, empty the tank. Steam the tank for at least two hours with low pressure steam. Position the tank so that condensation can drain away freely, ensuring that any sediment and sludge not volatised by the steam, is washed out during the steaming process.

BOILING: With the filler cap and tank unit removed, empty the tank. Immerse the tank completely in boiling water containing an effective alkaline degreasing agent or a detergent, with the water filling and also surrounding the tank for at least two hours.

After steaming or boiling a signed and dated label to this effect should be attached to the tank.

SPECIFICATION

Purchasers are advised that the specification details set out in this 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 specifications with or without notice, and at such times and in such manner as they think fit. Major as well as minor changes may be involved in accordance with the Manufacturer's policy of constant product improvement.

Whilst every effort is made to ensure the accuracy of the particulars contained in this Manual, neither the Manufacturer 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.

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Special Service Tools

The use of approved special service tools is important. They are essential if service operations are to be carried out efficiently, and safely. The amount of time which 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.

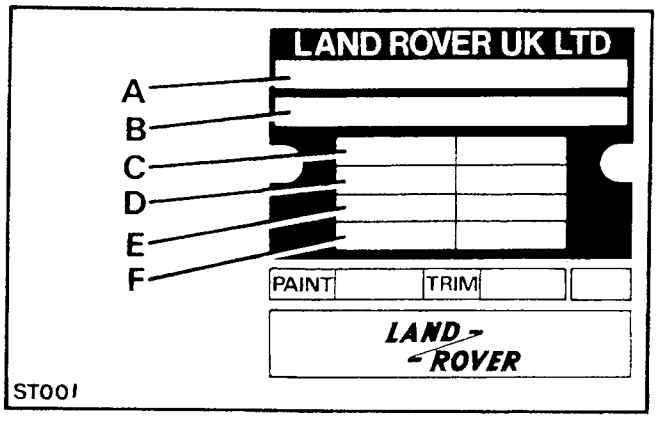
The tools recommended in this Workshop Manual are listed in a multi-language, illustrated catalogue obtainable from Messrs. V. L. Churchill at the above address under publication number 2217/2/84 or from Land Rover Ltd., under part number LSM0052TC from the following address, Land Rover Limited, Service Department, Lode Lane, Solihull, West Midlands, England B92 8NW.

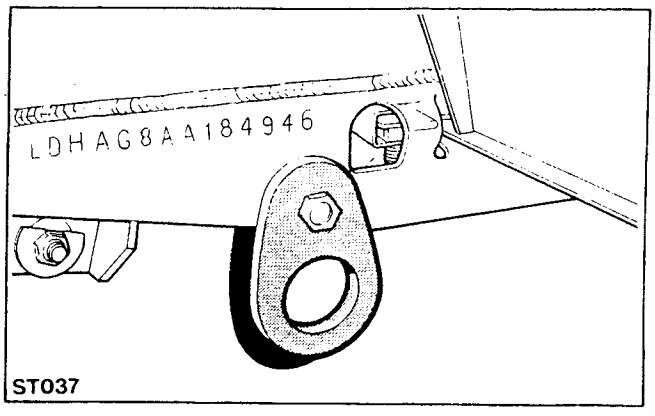
VEHICLE IDENTIFICATION NUMBER (VIN)

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 Limited.

Key to Vehicle Identification Number Plate

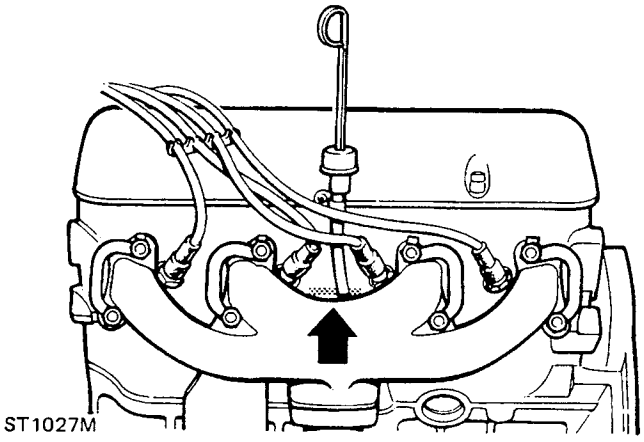
A Type approval
B VIN (minimum of 17 digits)
C Maximum permitted laden weight for vehicle
D Maximum vehicle and trailer weight
E Maximum road weight — front axle
F Maximum road weight — rear axle





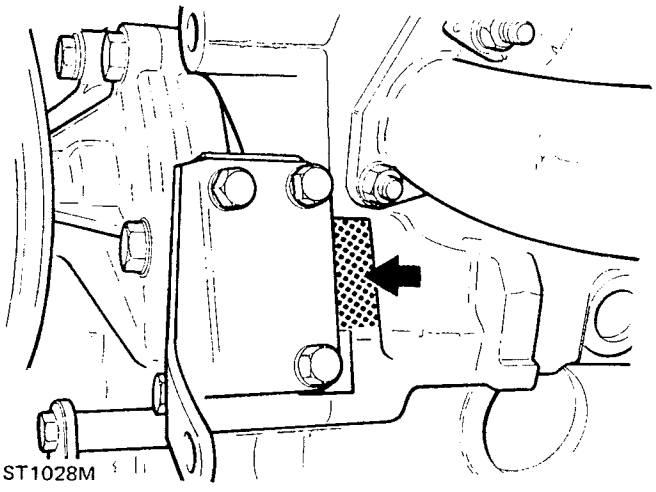
ENGINE SERIAL NUMBER — V8 ENGINE

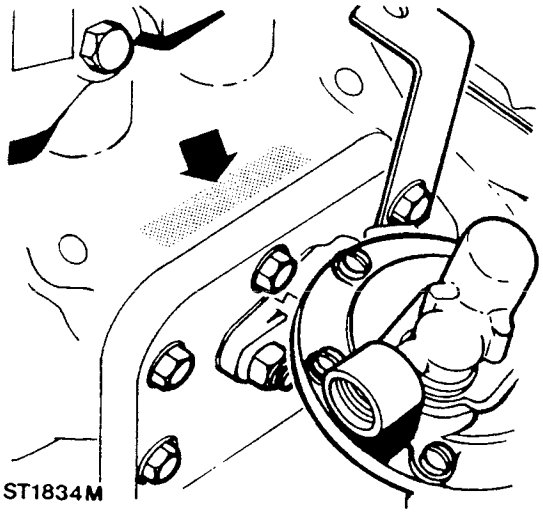
The V8 engine serial number is stamped on a cast pad on the cylinder block between numbers 3 and 5 cylinders.



ENGINE SERIAL NUMBER — 4 CYLINDER ENGINES

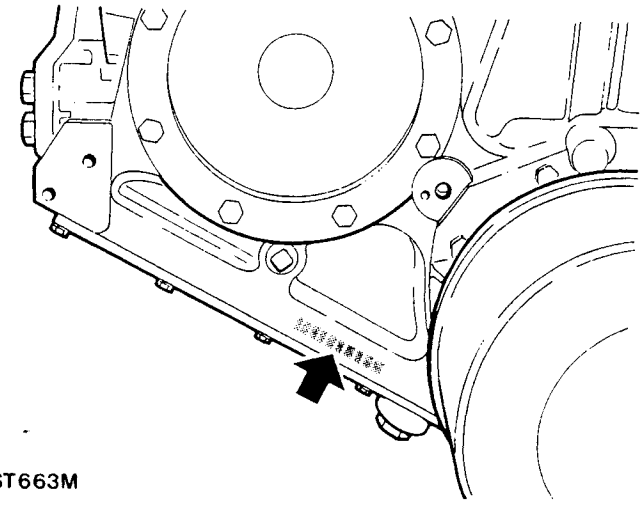
The 4 cylinder engine number is stamped on a machined surface at the front left-hand side of the engine adjacent to the exhaust manifold front flange. On later engines the number is stamped above the rear side cover, as the second illustration shows.





MAIN GEARBOX AND TRANSFER BOX LT95 — V8

Stamped on the rear of the transfer box on the opposite side to the transmission brake.



ST663M

FRONT AXLE

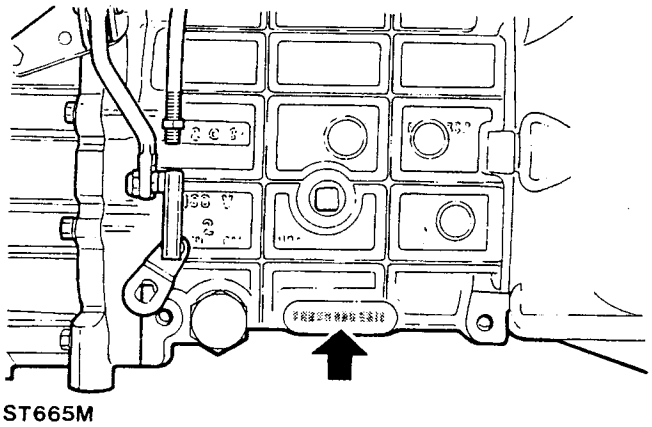
Stamped on top of the left-hand axle tube.

REAR AXLE

Stamped on rear of left-hand axle tube.

MAIN GEARBOX LT77 — 4 CYLINDER VEHICLES

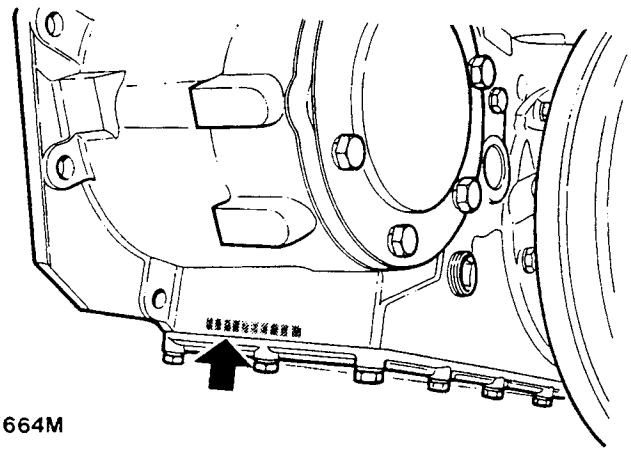
Stamped on a pad on the right-hand side of the gearbox immediately below the oil filler level plug.



ST665M

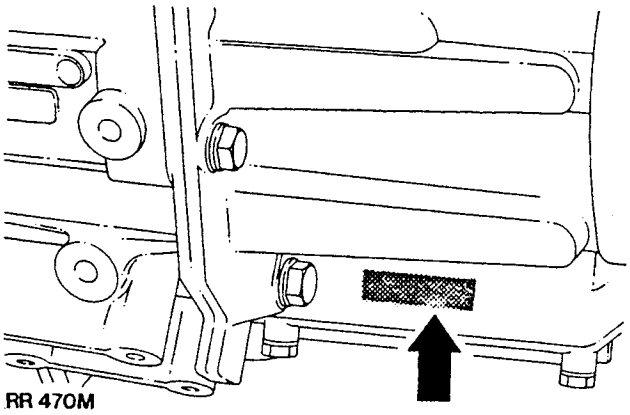
TRANSFER GEARBOX LT230R — 4 CYLINDER VEHICLES

Stamped on the casing on the left-hand side of the gearbox below the mainshaft rear bearing housing adjacent to the bottom cover.



ST664M

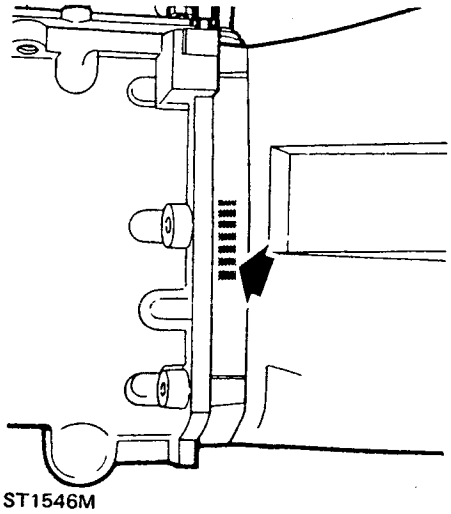
TRANSFER GEARBOX LT230T — 4 CYLINDER AND V8 VEHICLES FROM SERIAL NUMBER SUFFIX 'B' ONWARD



RR 470M

MAIN GEARBOX LT85 FIVE SPEED — V8 VEHICLES

Stamped on the right-hand side of the front bearing plate.



ST1546M

GENERAL SPECIFICATION DATA

V8 ENGINE

ENGINE

Type	V8
Number of cylinders	Eight, two banks of four
Bore	88,90 mm (3.500 in)
Stroke	71,12 mm (2.800 in)
Capacity	3528 cc (215 in³)
Valve operation	Overhead by push-rod
Maximum power — B.H.P.	113 } at 4000 rpm
Maximum power — KW	84.6 } at 4000 rpm
Maximum torque	251 Nm (185 lb ft) at 2500 rpm

Crankshaft

Main journal diameter	58,409 - 58,422 mm (2.2996 - 2.3001 in)
Minimum regrind diameter	57,393 - 57,406 mm (2.2596 - 2.2601 in)
Crankpin journal diameter	50,800 - 50,812 mm (2.0000 - 2.0005 in)
Minimum regrind diameter	49,784 - 49,797 mm (1.9600 - 1.9605 in)
Crankshaft end thrust	Taken on thrust washers of centre main bearing
Crankshaft end-float	0,10 - 0,20 mm (0.004 - 0.008 in)

Main bearings

Number and type	5, Vandervell shells
Material	Lead-indium
Diametrical clearance	0,010 - 0,048 mm (0.0004 - 0.0019 in)
Undersizes	0,254 mm, 0,508 mm (0.010 in, 0.020 in)

Connecting rods

Type	Horizontally split big end, plain small end
Length between centres	143,81 - 143,71 mm (5.662 - 5.658 in)

Big end bearings

Type and material	Vandervell VP lead-indium
Diametrical clearance	0,015 - 0,055 mm (0.0006 - 0.0022 in)
End-float on crankpin	0,15 - 0,36 mm (0.006 - 0.014 in)
Undersizes	0,254 mm, 0,508 mm (0.010 in, 0.020 in)

Gudgeon pins

Length	72,67 - 72,79 mm (2.861 - 2.866 in)
Diameter	22,215 - 22,22 mm (0.8746 - 0.8749 in)
Fit-in connecting rod	Press fit
Clearance in piston	0,002 - 0,007 mm (0.0001 - 0.0003 in)

Pistons

Clearance in bore, measured at bottom of skirt at right angles to gudgeon pin	0,018 - 0,033 mm (0.0007 - 0.0013 in)

Piston rings

Number of compression	2
Number of oil	1
No. 1 compression ring	Chrome parallel faced
No. 2 compression ring	Stepped to 'L' shape and marked 'T' or 'TOP'
Width of compression rings	1,56 - 1,59 mm (0.0615 - 0.0625 in)
Compression ring gap	0,44 - 0,57 mm (0.017 - 0.022 in)
Oil ring type	Perfect circle, type 98-6
Oil ring width	4,811 mm (0.1894 in) max
Oil ring gap	0,38 - 1,40 mm (0.015 - 0.055 in)

Camshaft

Location	Central
Bearings	Non-serviceable
Number of bearings	5
Drive	Chain 9,52 mm (0.375 in) pitch x 54 pitches

Valves

Length:	
Inlet	116,59 - 117,35 mm (4.590 - 4.620 in)
Exhaust	116,59 - 117,35 mm (4.590 - 4.620 in)
Seat angle:	
Inlet	45° - 45½°
Exhaust	45° - 45½°
Head diameter:	
Inlet	39,75 - 40,00 mm (1.565 - 1.575 in)
Exhaust	34,226 - 34,480 mm (1.3475 - 1.3575 in)
Stem diameter:	
Inlet	8,664 - 8,679 mm (0.3411 - 0.3417 in)
Exhaust	8,651 - 8,666 mm (0.3406 - 0.3412 in)
Stem to guide clearance:	
Inlet	0,025 - 0,066 mm (0.0010 - 0.0026 in)
Exhaust	0,038 - 0,078 mm (0.0015 - 0.0031 in)
Valve lift (inlet and exhaust)	9,49 mm (0.374 in)
Valve spring length fitted	40,4 mm (1.590 in) at pressure of 29,5 kg (65 lbs)

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2400 rpm	2,1 - 2,8 kgf cm^2 (30 - 40 lbf in^2)
Oil filter (external)	Full-flow, self-contained cartridge
Oil filter (internal)	Gauze. Pump intake filter
Oil pump type	Gear

Oil pressure relief valve

Type	Non-adjustable
Relief valve spring:	
Free length	81,2 mm (3.200 in)
Compressed length at 4,2 kg (9.3 lb) load	45,7 mm (1.800 in)

Oil filter by-pass valve

Type	Non-adjustable
By-pass valve spring:	
Free length	37,5 mm (1.48 in)
Compressed length at 0,34 kg (0.75 lb)	22,6 mm (0.89 in)

2.25 LITRE PETROL ENGINE

ENGINE

Type	4 cylinder
Bore	90,47 mm (3.562 in)
Stroke	88,9 mm (3.500 in)
Capacity	2286 cm^3 (139.500 in^3)
Valve operation	Overhead by push-rod
Compression ratio	8.0:1
Maximum power @ 4000 rpm	55.2 Kw (74 bhp)
Maximum torque @ 2000 rpm	163 Nm (120 lbf ft)

Crankshaft

Main journal diameter	63,487 - 63,500 mm (2.4995 - 2.500 in)
Minimum regrind diameter	63,246 - 63,2333 mm (2.4900 - 2.4895 in)
Crankpin journal diameter	58,725 - 58,744 mm (2.312 - 2.31275 in)
Minimum regrind diameter	58,48985 - 58,47080 mm (2.30275 - 2.30200 in)
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05 - 0,15 mm (0.002 - 0.006 in)

Main bearings

Number and type	5 halved shells
Material	Steel shell, tin-aluminium lined
Diametrical clearance	0,020 - 0,063 mm (0.0008 - 0.0025 in)
Undersizes	0,25 mm (0.010 in)

Connecting rods

Type	Horizontally split big end, plain small end
Length between centres	175,36 - 175,46 mm (6.904 - 6.908 in)

Big end bearings

Type and material	Steel shell, copper-lead lined
Diametrical clearance	0,019 - 0,068 mm (0.00075 - 0.0027 in)
End-float on crankpin	0,20 - 0,30 mm (0.007 - 0.012 in)
Undersizes	0,25 mm (0.010 in)

Gudgeon pins

Type	Floating
Fit in piston	Push fit by hand
Clearance in connecting rod	0,007 - 0,015 mm (0.0003 - 0.0006 in)

Pistons

Type 8.0:1 compression ratio	Aluminium alloy, flat top
Clearance in bore, measured at bottom of skirt at right angles to gudgeon pin:	
Standard size pistons	0,06 - 0,07 mm (0.0023 - 0.0027 in)
Oversize pistons	0,043 - 0,055 mm (0.0017 - 0.0022 in)

Piston rings

Compression	2
Gap in bore	0,38 - 0,50 mm (0.015 - 0.020 in)
Clearance in groove	0,046 - 0,097 mm (0.0018 - 0.0038 in)
Oil control	1
Gap in bore	0,38 - 0,50 mm (0.015 - 0.020 in)
Clearance in groove	0,038 - 0,089 mm (0.0015 - 0.0035 in)

Camshaft

Location	Right-hand side (thrust side) of engine
End-float	0,06 - 0,13 mm (0.0025 - 0.0055 in)
Number of bearings	4
Material	Steel shell, white metal lined
Drive	Chain

Valves

Length:	
Inlet	111,20 - 111,66 mm (4.378 - 4.396 in)
Exhaust	111,22 - 111,58 mm (4.388 - 4.412 in)
Seat angle:	
Inlet	30°
Exhaust	45°
Head diameter:	
Inlet	44,32 - 44,57 mm (1.744 - 1.755 in)
Exhaust	34,93 - 35,18 mm (1.378 - 1.380 in)
Stem diameter:	
Inlet	7,899 - 7,912 mm (0.3109 - 0.3115 in)
Exhaust	8,682 - 8,694 mm (0.3418 - 0.3422 in)
Stem to guide clearance:	
Inlet	0,033 - 0,048 mm (0.0013 - 0.0019 in)
Exhaust	0,058 - 0,073 mm (0.0023 - 0.0029 in)
Valve lift:	
Inlet	10,236 mm (0.403 in)
Exhaust	9,85 mm (0.388 in)

Valve springs

Type	Duplex interference coil
Inner:	
Length, free	42,67 mm (1.680 in)
Length, under 8,0 kg (17.7 lb) load	37,13 mm (1.462 in)
Outer:	
Length, free	46,28 mm (1.822 in)
Length, under 21 kg (46 lb) load	40,30 mm (1.587 in)

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2000 rpm	2,45 - 4,50 kgf cm^2 (35 - 65 lbf in^2)
Oil pump: Early type	
Type	Double gear
Drive	Splined shaft from camshaft skew gear
End-float of gears:	
Steel gear	0,05 - 0,12 mm (0.002 - 0.005 in)
Aluminium gear	0,07 - 0,15 mm (0.003 - 0.006 in)
Radial clearance of gears	0,02 - 0,10 mm (0.001 - 0.004 in)
Backlash of gears	0,15 - 0,28 mm (0.006 - 0.012 in)

Lubrication (continued)

Oil pump: Latest type	
Type	Double gear, 10 teeth, sintered iron gears
Drive	Splined shaft from camshaft skew gear
End-float of both gears	0,026 - 0,135 mm (0.0009 - 0.0045 in)
Radial clearance of gears	0,025 - 0,075 mm (0.0008 - 0.0025 in)
Backlash of gears	0,1 - 0,2 mm (0.0034 - 0.0067 in)

Oil pressure relief valve

Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm (2.670 in)
Compressed length at 2,58 kg (5.7 lb) load	61,23 mm (2.450 in)

2.5 LITRE PETROL ENGINE

ENGINE

Type	4 cylinder
Bore	90,47 mm (3.562 in)
Stroke	97 mm (3.82 in)
Capacity	2495 cm^3 (152.25 in^3)
Valve operation	Overhead by push-rod
Compression ratio	8.0:1
Maximum power @ 4000 rpm	59.5 Kw (80 bhp)
Maximum torque @ 2000 rpm	175 Nm (129 lbf ft)
Commencing serial no	17H00011C

Crankshaft

Main journal diameter	63,487 - 63,500 mm (2.4995 - 2.500 in)
Minimum regrind diameter	63,246 - 63,2333 mm (2.4900 - 2.4895 in)
Crankpin journal diameter	58,725 - 58,744 mm (2.312 - 2.31275 in)
Minimum regrind diameter	58,48985 - 58,47080 mm (2.30275 - 2.30200 in)
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05 - 0,15 mm (0.002 - 0.006 in)

Main bearings

Number and type	5 halved shells
Material	Copper-lead lined
Diametrical clearance	0,018 - 0,06 mm (0.0007 - 0.0026 in)
Undersizes	0,25 mm (0.010 in)

Connecting rods

Type	Horizontally split big end, plain small end
Length between centres	175,36 - 175,46 mm (6.904 - 6.908 in)

Connecting rod bearings

Type and material	Steel shell, copper-lead lined
Diametrical clearance	0,025 - 0,075 mm (0.001 - 0.003 in)
End-float on crankpin	0,20 - 0,30 mm (0.007 - 0.012 in)
Undersizes	0,25 mm (0.010 in)

Gudgeon pins

Type	Floating
Fit in piston	Push fit by hand
Clearance in connecting rod	0,007 - 0,015 mm (0.0003 - 0.0006 in)

Pistons

Type 8.0:1 compression ratio	Aluminium alloy. Recessed crown.
Clearance in bore measured @ 17 mm from bottom of skirt at right angles to gudgeon pin:	
Standard and oversize pistons	0,043 - 0,067 mm (0.0017 - 0.0026 in)

Piston rings

Compression	2
Gap in bore	0,40 - 0,65 mm (0.016 - 0.026 in)
Clearance in groove	0,046 - 0,097 mm (0.0018 - 0.0038 in)
Oil control	1
Gap in bore	0,30 - 0,55 mm (0.012 - 0.022 in)
Clearance in groove	0,026 - 0,076 mm (0.0012 - 0.003 in)

Camshaft

Location	Right-hand side (thrust side) of engine
End-float	0,06 - 0,13 mm (0.0025 - 0.0055 in)
Number of bearings	4
Material	Steel shell, white metal lined
Drive	76 link chain

Valves

Length:	
Inlet	111,20 - 111,66 mm (4.377 - 4.396 in)
Exhaust	111,12 - 111,59 mm (4.374 - 4.393 in)
Seat angle:	
Inlet	30°
Exhaust	45°
Head diameter:	
Inlet	44,32 - 44,58 mm (1.744 - 1.755 in)
Exhaust	34,43 - 34,18 mm (1.355 - 1.345 in)
Stem diameter:	
Inlet	7,899 - 7,912 mm (0.3109 - 0.3115 in)
Exhaust	8,697 - 8,679 mm (0.3424 - 0.3416 in)
Stem to guide clearance:	
Inlet	0,033 - 0,048 mm (0.0013 - 0.0019 in)
Exhaust	0,035 - 0,076 mm (0.0014 - 0.0022 in)
Valve lift:	
Inlet	10,236 mm (0.403 in)
Exhaust	9,85 mm (0.388 in)
Exhaust valve seat insert:	
External diameter	36,576 - 36,601 (1.440 - 1.441 in)
Internal diameter	28,448 - 28,702 mm (1.120 - 1.130 in)
Width	5,055 - 5,105 mm (0.199 - 0.201 in)
Seat angle and depth	45°. 0,635 - 0,889 mm (0.025 - 0.035 in)

Valve springs

Type	Duplex interference coil
Inner:	
Length, free	42,67 mm (1.680 in)
Length, under 8,0 kg (17.7 lb) load	37,13 mm (1.462 in)
Outer:	
Length, free	46,28 mm (1.822 in)
Length, under 21 kg (46 lb) load	40,30 mm (1.587 in)

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2000 rpm	2,45 - 4,50 kgf cm^2 (35 - 65 lbf in^2)
Oil pump:	
Type	Double gear, 10 teeth, sintered iron gears
Drive	Splined shaft from camshaft skew gear
End-float of both gears	0,026 - 0,135 mm (0.0009 - 0.0045 in)
Radial clearance of gears	0,025 - 0,075 mm (0.0008 - 0.0025 in)
Backlash of gears	0,1 - 0,2 mm (0.0034 - 0.0067 in)

Oil pressure relief valve

Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm (2.670 in)
Compressed length at 2,58 kg (5.7 lb) load	61,23 mm (2.450 in)

2.25 LITRE DIESEL ENGINE

ENGINE

Type	4 cylinder
Bore	90,47 mm (3.562 in)
Stroke	88,9 mm (3.500 in)
Capacity	2286 cm^3 (139 in^3)
Valve operation	Overhead by push-rod
Compression ratio	23:1
Maximum power	44Kw (59 bhp) at 4000 rpm
Maximum torque	136 Nm (100 lbf ft) at 1800 rpm

Crankshaft

Main bearing journal diameter	63,487 - 63,500 mm (2.4995 - 2.500 in)
Regrind dimensions:	
63,246 - 63,2333 mm (2.490 - 2.4895 in)	Use 0.010 in U/S bearings
Crankpin journal diameter	58,725 - 58,744 mm (2.312 - 2.31275 in)
Regrind dimensions:	
58,48985 - 58,4708 mm (2.30275 - 2.30200 in)	Use 0.010 in U/S bearings
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05 - 0,15 mm (0.002 - 0.006 in)

Main bearings

Number and type	5 halved shells
Material	Steel shell, copper-lead lined, tin plated
Diametrical clearance	0,020 - 0,063 mm (0.0008 - 0.0025 in)

Connecting rods

Type	Horizontally split big end, plain small end
Length between centres	175,38 - 175,43 mm (6.905 - 6.907 in)

Big end bearings

Type and material	Steel shell, copper-lead lined
Diametrical clearance	0,020 - 0,0635 mm (0.0008 - 0.0025 in)
End-float on crankpin	0,15 - 0,356 mm (0.006 - 0.014 in)

Gudgeon pins

Type	Floating
Fit in piston	Push fit by hand
Clearance in connecting rod	0,0196 - 0,0036 mm (0.0007 - 0.00014 in)
Diameter	30,1564 - 30,1625 mm (1.18726 - 1.1875 in)

Pistons

Type	Aluminium alloy, with V shape recess in crown
Clearance in bore, measured at bottom of skirt at right angles to gudgeon pin:	
Standard size pistons	0,111 - 0,134 mm (0.0044 - 0.0053 in)
Oversize pistons	0,111 - 0,157 mm (0.0044 - 0.0062 in)

Piston rings

Compression No. 1 (top):	
Type	Square friction edge, chrome plated
Gap in bore	0,35 - 0,50 mm (0.014 - 0.019 in)
Clearance in groove	0,06 - 0,11 mm (0.0025 - 0.0045 in)
Compression Nos. 2 and 3:	
Type	Bevelled friction edge. Marked 'T' or 'TOP' on upper side
Gap in bore	0,25 - 0,38 mm (0.010 - 0.015 in)
Clearance in groove	0,06 - 0,11 mm (0.0025 - 0.0045 in)
Oil control No. 4:	
Type	Ring and spring
Gap in bore	0,279 - 0,406 mm (0.011 - 0.016 in)
Clearance in groove	0,038 - 0,064 mm (0.0015 - 0.0025 in)

Valves

Length:	
Inlet	116,26 - 116,51 mm (4.377 - 4.587 in)
Exhaust	116,79 - 117,25 mm (4.598 - 4.616 in)
Seat angle:	
Inlet	45°
Exhaust	45°
Head diameter:	
Inlet	39,12 - 39,37 mm (1.540 - 1.550 in)
Exhaust	33,25 - 33,50 mm (1.309 - 1.318 in)
Stem diameter:	
Inlet	7,912 - 7,899 mm (0.3114 - 0.3109 in)
Exhaust	8,682 - 8,694 mm (0.3418 - 0.3422 in)
Stem to guide clearance:	
Inlet	0,033 - 0,048 mm (0.0013 - 0.0019 in)
Exhaust	0,058 - 0,073 mm (0.0023 - 0.0029 in)
Valve lift:	
Inlet	9,85 mm (0.388 in)
Exhaust	10,26 mm (0.404 in)

Camshaft

Location	Right-hand side (thrust side) of engine
End-float	0,1 - 0,2 mm (0.004 - 0.008 in)
Number of bearings	4
Material	Steel shell, white metal lined
Drive	Chain

Valve springs

Type	Duplex Interference double coil
Inner:	
Length, free	42,67 mm (1.680 in)
Length, under 8,0 kg (17.7 lb) load	40,30 mm (1.587 in)
Outer:	
Length, free	46,28 mm (1.822 in)
Length, under 21 kg (46 lb) load	40,30 mm (1.587 in)

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2000 rpm	2,5 - 4,57 kgf cm^2 (35 - 65 lbf in^2)
Oil pump:	
Type	Double gear
Drive	Splined shaft from camshaft skew gear
End-float of gears:	
Steel gear	0,05 - 0,12 mm (0.002 - 0.005 in)
Aluminium gear	0,07 - 0,15 mm (0.003 - 0.006 in)
Radial clearance of gears	0,02 - 0,10 mm (0.001 - 0.004 in)
Backlash of gears	0,15 - 0,28 mm (0.006 - 0.012 in)

Oil pressure relief valve

Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm (2.670 in)
Compressed length at 2,58 kg (5.7 lb) load	61,23 mm (2.450 in)

2.5 LITRE DIESEL ENGINE

ENGINE

Number of cylinders	4
Bore	90,47 mm (3.562 in)
Stroke	97,00 mm (3.819 in)
Capacity	2495 cc
Compression ratio	21:1
Piston area (total)	257,1 cm^3 (39.86 in^3)
Maximum power at 4000 rpm	65.5 bhp
Maximum torque at 1800 rpm	113 lbf ft

Crankshaft

Main bearing journal diameter	63,487 - 63,500 mm (2.4995 - 2.5000 in)
Regrind dimensions:	
63,246 - 63,2333 mm (2.490 - 2.4895 in)	Use 0.010 in U/S bearings
Crankpin journal diameter	58,725 - 58,744 mm (2.312 - 2.31275 in)
Regrind dimensions:	
58,48985 - 58,4708 mm (2.30275 - 2.30200 in)	Use 0.010 in U/S bearings
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05 - 0,15 mm (0.002 - 0.006 in)

Main bearings	
Number and type	5 halved shells
Diametrical clearance	0,018 - 0,061 mm (0.0007 - 0.0024 in)
Connecting rods	
Length between centres	175,38 - 175,43 mm (6.905 - 6.907 in)
Diametrical clearance (big-end bearings)	0,025 - 0,075 mm (0.001 - 0.003 in)
End-float on crankpin	0,15 - 0,356 mm (0.006 - 0.014 in)
Pistons	
Type	Aluminium alloy 'V' shaped valve recess in crown
Skirt diametrical clearance (at right angle to gudgeon pin)	0,025 - 0,05 mm (0.001 - 0.002 in)
Gudgeon pins	
Type	Floating
Fit in piston	Hand push fit
Diameter	30,1564 - 30,1625 mm (1.18726 - 1.18750 in)
Clearance in connecting rod	0,0196 - 0,0036 mm (0.00077 - 0.00014 in)
Piston rings	
Type: Top	Square friction edge, chrome plated
Second	Taper faced
Oil control	Expander and rails
Camshaft	
Drive	25,4 mm (0.1 in) wide dry toothed belt
Location	Right-hand side (thrust side)
End-float	0,1 - 0,2 mm (0.004 - 0.008 in)
Number of bearings	4
Material	Steel shell, white metal lined
Valves	
Seat angle:	
Inlet	45°
Exhaust	45°
Head diameter:	
Inlet	39,12 - 39,37 mm (1.540 - 1.550 in)
Exhaust	33,25 - 33,50 mm (1.309 - 1.319 in)
Valve lift:	
Inlet	9,85 mm (0.388 in)
Exhaust	10,26 mm (0.404 in)
Cam lift:	
Inlet	6,81 mm (0.268 in)
Exhaust	7,06 mm (0.278 in)
Stem diameter:	
Inlet	7,912 - 7,899 mm (0.3114 - 0.3109 in)
Exhaust	8,682 - 8,694 mm (0.3418 - 0.3422 in)

Valve springs

Type	Duplex Interference double coil
Inner:	
Length, free	42,67 mm (1.680 in)
Length, under 8,0 kg (17.7 lb) load	40,30 mm (1.587 in)
Outer:	
Length, free	46,28 mm (1.822 in)
Length, under 21 kg (46 lb) load	40,30 mm (1.587 in)

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2000 rpm	2,5 - 4,57 kgf cm^2 (35 - 65 lbf in^2)
Oil pump: Early type	
Type	Double gear
Drive	Splined shaft from camshaft skew gear
End-float of gears:	
Steel gear	0,05 - 0,12 mm (0.002 - 0.005 in)
Aluminium gear	0,07 - 0,15 mm (0.003 - 0.006 in)
Radial clearance of gears	0,02 - 0,10 mm (0.001 - 0.004 in)
Backlash of gears	0,15 - 0,28 mm (0.006 - 0.012 in)
Oil pump: Latest type	
Type	Double gear, 10 teeth, sintered iron gears
Drive	Splined shaft from camshaft skew gear
End-float of both gears	0,026 - 0,135 mm (0.0009 - 0.0045 in)
Radial clearance of gears	0,025 - 0,075 mm (0.0008 - 0.0025 in)
Backlash of gears	0,1 - 0,2 mm (0.0034 - 0.0067 in)

Oil pressure relief valve

Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm (2.670 in)
Compressed length at 2,58 kg (5.7 lb) load	61,23 mm (2.450 in)

GENERAL DATA

FUEL SYSTEM — 2.25 Petrol

Carburetter	See **'ENGINE TUNING DATA'**
Air cleaner	Oil bath with built-in centrifugal pre-cleaner

Fuel pump — Early Models

Type	Mechanical with sediment bowl and hand primer
Pressure range	3 - 5 psi

Fuel pump — Latest Models

Make and Type	Facet, electric. Mounted on R.H. side of chassis
Pressure range	3 - 5 psi

FUEL SYSTEM — 2.25 and 2.5 Diesel

Injection pump	See **'ENGINE TUNING DATA'**
Fuel lift pump type	Mechanical, with hand primer
Pressure range	0,35 - 0,56 kgf cm^2 (5 - 8 lbf ft^2)

FUEL SYSTEM — V8 engine

Carburetter	See **'ENGINE TUNING DATA'**
Fuel pump — Make, type	Facet, electric mounted vertically on R.H. side of chassis
Air cleaner	Cyclone, replaceable element

COOLING SYSTEM — 2.25 Petrol, 2.25 and 2.5 Diesel

Type	Pressurized spill return system with thermostat control, pump and fan assisted
Thermostat	82°C
Pressure cap	0,6 kgf cm^2 (9 lbf in^2)
Type of pump	Centrifugal

COOLING SYSTEM — V8 engine

Type	Pressurized spill return system with thermostat control, pump and fan assisted
Thermostat	Emission and non-emission 82°C, Australia 88°C
Type of pump	Centrifugal

CLUTCH — 2.25 Petrol

Type	Borg and Beck diaphragm spring
Centre plate diameter	242,1 mm (9.500 in)
Facing material	Raybestos 1488-05
Facing material identification colour	White/violet on periphary
Number of damper springs	6
Damper spring colour	Dark grey/light green
Clutch release bearing	Ball journal

CLUTCH — 2.25 and 2.5 Diesel engine — Early type

Type	Verto diaphragm spring
Centre plate diameter	242,1 mm (9.500 in)
Facing material	Raybestos 1488-05
Number of damper springs	8
Damper spring colour	2 off white/green 2 off pigeon blue 4 off ruby red
Clutch release bearing	Ball journal

CLUTCH — Later type

Type	Verto diaphragm spring
Centre plate diameter (friction plate)	235 mm (9.25 in)
Facing material	Verto 791
Number of damper springs	8
Damper spring colour	2 off white/green — suffix 'C' 2 off pigeon blue — suffix 'A' 4 off ruby red — suffix 'B'
Clutch release bearing	Ball journal

CLUTCH — V8 engine

Type	Borg and Beck diaphragm spring
Centre plate diameter	267 mm (10.5 in)
Facing material	Raybestos 1488-05. Grooved. White/violet
Damper spring colour	Light blue/dark blue
Release bearing	Ball journal
Number of damper springs	6

TRANSMISSION — 2.25 Petrol, 2.25 and 2.5 Diesel engine

Main gearbox

Type LT77	Single helical constant mesh
Speeds	5 forward 1 reverse
Synchromesh	All forward speeds
Ratios:	
Fifth	0.8314:1
Fourth (direct)	1.0000:1
Third	1.5074:1
Second	2.3008:1
First	3.5850:1
Reverse	3.7007:1

Transfer box

Type LT230R	Two-speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential
Ratios:	
High	1.6670
Low	3.3198

Overall ratios (final drive):	**In high transfer**	**In low transfer**
Fifth	4.9042:1	9.7666:1
Fourth	5.8987:1	11.7471:1
Third	8.8917:1	17.7075:1
Second	13.5715:1	27.0272:1
First	21.1472:1	42.1138:1
Reverse	21.8293:1	43.4723:1

Input gear	26 Teeth
Intermediate gear	19 x 41 x 35 Teeth
Output gear	40 x 37 Teeth

TRANSMISSION — V8 Engine

Main gearbox

Type LT95	Single helical constant mesh
Speeds	4 forward 1 reverse
Synchromesh	All forward speeds
Ratios:	
Fourth (direct)	1.0000:1
Third	1.5049:1
Second	2.4480:1
First	4.0691:1
Reverse	3.6643:1

Transfer box

Type LT95	Two-speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential
Ratios:	
High	1.3362
Low	3.3206

Overall ratios (final drive):	**In high transfer**	**In low transfer**
Fourth	4.7281:1	11.7497:1
Third	7.1154:1	17.6822:1
Second	11.5745:1	28.7634:1
First	19.2390:1	47.8101:1
Reverse	27.3250:1	43.0538:1

TRANSMISSION — Ninety and One Ten V8 with 5-speed gearbox

Main gearbox

Type — Manual ..... LT85 5-speed helical constant mesh, with synchromesh on all forward gears

Main gearbox ratios .....

Fifth (Cruising gear)	0.7951
Fourth	1.0000
Third	1.4362
Second	2.1804
First	3.6497
Reverse	3.8242

Transfer gearbox

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

— Ninety models	High	1.1923
	Low	3.3198
— One Ten models	High	1.410
	Low	3.3198

Overall ratio (including final drive) — Ninety models

	In high transfer	**In low transfer**
Fifth (Cruising gear)	3.3544	9.3401
Fourth	4.2189	11.7471
Third	6.0592	16.8712
Second	9.1989	25.6134
First	15.3977	42.8734
Reverse	16.1339	44.9233

Overall ratio (including final drive) — One Ten models

	In high transfer	**In low transfer**
Fifth (Cruising gear)	3.9695	9.3401
Fourth	4.9925	11.7471
Third	7.1702	16.8712
Second	10.8856	25.6134
First	18.2210	42.8734
Reverse	19.0922	44.9233

REAR AXLE — One Ten only

Type ..... Salisbury 8HA
Ratio 3.538
Track ..... 1485,90 mm (58.50 in)

FRONT AXLE — All models and Ninety rear

Type ..... Spiral bevel, enclosed constant velocity joints
Ratio 3.538

PROPELLER SHAFTS — All Models

Type: Front and rear ..... Single Hookes universal needle roller joints. Sliding portion on front shaft gaitered, rear shaft open

SUSPENSION — All Models

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

BRAKES 2.25 Petrol and V8 Engine

System	Direct acting servo assisted dual braking system with Girling tandem master cylinder and pressure differential warning actuator, combination valve, or G. valve

Footbrake — All Models

Front	Lockheed Disc
Disc diameter	300 mm (11.81 in)
Number of pistons per wheel	4
Total lining area	232 cm^2
Lining material	Don 230
Rear	Girling single cylinder drum brake
Drum diameter	280 mm (11 in)
Total lining area	493 cm^2
Brake drum width	63.9 mm
Lining material	Ferodo 2629

Handbrake — All Models

Type	Transmission drum brake cable operated
Drum diameter	254 mm (10 in)
Lining material	Don 269

BRAKES — 2.25 and 2.5 litre Diesel engine

System	Direct acting servo assisted dual braking system with Girling tandem master cylinder and pressure differential warning actuator, combination valve, or G. valve. Servo assistance initiated by an engine driven air evacuation pump and sustained by a vacuum tank (vacuum tank deleted on 2.5)

Evacuation pump — 2.25 litre Diesel

Maximum speed	5000 rpm. Belt drive
Oil capacity	40 cm^3 (2.4 in^3) SAE 15W-50

Evacuation pump — 2.5 litre Diesel

Maximum speed	4000 rpm. Gear drive from camshaft
Lubrication	Oil feed via skew gear
Minimum vacuum level at 2500 rpm	0,8 bar

STEERING — All Models

Type:	
Manual — Early Models only	Burman recirculating ball
Manual	Gemmer Hour-glass worm and wheel
Optional power assisted — Early Models	Adwest Varamatic
Optional power assisted — Later Models	Adwest Lightweight or Gemmer
Ratios:	
Manual Burman straight ahead	20,55:1
Manual Gemmer	20,2:Constant
Power assisted straight ahead	17.5:1
Number of turns lock to lock:	
Manual	4.75
Power assisted	3.49
Camber angle	Zero
Castor angle	3°
Swivel pin inclination	7°
Front wheel toe-out — permanent 4-wheel drive	1,19 - 2,38 mm ($\frac{3}{64}$ - $\frac{3}{32}$ in)
Turning circle between kerbs:	
Right-hand drive	14,0 m (45.67 ft)
Left-hand drive	13,28 m (43.58 ft)
Steering wheel diameter	420 mm (16.5 in)
Steering damper	Fitted to drag link
Track	1485,90 mm (58.50 in)
Steering column type	Collapsible coupling

WHEELS AND TYRES — All Models

Type of wheel	Ventilated disc
Wheel size	5.50 in F x 16 in
Number of studs	5
Tyre size	7.50 x 16

ELECTRICAL EQUIPMENT — All Models

System	12 volt, negative earth

Battery — 2.25 litre Petrol and V8 engine

Type:		
Lucas — standard 9 plate	B.B.M.S. No. 371	Designation
Chloride — standard 9 plate	B.B.M.S. No. 291	190/84/90
Lucas — cold climate 13 plate	B.B.M.S. No. 389	Designation
Chloride — cold climate 13 plate	B.B.M.S. No. 369	315/120/92

Battery — 2.25 and 2.5 litre Diesel engine

Type	Chloride B.B.M.S. No. 243 15 plate designation 395/175/90

Alternator — 2.25 litre Petrol and Diesel and 2.5 Diesel

Type	Lucas A115-34
Maximum D.C. output at 6000 rpm	34 amps
Rotor — winding resistance	3.27 ohms at 20°C ± 5%
Stator — winding resistance per phase	0.138 ohms at 20°C ± 5%
New brush length	20 mm
Renew brush at	10 mm
Brush spring pressure	1.3 - 2.7 N (4.7 - 9.8 oz)
Regulator controlled voltage	13.6 - 14.4 volts measured across battery

Note: From the following engine numbers a 45 amp output alternator is fitted.

12J05497C	Land Rover 90/110 2.5 litre Diesel
11H05639C	Land Rover 90 2.3 litre Petrol
11H05629C	Land Rover 110 2.3 litre Petrol

Alternator — V8 engine

Type	Lucas A115-45
Maximum D.C. output at 6000 rpm	45 amps
Rotor — winding resistance	3.2 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 (4.7 - 9.8 oz)
Regulator controlled voltage	13.6 - 14.4 volts measured across battery

Starter motor — 2.25 Petrol engine

Type	Lucas 2M100
Brush spring tension	1020 gms (36 ozs)
Minimum brush length	9,5 mm (0.375 in)

Starter motor — 2.25 and 2.5 Diesel engine

Type	Lucas 2M113
New brush length	22.2 mm (0.875 in)
Renew brush at	8 mm (0.312 in)
Armature end-float —	
Cast aluminium intermediate bracket	0,03 - 1,4 mm (0.001 - 0.056 in)
Pressed steel intermediate bracket	0,03 - 1,55 mm (0.001 - 0.061 in)
Commutator minimum diameter	38 mm (1.5 in)

Starter motor — V8 engine

Type	Lucas 3M100 pre-engaged
Brush spring tension	1020 gms (36 ozs)
Brush minimum length	9,5 mm (0.375 ins)

Wiper motor — All Models

Type	Lucas 14W uprated two-speed
Armature end-float	0,1 - 0,20 mm (0.004 - 0.008 in)
Minimum brush length	4,8 mm (0.190 in)

Distributor — All Petrol engines ..... } See **'ENGINE TUNING DATA'**

Coil — All Petrol engines ..... }

Fuses — All Models

Type	12 cartridge fuses of the following values: Three 10 amp Six 8 amp One 12 amp Two 2.5 amp

Starter motor — 2.5 litre Diesel — Later Models

Type	Paris Rhone D9R91 12 volt

TYRE PRESSURES

Tyres — size and type		Normal All load conditions		Emergency soft Unladen		Emergency soft Laden	
		Front	Rear	Front	Rear	Front	Rear
6.00-16 **CROSS-PLY**	bar	2,4	3,25	1,1	1,1	1,1	1,6
	lbf/in²	35	47	16	16	16	23
	kgf/cm²	2,5	3,3	1,1	1,1	1,1	1,6
7.50-16 **CROSS-PLY**	bar	1,9	2,4	1,1	1,1	1,1	1,6
	lbf/in²	28	35	16	16	16	23
	kgf/cm²	2,0	2,5	1,1	1,1	1,1	1,6
205R16 **RADIAL-PLY**	bar	1,9	2,4	1,1	1,1	1,1	1,6
	lbf/in²	28	35	16	16	16	23
	kgf/cm²	2,0	2,5	1,1	1,1	1,1	1,6
7.50R16 **RADIAL-PLY**	bar	1,9	2,75	1,1	1,1	1,1	1,6
	lbf/in²	28	40	16	16	16	23
	kgf/cm²	2,0	2,8	1,1	1,1	1,1	1,6
7.50-16 **CROSS-PLY**	bar	1,9	2,9	1,1	1,1	1,1	1,8
	lbf/in²	28	42	16	16	16	26
	kgf/cm²	2,0	3,0	1,1	1,1	1,1	1,8
750R16 **RADIAL-PLY**	bar	1,9	3,3	1,1	1,1	1,1	1,8
	lbf/in²	28	48	16	16	16	26
	kgf/cm²	2,0	3,4	1,1	1,1	1,1	1,8

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.
- For extra ride comfort at part load the normal rear tyre pressures may be reduced to following:
  90 models — Not more than 1050 kg rear axle load.
  6.00-16 tyres: 2,4 bar (35 lbf/in²) 2,5 kgf/cm²
  All other tyre sizes: 1,9 bar (28 lbf/in²) 2,0 kgf/cm²
  110 models — Not more than 1250 kg rear axle load.
  Cross-ply and radial tyres: 2,2 bar (32 lbf/in²) 2,25 kgf/cm²
- Towing: When vehicle is used for towing the reduced rear tyre pressures for extra ride comfort are **not** applicable.

REPLACEMENT BULBS AND UNITS

Headlamps:	
— UK and Europe (except France)	60/55 W Halogen bulb
— France and Algeria	60/55 W Halogen bulb, yellow
— Rest of world, right-hand steering	75/50 W Sealed beam unit
— Rest of world, left-hand steering	60/50 W Sealed beam unit
Front side lamps	12V 5W
Side repeater lamps	12V 4W
Stop/tail lamps	12V 21/5W
Flasher lamps	12V 21W
Number plate lamp	12V 4W
Reverse lamp	12V 21W
Rear fog guard lamp	12V 21W
Interior lamp	12V 21W
Warning lights	12V 12W
Instrument illumination	12V 3W
Hazard switch warning light	12V 0.6W

VEHICLE WEIGHTS AND PAYLOAD

Payload figures quoted in the accompanying table are nominal values for a base specification vehicle and will in general represent the maximum, as any options or extras fitted to the vehicle will increase its unladen weight and hence decrease its allowable payload.

When loading a vehicle to its maximum (Gross Vehicle Weight), consideration must be taken of the unladen vehicle weight and the distribution of the payload to ensure that axle loadings do not exceed the permitted maximum values. It is the customer's responsibility to limit the vehicle's payload in an appropriate manner such that neither maximum axle loads nor Gross Vehicle Weight are exceeded.

Land Rover Ninety

Model — Petrol/Diesel		Soft Top			Pick-up			Hard Top			Station Wagon		
		2.5P	2.5D	3.5P	2.5P	2.5D	3.5P	2.5P	2.5D	3.5P	2.5P	2.5D	3.5P
Gross Vehicle Weight	STANDARD SUSPENSION 2400 kg												
EEC Kerb Weight	kg	1606	1643	1602	1635	1672	1631	1648	1685	1644	1690	1727	1686
EEC Payload	kg	794	757	798	765	728	769	752	715	756	710	673	714
Unladen Weight	kg	1487	1519	1483	1516	1548	1512	1529	1561	1525	1571	1603	1567
Payload	kg	913	881	917	884	852	888	871	839	875	829	797	833
Maximum Axle Weights, all Ninety models with Standard Suspension Front Axle 1200 kg Rear Axle 1380 kg													
Gross Vehicle Weight	HIGH LOAD SUSPENSION 2550 kg												
EEC Kerb Weight	kg	1633	1670	1629	1662	1699	1658	1675	1712	1671	1717	1754	1713
EEC Payload	kg	917	880	921	888	851	892	875	838	879	833	796	837
Unladen Weight	kg	1514	1546	1510	1543	1575	1539	1556	1588	1522	1598	1630	1594
Payload	kg	1036	1004	1040	1007	975	1011	994	962	998	952	920	956
Maximum Axle Weights, all Ninety models with High Load Suspension Front Axle 1200 kg Rear Axle 1500 kg													

Land Rover One Ten

Model — Petrol/Diesel		Soft Top			Pick-up			Hard Top			Station Wagon			High Capacity Pick-up		
		2.5P	2.5D	3.5P	2.5P	2.5D	3.5P	2.5P	2.5D	3.5P	2.5P	2.5D	3.5P	2.5P	2.5D	3.5P
Gross Vehicle Weight	UNLEVELLED SUSPENSION 3050 kg															
EEC Kerb Weight	kg	1723	1742	1698	1724	1743	1699	1777	1796	1752	1887	1906	1862	1813	1859	1778
EEC Payload	kg	1327	1308	1352	1326	1307	1351	1273	1254	1298	1163	1144	1188	1237	1191	1272
Unladen Weight	kg	1588	1599	1563	1589	1600	1564	1642	1653	1617	1752	1763	1727	1678	1716	1643
Payload	kg	1462	1451	1487	1461	1450	1486	1408	1397	1433	1298	1287	1323	1372	1334	1407
Maximum Axle Weights, all One Ten models with Unlevelled Suspension Front Axle 1200 kg Rear Axle 1850 kg																
Gross Vehicle Weight	LEVELLED SUSPENSION 2950 kg															
EEC Kerb Weight	kg	1733	1752	1708	1734	1753	1709	1787	1806	1762	1897	1916	1872	1823	1869	1788
EEC Payload	kg	1217	1198	1242	1216	1197	1241	1163	1144	1188	1053	1034	1078	1127	1081	1162
Unladen Weight	kg	1598	1609	1573	1599	1610	1574	1652	1663	1627	1762	1773	1737	1688	1726	1653
Payload	kg	1352	1341	1377	1351	1340	1376	1298	1287	1323	1188	1177	1213	1262	1224	1297
Maximum Axle Weights, all One Ten models with Levelled Suspension Front Axle 1200 kg Rear Axle 1750 kg																

V8 PETROL ENGINE TUNING DATA
(with 4-speed gearbox and without electronic ignition)

ENGINE

Compression ratio	9.35:1 or 8.13:1 Dependent upon market
Firing order	1—8—4—3—6—5—7—2
Cylinder numbering system, front to rear:	
Left bank	1—3—5—7
Right bank	2—4—6—8
Compression pressure (minimum)	9,5 kgf cm^2 (135 lbf in^2)
Timing marks	On crankshaft pulley vibration damper
Valve clearance	Not adjustable
Valve timing:	
Inlet opens	36° B.T.D.C.
Inlet closes	64° A.B.D.C.
Inlet duration	280°
Inlet peak	99° A.T.D.C.
Exhaust opens	74° B.B.D.C.
Exhaust closes	26° A.T.D.C.
Exhaust duration	280°
Exhaust peak	119° B.T.D.C.

CARBURETTERS

Type	Two Solex
European Australian	175 CDSE
Other markets — non-emission	175 CD3
Needle:	
Australian	BIFH
Other markets — non-emission	BIFQ
— emission	BIFK
Idle speed (engine hot):	
Australian	700 - 750 rpm (run-in) 550 - 650 rpm (new engine)
Other markets — non-emission	550 - 650 rpm
— emission	700 - 750 rpm (run-in) 550 - 650 rpm (new engine)
Fast idle speed (engine hot)	1050 - 1150 rpm
Mixture setting — CO at idle:	
Australian	2% - 3.5% Pulsair connected
Other markets	1.5% - 3% Pulsair connected

IGNITION

Coil make/type	AC Delco with ballast resistor
Primary resistance at 20°C (68°F)	1.2 - 1.4 ohms
Consumption, ignition on, at 2000 rpm	1 amp
Sparking plug type	Champion N12Y or Unipart GSP131
Sparking plug gap	0,71 - 0,84 mm (0.028 - 0.033 in)
Ignition timing, dynamic or static	5° to 7° B.T.D.C.
Fuel octane rating Australia	97 RON minimum
Non-emission	97 RON minimum
Emission	90 RON minimum
Engine idle speed	750 rpm maximum with vacuum pipe disconnected

DISTRIBUTOR

Make/type	Lucas 35D8			
Rotation of rotor	Anti-clockwise			
Dwell angle	26° - 28°			
Contact breaker gap	0,35 - 0,40 mm (0.014 - 0.016 in)			
Condenser capacity	0.18 - 0.25 microfarad			
Centrifugal advance range and capsule	2° - 4° at 750 rpm 12° - 14° at 2300 rpm		1° - 3° at 800 rpm 7° - 9° at 1800 rpm	ADR
Vacuum advance capsule range	½° - 4½° at 10 in Hg	15.03 Emission	2½° - 4½° at 10 in Hg	36
Vacuum retard capsule range	5° - 7° at 20 in Hg 5° - 7° at 9 in Hg 5° - 7° at 14 in Hg	Engines	7° - 9° at 20 in Hg 5° - 7° at 9 in Hg 5° - 7° at 14 in Hg	Emission Engines

V8 ENGINE TUNING DATA
(Ninety and One Ten V8 with 5-speed gearbox and electronic ignition)

EUROPE

ENGINE	V8 cylinder	
Compression ratio	8.13:1	
Valve timing	Inlet	Exhaust
Opens	30° B.T.D.C.	68° B.B.D.C.
Closes	75° A.B.D.C.	37° A.T.D.C.
Duration	285°	285°
Valve peak	112.5° A.T.D.C.	105.5° B.T.D.C.

CARBURETTERS

Type	2 x Solex 175 CDSE
Solex specification number	3994
Needle	BIFK
Idle speed (engine hot)	700 to 750 rev/min (run-in engine) 550 to 650 rev/min (new engine)
Fast idle speed (engine hot)	1050 to 1150 rev/min
Mixture setting — CO at idle	1.5 to 3% Pulsair connected

IGNITION

Distributor make/type	Lucas 35 DM8 Electronic (Early Models) Lucas 35 DLM8 Electronic (Later Models)
Direction of rotation	Clockwise
Centrifugal advance	
Decelerating check with vacuum retard pipe disconnected	
Engine rev/min	Crankshaft angle
3600	22° to 28°
2400	13° to 21°
1600	5° to 9°
1000	0° to 3°
No advance below 500 rev/min	
Ignition timing, dynamic; models with emission control	6° B.T.D.C. with vacuum pipes disconnected using 90-93 octane fuel — 2 star rating in UK

V8 ENGINE TUNING DATA
(Ninety and One Ten V8 with 5-speed gearbox and electronic ignition)

AUSTRALIA

ENGINE	V8 cylinder	
Compression ratio	9.35:1	
Valve timing	Inlet	Exhaust
Opens	30° B.T.D.C.	68° B.B.D.C.
Closes	75° A.B.D.C.	37° A.T.D.C.
Duration	285°	285°
Valve peak	112.5° A.T.D.C.	105.5° B.T.D.C.

CARBURETTERS	
Type	2 x Solex 175 CDSE
Solex specification number	4104
Needle	BIFH
Idle speed (engine hot)	700 to 750 rev/min (run-in engine) 550 to 650 rev/min (new engine)
Fast idle speed (engine hot)	1050 to 1150 rev/min
Mixture setting — CO at idle	2% to 3.5% Pulsair connected

IGNITION	
Distributor make/type	Lucas 35 DM8 Electronic (Early Models) Lucas 35 DLM8 Electronic (Later Models)
Direction of rotation	Clockwise
Centrifugal advance	
Decelerating check with vacuum retard pipe disconnected	
Engine rev/min	Crankshaft angle
2900	12° to 16°
2400	8° to 12°
1600	2° to 6°
No advance below 800 rev/min	
Ignition timing	6° B.T.D.C. with vacuum pipes disconnected using 96 octane fuel

V8 ENGINE TUNING DATA
(Ninety and One Ten V8 with 5-speed gearbox and electronic ignition)

SAUDI ARABIA

ENGINE	V8 cylinder	
Compression ratio	8.13:1	
Valve timing (low lift camshaft)	Inlet	Exhaust
Opens	36° B.T.D.C.	74° B.B.D.C.
Closes	64° A.B.D.C.	26° A.T.D.C.
Duration	280°	280°
Valve peak	99° A.T.D.C.	119° B.T.D.C.

CARBURETTERS

Type	2 x Solex 175 CDSE
Solex specification number	3999
Needle	BIFC
Idle speed (engine hot)	700 to 750 rev/min (run-in engine) 550 to 650 rev/min (new engine)
Fast idle speed (engine hot)	1050 to 1150 rev/min
Mixture setting — CO at idle	1.5% to 3% Pulsair connected

IGNITION

Distributor make/type	Lucas 35 DM8 Electronic (Early Models) Lucas 35 DLM8 Electronic (Later Models)
Direction of rotation	Clockwise
Centrifugal advance	
Decelerating check with vacuum retard pipe disconnected	
Engine rev/min	Crankshaft angle
4600	21° to 25°
3600	16° to 20°
3000	12° to 16°
2400	7° to 11°
1600	1° to 3°
No advance below 900 rev/min	
Ignition timing, dynamic; models with emission control	6° B.T.D.C. with vacuum pipes disconnected using 90-93 octane fuel

V8 ENGINE TUNING DATA
(Ninety and One Ten V8 with 5-speed gearbox and electronic ignition)

ALL COUNTRIES EXCEPT EUROPE, SAUDI ARABIA AND AUSTRALIA

ENGINE	V8 cylinder	
Compression ratio	8.13:1	
Valve timing (low lift camshaft)	Inlet	Exhaust
Opens	36° B.T.D.C.	74° B.B.D.C.
Closes	64° A.B.D.C.	26° A.T.D.C.
Duration	280°	280°
Valve peak	99° A.T.D.C.	119° B.T.D.C.

CARBURETTERS

Type	2 x Solex 175 CDSE
Solex specification number	4000
Needle	BIFQ
Idle speed (engine hot)	700 to 750 rev/min (run-in engine) 550 to 650 rev/min (new engine)
Fast idle speed (engine hot)	1050 to 1150 rev/min

IGNITION

Distributor make/type	Lucas 35 DM8 Electronic (Early Models) Lucas 35 DLM8 Electronic (Later Models)
Direction of rotation	Clockwise
Centrifugal advance	
Decelerating check with vacuum retard pipe disconnected	
Engine rev/min	Crankshaft angle
4200	23° to 27°
3500	20° to 24°
3000	16° to 20°
2000	8° to 12°
1200	2° to 6°
No advance below 400 rev/min	
Ignition timing, dynamic	6° B.T.D.C. with vacuum pipes disconnected using 90 octane fuel

2.25 LITRE PETROL ENGINE TUNING DATA

ENGINE

Firing order	1—3—4—2
Compression pressure (approximately):	
8.0:1 compression ratio	11,2 kgf cm^2 (160 lbf in^2) @ 300 rpm cranking speed
Ignition timing, static and dynamic up to 600 rpm:	
8.0:1 compression ratio	T.D.C. when using 90 octane fuel 3° A.T.D.C. when using 85 octane fuel } with vacuum pipe connected
Timing marks	On crankshaft pulley
Valve clearance, inlet and exhaust	0,25 mm (0.010 in) Engine hot
Valve timing:	
Inlet opens	16° B.T.D.C.
Inlet closes	42° A.B.D.C.
Inlet peak	103° A.T.D.C.
Exhaust opens	51° B.B.D.C.
Exhaust closes	13° A.T.D.C.
Exhaust peak	109° B.T.D.C.

With a 0,38 mm (0.015 in) valve clearance. Nominal setting for checking only.

DISTRIBUTOR — LUCAS

Type	Lucas 45D
Rotation of rotor	Anti-clockwise
Contact breaker gap	0,35 - 0,40 mm (0.014 - 0.018 in)
Dwell angle	46° - 56°
Centrifugal advance range	1° - 1° at 300 Distributor 19° - 21° at 2250 rpm
Vacuum advance capsule range	0° - ½° at 3.5 Hg 11° - 13° at 25 Hg

DISTRIBUTOR — DUCELLIER

Type	Ducellier Sliding Contact
Rotation	Anti-clockwise
Contact breaker gap	0,35 - 0,40 mm (0.014 - 0.016 in)
Dwell angle	57°
Centrifugal advance range	0° - 1° at 300 Distributor 19° - 21° at 2250 rpm
Vacuum advance capsule range	0° - ½° at 3.5 Hg 11° - 13° at 25 Hg

SPARKING PLUGS

8.0:1 compression ratio	Champion N12Y or Unipart GSP 131
Gap	0,75 - 0,80 mm (0.029 - 0.032 in)

IGNITION COIL

Make/type	AC Delco 7992188
Primary resistance at 20°C (68°F)	3.0 - 3.5 ohms
Consumption — ignition on at engine idle speed	2.0 amps approx.

CARBURETTER

Make/type ..... Weber 32/34 DMTL

	Primary	Secondary
Venturi	24	25
Auxiliary Venturi	4	4
Main jet	110	115
Air correction jet	160	160
Emulsion tube	F30	F30
Idle jet	55	60

Idle CO% ..... 1% - 2.5%
Idle speed — hot ..... 600 - 700 rpm

2.5 LITRE PETROL ENGINE TUNING DATA

ENGINE

Firing order	1—3—4—2
Compression pressure (approximately):	11,2 kgf cm² (160 lbf in²) @ 300 rpm cranking speed
Ignition timing dynamic @ 2000 rpm	16° B.T.D.C. using 90 octane fuel } with vacuum pipe
Static, if no dynamic equipment available	T.D.C. } disconnected
Timing marks	On crankshaft pulley
Valve clearance, inlet and exhaust	0,25 mm (0.010 in) Engine hot
Valve timing:	
Inlet opens	11° B.T.D.C.
Inlet closes	47° A.B.D.C.
Inlet peak	108° A.T.D.C.
Exhaust opens	46° B.B.D.C.
Exhaust closes	18° A.T.D.C.
Exhaust peak	104° B.T.D.C.

With a 0,38 mm (0.015 in) valve clearance. Nominal setting for checking only.

DISTRIBUTOR — LUCAS

Type	Lucas 45D4
Rotation of rotor	Anti-clockwise
Contact breaker gap	0,35 - 0,40 mm (0.014 - 0.016 in)
Dwell angle	49° - 59°
Centrifugal advance range	0° - 1° at 500 Distributor rpm
	18° - 20° at 2250 Distributor rpm
Vacuum advance capsule range	0° - ½° at 3.5 Hg
	11° - 13° at 25 Hg

SPARKING PLUGS

8.0:1 compression ratio	Champion N9YC
Gap	0,72 - 0,88 mm (0.028 - 0.035 in)

IGNITION COIL

Make/type	Bosch 0221 119 368
Primary resistance at 20°C (68°F)	2.9 ohms
Consumption — ignition on at engine idle speed	2.0 amps approx.

CARBURETTER

Make/type	Weber 32/34 DMTL
Needle valve	175

	Primary	Secondary
Venturi	24	25
Auxiliary Venturi	4	4
Main jet	112	112
Air correction jet	160	190
Emulsion tube	F30	F39
Idle jet	52	60

Idle CO%	1.5% ± 1%
Idle speed — hot — Non Air Conditioning	700 rpm
Idle speed — hot — Air Conditioning	800 rpm ± 50 rpm
Float level	7 ± 0,5 mm (0.275 ± 0.019 in)

2.25 and 2.5 LITRE DIESEL ENGINE TUNING DATA

ENGINE

Firing order	1—3—4—2
Injection timing	13° B.T.D.C. (2.25 litre Diesel)
Timing marks:	
Valve timing	On engine flywheel and damper on 2.5 Diesel
Injection timing	On engine flywheel and pump flange
Valve clearance inlet and exhaust	0,25 mm (0.010 in)
Valve timing:	
Inlet opens	16° B.T.D.C.
Inlet closes	42° A.B.D.C.
Inlet peak	103° A.T.D.C.
Exhaust opens	51° B.B.D.C.
Exhaust closes	13° A.T.D.C.
Exhaust peak	109° B.T.D.C.
Low idle speed	650 ± 20 rpm
High idle speed	4200 ± 20 rpm

INJECTORS

Make/type	CAV Pintaux
Nozzle size	BDNO/SPC 6209 or BDNO/SP 6209
Opening pressure	135 Atm

HEATER PLUGS

Make/type	Probe type, Champion CH 63 12 volt

DISTRIBUTOR PUMP

Make/type	CAV DPA-2.25 DPS-2.50 type with mechanical governor and auto advance and solenoid electrical shut-off
Direction of rotation	Clockwise, viewed from drive end
Maximum speed setting (sealed) 2.25 engine	4200 engine rpm
Maximum speed setting (sealed) 2.50 engine	4400 ± 8 rpm
Back leakage rate 150 - 100 Atm:	
New nozzle	7 seconds
Original nozzle	5 seconds

TORQUE WRENCH SETTINGS

ENGINE — 2.25 litre Petrol and Diesel	Nm	lbf ft
Bearing in water pump casing	7 - 10	5 - 7.3
Breather filter to top cover	7 - 10	5 - 7.3
By-pass housing to thermostat housing	22 - 28	16 - 20.6
Carburetter to inlet manifold	22 - 28	16 - 20.6
Chainwheel pulley to camshaft	40 - 50	30 - 36.8
Clutch cover plate to flywheel	30 - 38	22 - 28
Connecting rod to cap	37 - 41	27 - 30
Fan assembly to water pump hub	22 - 28	16 - 20.6
Fly wheel to crankshaft	130 - 143	96 - 105
Fuel pump to side cover	20 - 28	14.7 - 20.6
Heat shield bracket to manifold	22 - 28	16 - 20.6
Heat shield to bracket	22 - 28	16 - 20.6
Oil strainer to mounting bracket	22 - 28	16 - 20.6
P. clip to lifting bracket	7 - 10	5 - 7.3
Plug to immersion heater tapping	20 - 28	14.7 - 20.6
Oil pump cover to pump body	20 - 28	14.7 - 20.6
Rocker shaft to pedestal	20 - 27	14.7 - 20
Solenoid heat shield to manifold heat shield	22 - 28	16 - 20.6
Starter motor to housing	40 - 50	30 - 36.8
Sump plug to sump	30 - 40	22 - 29.5
Distributor clamp	13 - 19	9.5 - 14
Distributor to adaptor	7 - 10	5 - 7.3
Pulley to crankshaft	260 - 280	192 - 206
Water temperature to cylinder head adaptor	14 - 18	10.3 - 13.2
Spark plug	14 - 19	10.3 - 14
Adaptor for water temperature transmitter to cylinder head	22 - 28	16 - 20.6
Cover thermostat housing to cylinder head	7 - 10	5 - 7.3
Lifting bracket to cylinder head	27 - 40	20 - 29.5
Rocker pedestal to cylinder head	22 - 28	16 - 20.6
Top cover to cylinder head	8 - 11	6 - 8
Alternator adjusting link to cylinder block	22 - 28	16 - 20.6
Alternator mounting bracket to cylinder block	22 - 28	16 - 20.6
Camshaft thrust plate to cylinder block	7 - 10	5 - 7.3
Chain damper to cylinder block	7 - 10	5 - 7.3
Cylinder head (Diesel) to cylinder block	115 - 130	84.8 - 95.8
Cylinder head (Petrol) to cylinder block	91 - 113	67 - 83
DPA injector pump (Diesel) to cylinder block	22 - 28	16 - 20.6
Distributor housing (Petrol) to cylinder block	22 - 28	16 - 20.6
Drive shaft/gear to cylinder block	10 - 17	7.4 - 12.5
Engine mounting foot to cylinder block	80 - 95	59 - 70
Flywheel housing to cylinder block	40 - 50	30 - 36.8
Front cover to cylinder block	22 - 28	16 - 20.6
Main bearing cap (Diesel) to cylinder block	130 - 136	96 - 100
Main bearing cap (Petrol) to cylinder block	130 - 136	96 - 100
Oil feed pipe to cylinder block	20 - 25	14.7 - 18.4
Oil filter to cylinder block	40 - 50	30 - 36.8
Oil pump to cylinder block	22 - 28	16 - 20.6
Plug oil gallery front to cylinder block	30 - 40	22 - 30
Plug oil gallery rear to cylinder block	30 - 40	22 - 30
Side cover to cylinder block	22 - 28	16 - 20.6
Side cover FP mounting to cylinder block	22 - 28	16 - 20.6
Sump to cylinder block (bolts and nuts)	15 - 20	11 - 14.7
Water pump to cylinder block	22 - 28	16 - 20.6
Dipstick tube assembly to cylinder block	22 - 28	16 - 20.6

ENGINE — 2.5 litre Diesel	Nm	lbf ft
DPS pump studs to front cover	6 - 10	4.5 - 7.3
DPS pump to front cover	22 - 28	16 - 20.6
DPS pump to support bracket	22 - 28	16 - 20.6
Pulley to DPS pump	42 - 48	31 - 35.4
Distributor pipe banjo bolts	14 - 20	10.3 - 15
Tensioner assembly	22 - 28	16 - 20.6
Vacuum pump	22 - 28	16 - 20.6
Oil squirt to cylinder block	14 - 20	10.3 - 15
Throttle linkage to DPS pump	5 - 7	4 - 5
Throttle bracket to DPS pump	5 - 7	4 - 5
Front cover to cylinder block	22 - 28	16 - 20.6
Front cover plate to cylinder block	22 - 28	16 - 20.6
Cover plate to front cover plate	22 - 28	16 - 20.6
Cowl mounting bracket to front cover	22 - 28	16 - 20.6
Timing pointer to front cover	22 - 28	16 - 20.6
Drain plate to front cover	7 - 10	5 - 7.3

ENGINE — V8 Petrol engine		
Air intake adaptor to carbs	24	17
Alternator mounting bracket to cylinder head	34	25
Alternator to mounting bracket	24	17
Alternator to adjusting link	24	17
Chainwheel to camshaft	54 - 61	40 - 45
Connecting rod bolt	47 - 54	35 - 40
Clutch attachment to flywheel	24 - 30	18 - 22
Cylinder head:		
Outer row	54 - 61	40 - 45
Centre row	88 - 95	65 - 70
Inner row	88 - 95	65 - 70
Distributor clamp bolt	19 - 22	14 - 16
Exhaust manifold to cylinder heads	19 - 22	14 - 16
Fan attachment	11,5	9
Flywheel to crankshaft	74 - 81	55 - 60
Inlet manifold to cylinder heads	47 - 54	35 - 40
Lifting eye to cylinder heads	24	17
Main bearing cap bolts	68 - 75	50 - 55
Main bearing cap rear bolts	88 - 95	65 - 70
Manifold gasket clamp bolt	13,5 - 20	10 - 15
Oil pump cover to timing cover	11 - 14	8 - 10
Oil plug	25 - 30	18 - 22
Oil relief valve cap	40	30
Oil sump drain plug	40,6 - 47	30 - 35
Oil sump to cylinder block	8 - 11	5 - 8
Oil sump rear to cylinder block	17,6 - 20,3	13 - 15
Rocker cover to cylinder head	7	5
Rocker shaft bracket to cylinder head	34 - 40	25 - 30
Spark plug	13,8 - 16,2	10 - 12
Starter motor attachment	40,6 - 47,4	30 - 35
Damper to crankshaft	257 - 285	190 - 210
Timing cover to cylinder block	24 - 30	18 - 22
Tempatrol unit to water pump	36 - 40	27 - 30
Water pump pulley to water pump hub	23	17
Water pump timing cover to cylinder block	24 - 30	18 - 22

CLUTCH — V8 Petrol engine	Nm	lbf ft
Clutch cover bolts	27,5	20
Slave cylinder bolts	27,5	20

CLUTCH — 4-cylinder Petrol and Diesel engine	Nm	lbf ft
Clutch cover bolts	30 - 38	22 - 28

MAIN GEARBOX (FIVE-SPEED) LT 77 mm — 4-cylinder Petrol and Diesel engine

Oil pump body to extension case	7 - 10	5 - 7
Clip to clutch release lever	7 - 10	5 - 7
Attachment plate to gearcase	7 - 10	5 - 7
Attachment plate to remote housing	7 - 10	5 - 7
Extension case to gearcase	22 - 28	16 - 21
Pivot plate	22 - 28	16 - 21
Remote selector housing to extension case	22 - 28	16 - 21
Gear lever housing to remote housing	22 - 28	16 - 21
Guide clutch release sleeve	22 - 28	16 - 21
Slave cylinder to clutch housing	22 - 28	16 - 21
Front cover to gearcase	22 - 28	16 - 21
5th support bracket	22 - 28	16 - 21
Plunger housing to remote housing	22 - 28	16 - 21
Blanking plug extension case	7 - 10	5 - 7
Gear lever retainer	7 - 10	5 - 7
Yoke to selector shaft	22 - 28	16 - 21
Fixing gear lever assembly nut	40 - 47	30 - 35
Reverse pin to centre plate nut	47 - 54	35 - 40
Clutch housing to gearbox bolt	65 - 80	48 - 59
Plug — detent spring	22 - 28	16 - 21
Oil drain plug	25 - 35	19 - 26
Oil filter plug	25 - 35	19 - 26
Plug oil filler — remote housing	25 - 35	19 - 26
Breather	7 - 11	5 - 8
Oil level plug	25 - 35	19 - 26
Blanking plug — reverse switch hole	20 - 27	15 - 20
Fifth gear layshaft nut	204 - 231	130 - 170

MAIN GEARBOX (FIVE-SPEED) LT85 — V8 engine

Stop — 4th speed adjustment	7 - 10	5 - 7
Clip to clutch release lever	7 - 10	5 - 7
Spring housing to top cover	7 - 10	5 - 7
Plate — lower (retained with Loctite 270)	22 - 28	16- 21
Slave cylinder to clutch housing	22 - 28	16 - 21
5th fork bracket	22 - 28	16 - 21
Front cover to bearing plate	22 - 28	16 - 21
Plate — Lower (upper fixings)	22 - 28	16 - 21
Selector fork to shaft and reverse beam to shaft	22 - 28	16 - 21
Top cover to gearbox	22 - 28	16 - 21
1st/2nd selector fork to shaft	30 - 40	22 - 30
Extension case to gearbox	47 - 54	35 - 40
Extension case to gearbox	47 - 54	35 - 40
Extension case to gearbox	47 - 54	35 - 40
Extension case to gearbox	47 - 54	35 - 40
Clutch housing/bearing plate/gearbox	65 - 80	48 - 59
Layshaft	204 - 231	150 - 170
Reverse lever pivot	65 - 80	48 - 59
Gross hole/gearbox casing	13,5 - 20	10 - 15
Filler/top cover	25 - 35	19 - 26
Oil level/gear case	25 - 35	19 - 26
Filter plug	65 - 80	48 - 59
Drain plug	25 - 35	19 - 26
Reverse light switch hole-blanking plug	13,5 - 20	10 - 15
Switch reverse light (optional)	13,5 - 20	10 - 15

TRANSFER BOX LT230R —

4-cylinder Petrol and Diesel engine	**Nm**	**lbf ft**
Pinch bolt, operating arm	7 - 10	5 - 7
Gate plate to grommet plate	7 - 10	5 - 7
End cover	7 - 10	5 - 7
Speedometer cable retainer	7 - 10	5 - 7
Speedometer housing/rear output	See note	
Locating plate to gear change housing	5 - 7	4 - 5
Bottom cover to transfer case	22 - 28	16 - 21
Front output housing to transfer case	22 - 28	16 - 21
Cross shaft housing to front output housing	22 - 28	16 - 21
Gear change housing	22 - 28	16 - 21
Pivot shaft	22 - 28	16 - 21
Connecting rod	22 - 28	16 - 21
Retaining plate intermediate shaft	22 - 28	16 - 21
Front output housing cover	22 - 28	16 - 21
Gear change housing	22 - 28	16 - 21
Bracket to extension housing	22 - 28	16 - 21
Finger housing to front output housing	22 - 28	16 - 21
Mainshaft bearing housing	22 - 28	16 - 21
Brake drum	22 - 28	16 - 21
Gearbox to transfer box	40 - 50	29 - 37
Bearing housing to transfer gearbox	40 - 50	29 - 37
Speedometer housing to transfer gearbox	40 - 50	29 - 37
Selector fork to cross shaft	22 - 28	16 - 21
Yoke to selector shaft high/low	22 - 28	16 - 21
Selector fork high/low to shaft	22 - 28	16 - 21
Operating arm high/low	22 - 28	16 - 21
Transmission brake	65 - 80	48 - 59
Gearbox to transfer case	40 - 50	29 - 37
Gearbox to transfer case	See note	
Oil drain plug	25 - 35	19 - 26
Differential case	55 - 64	40 - 47
Output flange	146 - 179	108 - 132
Differential case rear and shaft main drive 2/4-wheel drive	66 - 80	50 - 60
Link arm and cross shaft lever to ball joint	8 - 12	6 - 9
Oil filler/level plug	25 - 35	19 - 26
Transfer breather	7 - 11	5 - 8

NOTE:- 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.

TRANSFER GEARBOX LT230T —

4 cylinder Petrol and Diesel engine and V8		
Fixings securing mounting brackets to gearbox	80 - 100	59 - 73
Pinch bolt operating arm	7 - 10	5 - 7
Gate plate to grommet plate	7 - 10	5 - 7
Bearing housing to transfer case	7 - 10	5 - 7
Speedometer cable retainer	7 - 10	5 - 7
Speedometer housing	See note	
Locating plate to gear change	5 - 7	4 - 5
Bottom cover to transfer	22 - 28	16 - 21
Front output housing to transfer	22 - 28	16 - 21
Front output housing to transfer	22 - 28	16 - 21

TRANSFER GEARBOX LT230T — 4 cylinder Petrol and Diesel engine and V8 (cont.)	Nm	lbf ft
Cross shaft housing to front output housing	22 - 28	16 - 21
Gear change	22 - 28	16 - 21
Gear change	22 - 28	16 - 21
Cross shaft to high/low lever	22 - 28	16 - 21
Pivot shaft to link arm	22 - 28	16 - 21
Connecting rod	22 - 28	16 - 21
Anti-rotation plate intermediate shaft	22 - 28	16 - 21
Front output housing cover	22 - 28	16 - 21
Pivot bracket to extension housing	22 - 28	16 - 21
Finger housing to front output housing	22 - 28	16 - 21
Mainshaft bearing housing to transfer case	22 - 28	16 - 21
Brake drum to coupling flange	22 - 28	16 - 21
Gearbox to transfer case	40 - 50	29 - 37
Gearbox to transfer case	40 - 50	29 - 37
End cover bearing housing to transfer case	40 - 50	29 - 37
Speedometer housing to transfer	40 - 50	29 - 37
Speedometer housing to transfer	40 - 50	29 - 37
Selector finger to cross shaft (high/low)	22 - 28	16 - 21
Selector fork high/low to shaft	22 - 28	16 - 21
Transmission brake to speedometer housing	65 - 80	48 - 59
Gearbox to transfer case	40 - 50	29 - 37
Transfer case assembly	See note	
Oil drain plug	25 - 35	19 - 26
Detent plug	Plug to be coated with Hylomar and peened. Screw plug fully in (spring solid) then turn two complete turns back.	
Differential casings	55 - 64	40 - 47
Front and rear out flange	146 - 179	108 - 132
Differential case rear	66 - 80	50 - 59
Oil filler and level plug transfer	25 - 35	19 - 26
Transfer breather	7 - 11	5 - 8
Inter shaft stake nut	130 - 140	96 - 104

NOTE:- 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.

GEARBOX AND TRANSFER BOX LT95 — V8 Petrol engine		
Bell housing to cylinder block bolts	36,6 - 44,8	27 - 33
Gearbox casing to bell housing 2 off	146,5 - 179	108 - 132
Gearbox casing to bell housing 2 off	85,4 - 104,4	63 - 77
Gearbox casing to bell housing nuts	85,4 - 104,4	63 - 77
Gearbox casing to bell housing stud and nuts	146,5 - 179	108 - 132
Output flange — rear — nut and bolts	43,4 - 51,5	32 - 38
Output shaft — rear — nut	146,5 - 179	108 - 132
Output shaft — front — nut	146,5 - 179	108 - 132
Gear selector spherical seat bolts	13,6 - 16,3	10 - 12
Propeller shaft to flange bolts	43,4 - 51,5	32 - 38
All other nuts and bolts:		
M6	9,9 - 11,9	7.3 - 8.7
M8	23,7 - 29,7	17.5 - 21.9
M10	48 - 58	35.4 - 42.8

FRONT AXLE	Nm	lbf ft
Hub driving member to hub	60 - 70	44 - 52
Brake disc to hub	65 - 80	48 - 59
Stub axle to swivel pin housing	60 - 70	44 - 52
Brake caliper to swivel pin housing	120 - 150	88 - 111
Upper swivel pin to swivel pin housing	60 - 70	44 - 52
Lower swivel pin to swivel pin housing	22 - 28	16 - 21
Oil seal retainer to swivel pin housing	7 - 10	5 - 7
Swivel bearing housing to axle case	65 - 80	48 - 59
Pinion housing to axle case	36 - 46	26 - 34
Crown wheel to differential case	55 - 61	40 - 45
Differential bearing cap to pinion housing	80 - 100	59 - 74
U/J flange to prop shaft	41 - 52	30 - 38
Mudshield to swivel pin housing	7 - 10	5 - 7
Bevel pinion nut	95 - 163	70 - 120
REAR AXLE AND FINAL DRIVE		
Crown wheel to differential case	150 - 170	111 - 125
Rear cover to axle case	20 - 27	15 - 20
Ball joint mounting bracket to axle case	125 - 142	92 - 105
U/J flange to prop shaft	41 - 52	30 - 38
Drum to hub	15 - 20	11 - 15
Rear brake assembly and stub axle rear to axle case	60 - 70	44 - 52
Hub driving member to hub	60 - 70	44 - 52
PROPELLER SHAFTS		
Coupling flange bolts	43 - 51	32 - 38
REAR SUSPENSION		
Bottom link to chassis nut	176	130
Bottom link to mounting rubber nuts	64	47
Top link bracket to chassis nuts	47	35
Bump stop rubber bracket nuts	32	24
Shock absorber bracket to chassis nuts	64	47
Shock absorber upper attachment to bracket	82	60
Anti roll bar bush to chassis nuts	24	18
Upper link ball joint to axle castle nut	176	130
Anti roll bar ball joint castle nut	40	30
Shock absorber lower attachment nuts	75	55
STEERING AND FRONT SUSPENSION		
Tie bar to mounting arm nut	81	60
Mounting arm to chassis nuts	176	130
Tie bar to steering box nuts	81	60
Panard rod to mounting arm nut	176	130
Panard rod to anchor bracket nut	176	130
Panard rod mounting bracket to chassis bolts	115 - 130	85 - 96
Drop arm to drag link castle nut	81	60
Steering damper to drag link nut	50	37
Drop arm to steering box nut	176	130
Radius arm to axle nuts	176	130
Steering box to chassis nuts	81	60
Radius arms to chassis nuts	176	130
Track rod clamp bolt nuts	14	10
Drag link clamp bolt nuts	14	10
Steering wheel retaining nut	38	28
Road wheel nuts	108	80
Ball joint nuts	41	30
Collapsible coupling nuts	45	33

BRAKES		
Brake disc to hub	65 - 80	48 - 59
Brake caliper to swivel housing	120 - 150	88 - 111
Brake pipe connections to:		
P.D.W.A. valve	9 - 11	7 - 8
Servo, primary port	9 - 11	7 - 8
Servo, secondary port	20 - 24	15 - 18
Jump hose — female	11 - 13,5	8 - 10
Wheel cylinders	6,8 - 9,5	5 - 7
ELECTRICAL EQUIPMENT — V8 engine		
Alternator:		
Shaft nut	27,2 - 47,5	20 - 35
Through bolts	4,5 - 6,2	3.3 - 4.6
Rectifier bolts	3,4 - 3,96	2.5 - 2.9
Starter motor to engine bolts	40,6 - 47,4	30 - 35
Starter motor:		
Through bolts	10,8	8.0
Solenoid fixing stud nut	6	4.5
Solenoid upper terminal nut	4	3.0
Reverse light switch	20 - 27	15 - 20
Lucas 35 DM8 Electronic ignition distributor V8 engine		
Pick up bearing plate support pillars	1.0 - 1.2	9 - 11
Pick up barrel nuts	1.1 - 1.5	10 - 12
ELECTRICAL EQUIPMENT — 4-cylinder Petrol and Diesel engine		
Alternator:		
Shaft nut	27,2 - 47,5	20 - 35
Through bolts	4,5 - 6,2	3.3 - 4.6
Rectifier bolts	3,4 - 3,96	2.5 - 2.9
Heater plugs — Diesel	15 - 30	11 - 22
Starter motor to engine	40 - 50	30 - 36.8
Petrol models:		
Starter through bolts	10,8	8
Diesel models:		
Solenoid to starter nuts	6	4.5
Solenoid outer terminal nuts	4	3
Starter yoke terminal outer nut	2	1.5
Starter through bolts	10,8	8
Starter earth stud nut	8	6
Eccentric pivot pin locknut	21	16

GENERAL FITTING INSTRUCTIONS

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

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 all tapped holes, crevices, oilways and fluid passages with an air line. Ensure that any O-rings used for sealing are correctly replaced or renewed, if disturbed.
3. 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.

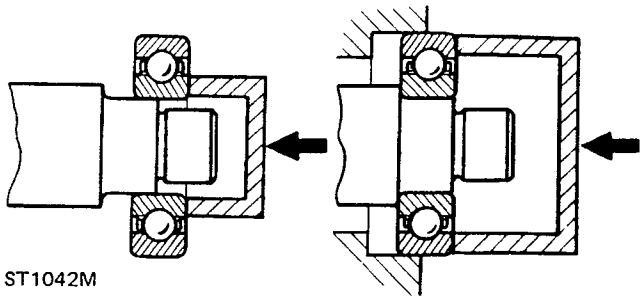
INSPECTION — GENERAL

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 dimension is exactly limit size, and is otherwise satisfactory.
4. Use 'Plastigauge' 12 Type PG-1 for checking bearing surface clearances; directions for its use, and a scale giving bearing clearances in 0,0025 mm (0.0001 in) steps are provided with it.

BALL AND ROLLER BEARINGS

NEVER REPLACE A BALL OR ROLLER BEARING WITHOUT FIRST ENSURING THAT IT IS IN AS-NEW 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.

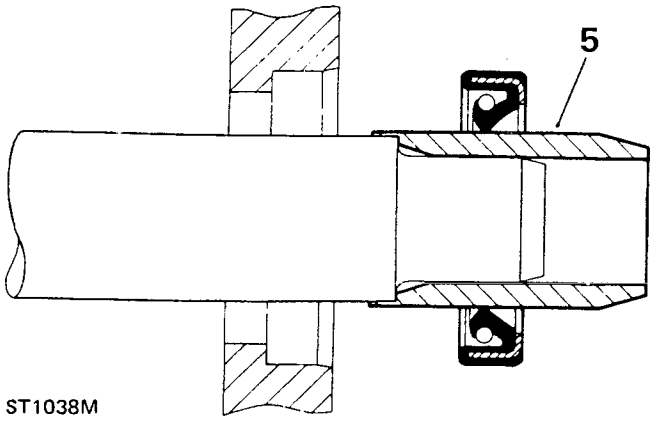


ST1042M

10. In the case of grease-lubricated bearings (e.g. hub bearings) fill space between bearing and outer seal with recommended grade of grease before fitting seal.
11. Always mark components of separable bearings (e.g. taper roller bearings) in dismantling, to ensure correct reassembly. Never fit new rollers in a used 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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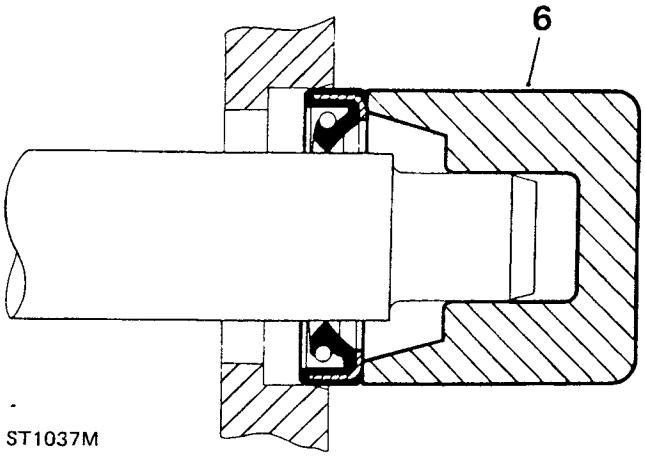
6. Grease outside diameter of seal, place square to housing recess and press into position, using great care and if possible a 'bell piece' to ensure that seal is not tilted. (In some cases it may be preferable to fit seal to housing before fitting to shaft.) Never let weight of unsupported shaft rest in seal.



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7. If correct service tool is not available, use a suitable drift approximately 0,4 mm (0.015 in) smaller than outside diameter of seal. Use a hammer VERY GENTLY on drift if a press is not suitable.
8. Press or drift seal in to depth of housing if housing is shouldered, or flush with face of housing where no shoulder is provided. Ensure that the seal does not enter the housing in a tilted position.

NOTE: Most cases of failure or leakage of oil seals are due to careless fitting, and resulting damage to both seals and sealing surfaces. Care in fitting is essential if good results are to be obtained.

JOINTS AND JOINT FACES

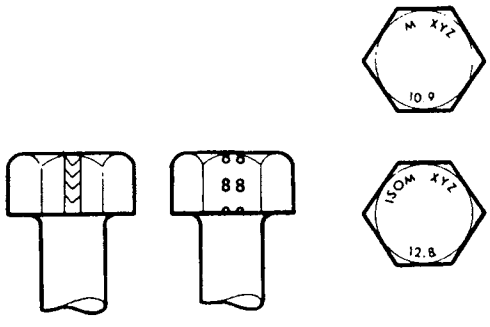
1. Always use correct gaskets where they are specified.
2. Use jointing compound only when recommended. Otherwise fit joints dry.
3. When jointing compound is used, apply in a thin uniform film to metal surfaces; take great care to prevent it from entering oilways, pipes or blind tapped holes.
4. Remove 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

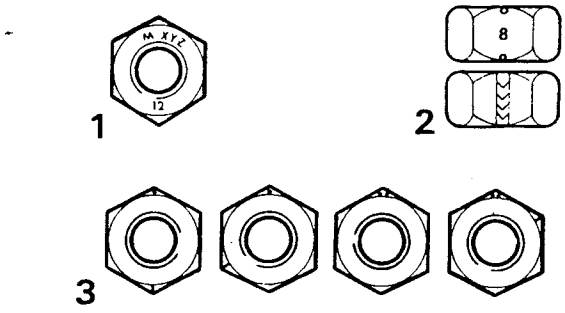
1. An ISO metric bolt or screw, made of steel and larger than 6 mm in diameter can be identified by either of the symbols ISO M or M embossed or indented on top of the head.
2. In addition to marks to identify the manufacture, the head is also marked with symbols to indicate the strength grade e.g. 8.8,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



ST1035M

METRIC NUT IDENTIFICATION

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



ST1036M

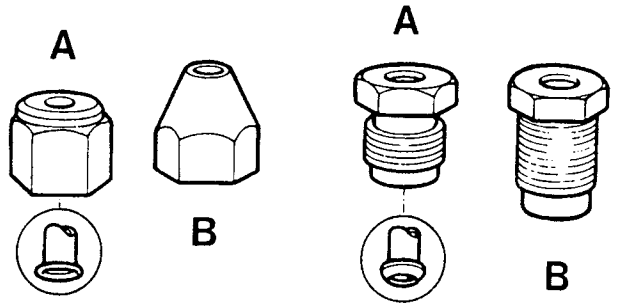
HYDRAULIC FITTINGS — Metrication

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 of 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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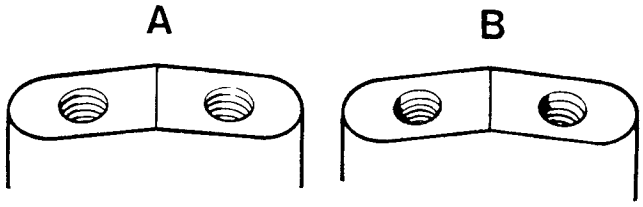

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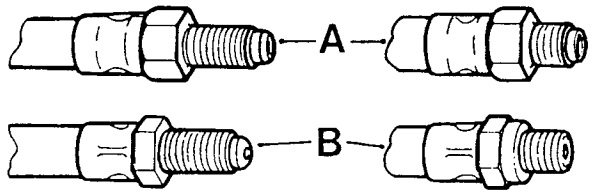
The metric female nut is **always** used with a trumpet flared pipe and the metric male nut is **always** used with a convex flared pipe.

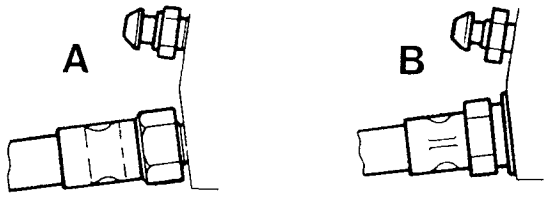
4. All metric ports in cylinders and calipers have no counterbores, but unfortunately a few cylinders with UNF threads also have no counterbore. The situation is, all ports with counterbores are UNF, but ports not counterbored are most likely to be metric.
5. The colour of the protective plugs in hydraulic ports indicates 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	$\frac{3}{8}$ in x 24 UNF
GREEN	$\frac{7}{16}$ in x 20 UNF
YELLOW	$\frac{1}{2}$ in x 20 UNF
PINK	$\frac{7}{8}$ 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 $\frac{3}{16}$ in, $\frac{1}{4}$ in and $\frac{5}{16}$ in outside diameter.
   Metric pipe sizes are 4,75 mm, 6 mm and 8 mm.
   4,75 mm pipe is exactly the same as $\frac{3}{16}$ in pipe. 6 mm pipe is 0.014 in smaller than $\frac{1}{4}$ in pipe. 8 mm pipe is 0.002 in larger than $\frac{5}{16}$ 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.



ST1031M



ST1032M

The greatest danger lies with the confusion of 10 mm and $\frac{3}{8}$ in UNF pipe nuts used for $\frac{3}{16}$ in (or 4,75 mm) pipe. The $\frac{3}{8}$ 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 $\frac{3}{8}$ in port, is difficult and unlikely to cause trouble. The 10 mm nut will screw in $1\frac{1}{2}$ 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

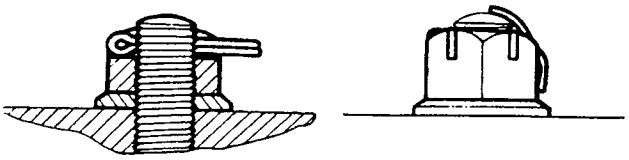
1. Remove burrs from edges of keyways with a fine file and clean thoroughly before attempting to refit key.
2. Clean and inspect key closely; keys are suitable for refitting only if indistinguishable from new, as any indentation may indicate the onset of wear.

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.



ST1030M

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

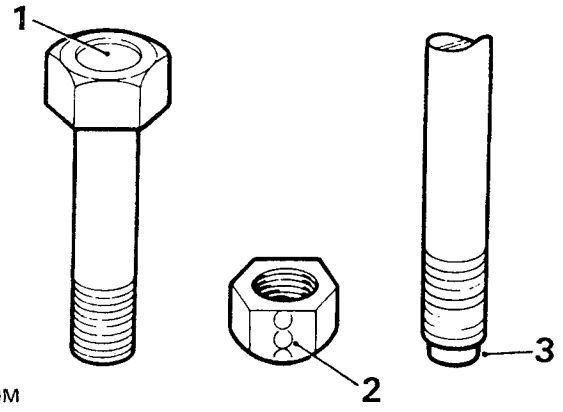
1. Fit new locking wire of the correct type for all assemblies incorporating it.
2. Arrange wire so that its tension tends to tighten the bolt heads, or nuts, to which it is fitted.

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.



ST1039M

RECOMMENDED LUBRICANTS AND FLUIDS

Service instructions for temperate climates — ambient temperature range −10°C to 35°C

COMPONENTS	BP	CASTROL	DUCKHAMS	ESSO	MOBIL	PETROFINA	SHELL	TEXACO
Engine V8 Carburetter Dashpots	BP Visco 2000 (15W/40) or BP Visco Nova (10W/40)	Castrol GTX (15W/50) or Castrolite (10W/40)	Duckhams 15W/50 Hypergrade Motor Oil	Esso Superlube (15W/40)	Mobil Super 10W/40 or Rally Formula 15W/50	Fina Supergrade Motor Oil 10W/40 or 15W/40	Shell Super Motor Oil 15W/40 or 10W/40	Havoline Motor Oil 15W/40 or Eurotex HD 10W/30
Engine 4-cyl. petrol	BP Visco 2000 (15W/40) or BP Visco Nova (10W/40)	Castrol GTX (15W/50) or Castrolite (10W/40)	Duckhams 15W/50 Hypergrade Motor Oil	Esso Superlube (15W/40)	Mobil Super 10W/40 or Mobil 1 Rally Formula 15W/40	Fina Supergrade Motor Oil 10W/40 or 15W/40	Shell Super Motor Oil 15W/40 or 10W/40	Havoline Motor Oil 15W/40 or Eurotex HD 10W/30
Engine 4-cyl. diesel	BP Visco 2000 (15W/40) BP Vanellus C3 Multigrade 15W/40 or BP Visco Nova (10W/40)	Castrol GTX (15W/50) or Castrol Deusol RX Super 15W/40 or Castrolite (10W/40)	Duckhams 15W/50 Hypergrade Motor Oil or Duckhams Fleetol Multi-V 20W/50 or Duckhams Fleet Master 15W/40	Esso Superlube (15W/40) or XD-3 15W/40 Essolube	Mobil Super 15W/40 or Mobil Delvac Super 15W/40 or Mobil 1 Rally Formula 15W/50	Fina Supergrade Motor Oil 10W/40 or 15W/40	Shell Super Motor Oil 15W/40 or Shell Rimula X 15W/40	Havoline Motor Oil 15W/40 or URSA Super Plus 15W/40 or Eurotex Motor Oil 10W/30
*LT77 — five-speed gearbox	BP Autran G	Castrol TQF	Duckhams Q-Matic	Esso ATF Type G	Mobil ATF 210	Fina Purimatic 33G	Shell Donax TF	Texamatic Type G
*LT95 — four-speed gearbox including transfer box	BP Visco 2000 (15W/40) or Visco Nova 10W/40	Castrol GTX (15W/50)	Duckhams 15W/50 Hypergrade Motor Oil	Esso Superlube (15W/40)	Mobil Super 10W/40	Fina Supergrade Motor Oil 10W/40 or 15W/40	Shell Super Motor Oil 15W/40 or 10W/40	Havoline Motor Oil 15W/40 or Eurotex HD 10W/30
Front differential Rear differential Swivel pin housings and LT230R & LT230T Transfer box	BP Gear Oil SAE 90EP	Castrol Hypoy SAE 90EP	Duckhams Hypoid 90	Esso Gear Oil GX 85W/90	Mobil Mobilube HD 90	Fina Pontonic MP SAE 80W/90	Shell Spirax 90 EP	Texaco Multigear Lubricant EP 85W/90
	Oils listed on lines marked (*) may also be used in LT230 transfer box.							
LT85 —five-speed gearbox — V8 cylinder	BP Visco 2000 (15W/40) or BP Visco Nova (10W/40)	Castrol GTX (15W/50)	Duckhams Hypergrade 15W/50	Esso Superlube 15W/40	Mobil Super 10W/40	Fina Supergrade Motor Oil 10W/40 or 15W/40	Shell Super Multigrade 15W/40 or 10W/40	Havoline Motor Oil 15W/40 or Eurotex HD 10W/30
Prop. shaft Front and rear	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi-purpose Grease H	Mobil-grease MP	Fina Marson HTL 2	Shell Retinax A	Marfak All purpose Grease
Steering box (Manual)	BP Gear Oil SAE 90EP	Castrol Hypoy SAE 90EP	Duckhams Hypoid 90	Esso Gear Oil GX 85W/90	Mobil Mobilube HD 90	Fina Pontonic MP SAE 80W/90	Shell Spirax 90EP	Texaco Multigear Lubricant EP 85W/90
Power steering fluid reservoir as applicable	BP Autran DX 2D	Castrol TQ Dexron IID	Duckhams Fleetmatic CD or Duckhams D-Matic	Esso ATF Dexron IID	Mobil ATF 220 D	Fina Dexron IID	Shell ATF Dexron IID	Texamatic Fluid 922G
Air cleaner 4-cyl. petrol	BP Visco 2000 (15W/40) or BP Visco Nova (10W/30)	Castrol GTX (15W/50) or Castrolite (10W/40)	Duckhams 15W/50 Hypergrade Motor Oil	Esso Superlube (15W/40)	Mobil Super 15W/40 or 10W/40	Fina Supergrade Motor Oil 15W/40 or 10W/40	Shell Super Motor Oil 15W/40 or 10W/40	Havoline Motor Oil 10W/30 or Eurotex HD 10W/30
Air cleaner 4-cyl. diesel	BP Visco 2000 (15W/40) or BP Visco Nova (10W/30)	Castrol GTX (15W/50) or Castrolite (10W/40)	Duckhams 15W/50 Hypergrade Motor Oil	Esso Superlube (15W/40)	Mobil Super 15W/40 or 10W/40	Fina Supergrade Motor Oil 10W/40	Shell Super Motor Oil 15W/40 or 10W/40	Havoline Motor Oil 15W/40 or 10W/30 or Eurotex HD 10W/30
Brake and clutch reservoirs	Universal Brake Fluid or other brake fluids having a minimum boiling point of 260°C (500°F) and complying with FMVSS 116 DOT 3							
Lubrication nipples (hubs, ball joints, etc.)	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi-purpose Grease H	Mobil-grease MP	Fina Marson HTL 2	Shell Retinax A	Marfak All purpose Grease
Ball joint assembly Top link	Dextragrease Super GP							
Cooling system Anti-freeze	Universal Anti-freeze See under Anti-freeze section 09.							

RECOMMENDED LUBRICANTS AND FLUIDS SERVICE INSTRUCTIONS ALL MARKETS

COMPONENTS	BP	CASTROL	DUCKHAMS	ESSO	MOBIL	PETROFINA	SHELL	TEXACO	SPEC. REF. ALL BRANDS
Windscreen hinges Ventilator hinges Ventilator control Seat slides. Hood retention clips Door lock striker	BP Energrease L2	Castrol LM Grease	Duckhams LB 10	Esso Multi-purpose Grease H	Mobil Mobil-grease MP	Fina Marson HTL2	Shell Retinax A	Marfak All purpose Grease	NGLI-2 Multi-purpose Lithium-based Grease
Windscreen washers	All Seasons Screen Washer Fluid								
Bonnet pintle	Graphite Lock Grease Type 'B'								
Door locks (anti-burst) Inertia reels	**DO NOT LUBRICATE.** These components are 'life' lubricated at the manufacturing stage								
	NOTE: The above lubricants are considered to be suitable for ambient temperatures in the range of: −40°C to +35°C For extreme ambient temperatures, outside the above range, refer to local Distributor								
Battery lugs Earthing surfaces Where paint has been removed	Petroleum jelly. **NOTE:** Do not use Silicone Grease								
Air Conditioning System Refrigerant Compressor Oil	METHYLCHLORIDE REFRIGERANTS MUST NOT BE USED Use only refrigerant 12. This includes 'Freon 12' and Arcton 12' Shell Clavus 68 BP Energol LPT 68 Sunisco 4GS Texaco Capella E Wax Free 68								

RECOMMENDED LUBRICANTS AND FLUIDS SERVICE INSTRUCTIONS FOR AMBIENT CONDITIONS OUTSIDE TEMPERATE CLIMATE LIMITS OR FOR MARKETS WHERE THE PRODUCTS LISTED ARE NOT AVAILABLE

COMPONENTS	SERVICE CLASSIFICATION WORLDWIDE			AMBIENT TEMPERATURE °C
	PERFORMANCE LEVEL		SAE VISCOSITY	−30° −20° −10° 0° 10° 20° 30° 40° 50°
Engine Carburetter dashpots Oil can Oils Oil bath air cleaners	Petrol: Oils must meet BL Cars spec. BLS.22.OL.02 or API service levels SE or SF or SE/CC or SF/CC or SE/CD or SF/CD or the CCMC requirements	Diesel: Oils must meet BL Cars spec. BLS.22.OL.02 and MIL-L-46152A or API service levels CC or CD or SE/CC or SE/CD or SF/CC or SF/CD or the CCMC requirements	5W/20 5W/30 5W/40 10W/30 10W/40 10W/50 15W/40 15W/50 20W/40 20W/50	
Power steering reservoir	ATF M2C 33 F or G			
Front and rear Axle differential Swivel pin housings LT230 transfer box Steering box	API GL4 or MIL-L-2105		90 EP 80W EP	
LT77 gearbox	ATF M2C 33 F or G			
LT95 gearbox including transfer box	Oils must meet BL Cars spec. BLS.22.OL.02 or API service levels SE or SF or SE/CC or SE/CD or SF/CC or SF/CD or the CCMC requirements		10W/30 10W/40 10W/50 10W/40 10W/50 15W/40 15W/50 20W/40 20W/50	
LT85 gearbox — V8 cylinder	Oils must meet BL Cars spec. BLS.22.OL.02 or API service levels SE or SF or SE/CC or SE/CD or SE/CC or SE/CD or the CCMC requirements		10W/30 10W/40 10W/50 10W/40 10W/50 15W/40 15W/50 20W/40 20W/50	
Brake and clutch reservoirs	Brake fluid must have a minimum boiling point of 260°C (500°F) and comply with FMVSS 116 DOT 3			
Lubrication nipples (hubs, ball joints, etc)	NLGI-2 multipurpose lithium based grease			

ANTI-FREEZE

Use only UNIVERSAL Anti-freeze or an Ethylene Glycol based anti-freeze, containing no methanol, with non-Phosphate corrosion inhibitors suitable for use in cast iron and aluminium alloy engines to ensure protection of the cooling system against frost and corrosion.

Engine	Mixture	Percentage Concentration	Protection
4-cyl. Engines (cast iron)	One part anti-freeze two parts water	33%	Down to -20°C
	One part anti-freeze one part water	50%°	Below -20°C to -36°C
V8 Engine (aluminium)	One part anti-freeze one part water	50%°	Down to —36°C

IMPORTANT: Coolant solution must not fall below proportions of one part anti-freeze to three parts water, i.e. min. 25° anti-freeze in coolant, otherwise damage to engine is liable to occur.

CORROSION INHIBITOR

When anti-freeze is not required the cooling system must be flushed out with clean water and filled with a solution of ONE PART MARSTONS SQ 36 inhibitor to NINE parts water to provide a 10° mixture concentration.

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 unit
Engine sump oil, 4-cylinder	6,00	11.00 pints
Extra when refilling after fitting new filter, 4-cylinder	0,85	1.50 pints
Air cleaner oil, 4-cylinder	0,85	1.50 pints
Engine sump oil, V8 cylinder	5,10	9.00 pints
Extra when refilling after fitting new filter, V8 cylinder	0,56	1.00 pint
Main gearbox oil, five-speed	2,20	3.90 pints
Transfer box oil, LT230R five-speed main gearbox	2,80	4.90 pints
LT85 five-speed gearbox	3,00	5.25 pints
LT230T transfer gearbox	2,80	4.9 pints
Main gearbox oil, four-speed	2,60	4.70 pints
Transfer gearbox oil, four-speed main gearbox	3,16	5.50 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
Fuel tank, rear	79,50	17.50 gallons
Fuel tank, side (except Station wagon)	68,20	15.00 gallons
Fuel tank, side (Station wagon only)	45,50	10.00 gallons
Cooling system, 4-cylinder petrol models (standard)	10,30	18.00 pints
Cooling system, 4-cylinder diesel models and heavy duty petrol models	11,00	19.00 pints
Cooling system, V8 cylinder models	12,80	22.50 pints
Steering box manual	0,43	0.75 pints
Power steering box and reservoir fluid	2,90	5.0 pints

MAINTENANCE SCHEDULES

Revised Maintenance Schedules are introduced with the commencement of the Land Rover Ninety V8 model range. The new schedules also apply to four-cylinder, petrol and diesel models, and feature a reduced 10.000 km (6,000 miles) service. The new schedules supersede previous issues.

Efficient maintenance is one of the biggest factors in ensuring continuing reliability and efficiency. For this reason the following detailed schedules are included so that at the appropriate intervals owners and operators may know what is required. The Maintenance Schedules are based upon intervals of 10.000 km (6,000 miles) or 6 months unless otherwise stated.

Note: The 10.000 km service must be repeated every 10.000 km (6,000 miles) or six months, whichever is first.

The 20.000 km service must be repeated every 20.000 km (12.000 miles) or 12 months, whichever is first, with additional maintenance at the intervals specified in the schedule.

	Every 10.000 km (6,000 miles) or 6 months	Every 20.000 km (12,000 miles) or 12 months	
1		☐	Check condition and security of seats, seat belt mountings, seat belts and buckles
2		☐	Check operation of all lamps
3		☐	Check operation of horns
4		☐	Check operation of warning indicators
5		☐	Check operation of windscreen and rear wipers and washers
6		☐	Check condition of wiper blades
7		☐	Check security and operation of handbrake
8		☐	Check rear view mirror(s) for security, cracks and crazing
9		☐	Check operation of all doors, bonnet and tailgate locks
10		☐	Check operation of window controls
11	☐	☐	Lubricate all locks (not steering lock) hinges and door — check mechanisms
12		☐	Lubricate accelerator control linkage and pedal pivot
13		☐	Check/adjust tyre pressures including spare
14		☐	Check/adjust headlamp alignment
15		☐	Check front wheel alignment
16	☐	☐	Check/top-up battery electrolyte
17		☐	Remove battery connections, clean and grease (refit)
18	☐	☐	Remove road wheels
19		☐	Check tyres comply with Manufacturer's specification
20		☐	Check tyres visually for cuts, lumps, bulges, uneven wear and tread depth
21	☐	☐	Remove road wheel brake drums, wash out dust, inspect shoes for wear and drums for condition
22	☐	☐	Inspect wheel cylinders for fluid leaks
23	☐	☐	Inspect brake pads for wear, calipers for leaks, and discs for condition
24	☐	☐	Refit road wheel brake drums
25	☐	☐	Adjust road wheel brakes
26	☐	☐	Adjust handbrake if required
27	☐	☐	Refit road wheels to original position
28	☐	☐	Renew engine oil
29	☐	☐	Renew engine oil filter
30	Every 40.000 km 24,000 ml		Renew gearbox oil

	Every 10.000 km (6,000 miles) or 6 months	Every 20.000 km (12,000 miles) or 12 months	
31	☐	☐	Check/top-up gearbox oil
32	Every 40.000 km 24,000 ml		Renew transfer box oil
33	☐	☐	Check/top-up transfer box oil
34	Every 40.000 km 24,000 ml		Renew front axle oil
35	☐	☐	Check/top-up front axle oil
36	Every 40.000 km 24,000 ml		Renew swivel pin housing oil
37	☐	☐	Check/top-up swivel pin housing oil
38	Every 40.000 km 24,000 ml		Renew rear axle oil
39	☐	☐	Check/top-up rear axle oil
40	☐	☐	Lubricate rear suspension upper link ball joint
41	Every 40.000 km 24,000 ml		Lubricate propeller shaft sealed sliding joints
42	☐	☐	Lubricate propeller shaft universal joints
43	☐	☐	Lubricate handbrake mechanical linkage
44		☐	Check visually brake, fuel, clutch pipes/unions for chafing, leaks and corrosion
45		☐	Check exhaust system for leakage and security
46		☐	Check for oil leaks from engine and transmission
47	☐	☐	Check for oil/fluid leaks from steering and suspension systems
48		☐	Check axle breather pipes, ensure they are not blocked, pinched or split
49		☐	Check security and condition of suspension fixings
50		☐	Check condition and security of steering unit, joints and gaiters
51		☐	Check tightness of propeller shaft coupling bolts
52		☐	Clean fuel sedimenter (Diesel only)
53	Every 80.000 km 48,000 ml		Clean electric fuel pump filter
54		☐	Renew fuel filter element (Petrol)
55		☐	Drain flywheel housing if drain plug is fitted for wading (refit)
56		☐	Clean camshaft drive belt housing filter (Diesel)
57		☐	Check condition of heater plug wiring for fraying, chafing and deterioration (diesel only)
58		☐	Remove heater plugs, clean, test and refit (diesel only)
59	Every 40.000 km 24,000 ml		Remove diesel injectors, clean, test and refit

	Every 10,000 km (6,000 miles) or 6 months	Every 20,000 km (12,000 miles) or 12 months	
60		☐	Renew fuel filter element (Diesel)
61		☐	Check/adjust valve clearance (all models except V8)
62	☐		Clean/adjust spark plugs
63		☐	Renew spark plugs
64		☐	Renew air cleaner elements
65		☐	Check air cleaner dump valve, clean or renew
66	Every 40,000 km 24,000 ml		Renew engine breather filter (V8)
67		☐	Clean engine breather filter (all models except V8)
68		☐	Renew engine flame trap(s) (V8)
69	Every 60,000 km 36,000 ml		Renew brake servo filter
70		☐	Check brake servo hose for security and condition
71		☐	Check air injection/pulsair system hoses/pipes for security and condition
72		☐	Check operation of pulsair check valves
73	☐	☐	Check crankcase breathing system for leaks, hoses for security and condition
74	☐	☐	Top-up carburetter piston dampers
75		☐	Check/top-up cooling system
76	☐	☐	Check/top-up fluid in power steering reservoir
77		☐	Check/top-up steering box (manual steering)
78		☐	Check/adjust steering box
79	☐	☐	Check/top-up clutch fluid reservoir
80	☐	☐	Check/top-up brake fluid reservoir
81	☐	☐	Check/top-up windscreen and rear washer reservoir
82		☐	Check cooling and heater system for leaks, hoses for security and condition
83	☐	☐	Check power steering system for leaks, hydraulic pipes and unions for chafing and corrosion
84	☐	☐	Check condition of driving belts — adjust if required (not camshaft drive belt – diesel)
85		☐	Check ignition wiring and HT leads for fraying, chafing and deterioration
86		☐	Clean distributor cap, check for cracks and tracking

	Every 10,000 km (6,000 miles) or 6 months	Every 20,000 km (12,000 miles) or 12 months	
87		☐	Clean/adjust distributor points (not V8)
88	Every 40,000 km 24,000 ml		Renew distributor points (not V8)
89	☐	☐	Lubricate distributor (not V8)
90		☐	Check voltage drop between coil CB and earth
91	☐	☐	Check dwell angle — adjust as necessary (not V8)
92	☐	☐	Check/adjust ignition timing **Note:** It is important that the ignition timing, dwell angle and carburetter adjustments are set in accordance with the vehicle engine specification and fuel octane rating. Refer to the relevant repair operation manual for details
93		☐	Check throttle operation
94	☐	☐	Check/adjust engine idle speed, and carburetter mixture settings with engine at normal running temperature
95	☐	☐	Check operation of air intake temperature control system (V8)
			Carry out road or roller test — Check:
96	☐	☐	For excessive engine noise
97	☐	☐	Clutch for slipping/judder/spinning
98	☐	☐	Gear selection/noise — high and low range
99	☐	☐	Steering for noise/abnormal effort required
100	☐	☐	All instruments, pressure, fuel and temperature gauges, warning indicators
101	☐	☐	Heater and air conditioning systems
102	☐	☐	Heated rear screen
103	☐	☐	Shock absorbers (irregularities in ride)
104	☐	☐	Foot brake, on emergency stop, pulling to one side, binding, pedal effort
105	☐	☐	Handbrake efficiency
106	☐	☐	Operation of inertia seat belts
107	☐	☐	Road wheel balance
108	☐	☐	Transmission for vibrations
109	☐	☐	For body noises (squeaks and rattles)
110	☐	☐	Fuel governor cut-off point
111	☐	☐	For excessive exhaust smoke
112	☐	☐	Engine idle speed
113	☐	☐	Endorse service record
114	☐	☐	Report any additional work required

WARNING: Two-wheel roller tests must be restricted to 5 km/h (3 m.p.h.) because the Land Rover One Ten and Ninety is is constant four-wheel drive.

At 100.000 km (60,000 mile) intervals it is imperative that the camshaft drive belt be renewed, failure to do so could result in serious engine damage.

RECOMMENDATIONS

At 30.000 km (18,000 mile) intervals or every 18 months, whichever is the sooner, the hydraulic brake fluid should be completely renewed.

At 40.000 km (24,000 mile) intervals remove the Pulsair injection manifold and connecting pipes, ensure that the internal bores and the cylinder head drillings are clean and free from obstructions, clean as necessary and refit. (Emission control V8 petrol engines)

At 60.000 km (36,000 mile) intervals or every 3 years, whichever is the sooner, all hydraulic brake 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 60.000 km (36,000 mile) intervals remove all suspension dampers, test for correct operation, refit or renew as necessary.

Vehicles fitted with free wheeling front hubs

The hubs require no routine maintenance. When the hub bearings are adjusted, or any time the vehicle has been used for wading, the moving parts of the free wheel hubs should be lightly smeared with Rocol 1000 grease or a similar molybdenum disulphide bearing grease.

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 the 'General specification data' 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.

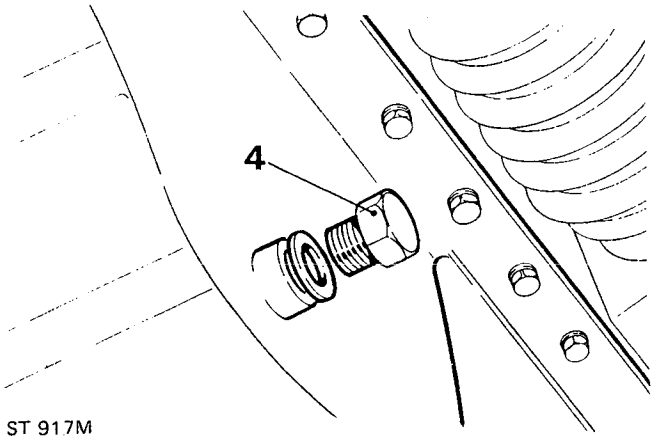
Where possible, always refill with oil of the make and specification recommended in the lubrication charts and from sealed containers.

RENEW ENGINE OIL AND FILTER

DRAIN THE OIL — All engines

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 at the left-hand side — V8 and right-hand side 4-cylinder engines. Allow oil to drain away completely and replace the plug and tighten to the correct torque.

NOTE: The example shown below is a 4 cylinder engine sump.

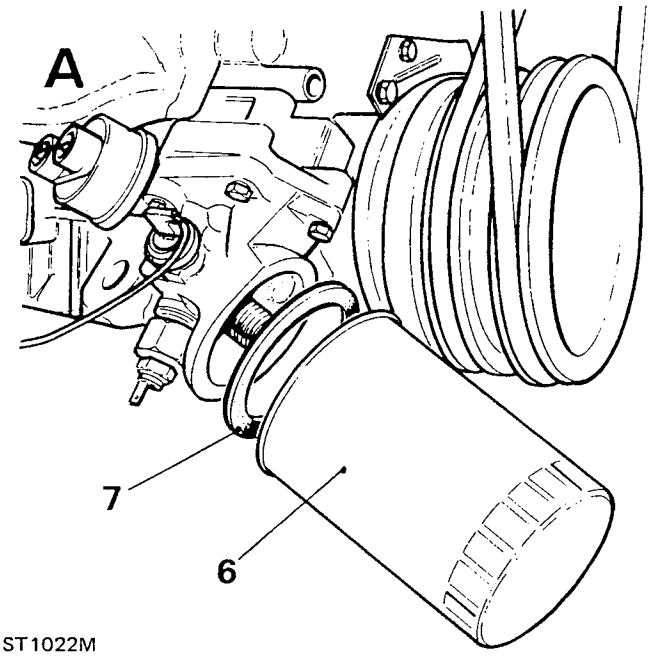


ST 917M

Renew oil filter — V8 and 2.5 Diesel engines

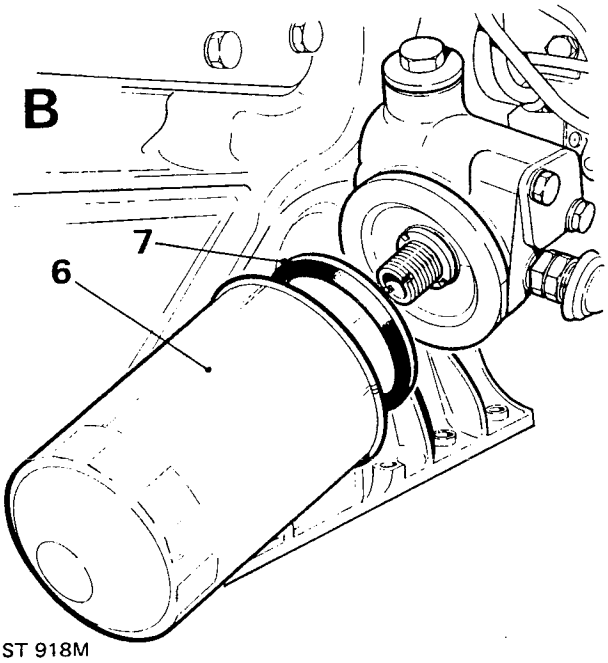
5. Place an oil tray under the engine.
6. Unscrew the filter anti-clockwise, using a strap spanner as necessary.
7. Smear a little clean engine oil on the rubber washer of the new filter, then screw the filter on clockwise until the rubber sealing ring touches the machined face, then tighten a further half turn by hand only. Do not overtighten.

Illustration A. V8 engine.



ST1022M

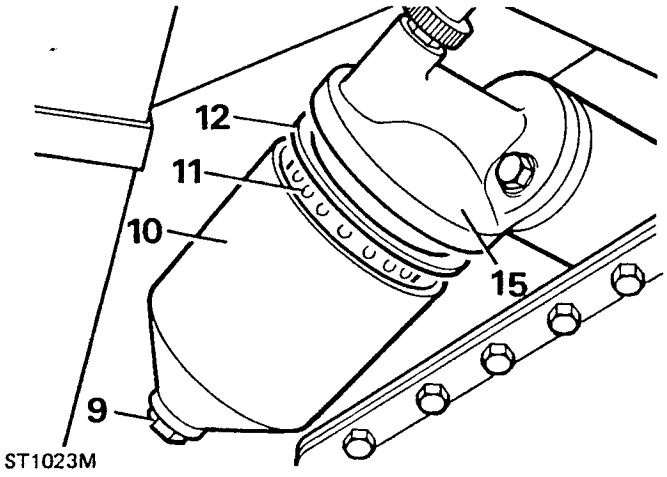
Illustration B. 2.5 Diesel engine.



ST 918M

Renew oil filter — 2.25 petrol and diesel engine

8. Place oil tray under engine.
9. Unscrew filter retaining bolt.
10. Remove the container.
11. Remove the element.
12. Discard the used filter element and large rubber washer.
13. Wash the container in kerosene.
14. Place the new filter element in the container and reassemble the unit, using the new large rubber washer supplied with the element.
15. Ensure that all the sealing washers are in position and intact, and that the container is correctly located in the adaptor.
16. Tighten the filter retaining bolt to the correct torque. Do not overtighten.



ST1023M

Refill sump with oil — all models

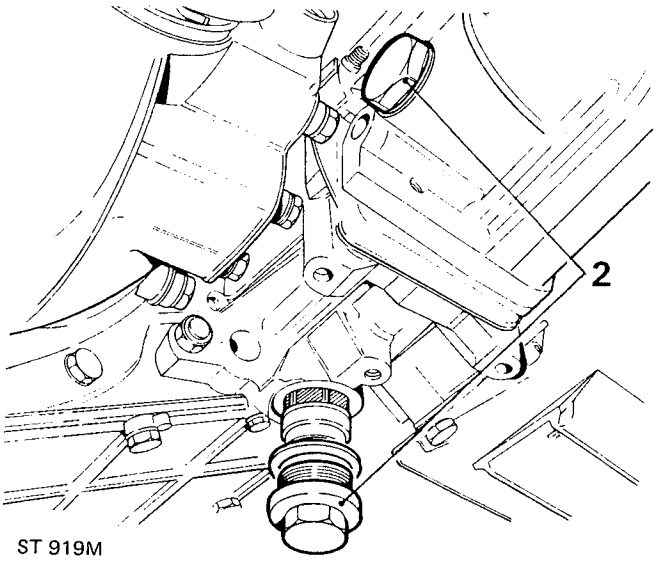
17. Check that the drain plug is tight.
18. Clean the outside of the oil filler cap, remove it from the rocker cover and clean the inside.
19. Pour in the correct quantity of new oil of the correct grade from a sealed container to the high mark on the dipstick and firmly replace the filler cap.
20. Run 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 LT77mm MAIN GEARBOX

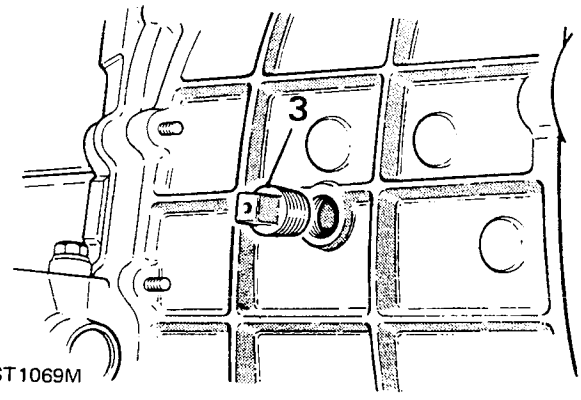
4-cylinder engines

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.



ST 919M

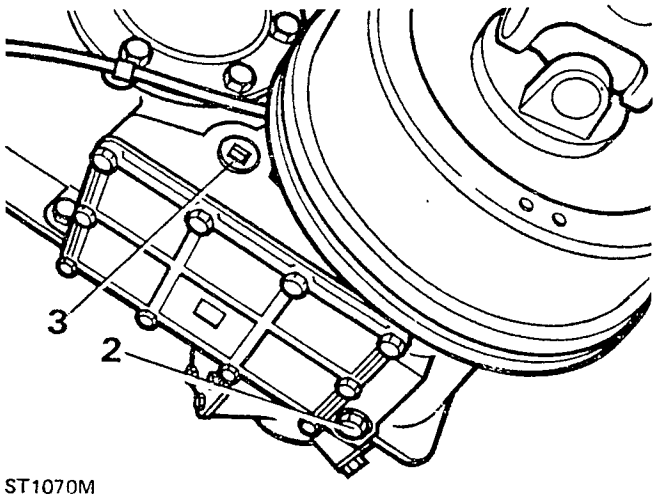
3. Remove the oil filler-level plug and inject the approximate quantity of new oil of the correct make and grade until it begins to run out of the filler-level hole. Fit the plug and tighten to the correct torque. Since the plug has a tapered thread it must not be overtightened. Wipe away any surplus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



ST1069M

DRAIN AND RENEW 230R AND 230T TRANSFER GEARBOX (4-cylinder engine)

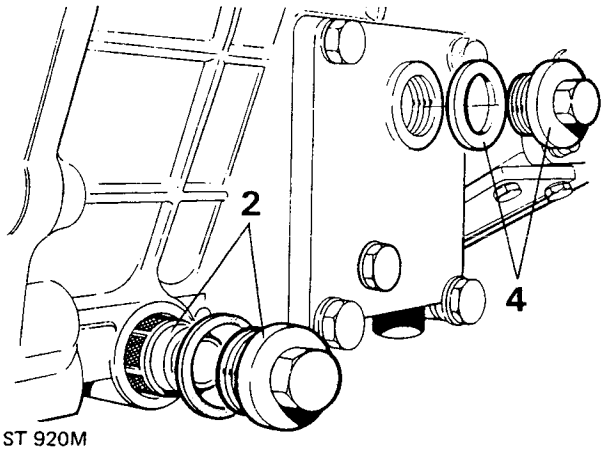
1. Drive the vehicle to level ground and place a container under the gearbox to catch the old oil.
2. Remove the drain plug and allow the oil to drain. Fit the plug using a new washer, if necessary, and tighten to the correct torque.
3. Remove the filler-level plug and inject the approximate quantity 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

DRAIN AND RENEW LT95 MAIN GEARBOX (V8 engines)

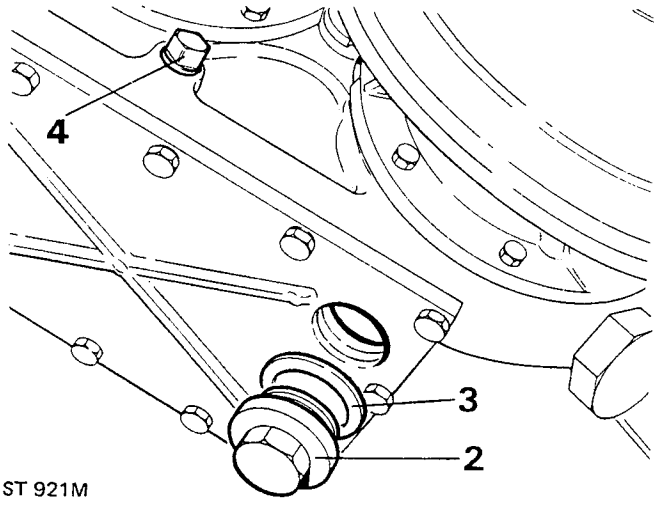
1. Drive the vehicle to level ground and place a container under the gearbox to catch the old oil.
2. Remove the drain plug, washer and filter from the bottom of the gearbox casing and allow the oil to drain completely.
3. Wash the filter in petrol, allow to dry and fit to the casing. Using a new washer, if necessary, fit the plug and tighten to the correct torque.
4. Remove the oil filler-level plug from the side of the gearbox and inject the approximate quantity of the correct oil until it begins to run from the filler-level hole. Clean and refit the plug using a new washer and tighten to the correct torque. Wipe away any surplus oil.



ST 920M

DRAIN AND RENEW LT95 TRANSFER GEARBOX OIL

1. Drive vehicle to level ground and place a container beneath the gearbox to catch the old oil.
2. Remove the drain plug and allow time for the oil to drain completely.
3. Clean and refit the drain plug using a new washer, if necessary and tighten to the correct torque.
4. Remove the oil filler-level plug and inject the approximate quantity of a recommended oil until it begins to run from the hole. Clean and fit the plug and tighten to the correct torque. Do not overtighten. Wipe away any surplus oil.

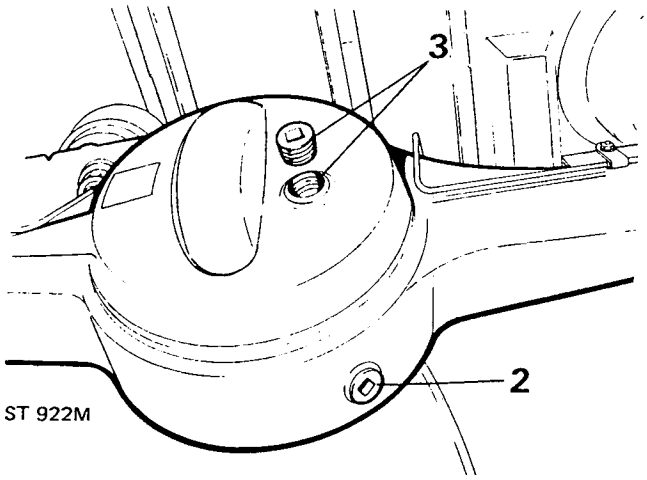


ST 921M

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 (0.5 in) 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.

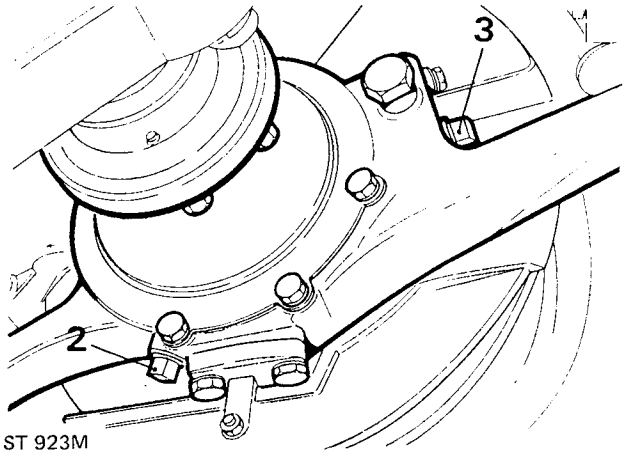
NOTE: Whilst the illustration shows a '90' model front differential, the procedure is the same for all axles.



ST 922M

RENEW SWIVEL PIN HOUSING OIL

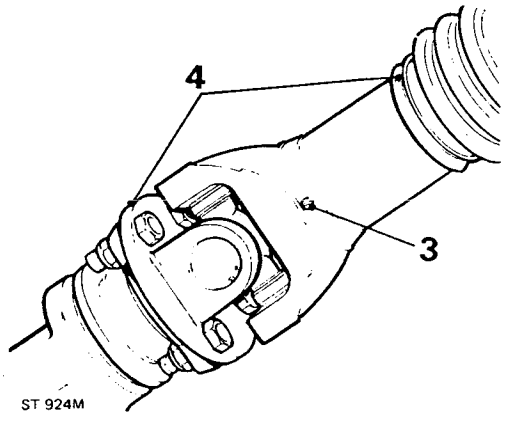
1. Drive the vehicle to level ground and place a container under each swivel housing to catch the used oil.
2. Remove the drain plug and allow the oil to drain completely and clean and refit the plugs.
3. Remove the oil filler-level plug and inject the recommended make and grade of oil until oil begins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



ST 923M

LUBRICATE PROPELLER SHAFTS

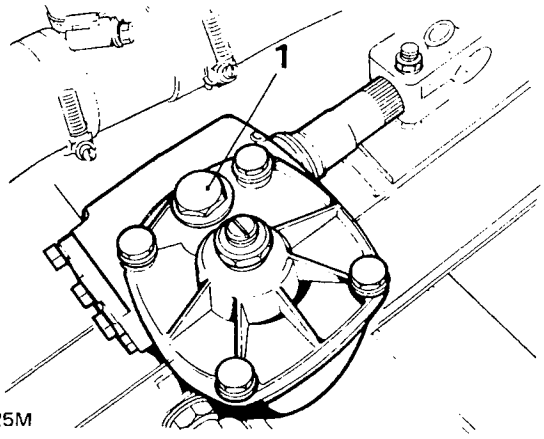
1. Clean all the grease nipples on the front and rear propshaft universal joints, and sliding portion of the rear shaft.
2. Charge a low pressure hand grease gun with grease of a recommended make and grade and apply to the grease nipples.
3. Remove the screwed plug from the front shaft and fit a suitable grease nipple.
4. Disconnect one end of the front propeller shaft and compress the sliding portion whilst applying grease. It is necessary to compress the shaft to prevent over filling with grease. It should be noted that this sliding portion must only be lubricated at 40.000 km (24,000 mile) intervals.
5. Reconnect the propeller shaft, remove the grease nipple and fit the screwed plug.



ST 924M

TOP-UP MANUAL STEERING BOX

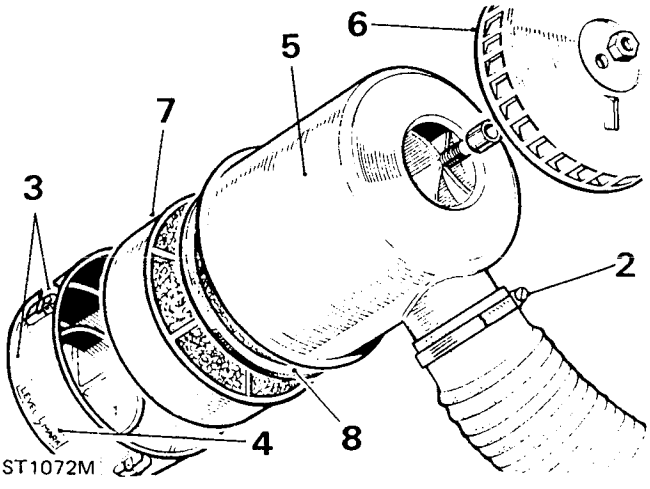
1. Remove the oil filler plug and observe the oil level which should be 25 mm (1.0 in) below the top of the filler hole.
2. If necessary top-up to the correct level with a recommended oil. Clean and refit the plug and wipe away any surplus oil.



ST 925M

RENEW AIR CLEANER OIL — 2.25 litre engines (early models)

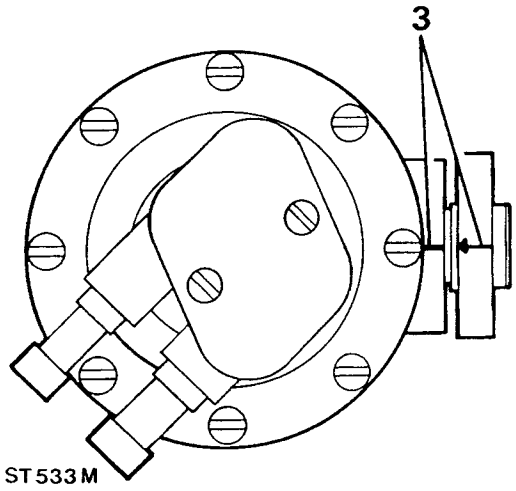
1. Slacken wing nut and release the clamping strap securing the complete air cleaner.
2. Disconnect the outlet elbow from the intake pipe and remove the cleaner from the vehicle.
3. Remove the oil bowl from the bottom of the cleaner by releasing the three securing clips.
4. Clean all dirty oil and sludge from the bowl and refill with fresh engine oil to the level indicated by a ring formed in the pressing; the capacity is approximately 0,85 litre (1.5 imperial pints).
5. Clean the spiral in the cleaner body by swilling the complete body in paraffin and shake off the surplus.
6. Remove and clean the air intake cap.
7. Clean the wire mesh filter.
8. Reassemble filter using a new sealing ring.
9. Refit the complete unit into the vehicle.



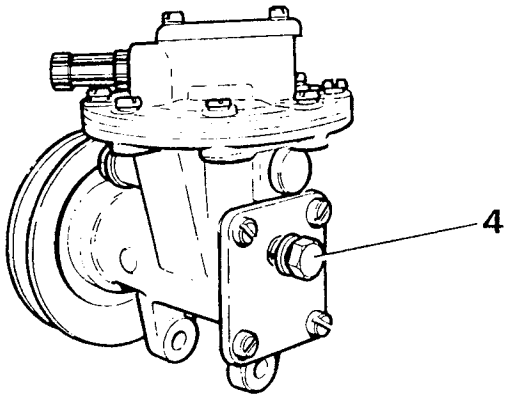
ST1072M

TOP-UP BRAKE VACUUM PUMP OIL — 2.25 litre Diesel engine

1. Slacken the drive belt, and the pump pivot bolts and nuts and slip the belt from the pulley.
2. Move the pump to an upright position and temporarily tighten the nuts and bolts to maintain this position.
3. Turn the pump pulley so that the indicating marks on the pulley hub and pump body line up.

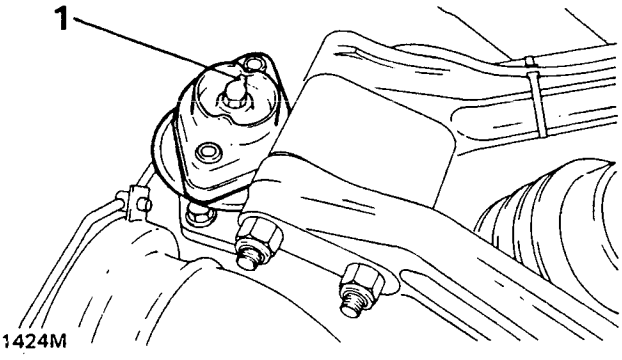


4. Remove the oil level plug at the rear of the pump and if necessary inject a recommended SAE 15W-50 oil up to the level of the hole.
5. Refit the level plug, and fit and tension the drive belt.



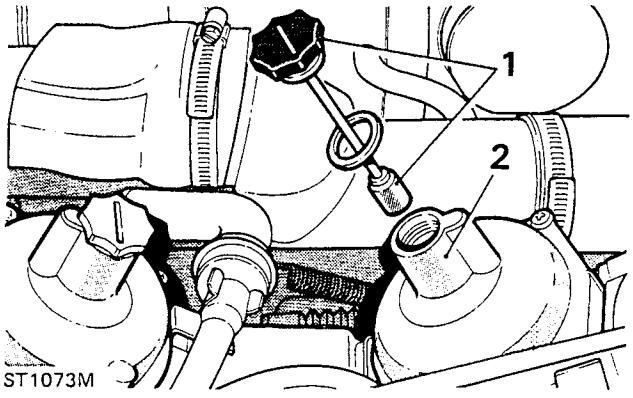
REAR SUSPENSION BALL JOINT

1. Apply a grease gun to the nipple using a recommended grease.



TOP-UP CARBURETTER PISTON DAMPER — V8 only

1. Unscrew the cap on top of both suction chambers and withdraw the damper.
2. Top-up the reservoir with engine oil to within 12 mm (0.5 in) from the top of the hollow piston rod. Refit the damper and secure the cap.

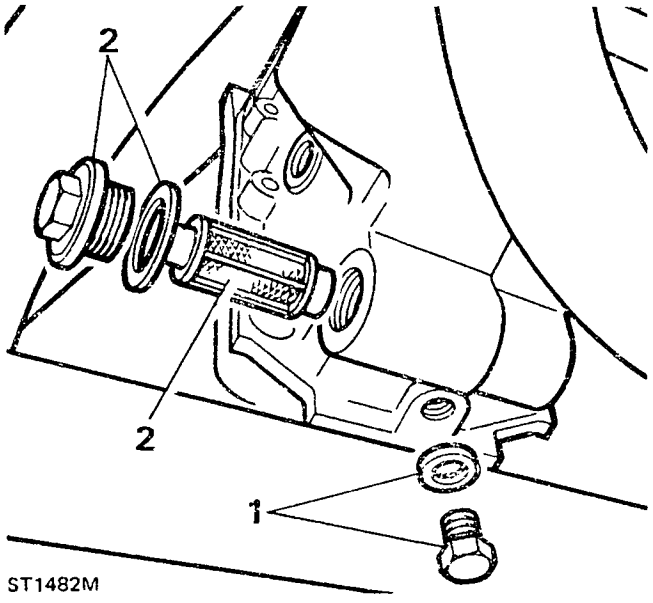


RENEW LT85 MAIN GEARBOX OIL

Drain and refill monthly when operating under severe wading conditions.

To change the gearbox oil proceed as follows:

1. Immediately after a run when the oil is warm, drain off the oil into a container by removing the drain plug and washer from the bottom of the gearbox casing.
2. Remove the oil filter.



3. Wash the filter in clean fuel; allow to dry and replace.
4. Clean and refit drain plug and washer and refill gearbox through the oil level/filler plug, with the correct grade of oil, to the bottom of the oil level/filler hole. For capacity see Data Section.

GENERAL MAINTENANCE AND ADJUSTMENT

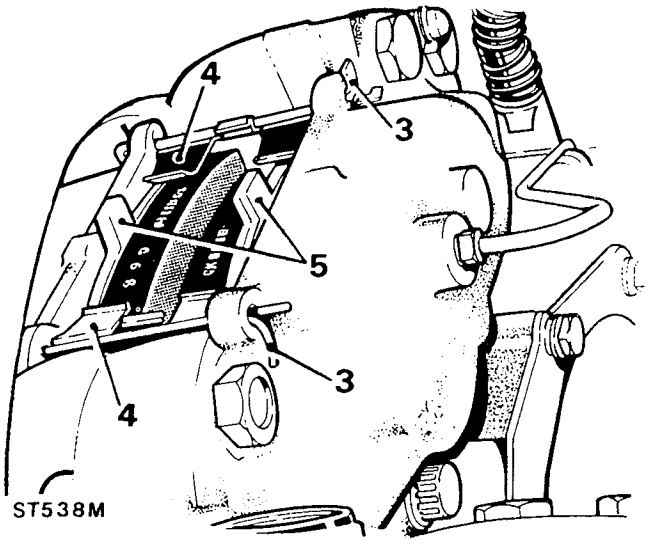
This second part of the maintenance section covers adjustments and items of general maintenance as dictated by the 'Maintenance Schedules'. However, only maintenance operations that are not included in the Overhaul Sections of the manual appear in this section.

EXAMINE AND RENEW FRONT BRAKE FRICTION PADS

Examine the friction pads for wear and if less than 3 mm (0.125 in) thick or oil contaminated, they must be renewed on both wheels at the same time, as follows:

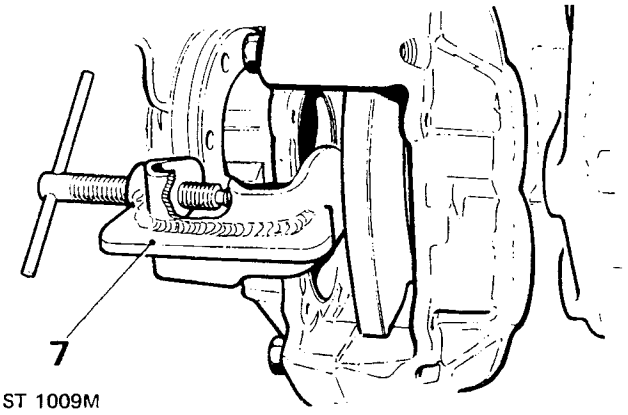
NOTE: See Book 4 Section 70 for latest method of friction pad retension.

1. Slacken both front wheel nuts and jack-up the vehicle and lower onto axle stands, and remove wheels.
2. Clean the exterior of the calipers.
3. Remove the split pins from the brake caliper.
4. Remove the retaining springs.
5. Withdraw the friction pads.
6. Clean the exposed parts of the pistons, using only new brake fluid.



ST538M

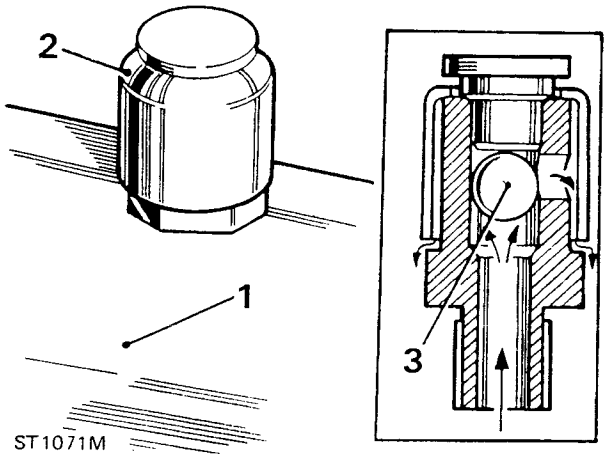
7. Using piston clamp 18G672 press each piston back into its bore, whilst ensuring that the displaced brake fluid does not overflow from the reservoir.
8. Smear the faces of the pistons with Lockheed disc brake lubricant taking care not to let any reach the lining material.
9. Insert the new friction pads.
10. Place the friction pad retaining springs in position and fit new split pins and splay the ends.
11. Apply the footbrake several times to locate the pads.
12. Check the fluid reservoir and top-up if necessary.
13. Fit the road wheels, lower the vehicle and finally tighten the wheel retaining nuts.



ST 1009M

CLEAN AND CHECK AXLE BREATHERS — ball valve type (where fitted)

1. Clean the outside of the breather and unscrew from the axle tube.
2. Wash the breather in petrol and shake to ensure that the ball valve is free.
3. Lubricate the ball with engine oil and refit to axle tube.



ST1071M

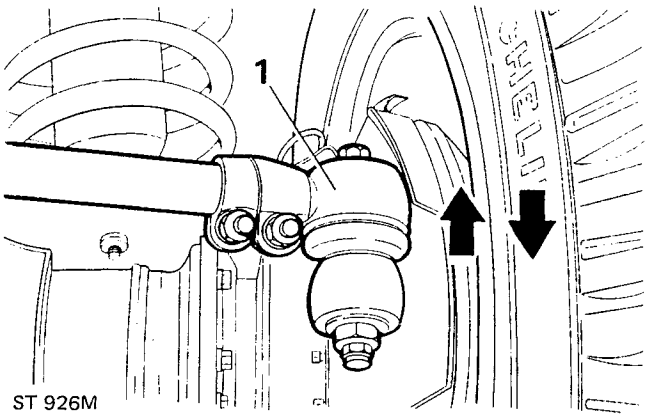
Remote axle breathers — where fitted

Pipes attached to the breathers on the axles terminate at points inside the chassis members on early models and into the engine compartment on later vehicles. 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 the normal life of ball joints 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.

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.

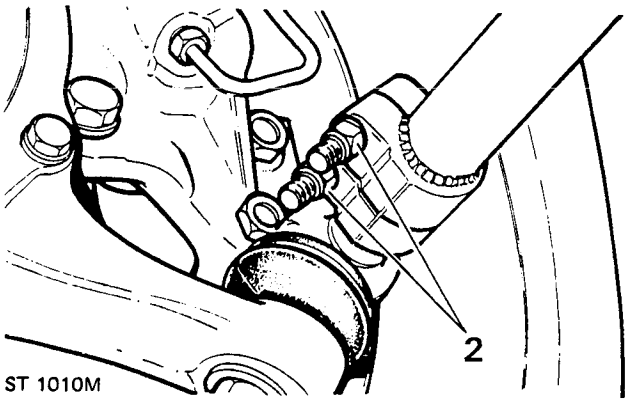


CHECK FRONT WHEEL ALIGNMENT

Use recognised wheel alignment equipment to perform this check and adjustment. See 'General Specification and Data' section for the correct alignment. Check and adjust with the vehicle on level ground.

1. Set the road wheels to the straight ahead position and push the vehicle forward a short distance.
2. Slacken the clamp bolts securing the ball joints at both ends of the track rod.
3. Twist the track-rod to decrease or increase its effective length as required to achieve the correct alignment.
4. Push the vehicle rearwards whilst moving the steering wheel from side to side to settle the ball joints. Then with the wheels in the straight ahead position push the vehicle forward a short distance and recheck the alignment. If necessary make further adjustments. When the alignment is correct tighten the ball joint clamp bolts.

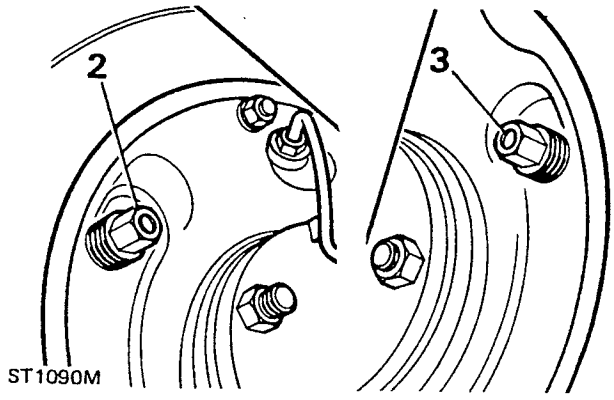
The ball joint pins must be central in their housing and not inclined to one side. See section 57.



ADJUST REAR BRAKES

Land Rover One Ten Vehicles

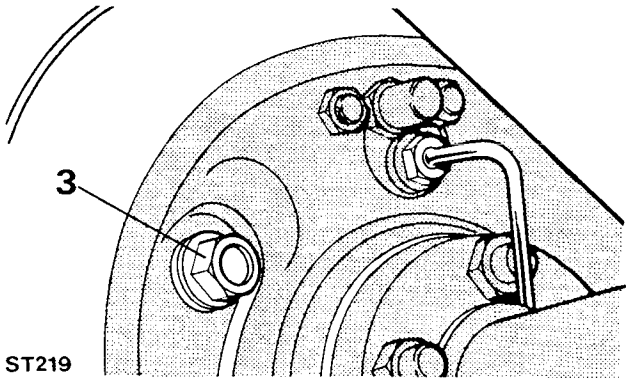
1. Raise up vehicle and lower onto axle stands.
2. Each shoe is independently set by means of a hexagon adjuster. Check that the wheel turns freely and turn one adjuster until the shoe is locked against the drum. Slacken off the adjuster sufficiently for the wheel to turn freely — approximately two serrations 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.



Land Rover Ninety Vehicles

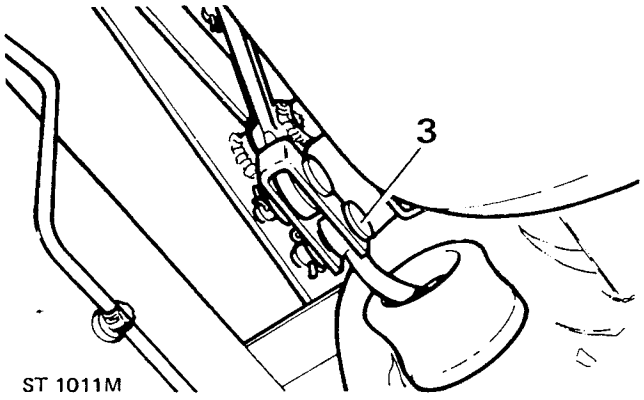
The shoes are set by a single hexagon adjustment bolt operating through a serrated snail cam enabling both shoes to be adjusted to obtain the best results.

1. Raise-up the vehicle on to axle stands.
2. Check that the wheel rotates freely then turn the adjuster until the brake shoes are in firm contact with the drum.
3. Slacken off the adjuster just sufficiently for the drum to rotate freely.
4. Repeat the procedure for the other wheel.
5. Remove the axle stands and road test the vehicle.



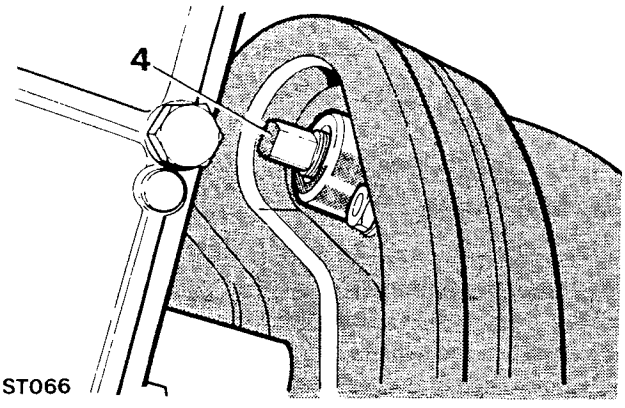
ADJUST TRANSMISSION BRAKE (Handbrake)

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.



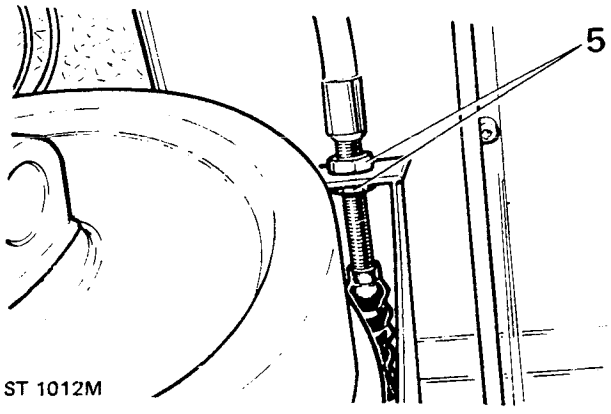
ST 1011M

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



ST066

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.



ST 1012M

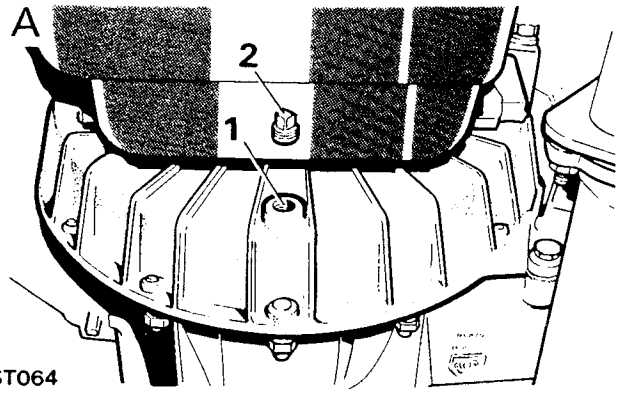
6. Fit the clevis pin, washer and a NEW split pin.
7. Slacken the adjuster 1 or 2 notches until handbrake shoes just clear the drum.
8. Apply the handbrake gradually. The drum should still rotate on the first ratchet and start to come on at the second ratchet.

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

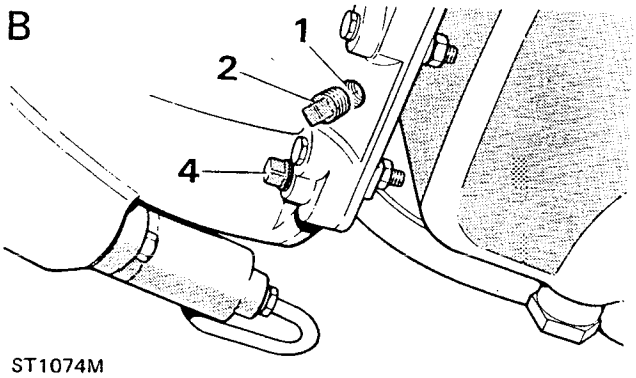
1. The flywheel housing can be completely sealed to exclude mud and water under severe wading conditions, by means of a plug fitted in the bottom of the housing.
2. The plug should only be fitted when the vehicle is expected to do wading or very muddy work.
3. When the plug is in use it must be removed periodically and all oil allowed to drain off before the plug is replaced.

Illustration A. 4-cylinder vehicles.



ST064

Illustration B. V8 vehicles.



ST1074M

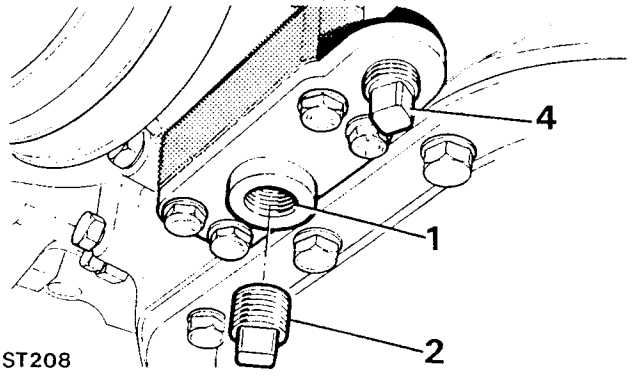
4. When plug is not in use it should be stowed as follows:
   4 cylinder models — in tool kit
   V8 — screwed into housing near drain hole.

DRAIN ENGINE TIMING COVER — 2.5 Diesel only

1. The timing cover can be completely sealed to exclude mud and water under severe wading conditions, by fitting a plug in the drain hole at the bottom of the cover.
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 present allowed to drain off before the plug is replaced.

   NOTE: There should not be any oil in the timing cover, but if there is, the cause should be investigated as soon as possible, as the timing belt will deteriorate if it becomes contaminated with oil.

4. When the plug is not in use it should be stowed in the tapped hole adjacent to the drain hole.

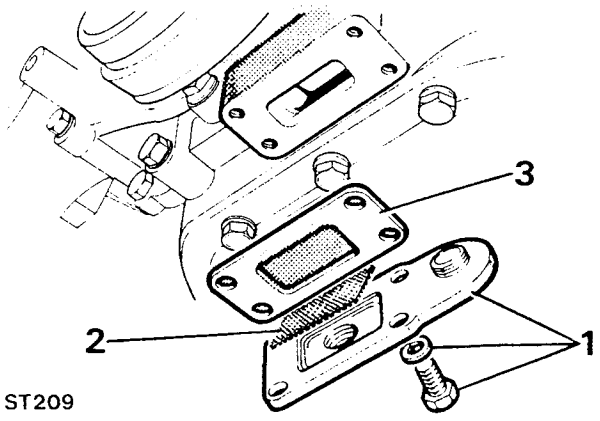


ST208

CLEAN ENGINE TIMING COVER FILTER — 2.5 Diesel only

A gauze filter is fitted at the bottom of the engine timing cover to help prevent mud and other debris entering the drain hole, when the wading plug is not in use. The filter must be removed and cleaned periodically, to ensure that it does not become blocked and prevent the timing cover draining properly. Under normal circumstances, the filter should be cleaned at the intervals specified in the Maintenance Schedule or, more frequently if the vehicle operates regularly in wet or dusty conditions.

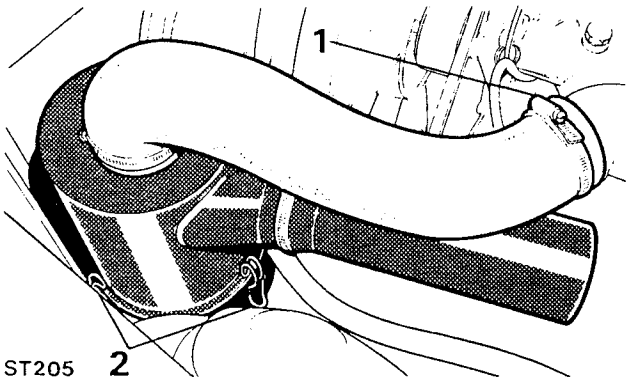
1. From underneath the vehicle, remove the four bolts and plain washers and, withdraw the wading plug plate from the bottom of the timing cover.
2. Wash the filter in kerosene or clean fuel. Brush off any mud or other debris and ensure that the whole filter is quite clean.
3. Check the condition of the gasket for the wading plug plate. If necessary, fit a new gasket.
4. Refit the wading plug plate. Tighten the securing bolts.



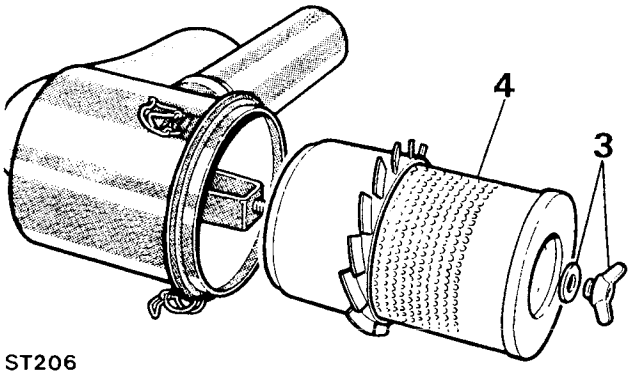
ST209

RENEW AIR CLEANER ELEMENT — 2.5 Diesel and 2.25 Petrol engines

1. Disconnect the air cleaner hose.
2. Pull up the three clips and lift out the air cleaner canister.
3. Unscrew element wing nut and sealing washer.
4. Remove and discard the element. DO NOT attempt to clean the element, fit a new one during reassembly.
5. Clean interior of canister.
6. Fit a new element and sealing washer.



ST205



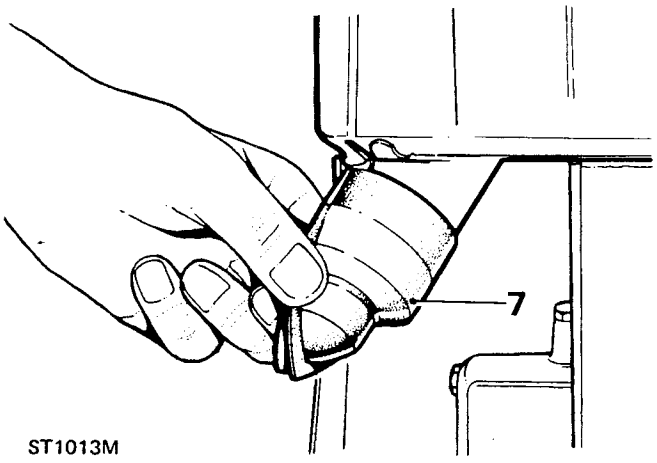
ST206

continued

Check 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.

7. Squeeze open the dump valve and check that the interior is clean. Also check that the rubber is flexible and in a good condition.
8. If necessary, remove the dump valve to clean the interior. Fit a new valve if the original is in a poor condition.



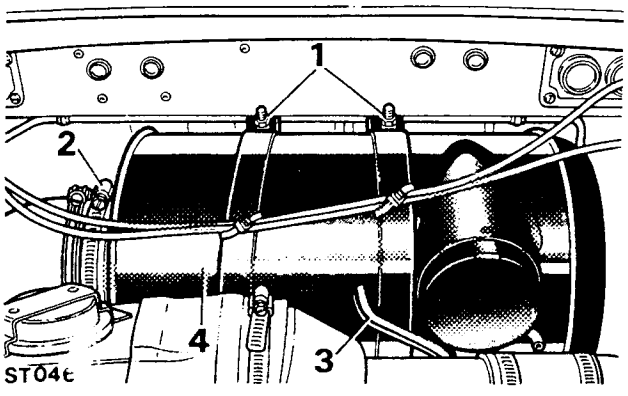
ST1013M

Fit air cleaner

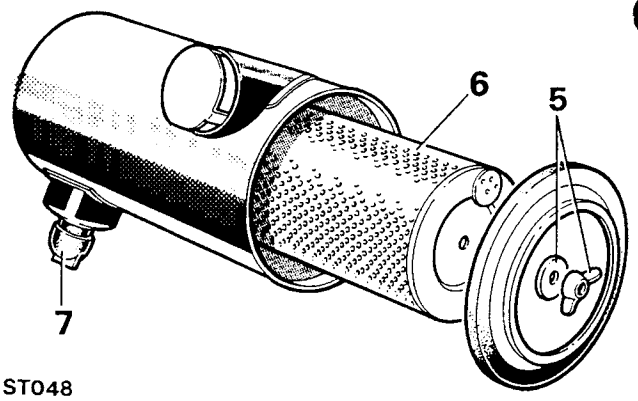
9. Fir air cleaner canister and secure with the clips.
10. Connect the air cleaner hose.

RENEW AIR CLEANER ELEMENT — V8 engine

1. Unscrew the two air cleaner strap retaining nuts.
2. Disconnect the air cleaner hose.
3. Remove the engine breather hose.
4. Withdraw air cleaner canister.
5. Unscrew element wing nut and washer and remove filter seal.
6. Remove and discard the element. DO NOT attempt to clean the element, fit a new one during reassembly and secure with the wing nut.



ST04E



ST048

Check air cleaner dump valve

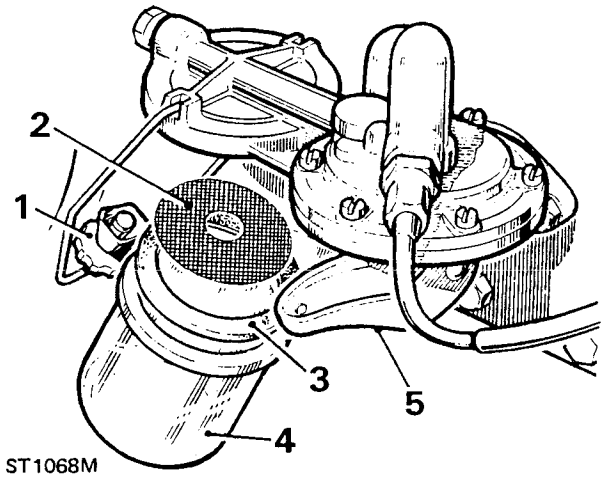
7. Squeeze open the dump valve and check that the interior is clean. Also check that the rubber is flexible and in a good condition.
8. If necessary, remove the dump valve to clean the interior. Fit a new valve if the original is in a poor condition.

Fit air cleaner

9. Fit a new element and reassemble the air cleaner.
10. Fit the air cleaner canister.
11. Fit the breather hose.
12. Fit the air cleaner hose.
13. Secure with the retaining straps and nuts.

CLEAN FUEL LIFT PUMP SEDIMENT BOWL — Petrol engine — early vehicles

1. Remove the bowl by slackening the thumb screw and swinging the retainer to one side.
2. Remove and clean the filter gauze in clean petrol.
3. Ensure that the sealing washer is in good condition.
4. Replace gauze and refit the bowl.
5. Prime the pump by operating the hand lever.

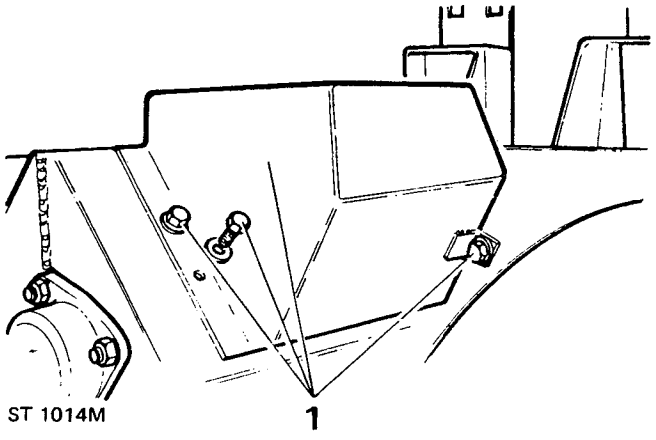


ST1068M

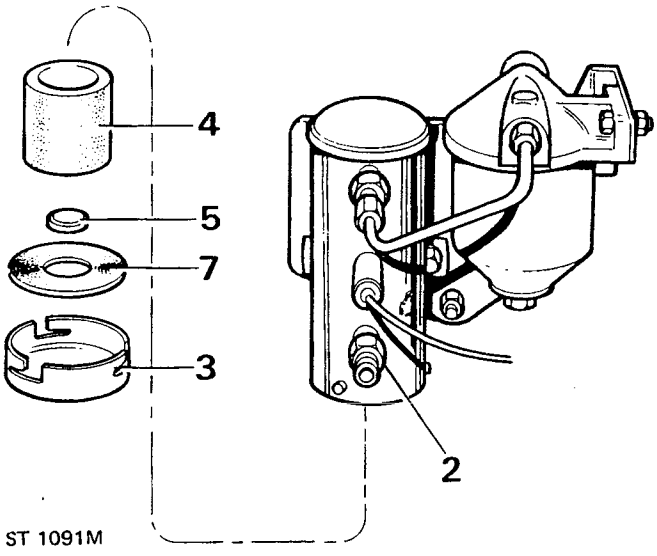
CLEAN ELECTRIC FUEL PUMP FILTER — V8 and later 2.25 Petrol engine vehicles

The pump is located mid-way along the right hand side of the chassis.

1. Release the three bolts and remove the protective cover — except '90' models.



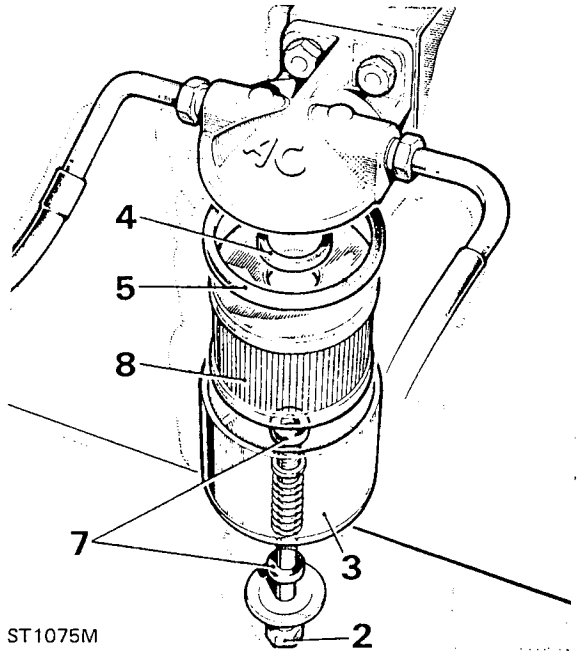
2. From beneath the vehicle disconnect the fuel inlet pipe from the pump and blank the end of the pipe by suitable means to prevent fuel draining from the tank.
3. Release the end cover from the bayonet fixing.
4. Withdraw the filter and clean by using a compressed air jet from the inside of the filter.
5. Remove the magnet (where fitted) from the end cover and clean. Replace the magnet in the centre of the end cover.
6. Reassemble the fuel pump and refit the fuel inlet pipe.
7. Use a new gasket for the end cover if necessary.
8. Fit the protective cover.



RENEW FUEL FILTER ELEMENT — Petrol engines 4-cylinder and V8

The element provides a filter between the pump and carburetter and is located adjacent to fuel pump on the right hand side of the chassis.

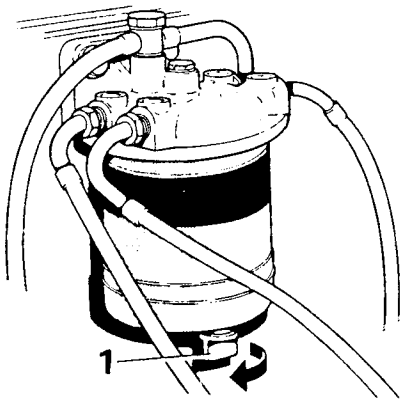
1. Release the three bolts and remove the protective cover. See 'Clean electric fuel pump filter'.
2. Unscrew the centre bolt.
3. Withdraw the filter bowl.
4. Remove the small sealing ring and remove the element.
5. Withdraw the large sealing ring from the underside of the filter body.
6. Discard the old element and replace with a new unit.
7. Ensure that the centre and top sealing rings are in good condition and replace as necessary.
8. Fit new element, small hole downwards.
9. Refit sealing rings (small and large).
10. Replace filter bowl and tighten the centre bolt.



RENEW FUEL FILTER ELEMENT — Diesel engines

Drain off Water

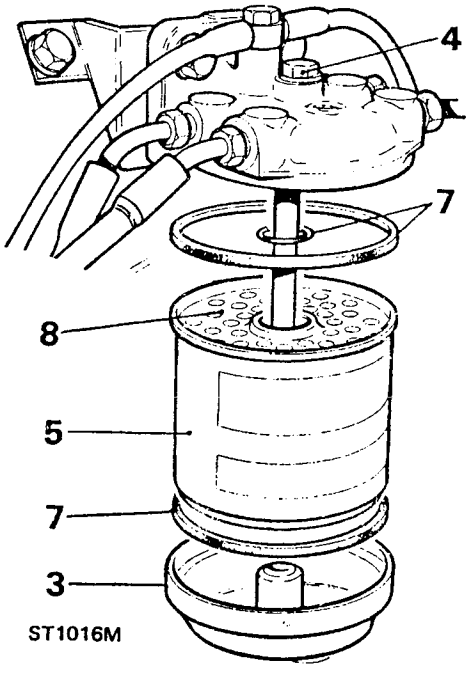
1. Slacken off drain plug to allow water to run out.
2. When pure diesel fuel is emitted, tighten drain plug.



ST062

Renew filter

3. Support element holder.
4. Unscrew the special bolt on top of the filter, the element holder can now be removed.
5. Remove and discard the used element.
6. Wash the element holder in petrol or fuel oil.
7. If necessary renew both the large rubber washer and the small rubber washer in the filter top, also renew the large rubber washer in the element holder.
8. Push the new element onto the filter top spigot with the holes in the element to the top.
9. Fit the element holder to the bottom of the element, and secure with the special bolt.
10. Prime the system and check for fuel leaks.



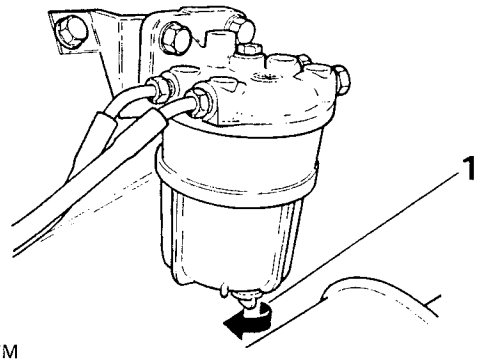
ST1016M

FUEL SEDIMENTER — Diesel engines (where fitted)

The sedimenter increases the working life of the fuel filter by removing the larger droplets of water and larger particles of foreign matter from the fuel.
Drain off water as follows:

Drain off Water

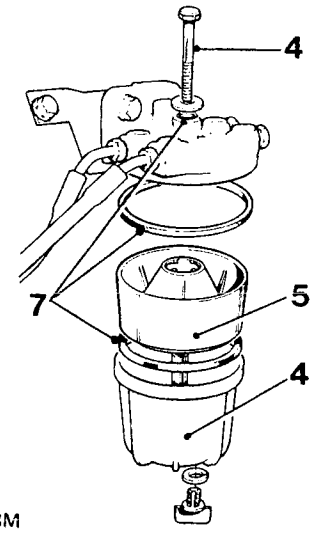
1. Slacken off drain plug to allow water to run out.
2. When pure diesel fuel is emitted, tighten drain plug. Dismantle and clean as detailed below.



ST 1017M

Clean element

3. Disconnect fuel inlet pipe at sedimenter and raise pipe above level of fuel tank to prevent draining from tank. Support in this positon.
4. Support sedimenter bowl and unscrew bolt on top of unit and remove bowl.
5. Remove the sedimenter element.
6. Clean all parts in kerosene.
7. Fit new seals and reverse removal procedure.
8. Slacken off the drain plug, when pure diesel fuel runs out tighten plug.
9. If necessary, prime the system.
10. Start engine and check for leaks from sedimenter.

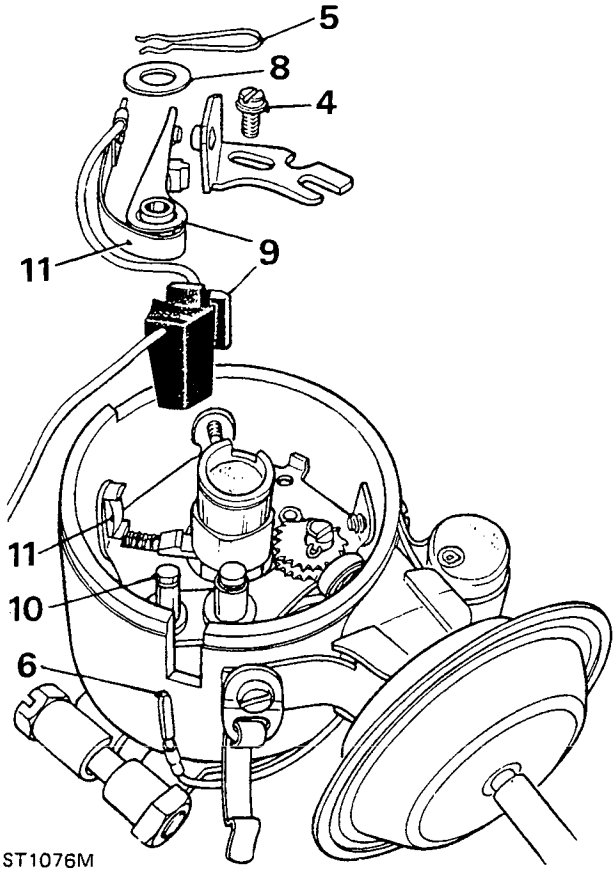


ST 1018M

RENEW DUCELLIER DISTRIBUTOR POINTS — 4-cylinder engines

Renew Points

1. Release the spring clips and remove the distributor cap.
2. Pull off the rotor arm.
3. Remove the dust shield.
4. Remove the retaining screw and remove the fixed contact point.
5. Slide the spring clip rearwards.
6. Disconnect the suppressor lead from the connector block.
7. Disconnect the lead from ignition coil.
8. Remove insulation washer from the moving contact point.
9. Lift off the moving contact point complete with leads and connector block from the distributor body.
10. Fit the new moving point over post.
11. Locate the leaf spring in the plastic guide.
12. Fit the insulation washer.
13. Secure the assembly with the spring clip.
14. Fit the connector block to the distributor body.
15. Connect ignition coil lead.
16. Fit suppressor lead to connector block.
17. Fit the fixed contact point and loosely retain with the screw.

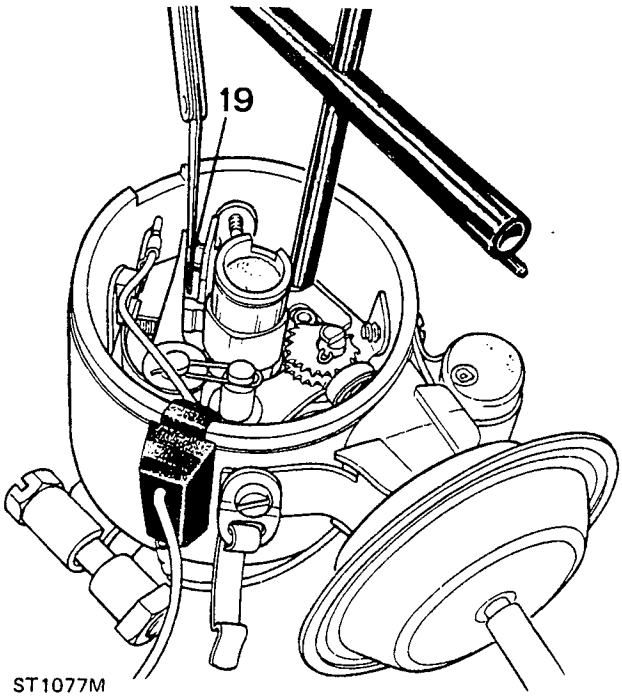


ST1076M

Adjust points

NOTE: The following two instructions describe the adjustment of the contact points. The accompanying illustration shows it being done with the aid of special tool 18G1308. Whilst the points can be adjusted to the datum setting only (see data) without the tool full distributor adjustment, i.e. dwell angle, dwell variation and vacuum advance can only be achieved by using this tool in conjunction with engine diagnostic equipment. It is essential that the above adjustments are carried out in order to maintain correct emission levels and maximum engine efficiency.

18. Rotate the engine until a cam of the rotor fully opens the points.
19. Using a feeler, adjust the position of the fixed contact point to the datum setting and tighten the retaining screw.
20. Check and adjust the dwell angle, dwell variation and vacuum advance.



ST1077M

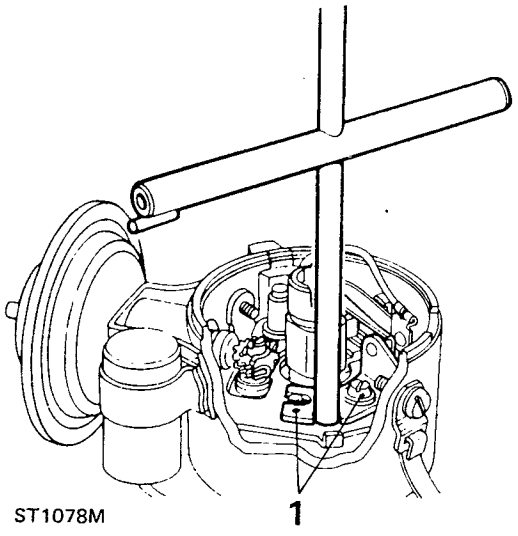
ADJUST DUCELLIER DISTRIBUTOR — 4-cylinder Petrol engine

Service tool:
18G1308

Check and Adjust Dwell Angle

NOTE: The following six instructions can only be carried out using engine diagnostic equipment and special tool 18G1308.

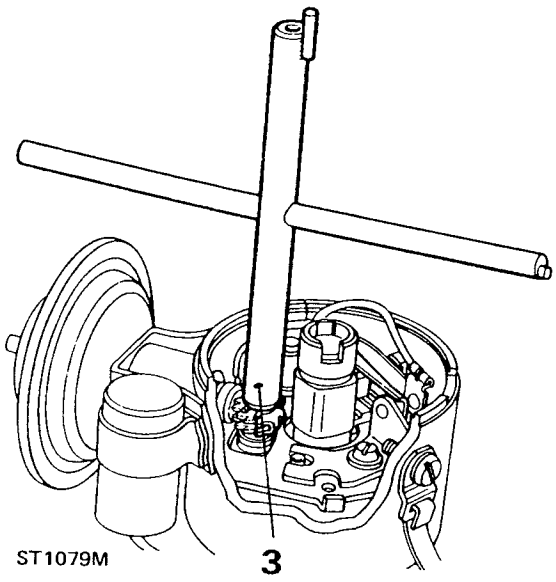
1. Start the engine, disconnect the vacuum pipe from the vacuum unit and with the engine idling check the dwell angle — see data. If adjustment is required stop the engine, remove the distributor cap, rotor arm and dust cover, slacken the fixed contact retaining screw and using the eccentric-post end of the special tool, as illustrated, make an appropriate adjustment. Tighten the retaining screw, reassemble the distributor and recheck the dwell angle.



Check and adjust dwell variation

NOTE: A dwell variation outside the accepted tolerance — see data — can be caused by a mechanical fault or wear within the distributor. This may be checked as follows:

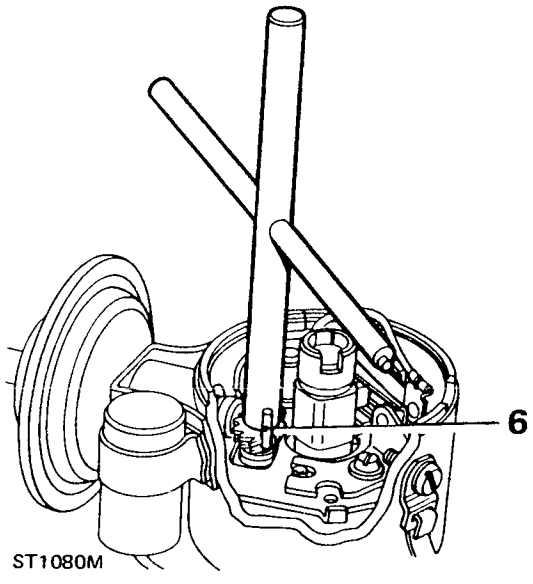
2. Disconnect the vacuum advance, start the engine and increase the speed to 2000 r.p.m. A variation outside the tolerance given in data indicates that the distributor has a mechanical fault which cannot be rectified by adjustment.
3. If the variation is acceptable, reconnect the vacuum pipe, start the engine and increase the engine speed to 2,000 r.p.m. and release the throttle. Check the dwell variation and if necessary adjust by turning the eccentric 'D' post with the special tool (female 'D' end). Setting the dwell for minimum variation may alter the basic setting and this must be rechecked at idle speed.



Check vacuum advance

NOTE: If the vacuum unit has been removed or the distributor dismantled, the vacuum advance must be checked and if necessary adjusted.

4. Disconnect the vacuum pipe and connect a vacuum pump to the unit.
5. Start and run the engine at idle speed and using a timing light, slowly increase the vacuum and note the point at which vacuum advance starts and compare the figure with that given in data.
6. Adjustment of the serrated cam, with the special tool, one tooth at a time, will alter the point at which vacuum advance starts.



RENEW LUCAS CONTACT BREAKER SLIDING CONTACTS — 4-cylinder petrol engine

The contact set should be renewed every 40.000 km (25,000 miles).

Remove the old contacts

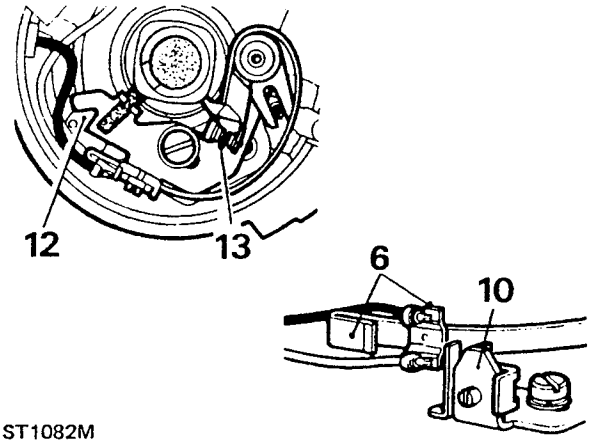
1. Remove the distributor cap.
2. Remove the rotor arm.
3. Remove the retaining screw and lift the contact set complete from the plate.
4. Press the contact set spring and release the terminal plate and leads from the spring.

Fit new contacts

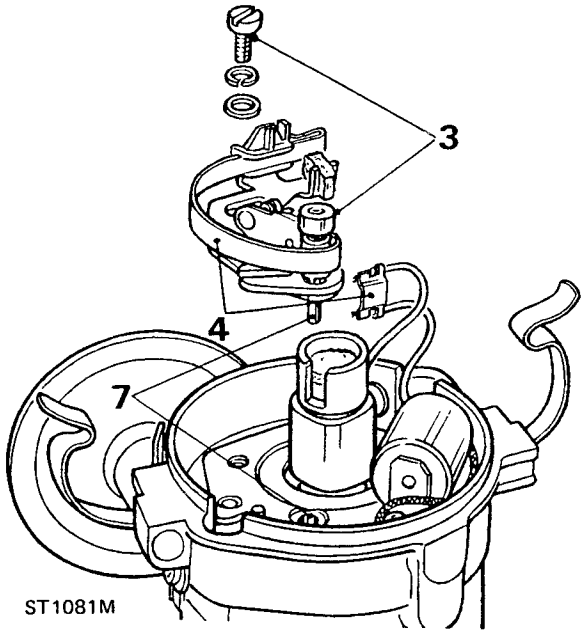
5. Clean the points with petrol to remove the protective coating.
6. Press the contact spring and fit the terminal plate with the black lead uppermost.
7. Fit the contact set to the moving plate, ensuring that the peg, underneath the contact pivot, locates in the hole in the moving plate.
8. The sliding contact actuating fork must also locate over the fixed peg.
9. Loosely secure the assembly with the screw, plain and spring washer.
10. Check that the contact leaf spring locates properly in the insulation shoe.

Adjust gap

11. Rotate the crankshaft until the contact heel is on the highest point of a cam.
12. Adjust the gap by inserting a screwdriver blade between the 'V' shaped notch and pip and twist the screwdriver.
13. Insert a 0,35 to 0,40 mm (0.014 to 0.016 in) feeler gauge between the points and adjust to a sliding fit and tighten the retaining screw.
14. Fit the rotor arm.



ST1082M



ST1081M

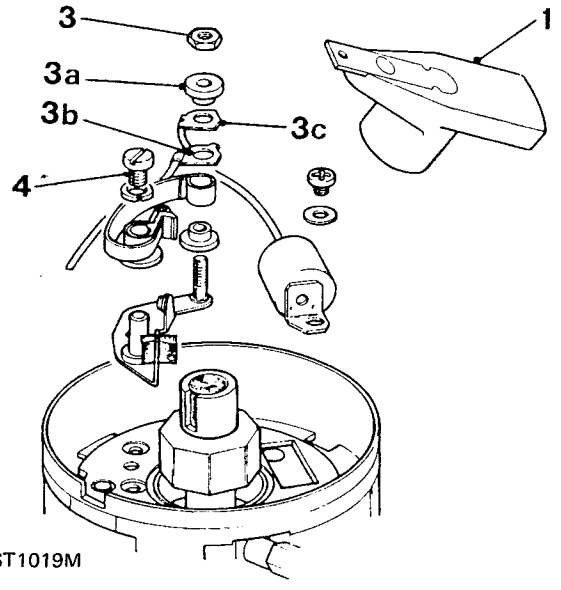
RENEW DISTRIBUTOR CONTACT SET — V8 engine

Fixed contact type

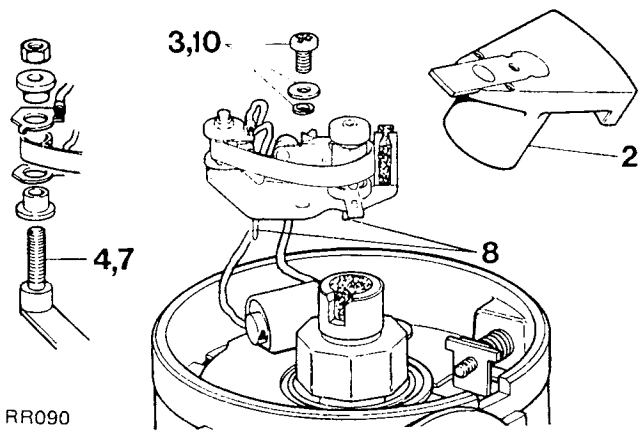
1. Unclip and remove the distributor cap.
2. Withdraw the rotor arm.
3. Remove the contact breaker spring anchor nut and lift off:
   (a) the top-half of insulation bush
   (b) the low tension lead (black)
   (c) the capacitor lead (orange)
4. Remove the contact breaker retaining screw, plain and spring washer and remove contact set assembly.
5. Remove the complete insulation bush.
6. Fit the contact breaker set ensuring that the small post protruding from below the contact set locates through the hole in the cover plate into the hole in the end of the vacuum unit actuating lever, secure with the screw, plain and spring washers.

continued

7. Assemble the contact breaker spring insulating bushes and electrical leads, as illustrated, in the following sequence:
   (a) lower bush
   (b) spring
   (c) low tension lead
   (d) capacitor lead
   (e) top bush
   and secure with the anchor spring nut.
8. Apply a few drops of engine oil to the distributor cam lubrication pad.



ST1019M



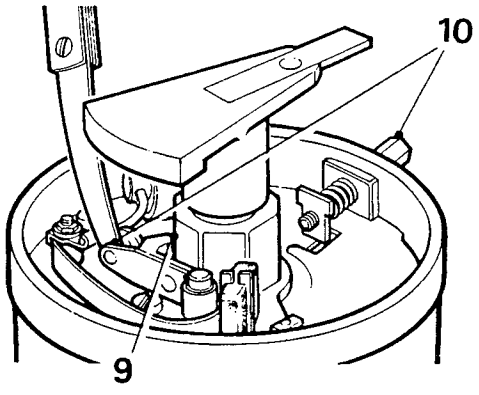
RR090

Adjust points — both types

9. Turn the engine in the direction of rotation until the contacts are fully open or the heel of the contact set is on the highest point of the cam.
10. Using a feeler gauge and the dwell angle adjuster on the side of the distributor, set the points to a nominal gap of 0,35 to 0,40 mm (0.014 to 0.016 in).
11. At the earliest opportunity check and adjust the dwell angle — see data — using special turning equipment.
12. Fit the rotor arm and distributor cap ensuring that the H.T. pick-up brush moves freely.

Sliding contact type

1. Release the clips and remove the distributor cap.
2. Remove the rotor arm from the cam spindle.
3. Remove the retaining screw and washers and lift the complete contact breaker assembly from the moveable plate.
4. Remove the nut and plastic bushes from the terminal post to release the leads and spring.
5. Discard the old contact breaker assembly.
6. Clean the new points with petrol to remove the protective coating.
7. Connect the leads to the terminal post in the following sequence:
   (a) lower plastic bush
   (b) red lead tab
   (c) contact breaker spring eye
   (d) black lead tab
   (e) upper plastic bush
   (f) retaining nut.
8. Fit the contact set to the moving plate ensuring that the two pegs locate in the holes.

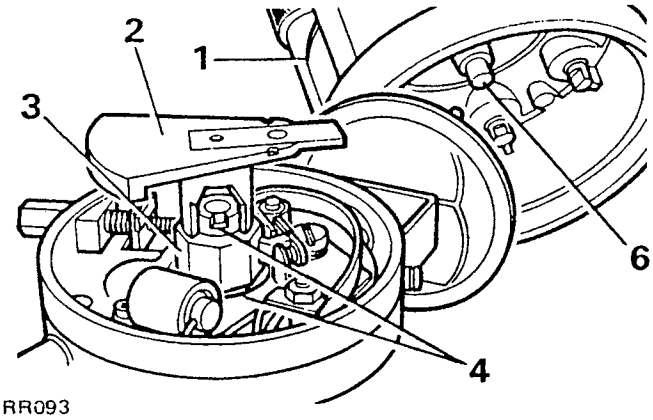


ST1083M

CLEAN AND LUBRICATE V8 ENGINE DISTRIBUTOR

Fixed contact type

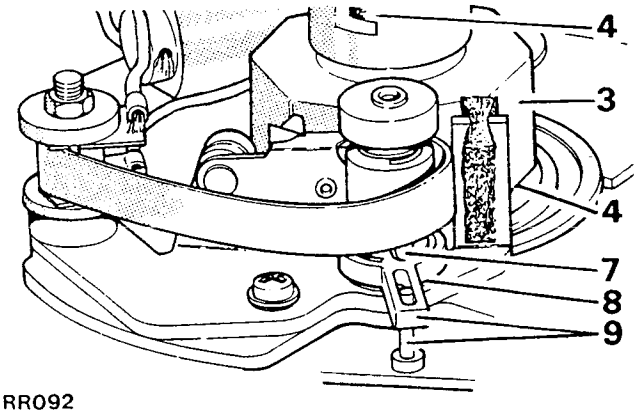
1. Remove distributor cap.
2. Remove rotor arm.
3. Lightly smear the cam with clean engine oil.
4. Add a few drops of thin machine oil to lubricate the cam bearing and distributor shaft.
5. Wipe the inside and outside of the distributor cap with a soft dry cloth.
6. Ensure that the carbon brush works freely in its holder.
7. Refit rotor arm and distributor cap.



RR093

Sliding contact type

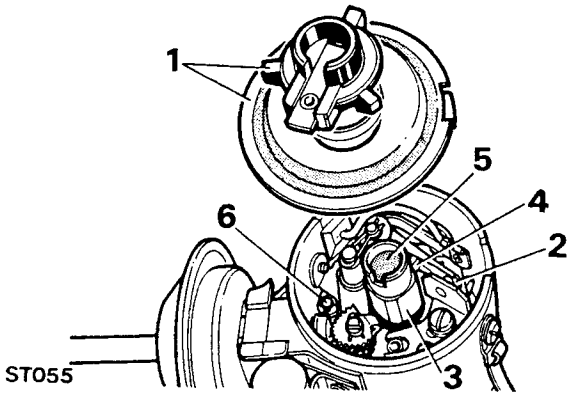
1. Remove distributor cap.
2. Remove rotor arm.
3. Lightly smear the cam with clean engine oil.
4. Add a few drops of thin machine oil to lubricate the cam bearing and distributor shaft.
5. Wipe the inside and outside of the distributor cap with a soft dry cloth.
6. Ensure that the carbon brush works freely in its holder.
7. Lubricate the actuator ramps and contact breaker heel ribs with Shell Retinax or equivalent grease.
8. Grease the underside of the heel actuator.
9. Apply grease to the fixed pin and actuator fork.
10. Refit rotor arm and distributor cap.



RR092

CLEAN AND LUBRICATE DUCELLIER DISTRIBUTOR

1. Remove the distributor cover and lift off the rotor arm and anti-dust shield.
2. Inspect the contact breaker points; if burnt or worn they should be renewed.
3. Very lightly smear the cam with grease — Shell Retinax.
4. Lubricate the pressure pad with grease — Shell Retinax.
5. Add a few drops of oil to the felt pad in the top of the cam spindle.
6. Turn the engine until the distributor centrifugal weight pivot post is visible through the cut-out in the base plate and lubricate the pivot post with a drop of oil. Repeat for the opposite pivot post.
7. Carefully wipe away all surplus lubricant; and ensure that the contact breaker points are clean and dry.
8. Fit the anti-dust shield.
9. Refit the rotor arm, engage the slot in the spindle and push down firmly.
10. Wipe clean with dry nap-free cloth, the inside and outside of the distributor cover, particularly between the electrodes, and fit the distributor cover.



ST055

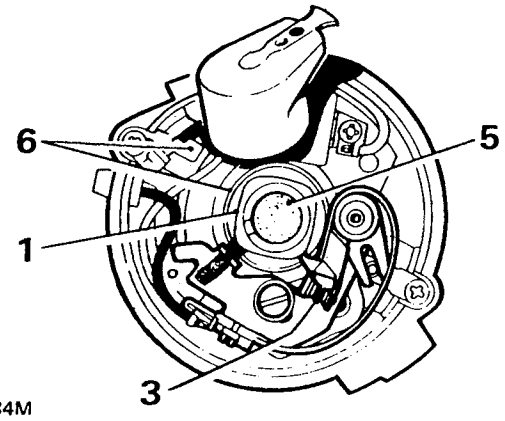
CLEAN V8 ENGINE ELECTRONIC IGNITION DISTRIBUTOR

80.000 km (48,000 miles)

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.

CLEAN AND LUBRICATE LUCAS DISTRIBUTOR

1. Clean and lightly grease the cam with Shell Retinax or equivalent and remove any surplus lubricant.
2. Using the same grease lubricate the underside of the heel actuator.
3. Grease the actuator ramps and contact breaker heel ribs.
4. Apply grease to the fixed pin and the actuator fork.
5. Apply a drop of clean engine oil to the felt pad underneath the rotor arm.
6. Every 40.000 km (25,000 miles) lubricate the automatic advance mechanism by injecting one or two drops of engine oil through the aperture in the base plate.
7. Wipe the internal and external surfaces of the distributor cap with clean dry nap-free cloth and fit the cap to the distributor body.



ST1084M

CHECK AND ADJUST V8 ENGINE DISTRIBUTOR TIMING

Using Electronic Timing Equipment

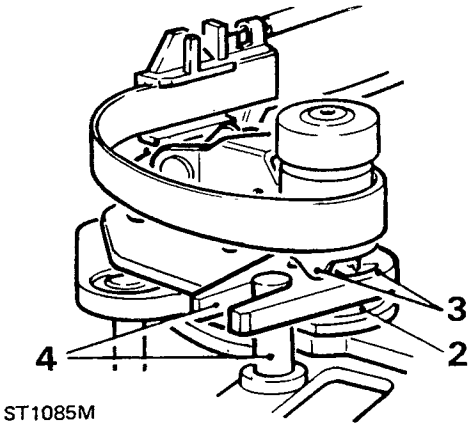
A pointer on the timing cover and marks on the crankshaft pulley indicate positions around T.D.C. on No. 1 cylinder (i.e. front cylinder on left-hand bank). Refer to 'Engine Tuning data' for appropriate ignition timing.

Engine speed accuracy during ignition timing is important. Any variation from the required idle speed, particularly in an upward direction, will lead to wrongly set ignition timing.

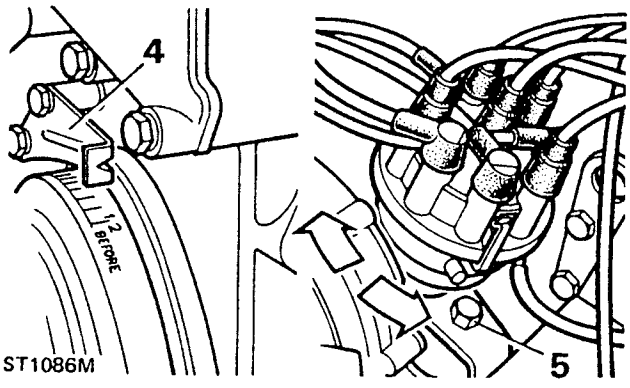
1. Connect a stroboscopic timing light as instructed by the manufacturer. The engine is timed on No. 1 cylinder.
2. Run the engine at idle speed.
3. Position the timing light to illuminate the crankshaft pulley and scale.

   WARNING: Ensure that personnel and equipment are kept clear of the rotating cooling fan while using the timing light.

4. If the timing is correct the pulley mark indicated in the Tuning Data will show. If correct, instruction 5 may be ignored.
5. With the engine still running at idle speed, slacken the clamp bolt and carefully rotate the distributor body as required until the correct pulley mark shows. Turn anticlockwise to advance and clockwise to retard.
6. Tighten the clamp bolt with the unit in this position.



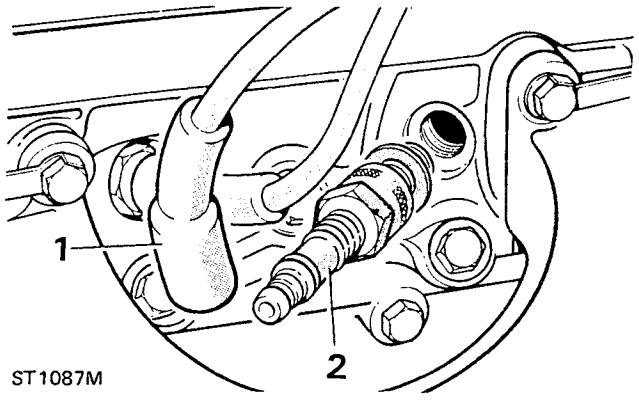
ST1085M



ST1086M

CLEAN, ADJUST OR RENEW SPARK PLUGS

1. Withdraw the H.T. leads from the spark plugs by gripping the shrouds, do not pull on the leads.
2. Using an appropriate plug spanner, remove the spark plugs.



ST1087M

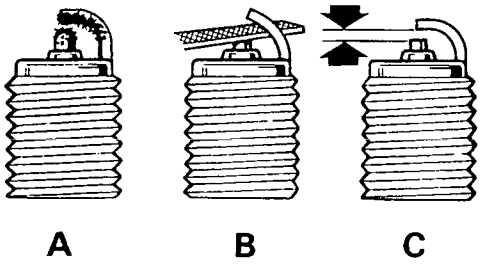
Clean and set gaps

3. Fit plug in plug cleaning machine.
4. Wobble plug with circular motion while operating abrasive blast for a maximum of four seconds.

   CAUTION: Excessive abrasive blasting will erode insulator nose.

5. Change to air blast only and continue to wobble plug for a minimum of thirty seconds to remove abrasive grit from plug cavity.
6. Wire-brush plug threads, open gap slightly.
7. Using point file, square off electrode surfaces.
8. Set electrode gap, see 'Engine Tuning data'.
9. Test plugs in accordance with cleaning machine manufacturer's instructions. If satisfactory, refit plugs in engine.
10. If no machine is available carefully wire brush electrodes and blow or wash away carbon particles.

Illustration shows:
A. Dirty or unsatisfactory electrode
B. Filing plug electrodes
C. A clean plug correctly set



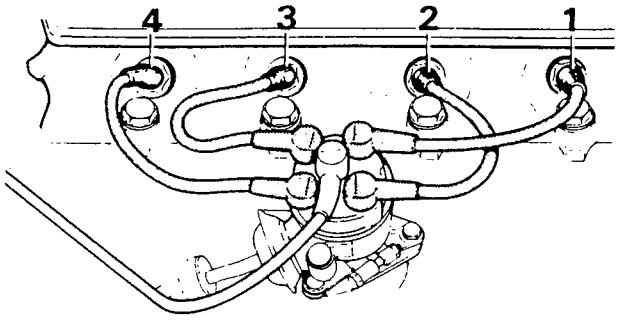
ST051

Refit or renew spark plugs

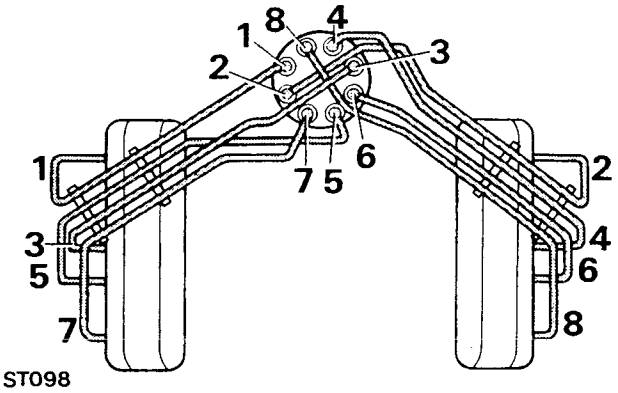
11. Check that the washers are fitted to the plugs.
12. It is important that only spark plugs specified in Data section are used for replacements.
13. Incorrect grades of plug may lead to piston overheating and engine failure.
14. Wash new plugs in petrol to remove the protective coating, then set the electrode gaps to the appropriate figures given in 'Engine Tuning data'.
15. Fit the plugs and washers to the engine but do not overtighten.
16. Examine high tension leads, including the coil to distributor lead, for insulation cracking or corrosion at end contacts. Fit new leads as necessary.
17. In addition to correct firing order, high tension leads must be fitted in correct relation to each other to avoid cross firing, as illustrated. This is particularly important on the V8 engine.

    First illustration. 4-cylinder engine.
    Second illustration. V8 engine.

18. When pushing leads on plugs ensure ferrules within shrouds are firmly seated on plugs.



ST052



ST098

CLEAN AND TEST HEATER PLUGS — Diesel engines

REMOVE THE PLUGS

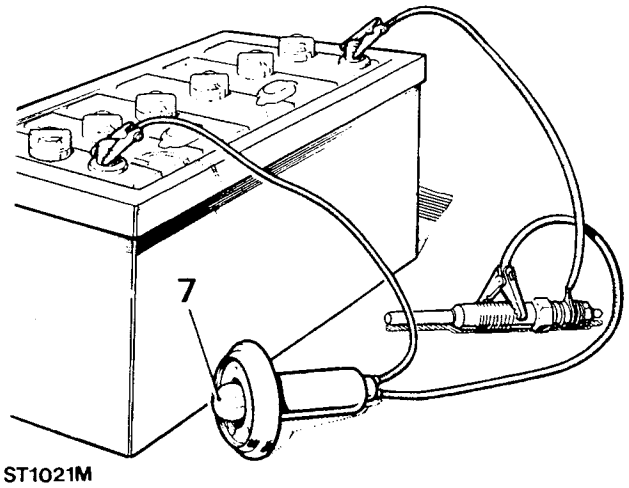
1. Disconnect the battery.
2. Remove the terminal nut from each heater plug.
3. Detach the heater plug lead and washer from each plug.
4. Remove the heater plugs.

Clean and inspect

5. Remove carbon from base of heater plugs to avoid the possibility of short circuiting of the element. Do not sandblast.
6. Examine the element for signs of fracture and deterioration and the seating for scores. Plugs with fractures or doubtful elements must be renewed. Where scoring of the seating may impair the sealing, the plug should be renewed.

Test and refit

7. Test the plug internal circuit for continuity by connecting it in circuit with a 12 volt side lamp bulb and a 12 volt supply. If the bulb does not light an open circuit is indicated and the heater plug must be renewed.

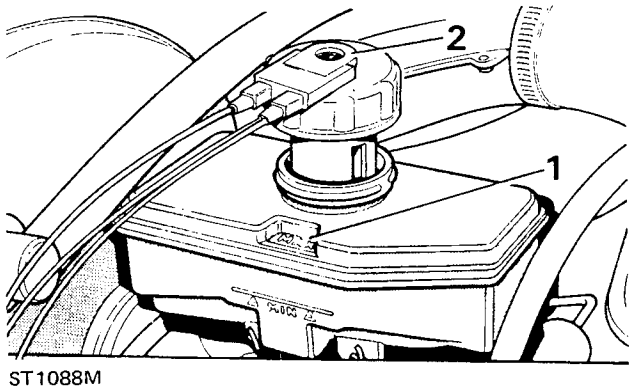


ST1021M

8. Ensure that the terminals are clean and that the thread at the base of the plug is free from carbon.
9. Fit the heater plugs to the engine. Do not overtighten.
10. Fit the heater plug lead and washer to each plug.
11. Connect the battery.

CHECK BRAKE FLUID RESERVOIR

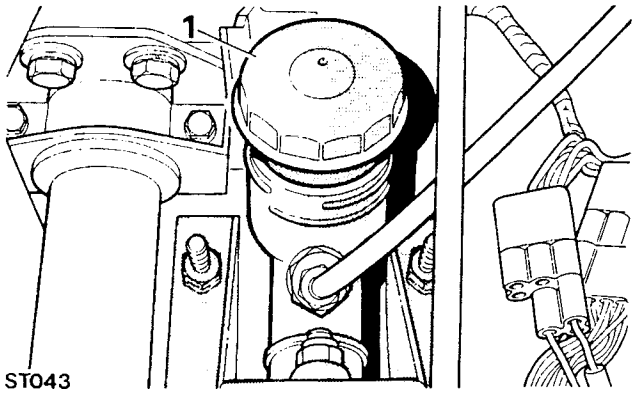
1. Check the fluid level in the fluid reservoir by observing the level in relation to the 'MIN' or 'MAX' marks on the side of the translucent reservoir.
2. If the level is below the 'MAX' mark clean the outside of the filler cap and top-up with new, clean fluid from a sealed container. Use only fluid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



ST1088M

CHECK CLUTCH FLUID RESERVOIR

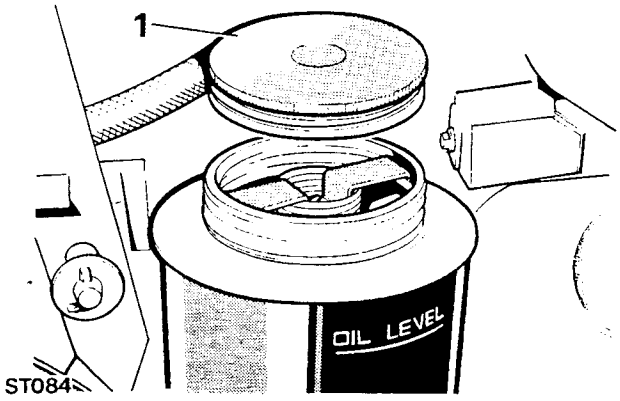
1. Clean and remove the reservoir cap and observe the fluid level in relation to the marks on the side of the reservoir.
2. Top-up if necessary with new, clean fluid from a sealed container and of a recommended specification — see 'General specification data' section. Refit the cap.



ST043

CHECK POWER STEERING FLUID RESERVOIR

1. Clean and remove the reservoir cap and observe the fluid level in relation to the mark on the side of the reservoir.
2. If necessary top-up with a recommended fluid — see 'General specification data' section — until the fluid is 12 mm (½ in) above the filter. Refit the cap.



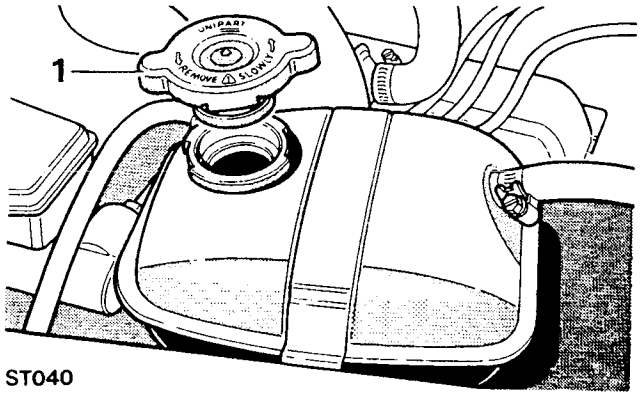
ST084

CHECK COOLING SYSTEM COOLANT

Refer to the 'Cooling system' section for details of anti-freeze and inhibitors and to the 'General specification data' section 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 the 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.



ST040

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 service, 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 service, 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.

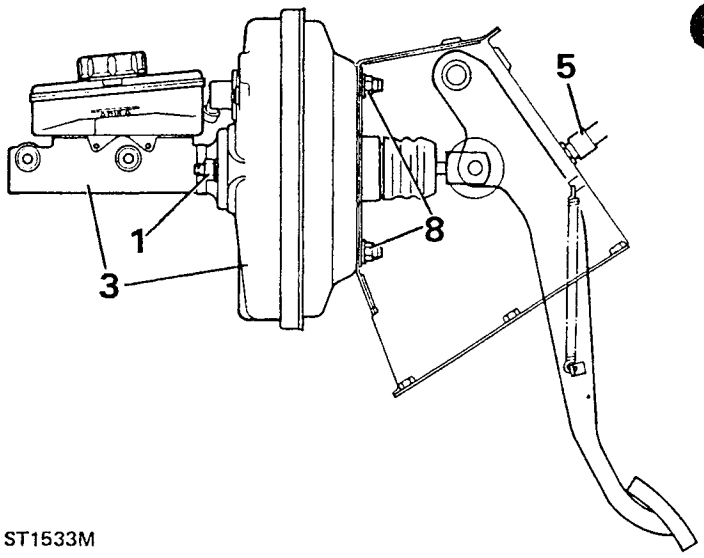
Battery terminals

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.

IMPORTANT NOTE: If a new battery is fitted to the vehicle, it should be the same type as fitted to the vehicle when new. Alternative batteries may vary in size 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.



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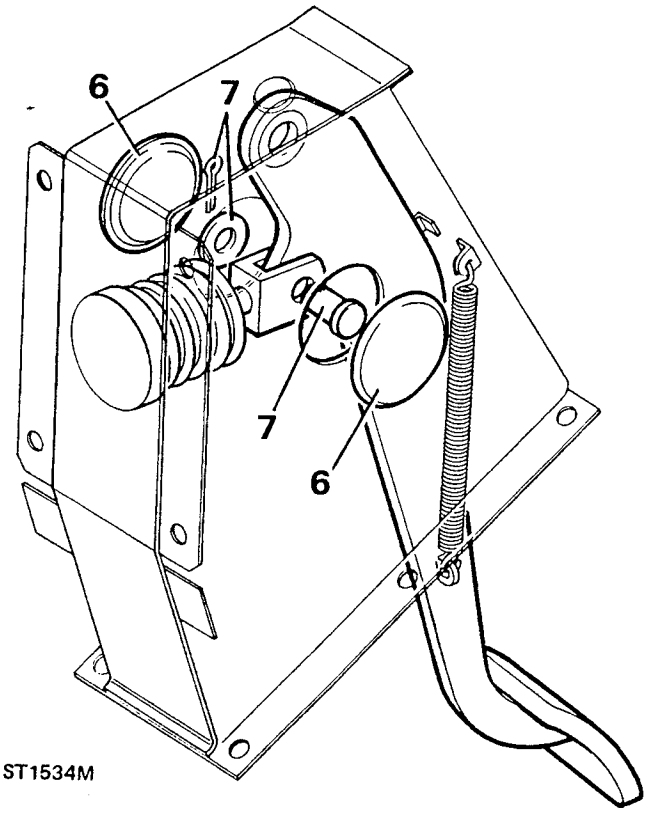
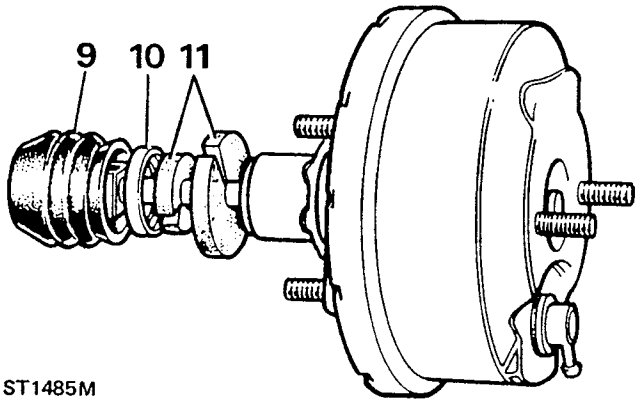


ST1534M

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

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

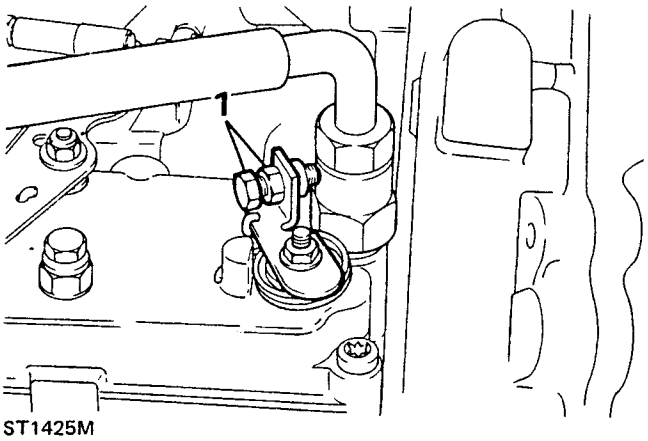


ST1485M

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.

ENGINE SLOW RUNNING — 2.5 Diesel

1. Using a suitable tachometer, check the engine slow running adjustment 'see Engine tuning data'. If adjustment is necessary slacken the locknut and turn the control screw clockwise to increase the revolutions and anti-clockwise to decrease the engine speed. Tighten the locknut, increase the engine speed for a few seconds then re-check the slow running.



ST1425M

2. If a tachometer is not available adjust the control screw until the slowest speed is obtained consistent with smooth and even running.

NOTE: The slow running control is the only permitted adjustment in service. Any additional adjustments required must only be carried out by authorised C.A.V. agents.

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INTRODUCTION

This Workshop Manual covers the Land Rover Ninety and One Ten range of vehicles. It is primarily designed to assist skilled technicians in the efficient repair and maintenance of Land Rover vehicles.

Using the appropriate service tools and carrying out the procedures as detailed will enable the operations to be completed within the time stated in the 'Repair Operation Times'.

The Manual has been produced in separate books; this allows the information to be distributed throughout the specialist areas of the modern service facility.

A table of contents in Book 1 lists the major components and systems together with the section and book numbers. The cover of each book details the sections contained within that book.

The title page of each book carries the part numbers required to order replacement books, binders or complete Service Manuals. This can be done through the normal channels.

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 and accessories:
Safety features embodied in the vehicle may be impaired if other than Land Rover parts are fitted. In certain territories, legislation prohibits the fitting of parts not to the vehicle manufacturer's specification. Torque 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.

POISONOUS SUBSTANCES

Many liquids and other substances used in motor vehicles are poisonous and should under no circumstances be consumed and should as far as possible be kept away from open wounds. These substances among others include antifreeze, brake fluid, fuel, windscreen washer additives, lubricants and various adhesives.

FUEL HANDLING PRECAUTIONS

The following information provides basic precautions which must be observed if petrol (gasoline) 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.

GENERAL

Petrol/gasoline vapour is highly flammable and in confined spaces is also very explosive and toxic.
When petrol/gasoline evaporates it produces 150 times its own volume in vapour, which when diluted with air becomes a readily ignitable mixture. The vapour is heavier than air and will always fall to the lowest level. It can readily be distributed throughout a workshop by air current, consequently, even a small spillage of petrol/gasoline is potentially 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.
Always disconnect the vehicle battery BEFORE carrying out dismantling or draining work on a fuel system.
Whenever petrol/gasoline is being handled, drained or stored, or when fuel systems are being dismantled all forms of ignition must be extinguished or removed, any head-lamps used must be flameproof and kept clear of spillage.

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

FUEL TANK DRAINING

WARNING: PETROL/GASOLINE MUST NOT BE EXTRACTED OR DRAINED FROM ANY VEHICLE WHILST IT IS STANDING OVER A PIT.

Draining or extracting petrol/gasoline from vehicle fuel tank must be carried out in a well ventilated area.
The receptacle used to contain the petrol/gasoline must be more than adequate for the full amount of fuel to be extracted or drained. The receptacle should be clearly marked with its contents, and placed in a safe storage area which meets the requirements of local authority regulations.
WHEN PETROL/GASOLINE HAS BEEN EXTRACTED OR DRAINED FROM A FUEL TANK THE PRECAUTIONS GOVERNING NAKED LIGHTS AND IGNITION SOURCES SHOULD BE MAINTAINED.

FUEL TANK REMOVAL

On vehicles where the fuel line is secured to the fuel tank outlet by a spring steel clip, it is recommended that such clips are released before the fuel line is disconnected or the fuel tank unit is removed. This procedure will avoid the possibility of residual petrol fumes in the fuel tank being ignited when the clips are released.
As an added precaution fuel tanks should have a PETROL/GASOLINE VAPOUR warning label attached to them as soon as they are removed from the vehicle.

FUEL TANK REPAIR

Under no circumstances should a repair to any tank involving heat treatment be carried out without first rendering the tank SAFE, by using one of the following methods:

STEAMING: With the filler cap and tank unit removed, empty the tank. Steam the tank for at least two hours with low pressure steam. Position the tank so that condensation can drain away freely, ensuring that any sediment and sludge not volatised by the steam, is washed out during the steaming process.

BOILING: With the filler cap and tank unit removed, empty the tank. Immerse the tank completely in boiling water containing an effective alkaline degreasing agent or a detergent, with the water filling and also surrounding the tank for at least two hours.

After steaming or boiling a signed and dated label to this effect should be attached to the tank.

SPECIFICATION

Purchasers are advised that the specification details set out in this 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 specifications with or without notice, and at such times and in such manner as they think fit. Major as well as minor changes may be involved in accordance with the Manufacturer's policy of constant product improvement.

Whilst every effort is made to ensure the accuracy of the particulars contained in this Manual, neither the Manufacturer 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.

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Special Service Tools

The use of approved special service tools is important. They are essential if service operations are to be carried out efficiently, and safely. The amount of time which 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, PO Box 3 Daventry, Northants, England NN11 4NF.

The tools recommended in this Workshop Manual are listed in a multi-language, illustrated catalogue obtainable from Messers. V. L. Churchill at the above address under publication number 2217/2/84 or from Land Rover Ltd., under part number LSM0052TC from the following address, Land Rover Publication Service, P.O. Box 534, Erdington, Birmingham B24 0QS.

DISMANTLE AND OVERHAUL

Special tools:—
Chain wheel extractor — RO 507231
Tappet guide remover — RO 530101A
***Camshaft bearing remover — 274388**
*** " " adaptor — 531760**
*** " " guide plug — 274394**
*** " " reamer — 274389**
Cork-seal guide — 270304
Seal guide - rear main bearing — 18G 1344
Seal replacer - rear main oil seal — 18G 134 - 11
Diesel engine timing gauge — RO605863
Diesel engine timing gauge — MS67B
Clutch centralising tool — RO605022
*** Whilst these tools are now not obtainable, their use is described for workshops that have them available.**

Remove the engine from the vehicle. Clean the exterior and in the interests of safety and efficient working, secure the engine to a recognised engine stand.

REMOVE ANCILLARY EQUIPMENT

Before commencing, make a careful note of the position of brackets, clips, harnesses, pipes, hoses, filters and other miscellaneous items to facilitate re-assembly.

Petrol engine

1. Disconnect the spark plug leads, release the distributor clamp bolt and withdraw the distributor complete. Remove the adaptor plate held by three bolts.
2. Remove the inlet and exhaust manifolds complete with carburetter. Removal of the heat shield will facilitate this operation.

Diesel engine

3. Release the fuel pipes from the injectors.
4. Remove the nuts securing the injector pump and withdraw the pump and the short drive shaft.
5. Remove the induction and exhaust manifolds.
6. Remove the six bolts and withdraw the oil filter tube (early engines only). At the same time remove the two joint washers and the baffle plate with the timing pointer attached. Do NOT disturb the two bolts retaining the timing pointer. Later engines have a single plate with timing pointer.
7. Remove the vacuum pump.

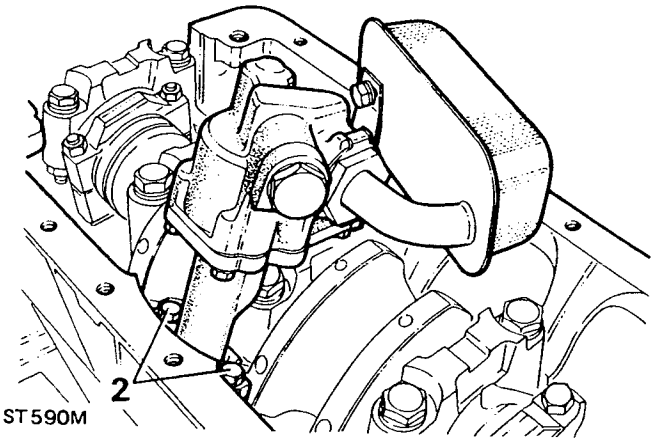
Petrol and diesel engines

8. Remove the six bolts and withdraw the rear side cover complete with fuel pump.
9. Remove the alternator and drive belt.
10. Remove the fan and pulley.
11. Remove the seven bolts and remove the water pump.
12. Drain the sump and remove the dipstick.
13. Remove the starter motor.
14. Restrain the flywheel, remove the crankshaft pulley nut and withdraw the pulley. (Bolt on later engines).
15. Evenly slacken and remove the clutch retaining bolts and withdraw the clutch assembly and centre plate.
16. Remove the two bolts and remove the oil filter assembly complete from the cylinder block. Remove the bowl retaining bolt, drain the oil and discard the element.
17. Remove the cylinder head.

REMOVE AND OVERHAUL OIL PUMP

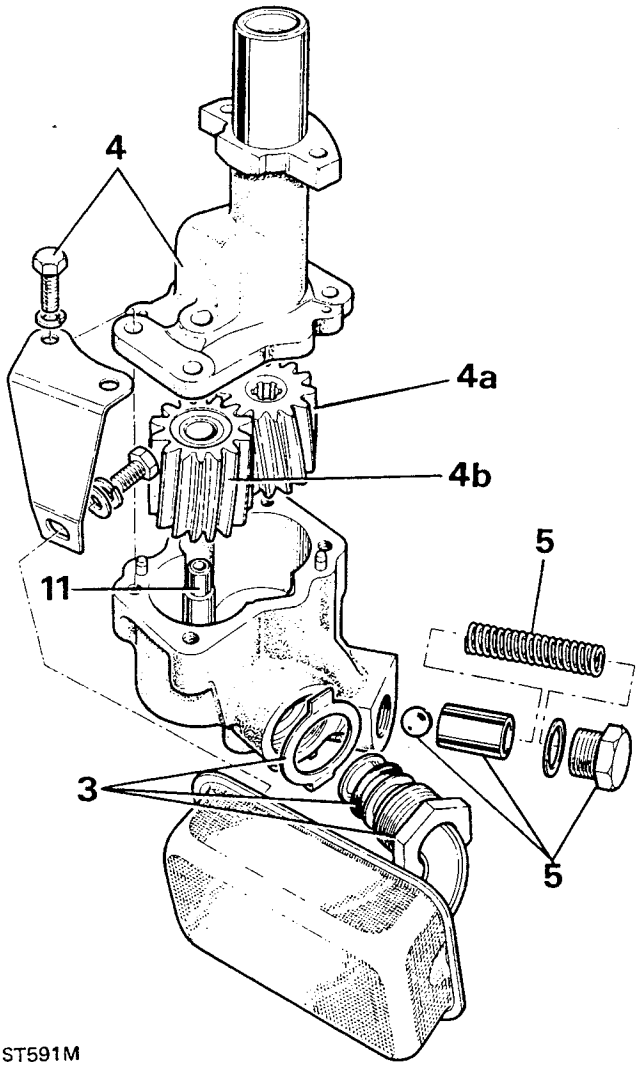
1. Remove the sump.
2. Bend back the lock washers and remove the two bolts securing the oil pump to the crankcase. Withdraw the oil pump complete with strainer and oil pump drive shaft.

continued



Dismantle oil pump

3. Bend back the lock washer and release the nut securing the strainer to the oil pump body and remove the strainer and sealing ring.
4. Remove four bolts and washers and lift off the oil pump cover and lift out the driven and idler gears.
   (a) driven gear
   (b) idler gear
5. Remove the oil pressure relief valve plug and sealing washer. Withdraw the relief valve spring, plunger and ball.

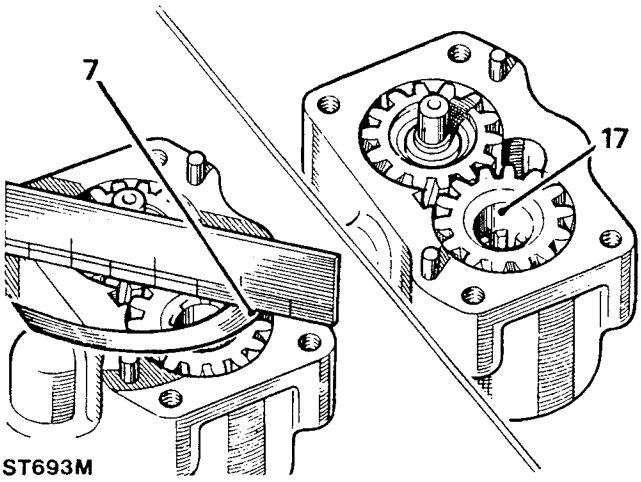


ST591M

Overhaul the oil pump

6. Examine the gears for wear, scores and pits. If the gears appear serviceable check for end-float as follows:

7. Clean the pump body and assemble the gears. Place a straight edge across the pump body face, as illustrated, and using a feeler gauge, measure the clearance between the body and gears. The correct clearances are as follows:
8. Idler gear 0,07 to 0,15 mm (0.003 to 0.006 in).
9. Driven gear 0,05 to 0,12 mm (0.002 to 0.005 in).



ST693M

10. Gears must be renewed in pairs. A worn, but serviceable gear, must not be matched with a new one.
11. If necessary renew idler gear spindle by drilling-out the peened over end of the spindle so that the spindle can be withdrawn from the pump body. To ensure squareness when fitting the new spindle, assemble it into the pump body with the two gears. Fit the cover and secure with the four bolts. Support the pump body and peen over the end of the new spindle. Remove the cover and gears and check security of the spindle.
12. If worn, remove the idler gear bush and press in a replacement. Drill the lubrication hole 3,17 mm (0.125 in) and ream the bush to 12,7 mm (0.500 in) diameter.

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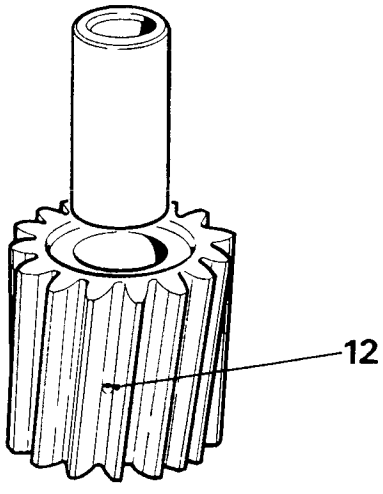
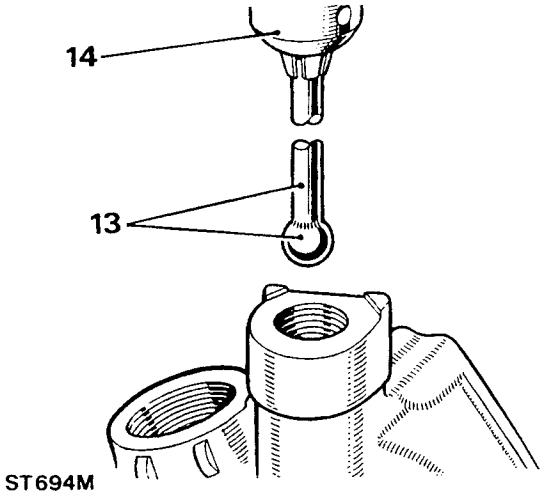


ST 911M

13. A scored ball valve seat can be restored by using a locally made lapping tool by silver soldering a new ball (part number 3748) onto a length of suitable tube.
14. Install the tube in a drill and lap-in using coarse grinding paste. Finally hand-lap the seat with fine paste using the same diabalo method as for lapping valves.
15. Thorougly wash the pump body to remove all traces of grinding paste.



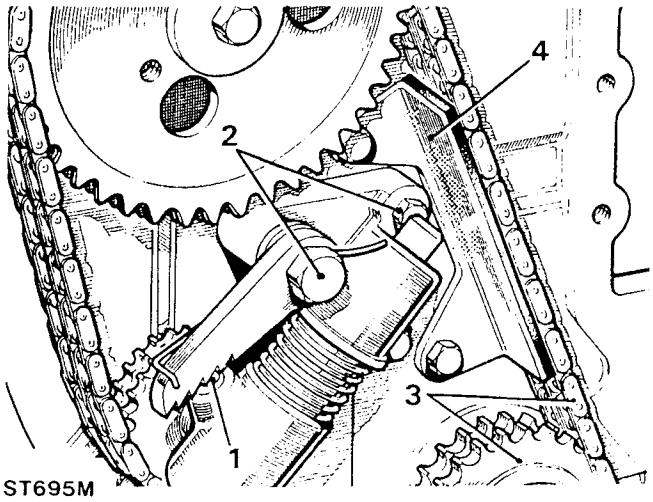
ST694M

Assemble the oil pump

16. Fit the idler gear to the spindle.
17. Fit the driven gear with plain part of the bore uppermost. See illustration after instruction 9.
18. Smear the joint face of the body with jointing compound and fit the cover over the dowels and secure with the four bolts and spring washers.
19. Hold relief valve bore vertically and insert the ball followed by the plunger with the ball seat end first. Fit the spring, sealing washer and plug.
20. Fit the oil strainer sealing ring to the pump body followed by the lock washer and strainer. Tighten the strainer retaining nut so that when fitted the strainer is positioned parallel to the sump baffle plate. Secure the nut with the lock washer tab. Later engines are fitted with a bracket to locate the strainer.

REMOVE AND OVERHAUL THE TIMING CHAIN, SPROCKETS AND TENSIONER

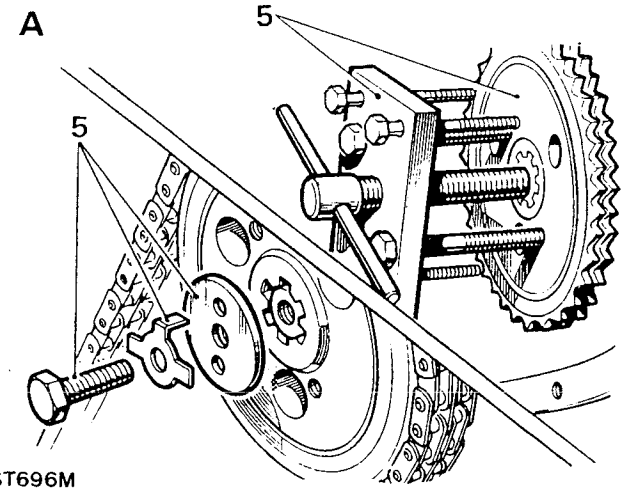
1. Remove the timing cover. Before removing the timing chain tensioner note the ratchet position in relation to the pawl which will give an indication of chain wear. If the last tooth of the ratchet is engaged with the pawl the chain is excessively worn and should be discarded.
2. Remove the ratchet pivot bolt, plain bolt and nut and withdraw the timing chain tensioner complete.
3. Remove the timing chain and crankshaft sprocket.
4. Remove timing chain damper.



ST695M

5. Remove the camshaft sprocket retaining bolt and washer. Withdraw the sprocket using chain wheel extractor 507231 or similar.

Illustration A shows the early retaining bolt and tab washer.
Illustration B shows the latest bolt and special washer.



ST696M

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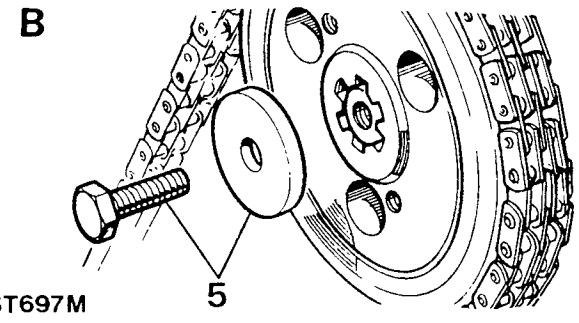
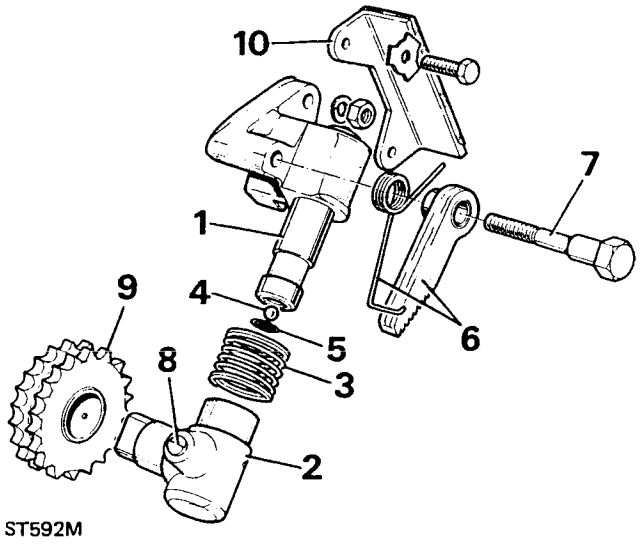


ST697M

6. Examine the sprockets and discard if the teeth are worn.
7. Dismantle the tensioner assembly and discard any worn parts. In particular check the condition of the ratchet and pawl. Check the tension of the spring by comparing it with a new one. Examine the jockey wheel teeth for wear, and renew bush if worn.

Key to tensioner assembly
1. Piston assembly
2. Cylinder assembly
3. Cylinder spring
4. Ball
5. Ball retaining clip
6. Ratchet and spring
7. Ratchet pivot bolt
8. Pawl
9. Jockey wheel
10. Timing chain damper

8. Assemble the tensioner as illustrated and compress the assembly ready for fitting to the engine.



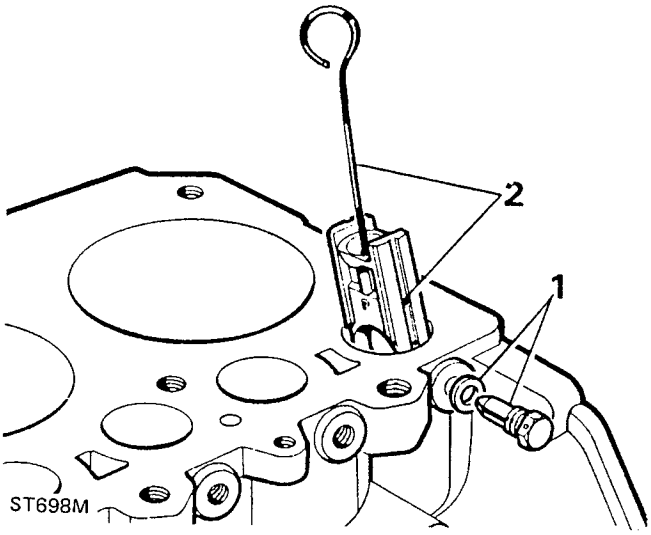
ST592M

REMOVE TAPPETS, ROLLERS AND GUIDES

1. Remove the eight tappet guide locating bolts from the right-hand side of the cylinder block.

CAUTION: Do not remove the tappet guides before the rollers otherwise the rollers may fall behind the camshaft.

2. Using long nosed pliers or a suitable bent length of wire lift out the tappet slides and identify them with their respective guides for possible refitting.

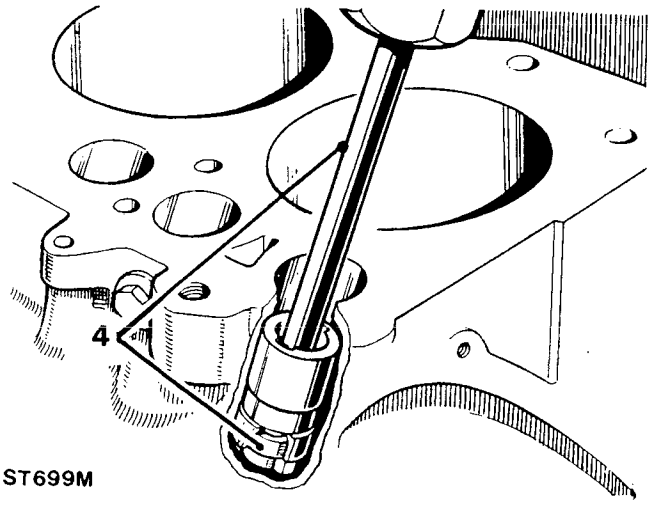


ST698M

3. Lift out the tappet rollers and mark the side facing the front of the engine for possible reassembly.

4. Lift out the tappet guides and retain with their respective slides and rollers. If the guides are difficult to remove use special tool 530101A.

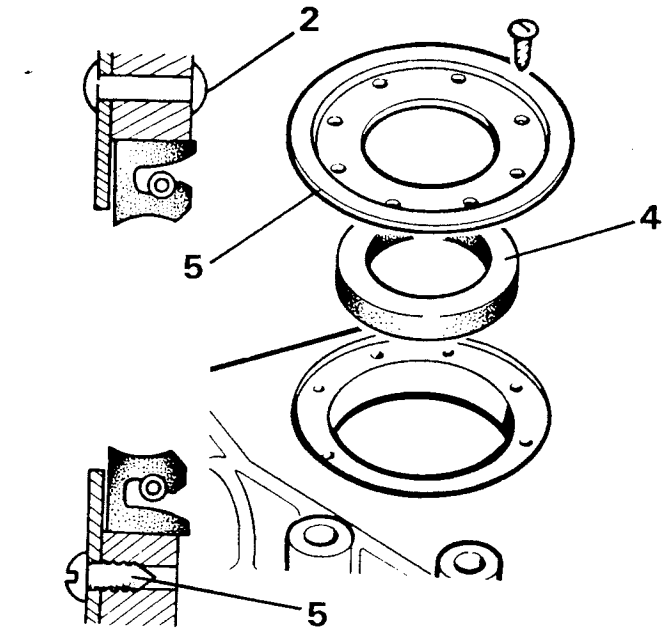
5. Carefully examine all parts and discard any that are worn or damaged.



ST699M

RENEW TIMING COVER OIL SEAL

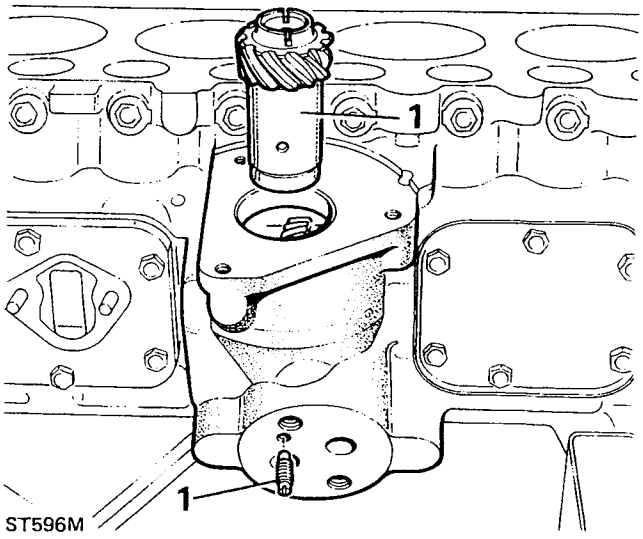
1. On initial assembly of the engine the mud shield around the oil seal is rivetted in position but after removal in service the rivets are substituted with self tapping drive screws.
2. Drill out the rivets securing the oil seal mud shield.
3. Press out the oil seal and clean the mating surfaces.
4. Smear the outside diameter of a new oil seal with Hylomar PL 32-M jointing compound. Press the oil seal into the timing cover, lip side facing crankshaft.
5. Coat the drive screws with Hylomar and secure the mud shield.



ST700M

REMOVE THE CAMSHAFT

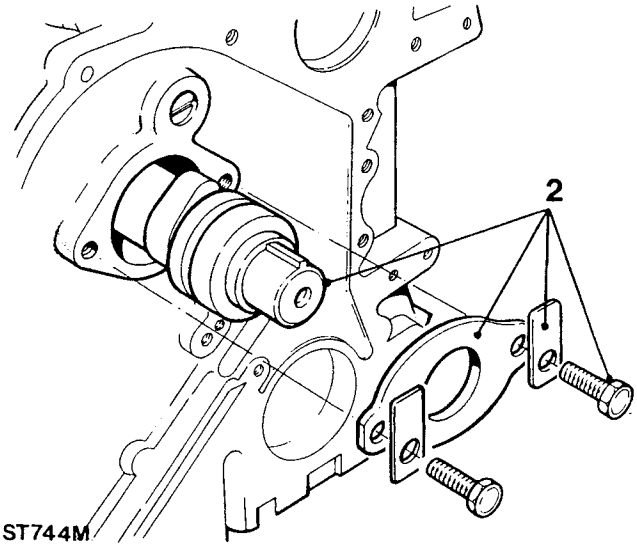
1. Remove the skew gear bush retaining screw and lift out the skew gear bush assembly. Also withdraw the distributor pump (diesel) or ignition distributor (petrol engine) drive coupling with the skew gear assembly.



ST596M

2. Since the camshaft sprocket has already been removed, bend back the lock tabs, remove the two bolts and the camshaft thrust plate. Carefully withdraw the camshaft.

NOTE: Lock tab washers are not used on later engines



ST744M

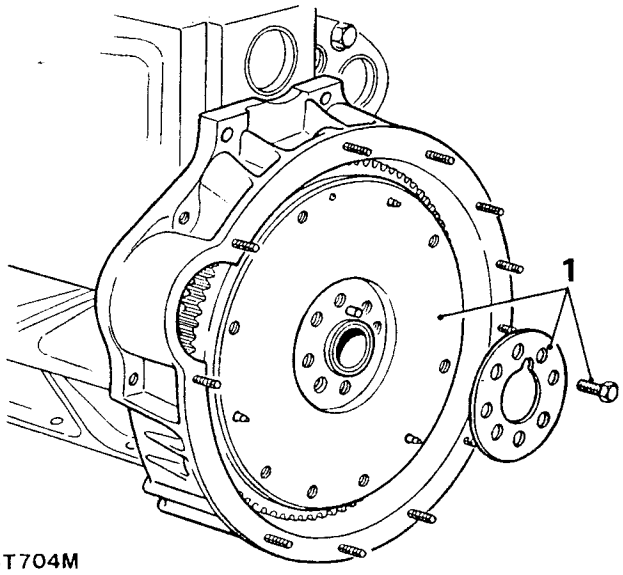
Inspect the camshaft

3. Discard the camshaft if any of the following visual defects are evident.
4. Scored, worn, pitted or chipped cams. Worn, corroded and discoloured journals. Worn and chipped gear teeth.

5. Check the journals for wear and if more than 0,050 mm (0.002 in) the shaft should be renewed.
6. Rest the camshaft between 'V' blocks and check for run-out with a dial indicator. If run-out is in excess of 0,050 mm (0.002 in) the shaft should be straightened or renewed.

REMOVE AND OVERHAUL THE FLYWHEEL

1. Remove the flywheel retaining bolts and withdraw the flywheel and reinforcing plate.



ST704M

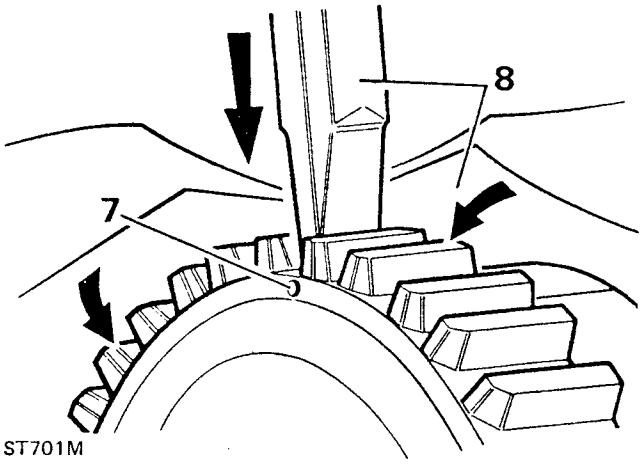
2. Wear or scores on the flywheel clutch face can be corrected by machining provided that the overall width of the flywheel is not reduced below the following dimensions:
   Petrol engines 34,72 mm (1.375 in).
   Diesel engines 36,96 mm (1.453 in).
3. Check that the flywheel has not been previously machined.
4. Examine the ring gear teeth and if chipped or worn the gear can be renewed.

Reface the flywheel

5. Remove the clutch location dowels.
6. Machine the flywheel over the complete clutch face removing only the minimum material necessary to achieve a smooth flat surface parallel with the crankshaft mating face and within the above width dimensions and fit new dowels.

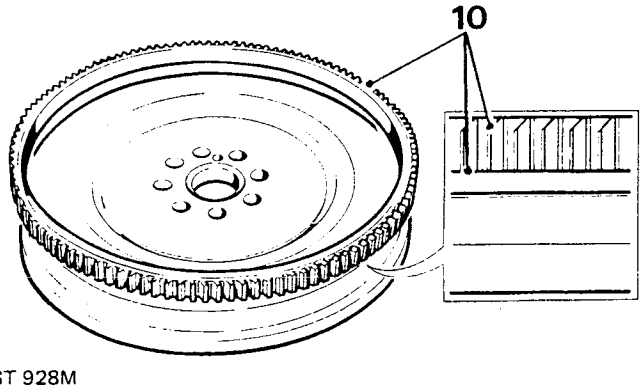
Renew the ring gear

7. Drill a 8,0 mm ($\frac{5}{16}$ in) hole between the root of any two teeth and the inner diameter of the starter ring deep enough to weaken the ring. Do not allow the drill to enter the flywheel.
8. Secure the flywheel in a soft jawed vice and cover it with a cloth to protect one from personal injury. Place a cold chisel above the drilled hole and strike it sharply to split the ring gear.



ST701M

9. Heat the new ring gear uniformally to between 225°C and 250°C but do not exceed the higher figure.
10. Place the flywheel, clutch face down, on a flat surface and locate the heated flywheel with the square edge of teeth downward towards the flywheel clutch face and chamfered edge of the teeth uppermost. This applies to both petrol and Diesel engines.
11. Press the starter ring firmly against the flange until the ring contracts sufficiently to grip the flywheel. Allow the ring gear to cool naturally. Do not hasten cooling in anyway.

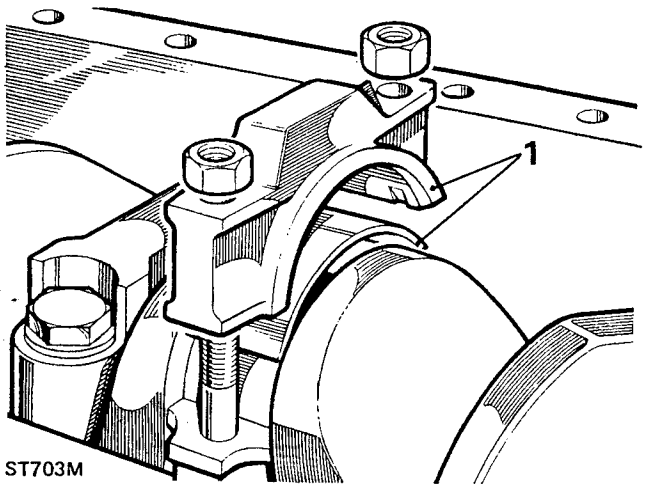


ST 928M

REMOVE THE CONNECTING-RODS AND PISTONS

During the following instructions it is important that all components are kept in related sets and the pistons are identified with their respective bores.

1. Turn the crankshaft to bring the connecting-rod caps to an accessible position and remove each cap and lower shell in turn. Note that the connecting-rod caps are numbered one to four.

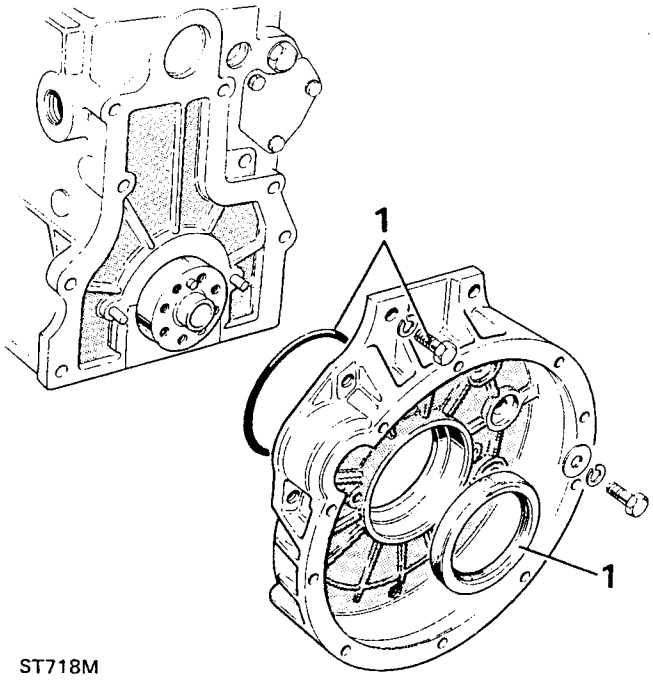


ST703M

2. Push each piston assembly up the bore and withdraw from the cylinder block. Assemble the caps and shells to the connecting-rods and place to one side for inspection with the cylinder block at a later stage.

REMOVE, INSPECT AND OVERHAUL CRANKSHAFT

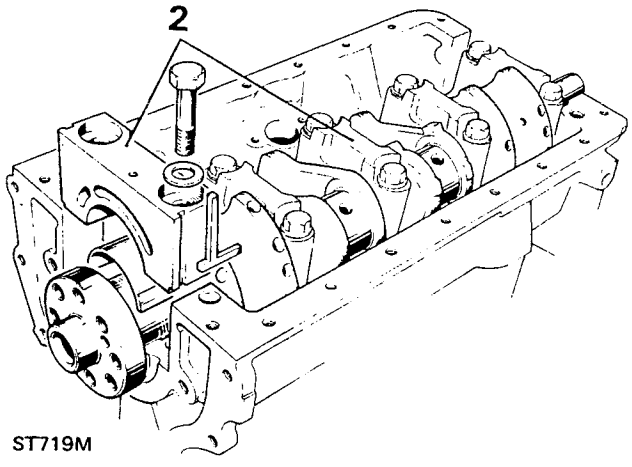
1. Remove the eight bolts securing the flywheel housing to the cylinder block and remove the housing and rear main bearing oil seal, and 'O' ring.



ST718M

2. Remove the main bearing caps and shells and lift out the crankshaft. Collect the bearing shells from the bearing saddles and the thrust washers from the centre saddle.

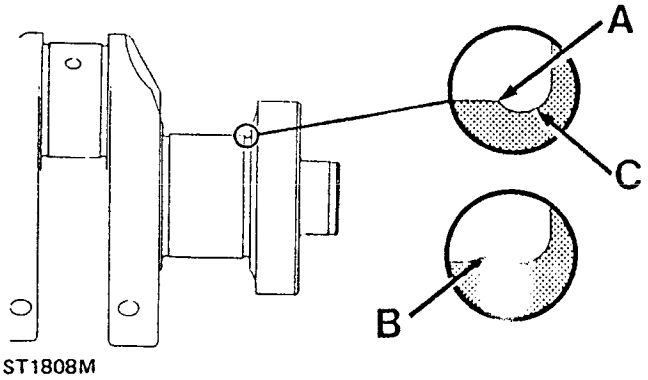
continued



ST719M

Inspect crankshaft

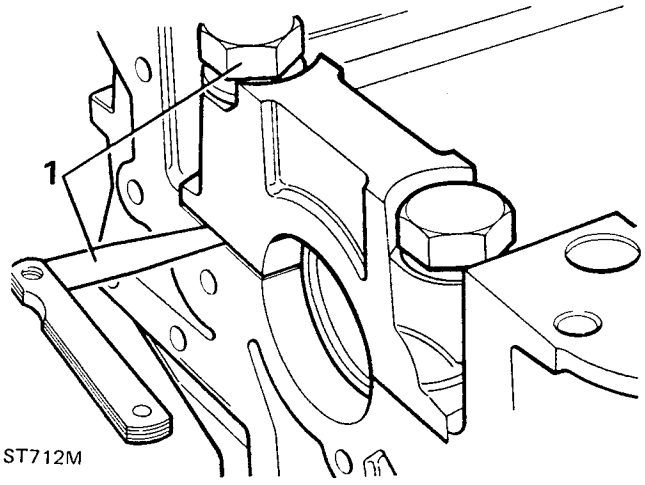
3. Degrease the crankshaft and clear out the oil ways, which can become clogged after long service.
4. Examine visually, the crankpins and main bearing journals, for obvious wear, scores, grooves and overheating. A decision at this stage should be made as to whether the condition of the shaft is worth continuing with more detailed examination.
5. With a micrometer, measure and note the ovality and taper of each main bearing journal and crankpin as follows:
6. **Ovality** — Take two readings at right-angles to each other at various intervals.
   The maximum ovality must not exceed 0,040 mm (0.0015 in).
7. **Taper** — Take two readings parallel to each other at both ends of the main bearing journal and crankpin. The maximum permissable taper must not exceed 0,025 mm (0.001 in).
8. To check for straightness, support the front and rear main bearing journals in 'V' blocks and position a dial indicator to check the run-out at the centre main bearing journal. Run-out must not exceed 0,076 mm (0.003 in) taking into account any ovality in the centre journal.
   The overall allowable wear limit should not exceed 0,114 mm (0.0045 in) for main bearing journals and 0,088 mm (0.0035 in) for crankpins.
   A crankshaft worn beyond the limits of maximum taper, ovality and overall wear can be ground undersize for which bearing shells are available see data, book 1.
   When grinding the crankshaft main bearing and crankpin journals, rotation of the grinding wheel and crankshaft must be in the same direction, anti-clockwise, viewed from the flywheel end of the crankshaft. Final finishing of the journals should be achieved by using a static tapping stone with the crankshaft rotating in a clockwise direction viewed from the flywheel end of the crankshaft. It is important to ensure that, when grinding, the stone travels beyond the edge of the journal 'A' to avoid formation of a step 'B' as illustrated. Also care must be taken not to machine or damage the fillet radii.C.



ST1808M

EXAMINE AND OVERHAUL THE CYLINDER BLOCK

1. Degrease the cylinder block and carry out a thorough visual examination checking for cracks and damage. To check the main bearing caps and saddles for distortion. Fit the main bearing cap without bearing shells and tighten to the correct torque. Slacken and remove the bolt on one side of each bearing cap and check with a feeler gauge that no clearance exists at the joint face between the cap and saddle.



ST712M

Inspect cylinder bores

2. Measure the cylinder bores for ovality, taper and general wear, using any suitable equipment. However, an inside micrometer is best for checking ovality and a cylinder gauge for taper.
3. Check the ovality of each bore by taking measurement at the top of the cylinder just below the ridge at two points diametrically opposite. The difference between the two figures is the ovality of the top of the bore. Similar measurements should be made approximately 50 mm (2.0 in) up from the bottom of the bore so that the overall ovality may be determined.
4. The taper of each cylinder is determined by taking measurements at the top and bottom of each bore at right angles to the gudgeon pin line. The difference between the two measurements is the taper.
5. To establish maximum overall bore wear, take measurements at as many points possible down the bores at right angles to the gudgeon pin line. The largest recorded figure is the maximum wear and should be compared with the original diameter of the cylinder bore.

   Maximum permissible ovality 0,127 mm (0.005 in).
   Maximum permissible taper 0,254 mm (0.010 in).
   Maximum permissible overall wear 0,177 mm (0.007 in).

continued

If the above figures are exceeded the cylinders must be rebored or sleeved depending upon the general condition of the bores and amount of wear. Alternatively, if the overall wear, taper and ovality are well within the acceptable limits and the original pistons are serviceable new piston rings may be fitted. It is important however, that the bores are deglazed, with a hone, to give a cross-hatched finish to provide a seating for the new rings. It is vital to thoroughly wash the bores afterwards to remove all traces of abrasive material.

Inspect camshaft bearings

9. Measure the internal diameter of each camshaft bearing at several points using an internal micrometer. A comparison of the bearing diameters with those of the respective camshaft journals will give the amount of clearance. The bearings should be renewed if the clearance exceeds 0,0508 mm (0.002 in). Or, in any event, if they are scored or pitted.

Fit cylinder sleeves

Cylinder bores that cannot be rebored can be restored by fitting sleeves to enable standard size pistons to be fitted. Sleeving one cylinder only will distort the adjacent bore so sleeving must be carried out in pairs, i.e. cylinders 1 and 2 or 3 and 4.

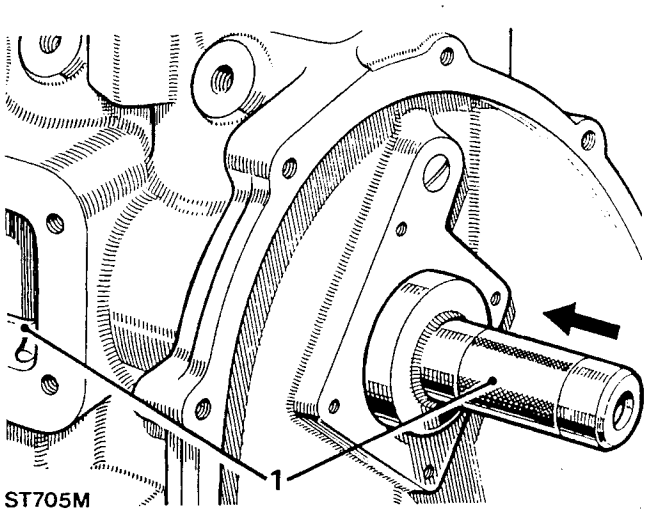
6. Machine the cylinder bores to accept the sleeves to 94,425 + 0,012 mm (3.7175 + 0.0005 in). This will give the sleeve a 0,076 to 0,114 mm (0.003 to 0.0045 in) interference fit.
7. Press the sleeves squarely into the bore using a pressure of two to three tons. Excessive pressure could damage the sleeve and cylinder block. The sleeves must not be proud of the cylinder block top face or more than 2,5 mm (0.10 in) below the surface.
8. Bore and hone the sleeves to accommodate the pistons with the required clearances, see piston and connecting-rod examination.

RENEW CAMSHAFT BEARINGS

The following special tools for this operation are no longer available from the suppliers. However, the operation is nevertheless described for workshops that have these tools in stock. If tools are not obtainable the work should be entrusted to line-boring specialists.

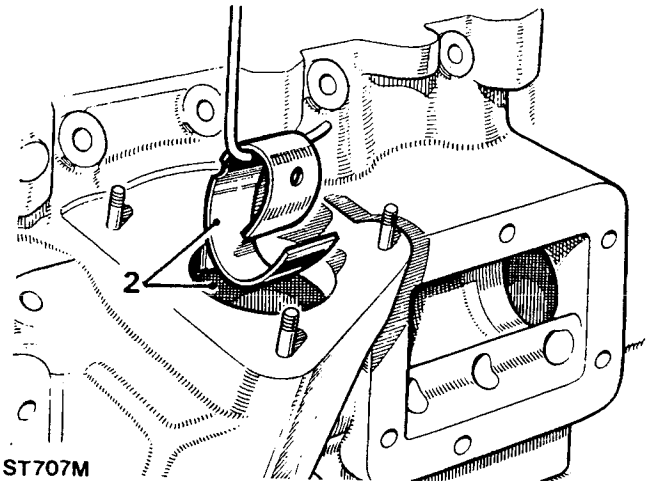
605975 Bearing drift and adaptor assembly comprising:
274388 Bearing drift and
531760 Adaptor.
274389 Reamer for bearings which includes:
274394 Guide plug.

1. Remove the rear bucket type plug and using special tool 274388 drift out the front and rear bearings and withdraw them through the side cover apertures.



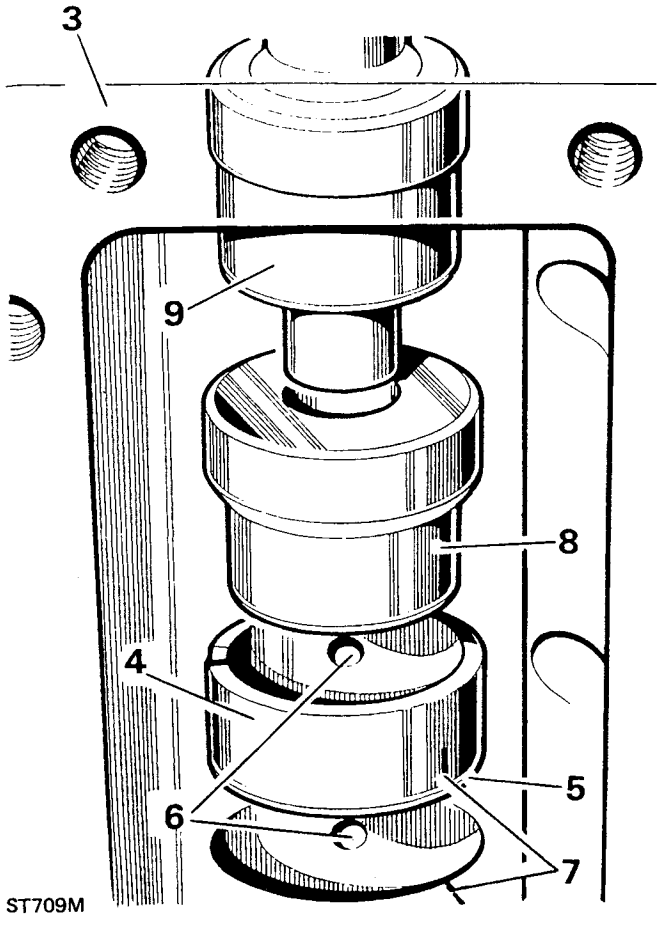
2. With the same tool, drift the two centre bearings into the distributor drive chamber and collapse them to assist withdrawal.

continued



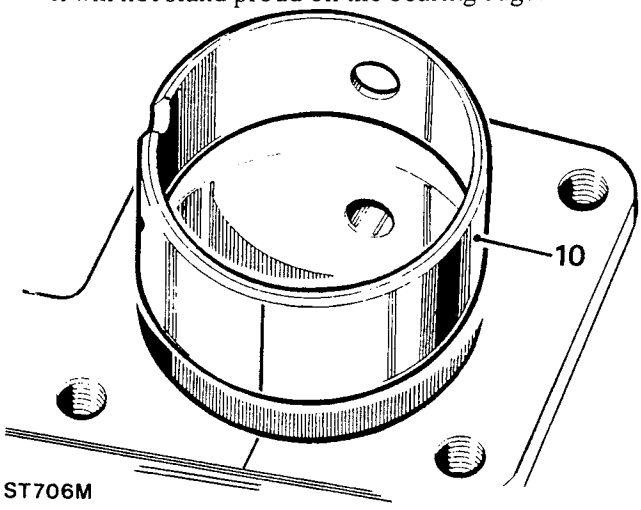
NOTE: The two centre and rear bearings are of the same width, whereas the front bearing is wider and has an additional oil feed hole. Also ensure that before fitting the bearings the oil passages leading to the bearings are free of sludge and dirt.

3. Position the cylinder block vertically, rear face down.
4. Place a new bearing into the front camshaft chamber and position it so that it is above the second bearing housing, counting from the front of the block.
5. The chamfer on the bearing edge must be towards the housing bore.
6. Align the oil hole in the bearing with the innermost oil feed drilling in the housing bore. Accuracy is essential otherwise misalignment of the oil holes may result and once the bearing is in place it cannot be rotated to correct any error.
7. Add pencil marks to the bearing outer diameter and the cylinder block adjacent to the housing to assist in checking alignment.
8. Having visually aligned the bearing, place inside it the special adaptor 531760.



ST709M

9. Maintain the bearing in a level position. Pass the drift through the front bearing housing into the camshaft chamber so that it rests on top of the adaptor. Commence drifting the bearing into the block. Ensure that the bearing is not drifted in too far, and that the oil feed holes are correctly aligned.
10. Repeat the above instructions for the front bearing. Note that the front bearing is wider and has a small hole in addition to the large oil feed hole. This small hole aligns with a vertical drilling in the block, which in turn feeds a horizontal drilling for the tappet mechanism. Drift this bearing in so that the outer edge is just below the machined surface of the front face. This is to ensure that when the camshaft thrust plate is fitted it will not stand proud on the bearing edge.

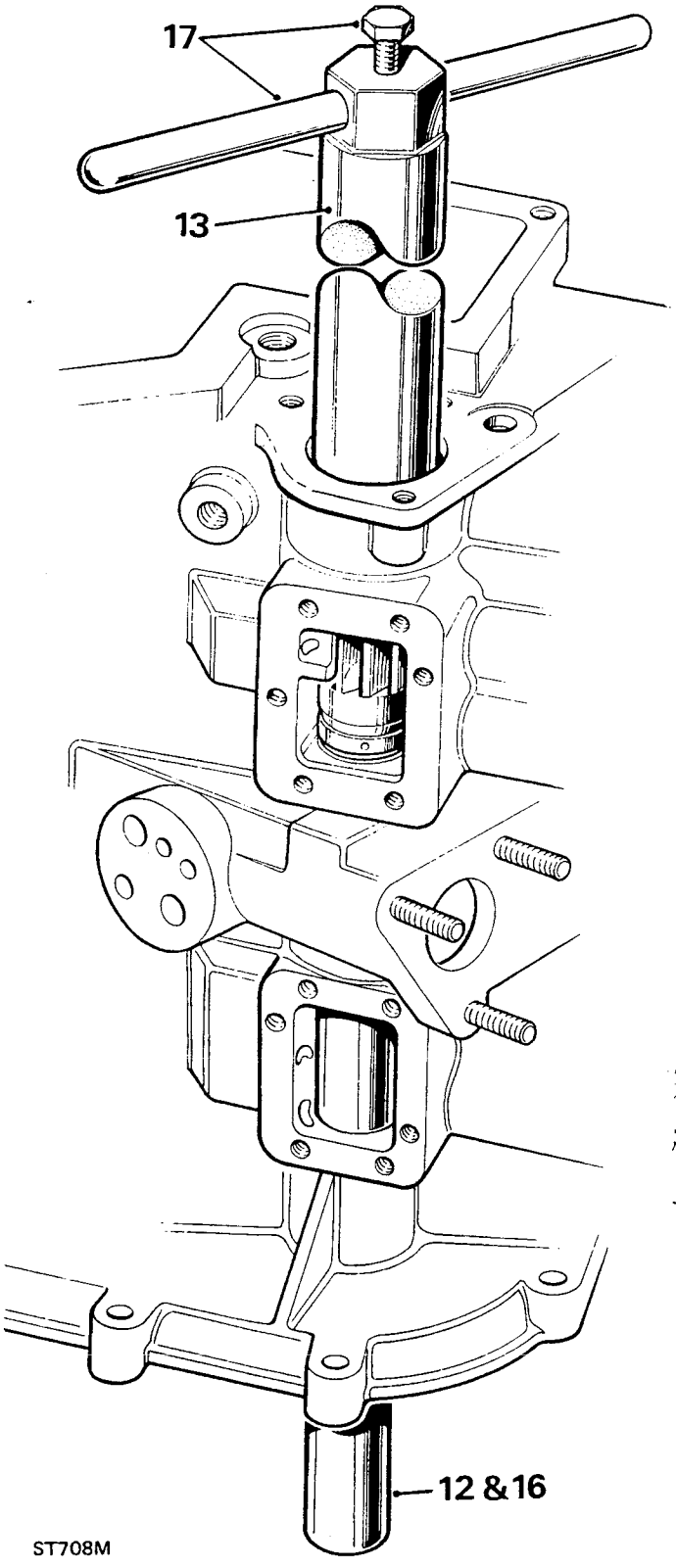


ST706M

11. Turn the cylinder block over so that the rear face is uppermost and repeat the foregoing procedures for the two remaining camshaft bearings.
    The bearings must now be reamed to size as follows: No lubricant is necessary for this operation since the best results are obtained when the bearings are cut dry.
12. Locate the guide plug 274394, into the front camshaft bearing and retain using the thrust plate screws, but do not tighten the screws at this stage.
13. Insert the reamer 274389 from the rear of the cylinder block, locating it through the guide plug at the front.
14. Locate the guide collar immediately in front of the reamer cutter into the rearmost bearing, then secure the screws retaining the guide plug at the front.
15. Position the cylinder block vertically, rear face uppermost and ream the rear and two centre bearings. As each bearing is cut the reamer should be held steady by the operator whilst an assistant, using a high pressure airline, blows away the white metal cuttings, before allowing the reamer to enter the next bearing.
16. Remove the guide plug 274394 and ream the front bearing.
17. Remove the reamer handle and bolt and withdraw the reamer, turning it in the same direction as for cutting.
18. Remove the plugs from the ends of oil gallery passage and clean the gallery and oil feed passages to camshaft and crankshaft bearings, using compressed air. Refit the plugs and lock in position.

continued

19. The hexagon-headed plugs at the rear of the block should have new washers fitted, and their threads coated with a suitable jointing compound.
20. Thoroughly clean the cylinder block preferably using an airline to remove all traces of metal cuttings.



ST708M

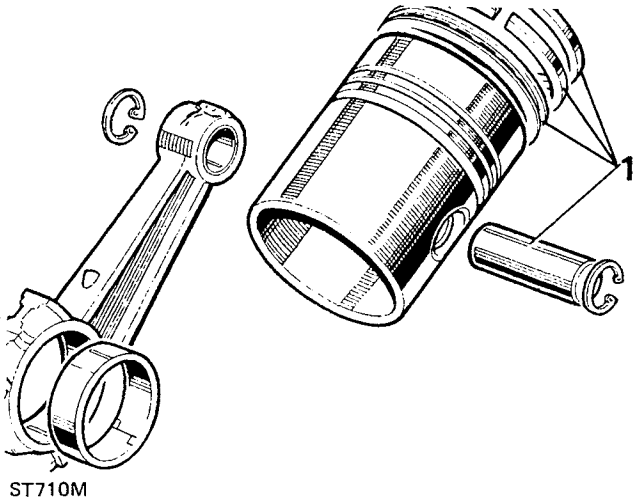
Check crankcase main bearings

21. Discard scored, pitted, cracked and worn bearing shells.
22. To determine the maximum wear, assemble the main bearing shells and caps to the crankcase and tighten the bolts to the correct torque figure.
23. Using an inside micrometer, measure each bearing at several points and note the greatest figure. The maximum wear is the difference between this figure and the smallest diameter of the corresponding crankshaft journal. The main bearing running clearance is in the data section.
24. The bearing clearances may also be determined by using 'Plastigauge'. Since this method requires the crankshaft to be fitted to the crankcase, the procedure is described under engine assembly.

PISTON AND CONNECTING-ROD INSPECTION

The following checks relating to pistons and rings must also be carried out prior to fitting new pistons to rebored and sleeved cylinder blocks.
Until it is decided if new components are required all parts must be kept in their related sets and the position of each piston to its connecting-rod should be noted.

1. Remove the piston rings and gudgeon pin from each piston and detach the connecting-rod.



ST710M

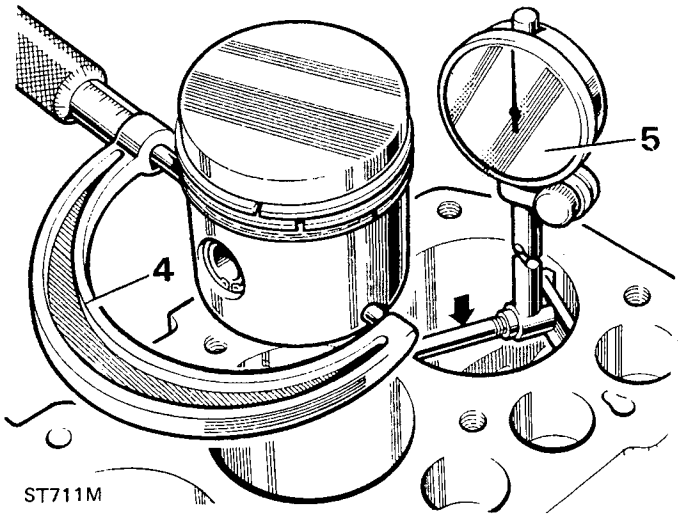
2. **Original pistons** — Decarbonise and degrease all components and carry out a visual examination of the pistons and rings and discard any which are unserviceable. Pistons which appear serviceable should be subjected to a more detailed examination described under 'New Pistons'.

continued

3. **New Pistons** — Original pistons fitted to new engines at the factory are specially graded to facilitate assembly. The grade letter on the piston crown should be ignored when ordering new pistons. Genuine Land Rover service standard size pistons are supplied 0,025 mm (0.001 in) oversize to allow for production tolerances on new engines. When fitting new pistons to a standard size cylinder block the bores must be honed to accommodate the pistons with the correct clearances. In addition Land Rover pistons are available 0,50 and 1,01 mm (0.020 and 0.040 in) oversize for fitting to rebored cylinder blocks.
   Clearance limits for new standard size pistons in a standard cylinder bore measured at right angles to the gudgeon pin are in the "General specification data" section.
   When taking the following measurements the cylinder block and pistons must be at the same temperature to ensure accuracy.

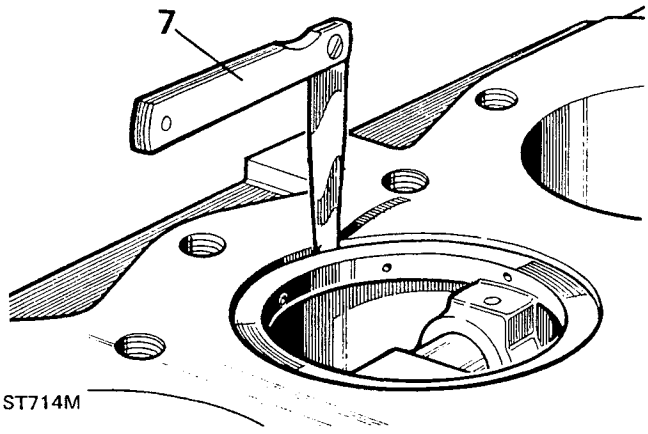
   NOTE: The illustration shows a petrol engine piston but the method is the same for the Diesel engine.

4. Using a suitable micrometer measure the pistons at the bottom of the skirt at right angles to the gudgeon pin.
5. With an inside micrometer or cylinder gauge measure the diameter of the bore at approximately half-way down and note the reading.
6. The clearance is determined by subtracting the piston diameter from the bore diameter.



NOTE: Early 2.25 Diesel pistons have a piston ring groove below the gudgeon pin. This has been deleted on later engines.

7. If gauge equipment is not available the clearance can be assessed by placing a long, suitably sized, feeler gauge down the thrust side of the bore and inserting the appropriate piston, 'upside down', in the bore and position it with the gudgeon pin parallel to the crankshaft axis. Push the piston down the bore and stop at the tightest point and whilst holding the piston still, slowly withdraw the feeler gauge. If a steady resistance of approximately 2,5 kg (6 lbs) is felt, the clearance is satisfactory.

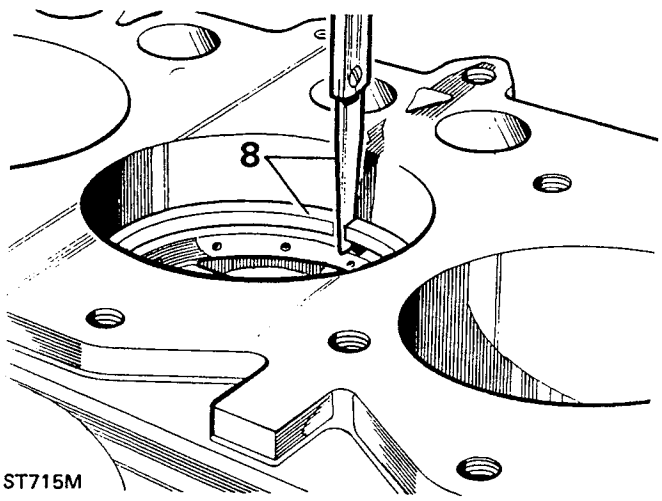


Inspect piston rings

Normally when an engine is being overhauled the piston rings are discarded unless the pistons have been removed for a different purpose and the engine has only completed a small mileage. Before refitting the piston the rings should be examined for wear and damage. In addition the rings must be checked for side clearance in the pistons and gap in the bores. The latter two checks must be made when fitting new rings to new and used pistons.

8. **Check gap** When checking the ring gap in worn bores, but are nevertheless within the acceptable taper and ovality limits, the ring must be inserted squarely into the bottom of the bore at the lowest point of the piston travel. To ensure squareness of the ring push the ring down the bore to the correct position with a piston. With newly machined bores, the ring may be inserted squarely into any position in the bore.
9. Using an appropriate feeler gauge check the gaps of all the rings, in turn, including the oil control ring assembly.
   The correct gaps are listed in the Data Section. If any gap is less than that specified, remove the ring, and file the ends square, whilst holding the ring in a filing jig or vice. Should any gap be excessively wide and not likely to close-up to within the specified limits when hot, an oversize ring should be fitted.

continued



ST715M

Check piston ring side clearance

Petrol engine pistons have two compression rings and one oil control ring assembly. The diesel engine has three compression rings and one oil control ring assembly. The method of checking clearances are the same for both engines but the clearances are different. It is important that clearances are correct. Rings that are too tight will bind when hot, imparing the radial pressure causing possible loss of compression. Excessive clearance will allow the rings to rock in the grooves and the resulting pumping action could cause excessive oil consumption and eventually broken rings.

10. **Diesel engine pistons** — Fit the oil control ring to the bottom groove (not groove in skirt). Fit the two unpolished rings with the word 'TOP' uppermost to the middle two grooves. Insert to polished chrome ring with the internal chamfer to the top groove with the word 'TOP' uppermost.
    A ring groove is provided at the bottom of the diesel engine piston skirt for the fitment of an oil control ring in cases of excessive oil consumption on high mileage engines (early engines only).
11. **Petrol engine pistons** — Fit the oil control ring to the bottom groove. Fit the unpolished compression ring with the word 'TOP' uppermost to the second groove. Insert the polished chrome ring with an internal chamfer and the word 'TOP' uppermost to the top groove.
12. After fitting each ring, roll it around the piston groove to ensure that it is free and does not bind.
13. Using an appropriate feeler gauge check the clearance between the rings and piston grooves. Clearances in excess of 0,106 to 0,152 mm (0.004 to 0.006 in) are unacceptable and the ring and or the pistons should be renewed.

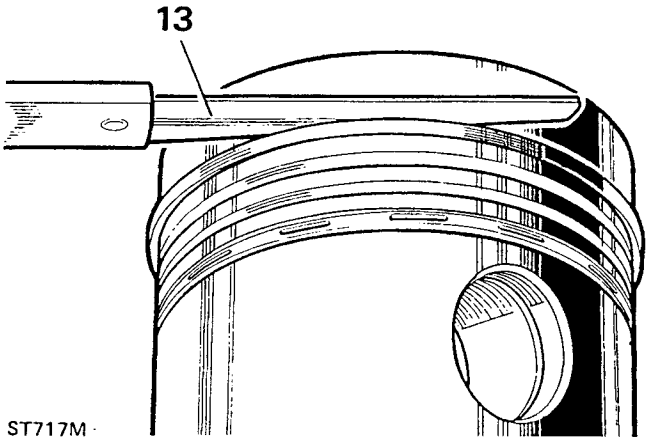
NOTE: Whilst the illustration shows a Diesel piston the method for the petrol is the same.

Side clearance data — petrol engine

Compression rings — 0,046 to 0,097 mm (0.0018 to 0.0038 in).
Oil control ring — 0,038 to 0,089 mm (0.0015 to 0.0035 in).

Side clearance — diesel engine

Compression rings — 0,06 to 0,11 mm (0.0025 to 0.0045 in).
Oil control ring — 0,038 to 0,064 mm (0.0015 to 0.0025 in).



ST717M

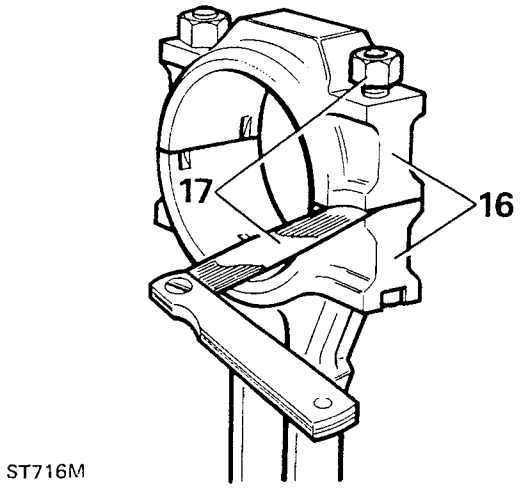
Inspect gudgeon pins

14. Check the gudgeon pin for wear, cracks, scores and overheating.
15. The gudgeon fit in the piston must be a tight push fit at a temperature of 68°F (20°C). Check the gudgeon pin for ovality and taper using a micrometer.

Connecting-rod inspection

16. Check the connecting-rods and caps for distortion as follows; fit the correct cap, less the bearing shells, to each connecting rod as denoted by the number stamped near the joint faces. This number also indicates the crankshaft journal to which it must be fitted.
17. Tighten the nuts to the correct torque and release the nut on one side only. Check, with a feeler gauge, that no clearance exists between the joint faces. If there is a gap the connecting-rod is distorted and should be renewed.

continued



ST716M

18. Use an accurate connecting-rod alignment gauge to check the rods for bend and twist. The maximum allowable for both conditions must not exceed 0,127 mm (0.005 ins).
19. Examine and check the small-end bush for wear. If necessary renew the bush. The correct clearance of the gudgeon pin in the small-end bush is given in "General specification data".
20. When renewing a bush ensure that the oil hole in the bush lines up with the hole in the connecting-rod. Finish the bush to the correct size and clearance.
21. Connecting-rod bearings that are worn, pitted, scored and show signs of overheating must be discarded. If more than one of the bearings show these signs they must all be replaced. When fitting new or used bearings to reground (petrol engines only) or serviceable crankpins the clearances must be checked.

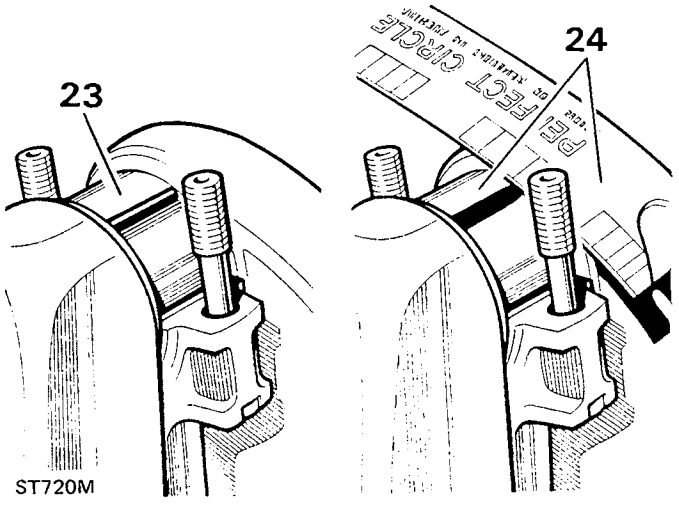
Connecting-rod bearing nip and clearance

New bearing halves are supplied with a protective coating and must be degreased before fitting.

22. Fit the bearing halves to the connecting-rod and cap and secure the assembly with the correct torque. Slacken the nut on one side only and check the clearance between the joint faces with a feeler gauge. The clearance should be between 0,10 and 0,20 mm (0.004 and 0.008 in). The bearing nip can be adjusted by the selective assembly of the bearing shells which are available in slightly varying thicknesses. Do not file or machine the caps or rods to vary the bearing nip. Make a final check to prove the clearance by inserting a 0,063 (0.0025 in) shim paper between the crankpin and one half of the bearing and tightening to the correct torque. The connecting-rod should resist rotation and move freely with the shim paper removed.

As an alternative, the bearing clearances can be determined by using 'Plastigauge' which consists of a thin piece of plastic material a few hundreds of a millimeter or thousands of an inch in diameter. When the material is flattened by being squeezed between the bearing and crankpin the width of the plastic is measured by a scale gauge which indicates the clearance.

23. Wipe any oil from the crankpins and place a piece of 'Plastigauge' across the centre of the bearing in the connecting-rod cap. Assemble the rod to the appropriate crankpin and tighten to the correct torque. Do not rotate the connecting-rod or crankshaft during this operation.
24. Remove the connecting-rod cap and bearing shell and using the scale supplied measure the flattened 'Plastigauge' at its widest point. The graduation that most closely corresponds to the width of the 'Plastigauge' indicates the bearing clearance.
    The correct clearance with new or overhauled components is 0,019 to 0,063 mm (0.0007 to 0.0025 in).
25. Wipe off the 'Plastigauge' with an oily rag. Do not scrape off otherwise it may damage the crankpins.

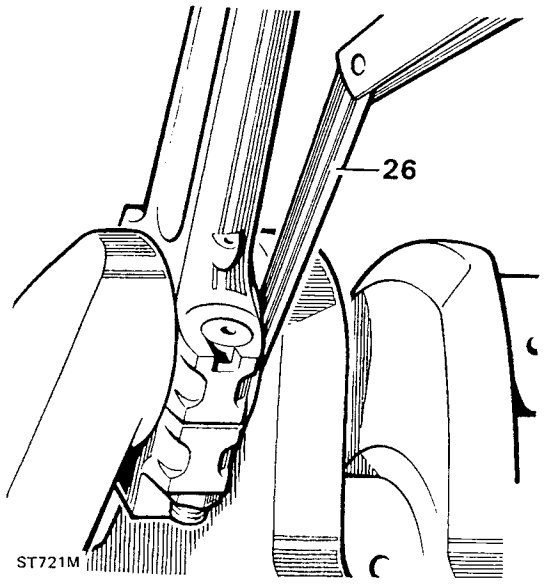


ST720M

Connecting-rod end-float

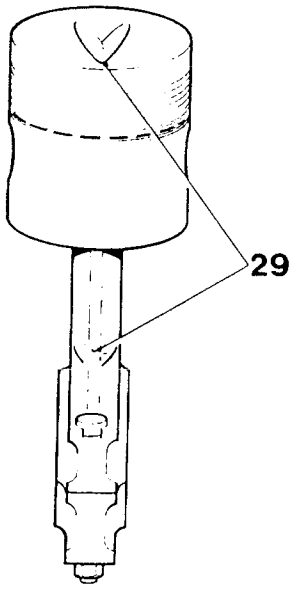
26. Fit the connecting-rods complete with bearings to their respective crankpins. Move the connecting-rod to one side and check the clearance, with a feeler, on the opposite side. The correct clearance is between 0,20 and 0,30 mm (0.007 and 0.012 in).

continued



Assemble pistons to connecting-rods

27. Petrol engine pistons can be fitted either way round, except those that are being refitted to their original bores in which case they must be fitted to the connecting-rod in the same position in accordance with the mark made during removal.
28. Insert a circlip in one side of the gudgeon pin boss and assemble the piston to the connecting-rod with the gudgeon pin. Secure the assembly with a circlip on the opposite side of the piston.
29. Diesel engine pistons must only be fitted one way in relation to the connecting-rod. The piston must be assembled with the point of the 'V', on the piston crown, on the same side as the lubrication hole in the connecting-rod. Assemble the piston to the connecting-rod in the same manner as for the petrol engine.
    Place the piston and connecting-rod assemblies to one side ready for fitting to the cylinder block. It is good practice to renew the connecting-rod bolts and nuts.



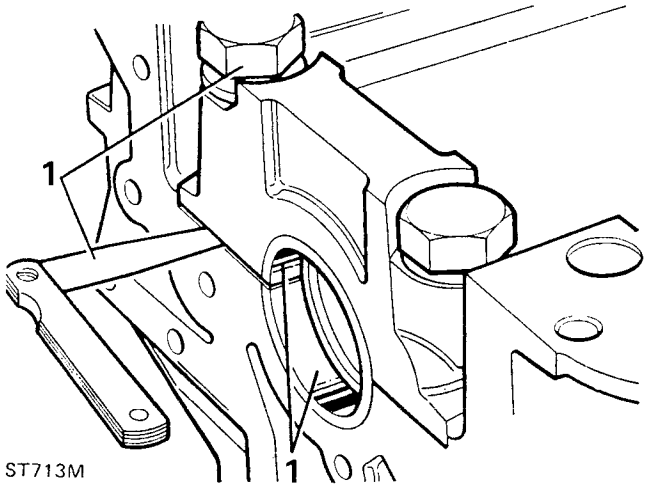
ASSEMBLE ENGINE

FIT CRANKSHAFT

Main bearing nip and clearance

New main bearing halves are supplied with a protective coating and must be degreased before fitting.

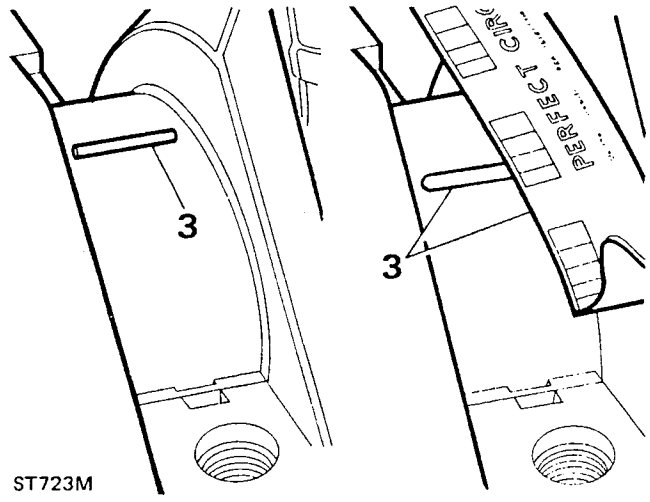
1. Fit the bearing halves in the crankcase saddles and caps and secure the caps to the crankcase and tighten to the correct torque. Slacken the bolts on one side of the caps only and, with a feeler gauge, check the gap between the joint faces. The clearance or nip must be within 0,10 to 0,15 mm (0.004 to 0.006 in). The bearing nip can be adjusted by selective assembly of the bearing halves available in varying thicknesses. Do not file or machine the caps or saddles to achieve the correct clearance. Note that the rear main bearings are wider than the remaining four.
2. To make a final check that the clearance is correct, leave the bearing halves in the crankcase saddles and carefully lower the crankshaft into position. Check each bearing in turn by inserting a 0,063 mm (0.0025 in) shim paper between the bearing cap and crankshaft journal and tighten the bolts to the correct torque. If the clearance is correct, there should be a slight increase in the resistance to rotation of the crankshaft.



As an alternative 'Plastigauge' may be used to check the clearance in the same manner as with the connecting-rod bearings. This material may also be used to determine the amount of wear in used bearings and journals.

continued

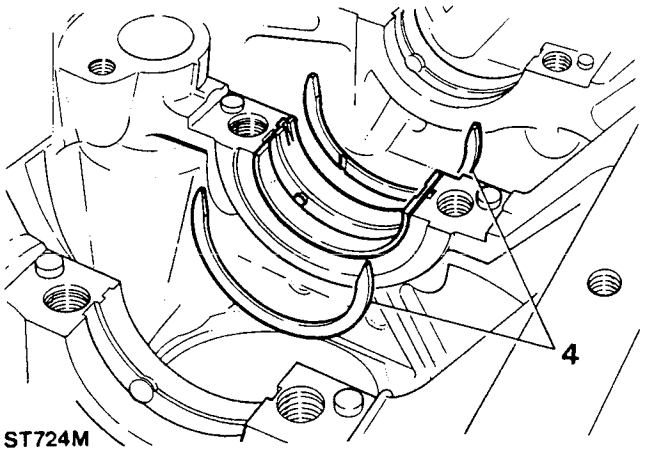
3. Locate the crankshaft in position on the upper bearing halves in the crankcase and wipe any oil from the journals since 'Plastigauge' is soluble in oil. Place a piece of 'Plastigauge' across the lower half of each crankshaft journal or lower bearing cap shell. Fit the cap and tighten to the correct torque. Remove the cap and bearing and using the scale supplied with the 'Plastigauge' measure the flattened 'Plastigauge' at its widest point. The graduation that most closely corresponds with the width of the 'Plastigauge' indicates the bearing clearance.
   The correct clearance with new or overhauled components is included in "General specification data" section. If new bearings are being fitted use selective assembly to obtain the correct clearance. Wipe off, not scrape the 'Plastigauge' with an oily rag from the journals or bearings.



ST723M

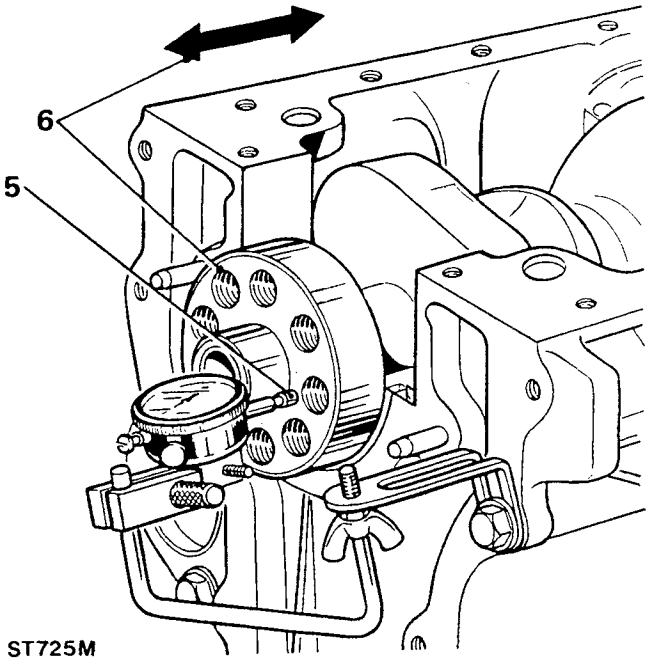
Adjust crankshaft end-float

4. Lift out the crankshaft and insert a standard size thrust washer both sides of the centre main bearing saddle with the grooves towards the crankshaft.



ST724M

5. Place the crankshaft in position in the crankcase and mount a dial test indicator to read-off the end of the crankshaft. A feeler gauge may be used instead of an indicator.
6. Determine the end-float by moving the crankshaft away from the indicator and zero the dial. Move the crankshaft in the opposite direction and note the indicator reading. Alternatively measure the clearance with a feeler gauge. The end-float should be 0,05 to 0,15 mm (0.002 to 0.006 in).
7. If adjustment is required substitute with oversize thrust washers. Variation of thrust washer thickness at each side of crankshaft journal must not exceed 0,08 mm (0.003 in) to ensure that the crankshaft remains centralised.



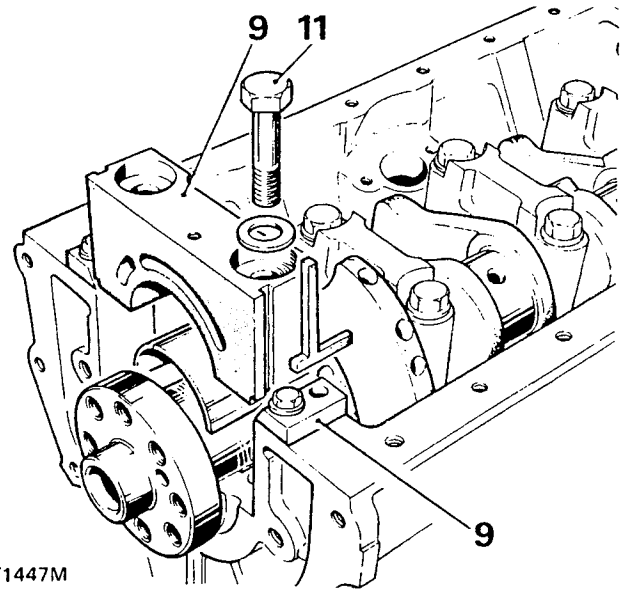
ST725M

8. Lubricate the crankshaft main journals with clean engine oil and fit the appropriate bearing caps and lower shells to the crankcase with the exception of number five main bearing. Ensure that the caps locate properly over the dowels. Using new bolts and washers evenly tighten to the correct torque figure.

continued

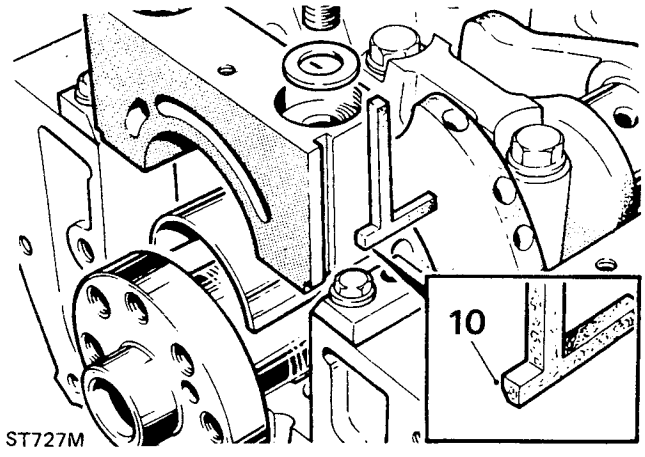
Fit rear main bearing cap

9. Ensure that number five main bearing cap is clean and free from old cork seal material.
Attach the cork seal guides number 270304 to the crankcase, as illustrated, and ensure that they are parallel to the crankcase edge.



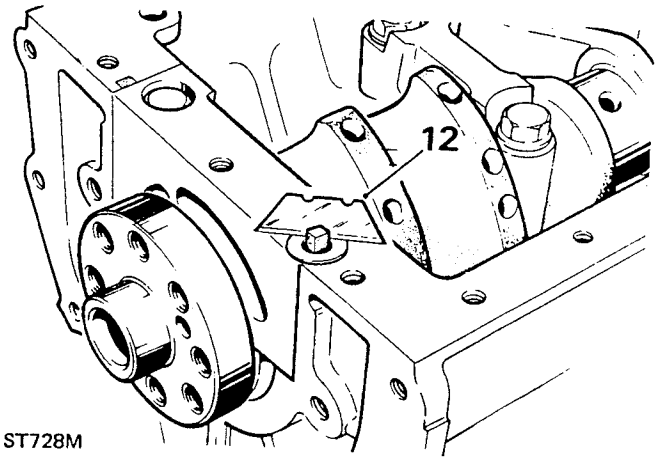
ST1447M

10. To prevent any cork seal material becoming trapped between the bearing cap and crankcase, chamfer the inner edge of the corks 0,40 to 0,80 mm ($\frac{1}{64}$ to $\frac{1}{32}$in) wide as illustrated.
Immerse the cork seals in engine oil and fit them to the bearing cap.



ST727M

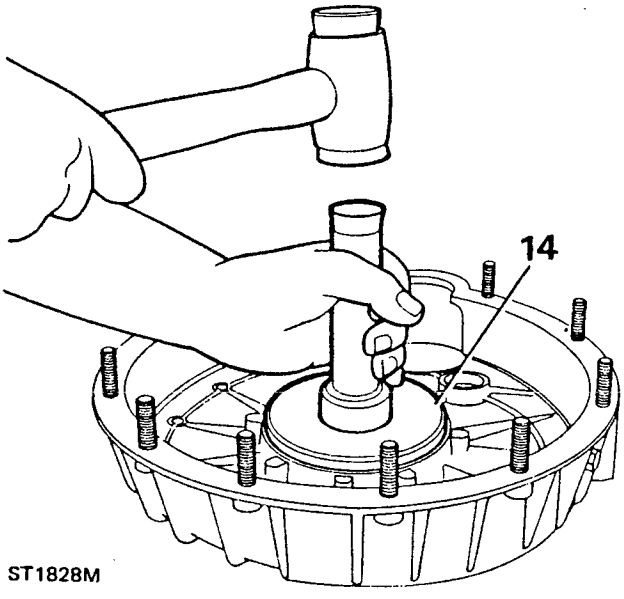
11. Fit the bearing cap and lower shell to the crankcase and secure with new bolts and washers and tighten to the appropriate torque.
12. To allow for shrinkage after fitting leave the cork seals standing proud of the crankcase-sump face. If possible delay the fitting of the sump for approximately twelve hours and leave the seal protruding 2,40 mm ($\frac{3}{32}$ in) and then place a 6,350 mm (¼ in) washer over the seal and cut off the surplus. If it is necessary to fit the sump immediately, trim the seals off leaving 0,80 mm ($\frac{1}{32}$ in) proud, that is, the thickness of the above washer.
Apply Hylomar SQ32M to the protruding end of the seals.



ST728M

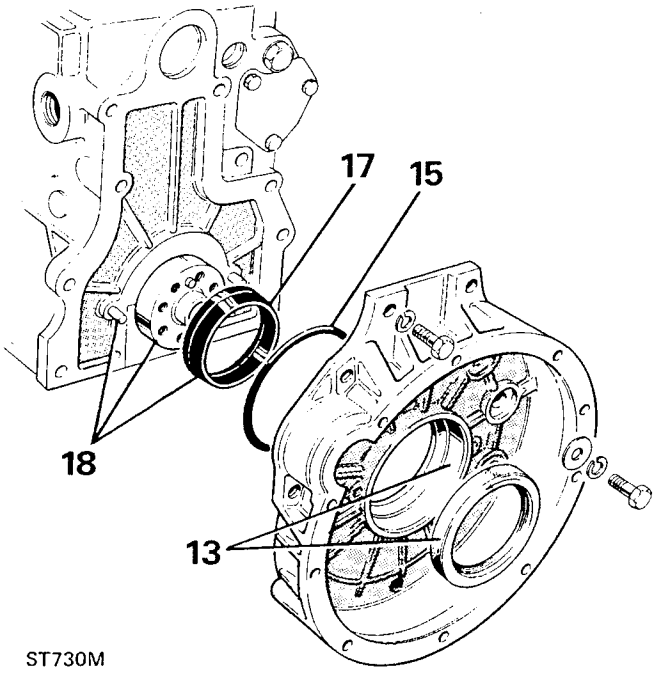
Fit rear main oil seal

13. Check that the crankshaft oil seal journal is undamaged and clean. Make sure the seal housing is clean and dry and free from burrs. Do not touch the seal lip and ensure that the outside diameter is clean and dry. The P.T.F.E. Seal Part No ETC 5369 which should be used, is supplied with a former to maintain the correct shape and must not be removed until the seal is to be fitted.
14. Using special seal replacer 18G 134-11 and with the lip side leading drive-in the seal as far as the tool allows. If the tool is not available fit the seal to the bottom of the housing to ensure squareness.



ST1828M

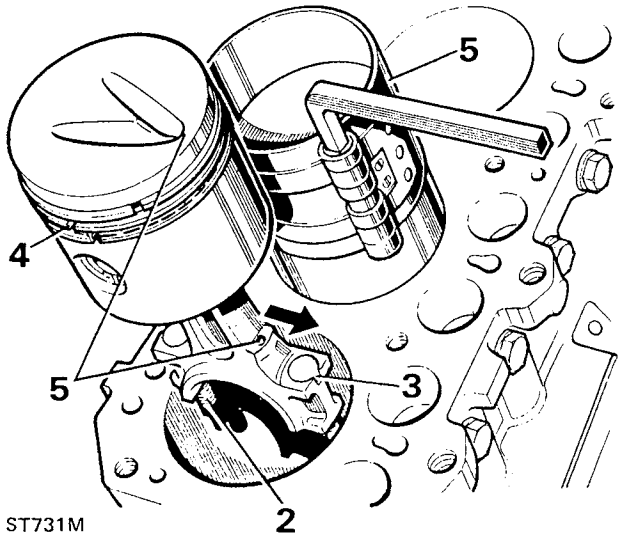
15. Fit the 'O' ring seal to the flywheel housing.
16. Examine the seal guide number 18G 1344 and repair any damage that could destroy the seal lip.
17. Lubricate the outside diameter of the seal guide and the seal journal with concentrated 'Oildag' in a 25% solution with clean engine oil.
18. Place the seal guide on the crankshaft flange and, using the two dowels protruding from the cylinder block rear face as a guide to ensure initial squareness, fit the flywheel housing and remove the seal guide. Secure the flywheel housing evenly tightening the retaining bolts.



ST730M

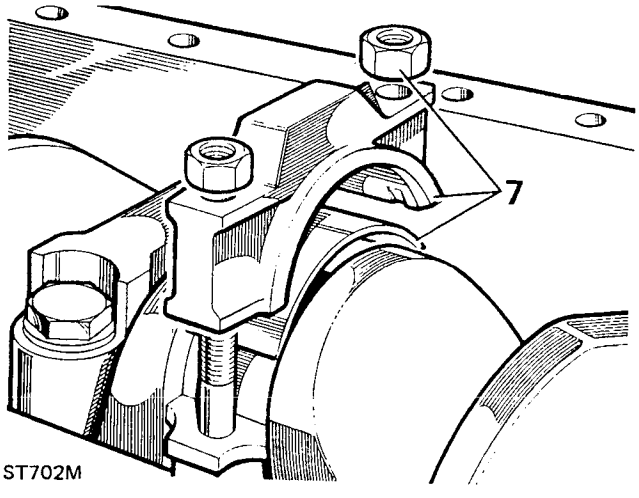
FIT THE CONNECTING-RODS AND PISTONS

1. Turn the crankshaft to position numbers one and four crankpins at bottom dead centre to facilitate fitting the connecting-rods.
2. When fitting the connecting-rods and pistons ensure that the bolts do not foul and damage the crankpins. As a precaution it is recommended that rubber or soft plastic sleeves are placed over the threads.
3. The connecting-rod bolts have eccentric heads which locate in a recess in the connecting-rod. It is essential that the head of each new bolt is properly located before tightening.
4. Stagger the compression rings so that the gaps are equidistantly spaced round the piston but, so arranged, that no gap is positioned on the thrust side of the piston i.e. opposite the camshaft. Turn the oil control ring so that the gap is in line with the gudgeon pin.
5. Lubricate the cylinder walls, piston rings and crankpins. Compress the piston rings with a suitable compressor tool and carefully lower the connecting-rod into the bore ensuring that the oil spray hole faces the camshaft side of the engine. With diesel engines the point of the arrow headed valve clearance indentation in the piston crown, and the oil spray hole must face the camshaft side of the engine.
6. Using a soft mallet, sharply tap the piston into the bore so that the whole of the piston is just below the surface of the cylinder block.



ST731M

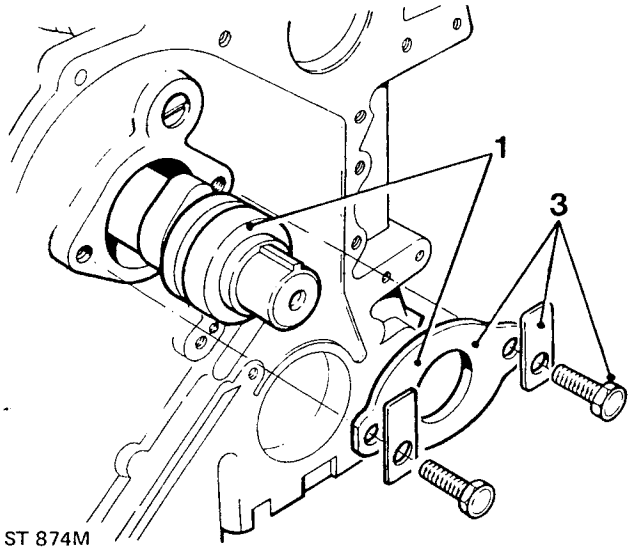
7. Check that the bearing shell is properly located in the connecting-rod and pull the rod onto the crankpin. Locate the bearing shell correctly and fit the cap so that the identification numbers are together on the camshaft side of the engine. Fit and tighten new nuts to the correct torque figure. Repeat the foregoing instructions for fitting the remaining piston and connecting-rod assemblies.



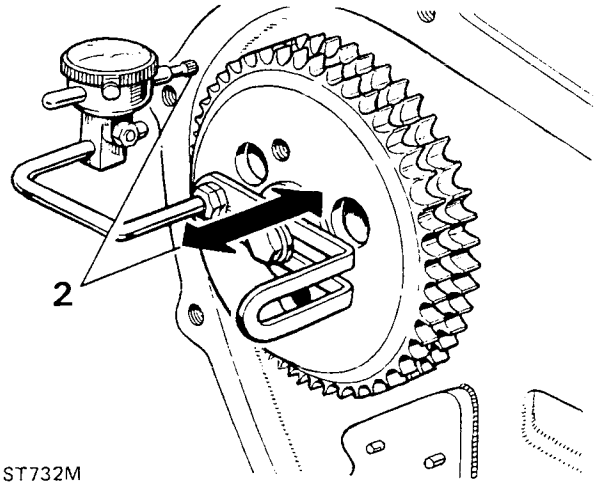
ST702M

FIT THE CAMSHAFT

1. Lubricate the camshaft bearings and with care, insert the camshaft into the cylinder block. Temporarily secure a new thrust plate with the two bolts.

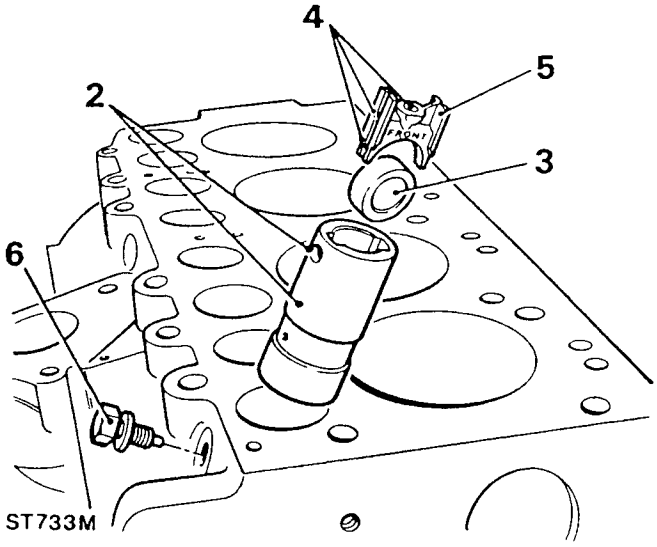


2. To check the camshaft end-float, fit the woodruff key and temporarily fit the camshaft chain wheel and mount a dial test indicator, as illustrated, so that the stylus rests in a loaded condition upon the machined face of the cylinder block. Zero the dial and move the camshaft back and forward and note the reading. The end-float should be within 0,06 to 0,13 mm (0.0025 to 0.0055 in). If the end-float is outside these limits, fit different thrust plates until the correct tolerance is achieved.
3. Remove the test indicator and chain wheel and secure the thrust plate with the two bolts and tab washers. (Tab washers ommitted on later engines).



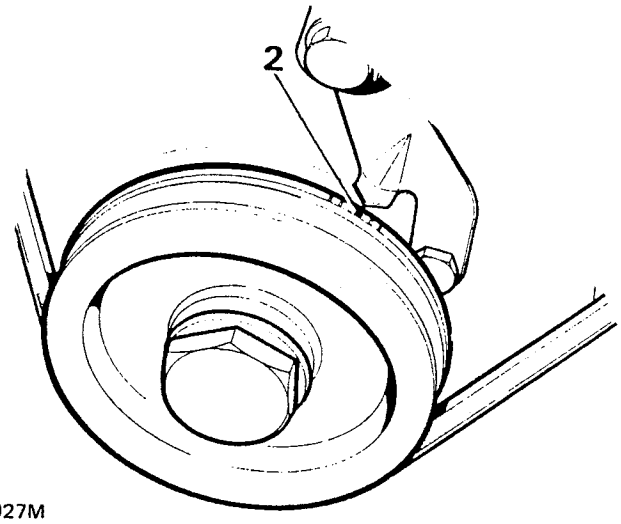
FIT TAPPETS, GUIDES AND ROLLERS

1. If the same parts are being refitted ensure that they are returned to their original positions. Ensure that the tappet slides move freely in the guides.
2. Insert the tappet guides into the cylinder block and align the locating screw holes.
3. Fit the tappet rollers ensuring that they are fitted in accordance with the marks made during removal. New rollers, however, may be fitted either way round.
4. Before fitting the tappet slides make sure the oilways are clear to the tappet bearing surface, the cross drilling and the oil feed to the push rod.
5. Insert the tappet slides with the word 'FRONT' towards the front of the engine.
6. Secure the tappet guides with NEW Micro encapsulated screws and tighten to the correct torque figure. Micro encapsulated screws should also be used on engines where the screws were originally wired for security.

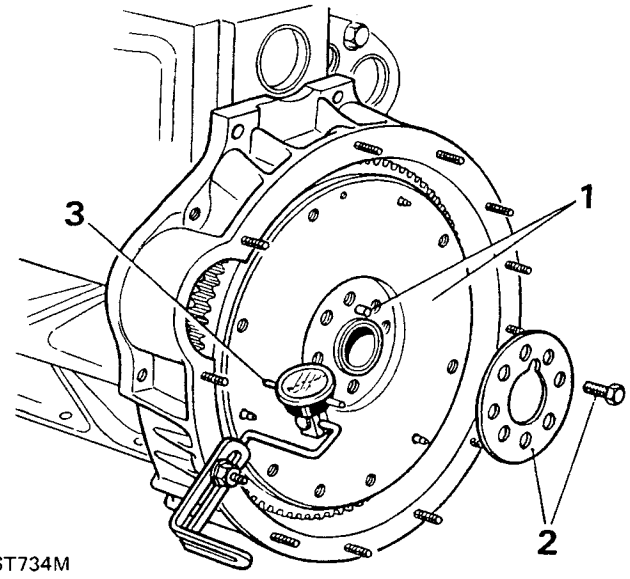


FIT THE FLYWHEEL

1. Examine the flywheel and crankshaft mating faces and remove any burrs or imperfections that could prevent the flywheel locating correctly. Check that the dowel is in position.
2. Offer up the flywheel to the crankshaft and secure with the reinforcing plate and retaining bolts. Evenly tighten the bolts to the correct torque figure.
3. To check the flywheel run-out, mount a dial test indicator so that the stylus rests, in a loaded condition, on the clutch pressure face at a radius of 114 mm (4.5 ins).
4. Turn the flywheel, and check that the run-out does not exceed 0,05 to 0,07 mm (0.002 to 0.003 in). Should the run-out be excessive, remove the flywheel, and check again for any irregularities on flywheel and crankshaft mating faces and dowel.



ST 927M



ST734M

FIT CYLINDER HEAD AND ROCKER SHAFT ASSEMBLY

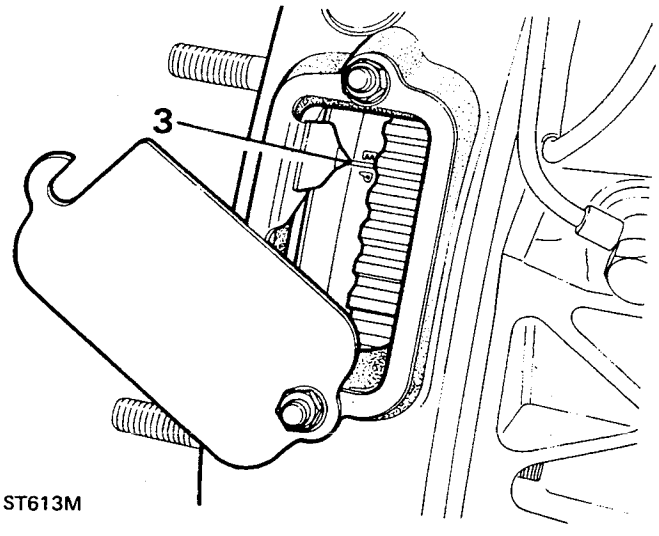
Petrol engine

1. Temporarily fit the timing cover with pointer and crankshaft pulley.
2. Turn the crankshaft clockwise, in the normal running direction, to bring numbers one and four pistons to T.D.C. If the crankshaft is inadvertently turned beyond T.D.C. do not turn it back, but continue on round until the T.D.C. mark on the pulley coincides with the pointer on the timing cover. Do not allow the crankshaft to be moved again until the valves are timed.

Diesel engine

3. Turn the crankshaft in a clockwise direction until the E.P. mark on the flywheel is in line with the pointer on the flywheel housing. The pointer on later engines has been omitted but can be obtained from Land Rover spares stockists under part number ERC 2250. If the crankshaft is inadvertently turned beyond the E.P. mark, do not turn it back but continue on round in a clockwise direction until the mark is exactly in-line with the pointer. To avoid serious damage to the valves and pistons once the cylinder head has been fitted, the crankshaft must not be rotated until the valves have been timed.

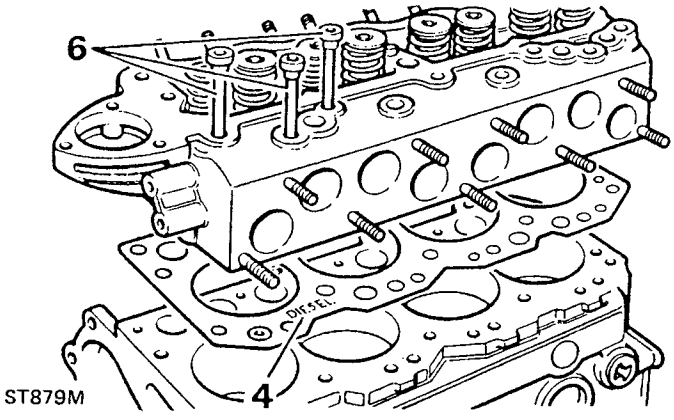
continued



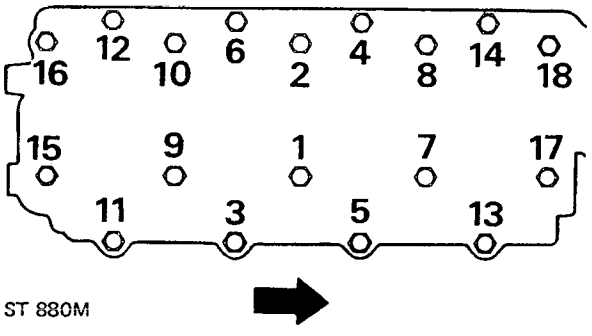
ST613M

Petrol and Diesel engines

4. Clean the cylinder head and cylinder block mating faces. Position a new cylinder head gasket on the cylinder block with the word 'Diesel' or 'Petrol' uppermost.
5. Lower the cylinder head onto the cylinder block using two long bolts to facilitate accurate positioning of the head.
6. Fit the cylinder head retaining bolts except those also used to secure the rocker shaft and leave finger-tight.
7. Insert the push rods ensuring that the ball end locates properly in the spherical seat in the tappet.
8. Whilst holding the rocker shaft assembly together, lower it into position making sure that the hollow dowels locate properly in the cylinder head. Also ensure that the rocker adjusting screw ball end locate in the push rods.
9. Fit the rocker shaft large retaining bolts and leave finger-tight.



10. Tighten the cylinder head retaining bolts, evenly, to the correct torque figure in the sequence illustrated below.
11. Fit and tighten the rocker shaft, small bolts to the specified torque.

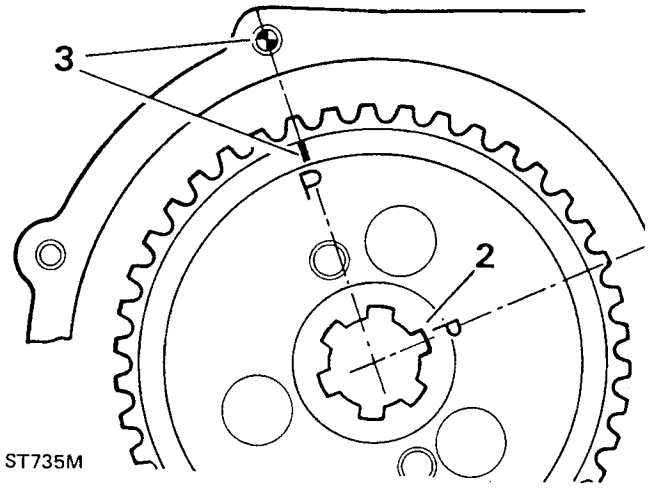


12. Do not allow the crankshaft to be turned, until the valves are timed.

VALVE TIMING

Petrol engines

1. Check that numbers one and four pistons are still at T.D.C. and without disturbing the crankshaft, remove the pulley and timing cover.
2. One of the keyways in the camshaft sprocket is stamped with the letter 'P' and this must locate on the camshaft key.
3. Fit the camshaft chain wheel, as above, and rotate the camshaft in a clockwise direction until the tooth also marked with a letter 'P' is in line with the top stud hole as illustrated.

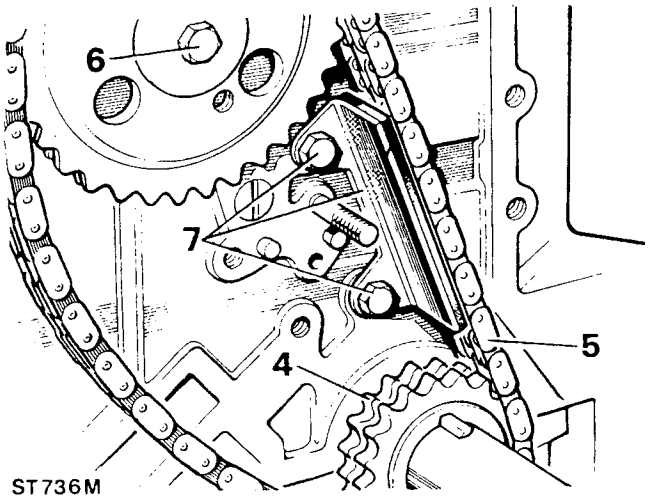


4. Fit the crankshaft chain wheel with the large shoulder towards the cylinder block.
5. Without moving either chain wheel, fit the timing chain, keeping it taut on the drive side. If it is not possible to obtain a taut fit on the drive side of the chain with the chain wheel in the set position, withdraw the camshaft chain wheel without disturbing the camshaft, and refit the chain wheel on one of the alternative keyways. This procedure may be repeated until a taught chain is obtained on the drive-side with the camshaft and crankshaft in their previously set positions.
6. Secure the camshaft sprocket to the camshaft with a new special micro encapsulated treated bolt and tighten to the correct torque figure.

NOTE: Early engines use an ordinary bolt and tab washer.

7. Fit and adjust the timing chain damper so that there is a maximum clearance of 0,25 mm (0.010 in) between the timing chain and damper. Tighten the retaining bolts and secure with new lock tabs.

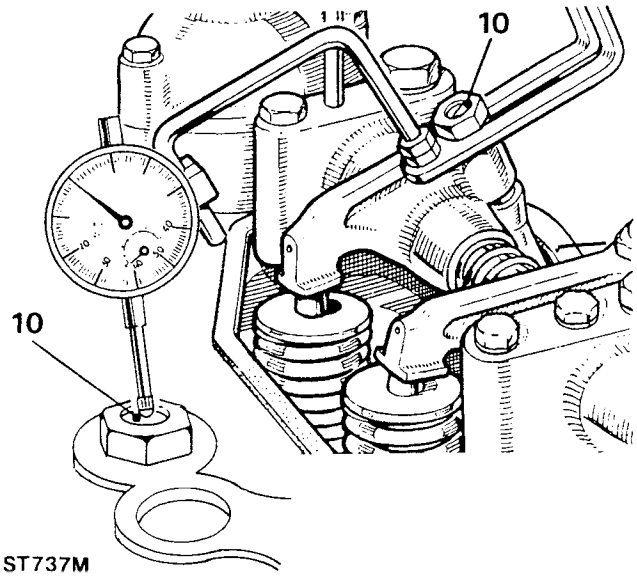
continued



ST736M

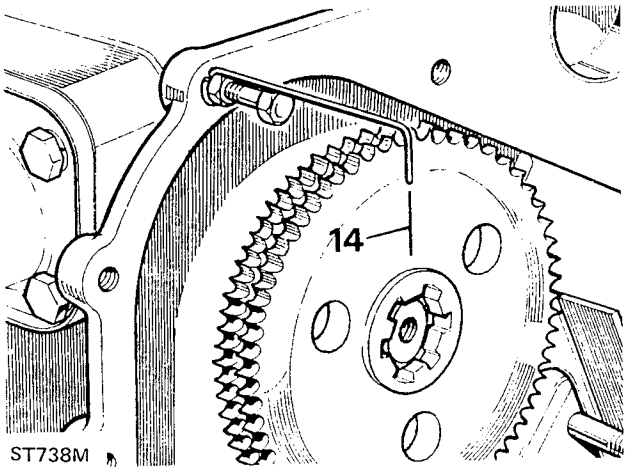
Diesel engines

8. Maximum engine performance and efficiency depends upon the care and accuracy excercised during the following instructions.
9. Check that the E.P. mark on the flywheel is still exactly aligned with the pointer on the flywheel housing.
10. The valve timing is based upon the exhaust valve peak of number one cylinder. To determine the point at which the valve is fully open mount a dial test indicator, as illustrated, with the bracket attached to the number one exhaust valve rocker and the stylus resting, in a loaded condition on a cylinder head bolt head.



ST737M

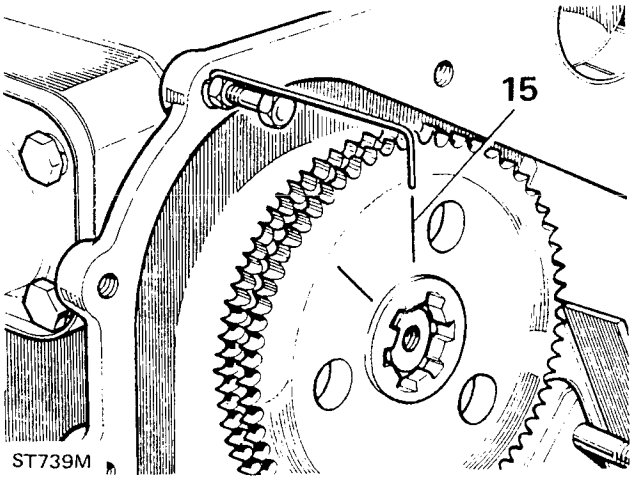
11. Manufacture a suitable pointer, and attach one end to the top bolt hole in the cylinder block and the pointer close to the camshaft chain wheel, as illustrated.
12. Turn the camshaft until the valve is fully open as indicated by maximum reading on the dial gauge.
13. Because the top of the cam is 'flat' the camshaft can be turned a further four degrees without movement of the dial gauge needle. Since an error of four degrees is not acceptable, the exact centre of the four degree period must be established, as follows.
14. Without moving the camshaft rub white chalk on the face of the chain wheel adjacent to the pointer. Zero the dial gauge and carefully turn the camshaft clockwise until the needle indicates 0,25 mm (0.010 in) which represents a point down the left-hand side of the cam lobe. Make a thin pencil mark, on the chalk, in line with the pointer.



ST738M

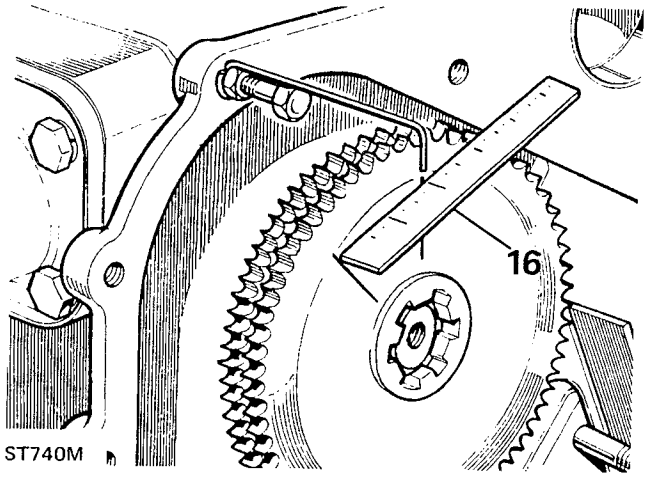
15. Turn the camshaft anti-clockwise and watch the needle move back to zero. Then continue turning until the needle indicates 0,25 mm (0.010 in) which represents a point down the right-hand side of the cam and make another mark in line with the pointer.

continued

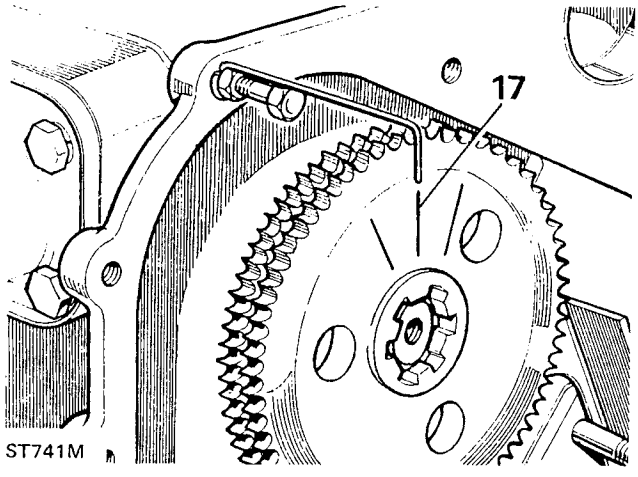


ST739M

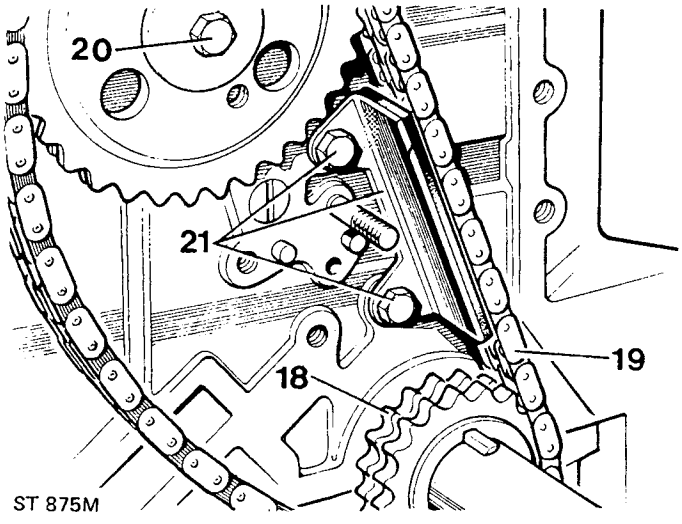
16. Using a rule, determine the exact mid-point between the two marks and make a third mark.



17. Remove the dial indicator, and turn the camshaft until the middle mark lines up with the pointer. The number one cylinder exhaust tappet roller should now be resting in the centre of the four degree flat period of the cam and the camshaft and crankshaft are in their correct relationship.

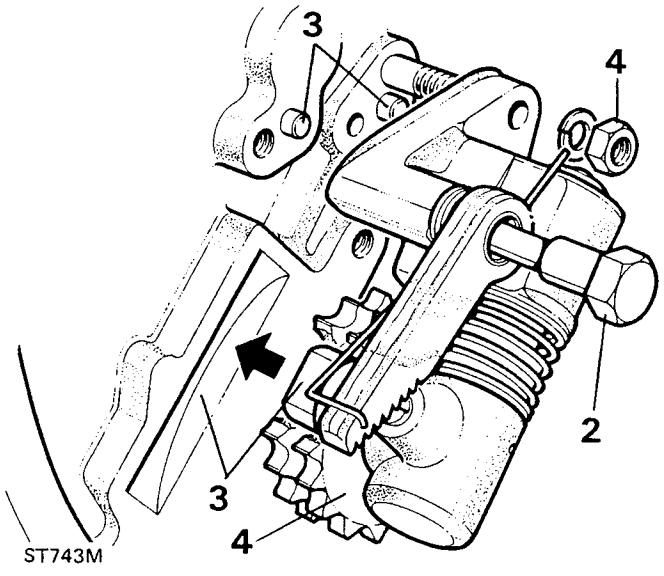


18. Fit the crankshaft chain wheel with the large shoulder towards the cylinder block.
19. Without moving the camshaft and crankshaft fit the timing chain keeping it taut on the drive side. Should it be impossible to obtain a taut fit, remove the chain wheel and position it in one of the five remaining keyways until the best position is obtained. It is preferable to choose a keyway which gives a slightly tight chain on the drive side rather than a slack one.
20. Secure the camshaft chain wheel to the camshaft with a new, special, micro encapsulated treated bolt and tighten to the correct torque figure — See Petrol engine.
21. Fit and adjust the timing chain damper so that there is a maximum clearance of 0,25 mm (0.010 in) between the timing chain and damper. Tighten the two bolts and secure with new lock tabs.



FIT TIMING CHAIN TENSIONER

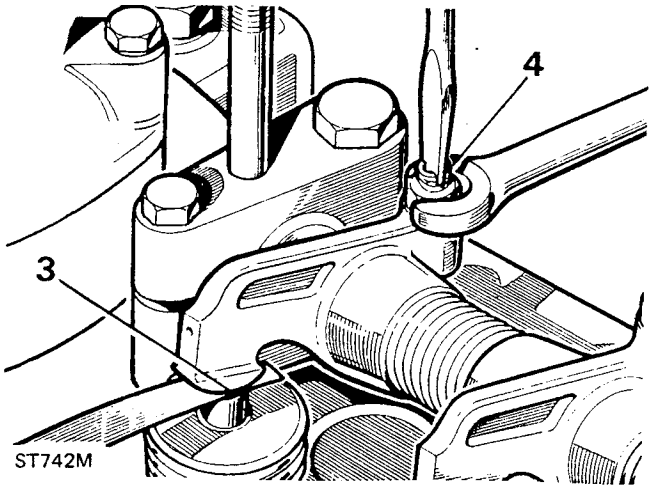
1. Assemble the timing chain tensioner in accordance with the illustration in "Dismantling".
2. Compress the assembly against the spring and fit to the engine whilst engaging the ratchet pivot bolt in the cylinder block.
3. Ensure that the piston housing locates on the dowels and single stud and the cylinder spigot fits into the milled slot in the cylinder block.
4. Allow the jockey wheel to take up the slack in the chain. Tighten the retaining nut and two bolts to secure the assembly. Do not rotate engine, see 'tappet adjustment'.



ADJUST TAPPET CLEARANCES

Petrol and diesel engines

1. If the crankshaft is rotated with excessive valve clearances, it is possible that the push rods may become dislodged from the tappet seating and fracture the tappet slide. To prevent damage, eliminate all clearance from any loose rockers before turning the crankshaft to adjust the clearances.
2. Turn the engine over until number eight valve (counting from front of engine) is fully open.
3. Using a 0,25 mm (0.010 in) feeler gauge check the clearance between the valve tip and rocker pad of number one valve.
4. Adjust the clearance by slackening the locknut and turning the tappet adjusting screw clockwise to reduce clearance and anti-clockwise to increase clearance. Recheck the clearance after tightening the lock nut.



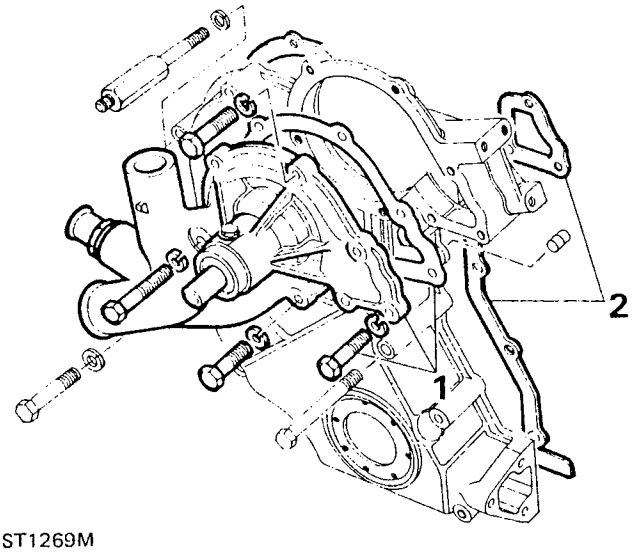
ST742M

5. Continue to check and adjust the remaining tappets in the following sequence:

   Set No. 3 tappet with No. 6 valve fully open.
   Set No. 5 tappet with No. 4 valve fully open.
   Set No. 2 tappet with No. 7 valve fully open.
   Set No. 8 tappet with No. 1 valve fully open.
   Set No. 6 tappet with No. 3 valve fully open.
   Set No. 4 tappet with No. 5 valve fully open.
   Set No. 7 tappet with No. 2 valve fully open.

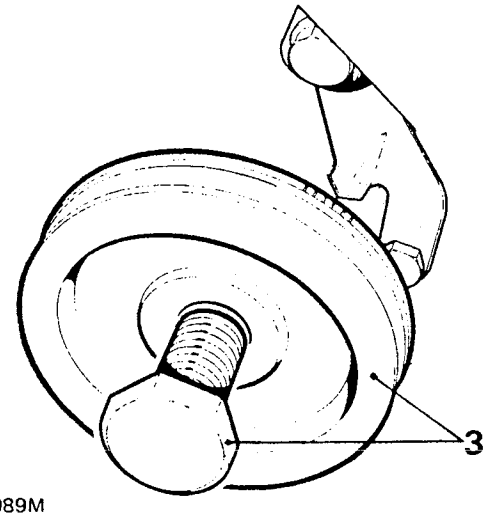
FIT TIMING COVER AND WATER PUMP

1. Using a new joint washer assemble the water pump to the front cover and loosely tighten the three retaining bolts.
2. Attach a new joint washer and water gallery joint to the timing cover and secure the cover together with the timing pointer (petrol engines only) and alternator link to the cylinder block with the fourteen bolts. Evenly tighten to the correct torque figure, including the water pump bolts.



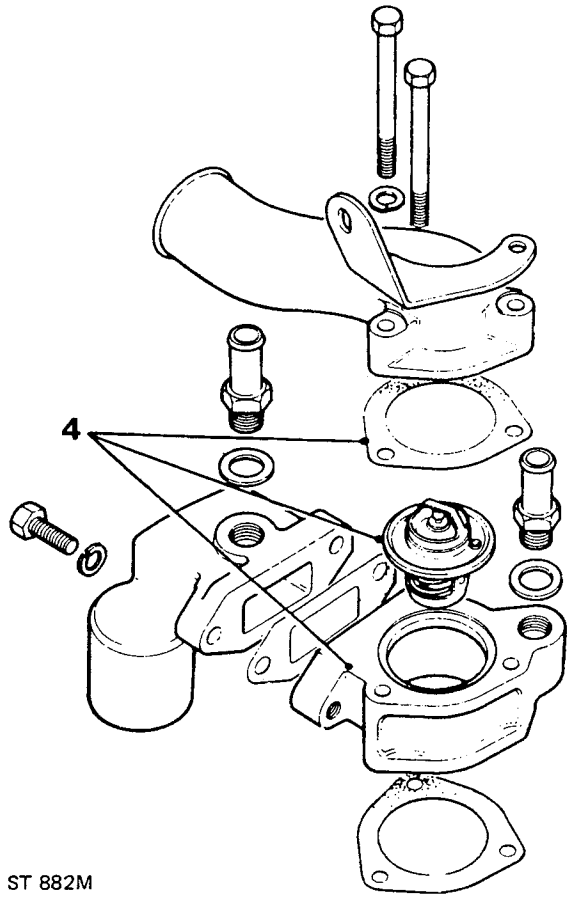
ST1269M

3. Fit the crankshaft pulley and secure with the special washer and bolt. Tighten to the correct torque figure.



ST1089M

4. Fit the thermostat into its housing and using new joint washers secure the assembly, together with the elbow, to the cylinder head. Tighten the three bolts to the correct torque. Connect the thermostat elbow to the water pump with a new hose and secure with hose clips.

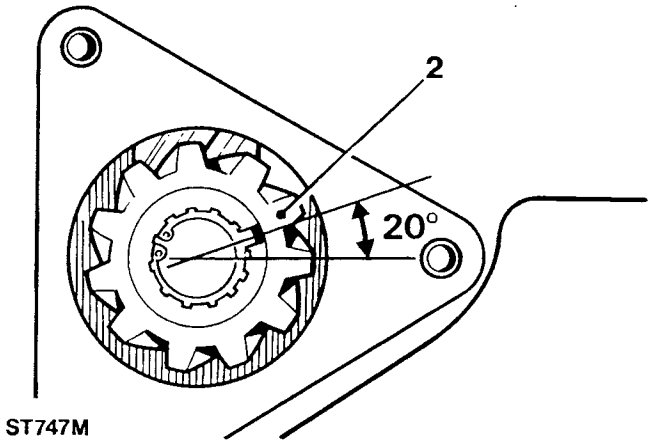


ST 882M

FIT THE SKEW GEAR

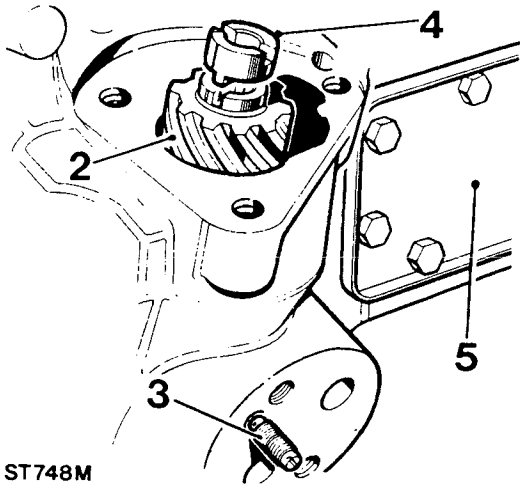
Petrol engine

1. Turn the crankshaft to bring number one piston to T.D.C. with number four cylinder valves on the 'rock'. Check that the timing gear pointer coincides with the mark on the crankshaft pulley.
2. Lubricate and insert the skew gear assembly into mesh with the camshaft gear. Due to the helex angle of the teeth the gear will turn anti-clockwise as it slides into mesh. The broad master spline must be at 20° to the centre line when correctly seated, as illustrated, but it may take several attempts to achieve this.



ST747M

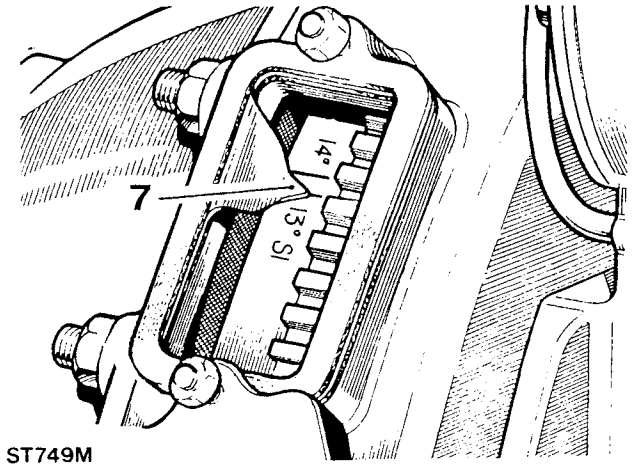
3. The skew gear assembly is located in its final position by a special screw. Without this screw the gear will go deeper into mesh resulting in an incorrect angle when the assembly is lifted up to locate the screw. The angle must therefore be checked again after the screw is fitted. Align the location hole in the bush and fit a new location screw into the cylinder block and re-check the angle.
4. Fit the distributor drive coupling, and ensure that it locates properly in the off-set slot of the skew gear.
5. Using a new joint washer, fit the side cover.



ST748M

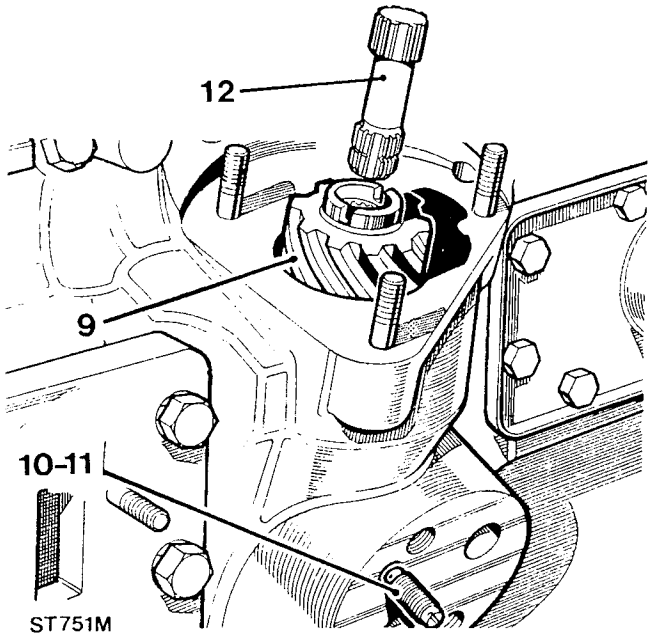
Diesel engine

6. Turn the crankshaft in the direction of rotation until both valves of number one cylinder are closed and the piston is ascending the bore on the compression stroke.
7. Continue to turn the crankshaft until the timing pointer aligns with the 13° mark on the flywheel, that is 13° BTDC. This must be done carefully. If the flywheel in inadvertently turned too far and the timing mark goes past the pointer do not turn the flywheel back but repeat the operation.
8. Ensure that a correct line of vision is taken when lining up the timing marks. An incorrect line of vision can result in the timing being 1° to 2° out.



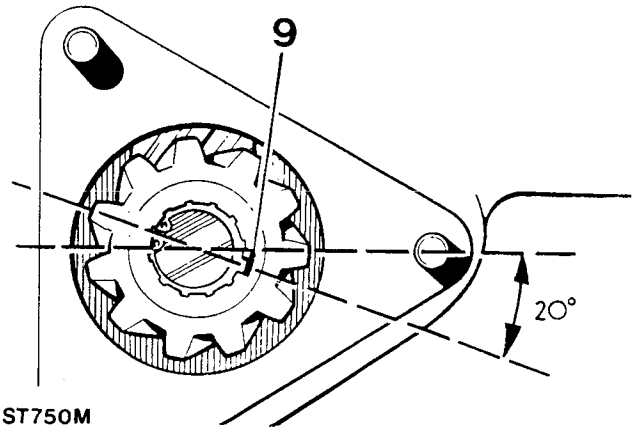
ST749M

10. The skew gear assembly is located in its final position by a special screw. Without this screw the gear will go deeper into mesh resulting in an incorrect angle when the assembly is lifted up to locate the screw. The angle must therefore be checked again after the screw is fitted.
11. Align the location hole in the bush and fit a new location screw into the cylinder block and re-check the angle.
12. Fit D.P.A. pump drive shaft long-splined-end leading and locate the master spline in the corresponding spline in the skew gear.



ST751M

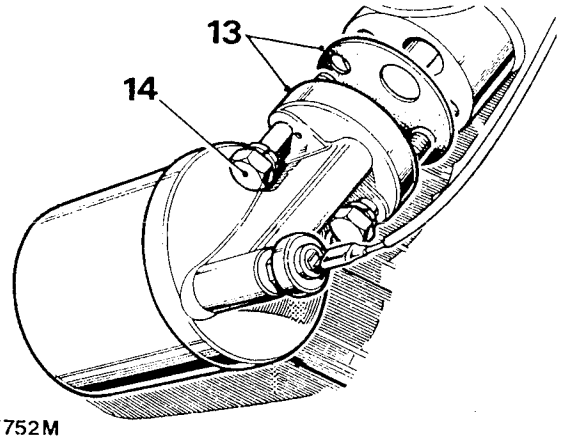
9. Lubricate and insert the skew gear assembly into mesh with the camshaft gear. Due to the helex angle of the teeth the gear will turn anti-clockwise as it slides into mesh. The broad master spline must be at 20° to the centre line when correctly seated, as illustrated, but it may take several attempts to achieve this.



ST750M

Petrol and Diesel engines

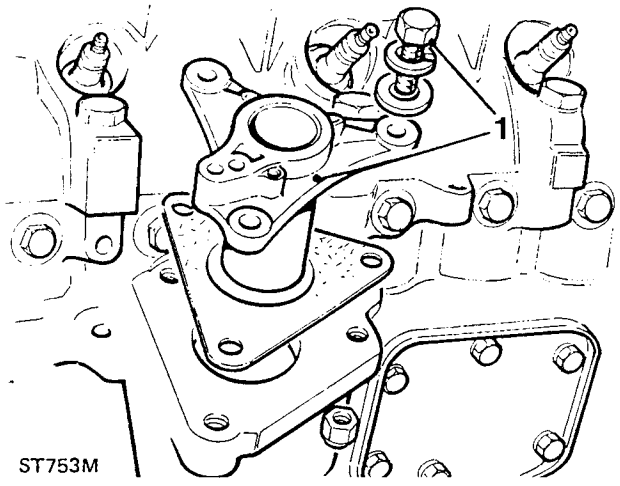
13. Using a new joint washer fit the oil filter housing, ensuring that the retaining bolts pass through the two small round holes in the joint washer.
14. Tighten the two retaining bolts evenly to the correct torque.



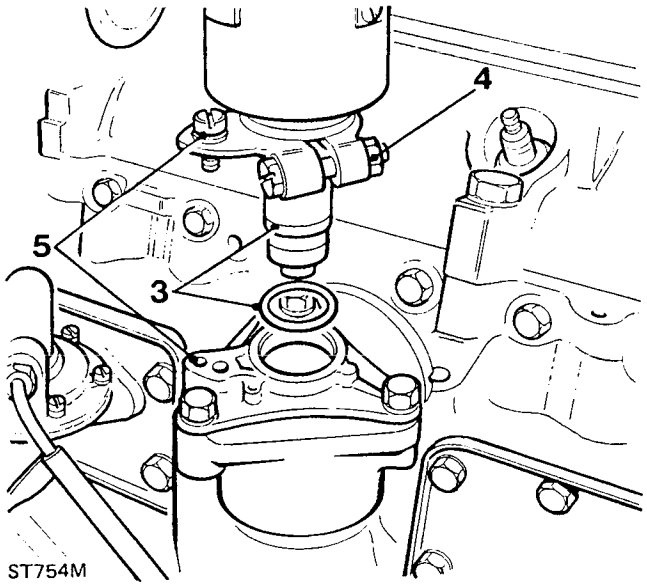
ST752M

FIT IGNITION DISTRIBUTOR

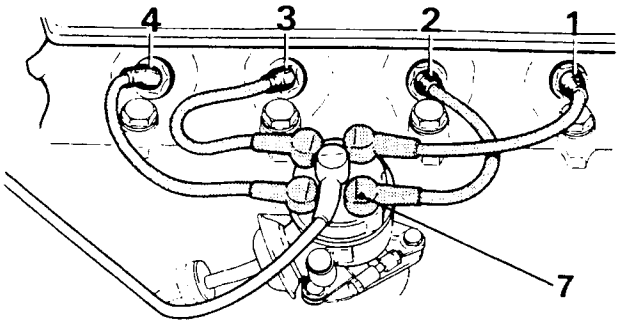
1. Fit the distributor adaptor plate using a new joint washer and evenly tighten the three retaining bolts to the correct torque figure.



2. Check that the distributor drive coupling, locates properly in the off-set slot of the skew gear.
3. Insert the distributor and "O" ring so that the vacuum unit faces towards the rear of the engine. Remove the cap and oscillate the rotor arm until the distributor drive shaft locates into the drive coupling slot thus enabling the distributor to be pushed fully home. The metal tip of the rotor arm should be in line with the electrode in the distributor cap that supplies electrical current to number one spark plug.
4. Temporarily tighten the distributor clamp bolt pending final ignition timing adjustment when the engine is fitted to the vehicle.
5. Secure the clamp to the adaptor plate with the single bolt.



6. Fit the correct spark plugs and washers and tighten to the specified torque figure.
7. Fit the distributor cap and connect the H.T. leads to the spark plugs in the sequence illustrated.

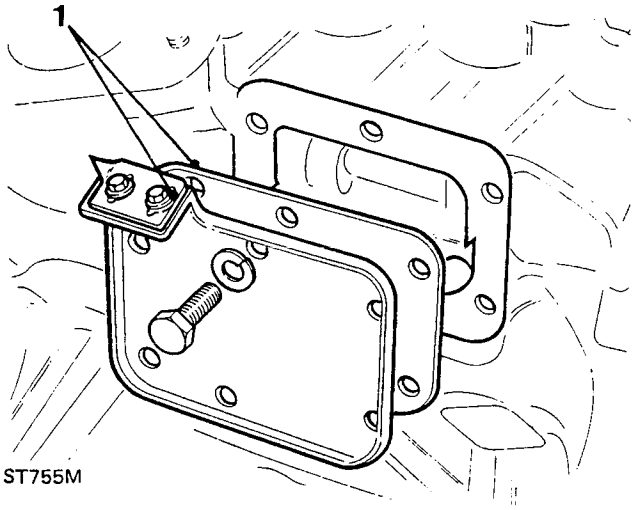


FIT FUEL INJECTION PUMP

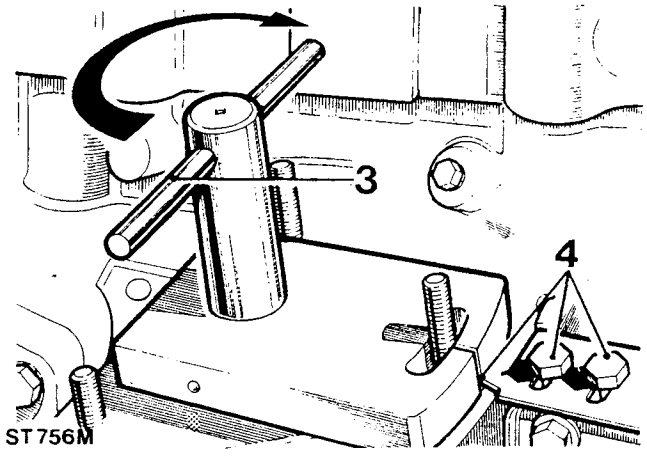
Using timing gauge 605863

1. Using a new joint washer fit the camshaft front side cover with the timing pointer. Tighten the retaining bolts evenly to the correct torque.
2. Earlier engines with the side oil filter, employ a baffle plate, with two joint washers interposed between the side filter plate and the cylinder block.

continued

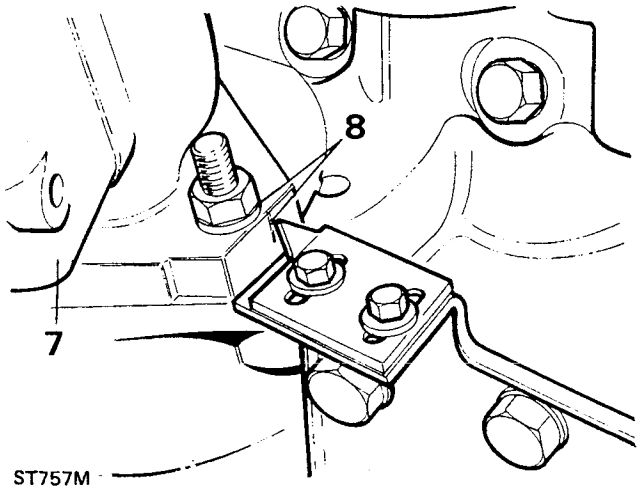


3. Insert the timing gauge, 605863, into the driving gear, then twist gauge in a clockwise direction to take up backlash and any wear in the gears.
4. Hold in this position, then, if necessary, slacken off bolts retaining the timing pointer on the side of the cylinder block. Adjust pointer so that it coincides with the line on the timing gauge, as illustrated, then retighten the bolts and remove the timing gauge.



ST756M

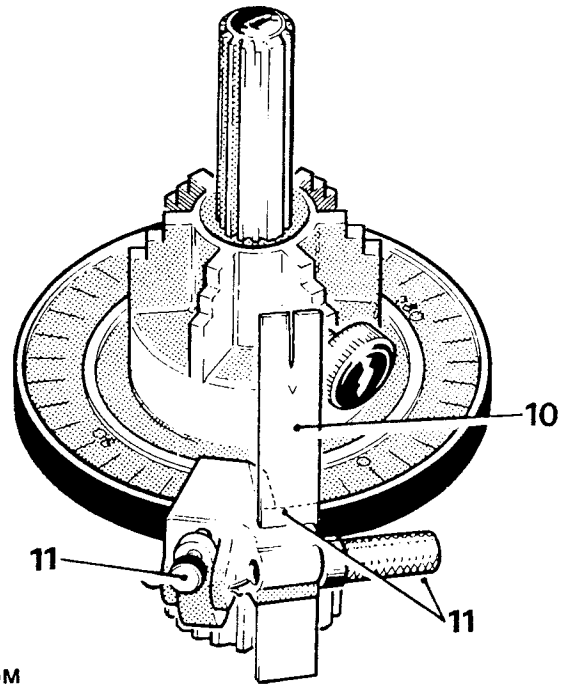
5. Rotate the driving gear on the distributor pump so that the master spline lines up with the master spline on the engine driving gear.
6. Check that the pump drive shaft is correctly located with the longer splines in the skew gear.
7. Fit the distributor pump to the engine engaging the master splines on the pump and the drive shaft. Do not tighten the fixings at this stage.
8. Align the vertical mark on the pump flange with the pump timing pointer, then tighten the pump fixings.



ST757M

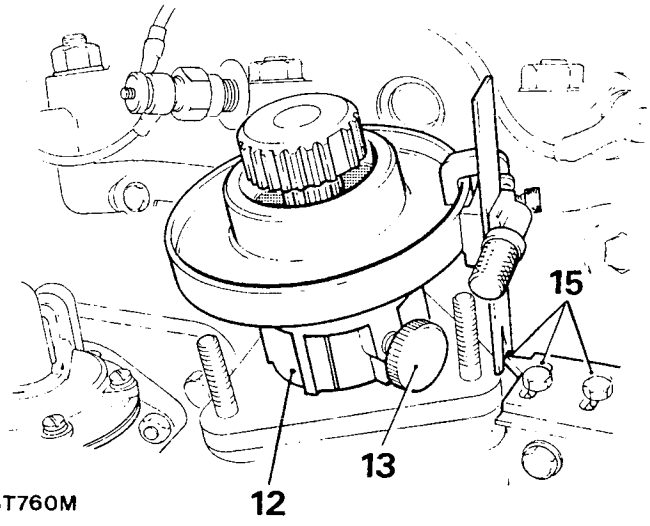
Using timing gauge MS 67B

9. Check that the drive shaft is correctly located with the longer splined-end in the skew gear.
10. Assemble the scribing arm of the timing gauge to the gauge body.
11. Set gauge by loosening knurled screws and sliding bracket around until chamfered edge aligns with the required angle of 22°, tighten knurled screw in this position.



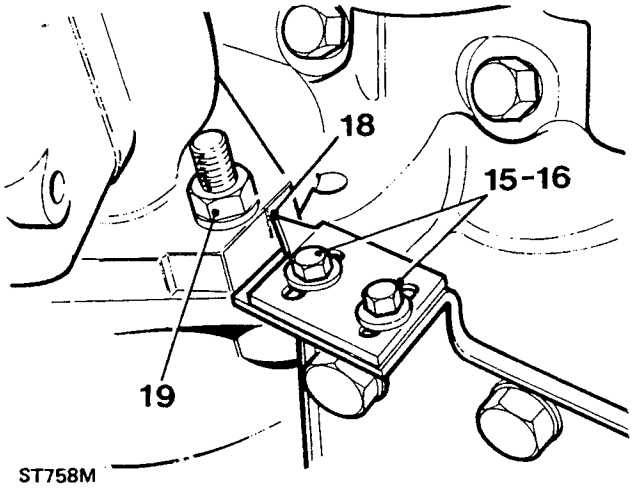
ST759M

12. Insert the gauge into the vacant injection pump position and engage the gauge gear into injection pump drive splines.



ST760M

13. Release centre shaft retaining screw and slide the gauge body along centre shaft until body engages injection pump drive gear hub. Lock shaft retaining screw.
14. Apply gentle clockwise pressure to take up backlash or wear in gears, retain in this position.
15. Slacken off timing pointer bolts. Adjust timing pointer so that it aligns with scribing arm on the gauge.
16. Tighten timing pointer bolts and remove the gauge.
17. Rotate driving gear on distributor pump so that master spline lines up with master spline on driving gear.
18. Fit pump to engine, ensuring that the timing mark on the pump flange coincides with the timing pointer.
19. Tighten the injection pump retaining nuts.

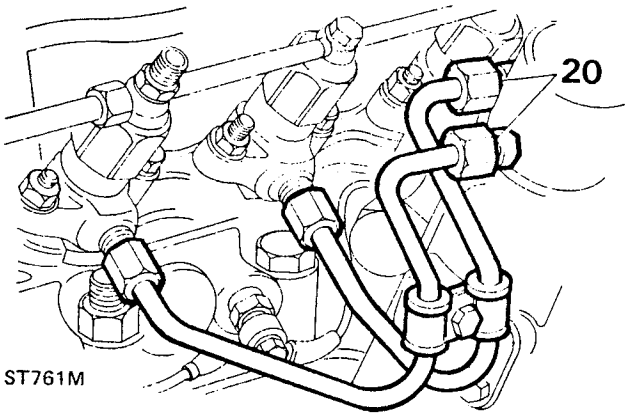


ST758M

NOTE: When the distributor pump is timed as detailed above, that is, with the timing pointer on the engine altered to take up backlash and wear on the gears, it ensures that optimum distributor pump timing is achieved.
Should there be any fall-off of power during the life of the engine, retiming the distributor pump to take up gear wear could well make a significant improvement to engine performance, provided the engine is generally in good condition.

continued

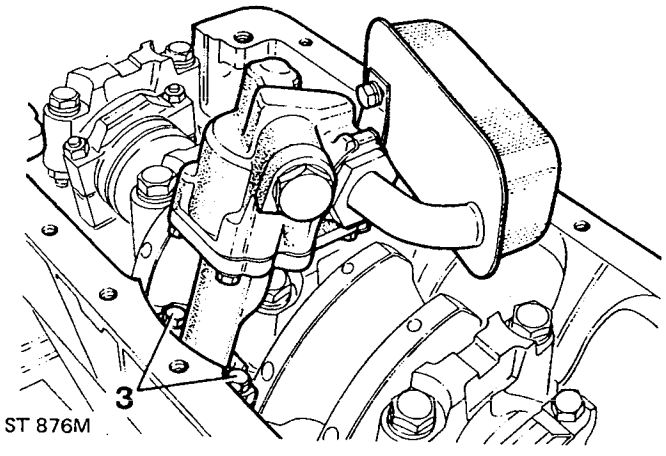
20. If the injectors have already been fitted, during cylinder head assembly, fit the injector feed pipes to the injector pump to prevent the ingress of dirt into the system. See FUEL SYSTEM - Section 19 for correct fitting of injectors.



ST761M

FIT OIL PUMP AND SUMP

1. Fit the longer splined end of the drive shaft into the oil pump.
2. Fit the oil pump and drive shaft to the crankcase, whilst revolving the shaft as necessary to engage the splines of the skew gear.
3. Using new lock washers, secure the pump to the crankcase tightening the bolts to the correct torque and bend over the lock tabs.
4. If necessary adjust the position of the strainer so that it is parallel to the sump baffle plate.

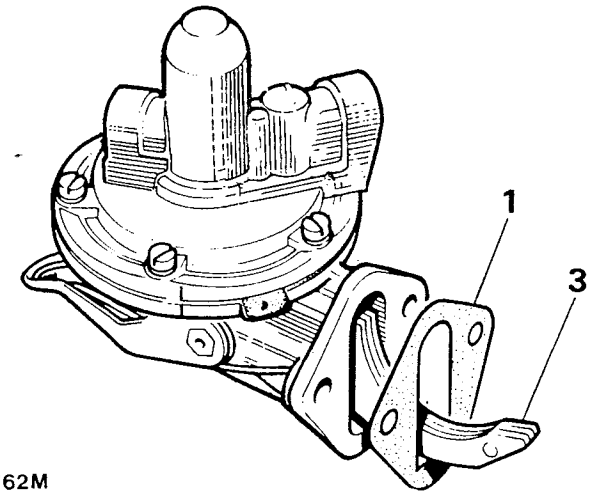


ST 876M

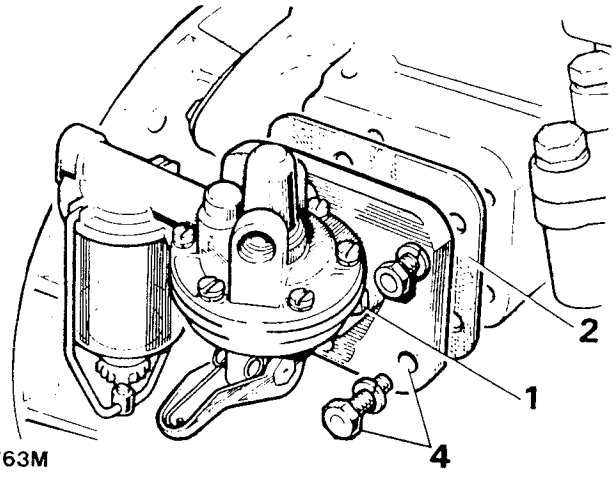
5. Clean the sump and crankcase mating faces and fit a new joint washer. Secure the sump with the twenty-one bolts and spring washers and one nut. Evenly tighten to the correct torque.

FIT FUEL LIFT PUMP

1. If the fuel lift was separated from the side cover, fit the pump to the cover first using a new joint washer and evenly tighten the retaining nuts.
2. Place a new cover plate joint washer in position and fit the cover and pump assembly to the cylinder block.
3. Ensure that the pump actuating lever rides on top of the camshaft.
4. Secure the cover, evenly tightening the retaining bolts.



ST762M



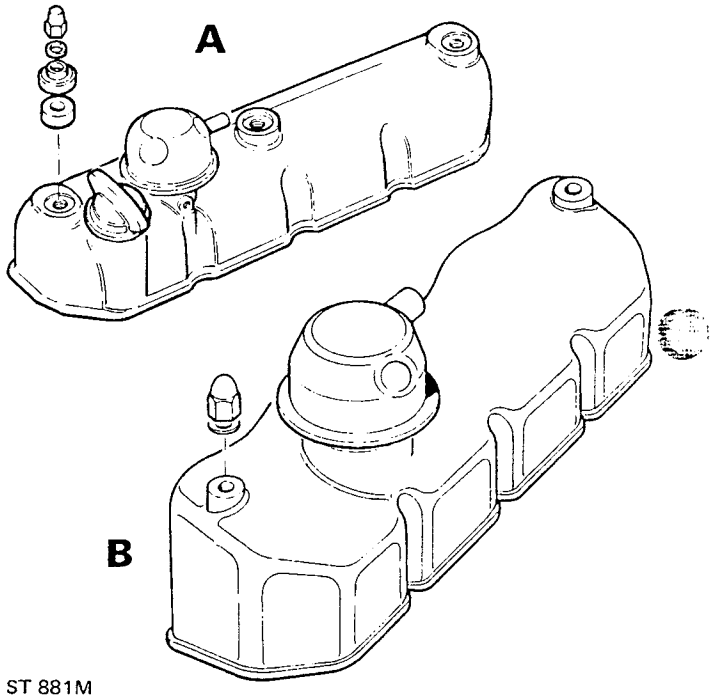
ST763M

NOTE: The illustration shows a petrol engine fuel pump but the fitting procedure is the same for the Diesel engine pump.

FIT ROCKER COVER

Clean the rocker cover and cylinder head faces and fit the cover using a new joint washer. Evenly tighten the dome headed nuts to the correct torque. Do not overtighten.

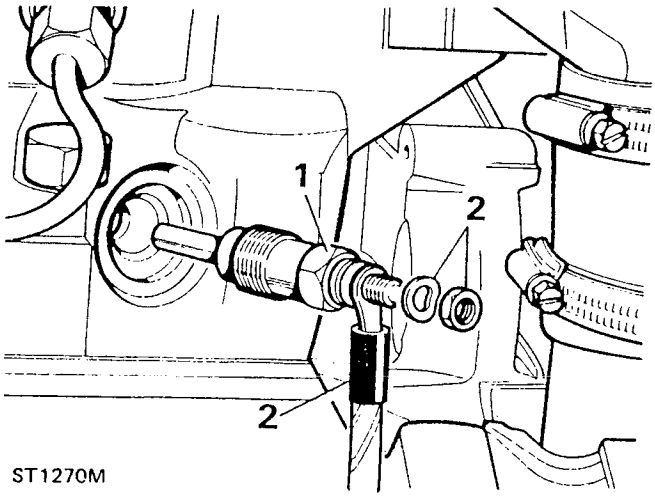
A. Petrol engine
B. Diesel engine



ST 881M

FIT HEATER PLUGS — Diesel engine

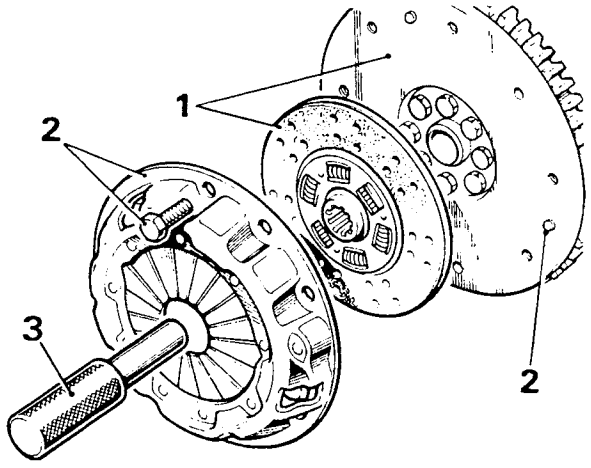
1. Clean and test the heater plugs as described in the maintenance Section. Fit the heater plugs and tighten to the correct torque according to the size of plug. Do not over tighten.
2. Fit the leads, washers and nuts as illustrated.



ST1270M

FIT THE CLUTCH

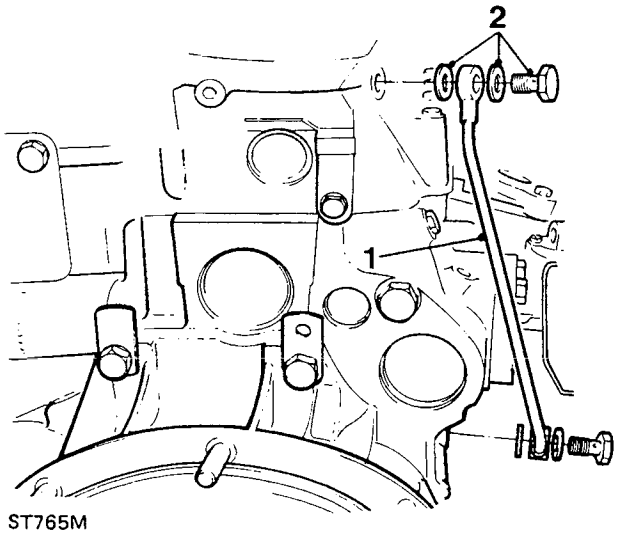
1. Clean the flywheel face and place the centre plate with the side marked 'Flywheel side' towards the flywheel.
2. Fit the clutch assembly locating it over the three dowels and loosely secure with the six bolts.
3. Centralise the centre plate using special tool RO 605022 or a spare primary shaft and tighten the six bolts evenly to the correct torque figure. Smear the splines of the centre plate with Molybdenum disulphide grease, such as Rocol MTS 1000.



ST764M

FIT CYLINDER HEAD OIL FEED

1. Connect the oil feed pipe, for lubrication of the rocker shaft assembly, to the cylinder head.
2. Secure with the two banjo bolts and four joint washers.

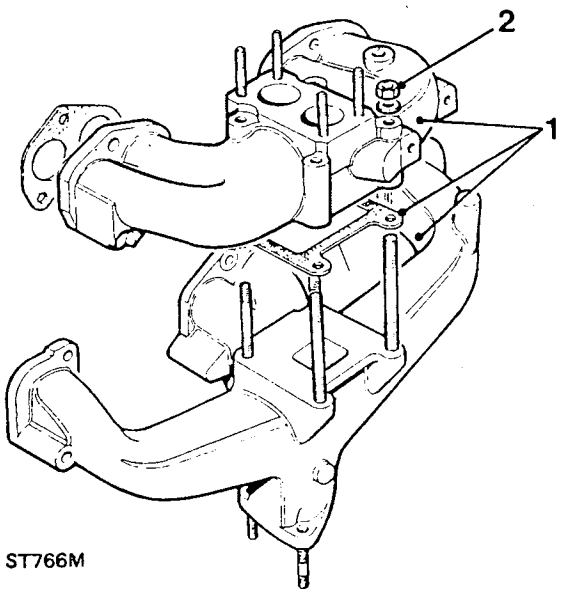


ST765M

FIT INLET AND EXHAUST MANIFOLDS

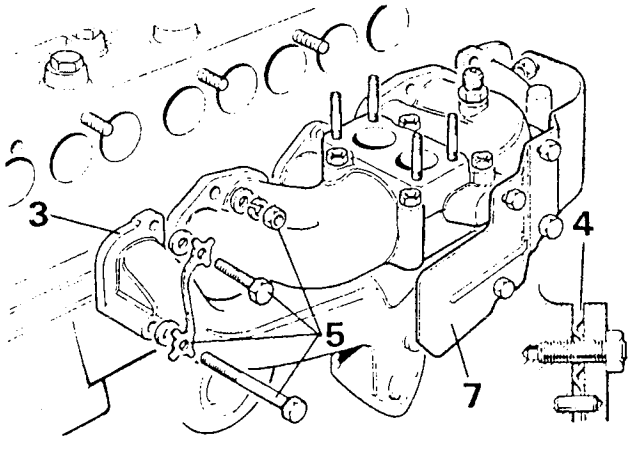
Petrol engine

1. Using a new 'hot spot' joint washer assemble the inlet manifold to the exhaust manifold.
2. Secure with the four nuts and evenly tighten to the correct torque, then slacken off but retain the 'nip' of the four nuts.



ST766M

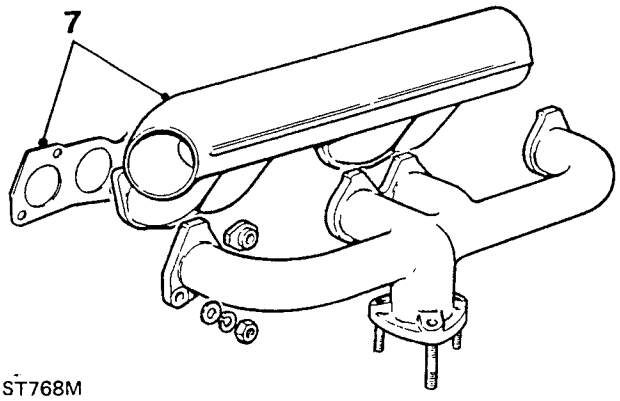
3. Coat the face of the exhaust manifold with Rocol anti-seize compound Foliac J166 (paste) and the corresponding face of the cylinder head.
4. Fit the joint washers of inlet manifold with the raised rings towards the cylinder head.
5. Fit and tighten the securing nuts and bolts to the correct torque including the two common bolts and clamps. Note the two outer bolts at both ends of the exhaust manifold have lock plates.
6. Finally tighten the four 'hot spot' joint nuts evenly to correct torque.
7. Fit the heat shield.



ST767M

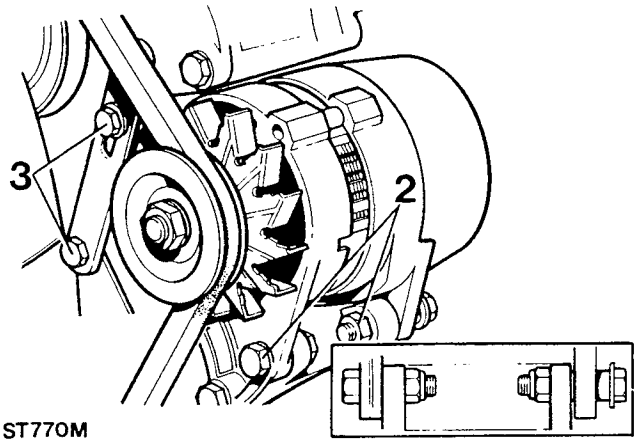
Diesel engine

7. Using a new gasket fit the manifolds and secure with the retaining nuts and clamps. Evenly tighten to the specified torque figure.



ST768M

2. Assemble the alternator to the engine bracket with the two pivot bolts, distance piece and washers, leaving the bolts slack.
3. Fit the adjustment link to the timing cover and attach to alternator with the adjusting clamp bolt.

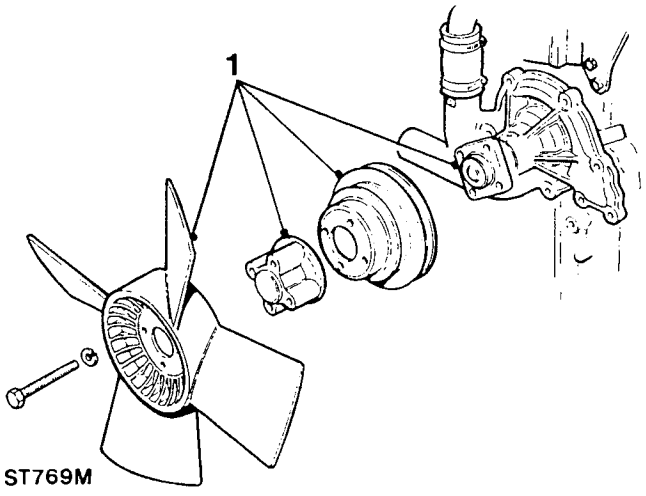


ST770M

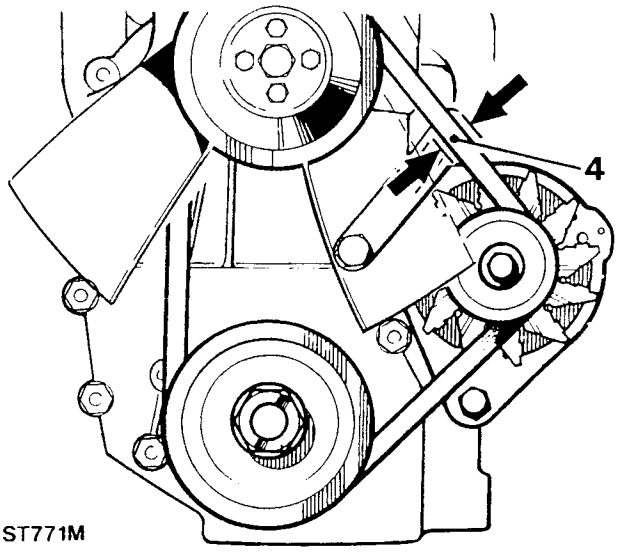
4. Fit the drive belt and pivot the alternator away from the engine, but do not apply pressure to the stator or slip-ring end bracket or damage may result. Tighten the clamp bolt and with thumb pressure, check the belt tension between the fan and alternator pulleys which should be 7 to 9 mm (¼ to ¾ in) at the mid-point.
5. When the tension is correct fully tighten the clamp bolt and the pivot nuts and bolts.

FIT ALTERNATOR, PULLEY AND FAN BLADES

1. Fit the pulley, spacer and fan blade assembly to the water pump shaft.



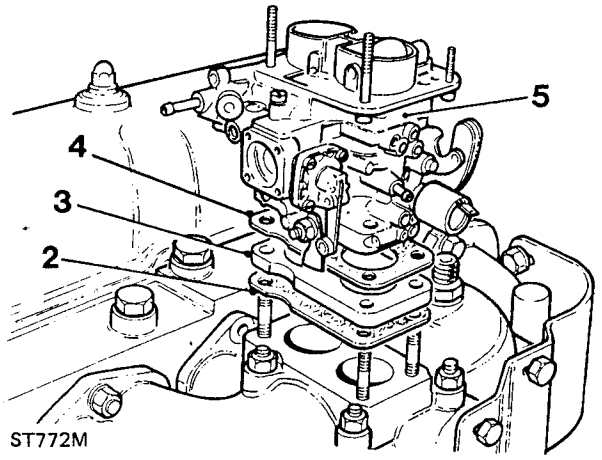
ST769M



ST771M

FIT THE CARBURETTER

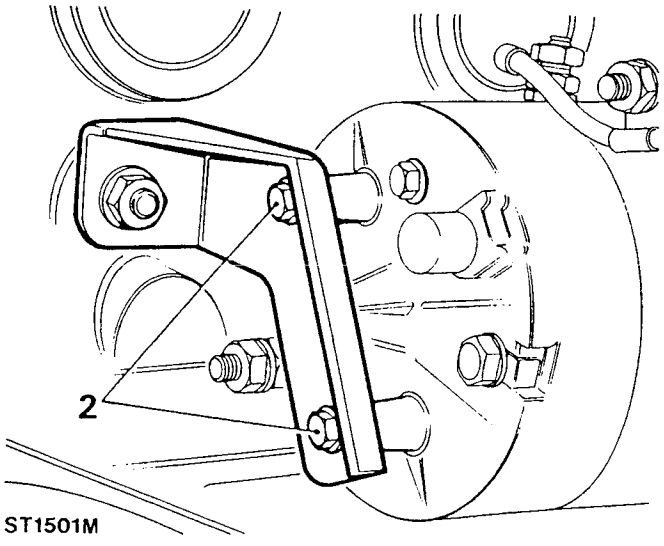
1. Clean the carburetter and manifold mating faces.
2. Place a joint washer, over the studs to the manifold.
3. Fit the packing piece.
4. Fit a second joint washer.
5. Fit the carburetter and secure with the four nuts and washers tightening evenly to the correct torque.



FIT THE STARTER MOTOR

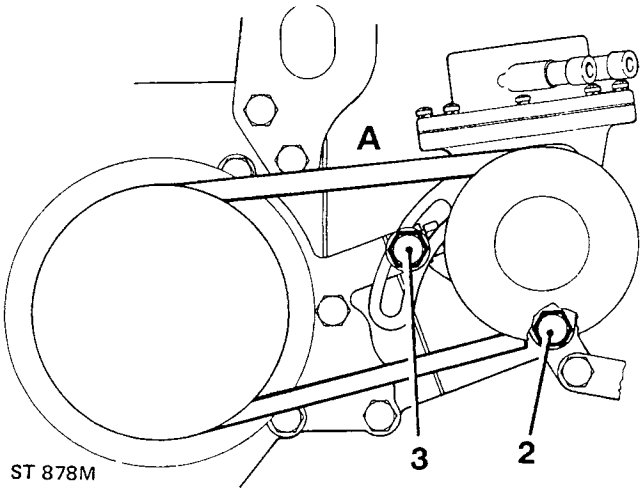
1. Secure the starter motor to the flywheel housing noting that the petrol engine starter is held by two studs, nuts and washers. The starter for the diesel engine is retained by one stud, one bolt and one nut and bolt. Tighten the fixings evenly to the correct torque.

2. In addition, the rear of the Diesel engine starter motor is secured by two bolts to a support bracket attached to the cylinder block.

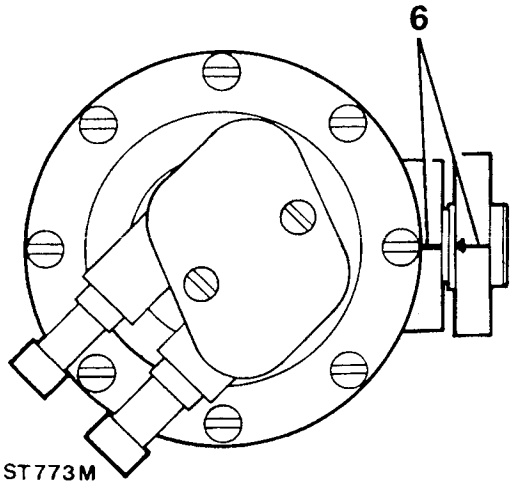


FIT VACUUM PUMP — Diesel engine only

1. Fit the pump attachment bracket to engine with two bolts.
2. Secure pump to bracket with pivot bolt and nuts leaving it slack.
3. Fit the tensioning clamp bolt and drive belt. Tension the belt and tighten the clamp bolt.
4. Check that the belt can be deflected 12 mm (½ in) by thumb pressure, at the mid-point of its run (A).
5. Tighten the pivot bolt and nut and finally tighten the clamp bolt.



6. Turn the pump pulley so that the indicating marks on the pulley hub and pump body line up.
7. Remove the oil level plug and inject a recommended SAE 15W-50 oil up to the level of the hole. Refit the plug. See Maintenance Section.



MISCELLANEOUS ITEMS

Fit any other parts, if removed, such as engine mounting brackets, lifting eyes and the dipstick. Also any other items of non-standard equipment peculiar to the vehicle concerned.

Make a careful inspection of the engine and check that all plugs are fitted and properly tightened.

REMOVE OVERHAUL AND REFIT

Special tools:
Drift inlet valve guides 274400
Drift exhaust valve guides 274401
Drift exhaust valve guide 600959
Drift inlet valve guide 601508
Seat cutters MS621 MS627
Insert replacer 530625

Before the cylinder head can be removed the following ancilliary items, common to petrol and diesel engines, need to be removed or disconnected for access and safety.

1. Disconnect the battery for safety.
2. Drain the cooling system.
3. Remove the bonnet.
4. Disconnect heater rail pipes and move aside.
5. Disconnect top hose from thermostat housing.
6. Disconnect heater control cables.
7. Release fan cowl from bracket attached to thermostat housing.
8. Disconnect lead from coolant temperature sensor.
9. Disconnect oil gallery pipe at rear of engine.
10. Disconnect coolant by-pass hose.
11. Disconnect the exhaust pipe from the manifold.

The following items concern the petrol engine only

12. Disconnect the air cleaner hose from the carburetter.
13. Disconnect brake vacuum hose from the manifold.
14. Disconnect mixture control cable from carburetter.
15. Disconnect throttle cable.
16. Disconnect fuel shut-off valve lead from carburetter.
17. Disconnect vacuum ignition advance pipe.
18. Remove H.T. leads from spark plugs.

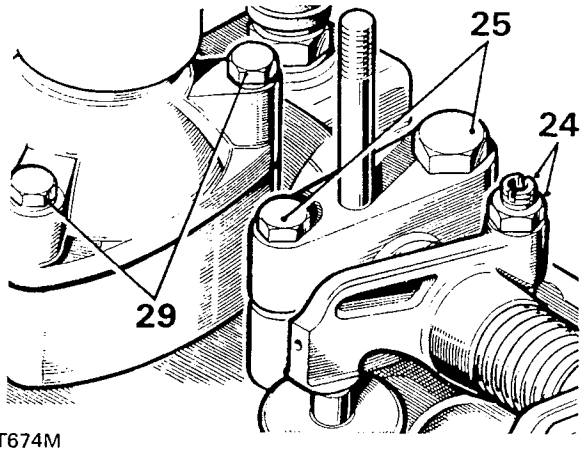
The following items concern only the diesel engine

19. Disconnect the fuel spill return union connected to spill rail.
20. Disconnect injector supply pipes from the injectors.
21. Remove injectors complete with spill rail.
22. Disconnect air hose from manifold.
23. Disconnect the heater plug electrical connections.

Remove the cylinder head

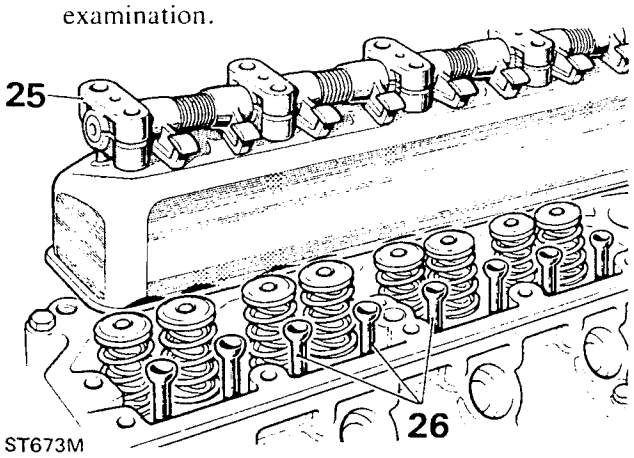
The following instructions for removing and overhauling the cylinder head are common to petrol and diesel engines unless otherwise stated.

24. Remove the rocker cover and slacken the tappet screw lock nuts. Turn the adjusting screws to release them from the push rods.
25. Remove the rocker shaft retaining bolts, lift-off the rocker shaft assembly, invert it and secure it to the rocker cover studs to prevent the assembly from falling apart.
26. Withdraw the push rods and retain them in numbered sequence.
27. Evenly slacken the remaining cylinder head retaining bolts and lift-off the cylinder head complete with manifolds. Remove and discard the cylinder head gasket.



ST674M

28. Remove the eight bolts and three nuts and remove the inlet and exhaust manifolds complete with carburetter (petrol engine).
29. Remove three bolts and lift-off the thermostat housing, elbow and thermostat.
30. Remove spark plugs, (petrol engine) temperature sensor and engine lifting eyes.
31. Using valve spring compressor 276102 or a suitable alternative, remove the valve and spring assemblies, keeping them identified with their original locations for possible refitting. Discard the valve spring and valve guide oil seals. Remove carbon deposits from the valves and combustion chambers and degrease all parts ready for examination.



ST673M

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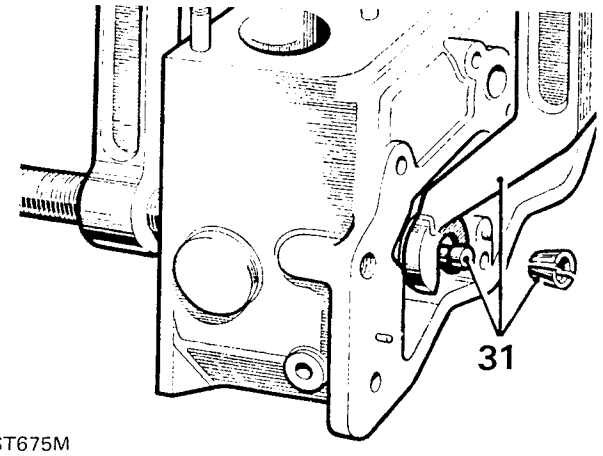
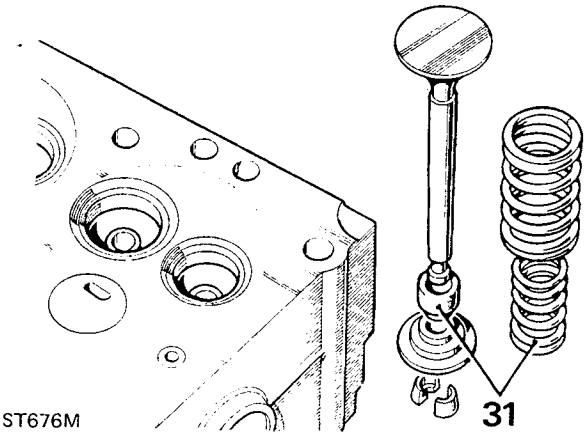


ST675M



ST676M

EXAMINATION OF COMPONENTS

Petrol engine

32. Examine the cylinder head for cracks and distortion. Burnt, pitted and pocketed seats must be repaired.

Diesel engine

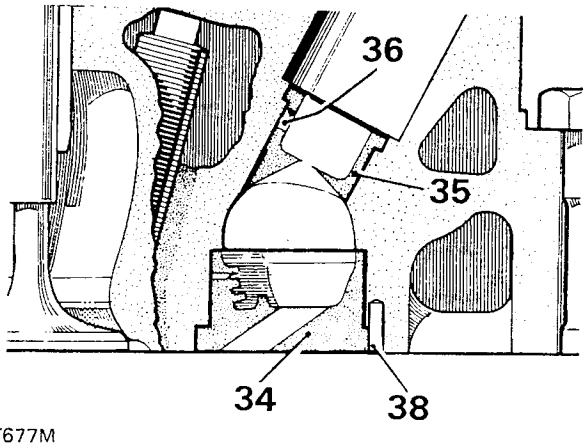
33. Same as for petrol engine and in addition, worn or damaged exhaust seat inserts should be renewed, as described later.

Hot plugs and injector shrouds — examine and renew

When carrying out normal top overhaul work on the cylinder head it is not necessary to remove either the injector shrouds or the hot plugs.

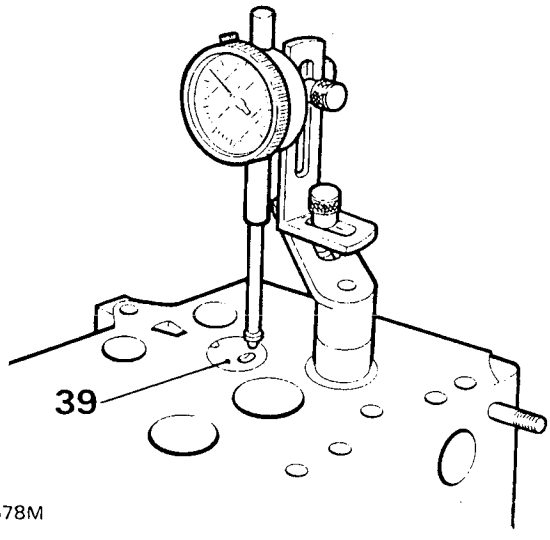
Small surface cracks in the hot plug, extending from the opening to approximately 8,0 mm (0.312 in) in length can be ignored. However if any severe cracks appear on the face of the hot plug, before attempting to remove it, closely inspect the cylinder head for signs of cracks, particularly between the inlet and exhaust valve seats. Such cracking indicates that the engine has overheated, usually through lack of coolant, and the cylinder head should be scrapped.

34. To remove a hot plug, insert a thin soft metal drift through the injector shroud throat and tap the hot plug from the inside. Once removed a faulty hot plug cannot be restored and must be renewed.
35. If the injector shroud is damaged, drift the shroud out towards the injector bore.
36. Thoroughly clean out the combustion chamber. The hole in the side of the injector shroud is for manufacturing purposes only but at the same time can be used as a guide when refitting the shroud.
37. Smear a little oil on the shroud and insert into the cylinder head with the hole pointing towards the centre of the cylinder head, and drift into position.



ST677M

38. Fit the hot plugs by tapping with a hide-faced mallet, and locate with a new roll pin. If the hot plugs are loose in the cylinder head they may be retained with a little grease.
39. When fitted, the hot plugs must be checked with a dial test indicator to ensure that they do not protrude above the level of the cylinder head face more than 0,025 mm (0.001 in) and are not recessed below the level of the cylinder head face more than 0,05 mm (0.002 in).



ST678M

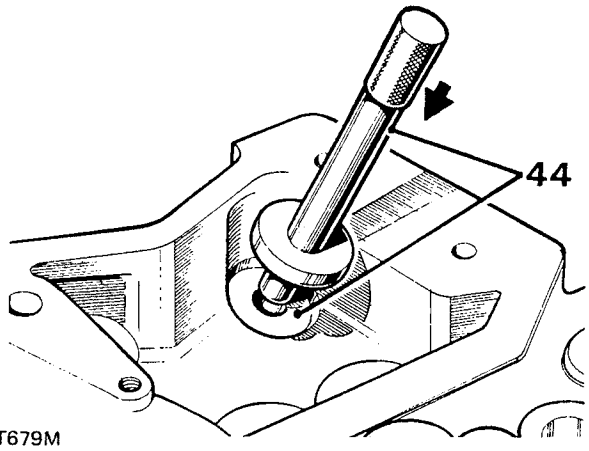
Petrol and diesel engines

40. Check the valve guides for wear by inserting a new valve in the appropriate guide 8 mm above the seat. If movement across the head exceeds 0,15 mm (0.006 in) renew the guide.
41. Inspect the valves and discard any that are burnt, bent or distorted. Check the stems for wear by inserting in a new guide. If wear is excessive, discard the valve. Valve faces that are pitted or ridged but otherwise serviceable may be refaced.
42. Renew push rods that are bent or have worn or scored ball or socket ends.

Renew push rod tube seals (Diesel only)

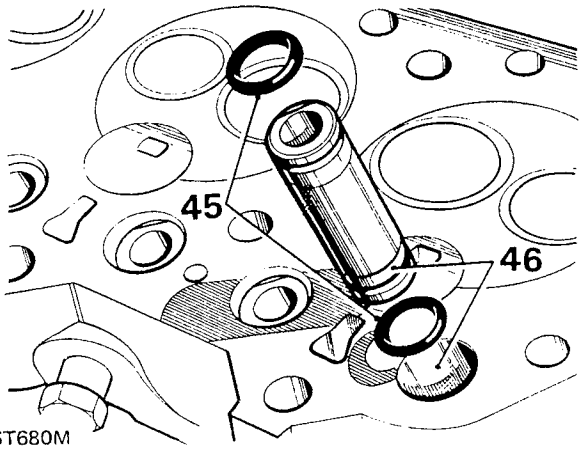
43. Whilst this is rarely necessary the procedure is nevertheless as follows.
44. Drive out the old push rod tubes using a suitable drift.

NOTE: Later engines are fitted with tubes without seals. See 2.5 litre Diesel engine for renewal.

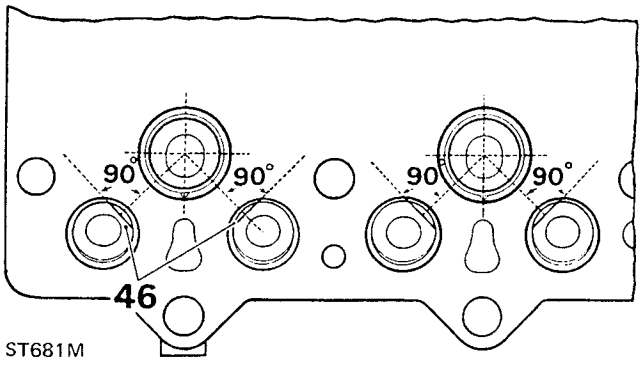


ST679M

45. Fit new sealing rings to new push rod tubes and smear with silicone MS4 grease.
46. Insert the new tubes, chamfered end first from the combustion chamber side. Align the flat on the push rod tube at right angles to an imaginary line between the centre of the push rod tube and centre of the hot plug.
47. Press the push rod tubes into position whilst maintaining the alignment. Also ensure that the chamfers on the tubes and in the cylinder head are fully engaged.



ST680M

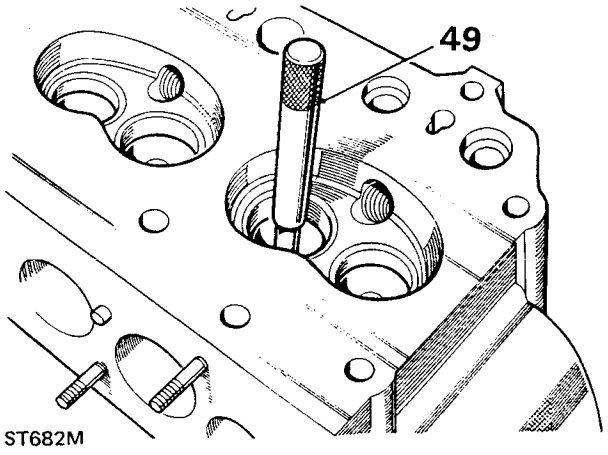


ST681M

Renew valve guide

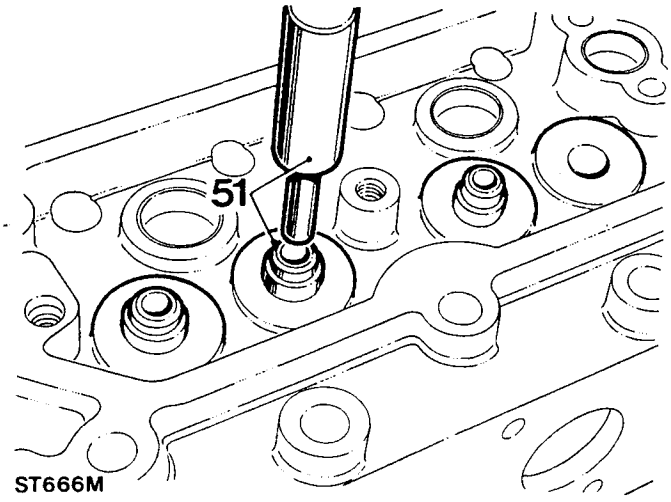
48. Support the cylinder head, combustion chamber uppermost on pieces of timber of sufficient thickness to allow clearance for the valve guides to be driven out.
49. Using special drift 274400 for inlet guides and 274401 for exhaust guides or suitable alternatives drive out the old guides from the combustion face side.

NOTE: The illustration shows a petrol engine cylinder head.



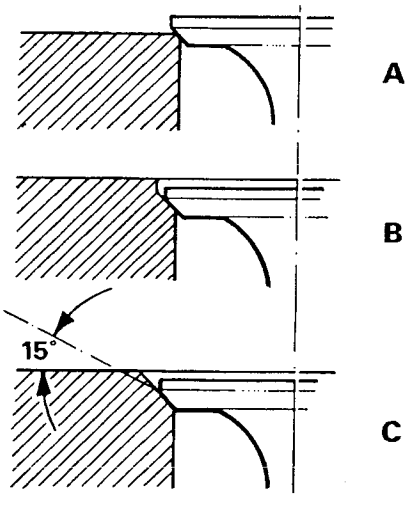
ST682M

50. Turn the cylinder head over so the combustion chambers face downwards. Since the inlet and exhaust valve guides are dimensionally different it is important that the correct guides are fitted to the appropriate ports.
51. Lubricate new guides with engine oil and using special drift 600959 for the exhaust and 601508 for the inlet valve guides or suitable alternatives, drive in the new guides until the shoulder is flush with the casting.



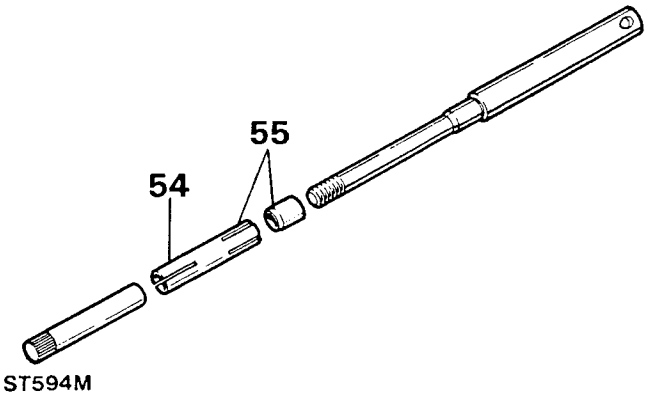
Reface cylinder head valve seats

52. Damaged or worn valve seats can be refaced provided they are not abnormally wide due to repeated refacing operations. See instruction 64.



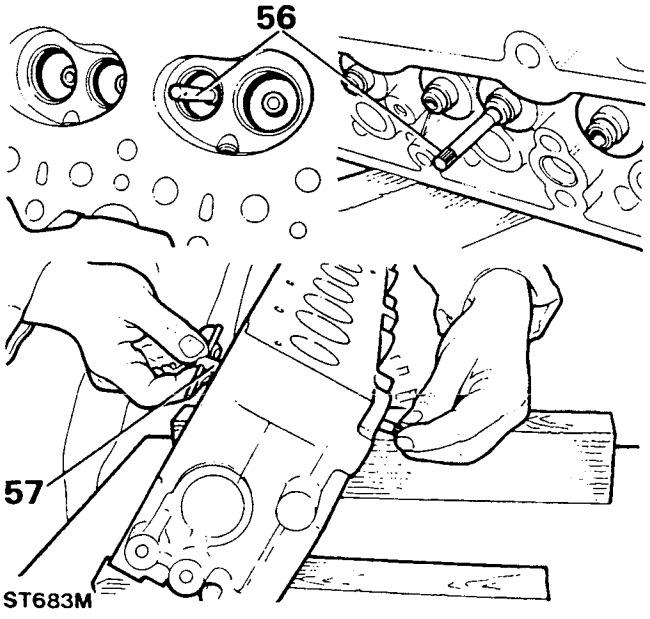
A. Correctly seated valve
B. Undesirable condition
C. Method of rectification

53. The special set of hand tools recommended for refacing include expandable pilots that fit tightly into new or worn guides to ensure that the valve seat is concentric with valve guide. The refacing tool has tungsten carbide cutters and can be used to cut a seat in a new exhaust seat insert.
54. Select the correct expandable collet for the valve guide concerned i.e. 8 mm for inlet guides and 8,5 mm for exhaust.
55. Loosely assemble the collet, expander and nuts. Ensure that the chamfered end of the expander is towards the collet.



56. Insert the assembled pilot into the valve guide from the combustion face side of the cylinder head until the shoulder contacts the valve guide and the whole of the collet is inside the valve guide.
57. Expand the collet in the guide by turning the tommy bar clockwise whilst holding the knurled nut.
58. Select the appropriate angled cutter for the seats to be cut.

continued

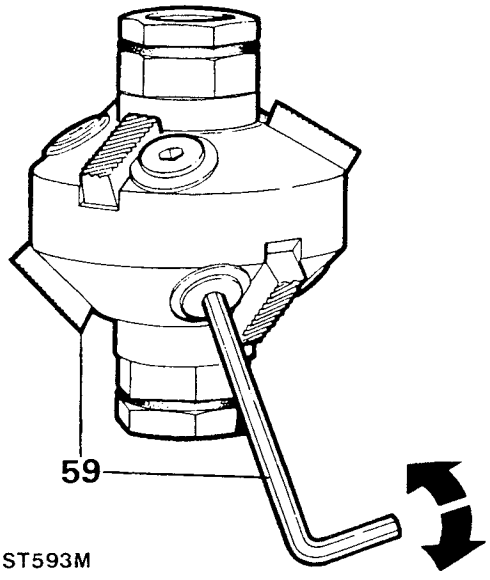


NOTE: MS 621 is a 45° and 15° cutter and MS 627 is 30° only.

A — Petrol engine — inlet valve seat 30° + ¼°
exhaust valve seat 45° + ¼°
B — Diesel engine — inlet valve seat 45° + ¼°
exhaust valve seat 45° + ¼°

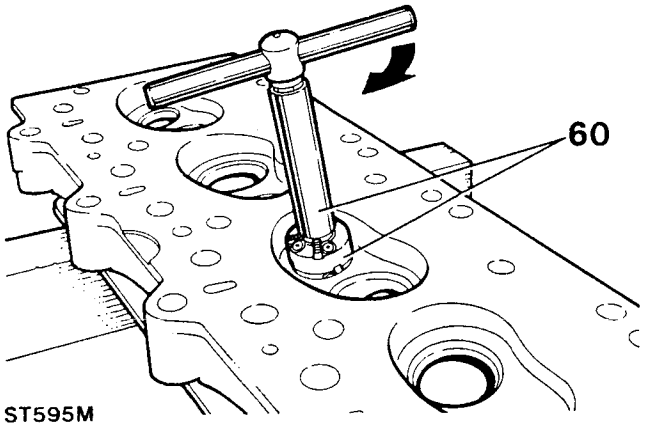
See illustrations following instruction 68.

59. Ensure that the cutter blades are correctly fitted to the cutter head with the angled end of the blade downwards facing the work, as illustrated. Check that the cutter blades are adjusted so that the middle of the blade contacts the area of material to be cut. Use the key provided in the hand set MS 76.



ST593M

60. Fit the wrench to the cutter head and turn clockwise using only very light pressure. Continue cutting to approximately the centre of the existing seat.

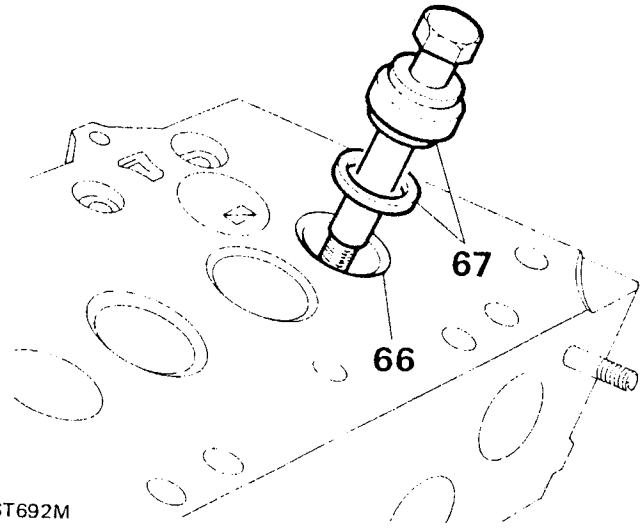


ST595M

61. To check the effectiveness of the cutting operation use engineers' blue or a feeler gauge made from cellophane.
62. Smear a small quantity of engineers' blue round the valve seat and revolve a properly ground valve against the seat. A continuous fine line should appear round the valve. If there is a gap of not more than 12 mm it can be corrected by lapping.
63. Alternatively, insert a strip of cellophane between the valve and seat, hold the valve down by the stem and slowly pull out the cellophane. If there is a drag the seal is satisfactory in that spot. Repeat this in at least eight places. Lapping-in will correct a small open spot.
64. After several trueing-up or lapping-in operations valve seats may have an excessive width which can be reduced by obtaining special correction cutters which narrow the seat by removing metal from the top and bottom of the seat. A 60° cutter is recommended for bottom narrowing and for top narrowing use a 15° cutter (MS 621) for a 30° valve seat and a 30° cutter for a 45° seat. The same method of assembly and operation is used for correction cutters as for refacing cutters. Use very light pressure removing only the minimum material necessary. Once the seats have been reduced carry out the normal refacing operation as previously described.

Renew exhaust seat inserts (Diesel only)

65. Hold the cylinder head firmly in a vice, wear protective goggles and grind the old insert away until thin enough to be cracked and prised out. Take care not to damage the insert pocket.
66. Remove any burrs and swarf from the pocket. Failure to do this could cause the new insert to crack when being fitted.
67. Assemble the new insert to the replacer tool number 530625 so that the chamfered edge of the insert is leading. Using a suitable bolt and nut draw the insert into the cylinder head pocket. Cut a new 45° seat using cutter MS 621.



ST692M

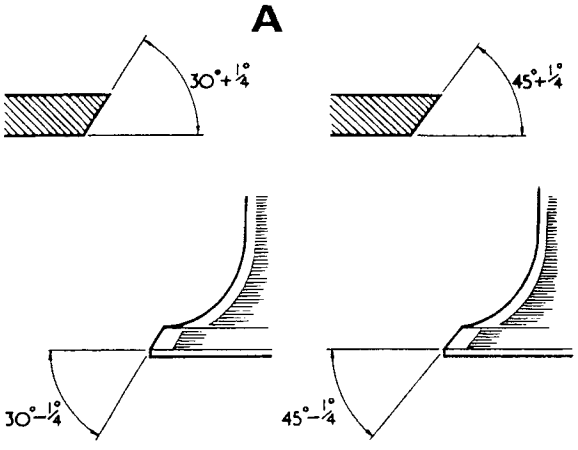
Reface valve faces

68. Valves that are satisfactory for further service can be refaced. This operation should be carried out using a valve grinding machine. Only the minimum of material should be removed from the valve face to avoid thinning of the valve edge. The valve is refaced correctly when all pits are removed and the face concentric with the stem.

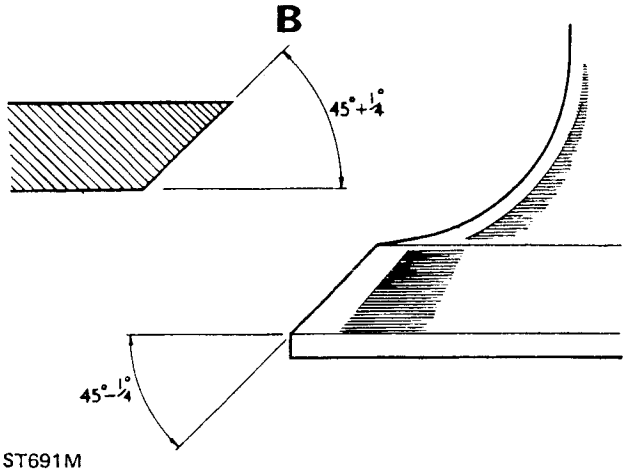
Valve face angles:

A. Petrol engine
Inlet valve face — 30° — ¼°
Exhaust valve face — 45° — ¼°

B. Diesel engine
Inlet valve face — 45° — ¼°
Exhaust valve face 45° — ¼°



ST690M

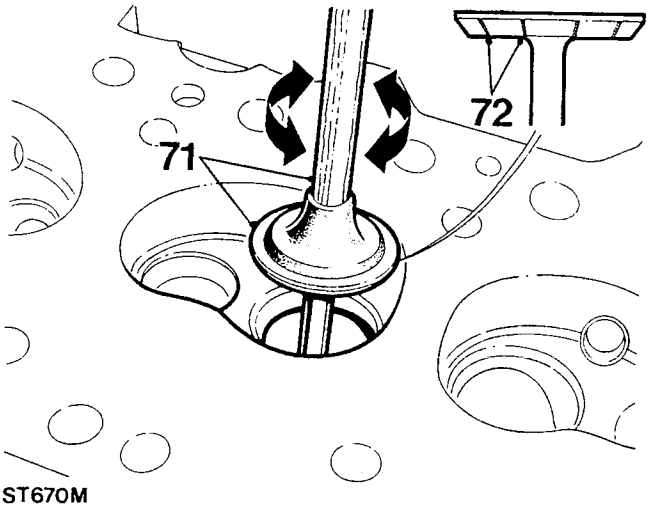


ST691M

Lap-in valves

69. To ensure a gas tight seal between the valve face and valve seat it is necessary to lap-in the appropriate valve to its seat. It is essential to keep the valve identified with its seat once the lapping-in operation has been completed. Remember that the inlet and exhaust valves in the petrol engine have different face angles.
70. Unless the faces to be lapped are in poor condition it should only be necessary to use fine valve lapping paste. Smear a small quantity of paste on the valve face and lubricate the valve stem with engine oil.
71. Insert the valve in the appropriate guide and using a suction type valve lapping tool employ a light reciprocating action while occasionally lifting the valve off its seat and turning it so that the valve returns to a different position on the seat.
72. Continue the operation until a continuous matt grey band round the valve face is obtained. To check that the lapping operation is successfull, wipe off the valve paste from the valve and seat and make a series of pencil lines across the valve face. Inset the valve into the guide and while pressing the valve onto the seat revolve the valve a quarter turn a few times. If all the pencil lines are cut through no further lapping is required.
73. Wash all traces of grinding paste from the valves and cylinder head seats.

continued



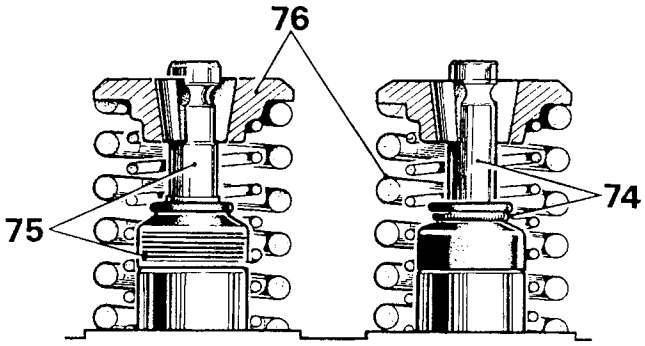
ST670M

Assemble valves to cylinder head

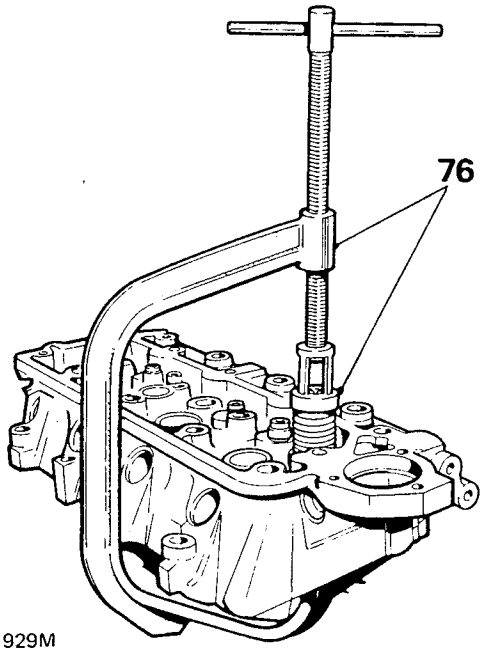
74. Insert the inlet valves into the guides and fit new oil seals with the plain exterior and circular spring. Ensure that the seal locates in the groove in the valve guide.
75. Insert the exhaust valves and fit the oil seals with the ridged exterior and no spring.

continued

76. Fit the double valve spring and retainer assembly to each valve in turn and using valve spring compressor, 18G106A with adaptor 18G106A/10 secure the assembly with the split collets.



ST669M



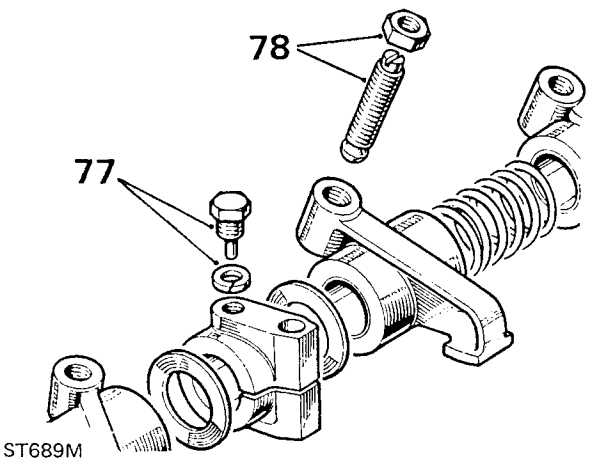
ST 929M

OVERHAUL ROCKER SHAFT ASSEMBLY

Most of the rocker shaft assembly components are not interchangeable between the petrol and diesel engines although the assembly method is the same.

Dismantle and inspection

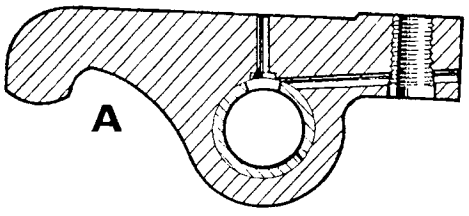
77. Remove the locating screw and washer from the number two rocker bracket and withdraw all the components from the rocker shaft. Note that on the petrol engine the locating screw also retains a splash plate.
78. Remove the locknuts and adjustment screws from the rockers.

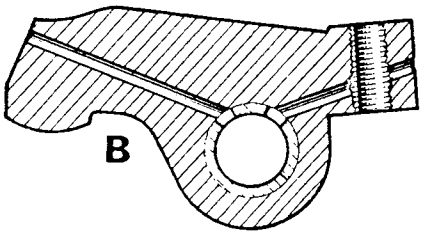


ST689M

79. Examine the rocker shaft for wear and discard if the bearing surface is worn more than 0,025 mm (0.001 in).
    Inspect the rockers and discard if the pads are worn. It is not permissible to grind pads in an attempt to reclaim the rockers.
80. Renew bushes if the clearance between shaft and bush is in excess of 0,101 to 0,127 mm (0.004 to 0.005 in).
    Press in replacements ensuring that the pre-drilled oil holes coincide with the holes in the rockers.

    Illustration A. Cross section of petrol engine rocker.
    Illustration B. Cross section of diesel engine rocker.





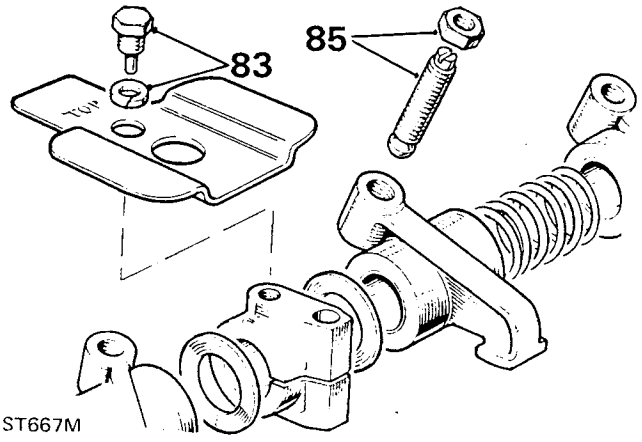
ST684M

81. Using a reamer finish the bushes to 13,4 mm + 0,02 mm (0.530 in + 0.001 in) and clear swarf from the oil holes.
82. Examine the ball-end of the adjusting screws and discard any that are worn. Regrinding is not permissible. Check the threads for damage and that the oil relief drilling is clear.

Assemble rocker shaft assembly

83. Check that the oil-ways in the rocker shaft are clear and fit number two rocker shaft bracket to the shaft and retain with the locating screw and washer. Note that the locating screw on petrol engines also secures the splash plate.

84. Using new spacers and springs, assemble the rockers and brackets to the shaft as illustrated, ensuring that the rockers move freely on the shaft. Note that the Diesel engine assembly has double spacers each side of the centre pedestal.

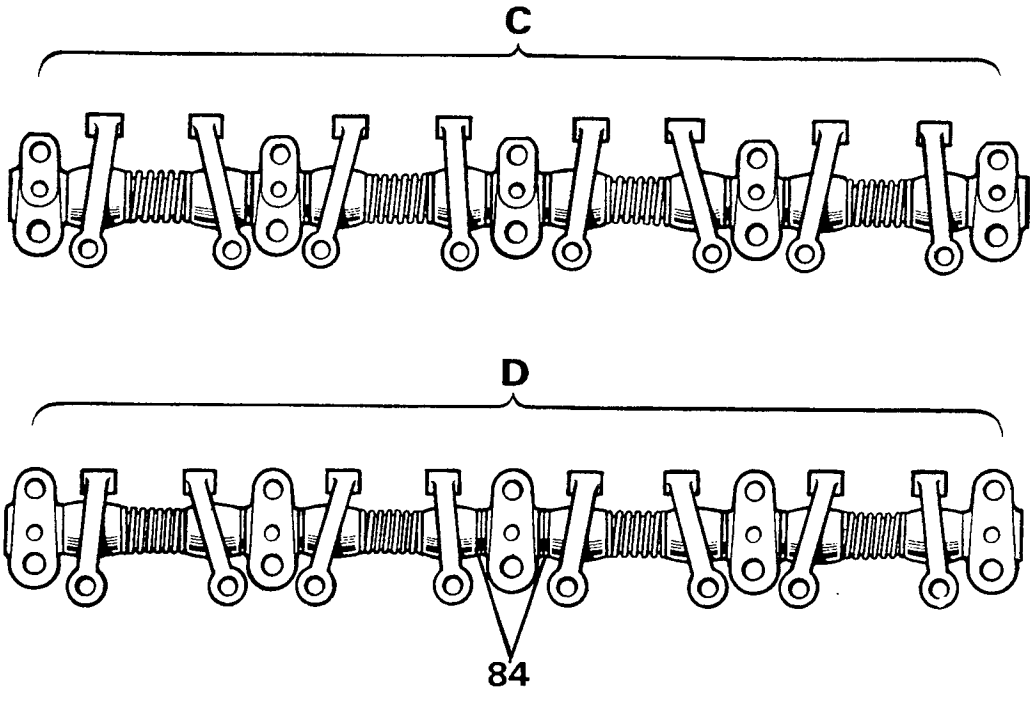


ST667M

Illustration C. Petrol engine assembly.
Illustration D. Diesel engine assembly.

85. Fit the tappet adjustment screws and lock nuts to the rockers.
86. Invert the rocker assembly and locate it on the rocker cover to prevent it falling apart.

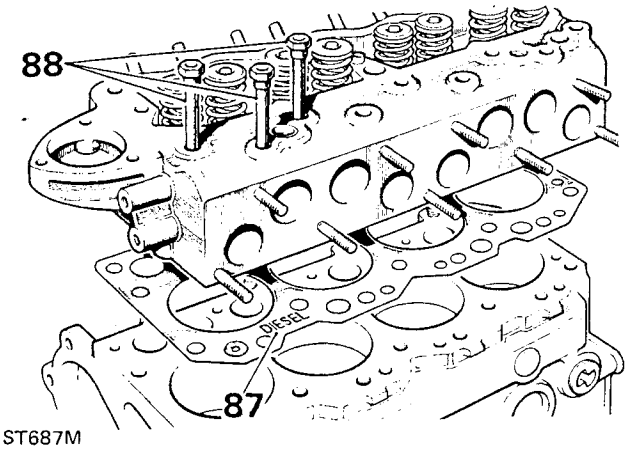
continued



ST688M

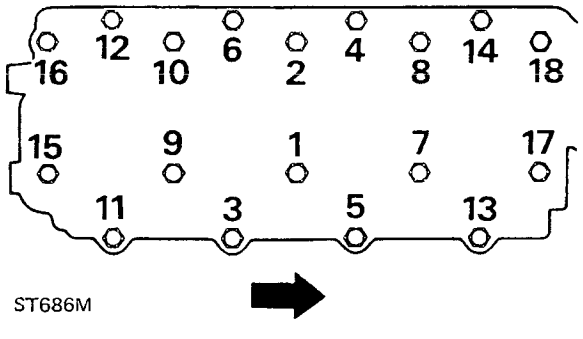
Fit the cylinder head

87. Clean the cylinder head and cylinder block mating faces and fit a new gasket, dry, without grease or sealing compound. The gasket will have either 'DIESEL' or 'PETROL' stamped in the position illustrated and the gasket must be fitted with these uppermost.
88. Place the cylinder head in position and engage all the cylinder head bolts and washers except those used to secure the rocker assembly. **Use new bolts and ensure that the correct bolts for the petrol and diesel engine are fitted. They are not interchangeable.**



ST687M

89. Insert the push rods into position ensuring that the ball-ends fit correctly into the spherical seats in the tappet slides.
90. Fit the rocker shaft assembly ensuring that the hole in the front and rear rocker bracket locates properly in the corresponding dowel in the cylinder head. Also, make sure that the ball-end of all the rockers fit into the spherical seats of the push rods. Evenly tighten the rocker shaft retaining bolts to the correct torque.
91. Tighten the cylinder head and rocker shaft securing nuts and bolts strictly in the sequence illustrated to avoid distortion of the cylinder head. Tighten to the torque figures given in the data section. The arrow points to the front of the engine.

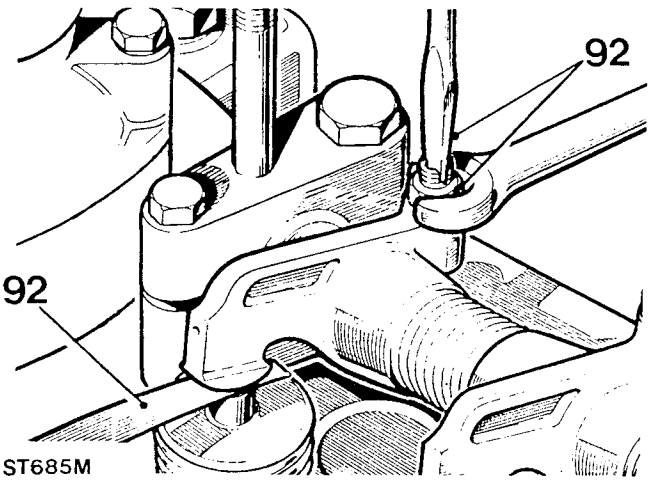


ST686M

92. Adjust the tappet clearances for petrol and diesel engines, inlet and exhaust to 0,25 mm (0.010 in) as follows: Using a feeler gauge adjust the clearance by slackening the locknut and turning the tappet adjusting screw clockwise to reduce clearance and anti-clockwise to increase clearance.

Set No. 1 tappet with No. 8 valve fully open.
Set No. 3 tappet with No. 6 valve fully open.
Set No. 5 tappet with No. 4 valve fully open.
Set No. 2 tappet with No. 7 valve fully open.
Set No. 8 tappet with No. 1 valve fully open.
Set No. 6 tappet with No. 3 valve fully open.
Set No. 4 tappet with No. 5 valve fully open.
Set No. 7 tappet with No. 2 valve fully open.

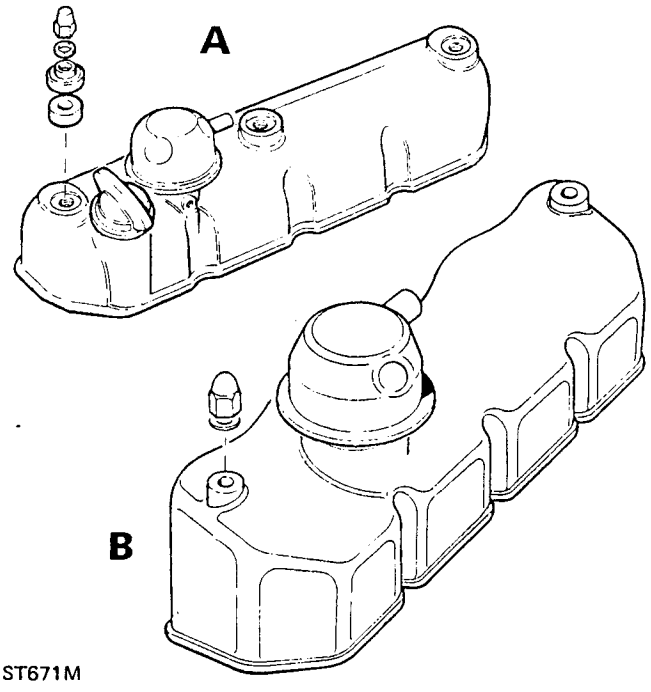
93. Recheck the clearances with the locknuts tightened and adjust as necessary.



ST685M

94. Using a new gasket fit the rocker cover and secure with the rubbers, cups and dome nuts. Tighten to the correct torque figure. Do not over-tighten.

A. Petrol, B. Diesel

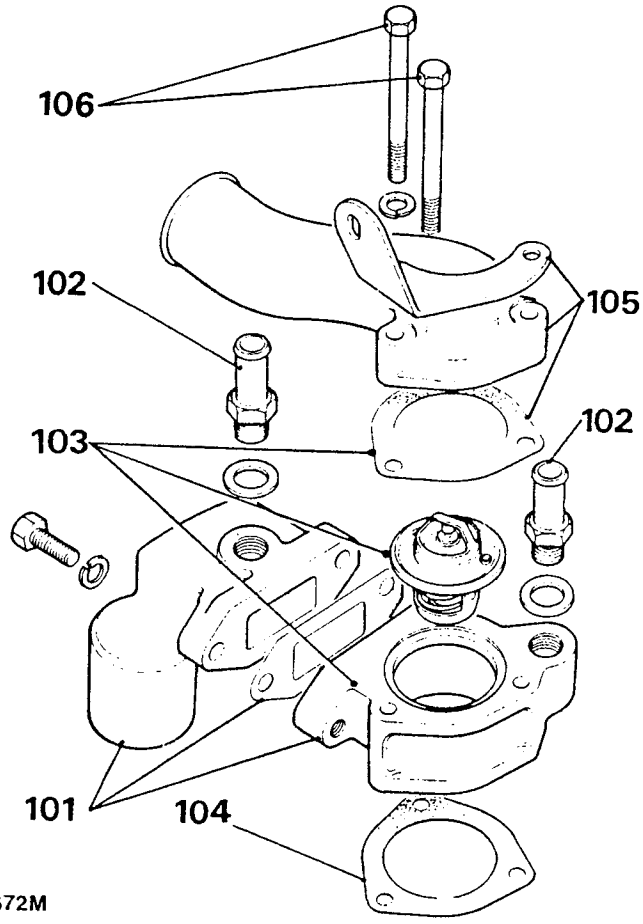


ST671M

95. Fit the inlet and exhaust manifolds complete with carburetter (petrol engine). See Engine overhaul.
96. Fit the air intake and exhaust manifolds (diesel engine). See Engine overhaul.
97. Fit the spark plugs (petrol engine).
98. Fit the injectors — see Diesel fuel system.
99. Fit the engine lifting eyes.
100. Fit the water temperature sensor.

Fit the thermostat housing assembly

101. Using a new joint washer secure the thermostat housing to the by-pass housing.
102. Fit the two hose adaptors.
103. Insert the thermostat into its housing.
104. Place a new joint washer on the cylinder head.
105. Using a new joint washer fit the thermostat cover and cowl mounting bracket.
106. Using the three bolts secure the complete assembly to the cylinder head. Note that one bolt is shorter and is fitted in-board.



ST672M

107. Refit or reconnect the items disturbed for access to the cylinder head.
108. Refill the cooling system when engine is refitted to vehicle.

2.5 LITRE PETROL ENGINE

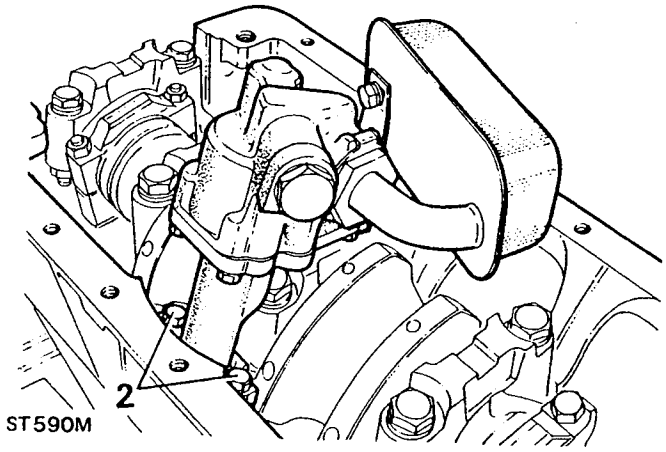
SUPPLEMENT TO THE 2.25 LITRE PETROL ENGINE OVERHAUL PROCEDURES

This Supplement should be used in conjunction with the 2.25 litre petrol engine overhaul procedures. Details of the differences between the 2.25 and 2.5 litre engines are listed below. Some of the new features were, however, introduced on later 2.25 petrol engines.

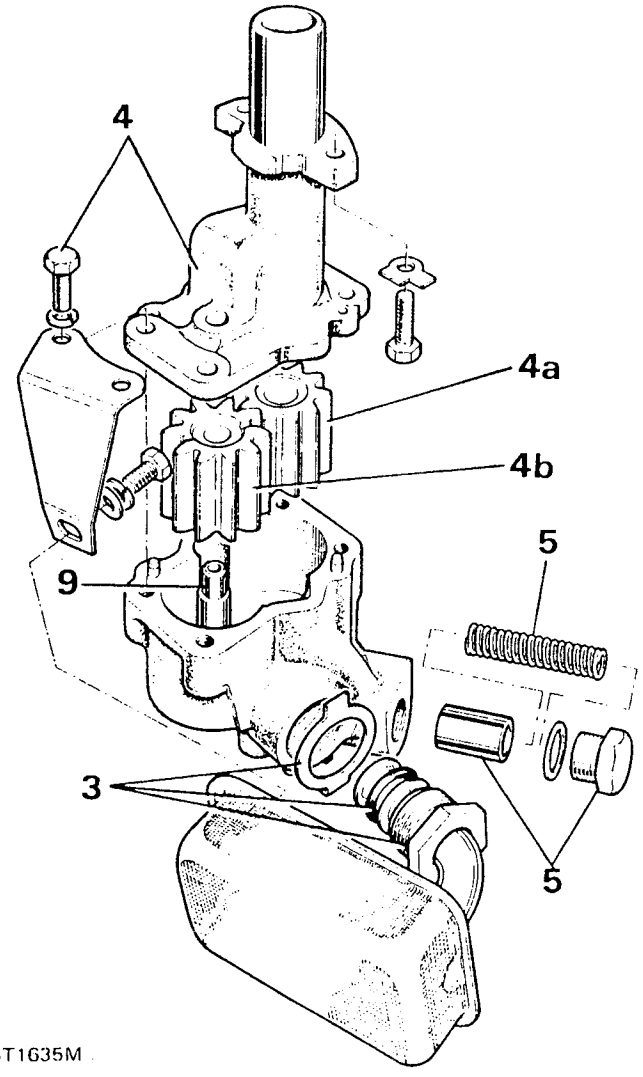
- Capacity increased to 2495 cc by lengthening the piston stroke from 89 mm to 97 mm.
- Crankshaft and main bearings same as the 2.5 litre Diesel engine.
- Oil squirt hole in connecting rods deleted.
- New pistons with controlled expansion skirts.
- Camshaft same as 2.5 litre Diesel engine.
- Camshaft sprocket similar to 2.25 litre petrol engine, but with a single keyway positioned to alter the exhaust value peak from 109° to 104°.
- Inserts fitted to exhaust valve seats in cylinder head.
- New timing chain tensioner assembly.
- Modified oil pump with gear having only ten teeth. Bush deleted from idler gear and ball ommitted from the pressure relief valve.
- The 'O' ring seal between the flywheel housing and cylinder block deleted. Sealing now achieved by a bead of sealant on the flywheel housing mating face with the cylinder block.
- Sump joint washer deleted and a liquid sealant, RTV Hylosill 102, now used.
- The Lucas 45 D4 sliding contact distributor now used.

REMOVE AND OVERHAUL OIL PUMP

1. Remove the sump.
2. Bend back the lock washers and remove the two bolts securing the oil pump to the crankcase. Withdraw the oil pump complete with strainer and oil pump drive shaft.



ST590M



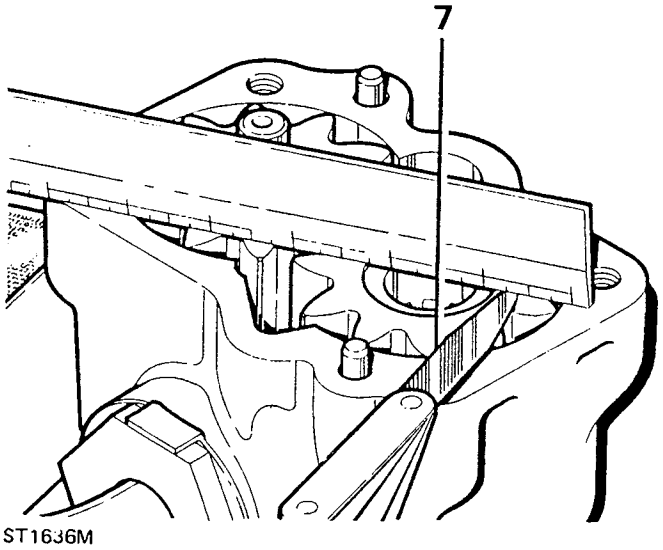
ST1635M

Dismantle oil pump

3. Bend back the lock washer and release the nut securing the strainer to the oil pump body and remove the strainer and sealing ring.
4. Remove four bolts and washers and lift off the oil pump cover and lift out the driven and idler gears.
   (a) driven gear
   (b) idler gear
5. Remove the oil pressure relief valve plug and sealing washer. Withdraw the relief valve spring and plunger.

Overhaul the oil pump

6. Examine the gears for wear, scores and pits. If the gears appear serviceable check for end-float as follows:
7. Clean the pump body and assemble the gears. Place a straight edge across the pump body face, as illustrated, and using a feeler gauge, measure the clearance between the body and gears and the backlash between the gears. The correct clearances are given in Data.

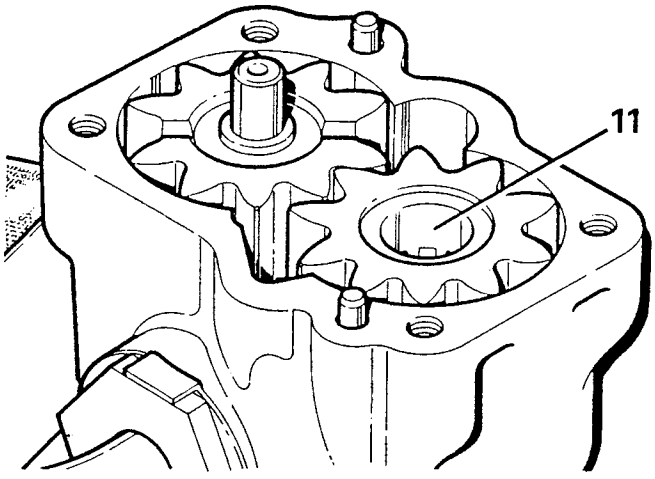


ST1636M

8. Gears must be renewed in pairs. A worn, but serviceable gear, must not be matched with a new one.
9. If necessary renew idler gear spindle by drilling-out the peened over end of the spindle so that the spindle can be withdrawn from the pump body. To ensure squareness when fitting the new spindle, assemble it into the pump body with the two gears. Fit the cover and secure with the four bolts. Support the pump body and peen over the end of the new spindle. Remove the cover and gears and check security of the spindle.

Assemble the oil pump

10. Fit the idler gear to the spindle.
11. Fit the driven gear with plain part of the bore uppermost. See illustration after instruction 9.

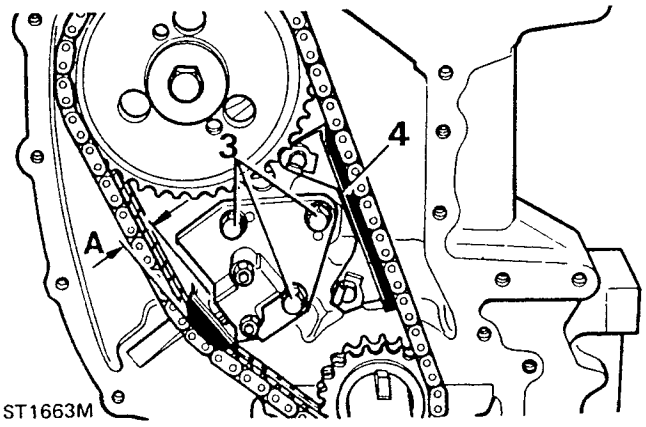


ST1637M

12. Smear the joint face of the body with jointing compound and fit the cover over the dowels and secure with the four bolts and spring washers.
13. Hold relief valve bore vertically and insert the plunger with the solid end first. Fit the spring, sealing washer and plug.
14. Fit the oil strainer sealing ring to the pump body followed by the lock washer and strainer. Tighten the strainer retaining nut so that when fitted the strainer is positioned parallel to the sump baffle plate. Secure the nut with the lock washer tab.

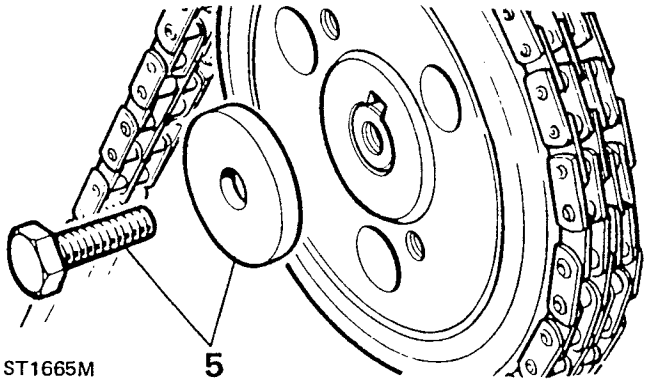
REMOVE AND OVERHAUL THE TIMING CHAIN SPROCKETS AND TENSIONER

1. Remove the bolts and withdraw the timing cover.
2. Before removing the timing chain tensioner check dimension 'A', which with a new chain and sprockets should be 14,22 mm (0.5 in) approximately. This will give an indication of chain wear. The dimension for a fully worn chain is 27 mm (1.06 in).
3. Remove the three bolts and whilst holding the pad inwards, to prevent it falling apart, remove the tensioner assembly.
4. Remove timing chain damper.



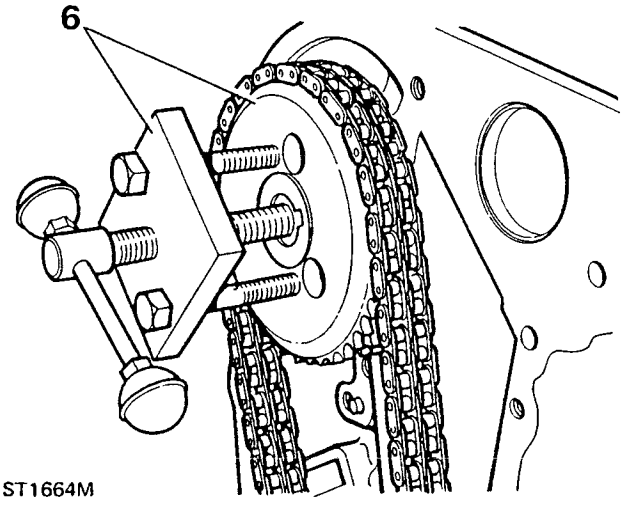
ST1663M

5. Remove the camshaft sprocket retaining bolt and washer.



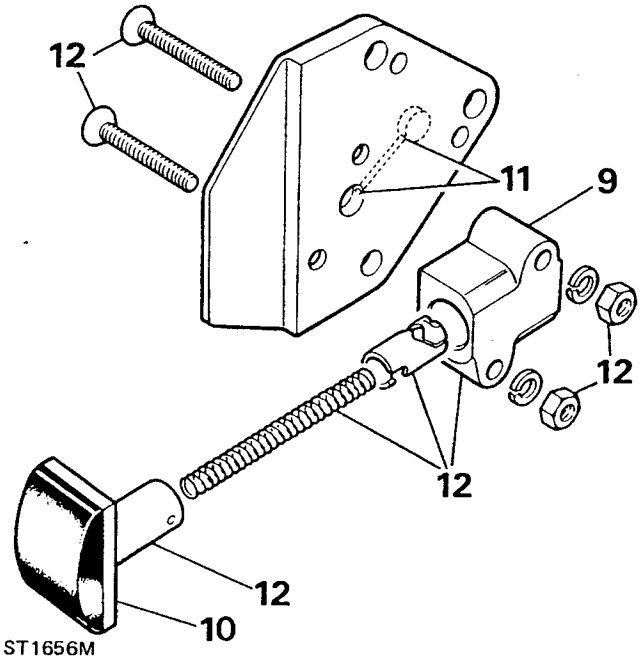
ST1665M

6. Withdraw the camshaft sprocket together with the timing chain and crankshaft sprocket. If necessary use special tool 507231.



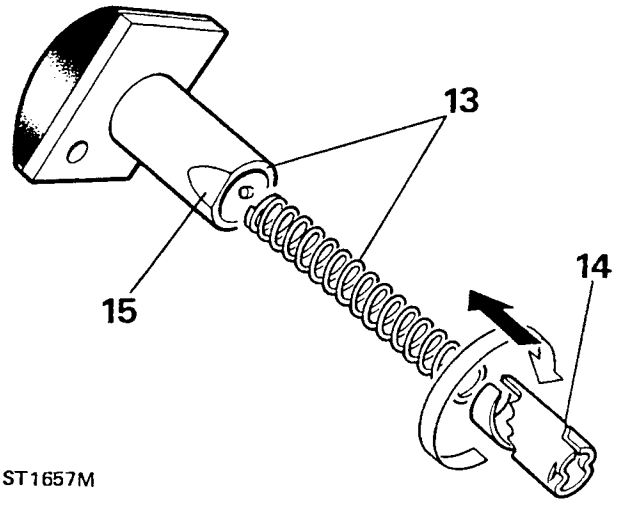
ST1664M

7. Examine the sprockets and discard if the teeth are worn.
8. Dismantle the tensioner assembly and discard if any of the parts are worn.
9. Examine the tensioner body and check that the oil inlet hole is clear.
10. Examine the slipper and check that the oil outlet hole is clear.
11. Check that the oil inlet and exit oil hole in the tensioner mounting plate is clear.



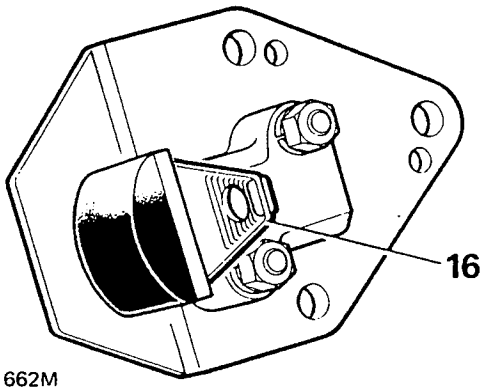
ST1656M

12. Assemble the tensioner body to the mounting plate with the two socket headed screws, spring washers and nuts.
13. Insert the spring into the slipper bore.
14. Fit the ratchet over the spring and against spring pressure, insert the ratchet into the slipper bore so that the groove in the ratchet locates over the small dowel inside the slipper bore. Push and turn the ratchet clockwise until it locks in the bore.
15. Insert the slipper assembly into the tensioner body ensuring that the small flat on the slipper shaft faces the mounting plate.



ST1657M

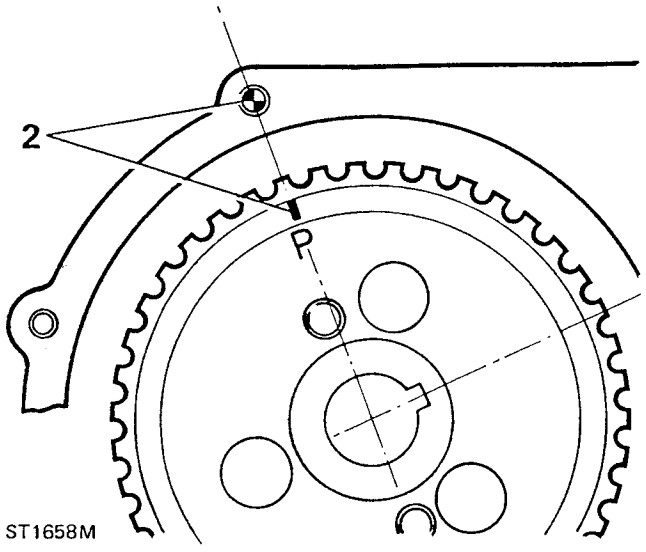
16. To prevent the tensioner releasing, insert a spacer approximately 2.3 mm thick between the tensioner body and back of the slipper prior to fitting to engine.



ST1662M

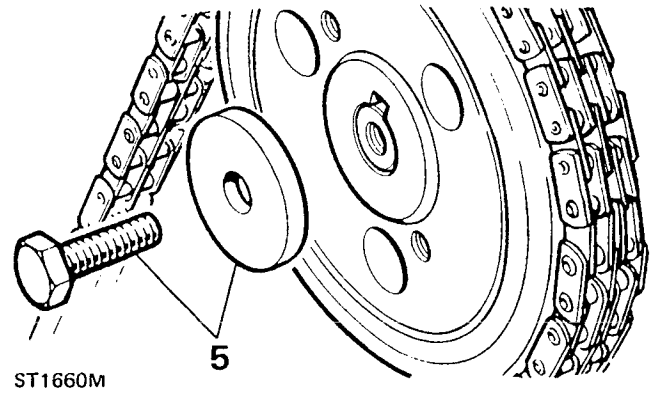
VALVE TIMING

1. Check that numbers one and four pistons are still at T.D.C. and without disturbing the crankshaft, remove the pulley and timing cover.
2. Fit the camshaft sprocket temporally and rotate the camshaft in a clockwise direction until the line on the tooth, also marked with a letter 'P' is in line with the top stud hole on the cylinder block as illustrated.



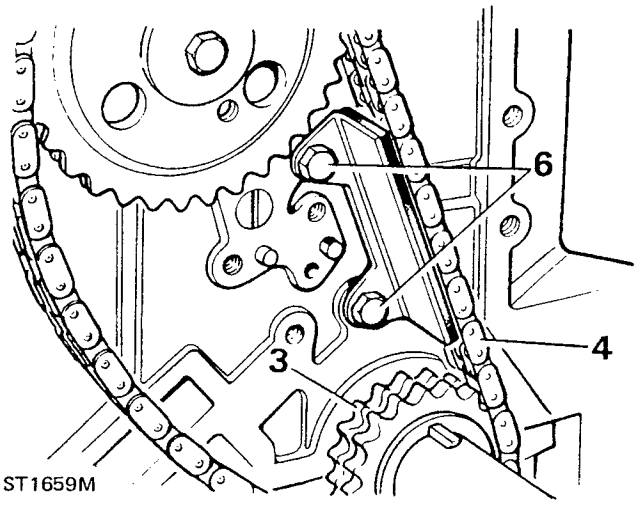
ST1658M

3. Remove the camshaft sprocket.
4. Encircle the camshaft and crankshaft sprockets with the timing chain and keeping it taut on the drive side and with the large shoulder of the crankshaft sprocket towards the cylinder block, fit the sprockets and chain assembly to the engine.
5. Secure the camshaft sprocket to the camshaft with a new special micro encapsulated treated bolt and tighten to the correct torque figure.



ST1660M

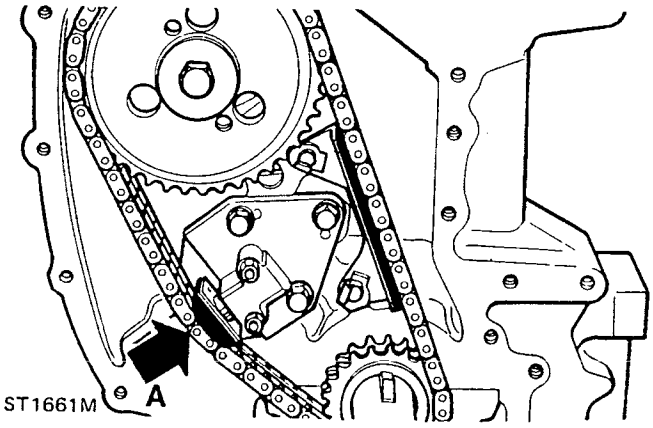
6. Fit and adjust the timing chain damper so that there is a maximum clearance of 0,25 mm (0.010 in) between the timing chain and damper. Tighten the retaining bolts and secure with new lock tabs.



ST1659M

FIT TIMING CHAIN TENSIONER

1. Fit the timing chain tensioner and mounting plate assembly to the cylinder block locating it over the two dowels.
2. Secure the assembly with the three bolts and evenly tighten.
3. Remove the spacer and to release the ratchet, to tension the chain, press the pad at point 'A'.



ST1661M

RENEW EXHAUST VALVE SEAT INSERTS

1. Hold the cylinder head firmly in a vice, wear protective goggles and grind the old insert away until thin enough to be cracked and prised out. Take care not to damage the insert pocket.
2. Remove any burrs and swarf from the pocket. Failure to do this could cause the new insert to crack when being fitted.

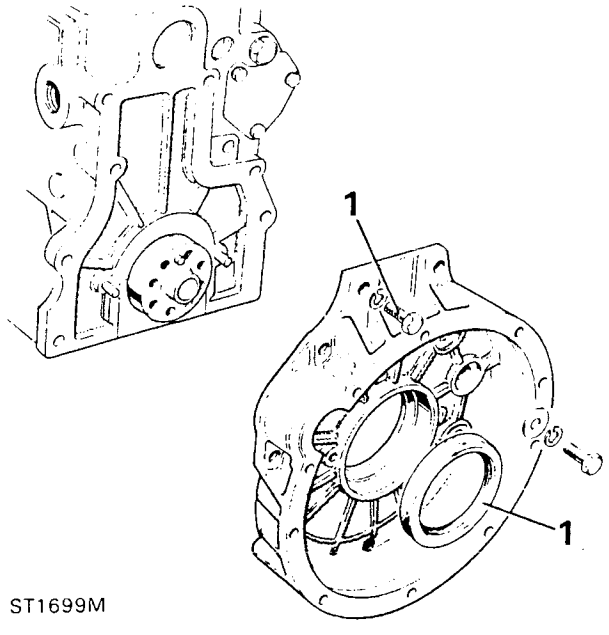
NOTE: Since no special tool is available for fitting a new insert, it is recommended that this work is entrusted to a cylinder head overhaul specialist.

FITTING PISTONS AND CONNECTING RODS

The delection of the oil spray hole in the connecting rod precludes the necessity of fitting this towards the camshaft side of the engine. See page 18 instruction 5.

REMOVE AND REFIT FLYWHEEL HOUSING AND REAR MAIN OIL SEAL

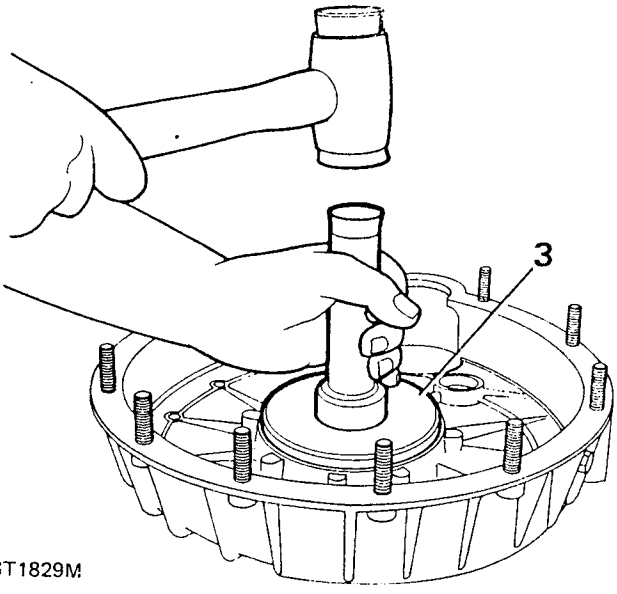
1. Remove the eight bolts securing the flywheel housing to the cylinder block and remove the housing and rear main bearing oil seal.



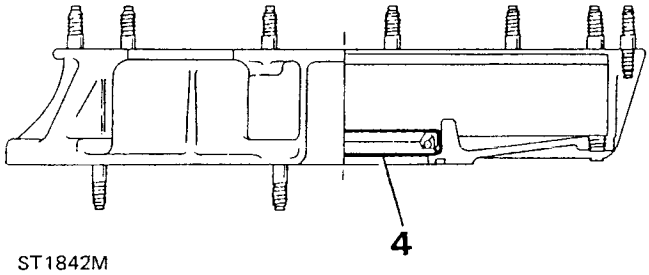
ST1699M

Fit rear main oil seal and flywheel housing

2. Check that the crankshaft oil seal journal is undamaged and clean. Make sure the seal housing is clean and dry and free from burrs. Do not touch the seal lip and ensure that the outside diameter is clean and dry.
3. The P.T.F.E seal Part No ETC 5369 which should be used is supplied with a former to maintain the correct shape and must not be removed until the seal is to be fitted.
4. Using special seal replacer 18G 134-11 and with the lip side leading drive-in the seal as far as the tool allows. If the tool is not available fit the seal to the bottom of the housing to ensure squareness.

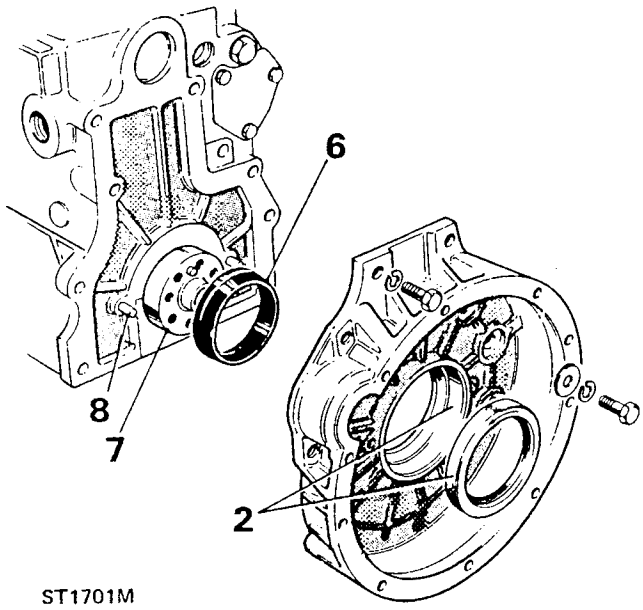


ST1829M

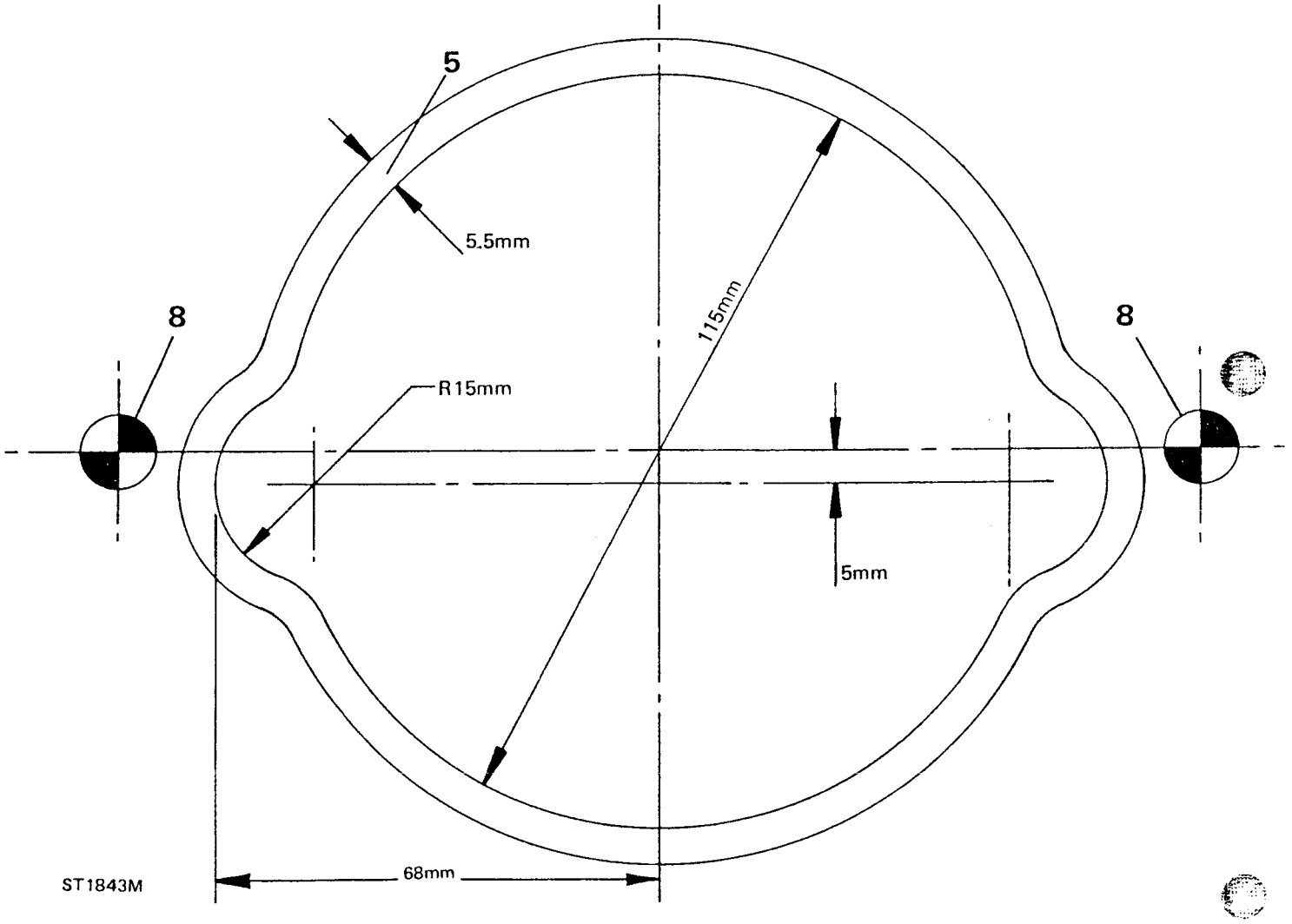


ST1842M

5. Apply a bead of Hylogrip 2000 sealant to the rear face of the flywheel housing to the dimensions and configuration as illustrated below. The illustration has been produced full size so that a template may be made to facilitate the application of the sealant. The bead should be 5,5 mm wide and 0,25 mm thick.
6. Examine the seal guide number 18G 1344 and repair any damage that could destroy the seal lip.
7. Lubricate the outside diameter of the seal guide and the seal journal with concentrated 'Oildag' in a 25% solution with clean engine oil.
8. Place the seal guide on the crankshaft flange and, using the two dowels protruding from the cylinder block rear face as a guide to ensure initial squareness, fit the flywheel housing and remove the seal guide. Secure the flywheel housing evenly tightening the retaining bolts.



ST1701M

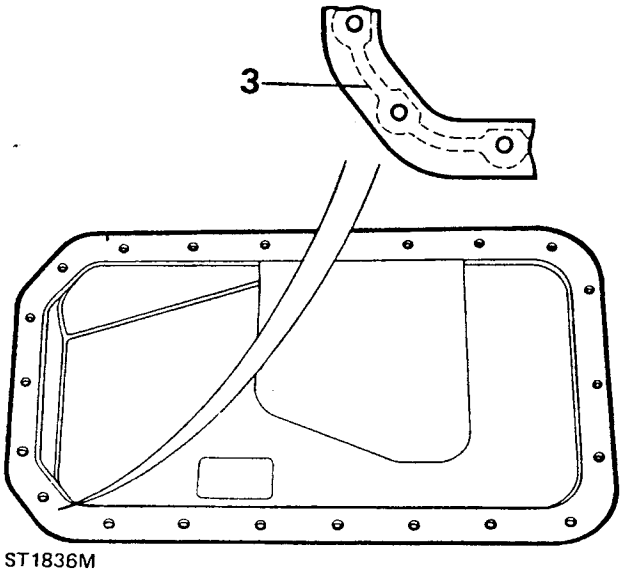


ST1843M

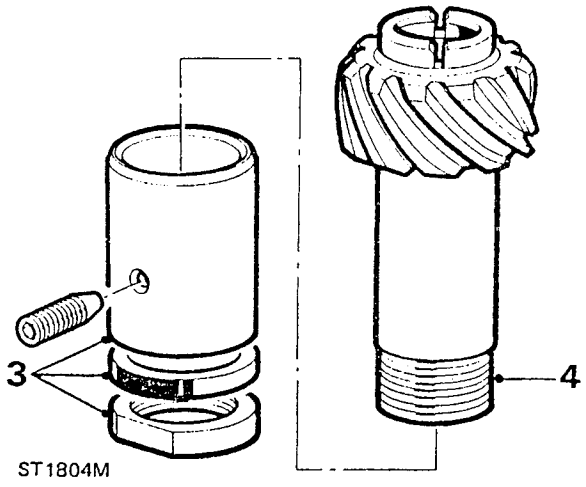
FITTING SUMP

1. Clean the sump and cylinder block mating faces.
2. Apply a bead of RTV HYLOSILL 102 black approximately 7 mm wide to the cylinder block or sump mating face.
3. Fit the sump within 30 minutes of applying sealant and secure with the bolts and tighten evenly to the correct torque.

NOTE: RTV Liquid Sealant is available under part number RTC 3254 from Land Rover Parts and Equipment Ltd.



ST1836M

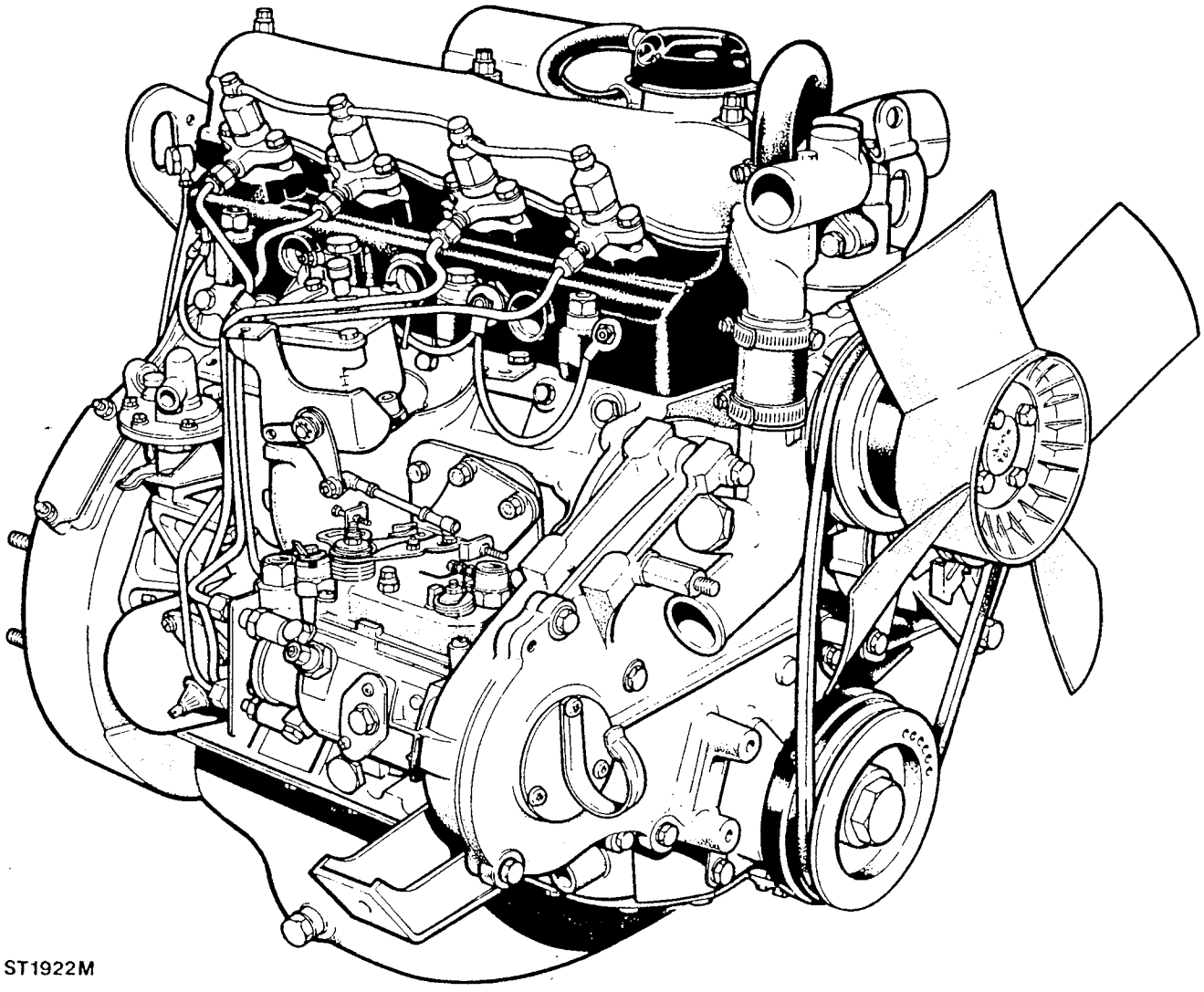


ST1804M

5. The gear should revolve freely in the bush with a clearance of 0,051 to 0,203 mm (0,001 to 0,007 in) between thrust washer and bush.

SKEW GEAR

1. To renew the bush, hold the gear firmly in a vice without damaging the teeth. If possible insert a scrap drive shaft in the gear internal splines and grip the shaft.
2. Turn the locknut clockwise (left-hand thread) to remove and withdraw the thrust washer and bush.
3. Fit a new bush removing any burrs before hand and ensure that the location hole is towards the lower end of the gear.
4. Fit a new thrust washer, if the original is worn or scored. Apply Loctite 601 to the thread and fit the locknut turning anti-clockwise and tighten to 27 - 34 Nm (20 - 25 lbf.ft).



ST1922M

2.5 LITRE DIESEL ENGINE

DISMANTLE AND OVERHAUL

Special tools:
274400 — Drift inlet valve guides
274401 — Drift exhaust valve guides
600959 — Drift exhaust valve guide
601508 — Drift inlet valve guide
MS621 — Seal cutter
530625 — Insert replacer
RO605022 — Clutch centralising tool
270304 — Cork-seal guide
18G 1344 — Seal guide - rear main bearing
18G 134-11 — Seal replacer rear main oil seal
530102A — Crankshaft nut spanner
18G 1457/1 — Dist. pump remover
18G 1464/2/6 — Crankshaft pulley remover
18G 1456 — Crankshaft oil seal replacer
18G 1482 — Camshaft oil seal replacer
18G 1458 — Dist. pump timing tool
MS47 — Press
18G705-1A — Collets
LST107 — Flywheel timing pin

REMOVE ANCILLIARY EQUIPMENT

Remove the engine from the vehicle. Clean the exterior and in the interests of safety and efficient working, secure the engine to a recognised engine stand.
Before commencing, make a careful note of the position of brackets, clips, harnesses, pipes, hoses, filters and other miscellaneous items to facilitate re-assembly.
Removal of the following components is a reversal of the fitting procedure described in engine assembly.

1. Remove the alternator and mounting brackets.
2. Remove the power steering pump and bracket.
3. Remove the fan and pulley.
4. Remove the inlet and exhaust manifolds.
5. Disconnect and remove the fuel supply pipes from the injectors and D.P.S. pump and cover the ports.
6. Disconnect coolant by-pass hose from the water pump, release the seven bolts and remove the water pump.
7. Drain the sump and remove the dipstick.
8. Remove the starter motor.
9. Restrain the flywheel, remove the crankshaft pulley bolt and withdraw the pulley.
10. Evenly slacken and remove the clutch retaining bolts and withdraw the clutch assembly and centre plate.
11. Remove the two bolts and remove the oil filter assembly complete from the cylinder block. Unscrew the filter element and discard.
12. Remove the six bolts and withdraw the rear side plate complete with fuel pump.

REMOVE AND OVERHAUL CYLINDER HEAD

Remove the cylinder head

1. Remove injectors complete with spill rail.
2. Disconnect the heater plug electrical connections.
3. Remove the engine lifting brackets.
4. Disconnect oil gallery pipe at rear of engine.
5. Remove three bolts and lift-off the thermostat housing, elbow and thermostat.
6. Remove the rocker cover and slacken the tappet screw lock nuts. Turn the adjusting screws to release them from the push rods.
7. Remove the rocker shaft retaining bolts, lift-off the rocker shaft assembly, invert it and secure it to the rocker cover studs to prevent the assembly from falling apart, see instruction 25, page 34 2.25 litre Petrol and Diesel engine.
8. Withdraw the push rods and retain them in numbered sequence.
9. Evenly slacken the remaining cylinder head retaining bolts and lift-off the cylinder head.
10. Remove the engine lifting eyes.
11. Using valve spring compressor 276102 or a suitable alternative, remove the valve and spring assemblies keeping them identified with their original locations for possible refitting.
12. Discard the valve spring and valve guide oil seals. Remove carbon deposits from the valves and combustion chambers and degrease all parts ready for examination.

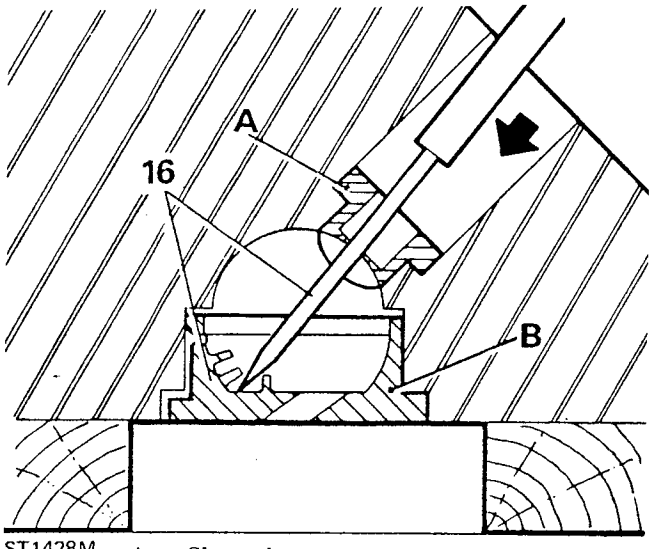
Examine components

13. Examine the cylinder head for cracks and distortion.
14. Burnt, pitted and pocketed seats must be repaired.
15. In addition, worn or damaged valve seats should be renewed, as described later.

Hot plugs and injector shrouds — examine and renew

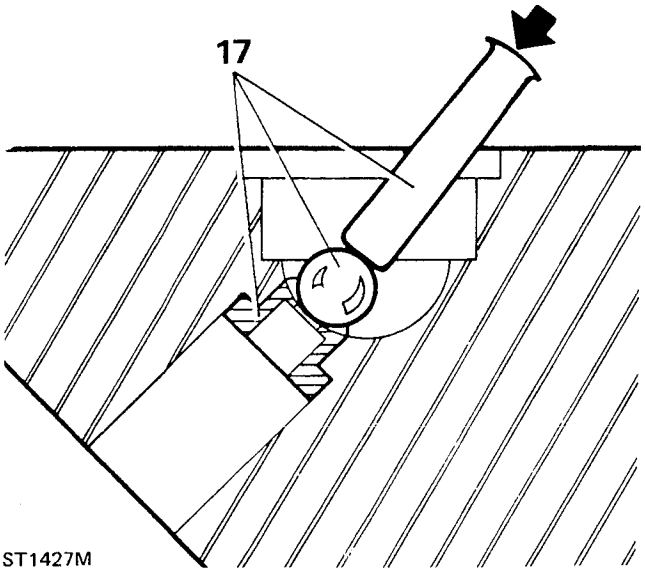
When carrying out normal top overhaul work on the cylinder head it is not necessary to remove either the injector shrouds or the hot plugs.
Small surface cracks in the hot plug, extending from the opening to approximately 8,0 mm (0.312 in) in length can be ignored. However, if any severe cracks appear on the face of the hot plugs before attempting to remove it, closely inspect the cylinder head for signs of cracks, particularly between the inlet and exhaust valve seats. Such cracking indicates that the engine has overheated, usually through lack of coolant, and the cylinder head should be scrapped.

16. To remove a hot plug support the cylinder head, face downwards on two pieces of timber and insert a thin soft metal drift through the injector shroud throat and tap the hot plug from the inside. Once removed, a faulty hot plug cannot be restored and must be scrapped.



ST1428M A — Shroud B — Hot Plug

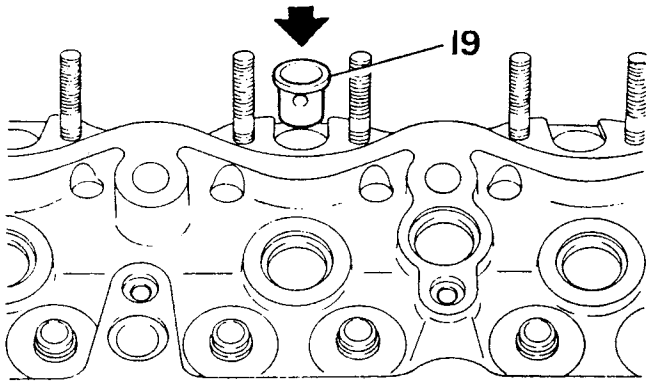
17. If the injector shroud is damaged using a 13 mm (1.05 in) ball bearing and drift, drift the shroud out towards the injector bore.



ST1427M

Fitting shrouds

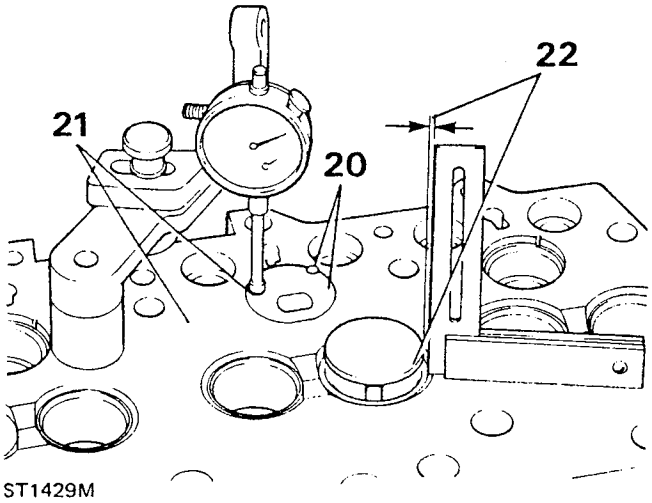
18. Thoroughly clean out the combustion chamber. The hole in the side of the injector shroud is for manufacturing purposes only but at the same time can be used as a guide when refitting the shroud.
19. Turn the cylinder head face down. Smear a little oil on the shroud and insert into the cylinder head with the hole pointing towards the centre of the cylinder head, and drift into position.



ST1422M

Fitting hot plugs

20. Fit the hot plugs by tapping with a hide-faced mallet, and locate with a new roll pin. If the hot plugs are loose in the cylinder head they may be retained with a little grease.
21. When fitted, the hot plugs must be checked with a dial test indicator to ensure that they do not protrude above the level of the cylinder head face more than 0,76 mm (0.003 in) and are not recessed below the level of the cylinder head face more than 0.025 mm (0.001 in).



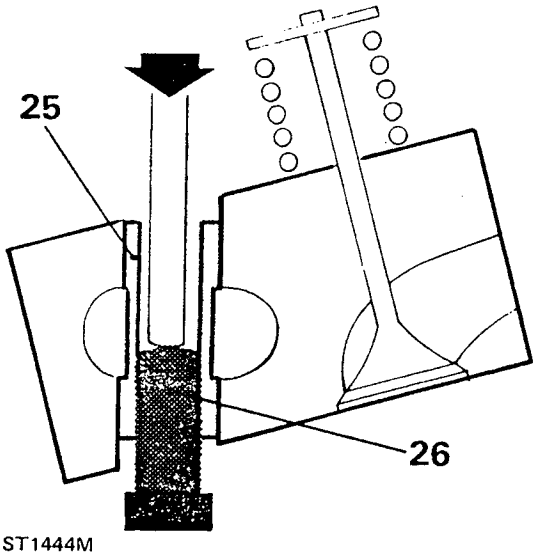
ST1429M

22. Check the valve guides for wear by inserting a new valve in the appropriate guide 8 mm above the seat. If movement across the head exceeds 0,15 mm (0.006 in) renew the guide.
23. Inspect the valves and discard any that are burnt, bent or distorted. Check the stems for wear by inserting a new guide. If wear is excessive, discard the valve. Valve faces that are pitted or ridged but otherwise serviceable may be refaced.
24. Renew push rods that are bent or have worn or scored ball or socket ends.

Renew push rod tube

Whilst this is rarely necessary the procedure is nevertheless as follows:

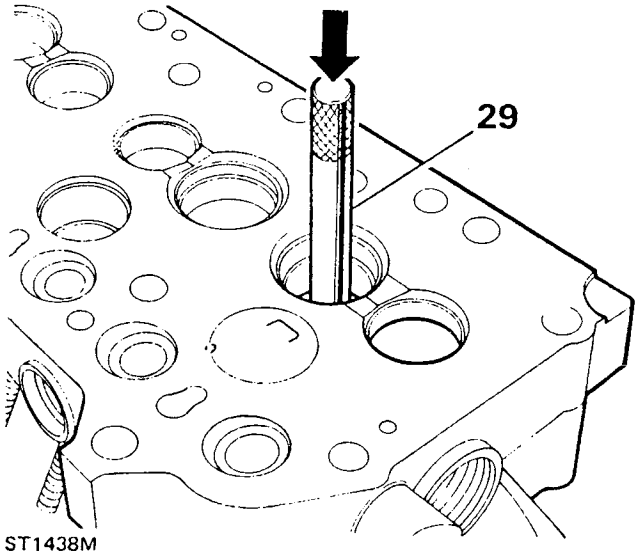
25. Using an 8 mm taper tap, cut a thread 30 mm (1,2 in) deep in the combustion face end of the tube to be removed.
26. Screw an appropriate bolt into the tube and press out the tube as illustrated.
27. Smear both ends of a new tube with silicone rubber sealant and press it into the cylinder head.



ST1444M

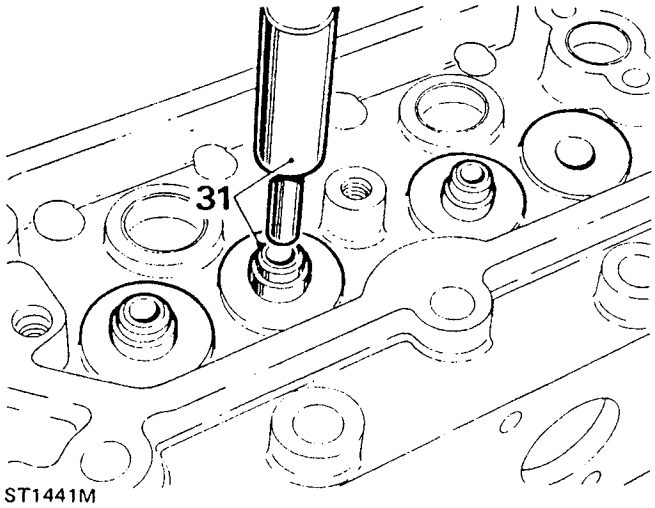
Renew valve guides

28. Support the cylinder head, combustion chamber uppermost on pieces of timber of sufficient thickness to allow clearance for the valve guides to be driven out.
29. Using special drift 274400 for inlet guides and 274401 for exhaust guides or suitable alternatives drive out the old guides from the combustion face side.



ST1438M

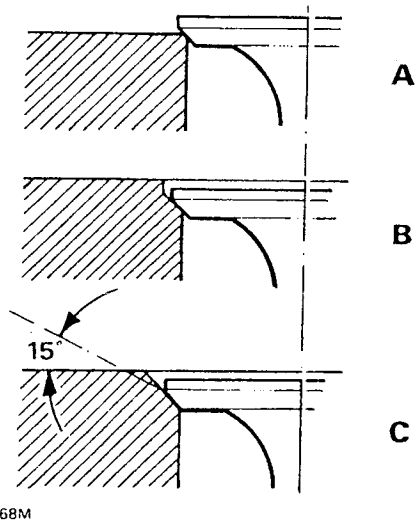
30. Turn the cylinder head over so the combustion chambers face downwards. Since the inlet and exhaust valve guides are dimensionally different it is important that the correct guides are fitted to the appropriate ports.
31. Lubricate new guides with engine oil and using special drift 600959 for the exhaust and 601508 for the inlet valve guides or suitable alternatives, drive in the new guides until the shoulder is flush with the casting.



ST1441M

Reface cylinder head valve seats

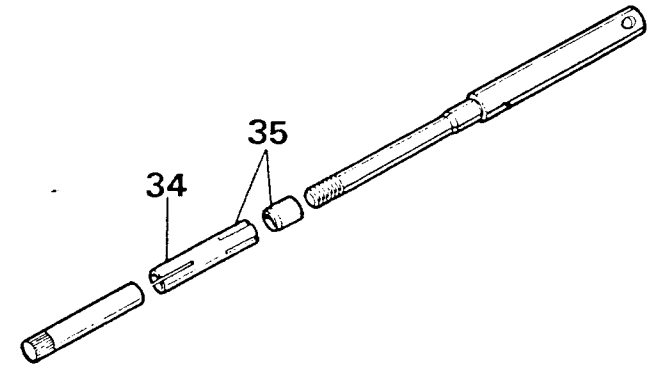
32. Damaged or worn valve seats can be refaced provided they are not abnormally wide due to repeated refacing operations. See instruction 43.



ST668M

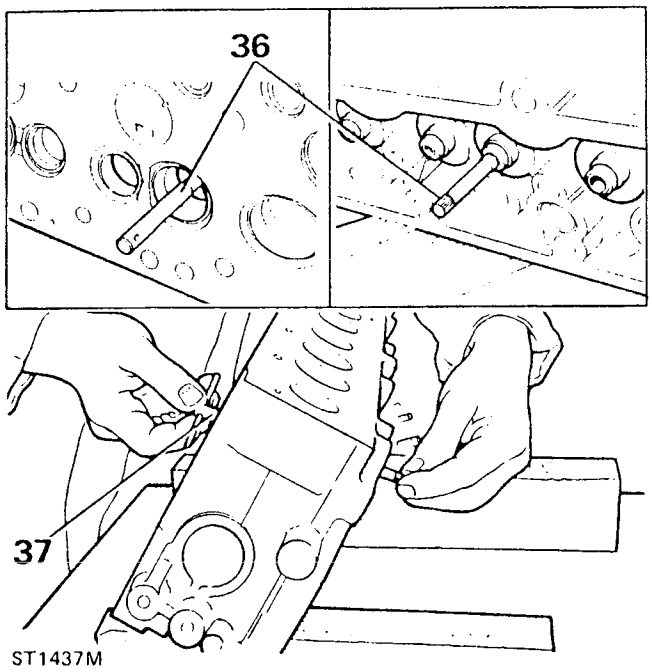
A. Correctly seated valve
B. Undesirable condition
C. Method of rectification

33. The special set of hand tools recommended for refacing include expandable pilots that fit tightly into new or worn guides to ensure that the valve seat is concentric with valve guide. The refacing tool has tungsten carbide cutters and can be used to cut a seat in a new exhaust seat insert.
34. Select the correct expandable collet for the valve guide concerned i.e. 8 mm for inlet guides and 8,5 mm for exhaust.
35. Loosely assemble the collet, expander and nuts. Ensure that the chamfered end of the expander is towards the collet.



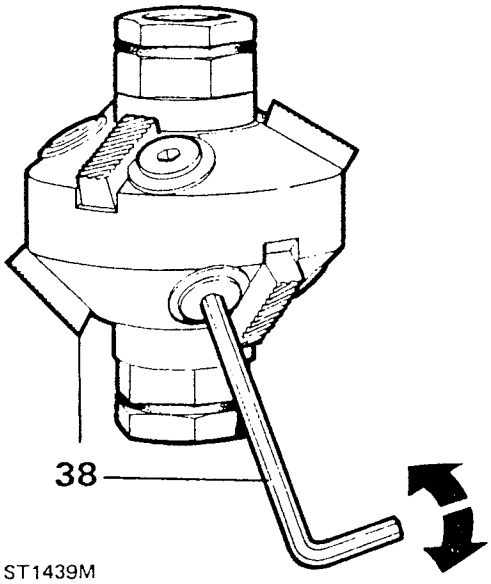
ST1440M

36. Insert the assembled pilot into the valve guide from the combustion face side of the cylinder head until the shoulder contacts the valve guide and the whole of the collet is inside the valve guide.
37. Expand the collet in the guide by turning the tommy bar clockwise whilst holding the knurled nut.



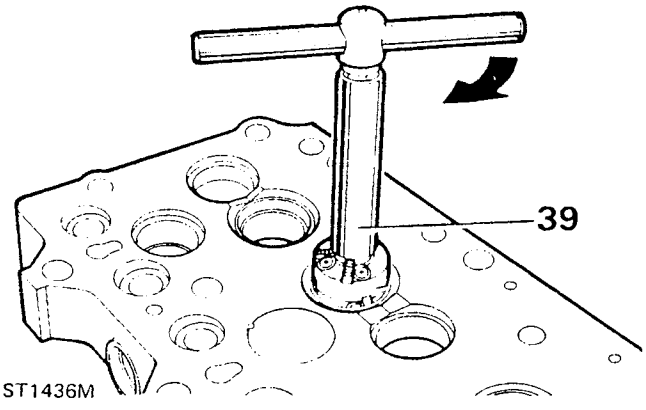
ST1437M

38. Use cutter MS 621 and ensure that the cutter blades are correctly fitted to the cutter head with the angled end of the blade downwards facing the work, as illustrated. Check that the cutter blades are adjusted so that the middle of the blade contacts the area of material to be cut. Use the key provided in the hand set MS 76.



ST1439M

39. Fit the wrench to the cutter head and turn clockwise using only very light pressure. Continue cutting to approximately the centre of the existing seat.



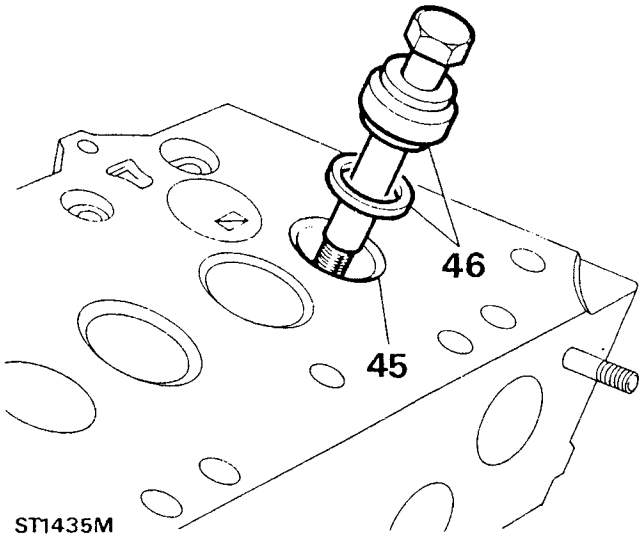
ST1436M

40. To check the effectiveness of the cutting operation use engineers' blue or a feeler gauge made from cellophane.
41. Smear a small quantity of engineers' blue round the valve seat and revolve a properly ground valve against the seat. A continuous fine line should appear round the valve. If there is a gap of not more than 2 mm it can be corrected by lapping.

42. Alternatively, insert a strip of cellophane between the valve and seat, hold the valve down by the stem and slowly pull out the cellophane. If there is drag the seal is satisfactory in that spot. Repeat this in at least eight places. Lapping-in will correct a small open spot.
43. After several trueing-up or lapping-in operations valve seats may have an excessive width which can be reduced by obtaining special correction cutters which narrow the seat by removing metal from the top and bottom of the seat. A 60° cutter is recommended for bottom narrowing and for top narrowing use a 30° cutter.

Renew inlet and exhaust seat inserts

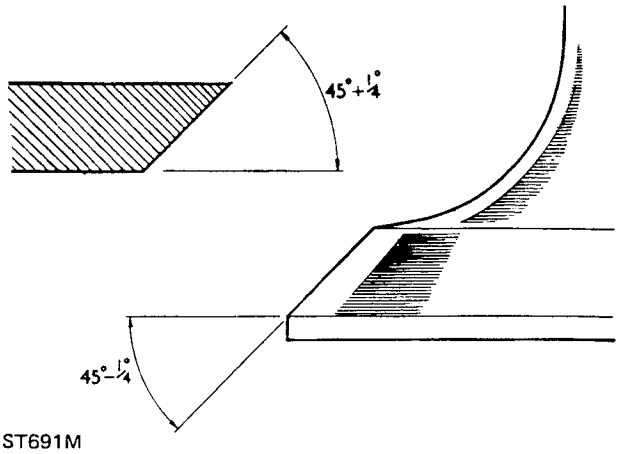
44. Hold the cylinder head firmly in a vice, wear protective goggles and grind the old insert away until thin enough to be cracked and prised out. Take care not to damage the insert pocket.
45. Remove any burrs and swarf from the pocket. Failure to do this could cause the new insert to crack when being fitted.
46. Assemble the new exhaust insert to the replacer tool number 530625 so that the chamfered edge of the insert is leading. Using a suitable bolt and nut draw the insert into the cylinder head pocket.
47. Since no tool is available for the inlet seat, use a suitable adaptor to press-in the new seat. Cut a new 45° seat using cutter MS 621.



ST1435M

Reface valve seats

48. Valves that are satisfactory for further service can be refaced. This operation should be carried out using a valve grinding machine. Only the minimum of material should be removed from the valve face to avoid thinning of the valve edge. The valve is refaced correctly when all pits are removed and the face concentric with the stem.



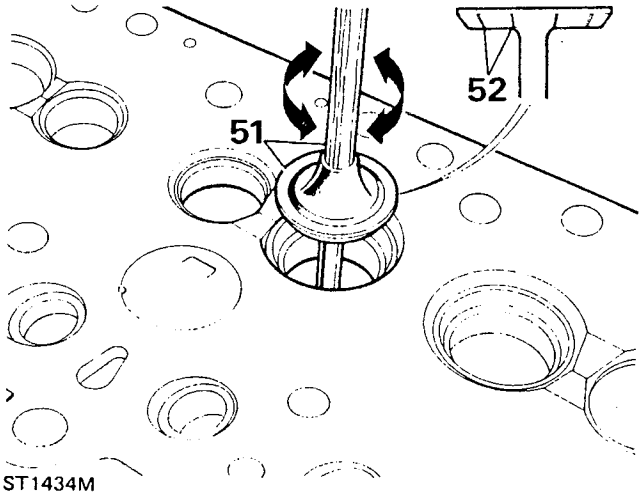
ST691M

Inlet valve seat face — 45° + ¼°
Exhaust valve seat face — 45° + ¼°

Inlet valve face — 45° – ¼°
Exhaust valve face — 45° – ¼°

Lap-in valves

49. To ensure a gas tight seal between the valve face and valve seat it is necessary to lap-in the appropriate valve to its seat. It is essential to keep the valve identified with its seat once the lapping-in operation has been completed.
50. Unless the faces to be lapped are in poor condition it should only be necessary to use fine valve lapping paste. Smear a small quantity of paste on the valve face and lubricate the valve stem with engine oil.
51. Insert the valve in the appropriate guide and using a suction type valve lapping tool employ a light reciprocating action while occasionally lifting the valve off its seat and turning it so that the valve returns to a different position on the seat.

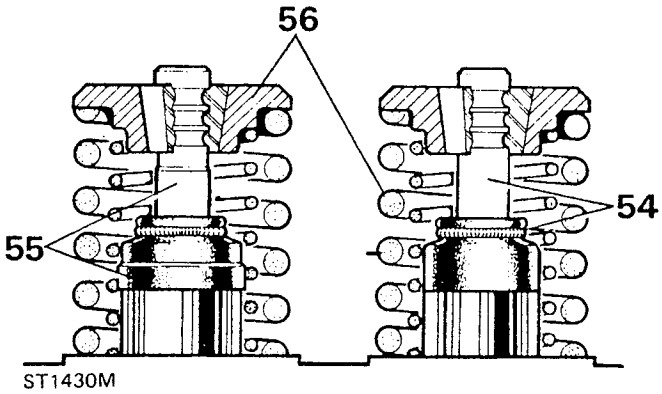


ST1434M

52. Continue the operation until a continuous matt grey band round the valve face is obtained. To check that the lapping operation is successful, wipe off the valve paste from the valve and seat and make a series of pencil lines across the valve face. Insert the valve into the guide and while pressing the valve onto the seat revolve the valve a quarter turn a few times. If all the pencil lines are cut through no further lapping is required.
53. Wash all traces of grinding paste from the valves and cylinder head seats.

Assembly valves to cylinder head

54. Insert the inlet valves into the guides and fit new oil seals with the plain exterior. Ensure that the seal locates in the groove in the valve guide.
55. Insert the exhaust valves and fit the oil seals with the stepped exterior. They are larger than the inlet valve seals.
56. Fit the double valve spring and cup to each valve in turn and using valve spring compressor, 276102 or a suitable alternative, secure the assembly with the multi-groove butting cotters.

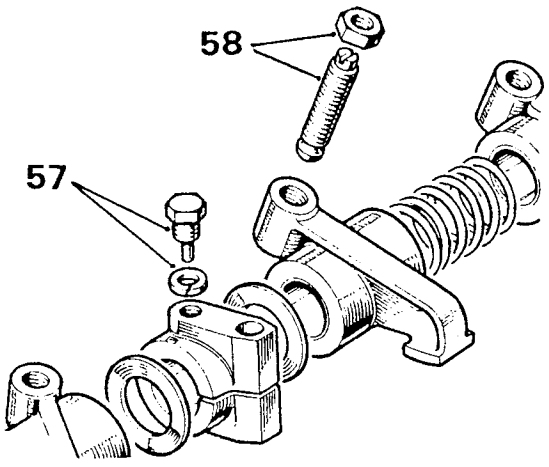


ST1430M

OVERHAUL ROCKER SHAFT ASSEMBLY

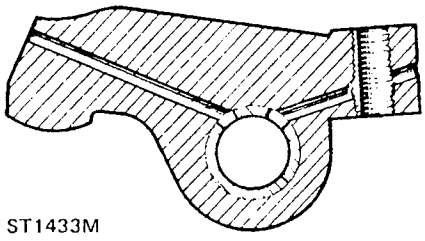
Dismantle and inspection

57. Remove the locating screw and washer from the number two rocker bracket and withdraw all the components from the rocker shaft.
58. Remove the locknuts and adjustment screws from the rockers.



ST1431M

59. Examine the rocker shaft for wear and discard if the bearing surface is worn more than 0,025 mm (0.001 in).
60. Inspect the rockers and discard if the pads are worn. It is not permissible to grind pads in an attempt to reclaim the rockers.
61. Renew bushes if the clearance between shaft and bush is in excess of 0,101 to 0,127 mm (0.004 to 0.005 in).
62. Press in replacements ensuring that the pre-drilled oil holes coincide with the holes in the rockers. The following cross section of a rocker shows the oil drillings.

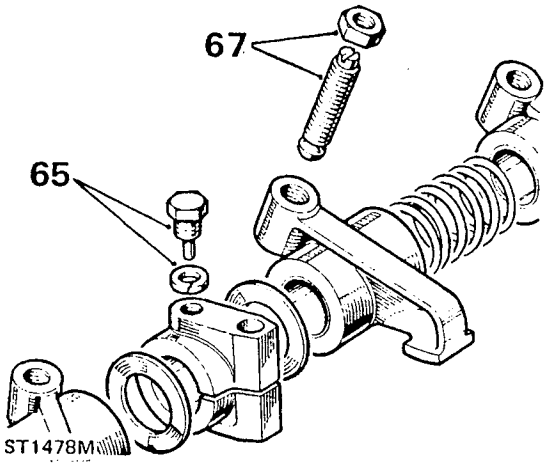

ST1433M

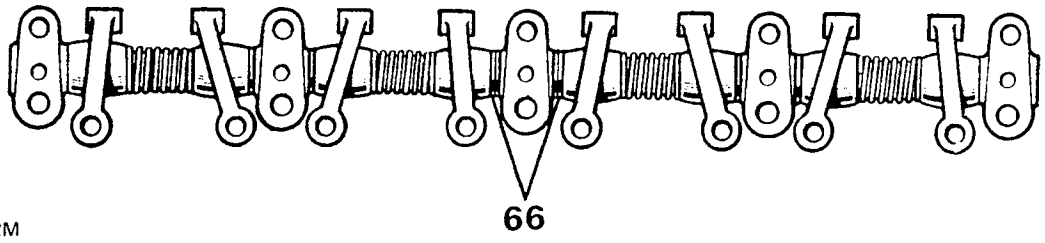
63. Using a $\frac{17}{32}$ reamer 13,5 mm + 0,2 mm (0.530 in + 0.001 in) finish the bushes and clear swarf from the oil holes.
64. Examine the ball-end of the adjusting screws and discard any that are worn. Regrinding is not permissable. Check the threads for damage and that the oil relief drilling is clear.

Assemble rocker shaft assembly

65. Check that the oil-ways in the rocker shaft are clear and fit number two rocker shaft bracket to the shaft and retain with the locating screw and washer.

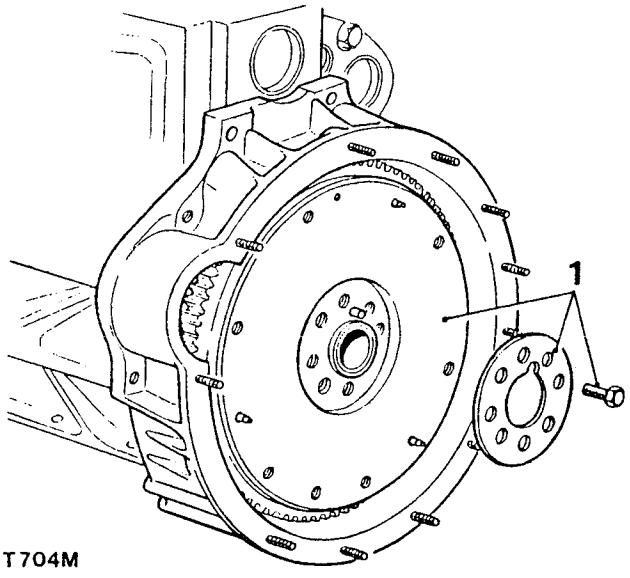
66. Using new spacers and springs, assemble the rockers and brackets to the shaft as illustrated, ensuring that the rockers move freely on the shaft. Note that double spacers are fitted each side of the centre pedestal.
67. Fit the tappet adjustment screws and lock nuts to the rockers.
68. Invert the rocker assembly and locate it on the rocker cover to prevent it falling apart. Place the reconditioned cylinder head and rocker assembly to one side ready for fitting to the engine.





REMOVE AND OVERHAUL THE FLYWHEEL

1. Remove the flywheel retaining bolts and withdraw the flywheel and reinforcing plate.



2. Wear or scores on the flywheel clutch face can be corrected by machining provided that the overall width of the flywheel is not reduced below 36,96 mm (1.453 in).
3. Check that the flywheel has not been previously machined.
4. Examine the ring gear teeth and if chipped or worn the gear can be renewed.

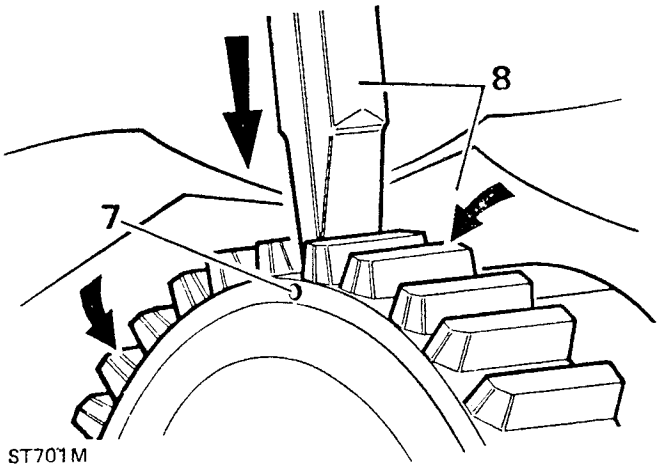
Reface the flywheel

5. Remove the clutch location dowels.
6. Machine the flywheel over the complete clutch face removing only the minimum material necessary to achieve a smooth flat surface parallel with the crankshaft mating face and within the above width dimensions and fit new dowels.

Renew the ring gear

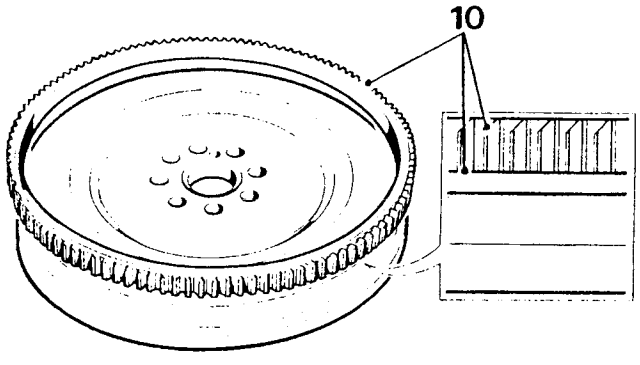
7. Drill a 8,0 mm ($\frac{5}{16}$ in) hole between the root of any two teeth and the inner diameter of the starter ring deep enough to weaken the ring. Do not allow the drill to enter the flywheel.

8. Secure the flywheel in a soft jawed vice and cover it with a cloth to protect one from personal injury. Place a cold chisel above the drilled hole and strike it sharply to split the ring gear.



ST701M

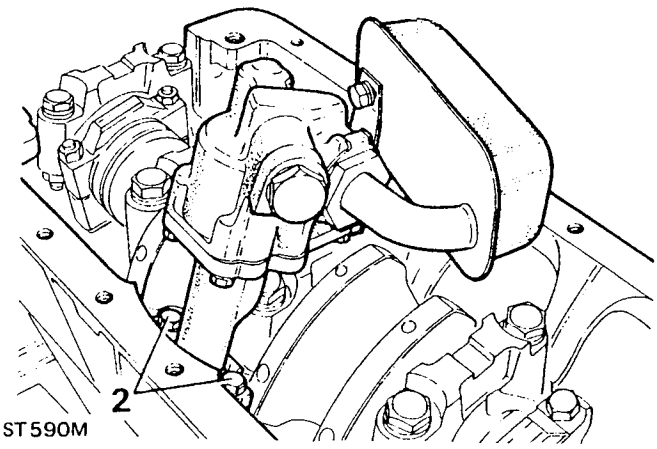
9. Heat the new ring gear uniformally to between 225°C and 250°C but do not exceed the higher figure.
10. Place the flywheel, clutch face down, on a flat surface and locate the heated flywheel with the square edge of teeth downward towards the flywheel clutch face and chamfered edge of the teeth uppermost.
11. Press the starter ring firmly against the flange until the ring contracts sufficiently to grip the flywheel. Allow the ring gear to cool naturally. Do not hasten cooling in anyway.



ST 928M

REMOVE AND OVERHAUL OIL PUMP — Early type

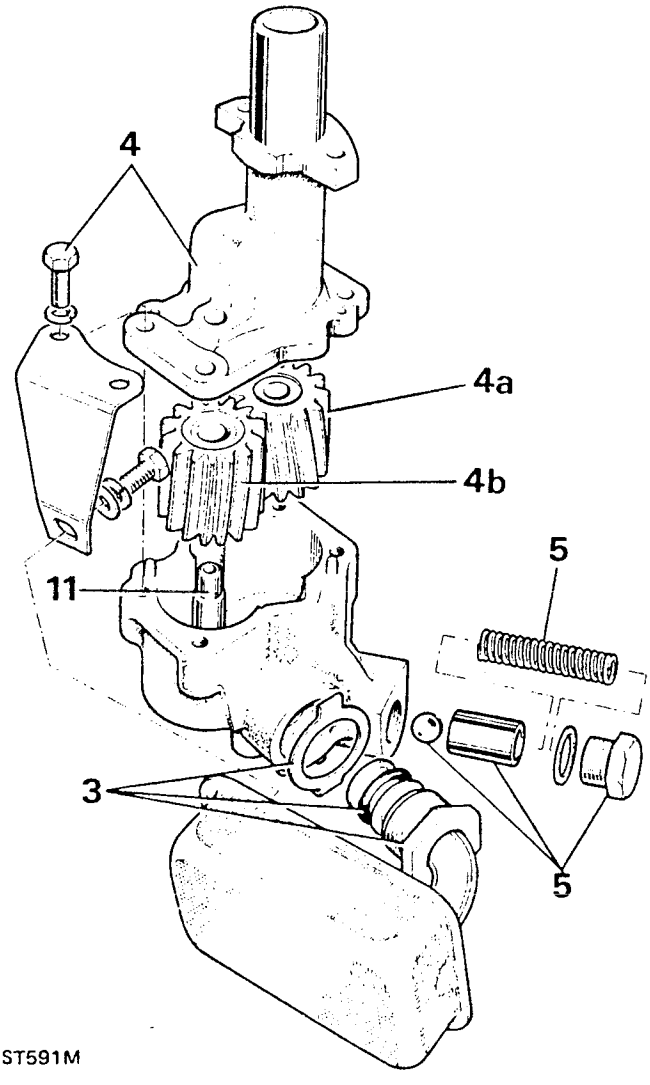
1. Remove the sump.
2. Bend back the lock washers and remove the two bolts securing the oil pump to the crankcase. Withdraw the oil pump complete with strainer and oil pump drive shaft.



ST590M

Dismantle oil pump

3. Bend back the lock washer and release the nut securing the strainer to the oil pump body and remove the strainer and sealing ring.
4. Remove four bolts and washers and lift off the oil pump cover and lift out the driven and idler gears.
   (a) driven gear
   (b) idler gear



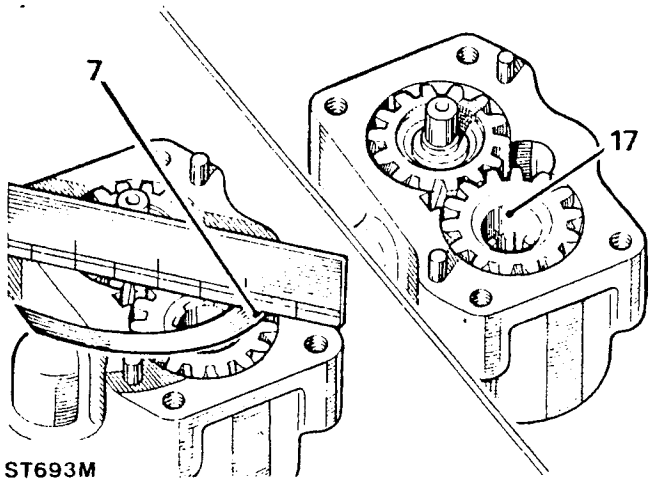
ST591M

5. Remove the oil pressure relief valve plug and sealing washer. Withdraw the relief valve spring, plunger and ball.

NOTE: Later pumps have ten toothed gears and no relief valve ball.

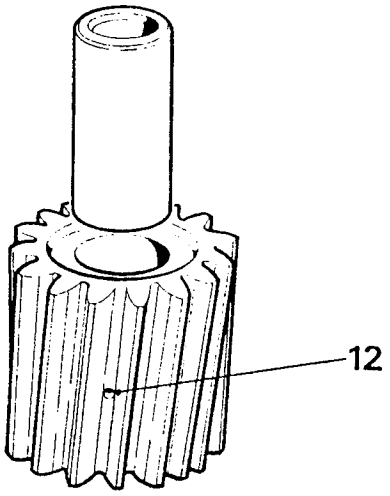
Overhaul the oil pump

6. Examine the gears for wear, scores and pits. If the gears appear serviceable check for end-float as follows:
7. Clean the pump body and assemble the gears. Place a straight edge across the pump body face, as illustrated, and using a feeler gauge, measure the clearance between the body and gears. The correct clearances are as follows:
8. Idler gear 0,07 to 0,015 mm (0.003 to 0.006 in).
9. Driven gear 0,05 to 0,12 mm (0.002 to 0.005 in).



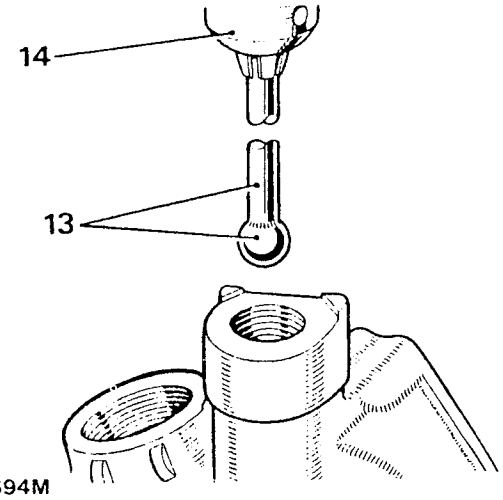
ST693M

10. Gears must be renewed in pairs. A worn, but serviceable gear, must not be matched with a new one.
11. If necessary renew idler gear spindle by drilling-out the peened over end of the spindle so that the spindle can be withdrawn from the pump body. To ensure squareness when fitting the new spindle, assemble it into the pump body with the two gears. Fit the cover and secure with the four bolts. Support the pump body and peen over the end of the new spindle. Remove the cover and gears and check security of the spindle.
12. If worn, remove the idler gear bush and press in a replacement. Drill the lubrication hole 3,17 mm (0.125 in) and ream the bush to 12,7 mm (0.500 in) diameter.



ST 911M

13. A scored ball valve seat can be restored by using a locally made lapping tool by silver soldering a new ball (part number 3748) onto a length of suitable tube.
14. Install the tube in a drill and lap-in using coarse grinding paste. Finally hand-lap the seat with fine paste using the same diabalo method as for lapping valves.
15. Thoroughly wash the pump body to remove all traces of grinding paste.



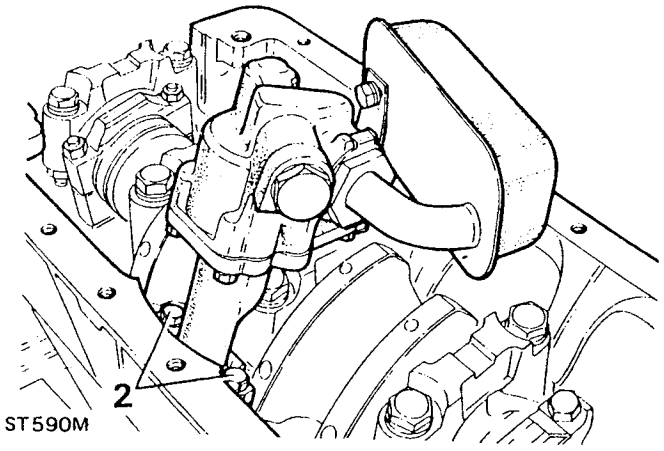
ST694M

Assemble the oil pump

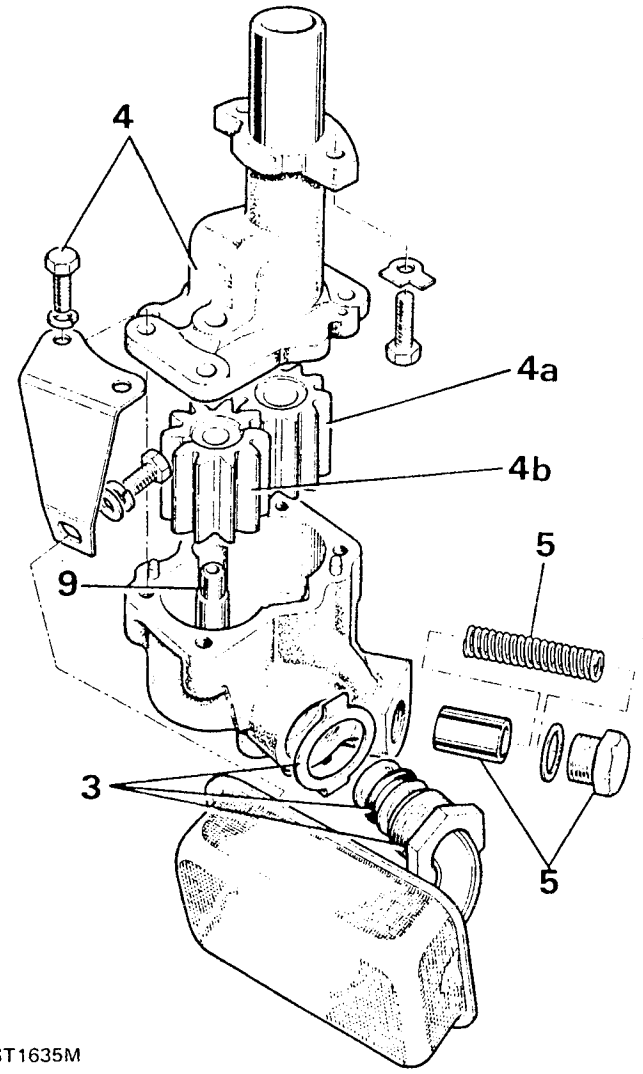
16. Fit the idler gear to the spindle.
17. Fit the driven gear with plain part of the bore uppermost. See illustration after instruction 9.
18. Smear the joint face of the body with jointing compound and fit the cover over the dowels and the strainer bracket and secure with the four bolts and spring washers.
19. Hold relief valve bore vertically and insert the ball followed by the plunger with the ball seat end first. Fit the spring, sealing washer and plug.
20. Fit the oil strainer sealing ring to the pump body followed by the lock washer and strainer. Tighten the strainer retaining nut so that when fitted the strainer is positioned parallel to the sump baffle plate. Secure the nut with the lock washer tab.
21. Secure the lower end of the bracket to the strainer with the single bolt, spring and plain washer.

REMOVE AND OVERHAUL OIL PUMP — Later Type

1. Remove the sump.
2. Bend back the lock washers and remove the two bolts securing the oil pump to the crankcase. Withdraw the oil pump complete with strainer and oil pump drive shaft.



ST590M



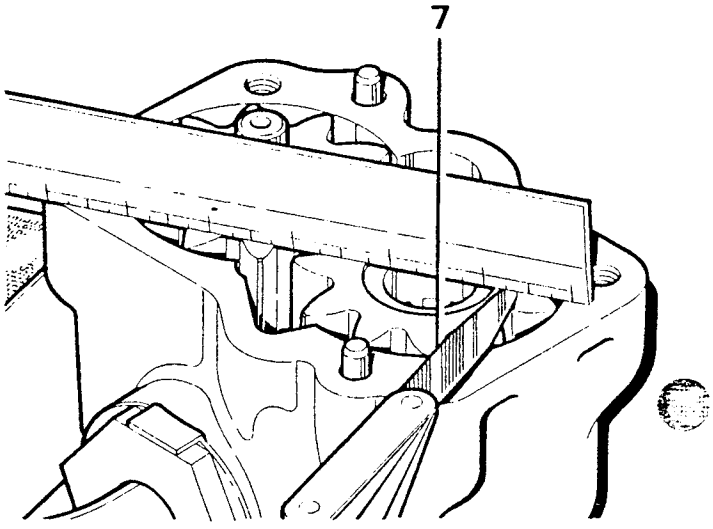
ST1635M

Dismantle oil pump

3. Bend back the lock washer and release the nut securing the strainer to the oil pump body and remove the strainer and sealing ring.
4. Remove four bolts and washers and lift off the oil pump cover and lift out the driven and idler gears.
   (a) driven gear
   (b) idler gear
5. Remove the oil pressure relief valve plug and sealing washer. Withdraw the relief valve spring and plunger.

Overhaul the oil pump

6. Examine the gears for wear, scores and pits. If the gears appear serviceable check far end-float as follows:
7. Clean the pump body and assemble the gears. Place a straight edge across the pump body face, as illustrated, and using a feeler gauge, measure the clearance between the body and gears. The correct clearances are given in the Data section 05 book one.



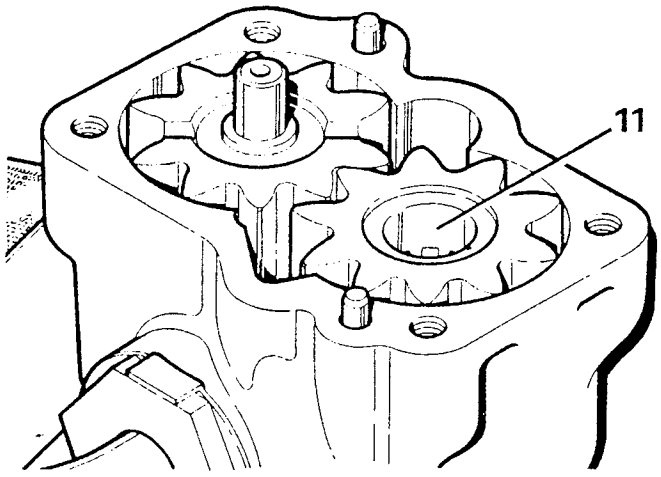
ST1636M

8. Gears must be renewed in pairs. A worn, but serviceable gear, must not be matched with a new one.
9. If necessary renew idler gear spindle by drilling-out the peened over end of the spindle so that the spindle can be withdrawn from the pump body. To ensure squareness when fitting the new spindle, assemble it into the pump body with the two gears. Fit the cover and secure with four bolts. Support the pump body and peen over the end of the new spindle. Remove the cover and gears and check security of the spindle.

continued

Assemble the oil pump

10. Fit the idler gear to the spindle.
11. Fit the driven gear with plain part of the bore uppermost.



ST1637M

12. Smear the joint face of the body with jointing compound and fit the cover over the dowels and secure with the four bolts and spring washers.
13. Hold relief valve bore vertically and insert the plunger with the solid end first. Fit the spring, sealing washer and plug.
14. Fit the oil strainer sealing ring to the pump body followed by the lock washer and strainer. Tighten the strainer retaining nut so that when fitted the strainer is positioned parallel to the sump baffle plate. Secure the nut with the lock washer tab.

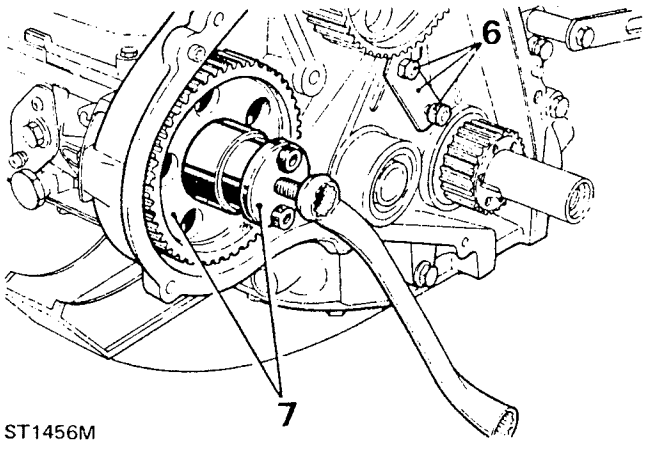
REMOVE TIMING BELT, PULLEYS AND COVERS

Remove front cover

1. Remove the four bolts and remove the front cover vent and wading plug bracket, gauze and gasket.
2. Remove nine timing cover bolts, but do not withdraw centre bolt from the cover since there is a fibre washer on the bolt behind the cover. Remove the cover and joint washer and retrieve the fibre washer.
3. Prise out the crankshaft seal.

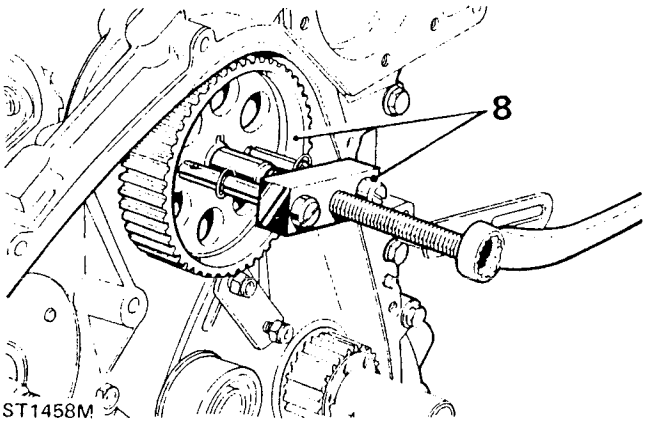
Remove timing belt and pulleys

4. Slacken and remove the camshaft retaining bolt, special washer and 'O' rings.
5. Slacken and remove the distributor pump timing pulley nut.
6. Slacken the belt tensioner clamp nuts and remove the belt. Remove the clamp nut and withdraw the tensioner assembly.
7. Use the centre part of special tool 18G1457/1 as illustrated, and withdraw the distributor pump pulley.



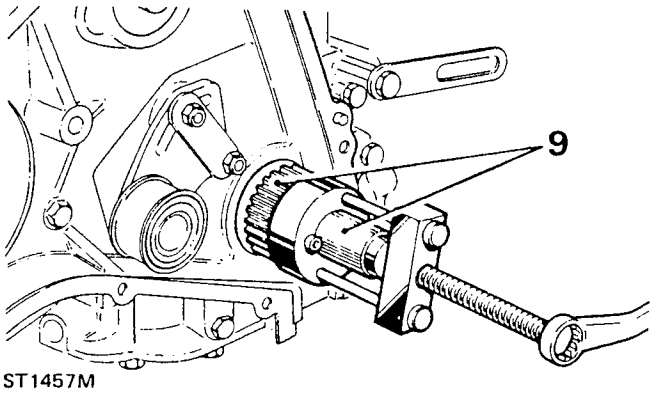
ST1456M

8. Use special puller tool 18G1464/2/6, as illustrated and withdraw the camshaft pulley.



ST1458M

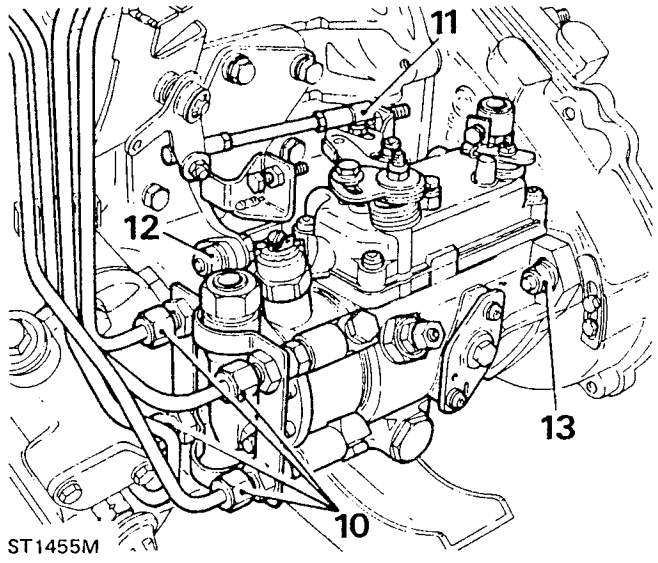
9. Withdraw the crankshaft pulley using complete tool 18G1464/2 and button 18G1464/5.



ST1457M

Remove distributor pump (D.P.S. Pump)

10. Remove the high and low pressure pipes from the D.P.S. pump and injectors. (If not already removed) and cover, not plug, the ports.
11. Disconnect the pump operating link from the lever on the bracket. (If not already removed).
12. Remove the nut and bolt securing the rear of the pump to the support bracket.
13. Remove the three nuts retaining the pump to the front cover and withdraw the pump and joint washer.



ST1455M

14. Remove the retaining bolts and remove the front cover and gaskets from the cylinder block. Prise out the old oil seals.

KEY TO TIMING GEAR AND COVER ASSEMBLY

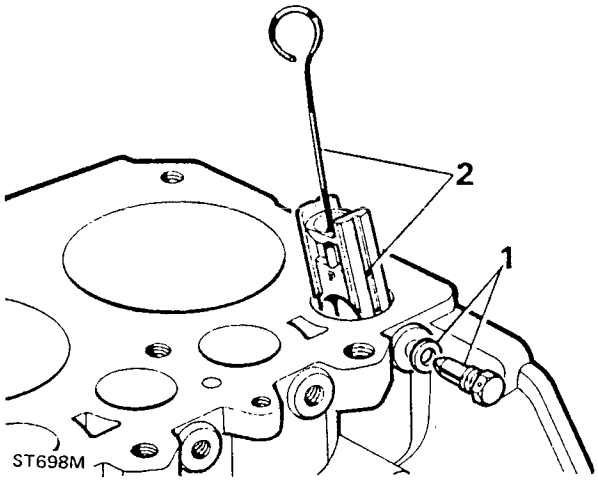
1. Fan blades
2. Spacer
3. Fan pulley
4. Special bolt — Later engines, starter dog early engines.
5. Crankshaft pulley
6. Wading plug
7. Timing cover vent
8. Inspection cover
9. Front cover plate
10. Front cover plate oil seal
11. Water pump
12. Water pump joint washer
13. Cover
14. Timing belt
15. D.P.S. pump pulley
16. Camshaft pulley
17. Jockey pulley (tensioner)
18. Coolant gallery joint washer
19. Front cover to cylinder block joint washer
20. Front cover plate joint washer
21. Camshaft front cover oil seal
22. Crankshaft cover oil seal
23. Triangular joint washer
24. Fibre washer

REMOVE TAPPETS, ROLLERS AND GUIDES

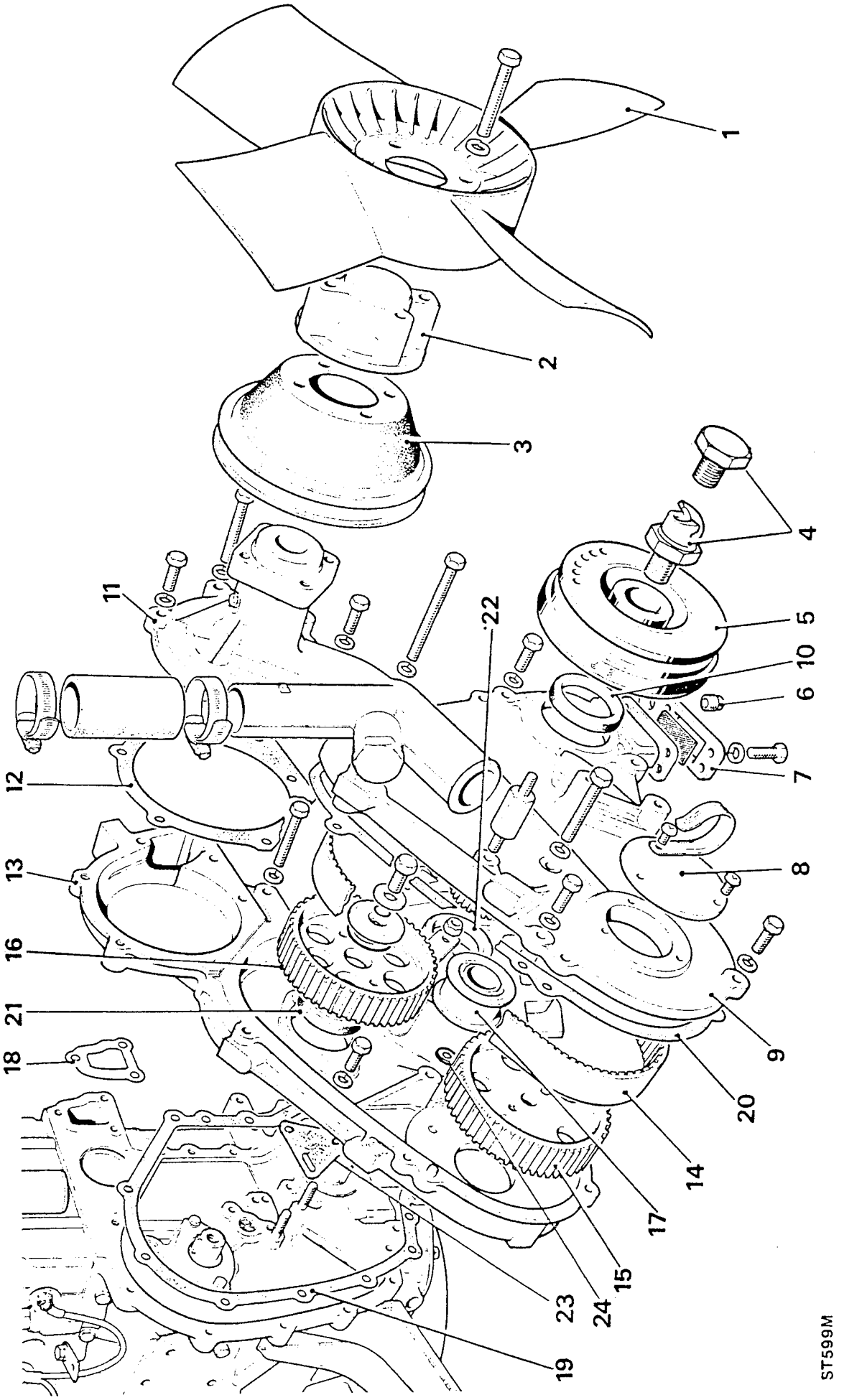
1. Remove the eight tappet guide locating bolts from the right-hand side of the cylinder block.

   CAUTION: Do not remove the tappet guides before the rollers otherwise the rollers may fall behind the camshaft.

2. Using long nosed pliers or a suitable bent length of wire lift out the tappet slides and identify them with their respective guides for possible refitting.



ST698M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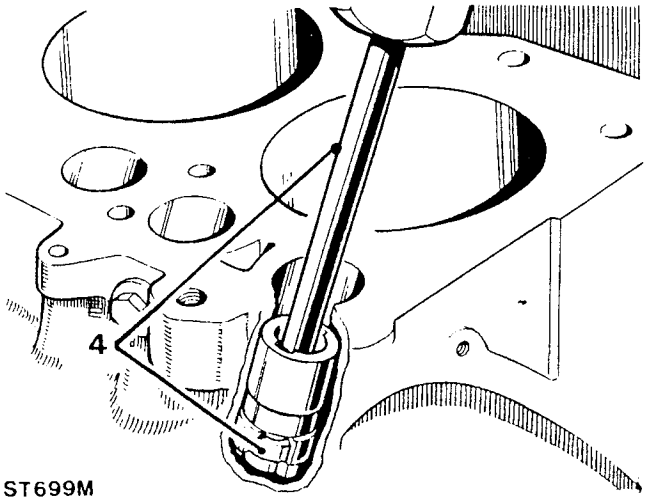
ST599M

3. Lift out the tappet rollers and mark the side facing the front of the engine for possible reassembly.
4. Lift out the tappet guides and retain with their respective slides and rollers. If the guides are difficult to remove use special tool 530101A.
5. Carefully examine all parts and discard any that are worn or damaged.

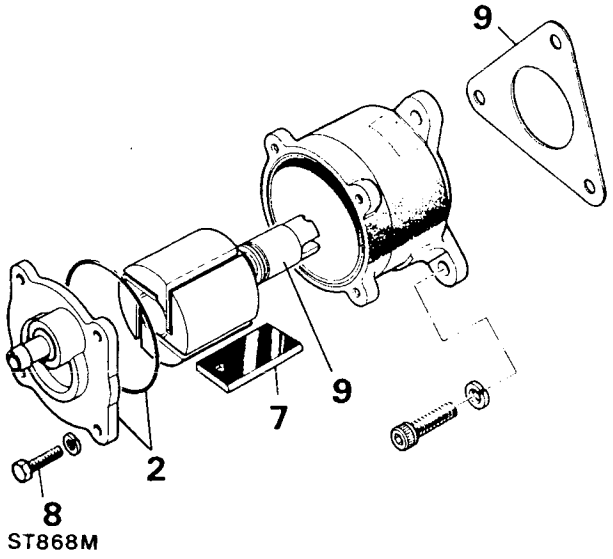


ST699M

REMOVE AND OVERHAUL VACUUM PUMP

Dismantle

1. Remove the pump from the engine.
2. Remove the four bolts securing the end plate and withdraw the end plate and 'O' ring seal.
3. Tap the shaft-end of the rotor to remove it from the pump body.



ST868M

Examine

4. Inspect the components for wear and damage and renew as necessary.
5. To check the rotor to body clearance, fit the rotor to the body and with feeler gauges measure the clearance at the narrow point between the rotor and body. The correct clearance is 0,05 mm (0.002 in).
6. Check the clearance between the rotor and end plate by placing a straight across the body and with feeler gauges measure the clearance between the straight edge and rotor. The correct clearance should be 0,10 to 0,12 mm (0.004 to 0.005 in).

Assemble

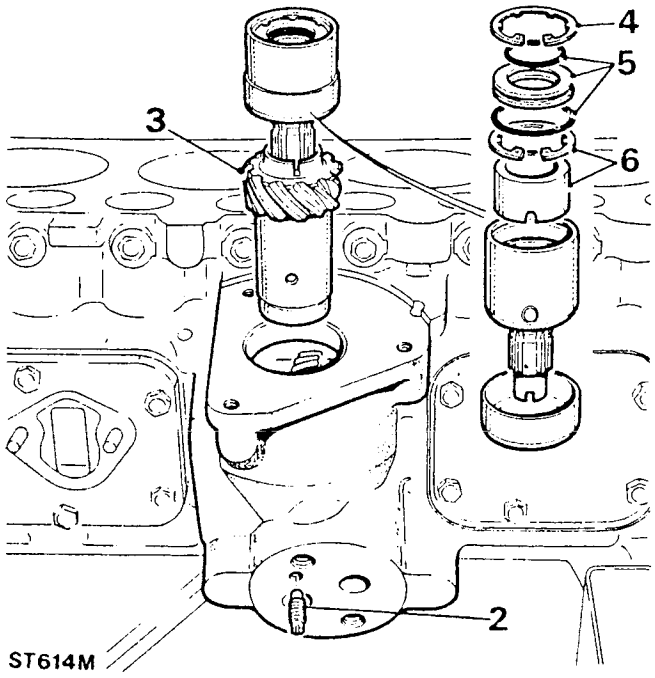
7. Fit the rotor blades to the rotor with the radius outwards and insert the rotor into the body.
8. Place a new 'O' ring seal in position in the body groove and fit the end plate and secure with the four bolts tightening evenly.
9. When fitting pump to engine use a new joint washer and ensure that the drive slot fits correctly over the coupling drive pin.

REMOVE AND OVERHAUL SKEW GEAR COUPLING

The coupling can be overhauled without separating it from the skew gear.

Remove skew gear assembly

1. Remove the oil filter housing complete with filter and joint washer.
2. Remove the skew gear bush locating screw.
3. Using long-nosed pliers lift out the skew gear assembly.



ST614M

Dismantle

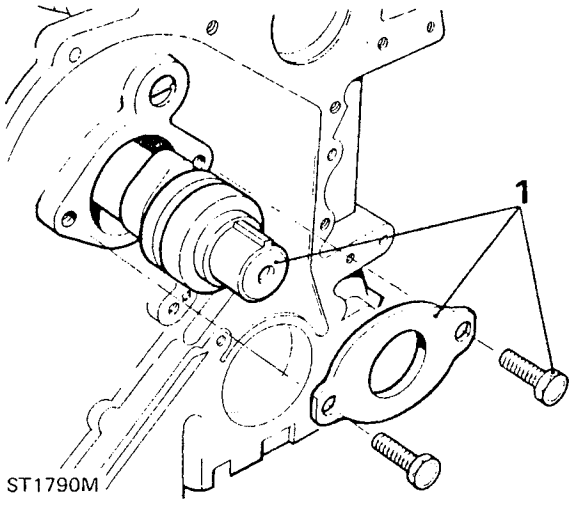
4. With circlip pliers remove the retaining circlip.
5. Withdraw the seal collar and remove the inner and outer seals.
6. Remove the lower circlip and withdraw the sleeve.

Assemble

7. Reassemble the coupling with any new parts necessary ensuring that the sleeve fits correctly over the lower cross-pin and secure with the circlip.
8. Lubricate and fit new seals to the collar and insert into the coupling and retain with the circlip. Make sure that the seals are properly located since damaged or misplaced seals could cause reduced engine oil pressure.

REMOVE THE CAMSHAFT

1. Since the camshaft sprocket has already been removed, remove the two bolts and the camshaft thrust plate and carefully withdraw the camshaft.



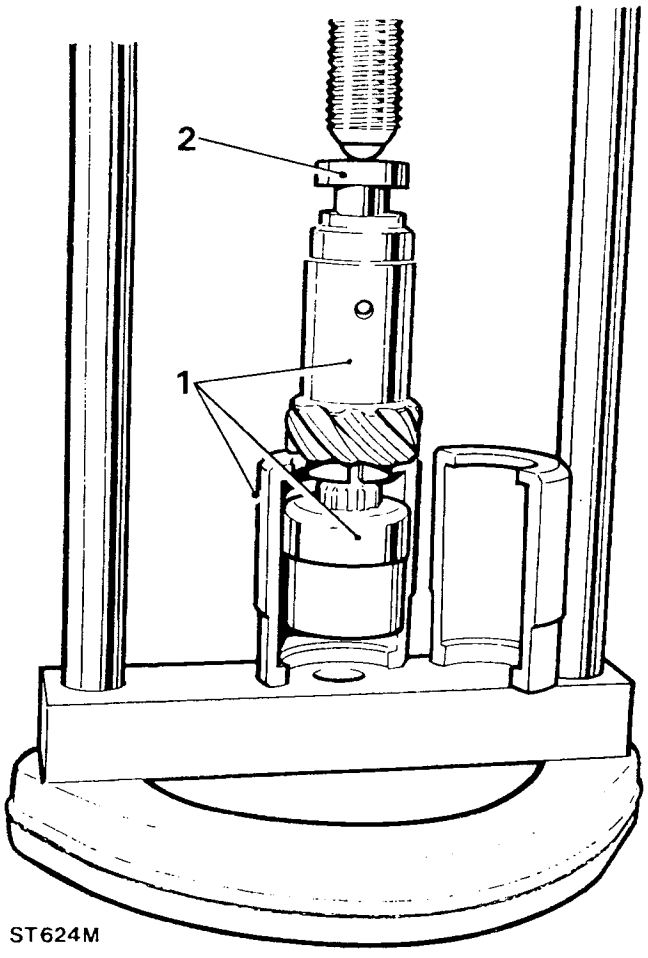
Inspect the camshaft

2. Discard the camshaft if any of the following visual defects are evident. Scored, worn, pitted or chipped cams. Worn, corroded and discoloured journals. Worn and chipped gear teeth.

RENEW SKEW GEAR COUPLING

Dismantle

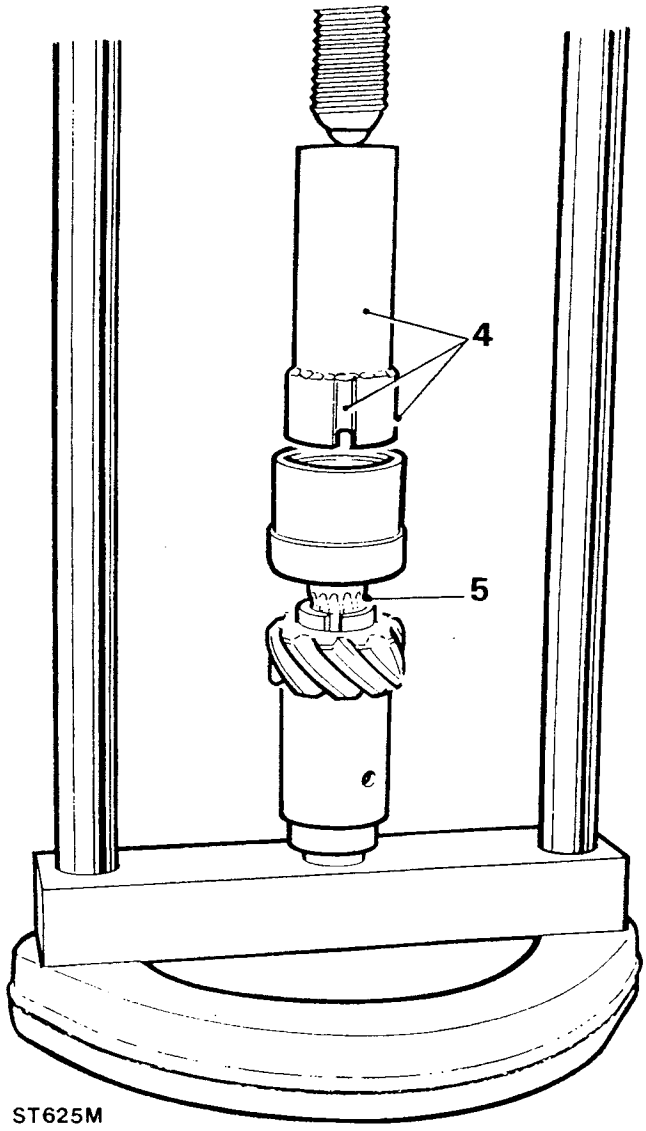
1. Position the skew gear and coupling assembly in a press and support it, as illustrated, with 18G705-1A or suitable metal bars.
2. Insert a suitable mandrel between the press ram and end of the coupling shaft and press out the coupling from the skew gear.



Fit new coupling to skew gear

3. Dismantle the new coupling, as described in 'Coupling Overhaul'. This is necessary, since in the assembled condition there is no suitable surface for the press tool to bear upon.
NOTE: See 2.5 litre petrol engine supplement for details of the latest skew gear bush retension.

4. Dismantle also the old coupling and use the sleeve to manufacture a suitable press tool. Use a round section file to increase the depth of the cross-pin slot so that it will not bear upon the cross-pin when used to press in the new coupling. Weld a suitable length of steel bar or tube to the sleeve to complete the tool.
5. Fill the annular groove round the splines of the coupling with silicone rubber sealant.
6. Assemble the skew gear and coupling with the manufactured press tool in position inside the coupling and place under the press and slowly press in the new coupling. Clean off surplus sealant and swarf from the internal splines of the skew gear.



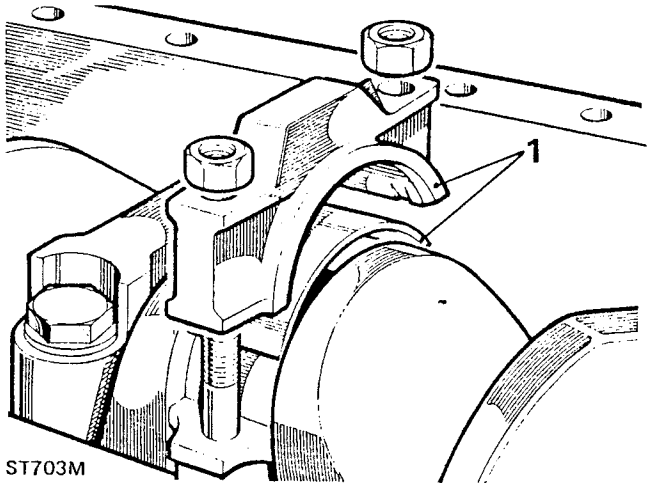
ST625M

7. Reassemble the new coupling as described under 'Coupling Overhaul'.

REMOVE THE CONNECTING-RODS AND PISTONS

During the following instructions it is important that all components are kept in related sets and the pistons are identified with their respective bores.

1. Turn the crankshaft to bring the connecting-rod caps to an accessible position and remove each cap and lower shell in turn. Note that the connecting-rod caps are numbered one to four.

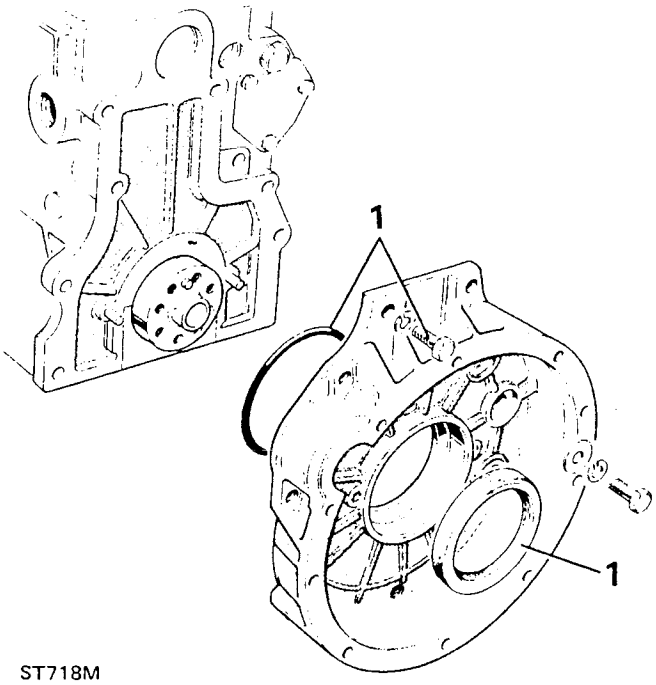


ST703M

2. Push each piston assembly up the bore and withdraw from the cylinder block. Assemble the caps and shells to the connecting-rods and place to one side for inspection with the cylinder block at a later stage.

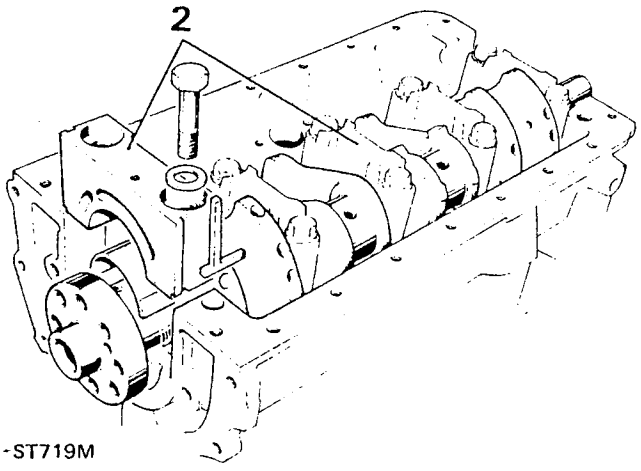
REMOVE AND INSPECT CRANKSHAFT

1. Remove the eight bolts securing the flywheel housing to the cylinder block and remove the housing and rear main bearing oil seal, and 'O' ring.
   The 'O' ring has been deleted on later engines.



ST718M

2. Remove the main bearing caps and shells and lift out the crankshaft. Collect the bearing shells from the bearing saddles and the thrust washers from the centre saddle.



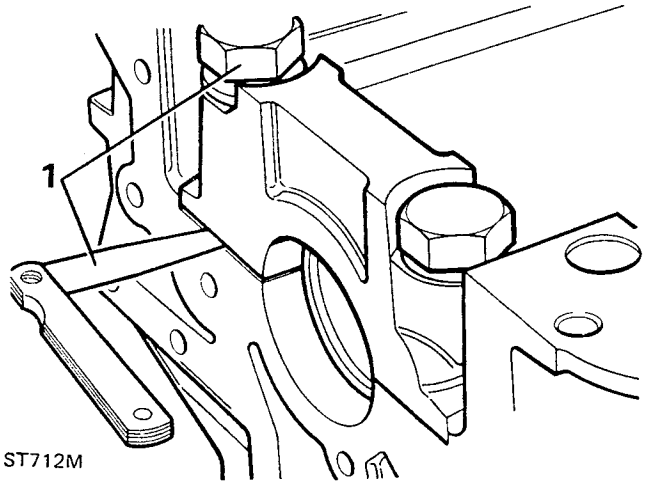
-ST719M

3. Degrease the crankshaft and clear out the oil ways, which can become clogged after long service.
4. Examine visually, the crankpins and main bearing journals, for obvious wear, scores, grooves and overheating. A decision at this stage should be made as to whether the condition of the shaft is worth continuing with more detailed examination.
5. With a micrometer, measure and note the ovality and taper of each main bearing journal and crankpin as follows:
6. **Ovality** — Take two readings at right angles to each other at various intervals.
   The maximum ovality must not exceed 0,040 mm (0.0015 in).
7. **Taper** — Take two readings parallel to each other at both ends of the main bearing journal and crankpin.
   The maximum permissable taper must not exceed 0,025 mm (0.001 in).
8. To check for straightness, support the front and rear main bearing journals in 'V' blocks and position a dial indicator to check the run-out at the centre main bearing journal. Run-out must not exceed 0,076 mm (0.003 in) taking into account any ovality in the centre journal.
   The overall allowable wear limit should not exceed 0,114 mm (0.0045 in) for main bearing journals and 0,088 mm (0.0035 in) for crankpins.
   A crankshaft worn beyond the limits of maximum taper, ovality and overall wear can be ground to 0.25 mm (0.010 in) under size.

NOTE: For regrinding information see page 8 2.25 litre petrol and Diesel engine overhaul.

EXAMINE AND OVERHAUL THE CYLINDER BLOCK

1. Remove the four jet tubes, see Engine assembly for illustrations and details.
   Degrease the cylinder block and carry out a thorough visual examination checking for cracks and damage. To check the main bearing caps and saddles for distortion. Fit the main bearing cap without bearing shells and tighten to the correct torque. Slacken and remove the bolt on one side of each bearing cap and check with a feeler gauge that no clearance exists at the joint face between the cap and saddle.



ST712M

Inspect cylinder bores

2. Measure the cylinder bores for ovality, taper and general wear, using any suitable equipment. However, an inside micrometer is best for checking ovality and a cylinder gauge for taper.
3. Check the ovality of each bore by taking measurement at the top of the cylinder just below the ridge at two points diametrically opposite. The difference between the two figures is the ovality of the top of the bore. Similar measurements should be made approximately 50 mm (2.0 in) up from the bottom of the bore so that the overall ovality may be determined.
4. The taper of each cylinder is determined by taking measurements at the top and bottom of each bore at right angles to the gudgeon pin line. The difference between the two measurements is the taper.
5. To establish maximum overall bore wear, take measurements at as many points possible down the bores at right angles to the gudgeon pin line. The largest recorded figure is the maximum wear and should be compared with the original diameter of the cylinder bore.

   Maximum permissible ovality 0,127 mm (0.005 in).
   Maximum permissible taper 0,254 mm (0.010 in).
   Maximum permissible overall wear 0,177 mm (0.007 in).

If the above figures are excceded the cylinders must be rebored or sleeved depending upon the general condition of the bores and amount of wear. Alternatively, if the overall wear, taper and ovality are well within the acceptable limits and the original pistons are serviceable new piston rings may be fitted. It is important however, that the bores are deglazed, with a hone, to give a cross-hatched finish to provide a seating for the new rings. It is vital to thoroughly wash the bores afterwards to remove all traces of abrasive material.

Inspect camshaft bearings

6. Measure the internal diameter of each camshaft bearing at several points using an internal micrometer. A comparison of the bearing diameters with those of the respective camshaft journals will give the amount of clearance. The bearings should be renewed if the clearance exceeds 0,0508 mm (0.002 in). Or, in any event, if they are scored or pitted. This work should only be entrusted to line boring specialists.

Check crankcase main bearings

7. Discard scored, pitted, cracked and worn bearing shells.
8. To determine the maximum wear, assemble the main bearing shells and caps to the crankcase and tighten the bolts to the correct torque figure.
9. Using an inside micrometer, measure each bearing at several points and note the greatest figure. The maximum wear is the difference between this figure and the smallest diameter of the corresponding crankshaft journal. The main bearing running clearance is in the data section.
10. The bearing clearances may also be determined by using 'Plastigauge'. Since this method requires the crankshaft to be fitted to the crankcase, the procedure is described under engine assembly.

Fit cylinder sleeves

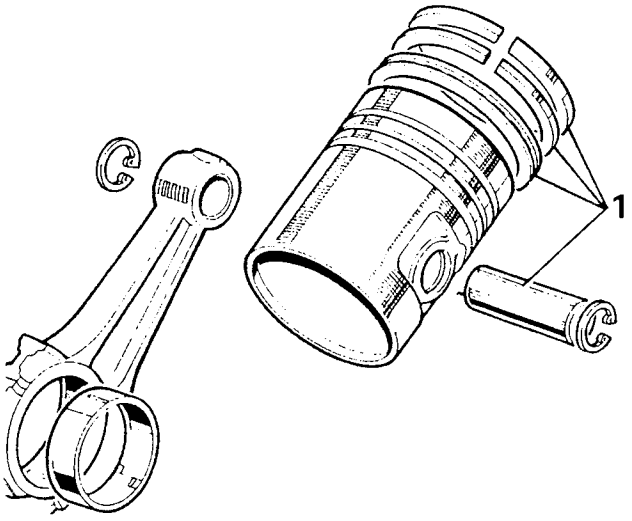
Cylinder bores that cannot be rebored can be restored by fitting sleeves to enable standard size pistons to be fitted. Sleeving one cylinder only will distort the adjacent bore so sleeving must be carried out in pairs, i.e. cylinders 1 and 2 or 3 and 4.

11. Machine the cylinder bores to accept the sleeves to 94,425 + 0,012 mm (3.7175 + 0.0005 in). This will give the sleeve a 0,076 to 0,114 mm (0.003 to 0.0045 in) interference fit.
12. Press the sleeves squarely into the bore using a pressure of two to three tons. Excessive pressure could damage the sleeve and cylinder block. The sleeves must not be proud of the cylinder block top face or more than 2,54 mm (0,10 in) below the surface.
13. Bore and hone the sleeves to accommodate the pistons with the required clearances, see piston and connecting-rod examination.

PISTON AND CONNECTING-ROD INSPECTION

The following checks relating to pistons and rings must also be carried out prior to fitting new pistons to rebored and sleeved cylinder blocks.
Until it is decided if new components are required all parts must be kept in their related sets and the position of each piston to its connecting-rod should be noted.

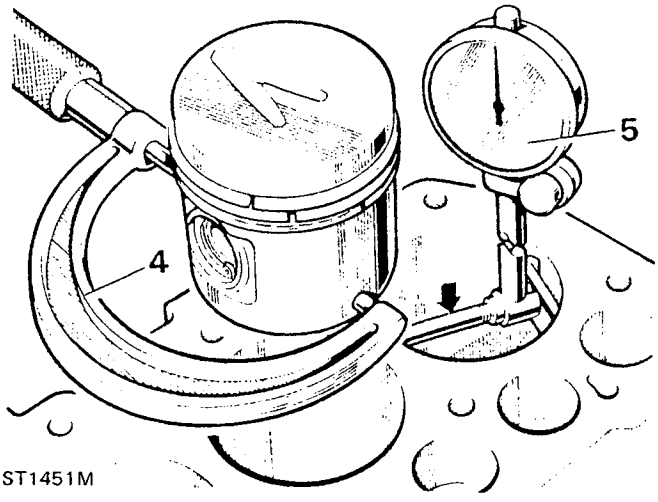
1. Remove the piston rings and gudgeon pin from each piston and detach the connecting-rod.



ST1452M

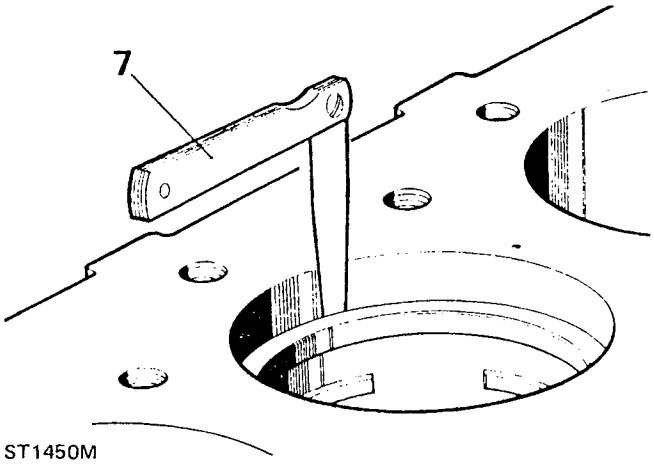
2. **Original pistons** — Decarbonise and degrease all components and carry out a visual examination of the pistons and rings and discard any which are unserviceable. Pistons which appear serviceable should be subjected to a more detailed examination described under 'New Pistons'.

3. **New Pistons** — Original pistons fitted to new engines at the factory are specially graded to facilitate assembly. The grade letter on the piston crown should be ignored when ordering new pistons. Genuine Land Rover service standard size pistons are supplied 0,025 mm (0.001 in) oversize to allow for production tolerances on new engines. When fitting new pistons to a standard size cylinder block the bores must be honed to accommodate the pistons with the correct clearances. In addition Land Rover pistons are available 0,50 and 1,01 mm (0.020 and 0.040 in) oversize for fitting to rebored cylinder blocks.
   Clearance limits for new standard size pistons in a standard cylinder bore measured at right angles to the gudgeon pin are in the "General specification data" section.
   When taking the following measurements the cylinder block and pistons must be at the same temperature to ensure accuracy.
4. Using a suitable micrometer measure the pistons at the bottom of the skirt at right angles to the gudgeon pin.
5. With an inside micrometer or cylinder gauge measure the diameter of the bore at approximately half-way down and note the reading.
6. The clearance is determined by subtracting the piston diameter from the bore diameter.



ST1451M

7. If gauge equipment is not available the clearance can be assessed by placing a long, suitably sized, feeler gauge down the thrust side of the bore and inserting the appropriate piston, 'upside down', in the bore and position it with the gudgeon pin parallel to the crankshaft axis. Push the piston down the bore and stop at the tightest point and whilst holding the piston still, slowly withdraw the feeler gauge. If a steady resistance of approximately 2,5 kg (6 lbs) is felt, the clearance is satisfactory.

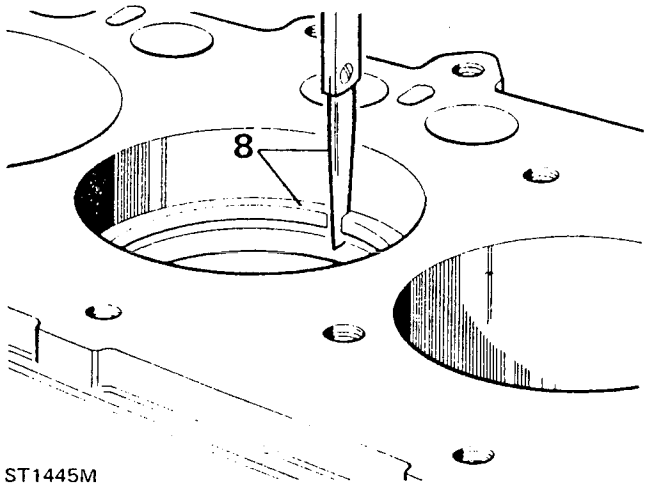


ST1450M

Inspect piston rings

Normally when an engine is being overhauled the piston rings are discarded unless the pistons have been removed for a different purpose and the engine has only completed a small mileage. Before refitting the piston the rings should be examined for wear and damage. In addition the rings must be checked for side clearance in the pistons and gap in the bores. The latter two checks must be made when fitting new rings to new and used pistons.

8. **Check gap** When checking the ring gap in worn bores, but are nevertheless within the acceptable taper and ovality limits, the ring must be inserted squarely into the bottom of the bore at the lowest point of the piston travel. To ensure squareness of the ring push the ring down the bore to the correct position with a piston. With newly machined bores, the ring may be inserted squarely into any position in the bore.
9. Using an appropriate feeler guage check the gaps of all the rings, in turn, including the oil control ring assembly.
   The correct gaps are listed in the Data Section. If any gap is less than that specified, remove the ring, and file the ends square, whilst holding the ring in a filing jig or vice. Should any gap be excessively wide and not likely to close-up to within the specified limits when hot, an oversize ring should be fitted.

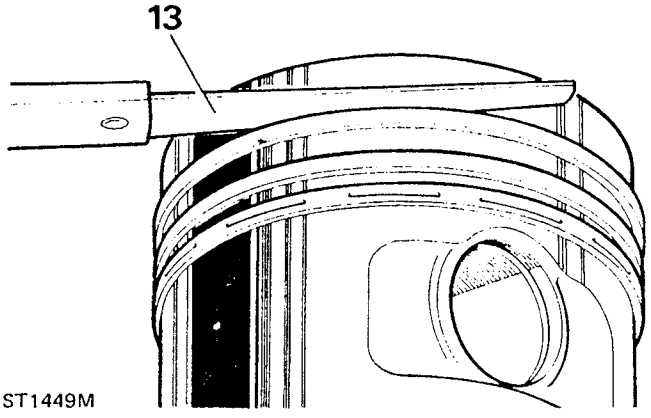


ST1445M

Check piston ring side clearance

10. It is important that clearances are correct. Rings that are too tight will bind when hot, imparing the radial pressure causing possible loss of compression. Excessive clearance will allow the rings to rock in the grooves and the resulting pumping action could cause excessive oil consumption and eventually broken rings.
11. Fit the oil control ring to the bottom groove. Fit the unpolished compression ring with the word 'TOP' uppermost to the second groove. Insert the polished chrome ring with an internal chamfer and the word 'TOP' uppermost to the top groove.
12. After fitting each ring, roll it round the piston groove to ensure that it is free and does not bind.
13. Using an appropriate feeler gauge check the clearance between the rings and piston grooves. Clearances in excess of 0,012 to 0,152 mm (0.004 to 0.006 in) are unacceptable and the ring and or the pistons should be renewed.

Compression rings — 0,06 to 0,011 mm (0.0025 to 0.0045 in).
Oil control ring — 0,038 to 0,064 mm (0.0015 to 0.0025 in).



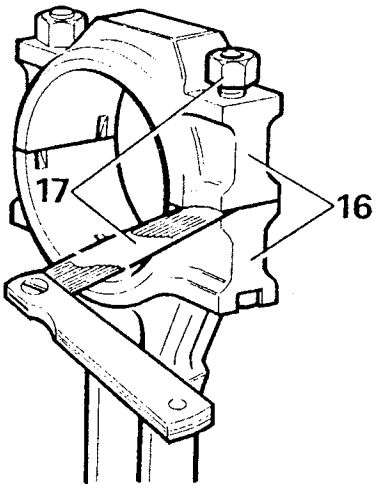
ST1449M

Inspect gudgeon pins

14. Check the gudgeon pin for wear, cracks, scores and overheating.
15. The gudgeon pin fit in the piston must be tight push fit at a temperature of 68°F (20°C). Check the gudgeon pin for ovality and taper using a micrometer.

Connecting-rod inspection

16. Check the connecting-rods and caps for distortion as follows; fit the correct cap, less the bearing shells, to each connecting-rod as denoted by the number stamped near the joint faces. This number also indicates the crankshaft journal to which it must be fitted.
17. Tighten the nuts to the correct torque and release the nut on one side only. Check, with a feeler gauge, that no clearance exists between the joint faces. If there is a gap the connecting-rod is distorted and should be renewed.



ST716M

18. Use an accurate connecting-rod alignment gauge to check the rods for bend and twist. The maximum allowable for both conditions must not exceed 0,127 mm (0.005 in).
19. Examine and check the small-end bush for wear. If necessary renew the bush. The correct clearance of the gudgeon pin in the small-end bush is given in "General specification data".
20. When renewing a bush ensure that the oil hole in the bush lines up with the hole in the connecting-rod. Finish the bush to the correct size and clearance.
21. Connecting-rod bearings that are worn, pitted, scored and show signs of overheating must be discarded. If more than one of the bearings show these signs they must all be renewed. When fitting new or used bearings to serviceable crankpins the clearances must be checked.

Connecting-rod bearing nip and clearance

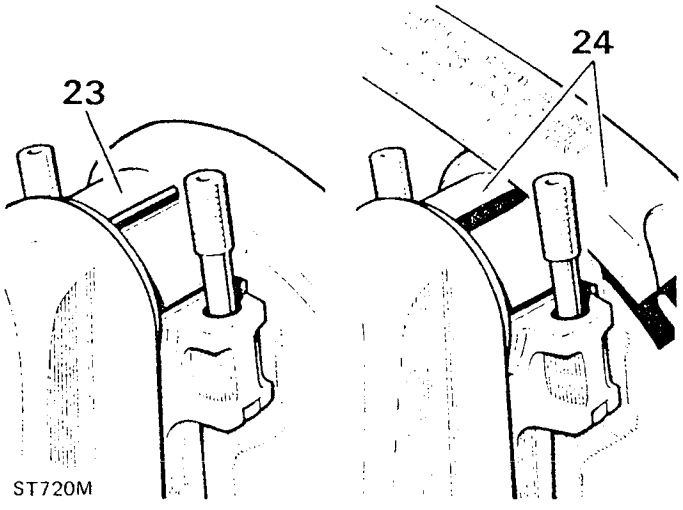
New bearing halves are supplied with a protective coating and must be degreased before fitting.
22. Fit the bearing halves to the connecting-rod and cap and secure the assembly with the correct torque. Slacken the nut on one side only and check the clearance between the joint faces with a feeler gauge.

The clearance should be between 0,10 and 0,20 mm (0.004 and 0.008 in). The bearing nip can be adjusted by the selective assembly of the bearing shells which are available in slightly varying thicknesses. Do not file or machine the caps or rods to vary the bearing nip. Make a final check to prove the clearance by inserting a 0,063 (0.0025 in) shim paper between the crankpin and one half of the bearing and tightening to the correct torque. The connecting-rod should resist rotation and move freely with the shim paper removed.

As an alternative, the bearing clearances can be determined by using 'Plastigauge' which consists of a thin piece of plastic material a few hundreds of a millimeter or thousands of an inch in diameter. When the material is flattened by being squeezed between the bearing and crankpin the width of the plastic is measured by a scale gauge which indicates the clearance.

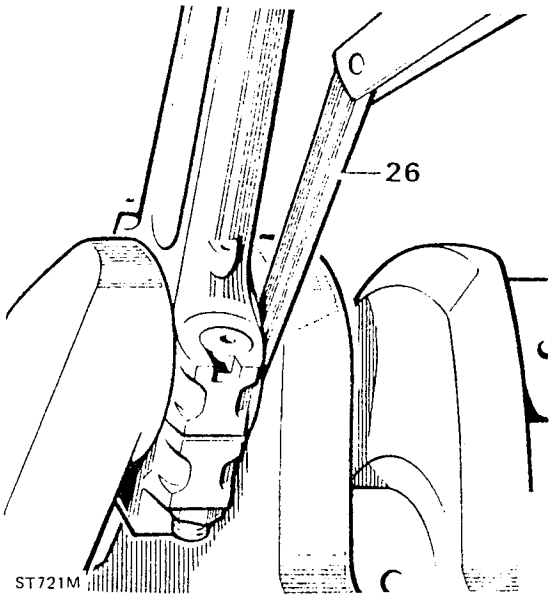
23. Wipe any oil from the crankpins and place a piece of 'Plastigauge' across the centre of the bearing in the connecting-rod cap. Assemble the rod to the appropriate crankpin and tighten to the correct torque. Do not rotate the connecting-rod or crankshaft during this operation.
24. Remove the connecting-rod cap and bearing shell and using the scale supplied measure the flattened 'Plastigauge' at its widest point. The graduation that most closely corresponds to the width of the 'Plastigauge' indicates the bearing clearance.

    The correct clearance with new or overhauled components is 0,019 to 0,063 mm (0.0007 to 0.0025 in).
25. Wipe off the 'Plastigauge' with an oily rag. Do not scrape off otherwise it may damage the crankpins.



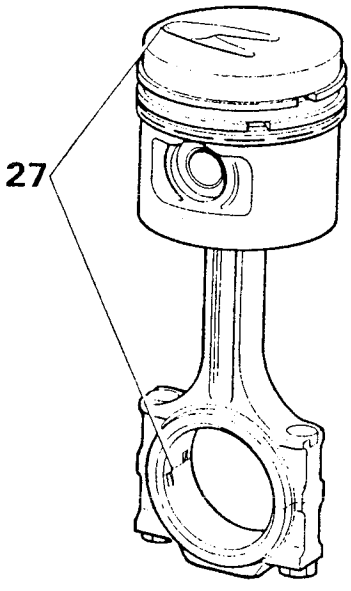
Connecting-rod end-float

26. Fit the connecting-rods complete with bearings to their respective crankpins. Move the connecting-rod to one side and check the clearance, with a feeler, on the opposite side. The correct clearance is between 0,20 and 0,30 mm (0.007 and 0.012 in).



Assemble pistons to connecting-rods

27. The piston must be assembled with the point of the 'V', on the piston crown, on the same side as the bearing shell location slots in the connecting-rod.
28. Insert a circlip in one side of the gudgeon pin boss and assemble the piston to the connecting-rod with the gudgeon pin. Secure the assembly with a circlip on the opposite side of the piston.



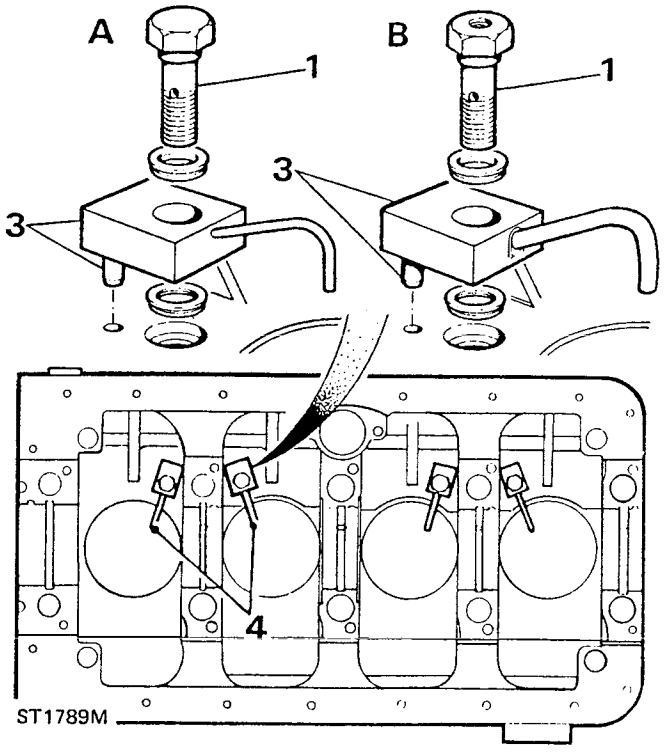
ASSEMBLE ENGINE

ASSEMBLE JET TUBES TO CYLINDER BLOCK

Oil jet tubes are fitted to lubricate the pistons and bores directly from the main oil gallery.

1. The jet tubes are 'Handed' and can only be fitted one way. It is important to note that the jet retaining 'bolt' contains a non-return valve and therefore on no account must an ordinary bolt be used.
2. Clean the recess in the cylinder block using an air line, if available, to remove any swarf.
3. Assemble and fit the jet tube assemblies as illustrated ensuring that the pegs locate in the holes in the cylinder block, and that the larger diameter washer fits under the bolt head.
4. Before tightening the retaining bolts ensure that the small squirt pipes do not foul the crankshaft or pistons. Firmly tap the jet tube assemblies down onto the cylinder block, thus ensuring that the locating dowel is fully home and avoiding any sideways distortion on the retaining bolt. Use a tube slightly larger than the bolt head. The old bolt should be discarded and a new bolt fitted.
5. When the crankshaft and pistons have been fitted slowly turn the crankshaft and check that no fouling occurs.

A. Early Type B. Latest Assembly.

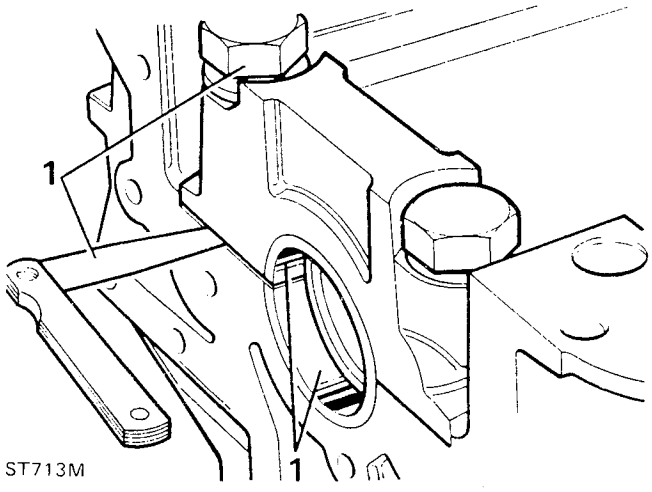


FIT CRANKSHAFT

Main bearing nip and clearance

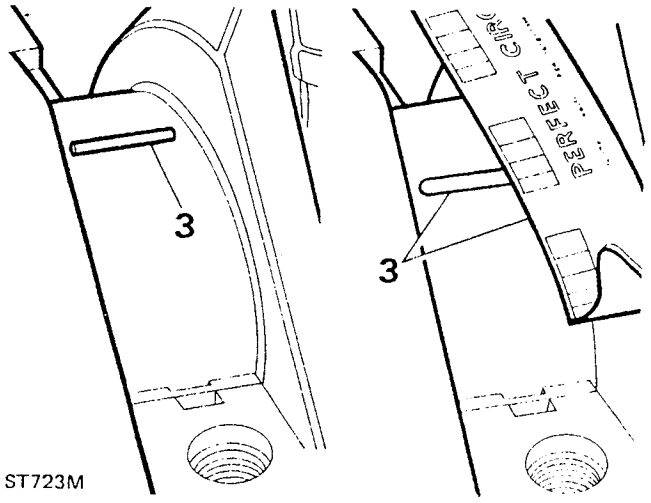
New main bearing halves are supplied with a protective coating and must be degreased before fitting.

1. Fit the bearing halves in the crankcase saddles and caps and secure the caps to the crankcase and tighten to the correct torque. Slacken the bolts on one side of the caps only and, with a feeler gauge, check the gap between the joint faces. The clearance or nip must be within 0,10 to 0,15 mm (0.004 to 0.006 in). The bearing nip can be adjusted by selective assembly of the bearing halves available in varying thicknesses. Do not file or machine the caps or saddles to achieve the correct clearance. Note that the rear main bearings are wider than the remaining four.
2. To make a final check that the clearance is correct, leave the bearing halves in the crankcase saddles and carefully lower the crankshaft into position. Check each bearing in turn by inserting a 0,063 mm (0.0025 in) shim paper between the bearing cap and crankshaft journal and tighten the bolts to the correct torque. If the clearance is correct, there should be a slight increase in the resistance to rotation of the crankshaft.



As an alternative 'Plastigauge' may be used to check the clearance in the same manner as with the connecting-rod bearings. This material may also be used to determine the amount of wear in used bearings and journals.

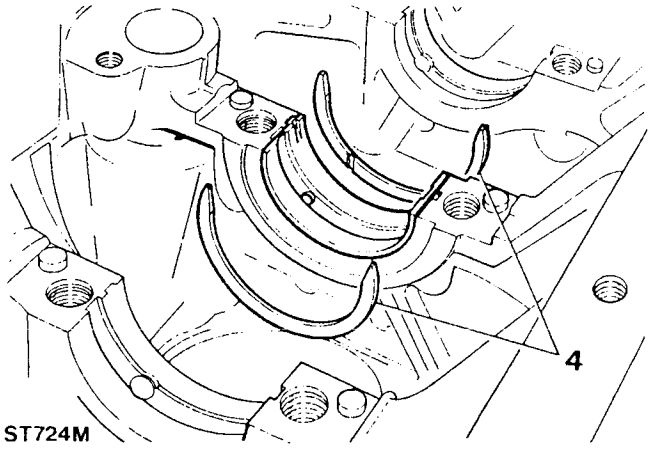
3. Locate the crankshaft in position on the upper bearing halves in the crankcase and wipe any oil from the journals since 'Plastigauge' is soluble in oil. Place a piece of 'Plastigauge' across the lower half of each crankshaft journal or lower bearing cap shell. Fit the cap and tighten to the correct torque. Remove the cap and bearing and using the scale supplied with the 'Plastigauge' measure the flattened 'Plastigauge' at its widest point. The graduation that most closely corresponds with the width of the 'Plastigauge' indicates the bearing clearance.
The correct clearance with new or overhauled components is included in "General specification data" section. If new bearings are being fitted use selective assembly to obtain the correct clearance. Wipe off, not scrape the 'Plastigauge' with an oily rag from the journals or bearings.



ST723M

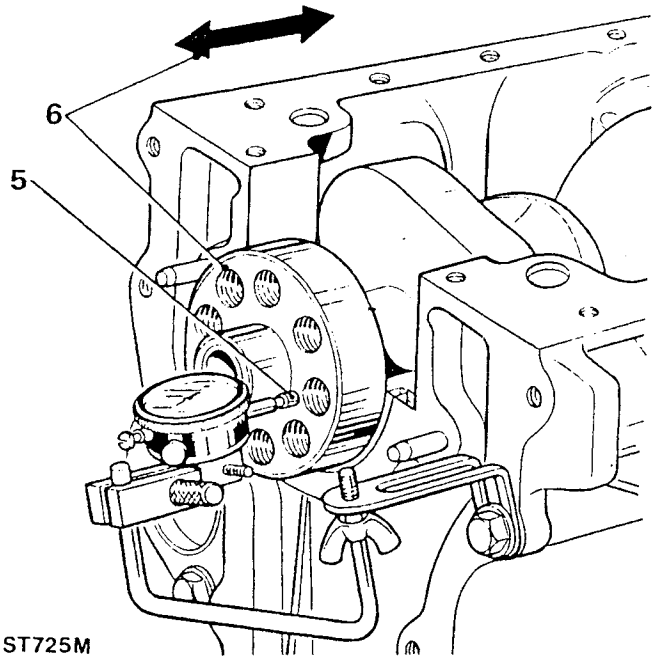
Adjust crankshaft end-float

4. Lift out the crankshaft and insert a standard size thrust washer both sides of the centre main bearing saddle with the grooves towards the crankshaft.



ST724M

5. Place the crankshaft in position in the crankcase and mount a dial test indicator to read-off the end of the crankshaft. A feeler gauge may be used instead of an indicator.
6. Determine the end-float by moving the crankshaft away from the indicator and zero the dial. Move the crankshaft in the opposite direction and note the indicator reading. Alternatively measure the clearance with a feeler gauge. The end-float should be 0,05 to 0,15 mm (0.002 to 0.006 in).
7. If adjustment is required substitute with oversize thrust washers. Variation of thrust washer thickness at each side of crankshaft journal must not exceed 0,08 mm (0.003 in) to ensure that the crankshaft remains centralised.

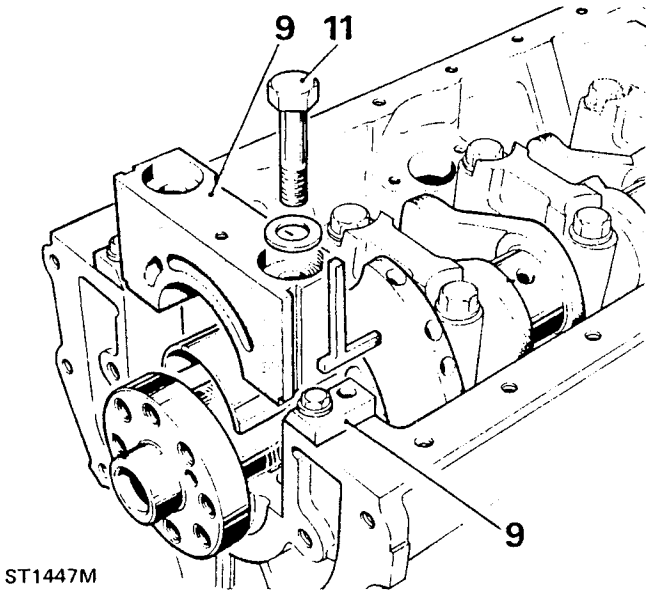


ST725M

8. Lubricate the crankshaft main journals with clean engine oil and fit the appropriate bearing caps and lower shells to the crankcase with the exception of number five main bearing. Ensure that the caps locate properly over the dowels. Using new bolts and washers evenly tighten to the correct torque figure.

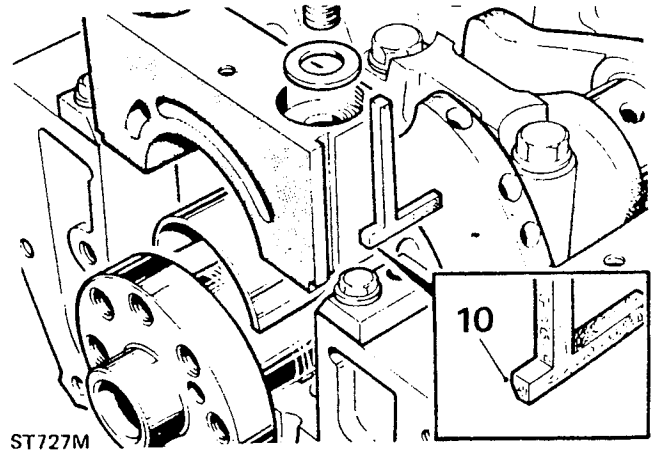
Fit rear main bearing cap

9. Ensure that number five main bearing cap is clean and free from old cork seal material.
Attach the cork seal guides number 270304 to the crankcase, as illustrated, and ensure that they are parallel to the crankcase edge.



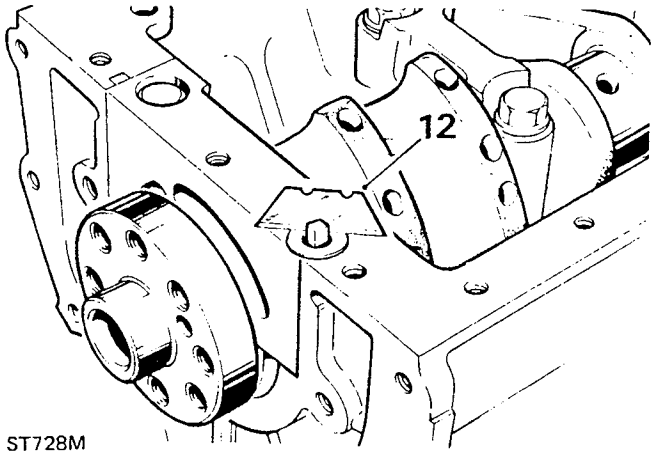
ST1447M

10. To prevent any cork seal material becoming trapped between the bearing cap and crankcase, chamfer the inner edge of the corks 0,40 to 0,80 mm($\frac{1}{64}$ to $\frac{1}{32}$ in) wide as illustrated.
Immerse the cork seals in engine oil and fit them to the bearing cap.



ST727M

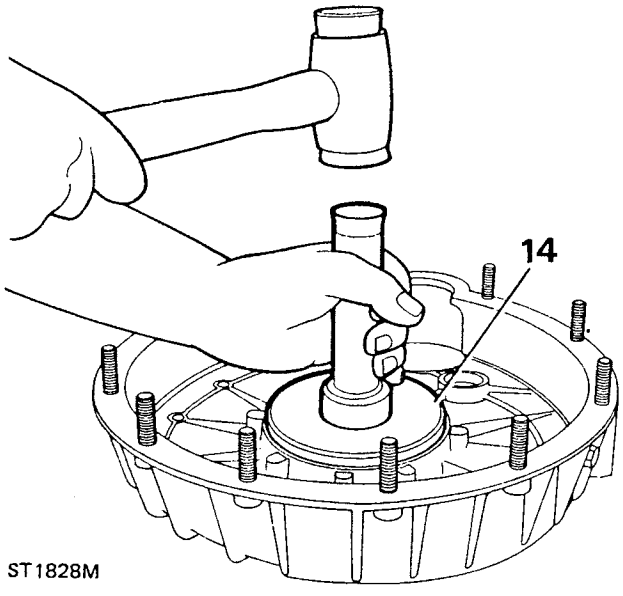
11. Fit the bearing cap and lower shell to the crankcase and secure with new bolts and washers and tighten to the appropriate torque.
12. To allow for shrinkage after fitting leave the cork seals standing proud of the crankcase sump face. If possible delay the fitting of the sump for approximately twelve hours and leave the seal protruding 2,40 mm ($\frac{3}{32}$ in) and then place a 6.350 mm (¼ in) washer over the seal and cut off the surplus. If it is necessary to fit the sump immediately, trim the seals off leaving 0,80 mm ($\frac{1}{32}$ in) proud, that is, the thickness of the above washer.
Apply Hylomar SQ32M to the protruding end of the seals.



ST728M

Fit rear main oil seal

13. Check that the crankshaft oil seal journal is undamaged and clean. Make sure the seal housing is clean and dry and free from burrs. Do not touch the seal lip and ensure that the outside diameter is clean and dry. The P.T.F.E Seal Part No. ETC 5369 which should be used is supplied with a former to maintain the correct shape and must not be removed until the seal is to be fitted.
14. Using special seal replacer 18G 134-11 and with the lip side leading drive-in the seal as far as the tool allows. If the tool is not available fit the seal to the bottom of the housing to ensure squareness.

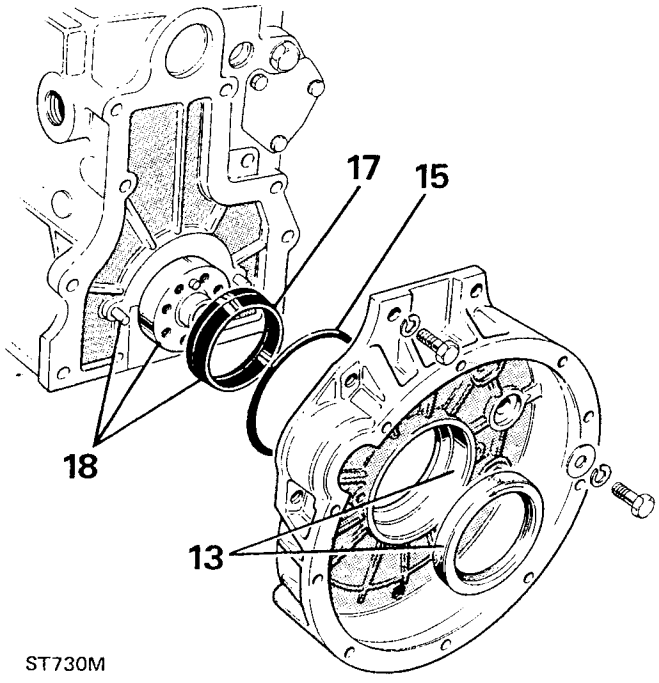


ST1828M

Fit flywheel housing — Early engines

15. Fit the 'O' ring seal to the flywheel housing.
16. Examine the seal guide number 18G 1344 and repair any damage that could destroy the seal lip.
17. Lubricate the outside diameter of the seal guide and the seal journal with concentrated 'Oildag' in a 25% solution with clean engine oil.

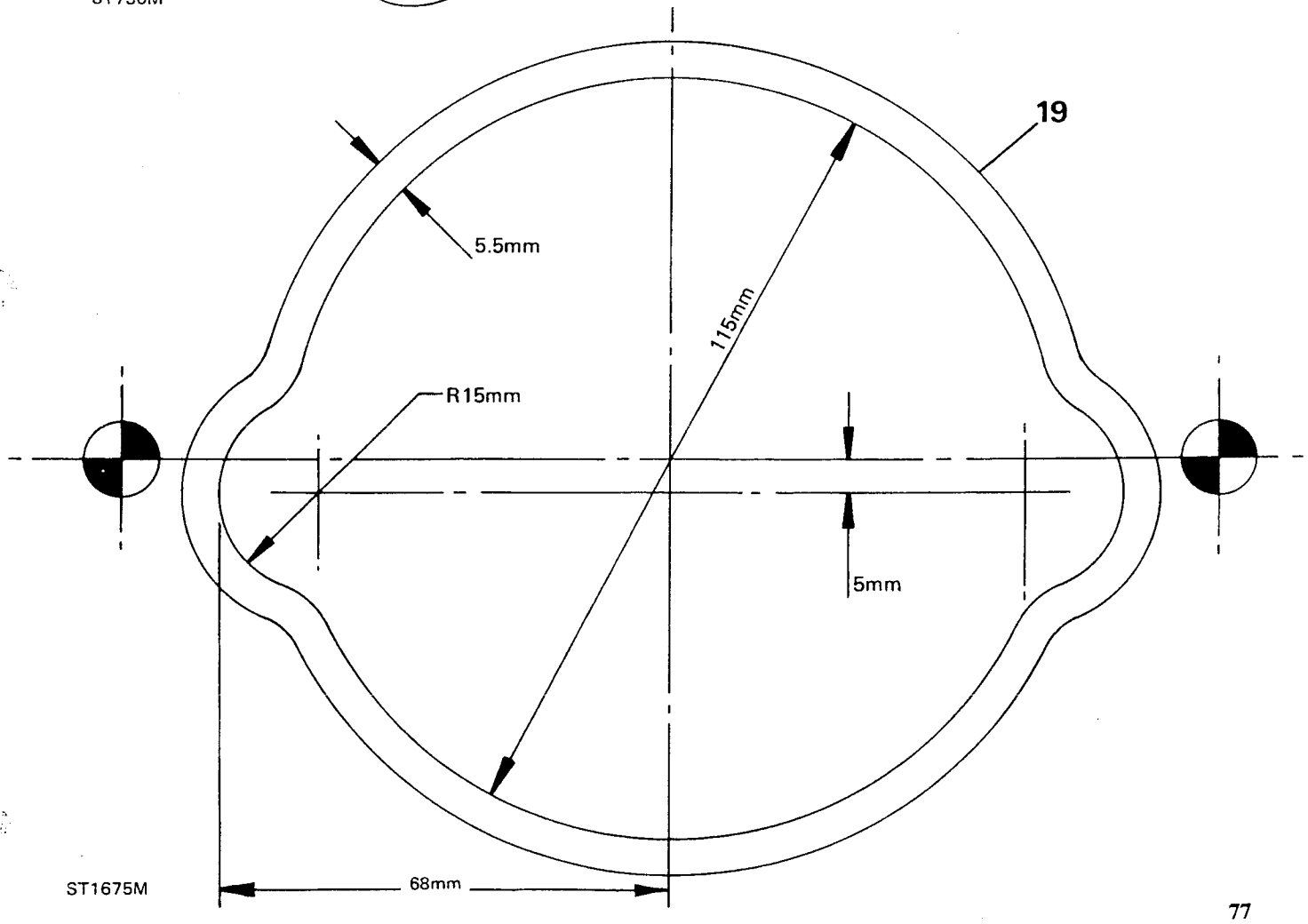
18. Place the seal guide on the crankshaft flange and, using the two dowels protruding from the cylinder block rear face as a guide to ensure initial squareness, fit the flywheel housing and remove the seal guide. Secure the flywheel housing evenly tightening the retaining bolts.



ST730M

Fit flywheel housing — Later engines

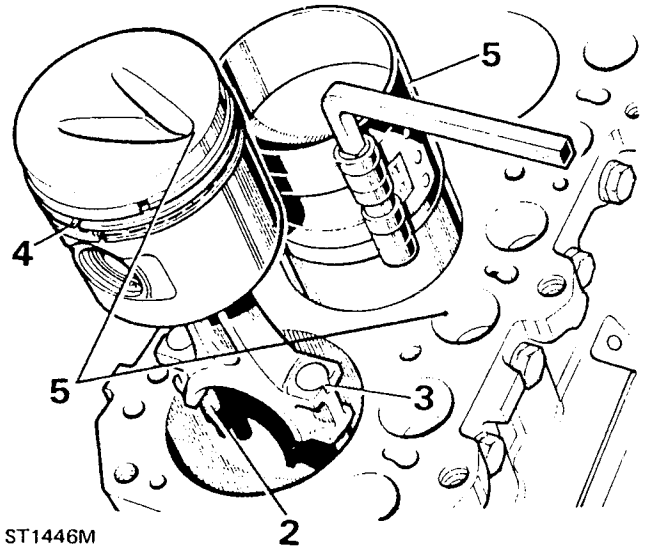
19. In place of the 'O' ring seal a bead of Hylogrip 2000 sealant must be applied to the rear face of the flywheel housing to the dimensions and configuration as illustrated below. The illustration has been produced full size so that a template may be made to facilitate the application of the sealant. The bead should be 5,5 mm wide and 0,25 mm thick.
20. Fit the housing following instructions 17 to 19.



ST1675M

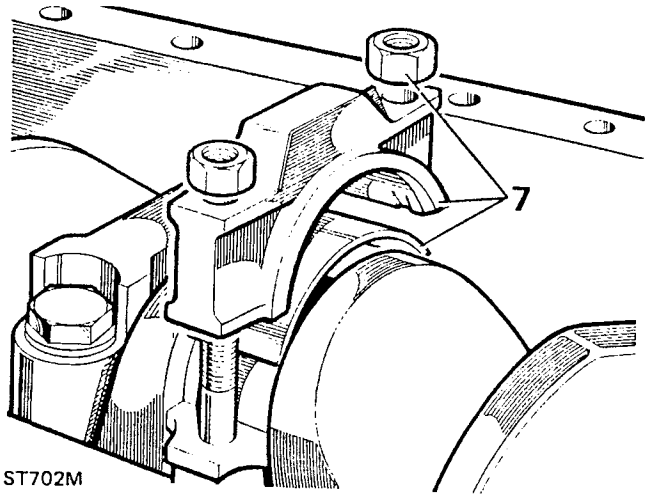
FIT THE CONNECTING-RODS AND PISTONS

1. Turn the crankshaft to position numbers one and four crankpins at bottom dead centre to facilitate fitting the connecting-rods.
2. When fitting the connecting-rods and pistons ensure that the bolts do not foul and damage the crankpins. As a precaution it is recommended that rubber or soft plastic sleeves are placed over the threads.
3. The connecting-rod bolts have essentric heads which locate in a recess in the connecting-rod. It is essential that the head of each new bolt is properly located before tightening.
4. Stagger the compression rings so that the gaps are equidistantly spaced round the piston but, so arranged, that no gap is positioned on the thrust side of the piston i.e. opposite the camshaft. Turn the oil control ring so that the gap is in line with the gudgeon pin.
5. Lubricate the cylinder walls, piston rings and crankpins. Compress the pistons rings with a suitable compressor tool and carefully lower the connecting-rod into the bore ensuring that the piston is assembled in accordance with instruction 27 under "Assemble pistons to connecting-rods". Also the point of the arrow headed valve clearance indentation in the piston crown, must face the camshaft side of the engine.
6. Using a soft mallet, sharply tap the piston into the bore so that the whole of the piston is just below the surface of the cylinder block.



ST1446M

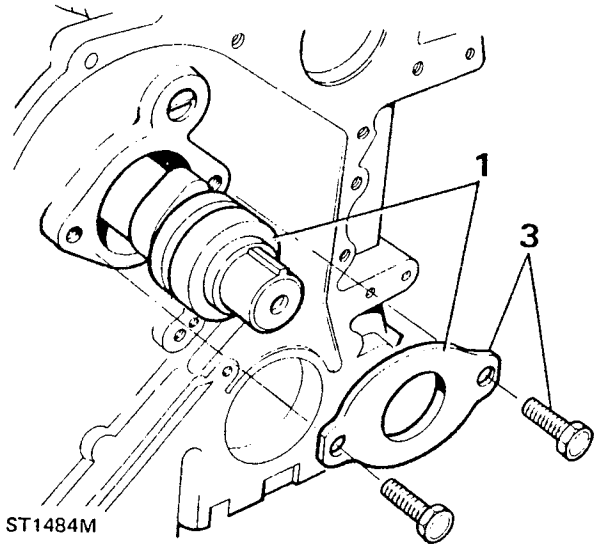
7. Check that the bearing shell is properly located in the connecting-rod and pull the rod onto the crankpin. Locate the bearing shell correctly and fit the cap so that the identification numbers are together on the camshaft side of the engine. Fit and tighten new nuts to the correct torque figure. Repeat the foregoing instructions for fitting the remaining piston and connecting-rod assemblies.



ST702M

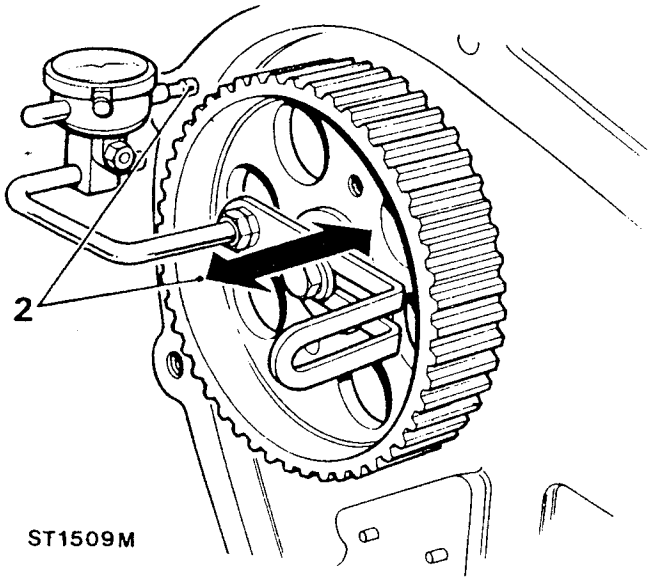
FIT THE CAMSHAFT

1. Lubricate the camshaft bearings and with care, insert the camshaft into the cylinder block. Temporarily secure a new thrust plate with the two bolts.



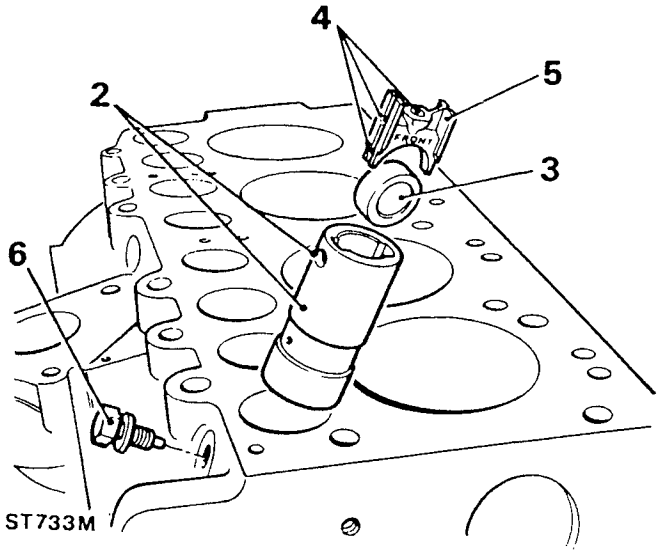
ST1484M

2. To check the camshaft end-float, fit the woodruff key and temporarily fit the cam-shaft pulley and mount a dial test indicator, as illustrated, so that the stylus rests in a loaded condition upon the machined face of the cylinder block. Zero the dial and move the camshaft back and forward and note the reading. The end-float should be within 0,06 to 0,13 mm (0.0025 to 0.0055 in). If the end-float is outside these limits, fit different thrust plates until the correct tolerance is achieved.
3. Remove the test indicator and pulley, and secure the thrust plate with the two bolts.



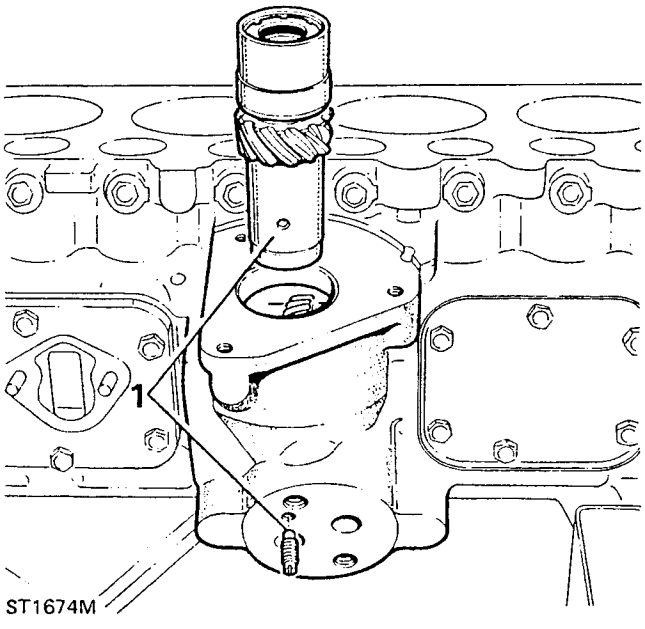
FIT TAPPETS, GUIDES AND ROLLERS

1. If the same parts are being refitted ensure that they are returned to their original positions. Ensure that the tappet slides move freely in the guides.
2. Insert the tappet guides into the cylinder block and align the locating screw holes.
3. Fit the tappet rollers ensuring that they are fitted in accordance with the marks made during removal. New rollers, however, may be fitted either way round.
4. Before fitting the tappet slides make sure the oilways are clear to the tappet bearing surface, the cross drilling and the oil feed to the push rod.
5. Insert the tappet slides with the word 'FRONT' towards the front of the engine.
6. Secure the tappet guides with NEW Micro encapsulated screws and tighten to the correct torque figure. Micro encapsulated screws should also be used on engines where the screws were originally wired for security.



FIT THE SKEW GEAR

1. Lubricate and insert the skew gear and coupling assembly into mesh with the camshaft gear. Align the location hole in the bush and fit a new location screw into the cylinder block.

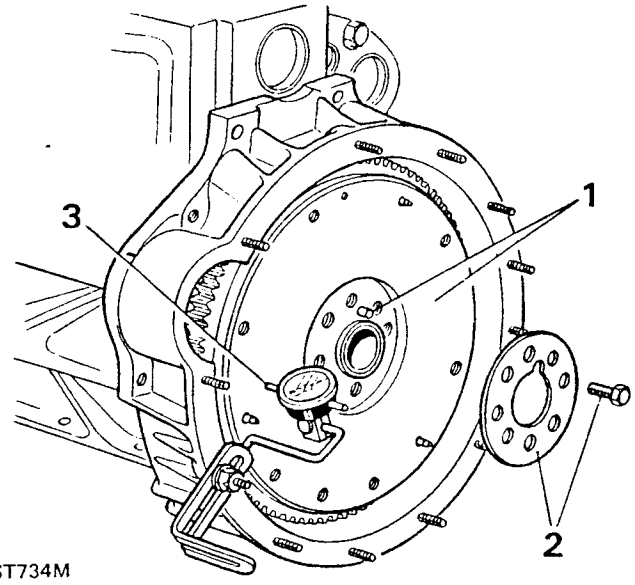


FIT THE FLYWHEEL

1. Examine the flywheel and crankshaft mating faces and remove any burrs or imperfections that could prevent the flywheel locating correctly. Check that the dowel is in position.

continued

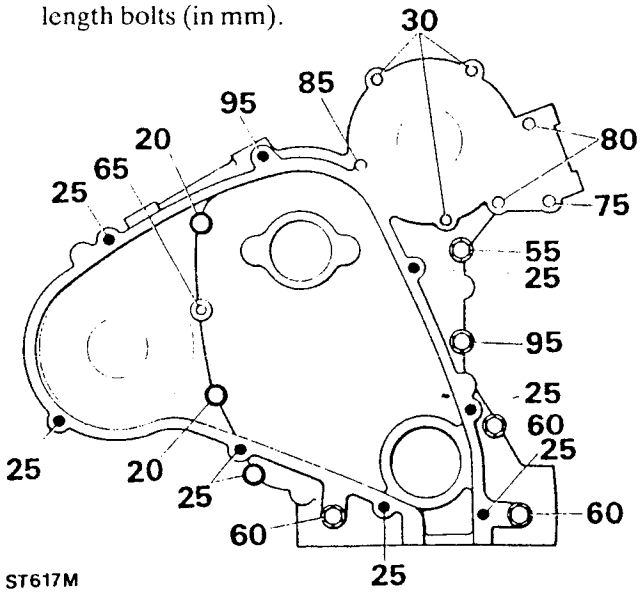
2. Offer up the flywheel to the crankshaft and secure with the reinforcing plate and retaining bolts. Evenly tighten the bolts to the correct torque figure.
3. To check the flywheel run-out, mount a dial test indicator so that the stylus rests, in a loaded condition, on the clutch pressure face at a radius of 114 mm (4.5 in).
4. Turn the flywheel, and check that the run-out does not exceed 0.05 to 0.07 mm (0.002 to 0.003 in). Should the run-out be excessive, remove the flywheel, and check again for irregularities on flywheel and crankshaft mating faces and dowel.



ST734M

FIT TIMING FRONT COVER, SEALS AND PULLEYS

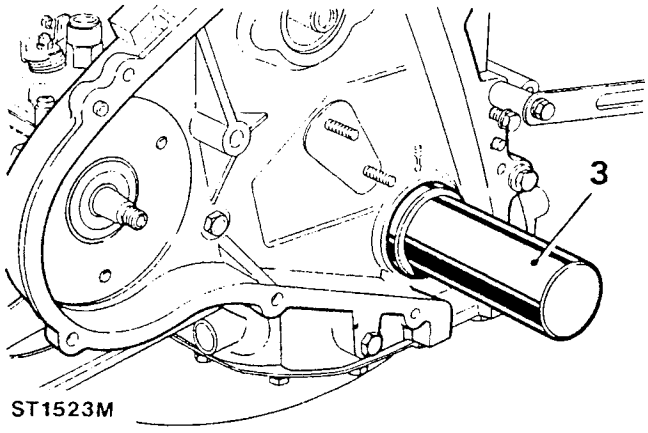
1. Fit new cover joint, triangular gasket, and water gallery gasket, to the cylinder block.
2. Fit and secure the rear cover with the eight bolts refering to the chart for location of the various length bolts (in mm).



ST617M

Rear cover — crankshaft seal

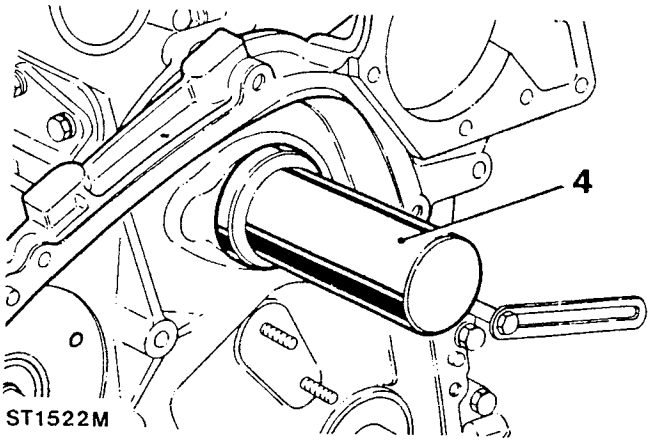
3. With the lip side leading drive in the new seal using special tool 18G 1456, until the seal is approximately 0,5 mm below the inner face of the cover.



ST1523M

Front cover — camshaft seal

4. Drive in a new seal, lip side leading until flush or approximately 1.0 mm below the inner surface using special tool 18G1482.

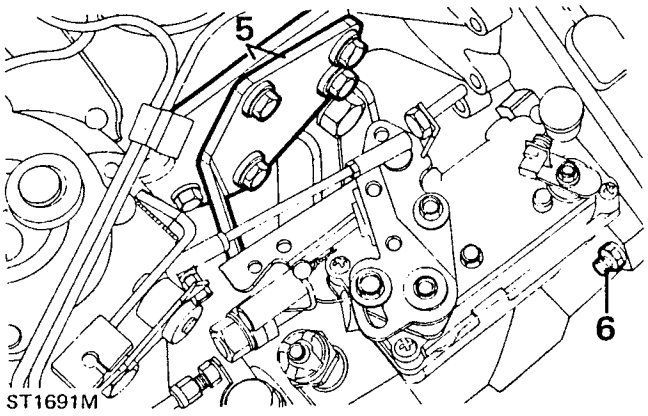


ST1522M

continued

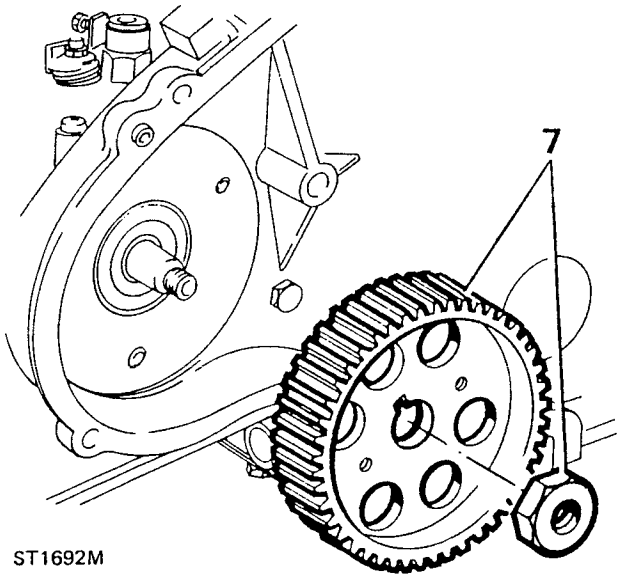
Fit distributor pump (D.P.S.)

5. Fit the camshaft front inspection cover complete with the D.P.S. pump rear rear support bracket. Using a new joint washer evenly tighten the six bolts.
6. Fit pump joint washer and loosely secure pump to cover with the three nuts and to the rear support bracket with the single nut and bolt. Position the pump so that the retaining studs are midway in the flange slots.



ST1691M

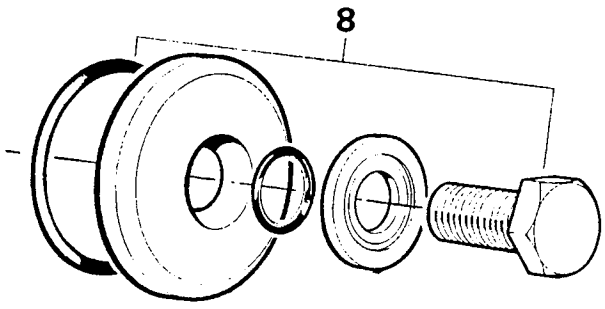
7. Fit D.P.S. pump pulley, and loosely secure with the nut.



ST1692M

Fit camshaft pulley

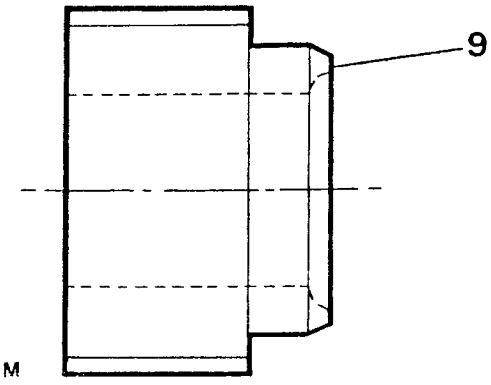
8. Fit pulley, boss towards engine, and loosely secure with special washer, 'O' rings, plain washer and new bolt. DO NOT drive pulley onto camshaft. Draw pulley on with a slave 10 mm diameter metric bolt, plain washer and nut.



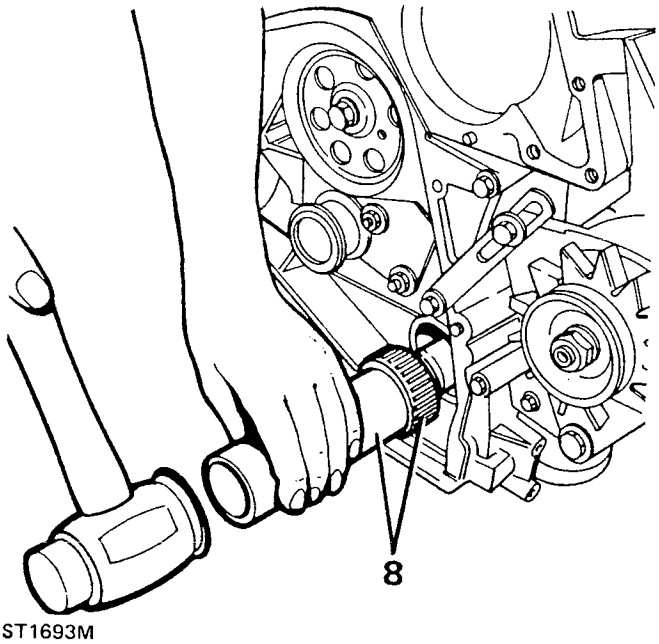
ST1521M

Fit crankshaft timing pulley

9. Apply Loctite 518 to the pulley face as illustrated; do not allow sealant to contact chamfered face. Lightly oil the crankshaft and pulley bore and fit the pulley, with timing dot outwards, and drive into position using a suitable tube as a drift.



ST1921M

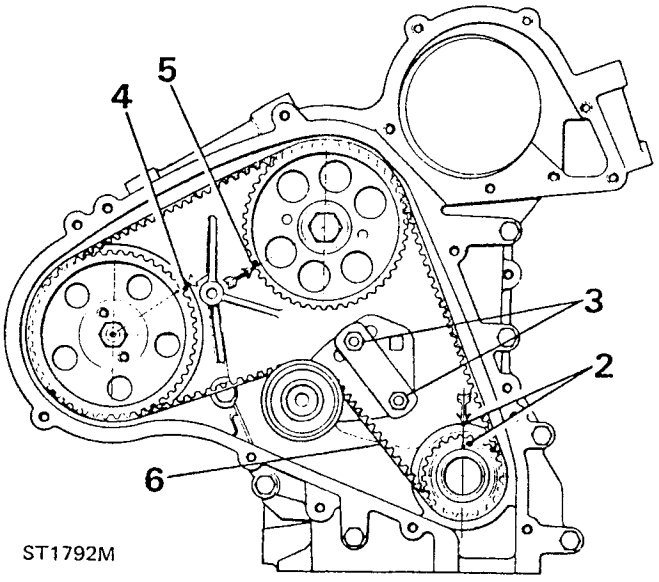


ST1693M

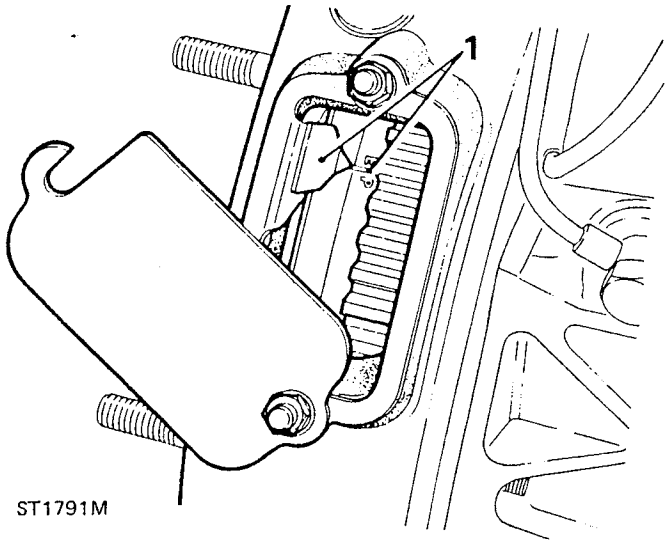
TIME D.P.S. PUMP AND VALVES — Early Engines

The D.P.S. pump and valves are timed using the exhaust valve peak of number one cylinder. On early engines the exhaust peak position is determined by the relationship of a line, marked E.P. on the flywheel perifery and a timing pointer on the flywheel housing. The pointer is available under Part Number ERC 2250.

1. Turn the crankshaft in a clockwise direction until the E.P. mark on the flywheel lines-up exactly with the pointer. If the crankshaft is inadvertently turned beyond the E.P. mark do not turn it back but continue on round in a clockwise direction until the mark and pointer coincide exactly.

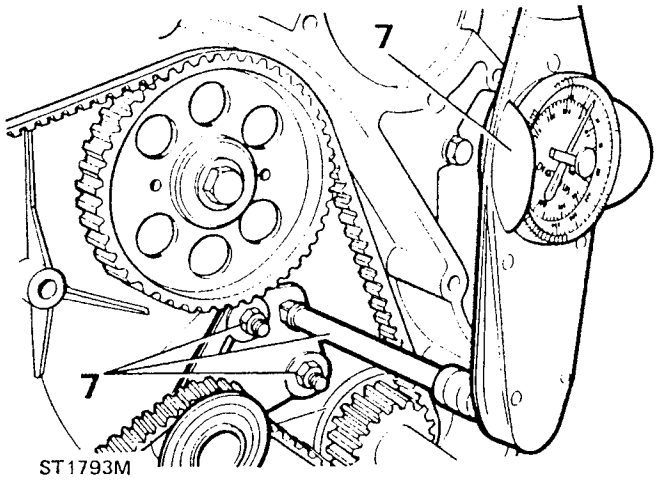


ST1792M



ST1791M

2. Check that the dot on the crankshaft pulley and the cast-on arrow on the rear cover line-up.
3. Fit the timing belt tensioner assembly and loosely secure with the two nuts (strap deleted on later models).
4. Turn the D.P.S. pump pulley clockwise until the dot lines up exactly with arrows in the rear cover.
5. Similarly, turn the camshaft pulley clockwise so that the dot coincides exactly with the cast-on arrow.
6. Fit the timing belt over the crankshaft pulley and whilst keeping the belt under tension, by hand, run the belt over the camshaft pulley. If the belt does not quite mate with the grooves, turn the pulley clockwise the necessary amount. Feed the belt over the pump pulley and if necessary turn the pulley clockwise to locate in the grooves. Keeping a firm grip on the belt pass it over the tensioner wheel.
7. Set a dial type torque wrench to 29,0 to 23,5 Nm (21 to 17 lbs ft) and whilst holding it vertically, insert the drive peg into the square hole in the tensioner base plate. Tension the belt and tighten the clamp nuts to the correct torque.



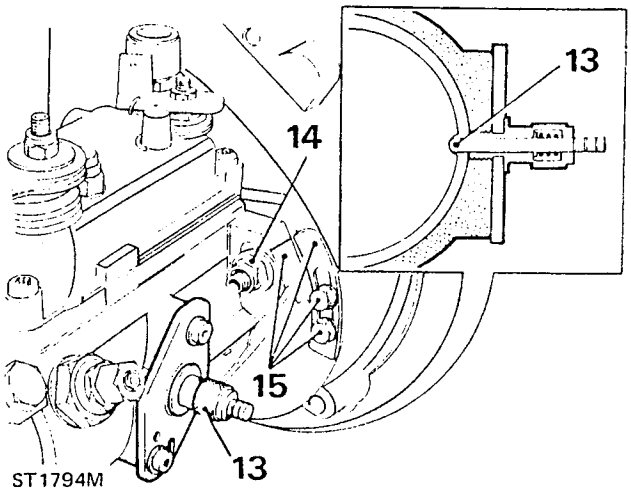
ST1793M

8. Rotate the engine TWO complete revolutions.
9. Slacken the tensioner clamp nuts.
10. Tension the belt again as described in instruction 7 and tighten the clamp nuts to the correct torque.

CAUTION: The double tensioning procedure is imperative, otherwise the belt could fail resulting in serious engine damage. See CAUTION Page 84 and "Care of belts".

11. Rotate the crankshaft until, the E.P. mark on the flywheel and the pointer line-up.
12. Check that the dots on the pump and camshaft pulleys coincide exactly with their respective arrows. If there is any misalignment the procedure must be repeated.

13. Remove the plug from the side of the D.P.S. pump and insert gauge tool 18G 1458 and if necessary rotate the pump body until the gauge can be fully inserted and screwed home indicating that the inner disc is centrally positioned with the hole.
14. Evenly tighten the three nuts securing the pump to the cover and the single nut and bolt to the support bracket.
15. Align timing pointer on rear of cover, with the scribed line on the pump flange and tighten the two screws. If a new pump is being fitted and there is no scribed line, scribe a line in the centre of the machined area on the pump flange. Align the timing pointer and tighten the screws. On later engines the timing pointer has been deleted and instruction 15 can be ignored.

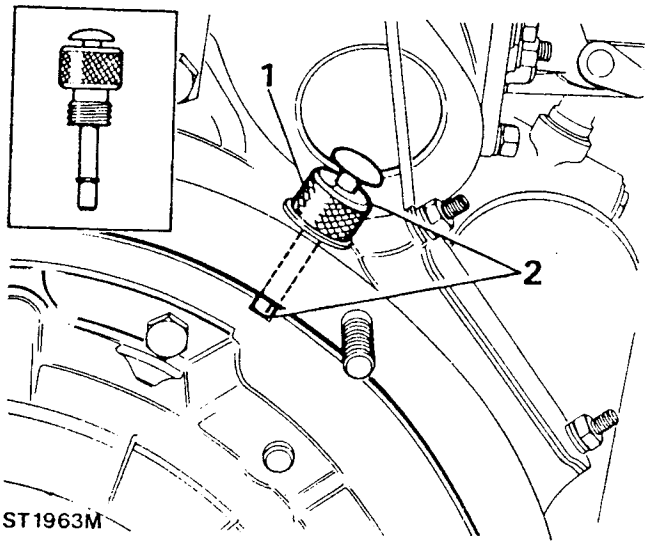


16. Tighten the D.P.S. pump timing pulley nut and the camshaft pulley retaining bolt to the correct torque.
17. Remove the timing pointer from the flywheel housing, close the cover and secure with the two nuts.

Time D.P.S. PUMP AND VALVES — Later Engines with slot in flywheel for determining the E.P.

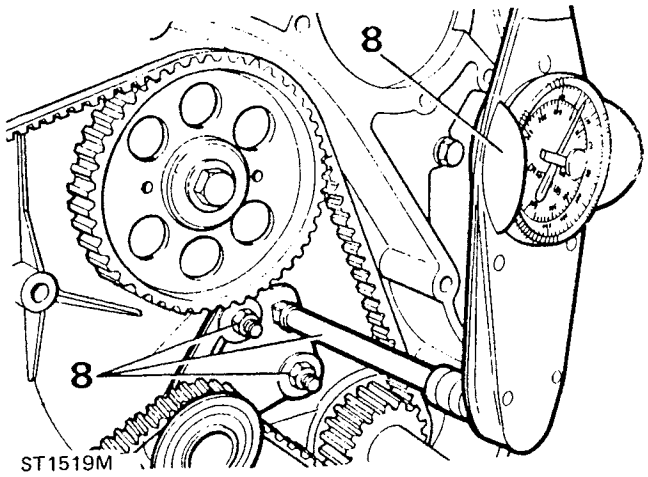
The D.P.S. pump and valves are timed using the exhaust valve peak of number one cylinder. This is determined on later engines by the relationship of a slot in the flywheel periphery and a plugged hole in the flywheel housing through which a flywheel timing pin, special tool number LST 107, is inserted.

1. Remove the plug from the flywheel housing and fit the body of special tool LST 107 without the pin.
2. Turn the crankshaft in a clockwise direction until the E.P. slot in the flywheel is in-line with the hole in the flywheel housing. If the crankshaft is inadvertently turned beyond the E.P. slot, do not turn the crankshaft back but continue on round in a clockwise direction until the pin of the special tool can be fully located in the flywheel slot.

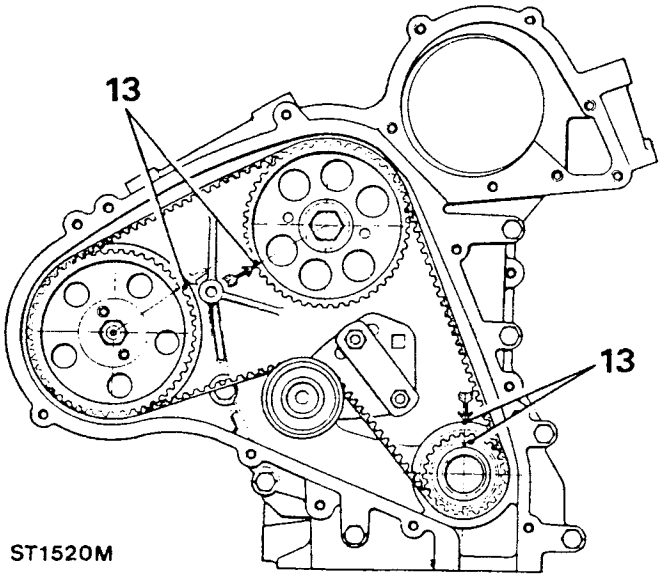


3. Fit the timing belt tensioner assembly and loosely secure with the two nuts.
4. Turn the D.P.S. pump pulley clockwise until the dot on the pulley lines-up exactly with the cast-on arrow inside the front cover.
5. Similarly, turn the camshaft pulley clockwise until the dot lines-up with the cast-on arrow in the front cover.
6. Fit a new timing belt over the crankshaft pulley and whilst keeping the belt under tension, by hand, run the belt over the camshaft pulley. Should the belt not quite mate with the grooves, turn the pulley clockwise the necessary amount. Feed the belt over the D.P.S. pump pulley and if necessary turn the pulley clockwise to locate in the grooves. Keeping a firm grip on the belt, pass it over the tensioner jockey pulley.
7. Withdraw the special tool timing pin from the flywheel slot.
8. Set a dial type torque wrench to 29.0 to 23.5 Nm (21 to 17 lbs ft) and whilst holding it vertically, insert the drive peg into the square hole in the tensioner base plate. Tension the belt and tighten the clamp nuts to the correct torque.
9. Rotate the crankshaft TWO complete revolutions.
10. Slacken the tensioner clamp nuts.
11. Tension the belt again as described in instruction 8 and tighten the clamp nuts to the correct torque.

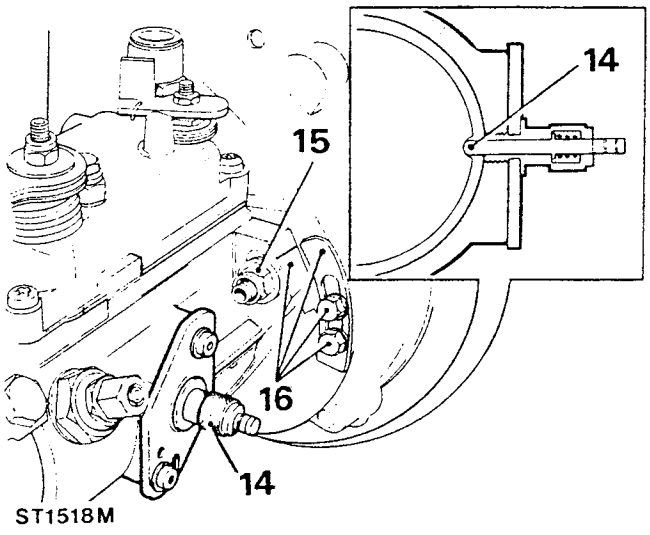
CAUTION: The double tensioning procedure is imperative otherwise the belt could fail resulting in serious engine damage. Also, if a new belt is not attainable and it is necessary to refit the old belt it should be only torqued to 19-24 Nm (14-18 lbs ft).



12. Rotate the crankshaft until the pin of the special timing tool can, once again, be inserted into the flywheel E.P. slot.
13. Check that the dots on the camshaft and D.P.S. pump pulleys coincide exactly with their respective cast-on arrows on the rear cover. Should there be any misalignment the foregoing procedure must be repeated.



14. Remove the plug from the side of the D.P.S. pump and insert special tool 18G 1458 and if necessary rotate the pump body until the tool can be fully inserted and screwed home indicating that the inner disc is centrally positioned with the hole.
15. Evenly tighten the three nuts securing the pump flange to the rear cover and the single nut and bolt to the rear support bracket.
16. Align the timing pointer on the rear of the cover with the scribed line on the pump flange and tighten the two screws. If a new pump is being fitted and there is no scribed line, scribe one in the centre of the machined area on the flange. Align the pointer and tighten the screws. Remove the special tool 18G 1458 and refit plug. The timing pointer has been deleted on later engines.



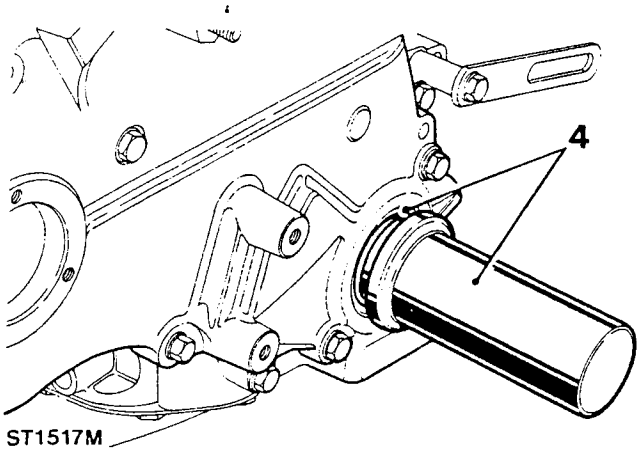
17. Remove the special tool LST 107 and refit the plug to the flywheel housing.
18. Tighten the D.P.S. pump pulley nut and the camshaft pulley retaining bolt to the correct torque.

Care of belts

1. Drive belts must be stored on edge on a clean flat surface and in such a manner that bends are not less than 2 in (50 mm) radius.
2. When a belt is handled, it must not be bent at an acute angle or an arc of less than 1 in (25 mm) in diameter, as damage may be caused to the glass fibre reinforcement and premature failure then result.
3. During use, a belt develops a wear pattern, therefore, if it is to be re-used, before removal, mark the direction of rotation, using soft chalk or a similar marker, and refit the belt so that it runs in the original direction.
4. Belts must be dry and FREE FROM ANY OIL OR OTHER FLUID CONTAMINATION.
5. Do not turn the crankshaft by applying leverage to the camshaft pulley or its retaining bolt.
6. To remove a belt always use clean hands, or a recommended tool — NEVER use a lever.

FIT FRONT COVER WATER PUMP AND CRANKSHAFT PULLEY

1. Place a new joint washer in position and insert the centre 65 mm long bolt into the cover with the fibre washer on the inside.
2. Fit the cover over the dowels and secure with the remaining various length bolts in accordance with the chart. See "Fit timing rear cover, seals and pulleys". Tighten evenly to the correct torque.
3. Fit the vent cover gauze and gasket and secure with the four bolts.
4. Fit a new crankshaft seal. Using special seal replacer tool 18G 1456 and with the lip side leading, drive in the seal up to the shoulder.

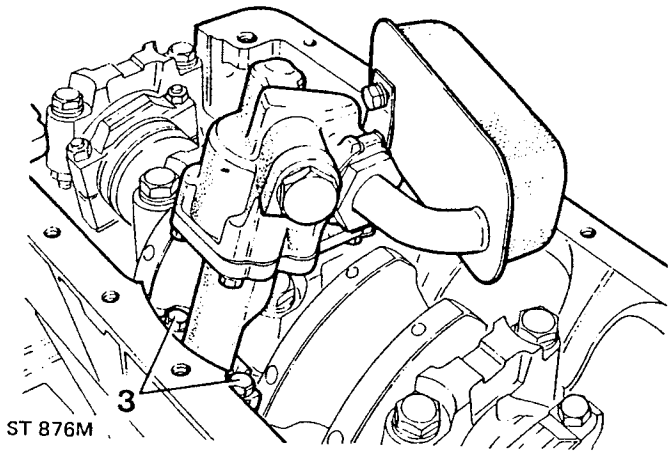


Fit water pump and crankshaft pulley

5. Place a new joint washer in position and offer up the water pump. Fit the different length bolts in accordance with the diagram and evenly tighten to the correct torque.
6. Fit the crankshaft pulley and secure with the special washer and bolt. Tighten to the correct torque figure.

FIT OIL PUMP AND SUMP

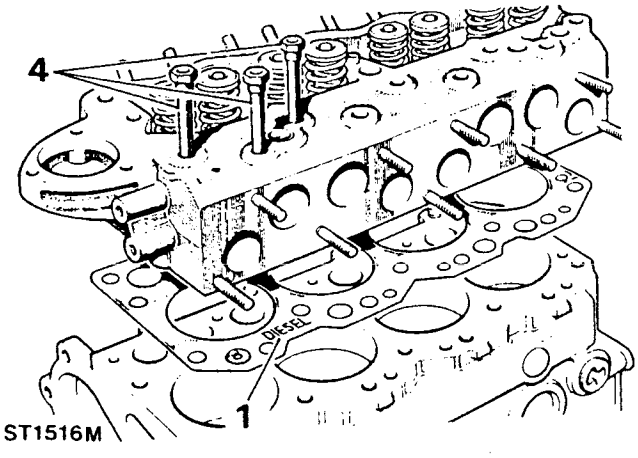
1. Fit the longer splined end of the drive shaft into the oil pump.
2. Fit the oil pump and drive shaft to the crankcase, whilst revolving the shaft as necessary to engage the splines of the skew gear.
3. Using new lock washers, secure the pump to the crankcase tightening the bolts to the correct torque and bend over the lock tabs.
4. If necessary adjust the position of the strainer so that it is parallel to the sump baffle plate.



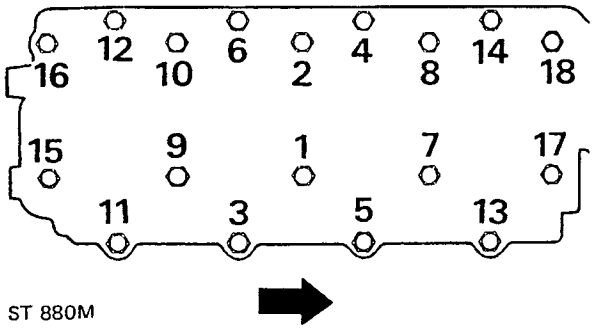
5. Clean the sump and crankcase mating faces and fit a new joint washer. Later engines without a joint washer, apply a bead of RTV HYLOSILL 102 black 7 mm wide to the sump or cylinder block. Secure the sump with the twenty-one bolts and spring washers and one nut. Evenly tighten to the correct torque.

FIT CYLINDER HEAD AND ROCKER SHAFT ASSEMBLY

1. Clean the cylinder head and cylinder block mating faces. Position a new cylinder head gasket on the cylinder block with the word 'Diesel' uppermost.
2. Lower the cylinder head onto the cylinder block using two long bolts to facilitate accurate positioning of the head.
3. Fit the cylinder head retaining bolts except those also used to secure the rocker shaft and leave finger-tight.
4. Insert the push rods ensuring that the ball end locates properly in the spherical seat in the tappet.
5. Whilst holding the rocker shaft assembly together, lower it into position making sure that the hollow dowels locate properly in the cylinder head. Also ensure that the rocker adjusting screw ball end locate in the push rods.
6. Fit the rocker shaft large retaining bolts and leave finger-tight.



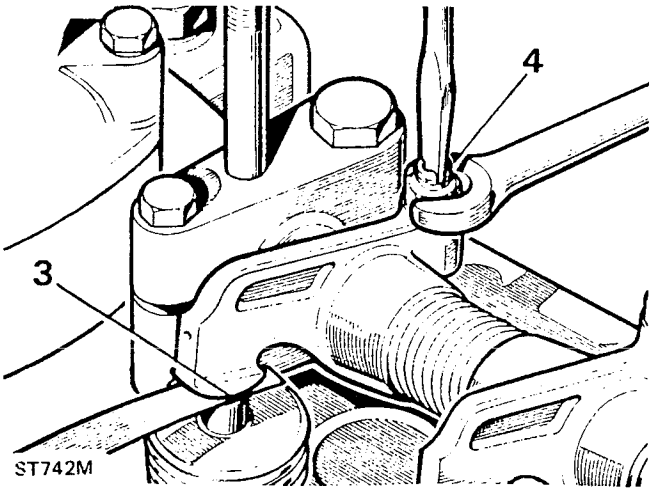
7. Tighten the cylinder head retaining bolts, evenly, to the correct torque figure in the sequence illustrated below.
8. Fit and tighten the rocker shaft, small bolts to the specified torque.



ST 880M

ADJUST TAPPET CLEARANCES

1. If the crankshaft is rotated with excessive valve clearances, it is possible that the push rods may become dislodged from the tappet seating and fracture the tappet slide. To prevent damage, eliminate all clearance from any loose rockers before turning the crankshaft to adjust the clearances.
2. Turn the engine over until number eight valve (counting from front of engine) is fully open.
3. Using a 0,25 mm (0.010 in) feeler gauge check the clearance between the valve tip and rocker pad of number one valve.
4. Adjust the clearance by slackening the lock nut and turning the tappet adjusting screw clockwise to reduce clearance and anti-clockwise to increase clearance. Recheck the clearance after tightening the lock nut.



ST742M

5. Continue to check and adjust the remaining tappets in the following sequence:

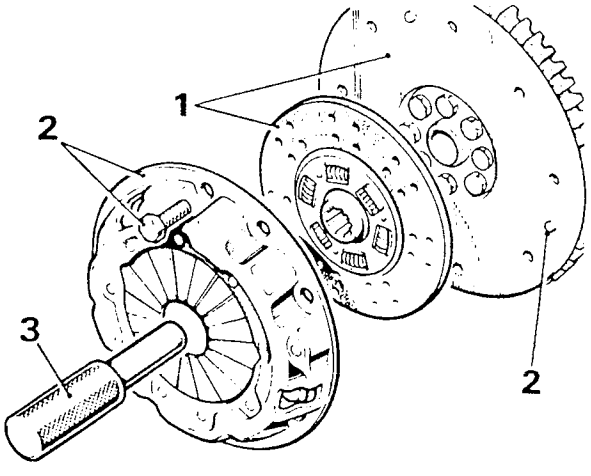
Set No. 3 tappet with No. 6 valve fully open.
Set No. 5 tappet with No. 4 valve fully open.
Set No. 2 tappet with No. 7 valve fully open.
Set No. 8 tappet with No. 1 valve fully open.
Set No. 6 tappet with No. 3 valve fully open.
Set No. 4 tappet with No. 5 valve fully open.
Set No. 7 tappet with No. 2 valve fully open.

Fit the rocker cover

6. Using a new gasket, fit the rocker cover and secure with the dome nuts and washers. Tighten evenly to the correct torque. Do not overtighten.

FIT THE CLUTCH

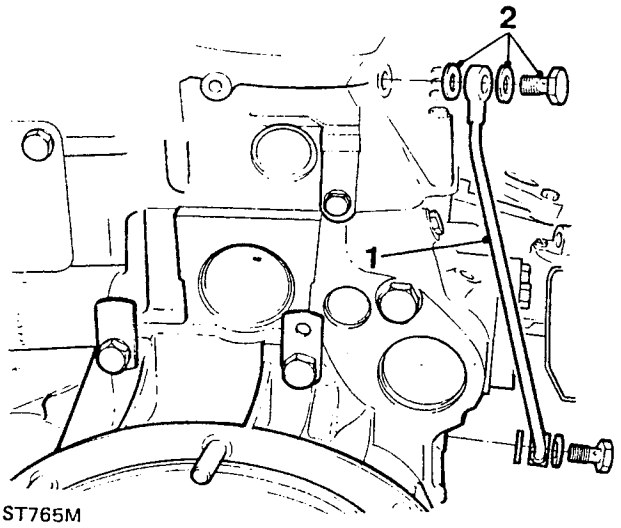
1. Clean the flywheel face and place the centre plate with the side marked 'Flywheel side' towards the flywheel.
2. Fit the clutch assembly locating it over the three dowels and loosely secure with the six bolts.
3. Centralise the centre plate using special tool RO 605022 or a spare primary shaft and tighten the six bolts evenly to the correct torque figure. Smear the splines of the centre plate with Molybdenum disulphide grease, such as Rocol MTS 1000.



ST764M

FIT CYLINDER HEAD OIL FEED

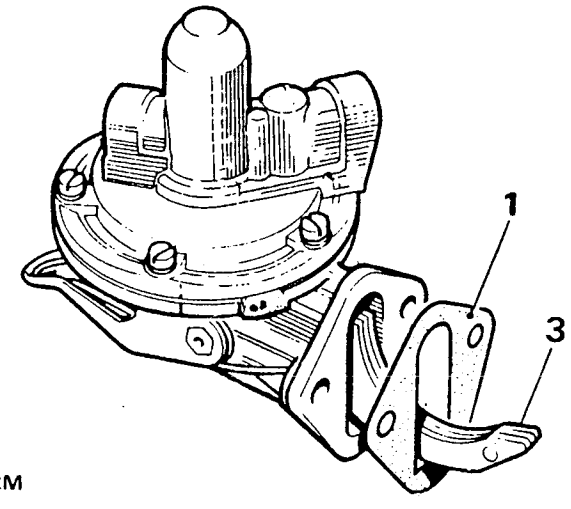
1. Connect the oil feed pipe, for lubrication of the rocker shaft assembly, to the cylinder head
2. Secure with the two banjo bolts and four joint washers.



ST765M

FIT FUEL LIFT PUMP

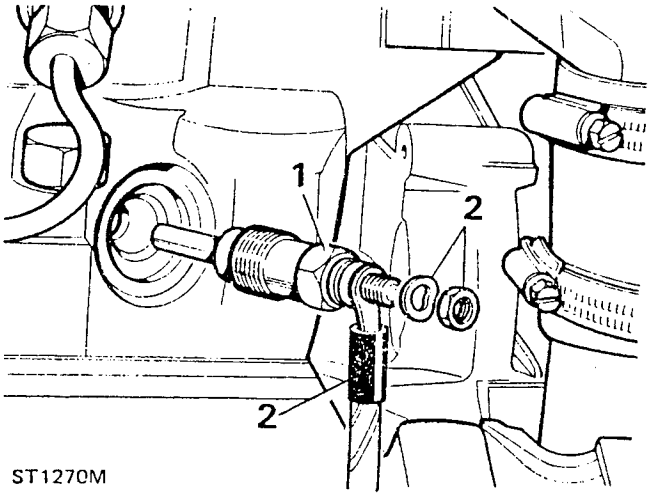
1. If the fuel lift was separated from the side cover, fit the pump to the cover first using a new joint washer between the pump flange and rear cover, evenly tighten the retaining nuts.
2. Place a new cover plate joint washer in position and fit the cover and pump assembly to the cylinder block.
3. Ensure that the pump actuating lever rides on top of the camshaft.
4. Secure the cover, evenly tightening the retaining bolts.



ST762M

FIT HEATER PLUGS

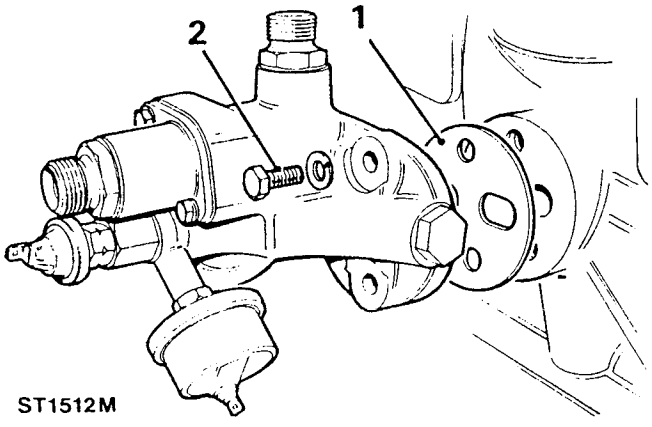
1. Clean and test the heater plugs as described in the maintenance Section. Fit the heater plugs and tighten to the correct torque. Do not over tighten.
2. Fit the leads, washers and nuts as illustrated, ensuring that each cable eyelet is fitted vertically downwards to prevent heat from cylinder head damaging the cable insulation.



ST1270M

FIT OIL FILTER AND ADAPTOR

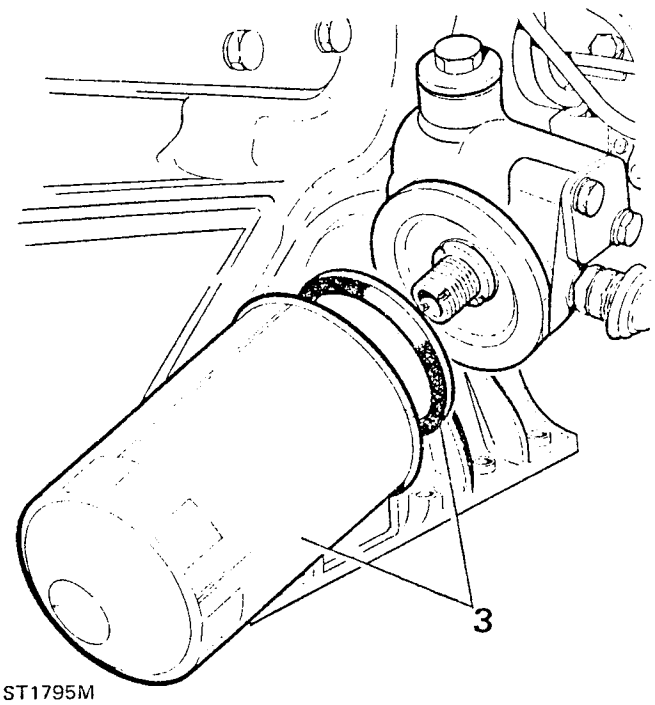
1. Using a new joint washer fit the oil filter adaptor. Ensure that the retaining bolts pass through the two small round holes in the joint washer.
2. Tighten the two retaining bolts evenly to the correct torque.



ST1512M

3. Smear a little clean engine oil on the rubber washer of the new filter, 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. See Maintenance Operations, section 10.

continued

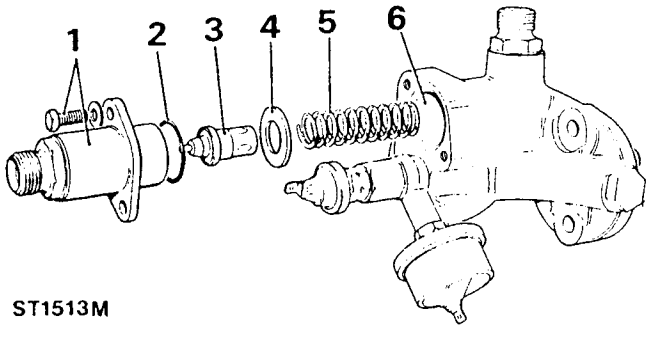


ST1795M

RENEW OIL TEMPERATURE THERMOSTAT

Used when an oil cooler is fitted.

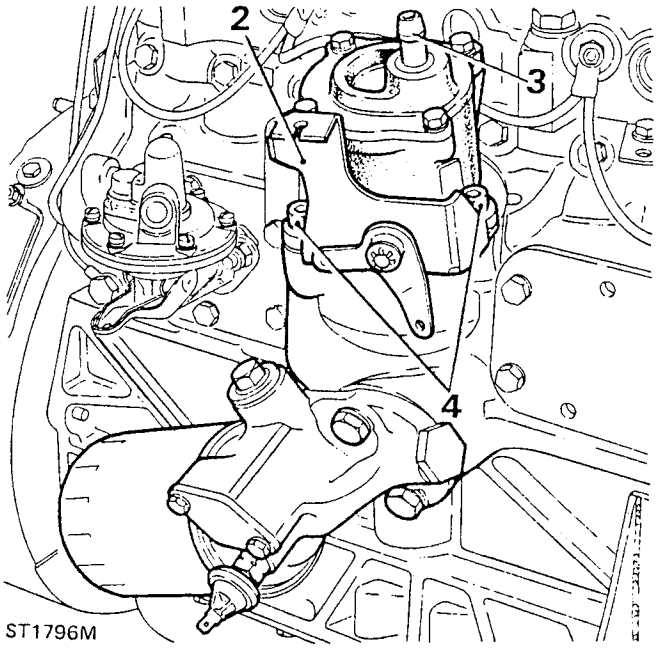
1. Remove the two bolts and carefully withdraw the thermostat extension housing.
2. Remove the 'O' ring.
3. Withdraw the thermostat.
4. Remove the washer.
5. Remove the spring.
6. Clean the adaptor housing with lint-free cloth.
7. Fit the spring and washer.
8. Fit a new thermostat with the pin uppermost.
9. Fit the extension housing using a new 'O' ring. Ensure that the pin protruding from the thermostat locates in the hole in the extension housing.
10. Secure the housing with the two bolts and washers.



ST1513M

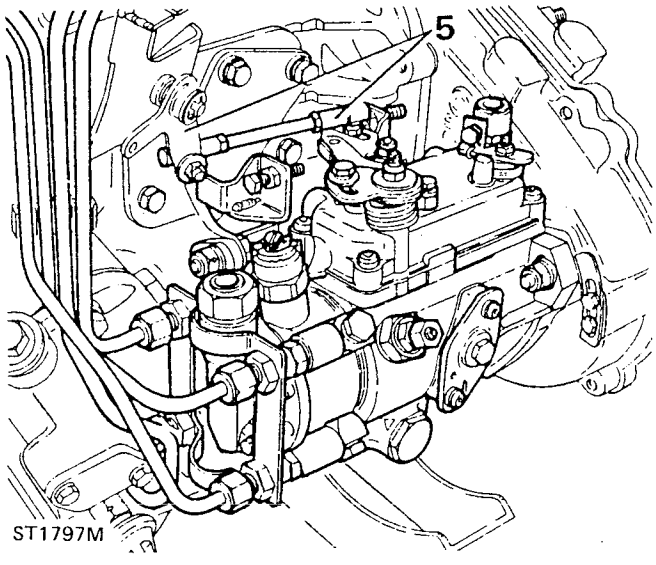
FIT VACUUM PUMP

1. Place a new joint washer on the cylinder block face.
2. Fit the D.P.S. pump control bracket.
3. Insert the vacuum pump drive shaft into the skew gear coupling ensuring that the shaft engages properly over the cross pins in the coupling. The hose connection should be towards the front of the engine.
4. Secure the pump and control bracket to the cylinder block with the three socket headed screws.



ST1796M

5. Connect the D.P.S. pump control rod to the control bracket lever.



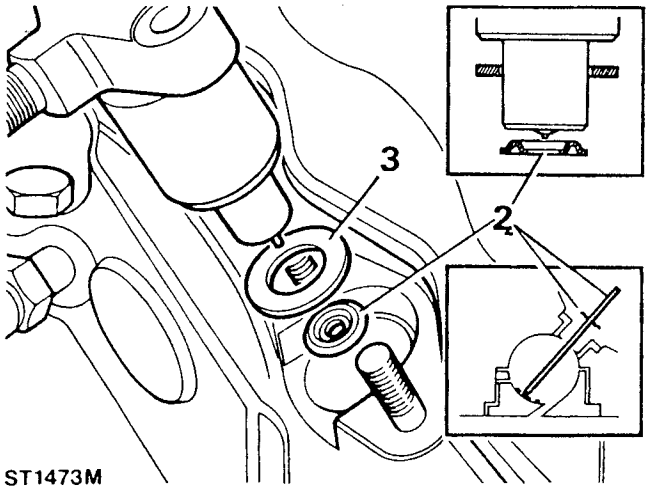
ST1797M

FIT THE FUEL INJECTORS AND PIPES

Fit the injectors

The steel sealing washer fitted below the injector nozzle is to ensure that combustion does not take place around the nozzle body and cause it to overheat. A washer which has been used more than once, or an incorrectly fitted washer may cause the nozzle to overheat and result in that cylinder misfiring.

1. Ensure that the new washers are separated from each other and are clean.
2. Use a length of thin welding wire to guide one washer only into each port with the domed side toward the injector as illustrated. Ensure that only one washer is fitted to each port.

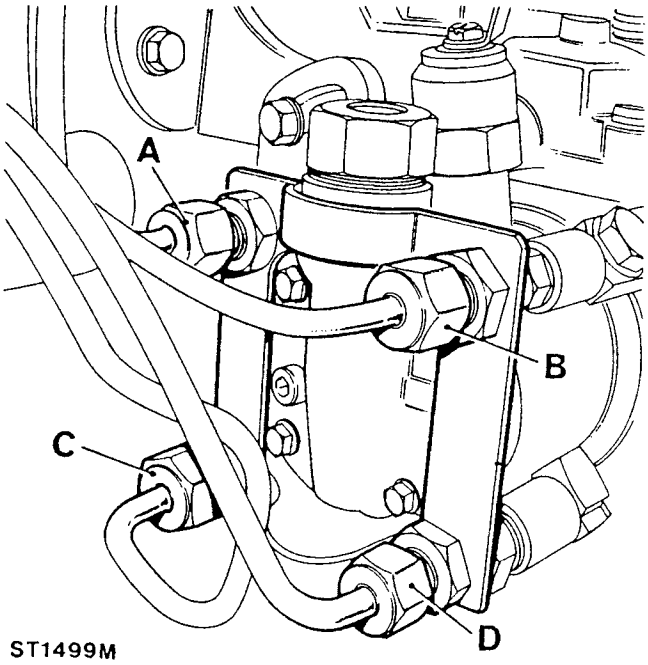


ST1473M

3. Lightly grease the copper washer into position on each injector before fitting to the cylinder head.
4. Fit the injector and evenly tighten the retaining nuts to the correct torque. Uneven or overtightening of the injector nuts could distort the nozzle and cause misfiring when normal running temperature is reached.

Fit the injector pipes

2. Fit the injector pipes to the injectors and D.P.S. pump. Counting from the front of the engine connect the pipes as follows:
   A. To number 1 injector.
   B. To number 2 injector.
   C. To number 3 injector.
   D. To number 4 injector.
   Do not overtighten the union nuts.

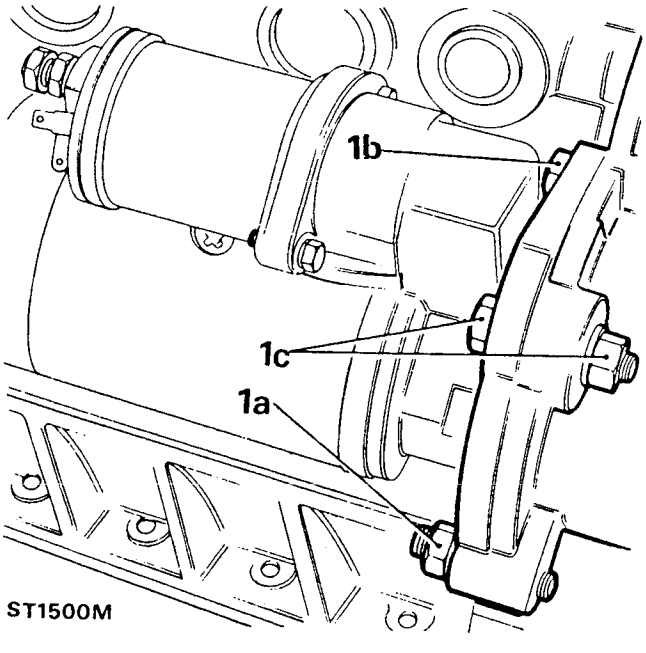


ST1499M

FIT THE STARTER MOTOR

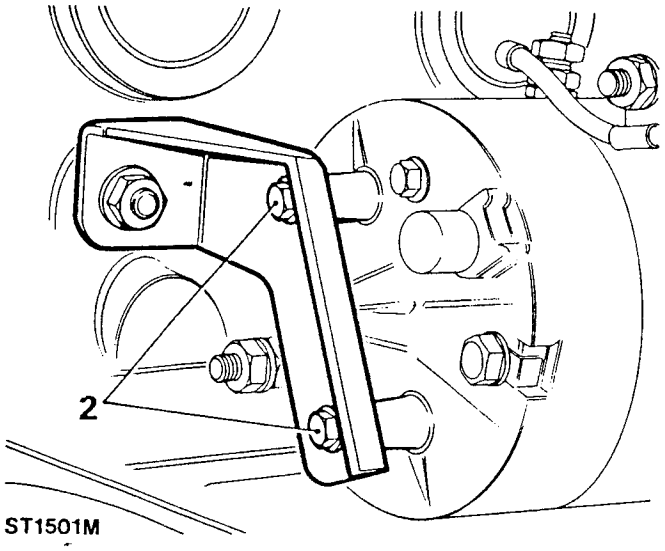
1. Fit the starter motor to the flywheel housing and secure with:
   a) one stud and nut
   b) one single bolt
   c) one nut and bolt.
   Evenly tighten to the correct torque.

continued



ST1500M

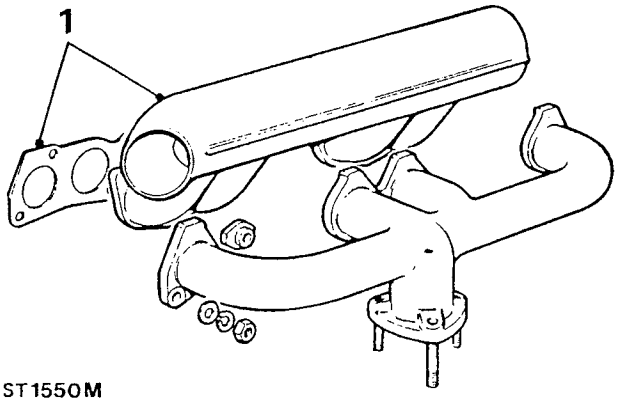
2. Secure the rear of the motor to the bracket with two bolts and tighten to the correct torque.



ST1501M

FIT THE AIR INTAKE AND EXHAUST MANIFOLDS

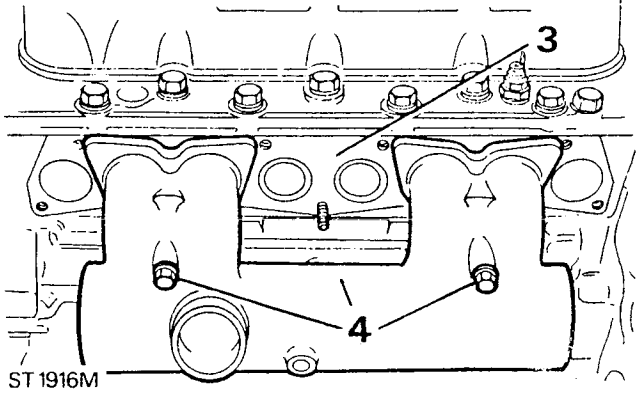
1. Using a new gasket fit the manifolds and secure with the retaining nuts and clamps. Evenly tighten to the specified torque figure.
2. Connect the breather hose to the oil filler cap.



ST1550M

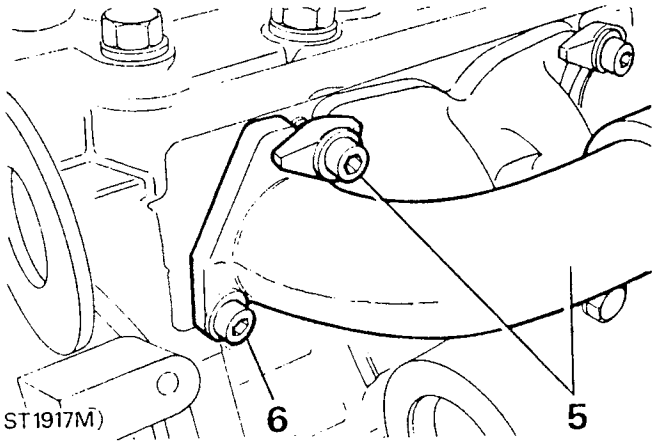
Turbo-charged engines

3. Fit a new gasket to the cylinder head.
4. Fit the air intake manifold and evenly tighten the bolts to the correct torque.



ST 1916M

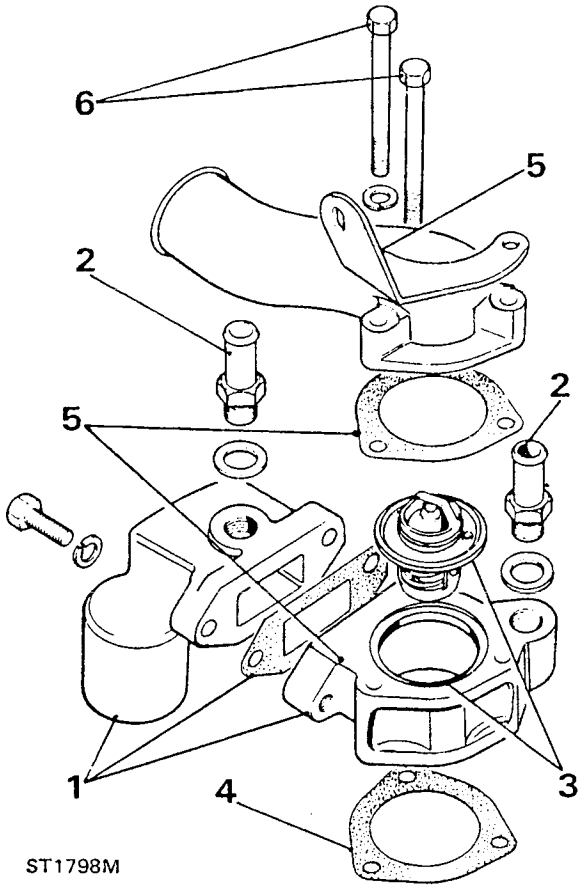
5. Fit the exhaust manifold and secure with the four socket headed bolts and clamps.
6. Fit the exhaust manifold, three lower retaining bolts and tighten to the correct torque.
7. Fit the turbo charger and prime the turbo-charger lubrication system, see Fitting Turbo-Charger, Instruction No. 20. Section 19.



ST1917M)

FIT THE THERMOSTAT HOUSING ASSEMBLY

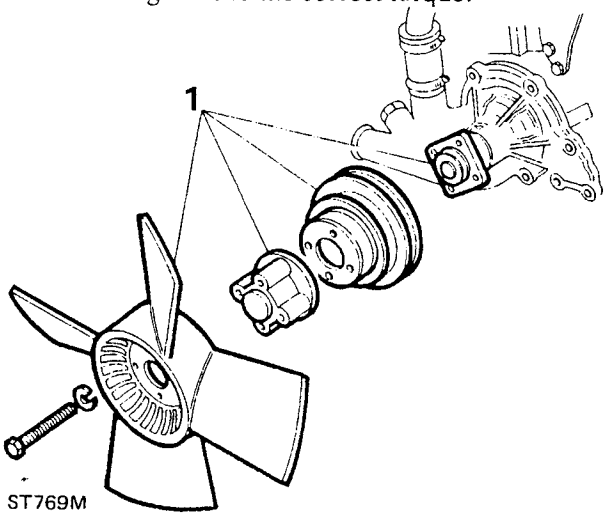
1. Using a new joint washer secure the thermostat housing to the by-pass housing — early engines only, later engines the two housings are combined as an integral casting.
2. Fit the two hose adaptors.
3. Insert the thermostat into its housing.
4. Place a new joint washer on the cylinder head mating face.
5. Using a new joint washer fit the thermostat cover and cowl mounting bracket.
6. With the three long bolts secure the complete assembly to the cylinder head. Note that one bolt is shorter and is fitted in-board.



ST1798M

FIT PULLEY AND FAN BLADES

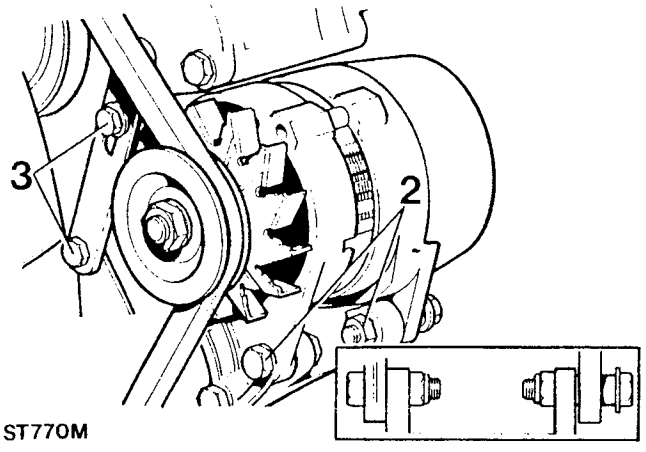
1. Fit the pulley, spacer and fan blade assembly to the water pump shaft and evenly tighten the four retaining bolts to the correct torque.



ST769M

FIT ALTERNATOR — 12 VOLT

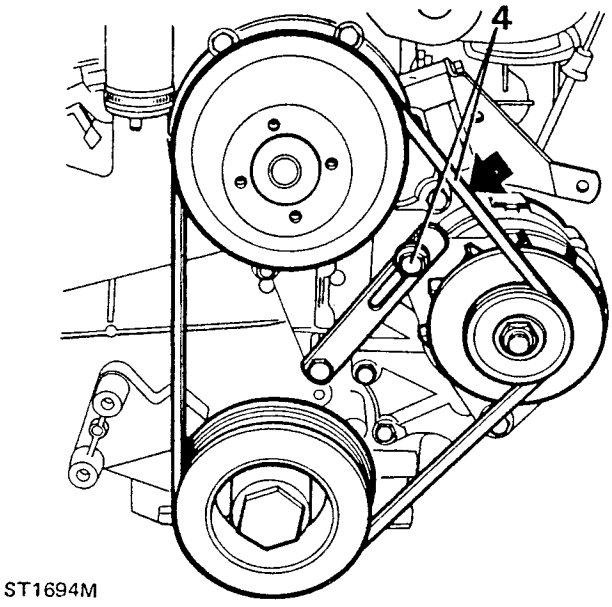
1. Fit adjustment link to front cover.
2. Assemble the alternator to the engine bracket with the two pivot bolts, distance piece and washers, leaving the bolts slack.
3. Fit the adjustment link to the timing cover and attach to alternator with adjusting clamp bolt.



ST770M

Adjust belt tension

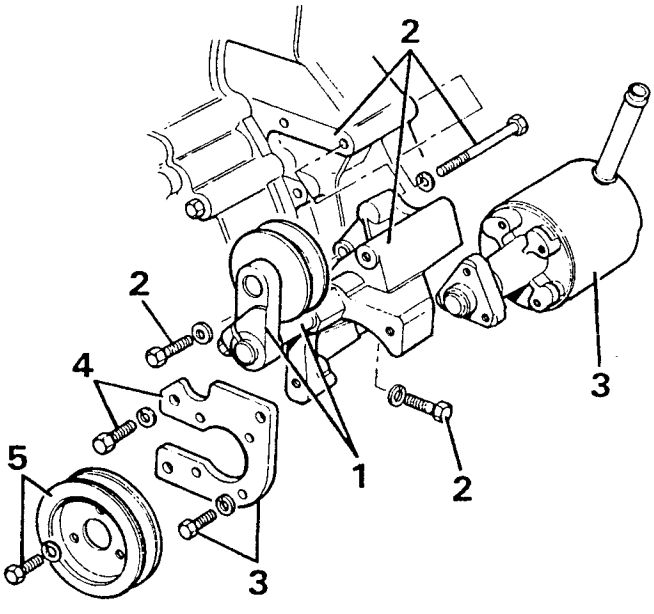
4. Fit the drive belt and pivot the alternator away from the engine, but do not apply pressure to the stator or slip-ring end bracket or damage may result. Tighten the clamp bolt and with thumb pressure, check the belt tension between the fan and alternator pulleys which should be 7 to 9 mm at the mid-point.
5. When the tension is correct fully tighten the clamp bolts and the pivot nuts and bolts.



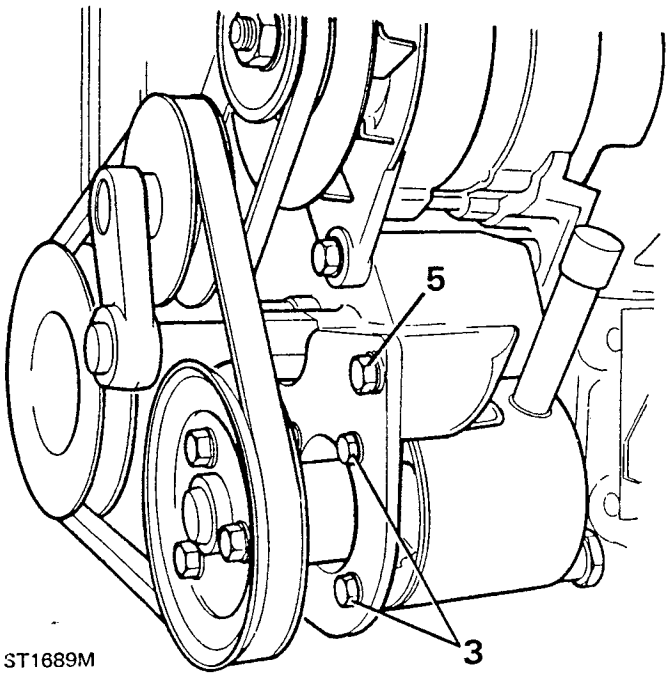
ST1694M

FIT POWER STEERING PUMP

1. If removed, fit the jockey pulley to the spindle.
2. Fit the bracket and jockey pulley assembly to the engine with the three bolts.
3. Fit the power steering pump to the bracket and secure the plate to the pump with four bolts.
4. Secure the plate to the bracket with the three bolts.
5. Fit the drive pulley to the pump with the three bolts.
6. Fit the drive belt.



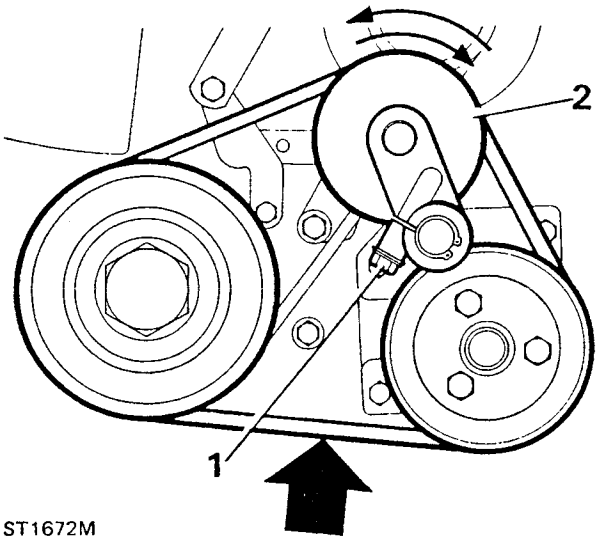
ST1687M



ST1689M

ADJUST POWER STEERING DRIVE BELT

1. Slacken the jockey pulley pinch bolt.
2. Move the jockey pulley to the left or right as necessary to achieve a deflection, by thumb pressure, of 12 mm at the mid-point of the belt run between the crankshaft and power steering pump pulley.
3. Tighten the pinch bolt.



ST1672M

DIESEL ENGINE MECHANICAL FAULTS

SYMPTOM	POSSIBLE CAUSE	CURE
MAIN BEARING RATTLE	34. Low oil level in sump	Replenish as necessary to high mark on dipstick
	35. Low oil pressure	Worn bearings. Faulty skew, gear assembly. 4-cylinder engine
	36. Excessive bearing clearance	Renew bearings; and or crankshaft
	37. Burnt-out bearings	Renew and investigate reason for failure
	38. Loose bearing caps	Tighten to correct torque
ENGINE OVERHEATING	39. Low coolant level	Check for leaks, check expansion tank level
	40. Faulty cooling system	Check fan and belt, pump, radiator fins not blocked
	41. Faulty thermostat	Test and renew, if necessary
	42. Cracked cylinder head	Renew
	43. Defective lubrication system	Renew Filter, Check pump, Clean strainer. Check oil circulation. Renew oil temperature thermostat.
LOW OIL PRESSURE WARNING LIGHT REMAINS ON, ENGINE RUNNING	44. Thin or diluted oil	Drain and refill with correct oil and renew filter
	45. Low oil level	Replensih to high mark on dipstick
	46. Choked pump strainer	Clean
	47. Faulty release valve	Rectify
	48. Excessive bearing clearance	Rectify
	49. Oil pressure switch unserviceable	Renew
	50. Electrical fault	Check circuit
	51. Relief valve plunger sticking	Remove and ascertain cause
	52. Weak relief valve spring	Renew
	53. Pump rotors excessively worn	Overhaul oil pump
	54. Excessively worn bearings; main, connecting rod, big end, camshaft, etc.	Ascertain which bearings and rectify
	55. Faulty skew gear assembly, 4-cylinder engines	Check skew gear bearing. Check plug not leaking or seals in 2.5 diesel engine. See engine overhaul
RATTLE IN LUBRICATION SYSTEM	56. Oil pressure relief valve plunger sticking	Remove and clean
NOISY VALVE MECHANISM	57. Sticking valves	Overhaul cylinder head
	58. Weak valve springs	
	59. Tappet clearance too wide	
	60. Deterioration of timing belt	
MECHANICAL NOISES:		
Low pitch knock	Big-end bearing slack or run	
Low pitch thud	Main bearing slack or run	
Intermittent thuds	Loose flywheel or excessive crankshaft end-float	
High pitch tap	Worn gudgeon pins	
Light tapping	Excessive valve clearance	
Slapping	Excessive piston clearance — more apparant when cold	

DISMANTLE AND OVERHAUL

Remove the engine from the vehicle and clean the exterior. In the interests of safety and efficient working secure the engine to a recognised engine stand. Drain and discard the sump oil.

Special tools:—
Guide bolts — 605351
Torque wrench — 18G537
Clutch centralising tool — 18G79
Gudgeon pin remover/replacer — Basic tool — 18G1150
Adaptor remover/replacer-
gudgeon pin. — 18G1150E or 605350
Spring compressor — 18G106A or RO276102
Valve guide drift exhaust — 600959
Valve cutter handle set — MS76
8.5 Adjustable pilot — MS150
Valve seat cutter — MS621
Distance piece for valve guide — RO605774
Drift for guide removal — inlet and exhaust — RO274401
Crankshaft rear seal sleeve — RO1014

REMOVE ANCILLARY EQUIPMENT

Before commencing, and whilst dismantling, make a careful note of the position of brackets, clips harnesses, pipes, hoses filters and other miscellaneous and non-standard items to facilitate reassembly.

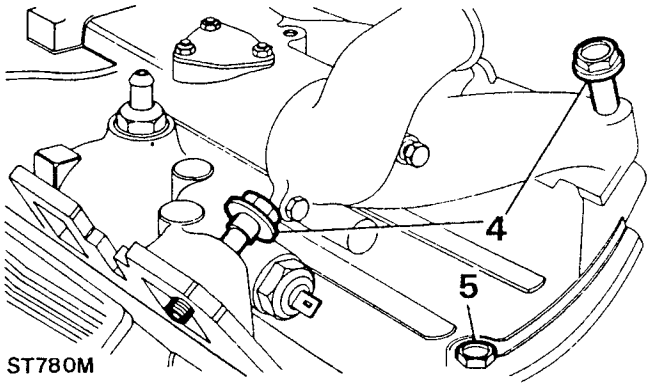
1. Remove the following items of equipment:
   Starter motor.
   Alternator and mounting bracket.
   Power steering pump — where fitted.
   Disconnect spark plug H.T. leads and remove the distributor.
   Clutch.
   Fan blades, pulley and drive belt.
   Remove pulse air rails from cylinder heads.
   Dipstick and engine mounting brackets.

Remove exhaust manifolds

2. Bend back the lock tabs, and remove the eight bolts securing each manifold, and withdraw the manifolds.

Remove induction manifold

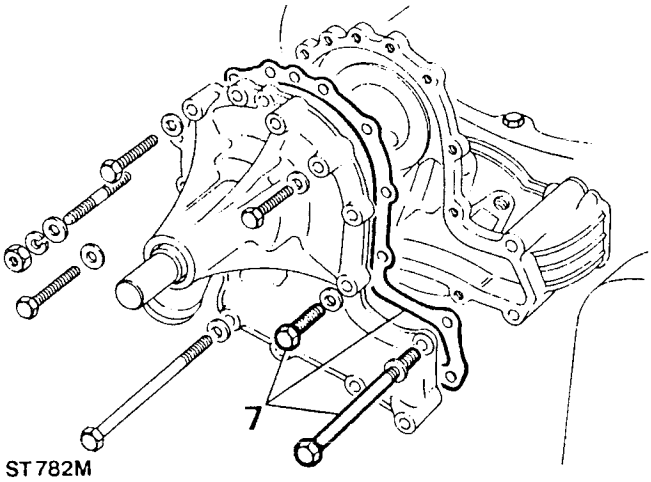
3. Disconnect miscellaneous pipes and hoses from the induction manifold and the carburetters.
4. Evenly slacken and remove the twelve bolts and lift off the induction manifold complete with carburetters.
5. Wipe away any surplus coolant lying on the manifold gasket and remove the gasket clamp bolts and remove the clamps.
6. Lift off the manifold gasket and seals.



ST780M

Remove water pump

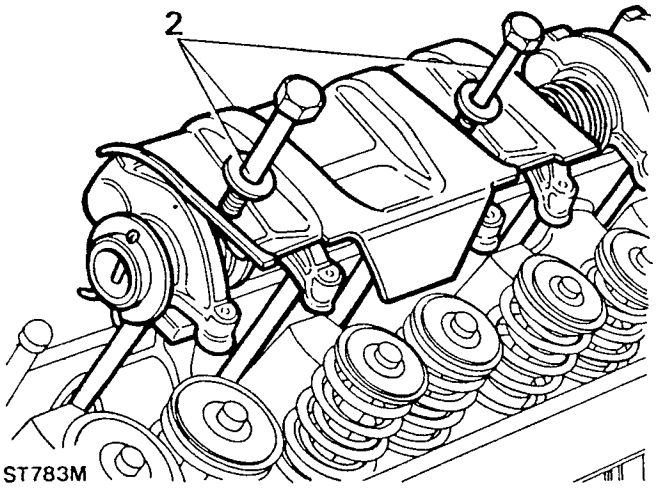
7. Remove the fifteen bolts and withdraw the water pump and joint washer.



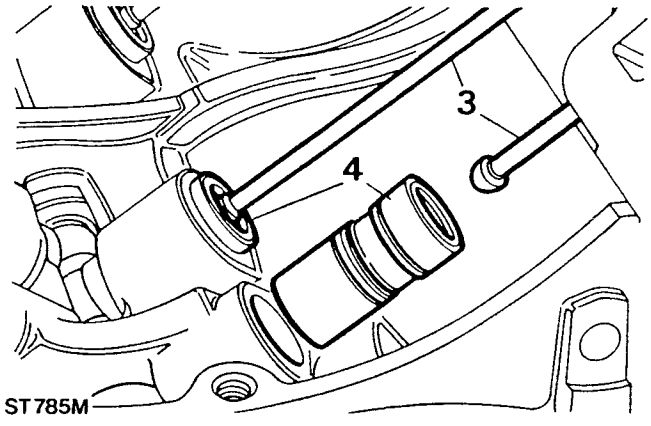
ST782M

REMOVE AND OVERHAUL ROCKER SHAFTS AND VALVE GEAR

1. Remove the four screws and lift off the rocker covers.
2. Remove the four rocker shaft retaining bolts and lift off the assembly complete with baffle plate.

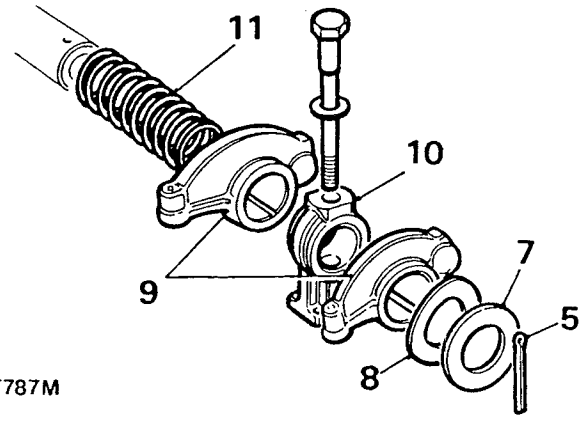


3. Withdraw the pushrods and retain in the sequence removed.
4. Remove the hydraulic tappets and place to one side with their respective pushrods. If a tappet cannot be removed leave in position until the camshaft is removed.



Dismantle rocker shafts

5. Remove the split pin from one end of the rocker shaft.
6. Withdraw the following components and retain them in the correct sequence for reassembly:
7. A plain washer.
8. A wave washer.
9. Rocker arms.
10. Brackets.
11. Springs.
12. Examine each component for wear, in particular the 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. Replace hydraulic tappet if body is roughly scored or grooved, or has a blow hole extending through the 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 the cam against the body while the tappet is moving vertically in its guide.
15. Inspect the cam contact surface of the tappets. Fit new tappets if the surface is excessively worn or damaged.
16. A hydraulic tappet body that has been rotating will have a round wear pattern and a non-rotating tappet body will have a square wear pattern with a very slight depression near the centre.
17. Tappets MUST rotate and a circular wear condition is normal. Tappets with this wear pattern can be refitted provided there are no other defects.
18. In the case of a non-rotating tappet, fit a new replacement and check camshaft lobes for wear; also ensure the new tappet rotates freely in the cylinder block.

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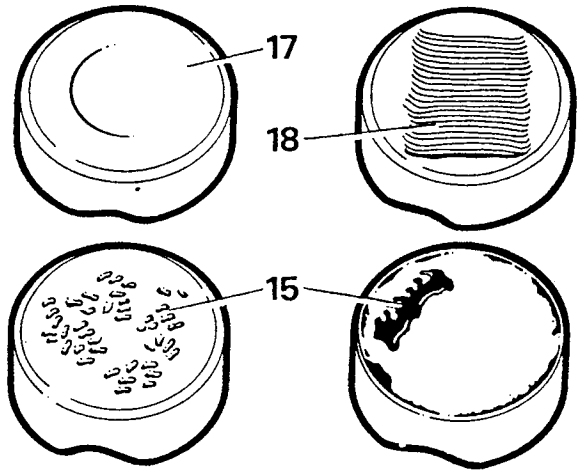


RR750M

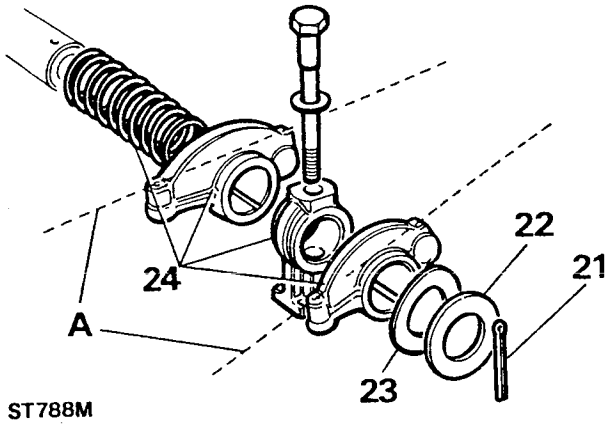
19. Fit a new hydraulic tappet if the area where the pushrod contacts is rough or otherwise damaged.
20. Renew any pushrod having a rough or damaged ball end or seat. Also bent rods must be renewed.

Assemble rocker shafts

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

NOTE: Two different rocker arms are used and must be fitted so that the valve ends of the arms slope away from the brackets, as indicated by the dotted lines 'A' on the illustration.

24. Assemble the rocker arms, brackets and springs to the rocker shaft.

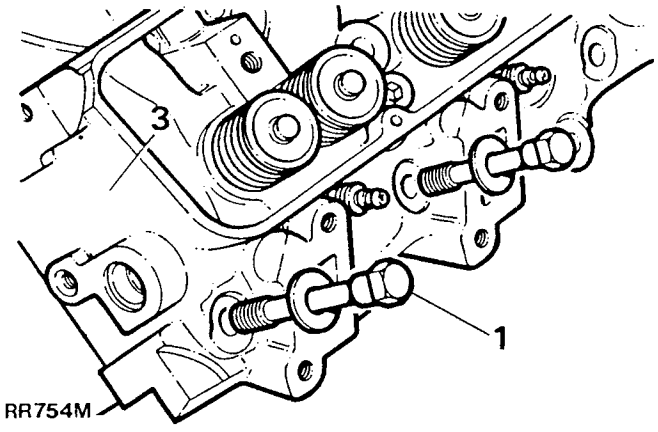


ST788M

25. Compress the springs, brackets and rockers, and fit a wave washer, plain washer and split pin to the end of the rocker shaft.
26. Locate the oil baffle plate in place over the rockers furthest from the notched end of the rocker shaft and fit the bolts through the brackets and place the assemblies to one side.

REMOVE AND OVERHAUL THE CYLINDER HEADS

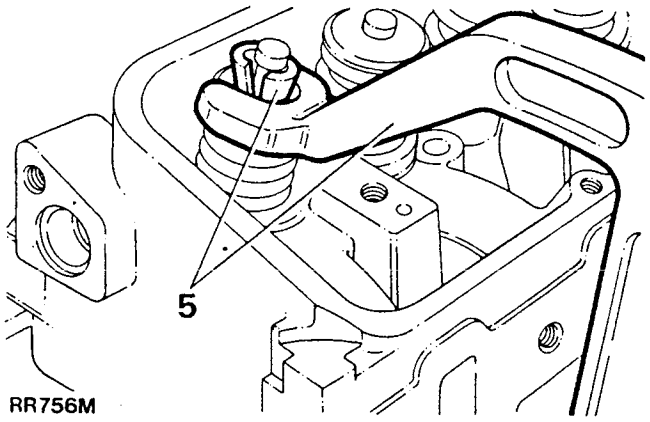
1. Evenly slacken the fourteen cylinder head bolts reversing the tightening order.
2. Before removing the heads mark them relative to the L.H. and R.H. side of the engine.
3. Lift off the cylinder heads and discard the gasket.



RR754M

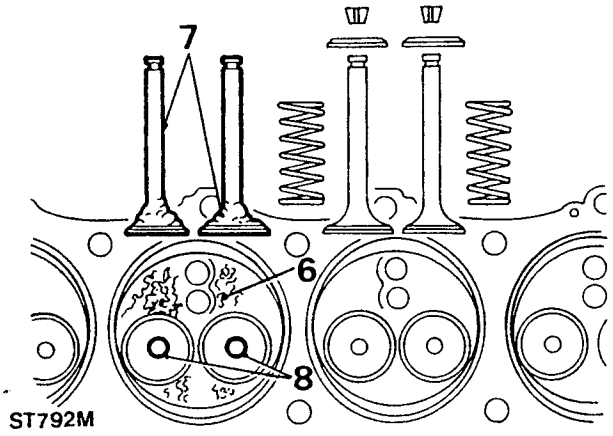
Dismantle cylinder heads

4. Remove the spark plugs.
5. Using the valve spring compressor 276102, or a suitable alternative, remove the valves and springs and retain in sequence for refitting.

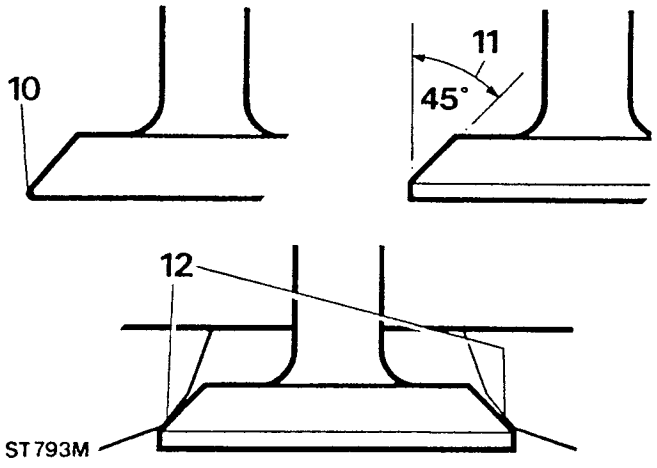


RR756M

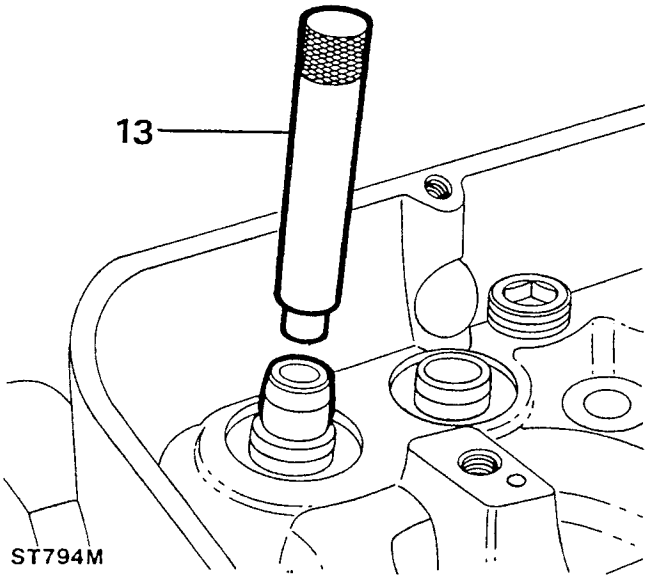
6. Clean the combustion chambers with a soft wire brush.
7. Clean the valves.
8. Clean the valve guide bores.



9. Regrind or fit new valves as necessary.
10. If a valve must be ground to a knife-edge to obtain a true seat, fit a new valve.
11. The correct angle for the valve face is 45 degrees.
12. The correct angle for the seat is 46 + ¼ degrees, and the seat witness should be towards the outer edge.



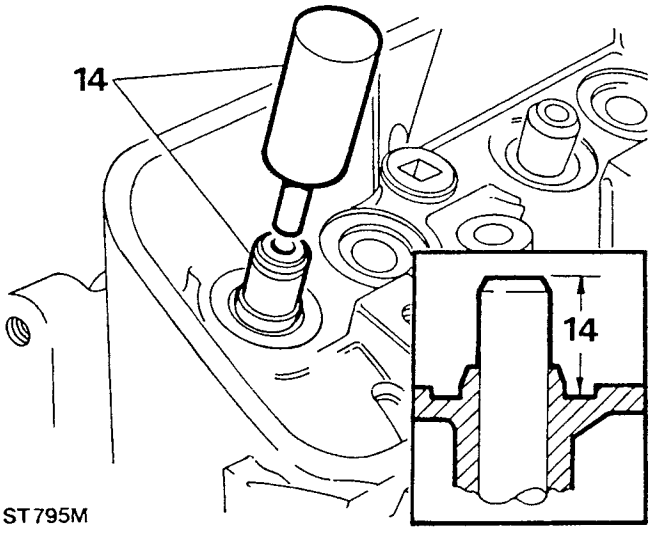
13. Check the valve guides and fit replacements as necessary. Using the valve guide remover 274401, drive out the old guides from the rocker shaft side of the cylinder head.



Fit new valve guides

14. Lubricate the new valve guide and place in position. Using guide drift 600959 drive the guide into the cylinder head until it protrudes 19 mm (¾ in) above the valve spring recess in the head.

NOTE: Service valve guides are 0,02 mm (0.001 in) larger on the outside diameter than the original equipment to ensure interference fit.



Examine and fit new valve seats

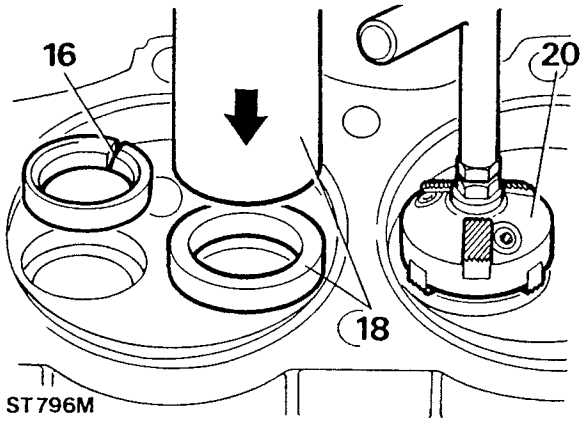
15. Check the valve seats for wear, pits and burning and renew the inserts if necessary.

continued

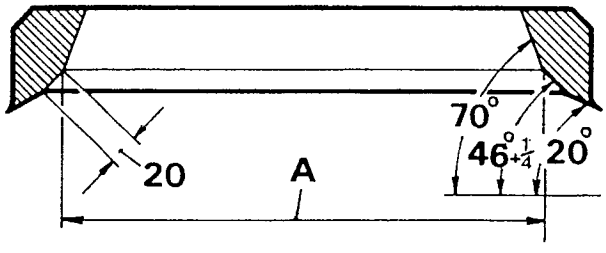
16. Remove the old seat inserts by grinding them away until they are thin enough to be cracked and prised out.
17. Heat the cylinder head evenly to approximately 65 degrees C (150 degrees F).
18. Press the new insert into the recess in the cylinder head.

NOTE: Service valve seat inserts are available in two over-sizes: 0,25 and 0,50 mm (0.010 and 0.020 in) larger on the outside diameter to ensure interference fit.

19. If necessary, cut the valve seats to 46 + ¼ degrees.
20. The nominal seat width is 1,5 mm (0.031 in). If the seat exceeds 2,0 mm (0.078 in) it should be reduced to the specified width by the use of 20 and 70 degree cutters.
21. The inlet valve seat diameter, A is 37,03 mm (1.458 ins) and the exhaust valve seat is 31,50 mm (1.240 ins) diameter.

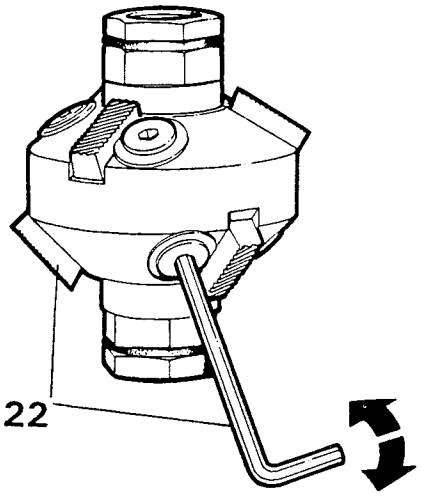


ST796M



ST797M

22. Ensure that the cutter blades are correctly fitted to the cutter head with the angled end of the blade downwards facing the work, as illustrated.
Check that the cutter blades are adjusted so that the middle of the blade contacts the area of material to be cut. Use the key provided in the hand set MS 76. Use light pressure, and remove only the minimum material necessary.

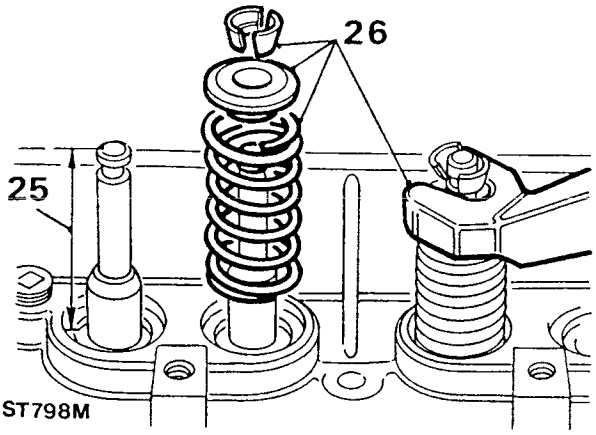


ST1024M

23. Smear a small quantity of engineers' blue round the valve seat and revolve a properly ground valve against the seat. A continuous fine line should appear round the 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 the valve and seat, hold the valve down by the stem and slowly pull out the cellophane. If there is a drag the seal is satisfactory in that spot. Repeat this in at least eight places. Lapping-in will correct a small open spot.

Assemble valves to cylinder head

25. Before fitting the valves and springs the height of each valve above the head must be checked. Insert each valve in turn in its guide and whilst holding the head firmly against the seat, measure the height of the stem above the valve spring seat surface. This dimension must not exceed 47,63 mm (1.875 ins). If necessary renew the valve or grind the end of the valve stem.
26. Lubricate the valve stems and assemble the valves, springs and caps and secure with the collets using valve spring compressor 276102.
NOTE: Seals are fitted to the inlet valves on later engines, but these can also be fitted to early engines if required.



ST798M

Reclaiming cylinder head threads

Damaged or stripped threads in the 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 (⅜ UNC 1½D 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 (⅜ UNC 1½D insert).

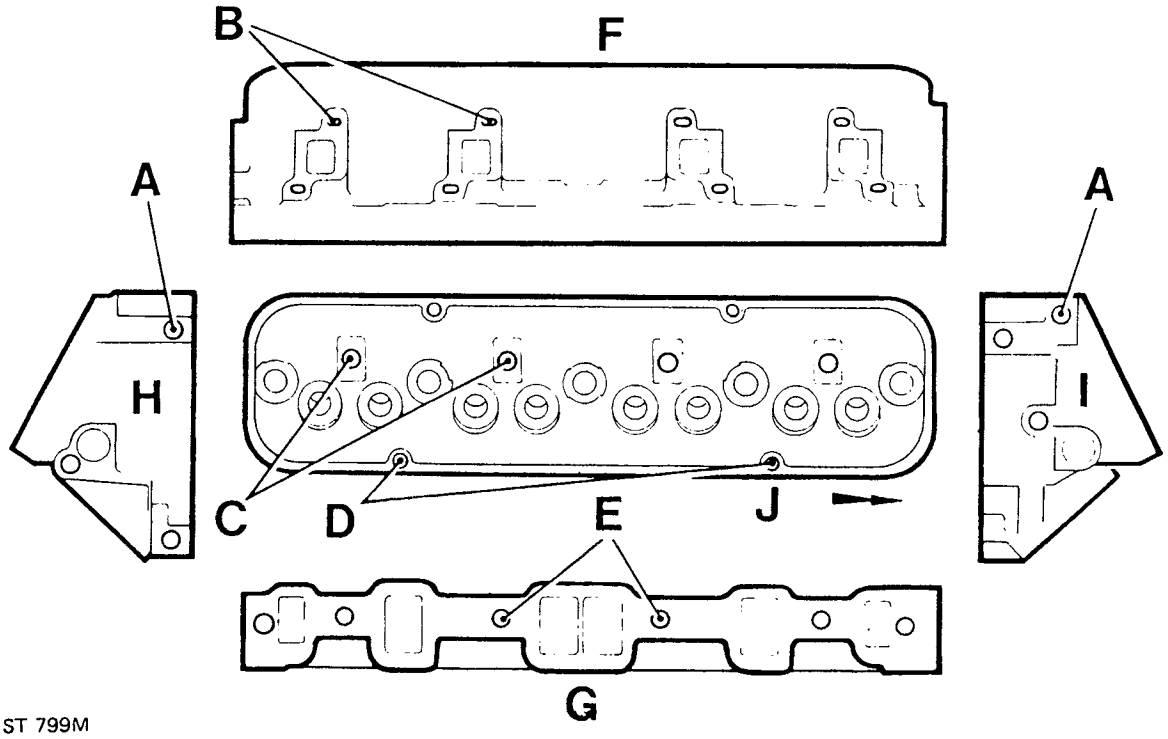
Holes C — These four holes may be drilled 0.3906 in. dia. x 0.937 + 0.040 in. deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.875 in. (min.) deep (⅜ UNC 1½D insert).

Holes D — These four holes may be drilled 0.261 in. dia. x 0.675 + 0.040 in. deep. Tapped with Helicoil Tap No. 4CPB or 4CS x 0.625 in. (min.) deep (½ UNC 1½D 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 (⅜ UNC 1½D insert).

NOTE: Right-hand cylinder head illustrated. American projection.

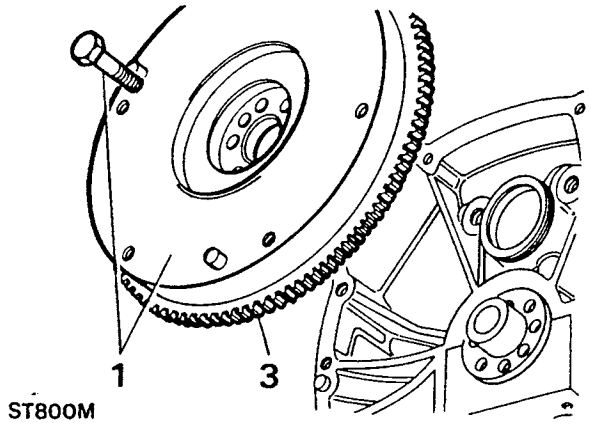
F Exhaust manifold face
G Inlet manifold face
H Front face
I Rear face
J Front of engine



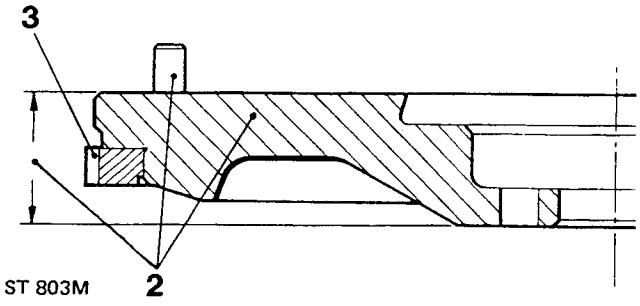
ST 799M

REMOVE AND OVERHAUL FLYWHEEL

1. Remove the retaining bolts and withdraw the flywheel from the crankshaft.



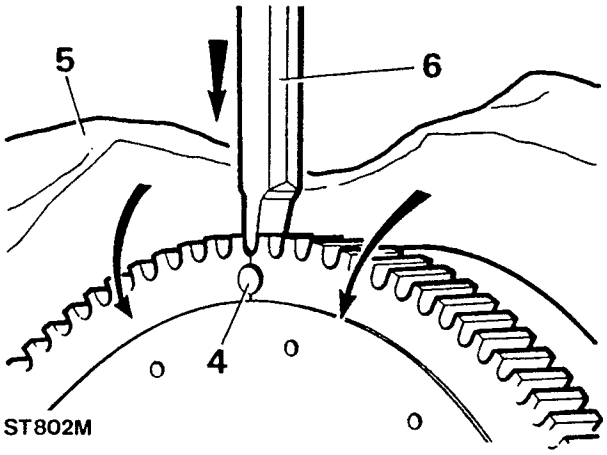
2. Examine the flywheel clutch face for cracks, scores and overheating. If the overall thickness of the flywheel is in excess of the minimum thickness i.e. 39,93 mm (1.572 in) it can be refaced provided that after machining it will not be below the minimum thickness. Remove the three dowels before machining.
3. Examine the ring gear and if worn or the teeth are chipped and broken it can be renewed as follows:



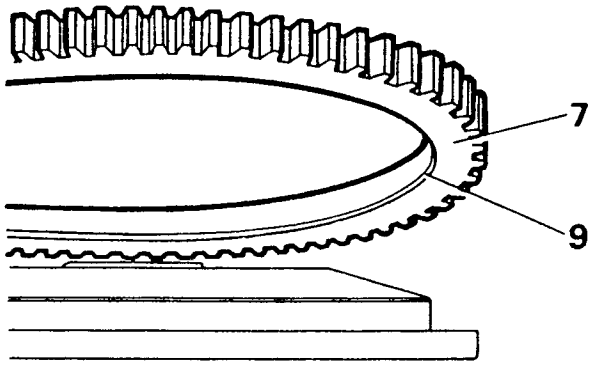
4. Drill a 10 mm (.375 in) diameter hole axially between the root of any tooth and the inner diameter of the starter ring sufficiently deep to weaken the ring. Do NOT allow the drill to enter the flywheel.
5. Secure the flywheel in a vice fitted with soft jaws and place a cloth over the flywheel to protect the operator from flying fragments.

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

6. Place a chisel immediately above the drilled hole and strike it sharply to split the starter ring gear.

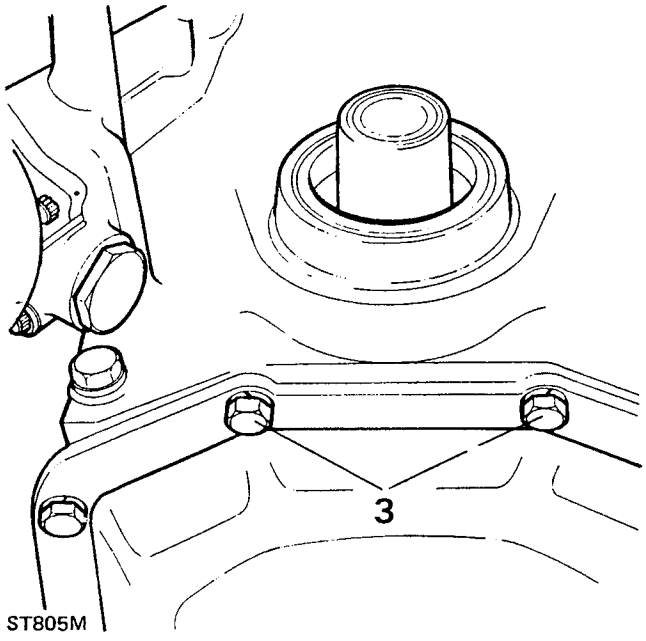


7. Heat the new ring gear uniformly to between 170 degrees and 175 degrees C (338 degrees to 347 degrees F) but do not exceed the higher temperature.
8. Place the flywheel, clutch side down, on a flat surface.
9. Locate the heated starter ring gear in position on the flywheel, with the chamfered inner diameter towards the flywheel flange. If the starter ring gear is chamfered both sides, it can be fitted either way round.
10. Press the starter ring gear firmly against the flange until the ring contracts sufficiently to grip the flywheel.
11. Allow the flywheel to cool gradually. Do NOT hasten cooling in any way or distorting may occur.
12. Fit new clutch assembly location dowels to the flywheel.



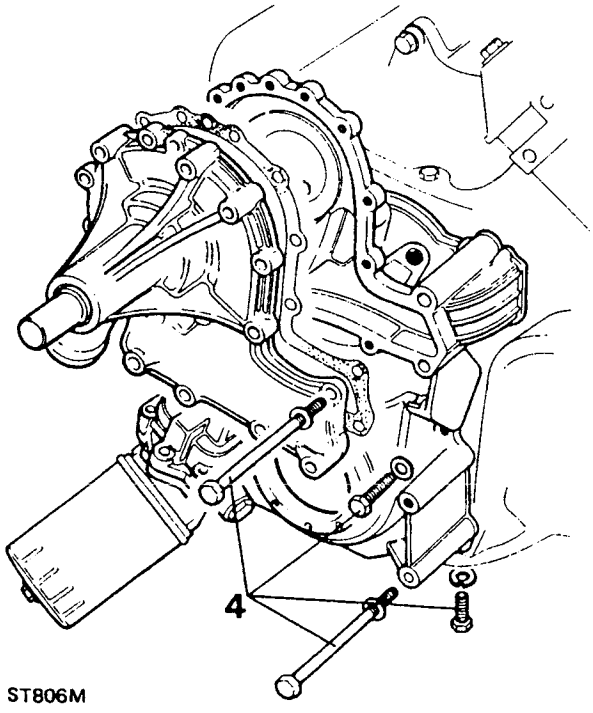
REMOVE TIMING GEAR COVER AND WATER PUMP

1. Place an oil drip-tray beneath the timing cover and remove the oil filter element.
2. Remove the crankshaft pulley bolt and special washer and withdraw the pulley.
3. Remove the two bolts securing the sump to the bottom of the timing cover.



ST805M

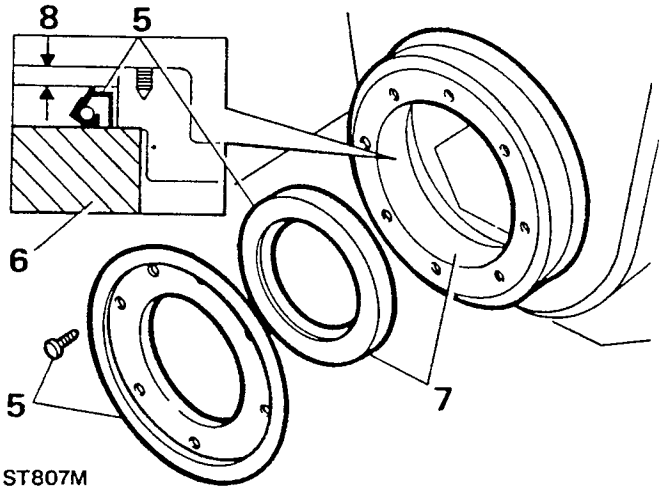
4. Remove the remaining timing cover retaining bolts and withdraw the cover complete with oil pump.



ST806M

Renewing timing cover oil seal

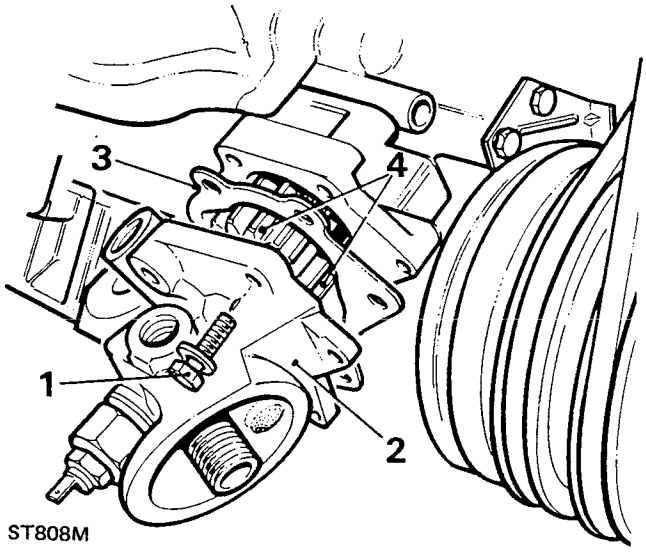
5. Remove the seven drive screws and withdraw the mud shield and the oil seal.
6. Position the gear cover with the front face uppermost and the underside supported across the oil seal housing bore on a suitable wooden block.
7. Enter the oil seal, lip side leading, into the housing bore.
8. Press in the oil seal until the plain face is 1,5 mm (0.062 in) approximately below the gear cover face.
9. Fit the mud shield and secure with the screws.



ST807M

REMOVE AND OVERHAUL THE OIL PUMP

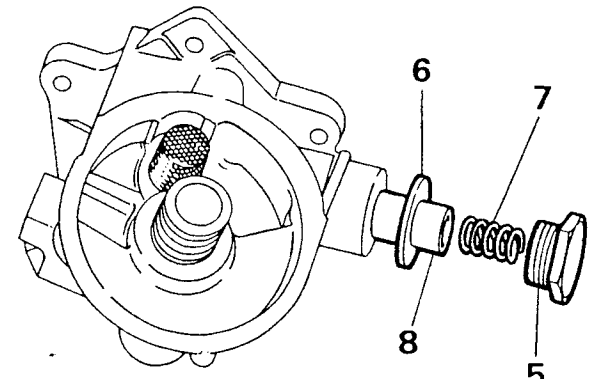
1. Remove the bolts from the oil pump cover.
2. Withdraw the oil pump cover.
3. Lift off the cover gasket.
4. Withdraw the oil pump gears.



ST808M

Dismantle pump

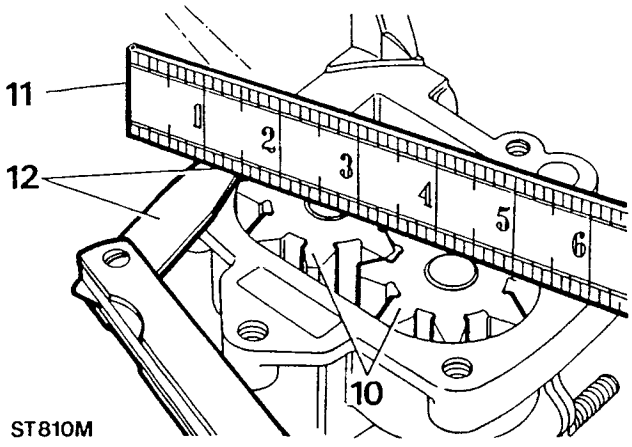
5. Unscrew the plug from the pressure relief valve.
6. Lift off the joint washer for the plug.
7. Withdraw the spring from the relief valve.
8. Withdraw the pressure relief valve.



ST809M

Examine pump

9. Check the oil pump gears for wear or scores.
10. Fit the oil pump gears and shaft into the front cover.
11. Place a straight-edge across the gears.
12. Check the clearance between the straight-edge and the front cover. If less than 0,05 mm (0.0018 in), check the front cover gear pocket for wear.



ST810M

13. Check the oil pressure relief valve for wear or scores.
14. Check the relief valve spring for wear at the sides or signs of collapse.
15. Clean the gauze filter for the relief valve.
16. Check the fit of the relief valve in its bore. The valve must be an easy slide fit with no perceptible side movement.

Assemble pump

17. Insert the relief valve spring.
18. Locate the sealing washer on to the relief valve plug.
19. Fit the relief valve plug and tighten to 4,0 to 4,9 kgf m (30 to 35 lbf ft).
20. Fully pack the oil pump gear housing with petroleum jelly. Use only petroleum jelly; no other grease is suitable.
21. Fit the oil pump gears so that the petroleum jelly is forced into every cavity between the teeth of the gears.

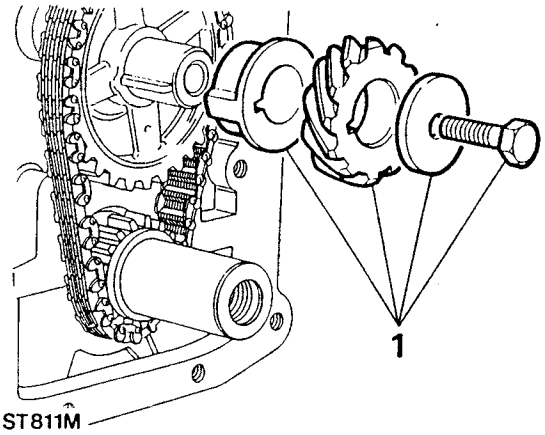
    IMPORTANT: Unless the pump if fully packed with petroleum jelly it may not prime itself when the engine is started.

22. Place a new gasket on the oil pump cover.
23. Locate the oil pump cover in position.
24. Fit the special fixing bolts and tighten alternately and evenly to the correct torque.

REMOVE TIMING CHAIN GEARS AND CAMSHAFT

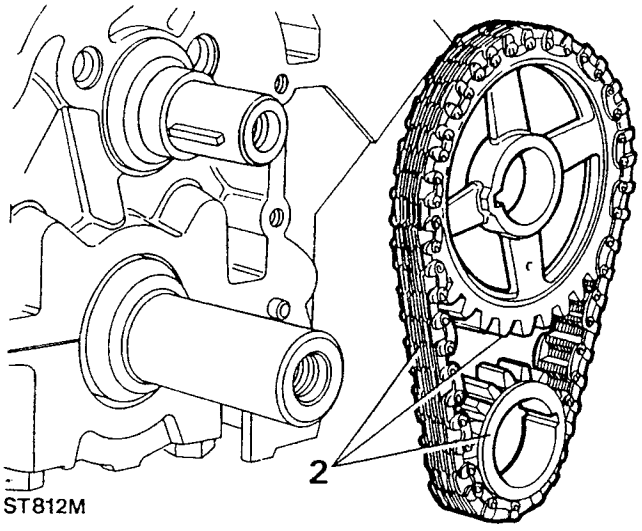
1. Remove the retaining bolt and washer and withdraw the distributor drive gear and spacer.

continued



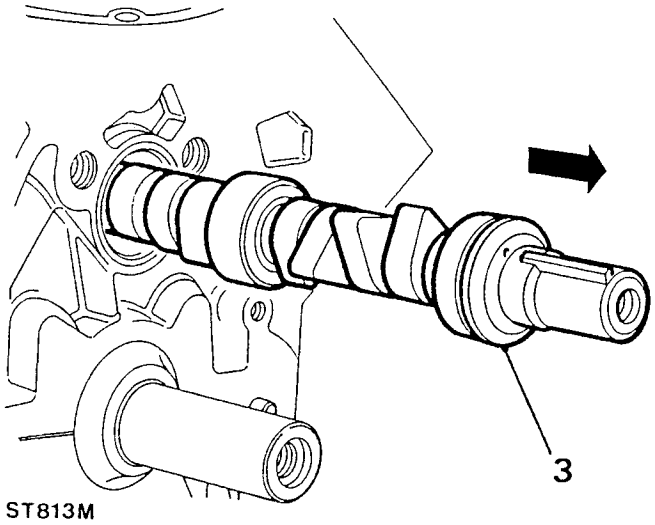
ST811M

2. Withdraw the chain wheels complete with timing chain.



ST812M

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



ST813M

Examine components

4. Visually examine all parts for wear. Check the camshaft bearing journals and cams for wear, pits, scores and overheating. Should any of these conditions be present the shaft should be renewed.
5. Examine the links and pins of the timing chain for wear and compare its condition with that of a new chain. Similarly the teeth of the chain wheels should be inspected and if necessary the wheels should be renewed.
6. Measure the camshaft journals for overall wear, ovality and taper. The diameters of the five journals are as follows commencing from the front of the shaft.

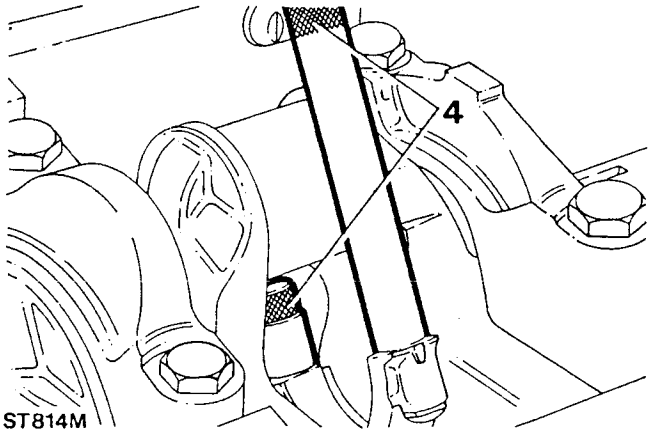
   Number 1 journal 1.786 to 1.785 ins
   Number 2 journal 1.750 to 1.755 ins
   Number 3 journal 1.726 to 1.725 ins
   Number 4 journal 1.696 to 1.695 ins
   Number 5 journal 1.666 to 1.665 ins

7. To check the camshaft for bow, rest the two end journals i.e. numbers 1 and 5 on 'V' blocks and mount a dial gauge on the centre journal. Rotate the shaft and note the reading. If the run out is more than 0,05 mm (0.002 in) it should be renewed.

REMOVE AND OVERHAUL CONNECTING-RODS AND PISTONS

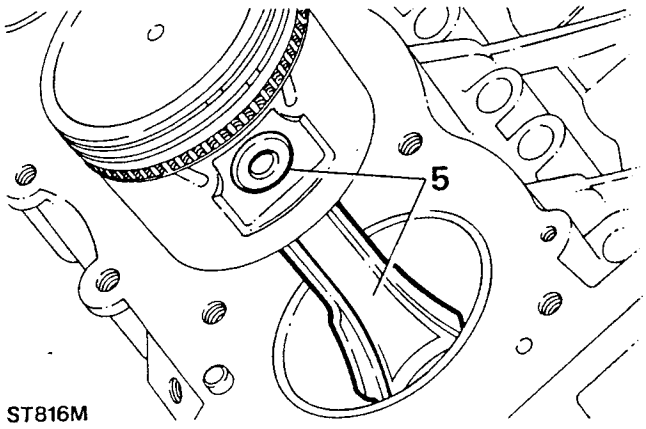
1. Withdraw the remaining bolts and remove the sump.
2. Remove the sump oil strainer.
3. Remove the connecting-rod caps and retain them in sequence for reassembly.
4. Screw the guide bolts 605351 onto the connecting-rods.

continued



ST814M

5. Push the connecting-rod and piston assembly up the cylinder bore and withdraw it from the top. Retain the connecting-rod and piston assemblies in sequence with their respective caps.
6. Remove the guide bolts 605351 from the connecting-rod.



ST816M

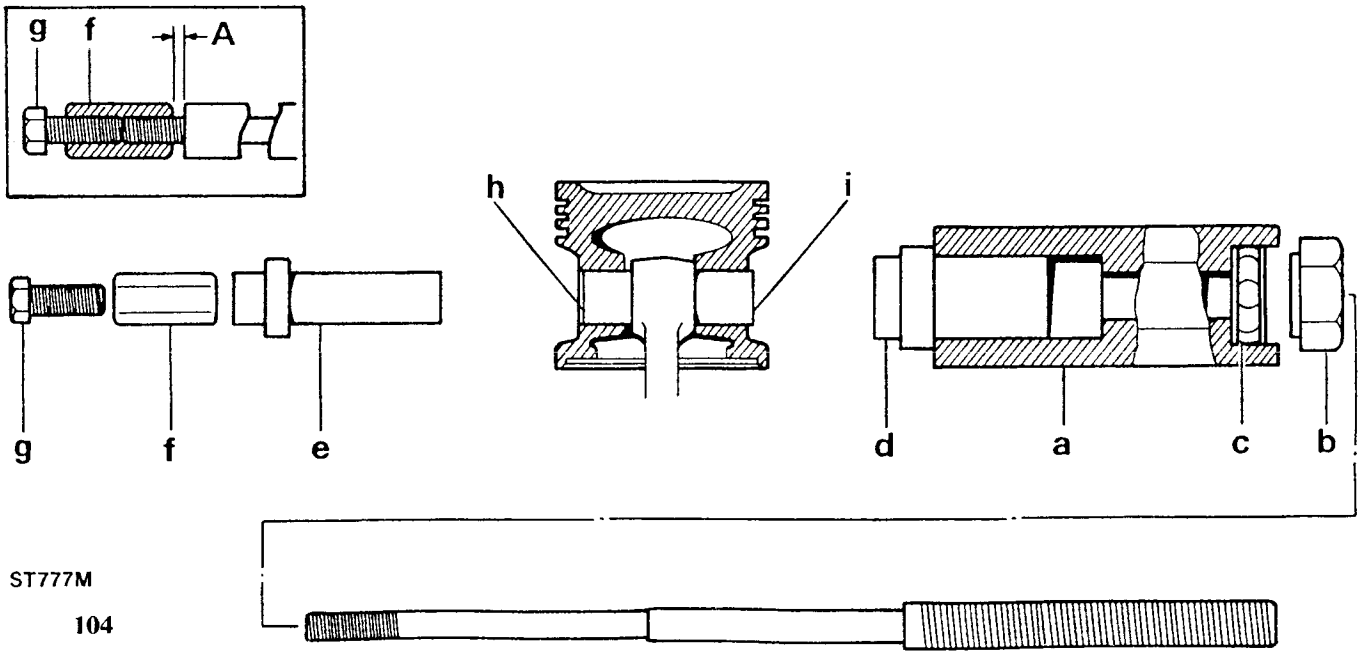
d. Locate the piston adaptor 18G 1150 E with its long spigot inside the bore of the hexagon body.
e. Fit the remover/replacer bush of 18G 1150 on the centre screw with the flanged end away from the gudgeon pin.
f. Screw the stop-nut about half-way onto the smaller threaded end of the centre screw, leaving a gap 'A' of 3 mm ($\frac{1}{8}$ in) between this nut and the remover/replacer bush.
g. Lock the stop-nut securely with the lock screw.
h. Check that the remover-replacer bush is correctly positioned in the bore of the piston.
i. Push the connecting-rod to the right to expose the end of the gudgeon pin, which must be located in the end of the adaptor 'd'.
j. Screw the large nut up to the thrust race.
k. Hold the lock screw and turn the large nut until the gudgeon pin has been withdrawn from the piston. Dismantle the tool.

continued

Overhaul

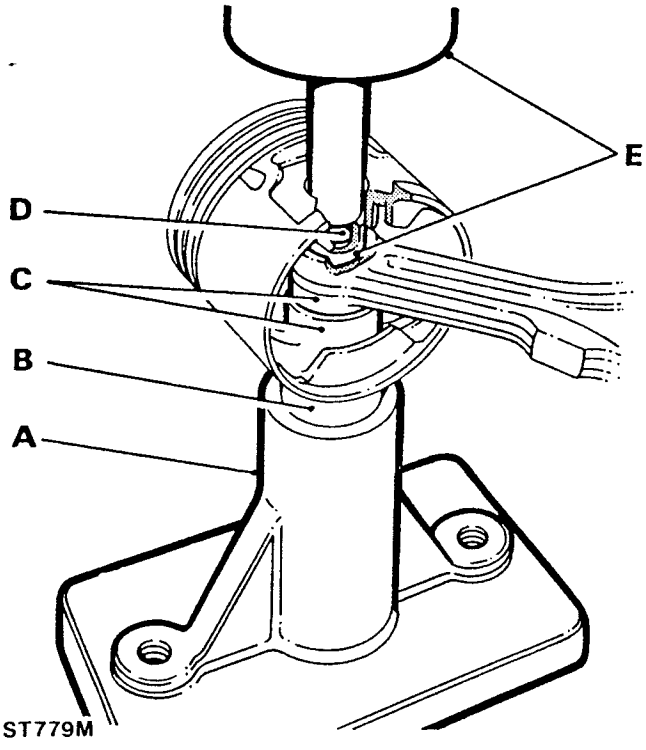
NOTE: The connecting-rods, caps and bearing shells must be retained in sets, and in the correct sequence. Remove the piston rings over the crown of the piston. If the same piston is to be refitted, mark it relative to its connecting-rod to ensure that the original assembly is maintained.

7. Withdraw the gudgeon pin, using tool 18G 1150 as follows:
   a. Clamp the hexagon body of 18G 1150 in a vice.
   b. Position the large nut flush with the end of the centre screw.
   c. Push the screw forward until the nut contacts the thrust race.



ST777M

8. As an alternative to tool 18G 1150, press the gudgeon pin from the piston using an hydraulic press and the components which comprise tool 605350 as follows:
   a. Place the base of tool 605350 on the bed of an hydraulic press which has a capacity of 8 tons (8 tonnes).
   b. Fit the guide tube into the bore of the base with its countersunk face uppermost.
   c. Push the piston to one side so as to expose one end of the gudgeon pin and locate this end in the guide tube.
   d. Fit the spigot end of the small diameter mandrel into the gudgeon pin.
   e. Press out the gudgeon pin, using the hydraulic press.



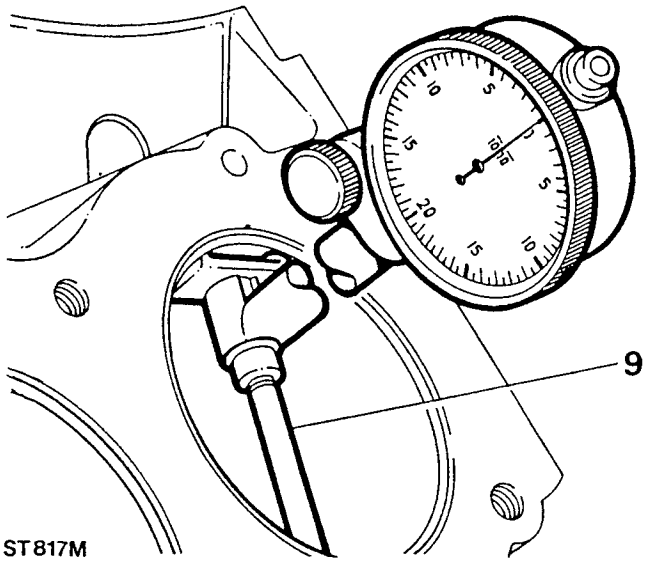
ST779M

New pistons

Pistons are available in service standard size and in oversizes of 0,25 mm (0.010 in) and 0,50 mm (0.020 in). Service standard size pistons are supplied 0,0254 mm (0.001 in) oversize. When fitting new service standard size pistons to a cylinder block, check for correct piston to bore clearance, honing the bore if necessary. Bottom of piston skirt-bore clearance should be 0,018 to 0,033 mm (0.0007 to 0.0013 in).

NOTE: The temperature of the piston and cylinder block must be the same to ensure accurate measurement. When reboring the cylinder block, the crankshaft main bearing caps must be fitted and tightened to the correct torque.

9. Check the cylinder bore dimension at right angles to the gudgeon pin, 40 to 50 mm (1½ to 2 in) from the top.



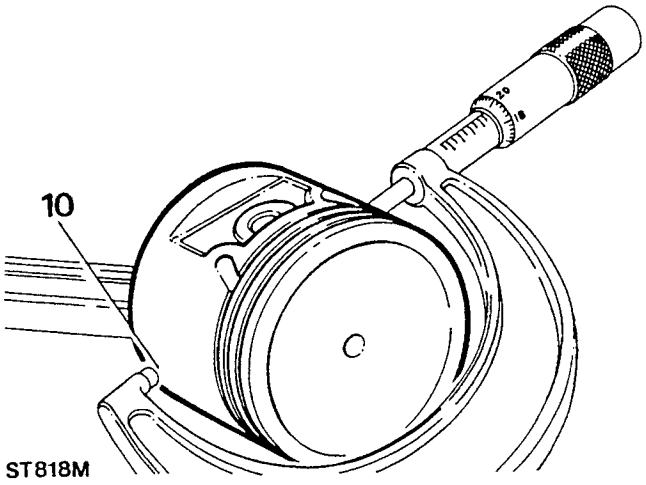
ST817M

Original pistons

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

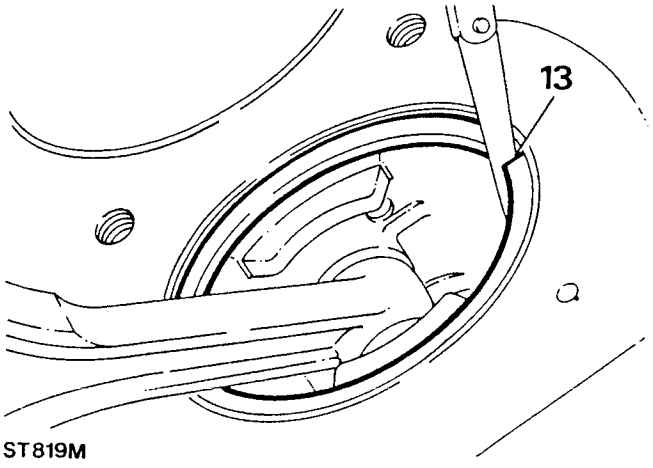
10. Check the piston dimension at right angles to the gudgeon pin, at the bottom of the skirt.
11. The piston dimension must be 0,018 to 0,033 mm (0.0007 to 0.0013 in) smaller than the cylinder.
12. If new piston rings are to be fitted without reboring, deglaze the cylinder walls with a hone, without increasing the bore diameter to provide a cross-hatch finish.

continued

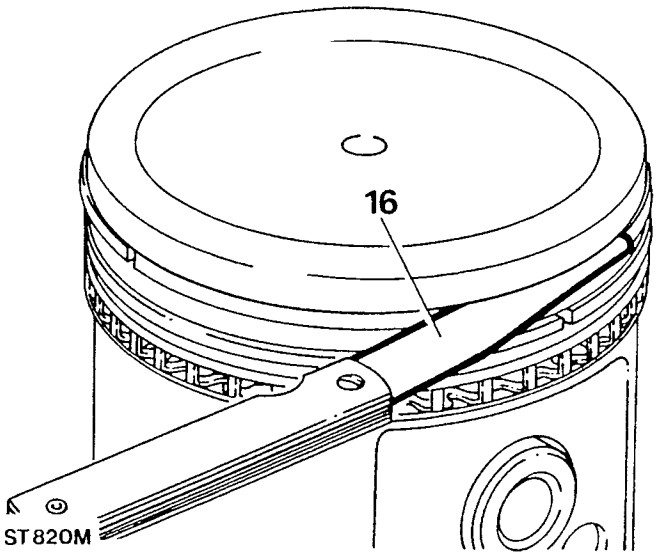


13. Check the compression ring gaps in the applicable cylinder, held square to the bore with the piston. Gap limits: 0,44 to 0,56 mm (0.017 to 0.022 in). Use a fine-cut flat file to increase the gap if required. Select a new piston ring if the gap exceeds the limit.

NOTE: Gapping does not apply to oil control rings.

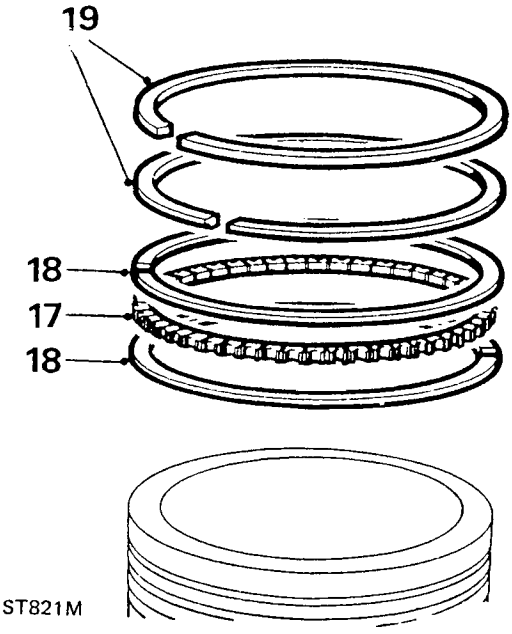


14. Temporarily fit the compression rings to the piston.
15. The ring marked 'TOP' must be fitted with the marking uppermost and into the second groove. The chrome ring is for the top groove and can be fitted either way round.
16. Check the compression ring clearance in the piston groove. Clearance limits: 0,05 to 0,10 mm (0.002 to 0.004 in).



Fit piston rings

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



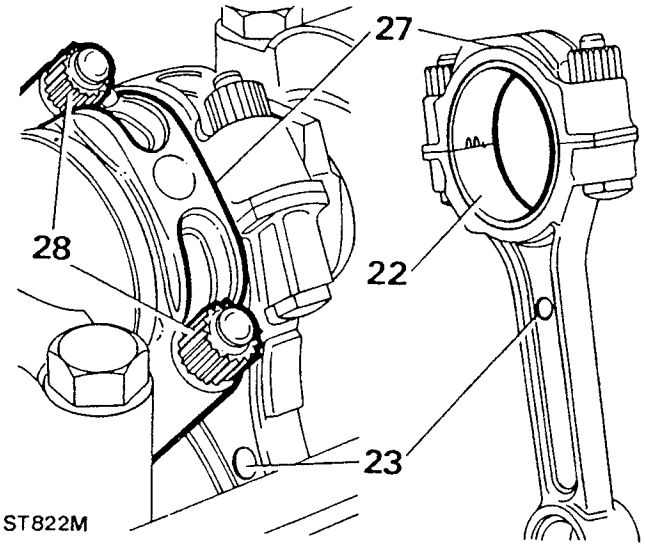
Examine connecting-rods

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

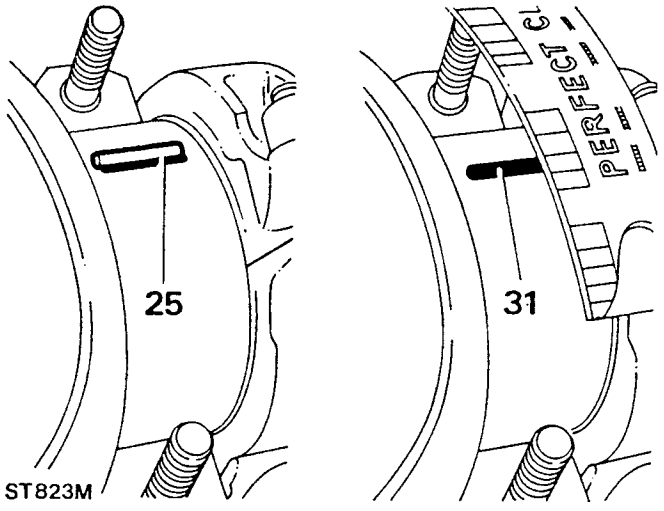
continued

Check crankshaft bearings

22. Locate the bearing upper shell into the connecting-rod.
23. Locate the connecting-rod and bearing on to the applicable crankshaft journal, noting that the domed shape boss on the connecting-rod must face towards the front of the engine on the right-hand bank of cylinders and towards the rear on the left-hand bank.
24. When both connecting-rods are fitted, the bosses will face inwards towards each other.
25. Place a piece of Plastigauge across the centre of the lower half of the crankshaft journal.
26. Locate the bearing lower shell into the connecting-rod cap.
27. Locate the cap and shell on to the connecting-rod. Note that the rib on the edge of the cap must be the same side as the domed shape boss on the connecting-rod.
28. Secure the connecting-rod cap, and tighten to the correct torque.



29. Do not rotate the crankshaft or connecting-rod while the Plastigauge is in use.
30. Remove the connecting-rod cap and shell.
31. Using the scale printed on the Plastigauge packet, measure the flattened Plastigauge at its widest point.
32. The graduation that most closely corresponds to the width of the Plastigauge indicates the bearing clearance.
33. The correct bearing clearance with new or overhauled components is 0,013 to 0,06 mm (0.0006 to 0.0022 in).
34. If a bearing has been in service, it is advisable to fit a new bearing if the clearance exceeds 0,08 mm (0.003 in).
35. If a new bearing is being fitted, use selective assembly to obtain the correct clearance.
36. Wipe off the Plastigauge with an oily rag. DO NOT scrape it off.

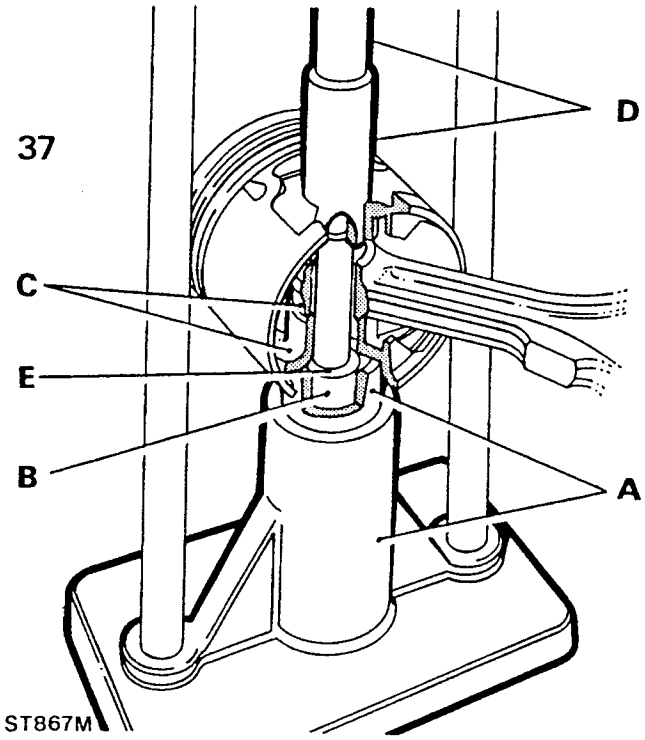


IMPORTANT: The connecting-rods, caps and bearing shells must be retained in sets, and in the correct sequence.

Assembling pistons to connecting-rods

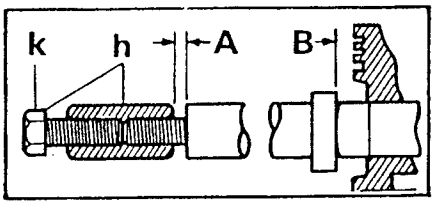
37. If an hydraulic press and tool 605350 was used for dismantling, refit each piston to its connecting-rod as follows:
    a. Check that the base of tool 605350 and the guide tube are fitted as follows:—
    Place the base of tool 605350 on the bed of an hydraulic press which has a capacity of 8 tons (8 tonnes).
    Fit the guide tube into the bore of the base with its countersunk face uppermost.
    b. Fit the long mandrel inside the guide tube.
    c. Fit the connecting-rod into the piston with the markings together if the original pair are being used, then place the piston and connecting-rod assembly over the long mandrel until the gudgeon pin boss rests on the guide tube.
    d. Fit the gudgeon pin into the piston up to the connecting-rod, and the spigot end of the small diameter mandrel into the gudgeon pin.
    e. Press in the gudgeon pin until it abuts the shoulder of the long mandrel.

continued

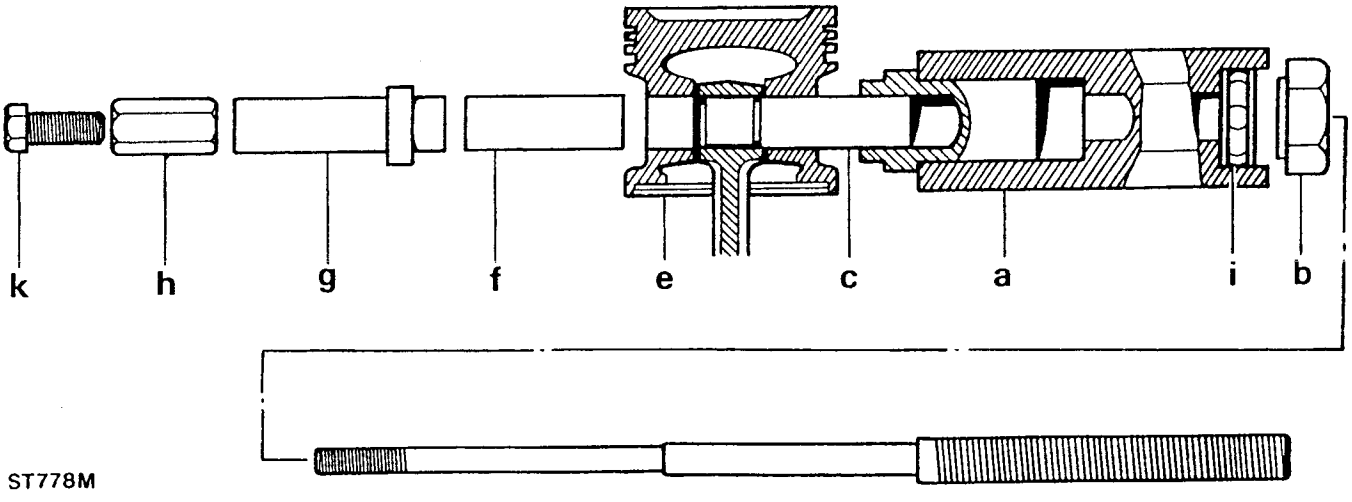


38. If tool 18G 1150 was used for dismantling, refit each piston to its connecting-rod as follows:
    a. Clamp the hexagon body of 18G 1150 in a vice, with the adaptor 18G 1150 E positioned as in 4d.
    b. Remove the large nut of 18G 1150 and push the centre screw approximately 50 mm (2 in) into the body until the shoulder is exposed.
    c. Slide the parallel guide sleeve, grooved end last, onto the centre screw and up to the shoulder.
    d. Lubricate the gudgeon pin and bores of the connecting-rod and piston with graphited oil (Acheson's Colloids 'Oildag'). Also lubricate the ball race and centre screw of 18G 1150.
    e. Fit the connecting-rod and the piston together onto the tool with the markings together if the original pair are being used and with the connecting-rod around the sleeve up to the groove.
    f. Fit the gudgeon pin into the piston bore up to the connecting-rod.
    g. Fit the remover/replacer bush 18G 1150/3 with its flanged end towards the gudgeon pin.
    h. Screw the stop-nut onto the centre screw and adjust this nut to obtain a 1 mm ($\frac{1}{32}$ in) end-float 'A' on the whole assembly, and lock the nut securely with the screw.
    i. Slide the assembly back into the hexagon body and screw on the large nut up to the thrust race.
    j. Set the torque wrench 18G 537 to 12 lbf ft. This represents the minimum load for an acceptable interference fit of the gudgeon pin in the connecting-rod.
    k. Using the torque wrench and socket 18G 587 on the large nut, and holding the lock screw, pull the gudgeon pin in until the flange of the remover-replacer bush is 4 mm (0.160 in) 'B' from the face of the piston. Under no circumstances must this flange be allowed to contact the piston.

    CAUTION: If the torque wrench has not broken throughout the pull, the fit of the gudgeon pin to the connecting-rod is not acceptable and necessitates the renewal of components. The large nut and centre screw of the tool must be kept well-oiled.

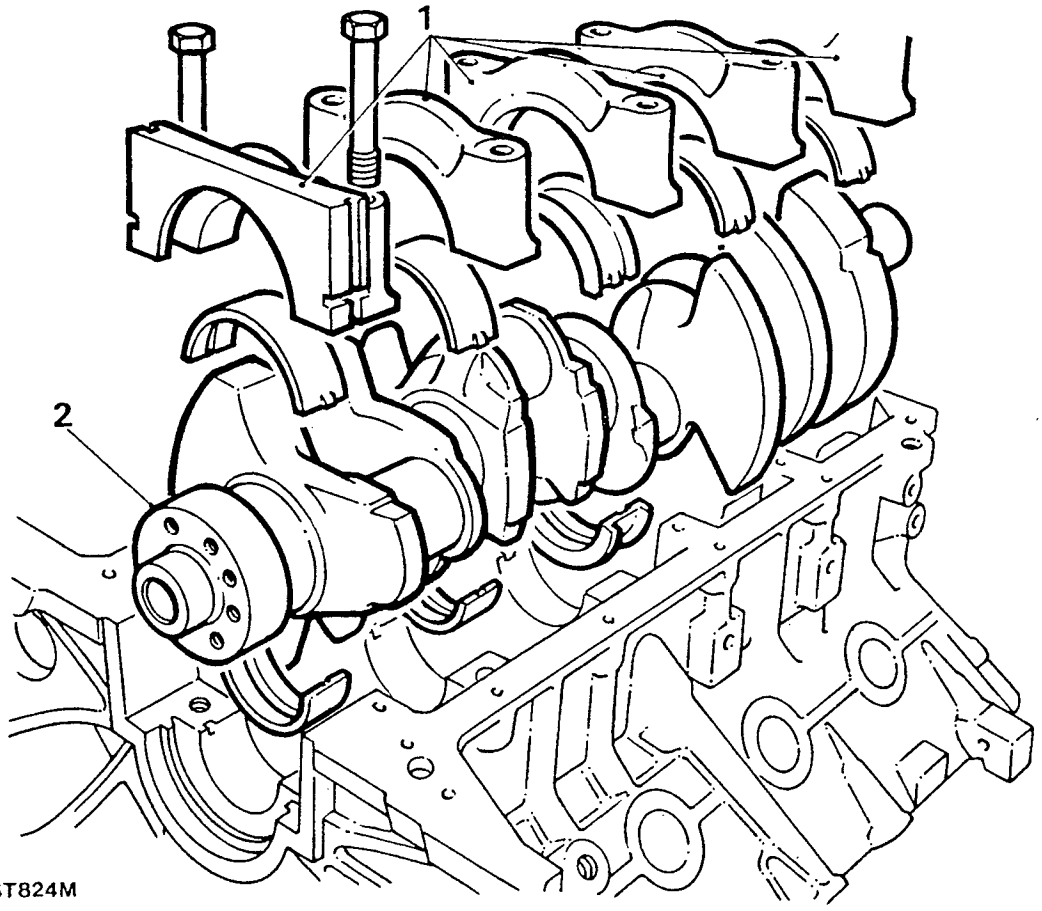


39. Remove the tool and check that the piston moves freely on the gudgeon pin and that no damage has occurred during pressing.



REMOVE AND OVERHAUL CRANKSHAFT

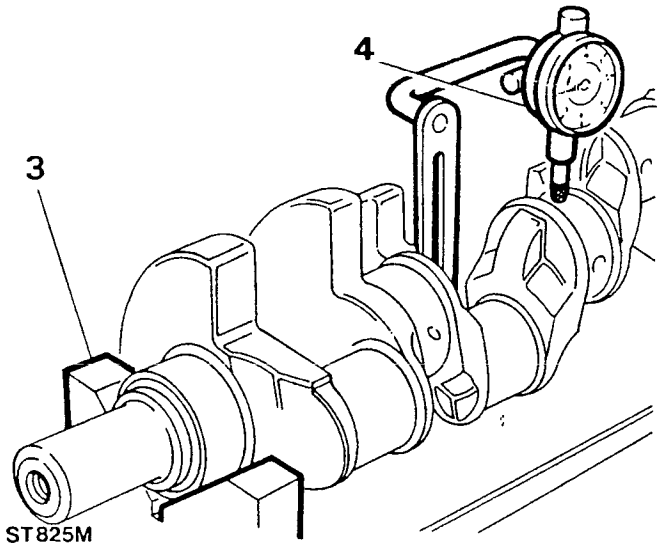
1. Remove the main bearing caps and lower bearing shells and retain in sequence. It is important to keep them in pairs and mark them with the number of the respective journal until it is decided if the bearing shells are to be refitted.
2. Lift out the crankshaft and rear oil seal.



ST824M

Inspect and overhaul crankshaft

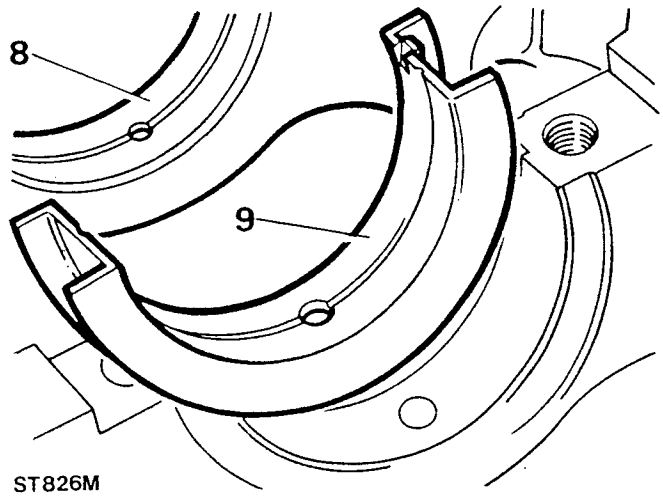
3. Rest the crankshaft on vee-blocks at numbers one and five main bearing journals.
4. Using a dial test indicator, check the run-out at numbers two, three and four main bearing journals. The total indicator readings at each journal should not exceed 0,08 mm (0.003 in).
5. While checking the run-out at each journal, note the relation of maximum eccentricity on each journal to the others. The maximum on all journals should come at very near the same angular location.
6. If the crankshaft fails to meet the foregoing checks it is bent and is unsatisfactory for service.
7. Check each crankshaft journal for ovality. If ovality exceeds 0,040 mm (0.0015 in), a reground or new crankshaft should be fitted.



ST825M

continued

8. Bearings for the crankshaft main journals and the connecting-rod journals are available in the following undersizes:
   0,25 mm (0.010 in)
   0,50 mm (0.020 in)
9. The centre main bearing shell, which controls crankshaft thrust, has the thrust faces increased in thickness when more than 0,25 mm (0.010 in) undersize, as shown on the following chart.



ST826M

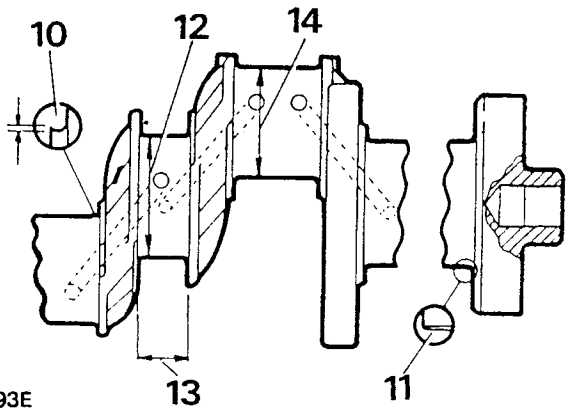
10. When a crankshaft is to be reground, the thrust faces on either side of the centre main journal must be machined in accordance with the dimensions on the following charts.

Main bearing journal size	Thrust face width
Standard	Standard
0,25 mm (0.010 in) undersize	Standard
0,50 mm (0.020 in) undersize	0,25 mm (0.010 in) oversize

11. For example: If a 0,50 mm (0.020 in) undersize bearing is to be fitted, then 0,12 mm (0.005 in) must be machined off each thrust face of the centre journal, maintaining the correct radius.

Crankshaft dimensions

12. The radius for all journals except the rear main bearing is 1,90 to 2,28 mm (0.075 to 0.090 in).
13. The radius for the rear main bearing journal is 3,04 mm (0.120 in).
14. Main bearing journal diameter, see the following charts.
15. Thrust face width, and connecting-rod journal diameter, see the following charts.



RR1793E

Crankshaft dimensions — millimetres

Crankshaft Grade	Diameter '12'	Width '13'	Diameter '14'
Standard	58,400-58,413	26,975-27,026	50,800-50,812
0,254 U/S	58,146-58,158	26,975-27,026	50,546-50,559
0,508 U/S	57,892-57,904	27,229-27,280	50,292-50,305

Crankshaft dimensions — inches

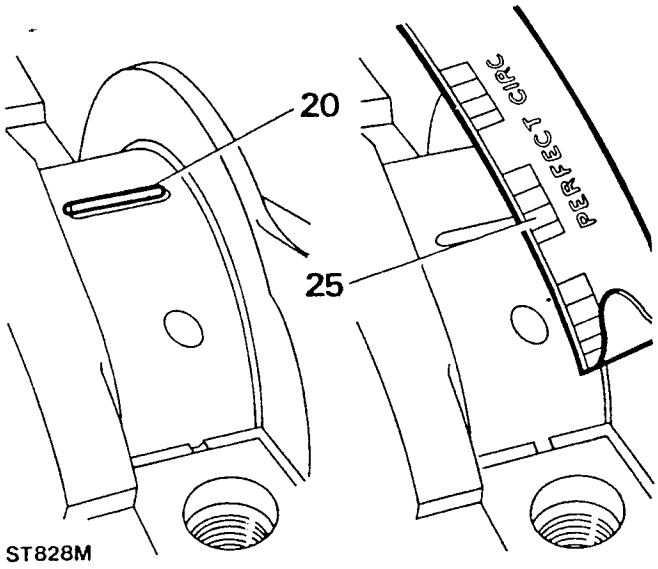
Crankshaft Grade	Diameter '12'	Width '13'	Diameter '14'
Standard	2.2992-2.2997	1.062-1.064	2.0000-2.0005
0.010 U/S	2.2892-2.2897	1.062-1.064	1.9900-1.9905
0.020 U/S	2.2792-2.2797	1.072-1.074	1.9800-1.9805

Check main bearing clearance

16. Remove the oil seals from the cylinder block and the rear main bearing cap.
17. Locate the upper main bearing shells into the cylinder block. These must be the shells with the oil drilling and oil grooves.
18. Locate the flanged upper main bearing shell in the centre position.
19. Place the crankshaft in position on the bearings.

continued

20. Place a piece of Plastigauge across the centre of the crankshaft main bearing journals.
21. Locate the bearing lower shell into the main bearing cap.
22. Fit numbers one to four main bearing caps and shells. Torque: 7,0 to 7,6 kgf m (50 to 55 lbf ft).
23. Fit the rear main bearing cap and shell. Torque: 9,0 to 9,6 kgf m (65 to 70 lbf ft). Do not allow the crankshaft to be rotated while the Plastigauge is in use.
24. Remove the main bearing caps and shells.
25. Using the scale printed on the Plastigauge packet, measure the flattened Plastigauge at its widest point.
26. The graduation that most closely corresponds to the width of the Plastigauge indicates the bearing clearance.

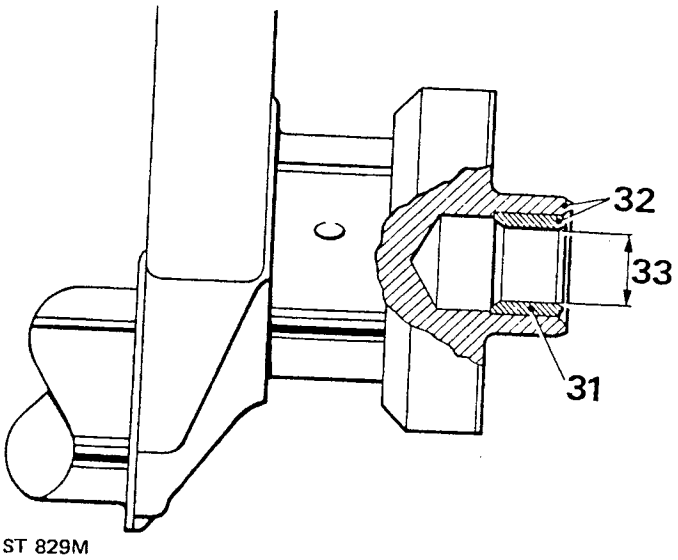


ST828M

27. The correct bearing clearance with new or overhauled components is 0,023 to 0,065 mm (0.0009 to 0.0025 in).
28. If the correct clearance is not obtained initially, use selective bearing assembly.
29. Wipe off the Plastigauge with an oily rag. Do NOT scrape it off.
30. Maintain the bearing shells and caps in sets and in the correct sequence.

Renew spigot bearing

31. Carefully remove the old bearing.
32. Fit the spigot bearing flush with, or to a maximum of 1,6 mm (0.063 in) below the end face of the crankshaft.
33. Ream the spigot bearing to 19,177 + 0,025 mm (0.7504 + 0.001 in) inside diameter. Ensure all swarf is removed.

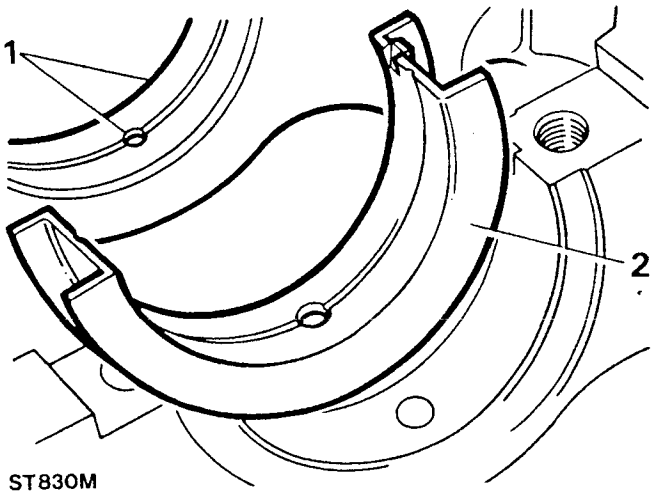


ST 829M

ASSEMBLING ENGINE

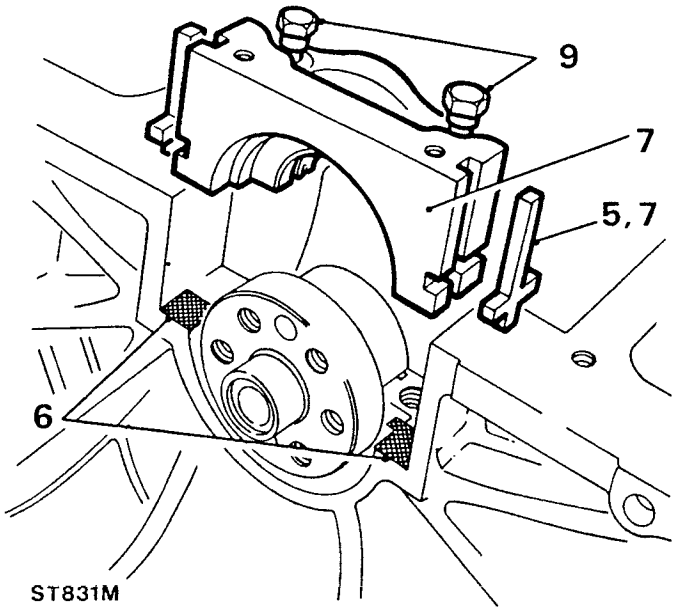
FIT CRANKSHAFT AND MAIN BEARINGS

1. Locate the upper main bearing shells into the cylinder block; these must be the shells with the oil drilling and oil grooves.
2. Locate the flanged upper main bearing shell in the centre position.
3. Lubricate the crankshaft main bearing journals and bearing shells with clean engine oil and lower the crankshaft into position.



ST830M

4. Lubricate the lower main bearing shells and fit numbers one to four main bearing caps and shells only, leaving the fixing bolts finger tight at this stage.
5. Fit the cruciform side seals to the grooves each side of the rear main bearing cap. Do not cut the side seals to length, they must protrude 1,5 mm (0.062 in) approximately above the bearing cap parting face.
6. Apply Hylomar PL32M jointing compound to the rearmost half of the rear main bearing cap parting face or, if preferred, to the equivalent area on the cylinder block as illustrated.
7. Lubricate the bearing half and bearing cap side seals with clean engine oil.
8. Fit the bearing cap assembly to the engine. Do not tighten the fixings at this stage but ensure that the cap is fully home and squarely seated on the cylinder block.
9. Tension the cap bolts equally by one-quarter turn approximately, then back off one complete turn on each fixing bolt.

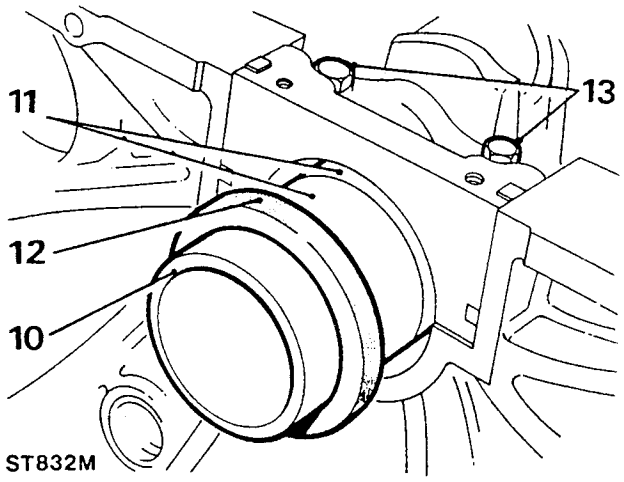


CAUTION: Do not handle the seal lip, visually check that it is not damaged and ensure that the outside diameter remains clean and dry.

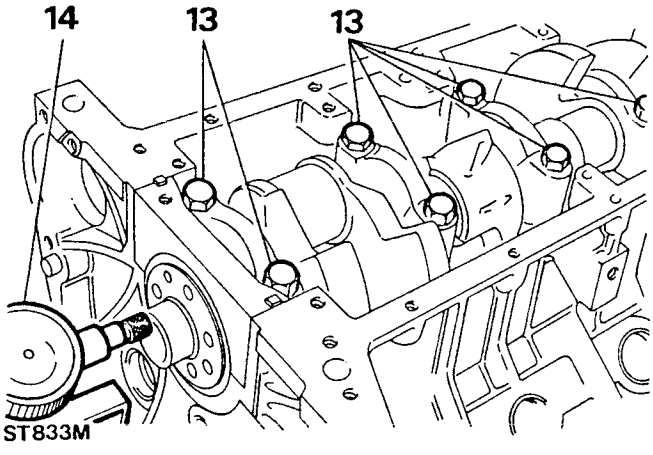
10. Position the seal guide RO 1014 on the crankshaft flange.
11. Ensure that the oil seal guide and the crankshaft journal are scrupulously clean, then coat the seal guide and oil seal journal with clean engine oil.

NOTE: The lubricant coating must cover the seal guide outer surface completely to ensure that the oil seal lip is not turned back during assembly.
Position the oil seal, lipped side towards the engine, onto the seal guide. The seal outside diameter must be clean and dry.

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



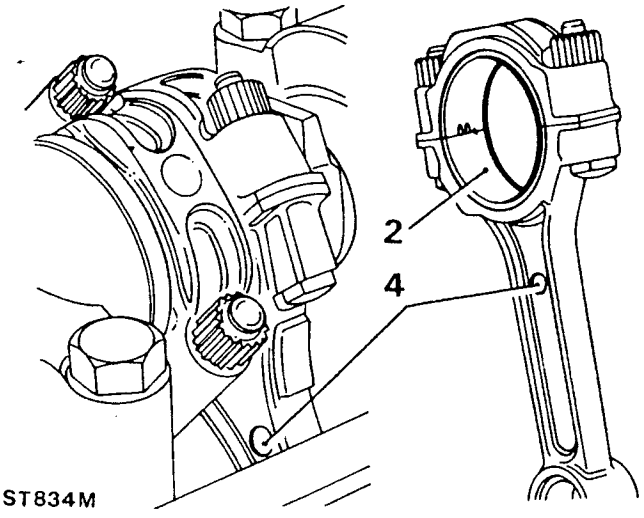
13. Tighten the main bearing cap bolts to the correct torque noting that the bolts for numbers one to four bearings have a different torque to number five bearing cap bolts.
14. Using a feeler gauge or a dial indicator check the crankshaft end-float, 0,10 to 0,20 mm (0.004 to 0.008 in).



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

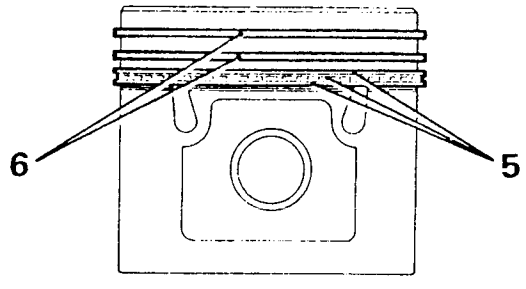
FIT CONNECTING-RODS AND PISTONS

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



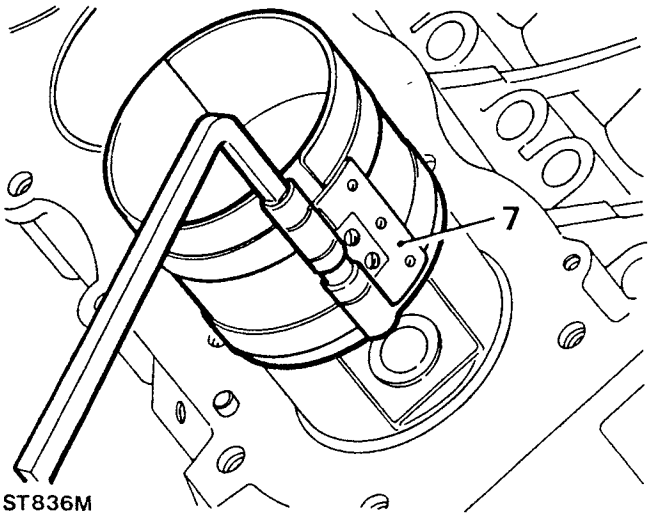
ST834M

5. Position the oil control piston rings so that the ring gaps are all at one side, between the gudgeon pin and piston thrust face. Space the gaps in the ring rails approximately 25 mm (1 in) each side of the expander ring joint.
6. Position the compression rings so that their gaps are on opposite sides of the piston between the gudgeon pin and piston thrust face.



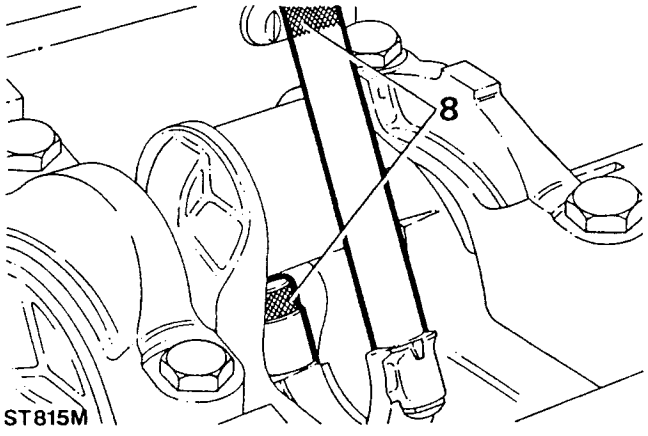
ST835M

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



ST836M

8. Pull the connecting rods on to the crankpins using the guide rods.

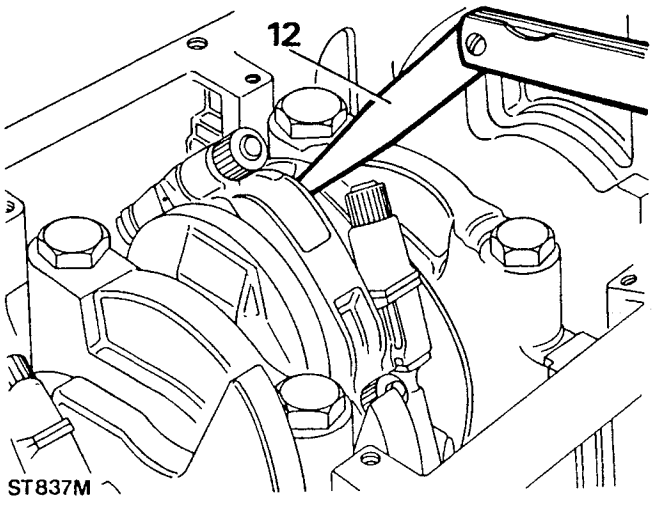


ST815M

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

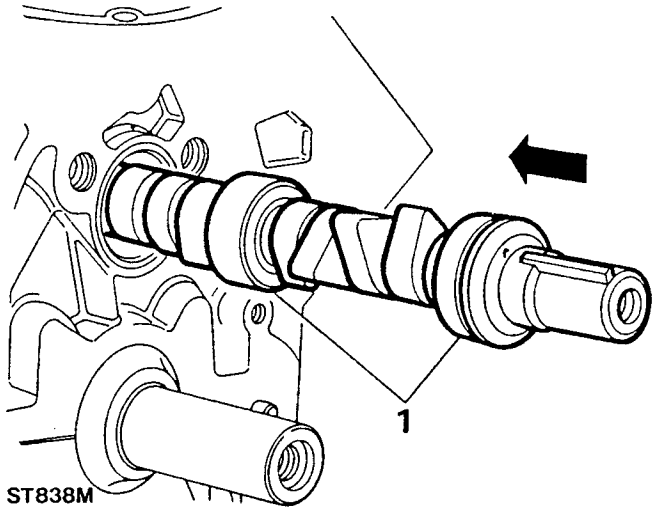
continued

12. Check the end-float between the connecting-rods on each crankshaft journal. Clearance limits: 0,15 to 0,37 mm (0.006 to 0.014 in).
13. Tighten the connecting-rod nuts to the correct torque. Fit the oil strainer and joint washer.

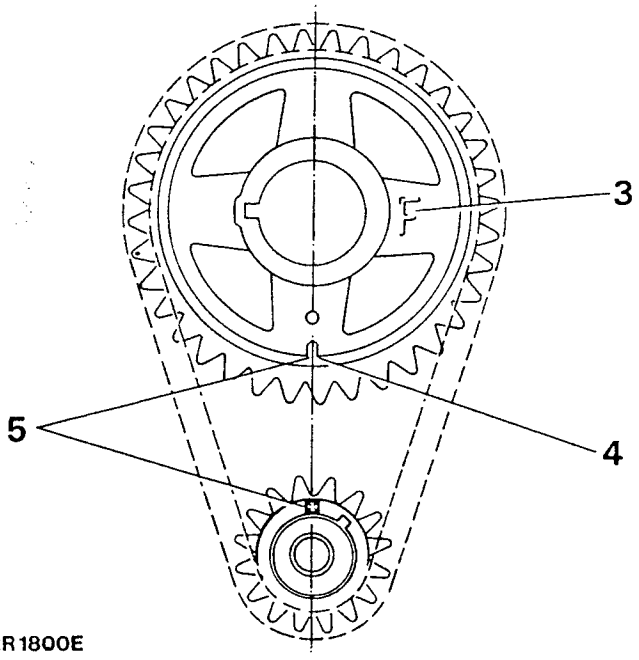


FIT CAMSHAFT TIMING GEARS AND CHAIN

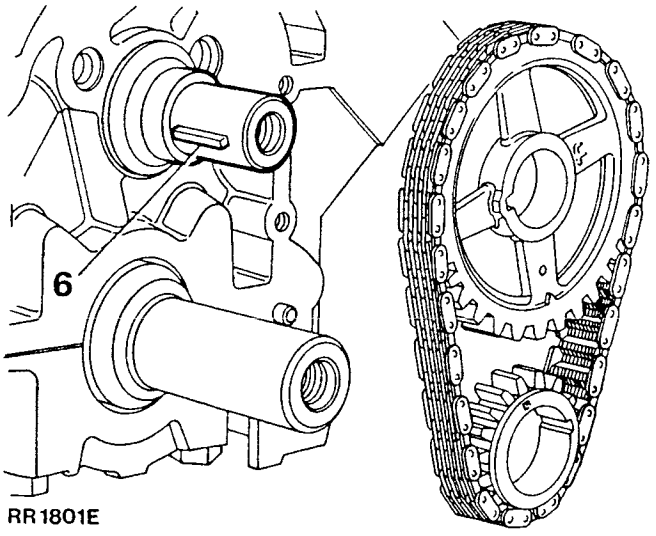
1. Lubricate the camshaft journals and carefully insert the camshaft into the cylinder block.



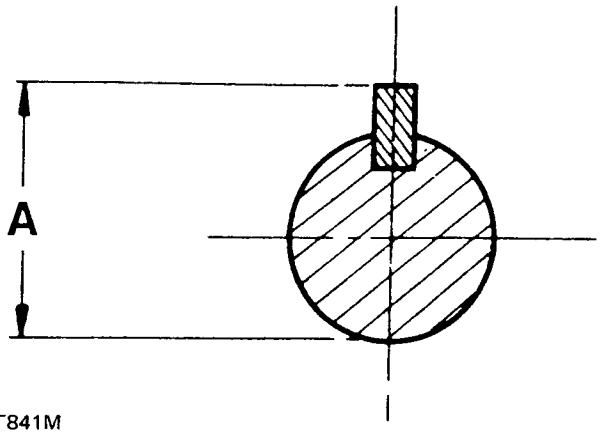
2. Turn the crankshaft to bring number one piston to T.D.C.
3. Temporarily fit the camshaft chain wheel with the marking 'FRONT' or 'F' outwards.
4. Turn the camshaft until the mark on the camshaft chain wheel is at the six o'clock position, then remove the chain wheel without disturbing the camshaft.
5. Encircle the chain wheels with the chain keeping the timing marks aligned.



6. Engage the chain wheel assembly on the camshaft and crankshaft key locations and check that the camshaft key is parallel to the shaft axis to ensure adequate lubrication of the distributor drive gear.

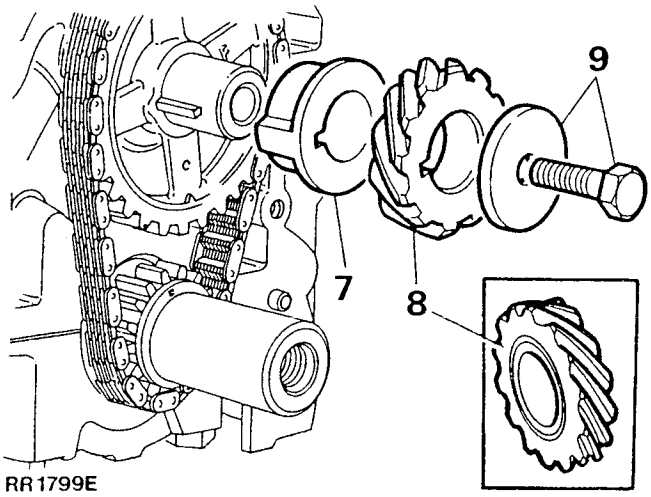


CAUTION: The space between the key and keyway acts as an oilway for lubrication of the drive gear. Ensure that the key is seated to the full depth of the keyway. The overall dimension of shaft and key must not exceed 30,15 mm (1.187 in). Dimension A below.



ST841M

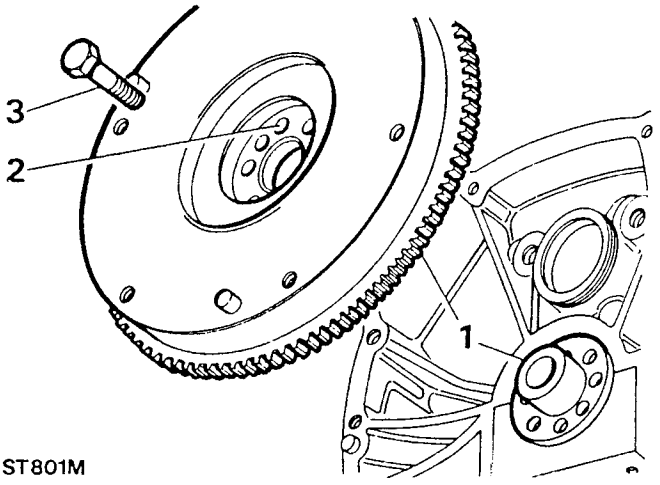
7. Check that the timing marks line-up and fit the spacer with the flange to the front.
8. Fit the distributor drive gear ensuring that the annular grooved side is fitted to the rear, that is towards the spacer.
9. Secure the drive gear and camshaft chain wheel assembly with the bolt and washer and tighten to the correct torque.



RR1799E

FIT THE FLYWHEEL

1. Locate the flywheel in position on the crankshaft spigot, with the ring gear towards the engine.
2. Align the flywheel fixing bolt holes which are off-set to prevent incorrect assembly.
3. Fit the flywheel fixing bolts and before finally tightening, take up any clearance by rotating the flywheel against the direction of engine rotation. Tighten the bolts evenly to the correct torque.

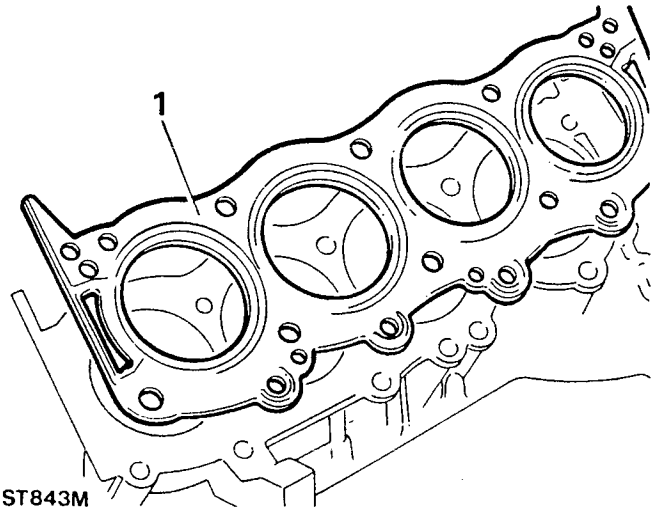


ST801M

FIT CYLINDER HEADS

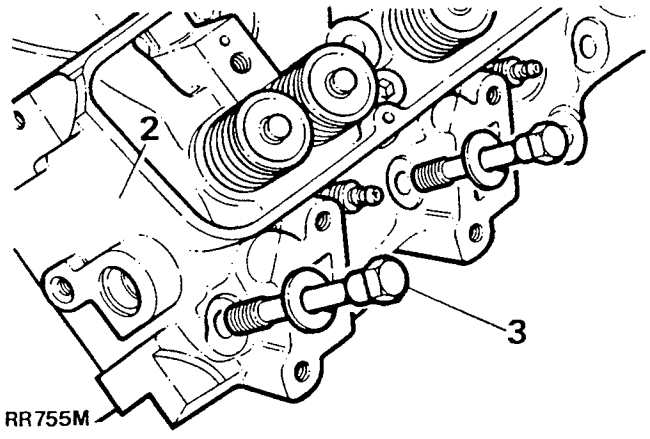
1. Fit new cylinder head gaskets with the word 'TOP' uppermost. Do NOT use sealant.

continued



ST843M

2. Locate the cylinder heads on the block dowel pins.
3. Clean the threads of the cylinder head bolts then coat them with Thread Lubricant-Sealant Loctite 572.



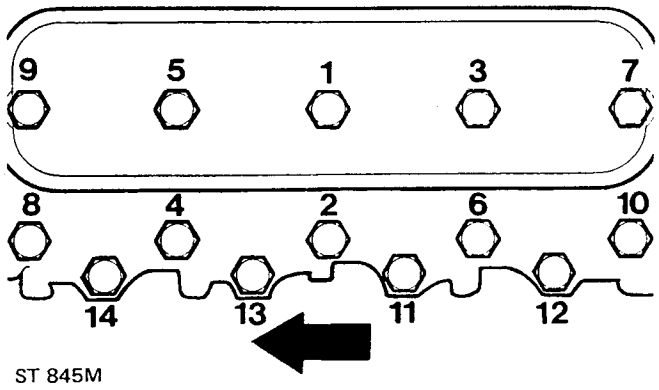
4. Locate the cylinder head bolts in position as illustrated and fit dipstick tube.

   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 the cylinder head bolts a little at a time in the sequence shown to the following figures:

   Bolts 1 to 10 65 to 70 lbf ft (88 to 95 Nm).
   Bolts 11 to 14 40 to 45 lbf ft (54 to 61 Nm).

6. When all bolts have been tightened, re-check the torque settings.

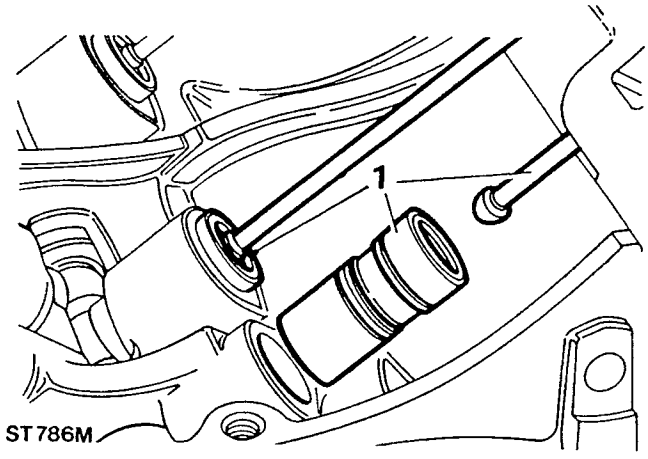


Note: Left-hand cylinder head illustrated. Arrow points to front of vehicle.

FIT TAPPETS, PUSH RODS AND ROCKER ASSEMBLIES

Fit tappets and push rods

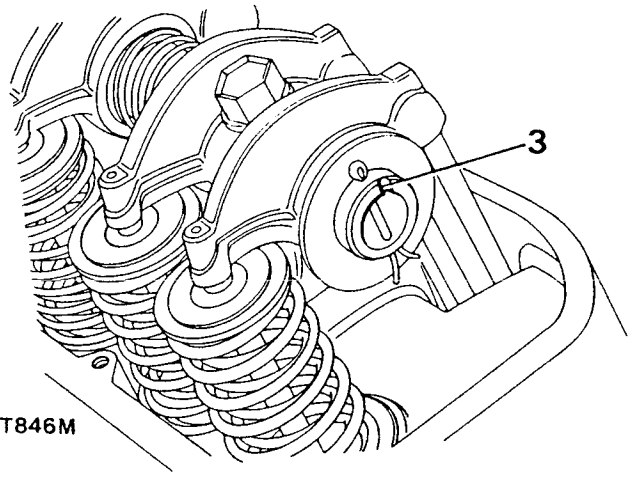
1. Fit the tappets and push rods to their original locations. Ensure that the tappets move freely in their respective bores. Before fitting the tappets immerse them in clean engine oil to reduce tappet noise when the engine is first started after the overhaul.



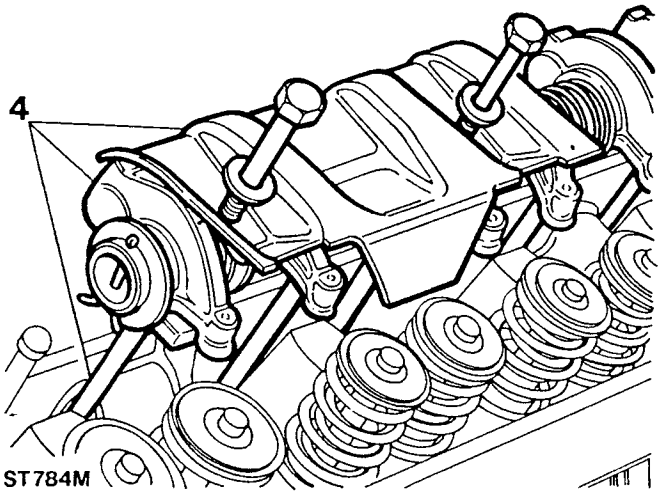
Fit the rocker assemblies

2. The rocker shafts are handed and must be fitted correctly to align the oilways.
3. Each rocker shaft is notched at one end and on one side only. The notch must be uppermost and towards the front of the engine on the right-hand side, and towards the rear on the left-hand side.

continued



4. Fit the rocker shaft assemblies. Ensure that the push-rods engage the rocker cups and that the baffle plates are fitted to the front on the left-hand side, and to the rear on the right-hand side. Tighten the bolts.

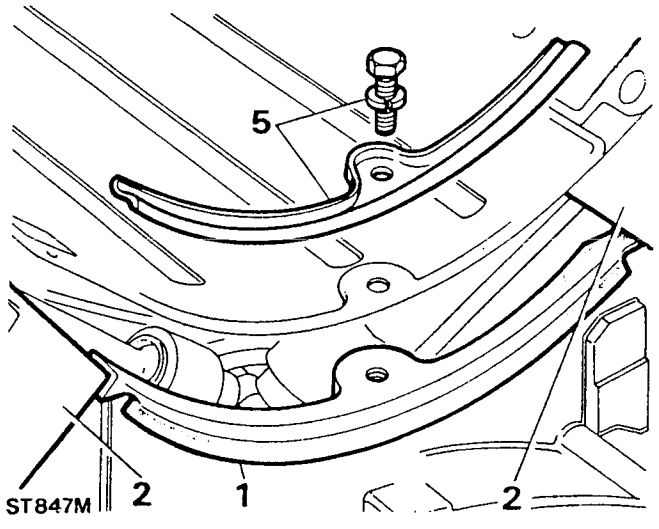


It should be noted that tappet noise can be expected on initial starting-up after an overhaul due to oil drainage from the tappet assemblies or indeed if the vehicle has been standing over a very long period. If excessive noise should be apparent after an overhaul, the engine should be run at approximately 2,500 rev/min for a few minutes (subject to the following caution), when the noise should be eliminated.

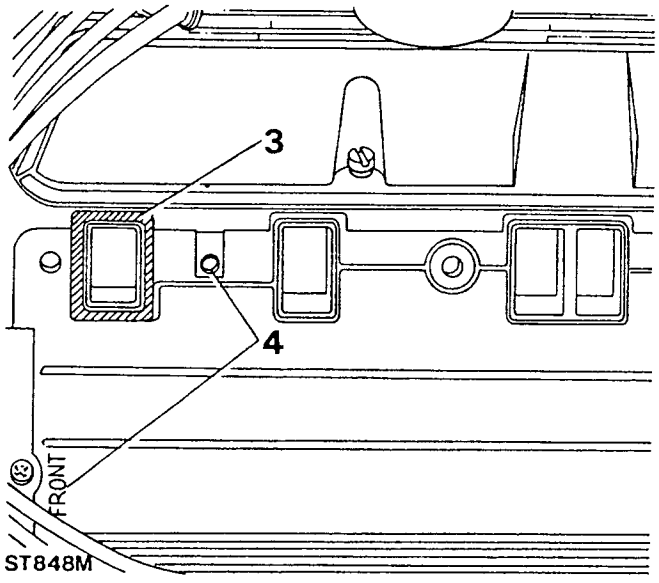
CAUTION: Do not exceed 1,000 engine rev/min when first starting the engine, otherwise the crankshaft rear oil seal will be damaged.

FIT THE INDUCTION MANIFOLD

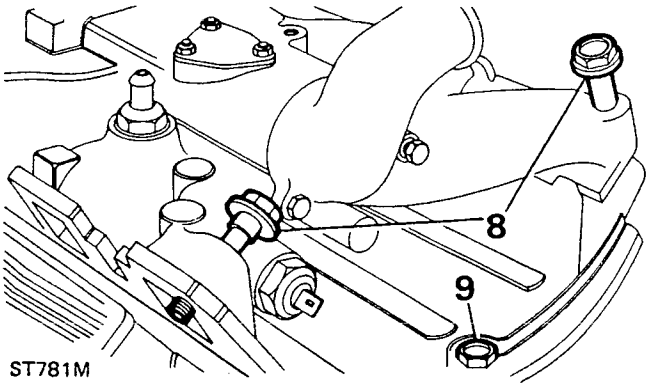
1. Coat both sides of new manifold gasket seals with silicon grease.
2. Locate the seals in position with their ends engaged in the notches formed between the cylinder head and block.



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

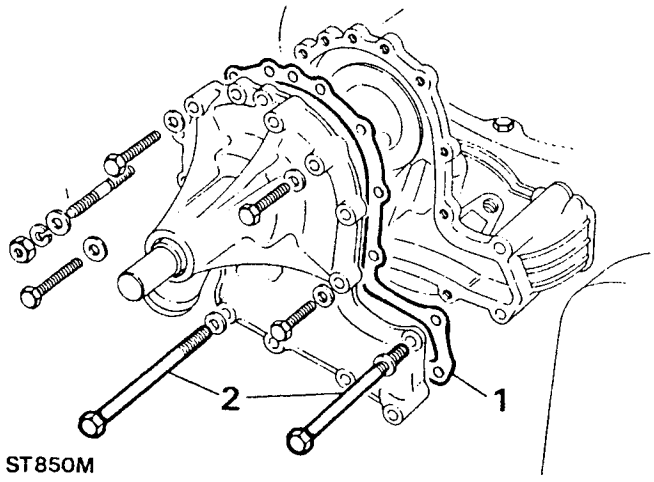


6. Locate the manifold onto the cylinder head.
7. Clean the threads of the manifold securing bolts and apply Loctite 572 to the threads.
8. Fit all the manifold bolts and tighten them a little at a time, evenly, alternate sides working from the centre to each end and finally tighten to the correct torque.
9. Tighten the gasket clamp bolts to the correct torque.

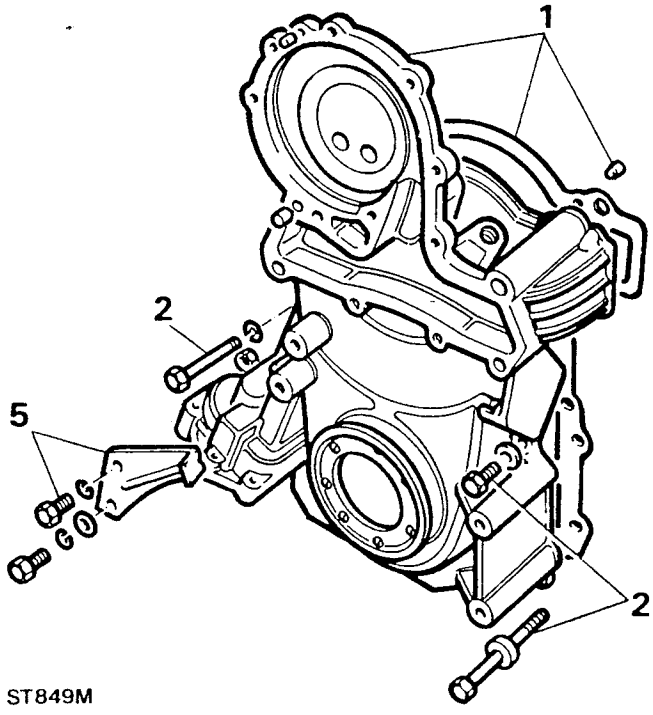


FIT THE TIMING COVER AND CRANKSHAFT PULLEY

1. Place a new timing cover joint washer in position and fit the timing cover locating it on the two dowels.
2. Clean the threads of the timing cover securing bolts, then coat them with Thread Lubricant-Sealant Loctite 572.
3. Fit and evenly tighten the timing cover bolts to the correct torque figure.
4. Fit the crankshaft pulley and tighten the retaining bolt to the correct torque.
5. Fit timing pointer.



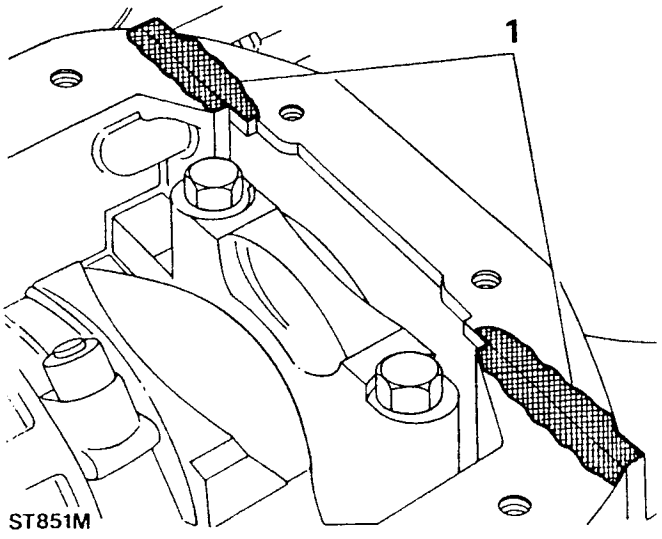
ST850M



ST849M

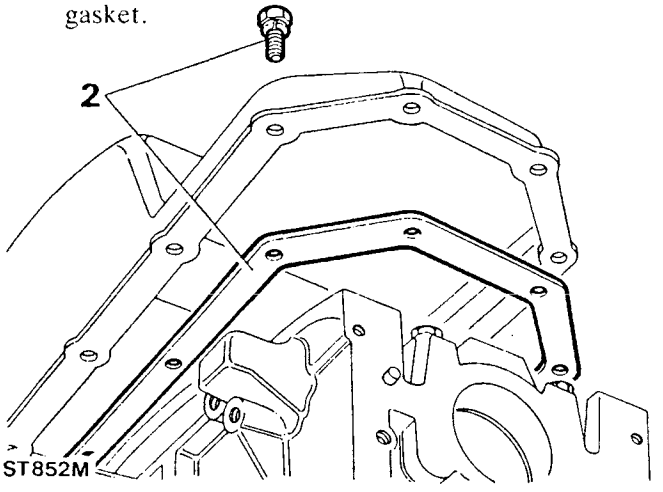
FIT THE SUMP

1. Clean the sump mating faces and at the joint between the timing cover and crankcase apply a coating of a universal jointing compound about 13 to 19 mm (½ to ¾ in) wide in the area illustrated.



ST851M

2. Place the sump gasket in position, fit the sump and evenly tighten the retaining bolts to the correct torque. Hylosil is used on later engines instead of a gasket.



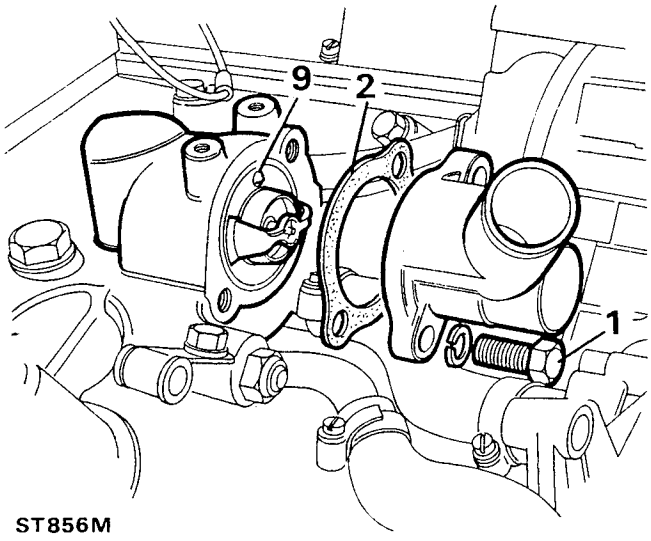
ST852M

FIT THE WATER PUMP

1. Lightly grease a new joint washer and place it in position on the the timing cover.
2. Clean the threads of the four long bolts and smear them with Loctite 572 thread lubricant-sealant. Locate the water pump in position.
3. Locate the alternator adjusting link on the water pump.
4. Leave the alternator adjusting link loose and tighten the remaining water pump housing bolts evenly and to the correct torque.

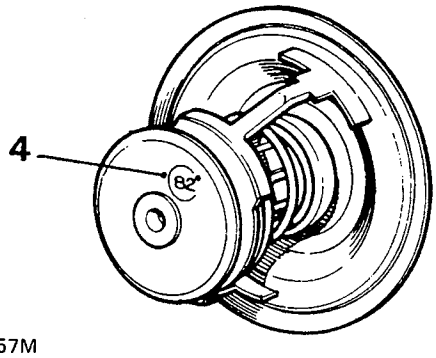
TEST AND FIT THERMOSTAT

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



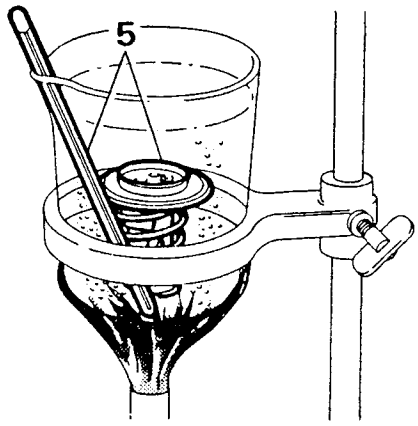
ST856M

4. Note the temperature stamped on the thermostat at which it should be fully open.



ST857M

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



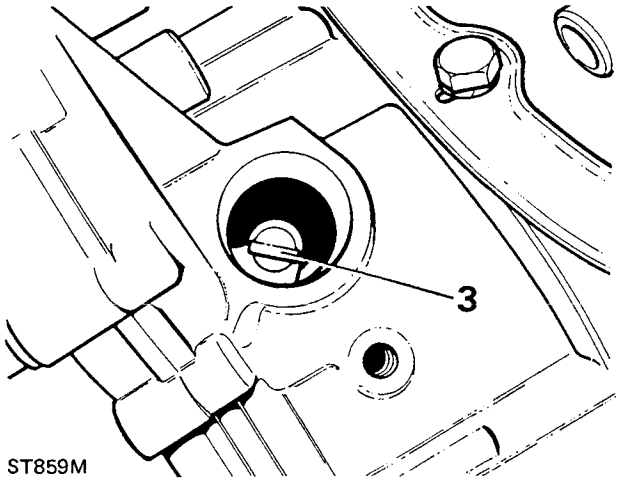
ST858M

8. Clean the induction manifold and thermostat housing mating faces.
9. Fit the thermostat with the jiggle pin uppermost at 12 o'clock.
10. Fit the housing using a new gasket, and evenly tighten the two bolts.

FIT THE DISTRIBUTOR — including electronic distributor

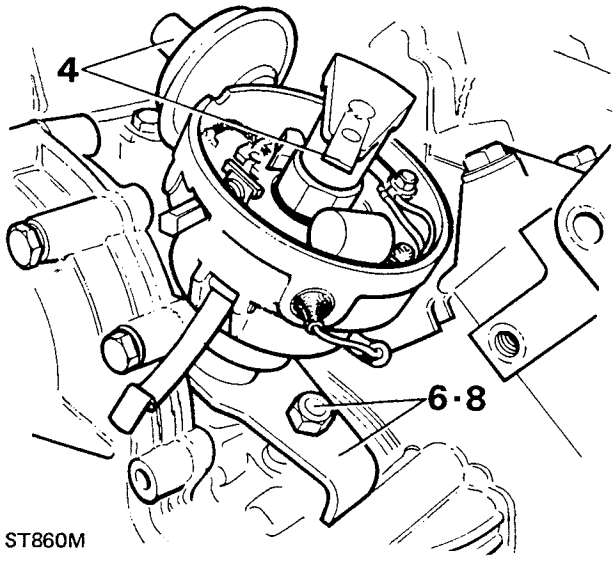
1. Turn the crankshaft to bring number one piston to T.D.C. on the compression stroke (both valves closed number one cylinder).
2. Turn distributor drive until rotor arm is approximately 30° anti-clockwise from number one sparking plug lead position on cap.
3. Turn the oil pump and distributor common drive shaft so that the tongue is in the approximate position as illustrated.

continued



ST859M

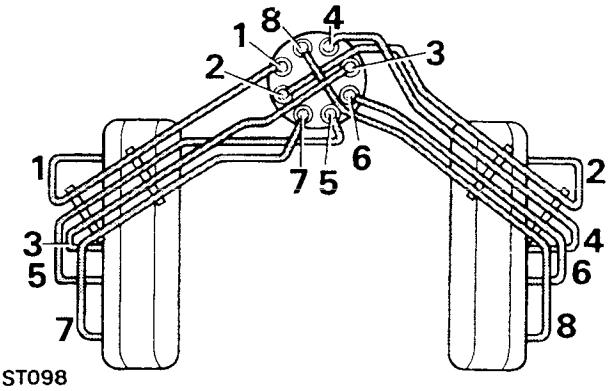
4. Fit distributor to engine and check that centre line of rotor arm is now in line with number one sparking plug lead in cap. Reposition distributor if necessary. The vacuum capsule should be at 90° to the camshaft.
5. If distributor does not seat correctly in front cover, oil pump drive is not engaged. Engage by lightly pressing down distributor while turning engine.
6. Fit clamp and bolt leaving both loose at this stage.



ST860M

7. Rotate distributor anti-clockwise until contact points just start to open.
8. Secure distributor in this position by tightening clamp bolt.
9. Fit the distributor cap and spark plugs and connect the H.T. leads in accordance with the illustration below.

NOTE: The above distributor setting is to enable the engine to be run so that the correct setting given in 'Engine Tuning data' can be achieved once the engine is refitted to the vehicle.



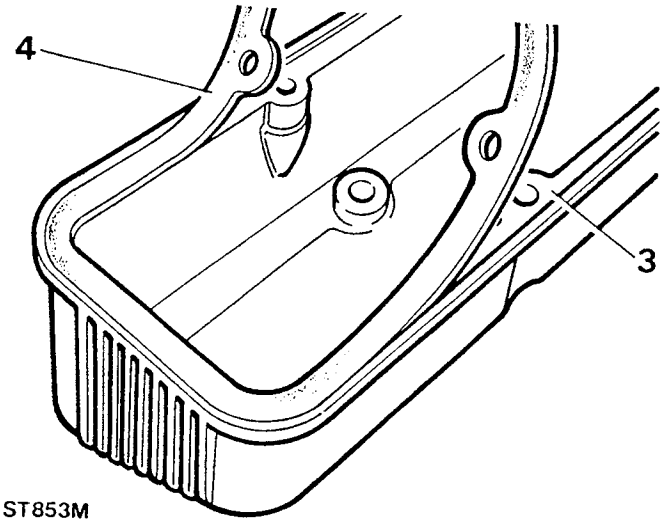
ST098

FIT ROCKER COVERS

1. Remove all traces of old gasket on the covers and cylinder heads.
2. Clean and dry the gasket mounting surface, using Bostik cleaner 6001.
3. Apply Bostik 1775 impact adhesive to the seal face and the gasket, using a brush to ensure an even film. Allow the adhesive to become touch-dry, approximately fifteen minutes.

NOTE: The gasket fits one way round only and must be fitted accurately first time; any subsequent movement would destroy the bond.

4. Place one end of the gasket into the cover recess with the edge firmly against the recess wall; at the same time hold the remainder of the gasket clear; then work around the cover, pressing the gasket into place ensuring that the outer edge firmly abuts the recess wall.

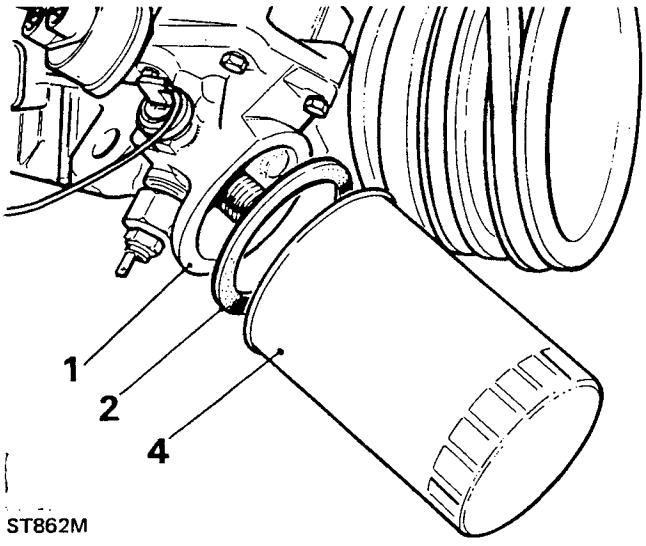


ST853M

5. Allow the cover to stand for thirty minutes before fitting it to the engine.
6. Secure the rocker covers to the engine with the four screws. Short screws — in board, long screws — out board.

FIT ENGINE OIL FILTER

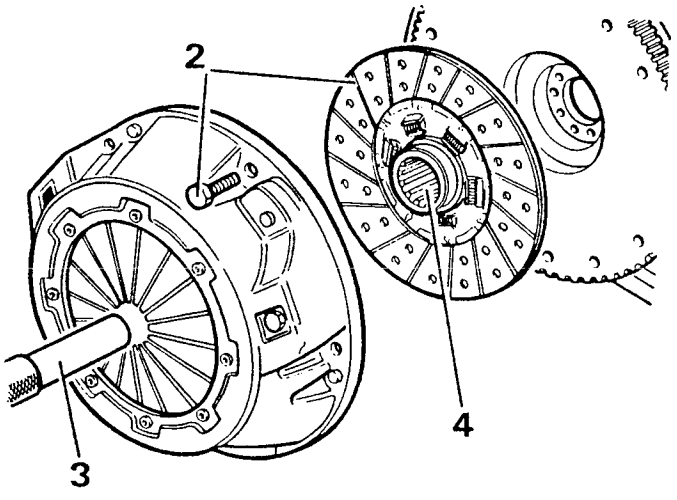
1. Clean oil pump mating face with filter.
2. Smear clean engine oil on the rubber washer of the new filter.
3. Fill the filter with new oil as far as possible, noting the angle at which the filter is to be fitted.
4. Screw on the filter until the sealing ring touches the oil pump cover face, then tighten it a further half turn by hand only. **Do not overtighten.**



ST862M

FIT THE CLUTCH

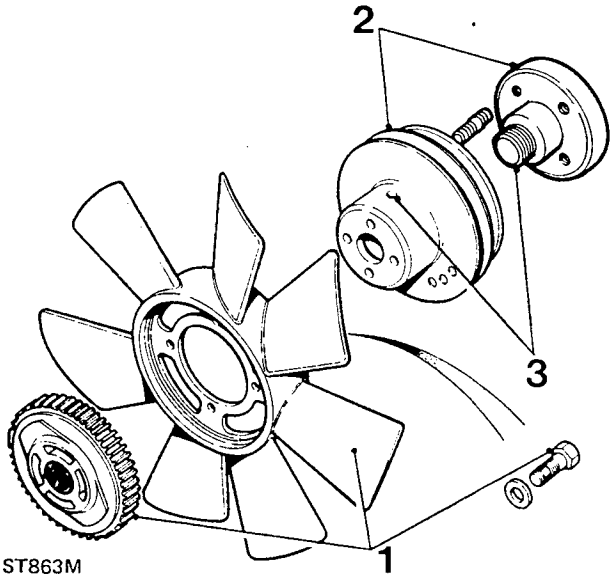
1. Clean the flywheel and clutch assembly pressure plate.
2. Fit the centre plate and the clutch assembly and loosely secure to the flywheel with the retaining bolts.
3. Insert centralising tool 18G 79 or a slave primary shaft and finally tighten the clutch assembly retaining bolts in a diagonal sequence, to the correct torque.
4. Smear the centre plate splines with Rocol MV3 or Rocol MTS 1000 grease.



ST854M

FIT THE FAN PULLEY, VISCOUS COUPLING AND FAN

1. Secure the fan to the viscous coupling with the four bolts and tighten evenly.
2. If removed, fit the pulley to hub assembly adaptor and secure with the four nuts.
3. Screw the viscous coupling onto the adaptor thread by inserting a tommy bar in the hole in the pulley to restrain it while tightening the coupling.
4. Fit the fan and any other drive belts.

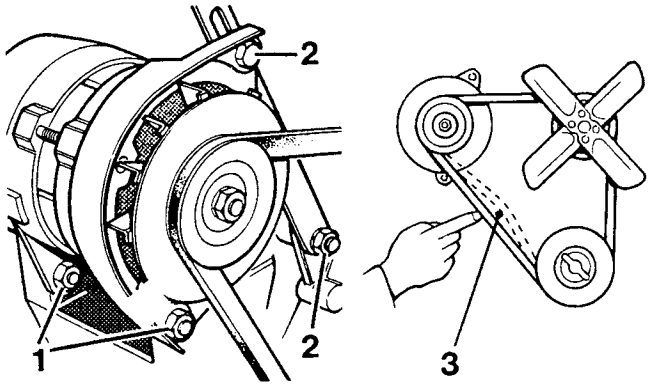


ST863M

FIT THE ALTERNATOR

1. Offer up the alternator to the mounting bracket and locate the pivot nuts and bolts noting that the fan guard is attached to the front nut and bolts.
2. Slacken the alternator adjustment bracket and attach alternator bracket. Note that the fan guard is attached to the adjustment bracket bolt.
3. Fit and tension the fan belt as follows:
   Pivot the alternator away from the engine but in doing so, do not apply any pressure to the slip-ring end bracket. Tighten the pivot nuts and bolts and adjustment bolt. The tension is correct when, with thumb pressure, the belt deflection is approximately 8 mm ($\frac{5}{16}$ in) for non-air condition engines, 4 mm ($\frac{5}{32}$ in) for air condition engines, between alternator and the crankshaft pulley. Finally, tighten the fixings and connect the wiring plug to the alternator.

continued



ST855M

FIT THE CARBURETTERS

If removed, fit the carburetters to the induction manifold, using new joint washers in the correct sequence as illustrated according to the engine serial number. See Section 19 for S.U. Carburetters.

Illustration A from serial number 1400001A Non-detoxed.

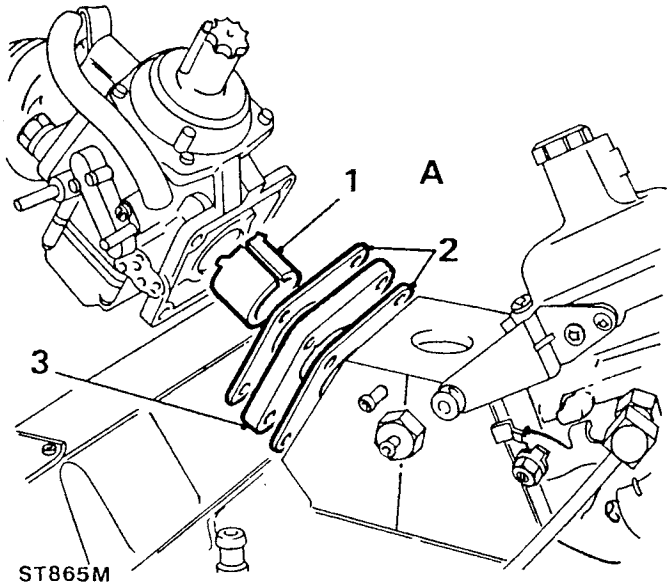
1. Fit the liner.
2. Fit the two joint washers.
3. In between the washers fit the insulator.

Illustration B from serial number 15G00001A detoxed.

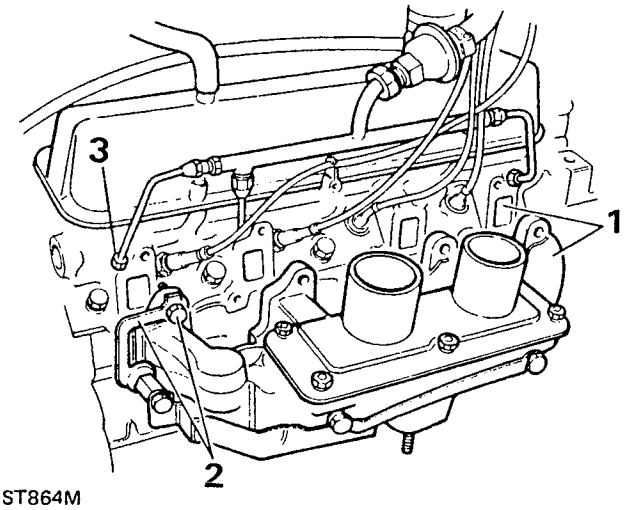
4. Fit the three joint washers.
5. Fit the saw toothed deflector.
6. Fit the insulator.

FIT EXHAUST MANIFOLD AND AIR RAILS

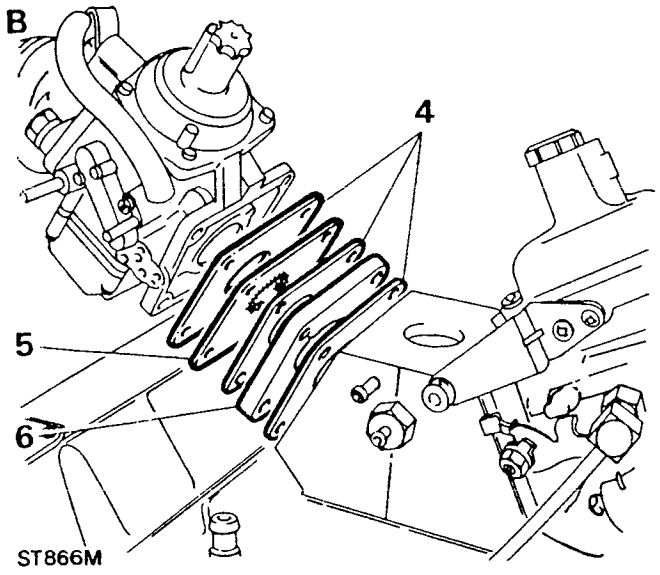
1. Ensure that the mating surfaces of the cylinder head and exhaust manifold are clean and smooth and coat the faces with 'Foliac J 166' or 'Moly Paul' anti-seize compound. 'Foliac J 166' is manufactured by Rocol Ltd., Rocol House, Swillington, Leeds, England.
   'Moly Paul' is manufactured by K.S. Paul Products Ltd., Nobel Road, London N18.
2. Place the manifold in position on the cylinder head and fit the securing bolts, lockplates and plain washers. The plain washers are fitted between the manifold and lockplates. Evenly tighten the manifold bolts to the correct torque figure and bend over the lock tabs.
3. Fit pulse-air rails to cylinder heads.



ST865M



ST864M



ST866M

MISCELLANEOUS AND NON-STANDARD ITEMS

Fit any other items of equipment and miscellaneous hoses, pipes, filters, clips and brackets to the positions noted during dismantling.

PETROL ENGINE

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
ENGINE FAILS TO START	1. Incorrect starting procedure 2. Starter motor speed too slow 3. Faulty ignition system 4. Water or dirt in fuel system 5. Carburetter(s) flooding 6. Defective fuel pump 7. Defective starter motor 8. Starter pinion not engaging	See owners handbook Check battery and connections Check each component in system Flush out system with clean fuel Check float chamber needle valve Remove, overhaul or renew Overhaul or renew Remove starter motor and overhaul
ENGINE STALLS	1. Low idling speed 2. Faulty sparking plugs 3. Faulty coil or condenser 4. Faulty distributor points 5. Incorrect mixture 6. Foreign matter in fuel system	Adjust carburetter(s) Clean and test; renew if necessary Renew Rectify or renew Adjust carburetter(s) Investigate source of foreign matter and clean as necessary
LACK OF POWER	1. Poor compression 2. Badly seating valves 3. Faulty exhaust silencer 4. Incorrect ignition timing 5. Leaks or restriction in fuel system 6. Faulty sparking plugs 7. Excessive carbon deposit 8. Brakes binding 9. Faulty coil, condenser or battery	If the compression is appreciably less then the correct figure, the piston rings or valves are faulty. Low pressure in adjoining cylinders indicates a faulty cylinder head gasket Overhaul cylinder head(s) Renew Check and adjust using electronic equipment Check through system Clean, test and renew, if necessary Decarbonize Adjust brakes or overhaul Determine which component and renew
ENGINE RUNS ERRATICALLY	1. Faulty electrical connections 2. Defective sparking plugs 3. Low battery charge 4. Defective distributor 5. Foreign matter in fuel system 6. Faulty fuel pump 7. Sticking valves 8. Defective valve springs 9. Incorrect ignition timing 10. Worn valve guides or valves 11. Faulty cylinder head gaskets 12. Damaged exhaust system 13. Vacuum pipes, disconnected at inlet manifold, distributor or gearbox	Check security of all ignition connections Clean, test and renew if necessary Recharge battery and test for condition Remove and overhaul Determine source of dirt, and clean system Remove and overhaul or renew Overhaul cylinder head(s) Overhaul cylinder head(s) Check timing with electronic equipment, if possible Overhaul cylinder head(s) Renew gaskets Rectify or renew Refit pipes
ENGINE STARTS, BUT STOPS IMMEDIATELY	1. Faulty electrical connections 2. Foreign matter in fuel system 3. Faulty fuel pump 4. Low fuel level in tank	Check HT leads for cracked insulation; check low tension circuit Determine source of matter and clean system Remove, overhaul or renew Replenish
ENGINE FAILS TO IDLE	1. Incorrect carburetter setting 2. Faulty fuel pump 3. Sticking valves 4. Faulty cylinder head gasket(s)	Adjust as necessary Remove, overhaul or renew Overhaul cylinder head(s) Renew
ENGINE MISFIRES ON ACCELERATION	1. Distributor points incorrectly set 2. Faulty coil or condenser 3. Faulty sparking plugs 4. Faulty carburetter(s) 5. Vacuum pipes disconnected at inlet manifold	Set to correct dwell angle Renew Clean, test or renew Overhaul Check all vacuum connections. Renew faulty pipes
ENGINE KNOCKS	1. Ignition timing advanced 2. Excessive carbon deposit 3. Incorrect carburetter setting 4. Unsuitable fuel 5. Worn pistons or bearings 6. Distributor advance mechanism faulty 7. Defective sparking plugs	Adjust using electronic equipment Decarbonise Adjust Adjust ignition timing to suit octane rating Overhaul engine Renew capsule and re-check Clean, test and renew if necessary
ENGINE BACKFIRES	1. Ignition defect 2. Carburetter defect 3. Sticking valve 4. Weak valve springs 5. Badly seating valves 6. Excessively worn valve stems and guides 7. Excessive carbon deposit 8. Incorrect sparking plug gap 9. Air leak in induction or exhaust systems	Check all ignition components and timing Overhaul carburetter(s) } Overhaul cylinder head Clean and reset Renew faulty gaskets or components

SYMPTOM	POSSIBLE CAUSE	CURE
BURNED VALVES	1. Sticking valves 2. Weak valve springs 3. Excessive deposit on valve seats 4. Distorted valves 5. Excessive mileage between overhauls	Overhaul cylinder head
NOISY VALVE MECHANISM	1. Excessive oil in sump, causing air bubbles in hydraulic tappets — V8 engine 2. Worn or scored parts in valve operating mechanism 3. Valves and seats cut down excessively, raising end of valve stem, 1,27 mm (0.050 in) above normal position 4. Sticking valves 5. Weak valve springs 6. Worn timing chain or chain wheels	Drain and refill to correct level on dipstick Replace faulty parts Grind off end of valve stem or replace parts V8 engine only Overhaul cylinder head Renew worn parts
NOISE FROM HYDRAULIC TAPPETS — V8 ENGINE ONLY 1. Rapping noise only when engine is started 2. Intermittent rapping noise 3. Noise on idle and low speed 4. General noise at all speeds 5. Loud noise at normal operating temperature only	1. Oil too heavy for prevailing temperature Excessive varnish in tappet 2. Leakage at check ball 3. Excessive leakdown 4. High oil level in sump Leakage at check ball Worn tappet body Worn camshaft 5. Excessive leak-down rate or scored lifter plunger	Drain and refill with correct grade Replace tappet Replace tappet Replace tappet Drain and refill to correct level on dipstick Replace tappet Replace tappet Replace camshaft Replace tappet
MAIN BEARING RATTLE	1. Low oil level in sump 2. Low oil pressure 3. Excessive bearing clearance 4. Burnt-out bearings 5. Loose bearing caps	Replenish as necessary to high mark on dipstick Worn bearings. Faulty skew, gear assembly. 4-cylinder engine Renew bearings; grind crankshaft — NOT diesel Renew and investigate reason for failure Tighten to correct torque
LOW OIL PRESSURE WARNING LIGHT REMAINS ON, ENGINE RUNNING	1. Thin or diluted oil 2. Low oil level 3. Choked pump strainer 4. Faulty release valve 5. Excessive bearing clearance 6. Oil pressure switch unserviceable 7. Electrical fault 8. Relief valve plunger sticking 9. Weak relief valve spring 10. Pump rotors excessively worn 11. Excessively worn bearings; main, connecting rod, big end, camshaft, etc 12. Faulty skew gear assembly, 4-cylinder engines	Drain and refill with correct oil and renew filter Replenish to high mark on dipstick Clean Rectify Rectify Renew Check circuit Remove and ascertain cause Renew Overhaul oil pump Ascertain which bearings and rectify Check skew gear bearing. Check plug not leaking or seals in 2.5 diesel engine. See engine overhaul
RATTLE IN LUBRICATION SYSTEM	1. Oil pressure relief valve plunger sticking	Remove and clean
ENGINE OVERHEATING	1. Low coolant level 2. Faulty cooling system 3. Faulty thermostat 4. Incorrect timing 5. Defective lubrication system	Check for leaks. Check expansion tank level Check fan and belt, pump, radiator fins not blocked Test and renew, if necessary Check and adjust using electronic equipment Renew filter. Check pump. Clean strainer. Check oil circulation
MECHANICAL NOISES: Medium low pitch knock Low pitch thud High pitch tap Intermittent thuds Continual tapping Continual slapping	Big-end bearing slack or run Main bearing slack or run Worn gudgeon pins Loose fly wheel or excessive crankshaft end-float Excessive valve clearance — NOT V8 Piston clearance excessive, — more apparent when engine cold may disappear when engine hot	

DIESEL ENGINE MECHANICAL FAULTS

SYMPTOM	POSSIBLE CAUSE	CURE
MAIN BEARING RATTLE	34. Low oil level in sump	Replenish as necessary to high mark on dipstick
	35. Low oil pressure	Worn bearings. Faulty skew, gear assembly. 4-cylinder engine
	36. Excessive bearing clearance	Renew bearings; and or crankshaft
	37. Burnt-out bearings	Renew and investigate reason for failure
	38. Loose bearing caps	Tighten to correct torque
ENGINE OVERHEATING	39. Low coolant level	Check for leaks, check expansion tank level
	40. Faulty cooling system	Check fan and belt, pump, radiator fins not blocked
	41. Faulty thermostat	Test and renew, if necessary
	42. Cracked cylinder head	Renew
	43. Defective lubrication system	Renew Filter, Check pump. Clean strainer. Check oil circulation
LOW OIL PRESSURE WARNING LIGHT REMAINS ON, ENGINE RUNNING	44. Thin or diluted oil	Drain and refill with correct oil and renew filter
	45. Low oil level	Replenish to high mark on dipstick
	46. Choked pump strainer	Clean
	47. Faulty release valve	Rectify
	48. Excessive bearing clearance	Rectify
	49. Oil pressure switch unserviceable	Renew
	50. Electrical fault	Check circuit
	51. Relief valve plunger sticking	Remove and ascertain cause
	52. Weak relief valve spring	Renew
	53. Pump rotors excessively worn	Overhaul oil pump
	54. Excessively worn bearings) main, connecting rod, big end, camshaft, etc.	Ascertain which bearings and rectify
	55. Faulty skew gear assembly, 4-cylinder engines	Check skew gear bearing. Check plug not leaking or seals in 2.5 diesel engine. See engine overhaul
RATTLE IN LUBRICATION SYSTEM	56. Oil pressure relief valve plunger sticking	Remove and clean
NOISY VALVE MECHANISM	57. Sticking valves 58. Weak valve springs 59. Tappet clearance too wide 60. Worn timing chain or chain wheels	Overhaul cylinder head
MECHANICAL NOISES:		
Low pitch knock	Big-end bearing slack or run	
Low pitch thud	Main bearing slack or run	
Intermittent thuds	Loose flywheel or excessive crankshaft end-float	
High pitch tap	Worn gudgeon pins	
Light tapping	Excessive valve clearance	
Slapping	Excessive piston clearance — more apparent when cold	

DIESEL ENGINE

FAULT DIAGNOSIS DPA AND DPS PUMPS — 2.25 and 2.5 litre diesel engines

SYMPTOM	POSSIBLE CAUSE	CHECK
DIFFICULT STARTING	1. Lack of fuel	Fuel level in tank
	2. Stop solenoid faulty	Audible operation when switched — Check electrical supply, replace solenoid
	3. Wrong starting procedure	Starting procedure correct — Throttle closed and heater plugs in operation
	4. Air in fuel system	All joints and unions are tight
	5. Fuel inlet restriction	Filter not chocked and feed pipes clear
	6. Fuel contamination	Diesel fuel being used, not petrol, free of water, dirt, ice, wax.
	7. Low cranking speed	Battery, starter, cable connections. Correct engine lubricating oil
	8. Starting aid ineffective	Correct functioning of heater plugs
	9. Injection timing incorrect	Pump to engine timing using timing tool
	10. Timing belt slipped	Belt condition and tension. Pump rotor not seized
	11. Back leakage restricted	Tank return clear, flow from cam box valve when cranking. Replace pump if blocked
	12. Fuel circuit incorrect	Inlet and back leak pipes correct way round. Banjo bolts of correct type for pump injector seating
	13. Engine condition	Cylinder compression, valve timing and clearances. Air filter not choked
	14. Fuel atomisation	Injectors; correct type, opening pressure, spray condition
	15. Fuel tank blockage	Tank vent and outlet unrestricted
	16. HP pipe leaking	HP pipe joint tightness
	17. Injection pump defective internally	If all other relevant checks satisfactory, replace pump

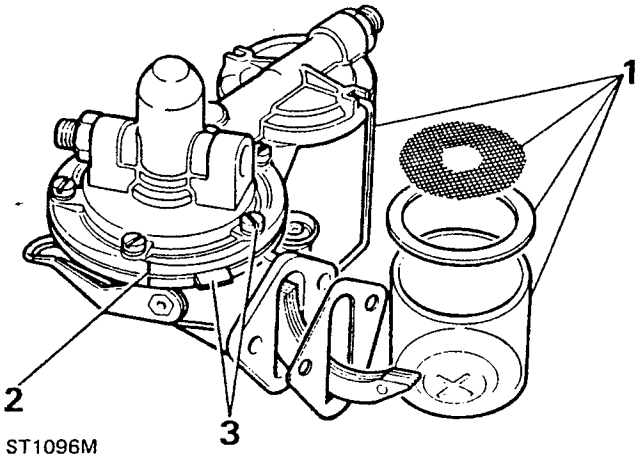
continued

SYMPTOM	POSSIBLE CAUSE	CHECK
IRREGULAR IDLE	Any of the following items: 4, 5, 6, 9, 11, 12, 13, 14, 16, 17. Plus: 18. HP pipe restriction 19. Idling speed incorrect 20. Anti-stall setting incorrect 21. Manual idle advance faulty 22. Accelerator linkage faulty 23. Engine vibration 24. Injection pump loose	HP pipes not kinked or bore reduced at nipples Idling speed given in 'engine tuning data' Recovery from acceleration, engine warm (Reset idling and anti-stall) Cable and lever operation satisfactory Lever tight on pump reaches stop screws, linkage wear, adjustment Engine mountings tight and effective Tightness of pump drive mounting bolts and rear support bracket nut and bolt
INSUFFICIENT MAXIMUM SPEED	Any of items 4, 5, 17, 22. Plus the following: 25. Max. speed setting incorrect 26. Vehicle brakes binding	Seal intact. Engine maximum speed in 'Engine tuning data' — adjust Brake freedom, all wheels in turn and transmission brake
ERRATIC RUNNING OR SURGING	Any of items 1, 2, 4, 5, 9, 12, 13, 14, 15, 16, 17, 18, 22, 23, 24.	
EXCESSIVE SMOKE	Any of items 6, 9, 13, 14 and 17	
EXCESSIVE NOISE	Any of items 9, 14, 24, 23. Plus the following: 27. Cambox pressure low	Pressure with gauge at control cover vent screw. Replace pump if pressure too low
LACK OF POWER	Any of items 4, 5, 6, 9, 11, 12, 13, 14, 15, 16, 18, 22, 24, 25, 26. Plus the following: 28. Exhaust system defective 29. L.P. leakage	System is unrestricted Feed and return pipes, filter and tank for leaks
EXCESSIVE FUEL CONSUMPTION	Any of items 9, 13, 14, 16, 17, 19, 26.	
STALLING	Any of the following items; 4, 5, 6, 9, 11, 13, 17, 19, 20, 21.	
SLOW ENGINE DIE DOWN	Any of the following items; 17, 20, 22	
ENGINE WILL NOT SHUT OFF	Either of the following two items: 2 and 17. Plus: 30. Stop solenoid valve leaking	Engine stops when supply lead removed. Replace solenoid if faulty
EXCESSIVE KNOCKING (DETONATION)	Items 8, 9, 13 or any of the following: 31. Injectors sticking 32. Lack coolant in radiator 33. Lack of oil in engine	Injectors individually — see 'Injector overhaul' Cooling system and expansion tank level. Radiator fins not blocked Oil level on dipstick

OVERHAUL FUEL LIFT PUMP

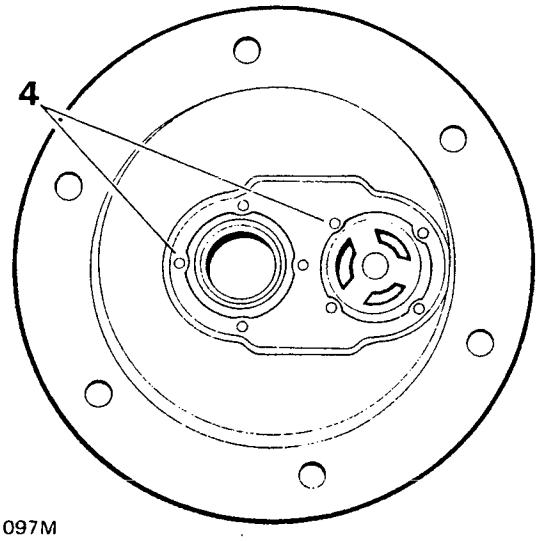
DISMANTLE

1. Remove the sediment bowl, where fitted, and collect the filter gauze and sealing washer.
2. Mark the upper and lower halves of pump casing to ensure correct alignment on reassembly.
3. Remove top cover fixing screws, and while pressing diaphragm tab against pump body, lift top cover clear.



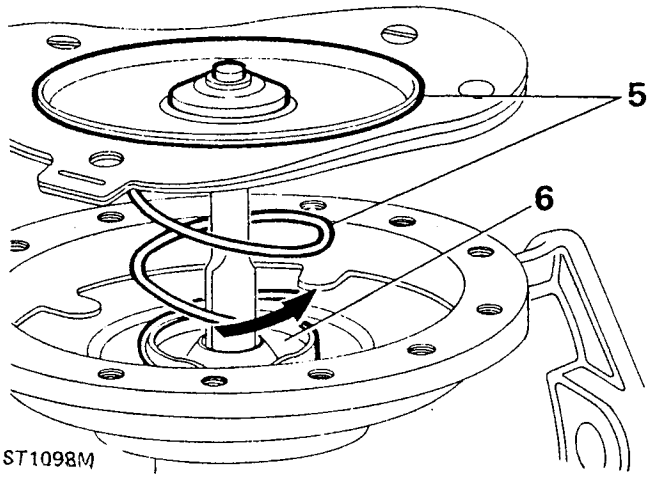
ST1096M

4. If necessary remove the valves by cutting away the retaining stakes with a scraper. Warm the top cover, note the position of the valves and withdraw them from the cover.



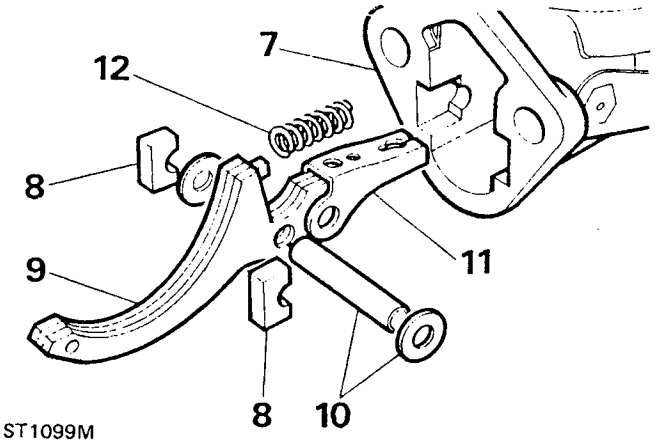
ST1097M

5. Turn, whilst pressing down the metal part of the diaphragm through 90° in either direction and withdraw the diaphragm and spring.
6. Unstake the oil seal housing and lever-out the oil seal and retainer.



ST1098M

7. Using a small chisel, remove the staking from the rocker arm retainers.
8. Withdraw the retainers.
9. Withdraw the rocker arm.
10. Withdraw the rocker arm pin and washers.
11. Detach the operating link.
12. Withdraw the rocker arm spring.



ST1099M

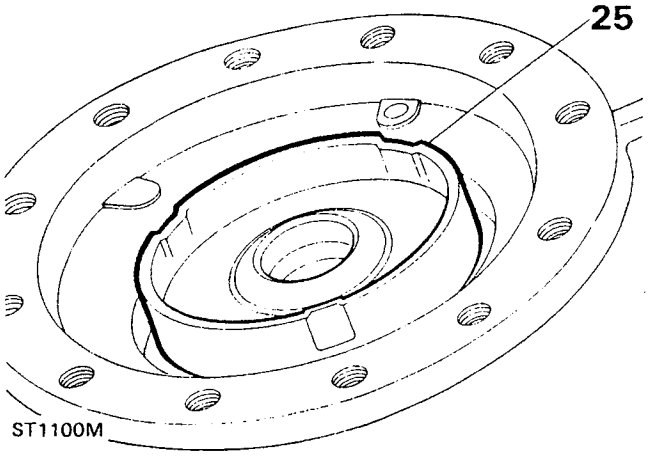
13. It is unlikely that the hand priming mechanism will ever require replacement, but it can be removed by filing the hexagon each side of the operating lever and springing the hand lever clear, withdraw the cork washers and hand rocker.

Inspect

14. Clean all parts in paraffin (Kerosene) and examine for wear and renew as necessary including all gaskets.
15. Sediment bowl filter disc must be free of damage and fit tightly around inlet neck of upper casing.
16. Renew diaphragm assembly if any sign of hardening, cracking or porosity is present.
17. Only very slight wear should be tolerated at the rocker arm contact face, pivot pin, operating link and diaphragm pull rod slots.
18. Springs should be renewed ensuring that the correct type are used.
19. Test valves for air tightness, by suction.
20. Check upper and lower casing flanges for distortion, using a straight edge.

Assemble

21. Fit the rocker arm spring.
22. Fit the operating link.
23. Fit the rocker arm pin and washers.
24. Fit the rocker arm assembly to the pump body and secure with the retainers and stake.
25. Fit the oil seal and retainer and secure by staking.



26. To refit the diaphragm assembly, hold the pump body with the diaphragm return spring in position, and the rocker arm held outwards. Position the diaphragm over the spring with the flattened end of the pull rod in line with the slot in the operating link. Push the diaphragm inwards and turn to lock.
27. Fit the inlet and outlet valves and secure by staking.
28. Place top cover assembly in position, aligning the marks made before dismantling. Fit securing screws, but do not tighten at this stage; using hand priming lever, fully depress diaphragm and fully tighten securing screws.
    The diaphragm o r edges should be approximately flush the outer edge of the pump joint faces when ed.
29. Fit the filter gauze and sealing ring on pumps with a sediment bowl and fit the bowl and secure with the retaining clip. Ensure that the bowl and seal are located squarely. Do not overtighten securing nut to prevent cracking the bowl.

Test fuel pump

30. Immerse pump in a bath of paraffin and operate rocker arm several times to flush.
31. Hold the pump clear of the bath and continue to operate the rocker arm until the pump is empty, then place a finger over the inlet port and operate rocker arm several times. A distinct suction should be heard when the finger is removed from the inlet port, denoting that a reasonable degree of suction has been developed.
32. Place a finger over the outlet port and again operate the rocker arm. Air pressure should be felt for two to three seconds after rocker movement has ceased. Build up the air pressure in the pump again, and with the finger held firmly over the outlet, submerge the pump completely in the paraffin bath, then observe the joint face edges for signs of air leakage.

OVERHAUL ELECTRICAL FUEL PUMP

NOTE: The electrical components of the pump are sealed and cannot be repaired.

DISMANTLE

1. Remove pump from the vehicle, and clean outside of pump before dismantling.
2. Release the end-cover from the bayonet fixing.
3. Remove the following items:
   a) filter and seal
   b) magnet
   c) gasket

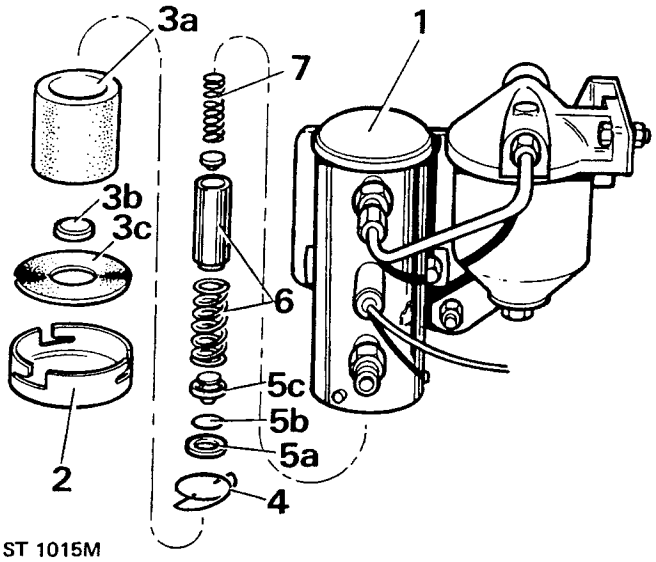
Pump piston assembly

4. Carefully prise out the retaining clip.
5. The following parts will then be released:
   a) plain washer
   b) rubber seal
   c) one-way valve
6. Withdraw the piston return spring with the piston. If the piston remains in the pump tube, hold the pump body vertically (in the fitted position) and tap the closed end until the piston is released from its magnetic hold and drops out.

NOTE: The piston is fitted with a one-way valve which should not be disturbed.

continued

7. Remove the short rebound spring.
8. Clean all components in paraffin.
9. Immerse pump body in petrol and use air-line inside pump tube.



ST 1015M

NOTE: The fuel filter assembly, instructions 2 and 3, can be carried out with the pump on the vehicle.

ASSEMBLE

Pump piston assembly

10. Fit the short rebound spring.
11. Fit the return spring over the opposite end of the piston.
12. Slide the piston assembly into the pump body.
13. Fit the following items:
    a) plain washer
    b) rubber seal
    c) one-way valve
14. Secure the assembly with the spring clip.

Fuel filter assembly

15. Fit the filter and seal.
16. Fit the magnet.
17. Fit the end cover with a new gasket.
18. Fit pump to vehicle and ensure that the earth connection lead and its mounting point is clean.

CARBURETTER FOUR CYLINDER ENGINE OVERHAUL

DESCRIPTION

The twin bored 32 - 34 DMTL Weber carburetter is a fixed choke instrument with a staggered throttle opening. The carburetter is divided, operationally, into two sections namely the primary and secondary carburetters with 32 mm and 34 mm bores respectively. The delayed throttle opening occurs in the secondary carburetter.

The primary carburetter, which incorporates fuel and air jets for idling, is used for starting, and normal running, up to approximately two thirds throttle opening. Shortly before this stage the secondary carburetter butterfly will begin to open and become increasingly more involved as the throttle is opened further. To ensure a smooth transition during the various stages of throttle opening both sections of the carburetter contain progression fuel and air jets and ports.

To prevent fuel vaporisation and air locks in the system fuel is continuously pumped back to the fuel tank from the carburetter float chamber. The top of the float chamber is so designed that fuel is drawn off from the main stream via the needle valve as dictated by the fuel level in the chamber.

DISMANTLE

1. Remove the carburetter.
2. Disconnect the fast idle cam assembly.
3. Disconnect the choke link.
4. Disconnect the pull-down lever and linkage.
5. Remove the top cover from the carburetter body.
6. Withdraw the float pivot and detach the float.
7. Remove the needle valve attached to the float tag.
8. Remove and discard the gasket from the top cover.
9. Withdraw the needle valve housing.
10. Remove the fuel filter plug and filter.
11. Remove the pull-down capsule.
12. Remove the fuel cut-off solenoid and valve.
13. Withdraw both 'primary' and 'secondary' idle jet holders noting their positions for ease of reassembly.
14. Withdraw both 'primary' and 'secondary' main jet assemblies, comprising main jet, emulsion tube and air correction jets.
15. Lift out the pump jet.
16. Remove the accelerator pump cover, diaphragm, gasket and spring.
17. Detach the economy pump assembly, comprising cover, spring and diaphragm.
18. Remove the idle mixture control screw. When the adjustment is tamper-proofed, the tamper-proofing cap must be removed to expose the screw.

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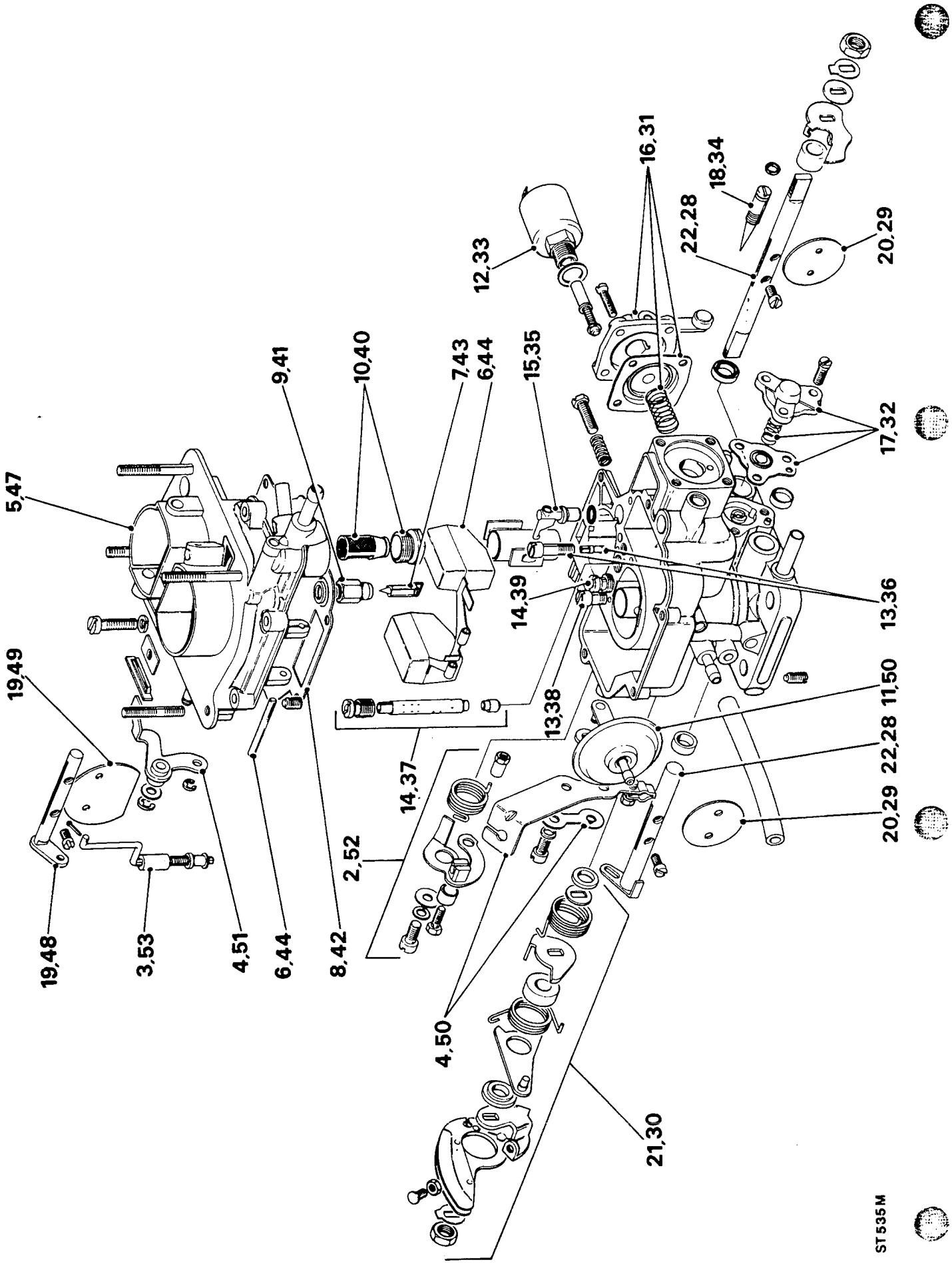
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19. Mark-up for reassembly purposes and remove the choke butterfly followed by the choke spindle and linkage.
20. Prior to removal, mark each throttle butterfly.
21. Remove the throttle linkage, springs and washers, noting their sequential positions to aid reassembly.
22. If required remove the primary and secondary throttle butterflies (after marking-up) followed by the respective spindles.

Inspection and cleaning

23. When cleaning fuel passages, DO NOT use metal tools which could cause dimensional changes in the drillings or jets. Cleaning should be effected using clean fuel, and, where necessary, a moisture free air blast.
24. If the joint faces on the emulsion block, top cover or carburetter body show any signs of distortion or the edges are burred, these faces may be reclaimed by flatting, using fine grade abrasive cloth and a surface plate. Examine the faces for deep scores which would lead to leakage taking place when assembled.
25. New gaskets and seals should be used throughout the carburetter rebuild. A complete set of gaskets is available for replacement purposes.
26. Examine the throttle spindle bushes for wear, if oval or badly worn, replace the carburetter body.
27. Examine the idle mixture volume screw for wear or damage, replace as required.

Reassembly

28. If previously dismantled, insert the primary and secondary throttle spindles into their respective positions.
29. Locate the primary and secondary throttle butterflies on to their respective spindles and loosely retain with the special screws. Operate each butterfly to centralise it on each spindle and secure the screws and lock them by peening.
30. Refit the throttle spindle assembly to the carburetter ensuring the pin on the free lever locates in the slot on the primary shaft plate, ensuring that the first spring is located on the spacer, whilst the second spring is engaged on the free lever.
31. Fit the accelerator pump assembly comprising spring, gasket, diaphragm, spring and pump cover.
32. Refit the economy pump assembly comprising diaphragm, spring and pump cover.
33. Replace the fuel cut-off valve and solenoid.
34. Fit the idle mixture control screw and carefully turn until fully home, then turn the screw 1½ to 2 turns in the reverse direction to serve as an initial setting.
35. Fit the pump jet with a new 'O' ring into the carburetter body.
36. Reassemble the primary jet to the jet holder and fit to the carburetter body.
37. Fit the secondary main and air correction jets to the secondary emulsion tube, locate and secure assembly to the carburetter body.
38. Assemble the secondary jet to the jet holder and fit assembly to the carburetter body.
39. Reassemble the primary main and air correction jets to the emulsion tube; and fit assembly to the carburetter body.
40. Fit the fuel filter and filter plug to the top cover.
41. Fit the needle valve seating and washer.
42. Place a new gasket into position.
43. Fit the needle valve into the needle valve seating.
44. Position the float tag in the needle valve wire loop. Align the float carrier with the pin holes and float carrier flange lugs. Secure the float carrier with the hinge pin.
45. With the needle valve on its seating and the float carrier tag resting against the needle valve (ensuring that neither the valve plunger nor the valve ball are depressed) measure the distance between the casing and the front edge of the float.
46. The dimension required is 7 mm (0.27 in). Any adjustment must be made by bending the float carrier tag. Adjustments must NOT be made by bending the float carrier arms.

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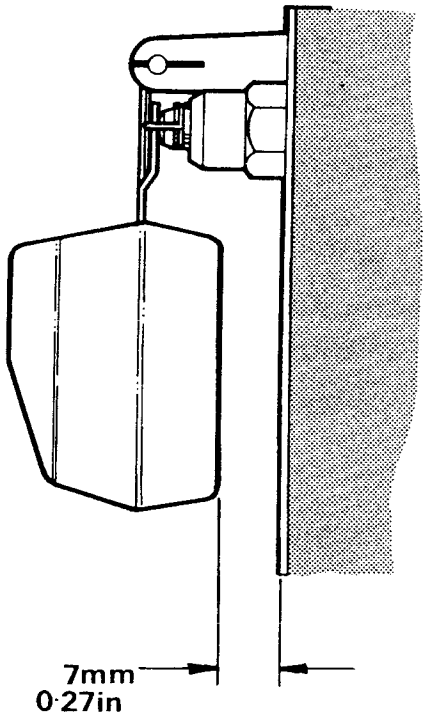
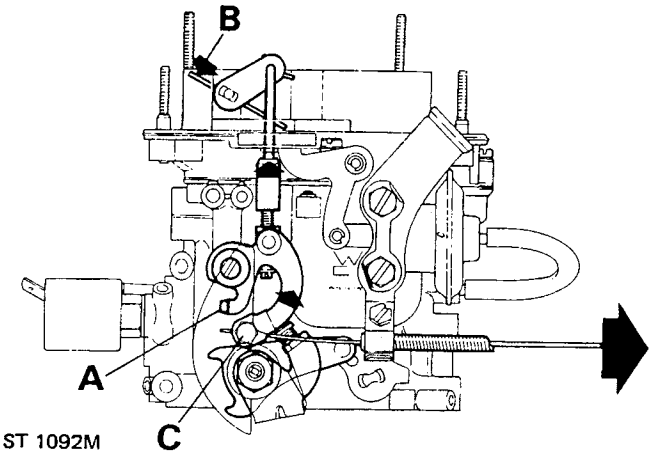


ST567M

47. Fit and secure the top cover assembly evenly, to the carburetter body.
48. Fit the choke spindle into its housing.
49. Locate the choke butterfly on the spindle and loosely retain with the two special screws. Operate the butterfly to centralise it on the spindle, then secure the screws and lock them by preening.
50. Refit the pull-down capsule, cable retaining bracket, spacer and fixings.
51. Fit the pull-down lever engaging the pivot with the pull-down capsule arm. Secure lever assembly with washer and circlip.
52. Fit the float idle cam ensuring the spring is engaged correctly to the cam.
53. Refit the choke link to the choke spindle, securing with a new split pin. Engage the opposite end of the choke link to the idle cam.



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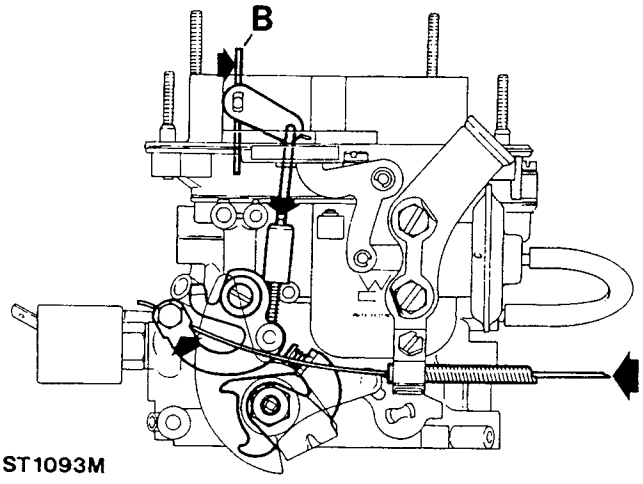
7. Push the mixture control fully in and confirm that flap 'B' is open, that is in the vertical position.



ST1093M

FOUR CYLINDER ENGINE CARBURETTER

TUNE AND ADJUST

1. Before attempting any carburetter adjustments ensure that cylinder compressions, valve clearances, spark plug gaps and ignition timing are satisfactory.
   Check also that there is no air leakage into the inlet system through the inlet manifold and carburetter gaskets and brake servo hose connections.

Throttle cable

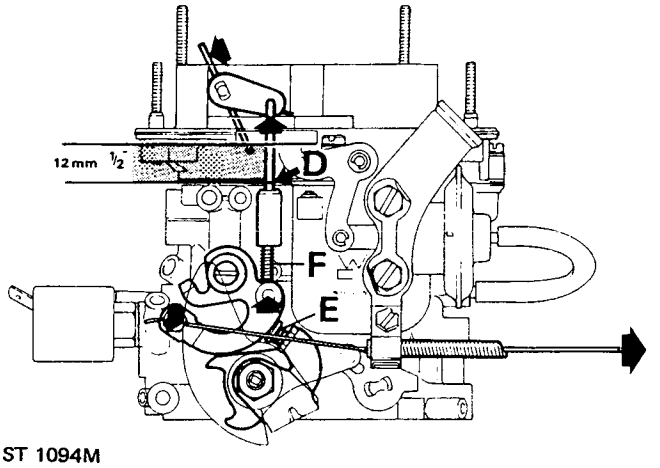
2. Check that the throttle pedal, cable and linkage operate smoothly.
3. Remove the elbow from the top of the carburetter.
4. If necessary adjust the pedal stop bolt so that no strain is exerted on the throttle cable. Depress the throttle pedal and check that both the butterflies are fully open, then adjust the pedal stop bolt so that it touches the floor, without strain on the cable and tighten the locknut.
5. Ensure that when the throttle pedal is released both butterflies are closed completely.

Mixture control (cold start)

6. Pull the mixture control cable fully out and check that lever 'A' is against its stop and the choke flap 'B' is fully closed. If necessary adjust the inner cable clamp 'C' to achieve this condition.

Fast idle adjustment

8. Pull the mixture control out until the dimension between the crank in the vertical rod 'D' and the underside of the carburetter top cover, without compressing the spring 'F' is 12,5 mm (0.5 in). Adjust the fast idle screw 'E' so that it just makes contact with the fast idle cam.

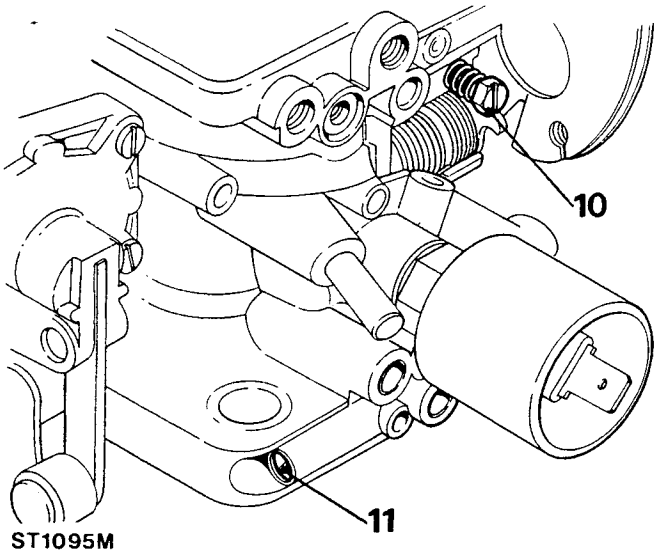


ST 1094M

Idle adjustment

NOTE: The idle mixture adjustment screw provides mixture variation at idle speed only. Above idle speed the mixture is determined by fixed size jets.

9. Start the engine and run until the normal operating temperature is attained.
10. Turn the throttle butterfly adjustment screw to obtain an idle speed of 600 to 700 r.p.m.
11. Turn the idle mixture adjustment screw clockwise or anti-clockwise by one-quarter turn increments to obtain the highest engine r.p.m. When this has been achieved, re-adjust, if necessary, the butterfly adjustment screw to maintain the 600 to 700 r.p.m. idle speed.
12. Fit the air intake elbow to the carburetter top.



ST1095M

V8 ENGINE ZENITH — CARBURETTER OVERHAUL

DISMANTLE

Remove the piston assembly

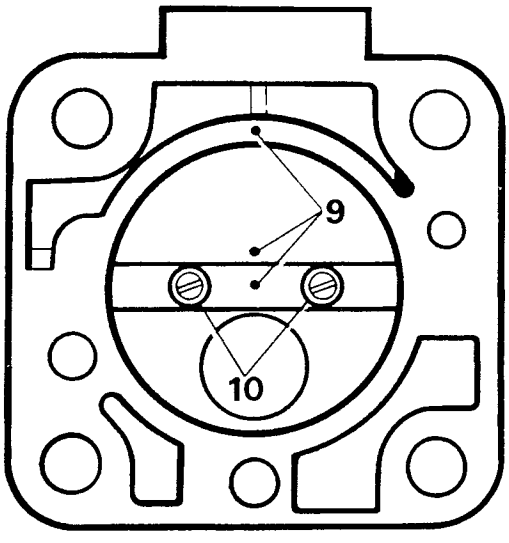
1. Remove the carburetters from the engine.
2. Release the four screws and withdraw the top cover and spring.
3. Withdraw the air valve, shaft and diaphragm assembly.
4. Remove the metering needle retained by a locking screw.
5. Release the four screws and separate the diaphragm from the air valve.

Remove the float chamber

6. Release the six screws and remove the float chamber and joint washer.
7. Release the float assembly and spindle from the two clips.
8. Unscrew the needle valve and washer from carburetter body.

Dismantle carburetter body

9. Make location marks, as illustrated, to assist correct assembly, on the throttle butterfly, spindle and carburetter body.
10. **Right-hand carburetter** Release the two screws and remove the butterfly and withdraw the spindle.



ST1119M

11. **Left-hand carburetter** Remove the left-hand lever assembly. Release the two screws, remove the butterfly and withdraw the spindle.
12. **Left-hand carburetter** Release the two retaining screws and shake-proof washers and remove the cold start assembly and joint washers.

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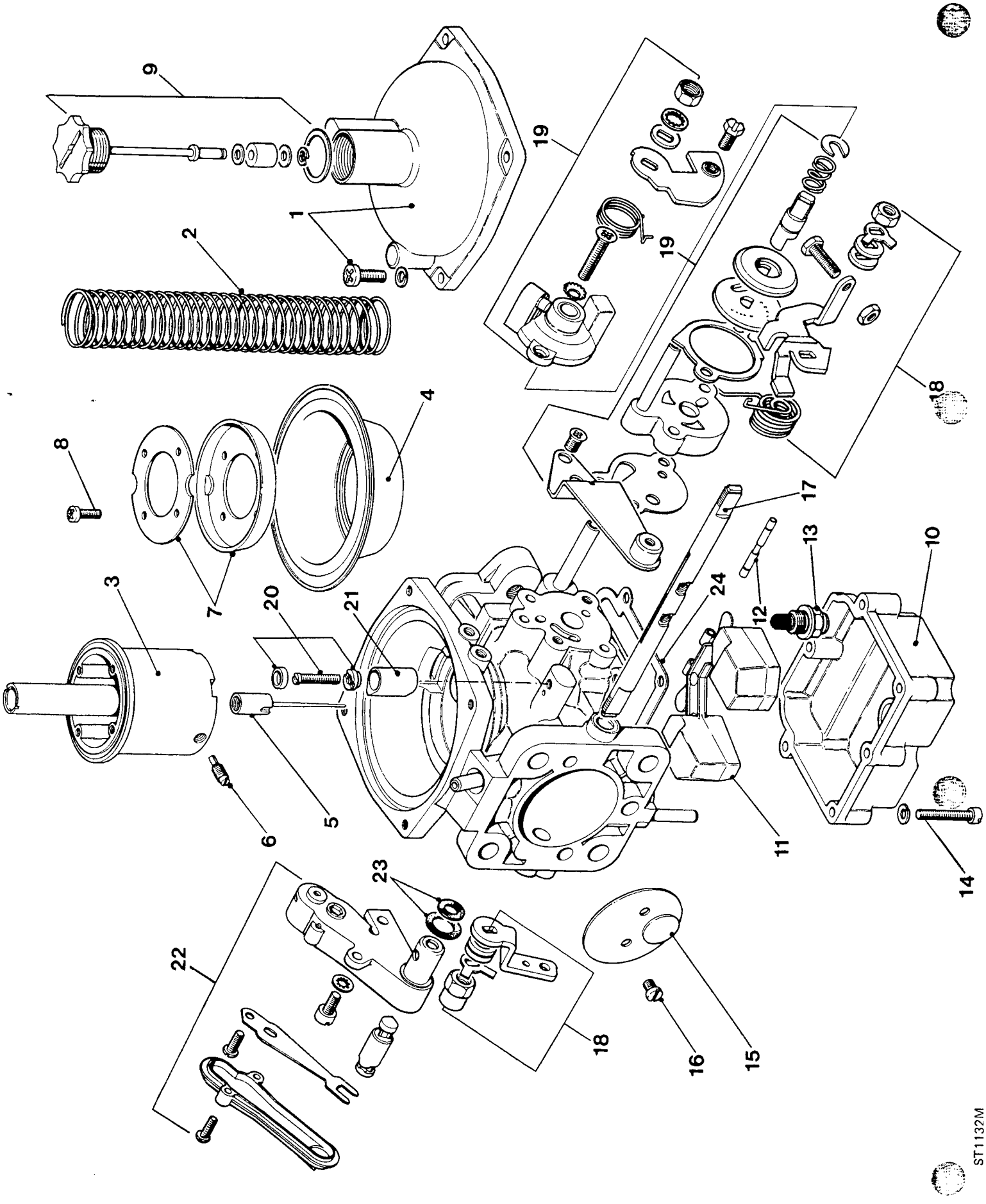
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KEY TO L.H. CARBURETTER

1. Top cover and retaining screws
2. Air valve return spring
3. Air valve
4. Diaphragm
5. Metering needle
6. Metering needle retaining screw
7. Diaphragm retaining ring and plate
8. Screw (4 off) retaining diaphragm to air valve
9. Damper assembly
10. Float chamber
11. Float assembly
12. Float assembly spindle
13. Needle valve
14. Float chamber retaining screws (6 off)
15. Butterfly
16. Butterfly retaining screws (2 off)
17. Butterfly (throttle) spindle
18. Throttle spindle lever assembly
19. Cold start assembly (left-hand carburetter only)
20. Slow running screw assembly
21. Tamper-proof sleeve
22. Temperature compensator assembly
23. Temperature compensator rubber seals (large and small)
24. Float chamber joint washer

13. Dismantle the cold start assembly but DO NOT remove the discs from the spindle.
14. If necessary, dismantle the throttle spindle lever assemblies from both carburetters.

Slow-running adjustment screws

Do not attempt to remove these screws or break the tamper-proof seals. See Cautionary note under 'Tune and Adjust'.

Remove temperature compensator

15. Release the two screws and withdraw the temperature compensator unit complete.
16. Remove the large and small rubber washers.

CLEANING AND INSPECTION

Cleaning

17. When cleaning fuel passages do not use metal tools (files, scrapers, drills etc.) which could cause dimensional changes in the drillings or jets. Cleaning of all components should be effected using clean fuel and, where necessary, a moisture-free air blast.

Joint washers and seals

18. New gaskets and seals should be used throughout carburetter rebuild. A complete set of gaskets is available for replacement purposes.
    Inspect metering needle; it is machined to very close limits and should be handled with care. Examine for wear, bend and twist; renew if necessary.
19. Examine the faces for deep scores which would lead to leakage taking place when assembled.

Diaphragm

20. Examine the diaphragm for deterioration, damage and punctures. Do not use any cleaning chemicals on the diaphragm only clean lint free rag.

Float assembly

21. Examine the two plastic floats and check for punctures and damage.
22. Check the spindle and retaining clips for wear.
23. Inspect the needle valve assembly for wear. Renew the valve if there is any tendency for the needle to stick.

Cold start assembly

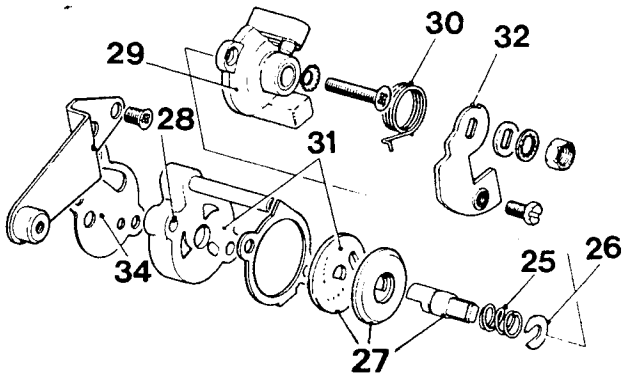
24. Examine all the cold start components for wear and corrosion and the machined faces for scores.

continued

ASSEMBLE CARBURETTERS

Cold start — L.H. carburetter

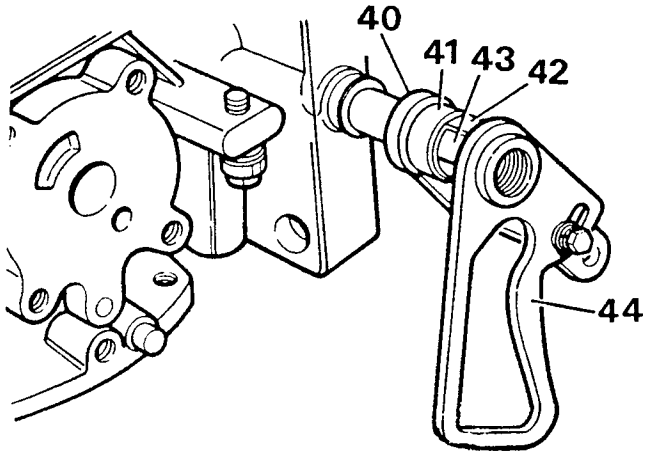
25. Place the spring on the cold start spindle.
26. Fit the spring retaining clip.
27. Check that the discs slide easily on the spindle.
28. Place the cold start spindle on the starter face.
29. Place the starter cover in position.
30. Fit the return spring over the spindle.
31. Rotate the spindle until the oval port in the end disc is aligned with the oval port in the starter face.
32. Fit the cold start lever.
33. Engage the return spring over the lug on the starter cover and the back of the cold start lever.
34. Place the cold start gasket onto the carburetter body.
35. Fit the cold start assembly to the carburetter body, and check for ease of operation.



ST1116M

Throttle spindle, L.H. carburetter

36. Place the return spring over either end of the spindle.
37. Fit the throttle stop and fast idle lever and secure with spacers, tab washer and nut.
38. Insert the throttle spindle from the cold start side of the carburetter body and fit the throttle return spring on the fast idle adjustment lug. Tension the spring half a turn.
    NOTE: Slacken the idle adjustment screw clear of lever to facilitate centralisation of the butterfly.
39. Fit the throttle butterfly, maintaining the previously marked alignment. Leave the retaining screws loose. Actuate the throttle several times to centralize the butterfly, then tighten the retaining screws and lock by peening ends.
40. Fit the throttle lever to the spindle at the opposite end.
41. Place the spacer on the spindle.
42. Place the tab washer on the spindle.
43. Fit the sleeve nut, sleeve end last, and engage the tab washer.
44. Fit the throttle adjusting lever.



ST1120M

Throttle spindle, R.H. carburetter

45. Place return spring over threaded end of the spindle.
46. Fit the throttle stop and fast idle lever.
47. Fit the bushed washer, bush outwards.
48. Fit the throttle lever on the bushed washer.
49. Fit the plain washer.
50. Fit the tab washer.
51. Fit the throttle adjustment lever.
52. Secure the assembly with the nut and lock with a tab.
53. Fit the throttle butterfly as described in instruction 39 and anchor the return spring as illustrated. See note before instruction 39.

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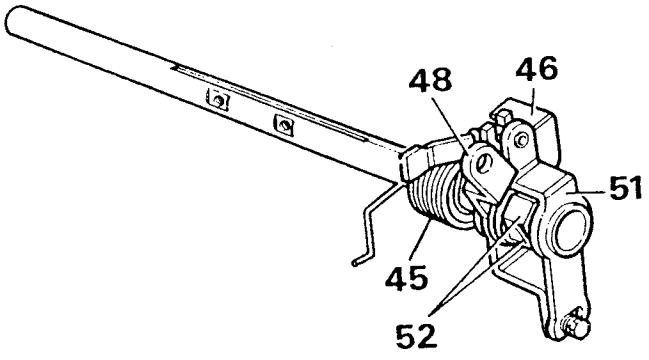

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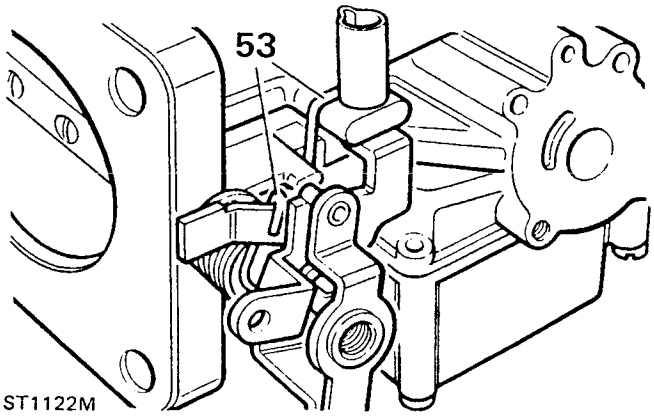
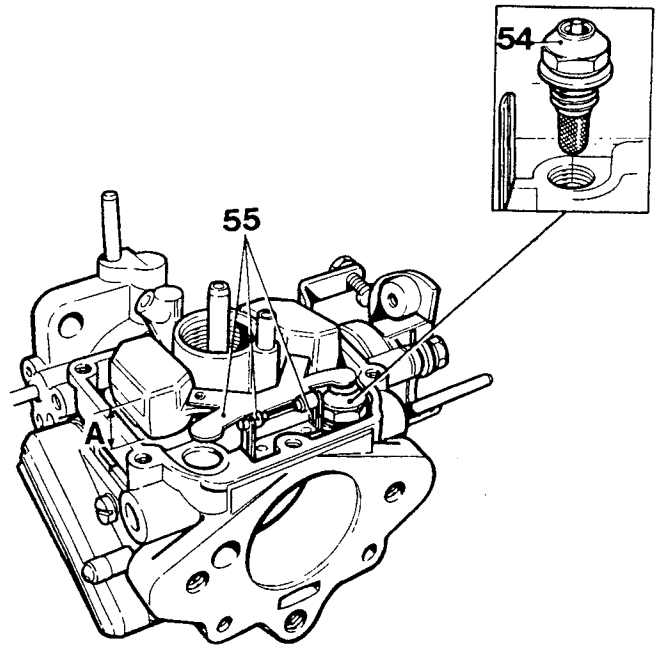


ST1122M

Float chamber assembly

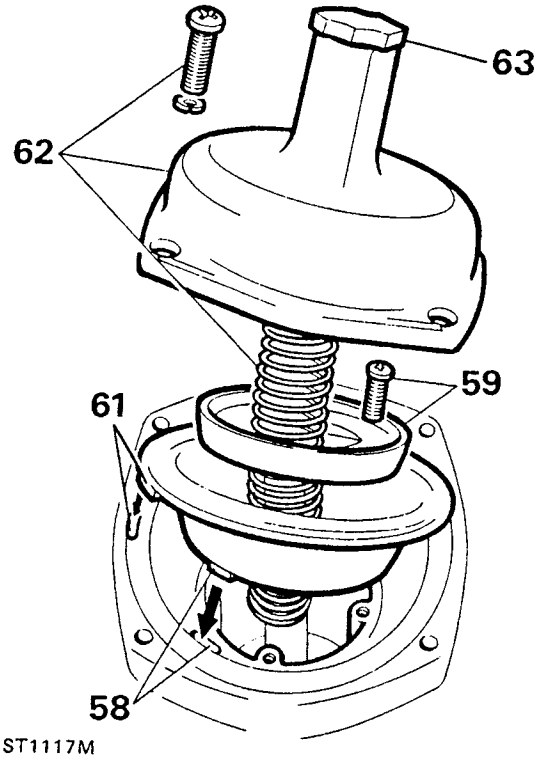
54. Fit the needle valve and new washer.
55. Locate the spindle in the float arm and fit the assembly into the retaining clips.
56. Invert the carburetter so that the needle is on its seating and the float tab is contacting the needle. Measure the dimension A between the carburetter gasket face and the highest point on the floats. The correct measurement should be 17 to 18 mm (0.67 to 0.71 in). Adjust by bending the float tab. This dimension must be the same for both floats. The float carrier tab must be maintained at right angles to the needle in the closed position.
57. Fit the float chamber and new gasket and evenly tighten the retaining screws.



ST1123M

Air valve and diaphragm

58. Fit the diaphragm to the air valve with the inner tag locating in the air valve recess.
59. Fit the diaphragm retaining ring and secure with the four screws.
60. Fit the metering needle into the air valve and secure with the locking screw.
61. Insert the air valve and needle into the carburetter and locate the diaphragm outer tag into the recess in the carburetter body.
62. Fit the spring and top cover and secure with the four screws.
63. Fit the damper.



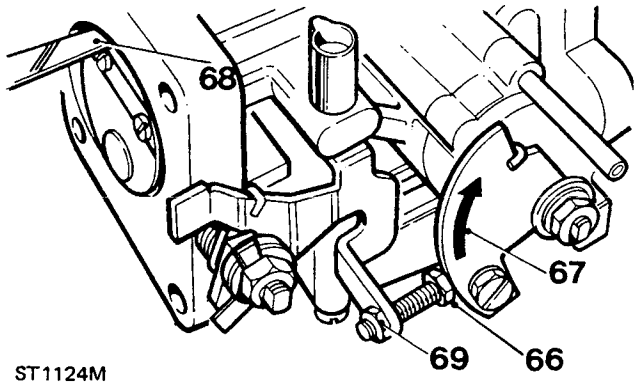
ST1117M

Temperature compensator

64. Clean the carburetter and compensator mating faces.
65. Fit a new inner and outer rubber washer and secure the temperature compensator with the two screws and shake-proof washers.

Fast idle adjustment — L.H. carburetter only

66. Slacken the fast idle adjusting screw.
67. Hold the cold start cam lever in the maximum position.
68. Adjust the fast idle adjusting screw against the cam lever until there is 0,61 to 0,66 mm (0.024 to 0.026 in) gap between the top edge of the throttle butterfly and the carburetter barrel wall. Use feeler gauges or a 0,65 mm diameter (No. 72) drill to measure the gap.
69. Secure the locknut on the fast idle adjusting screw without disturbing the adjustment.



ST1124M

V8 ENGINE ZENITH CARBURETTERS

TUNE AND ADJUST

Tamper-proofing

These carburetters may be externally identified by a tamper-proof sealing tube fitted around the slow running adjustment screw.
The purpose of these carburetters is to more stringently control the air fuel mixture entering the engine combustion chambers and, in consequence, the exhaust gas emissions leaving the engine.
For this reason the only readily accessible external adjustment is to the throttle settings for idle and fast idle speed and, for the former setting will require the use of a special tool to prevent breaking the tamper-proof seals.

CAUTION: Unauthorised breaking of tamper-proofing devices, adjustment of carburetter settings or the fitting of incorrectly related parts may render the vehicle user liable to legal penalties according to local territory legislation.
Whenever adjustments are made to the settings of tamper-proof or emission specification carburetters an approved type CO meter must be used to ensure that the final exhaust gas analysis meets with local territory requirements.

Emission Specifications

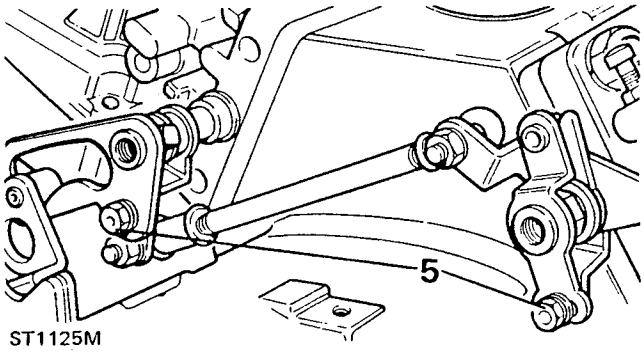
All carburetters fitted to the Land-Rover conform at the time of manufacture to particular territory requirements in respect of exhaust and evaporative emissions control. However, in some cases changes to the basic carburetters may have been necessary to achieve this.

Service tools:
605330 — Carburetter balancer
MS80 — Mixture adjusting tool
MS86 or B25243 — Tamper-proofed throttle adjustment tool

The service tool 605330 carburetter balancer must be used to adjust the carburetters. Primarily, this instrument is for balancing the air-flow through the carburetters, but it also gives a good indication of the mixture setting. Investigation has shown that incorrect mixture setting causes either stalling of the engine or a considerable drop in engine rev/min if the balancer is fitted when the mixture is too rich or a considerable increase in rev/min when used with the mixture setting too weak. Before balancing the carburetters it is most important therefore that the following procedure be carried out:

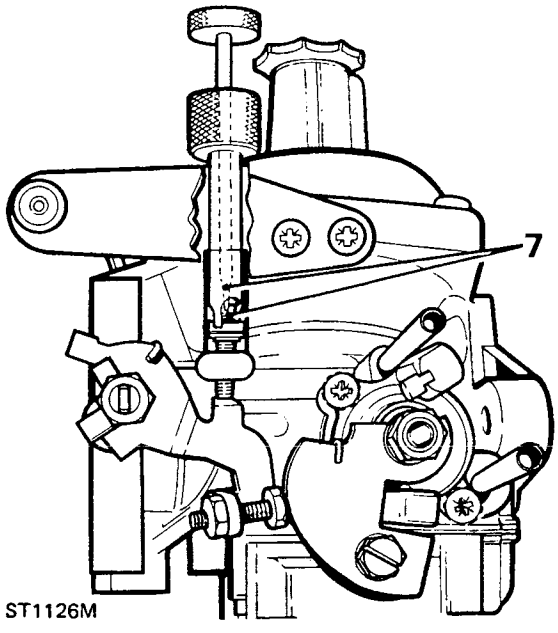
Slow running (idle) adjustment

1. Check that the throttle control between the pedal and the carburetters is free and has no tendency to stick.
2. Check the throttle cable setting with the throttle pedal in the released position. The throttle linkage must not have commenced movement, but commences with the minimum depression of the pedal.
3. Run the engine until it attains normal operating temperature; that is, thermostat open.
4. Remove the air cleaner elbows.
5. Slacken the screws securing the throttle adjusting levers on both carburetters to allow independent adjustment.



ST1125M

6. Start the engine and check the idle speed using a reliable proprietary tachometer.
7. If necessary, adjust the slow running screw to give the correct idle speed, see 'Engine tuning data'. If a tamper-proof sleeve is fitted over this screw the slow running speed can only be adjusted using special tool MS86 or B25243.

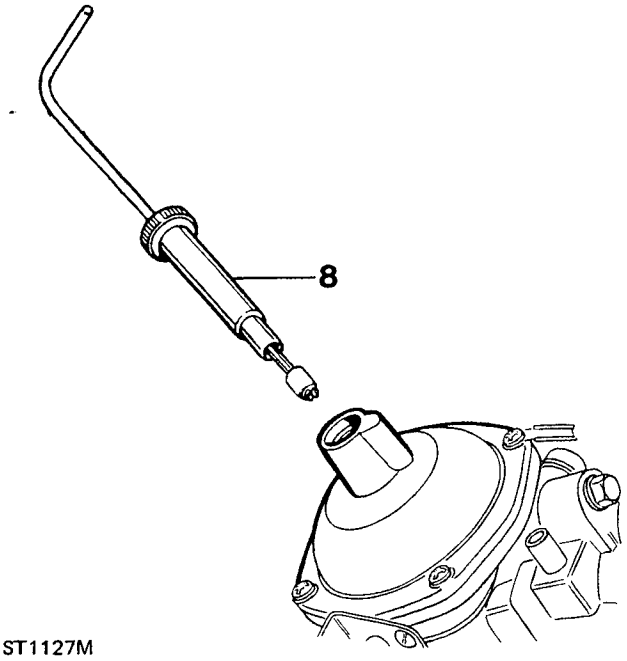


ST1126M

continued

Mixture setting and balance carburetters

8. Remove the piston damper plug, and using special tool MS80 adjust the mixture. Locate the outer sleeve of the tool to engage a machined slot to prevent the air valve twisting. Turn the inner tool clockwise to enrich the mixture and anti-clockwise to weaken it. After every adjustment the tool should be removed from the carburetter to allow engine to stabilise. Run engine at 2000 rev/min to aid stabilisation.
9. When the mixture is correctly adjusted, the engine speed will remain constant or may fall slowly a small amount as the air valve is lifted.



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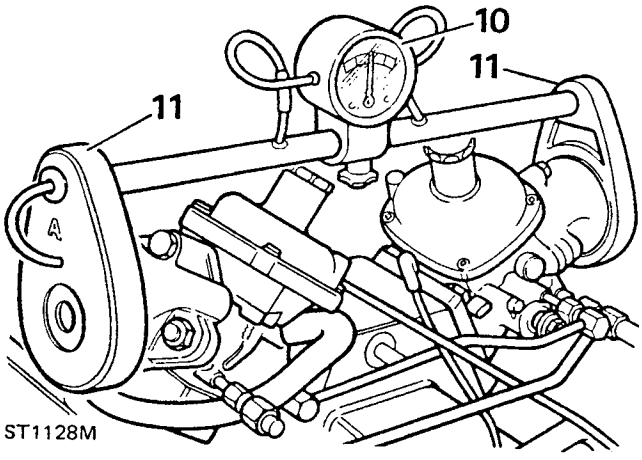
10. Check, and if necessary, zero the gauge on balancing tool 605330.
11. Place balancer on the carburetter adaptors, ensuring that there are no air leaks. If the engine stalls or decreases considerably in speed, the mixture is too rich. If the engine speed increases, the mixture is too weak.
12. If necessary, remove balancer and re-adjust the mixture, then refit the tool.
13. Check balancer gauge reading.
14. If the gauge pointer is in the 'zero' sector, no adjustment is required.
15. If the gauge pointer moves to the right, decrease the air-flow through the left-hand carburetter by unscrewing the slow running screw or increase the air-flow through the right-hand carburetter by turning clockwise the slow running screw. Reverse the procedure if the pointer moves to the left.
16. If the engine idle speed (slow running) rises too high or drops too low during balancing adjust to the correct idle speed, whilst maintaining the gauge pointer in the zero sector.
17. Remove balancer. With the mixture setting and carburetter balance correctly adjusted the difference in engine rev/min with the tool 605330 on or off will be negligible, approximately plus or minus 25 rev/min.

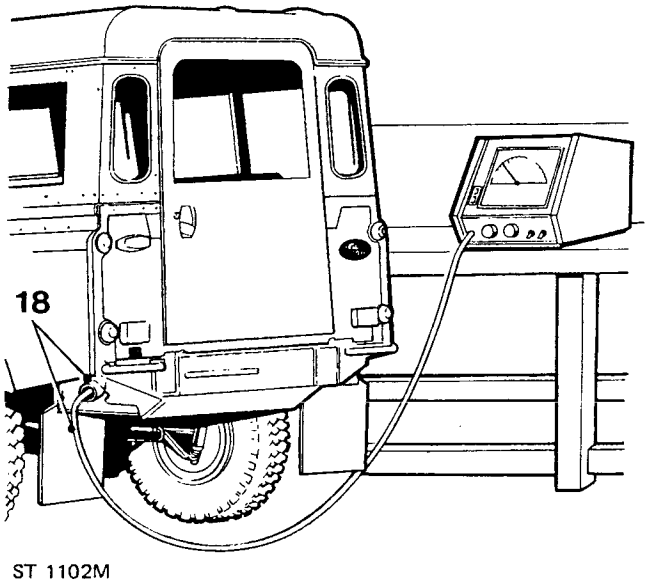


ST1128M

Check CO level

Use a proprietary non-dispersive infra-red exhaust gas analyser.

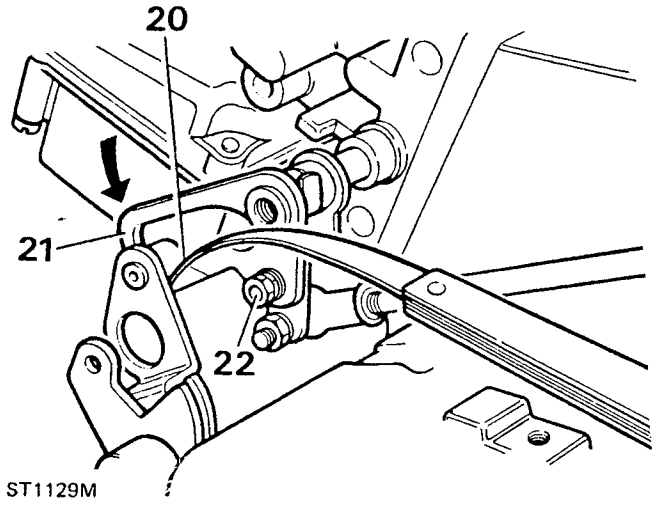
18. Insert the probe of the analyser as far as possible into the exhaust tail pipe, start the engine and allow a one to one and a half minute stabilisation period.
19. Check that the correct idle speed (slow running) is maintained and observe the CO reading against that given in the data section. If necessary re-adjust the mixture setting to achieve the correct CO level.



ST 1102M

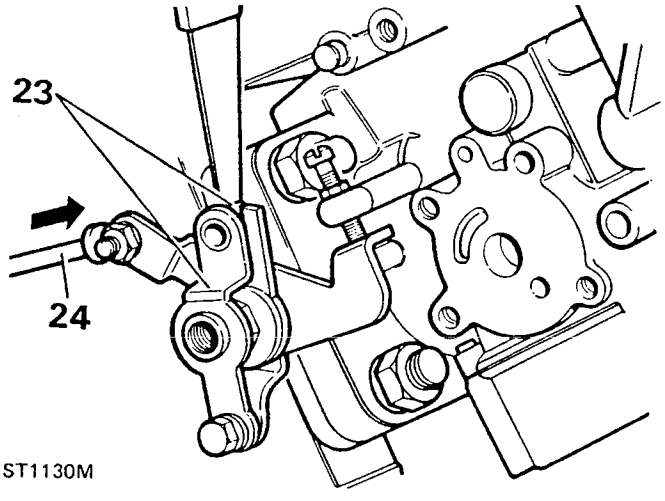
Adjust throttle linkage

20. On the left-hand carburetter, place a 0,15 mm (0.006 in) feeler between the underside of the roller on the countershaft lever and the throttle lever.
21. Apply pressure to the throttle lever to hold the feeler.
22. Tighten the screw to secure the throttle adjusting lever, then withdraw the feeler.



ST1129M

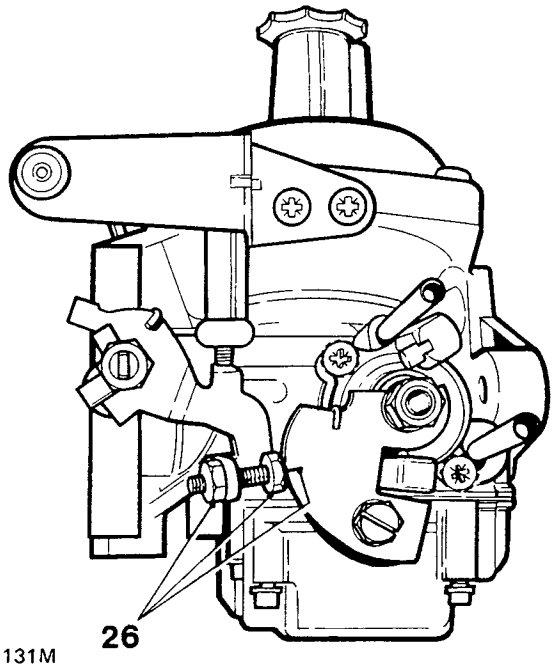
23. On the right hand carburetter, place a 0,15 mm (0.006 in) feeler between the left leg of the fork on the adjusting lever and the pin on the throttle lever.
24. Apply light pressure to the linkage to hold the feeler.
25. Tighten the screw to secure the throttle adjusting lever, then withdraw the feeler.



ST1130M

Fast idle adjustment

26. The fast idle adjustment is pre-set on the left-hand carburetter and should not normally require adjustment. If adjustment is required, the correct procedure is to remove the left-hand carburetter and carry out instructions 66 - 69 under carburetter overhaul. Alternatively the fast idle can be approximately set by pulling the choke cable until the mark on the cam is in-line with the head of the adjusting screw. Slacken the locknut and adjust the screw against the cam until the correct idle speed is achieved see 'Engine tuning data'. Tighten the locknut.



ST1131M

27. Fit the air cleaner elbows.
28. Remove the piston damper plug on both carburetters and replenish the damper reservoir with S.A.E.20 oil to within 12 mm (0.5 in) from the top of the tube and refit damper plug.

CARBURETTER OVERHAUL — S.U. HIF 44 — Right hand

DISMANTLE

1. Remove the carburetters from the engine and clean the exteriors with a suitable solvent.
2. Remove the two nuts and spring washers and withdraw the air intake adaptor and joint washer.
3. Unscrew and remove the piston damper assembly and drain the oil.
4. Remove the three screws and lift-off the suction chamber complete with piston and spring.
5. Remove the spring clip from the top of the piston rod and withdraw the piston and spring.
6. Unscrew the fuel metering needle guide locking screw. If the needle cannot be removed from the piston with the fingers, hold the needle as close to the piston as possible, in a soft jawed vice and with a sharp pull withdraw the needle, guide and spring assembly.
7. Remove the four screws and withdraw the float chamber cover plate and sealing ring.
8. Remove the jet adjusting lever retaining screw and spring.
9. Withdraw the jet complete with the bi-metal lever and seperate the lever from the jet.
10. Unscrew and remove the float pivot spindle and plain washer, and remove the float.
11. Lift-out the needle valve.
12. Unscrew and remove the needle valve and filter.
13. Unscrew and remove the jet bearing nut.
14. Invert the carburetter body to allow the jet bearing to fall out. If the bearing sticks, carefully tap it out from the bridge side.
15. Remove the piston guide peg.
16. Remove the suction chamber-to-body sealing ring.
17. Unscrew and remove the mixture adjusting screw and seal. Use thin nosed pliers to finally withdraw the screw.
18. Bend-back the cam lever nut lock tabs and remove the nut and lock washer.
19. Remove the cam lever and spring.
20. Remove the end seal cover and seal.
21. Remove the two screws and withdraw the cold start valve body and seal together with the valve spindle. Also collect the paper joint washer.
22. Note the position of the throttle levers and return spring.
23. Bend-back the lock washer tabs and remove the throttle lever nut.
24. Remove the lock washer, bush washer and throttle actuating lever.
25. Release the throttle return spring and remove the throttle adjusting leaver from the throttle butterfly spindle and remove the return spring.
26. Hold the butterfly closed and mark the relationship of the butterfly to the carburetter flange.
27. Remove the butterfly two retaining screws and withdraw the butterfly from the spindle.
28. Withdraw the throttle butterfly spindle from the carburetter body together with the two seals.
29. Clean all components with petrol or de-natured alcohol ready for inspection. Do not use abrasives for the removal of stains or deposits.

INSPECTION

30. Examine the throttle spindle and bearings for excessive axial clearance.
31. Check the float needle and seating for wear and the float for punctures and renew if necessary.
32. Check the condition of all rubber seals, 'O' rings and joint washers and renew if necessary. The float cover plate seal must be renewed.
33. Examine the carburetter body for cracks and damage.
34. Ensure that the inside of the suction chamber is clean and fit the piston into the chamber without the spring. Hold the assembly horizontally and spin the piston. The piston should spin freely in the suction chamber without any tendency to stick.
35. Inspect the metering needle for wear, scores and distortion. Check also that it has the correct designation number — see Engine Tuning Data, Section 05.
36. Examine the bi-metal jet lever for cracks.
37. Check all springs for cracks and distortion.

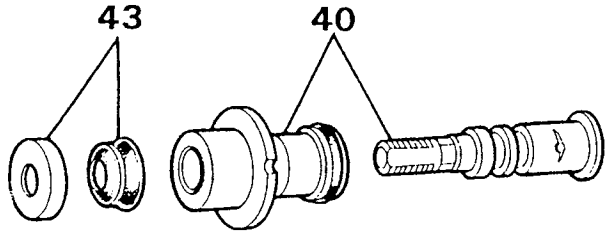
ASSEMBLE

Fit throttle butterfly

38. Fit the throttle spindle to the carburetter body and insert the throttle disc into the spindle in its original position. Secure the disc with new screws and ensure that before tightening the throttle disc is correctly positioned and closes properly. Splay the split ends of the screws to prevent turning.
39. Fit new seals to both ends of the throttle spindle ensuring that they are fitted the correct way round.

Fit cold start assembly

40. Fit a new 'O' ring to the valve body and assemble the valve spindle to the valve body.

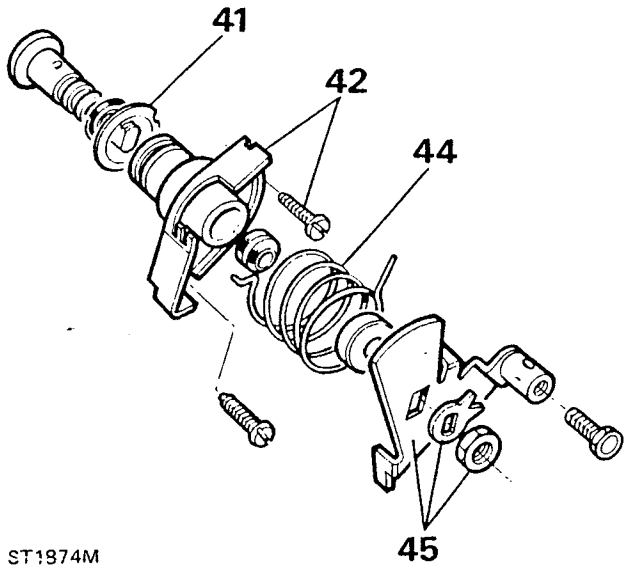


ST1873M

41. Fit a new paper joint washer to the valve noting that the half-moon cut-out in the washer is clearance for the top retaining screw.

continued

42. Fit the starter assembly to the carburetter body and secure with the two screws.
43. Fit the end seal and cover.
44. Fit the return spring.
45. Fit the cam lever and tension the spring. Fit a new lock washer and secure with the nut and bend the tabs over a convenient flat.
46. Adjust the coils of the spring, if necessary, to prevent coil binding.



ST1874M

KEY TO S.U. CARBURETTER COMPONENTS

1. Piston damper.
2. Spring clip.
3. Suction chamber.
4. Piston.
5. Piston spring.
6. Suction chamber retaining screws — 3 off.
7. Needle retaining screw.
8. Needle bias spring.
9. Needle guide.
10. Needle.
11. Suction chamber sealing ring.
12. Throttle adjusting screw and seal.
13. Piston key and retaining screw.
14. Mixture adjusting screw and seal.
15. Carburetter body.
16. Throttle butterfly and retaining screws.
17. Throttle spindle.
18. Throttle spindle seals — 2 off.
19. Float chamber.
20. Float chamber cover and retaining screws.
21. Float chamber cover seal.
22. Jet assembly.
23. Jet bearing.
24. Jet bearing nut.
25. Bi-metal jet lever.
26. Jet retaining and adjusting screw and spring.
27. Float needle.
28. Float needle seat.
29. Float needle seat filter.
30. Float
31. Float pivot spindle.
32. Cold start and cam lever assembly.
33. Throttle adjusting lever and lost motion assembly.
34. Throttle actuating lever.
35. Bush washer.
36. Throttle lever assembly retaining nut and lock washer.

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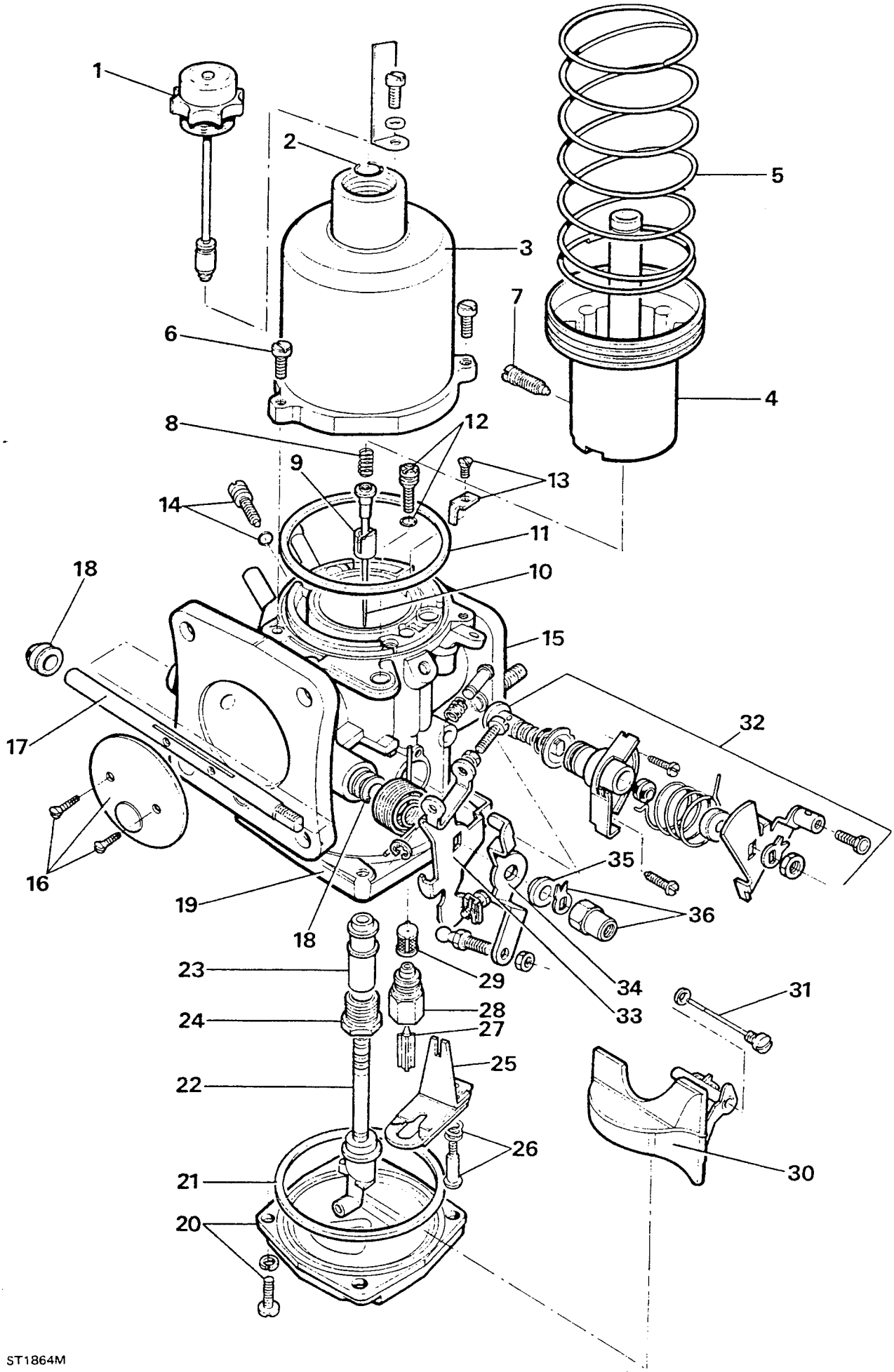
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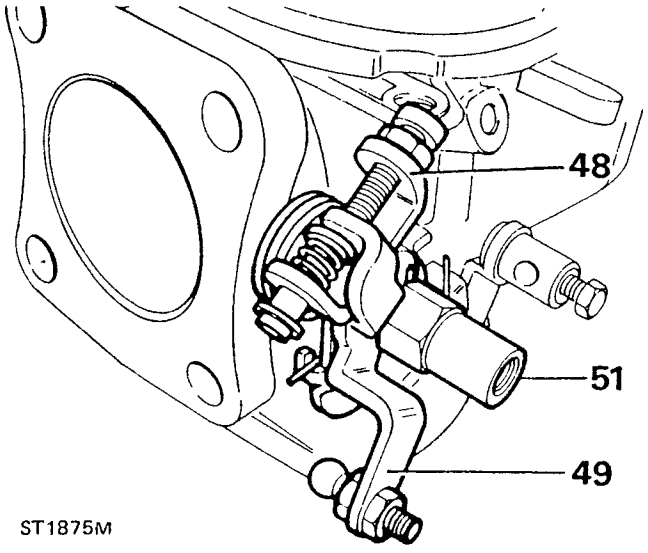
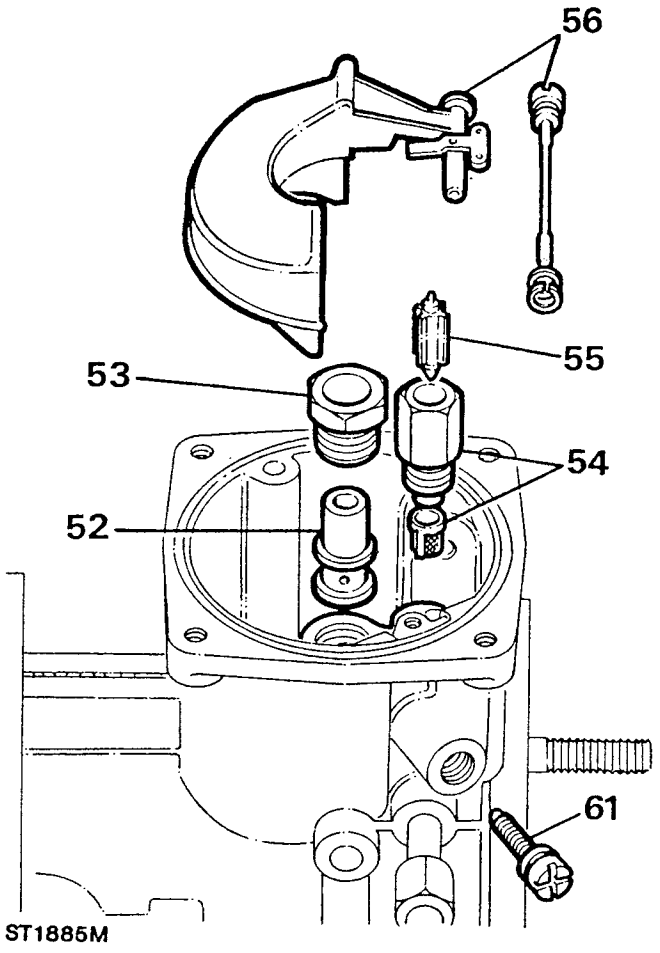
ST1864M

Fit throttle lever assembly

47. Fit the return spring so that the longest leg rests against the throttle adjusting screw housing.
48. Fit the throttle adjusting lever and lost motion assembly and tension the return spring.
49. Fit the throttle actuating lever.
50. Fit the bush washer and lock washer.
51. Fit and tighten the special nut and bend the lock tabs over a convenient flat.



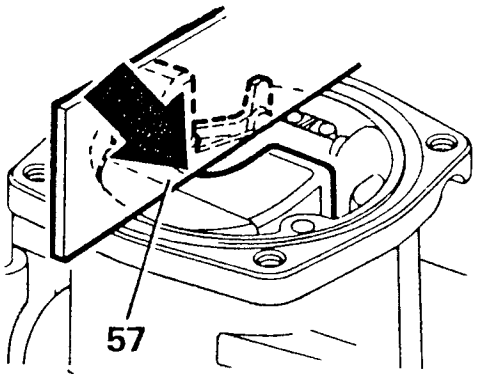
ST1875M

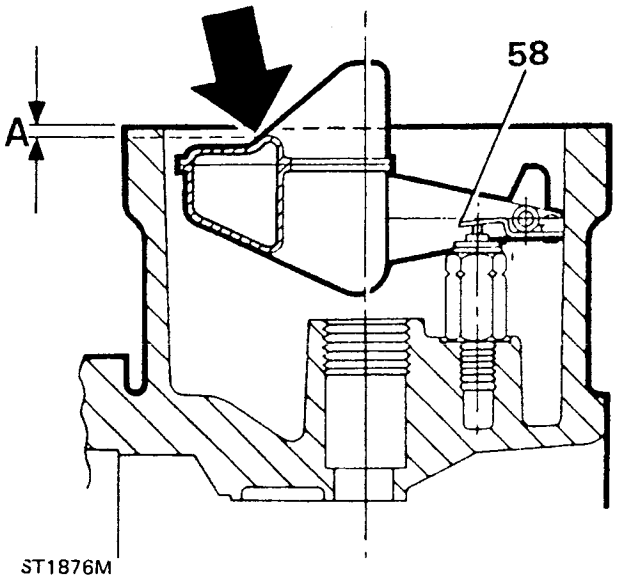


ST1885M

Fit jet and float assembly

52. Fit the jet bearing, long end towards the float.
53. Fit the jet bearing nut.
54. Clean or renew the filter and fit the float needle seat.
55. Fit the needle valve, spring loaded pin uppermost.
56. Fit the float and secure with the pivot pin.
57. Hold the carburetter in the inverted position so that the needle valve is closed by the weight of the float only. Check using a straight edge that the point on the float, arrowed on the illustration, is 1.0 to 1.5 mm (0.04 to 0.062 in) below the level of the float chamber face, dimension 'A'.
58. Adjust the float position by carefully bending the brass pad until the correct dimension is achieved. After adjustment, check that the float pivots freely about the spindle.

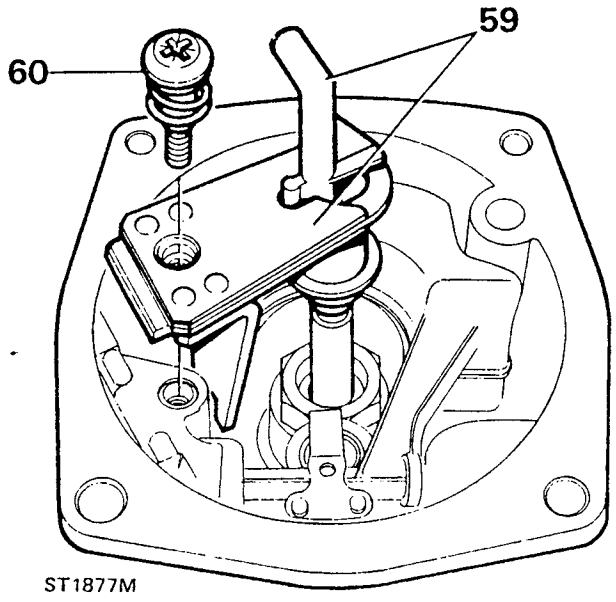




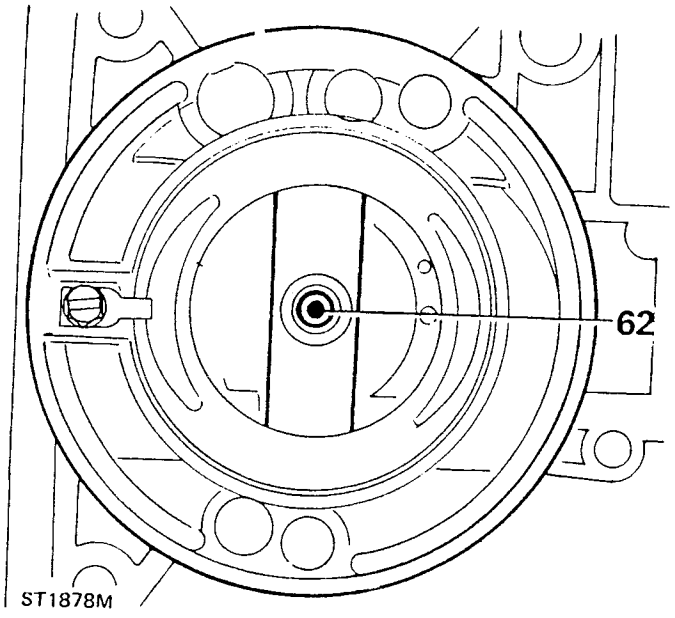
ST1876M

continued

59. Assemble the jet to the bi-metal jet lever and ensure that the jet head moves freely in the cut-out.
60. Fit the jet and bi-metal jet lever to the carburetter and secure with the spring loaded jet retaining screw.
61. Fit the mixture adjusting screw.



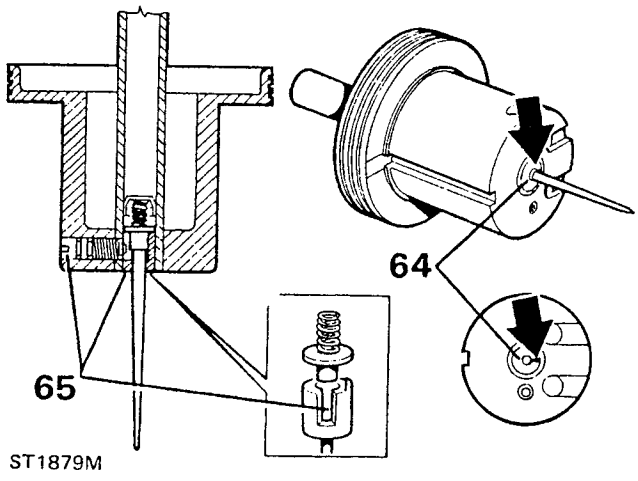
62. Adjust the mixture screw until the jet is flush with the carburetter bridge, then turn the screw a further three and one half turns clockwise.



63. Using a new sealing ring. fit the float chamber cover, noting that it can only be fitted one way. Secure with the four screws and spring washers and evenly tighten.

Fit piston and suction chamber

64. Fit the needle, spring and guide assembly to the piston ensuring that the etched arrow head on the needle locating guide is aligned between the piston transfer holes, as illustrated.
65. Secure and ensure that when the screw is tightened the guide is flush with the piston and that the screw locates in the guide slot.



66. Fit the piston key to the carburetter body using a new screw. Tighten the screw and splay the end.
67. Fit a new suction chamber sealing ring to the groove in the carburetter body.
68. To prevent the piston spring being 'wound-up' during assembly, temporarily fit the piston and suction chamber less the spring to the body, and pencil mark the relationship of the chamber to the body. Remove the suction chamber and fit the spring to the piston. Hold the suction chamber above the spring and piston, align the pencil marks and lower the chamber over the spring and piston, taking care not to rotate the suction chamber. Secure the chamber to the body with the three screws, tightening evenly and check that the piston moves freely.
69. Hold the piston at the top of its stroke and fit the spring clip.
70. Fit the piston damper.
71. Using a new joint washer, fit the air intake adaptor and secure with the two nuts and spring washers.
72. Fit the carburetters to the inlet manifold ensuring that the joint washers, deflector and insulator are fitted in the sequence illustrated. The insulator must be fitted with the arrow head uppermost and pointing inwards towards the manifold. Secure with the four nuts and spring washers and tighten evenly to the correct torque.
    A. Joint washer.
    B. Deflector-teeth pointing inwards.
    C. Joint washer.
    D. Insulator.
    E. Joint washer.

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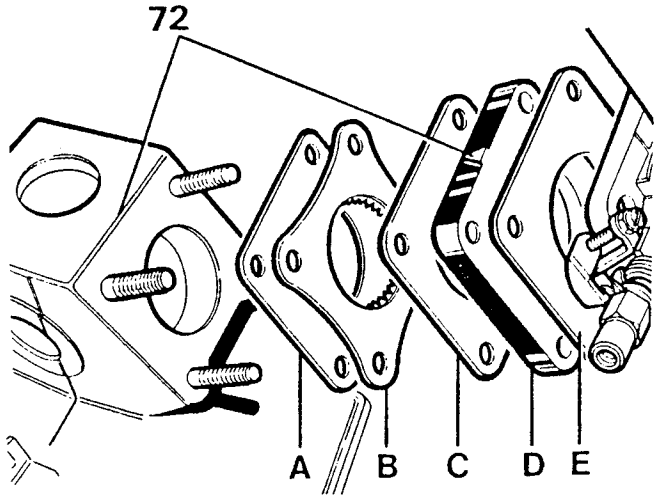
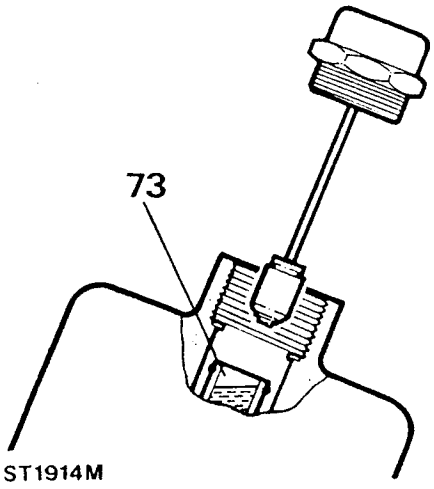


ST1880M

73. Connect the linkages and top-up the carburetter dampers with a recommended oil to the top of the hollow piston rod.
74. Tune and adjust the carburetters.



ST1914M

TUNE AND ADJUST — SU HIF 44 CARBURETTERS

Special tools:

Carburetter balancer 605330 or B89
Non-dispersive infra-red exhaust gas analyser.

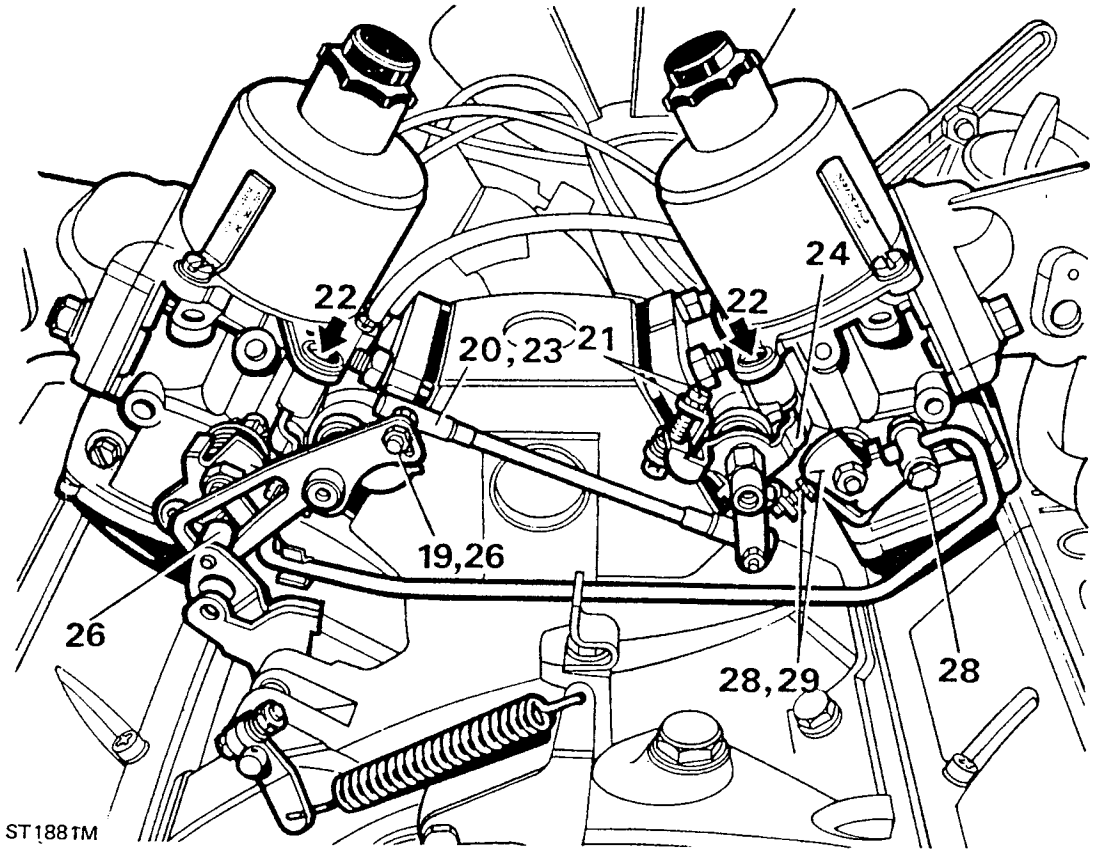
General Requirements Prior to Tuning Carburetters.

Accurate engine speed is essential during carburetter tuning, therefore the distributor pick up air gap and ignition timing must be checked together with the vacuum advance system.
Whenever possible the ambient air temperature of the tuning environment should be between 15° to 26°C (60° to 80°F). When checking engine speed, use an independent and accurate tachometer.
Idling adjustments should be carried out on a fully warmed up engine, that is, at least 5 minutes after the thermostat has opened. This should be followed by a run of one minute duration at an engine speed of approximately 2,500 rev/min before further adjustments or checks are carried out. This cycle may be repeated as often as required. It is important that the above cycle is adhered to, otherwise overheating may result and settings may be incorrect. The piston dampers must always be kept topped-up with the correct grade of oil.
Before any attempt is made to check settings a thorough check should be carried out to ensure that the throttle linkage between the pedal and carburetters is free and has no tendency to stick. Ensure that the choke control lever is pushed fully down.
NOTE: References to left and right hand are as from the drivers seat.

TAMPER — PROOFING

To comply with E.C.E. regulations the idle speed and mixture adjusting screws must be tamper — proofed following any adjustments. A red blanking plug; **Part number — JZX 1258** must be fitted into the mixture screw resess and a red cap; **Part number JZX 1197** fitted over the idle adjustment screw (throttle adjustment screw).

continued



TUNE AND ADJUST

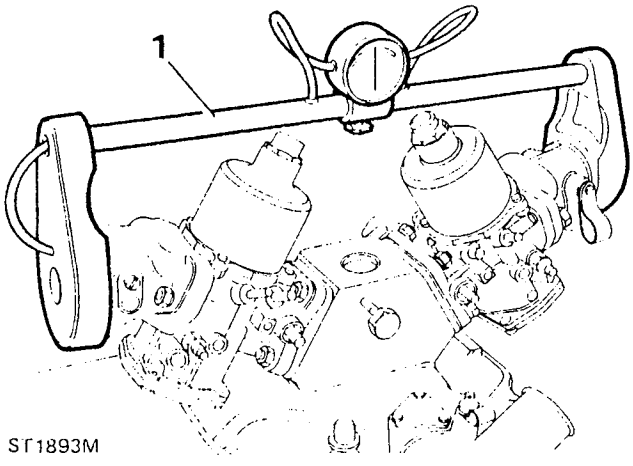
The following instructions apply to both carburetters unless otherwise stated.

Before commencing the following instructions, remove the air cleaner, air intake elbows, mixture adjustment screw plug and mixture screw cap.

CARBURETTER BALANCE

Using **balancer 605330**

1. Disconnect the interconnecting link between the two carburetters. Fit the balancer to the carburetter intakes and ensure that there are no air leaks, if necessary, zero the gauge with the adjustment screw.
2. Start the engine, and if necessary allow it to reach normal operating temperature. If the needle moves to the right, decrease the air flow through the left hand carburetter by unscrewing the idle screw. Alternatively, increase the air flow through the right hand carburetter by screwing down the idle screw. Reverse the procedure if the pointer moves to the left. Reconnect the carburetter inter-connecting link.

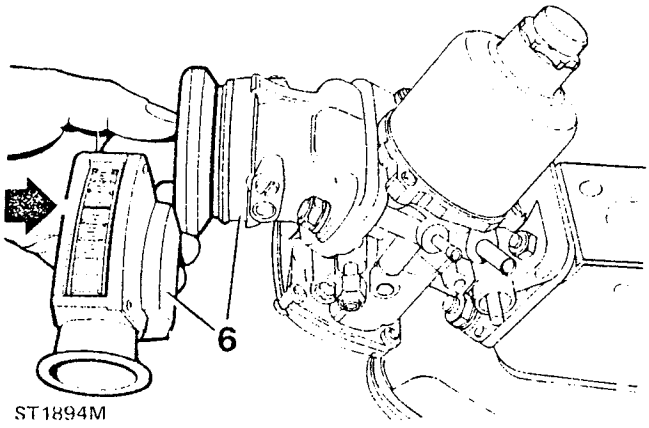


Using **balancer B89**

3. Disconnect the inter-connecting throttle link between the two carburetters.
4. Back-off the idle adjusting screw on each carburettter, clear of the throttle lever.
5. Turn each throttle adjusting screw so that it touches the throttle lever, then turn the screws by equal amounts to achieve an approximate idle speed of 700 to 800 rev/min.
6. Press the balancer firmly over the carburetter intake. Press or withdraw the control on the side of the balancer to adjust the meter needle reading to approximately half scale, and note the reading.

continued

7. Without altering the position of the balancer control, place the balancer on the second carburetter intake and adjust the idle screw as necessary to achieve the same reading.

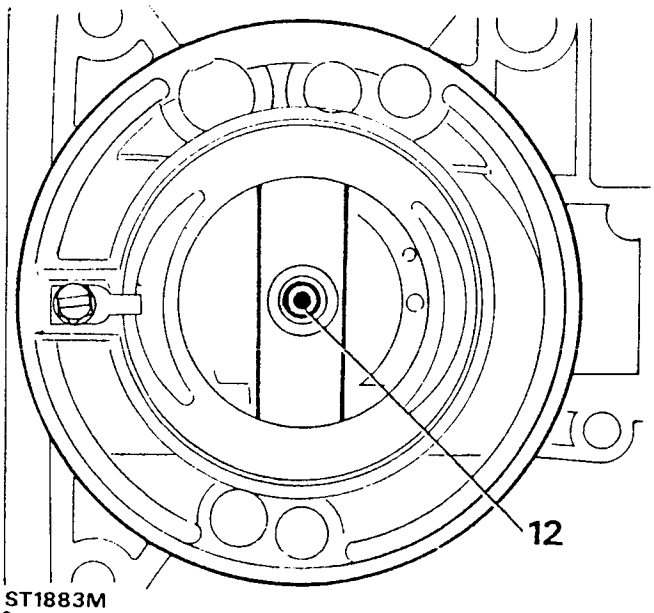


ST1894M

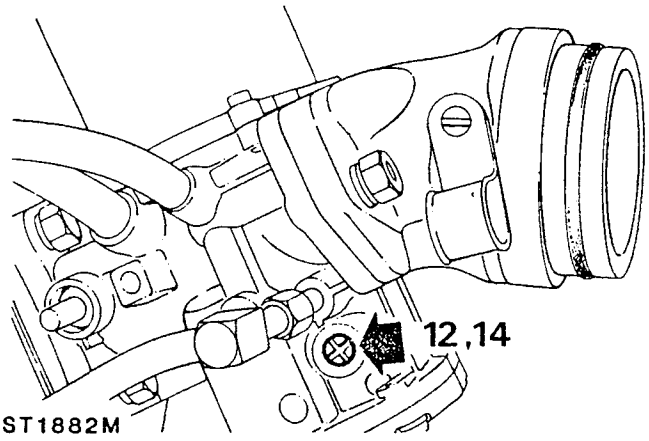
8. Alternatively, adjust and check the balance of both carburetters until an idle speed of 700 to 800 rev/min is obtained.
9. Reconnect the throttle inter-connecting link, and again check the idle speed and balance.

Mixture setting

10. Ensure that the engine is still at normal operating temperature.
11. Mark the relationship of the suction chamber to the carburetter body, remove the retaining screws and lift off the suction chamber complete with pistons.
12. To achieve a datum setting for the mixture screw, turn it anti-clockwise until the jet is level with the carburetter bridge. Check by placing a straight edge across the bridge and adjust as necessary so that the jet just touches the straight edge.
13. Refit the suction chamber and piston, evenly tighten the retaining screws. Check that the piston moves freely without sticking. Top-up the piston damper.

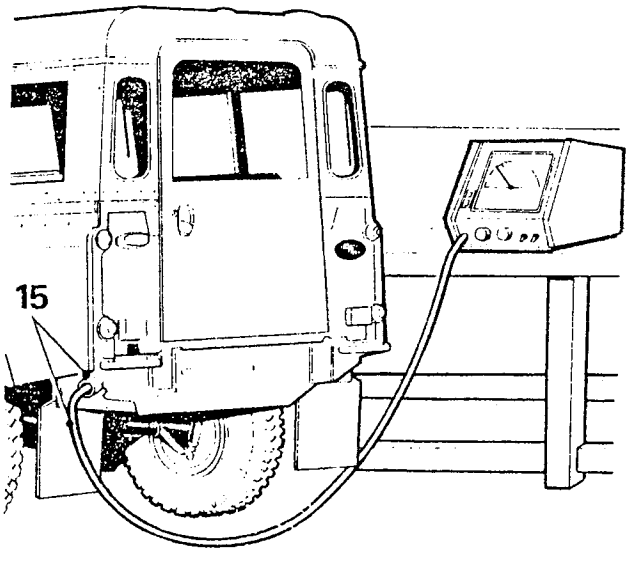


ST1883M



ST1882M

14. Turn the mixture adjustment screw three and one half turns clockwise.
15. Insert the probe of an infra-red exhaust gas analyser as far as possible up the exhaust pipe, start the engine and allow a one and one half minute stabilisation period.
16. Adjust the mixture screw on both carburetters by equal amounts, rich or weak to achieve a CO reading of 0.5 to 2.5%.
17. If after approximately two minutes the CO level is not satisfactory run the engine at 2000 rev/min for one minute to stabilise the equipment, continue the setting procedure until a stable CO reading of 0.5 to 2.5% at an idle speed of 700-800 rev/min is obtained.



ST1915M

Idle speed and linkage adjustment

18. Check that the engine is at normal operating temperature.
19. Slacken the nut, at the left hand carburetter securing the inter-connecting link ball to the throttle cam lever.

continued

20. Disconnect the inter-connecting link between the carburetters at the left hand carburetter.
21. At the right hand carburetter, release the lock nut and slacken off the lost motion adjustment screw, until it is well clear of the spring loaded pad.
22. If necessary adjust the idle screw to maintain the correct idle speed. Check the CO level and carburetter balance, adjust if required.
23. Re-connect the inter-connecting link to the left hand carburetter.
24. Hold the right hand throttle lever against the idle screw stop and adjust the lost motion screw until contact is made with the spring loaded pad, tighten the lock nut.
25. Check the idle speed and balance. Adjust the lost motion screw to restore balance if necessary.
26. Ensuring that the roller is firmly seated in the lower corner of the cam lever, tighten the nut which secures the inter-connecting link ball to the cam lever.

Fast idle adjustment

27. Pull out the cold start control (choke) until the scribed line on the left hand fast idle cam is in-line with the centre of the fast idle screw head.
28. Check that the scribed line on the right hand fast idle cam is similarly in-line with the fast idle screw head. If there is mis-alignment, slacken the fast idle cam link rod screw at the right hand carburetter and move the cam until the scribed line coincides with the centre of the screw head. Tighten the cam rod screw.
29. Turn the fast idle screw clockwise, on each carburetter, until just clear of the cam.
30. Turn the fast idle screw of the leading (left-hand) carburetter down (clockwise) until a slight change in engine speed is noted.
31. Similarly turn the fast idle screw of the second carburetter (right-hand) down until a further slight change of engine speed is noted.
32. Adjust the fast idle screws of both carburetters by equal amounts to achieve a fast idle speed of 1100 to 1150 rev/min.
33. Tighten the fast idle screw lock-nut on both carburetters. Push the cold start (choke) fully home then pull it out again to its full extent and re-check the fast idle speed.
34. Fit the appropriate blanking plug and cap to the mixture screw recess and idle adjusting screw.
35. Fit the carburetter air intake elbows and air cleaner.

V8 ENGINE CARBURETTER

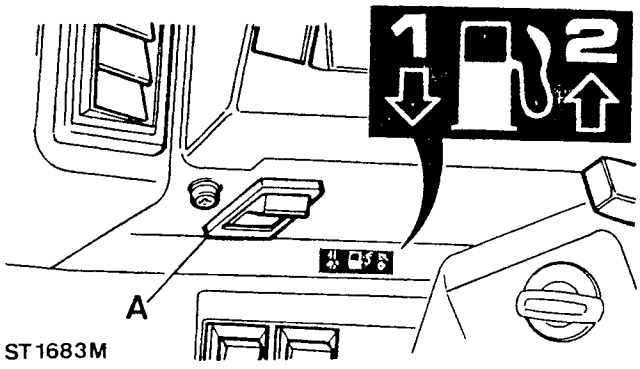
FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
DIFFICULT STARTING WHEN COLD	Insufficient choke action	Check action of cold start unit to ensure that the choke is being applied fully — adjust choke cable. Check position of cold start adjuster — move outward
	Fast idle adjustment incorrect	Check and adjust fast idle setting. Check linkage between choke and throttle for distortion
	Float chamber level too low	Check needle valve for sticking — (closed). Check float level setting. Check inlet connection filter for blockage. Check external fuel system in accordance with fuel system fault diagnosis
	Carburetter flooding	Check needle valve for sticking — (open) Float punctured Fuel pump pressure too high Float level too high
	No fuel supply to carburetter	Check filters and pump for blockage Check fuel tank breather and fuel lines for blockage Remove fuel pump and check operation Overhaul or fit new pump
DIFFICULT STARTING WHEN HOT	Choke sticking 'on'	Check to ensure choke is returning to fully 'off' position; reset as necessary
	Blocked air cleaner	Fit new air cleaner elements
	Float chamber level too high	Check float level setting. Check float arms for distortion. Check needle valve for sticking. Punctured float, fuel pump pressure too high
LACK OF ENGINE POWER	No oil in damper or oil too thin	Check level of oil in damper, and fill to correct level with oil of a viscosity of S.A.E.20
	Air valve sticking	Check air valve assembly moves freely and returns under spring load — centre jet assembly Check diaphragm for cracks or porosity — Zenith
	Water in fuel	If water is present in float chamber, the complete fuel system should be drained, fuel components should be dismantled, inspected for contamination, paying particular attention to filters.
ERRATIC SLOW-RUNNING OR STALLING ON DECELERATION	Float level too low	Check float chamber level Check for needle valve sticking
	Incorrect jet setting	Check and reset jet settings in accordance with carburetter overhaul instructions
	Carburetter air leaks	Check throttle spindle and bearings for wear
	Manifold air leaks	Check inlet manifold gasket for leakage. Check inlet manifold for cracks and distortion of mating faces. Check gasket between carburetter and manifold. Check condition of vacuum advance pipe and connections. Check vacuum servo pipes and connections
	Damper oil too thick. No oil in damper	Check and refill to correct level with oil specified
	Air valve sticking	Clean and check freedom
EXCESSIVE FUEL CONSUMPTION	Blocked air cleaner	Fit new air cleaner elements
	Damper oil too thick	Replace with correct grade
	Incorrectly adjusted carburetter	Check and reset slow running in accordance with carburetter tune and adjust instructions
	Float level too high	Check and reset float level
	Worn jets and needle	Check and replace as necessary
	Incorrect needle	Check needle type
	Choke sticking 'on'	Check to ensure choke is returning to fully 'off' position, reset as necessary
	Engine fault	See Engine Fault diagnosis

LAND ROVER 110 TWIN TANK INSTALLATION

Description

The fuel system includes two fuel tanks, one at the rear of the vehicle and an additional fifteen gallon (68,20 litres) capacity tank on the right-hand side of the vehicle. Both tanks contain an electrically operated submerged fuel pump in addition to a fuel level indicator unit in each tank. An ignition controlled switch on the control panel enables the driver to select the tank to be used. The switch also energises the fuel level indicator unit of the tank selected and records the fuel level on the single indicator dial. When the ignition is switched 'on' the pump in the selected tank will draw fuel into the carburetter float chamber via a paper element type filter and a vapour separator. To prevent fuel vapourisation and air locks a spill return system is incorporated in the fuel pipe layout to pass back vapour and excess fuel from the vapour separator to the tank in use through a restrictor and a solenoid operated valve. The valve, which is energised by the tank selection switch, closes the port to the tank not in use and simultaneously opens the port to the selected tank. The restrictor is necessary to prevent fuel by-passing the carburetter and flowing back to the selected tank through the spill return system.
In addition, a non-return valve is enclosed inside the hose connection of the supply pipe from the rear and side tanks to prevent the possibility of a back-flow of fuel along the supply lines to the fuel tanks.



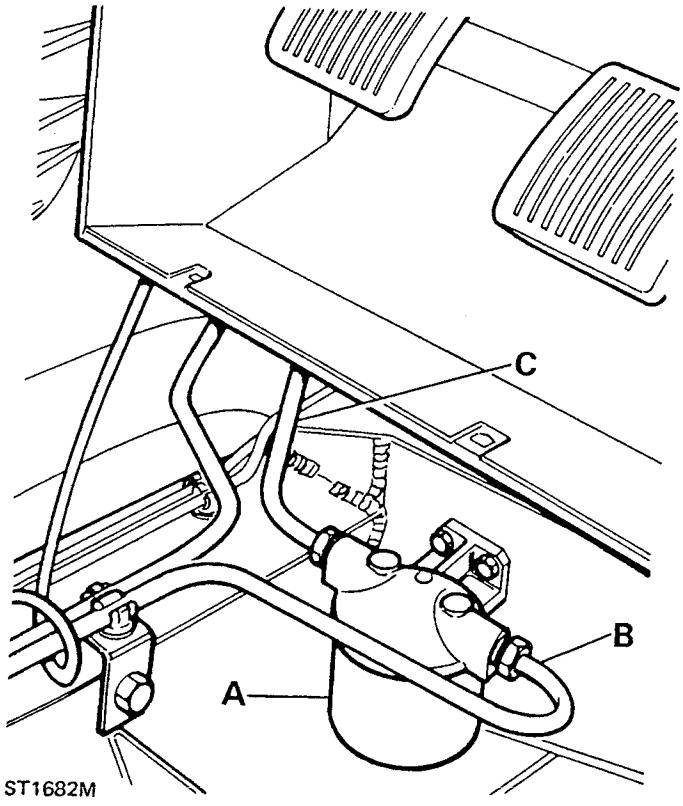
FUEL TANK SELECTION SWITCH

A. Fuel tank switch

LAND ROVER 110 REAR TANK AND 90 SIDE TANK INSTALLATION

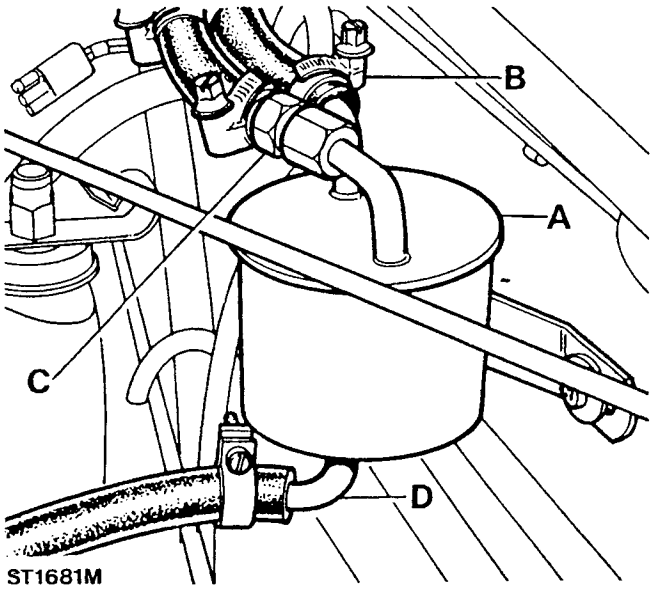
Description

Fuel drawn by the electrically operated in-tank pump, is delivered to a paper element type filter. Situated beneath the right-hand front footwell attached to a chassis outrigger from the filter, fuel enters a vapour separator located on the left-hand side of the bulkhead in the engine compartment. Fuel finally enters the carburetter float chamber from the port at the base of the vapour separator. The vapour separator comprises part of the spill return system and its purpose is to prevent fuel vapour causing air locks in the supply to the carburetter. Vapour and excess fuel flows back into the fuel tank through a restrictor fitted to the spill return port on the vapour separator. The restrictor is designed to assist in maintaining a constant fuel level in the vapour separator bowl and to prevent fuel flowing back to the tank at the same rate as the delivery.



FUEL FILTER

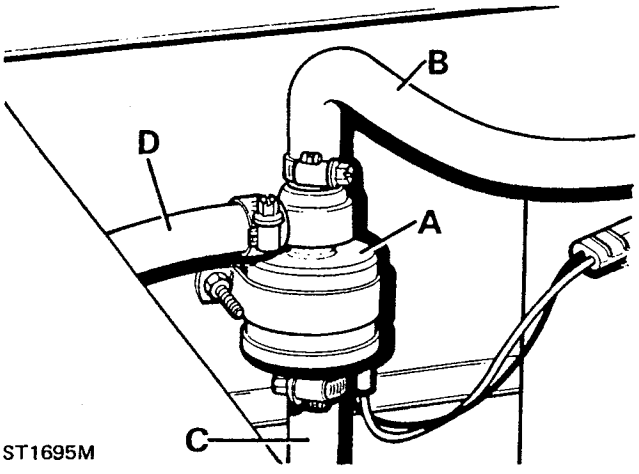
A. Fuel filter
B. From fuel pump to filter pipe
C. From fuel filter to carburetter via vapour separator



ST1681M

VAPOUR SEPARATOR

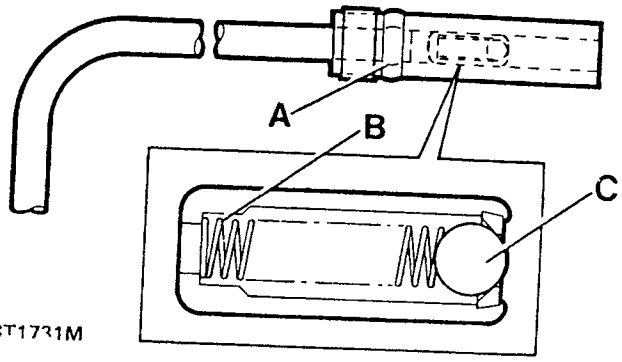
A. Vapour separator
B. Spill return to side tank
C. Restrictor and spill return to solenoid valve
D. Outlet from separator to carburetter



ST1695M

SPILL RETURN SOLENOID VALVE

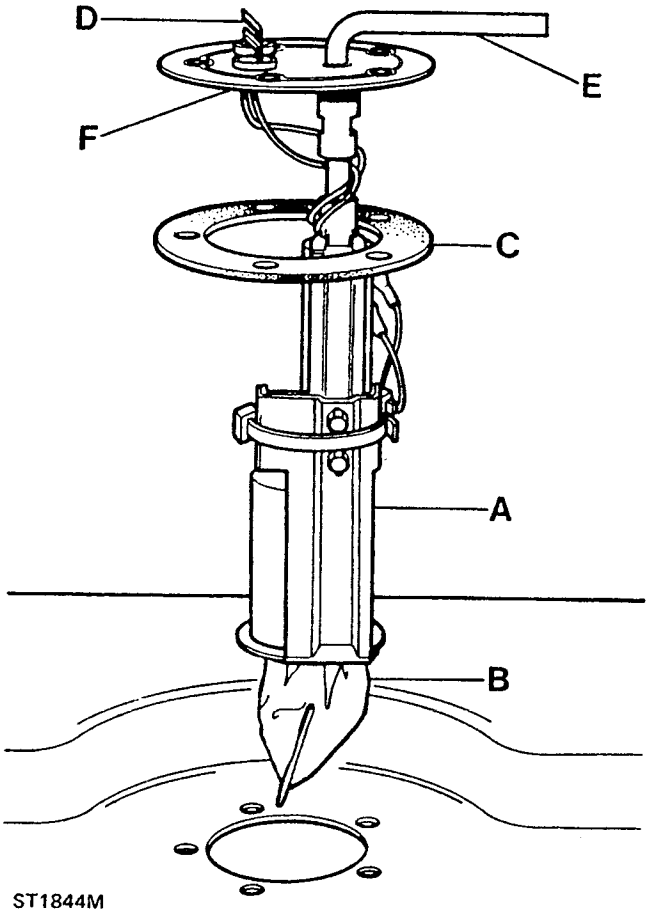
A. Solenoid valve
B. Spill return to side tank
C. Spill return to rear tank
D. To carburetter via filter and vapour separator



ST1731M

NON-RETURN VALVE

A. Non-return valve
B. Spring
C. Ball

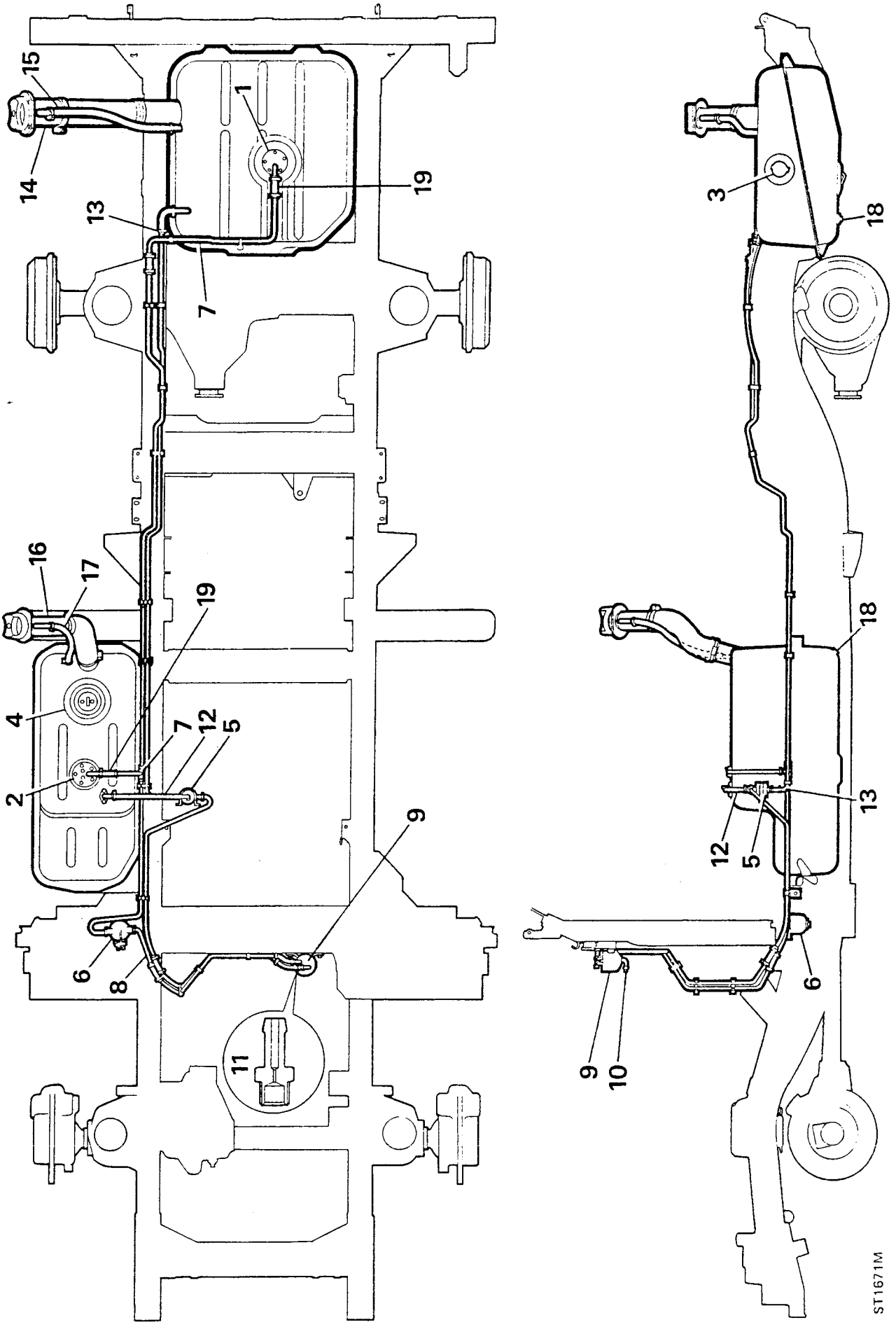


ST1844M

FUEL PUMP

A. Pump and motor
B. Filter
C. Gasket
D. Electrical terminals
E. Outlet pipe
F. Fixing plate to tank
G. Plastic tie clip — See CAUTION — remove and refit pump

LAND ROVER 110 TWIN TANK FUEL SYSTEM



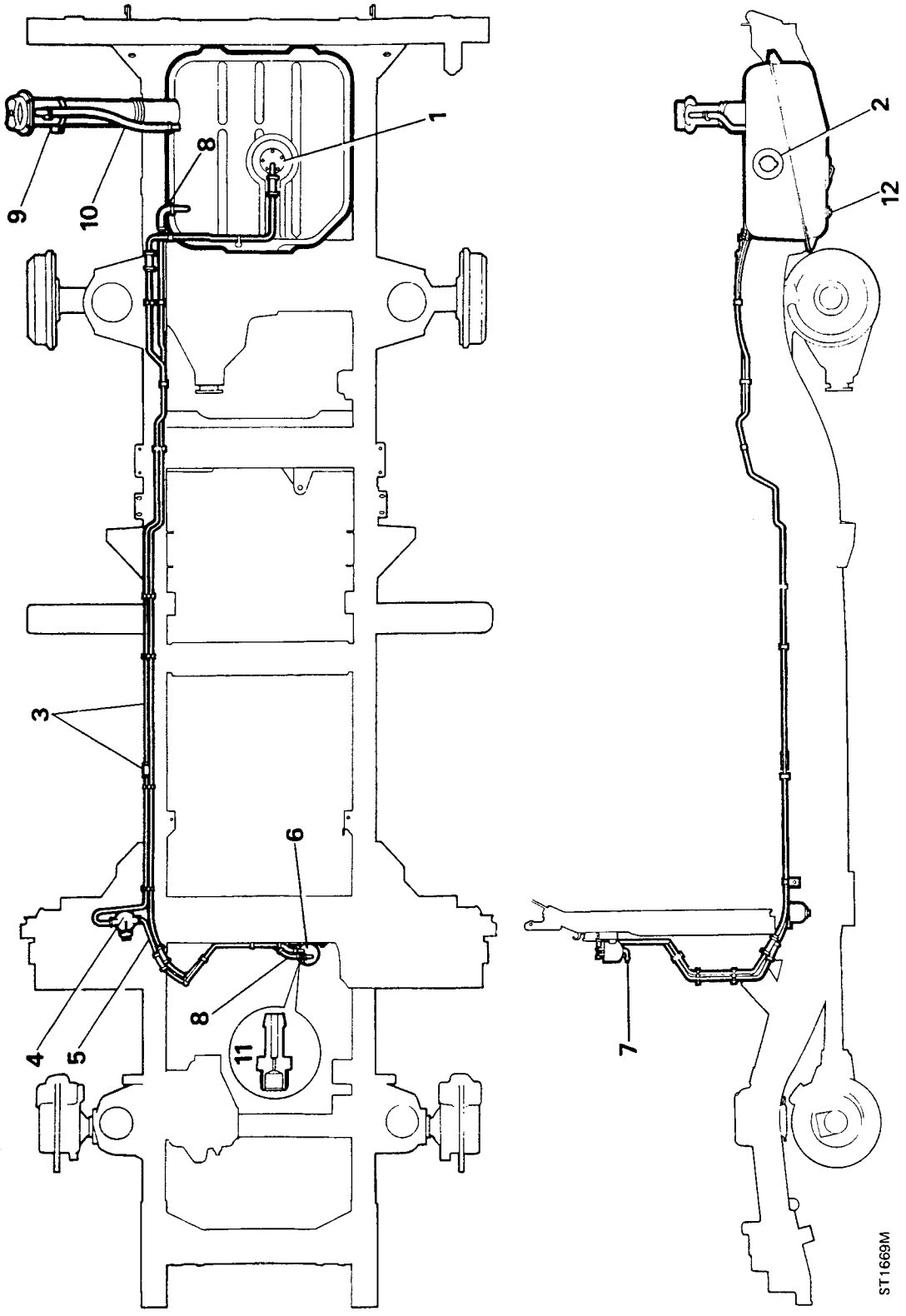
LAND ROVER 110 TWIN TANK FUEL SYSTEM

KEY TO FUEL LINE INSTALLATION

1. In-tank fuel pump — rear tank.
2. In-tank fuel pump — side tank.
3. Fuel gauge tank unit — rear tank.
4. Fuel gauge tank unit — side tank.
5. Spill return solenoid.
6. Fuel filter.
7. Fuel supply pipe — rear tank to filter via T-piece.
8. Pipe, filter to vapour separator.
9. Vapour separator.
10. Vapour separator outlet to carburetter.
11. Spill return pipe to fuel tank via restrictor and solenoid valve.
12. Spill return pipe to side tank from solenoid.
13. Spill return pipe to rear tank from solenoid.
14. Fuel filler — rear tank.
15. Breather pipe — rear tank.
16. Fuel filler — side tank.
17. Breather pipe — side tank.
18. Drain plugs side and rear tanks.
19. Non return valve incorporated in hose.

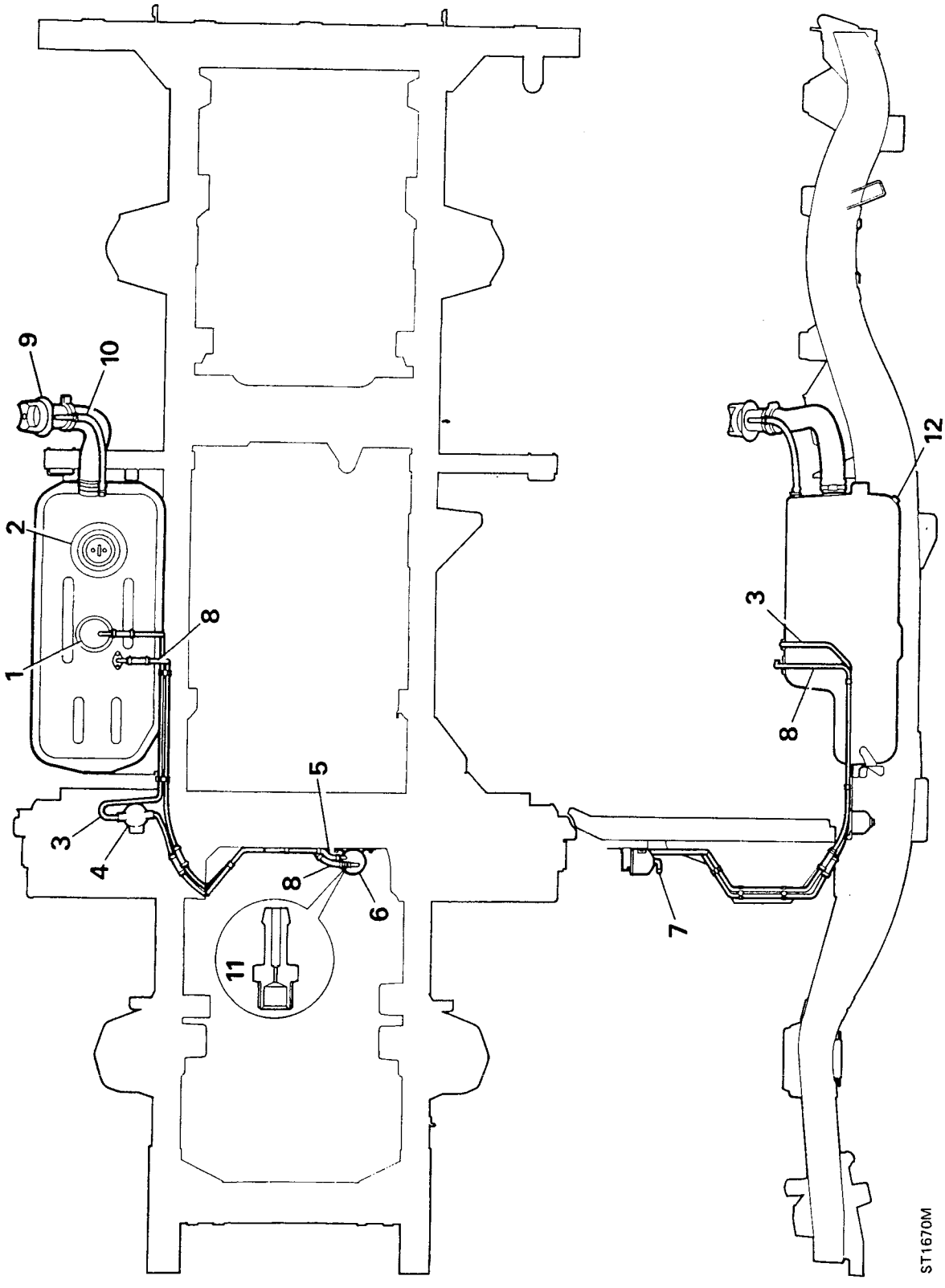
LAND ROVER 110 BASIC FUEL SYSTEM

1. In-tank fuel pump.
2. Fuel gauge tank unit.
3. Fuel supply pipe to filter via connector.
4. Fuel filter.
5. Fuel supply pipe filter to vapour separator.
6. Vapour separator.
7. Vapour separator, outlet to carburetter.
8. Spill return pipe to fuel tank via restrictor.
9. Fuel filler.
10. Breather hose.
11. Restrictor.
12. Fuel tank drain plug.



LAND ROVER 90 BASIC FUEL SYSTEM

1. In-tank fuel pump.
2. Fuel tank gauge unit.
3. Fuel supply pipe to filter.
4. Fuel filter.
5. Fuel supply pipe filter to vapour separator.
6. Vapour separator.
7. Vapour separator, outlet to carburetter.
8. Spill return pipe to fuel tank via restrictor.
9. Fuel filler.
10. Breather hose.
11. Restrictor.
12. Fuel tank drain plug.



REMOVE REAR TANK FUEL PUMP

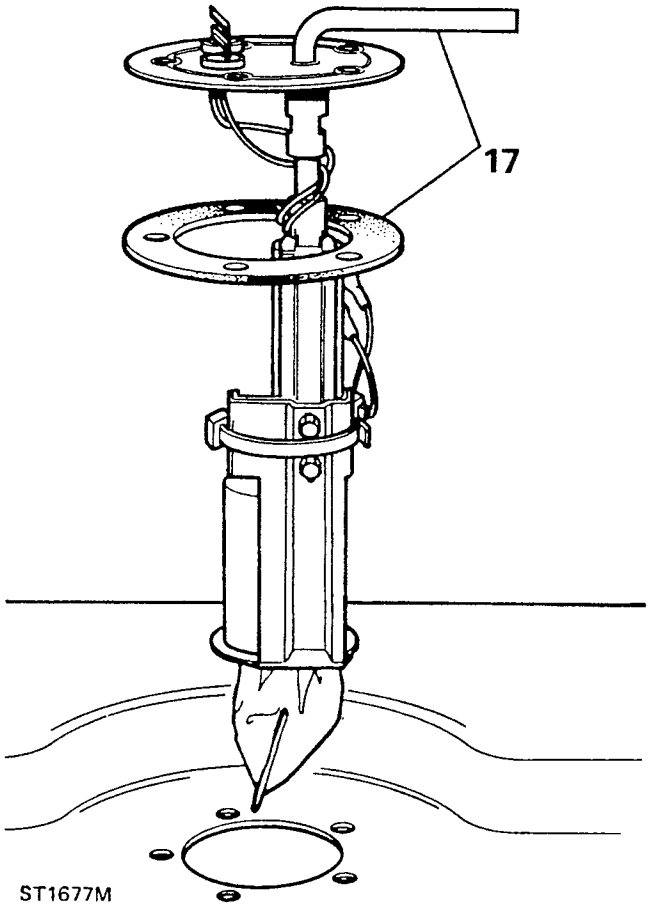
To renew the pump it is first necessary to remove the fuel tank from the vehicle. Before commencing the following instructions it is essential that the WARNINGS and safety precautions concerning fuel tank draining and removal are studied and observed. These precautions are included in the introduction to this and each of the five books comprising the workshop manual for the Ninety and One-Ten vehicles.

1. Move vehicle to well ventilated area and disconnect the battery.
2. Remove the fuel tank drain plug and allow the fuel to drain into a suitable receptacle and refit the plug.
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 filter 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. If the vehicle is fitted with a towing ball drop-plate with support bars the bars must be removed.
7. Remove the eight nuts and bolts securing the anti-roll bar to the chassis and push the roll bar down to provide access to the tank.
8. Remove the left-hand lashing eye to facilitate removal of the tank.
9. Place a support under the tank, preferably one which will enable the tank to be progressively lowered.
10. Remove the two nuts retaining the forward end of the tank.
11. Remove the two nuts securing the rear of the tank.
12. Carefully lower the tank sufficiently to enable the electrical leads to the fuel pump to be diconnected.
13. Finally remove the tank from the vehicle together with the pump and rear section of the fuel feed pipe.
14. Disconnect the rear section of the 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.

Fitting fuel pump

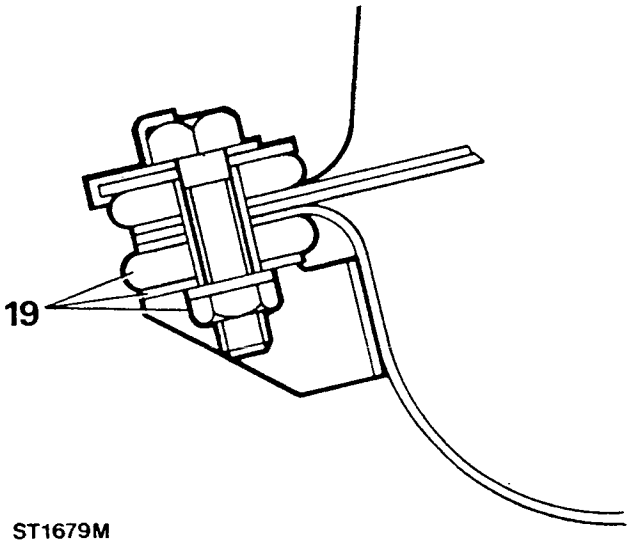
CAUTION: On some early models a modification was carried out to the fuel pump to prevent the possibility of the contacts earthing. These pumps can be recognised by a black plastic tie clip as illustrated. See Fuel System description. If the fuel tank only is being renewed and the original pump is being re-fitted, ensure that the tie clip is correctly positioned.

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.



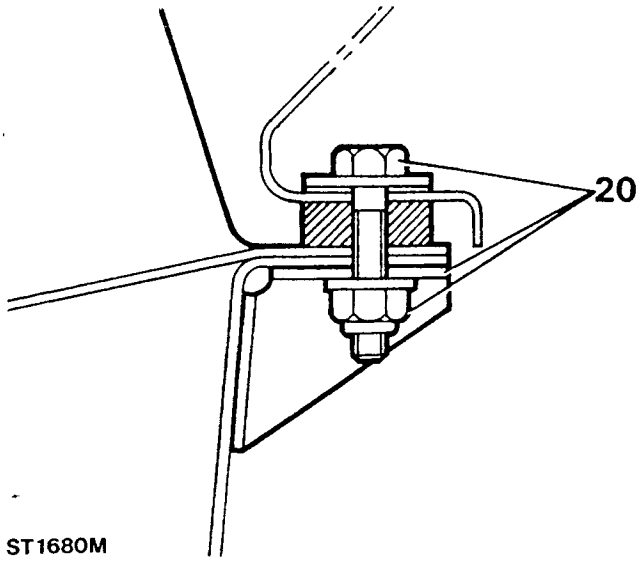
ST1677M

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



ST1679M

20. Secure the rear of the tank with the two captive bolts, plain washer and nyloc nut.

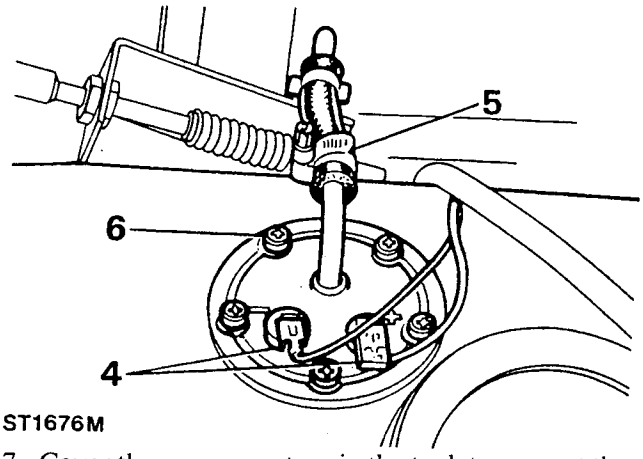


ST1680M

21. Connect the fuel feed pipe.
22. Connect the spill return pipe.
23. Connect the fuel filter hose and breather pipe to the 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 gauge unit leads.
28. Reconnect battery, and check operation of pump and change-over solenoid — if fitted.

REMOVE SIDE TANK FUEL PUMP

1. Move the vehicle to a well ventilated area, extinguish all naked lights and disconnect the vehicle batteries.
2. Remove the right-hand side front seat cushion.
3. Move the carpet aside, where fitted and unclip and remove the seat base cover.
4. Disconnect the two Lucars from the fuel pump.
5. Disconnect the fuel outlet pipe from the pump.
6. Remove the five retaining screws and withdraw the pump and sealing ring.



ST1676M

7. Cover the pump aperture in the tank to prevent the ingress of foreign matter.

CAUTION: On some early models a modification was carried out to the fuel pump to prevent the possibility of the contacts earthing. These pumps can be recognised by a black plastic tie clip as illustrated. See fuel system description. If the fuel tank only is being renewed and the original pump is being re-fitted, ensure that the tie clip is correctly positioned.

Refitting

8. Insert the pump and new sealing washer into the tank so that the outlet pipe is directed towards the left-hand side of the vehicle and the electrical connections to the right.
9. Secure the pump with the five screws tightening evenly.
10. Fit the supply pipe to the pump outlet and tighten the hose clip.
11. Connect the white/green wire to the positive (+) terminal and the black wire to the negative (−) terminal.
12. Connect the batteries, switch on ignition and operate the tank selection switch, if it is a twin tank installation and check that the pump operates.
13. Switch off ignition, fit the seal base cover and carpet and refit the seat cushion.

FUEL INJECTORS

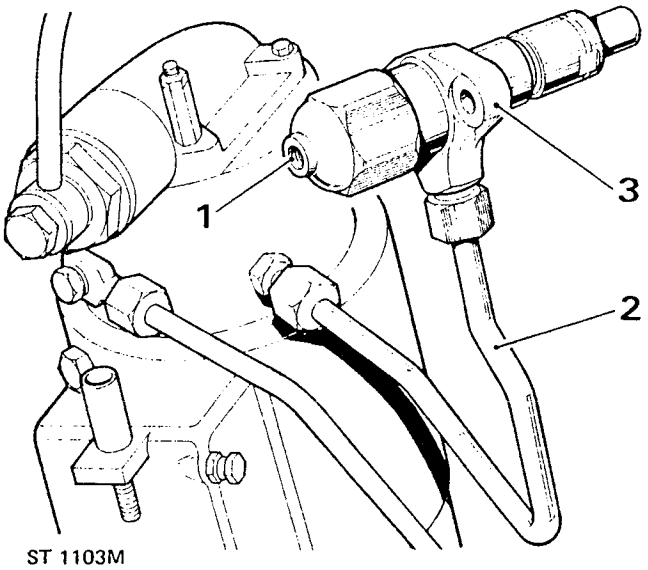
CHECKING NOZZLE ASSEMBLIES

WARNING: Do not allow the fuel spray to contact the person otherwise injury may result from skin penetration.

When an injection nozzle is considered to be the cause of irregular running and loss of power, a quick check may be made by loosening the fuel feed pipe union nut on each nozzle in turn, whilst the engine is idling at approximately 1,000 rev/min.
If the injection nozzle assembly being checked has been operating properly, there will be a distinct reduction in engine speed accompanied by obvious roughness, but a faulty injection nozzle may make little or no difference to the engine note when its fuel feed pipe is loosened.

Spray check

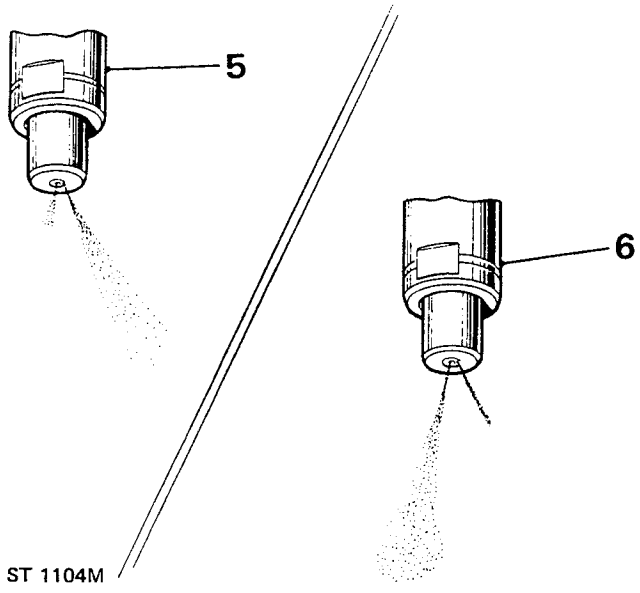
1. Remove the fuel spill gallery pipe complete from the injection nozzles.
2. Disconnect the fuel feed pipe (injection pump to nozzle) from the nozzle to be tested and from the injection pump.
3. Release the fixings and withdraw the suspected injection nozzle assembly; reconnect the pipe and nozzle assembly to the injection pump in a position whereby fuel ejection may be observed.



ST 1103M

NOTE: The above illustration shows the D.P.A. pump fitted to the 2.25 litre diesel engine.

4. Loosen the union nuts securing the remaining fuel pipes to injection nozzles.
5. Whilst the starter turns the engine over, observe the manner in which fuel issues from the nozzle and compare the spray form with the correct form as illustrated.
   Very little fuel should issue from the main spray hole with the engine turning over at starter speed but a fine spray comparable to that illustrated should be ejected from the auxiliary spray hole.
6. If the ejected fuel is more in the form of a liquid jet or issues from the main pintle hole, then the nozzle and holder assembly should be removed for overhaul and a replacement unit fitted.
7. Refit the injectors and tighten the union nuts.
8. Connect the spill gallery pipe with the bolt and two washers.



ST 1104M

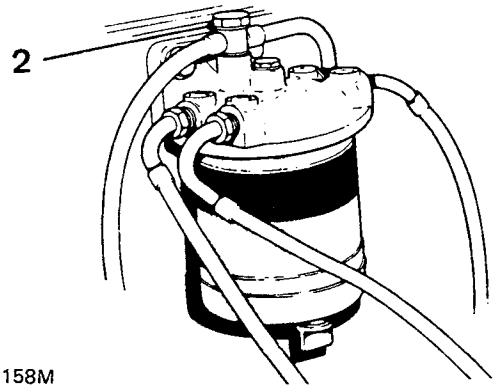
PRIME FUEL SYSTEM

Procedure following fuel filter or sedimentor service

When models fitted with a sedimentor have had the water drained only from the sedimentor bowl, no priming is necessary as the water is replaced by fuel automatically syphoned from the tank. However, if the sedimentor has been dismantled and air has entered the body, or where the fuel filter element has been replaced and the filter bowl cleaned, then the system must be primed as follows:

continued

1. Do not attempt to start the engine hoping to draw the fuel through in this way, otherwise the full priming procedure will be necessary.
2. Slacken the bleed pipe banjo bolt on the top of the main fuel filter.



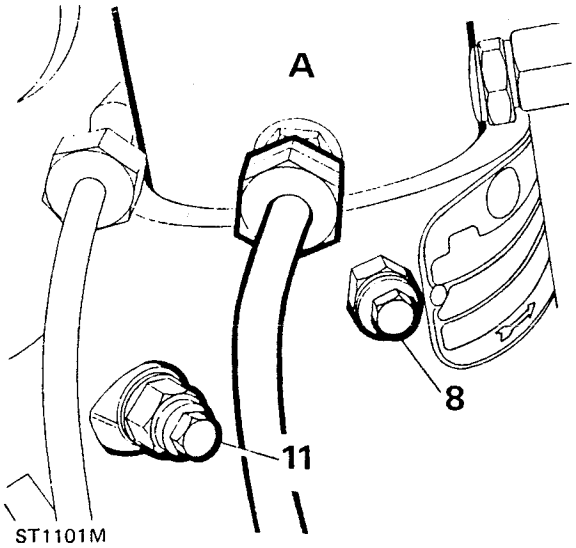
ST1158M

3. Operate the hand priming lever on the mechanical pump, until fuel free from bubbles emerges.
   Always ensure that fuel pump lever is on the bottom of the operating cam when priming the fuel system, otherwise maximum movement of the priming lever cannot be achieved.
4. Tighten the bleed pipe banjo bolt whilst the fuel is still emerging.
5. Operate the hand priming lever once or twice to clear the last bubbles of air into the filter bleed pipe.
6. Start engine in normal way and check for leaks.

Procedure when fuel system has been drained

7. Carry out instructions 1 to 5 inclusive.
8. Release air vent screw on distributor body.

Illustration A — 2.25 litre D.P.A. pump
Illustration B — 2.5 litre D.P.S. pump



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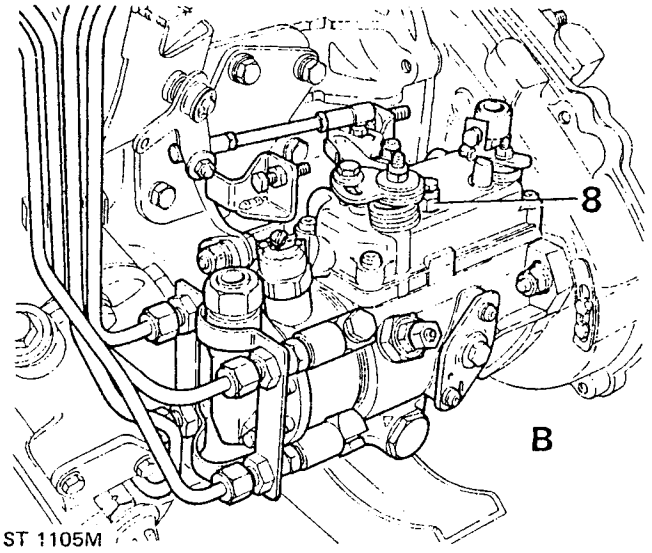


ST 1105M

9. Operate the fuel pump hand priming lever until fuel free of air emerges.
10. Retighten the air vent screw.
11. To ensure that all air is exhausted from the pump it may also be necessary to slacken air vent screw in the distributor control cover and repeat instructions 9 and 10. 2.25 litre engine D.P.A. pump only.
12. Start the engine in the normal way and check for leaks.

Procedure when distributor pump has been drained

13. Carry out instructions 8 to 12 inclusive.

FUEL INJECTION PUMP — Altitude compensation

When Diesel engines are operated at high altitude it is recognised that the reduced air density causes a reduction in the weight of air drawn into the engine cylinders, which results in incomplete combustion of the injected fuel at full throttle, unless this is reduced in proportion to the reduction in air density.
To compensate for these variations and to avoid excessive fuel consumption, accompanied by excessive exhaust smoke, the amount of fuel delivered to the cylinders must be reduced to suit the conditions under which the engine is required to operate. For every 330 metres (1000 feet) above 990 metres (3000 feet) the fuel delivery must be reduced by 3%.
Adjustments to the D.P.S. pump, however, must only be carried-out by an authorised C.A.V. Dealer.

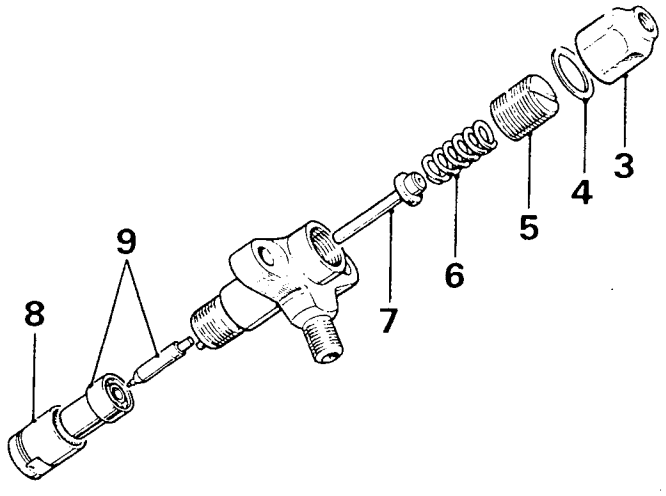
OVERHAUL FUEL INJECTORS

Service tools:

271483 or 18G109 or Diesel tune III	**Injector nozzle testing and setting kit**
278182 or 18G109B or Diesel tune 102	**Adaptor Pintaux Injector**
278181 or 18G109E	**Injector nozzle flushing tool**
605002 or 18G1487 or FT9101	**Injector nozzle cleaning kit**

DISMANTLE

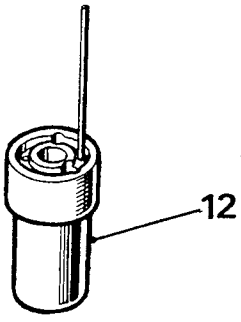
1. Remove the injectors from the engine.
2. Disconnect the injectors from the fuel spill rail.
3. Remove the combined locknut and end cap.
4. Withdraw the sealing washer.
5. Unscrew the pressure adjusting screw.
6. Withdraw the pressure spring.
7. Withdraw the valve spindle.
8. Unscrew the cap nut.
9. Withdraw the nozzle valve and body.

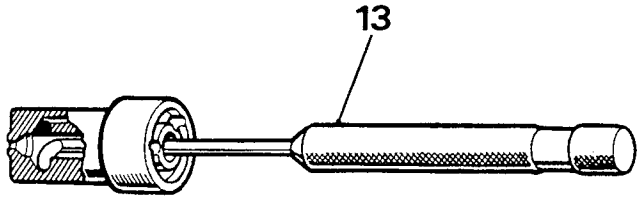


ST 1106M

Cleaning and inspecting

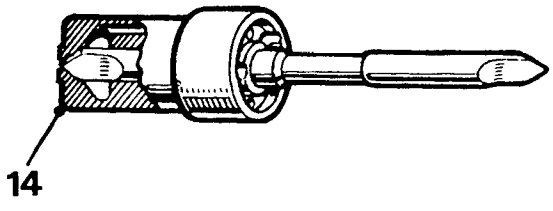
10. Soak the component parts of the assembly in Shell Calibration Fluid to loosen carbon deposits, but do not allow parts of any one assembly to be interchanged with those of another.
11. Brush away all external carbon deposits from component parts with a brass wire brush and return them to the fluid bath. Particular care must be exercised when cleaning the pintle and seat of nozzle valve to avoid scratching or scoring, which could result in spray distortion.
12. Clean the three oil feed passages in the nozzle body with a wire or drill of 1,5 mm (0.062 in) diameter.
13. Remove the carbon from the annular recess with the tool illustrated.

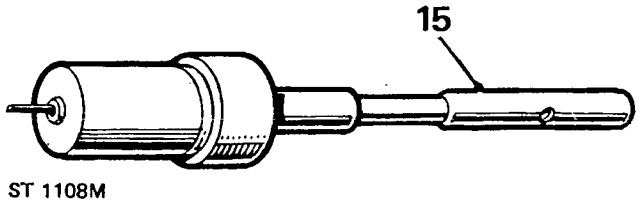




ST 1107M

14. Remove the carbon from the valve seat, using the appropriate tool with a rotary motion.
15. Select the appropriate size probe from the pocket of cleaning kit and secure it in the pintle hole cleaner.
    Insert the probe into the bore of nozzle valve body and allow the end to extend through the main fuel outlet, then turn in a rotary manner to remove carbon.



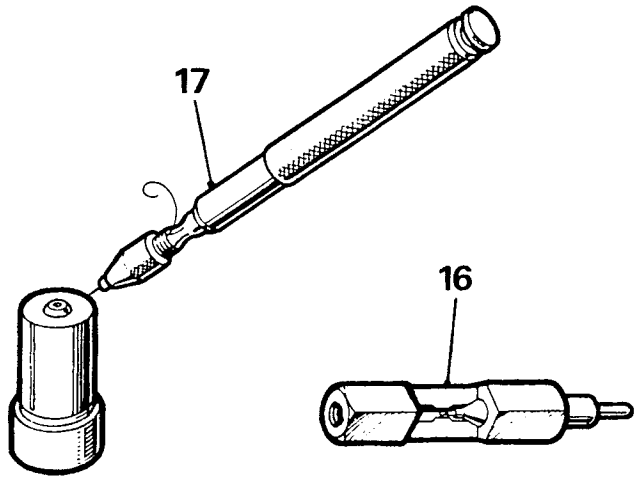


ST 1108M

continued

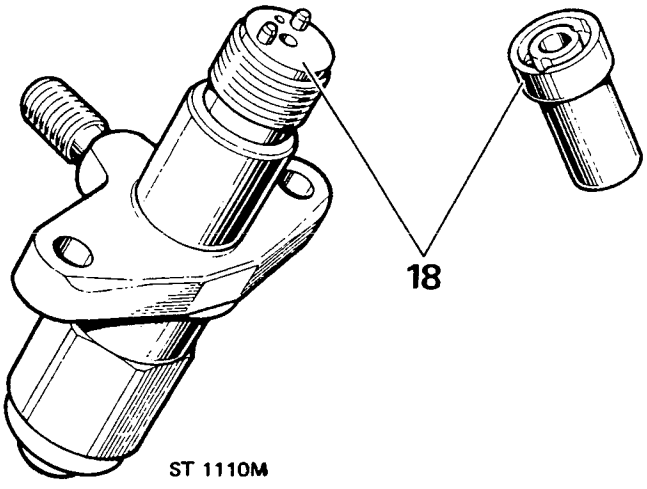
16. Carbon may be removed from the nozzle valve cone by inserting the valve into the tool illustrated and then rotating it alternately in a clockwise then anti-clockwise manner whilst pressing the valve inward. If the nozzle is blued or the seating has a dull circumferential ring indicating pitting or wear, the nozzle body and valve should be returned to a CAV Service Agent and replacement parts fitted. Do not attempt to lap the nozzle valve to body. This process requires special equipment and training.
17. Clean the auxiliary spray hole using the special tool fitted with probing wire 0,20 mm (0.008 in) diameter.

NOTE: Allow 1,5 mm (0.062 in) only to extend from the chuck and thus minimise the possibility of the wire bending or breaking while probing. Great care must be taken to prevent breakage of the wire in the hole.



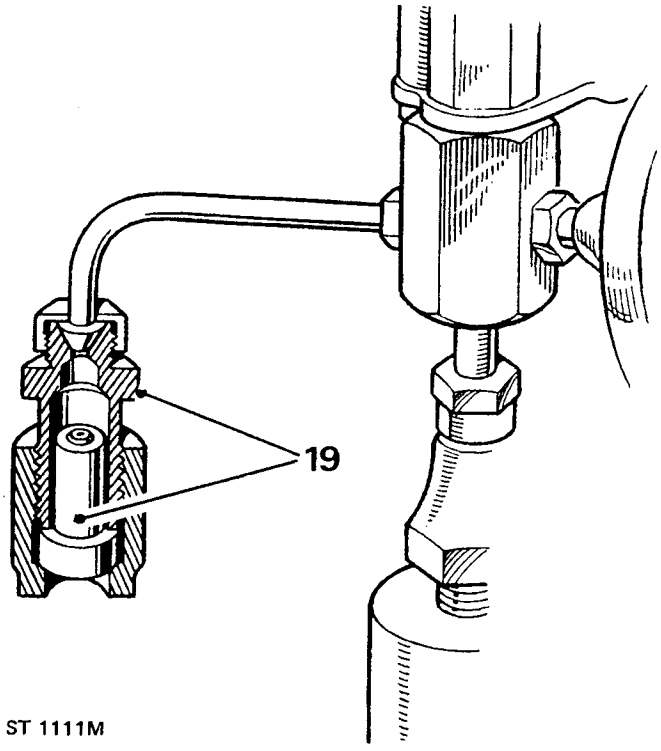
ST 1109M

18. Examine the pressure faces of nozzle body and nozzle holder to ascertain their freedom from scoring and scratches. These surfaces must be perfectly smooth.



ST 1110M

19. With the flushing tool secured to the nozzle testing outfit, fit the nozzle body (spray holes uppermost) to the flushing tool and pump test oil through vigorously. This flushing process is necessary for the removal of any tiny carbon particles which may have become lodged in the body after scraping and probing.



ST 1111M

Assemble

20. Fit the nozzle valve to nozzle and check for freedom of movement.
21. Immerse the nozzle body and valve in the fluid bath and assemble whilst submerged.
22. Wash the remaining components and assemble the injector in the sequence illustrated during the dismantling.
23. Set the injection nozzle assembly in accordance with the following test procedure.

Bench test injector nozzle and holder assembly

24. To check a nozzle assembly and to ensure that it is functioning correctly, a setting outfit, as illustrated, is essential. A bench covered with linoleum or non-ferrous sheet metal is most suitable for mounting the outfit; such a surface facilitates the cleanliness essential when checking nozzle parts. Between the bench and setting outfit, a tray, also of non-ferrous metal, should be positioned to prevent spilt fuel spreading. Small containers may be attached to the bench to isolate the component parts of each assembly. These parts are carefully mated by the manufacturers and must **not** be interchanged. Lastly, a small bath with a cover, containing Shell Calibration Fluid for washing components, should be kept conveniently near.

25. The efficient operation of the injection nozzle assembly is dependent on four main conditions, as follows:
    The nozzle valve must open at 135 Ats.
    The rate of back leakage must be within 150 to 100 Ats.
    Seat tightness must be sufficient to prevent leakage.
    Spray form must compare favourably with the illustrations.
26. Pressure setting, back leakage and seat tightness tests may be made by coupling the injection nozzle and holder assembly direct to the pressure feed pipe on the setting outfit, but an adaptor must be fitted between the pipe and injection nozzle and holder assembly when testing spray form. This adaptor, see instruction 38, increases the pressure of fuel to the injection nozzle and holder assembly sufficiently for the main and auxiliary spray form to be determined.

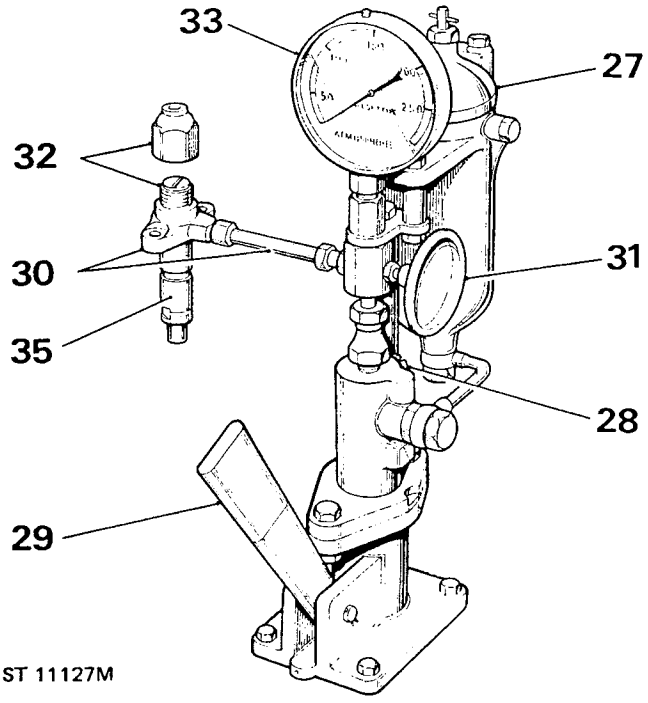
Test procedure

WARNING: The injection nozzle must not be allowed to point towards the operator when spraying and the hands must never be allowed to contact the spray which has a force that can penetrate the flesh.

27. Remove the cap from the setting outfit container and fill with 0,8 litre (1.5 pints) of Shell Calibration Fluid.
28. Air vent the system by removing the vent screw, allow oil to flow freely for a few seconds and replace the screw whilst the flow continues.
29. Operate the pump handle until fluid flows from pipe.
30. Connect the injector and holder assembly to the pressure feed pipe with the nozzle pointing downwards. The length and bore of this pipe is important and replacement pipes must be approximately 75 mm (2.8 in) between the union nuts and of 3 mm (0.118 in) bore.
31. Close the check valve to keep the pressure gauge out of circuit and smartly operate the hand lever several times to expel all air from the system.

Leak-back test

32. Adjustment is made by removing the combined end cap and locknut from the nozzle holder, and turning the adjusting screw clockwise to increase and anti-clockwise to decrease the opening pressure.
33. Fit assembled injector to nozzle setting outfit and adjust to open at 160 to 170 atmospheres then pump up to just below this figure, release handle to allow the needle of gauge to fall naturally. Time the pressure drop from 150 atmospheres down to 100 atmospheres.
34. This should be not less than 5 seconds for the original nozzle and not less than 7 seconds if a new one is to be fitted, and not more than 36 seconds for either with oil temperature 10° to 21°C (50° to 70°F).
35. Check externally the top and bottom of nozzle cap nut and pressure pipe union nuts for signs of oil leakage. If leakage occurs at the nozzle cap nut, remove the nut and examine the pressure faces of nozzle holders and nozzle body (see item 18) for presence of foreign matter or surface scoring, before tightening further.
    A leak-proof nozzle assembly with an excessive rate of pressure drop indicates a worn nozzle valve; the nozzle valve and nozzle body should be renewed.



ST 11127M

Pressure setting

36. The selected operational opening pressure of the nozzle valve is 135 atmospheres. Readjust to this setting in the manner described in item 32.

Seat tightness

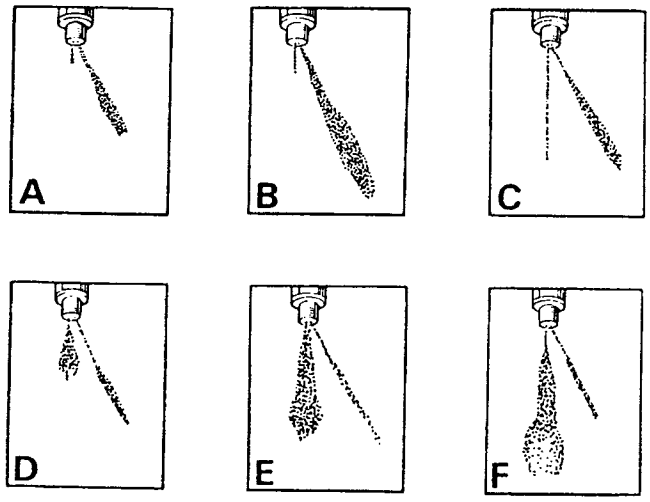
37. Wipe the bottom face of the injection nozzle dry and raise the pressure in the system to 125 atmospheres. A slight dampness on the bottom face is permissible, but blob formation or dripping indicates a badly seating valve in which case the assembly should be dismantled for further examination.

Spray form

38. Fuel delivery to the injection nozzle assembly when testing spray form must be characteristically similar to fuel delivery under normal operating conditions and to effect these conditions an adaptor (CAV Y7044872) must be fitted between the injection nozzle assembly and the pressure pipe.

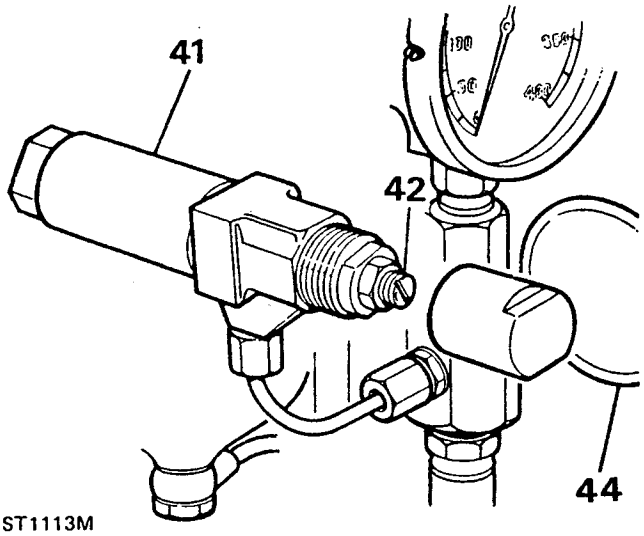
continued

39. The adaptor differs mainly in the cap nut and nozzle valve from the ordinary type of injection nozzle and holder assembly as fitted to the engine; the nozzle valve has no pintle.
40. The cap nut is extended, bored and threaded to receive nozzles for testing.
41. Connect the adaptor assembly to the pressure pipe.
42. Remove the end cap and adjust the opening pressure of the nozzle valve to 220 atmospheres.
43. Screw the injection nozzle and holder assembly to be tested, into the adaptor.
44. With the check valve closed, operate the handle smartly to expel air from the system. The auxiliary spray form may be tested at 60 strokes per minute and the main spray at 140. Spray development from starting to running speeds is illustrated, this illustration should be referred to and compared with the spray form of nozzles under test.
    Spray formation should be well formed and free from splits or distortion. A slight centre 'core' can be disregarded. Observe the main spray through 360 degrees to ensure a uniform spray.

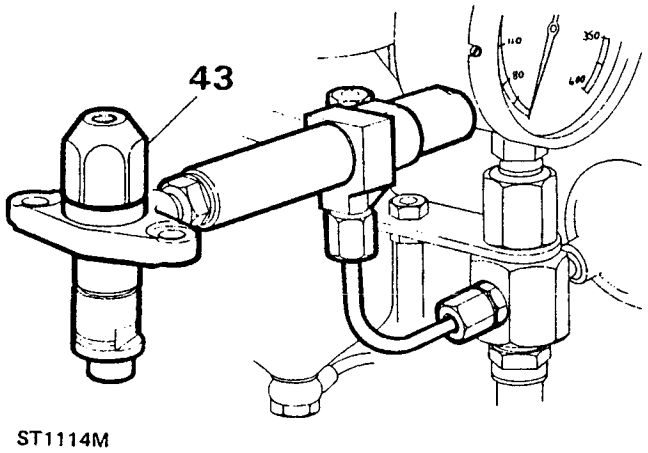


ST 1115M

45. When satisfactory, fit the combined locknut and end cap, connect the injectors to the fuel spill rail and fit them to the engine.



ST1113M



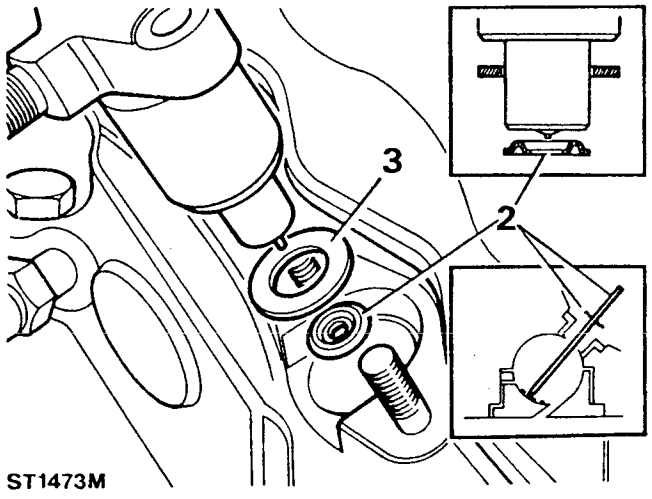
ST1114M

FITTING FUEL INJECTORS

The steel sealing washer fitted below the injector nozzle is to ensure that combustion does not take place around the nozzle body and cause it to overheat. A washer which has been used more than once, or an incorrectly fitted washer may cause the nozzle to overheat and result in that cylinder misfiring.

1. Ensure that the new washers are separated from each other and are clean.
2. Use a length of thin welding wire to guide one washer only into each port with the domed side toward the injector as illustrated. Ensure that only one washer is fitted to each port.

continued



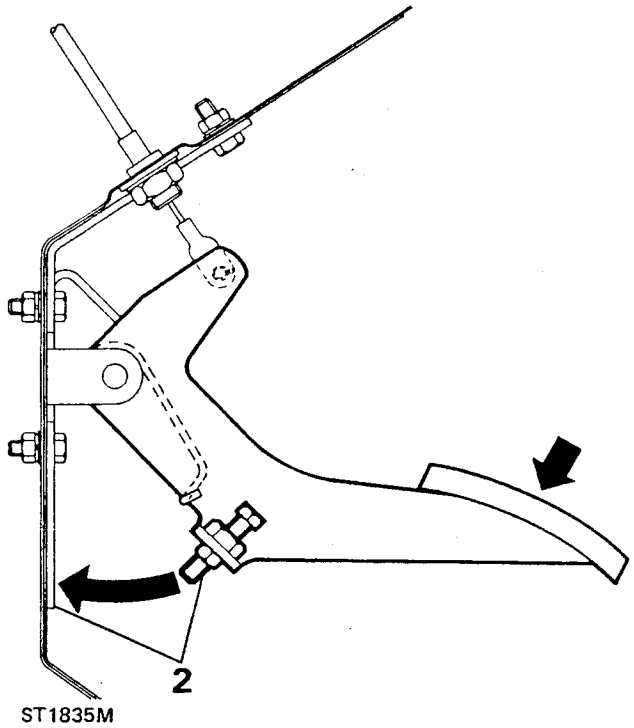
ST1473M

3. Lightly grease the copper washer into position on each injector before fitting to the cylinder head.
4. Fit the injector and evenly tighten the retaining nuts to the correct torque 6 to 8 Nm (4 to 6 lbs ft). Uneven or overtightening of the injector nuts could distort the nozzle and cause misfiring when normal running temperature is reached.
5. Reconnect the injector pipes but do not overtighten the union nuts.

THROTTLE PEDAL ADJUSTMENT —

Petrol and Diesel four cylinder engines

1. After renewing the throttle cable, remove any slack in the cable by adjustment of the cable adjuster at the engine end.
2. Depress the throttle pedal, by hand, to the full extent of the carburetter, DPA or DPS pump 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 carburetter or pump linkage.



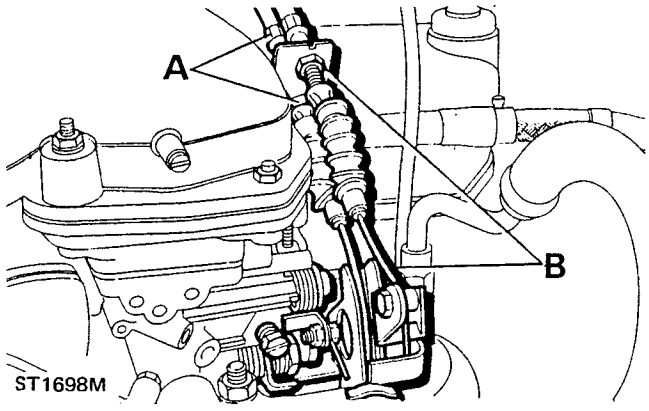
ST1835M

HAND THROTTLE — where fitted

Petrol and Diesel four cylinder engines

Adjust

1. Slacken the lock nut on the cable adjuster and turn the adjuster to remove all slack from the cable and tighten the locknut.
   NOTE: The first illustration petrol engine and second illustration Diesel engine.
   A.) Foot pedal cable adjuster
   B.) Hand throttle cable adjuster



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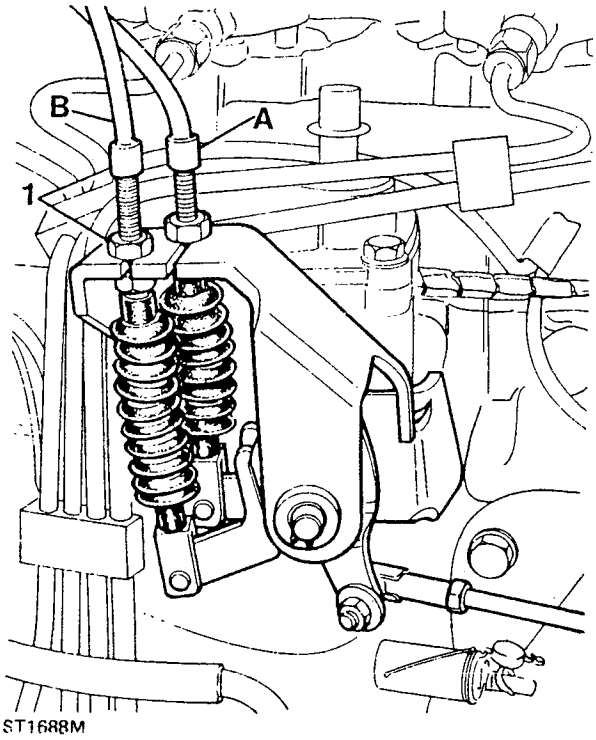


ST1688M

GENERAL SPECIFICATION DATA
2.5 Litre Turbo Charged Diesel Engine — Supplement

Number of cylinders	4
Bore	90, 47 mm (3.562 ins)
Stroke	97,00 mm (3.822 ins)
Capacity	2495 cc
Compression ratio	21:1
Valve charger	O.h.v. pushrod operated
Turbo charger	Garrett T2

Crankshaft

Main bearing journal diameter	63,487-63,500 mm (2.4995-2.500 in)
Regrind dimensions:	
63,246-63,2333 mm (2.490-2.4895 in)	Use 0.010 in U/S bearings
Crankpin journal diameter	58,725-58,744 mm (2.312-2.31275 in)
Regrind dimensions:	
58,48985-58,4708 mm (2.30275-2.30200 in)	Use 0.010 in U/S bearings
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05-0,15 mm (0.002-0.006 in)

Main bearings

Number and type	5 halved shells without oil grooves
Diametrical clearance	0,018-0,061 mm (0.0007-0.0024 in)

Connecting rods

Length between centres	175,38-175,43 mm (6.905-6.907 in)
Diametrical clearance (big-end bearings)	0,025-0,075 mm (0.001-0.003 in)
End-float on crankpin	0,15-0,356 mm (0.006-0.014 in)

Pistons

Type	Aluminium alloy 'V' shaped valve recess in crown
Skirt diametrical clearance (at right angle to gudgeon pin)	0,025-0,05 mm (0.001-0.002 in)

Gudgeon pins

Type	Floating
Fit in piston	Hand push fit
Diameter	30,1564-30,1625 mm (1.18726-1.18750 in)
Clearance in connecting rod	0,0196-0,0036 mm (0.00077-0.00014 in)

Piston rings

Type:	
Top	Chamfered friction edge, chrome plated
Second	Taper faced
Oil control	Expander and rails
Gap in bore:	
Top	0,30 to 0,50 mm (0.011-0.019 in)
Second	0,25 to 0,45 mm (0.009-0.017 in)
Oil control	0,3 to 0,6 mm (0.011-0.023 in)
Clearance in piston grooves:	
Top	0,140 to 0,180 mm (0.002 to 0.007 in)
Second	0,040 to 0,080 mm (0.001 to 0.003 in)
Oil control	0,04 to 0,080 mm (0.001 to 0.003 in)

continued

Camshaft

Drive	25,4 mm (0.1 in) wide dry toothed belt
Location	Right-hand side (thrust side)
End-float	0,1-0,2 mm (0.004-0.008 in)
Number of bearings	4
Material	Steel shell, white metal lined

Valves

Seat angle:	
Inlet	45°
Exhaust	45°
Head diameter:	
Inlet	39,12-39,37 mm (1.540-1.550 in)
Exhaust	33,25-33,50 mm (1.309-1.319 in)
Stem diameter:	
Inlet	7,912-7,899 mm (0.3114-0.3109 in)
Exhaust	8,682-8,694 mm (0.3418-0.3422 in)
Valve lift:	
Inlet	9,85 mm (0.388 in)
Exhaust	10,26 mm (0.404 in)
Cam lift:	
Inlet	6,81 mm (0.268 in)
Exhaust	7,06 mm (0.278 in)

Valve springs

Type	Duplex Interference double coil
Inner:	
Length, free	42,67 mm (1.680 in)
Length, under 8.0 kg (17.7 lb) load	40,30 mm (1.587 in)
Outer:	
Length, free	46,28 mm (1.822 in)
Length, under 21 kg (46 lb) load	40,30 mm (1.587 in)

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2000 rpm	2,5-4,57 kgf cm^2 (35-65 lbf in^2)
Oil pump:	
Type	Double gear 10 teeth, sintered iron gears
Drive	Splined shaft from camshaft skew gear
End-float of both gears	0,026-0,135 mm (0.0009-0.0045 in)
Radial clearance of gears	0,025-0,075 mm (0.0008-0.0025 in)
Backlash of gears	0,1-0,2 mm (0.0034-0.0067 in)
Oil pressure relief valve:	
Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm (2.670 in)
Compressed length at 2.58 kg (5.7 lb) load	61,23 mm (2.450 in)
Oil filter:	
Type	Screw-on disposable canister

FUEL SYSTEM

Inspection pump	See **'ENGINE TUNING DATA'**
Fuel lift pump type	Mechanical with hand primer
Pressure range	0,35-0,56 kgf cm^2 (5-8 lbf in^2)
Fuel filter	Paper element
Air cleaner	Paper element type

continued

COOLING SYSTEM

Type	Pressurized spill return system with thermostat control, pump and fan assisted
Thermostat opening temperature	82°C
Pressure cap	1,0 kgf cm^2 (15 lbf in^2)
Water pump type	Centrifugal
Fan type	7 blade with viscous coupling
Radiator	Combined engine coolant and oil cooler

CLUTCH

Type	Verto diaphragm spring
Centre plate diameter (friction plate)	235 mm (9.25 in)
Facing material	Verto 791
Number of damper springs	8
Damper spring colour	2 off white/green - Suffix 'C' 2 off pigeon blue - Suffix 'A' 4 off ruby red - Suffix 'B'
Clutch release bearing	Ball journal

TRANSMISSION

Type	LT230T. Two-speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential
Ratios Ninety and One Ten	High 1.4109:1 Low 3.3198:1

Rear axle

Type-Ninety models	Spiral bevel
Type-One Ten models	Hypoid; full floating shafts, Salisbury 8HA
Ratio-All models	3.54:1

Front axle

Type-Ninety models	Spiral bevel
Front wheel drive	Enclosed constant velocity joint
Ratio	3.54:1

Overall ratio (including final drive) Ninety and One Ten models

	In high transfer	In low transfer
Fifth (Cruising gear)	4.15:1	9.76:1
Fourth	4.99:1	11.75:1
Third	7.53:1	17.71:1
Second	11.49:1	27.03:1
First	17.90:1	42.11:1
Reverse	18.48:1	43.47:1

ELECTRICAL

Starter motor	Paris Rhone type D9R91 12 volt, with reduction gear

ENGINE TUNING DATA

ENGINE

Firing order	1-3-4-2
Injection timing	13° B.T.D.C.

Timing marks:

Valve timing	Slot for peg in flywheel and TDC mark on front pulley
Injection timing	Special tool 18G 1458 inserted in D.P.S. pump
Tappet clearances inlet and exhaust	0,25 mm (0.010 in)

Valve timing

Inlet opens	16° B.T.D.C.
Inlet closes	42° A.B.D.C.
Inlet peak	103° A.T.D.C.
Exhaust opens	51° B.B.D.C.
Exhaust closes	13° A.T.D.C.
Exhaust peak	109° B.T.D.C.

Valve lift

Inlet	9,85 mm (0,388 ins)
Exhaust	10,26 mm (0.404 ins)

Maximum governed speeds

Full load	4000 r.p.m.
No load (flight speed)	4400 ± 80 r.p.m.
Idle speed	670 ± 20 r.p.m.
Dic-down time	4 seconds

DISTRIBUTOR PUMP

Make/type	CAV DPS type with boost control and two speed mechanical governor with auto advance and solenoid electrical shut-off. Tamper proof sealing on flight speed and fuel adjustment screws.
Direction of rotation	Clockwise, viewed from drive end
Advance box (two stage)	7° advance with 3° start retard
Back leakage rate 150-100 Atm:	
New nozzle	7 seconds
Original nozzle	5 seconds
Despatch nozzle	8520A290A

INJECTORS

Make/type	CAV Pintaux DES5385001
Nozzle size	BDNO/SPC 6209
Opening pressure (working pressure)	135 to 140 Atmospheres
Injector pipe type	High pressure multi-bundy
size	1,94 to 2,06 mm
length	457,2 mm (18 ins)

HEATER PLUGS

Make/type	Probe type, Champion CH63 11 volts 90 watts nominal
Time to reach operating temperature of 850°C	8 seconds

TURBO-CHARGER

Make/type	Garrett T2
Maximum boost pressure	48 cm HG (9.3 P.S.I.G.) measured at wastegate actuator "T" piece

TORQUE WRENCH SETTINGS

TURBO-CHARGER FIXINGS	Nm	lbf.ft
Stud-Turbo charger to exhaust manifold	22-28	16-21
Nut-Turbo charger to exhaust manifold	21-26	15-19
Adaptor-Oil feed to cylinder block	22-28	16-21
Adaptor-Oil drain to cylinder block	22-28	16-21
Pipe-Oil feed to turbo charger	15-22	11-16
Pipe-Oil drain	32-48	23-35
Stud-Outlet elbow to turbo charger	22-28	16-21
Nut-Outlet elbow to turbo charger	21-26	15-19
Heat shield support to inlet manifold	22-28	16-21
Stud-Exhaust manifold to cylinder head	30-40	22-30
Nut-Exhaust manifold to cylinder head	28-36	21-26
Screw-inlet and exhaust manifold to cylinder head	30-40	22-30

RECOMMENDED ENGINE OILS

The following list of recommended engine oils for temperate climates - ambient temperature range - 10°C to 35°C should be used for oil changes and topping up. They are SHPD (Super High Performance Diesel) oils that allow a maximum of 10,000 km (6,000 miles) between oil and filter changes.

BP	Vanellus C3 Extra 15/40
CASTROL	Deusol Turbomax 15/40
MOBIL	Delvac 1400 Super 15/40
SHELL	Myrina 15/40

The following list of oils is for emergency use only if the above oils are not available. They can be used for topping-up without detriment, but if used for engine oil changing, they are limited to a maximum of 5,000 km (3,000 miles) between oil and filter changes.

BP	Vanellus C3 Multigrade 15/40
CASTROL	Deusol RX Super 15/40
DUCKHAMS	Hypergrade 15/50
ESSO	Essolube XD-3 15/40
MOBIL	Delvac Super 15/40
PETROFINA	Fina Dilano HPD 15/40
SHELL	Rimula X 15/40
TEXACO	URSA Super Plus 15/40

Use only oils to MIL-L-2104C/D or API Service levels CD or SE/CD-15W/40 SECTION 10

MAINTENANCE SCHEDULE

The following additional maintenance is required for the turbo charged engine to that contained in the main schedule for the non-Turbo Charged 2.5 Litre Diesel engine.

Every 500 km (250 miles)
- Check engine oil level

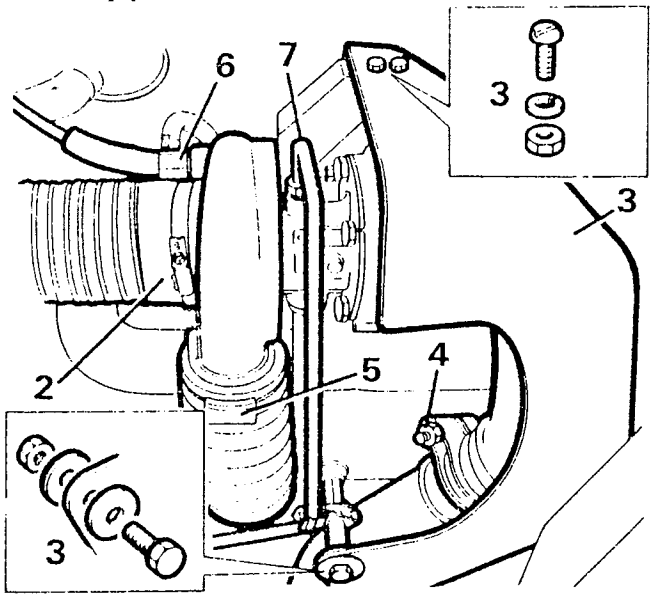
At 1,600 km (1,000 miles), 10,000 km (6,000 miles) and 20.000 km (12,000 miles) then every 20,000 km (12,000 miles)
- Check tappets, and adjust if necessary

Every 80.000 km (48,000 miles)
- Check maximum turbo-charge boost pressure.

TURBO-CHARGER

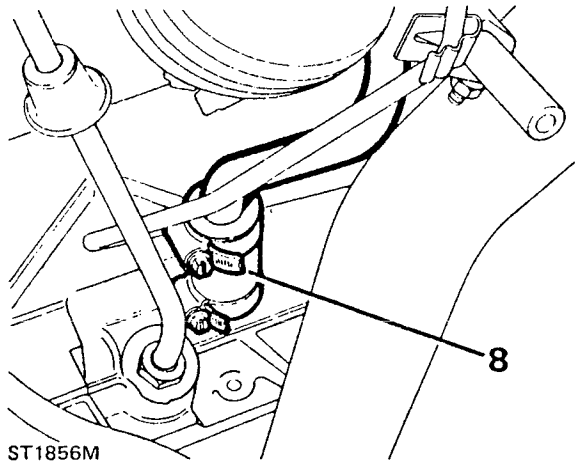
Removing

1. Remove the bonnet.
2. Remove the hose connecting the air cleaner to the turbo-charger.
3. Remove the turbo-charger heat shield fixings and remove the heat shield.
4. Release the clamp securing the turbo-charger elbow to the exhaust downpipe.
5. Remove the inlet manifold to the turbo-charger hose.
6. Disconnect the boost control hose from the turbo-charger.
7. Disconnect from the turbo-charger the lubrication inlet pipe.



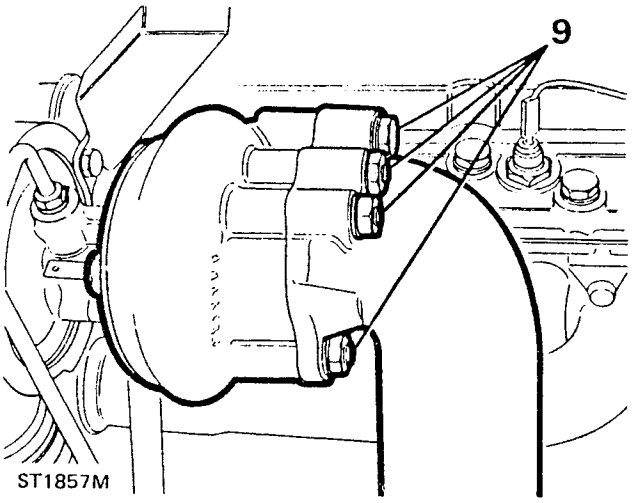
ST1855M

8. Disconnect, at the flexible hose, the lubrication drain pipe from the turbo-charger.



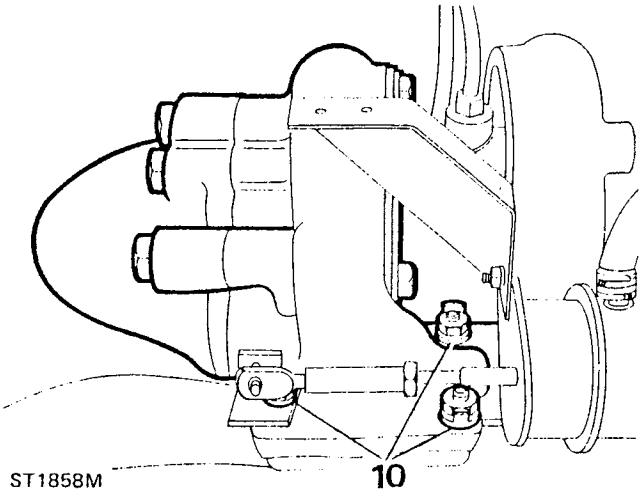
ST1856M

9. Remove the five nuts to release the exhaust elbow and gasket from the turbo-charger.



ST1857M

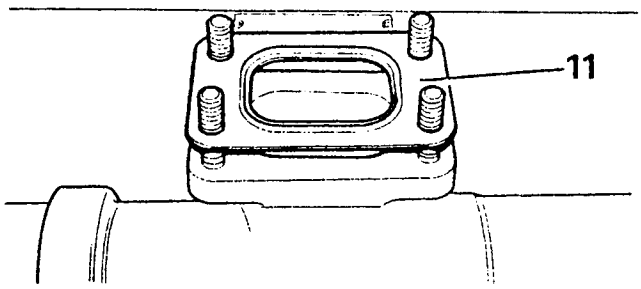
10. Release the lock tabs and remove the four nuts securing the turbo-charger to the exhaust manifold and remove the turbo-charger and gasket.



ST1858M

Fitting

11. Fit the raised bead side of a new gasket uppermost to the exhaust manifold and fit and secure the turbo-charger with the four nuts, tightening evenly to the correct torque and secure with lock tabs.
12. Fit the exhaust elbow, using a new gasket, to the turbo-charger and retain with the five nuts tightening evenly to the correct torque.

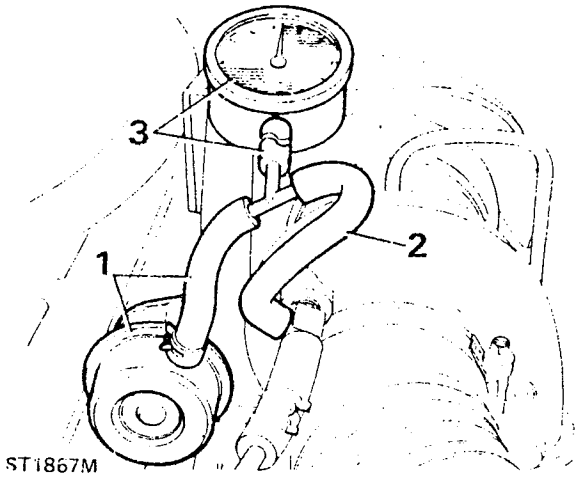


ST1863M

13. Fit the exhaust downpipe to the turbo-charger elbow and tighten the clamp bolt.
14. Connect the lubrication inlet pipe to the turbo-charger.
15. Fit the oil drain pipe to the flexible connection.
16. Connect the boost control pipe to the turbo-charger.
17. Fit the hose connecting the inlet manifold to turbo-charger.
18. Fit the heat shield.
19. Fit the air cleaner to turbo-charger hose.
20. Immediately prior to starting the engine release the oil inlet pipe to the turbo-charger and fill the centre housing with a recommended make and grade of engine oil and re-fit the pipe.

CHECKING TURBO-CHARGER BOOST PRESSURE

1. Disconnect, from the turbo-charger, the hose to the actuator and insert, into the free end a suitable 'T' piece.
2. Connect a short length of slave hose to the turbo-charger and connect the other end to the 'T' piece.
3. Connect a further slave hose to the third leg of the 'T' piece and the other end to a pressure gauge capable of reading in excess of 50 cm of Mercury. The pressure gauge hose must be long enough to reach into the cab of the vehicle so that the gauge can be observed by the driver or passenger.
4. Drive the vehicle in the normal manner (2,500-3,000 r.p.m. full load) and observe the maximum pressure obtained and compare with the figure in Data Section 05.



ST1867M

RENEW TURBO-CHARGER ACTUATOR

1. Remove the two screws securing actuator bracket to the turbo-charger.
2. Remove the nut and bolt securing actuator to the heat shield bracket and disconnect the hose.
3. Remove clip retaining actuator arm to the wastegate lever pin and withdraw the actuator from the engine.
4. Fit the replacement actuator with the two bolts and single nut and bolt. Tighten bolts to 12.5 to 14.0 Nm (111 to 124 in lbs).
5. Push the wastegate lever as far as possible towards the actuator and apply pressure to keep lever in this position.
6. Pressurize the replacement actuator to 57-62 cm HgG (11-12 p.s.i.g) and hold this pressure.

CAUTION: Use only the threaded rod-end to make adjustments. Forcing the entire rod in or out will change the calibration with the possibility of damaging engine over-boost.

7. Screw the rod-end in either direction until the rod end eye will locate easily over the wastegate pin and secure with retaining clip.
8. Release the calibration pressure and tighten the rod end locknut. Reconnect the hose.
9. Check the boost pressure, on the road, as described earlier. The pressure should not fall below 44 or exceed 50 cm HgG (8.5 — 9.7 p.s.i.g.)

TURBO-CHARGER FAULT TRACING

It is important to be aware that when tracing a suspected fault in a turbo-charger that a turbo-charger cannot compensate for incorrect engine operation deficiencies in the air, or fuel intake systems, exhaust emission components or for damaged and worn engine internal parts such as valves and pistons. Before suspecting the turbo-charger, the engine should be checked against the tuning data in Section 05. Replacing a sound turbo-charger with another will not correct engine deficiencies.

Systematic fault tracing of a suspected turbo-charger failure is important for two reasons. First, it must be found what, if anything, is wrong with the turbo-charger so that it can be exchanged. Second, it must be decided what action is necessary to prevent a repeat failure.

In many cases, evidence pointing to the cause of a failure is destroyed while removing the turbo-charger from the engine. For example, if a turbo-charger failed because of a faulty installation, such as loose connections that allowed dirt to enter the compressor, this would not be evident once the turbo-charger was removed from the engine. Failure to correct the installation, such as reinstalling defective manifold flange connections, could cause an identical failure of the replacement unit. The hose connecting the air cleaner to the compressor, which could contain dirt or harmful particles, should be cleaned or renewed if necessary.

In general, the fault tracing procedures that can be done with the least effort and in the least amount of time should be done first. Do not remove and renew the turbo-charger until the following visual checks and repairs that can be made with the turbo-charger installed, have been done. **DO NOT, UNDER ANY CIRCUMSTANCES, DISMANTLE THE TURBO-CHARGER.**

VISUAL INSPECTION

1. Inspect all connections within the intake system. Tighten loose connections as required.
2. Replace damaged air intake components.
3. Check the connection between the compressor and the engine intake manifold.
   Tighten loose bolts as required.
4. Check exhaust system connections at turbine housing inlet and outlet flanges for oil leakage and loose connections. Tighten loose connections as required. If oil leakage exists, check the general condition of the engine.
5. Check the oil line connections at the centre housing oil inlet and outlet ports for leakage.
   Tighten loose connections as required. Start engine and recheck connections.

ENGINE PROTECTION

To prevent corrosion of the aluminium alloy engine parts it is imperative that the cooling system is filled with a solution of clean water and the correct type of anti-freeze, winter and summer, or water and inhibitor if frost precautions are not required. Never fill or top-up with water only, always add an inhibitor (Marstons SQ36) if anti-freeze is not used. NEVER use salt water with an inhibitor 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.

Recommended solutions

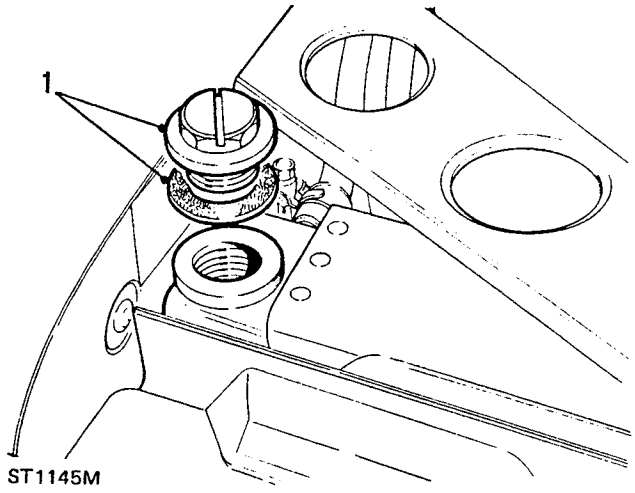
Anti-freeze Unipart Universal Anti-freeze or permanent type ethylene base, without methanol, with a suitable inhibitor for aluminium engines and engine parts.
Use one part of anti-freeze to one part water.

Inhibitor Marston Lubricants SQ36 inhibitor concentrate.
Use 100 cc of inhibitor per litre of water.
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.
Land Rovers leaving the factory have the cooling system filled with 50% of anti-freeze mixture. This gives protection against frost down to minus 47°C (minus 53°F). Vehicles so filled can be identified by a label affixed to the windscreen and radiator.
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 leakproof. Inhibitor solution should be drained and flushed out and new inhibitor solution introduced every two years, or sooner where the purity of the water is questionable.
See the 'General specification data' section for protection quantities.

DRAIN AND FILL V8 ENGINE 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.

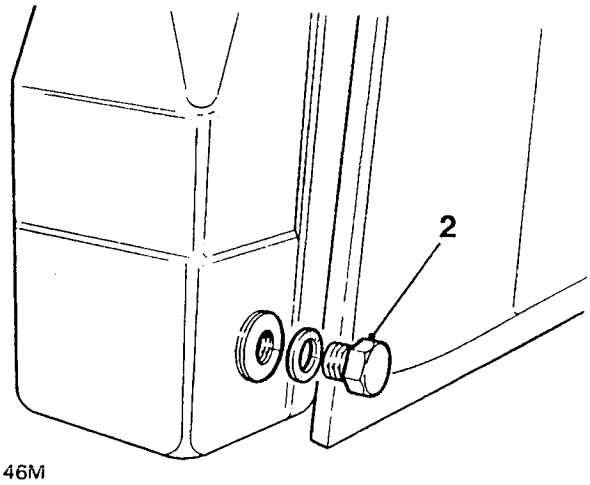
1. Remove the radiator filler plug.



ST1145M

2. Remove the radiator drain plug and allow the coolant to drain, if necessary, into a suitable container. Refit the drain plug and new washer. The drain plug is situated on the left-hand side of the radiator towards the bottom facing the engine compartment.

NOTE: Disconnect bottom hose to drain on radiators without a drain plug. Connect hose after draining.



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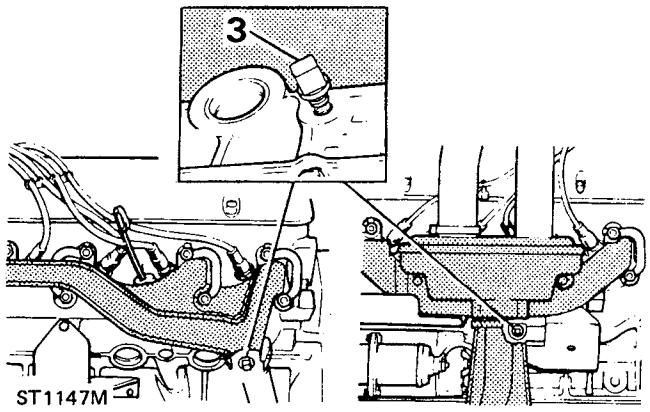
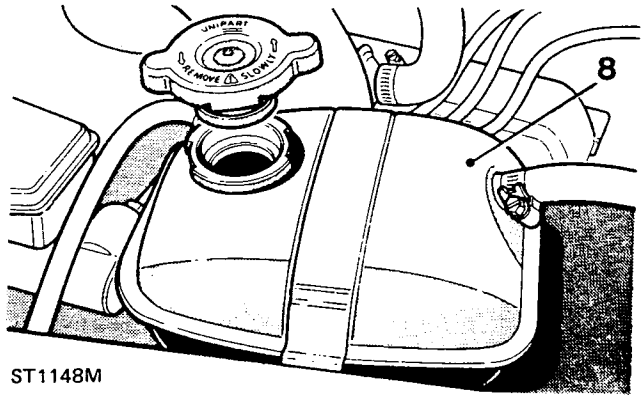
3. Remove the engine drain plugs, one each side of the cylinder block, beneath the exhaust manifolds. Allow the coolant to drain and refit plugs and washers.



4. To drain the expansion tank remove it from the vehicle, empty, flush-out and refit. If necessary renew the expansion tank hose.
5. 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.
6. If anti-freeze is not required use Marstons SQ36 in the concentration recommended as described under 'Engine protection'. Make up a quantity in excess of capacity for topping up and expansion tank.
7. Make sure all drain plugs are tight and fill the system through the radiator filler plug until the coolant is just below the filler neck. Fit the plug but do not over tighten.
8. Half fill the expansion tank with coolant and secure the cap correctly.

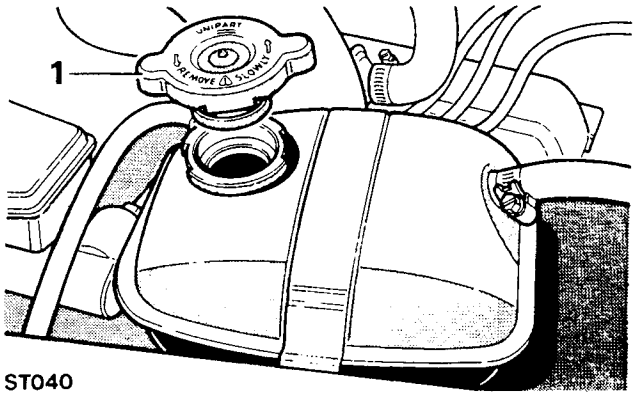


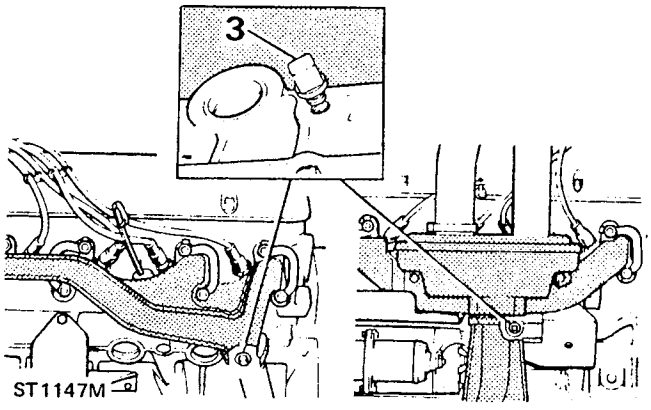
9. Start and run the engine until normal operating temperature is reached. Allow the engine to cool and check the levels in the radiator and expansion tank and top up if necessary. Finally check all hose connections for leaks.

DRAIN AND FILL 2.25 LITRE PETROL AND DIESEL AND 2.5 DIESEL SYSTEMS

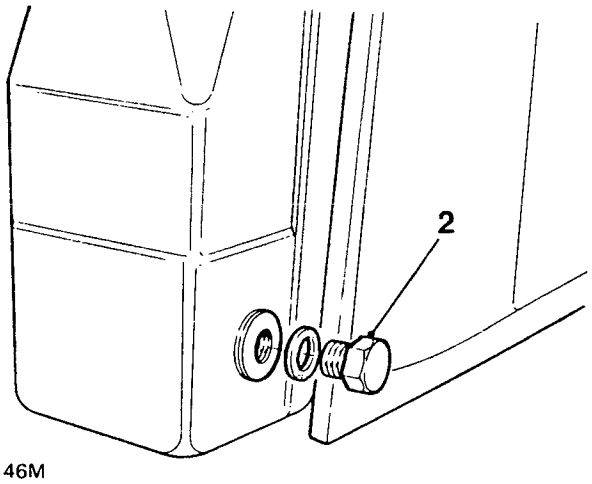
WARNING: Do not remove the radiator or expansion tank filler caps when the engine is hot because the cooling system is pressurized and personal scalding could result.

1. Remove the expansion tanks and radiator filler plug.



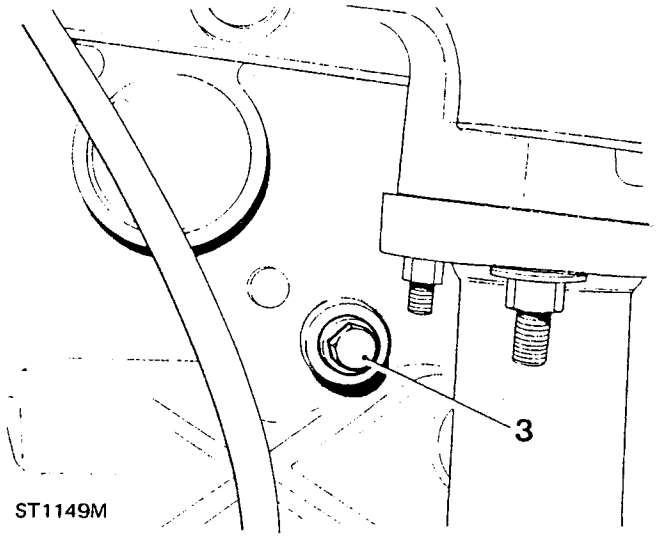


2. Remove the radiator drain plug and allow the coolant to drain, if necessary into a suitable container. Refit the drain plug with a new washer. The plug is located on the left-hand side of the radiator facing the engine compartment.



NOTE: Radiator without a drain plug, disconnected the bottom hose to drain. Reconnect after draining.

3. Remove the cylinder block drain plug, on the left-hand side of the engine, and allow coolant to drain completely before refitting the plug.



4. To drain the expansion tank, disconnect the hose from the tank to the water pump. Drain and flush and reconnect the hose.
5. Make up a solution of anti-freeze and water in a separate container in the concentration required. The cooling system capacity can vary so refer to 'Capacities' under 'General specification data'. To allow for topping up and the expansion tank prepare a quantity in excess of the capacity of the system concerned.
6. If anti-freeze is not required, use Marstons inhibitor SQ36 in the recommended concentration, see under 'Engine protection'. Prepare a quantity in excess of the capacity for topping up and the expansion tank.
7. Check all hoses and drain plugs for security and fill the system through the expansion tank until approximately three quarters full.
8. Fit the expansion tank cap and radiator filler plug and run the engine until normal operating temperature is reached. Allow the engine to cool completely. Remove the expansion tank cap and if necessary top up to half full. Remove the radiator filler plug and check that the coolant level is just below the filler neck. Finally examine the cooling system for leaks. Tighten the radiator filler plug to 40 — 50 lbs. in.

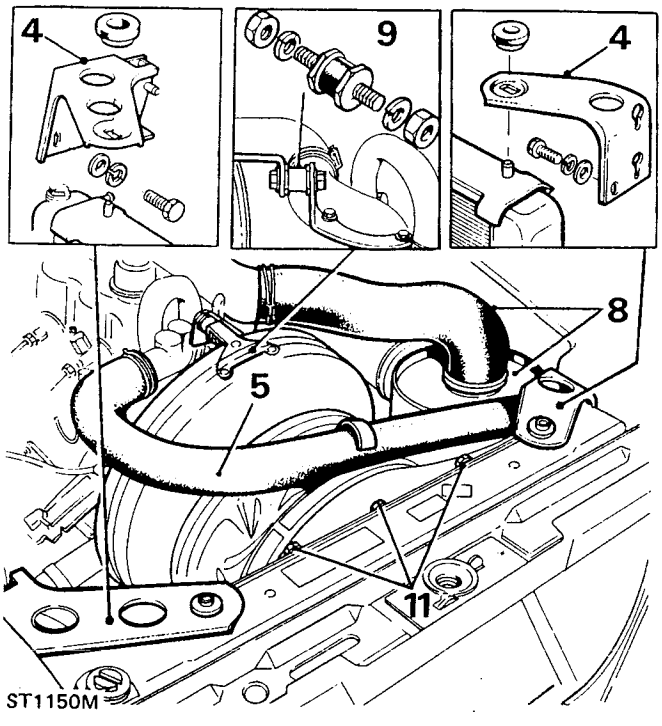
REMOVING THE RADIATOR (2.25 litre petrol and 2.25 and 2.50 diesel)

1. Disconnect the battery.
2. Drain the radiator by removing the drain plug at the bottom left-hand side of the radiator and releasing the expansion tank filler cap. See drain and fill cooling system.
3. Disconnect the overflow hose from the radiator.
4. The radiator is held in position by two brackets each secured by three screws. Remove the screws and brackets.
5. Disconnect the top and bottom hoses from the radiator.
6. **Diesel engine**
7. Disconnect the vacuum pump hose from the pump and release it from the clips on the radiator cowling.

Petrol engine

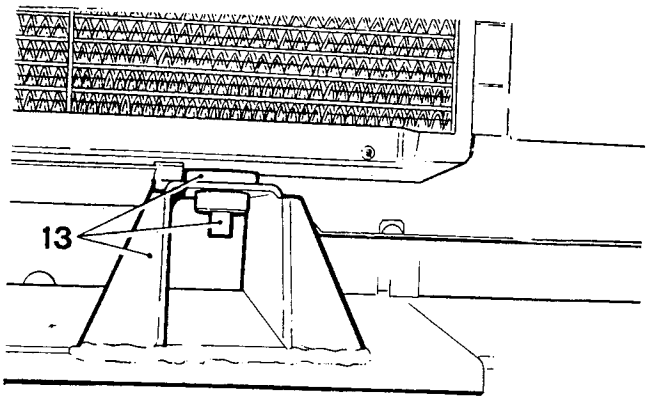
8. Disconnect the air cleaner hose from the carburetter and remove the air cleaner.
9. Release the three fixings securing cowling to the engine.
10. Pull back the cowling towards the radiator and lift radiator and cowl.
11. Remove the five screws securing the cowling to the radiator and separate the two units noting that the cowling is held to the bottom of the radiator by two clips.

continued



FITTING THE RADIATOR

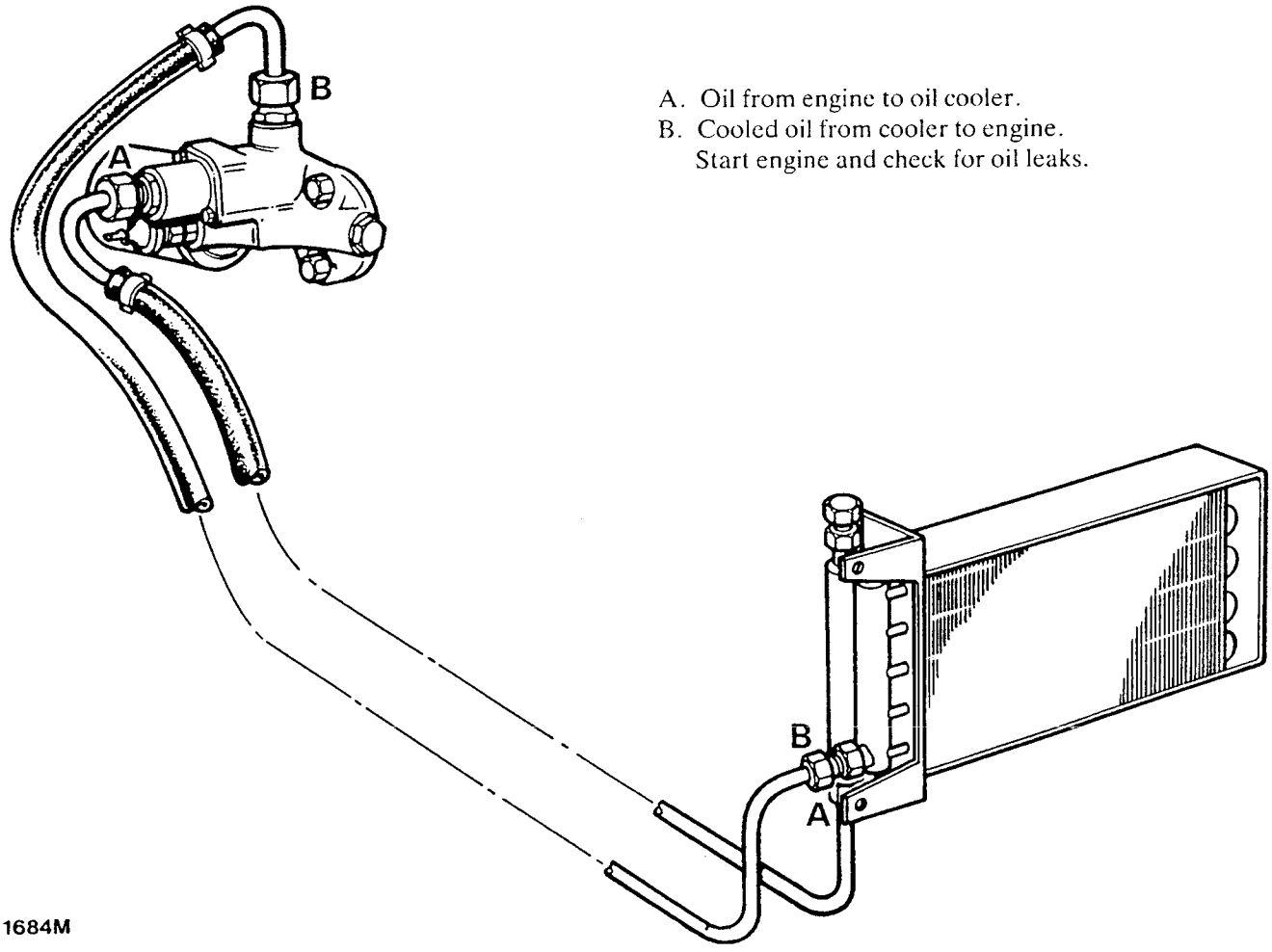
12. Locate the cowling into the clip at the bottom of the radiator and secure it at the top with the five screws.
13. Lower the radiator and cowl assembly into position in the vehicle ensuring that the two pegs at the bottom of the radiator locate in the corresponding rubber pads in the crossmember brackets.



ST1151M

14. Secure the top of the radiator with the two brackets and bolts.
15. Secure the cowling to the engine.
16. Connect the top, bottom and overflow hoses.
17. **Diesel engine**
    Fit the hose to the vacuum pump and secure it with the clips on the cowling.
    Fit the air cleaner and connect the hose to the air intake manifold.
18. **All engines**

    Check that the radiator drain plug (where fitted) is tight and fill the cooling system.



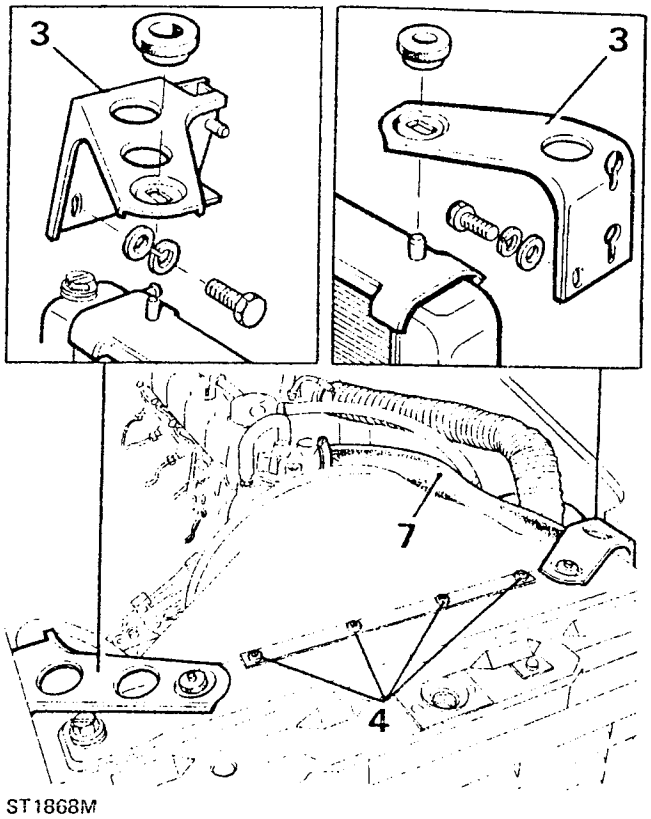
A. Oil from engine to oil cooler.
B. Cooled oil from cooler to engine.
Start engine and check for oil leaks.

ST1684M

RADIATOR ASSEMBLY — TURBO-CHARGED VEHICLES.

Removing

1. Disconnect the battery.
2. Remove the split pin and clevis pin securing the lower end of the bonnet stay and lift-off the bonnet.
3. Remove the three screws each side securing the radiator left-hand and right-hand retaining brackets and remove the brackets.
4. Remove the four screws and withdraw the radiator cooling fan cowl.
5. Disconnect the bottom hose from the radiator and drain the coolant.
6. Disconnect the oil cooler inlet and outlet pipes from the radiator and blank-off the pipes and radiator apertures to prevent ingress of dirt.
7. Disconnect the radiator top hose from the radiator and thermostat housing.
8. Disconnect expansion tank hose from radiator.
9. Lift the radiator from the engine compartment.
10. If the radiator is to be renewed, remove the oil cooler unions from the radiator and fit to the replacement radiator.



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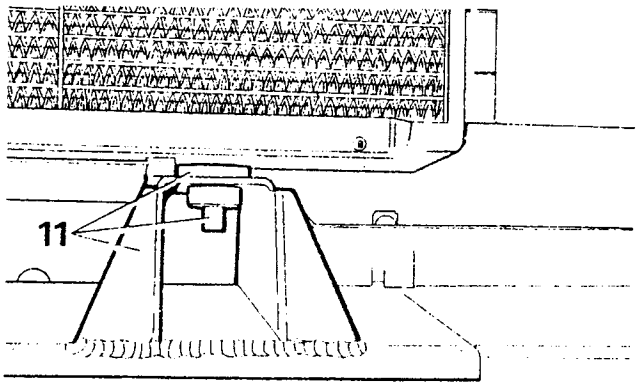
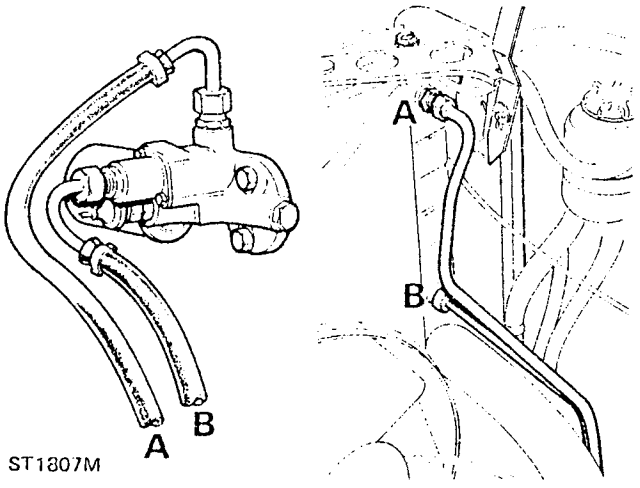
Fitting

11. Fit the radiator into position ensuring that the two pegs at the bottom of the radiator locate in the corresponding rubber pads in the cross member brackets.



ST1869M

12. Fit the radiator top hose to the radiator and thermostat housing.
13. Connect the radiator bottom hose.
14. Fit the expansion tank hose to radiator.
15. Fit the fan cowl and secure with the four screws.
16. Fit the radiator left-hand and right-hand retaining brackets.
17. Fit the oil cooler inlet and outlet hoses to the radiator.
    Hose A to top of radiator.
    Hose B to bottom of radiator.

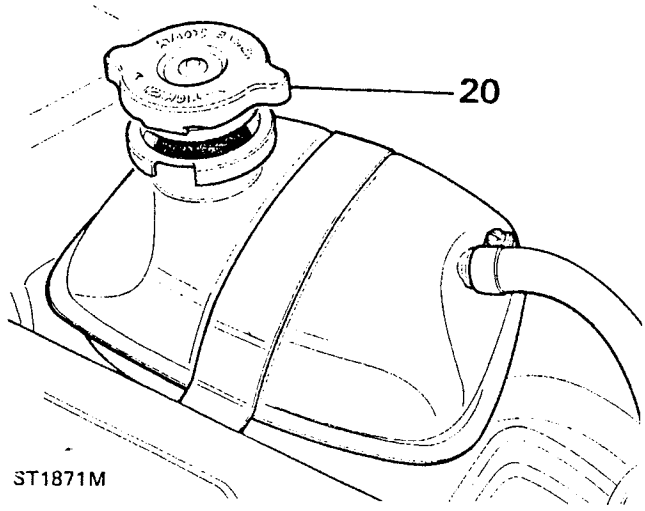


ST1807M

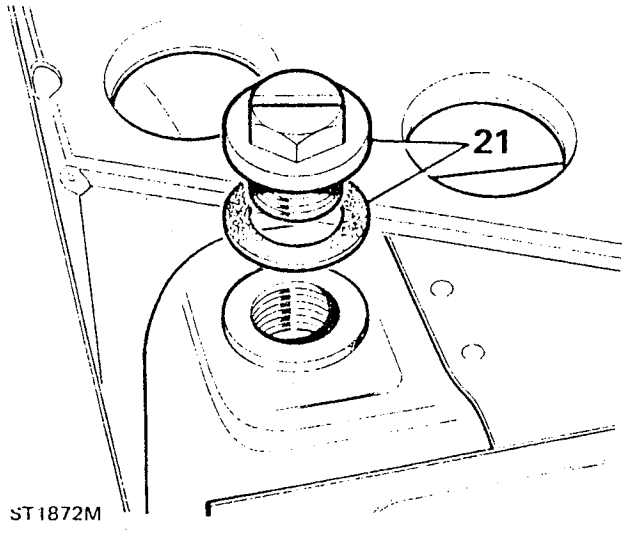
18. Fit the bonnet and stay securing with the clevis pin and new split pin.

Filling radiator

19. Check that all hose clips are tight.
20. Remove the expansion tank cap.



21. Remove the radiator plug.



22. Fill the system with coolant using a mixture of water and anti-freeze or anti-corrosion inhibitor, through the expansion tank untill the coolant is just below the level of the radiator plug hole. Continue filling until the expansion tank is half-full.
23. Fit the expansion tank cap and radiator plug. Tighten the plug to 40 — 50 lbs. in.
24. Check the engine oil level in sump and top-up.
25. Connect the battery and run the engine until normal running temperature is attained whilst checking for coolant leaks.
26. Stop the engine and allow it to cool completely.
27. Remove the radiator plug and check the level and fit and tighten plug.
28. Top-up level of expansion tank and fit the cap.

COOLING SYSTEM FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
A—EXTERNAL LEAKAGE	1. Loose hose clips 2. Defective rubber hose 3. Damaged radiator seams 4. Excessive wear in the water pump 5. Loose core plugs 6. Damaged gaskets 7. Leaks at the heater connections or plugs 8. Leak at the water temperature gauge plug	1. Tighten 2. Renew 3. Rectify 4. Renew 5. Renew 6. Renew 7. Rectify 8. Tighten
B—INTERNAL LEAKAGE	1. Defective cylinder head gasket 2. Cracked cylinder wall 3. Loose cylinder head bolts	1. Renew. Check engine oil for contamination and refill as necessary 2. Renew cylinder block 3. Tighten. Check engine for oil contamination and refill as necessary
C—WATER LOSS	1. Boiling 2. Internal or external leakage 3. Restricted radiator or inoperative thermostat	1. Ascertain the cause of engine overheating and correct as necessary 2. See items A and B 3. Flush radiator or renew the thermostat as necessary
D—POOR CIRCULATION	1. Restriction in system 2. Insufficient coolant 3. Inoperative water pump 4. Loose fan belt 5. Inoperative thermostat	1. Check hoses for crimps, reverse-flush the radiator, and clear the system of rust and sludge 2. Replenish 3. Renew 4. Adjust 5. Renew
E—CORROSION	1. Excessive impurity in the water 2. Infrequent flushing and draining of system 3. Incorrect anti-freeze mixtures	1. Use only soft, clean water together with correct anti-freeze or inhibitor mixture 2. The cooling system should be drained and flushed thoroughly at least once a year 3. Certain anti-freeze solutions have a corrosive effect on parts of the cooling system. Only recommended solutions should be used.
F—OVERHEATING	1. Poor circulation 2. Dirty oil and sludge in engine 3. Radiator fins choked with chaff, mud, etc. 4. Incorrect ignition timing 5. Insufficient coolant 6. Low oil level 7. Tight engine 8. Choked or damaged exhaust pipe or silencer 9. Dragging brakes 10. Overloading vehicle 11. Driving in heavy sand or mud 12. Engine labouring on gradients 13. Low gear work 14. Excessive engine idling 15. Inaccurate temperature gauge 16. Defective thermostat	1. See item D 2. Refill 3. Use air pressure from the engine side of the radiator and clean out passages thoroughly 4. Check using electronic equipment 5. See item D 6. Replenish 7. New engines are very tight during the 'running-in' period and moderate speeds should be maintained for the first 1,000 miles (1500 km) 8. Rectify or renew 9. Adjust brakes 10. In the hands of the operator 11. In the hands of the operator 12. In the hands of the operator 13. In the hands of the operator 14. In the hands of the operator 15. Renew 16. Renew
G—OVERCOOLING	1. Defective thermostat 2. Inaccurate temperature gauge	1. Renew 2. Renew

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 — V8.
5. Remove the slipper pads — 4-cylinder engines only.
6. Withdraw the release lever.
7. Discard worn parts.
8. Smear the pivot with grease and fit the release lever and retain with the spring clip and bolt — V8.
9. Smear the release bearing sleeve inner diameter with Molybdenum disulphide base grease.
10. Fit the slipper pads.
11. 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.

Illustration A. V8 engine

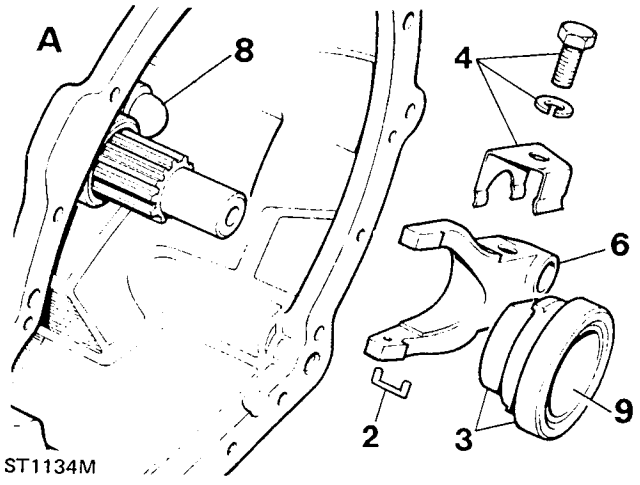


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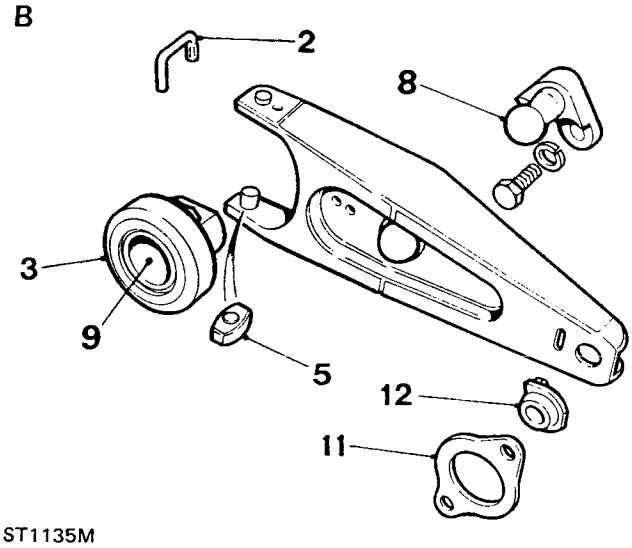
Illustration B. 4-cylinder engines



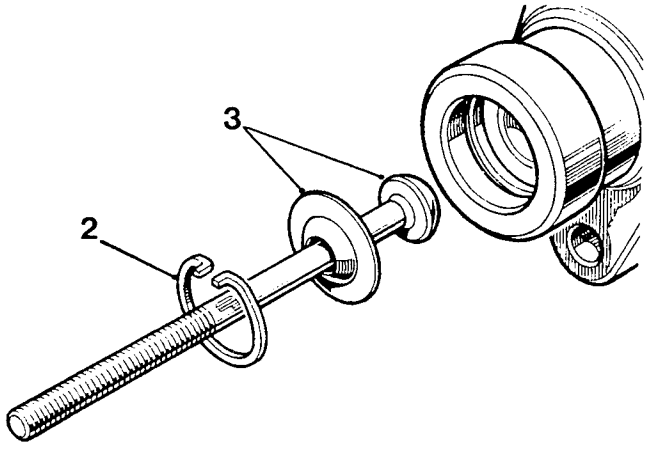
ST1135M

12. 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.
13. Check that the push-rod clip is in position.
14. 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, tightening evenly to the correct torque.

OVERHAUL MASTER CYLINDER — All models

DISMANTLE

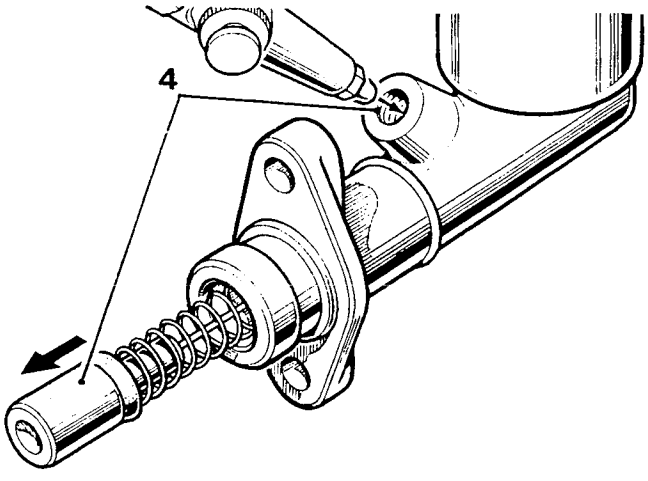
1. Remove the master cylinder from the vehicle.
2. Remove the circlip.
3. Withdraw the push-rod and retaining washer.



ST1136M

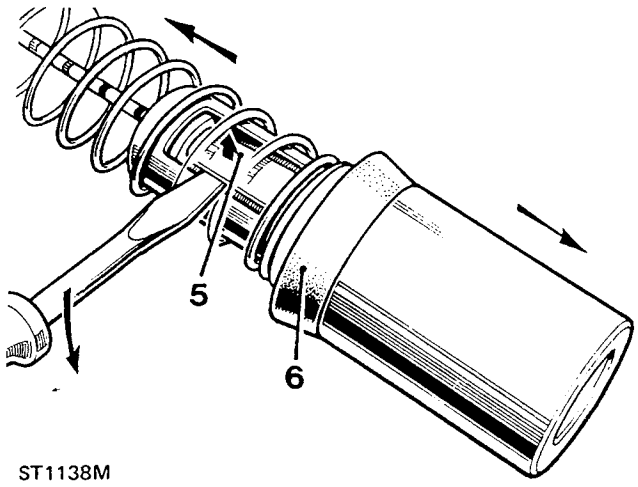
4. Withdraw the piston assembly. If necessary, apply a low air pressure to the outlet port to expel the piston.

continued



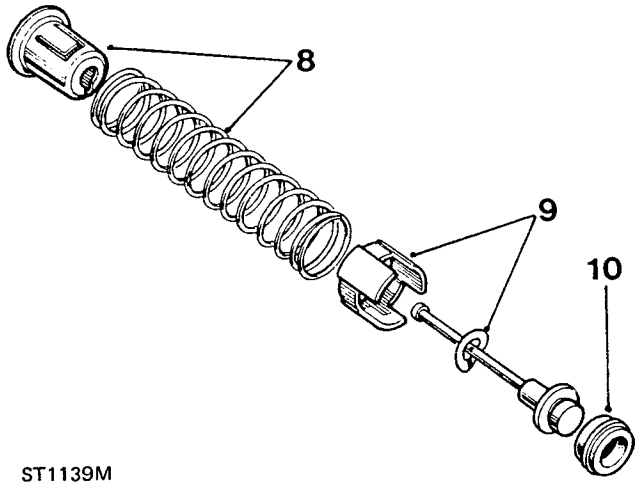
ST1137M

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.



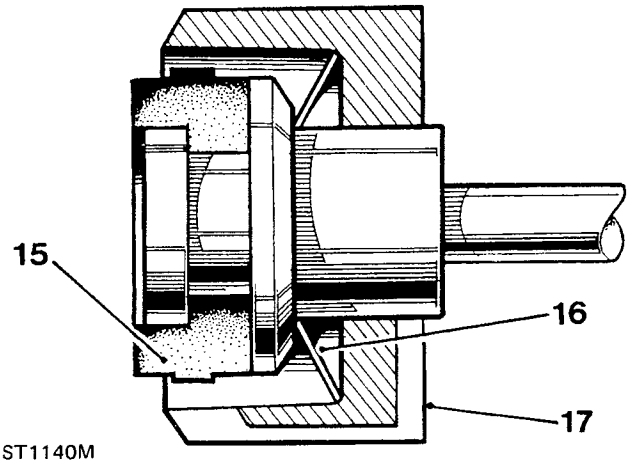
ST1139M

Inspection

11. Clean all components in Girling 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.

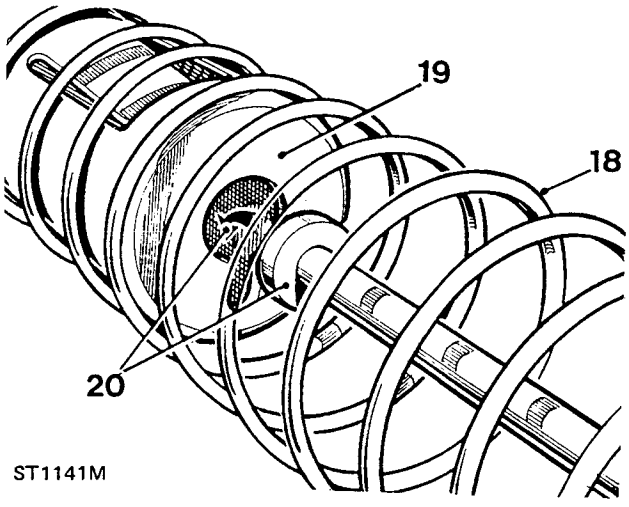
Assemble

14. Smear the seals with Castrol-Girling rubber grease and the remaining internal items with Castrol-Girling 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.



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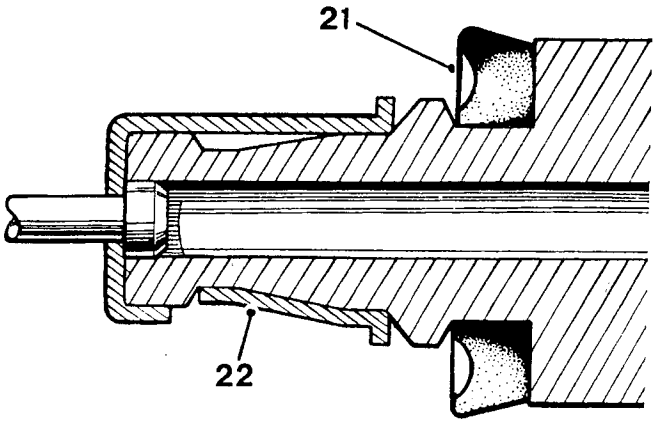
21. Fit the seal, large diameter last, to the piston.
22. Insert the piston into the spring retainer and engage the locking prong.

continued



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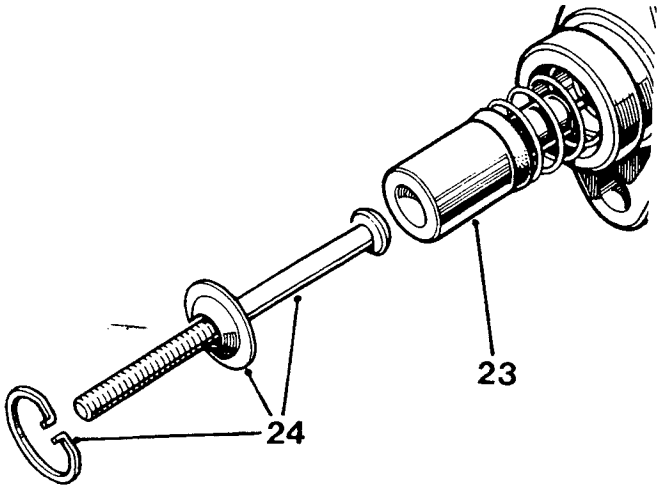
23. Smear the piston with Castrol-Girling rubber grease and insert the assembly, valve end first, into the cylinder.
24. Fit the push-rod, retaining washer and circlip.



ST1143M

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.

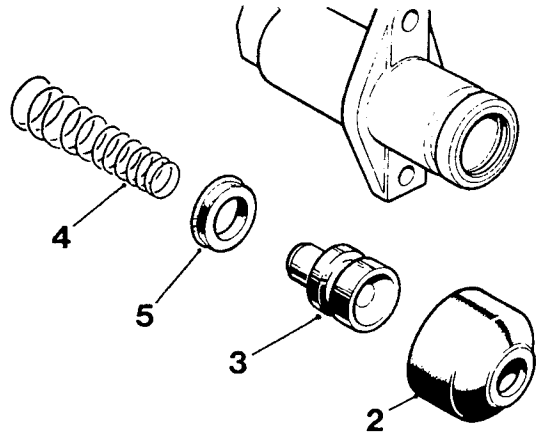
NOTE: During the following procedure, keep the fluid reservoir topped-up to avoid introducing air into the system. Use only the fluid recommended in the Lubrication chart. Use only new fluid from a sealed container.

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.

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.



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Inspection

6. Clean all components with Girling 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

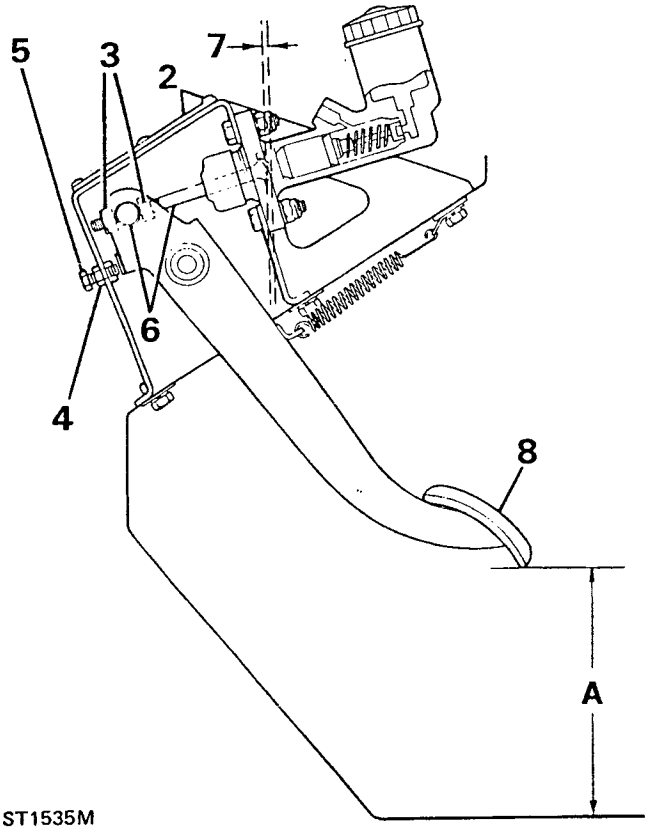
9. Smear the seal with Castrol-Girling rubber grease and the remaining internal items with Castrol-Girling brake and clutch fluid.
10. Fit the seal, large diameter last, to the piston.
11. Locate the conical spring, small diameter first, over the front end of the piston.
12. Smear the piston with Castrol-Girling rubber grease and insert the assembly, spring end first, into the cylinder.
13. Fill the dust cover with Castrol-Girling 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 (5.5 in), 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 (0.062 in) free-play between the push-rod and master cylinder. When correct tighten the locknuts.
8. Check that there is 6 mm (0.250 in) free movement of the pedal at the pad. If necessary re-adjust the push-rod.
9. Refit the top plate.



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INTRODUCTION

This Workshop Manual covers the Land Rover Ninety and One Ten range of vehicles. It is primarily designed to assist skilled technicians in the efficient repair and maintenance of Land Rover vehicles.

Using the appropriate service tools and carrying out the procedures as detailed will enable the operations to be completed within the time stated in the 'Repair Operation Times'.

The Manual has been produced in separate books; this allows the information to be distributed throughout the specialist areas of the modern service facility.

A table of contents in Book 1 lists the major components and systems together with the section and book numbers. The cover of each book details the sections contained within that book. Each section starts with a list of operations in alphabetical order.

The title page of each book carries the part numbers required to order replacement books, binders or complete Service Manuals. This can be done through the normal channels.

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 and accessories:
Safety features embodied in the vehicle may be impaired if other than Land Rover parts are fitted. In certain territories, legislation prohibits the fitting of parts not to the vehicle manufacturer's specification. Torque 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.

POISONOUS SUBSTANCES

Many liquids and other substances used in motor vehicles are poisonous and should under no circumstances be consumed and should as far as possible be kept away from open wounds. These substances among others include antifreeze, brake fluid, fuel, windscreen washer additives, lubricants and various adhesives.

FUEL HANDLING PRECAUTIONS

The following information provides basic precautions which must be observed if petrol (gasoline) 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.

GENERAL

Petrol/gasoline vapour is highly flammable and in confined spaces is also very explosive and toxic.
When petrol/gasoline evaporates it produces 150 times its own volume in vapour, which when diluted with air becomes a readily ignitable mixture. The vapour is heavier than air and will always fall to the lowest level. It can readily be distributed throughout a workshop by air current, consequently, even a small spillage of petrol/gasoline is potentially 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.
Always disconnect the vehicle battery BEFORE carrying out dismantling or draining work on a fuel system.
Whenever petrol/gasoline is being handled, drained or stored, or when fuel systems are being dismantled all forms of ignition must be extinguished or removed, any head-lamps used must be flameproof and kept clear of spillage.

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

FUEL TANK DRAINING

WARNING: PETROL/GASOLINE MUST NOT BE EXTRACTED OR DRAINED FROM ANY VEHICLE WHILST IT IS STANDING OVER A PIT.

Draining or extracting petrol/gasoline from vehicle fuel tank must be carried out in a well ventilated area.
The receptacle used to contain the petrol/gasoline must be more than adequate for the full amount of fuel to be extracted or drained. The receptacle should be clearly marked with its contents, and placed in a safe storage area which meets the requirements of local authority regulations.
WHEN PETROL/GASOLINE HAS BEEN EXTRACTED OR DRAINED FROM A FUEL TANK THE PRECAUTIONS GOVERNING NAKED LIGHTS AND IGNITION SOURCES SHOULD BE MAINTAINED.

FUEL TANK REMOVAL

On vehicles where the fuel line is secured to the fuel tank outlet by a spring steel clip, it is recommended that such clips are released before the fuel line is disconnected or the fuel tank unit is removed. This procedure will avoid the possibility of residual petrol fumes in the fuel tank being ignited when the clips are released.
As an added precaution fuel tanks should have a PETROL/GASOLINE VAPOUR warning label attached to them as soon as they are removed from the vehicle.

FUEL TANK REPAIR

Under no circumstances should a repair to any tank involving heat treatment be carried out without first rendering the tank SAFE, by using one of the following methods:

STEAMING: With the filler cap and tank unit removed, empty the tank. Steam the tank for at least two hours with low pressure steam. Position the tank so that condensation can drain away freely, ensuring that any sediment and sludge not volatised by the steam, is washed out during the steaming process.

BOILING: With the filler cap and tank unit removed, empty the tank. Immerse the tank completely in boiling water containing an effective alkaline degreasing agent or a detergent, with the water filling and also surrounding the tank for at least two hours.

After steaming or boiling a signed and dated label to this effect should be attached to the tank.

SPECIFICATION

Purchasers are advised that the specification details set out in this 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 specifications with or without notice, and at such times and in such manner as they think fit. Major as well as minor changes may be involved in accordance with the Manufacturer's policy of constant product improvement.

Whilst every effort is made to ensure the accuracy of the particulars contained in this Manual, neither the Manufacturer 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.

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Special Service Tools

The use of approved special service tools is important. They are essential if service operations are to be carried out efficiently, and safely. The amount of time which 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.

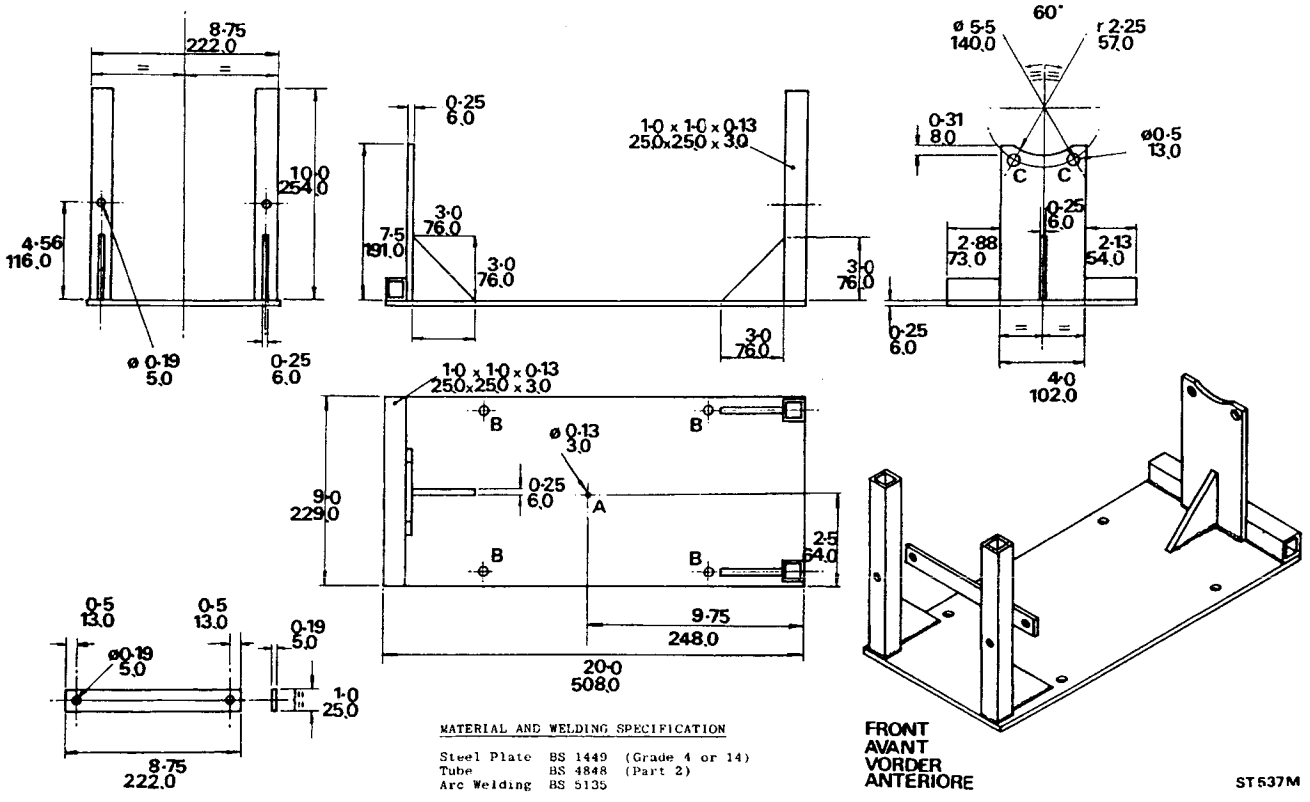
Special tools bulletins will be issued periodically giving details of new tools as they are introduced.

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, PO Box 3, Daventry, Northants, England NN11 4NF.

The tools recommended in this Workshop Manual are listed in a multi-language, illustrated catalogue obtainable from Messrs. V. L. Churchill at the above address under publication number 2217/2/84 or from Land Rover Ltd., under part number LSM0052TC from the following address, Land Rover Publication Service, P.O. Box 534, Erdington, Birmingham, B24 OQ5.

REMOVE LT77 FIVE SPEED GEARBOX AND 230R TRANSFER BOX — FOUR CYLINDER MODELS

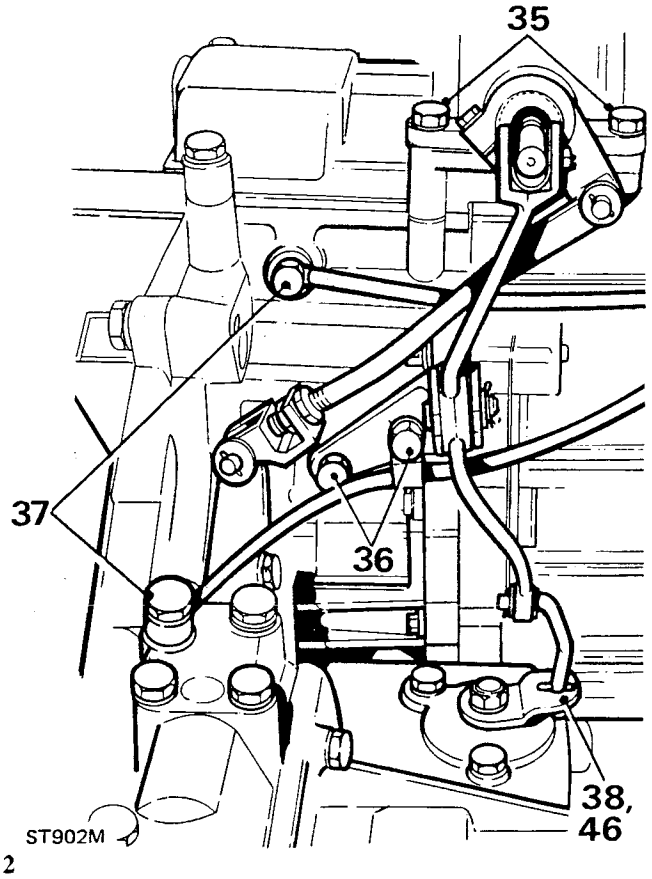
1. Install the vehicle on a ramp.
2. Disconnect the battery.
3. Remove the gear lever knob.
4. Remove the transfer and differential lock knob.
5. Remove the gear lever cover.
6. Remove the 10 mm Nyloc nut and plain washer. Mark the gear lever spline setting and detach the gear lever and gaiter from the 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 clamp holding heater pipes on top of engine to prevent heater inlet pipe fouling bulkhead.
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 L.H. 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).
29. Remove the cleat retaining the reverse light switch wires from the R.H. 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. Remove the breather pipes.
38. Disconnect the cranked lever from the differential lock lever. (A short link was used on early production).
39. Place a sling round the transfer box and attach to a hoist.
40. Remove the two nuts and four bolts retaining the transfer box to the extension housing.



41. Withdraw the transfer box. For LT230 transfer gear box dismantling refer to page 19. Dismantling information on LT77 gearbox, refer to page 3.

Assembling transfer box to main gearbox

42. Hoist the transfer box into position and ensuring that the loose upper dowel is fitted, assemble to main gearbox extension housing and secure with the four bolts and two nuts.
43. Fit the transfer selector housing to the main gearbox remote gear change housing with the four bolts. (The right hand rear bolt is longer).
44. Fit the breather pipes.
45. Fit the differential lock cross shaft lever pivot bracket to the extension housing with the two bolts.
46. Connect the cranked lever to the differential lock lever with a new split pin. (On early production connect the short link with a new 'Nyloc' nut).

Fitting main gearbox and transfer box to engine

47. 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.
48. Locate the gear lever temporarily and select any gear in the main gearbox to facilitate entry of the primary shaft.
49. Position and raise hoist and fit the transmission to the engine whilst keeping wires and pipes clear to prevent trapping.
50. Secure the transmission to the engine with the eleven nuts, noting that the top R.H. nut holds a clip for the speedometer cable.
51. Position the reverse light wires to the R.H. side of the main gearbox and secure with a cleat to the breather pipes.
52. Connect the reverse light wire to the switch at the top rear of the selector housing.
53. Connect the differential lock indicator wires (bullet connection).
54. Raise the transmission to line-up with the engine and ensure that the transfer lever clears the tunnel aperture.
55. Fit the transfer box L.H. and R.H. mounting brackets but only partially tighten the securing nuts and bolts.
56. Loosely fit the rubber mounting nuts and lower the transmission onto the mountings. Fully tighten all the securing nuts and bolts.
57. Remove the supporting jack from under the engine sump.
58. Remove the two bolts securing the cradle to the transfer box and remove the cradle and hoist.
59. Refit the two bolts using Loctite 290 on the threads and note that the L.H. bolt holds a clip for the speedometer cable.
60. Fit the slave cylinder using Hylosil on the gasket and tighten the two bolts evenly to 22 to 28 Nm (16 to 21 lb ft).

61. Fit the handbrake cable using a new split pin to secure the clevis pin. Grease the clevis and tighten the outer cable lock nuts.
62. Connect the speedometer cable.
63. Check that the three drain plugs are tight and remove the main gearbox and transfer box filler level plugs. Fill the main gearbox with approximately 1,76 litres (3 pints) of a recommended oil or 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 approximately 2,6 litres (4.5 pints) of recommended oil or until it runs out of the filler hole. Apply Hylosil to the threads and fit the plug and wipe away any surplus oil.
64. Line up the marks and fit the front and rear propeller shafts to the transfer box.
65. Fit the exhaust system, and evenly tighten the flange nuts and bolts. Fit the 'U' bolt and secure to the bracket.
66. Expand the chassis side members, fit the cross member and secure with the eight nuts and bolts (four each side).
67. Fit the heater pipe clamp.
68. Clip the breather pipes, speedometer cable and starter motor harness to rear of engine.
69. Fit the fan cowl.
70. Fit the bonnet.
71. 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.
72. Fit the cover to both gear levers.
73. Fit the gear lever knobs.
74. Connect the battery.

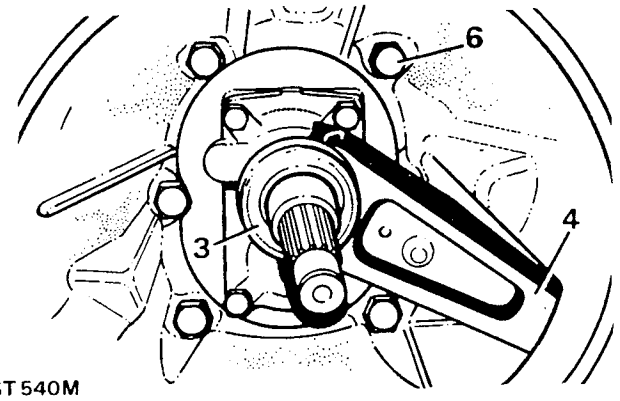
OVERHAUL LT77 FIVE SPEED GEARBOX

(4 cylinder petrol and diesel)

Service Tools:
18G705 — Bearing remover
18G705-1A — Adaptor for mainshaft
18G705-5 — Adaptor for layshaft
18G1400 — Remover for synchromesh hub and gear cluster
18G1400-1 — Adaptor mainshaft 5th gear
MS47 — Hand press
18G47BA — Adaptor, layshaft bearing remover
18G47BAX — Conversion kit
18G284 — Impulse extractor
18G284AAH — Adaptor for input shaft pilot bearing track
18G1422 — Mainshaft rear oil seal replacer
18G1431 — Mainshaft 5th gear and oil seal collar replacer

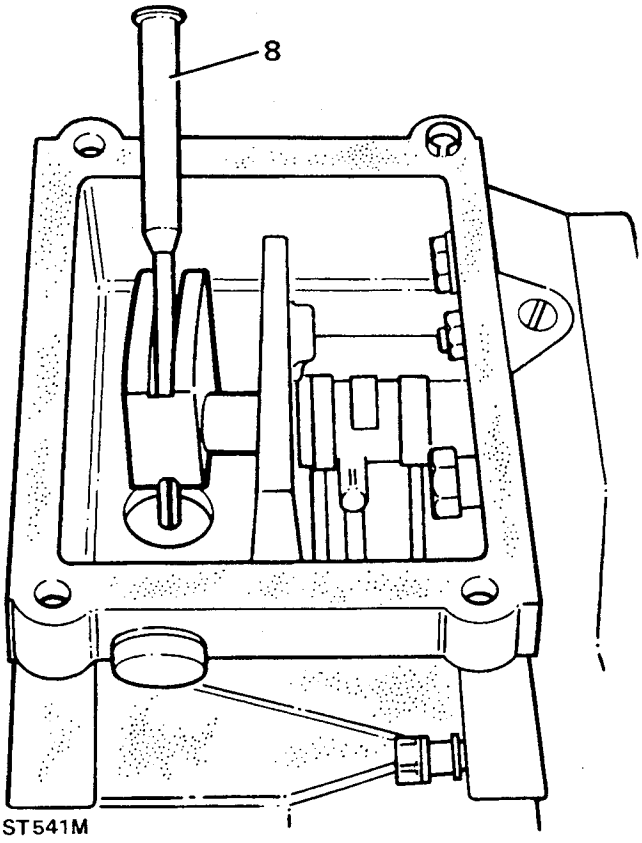
Dismantle

1. Place gearbox on a bench with the transfer gearbox removed, ensuring the oil is first drained.
2. Remove the clutch release bearing carrier clip.
3. Remove the clutch release bearing and carrier.
4. Pull the clutch release lever from the clutch release lever pivot.
5. Remove the bolts and washers securing the clutch release lever pivot.



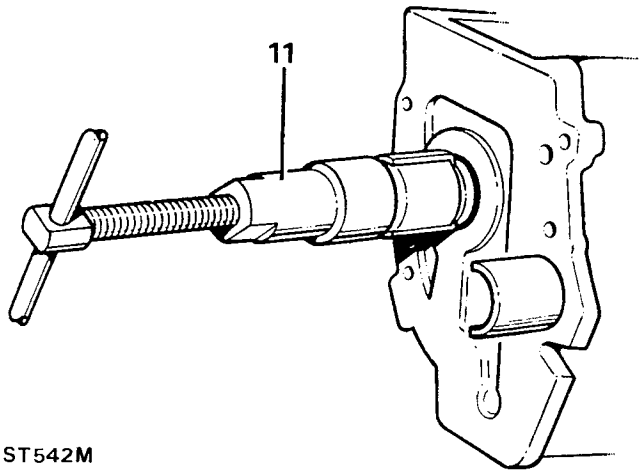
ST540M

6. Remove the bolts and washers securing the bell housing and remove the bell housing.
7. Remove the three bolts and washers retaining the gear selector housing to the fifth gear extension case. Lift the housing from the case and discard the gasket.



ST541M

8. Using a suitable pin punch, remove the roll pin retaining the selector yoke.
9. Push the selector shaft forward to engage a gear, and manoeuvre the selector yoke from the shaft. Return the selector shaft to neutral.
10. Remove the circlip which retains the mainshaft oil seal collar located at the rear of the gearbox.



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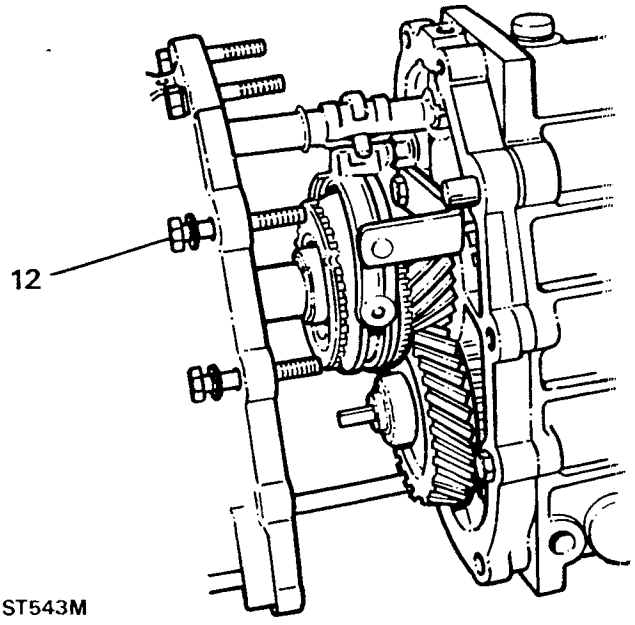
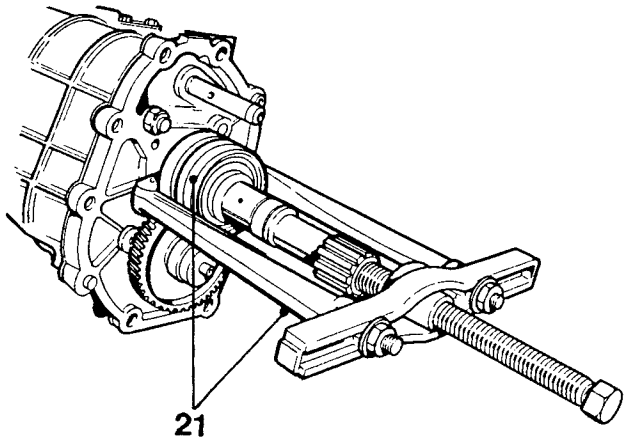
11. Using tools 18G705 and 18G705-1A remove the oil seal collar.



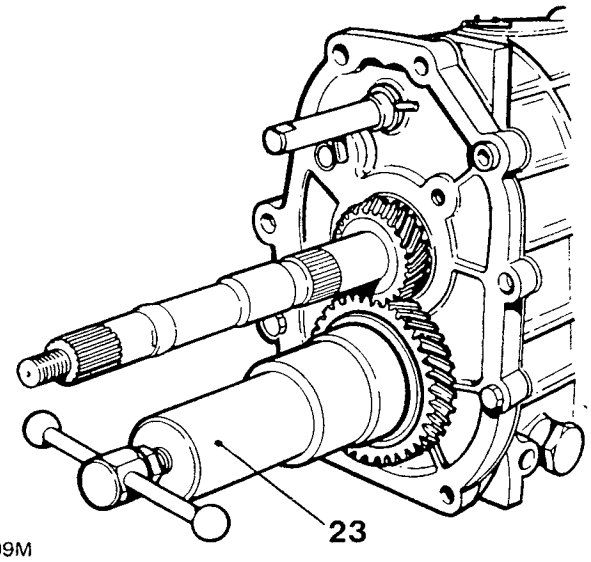
ST543M

12. Remove the ten bolts and spring washers securing the rear cover to the gearcase; withdraw the rear cover and discard the gasket.
13. Fit two dummy bolts (8 x 35 mm) to the casing to retain the centre plate to the main case.
14. Remove the oil seal collar 'O' ring from the mainshaft.
15. Withdraw the oil pump drive shaft.
16. Remove the two bolts and spring washers securing the fifth gear selector fork and bracket.
17. Withdraw the fifth gear selector spool.
18. Withdraw the fifth gear selector fork and bracket.
19. On early models, remove circlip retaining fifth gear (driving) from the layshaft. On later models, engage reverse gear by turning selector rail anti-clockwise and pulling rearwards. Move the fifth speed synchro hub into mesh with the fifth gear. De-stake the retaining nut securing the fifth gear layshaft and remove nut. Select neutral by pushing selector rail inwards and turning clockwise; and return fifth speed synchro hub to its out of mesh position.



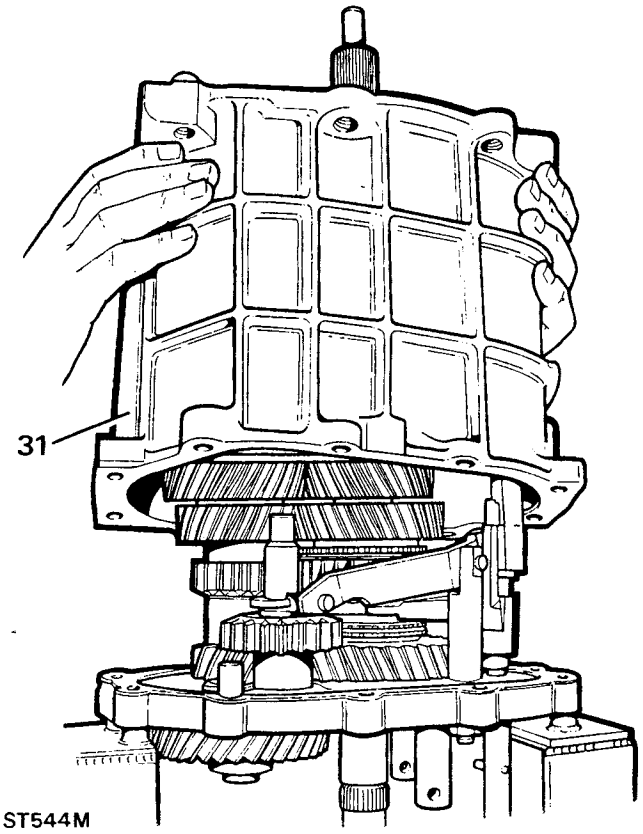
ST 908M

20. Release the circlip retaining the fifth gear synchromesh assembly to the mainshaft.
21. Using tools 18G1400-1 and 18G1400 withdraw the selective washer, fifth gear synchromesh hub and cone, fifth gear (driven) and spacer from the mainshaft.
22. Remove the split roller bearing assembly from the mainshaft.
23. Using tools 18G705 and 18G705-1A remove the layshaft spacer (if fitted) and layshaft fifth gear.



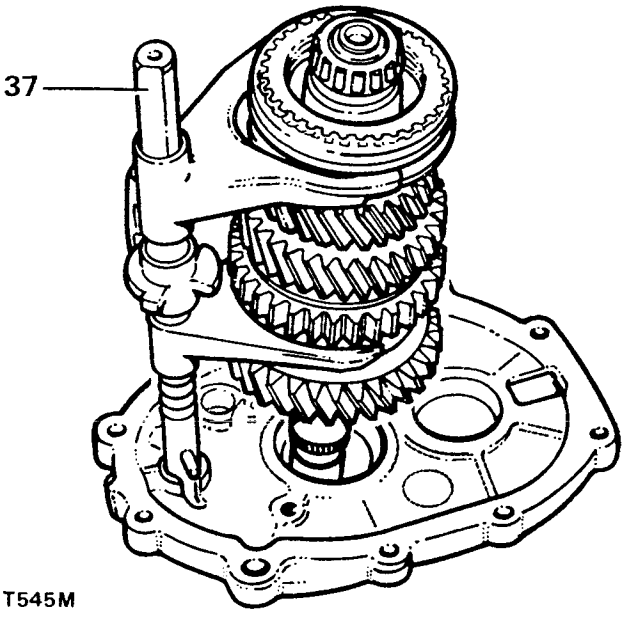
ST 909M

24. Remove the selector shaft circlip.
25. Fit suitable guide studs (measuring 8 x 60 mm) to the main gearbox case.
26. Locate the gearbox to a suitable stand.
27. Remove the six bolts and spring washers from the front cover, withdraw the cover and discard the gasket.
28. Remove the input shaft and layshaft selective washers from the gearcase.
29. Remove the two bolts and washers securing the locating boss for the selector shaft front spool, withdraw the locating boss.
30. Withdraw the selector plug, spring and ball from the centre plate.



ST544M

31. Remove the dummy bolts and carefully lift the gearcase, leaving the centre plate and gear assemblies in position. Discard gasket.
32. Insert two slave bolts and nuts to retain the centre plate to the stand; and remove the circlip, pivot pin, reverse lever and slipper pad.
33. Slide the reverse shaft rearwards and lift off the thrust washer, reverse gear and reverse gear spacer.
34. Lift off the layshaft cluster.
35. Remove the input shaft and fourth gear synchromesh cone.



ST545M

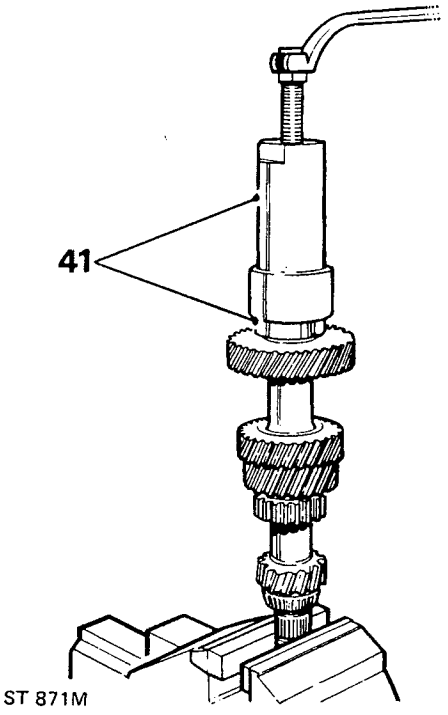
36. Rotate the fifth gear selector shaft clockwise (viewed from above) to align the fifth gear selector pin with the slot in the centre plate.
37. Remove the mainshaft and selector fork assemblies from the centre plate.
38. Detach the selector fork assembly from the mainshaft gear cluster.
39. Remove the slave bolts from the centre plate and lift the centre plate clear of the stand.

Front cover

40. Remove and discard the oil seal from the front cover. Do not fit a new oil seal at this stage.

Layshaft

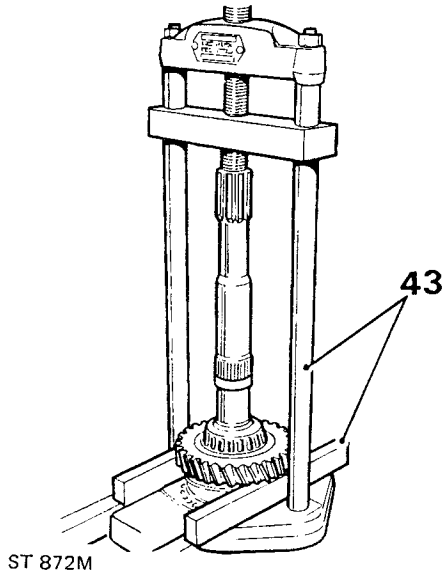
41. Using press 18G705 and tool 18G705-5 remove the layshaft bearings.



ST 871M

Mainshaft

42. Remove the centre bearing circlip.
43. Using press MS47 and any suitable metal bar, remove the centre bearing, first gear bush, first gear and needle bearings and first gear synchromesh cone.



ST 872M

44. If a difficulty is experienced in removing the first and second gear synchromesh hub, locate underneath the second gear with a suitable tool; and extract the complete synchromesh hub and second gear assemblies using a suitable press.
45. Using press MS47 and extension, with a support underneath the third speed gear, press the mainshaft through the pilot bearing spacer, third and fourth synchromesh hub, third gear synchromesh cone, third gear and third gear needle roller bearing.

First and second gear synchromesh assemblies

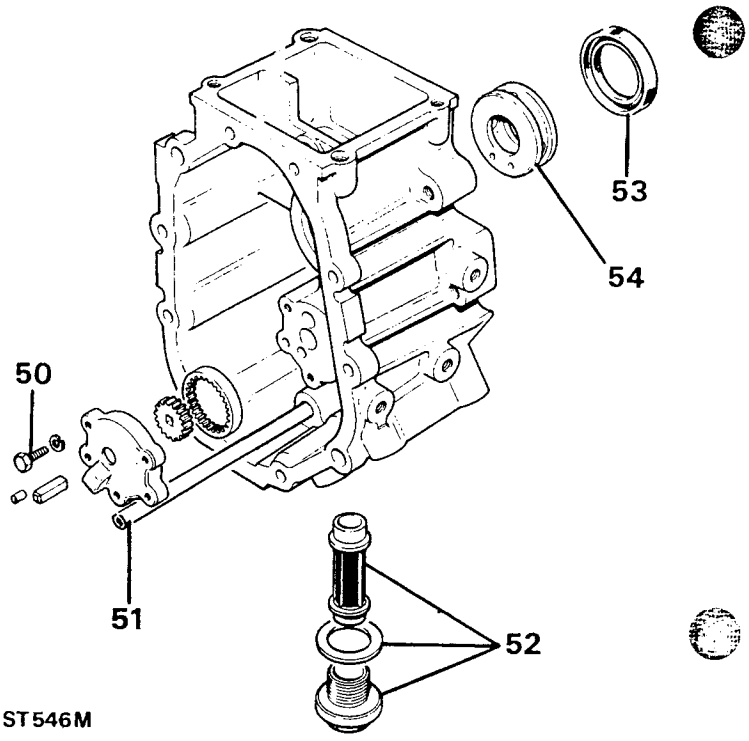
46. Mark the hub and sleeve to aid reassembly and remove the slipper rings from the front and rear of the first and second gear synchromesh assemblies.
47. Withdraw the slippers and hub from the sleeve.

Third and fourth gear synchromesh assemblies

48. Mark the hub and sleeve to aid reassembly and remove the slipper rings from the front and rear of the assembly.
49. Withdraw the slippers and hub from the sleeve.

Extension case

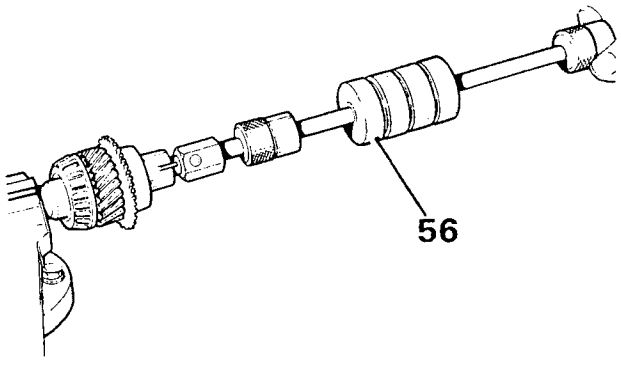
50. Remove the three oil pump housing bolts, spring washers and oil pump gears.
51. Do not withdraw the oil pick-up pipe.
52. Remove the plug, washer and filter.
53. Invert casing and extract the oil seal.
54. Press out the ferrobestos bush from the casing.



ST546M

Input shaft

55. Using tools MS47 and 18G47BA, remove the input shaft bearing.
56. With the aid of tools 18G284AAH and 18G284, extract the pilot bearing track.



ST 873M

Reverse idler gear

57. Remove the circlip from the reverse idler gear.
58. Having noted their positions, remove both needle roller bearings and remaining circlip from the gear.

Fifth gear synchromesh assembly

59. Lever the backing plate off the fifth gear synchromesh assembly.
60. Remove the slipper rings from the front and rear of the assembly.
61. Release the slippers and slide the hub from the sleeve.

Centre plate

62. Remove the layshaft and mainshaft bearing tracks from the centre plate and reverse pivot post.

Main gearbox casing

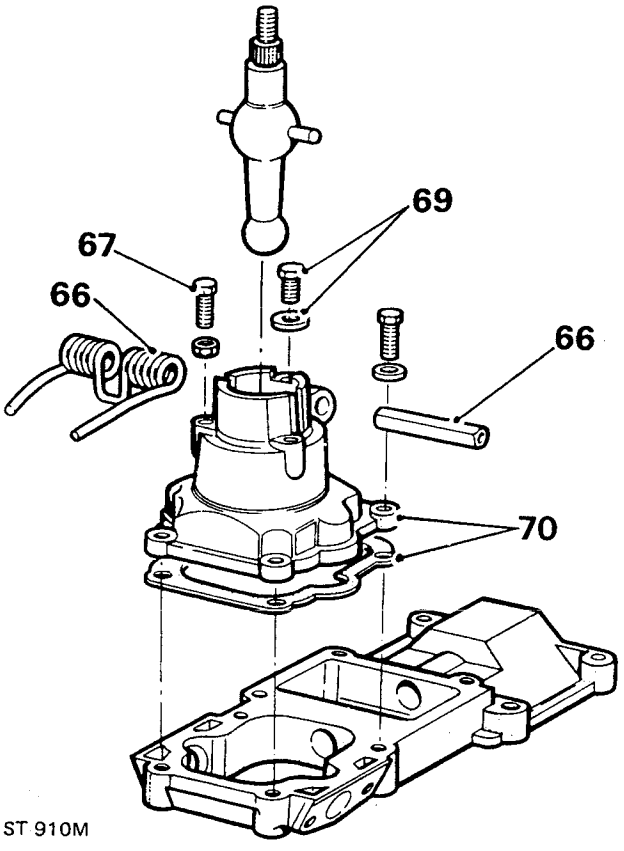
63. Remove the mainshaft and layshaft bearing tracks from the main casing.
64. Remove the plastic oil trough from the front of the casing.

Selector rail

65. The selector rail is supplied complete with first and second selector fork, pin and fifth speed selector pin. If it is required to replace the first and second selector fork on its own, press out the fifth speed gear selector pin and remove the first and second selector fork from the selector rail.

Gear selector housing — Latest models

66. Remove the roll pin and release the bias spring.
67. Remove the two adjusting screws and locknuts.
68. Remove the gear lever extension, secured by a nut (with plain washer).
69. Remove the bolt and special lock washer to release the gear lever shaft from the trunnion housing.
70. Remove the four bolts and spring washers retaining the gear lever housing to the selector housing. Lift off the housing and discard the gasket.

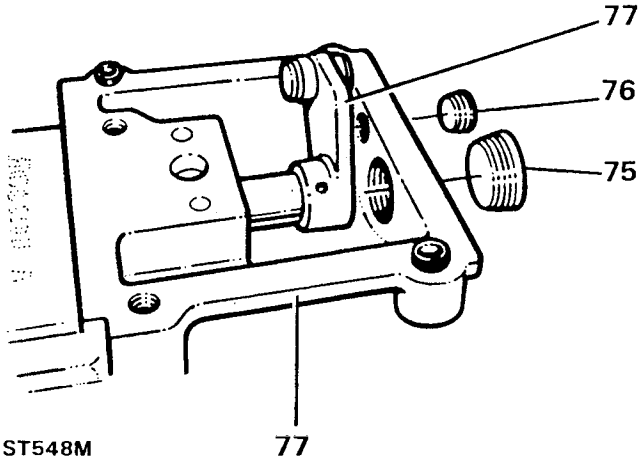


ST 910M

Gear selector housing — Early models (Not illustrated)

(a) Remove the gear lever gaiter and three bolts holding the gear lever retaining plate and anti-vibration pad.
(b) Remove gear lever from the gear lever housing.
(c) Remove the four bolts and spring washers retaining the gear lever housing to the selector housing. Lift off the housing and discard the gasket.
(d) Remove the bolts and washers retaining the fifth gear plunger assembly. Care must be taken not to lose the shims located on the plunger assembly casting.
(e) Withdraw the assembly from the selector housing and label components for identification on reassembly.

71. Remove the bolts and washers retaining the reverse gear plunger assembly. Care must be taken not to lose the shims located on the assembly casting. Detach from the selector housing and label components for identification.
72. Remove the locating bolt from the housing for nylon bush. Pull the selector shaft rearwards and remove the trunnion housing.
73. Release the circlip and detach the nylon insert from the trunnion housing.
74. Invert the gear selector housing and remove the fifth gear spool retainer bolts and spring washers. Lift off the fifth gear spool retainer.
75. Remove the large blanking plug at the rear of the housing.
76. Remove the reverse switch blanking plug.
77. Place the gear selector housing into protected vice jaws, using a suitable pin punch, drift out the selector yoke roll pin. Push the selector shaft forwards and remove the selector yoke. Remove housing from vice.

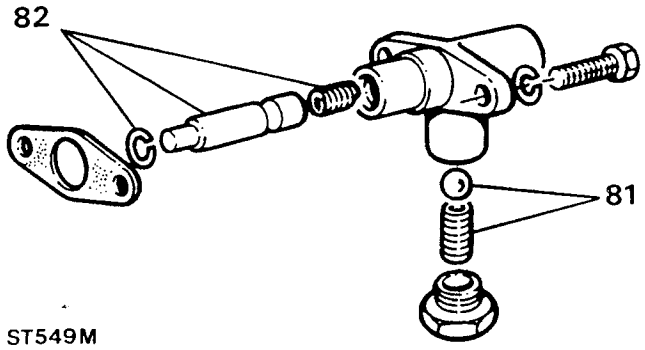


ST548M

78. Remove the selector yoke roller circlip and withdraw the pin and rollers.
79. Withdraw the gear selector housing shaft out through the large blanking plug orifice.
80. Remove and discard the gear selector shaft 'O' ring.

Fifth gear plunger assembly — Early models only

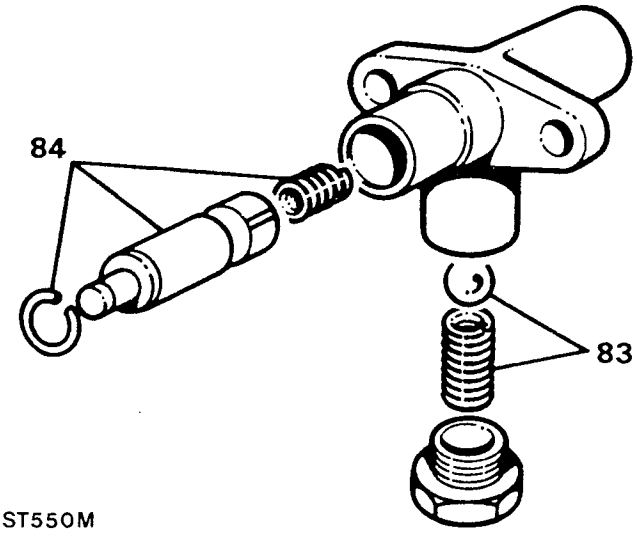
81. Remove the plug, long spring and detent ball from the fifth gear plunger.
82. Remove the circlip which retains the fifth gear plunger, pull out plunger and short spring. Keep all parts labelled and separated from the reverse plunger assembly.



ST549M

Reverse gear plunger assembly

83. Remove the plug, long spring and detent ball from the reverse gear plunger assembly.
84. Detach the circlip which retains the reverse gear plunger, pull out the plunger followed by the short spring. Label all parts and keep separate from the fifth gear plunger assembly.



ST550M

Cleaning and inspection

85. Clean gearcase thoroughly using a suitable solvent. Inspect case for cracks, stripped threads in the various bolt holes, and machined mating surfaces for burrs, nicks or any condition that would render the gearcase unfit for further service. If threads are stripped, install Helicoil, or equivalent inserts.
86. Inspect all gear teeth for chipped or broken teeth, or showing signs of excessive wear. Inspect all spline teeth on the synchromesh assemblies. If there is evidence of chipping or excessive wear, install new parts on reassembly. Check all slippers and slipper rings for wear or breakage. Replace with new parts if necessary.
87. Inspect all circlip grooves for burred edges. If rough or burred, remove condition carefully using a fine file.
88. Ensure all oil outlets are clear of sludge or contamination especially the mainshaft oil ways. Clean with compressed air observing the necessary safety requirements.
89. During the rebuild operation, it is recommended that new roller and needle bearings are fitted.

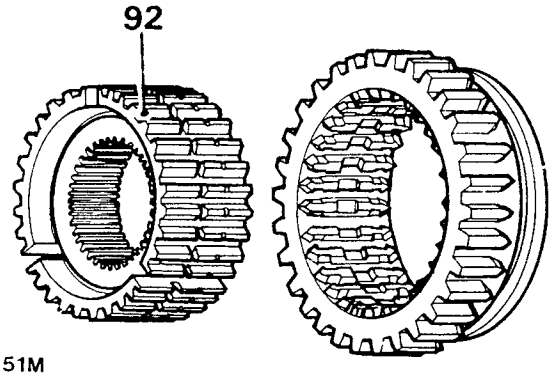
ASSEMBLY

Layshaft

90. Using tools MS47 and a suitable tube, fit new bearing cones to the layshaft.

Synchromesh assemblies

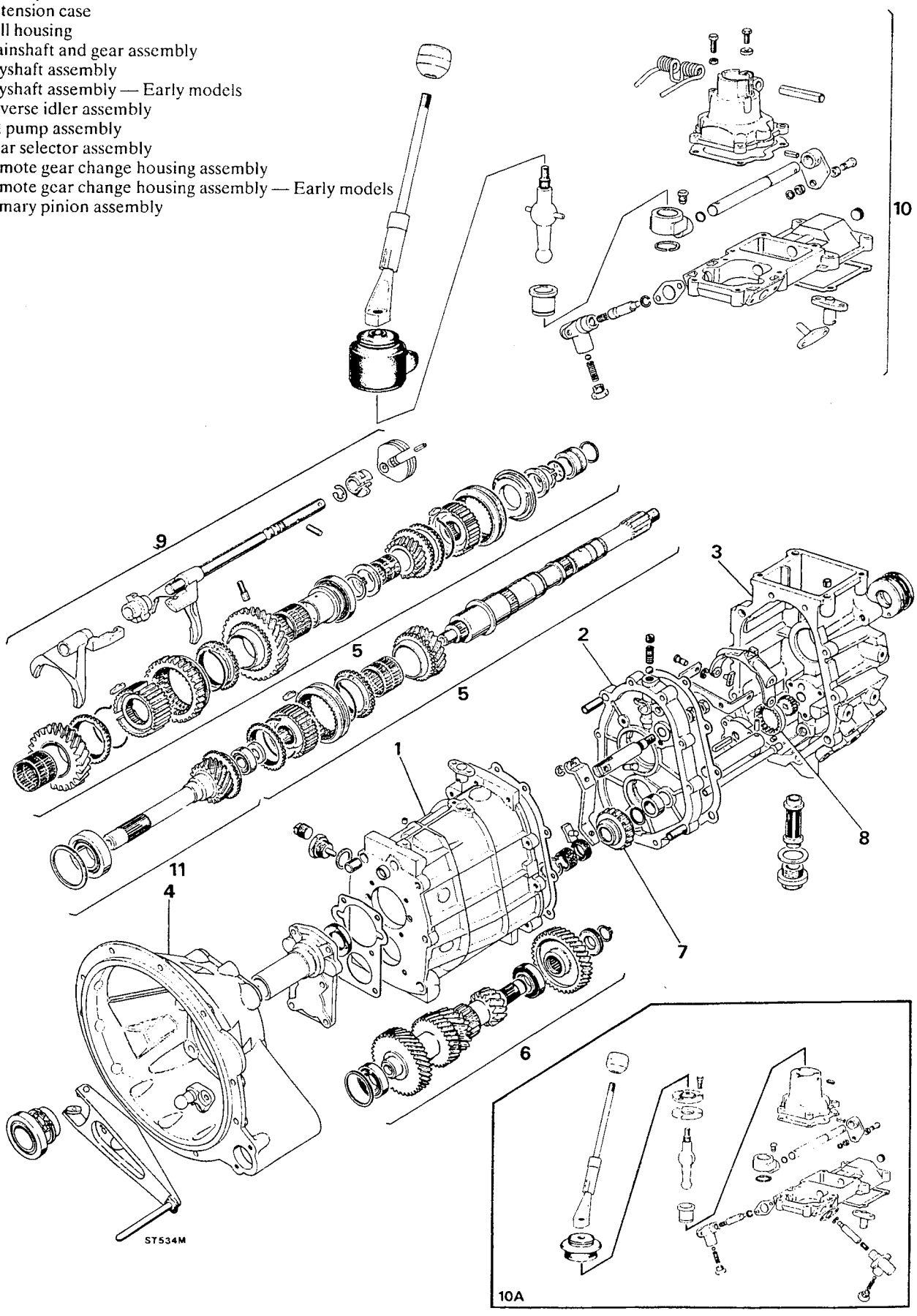
91. With the outer sleeve held, a push-through load applied to the outer face of the synchromesh hub should register 8,2 to 10 kgf m (18 to 22 lbf ft) to overcome the spring detent in either direction.
92. Assemble the first and second synchromesh assembly by locating the shorter splined face towards the second gear.



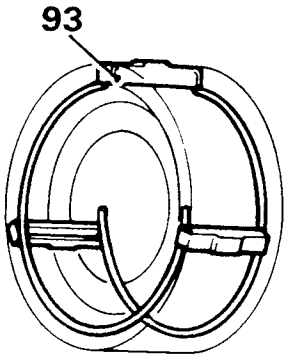
ST551M

KEY TO MAIN GEARBOX

1. Main gearcase
2. Centre plate
3. Extension case
4. Bell housing
5. Mainshaft and gear assembly
6. Layshaft assembly
6A. Layshaft assembly — Early models
7. Reverse idler assembly
8. Oil pump assembly
9. Gear selector assembly
10. Remote gear change housing assembly
10A. Remote gear change housing assembly — Early models
11. Primary pinion assembly

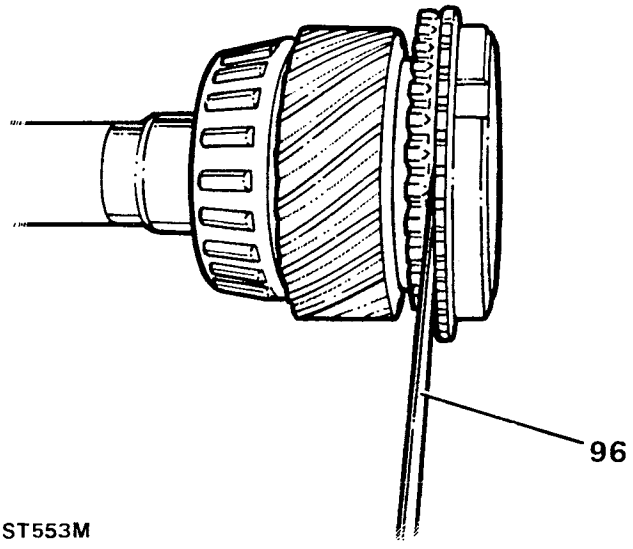


93. Refit the slippers and locate the slipper rings to each side of the assembly, ensuring that the hooked ends of both slipper rings are located in the same slipper; but running in opposite directions and finishing against the other two slippers.



ST552M

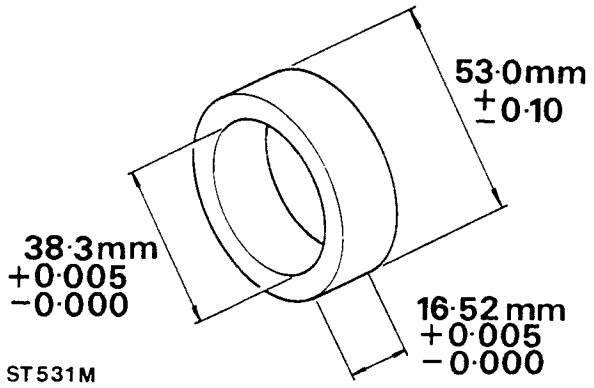
94. Assemble the third and fourth synchromesh assembly and ensure the hooked ends are located in the same slipper; and run in opposing directions and finally locate against the other two slippers.
95. Refit the fifth synchromesh hub assembly again ensuring the hooked ends of the rings are located in the same slipper, but running in opposite directions. Fit the backplate onto the rear of the synchromesh hub assembly. Ensure the tag on the backplate locates in the slot on the hub.
96. Check the wear between all the synchromesh cones and gears by pushing the cone against the gear and measuring the gap between the gear and cone. The minimum clearance is 0,64 mm (0.025 in). If this clearance is not met, fit new synchromesh cones.



ST553M

First gear bush end-float

97. Manufacture a spacer to the dimensions provided in the illustration, this will represent a slave bearing.



ST531M

98. Lubricate the second gear needle bearing with a light oil and fit the bearing, second gear and synchromesh cone to the mainshaft. It should be noted that the second gear synchromesh cone has larger slipper slots than the other synchromesh cones.
99. Fit the first and second synchromesh hub assembly with the selector fork annulus to the rear of the mainshaft.
100. Fit the first gear bush and slave bearing spacer and a new circlip to the mainshaft. When fitting the circlip, care must be taken to ensure it is not opened (stretched) beyond the minimum necessary to pass over the shaft.
101. Press the slave bearing spacer back against the circlip to allow the bush maximum end-float. Measure the clearance between the rear of the first gear bush and front face of the slave bearing spacer with a feeler gauge. The clearance should be within 0,005 to 0,055 mm. The first gear bush is available with collars of different thickness. Select a bush with a collar to give the required end-float. The bush must be free to rotate easily with the required end-float.
102. Remove the circlip, slave bearing spacer and first gear bush from the mainshaft.
103. First gear bushes are available in the following sizes:

Part No.	Thickness (mm)
FRC5243	40,16 - 40,21
FRC5244	40,21 - 40,26
FRC5245	40,26 - 40,31
FRC5246	40,31 - 40,36
FRC5247	40,36 - 40,41

104. Having selected a suitable first gear bush, lubricate the needle bearing and fit to the first gear.
105. Fit the selected bush to the first gear and place first gear synchromesh cone, followed by the first gear assembly to the mainshaft.
106. Using tools MS47, 18G47BA and 18G47BA-X refit the centre bearing and circlip to the mainshaft.
107. Invert the mainshaft, lubricate the third gear needle roller bearing with light oil, fit to the front end of the mainshaft.

108. Fit the third gear to the mainshaft; and locate the third gear synchromesh cone to the third gear.
109. Fit the third/fourth synchromesh assembly (with the longer box of the synchromesh hub to the front of the gearbox) to the mainshaft.
110. Fit the spacer and bearing to the front of the mainshaft.

Input shaft

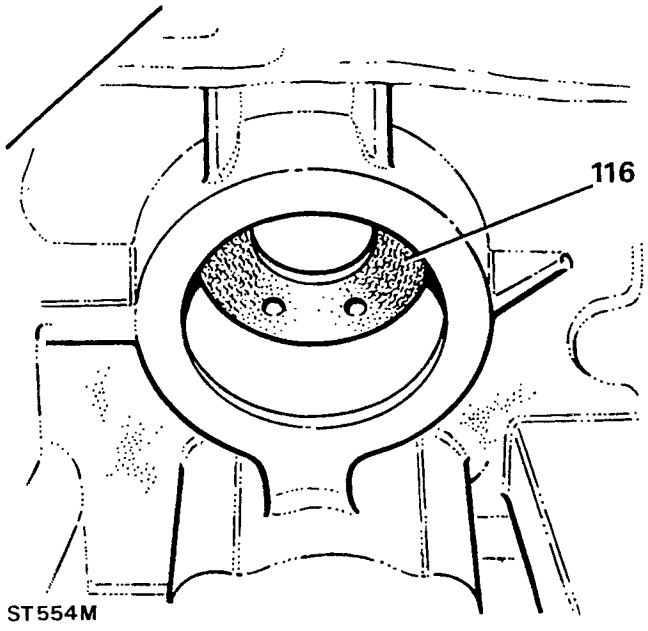
111. Using tool MS47 and any suitable tube, refit a new pilot bearing track to the input shaft.
112. Fit the input shaft bearing using tools MS47, 18G47BA and 18G47BA-X.

Reverse Gear and Shaft

113. Fit a new circlip to the rear of the reverse idler gear, ensuring that the circlip is not stretched beyond the minimum necessary to pass over the shaft.
114. Lubricate with light oil and fit both needle roller bearings. Fit the shorter needle bearing to the rear of the reverse idler gear.
115. Fit a new circlip to the front of the reverse idler gear.

Extension case

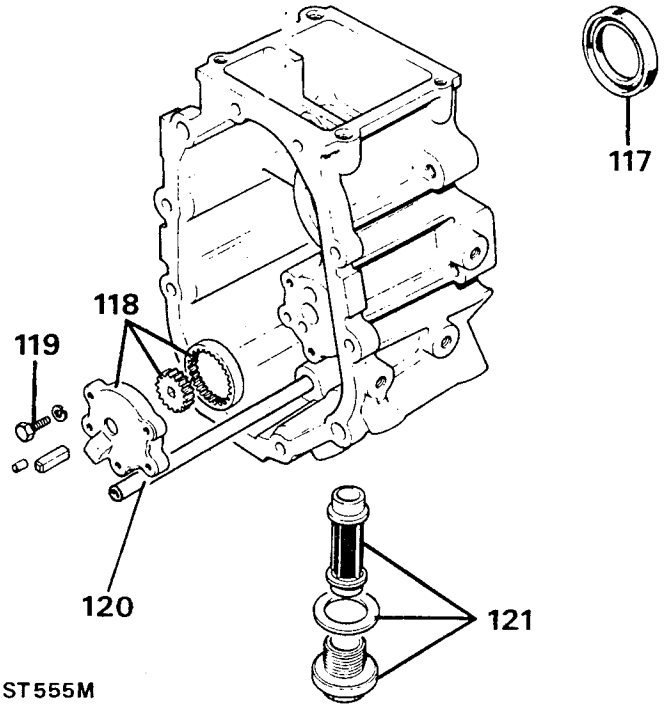
116. Using a suitable press, fit a new ferrobestos bush to the case, ensuring the two drain holes are towards the bottom of the case.



ST554M

117. With the aid of tool 18G1422, fit a new oil seal to the rear of the extension case. Ensure the seal lips are towards the ferrobestos bush. Lubricate the seal lips with a suitable SAE 140 oil.

118. Assemble and fit the fibre oil pump gears to the oil pump cover, whilst ensuring the centre rotor squared drive faces the layshaft.

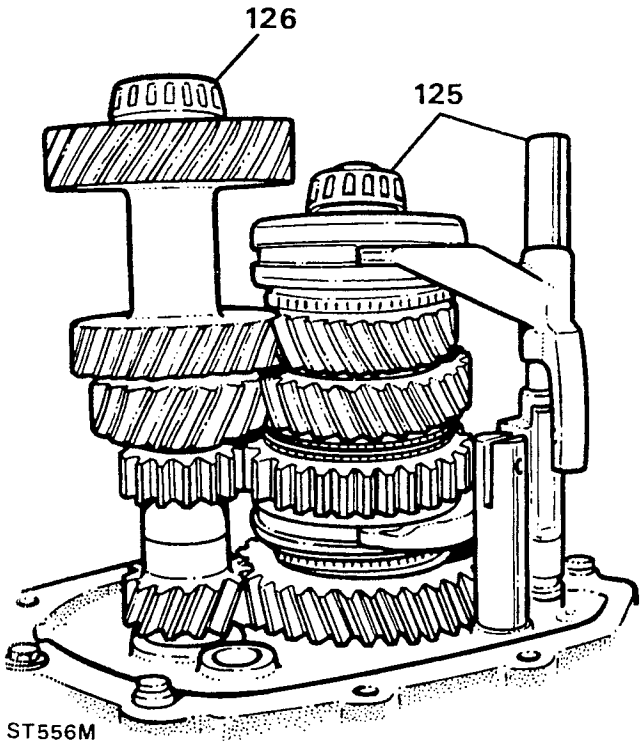


ST555M

119. Fit the three bolts and spring washers to secure the oil pump cover; and tighten to the specified torque.
120. Ascertain that the oil pick up pipe is free of contamination or blockage.
121. Fit a new oil filter, fibre gasket and tighten plug to the specified torque.

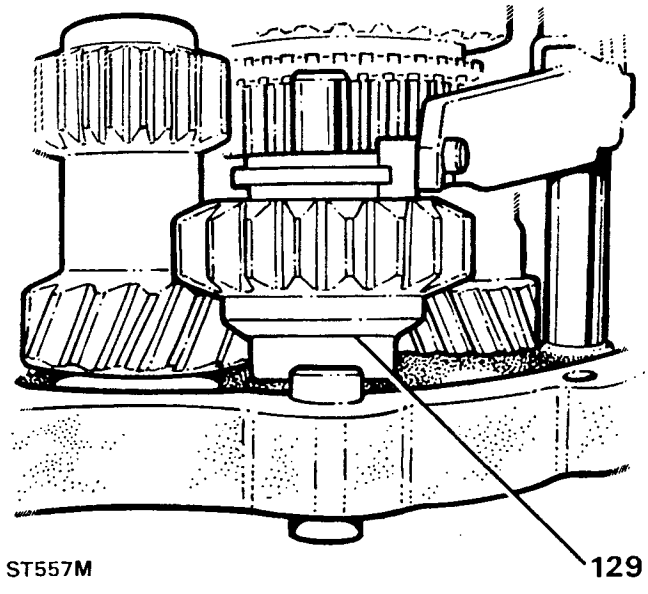
Centre plate

122. Fit the centre plate to a suitable stand and secure with two slave bolts.
123. Place the new mainshaft and layshaft bearing tracks to the centre plate.
124. Lightly lubricate the selector shaft with a light oil.
125. Take the selector shaft complete with the first and second selector fork, front spool and third and fourth selector fork; engage both selector forks in their respective synchromesh sleeves on the mainshaft, simultaneously engaging the selector shaft and mainshaft assemblies in the centre plate, whilst rotating the fifth gear selector pin to align with the slot in the centre plate.
126. Fit the layshaft to the centre plate.
127. Rotate the selector shaft and spool to enable the reverse crossover lever forks to correctly align to the reverse pivot shaft. Reposition the selector shaft and locate the lever between the fork on the reverse gear pivot shaft. Insert pivot pin and fit a new circlip, ensuring that it is not opened beyond the minimum necessary to pass over the shaft.



ST556M

128. Fit the slipper pad to the reverse lever. If a new reverse lever pivot shaft has been fitted, it will be necessary to ascertain that its radial location is consistent with the reverse pad slipper engagement/clearance. The radial location is determined during initial assembly.



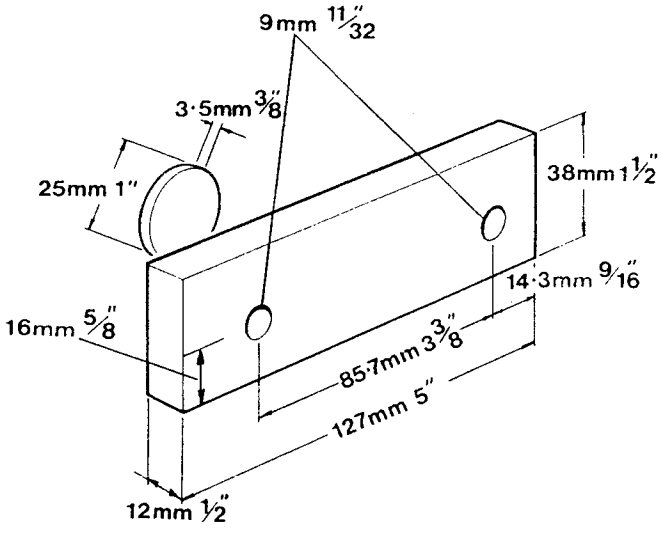
ST557M

129. Fit the reverse gear spacer and reverse gear assembly, locating the slipper pad lip to the reverse gear groove. Engage the reverse gear shaft from the underside of the centre plate, ensuring the roll pin is aligned with the slot in the centre plate casing.

130. Prior to assembly lubricate the detent ball and spring with light oil, and fit to the top of centre plate. Smear Hylomar PL32 or Loctite 290 to the plug threads and screw the plug flush with the case. Stake the plug to prevent rotation using a suitable centre punch. Release the slave bolts.
131. Locate the fourth gear synchromesh cone to the third/fourth synchromesh assembly.
132. Fit the input shaft to the mainshaft.
133. Fit the reverse gear spacer to the reverse gear shaft.
134. Fit a new gasket to the centre plate.

Main gearbox casing

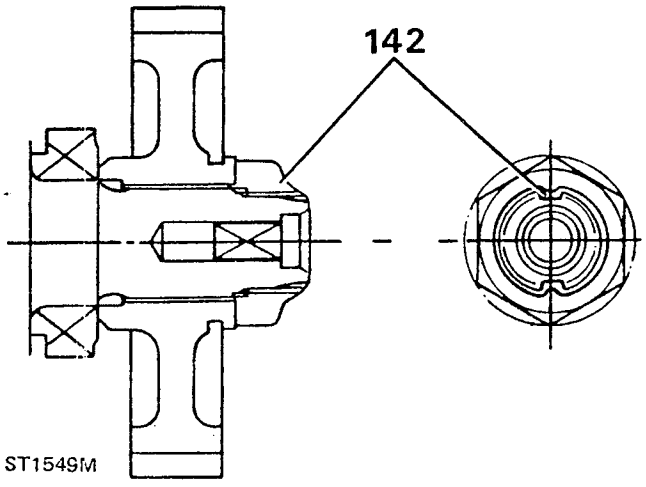
135. Insert a new plastic oil trough to the back of the main gearbox casing, ensuring the open trough faces the top of the case.
136. Carefully lower the gearcase into position over the gear assemblies. DO NOT USE FORCE. This operation can be assisted by the use of two 8 x 100 mm guide studs. Ensure the centre plate dowels and selector shaft are engaged in their respective locations.
137. Fit the layshaft and input shaft bearing outer tracks.
138. Using 8 x 35 mm slave bolts and plain washers to prevent damaging the rear face of the centre plate, evenly draw the gearcase into position on the plate.
139. Fit the locating shaft front spool to the top of the gearcase using Hylomar PL32 to seal between the spool and gearcase. Smear Loctite 290 or Hylomar PL32 to the bolt threads, tighten bolts and spring washers to the specified torque.
140. Manufacture a layshaft support plate and plain washer to the dimensions provided in the illustration.



ST1118M

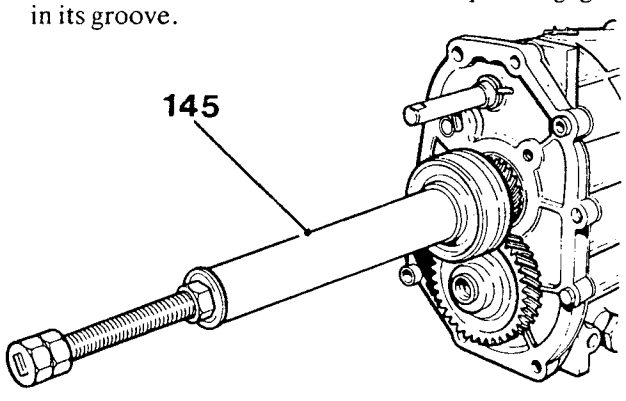
141. The layshaft support plate is fitted using two 8 x 25 mm bolts and washers to the front of the gearbox, with the plain washer situated between the support plate and layshaft. The plate also retains the input shaft bearing outer track.

142. On early models: With the aid of a suitable press, fit the fifth gear, collar and new circlip to the layshaft.
Later models: Fit the fifth gear to the layshaft using a suitable press and loosely fit a NEW special nut. To tighten the nut, hold the gearbox firmly in a Vice and if necessary use a flange holding wrench to restrain the gearbox. Tighten the nut to 204 to 231 Nm (150 to 170 lb ft). To prevent damage to the adjacent bearings when deforming the nut locking collar, support the fifth gear with a block of timber. Using a round nose punch carefully form the collar into the layshaft grooves, as illustrated.



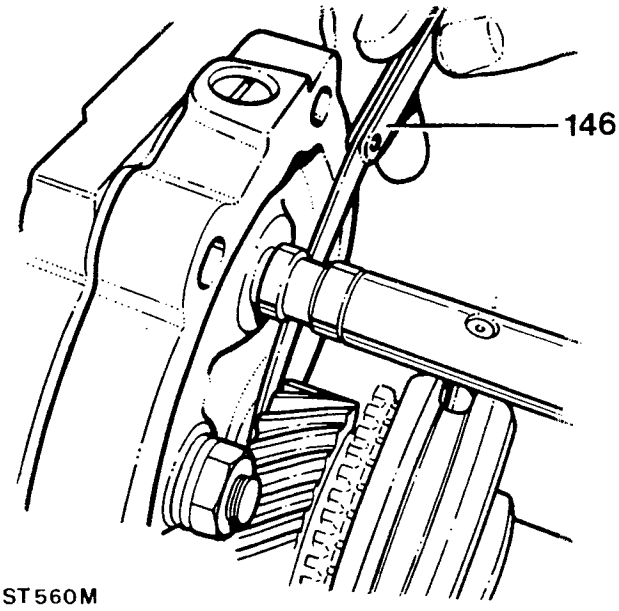
ST1549M

143. Locate assembly horizontally in a vice or suitable jig.
144. Fit the fifth speed washer, roller bearing, gear and cone to the mainshaft.
145. Press fit fifth gear synchromesh hub assembly using tool 18G1431. Fit a dummy spacer with an oversize bore to ascertain the correct spacer to provide the specified clearance on the fifth gear. When fitting, care must be taken to ensure the hub assembly and selective spacer are NOT pushed too far on the mainshaft. Only fit with sufficient clearance to allow the circlip to engage in its groove.



ST 870M

146. Measure the clearance between the front spacer and fifth gear (driven), which should be between 0,005 and 0,055 mm. Select the appropriate spacer to provide the aforementioned clearance.



ST560M

Part No.	Thickness (mm)	Part No.	Thickness (mm)
FRC5284	5,10	FRC5294	5,40
FRC5286	5,16	FRC5296	5,46
FRC5288	5,22	FRC5298	5,52
FRC5290	5,28	FRC5300	5,58
FRC5292	5,34	FRC5302	5,64

147. Fit the correct selective spacer and new circlip.

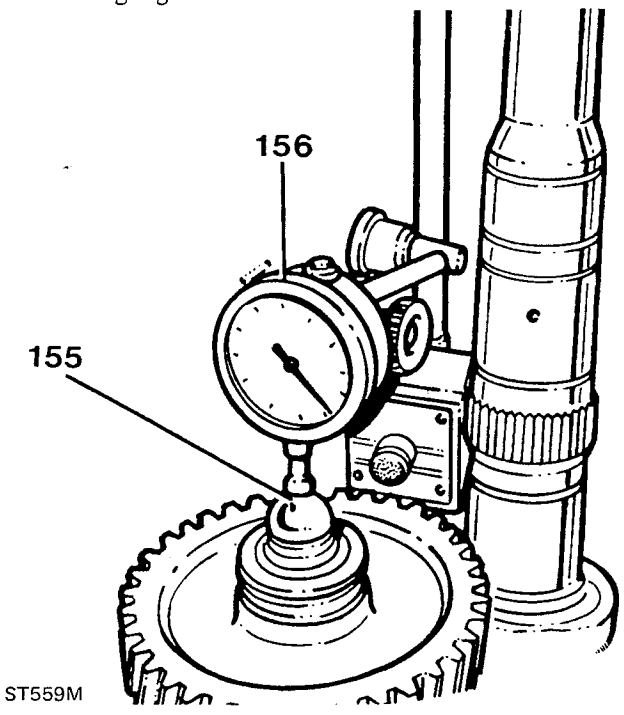
Mainshaft and layshaft end-float

148. Measure and adjust the mainshaft and layshaft end-float as necessary. Remove the layshaft support plate from the front of the gearbox.

Part No.	Thickness (mm)	Part No.	Thickness (mm)
FRC4327	1,51	FRC4349	2,17
FRC4329	1,57	FRC4351	2,23
FRC4331	1,63	FRC4353	2,29
FRC4333	1,69	FRC4355	2,35
FRC4335	1,75	FRC4357	2,41
FRC4337	1,81	FRC4359	2,47
FRC4339	1,87	FRC4361	2,53
FRC4341	1,93	FRC4363	2,59
FRC4343	1,99	FRC4365	2,65
FRC4345	2,05	FRC4367	2,71
FRC4347	2,11	FRC4369	2,77

149. When ascertaining the mainshaft end-float care must be taken when checking the dial gauge readings to ensure that the end-float only, as distinct from side movement, is recorded. To overcome the difficulty in differentiating between end-float and side movement, wrap approximately ten turns of masking tape around the plain portion of the input shaft below the splines. Ascertain that the rise and fall of the input shaft is not restricted by the tape.
150. Place a mainshaft and layshaft spacer of nominal thickness 1.02 mm on the mainshaft and layshaft bearing tracks, fit the front cover and gasket tighten bolts and spring washers to the specified torque.
151. Invert the gearbox on the stand. Rotate the mainshaft to correctly seat the bearing.

152. Place a suitable ball bearing in the mainshaft centre and mount the dial gauge on the gearcase with the stylus resting on the ball bearing centre. Zero the gauge.
153. Check the end-float by a 'push-pull' action to the mainshaft. The required mainshaft end-float measurement should be between 0,06 to 0,01 mm with no pre-load.
154. Spacer thickness required equals; Nominal thickness of spacer, plus end-float obtained. Remove the dial gauge and ball bearing.
155. Rotate the layshaft to correctly seat the bearing. Place a suitable ball bearing in the layshaft centre and mount the dial gauge on the gearcase, with the stylus resting on the ball bearing centre. Zero the gauge.



ST559M

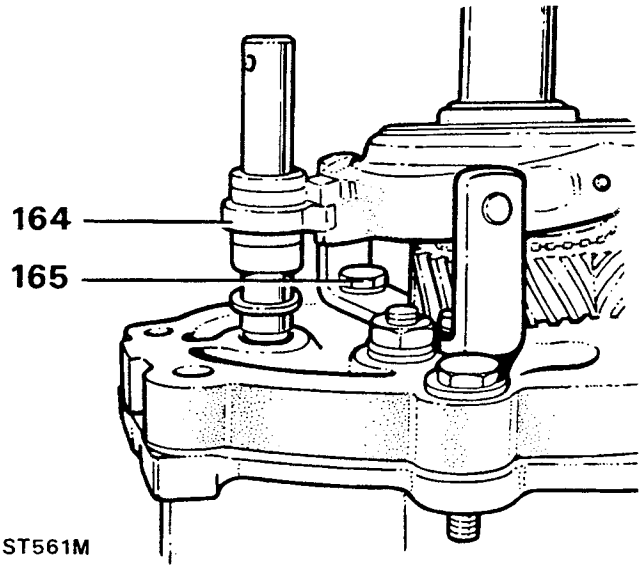
156. With the aid of levers approximately 23 cm long; to prevent component damage, check the end-float by a gentle 'push-lift' action to the layshaft. The required layshaft setting is:
0,025 mm end-float
0,025 mm preload.
Spacer thickness required equals; nominal thickness of spacer, plus end-float obtained. Remove the gauge and ball bearing.
157. Remove the front cover. Having ascertained the mainshaft and layshaft end-float, fit the mainshaft and layshaft spacers of the appropriate thickness to the mainshaft and layshaft bearing tracks. Selective spacers are available in a range of sizes to meet the aforementioned clearance limits.

Part No.	Thickness (mm)	Part No.	Thickness (mm)
TKC4633	1,69	TKC4649	2,17
TKC4635	1,75	TKC4651	2,23
TKC4637	1,81	TKC4653	2,29
TKC4639	1,87	TKC4655	2,35
TKC4641	1,93	TKC4657	2,41
TKC4643	1,99	TKC4659	2,47
TKC4645	2,05	TKC4661	2,53
TKC4647	2,11	TKC4663	2,59

158. Fit a new oil seal to the front cover, ensuring the seal lips face towards the gearbox. Lubricate the seal lips with SAE 140 gear oil.
159. Mask the splines with masking tape to protect the oil seal, refit the front cover and remove the spline masking tape.
160. Refit the bolts and spring washers having used Hylomar PL32 or Loctite 290 on the bolt threads. Tighten to the specified torque.
161. Remove gearbox from the stand and place suitably supported on the bench. Remove the guide studs fitted to the centre plate.
162. Select reverse gear by turning the selector rail anti-clockwise and pulling rearwards. Move the fifth speed synchromesh hub into mesh with the fifth gear. Tighten the staked nut onto the fifth gear layshaft to the specified torque. Stake the nut with a suitable punch to secure. Select neutral by pushing selector rail inwards and turning clockwise, thereby returning the fifth speed synchromesh hub to its out of mesh position.

Fifth gear selector fork assembly

163. Fit the fifth speed selector fork and bracket to the fifth gear synchromesh hub assembly, ensuring that the largest groove lip is facing the rear of the gearbox.
164. Fit the fifth gear spool to the selector shaft, rotate and engage the selector fork into the groove. It should be noted that the longer shoulder of the spool is fitted towards the front of the gearbox.
165. Fit the fifth speed selector fork bracket bolts and spring washers. Tighten to specified torque.



ST561M

166. Fit a new circlip to the selector shaft ensuring that it is not expanded beyond the minimum necessary to obtain entry.
167. Remove the six dummy bolts securing the centre plate to the main casing.
168. Position the gearbox assembly horizontally and fit the oil pump shaft to the pump.

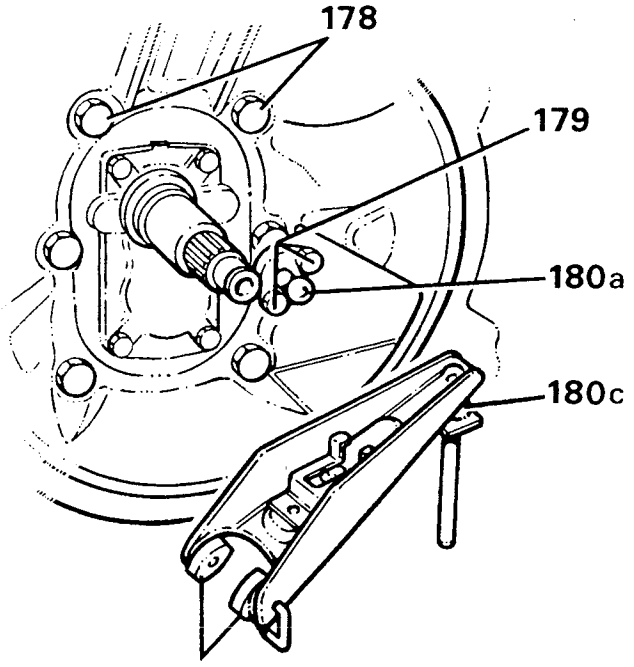
Extension case

169. Fit a new gasket to the centre plate.
170. Rotate the oil pump to align with the oil pump drive shaft.

171. Carefully fit the extension case ensuring that the oil pump shaft engages the layshaft.
172. Fit the extension case bolts and spring washers; tighten to specified torque.
173. Using a large screwdriver, ease the selector shaft forwards to select a gear. It may be found necessary to rotate the mainshaft to ease gear selection.
174. Fit the selector yoke to the selector shaft and secure with a new roll pin. Pull selector shaft rearwards to select a neutral position.
175. Cover the mainshaft splines with masking tape and fit a new oil seal collar 'O' ring. Remove the masking tape.
176. Using tool 18G1431 fit the oil seal collar to the mainshaft, ensuring the collar is NOT pushed too far on the shaft, fit only with sufficient clearance to allow the circlip to engage in its groove.
177. Fit a new gasket to the top of the fifth gear extension case and fit the gear change housing by engaging male selector yoke with the female yoke. Align the housing locating dowels and refit the housing. Secure with the three bolts and washers; and tighten to the specified torque.

Bell housing

178. Locate the bell housing to the dowels and fit the two long bolts (12 x 45 mm) with spring and plain washers to the dowel positions. The remaining four bolts (12 x 30 mm) are fitted with spring washers only. Tighten to the specified torque.



ST562M

179. Fit the clutch release lever pivot and secure with the bolts and spring washers. Tighten to the specified torque.
180. Prior to reassembly, lubricate the following with a thin film of molybdenum disulphide grease:
    (a) Clutch release lever fulcrum pivot socket.
    (b) The clutch release lever slipper pad pins and the faces of each slipper pad.
    (c) Ball ends of the clutch operating push rod.
181. Refit the slipper pads to the clutch release lever and locate the lever socket to the clutch release lever pivot.
182. Lubricate the inner face of the clutch release bearing carrier with molybdenum disulphide grease and fit to the front cover spigot, locating the clutch release lever slipper pads to the carrier recesses.
183. Fit a new nylon clutch release carrier clip.
184. Refit the gearbox oil level plug, and tighten to the specified torque.
185. Refit the gearbox oil drain plug and fit new fibre washer. Tighten plug to specified torque.

Reverse gear plunger assembly

186. Lubricate the short spring and plunger with BP Energrease L2 or similar prior to assembly.
187. Fit the short spring into the plunger base and slide the assembly into the reverse gear plunger housing. Fit a new circlip to retain the plunger. Ensure the spring is not trapped, the detent groove should be fully visible down the detent hole.
188. Lubricate the detent ball with light oil and fit into its bore.
189. Refit the long spring and plug, coat the plug threads with Loctite 290 or Hylomar PL32, and tighten to the specified torque.

The following instructions (190 to 211) relate to the early model gearbox with a spring-loaded plunger for fifth gear selection.

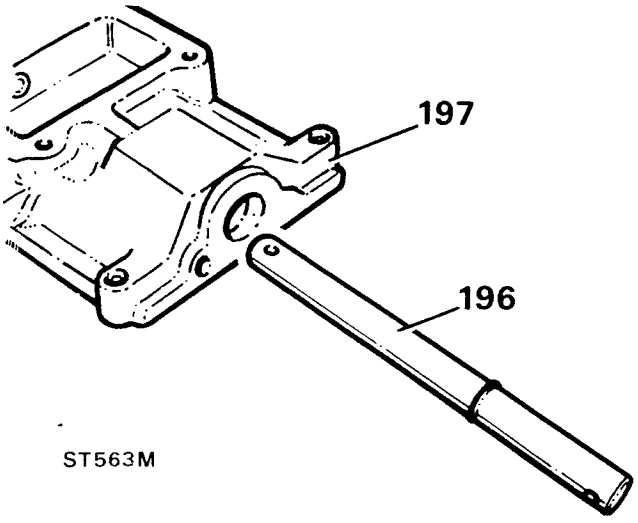
Fifth gear plunger assembly — Early models only

190. Lubricate the short spring and plunger with BP Energrease L2 or similar, prior to assembly.
191. Fit the short spring in the plunger base and slide the assembly into the fifth gear plunger housing. Fit a new circlip to retain the plunger. Ensure the spring is not trapped, the detent groove should be fully visible down the detent hole.
192. Lubricate the detent ball with light oil and fit into its bore.
193. Refit the long spring and plug, coat the plug threads with Loctite 290 or Hylomar PL32, tighten to the specified torque.

Gear selector housing — Early models

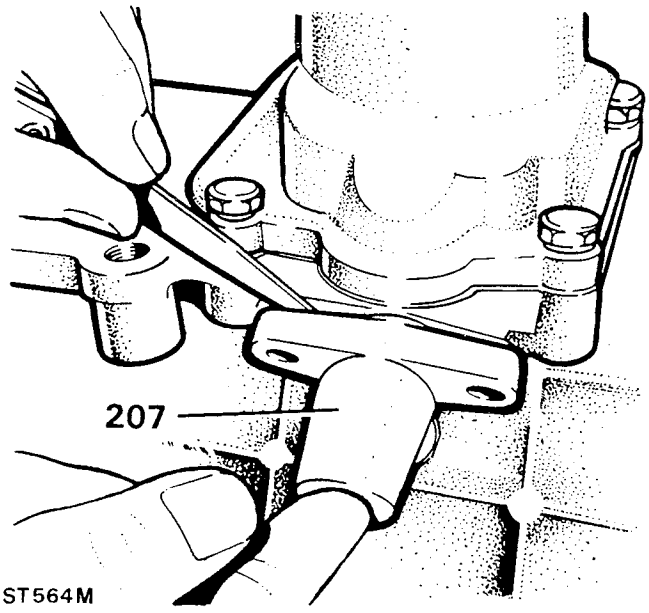
194. Refit the gear selector rollers, pin and new circlip ensuring circlip is not expanded beyond minimum necessary to obtain entry.
195. Lubricate the gear selector housing shaft with light oil and fit a new 'O' ring.

196. Insert shaft through the large blanking plug orifice, ensuring the shaft indent is uppermost.
197. Place the gear selector housing into protected vice jaws and fit the selector yoke to the shaft, using a suitable pin punch and new roll pin. Remove the housing assembly from the vice on completion.



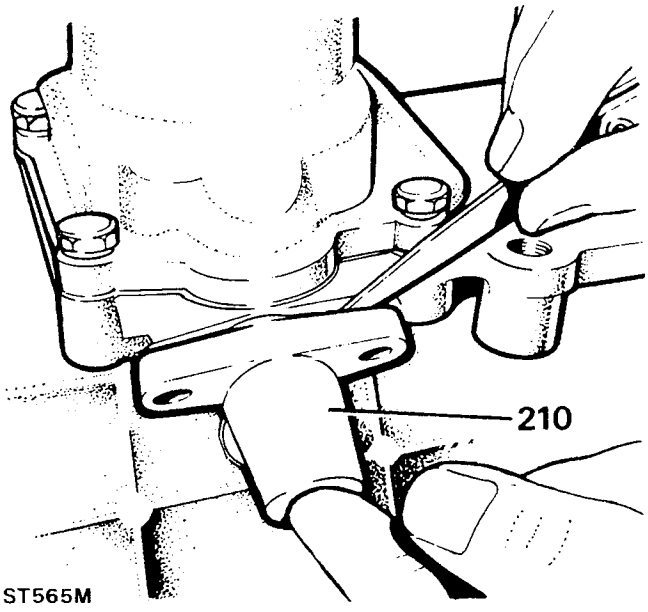
ST563M

198. Fit the reverse switch and large blanking plugs. Coat plug threads with Loctite 290 and tighten to the specified torque.
199. Refit the fifth gear spool retainer, coat the bolt threads with Loctite 290, and tighten the bolts and washers to the specified torque.
200. Fit a new nylon insert into the trunnion housing and secure with a new circlip.
201. Invert the gear selector housing and fit the trunnion housing to the selector shaft, ensuring the locating bolt aligns with the shaft indent. Coat the bolt threads with Loctite 290. Tighten bolt to the specified torque.
202. Fit a new gear lever housing gasket and fit the gear lever housing, spring washers and bolts. Tighten bolts to the specified torque.
203. Coat the upper and lower balls of the gear lever shaft with BP Energrease L2 or similar. Push lever into the trunnion nylon bush.
204. Place new vibration pad over the gear lever and fit the gear lever retaining plate. Refit the three shouldered bolts and tighten to the specified torque.
205. Refit the gear lever gaiter and attach the gear lever extension. Then carry out the following procedure to ensure a clearance of 0,3 to 0,9 mm between the gear lever yoke and stops.
206. Select first or second gear. It may be necessary to rotate the mainshaft whilst manipulating the gear lever.
207. Locate the reverse gear plunger on the right hand side viewed from the rear, giving sufficient load on the trunnion to eliminate side play. Whilst maintaining a light finger pressure, measure the clearance between the plunger assembly casting and gear selector casting. Add 0,6 mm to the measured figure and select suitable thickness shims to equal the total.



ST564M

208. Remove the reverse plunger assembly, fit the required thickness shim(s) refit the plunger assembly, spring washers and bolts. Tighten bolts to the specified torque.
209. Select third or fourth gear.
210. Locate the fifth gear plunger on the left hand side viewed from the rear, giving sufficient load on the trunnion to eliminate sideplay. Whilst maintaining a light finger pressure, measure the clearance between the plunger assembly casting and gear selector casting. Add 0,6 mm to the measured figure and select suitable thickness shims to equal the total.



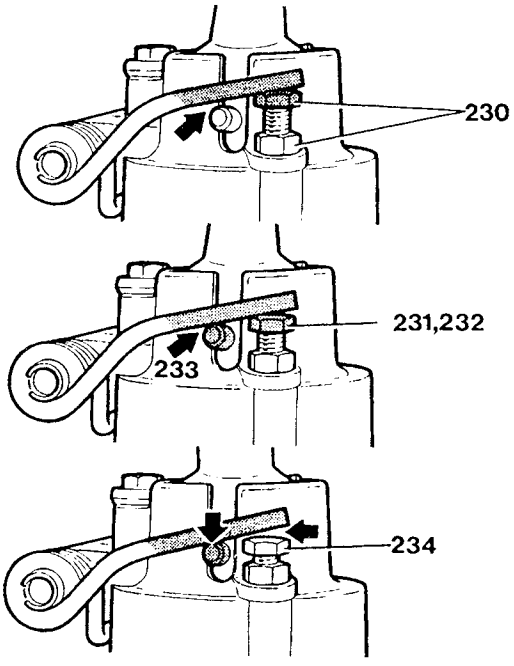
ST565M

211. Remove the fifth gear plunger assembly and fit the required shim(s), refit the plunger assembly, spring washers and bolts. Tighten bolts to the specified torque.

The latest model gearbox employs a spring-loaded biased gear change lever assembly and the following instructions (212 to 236) include the fitting and adjustment of this arrangement.

Gear selector housing

212. Refit the gear selector rollers, pin and new circlip ensuring circlip is not expanded beyond minimum necessary to obtain entry.
213. Lubricate the gear selector housing shaft with light oil and fit a new 'O' ring.
214. Insert shaft through the large blanking plug orifice, ensuring the shaft indent is uppermost.
215. Place the gear selector housing into protected vice jaws and fit the selector yoke to the shaft, using a suitable pin punch and new roll pin. Remove the housing assembly from the vice on completion.
216. Fit the reverse switch and large blanking plugs. Coat plug threads with Loctite 290 and tighten to the specified torque.
217. Refit the fifth gear spool retainer and tighten the bolts and washer 7 Nm (5 lbf ft) and fit a new nylon insert into the trunnion housing and secure with a new circlip.
218. Invert the gear selector housing and fit the trunnion housing to the selector shaft, ensuring the locating bolt aligns with the shaft indent. Coat the bolt threads with Loctite 290. Tighten bolt to the specified torque.
219. Fit a new gear lever gasket and locate the gear lever housing, spring washers and bolts. Tighten bolts to the specified torque.
220. Fit the two bias spring adjustment screws and lock nuts.
221. Place the bias spring in position with the spring legs either side of the gear lever housing and retain with a roll-pin.
222. Coat the upper and lower spheres of the gear lever shaft with Duckhams Q-5848 or Shell Alvania R1 and locate the lever in the gearbox and retain with the bolt and special lock washer.
223. Using a screw driver lift the bias spring legs over the gear lever crosspins. Do not overstress the spring legs. Refit the main gear lever with the gaiter. Align the marks made when dismantling. Tighten the 10 mm 'Nyloc' nut.
224. Select first or second gear. It may be necessary to rotate the mainshaft whilst manipulating the gear lever.
225. Locate the reverse gear plunger assembly on the right hand side viewed from rear, giving sufficient load on the trunnion to eliminate side play. Whilst maintaining a light finger pressure, measure the clearance between the plunger assembly casting and gear selector casting. Add 0,6 mm to the measured figure and select suitable thickness shims to equal the total.
226. Remove the reverse plunger assembly, fit the required thickness shim(s) and refit the plunger assembly, spring washers and bolts. Tighten to the specified torque.
227. Fit the fifth gear stop on the left hand side viewed from the rear, giving sufficient load on the trunnion to eliminate side play. Whilst maintaining a light finger pressure, measure the clearance between the plunger assembly casting and gear selector casting. Add 0,6 mm to the measured figure and select suitable thickness shims to equal the total.
228. Remove the fifth gear stop, fit the required thickness shim(s). Refit the gear stop assembly, spring washers and bolts. Tighten bolts to the specified torque.
229. To adjust the bias springs with the unit completely assembled, engage either third or fourth gear.



230. Adjust the two adjusting screws until both legs of the spring are approximately 0,5 mm clear of the cross-pin in the gear lever. This should allow a certain amount of radial movement of the gear lever without the cross-pin contacting either of the spring legs.
231. Apply a slight load to the gear lever knob in a left hand direction to position the gear lever at one extreme of the radial play. Adjust the right hand adjusting screw downwards until the right hand spring leg just makes contact with the cross-pin on the right hand side.
232. Repeat instruction 229 in the opposite direction.
233. At this stage, radial play will still be present, but at the other extreme the cross-pin should just make contact with the spring leg on the other side.
234. Lower both adjusting screws equal amounts until the radial play is just eliminated. Tighten locknuts.
235. Return gear lever to neutral position and rock across the gate several times. The gear lever should return to the third and fourth gate. If not, repeat the aforementioned procedure.
236. Fit the rubber gaiter and secure with a strap.

LT 230 R TRANSFER BOX

The following operations can be carried out with the gearbox in the vehicle. For ease of working, the vehicle should be raised on a ramp or placed over a pit. Also, the battery should be disconnected for safety.

RENEW SPEEDOMETER DRIVE PINION

1. Raise the vehicle on a ramp.
2. Remove the speedometer drive clamp and nut and withdraw the cable.
3. Prise out the drive pinion assembly.
4. Push in a new assembly and fit the speedometer cable and secure with the clamp and nut.

RENEW REAR OUTPUT SHAFT OIL SEAL

Special tool:
18G1422

1. Disconnect the battery for safety.
2. Disconnect the rear propshaft from the output flange.
3. Remove the brake drum retaining screws and withdraw the drum.
4. Remove the two back plate bolts that also retain the oil catcher and remove the catcher.

   NOTE: An hexagonal type socket should be used for these bolts.

5. Remove the output shaft nut and washer and withdraw the flange.
6. Using the slot provided, lever off the dust cover.
7. Prise out the output shaft oil seal(s).
8. Using special tool 18G1422 fit the double-lipped oil seal, open side inwards, with the seal in contact with the bearing circlip, taking care not to touch the seal lips.

   NOTE: The double-lipped oil seal supersedes the two oil seals used on early production.

9. Fit the dust cover.
10. Lubricate the surface of the flange which runs in the seal and carefully fit the flange.

    NOTE: To renew the flange bolts first remove the circlip before fitting the flange.

11. Secure the flange with the nut and washer and tighten to 146 to 179 Nm (108 to 132 lb ft).
12. Fit the oil catcher to the back plate using silicone rubber sealant and secure with the two back plate bolts (with plain washers).
13. Fit the brake drum and retain with the two screws.
14. Reconnect the propeller shaft.

RENEW FRONT OUTPUT SHAFT OIL SEAL

Special tool:
18G1422

1. Disconnect the front propeller shaft from the flange and move to one side.
2. Remove the output shaft nut and washer and withdraw the flange.
3. Remove the oil seal shield.
4. Prise out the oil seal(s).

   NOTE: The double-lipped oil seal supersedes the two oil seals used on early production.

5. Using special oil seal replacer tool 18G1422 fit the double-lipped oil seal, open side inwards, with the seal in contact with the bearing circlip, taking care not to touch the seal lip.
6. Lubricate the running surface of the flange and fit it together with the oil seal shield.
7. Secure the flange with the nut and washer and tighten to 146 to 179 Nm (108 to 132 lb ft).
8. Refit the propeller shaft.

REMOVE INTERMEDIATE SHAFT AND GEARS

Service tool:
RO605862

1. Drain the transfer gearbox oil.
2. Disconnect the rear propshaft from the output flange.
3. Remove the two screws and withdraw the brake drum.
4. Remove the four bolts securing the brake back plate and withdraw the back plate and oil catcher.

   NOTE: An hexagonal type socket should be used for these bolts.

5. Remove the intermediate shaft keeper plate, retained by a single bolt.
6. Remove the ten bolts and remove the bottom cover plate.
7. Using service tool RO605862 withdraw the intermediate shaft whilst holding the gear cluster. Collect the bearings and thrust washers from both ends of the cluster.
8. Remove the two 'O' rings, one from the shaft, the other from the casing.

Fit intermediate shaft gears

9. Fit the 'O' ring to the intermediate shaft.
10. Fit the 'O' ring into the front of the transfer case.
11. Lubricate thrust washers, bearings, shaft and spacer.
12. Fit needle bearings with spacer interposed.
13. Fit front thrust washer to slot in transfer case (plain side to case).
14. Locate gear assembly partially into the transfer case so that it rests on the front thrust washer.

15. Locate rear thrust washer (plain side uppermost) into slot in transfer case.
16. Gently push gear assembly into mesh.
17. Using a screwdriver through the intermediate shaft hole guide the locating tab on the rear thrust washer into the slot provided in the transfer case.
18. Align gear and thrust assembly and slide the intermediate shaft into the transfer box from the rear.
19. Align the shaft so that the lock plate in the end is on top.
20. Apply Loctite 290 to the lock plate bolt threads. Locate lock plate into position and fit securing bolt (with spring washer).
21. Lever the gear assembly to one side and measure the end-float with feeler gauges. This should be between 0,08 and 0,35 mm (0.003 and 0.014 in).
22. Grease and fit the bottom cover joint washer.
23. Apply Loctite 290 to the ten bolts and evenly tighten to 22 to 28 Nm (16 to 21 lbf ft).
24. Fit the oil catcher to the brake plate, using silicone rubber sealant and secure the backplate with the four bolts. The two bolts securing the oil catcher are fitted with plain washers.
25. Fit the brake drum and retain with the two screws.
26. Connect the rear prop shaft.
27. Refill the transfer box with the correct oil.

OVERHAUL LT230R TRANSFER GEARBOX

Service tools:
RO 605862 — Intermediate shaft removal
18G1271 — Seal remover
18G1205 — Flange wrench
18G257 — Circlip pliers
18G1422 — Oil seal replacer
18G1423 — Stake nut remover
MS47 — Hand press
18G47BB/1 — Collars
18G47BB/3 — Button
18G47BB/2 — Collars
18G1424 — Differential centre bearing drift
18G47-7 — Collars and buttons
LST 47-1 — Collars

REMOVE ASSEMBLIES FOR OVERHAUL

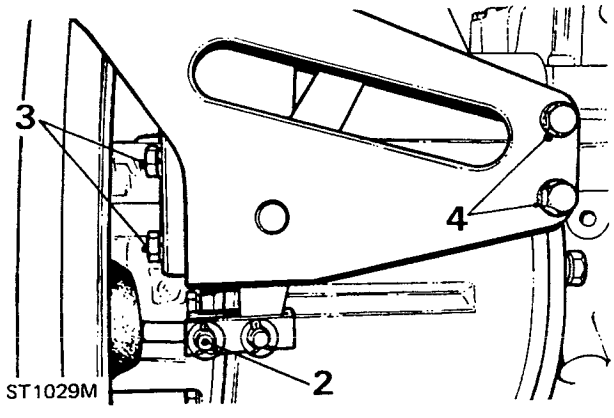
(Instructions 1 to 33)

1. Having removed the complete gearbox and transfer box assembly. The transfer box is separated from the gearbox on the work bench.

   NOTE: To facilitate removal of various items on the work bench, obtain suitable wooden blocks to enable the transfer box to be turned and propped up as required.

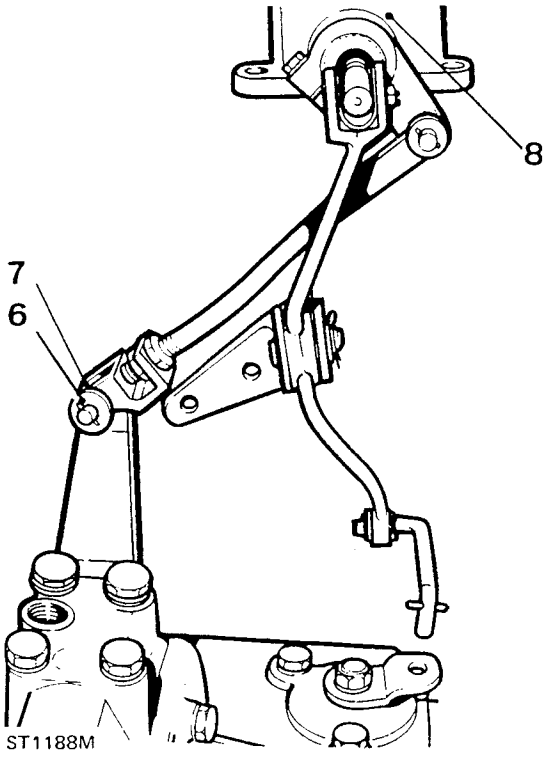
Hand brake linkage removal

2. Remove the split pin and clevis pin to release the handbrake linkage from the brake operating lever.
3. Remove the two bolts (with spring washers) securing the rear end of the handbrake mounting bracket to the casing, the lower bolt is shorter.
4. Remove the two bolts (with spring washers and distance pieces) securing the front side of the handbrake mounting bracket and remove from the transfer box.



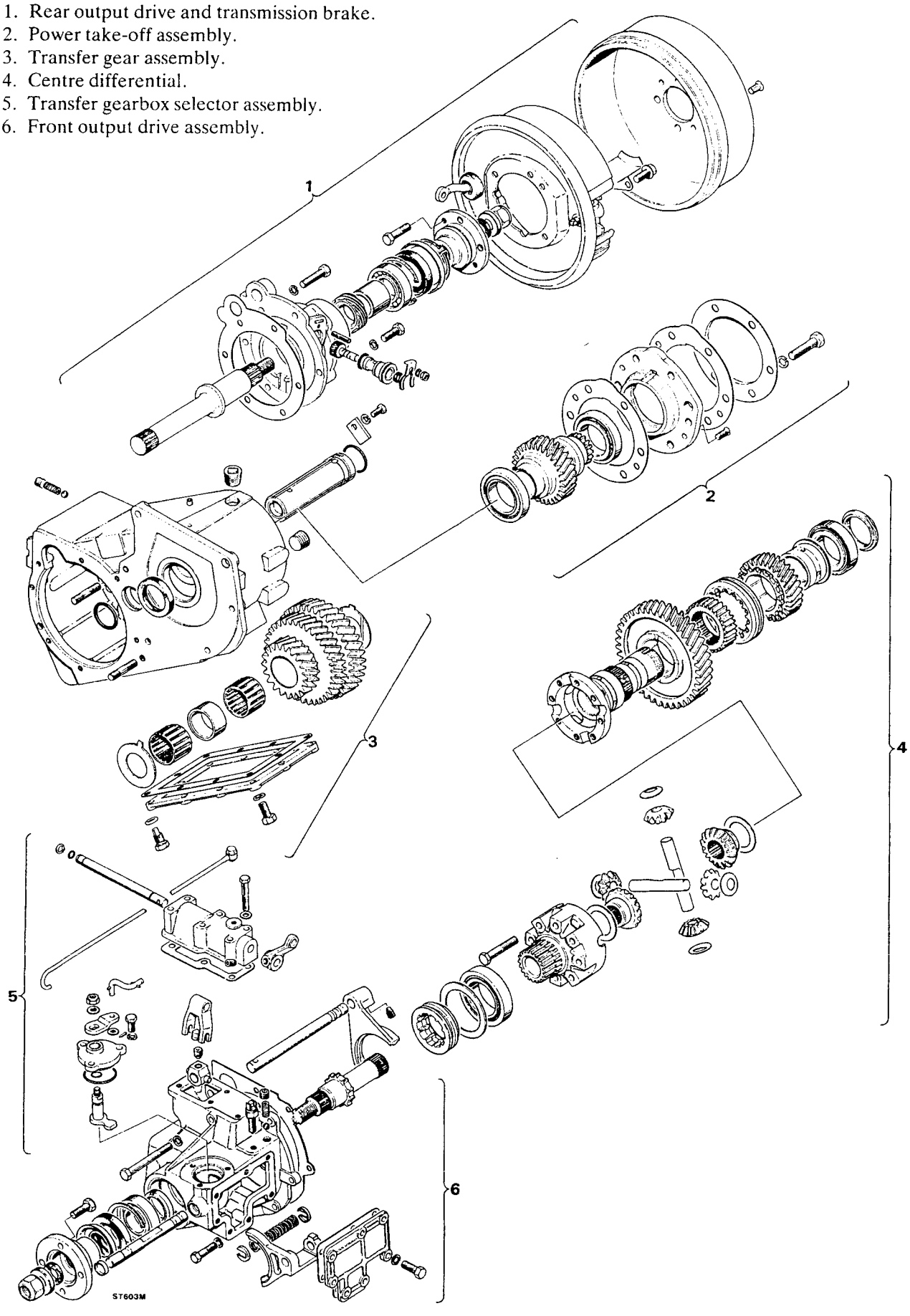
Transfer box mounting removal

5. Remove the bolts retaining the right hand rubber mounting plate.
6. Disconnect the bottom of the high/low connecting rod from the high/low operating arm by removing the split pin and clevis pin.
7. Remove the plastic bushes from the operating arm.
8. Remove the gearchange housing complete with linkage.



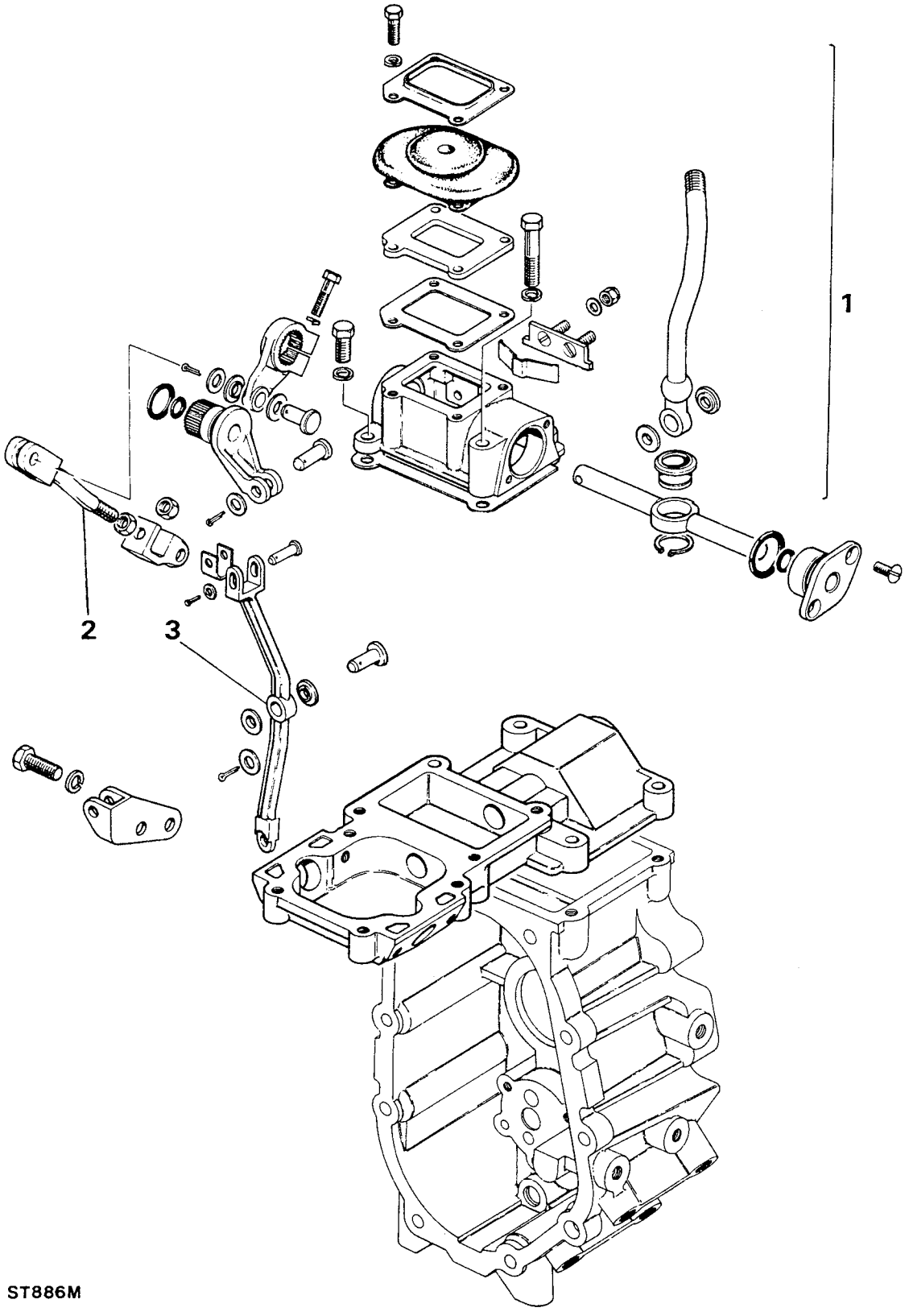
GENERAL ARRANGEMENT OF LT230R TRANSFER GEARBOX

1. Rear output drive and transmission brake.
2. Power take-off assembly.
3. Transfer gear assembly.
4. Centre differential.
5. Transfer gearbox selector assembly.
6. Front output drive assembly.



GENERAL ARRANGEMENT OF TRANSFER GEARCHANGE HOUSING

1. Main selector lever.
2. Transfer gear selector assembly.
3. Differential lock selector assembly.



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Transmission brake removal

9. Remove the two countersunk brake drum retaining screws and pull off the drum.
10. Remove the four bolts securing the brake backplate, two of these also retain the oil catcher.

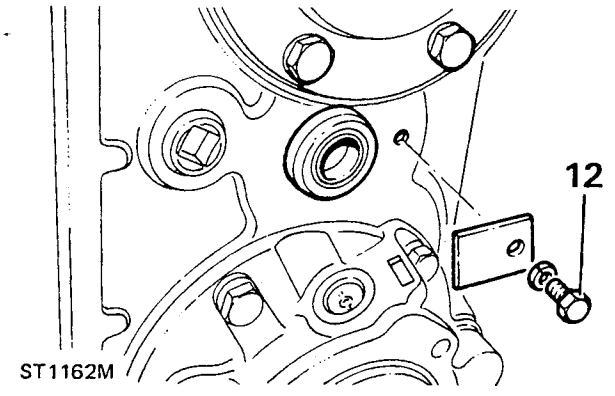
NOTE: An hexagonal type socket should be used for these bolts.

Bottom cover removal

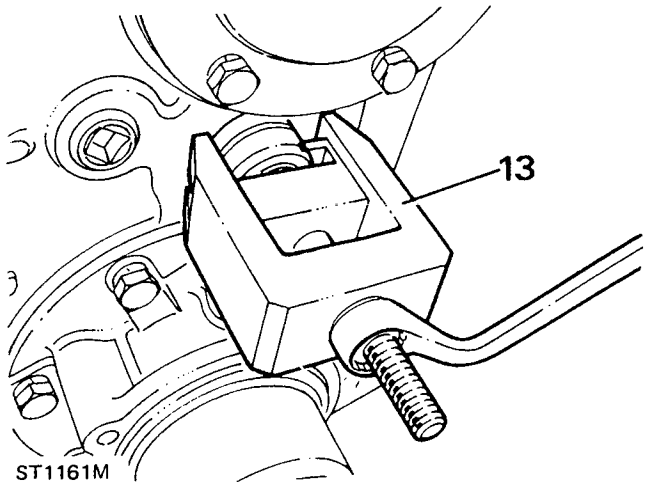
11. Remove the ten bolts retaining the bottom cover.

Intermediate shaft removal

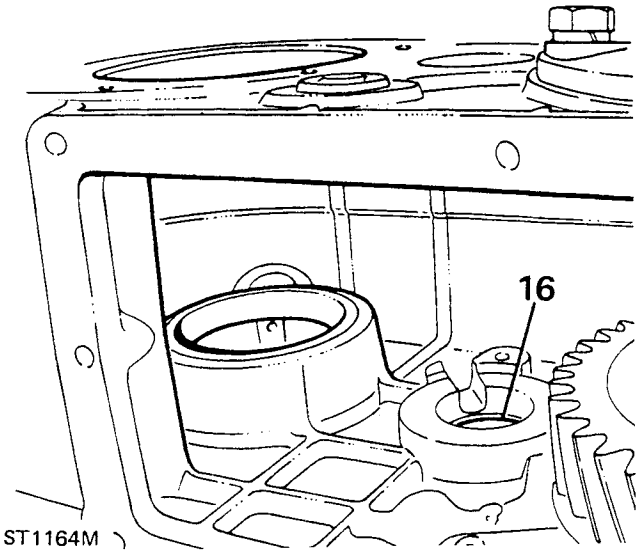
12. Remove the shaft lock plate retained by a single bolt at the rear face of the transfer box.



13. Withdraw the intermediate shaft, using a screw driver in the slotted end. Where the shaft cannot be easily withdrawn use extractor RO605862.



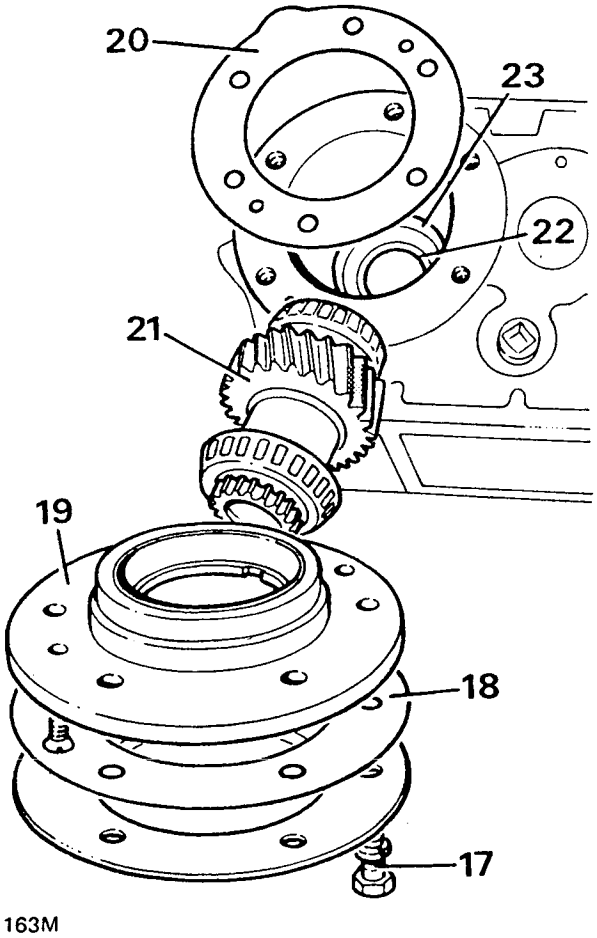
14. Lift out the intermediate gear cluster, roller bearings and spacer.
15. Remove the thrust washers.
16. Remove the 'O' ring from the intermediate shaft and the transfer box case.



Power take off cover removal

17. Remove the four bolts retaining the circular P.T.O. cover and the speedometer cable clip plate.
18. Remove the gasket.

NOTE: The other two bolts were removed with the gearbox assembly cradle.

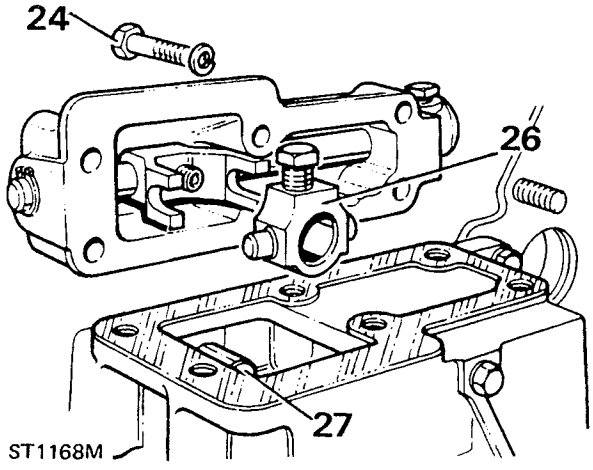


Input gear removal

19. Remove the two countersunk screws and release the mainshaft bearing housing.
20. Remove the gasket.
21. Remove the input gear assembly.
22. Prise out and discard the oil seal at the front of the transfer case using service tool 18G1271.
23. Drift out the input gear front bearing track.

High/low selector housing removal

24. Remove the six bolts to release the selector housing.
25. Remove the gasket.



ST1168M

Front output shaft housing removal

26. Slacken the square headed set screw securing the yoke to the high/low selector shaft inside the high/low selector housing aperture.
27. If necessary use a screw driver to move the selector shaft rearwards and allow the yoke to be lifted out.
28. Remove the eight bolts to release the front output shaft housing assembly. The upper middle bolt is longer.

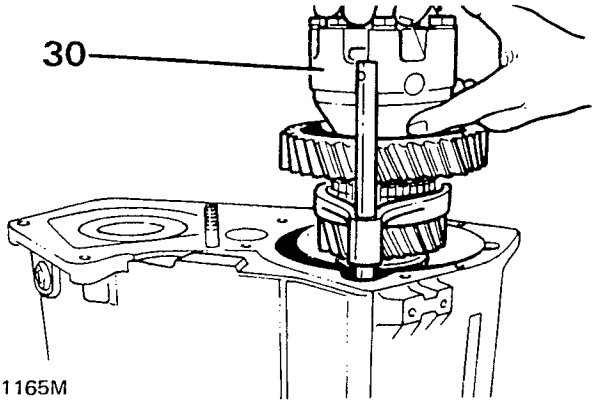
NOTE: The 'radial' dowel in the transfer box face should not be disturbed.

Centre differential removal

29. Remove the high/low selector shaft detent plug, spring and ball.

NOTE: The ball may be more easily retrieved from inside the transfer case after the selector shaft is taken out.

30. Remove the centre differential unit with the selector shaft/fork assembly.



ST1165M

Rear output shaft housing assembly removal

31. Remove the six screws to release the housing. The upper screw is longer.
32. Remove the gasket.

NOTE: Removal of the above housing will reveal the centre differential rear bearing track in the transfer box casing. Before drifting out, either unscrew the two studs and radial dowel projecting from the transfer box front face or use suitable wooden blocks to support the box to avoid damage to these items.

33. Drift out the differential rear bearing track.

NOTE: If it is required to completely strip down the transfer box to the basic casting, remove the level, filler and drain plugs.

IMPORTANT: Clean all parts ensuring any traces of Loctite are removed from faces and threads. Ensure that the magnetic drain plug is thoroughly cleaned. Renew oil seals and examine all other parts for wear or damage, renew as necessary.

Reassembling

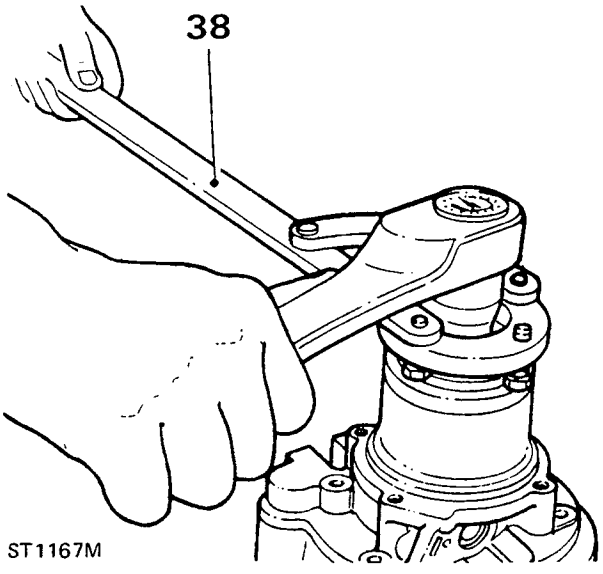
34. Ensure that all faces of the transfer box are clean.
35. Check that level/filler and drain plugs are in position.
36. Fit the two studs which are used for part retention of the extension housing.
37. Screw in the 'radial' dowel. It is important that its projecting blade is set radially in line with the tapped fixing hole centres in the transfer box casing.

Rear output shaft housing — Overhaul (Instructions 47 to 73)

Dismantling

38. Using flange wrench 18G1205 remove the flange nut, steel and felt washers.

NOTE: Ensure flange bolts are fully engaged in the wrench.

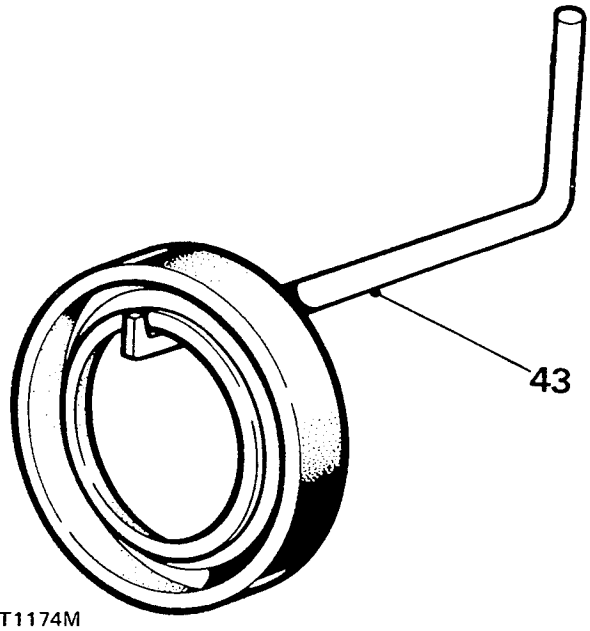


ST1167M

39. Remove the output shaft 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 renewed.

40. Remove the speedometer spindle housing. This can be prised out with a screw driver.
41. Remove assembly from vice and support the housing to allow removal of the shaft, drifting it out by striking the flange end of the shaft.
42. Carefully prise off the oil catch ring using a screw driver in the slot provided.
43. Prise out and discard the seal(s) using tool 18G1271.
44. Using circlip pliers 18G257 remove the circlip retaining the bearing.
45. Drift out the bearing from the back of the housing.
46. Remove the speedometer driven gear and spindle from the spindle housing.
47. Remove the 'O' ring and oil seal.



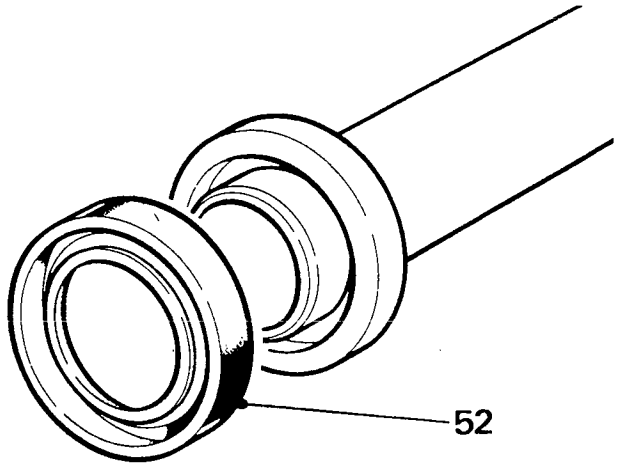
ST1174M

48. Slide off the spacer and speedometer drive gear from the output shaft.
49. Clean all parts, renew oil seals and Nyloc flange nut and examine all other parts for wear or damage, renew as necessary.

Reassembling

50. Press the output bearing into the housing. Do not use excessive force. If necessary warm the housing and case.
51. Fit the bearing retaining circlip using circlip pliers 18G257.
52. Fit a new dual lip oil seal (open side inward), with the seal in contact with the bearing circlip it is essential to use replacer tool 18G1422.

NOTE: On early production two separate seals were used, these should be replaced with the new dual lip seal.



ST903M

53. Carefully charge the lips of the seal with grease.
54. Fit oil catch ring on to housing.
55. Fit oil seal into speedometer spindle housing (open side inwards) with a suitable tube.
56. Fit 'O' ring to speedometer spindle housing.
57. Lubricate seal and 'O' ring with oil.
58. Locate speedometer driven gear and spindle in spindle housing and push into position.
59. Slide speedometer drive gear and spacer onto output shaft.
60. Fit output shaft to the bearing in the rear output shaft housing.
61. Examine the flange seal track to check for any damage that may harm the seal. Retain for fitting later.
62. Locate speedometer spindle housing assembly in the output shaft housing and push in flush with housing face.

NOTE: Before fitting the rear output shaft housing to the transfer box casing the centre differential rear bearing track must be fitted.

63. Drift the centre differential rear bearing track into the transfer box casing 1,5 mm ($\frac{1}{16}$ in) below the outer face of the casing. Check the depth before proceeding.

Fitting rear output shaft housing to transfer box

64. Grease and fit housing gasket and locate the housing in position on the transfer box.

NOTE: If the differential rear main bearing track has been correctly fitted there will be a gap between the housing face and the gasket at this stage.

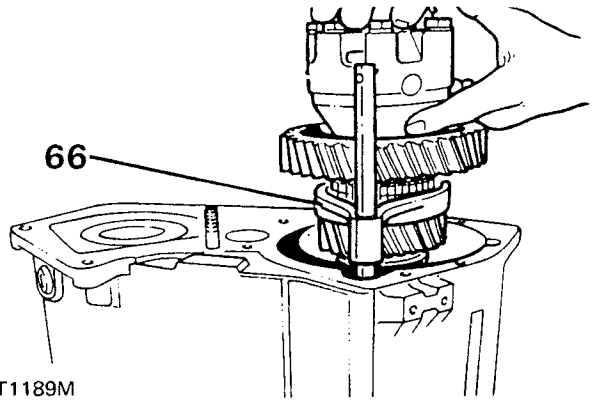
65. Apply Loctite 290 to the threads of the six housing securing screws, noting that the upper screw is longer. Fit the screws (with spring washers) evenly tightening them to the specified torque. This will press in the rear main bearing track to the correct position and seat the housing.

Centre differential Unit — Overhaul

(Instructions 66 to 119)

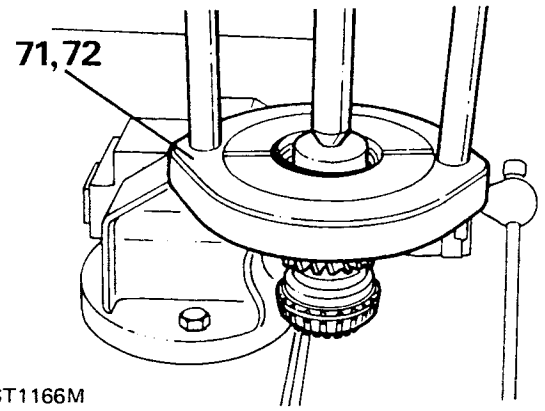
Dismantling

66. Detach the high/low selector shaft and fork.



ST1189M

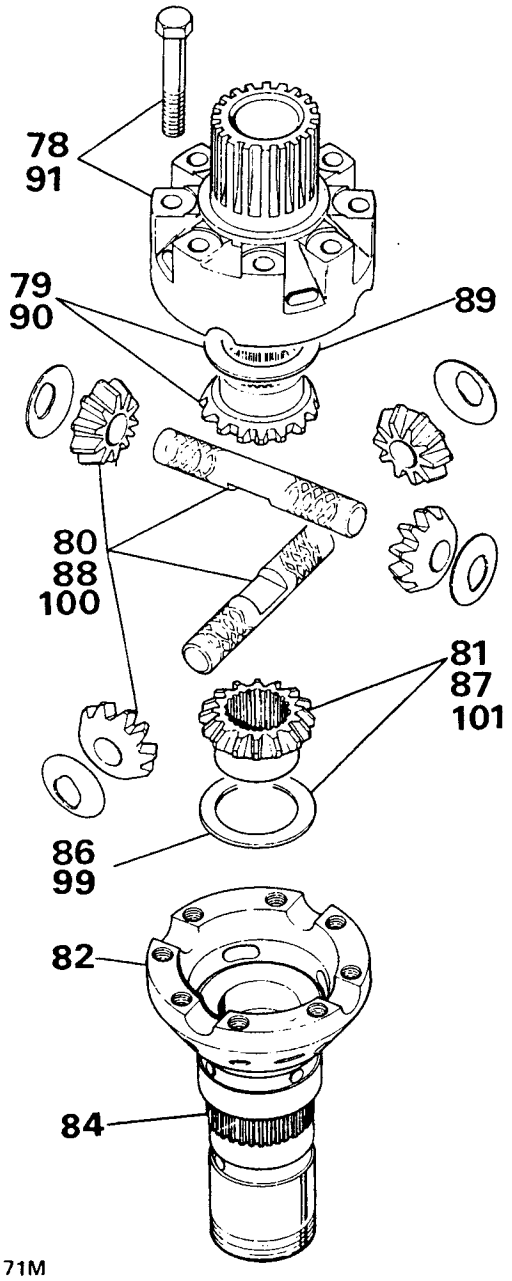
67. **Using soft jaws secure the differential unit in a vice** with the 'stake' nut uppermost.
68. Remove the peened-over metal to facilitate removal of the nut.
69. Remove the 'stake' nut using tool 18G1423.
70. **Remove the differential unit from the vice.**
71. **Secure hand press MS47 in vice** with collars 18G47BB/1 and using button 18G47BB/3 remove rear taper (twenty-four) roller bearing and collars LST 47-1 for latest (twenty-three) roller bearing.
72. Substituting collars 18G47BB/2 remove front taper roller bearing.
73. **Remove the hand press from the vice.**



ST1166M

74. Remove the high range (smallest) differential gear and its bush.
75. Mark the relationship of the high/low selector sleeve to the hub and remove the sleeve.

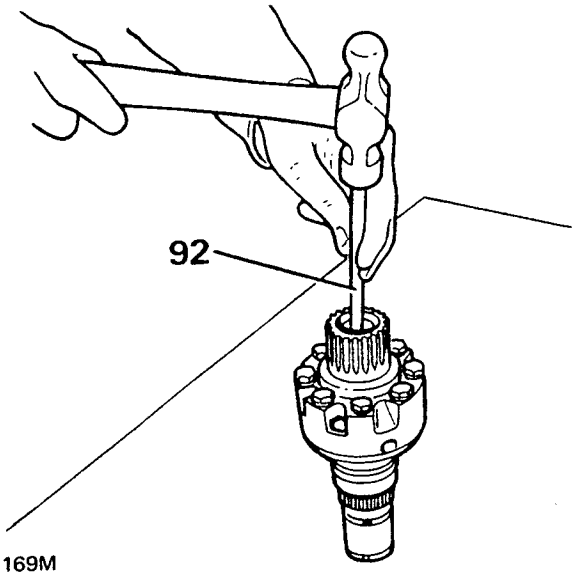
76. Using a suitable press behind the low range (largest) gear carefully remove both high/low hub and low range gear together. Alternatively, the rear carrier bearing, high output gear and bush, high/low hub and sleeve and low output gear can be pressed off in one operation by supporting the differential side of the low gear.
77. **Using soft jaws secure the differential unit in the vice by gripping the inner hub splines.**
78. Remove the eight retaining bolts and lift off the front differential case.
79. Lift off the front (upper) bevel gear and thrust washer.
80. Remove both pairs of side gears with their respective shafts and dished washers together.
81. Lift out the remaining rear (lower) bevel gear and thrust washer.
82. **Remove the rear differential case from the vice.**
83. Clean all parts, examine for wear or damage, renew as necessary.



ST1171M

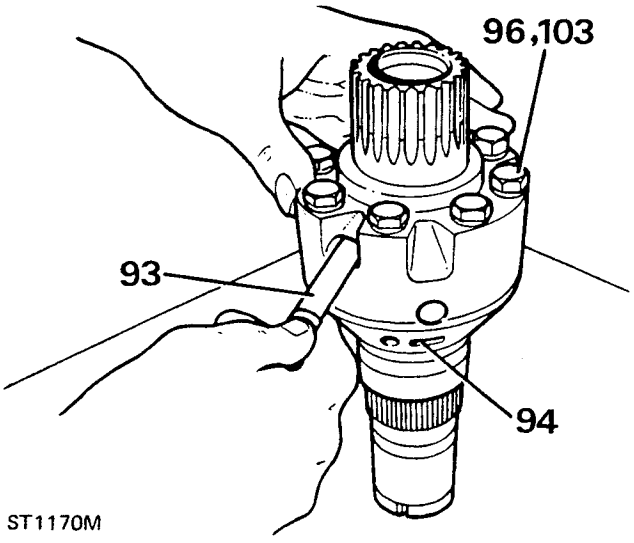
Obtaining differential backlash by checking bevel gear end-float

84. **Using soft jaws secure the rear differential case in the vice by gripping the inner hub splines.**
85. Ensure that all differential components are dry to assist in checking end-float.
86. Using a micrometer measure one of the bevel gear thrust washers and note thickness.
87. Fit the thrust washer and bevel gear to the rear (lower) differential case.
88. Assemble the side gears and dished washers on their respective shafts and fit to the rear case.
89. Measure the remaining bevel gear thrust washer, noting its thickness.
90. Fit the thrust washer and bevel gear to the front case.
91. Fit and align the front differential case tightening the eight securing bolts to the specified torque.
92. Ensure that the front bevel gear is fully in mesh by tapping it down, using a punch through the front differential case.



ST1169M

93. Measure the front bevel gear end-float with feeler gauges through the slots provided in the front differential case. This must be between 0,25 and 0,75 mm (0.001 and 0.003 in) maximum.
94. **Invert differential unit in vice** and repeat the above procedure (items 92 and 93) for the rear bevel gear in the rear differential case.
95. **Return the differential unit to its former position in the vice** i.e. with the front differential case uppermost.



ST1170M

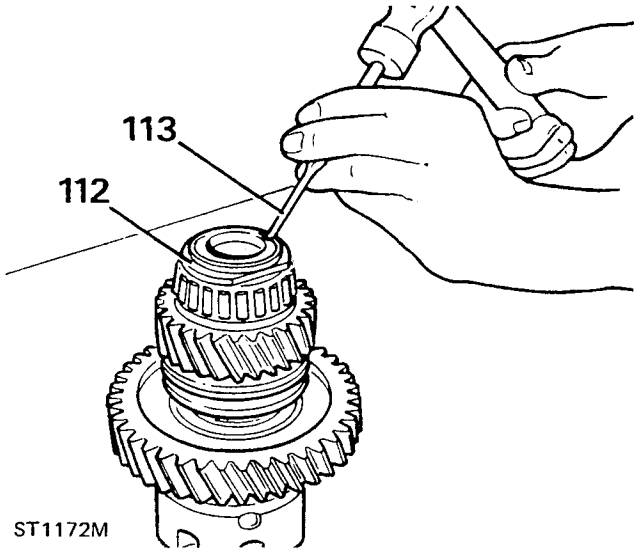
96. Remove the eight securing bolts and lift off the front differential case.
97. Remove the bevel gears and thrust washers, and side gear assemblies.
98. Select correct thrust washers required for final reassembly.

Reassembling

99. Fit the selected thrust washer and bevel gear to the rear (lower) differential case.
100. Assemble the side gears and dished washers on their respective shafts and fit to the rear case.
101. Fit the other selected thrust washer and bevel gear to the rear case.
102. Lubricate all parts with oil.
103. Fit and align the front differential case, locate the eight securing bolts and tighten to the specified torque.
104. Finally check that the differential gears revolve freely.
105. Place the front (outer) differential bearing on the front differential case and press into position using larger end of tool 18G1424.
106. **Invert the differential unit in the vice.**
107. Fit the low range gear (largest) to the rear differential case (with its 'dog' teeth uppermost).
108. Press the high/low hub onto the splined area of the case. Check end-float of low range gear. See Data at end of section.
109. Slide the high/low selector sleeve onto the hub outer splines, observing the alignment marks.
110. Fit the bush into the high range (smallest) gear and slide the bushed gear onto the rear differential case. Check end-float of high range gear and running clearance of gear on bush. See data at end of section.

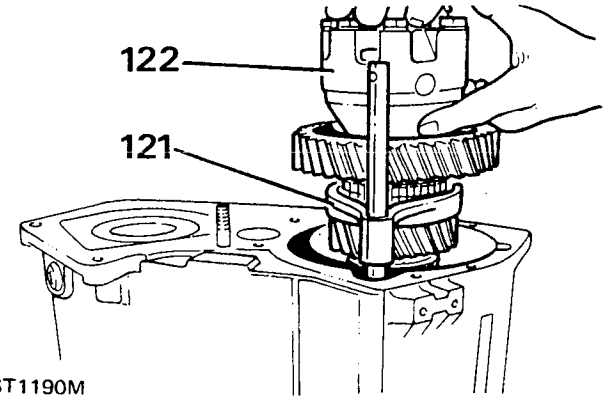
NOTE: If the clearances vary considerably from those specified in the data the assembly must be rebuilt.

111. Place the rear differential bearing on the rear differential case and press into position using the smaller end of tool 18G1424.



ST1172M

112. Fit the 'stake' nut using tool 18G1423 and tighten to the specified torque.
113. Peen the nut flange into the slot provided.
114. **Remove the differential unit from the vice.**
115. Lubricate gears, bearings, sleeve and bush with oil.
116. Clean and check the high/low selector fork assembly for wear and renew if necessary.
117. To renew the selector fork remove the square set screw retaining it to the selector shaft and ensure any traces of Loctite are removed from the threads.
118. Refit the selector fork with the fork boss towards the three detent grooves. Align the hole in the fork boss with the indent in the shaft nearest to the detent grooves.
119. Apply Loctite 290 to the set screw threads and fit the set screw to the correct torque.
120. **Prop up the transfer box so that its front side is uppermost.**
121. Fit the selector fork to the high/low selector sleeve in the differential assembly.
122. Locate the differential assembly and high/low selector fork assembly into the transfer case. It may be necessary to rotate the output shaft to ease fitment.
123. Fit the selector shaft detent ball and spring, apply Loctite 290 to the detent plug threads, screw in the detent plug until the spring is just coil bound, then back off two complete turns.



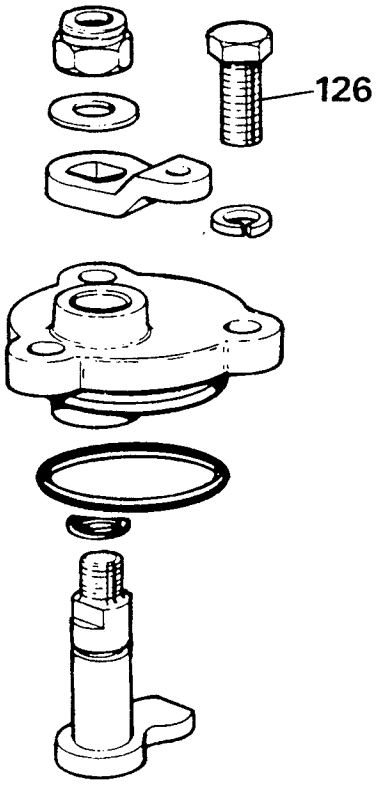
ST1190M

Front output shaft housing — Overhaul

(Instructions 125 to 175)

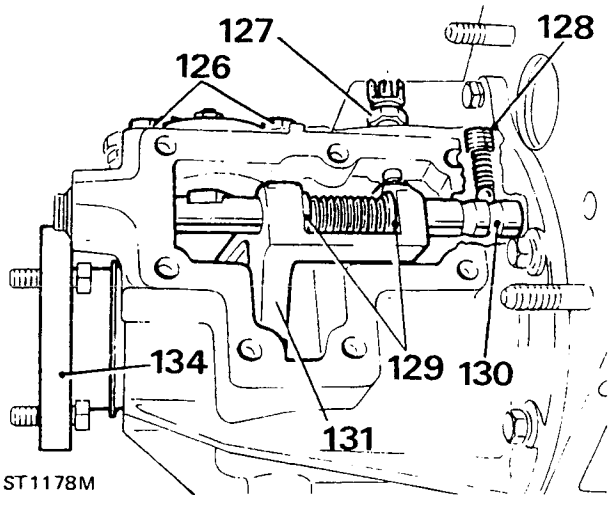
Dismantling

124. **Secure the housing in the vice, using soft jaws.**
125. Remove the seven screws securing the differential lock selector side cover and release the side cover and gasket.
126. Remove the three screws securing the differential lock finger housing and lift out the complete assembly.



ST1173M

127. Slacken the lock nut retaining the differential lock switch and unscrew the switch.



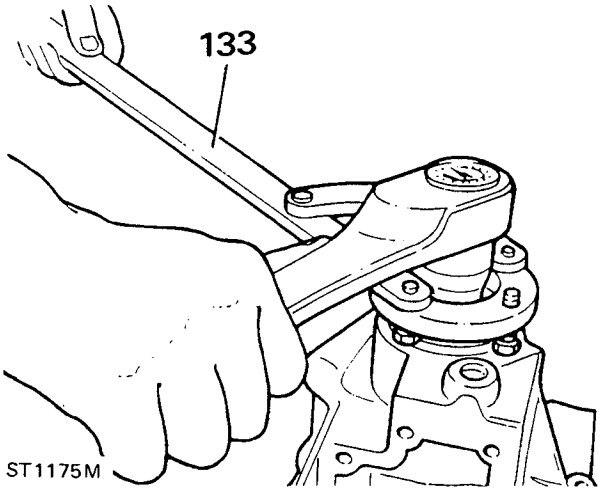
ST1178M

128. Remove the detent plug from the top of the housing and lift out the spring and ball using a magnet.
129. Compress the selector fork spring inside the housing and slide out the spring locating 'C' caps.
130. Slide the selector shaft out of the rear of the housing.
131. Remove the selector fork and spring through the side cover aperture.
132. Lift out dog sleeve from the back of the output shaft housing.
133. Using the flange wrench 18G1205 remove the flange nut, steel and felt washers. A two-legged puller may be necessary.

NOTE: Ensure that flange bolts are fully engaged in the wrench.

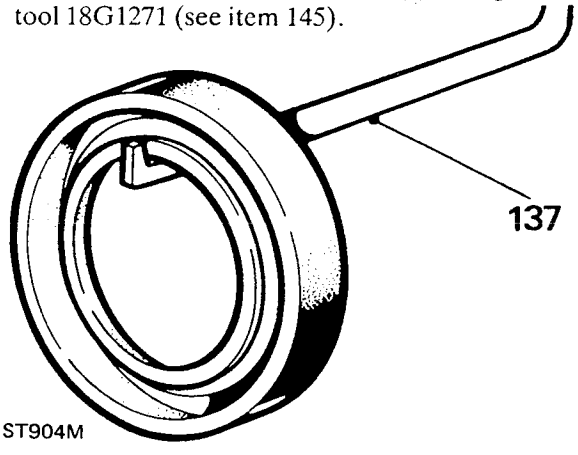
134. Remove the output shaft flange with oil seal shield.

NOTE: These parts need not be separated unless the flange bolts are to be renewed.



ST1175M

135. Drift the front output shaft rearwards out of the housing.
136. Slide off the collar from the output shaft.
137. Prise out and discard the oil seal(s), using service tool 18G1271 (see item 145).



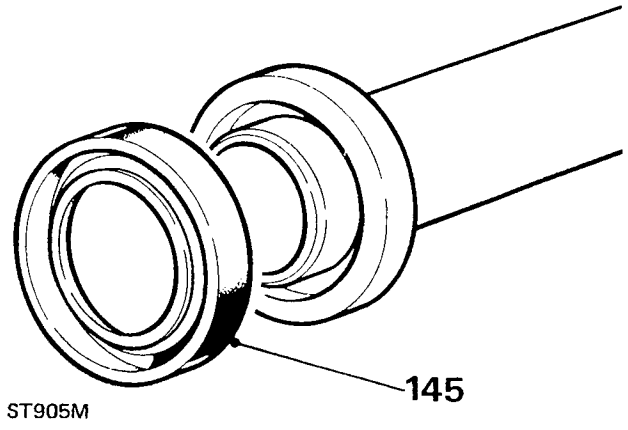
ST904M

138. Using circlip pliers 18G257 remove the circlip.
139. **Remove the housing from the vice** and drift out the bearing from inside.
140. Press out the differential front bearing cup and remove the shim behind it.
141. Clean all parts ensuring that any traces of Loctite are removed from faces and threads.
142. Renew oil seals and examine all parts for wear or damage, renew as necessary.

Reassembling

143. Press the front bearing into the housing. Do not use excessive force, if necessary, warm the housing assembly and case.
144. Fit the bearing retaining circlip, using circlip pliers 18G257.
145. Fit a new dual lip oil seal (open side inward) until the seal is in contact with the bearing circlip. It is essential to use replacer tool 18G1422.

NOTE: On early production two separate seals were used, these should be replaced with the new dual lip seal.



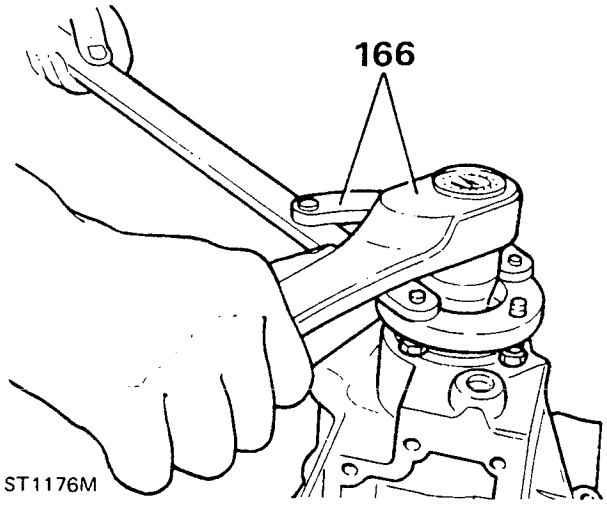
ST905M

146. Carefully charge the lips of the seal with grease.
147. Slide the collar onto the front of the output shaft with its chamfered edge to the front.
148. Fit the output shaft through the back of the housing.
149. Examine the flange seal track to check for any damage that may harm the seal.

Obtaining bearing pre-load

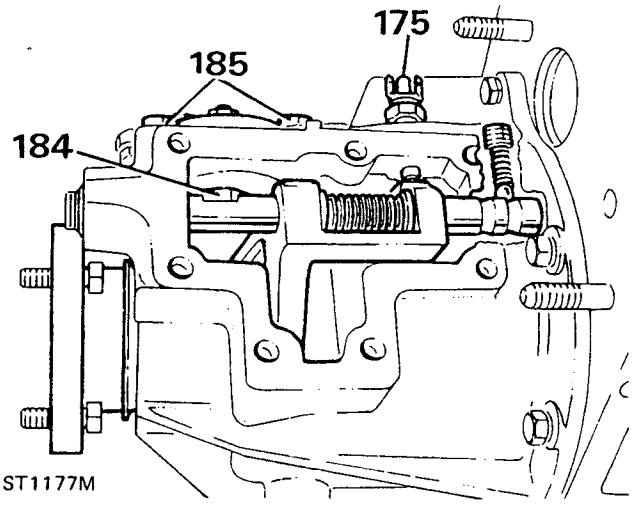
150. Measure the original differential front bearing track shim, noting its thickness.
151. Refit the original shim.
152. Drift the differential front bearing track into the housing.
153. Grease and fit a new gasket and locate the front output shaft housing on the transfer box.
154. Loosely retain the housing with the eight securing bolts (with spring washers), the upper middle bolt is longer. Do not fully tighten the bolts at this stage.
155. Engage high or low gear.
156. Check the rolling resistance of the differential, using a spring balance and a piece of string wound around the exposed splines on the high/low hub. Little or no resistance will register.
157. Tighten the bolts a little at a time, occasionally checking the rolling resistance. With the correct shim selected and the bolts tightened to the specified torque a pull of 1,8 to 4,5 Kg (4 to 10 lb) is required on the spring balance. This applies to new or used bearings.
158. If the reading is outside the above limits remove the front output shaft housing assembly from the transfer case.
159. Using a suitable extractor, withdraw the front differential bearing cup from the housing and exchange the shim for one of suitable thickness.
160. Refit the bearing cup.
161. Having obtained the correct rolling resistance prop-up the transfer box on the bench with the front side uppermost.
162. Grease and fit the front output shaft housing gasket and locate the housing on the transfer box.
163. Apply Loctite 290 to the threads of the housing securing bolts and fit the eight securing bolts (with spring washers). Note that the upper middle bolt is longer.
164. Turn the transfer box into its normal operating position.
165. Fit both input and output flanges as follows.
166. Using flange wrench 18G1205 and a torque wrench pull up output shaft to correct position. Check that the oil seal shield does not foul the housing.

NOTE: Ensure that flange bolts are fully engaged in the wrench.



ST1176M

167. Slide the dog sleeve onto the rear of the output shaft ensuring that the selector groove in the dog sleeve is to the front.
168. Compress the differential lock selector shaft spring, and fit it between the selector fork lugs.
169. Locate the selector fork inside the side cover aperture in the housing engaging the groove in the dog sleeve on the output shaft.
170. Fit the differential lock selector shaft into the housing from the back, grooved (detents) end last, and pass it through the selector fork lugs and spring and into the front of the housing.
171. Rotate the selector shaft until the two flats are uppermost.
172. Compress the spring slightly between the fork lugs and fit the two locating 'C' caps.



ST1177M

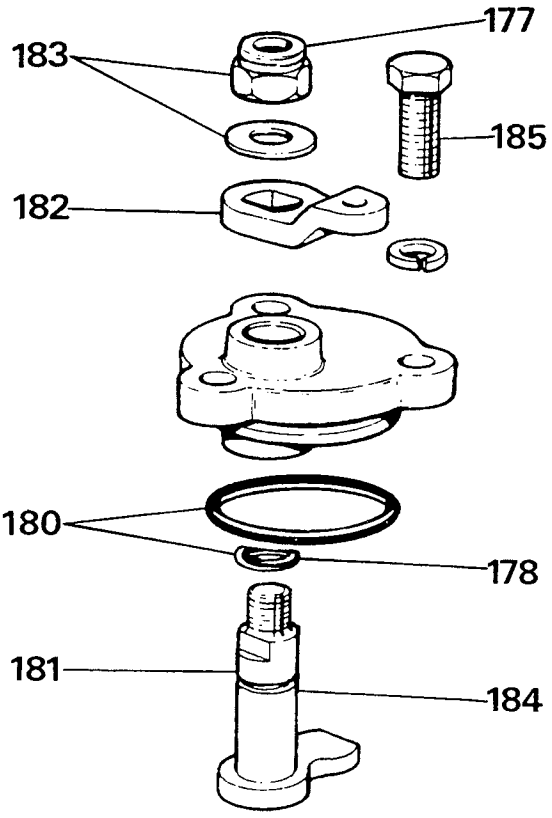
173. Fit the selector shaft detent ball and spring via the tapped hole in the top of the housing.
174. Apply Loctite 290 to the detent plug threads, screw in the detent plug until the spring is just coil bound, then back off two complete turns.
175. Loosely fit the differential lock switch in the tapped hole on top of the housing, leaving the locknut loose for adjustment.
176. Grease and fit the differential lock selector side cover gasket and fit the side cover, securing it with the seven bolts (with spring washers).

Differential lock finger housing — Overhaul

(Instructions 177 to 183)

Dismantling

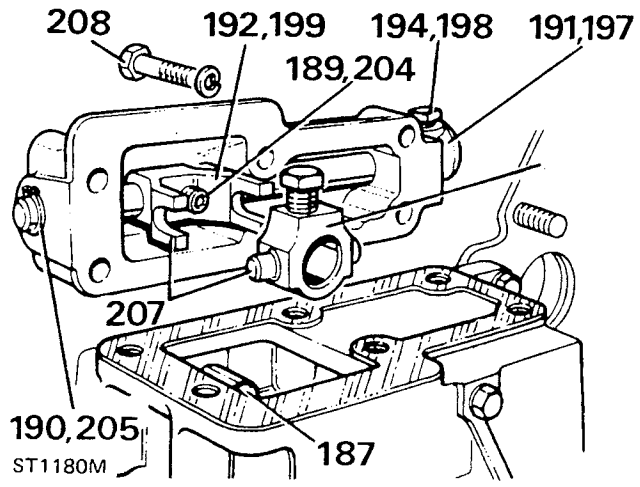
177. Remove and discard the Nyloc nut and release the lock lever and selector 'finger' from the 'finger' housing.
178. Remove and discard the 'O' rings from the selector finger and the selector finger housing.
179. Clean remaining parts, examine for wear or damage, renew as necessary.



ST1179M

Reassembly

180. Fit new 'O' rings to the finger housing and selector finger and lubricate with oil.
181. Locate the selector finger in the finger housing.
182. Fit the differential lock lever over the flats on the selector finger so that it will face forward in the operating position.
183. Fit the plain washer and a new Nyloc nut.
184. Fit the differential lock 'finger' housing assembly into the round aperture in the front output shaft housing locating the selector 'finger' on the flat on the selector shaft inside the housing.
185. Apply Loctite 290 to the 'finger' housing screw threads and fit the three securing screws (with spring washers) to the correct torque.
186. Grease and fit the differential lock selector side cover gasket and fit the side cover, securing it with the seven bolts (with spring washers).
187. Using a screwdriver inside the housing move the high/low selector shaft rearwards (i.e. into high range position) to provide access for fitting the yoke over the end of the selector shaft.
188. Locate the yoke on the selector shaft, apply Loctite 290 to the yoke set screw and fit the screw to the specified torque.



High/low selector housing — Overhaul

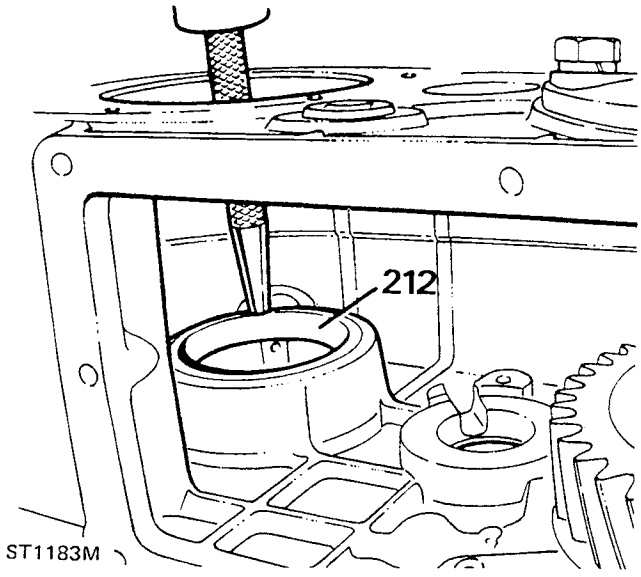
(Instructions 189 to 205)

Dismantling

189. Remove the selector fork grub screw **completely**.
190. Remove the cross shaft retaining circlip.
191. Withdraw the cross shaft from the selector housing with the operating arm attached.
192. Lift out the selector fork from the housing.
193. Remove the two 'O' rings from the cross shaft.
194. Remove the operating arm from the cross shaft by removing the retaining set screw.
195. Clean parts ensuring that all traces of Loctite are removed, examine for wear or damage, renew as necessary.

Reassembling

196. Fit the 'O' ring to the operating arm end of the cross shaft.
197. Locate operating arm on the shaft blind hole.
198. Apply Loctite 290 to the operating arm set screw threads and fit the set screw.
199. Locate the selector fork inside the housing.
200. Slide the cross shaft into the housing passing it through the selector fork.
201. Fit the 'O' ring to the fork end of the cross shaft (inside the housing) and lubricate both 'O' rings.
202. Position the cross shaft fully home.
203. Locate the selector fork on the shaft blind hole.
204. Apply Loctite 290 to the fork grub screw threads and fit the grub screw.
205. Fit the circlip on the end of the cross shaft.
206. Grease and fit the gasket to the high/low selector housing aperture on the front output shaft housing.
207. Position the high/low selector housing so that the projecting selector fork engages the yoke side pins inside the housing.
208. Fit the six selector housing retaining bolts (with spring washers).
209. **Prop up the transfer box on the bench with front side uppermost.**
210. Fit the oil seal into the front of the transfer box (seal lip to rear of case) using replacer tool 18G1422.
211. **Prop up the transfer box on the bench with rear side uppermost.**
212. Drift in the input gear front bearing track from inside the back of the transfer box, using a suitable punch.

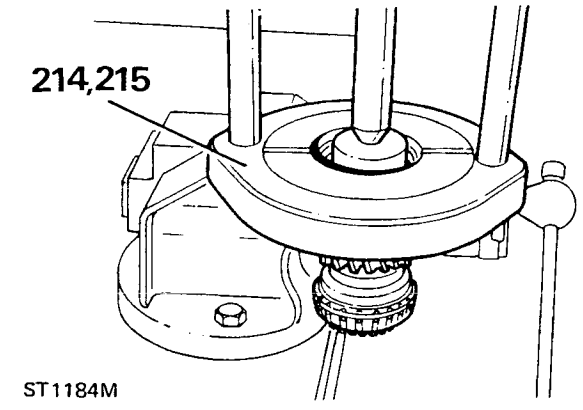


Input gear — Overhaul

(Instructions 231 to 237)

Dismantling

213. Clean all parts, examine for wear and damage, renew as necessary. Remove the bearings only if they are to be renewed.
214. **Secure hand press MS47 in vice** and using collars and buttons 18G47-7 remove the **front** taper roller bearing from the input gear assembly.
215. Reverse input gear assembly in hand press and remove the **rear** taper roller bearing.
216. **Remove the hand press from the vice.**



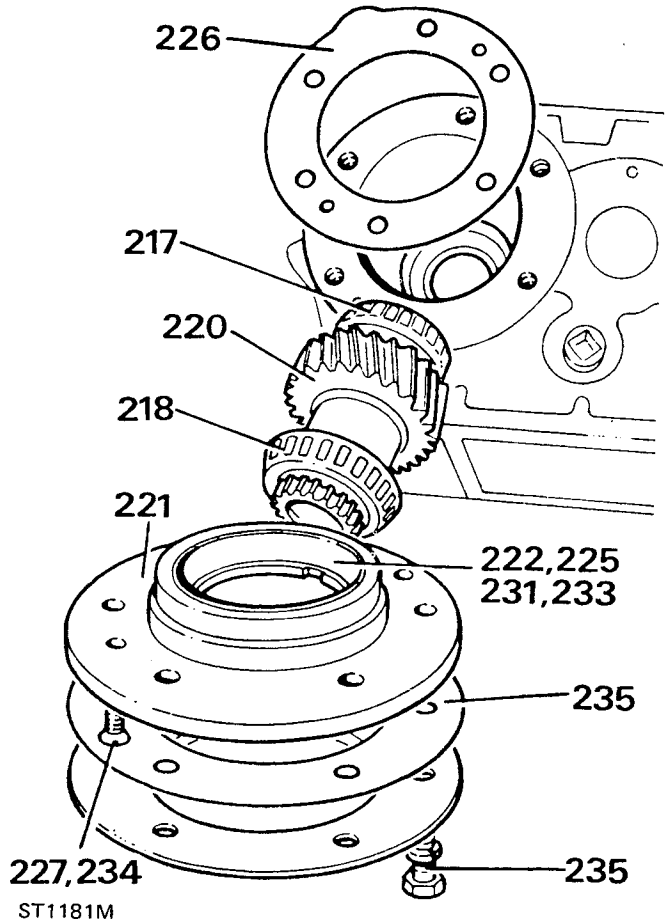
Reassembly

217. Locate the front taper roller bearing on the input gear assembly and press the bearing fully home.

218. Repeat above procedure and fit the **rear** taper roller bearing.
219. Lubricate both bearings with oil.
220. Fit input gear assembly into the transfer box from the rear (gear end first).

Obtaining bearing pre-load — with intermediate gear cluster removed

221. **Secure the mainshaft bearing housing in the vice.**
222. Press out the **rear** input gear bearing cup and remove the shim behind it.
223. Clean the main bearing housing and measure original shim, noting its thickness.
224. Fit the original shim to the main bearing housing.
225. Locate the **rear** bearing cup on the main bearing housing and press it fully home.
226. Apply grease to the gasket and fit onto the transfer box casing.
227. Fit the main bearing housing and tighten the two securing screws to the specified torque.



ST1181M

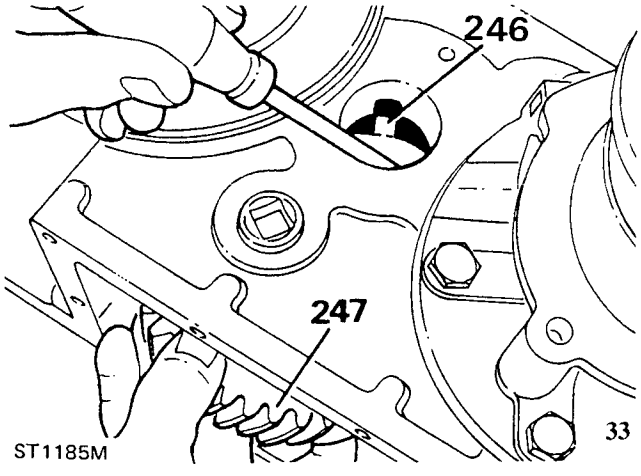
228. Wind sufficient string around the gear teeth to rotate the input gear. A pull of 1,4 to 3,6 Kg (3 to 8 lb) is required on the spring balance. This applies to new or used bearings.

NOTE: The pre-load can only be measured while the Transfer gearbox is separated from the main gearbox.

229. If the reading obtained is outside the above limits the original shim must be changed accordingly.
230. Remove the two screws retaining the mainshaft bearing housing.
231. Press out the rear bearing cup from the bearing housing and remove and discard the original shim.
232. Select a shim to the required thickness to obtain the correct pre-load of 0,02 to 0,07 mm (0.001 to 0.003 in) on reassembly.
233. Fit the shim to the main bearing housing and then press the rear bearing cup into position.
234. Fit the main bearing housing and tighten the two securing screws to the specified torque.
235. Grease and fit P.T.O. cover gasket and finally fit the P.T.O. cover securing it with six bolts (with plain washers) to the specified torque.

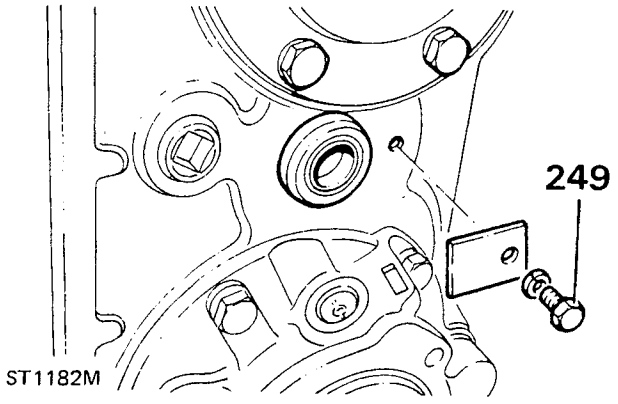
Intermediate gear assembly — Reassembly

236. First remove the needle roller bearings and spacer from the gear assembly.
237. Clean the parts, including the thrust washers and lock plate and examine for wear or damage, renew as necessary. Refer to DATA at end of section for thrust washer thickness.
238. Fit the 'O' ring to the intermediate shaft.
239. Fit the 'O' ring into the front of the transfer case.
240. Lubricate thrust washers, bearings, shaft and spacer.
241. Fit needle bearings with spacer interposed. If the bearings have plastic cages, the flanged end of each cage must face the thrust washers, when fitted.
242. Fit front thrust washer to slot in transfer (plain side to case).
243. Locate gear assembly partially into the transfer case so that it rests on the front thrust washer.
244. Locate rear thrust washer (plain side uppermost) into slot in transfer case.
245. Gently push gear assembly into mesh.
246. Using a screwdriver through the intermediate shaft hole guide the locating tab on the rear thrust washer into the slot provided in the transfer case.
247. Align gear and thrust assembly and slide the intermediate shaft into the transfer box from the rear.
248. Align the shaft so that the lock plate slot in the end is on top.

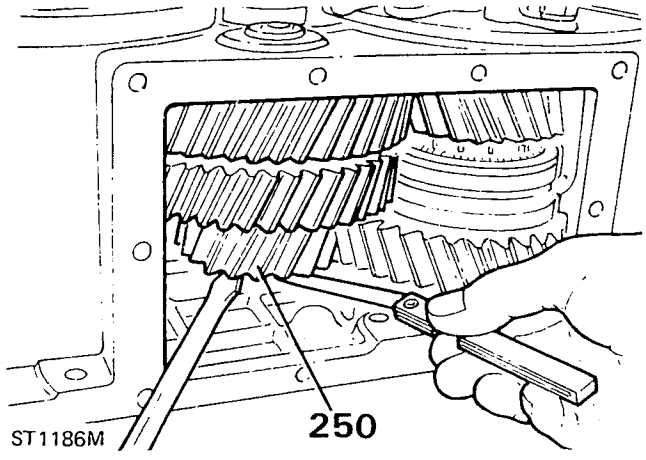


ST1185M

249. Apply Loctite 290 to the lock plate bolt threads. Locate lock plate into position and fit securing bolt (with spring washer).



250. Using a screwdriver via the bottom of the transfer case lift up the gear assembly and measure the end-float with feeler gauges. This should be between 0,08 and 0,35 mm (0.003 and 0.014 in).



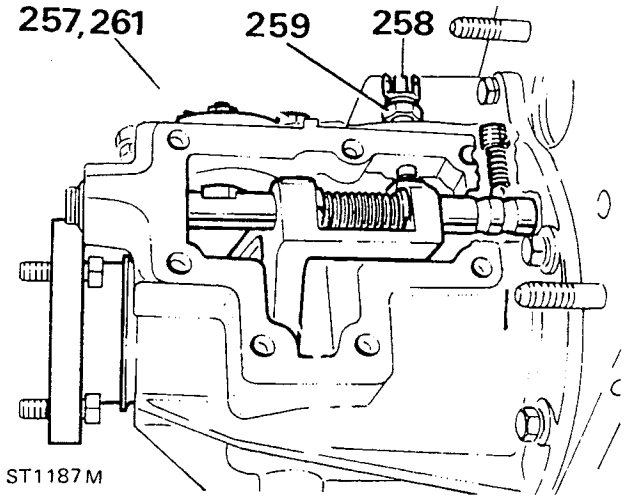
251. Grease and fit the bottom cover gasket.
252. Apply Loctite 290 to the ten bottom cover fixing bolts only.
253. Clean and fit the bottom cover, using the ten bolts (with spring washers).

Transmission brake assembly

254. Clean brake backplate and oil drip plate and apply silicone rubber sealant. Locate the backplate on the rear output shaft/speedometer housing so that the brake operating lever is on the right-side rear.
255. Fit the four Brako Durlok bolts, the lower two with plain washers, also retain the oil drip plate. Tighten to specified torque.
256. Clean and fit brake drum and fit the two countersunk retaining screws.

Differential lock switch adjustment

257. Select differential locked position by moving the differential lock lever towards the right side of the transfer box.
258. Obtain a battery and connect a test lamp circuit to the differential lock switch.
259. Slacken the lock nut off and screw in the lock switch until the bulb is illuminated.
260. Turn the lock switch another half turn and tighten the lock nut against the housing.
261. Disconnect the battery and move the differential lock lever towards the left side of the transfer box to disengage the differential lock.

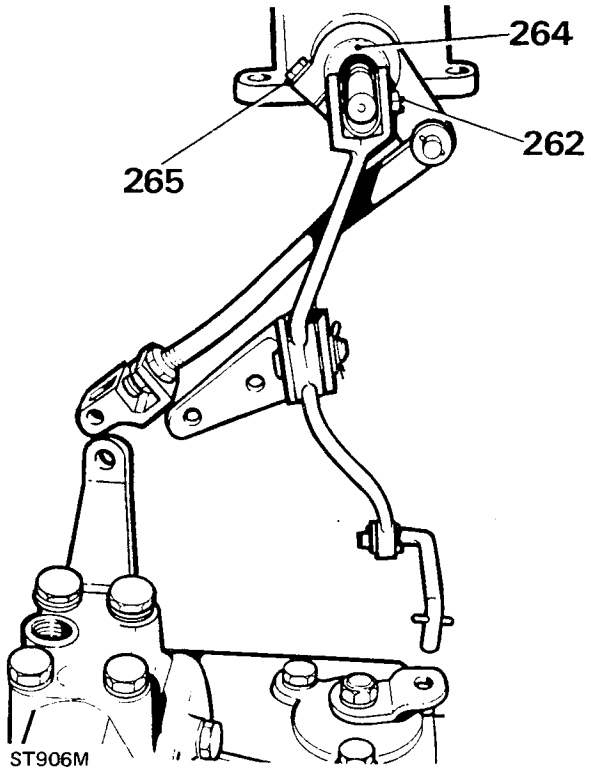


High/low gear change housing — Overhaul

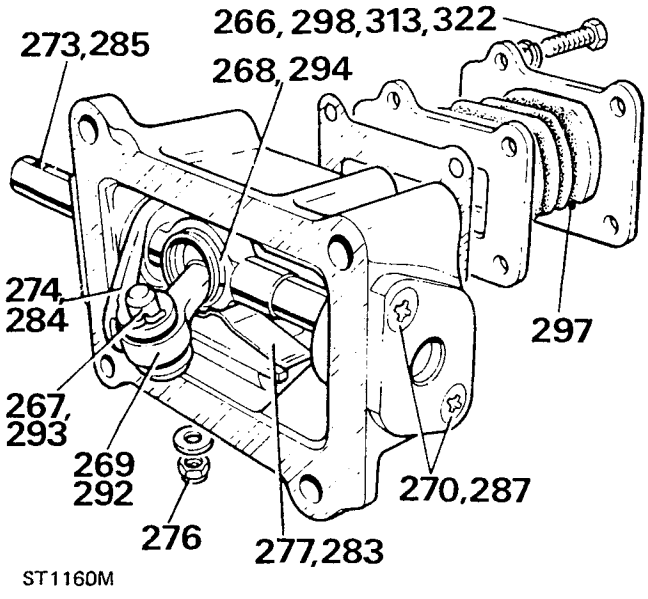
(Instructions 262 to 298)

Dismantling

262. Remove the split pin from the clevis pin at the top of the differential lock cross shaft lever which secures it to the gear change cross shaft.
263. Remove the washer and clevis pin and the anti-rattle nylon strip.
264. Mark the position of the high/low gear change operating arm on the splined shaft of the gear change crank arm.
265. Slacken the clamp bolt and remove the operating arm.
266. Remove the four bolts from the top of the gear change housing and lift off the grommet plate grommet, gate plate and gasket.
267. Remove the split pin from the gear change crank arm clevis pin and remove the clevis pin.
268. Remove the circlip from the high/low gear change lever bush.
269. Withdraw the gear change lever from the housing, with ball and socket bush.



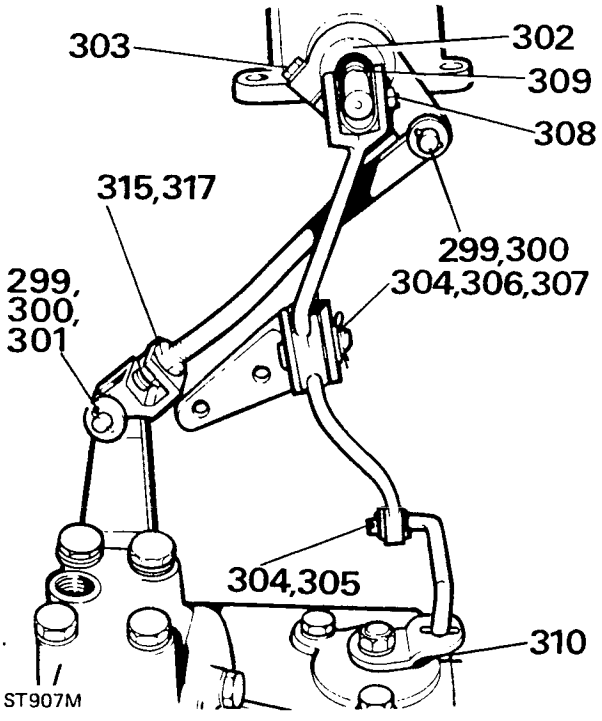
270. Remove the two countersunk screws from the housing end cover.
271. Remove the housing end cover.
272. Remove the two 'O' rings from the end cover.
273. Remove the cross shaft from the housing.
274. Compress the detent spring and remove the gear change arm from inside the housing.



275. Remove the two 'O' rings from the crank arm.
276. Remove and discard the two Nyloc nuts retaining the detent plate.
277. Remove the detent plate and spring from the housing.
278. Clean all parts, examine for wear or damage, renew as necessary.

Reassembly

279. Fit the two 'O' rings to the housing end cover.
280. Fit the two 'O' rings to the gear change crank arm.
281. Lubricate 'O' rings with oil.
282. Clip the detent spring onto the detent plate.
283. Fit detent plate assembly into housing and retain from outside with two Nyloc nuts (with plain washers).
284. Compress the detent spring and fit the gear change crank arm in the housing.
285. Fit cross shaft into position locating end in the crank arm.
286. Fit the housing end cover to support the other end of the cross shaft.
287. Finally secure the housing end cover with the two countersunk screws.
288. Before refitting the gear change lever remove the clevis pin bushes and the Nylon socket bush and ball.
289. Clean all parts, examine for wear or damage, renew as necessary.
290. Fit and grease gear lever ball and Nylon socket bush to gear lever.
291. Fit and grease clevis pin bushes.
292. Locate gear change lever assembly in cross shaft (do not fit socket bush retaining circlip at this stage).
293. Align gear change lever end with crank arm fork ensuring that the gear lever is cranked rearwards and fit clevis and split pin.
294. Finally secure Nylon socket bush with circlip.
295. Grease and fit gasket to gear change housing face.
296. Fit the gate plate.
297. Fit the grommet.
298. Fit the grommet plate and retain with the four securing bolts (with spring washers).



299. Before refitting the high/low connecting rod and gear change operating arms remove the respective clevis pins and Nylon bushes. Clean and examine for wear or damage, renew as necessary.
300. Grease and fit the Nylon bushes to the high/low selector and gear change operating arms.
301. Assemble both operating arms to the connecting rod with clevis pin, plain washer and split pin.
302. Slacken the gear change operating arm clamp bolt and fit the operating arm on to the splined shaft projecting from the high/low gear change housing, carefully aligning it to the marks on both components.
303. Tighten the clamp bolt to the specified torque.
304. Before refitting the differential lock cross shaft lever and pivot bracket remove the respective clevis pins and Nylon bushes. Also remove the split pin retaining the cranked lever and disconnect it. Clean and examine for wear or damage, renew as necessary.
305. Fit the cranked lever to the **bottom** of the cross shaft lever and secure with a new split pin (with plain washer).

NOTE: Early gearboxes were fitted with a short connecting link secured by a 'Nyloc' nut.

306. Grease and fit the Nylon bushes to the **middle** pivot of the cross shaft lever.
307. Fit the cross shaft lever to the (loose) pivot bracket with the clevis pin, washer and split pin.
308. Fit the cross shaft lever fork (top) to the gear change cross shaft.
309. Locate the anti-rattle Nylon strip and fit the clevis pin, plain washer and split pin.
310. Fit the cranked lever, at the bottom of the differential lock cross shaft lever, to the lock lever and retain the clevis pin and plain washer with a new split pin.
311. Grease and fit the Nylon bushes to the operating arm on the selector housing cross shaft.

Adjustment of high/low connecting rod

312. This operation is carried out in situ or on the bench, after assembly to the main gearbox.
313. Remove the four bolts from the top of the gear change housing and lift off the gear change lever grommet plate and the gear change lever grommet. Replace the four bolts temporarily to retain the gate plate in position.
314. Check that the gear lever does not foul the gate plate when high or low range is selected. If adjustment is required carry out the following procedure.
315. *Slacken off the connecting rod locknuts.
316. Move gear change lever into high range (rearwards) and move the operating arm on the selector housing cross shaft into high range (forwards).
317. Tighten locknut(s).
318. Check that the gear change lever does not foul the gate plate in this position.
319. Engage and check low range in the same way.
320. After adjustment return the gear change lever to the high range position.
321. Remove the four bolts retaining the gate plate and refit the grommet and grommet plate.
322. Refit the four bolts (with spring washers).

* On early versions of the transfer gearbox a different connecting rod fork end was used with a single locknut. In this case the following method of adjustment is recommended.

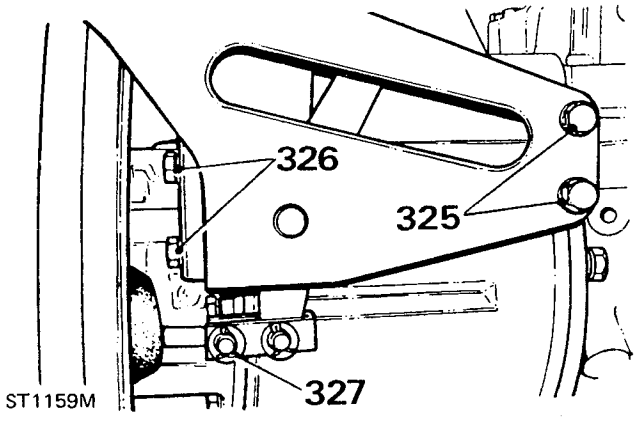
(a) Disconnect the top of the differential lock cross shaft lever from the gear change cross shaft.
(b) Remove the four bolts retaining the gear change housing to the remote gear change housing on the main gearbox.
(c) Lift up the housing assembly (with the connecting rod attached) and rotate it as required to vary the length of the connecting rod.

Transfer box mounting — Refitting

323. Fit the rubber mounting plate to the right side of the front output housing by fitting the four securing bolts (with new lock tabs).

Handbrake linkage — Refitting

324. Locate the handbrake linkage bracket in position on the right hand side of the transfer box casing and secure as follows.
325. Fit the two bolts (with spring washers) and distance pieces to retain the front side of the linkage bracket.



326. Fit the two bolts (with spring washers) to secure the rear end of the linkage bracket. The lower bolt is shorter.
327. Insert the clevis pin through the brake operating lever, fit the handbrake link, plain washer and split pin.

DATA

Input shaft bearing pre-load	0,02 to 0,07 mm (0.001 to 0.003 inch)
Intermediate gear end-float	0,08 to 0,35 mm (0.003 to 0.014 inch)
Intermediate gear thrust washer thickness	2,70 to 2,75 mm (1.06 to 1.08 in)
Centre differential rolling resistance — (minus intermediate gear cluster and output shaft flange)	1,8 to 4,5 Kg (4 to 10 lb) pull
Input gear rolling resistance — (minus intermediate gear cluster)	1,4 to 3,6 Kg (3 to 8 lb) pull
Differential pinions backlash	0,02 to 0,07 mm (0.001 to 0.003 inch)
Output shaft bearing pre-load	0,02 to 0,07 mm (0.001 to 0.003 inch)
Low range gear end-float High range gear end-float	0,05 to 0,15 mm (0.002 to 0.006 inch)
High range gear/bush running clearance diameter	0,03 to 0,09 mm (0.0012 to 0.0035 inch)

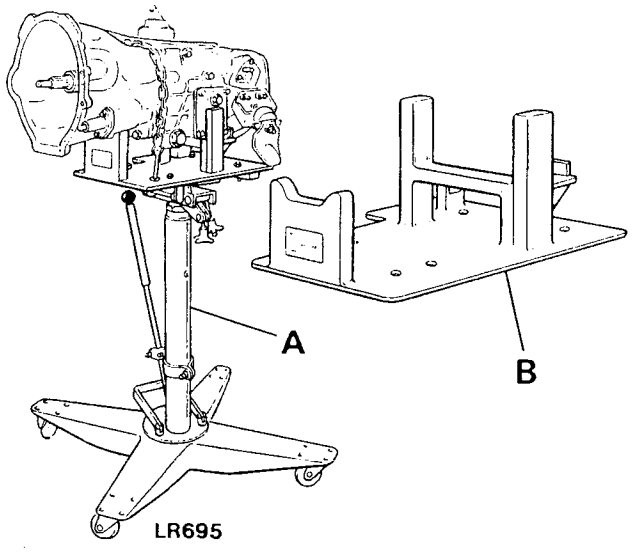
REMOVE LT 95 FOUR SPEED GEARBOX WITH INTEGRAL TRANSFER BOX — ONE TEN V8 MODELS

Service tools:
RO 1001 — Lifting bracket for gearbox. A hydraulic or mechanical chassis spreader is also required.

The gearbox should be removed from underneath the vehicle using a suitable lifting hoist. Number 3, chassis cross-member is removable to allow easy removal of the gearbox.

WARNING: It is essential, because of the considerable weight and offset position of the centre of gravity of the gearbox, that a hydraulic transmission hoist of adequate strength and stability is used. Failure to observe this precaution could result in the hoist tipping over and causing serious personal injury or damage to the gearbox.

Suitable hydraulic lifting equipment (A) is made by Blackhawk International Limited. A special adaptor plate (B) is produced by Claydrum Engineering Services for holding the Land Rover V8 gearbox. This adaptor plate can be used with various transmission hoists provided they meet the safety requirements indicated above.



Remove

Gear change levers.
Central section of exhaust system.

Disconnect

Handbrake and speedometer cables.
Front and rear propeller shafts from the gearbox.
Vacuum pipes and electrical leads from differential lock actuator.
Electrical leads from reverse light switch.
Make any remaining disconnections and note the following important points during removal.

When removing the chassis cross-member, do not allow it to fall. After removing the fixings, use a spreader on the chassis side members to free the cross-member.

Remove the cover plate from the front lower half of the bell housing.

Remove the clutch slave cylinder from the bell housing.

Position the transmission hoist under the gearbox and support it.
Release the two rear gearbox mounting brackets from the chassis side members.

Support the engine under the sump.
Pass the safety chain around the gearbox and make fast.
Remove the bell housing bolts (eight bolts).

Withdraw the gearbox from the engine.
Fit the lifting bracket RO 1001 to facilitate any subsequent removal from the transmission lift.

After refitting the gearbox into the vehicle, refill the main and transfer gearboxes with the correct grade oil, to the oil level plug hole.

For further information regarding the hydraulic transmission hoist and the special gearbox adaptor plate, please contact the equipment manufacturers direct. Their addresses are as follows:—

Transmission Hoist — type 67556 (T-3)

Blackhawk Automotive Limited
Brookfield Industrial Estate
Leacon Road
Ashford
Kent, England
Telephone: Ashford (0233) 32151
Telex: 965621 BLUK G

Gearbox Adaptor Plate — type DS RT

Claydrum Engineering Services
P.O. Box 5
Clayland Avenue
Worksop, England
Telephone Worksop (0909) 48021

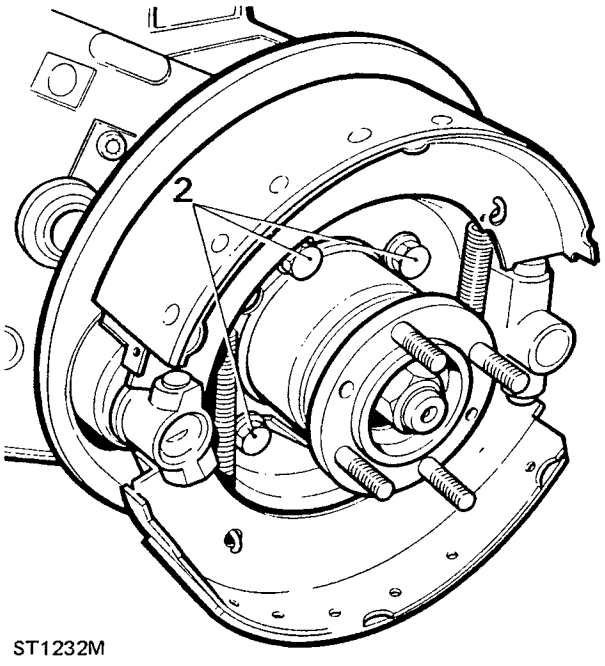
OVERHAUL LT 95 FOUR SPEED GEARBOX

The following overhaul instructions assume that the gearbox is removed from the vehicle and the oil drained.

Remove the clutch slave cylinder, release mechanism and bearing assembly, stand the gearbox on a wood block on the bell housing end.

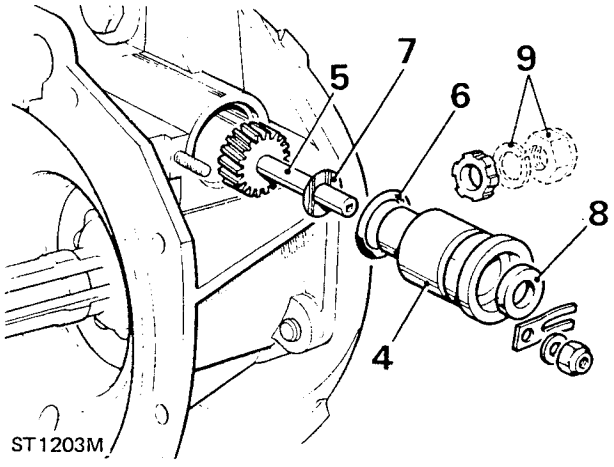
REMOVE AND OVERHAUL SPEEDOMETER DRIVE HOUSING

1. Remove the brake drum retaining screws and withdraw the drum.
2. Remove the four bolts retaining back plate, remove oil catcher and back plate assembly.



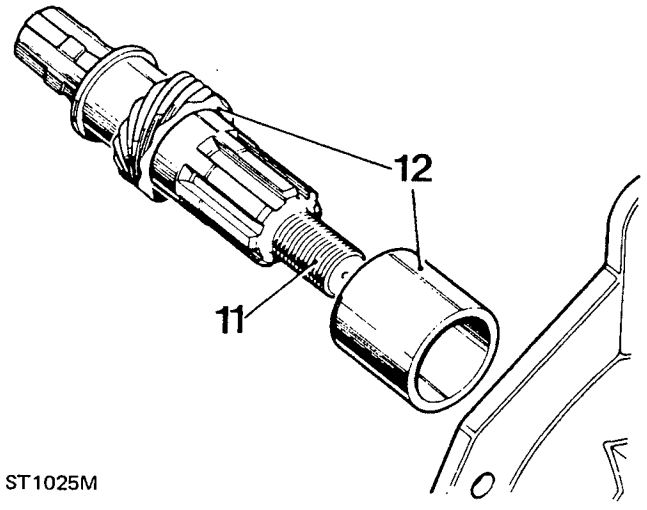
ST1232M

3. Remove the eight bolts and withdraw the speedometer drive housing.
4. Remove the speedometer spindle housing.
5. Lift out the driven gear and spindle.
6. Take off the 'O' ring seal.
7. Remove the thrust washer.
8. Withdraw the oil seal.
9. Remove the locking nut, using a flange tool, washer and felt seal, output coupling flange to output shaft.
10. Withdraw the coupling flange complete.



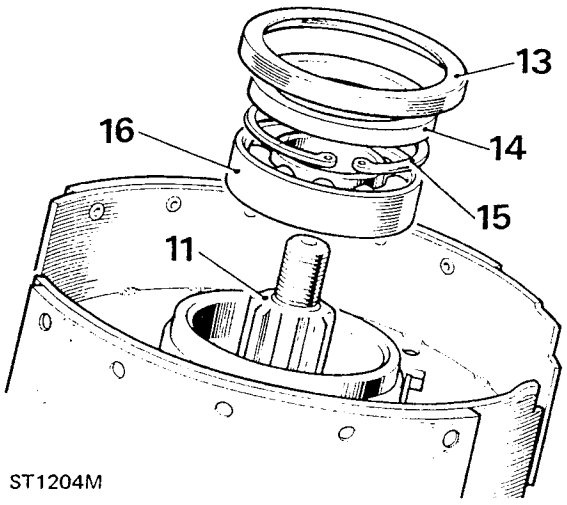
ST1203M

11. Drive out the rear output shaft, using a hide mallet on the threaded end.
12. Slide off the spacer and speedometer worm.

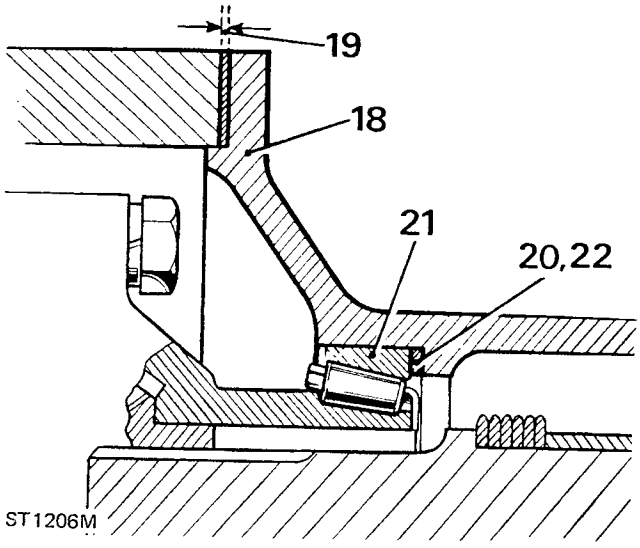


ST1025M

13. Withdraw the oil shield.
14. Prise-out the oil seal.
15. Remove the circlip.
16. Tap out the ball bearing race.



ST1204M



ST1206M

Check differential pre-load

This check must be carried out if a replacement speedometer drive housing is to be fitted. The check is also required if a replacement gearbox, differential unit or differential unit bearing is being fitted.

17. Measure and record the thickness of the new joint washer for the speedometer drive housing.
18. Offer the speedometer housing, less joint washer, to the gearbox.
19. Measure the clearance between the drive housing and gearbox joint faces. This must be 0,10 to 0,15 mm (0.004 to 0.006 in) more than the recorded thickness of the new joint washer. With the gasket fitted and the bolts tightened to 3 kgf.m (22 lbf.ft) a final rolling resistance check should be made using a spring balance and string wrapped round the differential case. The resistance should be 14-16 lbs (6-7 kg). The differential lock must be disengaged to allow free rotation of the unit whilst making this check.
20. To adjust the joint face clearance, adjust the thickness of shimming fitted behind the rear bearing outer face as follows: instructions 21 and 22.
21. Drive out the bearing outer race.
22. Withdraw the shim washer and select a replacement of the required thickness. Shim thickness range is 1,65 to 2,80 mm (0.065 to 0.110 in) in 0,05 mm (0.002 in) stages.

Assemble the housing

23. Fit the rear output shaft ball bearing and circlip.
24. Press in the output coupling flange oil seal, open face first, until the seal plain face just clears the chamfer on the seal housing bore.
25. Fit the oil shield, which must be a close fit on the speedometer housing.
26. Fit the speedometer worm followed by the spacer.
27. Fit the rear output shaft.
28. Fit the coupling flange.
29. Fit the felt seal, plain washer and locking nut to secure the output flange and tighten to the correct torque.
30. Assemble the following parts to the speedometer spindle housing:
31. Fit the oil seal.
32. Fit the thrust washer.
33. Fit a new 'O' seal.
34. Fit the speedometer driven gear and spindle.
35. Fit the speedometer spindle housing assembly to the drive housing.

Assemble speedometer drive housing to gearbox

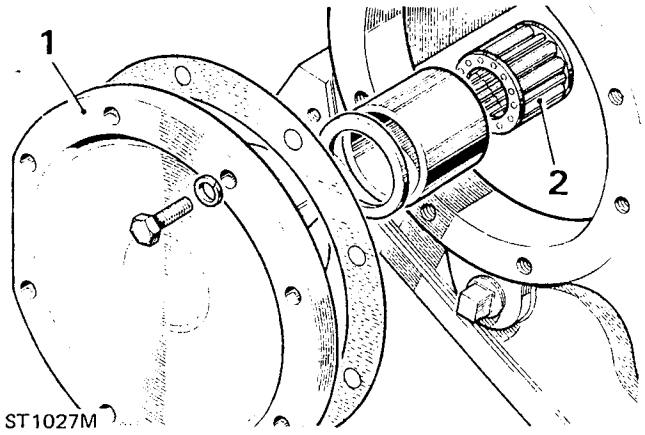
36. Place a new joint washer in position.
37. Offer the drive housing to the gearbox and engage the rear output shaft splines in the differential unit.
38. Position the flat on the drive housing adjacent to the flat on the intermediate shaft.
39. Secure the assembly with eight bolts and evenly tighten to the correct torque.
40. Fit back plate assembly.
41. Fit oil catcher and seal with Hylosil.
42. Tighten special bolts to 55 to 60 lbf.ft (75 to 80Nm) noting that plain washers are fitted.

REMOVE AND OVERHAUL MAINSHAFT TRANSFER GEAR

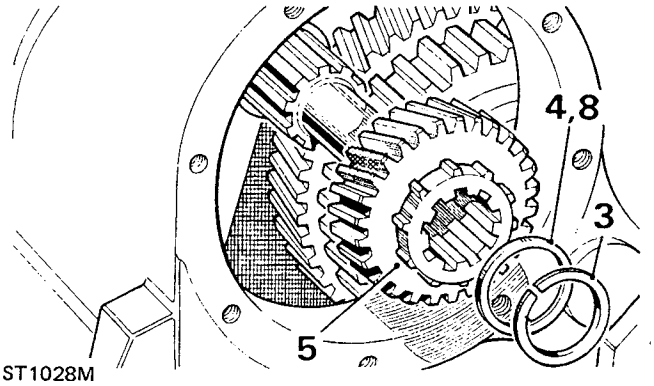
Special tool:
18G1388 — mainshaft output gear puller

1. Remove the mainshaft rear bearing housing.
2. Lift out the roller bearing.
3. Remove the snap-ring.
4. Withdraw the shim washer.
5. The transfer gear is retained on the splines with Loctite 275. Use a puller 18G1388 to withdraw it.

NOTE: The roller bearing outer race is located by a roll pin which must be punched-out before the race can be removed.



ST1027M



ST1028M

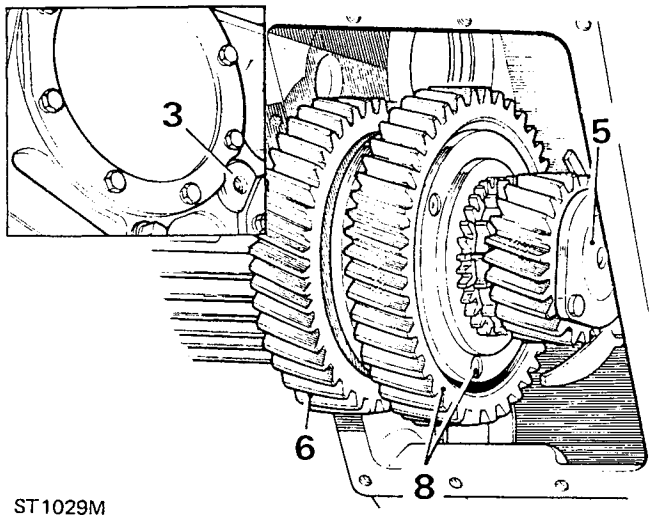
Assembling

6. Fit the transfer gear to the mainshaft.
7. Fit the shim washer and snap-ring.
8. Check the end-float between the shim washer and snap-ring. End-float to be 0,050 mm (0.002 in) maximum. Shim washer range 1,8 to 2,0 mm (0.071 to 0.079 in) in 0,05 mm (0.002 in) stages.
9. Fit the roller bearing and rear bearing housing.

REMOVE AND OVERHAUL INTERMEDIATE GEARS ASSEMBLY

Special tool:
RO1003 — slave intermediate shaft

1. Remove the speedometer drive housing.
2. Remove the gearbox bottom cover.
3. Screw a suitable extractor into the 8 mm threaded hole provided in the intermediate gear shaft.
4. Hold the intermediate gear cluster in position and withdraw the shaft.
5. Insert the slave shaft RO1003 to retain together the gears assembly.
6. Withdraw the intermediate gears assembly.
7. Slide the thrust washers, bearings and gears from the slave shaft.
8. The input gear and outer member is a riveted assembly and no dismantling is permitted.

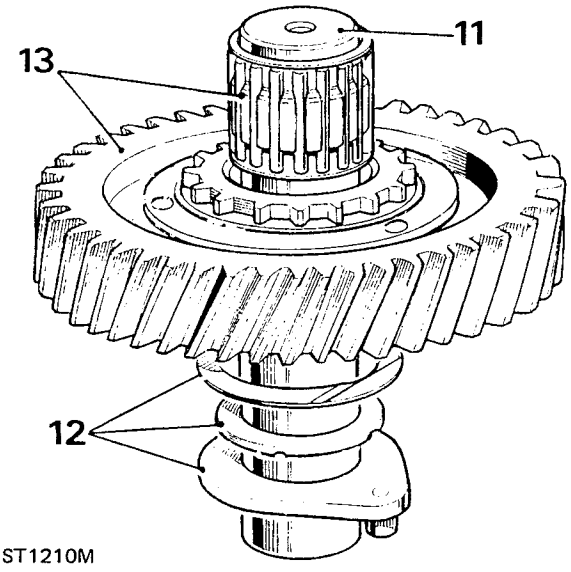


ST1029M

9. Remove the 'O' ring seal from the intermediate gear shaft.
10. Wash and degrease all parts and inspect for wear and renew if necessary. When new, the thrust bearing washers have a lead/tin coating, if this only has worn away there is no need to renew them.

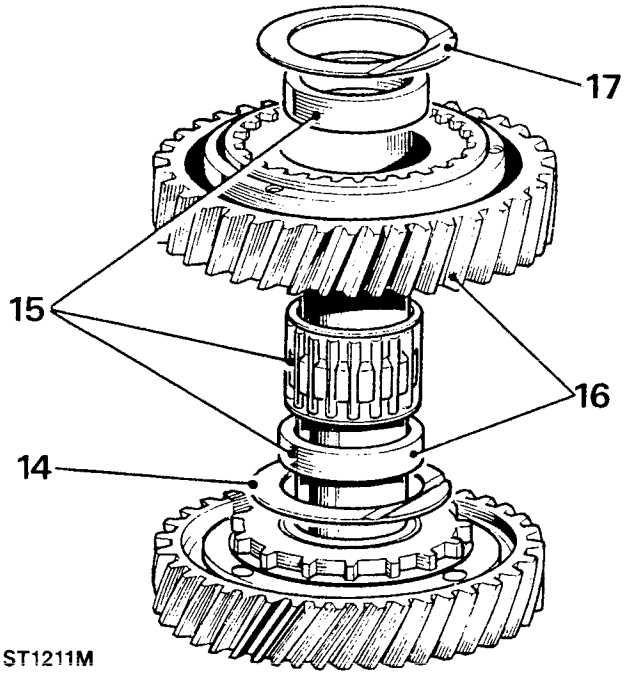
Assemble intermediate gears

11. Place the slave shaft on the bench, extractor thread end uppermost.
12. Fit a pear-shaped thrust washer, inner ring and a thrust bearing washer to the shaft (ring grooved face downwards).
13. Fit a needle-roller bearing and the 'high' gear (plain face first) to the shaft.



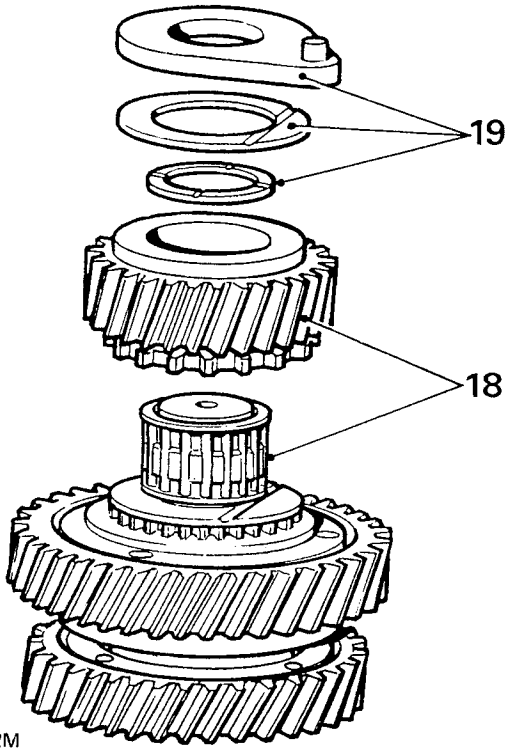
ST1210M

14. Position a thrust bearing washer on the 'high' gear.
15. Fit a spacer, needle-roller bearing and a further spacer to the input gear inner member.
16. Position the assembled input gear on the shaft and engage the lower spacer in the previously positioned thrust bearing washer.
17. Locate a thrust bearing washer over the upper spacer.



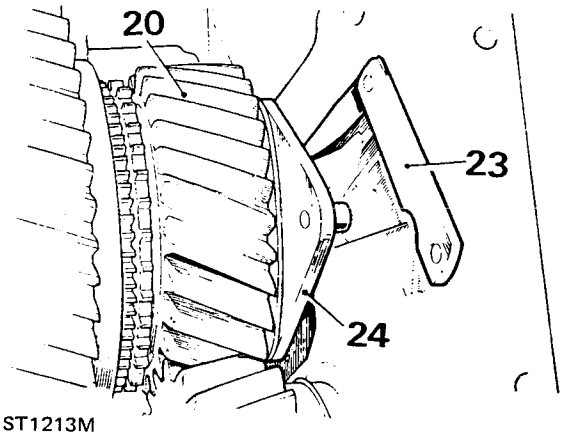
ST1211M

18. Fit a needle roller bearing and the 'low' gear (plain side last) to the shaft.
19. Fit the remaining thrust needle bearing, inner ring and thrust washer (ring grooved face upwards).



ST1212M

20. When the foregoing bearing clearance check has been completed, slide the gears and slave shaft assembly into the transfer gearbox and engage the selector forks.
21. Withdraw the slave shaft and lubricate the bearings through the shaft aperture.
22. Fit the intermediate shaft and 'O' ring seal with the flat on the shaft toward the differential unit.
23. Measure the clearance between the rear thrust washer and the gear casing. This must be 0,15 to 0,23 mm (0.006 to 0.009 in).
24. Adjustment is carried out by substituting one or both of the thrust washers. The washers are available in 3,55 mm (0.139 in), 3,63 mm (0.143 in) and 3,74 mm (0.147 in) thicknesses.
25. Refit the gearbox bottom cover.
26. Refit the speedometer drive housing.



ST1213M

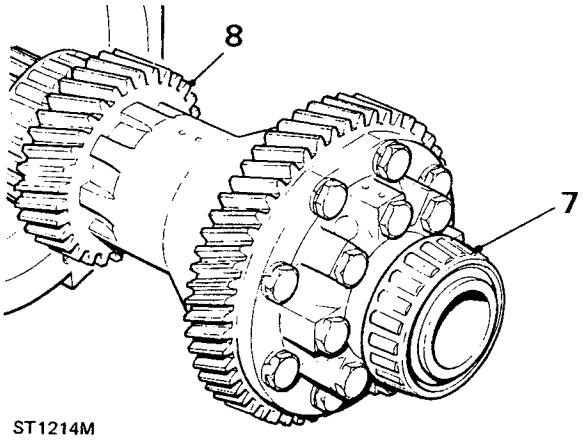
REMOVE AND OVERHAUL DIFFERENTIAL UNIT

Special tool:
18G47BB — bearing extractor

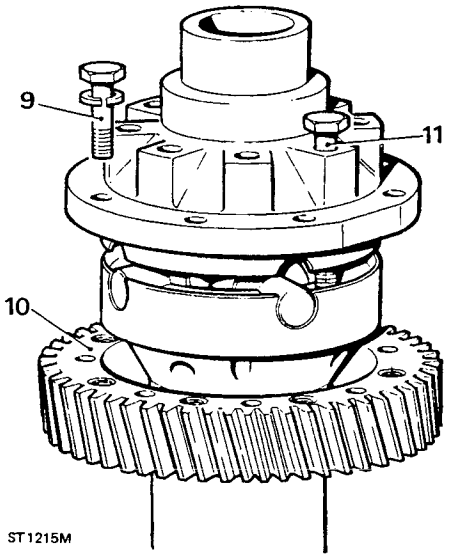
1. Select the differential lock.
2. Remove the differential lock actuator assembly.
3. Remove the front output shaft and housing.
4. Remove the speedometer drive housing.
5. Remove the intermediate cluster assembly.
6. Remove the differential assembly.

NOTE: During dismantling it is essential that all components are marked in their original position and relative to other components, so that if original components are refitted, their initial setting is maintained.

7. Press off the roller bearings using tool 18G47BB.
8. Withdraw the high-speed gear, which is secured by Loctite.

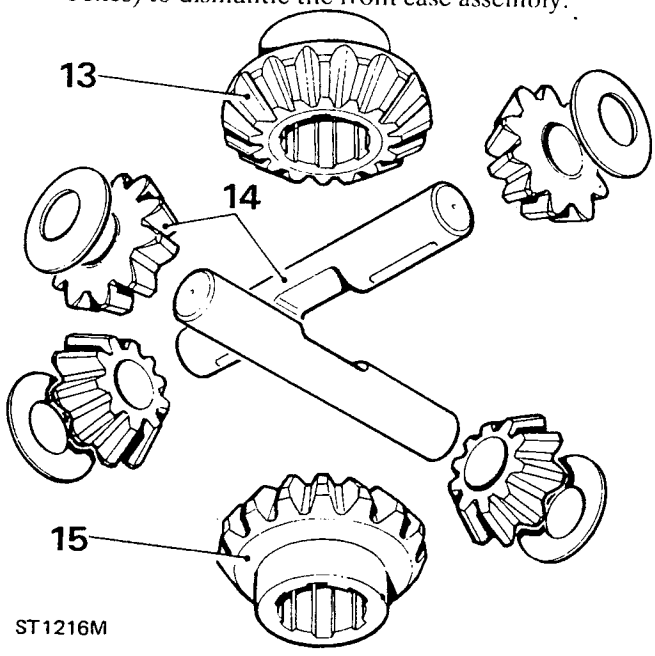


ST1214M



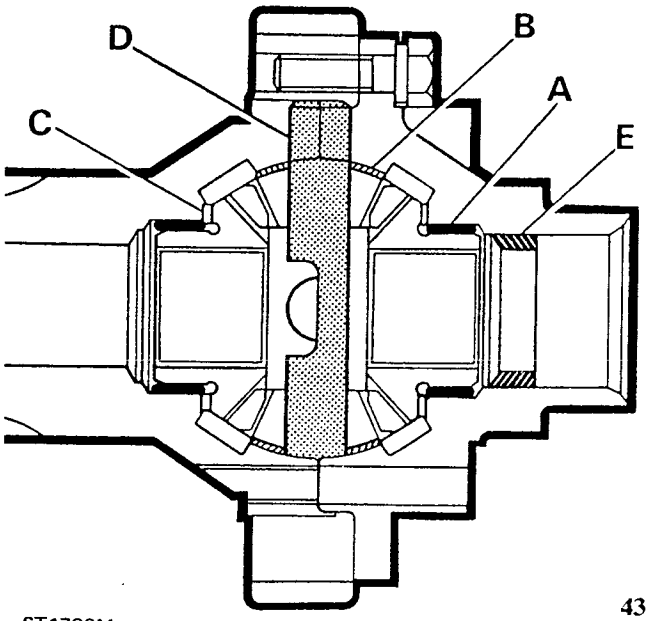
ST1215M

9. Remove the fixings, low-speed gear to casing.
10. Withdraw the gear.
11. Remove the casing securing bolts.
12. Lift off the rear case assembly (and oil retaining ring — later gearboxes).
13. Withdraw the side gear (and thrust washer — later boxes).
14. Slide out the cross-shafts and remove the bevel pinions and thrust washers from the front case assembly.
15. Withdraw the side gear (and thrust washer — later boxes) to dismantle the front case assembly.



ST1216M

NOTE: From gearbox numbers 1300 3481A and 1700 0007A the following modifications have been made to the differential.
A. Introduction of side gear bushes.
B. Improved thrust washers.
C. Addition of thrust washer on side gears.
D. Modified cross pins.
E. Addition of oil retaining ring.
The new differential part number FRC 7740 is only interchangeable with superceded unit part number 594 340.



ST1799M

NOTE: If replacements are required, replace the following items 16 and 17 as sets.

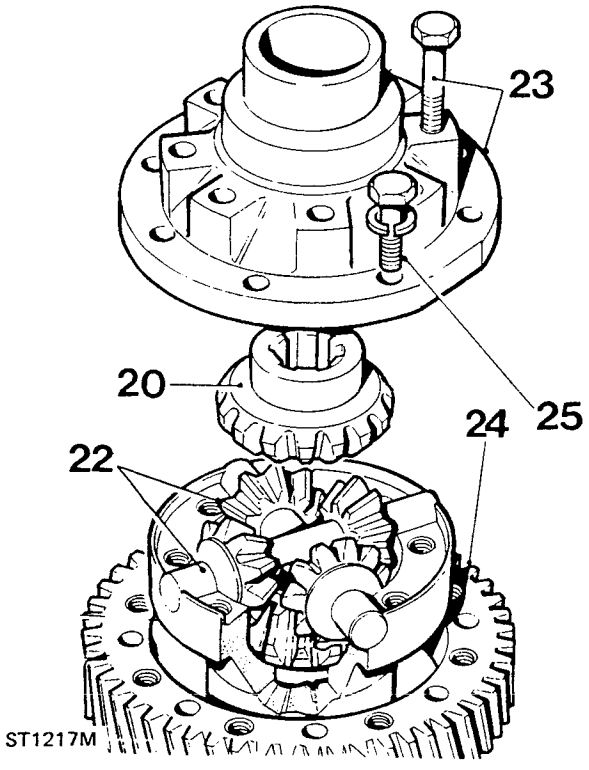
16. Bevel pinions and side gears (set of six).
17. Cross-shafts (set of two).
18. Check the gear teeth for damage.
19. Check all parts for satisfactory general condition including the side gear bushes.

NOTE: The differential case halves are a matched pair, and halves must not be changed individually.

Assemble differential

CAUTION: It is essential that during the following assembly all components are well lubricated with new oil of the correct grade.

20. Fit a side gear into the rear casing.
21. Fit a side gear into the front casing.
22. Fit the bevel pinions, thrust washers and cross-shafts into the front casing.
23. Fit the rear casing to the front casing. Tighten the bolts evenly in sequence to the correct torque. Use Loctite 275 on threads.
24. Offer the low gear to the differential casing.
25. Align the fixing holes and fit the bolts evenly in sequence to the correct torque. Use Loctite
26. Fit the roller bearings and refit the differential unit.



NOTE: If the differential case or bearings have been replaced, carry out the 'Differential bearing pre-load check'.

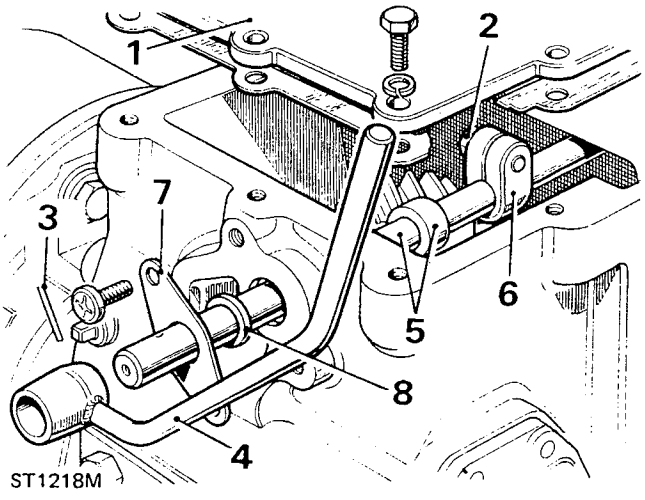
Assemble differential to gearbox

27. Refit the differential unit.
28. Refit the speedometer drive housing.
29. Refit the front output shaft and housing.
30. Refit the differential lock actuator assembly.

NOTE: If a replacement differential unit is being fitted, carry out the 'Differential bearing pre-load check', described in 'Speedometer drive housing — Overhaul'.

REMOVE AND OVERHAUL TRANSFER GEAR LEVER AND CROSS-SHAFT

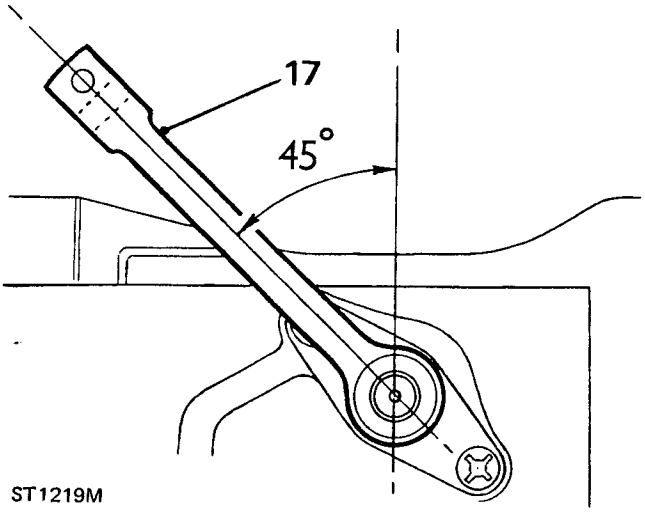
1. Remove the top cover.
2. Slacken the selector finger pinch bolt.
3. Drive out the retaining pin, gear lever to cross-shaft.
4. Withdraw the gear lever.
5. Withdraw the cross-shaft and spacer.
6. Lift out the selector finger.
7. Remove the retaining plates.
8. Withdraw the sealing rings.



Assemble gear lever and cross-shaft

9. Position the selector finger in the gearbox.
10. Fit the cross-shaft and spacing collar and engage the selector finger.
11. Fit the sealing ring and retaining plate at the R.H. side of the gearbox.
12. Fit the gear lever and retaining pin.

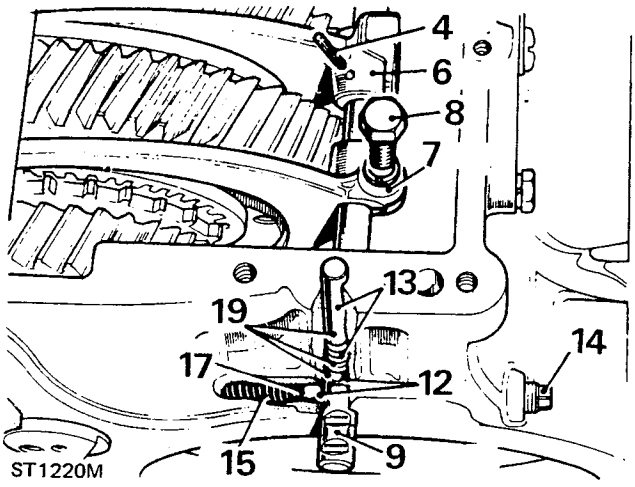
13. Fit the remaining sealing ring and retaining plate.
14. Tighten the selector finger pinch bolt.
15. Select 'High' transfer range, that is, the larger intermediate gear engaged.
16. Slacken the selector finger bolt.
17. Rotate the cross-shaft until the gear lever is inclined 45 degrees to the vertical position.



18. Tighten the selector finger pinch bolt.
19. Fit the top cover using a new joint washer and evenly tighten the retaining bolts.

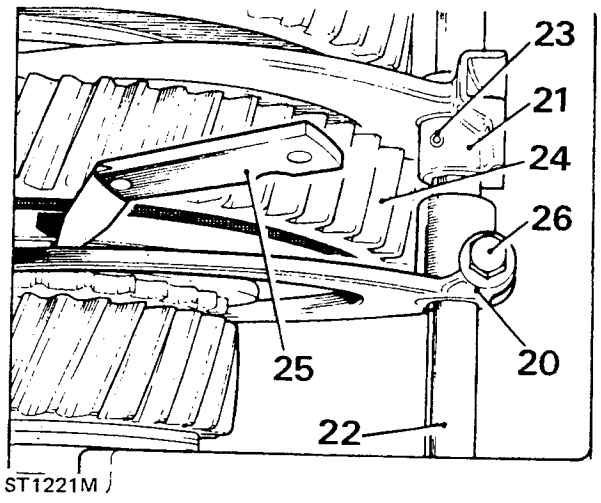
REMOVE AND OVERHAUL TRANSFER BOX SELECTORS AND SHAFT

1. Remove the speedometer drive housing.
2. Remove the transfer gearbox top cover.
3. Select 'Low' range transfer gear.
4. Drive out the retaining pin from the front selector fork sufficient to free the fork.
5. Ease the differential unit to the rear.
6. Push the forward selector fork forward on the shaft.
7. Pull to the rear on the rear selector fork to move the selector shaft out of engagement with the detent balls in the casing rear face.
8. Remove the pinch bolt on the rear fork.
9. Partially withdraw the selector shaft and lift out the selector forks.
10. Remove the retaining pin from the front fork.
11. Withdraw the selector shaft, closing the shaft housing by hand to prevent the detent balls from dropping into the casing.
12. Withdraw the two detent balls.
13. Lift out the spacing rod and spring.
14. Remove the blanking plug.
15. Withdraw the detent spring from the cross drilling.



Assemble shaft and selectors

16. Position the detent spring in the inner bore in the cross drilling.
17. Locate the detent ball on the spring.
18. Enter the selector shaft, push the ball against the spring and push in the shaft.
19. Fit the detent ball, spring and spacing rod to the vertical drilling.
20. Position the rear selector fork, plain face to rear, in the gearbox.
21. Position the front selector fork, extended boss to the rear, in the gearbox.
22. Align the retaining pin holes and engage the selector shaft in the selector forks.
23. Fit the retaining pin, front fork to shaft.
24. Set transfer gears in 'Neutral' position.
25. Adjust the rear fork position until there is 0,12 to 0,25 mm (0.005 to 0.010 in) clearance between the front face of the rear fork and the rear face of the input gear inner member.
26. Tighten the rear fork pinch bolt.



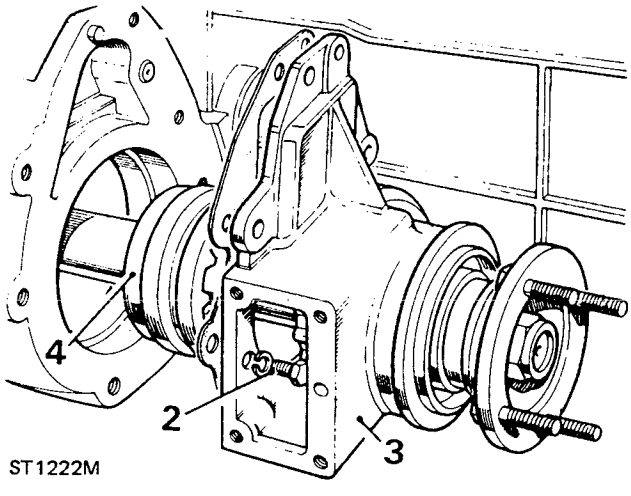
ST1221M

27. Fit the blanking plug to the cross drilling.
28. Fit the transfer box top cover using a new joint washer and evenly tighten the bolts to the correct torque.
29. Fit the speedometer drive housing.

REMOVE AND OVERHAUL FRONT OUTPUT SHAFT AND HOUSING

Remove output shaft assembly

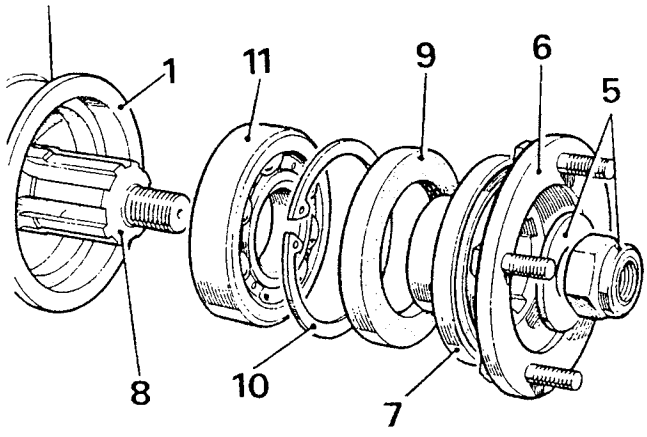
1. Remove the differential lock actuator assembly.
2. Remove the six retaining bolts, spring washers and gasket.
3. Withdraw the output shaft and housing complete.
4. Lift out the lock-up dog clutch.



ST1222M

Overhaul assembly

5. Hold the output shaft in a vice or use a flange restraining tool and remove the flange retaining nut and washer.
6. Withdraw the coupling flange complete with mudshield.
7. If required, press off the mudshield.
8. Press out the shaft toward the rear.
9. Withdraw the oil seal.
10. Remove the circlip.
11. Withdraw the output shaft bearing.
12. Wash and degrease all parts, examine for wear and renew as necessary.



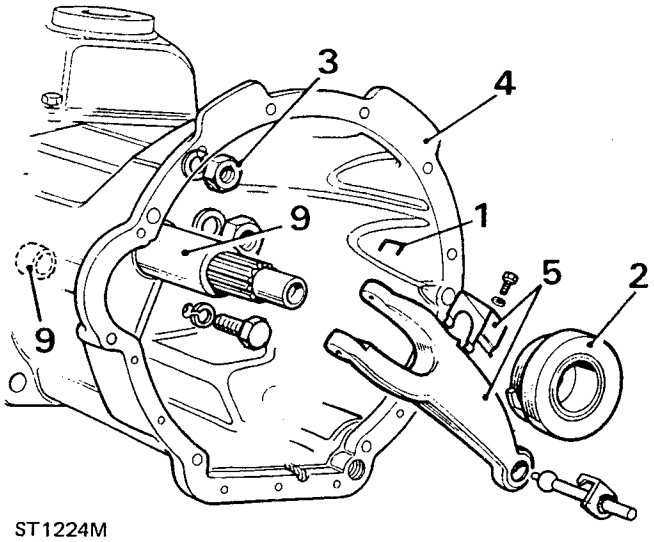
ST1223M

Assemble output shaft assembly to housing

13. Fit the output shaft bearing and secure with the circlip.
14. Fit the oil seal, lip side towards the bearing.
15. Press in the output shaft from the rear.
16. Fit the coupling flange complete with mudshield and flange bolts. Secure with the locking nut to the correct torque.

REMOVE AND OVERHAUL BELL HOUSING AND CLUTCH RELEASE

1. Withdraw the locating staple from the clutch release sleeve and release lever.
2. Lift out the release sleeve and bearing assembly.
3. Remove the bell housing fixings and make a note of the position of each bolt and nut.
4. Withdraw the bell housing complete with clutch release lever.
5. If required, remove the push rod clip and the spring clip and withdraw the clutch release lever.



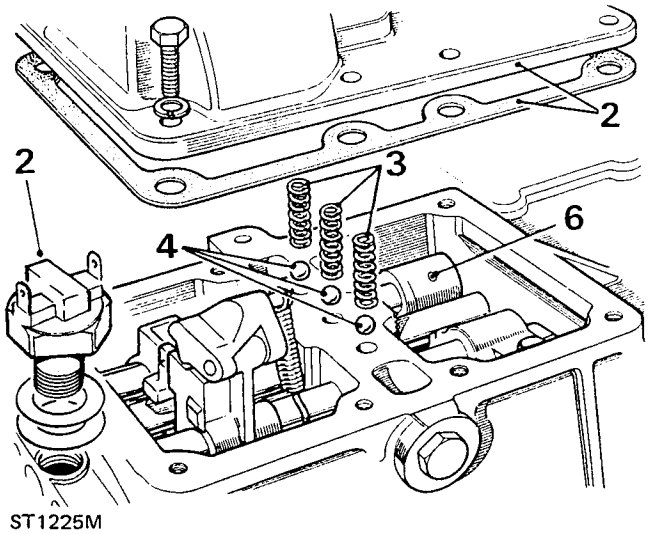
ST1224M

Assemble clutch release and bell housing

6. If removed, fit the release lever spring clip.
7. Apply a thin film of Unipart Universal or other suitable jointing compound around the three selector shaft holes in the bell housing rear face.
8. Fit the bell housing, locating on the dowels.
9. Apply a thin film of molybdenum disulphide grease onto the front cover extension sleeve.
10. Fit the release sleeve and bearing assembly.
11. Fit the locating staple to the clutch release sleeve and lever.

REMOVE AND OVERHAUL GEAR CHANGE SELECTORS

1. Remove the bell housing.
2. Select neutral, remove the reverse light switch and remove the gearbox top cover and joint washer.
3. Lift out the detent springs.
4. Withdraw the detent balls, using a small magnet or an air blast.
5. Slacken the pinch bolt securing the reverse selector finger.
6. Drive out the four retaining pins until the shafts are free in the selectors.

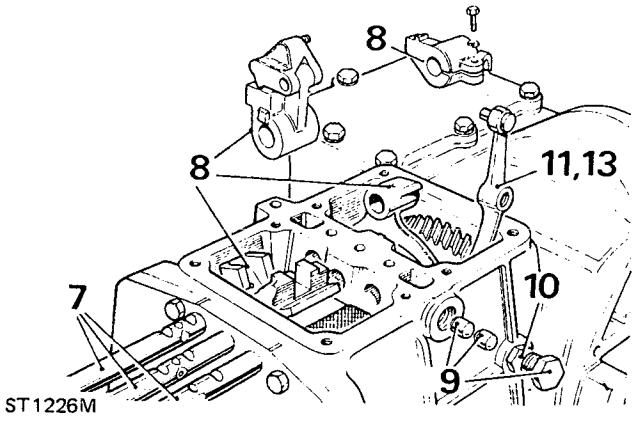


ST1225M

7. Tap out the selector shafts.
8. Withdraw the selector jaws and forks.
9. Withdraw the two interlock plungers from the cross-drilling.
10. Remove the lock-wired pivot bolt.
11. Lift out the reverse cross-over lever.

Overhaul

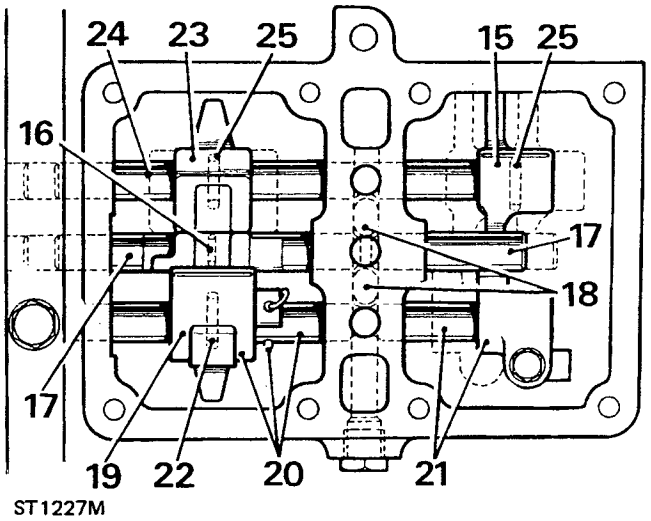
Examine all parts and renew if worn. Renew the detent springs. Ensure that the retaining pins are an interference fit, if not, renew.



ST1226M

Assemble gear change selectors

12. Withdraw the retaining pins from the selector jaws.
13. Engage the cross-over lever and locate fully in the groove in the reverse idler with the peg in the top of the cross-over lever fully in the selector finger.
14. Start the pivot bolt in the lever threads. Should it not start properly move the lever away from the selector finger but not out of engagement with the idler.
15. Locate the first/second gear selector fork in the groove in the outer member, with the boss on the fork to the rear. Position the boss to the R.H. side of the box.
16. Locate the third/fourth gear selector fork in the groove in the outer member. Position the fork with the retaining pin entry hole at the top R.H. side.
17. Fit the third/fourth gear selector shaft and interlock pin assembly and secure to the selector fork with a retaining pin.
18. Fit the two interlock pins to engage in the grooves each side of the third/fourth gear selector shaft.
19. Position the reverse stop hinge plate and selector jaw in the gearbox, adjacent to the third/fourth gear selector jaw.
20. Fit the reverse gear selector shaft and engage the selector jaw and hinge spring.
21. Push the shaft home and engage the reverse cross-over lever selector finger. Do not secure the pinch bolt at this stage.
22. Secure the reverse gear selector jaw to the shaft with a retaining pin.

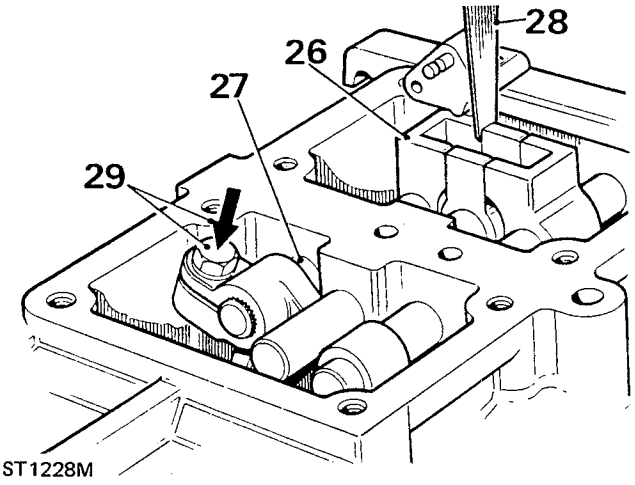


ST1227M

23. Position the first/second gear selector jaw in the gearbox.
24. Fit the first/second gear selector shaft; engage the selector jaw and selector fork as the shaft is pushed home.
25. Fit the retaining pins, fitting the rear pin first.
26. Move the reverse shaft forward until the selector jaw abuts the casing.
27. Holding the reverse shaft as described in the previous item, move the reverse selector finger forward on the shaft until it abuts the casing, then move it rearward until it is just clear of the casing.
28. Place a 0,25 mm (0.010 in) feeler gauge between the upper edges of the reverse and third/fourth selector jaws.

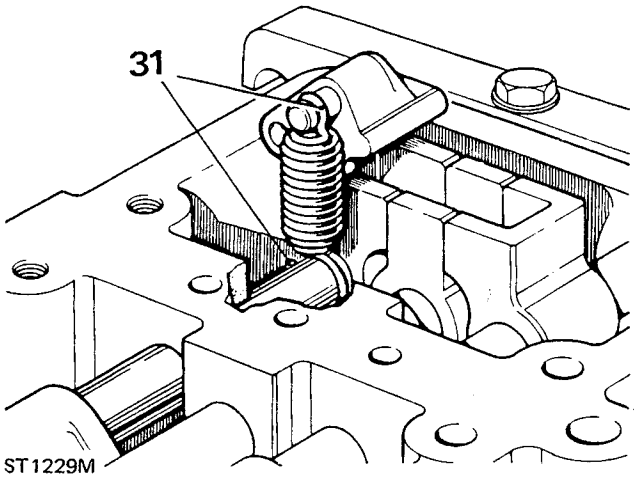
NOTE: The edges of the selector jaws taper slightly, therefore, it is important that the feeler gauge is positioned between the upper edges.

29. Hold the reverse and third/fourth selector jaws together to retain the feeler gauge, then rotate the reverse selector finger until it abuts the third/fourth selector shaft and tighten the pinch bolt.



ST1228M

30. Wire lock the cross-over lever pivot bolt.
31. When fitting the hinge spring to the reverse stop hinge, first engage the large hook around the selector shaft, as illustrated, before fitting the small hook to the reverse stop hinge pin.

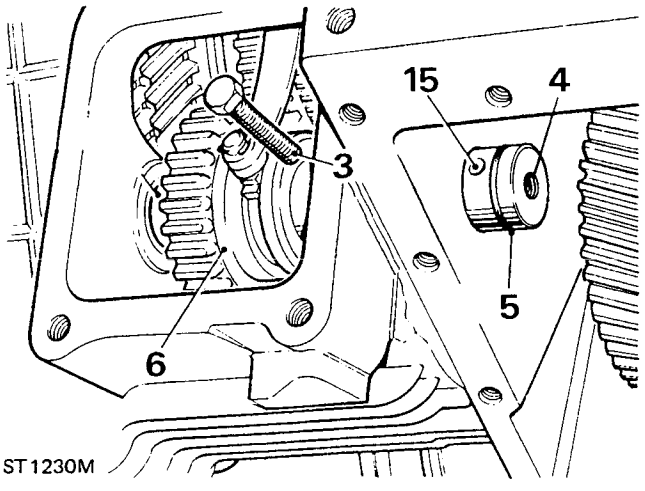


32. Fit the detent balls and springs.
33. Select neutral and using a new joint washer, fit the gearbox top cover and secure with the eight bolts, and evenly tighten to the correct torque.
34. Fit the reverse light switch.
35. Fit the bell housing.

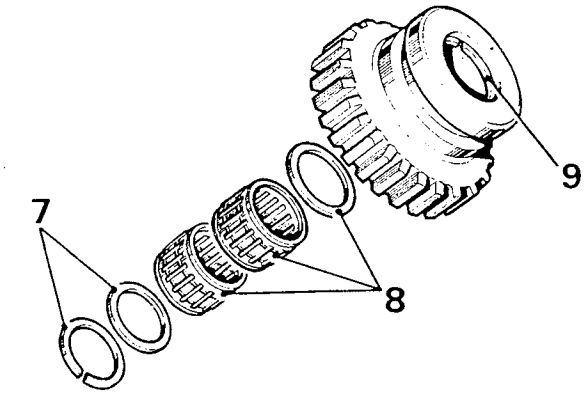
REMOVE AND OVERHAUL REVERSE IDLER GEAR AND SHAFT

Special tool:
18G1335 — extractor for shaft

1. Remove the gearbox side cover.
2. Remove the gearbox bottom cover.
3. Remove the bolt securing the idler gear shaft in the gearbox casing.
4. Withdraw the idler gear shaft, using extractor 18G1335.
5. Remove the 'O' ring seal.



6. Lift out the reverse idler gear assembly.
7. Remove the circlip and plain washer.
8. Lift out the needle roller bearings and further plain washer.
9. Withdraw the remaining circlip.



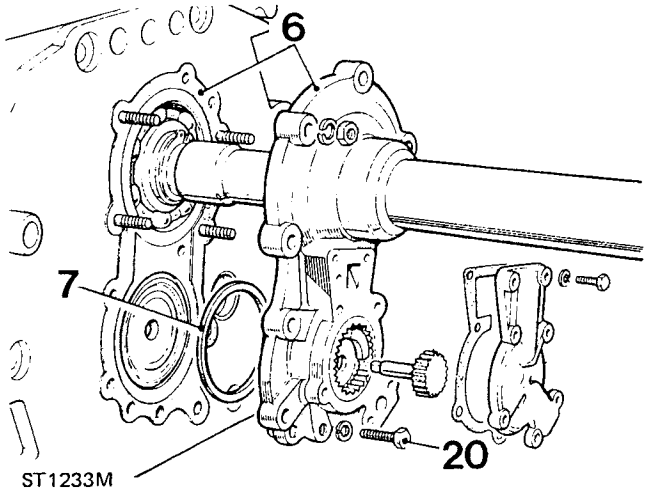
Assemble reverse idler gear and shaft

10. If removed, fit the shaft support bush, using Locquic primer grade 'T' and 'AVV' grade.
11. Fit the circlip to selector groove end of the gear.
12. Fit the plain washer and two needle roller bearings.
13. Fit the outer plain washer and secure with circlip.
14. Fit a new 'O' ring seal to the idler gear shaft.
15. Offer the idler shaft to the gearbox and align the retaining bolt holes.
16. Smear clean gearbox oil onto the 'O' ring seal.
17. Position the reverse idler assembly in the casing.
18. Engage the selector foot in the idler gear groove.
19. Drive in the idler gear shaft until the retaining bolt holes are aligned.
20. Before fitting the retaining bolt, treat the threads with Locquic primer grade 'T' and allow to dry. Then, fit the bolt using Loctite Studlock grade.
21. Fit the gearbox bottom cover using a new joint washer and secure with the fourteen bolts evenly tightening to the correct torque.
22. Using a new joint washer fit the side cover with the four bolts and tighten to the specified torque.

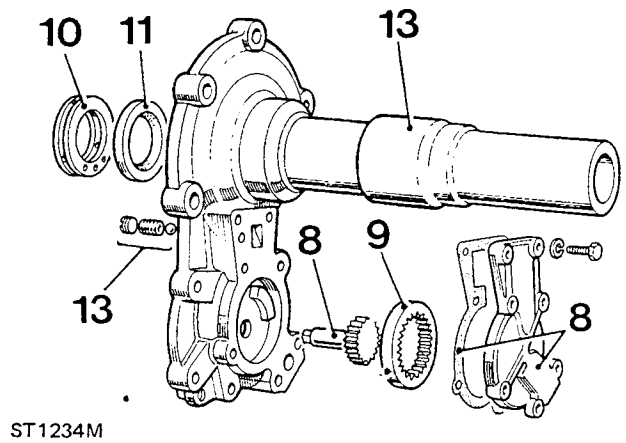
REMOVE AND OVERHAUL FRONT COVER AND OIL PUMP

Service tools:
RO1005 — Centralising tool
18G134 — guide and
18G134DG — assembly tool for fitting oil seal and oil feed ring.

1. Lift out the retainer staple from the clutch release bearing assembly and the release lever. See clutch release overhaul.
2. Withdraw the release bearing assembly.
3. Remove the slave cylinder pushrod.
4. Remove the spring clip.
5. Withdraw the clutch release lever.
6. Remove the front cover assembly, complete with oil pump joint washer.
7. Remove the shim washer located between the front cover and the layshaft front bearing.

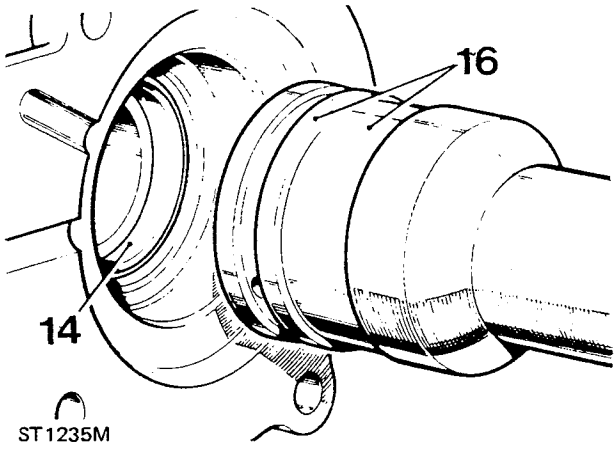


ST1233M



ST1234M

16. Press in the oil feed ring, using 18G134 guide and 18G134DG adaptor.
17. Fit the ball, spring and plug. When fitted, the plug must be flush with, or not more than 0,25 mm (0.010 in) below the front cover rear face.
18. Fit the oil pump ring gear.



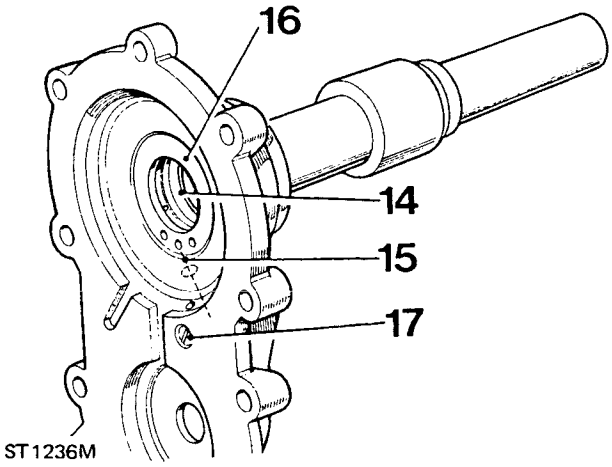
ST1235M

Overhaul

8. Remove the pump cover gasket and oil pump drive.
9. Withdraw the oil pump ring gear.
10. Remove the oil feed ring.
11. Withdraw the oil seal.
12. Remove the plug and withdraw the ball and spring from the relief valve housing.
13. If required, drift off the extension sleeve. Fit a replacement using Loctite 275 grade.

Reassemble

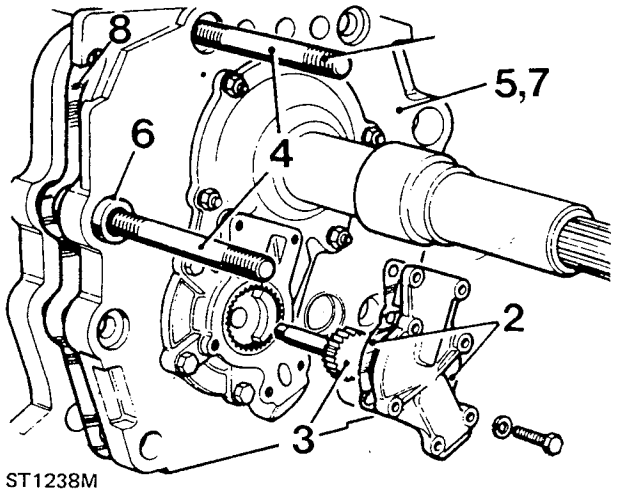
14. Press in the oil seal, plain face first, using 18G134 guide and 18G134DG adaptor.
15. Align the centre hole of three in the oil feed ring with the oil delivery hole in the front cover.



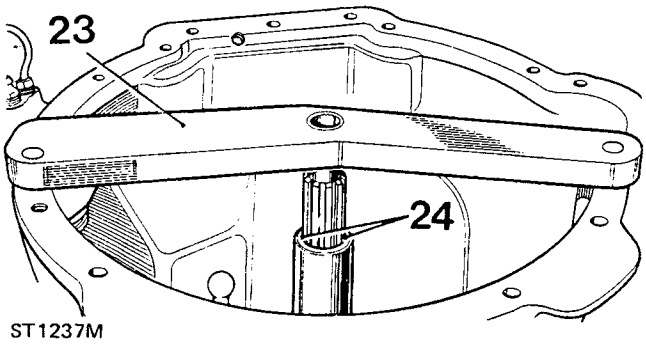
ST1236M

Fit cover assembly to gearbox

19. Position the layshaft bearing shim washer.
20. Position the front cover assembly and loosely fit the fixings.
21. Fit the oil pump drive gear to engage the drive square in the layshaft.
22. Fit the oil pump cover and joint washer and fit the fixing screws and washers and carefully tighten to the correct torque.
23. Fit the gauge RO1005 to align the primary pinion with the bell housing.
24. Visually check that the front cover is concentric about the primary pinion. Adjust the front cover position about its fixings to suit.



ST1238M



ST1237M

25. When satisfactory, tighten the front cover fixings.
26. Fit the clutch release lever and spring clip.
27. Fit the slave cylinder push-rod.
28. Fit the release bearing assembly.
29. Fit the retainer staple to the clutch release bearing assembly and lever.

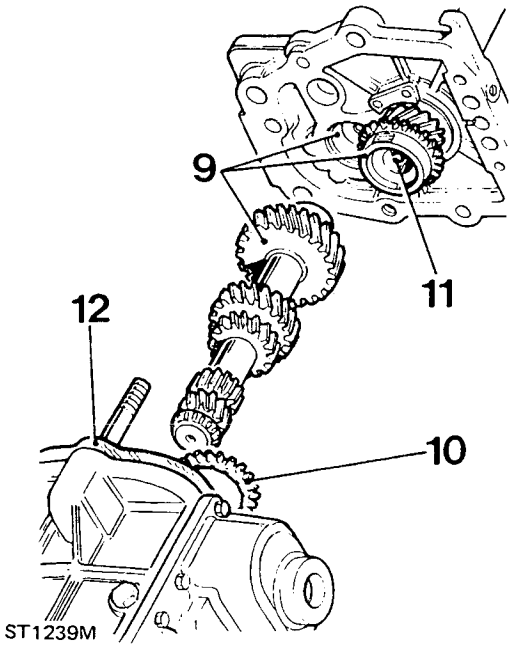
Assemble bearing plate assembly

NOTE: To replace a bearing plate, a bearing plate and gearbox casing mated assembly must be fitted.

10. Locate the cone into the third/fourth-speed synchromesh unit.
11. Lubricate the oil tube, using clean gearbox oil.
12. Position the joint washer.
13. Engage the layshaft with the primary pinion and front bearing outer member.
14. Fit the bearing plate and layshaft.
15. Align the bearing plate with the gearbox casing and slide home the dowel sleeves.
16. Refit the studs. Smear Loctite 'Studlock' grade CVX, on the two upper studs securing threads before fitting.
17. Fit the oil pump drive gear.
18. Using a new joint washer fit the oil pump gear cover.
19. Fit the bell housing.

REMOVE AND OVERHAUL BEARING PLATE ASSEMBLY

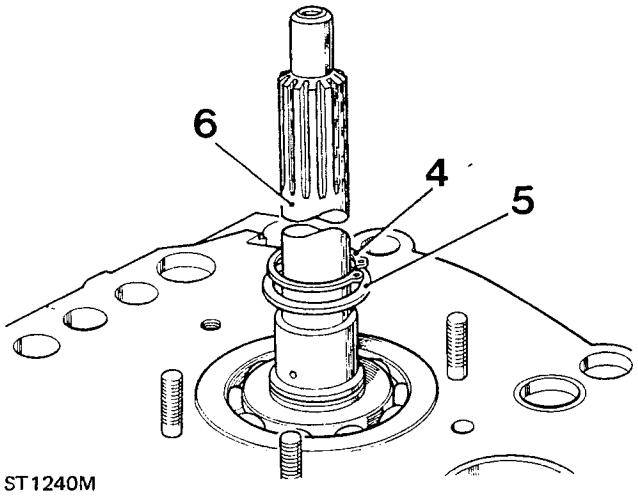
1. Remove the bell housing and position the gearbox with the front end uppermost.
2. Remove the oil pump gears cover and joint washer.
3. Withdraw the oil pump drive gear.
4. Temporarily remove the four fixing studs from the gearbox front face.
5. Ease the bearing plate away from the gearbox.
6. Withdraw the two dowel sleeves which locate the bearing plate.
7. Withdraw the bearing plate assembly complete with primary pinion and layshaft.
8. Withdraw the joint washer.
9. Withdraw the layshaft.



ST1239M

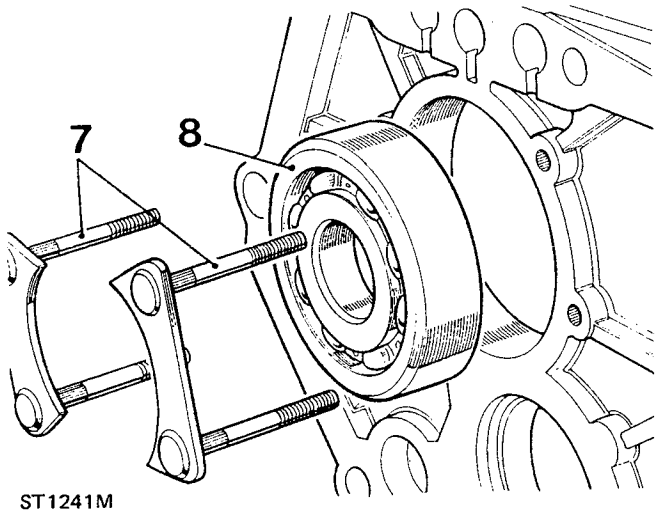
REMOVE AND OVERHAUL PRIMARY PINION

1. Remove the bell housing.
2. Remove the front cover and oil pump assembly.
3. Remove the bearing plate assembly.
4. Remove the circlip.
5. Lift off the shim washer.
6. Press out the primary pinion.



ST1240M

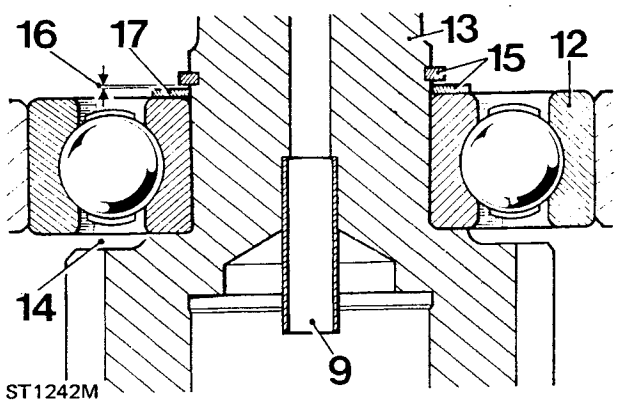
7. Withdraw the bearing retaining plates and serrated bolts.
8. Press out the primary pinion bearing.



ST1241M

Assemble primary pinion

9. Check that the orifice drilled in the oil tube is clear.
10. During refitting, take care to avoid damage to the oil tube. Rotate the shaft in the bearing to ensure that the oil tube is straight.
11. Support the bearing plate using suitable wooden blocks. Position the blocks across the bearing housing aperture to act as assembly stops.
12. Press in the bearing until flush with the bearing plate.
13. Press in the primary pinion. Check that the bearing remains flush with the bearing plate.
14. Fit the retaining plates and serrated bolts.
15. Fit the shim washer and circlip.
16. Measure the clearance between the circlip and the shim washer. There must be a clearance of 0,05 mm (0.002 in) maximum.
17. If required, adjust the clearance by fitting a replacement shim washer. Shim range is 2,0 to 2,15 mm (0.079 to 0.085 in) in 0,05 mm (0.002 in) stages.



ST1242M

18. Fit the bearing plate assembly.
19. Fit the front cover and oil pump assembly.
20. Fit the bell housing.

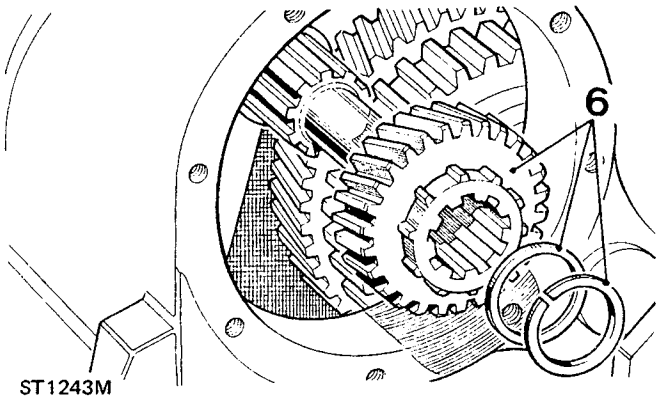
REMOVE AND OVERHAUL THE MAINSHAFT ASSEMBLY

Special tool:
18G1388 — extractor for mainshaft spacer and gear

1. Remove the bell housing.
2. Remove the front bearing plate.
3. Remove the main gearchange selectors.
4. Remove the mainshaft rear bearing housing and roller bearing.
5. Remove the bottom cover from the transfer gearbox.

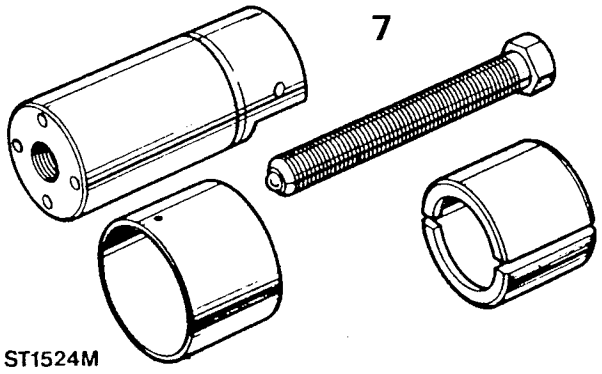
NOTE: At this stage in the dismantling, on early gearboxes only, it is necessary to remove the transfer top cover selector finger and shaft. On later gearboxes the cross-shaft is machined to enable the spacer to be completely withdrawn. Also the main shaft spacer and transfer gear are secured by Loctite 275 to the main shaft.

6. Remove the snap-ring, shim washer and mainshaft transfer gear, using special tool 18G1388.



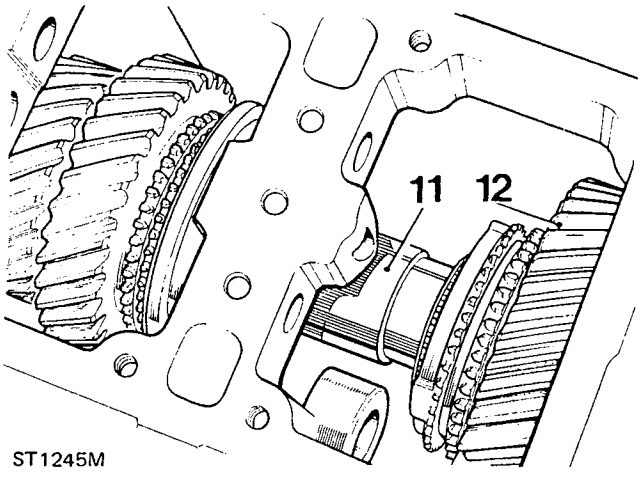
ST1243M

7. Fit extractor 18G1388 to transfer gear spacer.
8. Withdraw the spacer along the mainshaft until the larger diameter on the spacer reaches the transfer gear lever cross-shaft.
9. Withdraw the spacer through the machined scollop.
10. When the spacer is free on the mainshaft remove the extractor.



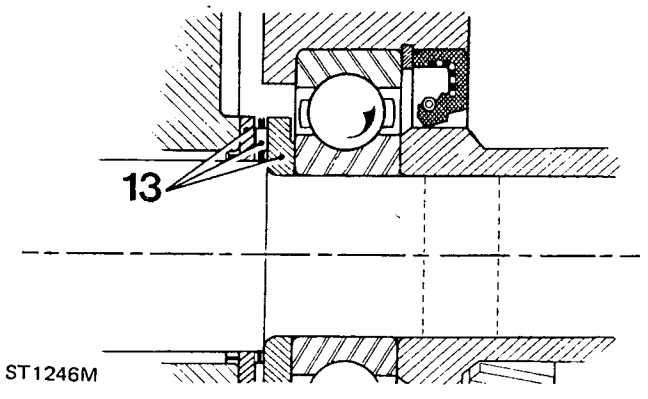
ST1524M

11. Withdraw the mainshaft assembly, allowing the first-speed gear to remain behind to avoid fouling on the casing.
12. Lift out the first-speed gear.



ST1245M

13. Refit the first-speed gear, scalloped thrust washer, thrust needle bearing and stepped thrust washer, stepped face outwards.
14. Withdraw the mainshaft spacer.

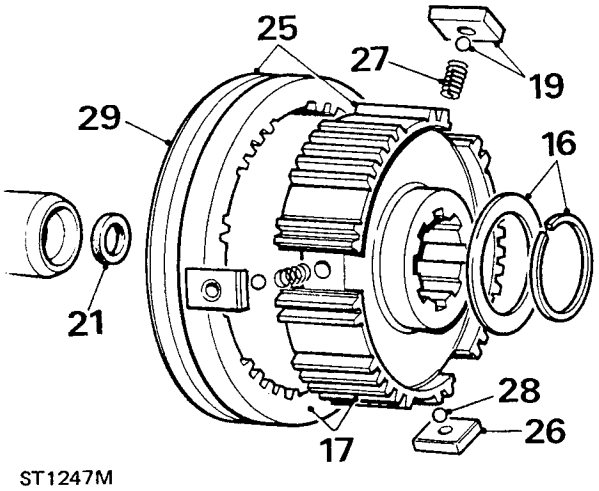


ST1246M

Overhaul mainshaft assembly

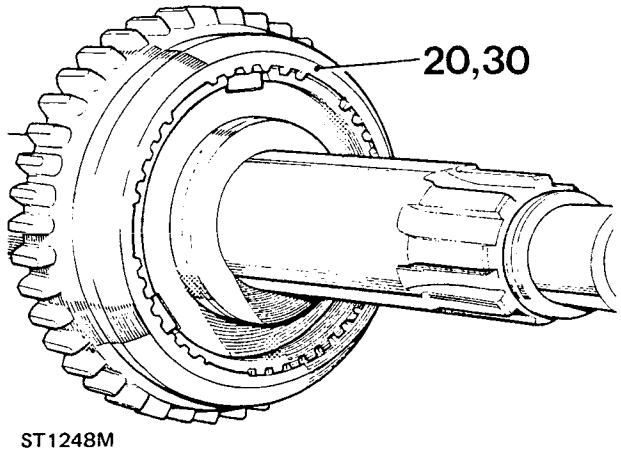
Dismantle

15. Withdraw the first-speed gear, thrust washers and roller bearings from the rear of the shaft.
16. Remove the snap-ring and shim washer from the front of the shaft.
17. Lift off the third/fourth gears synchromesh assembly.
18. Withdraw the third and second-speed gears and the associated thrust washers and needle-roller bearings.
19. Dismantle the third/fourth gears synchromesh assembly, first pushing down the sliding blocks to free the synchromesh balls from the retaining groove in the outer member.



ST1247M

20. Dismantle the first/second gears synchromesh assembly in a similar manner, particularly noting their position for refitting.
21. Withdraw the oil seal from the bore in the mainshaft front end.



ST1248M

Assemble

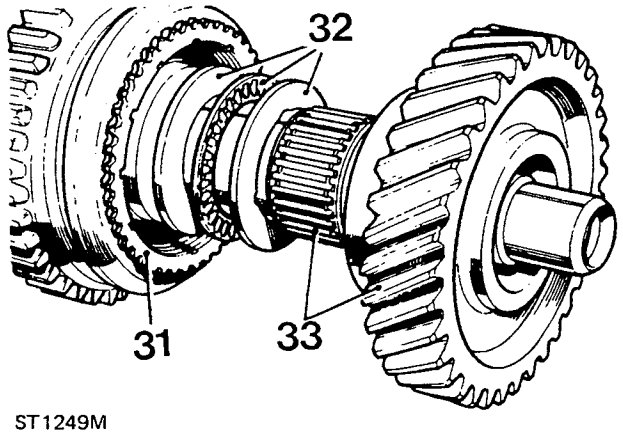
22. Replacement thrust washers and roller bearings must not be degreased.
23. Lubricate all items before assembly, using clean main gearbox oil.
24. Fit the oil seal to the mainshaft front end.

Assemble synchromesh units

25. Fit together the third/fourth gear synchromesh outer and inner members, outer member coned face toward inner member plain face.
26. Fit the sliding blocks, radius face outward.
27. Locate the springs through the sliding blocks into the housing bores in the inner member.
28. Position the balls on the spring ends; press home in sequence and retain by hand.
29. Lift the outer member to retain the balls. Continue lifting until the balls spring home into the annular groove in the outer member.
30. Assemble the first/second gear synchromesh unit in the manner described for third/fourth gear unit. Fit the outer member coned face toward the front end of the mainshaft.

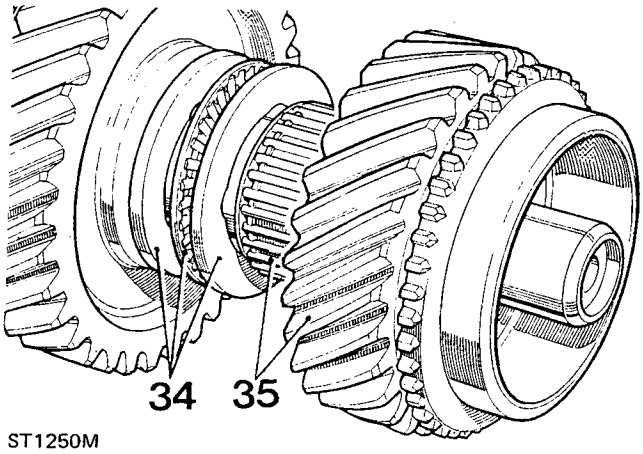
Assemble mainshaft front end

31. Fit a synchromesh cone to the first/second gear synchromesh outer member.
32. Position a chamfered thrust washer, a thrust needle bearing and a scalloped thrust washer on the mainshaft.
33. Fit a radial needle bearing and the second-speed gear.

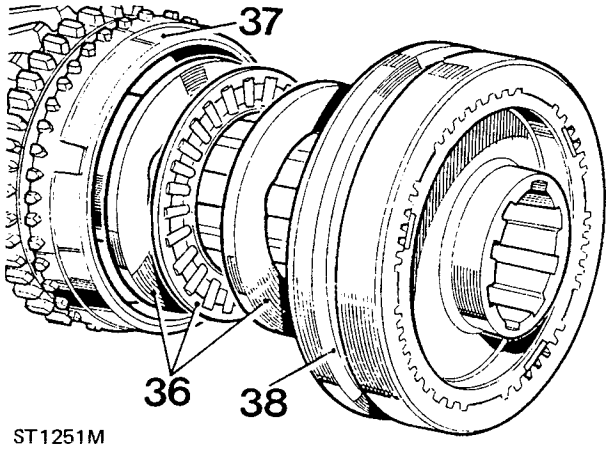


ST1249M

34. Fit a scalloped thrust washer, a thrust needle bearing and a further scalloped thrust washer.
35. Fit a radial needle bearing and the third-speed gear.
36. Fit a scalloped thrust washer, a thrust needle bearing and a further scalloped thrust washer.
37. Position a synchromesh cone onto the third-speed gear.
38. Fit the synchromesh unit, coned face to rear.



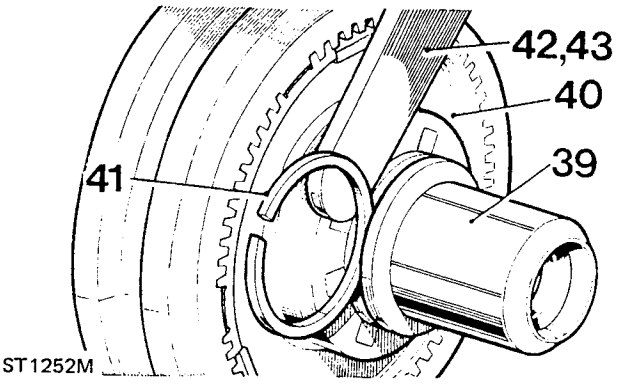
ST1250M



ST1251M

Set end-float of gears

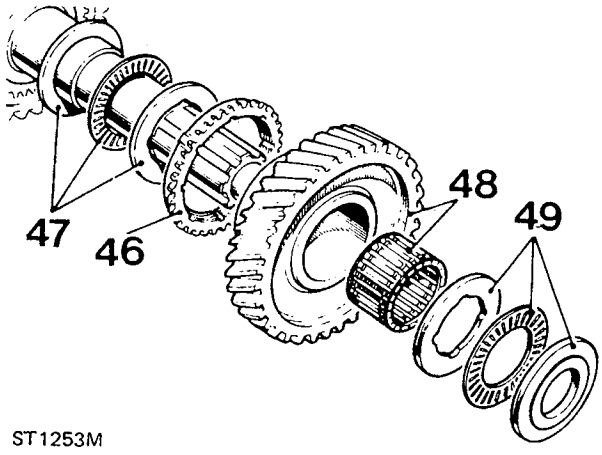
39. Position the mainshaft assembly vertical, front end uppermost.
40. Apply a light loading on the gears to remove end-float.
41. Position the snap-ring in the mainshaft groove.
42. Measure the distance between the snap-ring lower edge and the synchromesh unit inner member.
43. Select a shim to reduce the measured clearance to 0,025 to 0,150 mm (0.001 to 0.006 in) when fitted.
44. Shim range is 1,85 to 2,45 mm (0.073 to 0.096 in) in 0,15 mm (0.006 in) increments.
45. Fit the selected shim washer and the snap-ring.



ST1252M

Assemble mainshaft rear end

46. Fit a synchromesh cone to the first/second gear synchromesh outer member.
47. Position a chamfered thrust washer, a thrust needle bearing and a scalloped thrust washer on the mainshaft.
48. Fit the first-speed gear and bearing.
49. Fit a scalloped thrust washer, a thrust needle bearing and the stepped thrust washer, stepped face outwards.
50. The mainshaft spacer, transfer gear, shim washer and snap-ring are fitted during mainshaft refitting.

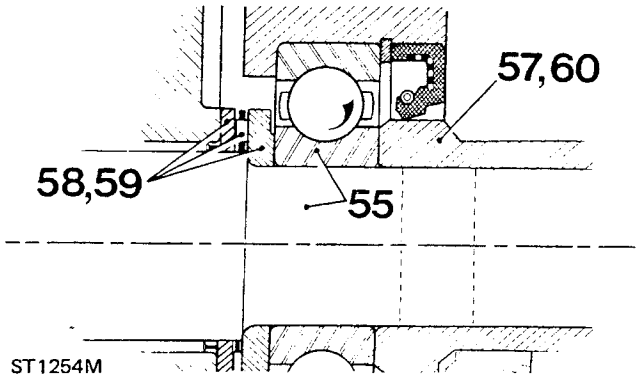


ST1253M

Assemble mainshaft assembly to gearbox

51. Position the gearbox with the R.H. side downwards to aid refitting.
52. Remove the gearbox side cover.
53. Temporarily move the first-speed gear toward the rear of the shaft.
54. Offer the assembled mainshaft to the gearbox and manoeuvre the first-speed gear past the reverse idler gear.

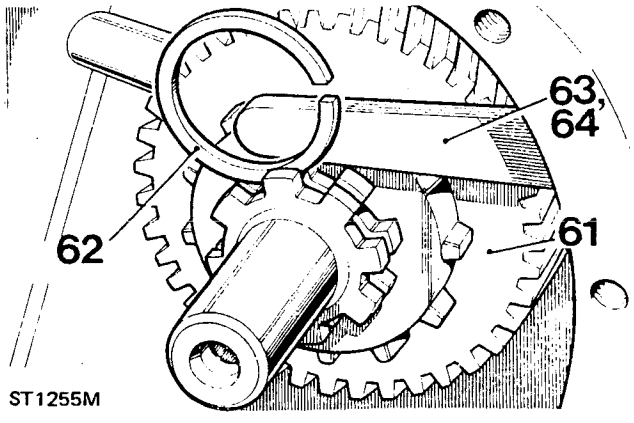
55. Engage the shaft into the main bearing.
56. Engage the first/second gear synchromesh outer member and the reverse idler gear.
57. Push the mainshaft home enough to allow the mainshaft spacer to be located on the rear end, with the spacer larger diameter forward of the transfer gear lever cross-shaft.



ST1254M

65. Temporarily remove the snap-ring and the mainshaft transfer gear.
66. Slide back the mainshaft spacer as far as the transfer gear lever cross-shaft will allow.
67. Apply a thin coating of Loctite 275 grade to the exposed area of the mainshaft.
68. Push home the mainshaft spacer.
69. Fit the mainshaft transfer gear.
70. Fit the previously selected shim washer and secure with the snap-ring.
71. Fit the bottom cover to the transfer box using a new joint washer and evenly tighten the fourteen retaining bolts to the correct torque.
72. Fit the mainshaft rear bearing housing and roller bearing.
73. Assemble the main gearchange selectors to the gearbox.
74. Fit the front bearing plate.
75. Fit the bell housing.

58. Re-position the first-speed gear, thrust washers and thrust needle bearing correctly on the mainshaft.
59. Push the mainshaft fully home, ensuring that the thrust washers and needle bearing remain correctly located against the first-speed gear.
60. Move the mainshaft spacer along the shaft, and into the oil seal, to abut the main bearing.
61. Temporarily fit the mainshaft transfer gear.
62. Position the snap-ring in the groove in the mainshaft.
63. Hold the mainshaft fully to the rear and measure the clearance between the snap-ring and the transfer gear.
64. Select a shim washer to allow 0,050 mm (0.002 in) maximum clearance between the snap-ring and transfer gear when fitted. Shim range 1,8 to 2,0 mm (0.071 to 0,079 in) in 0,05 mm (0.002 in) increments.

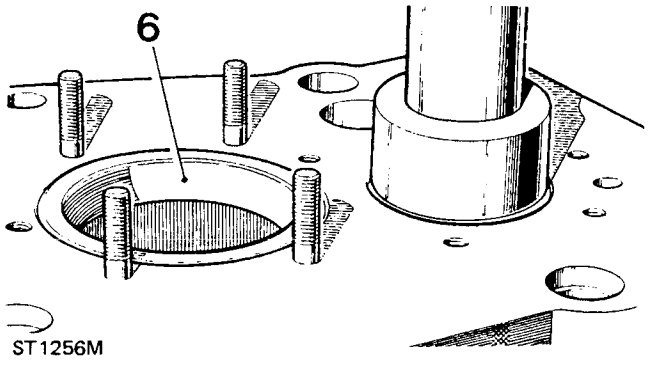


ST1255M

REMOVE AND OVERHAUL LAYSHAFT BEARINGS

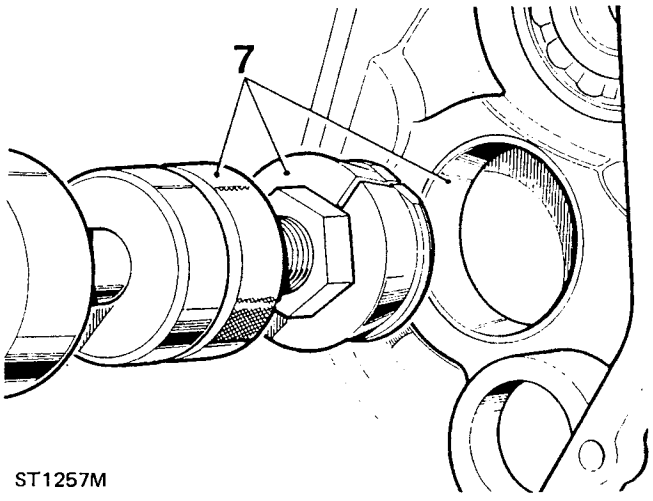
Special tools:
RO1004 — extractor mainshaft spacer
18G284 — extractor and 18G284AR — adaptor, extractor layshaft rear bearing outer member
18G47 — Press and 18G47BA — Collars, extractor for layshaft bearing inner members

1. Remove the bell housing.
2. Remove the front cover and oil pump assembly.
3. Remove the main gears selectors.
4. Remove the front bearing plate assembly.
5. Remove the mainshaft assembly.
6. Press out the layshaft front bearing outer member from the front bearing plate.



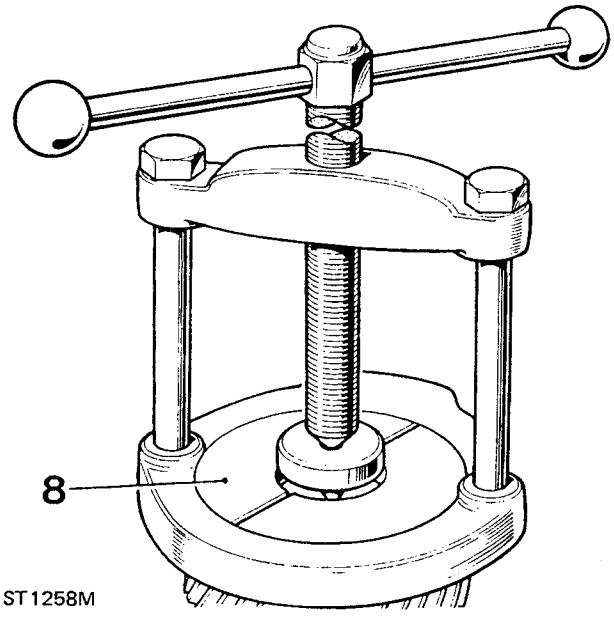
ST1256M

7. Extract the layshaft rear bearing outer member from the gearbox casing, extractor 18G284 and adaptor 18G284AR.



ST1257M

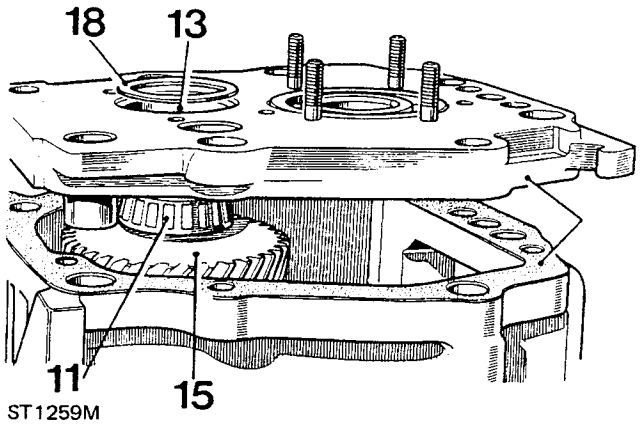
8. Withdraw the bearing inner members from the layshaft. Extractor 18G47 press and 18G47BA collars.



ST1258M

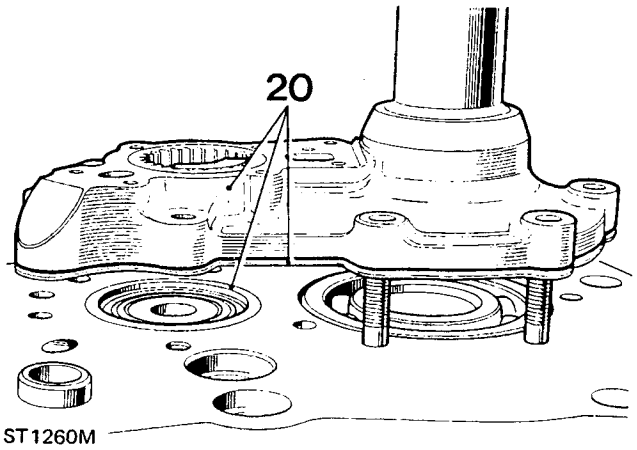
Check bearing pre-load

9. Replacement bearings inner and outer members are supplied as matched pairs and not as separate items.
10. The replacement bearings must not be degreased. Before fitting, lubricate with correct grade gearbox oil. Refer to lubrication chart.
11. Press the bearing inner members onto the layshaft.
12. Press the rear bearing outer member into the gearbox casing.
13. Enter the front bearing outer member into the front bearing plate. Do not fit fully in at this stage.



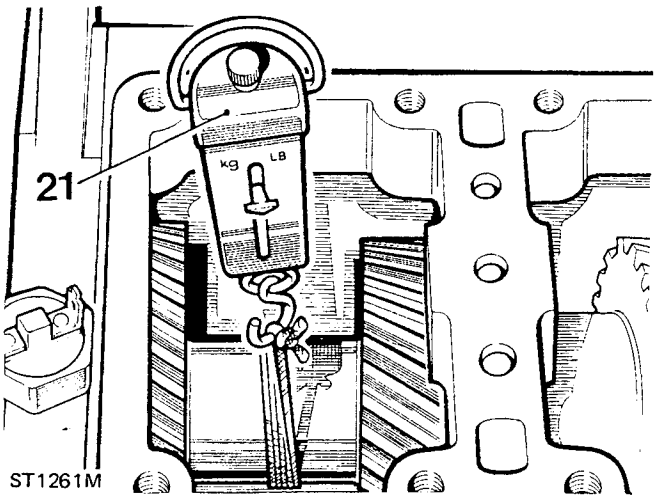
ST1259M

14. Remove the primary pinion from the bearing plate.
15. Position the layshaft in the gearbox casing.
16. Temporarily fit the front bearing plate and joint washer.
17. Press in the front bearing outer member until there is no end-float on the layshaft and no end-load on the bearings.
18. On the bearing outer member position a shim washer of a thickness suitable to stand 0,25 mm (0.010 in) approximately proud of the front bearing plate. This shim thickness may be subsequently adjusted depending on the amount of bearing pre-load it affords.
19. Temporarily remove the oil pump top cover and withdraw the pump drive gear.
20. Temporarily fit the front cover and new joint washer to the bearing plate. Ensure that the shim washer remains in position.



ST1260M

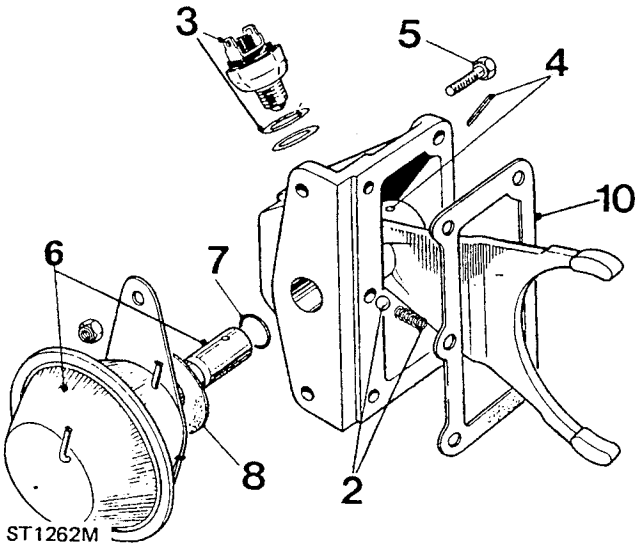
21. Measure the rolling resistance of the layshaft, using a spring balance and a cord coiled around the layshaft larger diameter. The rolling resistance must be 7 to 3,38 kg (6 to 7.5 lbs).



22. To adjust the pre-load, fit a replacement shim of suitable thickness to the front bearing outer member. Shim range is from 1,55 mm (0.059 in) to 2,50 mm (0.098 in) in 0,05 mm (0.002 in) increments.
23. When the pre-load is satisfactory, remove the front cover assembly.
24. Remove the front bearing plate.
25. Fit the primary pinion.
26. Fit the oil pump cover and drive gear.
27. Fit the front bearing plate assembly.
28. Assemble the selectors for the main gears.
29. Fit the front cover and oil pump assembly.
30. Fit the bell housing.

REMOVE AND OVERHAUL DIFFERENTIAL LOCK ACTUATOR ASSEMBLY

1. Remove the four bolts and withdraw the assembly from front output shaft housing.
2. Remove the detent spring and ball.



Dismantle and overhaul assembly

3. Remove the differential lock warning switch and washers.
4. Drive out the retaining pin.
5. Remove the actuator fixings.
6. Withdraw the actuator and shaft.
7. Withdraw the 'O' ring seal.
8. Withdraw the joint washer.

Assemble

9. Fit a new 'O' ring seal to actuator shaft.
10. Coat both sides of the joint washer with Hylomar PL32M.
11. Fit the actuator and shaft and secure to the housing.
12. Fit the actuator shaft retaining pin.
13. Fit the differential lock warning switch and washers.

Assemble to gearbox

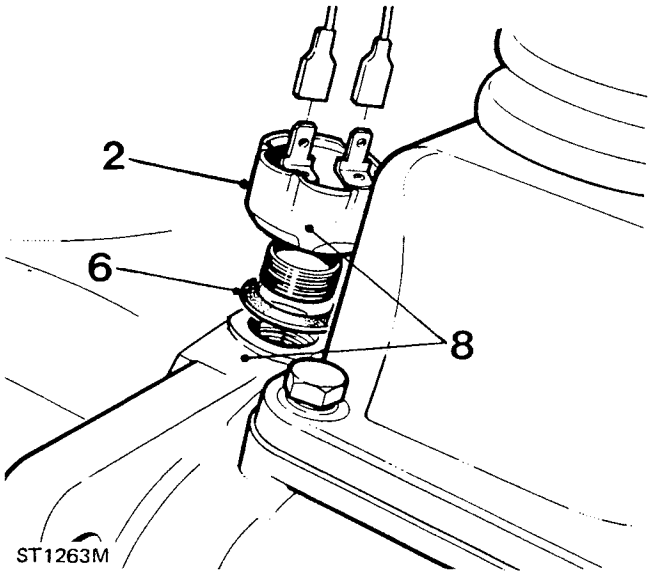
14. Fit the ball and detent spring.
15. Apply Hylomar PL32M jointing compound to both sides of a new actuator housing joint washer.
16. Fit and secure the assembly to the gearbox and evenly tighten the four retaining bolts.

The following operations can be carried out with the gearbox assembly in position in the vehicle.

RENEW REVERSE LIGHT SWITCH

Removing

1. Disconnect the electrical leads.
2. Unscrew the reverse light switch.



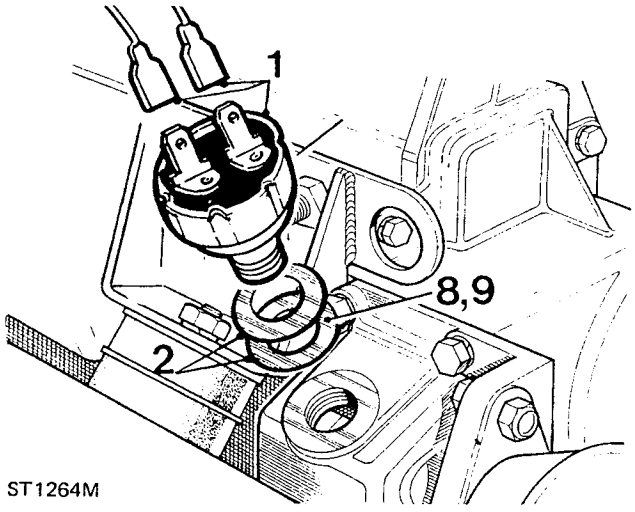
Renew

3. Engage reverse gear.
4. Connect the electrical leads to the switch.
5. Switch the ignition 'ON'.
6. Screw in the switch, less shim washers, until the switch contacts are made.
7. Screw in a further half turn.
8. Measure the clearance between the switch lower face and the gearbox.
9. Select shim washers to suit the clearance. Shim thicknesses are 0,5 mm (0.020 in) and 0,127 mm (0.005 in).
10. Fit the selected shim washer(s) and switch. Tighten to a torque of 1,4 to 2,0 kgf m (15 to 20 lbf ft) (20 to 27 Nm).

RENEW DIFFERENTIAL LOCK ACTUATOR SWITCH

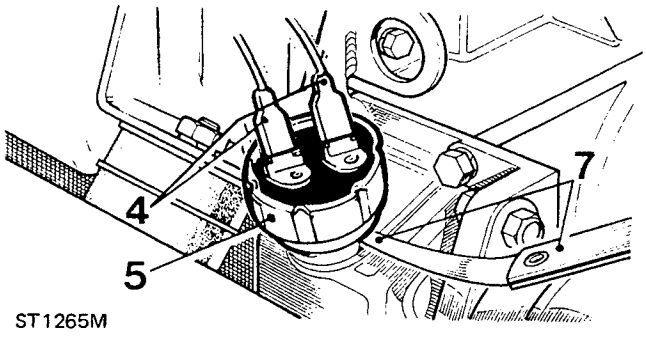
Remove

1. Disconnect the electrical leads, and unscrew the switch.
2. Collect the shims.



Renew

3. Start the engine and move the differential lock vacuum control valve to the 'up' position.
4. Connect the electrical leads to the actuator switch.
5. Screw in the switch, less shim washers, until the switch contacts are made.

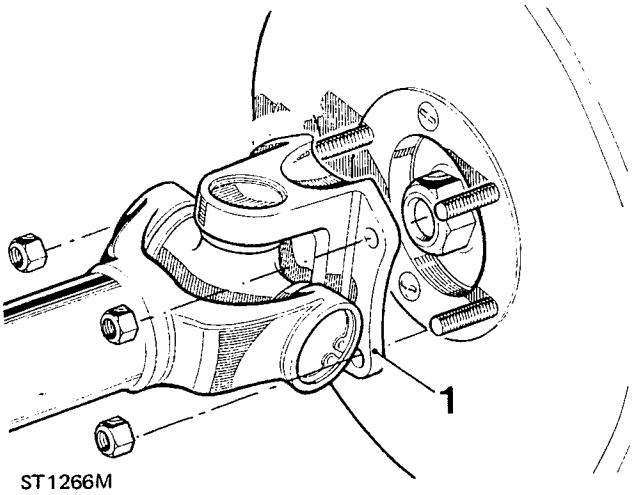


6. Screw in a further half turn.
7. Measure the clearance between the switch lower face and the housing.
8. Select shim washers to suit the clearance. Shim thicknesses are 0,5 mm (0.020 in) and 0,127 mm (0.005 in).
9. Fit the selected shim washer(s) and the switch.
10. Re-position control valve and stop engine.

RENEW REAR OUTPUT SHAFT OIL SEAL

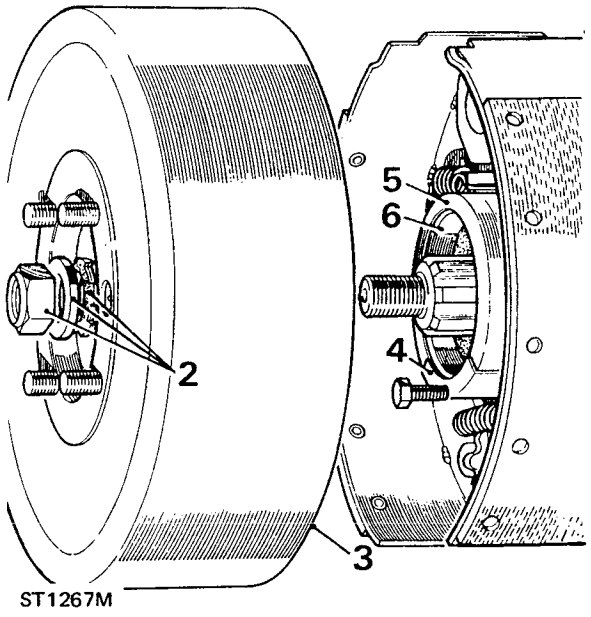
Remove

1. Disconnect the rear propeller shaft at the transmission brake.



ST1266M

2. Remove the locking nut, washer and the felt oil seal.
3. Withdraw the transmission brake drum complete with rear coupling flange.
4. Remove the oil catcher.
5. Prise off the oil shield.
6. Withdraw the oil seal.



ST1267M

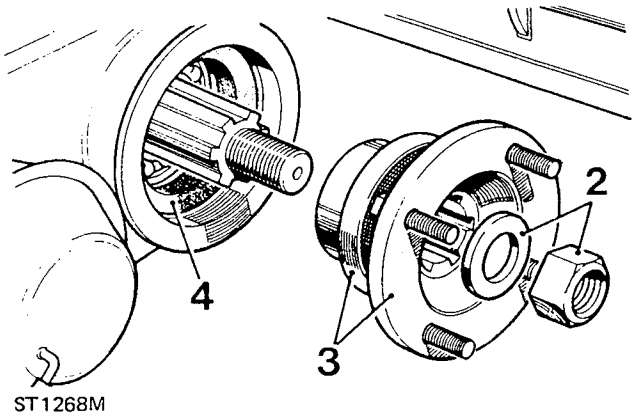
Renew

7. Press in the oil seal, open face first, until the seal plain face just clears the chamfer on the seal housing bore.
8. Fit the oil shield, which must be a close fit on the speedometer housing.
9. Fit the oil catcher, applying Bostik compound 771 to seal the oil catcher against the brake back plate.
10. Fit the transmission brake drum complete with rear coupling flange.
11. Fit the oil seal washer and locking nut and tighten to the correct torque.
12. Connect the rear propeller shaft to the transmission brake.

RENEW FRONT OUTPUT SHAFT OIL SEAL

Remove

1. Disconnect the front propeller shaft.
2. Remove the coupling flange locknut and washer.
3. Withdraw the coupling flange complete with mudshield.
4. Withdraw the oil seal.

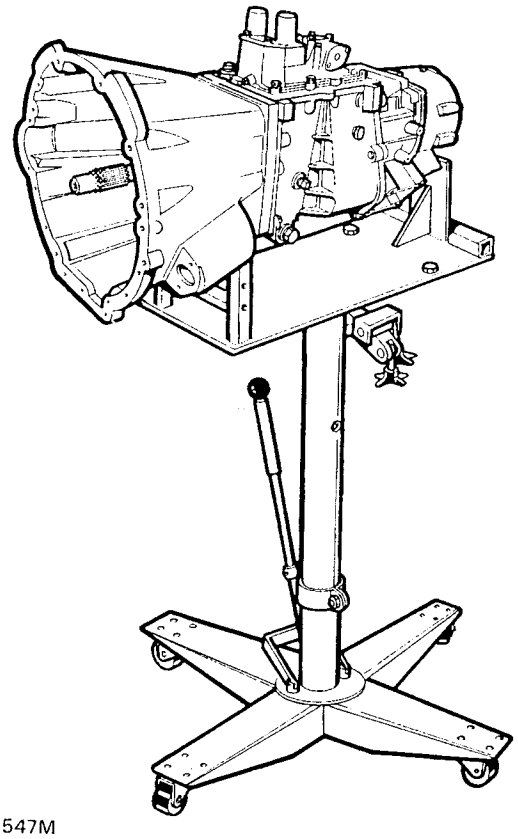


ST1268M

Renew

5. Fit the oil seal, lip side leading.
6. Fit the flange coupling with mudshield.
7. Secure the flange with locknut and washer and tighten to the correct torque.
8. Connect the propeller shaft.

REMOVE LT85/LT230T MAIN GEARBOX AND TRANSFER BOX



ST1547M

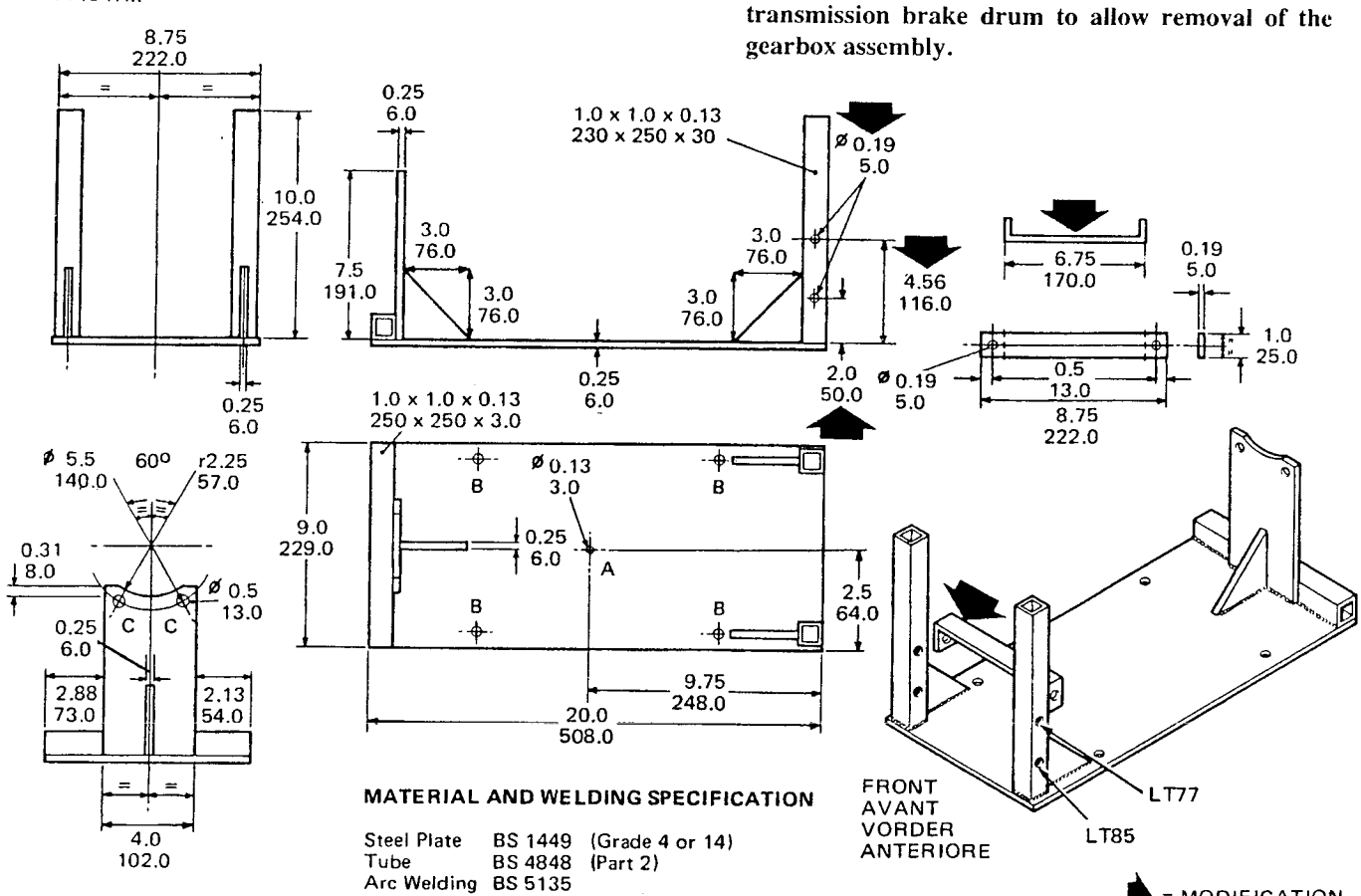
Cradle for removing gearbox

The gearbox should be removed from underneath the vehicle, using a hydraulic hoist, as illustrated; a cradle for locating the gearbox on to the hoist can be manufactured to the drawing below. If a similar cradle was made for the LT77 gearbox, it can be modified to suit both the LT77 and LT85 gearboxes by making the modifications shown by the large arrows.
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.

Refer to the Removal instructions for the LT77 gearbox page 1. The method for removing the LT85/ LT230T gearbox assembly is similar, except for the following.

1. It is not necessary to remove the engine fan cowl.
2. Remove the air cleaner.
3. Remove the high/low selector housing from the transfer box.
4. Use the cradle and hydraulic hoist already described, to remove the gearbox.

NOTE: It may be necessary to remove the transmission brake drum to allow removal of the gearbox assembly.



MATERIAL AND WELDING SPECIFICATION

Steel Plate	BS 1449	(Grade 4 or 14)
Tube	BS 4848	(Part 2)
Arc Welding	BS 5135	

ST 538M

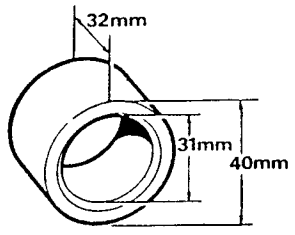
= MODIFICATION

OVERHAUL LT85 FIVE SPEED GEARBOX

— Ninety and One Ten V8 models

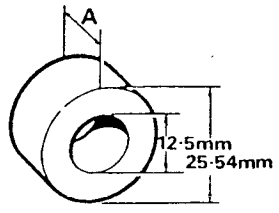
Service Tools:
18G 1294 — Guide studs
18G 1400 — Two legged puller
18G 1431 — Replacer, mainshaft bearings
MS 284 — Slide hammer
MS 550 — Driver handle
LST 101 — Gauge, first gear end float
LST 102 — Remover-Replacer, mainshaft rear oil seal
LST 284-1 — Adaptor-Remover, reverse idler shaft
LST 550-1 — Adaptor-Remover-Replacer, layshaft front bearing roller
LST 550-2 — Adaptor-Remover-Replacer, layshaft rear bearing outer track
LST 550-3 — Adaptor-Remover-Replacer, mainshaft front and rear bearing
LST 1431-1 — Remover-Replacer, front plate and mainshaft

In addition to the above Service Tools, the following five items should be manufactured locally to facilitate dismantling and reassembly of the gearbox.



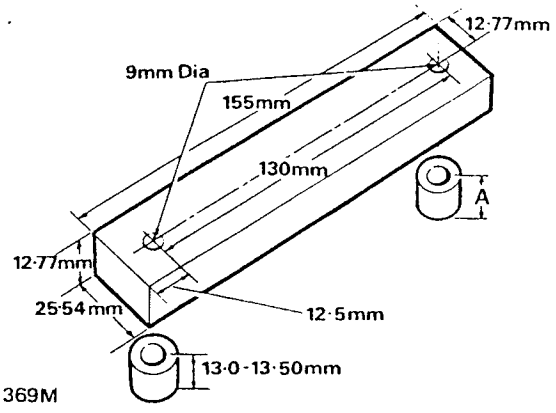
ST1476M

Spacer for retaining layshaft rear bearing



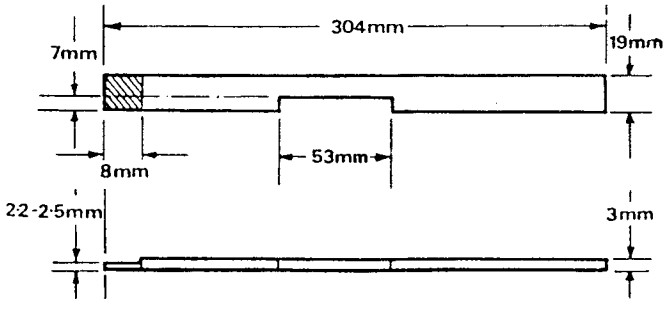
ST1475M

Spacers for retaining front bearing plate. Two required.
A — This dimension must be more than 12 mm.



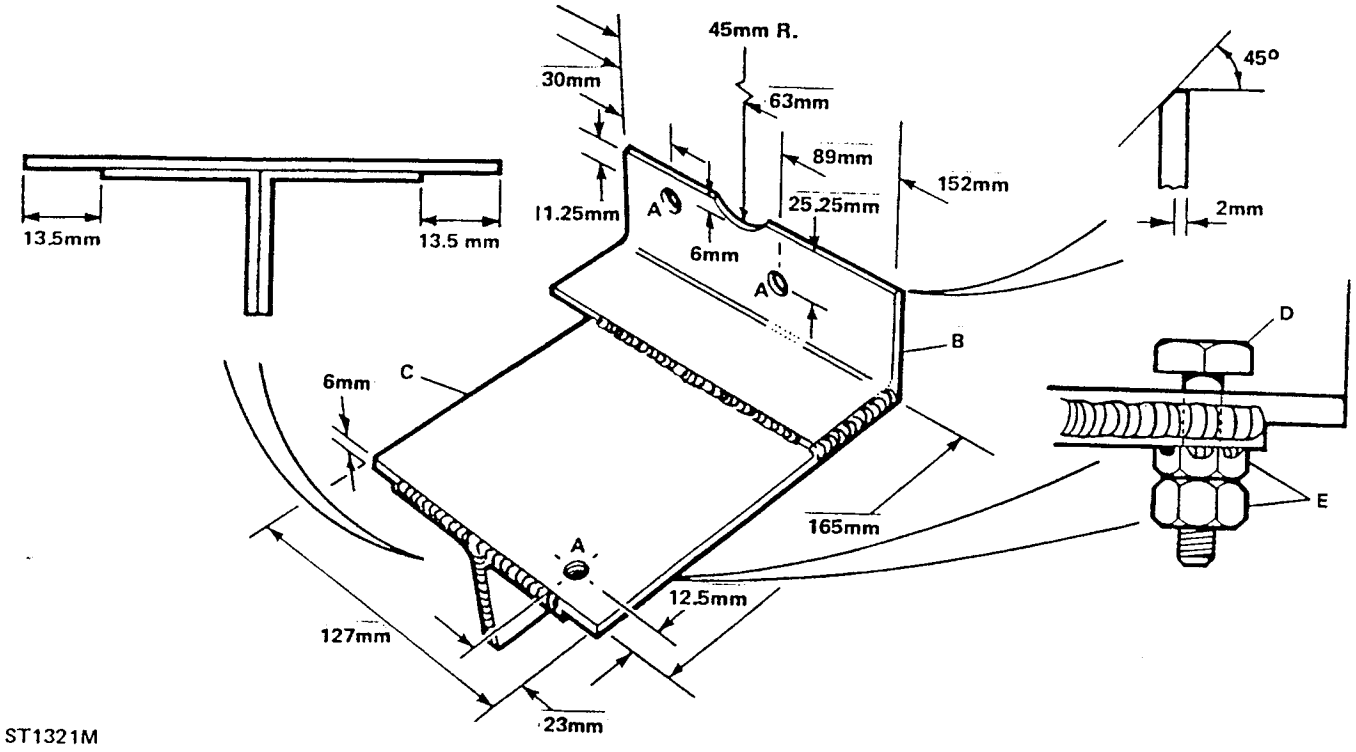
ST1369M

Selector detent spring retaining tool and spacers.
A — Spacers can be made up from washers



ST1371M

Gauge for reverse cross-over lever adjustment.



Stand for securing the gearbox in a vice

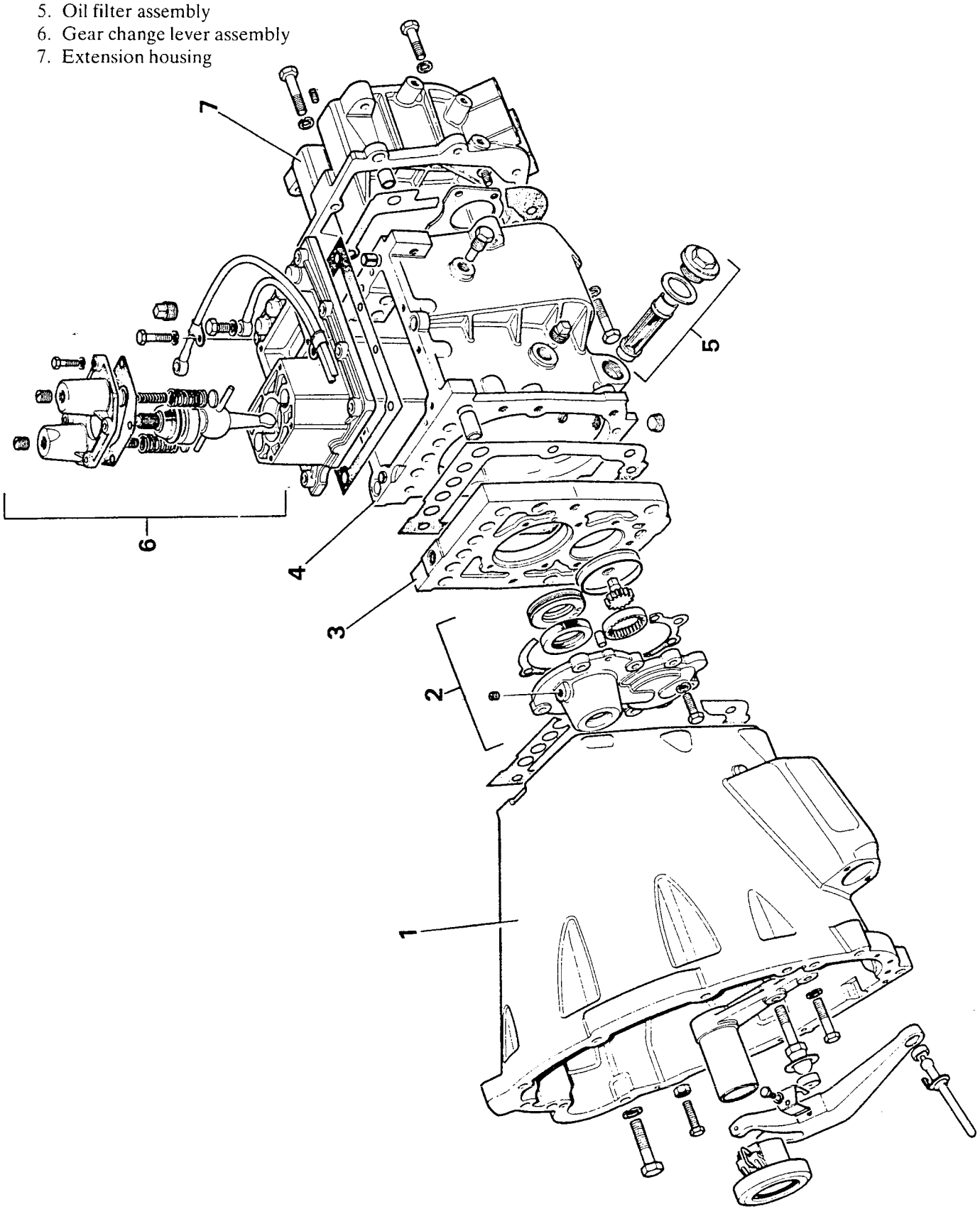
A. 11 mm diameter holes
B. Make from 50 mm x 6 mm steel angle
C. Make from 6 mm steel plate
D. 10 mm diameter bolt with hexagonal head
E. 10 mm nuts

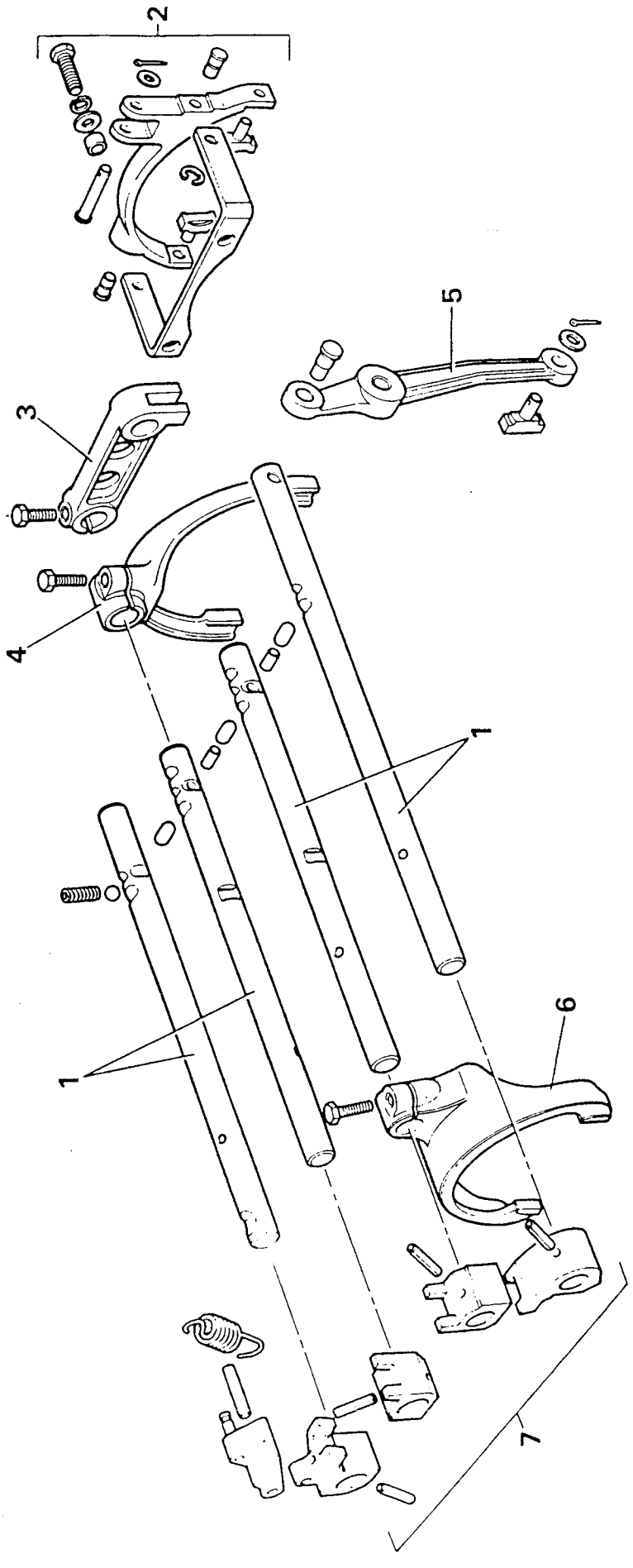
MATERIAL AND WELDING SPECIFICATION

Steel Plate BS 1449 (Grade 4 or 14)
Arc Welding BS 5135

GEAR CASINGS

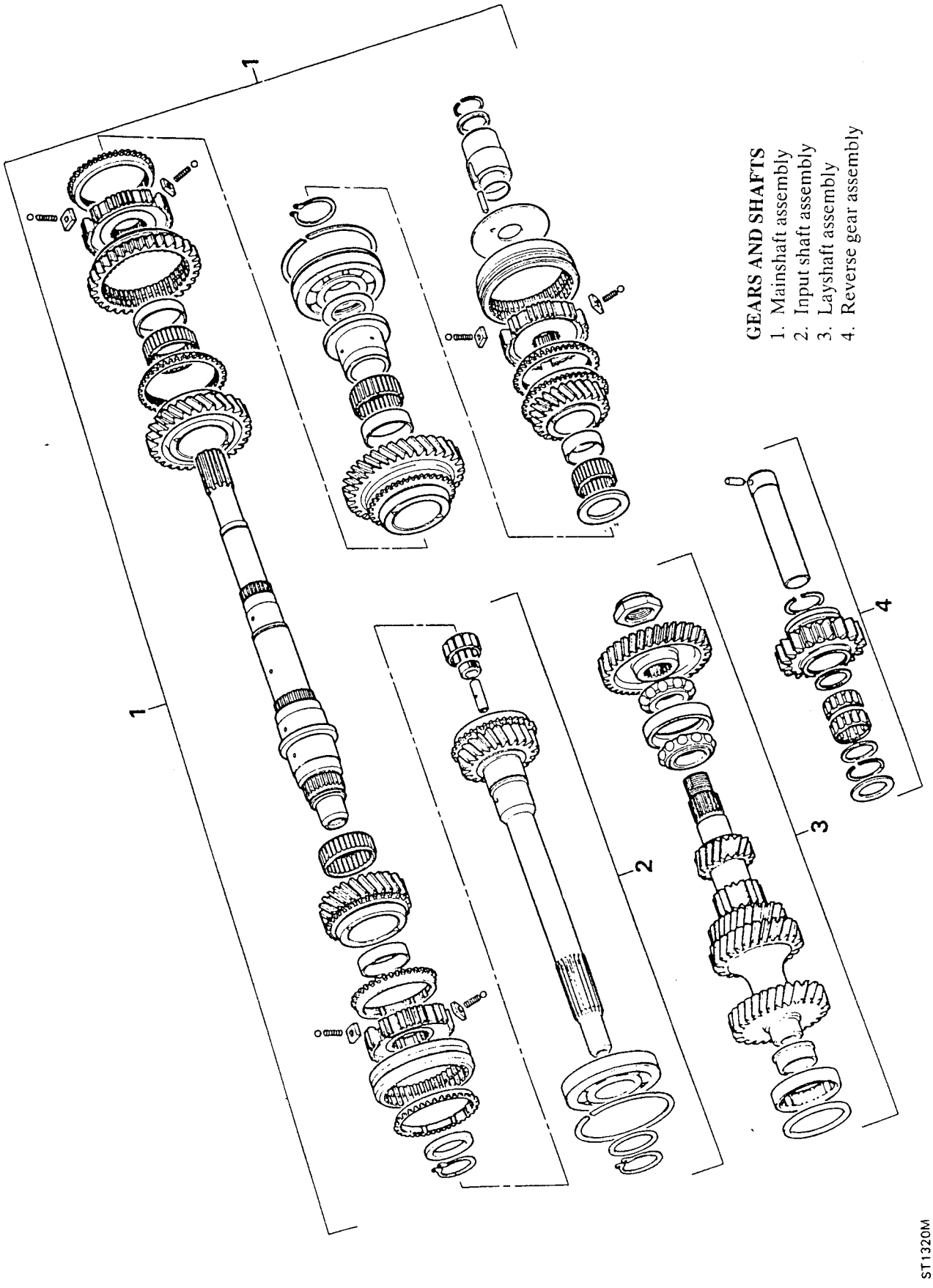
1. Bell housing and clutch release assembly
2. Oil pump assembly
3. Front bearing plate
4. Main gear case
5. Oil filter assembly
6. Gear change lever assembly
7. Extension housing





GEAR SELECTORS

1. Selector rails
2. Selector fork assembly for 5th gear
3. Selector arm for reverse gear
4. Selector fork for 1st and 2nd gear
5. Reverse gear cross-over lever assembly
6. Selector fork for 3rd and 4th gear
7. Selector jaws



GEARS AND SHAFTS

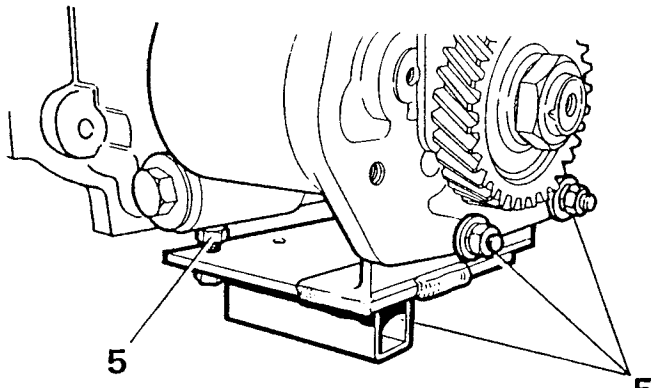
1. Mainshaft assembly
2. Input shaft assembly
3. Layshaft assembly
4. Reverse gear assembly

GEARBOX DATA

Mainshaft first speed gear running clearance	0,075 mm maximum
Mainshaft third speed gear running clearance	0,075 mm maximum
Mainshaft fifth speed gear running clearance	0,075 mm maximum
Input shaft bearing running clearance	0,075 mm maximum

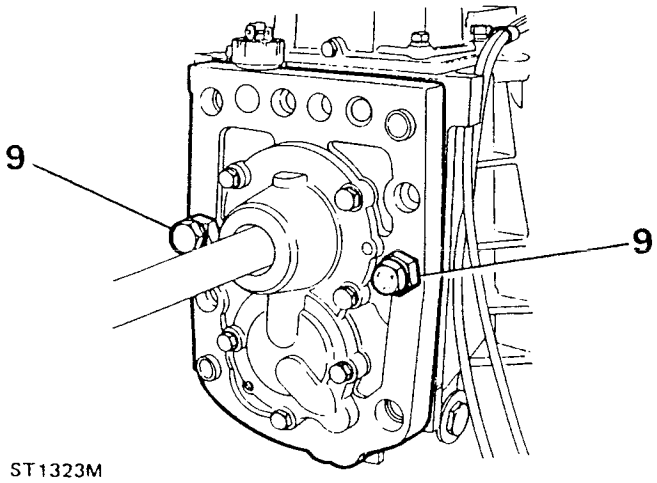
DISMANTLING

1. Ensure gearbox oil has been completely drained.
2. Position gearbox on bench and support with suitable wooden block.
3. Remove four bolts and detach L.H. gearbox mounting bracket.
4. Remove extension housing and gasket.
5. Fit manufactured stand to gearbox and secure with two bolts, nuts, spring and plain washers. Adjust bolt under filter housing as necessary.



ST1322M

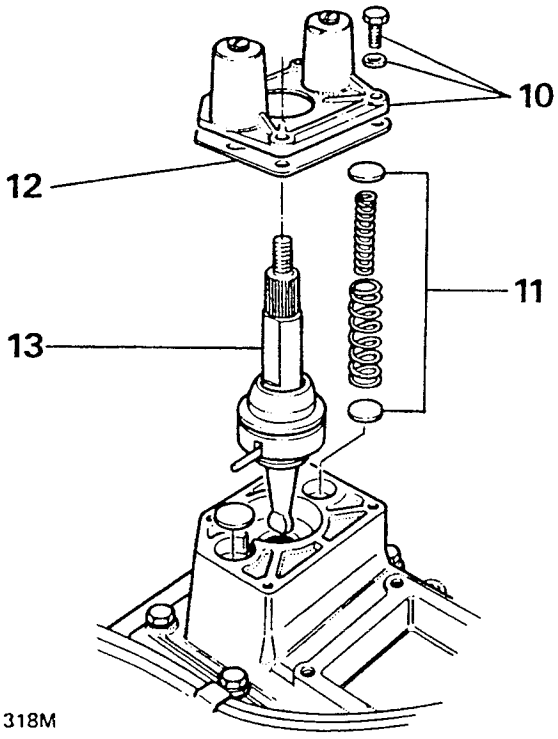
6. With assistance, fit gearbox and stand into a suitable vice and firmly secure.
7. Remove six bolts and washers and lift bell housing, complete with clutch release lever, sleeve and thrust bearing, from gearbox.
8. Remove bell housing gasket.
9. Fit two bell housing fixing bolts, with spacers to front bearing plate.



ST1323M

Bias spring housing and gear lever

10. Remove four bolts and spring washers and lift bias spring housing from gearbox.
11. Remove bias springs and shims. Care should be taken when removing lower shims to avoid them slipping under gear lever pivot bar and into gearbox.
12. Remove bias spring housing gasket.
13. Remove gear lever, complete with gaiter and nylon cup.



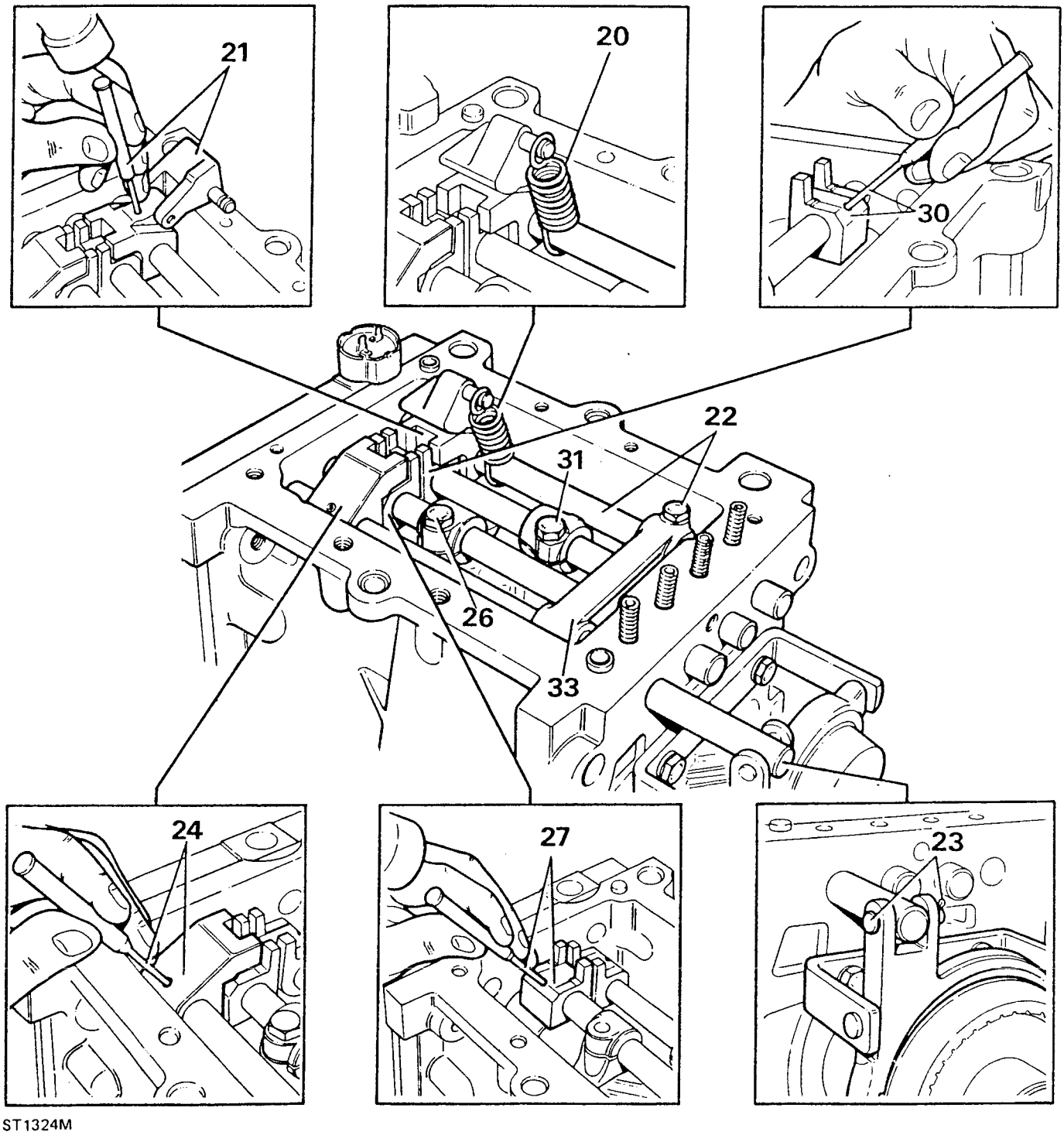
ST1318M

Gearbox top cover

14. Remove reverse light switch, if fitted.
15. Remove breather pipe banjo union fixing bolt.
16. Remove eight bolts and spring washers and lift top cover and breather pipes from gearbox.
17. Remove detent springs.
18. Remove top cover gasket.

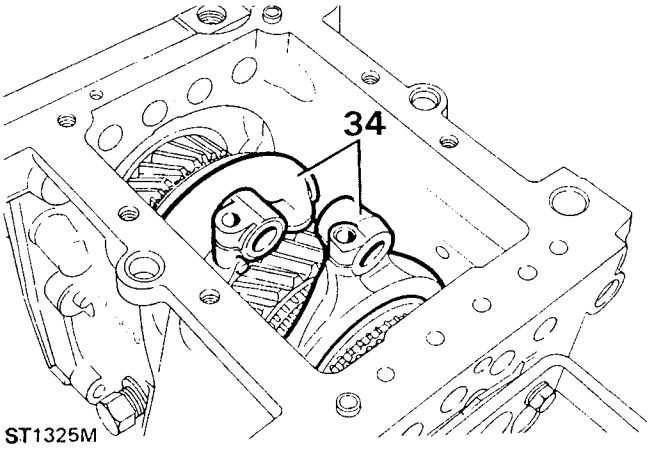
Selector rails and forks

19. Using a suitable magnet withdraw the selector rail detent balls from drillings in gearbox. If detent balls are tight leave operation until after selector rails have been withdrawn, when the detent balls can be pushed down into the selector rail bore, then removed.
20. Release reverse gate spring from knock-over lever and remove from reverse gear rail.
21. Raise knock-over lever and tap down reverse jaw roll-pin until jaw is free on rail.
22. Remove clamp bolt from reverse cross-over lever and withdraw reverse selector rail and jaw from gearbox.
23. Remove split pin washer and clevis pin securing 5th gear selector rail to selector fork and bracket assembly.
24. Push selector rail forwards and tap down 5th gear jaw roll pin until jaw is free on rail.
25. Withdraw 5th gear selector rail and jaw from gearbox.
26. Remove clamp bolt from 3rd/4th selector fork and move selector rail forward.



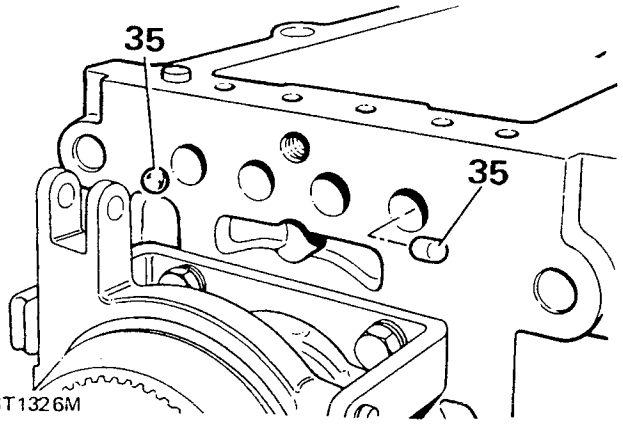
ST1324M

27. Tap down 3rd/4th jaw roll pin until jaw is free on selector rail.
28. Withdraw 3rd/4th selector rail and jaw.
29. Remove interlock from 3rd/4th selector rail.
30. Tap down 1st/2nd jaw roll pin until jaw is free on selector rail.
31. Remove clamp bolt from 1st/2nd selector fork and withdraw 1st/2nd selector rail and jaw.
32. Remove interlock from 1st/2nd selector rail.
33. Lift reverse cross-over lever from gearbox.
34. Remove 1st/2nd and 3rd/4th selector forks.

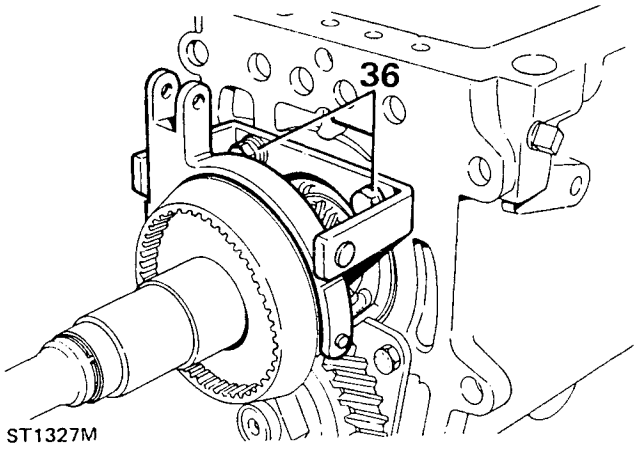


ST1325M

35. Remove interlock plungers and also detent balls if not removed in operation 19.



ST1326M

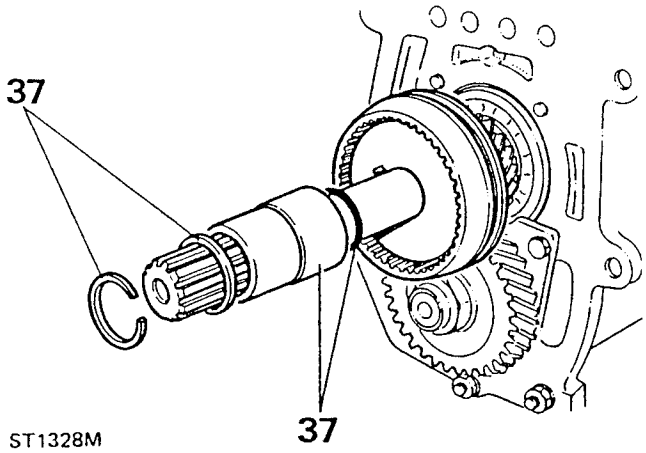


ST1327M

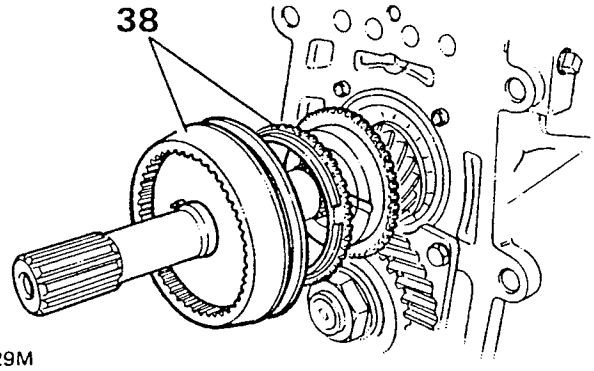
36. Remove two bolts, spring washers and plain washers securing 5th gear fork and bracket assembly to gearbox. Do not displace selector fork slipper pads when removing fork.

Reverse idler shaft, mainshaft and layshaft

37. Remove circlip, selective washer, oil seal collar and 'O' ring from mainshaft.

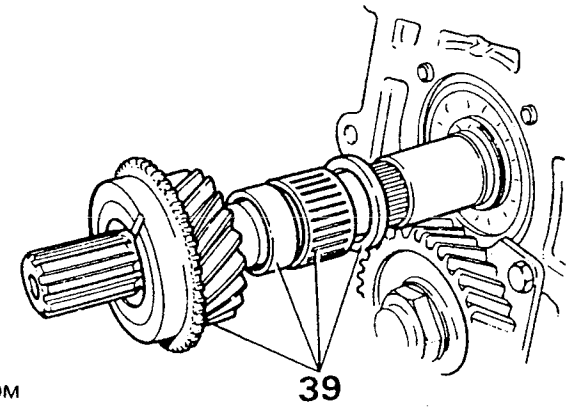


ST1328M

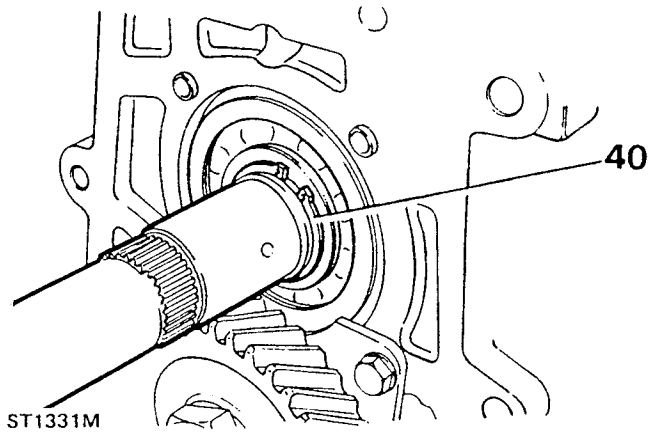


ST1329M

38. Remove 5th gear synchro hub and baulk ring.
39. Remove 5th gear, spacer, needle roller bearing and thrust washer.

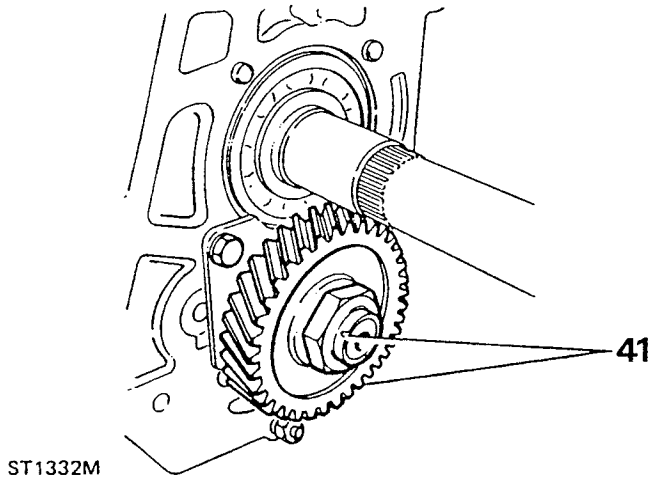


ST1330M

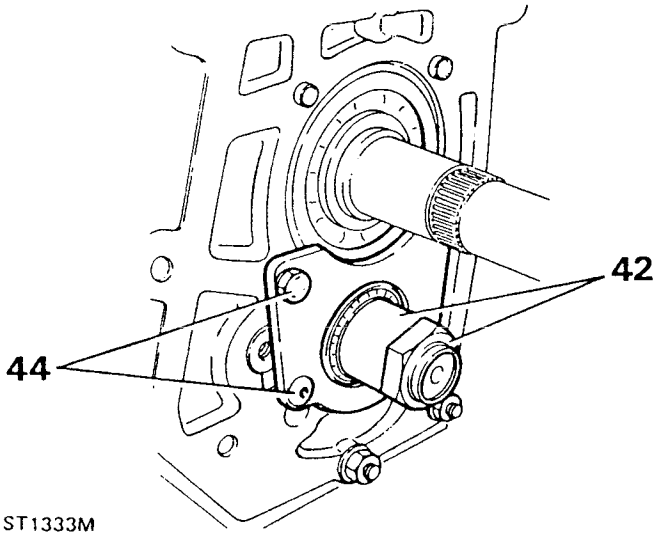


40. Remove mainshaft rear bearing circlip.
41. Release stake nut collar from recess in layshaft, remove stake nut and 5th gear from layshaft.

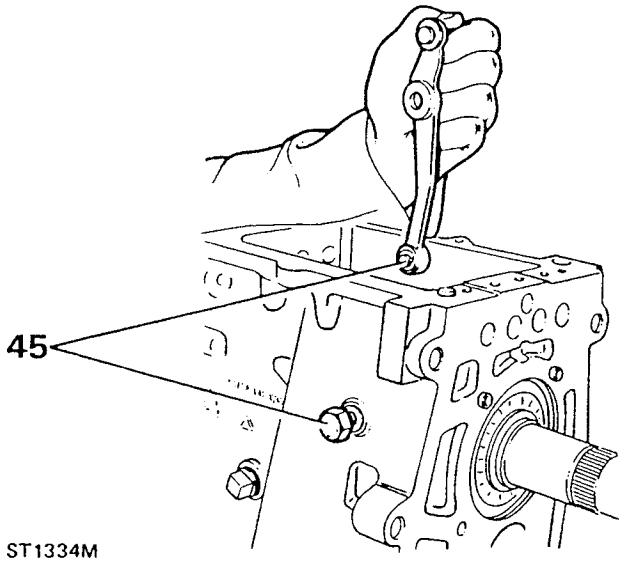
NOTE: To facilitate this operation lock gearbox by engaging both 1st and 4th gears.



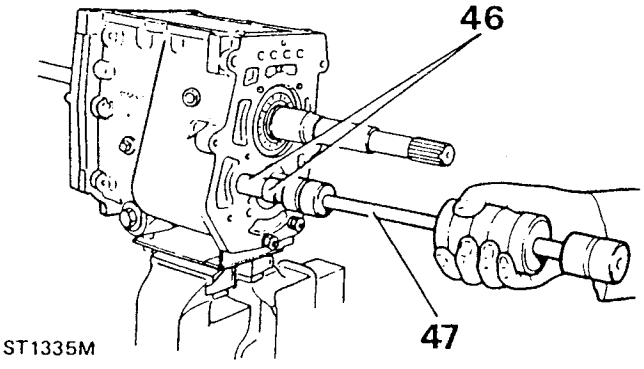
42. Fit manufactured spacer to layshaft to retain rear bearing and secure in position with stake nut finger-tight only.



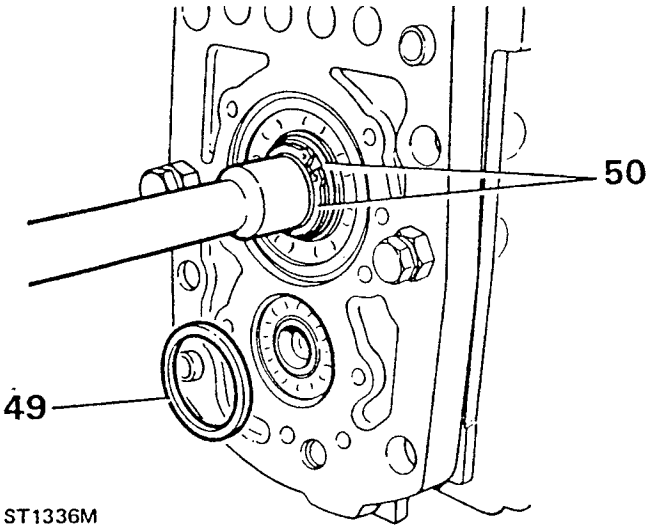
43. Disengage 1st and 4th gears.
44. Remove two socket head set screws and two bolts with spring washers and remove reverse shaft and layshaft bearing track retaining plate.
45. Remove reverse lever pivot bolt and lift reverse lever from gearbox.



46. Fit extractor adaptor Tool No. LST 284-1 to reverse idler shaft.
47. Fit slide hammer Tool No. MS 284 to adaptor and withdraw reverse idler shaft from gearbox. Reverse idler gear and thrust washer will drop into bottom of gearbox.
48. Remove seven bolts and spring washers and withdraw front cover and gasket from front bearing plate.



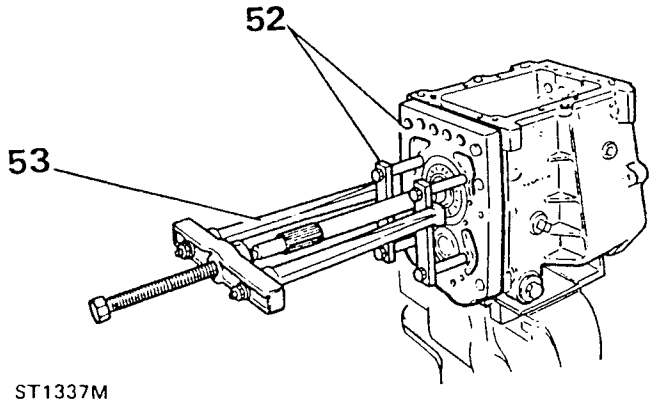
49. Remove layshaft front bearing spacer.
50. Remove input shaft bearing circlip and selective washer.
51. Remove bolts and spacers retaining front bearing plate to gearbox.



ST1336M

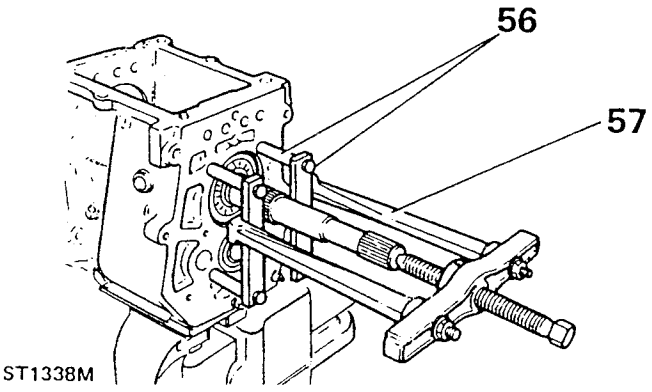
52. Fit plates and spacers of Tool No. LST 1431-1 to front bearing plate with 90 mm bolts.
53. Locate two legged puller Tool No. 18G 1400 as shown and remove front bearing plate from input shaft and gearbox.

NOTE: Centre bolt and legs of puller must be aligned squarely with input shaft.



ST1337M

54. Remove bearing plate gasket.
55. Remove stake nut and spacer from layshaft.
56. Fit plates and spacers of Tool No. LST 1431-1 to rear of gearbox with 95 mm bolts in top locations and 90 mm bolts in lower.
57. Locate two legged puller Tool No. 18G 1400, again ensuring centre bolt and legs of puller are aligned squarely.



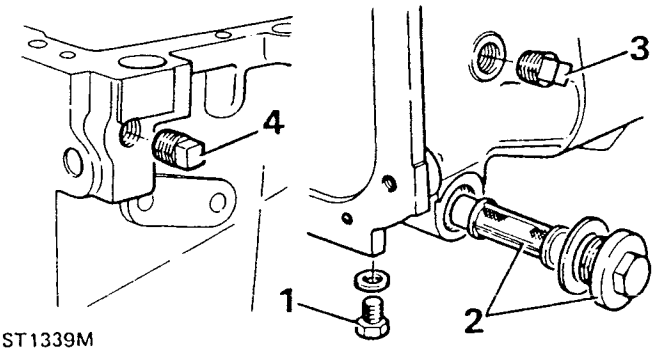
ST1338M

58. Extract mainshaft from rear bearing. To facilitate operation assistance will be needed to support mainshaft and layshaft.
59. Tap layshaft forwards and remove rear bearing race.
60. Withdraw mainshaft and layshaft assemblies.
61. Remove reverse idler gear and thrust washer from gearbox.

OVERHAUL

Main gearbox case

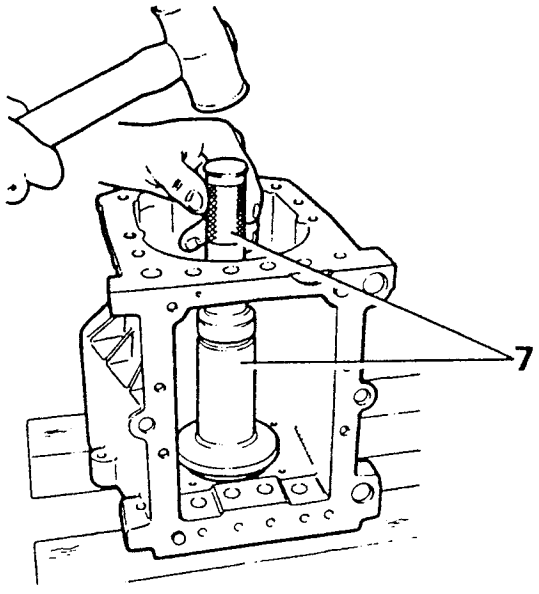
1. Remove drain plug.
2. Remove retaining plug and oil filter.
3. Remove filler/level plug.
4. Remove interlock cross drilling plug.



ST1339M

5. Remove top cover location dowels and 5th gear fork bracket dowels, if necessary.
6. Remove gearbox stand.

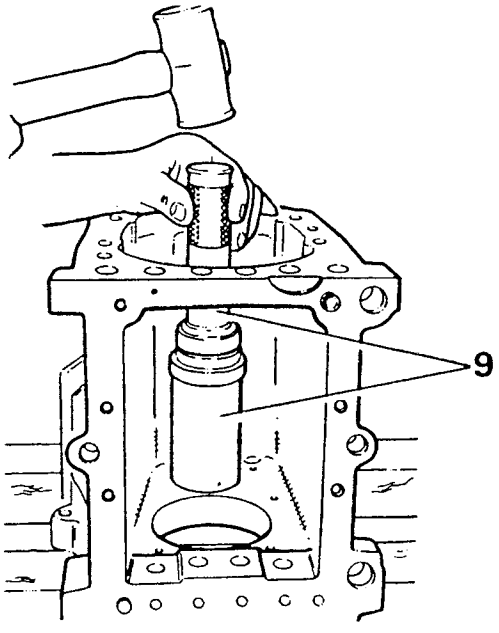
7. Position gearbox on suitable wooden blocks and remove mainshaft rear bearing using Tool Nos. LST 550-3 and MS 550.



ST1340M

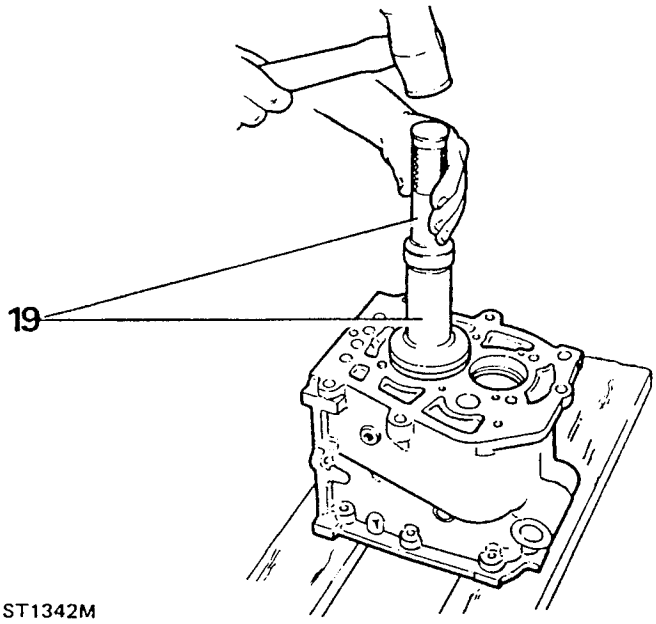
8. Remove rear bearing circlip and clean.
9. Using Tool Nos. LST 550-2 and MS 550 remove layshaft rear bearing outer track.

NOTE: Use rounded end of tool.



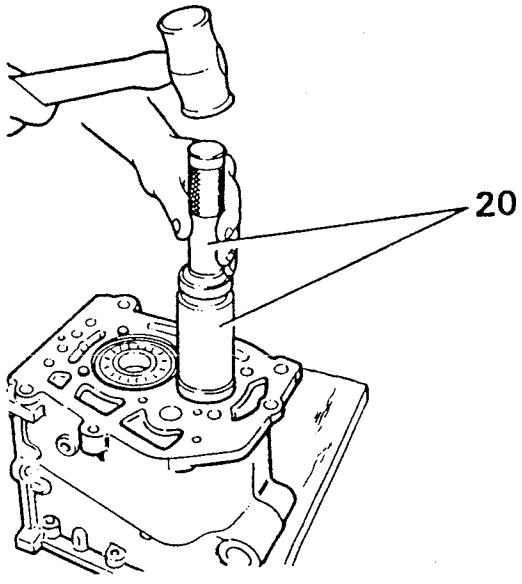
ST1341M

10. Clean gearbox case gasket faces, interior and exterior and inspect for cracks and obvious signs of damage etc.
11. Clean magnetic drain-plug, oil filter retaining plug, level/filler plug and oil filter.
12. Clean mainshaft and layshaft bearing seatings.
13. Clean reverse gear idler shaft seating, drain plug, and level/filler plug tappings.
14. Using an air line blow out filter plug tapping and oil-way, detent and interlock seatings.
15. Clean top cover face and 5th gear fork bracket dowels.
16. Heat gearbox case to facilitate fitting of mainshaft rear bearing and layshaft bearing track.
17. Fit circlip to mainshaft rear bearing.
18. Position rear bearing in gearbox seating.
19. Using Tool Nos. LST 550-3 and MS 550 tap rear bearing into position.



ST1342M

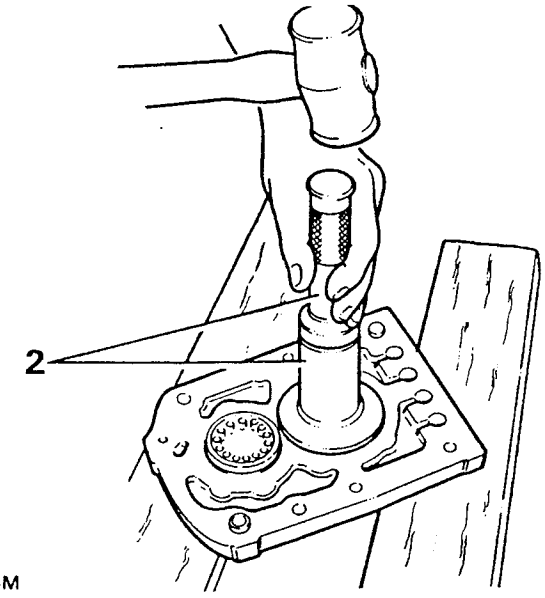
20. With gearbox still warm fit layshaft rear bearing outer track using Tool Nos. LST 550-2 and MS 550.
21. Refit interlock drilling plug.
22. Refit level/filler plug — do not tighten at this stage.
23. Refit oil filter and retaining plug using new copper washer.
24. Refit magnetic drain plug and new copper washer.



ST1343M

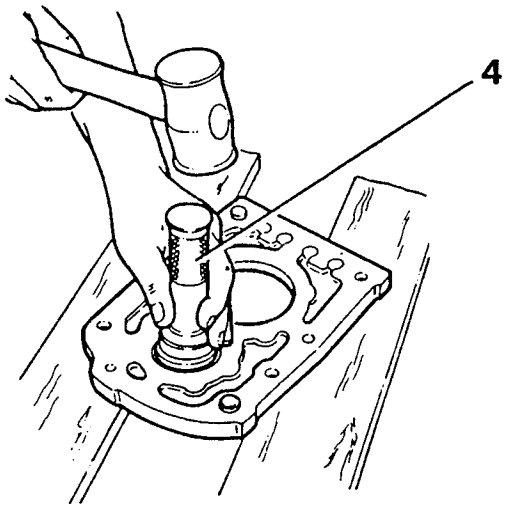
Front bearing plate

1. Support front bearing plate on suitable wooden blocks as shown.
2. Using Tool Nos. LST 550-3 and MS 550 remove input shaft bearing.



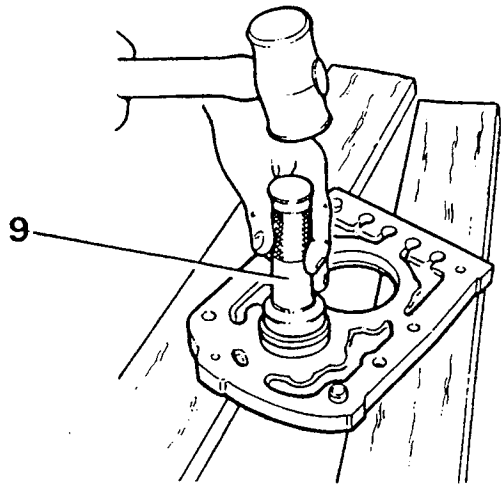
ST1344M

3. Remove circlip from bearing.
4. Remove layshaft front bearing from bearing plate using Tool No. LST 550-1.



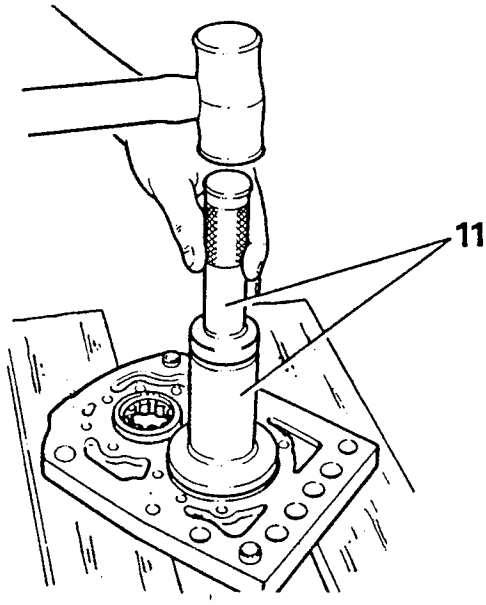
ST1345M

5. If necessary, replace bearing plate dowels.
6. Clean bearing plate, gasket forces and input shaft and layshaft bearing seatings.
7. Using an air line blow out oil-way in bearing plate.
8. Heat front bearing plate to facilitate refitting of input shaft and layshaft bearings.
9. Using Tool No. 550-1 fit layshaft bearing, with 6,5-7 mm of bearing protruding from front of bearing plate. This allows easier assembly of the layshaft and mainshaft at a later stage.



ST1347M

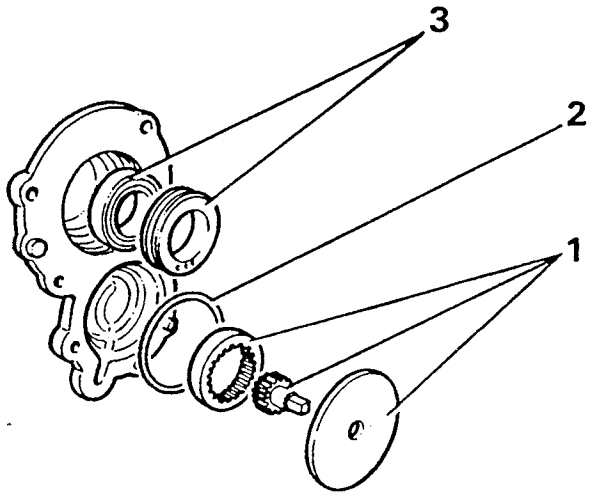
10. Fit circlip to input shaft bearing.
11. With the front bearing plate still warm fit input shaft bearing, using Tool Nos. LST 550-3 and MS 550.



ST1346M

Front cover and oil pump

1. Remove cover plate, drive gear and impellor gear.
2. Remove cover plate 'O' ring.
3. Position wooden blocks under front cover and remove oil feed ring and oil seal.

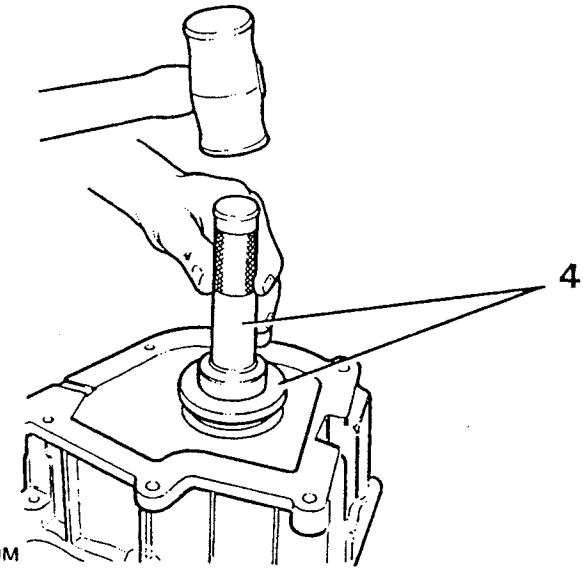


ST1348M

4. Clean all front cover components.
5. Lubricate lip of new oil seal and position in front cover seating with close side downwards.
6. Fully seat oil seal in position using suitable tube.
7. Fit oil feed ring, ensuring the three holes of the feed ring are at the bottom and the centre hole is aligned with the mating oil pump feed drilling in the front cover.
8. Fully seat feed ring in position using suitable tube.
9. Fit cover plate 'O' ring, lubricate and fit impellor gear, and drive gear.
10. Fit cover plate, ensuring chamfer of centre hole is facing towards oil pump.

Gearbox extension housing

1. Remove rear oil seal from extension housing using suitable drift.
2. If necessary, replace extension housing dowels.
3. Clean gasket faces and interior and exterior surfaces.
4. Using Tool No. LST 102 fit new oil seal to extension housing.



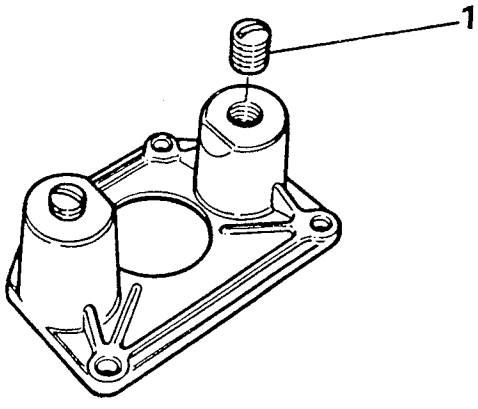
ST1349M

Top Cover

1. Clean top cover gasket faces and interior and exterior surfaces.
2. Remove top filler plug, clean, apply sealant and refit plug.

Bias spring housing and lower gear lever

1. Fit housing to vice and remove bias spring adjusting screws.

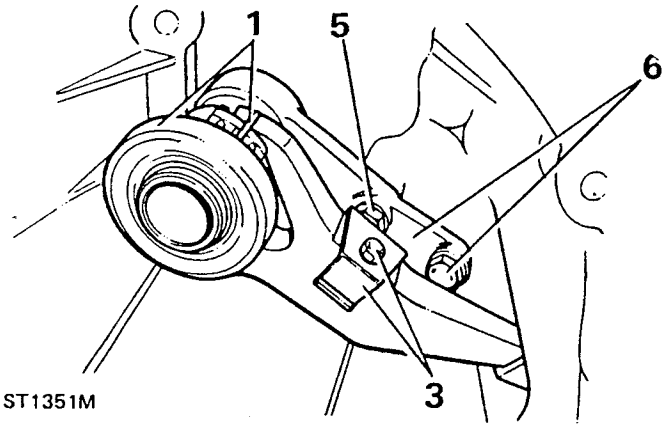


ST1350M

2. Clean lower gear lever and nylon cup.
3. Clean housing, adjusting screws, bias spring bores, springs and shims.
4. Refit bias spring screws — two turns only at this stage.

Bell housing

1. Remove clip retaining thrust bearing carrier to clutch operating lever fork.
2. Withdraw thrust bearing and carrier assembly from sleeve.
3. Remove bolt and spring washer securing operating lever pivot clip to lever. Remove pivot clip.
4. Remove operating lever and pivot slotted washer.
5. Remove operating lever pivot.
6. Unscrew single bolt and remove bearing sleeve from bell housing.



ST1351M

7. Remove bearing sleeve dowels, if necessary.
8. Clean bell housing interior, exterior and mating faces.
9. Apply grease to lever pivot and inner face of bearing carrier.
10. Reassemble in reverse order.

Input shaft

1. Remove 4th gear baulk ring and needle roller bearing.
2. Clean all components, ensuring oil-way on input shaft is blown through with air line.
3. Clean input bearing circlip and selective washer.

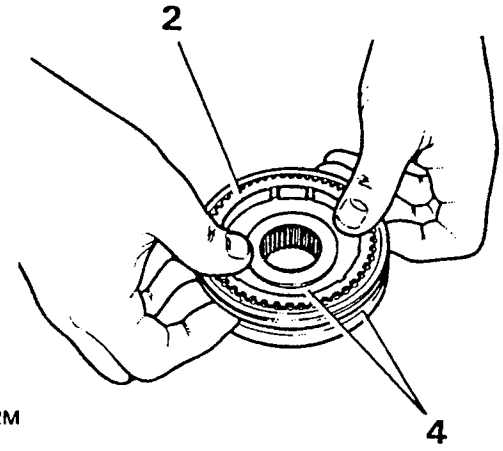
Mainshaft

1. Remove shim and 1st gear bush.
2. Remove 1st gear, needle roller bearing and bearing spacer.
3. Remove 1st gear baulk ring, 1st/2nd gear synchro assembly and 2nd gear.
4. Remove 2nd gear baulk ring, 2nd gear, needle roller spacer and needle roller bearing.
5. Fit mainshaft into vice and remove circlip retaining 3rd/4th synchro hub and gear assembly.
6. Remove selective washer, 3rd/4th synchro assembly and baulk ring.
7. Remove 3rd gear, needle roller spacer and needle roller bearing.
8. Remove oil seal from front of mainshaft.
9. Clean mainshaft, and all mainshaft components and check for obvious wear. Ensure oil-ways in mainshaft are blown through with air line.

1st/2nd synchro assembly

Before dismantling

1. Before dismantling, mark relationship of synchro hub to sleeve.
2. Fit synchro baulk rings.
3. Place synchro assembly and baulk rings into a plastic bag to ensure none of the components are lost during next operation.
4. Press sleeve from hub.

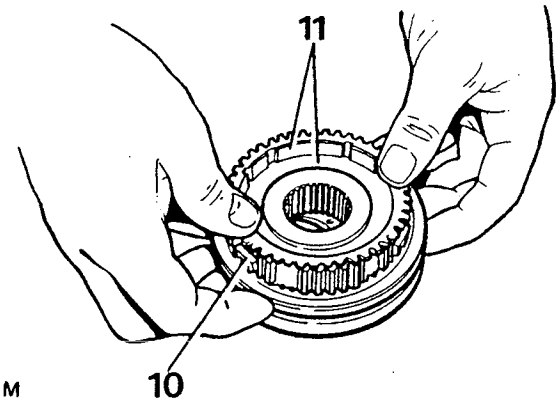


ST1352M

5. Retrieve synchro balls, springs and slipper pads and remove baulk ring.
6. Clean all synchro assembly components.

NOTE: Before reassembling the synchro assembly, carry out the checks for 3rd and 2nd gear end floats, as described in the following paragraphs under the heading 'Mainshaft and gear train'.

7. Fit synchro hub to sleeve ensuring the alignment marks match up.
8. Place hub and sleeve over suitable block.
9. With hub resting on block adjust height of hub sufficiently to fit springs.
10. Locate slipper pads, fit springs and press balls down to be retained by synchro sleeve.
11. Fit baulk ring to hub and sleeve.



ST1477M

12. Invert synchro assembly, carefully, and fit second baulk ring.
13. Press synchro sleeve over hub to locate balls in position.
14. Remove baulk rings.

3rd/4th synchro assembly

1. Repeat operation as for 1st/2nd synchro assembly (omitting the gear end float checks).

NOTE: When reassembling 3rd/4th synchro the large chamfer on synchro sleeve faces the small boss on the hub.

5th gear synchro assembly

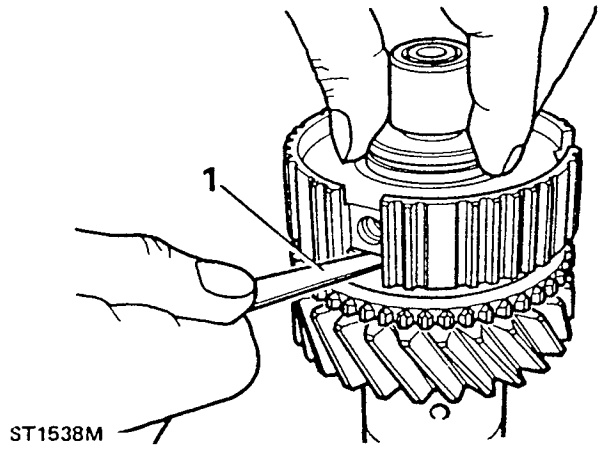
1. Repeat operation as for 1st/2nd synchro assembly.

NOTE: When reassembling 5th gear synchro the chamfer on the hub faces to the rear.

Mainshaft and gear train

3rd gear end float

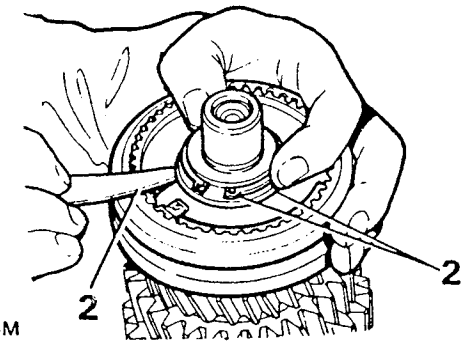
1. Locate the main shaft in a vertical position as shown. Fit 3rd gear and needle roller bearing to the shaft and replace the 3rd/4th synchro inner member. Press down on the synchro inner member and check the gear running clearance with a feeler gauge, as shown. A clearance in excess of 0,19 mm (.008 in) indicates that the thrust faces are worn and may be the cause of gear noise or transmission back lash. New or little worn components will usually have a clearance of between 0,075 mm and 0,125 mm (.003 in to .005 in).



ST1538M

3rd/4th synchro end float

2. Maintain the mainshaft in a vertical position as shown. Fit 3rd gear needle roller bearing, spacer, 3rd gear, baulk ring and synchromesh with the large area thrust face towards 3rd gear and the chamfer on the outer member towards the front.



ST1354M

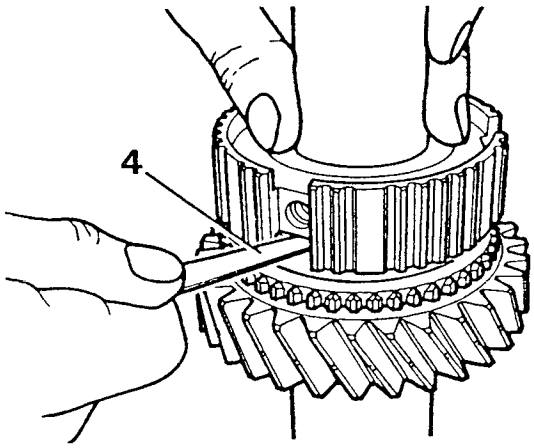
Next fit the original selective washer and retain with the circlip. Check the clearance between the washer and the synchro hub which must not exceed 0,075 mm (.003 in). The condition is ideal when the selective washer can be just turned by hand, i.e. minimum end float. Finally secure components with a new circlip.

Oil seal

3. Renew oil seal in the front of the main shaft at this stage then invert the shaft ready for assembly of the rear end.

2nd gear end float

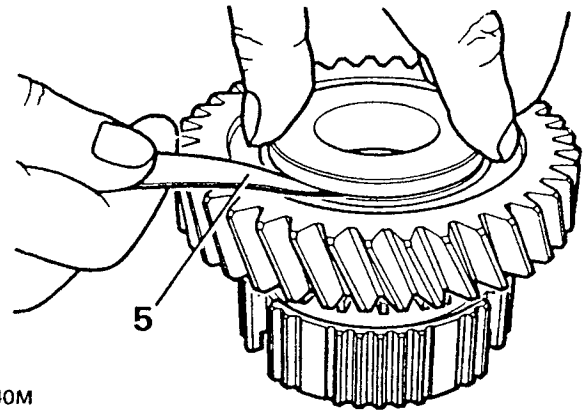
4. Fit 2nd gear needle roller bearing, spacer, 2nd gear and synchromesh inner member with the selector groove towards the rear as shown. Press down on the synchro inner member and check 2nd gear end float tolerance which is identical to 3rd gear previously described.



ST1539M

1st gear to bush end float

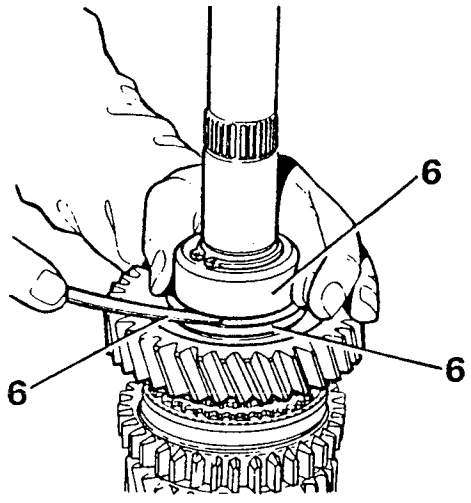
5. To carry out 1st gear check, it is not necessary to assemble the components on to the mainshaft. Assemble 1st gear on to the bush and using a suitable straight edge or flat plate (the oil pump back plate is ideal) check the end float of 1st gear on the bush as shown. The tolerance is identical to 3rd and 2nd gear end floats.



ST1540M

1st/2nd synchromesh end float

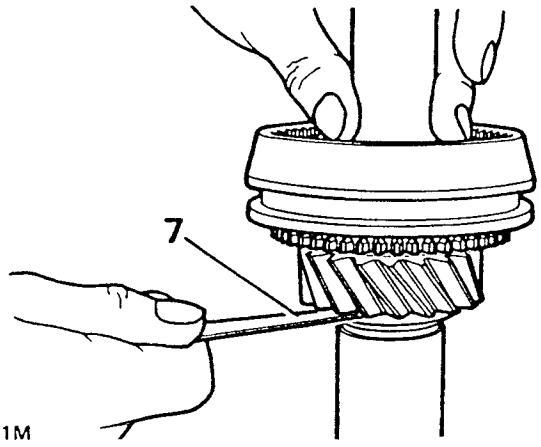
6. Next fit the 1st gear baulk ring, 1st gear bush and gear, original selective washer, dummy bearing LST 101 and circlip onto the shaft, then check the end float as shown. Choose a suitable selective shim washer to obtain the correct tolerance which is identical with 3rd/4th synchromesh, i.e. minimum to 0,075 mm (.003 in).



ST1353M

5th gear end float

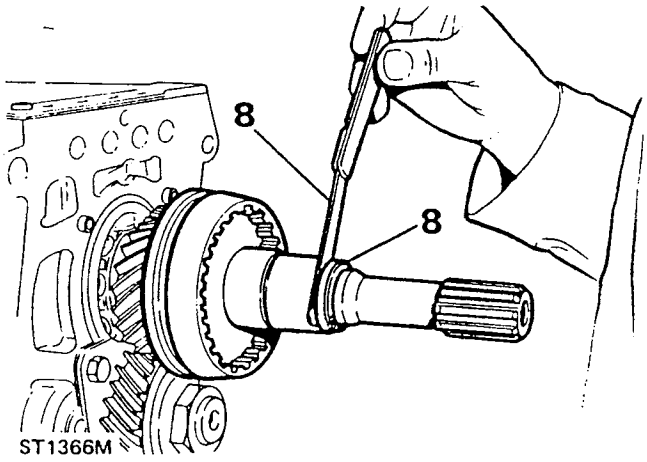
7. Fit 5th gear thrust washer, 5th gear, needle bearing and spacer followed by synchromesh unit but leaving out the baulk ring at this stage. Press down on the synchro inner member and check the gear end float as shown; this tolerance, again is identical to 3rd gear.



ST1541M

5th gear synchro end float

8. Fit the 5th gear synchromesh backing plate, seal collar, original selective shim washer and circlip. Then check the clearance as shown; select a suitable shim washer to minimise the clearance. This adjustment is identical to the 1st/2nd and 3rd/4th synchromesh units.
With all the mainshaft adjustments correct, remove the 5th gear components ready for assembly.



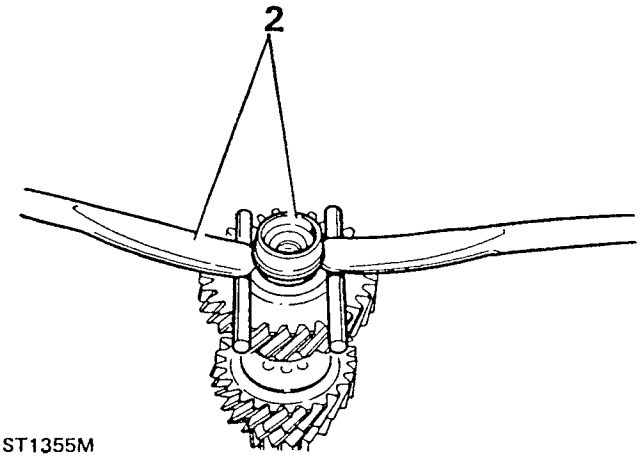
ST1366M

5th gear selector fork and bracket assembly

1. Remove slipper pads from selector fork and check for wear.
2. If necessary, remove circlips and remove selector fork pivot pins.
3. Clean all components and refit in reverse order.

Layshaft

1. Remove layshaft rear bearing inner race.
2. Fit layshaft to vice and lever off front bearing inner track.



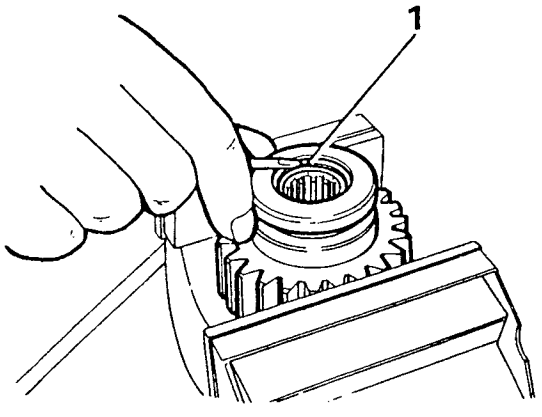
ST1355M

3. Clean layshaft, bearings and tracks and check for wear.
4. Fit layshaft front bearing track.
5. Fit rear bearing race to layshaft, ensuring the identification numbers etc., of the bearing are facing forwards.

NOTE: Inner tracks are offset and the bearings must be fitted with narrow shoulders together.

Reverse idler gear assembly, shaft and lever

1. Secure reverse gear in vice and remove circlip retaining bearings.



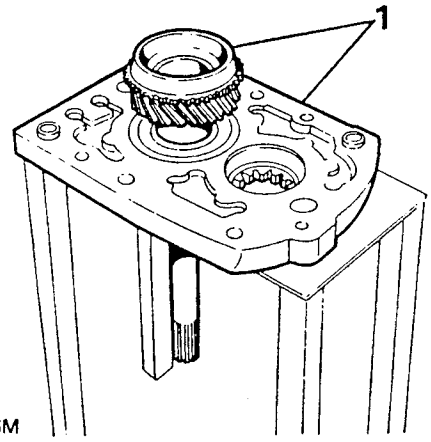
ST1359M

2. Remove upper thrust washer, two needle roller bearings and lower thrust washer.
3. Invert reverse gear and remove second circlip.
4. If necessary, remove split pin and withdraw slipper pads and washer from reverse gear lever.
5. Press out reverse lever cross link operating pin, if necessary.
6. Clean all components and check for wear.
7. Lubricate needle roller bearings and reassemble reverse idler gear assembly and lever in reverse order.

REASSEMBLING GEARBOX

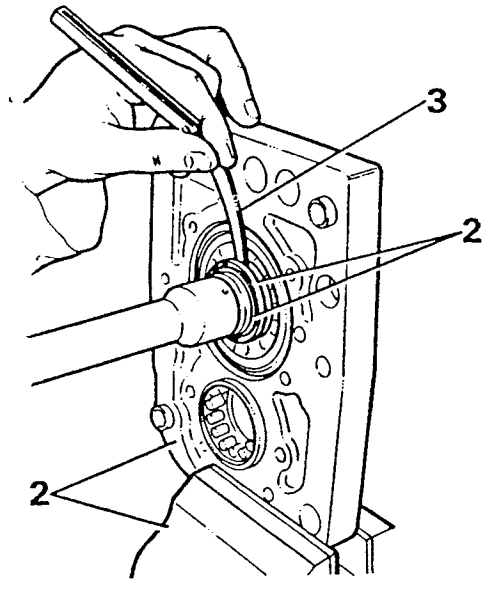
Input shaft, mainshaft and layshaft

1. Position front bearing plate on suitable stand and fit input shaft into bearing.



ST1356M

2. Secure bearing plate in vice, fit original selective washer and retain with circlip.
3. Measure the clearance between washer and input shaft bearing. If a measurement in excess of 0,075 mm is obtained remove circlip and washer.

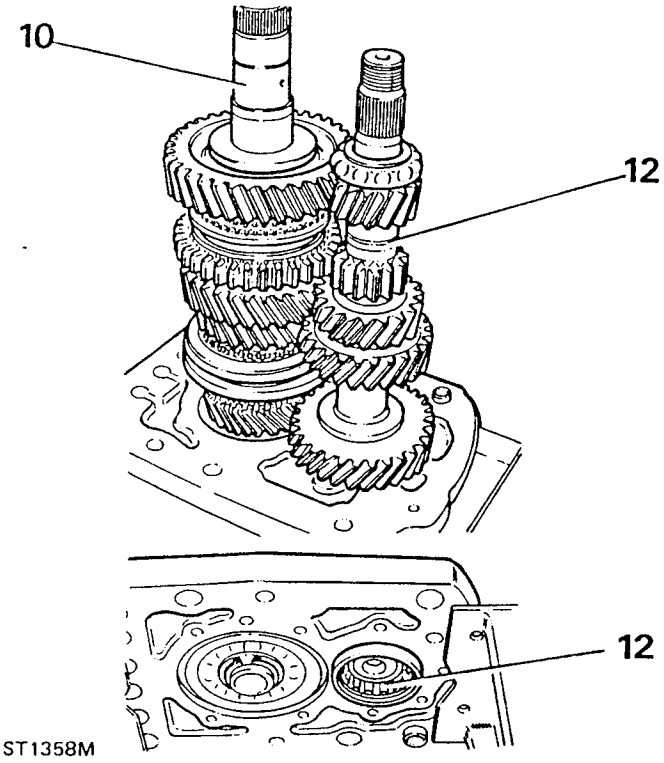


ST1357M

4. Select and measure new washer to take up the excessive running clearance.
5. Fit new selective washer and retain with circlip.
6. Recheck to ensure a running clearance of 0,075 mm is obtained between washer and bearing.
7. Position front bearing plate on suitable stand.
8. Lubricate mainshaft pilot bearing and fit to input shaft.
9. Fit 4th gear baulk ring to input shaft.

10. Lower mainshaft assembly into input shaft at the same time rotating to engage baulk ring slots and lugs.
11. Engage 3rd gear.
12. Fit layshaft assembly to front bearing plate and mesh with mainshaft.

NOTE: Take care to ensure that the front layshaft bearing rollers are not put out of alignment, then return 3rd/4th synchro hub to neutral.

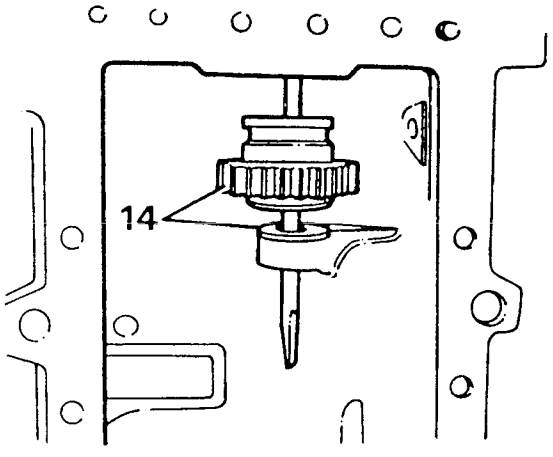


ST1358M

13. Remove the rear bearing circlip and dummy bearing.

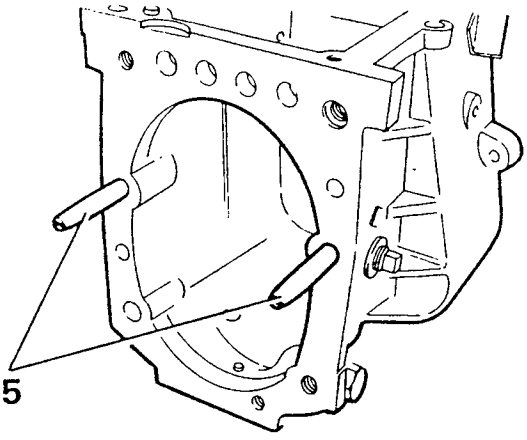
Reverse gear

14. Fit thrust washer to reverse gear, chamfer towards gear, locate gear in gearbox case, and retain temporarily in position with a screwdriver, or similar implement.



ST1360M

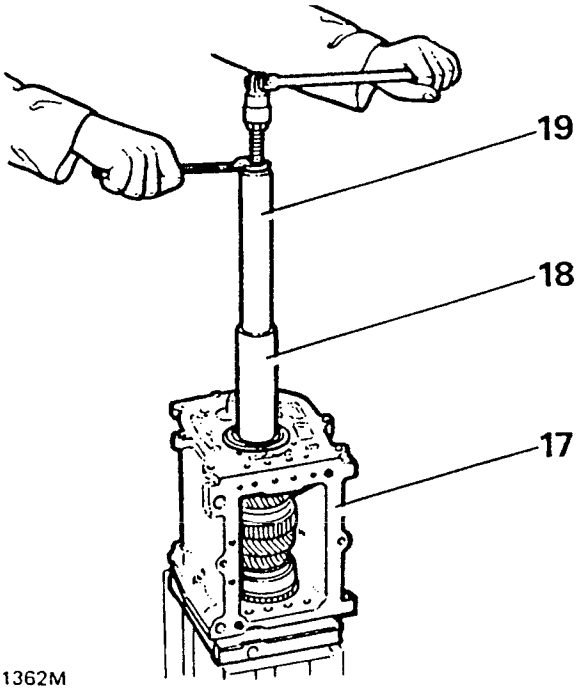
15. Fit guide studs 18G 1294 to gearbox.



ST1361M

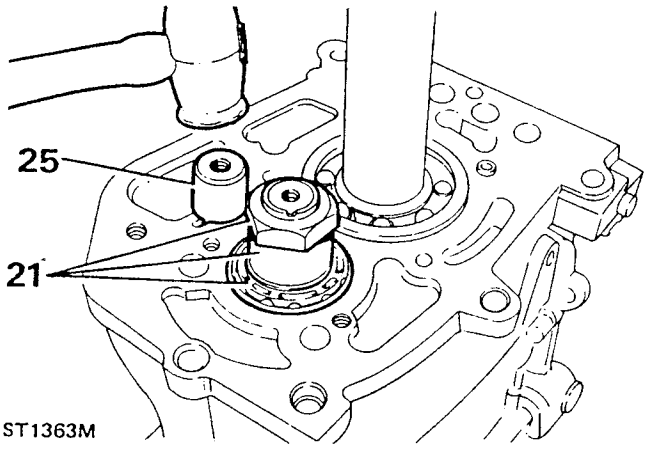
Gearbox case and reverse shaft

16. Fit new gasket on front bearing plate.
17. Lower gearbox case over mainshaft/layshaft assemblies using guide studs to locate front bearing plate.
18. Fit tube, Tool No. LST 1431-1 over mainshaft and locate on rear bearing.
19. Fit Tool No. 18G 1431 over mainshaft and locate on other tool.
20. With assistance, to prevent gearbox and mainshaft rotation, and using above tools, pull gearbox to front bearing plate.



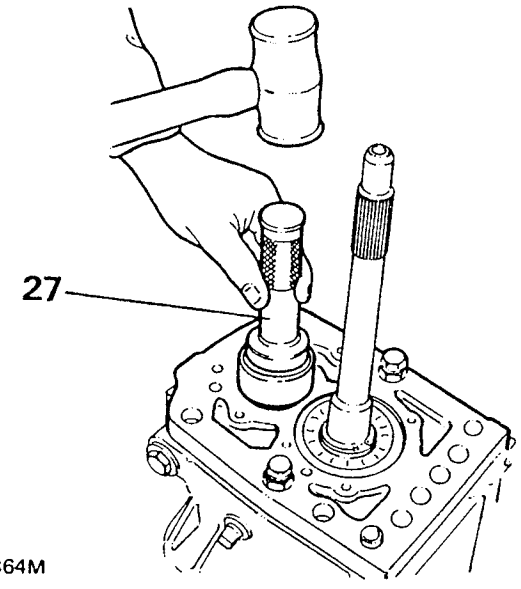
ST1362M

21. Fit layshaft rear bearing (identification numbers to rear) dummy spacer, and retain temporarily with layshaft nut.
22. Remove guide studs 18G 1294.
23. Temporarily fit two bell housing bolts with spacers, to secure front bearing plate to gearbox.
24. Remove Tool Nos. 18G 1431 and LST 1431-1 and then check that the mainshaft is engaged through bearing sufficiently to fit mainshaft bearing circlip.
25. Remove screwdriver from reverse shaft location and fit reverse shaft.



ST1363M

26. Invert gearbox and fit spacer to layshaft front bearing.
27. Using Tool Nos. LST 550-1 and MS 550 locate layshaft front bearing to final position.

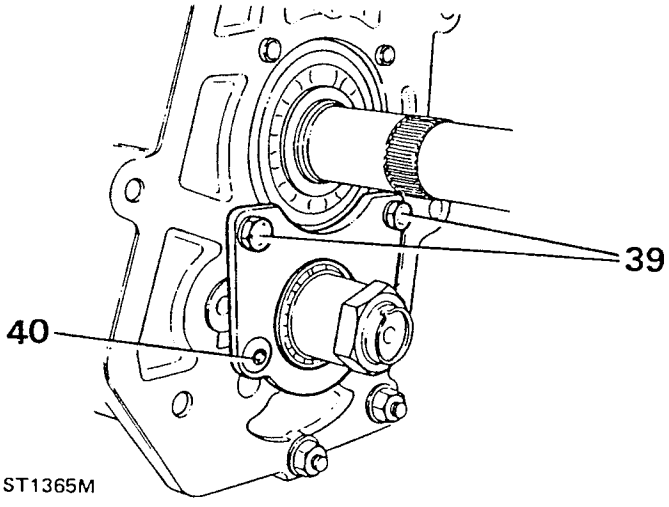


ST1364M

28. Temporarily remove layshaft bearing spacer.
29. Refit gearbox stand (manufactured tool) to underside of gearbox and secure with two bolts, nuts, spring and plain washers. Adjust bolt under filter housing as necessary.
30. Secure gearbox stand in vice.
31. Check that 4th gear baulk ring and all other baulk rings are free.
32. Fit layshaft front bearing spacer.
33. Fit new gasket to front cover.
34. Tape input shaft splines, to prevent damage to front cover oil seal in next operation.
35. Ensure oil pump drive aligns with the square seating in the layshaft and fit front cover to front bearing plate and secure with seven bolts and spring washers.
36. Remove tape from input shaft splines.

Reverse lever, reverse shaft/bearing retaining plate

37. Fit reverse lever to reverse gear.
38. Apply Loctite Stud and Bearing Fit (270) to pivot bolt threads, fit bolt in gearbox and locate in reverse lever pivot boss.
39. Position reverse shaft, layshaft bearing track retaining plate and secure top of plate with two bolts and spring washers.



ST1365M

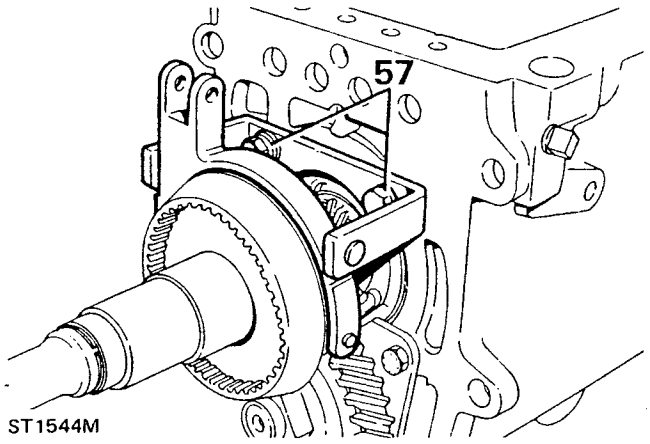
40. Apply Loctite Stud and Bearing Fit (270) to socket head set screws and secure bottom of retaining plate.

5th gear, layshaft and mainshaft

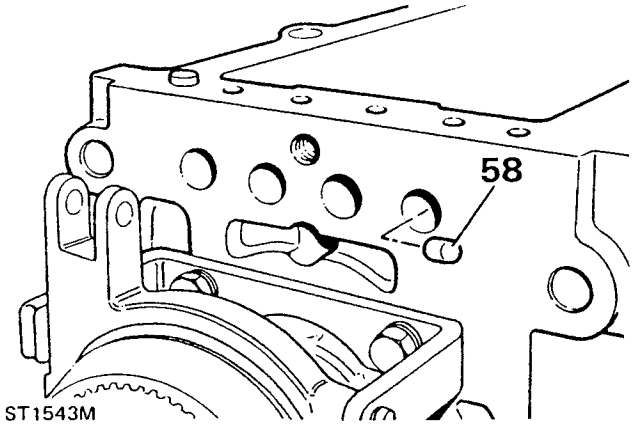
41. Remove nut from layshaft and remove dummy spacer.
42. Fit 5th gear to layshaft with large boss to the rear.
43. Rotate layshaft to give access to stake slot.
44. To facilitate next operation, lock gearbox by engaging 1st and 4th gears.
45. Fit a new 5th gear retaining nut and tighten to the specified torque.
46. Stake retaining nut collar into recess in layshaft.
47. Return 1st and 4th synchros to neutral.
48. Fit mainshaft rear bearing circlip.
49. Fit thrust washer.
50. Lubricate needle roller bearings and fit to mainshaft followed by spacer and 5th gear.
51. Fit 5th gear synchro cone and synchro hub assembly.
52. Tape mainshaft splines and fit 'O' ring to its seating on mainshaft.
53. Fit oil seal collar and locate in peg on hub backing plate.
54. Fit the washer selected during the 5th gear end float check and retain with circlip.
55. Remove tape.

Selector rails and forks

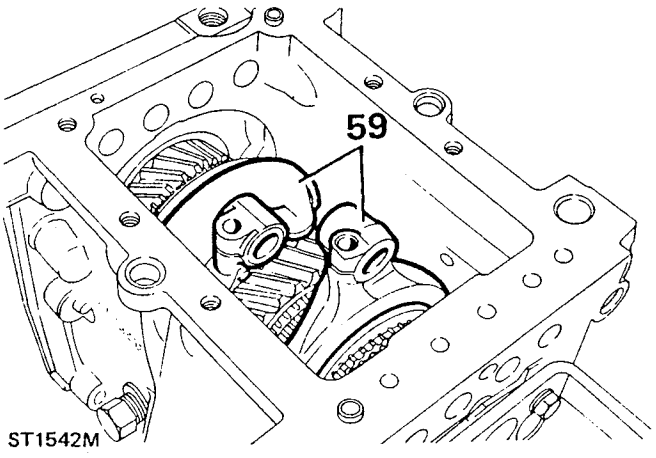
56. Locate 5th gear fork and bracket on to synchro hub and gearbox dowels.
57. Secure fork bracket to gearbox with two bolts, plain washers and spring washers.



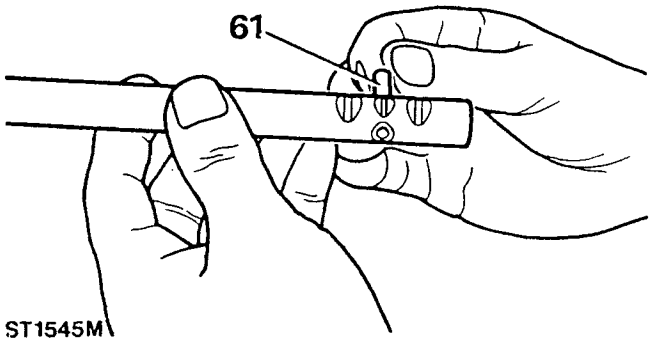
58. Fit selector rail interlock plungers into the cross-drilling in the gearbox case.



59. Fit 1st/2nd and 3rd/4th selector forks.



60. Fit reverse cross-over lever.
61. Insert interlock into 1st/2nd selector rail.

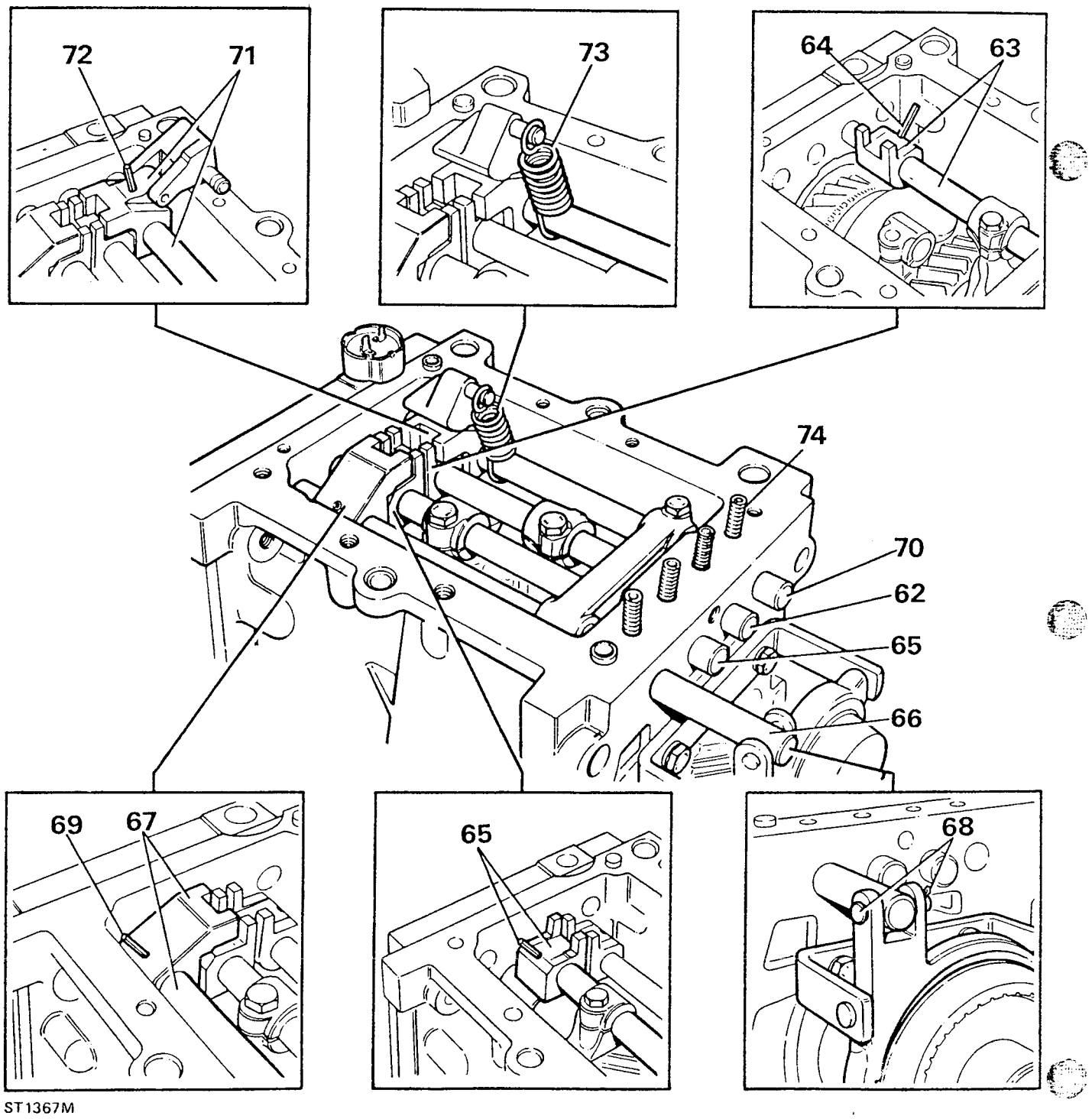


62. Push 1st/2nd selector rail through gearbox seating and locate in reverse cross-over lever and selector fork; do not tighten fork clamp bolt.

NOTE: 1st/2nd fork clamp bolt is not a set bolt.

63. Fit 1st/2nd selector jaw to rail and align for roll pin.
64. Using suitable drift, tap in roll pin to secure jaw and rail.
65. Repeat operation for 3rd/4th selector rail and jaw.
66. Push 5th gear selector rail through gearbox seating and locate in reverse cross-over lever.
67. Fit 5th gear selector jaw to rail, align for roll pin.
68. Locate selector rail into 5th gear selector fork and secure with clevis pin, washer, and split pin.
69. Fit roll pin and secure selector rail and jaw.
70. Push reverse selector rail through gearbox seating and locate in reverse cross-over. Do not tighten lever clamp bolt.
71. Fit jaw to rail and align for roll pin.
72. Using a suitable drift, fit roll pin to secure selector rail and jaw.

NOTE: The roll pin must be inserted sufficiently to be flush with the underside face of the selector jaw.

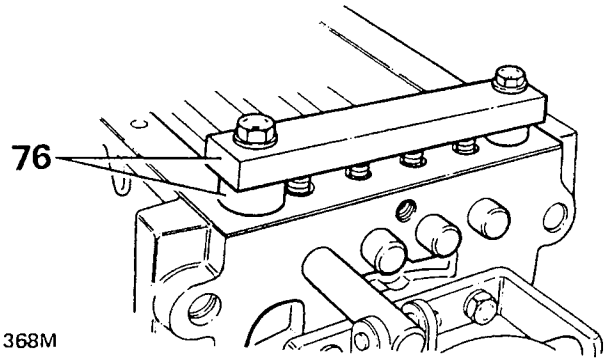


ST1367M

73. Fit reverse gate spring to selector rail and knock-over lever.
74. Fit detent balls and springs.

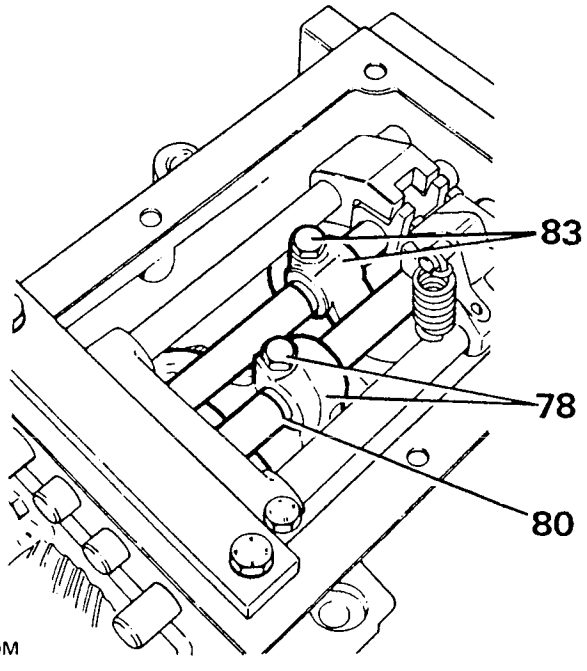
Selector fork adjustment

75. Fit top cover gasket.
76. Secure detent spring retaining tool and spacers to gearbox using two 8 x 50 mm bolts and plain washers.



ST1368M

77. Tighten bolts and compress detent springs until retaining plate contacts the two spacers.
78. Ensure that 1st/2nd selector rail and synchro sleeve are in neutral position. Tighten clamp bolt sufficiently to eliminate any rock in the selector fork and move selector fork rearwards.
79. Scribe a pencil line on rail at rear of fork yoke.
80. Move fork forwards on rail and scribe line on rail at rear of fork yoke.
81. Scribe a line midway between the other lines on the selector shaft.
82. Move selector fork to centre line and tighten clamp bolt.
83. Repeat operation for 3rd/4th selector fork and rail.

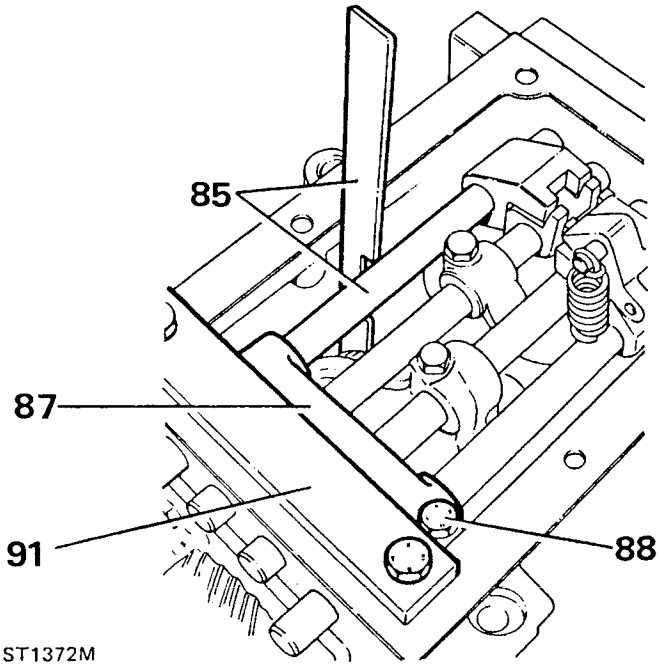


ST1370M

Reverse cross-over lever adjustment

The purpose of the following adjustment is to ensure that when 1st gear is selected the outer member of the 1st/2nd synchro member is not also engaged with the reverse idler.

84. Move reverse gear thrust washer fully forward.
85. Fit gauge (manufactured tool) to selector shaft.
86. Move rail rearwards and select reverse gear.
87. Move cross-over lever rearwards to lightly nip gauge between reverse gear and thrust washer.
88. Tighten reverse cross-over lever clamp bolt and return rail to neutral. Remove gauge.
89. Move 1st/2nd rail rearwards and select first gear. Ensure a minimum clearance of 1,0 mm has been obtained between reverse gear idler and reverse gear on 1st/2nd synchro sleeve. If there is not enough clearance, readjust the reverse cross-over lever.
90. Return 1st/2nd rail back to neutral.
91. Remove detent spring retaining tool and spacers.



ST1372M

Gearbox top cover

92. Fit top cover and locate over detent springs.
93. Position breather pipe, locate retaining clips and secure top cover and breather pipe clips with eight bolts and spring washers.
94. Fit breather pipe banjo union and fibre washers.
95. Fit reverse light switch.
96. Place clean rag in top cover to prevent entry of dirt etc.

Bell housing

97. Remove bolts and spacers securing front bearing plate to gearbox.
98. Fit new bell housing gasket.
99. Locate bell housing squarely on dowels and secure housing and front bearing plate to gearbox with six bolts and spring washers.

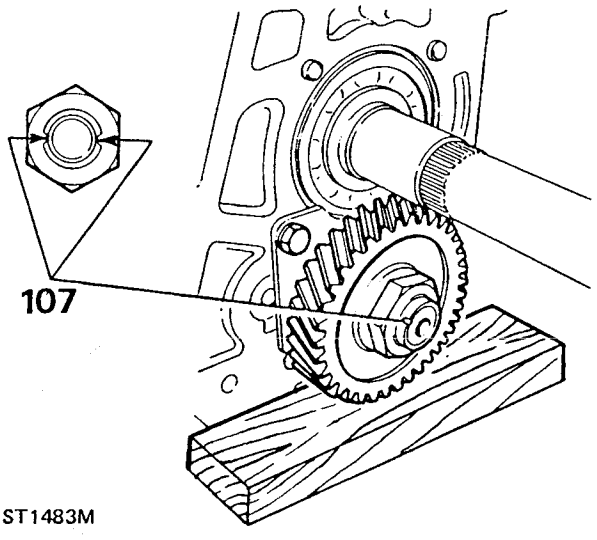
Lower gear lever/bias spring housing

100. Remove rag from gearbox top cover.
101. Lubricate gear lever ball and lower yoke.
102. Fit lower gear lever, nylon cup and grommet.
103. Fit new gasket to housing.
104. Grease bias springs.
105. Carefully fit shims and bias springs, followed by spring housing and secure with four set screws, and spring washers.
106. Remove gearbox assembly from vice and detach stand.

Gearbox extension housing

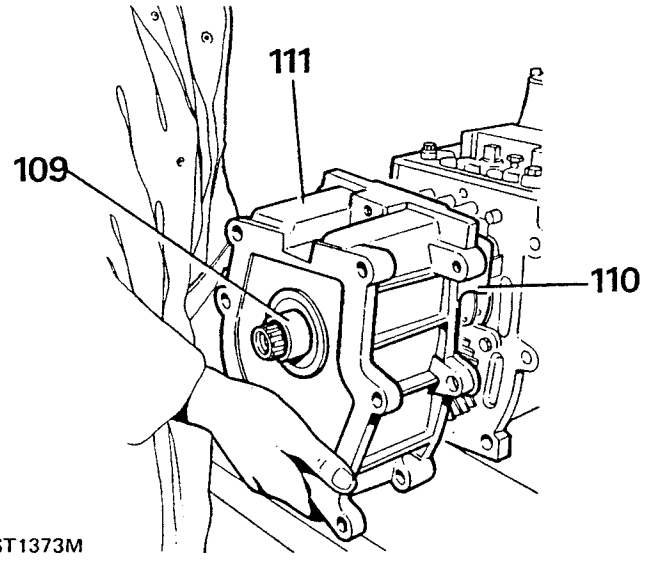
107. The special nut retaining the 5th gear to the layshaft must be secured in position, by carefully forming the collar of the nut into the layshaft slots, as illustrated.

CAUTION: A round nose tool must be used for this operation to avoid splitting the collar of the nut. Also, the 5th laygear should be supported by a wooden block when the nut is being deformed, to prevent damage to the bearings adjacent to the gear.



ST1483M

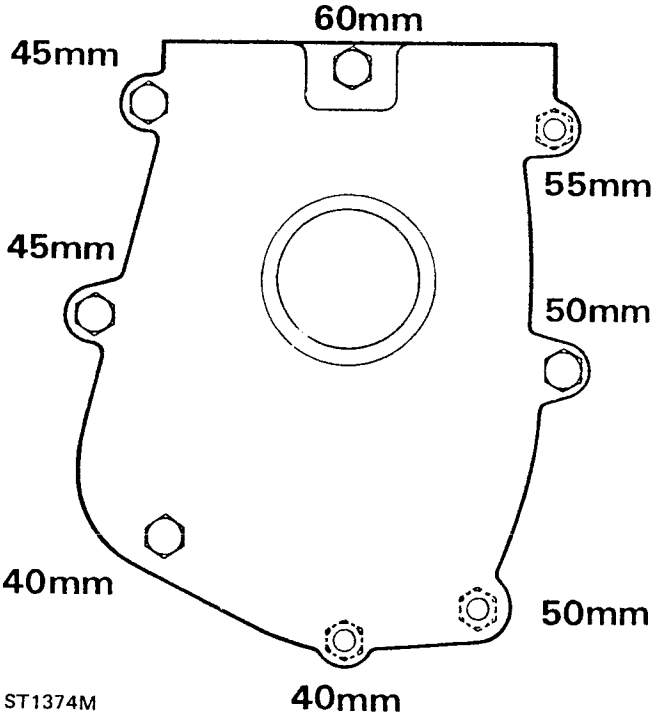
108. Support underside of gearbox with wooden block.
109. Lubricate oil seal protection sleeve Tool No. LST 102 and fit to oil seal from inside extension housing.
110. Fit new gasket to extension housing.
111. Carefully manoeuvre extension housing over mainshaft and position squarely on dowels.



ST1373M

112. Remove oil seal protection sleeve.
113. Secure extension housing to gearbox with eight bolts, spring washers and single nut.

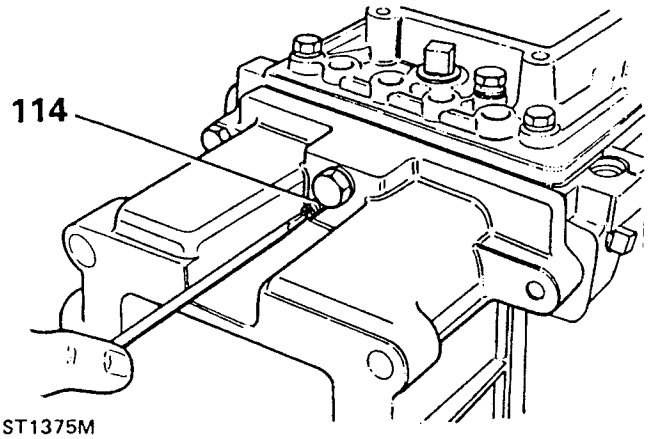
NOTE: Illustration shows correct bolt lengths and their locations in extension housing.



ST1374M

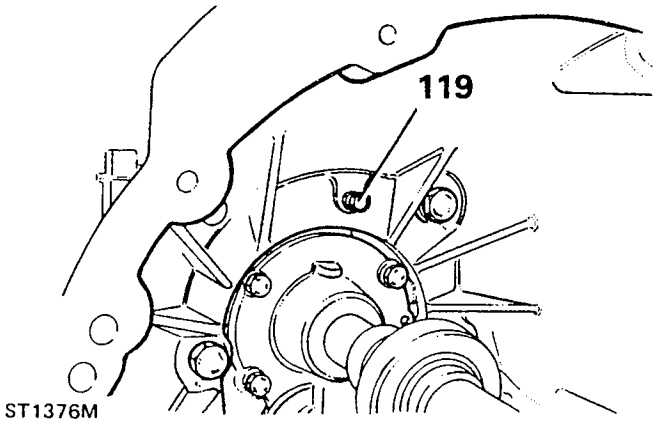
3rd/4th gear selector rail adjustment

114. Slacken 3rd/4th stop screw in extension housing.



ST1375M

115. Select 3rd gear.
116. Tighten stop screw until it makes contact with 3rd/4th selector rail.
117. Turn back stop screw one turn. Retighten locknut.
118. Return gear lever to neutral.
119. Slacken locknut on 3rd/4th stop bolt inside bell housing.

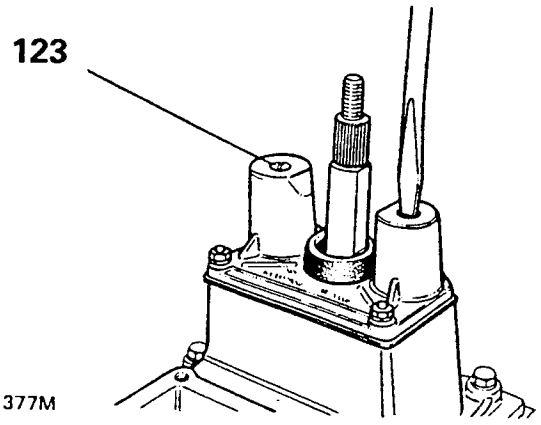


ST1376M

120. Unscrew stop bolt.
121. Select 4th gear and screw in stop bolt until contact is made with 3rd/4th selector shaft.
122. Turn back stop bolt one turn and retighten locknut.
Return gear lever to neutral.

Bias spring adjustment

123. Apply Loctite Stud and Bearing Fit (270) to bias springs screws and tighten up until screw heads are flush with top face of bias spring housing.



ST1377M

Gearbox mounting

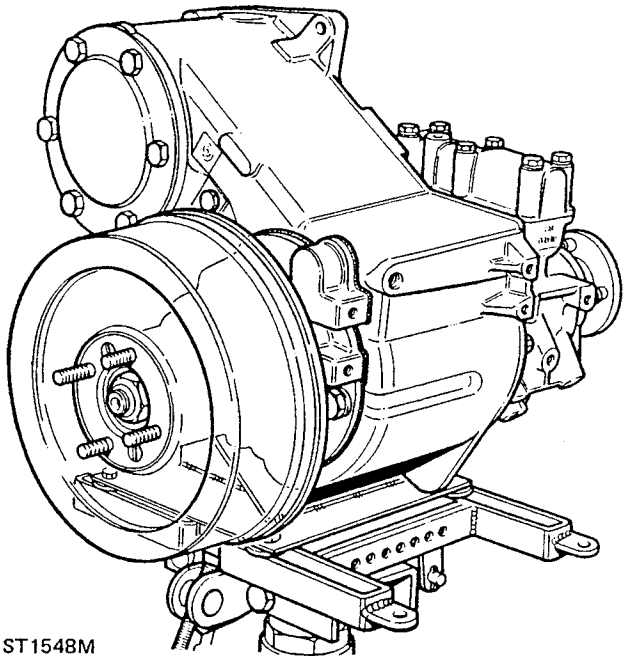
124. Refit mounting to extension housing and secure with four bolts.

REMOVE LT230T TRANSFER GEARBOX FROM THE LT85 GEARBOX

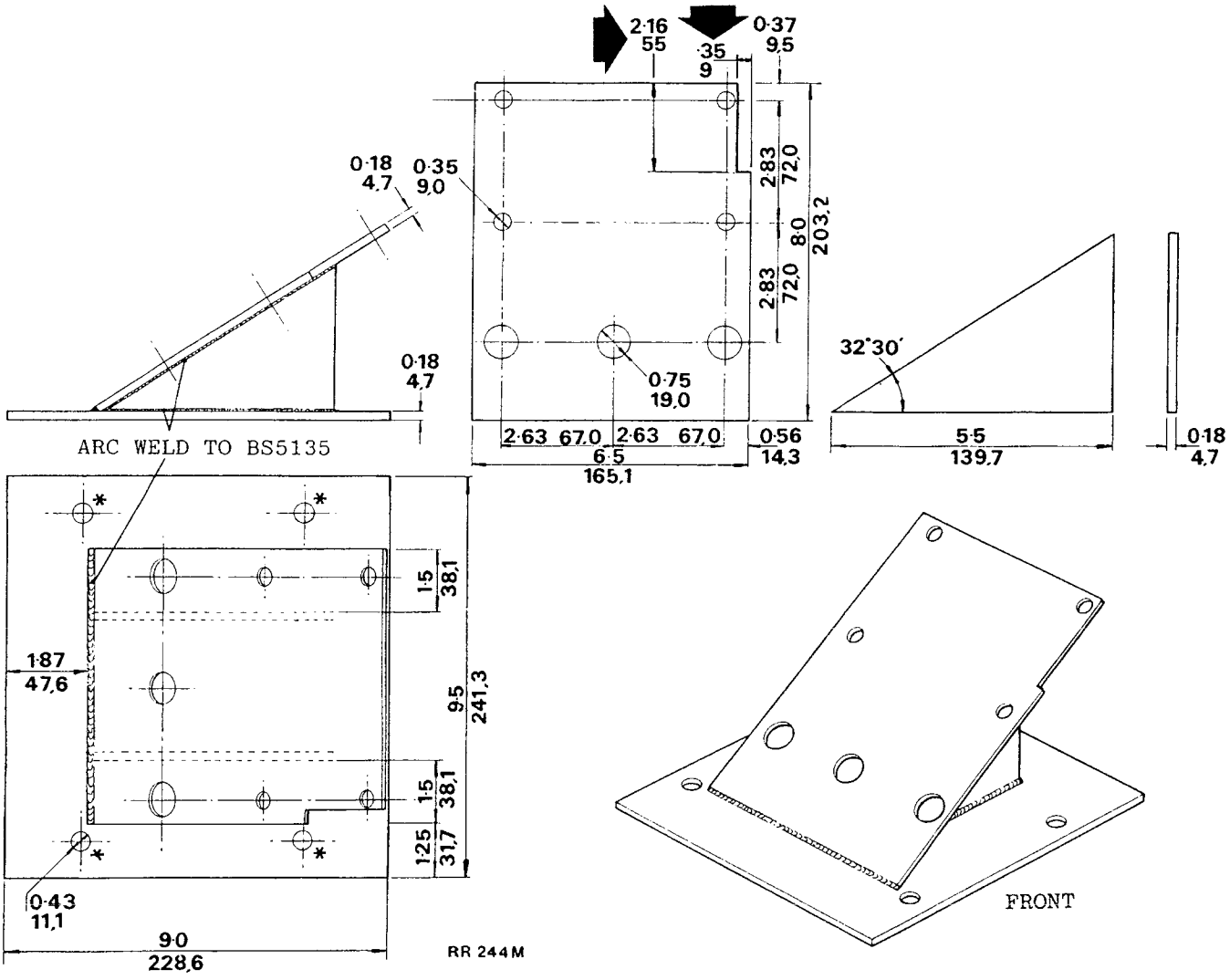
Special tool: 18G 1425 — Guide studs (3)
Also, locally manufactured adaptor plate, see below

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.



ST1548M

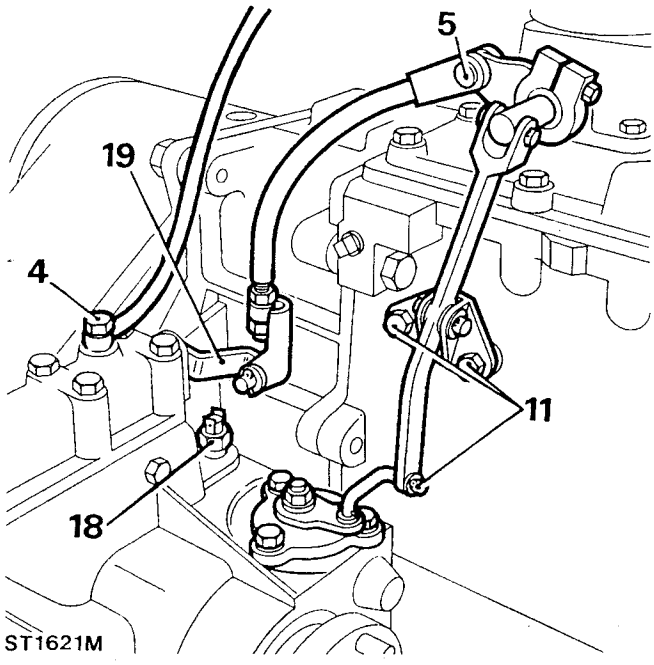


Material. Steel plate BS 1449 Grade 4 or 14
Holes marked thus * to be drilled to fit hoist being used.

◗ = MODIFICATION

Removing

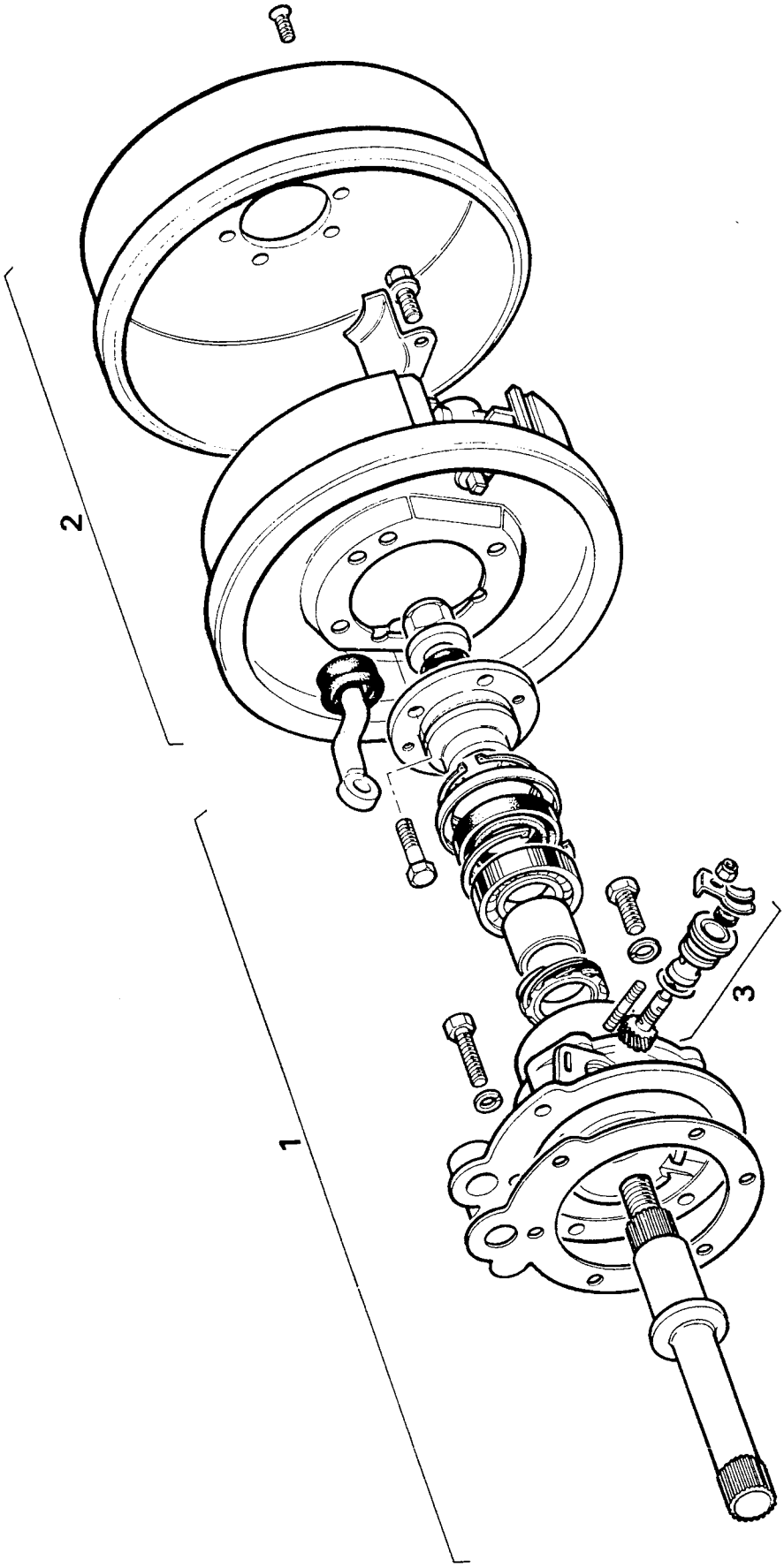
1. Install the vehicle on a ramp.
2. Disconnect the battery.
3. Remove the cover panel from the right-hand seat base.
4. Remove the breather pipe union from the transfer gearbox high/low cross-shaft housing.
5. Disconnect the high/low lever.



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.
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.
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 the 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.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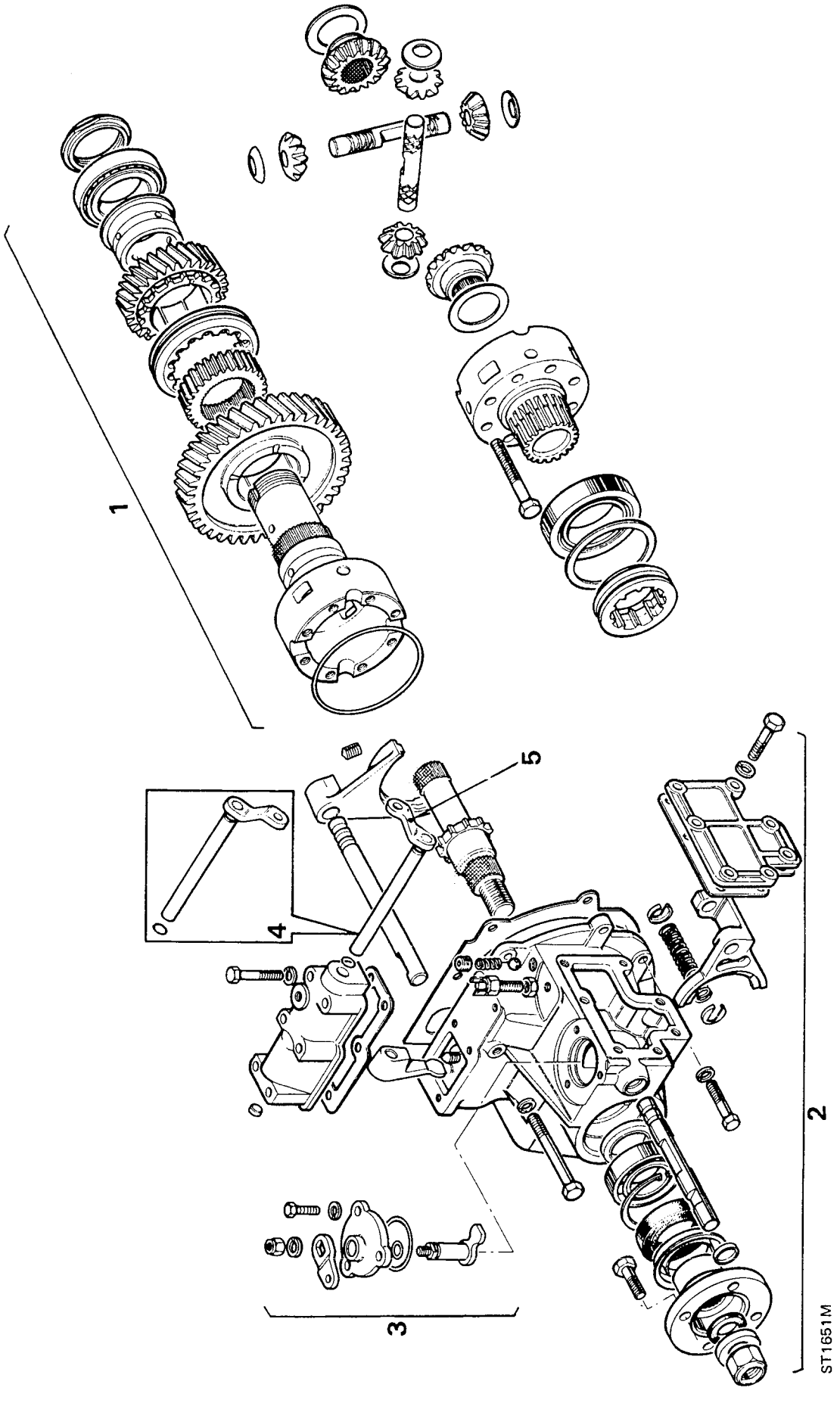
ST1650M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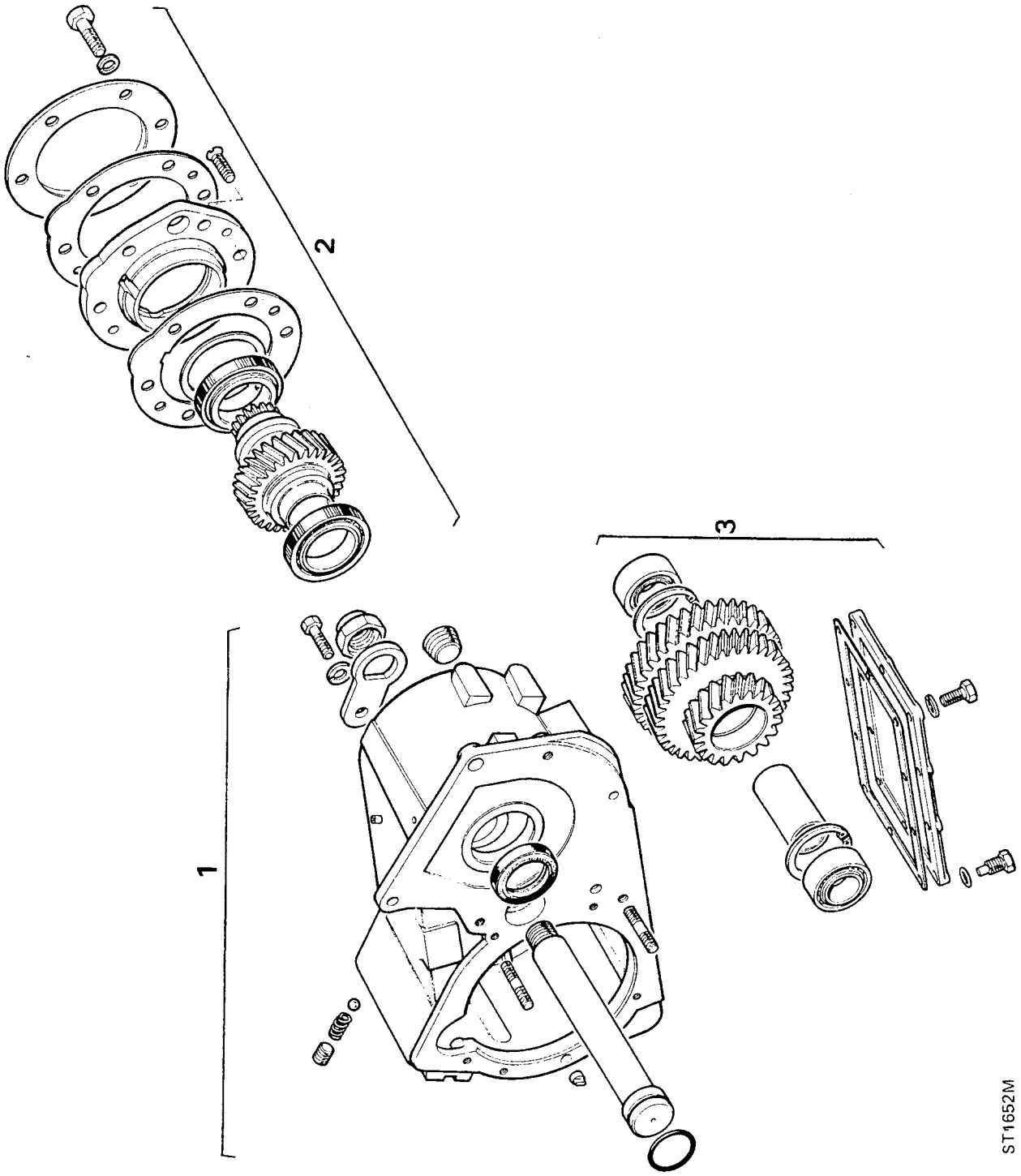
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LT230T TRANSFER GEARBOX OVERHAUL

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
18G257 — Circlip pliers
18G1205 — Prop flange wrench
18G1271 — Oil seal remover
18G1422 — Mainshaft rear oil seal replacer
18G1423 — Adaptor/socket centre differential stake nut 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

TRANSFER BOX DATA

Front bevel gear end-float	0,025 to 0,075 mm (0.001 to 0.003 in)
Rear bevel gear end-float	0,025 to 0,075 mm (0.001 to 0.003 in)
Rear output housing clearance	1,00 mm (0.039 in)
High range gear end-float	0,05 to 0,15 mm (0.002 to 0.006 in)
Front differential bearing pre-load	1.36 to 4.53 kg (3 to 10 lbs)
Input gear bearing pre-load	2.26 to 6.80 kg (5 to 15 lbs)
Intermediate shaft bearing pre-load	1.81 to 4.53 kg (4 to 10 lbs)

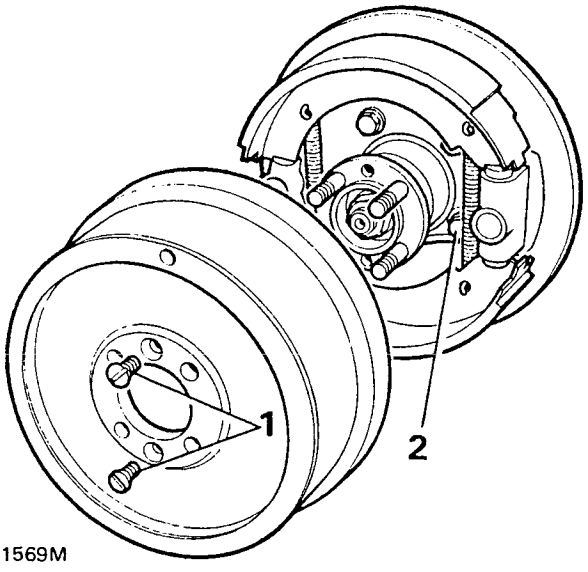
Transmission brake removal (if not previously removed)

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.

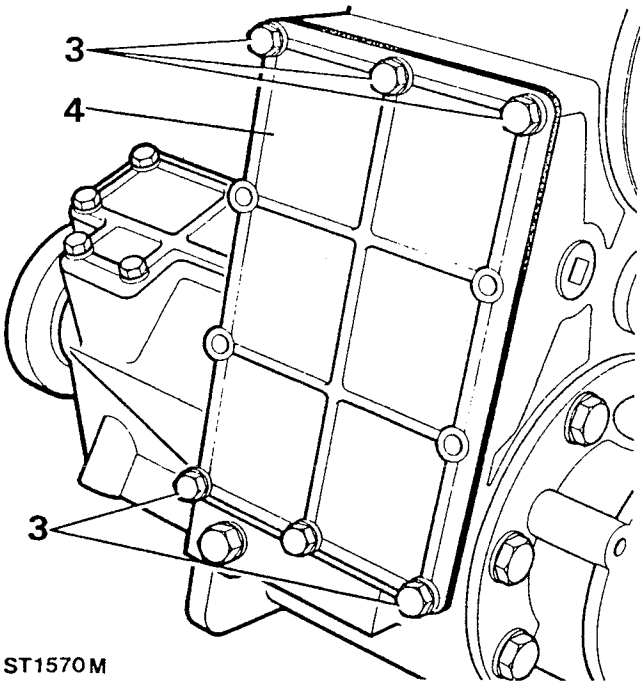
NOTE: An hexagonal type socket should be used for these bolts.

Bottom cover removal

3. Remove the six bolts and washers retaining the bottom cover.
4. Remove the gasket and bottom cover.



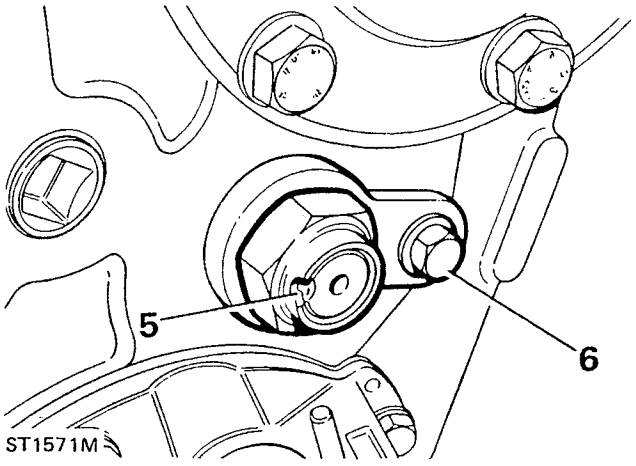
ST1569M



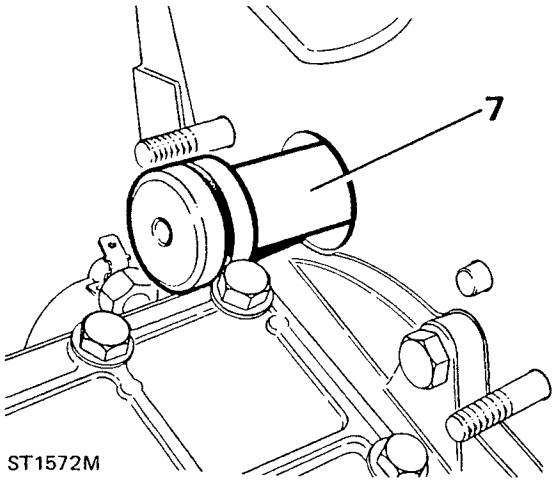
ST1570M

Intermediate shaft and gear cluster removal

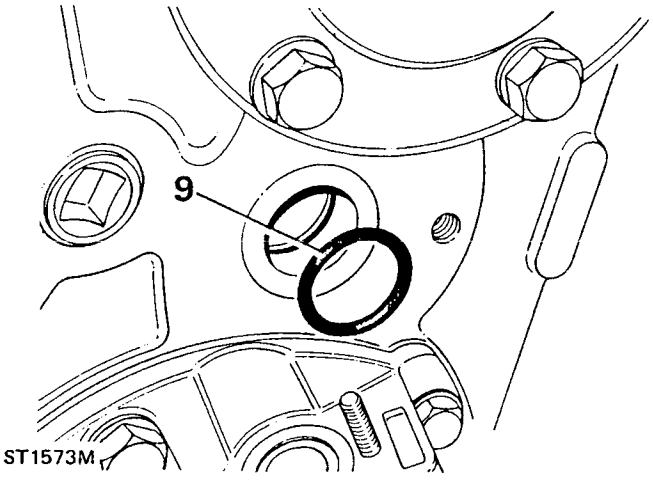
5. Release stake nut from recess in intermediate shaft and remove stake nut and discard.
6. Unscrew the single bolt and remove anti-rotation plate at the rear face of the transfer box.



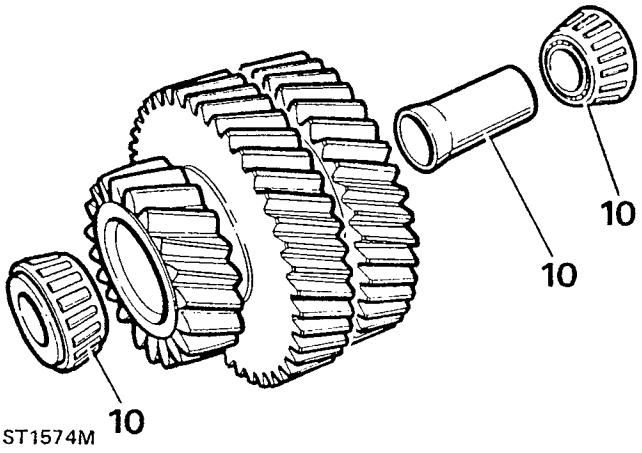
7. Tap the intermediate gear shaft from the transfer box.



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.

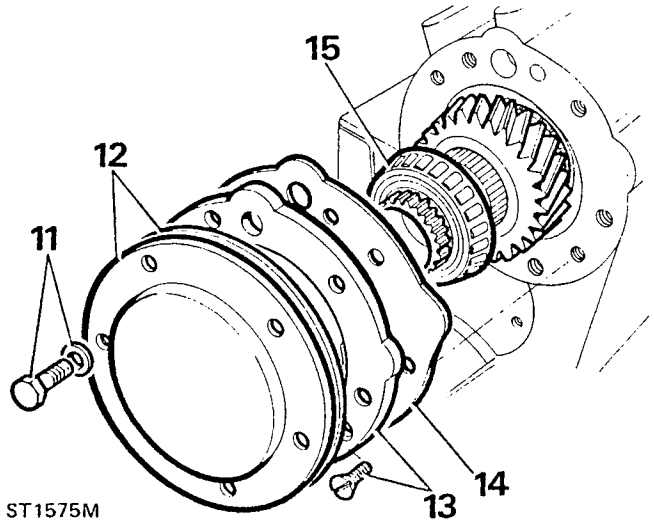


10. Remove taper roller bearings and bearing spacer from the intermediate gear cluster assembly.



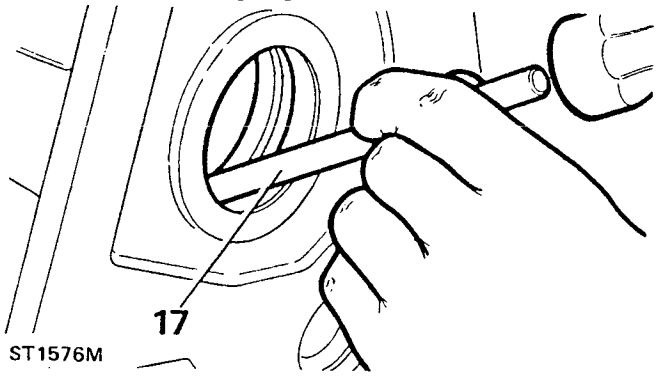
Power take-of cover removal

11. Remove six bolts and washers retaining the take-off cover and speedo cable clips.
12. Remove the gasket and cover.



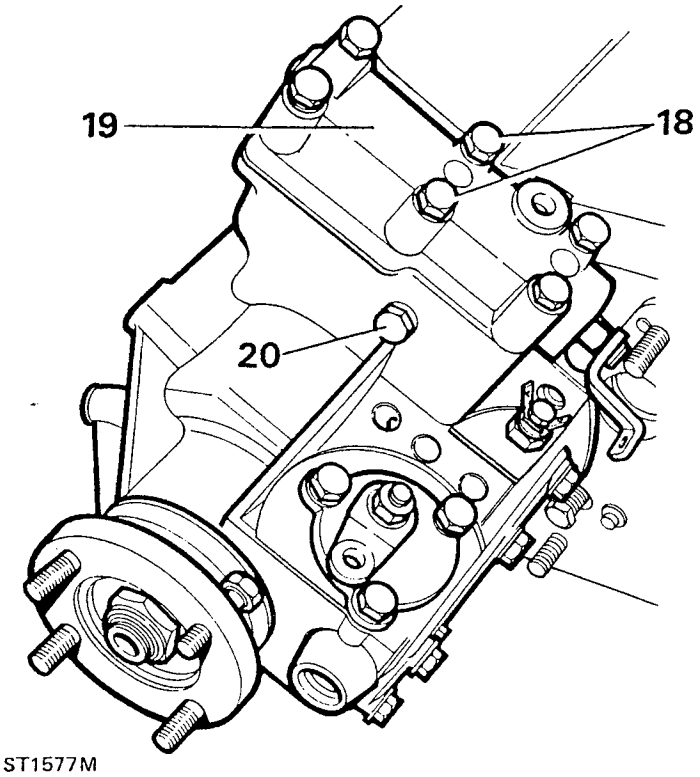
Input gear removal

13. Remove the two countersunk screws and detach the main shaft bearing housing.
14. Remove the gasket.
15. Withdraw the input gear assembly.
16. Prise out and discard the oil seal at the front of the transfer box casing using service tool 18G1271.
17. Drift 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 and earth lead.
19. Remove the gasket and cross-shaft housing.



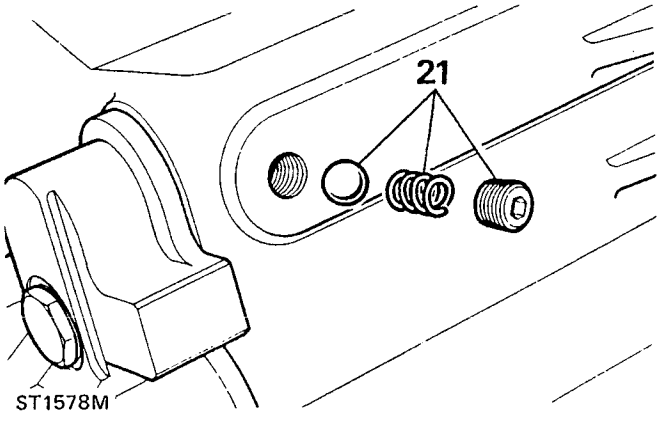
ST1577M

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.

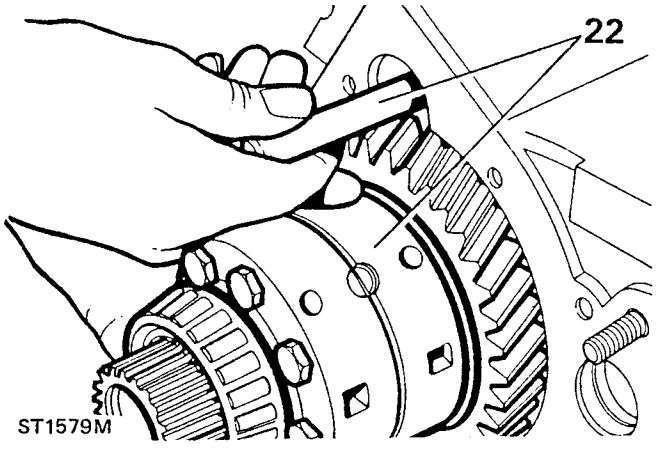
Centre differential removal

21. Remove high/low selector shaft detent plug, spring and retrieve the ball with a suitable magnet.



ST1578M

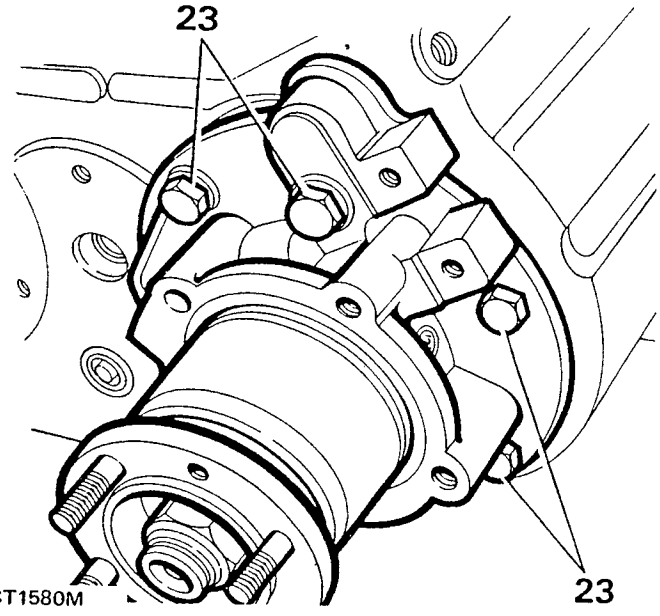
22. Withdraw the centre differential and selector shaft/fork assembly.



ST1579M

Rear output housing removal

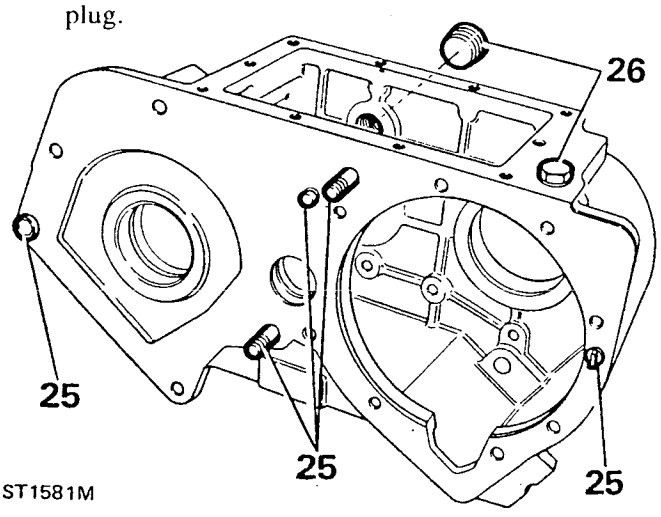
23. Remove six bolts and washers and detach the rear output housing and shaft assembly from the transfer casing.
24. Remove the gasket.



ST1580M

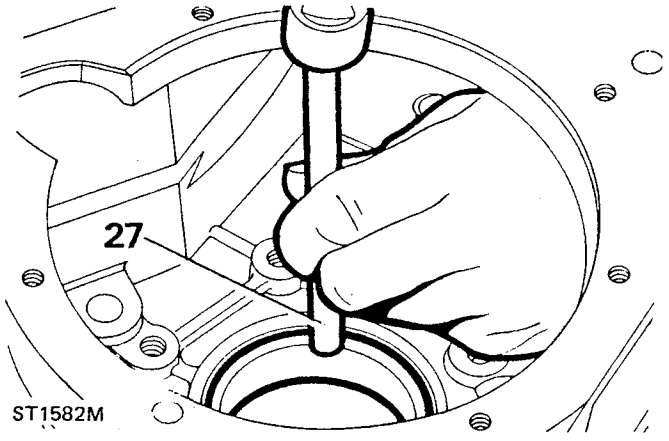
Transfer case overhaul — dismantling

25. Remove the studs and dowels.
26. Remove the magnetic drain plug and filler/level plug.



ST1581M

27. Drift out differential rear bearing track.
28. Clean all areas of the transfer casing ensuring all traces of "Loctite" are removed from faces and threads.

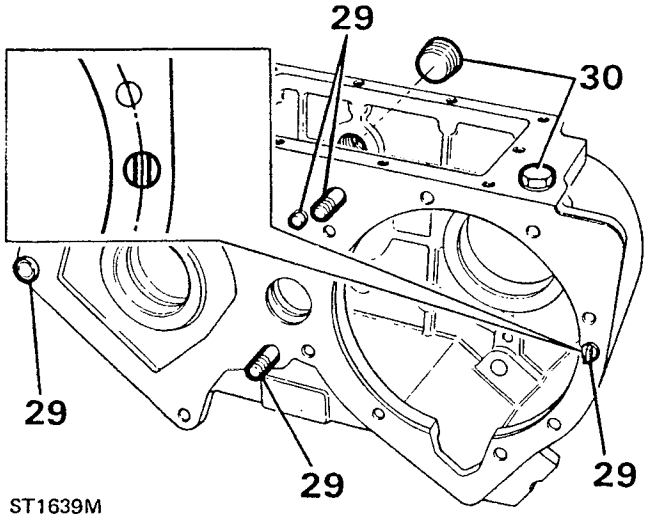


Transfer case overhaul — re-assembling

29. Fit studs and dowels to front face of the transfer casing.

    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.

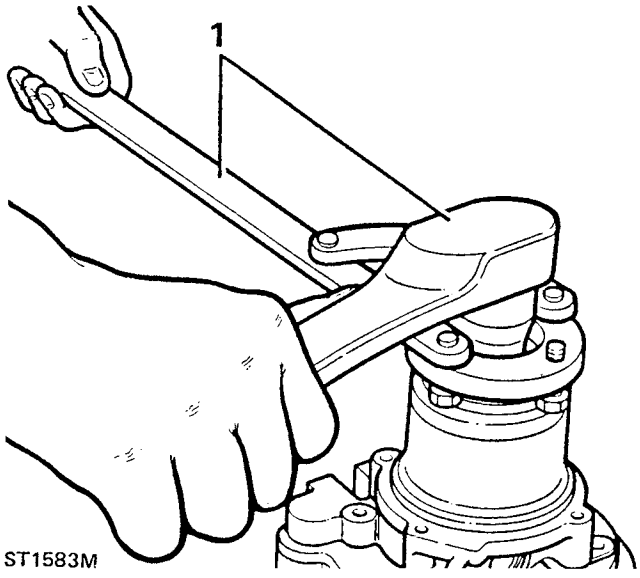
30. Refit magnetic drain plug with new copper washer and tighten to the specified torque, loosely fit the filler/level plug.



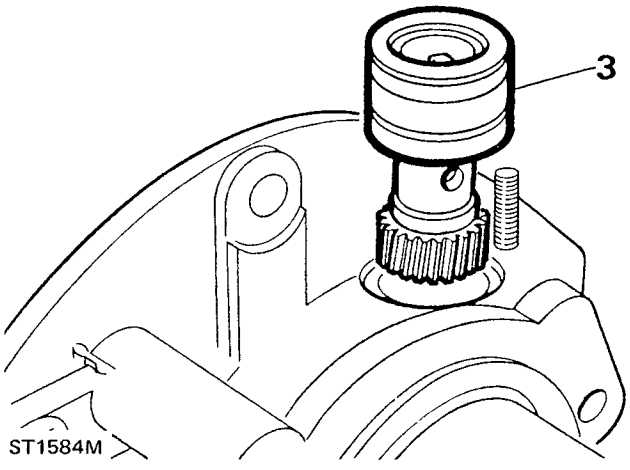
Rear output housing overhaul — dismantling

1. Using flange wrench 18G1205 and socket spanner, remove the flange nut, steel and felt washers. Ensure flange bolts are fully engaged in the wrench.
2. Remove output flange with circlips attached. If necessary, use a two-legged puller.

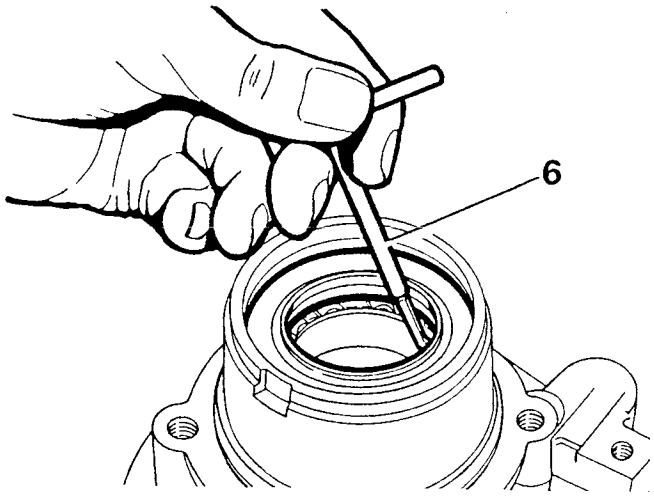
   NOTE: The circlip need only be released if the flange bolts are to be renewed.



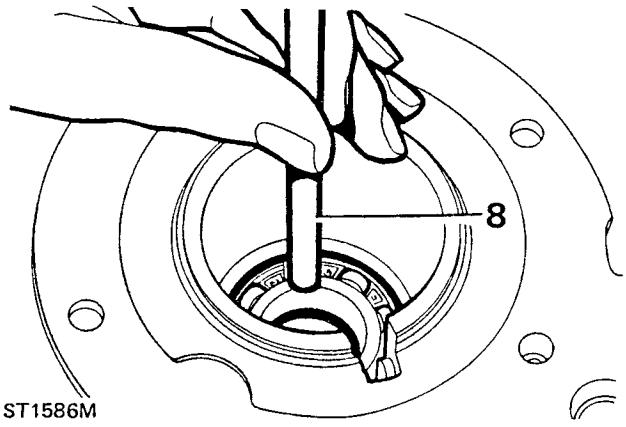
3. Remove speedo-drive housing. This can be prised out with a screwdriver.
4. Remove housing from the vice and drift out the output shaft, by striking the flange end of the shaft.
5. Carefully prise off the oil catch ring using a screwdriver in the slot provided.



6. Prise out and discard the seal from the output housing using tool 18G1271.
7. Using circlip pliers 18G257, remove the circlip retaining the bearing.

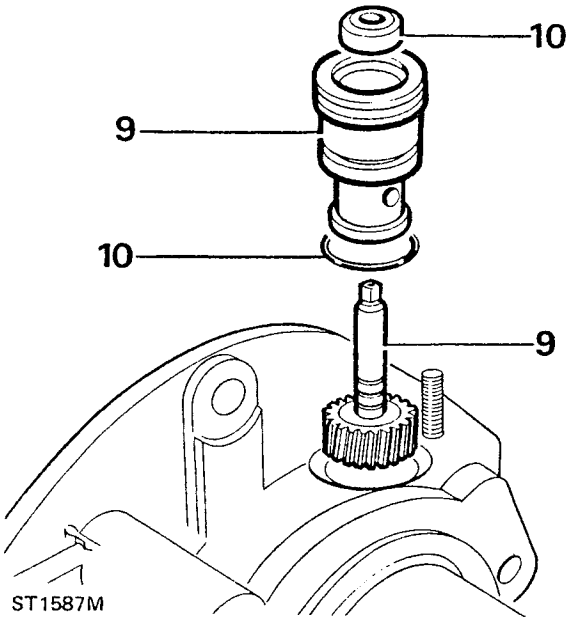


8. Drift out the bearing from the rear of the housing.



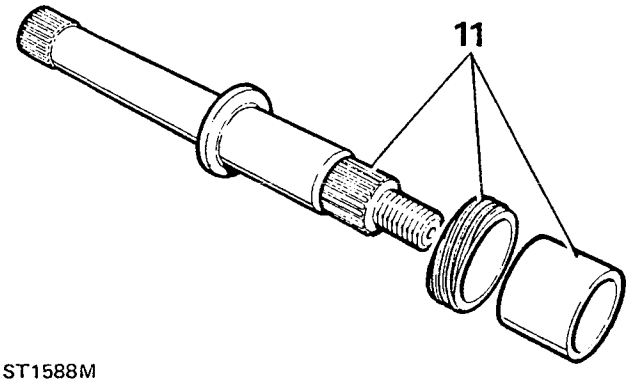
ST1586M

9. Remove speedometer gear (driven) from its housing.
10. Remove the 'O' ring and oil seal and discard.



ST1587M

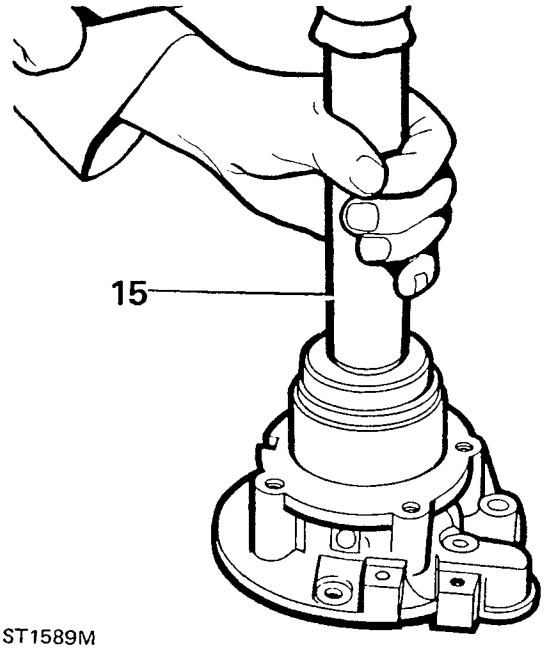
11. Slide off spacer and speedometer drive gear from output shaft.
12. Clean all parts, renew the 'O' ring, oil seals, felt seal and flange nut. Examine all other parts for wear or damage and renew, if necessary.



ST1588M

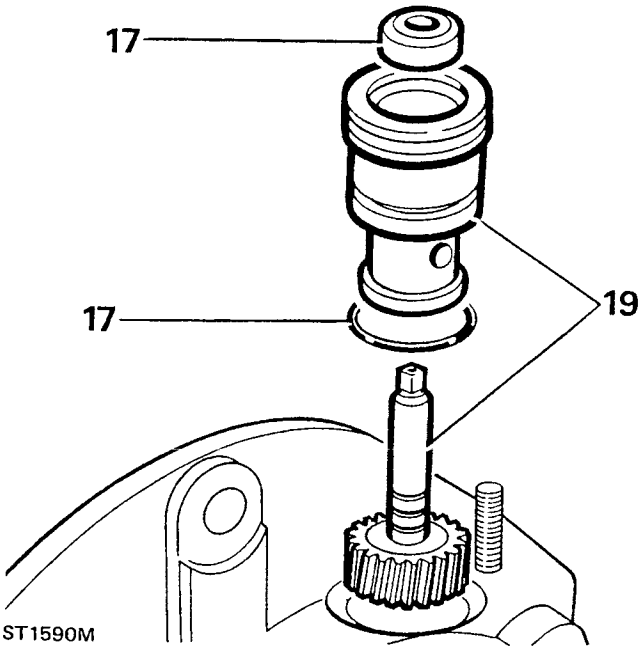
Reassembling

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).
14. Retain bearing with circlip, using circlip pliers 18G257.
15. Fit new seal (open side inwards) using tool 18G1422. The seal should just make contact with the bearing circlip.
16. Carefully charge the lips of the seal with clean grease and refit oil catch ring on to output housing.



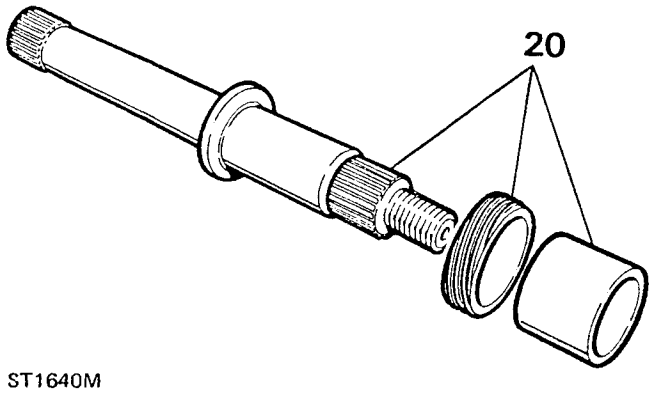
ST1589M

17. Fit the 'O' ring and oil seal (open 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

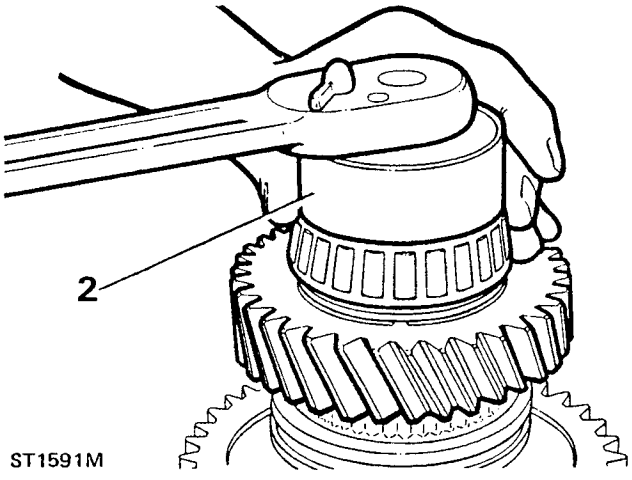
20. Slide drive gear and spacer on to the output shaft.
21. Locate output shaft into the bearing in the housing and drift into position.
22. Locate speedometer gear (driven) housing assembly into the output housing and press in until flush with the housing face.



ST1640M

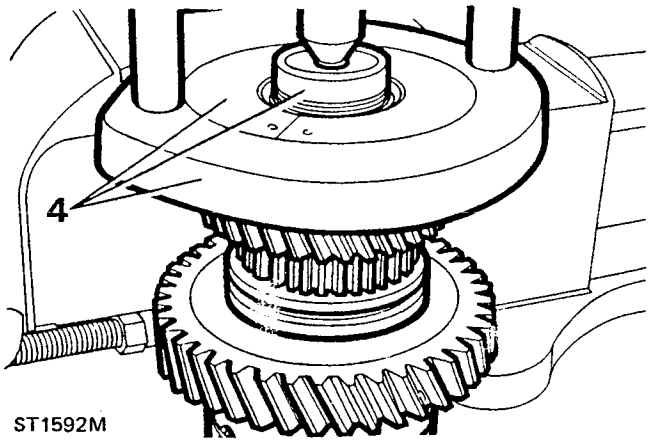
Centre differential unit overhaul — dismantling

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.
3. Remove the differential unit from the vice.



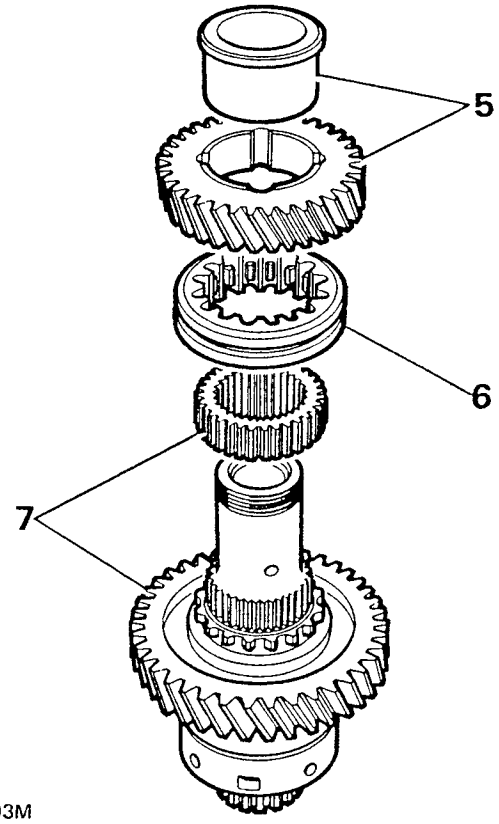
ST1591M

4. Secure hand press MS47 in vice with collars 18G47BB and using button 1847BB/3 remove the rear taper bearing and collars.



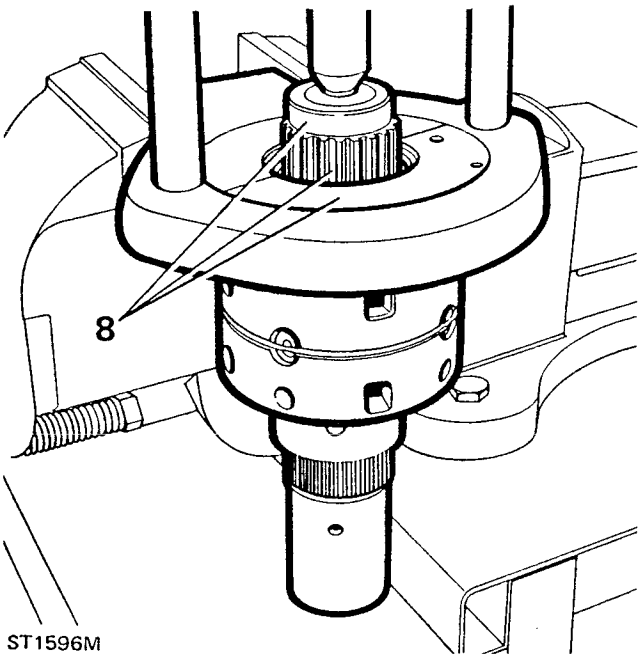
ST1592M

5. Remove the high range gear and bush, taking care not to disturb the high/low sleeve.
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.



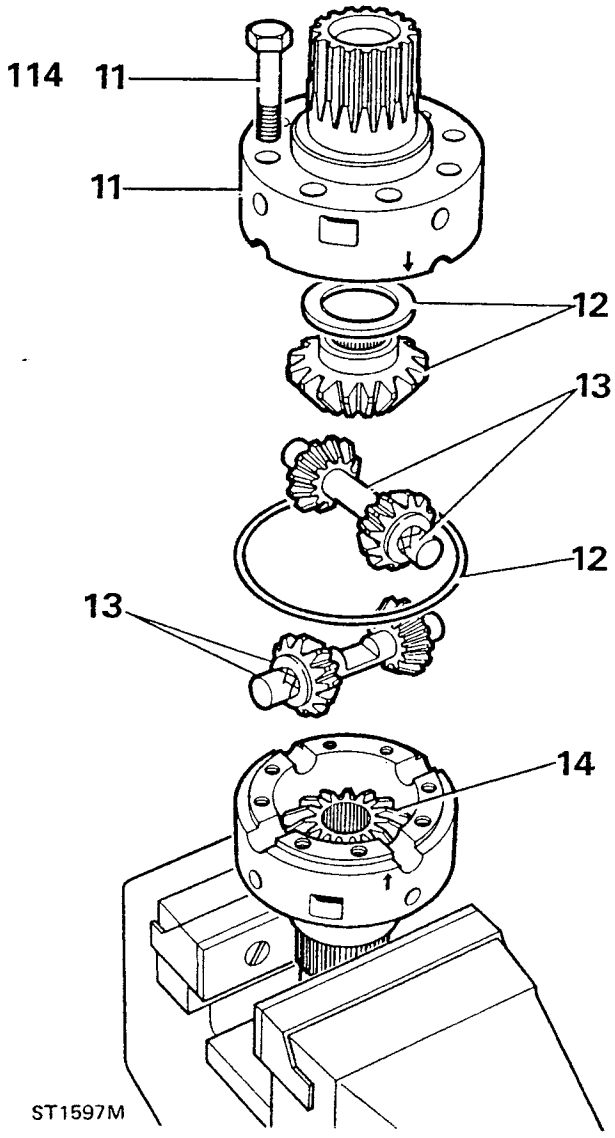
ST1593M

8. Substituting collar LST47-1 remove front taper roller bearing.
9. Remove hand press from the vice.
10. Using soft jaws secure the differential unit in the vice by gripping the hub splines.

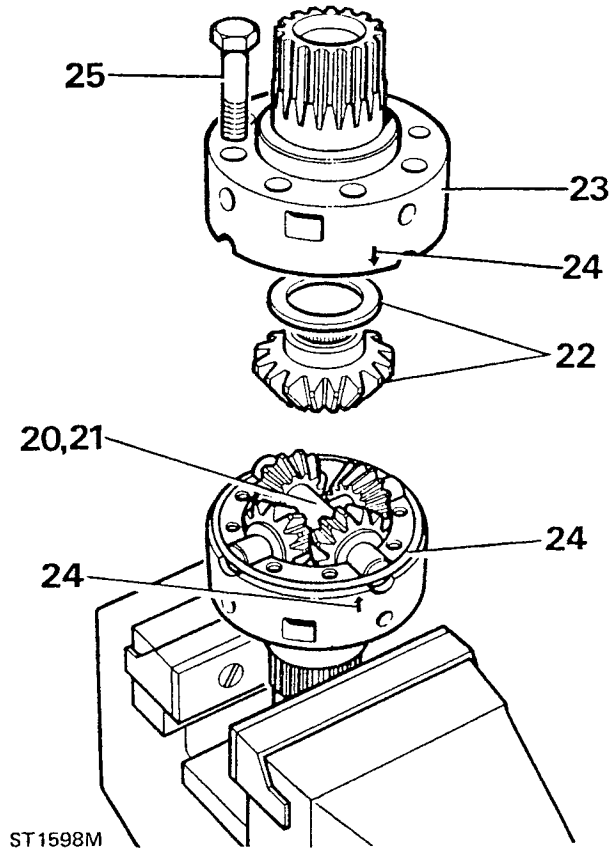


ST1596M

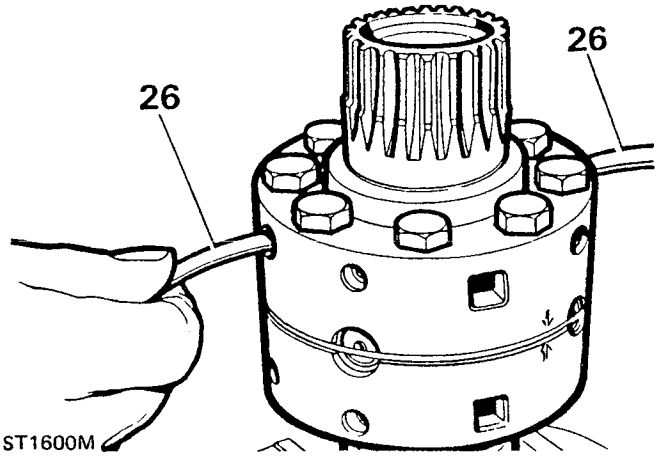
11. Remove the eight retaining bolts and lift off the front part of the differential unit.
12. Release the retaining ring and remove front upper bevel gear and thrust washer.
13. Remove the pinion gears and dished washers along with the cross shafts.
14. Remove the rear lower bevel gear and thrust asher from the rear part of the differential unit.



15. Remove the rear differential unit from the vice and clean all components; examine for wear or damage and renew if necessary.
16. Clean all components; examine for wear or damage and renew if necessary.
17. Using soft jaws secure the rear differential unit in the vice by gripping the hub splines.
18. Ensure that all differential components are dry to assist in checking end-float.
19. Using a micrometer, measure one of the bevel gear thrust washers and note the thickness.
20. Fit the thrust washer and bevel gear to the rear lower differential unit.
21. Assemble both pinion assemblies and dished washers on to their respective shafts and fit to the rear differential unit.
22. Measure the front upper bevel gear thrust washer and note the thickness.
23. Fit the thrust washer and bevel gear to the front unit.
24. Refit the retaining ring and front differential unit, aligning the two engraved arrows marked on both halves of the unit.
25. Fit four bolts equi-spaced and torque to the correct figure.



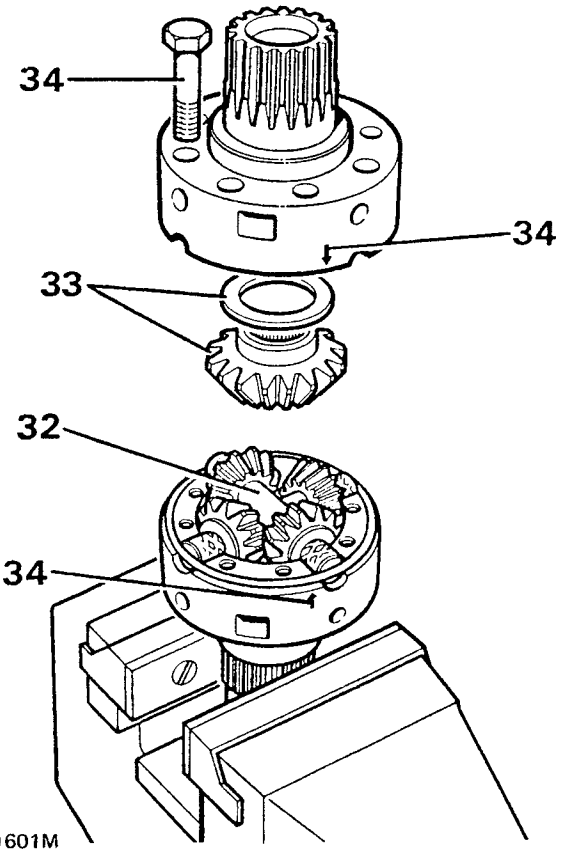
26. Measure the front bevel gear end-float with feeler gauges through the slots provided in the front differential unit. The end-float must be 0,025 to 0,075 mm (0.001 to 0.003 in) maximum. When measuring use two sets of feeler gauges, one on each side of the front differential unit. This will give a true reading of the end-float.



27. Invert the differential unit and repeat operation 26 for the rear bevel gear end-float.
28. Invert the differential unit and secure in vice and remove the four bolts and lift off the front differential unit.
29. Remove the retaining ring, bevel gear and the washer and both pinion assemblies.
30. Select the correct thrust washers required for final assembly.

Reassembling

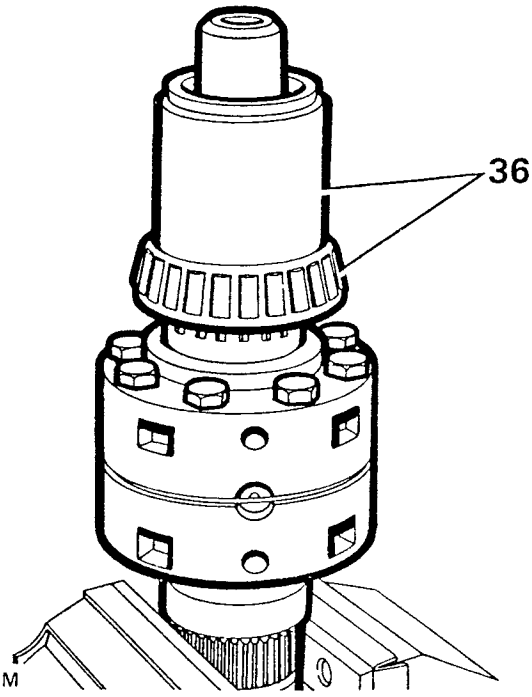
31. Fit the selected thrust washer and bevel gear into the rear lower differential unit.
32. Assemble both pinion assemblies and dished washers on to their respective shafts and fit the rear differential unit. Secure the assemblies with the retaining ring.
33. Lubricate all the components.
34. Fit the selected thrust washer and bevel gear into the front upper differential unit.



ST1601M

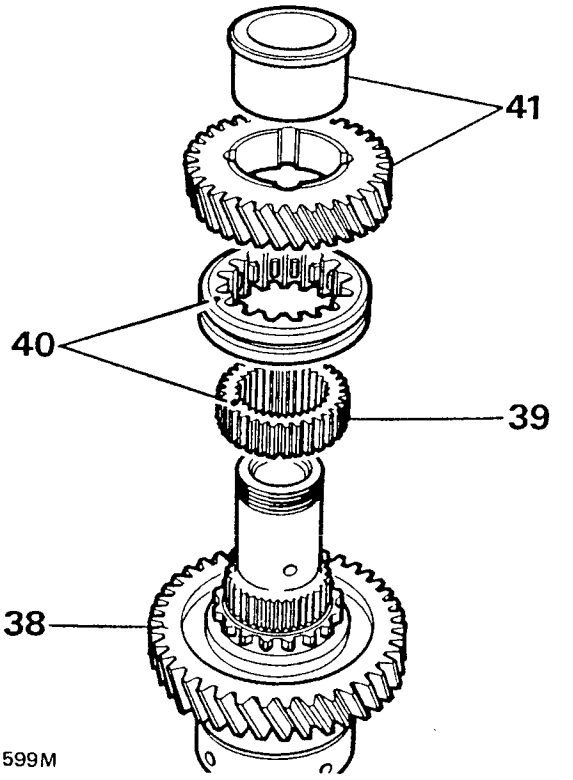
35. Align both units as previously described and secure with the eight bolts to the specified torque.
36. Finally check that the differential gears rotate freely. Locate the front differential bearing onto the front, upper differential shaft and press into position using larger end of tool 18G1424 as 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.



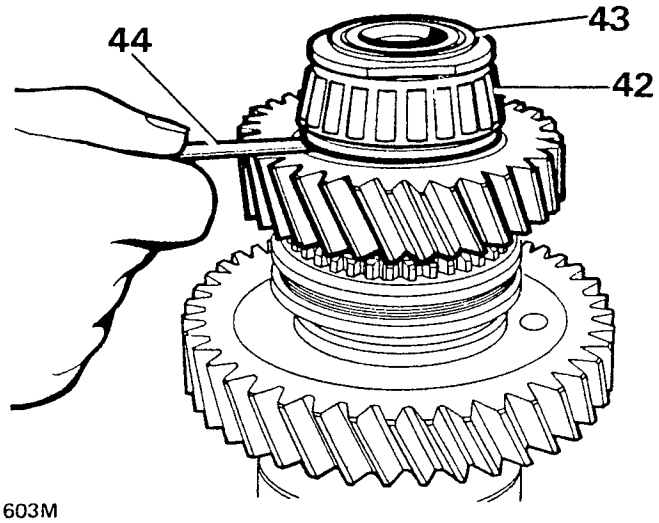
ST1602M

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.



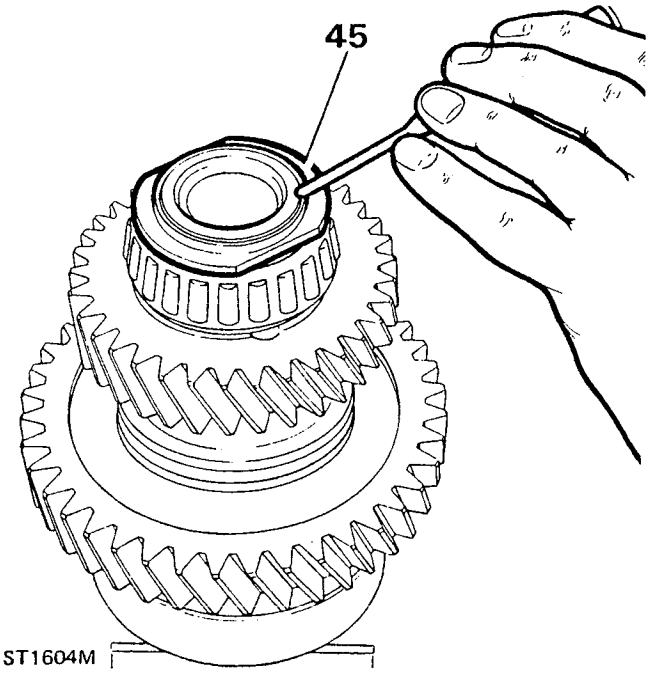
ST1599M

42. Locate the rear differential bearing on to the hub and press it into position using the smaller end of tool 18G1424.
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).
NOTE: If the clearances vary from those specified in the data, the assembly must be rebuilt using the relevant new parts.



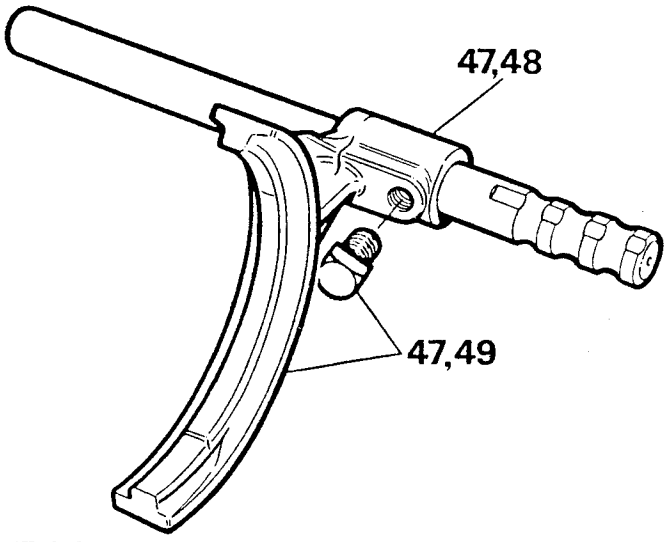
ST1603M

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

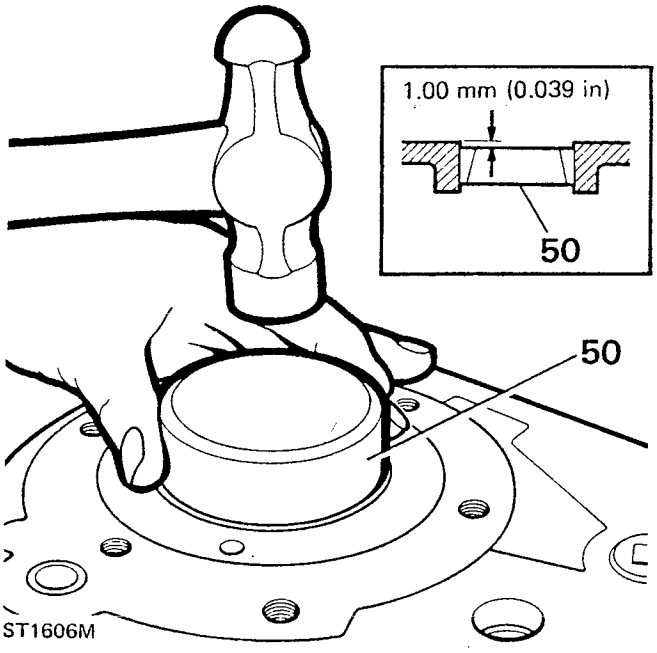
46. Clean and check high/low selector fork assembly for wear and renew if necessary.
47. To renew the selector fork remove the square set screw and slide the fork from the shaft.
48. Fit the new selector fork with its boss towards the three detent grooves. Align the tapped hole in the fork boss with 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.



ST1605M

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.

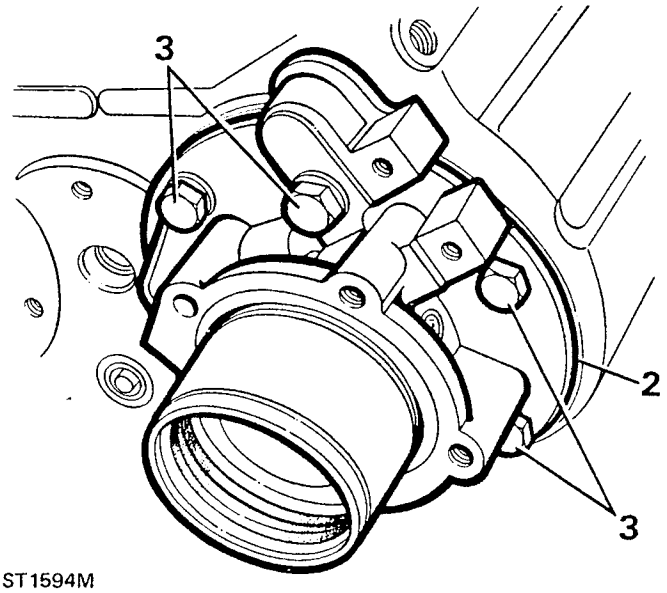


ST1606M

Rear output housing — refit

1. Grease output housing gasket and position on to the rear face of the transfer box casing.

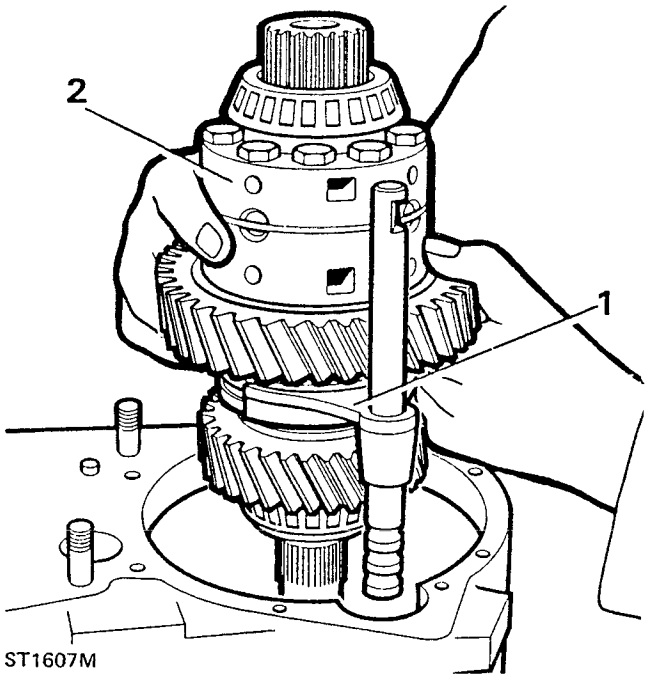
2. Fit output housing and ensure clearance of 1.00 mm (0.039 in) between housing face and gasket.
3. Fit the six output housing bolts with Loctite 290 on the threads, with washers and tighten evenly to the correct torque, which will pull the rear bearing into position.



ST1594M

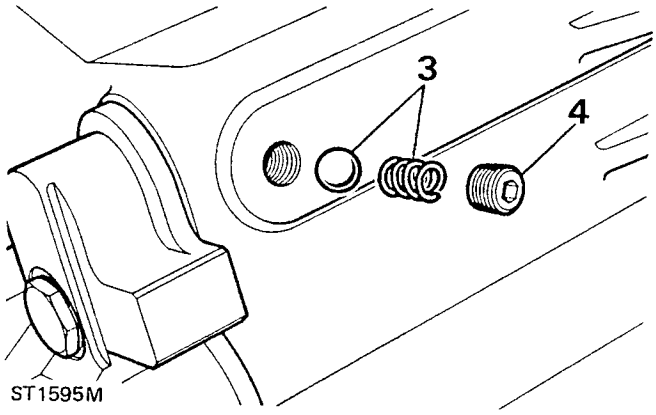
Centre differential unit refit

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

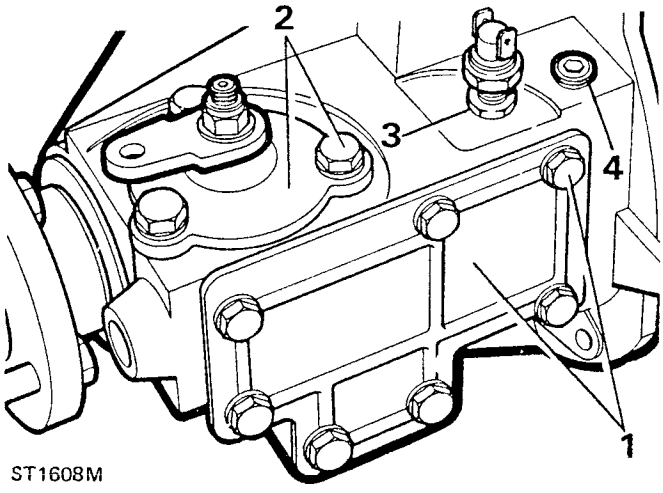
3. Fit selector shaft ball and spring through the side of the transfer box casing.
4. Apply Loctite 290 to detent plug; fit and locate, by screwing gently fully home and then unscrewing two turns.



ST1595M

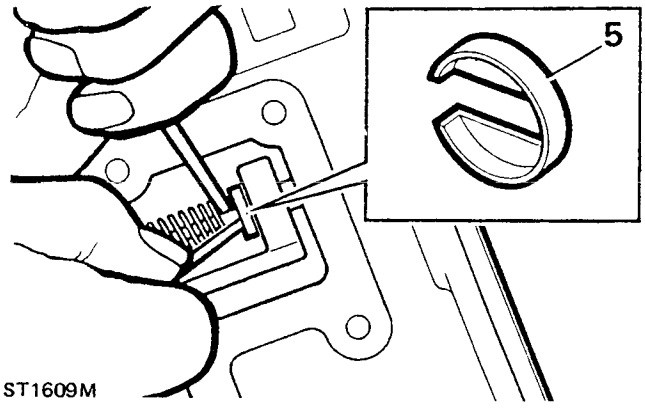
Front output housing overhaul — dismantling

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 selector shaft detent plug, spring and ball using a suitable magnet.



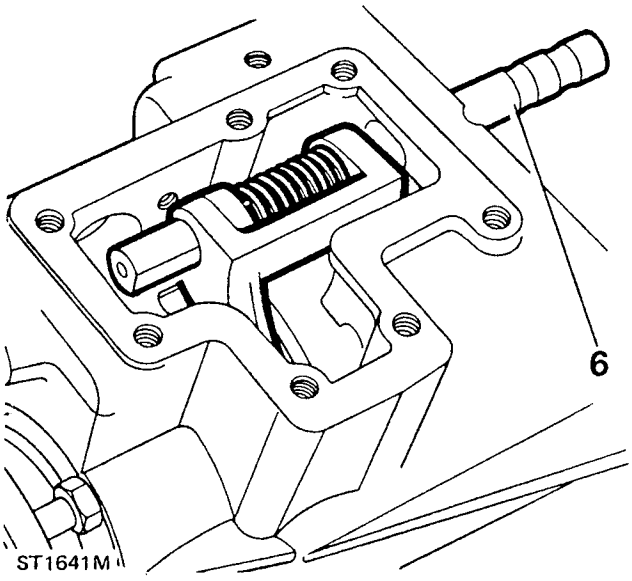
ST1608M

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.



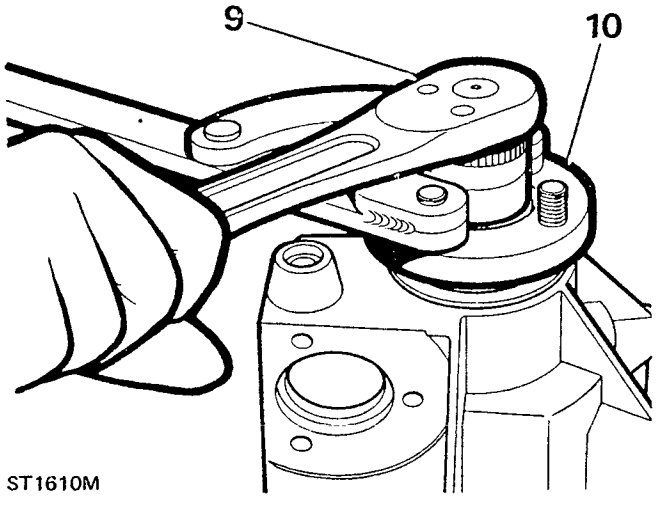
9. Using flange wrench 18G1205 and socket wrench, remove the flange nut, steel and felt washers.

NOTE: Ensure that flange bolts are fully engaged in the wrench

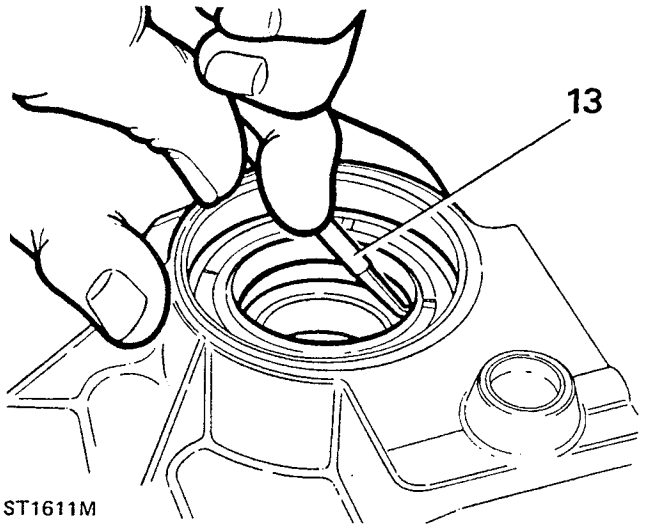
10. Remove the output flange with oil seal shield.

NOTE: These parts need not be separated unless the flange bolts are to be renewed.

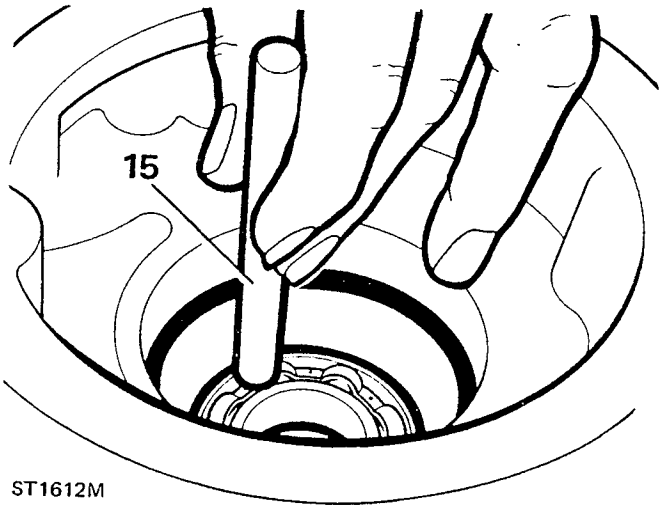
11. Drift output shaft rearwards from housing using a soft headed mallet.
12. Slide off the collar from the output shaft.



13. Prise out and discard oil seal from output housing using service tool 18G1271.
14. Remove circlip with circlip pliers 18G257.

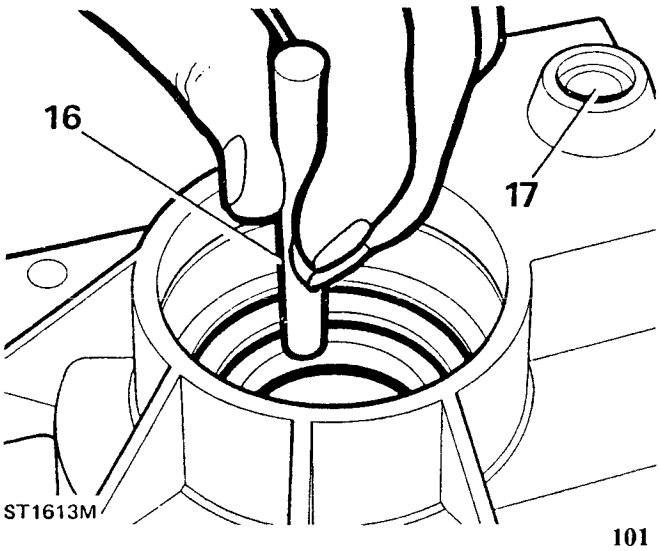


15. Invert housing and drift out bearing from inside the case as shown.



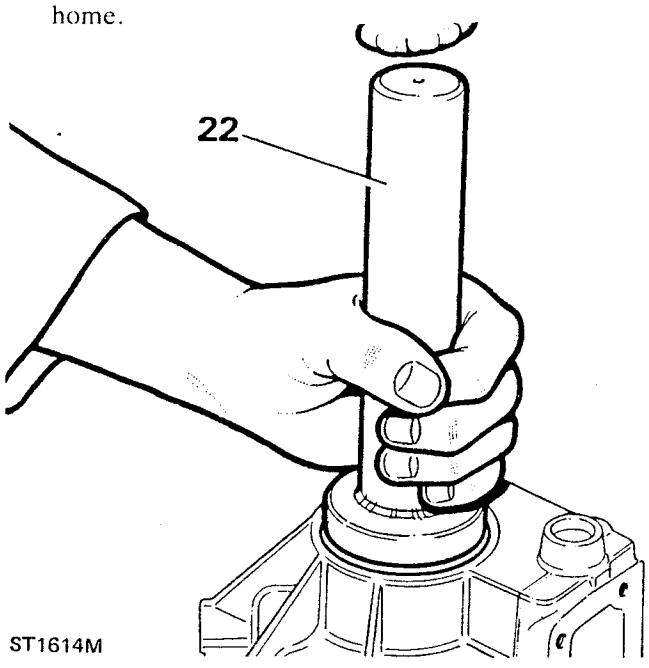
16. Drift out centre differential front taper roller bearing track and shim.
17. Drift out selector shaft cup plug from housing.
18. Clean all components ensuring all traces of "Loctite" are removed from faces and threads.
19. Examine components for wear or damage and renew if necessary.

NOTE: Renew oil seal and felt seal and flange nut.



Reassembling

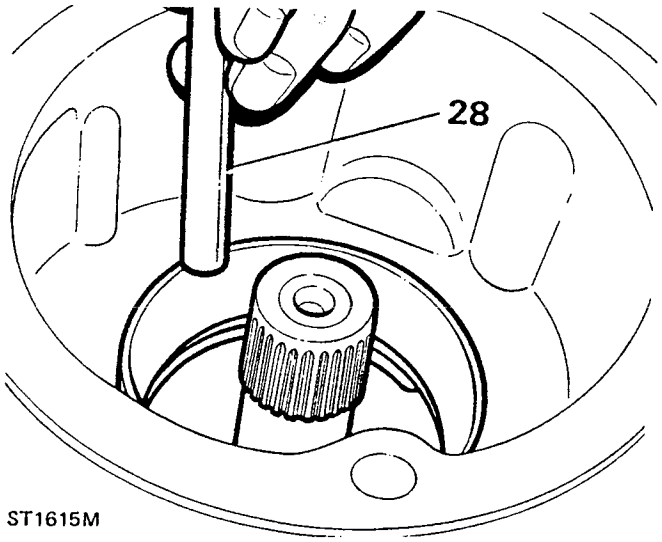
20. Press the bearing into the housing; do not use excessive force. To facilitate fitting the bearing, heat the front output housing. (This is not to exceed 100°C).
21. Using circlip pliers 18G257, fit the bearing retaining clips.
22. Fit a new oil seal (open side inwards) using replacer tool 18G1422, until the seal just makes contact with the circlip.
23. Carefully charge the lips of the seal with clean grease.
24. Slide collar on to the output shaft, with its chamfered edge towards the dog teeth.
25. Fit the output shaft through the bearing and drift home.



ST1614M

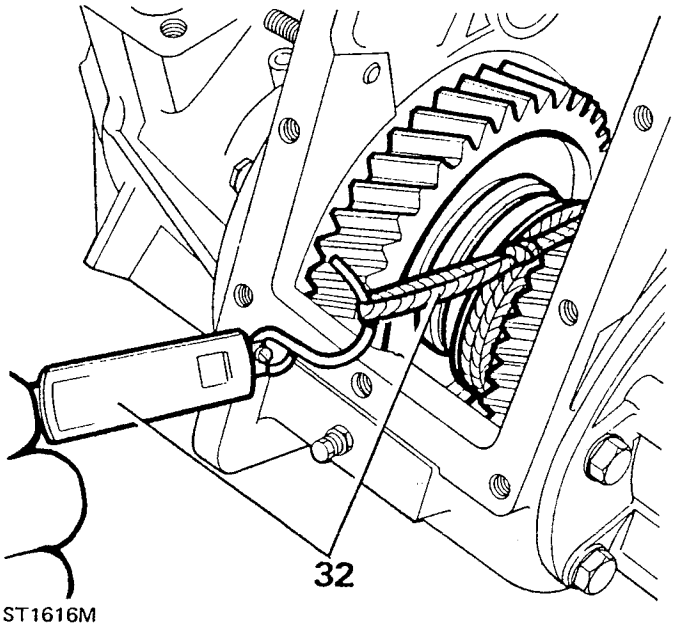
Adjusting front differential bearing pre-load

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

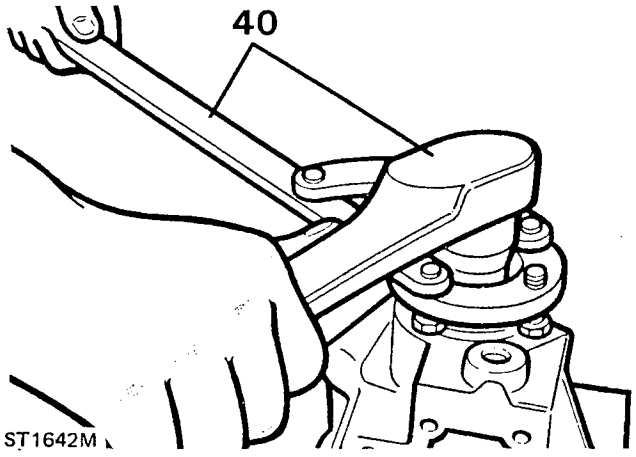
29. Grease and fit new gasket and locate the front output housing on the transfer box casing.
30. Secure housing with the eight retaining bolts and washers, the upper middle bolt being longer than the rest. Do not tighten the bolts at this stage.
31. Engage high or low gear.
32. Check the rolling resistance of the differential using a spring balance and a length of string wound around the exposed splines of the high/low hub.
33. With the correct shim fitted the load to turn should be 1.36 kg to 4.53 kg (3 lbs to 10 lbs). This applies to new or used bearings. (New bearings will register at the top end and used bearings will register at the low end.
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.



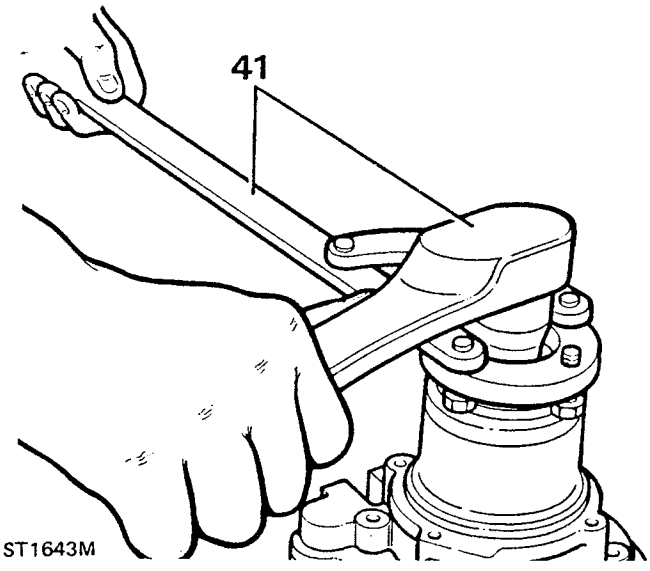
ST1616M

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.

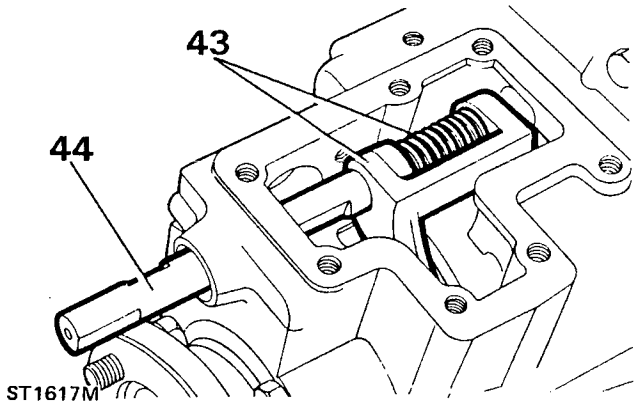
NOTE: Ensure that the flange bolts are fully engaged in the wrench.



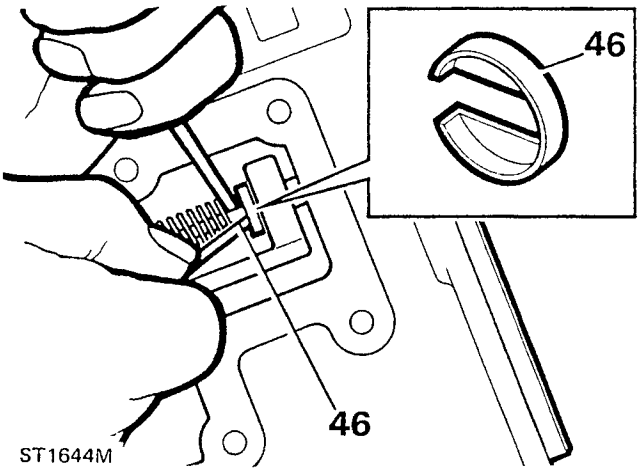
41. Repeat the above operation for the rear output flange.



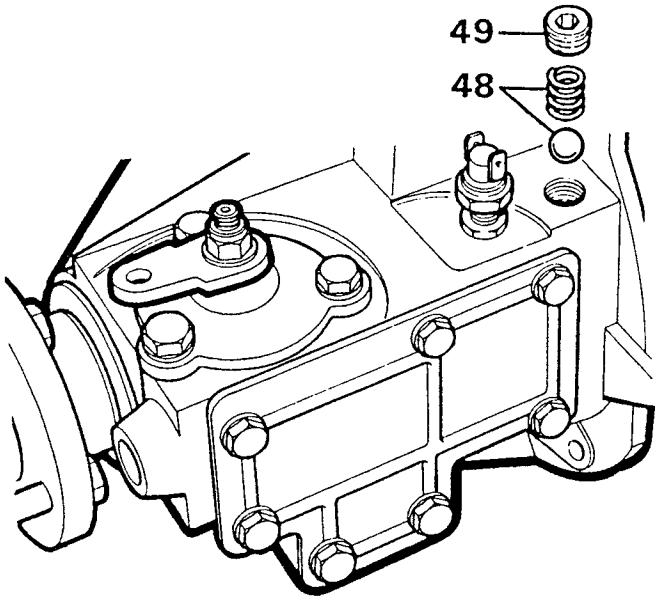
42. Compress the selector shaft spring and fit to the selector fork.
43. Locate selector fork through front output housing side cover aperture, ensuring that the fork engages in the groove of the lock-up sleeve.
44. Fit selector shaft through the aperture in the front of the output housing and pass it 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. Drift selector shaft seal 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.



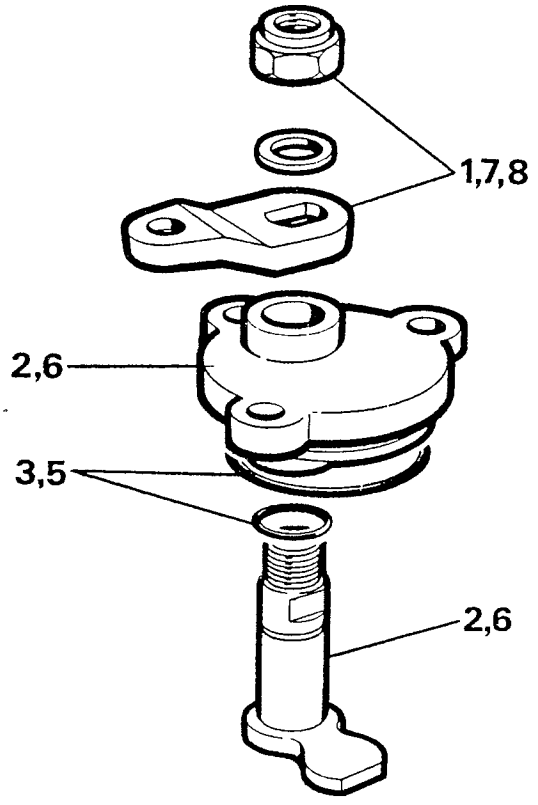
Differential lock finger housing overhaul — dismantling

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.

Reassembling

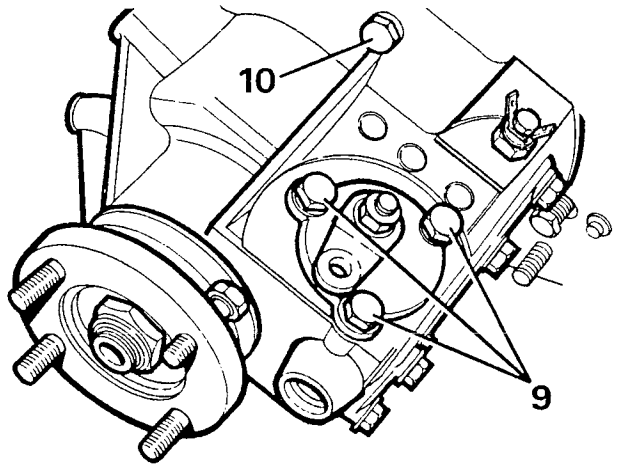
5. Fit new 'O' rings on to pivot shaft and lock finger housing and lubricate with oil.
6. Locate the pivot shaft in the housing.

7. Fit the differential lock lever over the pivot shaft so that the lever will face forward with the bend upwards. This lever is then in the correct operating position.
8. Retain the lever with a plain washer and new nyloc nut.



ST1618M

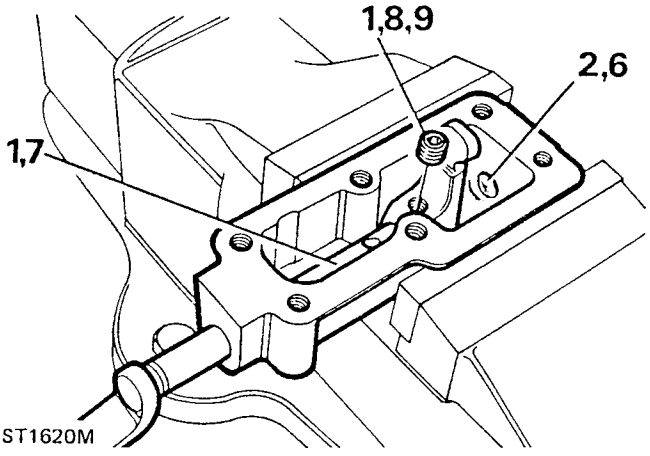
9. Fit the differential lock finger housing into its seating on the front output housing, ensuring that the selector finger is located in the flat of the selector shaft.
10. Apply Loctite 290 to the bolt threads and retain the lock finger housing with the three bolts and washers to the specified torque.



ST1619M

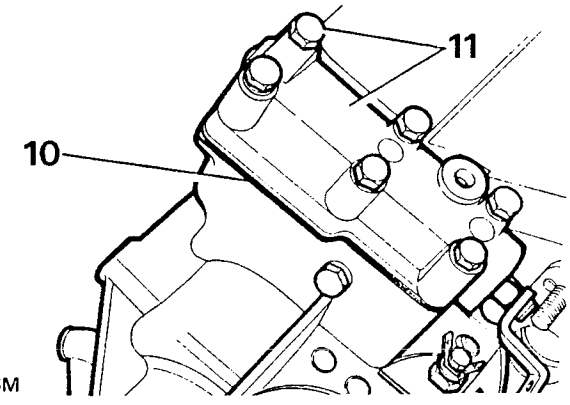
High/low cross-shaft housing overhaul

1. Remove the selector finger grub screw and withdraw the cross-shaft from the cross-shaft housing and remove the selector finger.
2. Remove the 'O' ring from the cross-shaft.
3. Drift out selector housing cup plug if necessary.
4. Clean all the components and check for damage or wear, replace if necessary.
5. Apply sealant to a new cup plug and fit so that the cup is just below the chamfer for the cross-shaft bore.
6. Fit new 'O' ring to cross-shaft.
7. Lubricate the shaft and insert into the cross-shaft housing.
8. Fit selector finger ensuring that it aligns with the recess in the cross-shaft.
9. Apply Loctite 290 to the grub screw and secure the selector finger to the cross-shaft and fully tighten to the specified torque.



ST1620M

10. Grease and fit the high/low selector housing gasket on the front output housing.
11. 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.

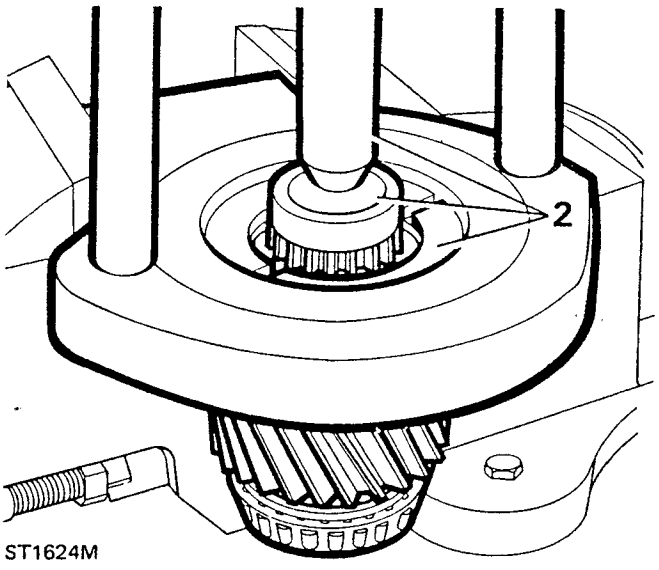


ST1646M

Input gear overhaul — dismantling

1. Clean the input gear assembly and examine for wear or damage. Remove the bearings only if they are to be renewed.

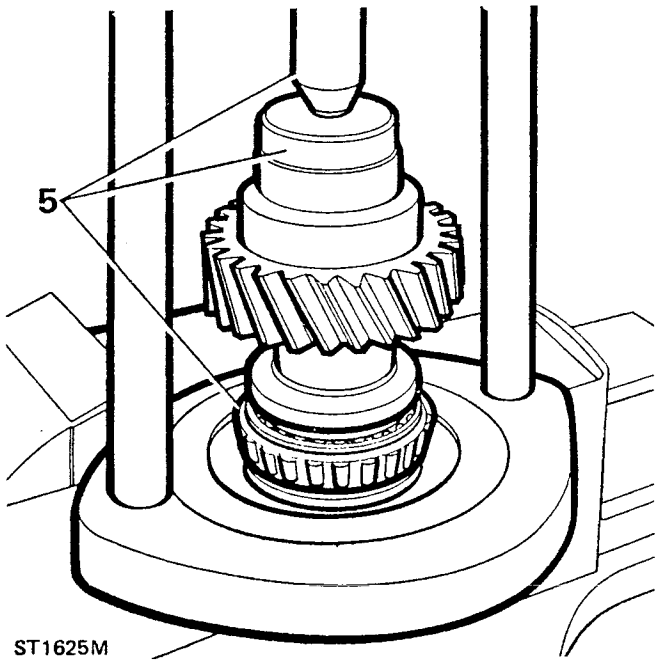
2. Secure hand press MS47 in the vice and using collars 18G47-7 and button 18G47-BB/3, remove rear taper roller bearing from input gear assembly.
3. Invert input gear assembly in hand press and remove front taper roller bearing.
4. Clean input gear.



ST1624M

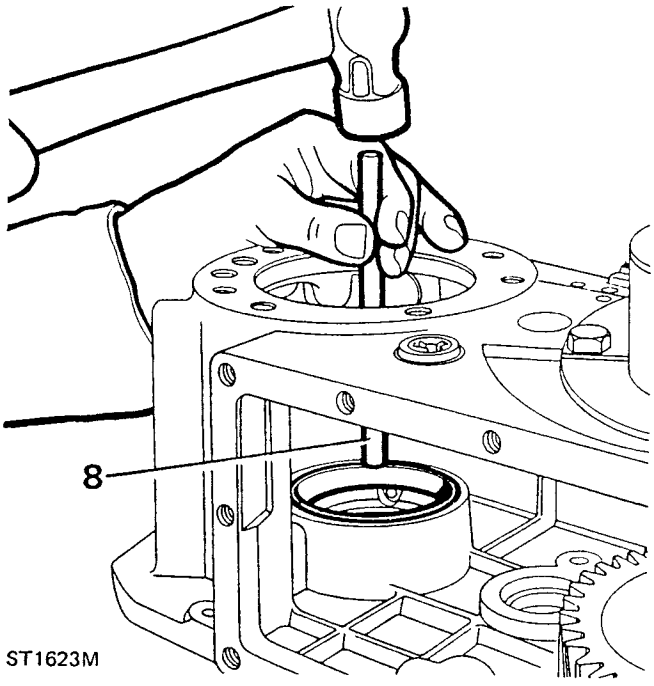
Reassembling

5. Position rear taper roller bearing on input gear and using hand press MS47 and collars 18G47-7 press the bearing fully home.
6. Invert input gear and fit the front taper roller bearing using the press and collars.



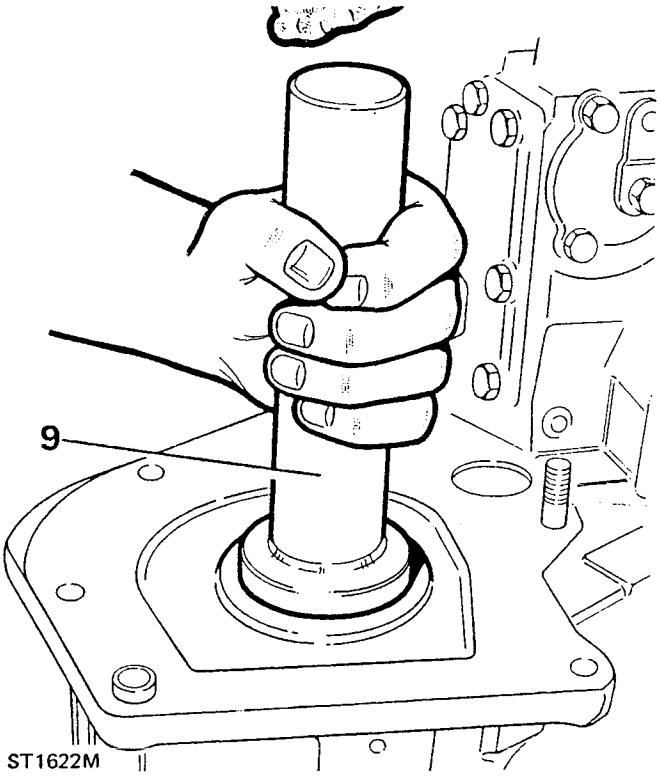
ST1625M

7. Prop up the transfer box casing on the bench with the rear face uppermost.
8. Drift in the front taper bearing track.



ST1623M

9. Reposition transfer box casing so the front face is uppermost and fit oil seal (open side inwards) using replacer tool 18G1422.

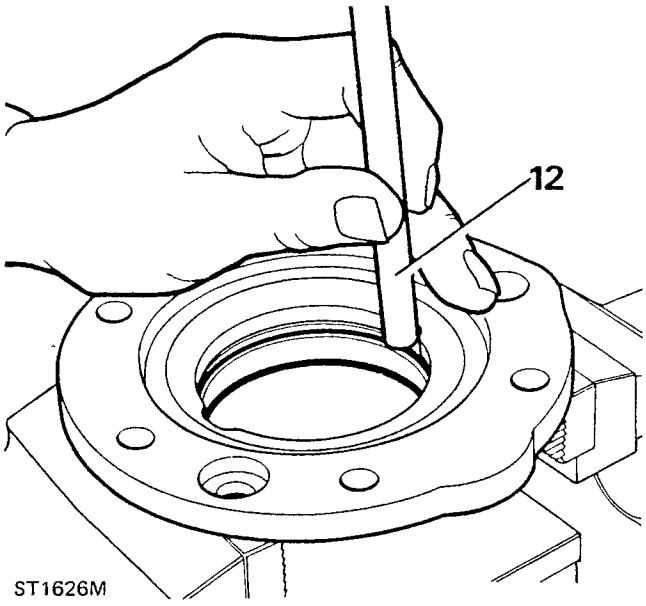


ST1622M

10. Lubricate both bearings with clean oil.
11. Fit the input gear assembly into the transfer box casing with the dog teeth uppermost.

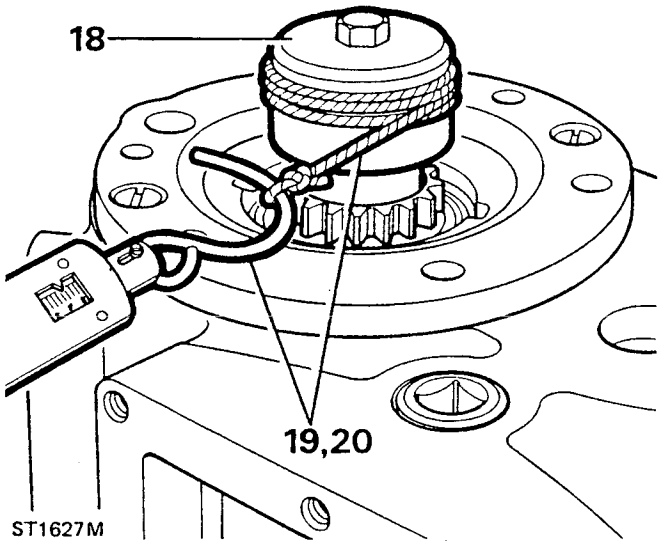
Checking input gear bearing pre-load

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.



ST1626M

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 6.80 kg (5 lb to 15 lbs) is required.
21. If the reading obtained is outside the above limits, the original shim must be changed.

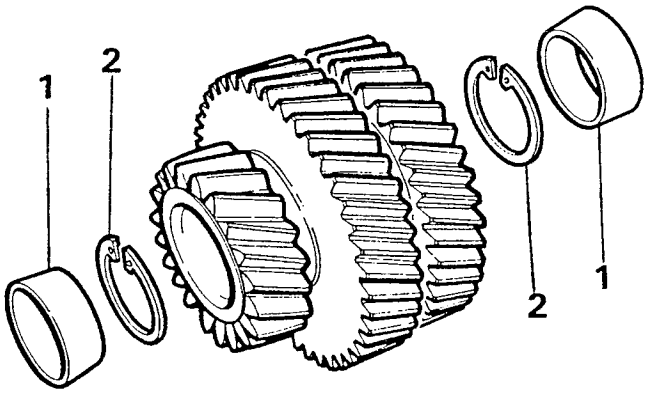


ST1627M

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 6.80 kg (5 lb to 15 lbs).
26. Fit shim to support plate, locate bearing track 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.

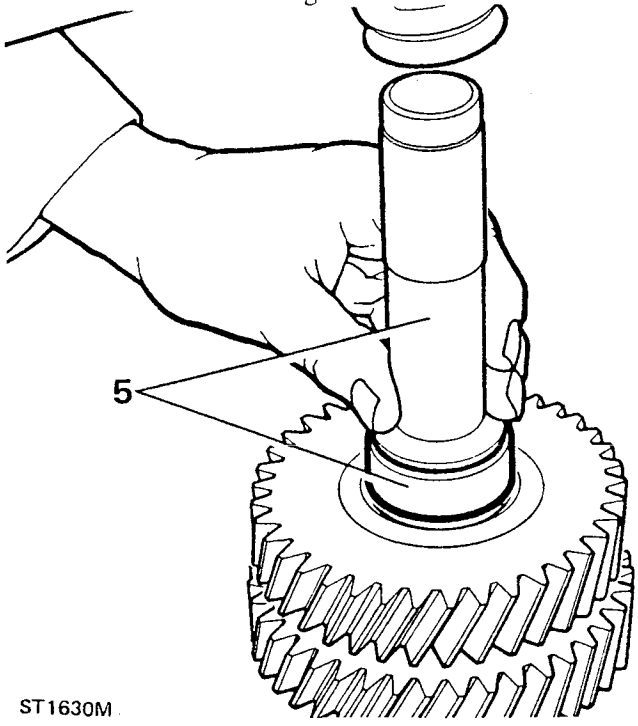
Intermediate gear assembly overhaul

1. Drift out intermediate gear bearing tracks.
2. Remove circlips.



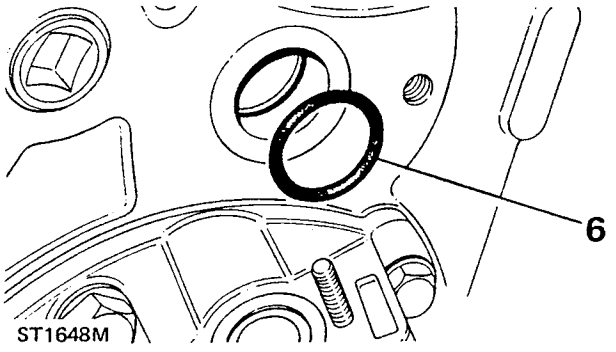
ST1628M

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.



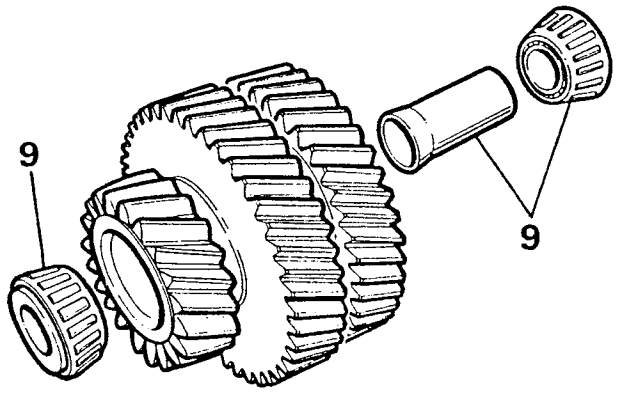
ST1630M

6. Fit the 'O' rings to the intermediate shaft and into the intermediate shaft bore at the front of the transfer box casing.

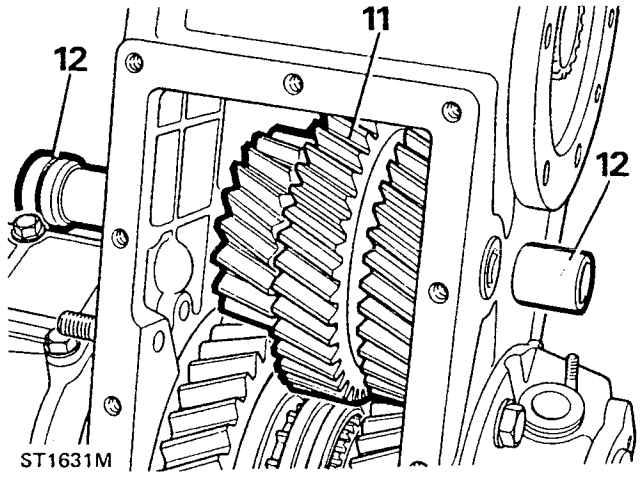


Intermediate gear reassembly

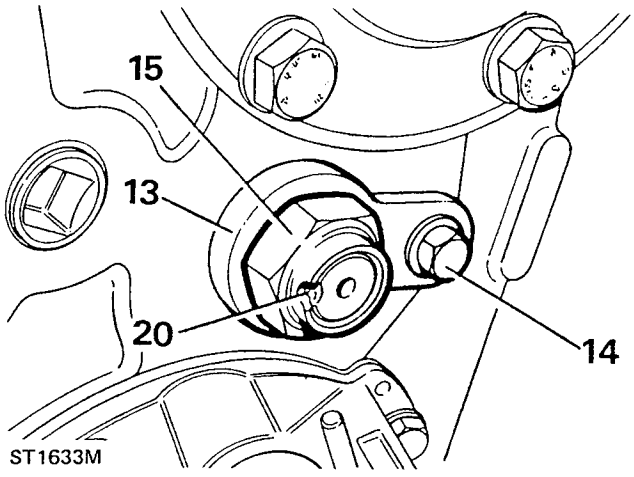
7. Check for damage to the intermediate shaft thread and if necessary clean up with a fine file or stone.
8. Lubricate the taper roller bearings and intermediate gear shaft.
9. Insert new bearing spacer to gear assembly, followed by the taper roller bearings.



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).



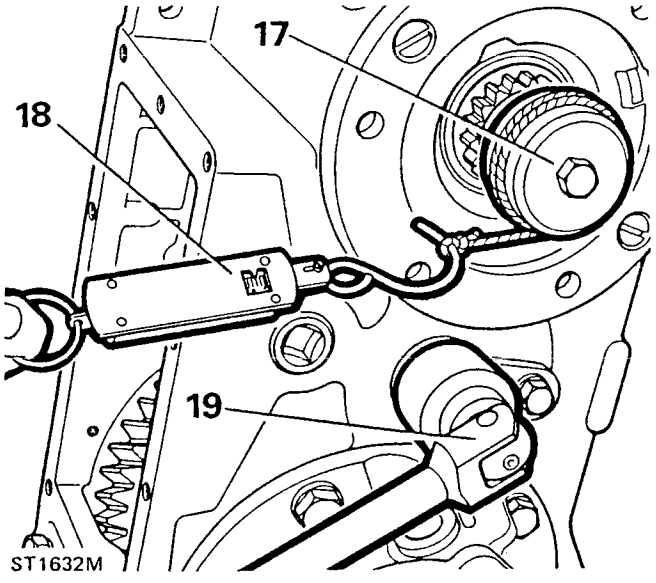
13. Turn the intermediate shaft to allow fitting of retaining plate.
14. Fit retaining plate and secure with retaining bolt and washer.
15. Fit the intermediate gear shaft retaining stake nut.



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 lbs) ± 1.63 kg (± 3 lbs) on that noted when checking input shaft load-to-turn. The torque to tighten the retaining nut will be approximately 203 Nm (150 lb ft).
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.

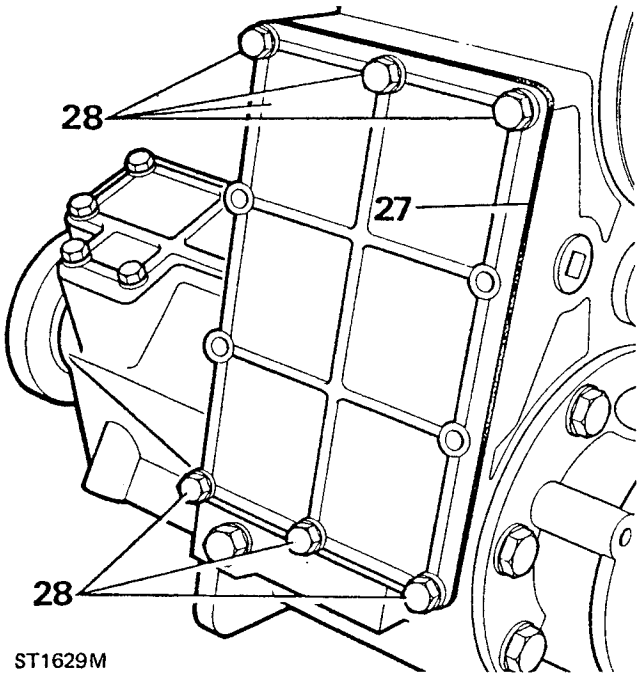


Power take-off cover — reassemble

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

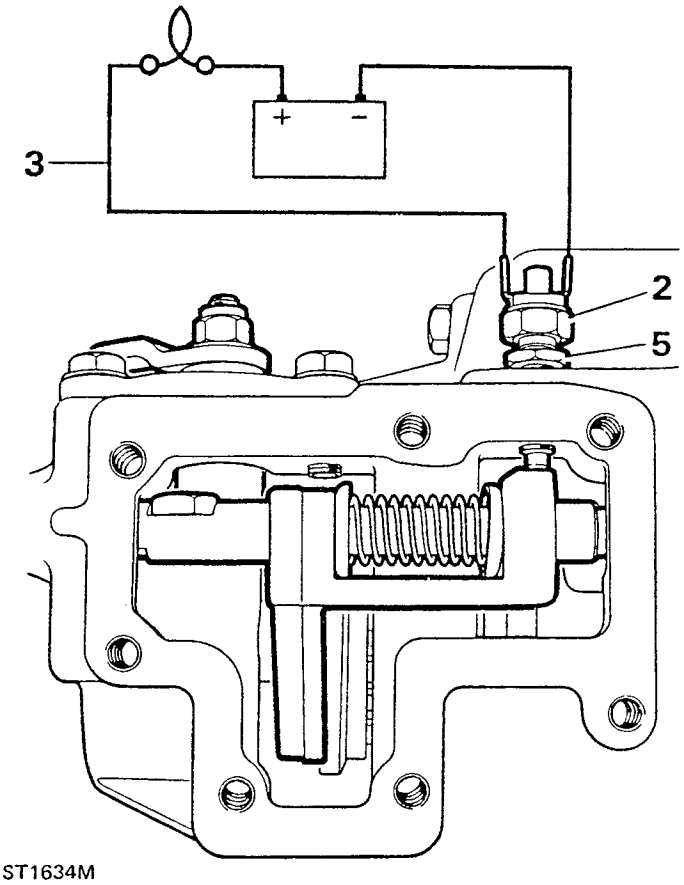
26. Clean bottom cover and gasket face.
27. Apply sealant to cover gasket and fit to transfer box casing.
28. Apply Loctite 290 to bolt threads and secure the bottom cover with six bolts and washers.



ST1629M

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 — reassemble

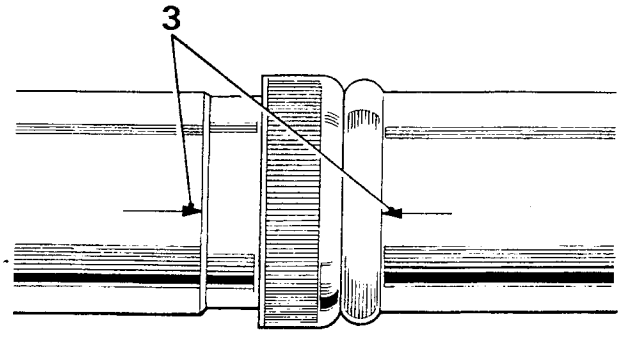
NOTE: Under certain circumstances it is better to fit the transmission brake assembly after being installed in the vehicle.

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

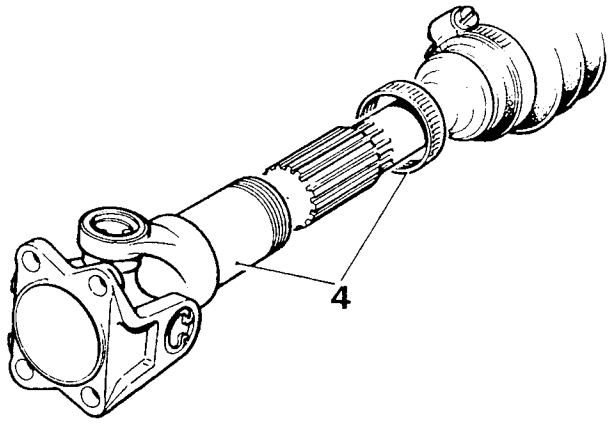
Dismantle

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.



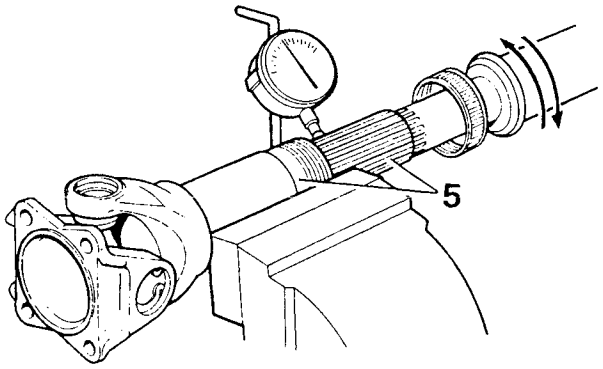
ST1000M

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.

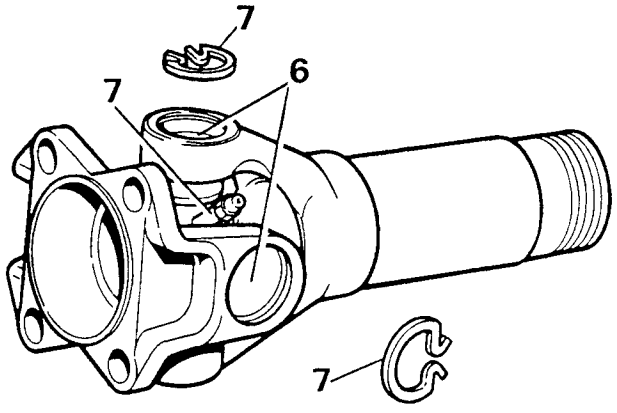


ST1002M

6. Remove paint, rust, etc. from the vicinity of the universal joint bearing cups and circlips.

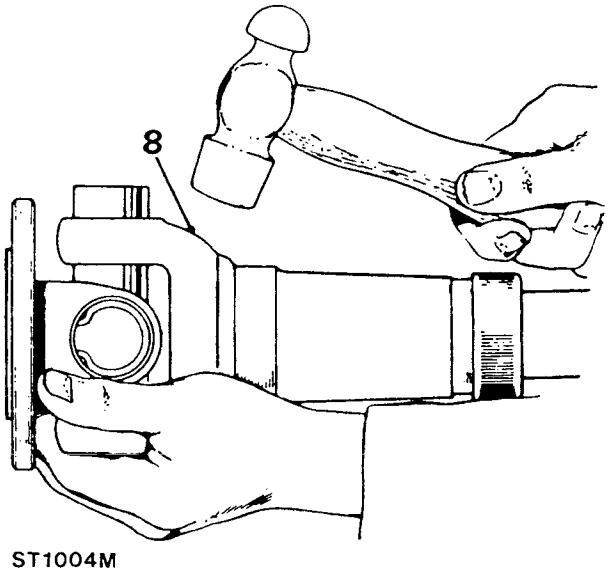
NOTE: Before dismantling the propeller shaft joint, mark the position of the spider pin lubricator relative to the journal yoke ears to ensure that the grease nipple boss is re-assembled in the correct running position to reduce the possibility of imbalance.

7. Remove the circlips, and grease nipple.



ST1003M

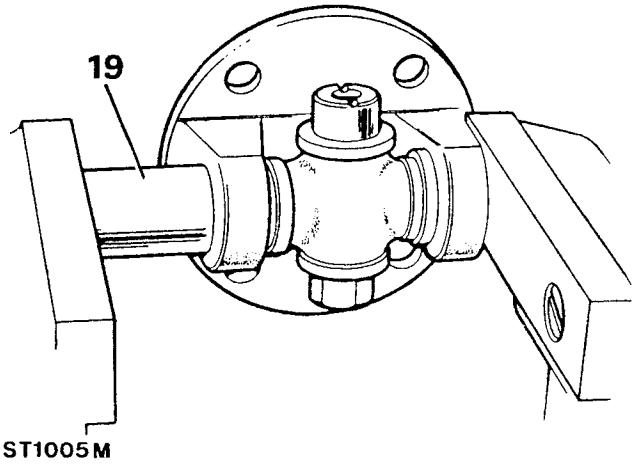
8. Tap the yokes to eject the bearing cups.
9. Withdraw the bearing cups and spider and discard.
10. Repeat instructions 5 to 8 at opposite end of propeller shaft.
11. Thoroughly clean the yokes and bearing cup locations.



ST1004M

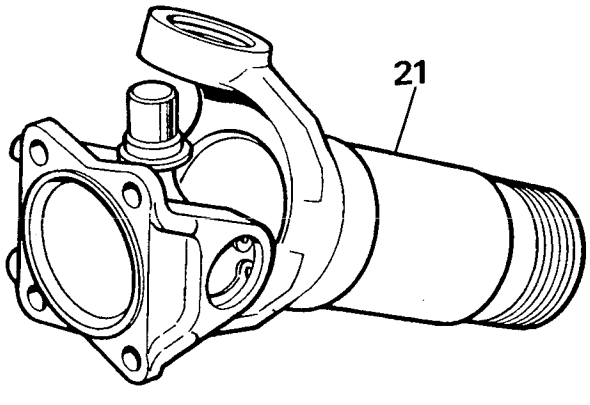
Assemble

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 Lubrication chart.
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.

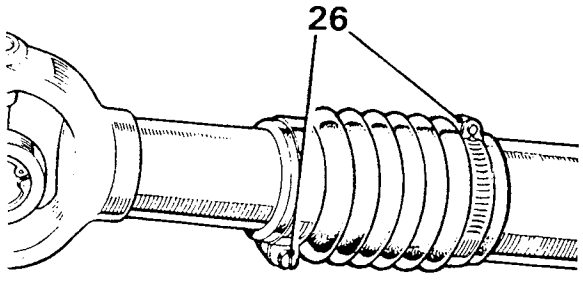


ST1006M

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.

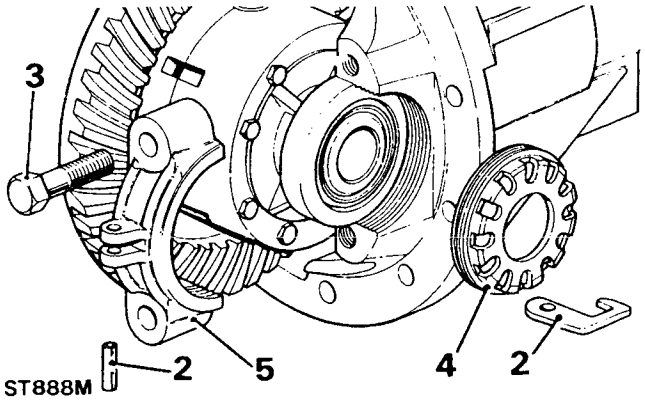
OVERHAUL REAR AXLE DIFFERENTIAL ASSEMBLY — Land Rover Ninety Heavy Duty (option)

Service tools:
18G 1205 flange holder tool;
18G 191 pinion height setting gauge;
18G 191-4 universal setting block;
18G 47-6 pinion head bearing remover/replacer;
18G 1382 oil seal replacer;
RO 262757A extractor for pinion bearing caps;
RO 262757-1 replacer — use with RO 262757A;
RO 262757-2 adaptor tail bearing cap replacer;
RO 530105 spanner — differential flange and carrier bearing nuts;
RO 530106 bracket for dial gauge and indicator;
MS 47 press

DISMANTLE

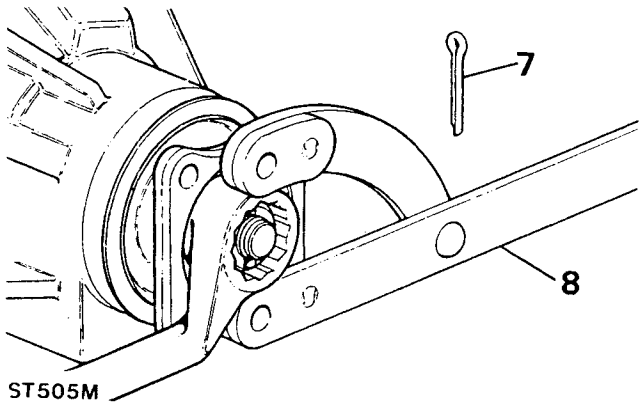
It is essential that differential components are marked in their original positions and relative to other components so that, if refitted, their initial setting is maintained. Note that the bearing caps **must not** be interchanged.

1. Remove the differential assembly from the axle.
2. Drift out the roll pin securing the bearing nut locking fingers to the bearing caps. Remove the locking fingers.
3. Slacken the bearing cap bolts and mark the caps for reassembly.
4. Using service tool RO 530105, remove the bearing adjusting nuts.
5. Remove the bearing cap bolts and bearing caps.
6. Lift out the crown wheel, differential unit and bearings.



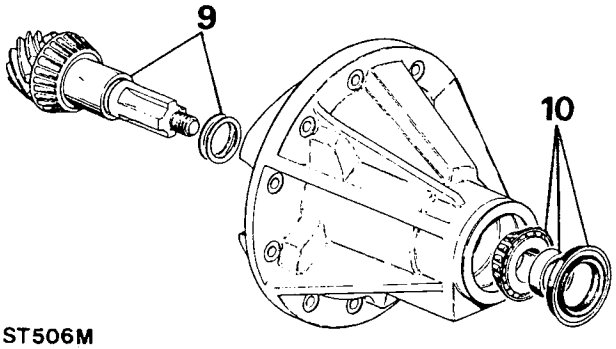
ST888M

7. Remove the split pin securing the pinion flange nut.
8. Remove the pinion flange nut using service tool 18G 1205, to restrain the flange.



ST505M

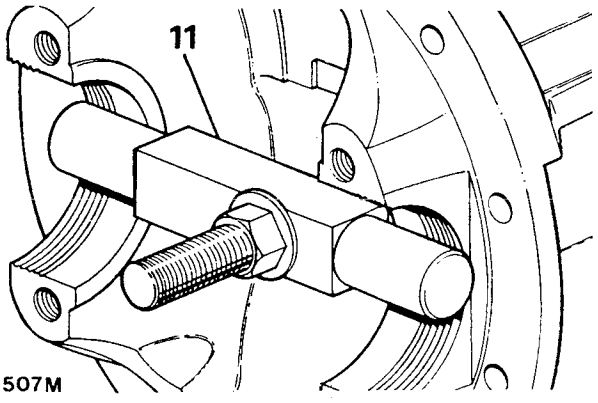
9. Withdraw the pinion complete with pinion head bearing and outer bearing shims. Withdraw the shims.
10. Remove the pinion flange oil seal, spacer and bearing. Discard the oil seal.



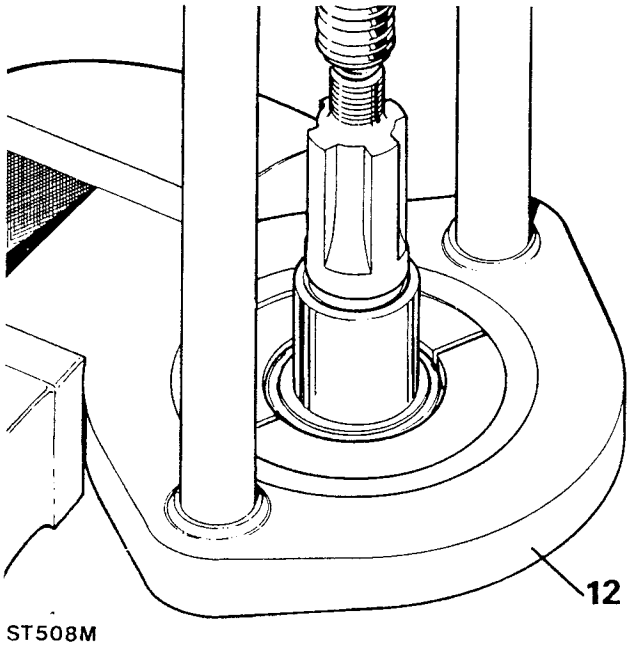
ST506M

11. Using service tool RO 262757A remove the pinion head bearing track and shim and drift out the outer bearing track from the differential housing.

continued



ST507M



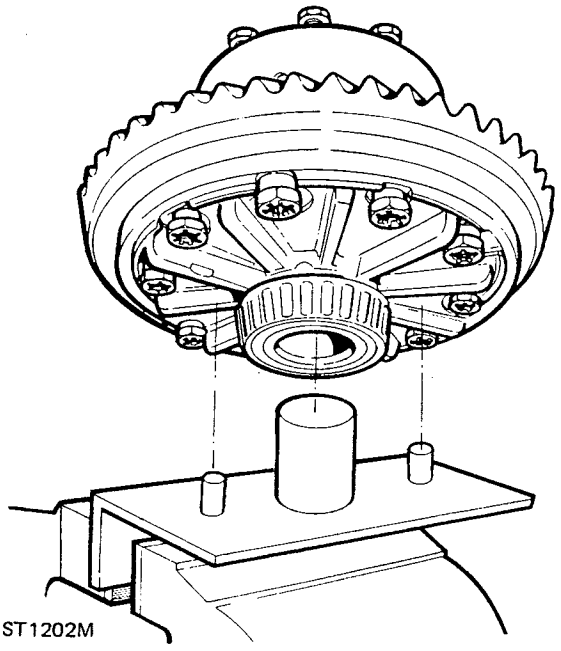
ST508M

12. Remove the pinion head bearing with service tool MS 47 and adaptor 18G 47-6.
13. For reassembly purposes, add alignment marks to the crown wheel and differential case halves.

WARNING: To avoid personal injury, the differential assembly must be very securely retained while removing the bolts from the crown wheel and case halves, as these bolts are Loctited and may be difficult to remove.

A retaining fixture can be made from angle iron with a tube and two bolts welded to it, as illustrated, so that when the fixture is clamped in a vice, the differential assembly can be located over the tube with the fixture bolts between the case webs.

14. Remove the crown wheel.
15. Remove the screws holding the case halves together.
16. Withdraw the upper half of the casing.
17. Withdraw the upper side gear. Note that there may be thrust washers fitted to the side gears.

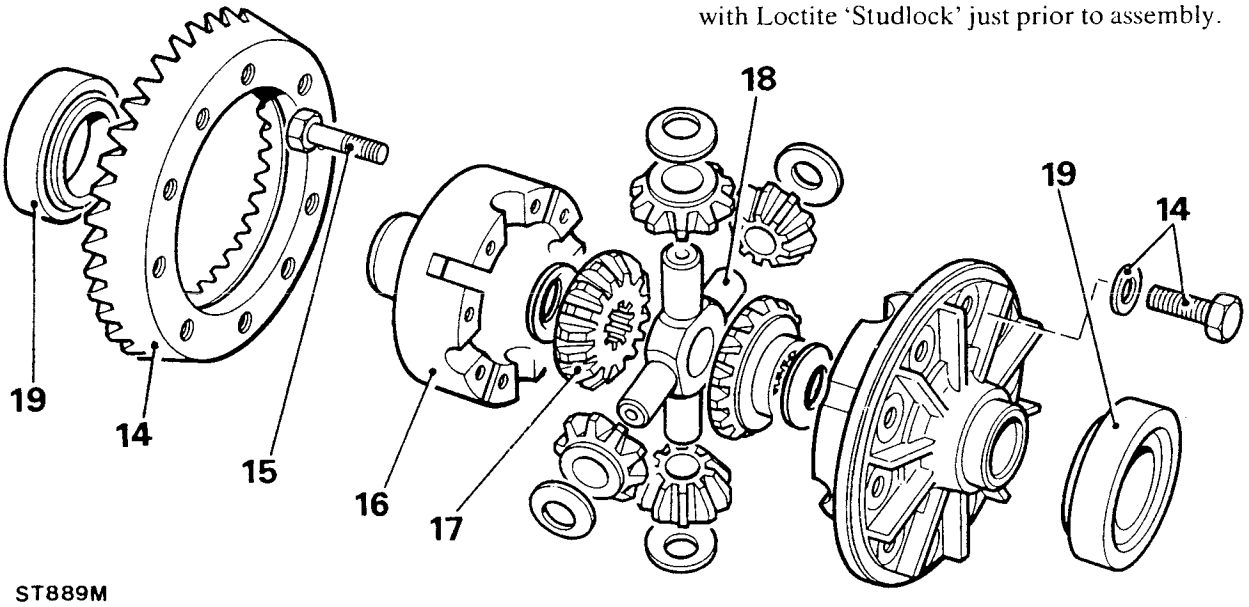


ST1202M

18. Dismantle the pinions and crosspin assembly, noting the relevant positions of all components.
19. If required, extract the roller bearings and place them in their relative outer tracks.

INSPECTING

20. Examine all components for obvious wear or damage.
21. All bearings must be press fit, except the flange end pinion bearing, which must be a slide fit on the shaft.
22. The crown wheel and pinion are only supplied as a matched set and must not be interchanged separately.
23. Bevel pinion housing and bearing caps are matched sets and must not be interchanged separately.
24. The differential case halves are a matched set and must not be interchanged separately. New screws for securing the case halves are already coated with a dry locking compound and do not require the application of Loctite. If the old screws are being reused, the threads must be cleaned and coated with Loctite 'Studlock' just prior to assembly.

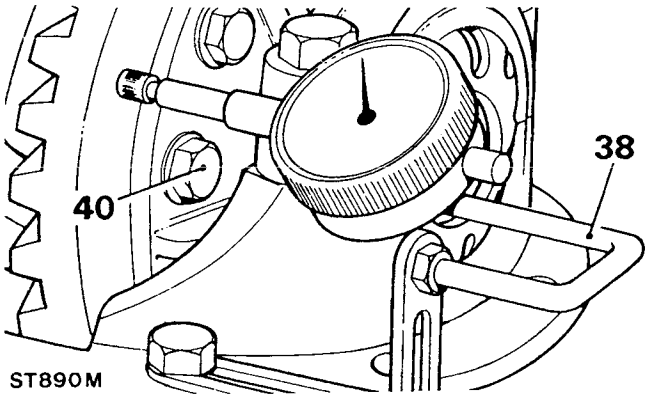


ST889M

ASSEMBLY

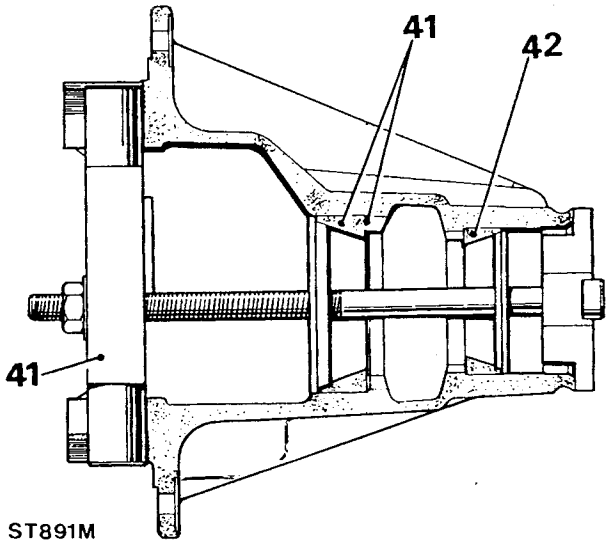
NOTE: If thrust washers were removed from the side gears during dismantling, the washers must be lubricated with EP90 oil and refitted during the following procedure. DO NOT allow oil to contact any holes or bolts that are to be Loctited.

25. Position the smaller case half with the open side uppermost and fit the side gear into the case.
26. Assemble the crosspins, pinions and thrust washers, lubricate the thrust washers with EP90 oil.
27. Fit the crosspin assembly on to the side gear already contained in the differential case half, ensuring that the gears locate correctly.
28. Fit the other side gear to the crosspin assembly ensuring that all the gears locate correctly.
29. Fit the two case halves together, maintaining the alignment marking and ensuring correct gear mating.
30. Fit the correct (high grade) screws and tighten them evenly to a torque of 3,0 to 3,7 kgf m (22 to 27 lbf ft) (30 to 36 Nm).
31. Check that the serial number marked on the pinion end face matches that marked on the crown wheel.
32. Ensure that the differential housing flange and crown wheel are thoroughly clean. Align the crown wheel with the differential case, fit the bolts and washers and tighten evenly.
33. If removed, press on the differential roller bearings.
34. Place the differential housing complete with crown wheel and bearings in the pinion housing.
35. Fit the bearing caps and bolts. Do not fully tighten the bolts.
36. Fit the bearing adjusting nuts and adjust to obtain zero end-float.
37. Tighten the bearing cap bolts.
38. Using a dial gauge check the crown wheel for run-out. This should not exceed 0,10 mm (0.004 in). If excessive run-out is recorded remove the crown wheel and examine crown wheel and mounting flange for burrs, grit, etc. Refit the crown wheel and recheck. Run-out, attributable to a buckled or damaged differential housing flange can be corrected only by renewing the differential gear housing.
39. When satisfied that run-out is within the specified limits remove the differential housing from the pinion housing.



ST890M

40. Remove the crown wheel bolts and refit them using Loctite 'Studlock'. Evenly tighten the bolts to 5,5 to 6,3 kgf m (40 to 45 lbf ft).



ST891M

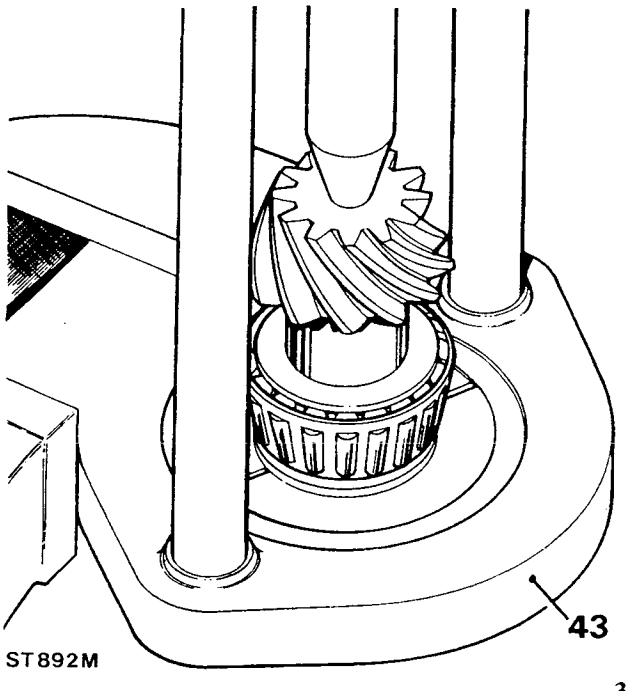
Drive pinion

41. Fit the pinion head bearing track and the original shim to the pinion housing using service tools RO 262757A and RO 262757-1. If the original shim was damaged or mislaid use a new shim of at least 1,27 mm (0.050 in) thickness.
42. Fit the pinion outer bearing track to the pinion housing with service tool RO 262757A and RO 262757-2.

NOTE: Instructions 41 and 42 are carried out in one operation as illustrated.

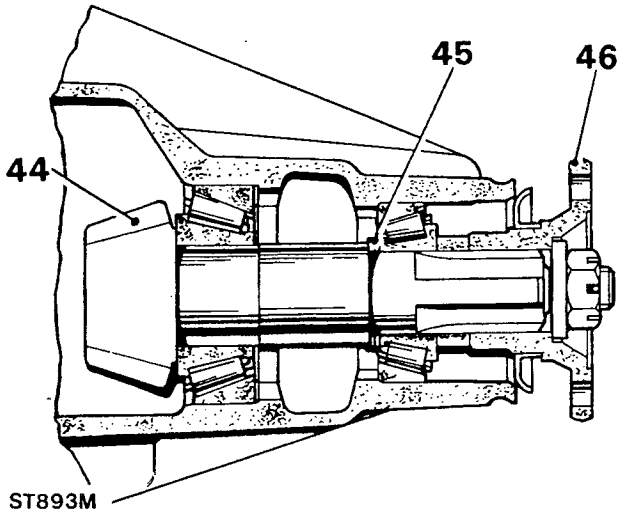
43. Fit the pinion head bearing to the pinion using service tool 18G 47-6.

continued



ST892M

44. Enter the pinion in its location in the pinion housing. Do not fit the shims for bearing pre-load at this stage.
45. Fit the outer bearing and spacer.
46. Fit the driving flange, washer and nut.



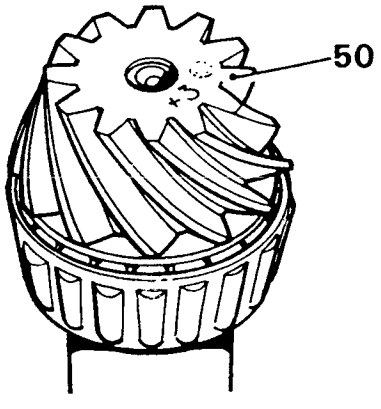
ST893M

47. Do not fit the oil seal at this stage.
48. Tighten the pinion flange nut slowly until the force required to rotate the pinion is 23 to 40,5 kgf cm (20 to 35 lbf in). This will pre-load the bearings in order to check the pinion height dimension.

NOTE: If using original bearings, which are bedded in, the pre-load figure is 11,5 to 17,25 kgf cm (10 to 15 in lb).

Drive pinion markings

49. The markings on the end face adjacent to the serial number are of no significance during servicing.
50. 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.



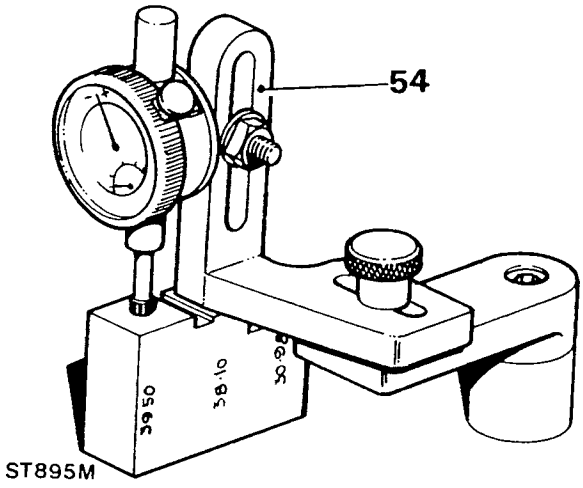
ST894M

51. The nominal setting dimension is represented by the setting gauge block 18G 191-4 which is referenced from the pinion end face to the bottom radius of the differential bearing bore.

Drive pinion adjustment

52. Ensure that the pinion end face is free of raised burrs around the etched markings.
53. Remove the keep disc from the magnetised base of dial gauge tool 18G 191.
54. Place the dial gauge and setting block on a flat surface and zero the dial gauge stylus on the setting block.

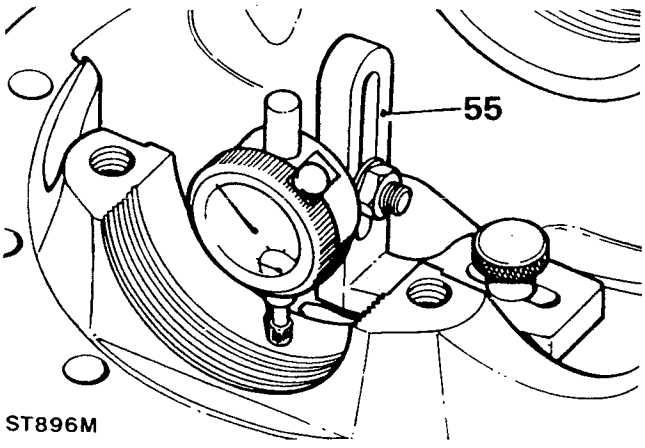
NOTE: The setting block has three setting heights as follows:
39.50 mm Rationalised axle
38.10 mm Pre-Rationalised axle
30.93 mm Salisbury axle
Ensure that the height marked 39.50 mm is used for this differential.



ST895M

55. 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.

continued

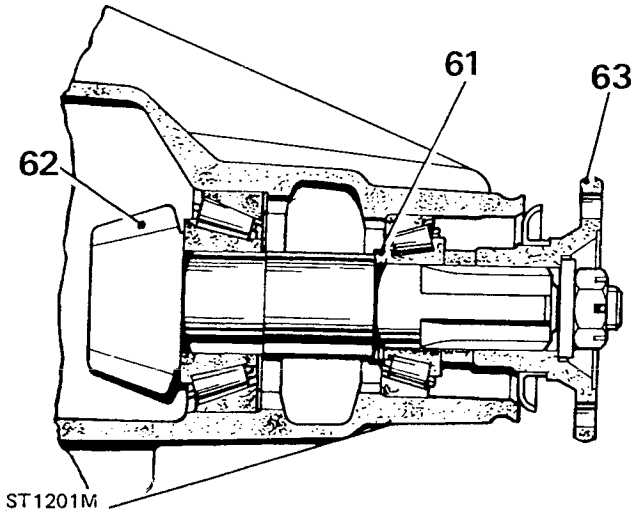


ST896M

56. 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.
    a. Where the stylus has moved down, the amount is equivalent to the thickness of shims that must be removed from under the pinion inner track to bring the pinion down to the nominal position.
    b. Where the stylus has moved up, the amount is equivalent to the additional thickness of shims required to bring the pinion up to the nominal position.
57. Before adjusting the shim thickness, check the pinion face marking and if it has a plus (+) figure, subtract that amount in thousandths of an inch from the shim thickness figure obtained in the previous item.
58. Alternatively, if the pinion has a minus (−) figure, add the amount to the shim thickness figure.
    Adjust the shim thickness under the pinion head bearing track as necessary.
59. Recheck the pinion height setting. 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 ins.

Bearing pre-load adjustment

60. Remove the pinion flange, pinion, outer bearing and spacer.
61. Slide new shims, of the same thickness as the originals (bearing pre-load) into position on the pinion shaft. If the original shim was damaged or mislaid use a new shim of at least 4,06 mm (0.160 in) thickness.
62. Enter the pinion in its location in the pinion housing and fit the outer bearing and spacer.
63. Fit the driving flange, washer and nut.
64. Do not fit the oil seal at this stage.

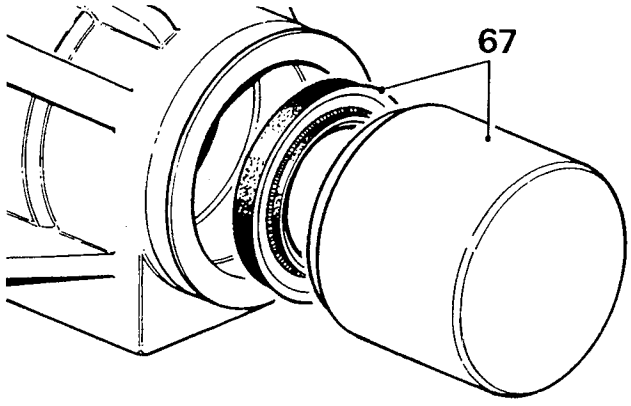


ST1201M

65. With the pinion flange nut tightened to a torque of 9,6 to 16,5 kgf m (70 to 120 lbf ft) (95 to 163 Nm) the force required to rotate the pinion shaft should be within 23 to 40,25 kgf cm (20 to 35 lbf ins) when initial inertia has been overcome. Change the bearing pre-load shim as necessary to obtain this requirement. A thicker shim will reduce pre-load; a thinner shim will increase pre-load.

NOTE: If using original bearings, which are bedded in, the pre-load figure is 11,5 to 17,5 kgf cm (10 to 15 in lb).

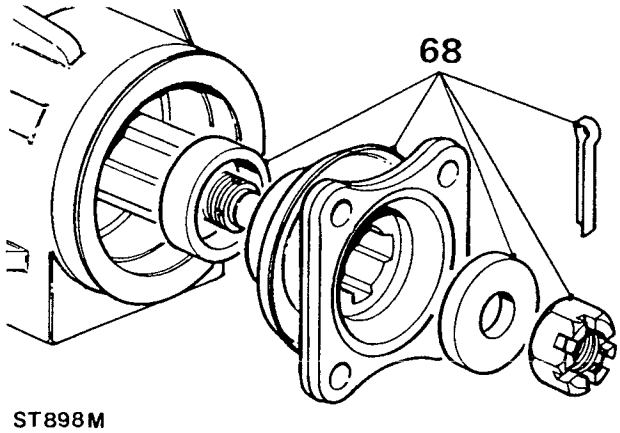
66. Remove the pinion flange.
67. Fit the oil seal (seal lips towards the pinion), using service tool 18G 1382 oil seal replacer.



ST897M

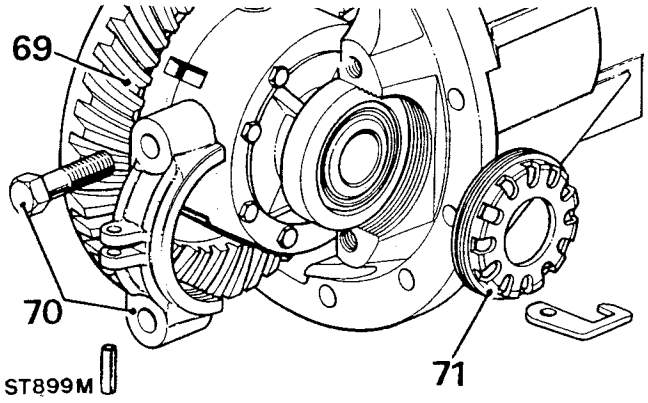
68. Lubricate the seal lips with EP90 oil. Fit the distance piece and flange and secure with washer and nut. Tighten the nut to 9,6 to 16,5 kgf m (70 to 120 lbf ft) (95 to 163 Nm). Fit a new split pin.

continued

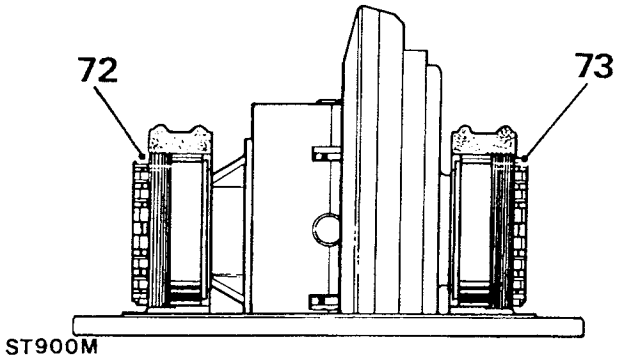


ST898M

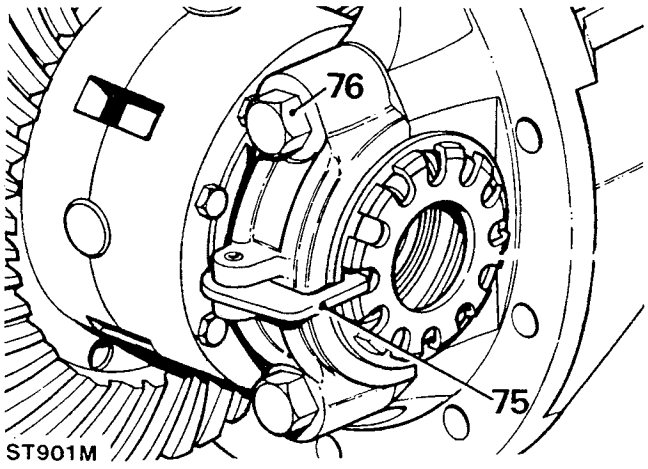
69. Place the differential housing in the pinion housing.
70. Fit the bearing caps and bolts. Do not fully tighten the bolts.
71. Fit the bearing adjusting nuts.



72. Using service tool RO530105, slacken the left hand bearing adjustment nut (as illustrated) to produce end float.



73. Tighten the right hand nut until crown wheel/pinion backlash is just removed.
74. Tighten the left hand nut slowly until the crown wheel/pinion backlash is 0,10 to 0,17 mm (0.004 to 0.007 in).
75. Fit the locking fingers and roll pins. If necessary, tighten the adjustment nuts slightly to align the locking finger with a slot.



76. Evenly tighten the bearing cap bolts torque 8,3 kgf m (60 lbf ft) (82 Nm).
77. Recheck crown wheel/pinion backlash.
78. Lubricate the bearings and gears.

DATA

Pinion bearing pre-load	23 to 40,25 kgf cm (20 to 35 lbf in)
Crown wheel run-out	0,10 mm (0.004 in)
Crown wheel/pinion backlash	0,10 to 0,17 mm (0.004 to 0.007 in)

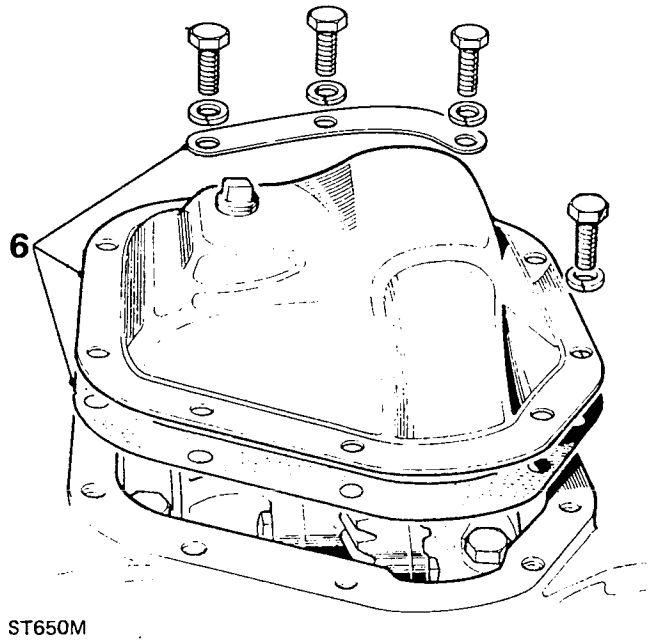
OVERHAUL REAR AXLE DIFFERENTIAL ASSEMBLY (SALISBURY) LAND ROVER ONE TEN MODELS

Service tools:
47 screw press;
18G 131 C axle spreader or axle compressor GKN 131;
18G 191 dial gauge, bracket and base;
18G 1122 screw press;
18G 1205 spanner for drive coupling;
S 123 A pinion bearing cup remover;
18G 47 BK pinion bearing cone remover/replacer;
18G 47 BL differential bearing remover;
18G 1122 G pinion bearing cup replacer;
18G 134 DP differential bearing replacer;
18G 191 P setting gauge for pinion height or 18G 191-4 universal setting block;
18G 131 F pegs for axle spreader;
RO 1008 oil seal replacer

DISMANTLE

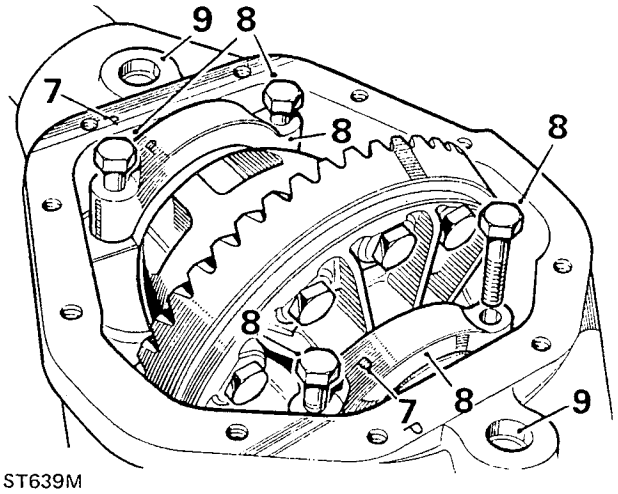
NOTE: All fixing bolts used on the differential assembly and differential cover have metric threads.

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.



ST650M

8. Remove the fixings and withdraw the differential bearing caps.



ST639M

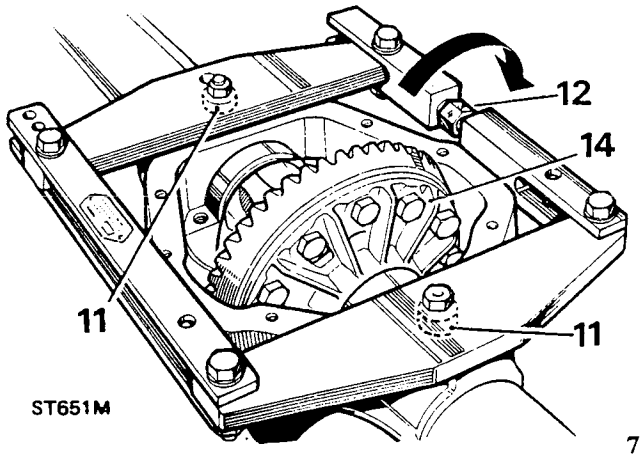
Using axle spreader 18G 131 C

9. Clean out and examine the spreader tool pegholes provided in the gear casing face; ensure that the holes are free from dirt and burrs and damage.
10. Ensure that the turnbuckle adjuster is free to turn.
11. Fit the axle spreader to engage the peg holes. Spreader 18G 131 C, Adaptor pegs 18G 131 F.
12. Using a spanner, turn the adjuster until all free play between the spreader and casing is taken up, denoted by the adjuster becoming stiff to turn.
13. Check that the side members of the spreader are clear of the casing.
14. Stretch the casing, rotating the adjuster by one flat at a time, until the differential assembly can be levered out. Do not lever against the spreader; use suitable packing under the levers to avoid damage to the casing.

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 (0.012 in), equivalent to three flats.

15. Ease off the adjuster and remove the spreader.

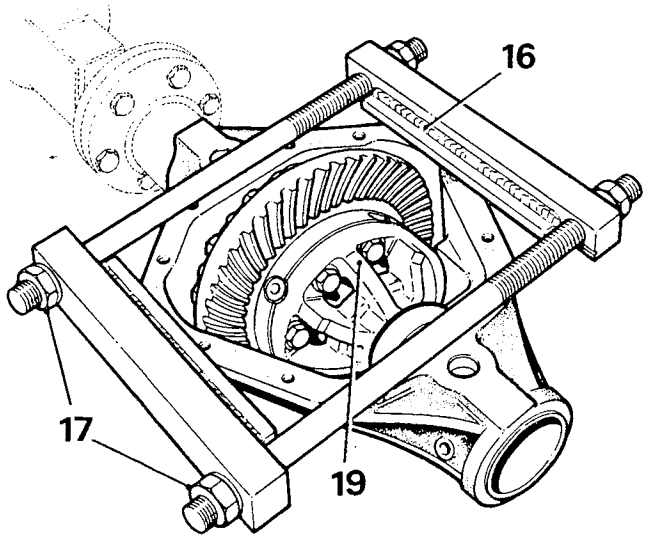
continued



ST651M

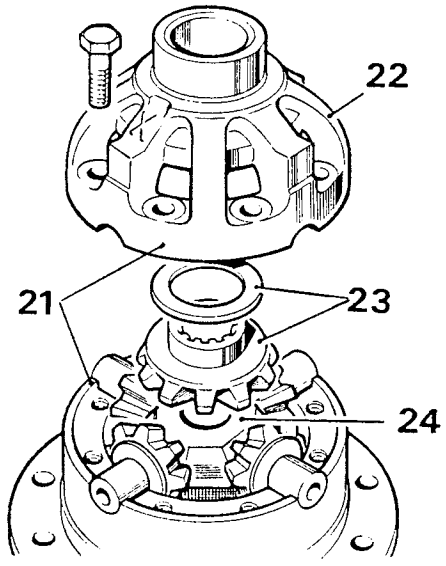
Using axle compressor GKN 131

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.



ST597M

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.

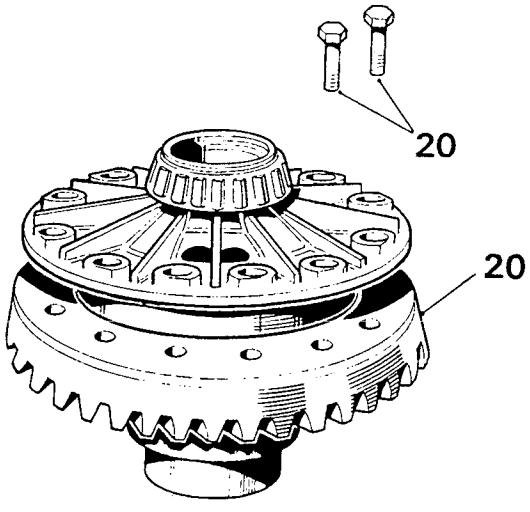


ST653M

24. Lift out the cross-shaft and pinions.
25. Withdraw the four dished thrust washers.
26. Withdraw the lower differential wheel and thrust washer.

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.



ST652M

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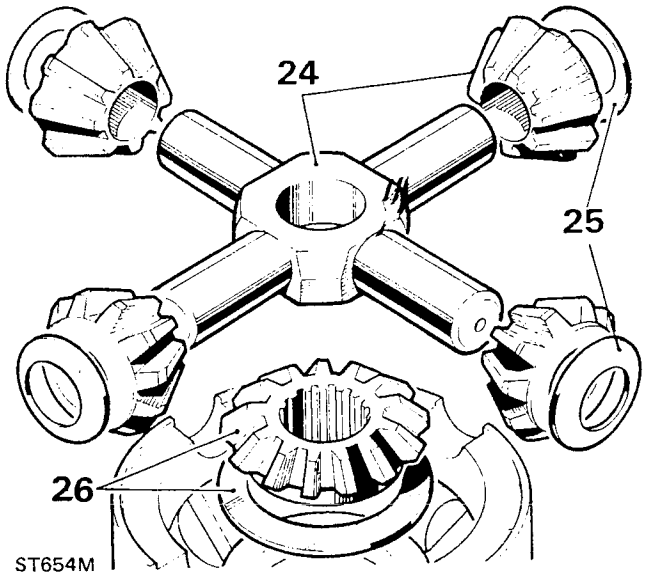
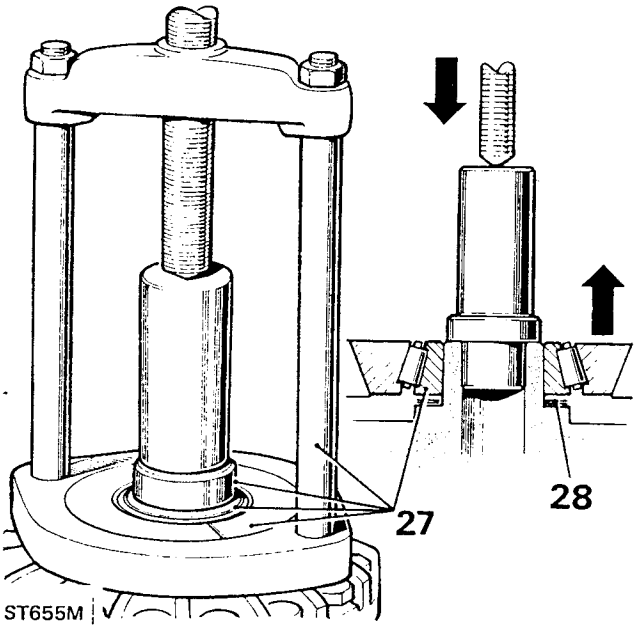


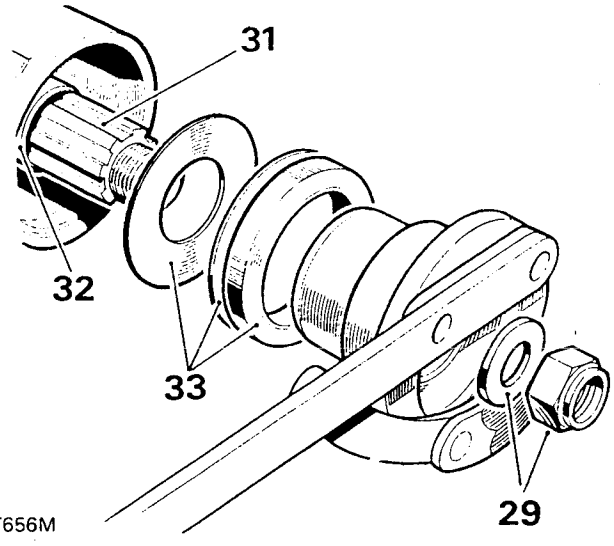
ST654M

27. Remove the differential bearing cones using remover 18G 47 BL and adaptors 1 and 2 and press 47.
28. Withdraw the shim washers fitted between the bearing cones and the differential casings.

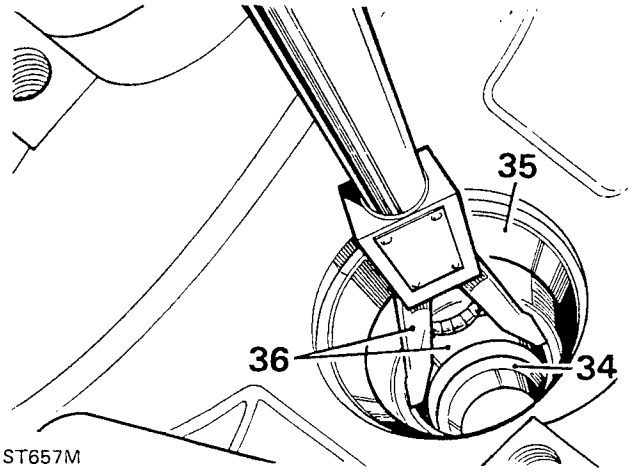


Remove final drive pinion

29. Prevent the coupling flange from rotating and remove the flange locknut and plain washer. Spanner 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 collapsable bearing spacer.
33. Withdraw the oil seal, gasket and oil thrower.

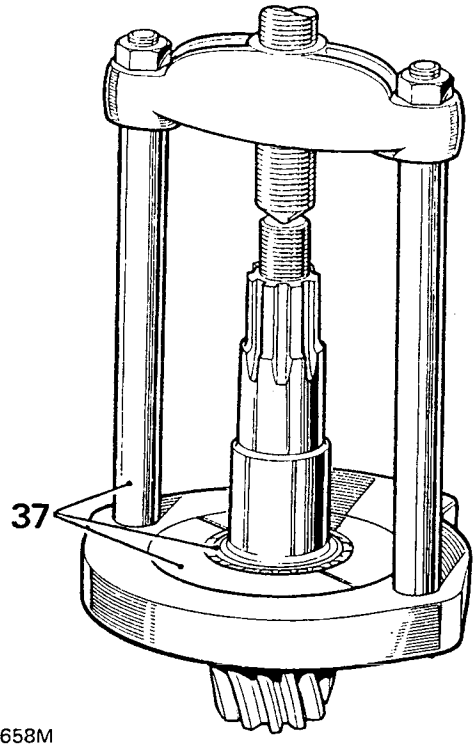


34. Withdraw the outer bearing cone.
35. Extract the pinion inner bearing cup and shim washers from the casing. Note the shim washer thickness. Remover S 123 A.
36. Extract the pinion outer bearing cup from the casing. Remover S 123 A.



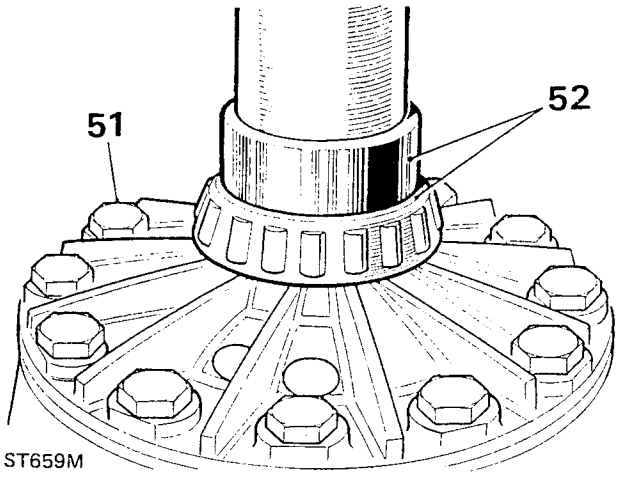
37. Remove the inner bearing cone from the pinion. Remover 18G 47 BK and Press 47.

continued



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.



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 (0.002in). 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.

ASSEMBLE

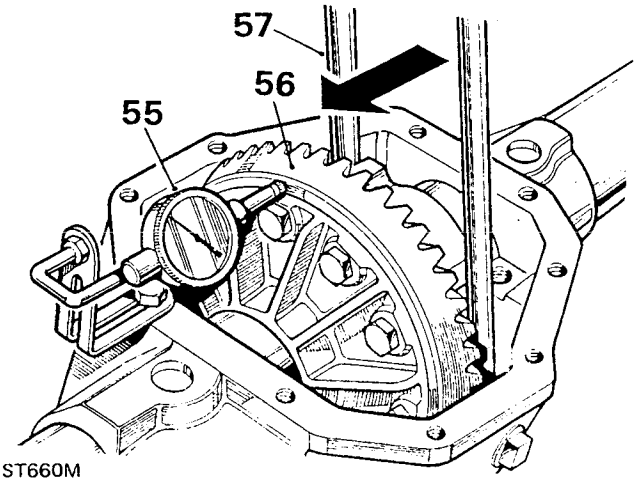
Assemble differential unit

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 marks.
50. Secure the assembly with bolts using Loctite 'Studlock' grade CVX on the threads and tighten evenly and diametrically to 9,1 to 10,4 kgf m (66 to 75 lbf ft).
51. Fit the crown wheel to the differential casing. Use Loctite 'Studlock' grade CVX on the fixing bolt threads and tighten to 13 to 14,5 kgf m (95 to 105 lbf ft).
52. Press on the differential roller bearing cones less shim 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.

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.

continued

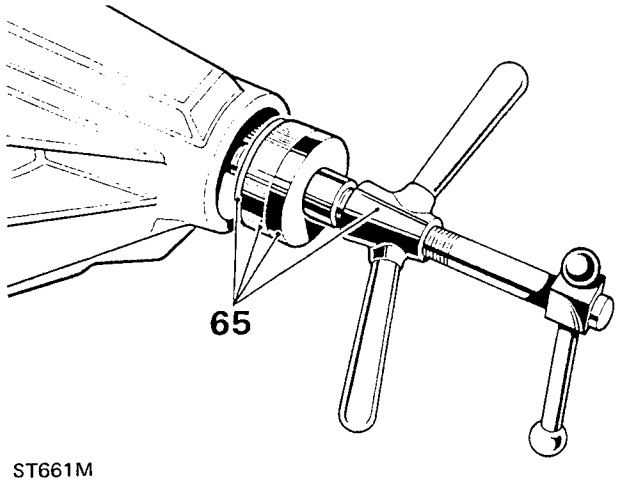


ST660M

61. Add 0,127 mm (0.005 in), 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 (0.003 in), 0,12 mm (0.005 in), 0,25 mm (0.010 in) and 0,76 mm (0.030 in). 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.

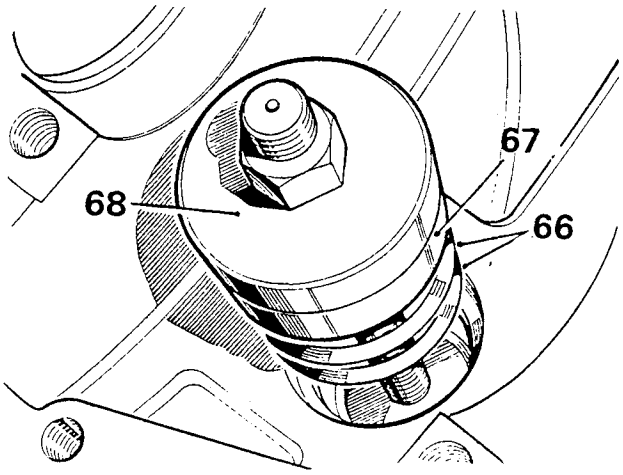
Fit drive pinion

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 on the press tool 18G 1122.
65. Locate the assembly into the pinion housing nose.



ST661M

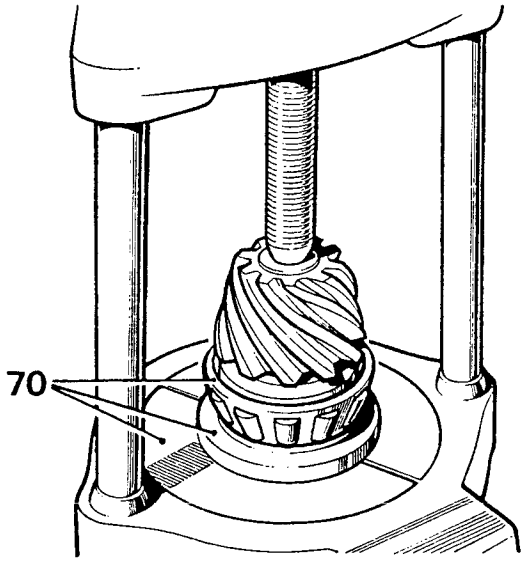
66. Place the selected shim washers on to the inner bearing cup seating.
67. Position the inner bearing cup in the casing.
68. Position the inner bearing replacer 18G 1122 G detail 1, onto 18G 1122 and secure with the fixing nut.
69. Hold still the centre screw and turn the butterfly lever to draw in the bearing cups.



ST662M

70. Press the inner bearing cone onto the drive pinion. 18G 47 BK, details 1 and 2 and press 47.
71. Position the pinion and bearing in the casing; omit the collapsable 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 (8 to 12 lbf in) to rotate the pinion.

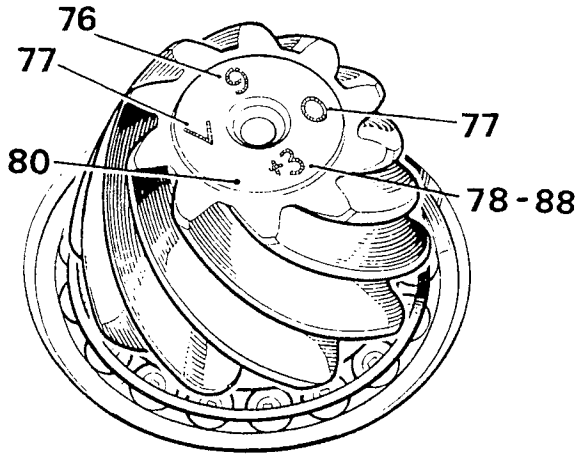
continued



ST638M

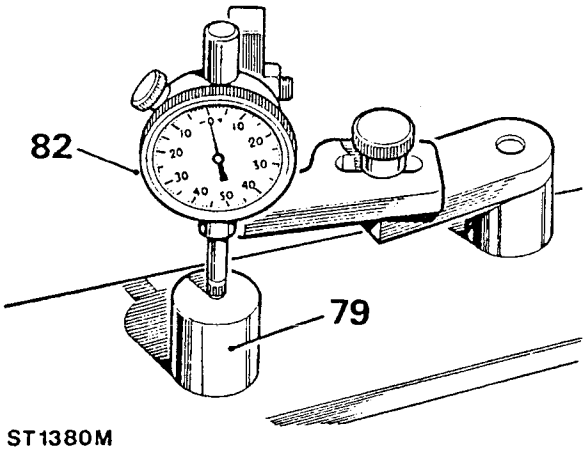
Drive pinion markings

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

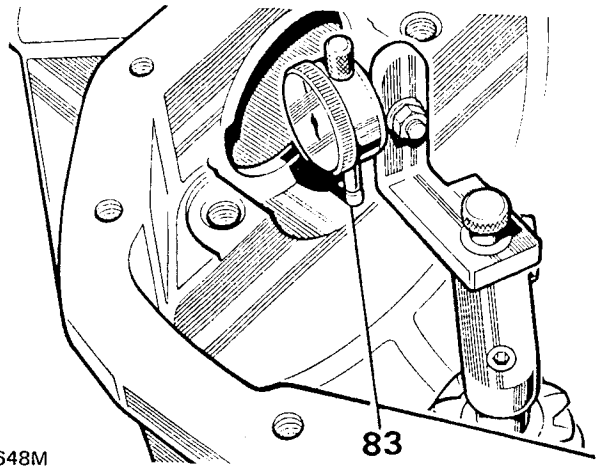
79. The nominal setting dimension is represented by the setting gauge block 18G 191 P or 18G 191-4, which is referenced from the pinion end face to the bottom radius of the differential bearing bore. The latter gauge is illustrated following instruction 85.



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 18G 191.
82. Place the dial gauge and setting gauge 18G 191 P or 18G 191-4 on a flat 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 + 0.006 in
Reading obtained R.H. side − 0.003 in

Add + 0.006 in
− 0.003 in
= + 0.003 in

Divide by 2 = $\frac{+\ 0.003}{2}$ = + 0.0015 in

Therefore **subtract** 0.0015 in from the shim thickness behind the pinion inner bearing track.

Example 2

Reading obtained L.H. side + 0.006 in
Reading obtained R.H. side − 0.008 in

Add + 0.006 in
− 0.008 in
= − 0.002 in

Divide by 2 = $\frac{-\ 0.002}{2}$ = − 0.001 in

continued

85a. Where the stylus has moved down, 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.

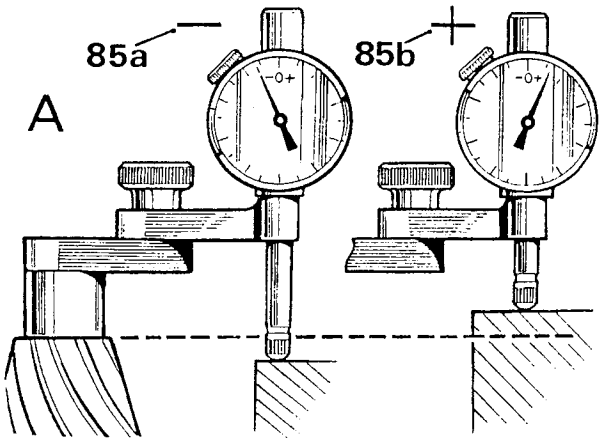
b. Where the stylus has moved up, the amount is equivalent to the additional thickness of shims required to bring the pinion up to the nominal position.

Illustration A. Using setting gauge 18G 191 P.

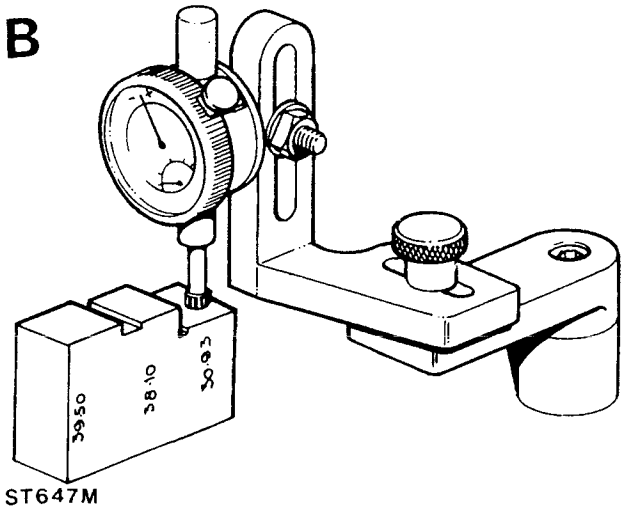
Illustration B. Using universal setting block 18G 191-4

NOTE: The 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.

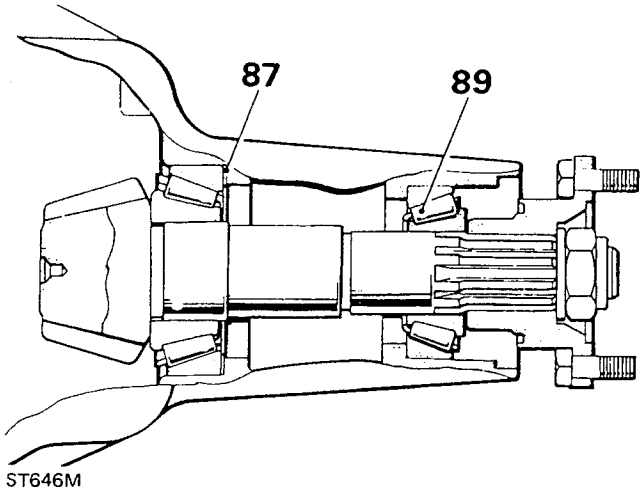


ST645M



ST647M

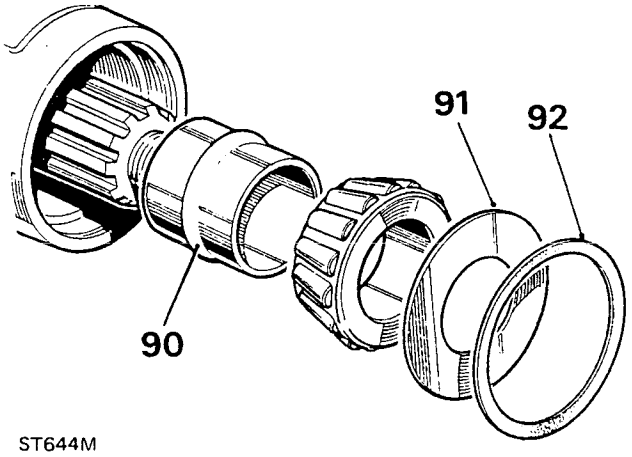
86. Before adjusting the shim thickness, check the pinion face marking and if it has a plus (+) figure, subtract that amount in thousands of inch from the shim thickness figure obtained in the previous instruction. Alternatively if the pinion has a minus (−) figure, add the amount to the shim thickness 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 below nominal.
89. When the pinion setting is satisfactory, temporarily remove the pinion outer bearing.



ST646M

90. Fit a new collapsable 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.

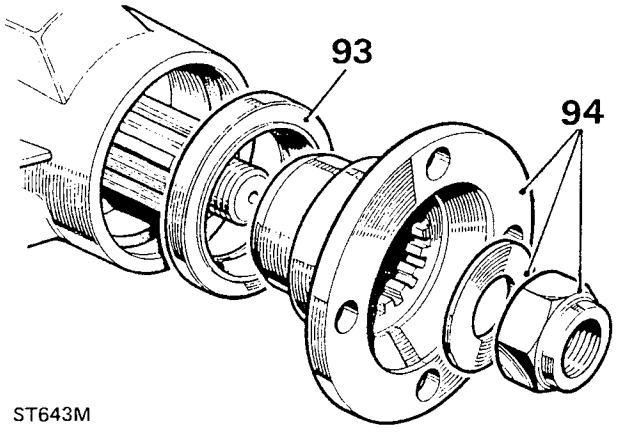
continued



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 34,5 kgf cm (15 to 30 lbf in).
    b. Assemblies with new pinion bearings: 34,5 to 46,0 kgf cm (30 to 40 lbf in).

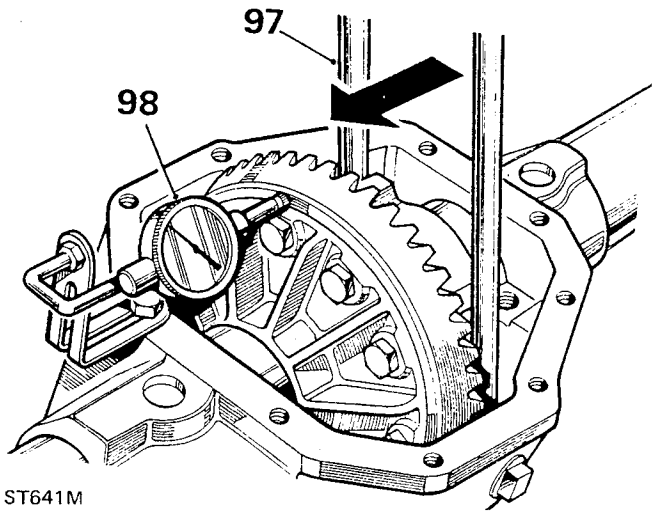
NOTE: Once the bearing spacer has started to collapse the torque resistance build-up is rapid, therefore check frequently, using a spring balance, to ensure the correct figures are not exceeded, otherwise a new collapsable bearing spacer will be required.



ST643M

Differential backlash checks

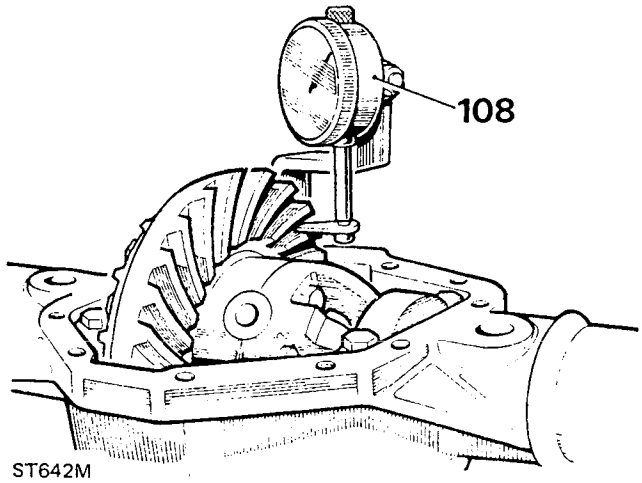
96. Pick up the differential unit as left after instruction 52.
97. Fit the differential unit and lever the unit away from the drive pinion until the opposite bearing cup is seated against the housing. Do not tilt the unit.
98. Install a dial gauge on the casing with its stylus resting on the back face 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 0,25 mm (0.010 in) to obtain the 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

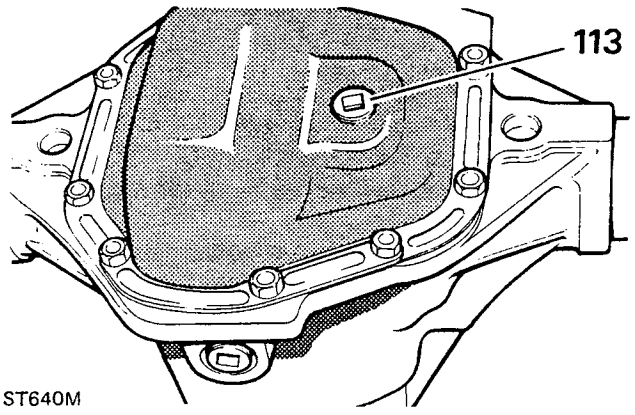
102. Fit the shim value determined in instruction 101, taking the shims from the pack previously determined during 'Differential bearing adjustment' checks, instructions 57 to 62 18G 47 BL details 1 and 2, press 47, 18G 134 DP.
103. Fit the remaining shims from instruction 101 to the opposite side of the differential. 18G 47 BL details 1 and 2, press 47, 18G 134 DP.
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 12,9 to 14,5 kgf m (93 to 105 lbf ft).
108. Mount a dial gauge on the axle casing with the stylus resting on a crown wheel tooth.

continued



ST642M

109. Prevent the drive pinion from rotating and check the crown wheel backlash which must be 0,15 to 0,27 mm (0.006 to 0.011 in). 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 2,8 to 3,5 kgf m (20 to 25 lbf ft).
111. Reverse instructions 3 to 5 and coat the threads of the hub driving member bolts with Loctite 'Studlock' grade CVX and fit and tighten the bolts evenly. Torque: 10,0 kgf m (73 lbf ft).
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 (0.006 to 0.011 in)
Differential bearings pre-load	0,127 mm (0.005 in)
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 (30 to 40 lbf in)
Torque to turn drive pinion re-using the original bearings	17,3 to 34,5 kgf cm (15 to 30 lbf in)

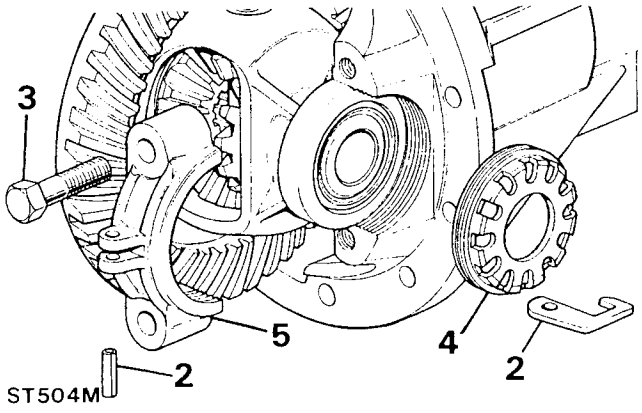
OVERHAUL AXLE DIFFERENTIAL ASSEMBLY

Service tools:
18G 1205 flange holder tool;
18G 191 pinion height setting gauge;
18G 191-4 universal setting block;
18G 47-6 pinion head bearing remover/replacer;
LST 106 oil seal replacer; or
RO 262757A extractor for pinion bearing caps;
RO 262757-1 replacer—use with RO 262757A;
RO 262757-2 adaptor tail bearing cap replacer;
RO 530105 spanner—differential flange and carrier bearing nuts;
RO 530106 bracket for dial gauge and indicator;
MS 47 press

DISMANTLE

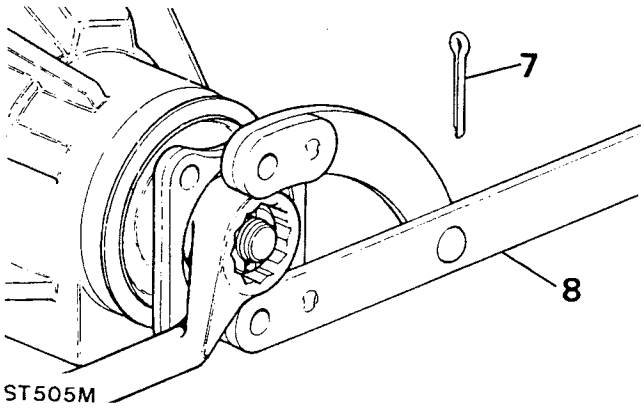
It is essential that differential components are marked in their original positions and relative to other components so that, if refitted, their initial setting is maintained. Note that the bearing caps must not be interchanged.

1. Remove the differential assembly from the axle.
2. Drift out the roll pin securing the bearing nut locking fingers to the bearing caps. Remove the locking fingers.
3. Slacken the bearing cap bolts and mark the caps for reassembly.
4. Using service tool RO 530105, remove the bearing adjusting nuts.
5. Remove the bearing cap bolts and bearing caps.
6. Lift out of the crown wheel, differential unit and bearings.



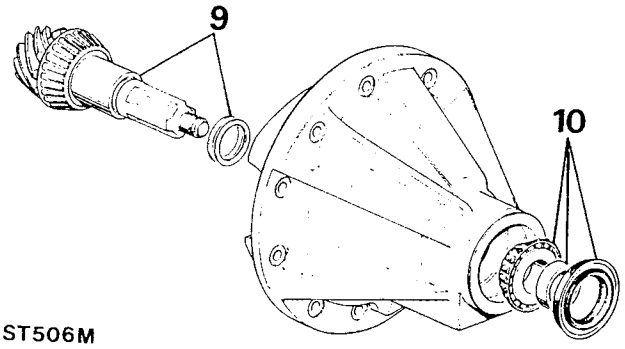
ST504M

7. Remove the split pin securing the pinion flange nut.
8. Remove the pinion flange nut using service tool 18G 1205 to restrain the flange.



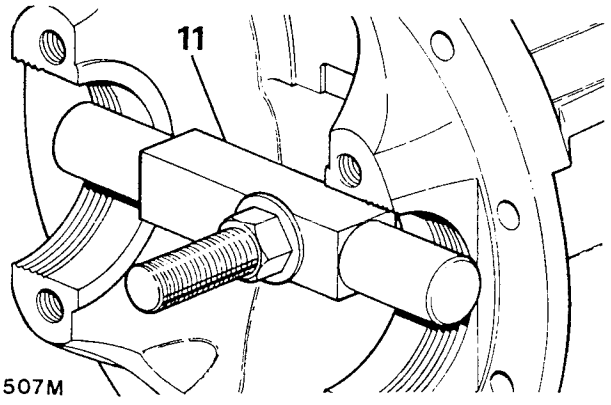
ST505M

9. Withdraw the pinion complete with pinion head bearing and outer bearing shims. Withdraw the shims.
10. Remove the pinion flange oil seal, spacer and bearing. Discard the oil seal.



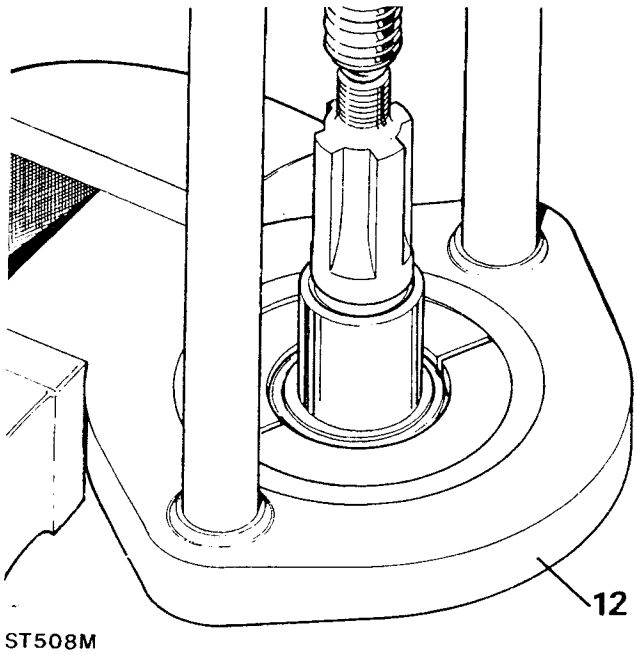
ST506M

11. Using service tool RO 262757A, remove the pinion head bearing track and shim and drift out the outer bearing track from the differential housing.



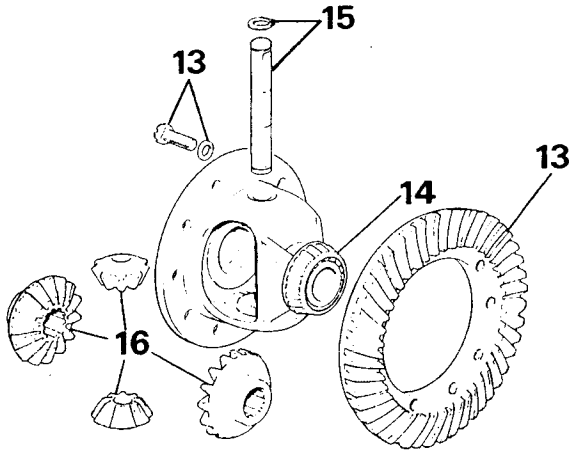
ST507M

12. Remove the pinion head bearing with service tool MS 47 and adaptor 18G 47-6.



ST508M

13. Remove the bolts and washers securing the crown wheel to the differential flange. Withdraw the crown wheel.
14. Remove the differential carrier bearings.
15. Remove the circlips securing the differential cross shaft. Extract the cross shaft.
16. Withdraw the differential gears and pinions.
17. Thoroughly clean all components.



ST509M

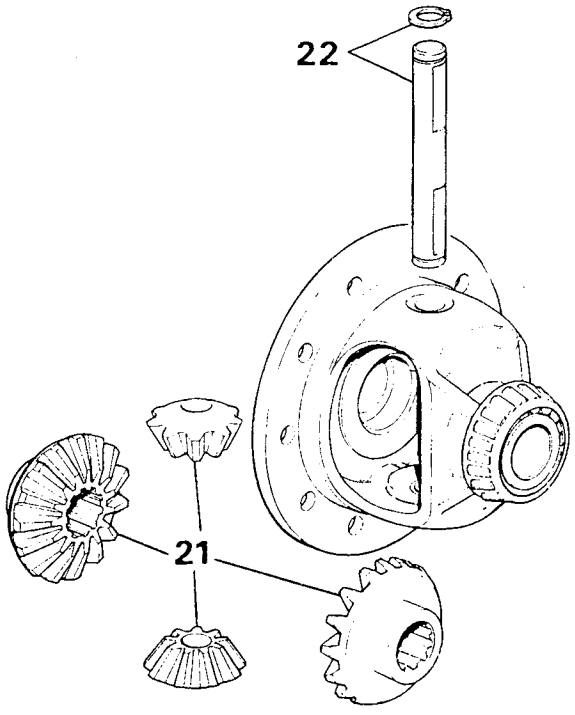
INSPECTION

18. Check all bearings for wear and/or pitting.
19. Check all gears for wear, scuffing, pitting and damaged teeth.
20. **NOTE. The crown wheel and pinion are supplied as a matched set, also the pinion housing and bearing caps.**

ASSEMBLE

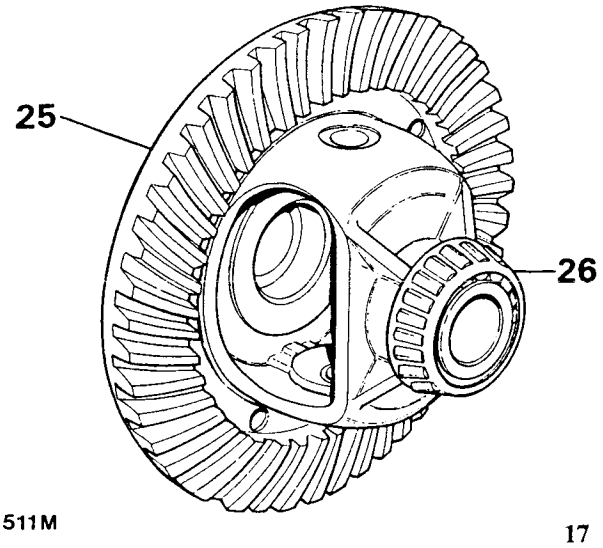
Differential gears

21. Fit the differential gears to the differential housing.
22. Fit the differential cross shaft and retaining circlips.



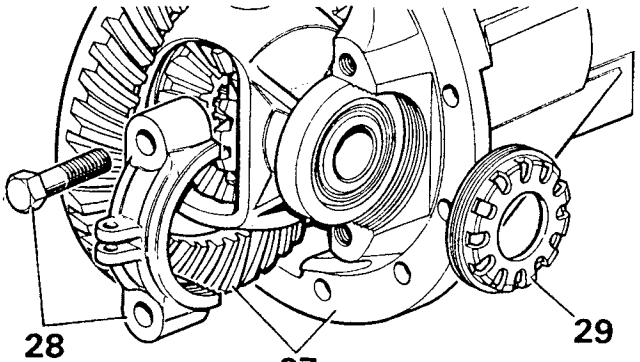
ST510M

23. Check the gear for freedom of rotation and backlash. Nominal backlash should be present. Excessive backlash will necessitate renewal of the gears and/or the differential housing. No provision is made for backlash adjustment.
24. Check that the serial number marked on the pinion end face matches that marked on the crown wheel.
25. Ensuring that the differential housing flange and crown wheel are thoroughly clean fit the crown wheel. Fit the crown wheel bolts and washers and evenly tighten.
26. Fit the carrier bearings using a suitable press or drift and assemble the tracks to the bearings.



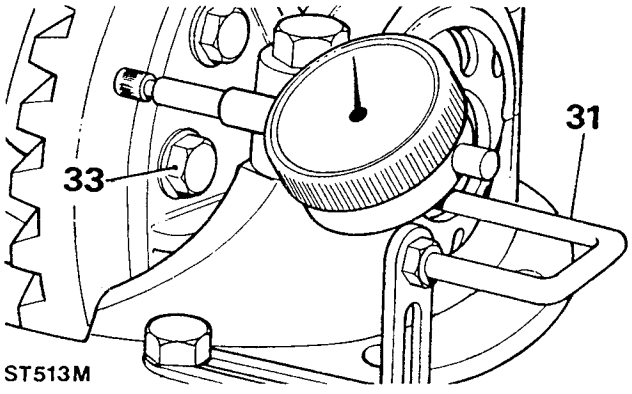
ST511M

27. Place the differential housing complete with crown wheel and bearings in the pinion housing.
28. Fit the bearing caps and bolts. Do not fully tighten the bolts.
29. Fit the bearing adjusting nuts and adjust to obtain zero end-float.
30. Tighten the bearing cap bolts.



ST512M

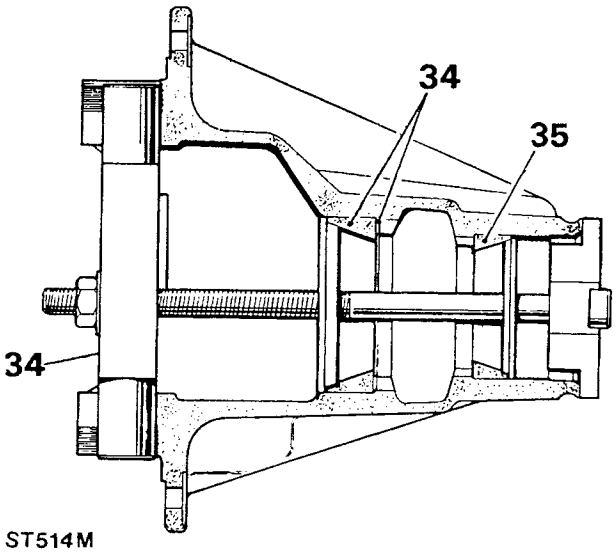
31. Using a dial gauge check the crown wheel for run-out. This should not exceed 0,10 mm (0.004 in). If excessive run-out is recorded remove the crown wheel and examine crown wheel and mounting flange for burrs, grit, etc. Refit the crown wheel and recheck. Run-out, attributable to a buckled or damaged differential housing flange can be corrected only by renewing the differential gear housing.
32. When satisfied that run-out is within the specified limits remove the differential housing from the pinion housing.
33. Remove the crown wheel bolts and refit them using Loctite 'Studlock'. Evenly tighten the bolts to the correct torque.



ST513M

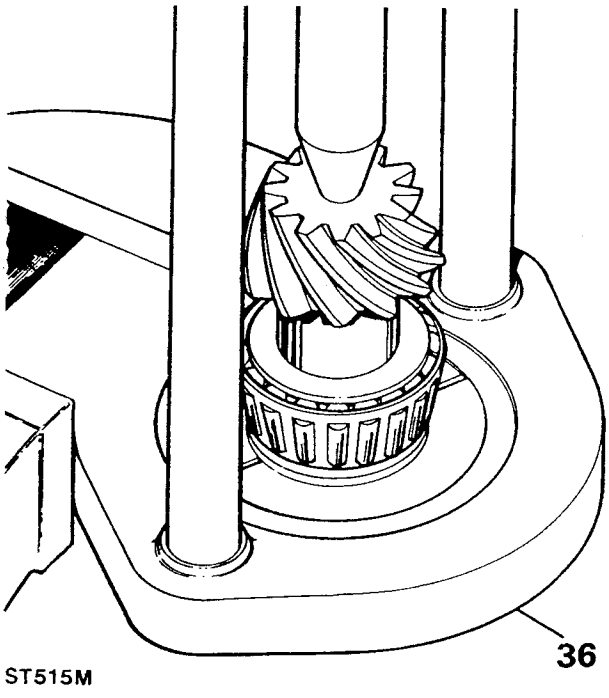
34. Fit the pinion head bearing track and the original shim to the pinion housing using service tools RO 262757A and RO 262757-1. If the original shim was damaged or mislaid use a new shim of at least 1,27 mm (0.050 in) thickness.
35. Fit the pinion outer bearing track to the pinion housing with service tool RO 262757A and RO 262757-2.

NOTE: Instructions 34 and 35 are carried out in one operation as illustrated.



ST514M

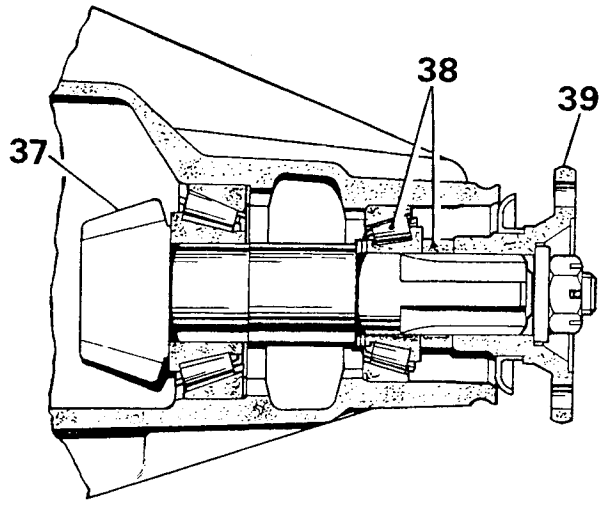
36. Fit the pinion head bearing to the pinion using service tool 18G 47-6.



ST515M

37. Enter the pinion into its location in the pinion housing. Do not fit the shims for bearing pre-load at this stage.
38. Fit the outer bearing and spacer.
39. Fit the driving flange, washer and nut.

continued

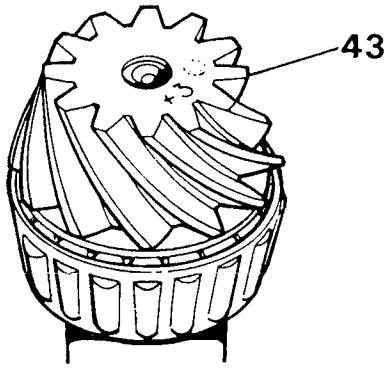


ST516M

40. Do not fit the oil seal at this stage.
41. Tighten the pinion flange nut slowly until the force required to rotate the pinion is 23 to 40,25 kgf cm (20 to 35 lbf in). This will pre-load the bearings in order to check the pinion height dimension.
NOTE: If using original bearings, which are bedded in, the pre-load figure is 11,5 to 17,25 kgf cm (10 to 15 in lb).

Drive pinion markings

42. The markings on the end face adjacent to the serial number are of no significance during servicing.
43. 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.
44. The nominal setting dimension is represented by the setting gauge block 18G 191-4 which is referenced from the pinion end face to the bottom radius of the differential bearing bore.



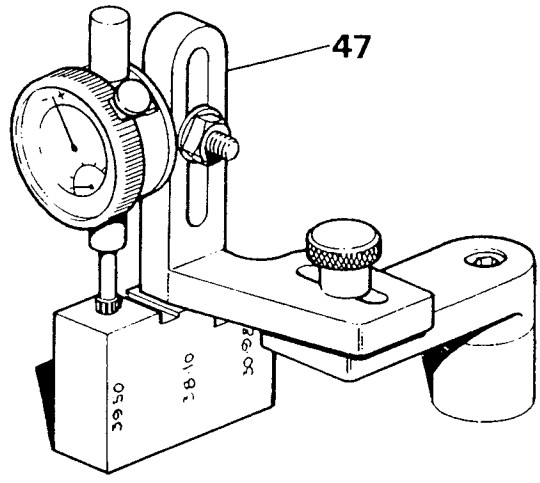
ST517

Drive pinion adjustment

45. Ensure that the pinion end face is free of raised burrs around the etched markings.
46. Remove the keep disc from the magnetised base of dial gauge tool 18G 191.
47. Place the dial gauge and setting block on a flat surface and zero the dial gauge stylus on the setting block.

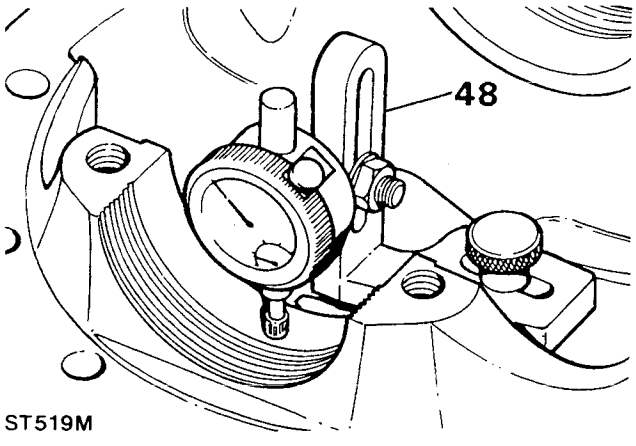
    NOTE: The setting block has three setting heights as follows:
    39,50 mm Rationalised axle
    38,10 mm Pre-Rationalised axle
    30,93 mm Salisbury axle

    Ensure that the height marked 39,50 mm is used for this differential.



ST518M

48. 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.



ST519M

continued

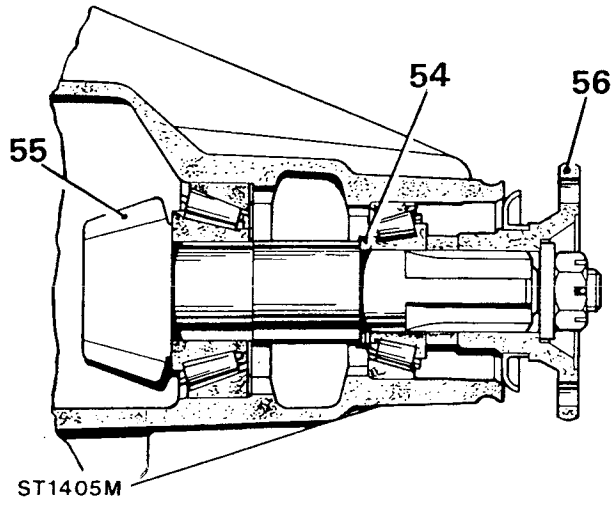
49. Repeat on the other bearing bore. Add together the readings then halve the sum to obtain the mean reading. Note whether the stylus has moved up or down from the zeroed setting.

a. Where the stylus has moved down, the amount is equivalent to the thickness of shims that must be removed from under the pinion inner track to bring the pinion down to the nominal position.
b. Where the stylus has moved up, the amount is equivalent to the addition thickness of shims required to bring the pinion up to the nominal position.

50. Before adjusting the shim thickness, check the pinion face marking and if it has a plus (+) figure, subtract that amount in thousandths of an inch from the shim thickness figure obtained in the previous item.
51. Alternatively, if the pinion has a minus (−) figure, add the amount to the shim thickness figure.
Adjust the shim thickness under the pinion head bearing track as necessary.
52. Recheck the pinion height setting. 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.

Bearing pre-load adjustment

53. Remove the pinion flange, pinion, outer bearing and spacer.
54. Slide new shims, of the same thickness as the originals (bearing pre-load) into position on the pinion shaft. If the original shim was damaged or mislaid use a new shim of at least 4,06 mm (0.160 in) thickness.
55. Enter the pinion in its location in the pinion housing and fit the outer bearing and spacer.
56. Fit the driving flange, washer and nut.
57. Do not fit the oil seal at this stage.



58. Tighten the pinion flange nut to the specified torque. The force required to rotate the pinion shaft should be within 23 to 40,25 kgf cm (20 to 35 lbf in) when initial inertia has been overcome. Change the bearing pre-load shim as necessary to obtain this requirement. A thicker shim will reduce pre-load; a thinner shim will increase pre-load.

NOTE: If using original bearings, which are bedded in, the pre-load figure is 11,5 to 17,25 kgf cm (10 to 15 in lb).

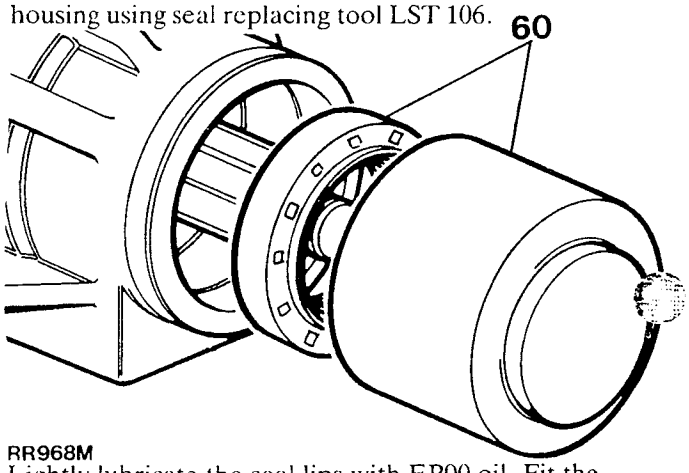
59. Remove the pinion flange.

Fitting Pinion Oil Seal — latest type FRC 8220

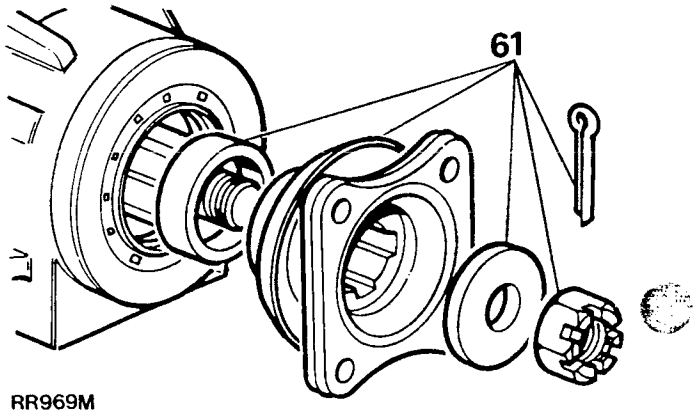
CAUTION A — When fitting the latest type oil seal FRC 8220 in place of the early type FRC 4586 the latest mudshield FRC 8154 must be fitted in place of the early type 236072.
Also seal replacer 18G 1382 must be used to fit the early type oil seal FRC 4586. This tool must not be used to fit latest seal FRC 8220.

CAUTION B — Before fitting the new seal to the differential, examine the seal to ensure that it is clean, undamaged and that the garter spring is properly located. A small scratch on the seal lips could impair its efficiency.

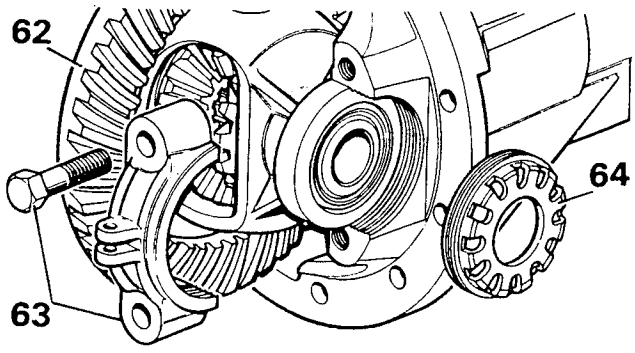
60. Coat the outer diameter of the new seal with an all-purpose grease and fit the seal, lip side leading squarely on the pinion nose housing and drive the seal into position flush with the end face of the housing using seal replacing tool LST 106.



61. Lightly lubricate the seal lips with EP90 oil. Fit the distance piece and flange and secure with washer and nut. Tighten the nut to the specified torque and fit a new split pin.

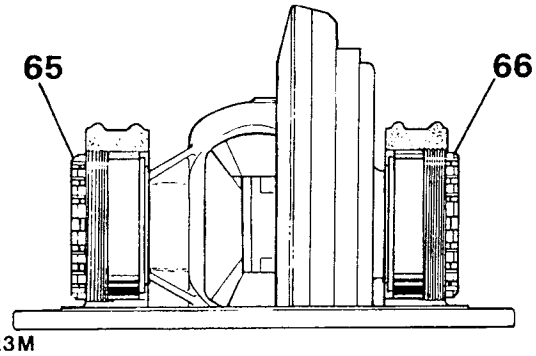


62. Place the differential housing in the pinion housing.
63. Fit the bearing caps and bolts. Do not fully tighten the bolts.
64. Fit the bearing adjusting nuts.



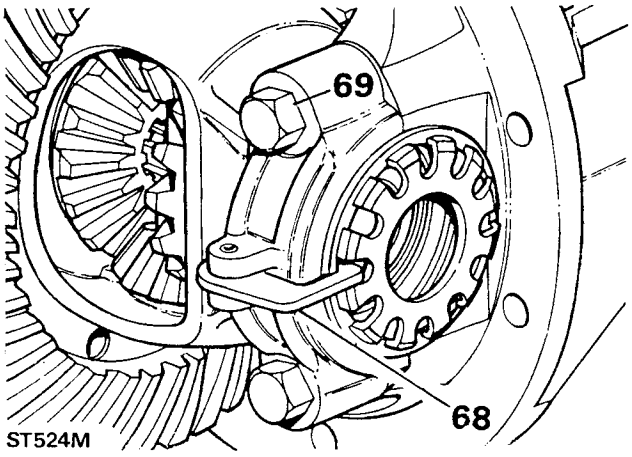
ST522M

65. Using service tool 530105, slacken the left hand bearing adjustment nut (as illustrated) to produce end float.
66. Tighten the right hand nut until crown wheel/pinion backlash is just removed.



ST523M

67. Tighten the left hand nut slowly until it contacts the bearing. Continue turning the left-hand nut until a backlash of 0,10 to 0,17 mm (0.004 to 0.007 ins) is achieved. Do not slacken the right-hand nut at any time, otherwise the bearing preload will be affected.
68. Fit the locking fingers and roll pins. If necessary, tighten the adjustment nuts slightly to align the locking finger with a slot.



ST524M

69. Evenly tighten the bearing cap bolts to the specified torque.
70. Recheck crown wheel/pinion backlash.
71. Lubricate the bearings and gears.

DATA

Pinion bearing pre-load	23 to 40,25 kgf cm (20 to 35 lbf in)
Crown wheel run-out	0,10 mm (0.004 in)
Crown wheel/pinion backlash	0,10 to 0,17 mm (0.004 to 0.007 in)

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INTRODUCTION

This Workshop Manual covers the Land Rover Ninety and One Ten range of vehicles. It is primarily designed to assist skilled technicians in the efficient repair and maintenance of Land Rover vehicles.

Using the appropriate service tools and carrying out the procedures as detailed will enable the operations to be completed within the time stated in the 'Repair Operation Times'.

The Manual has been produced in separate books; this allows the information to be distributed throughout the specialist areas of the modern service facility.

A table of contents in Book 1 lists the major components and systems together with the section and book numbers. The cover of each book details the sections contained within that book.

The title page of each book carries the part numbers required to order replacement books, binders or complete Service Manuals. This can be done through the normal channels.

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 and accessories:
Safety features embodied in the vehicle may be impaired if other than Land Rover parts are fitted. In certain territories, legislation prohibits the fitting of parts not to the vehicle manufacturer's specification. Torque 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.

POISONOUS SUBSTANCES

Many liquids and other substances used in motor vehicles are poisonous and should under no circumstances be consumed and should as far as possible be kept away from open wounds. These substances among others include antifreeze, brake fluid, fuel, windscreen washer additives, lubricants and various adhesives.

FUEL HANDLING PRECAUTIONS

The following information provides basic precautions which must be observed if petrol (gasoline) 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.

GENERAL

Petrol/gasoline vapour is highly flammable and in confined spaces is also very explosive and toxic.
When petrol/gasoline evaporates it produces 150 times its own volume in vapour, which when diluted with air becomes a readily ignitable mixture. The vapour is heavier than air and will always fall to the lowest level. It can readily be distributed throughout a workshop by air current, consequently, even a small spillage of petrol/gasoline is potentially 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.
Always disconnect the vehicle battery BEFORE carrying out dismantling or draining work on a fuel system.
Whenever petrol/gasoline is being handled, drained or stored, or when fuel systems are being dismantled all forms of ignition must be extinguished or removed, any head-lamps used must be flameproof and kept clear of spillage.

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

FUEL TANK DRAINING

WARNING: PETROL/GASOLINE MUST NOT BE EXTRACTED OR DRAINED FROM ANY VEHICLE WHILST IT IS STANDING OVER A PIT.

Draining or extracting petrol/gasoline from vehicle fuel tank must be carried out in a well ventilated area.
The receptacle used to contain the petrol/gasoline must be more than adequate for the full amount of fuel to be extracted or drained. The receptacle should be clearly marked with its contents, and placed in a safe storage area which meets the requirements of local authority regulations.
WHEN PETROL/GASOLINE HAS BEEN EXTRACTED OR DRAINED FROM A FUEL TANK THE PRECAUTIONS GOVERNING NAKED LIGHTS AND IGNITION SOURCES SHOULD BE MAINTAINED.

FUEL TANK REMOVAL

On vehicles where the fuel line is secured to the fuel tank outlet by a spring steel clip, it is recommended that such clips are released before the fuel line is disconnected or the fuel tank unit is removed. This procedure will avoid the possibility of residual petrol fumes in the fuel tank being ignited when the clips are released.
As an added precaution fuel tanks should have a PETROL/GASOLINE VAPOUR warning label attached to them as soon as they are removed from the vehicle.

FUEL TANK REPAIR

Under no circumstances should a repair to any tank involving heat treatment be carried out without first rendering the tank SAFE, by using one of the following methods:

STEAMING: With the filler cap and tank unit removed, empty the tank. Steam the tank for at least two hours with low pressure steam. Position the tank so that condensation can drain away freely, ensuring that any sediment and sludge not volatised by the steam, is washed out during the steaming process.

BOILING: With the filler cap and tank unit removed, empty the tank. Immerse the tank completely in boiling water containing an effective alkaline degreasing agent or a detergent, with the water filling and also surrounding the tank for at least two hours.

After steaming or boiling a signed and dated label to this effect should be attached to the tank.

SPECIFICATION

Purchasers are advised that the specification details set out in this 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 specifications with or without notice, and at such times and in such manner as they think fit. Major as well as minor changes may be involved in accordance with the Manufacturer's policy of constant product improvement.

Whilst every effort is made to ensure the accuracy of the particulars contained in this Manual, neither the Manufacturer 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.

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Special Service Tools

The use of approved special service tools is important. They are essential if service operations are to be carried out efficiently, and safely. The amount of time which 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, PO Box 3 Daventry, Northants, England NN11 4NF.

The tools recommended in this Workshop Manual are listed in a multi-language, illustrated catalogue obtainable from Messers. V. L. Churchill at the above address under publication number 2217/2/84 or from Land Rover Ltd., under part number LSM0052TC from the following address, Land Rover Merchandising Service, P.O. Box 534, Erdington, Birmingham B24 0QS.

GEMMER MANUAL STEERING BOX OVERHAUL

Special tool:
RO 1016

Dismantle

1. Remove the steering box from the vehicle, and remove the drop arm.
2. Remove the adjuster locknut.
3. Remove the four bolts securing the top cover.
4. Unscrew the top cover from the adjuster.
5. Lift out the sector shaft.
6. Remove the four bolts securing the worm shaft retaining plate and remove the plate complete with shims and joint washer.
7. Remove the taper bearing and track.
8. Withdraw the worm shaft and collect the opposite taper bearing.
9. Drift out the worm shaft oil seal.
10. Drift out the shaft-end bearing track and collect the shim. Note since this shim or one of the same value must be refitted, as a precaution against loss, check the thickness with a micrometer and note the reading.
11. Prise out the sector shaft oil seal.
12. Drift out the sector shaft needle roller bearings.

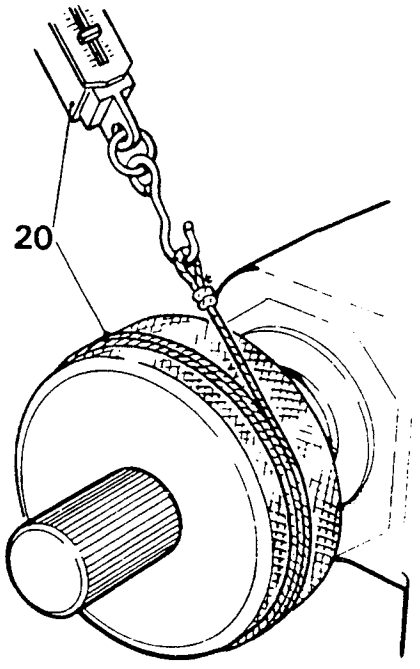
Inspection

13. Clean and degrease all parts and examine for wear and damage.
14. Renew the bearings (if worn), oil seals and joint washers and any other unsatisfactory parts.
15. If the bearing in the top cover is worn renew the complete cover with bearing.

Assembling

Cleanliness, during the following instructions, is essential.

16. Press or drift in the worm, shaft-end, bearing track ensuring that the same shim or one of the same value is fitted behind the track. It is essential that the track is fitted squarely and pressed fully home.
17. Lubricate and fit the bearing to the shaft and insert the shaft into the box.
18. Lubricate and fit the opposite bearing and track to the worm.
19. Fit the cover plate, joint washer and original shims. Secure with the four bolts and evenly tighten to 25 to 30 Nm (18 to 22 lbs ft).
20. Check the worm shaft bearing pre-load by attaching special tool RO1016 or a similar alternative 63,5 mm (2.5 in) diameter, to the worm shaft. Wrap string round the tool and attach a spring balance to one end and with a steady pull note the rolling resistance which should be 2.26 to 2.72 Kg (5 to 6 lbs force). Adjust by adding or subtracting shims. When the correct figure is achieved, remove the bolts, coat the threads with sealant and fit and evenly tighten to within the above torque figures.

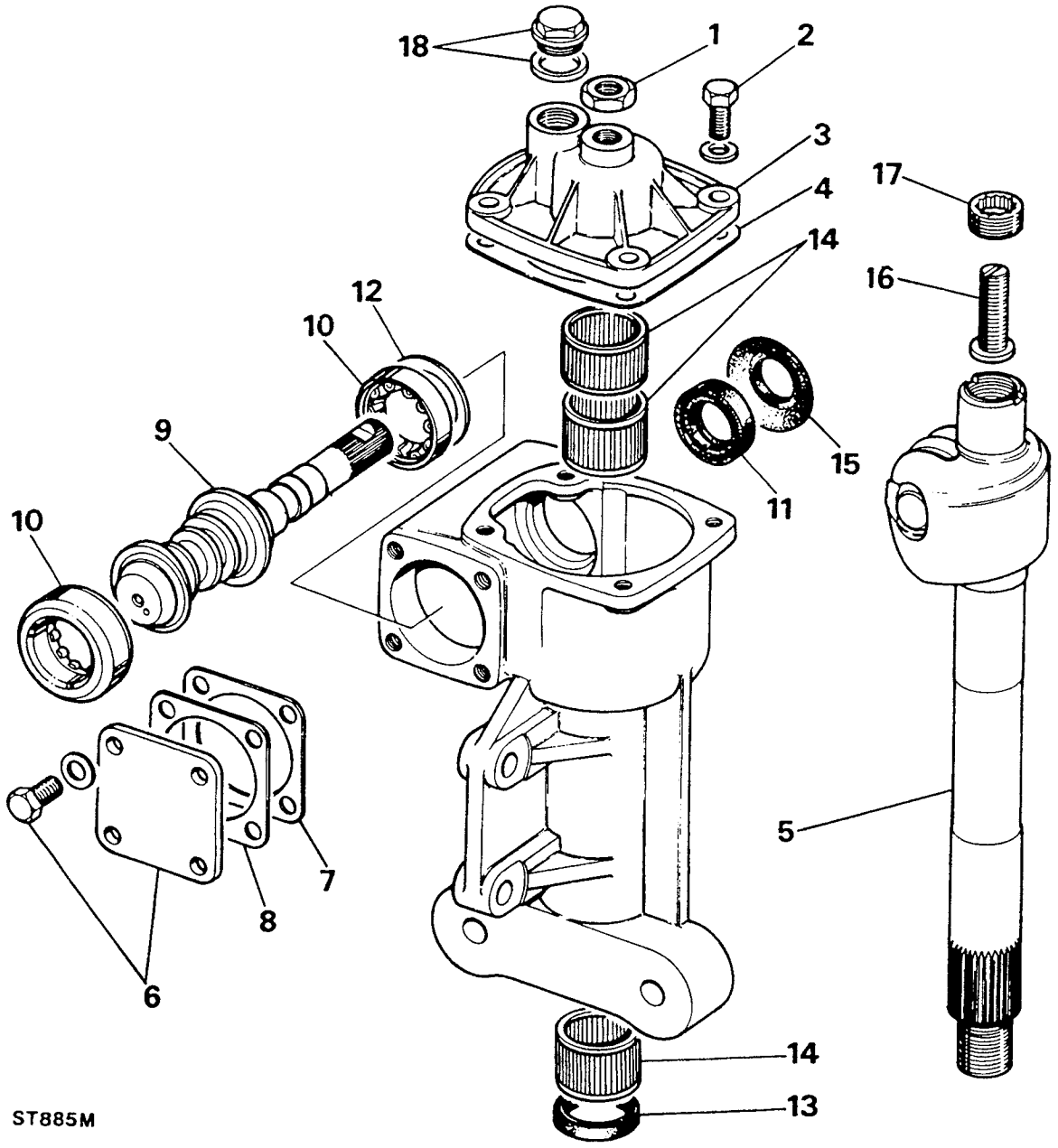


ST 887M

21. With the lip side leading fit the oil seal to the shaft-end of the box.

NOTE: When performing instructions 22, 23 and 26 pressure must only be applied to the hardened square end of the bearings.

22. Press in the sector shaft top bearing to a depth of 83 mm (3.150 in) from the top machined face of the steering box.
23. Press in the sector shaft lower bearing 1,00 mm (0.040 in) below the chamfer.
24. Check that no end-play exists in the sector shaft adjuster. To reduce end-play unstake the threaded cup and turn clockwise until all play is removed and restake.
25. Fit the sector shaft so that the roller is in the centre of the worm in the straight ahead position.
26. Fit the bearing to the sector shaft top cover.
27. Screw the top cover onto the adjuster and secure with the four bolts and evenly tighten to 25 to 30 Nm (18 to 22 lbs ft).
28. Loosely fit the adjuster locknut.
29. Keeping the sector shaft in the straight ahead position fit the drop arm and turn the adjuster clockwise until pre-load is applied to the shaft. The amount of pre-load should be such that when the shaft is turned half a turn to the left then half a turn to the right, the backlash must only just be perceptible. When satisfactory tighten the adjuster locknut.
30. Fit the sector shaft oil seal.
31. Remove the oil filter plug and pour in approximately 0,43 litres (0.75 pints) of the appropriate recommended oil to a minimum level of 25 mm (1.0 in) below the top of the filler hole. Refit the plug and tighten to 20 Nm (14.75 lbs ft).



KEY TO MANUAL STEERING BOX

1. Adjuster lock nut.
2. Top cover retaining bolts.
3. Top cover.
4. Top cover joint washer.
5. Sector shaft.
6. Worm shaft retaining plate and bolts.
7. Worm shaft shim(s).
8. Worm shaft joint washer.
9. Worm shaft.
10. Worm shaft taper bearing.
11. Worm shaft oil seal.
12. Worm shaft bearing track shim.
13. Sector shaft oil seal.
14. Sector shaft needle roller bearings.
15. Worm shaft grommet.
16. Sector shaft adjuster.
17. Sector shaft threaded cup.
18. Oil filler plug and washer.

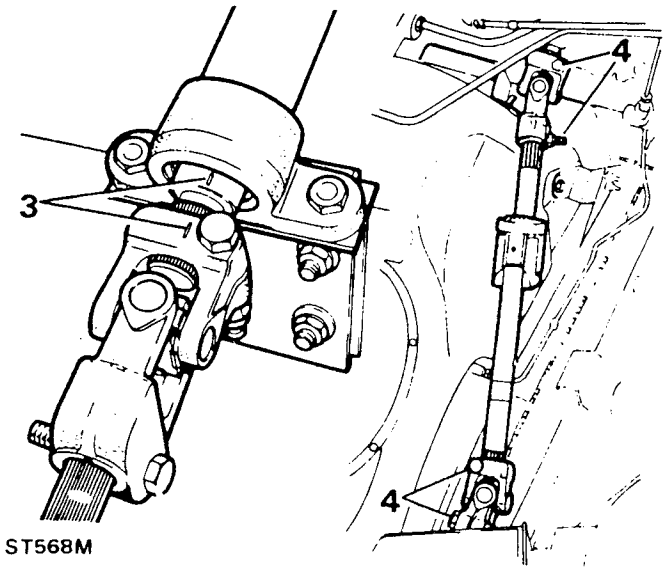
REMOVE AND OVERHAUL STEERING COLUMN

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.



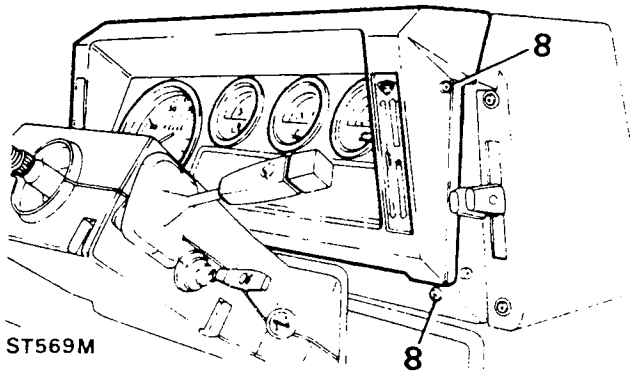
ST568M

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

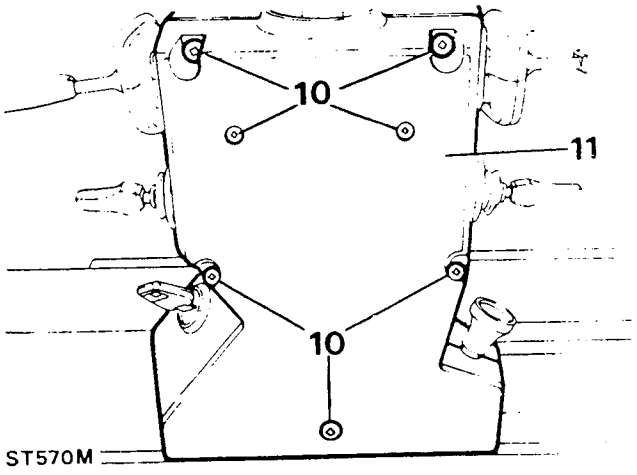
7. Disconnect the battery.
8. Remove the four screws securing the instrument panel and pull panel away from facia to enable the speedometer cable to be disconnected.
9. Also disconnect two block connectors, one multiplug connector and one white wire and withdraw the panel complete with instruments.



ST569M

Remove the steering column switches

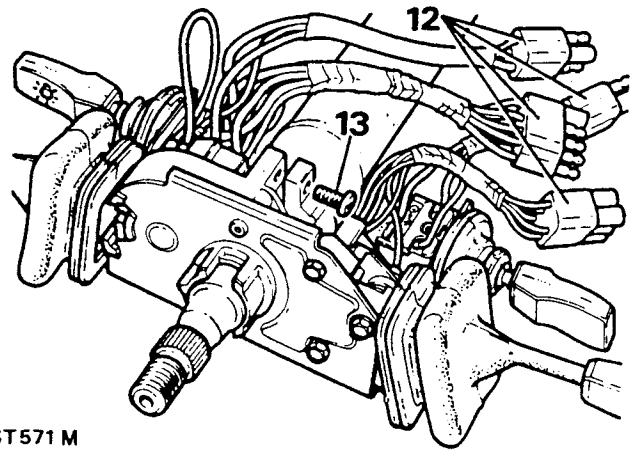
10. Remove five screws and two self-tapping screws to remove the top half of the nacelle.
11. Ease the bottom half of the nacelle from the four switch grommets and disconnect the mixture control cable (Petrol vehicle) and remove the lower nacelle.



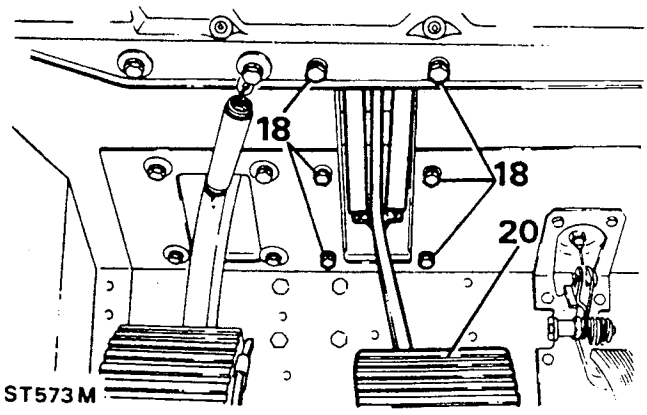
ST570M

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.

continued



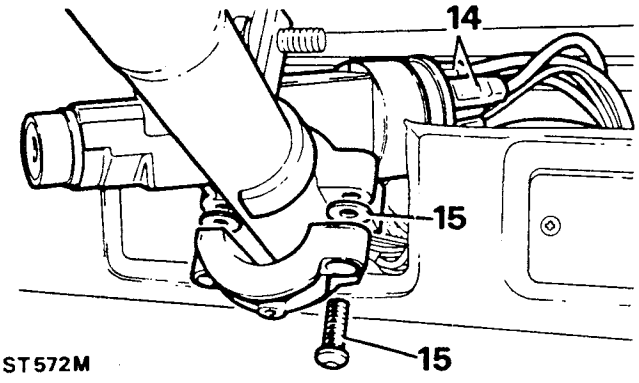
ST571 M



ST573 M

Remove the steering column lock-switch

14. Note the position of the wires on the back of the lock switch and disconnect the lucars.
15. Using a punch or stud extractor remove the two shear bolts securing the switch to the column. Remove the switch and collect the two plain washers between the switch and clamp.



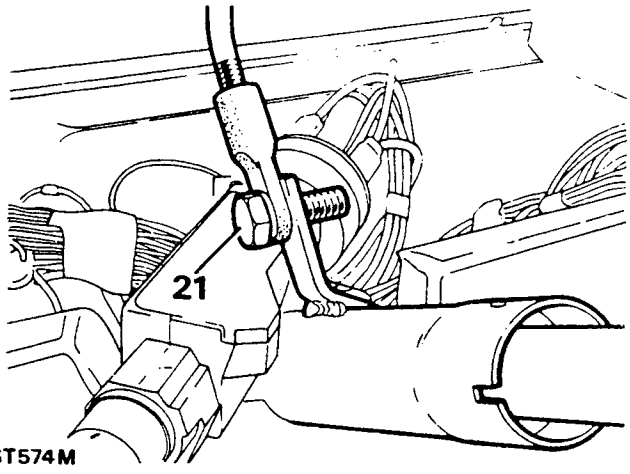
ST572M

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 the servo.
18. Remove the six bolts retaining the pedal box to the bulk head.
19. Disconnect the wires from the stop lamp switch.
20. Taking care not to damage the brake fluid pipes remove the pedal box from the bulkhead complete with the brake pedal assembly.

Remove the steering column

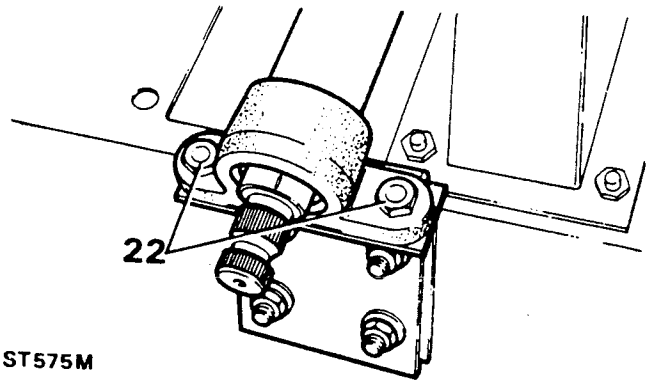
21. Remove the bolt securing the tie-bar to the steering column, behind the instrument panel.



ST574M

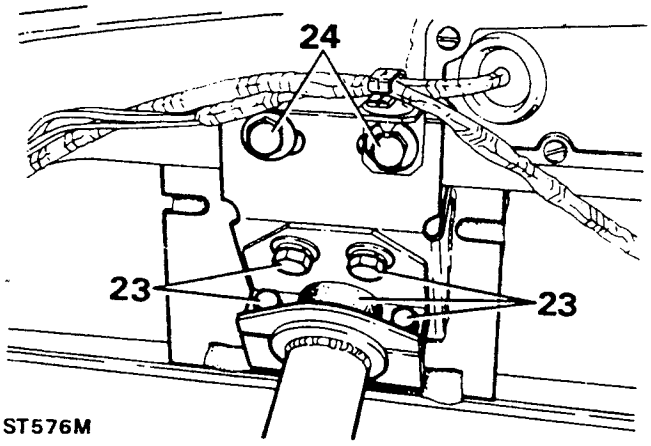
22. Remove the two bolts securing the lower end of the column.

continued



ST575M

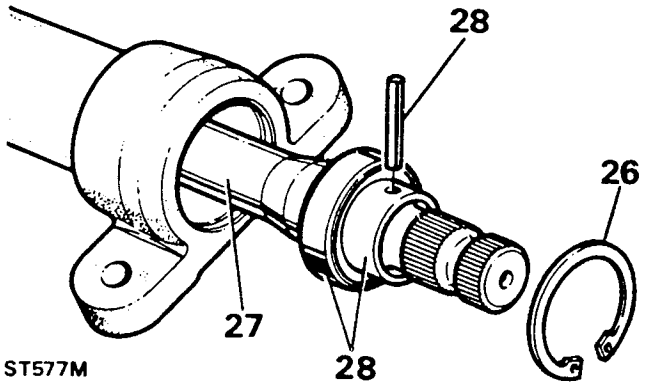
23. Remove the two bolts securing the two halves of the top clamp and the two bolts that secure the top half of the clamp to the bulkhead and remove the clamp and rubber packing.
24. Remove the two bolts securing the column main support bracket to the bulkhead.
25. Remove the steering column and main support bracket from the vehicle.



ST576M

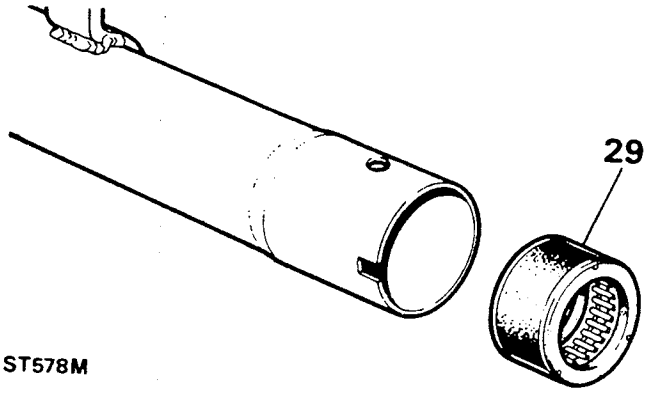
Overhaul the steering column

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

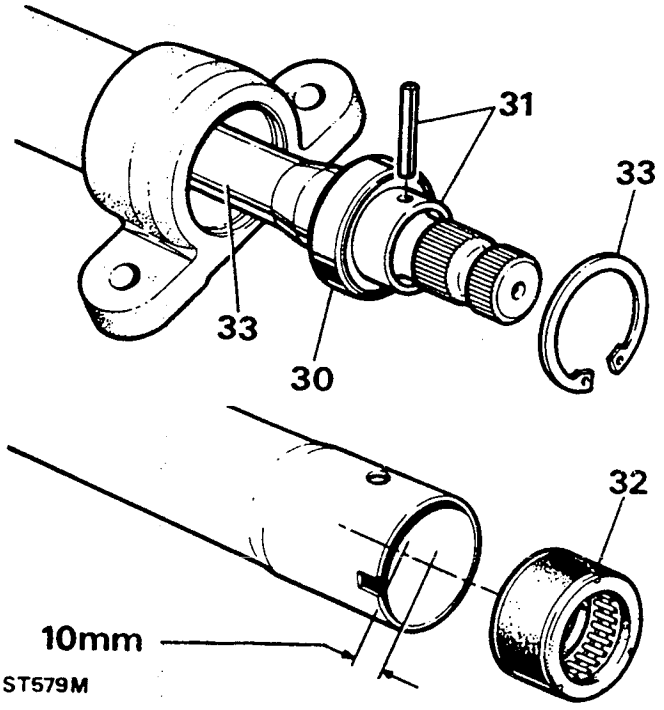
29. Drive the needle bearing from the outer column.



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.

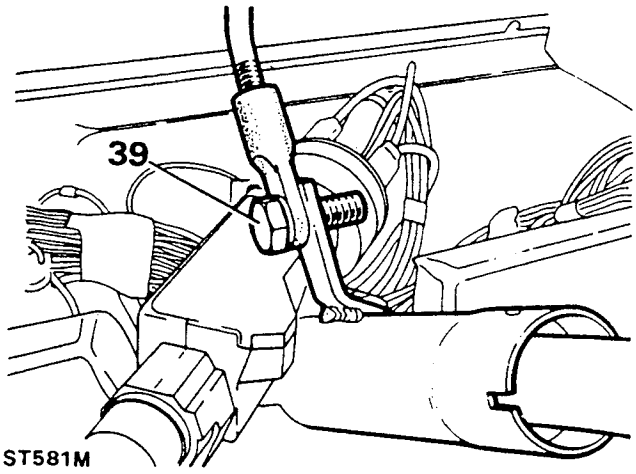
continued



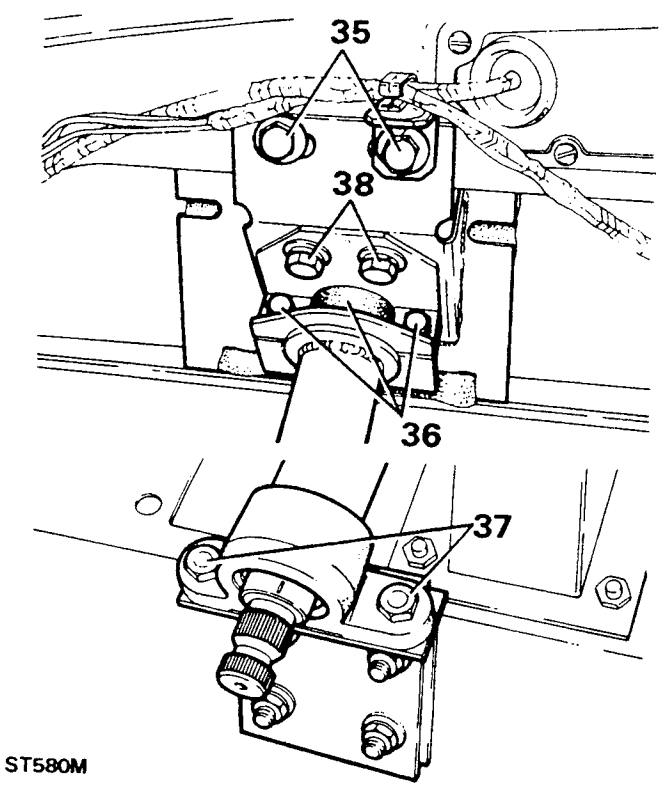
ST579M

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.

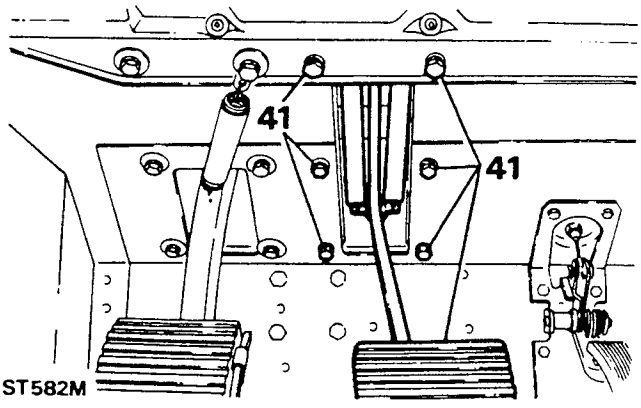


ST581M



ST580M

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

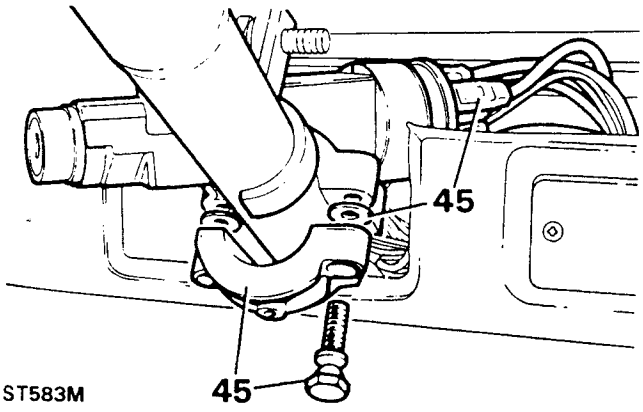
Fit steering column lock switch

44. Place lock switch in position and rotate the steering column inner shaft to line up the slot with the switch plunger.

continued

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.

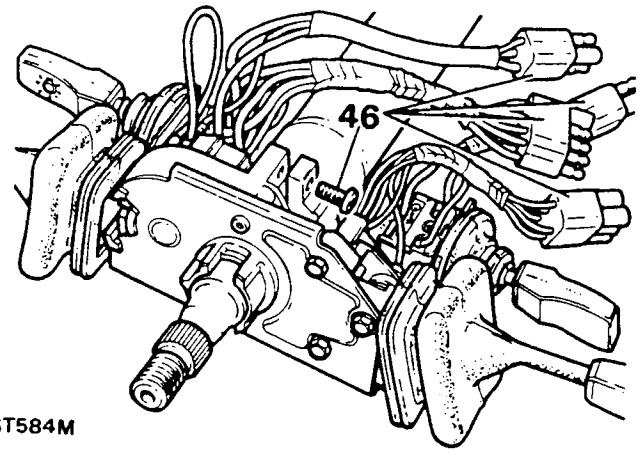
45. Secure the lock to the column with the clamp and shear bolts, whilst inserting two plain washers between the switch and clamp. Tighten the bolts but not enough to shear them. Temporarily fit the steering wheel and operate the switch and lock mechanism several times to ensure it functions properly before finally tightening the bolts until the heads shear. Connect the electrical leads to the rear of the switch.



ST583M

Fit steering column switch assembly

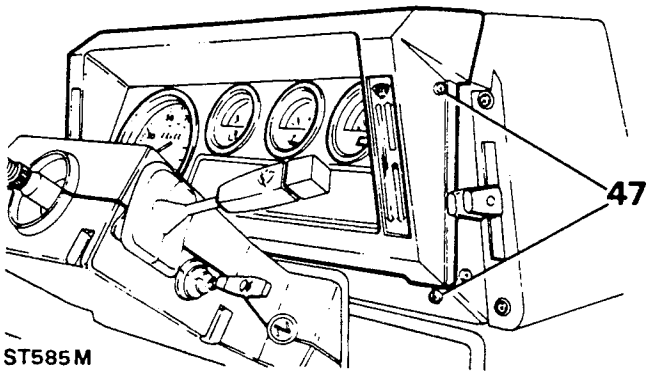
46. Fit the steering column switch assembly and secure with the single screw. Connect the four multi-plugs to the main harness.



ST584M

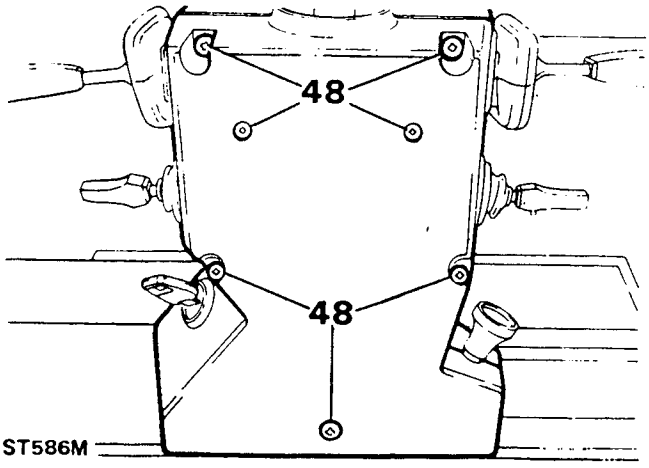
Fit instrument panel and nacelle

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.



ST585M

48. Locate the top half of the nacelle in position and fit the mixture control cable (Petrol only) to the lower half. Locate the switch grommets and secure the two halves together with the four long screws one short and two self-tapping screws.

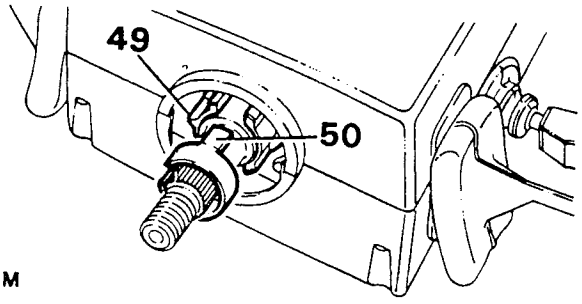


ST586M

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.

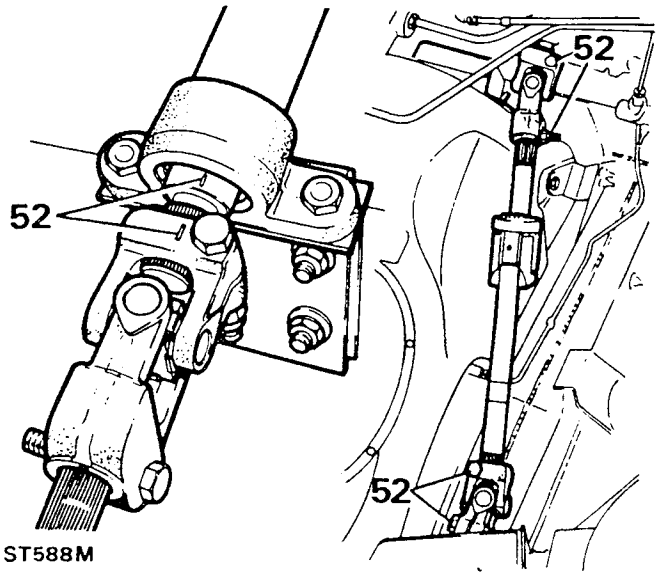
continued



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.



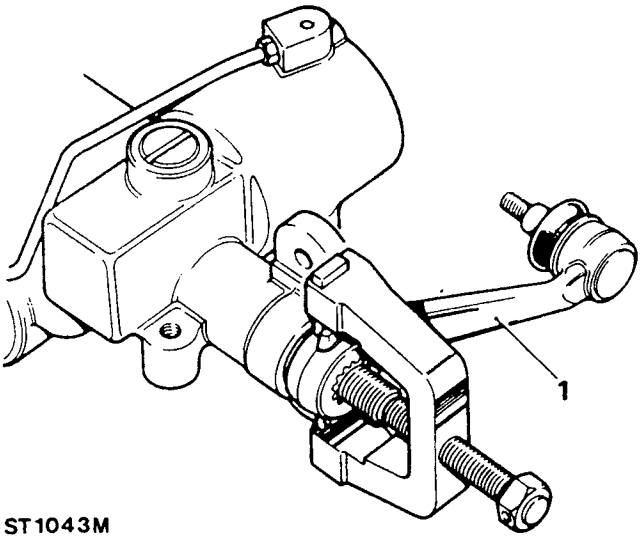
ST588M

POWER STEERING BOX OVERHAUL — Adwest early vehicles

Service tools:
'C' Spanner — 606600
Peg Spanner — 606601
Ring expander — 606602
Ring compressor — 606603
Seal saver, sector shaft — 606604
Seal saver, valve and worm — R01015
Torque setting tool — R01016

DISMANTLE

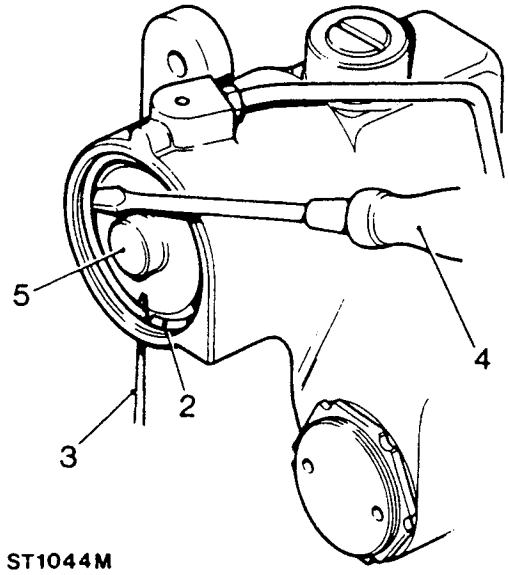
1. Remove the steering box from the vehicle, and withdraw the drop arm.



ST1043M

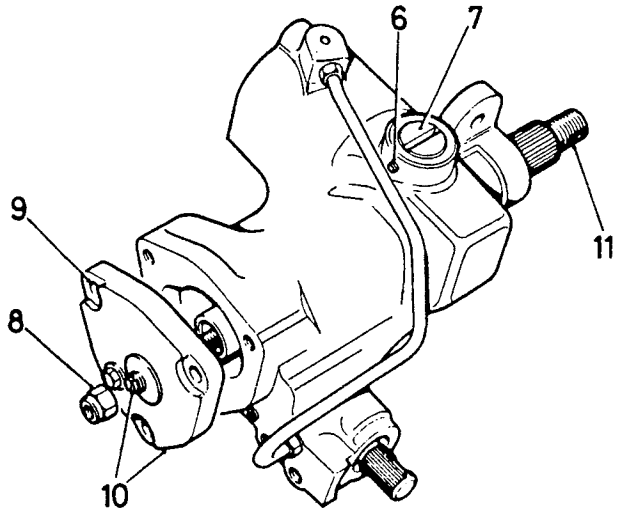
2. Rotate the retainer ring, as necessary, until one end is approximately 12 mm (0.500 in) from the extractor hole.
3. Lift the cover retaining ring from the groove in the cylinder bore, using a suitable pointed drift applied through the hole provided in the cylinder wall.
4. Complete the removal of the retainer ring, using a screwdriver.
5. Turn on left lock (L.H. steering) until the piston pushes out the end cover (for R.H. steering models, turn on right lock).

continued



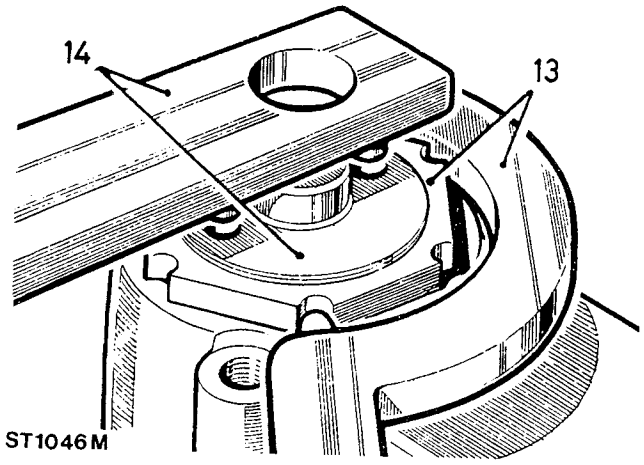
ST1044M

6. Slacken the grub screw retaining the rack pad adjuster.
7. Remove the rack pad adjuster.
8. Remove the sector shaft adjuster locknut.
9. Remove the sector shaft cover fixings.
10. Screw in the sector shaft adjuster until the cover is removed.
11. Slide out the sector shaft.



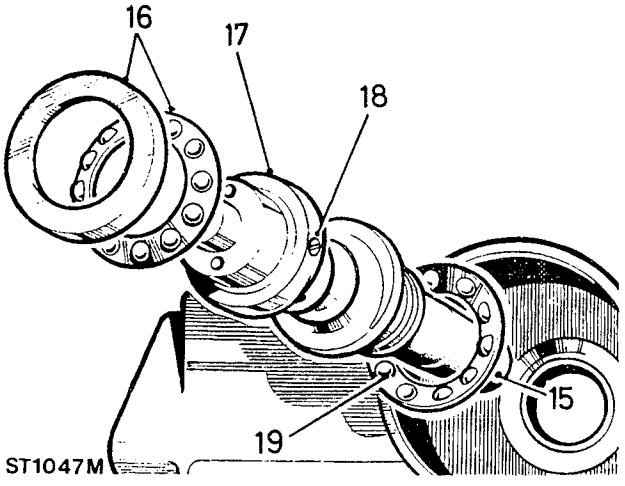
ST1045M

12. Withdraw the piston, using a suitable UNC bolt screwed into the tapped hole in the piston.
13. Remove the worm adjusting screw locknut using 'C' spanner 606600.
14. Remove the worm adjusting screw using peg spanner 606601.



ST1046M

15. Tap the splined end of the spindle shaft to free the bearing.
16. Withdraw the bearing cup and caged ball bearing assembly.
17. Withdraw the valve and worm assembly.
18. **Do not disturb the trim screw, otherwise the calibration will be adversely affected.**
19. Withdraw the inner bearing ball race and shims. Retain the shims.



ST1047M

Steering box seals

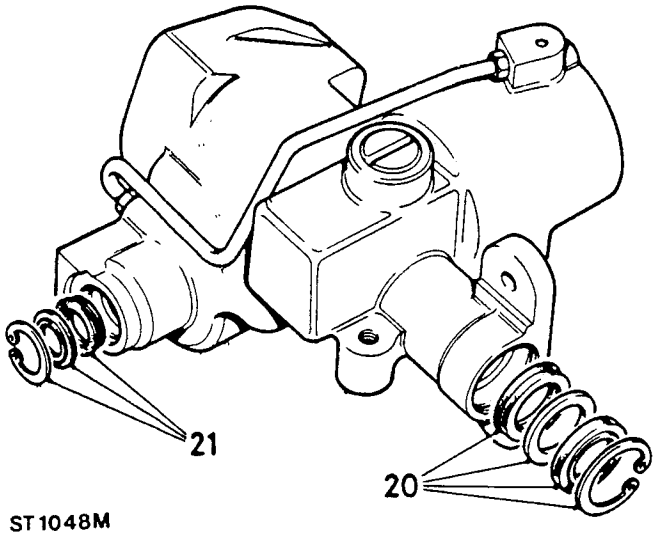
20. Remove the circlip and seals from the sector shaft housing bore.

    NOTE: Do not remove the sector bush unless replacement is required. Refer to instruction 23.

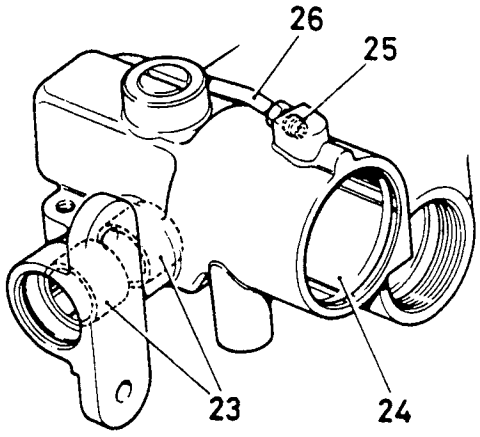
21. Remove the circlip and seals from the input shaft housing bore.

    NOTE: Do not remove the input shaft needle bearing unless replacement is required.

continued



ST1048M



ST1050M

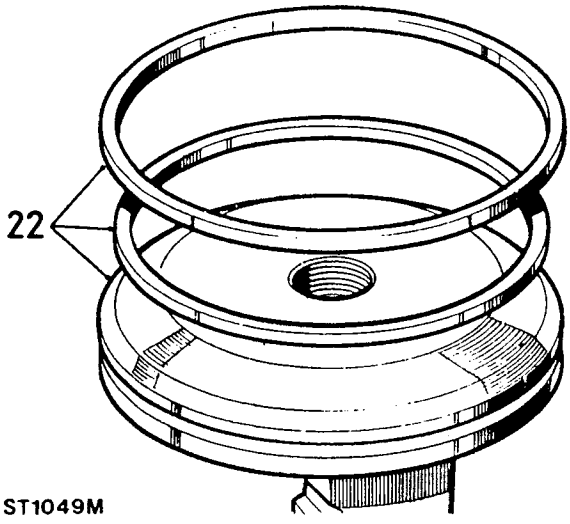
Inspecting

22. Discard all rubber seals and provide replacements.

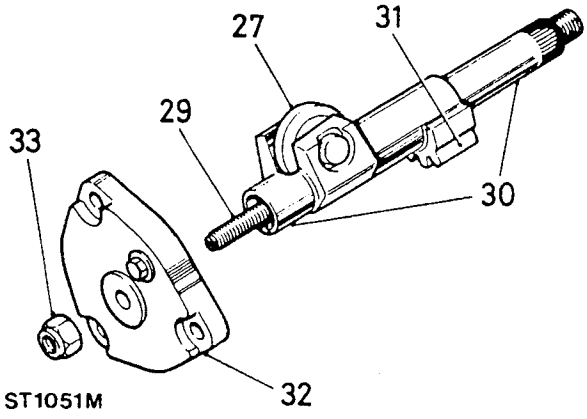
NOTE: A rubber seal is fitted behind the plastic ring on the rack piston. Discard the seal also the plastic ring and provide replacements.

Sector shaft assembly

27. Check that there is no side play on the rollers.
28. If excessive side play on the roller does exist renew the sector shaft.
29. Check the condition of the adjuster screw threads.
30. Examine the bearing areas on the shaft for excessive wear.
31. Examine the gear teeth for uneven or excessive wear.



ST1049M



ST1051M

Steering box casing

23. If necessary, replace the sector shaft bush, using suitable tubing as a drift.
24. Examine the piston bore for traces of scoring and wear.
25. Examine the inlet tube seat for damage. If replacement is necessary this can be undertaken by using a suitable tap.
26. Examine the feed tube for signs of cracking.

Sector shaft cover assembly

32. The cover, bush and seat are supplied as a complete assembly for replacement purposes.

Sector shaft adjuster locknut

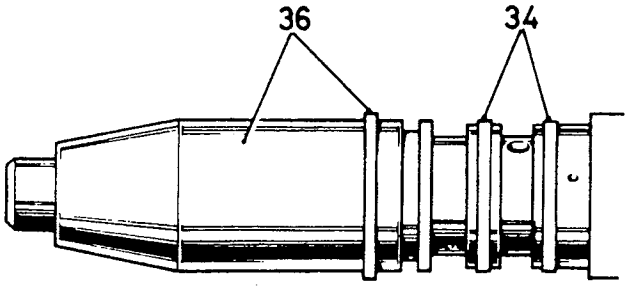
33. The locknut functions also as a fluid seal and must be replaced at overhaul.

continued

Valve and worm assembly

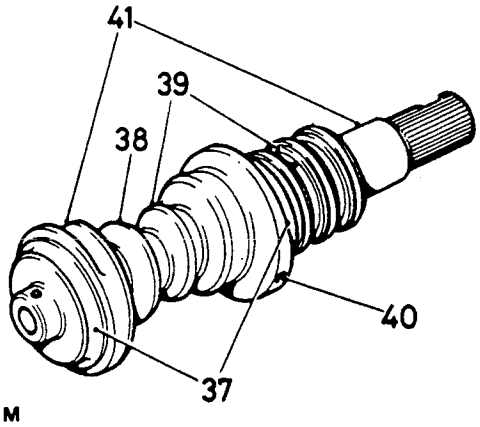
34. Examine the valve rings which must be free from cuts, scratches and grooves. The valve rings should be a loose fit in the valve grooves.
35. Remove the damaged rings ensuring that no damage is done to the seal grooves.
36. If required, fit replacement rings, using the ring expander 606602. Both rings and tool may be warmed if found necessary. Use hot water for this purpose. Then insert into the ring compressor 606603 to cool.

NOTE: The expander will not pass over rings already fitted. These rings must be discarded to allow access then renewed.



ST1052M

37. Examine the bearing areas for wear. The areas must be smooth and not indented.
38. Examine the worm track which must be smooth and not indented.
39. Check for excessive end-float between the worm and valve sleeve. End-float must not exceed 0,12 mm (0.005 in).
40. Rotary movement between the components at the trim pin is permissible.
41. Check for wear on the torsion bar assembly pins; no free movement should exist between the input shaft and the worm.



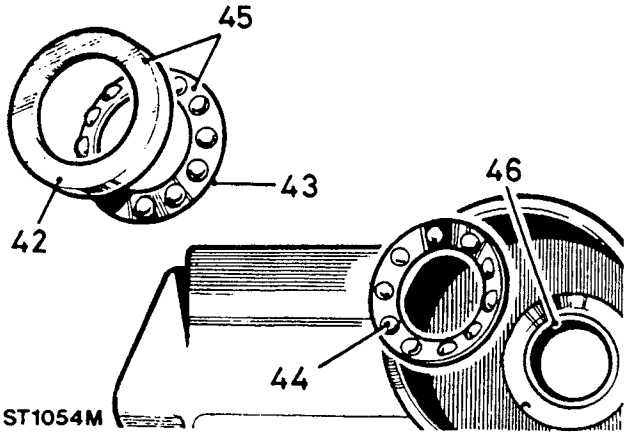
ST1053M

NOTE: Any sign of wear at locations 39, 40 and 41 make it essential that the complete valve and worm assembly are renewed.

Ball bearing and cage assemblies

42. Examine the ball races and cups for wear and general condition.
43. If the ball cage has worn against the bearing cup, fit replacements.
44. Bearing balls must be retained by the cage.
45. Bearings and cage repair are carried out by the complete replacement of the bearings and cage assembly. The bearing cup may be replaced separately only.
46. To remove the inner bearing cup and shim washers, jar the steering box on the work bench.

NOTE: Should difficulty be experienced at this stage, warm the casing and the bearing assembly. Cool the bearing cup using a suitable mandrel and jar the steering box on the bench.

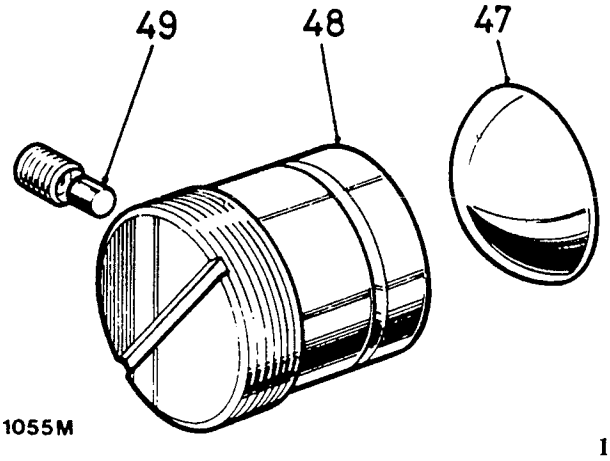


ST1054M

Rack thrust pad and adjuster

47. Examine the thrust pad for scores.
48. Examine the adjuster for wear in the pad seat.
49. Examine the nylon pad and adjuster grub screw assembly for wear.

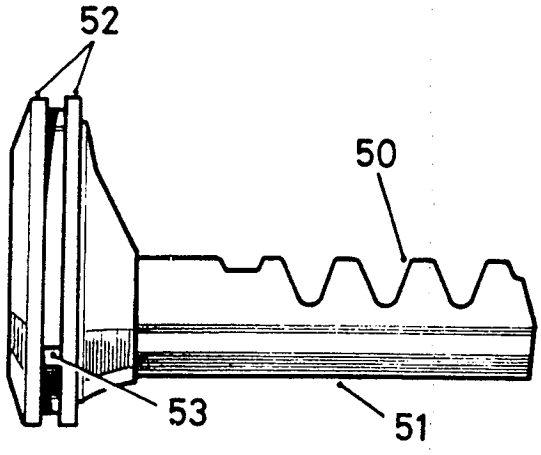
continued



ST1055M

Rack and piston

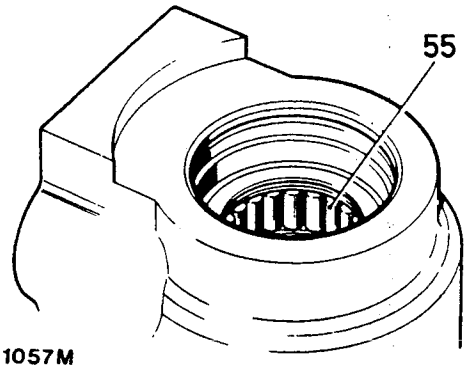
50. Examine for excessive wear on the rack teeth.
51. Ensure the thrust pad bearing surface is free of scores and wear.
52. Ensure that the piston outer diameters are free from burrs and damage.
53. Examine the seal and ring groove for scores and damage.
54. Fit a new rubber ring to the piston. Warm the white nylon seal and fit this to the piston. Slide the piston assembly into the cylinder with the rack tube outwards. Allow to cool.



ST1056M

Input shaft needle bearing

55. If necessary, replace the bearing. The replacement must be fitted squarely in the bore (numbered face of the bearing uppermost). Then, carefully push the bearing in until it is flush with the top of the housing bore. Ideally, the bearing will be just clear of the bottom of the housing bore.



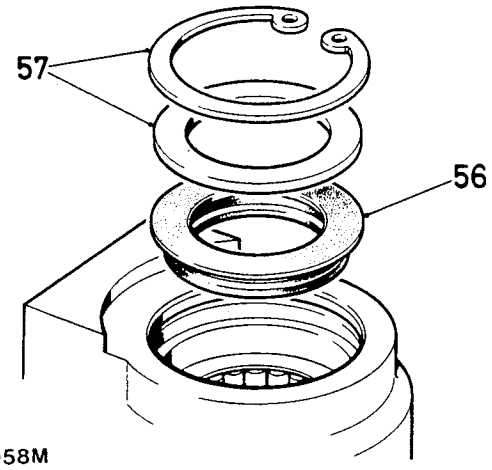
ST1057M

REASSEMBLE

NOTE: When fitting replacement oil seals, these must be lubricated with recommended fluid. Also ensure that absolute cleanliness is observed during assembly.

Input shaft oil seal

56. Fit the seal, lipped side first, into the housing. When correctly seated, the seal backing will lie flat on the bore shoulder.
57. Fit the extrusion washer and secure with the circlip.

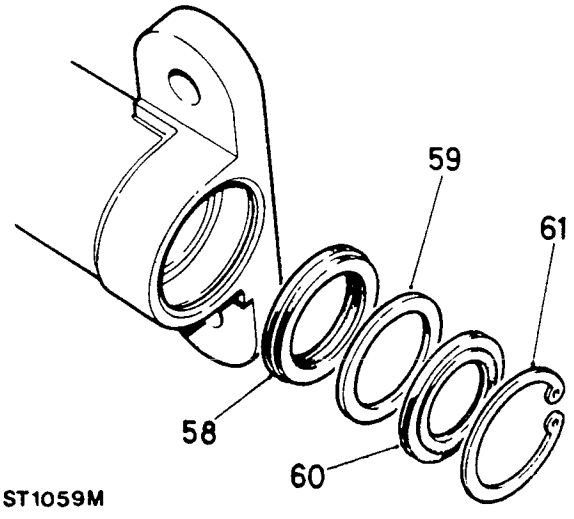


ST1058M

Sector shaft seal

58. Fit the oil seal, lipped side first.
59. Fit the extrusion washer.
60. Fit the dirt seal, lipped side last.
61. Fit the circlip.

continued



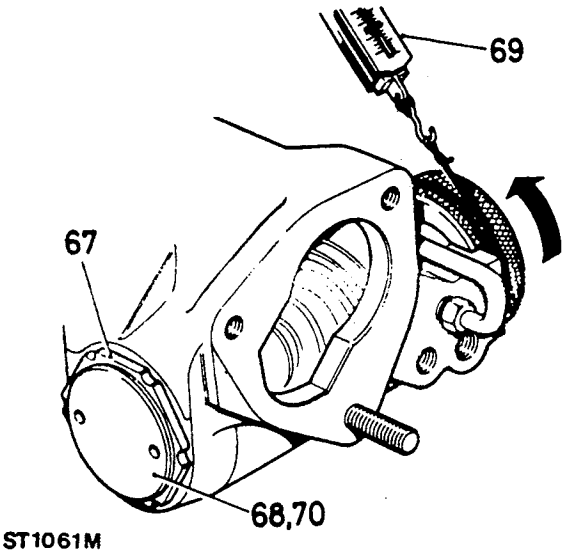
ST1059M

Fitting the valve and worm assembly

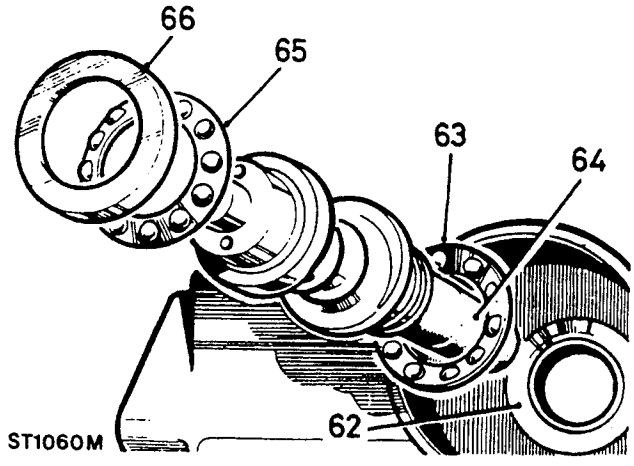
62. If removed, refit the original shim washer(s) and the inner bearing cap. Only vaseline must be used as an aid to assembling the bearings.

    NOTE: If the original shims are not available, fit shim(s) of 0.76 mm (0.030 in) nominal thickness.

63. Fit the inner cage and bearings assembly.
64. Fit the valve and worm assembly, using seal saver R01015 to protect the input shaft seal.
65. Fit the outer cage and bearings assembly.
66. Fit the outer bearing cup.



ST1061M



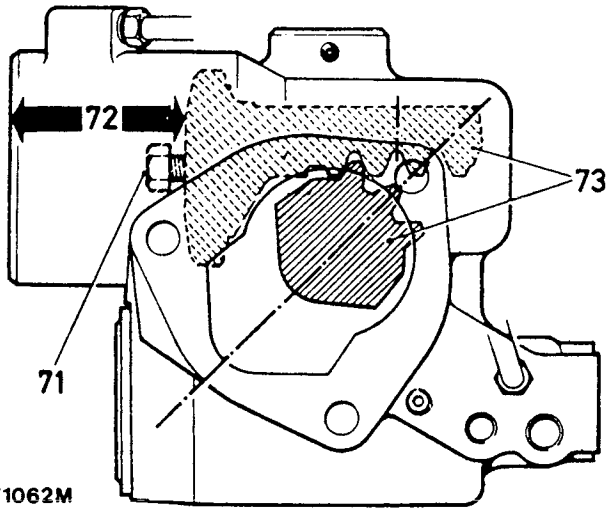
ST1060M

67. Renew the worm adjuster sealing ring and loosely screw the adjuster into the casing. Fit the locknut, but do not tighten.
68. Turn in the worm adjuster until the end-float at the input is almost eliminated.
69. Measure and record the maximum rolling distance of the valve and worm assembly, using a spring balance and cord coiled around the torque setting tool RO1016.
70. Turn in the worm adjuster to increase the figure recorded in instruction 69 by 1,8 to 2,2 kg (4 to 5 lb) at 1.250 in (31.7 mm) radius to settle the bearings, then back off the worm adjuster until the figure recorded in instruction 69 is increased by 0,9 to 1,3 kg (2 to 3 lb) only, with the locknut tight. Use peg spanner 606601 and 'C' spanner 606600.

Fitting the rack and piston

71. Screw a suitable bolt into the piston head for use as an assembly tool.
72. Fit the piston and rack assembly so that the piston is 63.5 mm (2.5 in) approximately from the outer end of the bore.
73. Feed in the sector shaft using seal saver 606604 aligning the centre gear pitch on the rack with the centre gear tooth on the sector shaft. Push in 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.

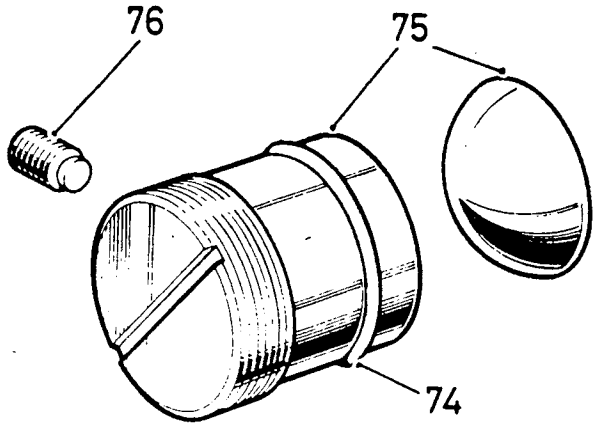
continued



ST1062M

Fitting the rack adjuster

74. Fit the sealing ring to the rack adjuster.
75. Fit the rack adjuster and thrust pad to engage the rack. Back off a half turn on the adjuster.
76. Loosely fit the nylon pad and adjuster grub screw assembly to engage the rack adjuster.



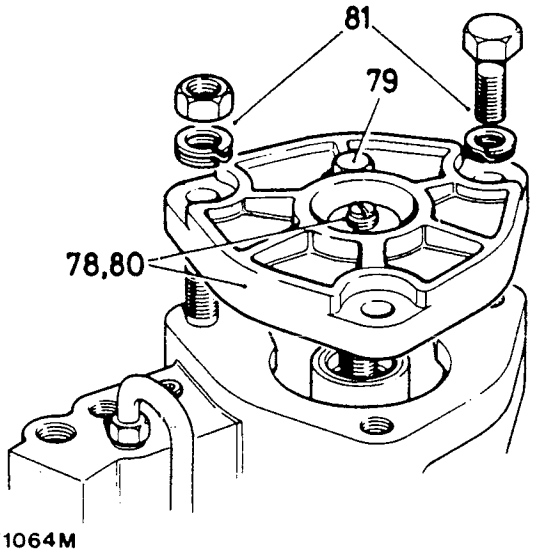
ST1063M

Fitting the sector shaft cover

77. Fit the sealing ring to the cover.
78. Screw the cover assembly fully on to the sector shaft adjuster screw.
79. Position the cover on to the casing.
80. Tap home the cover. If necessary back off on the sector shaft adjuster screw to allow the cover to joint fully with the casing.

NOTE: Before tightening the fixings, rotate the input shaft about a small arc to ensure that the sector roller is free to move in the valve worm.

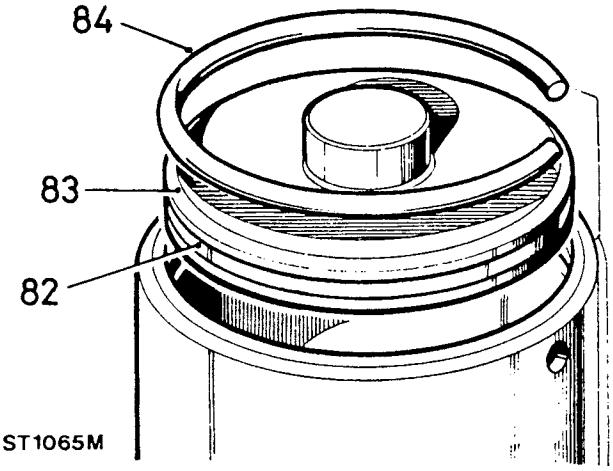
81. Fit the cover fixings and torque load to 2,2 to 2,8 kgf m (16 to 20 lbf ft) (23 to 28 Nm).



ST1064M

Fitting the cylinder cover

82. Fit the square section seal to the cover.
83. Remove the slave bolt and press the cover into the cylinder just sufficient to clear the retainer ring groove.
84. Fit the retainer ring to the groove with one end of the ring positioned 12 mm (0.5 in) approximately from the extractor hole.

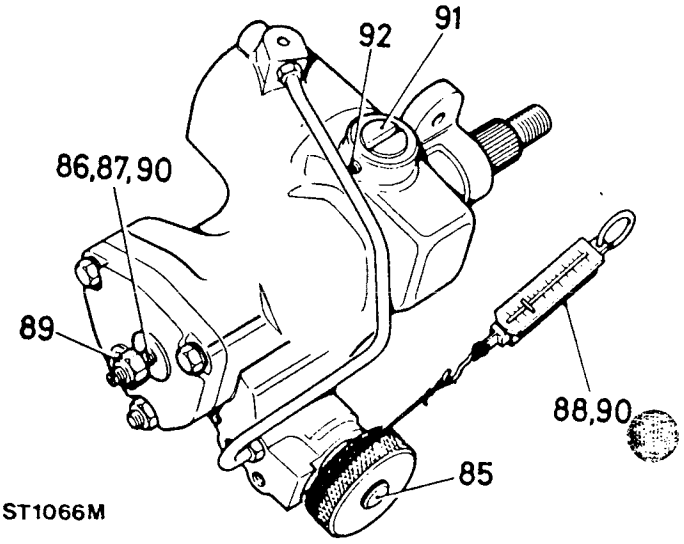


ST1065M

Adjusting the sector shaft

85. Set the worm on centre by rotating the input shaft half the total number of turns from either lock.
86. Rotate the sector shaft adjusting screw anti-clockwise to obtain backlash between the input shaft and the sector shaft.
87. Rotate the sector shaft adjusting screw clockwise until the backlash is just eliminated.
88. Measure and record the maximum rolling resistance at the input shaft, using a spring balance, cord and torque tool R01016.
89. Hold still the sector shaft adjuster screw and loosely fit a new locknut.
90. Turn in the sector shaft adjuster screw until the figure recorded in instruction 88 is increased by 0,9 to 1,3 kg (2 to 3 lb) with the locknut tightened.

continued



ST1066M

Adjusting the rack adjuster

91. Turn in the rack adjuster to increase the figure recorded in 90 by 0,9 to 1,3 kg (2 to 3 lb). **The final figure may be less than but must not exceed 7,25 kg (16 lb).**
92. Lock the rack adjuster in position with the grub screw.

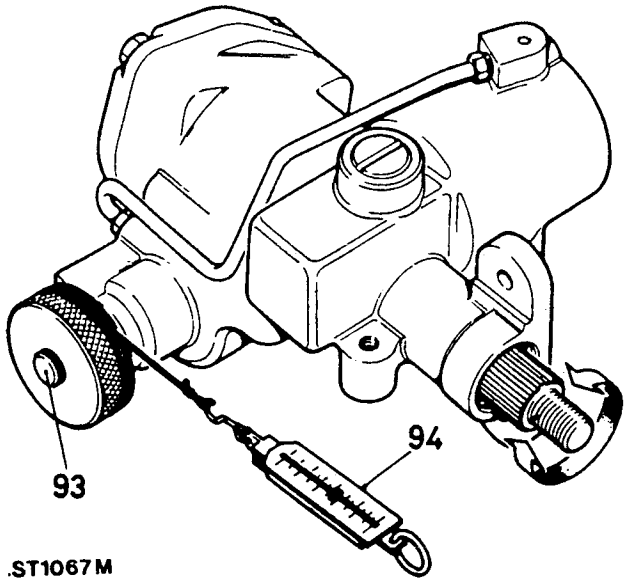
Torque peak check

With the input shaft rotated from lock-to-lock, the rolling resistance torque figures should be greatest across the centre position (1½ turns approximately from full lock) and equally disposed about the centre position.
This condition depends on the value of shimming fitted between the valve and worm assembly inner bearing cup and the casing. The original shim washer value will give the correct torque peak position unless major components have been replaced.

NOTE: During the following 'Procedure', the stated positioning and direction of the input shaft applies for both L.H. and R.H. boxes. However, the procedure for shim adjustment where necessary, differs between L.H. and R.H. steering boxes and is described under the applicable L.H. stg. and R.H. stg. headings.

Procedure

93. With the input coupling shaft toward the operator, turn the shaft fully anti-clockwise.
94. Check the torque figures obtained from lock-to-lock using a spring balance cord and torque tool R01016.



ST1067M

Adjustments

95. Note where the greatest figures are recorded relative to the steering gear position. If the greatest figures are not recorded across the centre of travel (i.e. steering straight ahead position), adjust as follows:
    L.H. steering models. If the torque peak occurs **before** the centre position, add to the shim washer valve; if the torque peak occurs **after** the centre position, **subtract** from the shim washer valve.
    R.H. steering models. If the torque peak occurs **before** the centre position, subtract from the shim washer valve; if the torque occurs **after** the centre position, **add** to the shim washer valve.

Shim washers are available as follows:
0,03 mm, 0,07 mm, 0,12 mm and 0,24 mm (0.0015 in, 0.003 in, 0.005 in and 0.010 in).

NOTE: Adjustment of 0,07 mm (0.003 in) to the shim value will move the torque peak area by ¼ turn approximately on the shaft.

96. Fit the drop arm to the steering box using a new tab washer. Tighten the nut to the correct torque and bend over tab.
97. Refit the steering box to the vehicle.
98. Replenish the system with the correct grade of fluid. Refer to Recommended Lubricants and bleed the system.
99. Test the system for leaks, with the engine running, by holding the steering hard on full lock in both directions.

    NOTE: Do not maintain this pressure for more than 30 seconds in any one minute to avoid over-heating the fluid and possibly damaging the seals.

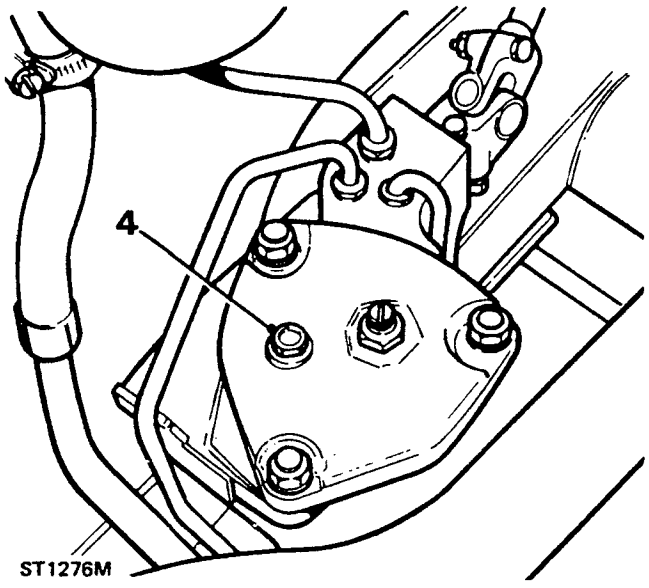
100. Road test the vehicle.

BLEEDING THE POWER STEERING SYSTEM

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. Run the engine at idle speed.

   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. 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 POWER STEERING SYSTEM

Service tools:
Three-way adaptor — JD10-2/1
Gauge — JD10
Hose — JD10-3
2-off Hose — JD10-3A
Adaptor — JD10-6/1
Adaptor — JD10-6/2

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.

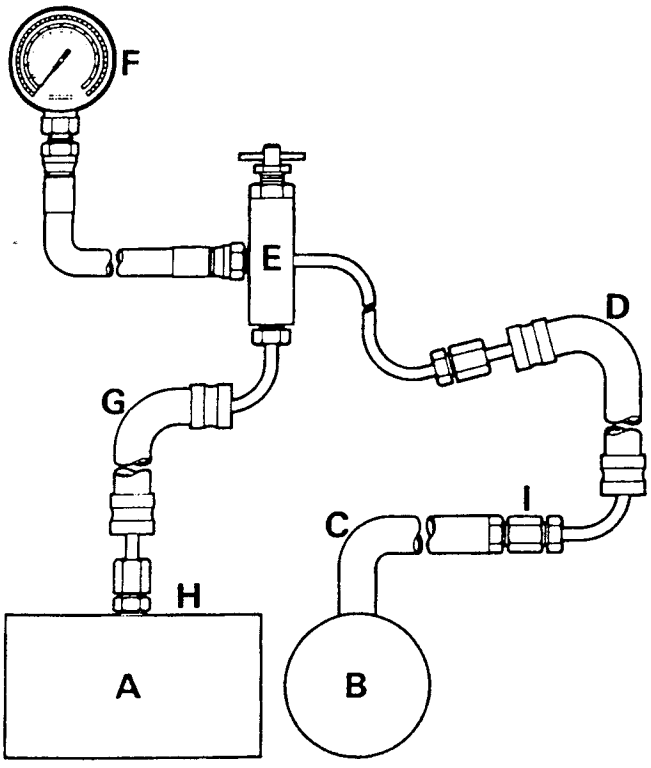
PROCEDURE

1. The hydraulic pressure test gauge is used in conjunction with the special adaptor (as illustrated) for testing the power steering system. This gauge is calibrated to read up to 140 kgf/cm^2 (2000 lbf/in^2) and the normal pressure which may be expected in the power steering system is 60 kgf/cm^2 (850 lbf/in^2).
2. Under certain fault conditions of the hydraulic pump it is possible to obtain pressures up to 105 kgf/cm^2 (1500 lbf/in^2). 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.
   The pump used on the V8 engined vehicle is different from that fitted to the four cylinder engined vehicles but the test figures are the same for both pumps. Diagrams show how the test equipment is assembled for both vehicles.
6. Assemble the test equipment in accordance with the diagram for the vehicle concerned.
7. Open the tap in the adaptor JD10-2/1.
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 60 to 67 kgf/cm^2 (850 to 950 lbf/in^2).
   (b) With the engine idling and the steering wheel held hard on full lock, the pressure should be 28 kgf/cm^2 (400 lbf/in^2) minimum.

continued

These checks should be carried out first on one lock, then on the other.

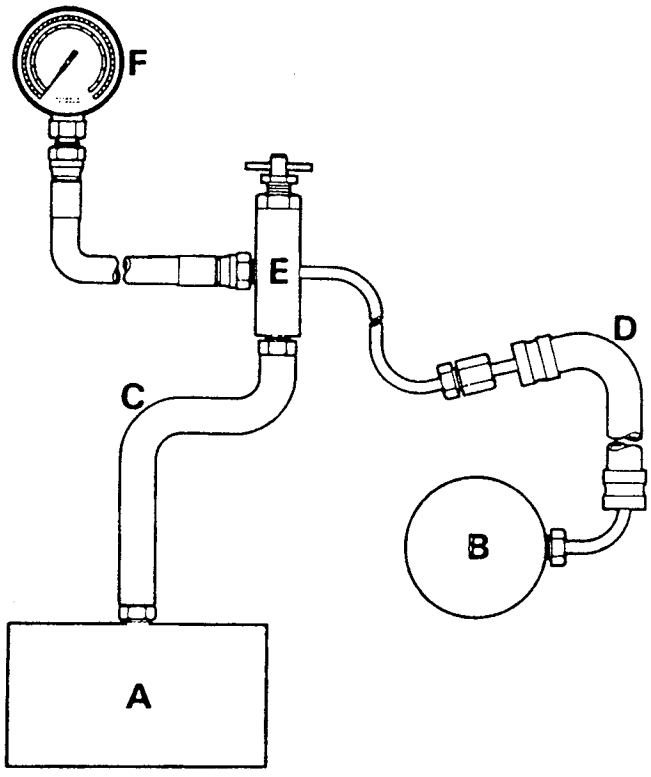
CAUTION: Under no circumstances must the steering wheel be held on full lock for more than 30 seconds in any one minute, otherwise there will be a tendency for the oil to overheat and possible damage to the seals may result.



ST915M

110 and 90 Engine Diagram

A Steering box.
B Steering pump.
C Existing hose, steering box to pump.
D Hose JD10-3A.
E Test adaptor JD10-2.
F Pressure gauge HY23.
G Hose JD10-3A.
H Thread adaptor JD10-6.
I Thread adaptor JD10-6.



ST916M

V8 Engine Diagram

A Steering box.
B Steering pump.
C Existing hose, steering box to pump.
D Hose JD10-3.
E Test adaptor JD10-2.
F Pressure gauge HY23.

10. Release the steering wheel and allow the engine to idle. The pressure should be: 7 kgf/cm^2 (100 lbf/in^2).
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.

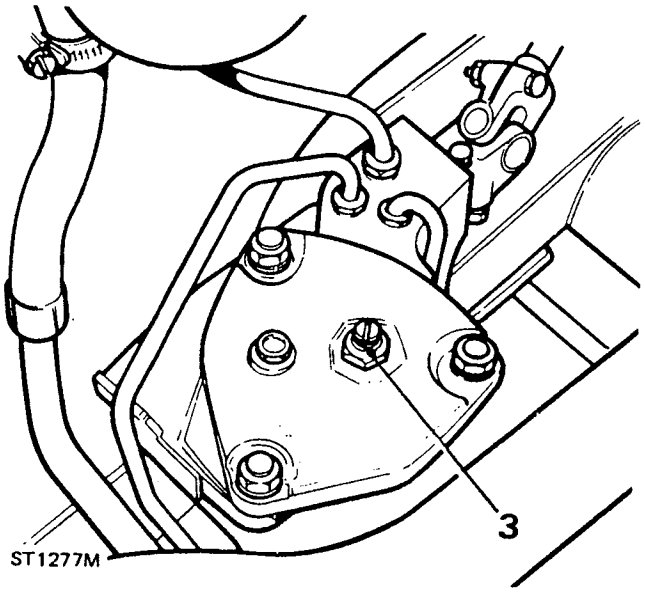
ADJUST POWER STEERING BOX

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 (0.375 in).
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 (0.375 in) 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.

V8 ENGINE POWER STEERING PUMP OVERHAUL — Series 30

Dismantle

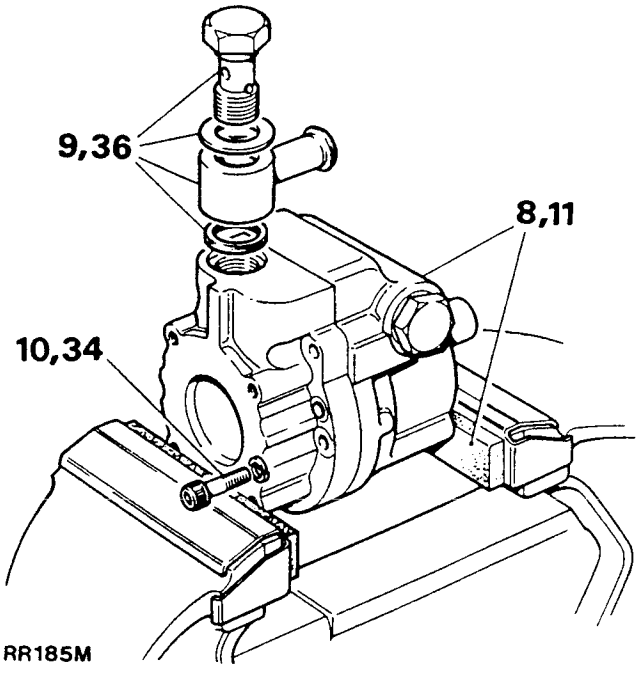
1. Remove the steering pump from the vehicle.
2. Clean the exterior of the pump and drain off any oil.
3. Remove the bolt, spring washer and large plain washer securing the pulley to the pump shaft.
4. Using a suitable puller, withdraw the pulley. Do not attempt to hammer the shaft from the pulley, or lever the pulley from the shaft, as this may cause internal damage.
5. Withdraw the square key from the shaft.
6. Remove the four bolts and spring washers securing the bearing retainer plate and front mounting plate to the pump body. Remove the plates.
7. Remove the three bolts and spring washers securing the rear mounting plate to the pump body and remove the plate.
8. Clamp the pump body in a vice, ensuring that the jaws are protected.
9. Remove the union bolt and withdraw the fibre washer, inlet adaptor and rubber gasket.

NOTE: The tubular steel venturi flow director under the inlet adaptor is pressed into the cover and should not be removed.

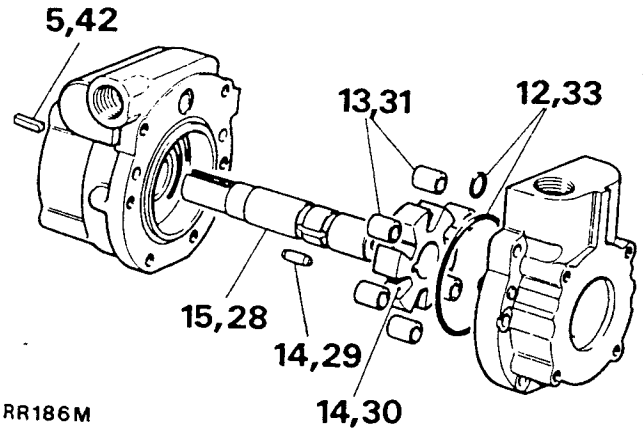
10. Remove the six Allen screws securing the cover to the pump body. Separate the cover from the body vertically to prevent the parts falling out.

11. Remove the pump from the vice.

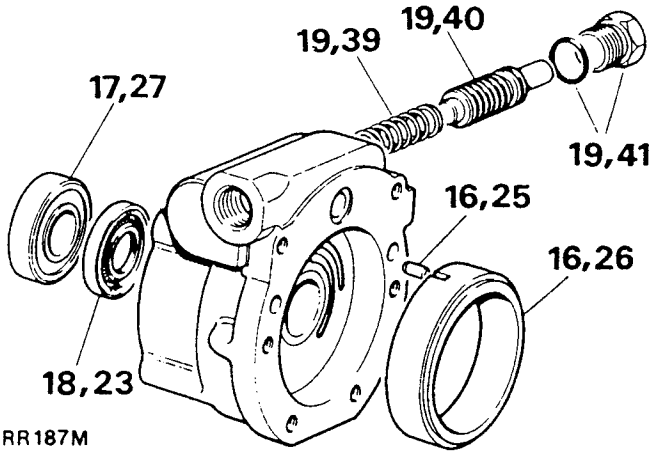
continued



12. Remove the 'O' ring seals from the grooves in the pump body.
13. Carefully tilt the pump body, and remove the six rollers.
14. Draw the carrier off the shaft, and remove the drive pin.
15. Remove the shaft from the body.



16. Remove the cam and the cam lock peg from the pump body.
17. If necessary withdraw the sealed bearing from the shaft
18. Remove the shaft seal from the body, ensuring that no damage is caused to the shaft bushing.
19. Remove the valve cap, 'O' ring, valve and valve spring from the body. Place all parts where they will not be damaged, or subject to contamination.



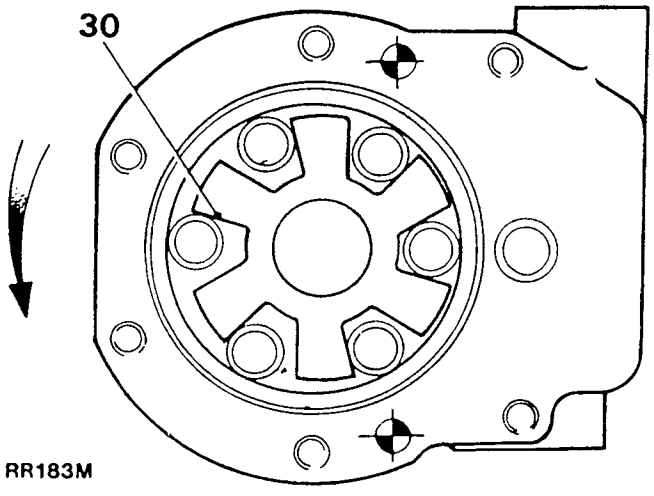
Inspection

20. Wash all parts in a suitable solvent, air dry, or wipe clean with a lint-free cloth if air is not available.
21. Check the pump body and cover for wear. Renew either part, if faces or bushes are worn.
22. Check the pump shaft around the drive pin slot. Remove any burrs.

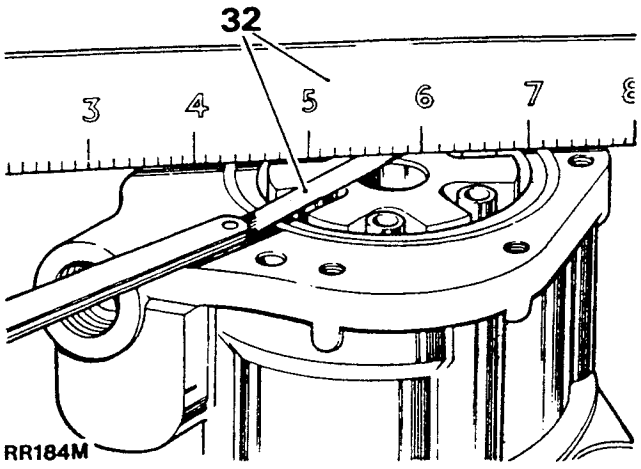
NOTE: Ensure that the aluminium restrictor in the output port is thoroughly cleaned but not dislodged.

Reassemble

23. Carefully examine a new shaft seal to ensure that it is clean and undamaged. Smear the sealing lips with grease and apply a fine smear of 'Wellseal' to the pump body where the outside diameter of the oil seal locates (applies to metal cased seals). Place the seal square to the housing recess with the lip towards the inside of the housing.
24. Press the seal into position approximately 0.80 mm ($\frac{1}{32}$ in) below the seal housing face, ensuring that it does not tilt.
25. Replace the cam lock peg into the location in the body.
26. Renew the cam if worn or damaged. Refit the cam, ensuring that it seats correctly in the body and that the slot locates over the locking peg.
27. Fit a new sealed bearing onto the pump shaft.
28. Insert the shaft and bearing assembly into the seal side of the body.
29. Refit the carrier drive pin in the shaft.
30. Inspect the carrier and replace in position, ensuring that the greater angle on the carrier teeth is in the leading position as illustrated.



31. Inspect the rollers, paying particular attention to the finish on the end. Renew the rollers if scored, damage or oval. Refit the rollers to the carrier.
32. Using a straight edge across the cam surface, and a feeler gauge, check the end clearance of the carrier and rollers in the pump body. If the end clearance is more than 0,05 mm (0.002 in) renew the carrier and rollers.



RR184M

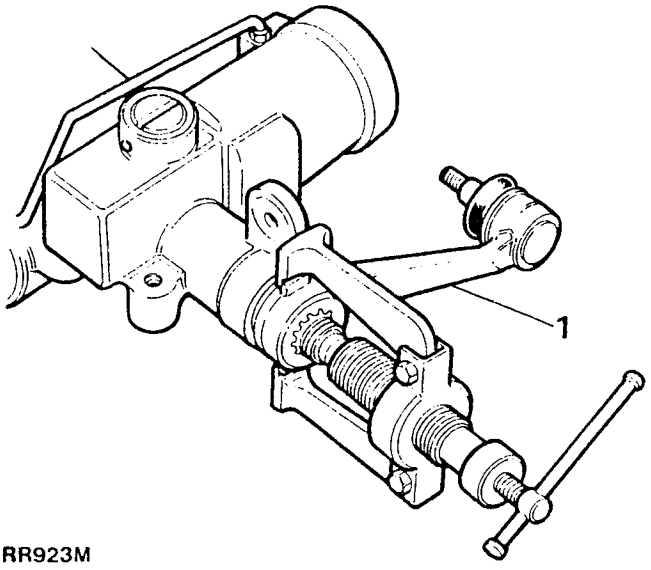
33. Smear a fine trace of Loctite 275 to the pump body in a 'figure of 8' outside the 'O' rings and inside the bolt holes. Install new 'O' rings to the body of the pump.
34. Refit the cover on the pump body and secure with six Allen screws and spring washers.
35. Tighten the Allen screws, in diagonal sequence, checking that the shaft rotates freely and does not bind. Final torque to be 15 to 17 lbf.ft (20 to 23 Nm).
36. Replace the square sectioned rubber gasket to the groove around the inlet port and replace the inlet adaptor, fibre washer and union bolt. Torque to 28 to 30 lbf.ft (38 to 41 Nm).
37. Refit the rear mounting plate to the pump body and secure with three bolts and spring washers.
38. Refit the front mounting plate and the bearing retainer plate to the pump body and secure with four bolts and spring washers.
39. Refit the flow control valve spring in the bore. The spring tension should be 8 to 9 lbf (11 to 12 Nm) at 21 mm (0.820 in). If not, renew the spring.
40. Replace the valve in the bore, inserting the valve so that the exposed ball end enters last. Ensure that the valve is not sticking.
41. Renew the 'O' ring on the valve cap and assemble in the pump. Tighten the cap to a torque figure of 30 to 35 lb.ft (40 to 47 Nm).
42. Refit the pulley key.
43. Refit the pulley to the shaft and secure with the special washer, spring and washer and bolt. Tighten the bolt to a torque figure of 10 to 12 lbf.ft (13 to 16 Nm).
44. Refit the steering pump to the vehicle.

POWER STEERING BOX OVERHAUL — Lightweight Adwest

Service tools:
'C' Spanner — LST120
Worm adjusting socket — LST119
Drop arm extractor — MS252A
Ring expander — 606602
Ring compressor — 606603
Seal saver, sector shaft — 606604
Seal saver, valve and worm — R01015
Torque setting tool — R01016

Dismantle

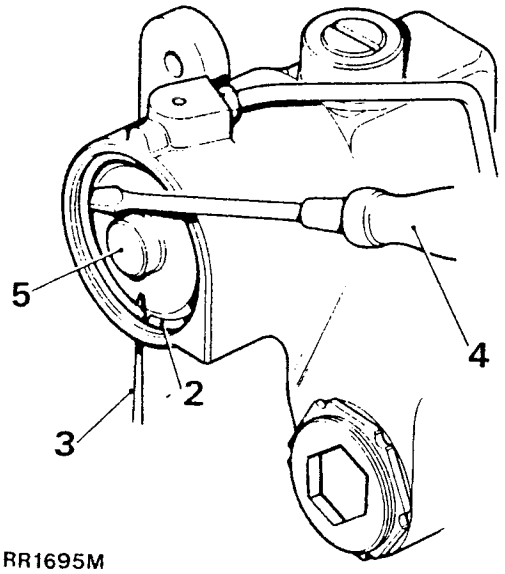
1. Remove the steering arm from the vehicle, and withdraw the drop arm.



RR923M

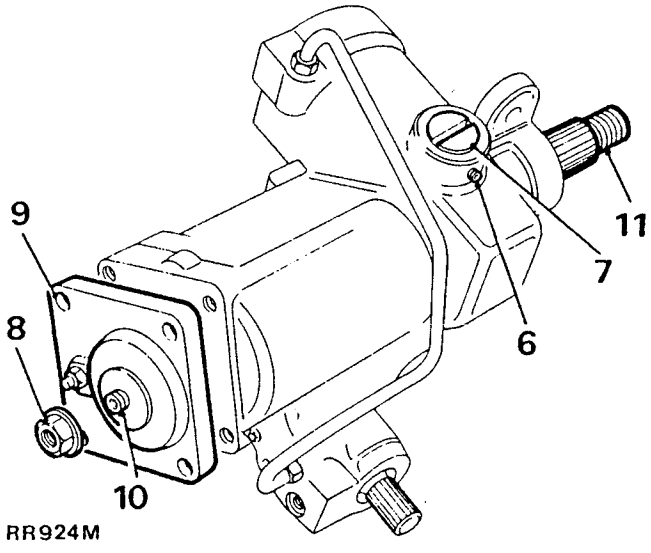
2. Rotate the retainer ring, as necessary, until one end is approximately 12 mm (0.500 in) from the extractor hole.
3. Lift the cover retaining ring from the groove in the cylinder bore, using a suitable pointed drift applied through the hole provided in the cylinder wall.
4. Complete the removal of the retainer ring, using a screwdriver.
5. Turn on left lock (LH steering) until the piston pushes out the end cover (for RH steering models, turn on right lock).

continued



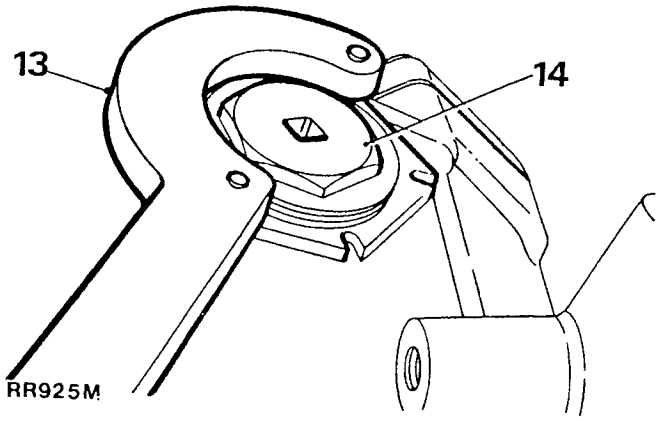
RR1695M

6. Slacken the grub screw retaining the rack pad adjuster.
7. Remove the rack pad adjuster.
8. Remove the sector shaft adjuster locknut.
9. Remove the sector shaft cover fixings.
10. Screw in the sector shaft adjuster until the cover is removed.
11. Slide out the sector shaft.



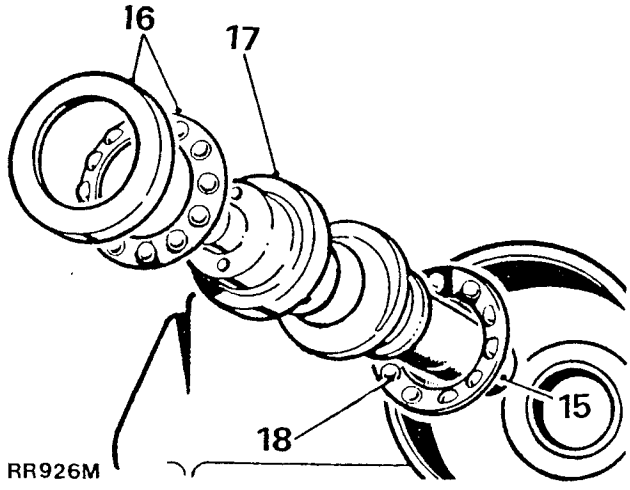
RR924M

12. Withdraw the piston, using a suitable bolt screwed into the tapped hole in the piston.
13. Remove the worm adjuster locknut using 'C' spanner, LST120.
14. Remove the worm adjuster using socket LST119.



RR925M

15. Tap the splined end of the spindle shaft to free the bearing.
16. Withdraw the bearing cup and caged ball bearing assembly.



RR926M

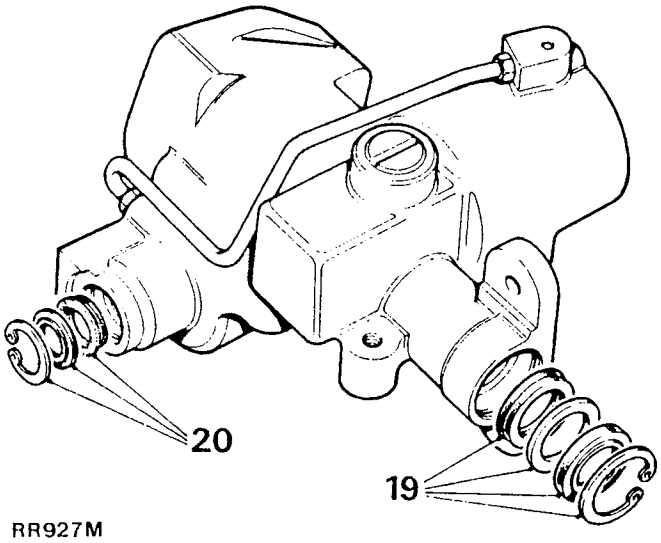
17. Withdraw the valve and worm assembly.
18. Withdraw the inner bearing ball race and shims. Retain the shims.

continued

Steering box seals

19. Remove the circlip and seals from the sector shaft housing bore.

NOTE: Do not remove the sector bush unless replacement is required. Refer to instruction 22.



RR927M

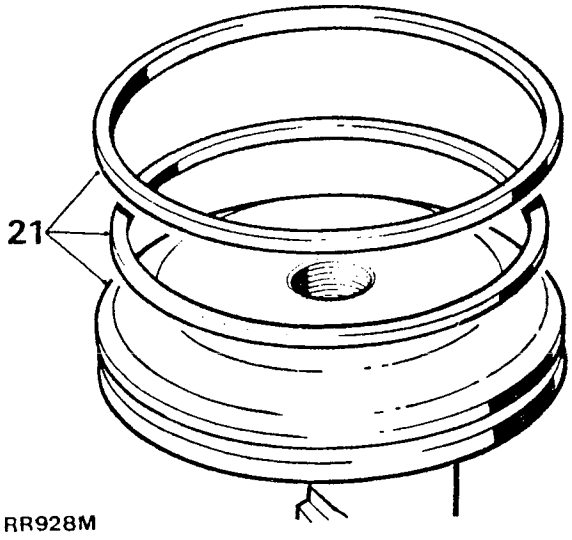
20. Remove the circlip and seals from the input shaft housing bore.

NOTE: Do not remove the input shaft needle bearing unless replacement is required.

Inspecting

21. Discard all rubber seals and provide replacements.

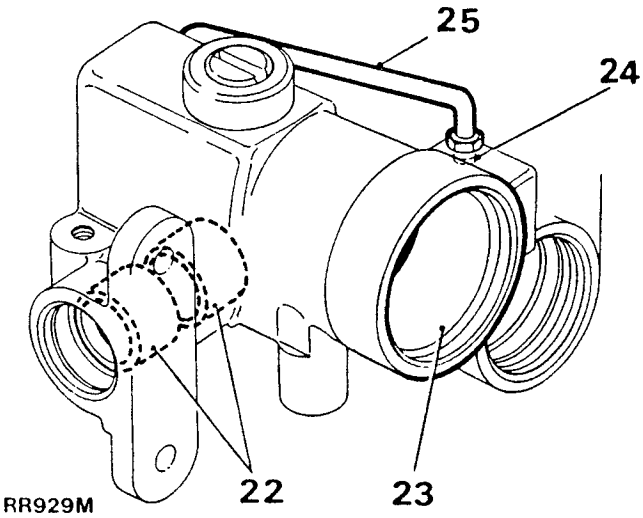
NOTE: A rubber seal is fitted behind the plastic ring on the rack piston. Discard the seal also the plastic ring and provide replacements.



RR928M

Steering box casing

22. If necessary, replace the sector shaft bush, using suitable tubing as a drift.
23. Examine the piston bore for traces of scoring and wear.

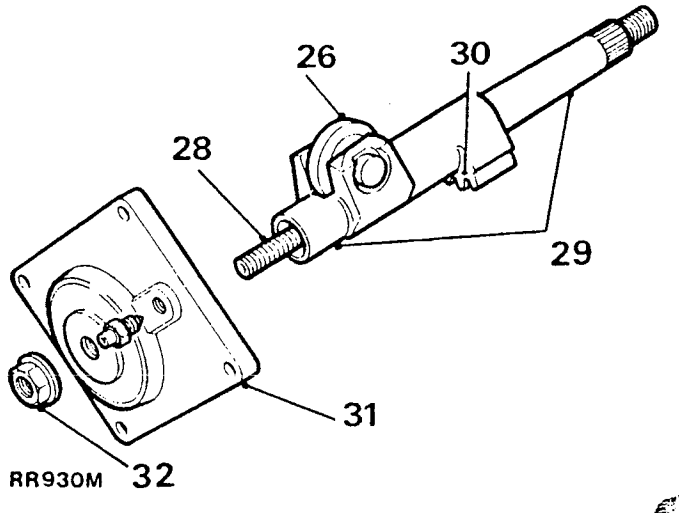


RR929M

24. Examine the inlet tube seat for damage. If replacement is necessary this can be undertaken by using a suitable tap.
25. Examine the feed tube for signs of cracking.

Sector shaft assembly

26. Check that there is no side play on the rollers.
27. If excessive side play on the roller does exist renew the sector shaft.
28. Check the condition of the adjuster screw threads.
29. Examine the bearing areas on the shaft for excessive wear.
30. Examine the gear teeth for uneven or excessive wear.



RR930M

Sector shaft cover assembly

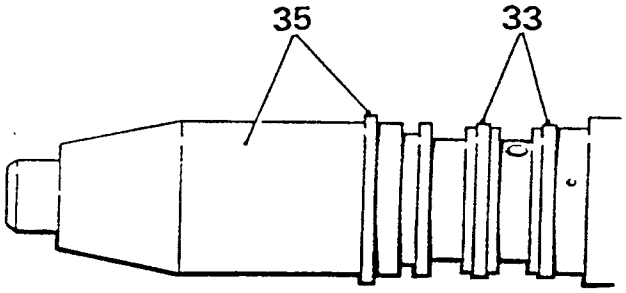
31. The cover, bush and seat are supplied as a complete assembly for replacement purposes.

Sector shaft adjuster locknut

32. The locknut functions also as a fluid seal and must be replaced at overhaul.

Valve and worm assembly

33. Examine the valve rings which must be free from cuts, scratches and grooves. The valve rings should be a loose fit in the valve grooves.

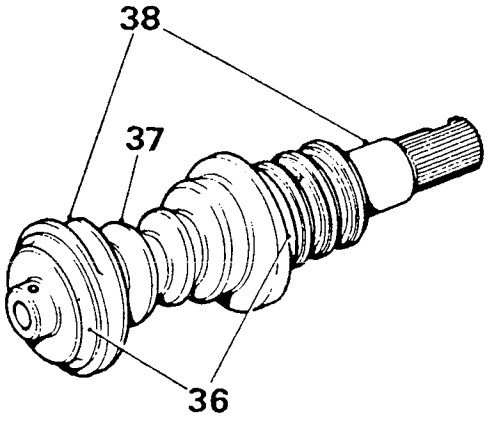


RR931M

34. Remove the damaged rings ensuring that no damage is done to the seal grooves.
35. If required, fit replacement rings, using the ring expander 606602. Both rings and tool may be warmed if found necessary. Use hot water for this purpose. Then insert into the ring compressor 606603 to cool.

NOTE: The expander will not pass over rings already fitted. These rings must be discarded to allow access then renewed.

36. Examine the bearing areas for wear. The areas must be smooth and not indented.



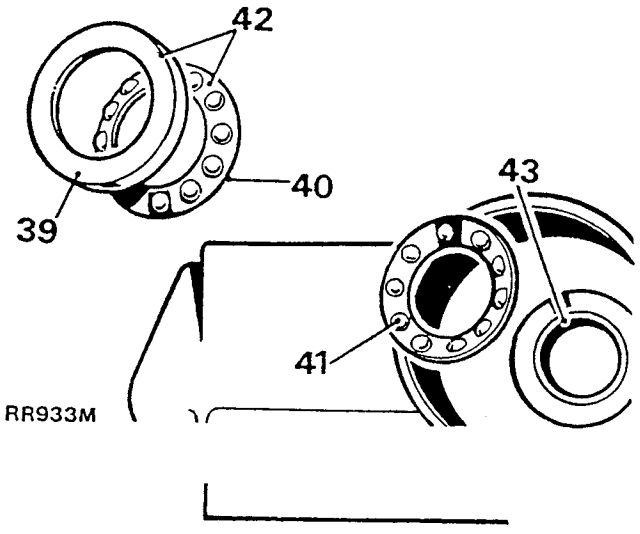
RR932M

37. Examine the worm track which must be smooth and not indented.
38. Check for wear on the torsion bar assembly pins; no free movement should exist between the input shaft and the worm.

NOTE: Any sign of wear makes it essential that the complete valve and worm assembly is renewed.

Ball bearing and cage assemblies

39. Examine the ball races and cups for wear and general condition.
40. If the ball cage has worn against the bearing cup, fit replacements.



RR933M

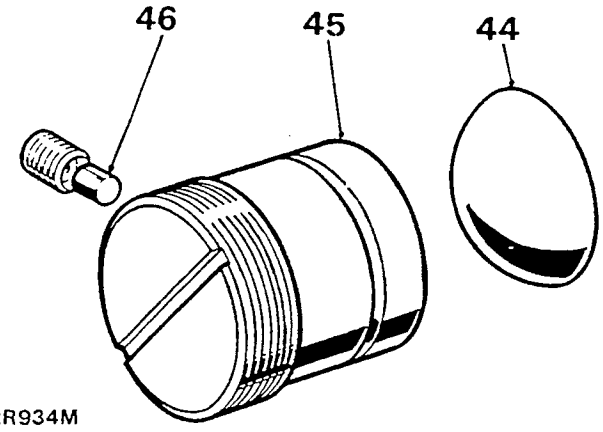
41. Bearing balls must be retained by the cage.
42. Bearings and cage repair are carried out by the complete replacement of the bearings and cage assembly.
43. To remove the inner bearing cup and shim washers, jar the steering box on the work bench, or use a suitable extractor.

NOTE: Should difficulty be experienced at this stage, warm the casing and the bearing assembly. Cool the bearing cup using a suitable mandrel and jar the steering box on the bench.

continued

Rack thrust pad and adjuster

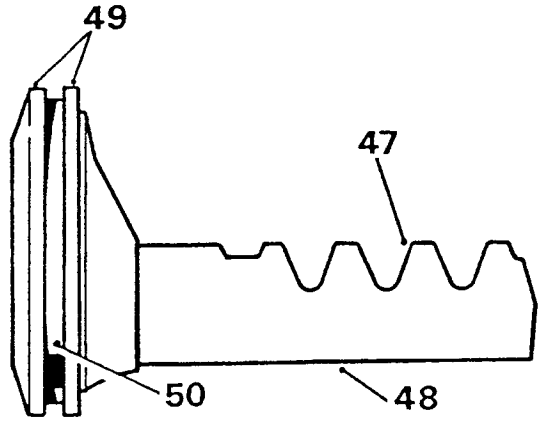
44. Examine the thrust pad for scores.
45. Examine the adjuster for wear in the pad seat.
46. Examine the nylon pad for distortion and adjuster grub screw assembly for wear.



RR934M

Rack and piston

47. Examine for excessive wear on the rack teeth.
48. Ensure the thrust pad bearing surface is free of scores and wear.

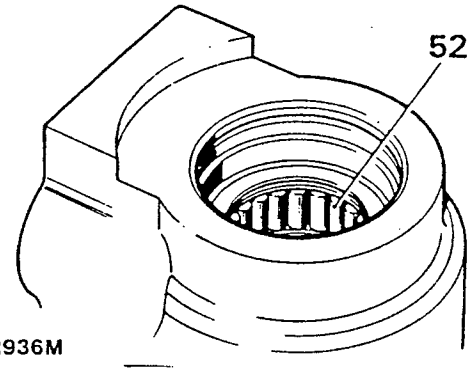


RR935M

49. Ensure that the piston outer diameters are free from burrs and damage.
50. Examine the seal and ring groove for scores and damage.
51. Fit a new rubber ring to the piston. Warm the white nylon seal and fit this to the piston. Slide the piston assembly into the cylinder with the rack tube outwards. Allow to cool.

Input shaft needle bearing

52. If necessary, replace the bearing. The replacement must be fitted squarely in the bore (numbered face of the bearing uppermost). Then, carefully push the bearing in until it is flush with the top of the housing bore. Ideally, the bearing will be just clear of the bottom of the housing bore.



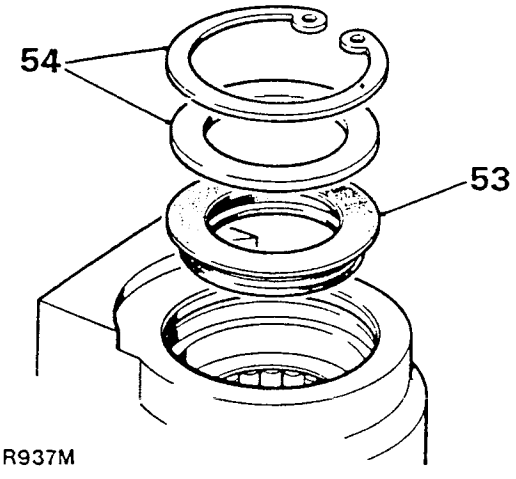
RR936M

Reassemble

NOTE: When fitting replacement oil seals, these must be lubricated with recommended fluid. Also ensure that absolute cleanliness is observed during assembly.

Input shaft oil seal

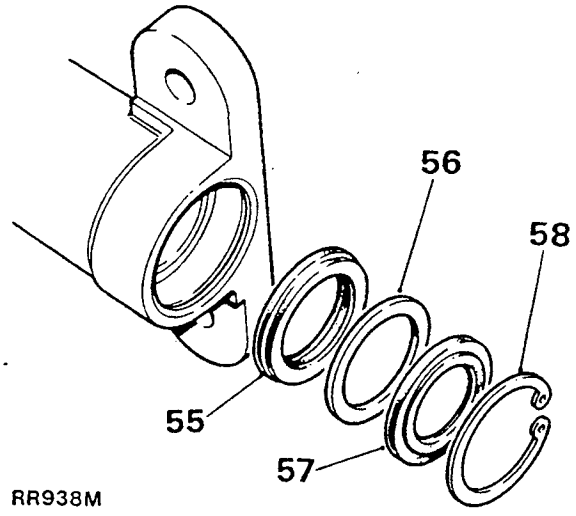
53. Fit the seal, lipped side first, into the housing. When correctly seated, the seal backing will lie flat on the bore shoulder.
54. Fit the extrusion washer and secure with the circlip.



RR937M

Sector shaft seal

55. Fit the oil seal, lipped side first.
56. Fit the extrustion washer.
57. Fit the dirt seal, lipped side last.
58. Fit the circlip.



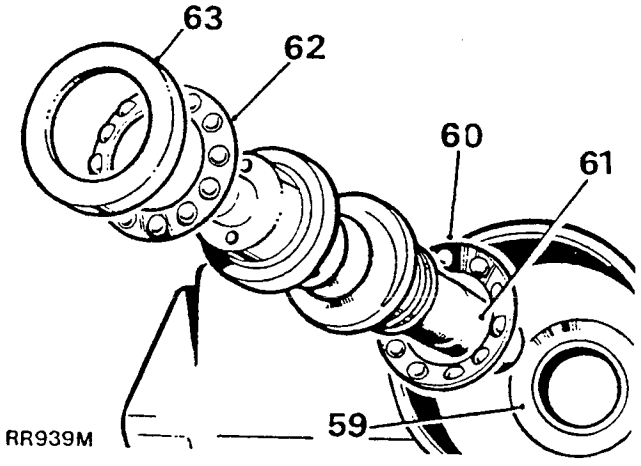
RR938M

Fitting the valve and worm assembly

59. If removed, refit the original shim washer(s) and the inner bearing cap. Only vaseline must be used as an aid to assembling the bearings.

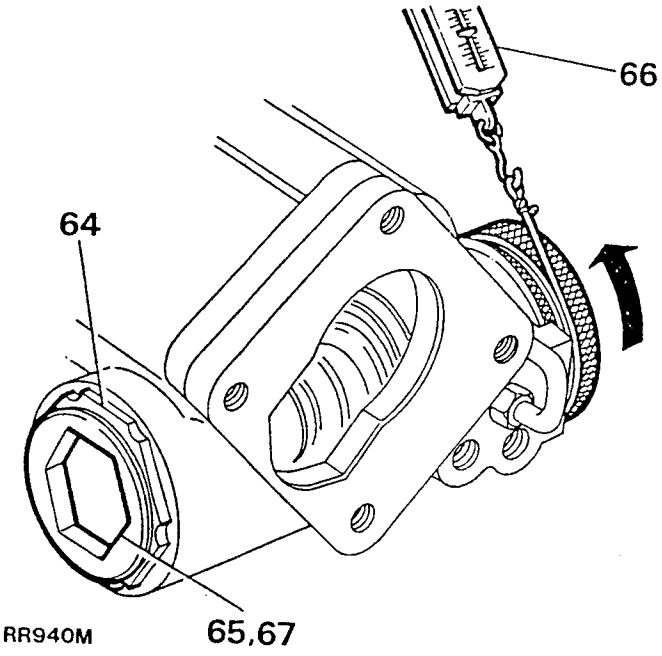
    NOTE: If the original shims are not available, fit shim(s) of 0,76 mm (0.030 in) nominal thickness.

60. Fit the inner cage and bearings assembly.
61. Fit the valve and worm assembly, using seal saver R01015 to protect the input shaft seal.
62. Fit the outer cage and bearings assembly.
63. Fit the outer bearing cup.



RR939M

64. Renew the worm adjuster sealing ring and loosely screw the adjuster into the casing. Fit the locknut, but do not tighten.
65. Turn in the worm adjuster until the end-float at the input is almost eliminated.
66. Measure and record the maximum rolling distance of the valve and worm assembly, using a spring balance and cord coiled around the torque setting tool R01016.
67. Turn in the worm adjuster to increase the figure recorded in instruction 66 by 1,8 to 2,2 kg (4 to 5 lb) at 31,7 mm (1.250 in) radius to settle the bearings, then back off the worm adjuster until the figure recorded in instruction 66 is increased by 0,9 to 1,3 kg (2 to 3 lb) only, with locknut tight. Use worm adjusting socket LST119 and 'C' spanner LST120.

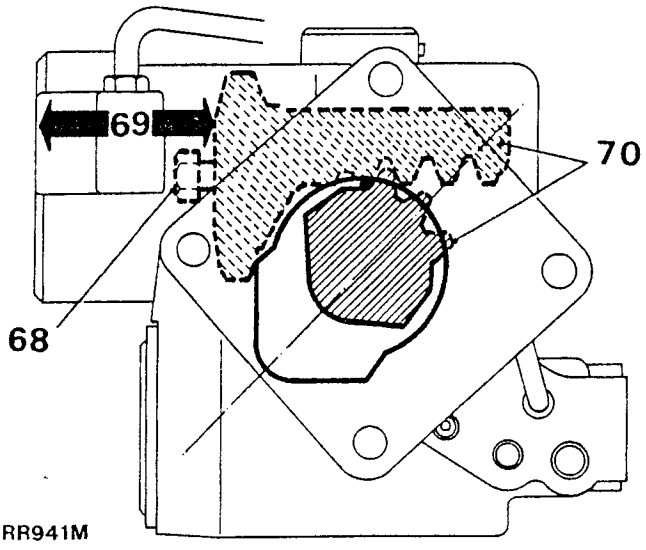


RR940M

continued

Fitting the rack and piston

68. Screw a suitable bolt into the piston head for use as an assembly tool.

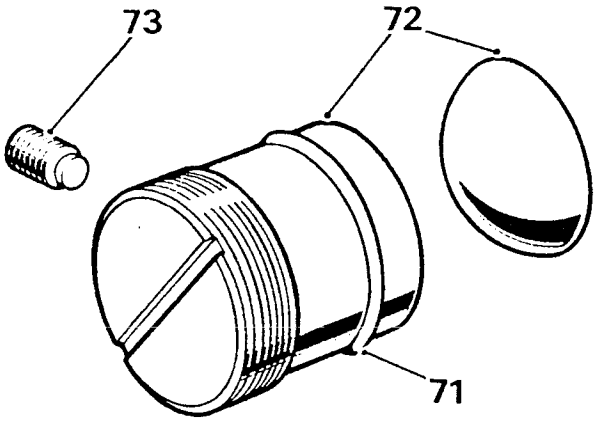


RR941M

69. Fit the piston and rack assembly so that the piston is 63,5 mm (2.5 in) approximately from the outer end of the bore.
70. Feed in the sector shaft using seal saver 606604 aligning the centre gear pitch on the rack with the centre gear tooth on the sector shaft. Push in 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.

Fitting the rack adjuster

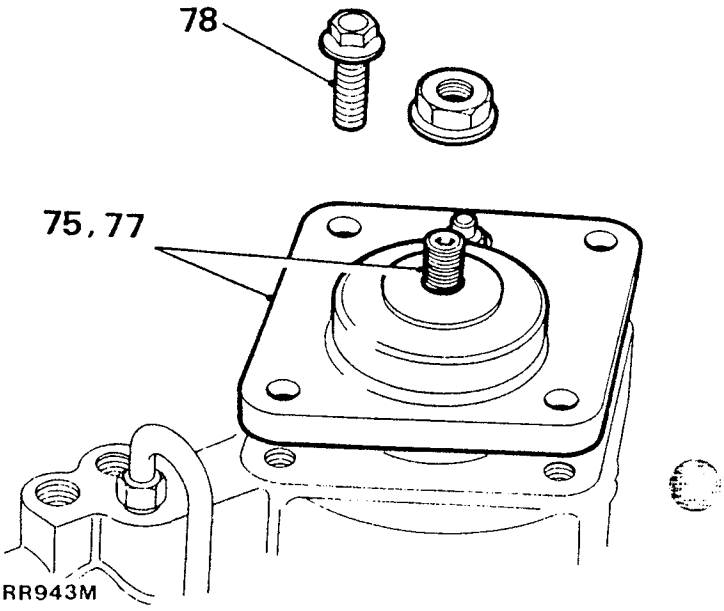
71. Fit the sealing ring to the rack adjuster.
72. Fit the rack adjuster and thrust pad to engage the rack. Back off a half nylon turn on the adjuster.
73. Loosely fit the nylon pad and adjuster grub screw assembly to engage the rack adjuster.



RR942M

Fitting the sector shaft cover

74. Fit the sealing ring to the cover.
75. Screw the cover assembly fully on to the sector shaft adjuster screw.



RR943M

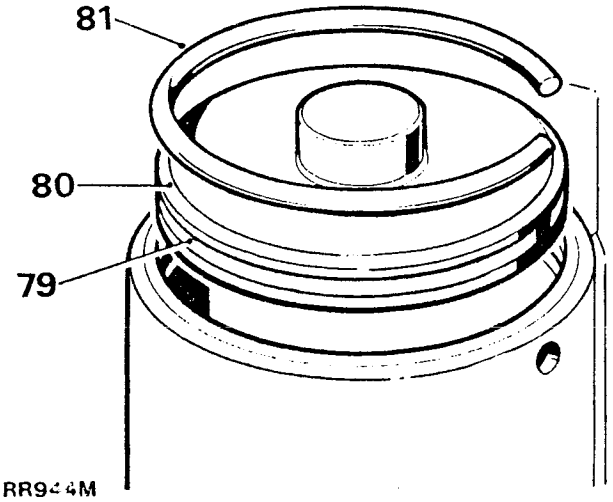
76. Position the cover on to the casing.
77. Tap home the cover. If necessary back off on the sector shaft adjuster screw to allow the cover to joint fully with the casing.

    NOTE: Before tightening the fixings, rotate the input shaft about a small arc to ensure that the sector roller is free to move in the valve worm.

78. Fit the cover fixings and tighten to the correct torque.

Fitting the cylinder cover

79. Fit the square section seal to the cover.
80. Remove the slave bolt and press the cover into the cylinder just sufficient to clear the retainer ring groove.

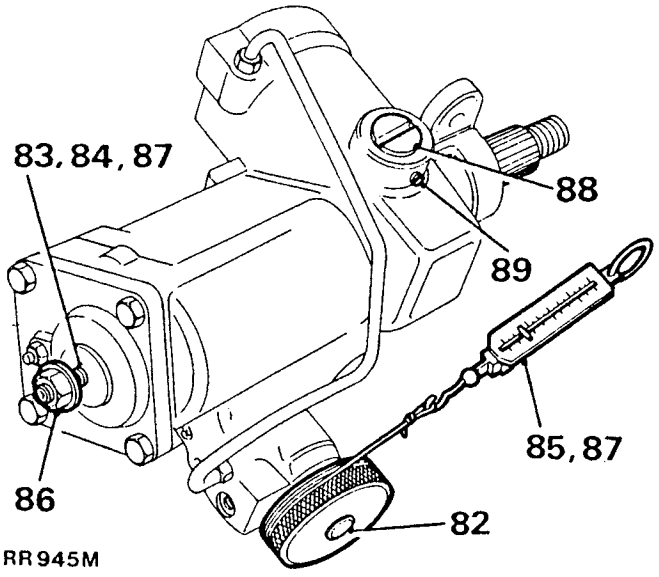


RR944M

81. Fit the retainer ring to the groove with one end of the ring positioned 12 mm (0.5 in) approximately from the extractor hole.

Adjusting the sector shaft

82. Set the worm on centre by rotating the input shaft half the total number of turns from either lock.



RR945M

83. Rotate the sector shaft adjusting screw anti-clockwise to obtain backlash between the input shaft and the sector shaft.
84. Rotate the sector shaft adjusting screw clockwise until the backlash is just eliminated.
85. Measure and record the maximum rolling resistance at the input shaft, using a spring balance, cord and torque tool R01016.
86. Hold still the sector shaft adjuster screw and loosely fit a new locknut.
87. Turn in the sector shaft adjuster screw until the figure recorded in instruction 88 is increased by 0,9 to 1,3 kg (2 to 3 lb) with the locknut tightened.

Adjusting the rack adjuster

88. Turn in the rack adjuster to increase the figure recorded in 90 by 0,9 to 1,3 kg (2 to 3 lb). **The final figure may be less than but must not exceed 7,25 kg (16 lb).**
89. Lock the rack adjuster in position with the grub screw.

Torque peak check

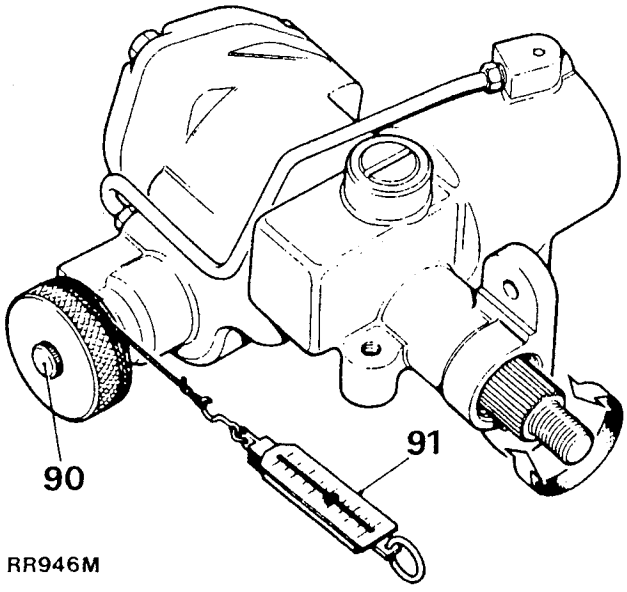
With the input shaft rotated from lock-to-lock, the rolling resistance torque figures should be greatest across the centre position (1½ turns approximately from full lock) and equally disposed about the centre position.

The condition depends on the value of shimming fitted between the valve and worm assembly inner bearing cup and the casing. The original shim washer value will give the correct torque peak position unless major components have been replace.

NOTE: During the following 'Procedure', the stated positioning and direction of the input shaft applies for both LH and RH boxes. However, the procedures for shim adjustment where necessary, differs between LH and RH steering boxes and is described under the applicable LH stg. and RH stg. headings.

Procedure

90. With the input coupling shaft toward the operator, turn the shaft fully anti-clockwise.
91. Check the torque figures obtained from lock-to-lock using a spring balance cord and torque tool R01016.



RR946M

Adjustments

92. Note where the greatest figures are recorded relative to the steering position. If the greatest figures are not recorded across the centre of travel (i.e. steering straight-ahead position), adjust as follows:
    LH steering models. If the torque peak occurs **before** the centre position, add to the shim washer value; if the torque peak occurs **after** the centre position, **subtract** from the shim washer value.
    RH steering models. If the torque peak occurs **before** the centre position, subtract from the shim washer value; if the torque occurs **after** the centre position, **add** to the shim washer value.

Shim washers are available as follows:
0,03 mm, 0,07 mm, 0,12 mm and 0,24 mm (0.0015 in, 0.003 in, 0.005 in and 0.010 in).

NOTE: Adjustment of 0,07 mm (0.003 in) to the shim value will move the torque peak area by ¼ turn approximately on the shaft.

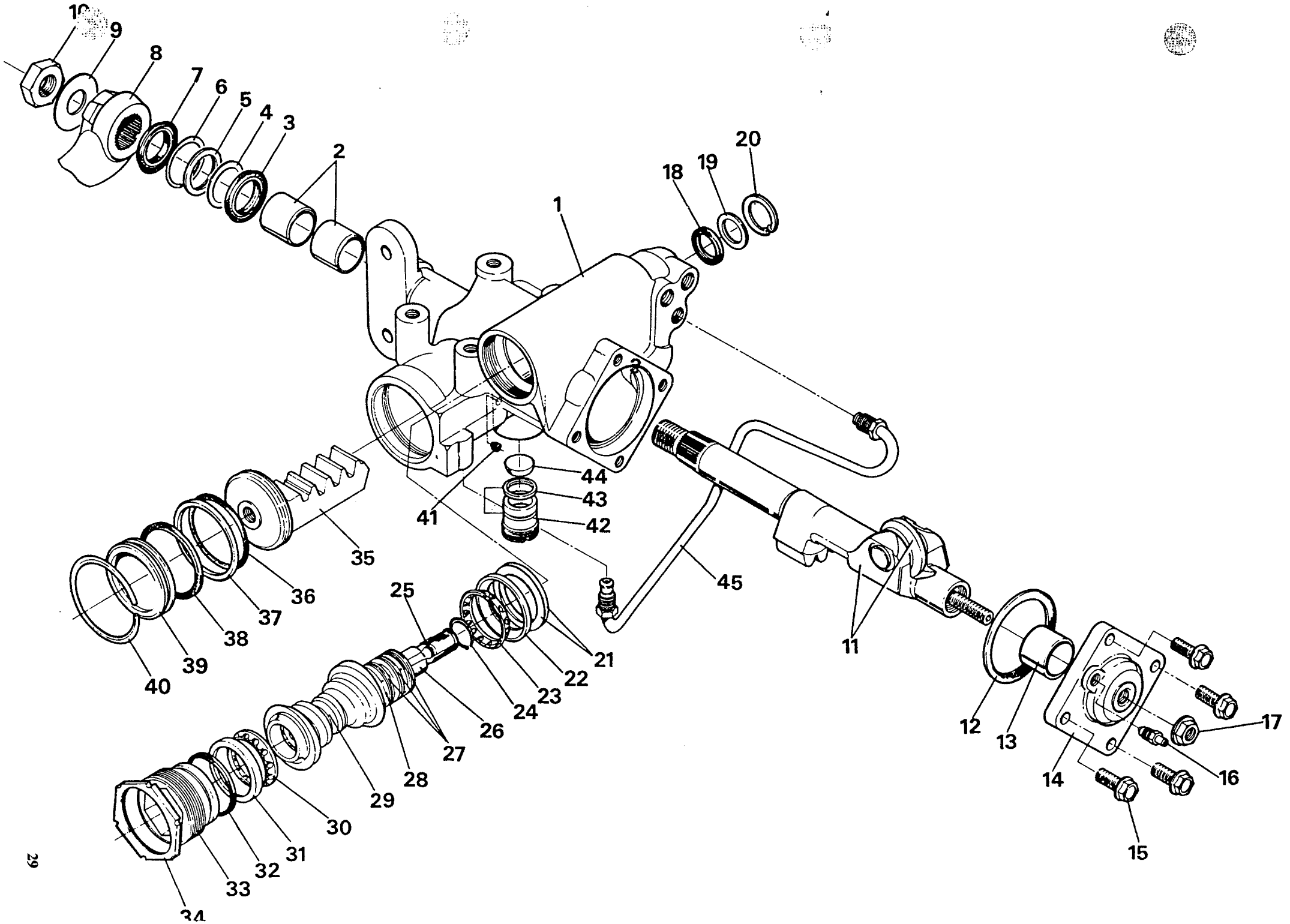
93. Fit the drop arm to the steering box using a new tab washer. Tighten the nut to the correct torque and bend over tab.
94. Refit the steering box to the vehicle.
95. Replenish the system with the correct grade of fluid. Refer to Recommended Lubricants and Power Steering System — bleed.
96. Test the system for leaks, with the engine running, by holding the steering hard on full lock in both directions.

    NOTE: Do not maintain this pressure for more than 30 seconds in any one minute to avoid overheating the fluid and possibly damaging the seals.

97. Road test the vehicle.

KEY TO ADWEST LIGHTWEIGHT POWER STEERING BOX

1. Housing.
2. Housing bushes.
3. Seal.
4. Back-up washer.
5. Back-up seal.
6. Circlip.
7. Seal.
8. Drop-arm.
9. Tab washer.
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 case and balls.
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.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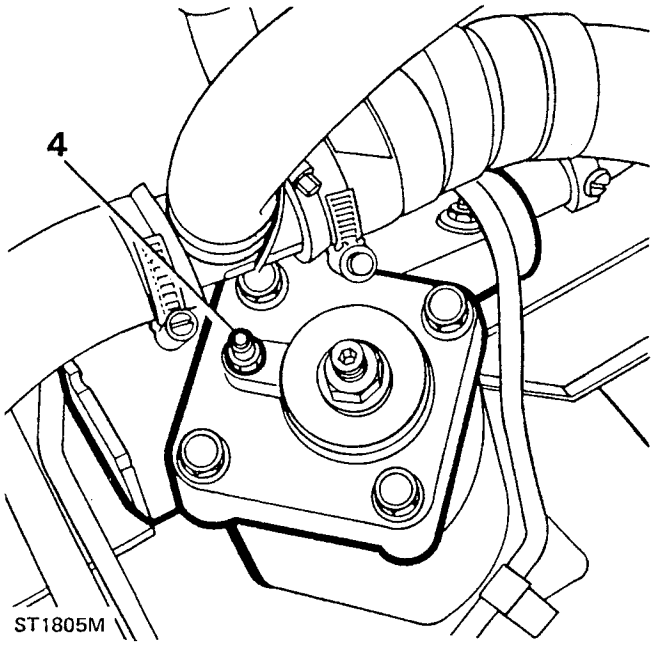
POWER STEERING SYSTEM — Adwest Lightweight box

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 ut a short road test. If necessary, repeat the complete foregoing procedure.

POWER STEERING SYSTEM — Adwest Lightweight box

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/cm^2 (2000 lbf/in^2) and the normal pressure which may be expected in the power steering system is 77 kgf/cm^2 (1100 lbf/in^2).
2. Under certain fault conditions of the hydraulic pump it is possible to obtain pressures up to 105 kgf/cm^2 (1500 lbf/in^2). 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/cm^2 (1000 to 1100 lbf/in^2).
   (b) With the engine idling and the steering wheel held hard on full lock, the pressure should be 28 kgf/cm^2 (400 lbf/in^2) minimum.

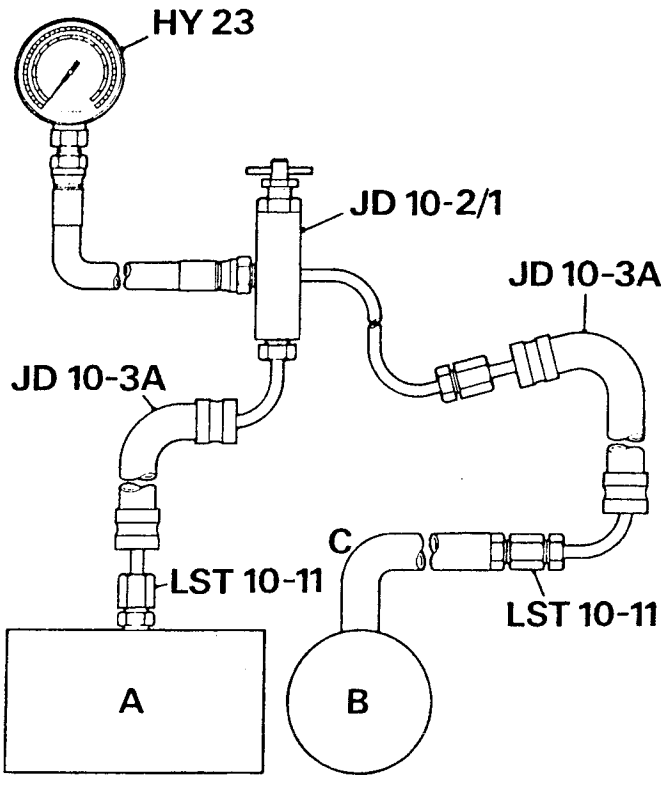
These checks should be carried out first on one lock, then on the other.

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 kgf/cm^2 (100 lbf/in^2).

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



ST1854M

A. Steering box
B. Steering pump
C. Existing hose from steering box

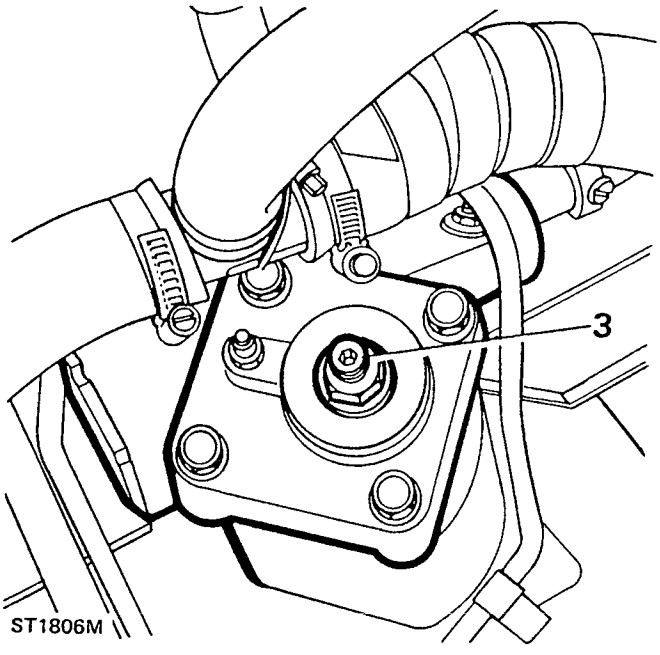
ADJUST POWER STEERING BOX — Adwest Lightweight box

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 (0.375 in).
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 (0.375 in) maximum.



ST1806M

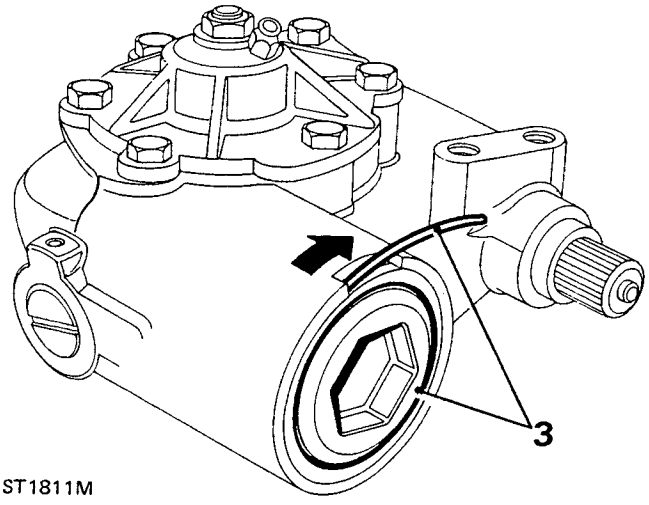
4. Tighten the locknut, then turn the steering wheel from lock to lock and check that no excessive tightness exists at any point.
5. Lower the vehicle to ground level and remove the wheel chocks.
6. Road test the vehicle.

GEMMER POWER STEERING BOX OVERHAUL

Special tools:
Drop arm puller MS 252 A
End cover wrench adaptor LST123
Input shaft oil seal installer LST124
Sector shaft oil seal installer LST125
Valve seal installer and valve ring compressor LST126
Preload setting tool R01016

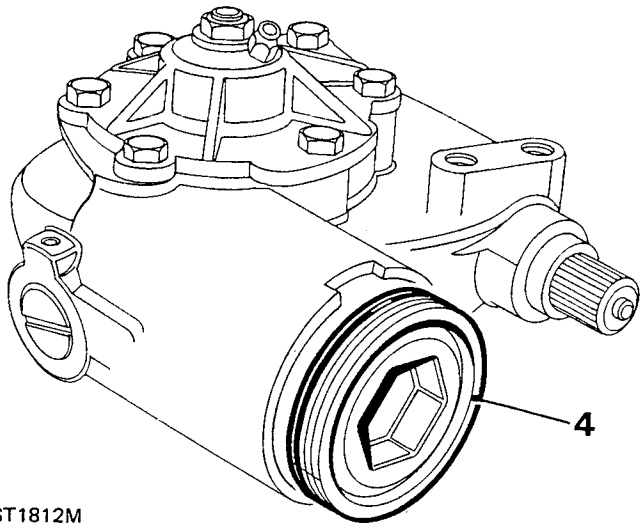
Dismantle

1. Remove the steering box from the vehicle.
2. Bend back the locking tab and remove the drop arm nut. Using special tool MS 252 A or a suitable alternative, withdraw the drop arm from the sector shaft.
3. Using special adaptor tool LST123 turn the cylinder cover anti-clockwise to expose end of the locking ring. Now turn the cover clockwise to extract the ring.



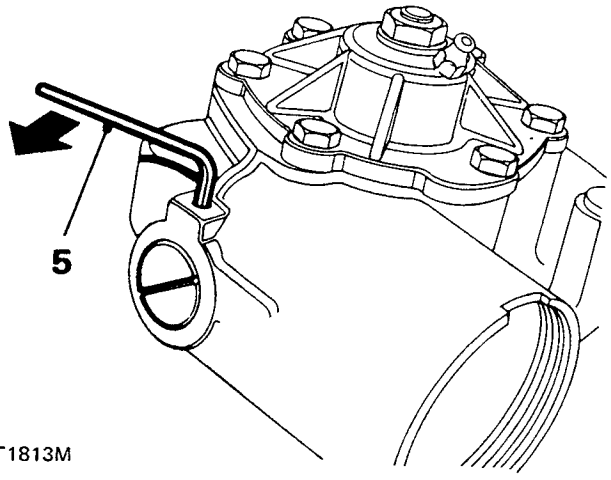
ST1811M

4. To remove the cover, turn the input shaft to the left lock for a LHD drive steering box or to the right for a RHD drive steering box until the rack piston pushes the cover out to enable it to be withdrawn by hand.



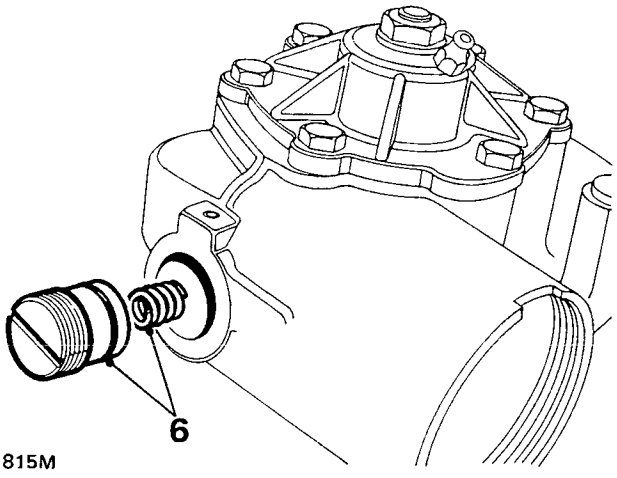
ST1812M

5. Slacken the grub screw securing the rack pad adjuster.



ST1813M

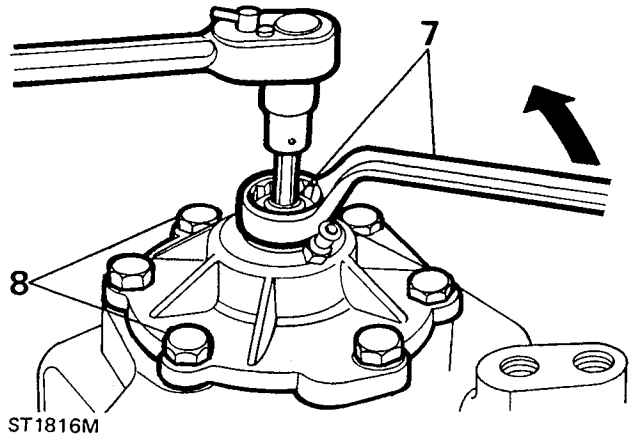
6. With a screwdriver remove the rack pad adjuster, 'O' ring and spring.



ST1815M

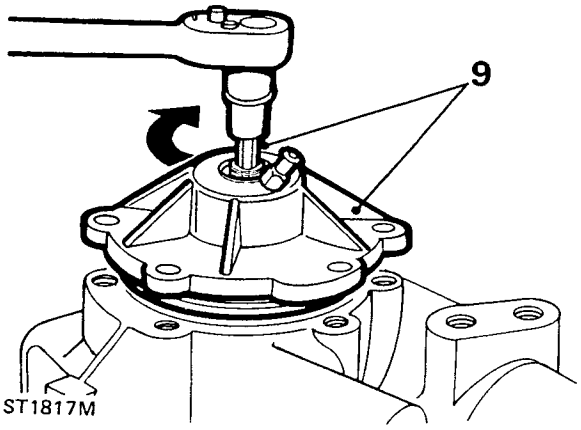
continued

7. Restrain the sector shaft adjuster with a 6 mm hexagonal key and remove the locknut.
8. Remove the six bolts securing the sector shaft cover.



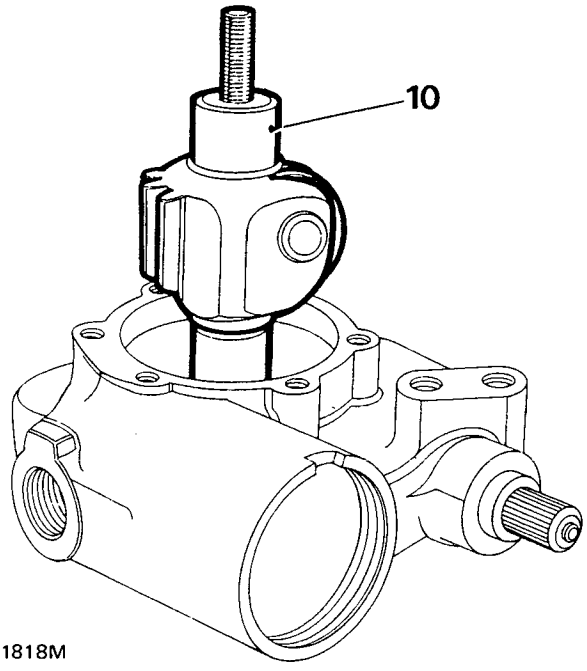
ST1816M

9. Hold the sector shaft cover and turn the adjuster and screw clockwise until the cover can be removed.



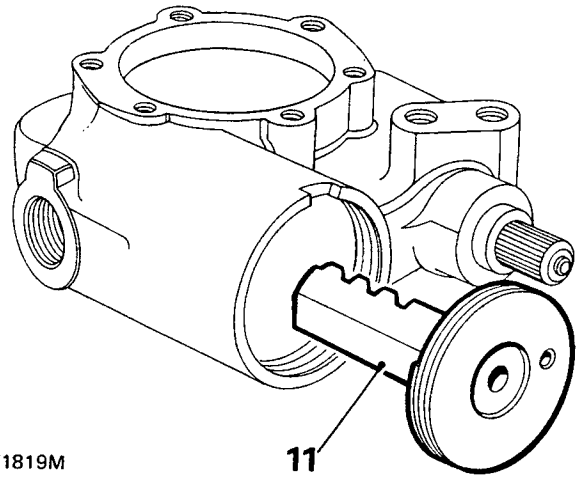
ST1817M

10. Lift-out the sector shaft.



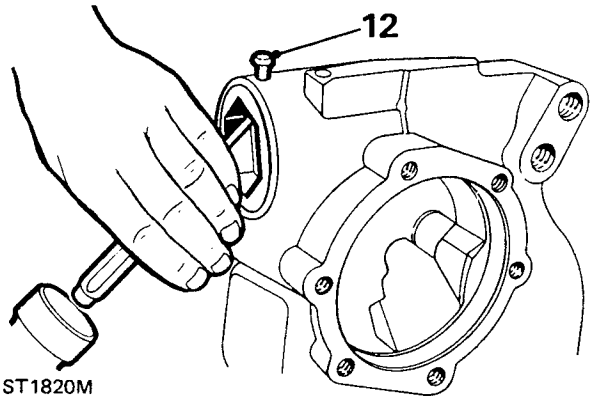
ST1818M

11. Remove the rack and piston assembly and collect the rack adjuster thrust pad.



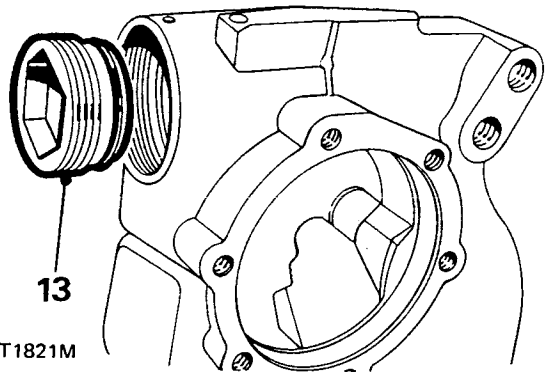
ST1819M

12. Drive-out the worm adjusting screw locking pin.



ST1820M

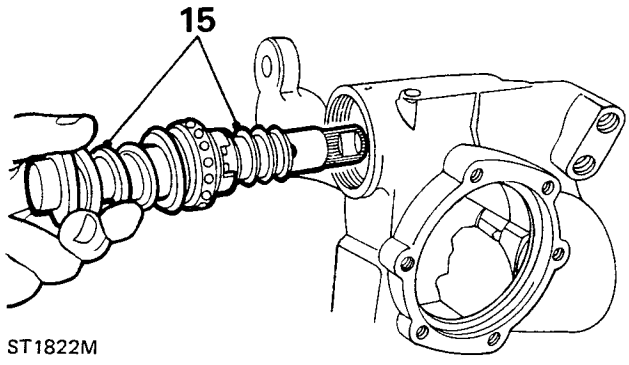
13. Using special tool LST123, remove the input shaft worm adjusting screw anti-clockwise.



ST1821M

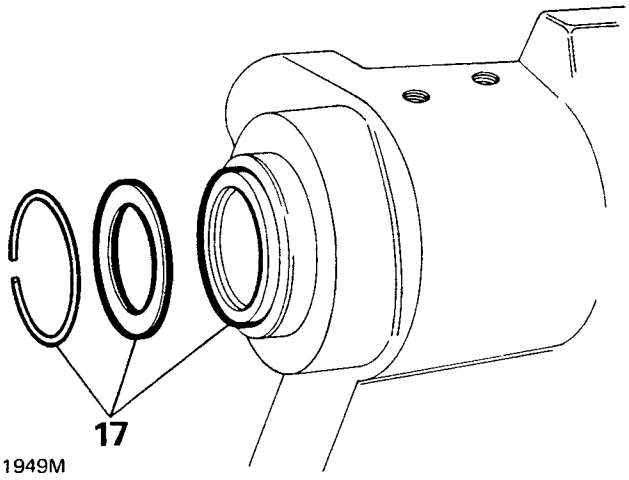
14. Tap the splined end of the input shaft to free the outer bearing. Remove the bearing track and ball cage assembly.

15. Withdraw the input shaft, worm and valve assembly.



ST1822M

16. Release the circlip and remove the steel washer and oil seal from the sector shaft housing.
17. Remove the wire circlip, anti-extrusion washer and oil seal from the input shaft housing.

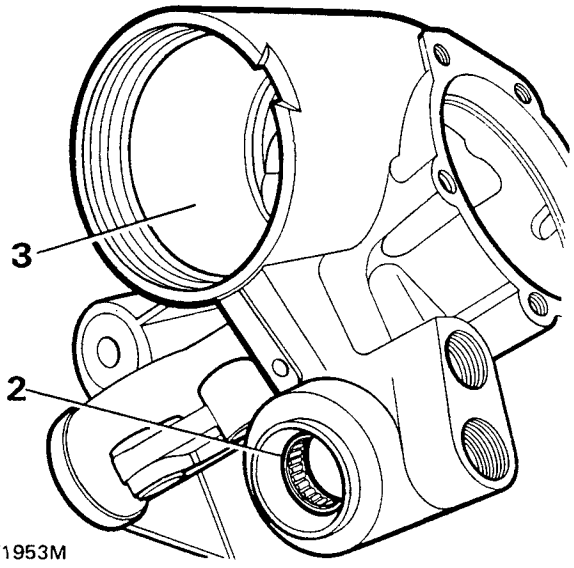


ST1949M

INSPECTION AND OVERHAUL OF COMPONENTS

Steering box housing

1. Examine the sector shaft upper and lower needle roller bearings and if necessary drive them from the housing with a suitable drift.
2. Inspect the input shaft needle bearing and if worn drive it from the housing and press-in a replacement.
3. Examine the piston bore for wear and scores.
4. Check the input shaft bores for wear and scores.

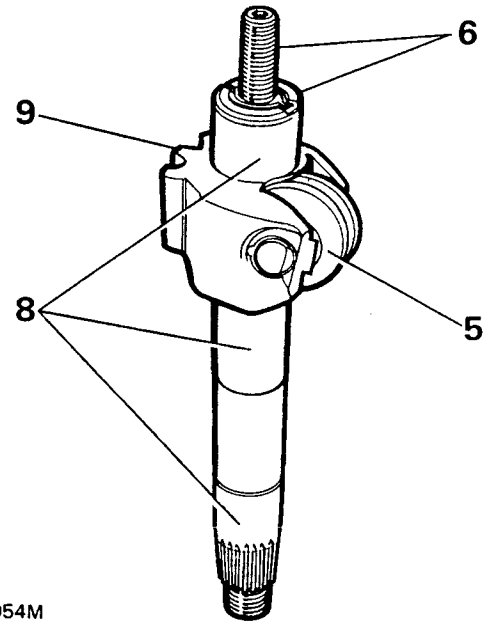


ST1953M

Sector shaft assembly

5. Check that no side play or wear exists in the roller.
6. Check the condition of the adjuster and its retainer and that the crimping is sound.
7. The axial clearance of the adjuster should not exceed 0,20 mm (0.008 in).
8. Examine the bearing journals on the shaft for wear and damage.
9. Check the gear teeth for excessive and uneven wear, scores and pitting.

continued



ST1954M

Valve and worm assembly

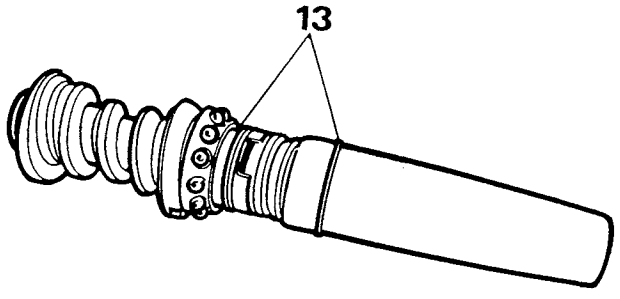
NOTE: If the inner ball race is faulty and unfit for further service it cannot be renewed and a new valve and worm assembly must be obtained and fitted. Should this be the case, the following checks of the valve and worm can be ignored.

10. Examine the valve rings which must be free from cuts, scratches and scores. Also, the rings should be a loose fit in the grooves.
11. If any ring is unsatisfactory, all the rings must be renewed. When removing the rings take care not to damage the valve grooves.
12. To fit new rings use special tool LST126, which consists of the following three parts:-

    a) Ring expander.
    b) Split coller.
    c) Ring compressor.

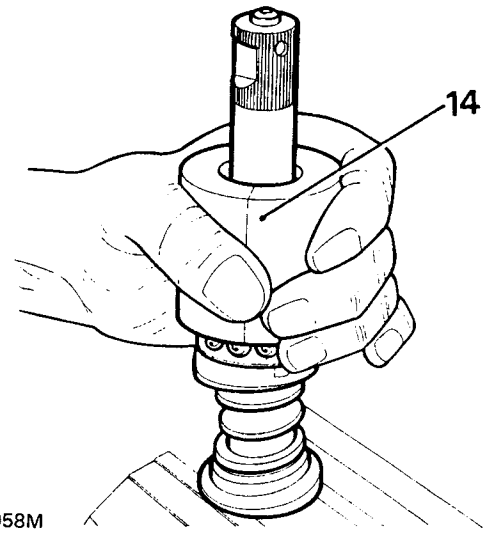
    Before using the tool lubricate each part with the recommended power steering fluid.

13. Warm the five rings in hot water leaving them in the water until ready for fitting. When pliable, feed the ring for the lower groove (nearest the roller bearing) over the expander and position the expander over the input shaft, slide the ring into the groove and mould it into position with the fingers.



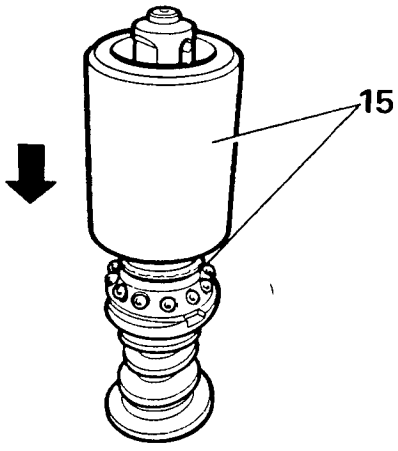
ST1941M

14. Encircle the ring with the split coller and squeeze the coller together, by hand, and hold for approximately thirty seconds.



ST1958M

15. Remove the split coller and with care, ease the compressor tool over the ring and leave for a few minutes to cool before carefully removing the tool.

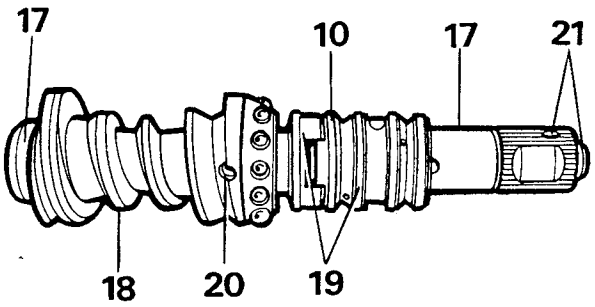


ST1942M

16. Using the expander tool, as before, fit the remaining four rings, one at a time, into the grooves and mould with the fingers. It is important that only one ring at a time is placed on the expander since in the meantime the remaining rings could cool in an expanded condition making it difficult to locate and contract the rings in the valve grooves. Encircle the four rings with the split coller and squeeze together for approximately thirty seconds. Then, with care, ease the compression tool over the four rings and allow to cool for about five minutes before carefully withdrawing the compressor.

continued

17. Examine the bearing surfaces of the valve assembly for wear and scores.
18. Examine the worm track for wear and pitting.
19. Check that the end-float between the locator and valve sleeve does not exceed 0,12 mm (0.005 in).
20. Rotary movement between the components at the trim pin is permissible.
21. Check that no free movement exists on the torsion bar assembly pin between the input shaft and worm.



ST1955M

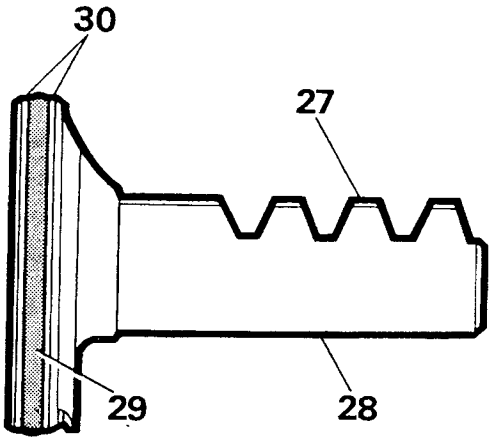
22. The valve and worm assembly should be renewed if there is wear at the following points:
    a) Inner and outer bearing tracks.
    b) Worm.
    c) Valve locator.
    d) Input shaft needle bearing journal.
23. Examine the outer ball race and track for wear and general condition. The race should be renewed if there is wear and pitting or if a new valve and worm assembly is being fitted.

Thrust pad and adjuster

24. Examine the thrust pad for scores.
25. Check that the thrust pad seat in the adjuster is not worn or scored.
26. Check that the thrust pad spring is not broken.

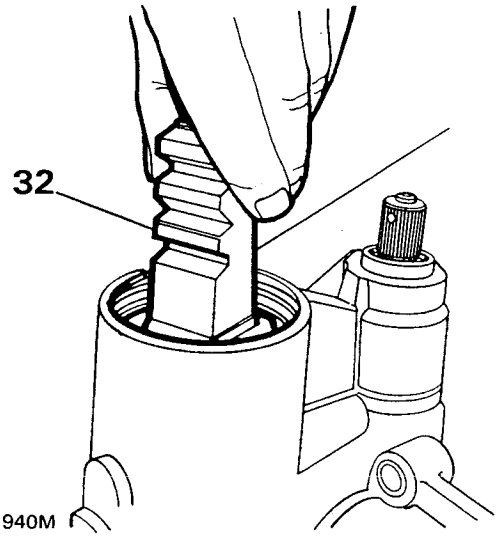
Rack and piston

27. Examine the rack teeth for wear and pitting.
28. Check that the surface on which the thrust pad bears is not worn and scored.
29. Remove the plastic seal and the 'O' ring seal beneath it, from the piston groove.
30. Ensure that the outer diameters of the piston are free from burrs and damage.
31. Fit a new 'O' ring seal to the piston groove.



ST1957M

32. To fit a new plastic seal to the piston, warm the seal in hot water and fit to the piston groove. Insert the piston in the inverted position i.e. piston first into the cylinder and leave to cool.



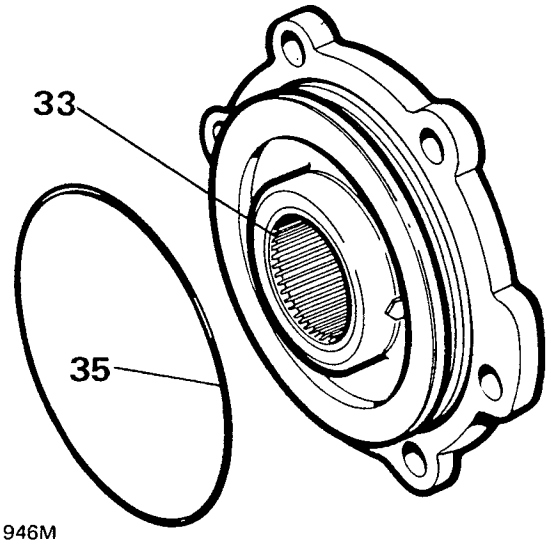
ST1940M

Sector shaft cover

33. Examine the sector shaft cover needle bearing and if necessary extract the bearing taking care not to damage the housing.

continued

34. Drive-in a new bearing, up to the shoulder, with the bearing number and chamfered ends of the rollers trailing.
35. Fit a new 'O' ring seal to the cover.
36. Check that the cover bearing lubrication passage and bleed nipple hole is clear.

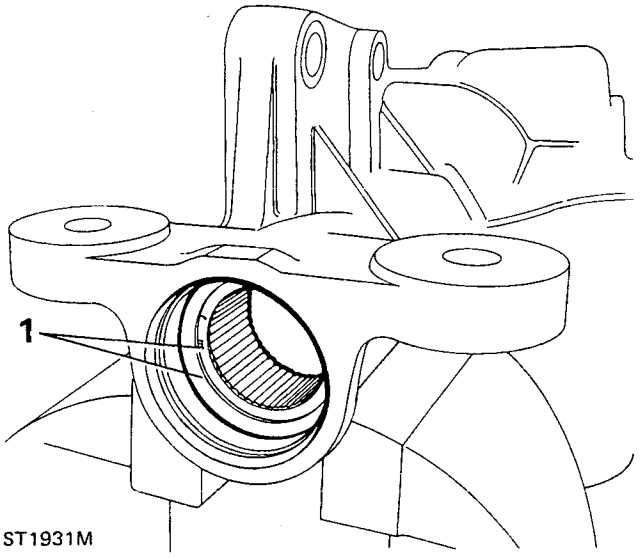


ST1946M

Assemble

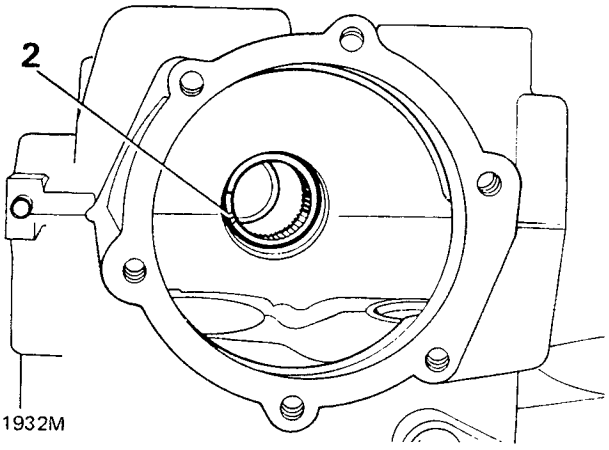
During the following assembly instructions absolute cleanliness must be observed. Also when fitting components and oil seals they must only be lubricated with the recommended fluid, or petroleum jelly.

1. If removed, fit the sector shaft lower needle bearings, numbers outwards, to the steering box to just below the chamfer.



ST1931M

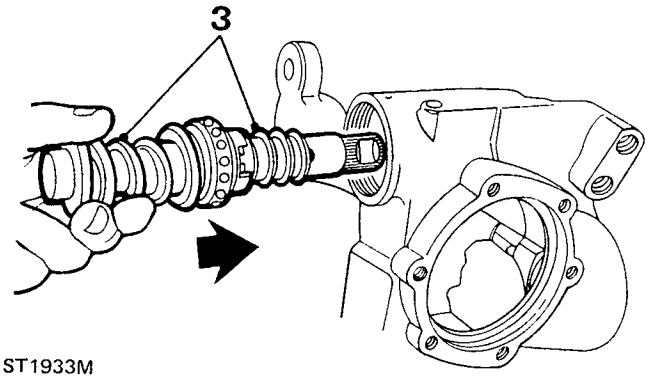
2. Fit the sector shaft upper needle bearings, number outwards, up to the shoulder.



ST1932M

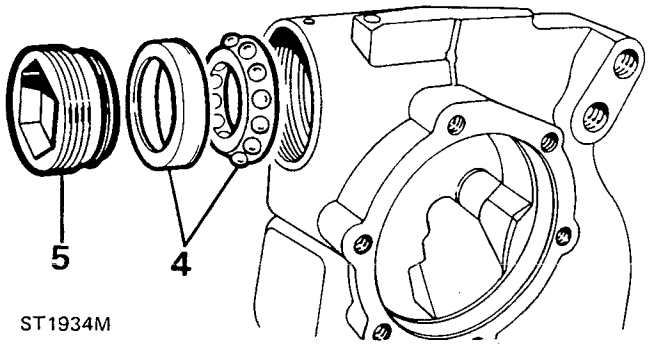
Fitting the valve and worm assembly (input shaft)

3. Fit the input shaft to the steering box housing and lubricate with the recommended fluid. Turn the shaft to the straight ahead position.

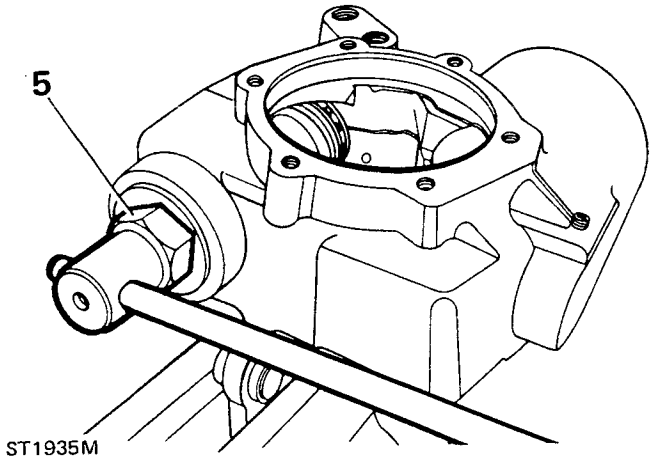


ST1933M

4. Fit the input shaft outer bearing and track.
5. Lubricate and fit the input shaft cover and 'O' ring seal using special tool LST123.

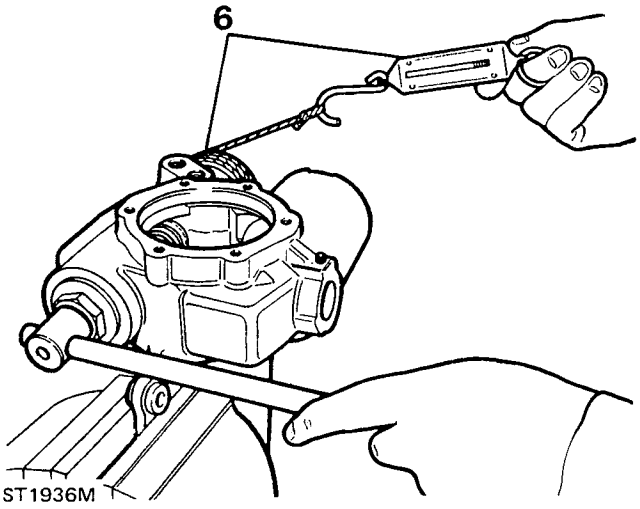


ST1934M



ST1935M

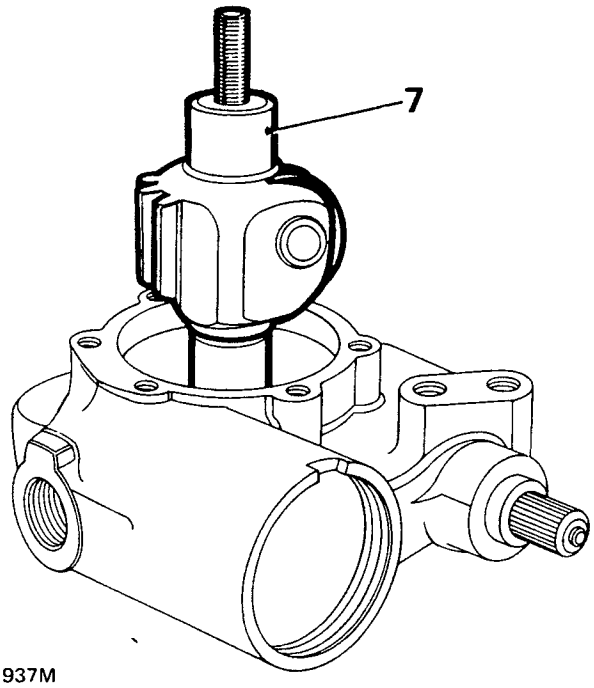
6. Secure preload setting tool R01016 to the input shaft with the grub screw. Wind string round the tool and tie a spring balance to the free end of the string. Whilst turning the input shaft cover clockwise, pull the spring balance until a constant preload reading of 0,69 Nm is achieved.



ST1936M

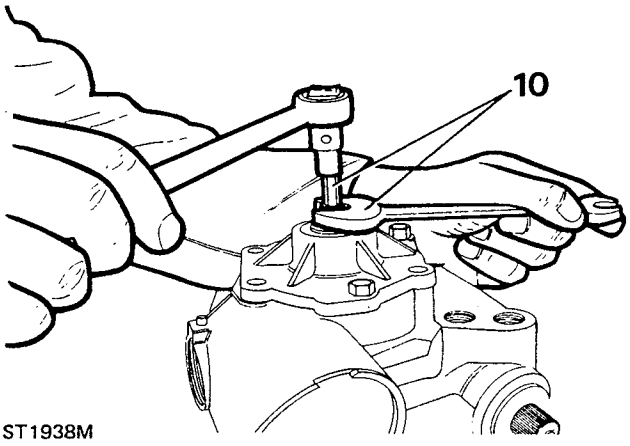
Fitting sector shaft and piston-rack assembly

7. Fit the sector shaft to the housing and engage it with the input shaft worm in the straight ahead position.
8. Screw-on, to the sector shaft adjuster, the sector shaft cover and secure with two or three of the six retaining screws.
9. Turn the adjuster screw clockwise, with a 6 mm hexagonal key, until the sector shaft just makes contact with the input shaft worm.



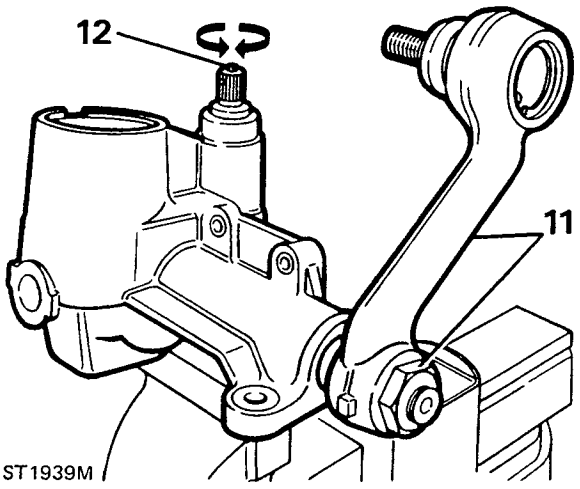
ST1937M

10. Without moving the adjuster, fit the locknut whilst restraining the adjuster screw with the 6 mm key and just nip the locknut with an open-ended spanner.



ST1938M

11. Temporarily fit the drop arm and tighten the locknut until no clearance is felt between the sector shaft and drop arm.
12. Rotate the input shaft one turn clockwise, then turn the shaft back to the straight ahead position whilst noting the point at which the backlash to the drop arm disappears or is 'taken-up'.
13. Repeat instruction 12 and rotate the input shaft anti-clockwise on to the opposite lock.

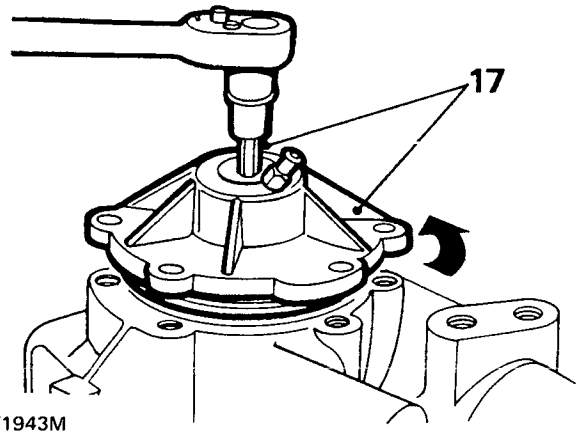


ST1939M

14. If the difference between the two points at which the backlash is 'taken-up' or disappears is greater than 90° (¼ of a turn) it will be necessary to change the shimming behind the input shaft inner bearing cup.
15. If the shimming requires adjustment, add a shim on right-hand drive steering boxes if backlash starts too quickly on clockwise rotation. Should backlash start too quickly for anti-clockwise rotation, remove a shim. For a left-hand drive steering box, reverse the foregoing procedure.

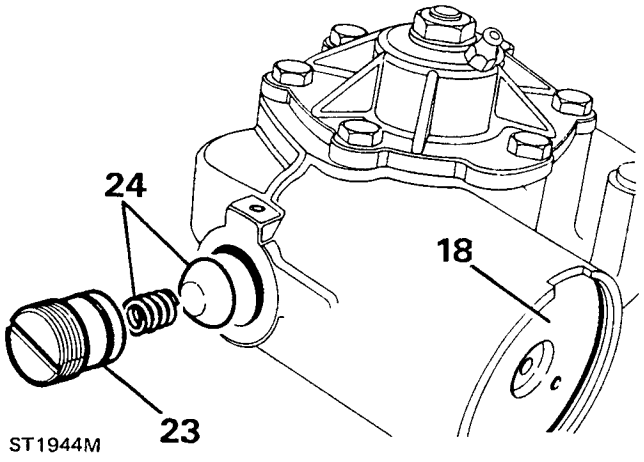
NOTE: If it is necessary to perform instruction 15, instructions 3 to 13 must be repeated afterwards.

16. Remove the drop arm and whilst restraining the sector shaft adjuster, so that it does not turn, remove the locknut.
17. Remove the sector shaft cover screws and while still restraining the adjuster, unscrew clockwise, the cover from the sector shaft and withdraw the sector shaft.



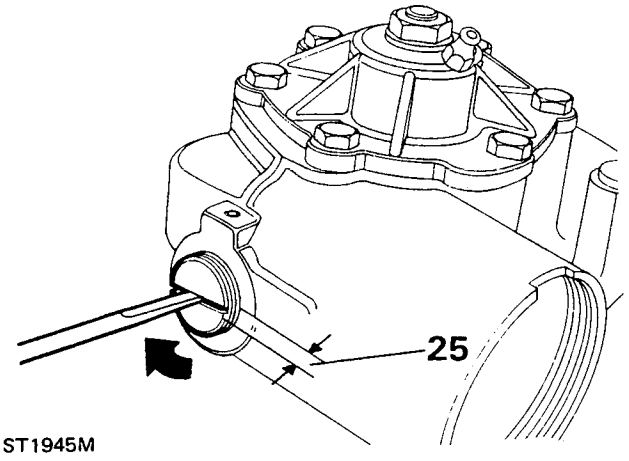
ST1943M

18. Lubricate the rack piston plastic seal and insert the piston into the piston bore, rack end first, as in instruction 11 of the dismantling procedure, to a depth of 37 mm below the lip of the bore.
19. Lubricate and fit the sector shaft in the straight ahead position.
20. Lubricate and fit 'O' ring seal to the sector shaft cover.
21. Restrain the sector shaft adjuster and screw-on the cover, reversing instruction 17. Secure with the six bolts, tightening evenly to 25 to 30 Nm (18 to 22 lbs ft).
22. Restrain the sector shaft adjuster and fit and tighten the locknut, as instruction 10.
23. Fit and lubricate an 'O' ring seal to the rack adjuster screw.
24. Fit the rack pad and spring noting that the larger flat side of the pad is towards the rack.



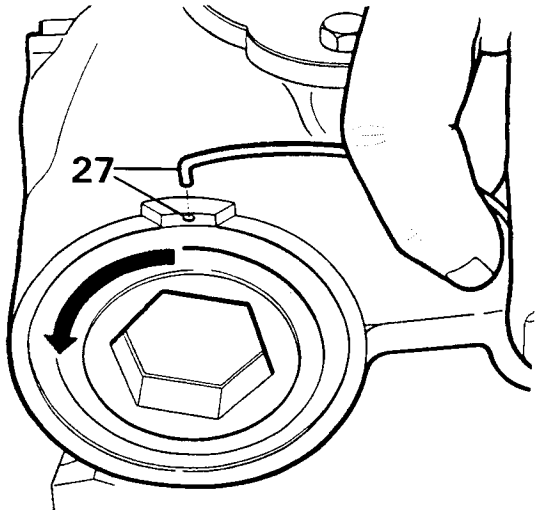
ST1944M

25. Screw-in the rack pad adjuster until the head is 4 mm from the steering box face.



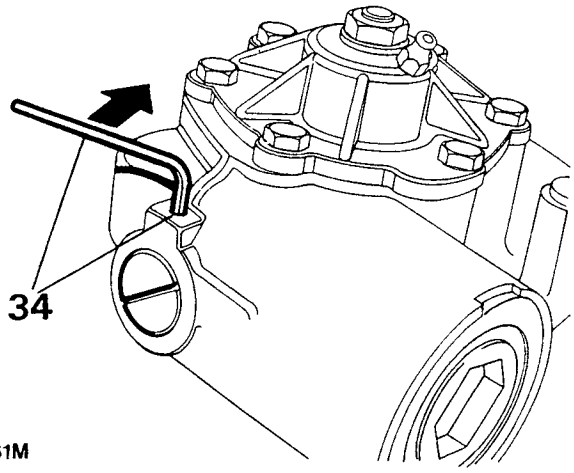
ST1945M

26. Lubricate and fit an 'O' ring seal to the piston-rack cover.
27. Fit the piston cover to steering box. Align the retaining ring hole in the cover with the cut-out in steering box housing and insert hooked end of the retaining ring in the hole. Using special tool LST123, rotate the cover anti-clockwise to feed the ring into the groove until the ring is fully seated. This is a reversal of instruction 3 of the dismantling procedure.



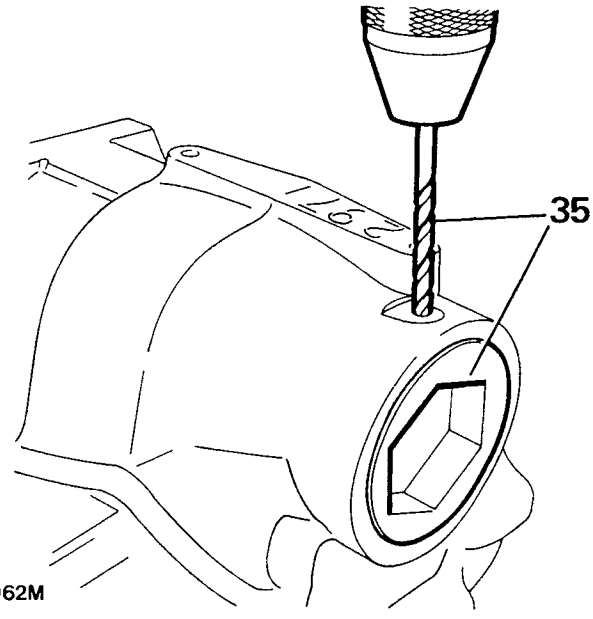
ST1956M

28. Temporarily fit the drop arm and secure with the nut so that no backlash is present between the arm and sector shaft. Set the steering in the straight ahead position.
29. Fit the preload setting tool R01016 to the input shaft and secure with the grub screw. Rotate the input shaft in both directions clockwise and anti-clockwise ½ to ¾ of a turn to check the backlash distribution.
30. To check the drop arm angular travel for a LHD drive steering box use the preload setting tool to turn the input shaft two turns clockwise and one and three-quarter turns anti-clockwise. For RHD drive boxes, the opposite applies.
31. Remove the drop arm.
32. Return to the straight ahead position and screw the rack adjuster clockwise until the adjuster pad just contacts the pad.
33. Restrain the sector shaft adjuster, as in instruction 10, and tighten the locknut to 70 to 90 Nm (52 to 66 lbs/ft).
34. Secure the rack adjuster with the grub screw, reversing the dismantling procedure instruction 5.



ST1961M

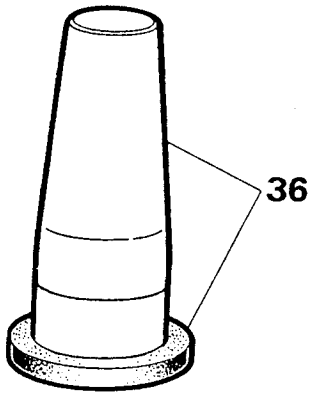
35. Secure the worm adjuster with a new pin. If necessary, drill a new 4 mm hole in the adjuster through the hole in the steering box housing to locate the pin. Check, before drilling that the new hole will not break into the side of the existing hole.



ST1962M

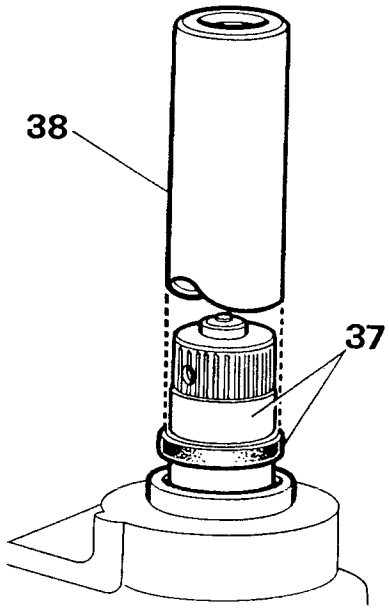
Fitting input shaft oil seal

36. Using the three part tool LST124, lubricate a new seal and slide it, lip side leading, over the conical seal-saver to the detachable lower part of the tool.



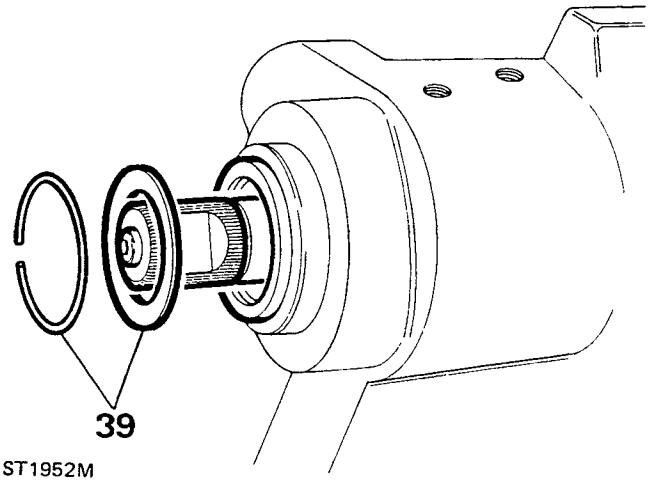
ST1947M

37. Withdraw the conical seal-saver and place the lower part of the tool with the seal, lip side downwards, over the input shaft.
38. Place the seal-driver part of the tool on top of the seal and drive it fully home.



ST1948M

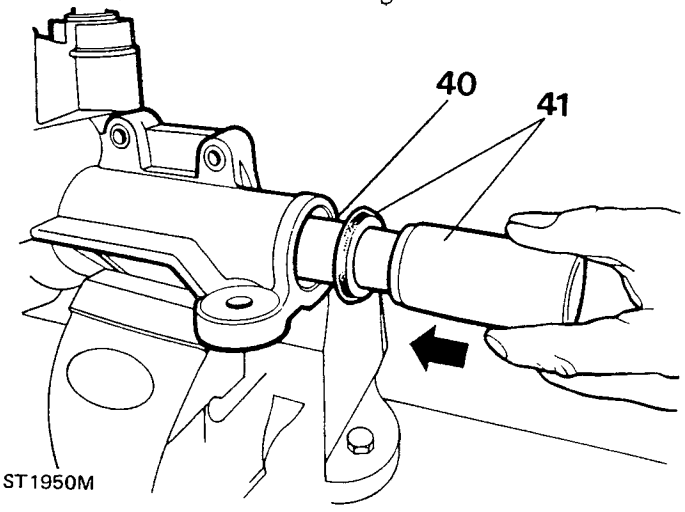
39. Fit the anti-extrustion washer and secure the assembly with the wire circlip.



ST1952M

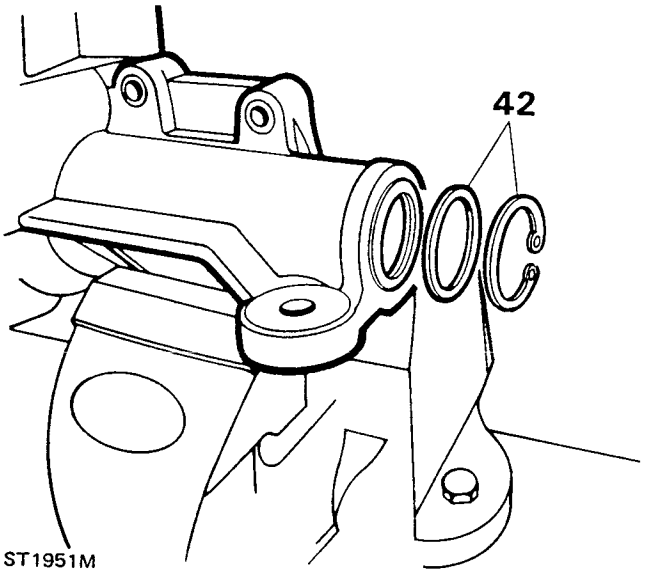
Fitting sector shaft oil seal

40. Lubricate the oil seal and seal-saver LST125, and slide the seal over the tool, lip side leading.
41. Using the seal-driver part of the tool, push the seal fully home into the housing.



ST1950M

42. Fit the steel washer and secure the assembly with the circlip.



ST1951M

43. Fit the drop arm, tab washer and nut. Tighten the nut to 170 to 180 Nm (125 to 132 lbs/ft). Fold one side of the tab washer over the drop arm and the other over a flat against the nut.
44. Refit the steering box to the vehicle and bleed the hydraulic system.

NOTE: Bleeding and test of the power steering box is the same as that for the Adwest Lightweight box.

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 to 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 BOX	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.

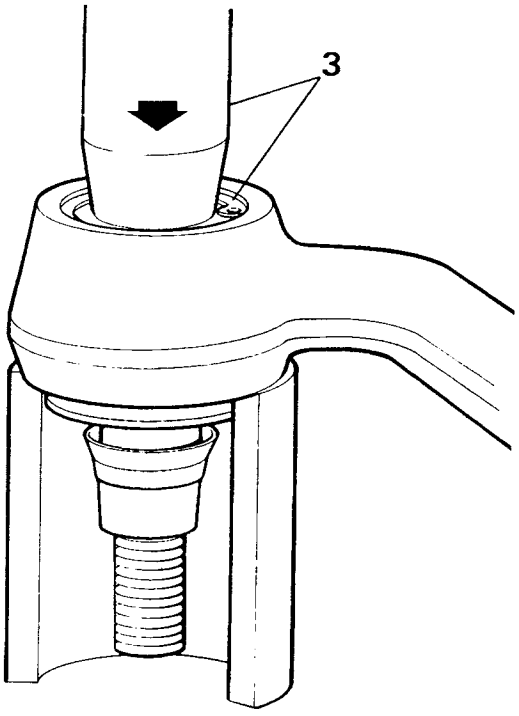
Ball Pin	**Ball lower socket**
Retainer	**Spring**
Spring rings	**'O' ring**
Dust cover	**Cover plate**
Ball top socket	**Circlip**

Dismantle

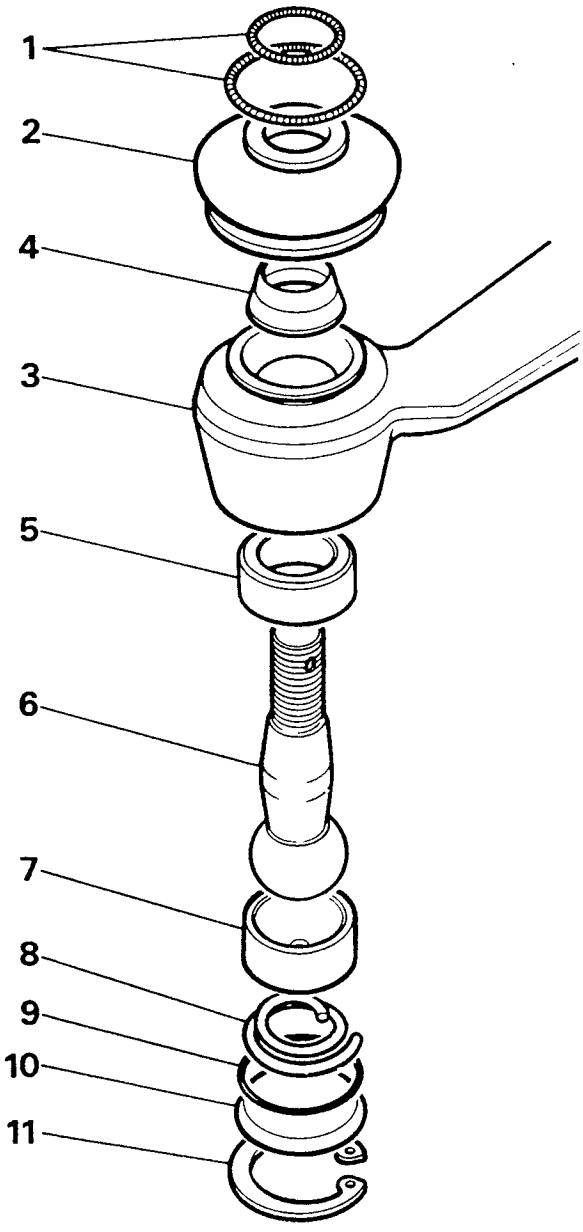
1. Remove the drop arm from the vehicle and clean the exterior.
2. Remove the spring rings and prise-off the dust cover.
3. In the interests of safety, position the ball joint under a press to relieve the spring tension and support the housing both sides of the ball pin, as illustrated. Apply pressure 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.



ST1382M

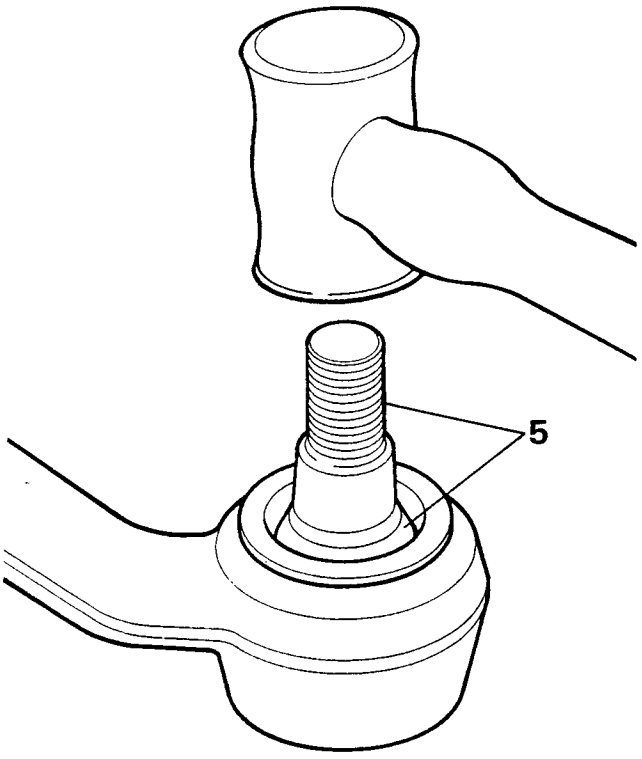


ST1381M

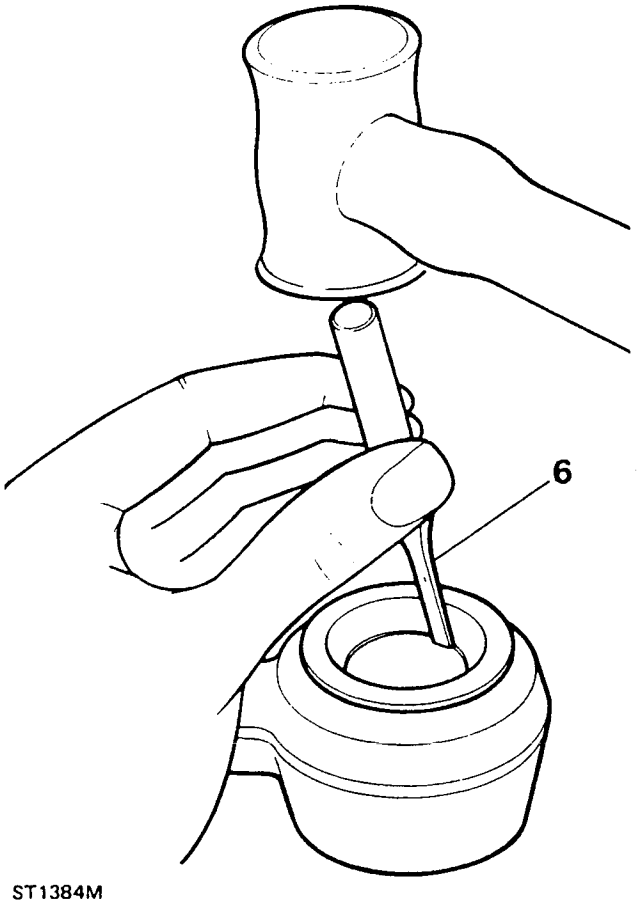
KEY TO BALL JOINT

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.



ST1383M

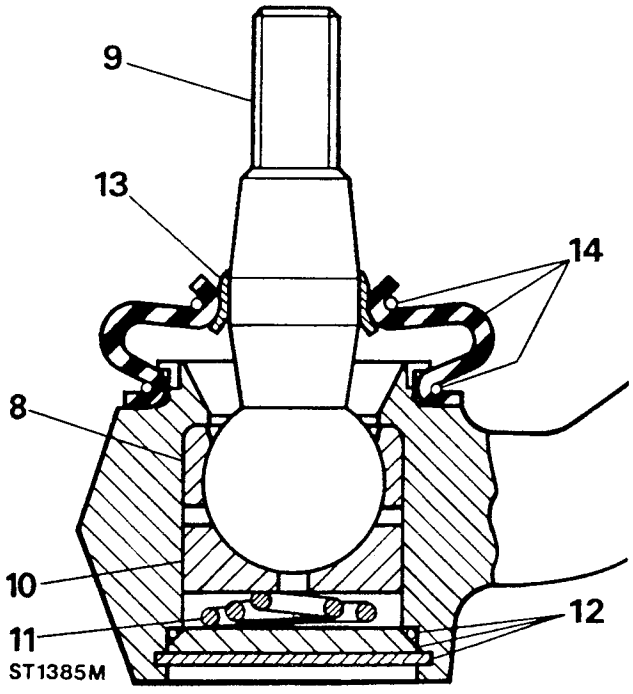


ST1384M

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 LB10 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.

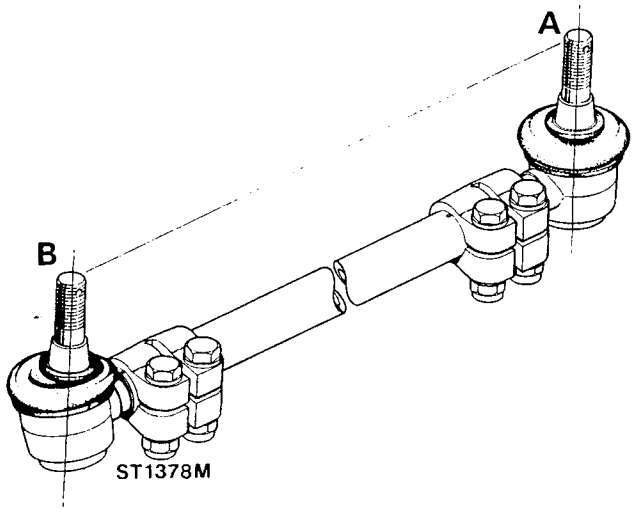


ST1385M

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 — All Models

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.

OVERHAUL FRONT HUB ASSEMBLY

Service tools:
Drift 18G 134
Hub oil seal replacer 18G 1349
Dial gauge bracket RO 530106

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 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.

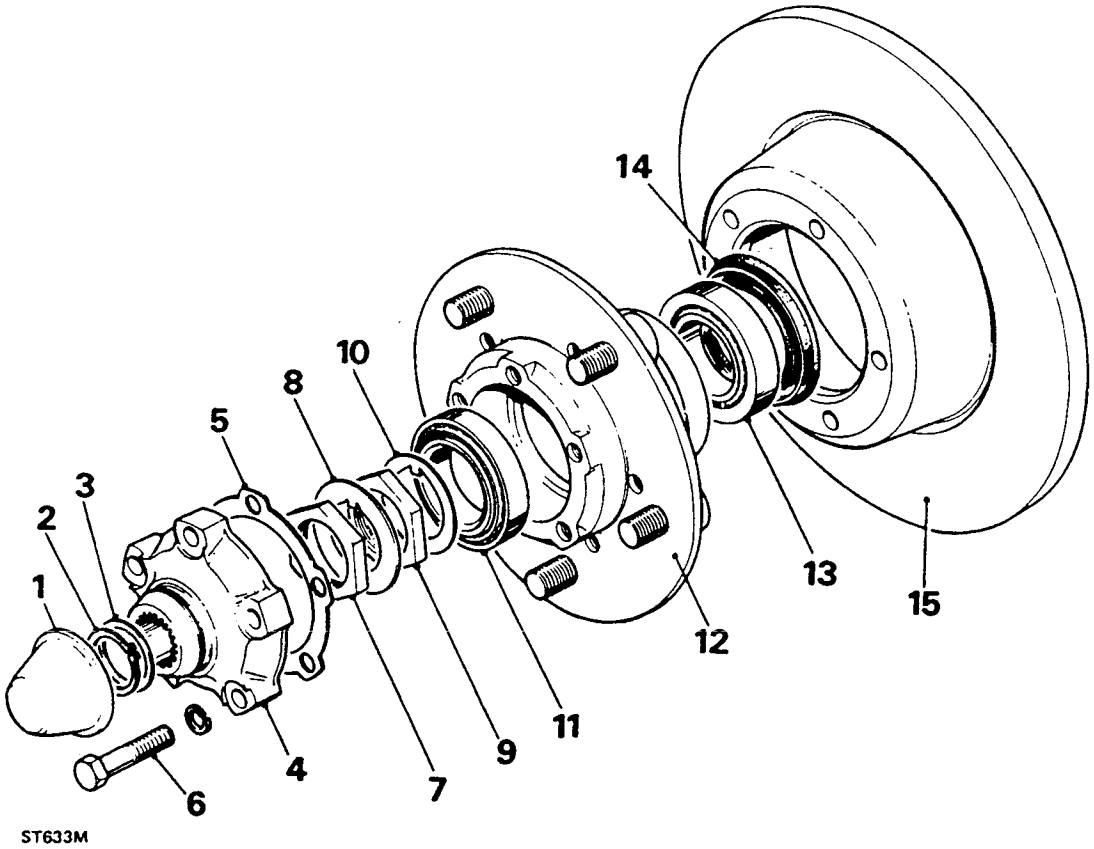
6. Lever-off the dust cap.
7. Remove the circlip from the drive shaft.
8. Remove the drive shaft shim.
9. Remove the five bolts and withdraw the driving member and joint washer.
10. Bend back the lock washer tab.
11. Remove the locknut and tab washer.
12. Remove the hub adjusting nut.
13. Remove the 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 unservicable a new hub complete with studs must be obtained.

continued

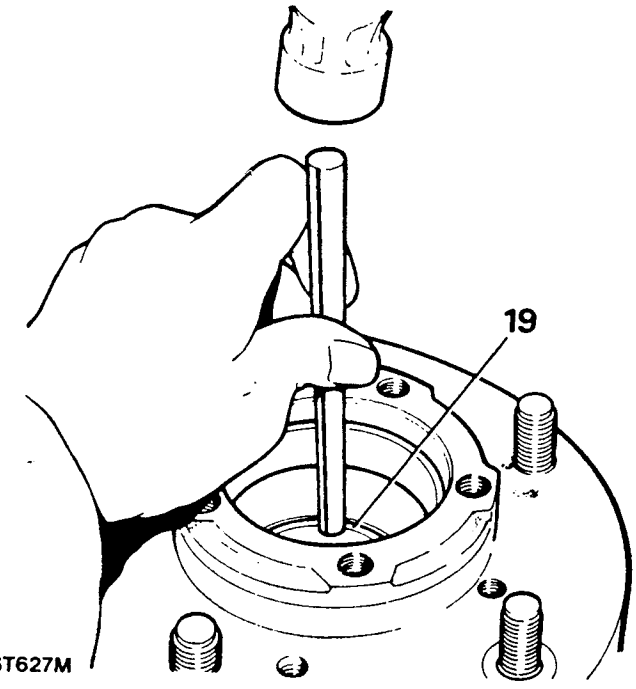
KEY TO HUB ASSEMBLY

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.



ST633M

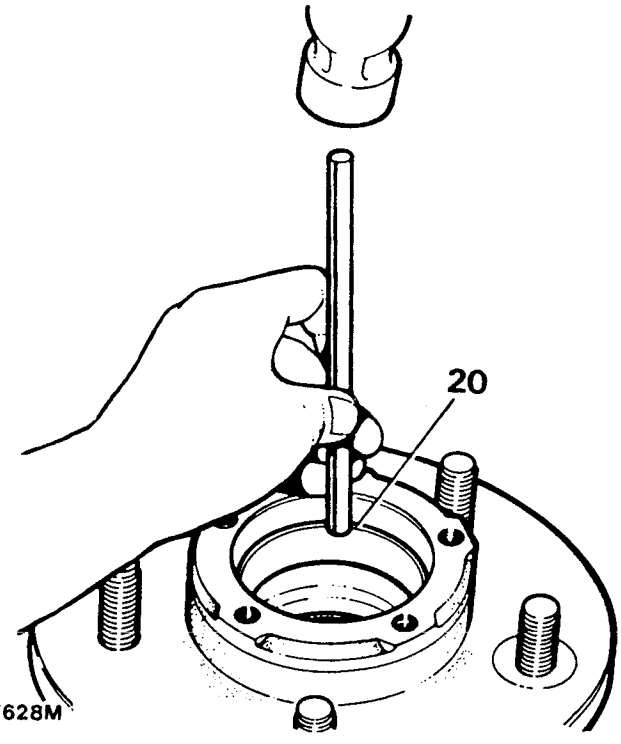
18. Drift-out the grease seal and inner bearing from the hub and discard the seal.
19. Drift-out the inner and outer bearing tracks.



ST627M

ASSEMBLE

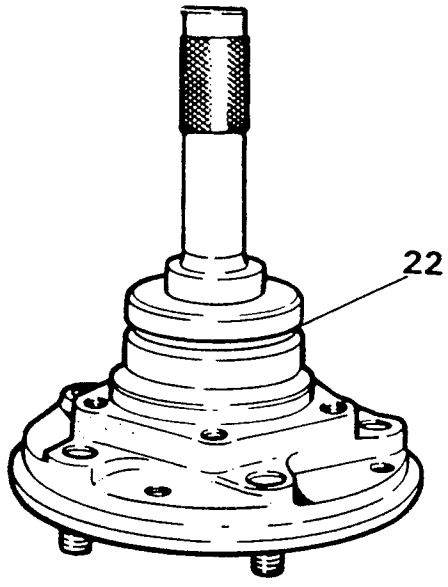
20. Clean and degrease the hub and drift-in the inner and outer bearing tracks.



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.

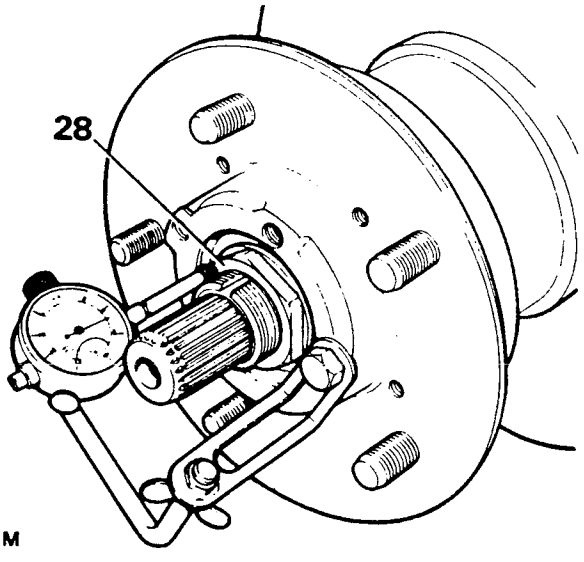
22. With the lip side leading fit a new seal to the hub using special tool 18G 1349 grease seal replacer and drift 18G 134. Drive-in the seal so that it is recessed 4,83 to 5,33 mm (0.190 to 0.210 in) below the rear face of the hub. Apply grease liberally between the seal lips and springs.



ST631M

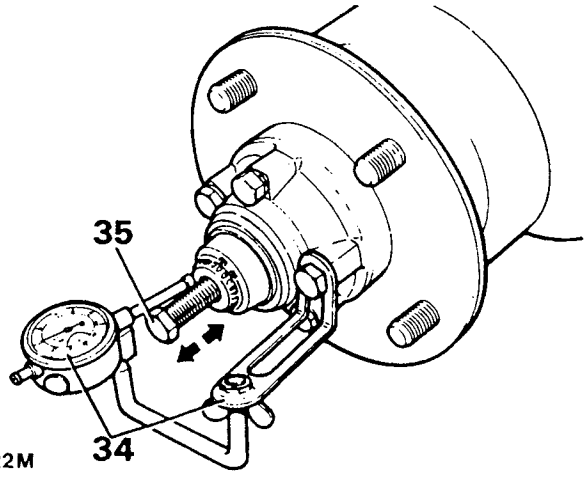
23. Assemble the brake disc to the hub lining up the marks made during dismantling. Fit and tighten the five retaining bolts to 65 to 80 Nm (48 to 59 lbf ft).
24. Grease as in instruction 21 and fit the outer bearing to the hub.
25. Clean the stub axle and drive shaft and fit the hub assembly to the 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 RO 530106 and rest the stylus in a loaded condition on the adjusting nut.

continued



ST621M

29. Slacken off the adjusting nut until an end-play of 0,1270 to 0,1016 mm (0.0005 to 0.004 in) 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 (44 to 52 lbf ft).
33. Fit the original drive shaft shim and secure with the circlip.
34. To check the drive shaft end-play mount a dial gauge using bracket RO 530106 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 gauge reading. The end-play should be between 0,127 to 0,254 mm (0.005 to 0.010 in).



ST622M

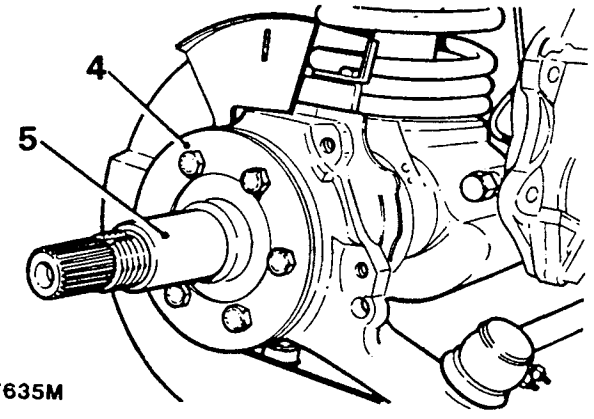
36. If the end-play requires adjustment, remove the circlip, measure the shim thickness and fit an appropriate selective shim to give the required end-play.
37. Remove the bolt from the drive shaft, fit the circlip and dust cap.
38. Fit the brake caliper and tighten the two bolts to 120 to 150 Nm (88 to 111 lbf ft).
39. Locate the jump hose in the bracket and tighten the locknuts.
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: 18G 284AAH bush extractor

Remove stub axle, axle shaft and constant velocity joint

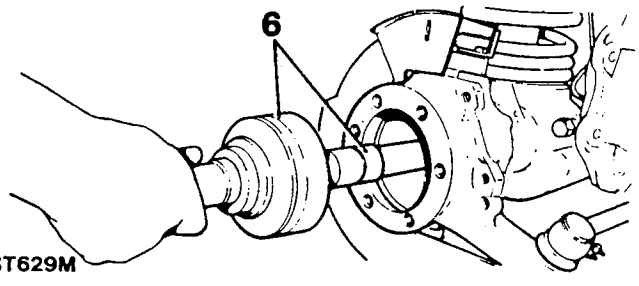
1. Remove the hub complete as described in the operation to overhaul the hub assembly instructions 1 to 14.
2. Drain the swivel pin housing and refit plug.
3. Remove the six bolts retaining the stub axle to the swivel housing.
4. Remove the mud shield.
5. Remove the stub axle and joint washer.



ST635M

6. Pull-out the axle shaft and constant velocity joint from the axle casing.

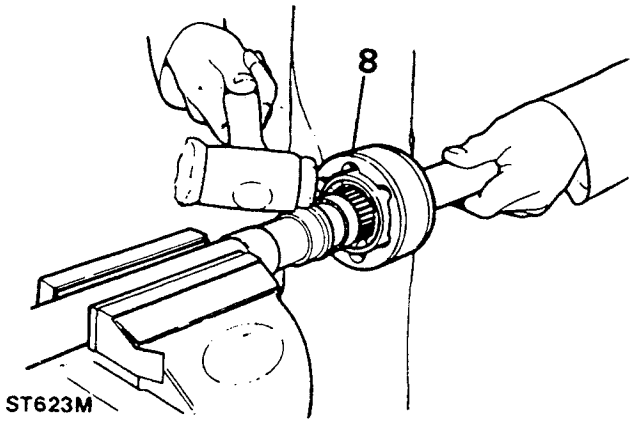
continued



ST629M

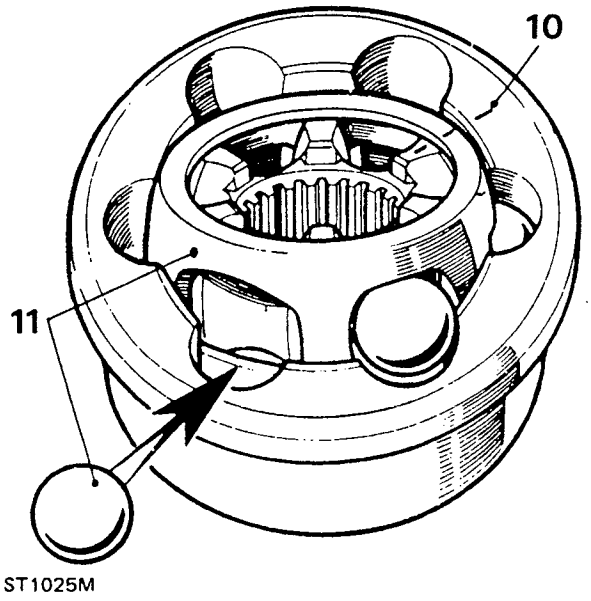
Remove constant velocity joint from axle shaft

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.



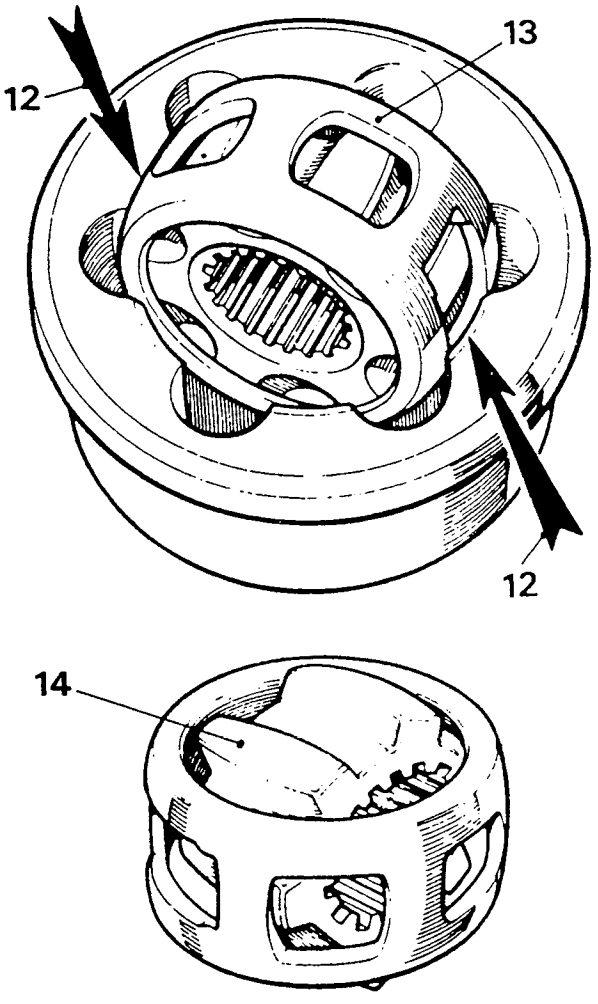
Dismantle the constant velocity joint

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.



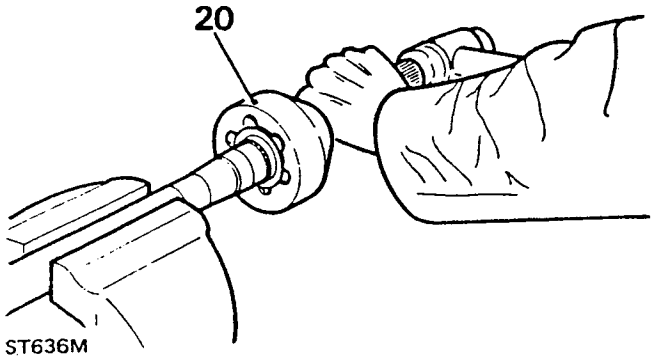
12. Swivel the cage into line with the axis of the joint and turn is until two opposite windows coincide with two lands of the joint housing.
13. Withdraw the cage.
14. Turn the inner track at right angles to the cage with two of the lands opposite the cage openings and withdraw the inner race.
15. Degrease 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 (0.025 in).

continued



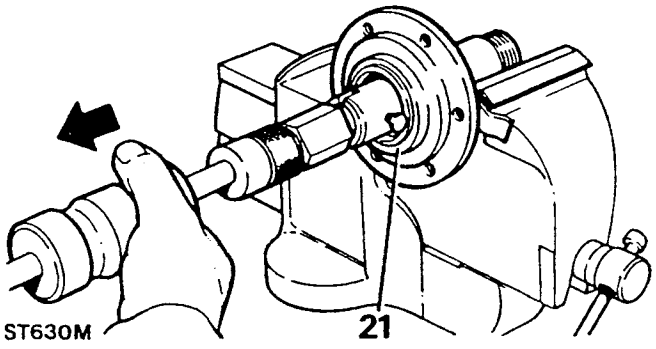
Fit constant velocity joint to axle

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 bush and oil seal use special tool 18G 284AAH and a slide hammer. Ensure that the fingers of the tool locate behind the oil seal so that the seal and bush are driven-out together.



22. Lubricate the seal and lip with EP90 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 washer by tapping the small protruding lug.
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.

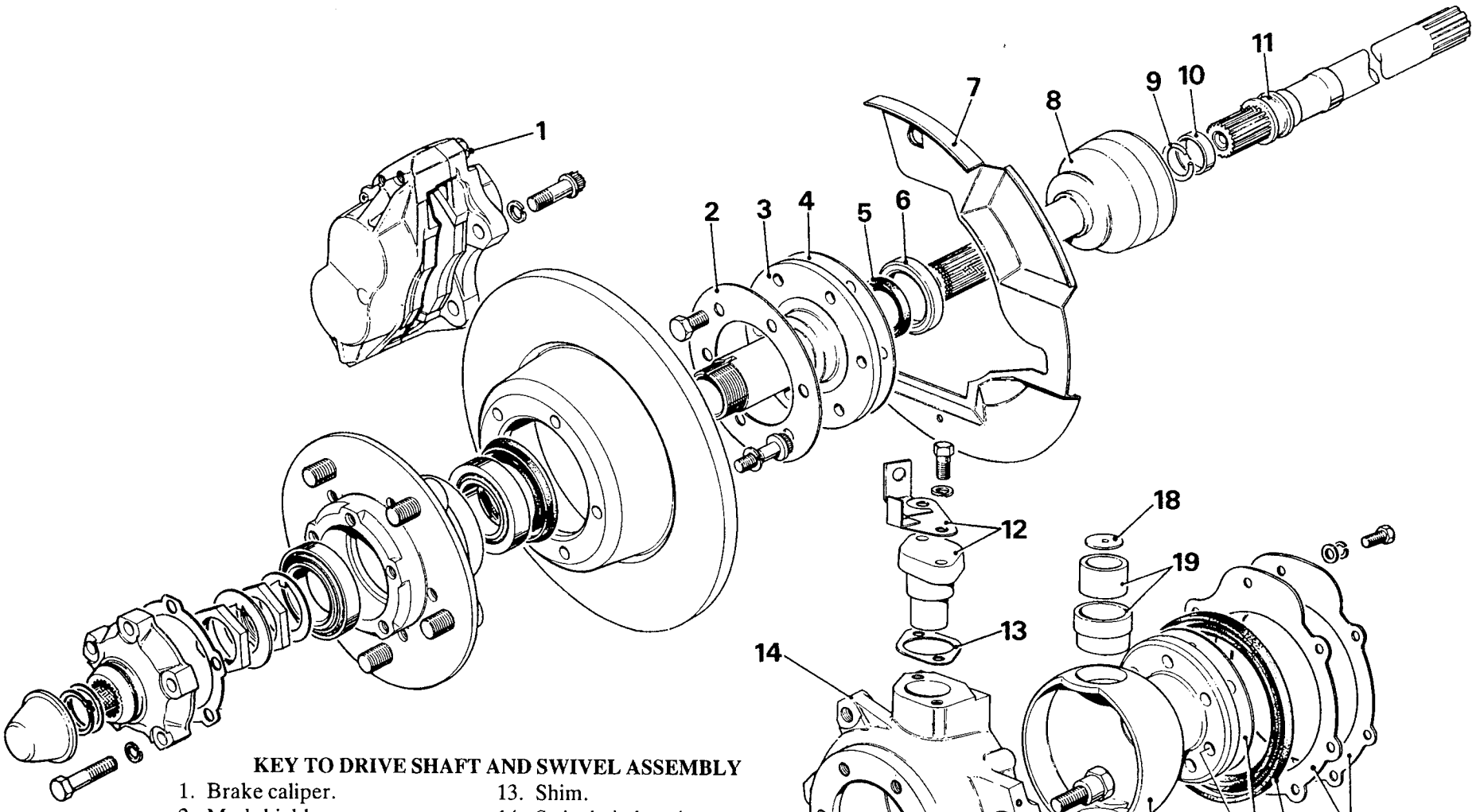
Fit swivel pin bearing housing to axle

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 the 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 (48 to 59 lbf ft).

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 bearing housing.

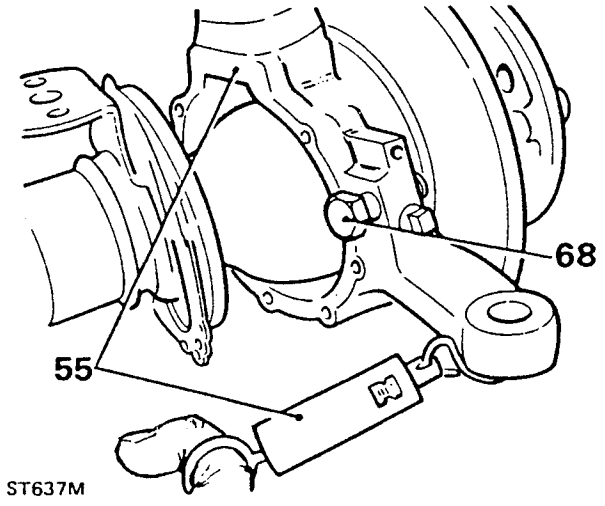
continued



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.

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 (16 to 21 lbf ft).
54. Tighten the top swivel pin securing bolts to 60 to 70 Nm (44 to 52 lbf ft).
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 (8 to 10 lbs). If necessary, adjust by removing or adding shims to the top swivel pin as required.



ST637M

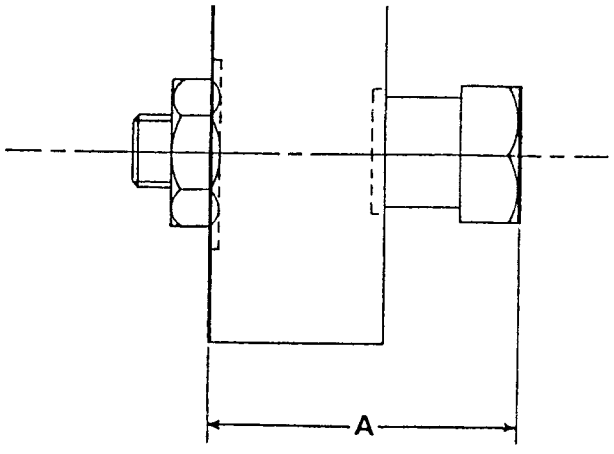
56. Liberally apply — but do not pack — a recommended grease between the lips of the swivel oil seal (2,5 to 4,0 grams).
57. Secure the oil seal and joint washer with the retaining plate and securing bolts tightening evenly to 7 to 10 Nm (5 to 7 lbf ft).
58. Fit the track-rod and drag link and secure 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 (44 to 52 lbf ft).
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 (½ pint) 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
750 × 16 Michelin XS	54,00 mm
750 × 16 Avon Rangers	54,00 mm
750 × 16 (All others)	51.00 mm

The clearance should be set to a minimum of 20 mm on vehicles fitted with 205R × 16 or 600 × 16 tyres.



ST1801M

OVERHAUL REAR HUB ASSEMBLY

Service tool: 18G 1349 seal replacer

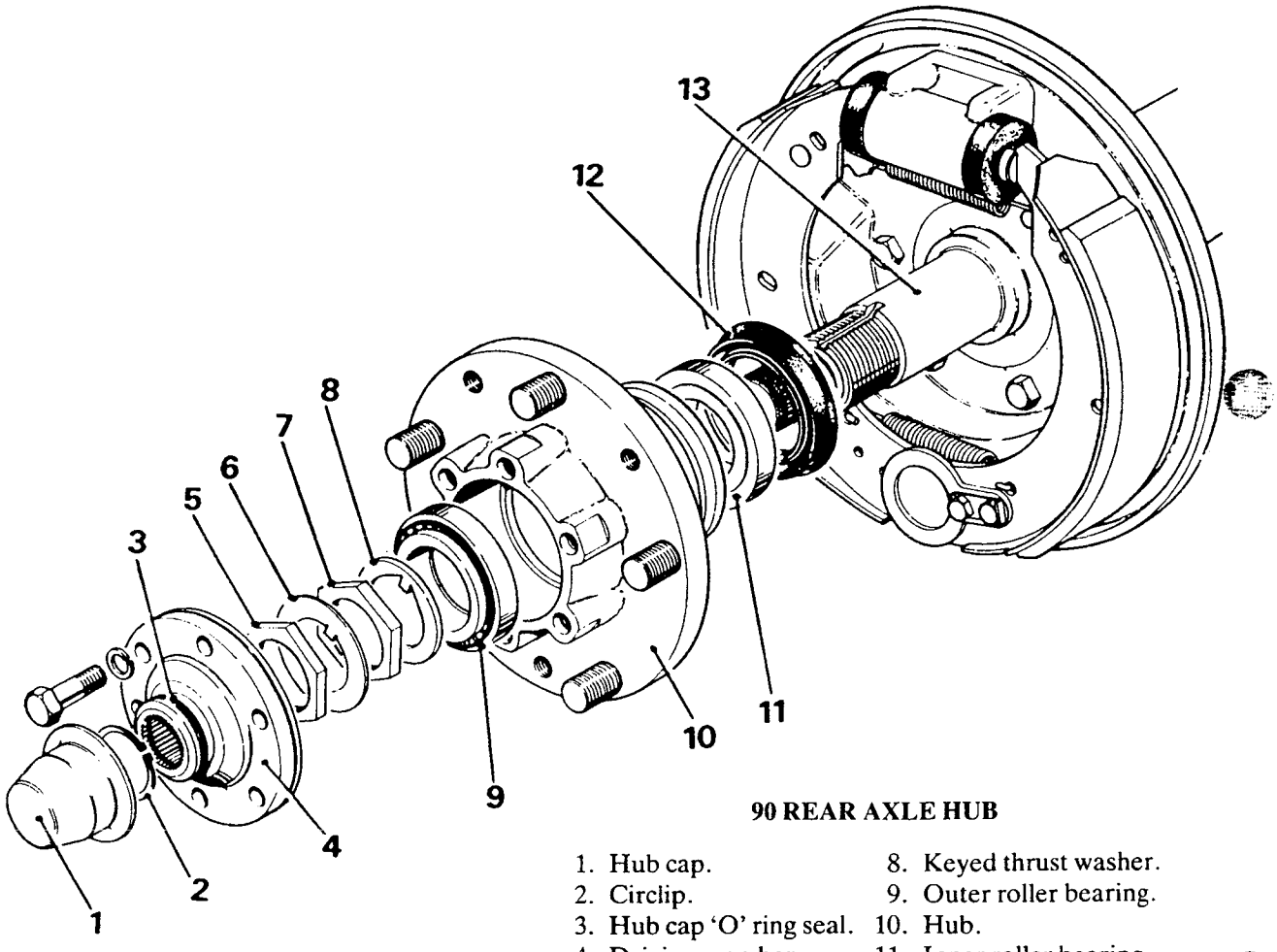
Dismantle

NOTE: The oil catcher mentioned in instructions 7 and 17, is fitted to 110 models only.

1. Slacken the road wheel retaining nuts, jack up the vehicle, lower onto axle stands and remove the road wheels.
2. Remove the three brake drum retaining screws and withdraw the brake drum. If necessary, slacken the brake adjuster to facilitate removal.
3. Lever off the hub cap and remove the axle shaft circlip.
4. Remove the six bolts and withdraw the hub driving member and joint washer.
5. Unlock the tab washer, remove the outer and inner locknuts and keyed thrust washer.
6. Withdraw the hub complete with inner and outer taper roller bearings and dual lipped seal.
7. If required, remove the oil catcher and bearing sleeve by removing the six brake backplate retaining nuts and bolts.

Overhaul hub

8. Remove the dual lipped seal and inner bearing from the hub.
9. If new bearings are to be fitted drift or press out the old bearing cups.
10. Examine the road wheel studs and renew any worn or damaged ones.
11. Press in new bearing cups up to the shoulder.
12. Examine the oil seal housing in the hub and remove any burrs that could damage the seal.
13. Pack the inner bearing with Shell Retinax A grease or equivalent and fit to the hub.
14. While taking care not to touch the seal lips, liberally smear — not pack — the cavity between the seal lips with Shell Retinax A or equivalent.

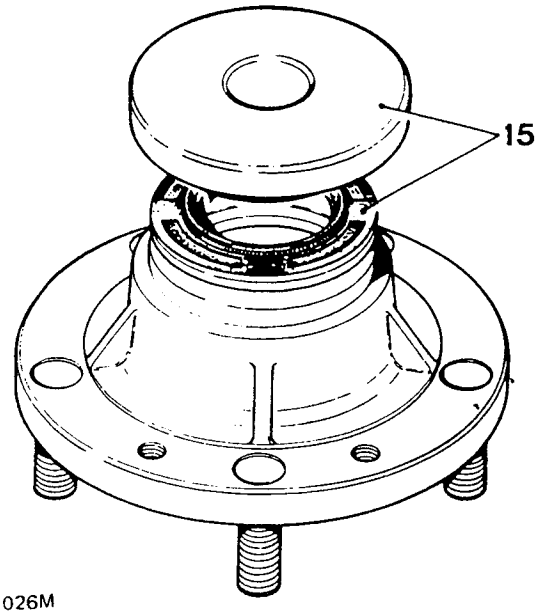


ST775M

90 REAR AXLE HUB

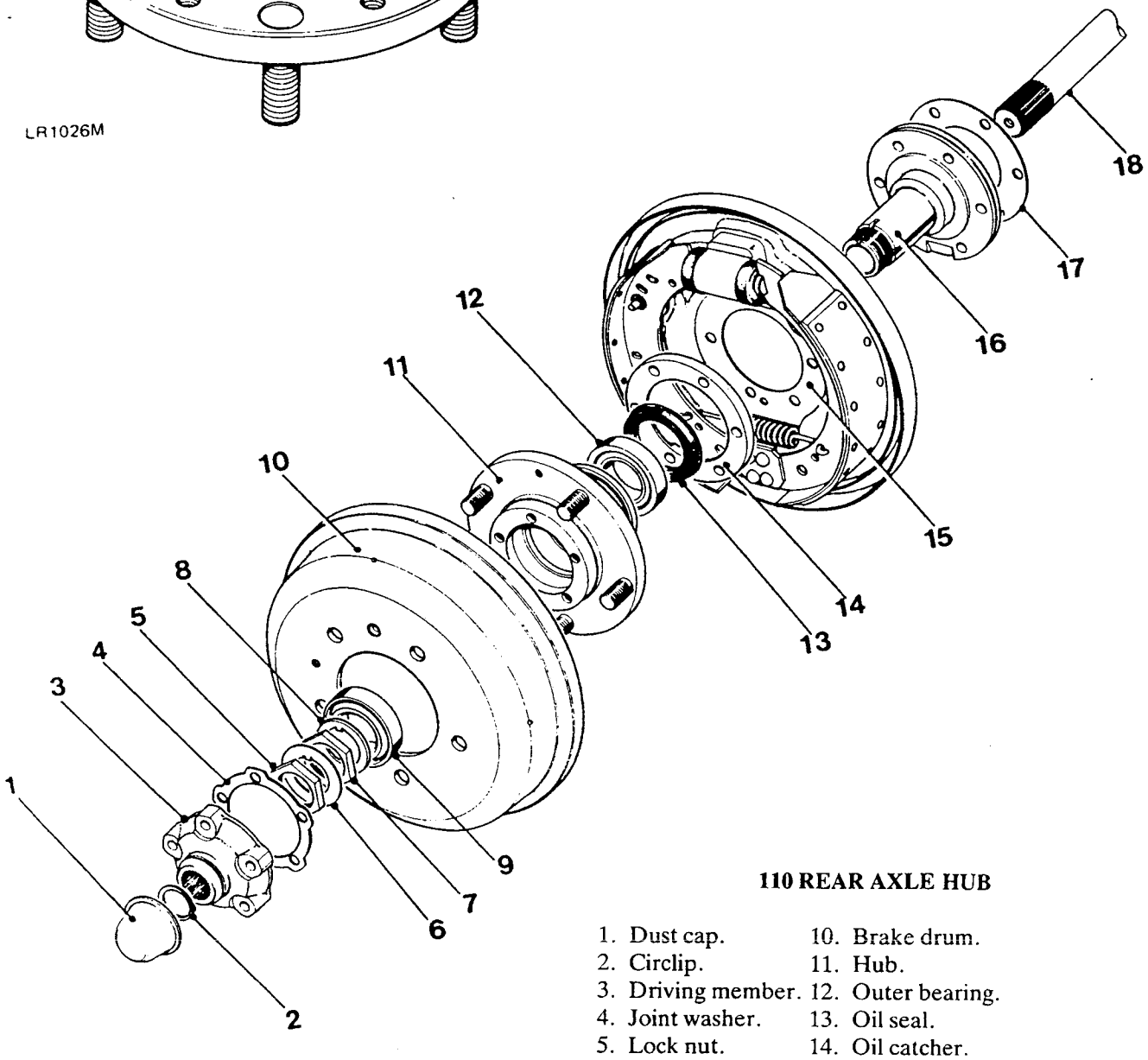
1. Hub cap.
2. Circlip.
3. Hub cap 'O' ring seal.
4. Driving member.
5. Outer locknut.
6. Lock washer.
7. Inner adjusting nut.
8. Keyed thrust washer.
9. Outer roller bearing.
10. Hub.
11. Inner roller bearing.
12. Dual lipped seal.
13. Bearing sleeve.

15. To avoid possible damage to the seal and to ensure the correct depth into the hub, press-in the seal, lip side leading, using special tool 18G 1349.



LR1026M

16. If this tool is not available obtain a suitable tube that will fit exactly on the four diametrically opposed pads in the channel round the seal on the opposite side to the lip and with the lip leading press-in the seal so that it is recessed 4,8 to 5,3 m (0.190 to 0.210 in) from the rear face of the hub.



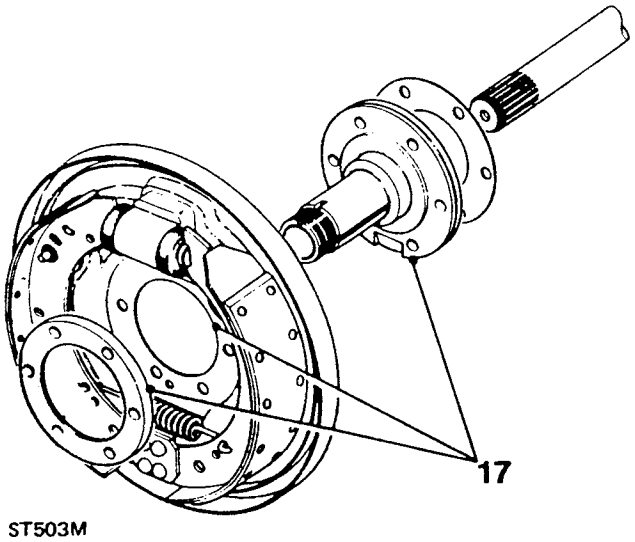
ST626M

110 REAR AXLE HUB

1. Dust cap.
2. Circlip.
3. Driving member.
4. Joint washer.
5. Lock nut.
6. Lock washer.
7. Adjusting nut.
8. Key washer.
9. Outer bearing.
10. Brake drum.
11. Hub.
12. Outer bearing.
13. Oil seal.
14. Oil catcher.
15. Brake back plate assembly.
16. Stub axle.
17. Joint washer.
18. Half-shaft.

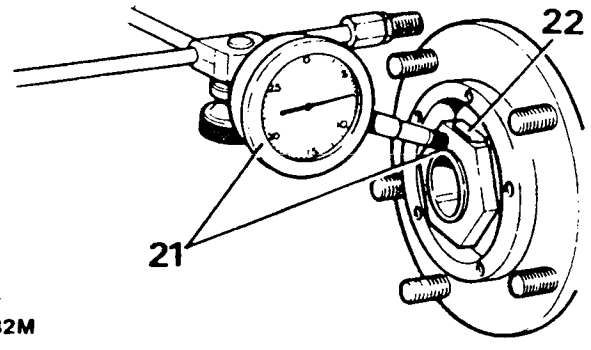
Reassemble hub to axle

17. If removed, assemble the backplate and oil catcher to the axle having first smeared Hylomar SQ32M on the face of the oil catcher to seal it to the backplate. Ensure that the milled slot and the drain hole in the backplate line up at the bottom. Secure the assembly to the axle with the six bolts and nuts and tighten to the correct torque.



ST503M

18. Before fitting the hub, ensure that the journal on which the dual lipped seal runs is clean and free from imperfections that could damage the seal.
19. Fit the hub to the bearing sleeve, pack the outer bearing with grease and fit to the hub.
20. Fit the keyed thrust washer and adjusting inner nut. Tighten the nut, by hand, whilst rotating the hub until all the end-play is taken up.
21. Mount a dial test indicator so that the stylus rest on the adjusting nut. Slacken the nut back to obtain an end-float of 0,050 to 0,101 mm (0.002 to 0.004 in).
22. Fit the tab washer and outer locknut. Tighten the locknut, re-check the end-float and lock the nuts.



ST632M

23. Using a new joint washer, fit the hub driving member and tighten the retaining bolts and spring washers to 60 to 70 Nm (44 to 52 lbf ft).
24. Fit the circlip to the axle shaft, ensuring that it locates correctly in the groove.
25. Fit the hub cap, if necessary using a new 'O' ring seal.
26. Fit the brake drum and secure, if necessary with new screws.
27. Adjust the brake shoes to the drum.
28. Fit the road wheels, using new nuts if necessary.
29. Remove the vehicle from the axle stands and finally tighten the wheel nuts to the correct torque.

REAR HUBS

With inner and outer seals. From axle numbers onwards

Land Rover 90	22S08284B
Land Rover 110	21S22955B

REMOVE AND OVERHAUL

Special tools:
Oil seal replacer LST 550-5
Drift for seal replacer MS 550 or 18G134
Hub nut spanner 606435

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.

continued

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

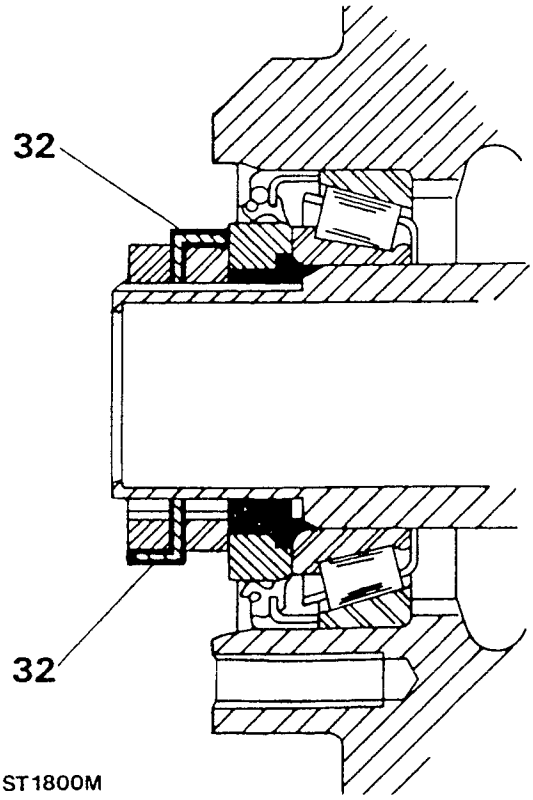
17. Clean the hub oil seal housing and ensure that the seal locating surface is smooth and the chamfer on the leading edge is also smooth and free from burrs.
18. Examine the new seal and ensure that it is clean, undamaged and that the garter spring is properly located. Even a small scratch on the seal 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 LST 550-5 and drift 550 or 18 G 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 LST 550-5 and drift 550 or 18 G 134, drive the seal into position to the depth determined by the tool.

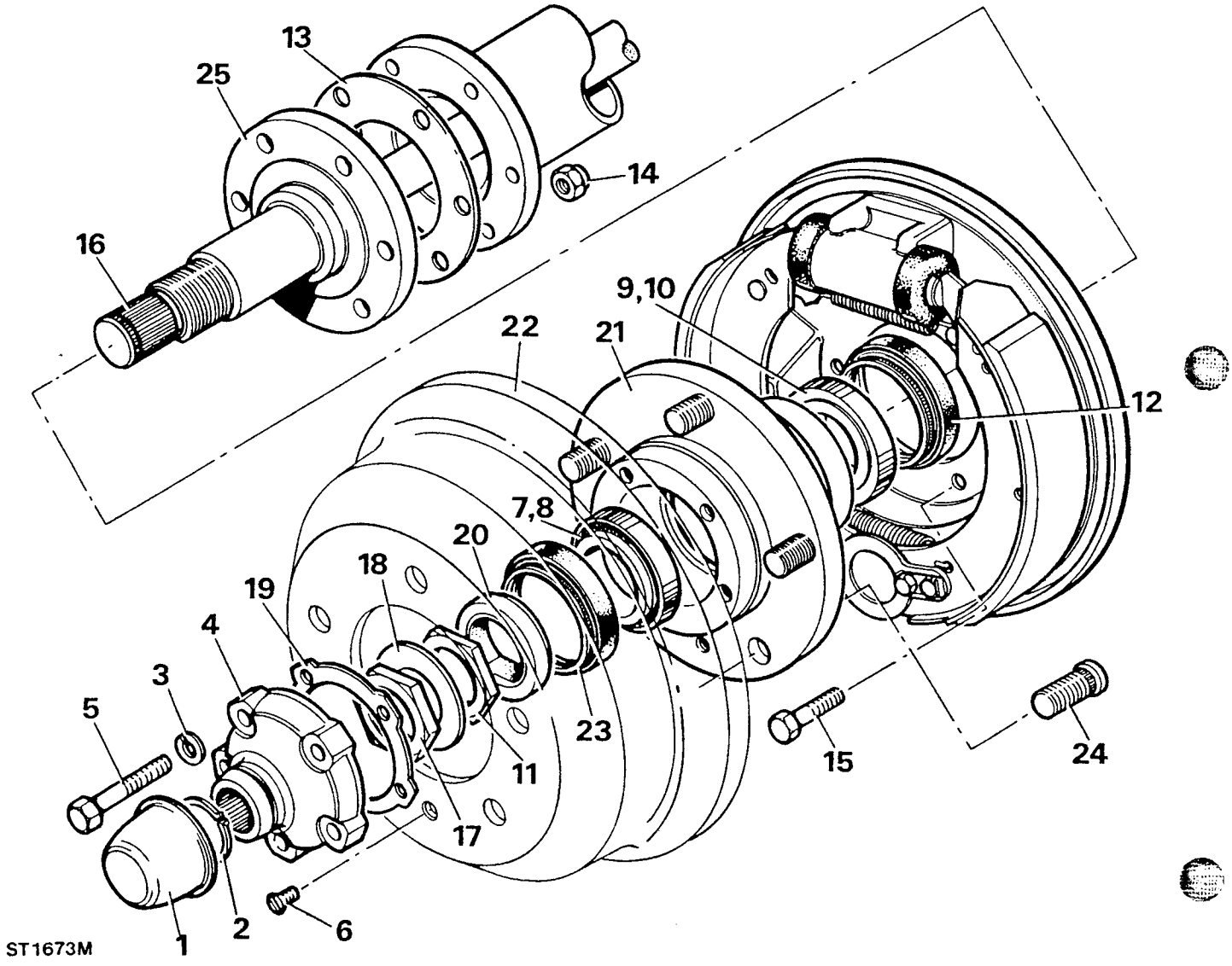
Fitting hub to stub axle

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.
28. Fit the hub inner nut and using spanner 606435 tighten the adjusting nut whilst slowly revolving the hub until all end-float is removed then back-off the nut approximately half-a-turn.
29. Mount a dial test indicator and bracket on the hub so that the stylus rests in a loaded condition on the nut. Check the end-float which must be 0,013 to 0,010 mm (0.0005 to 0.0004 in). Adjust the nut as necessary to achieve this.
30. Fit the locker and locknut and tighten against the adjusting nut.
31. Rotate the hub several times to settle the bearings then re-check the end-float.
32. Bend one segment of the locker over the adjusting nut and another, diametrically opposite, over the locknut.



ST1800M

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 HUB COMPONENTS

1. Hub cap.
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. } stub axle to axle casing
15. Bolt. }
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 SUSPENSION

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 in 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 (130 lbf ft).

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 RO1006 or a suitable proprietry 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.

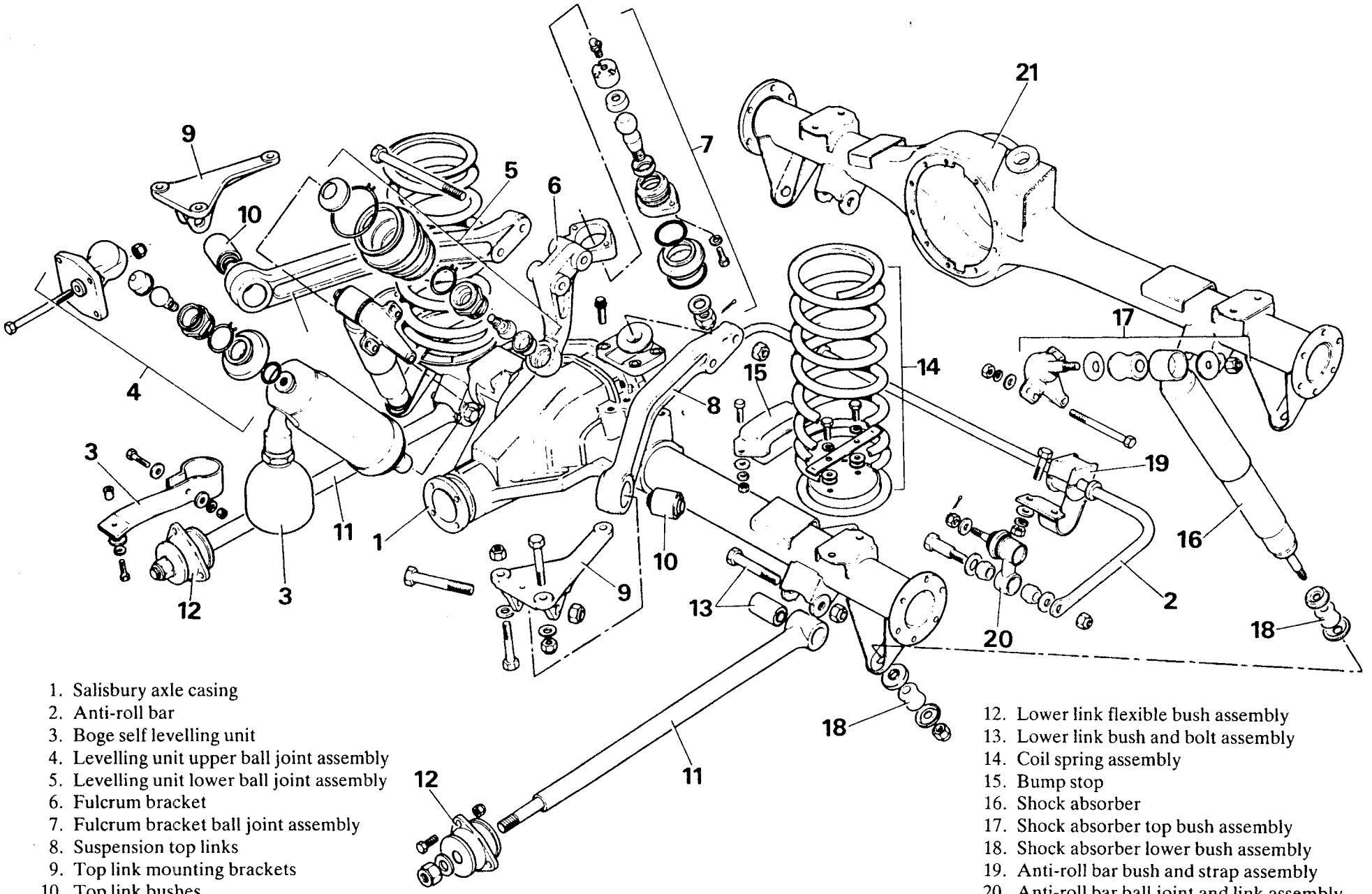
25. Using two bolts as a guide to ensure correct alignment press the knurled ball joint into the pivot bracket and secure with the two nuts and bolts.

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 (130 lbf ft).
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 (35 lbf ft).
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 (85 lbf ft).
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 (18 lbf ft).
36. Fit the ball joint and link to the axle location and tighten the castle nut to 176 Nm (130 lbf ft) 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 torque.



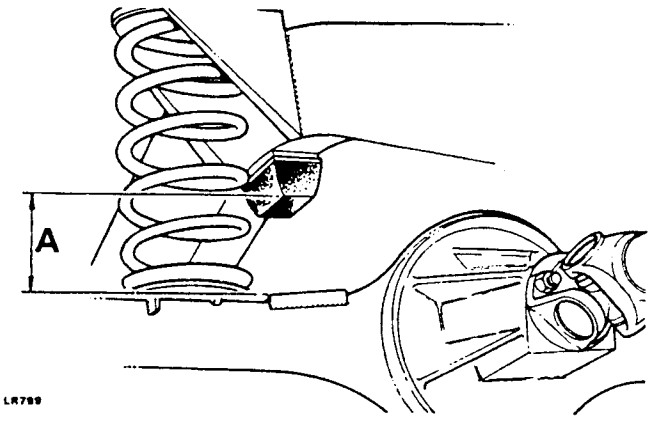
1. Salisbury axle casing
2. Anti-roll bar
3. Boge self levelling unit
4. Levelling unit upper ball joint assembly
5. Levelling unit lower ball joint assembly
6. Fulcrum bracket
7. Fulcrum bracket ball joint assembly
8. Suspension top links
9. Top link mounting brackets
10. Top link bushes
11. Lower links
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
21. Heavy duty Rover axle casing

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, verify 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 (2.8 in).
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 (0.787 in) 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 (2.8 in) renew the levelling unit.



6. Load weights to the value of 650 kg (1143 lbs) 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 (165 lbs) check the bump stop clearance and note the measurement.
8. Drive the vehicle on a test route approximately 5 km (3 miles) 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 (0.394 in) the levelling unit is functioning correctly.
11. If the figures obtained in instructions 9 and 10 do not exceed 45 mm and 10 mm (1.77 and 0.39 in) respectively unload the vehicle and renew the levelling unit.

Steering	Side	Part Number	Rate Nm	Rate (lb/in)	Number of Coils	Free length (mm)	Colour Code
R.H.	DRIVER	NRC 6388	31.5	(180)	6	412	Two Blue stripes
R.H.	PASSENGER	NRC 7000	31.5	(180)	6	400	One Green and one White stripe
L.H.	DRIVER	NRC 6388	31.5	(180)	6	412	Two Blue stripes
L.H.	PASSENGER	NRC 7000	31.5	(180)	6	400	One Green and one White stripe

REMOVE LEVELLING UNIT — where fitted

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 (35 lbf ft).
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.

Renew 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.

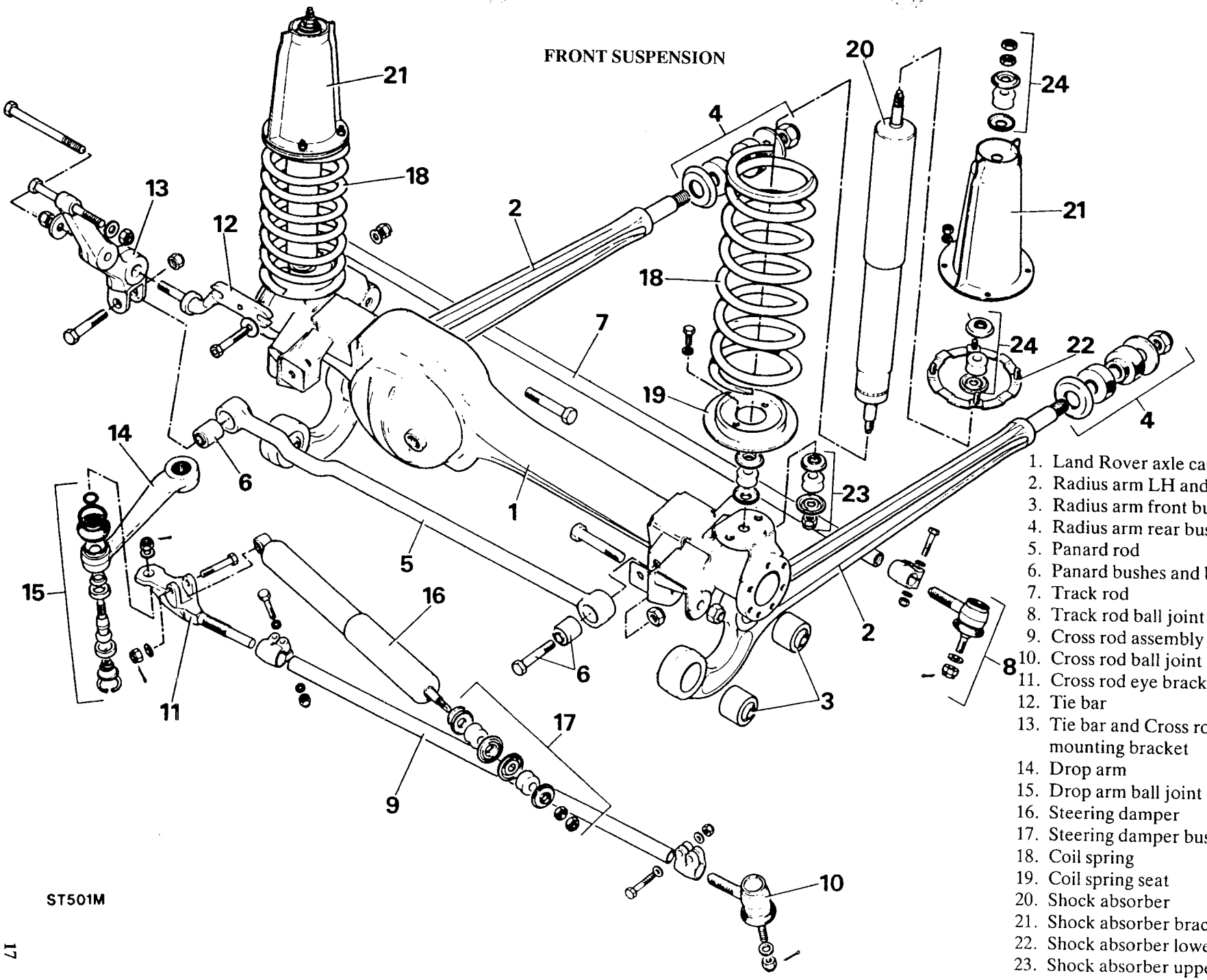
Test shock absorbers

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.

FRONT SUSPENSION



ST501M

1. Land Rover axle casing
2. Radius arm LH and RH
3. Radius arm front bushes
4. Radius arm rear bushes
5. Panard rod
6. Panard bushes and bolts
7. Track rod
8. Track rod ball joint
9. Cross rod assembly
10. Cross rod ball joint
11. Cross rod eye bracket
12. Tie bar
13. Tie bar and Cross rod mounting bracket
14. Drop arm
15. Drop arm ball joint assembly
16. Steering damper
17. Steering damper bush assembly
18. Coil spring
19. Coil spring seat
20. Shock absorber
21. Shock absorber bracket
22. Shock absorber lower bush assembly
23. Shock absorber upper bush assembly

BRAKES

DESCRIPTION

The mechanical components of the Land Rover 90 and 110 braking system consist of single cylinder Girling drum brakes at the rear and Lockheed, four piston caliper disc brakes at the front. The cable controlled handbrake is a mechanically operated single drum 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.

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 brake calipers. The tandem master cylinder, which is assisted by a type 50 direct acting servo, is fed by a divided fluid reservoir. The rear section contains fluid for the primary cicuit and the front portion supplies fluid for the secondary circuit.

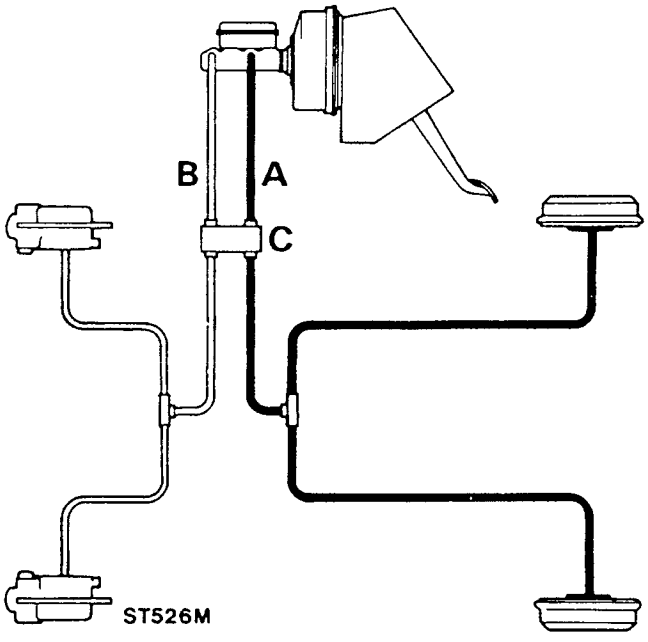
Land Rover 90 models have a brake fluid loss switch fitted to the master cylinder filler cap. The switch is wired to a warning lamp bulb on the drivers control panel and the bulb will illuminated momentarily when the starter motor is actuated, indicating that the brake warning circuit is functioning 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. In some territories, alternative and additional switches and controls may be fitted (as described in the following for 110 models) to meet legal legislation.

Land Rover 110 models have a Pressure Differential Warning Actuator Valve (P.D.W.A. Valve) or in some cases a combined P.D.W.A. Valve and a Pressure Conscious Reducing Valve (P.C.R. Valve) situated between the master cylinder and the front and rear brakes.

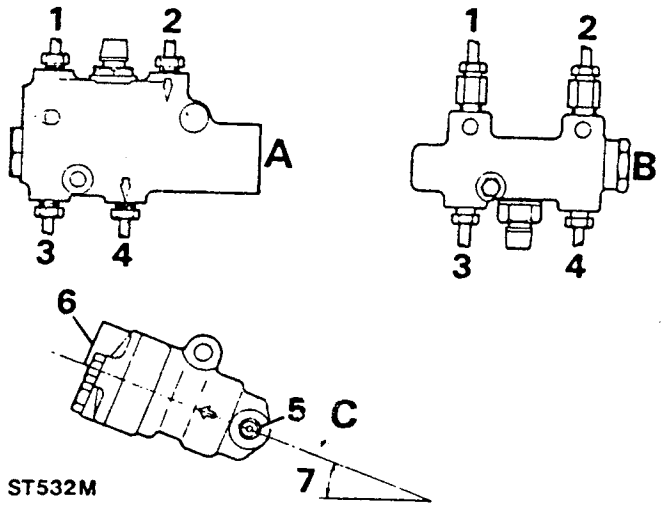
The valves are bolted to the bulkhead within the engine compartment. The type of valve fitted is dependent upon the nature of the vehicle and the braking classification regulations prevailing in the territory where the ehicle is to operate. Both types of valve incorporate an electrical switch wired to a warning bulb on the vehicle control panel. The bulb will illuminate momentarily when the starter motor is actuated indicating that the brake warning circuit is functioning correctly. A fault in either the primary or secondary circuits is evident if the warning bulb illuminates upon application of the foot brake while the engine is running. Should a pressure failure occur in the front brake circuit (secondary) the piston in the P.D.W.A. valve will move in the diretion of the failed circuit causing the switch to operate and the warning bulb to illuminate. At the same time full fluid pressure in the primary circuit to the rear brakes will continue. The P.D.W.A. will function in a similar manner should a failure occur in the primary, rear brake circuit. A Girling type 80 vacuum servo is fitted when a combination valve is used.

The P.C.R. 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.

To satisfy the demand of other regulations certain vehicles are equipped with a deceleration actuated anti-lock valve fitted in the rear brake (primary) line instead of a P.C.R. valve. Then this valve is used a Girling type 80 vacuum servo is fitted. The valve is situated on the inner face of the chassis right-hand side member at an angle of 20° to the horizontal so that the angle of inclination is towards the front of the vehicle. Under normal braking conditions the valve remains passive. When fierce or emergency braking is necessary the valve operates at a pre-determined deceleration figure and reduces the rate of increase in the hydraulic pressure to the wheel cylinders.



A. Primary circuit.
B. Secondary circuit.
C. P.D.W.A. or combination valve.



ST532M

A. Combination valve.
B. P.D.W.A. valve.
C. G. valve.

1. Inlet from master cylinder to secondary circuit.
2. Inlet from master cylinder to primary circuit.
3. Outlet to front calipers via 'T' junction.
4. Outlet to rear brakes via 'T' junction.
5. Inlet port.
6. Outlet port.
7. Angle of inclination (20°C).

REMOVE AND OVERHAUL FRONT BRAKE CALIPERS

Special tool:
18G672 — Piston clamp

NOTE: The following procedure is applicable to Land Rover 90 and 110 models. A 110 caliper is illustrated and varies mainly in size and external pipe connections from the 90 version.

REMOVE CALIPER

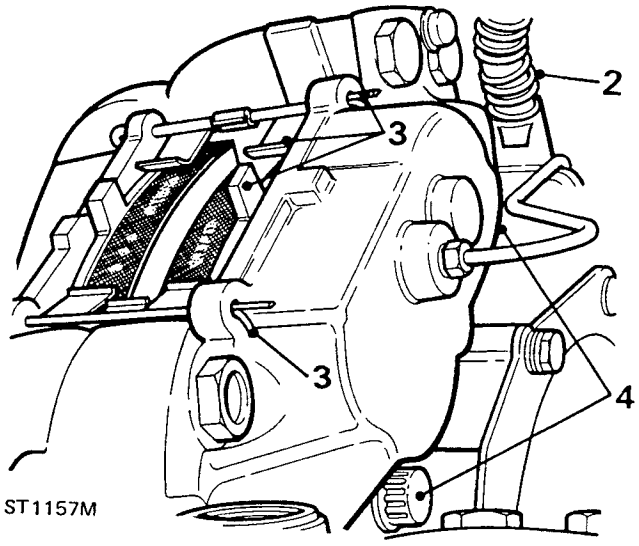
1. Slacken the front wheel retaining nuts, jack-up the vehicle and lower onto axle stands and remove the wheels.
2. Expose the brake flexible hose by moving the coiled protective covering and clamp the hose. Disconnect the hose from the caliper.

   NOTE: The first illustration shows the early type of friction pad retaining pins and anti-rattle springs. The second illustration shows the latest anti-rattle springs and method of retaining the pads, using parallel pins and retaining clips, or split pins.

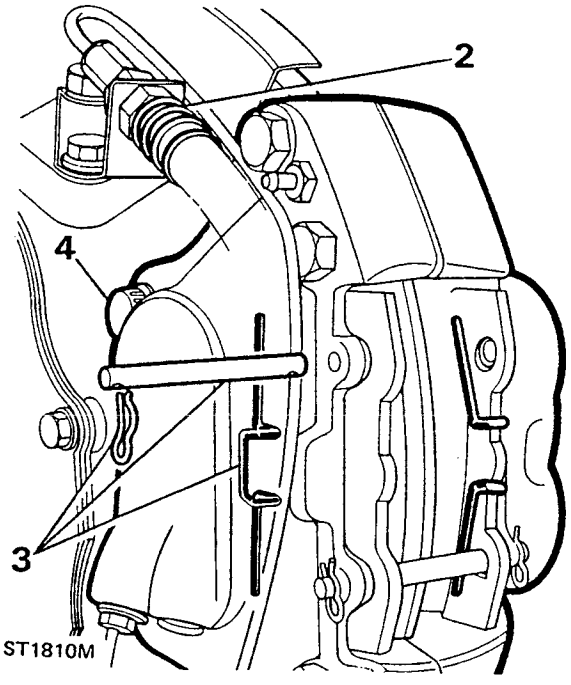
3. **Removing friction pads — early type**
   Remove the retaining pins and anti-rattle springs and withdraw the pads. If the same pads are to be refitted, identify them for assembly to their original locations.

   Removing friction pads — latest type
   Remove the four spring clips and remove the retaining pins and anti-rattle springs and withdraw the 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.

continued

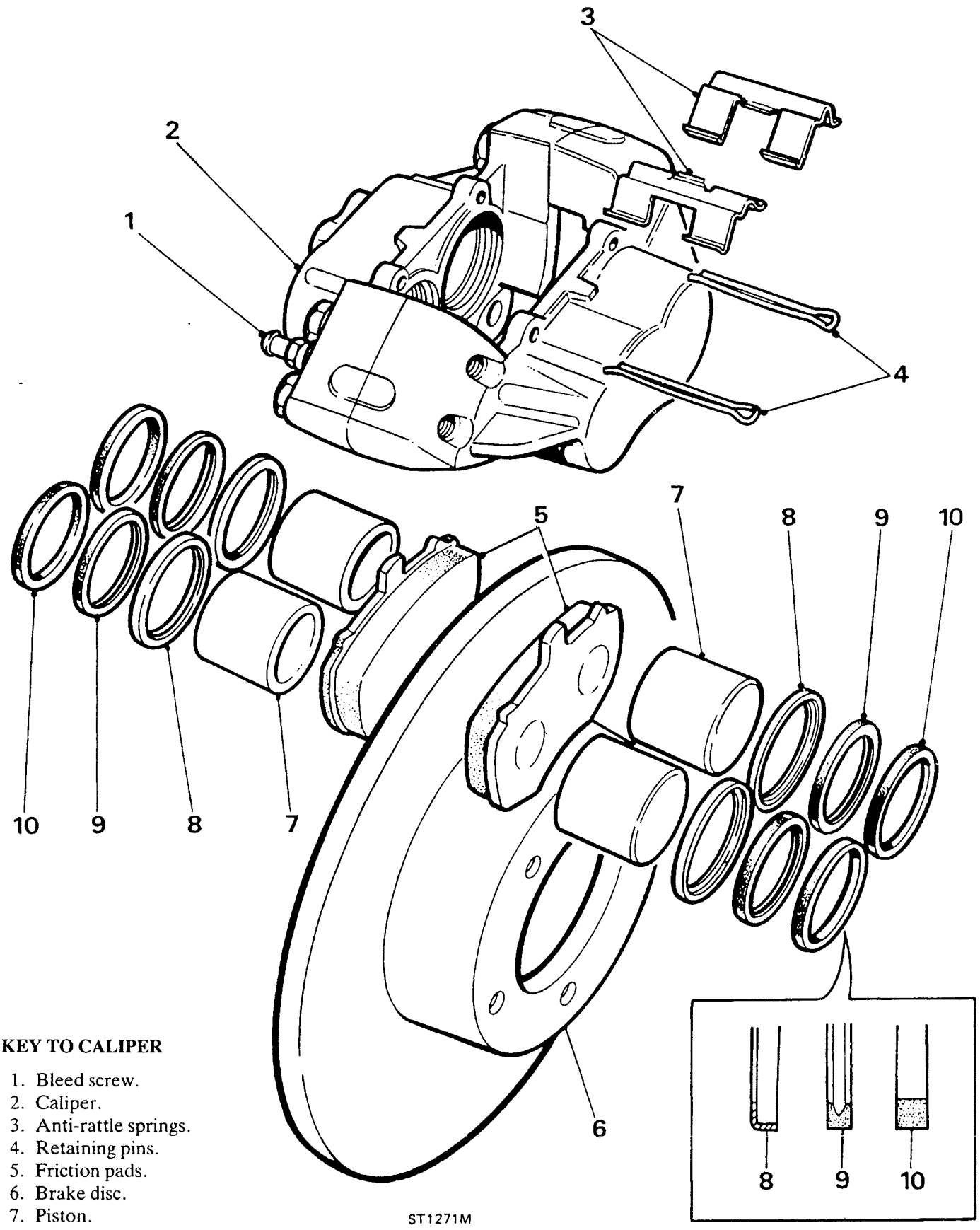


ST1157M



ST1810M

FRONT BRAKE CALIPER ASSEMBLY (EARLY TYPE)

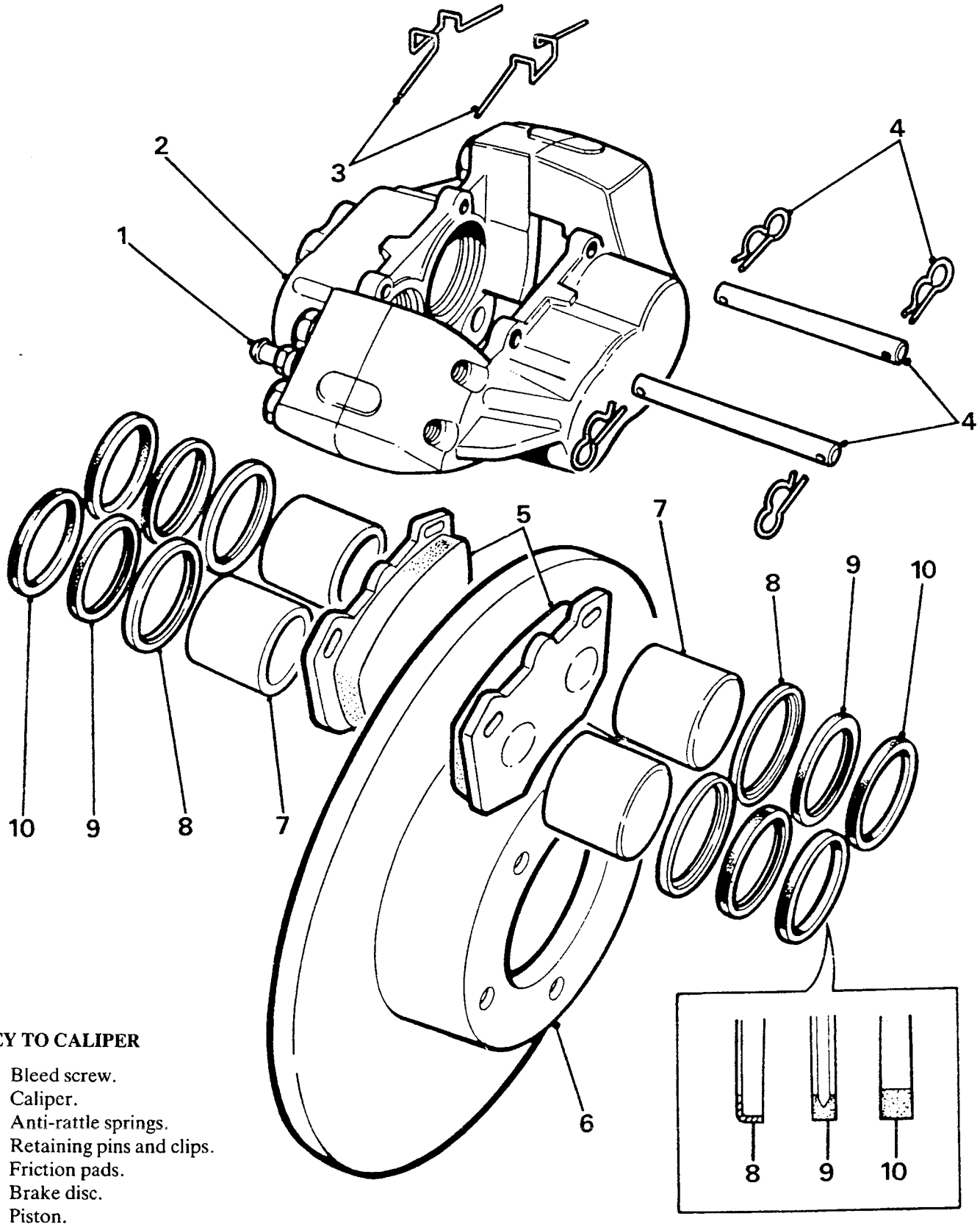


ST1271M

KEY TO CALIPER

1. Bleed screw.
2. Caliper.
3. Anti-rattle springs.
4. Retaining pins.
5. Friction pads.
6. Brake disc.
7. Piston.
8. Wiper seal retainer.
9. Wiper seal.
10. Fluid seal.

FRONT BRAKE CALIPER ASSEMBLY (LATER TYPE)



ST1809M

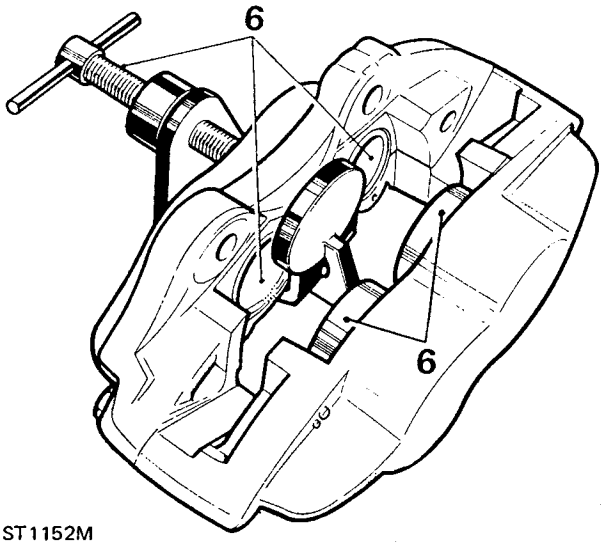
KEY TO CALIPER

1. Bleed screw.
2. Caliper.
3. Anti-rattle springs.
4. Retaining pins and clips.
5. Friction pads.
6. Brake disc.
7. Piston.
8. Wiper seal retainer.
9. Wiper seal.
10. Fluid seal.

DISMANTLE AND OVERHAUL

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

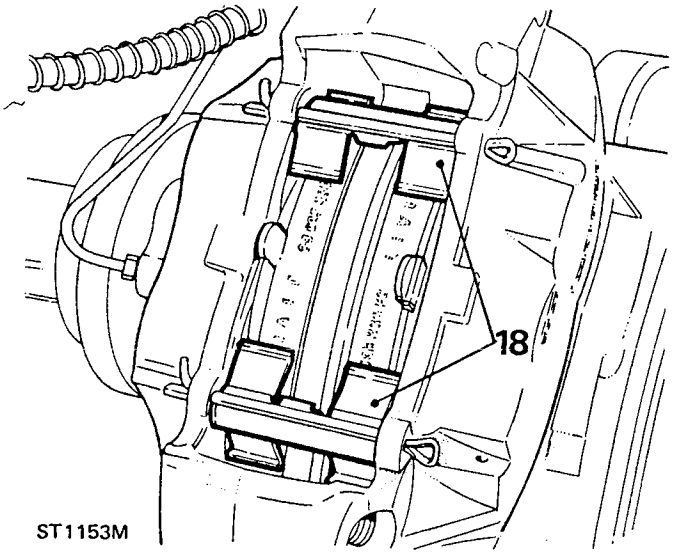
11. Coat a new fluid seal with Lockheed disc brake lubricant. Ease the seal into the groove in the bore using only the fingers and ensure that it is properly seated. The fluid seal and the groove are not the same in section so that when the seal is seated it feels proud to the touch at the edge furthest away from the mouth of the bore.
12. Smear the appropriate piston with disc brake lubricant and insert it squarely into the bore by hand only. Do not tilt the piston during insertion and leave approximately 8 mm projecting from the bore.
13. Coat a new wiper seal with disc 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 retaining clips or split pins (latest type) and anti-rattle springs. Splay the ends of the early type retaining pins.
19. When the foregoing instructions have been completed on both calipers, depress the brake pedal firmly several times to locate the friction pads.
20. Fit the road wheels, remove the axle stands and finally tighten the road wheel nuts, see data.
21. 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.



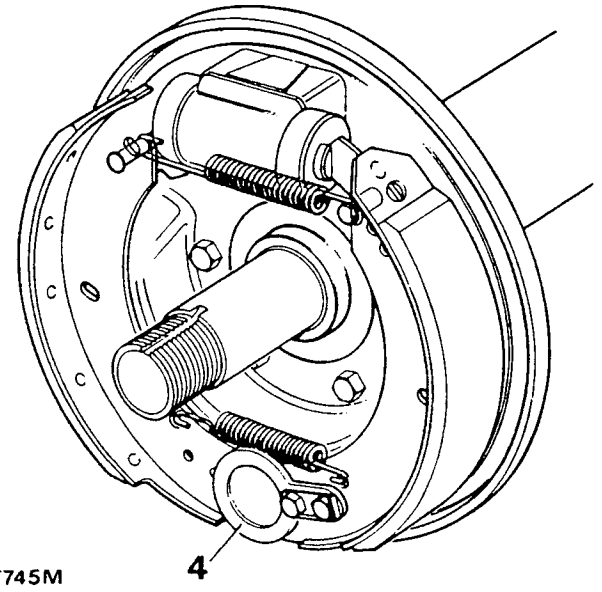
ST1153M

OVERHAUL REAR BRAKES — 90 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 brake shoe adjuster on the rear of the back-plate to assist removal of brake drum.
3. Remove the single retaining screw and withdraw the brake drum.
4. Remove the trailing shoe anchor plate.
5. Lever off the brake shoes whilst noting the position of the pull-off springs.
6. Disconnect the brake fluid pipe to the wheel cylinder and cover the pipe end to prevent ingress of dirt.

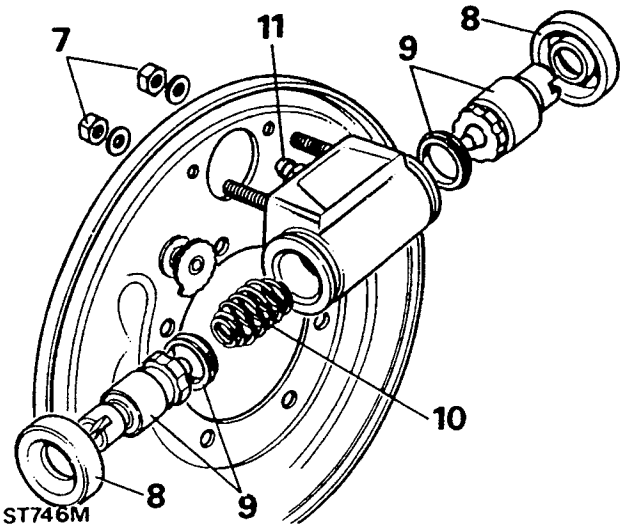


ST745M

7. Remove the two retaining nuts and withdraw the wheel cylinder from the back-plate.

Dismantle and overhaul wheel cylinder

8. Remove the two dust covers.
9. Withdraw the pistons and discard seals.
10. Remove the spring.
11. Remove the bleed screw.
12. Clean components with Girling cleaning fluid and allow to dry.
13. Examine the cylinder and pistons for corrosion, scores and wear. Renew any component that is not satisfactory or replace complete cylinder assembly.



ST746M

14. Fit new seals to the pistons noting that the seal lip is towards the cylinder.
15. Lubricate the pistons with new clean Girling brake fluid.
16. Fit the spring between the two pistons.
17. Fit the dust covers.
18. Fit a rubber band around the cylinder to retain the parts, until the brake shoes are in position.
19. Fit the bleed screw and tighten to 0,5 to 0,8 kgf m (4 to 6 lbf ft).

ASSEMBLING REAR BRAKE

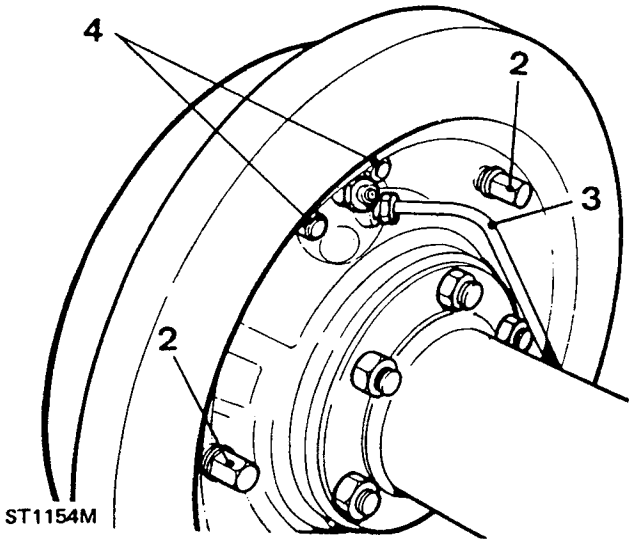
1. Fit the wheel cylinder to the back-plate and secure with the two nuts and spring washers.
2. Reconnect the pull-off spring to the brake shoes and fit the shoes at the wheel cylinder end first.
3. Reconnect the leading shoe pull-off spring; replace it with its long end hooked over the post on the shoe web.
4. Refit the trailing shoe anchor plate and secure with the two bolts and tab plate.
5. Turn the adjuster on the back-plate to check operation.
6. Connect the brake fluid pipe to the wheel cylinder.
7. Examine the brake drum for internal scoring and ovality. If required, the interior of the drum can be machined to a maximum diameter of 255,52 mm (10.060 in).
8. Fit the brake drum and ensure that it seats correctly on the hub register and secure with the single screw.
9. Turn the adjuster on the back-plate until the brake shoe is locked against the drum. Back off approximately two serrations so that the drum revolves freely.
10. Repeat the procedure for the opposite brake.
11. Bleed the brakes.
12. Fit the road wheels, remove the axle stands and finally tighten the road wheel nuts to the correct torque.

OVERHAUL REAR BRAKES — 110 models

DISMANTLING

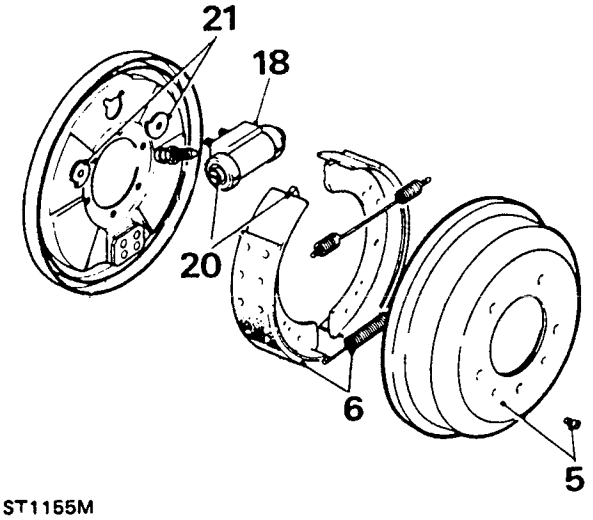
WARNING: Do not use an air line to blow dust from the brake assemblies — asbestos dust from brake linings can be a serious health risk if inhaled.

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

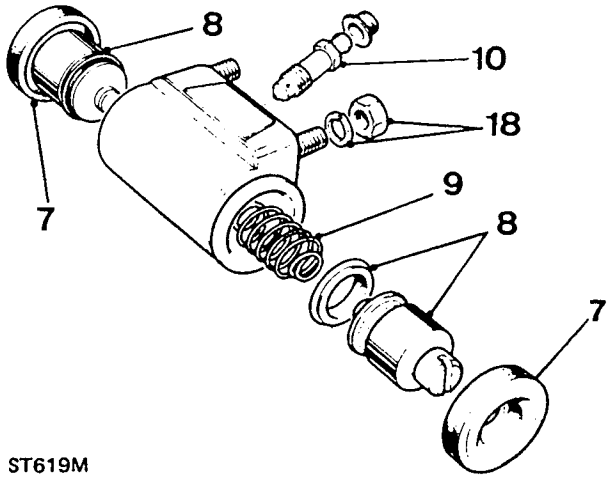
5. Remove the single retaining screw and withdraw the brake drum.
6. Lever off the brake shoes whilst noting the position of the pull-off springs.



ST1155M

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 (4 to 6 lbf ft).

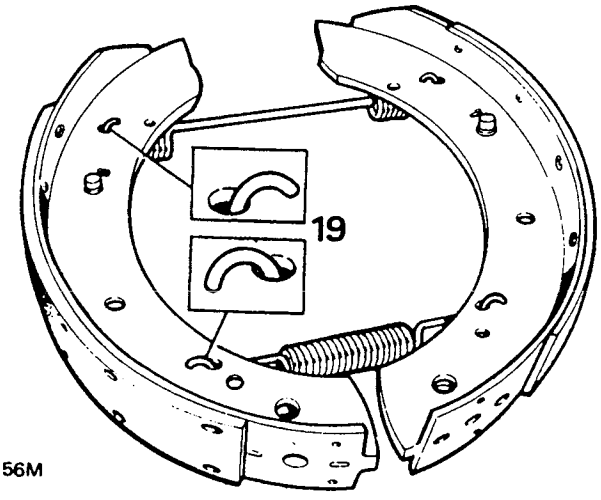


ST619M

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 re-lined brake shoes as illustrated.

continued



ST1156M

20. Locate 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

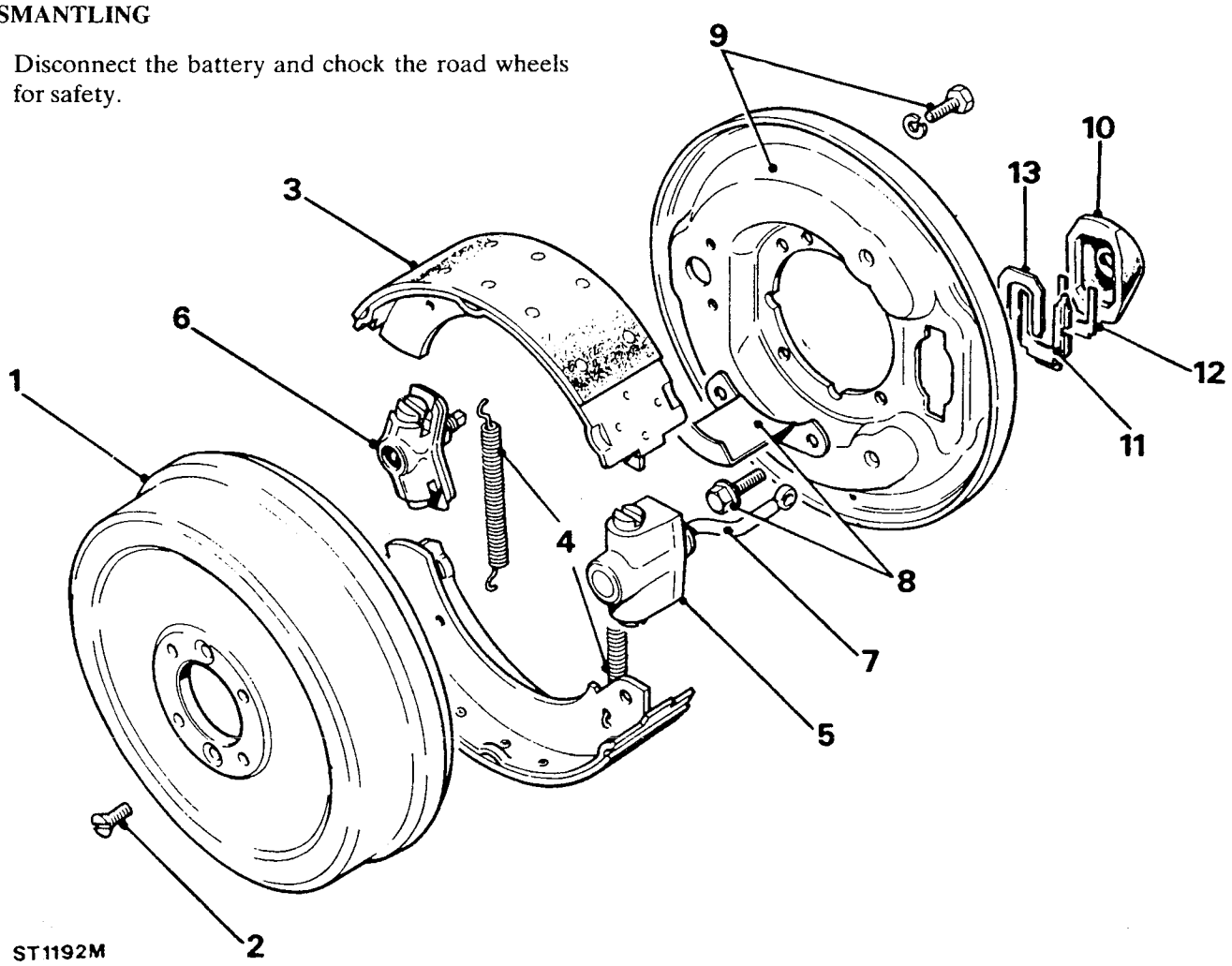
WARNING: Do not use an air line to remove dust from the brake assembly. Asbestos dust from the brake linings can be a serious health risk, if inhaled.

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.



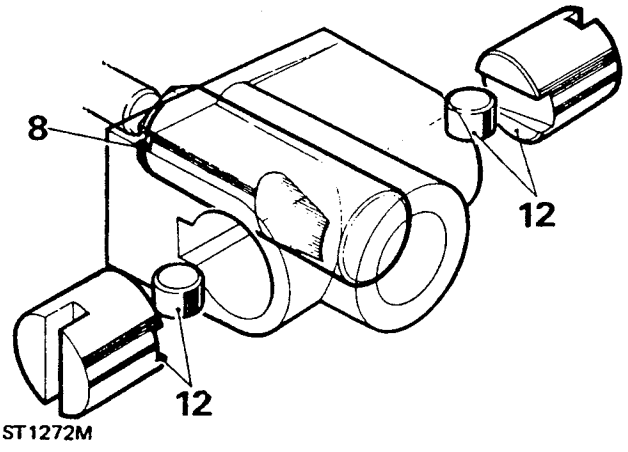
ST1192M

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. 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 with a rubber band to prevent the plungers falling out and place to one side for assembly to back-plate.



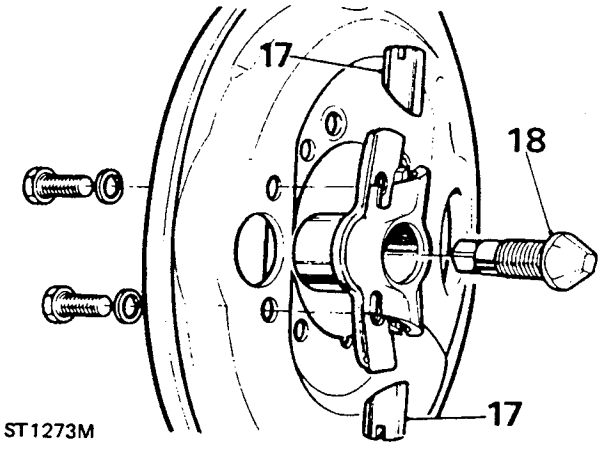
ST1272M

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.



ST1273M

ASSEMBLE

NOTE: If the brake linings are oil-soaked check and if necessary renew the output shaft oil 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. Packing piece.
24. Locking plate.
25. Retainer spring.
26. Fit the rubber dust cover.

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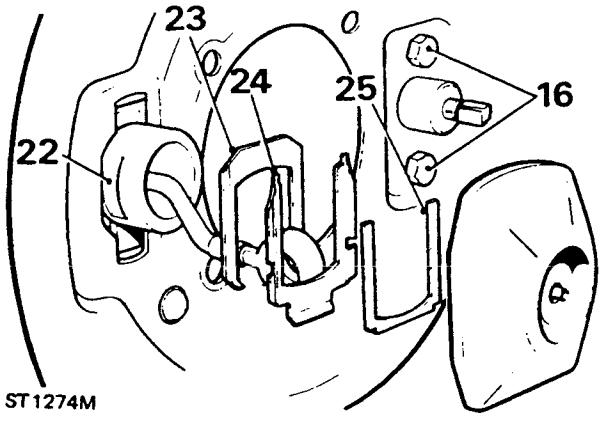
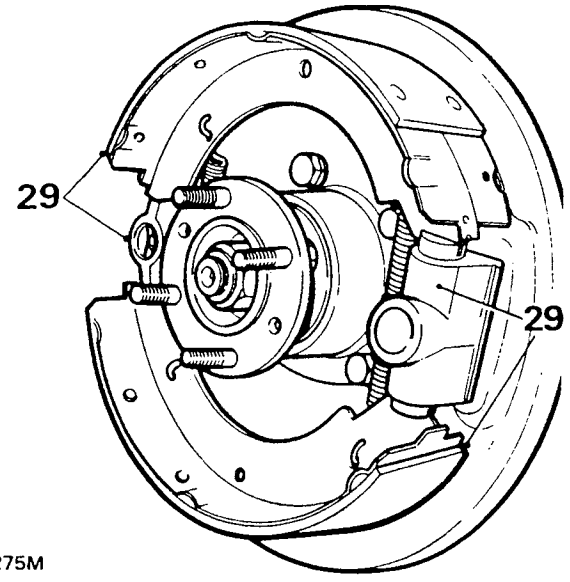


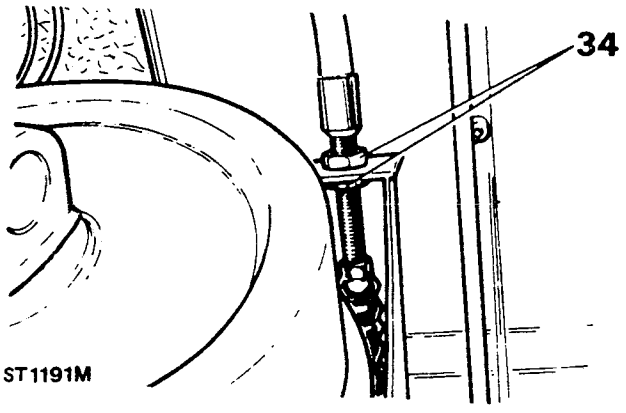
ST1274M

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.
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.

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.

OVERHAUL THE MASTER CYLINDER

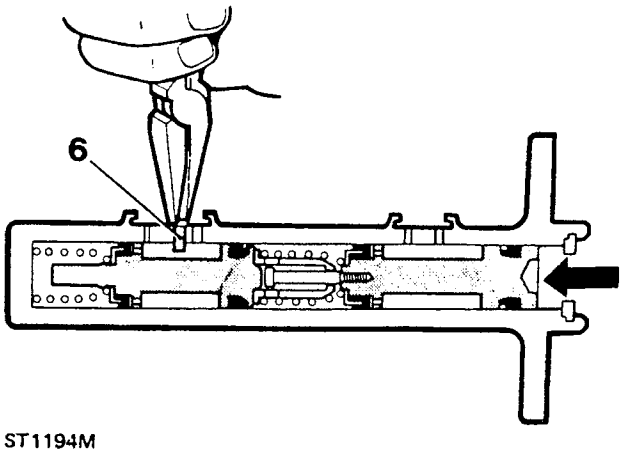
1. Remove the master cylinder from the servo and vehicle.
2. Remove the master cylinder filler cap and pour off surplus fluid.
3. From the filler cap, prise out the plastic baffle and rubber seal.
4. Drive out the two roll pins and remove the reservoir from the master cylinder.
5. Prise out from the master cylinder the two reservoir retaining seals.

KEY TO MASTER CYLINDER

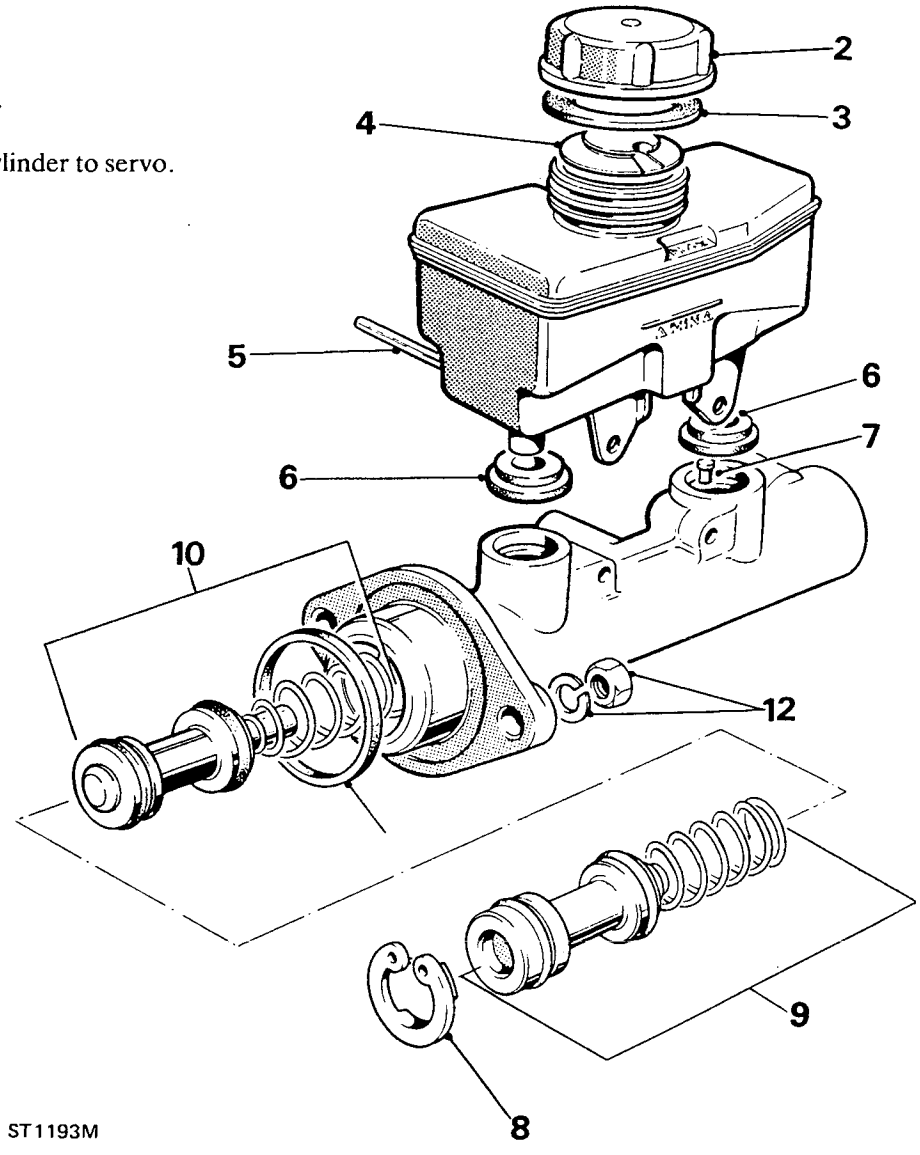
1. Reservoir.
2. Reservoir filler cap.
3. Rubber seal.
4. Plastic baffle.
5. Roll pins.
6. Reservoir retaining seals.
7. Secondary plunger stop pin.
8. Plastic circlip
9. Primary plunger assembly.
10. Secondary plunger assembly.
11. Master cylinder flange seal.
12. Nuts and washers securing cylinder to servo.

6. Secure the master cylinder in a vice and push the primary plunger down the bore and withdraw the secondary plunger stop pin.

continued

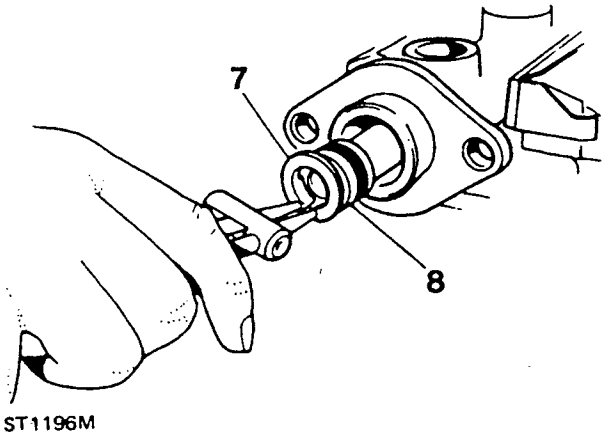


ST1194M



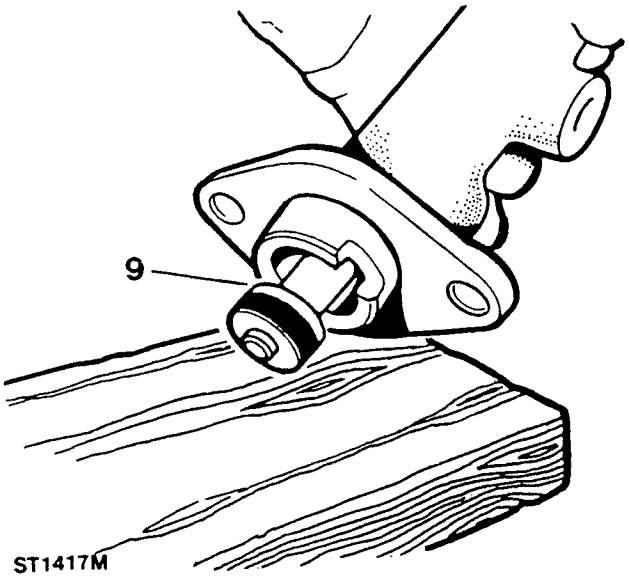
ST1193M

7. Press down the primary plunger and remove the plastic circlip.
8. Withdraw the primary plunger assembly.



ST1196M

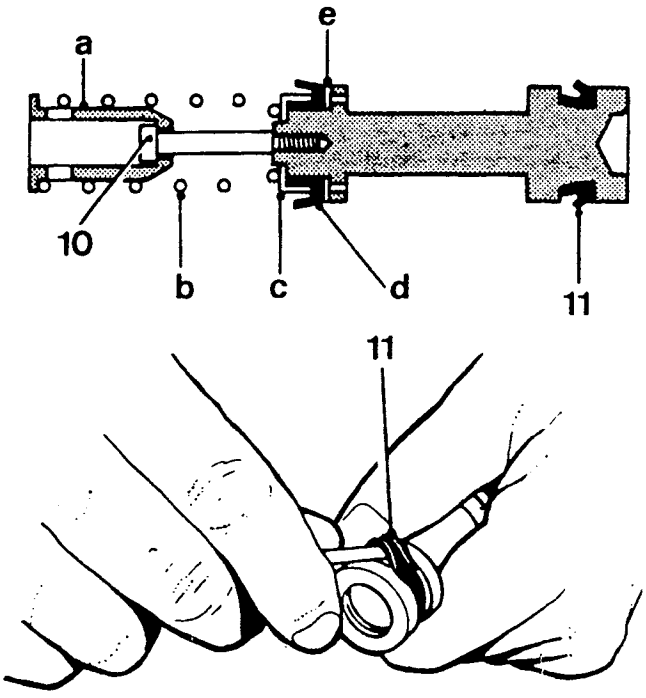
9. Tap the master cylinder sharply on a soft or wooden surface to remove the secondary plunger assembly.



ST1417M

Renewing primary plunger seals

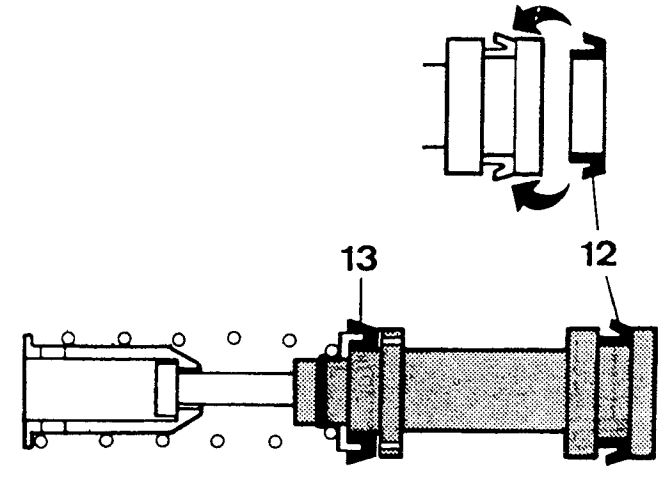
10. Using a 2.5 mm Allen key, unscrew the retaining bolt from the primary plunger and remove:
    (a) spring retainer
    (b) plunger spring
    (c) seal retainer
    (d) recuperating seal
    (e) washer
11. Taking care not to damage the plunger, prise off the outer seal.



ST1195M

12. Fit a new outer seal into its groove by squeezing the seal between the finger and thumb into an ellipse and press the raised part of the seal over the flange using the fingers of the other hand. Using the method illustrated for renewing the secondary seals following instruction 16.
13. Fit the recuperating seal assembly parts in the reverse order of removal. Compress the spring and secure the assembly with the bolt tightening to 2 to 3 Nm (1.5 to 2.2 lbf ft). Do not overtighten.

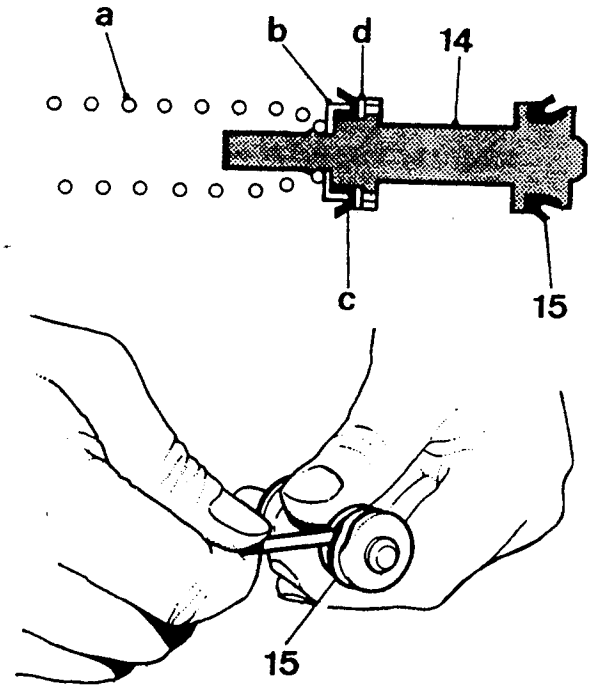
continued



ST1197M

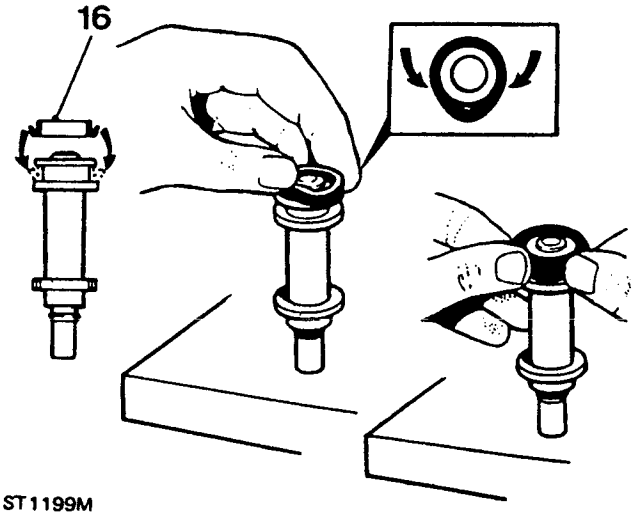
Renewing secondary plunger seals

14. Remove the following items from the plunger:
    (a) spring
    (b) seal retainer
    (c) recuperating seal
    (d) washer
15. Taking care not to damage the plunger prise off the outer seal.



ST1198M

16. Fit a new outer seal using the same procedure as for the primary plunger outer seal by squeezing the seal between the finger and thumb into an ellipse and press the raised part of the seal over the flange using the fingers of the other hand.



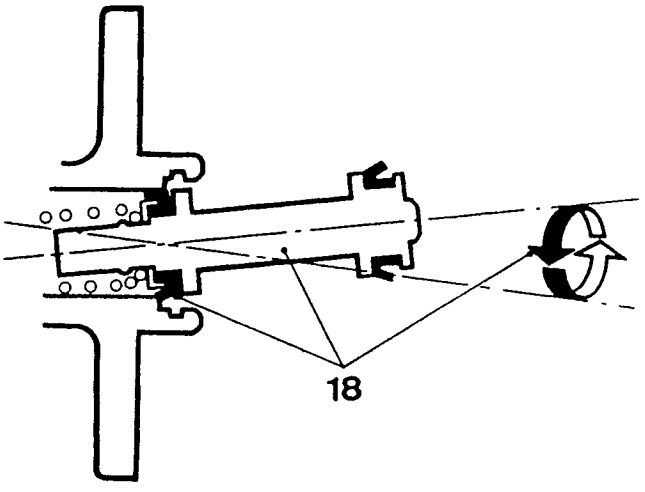
ST1199M

17. Fit the recuperating seal assembly parts in the reverse order of removal.

Assembling master cylinder

It is important that the following instructions are carried out precisely, otherwise damage could be caused to the new seals when inserting 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.

18. Clamp the cylinder in a vice and lubricate the secondary plunger seals 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. Whilst ensuring that the seal does not become trapped, ease the seal into the bore and slowly push the plunger down in one continuous movement.



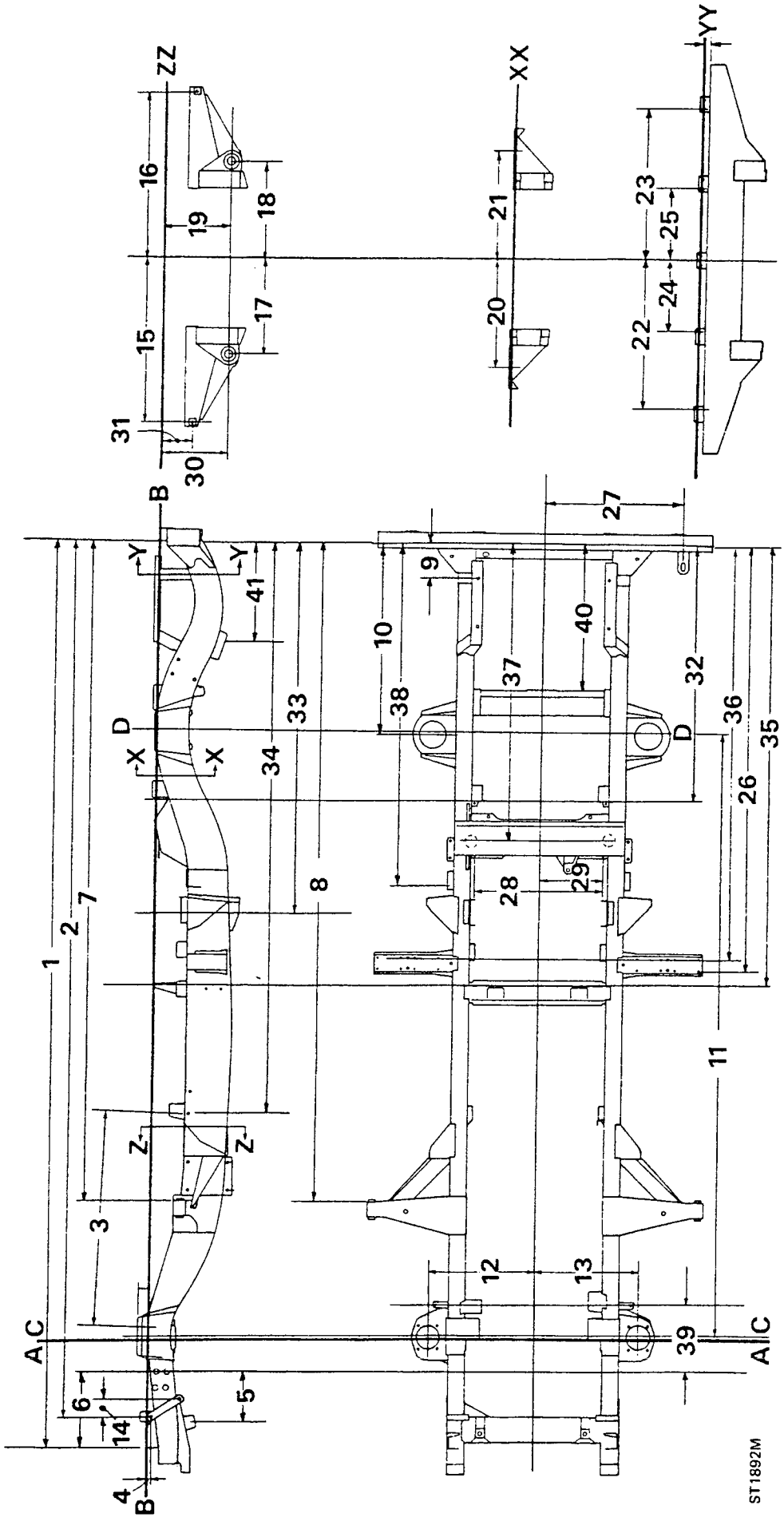
ST1200M

19. Fit the primary plunger assembly using the same method as for the secondary plunger. Press the plunger down and secure the assembly with the plastic circlip.
20. Slowly press the plunger down the bore and fit the secondary plunger stop-pin.
21. Lubricate new seals and fit to the inlet ports (large diameter downwards).
22. Press the reservoir into position and secure with the two roll pins.
23. Fit a new washer to the reservoir cap and press the plastic baffle into position inside the cap.
24. Fit a new rubber seal to the cylinder flange and fit the master cylinder to the servo and secure with two nuts and spring washers.

BRAKING SYSTEM

FAULT DIAGNOSIS

FAULT	CAUSE	ACTION
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 Discs running out pushing pads back. Misplaced dust covers. B. Drum Brakes Brakes need adjustment. Fluid leak. Fluid contamination. Worn or swollen seals in master cylinder. Blocked filler cap vent.	A. Check the disc run out does not exceed 0,10 mm (0.004 in) 1. Rotate the disc on the hub. 2. Check the disc/hub mounting faces. B. Check the brake adjustment, filler cap vent and for fluid leaks. Adjust brakes, repair leak, if necessary, or renew seals and change fluid.
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, lightly rub down with rough sandpaper. Check caliper for damage and repair as necessary. Check servo. Fit new shock absorbers.
BRAKES PULLING	Siezed 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.



LAND ROVER 90

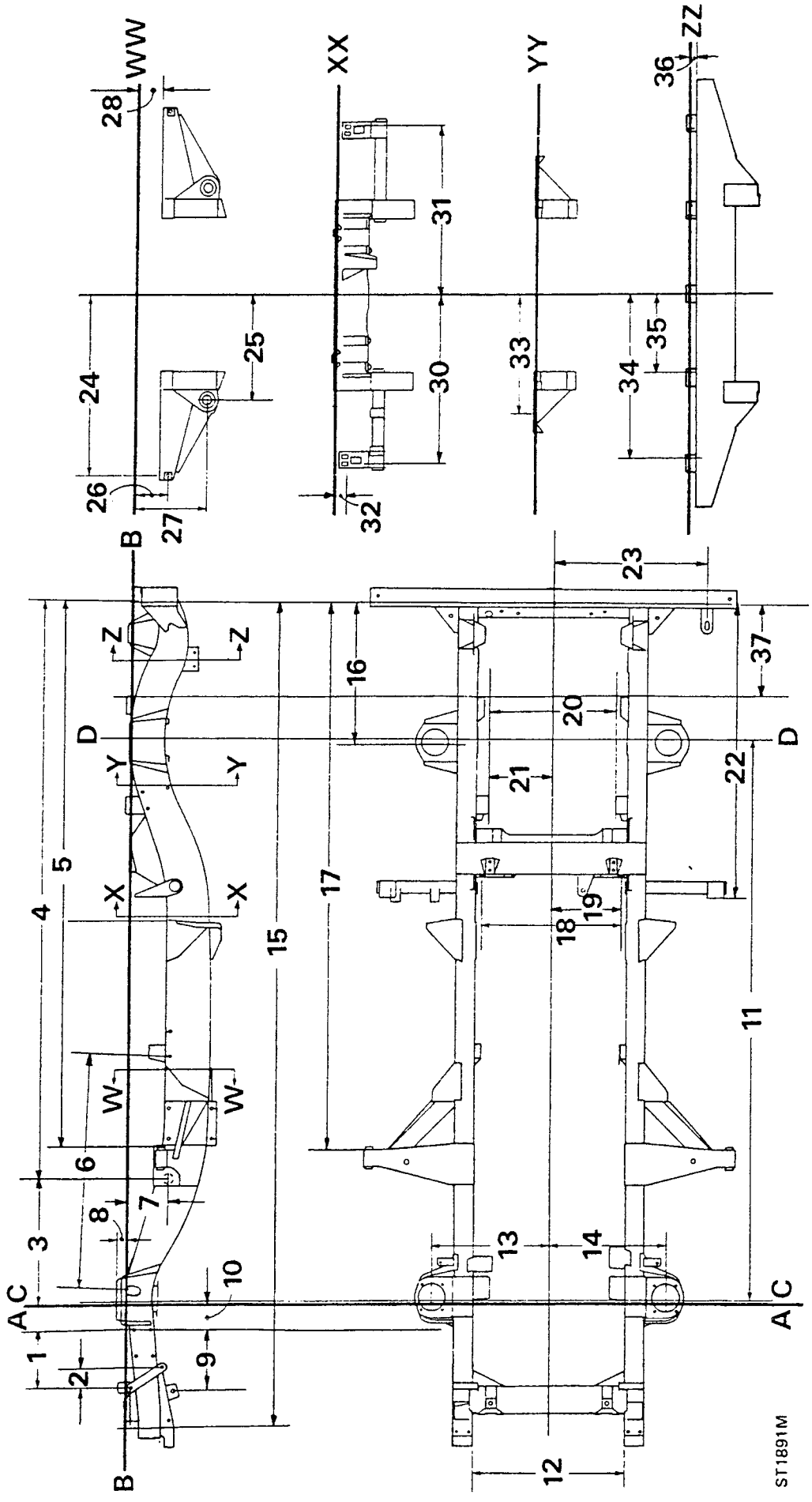
LAND ROVER 90

CHASSIS ALIGNMENT DIMENSIONS

A Front Datum
B Chassis Datum
C Front axle centre line
D Rear axle centre line

1. 239,0 — 236,5 mm
2. 82,0 — 79,5 mm
3. 633 mm
4. 2420,6 — 2418,6 mm
5. 2306,4 — 2305,4 mm
6. 981,2 — 978,7 mm
7. 182,7 mm
8. 41,5 — 37,0 mm
9. 252 — 250 mm
10. 110 mm
11. 2360mm — Wheelbase
12. 636 — 654 mm
13. 488 — 483 mm
14. 488 — 483 mm
15. 3431,1 — 3426,1 mm
16. 588,3 — 586,3 mm
17. 2313,8 — 2311,8 mm
18. 590,5 mm
19. 295,25 mm
20. 519,60 — 517,00 mm
21. 259,80 — 258,50 mm
22. 1242,6 — 1240,6 mm
23. 642,5 — 639,5 mm
24. 750,9 mm
25. 639,5 — 436,5 mm
26. 136,5 mm
27. 299,5 — 295,5 mm
28. 103 — 100 mm
29. 131,5 — 126,5 mm
30. 705,5 — 704,5 mm
31. 705,5 — 704,5 mm
32. 42,2 — 40,2 mm
33. 491 — 486 mm
34. 594,2 — 593,4 mm
35. 283,0 — 282,2 mm
36. 32,25 — 31,25 mm
37. 397 — 395 mm

LAND ROVER 110



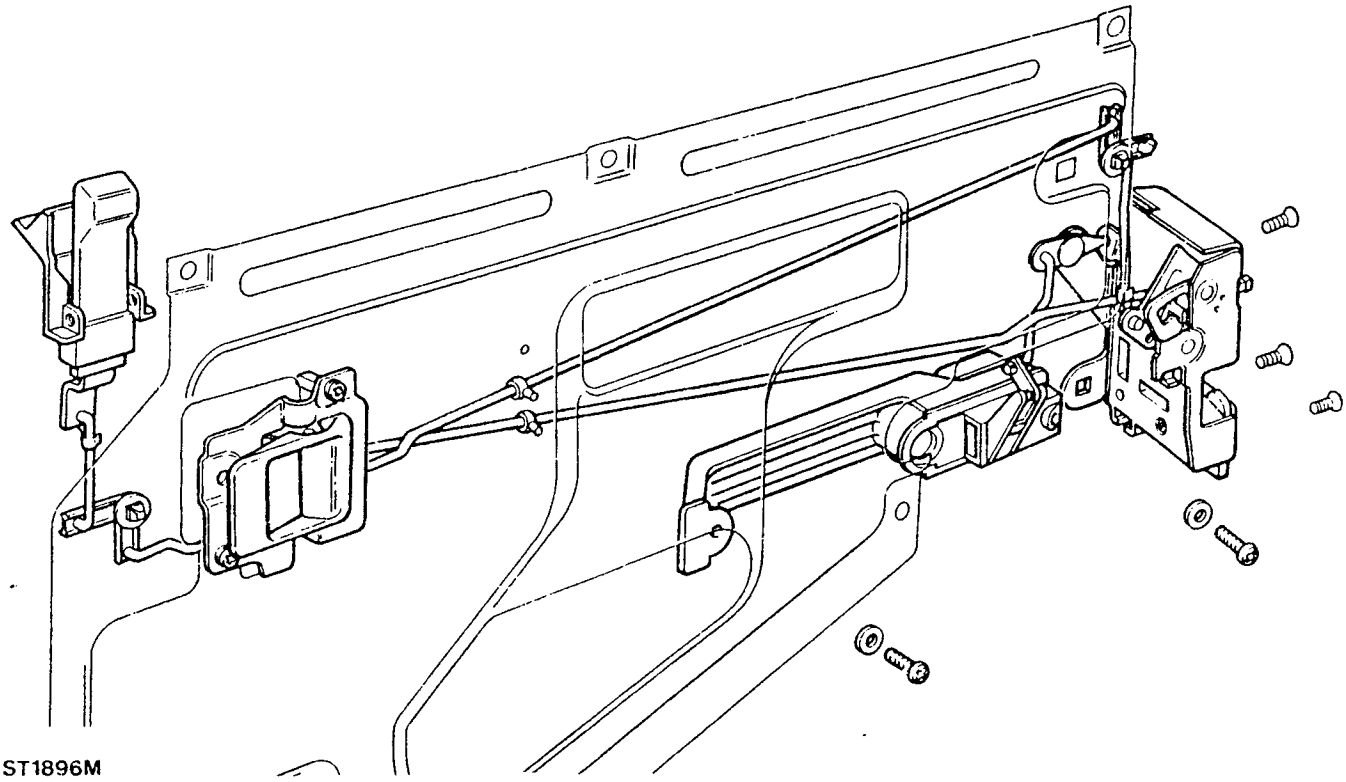
LAND ROVER 110

CHASSIS ALIGNMENT DIMENSIONS

A Front Datum
B Chassis Datum
C Front axle centre line
D Rear axle centre line

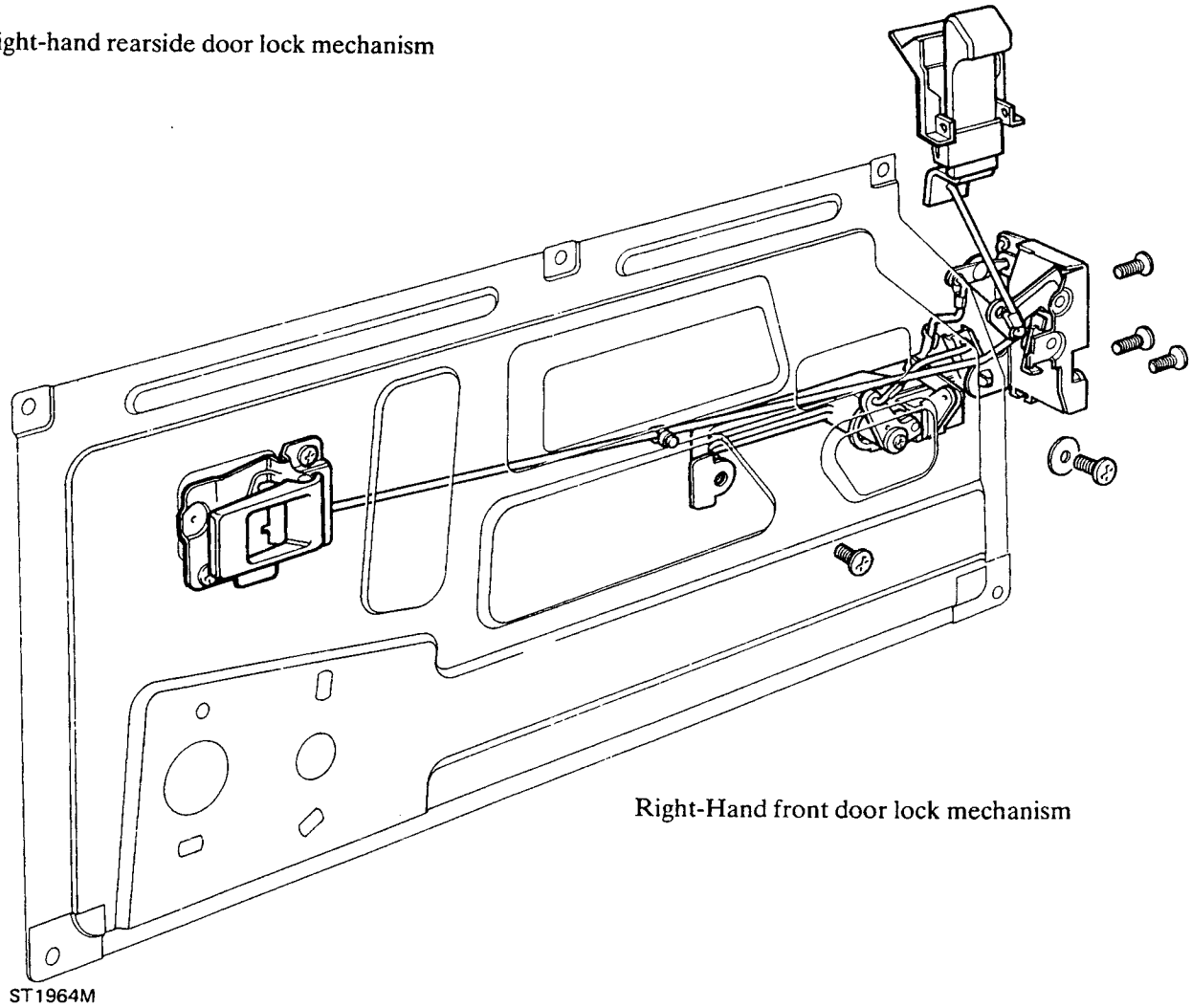
1. 4148 — 4143 mm
2. 4009,5 — 4005 mm
3. 978,7 — 981,2 mm
4. 22 — 20 mm
5. 252 — 250 mm
6. 239 — 236,5 mm
7. 3023,3 — 3022,3 mm
8. 3030,7 — 3028,7 mm
9. 155 — 153 mm
10. 871,2 — 869,2 mm
11. 2794 mm — Wheelbase
12. 488 — 433 mm
13. 488 — 433 mm
14. 82 — 79,5 mm
15. 750,9 mm
16. 750,9 mm
17. 439,5 — 436,5 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. 136,5 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 — 438 mm

DOORS — 1986 ONWARDS



ST1896M

Right-hand rearside door lock mechanism

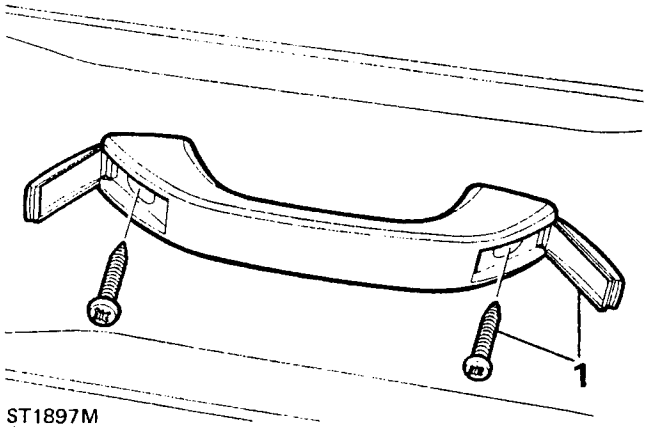


ST1964M

Right-Hand front door lock mechanism

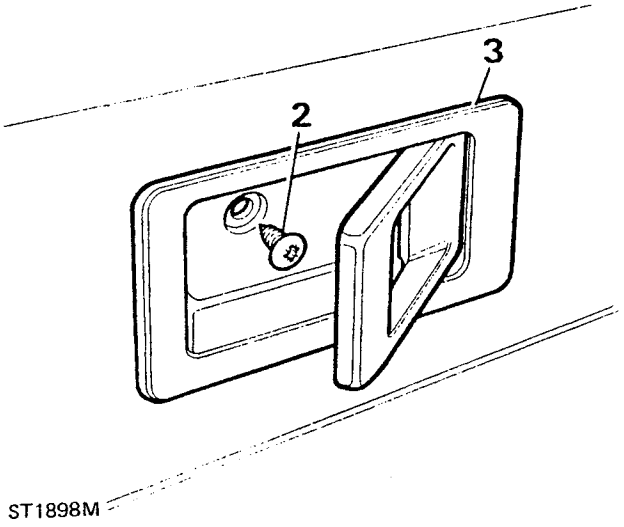
REMOVING THE DOOR TRIM — Front and rear doors

1. Prise off the two finishers and remove the two screws securing the door pull.



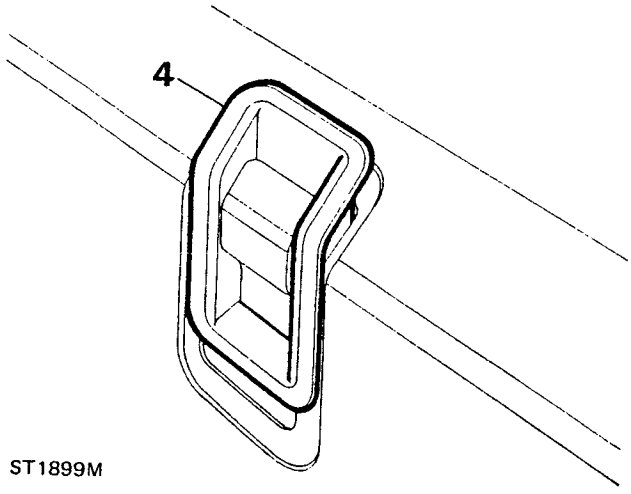
ST1897M

2. Remove the single screw behind the remote control lever.
3. Prise off the remote control lever bezel.



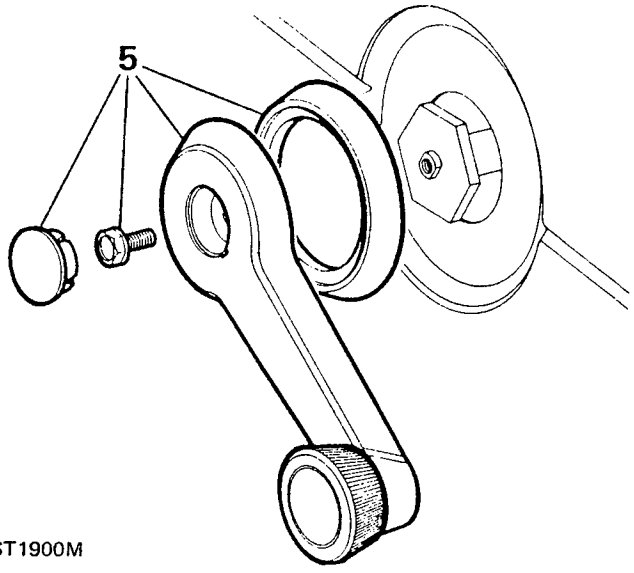
ST1898M

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.

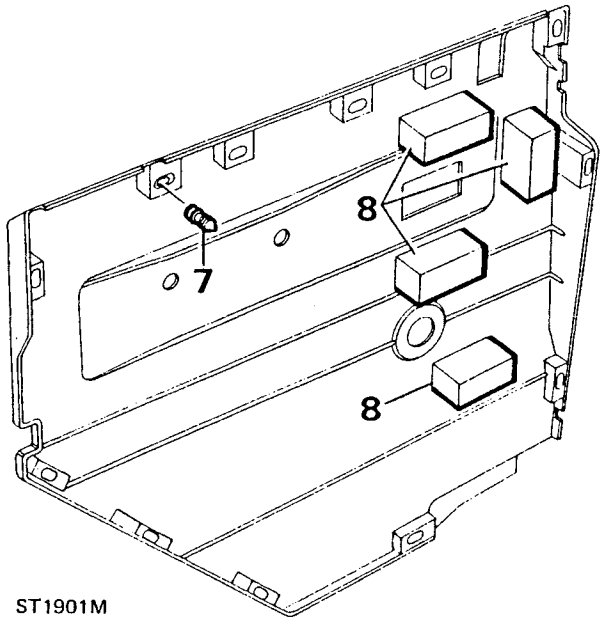


ST1900M

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.



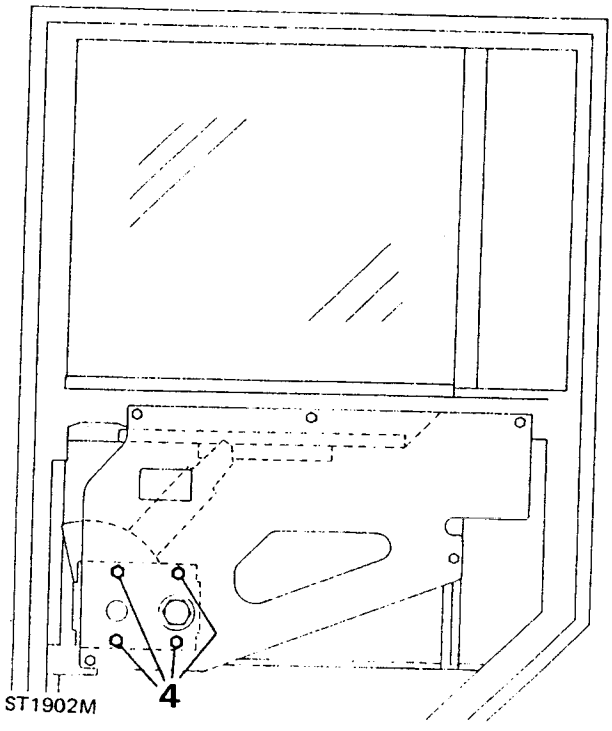
ST1901M

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 — rear side door

To remove

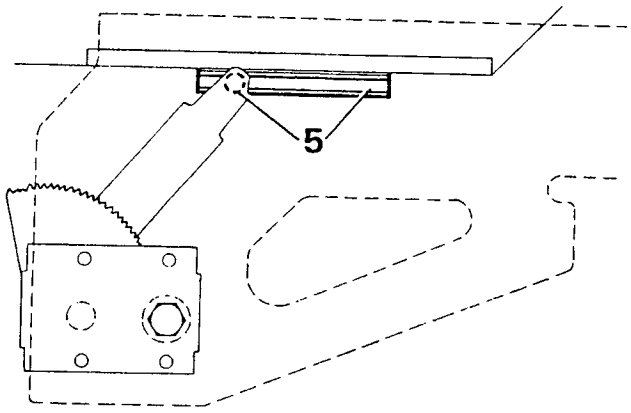
1. Remove the door trim.
2. Remove the protective weather sheet.
3. Temporarily fit the handle and wind the window up to its fullest extent and support the glass in this position, with a length of timber, to prevent it falling when removing the regulator.
4. Remove the four screws retaining the regulator 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.



ST1902M

Fitting regulator

5. Insert the lifting arm button into the lifting channel.



ST1903M

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.

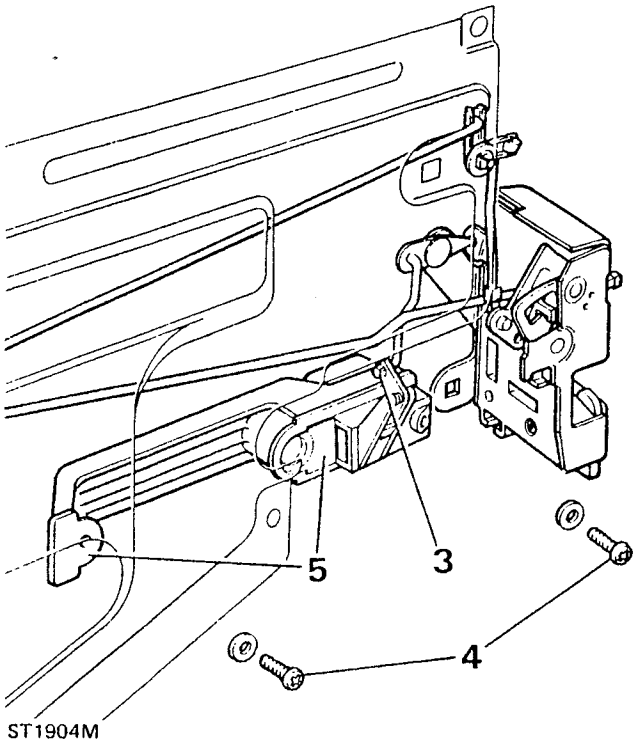
REMOVING EXTERIOR HANDLE — rear side door

To 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.



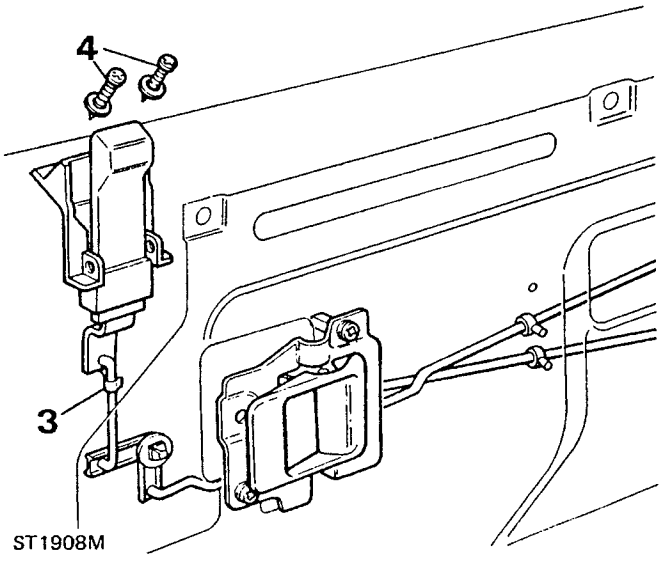
ST1904M

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.

RENEWING DOOR LOCKING BUTTON — rear side door

To 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.



ST1908M

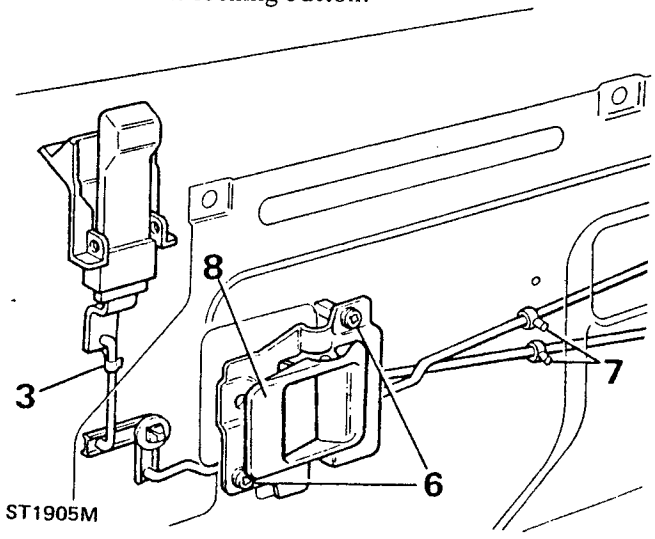
Fitting locking button

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. Reseal the weather protection sheet and fit the door trim, door pull, regulator handle and bezels.

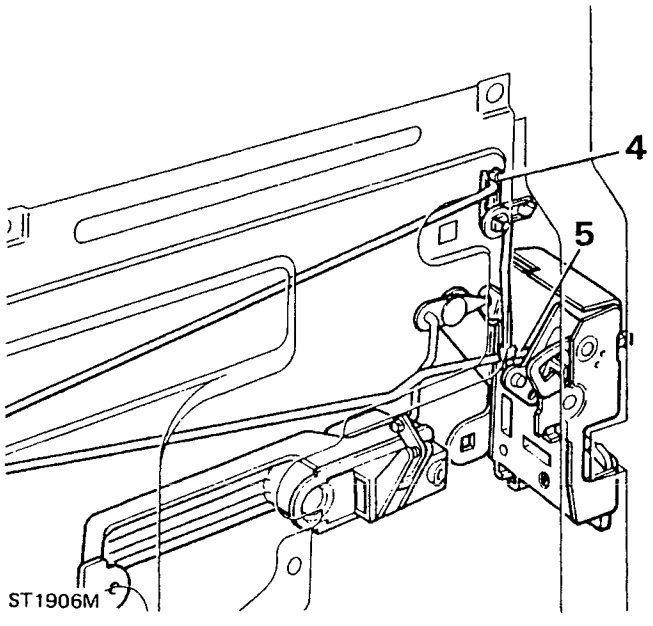
RENEW REMOTE CONTROL LEVER — rear side door

To 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

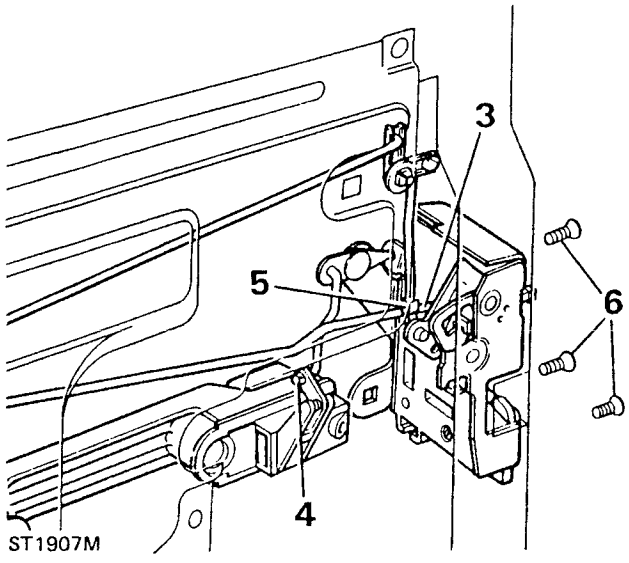
9. Fit the plastic retaining clips to the rod assembly into position and secure with the two screws.
10. Connect the control rods to the latch assembly and secure with the clips.
11. Fit the plastic retaining rod clips to the mounting panel.
12. Connect the control rod to the locking button and secure with the clip.
13. Re-seal the weather protection sheet and fit the trim panel, regulator handle, door pull and bezels.

REMOVE DOOR LATCH ASSEMBLY — rear side door

To 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.

continued



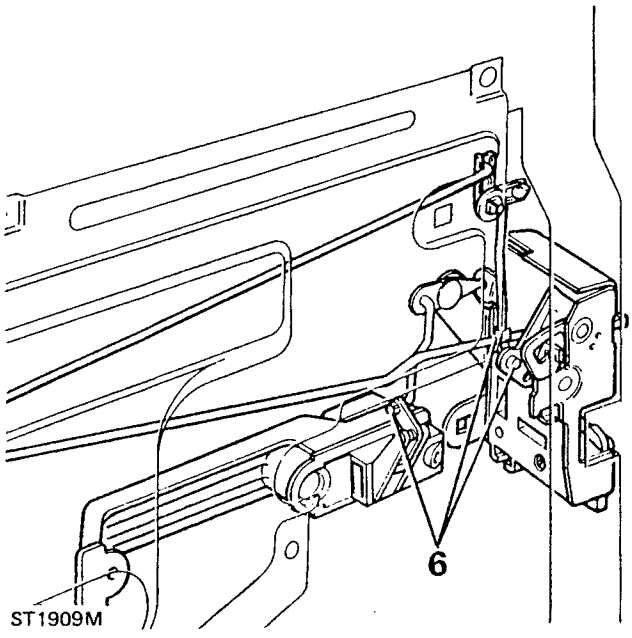
Fitting the latch

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 — rear side door

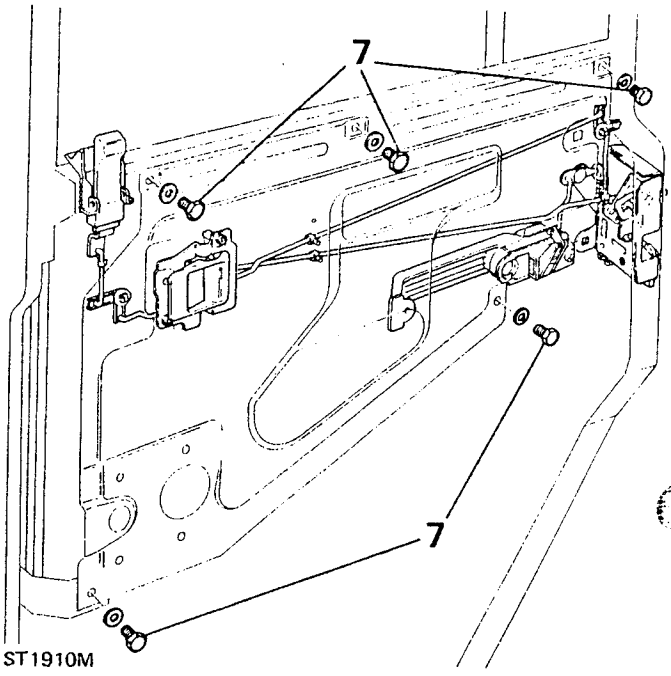
To remove

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.



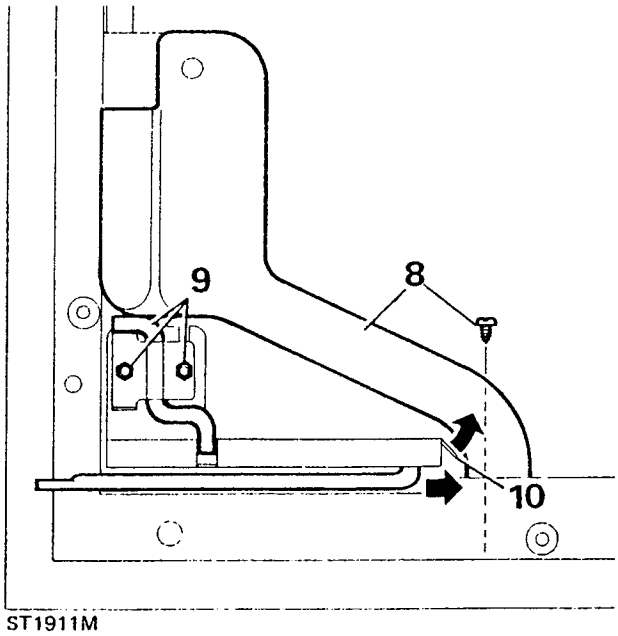
ST1909M

7. Remove the four screws retaining the mounting panel to the door and remove the panel complete with rods and control lever.



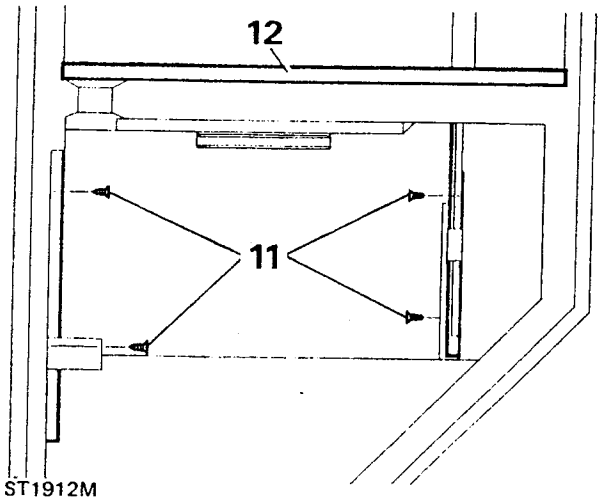
ST1910M

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.



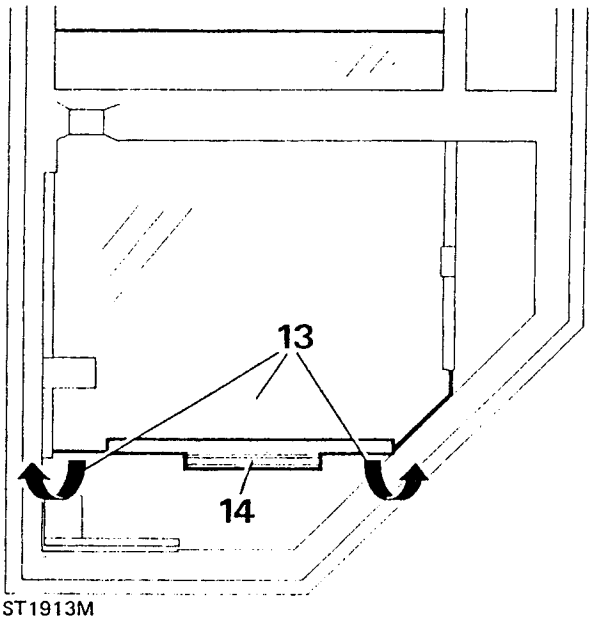
ST1911M

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.



ST1912M

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.



ST1913M

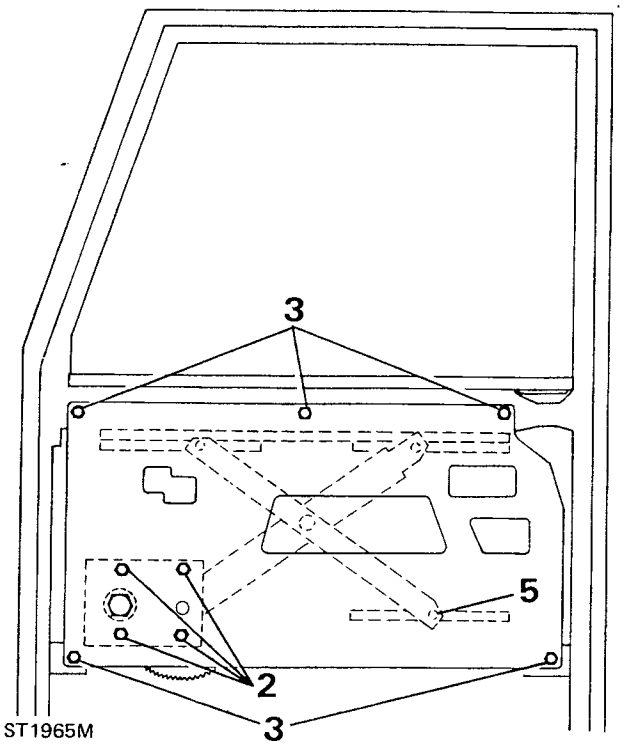
Fitting glass

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 rod.
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.

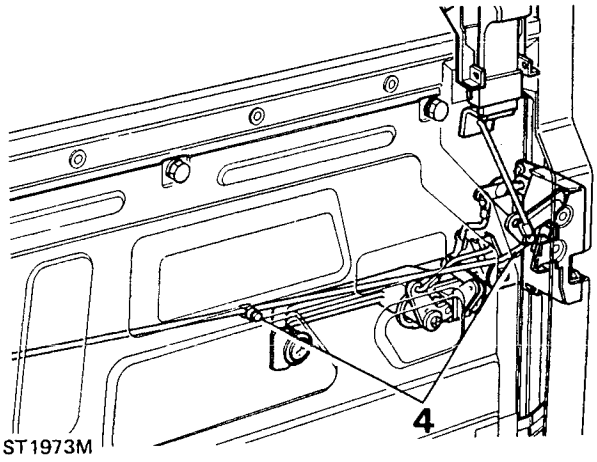
REMOVING MOUNTING PANEL — front doors

To 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.



ST1965M



ST1973M

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

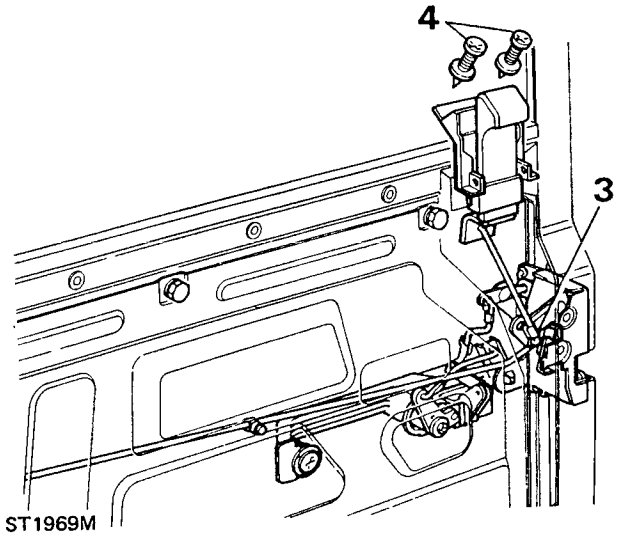
6. Engage the window regulator arm in the mounting panel channel.
7. Connect the remote control rod to the latch mechanism and secure with the clip.
8. Fit the mounting panel and retain with the five screws.
9. Secure the window regulator to the mounting panel with the four screws.
10. Raise and lower 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 — front doors

To 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.

continued



ST1969M

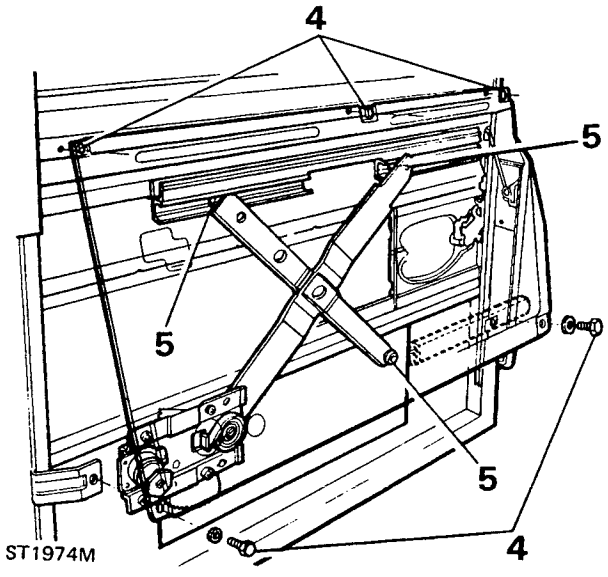
Fitting locking button

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. Reseal the weather protection sheet and fit the door trim, door pull, regulator handle, and bezels.

REMOVING WINDOW REGULATOR — front doors

To remove

1. Remove the door trim.
2. Remove the weather protection sheet.
3. Temporarlly 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.



ST1974M

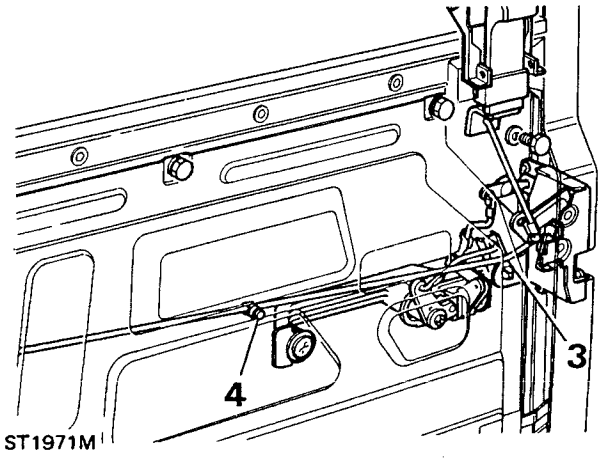
Fitting regulator

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.

REMOVE REMOTE CONTROL LEVER — front doors

To remove

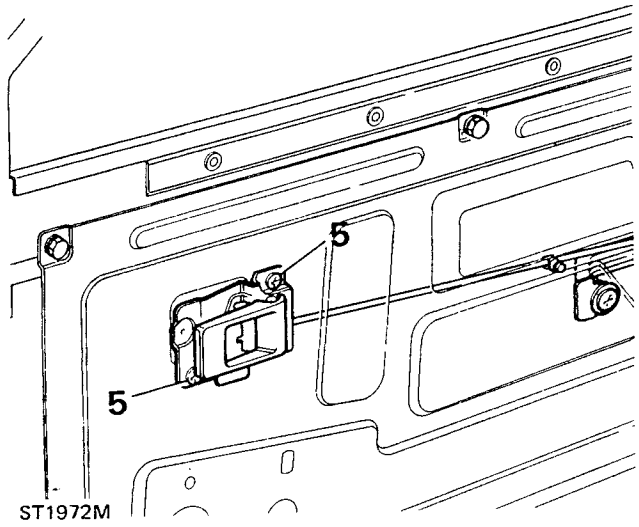
1. Remove the door pull, regulator handle, bezels and door trim.
2. Peel back sufficient of the weather protection sheet to gain access to the remote lever.
3. Release the spring clip and disconnect the control rod from the latch mechanism.
4. Release the control rod from the plastic clip in the mounting panel.



ST1971M

continued

5. Remove the two screws securing the remote control lever to the mounting panel and withdraw the lever and control rod.



ST1972M

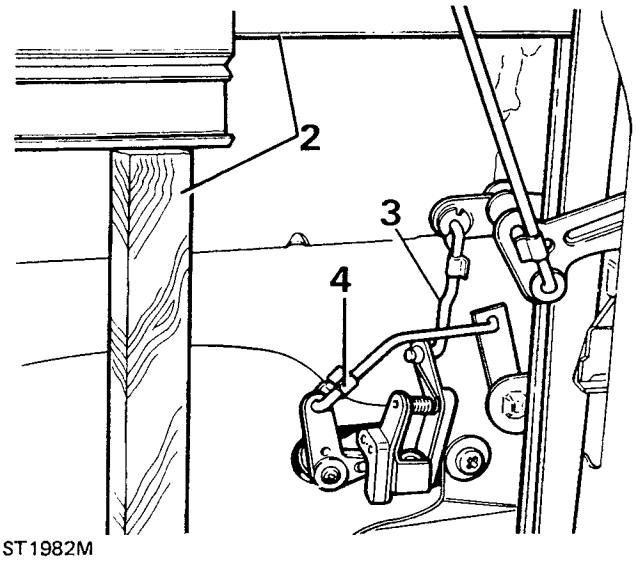
Fitting remote control lever

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 — front doors

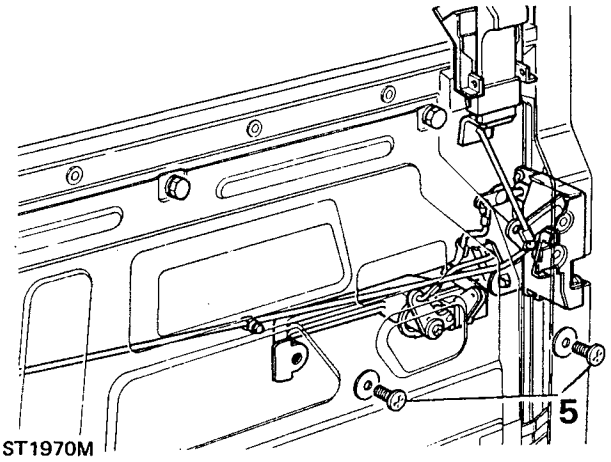
To remove

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.



ST1982M

5. Remove the two screws and withdraw the handle assembly.



ST1970M

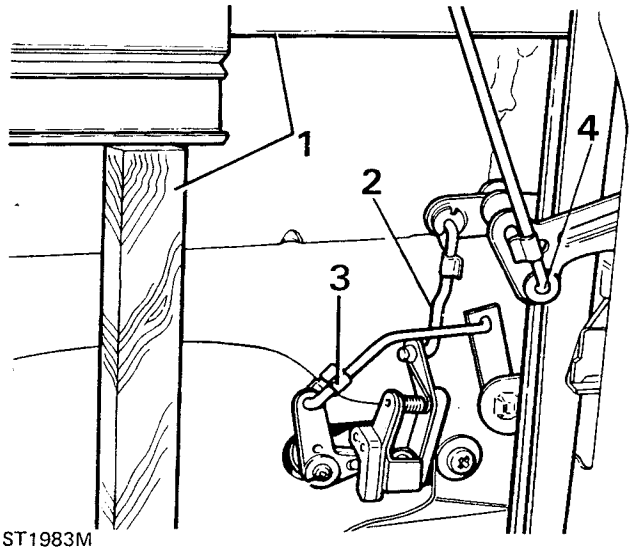
Fitting the handle

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.
8. Carry-out the instructions for fitting the mounting panel and door trim and fittings.

REMOVE THE DOOR LATCH ASSEMBLY — front doors

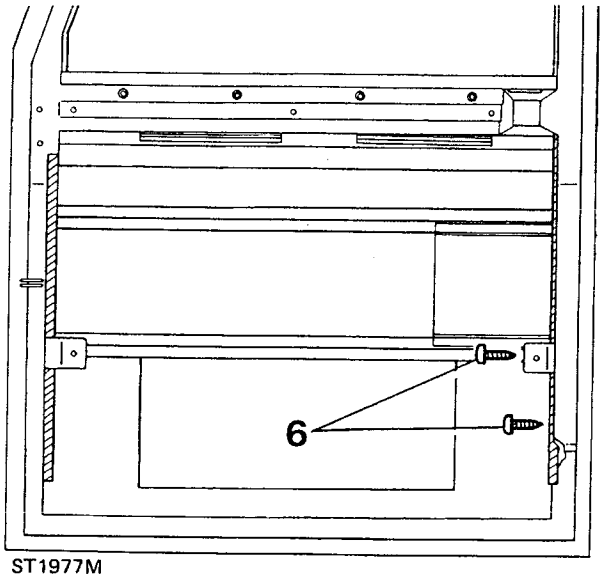
To remove

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.



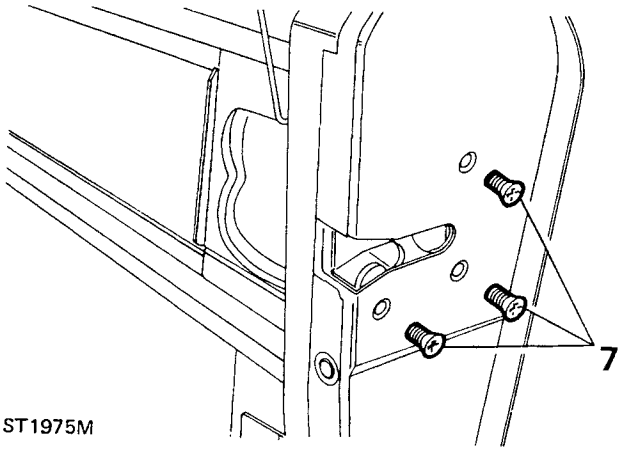
ST1983M

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.



ST1977M

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.



ST1975M

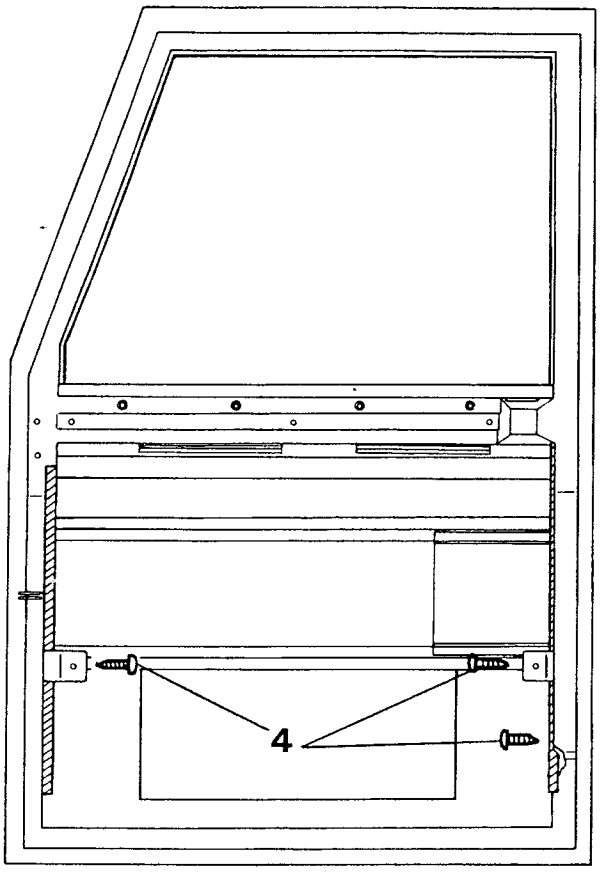
Fitting latch assembly

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 — front doors

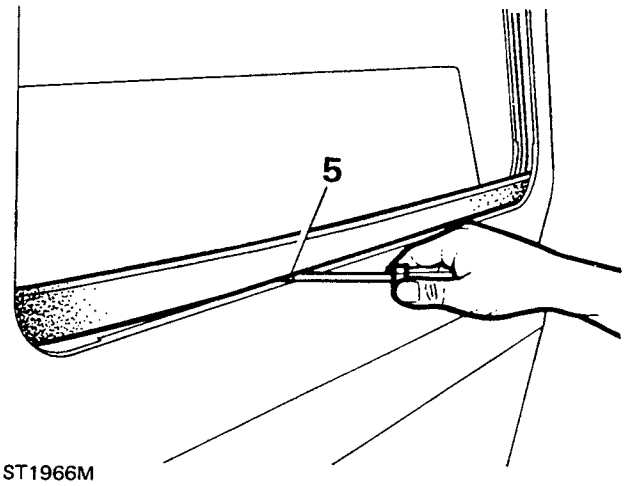
To remove

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.



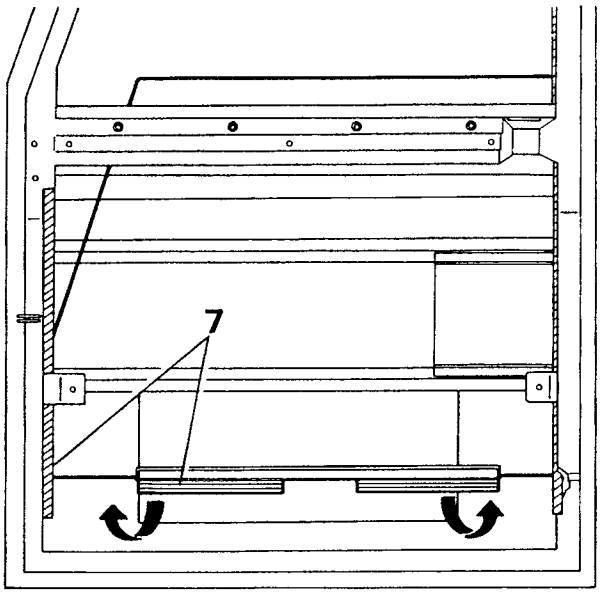
ST1976M

5. Taking care not to damage the paint work, prise the exterior waist weatherstrip 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.

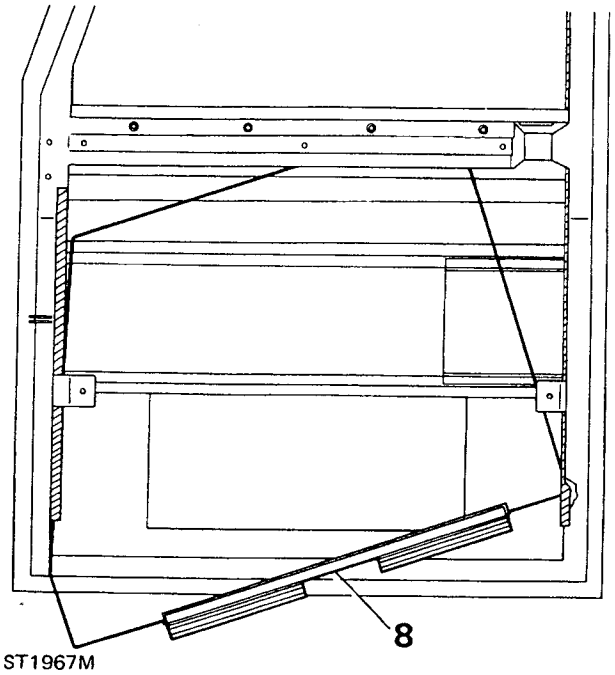


ST1968M

Fitting glass

8. Insert the glass into the runners at an angle as illustrated.
9. Whilst lifting the 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.

continued



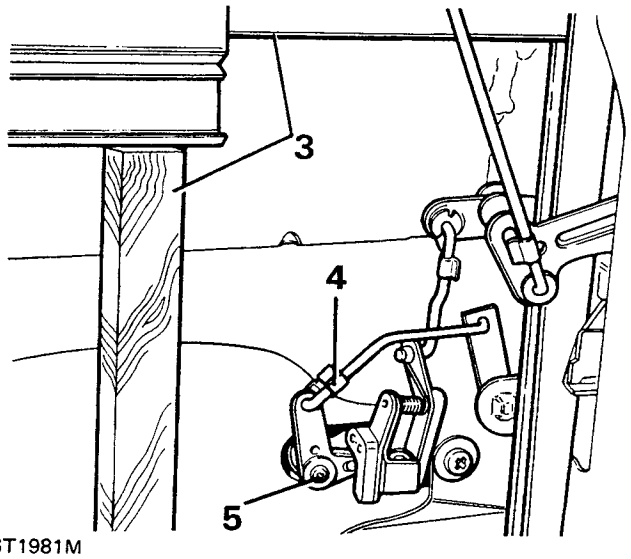
ST1967M

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 — front doors

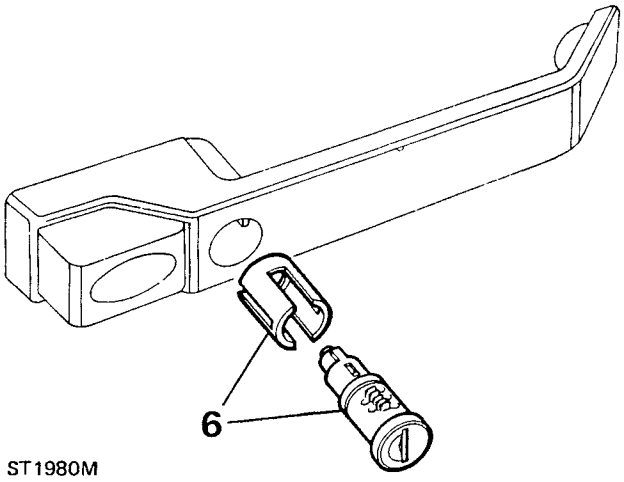
To remove

1. Remove the 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 the 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.



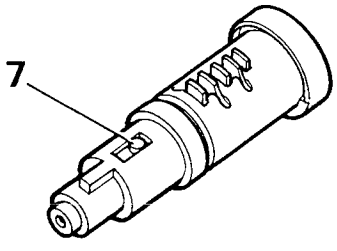
ST1981M

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.



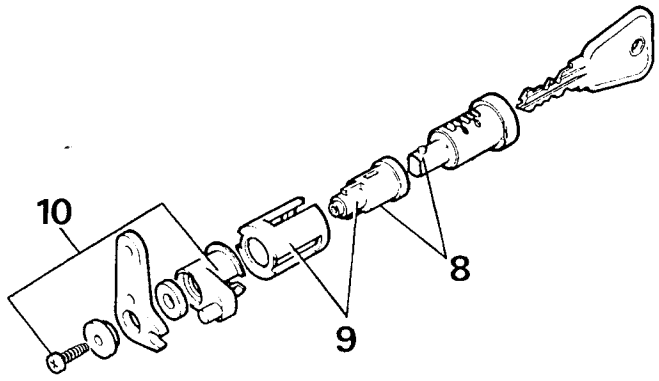
ST1979M

continued

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 accompaning key.

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.

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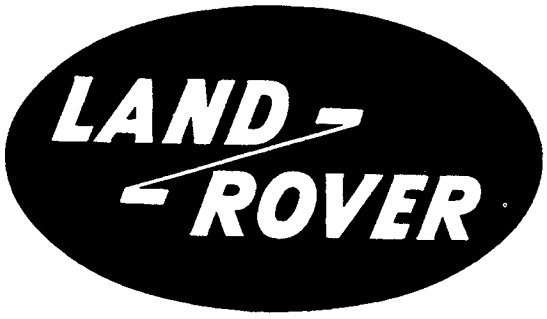

Special Service Tools

The use of approved special service tools is important. They are essential if service operations are to be carried out efficiently, and safely. The amount of time which 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, PO Box 3 Daventry, Northants, England NN11 4NF.

The tools recommended in this Workshop Manual are listed in a multi-language, illustrated catalogue obtainable from Messers. V. L. Churchill at the above address under publication number 2217/2/84 or from Land Rover Ltd., under part number LSM0052TC from the following address, Land Rover Merchandising Service, P.O. Box 534, Erdington, Birmingham B24 0QS.

INTRODUCTION

This Workshop Manual covers the Land Rover Ninety and One Ten range of vehicles. It is primarily designed to assist skilled technicians in the efficient repair and maintenance of Land Rover vehicles.

Using the appropriate service tools and carrying out the procedures as detailed will enable the operations to be completed within the time stated in the 'Repair Operation Times'.

The Manual has been produced in separate books; this allows the information to be distributed throughout the specialist areas of the modern service facility.

A table of contents in Book 1 lists the major components and systems together with the section and book numbers. The cover of each book details the sections contained within that book.

The title page of each book carries the part numbers required to order replacement books, binders or complete Service Manuals. This can be done through the normal channels.

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 and accessories:
Safety features embodied in the vehicle may be impaired if other than Land Rover parts are fitted. In certain territories, legislation prohibits the fitting of parts not to the vehicle manufacturer's specification. Torque 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.

POISONOUS SUBSTANCES

Many liquids and other substances used in motor vehicles are poisonous and should under no circumstances be consumed and should as far as possible be kept away from open wounds. These substances among others include antifreeze, brake fluid, fuel, windscreen washer additives, lubricants and various adhesives.

FUEL HANDLING PRECAUTIONS

The following information provides basic precautions which must be observed if petrol (gasoline) 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.

GENERAL

Petrol/gasoline vapour is highly flammable and in confined spaces is also very explosive and toxic.
When petrol/gasoline evaporates it produces 150 times its own volume in vapour, which when diluted with air becomes a readily ignitable mixture. The vapour is heavier than air and will always fall to the lowest level. It can readily be distributed throughout a workshop by air current, consequently, even a small spillage of petrol/gasoline is potentially 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.
Always disconnect the vehicle battery BEFORE carrying out dismantling or draining work on a fuel system.
Whenever petrol/gasoline is being handled, drained or stored, or when fuel systems are being dismantled all forms of ignition must be extinguished or removed, any head-lamps used must be flameproof and kept clear of spillage.

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

FUEL TANK DRAINING

WARNING: PETROL/GASOLINE MUST NOT BE EXTRACTED OR DRAINED FROM ANY VEHICLE WHILST IT IS STANDING OVER A PIT.

Draining or extracting petrol/gasoline from vehicle fuel tank must be carried out in a well ventilated area.
The receptacle used to contain the petrol/gasoline must be more than adequate for the full amount of fuel to be extracted or drained. The receptacle should be clearly marked with its contents, and placed in a safe storage area which meets the requirements of local authority regulations.
WHEN PETROL/GASOLINE HAS BEEN EXTRACTED OR DRAINED FROM A FUEL TANK THE PRECAUTIONS GOVERNING NAKED LIGHTS AND IGNITION SOURCES SHOULD BE MAINTAINED.

FUEL TANK REMOVAL

On vehicles where the fuel line is secured to the fuel tank outlet by a spring steel clip, it is recommended that such clips are released before the fuel line is disconnected or the fuel tank unit is removed. This procedure will avoid the possibility of residual petrol fumes in the fuel tank being ignited when the clips are released.
As an added precaution fuel tanks should have a PETROL/GASOLINE VAPOUR warning label attached to them as soon as they are removed from the vehicle.

FUEL TANK REPAIR

Under no circumstances should a repair to any tank involving heat treatment be carried out without first rendering the tank SAFE, by using one of the following methods:

STEAMING: With the filler cap and tank unit removed, empty the tank. Steam the tank for at least two hours with low pressure steam. Position the tank so that condensation can drain away freely, ensuring that any sediment and sludge not volatised by the steam, is washed out during the steaming process.

BOILING: With the filler cap and tank unit removed, empty the tank. Immerse the tank completely in boiling water containing an effective alkaline degreasing agent or a detergent, with the water filling and also surrounding the tank for at least two hours.

After steaming or boiling a signed and dated label to this effect should be attached to the tank.

SPECIFICATION

Purchasers are advised that the specification details set out in this 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 specifications with or without notice, and at such times and in such manner as they think fit. Major as well as minor changes may be involved in accordance with the Manufacturer's policy of constant product improvement.

Whilst every effort is made to ensure the accuracy of the particulars contained in this Manual, neither the Manufacturer 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.

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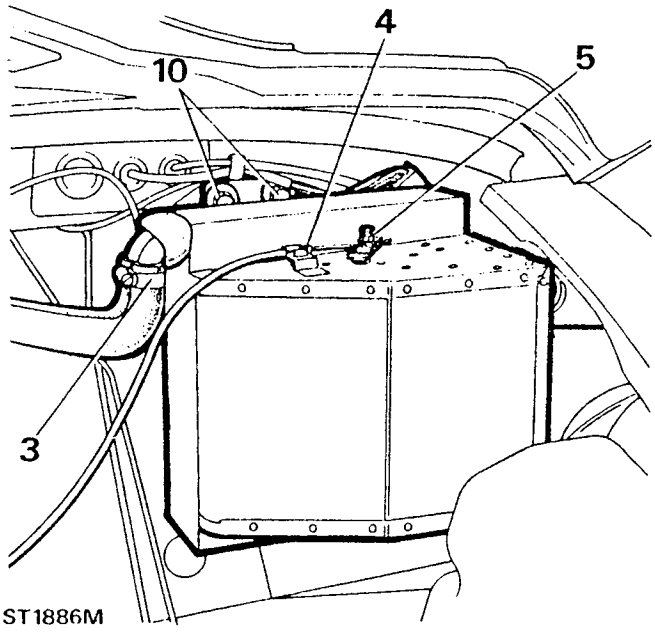
HEATER/FAN UNIT
Remove, Overhaul and refit

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.



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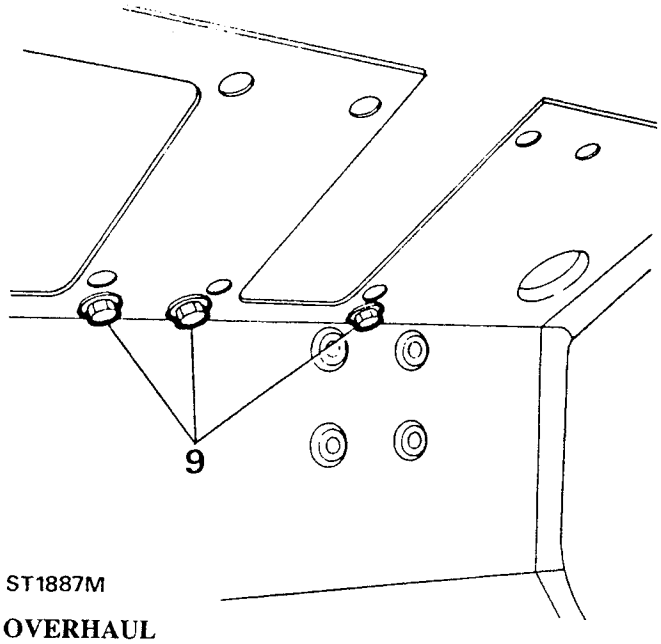
9. Remove lower nuts and bolts securing the heater unit to the bulkhead.
10. Slacken heater unit upper retaining bolts.
11. Manoeuvre heater unit clear of engine bay.



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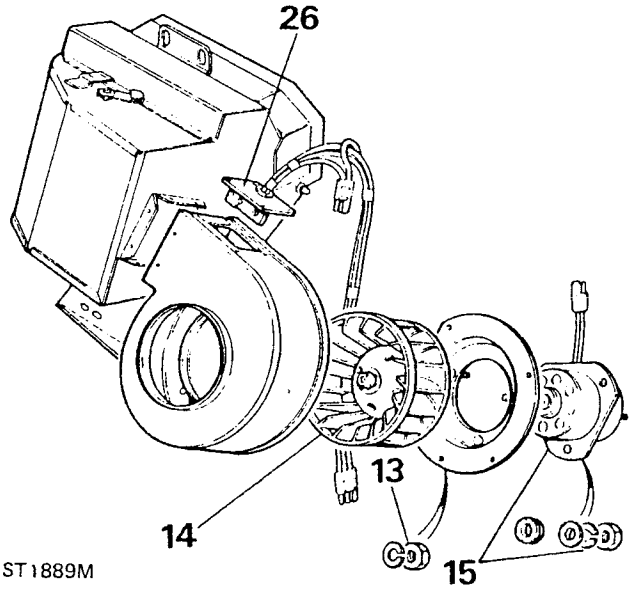
OVERHAUL

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.



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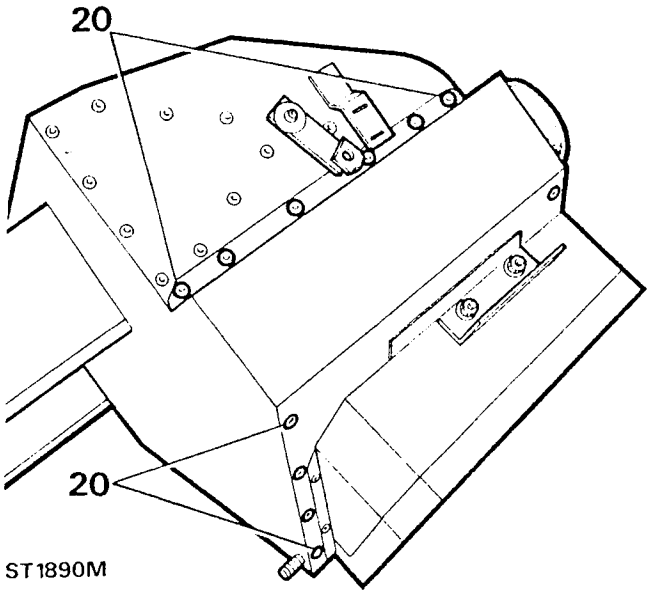
16. Fit fan motor into mounting plate, apply Bostik 1261 adhesive to mating faces, and secure with the three nuts.
17. Refit impeller to fan drive shaft and fit circlip.
18. Refit fan assembly to casing and secure with the five nuts.
19. Plug in connector to resistor harness and refit angled bracket.

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).



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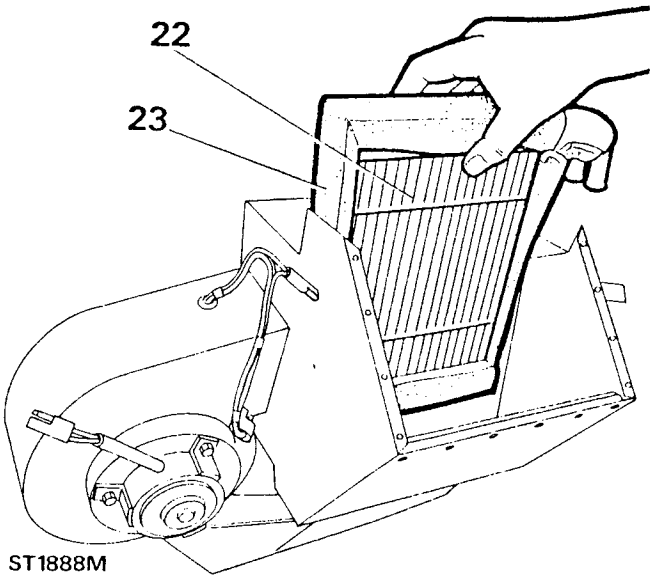
21. Lift off cover, air duct and seal.
22. Lift heater matrix out of casing.
23. Fit foam rubber to heater matrix casing and position matrix in casing.
24. Check that flap valves operate correctly and without sticking.
25. Refit top cover and rivet into place.

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 manouevre 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.



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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.

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.

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.

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 2, which includes Freon 2 or Arcton 2.

CAUTION: Methychloride refrigerants must not be used.
Nominal charge weight: 1,25 kg (2.75 lbs).
Compressor oil: See Recommended Lubricants.

PRECAUTIONS IN HANDLING REFRIGERANT

The refrigerant used in the air conditioning system is Refrigerant 2, 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.

PRECAUTIONS IN HANDLING REFRIGERANT LINES

WARNING: Always wear safety goggles when opening refrigerant connections.

(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 inital 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 (2 ins) of the exhaust manifold.
(r) Completed assemblies must be checked for 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

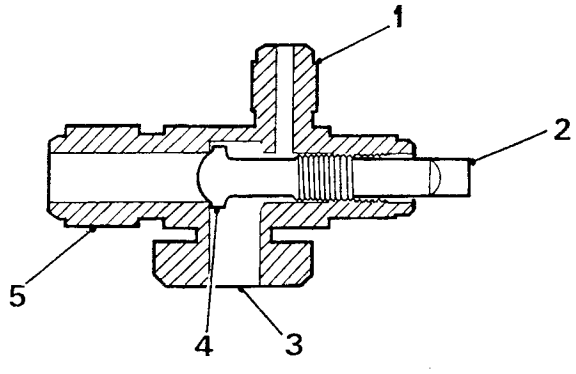
Examine the refrigeration connections at the unit. If the system should develop a fault, or if erratic operation is noticed, refer to the fault diagnosis chart.

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.



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Stem type service valve
1 Service port
2 Valve stem
3 Compressor port
4 Valve seat
5 Hose connector

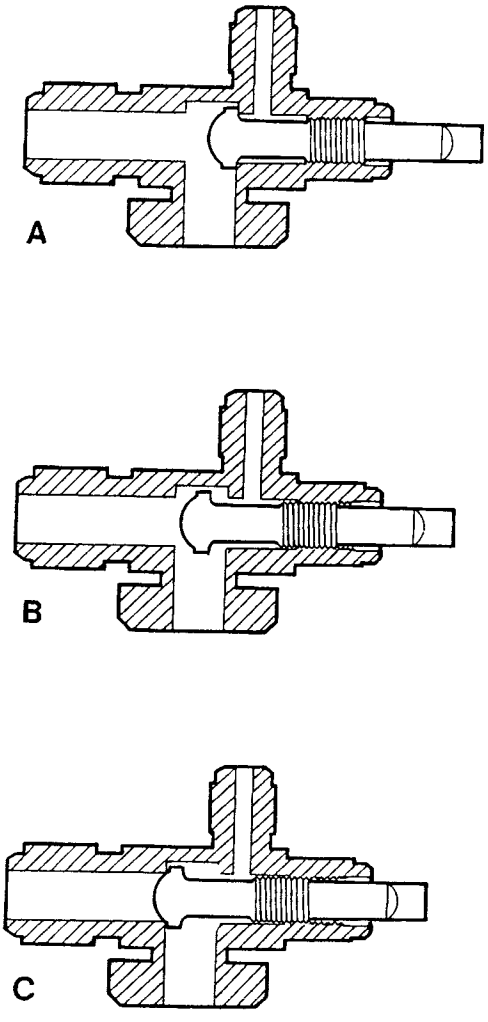
NOTE: A special wrench should be used to adjust the valve to prevent damage to the stem.

The stem type service valve has three positions, the operation of which is explained as follows.

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.



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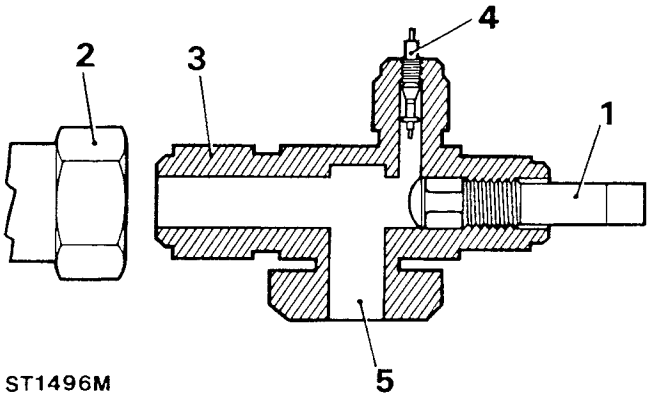
WARNING: NEVER operate the air conditioning system with the service valves in the OFF POSITION, it will cause severe damage to the compressor.

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

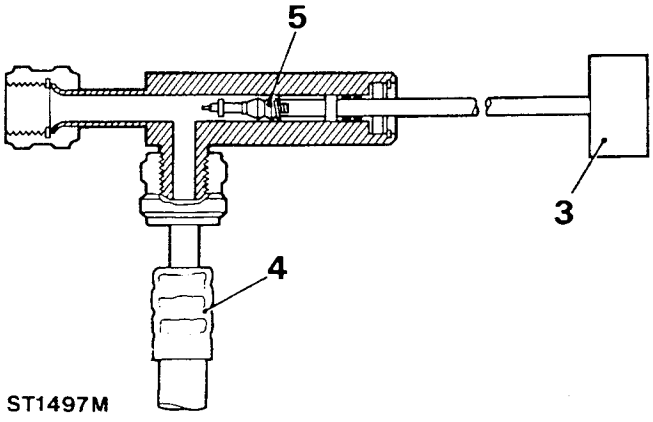
Where Schrader Valve depressors are not fitted to the Testing equipment lines Valve core removers can be used.

Valve Core Removal

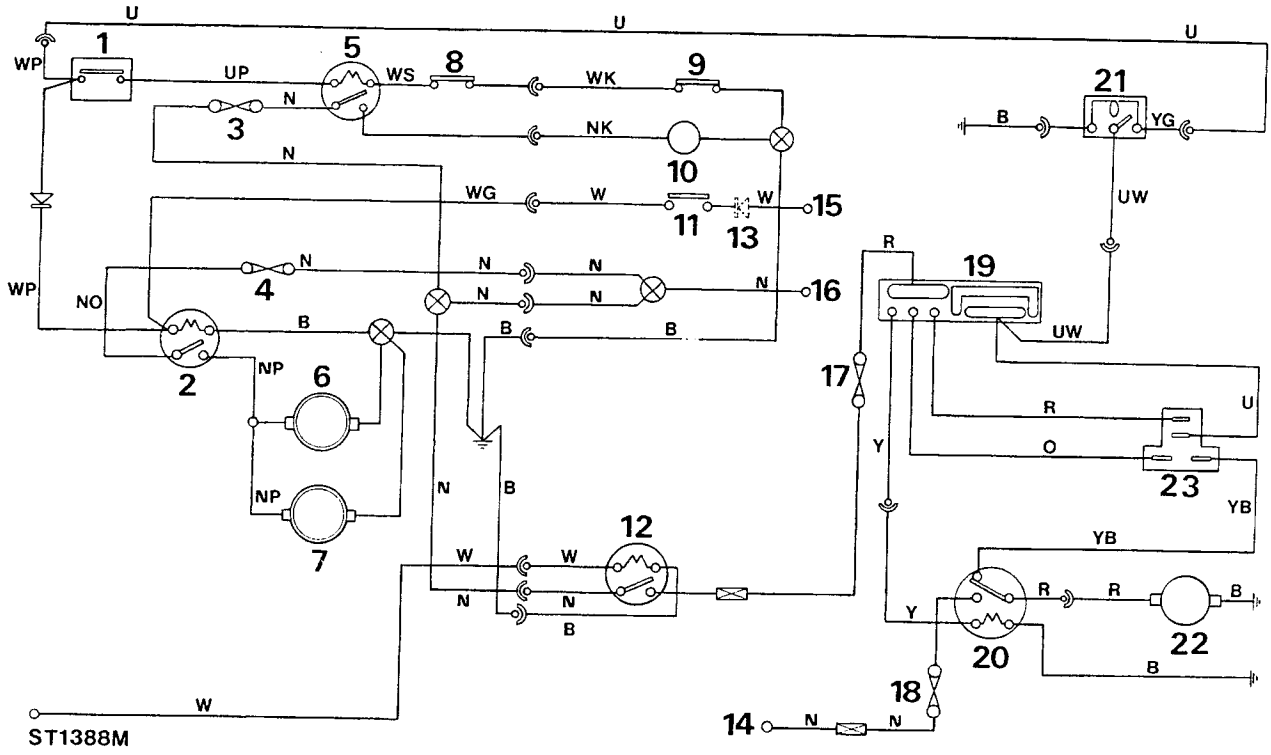
The use of valve core removers will facilitate servicing operations and should be used as follows:

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.



ELECTRICAL CIRCUIT DIAGRAM



Key to Circuit Diagram

1. Thermostat
2. Condenser fan relay
3. 5 amp fuse
4. 17 amp fuse
5. Compressor clutch relay
6. L.H. fan
7. R.H. fan
8. High pressure switch
9. Compressor clutch temperature switch
10. Compressor clutch
11. Fan temperature switch
12. Blower fan relay
13. Diode — Diesel engines only
14. Termination point*
15. Ignition feed pick-off point
16. Starter solenoid pick-off point
17. 30 amp fuse
18. 30 amp fuse
19. Fan speed selector switch
    Wiring U = 1st speed
    R = 2nd speed
    O = 3rd speed
    Y = 4th speed
20. Relay
21. Air conditioning on/off switch
22. Evaporator motor
23. Resistor block

NOTE: R.H. steering models have only three fan speeds

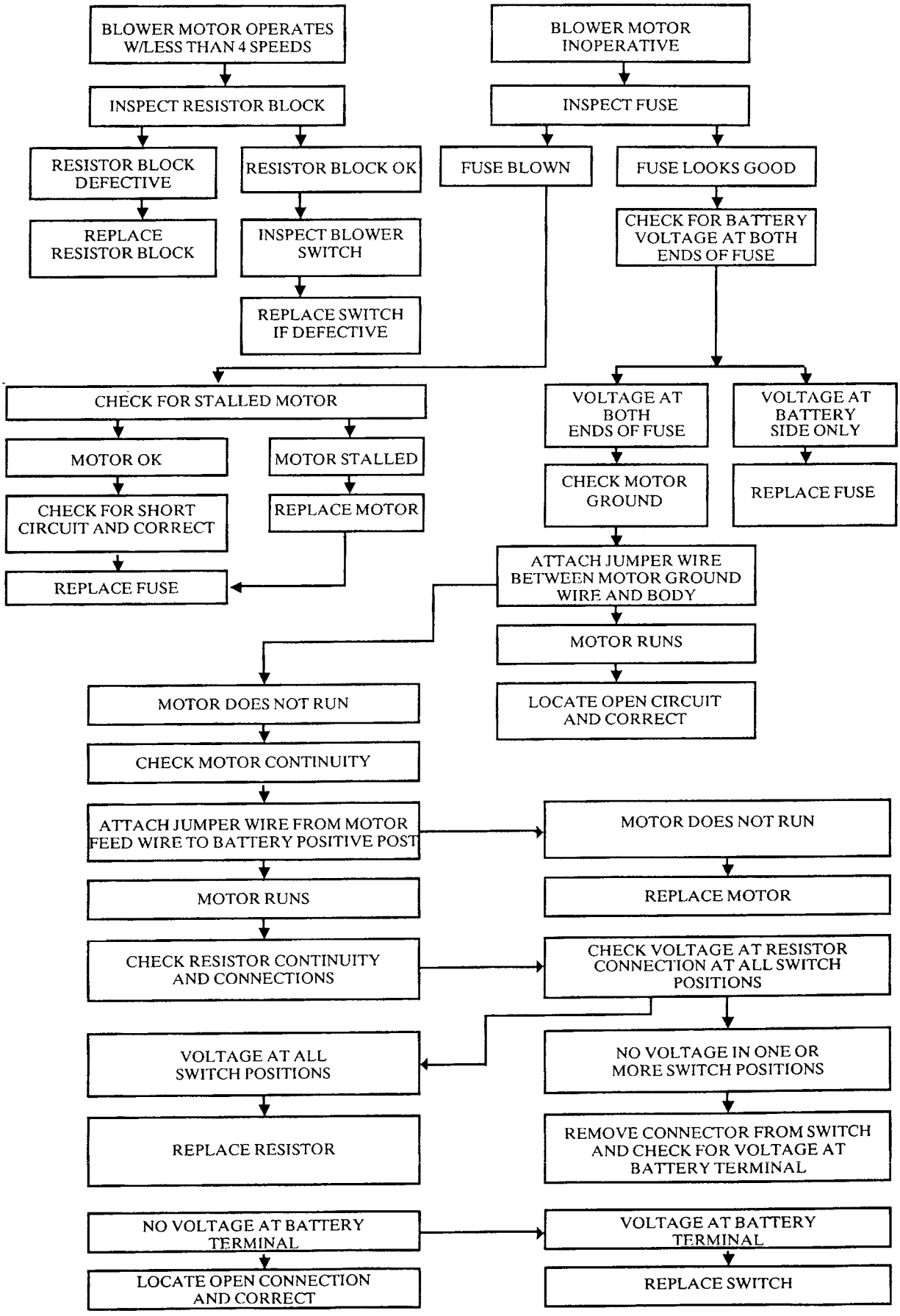
* denotes: L.H. petrol, L.H./R.H. diesel models, termination at starter solenoid.
R.H. petrol models, termination via link lead to ignition switch.

Key to cable colours

B Black G Green K Pink L Light N Brown O Orange P Purple R Red S Slate U Blue W White Y Yellow

The last letter of a colour code denotes the tracer colour

ELECTRICAL
AIR CONDITIONER 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 setting, compressor speed and air leakage into the cooled area, etc. With these factors constant, any sudden increase in the length of the cooling cycle would be indicative of abnormal operation of the air conditioner.
The low and high side pressures at the compressor will vary with changing ambient temperature, humidity, cab temperature and altitude.

The following conditions should be checked after operating the system for several minutes:

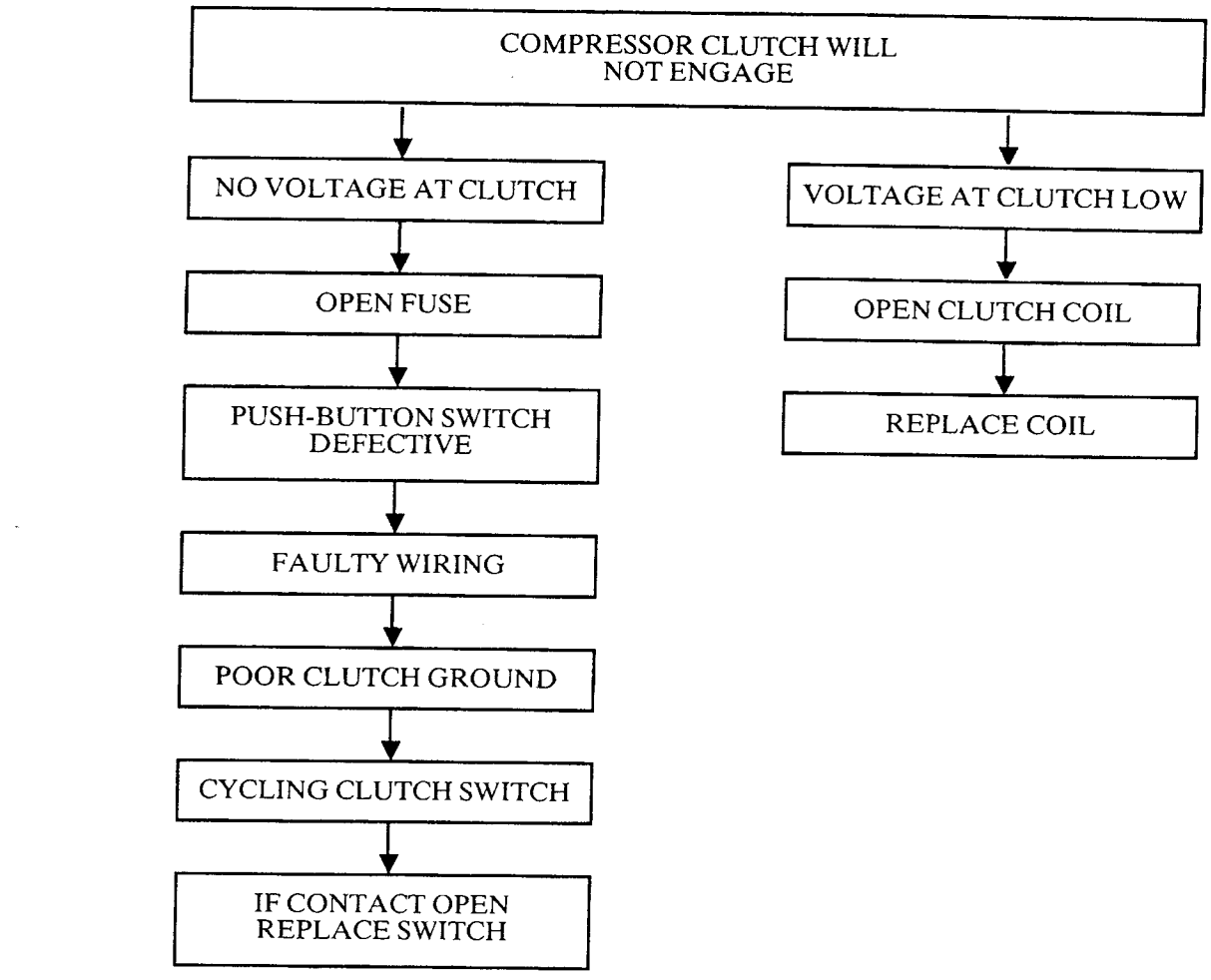
1. All high side lines and components should be warm to the touch.
2. All low side lines should be cool to the touch.
3. Inlet and outlet temperatures at the receiver/drier should be at the same temperature (warm). Any very noticeable temperature difference indicates a blocked receiver/drier.
4. Heavy 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.

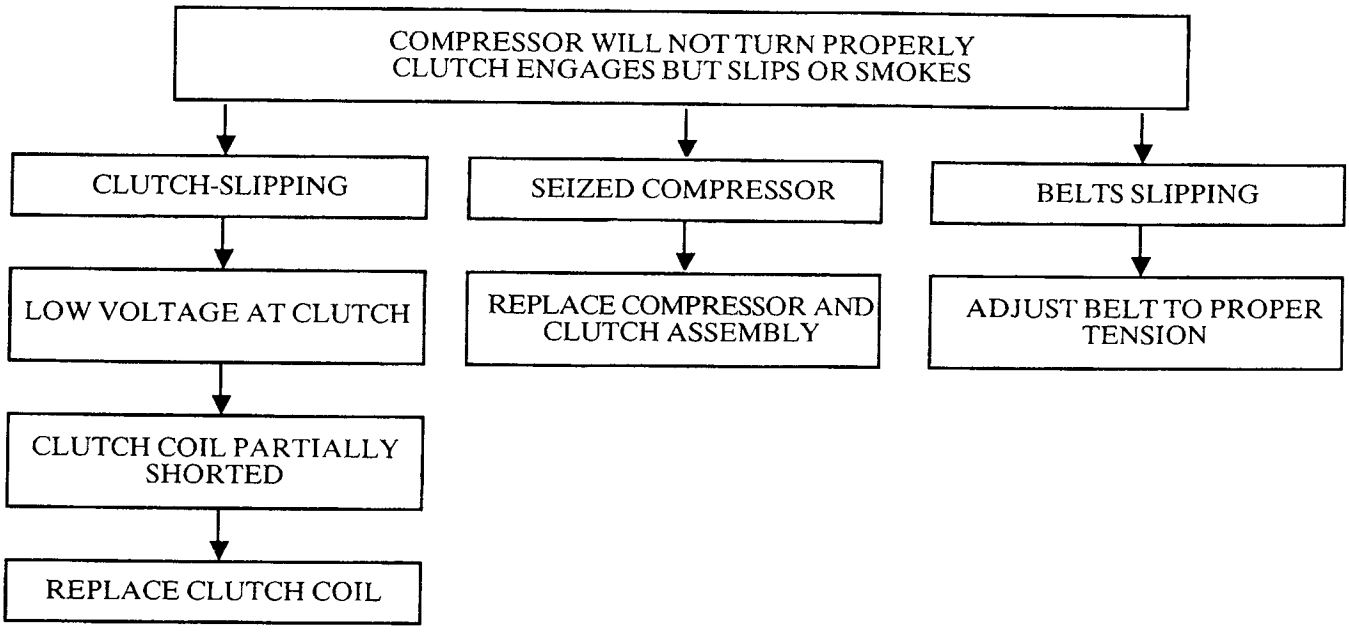
Type of Weather	Evaporator Air Temp °F (°C)	Low Side Pressure lb/in² (Kg/cm²)	High Side Pressure lb/in² (Kg/cm²)
Cool Day 70°F-80°F (21-27°C)	35-45°F (1.7-7.2°C)	15-20 (1.1-1.4)	160-200 (11.2-14)
Warm Day 80°F-90°F (27-32°C)	40-50°F (4.4-10°C)	20-25 (1.4-1.8)	190-240 (13.4-16.9)
Hot Day Over 90°F (Over 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.

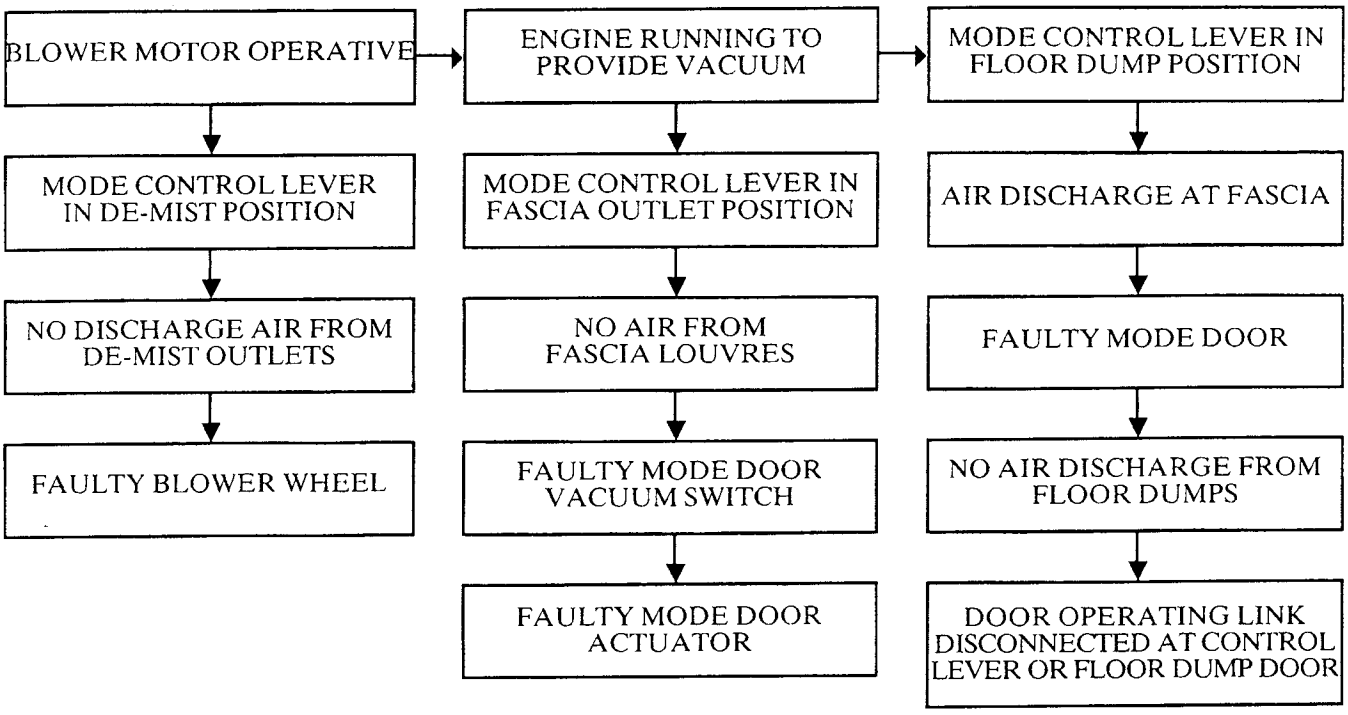
FAULT	CAUSE	REMEDY
A. HIGH HEAD PRESSURE	1. Overcharge of refrigerant.	1. Purge with bleed hose until bubbles start to appear in sight glass; then, add sufficient refrigerant gas to clear sight glass.
	2. Air in system.	2. Slowly blow charge to atmosphere. Install new drier; evacuate and charge system.
	3. Condenser air passage clogged with dirt or other foreign matter.	3. Clean condenser of debris.
	4. Condenser fan motor defective.	4. Replace motor.
B. LOW HEAD PRESSURE	1. Undercharge of refrigerant; evident by bubbles in sight glass while system is operating.	1. Evacuate and recharge the system. Check for leakage.
	2. Split compressor gasket or leaking valves.	2. Replace gasket and install new drier, evacuate, and charge the system.
	3. Defective compressor.	3. Replace compressor.
C. HIGH SUCTION PRESSURE	1. Slack compressor belt.	1. Adjust belt tension.
	2. Refrigerant flooding through evaporator into suction line; evident by ice on suction line and suction service valve.	2. Check thermobulb. Bulb should be securely clamped to clean horizontal section of copper suction pipe.
	3. Expansion valve stuck open.	3. Replace expansion valve.
	4. Compressor suction valve strainer restricted.	4. Replace compressor.
	5. Leaking compressor valves, valve gaskets and/or service valves.	5. Replace valves and/or gaskets. Install new drier, evacuate, and charge the system.
	6. Receiver/drier stopped; evident by temperature difference between input and output lines.	6. Install new drier, evacuate and charge the system.
D. LOW SUCTION	1. Expansion valve thermobulb not operating.	1. Warm thermobulb with hand. Suction should rise rapidly to 20 lbs. or more. If not, replace expansion valve.
	2. Expansion valve sticking closed.	2. Check inlet side screen. Clean if clogged. Refer to C-2 and C-3.
	3. Moisture freezing in expansion valve orifice. Valve outlet tube will frost while inlet hose tube will have little or no frost. System operates	3. Install new drier, evacuate and charge the system. periodically.
	4. Dust, paper scraps, or other debris restricting evaporator blower grille.	4. Clean grilles as required.
	5. Defective evaporator blower motor, wiring, or blower switch.	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.	1. Refer to C-2, C-3, D-2, D-3 and E.
	2. Low refrigerant charge; evident by bubbles in sight glass.	2. Refer to B-1 and E.
	3. Compressor not pumping.	3. Refer to B-2 and B-3.
G. COMPRESSOR BELT	1. Belt tension.	1. With tension gauge adjust to 100 lbs. (45 kg); or tighten until depression of about ½ inch (1,25 cm) occurs across longest span.
	2. Excessive head pressure.	2. Refer to A-1 through A-4 and C-6.
	3. Incorrect alignment of pulleys or worn belt not riding properly.	3. Repair as needed.
	4. Nicked or broken pulley.	4. Replace pulley.
	5. Frozen compressor.	5. Replace compressor.
H. ENGINE NOISE AND/OR VIBRATION	1. Loose or missing mounting bolts.	1. Repair as necessary.
	2. Broken mounting bracket, idler bracket, or brace.	2. Replace defective part.
	3. Loose flywheel or clutch retaining bolt.	3. Repair as necessary.
	4. Rough idler pulley bearing.	4. Replace bearing.
	5. Bent, loose, or improperly mounted engine drive pulley.	5. Repair as necessary.
	6. Incorrect installation of clutch bearing seal.	6. Replace bearing.
	7. Insecure mountings of accessories: generator, power steering, air filter, etc.	7. Repair as necessary.
	8. Excessive head pressure.	8. Refer to A-1, A-2, A-3, A-4 and C-6.
	9. Incorrect compressor oil.	9. Refer to Compressor Oil Level Check.

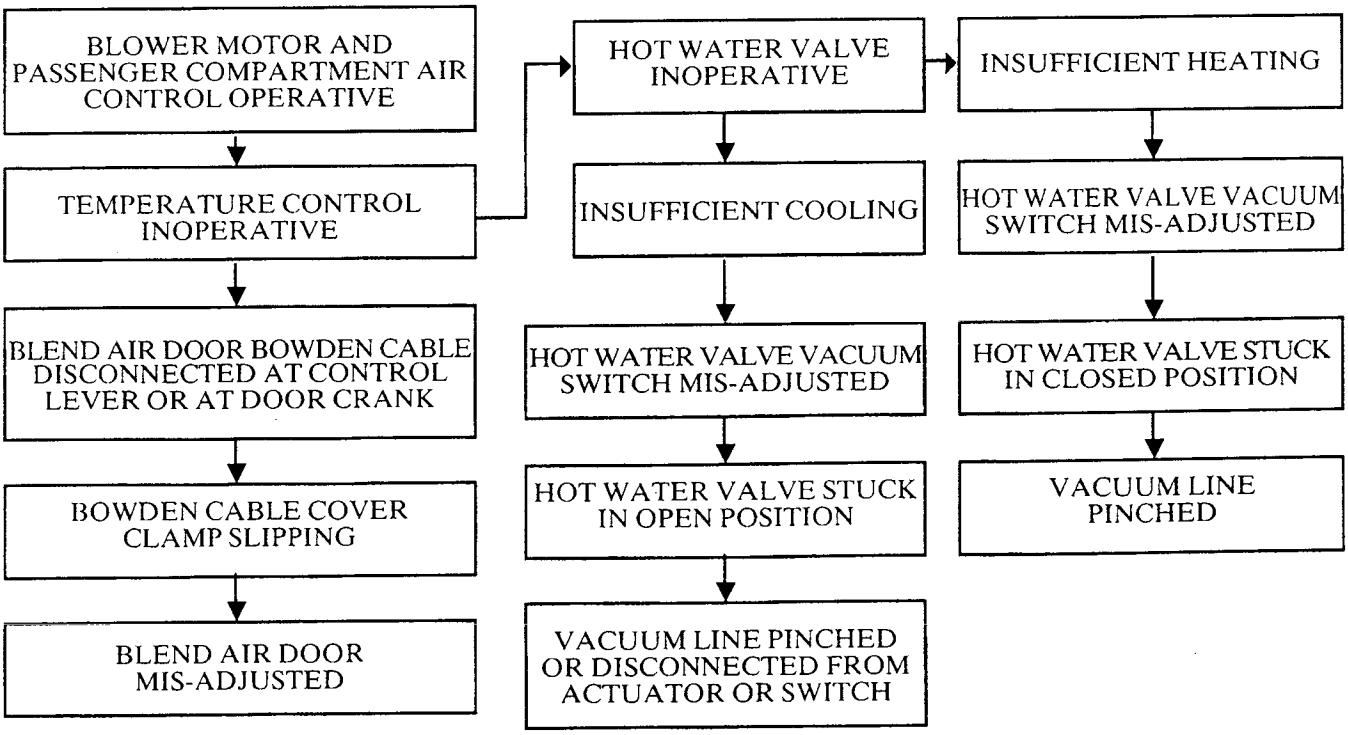
COMPRESSOR AND CLUTCH DIAGNOSIS





MECHANICAL
AIR CONDITIONER BLOWER MOTOR AND CONTROL SYSTEM DIAGNOSIS





CHARGING AND TESTING EQUIPMENT

Connecting the gauge set

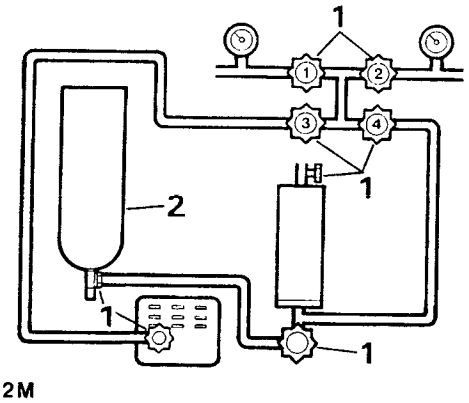
NOTE 1: There are two methods of connecting the charging and testing equipment, depending on the operation to be carried out. The method described for 'evacuating or charging with liquid refrigerant' also applies to 'pressure test' and 'compressor oil level check' operations.

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.

NOTE: The boxed instructions in the following procedure refer to compressors with STEM type valves. All other instructions refer to SCHRADER type valves.

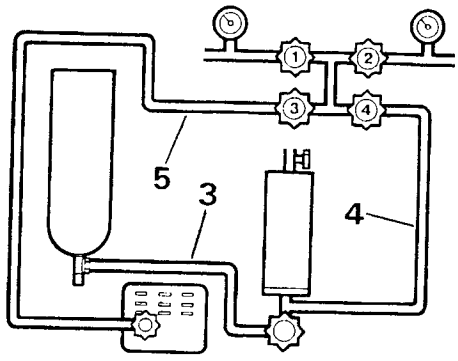
Fitting

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 (25 lb) drum of refrigerant upside down on the support at the rear of the charging equipment, and secure with the strap.



ST 1392M

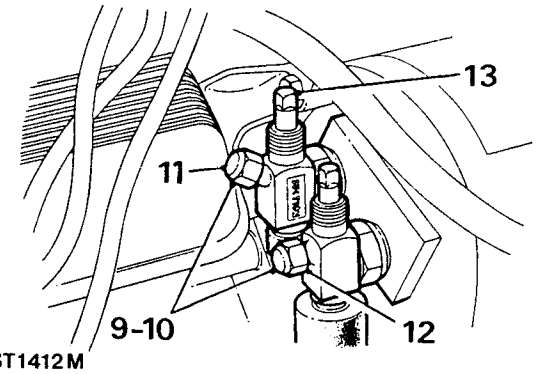
3. Connect the hose from the bottom of the charging cylinder to the refrigerant drum valve.
4. Connect the hose between the bottom of the charging cylinder and the refrigerant control valve (No. 4).
5. Connect the hose between the vacuum pump valve and the vacuum control valve (No. 3).



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

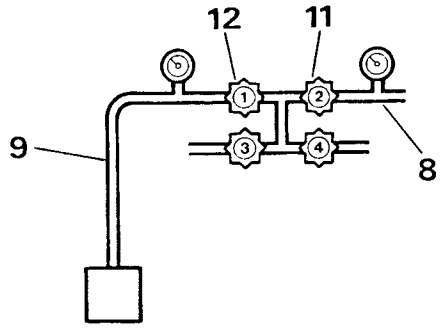
NOTE: The air conditioning refrigeration system contains 'Refrigerant 12' under pressure, and before any component is disconnected or removed, the system must be discharged of all pressure.
Refrigerant 12 evaporates so rapidly at normal atmospheric pressures and temperatures that it tends to freeze anything 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

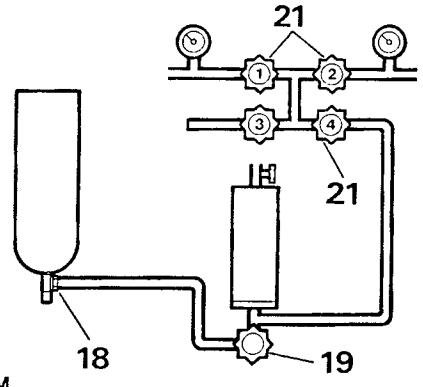
13. Measure the amount of oil discharged from the system so that an equal amount of new oil can be returned to the system during the charging operation. Discard the old oil.
14. When the gauge pressure is below 50 psi, slowly open the valve No. 1 to maintain refrigerant flow.
15. When the pressure has 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 (0.5 lb) 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.



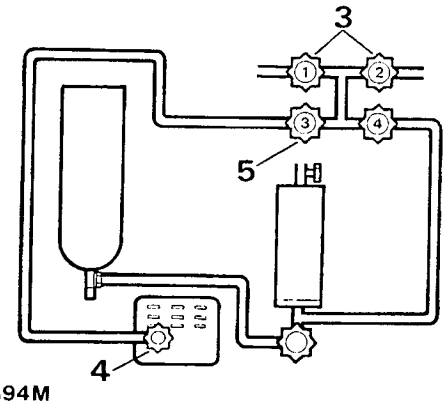
ST 1414M

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.

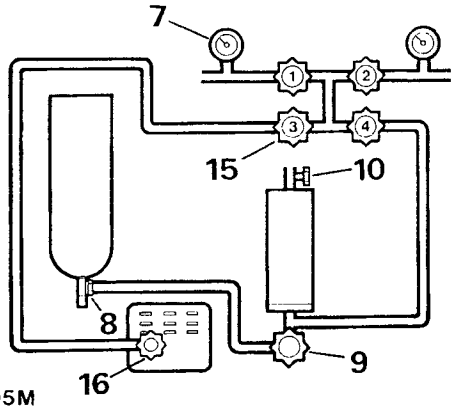


ST 1394M

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 (1 in) Hg per 300 m (1000 ft). The following chart provides a guide to the various gauge readings at differing altitudes, for the same 10 mm (0.4 in) 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 (26 in) 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 1,0 kg (2.2 lb) 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 (26 in) 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.

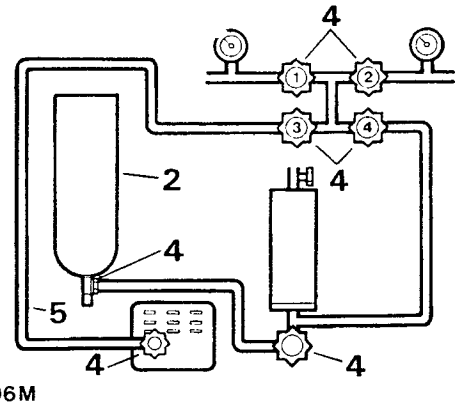


ST 1395M

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.

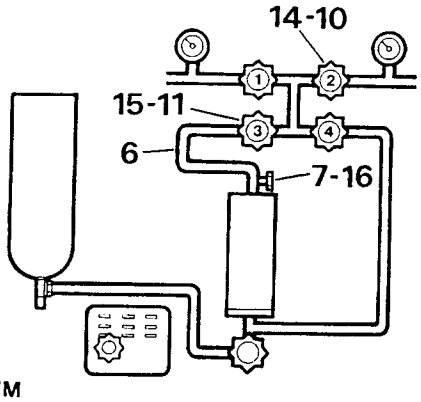
1. Fit a new liquid receiver/drier, as detailed under the heading "Receiver/Drier".
2. Ensure that a full drum of refrigerant is fitted on the charging and testing equipment.
3. Fit the charging and testing equipment as previously described for evacuating and evacuate the air conditioning system, allowing 0,25 to 0,45 kg (½ to 1 lb) 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 (½ to 1 lb) of refrigerant will enter the system.
12. Allow the dry refrigerant introduced into the system to remain for 10 minutes.

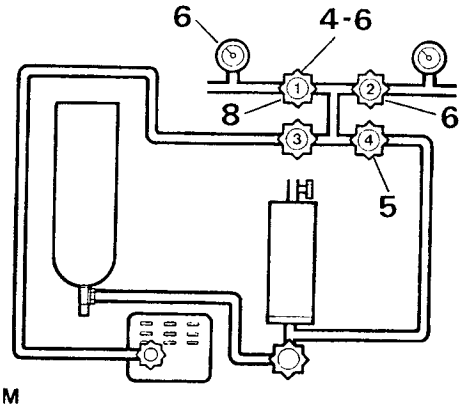
13. Crack the suction valve charging line at the service port on the compressor to allow an escape of refrigerant, at the same time observing the sight glass in the charging cylinder. A slight drop in the level should be allowed before closing the connection at the compressor.
14. Close the high pressure 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.

6. If the full charge of 1,0 kg (2.2 lb) 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 40 psi.
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 of 1,0 kg (2.2 lb) 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.

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 1,0 kg (2.2 lb) 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.

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

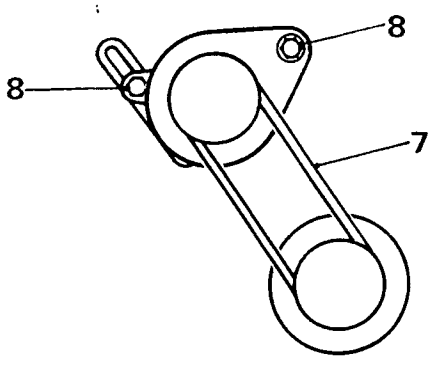
Removal

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.
3. Remove the caps from the compressor service valves and connect the gauge set for evacuating.
4. Evacuate the system as previously described.
5. Open fully (turn anti-clockwise) the compressor service valves and disconnect the gauge set. Cap all pipe and valve connections to prevent dirt or moisture entering the system.
6. Remove the electrical connections to the compressor.

4-cylinder Petrol only

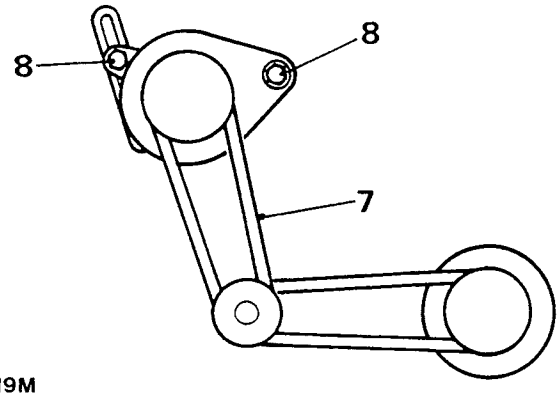
7. Slacken all the Compressor adjustment fixings and remove the drive belt from the compressor.
8. Remove the adjusting and pivot fixings and the compressor from retaining bracket.

Diesel model



ST1418M

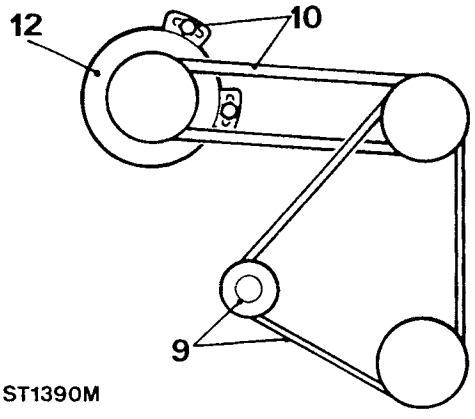
Petrol model



ST1419M

V8 models only

9. Release the jockey wheel adjuster to enable the front drive (fan) belt to be removed.
10. Release the tensioner on the compressor drive belt.
11. Remove the fixing bolt and swivel the compressor and bracket assembly to expose the bolt which is securing the bracket.
12. Remove the bolt and lift the compressor and bracket clear and place on a bench.
13. Whilst supporting the compressor, remove the five bolts holding the compressor to the brackets.



ST1390M

All engines

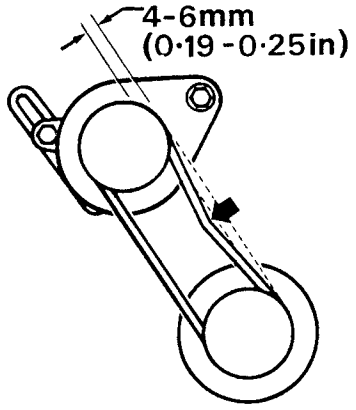
14. No servicing is recommended to the compressor, therefore a new unit must be fitted.
15. Reverse procedure as appropriate 13 to 9 and 6 to 3 for V8 models or 8 to 3 for 4-cylinder models noting the procedure for adjusting the compressor drive belts.

Refitting

Drive belt adjustment

Diesel only

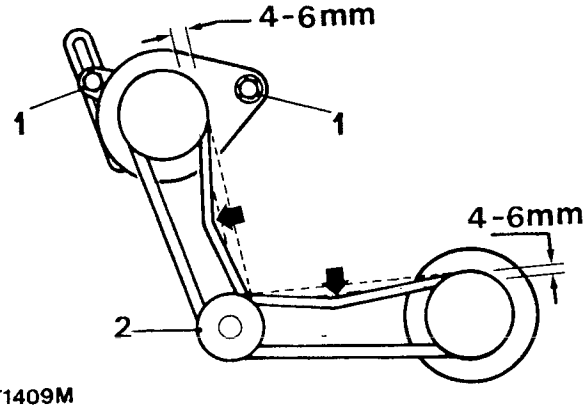
16. Ensure all adjustment bolts associated with the compressor are slack.
17. Alter the position of the compressor to provide a belt tension of 4-6 mm (0.19-0.25 in). Secure all compressor adjustment bolts and recheck the tension.



ST1408M

4-cylinder Petrol only

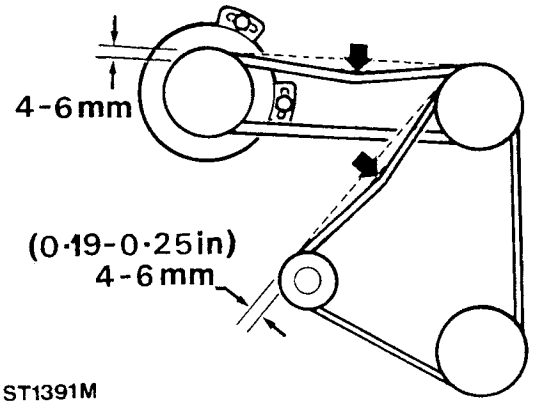
18. Ensure all adjustment bolts associated with the compressor (1) and the lower pulley pivot fixing (2) are slack.
19. Adjust the position of the lower pulley to give a belt tension of 4-6 mm (0.19-0.25 in).
20. Tighten the pivot bolt and recheck the tension.
21. Alter the position of the compressor to provide a belt tension of 4-6 mm (0.19-0.25 in).
22. Secure all compressor adjustment bolts and recheck the tension.



ST1409M

V8 Petrol only

23. Ensure all adjustment bolts associated with the compressor are slack.
24. Alter the position of the compressor to provide a belt tension of 4-6 mm (0.19-0.25 in). Secure all compressor adjustment bolts and recheck the tension.
25. Ensure the jockey pulley adjustment bolts are slack.
26. Alter the position of the jockey pulley to give a belt tension of 4-6 mm (0.19-0.25 in). Secure the adjustment bolts and recheck tension.

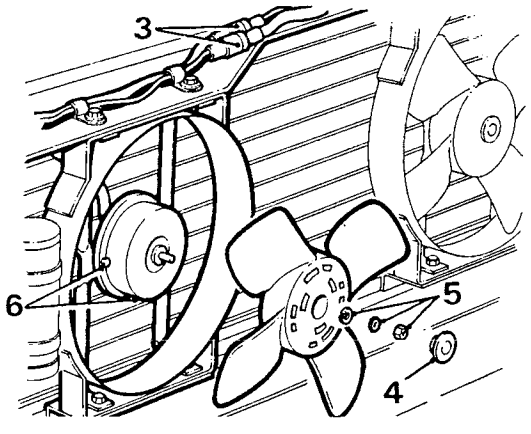


ST1391M

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.



ST1401M

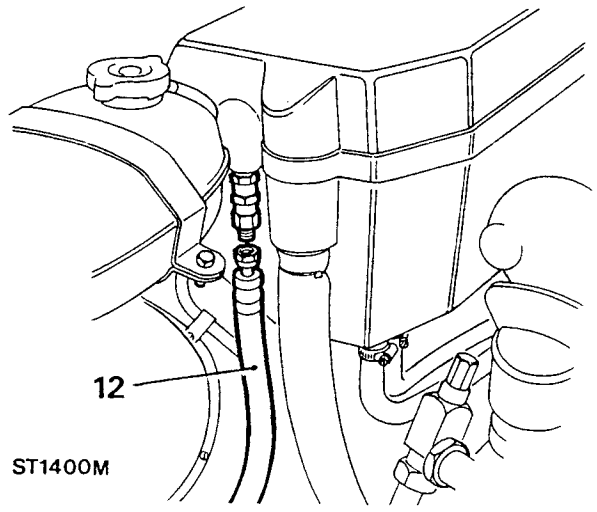
Refitting

7. Reverse procedures 6 to 1 ensuring the fan supply wiring is routed and securely clipped so that the wiring does not foul the fan blades.

CONDENSER AND RECEIVER/DRIER

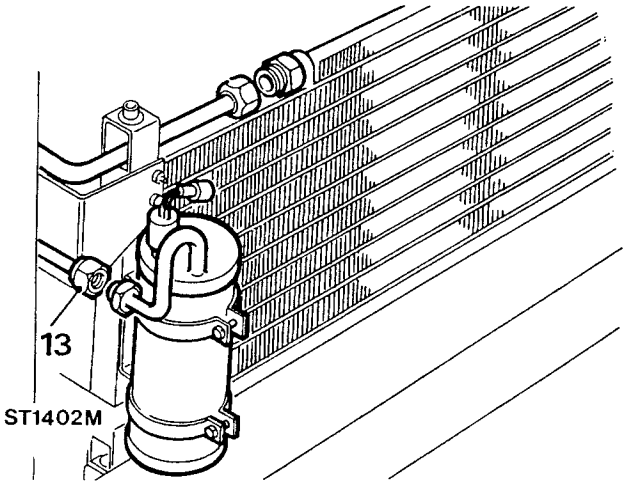
Removal

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.



NOTE: L.H. steering vehicle illustrated on R.H. steering vehicles the high pressure hose is on the side of the evaporator unit facing the engine.

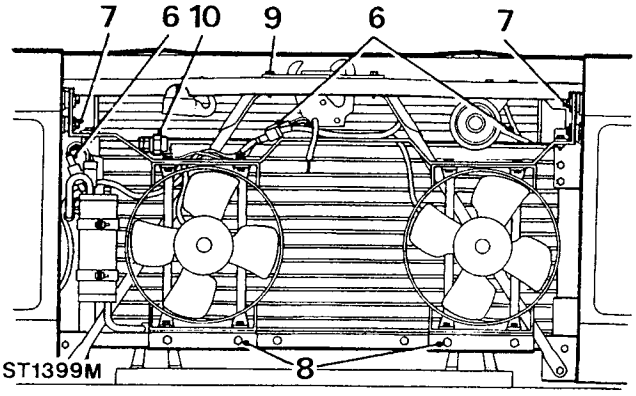
13. Release the high pressure pipe from the receiver/drier, cap the pipe end connections.



14. Release both air conditioning pipes from the condenser extension plate. Lift the condenser clear.

Condenser removal only

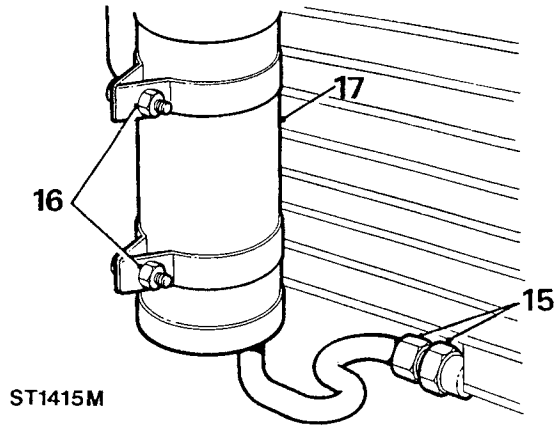
10. Release the top air conditioning hose and cap the ends to prevent moisture and dirt entering the system.



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.

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 the 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 17 to 15 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.
    Connect and tighten the air conditioning hose to the top of the condenser. Use two spanners on each union.
21. Refit the condenser to the bottom bracket.
22. Place the bonnet striker support plate into position, do not secure at this stage.
23. 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.
24. Secure the steady rods and the lower condenser mounting bracket. Do not tighten the bolts at this stage. Reconnect the top horn electrical leads.
25. Loosely fit the four bolts and distance washers which support the bonnet striker support plate and fan cowling to the wing sides.
26. Tighten the lower condenser bracket bolts.
27. 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.
28. Tighten the four nuts and washers which secure the fan cowling mounting.
29. Reconnect the electrical wiring for the fan assemblies, horn and receiver/drier.
30. Recheck the security of all fixings.
31. Refit the front nose and grille assembly and secure.
32. Evacuate, sweep and charge the air conditioning system as previously described.

EVAPORATOR — LH steering models

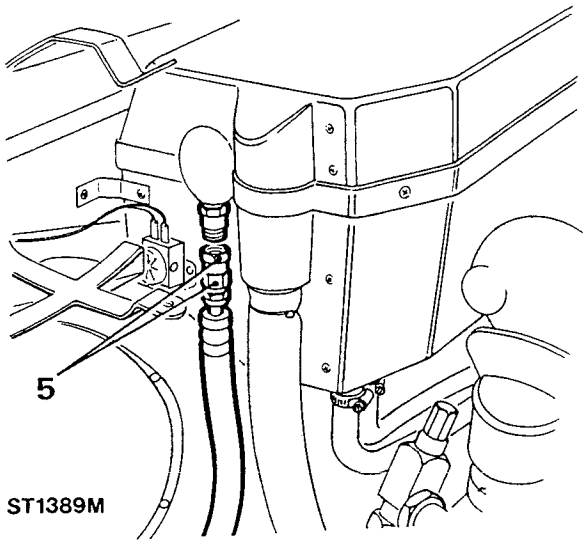
NOTE: It is only necessary to evacuate the air conditioning system when removing the evaporator matrix or to change the expansion valve.

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

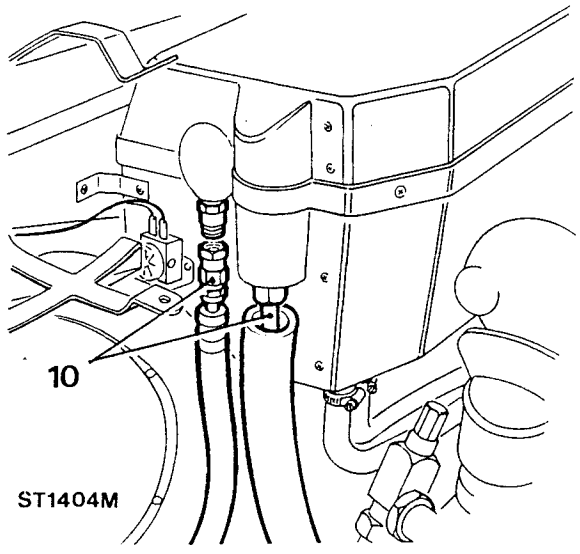
3. Remove the caps from the compressor service valves and close (turn clockwise) fully.
4. Disconnect the low pressure valve from the compressor and cap both ends to prevent dirt or moisture entering the system.
5. Using two suitable spanners remove the high pressure pipe from the evaporator side. Cap both ends to prevent dirt or moisture entering the system.



Evaporator matrix and expansion valve only

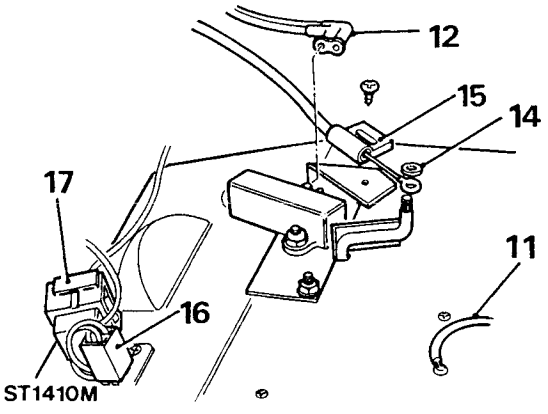
6. Remove the caps from the compressor service valves and connect the gauge set for evacuating.
7. Evacuate the air conditioning system as previously described.
8. Open the compressor service valves and disconnect the gauge set. Cap all pipes and gauge connections to prevent dirt or moisture entering 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.

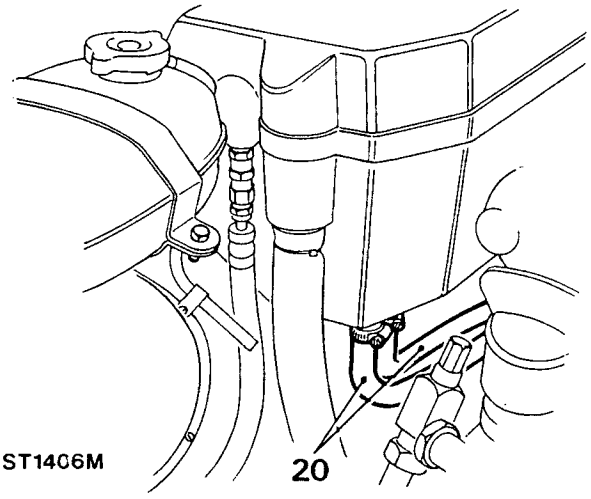


Evaporator unit

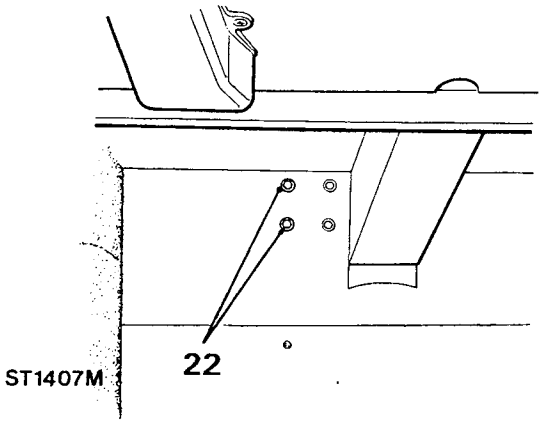
11. Disconnect the electrical leads feeding the compressor clutch cycling switch.
12. Detach the vacuum pipes from the water valve switch.
13. Remove the fixings securing the water valve switch and withdraw it.
14. Remove the clip and cable connection from the evaporator heater flap rod. Use a new clip on reassembly.
15. Release the nylon cable retainer.
16. Detach the heater electric supply lead at the connecting block.
17. Remove the relay from its connecting block revealing one self tapping screw.



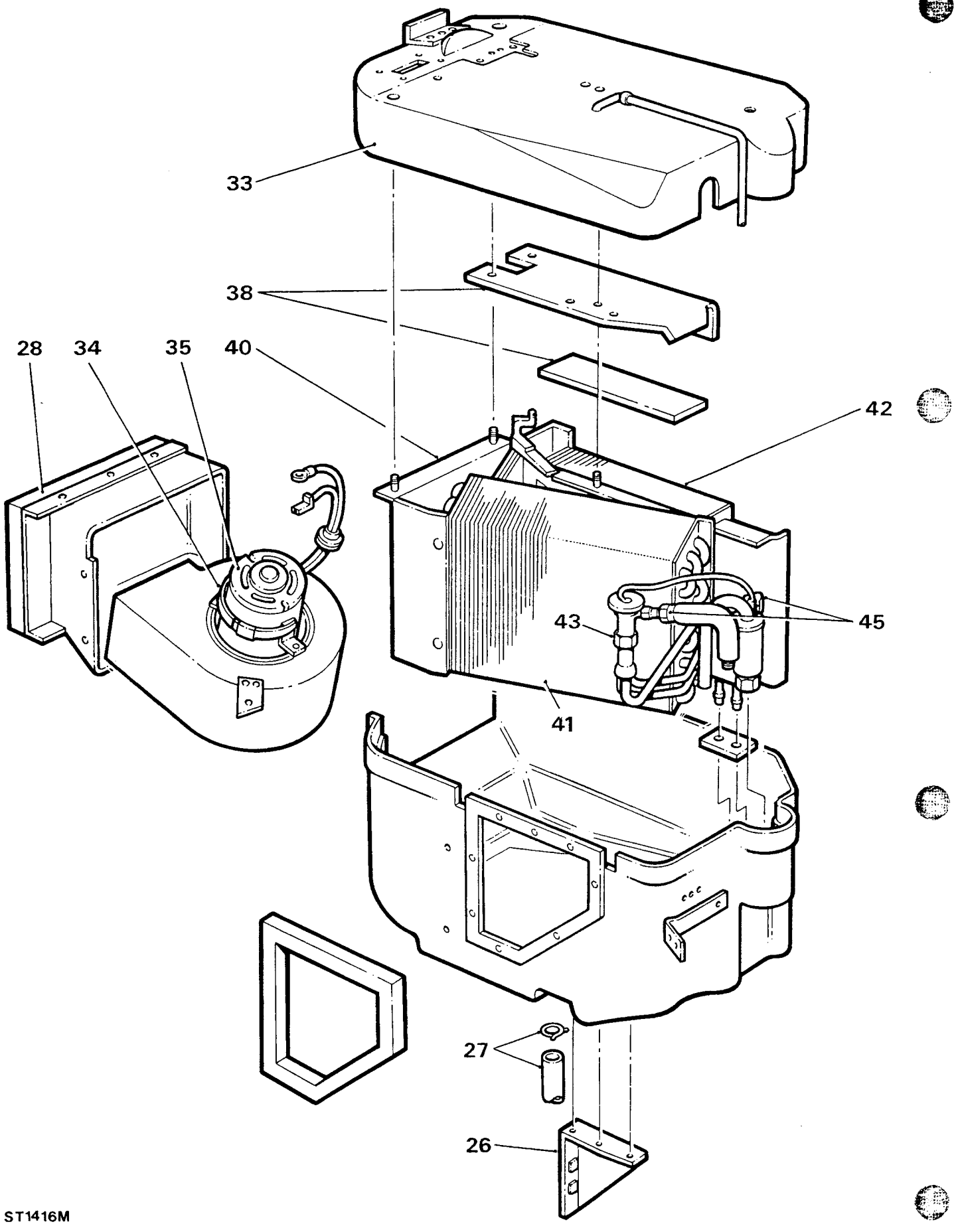
18. Remove the screw, releasing the relay connector block.
19. All wiring on the top of the evaporator is now disconnected with the exception of the earth lead, this is disconnected when the evaporator mounting block is removed.
20. Using suitable pipe clamps, clamp the inlet and outlet coolant pipes 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 upper evaporator mounting block bolts fitted to the engine bulkhead. This also releases the earthing leads.
24. Remove the bolt securing the angled bracket at the front of the evaporator casing.



ST1416M

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.
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

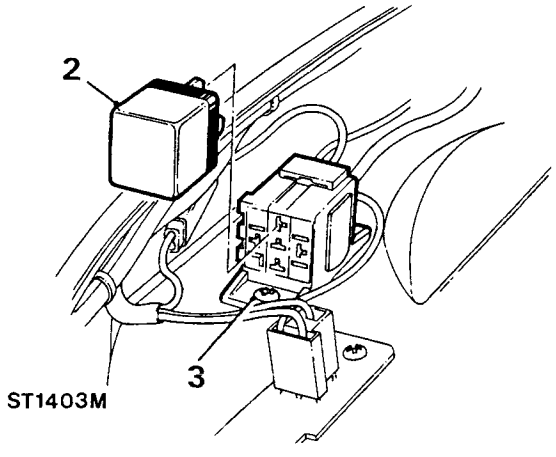
47. Reverse procedures 46 to 11 noting that all threads, unions, 'O' rings are coated with refrigerant oil prior to fitting.

NOTE: Depending upon which unit has been refitted reverse the appropriate procedures:
Heater Matrix or Blower Motor 5 to 3
Evaporator Matrix or Expansion Valve 10 to 6 and then charge the air conditioning system as previously described with Refrigerant 12.

RESISTOR BLOCK

Removal

1. Stop the engine and secure the bonnet in an open position.
2. Detach the blower motor wiring connector.
3. Remove the self tapping screw and lift the resistor block out.



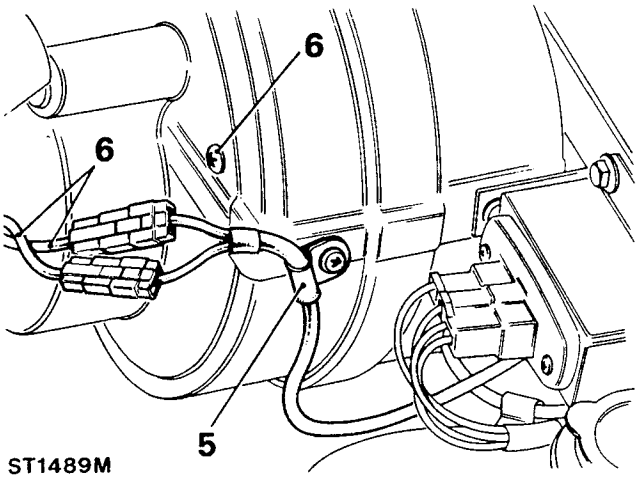
Refitting

4. Reverse procedures 3 to 1.

EVAPORATOR BLOWER MOTOR — RH Steering models

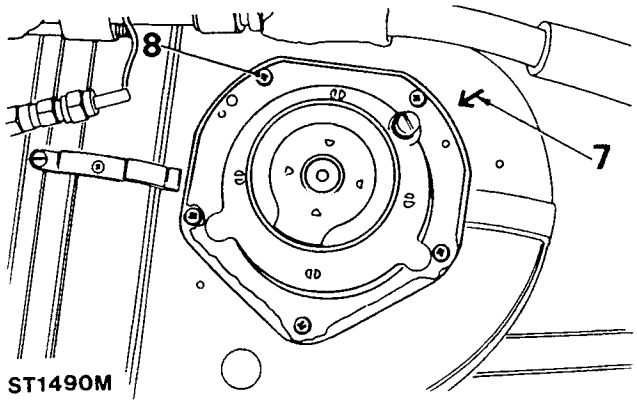
Removal

1. Open and secure the bonnet.
2. Release the plastic tie retaining the carburetter breather pipe to the right hand air intake elbow.
3. Remove the pulsair pipe connected to the air intake elbow.
4. Remove the right hand air intake elbow.
5. Disconnect the clip and blower motor wiring.
6. Release the blower motor cover fixings and separate the casing slightly to allow the earth and Lucar connectors to be released.



ST1489M

7. Remove the cover ensuring that a mark is made on the casing to indicate the correct positioning of the blower motor when refitting.
8. Release the five self-tapping screws and withdraw the blower motor and impeller. It may be necessary to move the low pressure air conditioning pipe aside to provide sufficient clearance.



ST1490M

9. Remove the centre nut on the impeller and carefully ease the impeller from the blower motor shaft.

Refitting

10. Reverse procedures 9 to 1 ensuring that all seals are replaced.

Evaporator remove and refit — R.H. steering models

For removal of the blower motor only, see section "Evaporator Blower Motor".

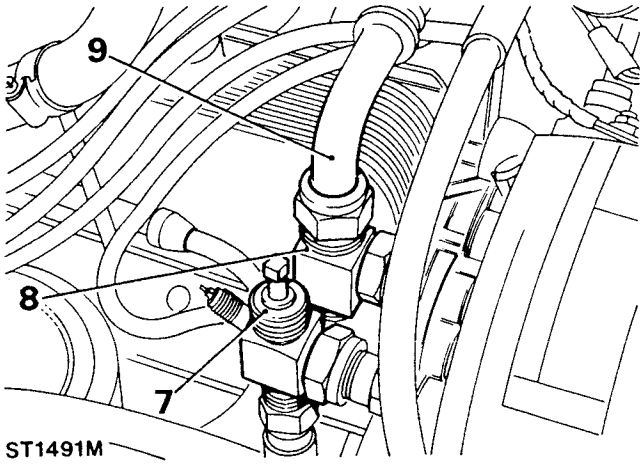
NOTE: It is only required to evacuate the air conditioning system when removing the evaporator matrix or changing the expansion valve.

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.
3. Disconnect the battery.
4. Unscrew the radiator drain-plug and partially drain the radiator.
5. Remove the air-cleaner.
6. Remove the caps from the compressor service valves.

Heater matrix only

7. Fully close (turn clockwise) the high pressure valve.
8. Fully open (turn anti-clockwise) the low pressure valve.
9. Slowly disconnect the low pressure pipe from the compressor rotor lock adaptor plate.



ST1491M

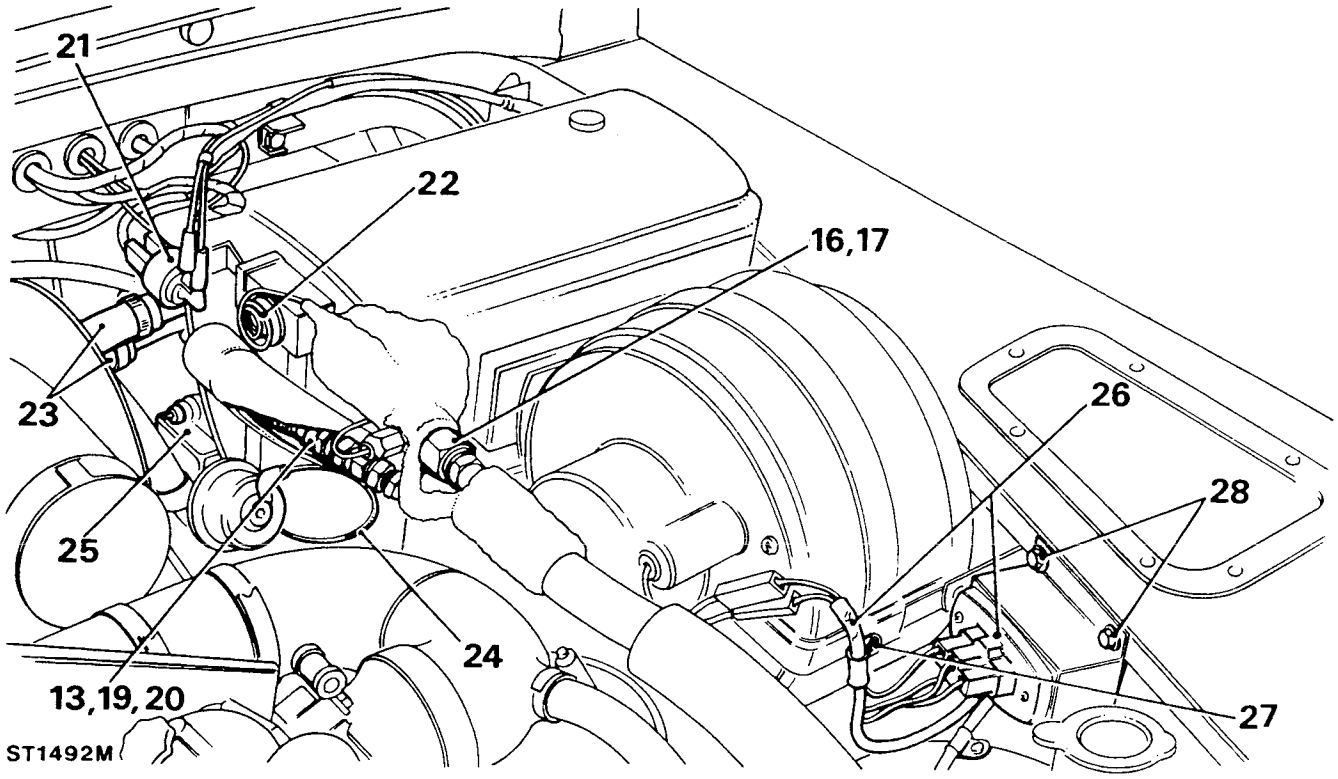
10. Remove the plastic 'O' ring from the rotor lock seal. Cap and seal both unions to prevent dirt or moisture entering the system.
11. Release the plastic tie securing the low pressure pipe to the upper engine bracket.
12. Remove the two plastic ties, securing the insulation cover on the high pressure pipe and remove the cover.
13. Whilst supporting both unions with suitable spanners, unscrew the high pressure air conditioning pipe from the evaporator.

Evaporator matrix and expansion valve only

14. Evacuate the air conditioning system as previously described.
15. Open (turn anti-clockwise) the compressor service valves and disconnect the gauge set. Cap all pipes and gauge connections to prevent dirt or moisture entering the system.
16. Remove the insulating cover on the low pressure pipe.
17. Whilst supporting both unions with suitable spanners, unscrew the low pressure air conditioning pipe from the evaporator.
18. Cap both ends to prevent dirt or moisture entering the system.
19. Remove the two plastic ties, securing the insulation cover on the high pressure pipe and remove the cover.
20. Whilst supporting both unions with suitable spanners, unscrew the high pressure air conditioning pipe from the evaporator.

Evaporator unit

21. Remove the self tapping screw securing the air control flap solenoid.
22. Disconnect the two 'Ronco' thermostat wires.
23. Disconnect the two heater hoses from the side of the evaporator unit.
24. Remove the vacuum pipe from the water valve switch.
25. Remove the clip and cable connection from the evaporator air flap rod. Use a new clip on reassembly.
26. Disconnect the blower motor wiring connections.
27. Remove the screw retaining the blower motor wiring tot he blower motor housing.
28. Remove the two bolts securing the blower motor resistor block to the engine compartment.
29. Remove the bolt securing the front support bracket to the blower motor housing.
30. From inside the vehicle remove the front passenger carpet and five self tapping screws which retain the toe-box cover.
31. Release the four bottom mounting bracket bolts, ensuring that the spacing washers from the two innermost bolts are retrieved from the engine bulkhead side.
32. From inside the engine compartment remove the two 13 mm upper evaporator mounting bracket bolts fitted to the engine bulkhead.
33. Lift the evaporator clear of the vehicle and place on a bench with the blower motor cover facing up.
34. Turn the evaporator unit around and remove the fixings retaining the blower motor housing duct.
35. Remove the "Ranco" thermostat from the top of the unit.
36. Remove the seven self-tapping screws securing the top and bottom halves of the unit together.
37. Remove the eight screws from the right hand side of the unit.
38. Peel back the sponge pad on the outlet duct to expose the last retaining screw. Remove the screw.
39. Remove the two screws on the top of the unit.
40. Remove the joint sealant around the seam and separate the two halves of the evaporator cover assembly.
41. Remove the heater matrix from the evaporator casing.



Evaporator matrix and Expansion valve only

42. Release the screws attached to the blower motor retaining plate and remove the plate.
43. Remove the blower motor inner housing.
44. Remove the bleed-pipe retaining nut from the low pressure pipe.
45. Remove the spring clip retaining the expansion valve sensor pipe to the low pressure pipe and remove the expansion valve and high pressure pipe.
46. Unscrew the high pressure pipe from the expansion valve.
47. Seal and cap all pipes and connections to prevent dirt or moisture entering the system. Discard all 'O' rings, which are renewed on refitting.
48. Release the two nuts adjacent to the dump valve.
49. Remove the two evaporator mounting screws from each side of the casing.
50. Release the two upper evaporator mounting bracket screws and pull the bracket away from the evaporator.
51. Lift the evaporator matrix from the casing with the two side plates and place on a bench.

Refitting

52. Reverse procedures 51 to 21, ensuring that all threads, unions and 'O' rings are coated with refrigerant oil prior to fitting. Discard all old 'O' rings and renew on refitting. When reversing procedure 31, ensure that the spacing washers are fitted to the two innermost bolts.

NOTE: Depending upon which component has been removed, reverse the appropriate procedure as follows:
Evaporator matrix and expansion valve 20 to 2
Heater matrix 13 to 2.

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.

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.

TEST EQUIPMENT

A range of 'Fast Check' testers is available to provide a means of fast effective diagnosis of faults in electronic systems currently fitted to Land Rover and Range Rover vehicles.

It is essential that operators familiarise themselves with the components of the system to be checked and the instruction for the relevant fast check test before commencing diagnosis.

OVERHAUL V8 ENGINE DISTRIBUTOR

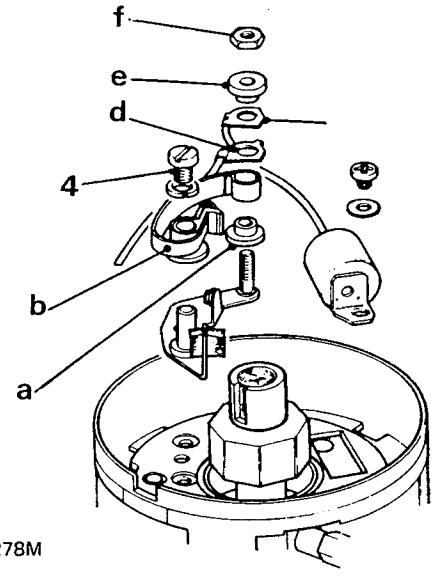
DISMANTLE

1. Unclip and remove the distributor cap.
2. Withdraw the rotor arm.
3. Remove the contact breaker spring anchor nut and lift off:
   a) the top-half of insulation bush
   b) the low tension lead (Black)
   c) the capacitor lead (Orange).
4. Remove the contact breaker retaining screw, plain and spring washer and remove contact set assembly.
5. Remove the complete insulation bush.
6. Remove the capacitor.
7. Remove the dwell-angle adjuster screw and spring.
8. Remove the two screws and withdraw the vacuum unit and rubber joint washer.
9. Remove the three screws and lift off the centrifugal advance cover-plate with the cover plate earth lead.
10. Punch out the drive pinion roll-pin and remove the drive pinion and tab washer.

INSPECTION

11. Examine the parts for wear and replace as necessary. Renew the capacitor and contact set. Examine the distributor cap for cracks and tracking. Renew the cap if the electrodes are worn and burned. If the cap is serviceable fit a new H.T. pick-up brush and spring. Renew the rotor arm if cracked and if the metal contact is burnt and worn. Check the low tension lead for continuity and renew if faulty. Check the vacuum unit diaphragm by withdrawing the air and placing a finger over the air pipe to determine if the vacuum is being held. Renew the unit if unsatisfactory.

15. Fit the dwell angle adjustment screw and spring.
16. Fit the capacitor.
17. Fit the contact breaker set ensuring that the small post protruding from below the contact set locates through the hole in the cover plate into the hole in the end of the vacuum unit actuating lever. Secure with the screw, plain and spring washers.
18. Assemble the contact breaker spring insulating bushes and electrical leads, as illustrated in the following sequence:
    a) lower bush
    b) spring
    c) low tension lead
    d) capacitor lead
    e) top bush
    f) and secure with the anchor spring nut.
19. Apply a few drops of engine oil to the distributor cam lubrication pad.



ST1278M

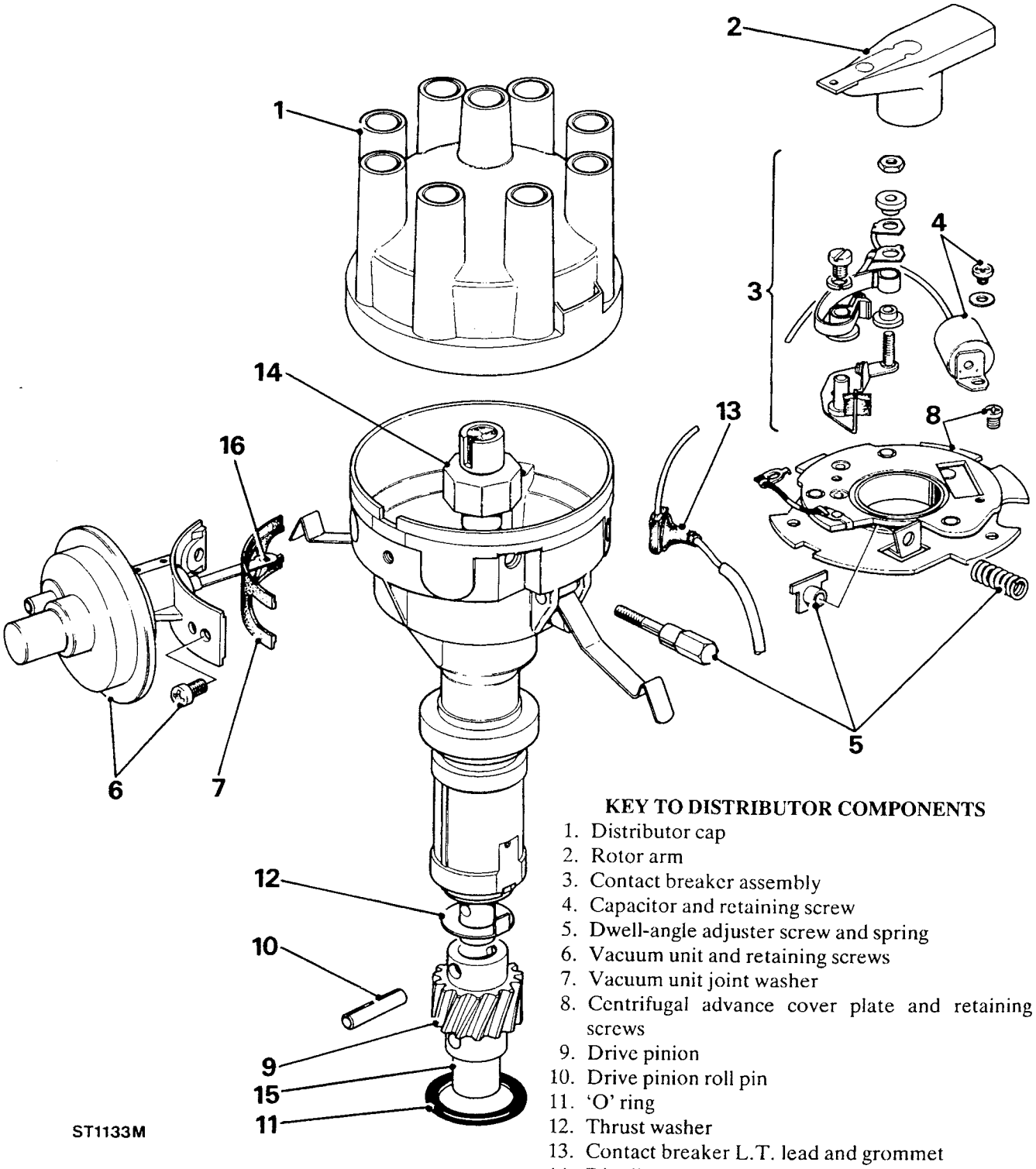
ASSEMBLE

When assembling, smear the centrifugal cover-plate and vacuum lever with Chevron SR1 grease or equivalent.

12. Fit the tab washer and drive pinion and secure with a new roll pin.
13. Fit the centrifugal advance cover-plate and secure with the three screws noting that one screw is used to retain the centrifugal advance cover plate earth lead.
14. Fit the vacuum unit and rubber joint washer and ensure that the operating lever is inserted between the two plates which make up the centrifugal cover plate assembly.

20. Using a feeler gauge, and the dwell angle adjuster, set the contact breaker points to a nominal clearance of 0,35 to 0,40 mm (0.014 to 0.016 in). Once the distributor is fitted to the engine the dwell angle must be adjusted to 26° to 28° using special tuning equipment.
21. Fit the rotor arm.
22. Fit the distributor cap ensuring that the H.T. pick-up brush moves freely in its location.
23. When fitting the distributor to the engine insert a new 'O' ring seal into the body groove.

V8 ENGINE DISTRIBUTOR
(Fixed contact)



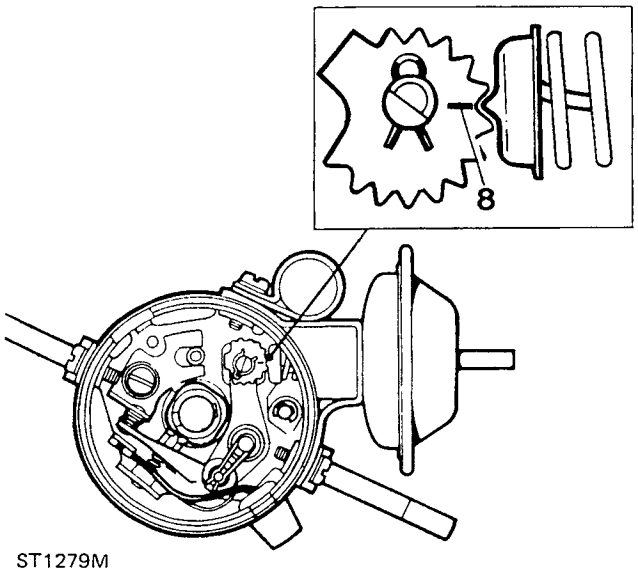
KEY TO DISTRIBUTOR COMPONENTS

1. Distributor cap
2. Rotor arm
3. Contact breaker assembly
4. Capacitor and retaining screw
5. Dwell-angle adjuster screw and spring
6. Vacuum unit and retaining screws
7. Vacuum unit joint washer
8. Centrifugal advance cover plate and retaining screws
9. Drive pinion
10. Drive pinion roll pin
11. 'O' ring
12. Thrust washer
13. Contact breaker L.T. lead and grommet
14. Distributor cam
15. Distributor drive dog
16. Vacuum unit actuating lever

OVERHAUL DUCELLIER DISTRIBUTOR — four cylinder engine

DISMANTLE

1. Remove the distributor from the engine.
2. Remove the distributor cap.
3. Remove the rotor arm.
4. Remove the dust cover.
5. Remove the felt pad from the top of the rotor.
6. Remove the two screws retaining the condenser and vacuum unit and remove the condenser lead from the connector block.
7. Remove the retaining clip from the eccentric 'D' post.
8. Mark the position of the serrated cam in relation to the spring seat of the vacuum operating link.



ST1279M

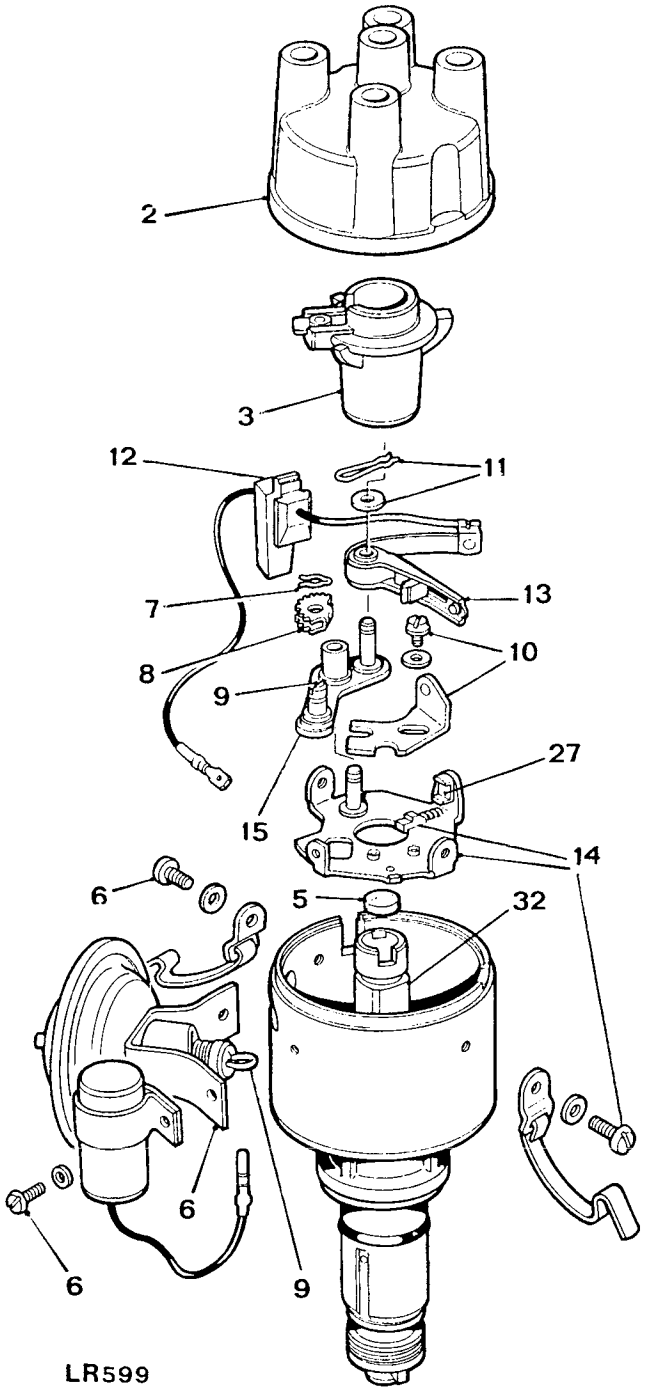
9. Disengage the vacuum operating link and serrated cam from the eccentric 'D' post and remove the vacuum unit.
10. Remove the retaining screw and withdraw the fixed contact plate.
11. Remove the retaining clip and insulation washer.
12. Release the connector block from the distributor body.
13. Lift out the moving contact complete with connector block and leads.
14. Mark the relationship of the base plate to the body and remove the retaining screw. Whilst holding the pressure pad clear of the rotor, withdraw the base plate.
15. Remove the moving contact post-plate.

INSPECTION

NOTE: The distributor drive dog is loosely retained on the drive shaft, the 'float' allows for any misalignment.

16. Examine the advance mechanism of the cam, check the shaft for excessive side play. If any of these parts are damaged or worn renew the complete distributor.
17. Examine all other components for damage or excessive wear and renew where necessary.
18. Check the distributor cover for signs of tracking or cracks and check that the pick-up brush moves freely in its holder.
19. Check the rotor arm for damage, electrode security, burning and tracking.

continued



LR599

REASSEMBLE

20. Using Retinax 'A' or equivalent grease lubricate the centrifugal weight pivot posts and lightly smear the cam pressure pad and contact pivot post.
21. Fit the pressure pad and spring to the base plate.
22. Fit the base plate to the body, lining up the marks, and secure with the retaining screw and clip on the opposite side to the vacuum unit.
23. Smear a little grease on the post and fit the moving contact post-plate to the base plate.
24. Offer up the vacuum unit to the body and fit the operating link and serrated cam to the 'D' post. Ensure that the identification marks line up — see instruction 8. Secure the assembly with the spring clip.
25. Secure the vacuum unit and condenser to the body with the remaining screw and clip.
26. Fit the fixed contact and loosely retain with the screw.
27. Fit the moving contact ensuring that the leaf spring locates in the nylon guide.
28. Fit the connector block to the body.
29. Fit the insulation washer and retain assembly with the spring clip.
30. Fit condenser lead to connector block.
31. Place the felt pad in the top of the rotor and add a few drops of oil.
32. Smear a small quantity of grease on the rotor cam.
33. Adjust the contact point gap to a datum setting of 0,43 mm (0.017 in) with a feeler gauge by turning the rotor spindle until a cam fully opens the points. Move the fixed contact plate to obtain the required gap and tighten the retaining screw.
34. Fit the distributor to the engine.
35. Fit the dust cover.
36. Fit the rotor arm and distributor cap.
37. Connect the H.T. leads to the appropriate spark plugs.

OVERHAUL LUCAS 45D4 DISTRIBUTOR — Four cylinder engine

Dismantling

1. Remove the rotor arm.
2. Extract the felt pad, if fitted, from the cam.
3. Remove the two vacuum unit retaining screws, tilt the unit to disengage the operating arm and remove the vacuum unit.
4. Push the low tension lead and grommet into the inside of the body.
5. Remove the securing screws and lift out the base plate assembly.
6. Drive out the parallel pin retaining the drive dog.
7. Remove the drive dog and thrust washer.
8. Remove the shaft complete with automatic advance mechanism and steel washer.
9. Push the moving contact spring inwards and detach the low tension connector from the spring loop.
10. Remove the screw to release the earth lead and capacitor.
11. Remove the securing screw and lift off the contact set.

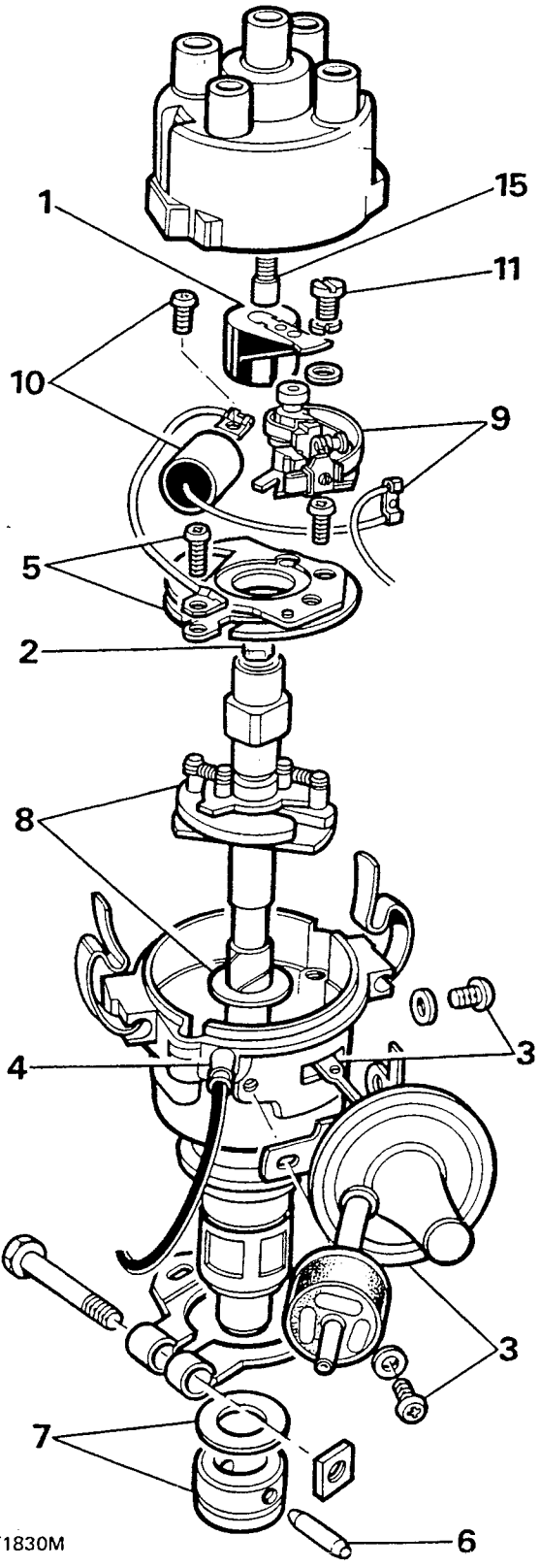
Inspection

12. Do not dismantle the advance mechanism beyond removing the control springs. If any of the moving parts or the cam are worn or damaged, renew the complete shaft assembly.
13. Check the fit of the shaft in its bearing: if the bearing allows excessive side play, renew the complete distributor.
14. Check the base plate assembly; if the spring between the plates is damaged or if the plates do not move freely, renew the assembly.
15. Check the distributor cap for signs of tracking or cracks and check that the pick-up brush moves freely in its holder.
16. Check the rotor arm for damage, electrode security, and burning or tracking.

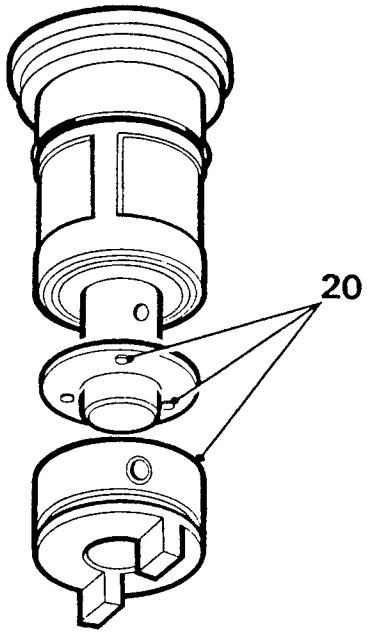
Reassembling

17. Reverse the procedure in 1 to 11, noting the following instructions.
18. Lubricate the contact pivot post with Retinax 'A' or equivalent grease.
19. Ensure that the steel washer is fitted on the shaft and lubricate the shaft with Rocol MP (Molypad).
20. Fit the thrust washer with its raised pips towards the drive dog.

continued

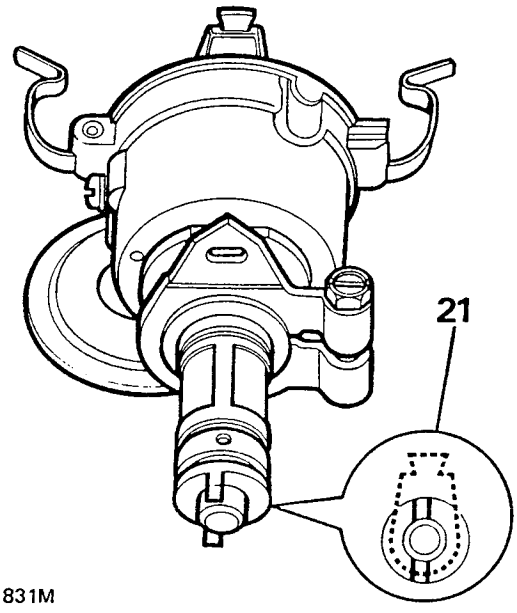


ST1830M



ST1832M

21. Fit the drive dog so that the driving tongues are parallel with the rotor arm electrode and to the left of its centre line when the rotor arm points upwards as shown.



ST1831M

22. If a new shaft is fitted it must be drilled through the hole in the drive dog using a 4.76 mm ($\frac{3}{16}$) drill.
23. During drilling, push the shaft from the cam end, pressing the drive dog and washer against the body shank.
24. Secure the pin in the drive dog by ring-punching the holes. If the shaft is new, tap the drive end to flatten the washer pips and ensure the correct end-float.
25. Set the contact points gap.

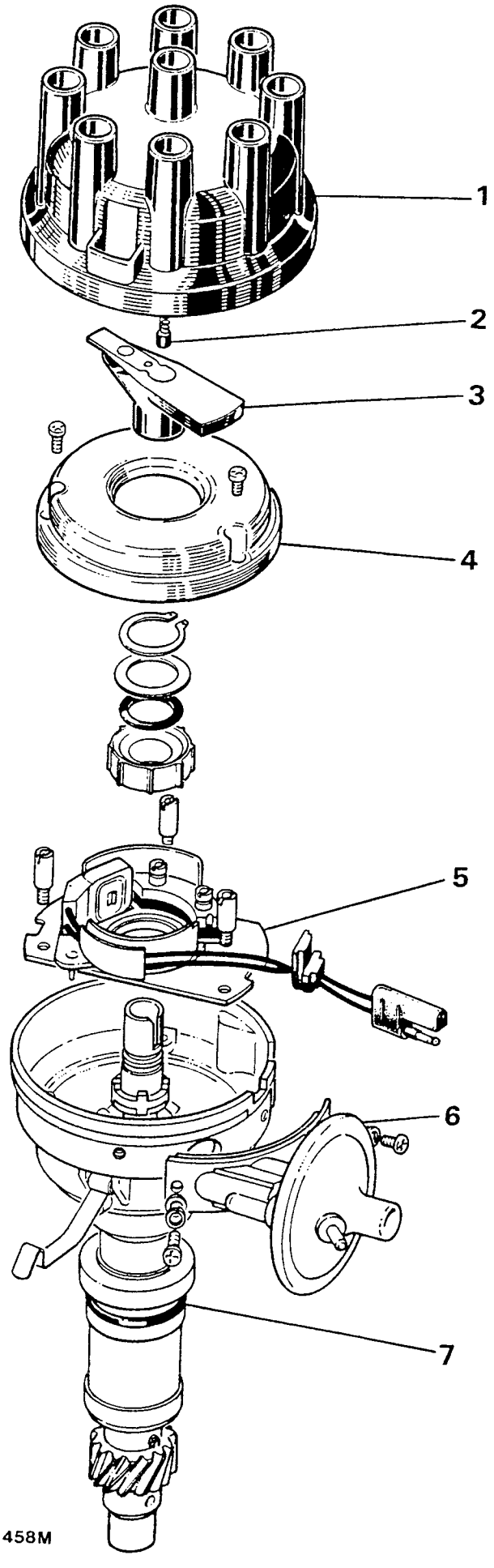
ELECTRONIC IGNITION — WITH 35DMS DISTRIBUTOR

The Lucas model 35DM8 distributor has a conventional advance/retard vacuum 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 unit fitted under the ignition coil mounted on top of the left front wing valance.

Key to illustration

1. Cap
2. HT Brush and spring
3. Rotor arm
4. Insulation cover (Flash shield)
5. Pick-up and base plate assembly
6. Vacuum unit
7. 'O' ring oil seal



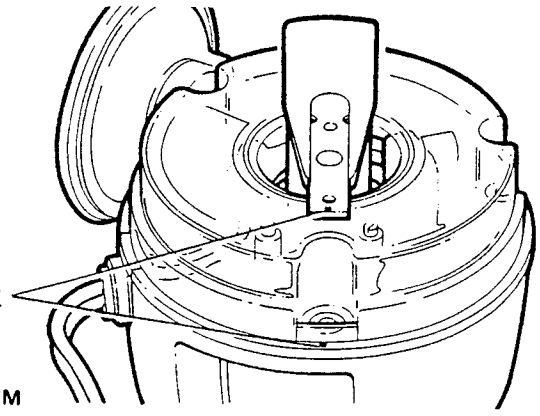
RR458M

DISTRIBUTOR — ELECTRONIC IGNITION — V8 ENGINES 35DM8

Remove and refit

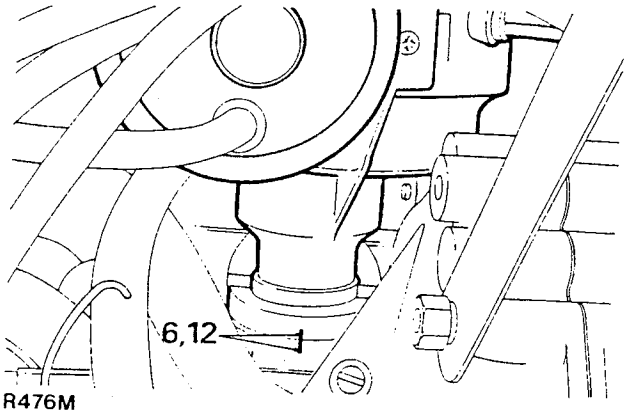
Removing

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.



RR 477M

6. Add alignment marks to distributor and front cover.



RR476M

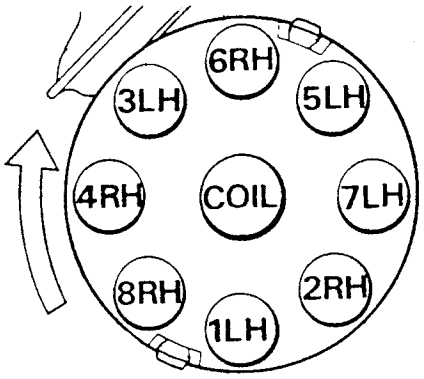
NOTE: Marking distributor enables refitting in exact original position, but if engine is turned while distributor is removed, complete ignition timing procedure must be followed.

7. Release the distributor clamp and remove 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.



RR616M

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 original 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 ignition timing as follows.
18. If, with distributor removed, engine has been turned it will be necessary to carry out the follwing procedure.
19. Set engine — No. 1 piston to static ignition timing figure (see section 05) on compression stroke.
20. Turn distributor drive until rotor arm is approximately 30° anti-clockwise from number one sparking plug lead position on cap.
21. Fit distributor to engine.
22. Check that centre line of rotor arm is now in line with number one sparking plug lead on cap.
    Reposition distributor if necessary.
23. If distributor does not seat correctly in fron cover, oil pump drive is not engaged. Engage by lightly pressing down distributor while turning engine.
24. Fit clamp and bolt leaving both loose at this stage.
25. Set the timing statically to within 2°-3° of T.D.C.
26. Connect vacuum pipe(s) to distributor.
27. Fit low tension lead to coil.
28. Fit distributor cap.
29. Reconnect battery.
30. Using suitable electronic equipment set the ignition timing.

Ignition timing

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 within 2°-3° of 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.** Refer to 'Engine Tuning Data' for ignition timing specification.

Equipment required

Calibrated Tachometer
Stroboscopic lamp

3. Couple stroboscopic timing lamp and tachometer to engine following the manufacturers instructions.
4. Disconnect the vacuum pipes from the distributor.
5. Start engine; with no load and not exceeding 3,000 rpm, run engine until normal operating temperature is reached. (Thermostat open). Check that the normal idling speed falls within the tolerance specified in table.
6. Idle speed for timing purposes must not exceed 750 rpm, and this speed should be achieved by removing a breather hose, **NOT BY ADJUSTING CARBURETTER IDLE SETTING SCREWS.**
7. 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 table.
8. Retighten the distributor clamping bolt securely. Recheck timing in the event that retightening has disturbed the distributor position.
9. Refit vacuum pipes.
10. Disconnect stroboscopic timing lamp and tachometer from engine.

LUCAS CONSTANT ENERGY IGNITION SYSTEM 35DM8 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 MODULE AIR GAP SETTINGS

Air gap settings vary according to vehicle application.

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 Notes

(i) The ignition must be switched on for all checks.
(ii) Key to symbols used in charts for Tests 2.

[V] Correct Reading	[H] High Reading	[L] Low Reading

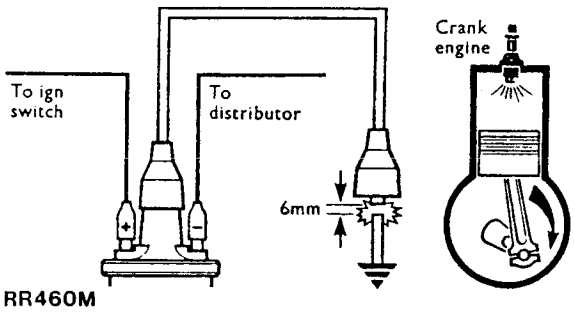
(iii) Use feeler gauges manufactured from a non-magnetic material when setting air gaps.

TEST 1:

Check HT Sparking

Remove coil/distributor HT lead from distributor cover and hold approximately 6 mm (0.25 in) 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 1



RR460M

TEST 2:

Amplifier Static Checks

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.

NOTE: Only move the voltmeter positive lead during tests 2, 3 and 4.

(b) Compare voltages obtained with the specified values listed below:—

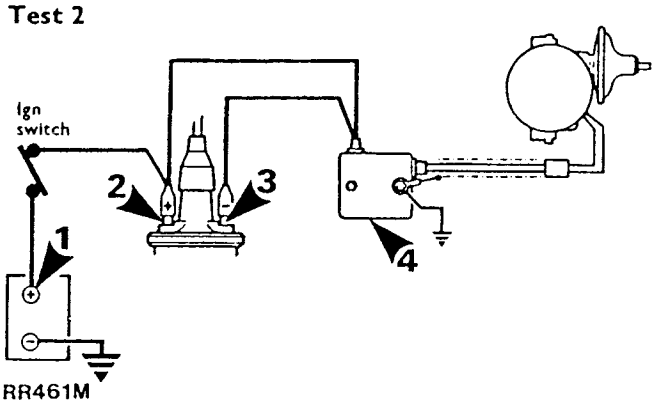
EXPECTED READINGS

1 More than 11.5 volts
2 1 volt max below volts at point 1 in test circuit
3 1 volt max below volts at point 1 in test circuit
4 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".

Test 2



RR461M

1	2	3	4	SUSPECT
L	√	√	√	Discharged battery
√	L	L	√	Ign. switch and/or wiring
√	√	L	√	Coil or amplifier
√	√	√	H	Amplifier earth

TEST 3:

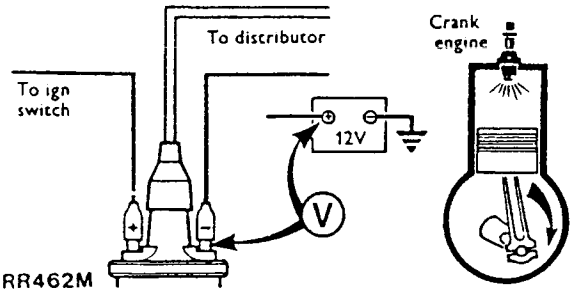
Check Amplifier Switching

Disconnect the High Tension lead between the coil and distributor.

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 3



RR462M

TEST 4:

Pick-Up Coil Resistance. Applications with Separate Amplifier

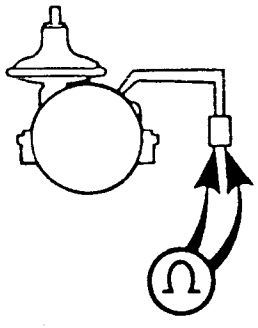
Disconnect the pick-up leads at the harness connector.

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. Change the amplifier if ohmmeter reading is correct. 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 4



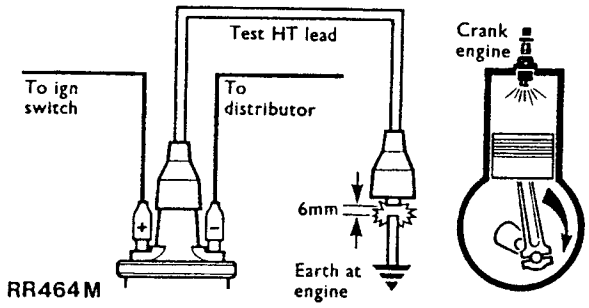
RR463M

TEST 5:

Check HT Sparking

Remove existing coil/distributor HT lead and fit test HT lead to coil chimney. Hold free end about 6 mm (0.25 in) from the engine block and crank the engine.
HT sparking good, repeat test with original HT lead, if then no sparking, change HT lead. If sparking is good but engine will not start, proceed to Test 6.
If no sparking, replace coil.
If engine will not start carry out Test 6.

Test 5

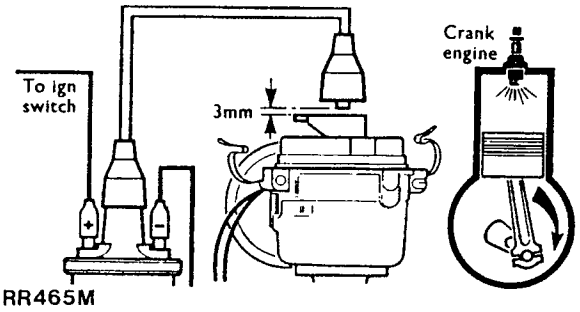


TEST 6:

Check Rotor Arm

Remove distributor cover. Disconnect coil HT lead from cover and hold about 3 mm (0.13 in) 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.
HT sparking, replace rotor arm.
If engine will not start carry out Test 7.

Test 6



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 Shield	Must not be cracked or show signs of tracking marks.

OVERHAUL DISTRIBUTOR — LUCAS 35DM8

Distributor Cap

1. Unclip and remove cap.
2. Renew cap if known to be faulty.
3. Clean 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 3 screws.
7. Renew cover if known to be faulty.

Vacuum Unit

8. Remove 2 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.

Pick-Up and Base Plate Assembly

9. Use circlip pliers to remove the circlip retaining the reluctor on rotor shaft.
10. Remove the flat washer and then the 'O' ring recessed in the top of the reluctor.
11. Insert the blade of a small screwdriver beneath the reluctor and prise it partially along the shaft, sufficient to enable it to be gripped between fingers and withdrawn from the shaft.

    NOTE: Coupling ring fitted beneath reluctor.

12. Remove pick-up and base plate assembly, secured by 3 support pillars.

    NOTE: Do not disturb the 2 barrel nuts securing the pick-up module, otherwise the air gap will need re-adjustment.

13. Renew pick-up and base plate assembly if module is known to be faulty, otherwise check pick-up winding resistance (2k-5k ohms).

Re-Assembly

14. This is mainly a reversal of the dismantling procedure, noting the following points:

    Lubrication

    Apply clean engine oil:

    (a) 3 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 assy) and
    (f) the connecting peg hole in vacuum unit connecting rod.

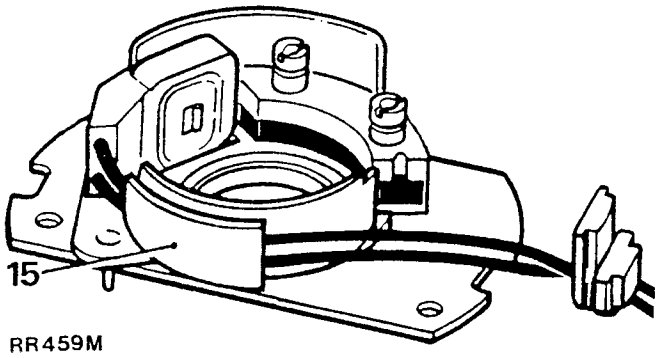
    Apply Rocal MHT (or equivalent) grease.

    (g) Vacuum unit connecting rod seal (located in vacuum unit where connecting rod protrudes)

    NOTE: Applicable only to double acting vacuum units.

Fitting Pick-Up and Base Plate Assembly

15. 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.



RR459M

TECHNICAL DATA

Firing angles	0°-45°-90° etc. ± 1°
Application	12V Negative earth
Pick up air gap adjustment (Pick up limb/reluctor tooth)	0.20 mm - 0.35 mm (0.008 in - 0.014 in)
Pick up winding resistance	2k - 5k ohms

Refitting Reluctor

16. 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.

Pick Up Air Gap Adjustment

17. The air gap between the pick up limb and reluctor teeth must be set within the specified limits, using a non-ferrous feeler gauge.

    NOTE 1: When the original pick up and base plate assembly has been refitted the air gap should not normally require resetting as it is pre-set at the factory. When renewing the assembly the air gap will require adjusting to within the specified limits. See technical data.

ELECTRONIC IGNITION — with Lucas 35DLM8 Distributor

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.

AMPLIFIER

Remove and Refit

Removing

18. Disconnect the battery.
19. Disconnect the electrical leads from the amplifier and coil.
20. Remove the two retaining bolts with washers securing the coil to the amplifier.
21. Remove the two bolts securing the amplifier to the valance.

Refitting

22. Reverse the removal procedure, ensuring that all electrical leads are correctly reconnected.

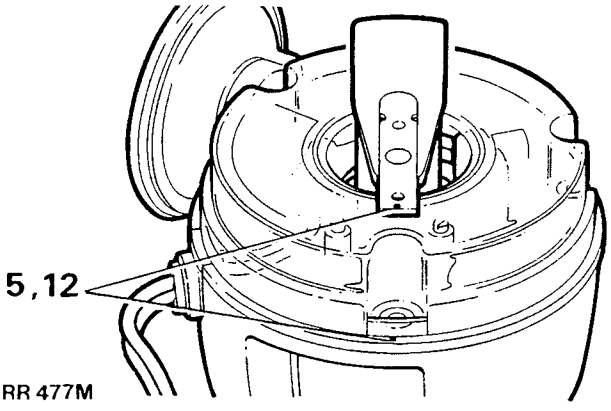
    NOTE: The amplifier is not serviceable, in the event of a fault a new amplifier must be fitted.

DISTRIBUTOR — 35DLM8

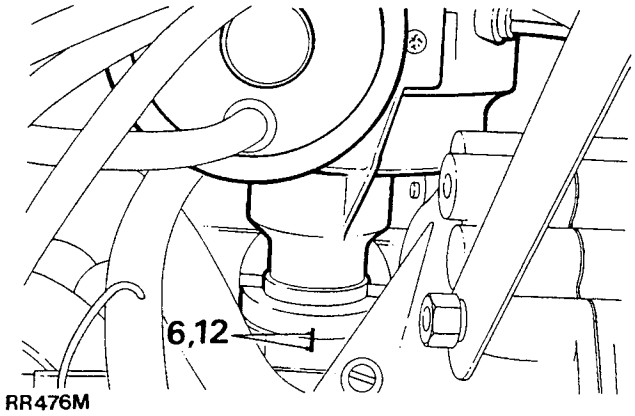
Remove and refit

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.



RR476M

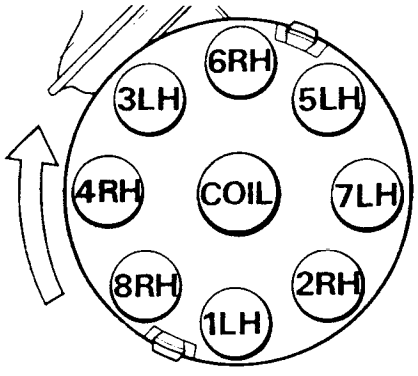
NOTE: Marking distributor enables refitting in exact original position, but if engine is turned while distributor is removed, complete ignition timing procedure must be followed.

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.



RR616M

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 — Adjust.
18. If, with distributor removed, engine has been turned it will be necessary to carry out the following procedure.
19. Set engine — No. 1 piston to static ignition timing figure (see data section) on compression stroke.
20. Turn distributor drive until rotor arm is approximately 30° anti-clockwise from number one sparking plug lead position on cap.
21. Fit distributor to engine.
22. Check that centre line of rotor arm is now in line with number one sparking plug lead on cap. Reposition distributor if necessary.
23. If distributor does not seat correctly in front cover, oil pump drive is not engaged. Engage by lightly pressing down distributor while turning engine.
24. Fit clamp and bolt leaving both loose at this stage.
25. Set the ignition timing statically to within 2°-3° of T.D.C.
26. Connect the vacuum pipe to the distributor.
27. Fit low tension lead to coil.
28. Fit distributor cap.
29. Reconnect the battery.
30. Using suitable electronic equipment set the ignition timing, See IGNITION TIMING — Adjust.

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:

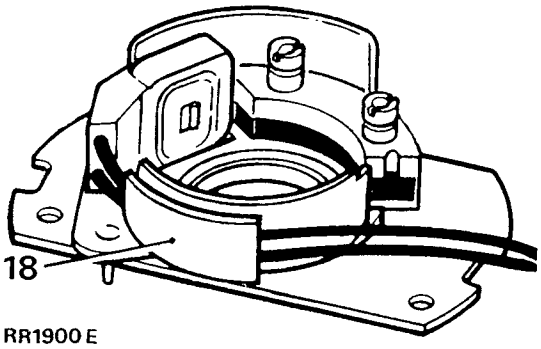
a. Three drops to felt pad reservoir in rotor shaft.

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.



RR1900E

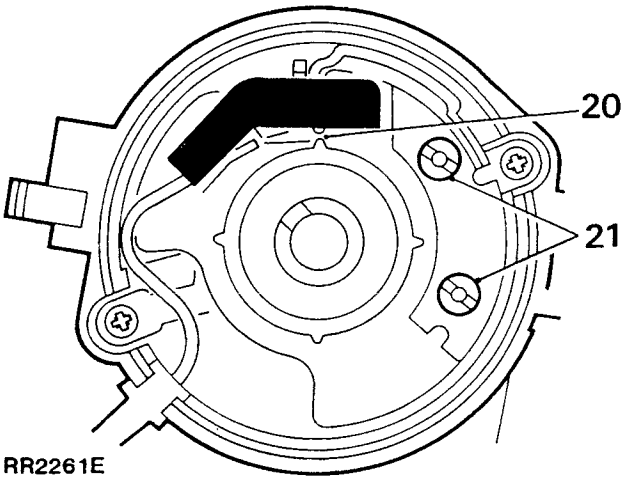
REFITTING RELUCTOR

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.



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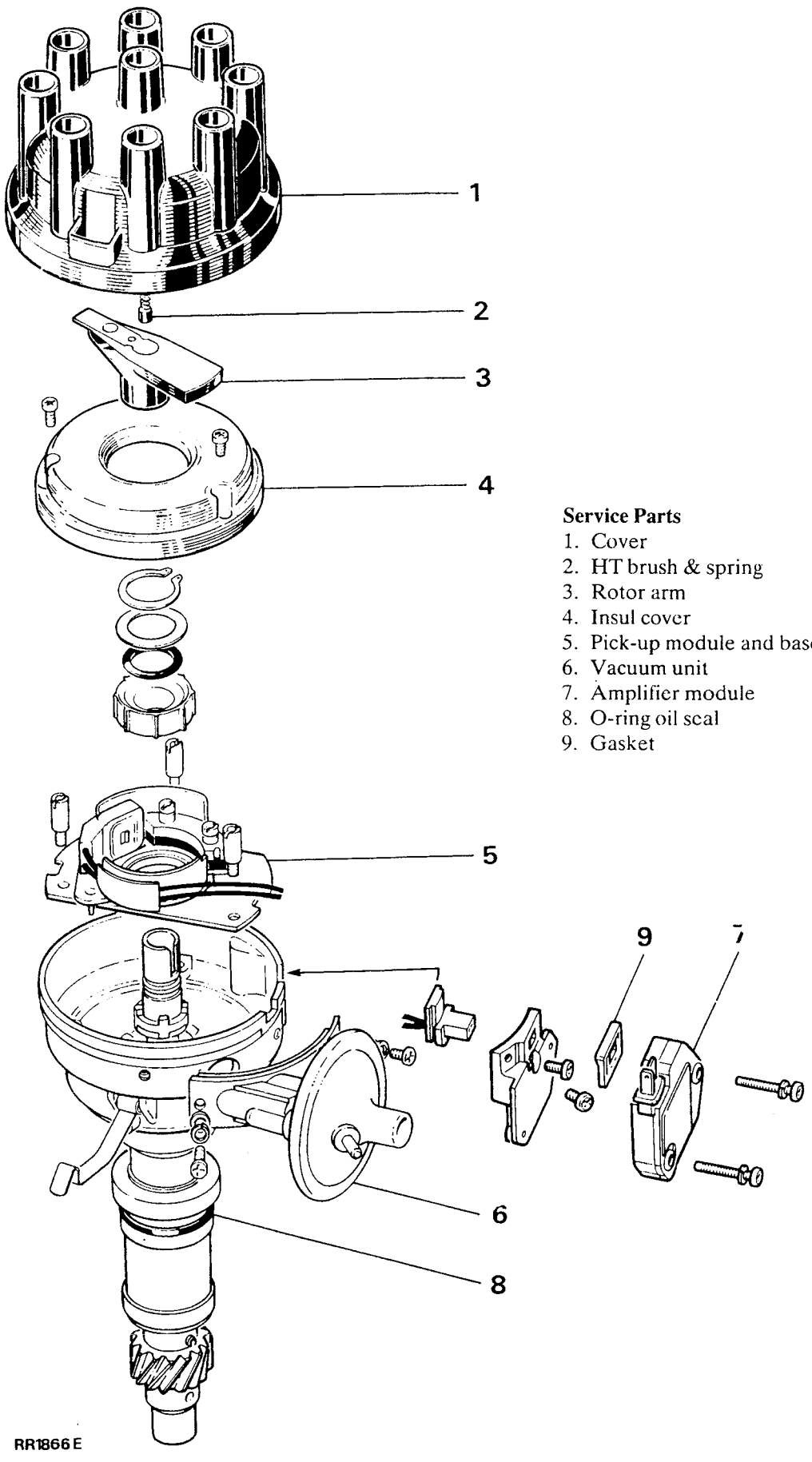
NOTE: When the original pick-up and base plate assembly has been refitted the air gap should be checked, and adjusted if necessary.
When renewing the assembly the air gap will require adjusting to within the specified limits.



Service Parts

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

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

Adjust

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.**

Equipment required

Calibrated Tachometer
Stroboscopic lamp

3. Couple stroboscopic timing lamp and tachometer to engine following the manufacturers instructions.
4. Disconnect the vacuum pipes from the distributor.
5. Start engine, with no load and not exceeding 3,000 rpm, 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.
6. 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.**
7. 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.
8. Retighten the distributor clamping bolt securely. Recheck timing in the event that retightening has disturbed the distributor position.
9. Refit vacuum pipes.
10. Disconnect stroboscopic timing lamp and tachometer from engine.

LUCAS CONSTANT ENERGY IGNITION SYSTEM 35DLM8 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

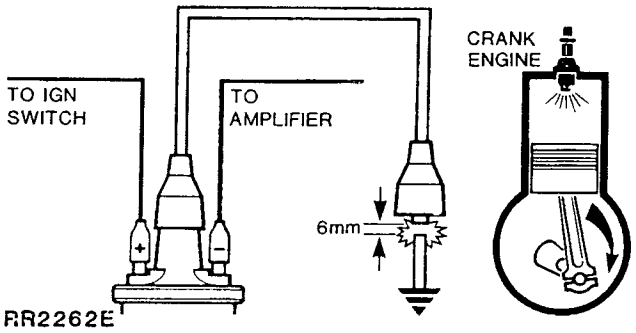
Check air gap with a non-ferrous feeler gauge.

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 (0.25 in) 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

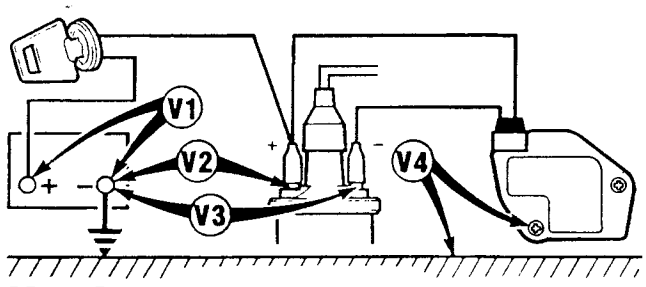
Switch the ignition 'on'

(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



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(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	√	√	√	Discharged battery
√	L	L	√	Ign. switch and/or wiring
√	√	L	√	Coil or amplifier
√	√	√	H	Amplifier earth

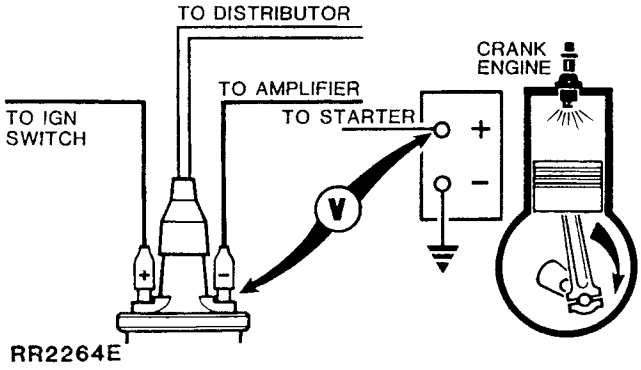
KEY

√ 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.



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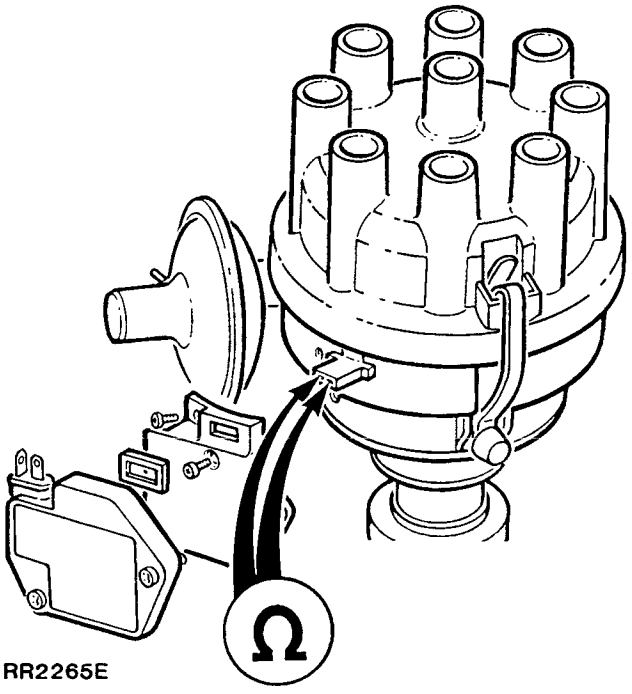
TEST 4:

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.



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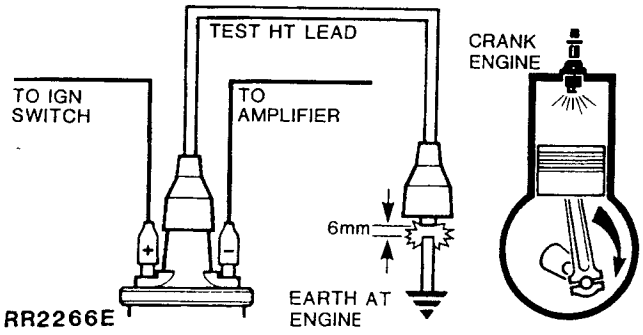
TEST 5:

Coil HT Sparking

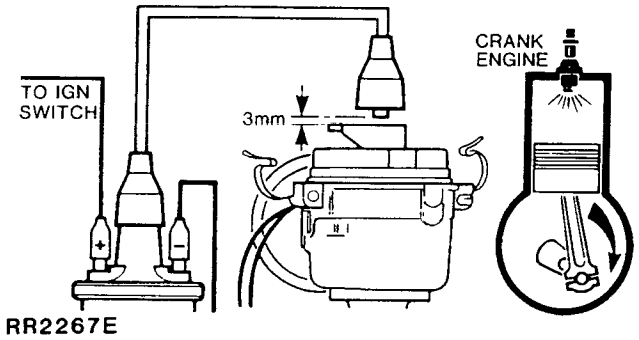
Remove existing coil/distributor HT lead and fit test HT lead to coil tower. Using suitable insulated pliers, hold free end about 6 mm (0.25 in) from the engine block and crank the engine. There should be a good HT spark.
If weak or no sparking, fit new coil, repeat test.
HT sparking good, repeat test 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 (0.13 in) 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 Shield	Must not be cracked or show signs of tracking marks.

ALTERNATOR OVERHAUL — Lucas A115-3 and A115-45

DISMANTLE

1. Remove the alternator from the engine.
2. Remove the cover retaining screws and lift off the cover.

Removing the surge protection diode

3. Withdraw the screw securing the diode to the slip ring end bracket.
4. Disconnect the lead from the rectifier assembly and remove the diode.

Removing the regulator (Note arrangement of the brush box connections)

5. Disconnect the regulator leads.
6. Remove the screw securing the regulator to the brush box and withdraw the regulator. Note that this screw also secures the inner brush mounting plate in position.

Removing brush box assembly

7. Remove the screw retaining the outer brush mounting plate.
8. Withdraw both brushes.
9. Remove the two screws securing the brush box to the slip ring end bracket and lift off the brush box.

Removing the rectifier assembly

10. Securely clamp the alternator and release the stator winding cable ends from the rectifier by applying a hot soldering iron to the terminal tags of the rectifier. When the solder melts prise out the cable end.
11. Remove the two remaining screws securing the rectifier assembly to the slip ring end bracket and lift off the rectifier.

NOTE: Further dismantling of the rectifier is not required.

Removing the slip ring end bracket

12. Securely clamp the alternator and remove the three fixing bolts.
13. Lift off the bracket. If necessary tap under each fixing bolt with a soft mallet.

Removing stator assembly

14. Note the position of the stator output leads relative to the alternator fixing lugs and then lift the stator from the drive end bracket.

Separating drive end bracket and rotor

15. Remove the shaft nut washers from the pulley, woodruff key and spacers.
16. Use a press to remove the rotor shaft from the drive end bearing.
    Check all components as detailed under bench testing and renew any parts that are unsatisfactory.
    If necessary the slip rings and or the slip ring end bearing on the rotor shaft can be replaced. To renew the bearing, both slip rings must be removed as follows:
17. Unsolder outer slip ring connection and gently prise the slip ring off the shaft.
18. Unsolder inner slip ring connection and gently prise the slip ring off the shaft.

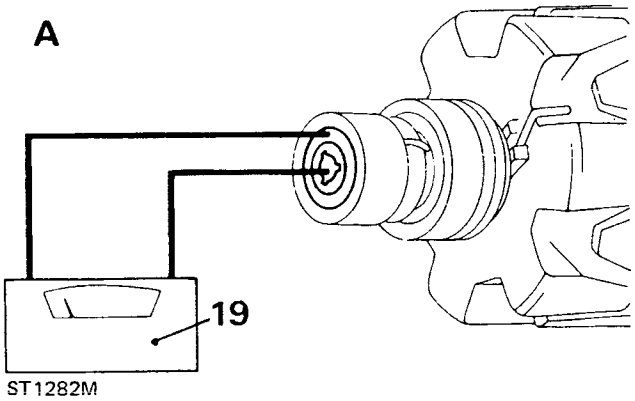
Whilst carrying out the above two instructions take care not to damage the insulation covering the winding leads.

ELECTRICAL TEST OF COMPONENTS

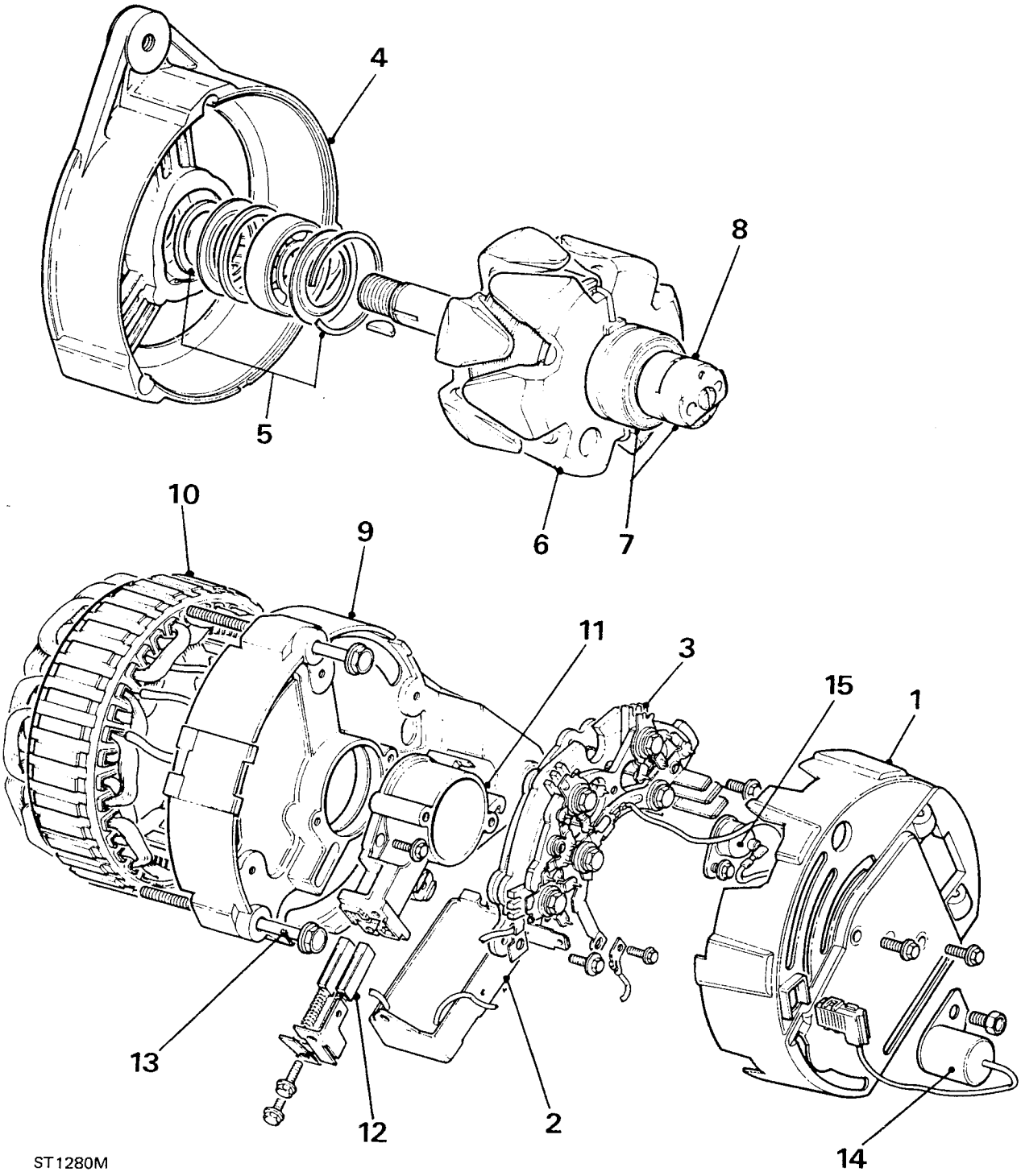
The illustrations for the following tests show the components separated from the alternator, for clarity.

Rotor field winding

19. Check field winding continuity and resistance simultaneously, by connecting either a battery-operated ohmmeter (illustration A) or a 12 volt battery and moving coil ammeter (illustration B) between the slip rings. The ohmmeter should indicate the appropriate resistance given in the data, or it should indicate a current approximate to the figure obtained by dividing the appropriate resistance of the rotor into the battery voltage.



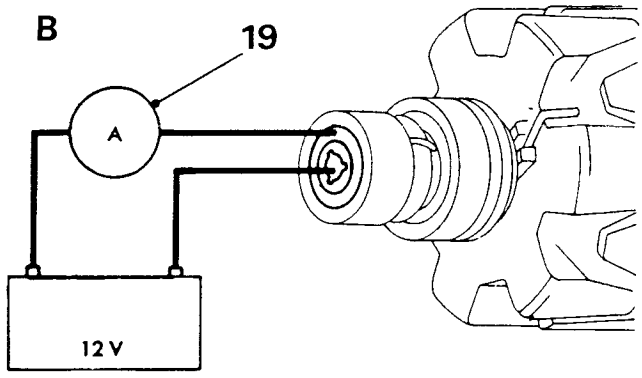
ST1282M



ST1280M

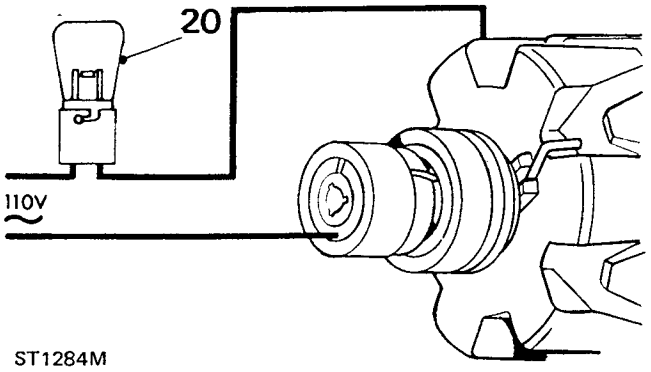
KEY TO ALTERNATOR

1. Cover
2. Regulator
3. Rectifier
4. Drive-end bracket
5. End bearing kit
6. Rotor assembly
7. Slip ring end bearing
8. Slip rings
9. Slip ring end bracket
10. Stator
11. Brush box
12. Brush set
13. Fixing bolt — slip ring end bracket to drive-end bracket
14. Suppression capacitor
15. Surge protection diode



ST1283M

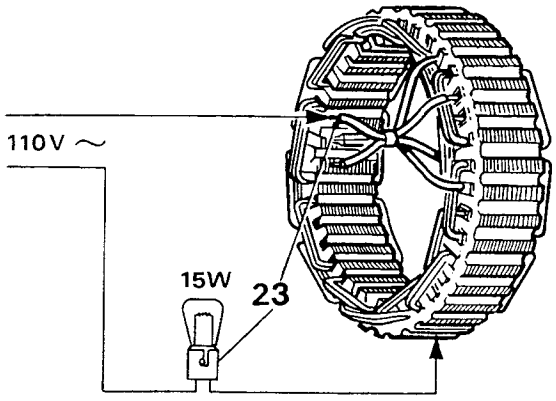
20. Check for satisfactory field winding insulation by connecting a 110 V A.C. 15-watt test lamp between either of the slip rings and the rotor body. The lamp should not light.



ST1284M

Stator winding

21. Due to the very low resistance of the stator windings, a practical test to determine the presence of short-circuited turns cannot be carried out without the use of special instruments. However, in practice inter-winding short-circuiting is usually indicated by obvious signs of burning of the insulating varnish covering the windings. If this is the case, renew the stator assembly without the need for further testing.
22. Check continuity of stator windings, by first connecting any two of the three stator winding connecting cables in series with a 12 V battery-operated test lamp, of not less than 36 watts. The test lamp should light. If not, renew the stator assembly. Providing the first part of the test is satisfactory, transfer one of the test lamp leads to the other (third) cable. Again the test lamp should light. If so, proceed to insulation test.
23. Check insulation of stator windings, by connecting a 110 V A.C. 15-watt test lamp between the stator laminations and any one of the three connecting cables. The lamp should not light.



ST1285M

Rectifier diodes

24. Test each of the nine diodes separately, as follows. Connect a 12 V battery and a 1.5 watt bulb in series with one of the diodes, one test lead being applied to the diode connecting pin and the other to the particular heat sink plate in which the diode undergoing test is soldered. Note whether lamp lights, then reverse the test lead connections. The lamp should light during one half of the test only. If any one diode test is unsatisfactory, renew the rectifier assembly.

Regulator

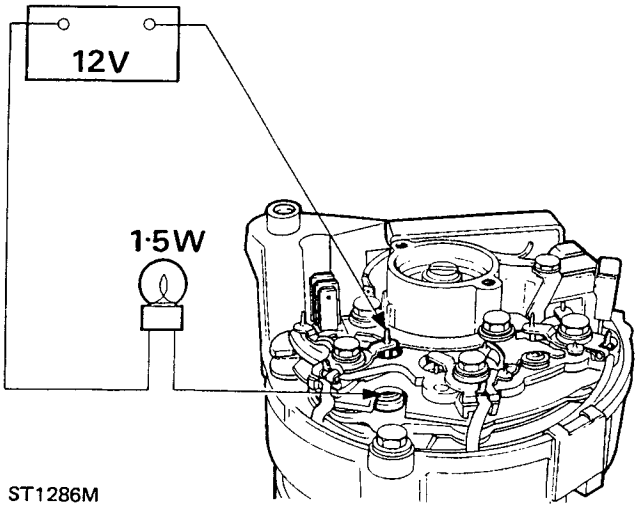
25. Individual testing of the regulator can only be carried out with special test equipment and unless this is available the regulator must be proved by substitution.

ASSEMBLE

Reassembly of the alternator is a reversal of the dismantling procedure. However the following points should be observed.

26. Take care not to damage the insulation covering the winding leads when renewing the slip rings.
27. A build up of solder must not occur on the upper face of the inner slip ring.
28. Use resin cored solder only.
29. Pack the bearings with a suitable high melting point grease.
30. Ensure that the brushes move freely in the brush box.
31. If the slip rings are not renewed the existing ones must be clean and smooth.
32. Tighten fixings to the torque figures quoted.

continued



TIGHTENING TORQUES

Through bolts	4.5 - 6.2 Nm (3.3 - 4.6 lbf ft)
Shaft nut	27.2 - 47.5 Nm (20.0 - 35.0 lbf ft)
Rectifier fixing bolts	3.4 - 3.96 Nm (2.5 - 2.9 lbf ft)
Sundry screws:	
SRE Cover	1.7 - 2.25 Nm (1.3 - 1.7 lbf ft)
Brush Box	3.4 - 3.96 Nm (2.5 - 2.9 lbf ft)
Surge Diode	3.4 - 3.96 Nm (2.5 - 2.9 lbf ft)
Capacitor	3.61 - 4.74 Nm (2.7 - 3.5 lbf ft)
Brush and Regulator fixing	1.7 - 2.25 Nm (1.3 - 1.7 lbf ft)
D/E Bearing Plate	4.7 - 5.7 Nm (3.5 - 4.2 lbf ft)
Reg 'IND' Lead	1.1 - 1.36 Nm (9.7 - 12.0 lbf in)
NUTS:	
Main output terminal	3.96 - 5.08 Nm (2.9 - 3.7 lbf ft)
'IND' terminal nuts	3.61 - 4.74 Nm (2.7 - 3.5 lbf ft)

ALTERNATOR OVERHAUL — Lucas A127-65

Description

The model A127 alternator is a three phase, field sensed unit, the rotor and stator windings generate three phase alternating current (AC) which is rectified to direct current (DC). The electronic voltage regulator unit controls the alternator output voltage by high frequency switching of the rotor field circuit.

It is essential that good electrical connections are maintained at all times. Of particular importance are those in the charging circuit (including those at the battery) which should be occasionally inspected to see that they are clean and tight. In this way any significant increase in circuit resistance can be prevented.

Do not disconnect battery cables while the engine is running or damages to the semi-conductor devices may occur. It is also inadvisable to break or make any connections in the alternator charging and control circuits while the engine is running.

The model 21TR electronic voltage regulator employs micro-circuit techniques resulting in improved performance under difficult service conditions. The whole assembly is encapsulated in silicone rubber and housed in an aluminium heat sink, ensuring complete protection against the adverse effects of temperature, dust, and moisture etc.

The brushbox assembly is incorporated in the regulator unit.

Surge protection is incorporated in the regulator unit.

The regulating voltage is set during manufacture to give the required regulating voltage range of 13.6 to 14.4 volts, and no adjustment is necessary. The only maintenance needed is the occasional check on terminal connections and wiping with a clean dry cloth.

The alternator system provides for direct connection of a charge (ignition) indicator warning light, and eliminates the need for a field switching relay or warning light control unit. As the warning lamp is connected in the charging circuit, lamp failure will cause loss of charge. Lamp should be checked regularly and a spare carried.

When using rapid charge equipment to re-charge the battery, the battery must be disconnected from the vehicle.

NOTE: Alternator charging circuit - The ignition warning light is connected in series with the alternator field circuit. Bulb failure would prevent the alternator charging, except at very high engine speed, therefore, the bulb should be checked before suspecting an alternator failure.

Precautions

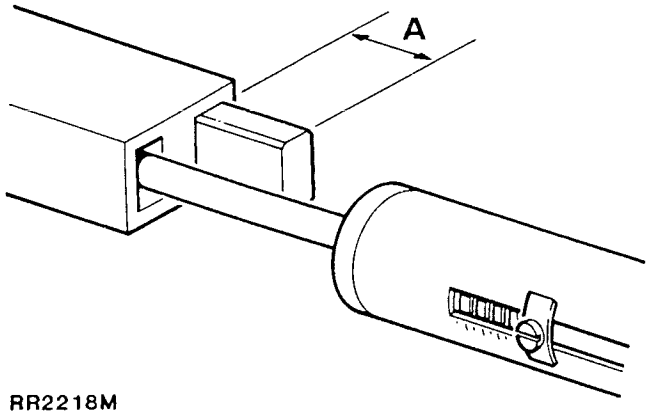
Battery polarity is NEGATIVE EARTH, which must be maintained at all times.

No separate control unit is fitted; instead a voltage regulator of micro-circuit construction is mounted on the slip ring end bracket.

Battery voltage is applied to the alternator output cable even when the ignition is switched off, the battery must be disconnected before commencing any work on the alternator. The battery must also be disconnected when repairs to the body structure are being done by arc welding.

DISMANTLE

1. Withdraw the connectors from the alternator.
2. Remove the alternator.
3. Remove the nuts from the through bolts, disconnect the connectors and remove two suppression capacitors.
4. Remove three screws, disconnect one lead and withdraw the regulator and brushbox assembly.
5. Check the brush lengths by measuring length of protrusion from moulding. If dimension A is 5mm (0.20in) or less, change the assembly.



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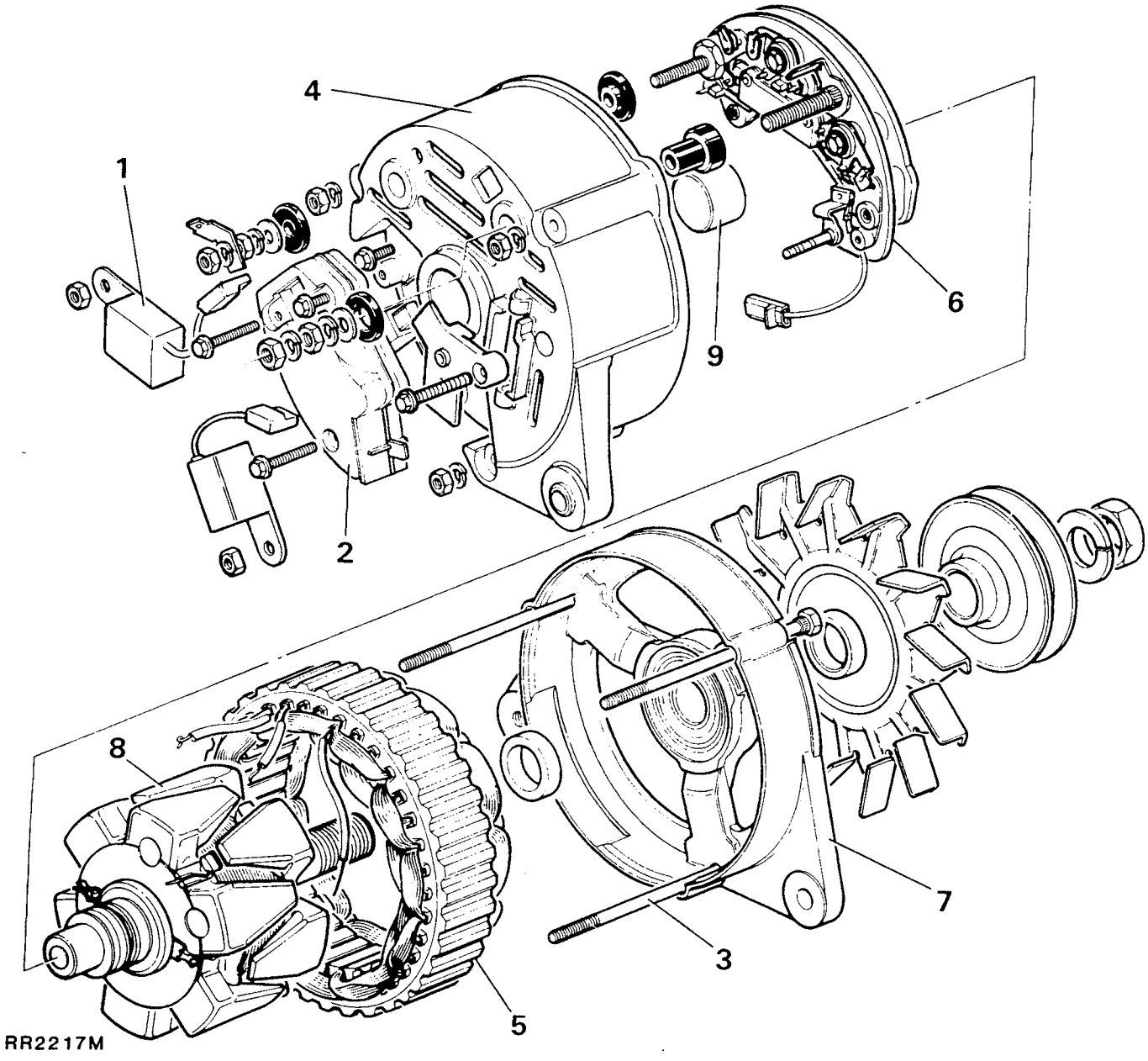
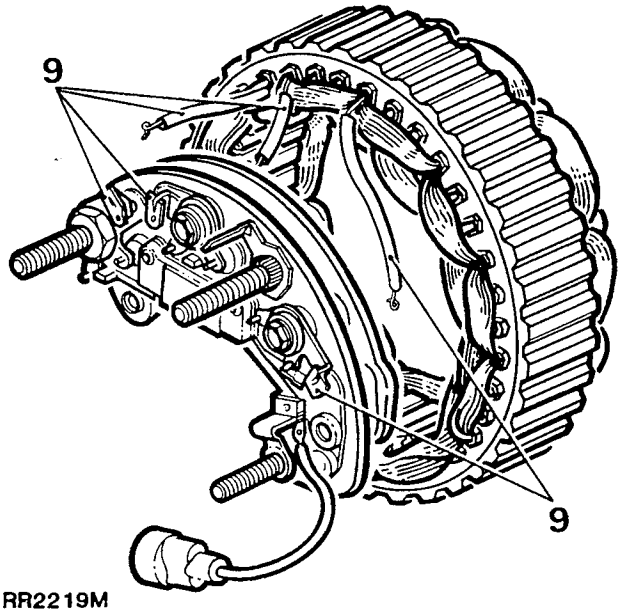
ALTERNATOR — LUCAS A127-65



Service parts

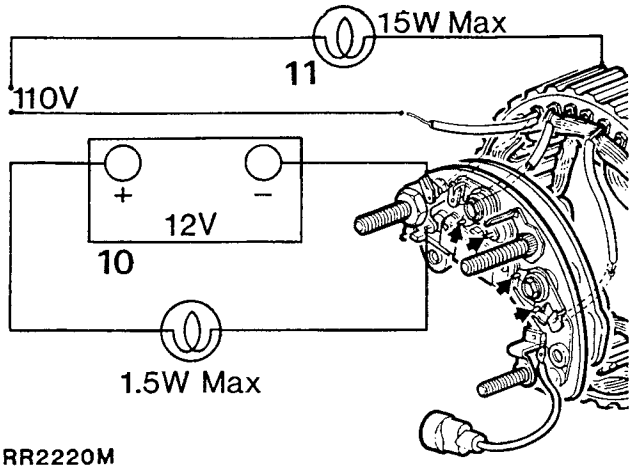
1. Suppression capacitors - 2 off
2. Regulator/Brushbox assembly
3. Through bolts
4. Slip ring end (SRE) bracket
5. Stator
6. Rectifier
7. Drive end bracket (DRE)/bearing assembly
8. Rotor
9. Slip ring end bearing

6. Check brush spring pressure using a push type spring guage. Gauge should register 136 to 279 g (5 to 10 oz) when brush is pressed until face is flush with housing. If reading is outside these limits, renew assembly.
7. Mark the relative positions of the end brackets and stator. Remove through bolts and withdraw slip ring end bracket and stator assembly. Carefully tap the mounting lugs with a mallet if necessary.
8. Remove nuts, washers and insulators from stud terminals noting their position for reassembly. Remove two screws and insulation cover and withdraw rectifier and stator from slip ring end bracket.



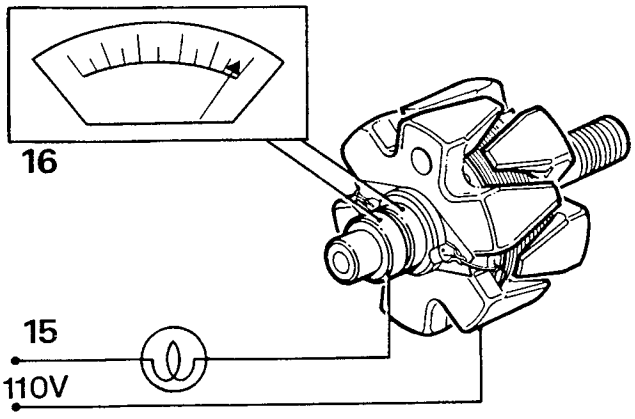
RR2219M

9. Release the stator winding cable ends from the rectifier by applying a hot soldering iron to the terminal tags of the rectifier. Prise out the cable ends when the solder melts, and separate the rectifier and stator. Further dismantling of the rectifier is not required.
10. Check the diodes. Connect the test equipment as shown and test each diode in turn, note whether lamp lights, then reverse test lead connections. The lamp should light in one direction only. Renew the rectifier assembly if a faulty diode is diagnosed.
11. Visually inspect the stator windings for signs of damage or burning. Check the stator insulation using a suitable 110 volt test lamp. Connect the test leads to the laminated yoke and to each of the three leads in turn. If test lamp lights, fit a new stator.
12. Remove the fan and pulley assembly. Push out the rotor shaft from the bearing using a suitable press and remove the spacer from the shaft.



RR2220M

13. Clean surfaces of slip rings using a solvent moistened cloth.
14. Inspect slip ring surfaces for signs of burning, remove burn marks using extra fine glasspaper. On no account should emery cloth or similar abrasives be used, or any attempt made to machine the slip rings.
15. Check the insulation of the rotor field windings, using a suitable 110 volt test lamp connected between one of the slip rings and one of the rotor poles. If the test lamp lights, the rotor must be renewed.



RR2221M

16. Check the resistance/continuity of the rotor field windings by connecting an ohmmeter to the slip rings as shown. A reading of 3.2 ohms should be obtained.
17. Check condition of bearings. If signs of rubbing between rotor poles and stator is evident, both bearings are excessively worn, and must be renewed.
18. Use a suitable press, applying pressure from the rear of the slip ring end bracket, to withdraw or refit the bearing. Note that the drive end bracket and bearing are only supplied as a unit.

Assembling

19. Fit the spacer and press the rotor into the drive end bracket. Insert the through bolts. Fit the spacer, fan, pulley and spring washer to the shaft. Fit and tighten the pulley nut to the correct torque.
20. Fit the stator and rectifier assembly to the drive end bracket in the position previously marked.
21. Fit the slip ring end bracket in the position previously marked, locating the regulator lead through its aperture. Fit the insulation cover and tighten two rectifier securing screws.
22. Fit and tighten the through bolt nuts evenly and to the correct torque.
23. Connect the lead to the regulator, locate the brushes on the slip rings and secure the regulator/brushbox assembly, taking care not to damage the brushes.
24. Fit both suppression capacitors.
25. Refit the alternator.

ALTERNATOR DATA

Manufacturer	Lucas
Type	A127/65
Polarity	Negative earth
Maximum operating speed	15000 rev/min
Maximum DC output at 6000 rev/min	65 amp
Stator windings	3 phase
Stator winding resistance	0.15 ohm/phase
Regulator type	21TR
Regulator controlled voltage	13.6-14.4V
Field winding rotor poles	12
Rotor winding resistance	3.2 ohms
Brush length - new	17 mm (0.67 in) } From
Renew regulator/brushbox assembly at	5 mm (0.20 in) } moulding
Brush spring pressure - flush with brushbox moulding	1.3-2.7N (4.7-9.8oz)

TORQUE WRENCH SETTING

	Nm	lbf ft
Alternator shaft nut	50-70	37-52
Alternator through bolts	5.5	4.0
Alternator rectifier screws	3.5	2.5
Regulator/brushbox screws	2.5	2.0
Terminal nut - main output	4.0	3.0
Terminal nut - phase	4.0	3.0

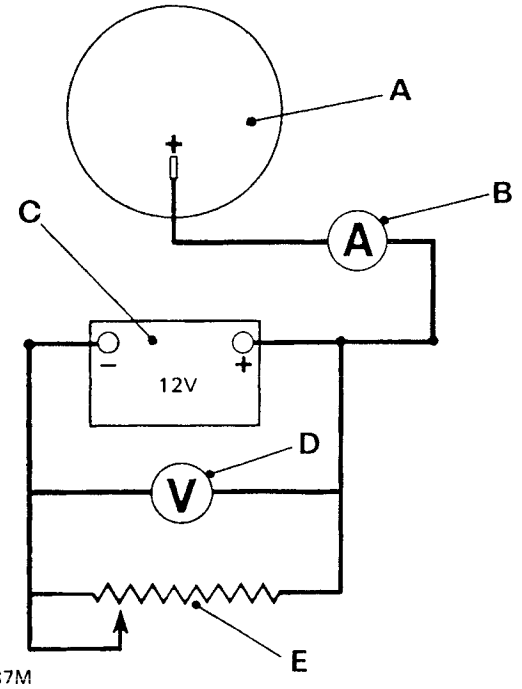
ALTERNATOR FUNCTIONAL CHECK

The alternator contains polarity sensitive components that could be permanently damaged if subjected to incorrect polarity.
Do not connect or disconnect any part of the charging circuit — including the battery leads — while the engine is running. Run the alternator with all connections made or with the unit disconnected.
This operation must be performed in two parts. The first to prove the alternator's capacity to produce current. The second to prove the performance of the integral regulator.

Check capacity to produce current

NOTE: The stated output may be exceeded slightly when the alternator is cold. To avoid misleading results, the check should be performed with the unit as near to its normal operating temperature as possible.

1. Check drive belt adjustment.
2. Disconnect the multi-socket connector.
3. Remove the cover and provide a suitable probe and wire to enable the field winding earth brush to be earthed direct thus by-passing the regulator.
4. Provide a test circuit as shown below.
   A. Alternator
   B. Ammeter
   C. 12 volt battery
   D. Voltmeter
   E. Variable resistance



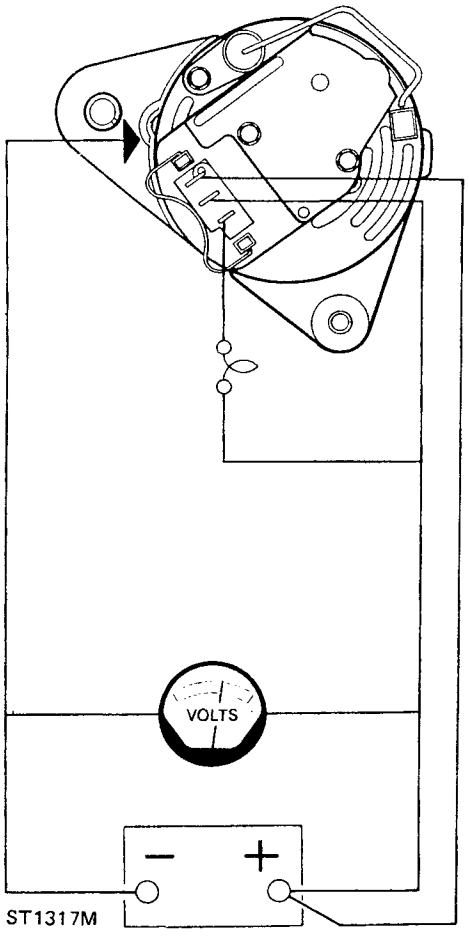
ST1287M

5. Do not connect the variable resistor across the battery for longer than is necessary to perform the check.
6. Run the engine.
7. Gradually increase the speed. At 1550 alternator rev/min (775 engine rev/min) the light should be extinguished.
8. Hold the speed at approximately 6000 alternator rev/min (3000 engine rev/min). Adjust the variable resistor so that the voltmeter reads 14 volts. The ammeter reading should now be approximately equal to the nominal output given in data.
9. If the ammeter reading is not correct the indication is that the alternator requires overhaul or replacement.

Check control regulator

NOTE: The stated output may be exceeded slightly when the alternator is cold. To avoid misleading results, the check should be performed with the unit as near to its normal operating temperature as possible.

10. Check drive belt adjustment.
11. Disconnect multi-socket connector.
12. Provide a test circuit as shown.



ST1317M

13. Start the engine and gradually increase the speed. At 1550 alternator rev/min (775 engine rev/min) the light should be extinguished.
14. Hold the speed at approximately 6000 alternator rev/min (3000 engine rev/min). The voltmeter reading should now be steady at 13.6 to 14.4 volts.
15. If the voltmeter reading is not steady at the above figure — and a satisfactory 'check capacity to produce current' has been performed — the indication is that the control regulator should be replaced.

DIODE FAULT SYSTEM

Failure of one or more of the diodes will be indicated by the output of the alternator and in some instances by an abnormally high temperature and noise level. The following fault symptom chart shows how diode failure will influence alternator test results.

Warning Light	Temperature	Noise	Output	Probable Fault (Associated Damage)
Illuminated at stand-still, extinguished at cut-in speed (1,500 rev/min) but at higher speeds becomes partially illuminated again and gets progressively brighter	High	Normal	Higher than normal at 6,000 rev/min. Approximately 40A	Live-side main output diode open circuit. (May damage rotor field winding and regulator, overheat, brushboxes, and fuse warning light bulb)
Not illuminated between zero at 1,500 rev/min	High	Excessive	Very low at 6,000 rev/min. Approximately 10A	Live-side main output diode short circuit. (May damage associated 'field' diode)
Illuminated at stand-still, dims appreciably at cut-in speed (1,500 rev/min) and gets progressively dimmer or may be extinguished at higher speeds	Normal	Excessive	Poor at low speed Slightly below normal at 6,000 rev/min. Approximately 32A	Earth-side main output diode open circuit
Illuminated at stand-still, dims appreciably at cut-in speed (1,500 rev/min) and gets progressively dimmer or may be extinguished at higher speeds	Normal	Normal	Lower than normal at 6,000 rev/min. Approximately 29A	'Field' diode open-circuit
Illuminated at stand-still, dims at cut-in speed (1,500 rev/min) and remains dim, but may be extinguished at very high speeds	Normal	Excessive	Very low at all speeds above cut-in (1,500 rev/min).	Earth-side main output diode short-circuit, or stator winding short-circuit to earth
Illuminated at stand-still, dims at cut-in speed (1,500 rev/min) and remains dim, but may be extinguished at very high speeds	Normal	Excessive	Very low at 6,000 rev/min. Approximately 7A	'Field' diode short-circuit

ALTERNATOR FAULT AND DIAGNOSIS CHART

ALTERNATOR DOES NOT CHARGE	WORN OR SLACK BELT WORN OR DIRTY BRUSHES BROKEN OR FAULTY ROTOR WINDING BREAK IN CHARGING CIRCUIT OPEN CIRCUIT OR FAULTY FIELD DIODE FAULTY REGULATOR 2 OR 3 RECTIFIER DIODES OF SAME POLARITY FAULTY
WEAK OR IRREGULAR CHARGE	WORN OR SLACK BELT WORN OR DIRTY BRUSHES ONE OR MORE DEFECTIVE RECTIFIER DIODES OPEN OR SHORT-CIRCUITED STATOR FAULTY REGULATOR FAULTY CONNECTIONS
OVER CHARGE	FAULTY REGULATOR FAULTY CONNECTIONS BETWEEN ALTERNATOR AND REGULATOR
NOISY ALTERNATOR	WORN BELT LOOSE PULLEY LOOSE ALTERNATOR MOUNTINGS MISALIGNMENT OF PULLEYS FAULTY BEARING ONE OR SEVERAL RECTIFIER DIODES OPEN OR SHORT-CIRCUITED SHORT-CIRCUITED STATOR

CHECK EACH ITEM IN TURN AND RECTIFY IF NECESSARY BEFORE PROCEEDING TO NEXT ITEM.

DIESEL ENGINE STARTER MOTOR (2M113)

DISMANTLE TEST AND OVERHAUL

Solenoid Unit

1. Disconnect link from starter terminal.
2. Unscrew and remove solenoid securing screws and withdraw the solenoid body.
3. Remove plunger complete with seal and nylon block (if fitted) by lifting front end of plunger to release it from the top of the engagement lever.

Commutator end bracket

4. Remove the two brush plate securing screws.
5. Remove the two through bolts.
6. Withdraw the commutator end bracket and seal (if fitted). Note position of the dowel pegs in the end of commutator.

Brush plate assembly

7. Disengage the brushes and remove the brush plate assembly.

Yoke assembly

8. Withdraw the yoke assembly complete with field coils, brushes and seal (if fitted).

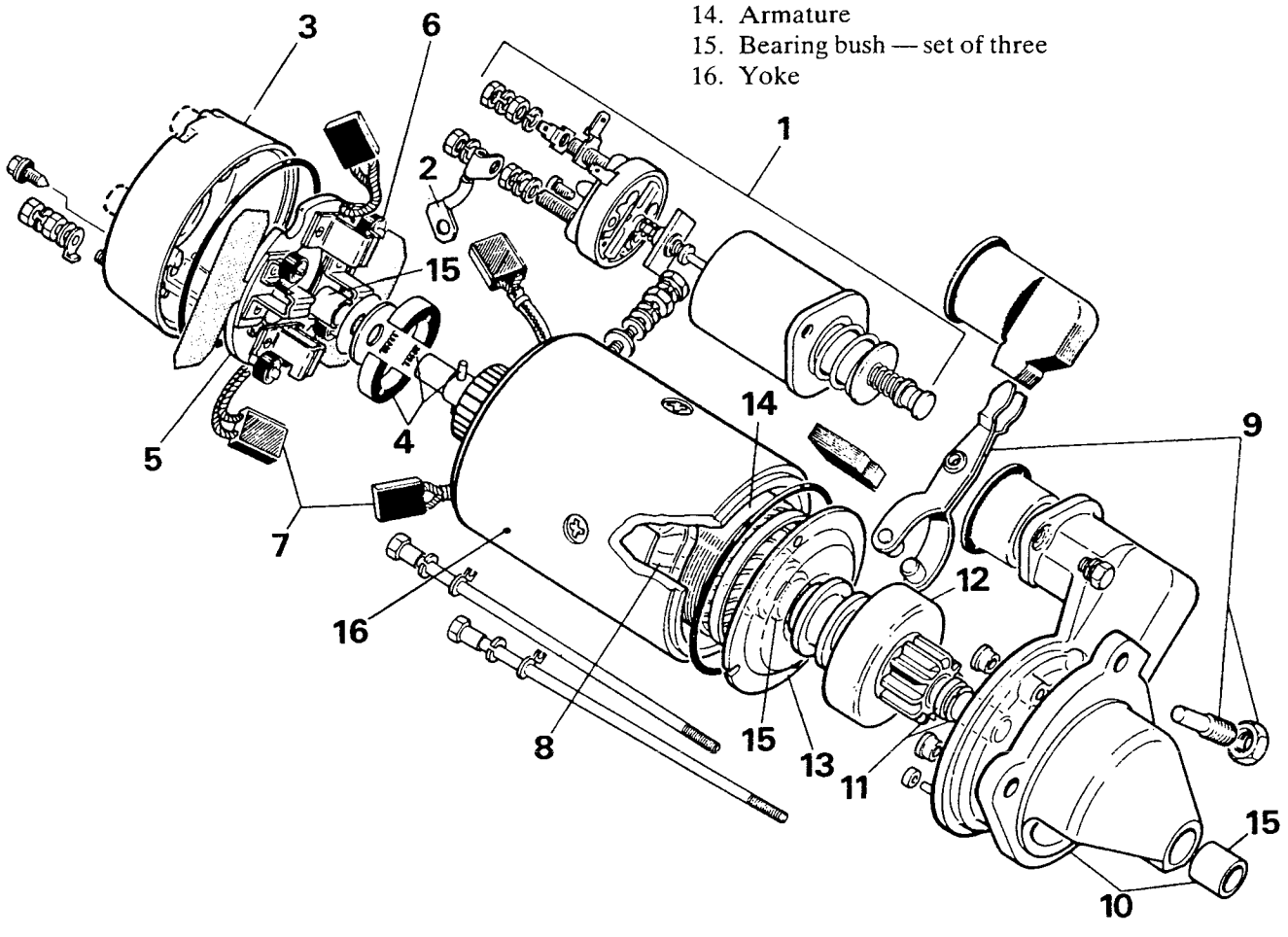
Drive end bracket

9. Remove the eccentric pivot pin.
10. Withdraw the drive-end bracket by releasing engagement lever from drive operating collar whilst the bracket is being removed.

continued

KEY TO STARTER MOTOR COMPONENTS

1. Solenoid
2. Solenoid — starter link
3. Bracket assembly — commutator end
4. Brake assembly
5. Brush box mounting plate assembly
6. Brush springs
7. Brush set
8. Field coil assembly
9. Engaging lever assembly
10. Bracket assembly drive-end
11. Retention assembly
12. Drive
13. Bracket assembly, intermediate
14. Armature
15. Bearing bush — set of three
16. Yoke



ST1289M

Drive assembly and intermediate bracket

11. Drive the thrust collar back towards the drive pinion away from the jump ring.
12. Prise the jump ring from the groove in the drive shaft.
13. Remove the collar, drive pinion and intermediate bracket from the armature and note the position of the peg in the bracket.

TEST AND OVERHAUL

Solenoid Windings

14. Check the continuity and resistance value of the winding, see technical data. If unsatisfactory renew the solenoid.

Solenoid Contacts

15. With the solenoid plunger removed, check, with an ohmmeter, the continuity across the main contacts. The reading should be infinity.
16. Fit the plunger and operate it, by hand, to close the contacts. If satisfactory the ohmmeter should register zero.
17. If one or both of the above tests prove unsatisfactory, renew or repair the solenoid.
18. Check the operation of all springs for freedom of movement.

Brush gear

19. Check the brushes for damage, wear and length against the figures in the technical data. If necessary renew brushes, but see 'Field Coils' first.
20. Before renewing brushes check the field coils and brush plate assembly.
21. If necessary, clean the brushes with a petrol moistened cloth.
22. Check the brush springs and ensure that the brushes move freely in their holders.

Drive pinion

23. Examine the pinion for wear and damage. The pinion should rotate in one direction only, independent of the clutch body. Renew pinion if unsatisfactory.

Field coils

24. Inspect the coils for damage and ensure that the insulation tape is firm and not loose. Check all joints for continuity and evidence of burning which indicates an insulation fault.
25. If the brushes are being renewed cut the flexible leads leaving a sufficient length to enable the new brush leads to be joined with a soldered connection.

Armature

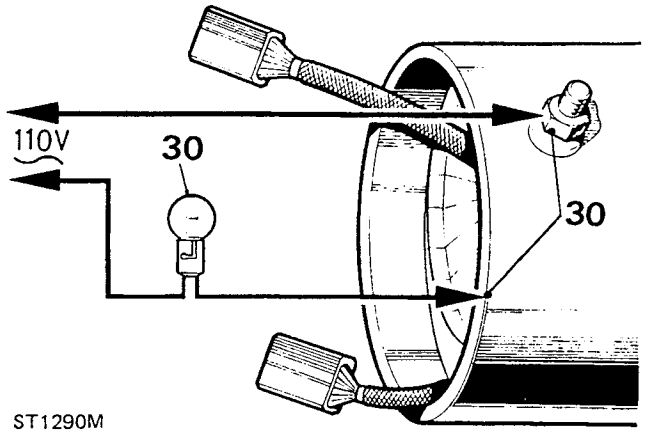
26. Clean the armature with a petrol moistened cloth.
27. If growler equipment is available check for short-circuited windings.
28. Examine the commutator and if worn or damaged it can be skimmed provided that it is not machined below the minimum diameter of 38 mm (1.5 in).
29. Finally, finish the commutator with fine emery cloth. **Do not undercut the commutator segments.**

Insulation test

Check the insulation of the following components using a 110 V A.C. 15 watt test lamp:
Field coils, armature commutator and windings, insulated brush boxes.

Field coil insulation

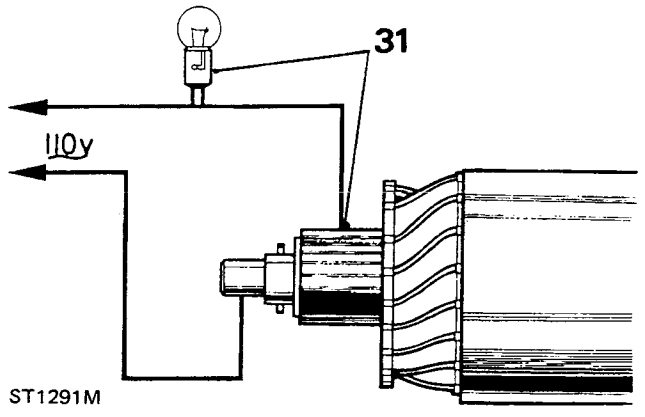
30. Connect the test lamp between the yoke terminal and the yoke. Ensure that the brushes are not touching the yoke. The lamp should **not** light if the insulation is satisfactory. If the lamp does illuminate renew the field coil assembly.



ST1290M

Armature insulation

31. Connect the test lamp between any one of the commutator segments and the armature shaft. The lamp should not light, if it does replace the armature.



ST1291M

Brush box insulation

32. Connect the test lamp between a clean part of the bracket and each of the two insulated brush boxes in turn. If the test lamp lights renew the commutator end bracket assembly.

Bearing bushes

33. If the armature fouls the pole shoes or side play exists between the armature shaft and bush, renew the bearing bushes using a suitable hand press mandrel.

ASSEMBLE STARTER MOTOR

Re-assembly is mainly a reversal of the foregoing dismantling procedure. However, the following points should be observed.

Lubrication

34. Smear the drive shaft splines and the drive operating collar and bearing surface of the engagement fork with Shell Retinax 'A' grease.

Armature

35. Ensure that the brake pin is tight and symmetrically positioned.
36. Check that the jump ring locates properly in the drive shaft groove and is covered by the thrust collar.

Drive-end and intermediate brackets

37. Ensure that the dowel peg in the drive-end bracket aligns with matching location in the intermediate bracket before offering the yoke into position.

Brush plate

38. Wedge the earth brushes in raised position with brush springs.
39. Offer the brush plate into position and fit the field coil brushes in the boxes.
40. Release the earth brushes and position the springs.
41. Ensure that the brushes move freely in the holders.

Commutator end bracket

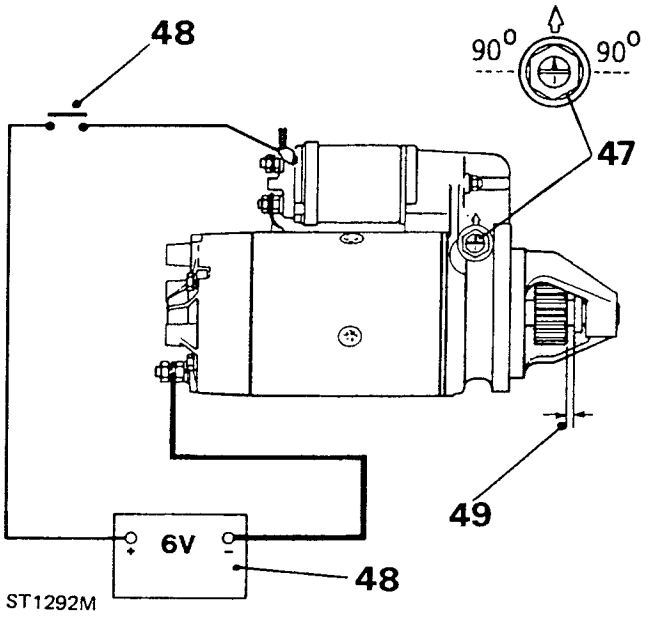
42. Check that the earth stud is fixed securely.
43. Ensure that the armature brake pin and slots in the brake shoes align with each other.
44. Make sure that the fixing holes in the brush plate line up with the holes in the commutator end bracket.
45. Check that the through bolts are aligned with the threaded holes in the drive-end bracket.

Solenoid

46. Ensure that the plunger locates properly with the operating lever.

Pinion setting

47. Screw the eccentric pivot pin fully into the casing and slacken one full turn and position as illustrated with arrow on the pin in line with the arrow on casing and tighten locknut. This provides an initial setting for final adjustment.
48. Connect up the starter, as illustrated, using a 6 volt supply and operate a starter control switch so that the pinion will move into the engaged position without rotating.
49. Whilst maintaining this position press back the pinion towards the yoke. Insert a feeler gauge between the pinion end face and jump ring collar. The correct clearance should be 0,13 to 0,38 mm (0.005 to 0.015 in).
50. If adjustment is required, release the locknut and turn the pivot pin as necessary to achieve the correct setting. Apply 'gold size' to the threads of the pivot pin and locknut and tighten the latter to the correct torque.



TECHNICAL DATA

Starter performance (2M113)

Minimum battery requirement	12 V 128 Ah (20 hr rate) battery at least 70% charged.	
Lock torque	39.4 Nm 4.0 Kg m 29.0 lb ft	940 A max at 6.5 V min
Torque at 1000 rev/min	14.9 Nm 1.5 Kg m 11.0 lb ft	540 A max at 8.0 V min
Light running current	100 A max at 5,000 - 7,500 rev/min	

Solenoid Windings Resistance

Operating winding resistance measured between small unmarked Lucar terminal and main terminal marked 'STA'.	0.145 - 0.165 ohms
Hold-on winding resistance measured between small unmarked Lucar terminal and earth point on solenoid body.	0.46 - 0.56 ohms

Brushgear

New brush length	22.2 mm (7/8 in) ± 0.50 mm (0.020 in)
Renew brush at	8 mm ($\frac{5}{16}$ in)

Armature end-float

Cast aluminium intermediate bracket	0.03 - 1.4 mm (0.001 - 0.056 in)
Pressed steel intermediate bracket	0.03 - 1.55 mm (0.001 - 0.061 in)

Commutator

Commutator minimum diameter	38 mm (1.5 in)

TIGHTENING TORQUES

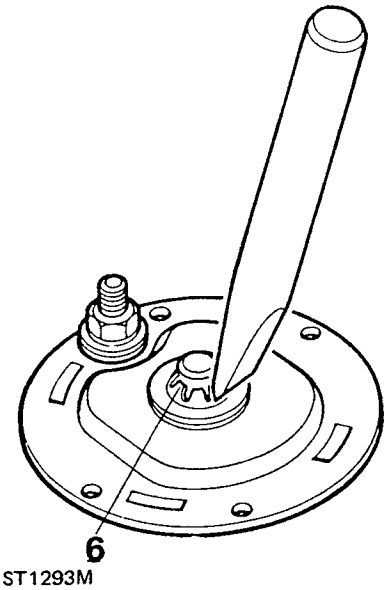
Solenoid main 'BAT' terminal cable fixing nut	3.9 Nm (2.9 lb ft)
Solenoid/starter link terminal fixing nuts	3.5 Nm (2.6 lb ft)
Solenoid end cover fixing screws	2.82 Nm (2.1 lb ft)
Solenoid unit fixing screws	6 Nm (4.5 lb ft)
Brush plate fixing screws	7 Nm (5.0 lb ft)
Starter earth stud, nuts	6 Nm (4.5 lb ft)
Pole shoe fixing screws	40.68 Nm (30 lb ft)
Through bolts	10.84 Nm (8 lb ft)
Eccentric pivot pin locknut	20 Nm (15.0 lb ft)

V8 ENGINE STARTER MOTOR (3M100PE)

DISMANTLE TEST AND OVERHAUL

DISMANTLE

1. Remove the starter motor.
2. Remove the connecting link between the starter and the solenoid terminal 'STA'.
3. Remove the solenoid from the drive end bracket.
4. Grasp the solenoid plunger and lift the front end to release it from the top of the drive engagement lever.
5. Remove the end cap seal.
6. Using an engineer's chisel, cut through a number of the retaining ring claws until the grip on the armature shaft is sufficiently relieved to allow the retaining ring to be removed.



ST1293M

7. Remove the two through-bolts.
8. Partially withdraw the commutator end cover and disengage the two field coil brushes from the brush box.
9. Remove the commutator end cover.
10. Withdraw the yoke and field coil assembly.
11. Withdraw the pivot pin.
12. Withdraw the armature.
13. Using a suitable tube, remove the collar and jump ring from the armature shaft.
14. Slide the thrust collar and the roller clutch drive and lever assembly off the shaft.

TEST AND OVERHUAL

Clutch

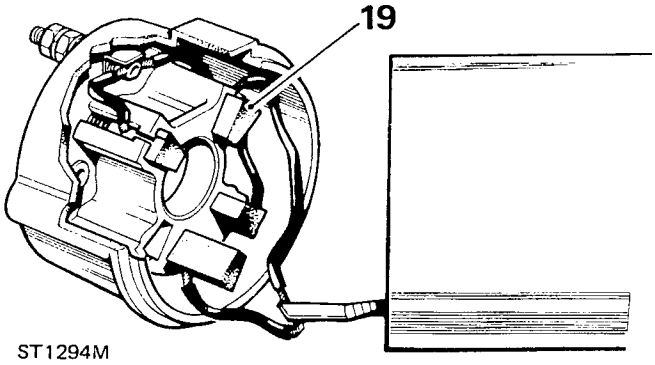
16. Check that the clutch gives instantaneous take-up of the drive in one direction and rotates easily and smoothly in the other direction.
17. Ensure that the clutch is free to move round and along the shaft splines without any tendency to bind.

    NOTE: The roller clutch drive is sealed in a rolled steel cover and cannot be dismantled.

18. Lubricate all clutch moving parts with Shell SB 2628 grease for cold and temperate climates or Shell Retinax 'A' for hot climates.

Brushes

19. Check that the brushes move freely in the brush box moulding. Rectify sticking brushes by wiping with a petrol-moistened cloth.



ST1294M

20. Fit new brushes if they are damaged or worn to approximately 9,5 mm (0.375 in).
21. Using a push-type spring gauge, check the brush spring pressure. With new brushes pushed in until the top of the brush protrudes about 1,5 mm (0.065 in) from the brush box moulding, dimension A, the spring pressure reading should be 1,0 kgf (36 ozf).

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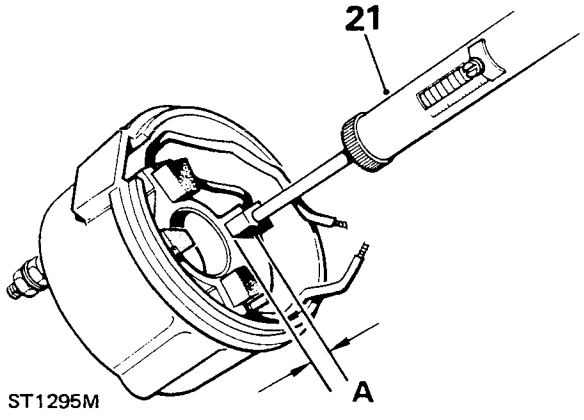
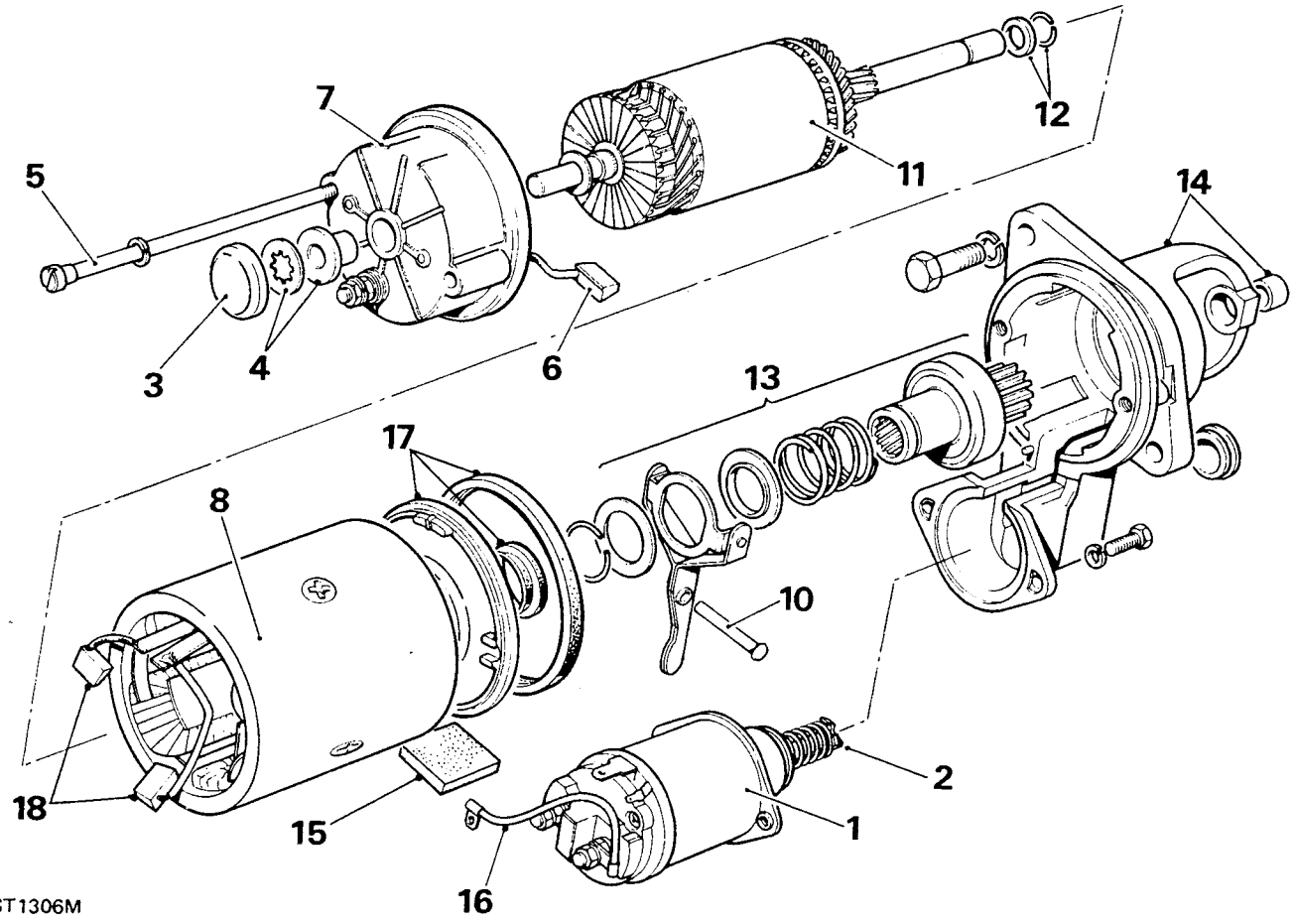


ST1295M

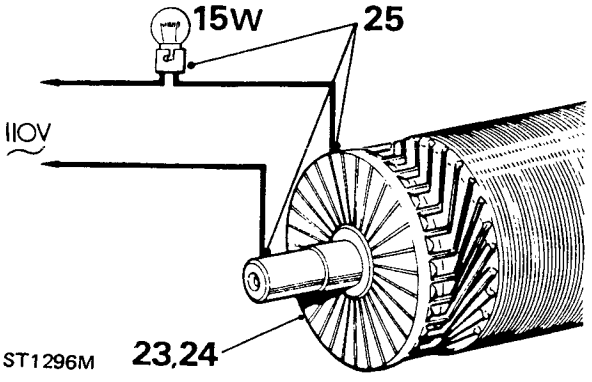


ST1306M

22. Check the insulation of the brush springs by connecting a 110 V A.C. 15W test lamp between a clean part of the commutator end cover and each of the springs in turn. The lamp should not light.

Armature

23. Check the commutator. If cleaning only is necessary, use a flat surface of very fine glass paper, and then wipe the commutator surface with a petrol-moistened cloth.
24. If necessary, the commutator may be machined provided a finished surface can be obtained without reducing the thickness of the commutator copper below 3,5 mm (0.140 in), otherwise a new armature must be fitted. **Do not undercut the insulation slots.**



ST1296M

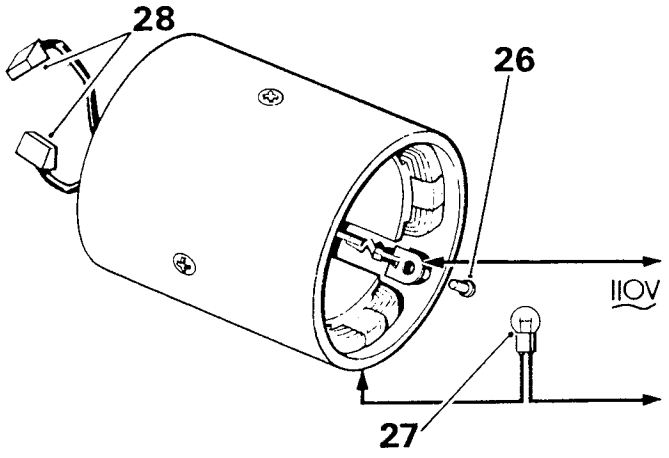
KEY TO STARTER MOTOR COMPONENTS

1. Solenoid
2. Solenoid plunger
3. End cap seal
4. Spire ring and bush
5. Through bolts
6. Brush plate brushes
7. Commutator end cover
8. Yoke and field coil assembly
9. Retaining ring
10. Pivot pin
11. Armature
12. Collar and jump ring
13. Thrust collar and roller clutch drive and lever assembly
14. Drive-end bracket and bush
15. Rubber block
16. Connecting link between starter and solenoid
17. Intermediate bracket and seals
18. Field coil brushes

25. Check the armature insulation by connecting a 110 V A.C. 15 W test lamp between any one of the commutator segments and the shaft. The lamp should not light; if it does light, fit a new armature.

Field coil insulation

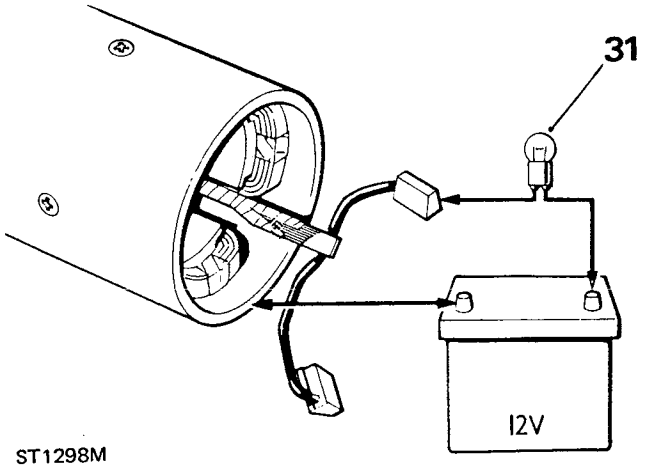
26. Disconnect the end of the field winding where it is riveted to the yoke, by filing away the riveted over end of the connecting-eyelet securing rivet, sufficient to enable the rivet to be tapped out of the yoke.
27. Connect a 110 V A.C. 15 W test lamp between the disconnected end of the winding and a clean part of the yoke.
28. Ensure that the brushes or bare parts of their flexibles are not touching the yoke during the test.
29. The lamp should not light; if it does light, fit a new field coil assembly.
30. Re-secure the end of the field winding to the yoke.



ST1297M

Field coil continuity

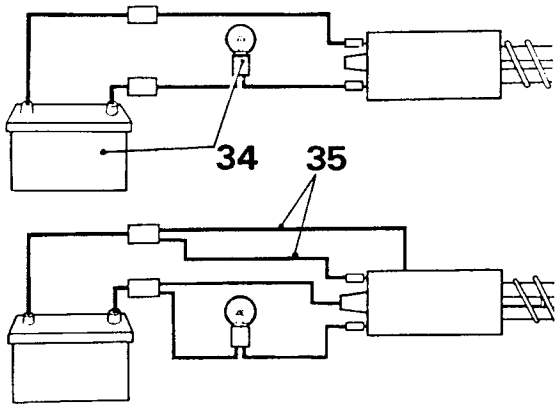
31. Connect a 12 V battery-operated test lamp between each of the brushes in turn and a clean part of the yoke.
32. The lamp should not light; if it does light, fit a new field coil assembly.



ST1298M

Solenoid

33. Disconnect all cables from the solenoid terminals and connectors.
34. Connect a 12 V battery and a 12 V 60 W test lamp between the solenoid main terminals. The lamp should not light; if it does light, fit new solenoid contacts or a new solenoid complete.
35. Leave the test lamp connected and, using the same 12 V battery supply, energize the solenoid by connecting 12 V between the small solenoid operating Lucar terminal blade and a good earth point on the solenoid body.
36. The solenoid should be heard to operate and the test lamp should light with full brilliance, otherwise fit new solenoid contacts or a new solenoid complete.



ST1299M

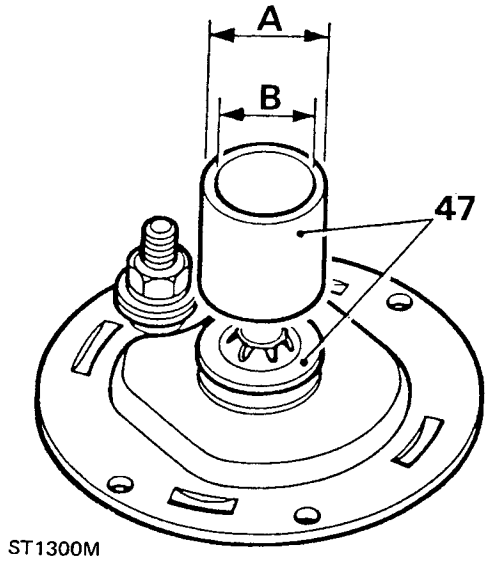
ASSEMBLE

37. Fit the intermediate bracket and inner seal over the armature shaft.
38. Slide the thrust collar and the roller clutch drive and lever assembly onto the armature shaft.
39. Fit the jump ring and collar to the armature shaft.
40. Fit the armature.
41. Fit the pivot pin and splay the end.
42. Fit the yoke and field coil assembly and ensure that the dowel peg in the drive-end bracket aligns with matching location in the intermediate bracket before offering the yoke into position.
43. Fit the internal thrust washer to the shaft.
44. Engage the two field coil brushes in the brush box and fit the commutator end cover.
45. Secure the assembly with the two through bolts and tighten to the correct torque.
46. Fit the sintered bearing bush.

continued

47. Using a suitable tube, drive a new spire ring into position, as illustrated. The position of the spire ring on the armature shaft determines the armature end-float which should be 0,25 mm (0.010 in) maximum between the spire retaining ring and the sintered bearing bush shoulder. Care, therefore, must be used when fitting the spire ring.

    Dimension A 25,4 mm (1.00 ins)
    Dimension B 19 mm (0.75 ins)



ST1300M

48. Fit the end cap seal.
49. Fit the solenoid to the drive-end bracket whilst locating the drive engagement lever.
50. Fit the connecting link between the starter and solenoid terminal 'STA'.

PETROL ENGINE 2.25 LITRE STARTER MOTOR (2M100) LUCAS.

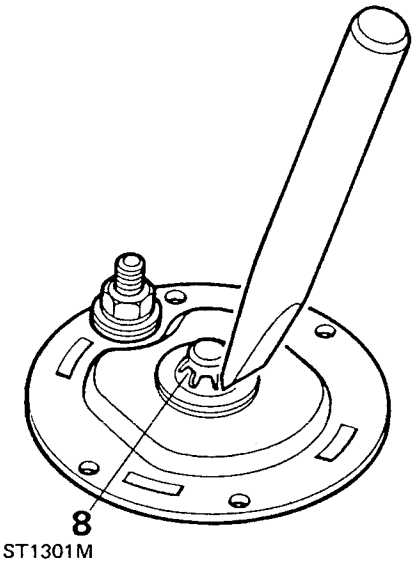
DISMANTLE TEST AND OVERHAUL

DISMANTLE

1. Remove the nut securing the (solenoid-to-starter) connecting link to the solenoid 'STA' terminal.
2. Pull back the connecting link from the solenoid terminal.
3. Remove the nuts securing the solenoid to the drive-end bracket.
4. Remove the solenoid unit from the drive-end bracket.
5. Lift the solenoid plunger and return spring from the engagement lever.
6. Remove the block-shaped grommet.

NOTE: Before carrying out instructions 7 to 14 ensure that new retaining rings are available for the armature shaft and the engagement lever pivot pin are available for reassembly of the starter.

7. Remove the end cap seal.
8. Using an engineer's chisel, cut through a number of the retaining ring claws until the grip on the armature shaft is sufficiently relieved to allow the retaining ring to be removed.



ST1301M

9. Remove the through-bolts.
10. Detach the commutator end cover from the yoke, disengaging the field brushes from the brush box moulding, and remove the end-cover.
11. Remove the thrust washer from the armature shaft.
12. Withdraw the yoke from the armature and drive-end assembly.

13. Drive the pivot pin from the engagement lever and drive-end bracket.
14. Move the thrust collar clear of the jump ring, and remove the jump ring from the armature shaft.
15. Remove the thrust collar.
16. Remove the roller clutch drive and engagement lever assembly and intermediate bracket assembly from the armature shaft.

INSPECTION

Brush gear

17. Check the brush spring tension using a spring balance; renew a spring if its tension is not within the limits given.
18. Check the brushes for wear; renew any brush worn to or approaching the minimum length.
19. To renew a brush, unsolder the flexible connection, remove the brush and re-solder the flexible connection of the new brush in place. New brushes are pre-formed and do not require bedding to the commutator.

Commutator

20. Clean the commutator with a cloth moistened with fuel and examine it for burns, pitting, and excessive wear.
21. Carry out instructions 22-24 to recondition the commutator.
22. Skim the commutator at high speed using a very sharp tool and removing the minimum amount of metal necessary to restore the surface.
23. Polish the commutator with very fine sandpaper.
24. Using an air blast, clean any copper residue from the armature.

IMPORTANT: The commutator segment insulators must not be undercut.

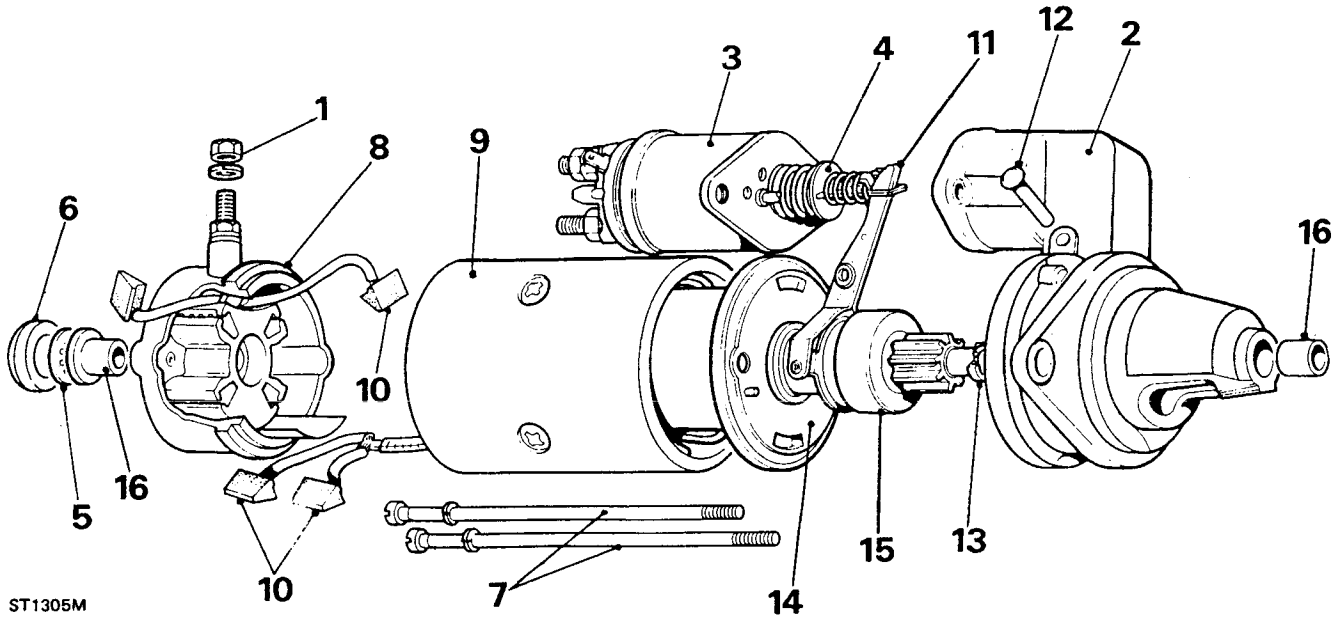
Armature

25. Test the insulation of the armature windings with a 12-volt test lamp and battery connected between the armature shaft and the commutator; if the lamp lights the armature must be renewed.
26. Check the windings at their connections with the commutator riser for signs of melted solder or lifted conductors.

continued

KEY TO STARTER MOTOR

1. Nut securing connecting link to STA terminal
2. Drive-end bracket
3. Solenoid
4. Solenoid plunger and return spring
5. Spire ring
6. End cap seal
7. Through bolts
8. Commutator end cover
9. Yoke
10. Field coil and brush plate brushes
11. Engagement lever
12. Pivot pin
13. Thrust collar and jump ring
14. Intermediate bracket
15. Roller clutch drive assembly
16. Bush



ST1305M

27. Check the shaft for distortion; if the shaft is bent or distorted the armature must be renewed. Do not attempt to straighten the shaft or machine the armature core laminations.

Field windings

28. Connect a 12-volt battery-operated test lamp between each of the field brushes and a clean part of the yoke; the lamp will light if continuity is satisfactory between the brushes, windings, and yoke connection.
29. Disconnect the field windings from the riveted connection with the yoke. Using a 110-volt A.C., 15-watt test lamp connected between each of the brushes in turn and the yoke, check the insulation of the field windings, if the lamp lights the windings must be renewed. The field windings may be renewed as follows:
30. Disconnect the end of the field winding where it is riveted to the yoke.
31. Remove the four pole-shoe retaining screws using a wheel-operated screwdriver.
32. Withdraw the field coil assembly from the yoke.
33. Clean the inside of the yoke and insulating pieces which the through-bolts locate.
34. Loosely fit the new field coil assembly with the pole-shoes into the yoke.
35. Fit the pole-shoe retaining screws but do not tighten.
36. Slide the insulating pieces between the field coils and the yoke, positioned 90° each side of the field coil brush connection point.
37. Tighten the pole-shoe screws evenly using a wheel-operated screwdriver, to the correct torque.
38. Reconnect the end of the winding to the yoke.

Commutator end bracket

39. Check the insulation of the brush springs by connecting a 110-volt A.C., 15-watt test lamp between a clean part of the commutator end cover and each of the springs in turn; the lamp will light if the insulation is not satisfactory.

Bearings

40. If the bearings in the commutator end cover and the drive-end bracket are worn sufficiently to allow excessive side-play of the armature shaft, the bearing bush must be renewed as follows; instructions 41 and 42.
41. Support the bracket and drive out the bush using a suitable sized mandrel.
42. Using a polished, shouldered mandrel, the same diameter as the shaft bearing journal, press the new bushes into the brackets.

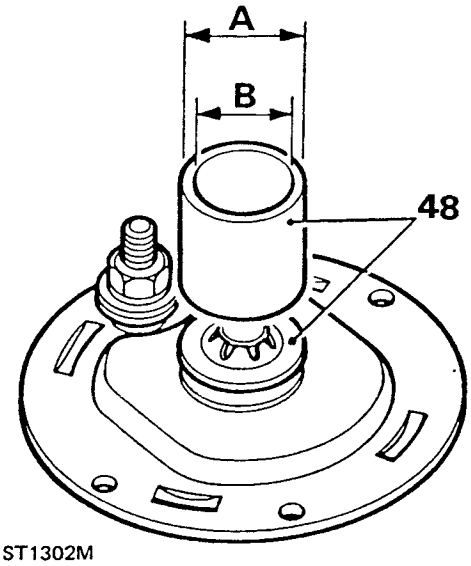
Roller clutch drive

43. Check the operation of the drive clutch, it should provide instantaneous take-up of the drive in one direction and rotate easily and smoothly in the other direction.
44. Check that the drive moves freely on the armature splines without binding or sticking.

ASSEMBLE

45. Reverse instructions 1 to 16 whilst observing the following instructions 46 to 48, also ensure that the dowel peg in the drive-end bracket aligns with matching location in the intermediate bracket before offering the yoke into position.
46. When assembling the drive-end bracket use a new engagement lever pivot pin, and splay the end.
47. Ensure that the internal thrust washer is fitted to the commutator end of the armature shaft before the armature end cover is fitted.
48. Using a suitable tube, drive a new spire ring into position, as illustrated. The position of the spire ring on the armature shaft determines the armature end-float which should be 0,25 mm (0.010 in) maximum between the spire retaining ring and the sintered bearing bush shoulder. Care, therefore, must be used when fitting the spire ring.

Dimension A 25,4 mm (1.00 in)
Dimension B (19 mm (0.75 in)



ST1302M

BENCH TEST

Lock torque and current

49. Clamp the starter firmly in a vice.
Connect a starter switch, a 0-600 amp ammeter and a 12-volt battery in series to the starter.
50. Connect a voltmeter between the solenoid two main terminals.
51. Secure an arm to the driving pinion, and connect a spring balance to the free end of the arm.

52. Operate the switch and note the ammeter, voltmeter, and spring balance readings. Calculate the lock torque by multiplying the reading of the spring balance in pounds by the length of the arm in feet.
53. Check the readings obtained in instruction 52 against the figures given in **DATA** for lock torque current and voltage.

NOTE: If a constant-voltage supply is used for this test, a higher voltage may be registered on the voltmeter than the figure given. If this should occur a variable resistance must be added to the circuit and adjusted to give the required reading and the test repeated.

Solenoid — Coil

54. Check the continuity of the coil windings between the terminal 'STA' and a good earth point on the solenoid body, using an ammeter (in series); a reading of 11.2 to 11.8 amps should be obtained. If no reading, renew the solenoid.
55. Using an ohmmeter connected between the small unmarked Lucar terminal and terminal 'STA' check the resistance of the closing (series) winding; if the reading differs considerably from the limits given the solenoid must be renewed.
56. Using an ohmmeter connected between the small unmarked Lucar terminal and a good earth on the solenoid body, check the resistance of the hold-on (shunt) winding; if the reading differs considerably from the limits given, the solenoid must be renewed.

Solenoid contacts

57. Check the contacts for correct opening and closing by carrying out the instructions 49 to 51 plus the following instruction 58.
58. Operate the switch and note the voltmeter reading; it should register practically zero if the solenoid is satisfactory. Alternatively the solenoid should be checked by substitution.
59. The contacts must only be renewed as a set, e.g. moving and fixed contacts. The fixed contacts are an integral part of the moulded cover. Renew a set of contacts by following instructions 60 to 66.
60. Remove the screws securing the terminal and base assembly to the solenoid.
61. Unsolder the coil connections from the cover terminals.
62. Clamp the solenoid in a vice.
63. Remove the terminal and base assembly.
64. Assemble the new terminal and base assembly.
65. Resolder the connections to the terminal and base assembly.
66. Refit the securing screws and tighten to correct torque.

TECHNICAL DATA

Brush spring tension	1,02 kg (36 oz)
Minimum brush length	9,5 mm (0.375 in)
Minimum commutator thickness	3,5 mm (0.140 in)
Lock torque	2,02 kgm (14.4 lb ft) with 463 amps
Torque at 1,000 r.p.m.	1,02 kgm (7.3 lb ft) with 300 amps
Light running current	40 amp at 6,000 r.p.m. (approx.)
Maximum armature end-float	0,25 mm (0.010 in)

Solenoid

Closing (series) winding resistance	0.25 to 0.27 ohm
Hold on (shunt) winding resistance	0.76 to 0.80 ohm

TIGHTENING TORQUES

Drive-end bracket nuts	6 Nm (4.5 lb ft)
Through bolts	10 Nm (8 lb ft)
Pole-shoe screws	40 Nm (30 lb ft)
Solenoid base assembly screws	2 Nm (1.8 lb ft)

STARTER MOTOR — Paris Rhone — 4 cylinder Diesel

Dismantle and Test

DISMANTLE

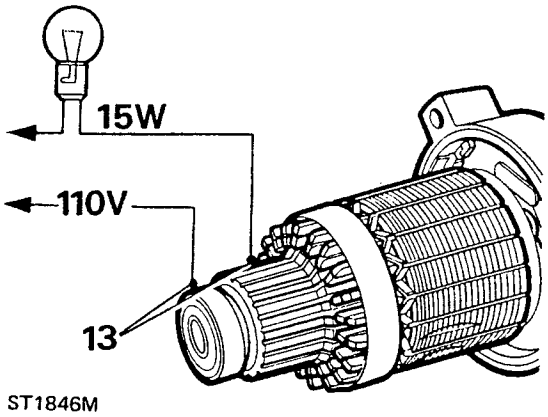
1. Remove starter motor from engine.
2. Disconnect field winding lead from the solenoid.
3. Remove the two nuts and withdraw the solenoid, plunger and spring.
4. Remove the terminal strap.
5. Remove the two through-stud nuts.
6. Remove the brush plate cover.
7. Withdraw the yoke complete with brush plate assembly whilst noting the position of the yoke location plate in the reduction gear housing.
8. Remove the single socket headed screw and withdraw the armature and reduction gear housing from the drive-end bracket.
9. Remove the clutch drive and pinion assembly.
10. Withdraw the brushes from the holders.

Inspection and test

11. Examine all parts for condition. Check the bearings and bushes and pinion drive assembly for wear. Examine the reduction drive pinion and drive gear internal teeth. Check the field coil and armature brushes.

Armature

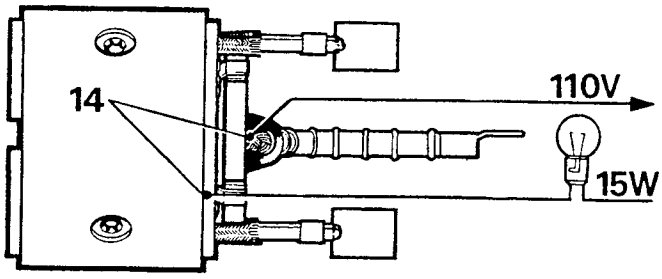
12. Using very fine glass paper, clean the commutator and wipe the surface with a petrol-moistened cloth. Do not undercut the insulation slots.
13. Check the armature insulation by connecting a 110 V.A.C. 15 W test lamp between each commutator segment in turn and the armature shaft. The lamp should not light.



ST1846M

Field coil insulation

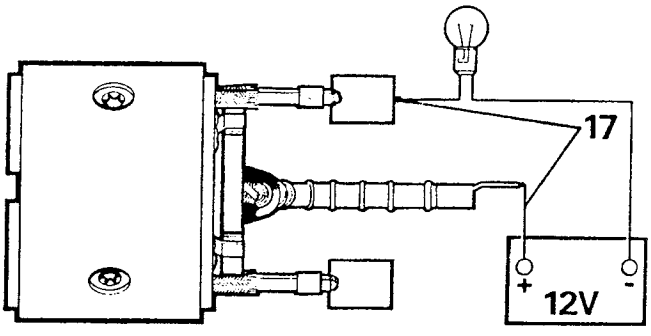
14. Connect a 110 V.A.C. 15 W test lamp between the disconnected end of the winding and a clean part of the yoke.
15. Ensure that the brushes or leads do not touch the yoke during the test.
16. The lamp should not light; if it does light, fit a new field coil assembly.



ST1847M

Field coil continuity

17. Connect a 12 V battery-operated test lamp between each brush in turn and a link lead.
18. The lamp should light; if it does not light, fit a new field coil assembly.

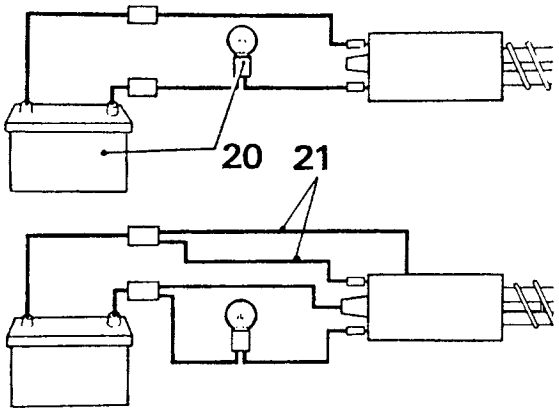


ST1848M

Solenoid

19. Disconnect all cables from the solenoid terminals and connectors.
20. Connect a 12 V battery and a 12 V 60 W test lamp across the solenoid main terminals. The lamp should not light; if it does light, fit a new solenoid complete.
21. Leave the test lamp connected and, using the same 12 V battery supply, energize the solenoid by connecting a 12 V supply between the small solenoid operating Lucar terminal blade and a good earth point on the solenoid body.

continued

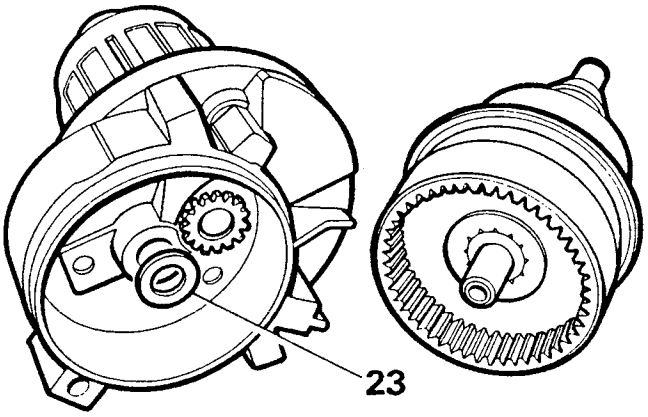


ST1853M

22. The solenoid should be heard to operate and the test lamp should light with full brilliance, otherwise fit a new solenoid complete.

ASSEMBLE

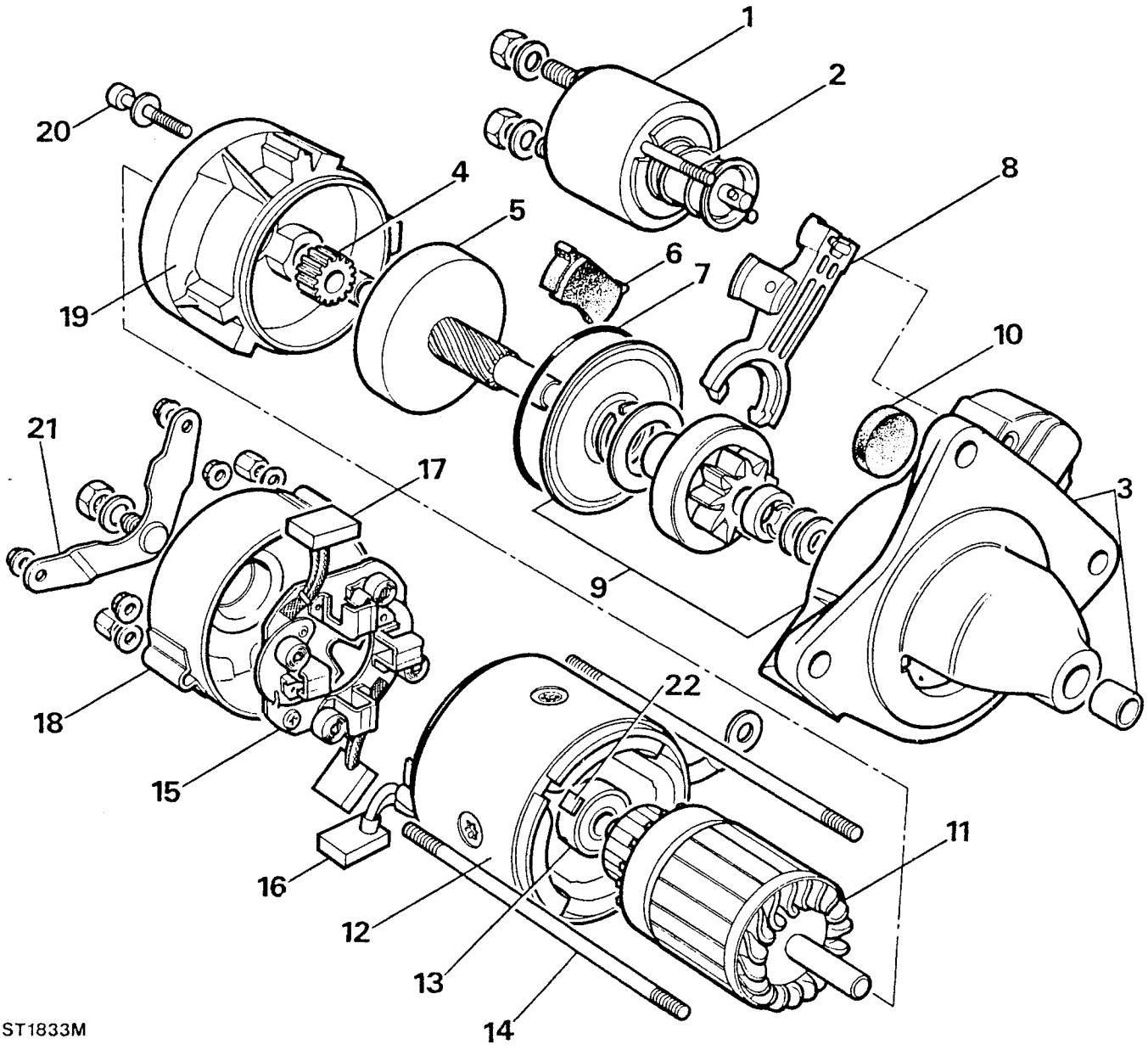
23. Fit the round rubber pad to the drive-end bracket.
24. Fit the lever to clutch drive and pinion assembly and fit to the drive-end bracket ensuring that the two washers are in position on the shaft.
25. Check that the fibre washer is positioned on the shaft inside the reduction gear.



ST1849M

26. Place the rubber pad, with plain side towards the drive-end bracket fit the 'O' ring seal and assemble the reduction gear housing to the drive-end bracket and secure with the single socket-headed bolt.
27. Place the yoke location plate in position in the slot in the reduction gear housing and fit the yoke and brush plate to the armature.
28. Insert the brushes into their holders and release the retaining springs. Ensure that the brushes rest correctly on the commutator.
29. Fit the through-studs to the drive-end bracket.
30. Fit the brush plate cover and secure to the brush plate with the two nuts.
31. Secure the assembly with the through-stud nuts.
32. Fit the terminal strap to the through-studs and retain with the two nuts.
33. Fit the coil spring to the solenoid plunger and assemble the solenoid to the drive-end bracket and secure with the two nuts.
34. Check that the starter motor turns freely without tight spots.

TIGHTENING TORQUES	
Battery connection	11 NM
Earth connection	11 NM
Socket headed screw	7 ± 1,4 NM
Field winding to solenoid nut	9,5 ± 1,5 NM
Through-stud nut	8,5 ± 1,5 NM
Brush cover nuts	4,2 ± 0,6 NM
Solenoid retaining nuts	3,1 ± 0,4 NM



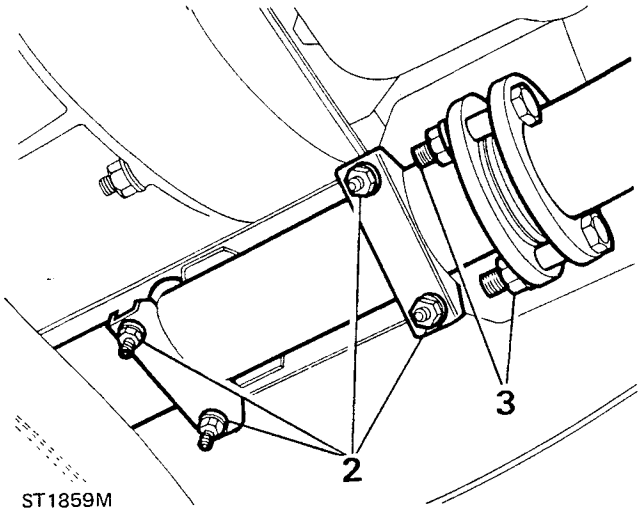
KEY TO STARTER MOTOR

1. Solenoid
2. Solenoid plunger and spring
3. Drive-end bracket and bush
4. Reduction gear pinion
5. Reduction gear
6. Rubber pad
7. 'O' ring seal
8. Lever
9. Clutch drive and pinion assembly
10. Rubber pad
11. Armature
12. Yoke
13. Roller bearing
14. Through-studs
15. Brush plate
16. Field coil brushes
17. Armature brushes
18. Brush plate cover
19. Reduction gear housing
20. Socket-headed screw
21. Terminal strap
22. Yoke location key

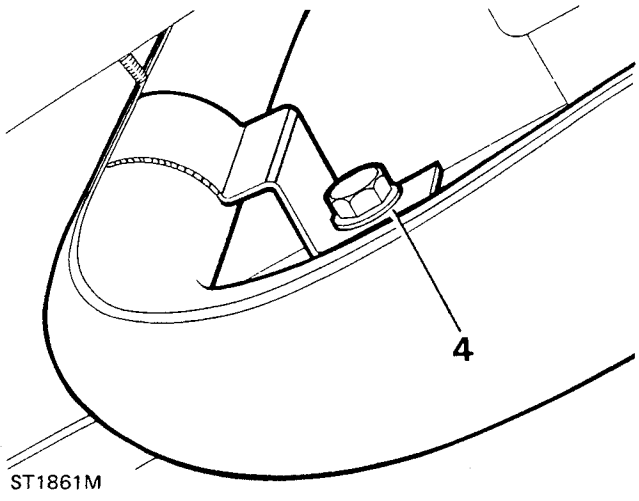
STARTER MOTOR — Paris Rhone, Turbo charged 2.5 Diesel engine.

Removing

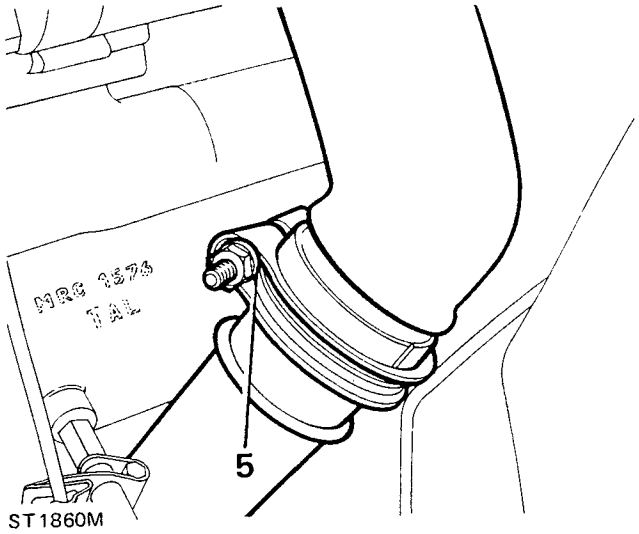
1. Disconnect the battery.
2. Slacken the four nuts securing the intermediate exhaust pipe heat shield and move the shield rearwards.
3. Remove the exhaust flange nuts and bolts.



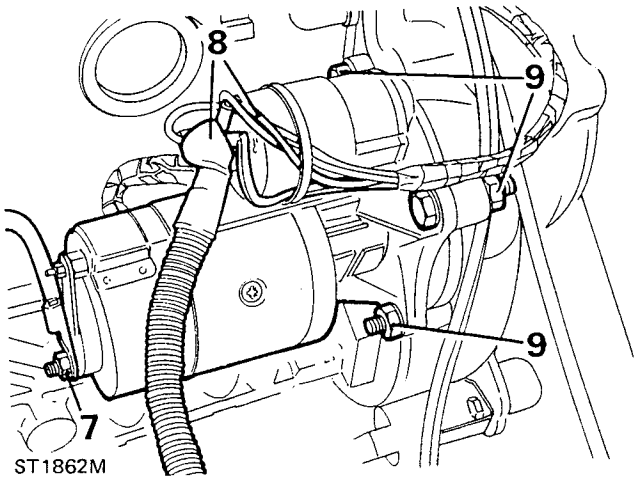
4. Remove the bolt securing the front downpipe to the cylinder block.



5. Release the clamp securing the front downpipe to the turbo-charger elbow.
6. Remove the front downpipe.
7. Disconnect the earth straps from the starter motor.
8. Disconnect the battery, alternator and ignition leads from the starter motor.



9. Remove the starter motor fixings to the engine i.e. one nut and bolt, one nut and one bolt.
10. Remove the starter motor.



Fitting

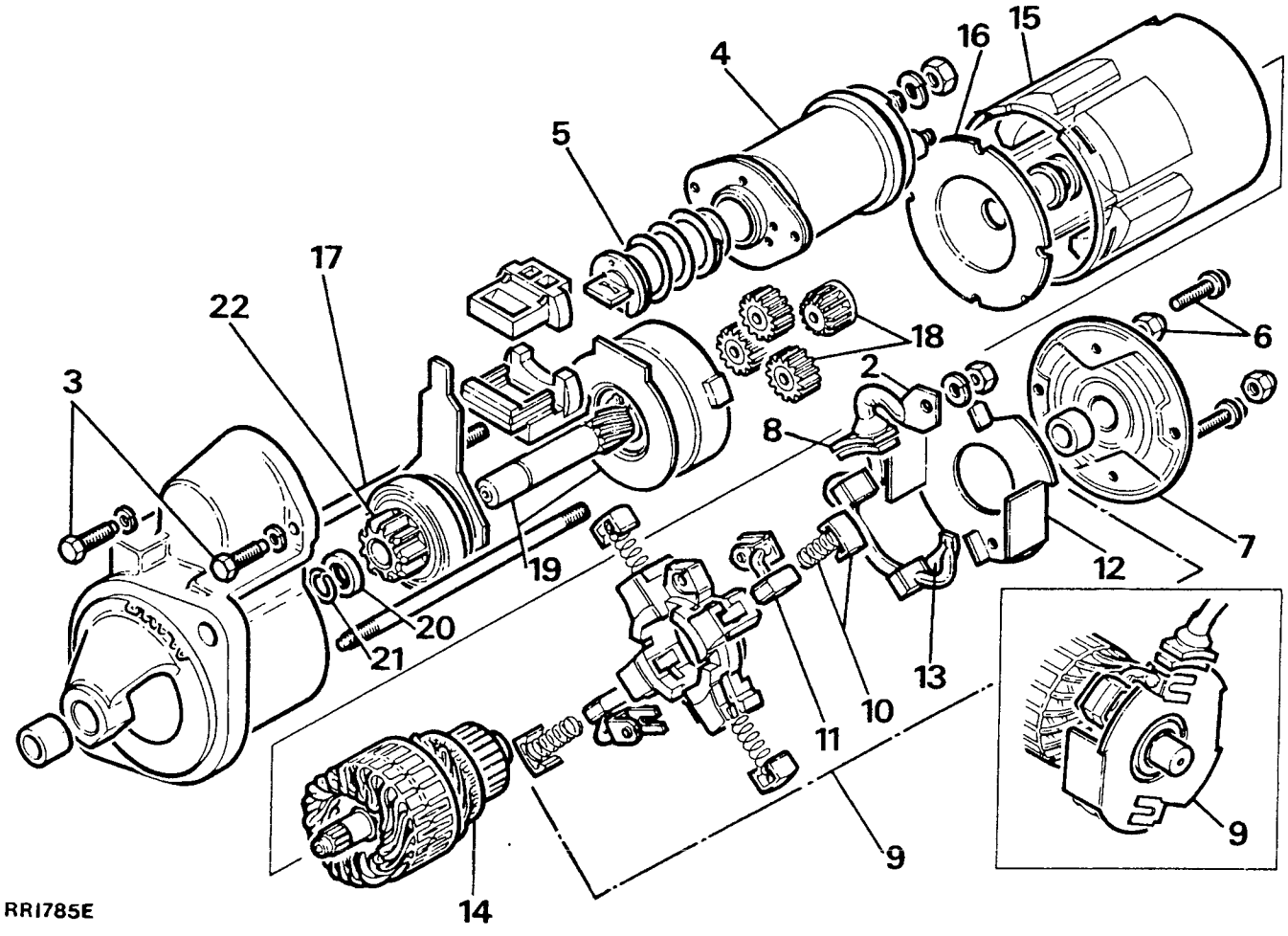
11. Fit starter motor to engine locating it on the single stud and secure with the remaining fixings and evenly tighten to the correct torque.
12. Connect the alternator, ignition and battery leads to the starter solenoid.
13. Connect the earth leads to the rear of the starter motor.
14. Fit the exhaust front-pipe to the intermediate system and evenly tighten the three bolts. Re-position the heatshield and tighten the four nuts.
15. Connect the front pipe to the turbo-charger elbow and secure with the clamp.
16. Secure the front pipe to the cylinder block with the single bolt.

STARTER MOTOR — Lucas M78R — V8 Engine.

Overhaul

Dismantling

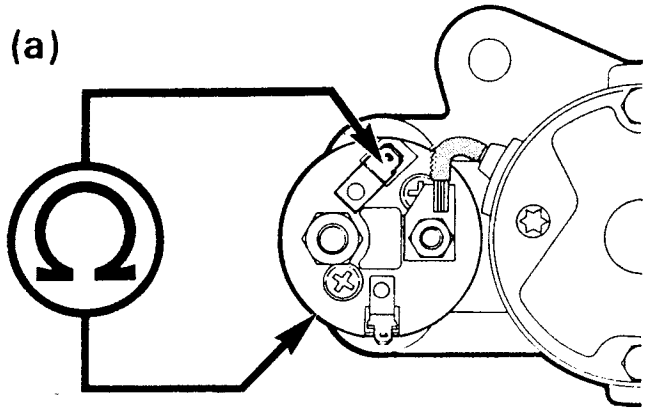
1. Remove the starter motor.
2. Remove the braid between the starter and the solenoid terminal.
3. Remove the solenoid fixing screws.
4. Withdraw the solenoid body.
5. Lift and remove the solenoid plunger.
6. Remove two nuts and two screws from the commutator end bracket.
7. Remove the commutator end 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

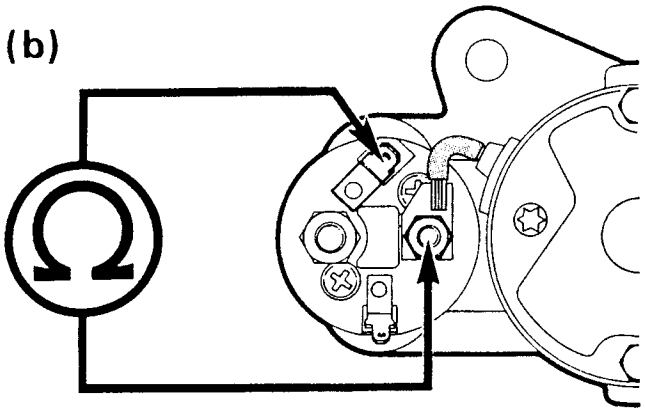
Solenoid

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

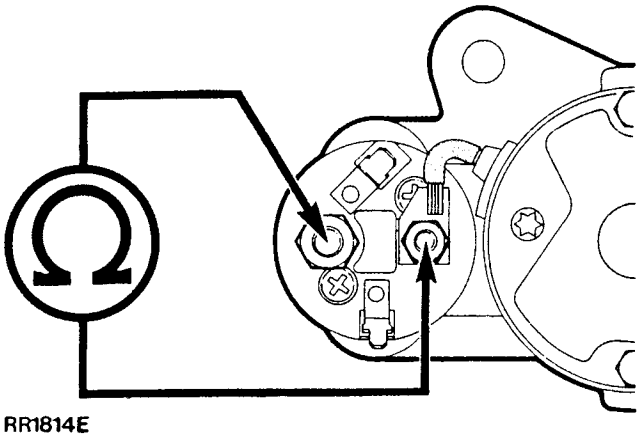


RR1813E

(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.



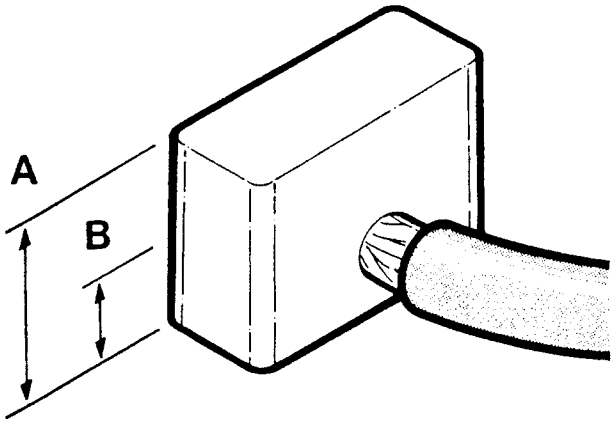
RR1814E

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.

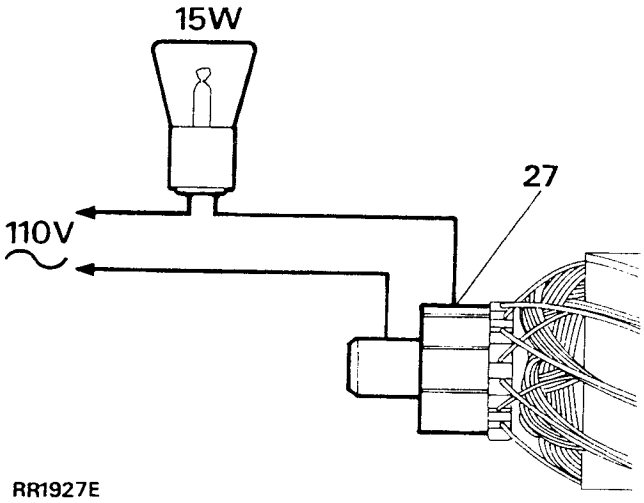


RR1815E

Brush length new, Dimension A is 9 mm (0.354 in).
Minimum brush length, Dimension B is 3.5 mm (0.138 in).

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.



RR1927E

28. If necessary, the commutator may be machined, providing a finished surface can be obtained without reducing the diameter below 28.8 mm (1.13 in), 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 $\frac{9}{16}$" 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

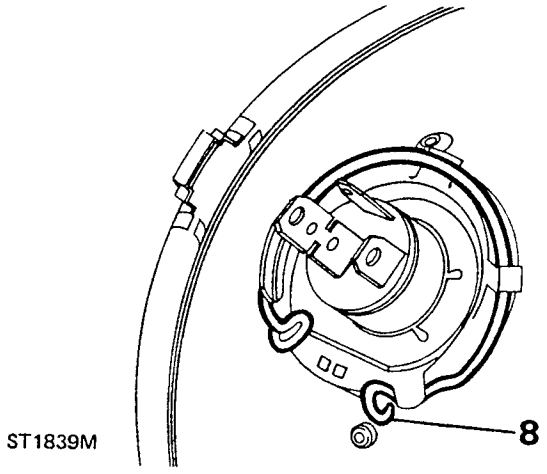
34. Reverse the instructions 1 to 22. Smear the teeth and operating collar of the roller clutch with Shell Retinax 'A' grease. Smear the pivot lever of the drive assembly with Mobil 22 grease. Smear the drive shaft sun and planet gears with Rocol BRB1200 grease.
35. Tighten all the fixings to the correct torque — see Torque Wrench Settings.

REMOVE AND OVERHAUL HEADLAMPS

Remove and dismantle

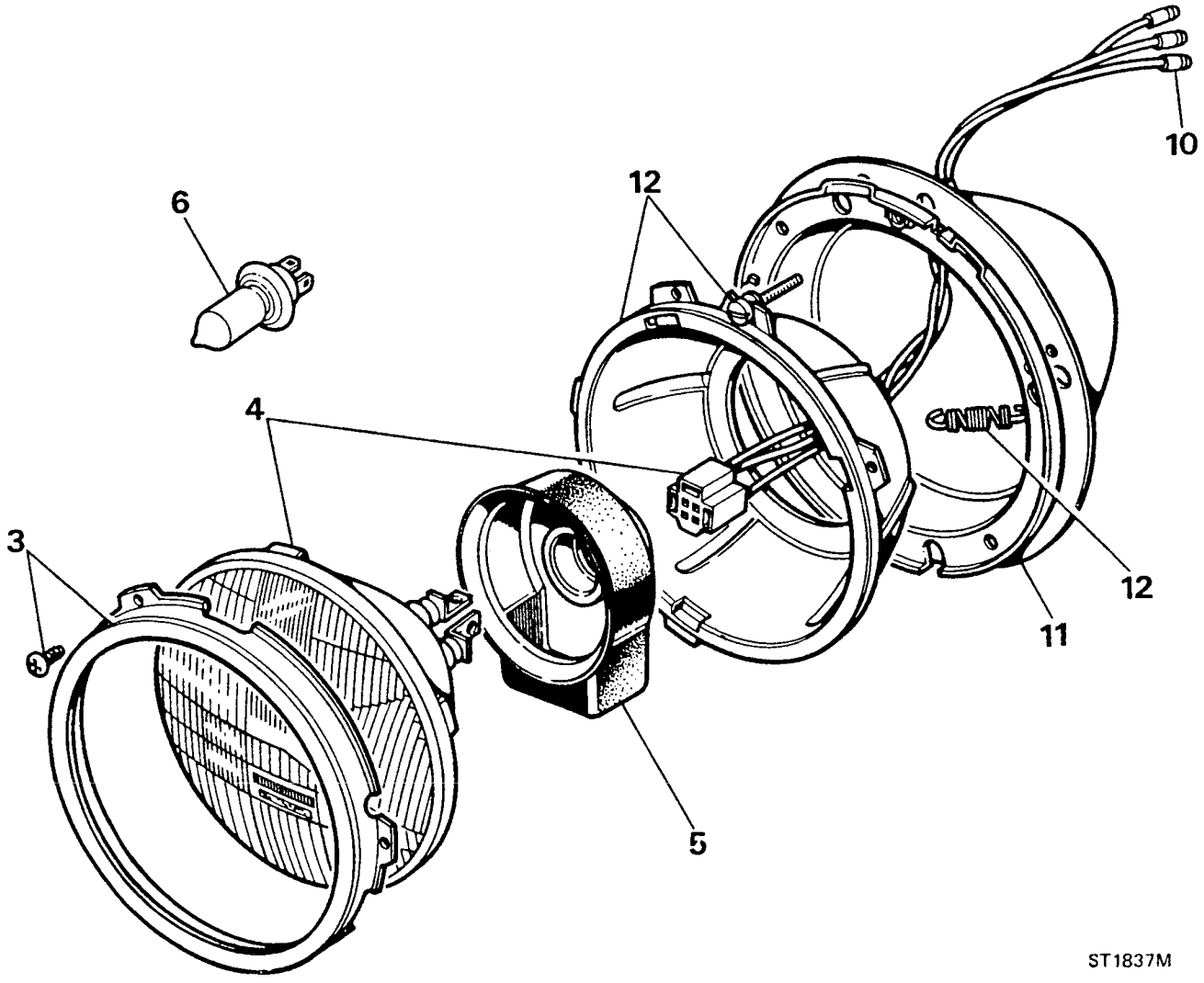
NOTE: Instructions 1 to 8 cover renewal of the bulb or light unit only.

1. Disconnect the battery for safety.
2. Remove the six screws and remove the plastic bezel surrounding the head, side and flasher lamps.
3. Remove the three screws retaining the rim and light unit, and remove the rim.
4. Withdraw the light unit or reflector and pull-off the electrical connector.
5. Remove the rubber grommet.
6. Discard the light unit, if faulty, or the bulb if failed.
7. Release the spring clip to remove the bulb from the reflector unit.
8. If required, fit a new bulb of the correct wattage and secure with the spring clip, as illustrated.

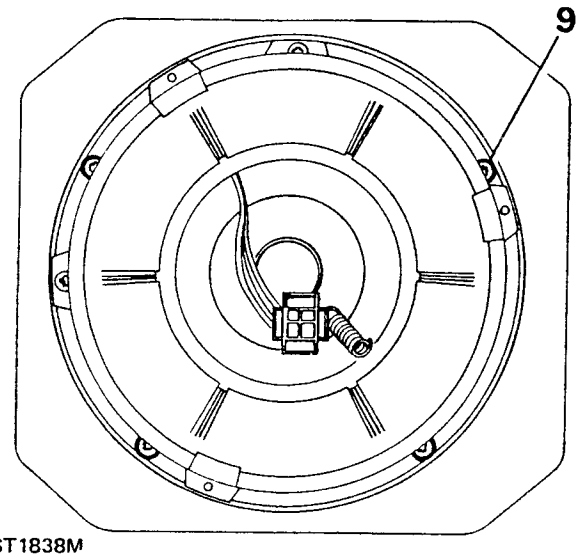


ST1839M

9. Remove the four screws and release the headlamp shell from the front wing.
10. Disconnect the electrical leads from the bullet connectors and remove the headlamp shell.
11. Remove the rubber seal.
12. Release the two trimmer screws and coil spring and detach the rim seating from the headlamp shell.



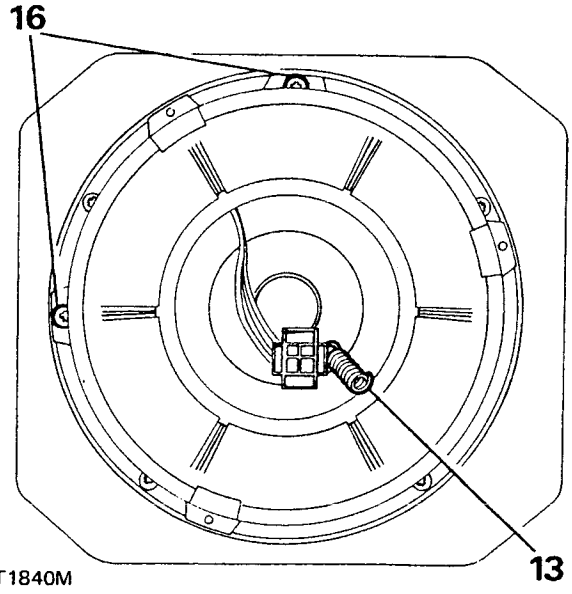
ST1837M



ST1838M

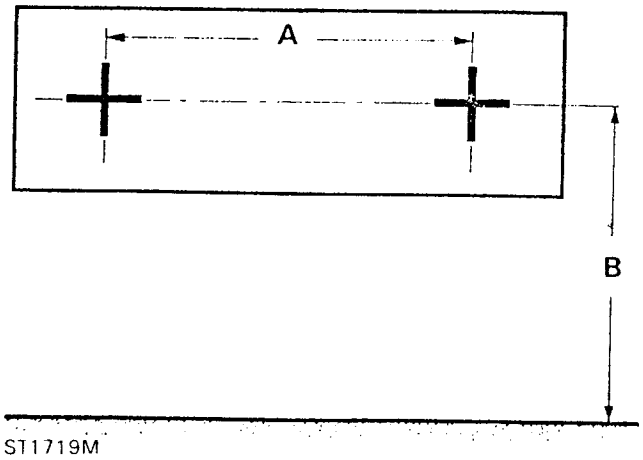
Assemble and refit

13. Fit the rim seating to the headlamp shell with the two trimmer screws and coil spring.
14. Fit the rubber seal to the headlamp shell.
15. Connect the leads to the bullet connectors.
16. 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.
17. Secure the shell assembly to the wing with the four screws.
18. Offer-up the light or reflector unit to the rim seating and connect the electrical plug.



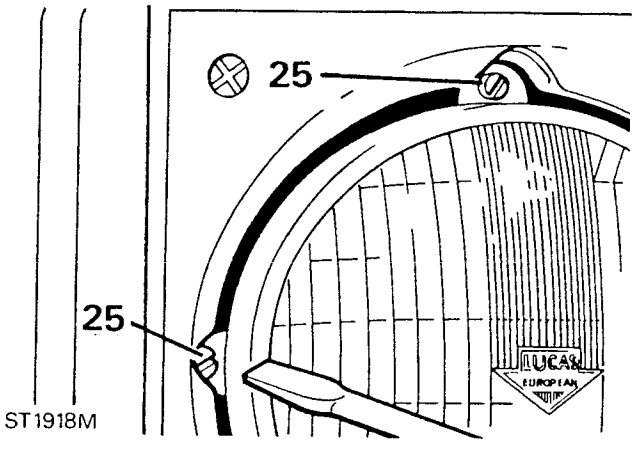
ST1840M

19. Secure the assembly with the rim and three screws.
20. Fit the plastic bezel with the six screws.
21. Connect the battery and check that the lamps function.
22. 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:-
23. Position the vehicle on level ground with the tyres correctly inflated, approximately four meters from a wall or screen, marked as illustrated.
24. The beam centres 'A' are measured horizontally on the vehicle and the dimension 'B' vertically from the ground.



ST1719M

25. Switch-on the main beam and adjust the setting as necessary with the trimmer screws.

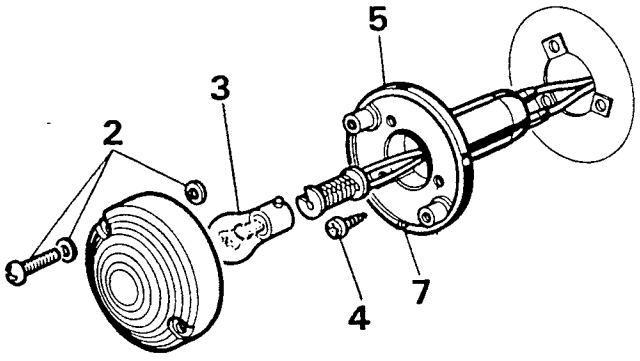


ST1918M

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

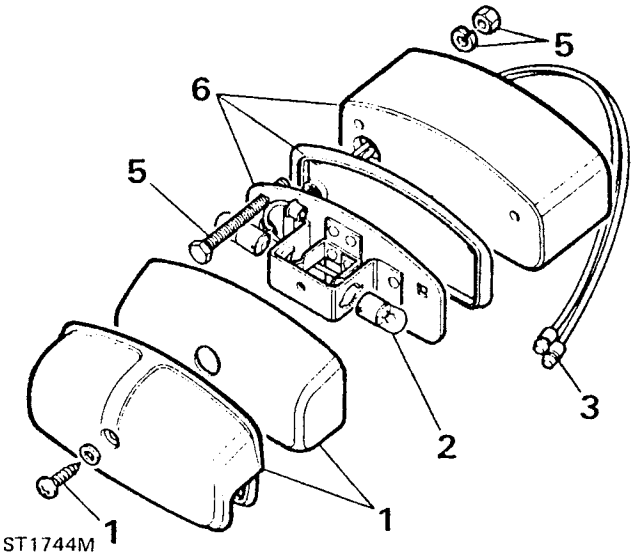
Refitting lamp and bulbs

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

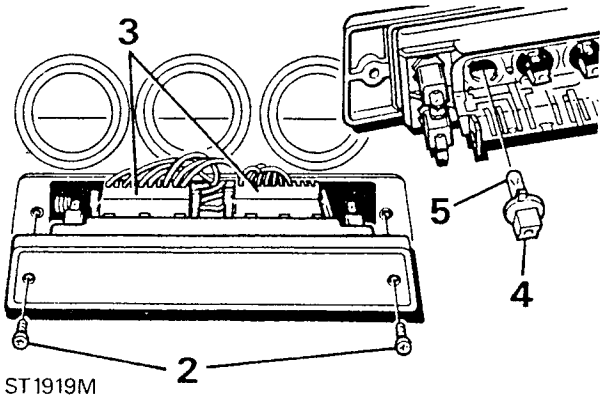
Refitting lamp and bulbs

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.

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.

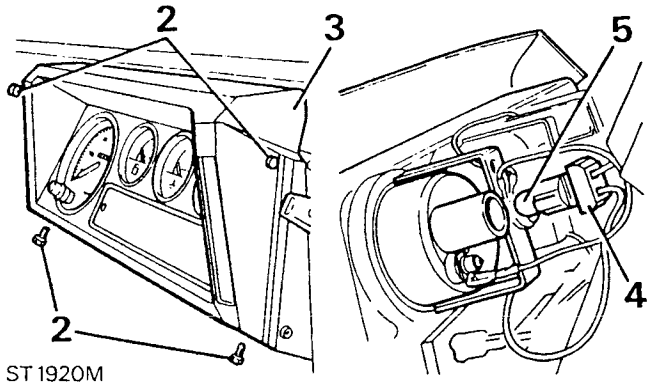


ST1919M

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.



ST1920M

OVERHAUL WIPER MOTOR

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 (0.190 in) 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 (5 to 7 oz) 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.

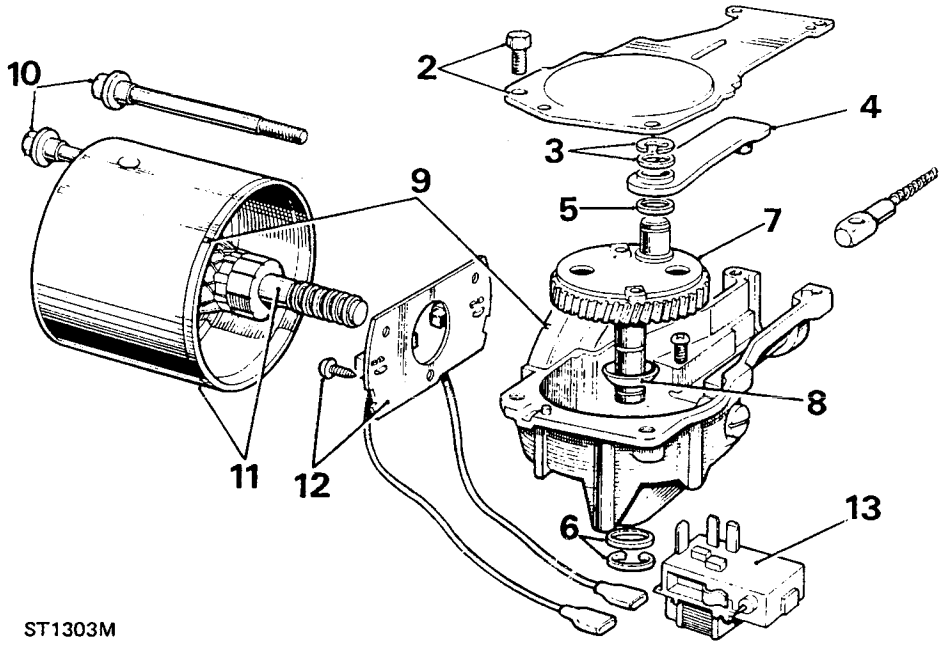
ASSEMBLE

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.

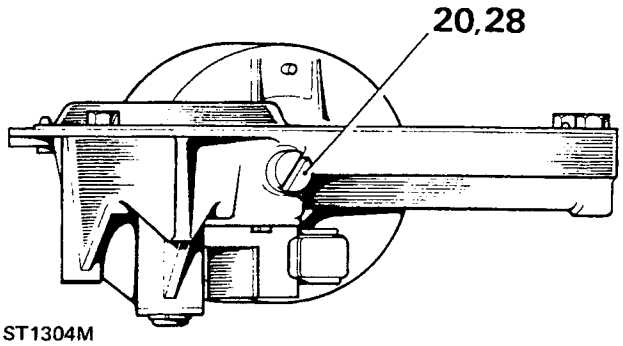
KEY TO WIPER MOTOR COMPONENTS

1. Flexible drive
2. Gearbox cover
3. Connecting-rod retaining washer and circlip
4. Connecting-rod
5. Flat 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 yoke
12. Brush gear assembly
13. Limit switch



ST1303M

20. Fit the armature and yoke to gearbox using alignment marks, secure with the yoke retaining bolts tightening to 23 Kg f cm (20 lbf in). 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

DATA

Windscreen wiper motor	
Armature end-float	0,1 to 0,2 mm (0.004 to 0.008 in)
Brush length, minimum	4,8 mm (0.190 in)
Brush spring tension	140 to 200 g (5 to 7 oz)
Resistance of armature winding at 16°C (69°F) measured between adjacent commutator segments	0.23 to 0.35 ohms
Light running, rack disconnected: Current at 13.5 V	2.0 amps
Speed, 60 seconds from cold — Low speed	45± 3 rev/min
— High speed	65± 5 rev/min

ELECTRICAL EQUIPMENT FAULT TRACING

INTRODUCTION

The following information is designed to assist electricians in diagnosing faults by a process of elimination.
If the diagnosis charts are followed step by step, isolation of a fault and its rectification will be achieved logically and consistently in the minimum of time.
Basic information on the use of standard equipment and normal workshop practice is not given. If electronic diagnostic equipment is being used, the manufacturer's operating instructions must be followed.

SYSTEMATIC DIAGNOSIS

Normally, if the tests are completed in the sequence given, it should be possible to detect the fault. If difficulty is experienced, return to the beginning and analyse the results to check that you are on the right path.

1. Collect Evidence
Collect as much evidence as possible, do not rely on just a few symptoms.
Use all the senses — sight, smell, sound.

2. Analyse Evidence
Consider all evidence collected.

3. Locate Fault
Narrow down the fault to a component, using test equipment and the collected evidence.

4. Determine and Remove Cause
Ask why the fault has occurred. Trace and rectify the cause.

5. Rectify Fault
Adjust, overhaul or renew the faulty component, but ensure the cause of the fault is also rectified.

6. Check System
Ensure the equipment operates correctly and is properly fixed.

PRELIMINARY CHECKS AND TESTS

The checks and test procedures given must be carried out in the sequence indicated.

Battery
State of charge and condition of the battery must be checked before circuits are tested.

Connections
Ensure all connections are clean and secure. Earth connections must be made to clean unpainted surfaces.

Fuses
Check for obvious signs of overload or short circuit before renewing a blown fuse or resetting an overload cut-out.
Under no circumstances must a higher rating fuse be used than that specified.

Voltage Drop
Check a circuit with the normal load applied and the voltmeter connected in parallel. Voltage drop varies with load, cable size and current.

Current Flow
Connect the ammeter in series with the supply cable (not starter cable).

Resistance
Use an ohmmeter to measure the resistance in a circuit or component.

Required Test Equipment

Charging Tests 1 to 9
0 - 20 V Moving coil voltmeter
5-0-50 A Moving coil ammeter
Hydrometer
Heavy discharge voltage tester
Cadium sticks

Ignition Tests 10 to 15
0 - 20 V Moving coil voltmeter
0 - 1 V Moving coil voltmeter
Ohmmeter

Starter Tests 16 to 26
0 - 20 V Moving coil voltmeter
5-0-60 A Moving coil ammeter
Hydrometer
Lock torque clamps
Spring balance

ABBREVIATIONS

A.	Amperes	L.T.	Low tension
Ah	Ampere-hour	mm	Millimetre
C	Centigrade (Celsius)	rev/min	revolutions per minute
d.c.	Direct current	V	Volts
F	Fahrenheit	°	Degree temperature
H.T.	High tension	%	Percentage
in	Inch		

Fault	Check	Test	Rectification
CHARGING SYSTEM			
Battery will not hold charge	**1, 2, 3, 4**	**1. Charging circuit:** Check continuity of leads, tightness and cleanliness of connections	Clean, renew as necessary
		Battery Service **Topping-up:** Use distilled or deionised water. Battery additives should never be used. **Charging:** A slow charge at normal rate is more beneficial than at a fast rate. **Condition:** If after charging, battery voltage is below 9 V, renew the battery.	
		2. Check battery charge: Using a hydrometer, check the specific gravity in each battery cell. **Note:** Readings should not be taken if the battery has only just been topped up. It should be charged for 1 - 2 hours before taking any readings.	
		(i) Climates normally below 25°C (77°F): 1.260 - 1.280; Climates normally above 25°C (77°F): 1.210 - 1.230 — Battery fully charged	Carry out Test 3
		(ii) Climates normally below 25°C (77°F): 1.230 - 1.250; Climates normally above 25°C (77°F): 1.170 - 1.190 — Battery 70% charged	Carry out Test 3
		(iii) Climates normally below 25°C (77°F): 1.110 - 1.130; Climates normally above 25°C (77°F): 1.050 - 1.070 — Battery discharged	Charge battery and recheck or renew
		(iv) A variation of 0.040 between cells indicates a suspect battery For every 10°C (18°F) subtract 0.007. For every 10°C (18°F) above 15°C (60°F) add 0.007.	Renew battery
		3. Heavy voltage discharge check: Using heavy discharge test equipment, set the tester to discharge the battery at three times the Ah capacity (20 hour rate) for 15 seconds.	
		(i) Voltage reading more than 9.6 V — Battery satisfactory	
		(ii) Voltage reading less than 9.6 V — Battery unsatisfactory	Carry out Test 4
		4. Intercell voltage check: Charge the battery for three minutes at the stated Ah capacity (20 hour rate) or at 40A, whichever is the lowest. With battery still on charge, record overall voltage and the inter cell readings using the cadmium sticks. Subtract the lowest inter cell reading from the highest.	
		(i) Inter cell voltage variation more than 0.15 V — Defective battery.	Renew battery
		(ii) Battery voltage below 15.5 V, inter cell voltage variation less than 0.15 V — Battery satisfactory but discharged	Charge battery
		(iii) Battery voltage above 15.5 V, inter cell voltage variation less than 0.15 V — Battery discharged and may be sulphated	Charge battery and re-test

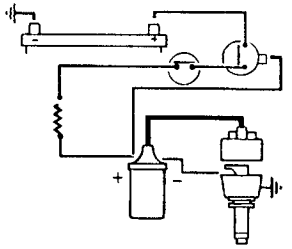
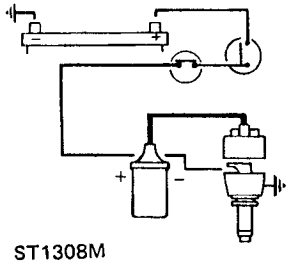
continued

Fault	Check	Test	Rectification
Battery not being charged **CAUTION: The vehicle battery must never be disconnected while the engine is running**	**1, 2, 3, 4, 5**	**5. Alternator output** Connect a voltmeter across the battery terminals. Connect an ammeter into the alternator battery sensing circuit either at the battery terminal or solenoid. Switch on all loads (except wipers) for one minute. Run the engine at 3,000 rev/min and wait until the ammeter reading is stable.	
Warning light stays on	**1, 2, 3, 4, 6, 7**	(i) Ammeter reading Zero — Faulty alternator	Overhaul alternator
Warning light does not function when ignition switched on	**1, 2, 3, 4, 8, 9**	(ii) Ammeter reading below 10A, voltmeter reading between 13.6 and 14.6 V and battery in low state of charge	Bench test and overhaul
		(iii) Ammeter reading below 10A, voltmeter reading below 13.6V	Renew voltage regulator
		(iv) Ammeter reading above 10A, voltmeter reading above 14.6V	Renew voltage regulator
		6. Drive belt: Check the drive belt is not broken or slipping	Adjust or renew
		7. IND lead: Disconnect the IND lead from the alternator, start engine and run above idle speed. (i) Warning light stays on — Short circuit to earth between IND lead and warning light	Repair or renew
		(ii) Warning light goes out	Carry out Test 5
		8. Warning light bulb: Check warning lamp bulb (i) Bulb faulty	Renew
		(ii) Bulb not faulty	Carry out Test 9
TEST EQUIPMENT **Voltmeter 0 - 20 V moving coil** **Ammeter 5-0-60A moving coil** **Hydrometer**		**9. Alternator plug connections:** Remove plug from alternator, switch on ignition and connect a voltmeter between earth and each terminal in turn. (i) Voltmeter reads 12V	Carry out Test 5
		(ii) Voltmeter does not read 12V — cable circuits faulty	Check cable continuity; repair or renew
IGNITION SYSTEM			
Engine will not fire	**10, 11, 12, 13, 14, 15**	**10. Engine cranking speed:** Too low	See STARTING SYSTEM
		11. Sparking plugs: Check for dirty electrodes or incorrect gaps for faulty operation on pressure test equipment	Clean, set gaps or renew contact breaker distributors carry out Test 12
		12. Contact breaker points: Check for incorrect gap, burning or pitting	Clean, adjust or renew
		13. Distributor cap: Check for 'tracking' (thin lines of burned bakelite), ensure cap is clean and dry and that the centre brush moves freely with no excessive side movement and contacts the rotor arm.	Rectify or replace. Carry out Test 14. Rectify or replace. Carry out Test 14.

continued

Fault	Check	Test	Rectification
IGNITION SYSTEM		a. Connect 0 - 1 V voltmeter as in Test 15c, fit a jumper lead from earth to distributor body, with ignition on and contact breaker points closed: (i) Below 0.2V	Remake earth connections between distributor body and earth
		(ii) Above 0.2V — High resistance or open circuit in distributor	Check/repair or renew contact breaker points, base plate screws earth lead or supply lead as necessary
		b. Connect 0 - 20 V voltmeter as in Test 15b, with ignition on and contact breaker points open: (i) Above 12 V — Continuity in primary windings of coil, supply line and ballast resistor if fitted	Carry out Test 15g
		(ii) Zero — open circuit feed to coil, open circuit primary windings, open circuit (iii) ballast resistor if fitted or short circuit in distributor or coil negative lead	Carry out Test 15f
		c. Connect 0 - 20 V voltage as in Test 15b, with ignition on and contact breaker points open. Remove coil negative lead from coil and recheck voltage: (i) Above 12 V — Short circuit in coil, negative lead or distributor	Check contact breaker points correctly fitted, short circuit in condenser (or capacitor when ballast resistor fitted) or supply lead; repair or renew
		(ii) Zero — reconnect coil negative lead	Carry out Test 15g
		d. Connect 0 - 20 V voltmeter between earth and coil positive terminal, with ignition on and contact breaker points closed: (i) Above 12V — Coil primary windings open circuit	Renew coil
		(ii) 11.5V - 12V without ballast resistor 5V - 7V with ballast resistor — If result of Test 15f was above 12V L.T. circuit is satisfactory	Fault elsewhere
		(iii) Below 11.5V or zero without ballast resistor — Excessive resistance or open circuit supply to coil. Leaving the voltmeter connected to earth, work back through the supply circuit at the terminals on the ignition switch and solenoid until the resistance or open circuit is located	Rectify and recheck
		(iv) Below 5V or zero with ballast resistor — Excessive resistance or open circuit in supply to coil	Carry out Test 15H
		e. Connect 0 - 20 V voltmeter between earth and the lead from the ballast resistor to the coil positive terminal, with the ignition on and contact breaker points closed: (i) 5V - 7V or above 12V — Fault in the ballast resistor to coil lead	Repair or renew lead then re-test
		(ii) Below 5V or zero — Excessive resistance or open circuit between battery and coil	Carry out Test 15j
		f. Connect 0 - 20 V voltmeter between earth feed lead to ballast resistor, with ignition on and contact breaker points closed: (i) Above 12V — Fault in ballast resistor	Renew and re-test. If satisfactory fault elsewhere
		(ii) Zero or below 11.5V — Fault in supply circuit from battery. Leaving the voltmeter connected to earth, work back through the supply circuit at the terminals on the ignition switch and solenoid until the fault is located.	Rectify and re-test. If satisfactory fault elsewhere

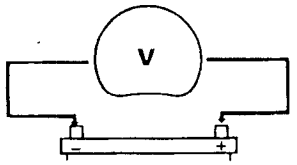
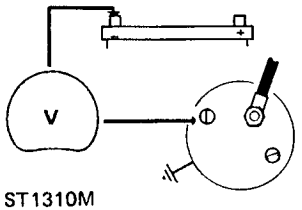
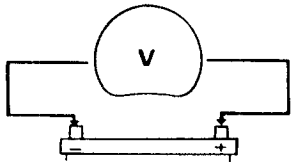
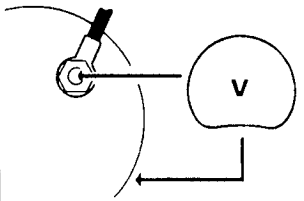
continued

Fault	Check	Test	Rectification
IGNITION SYSTEM		**14. H.T. Circuit**	
		 ST1307M	
		a. Disconnect main H.T. lead from distributor cap, hold approximately 6 mm (¼ in) from a good earth, ensure contact breaker points are closed, switch on ignition and flick contact breaker points open.	
		(i) Good healthy spark — Main H.T. lead, condenser and coil satisfactory	Carry out Test 14e
		(ii) Poor or no spark	Carry out Test 14b
		b. Replace main H.T. lead with a known good H.T. lead and repeat Test	
		(i) Good healthy spark — Original H.T. lead faulty	Renew main H.T. lead. Carry out Test 14e
		(ii) Poor or no spark	Carry out Test 14c
		c. Replace condenser with a known good one and repeat Test	
		(i) Good healthy spark — Original condenser faulty	Renew condenser. Carry out Test 14e
		(ii) Poor or no spark	Carry out Test 14d
		d. Replace ignition coil with a known good coil and repeat Test	
		 ST1308M	
		(i) Good healthy spark — original coil faulty	Renew coil, refit original H.T. lead and condenser and repeat Tests 14a and b, or carry out Test 14e
TEST EQUIPMENT **(A) Voltmeter 0 - 20V moving coil** **(B) Voltmeter 0 - 1V moving coil** **Ohmmeter**		e. Hold loose end of main H.T. lead approximately 3 mm (⅛ in) from the rotor arm electrode. Ensure contact breaker points are closed, switch on ignition and flick points open	
		(i) Good healthy spark — Rotor arm shorting to earth	Renew rotor arm
		(ii) Very faint or no spark — Rotor arm insulation satisfactory	Carry out Test 15
		15. L.T. circuit continuity check:	
		a. Check battery voltage and state of charge	See STARTING SYSTEM
		b. Connect voltmeter 0 - 1V between earth and coil negative terminal with ignition on and contact breaker points closed:	
		(i) Below 0.2V	Carry out Test 15e
		(ii) Above 0.2V — Resistance or open circuit	Carry out Test 15c
		c. Connect 0 - 1V voltmeter between earth and distributor L.T. terminal with ignition on and contact breaker points closed:	
		(i) Below 0.2V — Resistance or open circuit between coil negative and distributor L.T. terminal	Renew lead
		(ii) Above 0.2V — Resistance or open circuit between earth and distributor L.T. terminal	Carry out Test 15d

continued

Fault	Check	Test	Rectification
IGNITION SYSTEM (continued)		d. Connect voltmeter (B) as in Test 15C, fit a jumper lead from earth to distributor body, with ignition on and contact breaker points closed: (i) Below 0.2V	Remake earth connections between distributor body and earth
		(ii) Above 0.2V — High resistance or open circuit in distributor	Check/repair or renew contact breaker points, base plate screws earth lead or supply lead as necessary
		e. Connect voltmeter (A) as in Test 15b, with ignition on and contact breaker points open: (i) Above 12 V — Continuity in primary windings of coil, supply line and ballast resistor if fitted	Carry out Test 15g
		(ii) Zero — open circuit feed to coil, open circuit primary windings, open circuit ballast resistor if fitted or short circuit in distributor or coil −ve lead	Carry out Test 15f
		f. Connect voltage (A) as in Test 15b, with ignition on and contact breaker points open. Remove coil −ve lead from coil and recheck voltage: (i) Above 12 V — Short circuit in coil, −ve lead or distributor	Check contact breaker points correctly fitted, short circuit in condenser (or capacitor when ballast resistor fitted) or supply lead; repair or renew
		(ii) Zero — reconnect coil −ve lead	Carry out Test 15g
		g. Connect voltmeter (A) between earth and coil +ve terminal, with ignition on and contact breaker points closed: (i) Above 12V — Coil primary windings open circuit	Renew coil
		(ii) 11.5V - 12V without ballast resistor 5V - 7V with ballast resistor } If result of Test 15f was above 12V L.T. circuit is satisfactory	Fault elsewhere
		(iii) Below 11.5V or zero without ballast resistor — Excessive resistance or open circuit supply to coil. Leaving the voltmeter connected to earth, work back through the supply circuit at the terminals on the ignition switch and solenoid until the resistance or open circuit is located	Rectify and recheck
		(iv) Below 5V or zero with ballast resistor — Excessive resistance or open circuit in supply to coil	Carry out Test 15h
		h. Connect voltmeter (A) between earth and the lead from the ballast resistor to the coil +ve terminal, with the ignition on and contact breaker points closed: (i) 5V - 7V or above 12V — Fault in the ballast resistor to coil lead	Repair or renew lead then re-test
		(ii) Below 5V or zero — Excessive resistance or open circuit between battery and coil	Carry out Test 15j
		j. Connect voltmeter (A) between earth feed lead to ballast resistor, with ignition on and contact breaker points closed: (i) Above 12V — Fault in ballast resistor	Renew and re-test. If satisfactory fault elsewhere
		(ii) Zero or below 11.5V — Fault in supply circuit from battery. Leaving the voltmeter connected to earth, work back through the supply circuit at the terminals on the ignition switch and solenoid until the fault is located.	Rectify and re-test. If satisfactory fault elsewhere

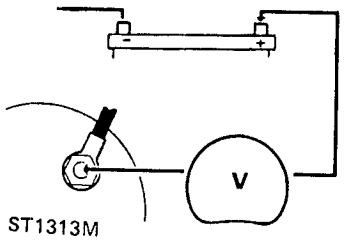
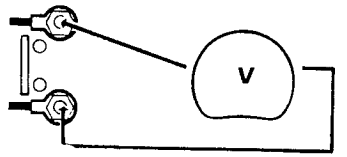
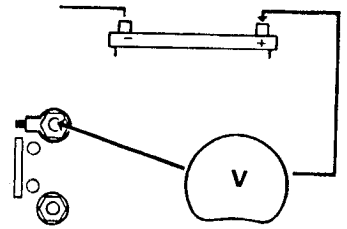
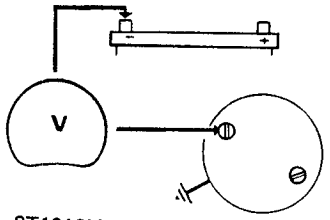
continued

Fault	Check	Test	Rectification
STARTER SYSTEM			
Starter will not operate	**16, 17, 18, 19, 20, 21, 22**	**16. Battery voltage** Connect voltmeter between battery terminals: Below 12V  ST1309M	Charge or renew battery
Engine cranking speed low	**16, 17, 18, 19, 23, 24, 25**		
Engine will not start	**16, 17, 18, 19, 24, 25**		
Starter operates but crankshaft stationary	**23, 24, 25**	**17. Battery charge** Take hydrometer readings: Below 70% charged — 1.230 at 15°C	Charge battery, see **CHARGING SYSTEM**
		18. Wiring  ST1310M a. Check that all connections are clean and tight	a. Renew wiring and connectors
		b. Disconnect coil negative lead. Voltmeter between battery negative and starter end bracket bolt Operate starter: Above 0.5V	b. Clean and tighten all earth connections, battery, starter engine Tighten starter through bolts Remove starter, clean motor and backplate faces
		19. Battery — on load  ST1311M Disconnect coil negative lead, Voltmeter as Test 1 Operate starter	
		a. Below 10V — starter or circuit taking too much current	a. Check circuit Overhaul or renew starter
		b. Between 10V to 12V but crankshafts turn slowly	b. Carry out Test 20
		20. Battery voltage at starter — on load  ST1312M Disconnect coil negative lead. Voltmeter starter terminal to earth on motor Operate starter	
		a. Above 9.5V — Starter satisfactory	a. Check solenoid Test 23
		b. Below 9.5V	b. Carry out Test 21
		c. Below 9.5V — solenoid operating	c. Carry out Test 25

TEST EQUIPMENT
Voltmeter 0 - 20V moving coil
Ammeter 5.0-60A moving coil
Hydrometer

Lock torque clamps and spring balance

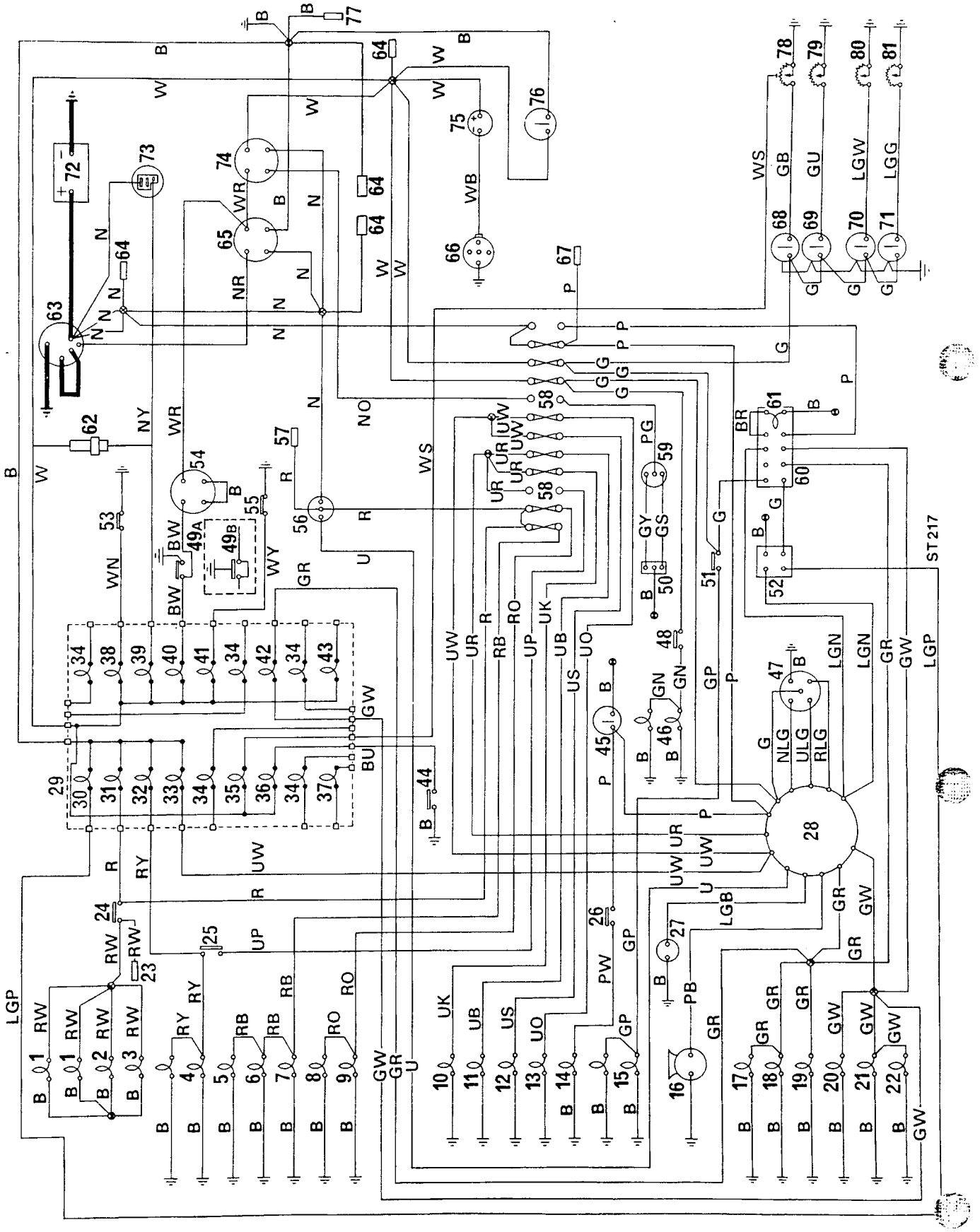
continued

Fault	Check	Test	Rectification
STARTER SYSTEM		**21. Starter voltage — on load**  ST1313M Voltmeter starter terminal to battery positive. Switch on ignition, battery voltage Disconnect coil positive lead Operate starter a. Below 0.5V — cable and connections satisfactory b. Above 0.5V — Resistance between battery and starter	a. Carry out Test 23 b. Check all connections and cables
		22. Voltage drop across solenoid switch  ST1314M Voltmeter between starter solenoid terminals. Switch on ignition, battery voltage Disconnect coil negative lead. Operate starter a. Below 0.5V b. Above 0.5V	a. Carry out Test 23 b. Faulty switch or connections
		23. Voltage at Solenoid — on load  ST1315M Disconnect coil negative lead, Voltmeter between solenoid feed terminal and battery positive Operate starter a. 9V to 10V — and result of Test 22 was 'b' (below 9V with ballast resistor circuit) b. above 12V — Starter does not operate (above 9V with ballast resistor circuit)	a. Change solenoid b. Clean earth, re-test — renew solenoid
		24. Voltage drop in earth line  ST1316M Disconnect coil negative lead. Voltmeter between starter through bolt and battery negative terminal Operate starter: abvoe 0.5V	i Clean and tighten all earth connections, battery, starter, engine ii Tighten starter, through bolts iii Remove starter, clean motor and backplate faces

continued

Fault	Check	Test	Rectification
STARTER SYSTEM		**25. Drive faulty**	
		a. Remove starter: check condition of pinion and starter ring gear	a. Renew pinion or ring gear
		b. Inertia drive, check that pinion rotates freely	b. Renew inertia drive
		c. Check that crankshaft rotates freely	c. Check for engine fault, tight or siezed
		d. Lock torque, free running speed and current	d. Check brushes — overhaul starter
		26. Ignition circuit fault	See **IGNITION SYSTEM**

FOUR CYLINDER PETROL



KEY TO FOUR CYLINDER PETROL DIAGRAM

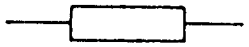
1. Speedometer illumination
2. Fuel indicator illumination
3. Water temperature illumination
4. Rear fog lamps
5. Number plate lamp
6. LH tail lamp
7. LH side lamp
8. RH tail lamp
9. RH side lamp
10. LH headlamp dip beam
11. RH headlamp dip beam
12. LH headlamp main beam
13. RH headlamp main beam
14. Interior lamp
15. Stop lamp
16. Horn
17. LH side repeater
18. LH front indicator
19. LH rear indicator
20. RH front indicator
21. RH rear indicator
22. RH side repeater
23. Auxiliary instrument illumination
24. Panel illumination switch
25. Rear fog switch
26. Interior lighting switch
27. Washer pump
28. Steering column switches
29. Grouped warning lights (comprising items 30 to 43)
30. Trailer warning light
31. Side light warning light
32. Rear fog warning light
33. Main beam warning light
34. Spare position
35. Low fuel warning light
36. Locked four-wheel drive warning light
37. Cold start warning light
38. Oil warning light
39. Charge warning light
40. Brake warning light
41. Park brake warning light
42. Direction indicator warning light
43. Seat belt warning light
44. Locked four-wheel drive switch
45. Clock
46. Reversing lamps
47. Wiper motor
48. Reversing lamp switch
49a Brake fluid loss switch (Ninety models only
49b Pressure differential warning actuator switch (One Ten models only)
50. Heater switch
51. Stop lamp switch
52. Flasher unit
53. Oil pressure switch
54. Brake check relay
55. Park brake switch
56. Light switch
57. Pick-up point for front fog lamps
58. Fuses
59. Heater motor
60. Hazard switch
61. Hazard switch illumination
62. Ignition light resistor
63. Starter solenoid
64. Spare pick-up point
65. Start relay
66. Distributor
67. Pick-up point for auxiliary trailer
68. Fuel indicator
69. Water temperature indicator
70. Oil pressure indicator
71. Oil temperature indicator
72. Battery
73. Alternator
74. Start switch
75. Coil
76. Battery condition indicator
77. Pick-up point for auxiliary instrument illumination
78. Fuel tank unit
79. Water temperature transmitter
80. Oil pressure transmitter
81. Oil temperature transmitter

Key to cable colours

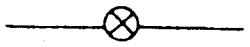
B Black G Green K Pink L Light N Brown O Orange P Purple R Red S Slate U Blue W White Y Yellow

The last letter of a colour code denotes the tracer colour

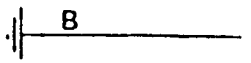
Connectors via plug and socket



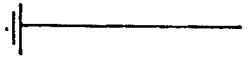
Snap connectors



Permanent in-line connections

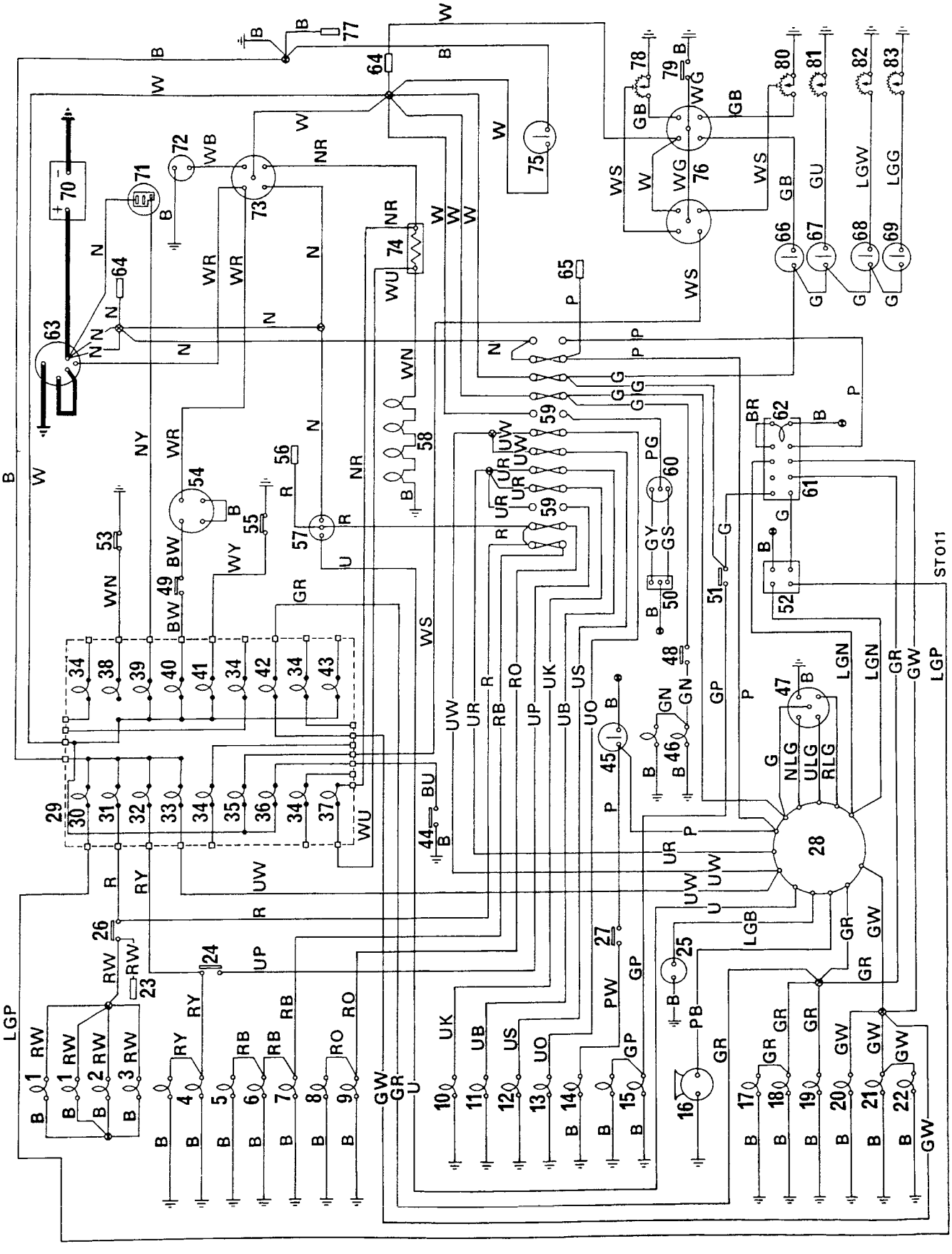


Earth connections via cables



Earth connections via fixing bolts

FOUR CYLINDER 2.25 DIESEL



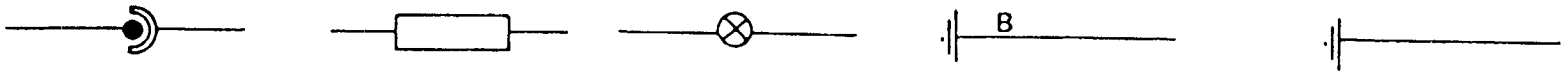
KEY TO FOUR CYLINDER 2.25 LITRE DIESEL DIAGRAM

1. Speedometer illumination
2. Fuel indicator illumination
3. Water temperature indicator illumination
4. Rear fog lamps (when fitted)
5. Number plate lamp
6. LH tail lamp
7. LH side lamp
8. RH tail lamp
9. RH side lamp
10. LH headlamp dip beam
11. RH headlamp dip beam
12. LH headlamp main beam
13. RH headlamp main beam
14. Interior lamp
15. Stop lamp
16. Horn
17. LH side repeater (when fitted)
18. LH front indicator
19. LH rear indicator
20. RH front indicator
21. RH rear indicator
22. RH side repeater (when fitted)
23. Pick-off point for auxiliary instrument illumination (when fitted)
24. Rear fog switch (when fitted)
25. Washer pump
26. Panel illumination switch
27. Interior light switch
28. Steering column switches
29. Grouped warning lights (comprising items 30 to 43)
30. Trailer warning light
31. Side light warning light
32. Rear fog warning light
33. Main beam warning light
34. Spare
35. Low fuel warning light
36. Locked four-wheel drive warning light
37. Cold start warning light
38. Oil warning light
39. Charge warning light
40. Brake warning light
41. Park brake warning light
42. Direction indicator warning light
43. Seat belt warning light
44. Locked four-wheel drive switch
45. Clock (when fitted)
46. Reversing lamps (when fitted)
47. Wiper motor
48. Reversing lamp switch (when fitted)
49. Pressure differential warning actuator switch
50. Heater switch (when fitted)
51. Stop lamp switch
52. Flasher unit
53. Oil pressure switch
54. Brake check relay
55. Park brake switch (when fitted)
56. Pick-off point for front fog lamps (when fitted)
57. Light switch
58. Heater plugs
59. Fuses
60. Heater motor (when fitted)
61. Hazard switch (when fitted)
62. Hazard switch illumination (when fitted)
63. Starter solenoid
64. Spare pick-up point
65. Pick-off point for auxiliary trailer
66. Fuel indicator
67. Water temperature indicator
68. Oil pressure indicator (when fitted)
69. Oil temperature indicator (when fitted)
70. Battery
71. Alternator
72. Fuel shut off valve
73. Heat/Start switch
74. Ballast resistor
75. Battery condition indicator
76. Fuel changeover relays (when fitted)
77. Pick-up point for auxiliary instrument illumination (when fitted)
78. Rear tank unit
79. Fuel cock switch (when fitted)
80. Side tank unit
81. Water temperature transmitter
82. Oil pressure transmitter (when fitted)
83. Oil temperature transmitter (when fitted)

Key to cable colours

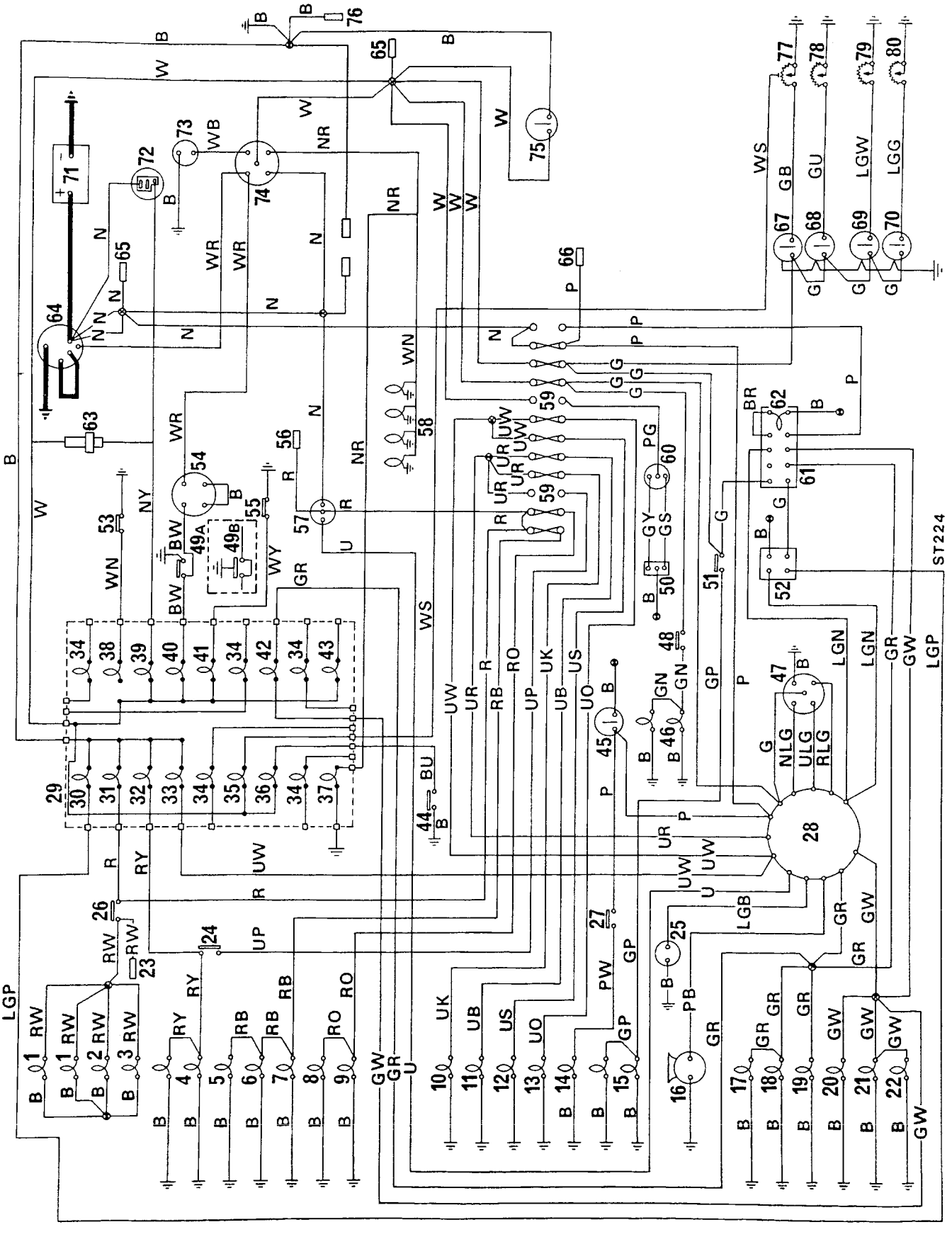
B Black G Green K Pink L Light N Brown O Orange P Purple R Red S Slate U Blue W White Y Yellow

The last letter of the colour code denotes the tracer colour



Connectors via plug and socket **Snap connectors** **Permanent in-line connections** **Earth connections via cables** **Earth connections via fixing bolts**

FOUR CYLINDER 2.5 LITRE DIESEL



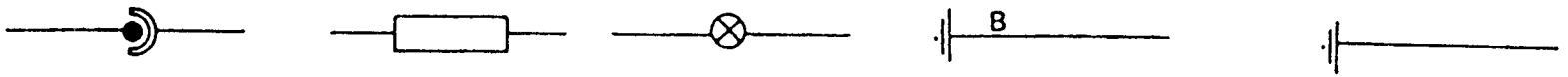
KEY TO FOUR CYLINDER 2.5 LITRE DIESEL DIAGRAM

1. Speedometer illumination
2. Fuel indicator illumination
3. Water temperature indicator illumination
4. Rear fog lamps
5. Number plate lamp
6. LH tail lamp
7. LH side lamp
8. RH tail lamp
9. RH side lamp
10. LH headlamp dip beam
11. RH headlamp dip beam
12. LH headlamp main beam
13. RH headlamp main beam
14. Interior lamp
15. Stop lamp
16. Horn
17. LH side repeater
18. LH front indicator
19. LH rear indicator
20. RH front indicator
21. RH rear indicator
22. RH side repeater
23. Pick-off point for auxiliary instrument illumination
24. Rear fog switch
25. Washer pump
26. Panel illumination switch
27. Interior lighting switch
28. Steering column switches
29. Grouped warning lights (comprising items 30 to 43)
30. Trailer warning light
31. Side light warning light
32. Rear fog warning light
33. Main beam warning light
34. Spare
35. Low fuel warning light
36. Locked four-wheel drive warning light
37. Cold start warning light
38. Oil warning light
39. Charge warning light
40. Brake warning light
41. Park brake warning light
42. Direction indicator warning light
43. Seat belt warning light
44. Locked four-wheel drive switch
45. Clock
46. Reversing lamps
47. Wiper motor
48. Reversing lamp switch
49a Brake fluid loss switch (Ninety models only)
49b Pressure differential warning actuator switch (One Ten models only)
50. Heater switch
51. Stop lamp switch
52. Flasher unit
53. Oil pressure switch
54. Brake check relay
55. Park brake switch
56. Pick-off point for front fog lamps (when fitted)
57. Light switch
58. Heater plugs
59. Fuses
60. Heater motor
61. Hazard switch
62. Hazard switch illumination
63. Ignition light resistor
64. Starter solenoid
65. Spare pick-up point
66. Pick-off point of auxiliary trailer
67. Fuel indicator
68. Water temperature indicator
69. Oil pressure indicator
70. Oil temperature indicator
71. Battery
72. Alternator
73. Fuel shut off valve
74. Heat/Start switch
75. Battery condition indicator
76. Pick-up point for auxiliary instrument illumination
77. Fuel tank unit
78. Water temperature transmitter
79. Oil pressure transmitter
80. Oil temperature transmitter

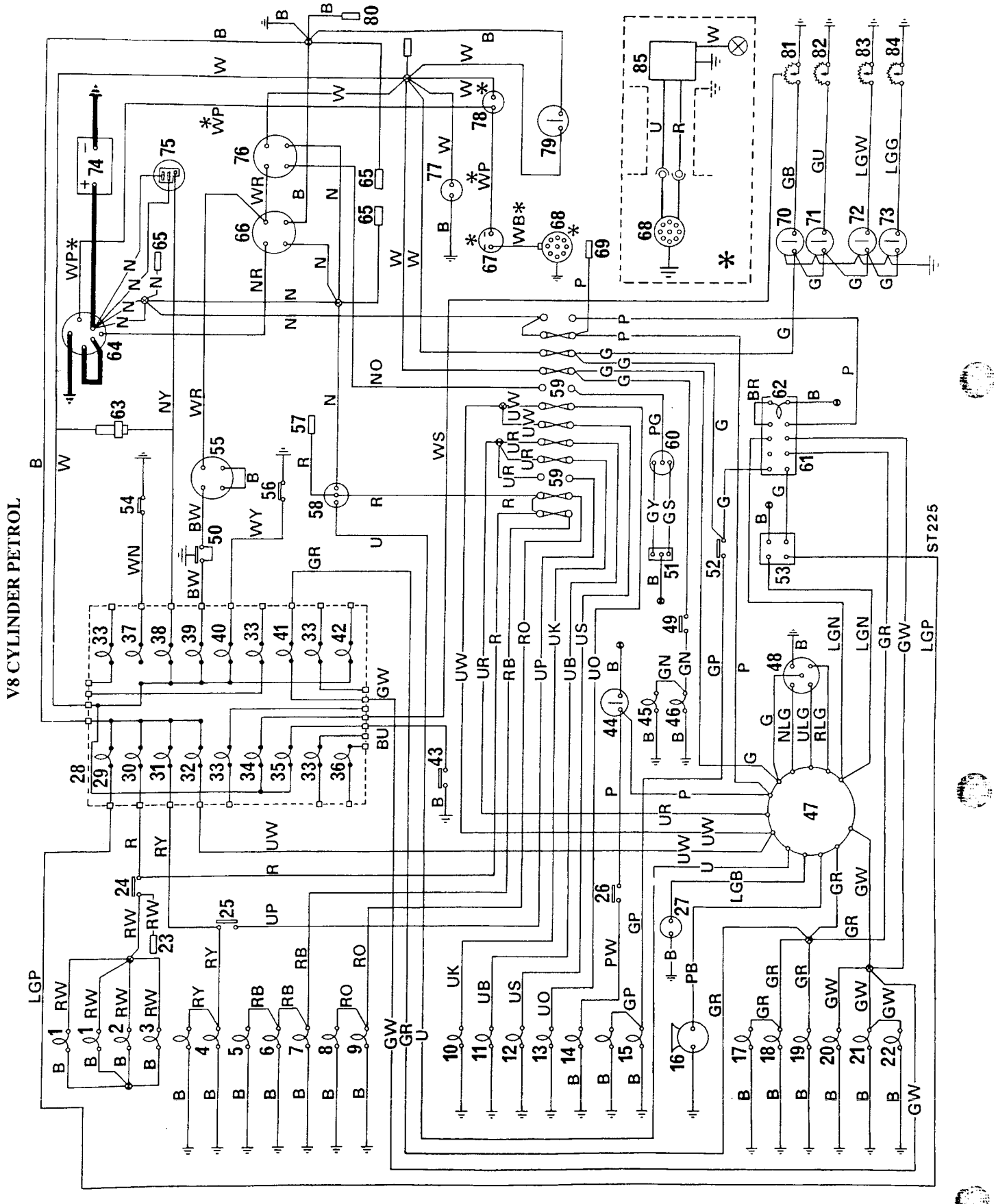
Key to cable colours

B Black G Green K Pink L Light N Brown O Orange P Purple R Red S Slate U Blue W White Y Yellow

The last letter of a colour code denotes the tracer colour



Connectors via plug and socket | **Snap connectors** | **Permanent in-line connections** | **Earth connections via cables** | **Earth connections via fixing bolts**


V8 CYLINDER PETROL
ST225

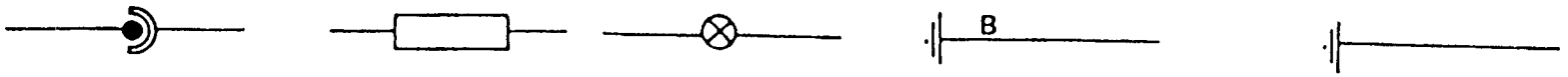
KEY TO V8 CYLINDER PETROL DIAGRAM

1. Speedometer illumination
2. Fuel indicator illumination
3. Water temperature illumination
4. Rear fog lamps
5. Number plate lamp
6. LH tail lamp
7. LH side lamp
8. RH tail lamp
9. RH side lamp
10. LH headlamp dip beam
11. RH headlamp dip beam
12. LH headlamp main beam
13. RH headlamp main beam
14. Interior lamp
15. Stop lamp
16. Horn
17. LH side repeater
18. LH front indicator
19. LH rear indicator
20. RH front indicator
21. RH rear indicator
22. RH side repeater
23. Pick-off point for auxiliary instrument illumination
24. Panel illumination switch
25. Rear fog switch (when fitted)
26. Interior light switch
27. Washer pump
28. Grouped warning lights (comprising items 29 to 42)
29. Trailer warning light
30. Side light warning light
31. Rear fog warning light
32. Main beam warning light
33. Spare position
34. Low fuel warning light
35. Locked four-wheel drive warning light
36. Cold start warning light
37. Oil warning light
38. Charge warning light
39. Brake warning light
40. Park brake warning light
41. Direction indicator warning light
42. Seat belt warning light
43. Locked four-wheel drive switch
44. Clock (when fitted)
45. LH Reversing lamp
46. RH Reversing lamp
47. Steering column switches
48. Wiper motor
49. Reversing lamp switch
50. Pressure differential warning actuator switch
51. Heater switch
52. Stop lamp switch
53. Flasher unit
54. Oil pressure switch
55. Brake check relay
56. Park brake switch
57. Pick-off point for front fog lamps (when fitted)
58. Light switch
59. Fuses
60. Heater motor
61. Hazard switch
62. Hazard switch illumination
63. Ignition light resistor
64. Starter solenoid
65. Spare pick-off point
66. Start relay
67. Coil
68. Distributor
69. Pick-off point for auxiliary trailer
70. Fuel indicator
71. Water temperature indicator
72. Oil pressure indicator
73. Oil temperature indicator (when fitted)
74. Battery
75. Alternator
76. Start switch
77. Fuel pump
78. Ballast resistor
79. Battery condition indicator
80. Pick-off piont for auxiliary instrument illumination
81. Tank unit transmitter
82. Water temperature transmitter
83. Oil pressure transmitter
84. Oil temperature transmitter
85. Ignition module (when fitted)

Key to cable colours

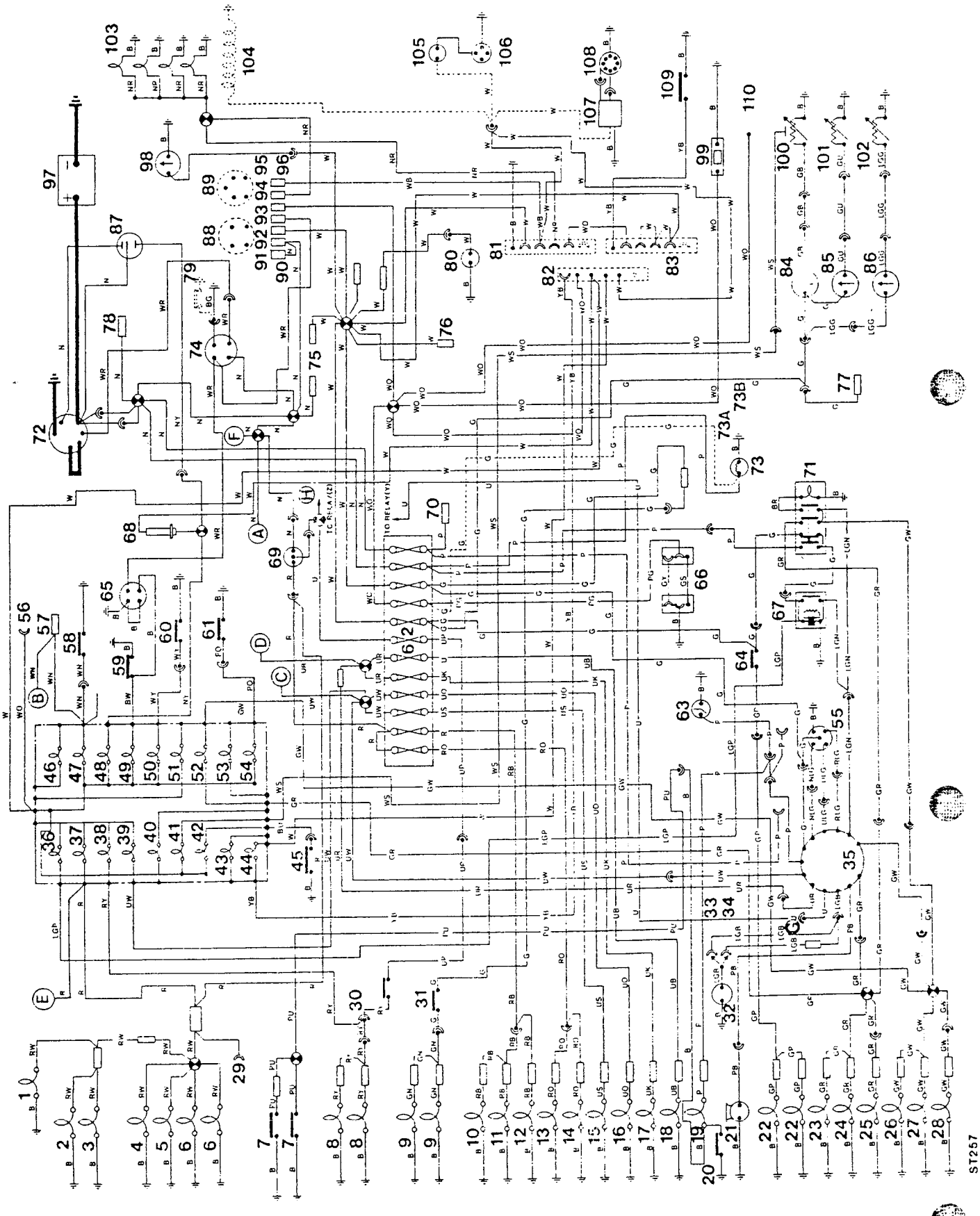
B Black G Green K Pink L Light N Brown O Orange P Purple R Red S Slate U Blue W White Y Yellow

The last letter of a colour code denotes the tracer colour



Connectors via plug and socket **Snap connectors** **Permanent in-line connections** **Earth connections via cables** **Earth connections via fixing bolts**

COMPOSITE CIRCUIT DIAGRAM — ALL MODELS AND MARKETS — 1986 ONWARDS



ST257

KEY TO COMPOSITE CIRCUIT DIAGRAM

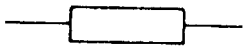
1. Battery condition indicator illumination
2. Cigar lighter illumination
3. Oil temperature indicator illumination
4. Water temperature indicator illumination
5. Fuel indicator illumination
6. Speedometer illumination
7. Door switches (when fitted)
8. Rear fog lamp
9. Reverse lamp
10. Number plate lamp
11. LH tail lamp
12. LH side lamp
13. RH tail lamp
14. RH side lamp
15. LH headlamp main beam
16. RH headlamp main beam
17. LH headlamp dip beam
18. RH headlamp dip beam
19. Interior lamp (when fitted)
20. Interior lamp switch
21. Horn
22. Stop lamp
23. LH side repeater
24. LH front indicator
25. LH rear indicator
26. RH side repeater
27. RH front indicator
28. RH rear indicator
29. Front fog feed
30. Rear fog switch
31. Reverse lamp switch
32. Washer pump
33. RH washer pump connection
34. LH washer pump connection
35. Steering column switches
36. Trailer warning light
37. Side light warning light
38. Rear fog warning light
39. Main beam warning light
40. Spare
41. Low fuel warning light
42. Locked 4WD warning light
43. Spare
44. Cold start warning light
45. Locked 4WD switch
46. Spare
47. Oil warning light
48. Ignition warning light
49. Brakes warning light
50. Park brake warning light
51. Spare
52. Direction indicator warning light
53. Spare
54. Seat belt warning light
55. Wiper motor
56. Norwegian daytime running lights connection
57. German fuel shut off and Norway connections
58. Oil pressure switch
59. Pressure differential warning actuator switch
60. Park brake switch (when fitted)
61. Seat belt switch (when fitted)
62. Fuses
63. Clock (when fitted)
64. Stop lamp switch
65. Brake check relay
66. Heater connections
67. Flasher unit
68. Ignition light resistor
69. Light switch
70. Auxiliary
71. Hazard unit
72. Starter solenoid
73. Cigar lighter (when fitted)
    a) Australia
    b) Rest of World
74. Start relay
75. Spares
76. Auxiliary instrument illumination
77. Spare auxiliary instrument
78. Spare
79. Starter inhibitor switch (auto only)
80. Fuel pump (petrol only)
81. Connector — Diesel
82. Connector — common
83. Connector — petrol
84. Fuel indicator
85. Water temperature indicator
86. Oil temperature indicator
87. Alternator
88. Petrol ignition switch
89. Diesel ignition switch
90. Feed snap connector
91. Feed snap connector
92. Ignition snap connector
93. Starter snap connector
94. Auxiliary snap connector
95. Heater snap connector
96. Fuel shut-off snap connector
97. Battery
98. Battery condition indicator (when fitted)
99. Radio (when fitted)
100. Tank unit — for twin tanks system
101. Water temp transmitter
102. Oil temperature transmitter (when fitted)
103. Glow plugs (Diesel only)
104. Fuel shut off solenoid
105. (4 cylinder petrol only) coil
106. Distributor (4 cylinder petrol only)
107. 2 CE unit — V8 only
108. Distributor — V8 only
109. Choke switch (petrol only)
110. Air conditioning feed (when fitted)

Key to cable colours

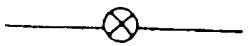
B Black G Green K Pink L Light N Brown O Orange P Purple R Red S Slate U Blue W White Y Yellow

The last letter of a colour code denotes the tracer colour

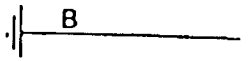
Connectors via plug and socket



Snap connectors



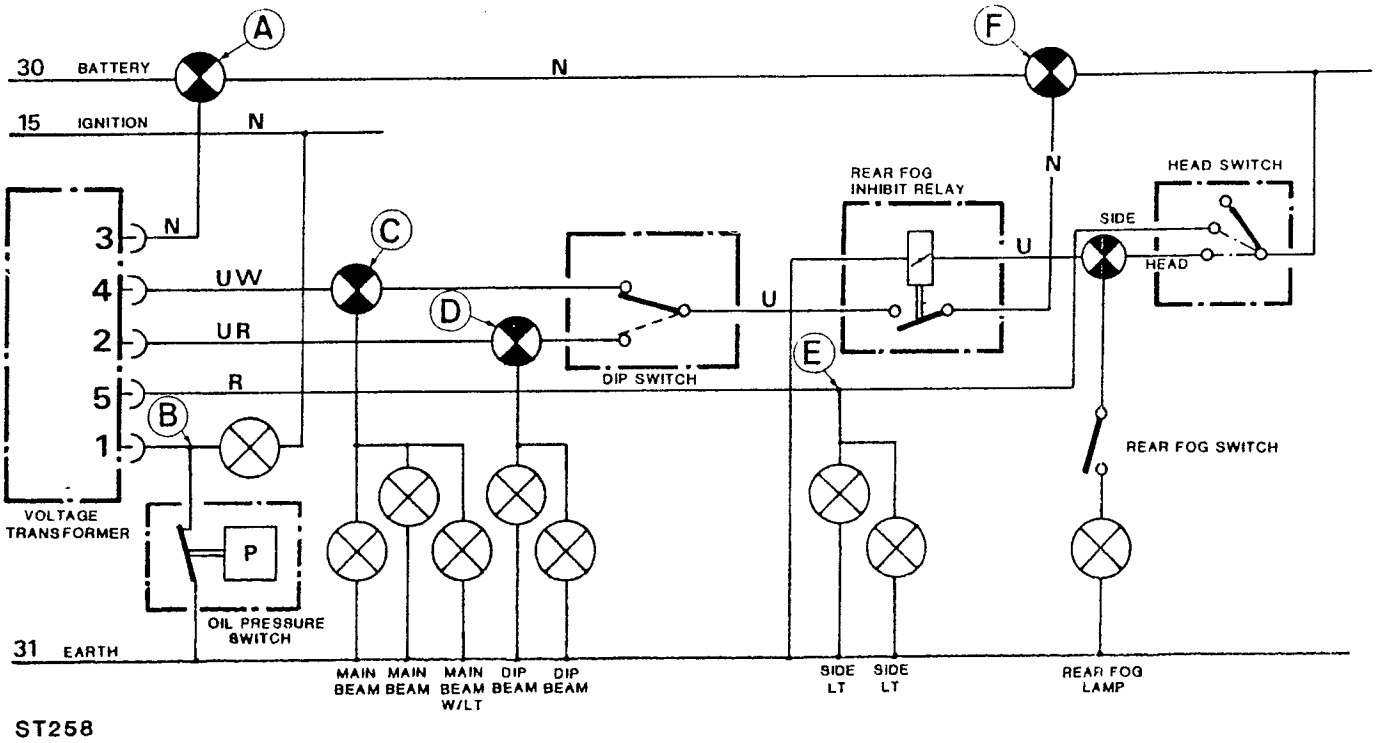
Permanent in-line connections



Earth connections via cables

Earth connections via fixing bolts

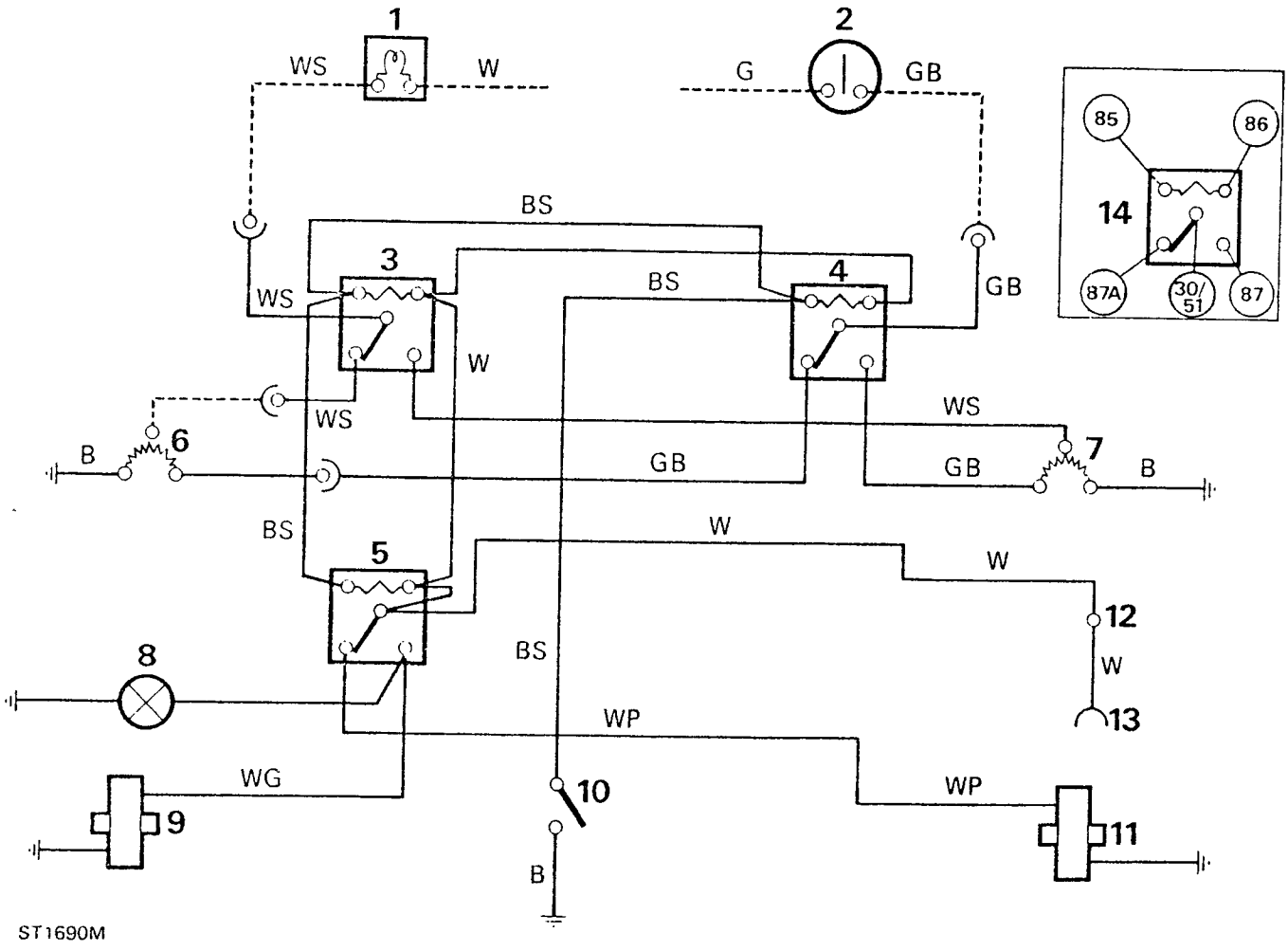
DIM-DIP CIRCUIT — UNITED KINGDOM ONLY



ST258

The in-line connections lettered A, B, C, D, E and F connect into the corresponding lettered connections in the main composite circuit diagram.

CIRCUIT DIAGRAM — TWIN TANK — TWIN PUMPS



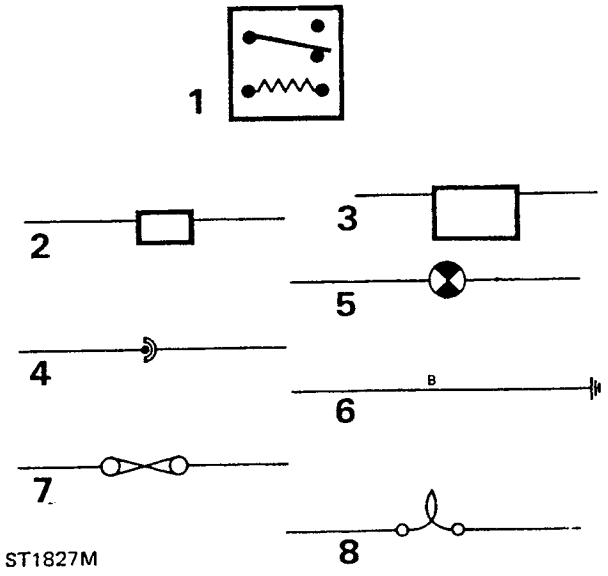
ST1690M

KEY TO CIRCUIT DIAGRAM

1. Low fuel warning light
2. Fuel gauge
3. Relay 28RA low level warning
4. Relay 28RA Fuel gauge
5. Relay 28RA Fuel pumps
6. Rear tank unit
7. Side tank unit
8. Solenoid, normally open piped to rear tank
9. Fuel pump-side tank
10. Fuel change-over switch
11. Fuel pump-rear tank
12. Ignition feed main harness
13. Ignition feed (spare)
14. Key to terminal numbers on relays

---------Existing wiring
_____New wiring

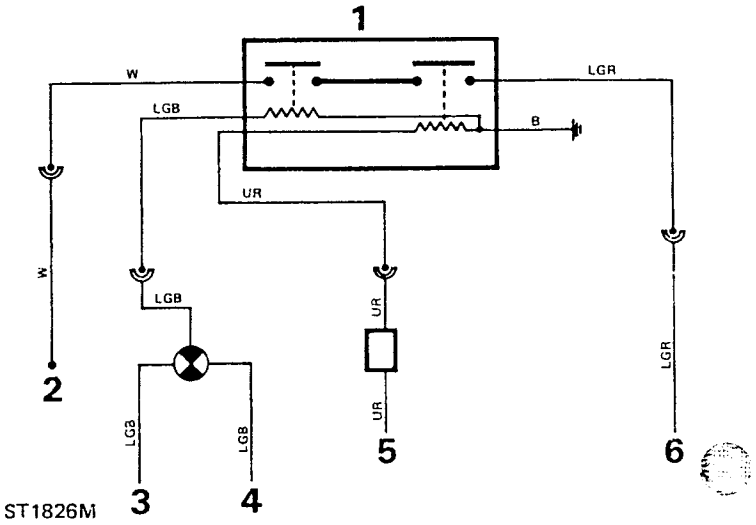
OPTIONAL EQUIPMENT CIRCUIT DIAGRAMS



ST1827M

KEY TO TERMINATIONS

1. 28 RA Relay (normally closed position)
2. 4 way moulded connecting tube
3. 6 way moulded connecting tube
4. Pin and socket connector
5. Clinch connections
6. Earth connections via cables
7. Fuse connections
8. Bulb connections

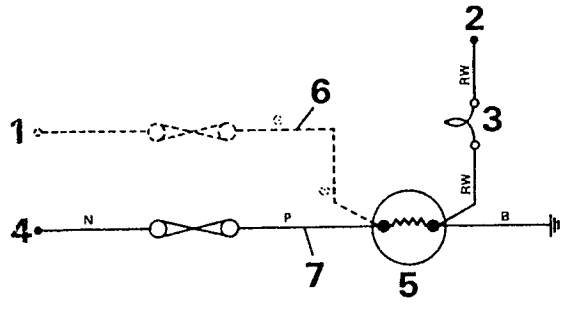


ST1826M

POWER WASH SYSTEM

1. Power wash timer
2. Ignition feed
3. Screen wash pump
4. Screen wash switch
5. Dip switch
6. Power wash pump

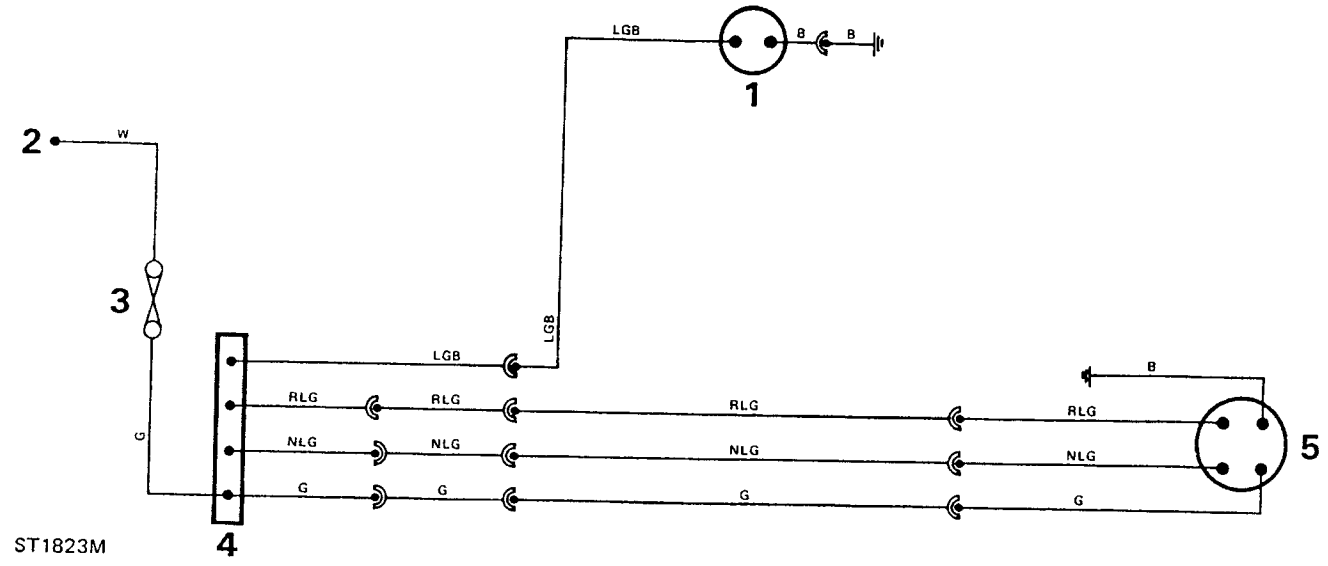
continued



ST1824M

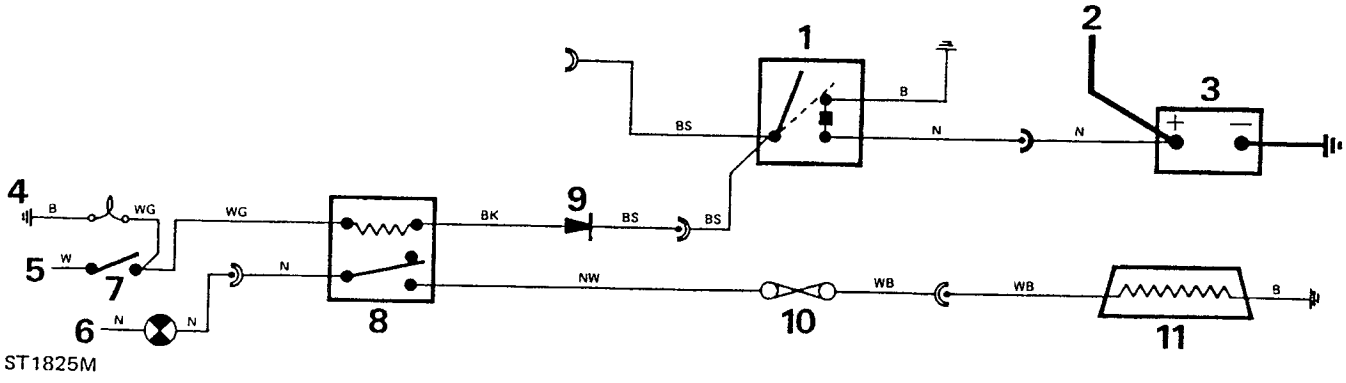
CIGAR LIGHTER

1. Ignition feed
2. Side light circuit
3. Battery positive
4. Cigar lighter
5. Australia Only (dotted line)
6. Standard Circuit (solid line)



REAR WASH-WIPE SYSTEM

1. Washer pump
2. Ignition feed
3. 5 amp fuse
4. Wiper switch
5. Wiper motor



HEATED REAR WINDOW

1. Voltage sensitive switch
2. Starter solenoid
3. Battery
4. Heated rear window warning light
5. Ignition feed
6. Battery positive
7. Heated rear window switch
8. Heated rear window relay
9. Diode
10. 10 amp fuse
11. Heated rear window

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DEFENDER 90 · 110 · 130

WORKSHOP MANUAL SUPPLEMENT

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Solihull
West Midlands, B92 8NW
England

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INTRODUCTION

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

Individuals who undertake their own repairs should have some skill and training, and limit repairs to components which could not affect the safety of the vehicle or its passengers. Any repairs required to safety critical items such as steering, brakes, 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 Supplement 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 supplement are made when viewing the vehicle from the rear unless otherwise stated. With the engine and gearbox assembly removed, the water pump end of the engine is referred to as the front.
To reduce repetition, some operations covered in this Manual do not include reference to testing the vehicle after repair. **It is essential that work is inspected and tested after completion and if necessary a road test of the vehicle is carried out particularly where safety related items are concerned.**

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.

REPAIRS AND REPLACEMENTS

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

POISONOUS 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.

ASBESTOS

WARNING: Some components on the vehicle, such as gaskets and friction surfaces (brake linings, clutch discs) may contain asbestos. Inhaling asbestos dust is dangerous to your 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 on the vehicle should be removed by vacuuming and not by blowing.
3. Dust waste should be dampened, placed in a sealed container and marked to ensure safe disposal.
4. If any cutting, drilling etc., is attempted on materials containing asbestos the item should be dampened and onl hand tools or low speed power tools used.

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 station.

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

Always have a fire extinguisher containing **FOAM** CO_2 **GAS,** or **POWDER** close at hand when handling fuel, or when dismantling fuel systems and in areas where fuel containers are stored.

WARNING: It is imperative that the battery is not disconnected during fuel system repairs as arcing at the battery terminal could ignite fuel vapour in the atmosphere. Always disconnect the vehicle battery BEFORE carrying out work on 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 head-lamps used must be flameproof and kept clear of spillage.

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

HOT FUEL HANDLING

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.

FUEL TRANSFER

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

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

FUEL TANK REMOVAL

A fuel vapour label should be attached to the fuel tank upon removal from the vehicle.

FUEL TANK REPAIR

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

RECOMMENDED SEALANTS

A number of branded products are recommended in this Supplement 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

USED ENGINE OIL HANDLING PRECAUTIONS

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

DISPOSING OF USED OILS 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 authorised waste disposal contractors.

SPECIFICATION

Purchasers are advised that the specification details set out in this Supplement apply to a range of vehicles and not to any one. For the specification of a particular vehicle, purchasers should contact their Dealer. The Manufacturers reserve the right to vary their specifications with or without notice, and at such times and in such manner as they think fit. Major as well as minor changes may be involved in accordance with the Manufacturer's policy of constant product improvement.

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

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SPECIAL SERVICE TOOLS

The use of approved special service tools is important. They are essential if service operations are to be carried out efficiently, and safely. Where the use of special service tools i specified, only these tools should be used to avoid the possibility of personal injury or damage to components.

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 this vehicle. 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.

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
Centigrade (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 Unit	E.C.U.
Electronic Fuel Injection	E.F.I.
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)	-
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)	US pt
Plus (tolerance)	+
Positive (electrical)	+
Pound (force)	lbf
Pounds inch (torque)	in.lbf.
Pound (mass)	lb
Pounds per square inch	P.S.I.
Ratio	:
Reference	ref.
Revolution per minute	r.p.m
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

Special Service Tools

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

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

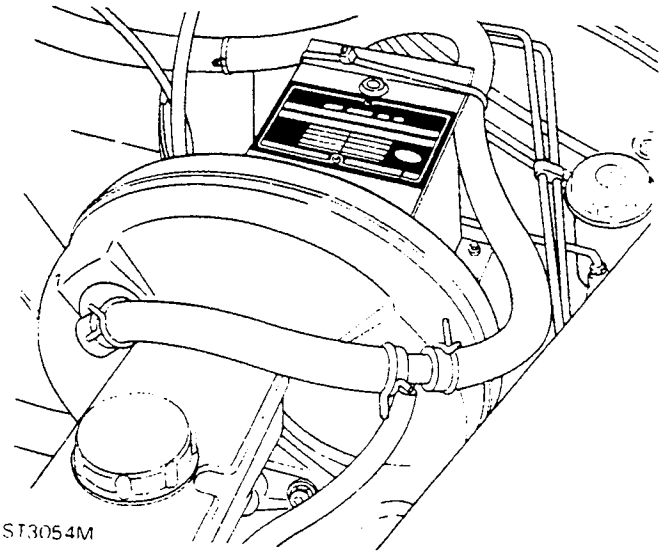
Special tools bulletins will be issued periodically giving details of new tools as they are introduced.

All orders and enquiries from the United Kingdom should be sent direct to V. L. Churchill. Overseas orders should be placed with the local V. L. Churchill distributor, where one exists. Countries where there is no distributor may order direct from V. L. Churchill Limited, PO Box 3, Daventry, Northants, England, NN11 4NF.

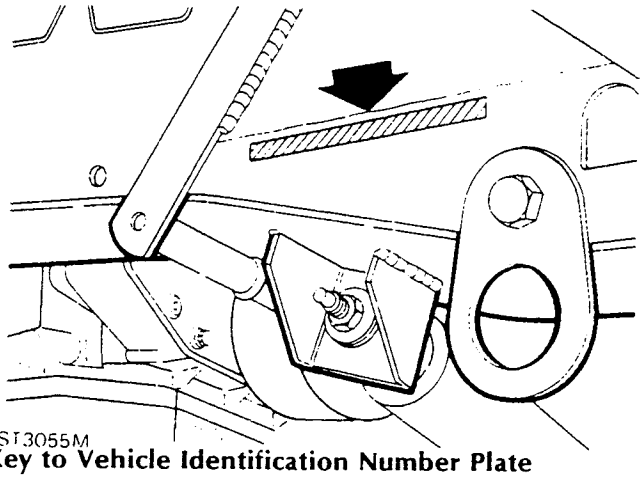
The tools recommended in this Workshop Manual Supplement are listed in a multi-language illustrated catalogue obtainable from Messers. V. L. Churchill at the above address under publication number VLC 2372/1/87 or from Land Rover Merchandising Service, quoting publication number SMR 681 MI, PO Box 534, Erdington, Birmingham, B24 0Q5.

VEHICLE IDENTIFICATION NUMBER (VIN)

The Vehicle Identification Number and the recommended maximum vehicle weights are stamped on a plate riveted to the top of the pedal box behind the brake servo

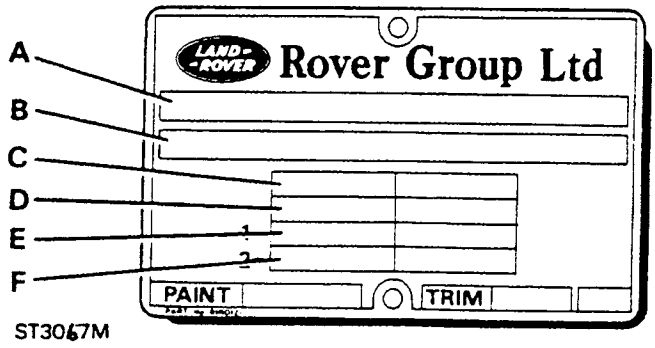

ST3054M

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.


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



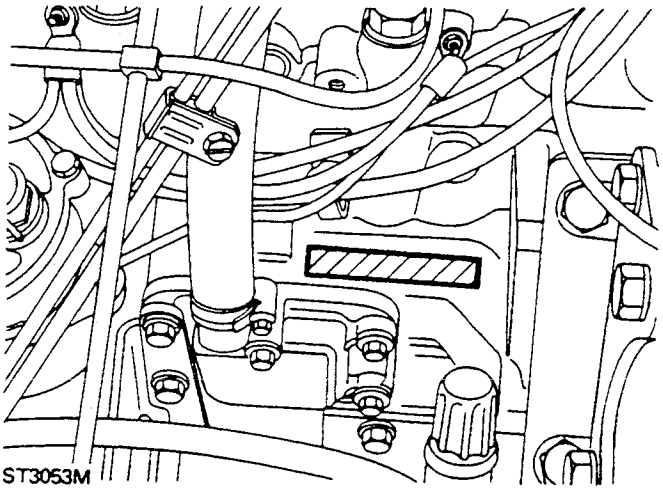
ST3067M

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 World manufacturer identifier
LD Land Rover
G Class 100 inch
V Class 90 inch
H Class 110 inch
A Basic
B 2 door
M 4 door
H High Capacity
F Tdi or
8 5 speed LHD or
7 5 speed RHD
H 1991 MY
A Solihull site

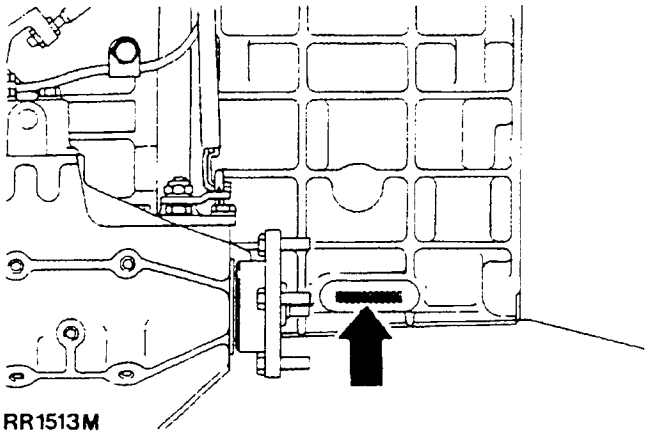
ENGINE SERIAL NUMBER - Tdi ENGINE

The engine number is stamped on the cylinder block on the right hand side of the engine above the camshaft front cover plate. Commencing Serial Number IIL 00001.


ST3053M

MAIN GEARBOX LT77 - 5 SPEED

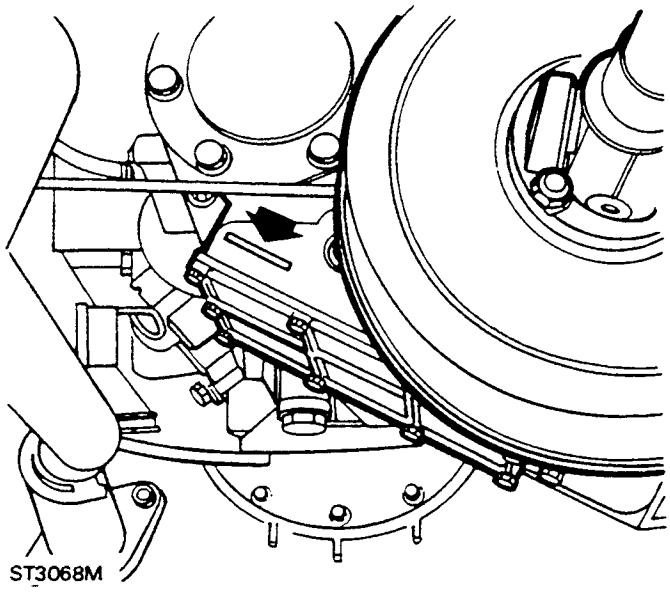
The serial number is stamped on a cast pad on the bottom right hand side of the gearbox.



RR1513M

TRANSFER GEARBOX LT230

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



ST3068M

FRONT AND REAR AXLES

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

Tdi ENGINE

Type	Direct injection, turbocharged, intercooled
Number of cylinders	4
Bore	90,47 mm (3.562 in)
Stroke	97,00 mm (3.822 in)
Capacity	2495 cc
Compression ratio	19.5:1 +- 0.5:1
Valve operation	O.H.V. pushrod operated
Turbo charger	Garrett T25

Crankshaft

Main journal diameter	63,475 - 63,487 mm (2.499 - 2.4993 in)
Regrind dimensions	63,2333 - 63,246 mm (2.4895 - 2.490 in) Use 0.010 in U/S bearings
Crankpin journal diameter	58,725 - 58,744 mm (2.312 - 2.31275 in)
Regrind dimensions	58,4708 - 58,49985 mm (2.30200 - 2.30275 in) Use 0.010 in U/S bearings
Crankshaft end thrust	Taken on thrust washers of centre main bearing
Crankshaft end float	0,05 - 0,15 mm (0.002 - 0.006 in)

Main bearings

Number and type	5 halved shells with oil grooves
Diametrical clearance	0,0792 - 0,0307 mm (0.0031 - 0.0012 in)

Connecting rods

Length between centres	175,38 - 175,43 mm (6.905 - 6.907 in)
Diametrical clearance (big-end bearings)	0,025 - 0,075 mm (0.001 - 0.003 in)
End float on crankpin	0,15 - 0,356 mm (0.006 - 0.014 in)

Pistons

Type	Aluminium alloy, combustion chamber in crown
Skirt diametrical clearance (at right angle to gudgeon pin	0,025 - 0,05 mm (0.001 - 0.002 in)
Maximum height above combustion face	0,8 mm (0.031 in)

Gudgeon pins

Type	Floating
Fit in piston	Hand push in
Diameter	30,1564 - 30,1625 mm (1.18726 - 1.18750 in)
Clearance in connecting rod	0,0036 - 0,0196 mm (0.00014 - 0.00077 in)

Pistons rings

Type	
- Top	Chamfered friction edge, chrome plated
- Second	Taper faced
- Oil control	Expander ands rails
Gap in bore:	
- Top	0,40 - 0,65 mm (0.0157 - 0.0255 in)
- Second	0,30 - 0,50 mm (0.0118 - 0.0196 in)
- Oil control	0,3 - 0,6 mm (0.011 - 0.023 in)
Clearance in piston grooves:	
- Top	0,167 - 0,232 mm (0.0065 - 0.0091 in)
- Second	0,05 - 0,08 mm (0.0019 - 0.0031 in)
- Oil control	0,05 - 0,08 mm (0.0019 - 0.0031 in)

Camshaft

Timing Belt	30 mm (1.2 in dry toothed belt
Location	Right hand side (thrust side)
End float	0,1 - 0,2 mm (0.004 - 0.008 in)
Number of bearings	4
Material	Steel shell, white metal lined

Valves

Tappet clearance:	
- Inlet and exhaust	0,20 mm (0.008 in)
Seat angle:	
- Inlet	30°
- Exhaust	45°
Head diameter:	
- Inlet	39,35 - 39,65 mm (1.549 - 1.560 in)
- Exhaust	36,35 - 36,65 mm (1.431 - 1.443 in)
Stem diameter:	
- Inlet	7,960 - 7,975 mm (0.313 - 0.314 in)
- Exhaust	7,940 - 7,960 mm (0.212 - 0.313 in)
Valve lift:	
- Inlet	9,93 mm (0.401 in)
- Exhaust	10,26 mm (0.404 in)
Cam lift	
- Inlet	6,81 mm (0.268 in)
- Exhaust	7,06 mm (0,278 in)
Valve head stand down	
- Inlet and exhaust	0,9 - 1,1 mm (0.035 - 0.040 in)
Valve spring length fitted	40,4 mm (1.590 in) at pressure of 29.5 kg (65 lb)

Lubrication

System	Wet sump, pressure fed
Pressure, engine warm at normal operating speeds	25- 55 p.s.i. (1.76 - 3.86 kgf/cm^2)
Oil pump:	
- Type	Double gear 10 teeth, sintered iron gears
- Drive	Splined shaft from camshaft skew gear
- End float of both gears	0,026 - 0,135 mm (0.0009 - 0.0045 in)
- Radial clearance of gears	0,025 - 0,075 mm (0,0034 - 0.0067 in)
- Backlash or gears	0,1 - 0,2 mm (0.0034 - 0,0067 in)
Oil pressure relief valve	Non-adjustable
Relief valve spring:	
- Full length	67,82 mm (2.670 in)
- Compressed length at 2.58 kg (5.7 lb) load	61,23 mm (2.450 in)
Oil filter	Screw-on disposable canister
Engine oil cooler	Combined with coolant radiator and intercooler

FUEL SYSTEM - Tdi Engine

Injection pump type	Bosch rotary VE4/11F (see section 05)
Injection pump timing	see section 05
Injectors	see section 05
Heater plugs	see section 05
Fuel lift pump type	Mechanical with hand primer
Fuel lift pump pressure	42 - 55 kpa at 1800 rpm
Fuel filter	Paper element in disposable canister
Air cleaner	Paper element type
Turbo charger	Garrett T25 (see section 05)

COOLING SYSTEM - Tdi engine

System type	Pressurised, spill return, thermostatically controlled water and anti freeze mixture. Pump assisted thermosyphon. Coolant radiator combined with oil cooler and turbo intercooler.
Cooling fan	7 blade axial flow 395 mm diameter. 1.1:1 drive ratio. Viscous coupling.
Pump type	Centrifugal, impellor, belt driven.
Thermostat opening	88°C
Expansion tank cap pressure	15 p.s.i. (system pressure)

CLUTCH - Tdi engine

Type	Valeo iaphragm spring
Centre plate diameter	235 mm (9.25 in)
Facing material	Verto F202 grooved
Number of damper springs	8
Damper spring colour	2 off white/green - suffix 'C' 2 off pigeon blue - suffix 'A' 4 off ruby red - suffix 'B'
Release bearing	Ball journal

Tdi ENGINE TUNING DATA

ENGINE

Firing order	1-3-4-2	
Injection pump timing	1,54 mm lift at T.D.C.	
Timing marks:		
Valve timing	Slot for peg in flywheel and TDC mark on front pulley	
Injection timing	Statically timed with special tool inserted in Bosch pump hub	
Tappet clearances inlet and exhaust	0,20 mm (0.008 in) cold	
Valve timing:	Inlet	Exhaust
- Opens	16° B.T.D.C.	51° B.B.D.C.
- Closes	42° A.B.D.C.	13° A.T.D.C.
- Peak	103° A.T.D.C.	109° B.T.D.C.
- Lift	9,93 mm (0.401 in)	10,26 mm (0.404 in)
Maximum governed speeds:		
- Full load (speed cut-off starts)	3800 r.p.m.	
- No load (flight speed)	4100 - 4260 r.p.m.	
- Idle speed	780 - 800 rpm	

INJECTION PUMP

Make/type	Bosch rotary VE 4/11F 1900R 347-1 Type with boost control and negative mechanical torque control. Two speed mechanical governor with speed advance and solenoid electrical shut-off. Tamper proof sealing on flight speed and fuel adjustment screws
Direction of rotation	Clockwise, viewed from drive end
Advance box (single stage)	9° advance (7.38 mm)
Peak pumping pressure	650 bar

INJECTORS

Make/type	Bosch two spring (0432193879 assembly number)
Nozzle size/type	DSLA 145P208
Nozzle holder	KBEL 98 P52
Opening pressure (working pressure)	Initial pressure 200 atmospheres Secondary 280 atmospheres
Injector pipe type	Guido high pressure cold drawn steel
Injector pipe size	1,8 mm dia. Length 490 mm

HEATER PLUGS

Make/type	Probe type, Beru 11 volts
Time to reach operating temperature of 850°C	8 seconds

TURBOCHARGER

Make/type	Garrett T25
Maximum boost pressure	0.82 bar (12 P.S.I.G.) measured at wastegate actuator 'T' piece
Fuel specification	Diesel BS2869 (certain levels down to 45 with adjustment

Tdi ENGINE	Nm
Bearing cap to cylinder block	130 - 136
Camshaft thrust plate to cylinder block	7 - 10
Clutch cover plate to flywheel	30 - 38
Connecting rod to cap	56 - 62
Dipstick tube assembly to cylinder block	22 - 28
Dipstick mounting bracket to inlet manifold	7 - 10
Earthing strap stud to cylinder block	21 - 30
Engine mounting foot to cylinder block	80 - 90
Housing flywheel to cylinder block	40 - 50
Flywheel to crankshaft	139 - 153
Ladderframe to cylinder block	22 - 28
Oil filter adaptor to cylinder block	40 - 50
Oil pressure switch	15 - 19
Oil pump cover to pump body	20 - 28
Oil pump relief valve plug	27 - 33
Oil pump to cylinder block	22 - 28
Oil pump strainer to oil pump	40 - 50
Oil squirt jet assembly to cylinder block	14 - 20
Oil strainer to mounting bracket	22 - 28
Plug - blanking oil gallery	32 - 42
Plug - drain oil sump	40 - 50
Plug - drain cylinder block	25
Plug - drain flywheel housing	10 - 14
Plug - inlet manifold (boost take-off)	23 - 27
Side cover to cylinder block	23 - 30
Starter motor to flywheel housing	40 - 50
Sump to ladderframe	22 - 28
Sump to ladderframe/cylinder block	22 - 28
Sump to cylinder block/front cover	20 - 24
Support brackets	
- exhaust manifold to cylinder block	22 - 28
Vacuum pump to cylinder block	22 - 28
Vertical drive shaft gear to cylinder block	22 - 28
Alternator and heat shield to mounting bracket	22 - 28
Adjusting link to alternator	22 - 28
Adjusting link to pas pump plate	22 - 28
Cylinder head to cylinder block	See section 12
Breather cylcone to rocker cover	7 - 10
Engine lifting bracket to cylinder head	22 - 28
Electrical harness clip to cylinder head	22 - 28
Exhaust manifold to cylinder head	20 - 26
Glow plug terminal nut	3 - 5
Glow plug to cylinder head	15 - 30
Heater stud (water) to cylinder head	15 - 30
Injector clamp stud to cylinder head	6 - 10
Injector clamp to injector nut	20 - 25
Inlet manifold to cylinder head	20 - 26
Rocker cover to cylinder head	3,5 - 4,5
Rocker shaft to cylinder head	28 - 32
Tappet adjusting nut	22 - 26
Thermostat housing to cylinder head	22 - 28
Water outlet to thermostat housing	7 - 10
Water temperature switch to thermostat housing	15 - 19
Cowl mounting bracket to front cover	22 - 28
Fan assembly to water pump hub	22 - 28
Front cover plate to cylinder block	22 - 28
Front cover plate to front cover	22 - 28
Front cover to cylinder block	22 - 28
Injector pump to front cover	22 - 28
Injector pump stud to front cover	6 - 10

Tdi ENGINE (continued)	Nm
Injector pump to support bracket	22 - 28
Tensioner (timing belt) to cylinder block	40 - 50
Timing pulley to camshaft	40 - 50
Timing pulley to injector pump hub	22 - 28
TV damper pulley to crankshaft	333 - 350
Water pump to cylinder block	23 - 30
Water pump to cylinder block - stud	23 - 30
Water pump to front cover	22 - 28
Oil drain adaptor to cylinder block - Turbo	22 - 28
Oil drain pump to turbo	32 - 48
Oil feed pipe adaptor to cylinder block - Turbo	22 - 28
Oil feed pipe to turbo	15 - 22
Outlet elbow to turbo - nut	21 - 26
Outlet elbow to turbo - stud	22 - 28
Turbocharger to exhaust manifold	21 - 26
Belt tensioner assembly to front cover plate compressor	14 - 16
Compressor to mounting bracket	40 - 50
Compressor mounting bracket to front cover and plate	40 - 50
Banjo bolt - fuel pump	10 - 14
Banjo bolt - boost pipe	8 - 12
Banjo bolt - spill rail	20 - 30
Banjo bolt - fuel filter	14 - 20
Banjo bolt - injector spill rail	2
Fuel lift pump to fuel filer unions	10 - 14
Fuel lift pump to cylinder block	22 - 28
Injector pipes to injectors and injector pump	22 - 25
P.A.S. pump to mounting plate	14 - 16
P.A.S. pump mounting plate to front cover	22 - 28
P.A.S. pump pulley to hub	14 - 16
Tappet guide retaining screw	13 - 15

ENGINE OIL - Tdi ENGINES

The minimum performance level oil required for satisfactory engine performance and protection is defined by specifications BLS 22.OL.09 and CCMC PD1.

The engine oil and filter must be changed every 10,000 km (6000 miles) and it is important that only oils listed below, or clearly marked as meeting the required specification, should be used. Superior engine protection can be obtained by the use of Super High Performance Diesel (SHPD) oils to specification CCMC D3. Some of the oils meeting the above specifications are listed below:-

Oils to BLS 22.OL.09/CCMC PD1
Agip Superdiesel or Sint Turbo Diesel
BP Vanellus C3 or Visco Diesel
Caltex RPM Delo 400*
Castrol Syntron X, TXT, Dynamax or GTX
Century Superb
Duckhams QXR or Hypergrade
Esso Superlube EX 2, Superlube +, Ultra Oil or Super Oil
Gulf Super Diesel or Engine Oil T
Mobil Delvac Super, Mobil 1 Rally Formula or Mobil 1 Formula 15W/50
Kuwait Q8 Auto-4 or Q8 Auto-7
Shell Rimula X or Rotella MTX
Texaco Dieseltex

SHPD oils to CCMC D3
Agip Sigma Turbo
BP Vanellus C3 Extra
Castrol Turbomax
Century Centurion
Caltex RPM Delo 450
Duckhams Fleetmaster SHPD or Fleetmaster Extra
Elf Multiperformance 4D
Esso Super Diesel Oil TD or Special Diesel Oil
Fina Kappa LDO
Gulf Superfleet Special
Mobil Delvac 1400 Super
Texaco Ursa Super TD
Shell Myrina
Total Rubia TIR or Total Diesel
Silkolene Turbolene D

In markets where oils to the above specifications are not available use products to MIL-L-2104D or API CD.

Under severe operating conditions, eg. off road in mud, airborne sand, dust, operating at high speeds in high ambient temperatures above 40°C or continual stop/start operation, the oil and filter change period should not exceed 5000 km (3000 miles). Continuous off road operation in mud, dust and wading conditions requires a monthly oil and filter change. Failure to adhere to the recommended service and operating instructions may result in premature engine wear or damage.

Oil Viscosity - Ambient Temperatures Applications Chart

SPECIFICATION	SAE VISCOSITY	AMBIENT TEMPERATURE °C
		-30° -20° -10° 0° 10° 20° 30° 40° 50°
Oils must meet BLS.22.OL.09 or CCMC PD1 or CCMC D3	5W/30 5W/40) 5W/50)	
	10W/30 10W/40) 10W/50)	
	15W/40) 15W/50)	
	20W/40) 20W/50)	
	25W/40) 25W/50)	

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.

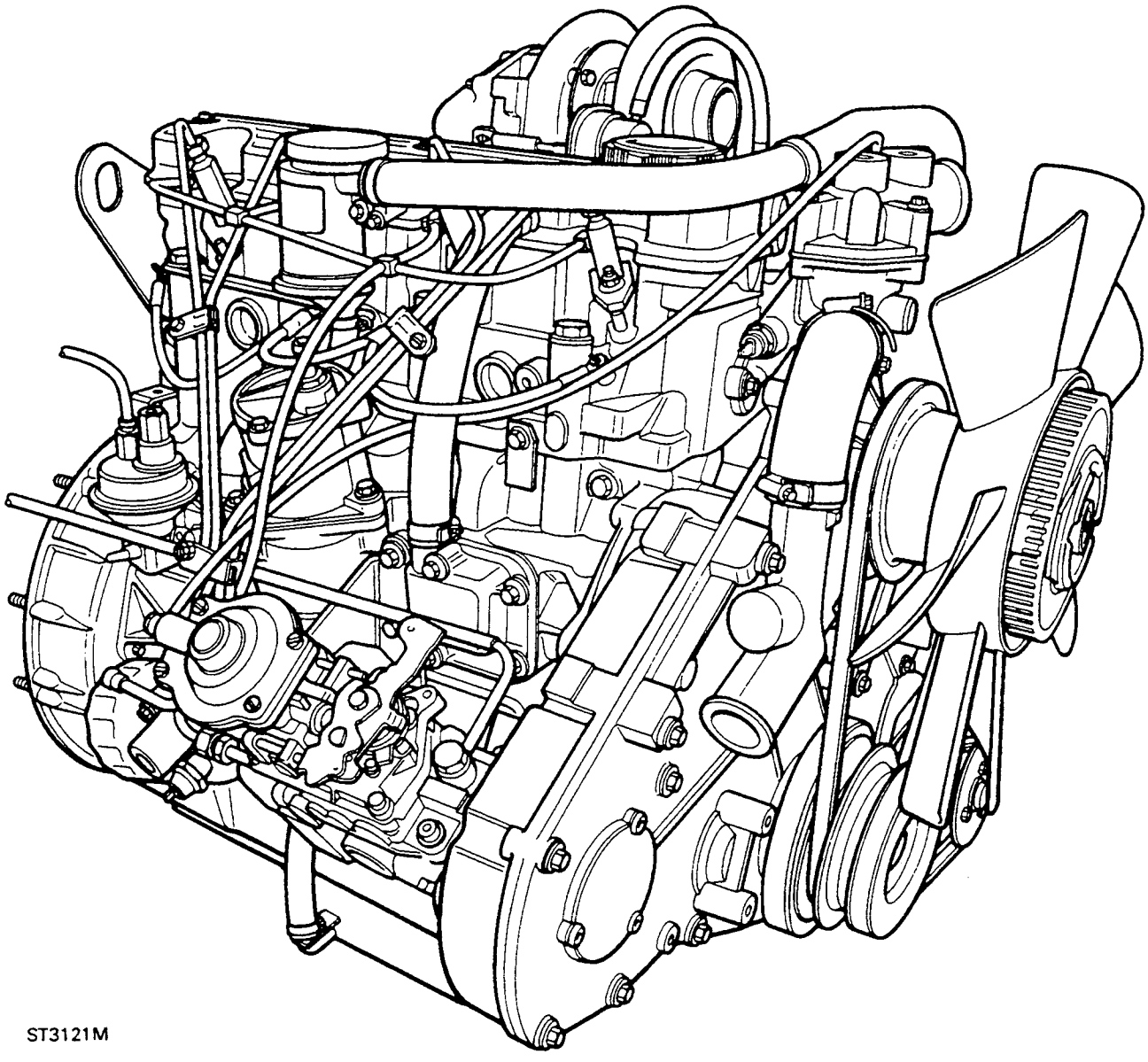
Engine sump oil	6,00 litres (10.56 pints)
Extra when filling following new filter	0,85 litres (1.50 pints)
Transfer box oil	2,30 litres (4 pints)
Cooling system	11,10 litres (20 pints)

Anti-freeze

Ethylene Glycol based anti-freeze (containing no methanol) with non-phosphate corrosion inhibitors only are suitable for use in Tdi engines to ensure protection of the cooling system against frost and corrosion. No inhibitors should be used. Only anti-freeze, summer and winter even in climates where anti-freeze is not necessary.

One part anti-freeze, one part water, i.e. 50% anti-freeze in coolant. Complete protection below -36°C.

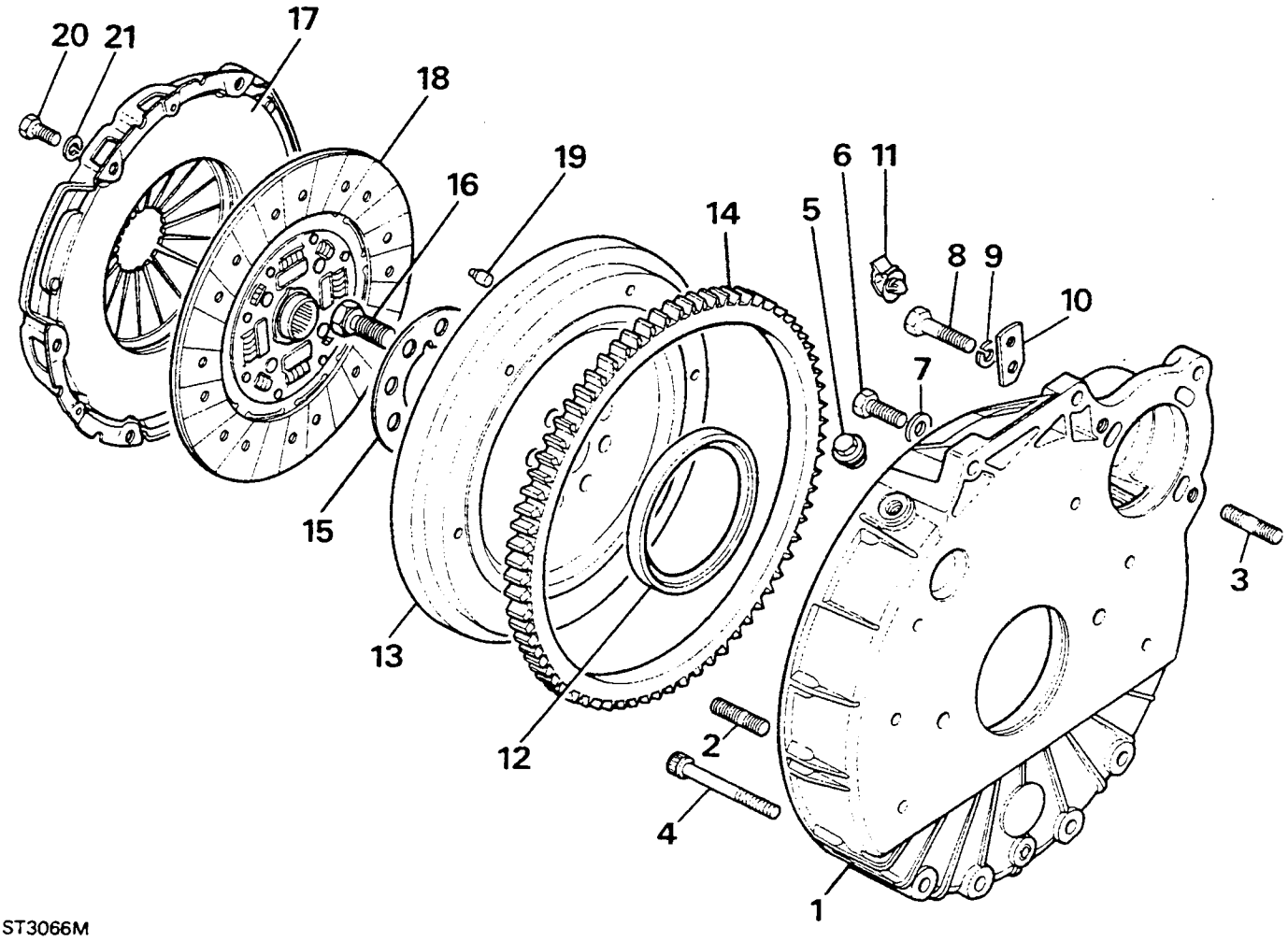
See cooling system section 26 for engine protection information.



ST3121M

CLUTCH AND FLYWHEEL HOUSING COMPONENTS ST3066M - LAND ROVER Tdi engine

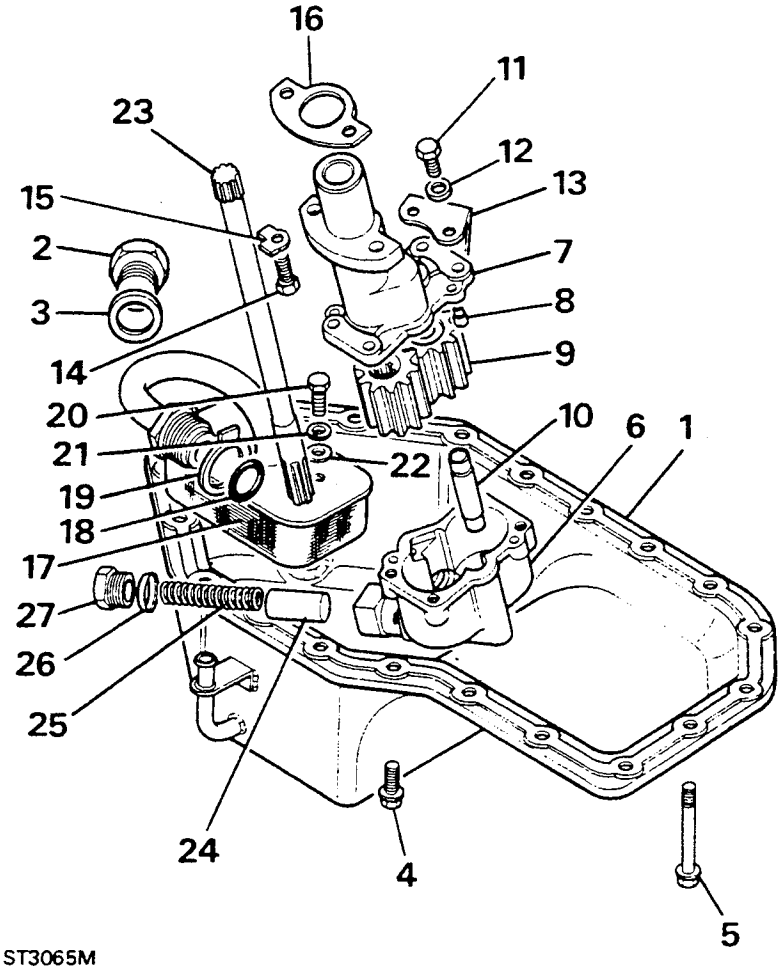
1. Clutch housing
2. Bell housing stud (9)
3. Starter motor stud (1)
4. Allen bolts (4)
5. Plug (2)
6. Screw housing to block (6)
7. Washer (6)
8. Bolt housing to block (2)
9. Spring washer (2)
10. Bracket (2)
11. Harness clip (2)
12. Oil seal
13. Flywheel
14. Starter ring
15. Reinforcing plate
16. Bolt flywheel to crank
17. Clutch cover
18. Clutch plate
19. Dowel
20. Screw
21. Spring washer



ST3066M

SUMP AND OIL PUMP COMPONENTS ST3065M - LAND ROVER Tdi engine

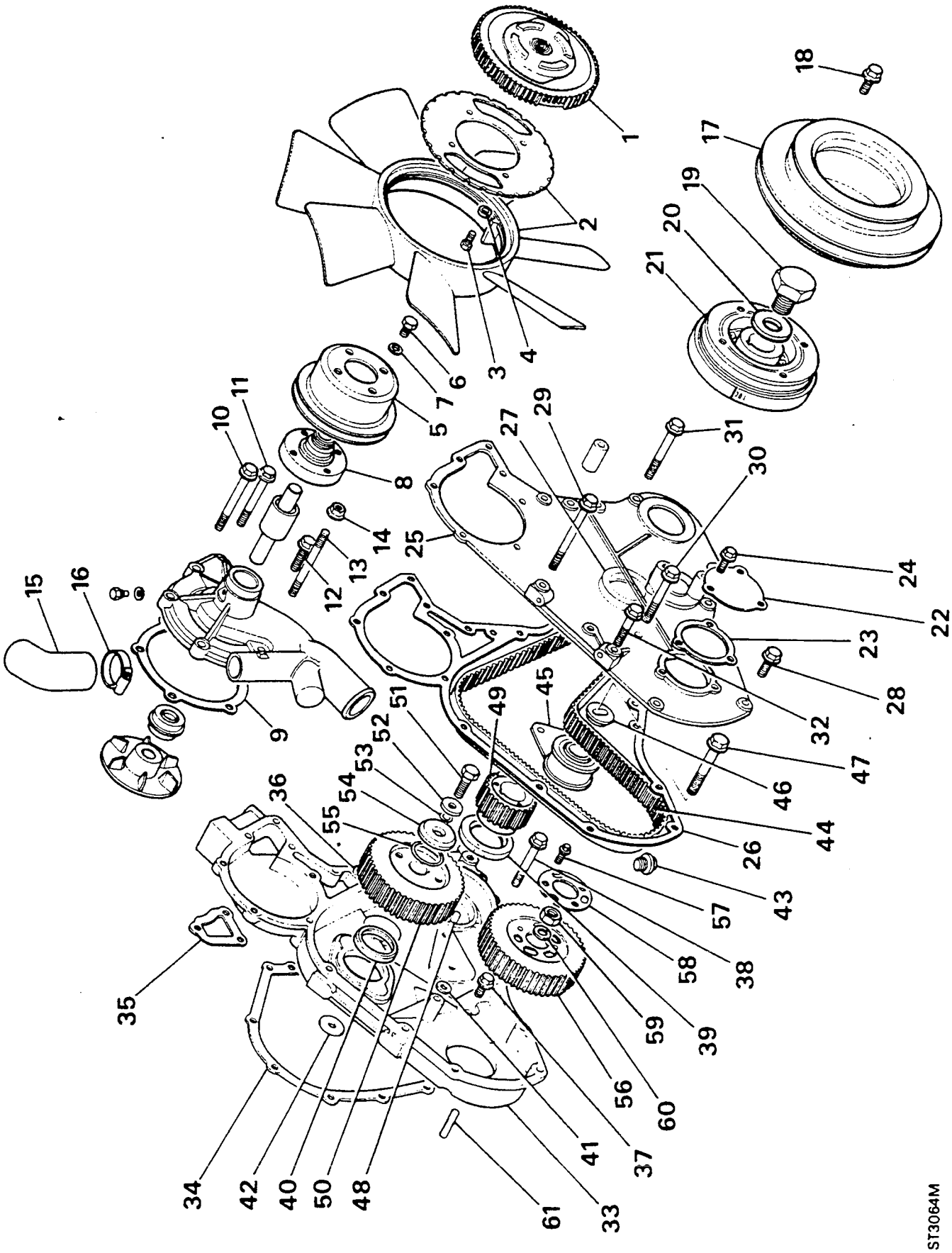
1. Sump
2. Drain plug
3. Joint washer
4. Flange bolt M8x20 (8)
5. Flange bolt M8x60 (12)
6. Oil pump housing lower
7. Oil pump housing upper
8. Dowel
9. Oil pump gears
10. Spindle
11. Screw
12. Spring washer
13. Support bracket
14. Screw
15. Lock washer
16. Gasket
17. Filter
18. O ring
19. Lock washer
20. Screw
21. Spring washer
22. Plain washer
23. Drive shaft
24. Oil relief plunger
25. Spring
26. Joint washer
27. Oil relief plug



ST3065M

FRONT COVER COMPONENTS ST3064M - LAND ROVER Tdi engine

1. Viscous unit
2. Fan assembly
3. Bolt (4)
4. Plain washer (4)
5. Pulley
6. Screw (4)
7. Spring washer (4)
8. Water pump assembly
9. Gasket
10. Flange bolt M8x85 (2)
11. Flange bolt M8x75 (1)
12. Flange screw M8x35 (3)
13. Stud M8
14. Flange nut M8
15. By pass hose
16. Hose clip
17. Crank pulley
18. Flange bolts (4)
19. Crank pulley bolt
20. Washer
21. Torsional vibration damper
22. Inspection plate
23. Gasket
24. Flange screw M6x20 (3)
25. Front cover plate
26. Gasket
27. Cover plate seal
28. Flange screw M8x25 (3)
29. Flange bolt M8x100 (2)
30. Flange bolt M8x70 (2)
31. Flange bolt M8x75 (3)
32. Flange bolt M8x50 (1)
33. Front cover
34. Front cover gasket
35. Front cover/water inlet gasket
36. Front cover dowel
37. Flange screw M8x20 (2)
38. Flange bolt M8x65
39. Crankshaft oil seal
40. Camshaft oil seal
41. Gasket - centre bolt
42. Gasket - block front face
43. Plug
44. Timing belt
45. Timing belt tensioner assembly
46. Slotted washer
47. Flange bolt M10x70
48. Tensioner pivot pin
49. Crankshaft gear wheel
50. Camshaft gear wheel
51. Bolt
52. Washer
53. O ring
54. Retaining plate
55. O ring
56. Injection pump timing gear
57. Flange screw (3)
58. Retaining plate
59. Nut
60. Spring washer (3)
61. Stud injection pump to front cover (3)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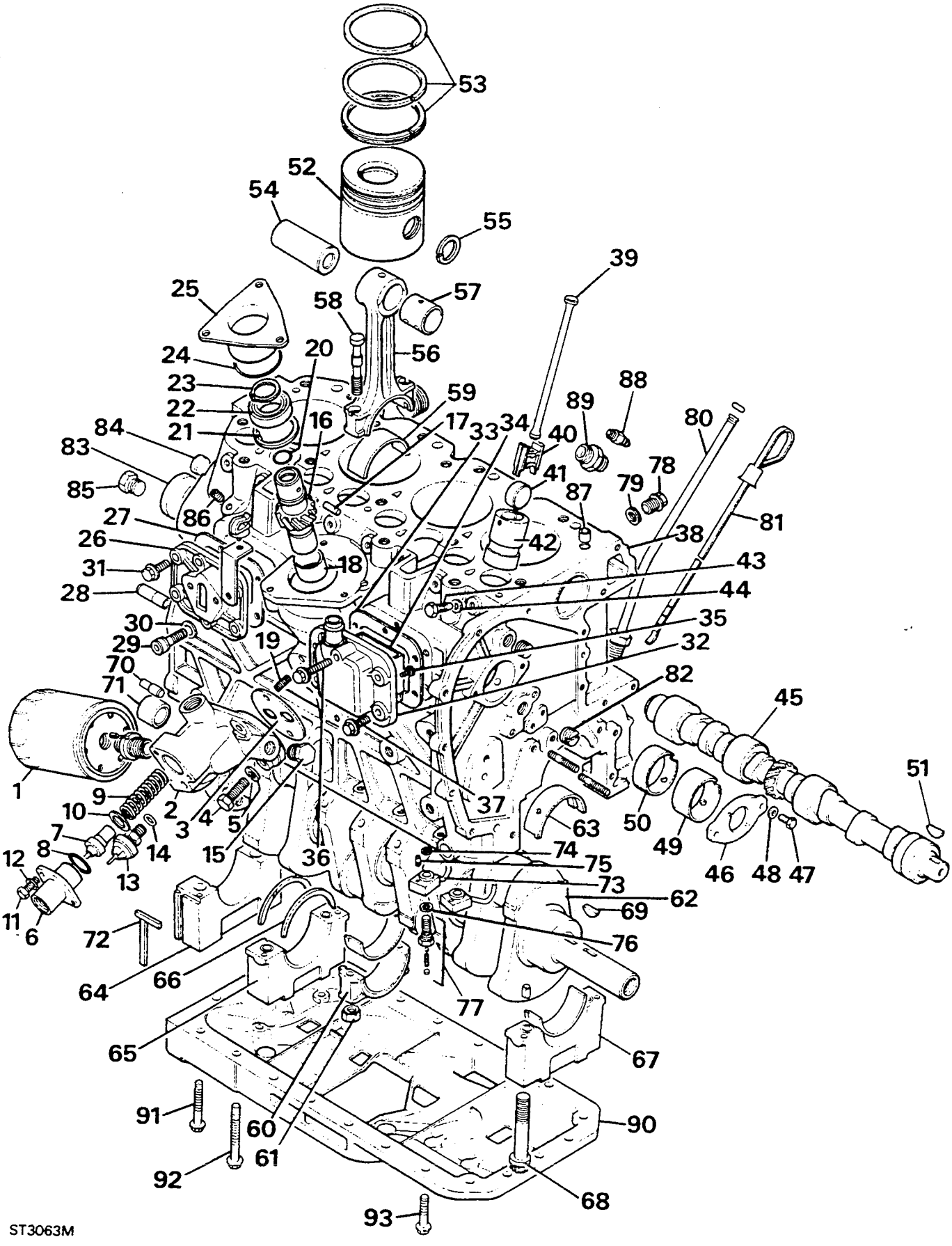
ST3064M

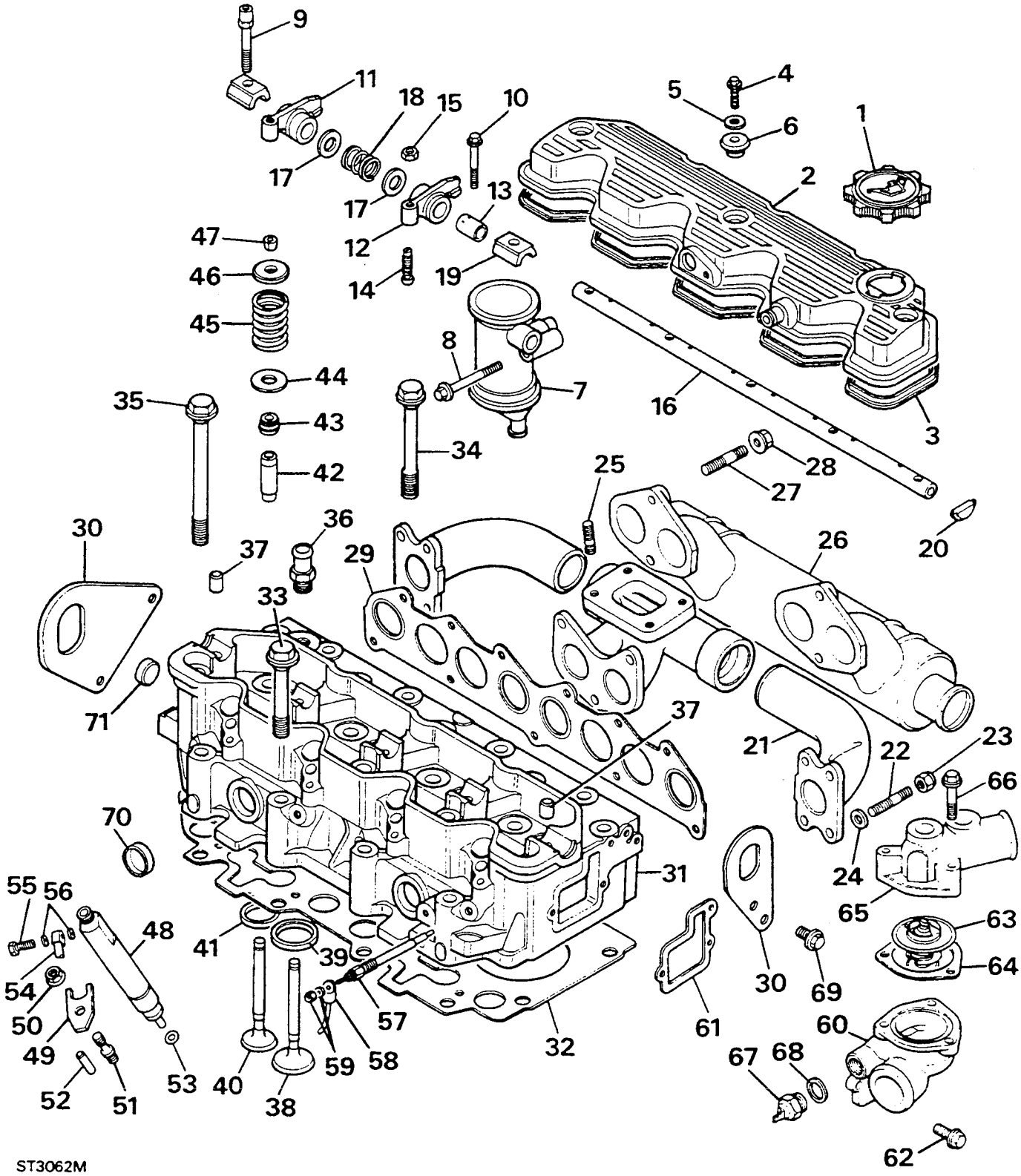
CYLINDER BLOCK COMPONENTS ST3063M - LAND ROVER Tdi engine

1. Oil filter element
2. Oil filter adaptor
3. Gasket
4. Screw (2)
5. Spring washer (2)
6. Oil cooler adaptor
7. Thermostat bulb
8. O ring
9. Spring
10. Washer
11. Screw (2)
12. Washer (2)
13. Oil pressure switch
14. Copper washer
15. Blanking plug
16. Skew gear
17. Dowel pin
18. Bush
19. Locking screw
20. O ring
21. Snap ring - external
22. Deep groove bearing
23. Snap ring - internal
24. O ring - bearing housing
25. Bearing housing
26. Rear side cover
27. Gasket
28. Dowel - flywheel housing (2)
29. Socket screw (2)
30. Washer (2)
31. Flange bolts (6)
32. Front side cover breather
33. Gasket
34. Baffle plate
35. Screw No.6 (2)
36. Flange bolt M8x40 (1)
37. Flange screw M8x25 (5)
38. Cylinder block
39. Pushrod
40. Tappet slide
41. Roller follower
42. Tappet guide
43. Set bolt
44. Washer
45. Camshaft
46. Locking plate
47. Screw (2)
48. Spring washer (2)
49. Camshaft bearing - front
50. Camshaft bearing - inter/rear (3)
51. Camshaft key
52. Piston
53. Piston rings
54. Gudgeon pin
55. Circlip (8)
56. Connecting rod
57. Gudgeon pin bush
58. Connecting rod bolt
59. Big end bearing
60. Big end bearing cap
61. Connecting rod nut
62. Crankshaft
63. Crankshaft main bearing
64. Main bearing cap - rear
65. Main bearing cap - centre
66. Thrust washers
67. Main bearing cap (3)
68. Main bearing cap bolt
69. Crankshaft key
70. Crankshaft dowel
71. Crankshaft bush
72. Packing strip
73. Jet adaptor
74. Joint washer
75. Dowel
76. Joint washer
77. Relief valve assembly
78. Drain plug
79. Joint washer
80. Dipstick tube
81. Dipstick
82. Oil gallery plug
83. Cup plug (5)
84. Cup plug
85. Oil gallery plug
86. Camshaft oil feed plug (3)
87. Ring dowel (2)
88. Oil feed adaptor
89. Oil drain adaptor
90. Ladder frame
91. Flange bolt M8x125 (3)
92. Flange bolt M8x60 (4)
93. Flange screw M8x30 (3)


ST3063M

CYLINDER HEAD COMPONENTS ST3062M - LAND ROVER Tdi engine

1. Oil filler cap
2. Rocker cover
3. Rocker cover gasket
4. Flange headed bolt
5. Washer
6. Sealing washer
7. Breather cyclone
8. Flange headed screw
9. Rocker shaft bolt (3)
10. Rocker shaft bolt (2)
11. Rocker arm RH
12. Rocker arm LH
13. Rocker arm bush
14. Tappet adjuster screw
15. Locknut
16. Rocker shaft
17. Rocker shaft spacer
18. Rocker shaft spring
19. Rocker shaft clamp
20. Rocker shaft seal
21. Exhaust manifold
22. Manifold stud - exhaust
23. Self locking nut
24. Plain washer
25. Stud turbocharger mounting
26. Inlet manifold
27. Manifold stud - inlet
28. Flange nut
29. Manifold gasket
30. Engine lifting brackets
31. Cylinder head
32. Cylinder head gasket
33. Head bolts M12 short (4)
34. Head bolts M12 long (10)
35. Head bolts M10 (4)
36. Adaptor cooling system
37. Ring dowel
38. Valve - inlet
39. Valve seat insert
40. Valve - exhaust
41. Valve seat insert
42. Valve guide
43. Valve stem seal
44. Valve spring seat
45. Valve spring
46. Valve spring cup
47. Split cotters
48. Injector
49. Injector clamp
50. Injector clamp nut
51. Injector clamp stud
52. Injector clamp dowel
53. Injector sealing washer
54. Spill return pipe
55. Banjo bolt 6mm
56. Copper washers
57. Glow plug
58. Glow plug cable
59. Nut and washer
60. Thermostat housing
61. Gasket
62. Flange screw (3)
63. Thermostat
64. Gasket
65. Thermostat housing cover
66. Flange bolt M6x40 (3)
67. Thermal transmitter
68. Joint washer
69. Flange bolt
70. Cup plug (1)
71. Cup plug (2)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ST3062M

The following list of operations can be carried out with the engine installed using the appropriate sections of the ENGINE OVERHAUL PROCEDURE.

OPERATION	Remove Page	Overhaul Page	Refit Page
Cylinder Head	38	72	76 - 77
Heater plugs	38	-	80
Injectors	38	-	80
Rocker cover	39	-	79
Rocker shaft	39	78	78
Removing cylinder head	40	-	76
Front cover oil seals/timing belt/camshaft	40	66	62 - 66
Water pump	40	-	70
Front cover plate or seal	40	-	66
Front pulley damper	40	-	69
Front cover plate	41	-	69
Removing timing belt	41 - 42	-	68
Removing timing belt gears	43	-	66
Removing injection pump	44	-	67
Removing front cover	44	-	66
Vacuum pump/skew gear/bush/oil filter adaptor	44 - 45	63	63 - 64
Fuel pump and side cover	46	-	65
Front side cover plate	46	-	65
Camfollowers	46	-	62
Removing camshaft	47	-	62
Sump and oil pump	48	70	72
Removing oil pump	48	-	72

The foregoing list of remove and refit operations are those which can be carried-out with the engine in the vehicle. Cross reference, where necessary, is made to thr relevant instructions in the engine overhaul procedure 12.41.05. Each operation is numbered with the appropriate Repair Operation Time Contained in publication SMR 670 EN RT A91.

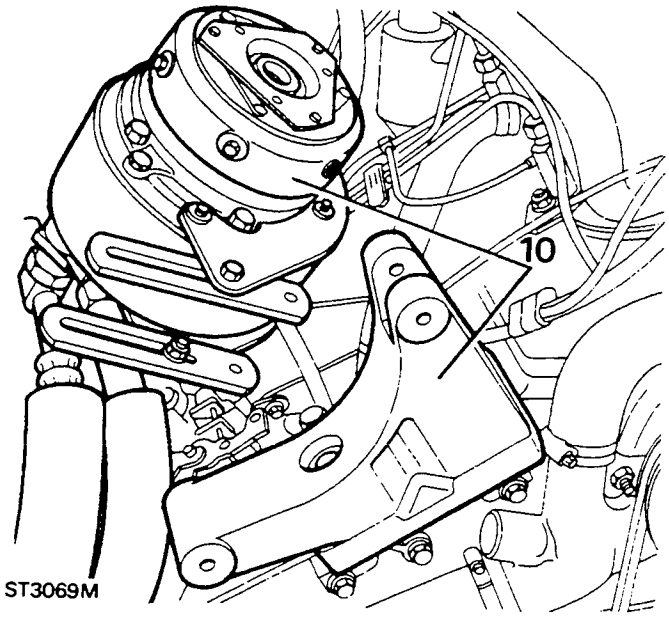
OPERATION	Number	Page
Camshaft	12.13.02	30
Power steering pump bracket	12.35.22	31
Cylinder head	12.29.02	32
Fuel injection pump	19.30.07	81
Air cleaner	19.10.01	84
Turbo charger	19.42.01	35
Inter Cooler	19.42.15	86
Cooling system	26.10.01	87
Fan cowl	26.25.11	88
Fan and coupling	26.25.19	88
Radiator	26.40.01	89
Water pump	26.50.01	90
Exhaust and inlet manifolds	30.15.01	91
Power steering pump	57.20.14	93
Alternator	86.10.02	94

CAMSHAFT

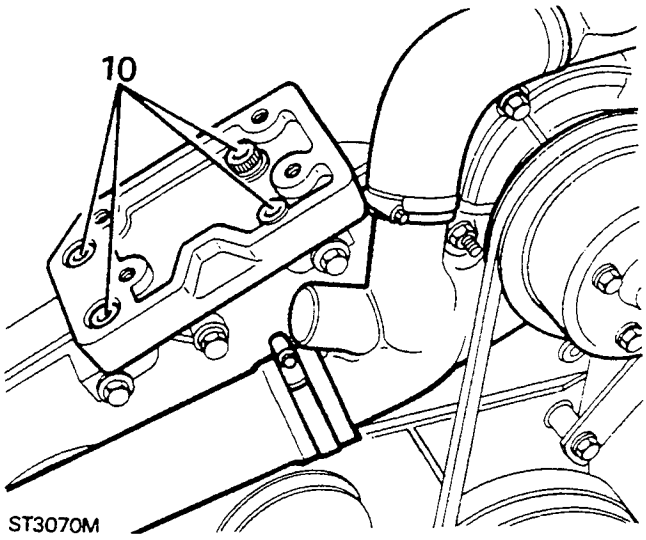
Service Repair No. 12.13.02.

Remove and refit

1. Remove the bonnet and disconnect the battery.
2. Disconnect the radiator bottom hose and allow the coolant to drain and reconnect the hose.
3. Remove the radiator top coolant hose.
4. Remove the fan and viscous coupling assembly, see operation 26.25.19. instructions 4 to 7.
5. Remove the fan cowl.
6. Remove the radiator, see operation 26.40.01. instructions 3 to 5 and 7 to 8.
7. Remove the air cleaner, see operation 19.10.01. instructions 1 to 5.
8. Remove the alternator, see operation 86.10.02. instruction 5 to 9.
9. Remove the power assisted steering pump bracket, see operation 12.25.22 instructions 4 to 9.
10. Remove the air conditioning compressor, where fitted, and the mounting bracket together with the platform secured by four socket headed bolts. Note that the hoses must not be removed from the compressor but it should be carefully secured to one side.



ST3069M

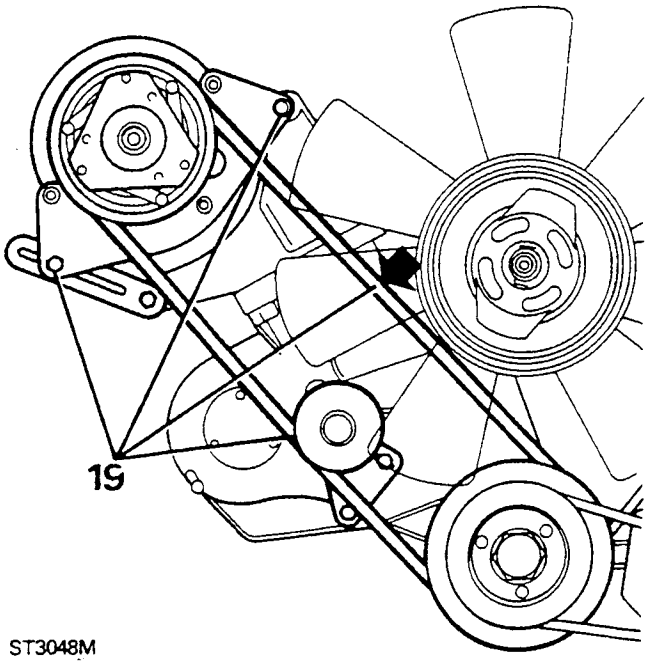


ST3070M

11. Remove the exhaust and inlet manifolds, see operation 30.15.01 instructions 4 to 15.
12. Remove the cylinder head, see operation 12.29.02 instructions 6 to 7 and 9 to 17.
13. Now follow the instructions in ENGINE OVERHAUL section 12. **SEE INDEX:- Operations with engine installed in vehicle**

Refitting

14. Follow the instructions for fitting the camshaft and assembly of the engine up to the fitting of the rocker cover, crankshaft damper and pulley.
15. Fit the inlet and exhaust manifolds see operation 30.15.01 instructions 16 to 24 and 27.
16. Fit the power assisted steering pump bracket and secure and the four bolts.
17. Fit the power steering pump to the bracket with the single pivot bolt and clamp bolts. Leave the bolts slack at this stage.
18. Fit the alternator to the common bracket, see operation 86.10.02 instructions 10 to 15.
19. Where applicable, fit the air conditioning compressor and tension the drive belt as follows:- Move the compressor clockwise about the pivot bolts (do not use a lever against the pump) until the belt deflects 12 mm (0.5ins.) at the mid point of the run between the compressor and crankshaft pulleys . Tighten the pivot and clamp bolts. Move the drive belt damper so that is is just in contact with the belt or 1,0mm clear of the belt and tighten the damper bolts.



ST3048M

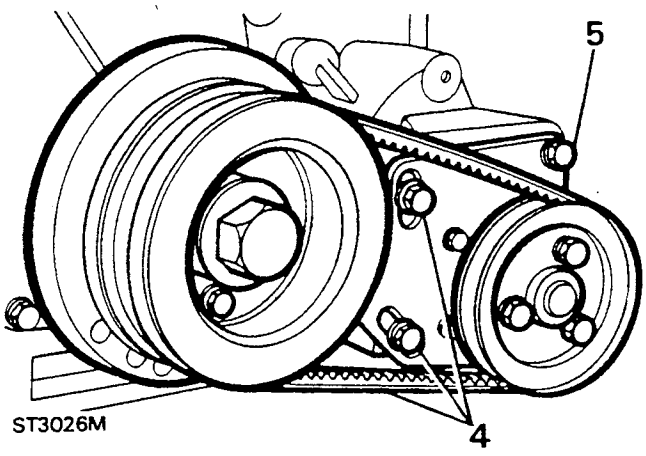
20. Fit and tension the power steering pump drive belt, see operation 57.20.14 instruction 10. Take note of the CAUTION when tensioning the belt.
21. Fit the air cleaner, see operation 19.10.01 instructions 12 to 14.
22. Fit the radiator, see operation 26.40.01 instructions 9 to 15.
23. Fit the fan cowl in position but do not secure to the radiator.
24. Fit the fan and coupling assembly, see operation 26.25.19 instructions 8 to 11.
25. Fill the cooling system, see operation 26.10.01 instructions 5 to 8.

POWER STEERING PUMP BRACKET

Service Repair No. 12.25.22

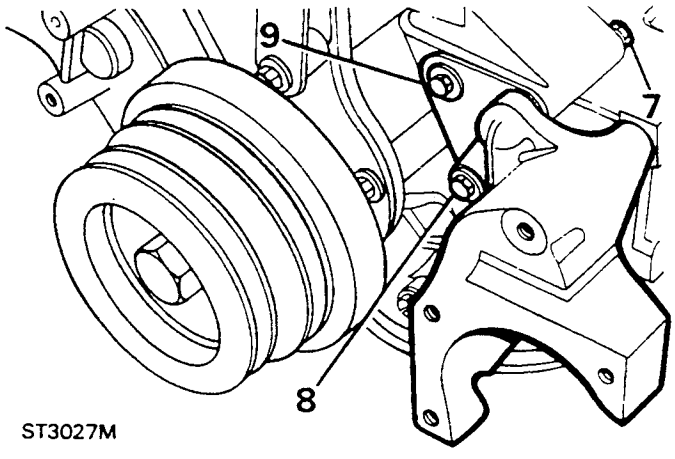
Remove and refit

1. Disconnect the battery.
2. Remove the air cleaner, see operation 19.10.01.
3. Remove the alternator, instructions 2 to 9 operation 86.10.02.
4. Remove the steering pump two adjustment clamp bolts and remove the drive belt.
5. Remove the single pivot bolt.



ST3026M

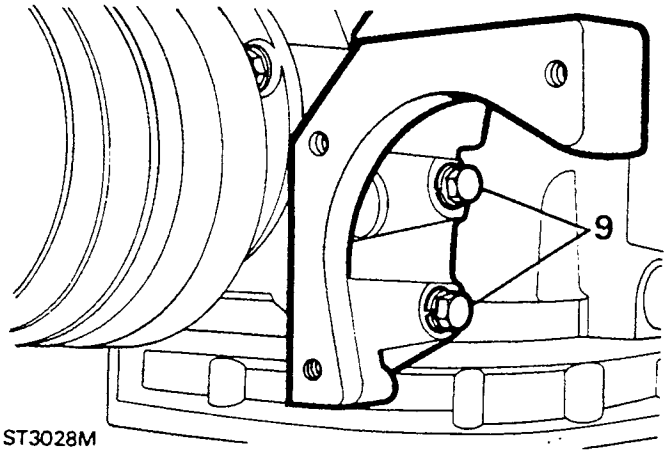
6. Move the pump aside with the two hoses still attached to gain access to the bracket four retaining bolts.
7. Remove the single long bolt through the cylinder block into the bracket.
8. Remove the single bolt from the front into the cylinder block.



ST3027M

Continued

9. Remove the two bolts inside the bracket into the front cover and remove the bracket and triangle shaped packing plate.



Refitting

10. Fit the bracket to the cylinder block with the four bolts, reversing instructions 7 to 9.
11. Loosely secure the pump to the bracket with the three bolts.
12. Fit and tension the drive belt.

CAUTION:- Do not apply any pressure against the pump casing when tensioning the drive belt since it will damage the casing, permanently, beyond repair.

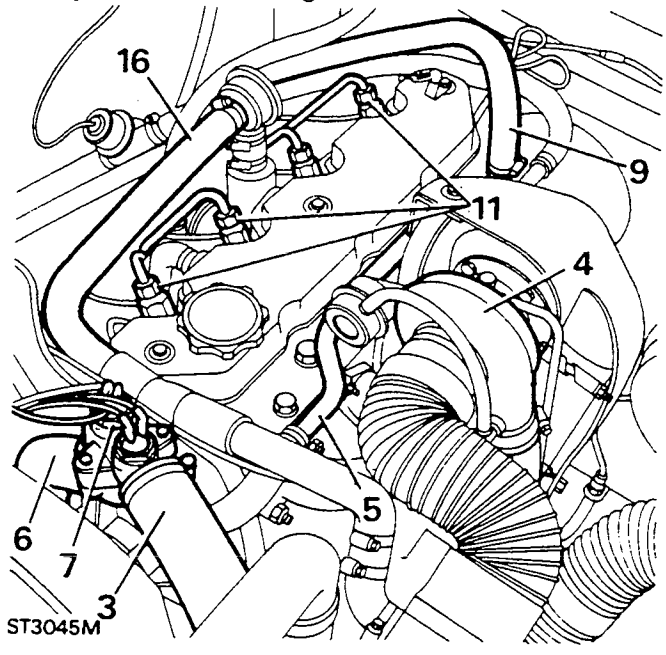
13. Tighten the two clamp bolts and single pivot bol. The belt is correctly tensioned when the belt can be deflected by thumb pressure 12 mm (0.5ins.)
14. Fit the alternator and tension the drive belt, see operation 86.10.02.
15. Fit the air cleaner.
16. Connect the battery, run the engine at a fast idle for approximately three to five minutes. Stop the engine and check the drive belt tensions.

CYLINDER HEAD

Service Repair No. 12.29.02.

Remove and refit

1. Remove the bonnet and disconnect the battery.
2. Drain the coolant.
3. Remove the radiator top hose.
4. Remove the exhaust and inlet manifolds, complete with turbo charger see operation 30.29.02.
5. Remove the heater rail.
6. Remove the thermostat to waterpump hose.
7. Disconnect the electrical leads fromthe thermostat housing sensors.
8. Disconnect the harness from the alternator.
9. Remove the heater hose from the cylinder head.
10. Remove the axle breather pipe bracket from the rear of the cylinder head.
11. Remove the fuel pipes from the injectors and injector pump.
12. Remove the spill return pipes from the injectors.
13. Remove the injectors and washers and place in a clean, sealable container, for safe keeping.
14. Remove the electrical leads from the heater plugs.
15. Remove the heater plugs and store in a safe place.
16. Remove the hose from the breather valve.
17. Follow the instructions in the ENGINE OVERHAUL section 12. **SEE INDEX:- Operations with engine installed in vehicle.**



Continued

Refitting

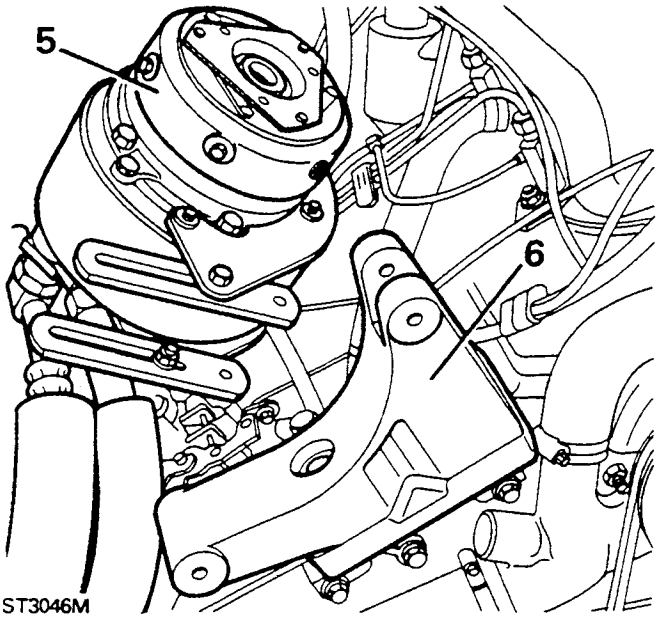
18. Follow the instructions in ENGINE OVERHAUL from "fitting cylinder head" and continue until the rocker cover is fitted.
19. Fit the heater plugs and connect the electrical leads. Do not allow any part of the lead or insulation to touch the cylinder head when fitted.
20. Fit the injectors - see ENGINE OVERHAUL.
21. Fit the spill return pipes to the injectors.
22. Fit the supply pipes to the injectors and pump.
23. Fit the hose to the breather valve.
24. Fit the axle breather bracket.
25. Fit the heater hose to cylinder head.
26. Connect the harness to the alternator.
27. Fit the waterpump to thermostat hose.
28. Connect the leads to the thermostat sensors.
29. Fit the inlet and exhaust manifolds and heater rail.
30. Fit the radiator top hose.
31. Fill the cooling system, see operation 26.10.01.
32. Fit the bonnet.

CAMSHAFT TIMING BELT

Service Repair No. 12.65.18

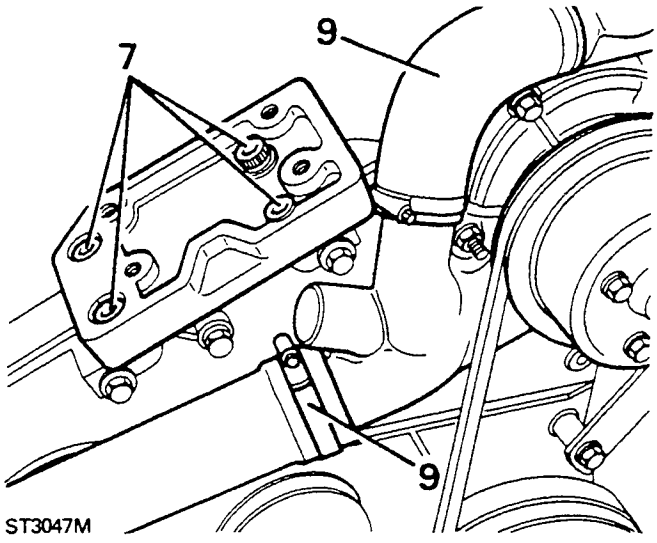
Renew

1. Disconnect the battery.
2. Remove the fan and viscous coupling assembly, see operation 26.25.19.
3. Slacken and remove the power steering pump drive belt, see operation 57.20.14.
4. Slacken and remove the air conditioning compressor drive belt.
5. Remove the air conditioning compressor from the mounting bracket but do not detach the fluid hoses from the compressor. Move the compressor aside taking care not to strain the hoses.
6. Remove the compressor mounting bracket



7. Using an 8,0 mm Allen Key, remove the four socket headed bolts that secure the compressor bracket mounting platform to the front cover and cover plate.
8. Remove the water pump and alternator drive belt, see operation 86.10.02 insturctions 4 to 7.
9. Remove the hoses from the water pump.

NOTE: From this stage onwards reference should be made to the instructions in the ENGINE OVERHAUL section 12. **SEE INDEX:- Operations with engine installed in vehicle.** These instructions should be followed to the point when the timing belt has been fitted and the engine and injector pump are correctly timed.



Assembling

10. Fit the front cover plate using a new gasket and a new gasket washer on the centre bolt boss.
11. Secure the cover with the various length bolts tightening evenly to the correct torque. Refer to the bolt length chart in ENGINE OVERHAUL
12. Using a new gasket fit the water pump, see instructions 9 to 12 operation 26.50.01.
13. Connect the hoses to the water pump.
14. Fit the air conditioning compressor bracket mounting platform and secure with the four socket headed bolts.
15. Fit the compressor mounting u bracket.
16. Refer to ENGINE OVERHAUL for the correct method of fitting the crank shaft damper.
17. Fit the pulley to the damper and evenly tighten the four bolts to the correct torque.
18. Fit the water pump pulley and secure with the four bolts. Use a tommy bar in the hole provided to restrain the pulley while tightening the bolts.
19. Fit and tension the water pump/alternator drive belt.
20. Fit and tension the compressor drive belt. SEE OPERATION 12.13.02
21. Fit and tension the power steering pump drive bel.
22. Fit the fan cowl into position but do not secure to the radiator until the fan is fitted.
23. Fit the fan and viscous coupling assembly to the water pump spindle. Tighten the left hand thread to the correct torque using a tommy bar in the hole provided in the fan pulley to restrain the coupling.
24. Secure the fan cowl to the radiator with the two nuts and fit the top hose.

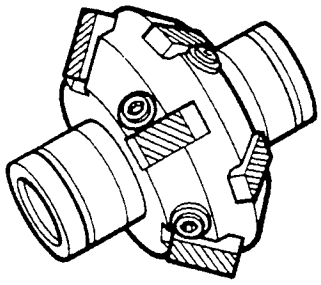
ENGINE OVERHAUL PROCEDURE.

Service Repair No. 12.41.05

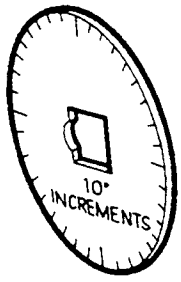
Special service tools

Handle set, seat cutter	MS76B
Pilot, seat cutter	MS150-8
Valve seat cutter	MS621
Cylinder head bolt degree plate	LST122
Adaptor, crankshaft rear seal	18G134-11
Crankshaft rear seal saver	18G1344
Valve spring compressor	MS1519A
Drift, valve guide removal	RO274400
Distance piece, valve guide fitting	RO605774A
Drift, valve guide fitting	LST130
Mandrel, clutch plate	RO605022
Replace, crankshaft front seal	18G1456
Remover. crankshaft/camshaft gear	18G1464
Replace, camshaft oil seal	18G1482
Flywheel timing pin	LST128
Crankshaft damper restraining tool	LST127
Rear main cap seal guide	270304
Crankshaft damper tool	LST136
Injection pump timing pin - part of LST129 pump remover tool	LST129/2

MS.621

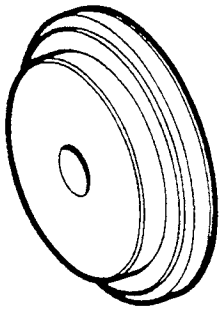


LST. 122



Dia. Range 28.5 mm - 44 mm 15 & 45

18G.134-11



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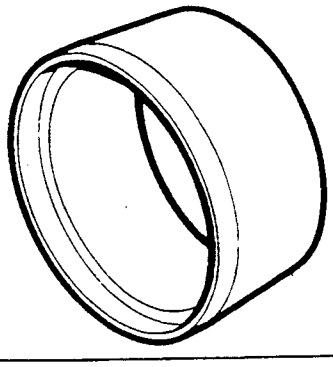
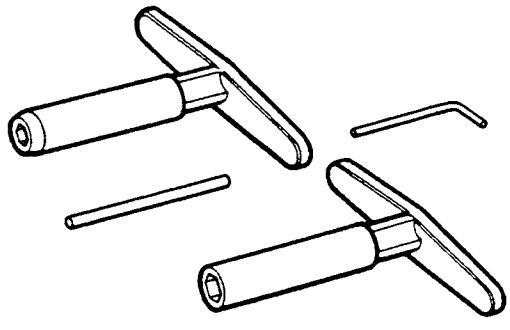
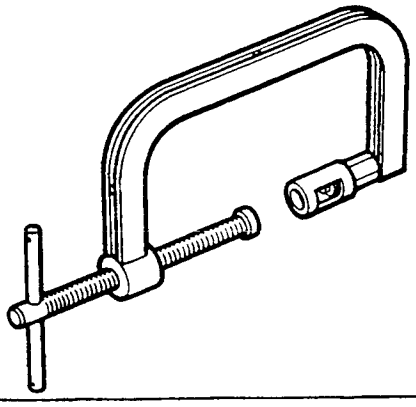


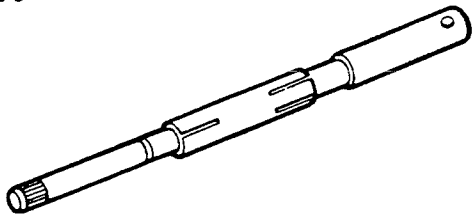
MS.76B



MS. 1519A



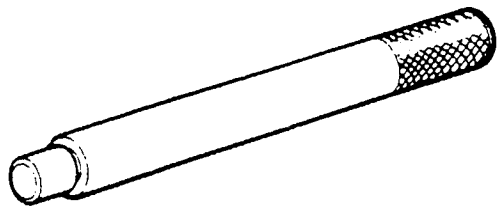
MS.150-8



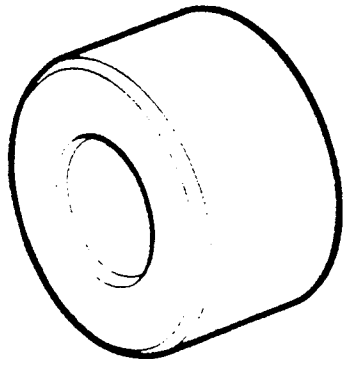
Dia 7.9 mm - 8.5 mm

ST2675M

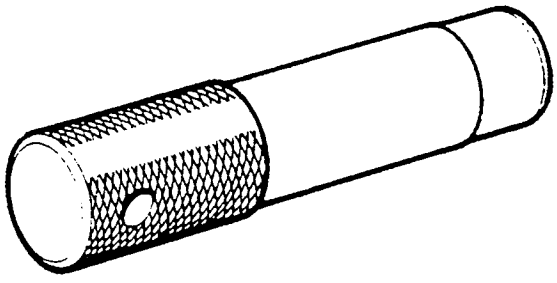
RO.274400



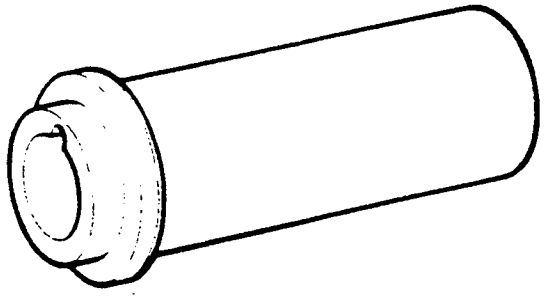
RO.605774A



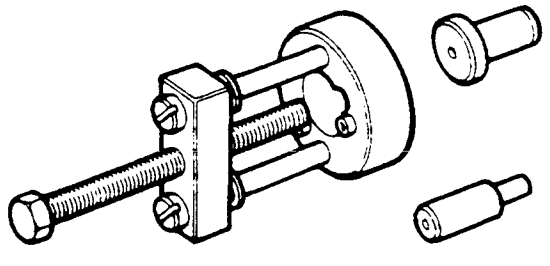
RO.605022



18G.1456

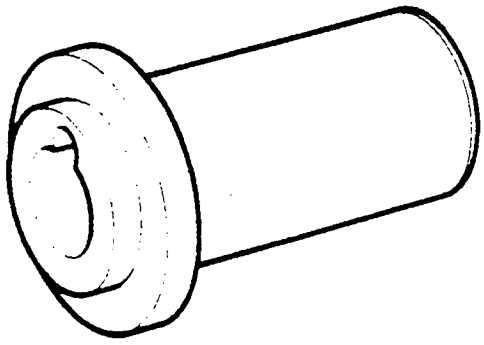


18G.1464

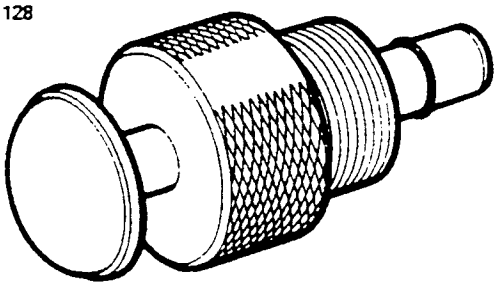


ST2944M

18G.1482



LST.128



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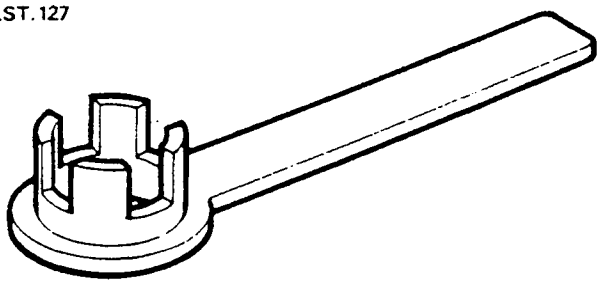

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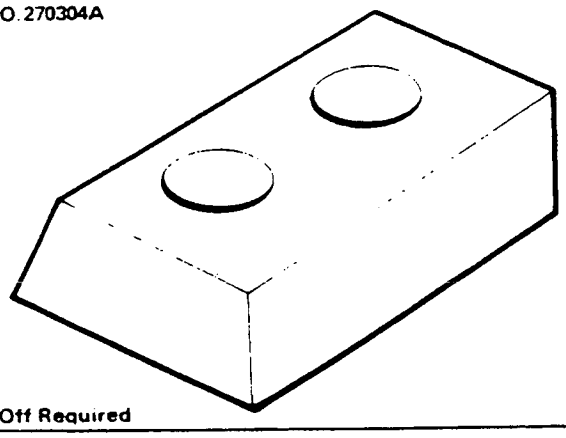

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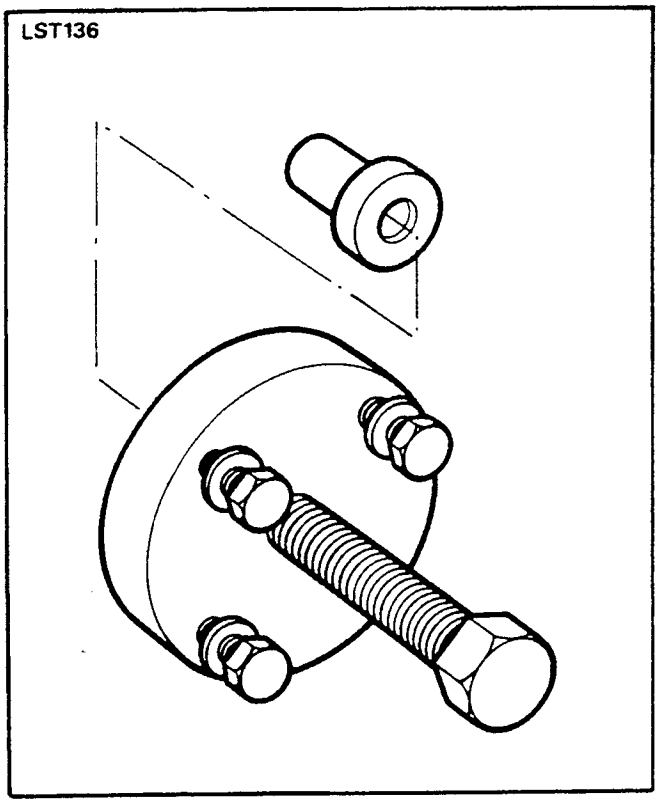
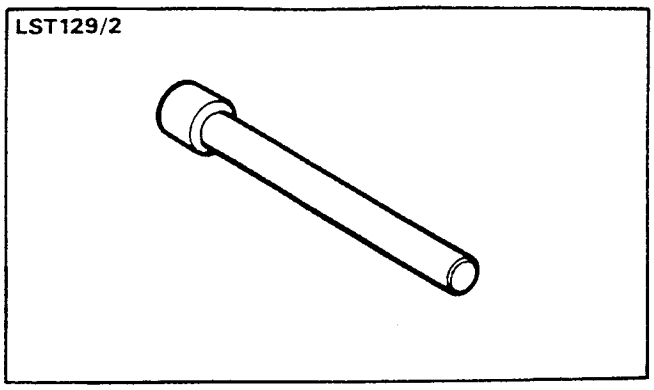
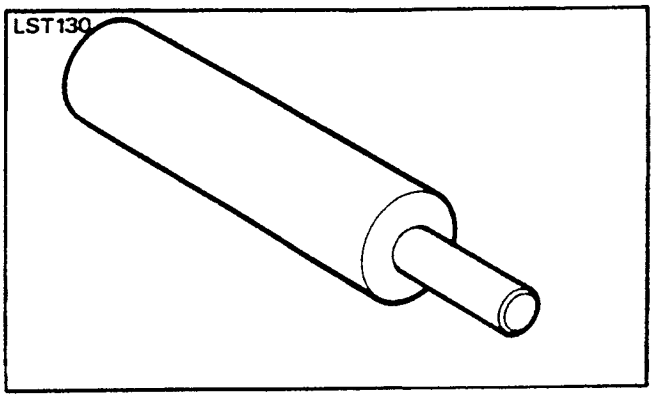


ST2677M





CAUTION AND WARNING
Note that 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.

WARNING. Where the use of an engine stand is recommended, it is absolutely essential to follow the stand manufactures instructions to ensure safe and effective use of the equipment.
In the intrests of safety and efficient working, secure the engine to an engine stand recognised by the garage repair trade. Drain and discared the sump oil whilst strictly observing the the handling and disposal instructions in the Introduction section 01.

Remove the following ancillary equipment prior to dismantling the engine.

Air conditioning compressor-where fitted .

Power steering pump and alternator.

Starter motor

Engine electrical harness.

Air Inlet manifold.

Exhaust manifold and turbo charger.

Whilst dismantling, make a note of the the position of miscellaneous brackets, clips, harness, pipes, and hoses, that are removed at the same time, and any non standard items, to facilitate assembly.

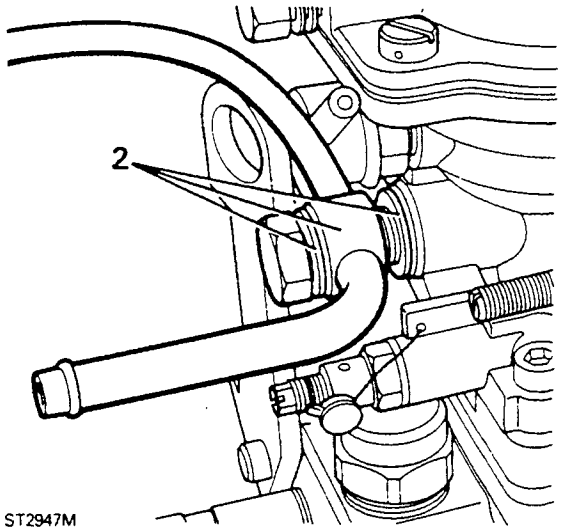
CYLINDER HEAD REMOVE.

CAUTION: Since the injectors and heater plugs protrude below the combustion face of the cylinder head, it is important that they are removed before removing the cylinder head to avoid the possibility of damage to the injectors, heater plugs and pistons.

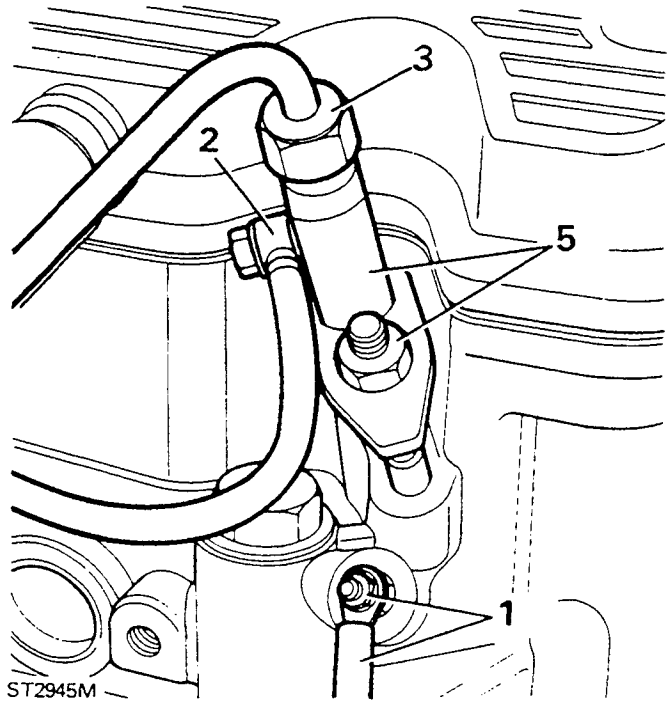
Heater plugs remove

1. Disconnect the wiring, remove the heater plugs and store in a safe place to avoid damage.

See fitting heater plug



ST2947M

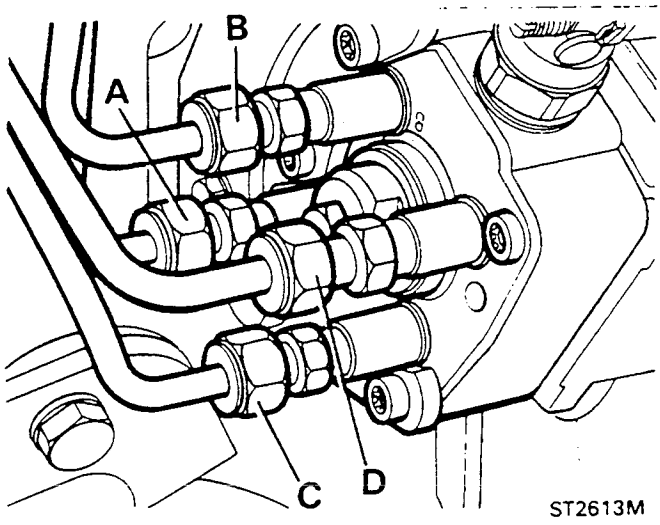


ST2945M

Injectors remove

2. Disconnect the spill return at the pump and injectors.
3. Release the pipes at the injectors and at the pump A-B-C and D as illustrated.
4. Remove the pipes and store in a clean plastic bag.
5. Release the injector clamp nuts, remove the injectors and store in separate plastic bags to prevent contamination and damage. Retrieve the sealing washers from the injector seating in the cylinder head.

See fitting injectors and pipes

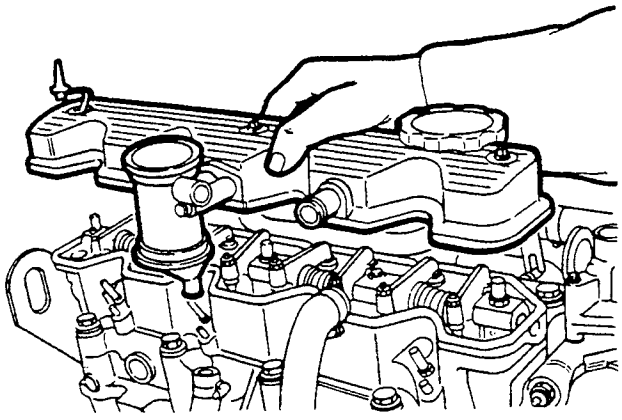


ST2613M

Rocker cover remove.

1. Release the crankcase ventilation hose connections, evenly slacken and remove the three bolts then lift-off the rocker cover.

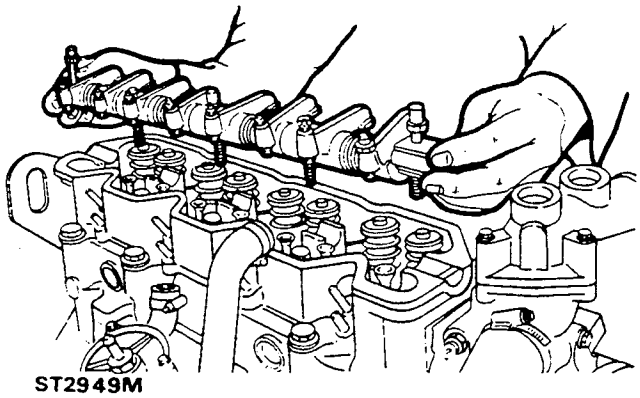
See fitting rocker cover



ST2948M

Rocker shaft remove.

2. Evenly release the five rocker shaft retaining bolts but do not remove the bolts from the shaft, especialy the two end ones, to prevent the assembly from falling apart when removed from the cylinder head.

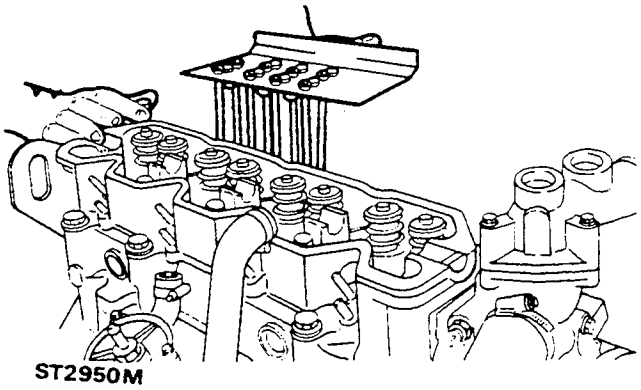


ST2949M

4. Having removed the rocker shaft, lift-out the push rods and insert them through holes in a piece of card marked from 1 to 8 to ensure assembly to their original locations.

5. Remove the cap from each valve stem.

See fitting rocker shaft

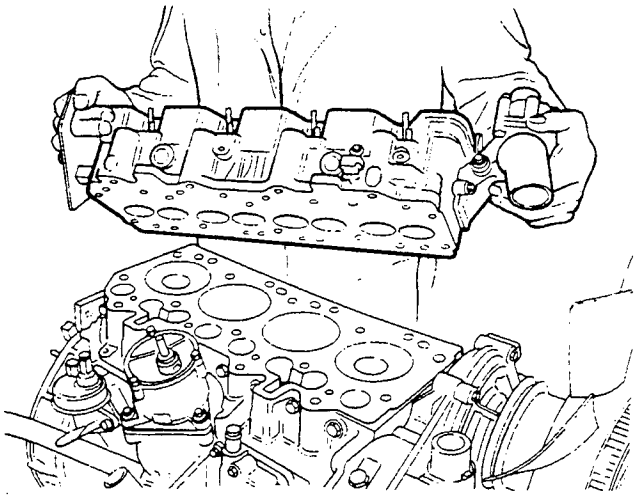


ST2950M

Removing cylinder head

8. Evenly slacken and remove the eighteen bolts retaining the cylinder head and lift the cylinder head from the cylinder block and remove the gasket.

See cylinder head overhaul or see fitting cylinder head



ST2951M

Note:- If necessary, at this stage the cam followers may be removed for inspection. See Cam follower removal

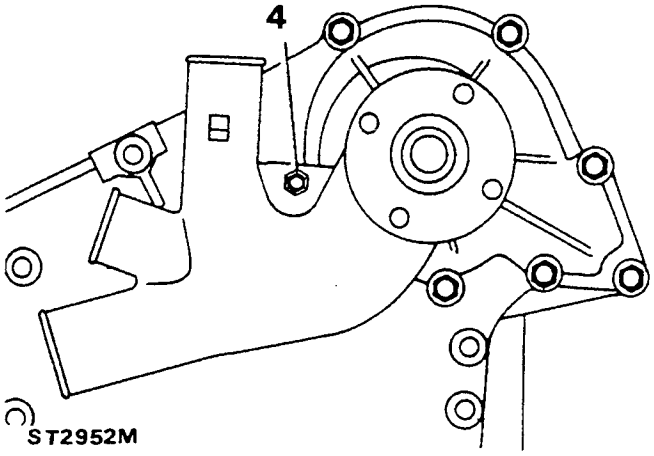
FRONT COVER OIL SEALS/TIMING BELT/CAMSHAFT

See radiator remove/refit

Water pump remove.

1. If necessary remove the viscous coupling complete, with the fan, from the water pump spindle, using a cranked open-ended spanner, noting that it has a left-handed thread.
2. Remove the four screws, to release the pulley from the water pump hub.
3. If necessary release the two Jubilee clips and remove the by-pass hose.
4. Evenly release and remove the six bolts and one nut to remove the water pump from the front cover plate.

See water pump inspection and fitting.

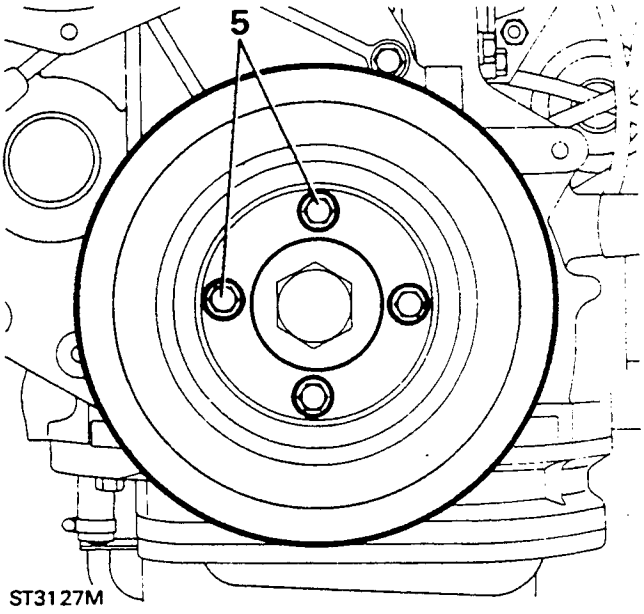


ST2952M

Front cover plate or seal remove

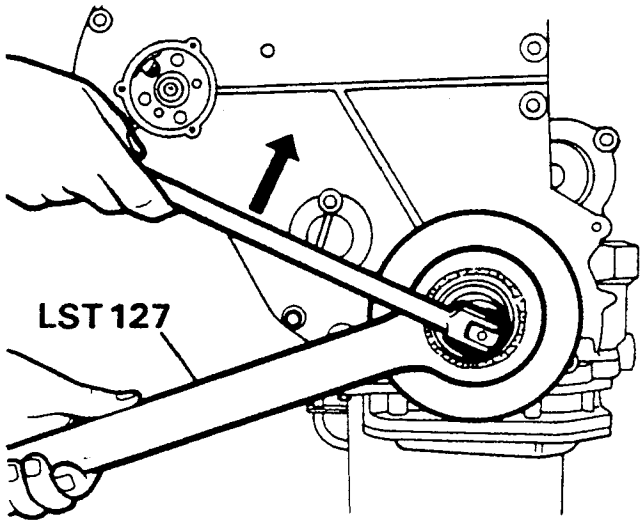
Front pulley and damper.

5. Release the four bolts and remove the crankshaft pulley from the damper.



ST3127M

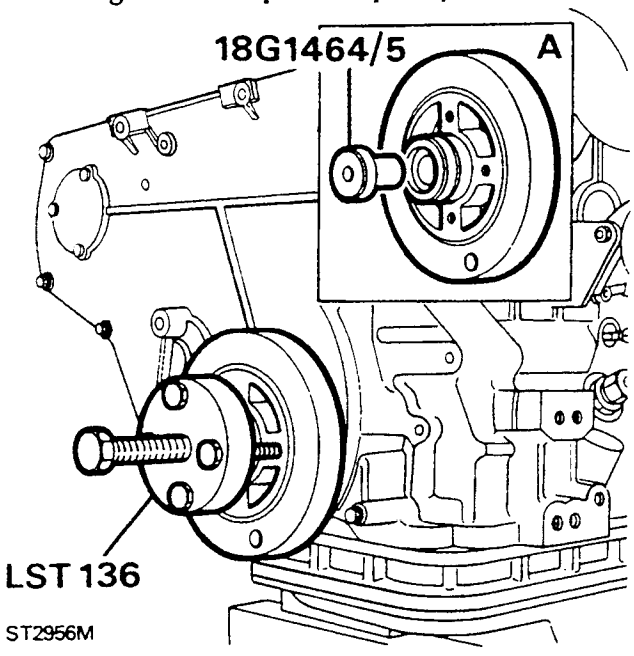
6. To remove the crankshaft damper retaining bolt use pecial service tool FR 101 tor LST 127 o restrain the damper and a 30mm socket to remove the special bolt.



ST3125M

7. Fit the pressure button 18G1464/5 to the end of the crankshaft and using service tool LST 136, extract the damper as illustrated.

See fitting front damper and pulley

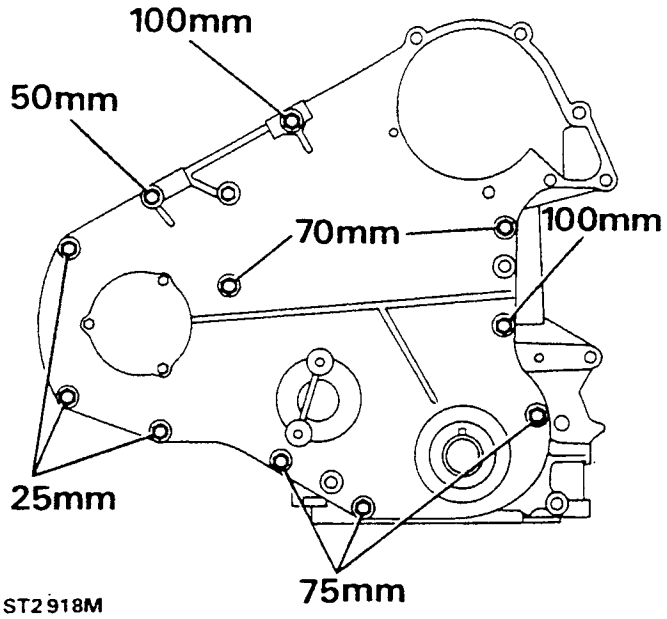


ST2956M

Removing front cover plate.

9. Unscrew the 11 bolts and one nut to release the cover plate.

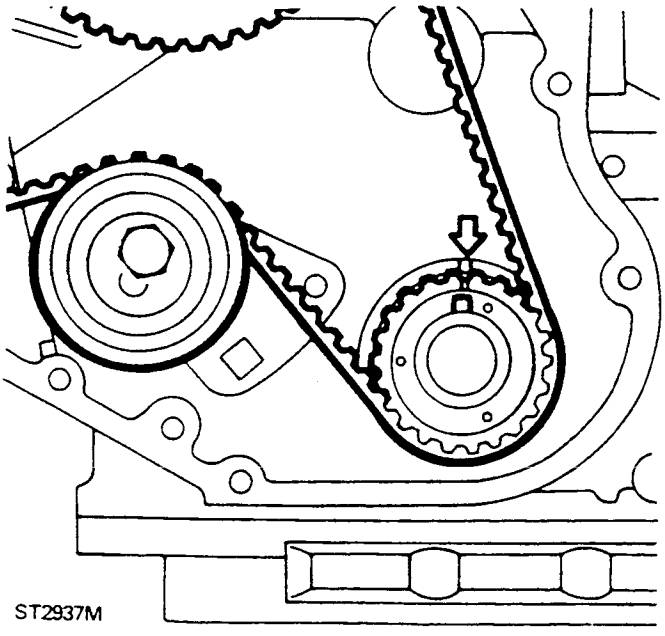
See fitting front cover plate



ST2918M

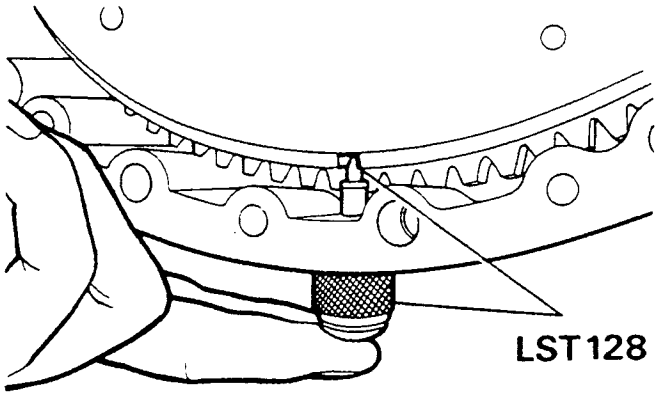
Removing timing belt

1. Use the restraining tool LST 127 to turn the crankshaft in a clockwise direction to TDC so that the valves of number one cylinder are closed with number four cylinder valves on the "rock" and the crankshaft key aligned with the arrow cast into the front cover as illustrated. If the crankshaft is turned inadvertently beyond TDC do not turn it back but continue on round until the above conditions are achieved...



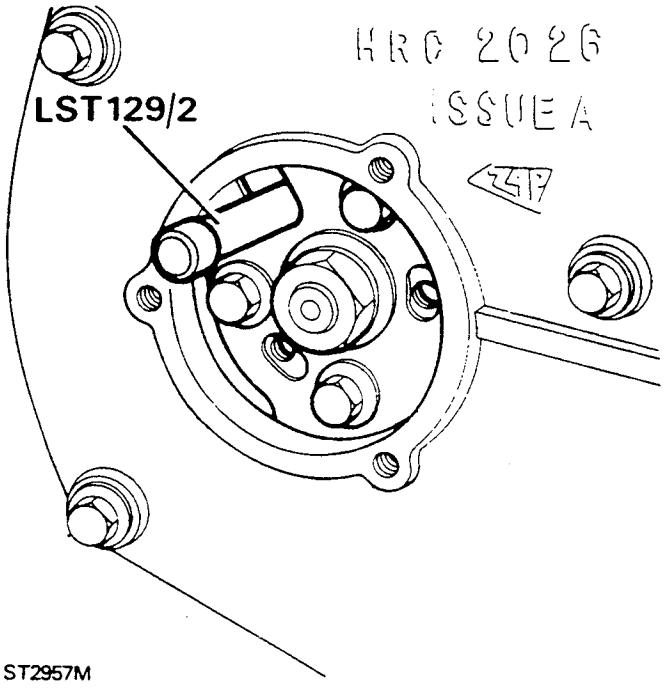
ST2937M

2. Now screw the body of the timing pin tool LST 128 into the flywheel housing and check that the pin can be inserted in to the appropriate slot in the flywheel periphery. Note that there are two slots in the flywheel one being wider than the othe. The narrowest slot determines TDC for this engine and it is therefore important that the correct slot is used.



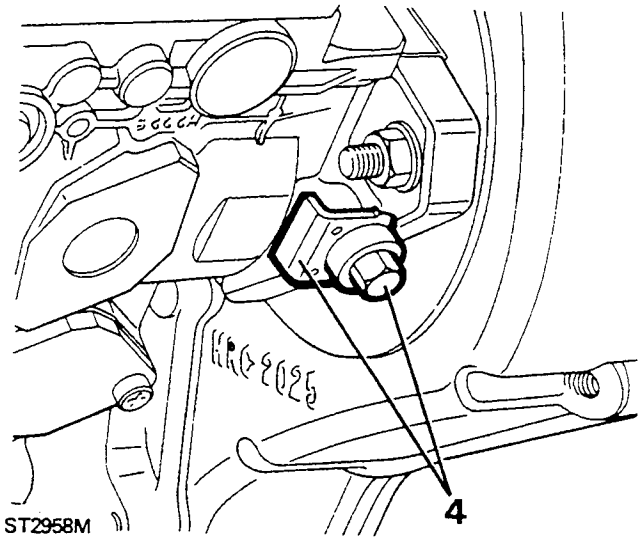
ST2954M

3. Remove the three screws to release the injection pump access cover from the front cover plate and insert the locking pin LST129/2 through the "U" shaped cut-out in the pump hub and into the hole in the pump body. This will confirm that the injection pump is correctly timed in relation to the valves and crankshaft and can be locked ready for removing. Leave the pin in position in the pump.



ST2957M

4. To lock the pump, Slacken the locking screw anticlockwise and remove the inhibiting plate. Turn the screw clockwise to lock the pump shaft. Remove the timing pin from the flywheel housing.

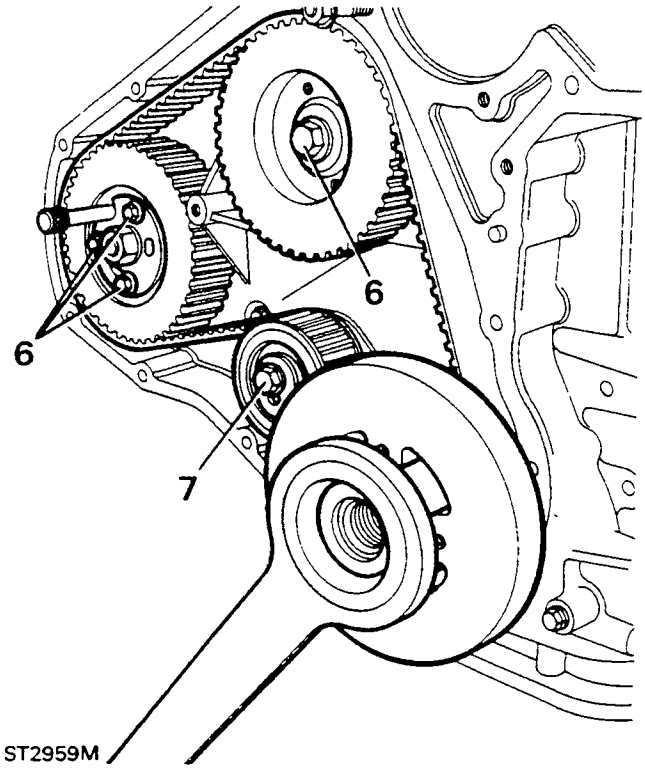


ST2958M

CAUTION: It is important to ensure that once the injection pump has been locked no attempt must be made to rotate it. Therefore take care not to allow the crankshaft to be turned until the pump has been removed.

NOTE:- If renewing the timing belt,oil seals or gears (with the cylinder head fitted) and there is any possibility that the crankshaft will need to be rotated after removal of the timing belt, it would be advisable to remove the rocker shaft. This will prevent the pistons contacting the valves as the crankshaft is turned. If necessary, See rocker shaft removal.

5. To verify any timing error, check that the timing marks inside the front cover line-up with the gear wheels.
6. If necessary temporarily fit the damper and restrain the crankshaft with service tool FR 101 while the three screws securing the pump timing gear to the pump hub and the camshaft gear wheel retaining bolt is being slackened.
7. Remove the single bolt, special washer and remove the tensioner.
8. If the original belt is to be re-fitted, mark its direction of rotation with soft chalk before removing it.

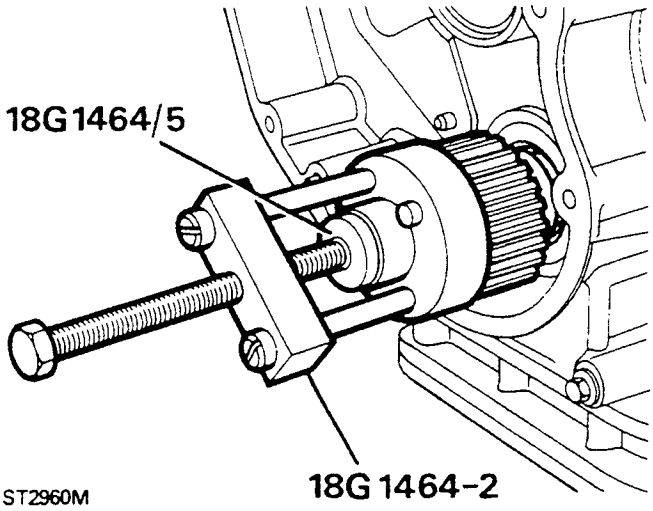


NOTE:- A used drive belt develops a wear pattern relative to the driving loads and its direction of rotation. If the belt is to be re-used it must be refitted so that it continues to operate in the original direction.

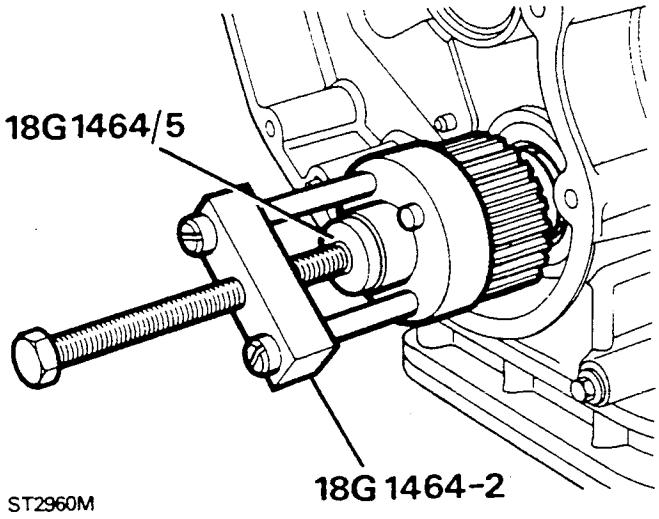
See fitting Timing gears and belt.

Removing timing belt gears

9. If the crankshaft gear wheel cannot be removed by hand, use special service tool 18G 1462-2 and pressure button 18G 1464-5. Assemble the tool and withdraw the gear wheel as illustrated.



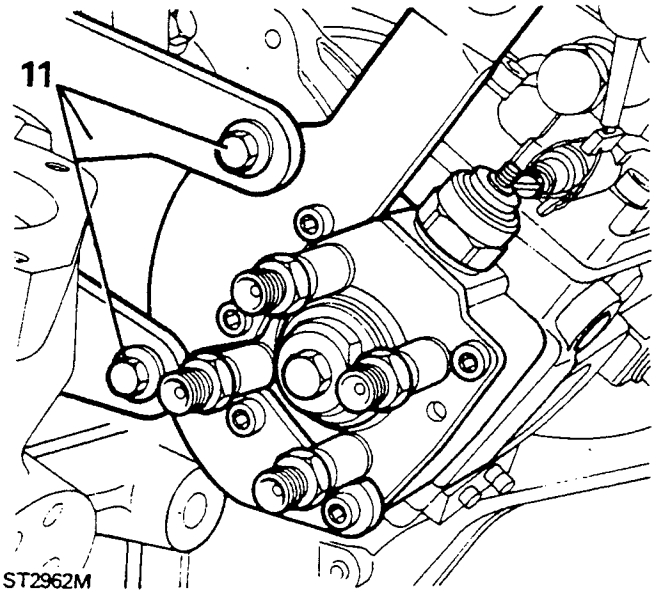
10. Remove the camshaft gear wheel retaining bolt assembly to enable the gear to be removed. Use special service tool 18G 1462-2 and button 18G 1464-6. Assemble as shown and withdraw the the gear.



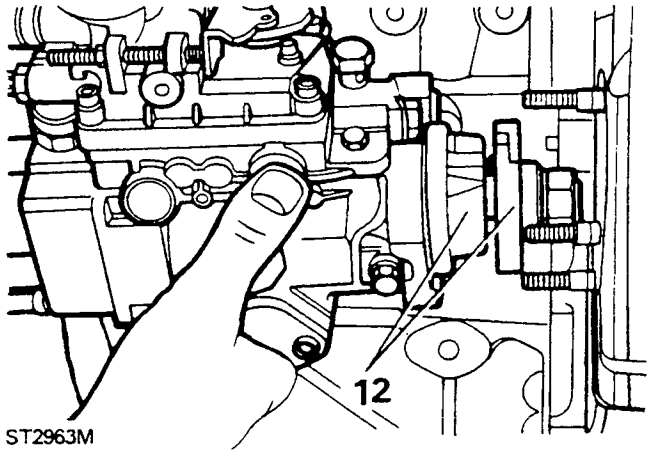
The camshaft and crankshaft oil seals may be renewed at this stage with the engine in the vehicle without removing the front cover.
See fitting front cover seals

Removing injection pump

11. Release the injection pump from the rear support bracket.



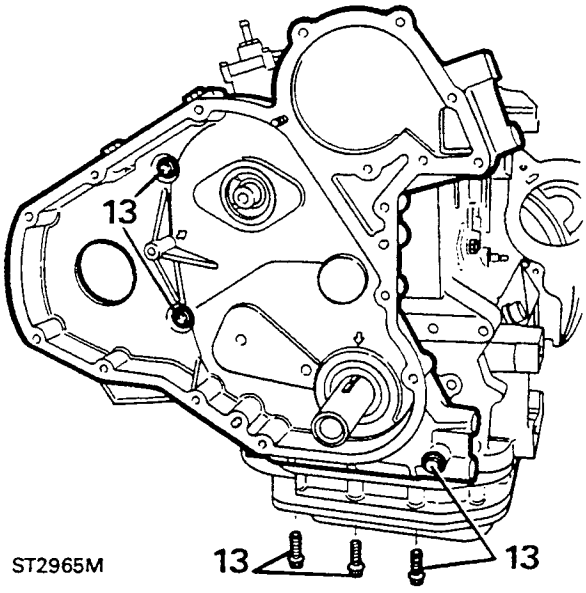
12. Remove the three nuts securing the pump flange to the front cover and withdraw the pump and gasket complete with hub and timing pin.



Removing front cover

13. To remove the front cover,release the three bolts securing it to the cylinder block front face and the three bolts that pass up through the sump and ladder frame into lower face of the cover.

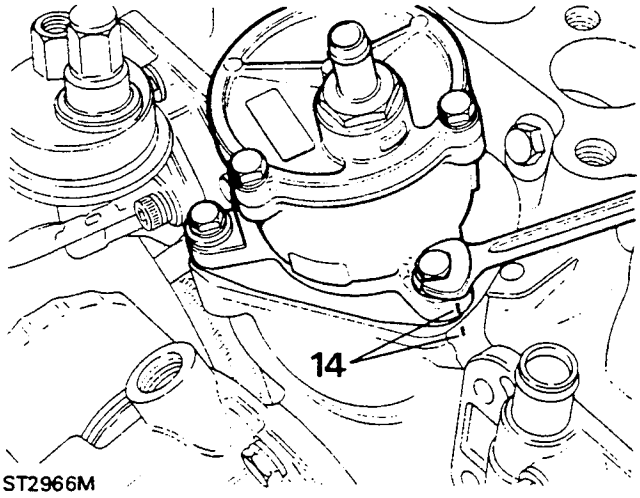
See fitting front cover timing belt and gears



Removing vacuum pump

14. Mark the position of the brake servo vacuum pump with relation to the cylinder block. Using a 6mm Allen key remove the three screws and lift-out the pump.

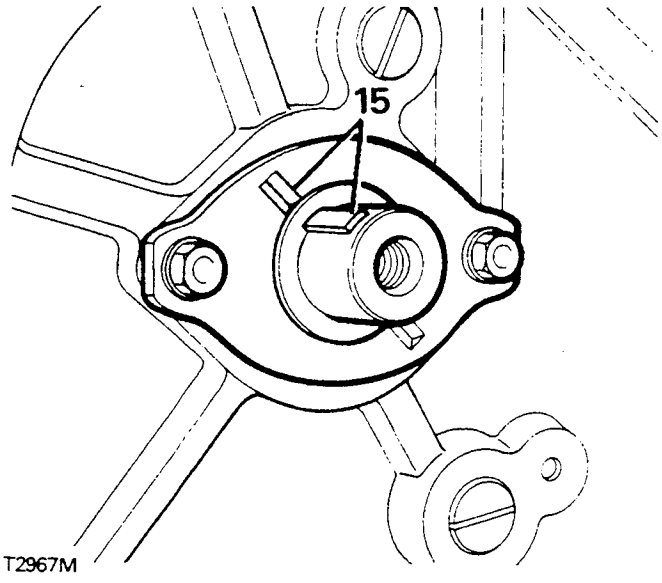
See fitting vacuum pump

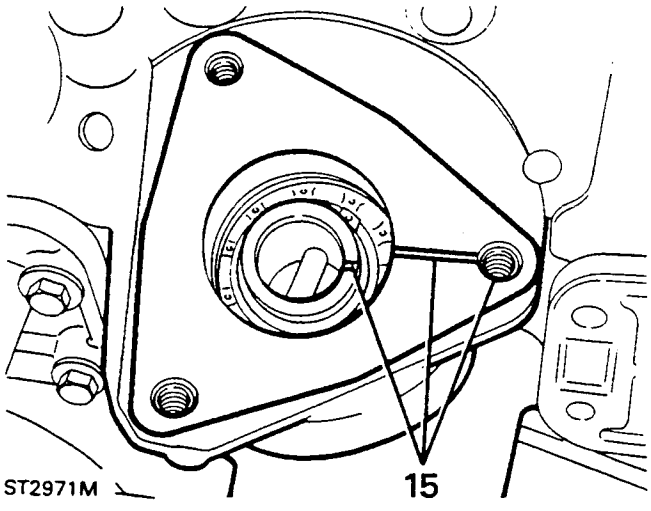


Removing skew gear

During normal operation of the engine the camshaft and skew gear teeth develop a mated a wear pattern. It is therefore important that if the skew gear is to be re-used it should be fitted so that the teeth on the gear and camshaft engage in the original running position.

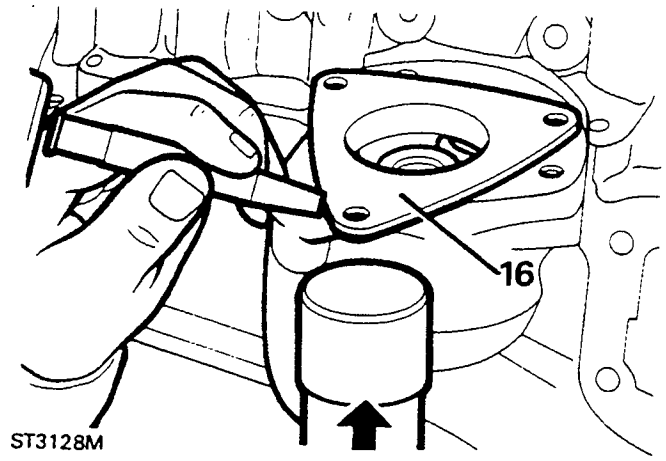
15. To ensure orininal re-engagement of the gears turn the camshaft so that the camshaft key is aligned with the oil groove in the thrust plate and mark the position of the skew gear in relation to the one of the three bolt holes for securing the vacuum pump. Also mark the skew gear housing flange to the same bolt hole.





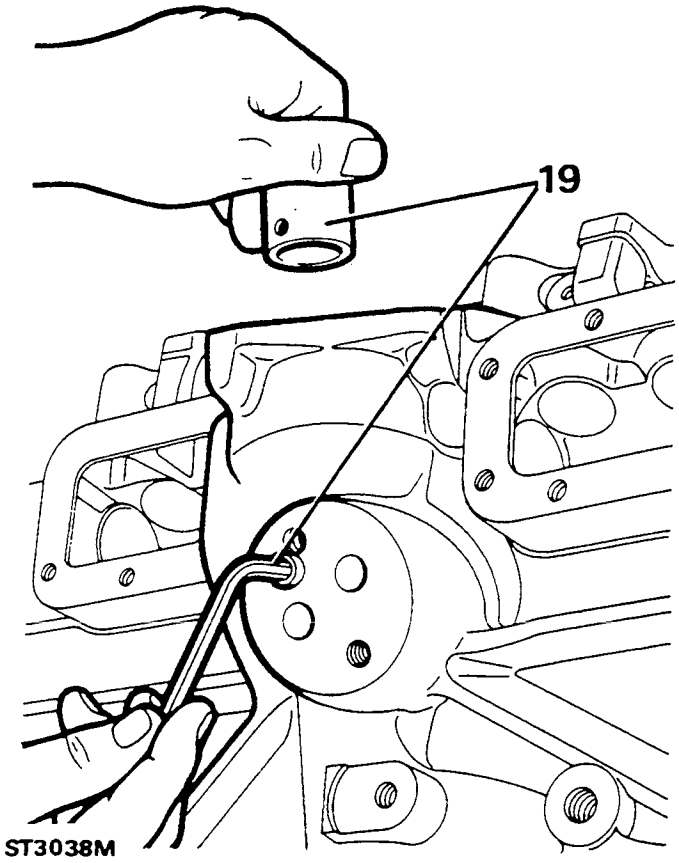
16. To remove the skew gear assembly, tap the flange round so that the edge overlaps the cylinder block, then tap the flange upwards to enable the skew gear assembly to be lifted out.

If necessary the oil pump drive shaft may be removed at this stage



Removing skew gear bush

17. Unscrew the oil filter cartridge, anti-clockwise, using a strap wrench. Dispose of the oil safely.
18. Release the two bolts and remove the oil filter adaptor and gasket from the engine.
19. Using a 6 mm allen key remove the retaining screw and bush.



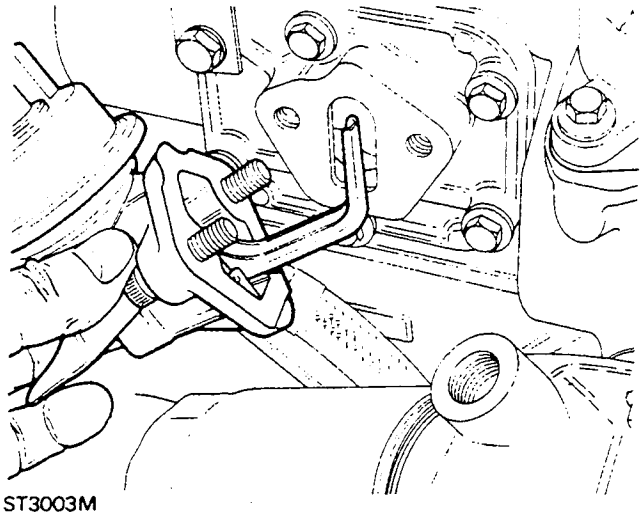
Removing fuel pump and side cover

20. Use a 6 mm allen key to release the fuel lift pump to gain access to the side cover retaining bolts.
21. Release the six bolts and remove the cover plate.

See fitting lift pump.

Remove front side cover plate

22. Release the six bolts and remove the front side cover plate complete with the crankcase ventilation pipe.



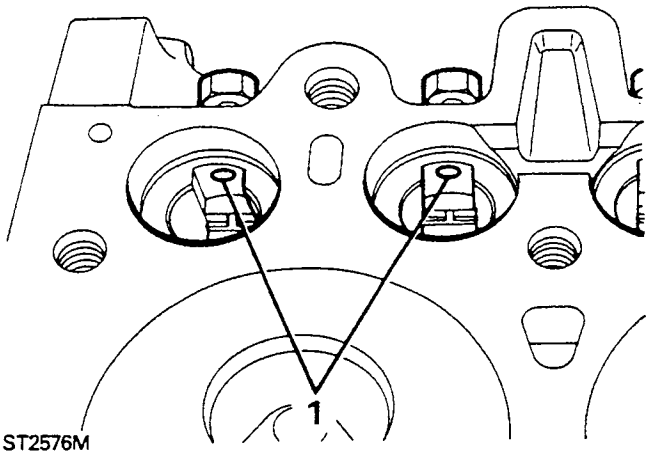
ST3003M

Remove camfollowers

See cylinder head remove

CAUTION: The camfollers are solid rollers held in position against the cam by a slide inside a fixed guide. If the guide is removed before the roller, it is possible that the roller can fall behind the camshaft and become jammed. Furthermore the roller could slip past the cam and fall into the crankcase. It is therefore important to adopt the following procedure for removal.

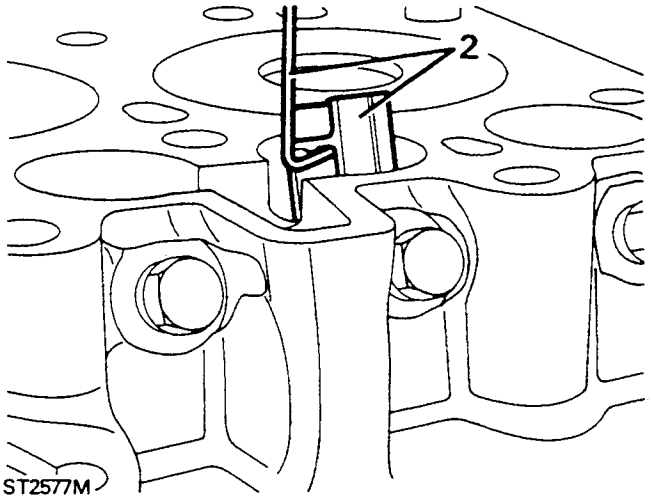
1. Slacken back the guide locating screw so that the end is below the bore of the guide.



ST2576M

2. Using a length of thin wire with a hooked end lift-out the slide.
3. With the same piece of wire remove the roller.
4. Remove the guide locating screw and lift-out the guide.
6. As each assembly is removed number it, from one to eight, for refitting to its original location.

See fitting cam followers

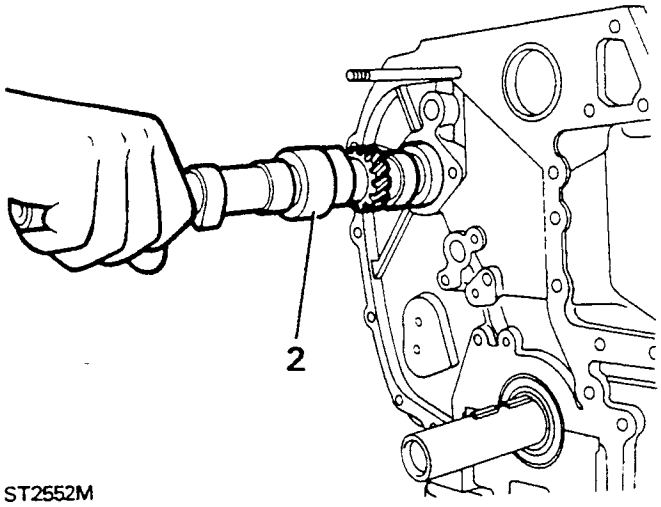


ST2577M

Removing the camshaft.

1. Release the two screws and remove the camshaft thrust plate.
2. Carefully Withdraw the camshaft taking care not to allow the end of the shaft to drop on to the bearings as it is removed.

See fitting camshaft



ST2552M

Removing Clutch and Flywheel housing

See engine unit removal

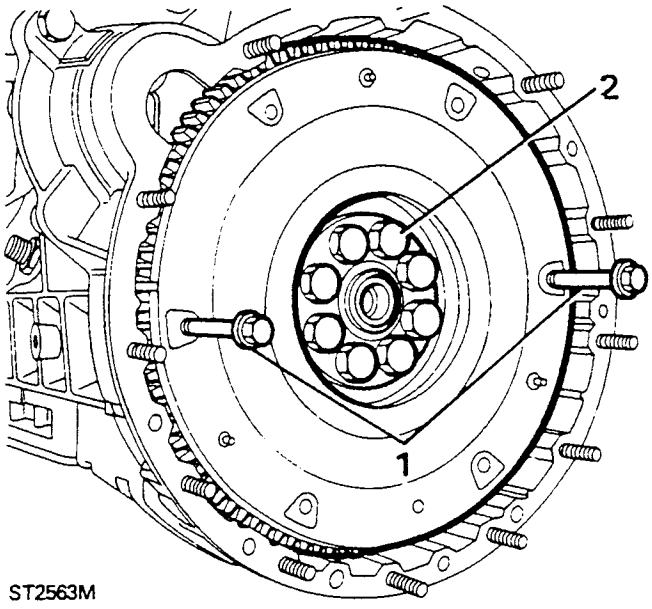
1. Mark the relationship of the cover to the flywheel to ensure original balance is maintained.
2. Evenly slacken and remove the six retaining bolts and washers and remove the assembly complete with the friction plate.

See fitting clutch

Removing flywheel

1. In the intrests of safety, fit two long 8mm bolts into the clutch bolt holes, diametrically opposite, to use as handles for lifting the flywheel off the crankshaft.
2. temporarily fit the the crankshaft damper and use special service tool FR 101 to restrain the crankshaft while slackening the flywheel eight retaining bolts. Remove the bolts and reinforcing plate and lift-off the flywheel.

See overhaul and fitting flywheel

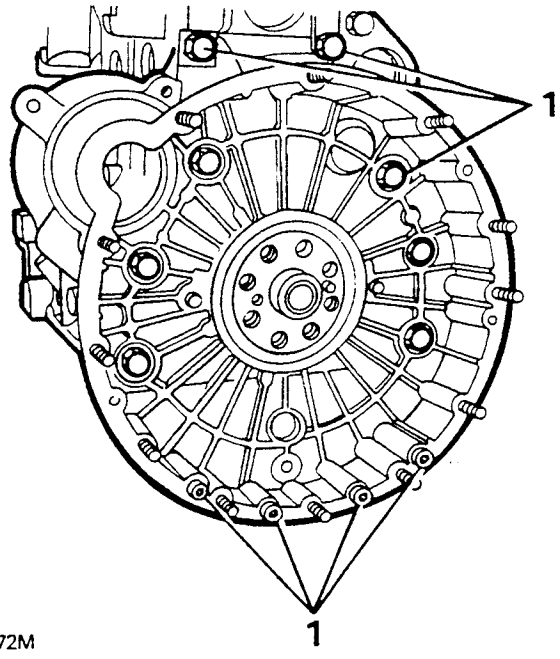


ST2563M

Removing flywheel housing.

1. Remove the eight internal and two external and five ladder frame securing bolts, then ease the flywheel housing from the two locating dowels and crankshaft.

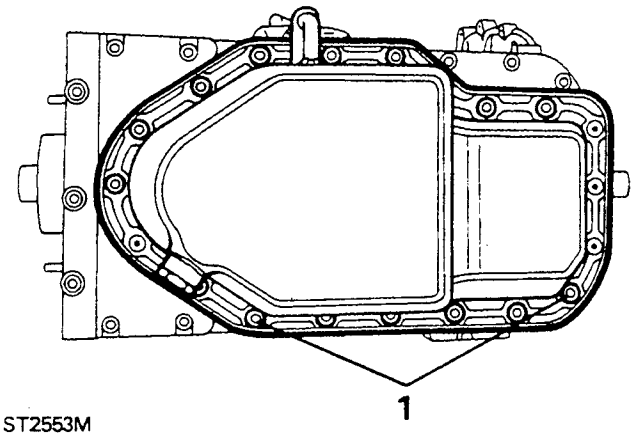
See fitting rear main oil seal to flywheel housing.



ST2972M

Removing sump and oil pump

1. If necessary drain the engine oil. When working with the engine on a work stand, invert the cylinder block so that the sump is uppermost. Remove the screws and ease the sump from the ladder frame to reveal the oil pump.



ST2553M

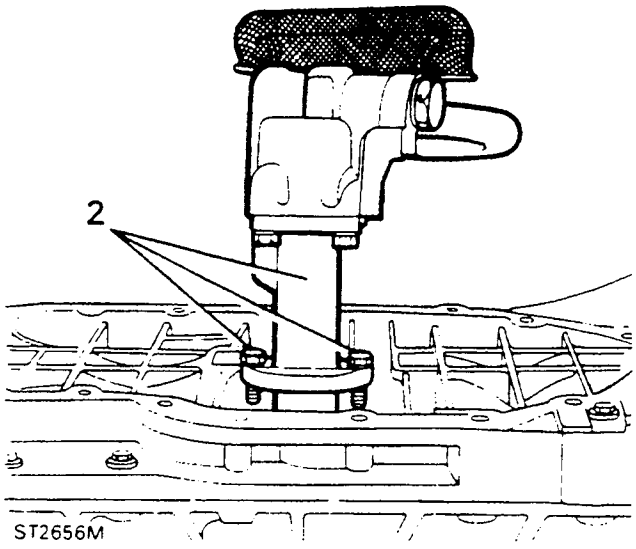
Note: After removing the oil sump when the engine is in the vehicle, refit and tighten two of the retaining bolts to the left side of the cylinder block to maintain pressure on the ladder frame cylinder block joint seal.

See fitting sump

Removing oil pump

2. Two bolts secure the oil pump to the crankcase. Access to the right hand bolt may require the use of a socket with a universal joint. Removal of the two bolts will enable the pump to be withdrawn.

See fitting oil pump



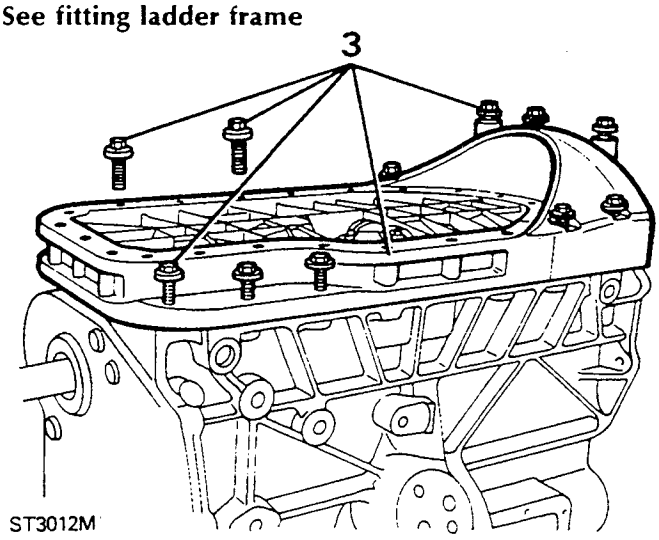
ST2656M

Removing ladder frame

Note: The ladder frame and flywheel housing are secured by five bolts which are inaccessable with the gearbox bell housing fitted. Therefore it is not possible to remove the ladder frame when the engine is in the vehicle without first removing the gearbox or engine unit, flywheel flywheel housing, engine sump and oil pump

3. With the engine removed, release the remaining ten bolts and separate the ladder frame from the crankcase by gently tapping to break the seal.

See fitting ladder frame

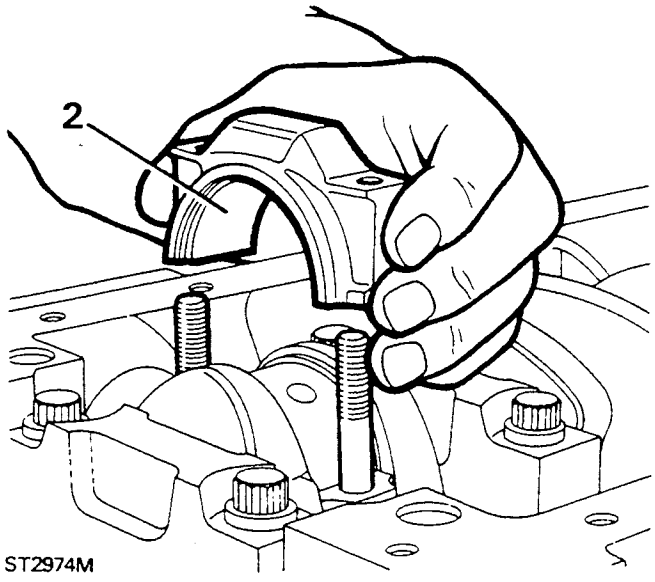


ST3012M

Removing pistons and connecting rods

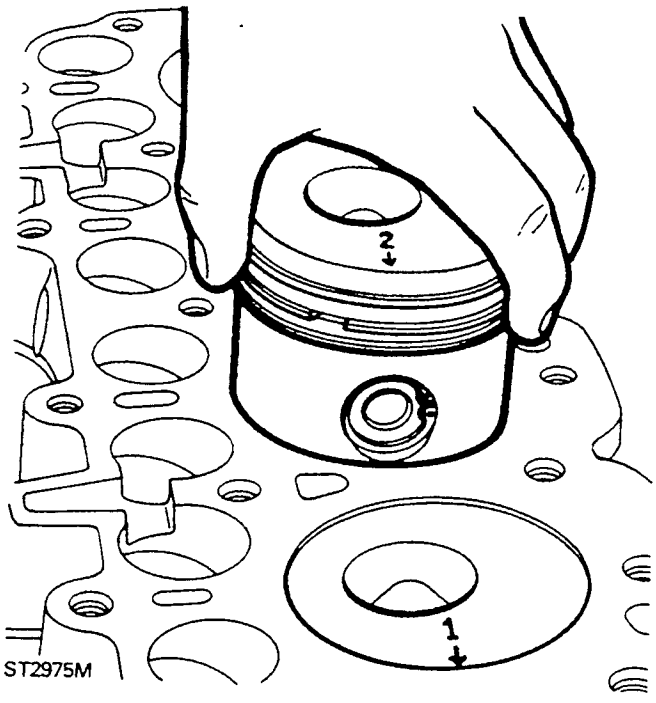
Note: On this version of the Tdi engine, it is not possible to remove the connecting rods or pistons with the engine in the vehicle because of the method by which the ladder frame is secure. See note under Ladder frame removal.

1. Turn the crankshaft to bring all the connecting rod cap nuts to an accessable position and slacken the nuts using a 15mm socket.
2. Remove the connecting rod nuts and remove the caps complete with lower bearing halves.



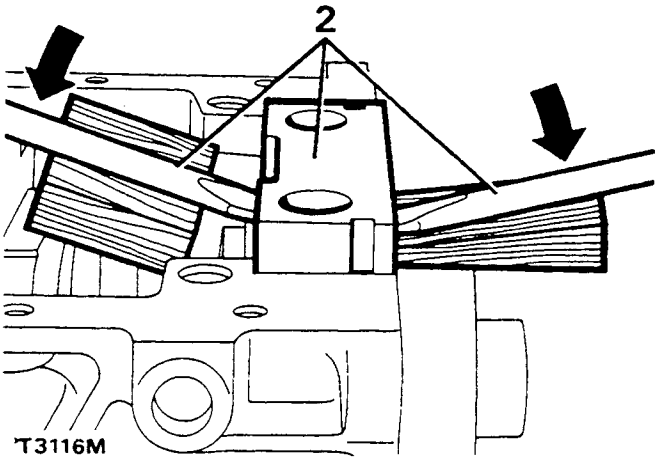
3. Before removing the piston assemblies, number each piston from one to four so that it can be identified with the bore from which it was removed.
4. Taking care not to damage the bores, push each connecting rod and piston, in turn, up the bore until it can be withdrawn from the cylinder block combustion face. As each piston assembly is removed fit the corresponding cap and bearing shell to the connecting rod noting that the shell locating tags are together on the same side as the connecting rod number.

See piston and connecting rods



Removing crankshaft.

1. Slacken the ten mainbearing bolts with a 14mm socket.
2. If difficulty is experienced removing the cap a suggested method is to lever the cap from both sides, as illustrated.
3. Insert a suitable bar in the hole in the inside face of the cap and lever against the crankshaft journal on the outside face. Ensure that blocks of timber are used under the levers particularly to protect the crankshaft.
4. Release the remaining bolts and remove the mainbearing caps complete with the lower bearing shells.

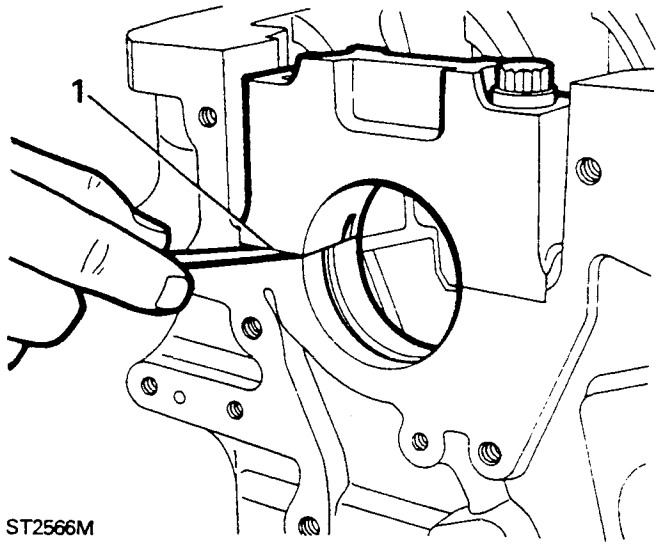


5. Lift-out the crankshaft either by hand or hoist. If a hoist is used be sure to insert adequate protection between the sling and journals to avoid damage.
6. Remove the mainbearing upper shells from the cylinder block.
7. Remove the two thrust washers from each side of the centre bearing location.
8. Remove the four cylinder lubrication, jet tubes.

CYLINDER BLOCK INSPECTION AND OVERHAUL

Inspection

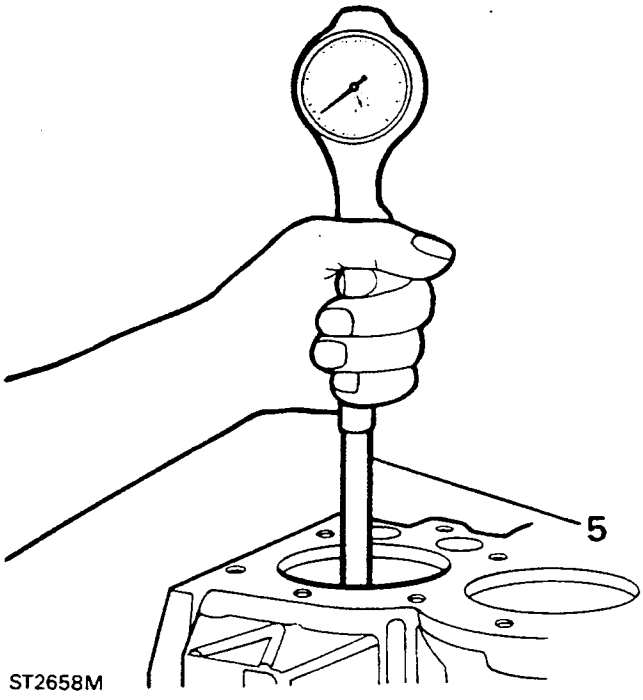
1. Degrease the cylinder block and carry out a thorough visual examination checking for cracks and damage. To check each main bearing cap and its location on the cylinder block, fit the bearing caps without the bearing shells.
2. Fit the bolts and tighten to the correct torque, then remove one bolt from each bearing cap and check with a feeler gauge that no clearance exists at the joint face as illustrated.
3. A clearance indicates either a bent bolt, damaged dowl, distortion of the caps or block, or that the cap has been filed or machined in an attempt to reduce any clearance due to wear in the bearings. Main bearing caps are not available separately from the cylinder block therefore any clearance should be investigated and rectified or the block renewed.



ST2566M

Cylinder bores

4. Measure the cylinder bores for ovality, taper and general wear, using any suitable equipment. However, an inside micrometer is best for checking ovality and a cylinder gauge for taper. Check the ovality of each bore by taking measurement at the top of the cylinder just below the ridge at two points diametrically opposite.
5. The difference between the two figures is the ovality at the top of the bore. Similar measurements should be made approximately 50 mm (2.0 ins) up from the bottom of the bore so that the overall ovality may be determined. The taper of each cylinder is determined by taking measurements at the top and bottom of each bore at right angles to the gudgeon pin line, the difference between the two measurements is the taper.



ST2658M

To establish maximum overall bore wear, take measurements at as many points as possible down the bores at right angles to the gudgeon pin line. The largest recorded figure is the maximum wear and should be compared with the original diameter of the cylinder bore.

Maximum permissible ovality
0,127 mm (0.005 in).

Maximum permissible taper
0,254 mm (0.010 in).

Maximum permissible overall wear
0,177 mm (0.007 in).

If the above figures are exceeded the cylinders must be rebored or sleeved depending upon the condition of the bores and the amount of wear. Alternatively, if the overall wear, taper and ovality are well within the acceptable limits and the original pistons are serviceable new piston rings may be fitted. It is important however, that the bores are deglazed, with a hone, to give a cross-hatched finish to provide a seating for the new ring.

Fitting cylinder sleeves

Cylinder bores that cannot be rebored can be restored by fitting sleeves to enable standard size pistons to be fitted. Sleeving one cylinder only will distort the adjacent bore so sleeving must be carried out in pairs, i.e. cylinders 1 and 2 or 3 and 4.

6. Machine the cylinder bores to accept the sleeves to 94,425 + 0,012 mm (3.7175 + 0.0005 in). This will give the sleeve a 0,076 to 0,114 mm (0.003 to 0.0045 in) interference fit. Press the sleeves squarely into the bore using a pressure of two or three tons. Excessive pressure could damage the sleeve and cylinder block.

The sleeves must not be proud of the cylinder block top face or more than 2,54 mm (0.10 in) below the surface.

7. Bore and hone the sleeves to accomodate the pistons with the required clearances, see piston and connecting rod examination.

Camshaft bearings

8. Measure the internal diameter of each camshaft bearing at several points using an internal micrometer.

A comparison of the bearing diameters with those of the respective camshaft journals will give the amount of clearance. The bearings should be renewed if the clearance exceeds 0,0508 mm (0.002 in). Or, in any event, if they are scored or pitted. This work should only be entrusted to line boring specialists.

It is vital to thoroughly wash the cylinder block after machining to remove all traces of abrasive material, ensuring that all oil galleries are clean.

Check crankcase main bearings

Discard scored, pitted, cracked and worn bearing shells. To determine the maximum wear, assemble the main bearing shells and caps to the crankcase and tighten the bolts to the correct torque figure.

Using an inside micrometer, measure each bearing at several points and note the greatest figure. The maximum wear is the difference between this figure and the smallest diameter of the corresponding crankshaft journal.

The main bearing running clearance is given in the data section.

CRANKSHAFT

1. Degrease the crankshaft and clear out the oil ways which can become clogged after long service.
2. Examine visually, the crankpins and main bearing journals for obvious wear, scores, grooves and overheating. A decision at this stage should be made as to whether the condition of the shaft is worth continuing with a more detailed examination.
3. With a micrometer, measure and note the ovality and taper of each main bearing journal and crankpin as follows.

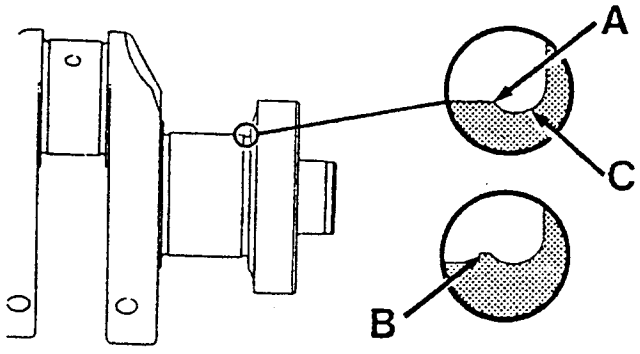
4. Ovality - Take two readings at right angles to each other at various intervals. The maximum ovality must not exceed 0,040 mm (0.0015 in).
5. Taper - Take two readings parallel to each other at both ends of the main bearing journal and crankpin. The maximum permissible taper must not exceed 0,025 mm (0.001 in).
6. To check for straightness, support the front and rear main bearing journals in 'V' blocks and postion a dial indicator to check the run-out at the centre main bearing journal. Run-out must not exceed 0,076 mm (0.003 in) taking into account any ovality in the centre journal. The overall wear limit should not exceed 0,114 mm (0.0045 in) for main bearing journals and 0,088 mm (0.0035 in) for crankpins.
7. A crankshaft worn beyond the limints of maximum taper, ovality and overall wear, can be ground to0,25 mm (0.010 in).

When grinding the crankshaft main bearing and crankpin journals, rotation of the grinding wheel and crankshaft must be in the same direction, anti-clockwise, viewed from the flywheel end of the crankshaft.

Final finishing of the journals should be achieved by using a static lapping stone with the crankshaft rotating in a clockwise direction viewed from the flywheel end of the crankshaft.

It is important to ensure that, when grinding, the stone travels beyond the edge of the journal 'A' to avoid formation of a step 'B' as illustrated. Also care must be taken not to machine or damage the fillet radii 'C'.

It is vital to thoroughly wash the crankshaft after machining to remove all traces of abrasive material, ensuring that all oil galleries are clean.

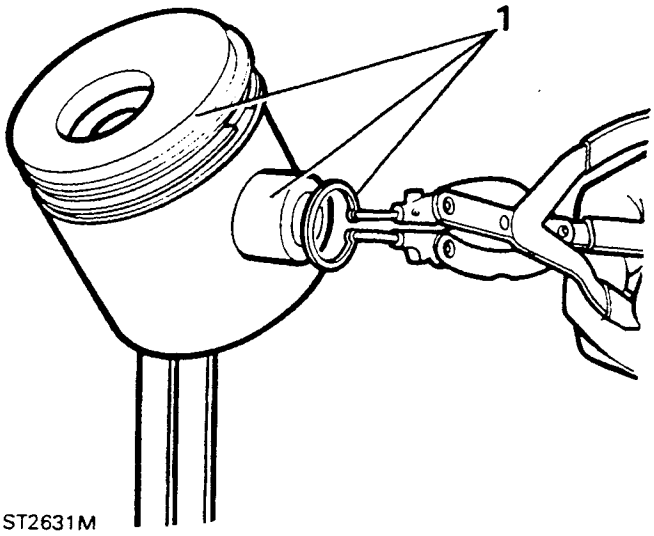


ST1808M

Pistons and connecting rods

The following checks relating to pistons and rings must also be carried out prior to fitting new pistons to rebored and sleeved cylinder blocks. Until it is decided if new components are required all parts must be kept in their related sets and the position of each piston to its connecting rod should be noted.

1. Remove the piston rings and gudgeon pin from each piston and detach the connecting rod.
2. Original pistons - Decarbonise and degrease all components and carry out a visual examination of the piston and rings and discard any which are unserviceable. Pistons which appear serviceable should be subjected to a more detailed examination described under 'New Pistons'.
3. New pistons - Original pistons fitted to new engines at the factory arespecially graded to facilitate assembly. The grade letter on the piston crown should be ignored when ordering new pistons.

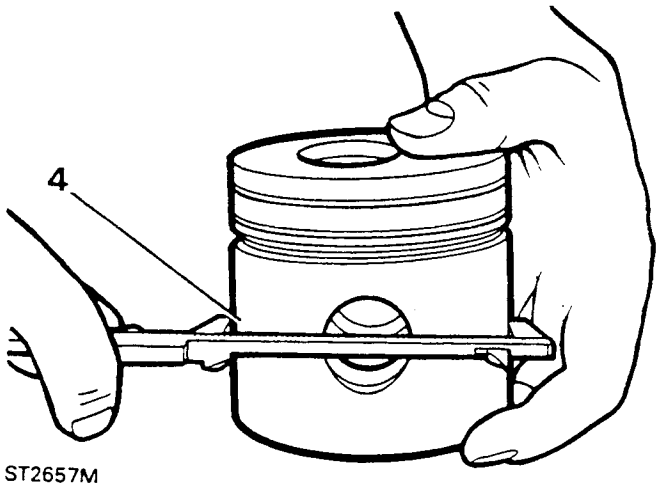


ST2631M

Genuine Land Rover service standard size pistons are supplied 0,025 mm (0.001 in) oversize to allow for production tolorance on new engines. When fitting new pistons to a standard size cylinder, the bores must be honed to accomodate the pistons with the correct clearances. In addition Land Rover pistons are available 0,50 and 1,01 mm (0.020 and 0.040 in) oversize for fitting to rebored cylinders.

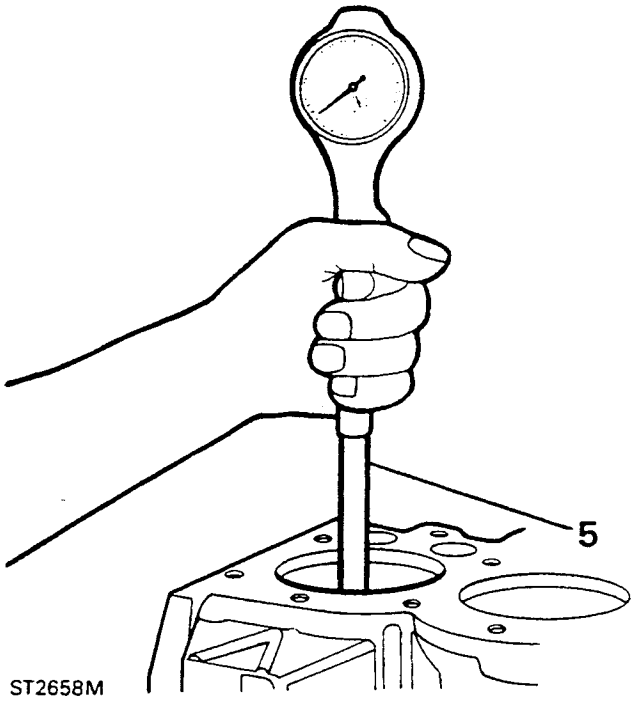
Clearance limits for new standard size pistons in a standard cylinder bore measured at right angles to the gudgeon pin are in the data section. When taking the following measurements the cylinder block and pistons must be the same temperature to ensure accuracy.

4. Using a suitable micrometer or vernier measure the pistons at the bottom of the skirt at right angles to the gudgeon pin.



ST2657M

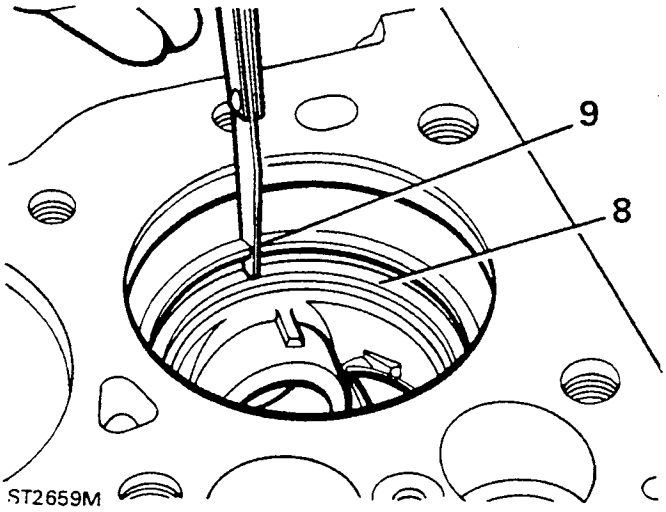
5. With an inside micrometer or cylinder gauge measure the diameter of the bore at approximately half-way down and note the reading.



6. The clearance is determined by subtracting the piston diameter from the bore diameter.
7. If gauge equipment is not available the clearance can be assessed by placing a long, suitably sized, feeler gauge down the thrust side of the bore and inserting the appropriate piston, 'upside down', in the bore and position it with the gudgeon pin parallel to the crankshaft axis. Push the piston down the bore and stop at the tightest point and whilst holding the piston still, slowly withdraw the feeler gauge. If a steady resistance of approximately 2,5 kg (6 lbs) is felt, the clearance is satisfactory.

Piston ring gaps

8. When checking the piston ring gap in worn bores which are within the acceptable taper and ovality limits, the ring must be inserted squarely into the bottom of the cylinder at the lowest point of the piston travel. To ensure squareness push the ring to the correct position using a piston.



9. With the appropriate feeler gauge check all the ring gaps in turn, including the oil control rings.

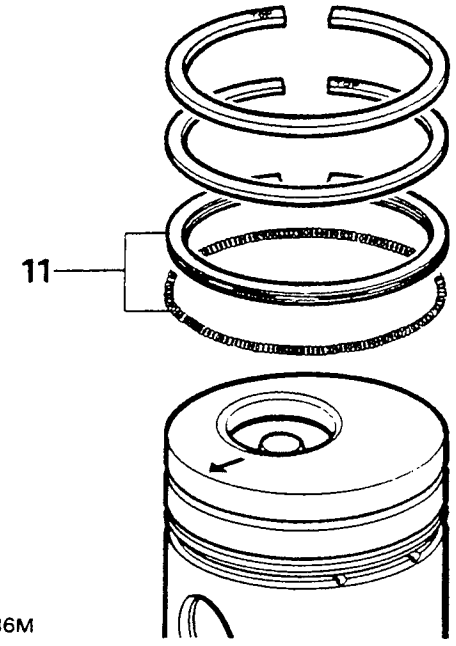
The correct gaps are listed in the data section. If any gap is less than that specified, remove the ring, and file the ends square, whilst holding the ring in a filing jig or vice. Should any gap be excessively wide and not likely to close up to within the specified limits when hot, an oversize ring should be fitted.

Once the rings have been selected for a particular cylinder and piston ensure that they are not again mixed up.

Piston ring groove clearance

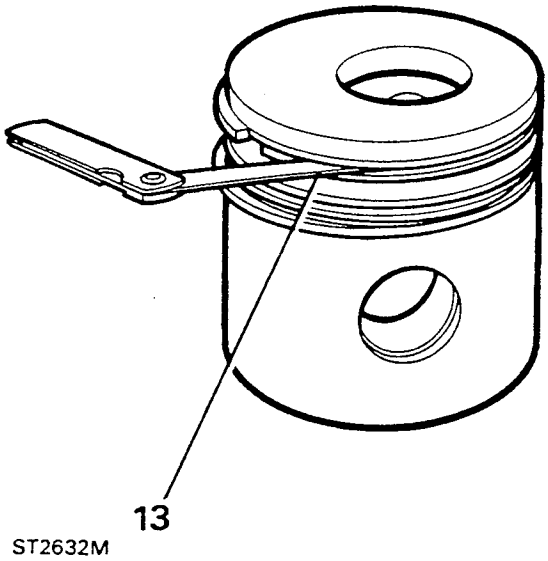
10. It is important that the groove clearances are correct. Rings that are too tight may bind or fracture when hot and cause loss of compression. Excessive clearance allows the rings to rock in the groove and may result in a pumping action and excessive oil consumption.

11. Fit the oil control ring expander to the bottom groove, then fit the oil control ring ensuring that it fits over the expander. Fit the second, narrow, compression ring with the word "TOP" uppermost. Likewise fit the first compression ring to the top groove, word "TOP" uppermost.



ST2636M

12. After fitting slide each ring around the groove to ensure that it is free and does not bind.
13. Using an appropriate feeler gauge check the groove clearance between the rings and piston. If the clearances in excess of the figures given in data section the rings or the pistons should be renewed.



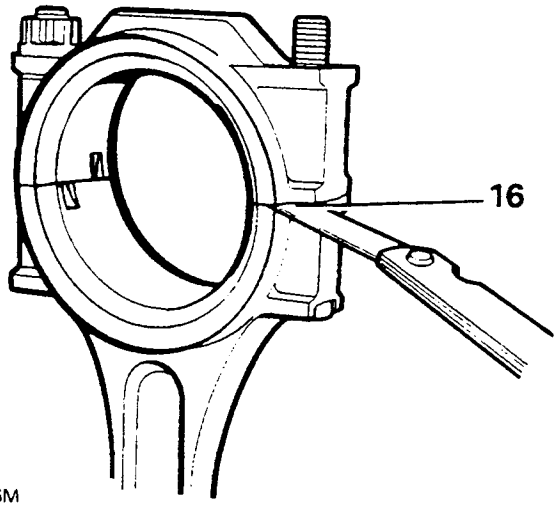
ST2632M

Gudgeon pins

14. Examine the gudgeon pin for obvious wear, cracks, scores, or overheating and ovality and taper using a micrometer.

Connecting rods

15. Check the connecting rods and caps for distortion as follows; fit the correct cap, less the bearing shells, to each connecting rod as denoted by the number stamped near the joint faces. This number also indicates the piston/cylinder/ crankshaft journal to which it must be fitted.
16. Tighten both nuts to the correct torque, then release one nut on each cap, now check that no clearance exists at the joint face as illustrated. A clearance may indicate a bent bolt or that either of the joint faces has been filed or machined previously, in attempt to rectify excessive bearing wear.



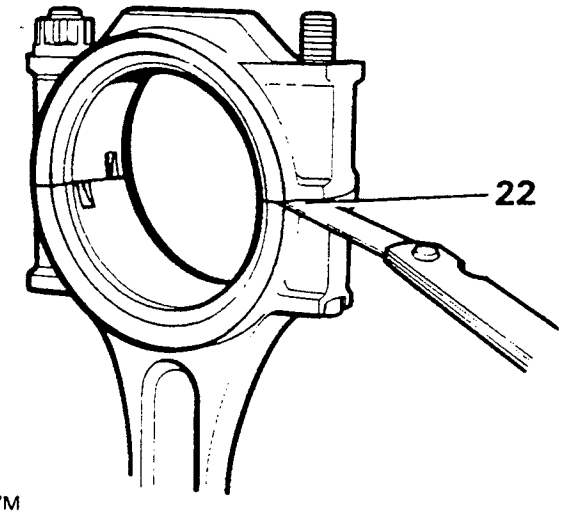
ST2976M

17. Use an accurate connecting rod alignment gauge to check the rods for bend and twist. The maximum allowable for both conditions must not exceed 0,127 mm (0.005 in).
18. Examine and check the small-end bush for wear. If necessary renew the bush. The correct clearance of the gudgeon pin in the small-end bush is given in the data section.
19. When renewing a bush ensure that the oil hole in the bush lines up with the hole in the connecting rod. Finish the bush to the correct size and clearance.

20. Connecting rod bearings that are worn, pitted, scored and show signs of overheating must be discarded. If more than one of the bearings show these signs they must all be renewe. When fitting new or used bearings to serviceable crankpins the clearances must be checked.

Big end bearing nip and clearance

21. Clean the protective coating from new bearings before fitting.
22. Fit the bearing shells to each connecting rod and cap ensuring that the location tags are correctly seated and aligned. Fit and tighten both bolts to the correct torque, next release one nut on each cap then check for a nip clearance of between 0,10 to 0,20mm (0.004 to 0.008).



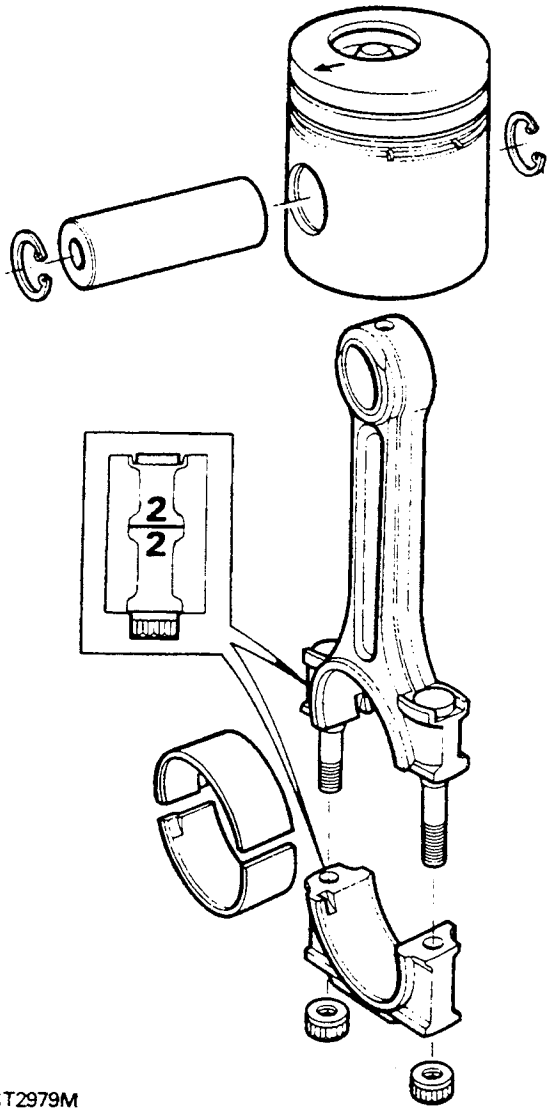
ST2977M

23. Check the joint face of faces of both cap rod and bearing shells if the nip clearance is excessive. Too little nip clearance will allow the shell bearings to move (possibly rotate) inside the connecting rod when the engine is running. After satisfactory fittting of the bearings temporary retain the shells and caps to the appropriate connecting rod.

Assembling pistons to connecting rods

The piston must be assembled to the connecting rod so that the arrow on the piston crown points to the front of the engine and the off-set combustion chamber, bearing shell tags and connecting rod number are all on the same, right hand side of the cylinder block viewed from the rear of the engine (camshaft side).

24. Insert a circlip in one side of the gudgeon pin boss and assemble the piston to the connecting rod with the gudgeon pin. Secure the assembly with a circlip on the opposite side of the piston.



ST2979M

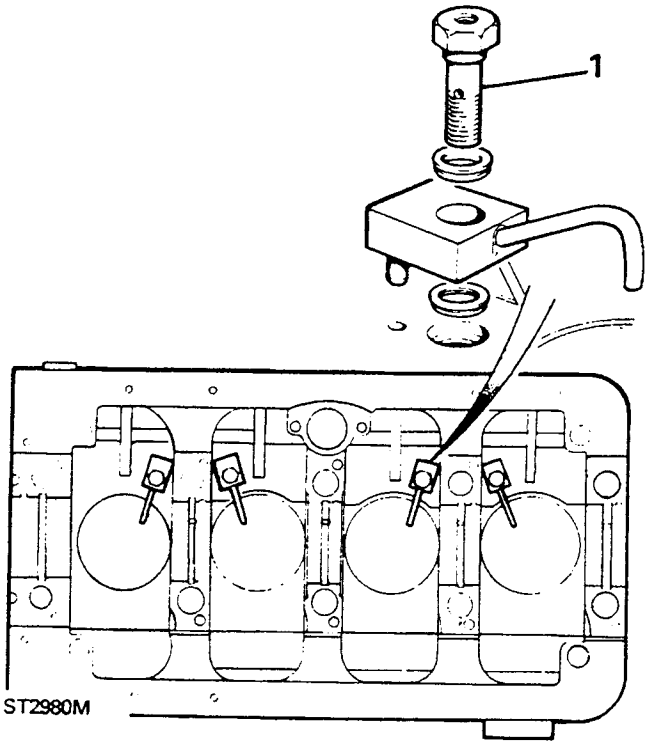
ASSEMBLE ENGINE

Ensure that the cylinder block and all oilways are thoroughly clean using an air line, if available, prior to assembly.

Refitting cylinder lubrication jet tubes

Oil jet tubes are fitted to lubricate the pistons and bores directly from the main oil gallery.

1. Assemble and fit the jet tube as illustrated ensuring that the dowls locate in the holes in the cylinder block, and that the larger diameter washer fits under the bolt head. Tap the jet blocks down to ensure that the locating dowel is fully home. Fit and tighten the retaining bolts to the correct torque.

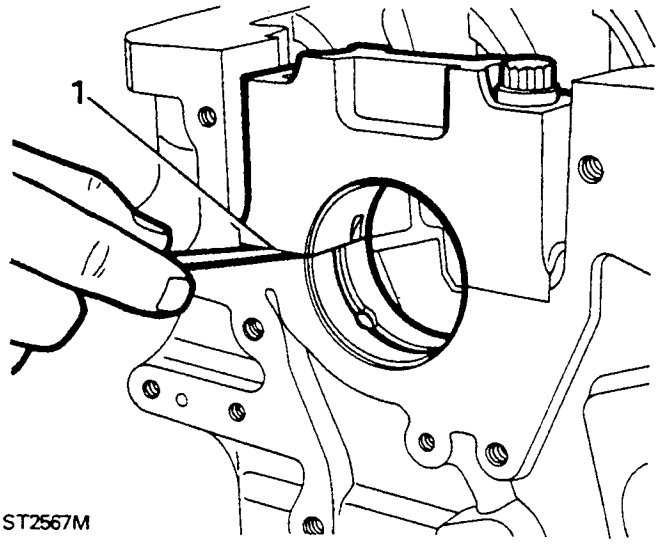


Crankshaft bearings.

Main bearing nip clearance

Clean the protective coating from new bearings before fittin.

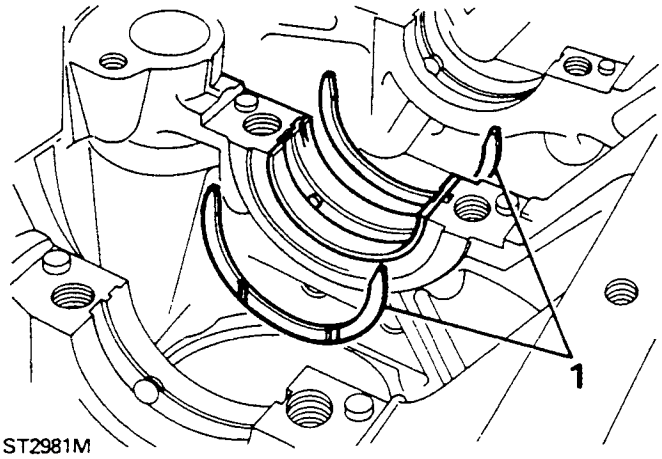
1. Fit the bearing halves to the cylinder block ensuring full engagement of the location tags.
2. Install the other half shells into the main bearing caps, again ensuring that the tags locate correctly.
3. Fit all the main bearing caps to their original locations tightening the bolts to the correct torque, then release one bolt on each cap.
4. Check the clearance between the cap and the block as illustrated.



The nip clearance which ensures that the bearings are correctly clamped, must be within 0,10 to 0,15 mm (0.004 to 0.006 in). Investigate and correct any nip clearance errors before removing the main bearing caps prior to fitting the crankshaft.

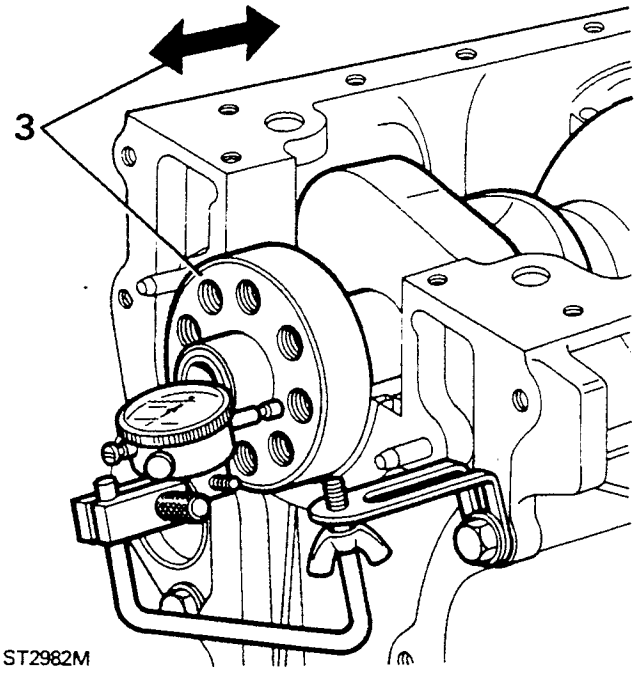
Fitting crankshaft

1. Insert two standard thickness thrust washers each side of the centre main bearing location with the oil grooves towards the crank thrust faces.
2. Lubricate the cylinder block bearing shells and carefully install the crankshaft.



Crankshaft end float

3. To determine the crankshaft end-float mount a dial test indicator to read-off the end of the crankshaft. Move the crankshaft away from the indicator and zero the dial, then Move the crankshaft in the opposite direction and note the indicator reading. The end-float should be 0,05 to 0,15 mm (0.002 to 0.006 in).

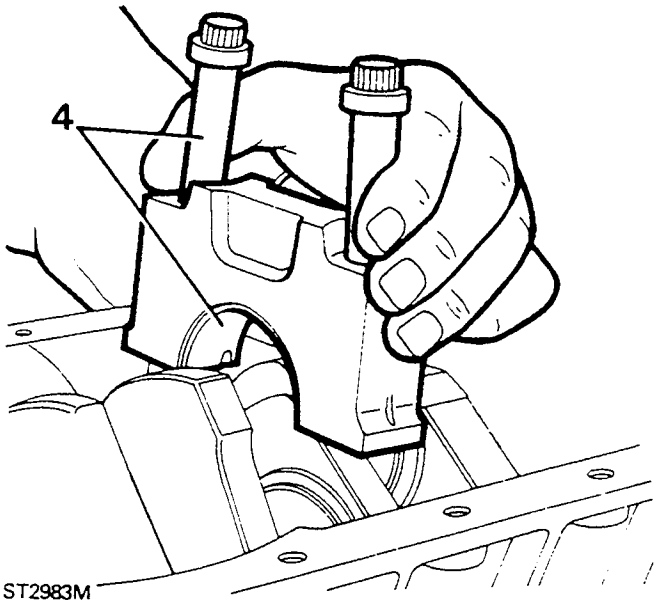


ST2982M

Alternatively measure the clearance with a feeler gauge. If adjustment is required substitute with oversize thrust washers. Variation of thrust washer thicknesses at each side of the crankshaft journal must not exceed 0,08 mm (0.003 in) to ensure that the crankshaft remains centralised.

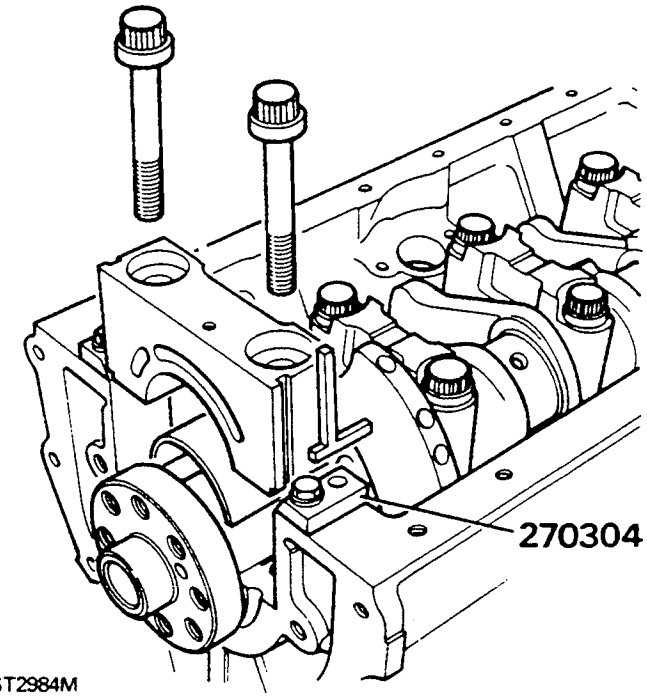
Main bearing caps

4. Lubricate and fit the centre main bearing cap, tighten both bolts to the correct torque and ensure that the shaft is free to rotate before fitting the next bearing cap.
5. Lubricate and fit 1-2 and 4 main bearing caps checking that the shaft is free to rotate after tightening the bolts for each.



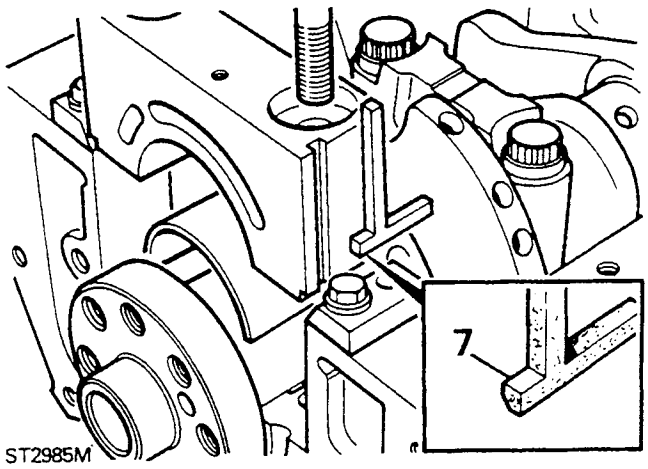
ST2983M

6. Ensure that number five main bearing cap is clean and free from old seal material. Attach the seal guides number 270304 to the crankcase, as illustrated, and ensure that they are parallel to the crankcase edge.



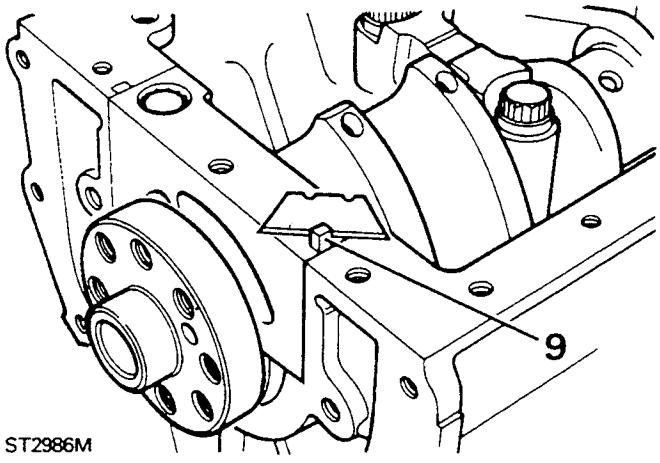
ST2984M

7. To prevent any seal material becoming trapped between the bearing cap and crankcase, chamfer the inner edge of the seal 0,40 to 0,80 mm wide as illustrated. Smear the seals with engine oil and fit them to the bearing cap.
8. Fit the bearing cap complete with shell bearing to the crankcase and secure with new bolts and tighten to the appropriate torque. Remove seal guides and check that the shaft is free to rorate.



ST2985M

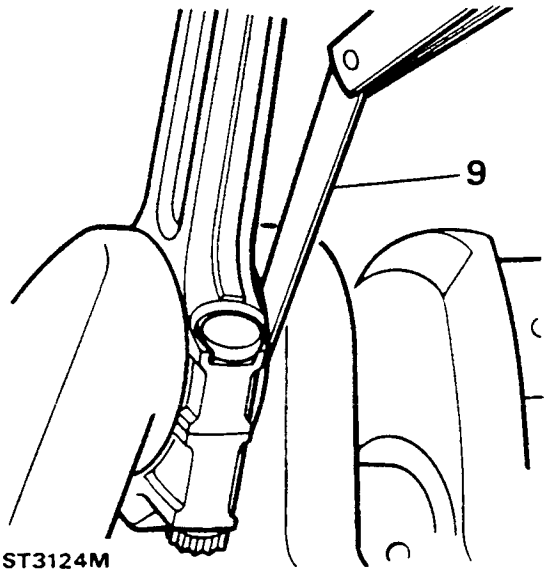
9. To allow for shrinkage after fitting leave the seals standing proud of the crankcase face then using a sharp blade, trim the seals off to approximately 0,80 mm above the crankcase face.



ST2986M

Fitting connecting rods and pistons

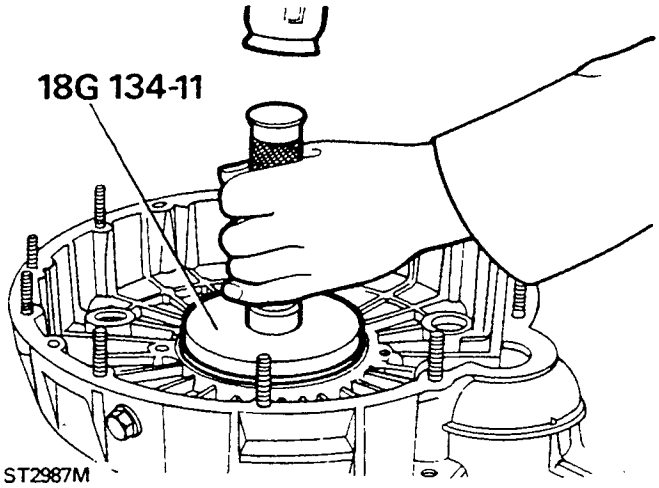
1. Ensure that the essentric headed big end bolts and shell bearings are correctly located in the connecting rods and as a precaution against possible damage to the crankshaft journals during installation of the pistons, cover the bolt threads with a layer of adheasive tape. Check that the number on the connecting rod is the same as the piston and cylinder and that they are correctly orientated.
2. With the cylinder block vertical, and 2 and 3 crankshaft journals at BDC lubricate and install 2 and 3 piston connecting rod assemblies so that the piston rings are resting on the block face.
3. Stagger the piston rings on both pistons as illustrated, then using a suitable tool compress the piston rings and gently push each piston into the cylinder bore.
4. Pull both connecting rod big ends on to the journals and fit the caps ensuring the the numbers match and orientation is correct. Retain the caps with new nuts but do not tighten at this stage.
5. Turn the crankshaft so that 1 and 4 journals are at BDC and install the pistons and connecting rods as previously discribed.
7. Tighten both nuts on one connecting rod to the correct torque and check that the crankshaft is free to rotate before securing the next connecting rod cap nuts.
8. Investigate and rectify any big end bearing which when tightened restricts the freedom of the crank shaft.
9. Check that each big end is free to move sideways on its journal and if necessary check the actual side clearance using a feeler gauge. The correct clearance is given in the data section.



ST3124M

Fitting rear main oil seal to flywheel housing

The oil seal is manufactured from P.T.F.E. and is supplied with a former to maintain the correct shape which must not be removed until the seal is to be fitted.



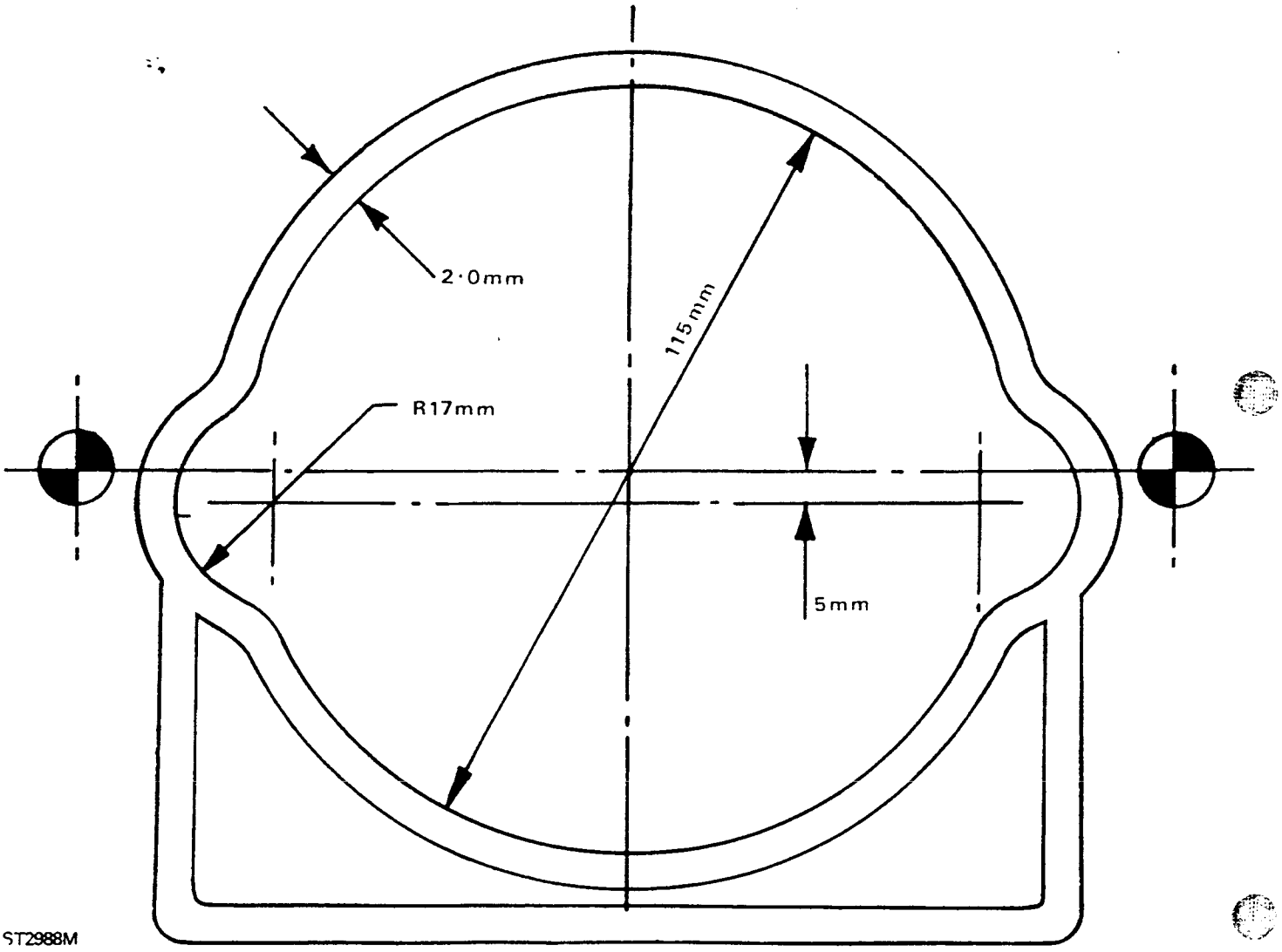
ST2987M

1. Make sure the seal housing is clean and dry and free from burrs. Do not touch the seal lip and ensure that the outside diameter is clean and dry.
2. Using special seal replacer 18G134-11 and with the lip side leading drive-in the seal as far as the tool allows. If the tool is not available fit the seal to the bottom of the housing to ensure squareness.

Fitting flywheel housing

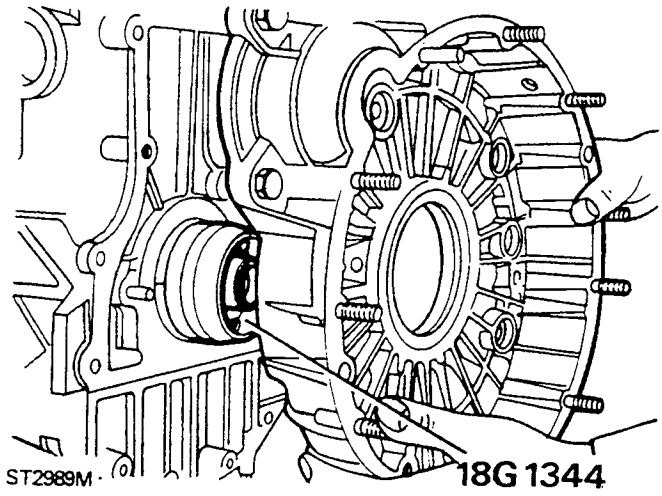
3. Clean the rear face of the cylinder block and flywheel housing, then apply a bead of Hylosil 102 sealant to the dimensions and configuration, illustrated.

The illustration has been produced full size so that a template may be made to facilitate the application of the sealant. The bead should be 2,0 mm diameter and must extend around the periphery of the bearing cap so that the joint between cap and block is sealed.



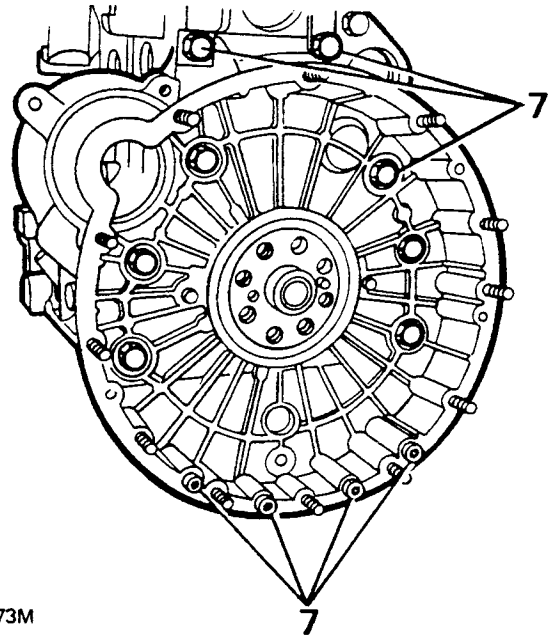
ST2988M

4. Examine the seal guide, number 18G1344 ensuring that it is perfectly smooth and not damage or scratched. Also check that the crankshaft oil seal journal is smooth and clea.
5. Locate the seal guide on to the crankshaft and lubricate the seal, guide and journal with concentrated 'Oildag' in a 25% solution with clean engine oil.



ST2989M

6. Carefully locate the flywheel housing over the seal and on to the dowels.
7. Remove the seal guide and secure the flywheel housing, evenly tightening the retaining bolts to the correct torque.



ST2973M

OVERHAUL AND FITTING FLYWHEEL

Inspection

Normal wear and scores on the flywheel clutch face can be repaired by machining provided that the overall width of the flywheel is not reduced below 36,96 mm (1.453 in) therefore check that the flywheel has not been previously machined before proceding further. The ring gear may be renewed if the teeth are chipped or damage.

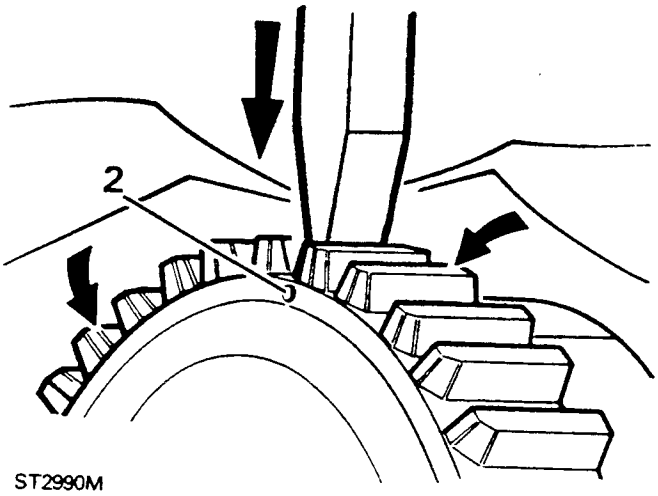
Reface the flywheel

1. Remove the clutch cover locating dowels. Machine the flywheel over the entire clutch face removing only the minimum of material necessary to achieve a smooth surface parallel with the crankshaft mating face within the dimensions given above.

Renew Ring gear

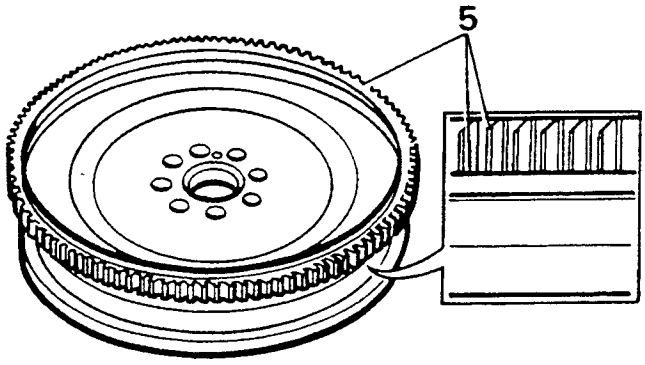
WARNING: Wear industrial goggles to protect the eyes from flying fragments.

2. To renew the ring gear, drill a 8 mm hole between the root of any two teeth and the inner diameter of the ring gear deep enough to weaken the gear. Take care not to allow the drill to enter the flywheel.



ST2990M

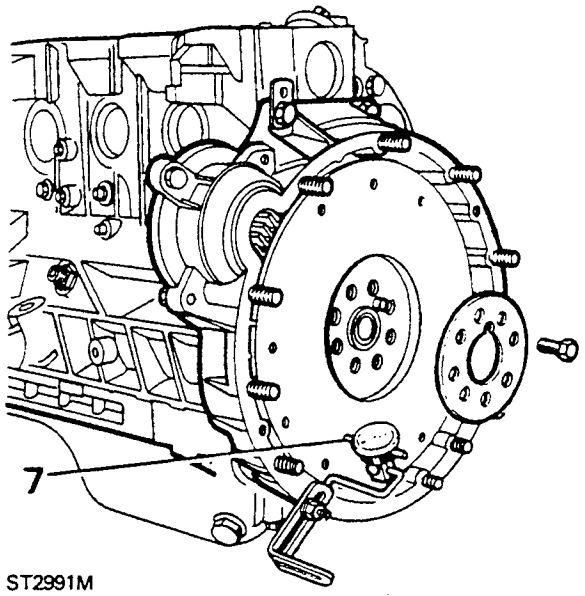
3. Secure the flywheel in a soft jawed vice and cover it with a cloth to avoid personal injury. Place a cold chisel above the drilled hole and strike it sharply to split the ring gear.
4. Heat the new ring uniformally to between 225°C and 250°C but do not exceed the higher figure.
5. Place the flywheel, clutch face down, on a flat surface and press the starter ring firmly against the flange until the ring contracts sufficiently to grip the flywheel. Allow the ring to cool naturally. Do not hasten cooling in anyway otherwise distortion may occur.



ST2640M

Fitting flywheel

6. Locate the flywheel on the crankshaft and secure with the reinforcing plate and retaining bolts. Temporarily fit the damper to front of crankshaft and use special service tool FR101 or LST127 to restrain the crankshaft whilst the eight retaining bolts are being tightened to the correct torque.
7. To check the flywheel for possible run-out, mount a dial test indicator so that the stylus rests, in a loaded condition, on the clutch pressure face at a radius of 114 mm (4.5 in) from the centre of the flywheel.
8. Turn the flywheel, and check that run-out does not exceed 0,05 to 0,07 mm (0.002 to 0.003 in). Should any run-out be excessive, remove the flywheel, and check again for irregularities on flywheel and crankshaft mating faces and dowel.

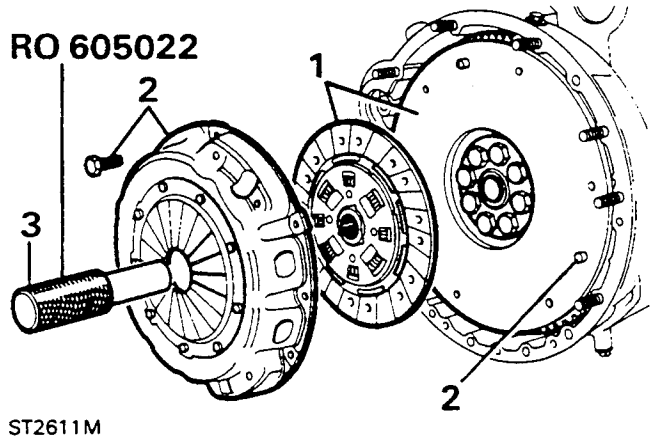


ST2991M

Fitting clutch

If the original clutch cover is being refitted, ensure any marks made during dismantling are aligned to maintain original balance.

1. Clean the flywheel and place the friction plate with the raised centre section outwards away from the flywheel.
2. Fit the clutch assembly locating it over the three dowels and loosely secure with the six bolts.
3. Centralise the centre plate using special tool RO605022 or a spare primary shaft and tighten the six bolts evenly to the correct torque.
4. Remove the tool and smear the splines of the centre plate with Molybdenum disulphide grease, such as Rocol MTS1000.



ST2611M

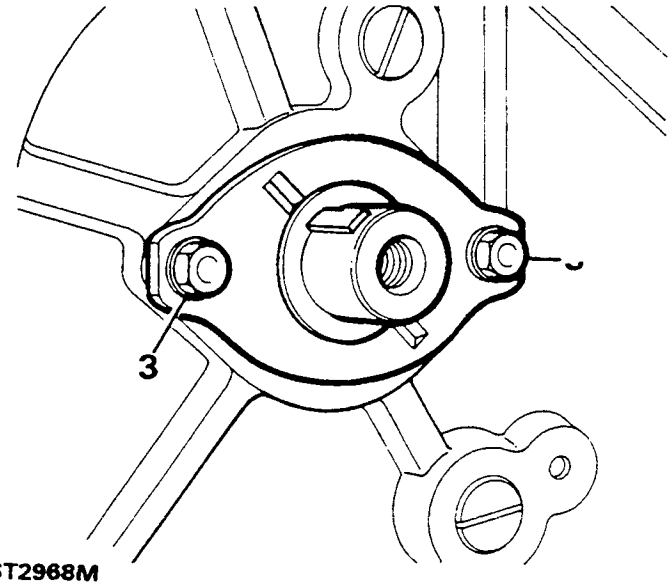
Fitting camshaft

Inspection

1. Mount the camshaft on "v" blocks on a surface plate for convenience and examine the cams for wear, scores, pitting and chipped edges.
2. Examine the journals for obvious wear and scores and signs of overheating, in particular, check the thrust plate. If the journals are visibly serviceable, check with a dial gauge or micrometer for overall wear, ovality, taper and runout.

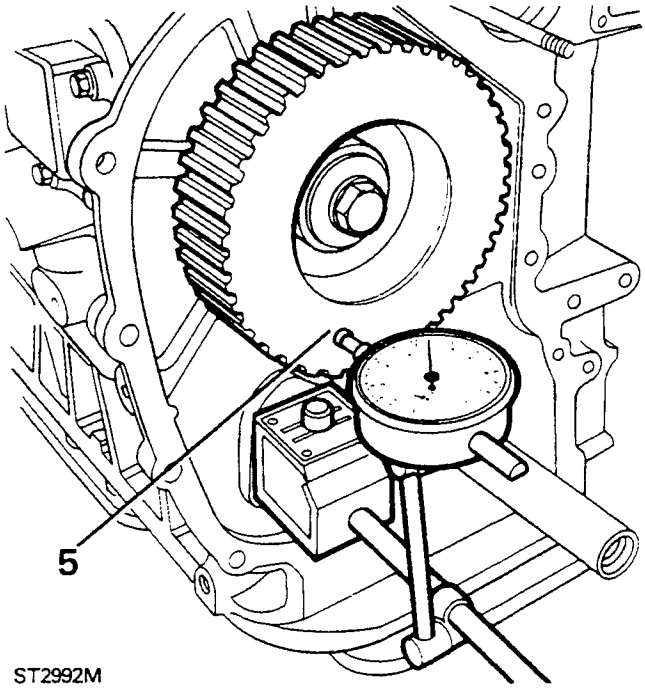
   CAUTION: If the skew gear is worn and requires renewal, the camshaft must also be renewed even though the camshaft gear may appear satisfactory. Once the two gears have run together they become a matched pair.

3. Lubricate the camshaft bearings and journals with clean engine oil and carefully insert the camshaft into the cylinder block. Fit the thrust plate and secure with the two bolts and tighten to the correct torque.



ST2968M

4. To check the camshaft end-float, temporarily fit the camshaft gear and mount a dial test indicator so that the stylus rests in a loaded condition upon the machined face of the gear.
5. Zero the dial and move the camshaft back and forward and note the reading. The end-float should be within 0,06 to 0,13 mm (0.0025) to 0.0055 in) If necessary fit another thrust plate to achieve the correct end float.

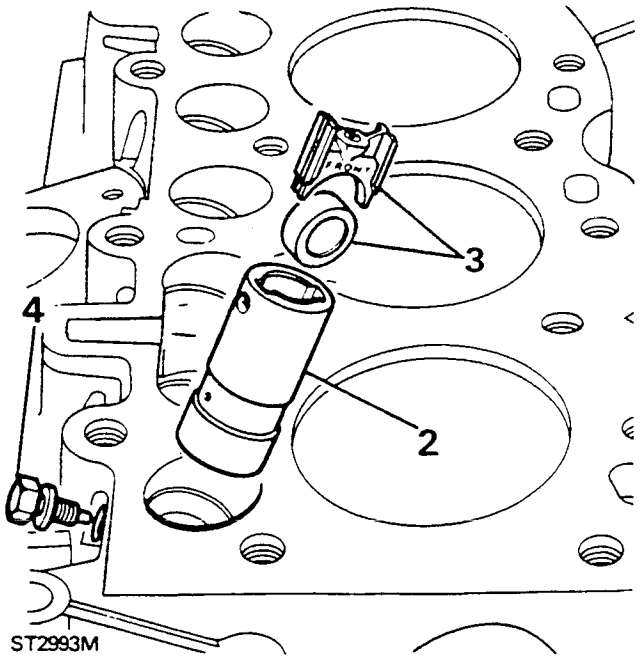


ST2992M

Fitting camfollowers

1. Examine all the components for wear and damage particularly the rollers and pushrod seating in the slides and ensure that the tappet slides move freely in the guides. If the same parts are being refitted, ensure that they are returned to their original positions.

Note: The tappet retaining screws have a micro encapsulated locking compound applied to the threads to ensure that they do not become loose. Once the screw has been used the locking ability is lost.



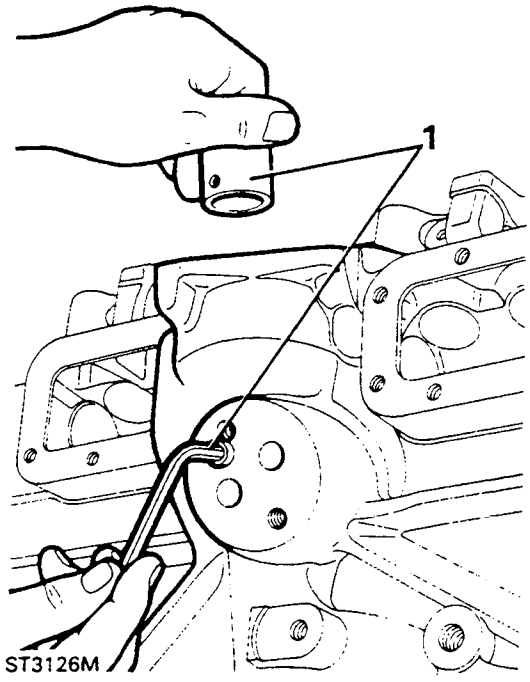
ST2993M

2. Insert the tappet guides into the cylinder block, retaining each with a new screw which should be screwed in sufficiently to allow the rollers and slides to be installed. Ensure the rollers are fitted in accordance with any marks made during removal. New rollers, however, may be fitted either way around.
3. Before fitting the tappet slides make sure the oilways are clear to the running surface of the roller and the pushrod seating. Insert the the tappet slides with the word 'FRONT' or 'F' to the front of the engine.
4. Finally tighten the screws to the correct torque to secure the guides.

Fitting skew gear bush.

Inspect the skew gear bush for wear and renew if necessary.

1. Insert the bush into the cylinder block and secure with a new screw to the correct torque. Do not over tighten as this may damage the bush.



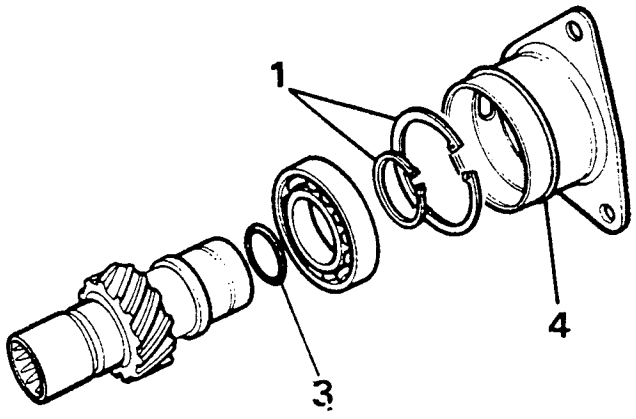
ST3126M

Overhaul and fitting skew gear

1. Remove the circlips retaining the skew gear shaft to the bearing and the bearing in the housing.
2. Press the bearing and shaft assembly from the housing and the shaft from the bearing.

Discard both rubber "O" rings, examine all components especially the bearing and skew gear for wear and damage and renew if necessary.

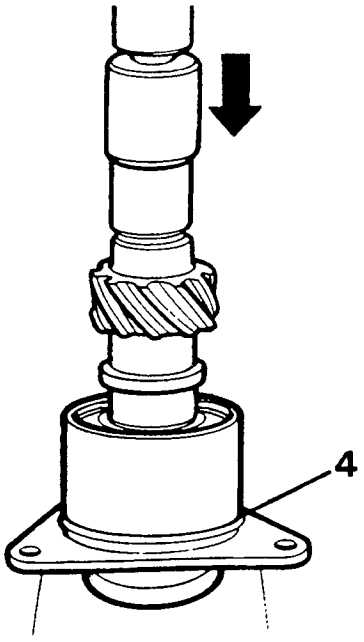
CAUTION: If the original skew gear and camshaft are to be re-used, they must be fitted so that the teeth on each, mesh in the original position. If either the skew gear or the camshaft are renewed, the mating component must also be renewed.



ST2995M

Assembling

3. Press the bearing into the housing and secure with the circlip. Support the housing and press the shaft into position and secure with the circlip.
4. Fit a new rubber "O" ring to the outside of the housing and to the internal annular groove in the shaft ready for installation.

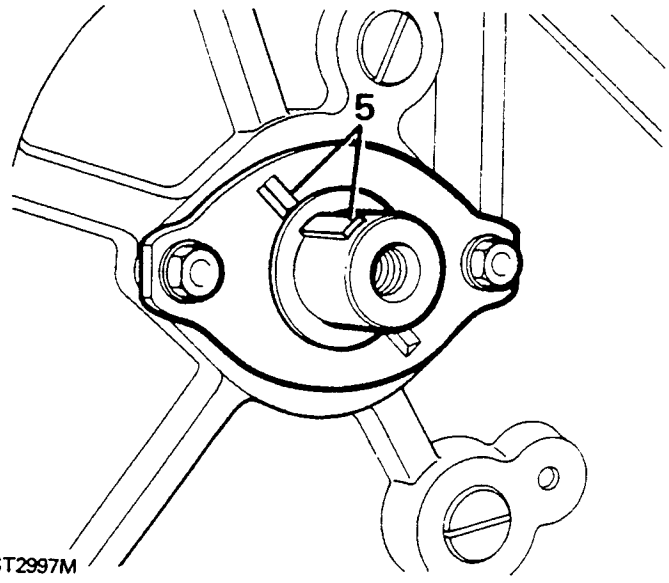


ST2999M

Fitting skew gear

If the original skew gear and camshaft are being re-used it is important that the gear teeth mesh in the original position as follows.

5. Turn the camshaft so that the key aligns with the oil groove as illustrated.



6. Fit the skew gear assembly so that the ventilation slot in the gear housing is towards the front of the engine as illustrated and ensuring that any alignment marks made during dismantling are realigned.

If both components are new it is only necessary to correctly align the ventilation slot as described above.

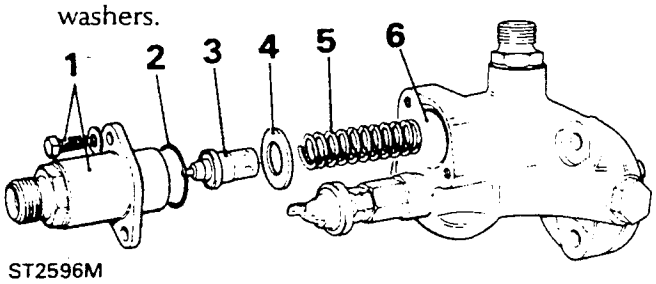
OVERHAUL AND FITTING OIL FILTER ADAPTOR

Oil temperature thermostat

1. Remove the two bolts and carefully withdraw the thermostat extension housing complete with, the 'O' ring (2),thermostat (3),washer (4), and spring (5). 2. Clean the adaptor housing (6) with lint-free cloth.

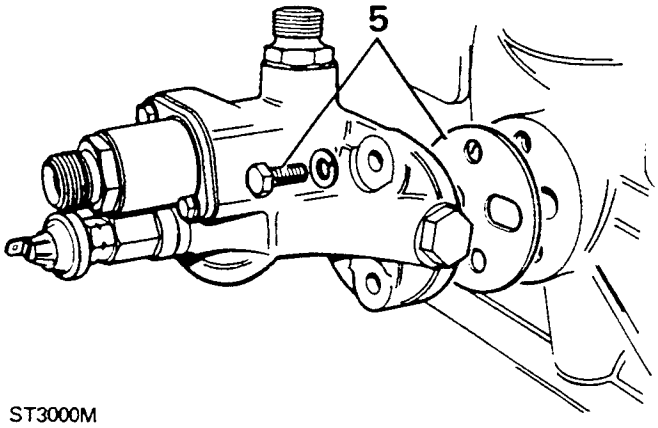
Inspect all the parts and renew as necessary.

3. Fit the spring, washer and thermostat with the pin uppermost.
4. Fit the extension housing using a new 'O' ring. Ensure that the pin protruding from the thermostat locates in the hole in the extension housing and secure with the two bolts and washers.



ST2596M

5. Using a new joint washer fit the oil filter adapto. Ensure that the retaining bolts pass through the two small holes in the joint washer. Tighten the two retaining bolts evenly to the correct torque.



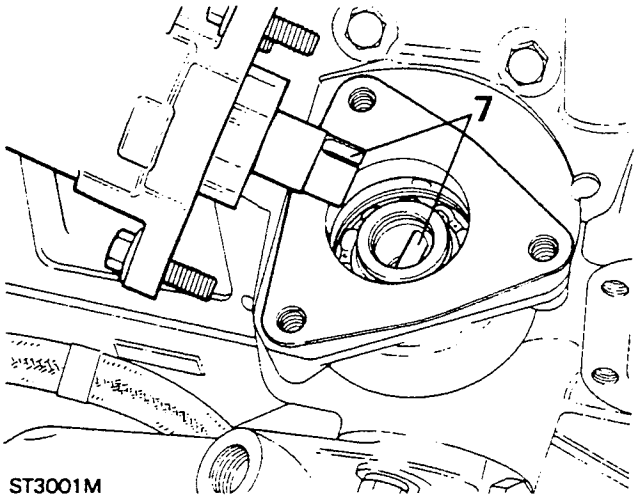
ST3000M

Oil filter

6. Smear the filter sealing ring with oil and screw the filter clockwise until the seal touches the machined face, then tighten the filter a further half turn only. Do not over tighten. see Maintenance operations, section 10.

Fitting vacuum pump

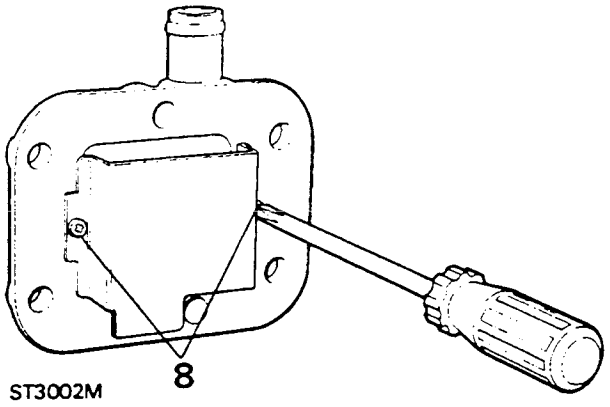
7. Using a new gasket fit the vacuum pump so that the brake servo connection is towards the front of the engine, ensuring that the cross-pin in the skew gear locates in the pump drive shaft then secure with three screws tightened to the correct torque.



ST3001M

Fitting front and rear side covers and fuel lift pump

8. Check that the front side cover baffle plate is secure and fit the cover using a new gasket securing with only four of the six fixing bolts at this stage , leaving out the two which secure the injection pump support bracket as illustrated.



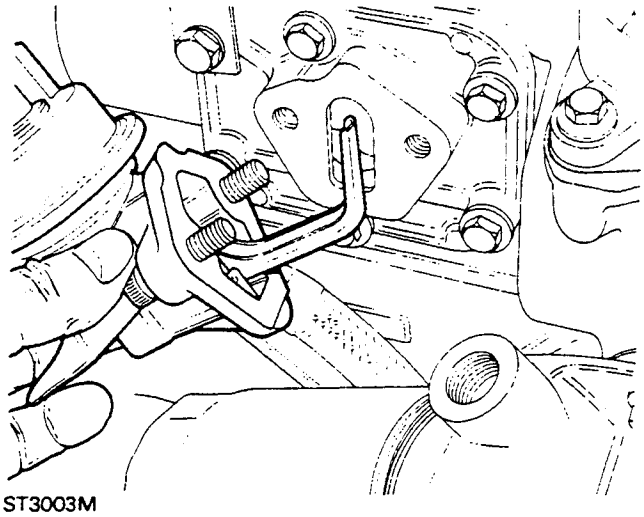
ST3002M

Fitting rear cover

9. Fit the rear cover also using a new gasket and secure with six bolts tightened to the correct torque.

Fitting fuel lift pump

10. Check that the lift pump is serviceable and refit using a new gasket, ensuring that the pump actuating lever locates correctly onto the camshaft.

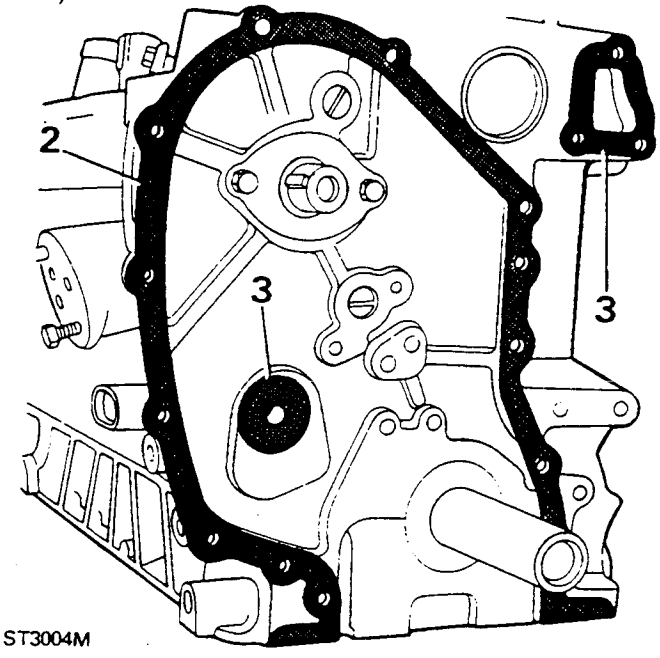


ST3003M

FITTING FRONT COVER TIMING BELT AND GEARS

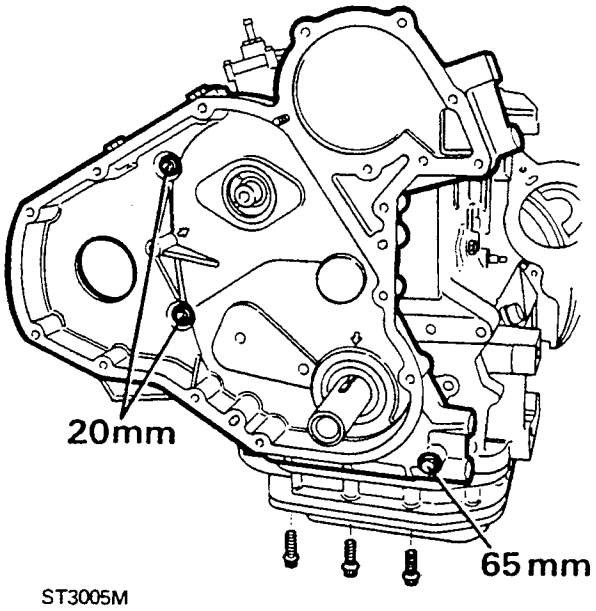
1. Clean the front cover and remove the crankshaft and camshaft oil seals taking care not to damage the seal housing. Examine the cover for damage, cracks and distortion. Check the mating face of the cylinder block and the cover plate for burrs.

2. Clean the front face of the cylinder block and use a little grease to hold in position a new joint washer.



ST3004M

3. Also fit a new joint washer to the coolant aperture and to the tapped hole for the jockey pulley clamp bolt.
4. Fit the front cover locating it over the single stud and secure with the three retaining bolts tightening evenly to the correct torque. The correct bolt length for each hole is given in the following chart.

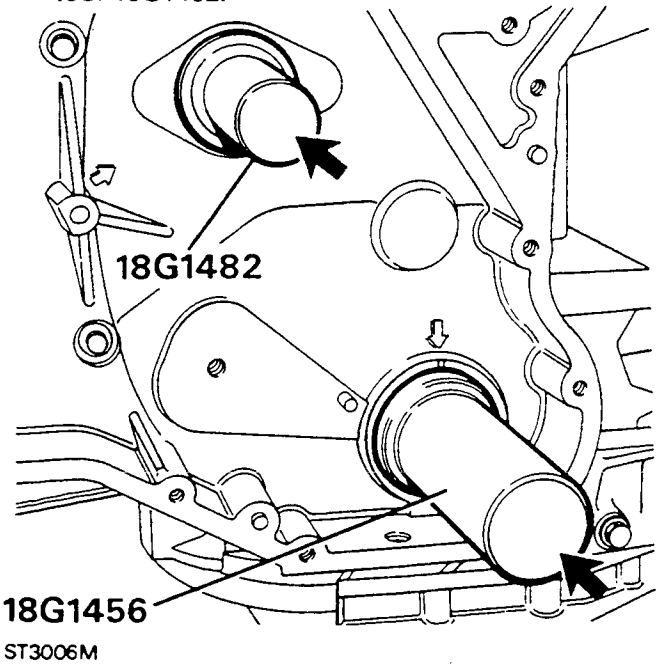


ST3005M

Front cover seals

5. Lubricate a new crankshaft oil seal. With the lip side leading, drive-in the seal, squarely, using special service tool 18G1456.

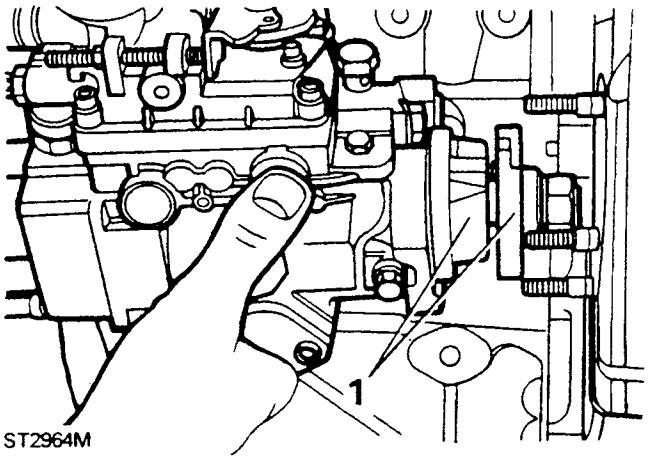
6. Similarly, lubricate and drive-in a new camshaft oil seal, lip side leading, using special service tool 18G1482.



ST3006M

Fitting injection pump

1. Insert the timing pin in the pump hub and body. Fit the injection pump and secure with the three nuts and tighten evenly to the correct torque.



2. Fit the pump rear support bracket to the front side cover and secure to the pump with two bolts and nuts.
3. Inspect the pump drive gear for wear and damage, ensure it is thoroughly clean and dry before fitting to the pump. Retain the gear with three bolts and renforceing plate. Do not overtighten the bolts at this stage.

Injection pump, valve timing and drive belt.

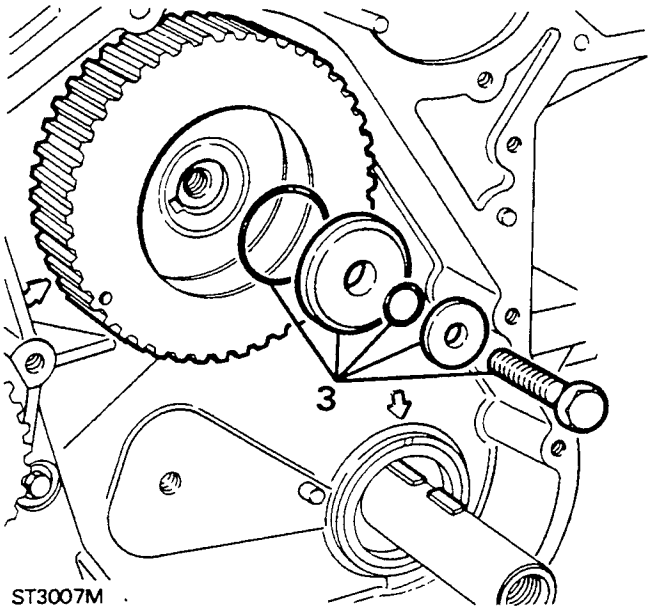
Drive belt.

During use, a belt develops a wear pattern relative to its running direction, therefore, if the original belt is to be re-used it must be fitted so that it continues to rotate in the original direction, otherwise the belt must be renewed.

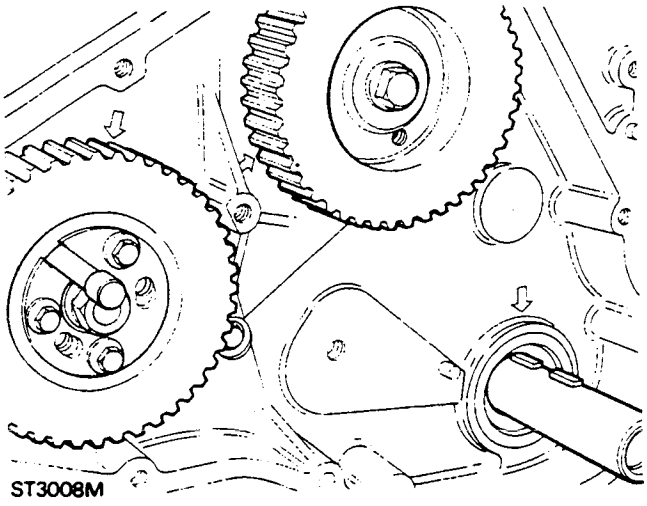
Drive belts must be stored on edge on a clean flat surface and in such a manner that bends are not less than 50 mm (2 in) radius. Do not bend the belt at an acute angle or radius less than 50 mm (2 in) otherwise premature failure of the fibre reinforcement could result.

Cleanliness and accuracy are vital when carrying out the timing operations and fitting the drive belt.

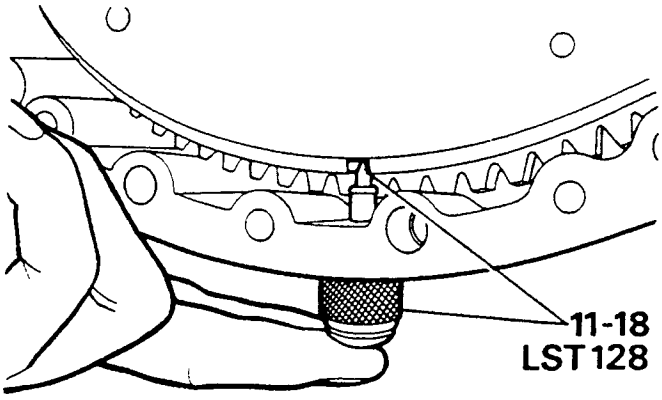
1. Check the gear wheels are not damaged or scratched and that they are thoroughly clean and dry.
2. Ensure that the belt adjustment idler bearing is sound and not leaking lubricant.
3. Fit the crankshaft and camshaft gears ensuring that the camshaft gear is retained with the special bolt, washer and new 'O' ring but do not tighten at this stage.



4. Rotate the camshaft so that the centre dot on the camshaft gear is aligned with the arrow in the front cover.
5. Temporarily refit the crankshaft pulley and turn th crankshaft so that one and four pistons are at TDC and the crankshaft key is aligned with the arrow in the front cover.



6. Screw the body of timing pin LST128 into the bottom of the flywheel housing and check that the pin will locate into the flywheel slot. It is important to note that there are two slots in the flywheel and that the narrowest is the one that must be used for this direct injection engine.



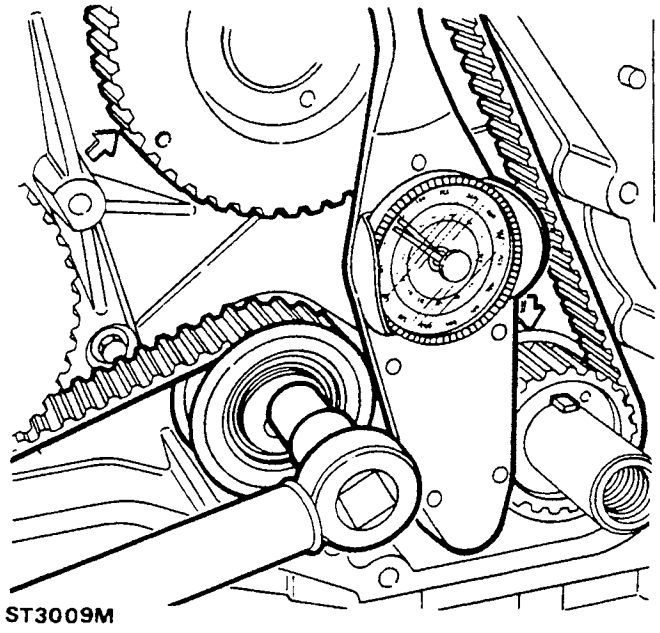
ST2641M

Fitting and tensioning belt drive

Note: It is vitally important that the following belt tensioning procedure it carried out carefully and accuratly. The procedure involves tensioning the belt twice. New and original delts are tensioned to different figures.

8. Ensure that the crankshaft, camshaft and in jection pump are correctly aligned then carefully fit the belt observing any rotational marks made during removal. Feed the delt over the gears keeping it tight on the drive side.
9. Fit the belt tensioner with the special washer and single bolt. Insert a 13 mm (0.5 in) square drive extension into the tensioner plate and with a dial type torque meter, apply a tension of 21.7 Nm (16 Lbf ft) for a new belt, or 16.3 Nm for an original belt. When the tension is correct and the meter is in the vertical position, tighten the clamp bolt.

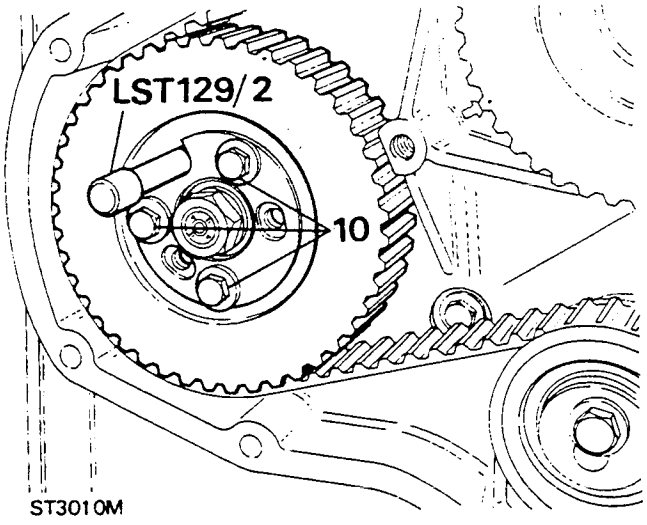
Note: To ensure correct belt tension it is very important that the tensioner is clamped when the torque meter is in the vertical position and the applied tension is correct.


ST3009M

10. Tighten the three bolts that secure the pump gear and reinforcing plate to the pump hub to the correct torque and remove the timing pin LST129/2.

CAUTION: Unlock the injection pump and fit the keeper plate before attempting to turn the crankshaft. Also ensure that the flywheel timing pin LST128 is clear of the flywheel slot.

11. Rotate the crankshaft two complete revolutions and slacken the tensioner clamp bolt and tension the belt again, as previously described.



ST3010M

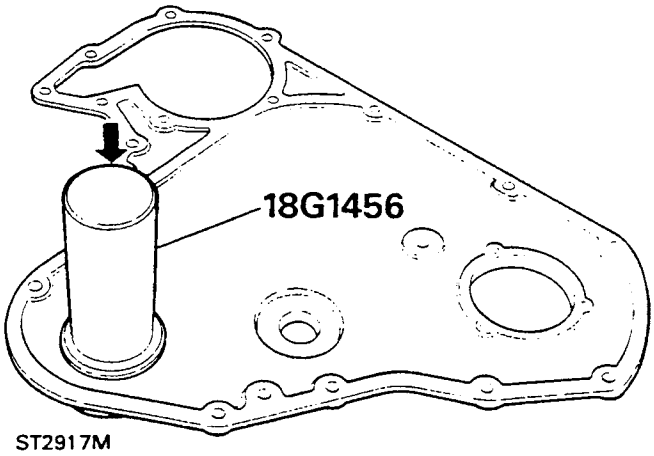
CAUTION:

The double tensioning procedure is vital otherwise the belt could fail resulting in serious damage to the engine.

12. Turn the crankshaft again in a clockwise direction until the flywheel timing pin locates in the T.D.C. slot.
13. Insert the timing pin in the pump hub and check that the crankshaft key aligns with the arrow on the front cover. Also check that the dot on the camshaft gear aligns with the arro. If the timing pin cannot be inserted fully into the pump hub slot, it is necessary toslacken the three pump gear retaining boltsand slightly turn the hub, in the appropriate direction, to allow the pin to locate. Retighten the bolts to the correct torqu.

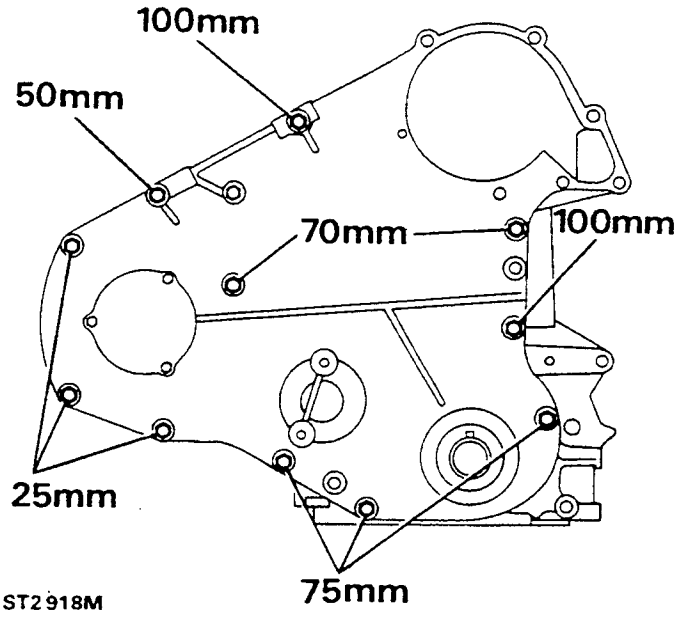
Fitting front cover plate

14. Remove the worn seal from the cover and clean the recess. Support the cover on a flat surface and using service tool 18G1456 press in the new seal into the location, lip side leading, so that when fitted the lip faces away from the crankshaft.



ST2917M

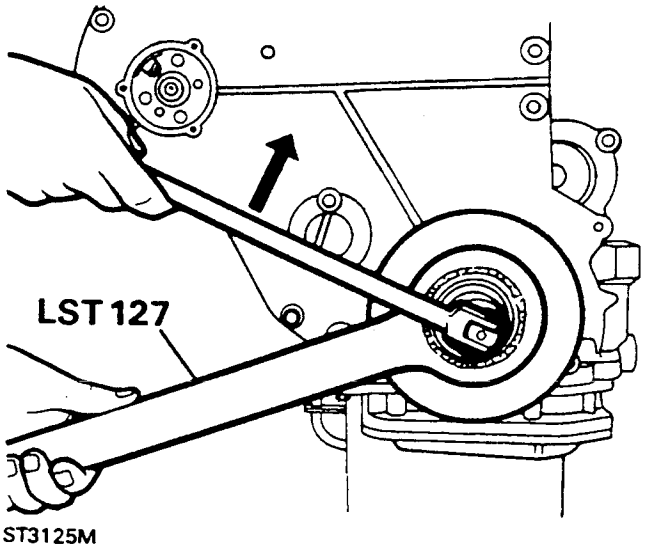
15. Ensure that the front cover and plate joint faces are clean and fit a new gasket to the front cover using a little grease.
16. Fit a new gasket to the centre hole in the cover plate and locate in position by inserting a bolt. Then fit the plate to the cover securing with the eleven retaining bolts using the location chart showing the various lengths. Tighten the bolts evenly to the correct torque.



ST2918M

Fitting front damper and pulley

17. Check that the damper rubber is in good condition then locate the unit on the crankshaft key and secure with the distance piece and special bolt. Apply a little Loctite 242 to the bolt threads and tighten to the correct torque using service tool LST127 to restrain the crankshaft, as illustrated.
18. Refit the pulley securing with the four bolts and tighten to the correct torque.



ST3125M

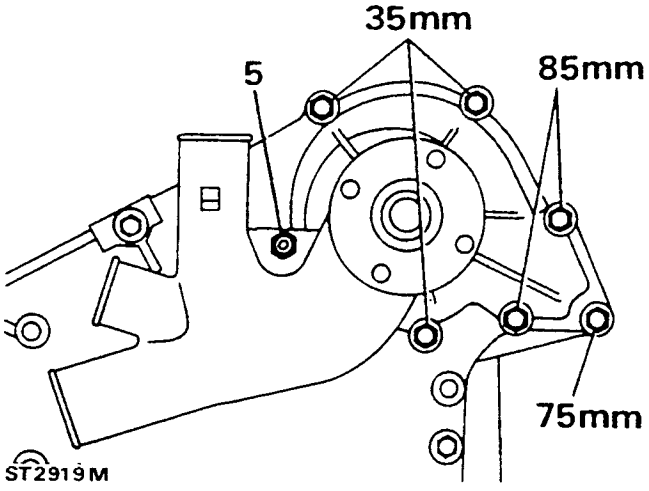
WATER PUMP INSPECTION AND FITTING

The water pump is not a reconditionable unit but its condition can be determined by the following checks.

1. Spin the pump spindle and listen for bearing noise, also push and pull the spindle and check for sideways movement. If the bearing is in good condition the clearance between the impeller and the pump body should not vary.
2. Inspect the vent hole in the pump body for signs of coolant or lubricant leaks. If there is any evidence of leakage, the pump should be renewed.

Fitting water pump

3. Lightly grease a new joint washer and place it in position on the timing cover.
4. Clean the threads of the water pump retaining bolts and apply Loctite 572 thread lubricant sealant to the threads of the long bolts which penetrate into the cylinder block.
5. Fit the pump to the cylinder block and secure in accordance with the bolt chart. Tighten the six bolts and one nut evenly to the correct torque.

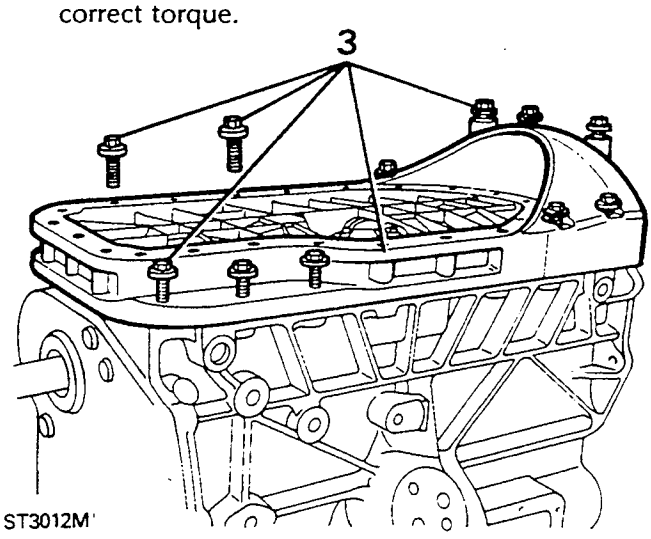


6. If separated, fit the fan blades to the viscous coupling with the four screws. Fit the fan and viscous coupling assembly to the water pump spindle noting that it is secured with a left-hand thread. If air conditioning is fitted do not at this stage fit the drive belt until the compressor belt is fitted.

Fitting ladder frame

Since the sealant specified to seal the ladder frame to the crankcase cures within fifteen minutes it is important to fit sufficient bolts to ensure adequate compression while the sealeant cures.

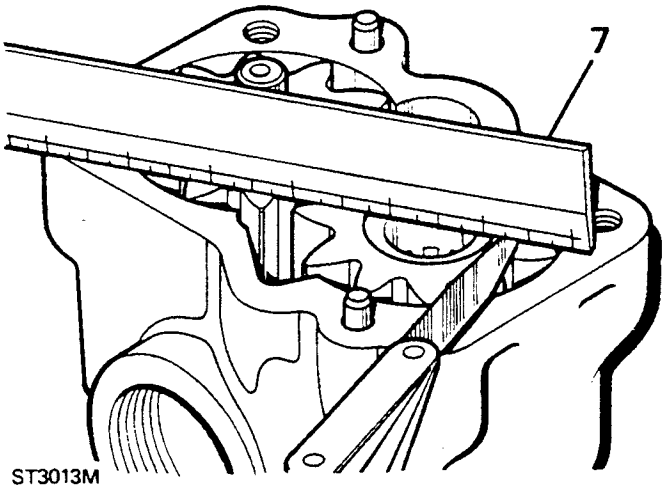
1. Clean both sides of the ladder frame and remove all traces of old sealant. Check that the frame is not distorted and is free from burrs and damage on the mating faces that could cause oil or bypass gas to leak.
2. Coat both faces with Hylogrip Primer to clean and hasten curing then apply a bead of "Hylogrip 2000" 3,0 mm wide to the mating face with the crankcase.
3. Fit ten securing bolts through the ladder frame flange and two more through the sump face as illustrated. Tighten all bolts evenly to the correct torque.



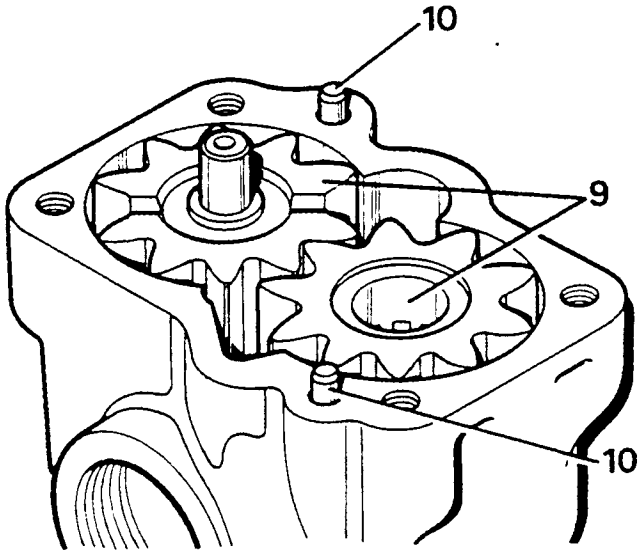
OIL PUMP OVERHAUL

1. Bend back the lock washer and release the nut securing the strainer to the oil pump body and remove the strainer and sealing ring.
2. Remove the four bolts and washers, lift off the oil pump cover and remove the driving and driven gear.
3. Remove the oil pressure relief valve plug and sealing washer. Withdraw the relief valve spring and plunger and examine for wear and scores.
4. Examine the gears for wear, scores and pitting and renew if necessary. Note: Gears must be renewed in pairs only.
5. If showing signs of wear the driven gear spindle may be renewed.

6. Clean all the components then install both gears into the body ensuring that the recessed end of the driving gear is uppermost.
7. Place a straight edge across both gears as illustrated to measure the end float of each using a feeler gauge. Also check the gear backlash and the clearance between the gears and pump body. The correct clearances are given in the data section.
8. Examine the gear thrust face on the pump cover, any slight scratches may be erased by rubbing on fine emery cloth on a flat surface.



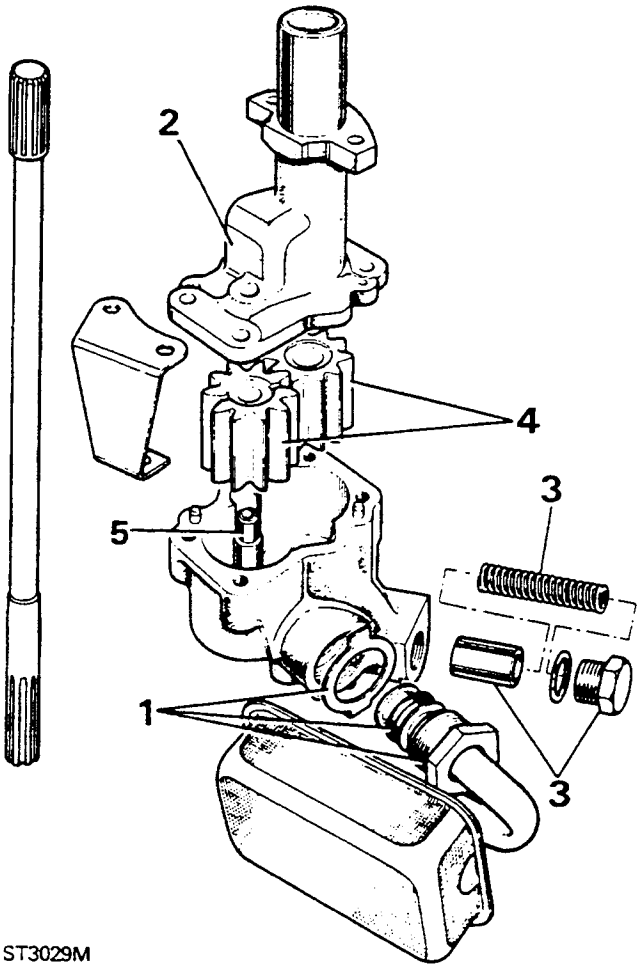
ST3013M



ST3014M

Pump assembly.

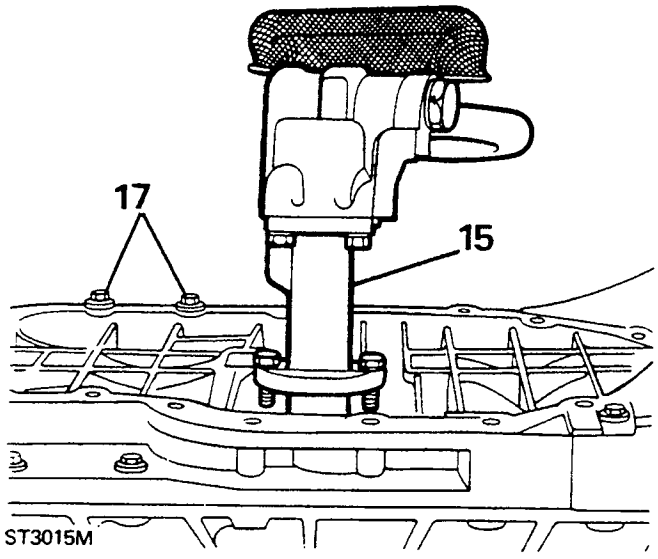
9. With gear tolorances correct, lubricate and fit the driven gear to the spindle and install the driving gear with the counter bored splined end of the gear uppermost in the pump housing.
10. Fit the cover locating it over the two dowels and loosley secure with the four bolts until the strainer is fitted.
11. Install the spring into the relief valve then lubricate and insert the valve into the relief valve bore retaining with the sealing washer and plug.
12. Fit a new 'O' ring to the oil strainer pipe and insert into the pump body and loosely secure with the lock washer and nut.
13. Secure the strainer bracket to the pump body and tighten the four screws. Tighten the strainer pipe nut and secure with the lock tab.
14. Insert the pump drive shaft and check that the gears are free to operate before refitting to the engine.



ST3029M

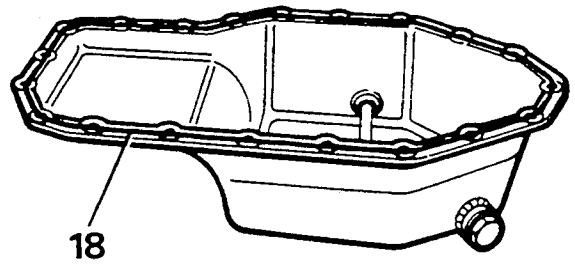
Fitting oil pump

15. Ensure that the oil pump drive shaft is located in the appropriate splines and fit the oil pump and strainer assembly into the cylinder block using a new gasket, tighten the two bolts to the correct torque.

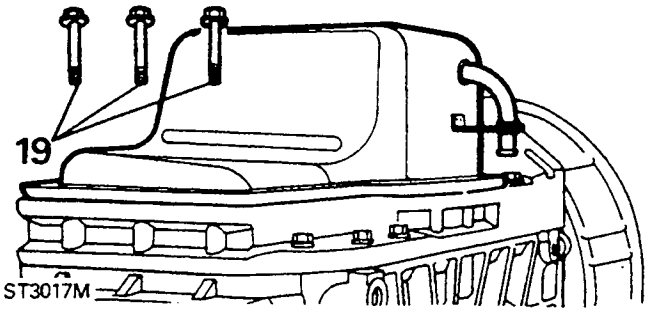


Fitting the sump

16. Ensure that all traces of old sealant are removed from the sump joint face and that the sump is thoroughly clean inside and out.
17. Remove the two two bolts securing the ladder frame to the cylinder block to allow fitting of the sump.
18. Apply a 2,0 mm wide bead of "Hylosil" RTV102 black to the sump face and fit the sump.
19. Install and tighten the twenty remaining bolts to the correct torque. Note that the three long bolts pass through the sump and ladder frame into the front cover.



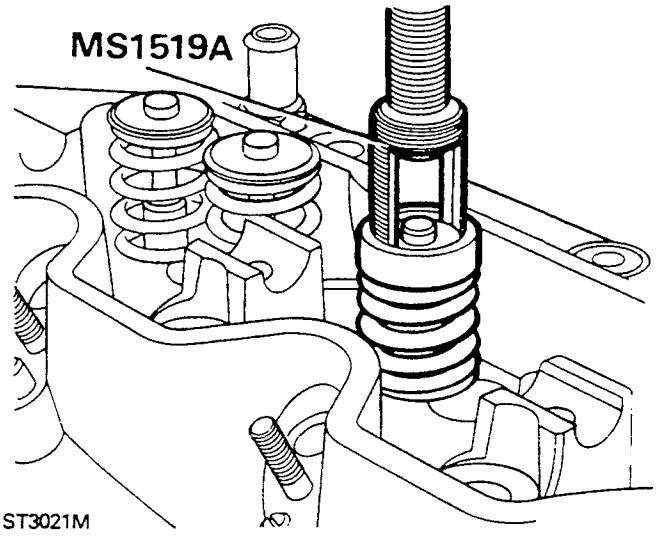
ST3016M



CYLINDER HEAD OVERHAUL

CAUTION: Since the cylinder head is manufactured from an aluminium alloy care must be taken to ensure that the combustion face, in particular, is not damaged or scratched by placing it on a hard or abrasive surface while carrying out the overhaul operations.

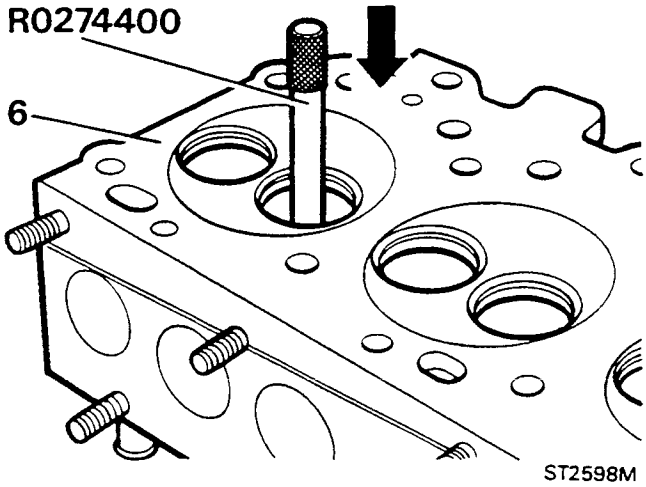
1. Using valve spring compressor MS 1519A or a suitable alternative, remove the valve and spring assemblies identified to their original locations.



2. Discard the valve springs and valve guide oil seal. Remove carbon deposits from the valves and combustion chambers and degrease all parts ready for examination.
3. Examine the cylinder head for damage and distortio. Inspect the valve seat inserts for damage. Seat inserts that are beyond repair and require renewal should be replaced by a skilled specialist in this type of work.
4. Examine each valve guide and valve stem for wear and damage. Suspect guides should be checked by inserting a new valve into the guide and with the valve lifted approximatly 8 mm clear of the seat the valve head should not rock more than 0,15 mm (0.006 in). If the valve head movement exceeds 0,15 mm (0.006 in) the guide should be renewed.
5. Inspect the valves for wear and damage. Valve heads that are burnt and cracked should be renewed. So should valves which are bent and distorted. Insert the valve into a new guide and check the side movement as described above to determine the wear on the valve stem.

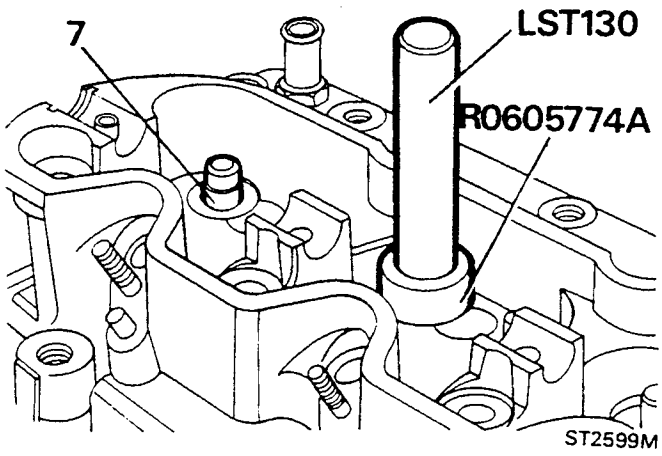
Renew valve guides

6. Support the cylinder head, combustion chamber uppermost on pieces of timber of sufficient thickness to allow clearance for the inlet or exhaust for the valve guides to be driven out using special tool RO274400.



ST2598M

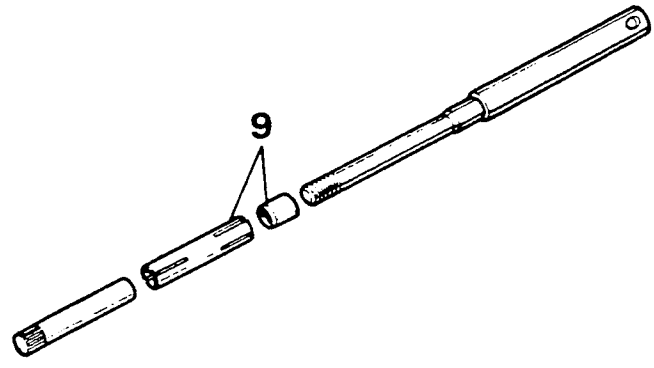
7. Turn the cylinder head over so that the combustion face is downwards. Lubricate the new valve guides and using special service tool LST 130 and depth gauge RO 60774A press the guide into position to the depth determined by the gauge of 19,0 mm (0.748 in).



ST2599M

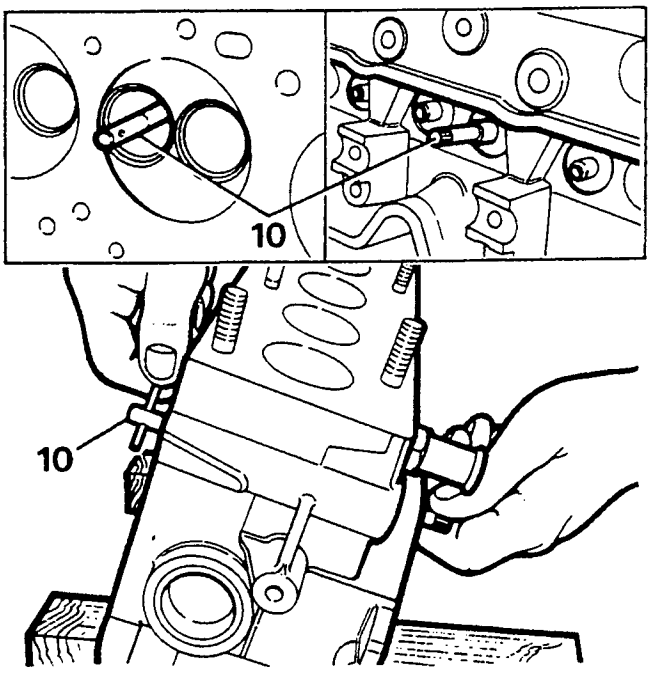
Reface valve seat inserts

8. The special set of hand tools recommended for refacing include expandable pilots that fit tightly into new or worn guides to ensure that the valve seat is concentric with the valve guide. The refacing tool has tungsten carbide cutters and can be used to cut a new seat in the insert. The valve seat cutter is numbered MS621, the handle set MS76B and the pilot MS150-8.
9. Loosely assemble the pilot in the sequence illustrated. Ensure that the chamfered end of the expander is towards the collet.



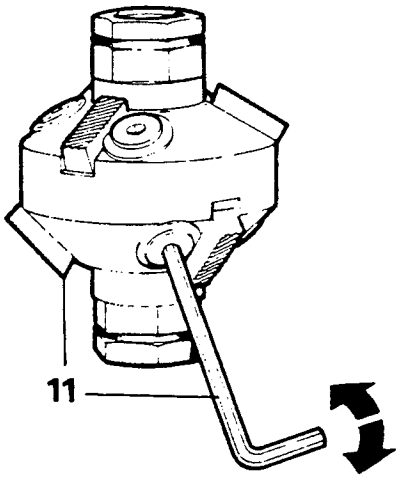
ST2644M

10. Insert the assembled pilot into the valve guide from the combustion chamber side of the cylinder head until the shoulder contacts the valve guide and the whole of the collet is inside the guide. To lock the pilot in the guide turn the tommy bar clockwise whilst holding the knurled knob.



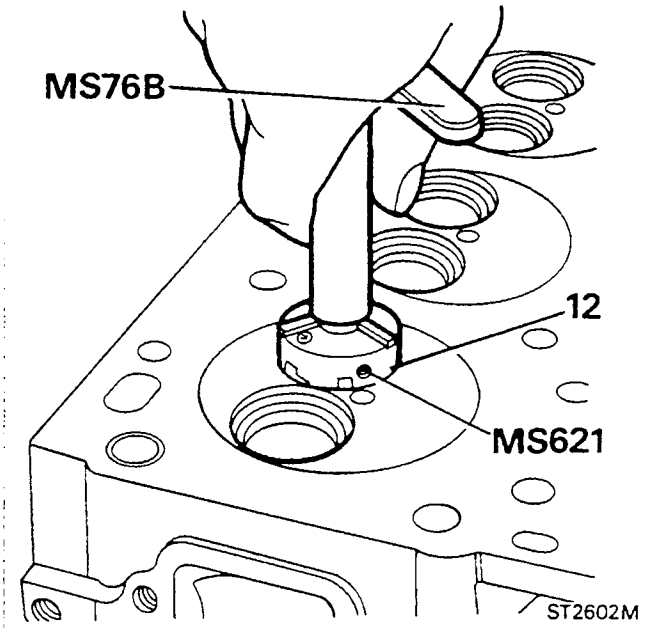
ST2670M

11. Check that the seat cutter MS621 is assembled correctly using the key MS76 ensuring that the angled end of each cutter is towards the seat and set so that the middle of the blade contacts the seat first. One end of the cutter is angled at 45° and the other end is 30°.



ST2645M

12. Using very light pressure turn the cutter clockwise until the angled face is approximatly 01,5 mm wide.
13. To check the effectiveness of the cutting operation smear a small quantity of engineers' blue round the valve seat and revolve a correctly ground valve against the seat. A good seating will produce a continuous fine polished line around the valve face. A slight gap of not more than 12 mm in the polished line, can be corrected by lapping.

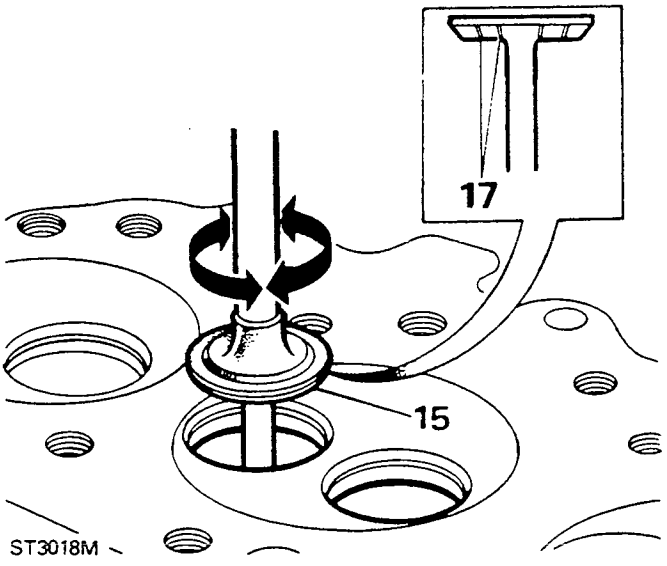


ST2602M

Valve refacing

14. Valves that are satisfactory for further service can be refaced. This operation should be carried out using a valve grinding machine. Only the minimum of material should be removed from the valve face to avoid thinning of the valve edge. The valve is refaced correctly whan all pits are removed and the face is concentric with the stem.

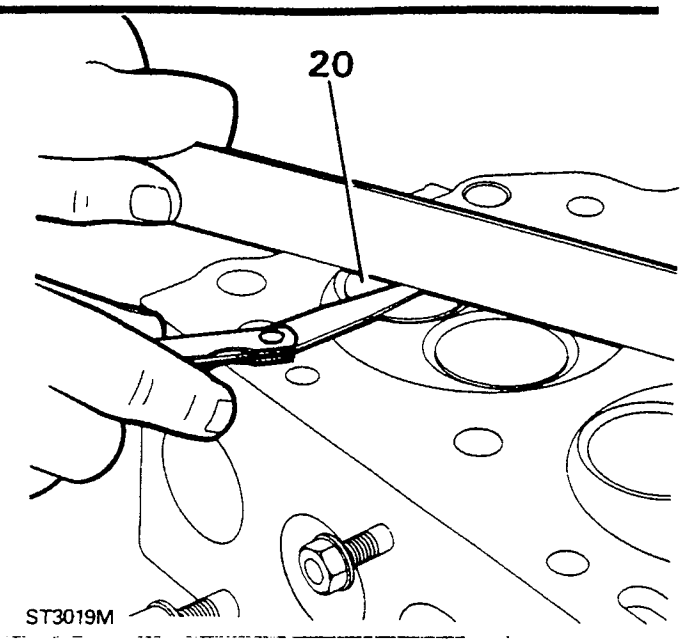
Inlet valve seat face -	30° + 0,25°
Exhaust valve seat face -	45° + 0,25°
Inlet valve face -	30° - 0,25°
Exhaust valve face -	45° - 0,25°

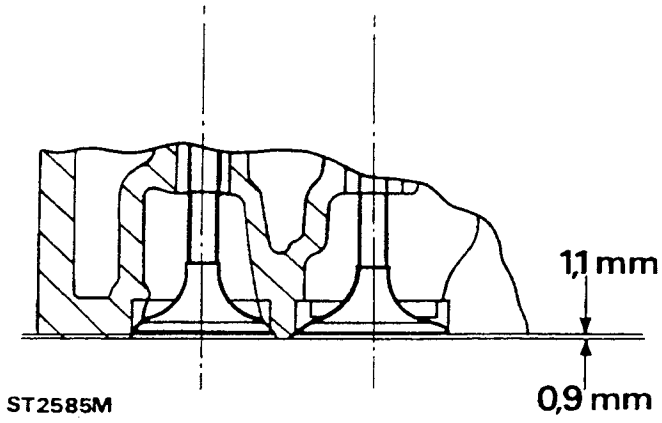


ST3018M

Lapping valves

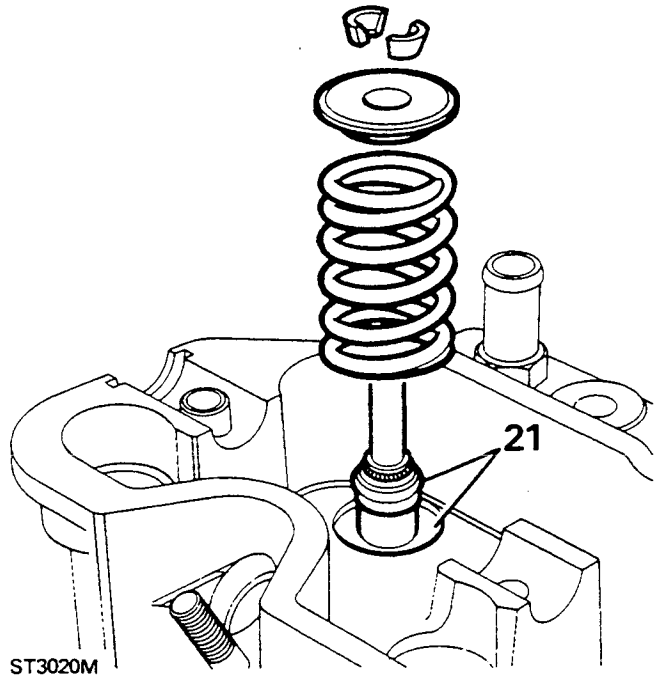
15. To ensure a gas tight seal between the valve face and valve seat it is necessary to lap-in the appropriate valve to its seat. It is essential to keep the valve identified with its seat once the lapping-in operation has been completed. Unless the faces to be lapped are in poor condition it should only be necessary to use fine valve lapping paste.
16. Smear a small quantity of paste on the valve face and lubricate the valve stem with engine oil. Insert the valve in the appropriate guide and using a suction type valve lapping tool employ a light reciprocating action while occasionally lifting the valve off its seat and turning it so that the valve returns to a different position on the seat.
17. Continue the operation until a continuous matt grey band round the valve face is obtained. To check that the lapping operation is sucessful, wipe off the valve paste from the valve and seat and make a series of pencil lines across the valve face.
18. Insert the valve into the guide and while pressing the valve onto the seat revolve the valve a quarter of turn a few times. If all the pencil lines are cut through no further lapping is necessary. Thoroughly wash the cylinder head ensuring no lapping paste remains before fitting the valves.
19. Position the cylinder head with the combustion face uppermost, lubricate and insert the valves into their respective guides. To check the valve head stand-down or the correct dimension of the valve head below the combustion face, use either a dial test indicator or a straight edge and feeler gauge as follows.
20. Hold the straight edge across the centre of each valve in turn and measure the gap between the valve head and straight edge. The correct dimension should be 1,1 to 0,9 mm (0.040 to 0.035 in). Using a dial gauge zero the gauge on the combustion face then move the stylus across to the valve head and note the reading.



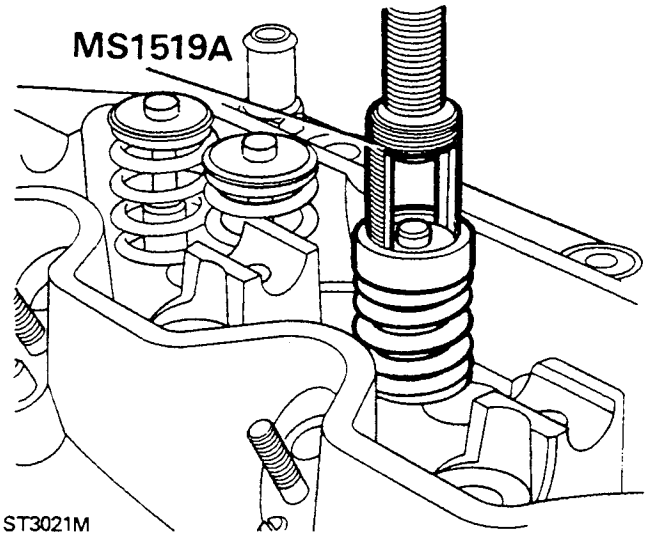


Assembling valves to cylinder head

21. Insert the valves to their respective guides and locate a spring protection washer over each guide. Fit new oil seals to all the valve guides with the garter spring uppermost. Ensure that the seals fully locate on valve guides.



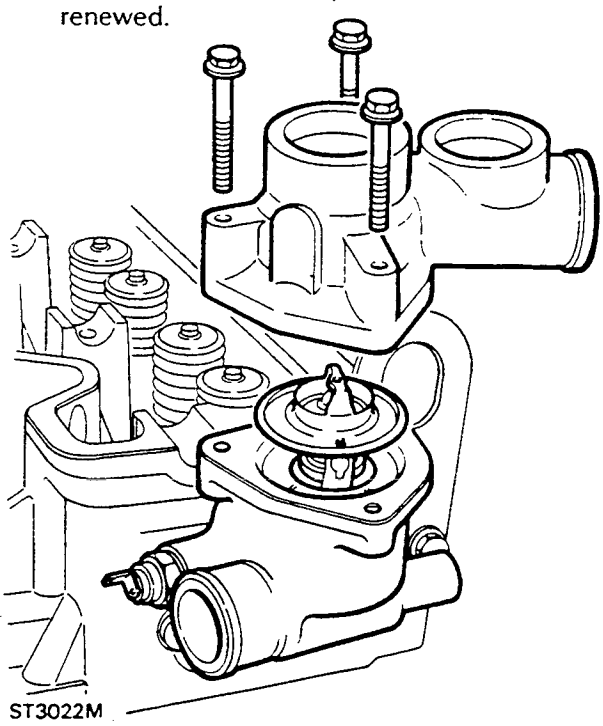
22. Fit a spring and cup to each valve and compress with special service tool MS1519A or a suitable alternative. Retain with the multi-groove cotters ensuring that they are fully located in the valve stem and cup.



ST3021M

Thermostat and housing

23. If necessary remove the temperature transmitter and temperature sensor from the housing.
24. Release the three bolts securing the thermostat cover and lift out the thermostat. The thermostat may be tested by immersing it in hot water of a known temperature and comparing its operation with the temperature range stamped on the flange. Any leakage of wax (which is the colour of copper) from around the center pin of the thermostat, indicates that it is faulty and should be renewed.

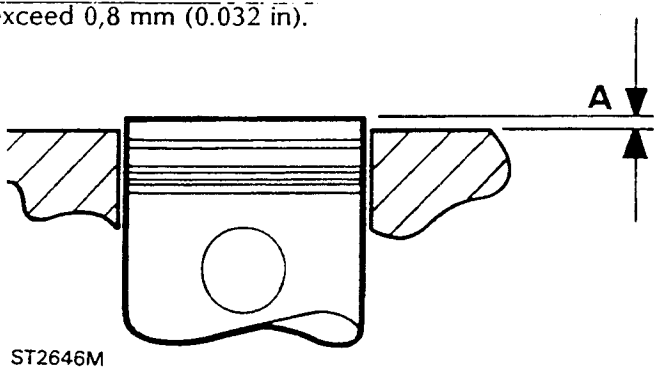

ST3022M

25. The thermostat housing may be removed from the cylinder head at this stage and if necessary the gasket renewed.
26. The "jiggle pin" which allows any air to escape from below the thermostat, may be fitted in any position. Renew the gasket when fitting the thermostat and apply a little Hylomar sealant to the threads of temperature sensor and transmitter before screwing into position.

FITTING CYLINDER HEAD

Piston protrusion and gasket selection

Before fitting the cylinder head, the protrusion of the pistons above the block face must be checked in order that the correct thickness gasket may be selected from the range of three. The height of all the pistons above the cylinder block must be measured and the thickness of the gasket selected is based upon the largest value of dimension 'A', as illustrated. This dimension, however, must not exceed 0,8 mm (0.032 in).

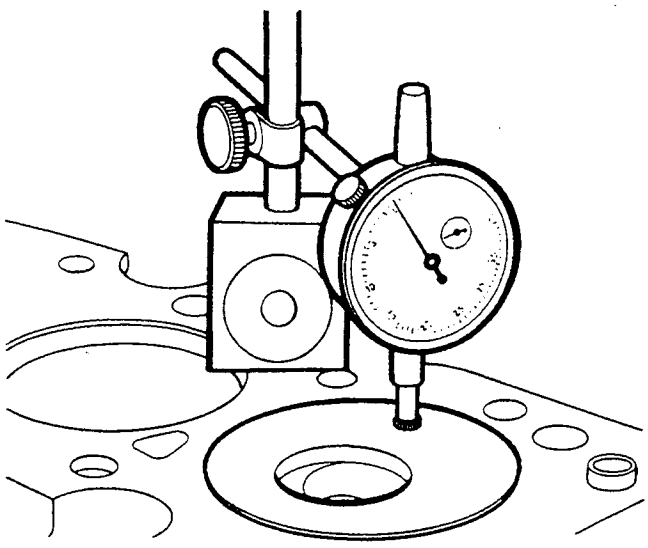


ST2646M

Three thicknesses of gasket are available and each size can be recognised by the number of identification holes punched in the side of the gasket as illustrated. The table below gives the details of the gaskets available. The thickness of gasket fitted can be seen when the cylinder head is fitted since the identification holes can be seen protruding from the right hand side of the engine towards the rear.

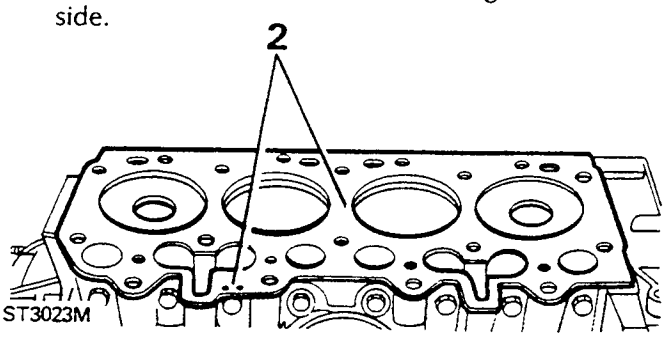
Number of holes	Metric	Imperial	Gasket
1	0.60 to 0.50	0.0196 to 0.0236	ERR0382
2	0.70 to 0.61	0.024 to 0.0275	ERR038
3	0.80 to 0.71	0.0279 to 0.0314	ERR0384

1. Clean the cylinder block combustion face and turn the crankshaft so that number one and number four pistons are at . D.C. Use a dial test indicator to determine the highest travel of the piston then zero the gauge and move the stylus over to the cylinder block and note the reading. Repeat the procedure on the remaining pistons. The highest figure obtained will determine the gasket selected.



ST2581M

2. Place the selected the head gasket in position on the cylinder block so that the identification holes are towards the rear on the right-hand side.



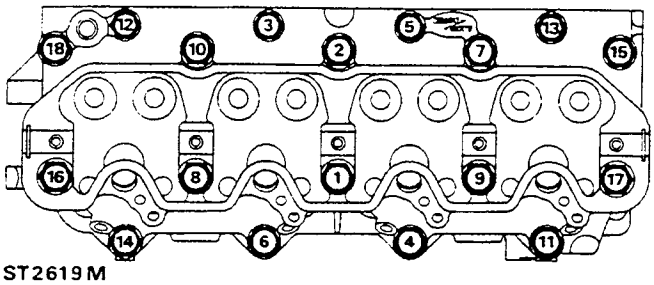
ST3023M

3. Clean the cylinder head face and if preferred, guide studs may be fitted to the cylinder block to facilitate the lowering of the head into position. Locate the head over the two dowels.
4. Lubricate the threads of new bolts, with light oil, and fit to the positions illustrated according to length and diameter. Tighten the bolts down so that the heads just make contact with the cylinder head. Now, in the sequence shown, tighten all the bolts down to 40 Nm with a suitable torque wrench.

Bolt sizes:

M10 locations 3, 5, 12 and 13

M12 locations 1, 2, 4, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 18



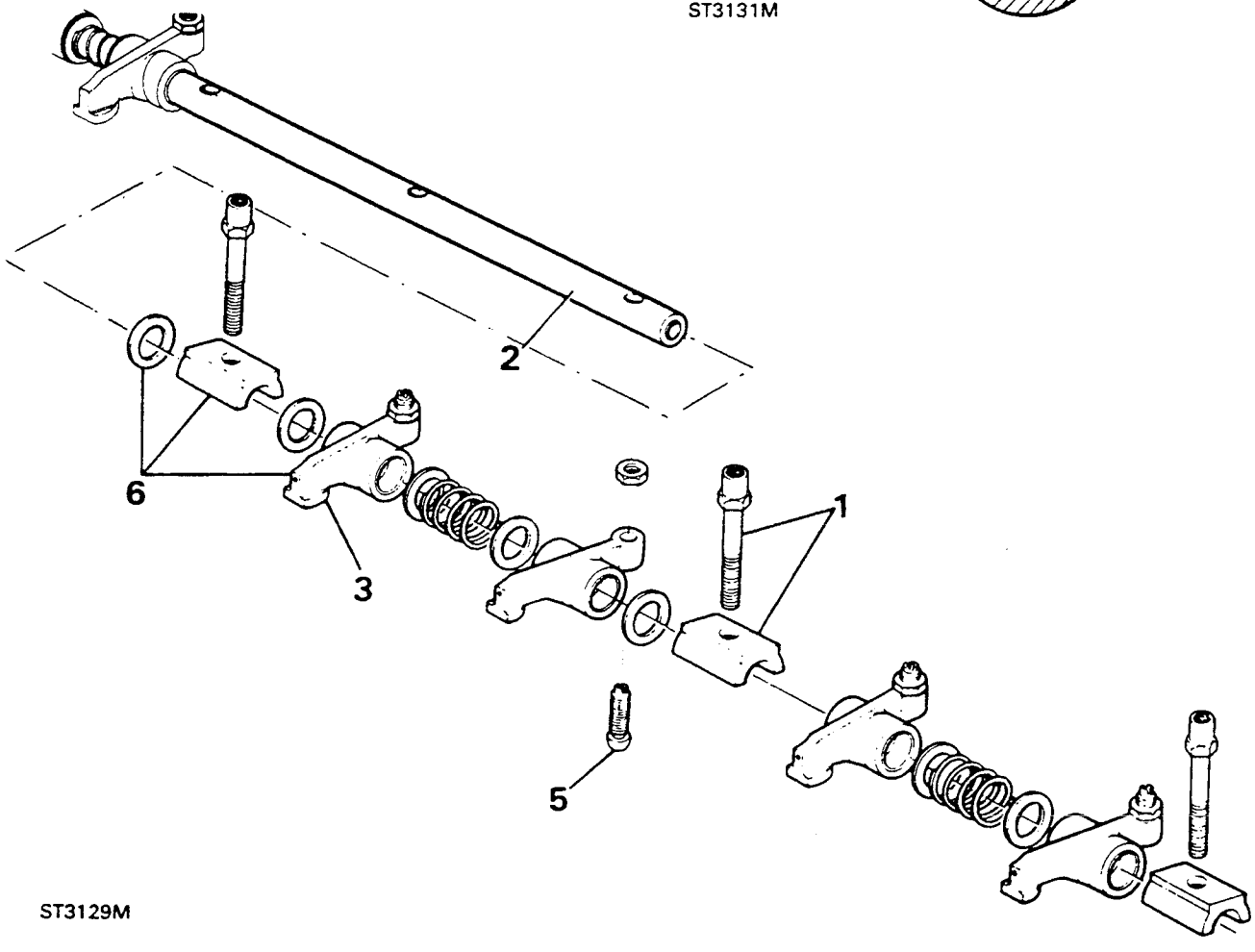
ST2619M

5. Attach the special service tool degree disc LST122 to a power bar. Make a suitable pointer from welding rod and attach it to a bolt screwed into a rocker shaft securing bolt hol.
6. Tighten all the bolts down through an angle of 60° strictly in the sequence illustrated. As each bolt is tightened scribe a line across the head with a piece of chalk or crayon to identify which bolts have been tightened, then tighten each bolt a further 60° again in the correct sequence to complete the tightening procedure. Re-positioning of the pointer will, no doubt, be necessary to reach all bolts.

CAUTION: It is important that the double torquing procedure is observed and that on no account should the total angle of 120° be performed in one operation otherwise damage and distortion of the cylinder head may occur.

OVERHAUL ROCKER SHAFT

1. Remove the five rocker shaft retaining bolts and withdraw the bearing caps, rockers, washers and springs from the shaft.
2. Examine the rocker shaft for wear and discard if the bearing surface is worn, scored or pitted. Check also that the oilways are clear.
3. Inspect the rockers and discard if the pads are worn. It is not permissible to grind pads in an attempt to reclaim rockers.
4. Renew the bushes if the clearance exceeds 0,127 mm (0.005 in). Press in replacements ensuring that the pre-drilled holes align with those in the rockers and machine the inside bore of the bushes to 18,018 mm. The rocker arm and bush oil drillings are shown in the cross section illustration.
5. Examine the tappet adjustment screws and check that the ball end is not worn or pitted and that the lubrication hole is clear.
6. Assemble the rockers, bearing caps, new springs and washers to the shaft noting where the washers are fitted. Hold the assembly together with the five rocker shaft retaining bolts.



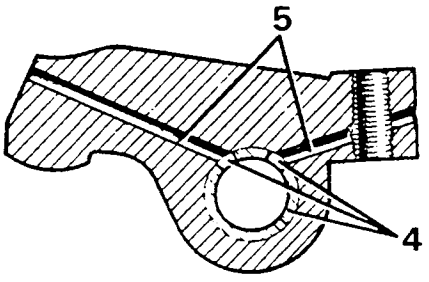
ST3129M

Push rods

1. Examine the push rods and renew any that are bent or where the ball or cup ends are worn or pitted.
2. Fit the push rods to the engine ensuring that the ball-end locates properly in each camfollower slide.

FITTING ROCKER SHAFT

1. Ensure that a new cap is fitted to each valve stem before fitting the rocker shaft.
2. Fit the rocker shaft to the cylinder head ensuring that the retaining bolts and push rods are correctly located then evenly tighten the bolts to correct torque.



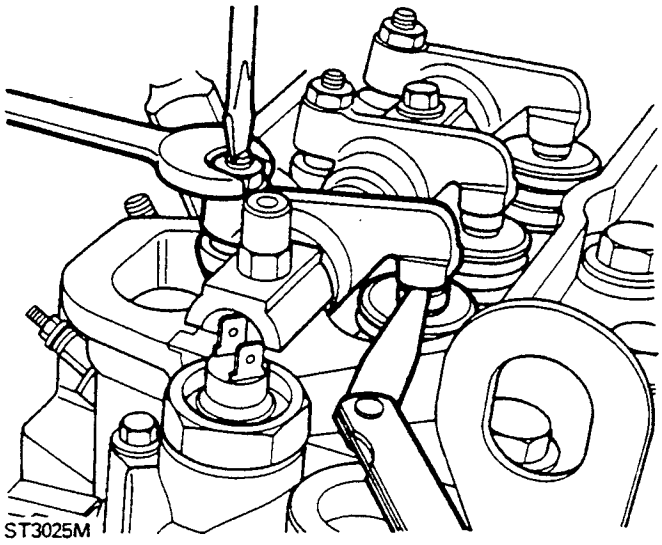
ST3131M

Adjust tappet clearances

WARNING If the crankshaft is rotated with excessive valve clearances, it is possible that the push rods may become dislodged from the tappet seating and fracture the tappet slide.

To prevent damage, eliminate all clearance from any loose rockers before turning the crankshaft to adjust clearances.

1. Turn the engine over until number eight valve (counting from front of engine) is fully open.
2. Using a 0,20 mm (0.008 in) feeler gauge adjust the clearance of number one valve.



Continue to adjust the remaining tappets in the following sequence:

Set No. 3 tappet with No. 6 valve fully open.
Set No. 5 tappet with No. 4 valve fully open.
Set No. 2 tappet with No. 7 valve fully open.
Set No. 8 tappet with No. 1 valve fully open.
Set No. 6 tappet with No. 3 valve fully open.
Set No. 4 tappet with No. 5valve fully open.
Set No. 7 tappet with No. 2 valve fully open.

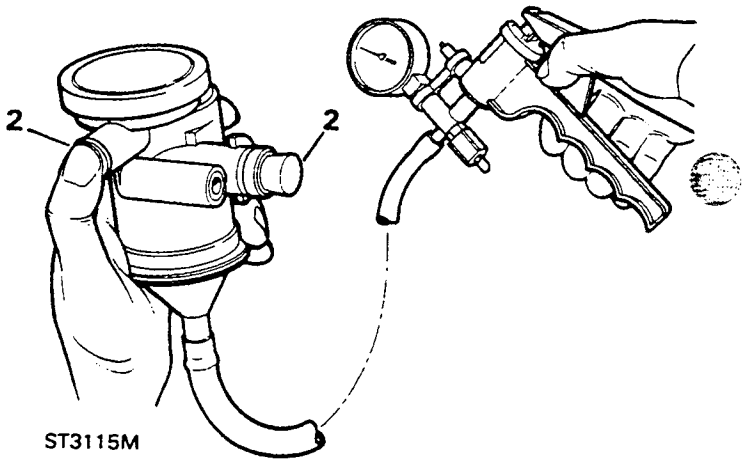
Rocker cover and crankcase ventilator

1. If necessary release the single bolt and remove the oil separator ventilation valve unit, from the side of the rocker cover and thoroughly clean.

Its function is to separate the oil from the crankcase ventilation atmosphere, allowing the oil to return to the sump and the residues to be drawn into the combustion chamber where they are burned. The unit also contains a diaphragm valve which controls the purge rate of the crankcase fumes. The operation of the valve may be tested as follows.

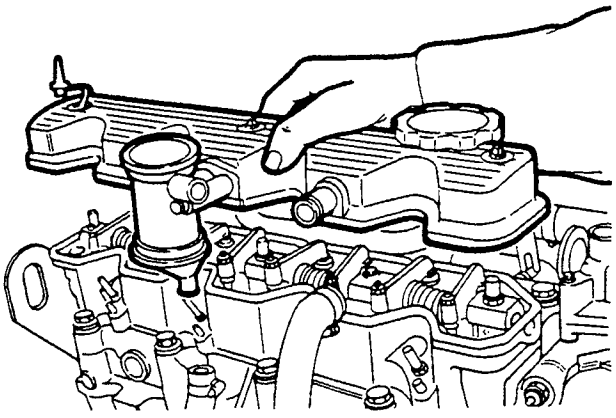
Test procedure crankcase ventilator

2. With the unit removed from the rocker cover seal off the two ports illustrated and apply a vacuum to the third por. As the vacuum pump is operated the diaphragm valve will be heard to seat. While holding the vacuum unseal either of the other two ports and the diaphram valve will release.
3. Failure of the diaphragm valve to seat during test, indicates that the diaphragm is punctured and the unit should be renewed.
4. Refit the unit using a new rubber "O" ring.



Fitting rocker cover

5. Apply a continuous bead of RTV Hylosil which starts and finishes 10 mm each side of the half moon grooves at both ends of the rocker shaft and press the seals into position.
6. Locate a new seal in the rocker cover and fit the cover to the cylinder head securing with the three special bolts and conical washers. Tighten the bolts evenly to the correct torque and reconnect the ventilation hoses.



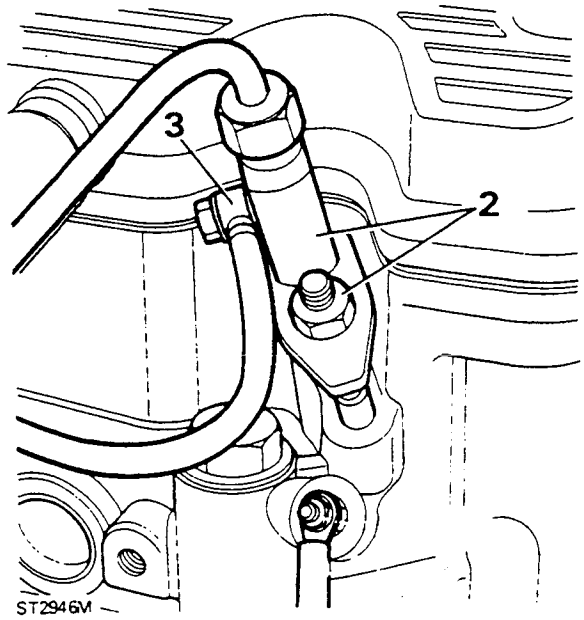
ST2948M

FITTING HEATER PLUGS

1. If necessary check the operation of each heater plug before fitting and tighten to the correct torque, do not over-tighten.
2. Connect the electrical harness to the plugs and secure with the single nut and washer. Ensure that each spade terminal is fitted so that neither the terminal nor the insulation touches the cylinder head, or oil separator.

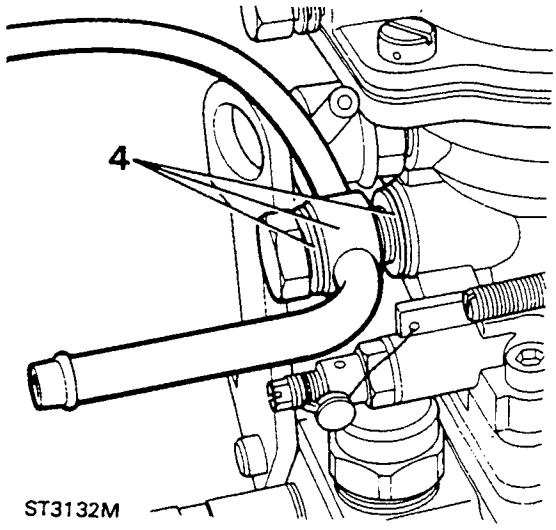
FITTING INJECTORS AND PIPES

1. Ensure that the injector and seating in the cylinder head is clean then lightly grease a new copper washer in position on the injector.
2. Fit the injectors with the spill return outlet facing towards the rear of the engine and secure each with a clamp and nut. The clamps are slightly curved and the convex side should be fitted uppermost. Tighten the nuts to the correct torque.
3. Fit the spill return rail to the injectors, noting that there are two copper washers and one must be fitted each side of the retaining union screw. The in-board washer locates in a recess in the injector. Do not over-tighten the screws.



ST2946M

4. Fit the banjo-union end of the spill return rail to the rear of the injector pump and secure with a copper washer each side of the banjo and the union bolt.



ST3132M

5. Fit the injector fuel supply pipes securing each end of the pipes to their respective locations loosely, then tighten evenly. Do not, however, over-tighten.

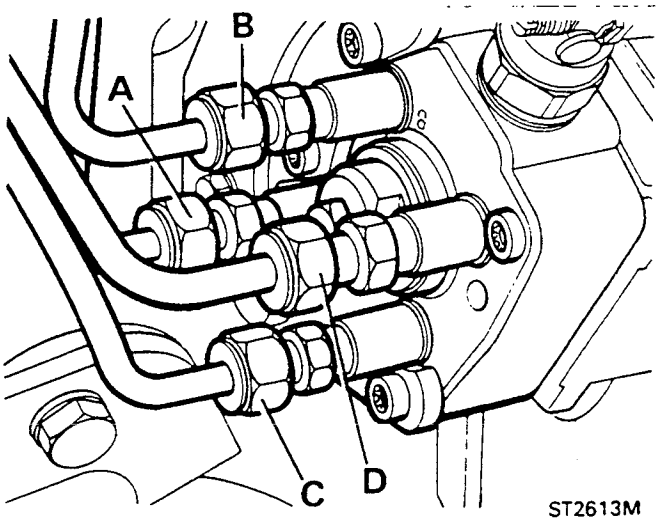
Commencing at the front of the engine connect the pipes as follows:

A. To number 1 injector.

B. To number 2 injector.

C. To number 3 injector.

D. To number 4 injector.



ST2613M

FUEL INJECTION PUMP

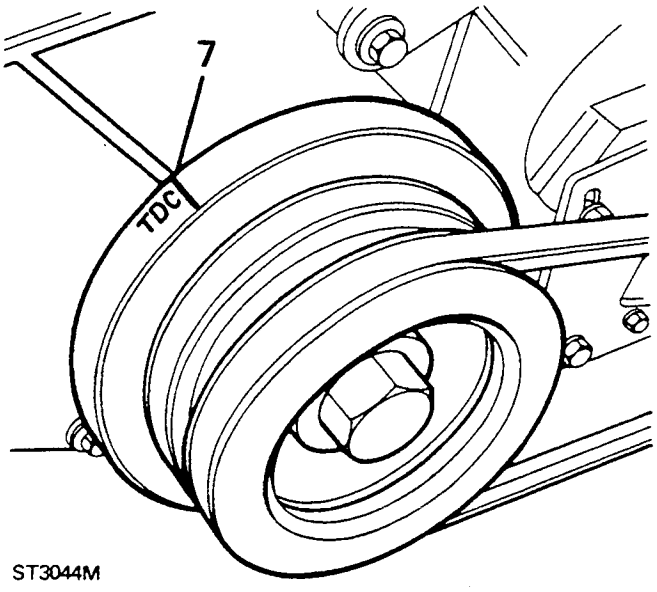
Service Repair No. 19.30.07

Remove and refit

Special tools:-

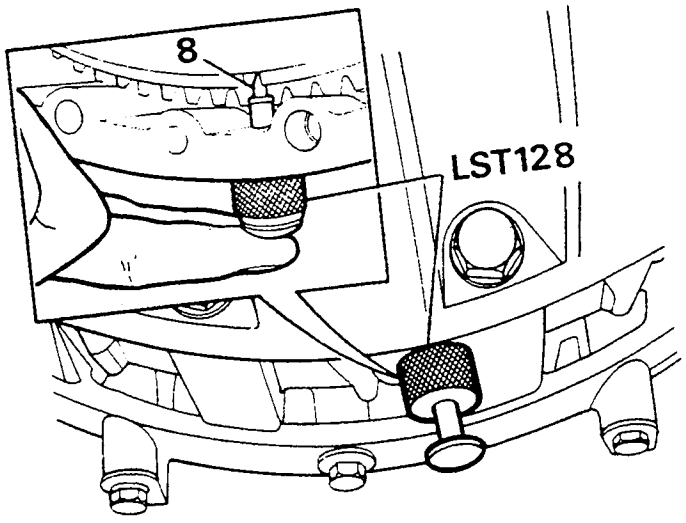
Flywheel timing pin	LST 128
Pump gear retaining tool	LST 129/1
Pump timing pin	LST 129/2

1. Remove the bonnet and disconnect the battery.
2. Drain the cooling system.
3. Remove the fan and viscous coupling assembly see operation 26.25.19
4. Remove the fan cowl see operation 26.25.11.
5. Disconnect the lower cooling hose from the waterpump.
6. Remove the oil filler cap so that the position of number one cylinder valve rockers can be seen to assist in obtaining T.D.C.
7. Turn the crankshaft to align the T.D.C mark on the crankshaft damper with the the web on the front cover plate. At the same time check that the valves of number one cylinder are closed.



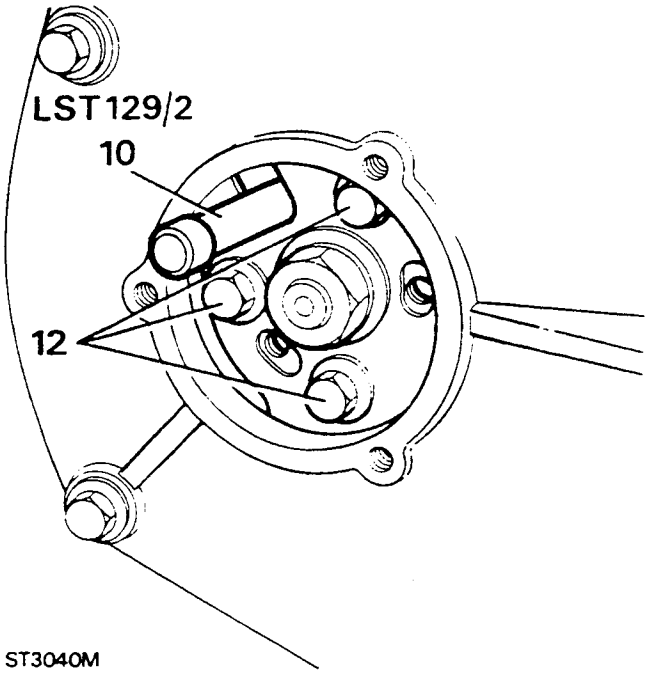
ST3044M

8. Remove the blanking plug from the bottom of the flywheel housing and fit the timing pin LST 128. Check that the pin can be inserted into the appropriate slot in the flywheel. Note that there are two slots in the flywheel the narrowest one being that which determines T.D.C. for this engine.



ST3039M

9. Remove the injector pump hub blanking plate.
10. Insert the injector pump timing pin LST 129/2 Through the "U" shaped slot in the pump hub into the pump body. Ensure that the pin fits easily and is fully inserted.

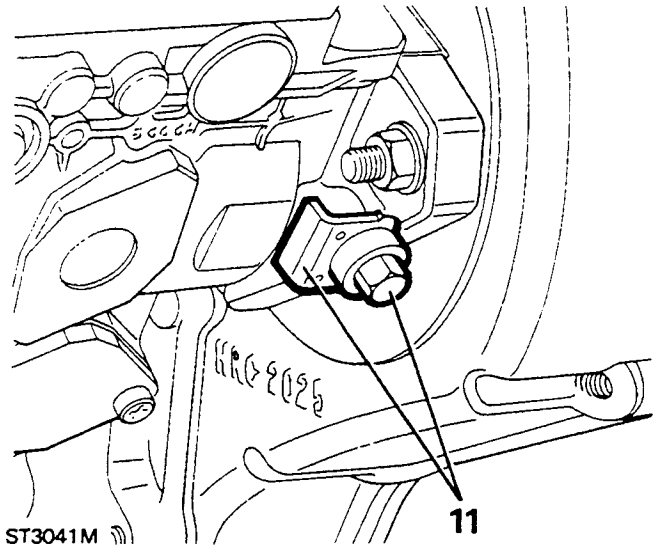


ST3040M

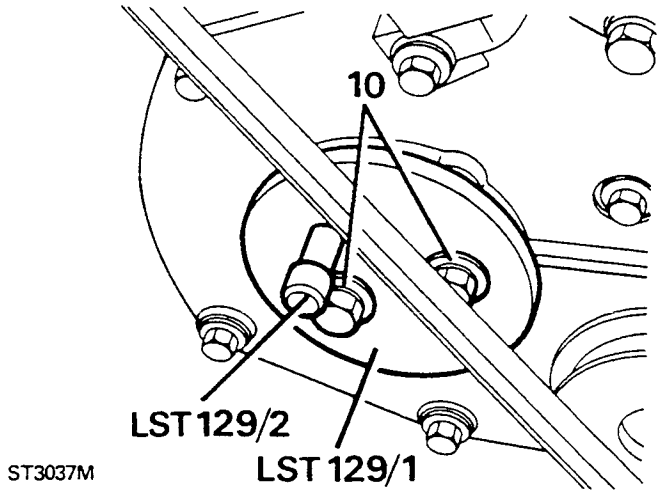
Continued

11. Slacken the pump locking screw and remove the keeper plate. Tighten the screw to lock the pump.

CAUTION: Once the timing pin LST 129/2 is inserted and the pump shaft locked, no attempt must be made to rotate the crankshaft.



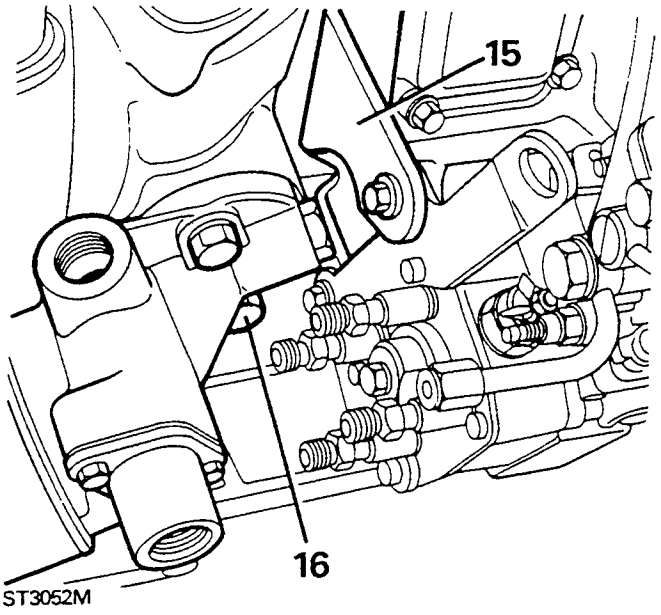
12. Remove the pump drive gear three retaining bolts and remove the lock plate and timing pin.
13. Fit the pump gear retaining tool LST 129/1 and align and tighten the two bolts. Insert the timing pin LST 129/2, again, through the hole provided in the retaining tool.



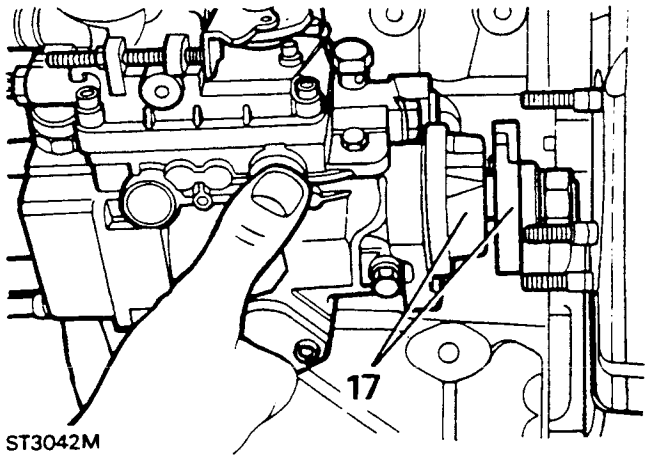
14. Remove the injector pipes and disconnect the following items from the injector pump.

Throttle cable.
stop control solenoid lucar.
Spill return pipe.
Turbo charger boost hose.
Main fuel supply pipe.

15. Remove the injector pump rear support bracket.
16. Remove the oil filter adaptor rear attachment bolt to allow clearance for the pump to be withdrawn.

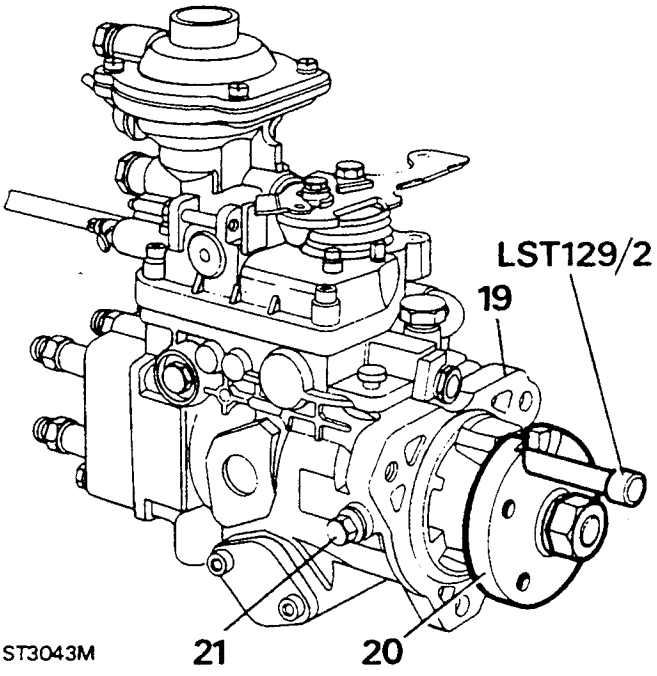


17. Remove the pump three retaining nuts and withdraw the pump and gasket, with LST 129/2
18. Fit blanks to the inlet and outlet ports to prevent entry of dirt. Slacken the locking screw, fit the keeper plate and tighten the screw.



Reffiting

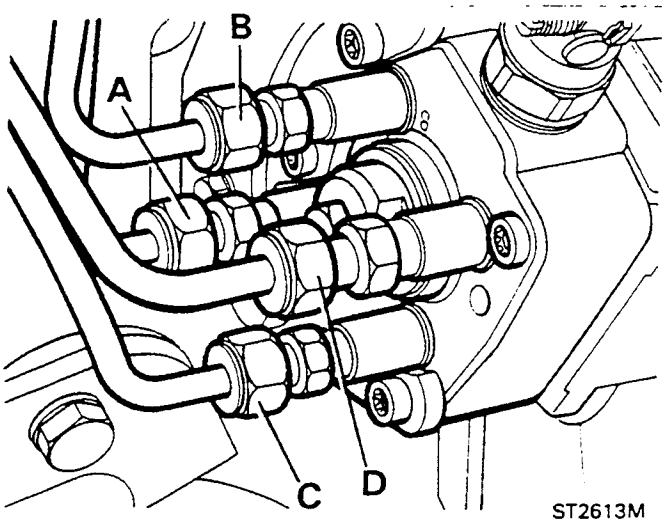
19. Clean the pump flange and front cover mating face and place a new gasket in position over the the studs.
20. Fit the timing pin LST 129/2 to the pump, if necessary, rotate the pump to enable the pin easily and fully.
21. Slacken the pump locking screw, remove the keeper plate and tighten the screw to lock the pump.



ST3043M

22. Fit the pump to the front cover and drive gear and secure with the three nuts tightening evenly to the correct torqu.
23. Fit the rear support bracket to the cylinder block and secure the pump to the bracket. Tighten all bolts the the correct torque.
24. Fit the oil filter adaptor rear attachment bolt.
25. Connect the items listed in instruction 14.
26. Fit the injector supply pipes securing each end to their respective locations, loosely then tighten evenly but do not over tighten. Commencing at the the front of the engine connect the pipes as follows:-

    A to number one injector.
    B to number two injector.
    C to number three injector.
    D to number four injector.



ST2613M

27. Remove the pump timing pin and the pump gear retaining tool LST 129/1.
28. Insert the pump timing pin again and fit the gear lock plate and secure with the three bolts and tighten to the correct torque.
29. Remove the timing pin. Unlock the pump, fit the keeper plate and tighten the bolt.
30. To check that the pump timing is correct, turn the crankshaft two complete revolutions and check that the timing pin LST 129/2 can be inserted easily and fully into the pump. at the same time check that the flywheel timing pin can also be inserted in the flywheel slot.
31. If, with the flywheel timing pin located, the timing pin cannot be inserted cleanly into the pump, carry out the following instructions:-

    1. Turn the crankshaft the small amount necessary to enable the timing pin to be inserted into the pump.
    2. Remove the keeper plate and lock the pump.
    3. Slacken the three pump gear retaining bolts.
    4. Turn the crankshaft to T.D.C.
    5. Check that the timing pin is an easy fit in the pump and that the flywheel timing pin locates.
    6. Tighten the pump gear retaining bolts to the correct torque.
    7. Unlock the pump, fit the keeper plate and tighten the bolt. Remove the timing pin from the the pump and the timing pin tool from the flywheel.

32. Fit the pump aperture cover with a new gasket and secure with the screws.
33. Connect the cooling system bottom hose to the waterpump.

Continued

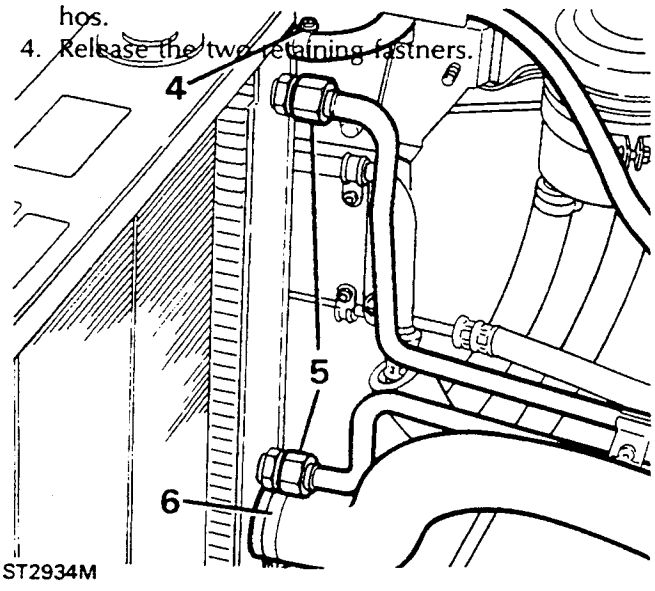
34. Place the fan cowl in position but do not secure it to the radiator until the fan and coupling is fitted.
35. Fit the fan and viscous coupling assembly to the waterpump spindle. Tighten the left hand thread to the correct torque using a Tommy bar in the hole provided in the fan pulley to restrain the coupling.
36. Secure the fan cowl to the radiator with the two nuts.
37. Fit the top coolant hose.
38. Refil the cooling system with the correct concentration of water and anti-freeze see operation 26.10.01.

AIR CLEANER

Service Repair No. 19.10.01

Remove and refit

1. Disconnect the hose from the turbo charger compressor housing to air cleaner.
2. Disconnect, from the air cleaner, the engine breather hose.
3. Disconnect from the air cleaner, the air inlet hos.
4. Release the two retaining fastners.

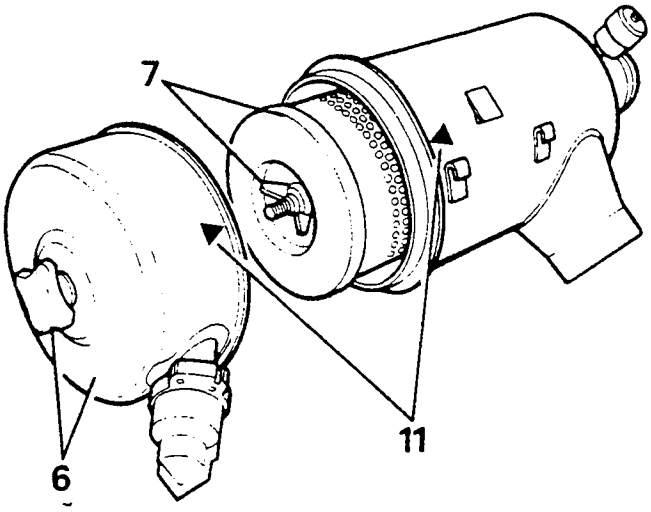


ST2934M

5. To release and remove the air cleaner from its mounting cradle, twist the body of the air cleaner anti-clockwise (viewing it from the front of the engine) and remove it from the vehicle.

Renewing element

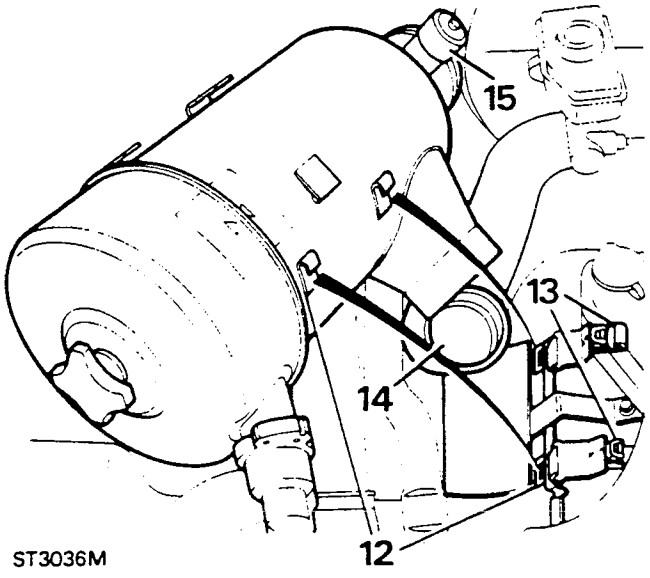
6. Unscrew the handwheel anti-clockwise and remove the end cover.
7. Unscrew the wing nut and withdraw the element.
8. Clean the interior of the casing and cover.
9. Fit a new element, fins leading, into the casing.
10. Secure the element with the wing nut.
11. Fit the end cover and aline the two arrows.



ST3035M

Refitting

12. The two clips on the side of the casing locate in the square slots in the air cleaner mounting cradle. It is necessary therefore, to twist the air cleaner clockwise into its final position and ensure that the clips engage in the slots.
13. Secure the air cleaner with the two fastners.
14. Connect all the hoses, reversing instructions 1 to 3.
15. Finally, reset the element change indicator, where fitted, by depressing the button.



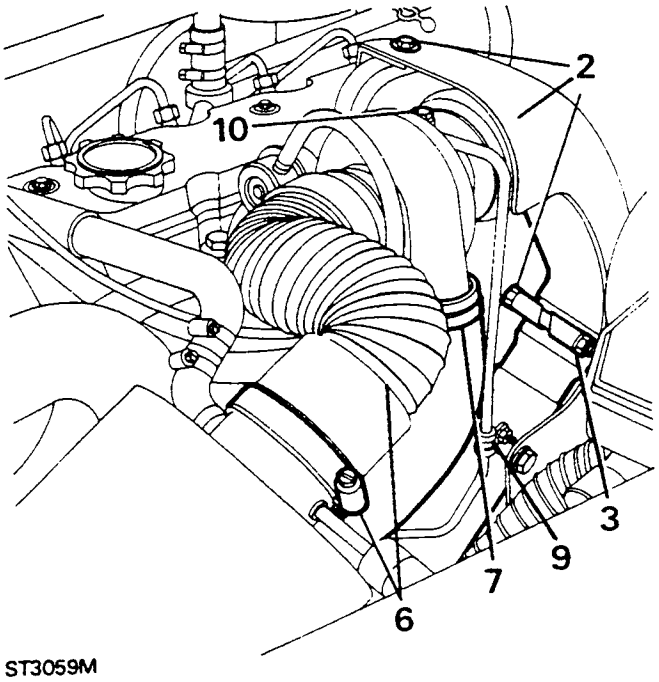
ST3036M

TURBO CHARGER

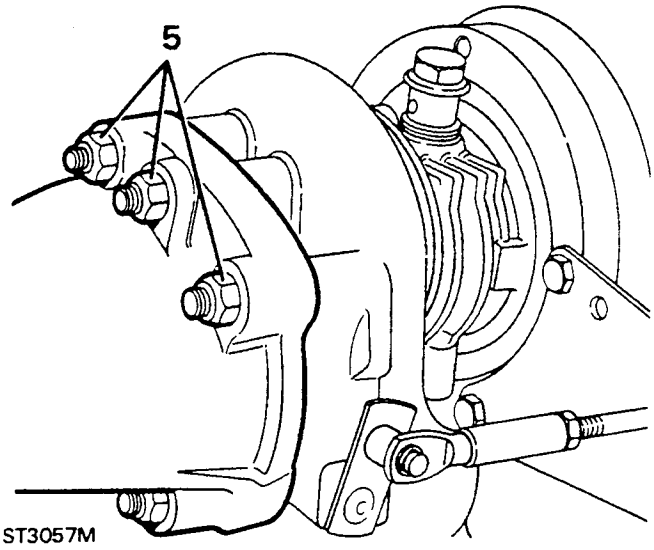
Service Repair No. 19.42.01

Remove and refit

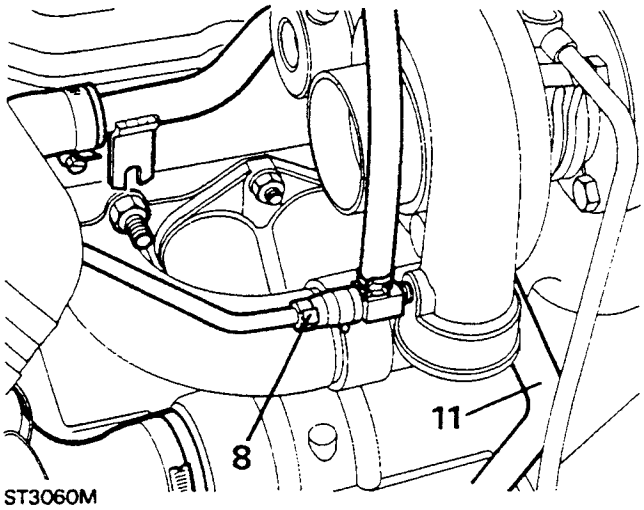
1. Remove the bonnet and disconnect the battery.
2. Remove the turbo charger heat shield.
3. Disconnect the exhaust front pipe from the turbo charger elbow.
4. Release the front exhaust pipe from the support bracket attached to the cylinder block.
5. Remove the five nuts and remove the elbow from the turbo charger.
6. Remove the air inlet hose from the air cleaner and turbo charger.
7. Disconnect, from the turbo charger, the bottom hose from the intercooler.
8. Remove the boost pressure pipe from the turbo "T" piece.
9. Slacken the turbo charger oil feed pipe clamp.
10. Disconnect the oil supply pipe from the turbo charger centre housing.
11. Release the oil return drain pipe from the turbo charger.
12. Remove the four nuts and lift the turbo charger from the exhaust manifold and retrieve the steel joint washer.



ST3059M



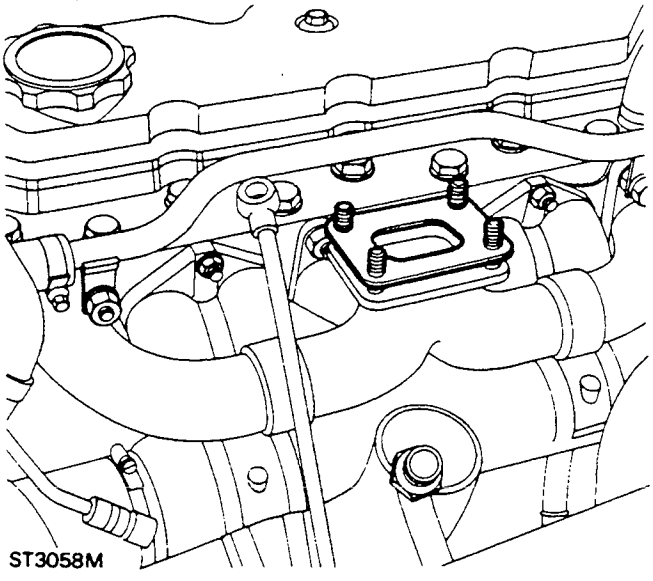
ST3057M



ST3060M

Refitting

13. Fit the steel joint washer to the to the exhaust manifold


ST3058M

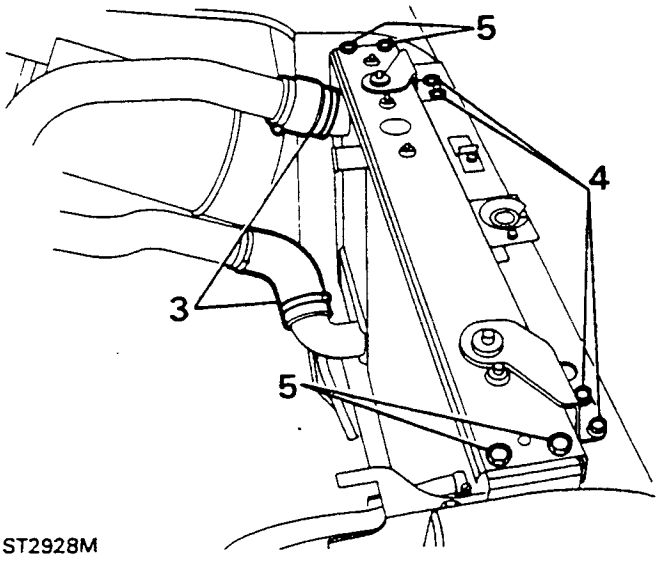
14. Fit the turbo charger and secure with the four nuts and tighten evenly to the correct torque.
15. connect the oil feed and return pipes to the turbo charger and tighten the feed pipe clamp.
16. Connect the boost pressure pipe to the "T" piece and secure with the clip.
17. Connect the intercooler hose to the turbo inlet.
18. Fit the hose to air cleaner and turbo charger.
19. Fit the turbo charger elbow.
20. Connect the exhaust front pipe to the elbow using Holts "Firegum" to seal the joint.
21. Fit the heat shield and secure at the two fixing points.
22. Fit the bonnet and connect the battery.

INTERCOOLER

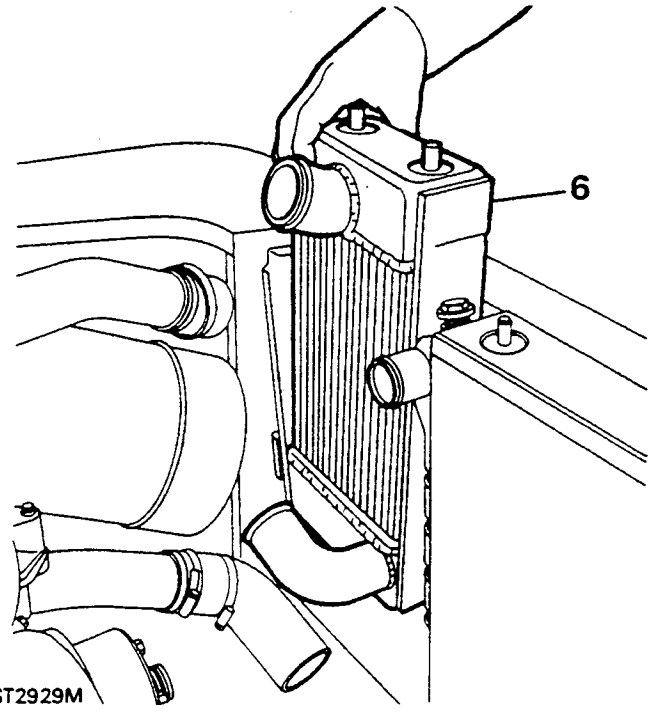
Service Repair No. 19.42.15

Remove, clean and refit.

1. Remove the fan and viscous coupling assembly, see operation 26.25.19.
2. Remove the fan cowl, see operation 26.25.11.
3. Disconnect the top and bottom hoses from the Intercooler.
4. Remove the four bolts (two each side) retaining the radiator top support brackets.
5. Remove the four bolts (two each end) securing the radiator surround top panel, and remove the panel.
6. Lift out the Intercooler.



ST2928M



ST2929M

Cleaning.

7. Flush the intercooler with ICI "GENKLENE" propriety cleaner, following the manufacturers instructions.
8. Dry the Intercooler completely ensuring that no liquid remains in the element.

Refitting.

9. Slide the Intercooler into position taking care not to damage the insulation material on the sides.
10. Fit the radiator surround top panel and secure with the four bolts.
11. Fit the two top brackets and secure with the four bolts.
12. Connect the top and bottom hoses.
13. Fit the fan cowl.
14. Fit the fan and coupling assembly.

COOLING SYSTEM

Engine protection

To prevent corrosion of 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 rain water or distilled water, with anti- freeze added.

Use only Universal anti-freeze or permanent type ethylene base, without methanol, containing, a suitable inhibitor for aluminiium engine parts. Use one part of anti-freeze to one part water. Anti-freeze should be used even in climates where it is not necessary.

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.

Land Rovers leaving the factory have the cooling system filled with a 50% anti- freeze mixture. This gives protection down to minus 47 degrees Centigrade (minus 53 degrees Fahrenheit).

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.

Service Repair No. 26.10.01

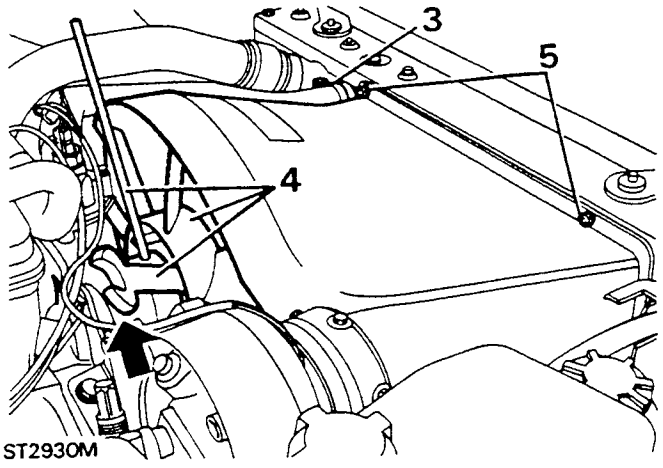
Drain and refil

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

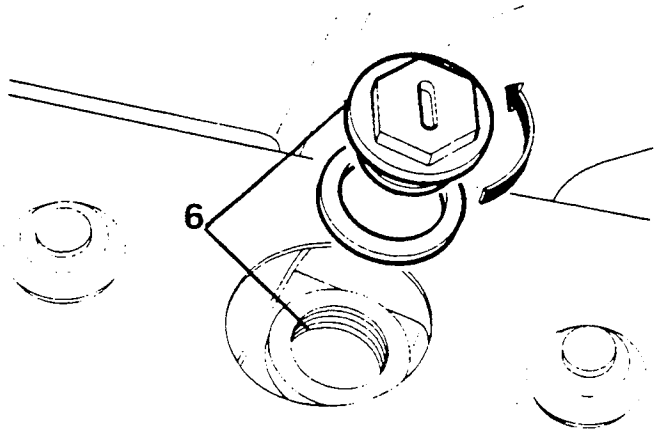
1. Disconnect the battery.
2. Disconnect the bottom coolant hose from the radiator. Allow to drain and reconnect the hose.
3. To drain the cylinder block, remove the drain plug which is situated on the left hand side of the engine immediately below front core plug. Refit the plug, with a new washer, when the draining is completed.
4. To drain the expansion tank, remove the cap and disconnect the expansion hose from the radiator and allow it to drain into a suitable container. Flush the tank with clean water and reconnect the hose.

Refilling.

5. Make up a solution of anti-freeze and water in a separate container in the concentration required. To allow for topping-up, and for filling the expansion tank, prepare a quantity in excess of the cooling system capacity.
6. Remove the radiator filler cap and fill the radiator until the coolant level is just below the filler neck and refit the cap.
7. Fill the expansion tank to approximately half full and refit the cap.
8. Connect the battery and run the engine until normal operating temperature is attained. Allow the engine to cool completely and removethe radiator and expansion tank caps. If necessary, top-up the the radiator to just below the filler neck. Top-up the expansion tank to about half full. Fit both filler caps.



ST2930M



ST3032M

FAN COWL

Service Repair No. 26.25.11

Remove and refit.

1. Follow instructions 1 to 7 operation 26.25.19.
2. Remove the cowl from the engine compartment.

Refitting.

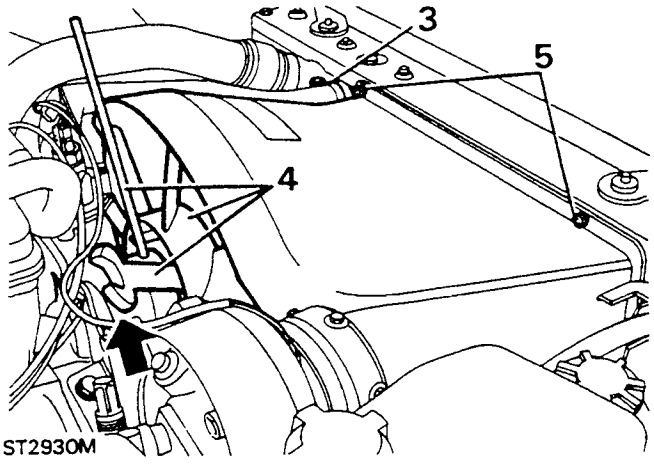
3. Reverse instructions 1 and 2.

FAN AND COUPLING ASSEMBLY

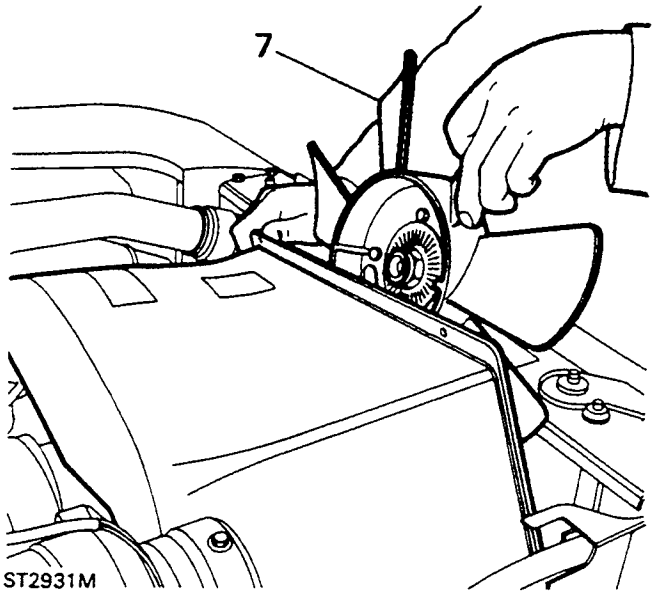
Service Repair No. 26.25.19

Remove and refit.

1. Disconnect the battery for safety reasons.
2. Drain the coolant by disconnecting the radiator bottom hose and reconnect when coolant has drained.
3. Remove the top hose.
4. Using a cranked open ended spanner and a restraining bar in the hole in the pulley hub, release anti-clockwise, the viscous coupling from the water pump spindle. Lower the fan and coupling assembly into the base of the cowl.
5. Remove the two nuts securing the cowl to the radiator.



6. Lift the cowl to release it from its lower location.
7. Move the cowl forward, towards the engine and withdraw the fan and coupling assembly from the gap created between the cowl and radiator.



Refitting

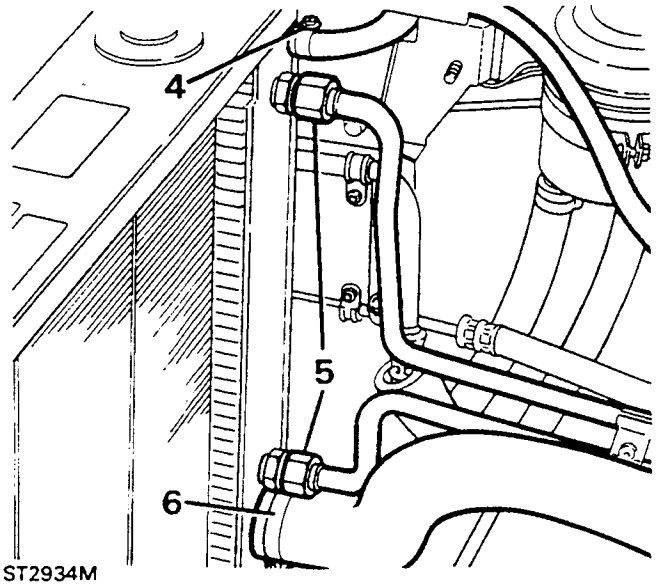
8. Insert the fan and coupling into the base of the cowl reversing the removal procedure.
9. Fit the coupling to the water pump spindle noting that it has a left hand thread. Tighten the coupling using the restraining bar and cranked spanner.
10. Fit the cowl and secure with the two nuts. Ensure that the cowl fits properly in its lower location.
11. Fit the top hose and refill the cooling system with the correct concentration of anti-freeze and water.
12. Connect the battery, run the engine and check for coolant leaks.

RADIATOR

Service Repair No. 26.40.01

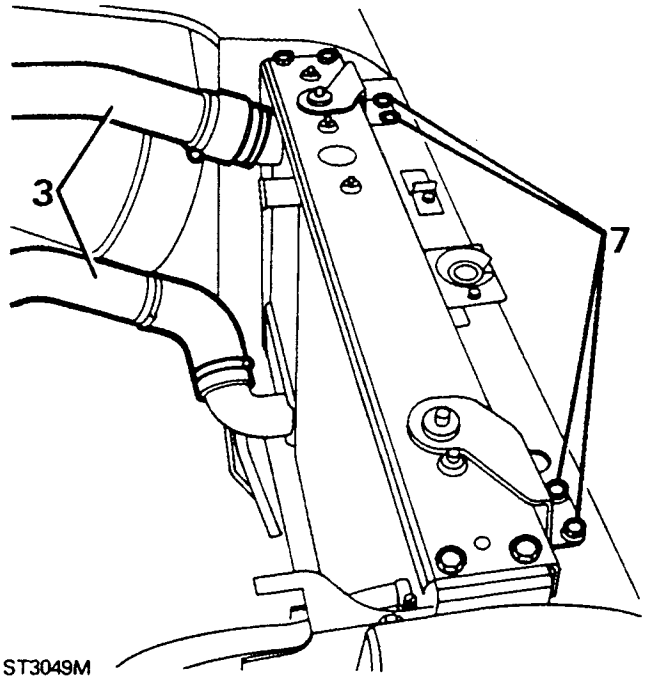
Remove and refit

1. Remove the fan and viscous coupling assembly, see operation 26.25.19.
2. Remove the fan cowl, see operation 26.25.11.
3. Disconnect the hoses from the intercooler.
4. Disconnect the expansion tank hose from the radiator.
5. Disconnect the oil cooler pipes from the radiator and cover the ends to prevent entry of dirt.
6. Disconnect the bottom hose from the radiator.



ST2934M

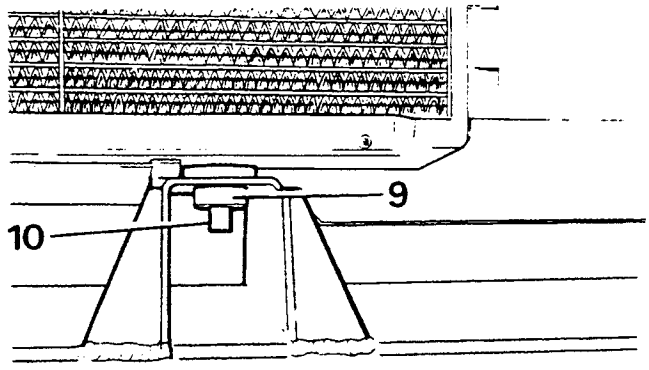
7. Remove the four bolts, two each side, retaining the radiator top securing brackets, and remove the brackets.
8. Lift out the radiator complete with the intercooler.



ST3049M

Refitting

9. Check that the rubber grommets on the radiator locating pegs and beneath the radiator mounting brackets on the chassis cross member are in position.
10. Lower the radiator into position ensuring that the pegs locate in the mounting brackets.



ST3033M

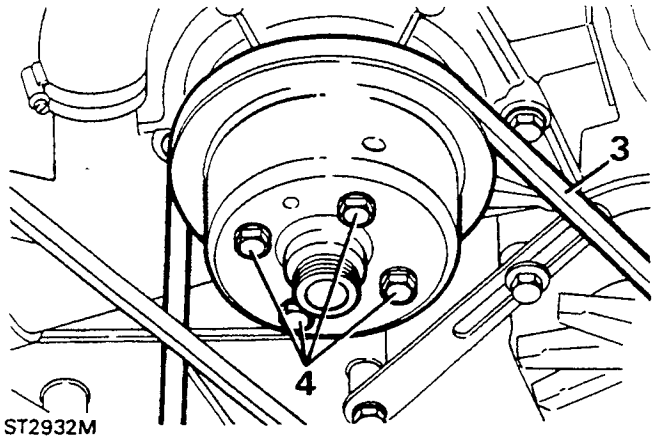
11. Fit the radiator top mounting brackets and secure with the four bolts.
12. Connect the radiator bottom hose.
13. Fit the oil cooler pipes to the radiator.
14. Connect the expansion tank hose.
15. Connect the top and bottom hoses to the intercooler.
16. Place the fan cowl in position but do not secure at this stage.
17. Fit the fan and viscous coupling and secure the cowl with the two nuts.
18. Check that all the coolant hose clips are tight and refill the cooling system with the correct concentration of water and anti-freeze, see operation 26.10.01.

WATER PUMP

Service Repair No. 26.50.01

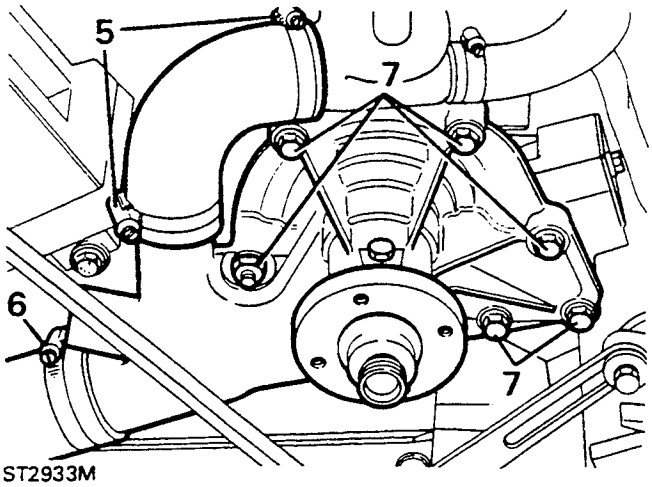
Remove and refit

1. Remove the fan and coupling assembly operation 2. 25.19.
2. Remove the fan cowl operation 26.25.11.
3. Slacken the fan belt tension and remove it from the pulley.
4. Remove the four bolts securing pulley to hub.



ST2932M

5. Remove the thermostat housing to water pump hose.
6. Disconnect the bottom hose from the water pump.
7. Remove the six bolts and one nut securing the water pump to the front cover plate.
8. Remove the water pump and gasket.



ST2933M

Refitting

9. Clean the water pump and front cover plate mating faces.
10. Lightly grease a new gasket and place in position on the cover plate.
11. Clean the threads of the water pump retaining bolts and apply Loctite 572 thread lubricant sealant to the threads of all the bolts.
12. Fit the pump to the engine and secure with the six bolts and one nut in accordance with the chart below. Tighten the fixings evenly and to the correct torque.
13. Connect the bottom hose to the water pump.
14. Fit the pulley to the water pump hub and secure with the four bolts.
15. Fit and tension the water pump/alternator belt.
16. Fit the fan cowl.
17. Fit the fan and coupling assembly.
18. Check that all the coolant hose clips are tight and refill the cooling system with the correct concentration of water and anti-freeze, see operation 26.10.01.
19. Connect the battery, run the engine and check for coolant leaks.

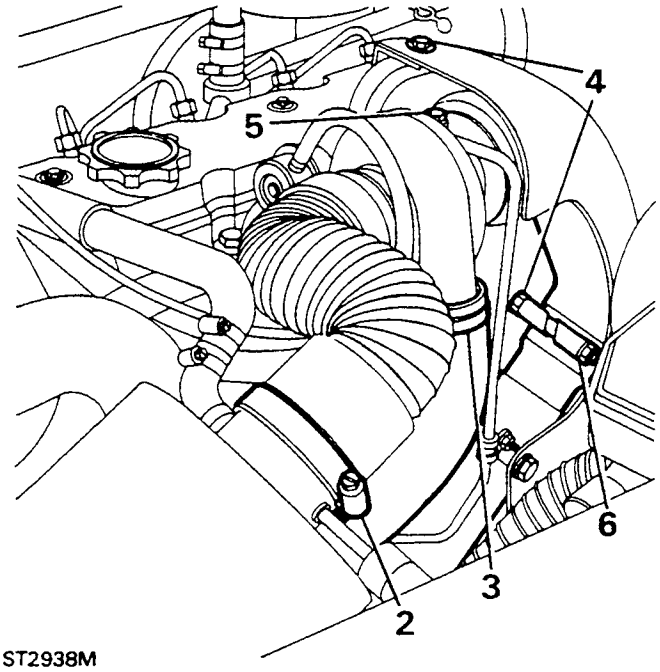
EXHAUST AND INLET MANIFOLDS

Service Repair No. 30.15.01

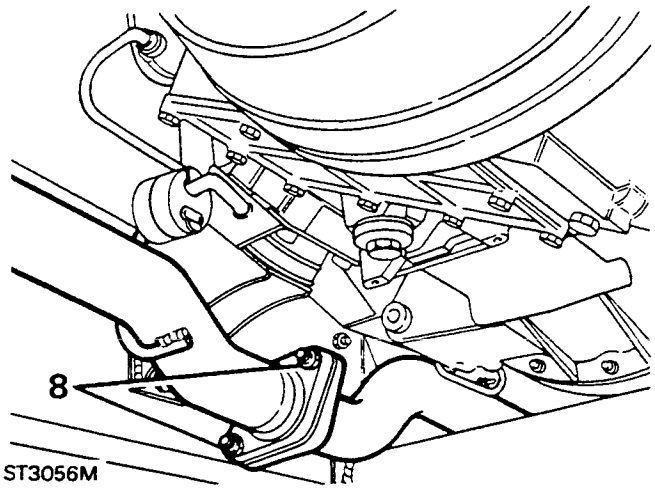
Remove and refit

Note: to remove the inlet manifold, the exhaust mainifold must be removed first.

1. Disconnect the battery.
2. Remove the air cleaner to turbo charger inlet hose from the turbo charger.
3. Disconnect hose from turbo charger to intercooler.
4. Remove the turbo charger heat shield.
5. Disconnect from the turbo charger, the oil feed pipe.
6. Disconnect the front exhaust pipe from the turbo charger elbow.

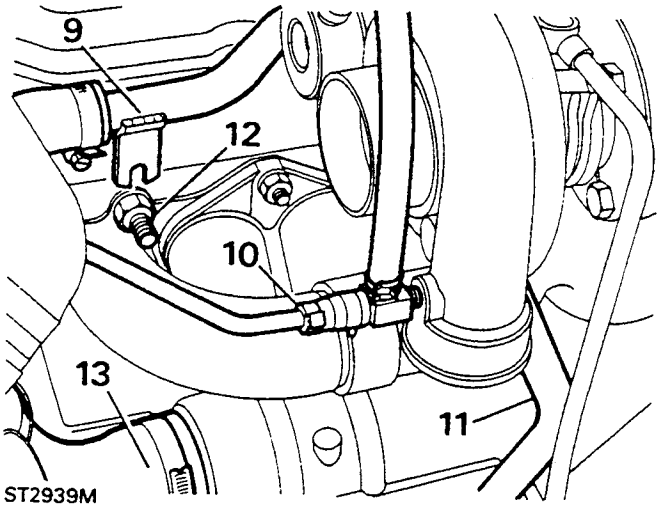


ST2938M



ST3056M

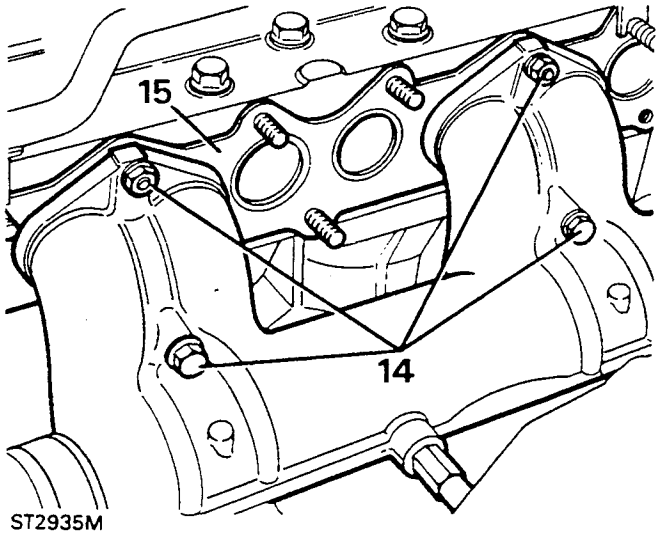
7. Release the front exhaust pipe bracket from the cylinder block.
8. Disconnect the front exhaust pipe from the forward silencer pipe.
9. Release the heater rail from the exhaust manifold studs.
10. Disconnect the boost pressure pipe from the turbo charger.
11. Disconnect the turbo charger oil drain pipe from the cylinder block.
12. Remove the exhaust mainfold nuts and withdraw the manifold complete with the turbo charger.



ST2939M

Inlet manifold

13. Disconnect hose from inlet manifold
14. Remove the two bolts and two nuts and withdraw the inlet manifold.
15. Remove the common gasket.



ST2935M

Continued

Refittng

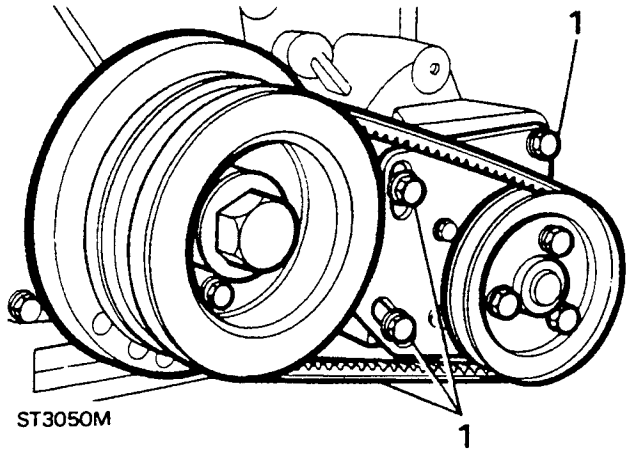
15. Place a new gasket in position and fit the inlet manifold and secure with the two bolts and two nuts and tighten to the correct torque.
16. Fit the exhaust manifold complete with turbo charger and secure with the nuts.
17. Fit the heater rail to the manifold studs.
18. Connect the turbo charger oil drain pipe to the cylinder block.
19. Connect the boost pressure pipe to the turbo charger.
20. Using "HOLTS" "FIRE GUM" fit the front exhaust pipe to the turbo charger elbow and secure with the clamp. Note, before fitting the pipe to the elbow make sure that the securing clamp is above the inlet manifold since the clip will not pass between the front pipe and manifold.
21. Connect the front pipe to the forward silencer.
22. Fit the front pipe support bracket to the cylinder block with the single bolt.
23. Connect the turbo charger oil feed pipe.
24. Fit the intercooler to turbo charger hose.
25. Fit the air cleaner to turbo charger hose.
26. Fit the turbo charge heat shield.
27. Connect the battery, run the engine and check for exhaust gas leaks.

POWER STEERING PUMP

Service Repair No. 57.20.14

Remove and refit

1. Working from beneath the vehicle, release the drive belt tension by slackening the two adjustment clamp bolts and the single pivot bolt and remove the belt.



ST3050M

2. Disconnect from the pump, the supply hose from the fluid reservoir and drain into a suitable container.
3. Remove the banjo union bolt from the rear of the pump and allow fluid to drain into a container.
4. Remove the three bolts slackened in instruction 1 and remove the pump complete with adjustment plate and pulley.
5. Remove the four bolts to release the drive pulley from the pump hub.
6. Since the adjustment plate can be fitted in more than one position on the pump, mark the relationship of the pump to the plate before removing the four attachment bolts.

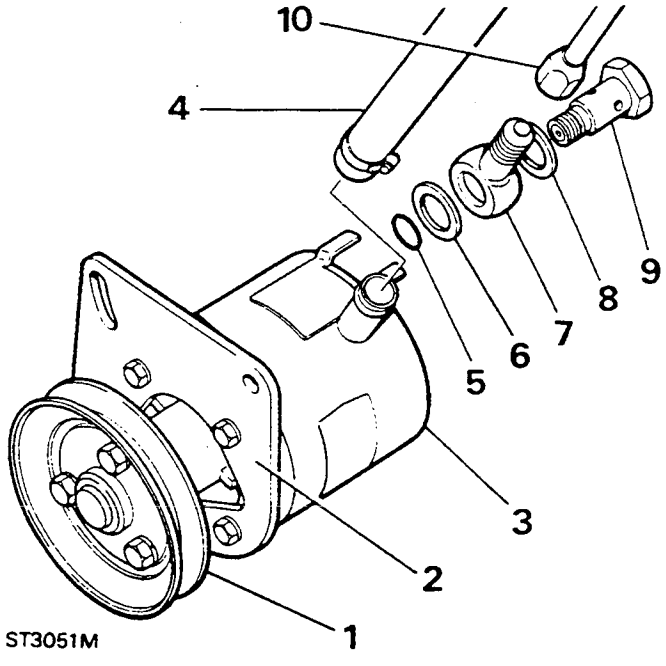
Refitting

7. Fit the adjustment plate to the pump aligning the marks made when dismantling and secure with the four bolts.
8. Fit the drive pulley and retain with the four screw.
9. Fit the pump and adjustment plate to the engine bracket and loosely secure with the pivot bolt and two adjustment clamp bolts.
10. Fit the drive belt and lever the pump away from the engine to tension the belt and tighten the two clamp bolts and single pivot bolt. The belt is correctly tensioned when, at the mid-point of its run it can be deflected by thumb pressure 12mm (. 5ins.)

CAUTION: Do not apply any pressure against the pump casing when tensioning the drive belt since it will damage the casing permanently, beyond repair.

11. Connect the fluid hose and secure with the clip.
12. Fit the banjo bolt ensuring that a special steel washer is fitted each side of the banjo.
13. Top up the fluid reservoir with the correct make and grade of fluid, see section 09.
14. Run the engine and turn the steering from lock to lock. Re-check the fluid level and the drive belt tension. Also examine for fluid leaks.

1. Pulley
2. Adjustment plate
3. Pump
4. Inlet hose
5. 'O' rings
6. Washer(special)
7. Banjo
8. Washer(special)
9. bolt
10. Union nut



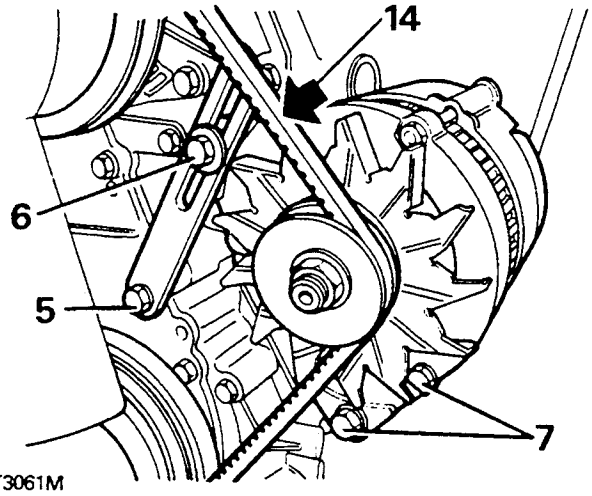
ST3051M

ALTERNATOR

Service Repair No. 86.10.02

Remove and refit

1. Disconnect the battery.
2. Remove the air cleaner, see operation 19.10.01.
3. Remove the intercooler top hose assembly to the inlet manifold.
4. Remove the intercooler bottom hose assembly to the compressor housing.
5. Slacken the adjustment strap pivot bolt.
6. Remove the adjustment strap clamp bolt.
7. Remove the alternator two pivot bolts.
8. Release the drive belt from the alternator pulley. Note, to renew the drive belt, the power assisted steering pump and air conditioning compressor drive belts must first be removed.
9. Disconnect the electrical leads and remove the alternator.

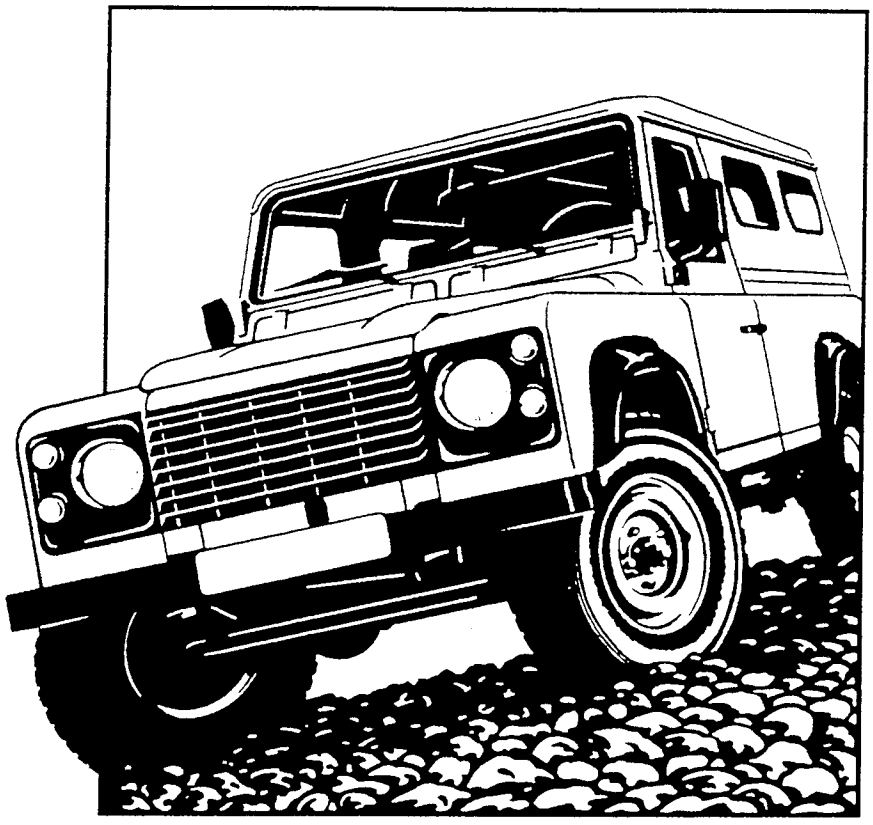


ST3061M

Refitting

10. Connect the electrical leads to the alternator before placing it in position on the common bracket.
11. Secure the alternator with the two pivot bolts and nuts, but leave slack at this stage.
12. Fit the adjustment strap clamp bolt and leave slack.
13. Fit the drive belt to the pulleys.
14. Tension the drive belt by levering the alternator away from the engine, taking care not to damage the alternator, and then tighten the adjustment strap clamp bolt. The tension is correct when the belt can be deflected 12mm (0.5ins.) at the the mid-point of the longest run between the pulleys.
15. Tighten the adjustment strap pivot bolt and the alternator two pivot nuts and bolts.
17. Reconnect the battery, run the engine and recheck the fan drive belt tension.

DEFENDER 90 · 110 · 130



DEFENDER
LT77S GEARBOX

WORKSHOP MANUAL SUPPLEMENT

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SERVICE TOOLS 1

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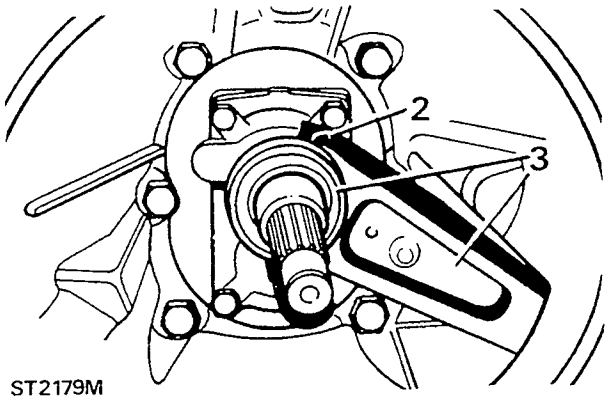
DISMANTLE

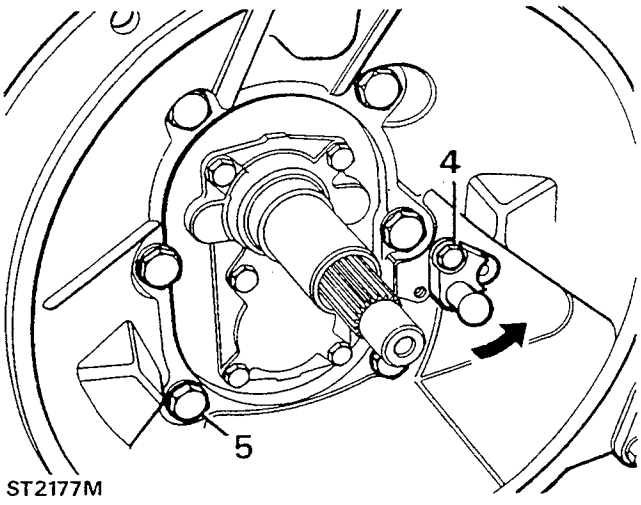
Bell housing - four cylinder engine

1. Remove transfer box, drain oil and clean exterior.
2. If fitted, clutch release bearing clip.
3. Remove clutch release assembly.



ST2179M

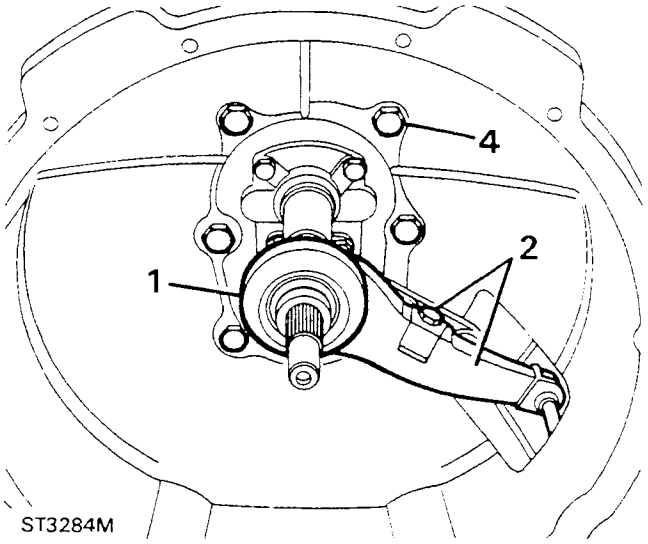
4. Remove one pivot post bolt, slacken the other and move post aside.
5. Remove six bolts and withdraw bell housing.



ST2177M

Bell housing - V8 engine

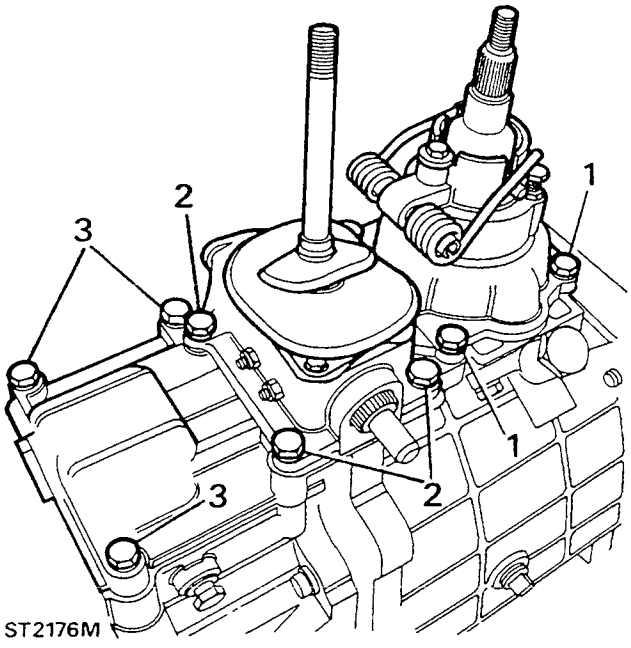
1. Remove clutch release bearing.
2. Remove screw and spring clip and remove release lever.
3. Remove "C" clip from pivot post.
4. Remove six bolts and bell housing.



ST3284M

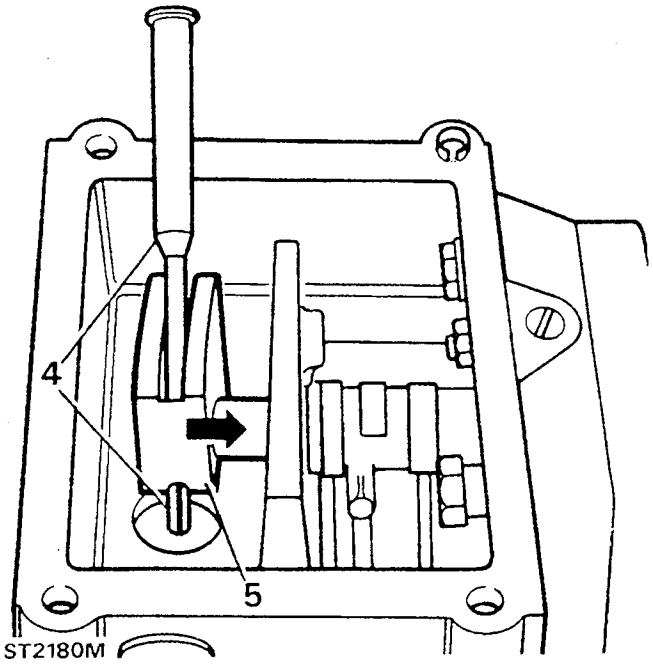
GEAR SELECTOR HOUSING

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



ST2176M

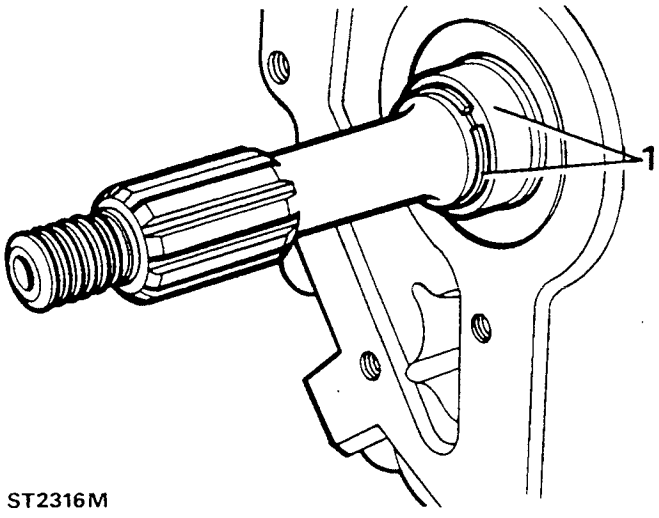
4. Drive out quadrant roll pin.
5. Move selector shaft forward to remove quadrant.



ST2180M

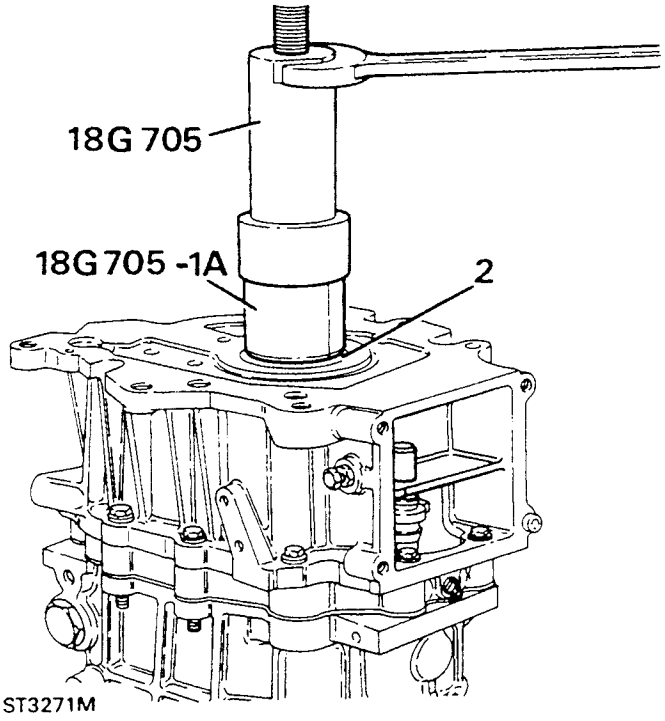
EXTENSION HOUSING

1. Remove snap ring retaining oil seal collar.



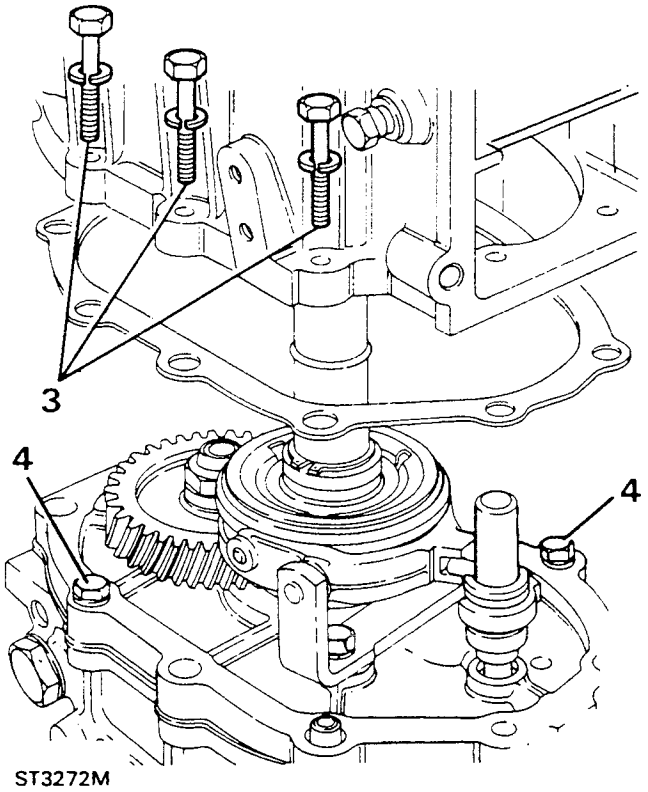
ST2316M

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



ST3271M

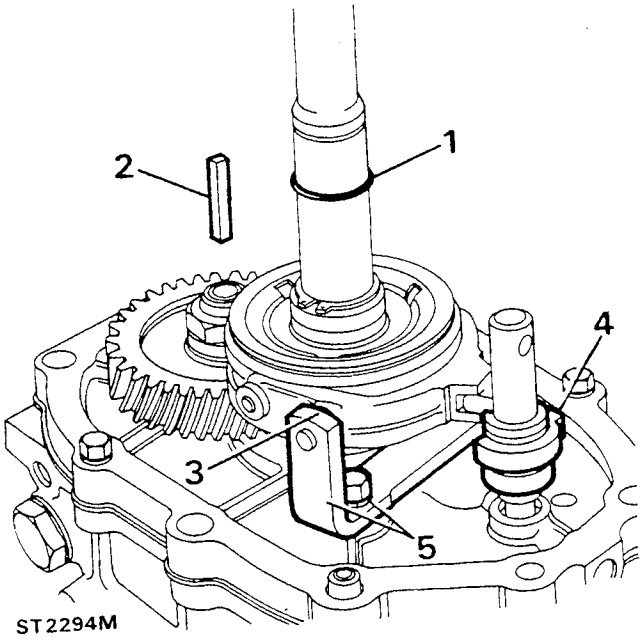
3. Remove the fifth gear extension housing.
4. Secure the centre plate to the gearcase with two 8 x 35mm bolts.



ST3272M

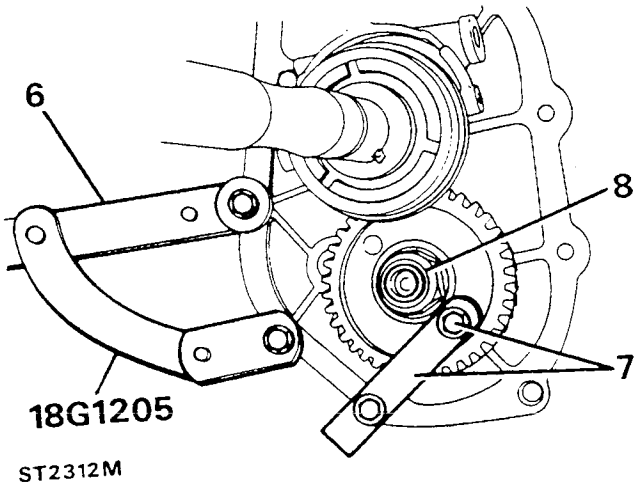
MAINSHAFT AND LAYSHAFT FIFTH GEARS

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

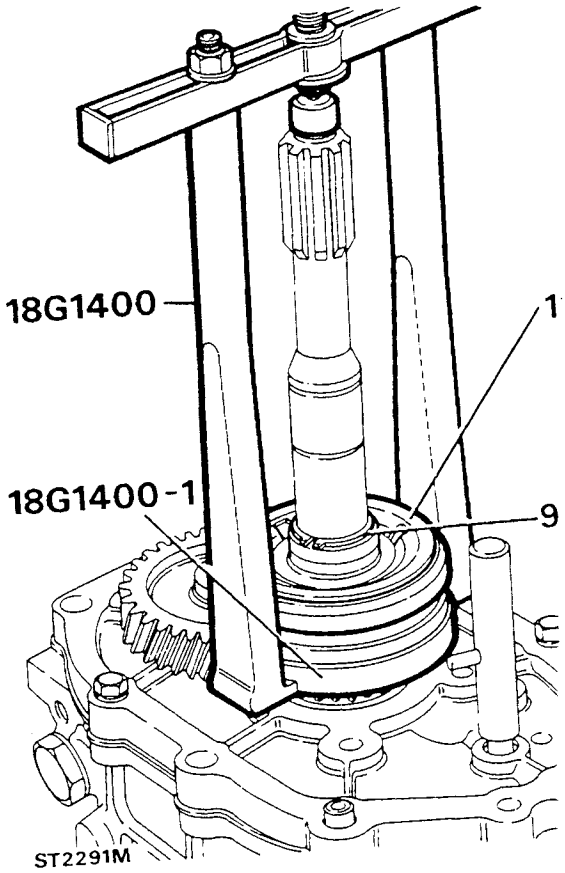
6. Locate flange holder tool 18G 1205.
7. Fit manufactured tool "A" and spacer to restrain layshaft fifth gear.
8. De-stake and remove fifth gear nut.



ST2312M

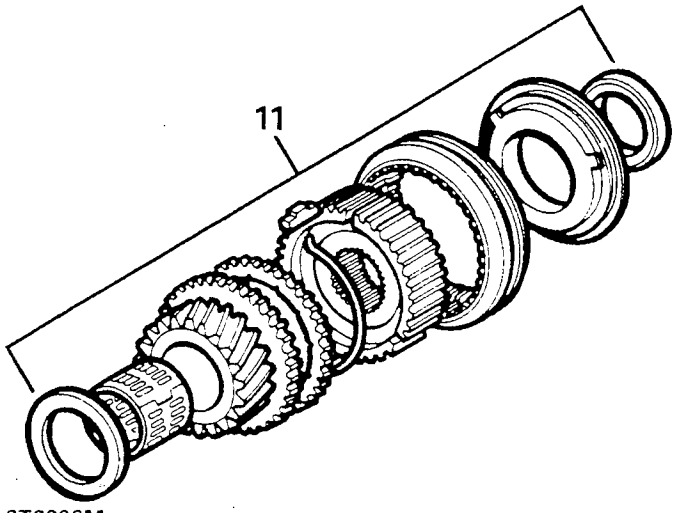
9. Remove circlip retaining mainshaft fifth gear synchromesh.
10. Fit special tool 18G 1400-1 and 18G 1400 as illustrated.

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



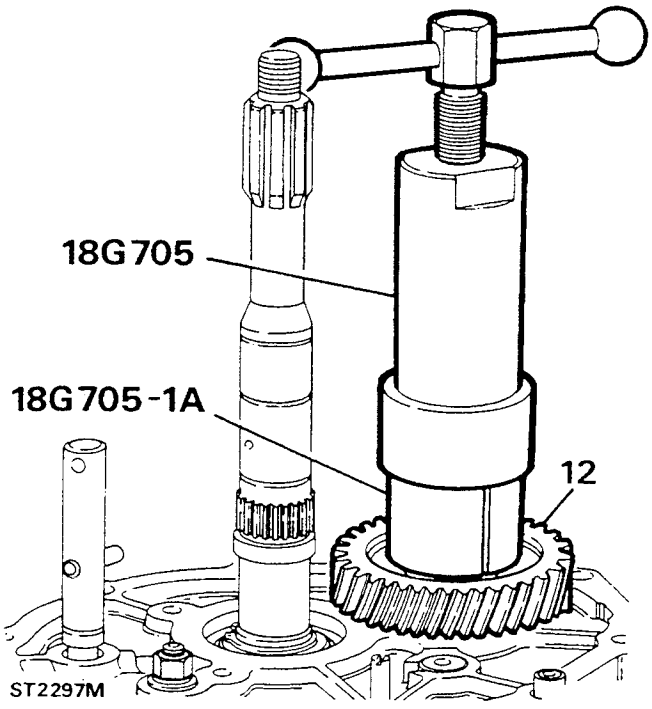
ST2291M

11. Remove fifth gear synchromesh.

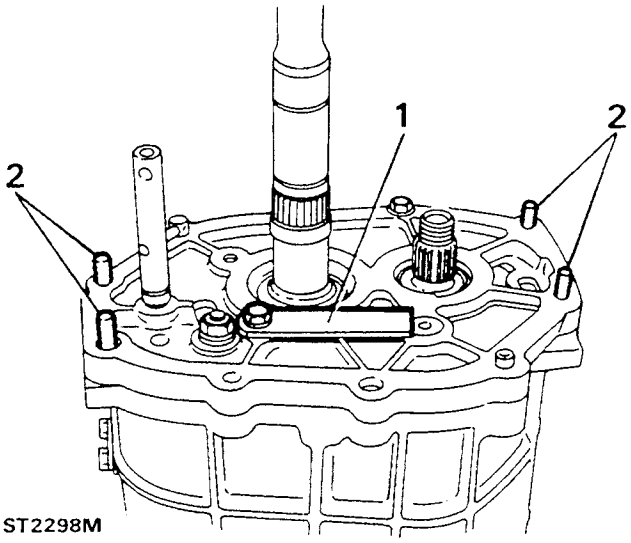


ST2296M

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

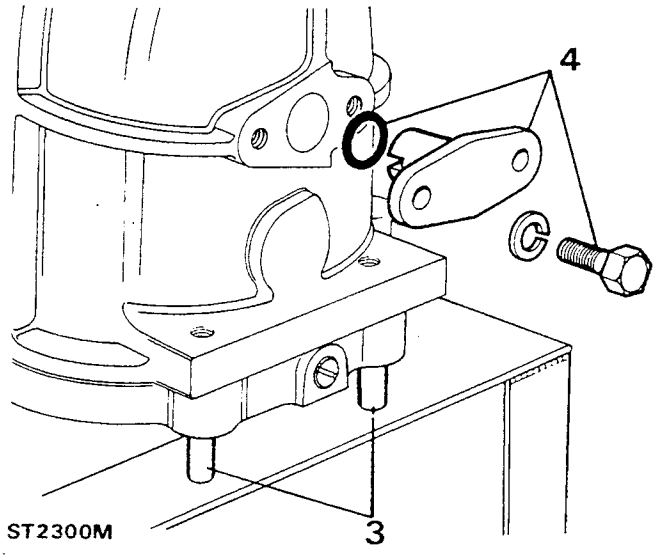


ST2297M



ST2298M

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

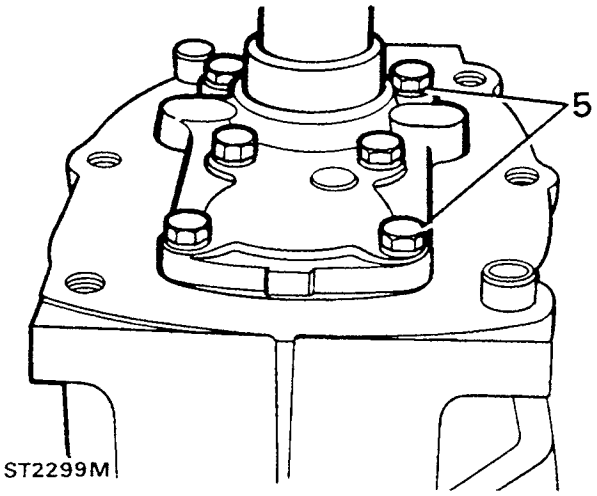


ST2300M

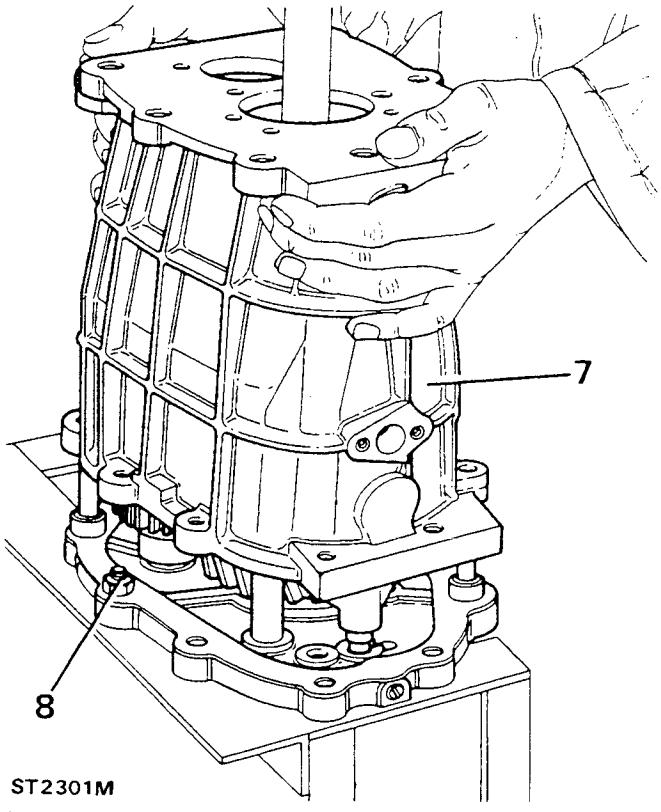
Main gear case.

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

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

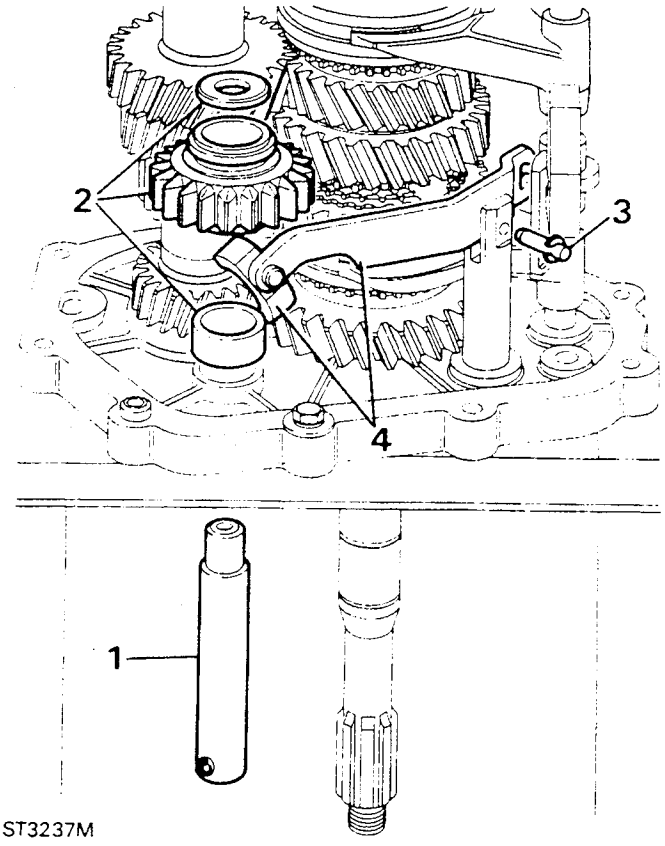


7. Remove bolts and lift-off gear case.
8. Secure centre plate with nut and bolt.

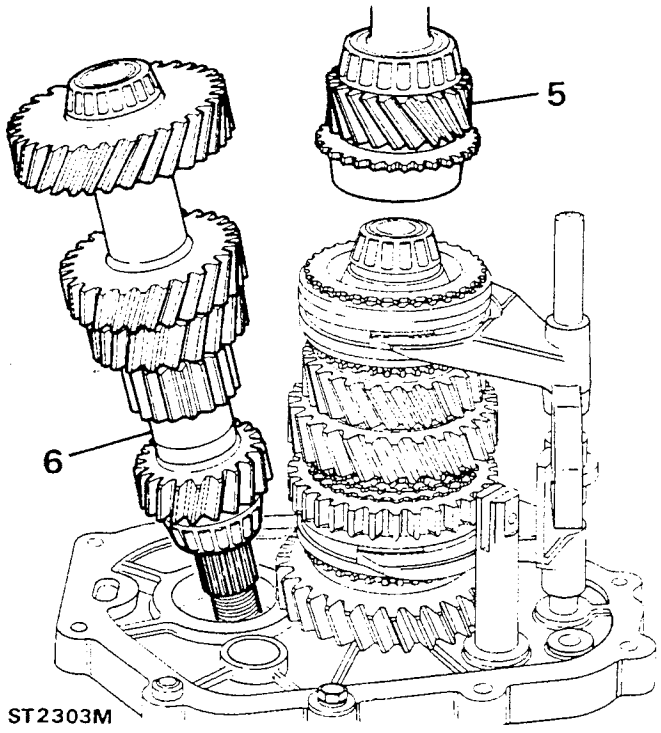


REVERSE SHAFT, LAYSHAFT AND MAINSHAFT

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.

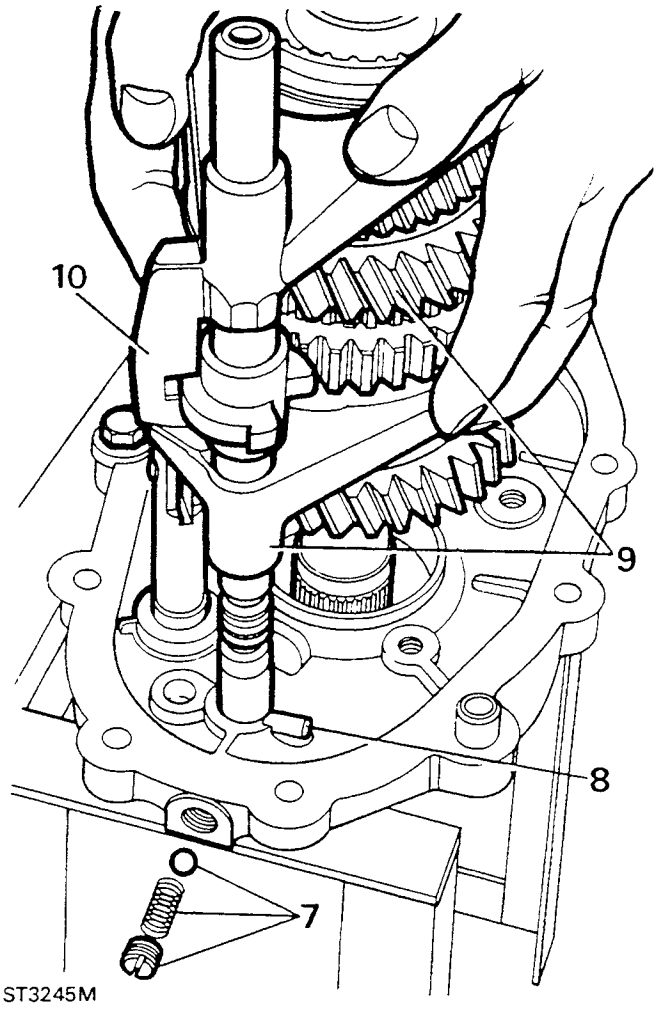


5. Remove input shaft and fourth gear baulk ring.
6. Remove layshaft by tilting, as illustrated and lifting mainshaft.



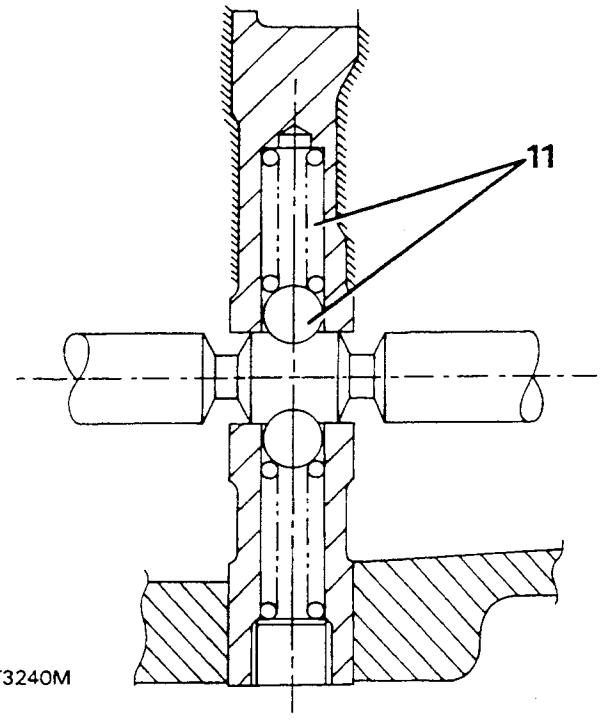
ST2303M

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.



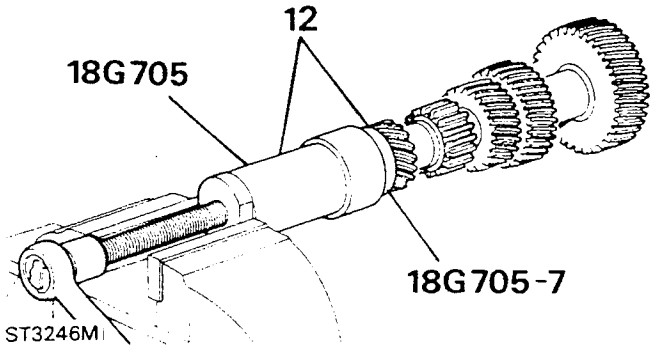
ST3245M

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



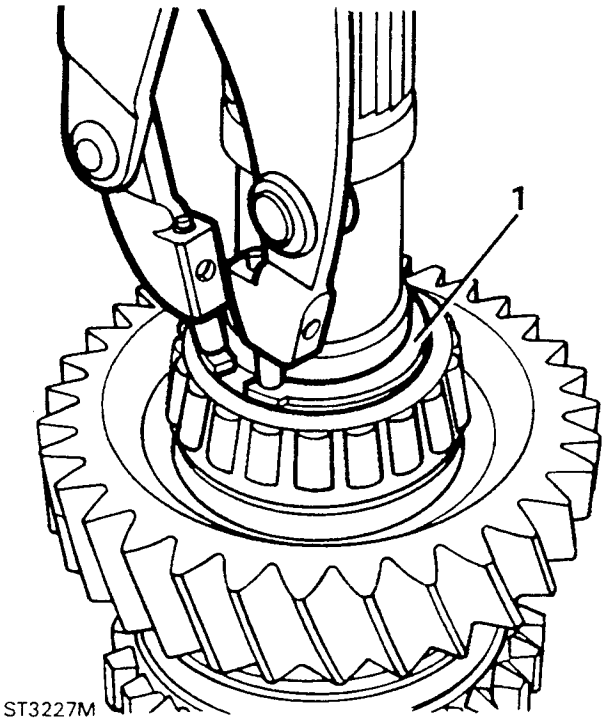
ST3240M

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

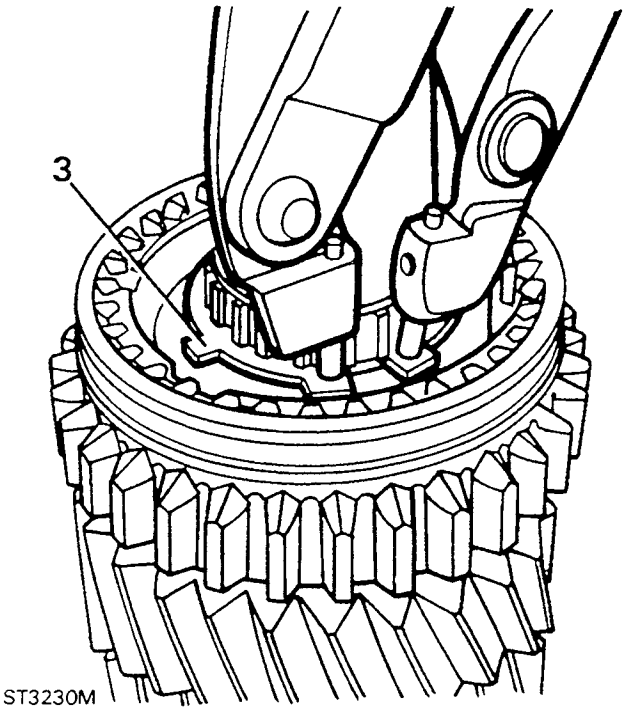


DISMANTLE MAINSHAFT

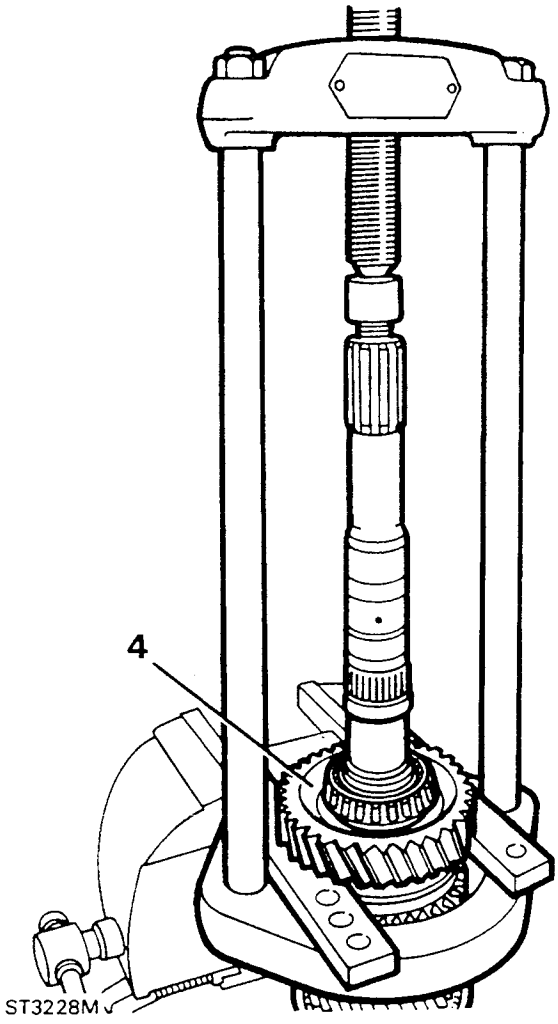
1. Remove circlip retaining first gear assembly.



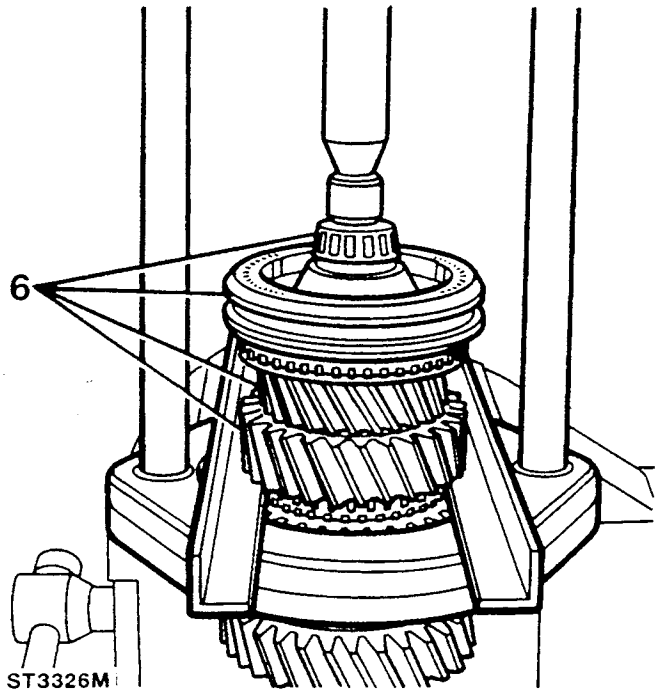
2. Remove taper bearing, bush, needle bearing, first gear spacer, cone, inner and outer baulk rings.
3. Remove circlip to release first and second gear synchromesh assembly.



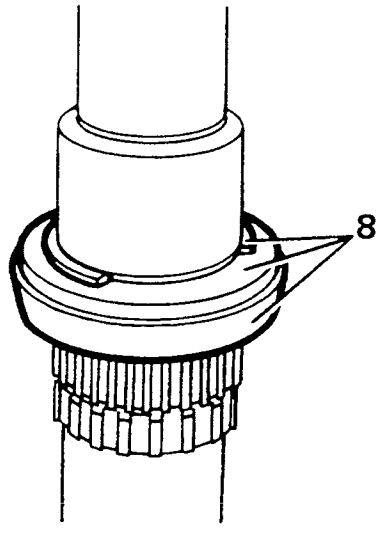
4. With MS 47 press first gear assembly from mainshaft.



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.

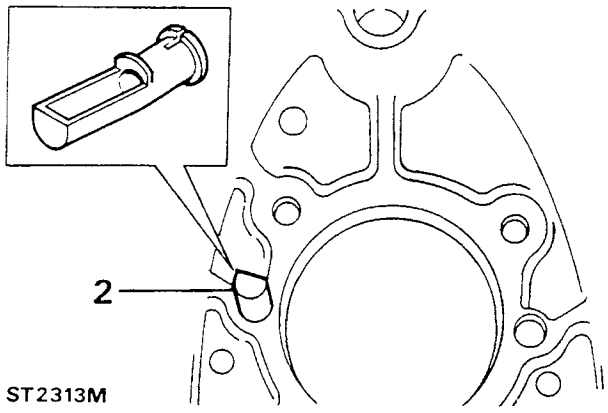


GEARBOX CASINGS AND OIL PUMP

Degrease and clean all components and discard gaskets and seals.

Gearbox casing

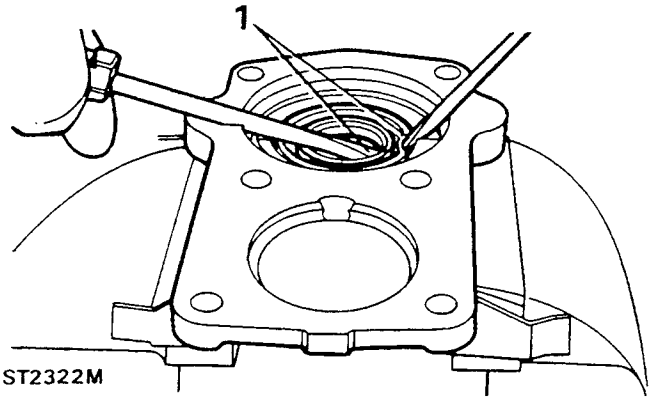
1. Remove mainshaft and layshaft bearing tracks.
2. Remove plastic scoop from inside the casing.



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

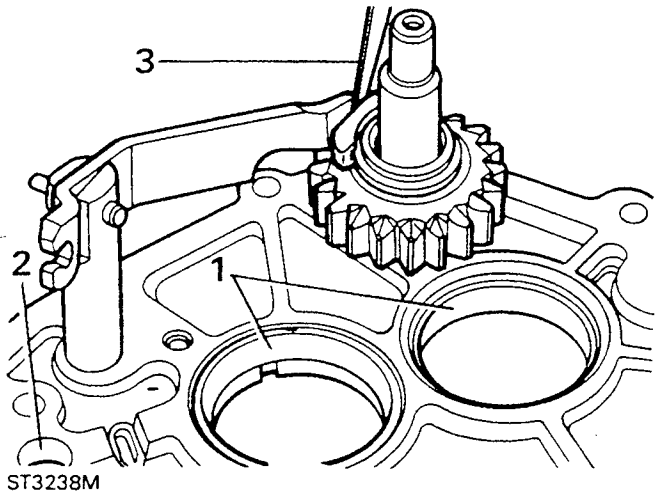
Front cover

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



Centre plate

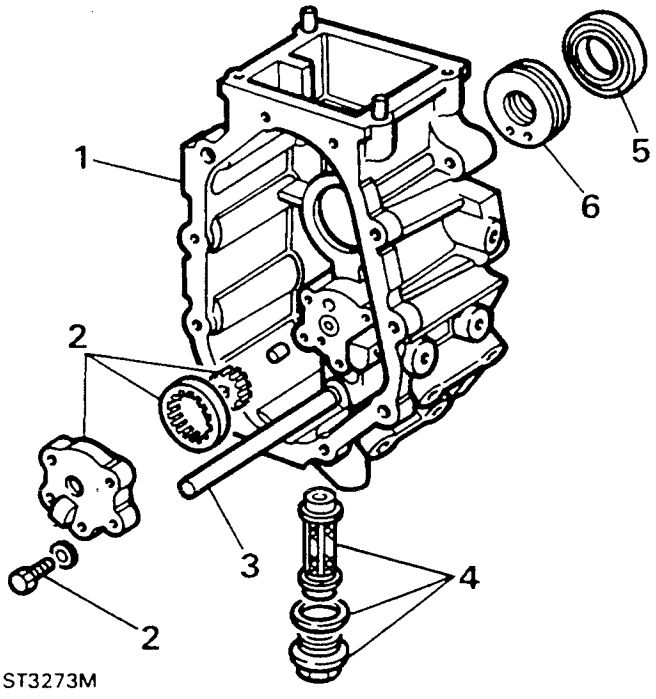
1. Remove bearing tracks.
2. Inspect for damage and selector rail bore for wear.
3. Temporally fit reverse shaft gear and lever and check clearance between slipper and lever does not exceed 0,20 mm (0.008 in).



ST3238M

Extension case

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



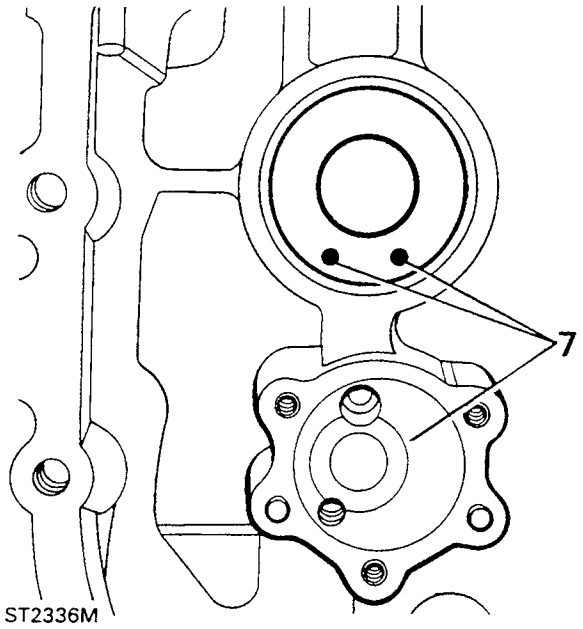
ST3273M

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 abestos. Do not attempt to clean it. ***see INTRODUCTION, Information, Poisonous substances.***

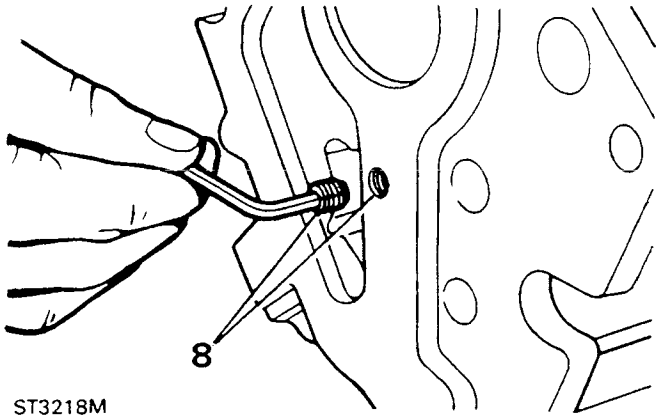
7. Fit new bush with drain holes towards bottom of casing.

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



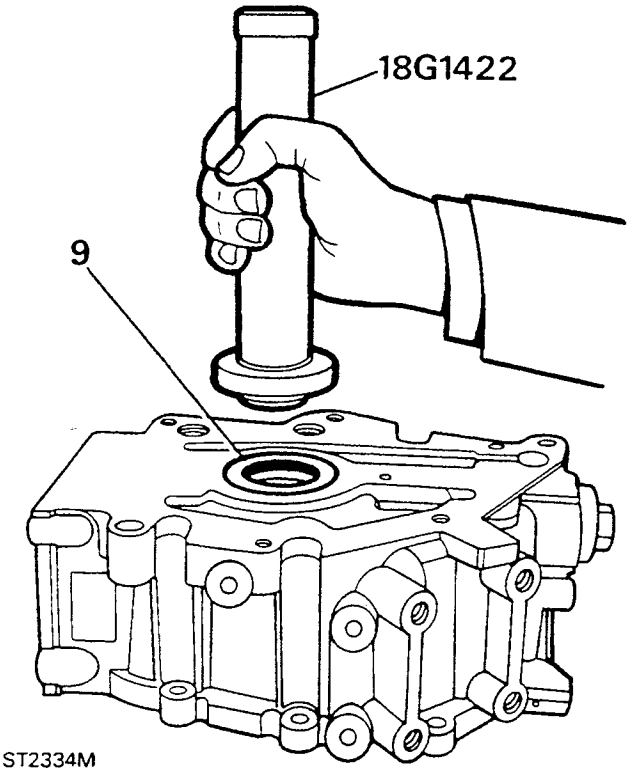
ST2336M

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



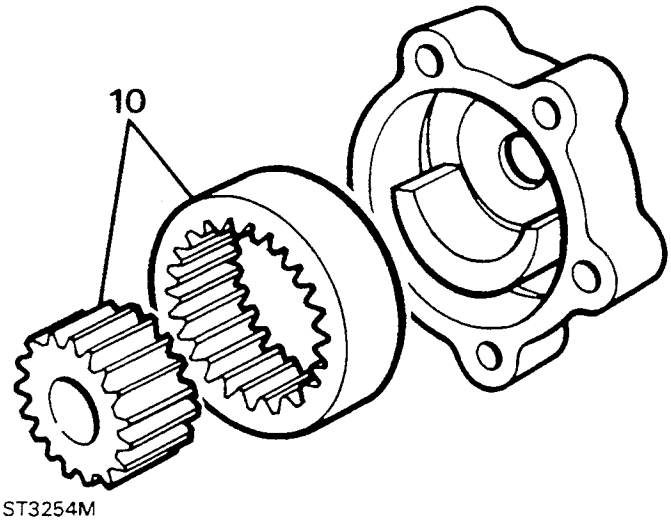
ST3218M

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



ST2334M

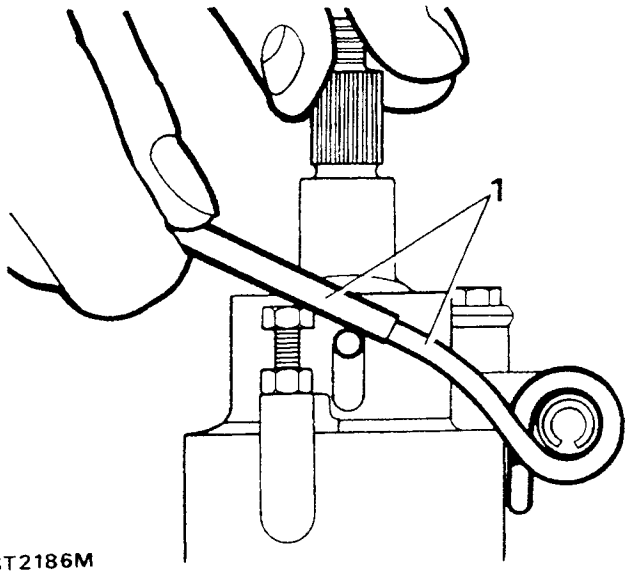
10. Assemble gears to oil pump and fit cover.



ST3254M

GEAR CHANGE HOUSING

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

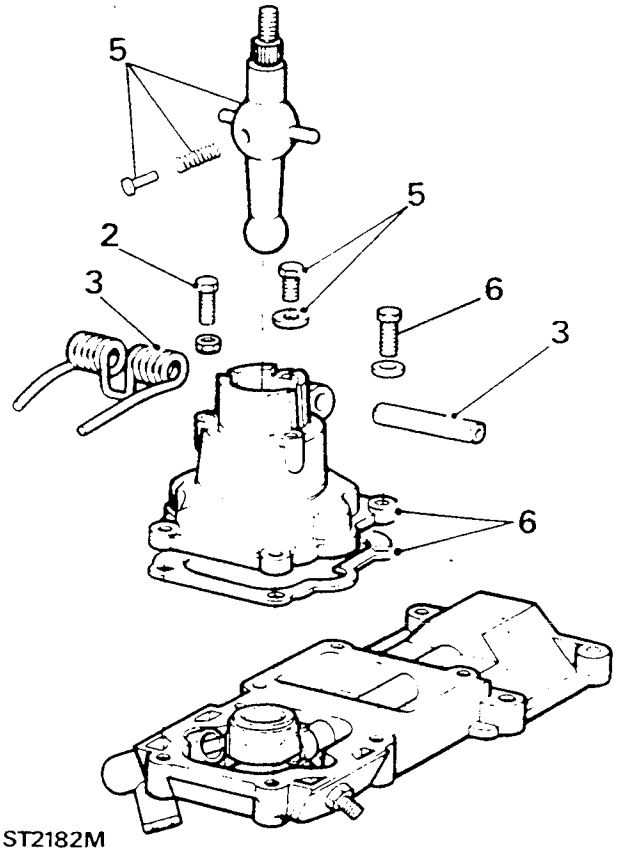


ST2186M

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.



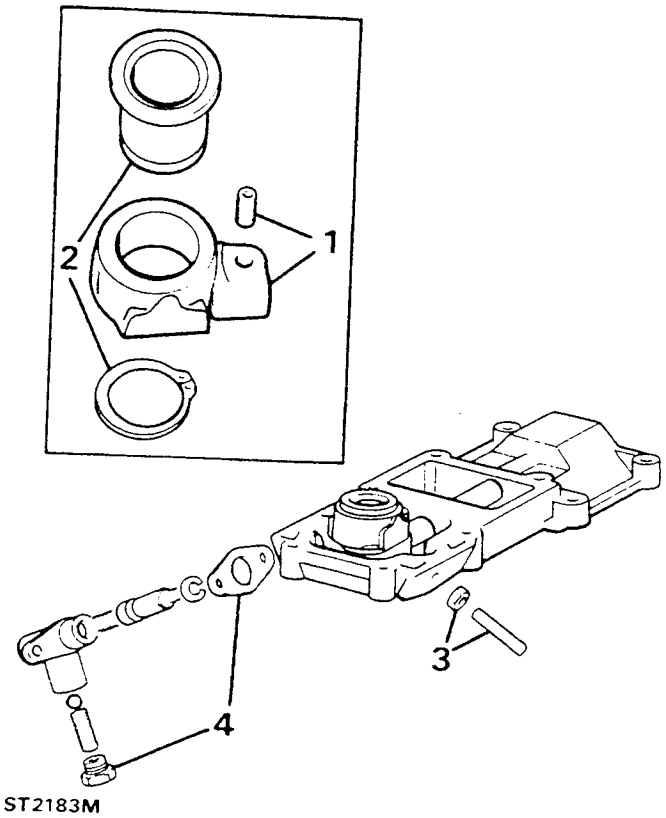
ST2182M

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.

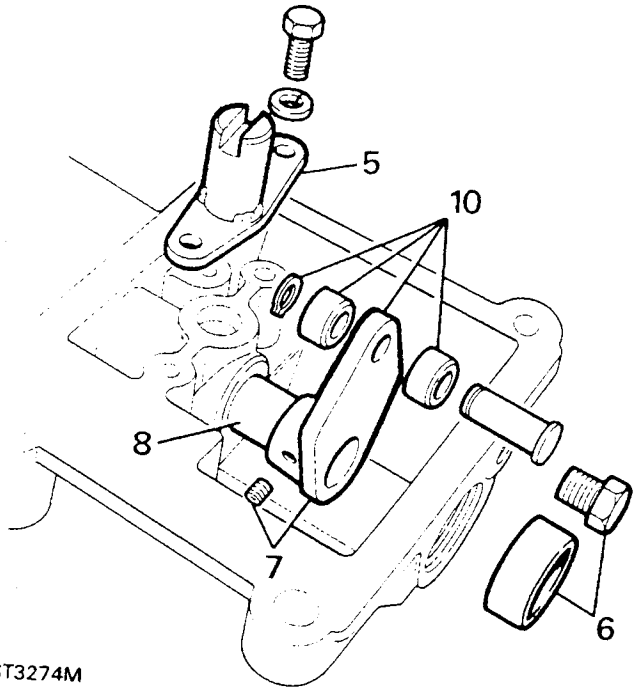
1. Release socket headed screw to remove trunnion.
2. Remove circlip to release seating from trunnion.
3. Remove fifth gear locknut and stud.
4. Remove reverse gear plunger and shim.



ST2183M

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

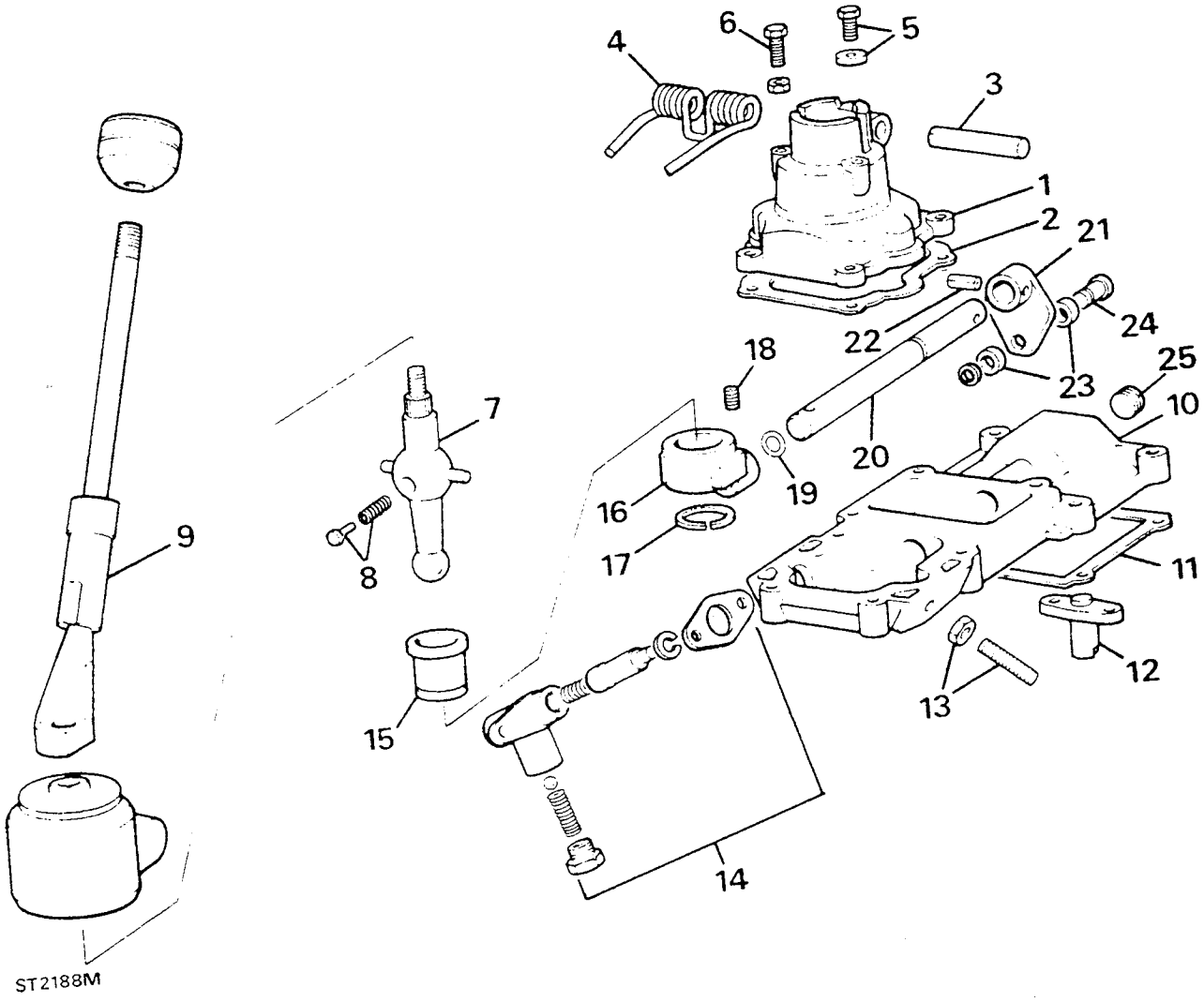
10. Remove circlip to release rollers and pin from quadrant.



ST3274M

11. Clean and examine all components and renew where necessary.
12. Assemble housing by first fitting "O" 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 bucket plug with Hylomar PL 32.
22. Fit gear selector housing to remote housing.

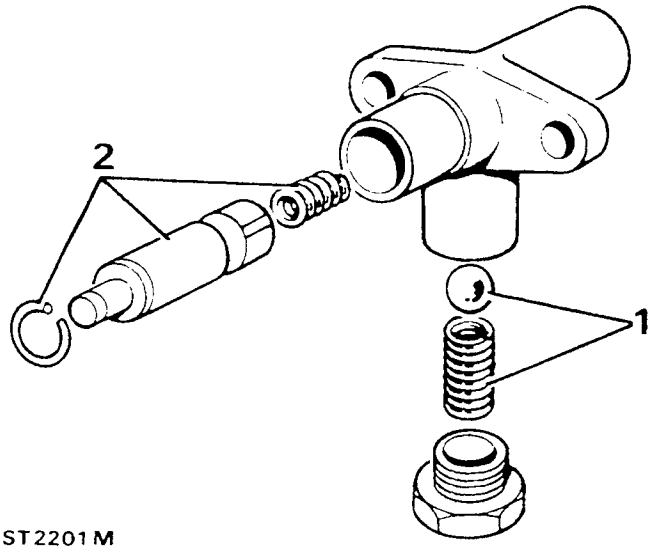
GEAR SELECTOR HOUSING



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. 'O' 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.



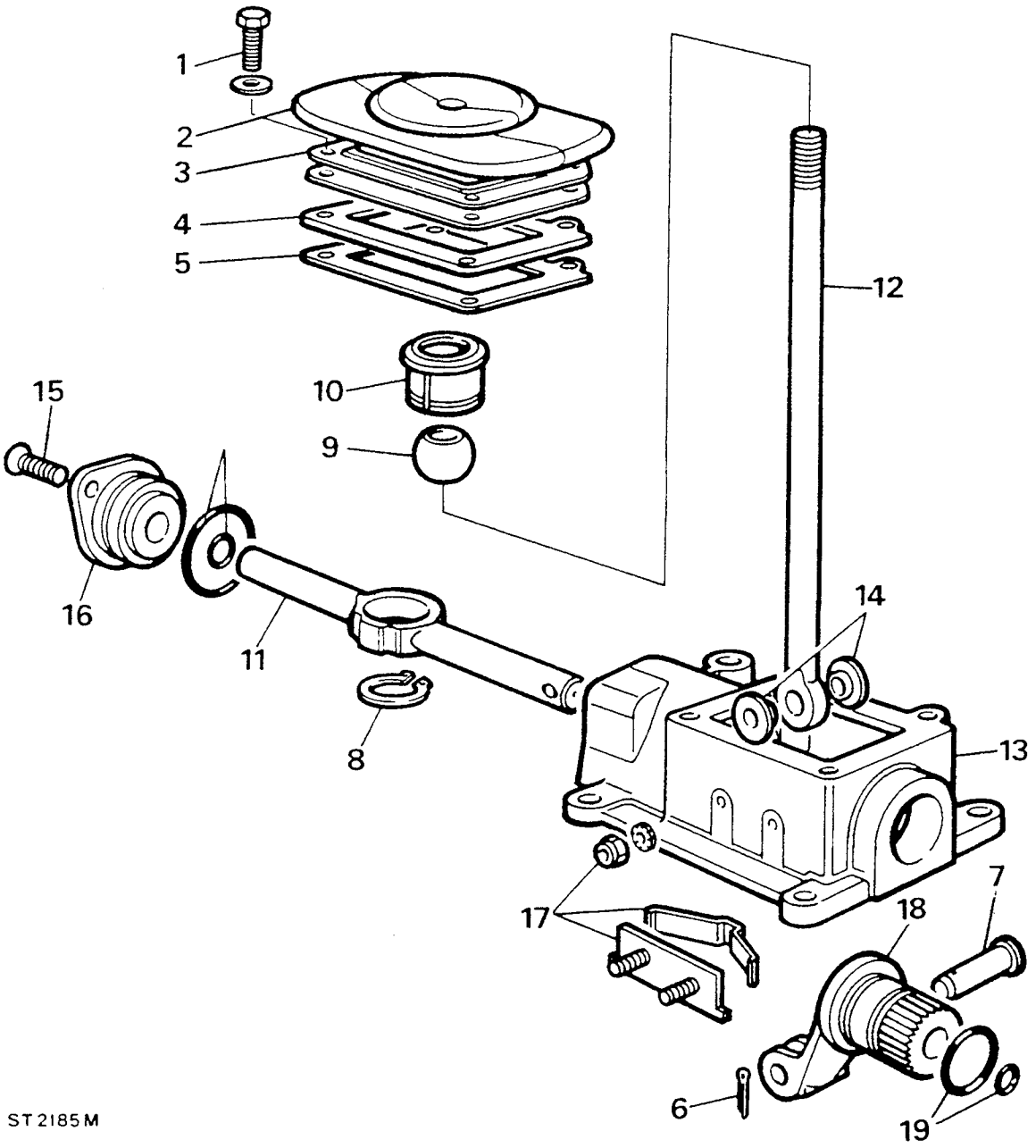
ST2201M

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.



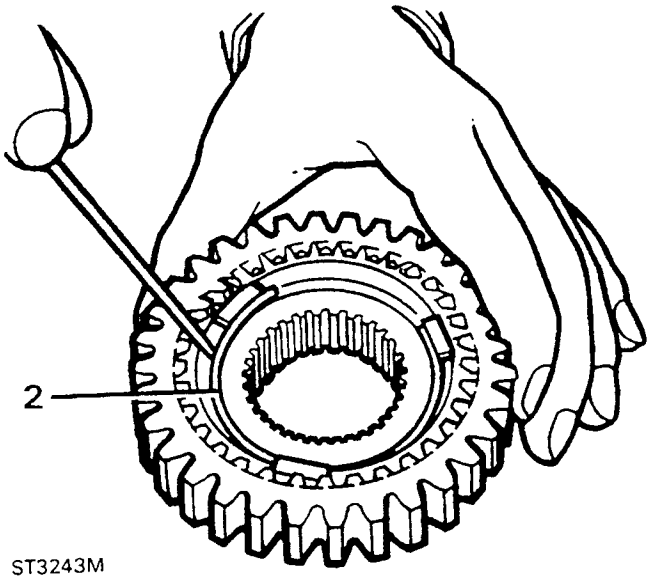
1. Gaiter retaining screw - 4 off.
2. Gaiter.
3. Gaiter support plate.
4. Gate plate.
5. Gasket.
6. Split pin.
7. Clivis pin.
8. Circlip retaining Nylon seat.
9. Gear lever ball.
10. Nylon seat.
11. Cross shaft.
12. Gear lever.
13. Gear change housing.
14. Non-mettalic bushes.
15. Counter sunk screws.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

SYNCHROMESH ASSEMBLIES

Third-fourth and fifth gear synchromesh.

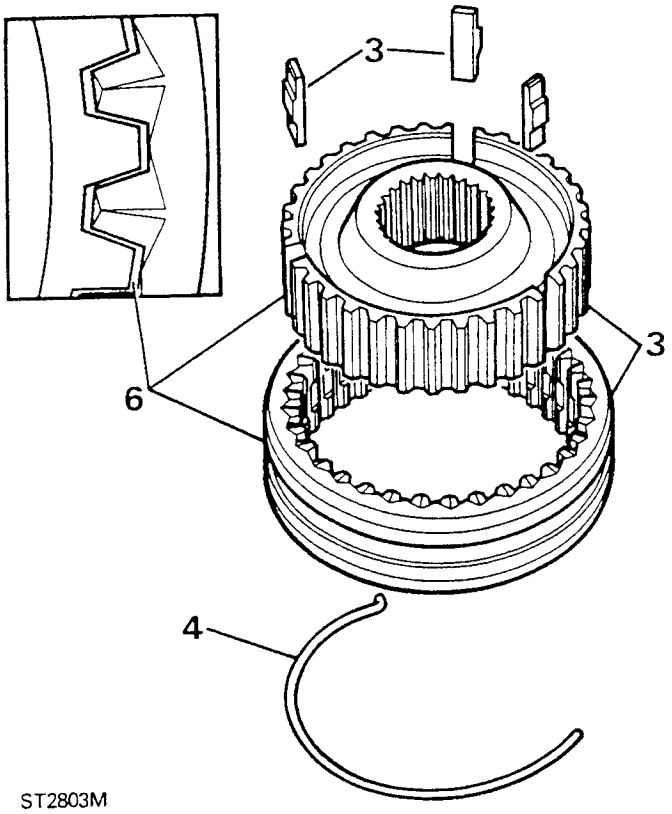
NOTE: the above assemblies are the same except that fifth gear synchromesh has a retainer plate.

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



ST3243M

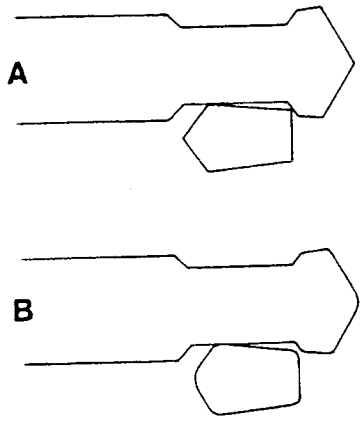
3. Remove slippers and separate the two members.
4. Examine all parts for damage and wear including wire clips for tension.
5. Check no radial movement exists between inner members and mainshaft splines. (except fifth gear synchromesh).
6. Examine inner and outer splines for wear.



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.

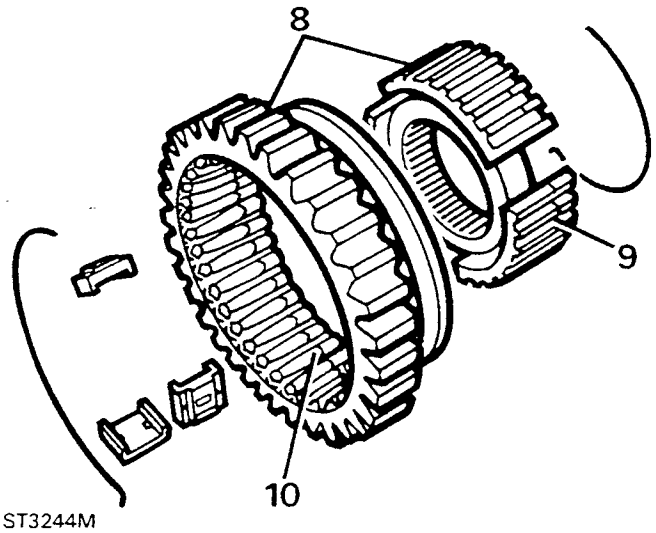


ST2449M

First-second synchromesh

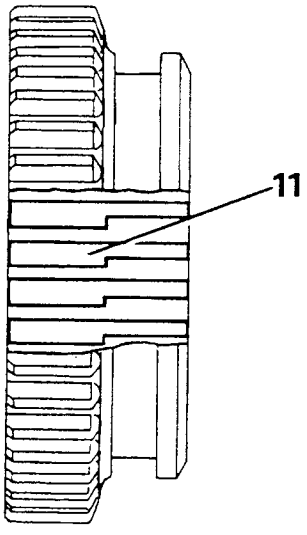
8. Repeat instructions 1 to 6 for third-fourth synchromesh.
9. Examine step in each of outer splines.
10. Check that the step on both sides of the internal splines are sharp not rounded.

△ **NOTE: this applies only to splines on selector groove side of member.**



ST3244M

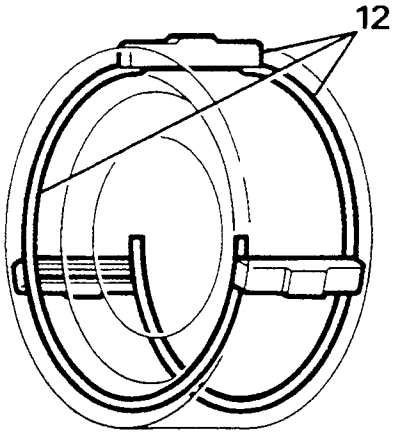
11. Fit inner member to outer so that the wide splines of inner member are under the spur gear teeth.



ST3247M

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

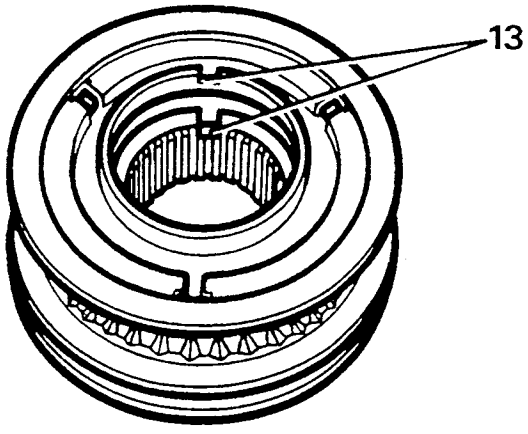
△ **NOTE: The hooked end of each spring must locate in the same slipper with the free ends running in opposite directions and resting against the remaining slippers.**



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.**

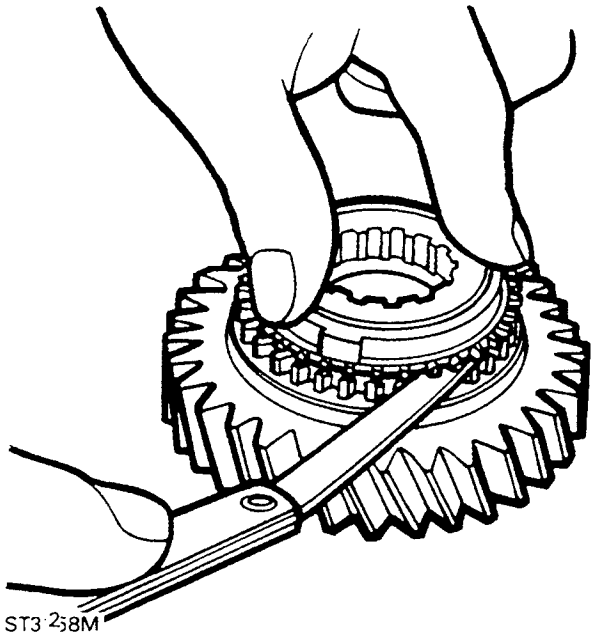


ST3276M

CHECKING BAULK RING CLEARANCES

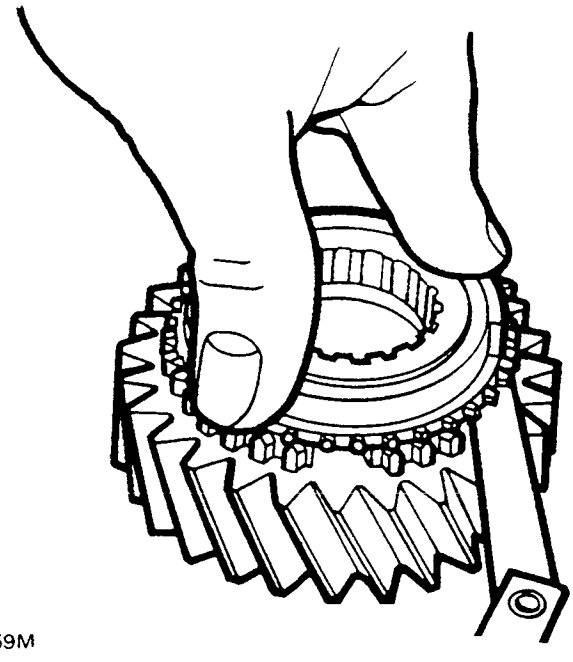
Check clearance of all baulk rings and gears by pressing the baulk ring against the gear and measuring the gap. The minimum clearance should be 0,38mm (0.015in).

First gear



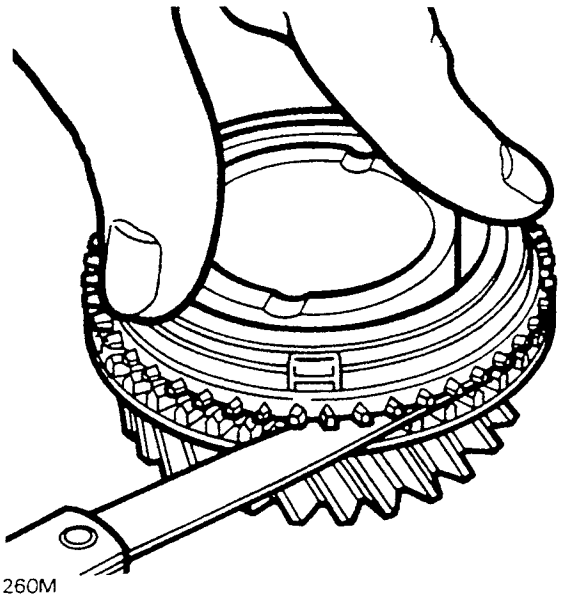
ST3238M

second gear



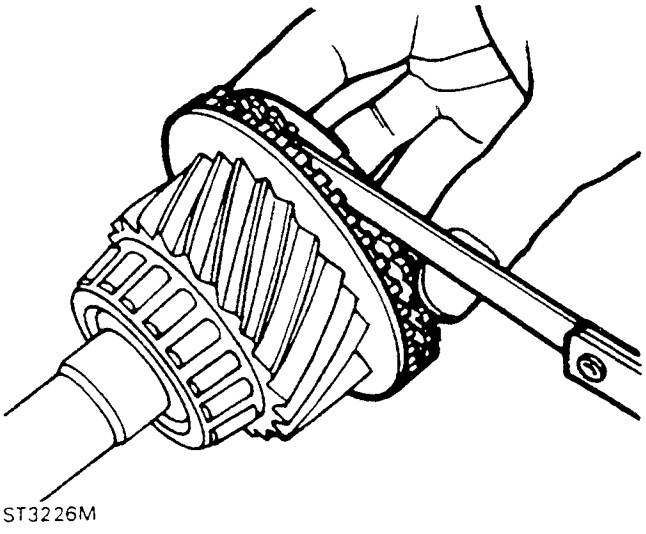
ST3259M

Third gear



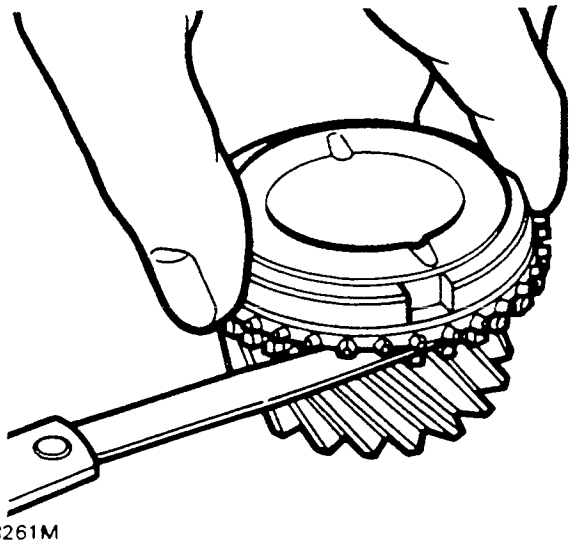
ST3260M

Fourth gear



ST3226M

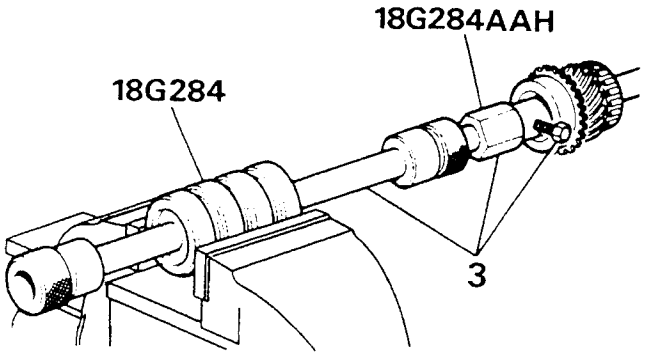
Fifth gear



ST3261M

INPUT SHAFT

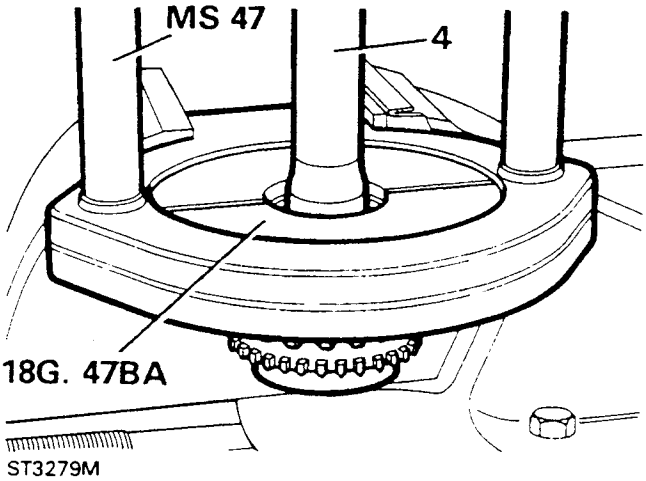
1. Examine the gear and dog teeth for wear and damage.
2. Polish oil seal track if necessary.
3. Using 18G 284 AAH and 18G 284 remove pilot bearing track.



ST3278M

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

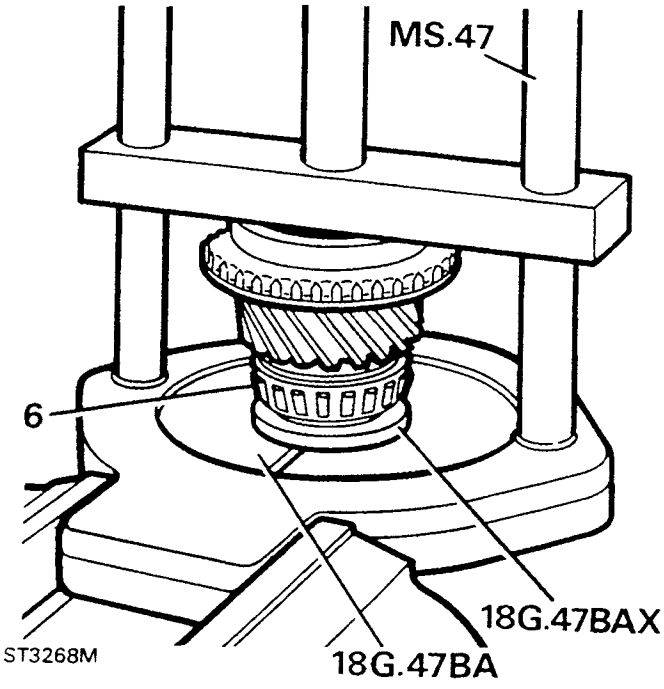
△ **NOTE: ensure that the bearing is supported by the lip inside 18G 47 BA.**



ST3279M

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

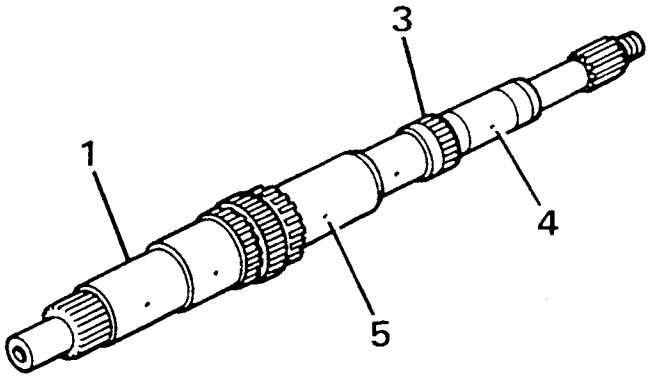
6. Using Press MS 47, Collets 18G 47B and adaptor 18G 47 BAX fit a new taper bearing.



ST3268M

MAINSHAFT

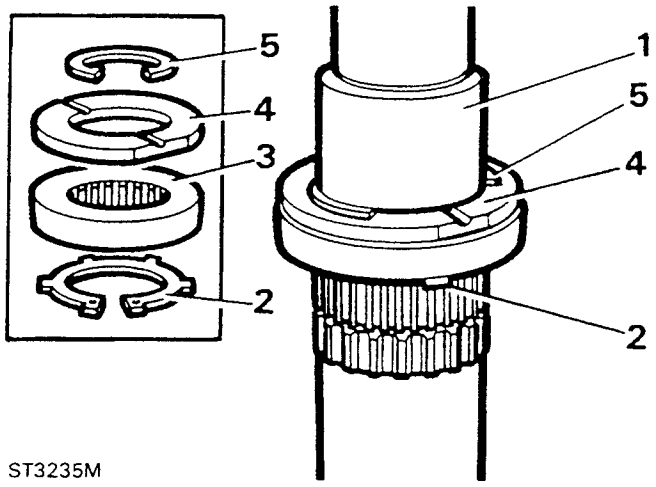
1. Examine bearing journals for wear and scores.
2. Check condition of circlip grooves.
3. Examine splines for wear and damage.
4. Use an air line to check that the main oil feed from the pump is clear and feed to spigot bearing.
5. Check oil feed holes to roller bearings are clear.



ST3241M

MAINSHAFT GEAR END FLOAT CHECKS

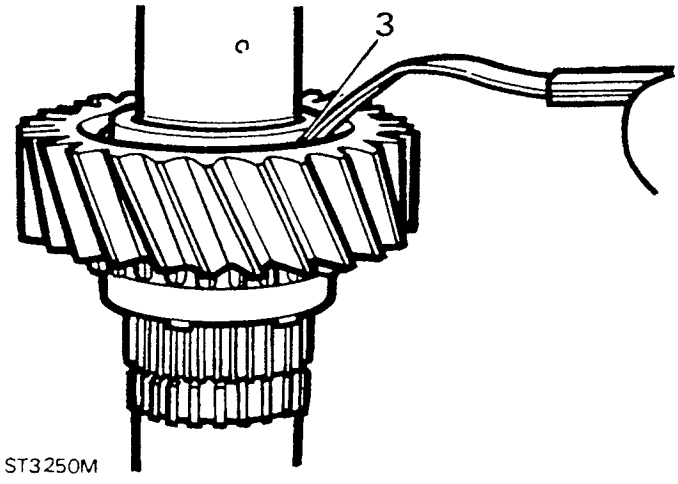
1. Hold mainshaft in vice front end downwards.
2. Fit front circlip for first-second synchromesh.
3. Fit second gear cone.
4. Fit spacer.
5. Fit snap ring.



ST3235M

Second gear end-float.

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

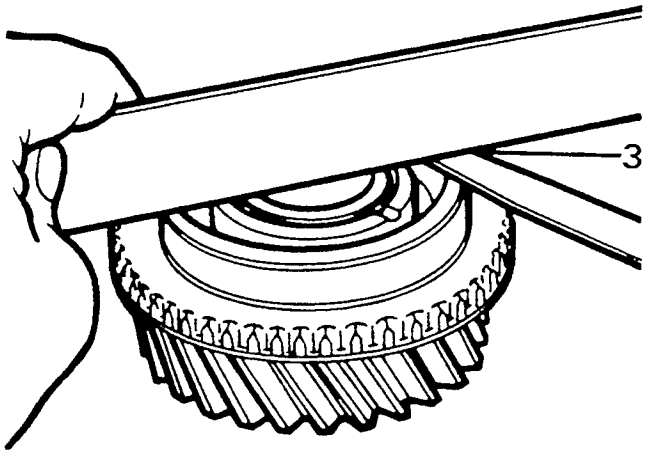


ST3250M

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

Third gear end-float.

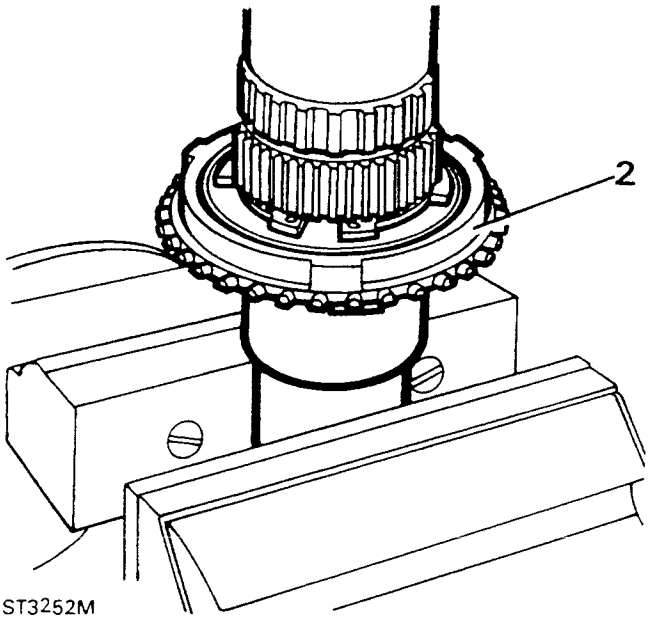
1. Fit needle roller to third gear.
2. fit third gear bush to third gear.
3. Place gear on flat surface, bush flange downwards, and with a straight edge across gear check clearance between straight edge and gear. Not to exceed 0,20 (0.008in).



ST3251M

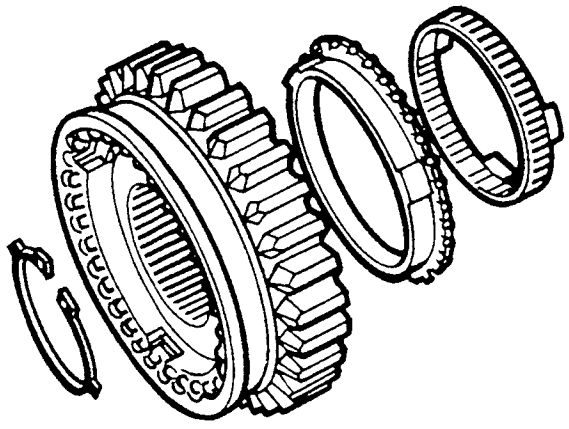
First gear bush end-float.

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



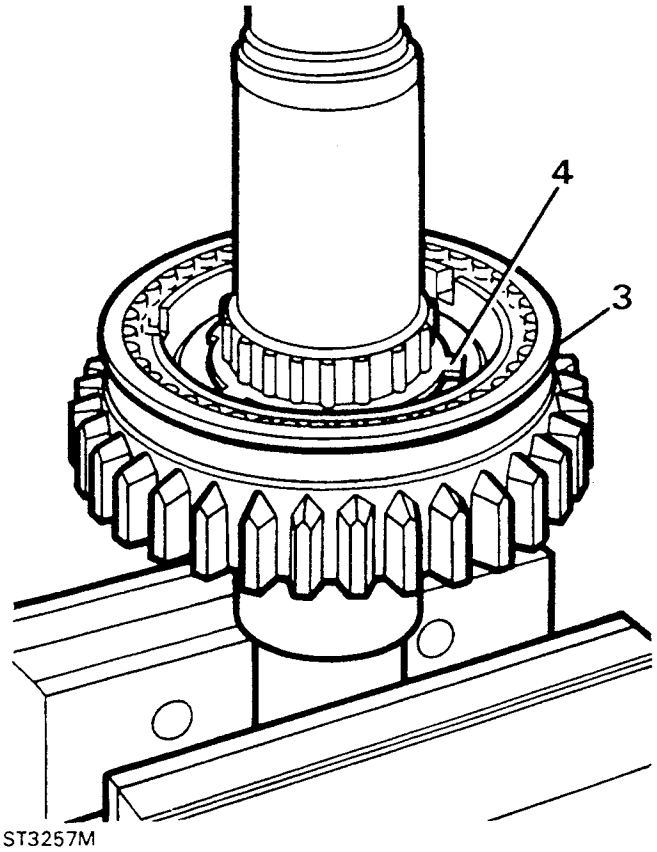
ST3252M

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



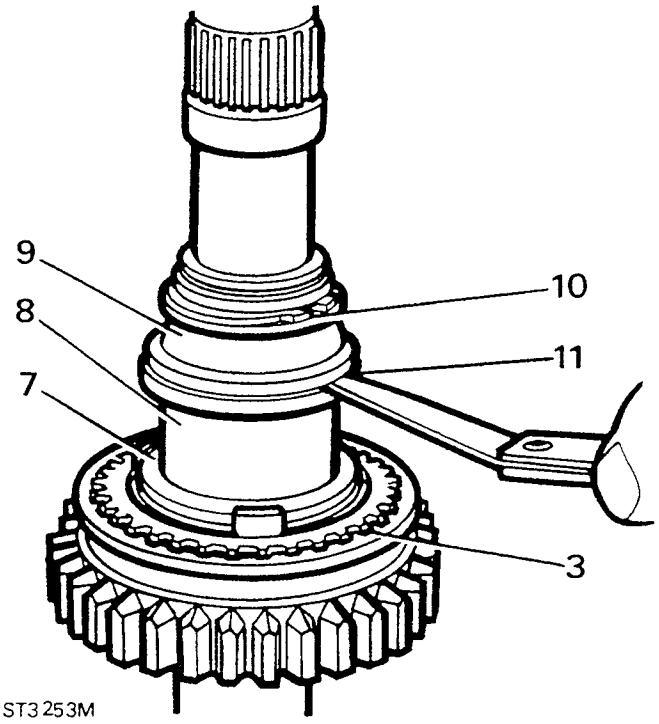
ST3231M

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

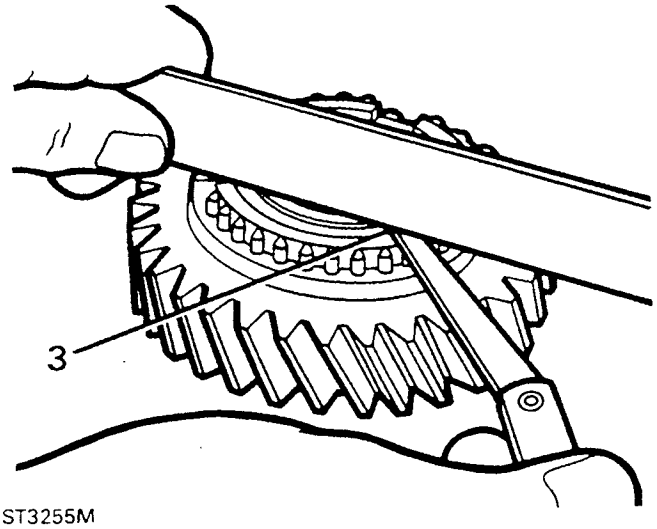
Part number	Thickness
FTC2005	30,905/30,955
FTC2006	30,955/31,005
FTC2007	31,005/31,055
FTC2008	31,055/31,105
FTC2009	31,105/31,155

Check first gear to bush end-float.

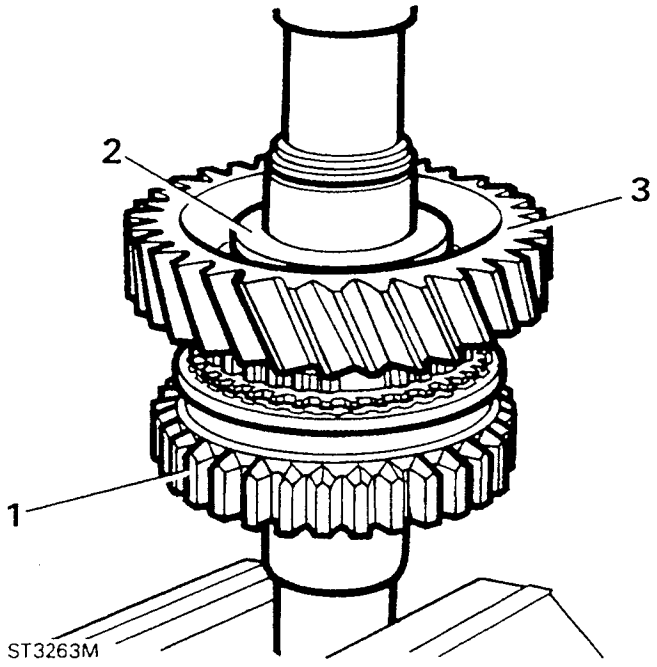
1. Fit roller bearing and bush to first gear.
2. Place bush flange side downwards on a raised block on a flat surface.

△ **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).



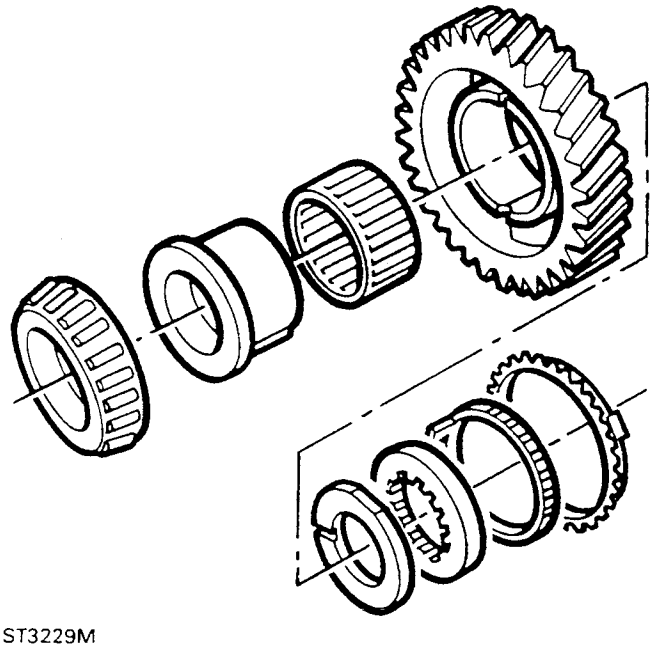
ST3255M



ST3263M

ASSEMBLING MAINSHAFT

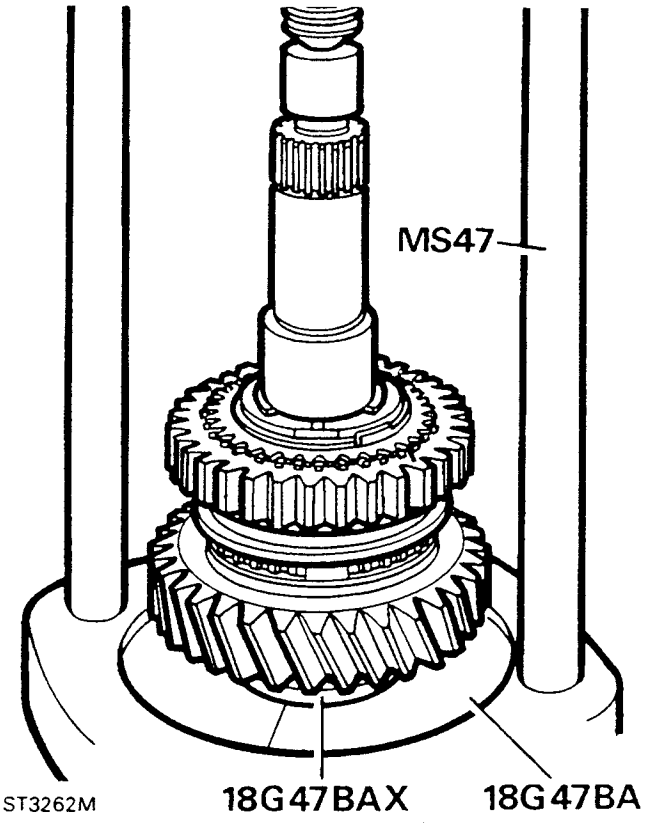
1. With the first-second synchromesh hub and spacer in position, assemble the rear end of the shaft.
2. Fit the roller bearing and bush to first gear.
3. Fit first gear to mainshaft.



ST3229M

First gear assembly

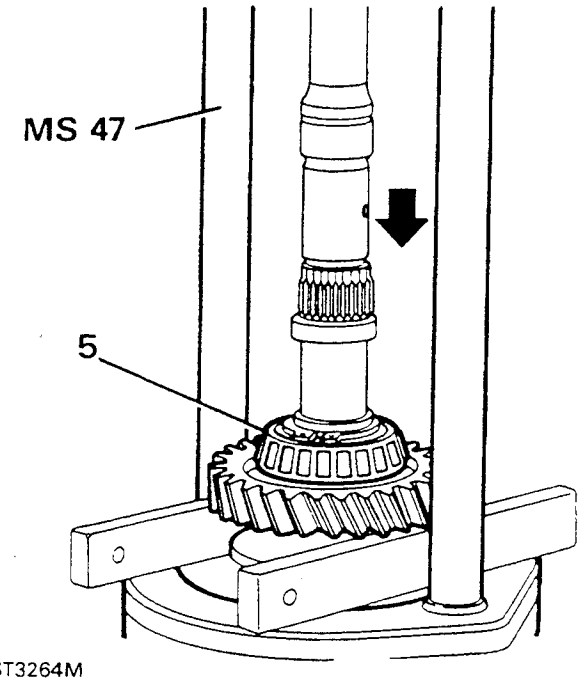
4. Fit the taper bearing to mainshaft using MS 47, collets 18G 47 BA and adaptor 18G 47 BAX.



ST3262M

CAUTION: Ensure that the slots in the baulk ring align with the synchromesh slippers while pressing on the bearing.

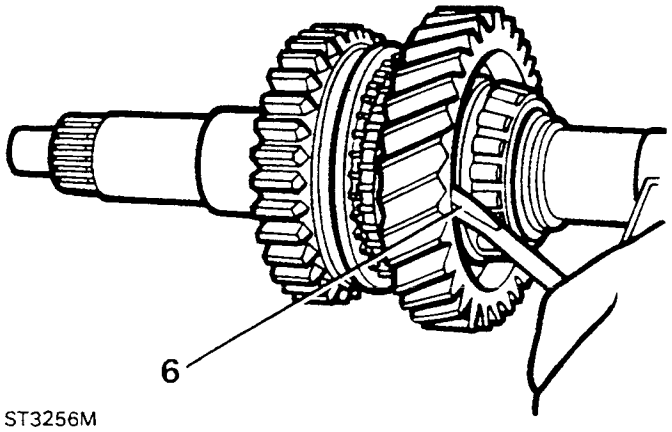
5. Invert mainshaft and press assembly back against circlip.



ST3264M

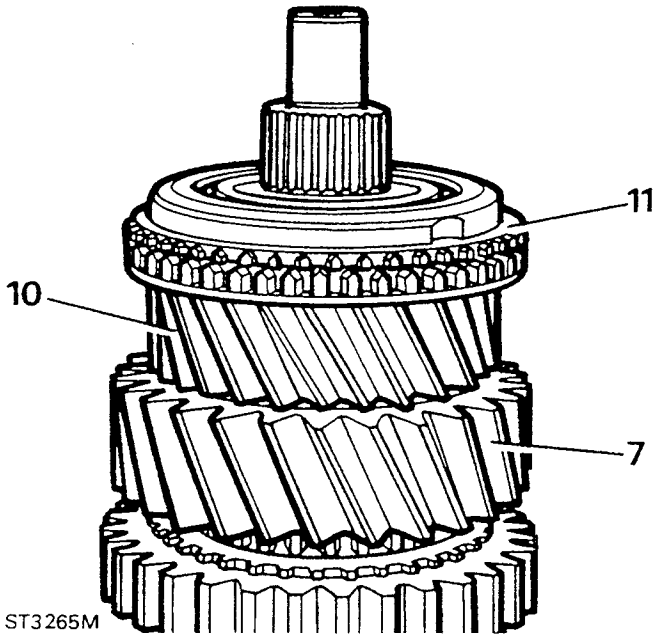
NOTE: Instruction 5 is necessary since it is probable that when pressing on the bearing it will have clamped the first gear bush preventing it from turning.

6. Reposition mainshaft in vice and using a screw driver blade check that the first gear bush is free to turn.

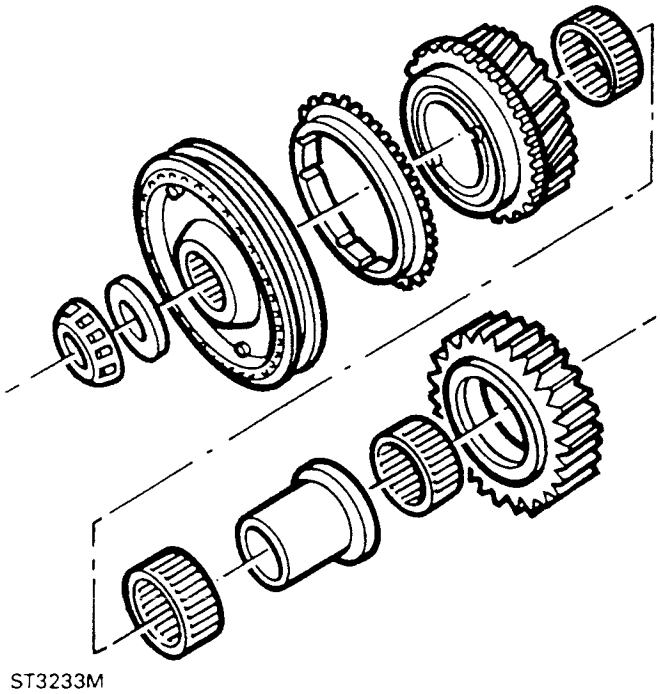


ST3256M

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.

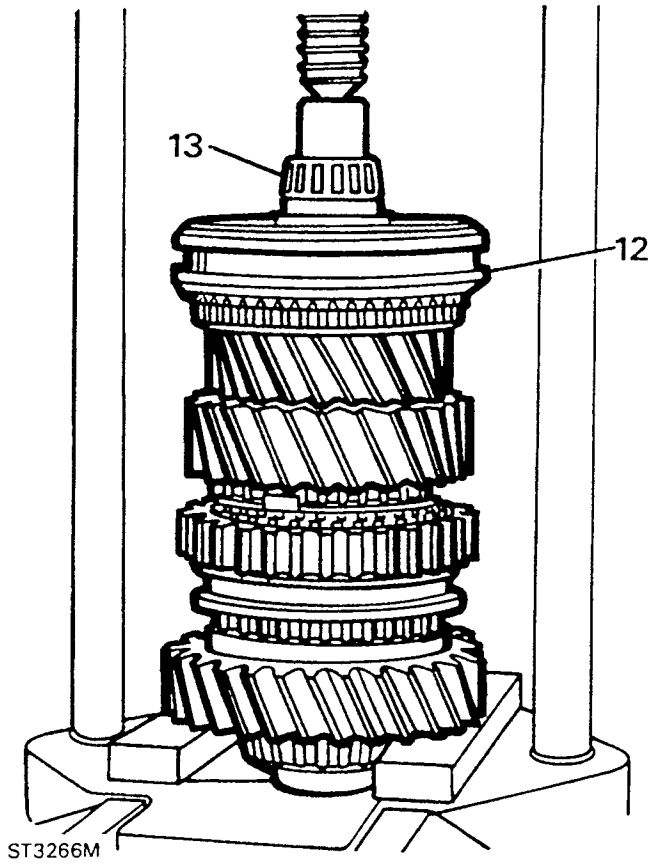


ST3265M


ST3233M

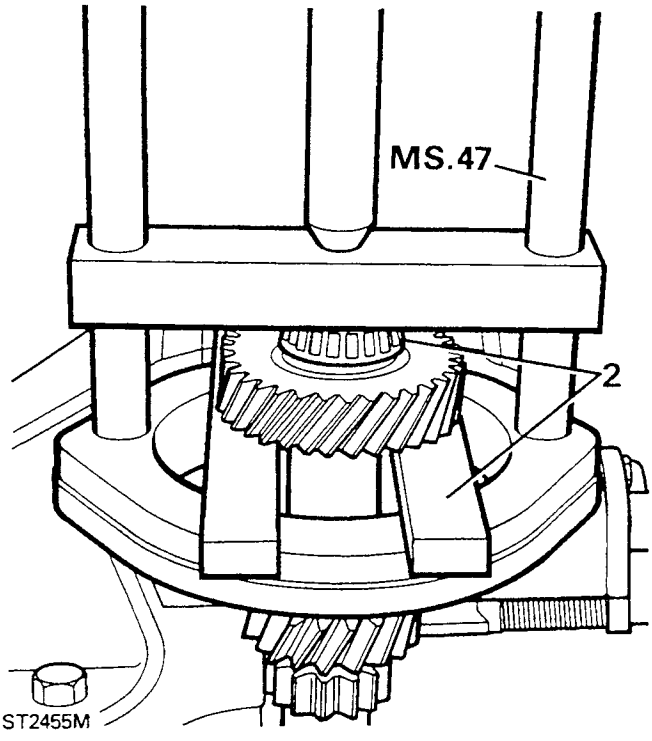
Third-fourth synchomesh assembly

12. Fit third-fourth gear synchromesh hub.
13. Using MS 47 with supports under first gear, press the spigot bearing on to shaft.



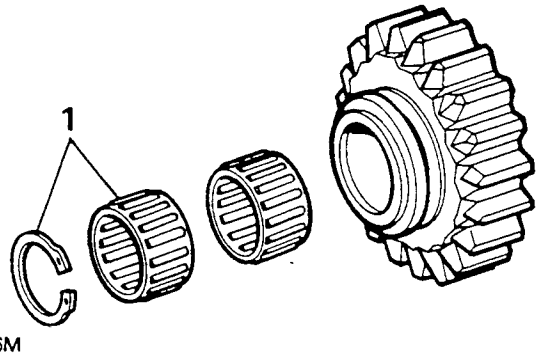
LAYSHAFT

1. Examine the layshaft for wear and damage.
2. Press bearings on to layshaft using MS 47 and supporting bars.

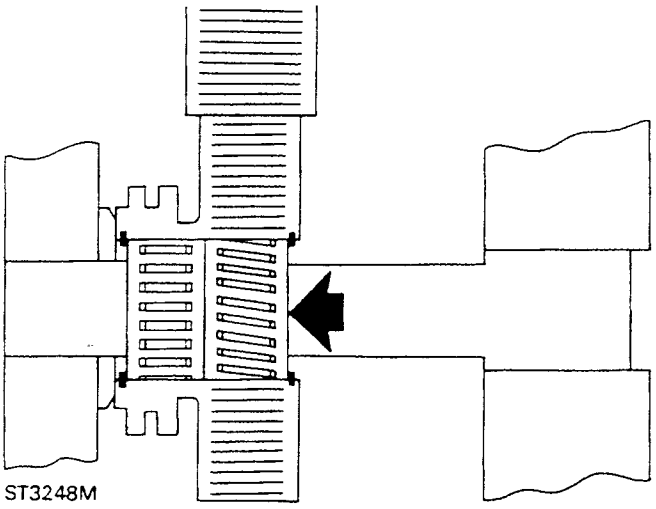


REVERSE GEAR AND SHAFT

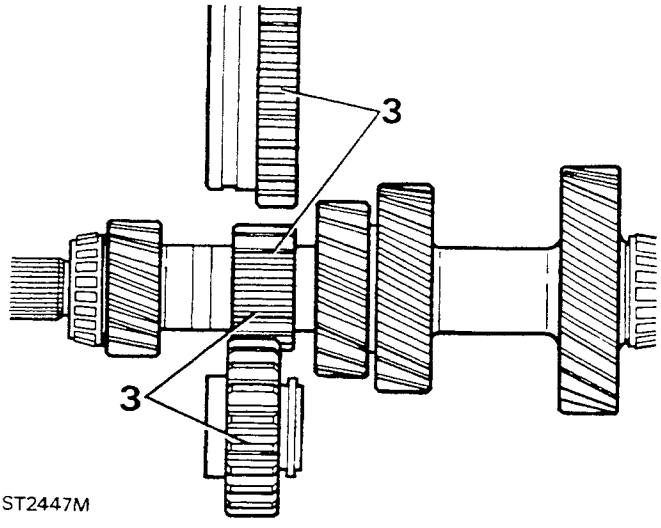
1. Remove one circlip from the idler gear and remove bearings.



△ **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

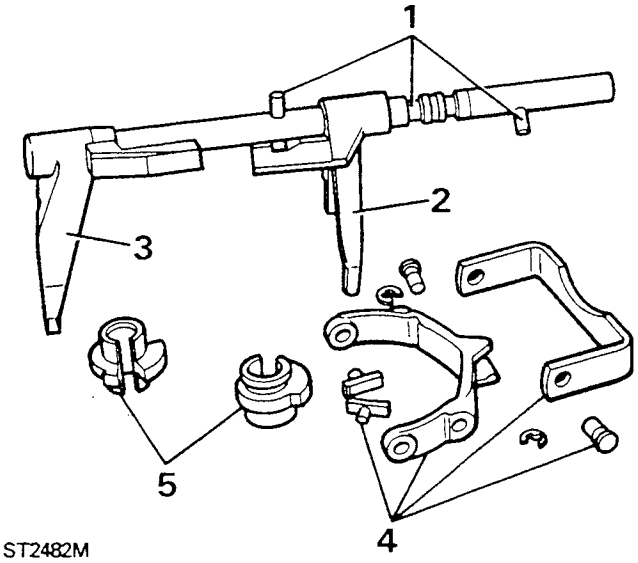
4. Examine idler shaft for wear, scores and pitting.

SELECTORS

1. Examine selector rail and pins for wear and damage.
2. Examine first-second selector fork for wear cracks and damage.

△ **NOTE: The 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.

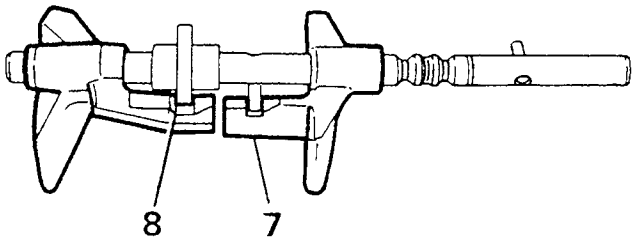


ST2482M

6. Renew retaining circlips if distorted.

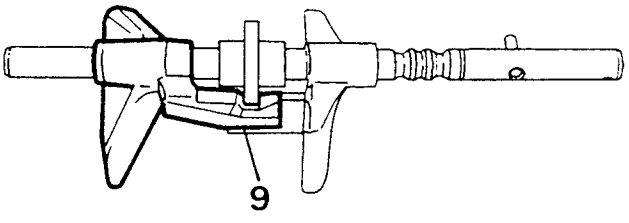
Assembling selectors.

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.

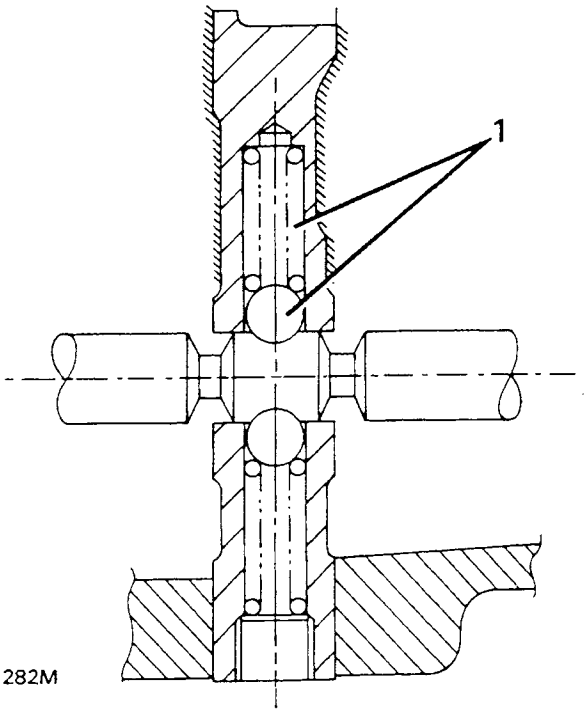


ST2487M

ASSEMBLING GEARBOX SHAFTS TO CENTRE PLATE

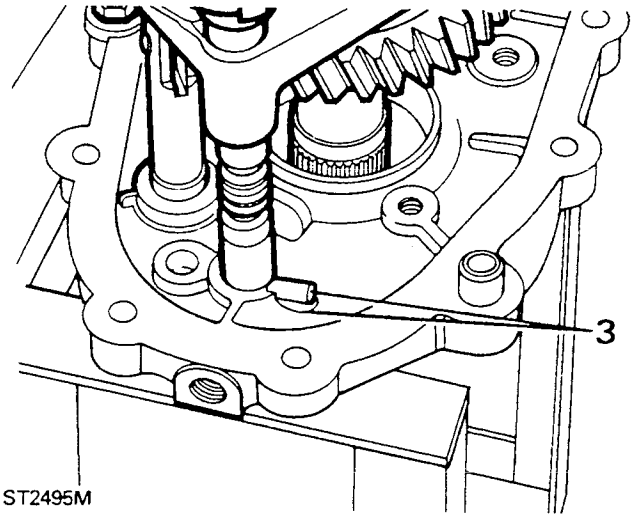
Fitting gears to centre plate

1. Secure centre plate to workstand, fit bearing tracks and inboard detent ball and spring.



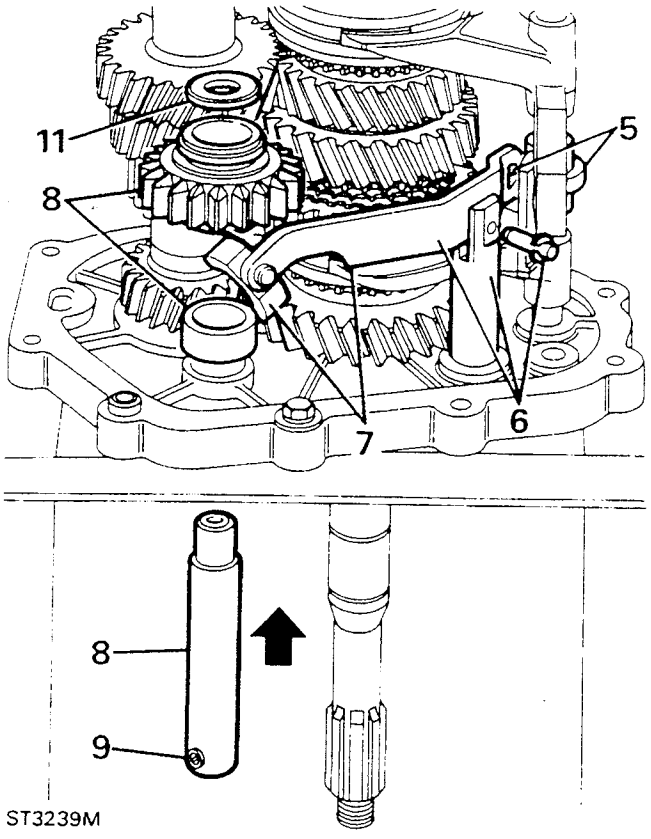
ST3282M

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.

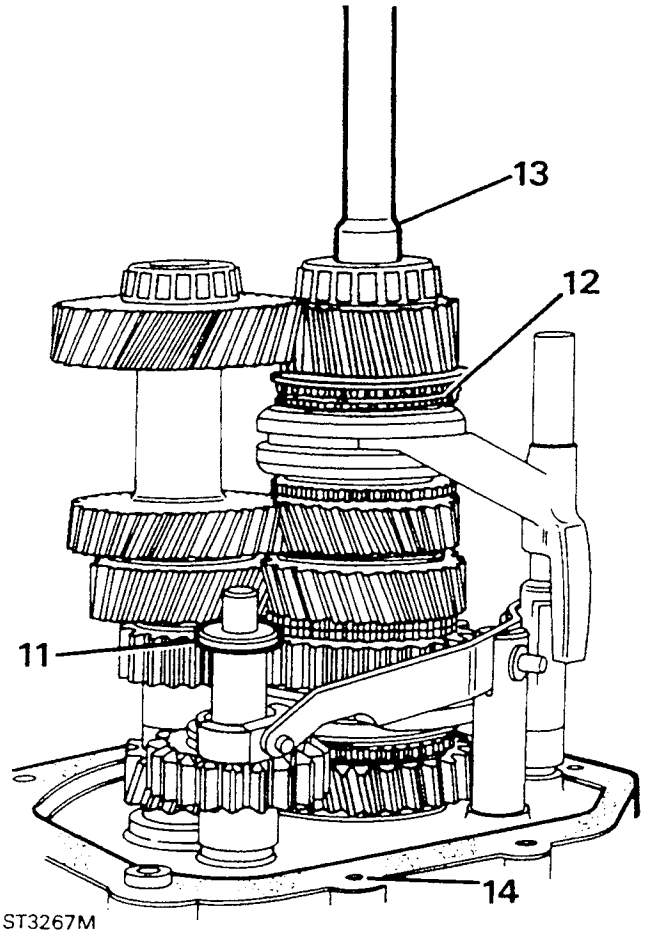


ST2495M

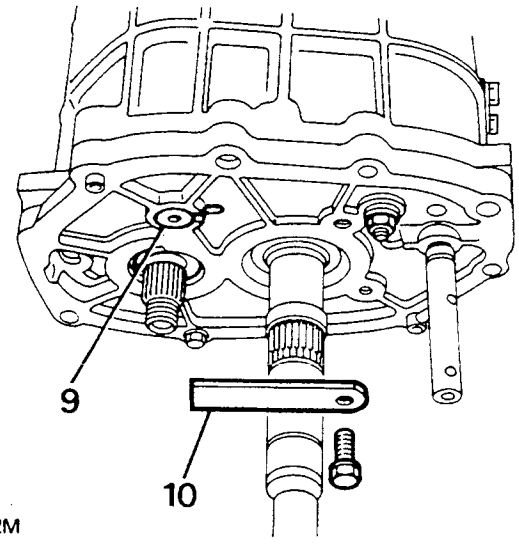
4. Fit layshaft While lifting mainshaft to clear layshaft rear bearing.
5. Turn selector shaft and interlock spool to allow reverse lever to engage spool flange.
6. Fit reverse lever to pivot post and secure with pin and circlip.
7. Fit slipper pad to lever.
8. Fit reverse gear shaft, spacer and gear.
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



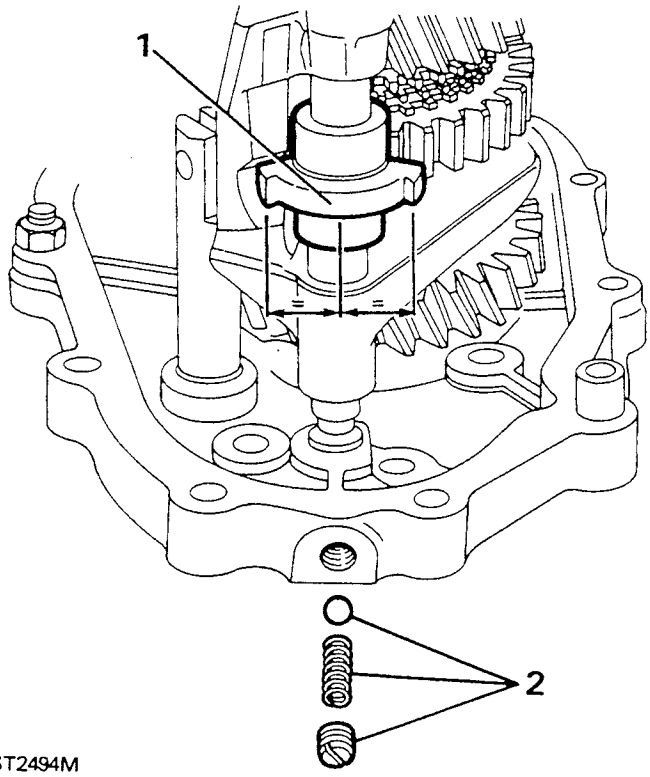
ST3267M



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.

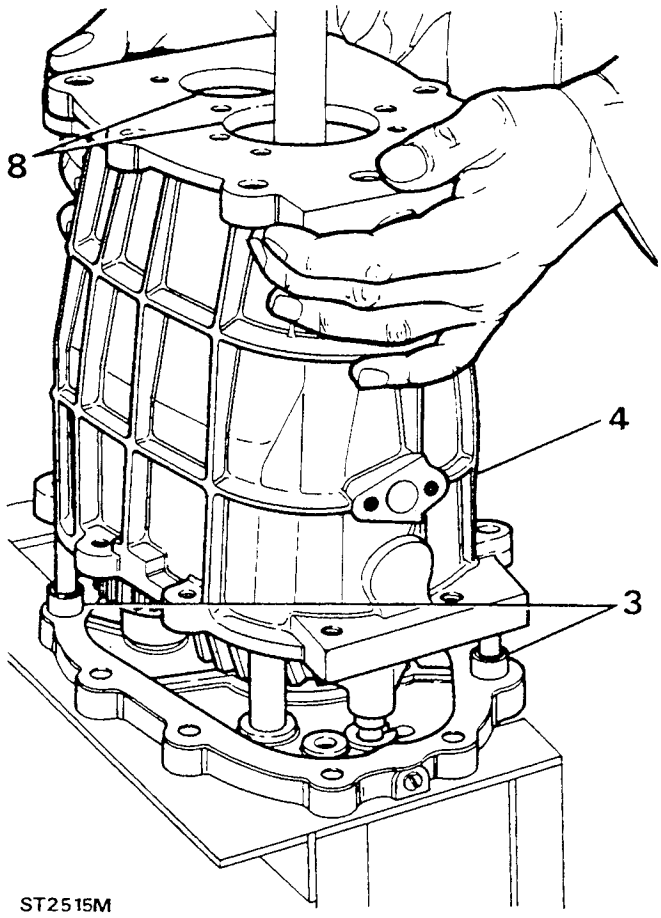


ST2494M

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.

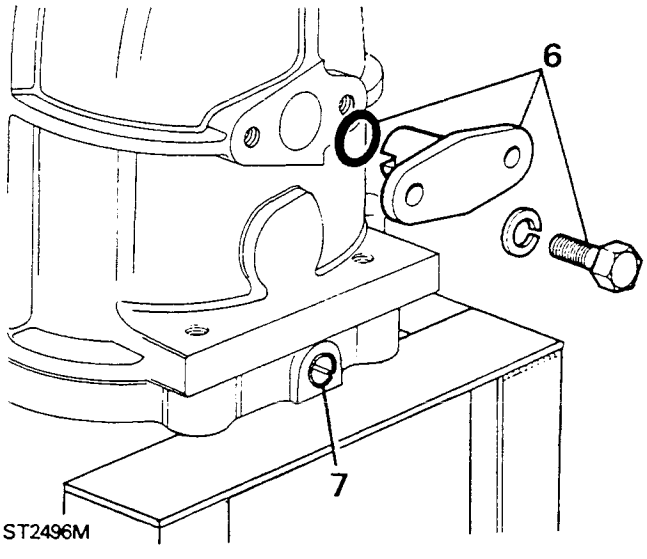
5. Secure centre plate and gearcase to workstand with two 8 x 35mm bolts.
6. Apply PL 32 to joint face and bolt threads and fit spool retainer.



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.

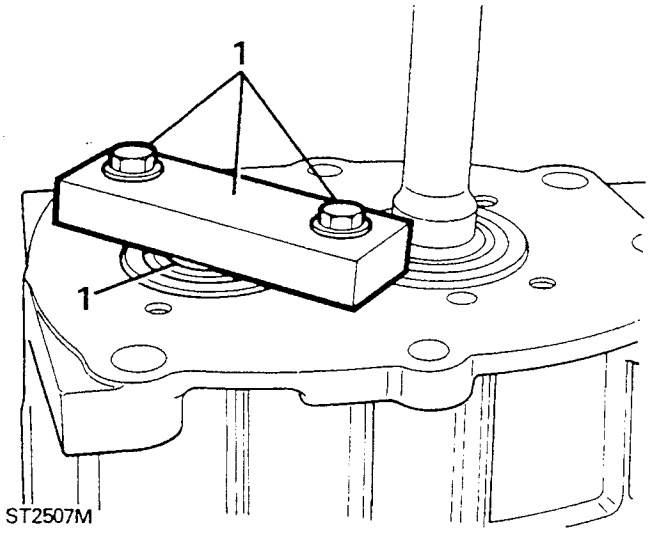


ST2496M

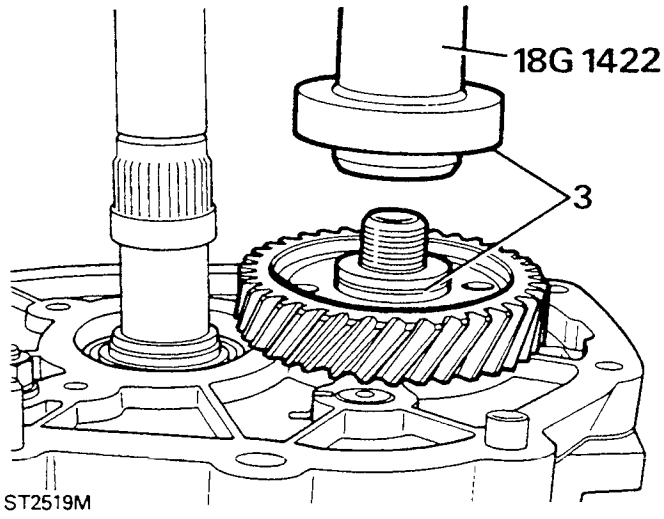
FITTING FIFTH GEAR

CAUTION: Since the fifth gear is a tight fit on the layshaft, the force, when pressing the gear, must not be transfered 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.

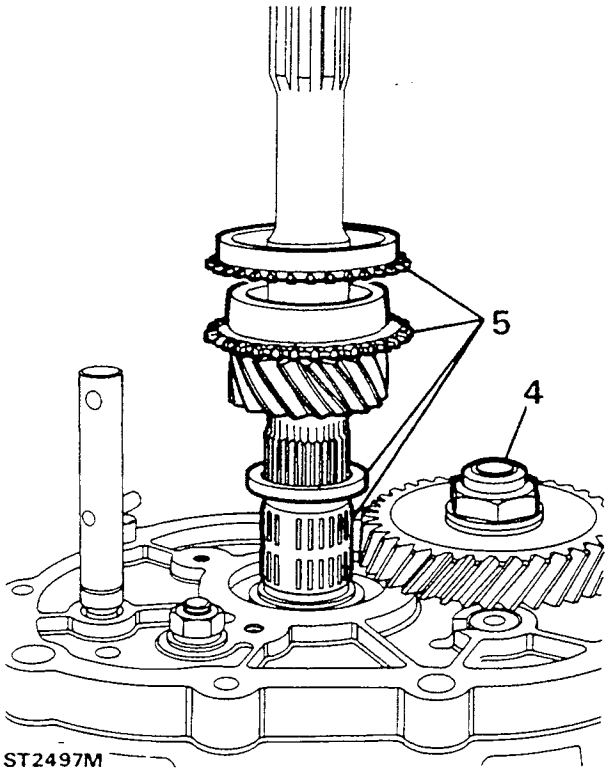
1. Secure the plate with two 8x25mm bolts. Insert disc between plate and layshaft.



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.

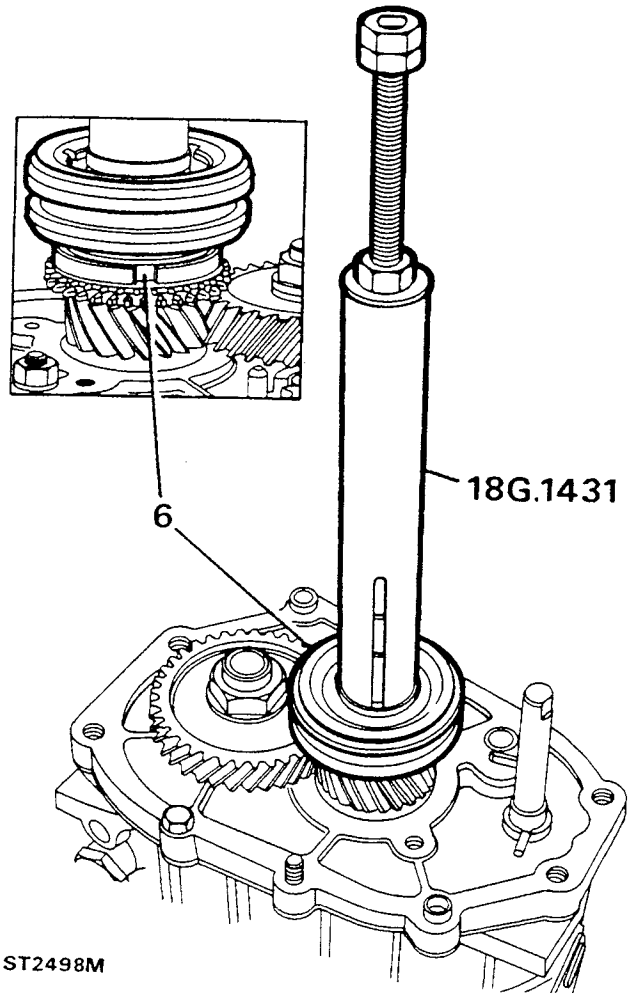


4. Fit a new stake nut but do not tighten.
5. Fit fifth gear assembly to mainshaft.



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.

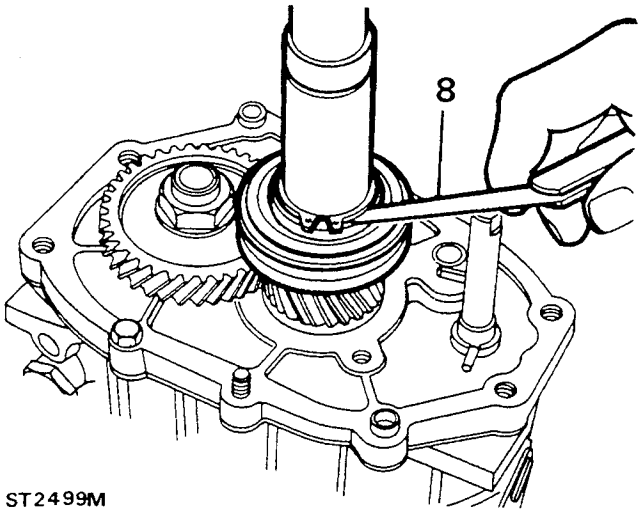


ST2498M

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	5,58
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.

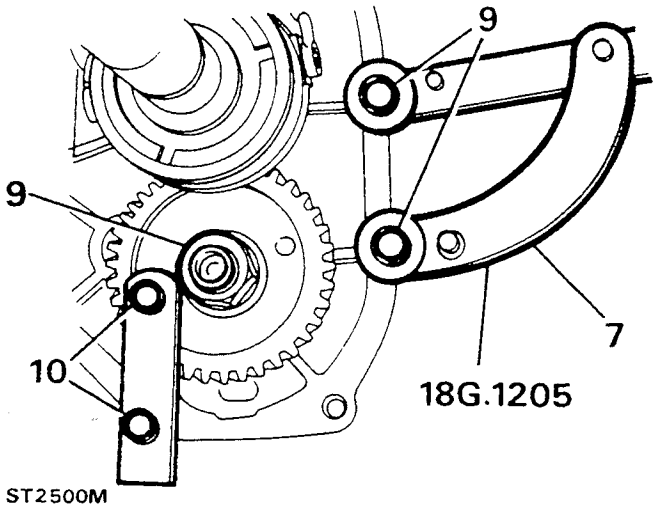


ST2499M

9. Tighten layshaft stake nut using 18G 1205.

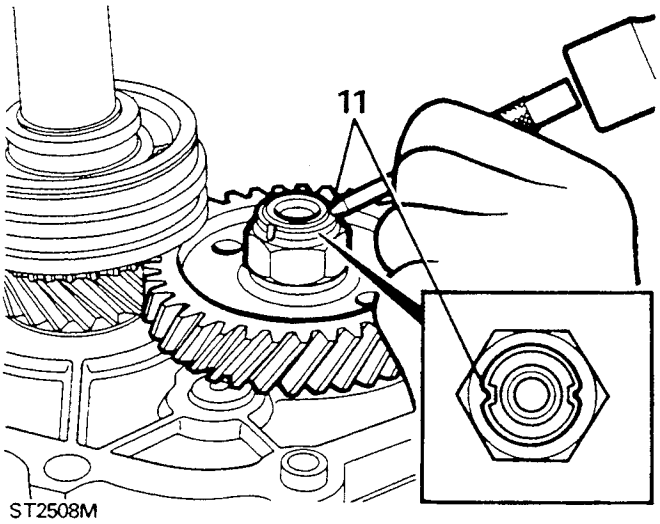
CAUTION: The practice of locking gears to provide a restraint to tighten the nut is not acceptable due to high torque figure required.

10. Secure tool "A" to gear and gear case and using a suitable torque wrench tighten the nut to the correct torque.



ST2500M

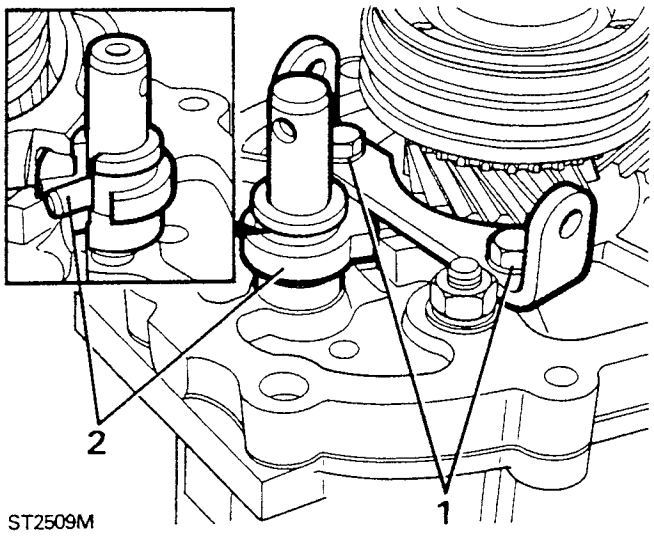
11. Using a round nose punch, form the collar into the layshaft slots.



ST2508M

FIFTH GEAR SELECTOR FORK ASSEMBLY

1. Fit fifth gear selector fork bracket.
2. Fit the fifth gear spool long end towards centre plate.

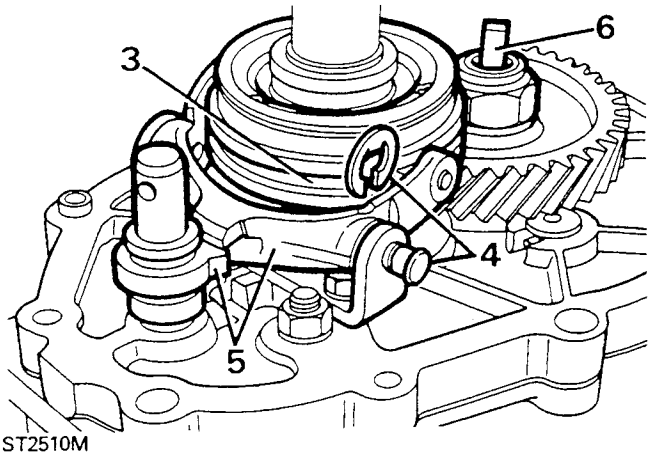


ST2509M

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.



ST2510M

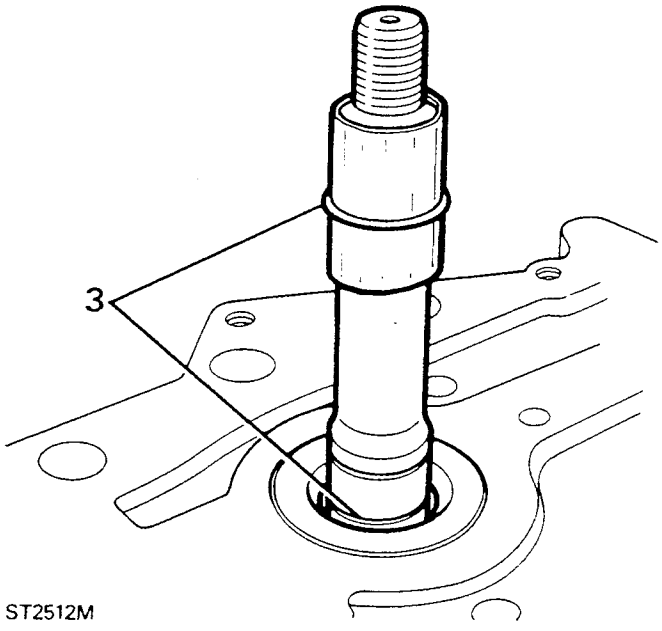
EXTENSION CASE

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 force, if necessary remove case and re-align oil pump drive if case does not fit first time.**

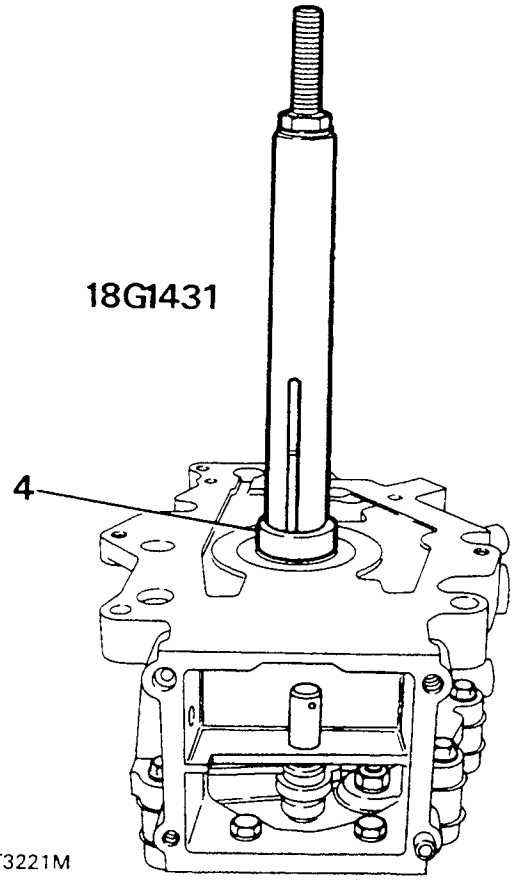
⚠ **CAUTION: To protect "O" ring while fitting, cover mainshaft splines with smooth tape.**

3. Fit "O" ring to mainshaft groove.



ST2512M

4. Fit "O" ring collar to mainshaft using 18G 1431.



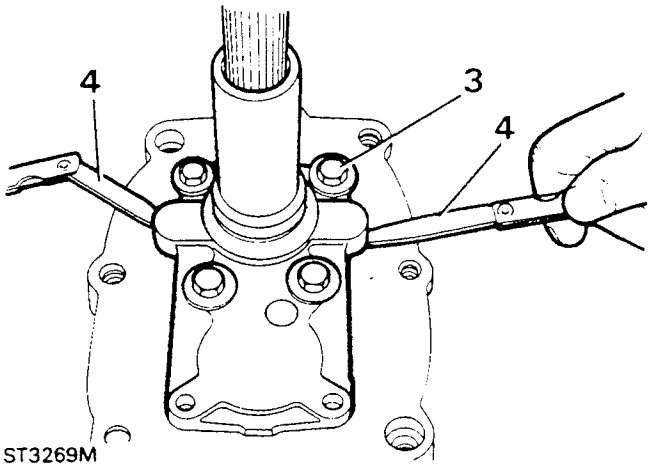
ST3221M

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.



ST3269M

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.

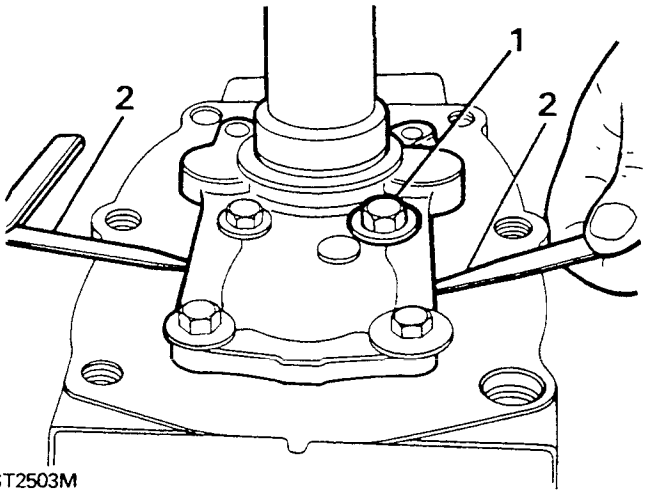
6. Remove front cover and keep gasket and selective washer together.

Mainshaft selective washers

Part number	Thickness(mm)
FRC 4327	1,51
FRC 4329	1,57
FRC 4331	!,63
FRC 4333	1,69
FRC 4335	1,75
FRC 4337	1,81
FRC 4339	1,87
FRC 4341	1,93
FRC 4343	1,99
FRC 4345	2,05
FRC 4347	2,11
FRC 4349	2,17
FRC 4351	2,23
FRC 4353	2,29
FRC 4355	2,35
FRC 4357	2,41
FRC 4359	2,47
FRC 4361	2,53
FRC 4363	2,59
FRC 4365	2,65
FRC 4367	2,67
FRC 4369	2,77

LAYSHAFT BEARING ADJUSTMENT

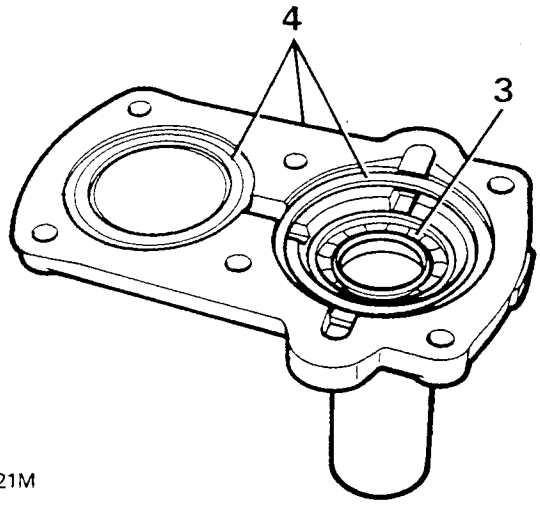
1. Place original selective washer on layshaft bearing, fit front cover without gasket, and finger tighten bolts.
2. Measure clearance, with two feeler gauges, between cover and gearcase. Select a shim that will provide a clearance equal to the thickness of the gasket that was selected and measured when calculating the adjustment of the input and mainshaft bearing.



ST2503M

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.

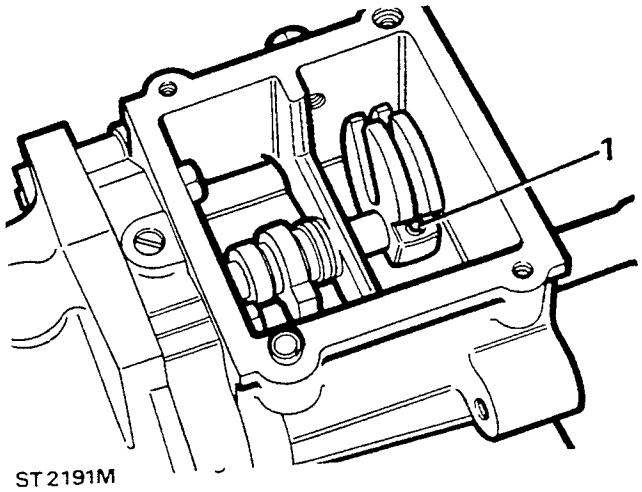
Layshaft selective washers.

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

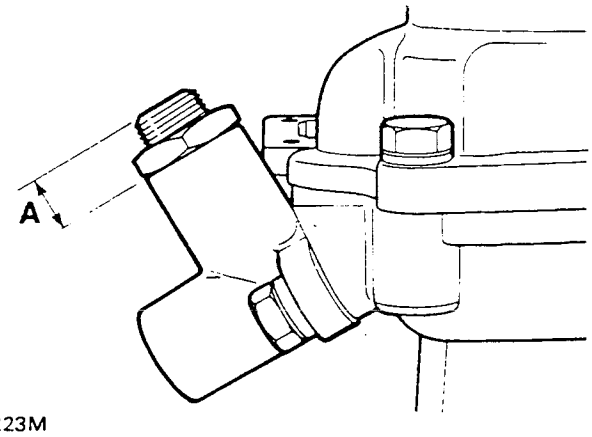
2. With a new gasket, fit remote housing locating over dowels.

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 mm (0.50 in). Tighten locknut.



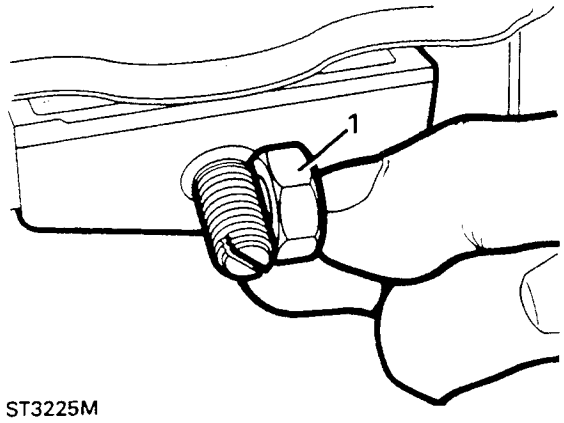
ST3223M

△ **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.

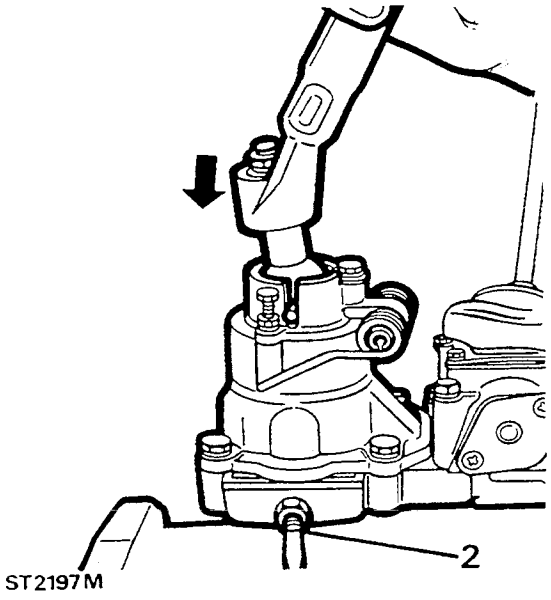
1. Adjust screw to protrude from housing the distance across corners of locknut.

△ **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

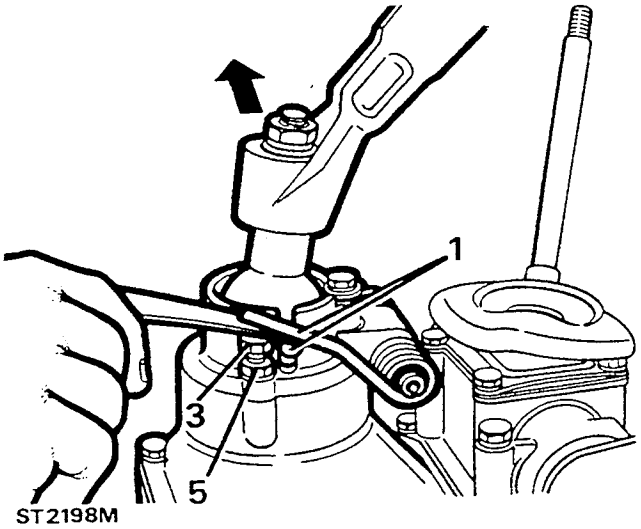
Bias spring adjustment

△ **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

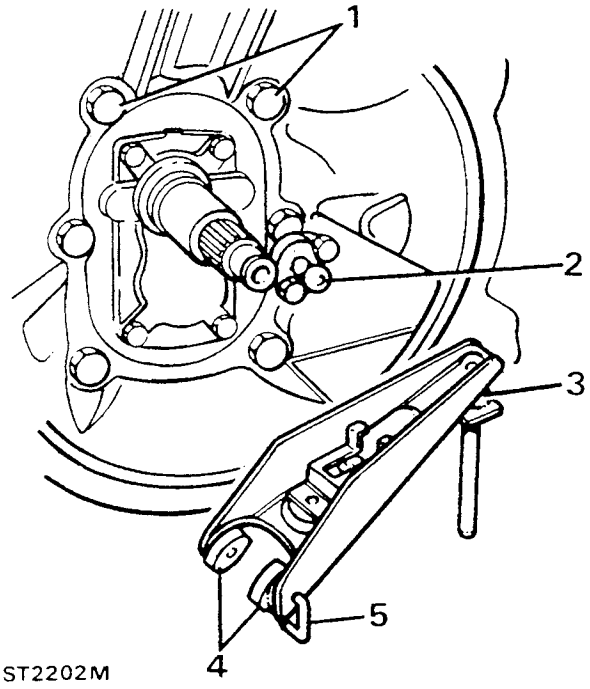
BELL HOUSING - FOUR CYLINDER ENGINE

1. Fit bellhousing locating over hollow dowels and secure with bolts.

△ **NOTE: Fit the 12 x 45 mm bolts through dowels and 12 x 30 mm bolts in remaining positions.**

2. Secure pivot post.
3. Apply molybdenum disulphide grease to pivot post, lever pads and pins.
4. Assemble pads to lever and lever to bearing and fit assembly to pivot post.
5. Fit staple to release assembly, short leg to lever.

△ **NOTE: The staple is an aid to assembly only which may become dislodged or lost in service without detriment.**



ST2202M

BELL HOUSING - V8 ENGINE

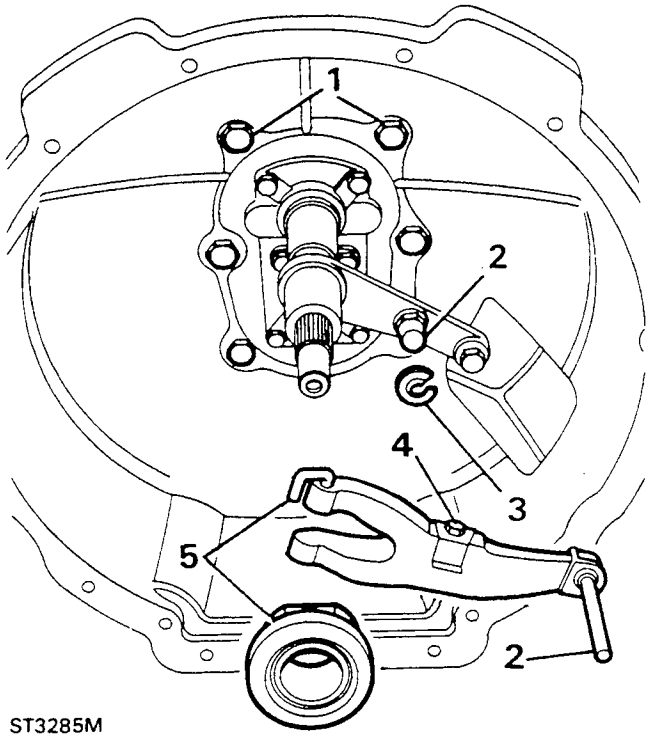
1. Fit bell housing locating on hollow dowels.

△ **NOTE: Fit the 12 x 45mm bolts through dowels and 12 x 30mm bolts in remaining positions.**

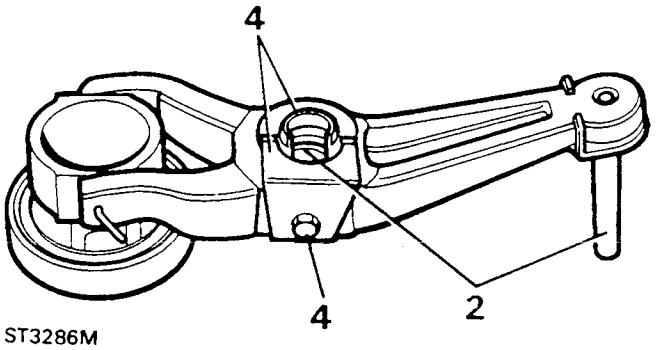
2. Apply molybdenum disulphide grease to pivot post, release lever, socket and push rod. Not the bearing guide.
3. Fit 'C' washer to pivot post.
4. Fit spring clip to lever and fit lever to pivot post.

△ **NOTE: Position spring clip behind 'C' washer and tighten screw.**

5. Fit bearing and retain with plastic staple.



ST3285M



ST3286M

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

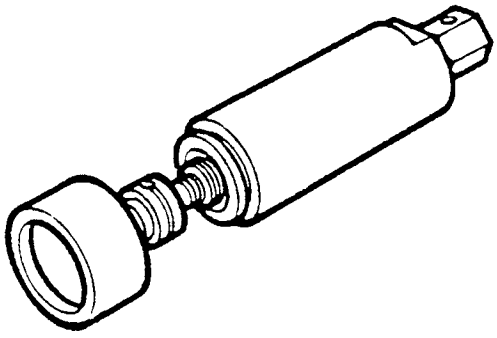
NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	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	22 - 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

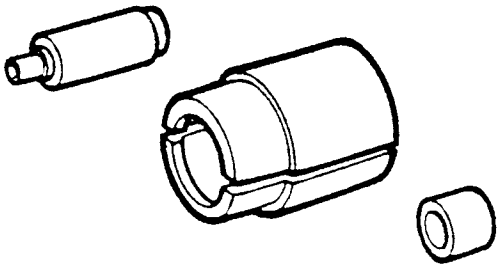
NOTE: Where the use of special tools is specified, only these tools should be used to avoid the possibility of personal injury and or damage to components.

18G.705



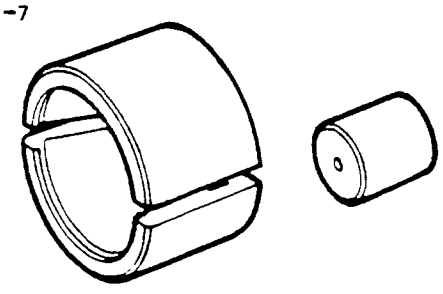
18G 705 Puller, bearing remover

18G.705-1A



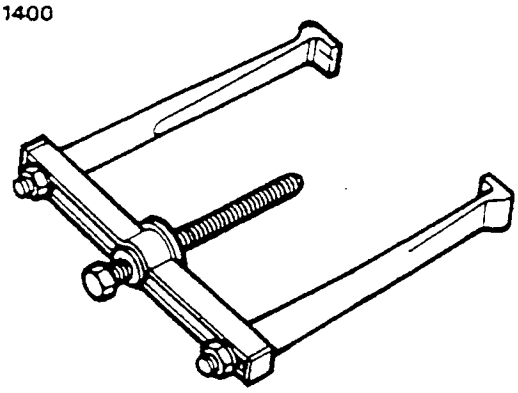
18G 705-1A Adaptor for mainshaft oil seal track and layshaft fifth gear

18G.705-7



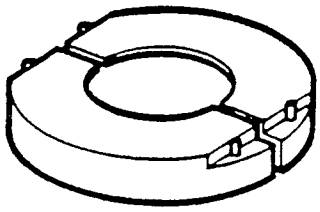
18G 705-7 Adaptor for layshaft bearings

18G.1400

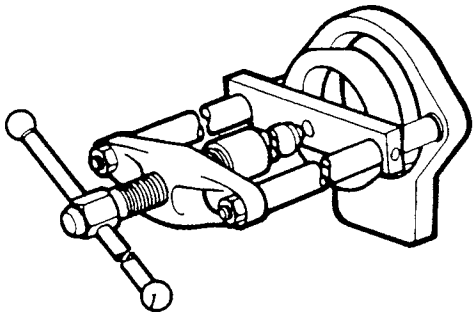


18G 1400 Remover synchromesh hub and gear cluster

18G.1400-1



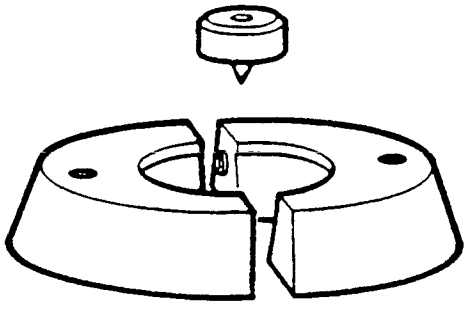
18G 1400-1 Adaptor mainshaft fifth gear



MS47

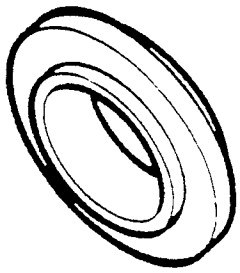
MS 47 Hand press

18G.47BA



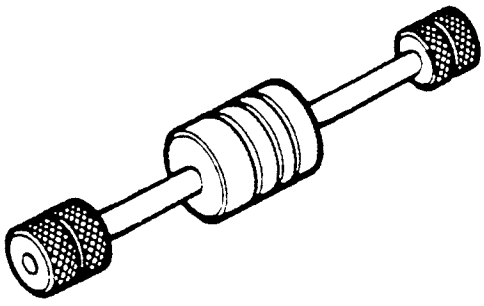
18G 47BA Adaptor input shaft bearing

18G.47BAX

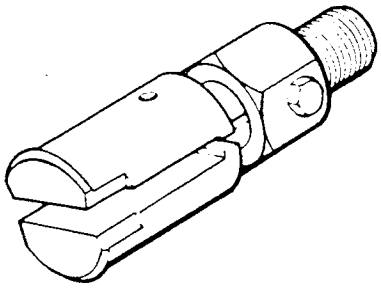


18G 47BAX Conversion kit

18G.284 (MS.284)



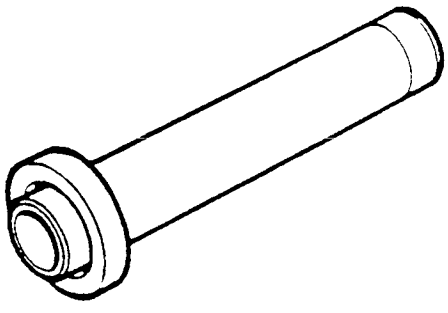
18G 284 Impulse extractor



18G284AAH

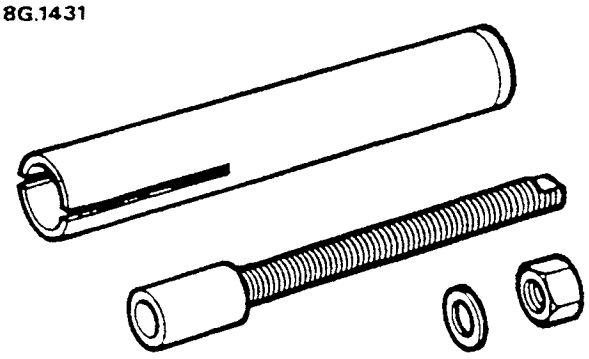
18G 284AAH Adaptor for input shaft pilot bearing track

18G.1422

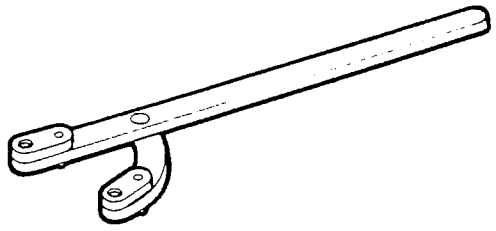


18G 1422 Mainshaft rear oil seal replacer

18G.1431



18G 1431 Mainshaft rear oil seal replacer



18G1205

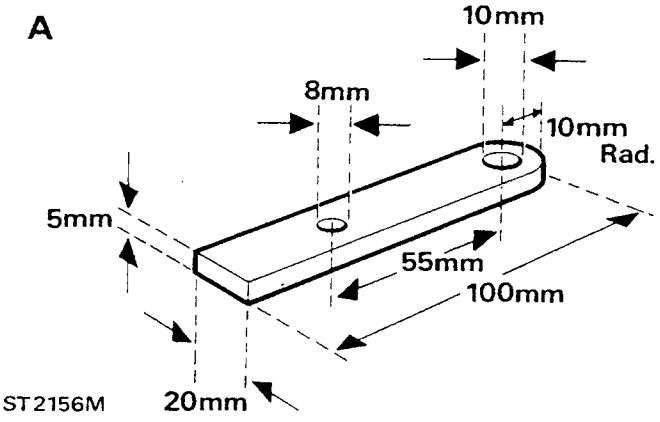
18G 1205 Flange holder

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 following 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.

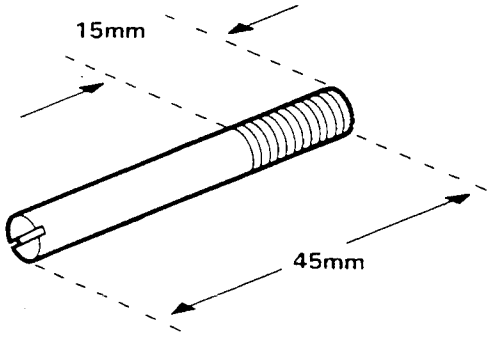
A



ST2156M

Tool 'B'. Four pilot studs with an 8mm thread for locating in the four counter sunk blind holes in the workstand.

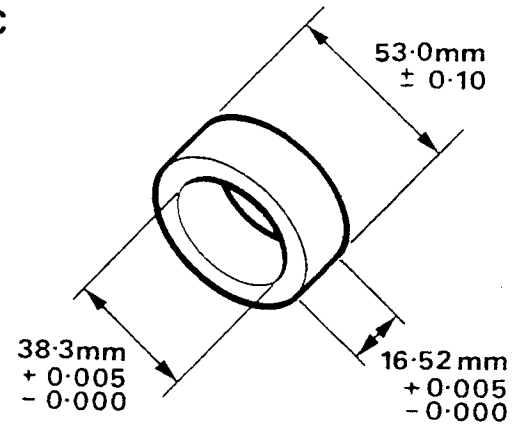
B



ST 2155M

Tool 'C'. Mild steel dummy centre bearing for the selection of first gear bush.

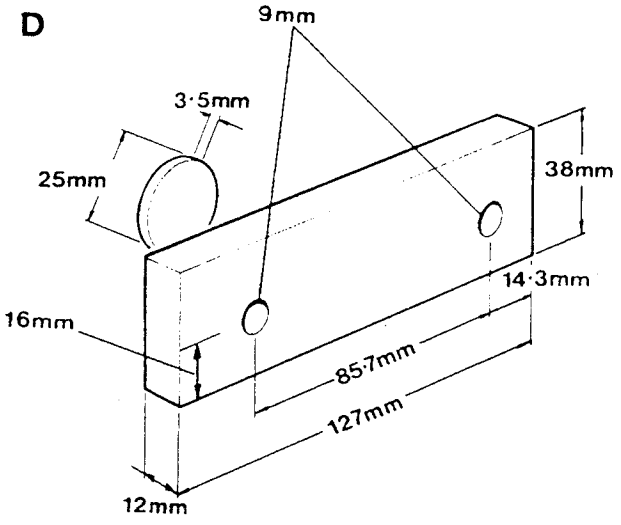
C



ST2154M

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.

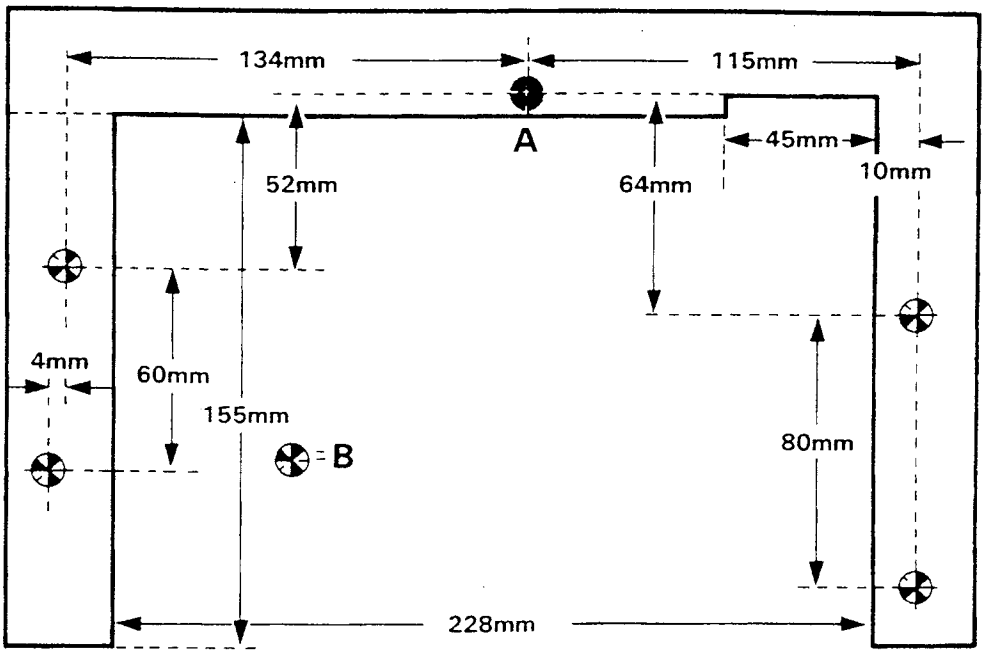
D

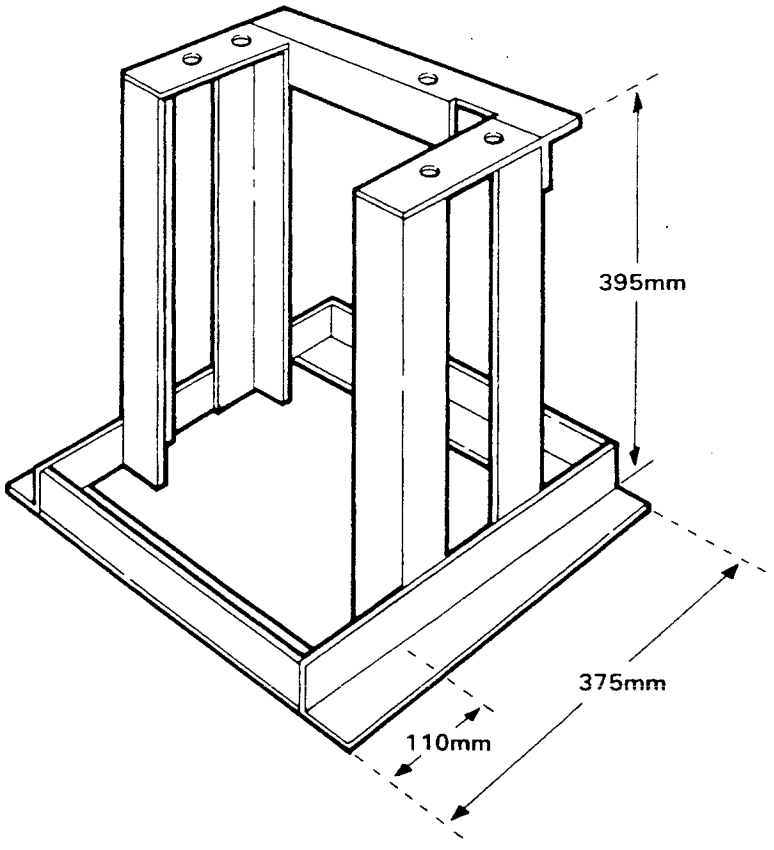


ST1118M

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.

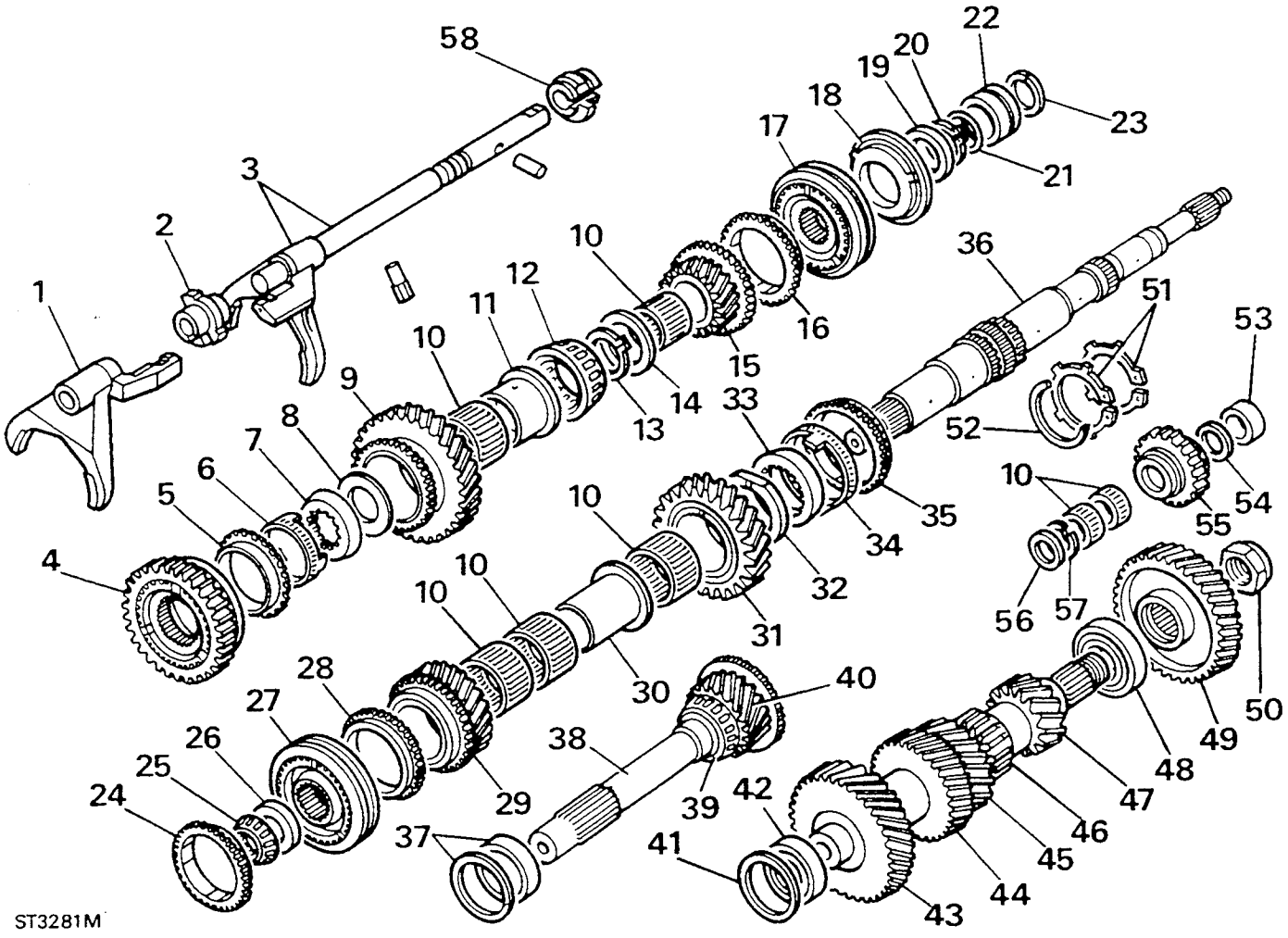




ST2153M

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 synchromesh selective 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 retaining first gear and first-second gear synchromesh.
52. Snap ring retaining second gear cone and spacer.
53. Spacer.
54. Snap ring.
55. Reverse idler gear.
56. Thrust washer.
57. Snap ring.
58. Fifth gear spool.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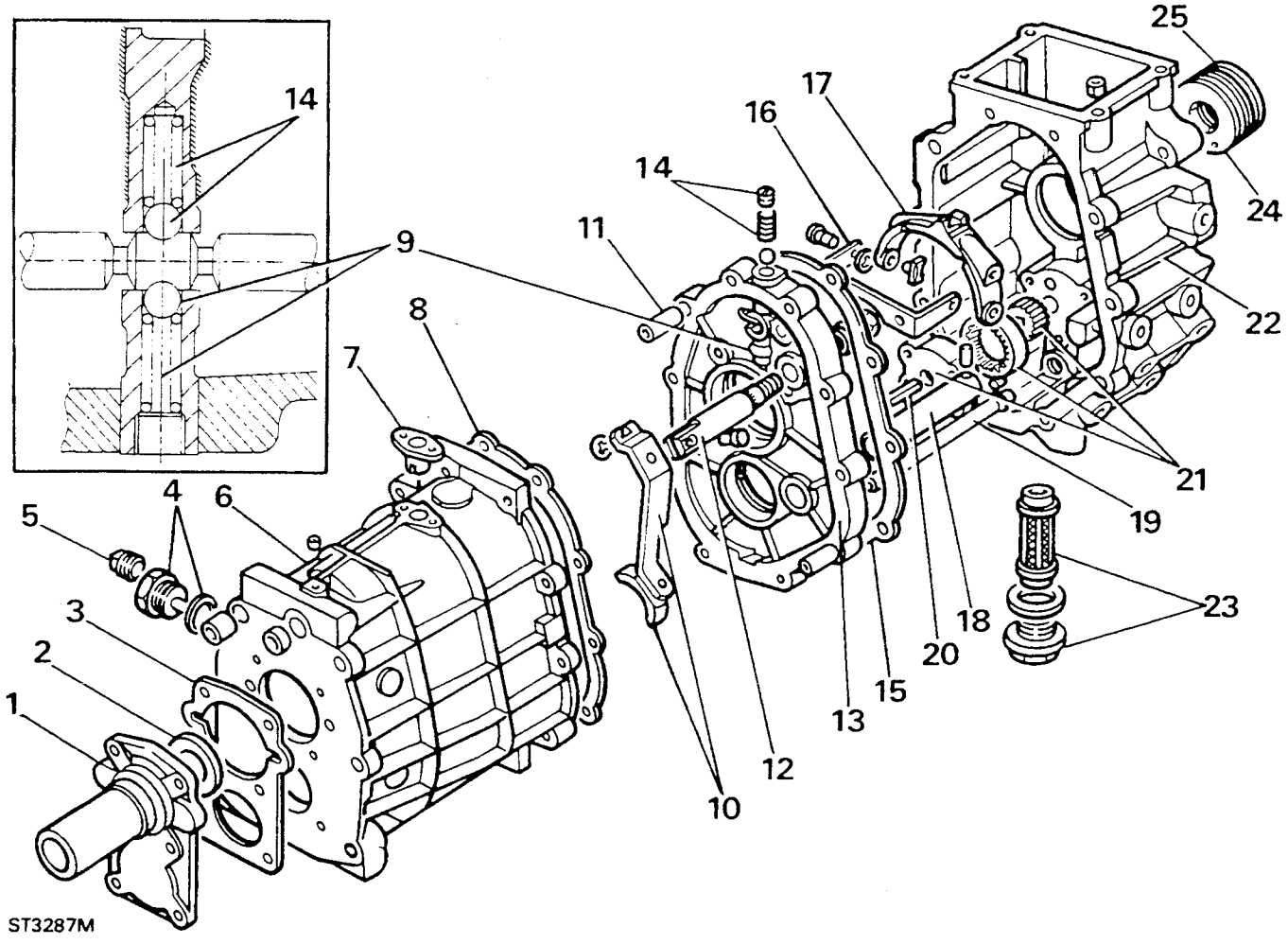
ST3281M

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.



Land Rover
Range Rover

Workshop Bulletin

ATTENTION SERVICE MANAGER

JUNE 1987
BULLETIN NUMBER SLR 621 EN WB1

LAND ROVER

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GEMMER POWER ASSISTED STEERING

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57 STEERING

— Gemmer power assisted steering box — Overhaul 13

INTRODUCTION

This Bulletin covers the Introduction of the twin SU H.I.F. 44 Carburetters on the Land Rover 90 and 110 V8 Engine, and the Gemmer Power assisted steering box prior to it being included in the updated 90-110 Workshop Manual, which will be numbered as follows

SLR 621 EN WM — English
SLR 622 DU WM — Dutch
SLR 623 FR WM — French
SLR 624 GR WM — German
SLR 625 IT WM — Italian

CARBURETTER OVERHAUL — S.U. HIF 44 — Right hand

DISMANTLE

1. Remove the carburetters from the engine and clean the exteriors with a suitable solvent.
2. Remove the two nuts and spring washers and withdraw the air intake adaptor and joint washer.
3. Unscrew and remove the piston damper assembly and drain the oil.
4. Remove the three screws and lift-off the suction chamber complete with piston and spring.
5. Remove the spring clip from the top of the piston rod and withdraw the piston and spring.
6. Unscrew the fuel metering needle guide locking screw. If the needle cannot be removed from the piston with the fingers, hold the needle as close to the piston as possible, in a soft jawed vice and with a sharp pull withdraw the needle, guide and spring assembly.
7. Remove the four screws and withdraw the float chamber cover plate and sealing ring.
8. Remove the jet adjusting lever retaining screw and spring.
9. Withdraw the jet complete with the bi-metal lever and seperate the lever from the jet.
10. Unscrew and remove the float pivot spindle and plain washer, and remove the float.
11. Lift-out the needle valve.
12. Unscrew and remove the needle valve and filter.
13. Unscrew and remove the jet bearing nut.
14. Invert the carburetter body to allow the jet bearing to fall out. If the bearing sticks, carefully tap it out from the bridge side.
15. Remove the piston guide peg.
16. Remove the suction chamber-to-body sealing ring.
17. Unscrew and remove the mixture adjusting screw and seal. Use thin nosed pliers to finally withdraw the screw.
18. Bend-back the cam lever nut lock tabs and remove the nut and lock washer.
19. Remove the cam lever and spring.
20. Remove the end seal cover and seal.
21. Remove the two screws and withdraw the cold start valve body and seal together with the valve spindle. Also collect the paper joint washer.
22. Note the position of the throttle levers and return spring.
23. Bend-back the lock washer tabs and remove the throttle lever nut.
24. Remove the lock washer, bush washer and throttle actuating lever.
25. Release the throttle return spring and remove the throttle adjusting leaver from the throttle butterfly spindle and remove the return spring.
26. Hold the butterfly closed and mark the relationship of the butterfly to the carburetter flange.
27. Remove the butterfly two retaining screws and withdraw the butterfly from the spindle.
28. Withdraw the throttle butterfly spindle from the carburetter body together with the two seals.
29. Clean all components with petrol or de-natured alcohol ready for inspection. Do not use abrasives for the removal of stains or deposits.

INSPECTION

30. Examine the throttle spindle and bearings for excessive axial clearance.
31. Check the float needle and seating for wear and the float for punctures and renew if necessary.
32. Check the condition of all rubber seals, 'O' rings and joint washers and renew if necessary. The float cover plate seal must be renewed.
33. Examine the carburetter body for cracks and damage.
34. Ensure that the inside of the suction chamber is clean and fit the piston into the chamber without the spring. Hold the assembly horizontally and spin the piston. The piston should spin freely in the suction chamber without any tendency to stick.
35. Inspect the metering needle for wear, scores and distortion. Check also that it has the correct designation number — see Engine Tuning Data, Section 05.
36. Examine the bi-metal jet lever for cracks.
37. Check all springs for cracks and distortion.

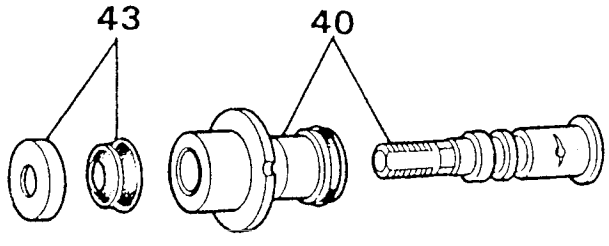
ASSEMBLE

Fit throttle butterfly

38. Fit the throttle spindle to the carburetter body and insert the throttle disc into the spindle in its original position. Secure the disc with new screws and ensure that before tightening the throttle disc is correctly positioned and closes properly. Splay the split ends of the screws to prevent turning.
39. Fit new seals to both ends of the throttle spindle ensuring that they are fitted the correct way round.

Fit cold start assembly

40. Fit a new 'O' ring to the valve body and assemble the valve spindle to the valve body.



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41. Fit a new paper joint washer to the valve noting that the half-moon cut-out in the washer is clearance for the top retaining screw.

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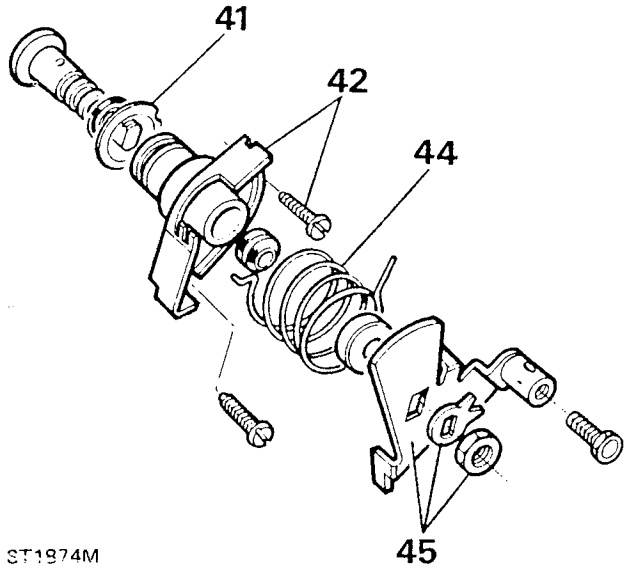
42. Fit the starter assembly to the carburetter body and secure with the two screws.
43. Fit the end seal and cover.
44. Fit the return spring.
45. Fit the cam lever and tension the spring. Fit a new lock washer and secure with the nut and bend the tabs over a convenient flat.
46. Adjust the coils of the spring, if necessary, to prevent coil binding.



KEY TO S.U. CARBURETTER COMPONENTS

1. Piston damper.
2. Spring clip.
3. Suction chamber.
4. Piston.
5. Piston spring.
6. Suction chamber retaining screws — 3 off.
7. Needle retaining screw.
8. Needle bias spring.
9. Needle guide.
10. Needle.
11. Suction chamber sealing ring.
12. Throttle adjusting screw and seal.
13. Piston key and retaining screw.
14. Mixture adjusting screw and seal.
15. Carburetter body.
16. Throttle butterfly and retaining screws.
17. Throttle spindle.
18. Throttle spindle seals — 2 off.
19. Float chamber.
20. Float chamber cover and retaining screws.
21. Float chamber cover seal.
22. Jet assembly.
23. Jet bearing.
24. Jet bearing nut.
25. Bi-metal jet lever.
26. Jet retaining and adjusting screw and spring.
27. Float needle.
28. Float needle seat.
29. Float needle seat filter.
30. Float
31. Float pivot spindle.
32. Cold start and cam lever assembly.
33. Throttle adjusting lever and lost motion assembly.
34. Throttle actuating lever.
35. Bush washer.
36. Throttle lever assembly retaining nut and lock washer.

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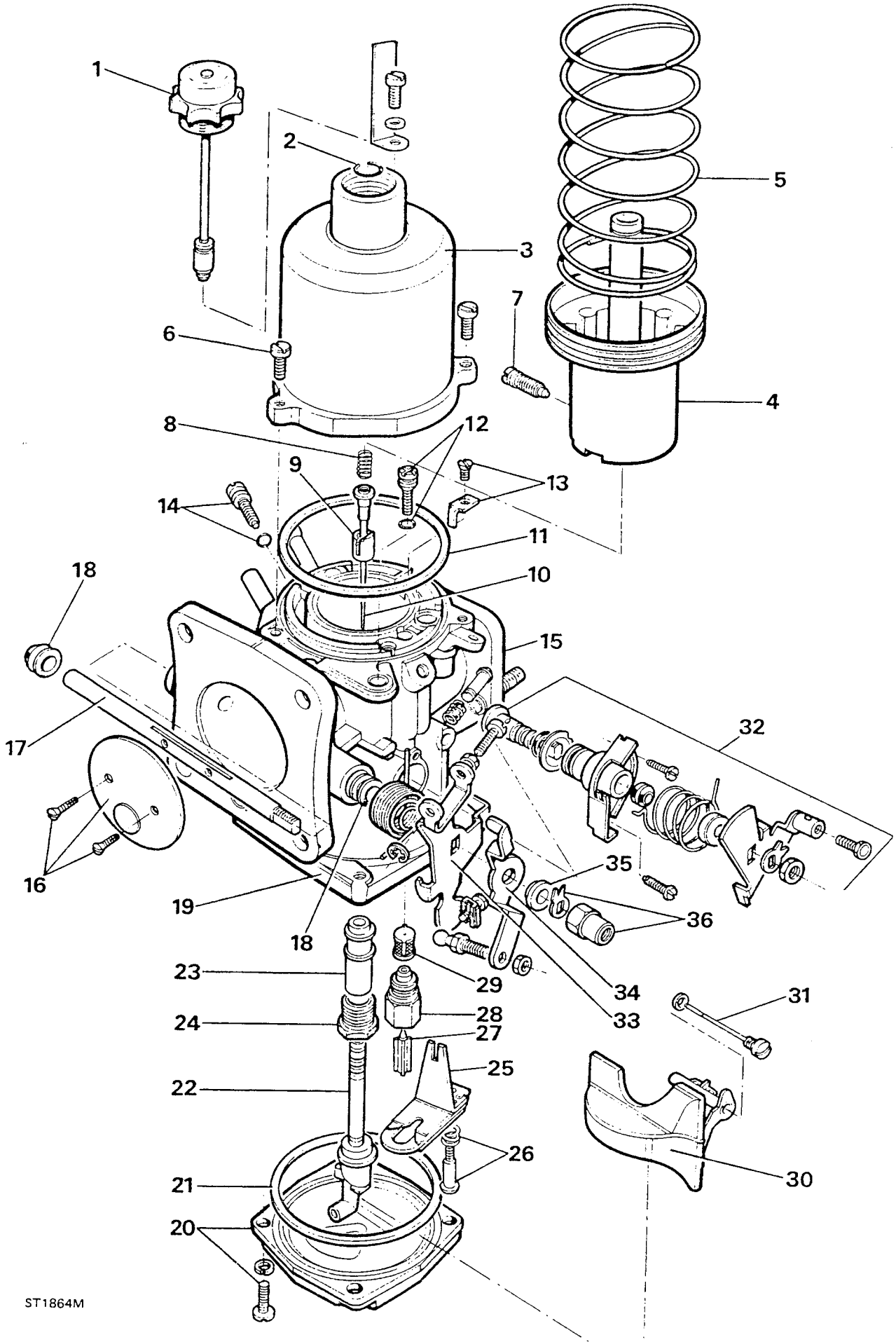
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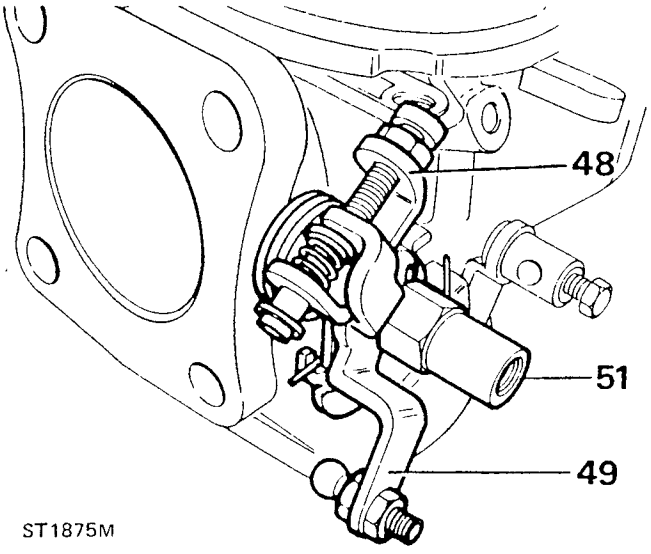
Fit throttle lever assembly

47. Fit the return spring so that the longest leg rests against the throttle adjusting screw housing.
48. Fit the throttle adjusting lever and lost motion assembly and tension the return spring.
49. Fit the throttle actuating lever.
50. Fit the bush washer and lock washer.
51. Fit and tighten the special nut and bend the lock tabs over a convenient flat.



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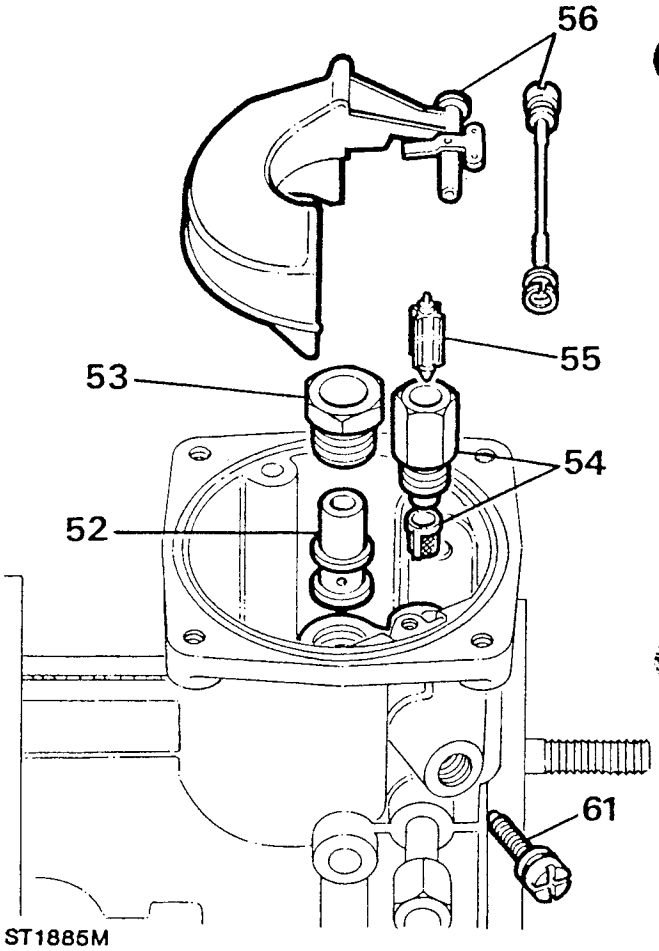

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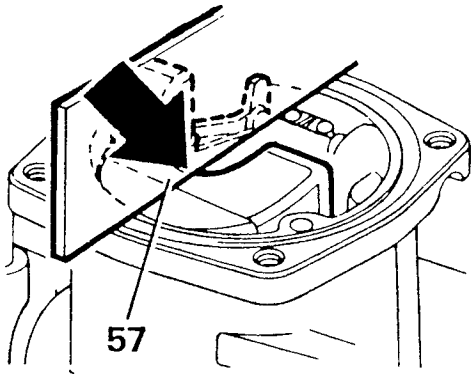
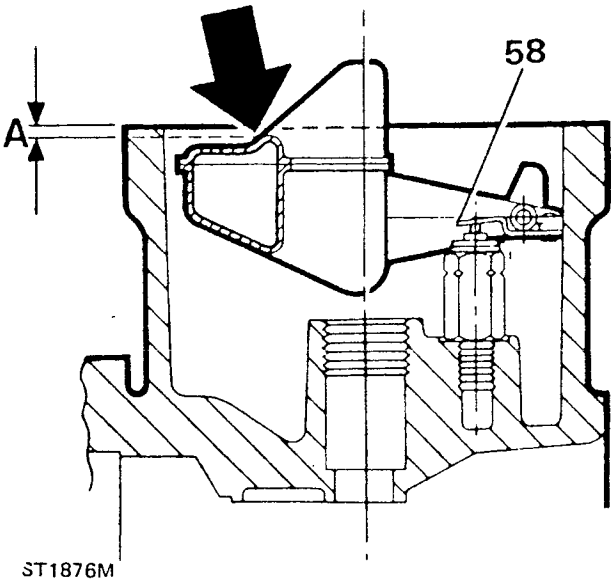
Fit jet and float assembly

52. Fit the jet bearing, long end towards the float.
53. Fit the jet bearing nut.
54. Clean or renew the filter and fit the float needle seat.
55. Fit the needle valve, spring loaded pin uppermost.
56. Fit the float and secure with the pivot pin.
57. Hold the carburetter in the inverted position so that the needle valve is closed by the weight of the float only. Check using a straight edge that the point on the float, arrowed on the illustration, is 1.0 to 1.5 mm (0.04 to 0.062 in) below the level of the float chamber face, dimension 'A'.
58. Adjust the float position by carefully bending the brass pad until the correct dimension is achieved. After adjustment, check that the float pivots freely about the spindle.





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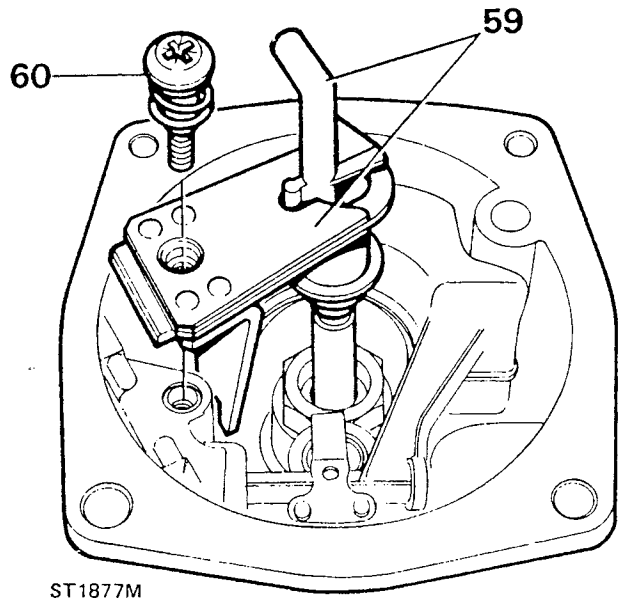
59. Assemble the jet to the bi-metal jet lever and ensure that the jet head moves freely in the cut-out.
60. Fit the jet and bi-metal jet lever to the carburetter and secure with the spring loaded jet retaining screw.
61. Fit the mixture adjusting screw.



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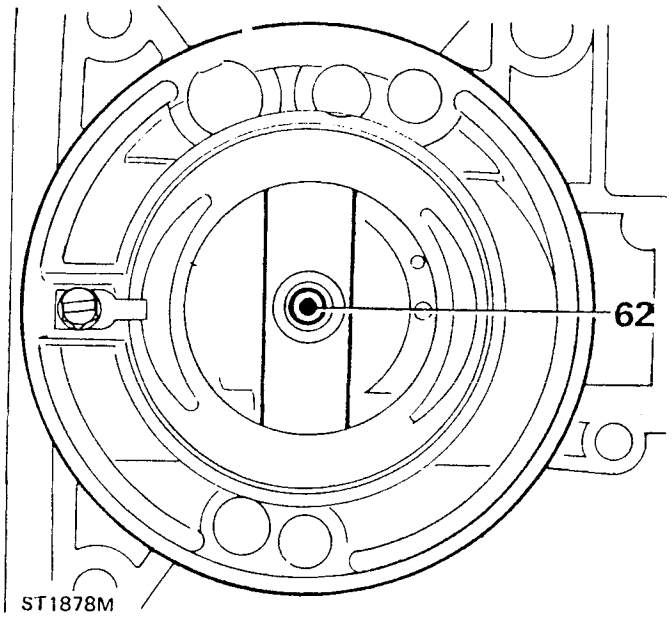
62. Adjust the mixture screw until the jet is flush with the carburetter bridge, then turn the screw a further three and one half turns clockwise.



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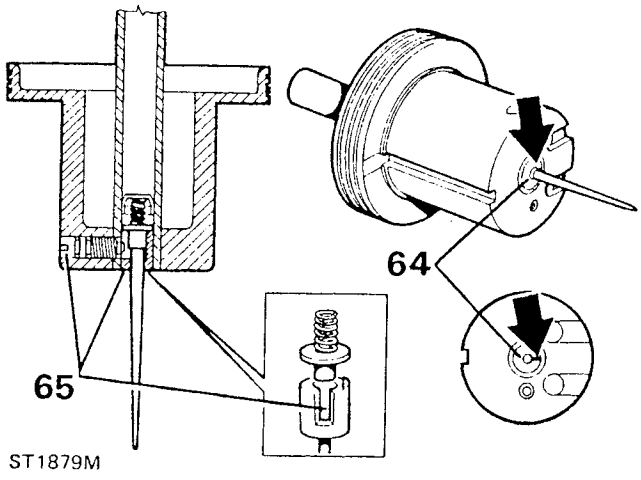
63. Using a new sealing ring, fit the float chamber cover, noting that it can only be fitted one way. Secure with the four screws and spring washers and evenly tighten.

Fit piston and suction chamber

64. Fit the needle, spring and guide assembly to the piston ensuring that the etched arrow head on the needle locating guide is aligned between the piston transfer holes, as illustrated.
65. Secure and ensure that when the screw is tightened the guide is flush with the piston and that the screw locates in the guide slot.



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66. Fit the piston key to the carburetter body using a new screw. Tighten the screw and splay the end.
67. Fit a new suction chamber sealing ring to the groove in the carburetter body.
68. To prevent the piston spring being 'wound-up' during assembly, temporarily fit the piston and suction chamber less the spring to the body, and pencil mark the relationship of the chamber to the body. Remove the suction chamber and fit the spring to the piston. Hold the suction chamber above the spring and piston, align the pencil marks and lower the chamber over the spring and piston, taking care not to rotate the suction chamber. Secure the chamber to the body with the three screws, tightening evenly and check that the piston moves freely.
69. Hold the piston at the top of its stroke and fit the spring clip.
70. Fit the piston damper.
71. Using a new joint washer, fit the air intake adaptor and secure with the two nuts and spring washers.
72. Fit the carburetters to the inlet manifold ensuring that the joint washers, deflector and insulator are fitted in the sequence illustrated. The insulator must be fitted with the arrow head uppermost and pointing inwards towards the manifold. Secure with the four nuts and spring washers and tighten evenly to the correct torque.
    A. Joint washer.
    B. Deflector-teeth pointing inwards.
    C. Joint washer.
    D. Insulator.
    E. Joint washer.

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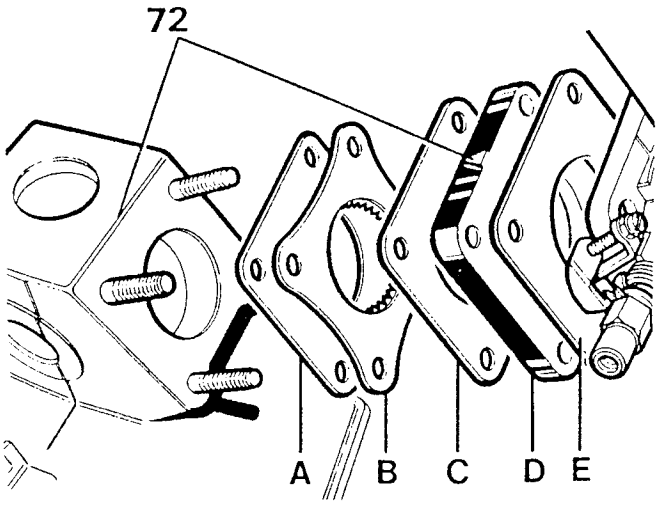

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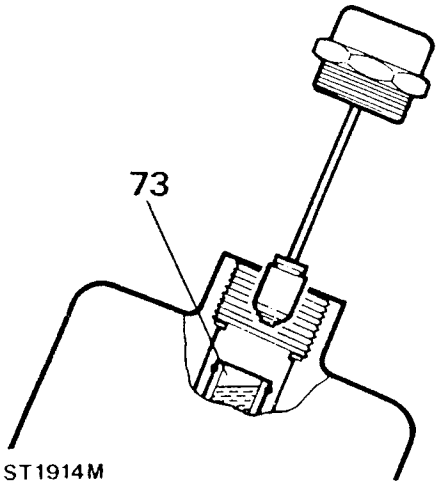
73. Connect the linkages and top-up the carburetter dampers with a recommended oil to the top of the hollow piston rod.
74. Tune and adjust the carburetters.



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TUNE AND ADJUST — SU HIF 44 CARBURETTERS

Special tools:

Carburetter balancer 605330 or B89
Non-dispersive infra-red exhaust gas analyser.

General Requirements Prior to Tuning Carburetters.

Accurate engine speed is essential during carburetter tuning, therefore the distributor pick up air gap and ignition timing must be checked together with the vacuum advance system.
Whenever possible the ambient air temperature of the tuning environment should be between 15° to 26°C (60° to 80°F). When checking engine speed, use an independent and accurate tachometer.
Idling adjustments should be carried out on a fully warmed up engine, that is, at least 5 minutes after the thermostat has opened. This should be followed by a run of one minute duration at an engine speed of approximately 2,500 rev/min before further adjustments or checks are carried out. This cycle may be repeated as often as required. It is important that the above cycle is adhered to, otherwise overheating may result and settings may be incorrect. The piston dampers must always be kept topped-up with the correct grade of oil.
Before any attempt is made to check settings a thorough check should be carried out to ensure that the throttle linkage between the pedal and carburetters is free and has no tendency to stick. Ensure that the choke control lever is pushed fully down.
NOTE: References to left and right hand are as from the drivers seat.

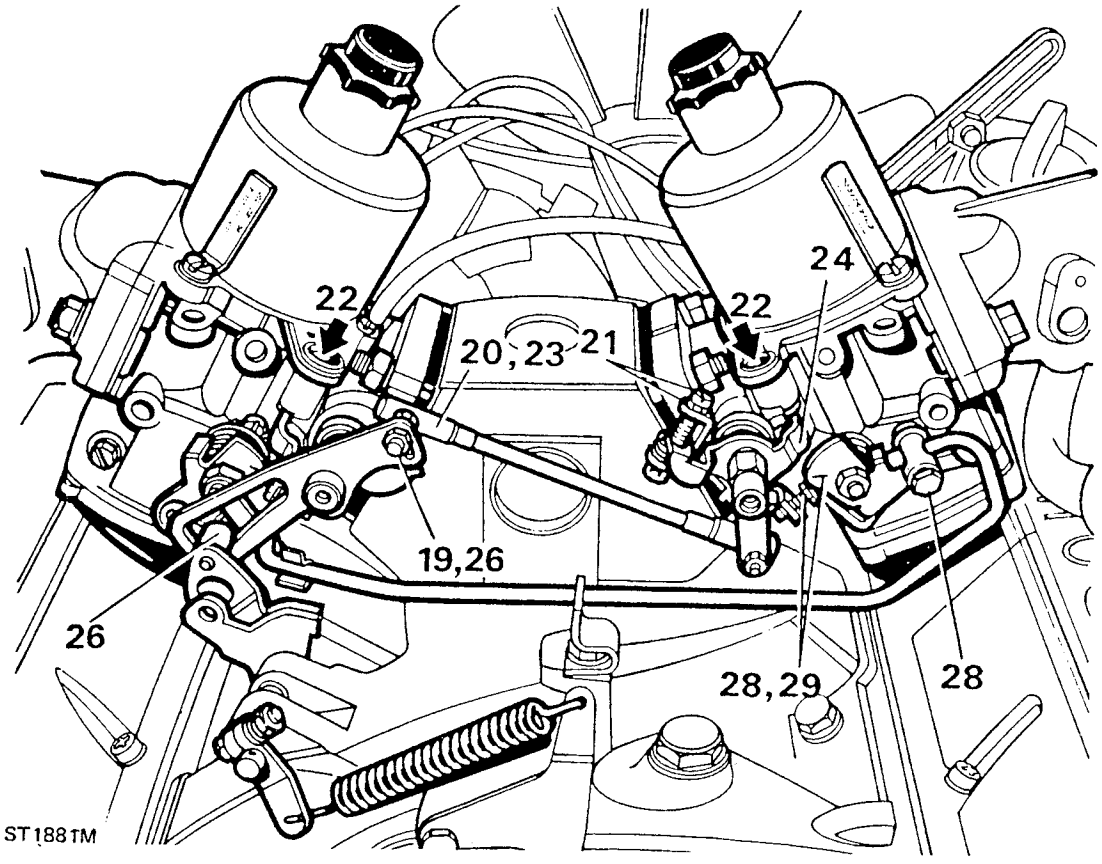
TAMPER — PROOFING

To comply with E.C.E. regulations the idle speed and mixture adjusting screws must be tamper — proofed following any adjustments. A red blanking plug; **Part number — JZX 1258** must be fitted into the mixture screw resess and a red cap; **Part number JZX 1197** fitted over the idle adjustment screw (throttle adjustment screw).

continued

TUNING DATA

MODEL	CARBURETTER PART No.	S.U. SPEC No.	EXHAUST CO (NEW ENGINE)	EXHAUST (After 3000 km)	IDLE SPEED R.P.M.	FAST IDLE SPEED R.P.M.
ALL H/COMP V8 ENGINES	ETC7122 ETC7123	FZX2006	0,5 to 2,5%	0.5 to 2,5%	600 - 700 NEW ENGINE 700 - 800 RUN-IN ENGINE	1100 ±50
ALL L/COMP V8 ENGINES	ETC7124 ETC7125	FZX2005				



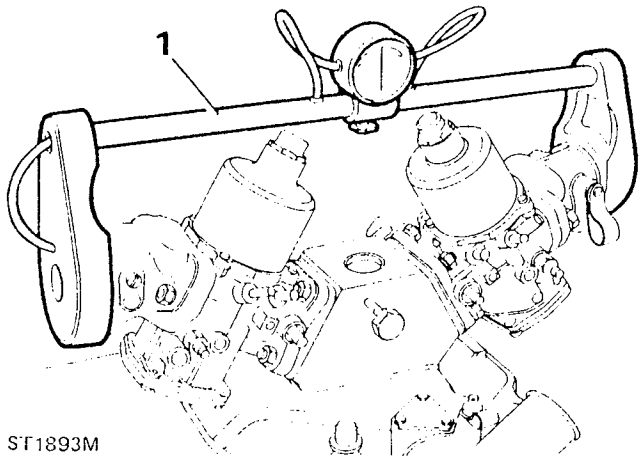
The following instructions apply to both carburetters unless otherwise stated.

Before commencing the following instructions, remove the air cleaner, air intake elbows, mixture adjustment screw plug and mixture screw cap.

CARBURETTER BALANCE

Using balancer 605330

1. Disconnect the interconnecting link between the two carburetters. Fit the balancer to the carburetter intakes and ensure that there are no air leaks, if necessary, zero the gauge with the adjustment screw.
2. Start the engine, and if necessary allow it to reach normal operating temperature. If the needle moves to the right, decrease the air flow through the left hand carburetter by unscrewing the idle screw. Alternatively, increase the air flow through the right hand carburetter by screwing down the idle screw. Reverse the procedure if the pointer moves to the left. Reconnect the carburetter inter-connecting link.



Using balancer B89

3. Disconnect the inter-connecting throttle link between the two carburetters.
4. Back-off the idle adjusting screw on each carburettter, clear of the throttle lever.
5. Turn each throttle adjusting screw so that it touches the throttle lever, then turn the screws by equal amounts to achieve an approximate idle speed of 700 to 800 rev/min.
6. Press the balancer firmly over the carburetter intake. Press or withdraw the control on the side of the balancer to adjust the meter needle reading to approximately half scale, and note the reading.

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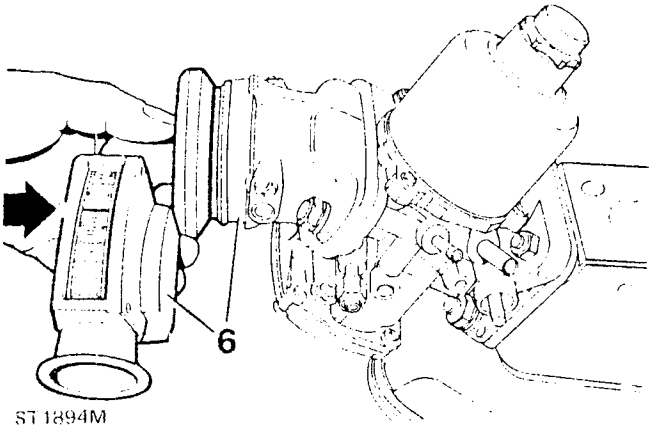
7. Without altering the position of the balancer control, place the balancer on the second carburetter intake and adjust the idle screw as necessary to achieve the same reading.



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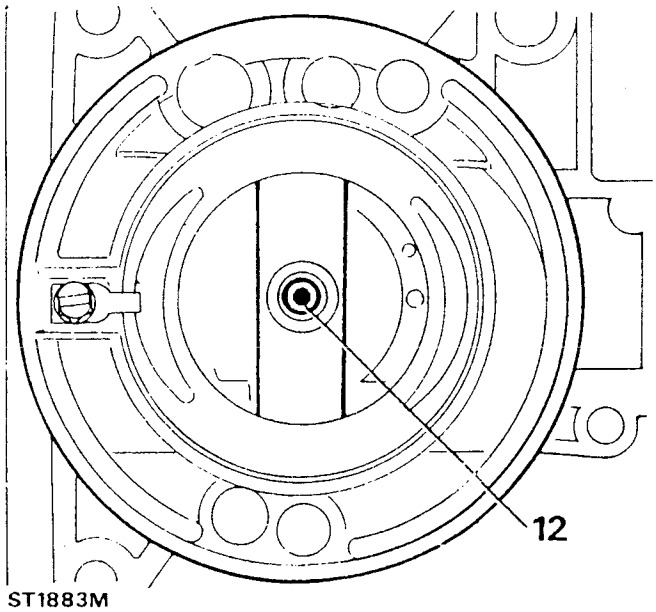
8. Alternatively, adjust and check the balance of both carburetters until an idle speed of 700 to 800 rev/min is obtained.
9. Reconnect the throttle inter-connecting link, and again check the idle speed and balance.

Mixture setting

10. Ensure that the engine is still at normal operating temperature.
11. Mark the relationship of the suction chamber to the carburetter body, remove the retaining screws and lift off the suction chamber complete with pistons.
12. To achieve a datum setting for the mixture screw, turn it anti-clockwise until the jet is level with the carburetter bridge. Check by placing a straight edge across the bridge and adjust as necessary so that the jet just touches the straight edge.
13. Refit the suction chamber and piston, evenly tighten the retaining screws. Check that the piston moves freely without sticking. Top-up the piston damper.



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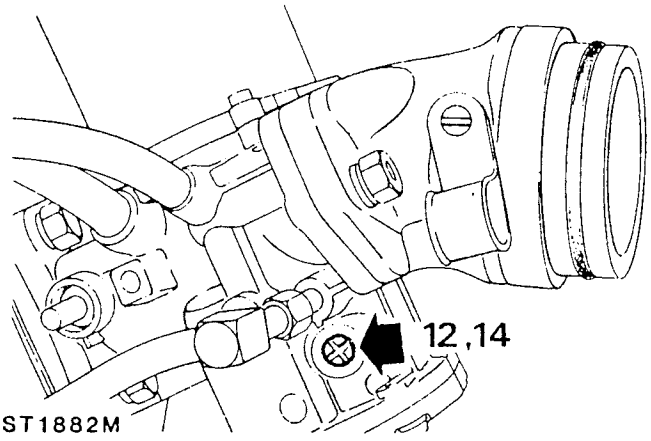

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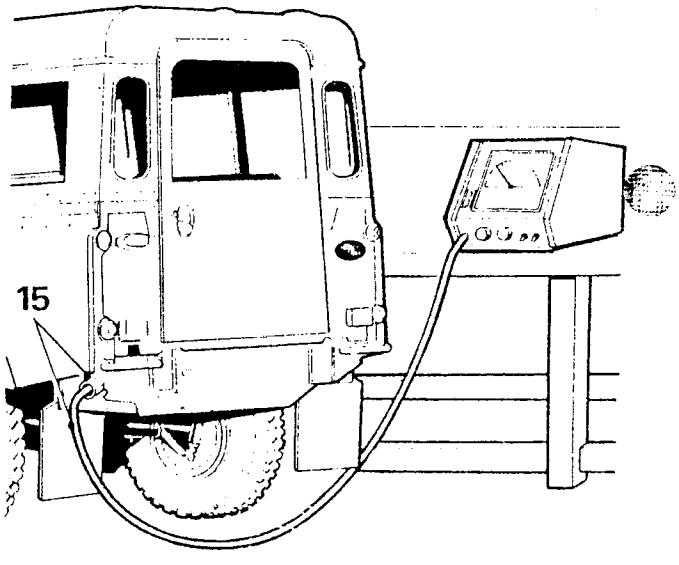
14. Turn the mixture adjustment screw three and one half turns clockwise.
15. Insert the probe of an infra-red exhaust gas analyser as far as possible up the exhaust pipe, start the engine and allow a one and one half minute stabilisation period.
16. Adjust the mixture screw on both carburetters by equal amounts, rich or weak to achieve a CO reading of 0.5 to 2.5%.
17. If after approximately two minutes the CO level is not satisfactory run the engine at 2000 rev/min for one minute to stabilise the equipment, continue the setting procedure until a stable CO reading of 0.5 to 2.5% at an idle speed of 700-800 rev/min is obtained.



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Idle speed and linkage adjustment

18. Check that the engine is at normal operating temperature.
19. Slacken the nut, at the left hand carburetter securing the inter-connecting link ball to the throttle cam lever.

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20. Disconnect the inter-connecting link between the carburetters at the left hand carburetter.
21. At the right hand carburetter, release the lock nut and slacken off the lost motion adjustment screw, until it is well clear of the spring loaded pad.
22. If necessary adjust the idle screw to maintain the correct idle speed. Check the CO level and carburetter balance, adjust if required.
23. Re-connect the inter-connecting link to the left hand carburetter.
24. Hold the right hand throttle lever against the idle screw stop and adjust the lost motion screw until contact is made with the spring loaded pad, tighten the lock nut.
25. Check the idle speed and balance. Adjust the lost motion screw to restore balance if necessary.
26. Ensuring that the roller is firmly seated in the lower corner of the cam lever, tighten the nut which secures the inter-connecting link ball to the cam lever.

Fast idle adjustment

27. Pull out the cold start control (choke) until the scribed line on the left hand fast idle cam is in-line with the centre of the fast idle screw head.
28. Check that the scribed line on the right hand fast idle cam is similarly in-line with the fast idle screw head. If there is mis-alignment, slacken the fast idle cam link rod screw at the right hand carburetter and move the cam until the scribed line coincides with the centre of the screw head. Tighten the cam rod screw.
29. Turn the fast idle screw clockwise, on each carburetter, until just clear of the cam.
30. Turn the fast idle screw of the leading (left-hand) carburetter down (clockwise) until a slight change in engine speed is noted.
31. Similarly turn the fast idle screw of the second carburetter (right-hand) down until a further slight change of engine speed is noted.
32. Adjust the fast idle screws of both carburetters by equal amounts to achieve a fast idle speed of 1100 to 1150 rev/min.
33. Tighten the fast idle screw lock-nut on both carburetters. Push the cold start (choke) fully home then pull it out again to its full extent and re-check the fast idle speed.
34. Fit the appropriate blanking plug and cap to the mixture screw recess and idle adjusting screw.
35. Fit the carburetter air intake elbows and air cleaner.

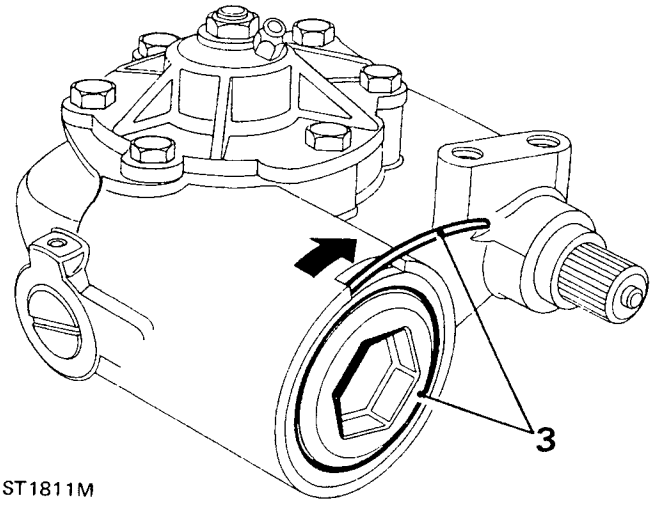
GEMMER POWER STEERING BOX OVERHAUL

Special tools:

Drop arm puller	**MS 252A**
End cover wrench adaptor	**LST123**
Input shaft oil seal installer	**LST124**
Sector shaft oil seal installer	**LST125**
Valve seal installer and valve ring compressor	**LST126**
Preload setting tool	**RO1016**

Dismantle

1. Remove the steering box from the vehicle.
2. Bend back the locking tab and remove the drop arm nut. Using special tool MS 252 A or a suitable alternative, withdraw the drop arm from the sector shaft.
3. Using special adaptor tool LST123 turn the cylinder cover anti-clockwise to expose end of the locking ring. Now turn the cover clockwise to extract the ring.



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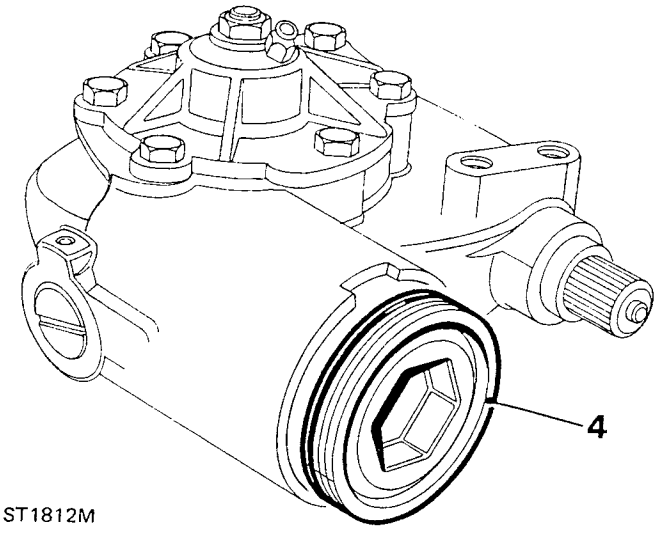
4. To remove the cover, turn the input shaft to the left lock for a LHD drive steering box or to the right for a RHD drive steering box until the rack piston pushes the cover out to enable it to be withdrawn by hand.



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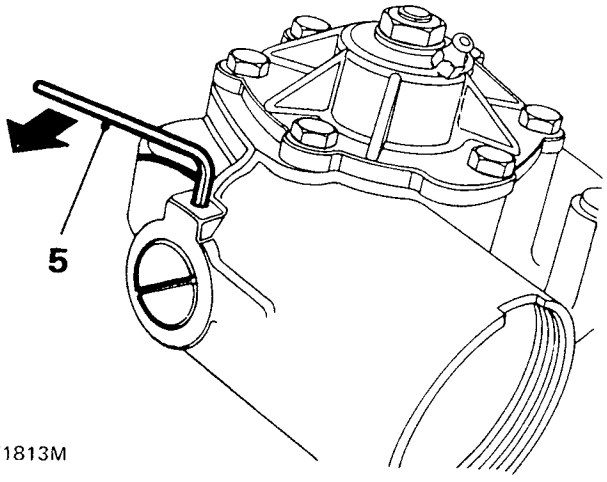
5. Slacken the grub screw securing the rack pad adjuster.



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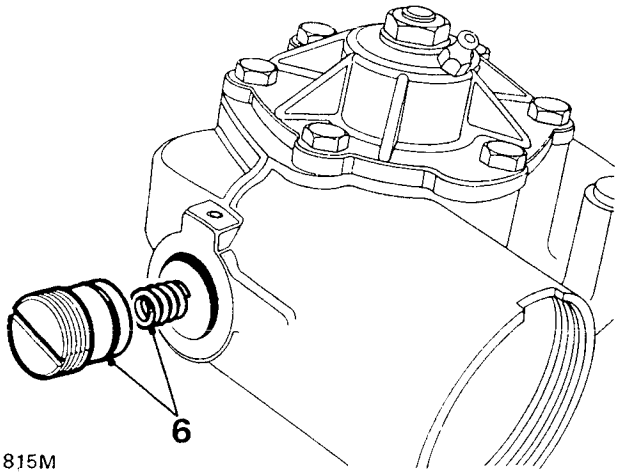
6. With a screwdriver remove the rack pad adjuster, 'O' ring and spring.



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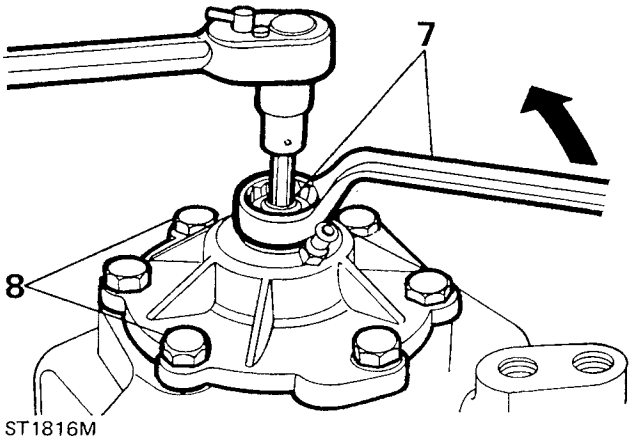
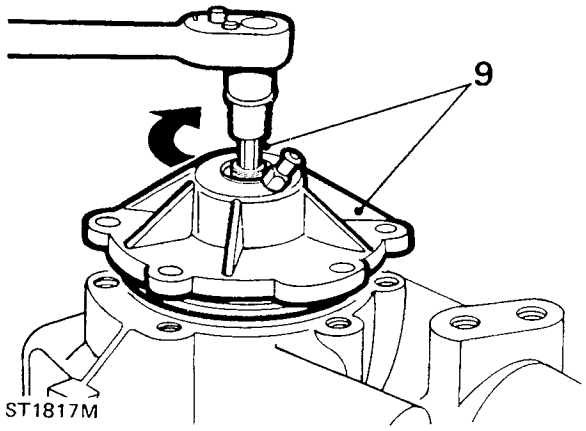
7. Restrain the sector shaft adjuster with a 6 mm hexagonal key and remove the locknut.
8. Remove the six bolts securing the sector shaft cover.



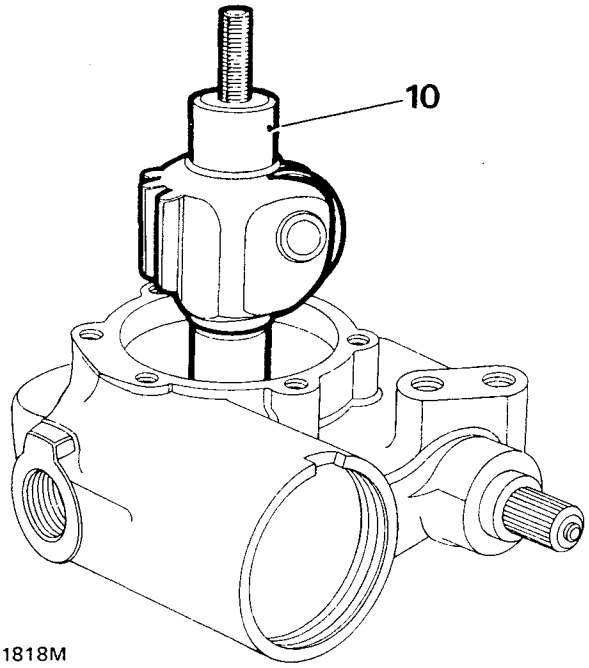
ST1816M

9. Hold the sector shaft cover and turn the adjuster and screw clockwise until the cover can be removed.



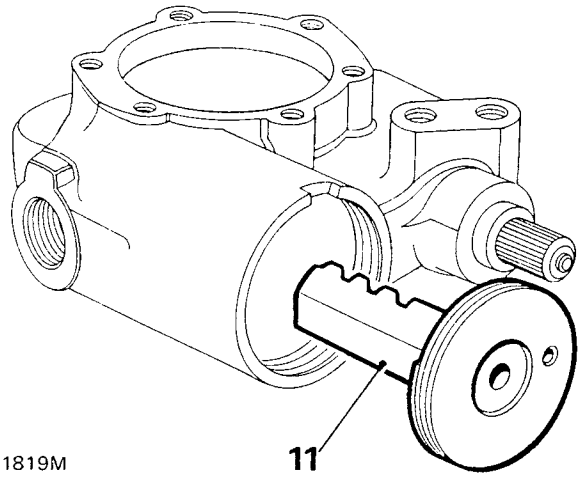
ST1817M

10. Lift-out the sector shaft.



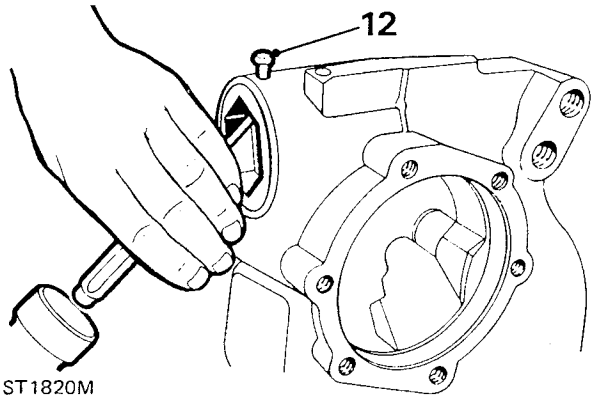
ST1818M

11. Remove the rack and piston assembly and collect the rack adjuster thrust pad.



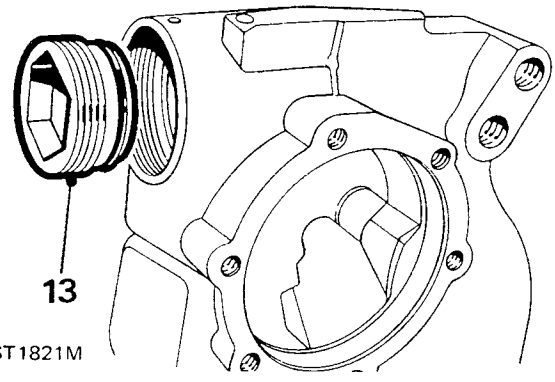
ST1819M

12. Drive-out the worm adjusting screw locking pin.



ST1820M

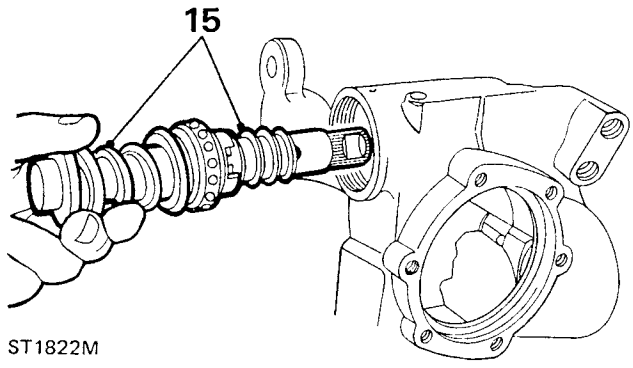
13. Using special tool LST123, remove the input shaft worm adjusting screw anti-clockwise.



ST1821M

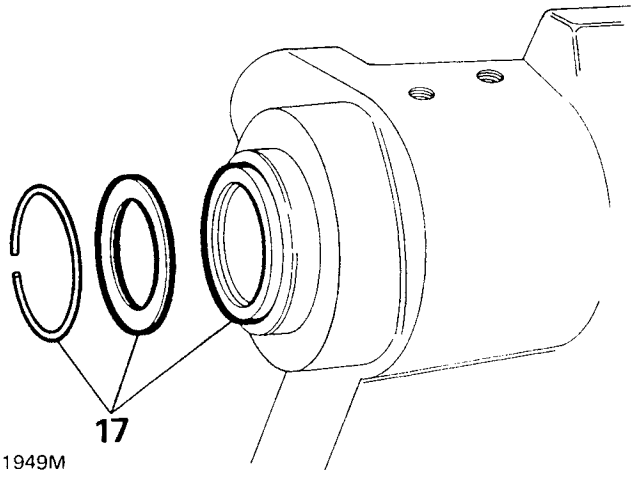
14. Tap the splined end of the input shaft to free the outer bearing. Remove the bearing track and ball cage assembly.

15. Withdraw the input shaft, worm and valve assembly.



ST1822M

16. Release the circlip and remove the steel washer and oil seal from the sector shaft housing.
17. Remove the wire circlip, anti-extrusion washer and oil seal from the input shaft housing.

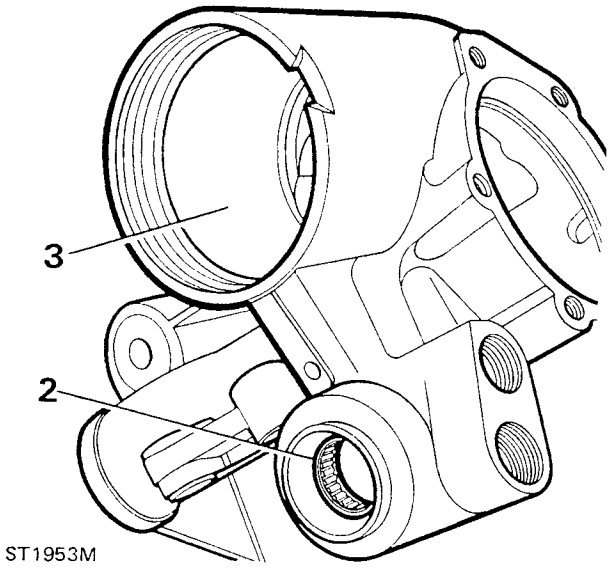


ST1949M

INSPECTION AND OVERHAUL OF COMPONENTS

Steering box housing

1. Examine the sector shaft upper and lower needle roller bearings and if necessary drive them from the housing with a suitable drift.
2. Inspect the input shaft needle bearing and if worn drive it from the housing and press-in a replacement.
3. Examine the piston bore for wear and scores.
4. Check the input shaft bores for wear and scores.

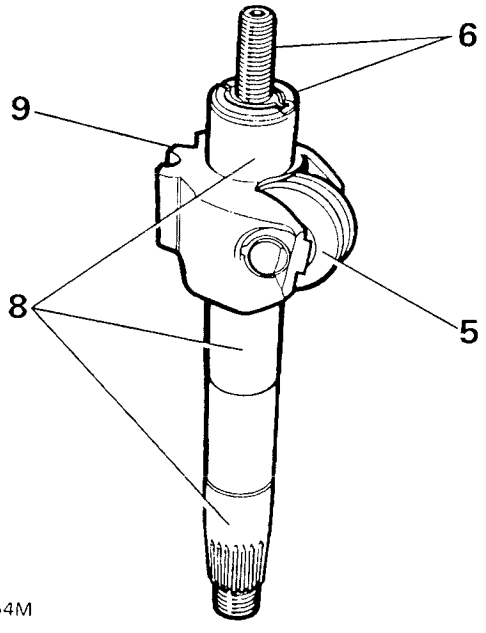


ST1953M

Sector shaft assembly

5. Check that no side play or wear exists in the roller.
6. Check the condition of the adjuster and its retainer and that the crimping is sound.
7. The axial clearance of the adjuster should not exceed 0,20 mm (0.008 in).
8. Examine the bearing journals on the shaft for wear and damage.
9. Check the gear teeth for excessive and uneven wear, scores and pitting.

continued



ST1954M

Valve and worm assembly

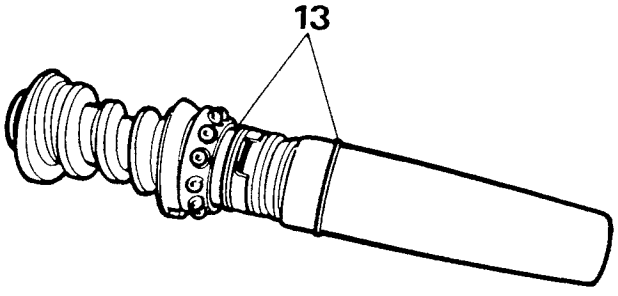
NOTE: If the inner ball race is faulty and unfit for further service it cannot be renewed and a new valve and worm assembly must be obtained and fitted. Should this be the case, the following checks of the valve and worm can be ignored.

10. Examine the valve rings which must be free from cuts, scratches and scores. Also, the rings should be a loose fit in the grooves.
11. If any ring is unsatisfactory, all the rings must be renewed. When removing the rings take care not to damage the valve grooves.
12. To fit new rings use special tool LST126, which consists of the following three parts:-

    a) Ring expander.
    b) Split coller.
    c) Ring compressor.

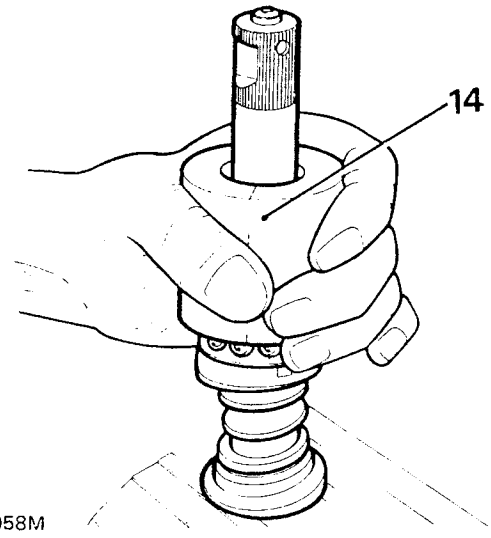
    Before using the tool lubricate each part with the recommended power steering fluid.

13. Warm the five rings in hot water leaving them in the water until ready for fitting. When pliable, feed the ring for the lower groove (nearest the roller bearing) over the expander and position the expander over the input shaft, slide the ring into the groove and mould it into position with the fingers.



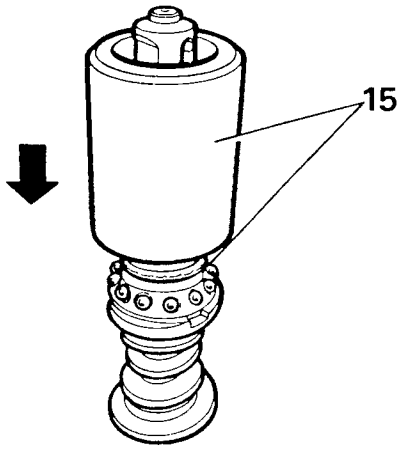
ST1941M

14. Encircle the ring with the split coller and squeeze the coller together, by hand, and hold for approximately thirty seconds.



ST1958M

15. Remove the split coller and with care, ease the compressor tool over the ring and leave for a few minutes to cool before carefully removing the tool.

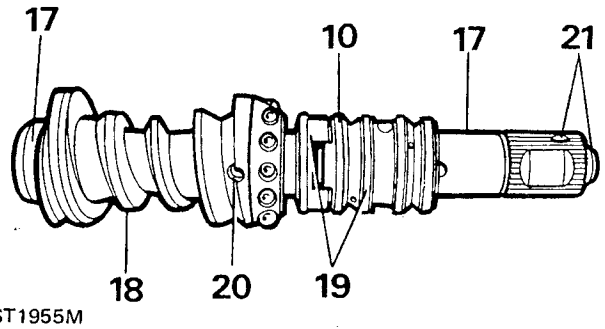


ST1942M

16. Using the expander tool, as before, fit the remaining four rings, one at a time, into the grooves and mould with the fingers. It is important that only one ring at a time is placed on the expander since in the meantime the remaining rings could cool in an expanded condition making it difficult to locate and contract the rings in the valve grooves. Encircle the four rings with the split coller and squeeze together for approximately thirty seconds. Then, with care, ease the compression tool over the four rings and allow to cool for about five minutes before carefully withdrawing the compressor.

continued

17. Examine the bearing surfaces of the valve assembly for wear and scores.
18. Examine the worm track for wear and pitting.
19. Check that the end-float between the locator and valve sleeve does not exceed 0,12 mm (0.005 in).
20. Rotary movement between the components at the trim pin is permissible.
21. Check that no free movement exists on the torsion bar assembly pin between the input shaft and worm.



ST1955M

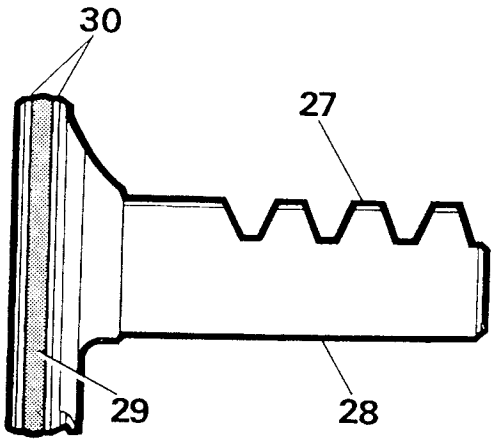
22. The valve and worm assembly should be renewed if there is wear at the following points:
    a) Inner and outer bearing tracks.
    b) Worm.
    c) Valve locator.
    d) Input shaft needle bearing journal.
23. Examine the outer ball race and track for wear and general condition. The race should be renewed if there is wear and pitting or if a new valve and worm assembly is being fitted.

Thrust pad and adjuster

24. Examine the thrust pad for scores.
25. Check that the thrust pad seat in the adjuster is not worn or scored.
26. Check that the thrust pad spring is not broken.

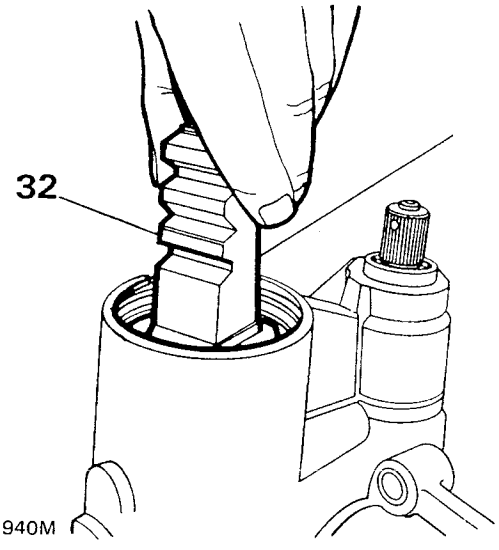
Rack and piston

27. Examine the rack teeth for wear and pitting.
28. Check that the surface on which the thrust pad bears is not worn and scored.
29. Remove the plastic seal and the 'O' ring seal beneath it, from the piston groove.
30. Ensure that the outer diameters of the piston are free from burrs and damage.
31. Fit a new 'O' ring seal to the piston groove.



ST1957M

32. To fit a new plastic seal to the piston, warm the seal in hot water and fit to the piston groove. Insert the piston in the inverted position i.e. piston first into the cylinder and leave to cool.



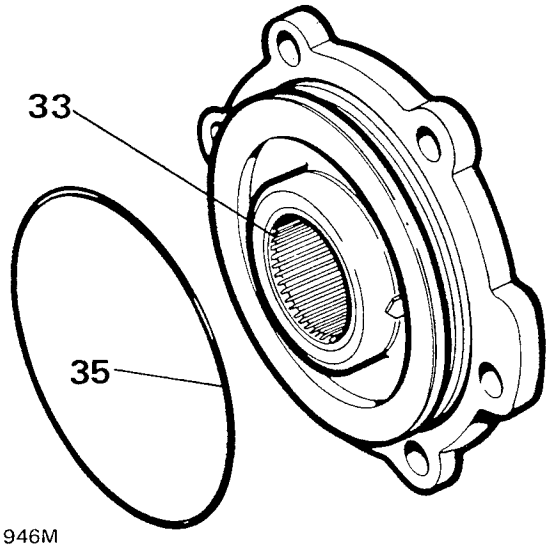
ST1940M

Sector shaft cover

33. Examine the sector shaft cover needle bearing and if necessary extract the bearing taking care not to damage the housing.

continued

34. Drive-in a new bearing, up to the shoulder, with the bearing number and chamfered ends of the rollers trailing.
35. Fit a new 'O' ring seal to the cover.
36. Check that the cover bearing lubrication passage and bleed nipple hole is clear.

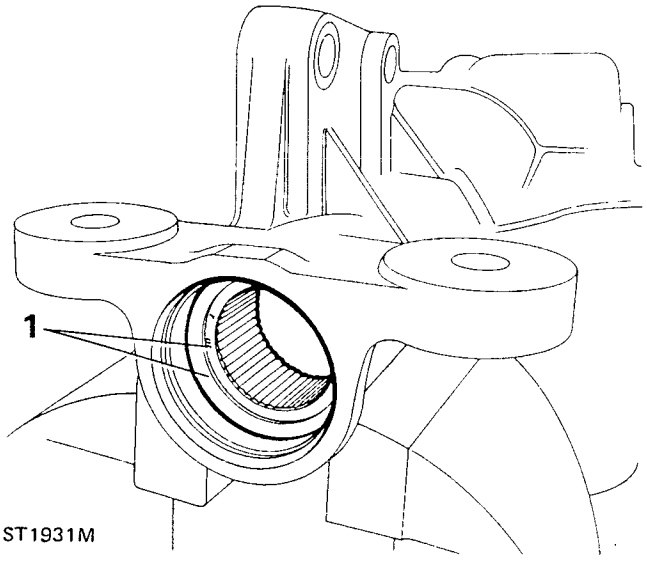


ST1946M

Assemble

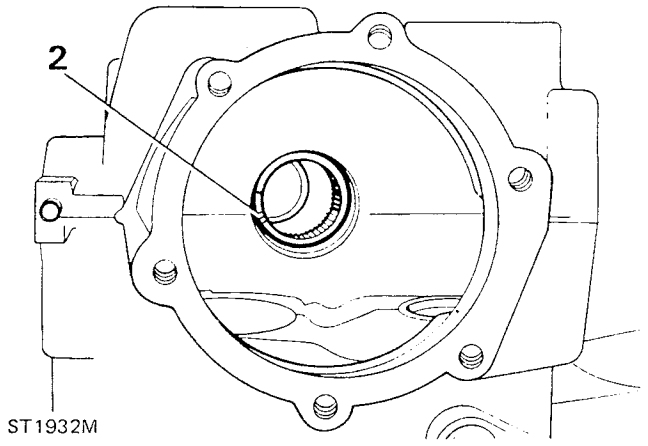
During the following assembly instructions absolute cleanliness must be observed. Also when fitting components and oil seals they must only be lubricated with the recommended fluid, or petroleum jelly.

1. If removed, fit the sector shaft lower needle bearings, numbers outwards, to the steering box to just below the chamfer.



ST1931M

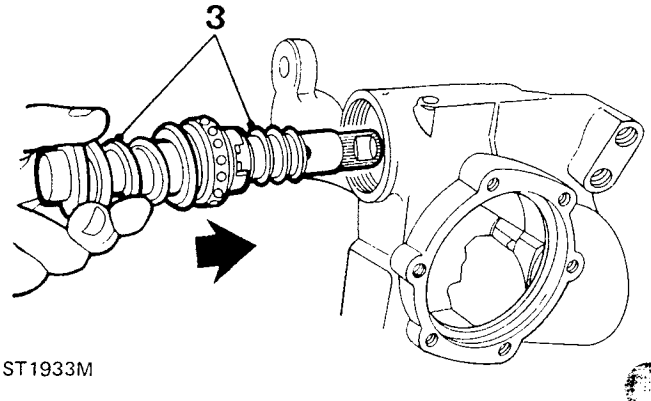
2. Fit the sector shaft upper needle bearings, numbers outwards, up to the shoulder.



ST1932M

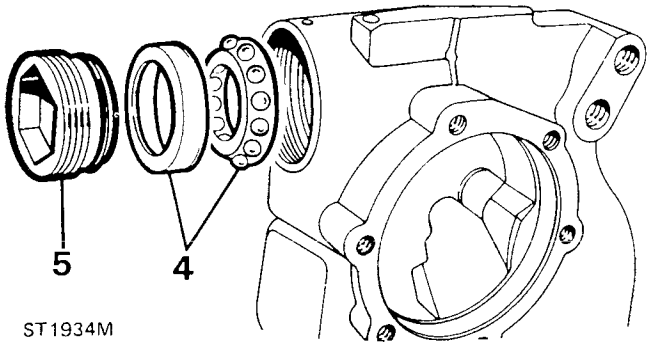
Fitting the valve and worm assembly (input shaft)

3. Fit the input shaft to the steering box housing and lubricate with the recommended fluid. Turn the shaft to the straight ahead position.

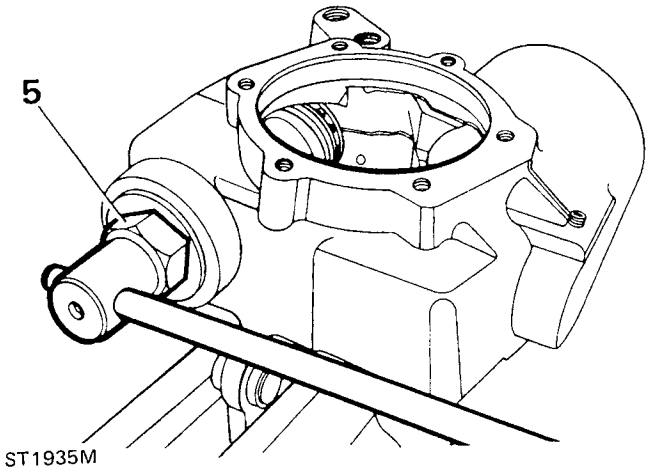


ST1933M

4. Fit the input shaft outer bearing and track.
5. Lubricate and fit the input shaft cover and 'O' ring seal using special tool LST123.

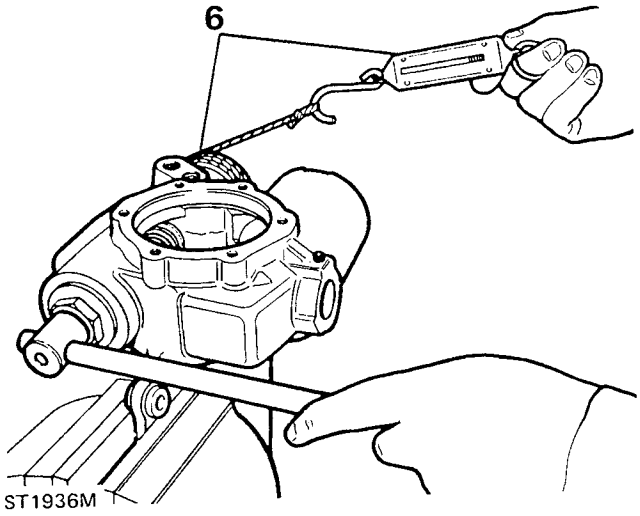


ST1934M



ST1935M

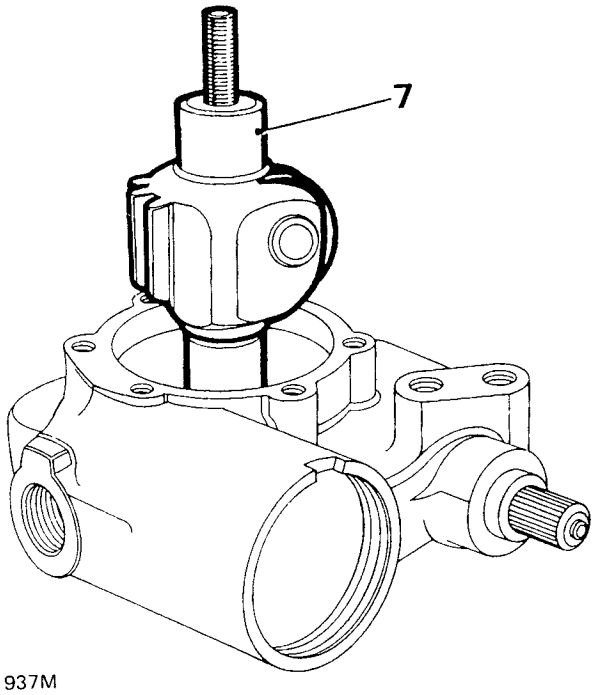
6. Secure preload setting tool R01016 to the input shaft with the grub screw. Wind string round the tool and tie a spring balance to the free end of the string. Whilst turning the input shaft cover clockwise, pull the spring balance until a constant preload reading of 0,69 Nm is achieved.



ST1936M

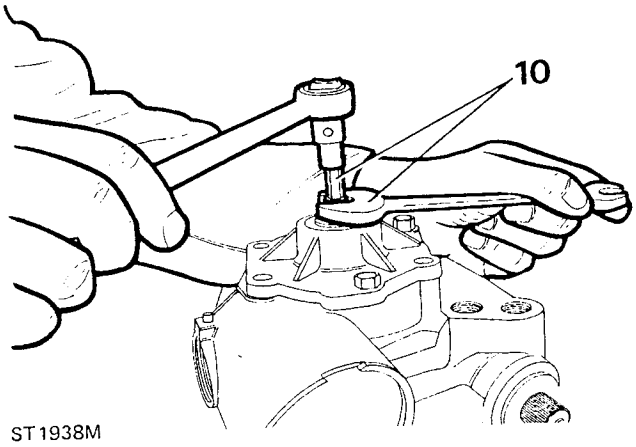
Fitting sector shaft and piston-rack assembly

7. Fit the sector shaft to the housing and engage it with the input shaft worm in the straight ahead position.
8. Screw-on, to the sector shaft adjuster, the sector shaft cover and secure with two or three of the six retaining screws.
9. Turn the adjuster screw clockwise, with a 6 mm hexagonal key, until the sector shaft just makes contact with the input shaft worm.



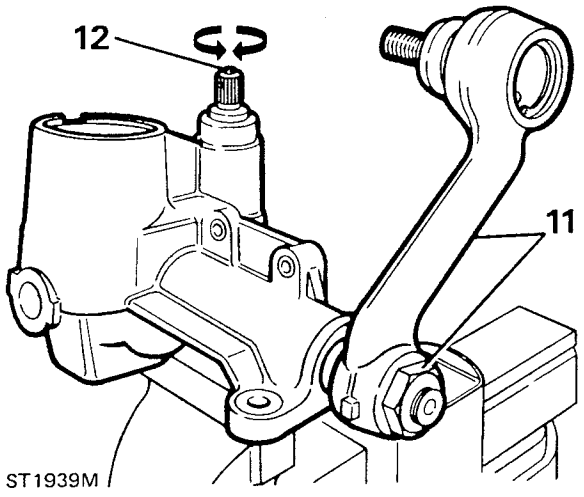
ST1937M

10. Without moving the adjuster, fit the locknut whilst restraining the adjuster screw with the 6 mm key and just nip the locknut with an open-ended spanner.



ST1938M

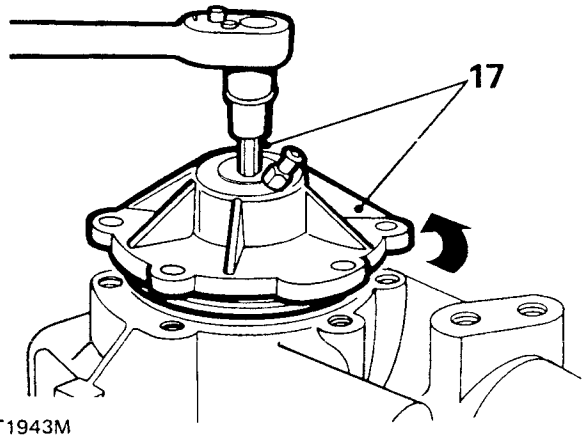
11. Temporarily fit the drop arm and tighten the locknut until no clearance is felt between the sector shaft and drop arm.
12. Rotate the input shaft one turn clockwise, then turn the shaft back to the straight ahead position whilst noting the point at which the backlash to the drop arm disappears or is 'taken-up'.
13. Repeat instruction 12 and rotate the input shaft anti-clockwise on to the opposite lock.



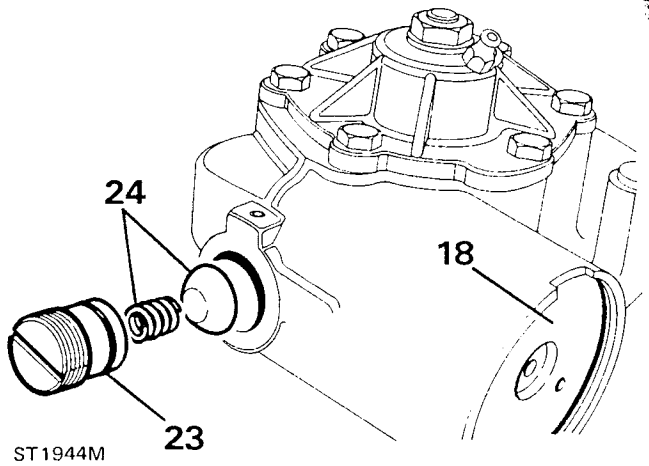
14. If the difference between the two points at which the backlash is 'taken-up' or disappears is greater than 90° (¼ of a turn) it will be necessary to change the shimming behind the input shaft inner bearing cup.
15. If the shimming requires adjustment, add a shim on right-hand drive steering boxes if backlash starts too quickly on clockwise rotation. Should backlash start too quickly for anti-clockwise rotation, remove a shim. For a left-hand drive steering box, reverse the foregoing procedure.

NOTE: If it is necessary to perform instruction 15, instructions 3 to 13 must be repeated afterwards.

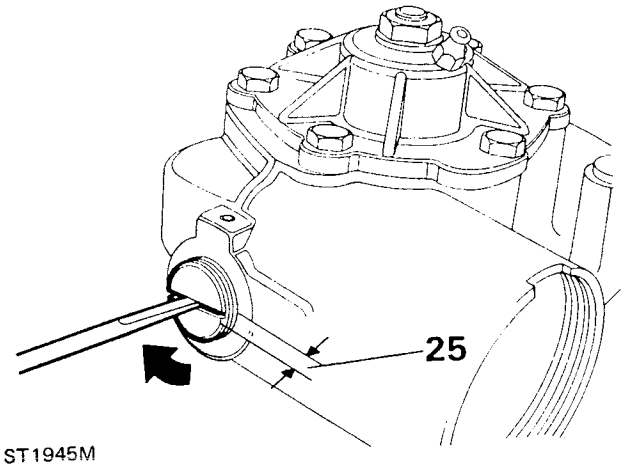
16. Remove the drop arm and whilst restraining the sector shaft adjuster, so that it does not turn, remove the locknut.
17. Remove the sector shaft cover screws and while still restraining the adjuster, unscrew clockwise, the cover from the sector shaft and withdraw the sector shaft.



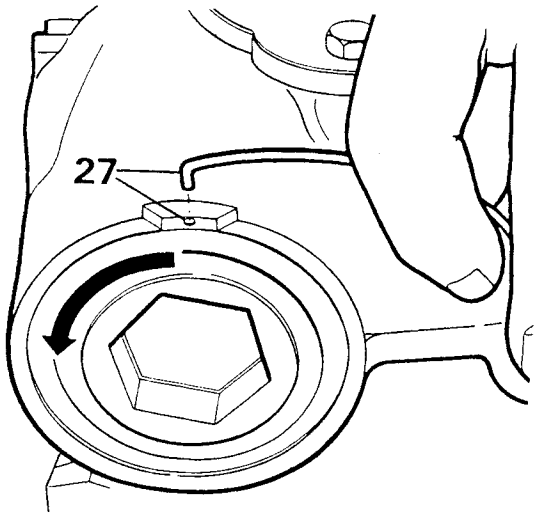
18. Lubricate the rack piston plastic seal and insert the piston into the piston bore, rack end first, as in instruction 11 of the dismantling procedure, to a depth of 37 mm below the lip of the bore.
19. Lubricate and fit the sector shaft in the straight ahead position.
20. Lubricate and fit 'O' ring seal to the sector shaft cover.
21. Restrain the sector shaft adjuster and screw-on the cover, reversing instruction 17. Secure with the six bolts, tightening evenly to 25 to 30 Nm (18 to 22 lbs ft).
22. Restrain the sector shaft adjuster and fit and tighten the locknut, as instruction 10.
23. Fit and lubricate an 'O' ring seal to the rack adjuster screw.
24. Fit the rack pad and spring noting that the larger flat side of the pad is towards the rack.



25. Screw-in the rack pad adjuster until the head is 4 mm from the steering box face.

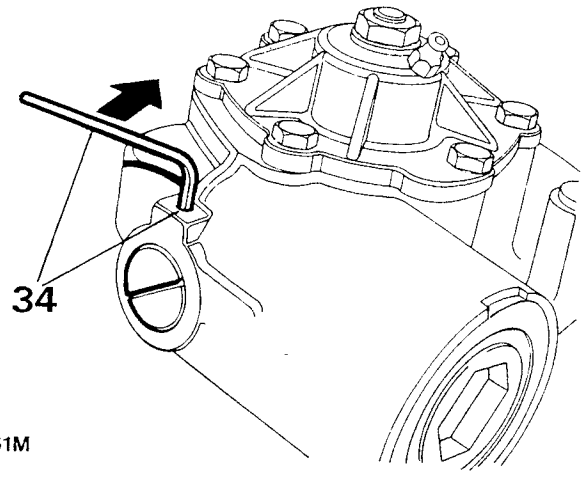


26. Lubricate and fit an 'O' ring seal to the piston-rack cover.
27. Fit the piston cover to steering box. Align the retaining ring hole in the cover with the cut-out in steering box housing and insert hooked end of the retaining ring in the hole. Using special tool LST123, rotate the cover anti-clockwise to feed the ring into the groove until the ring is fully seated. This is a reversal of instruction 3 of the dismantling procedure.



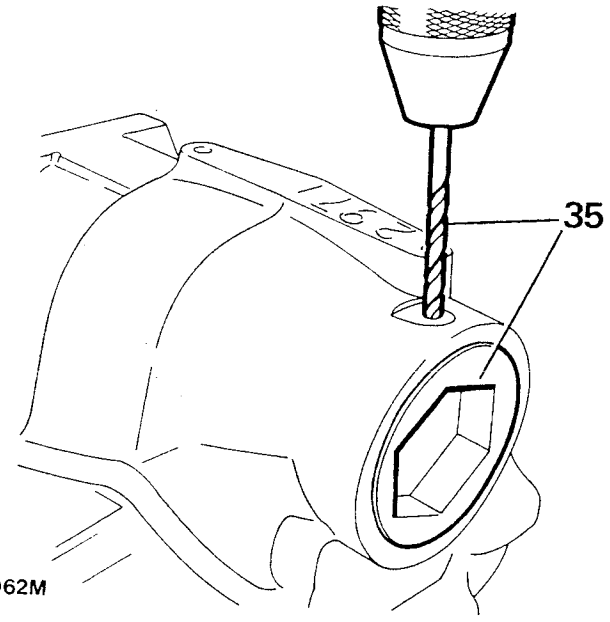
ST1956M

28. Temporarily fit the drop arm and secure with the nut so that no backlash is present between the arm and sector shaft. Set the steering in the straight ahead position.
29. Fit the preload setting tool R01016 to the input shaft and secure with the grub screw. Rotate the input shaft in both directions clockwise and anti-clockwise ½ to ¾ of a turn to check the backlash distribution.
30. To check the drop arm angular travel for a LHD drive steering box use the preload setting tool to turn the input shaft two turns clockwise and one and three-quarter turns anti-clockwise. For RHD drive boxes, the opposite applies.
31. Remove the drop arm.
32. Return to the straight ahead position and screw the rack adjuster clockwise until the adjuster pad just contacts the pad.
33. Restrain the sector shaft adjuster, as in instruction 10, and tighten the locknut to 70 to 90 Nm (52 to 66 lbs/ft).
34. Secure the rack adjuster with the grub screw, reversing the dismantling procedure instruction 5.



ST1961M

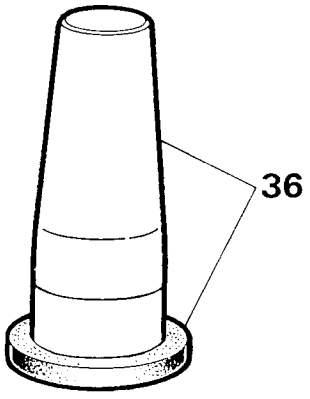
35. Secure the worm adjuster with a new pin. If necessary, drill a new 4 mm hole in the adjuster through the hole in the steering box housing to locate the pin. Check, before drilling that the new hole will not break into the side of the existing hole.



ST1962M

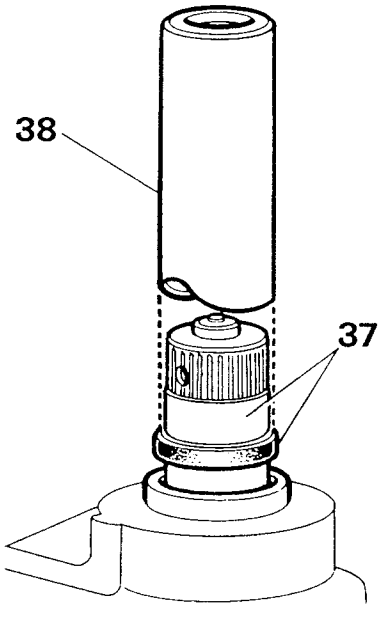
Fitting input shaft oil seal

36. Using the three part tool LST124, lubricate a new seal and slide it, lip side leading, over the conical seal-saver to the detachable lower part of the tool.



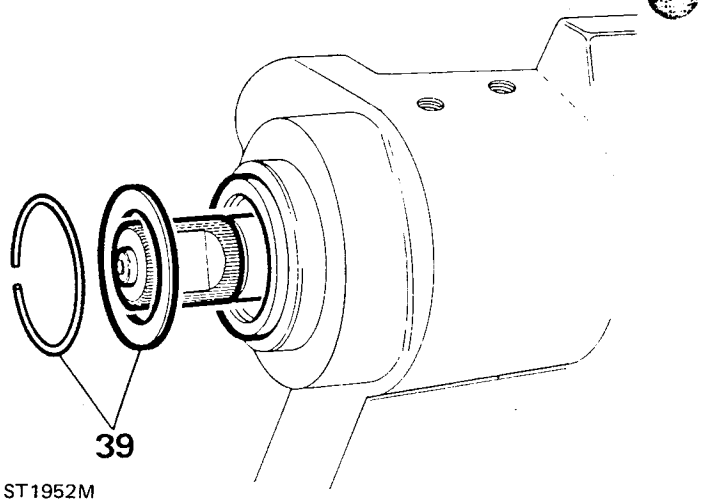
ST1947M

37. Withdraw the conical seal-saver and place the lower part of the tool with the seal, lip side downwards, over the input shaft.
38. Place the seal-driver part of the tool on top of the seal and drive it fully home.



ST1948M

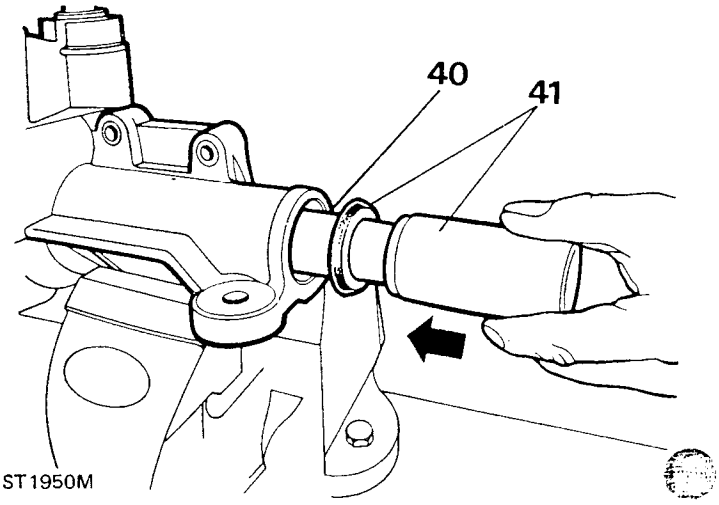
39. Fit the anti-extrustion washer and secure the assembly with the wire circlip.



ST1952M

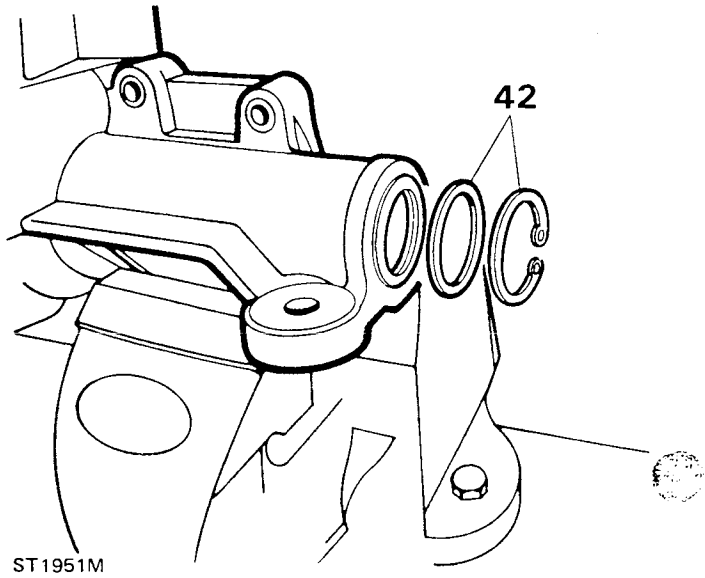
Fitting sector shaft oil seal

40. Lubricate the oil seal and seal-saver LST125, and slide the seal over the tool, lip side leading.
41. Using the seal-driver part of the tool, push the seal fully home into the housing.



ST1950M

42. Fit the steel washer and secure the assembly with the circlip.



ST1951M

43. Fit the drop arm, tab washer and nut. Tighten the nut to 170 to 180 Nm (125 to 132 lbs/ft). Fold one side of the tab washer over the drop arm and the other over a flat against the nut.
44. Refit the steering box to the vehicle and bleed the hydraulic system.

NOTE: Bleeding and test of the power steering box is the same as that for the Adwest Lightweight box.

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Land Rover
Range Rover

Workshop Bulletin

ATTENTION SERVICE MANAGER

SEPTEMBER 1987
BULLETIN NUMBER SLR 621 EN WB2

LAND ROVER

TURBO-CHARGER MAINTENANCE
2.5 LITRE TURBO-CHARGED DIESEL ENGINE

Further supplies of this Bulletin can be obtained, free of charge, from:

Land Rover Merchandising Service
P.O. Box 534, Erdington, Birmingham B24 0QS

The following supplementary maintenance schedule for the 2.5 litre Turbo-Charged Diesel engine replaces the schedule printed in Workshop Bulletin 01/86 dated October 1986.

Daily or Weekly depending on operating conditions, and at every maintenance inspection.
— Check engine oil level.

At 1,600km (1,000 miles), 10,00km (6,000 miles) and 20,000km (12,000 miles) then every 20,000km (12,000 miles).
— Check tappets, and adjust if required.

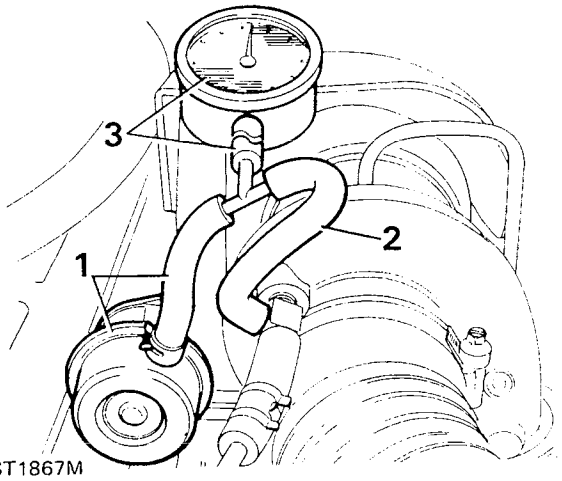
Every 40,000km (24,000 miles)
— check the turbo-charger boost pressure and if below the bottom limit – 44cm Hg – (8.5 p.s.i.g.), clean the turbo-charger compressor housing internally, as described in the following pages.

CHECKING BOOST PRESSURE

Maximum boost pressure – 50cmHg (9.7 p.s.i.g.)

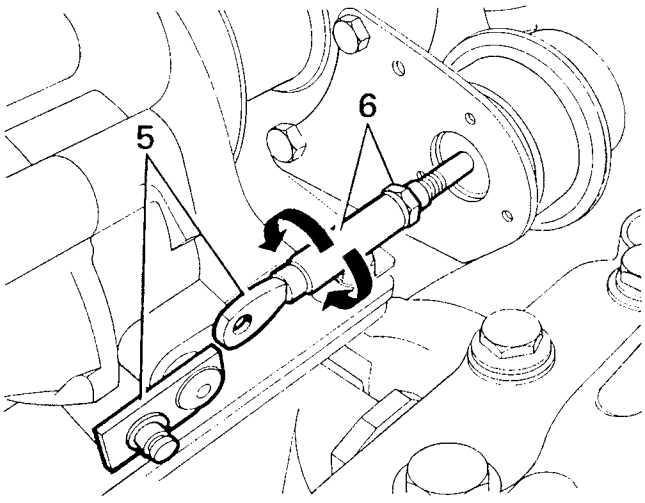
Minimum boost pressure – 44cmHg (8.5 p.s.i.g.)

1. Disconnect, from the turbo-charger, the hose to the actuator and insert into the free end a suitable 'T' piece.
2. Connect a short length of slave hose to the turbo charger and connect the other end to the 'T' piece.
3. Connect a further slave hose to the third leg of the 'T' piece and the other end to a pressure gauge capable of reading in excess of 50cm of Mercury. The pressure gauge hose must be long enough to reach into the cab of the vehicle so that the gauge can be observed by the driver or passenger.



ST1867M

4. To check the maximum boost pressure drive the vehicle normally but in such a manner that full throttle can be maintained whilst climbing a hill with the engine speed held steady between 2,500 – 3,000 r.p.m. Under these circumstances, the boost pressure should be between 44-50 cmHg (9.7-8.5 p.s.i.g.). If the pressure requires adjustment carry out the following instructions.
5. Taking care not to burn the fingers remove the retaining clip and disconnect the actuator control rod from the waste gate lever.
6. Hold the rod with a pair of grips and release the locknut.
7. Turn the rod-end, by no more than one turn, clockwise to increase the boost pressure or anti-clockwise to decrease the pressure.



ST1993M

8. Reconnect the actuator rod to the waste gate lever, secure with the clip and tighten the locknut.
9. Road test the vehicle again and if necessary repeat instructions 5 to 8.
10. Disconnect the test equipment and reconnect the hoses.
11. If the correct boost pressure range is not attained after several attempts, a general condition check of the engine should be undertaken. Examine the air intake system for damaged pipes or a blocked air filter. Check that the inlet manifold nuts and bolts are tight and if necessary retorque. Examine and if necessary, renew the hose between the turbo-charger compressor housing and the actuator and the boost control pipe from the distributor pump. Inspect the exhaust system for general condition and check that the joints are secure and not leaking. Check also that the hose between the

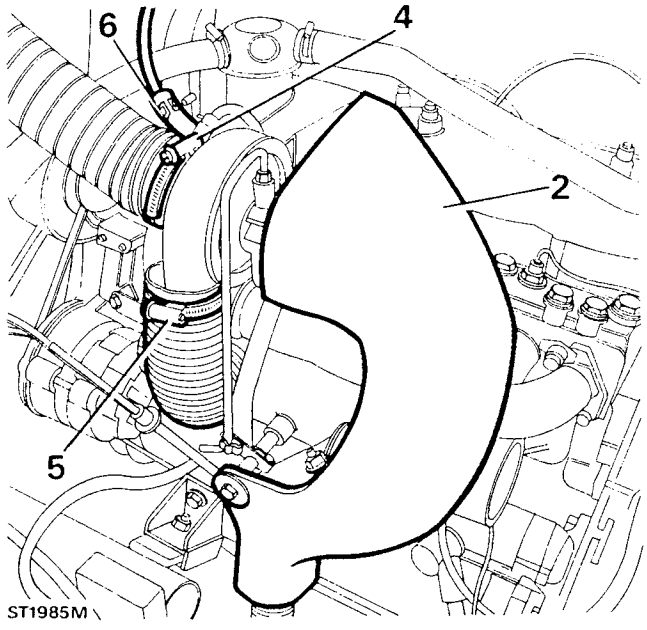
turbo-charger and inlet manifold is satisfactory and the clips are tight. Check that the four nuts securing the turbo-charger to the exhaust manifold are correctly torqued to 21-26Nm (15-19lbf.ft).

12. If any defects were found and corrected, reconnect the test equipment and road test the vehicle again. Should the boost pressure figure still be unsatisfactory clean the compressor housing.

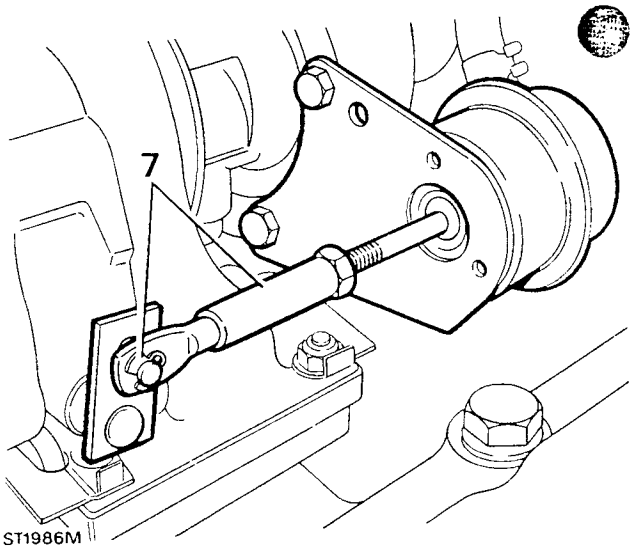
CLEANING TURBO-CHARGER COMPRESSOR HOUSING

Removing

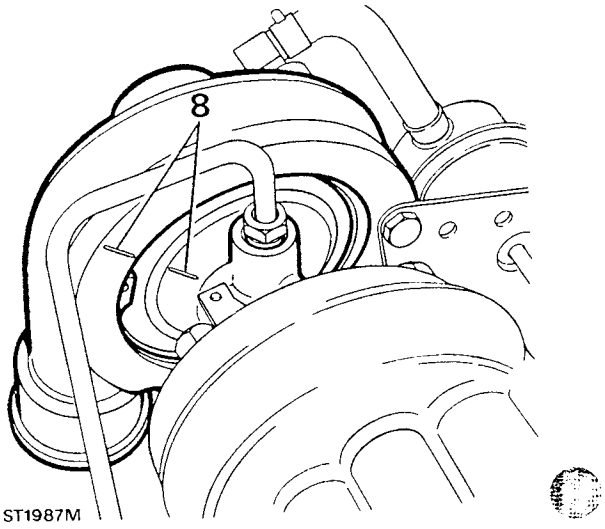
1. Remove the vehicle bonnet panel.
2. Remove the heat shield.
3. Clean the exterior of the turbo-charger with a non-caustic solvent.
4. Disconnect, at the turbo-charger, the air inlet hose from the air cleaner.
5. Remove the inlet manifold to turbo-charger hose.
6. Disconnect the boost control pipe.



7. Remove the clip and disconnect the actuator rod from the waste gate lever pin. This can be more easily achieved if a pressure of 57 to 62cm HgG (11 to 12 Psi) is applied to the actuator.

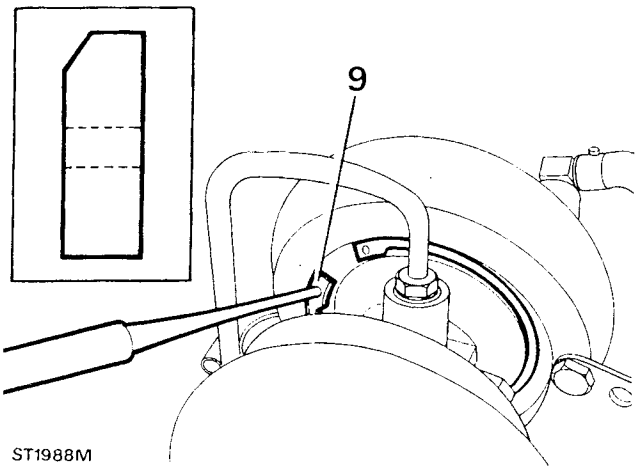


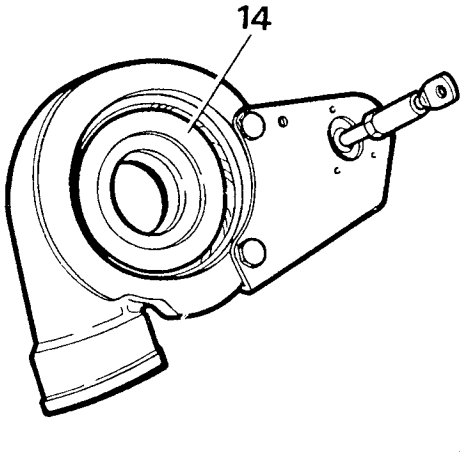
8. Mark the position of the compressor housing in relation to the centre housing with a scribe line to assist reassembly.



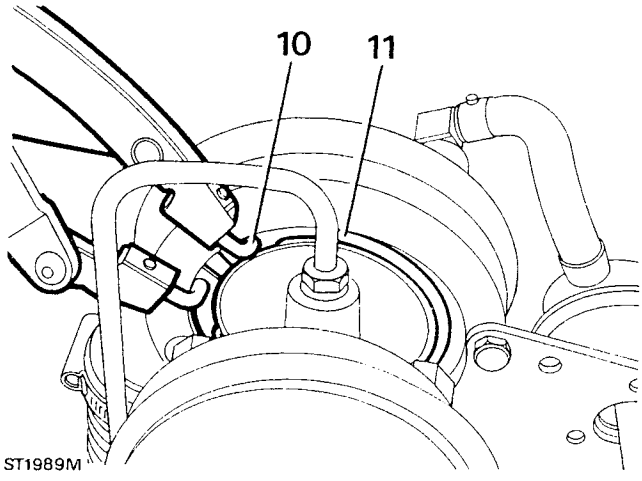
9. The circlip retaining the compressor housing to the centre housing is tapered, in cross section, on one side. It is necessary to 'break' the taper to enable the circlip to be removed in the usual manner. Using a flat nosed punch, carefully tap each ear of the circlip away from the groove in the compressor housing.

continued





10. Remove the circlip using a strong pair of circlip pliers with well fitting 90 degree angle tips.
11. Remove any burrs made on the back plate clearance diameter of the compressor housing before removing it from the centre housing.



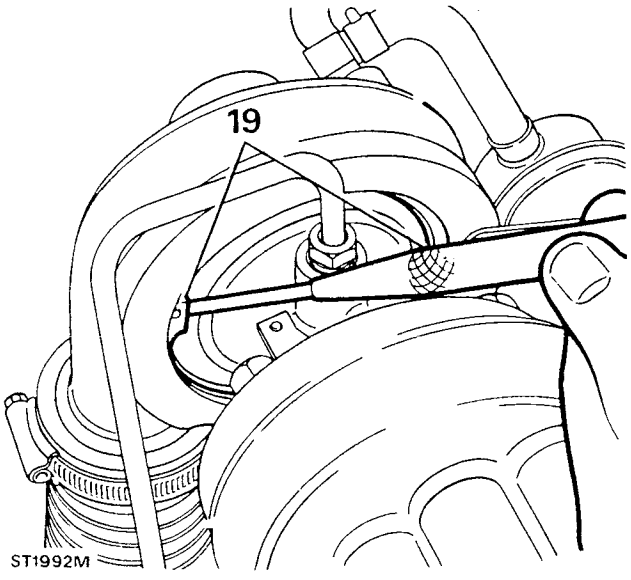
12. Withdraw the compressor housing complete with the actuator. To avoid damaging the compressor wheel withdraw the housing squarely without tilting the housing.

Cleaning

13. Remove the 'O' ring seal from the back plate.
14. Clean the internal surfaces of the compressor housing, the compressor wheel and back plate with a soft brush and a non-caustic solvent. Do not use compressed air to dry the compressor wheel and back plate.
15. Clean the circlip, remove burrs, and repair any damage caused during removal.

Refitting

16. Fit a new 'O' ring seal to the back plate.
17. Place the circlip in position over the centre housing with the tapered side towards the rear of the vehicle.
18. Offer-up the compressor housing, taking care not to damage the compressor wheel and back plate, and line up the scribe marks made before removal.
19. Secure the housing with the circlip and carefully tap the ears and inner diameter of the circlip with a flat nosed punch to ensure that it is fully seated in the groove.



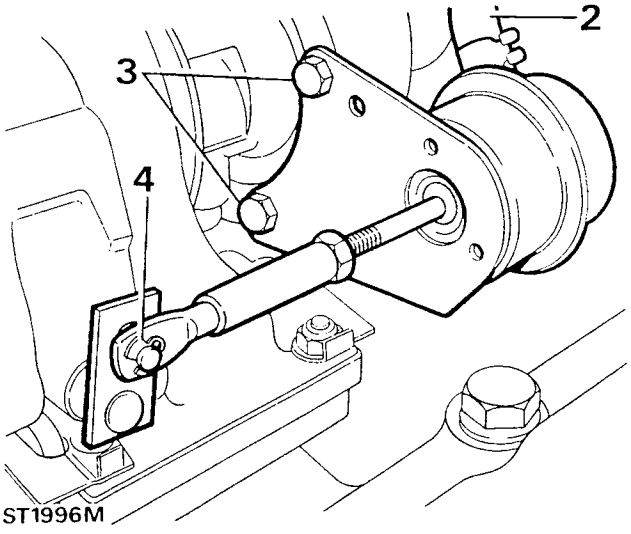
20. Connect the actuator rod to the wastegate lever and secure with the clip.

continued

21. Connect the boost control pipe.
22. Fit the inlet manifold to turbo charger hose and secure with the clips.
23. Connect the air intake hose and secure with the clip.
24. Fit the heat shield.
25. Fit the bonnet.
26. Re-check the boost pressure.
27. If the boost pressure is still not satisfactory, change the actuator.

RENEW TURBO-CHARGER ACTUATOR

1. Remove the heat shield.
2. Remove the actuator hose.
3. Remove the two screws securing the actuator bracket to the turbo-charger.
4. Remove the clip retaining the actuator rod to the wastegate lever pin and withdraw the actuator from the engine.



ST1996M

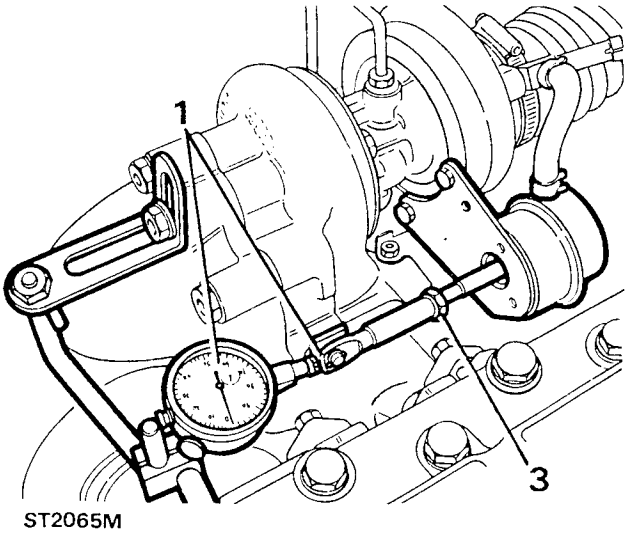
5. Fit the replacement actuator with the two bolts and single nut and bolt. Tighten the bolts to 12.5 to 14.0 Nm (111 to 124 ins lbs.)
6. Push the wastegate lever as far as possible towards the actuator and apply pressure to keep the lever in this position.
7. Pressurise the actuator to 57 to 62cm HgG (11 to 12 p.s.i.g.) and hold this pressure.

CAUTION: Use only the threaded rod-end to make adjustments. Forcing the complete rod in or out will change the calibration with the possibility of damaging engine boost.

8. Screw the rod end in either direction until the rod end eye will locate easily over the wastegate lever pin and secure with the retaining clip.
9. Release the pressure and tighten the rod end lock nut.

STATIC CALIBRATION OF ACTUATOR

1. Mount a dial test indicator so that the stylus rests on the end of the actuator rod.
2. Pressurise the actuator until the lever moves 0.38mm (0.015ins). At this point the pressure should be 11.5 p.s.i.g. ± 0.5 p.s.i.g.
3. If the pressure is higher, slacken the lock nut and lengthen the actuator rod. Should the pressure be lower, shorten the rod.
4. When the correct pressure is achieved, tighten the rod end lock nut.



ST2065M

5. Fit the heat shield.
6. Check the boost pressure on the road as previously described.

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Land Rover
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Workshop Bulletin

ATTENTION SERVICE MANAGER

DECEMBER 1987

BULLETIN No. SLR 621 EN WB 3

LAND ROVER

LT85 LIGHTWEIGHT

DIVIDED-CASE GEARBOX

Further supplies of this Bulletin can be obtained, free of charge, from:

Land Rover Merchandising Service,
P.O. Box 534, Erdington, Birmingham B24 OQS

INTRODUCTION

This Workshop Bulletin is a supplement to the current Land Rover Workshop Manual Publication SLR 621 EN WM and covers the introduction and overhaul ofthe LT 85 light weight divided - case gearbox.This unit replaces the earlier heavy duty LT 85 gearbox fitted to the basic V8 engined Land Rover 90 and 110 models. The heavy duty version is still being used for certain non - standard applications.

The new gearbox, which is interchangeable with the heavy duty version, can be recognised by the prefix 22C before the serial number. The gearbox was first fitted from the following vehicle numbers:

Land Rover 90 V8. VIN SALLD VBV 7AA 299109. Gearbox number 22C 00070.

Land Rover 110 V8. VIN SALLD HAV 8BA 298614. Gearbox number 22C 00061.

The individual gears and shafts are not, however, interchangable between the two gearboxes.

GEARBOX DATA

Ratios: as heavy duty version.

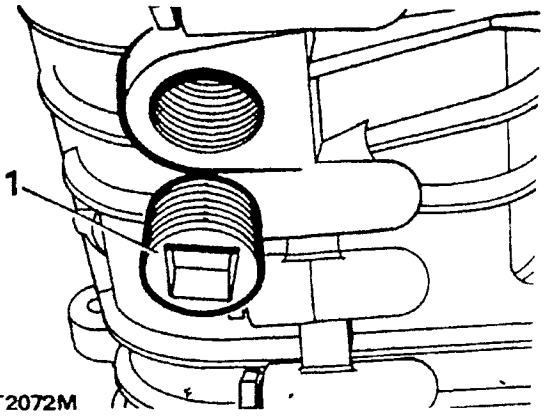
Lubrication: as heavy duty version.

Torque figures: as heavy duty gearbox where applicable with the exception of the following:

Divided case retaining bolts M8- 7off (5 bolts and two bolts and nuts) 22- 28 Nm (16-21 lbs.ft.)

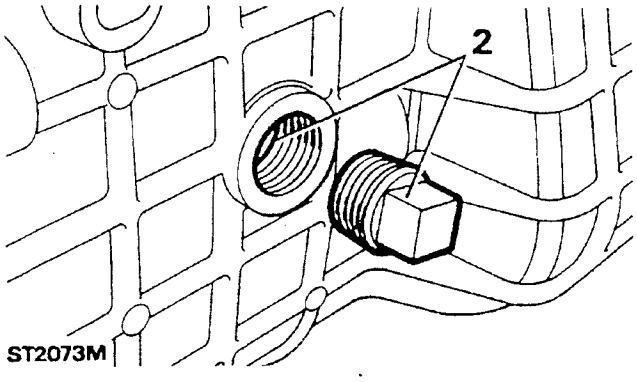
Maintenance: Oil check and top-up and drain and renew oil are at the same mileage intervals but the drain and refil method differs from the heavy duty gearbox, as follows:

1. Immediately after a run, when the oil is warm, park the vehicle on level ground and disconnect the battery. Drain-off the oil into a container by removing the drain plug anti-clockwise from beneath the gearbox casing using a 12,7mm (1/2in) square socket drive.When all the oil is drained, clean and refit the drain plug and tighten to the correct torque.



ST2072M

2. Remove the square headed oil level/filler plug from the left-hand side of the gearbox and inject oil of the correct grade until the oil is level with the filler hole. Clean and fit the level/filler plug and tighten to the correct torque. wipe away any surplus oil and reconnect the battery.



ST2073M

GEARBOX AND TRANSFER BOX REMOVAL

This operation is the same as that described in Supplement LSM 25WS and the current Land Rover Workshop Manual Publication SLR 621 EN WM for the heavy duty LT 85 gearbox.

In the interests of saftey, it is essential that the locally manufactured cradle is used with the hydraulic ramp. Before fitting the cradle the gearbox filler/level plug must be removed and a suitable blank fitted.

OVERHAUL LT85 LIGHT WEIGHT DIVIDED CASE GEARBOX.

Service Tools

18G 284	Impulse extractor.
LST 284-1	Reverse idler shaft remover adaptor.
LST 101	Gauge first gear end-float.
LST 102	Mainshaft oil seal remover, replacer.
MS 47	Hand press.

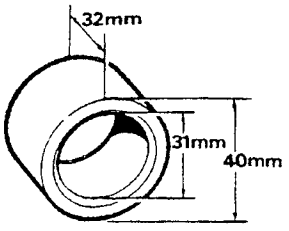
With the exception of MS 47 the above are existing tools used on the heavy duty LT 85 integral case gearbox.

Special sockets and spanners.

41mm socket - Layshaft fifth gear retaining nut.
5mm Allan key - Reverse shaft retaining plate

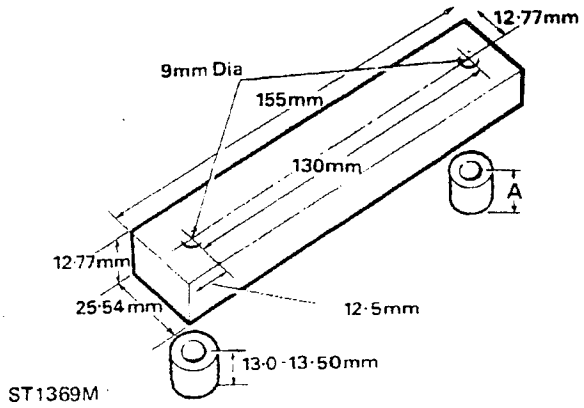
Locally manufactured tools.

In addition to the above service tools,the following tools can be locally manufactured to assist the dismantling and assembly of the gearbox. These tools are the same as for the heavy duty gearbox except the stand to which a small modification is necessary.



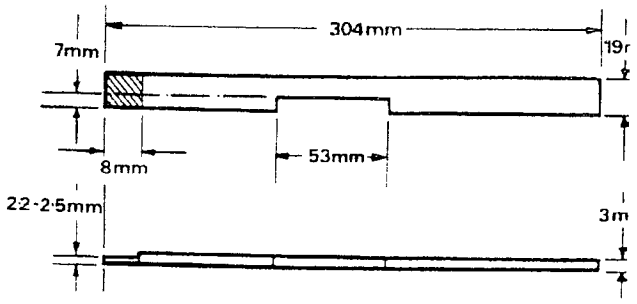
ST1476M

Spacer for retaining layshaft rear bearing.



ST1369M

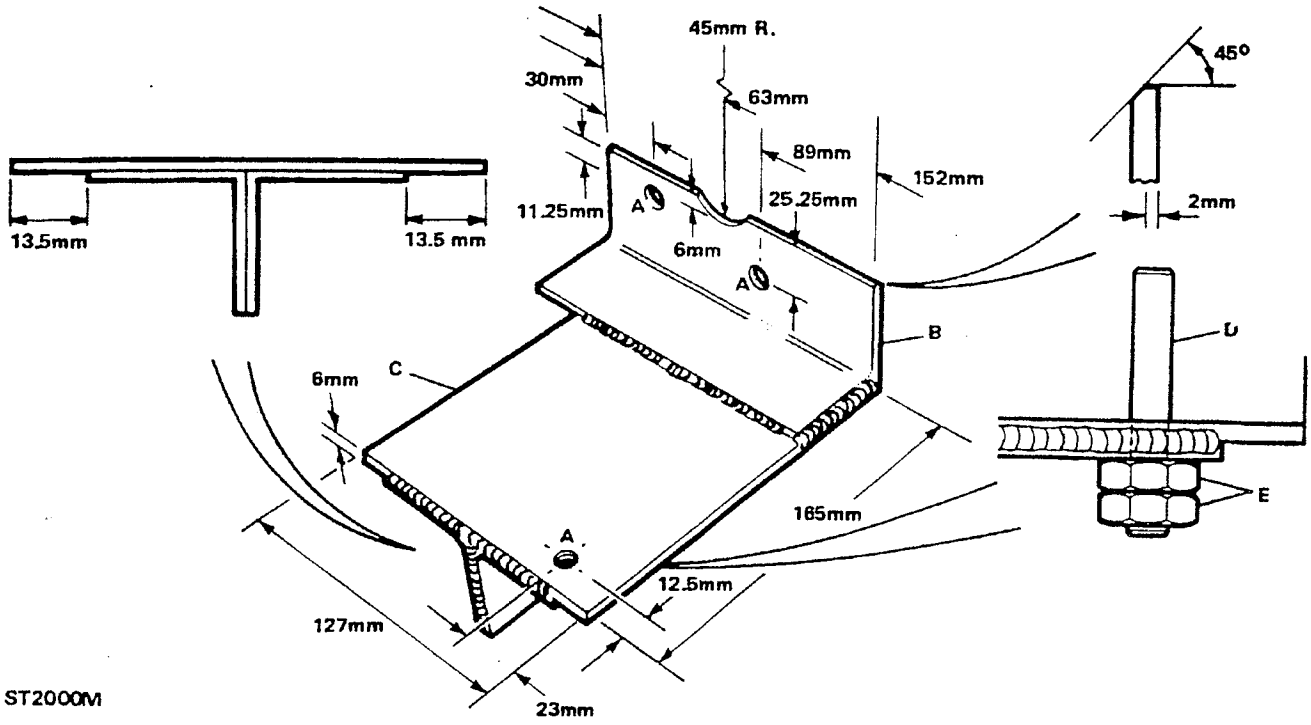
Selector detent spring retaining tool and spacers.



ST1371M

Gauge for reverse cross-over lever adjustment.

Continued



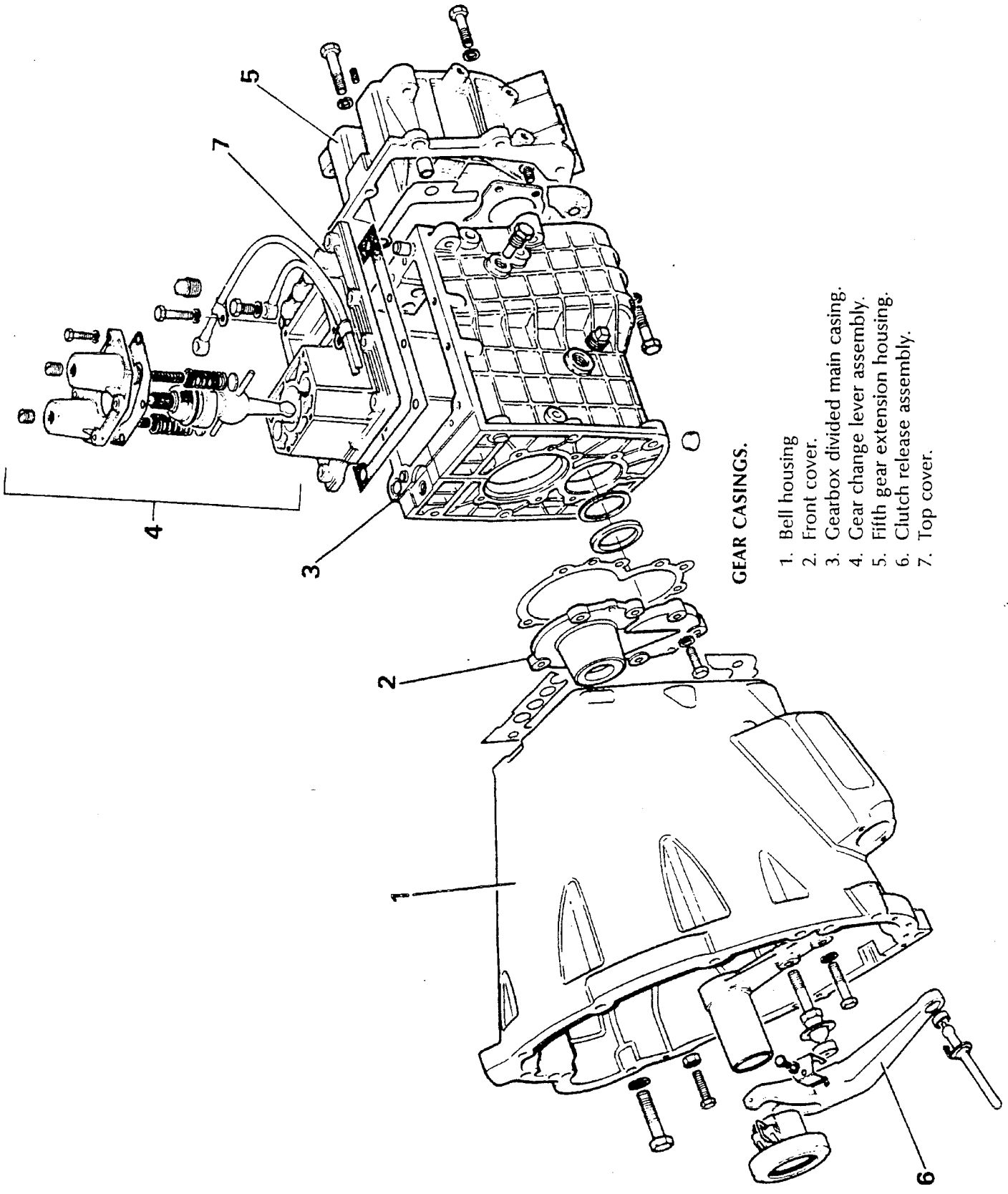
Stand for securing the gearbox in a vice

A. 11mm diameter holes.
B. Make from 50mm x 6mm steel angle.
C. Make from 6mm steel plate.
D. 10mm diameter stud 70mm long with 25mm of thread for adjustment.
E. 10mm nuts.

Note: Item D is where the modification to the original stand is necessary.

Material and welding specification

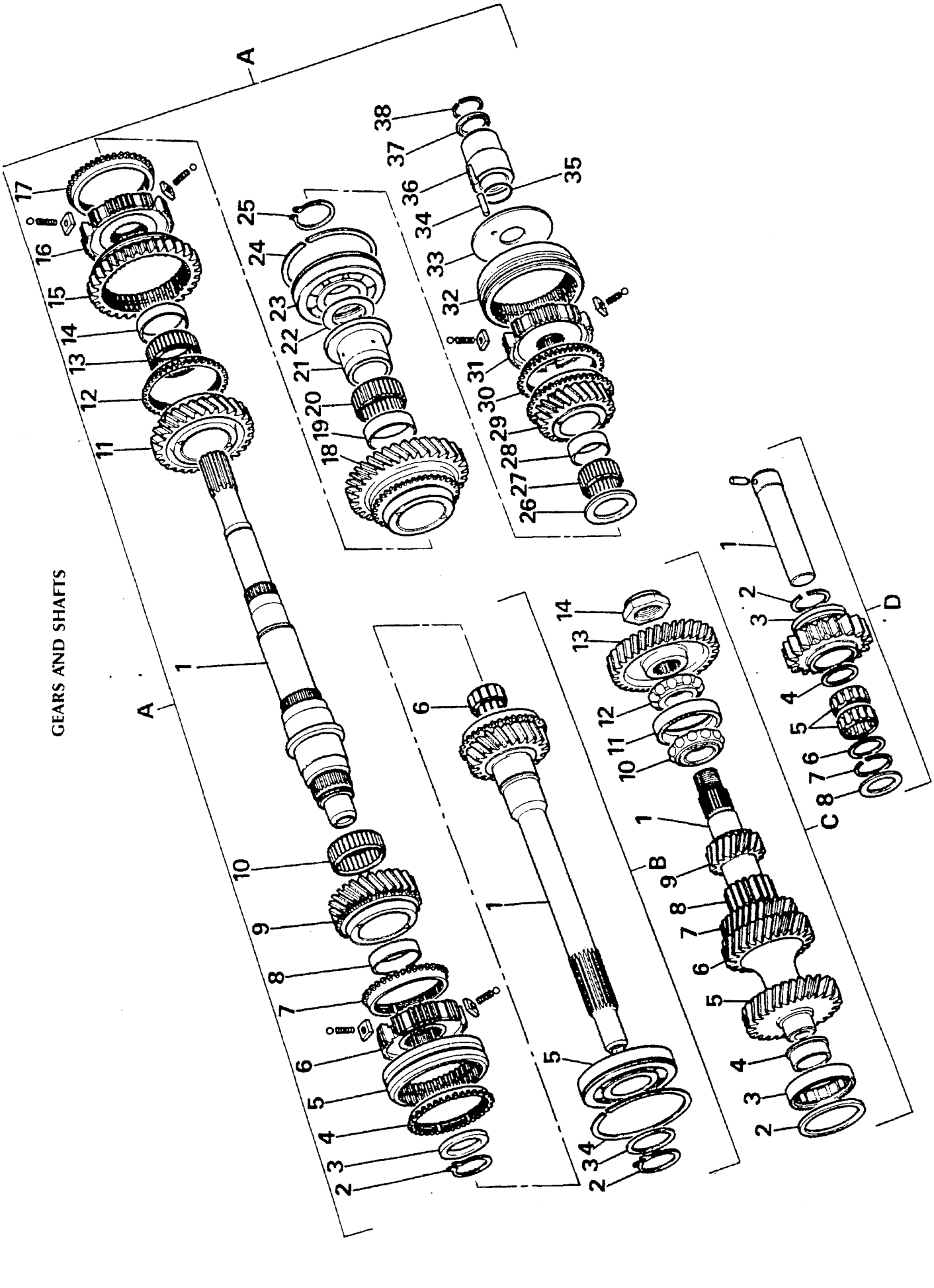
Steel plate BS 1449 Grade 4 or 14
Arc welding BS 5135.



GEAR CASINGS.

1. Bell housing
2. Front cover.
3. Gearbox divided main casing.
4. Gear change lever assembly.
5. Fifth gear extension housing.
6. Clutch release assembly.
7. Top cover.

GEARS AND SHAFTS



ST2071M

KEY TO GEARS AND SHAFTS

MAINSHAFT ASSEMBLY A.

1. Mainshaft.
2. Circlip.
3. Selective washer.
4. 4th gear baulk ring.
5. 3rd/4th gear synchromesh sleeve.
6. 3rd/4th gear synchromesh hub.
7. 3rd gear baulk ring.
8. Spacer.
9. 3rd gear.
10. Needle roller bearing.
11. 2nd gear.
12. 2nd gear baulk ring.
13. Needle roller bearing.
14. Spacer.
15. 1st/2nd synchromesh sleeve and reverse gear.
16. 1st/2nd gear synchromesh hub.
17. 1st gear baulk ring.
18. 1st gear.
19. Spacer.
20. Needle roller bearing.
21. 1st gear bush.
22. Selective washer.
23. Ball bearing.
24. Snap ring.
25. Circlip.
26. Washer.
27. Needle roller bearing.
28. Spacer.
29. 5th gear.
30. 5th gear baulk ring.
31. 5th gear synchromesh.
32. 5th.gear synchromesh sleeve.
33. 5th gear synchromesh plate.
34. Dowel retaining plate.
35. "O" ring seal.
36. Sleeve
37. Selective
38. Circlip.

INPUT SHAFT ASSEMBLY B.

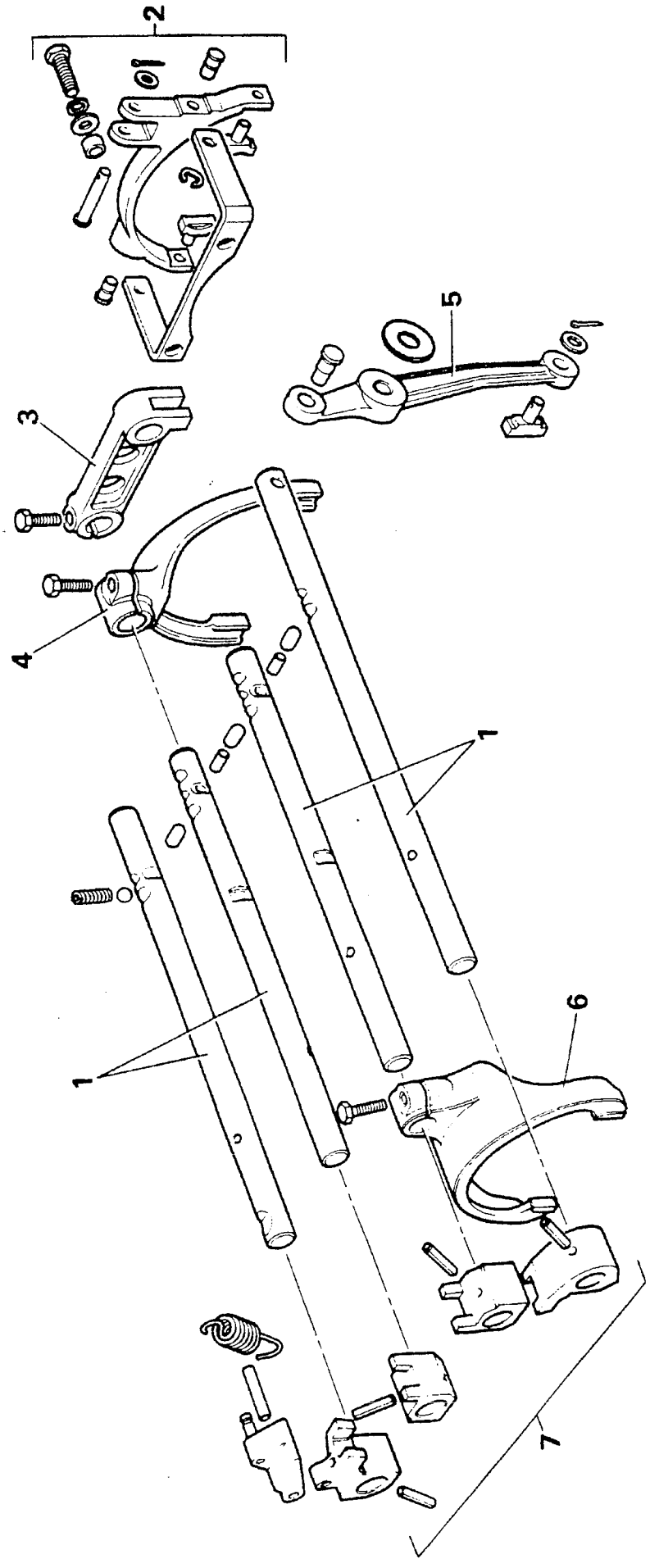
1. Input shaft and 4th gear
2. Circlip.
3. Selective washer
4. Snap ring.
5. Ball bearing.
6. Needle roller bearing.

LAYSHAFT ASSEMBLY C.

1. Layshaft
2. Spacer.
3. Roller bearing.
4. Roller bearing track.
5. 4th gear.
6. 3rd gear.
7. 2nd gear.
8. Reverse gear.
9. 1st gear.
10. Inner ball bearing race.
11. Bearing track.
12. Outer ball bearing race.
13. 5th gear.
14. 5th gear retaining nut.

REVERSE SHAFT ASSEMBLY D

1. Reverse idler gear shaft
2. Wire circlip.
3. Reverse idler gear.
4. Washer.
5. Needle roller bearing.
6. Washer.
7. Wire circlip.
8. Thrust washer.

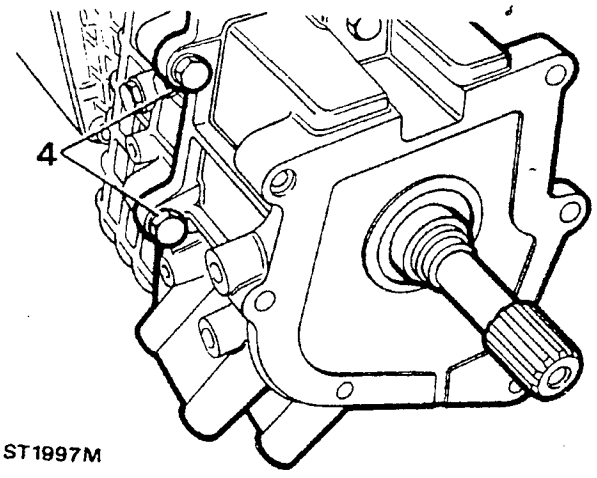


GEAR SELECTORS.

1. Selector rails.
2. Fifth gear selector fork assembly.
3. Reverse gear cross-over lever.
4. First and second gear selector fork.
5. Reverse gear lever.
6. Third and fourth gear selector fork.
7. Selector jaws.

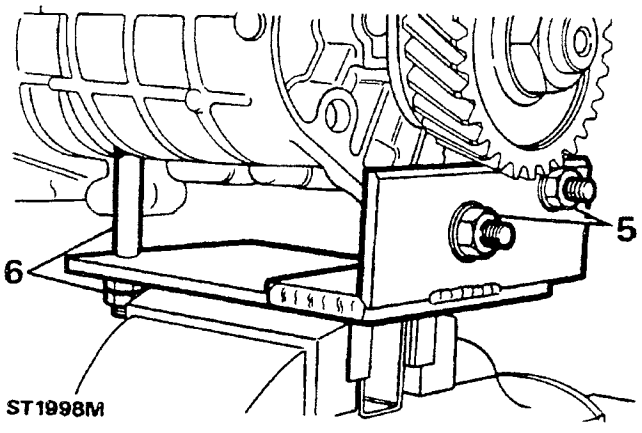
DISMANTLE

1. Ensure that the gearbox oil has been drained.
2. Position gearbox on a bench and support with a suitable block of timber.
3. Remove the four bolts and detach the L.H. mounting bracket.
4. Remove the eight bolts, four forward facing and four rearward facing and withdraw the extension housing and gasket.



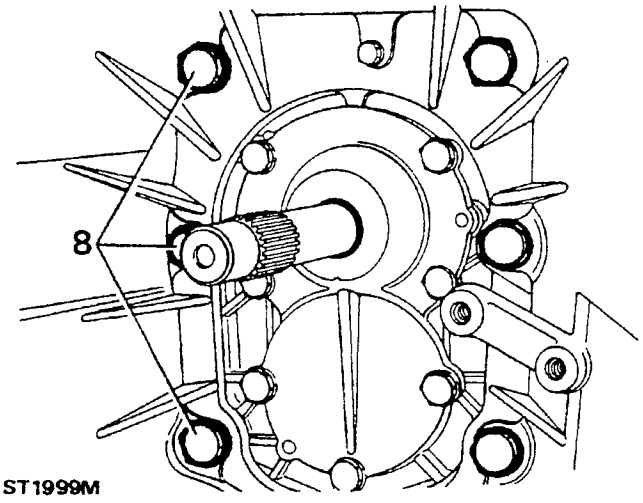
ST1997M

5. Fit the locally manufactured stand to the gearbox and secure with two bolts, nuts, spring and plain washers.
6. Adjust the stud under the gearbox case as necessary so that it just contacts the case to provide support.



ST1998M

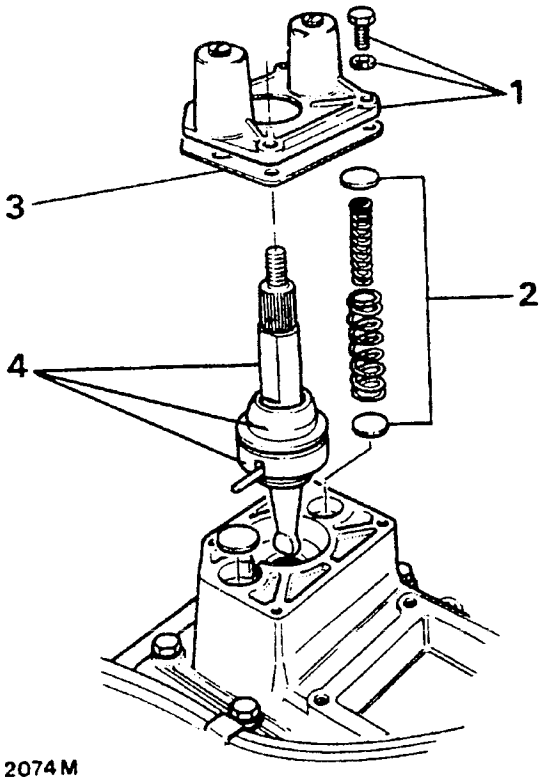
7. Secure the gearbox and stand in a vice.
8. Remove the six bolts and withdraw the bell housing complete with clutch release lever, sleeve and thrust bearing from the gearbox.
9. Remove the bell housing gasket.



ST1999M

Bias spring housing and gear lever.

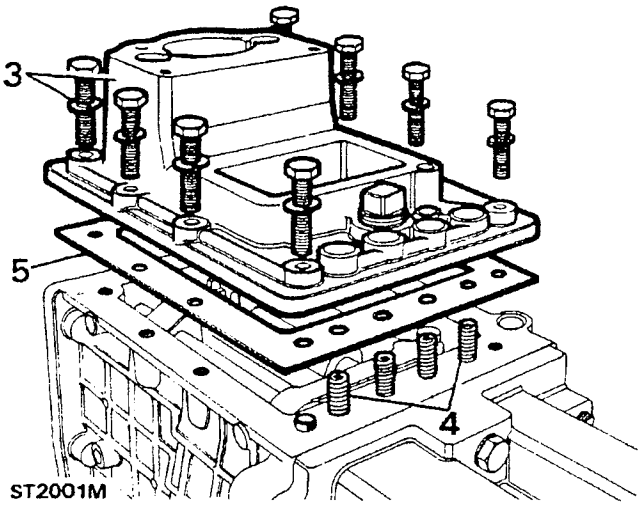
1. Remove the four bolts and lift the bias spring housing from gearbox.
2. Remove the bias springs and shims. Take care not to allow the lower shims to slip under the gear lever pivot bar into the gearbox.
3. Remove the bias spring housing gasket.
4. Remove the gear lever complete with gaiter and nylon cup.



ST 2074 M

Gearbox top cover.

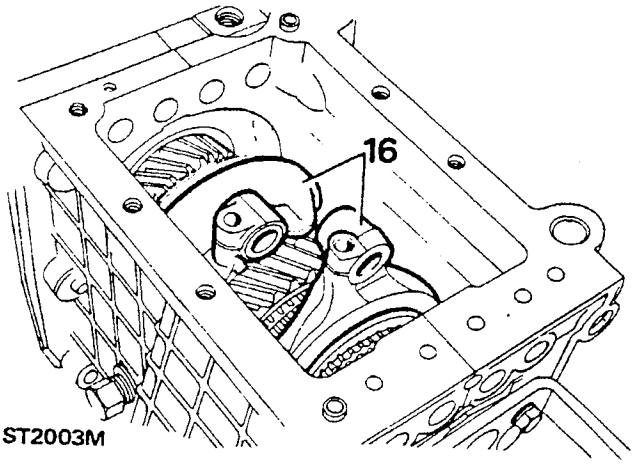
1. Remove the reverse light switch, if fitted.
2. Remove breather pipe banjo union fixing bolt.
3. Remove the eight bolts and lift the top cover and breather pipes from gearbox whilst taking care not to allow the detent springs to fall into the gearbox.
4. Remove the detent springs.
5. Remove the top cover gasket.



ST2001M

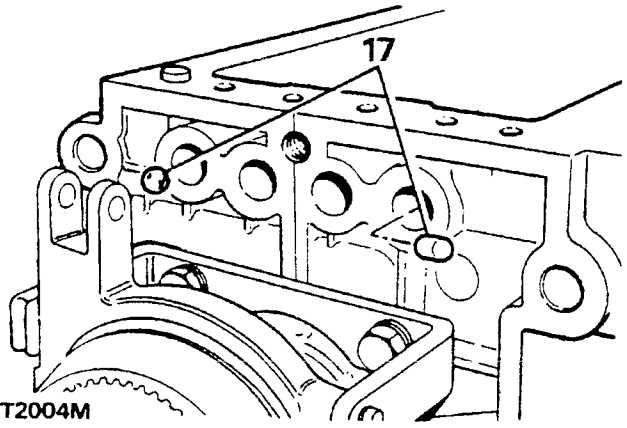
Selector rails and forks.

1. Using a magnet, withdraw the selector rail detent balls from drillings in gearbox. If the balls are tight leave until the selector rails have been removed.
2. Release reverse gate spring from the knock-over lever and remove from reverse gear rail.
3. Raise the knock-over lever and tap down the reverse jaw roll pin until the jaw is free on the rail.
4. Remove the clamp bolt from the reverse gear cross-over lever, slide the reverse selector rail out from the gearbox and remove the jaw.
5. Remove the split pin, washer, and clevis pin securing the fifth-gear selector fork to the fifth gear rail.
6. Push the selector rail forwards and tap down the fifth-gear jaw roll pin until the jaw is free on the rail.
7. Withdraw the fifth-gear selector rail and jaw from the gearbox.
8. Remove the clamp bolt from the third/fourth selector fork and move the selector rail forward.
9. Tap-down the third/fourth jaw roll pin until jaw is free on the selector rail.
10. Withdraw the third/fourth selector rail and jaw.
11. Remove the interlock from the third/fourth selector rail.
12. Tap-down the first/second jaw roll pin until the jaw is free on the selector rail.
13. Remove the clamp bolt from the first/second selector fork and withdraw the first/second selector rail and jaw.
14. Remove the interlock from the first/second selector rail.
15. Lift the reverse cross-over lever from the gearbox.
16. Remove the first/second and third/fourth selector forks.



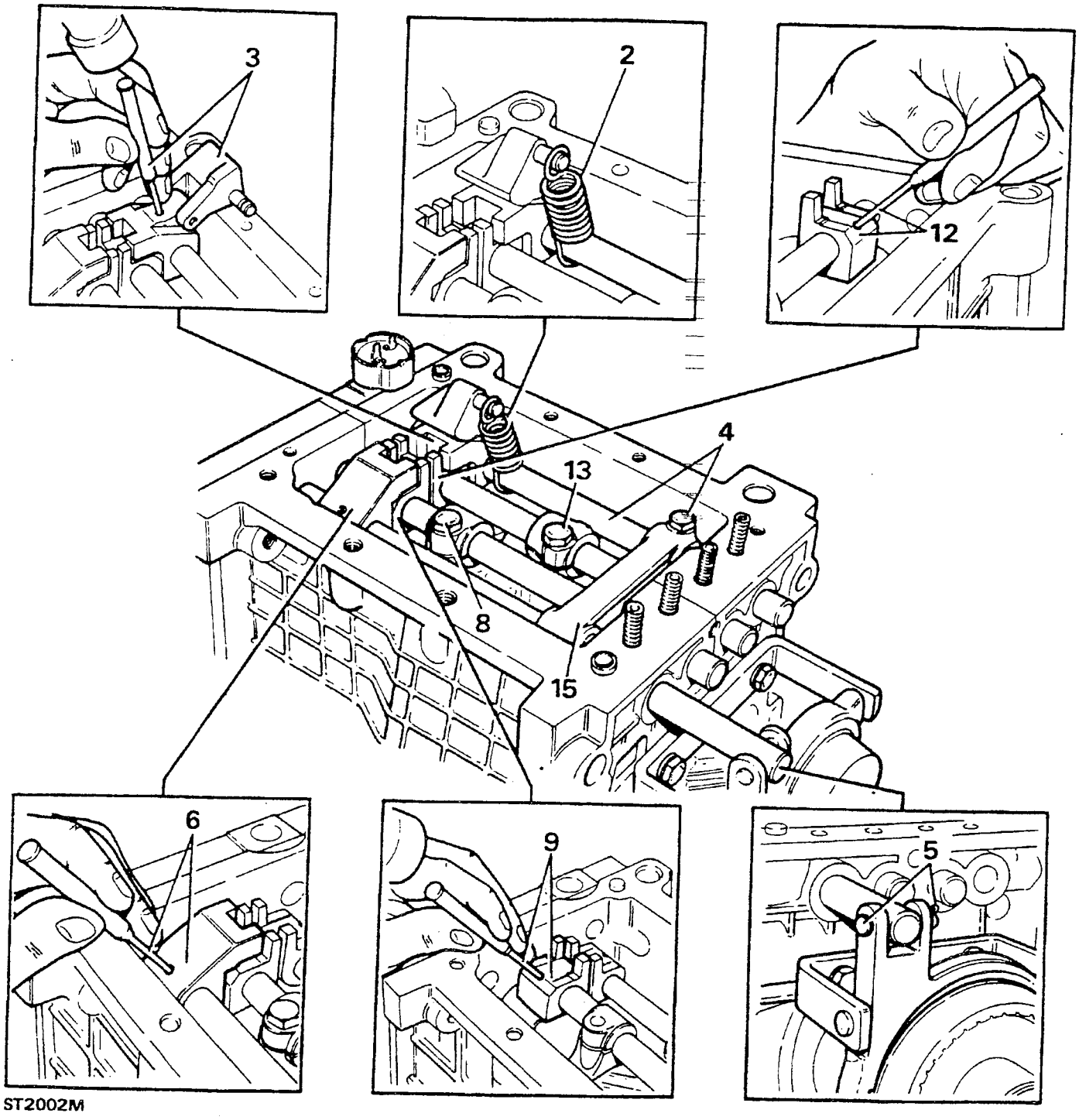
ST2003M

17. Remove the interlock plungers, and the detent balls, if the latter were not removed in instruction 1.



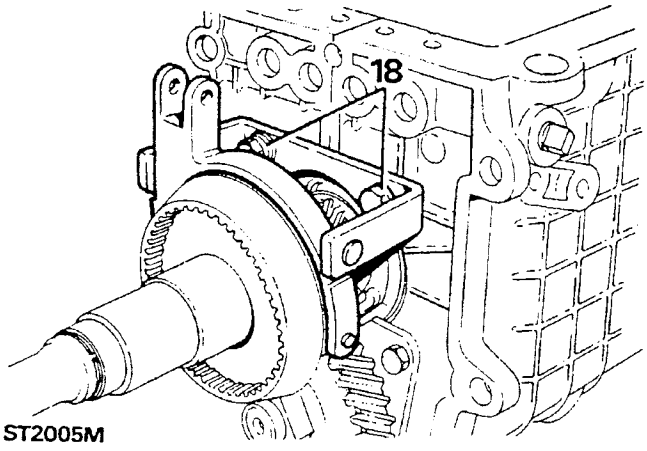
ST2004M

SELECTOR RAILS AND FORKS



ST2002M

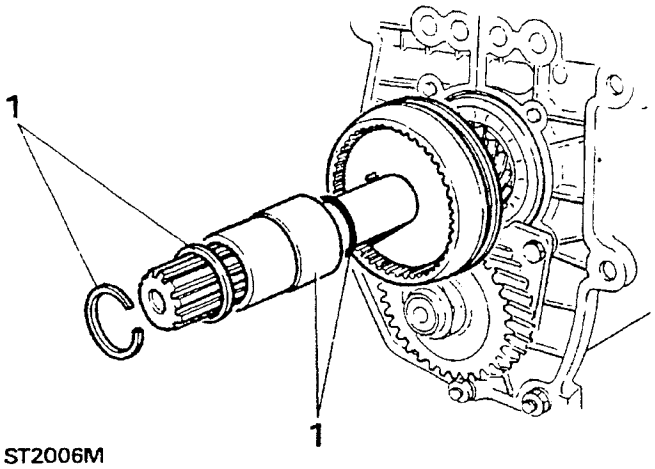
18. Remove the two bolts securing the fifth gear fork and bracket assembly to the gearbox. Do not displace the selector fork slipper pads when removing the fork.



ST2005M

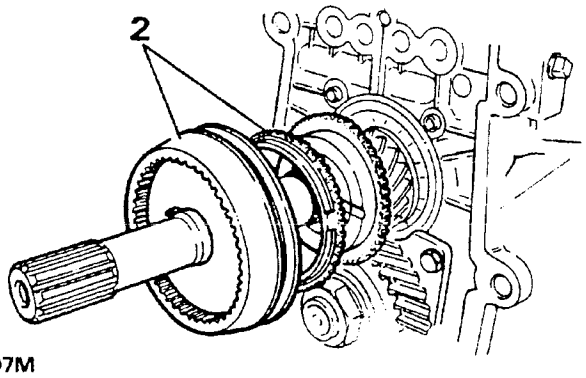
Reverse shaft, mainshaft, and layshaft.

1. Remove the circlip, selective washer, oil seal collar, and "O" ring from the mainshaft.



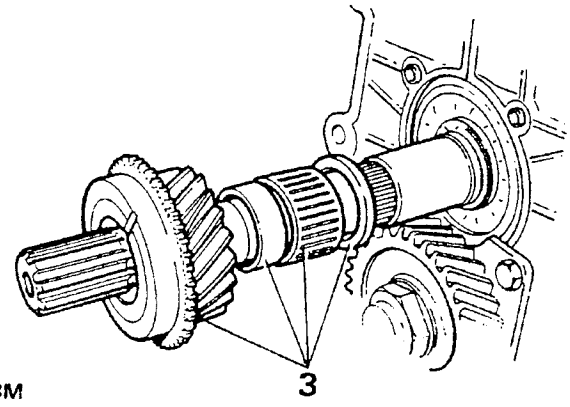
ST2006M

2. Remove the fifth gear synchromesh hub and baulk ring.



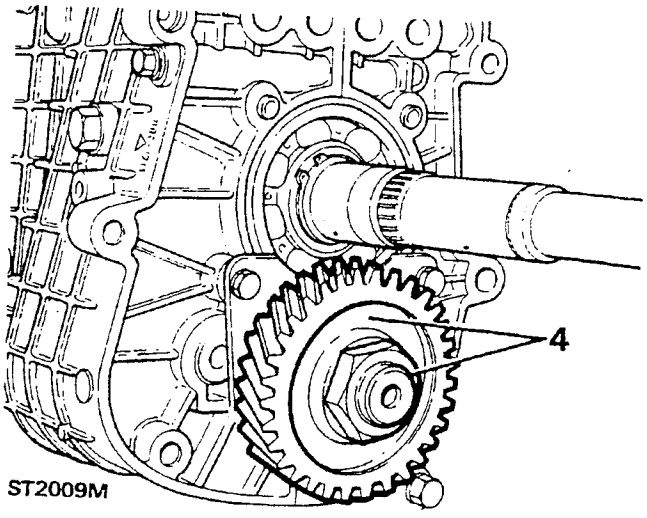
ST2007M

3. Remove the fifth gear, spacer, needle roller bearing and thrust washer.



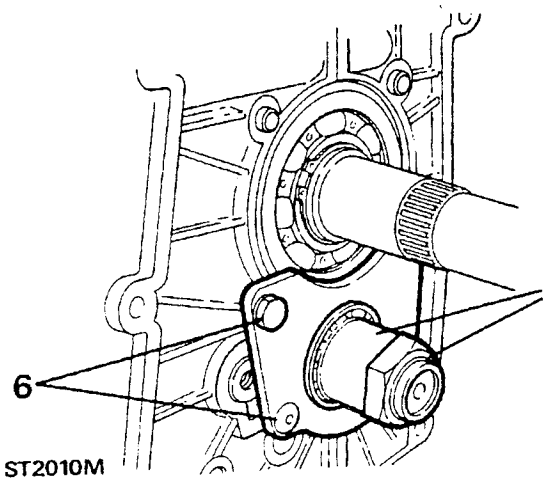
ST2008M

4. Engage both first and fourth gears to lock the gearbox. Release the stake nut collar from the recess in the layshaft and remove the nut and fifth gear.



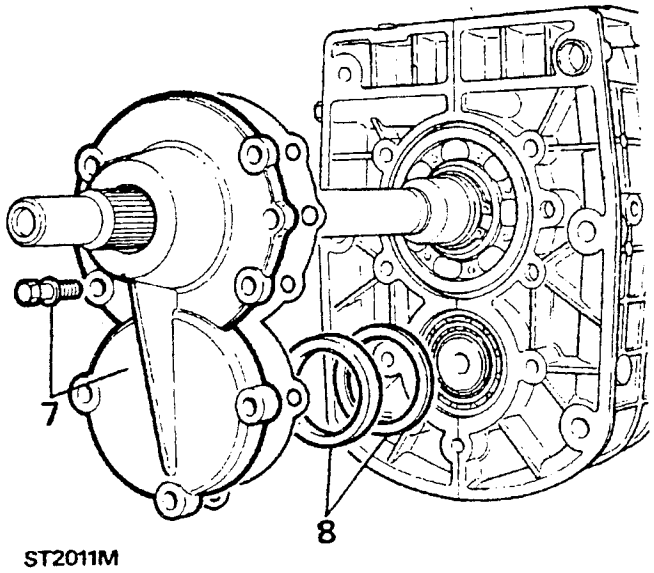
ST2009M

5. Fit the manufactured spacer to the layshaft to keep the rear bearing in position and retain with the stake nut, finger-tight only. Disengage the first and fourth gears.
6. Remove the two socket-headed set screws and two bolts and remove the plate that retains the layshaft bearing track and reverse shaft.



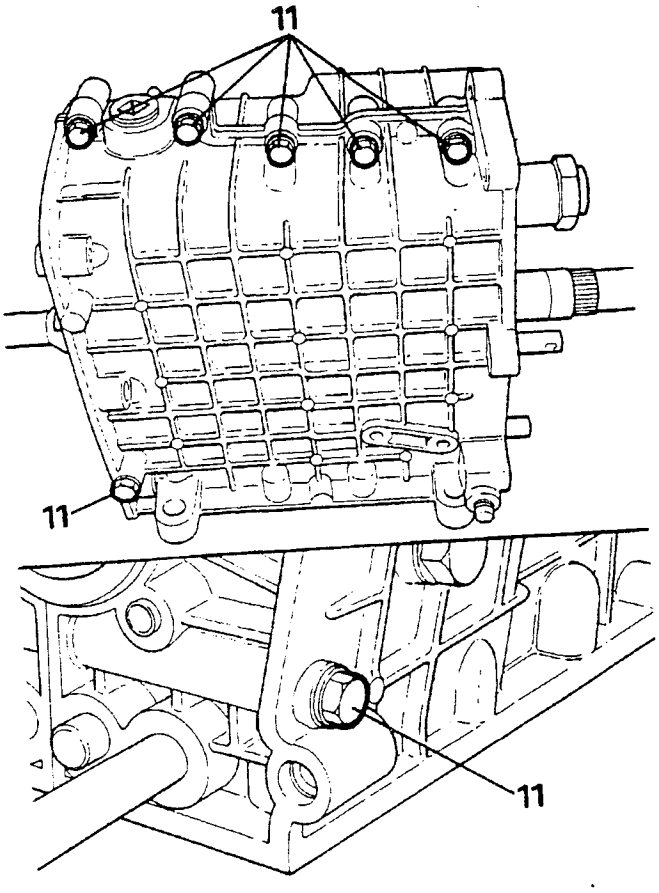
ST2010M

7. Remove the seven bolts and withdraw the front cover and gasket.
8. Remove the layshaft front bearing spacer and shims.



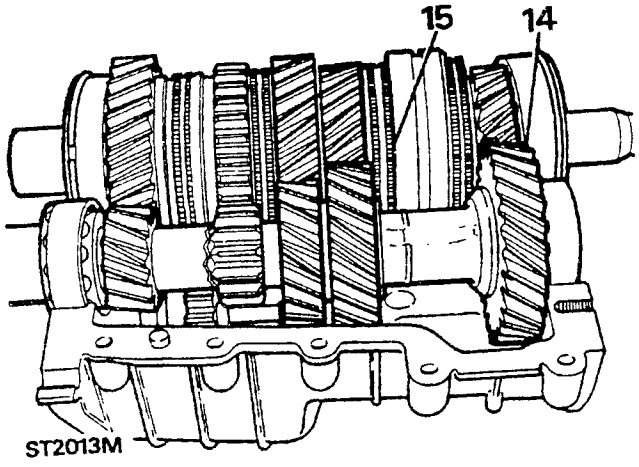
ST2011M

9. Remove the gearbox case and stand from the vice.
10. Remove the stand from the case.
11. Remove the seven bolts that secure the two halves of the case together.
12. Rest the case on the bench with the reverse gear idler side downwards.
13. Carefully separate the case by tapping with a hide mallet alternately at the four corners,to break the seal.



ST2012M

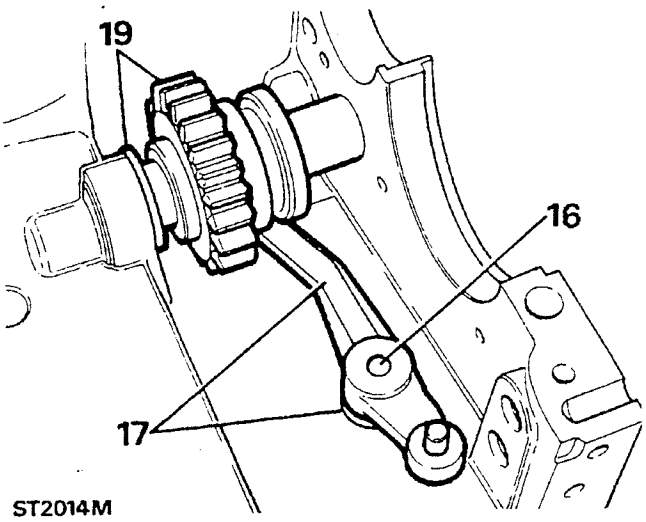
14. Lift-out the layshaft assembly.
15. Remove the mainshaft assembly.



ST2013M

Continued

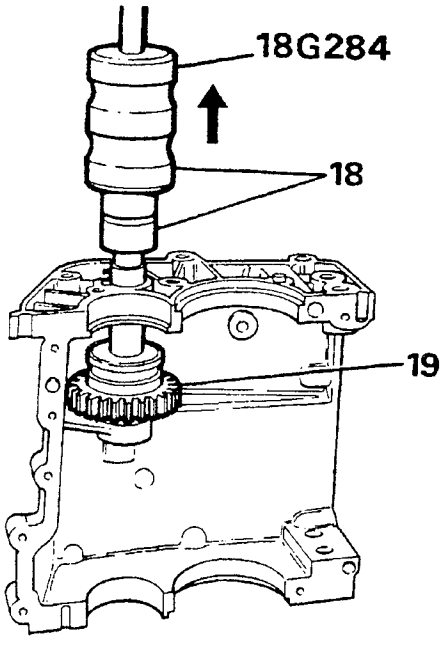
16. Remove the reverse lever pivot bolt from the outside of the casing.
17. Remove the reverse lever and spacer from the idler gear and case.



ST2014M

18. To remove the reverse gear idler shaft, place the case on a block of timber and with assistance, hold the case firmly and drive-out the shaft using impulse extractor 18G 284 and adaptor LST 284-1.

19. Remove the reverse idler gear and thrust washer.



ST2015M

INSPECTION AND OVERHAUL.

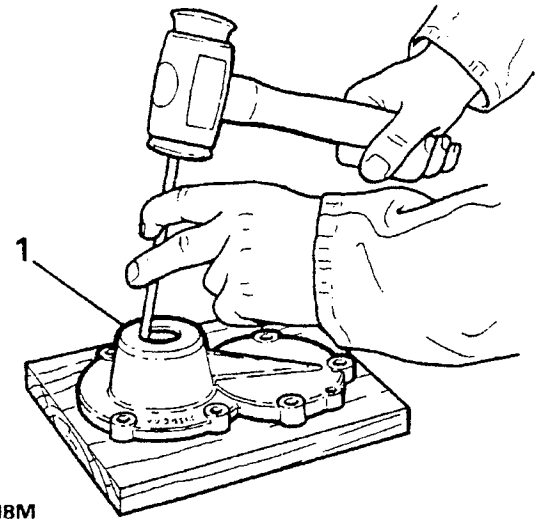
Main gearbox case

Note: The following instructions 1 to 4 are only necessary if the gear casings, plugs or dowels are being renewed.

1. Remove the drain plug.
2. Remove the filler/level plug.
3. Remove the interlock cross drilling plug.
4. Remove the six hollow dowels.

Front cover.

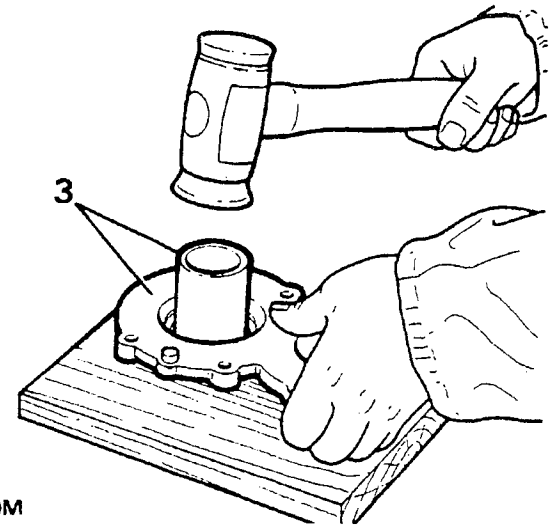
1. Place the front cover on a block of timber and drift-out the oil seal.



ST2018M

2. Clean the cover and check for damage or burrs.
3. Lubricate the outer diameter of a new seal and using a suitable tube, drift-in the seal, lip side trailing, squarely into the cover.

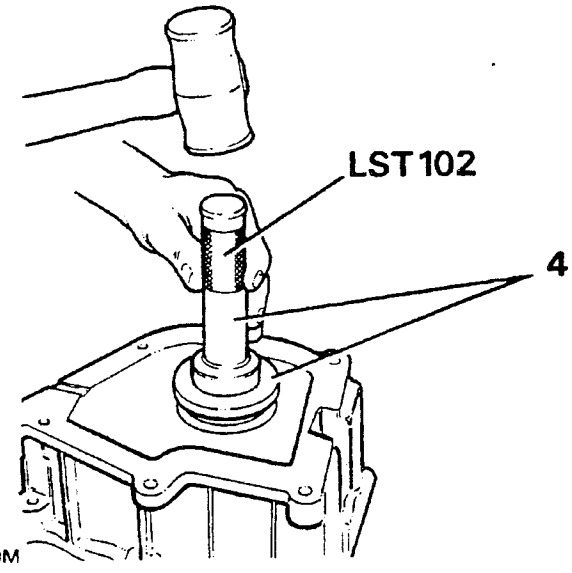
Continued



ST2019M

Gearbox fifth gear extension housing.

1. Remove the rear oil seal from the extension housing using a suitable drift.
2. If necessary, renew the extension housing dowels.
3. Clean the the exterior and interior and the mating faces.
4. Using service tool LST 102 fit a new seal to the extension housing.



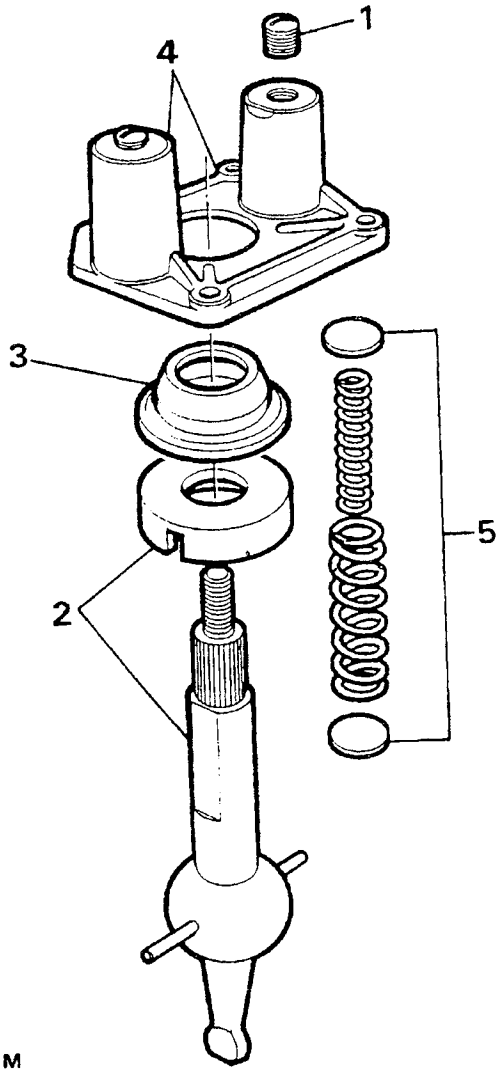
ST1349M

Top cover

1. Clean top cover gasket faces and the interior and exterior surfaces.
2. Remove the top filler plug, clean, apply sealant and refit.
3. Clean the gear lever housing and check for cracks and wear.

Bias spring housing and lower gear lever

1. Secure the housing in a vice and remove the bias spring adjusting screws.
2. Clean the lower gear lever and nylon cup. Check for wear and damage.
3. Check the rubber dust cover for damage.
4. Clean the housing, adjusting screws and bias spring bores.
5. Clean and examine the bias springs.
6. Refit the bias spring screws, two turns only at this stage.



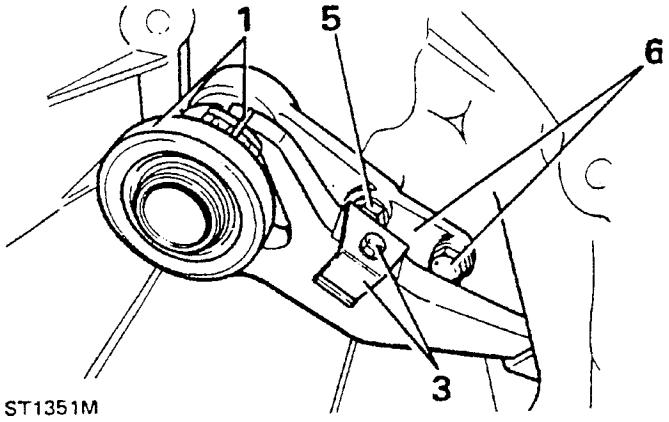
ST2021M

Bell housing.

1. Remove the clip retaining the thrust bearing carrier to the clutch operating lever fork if still in position.

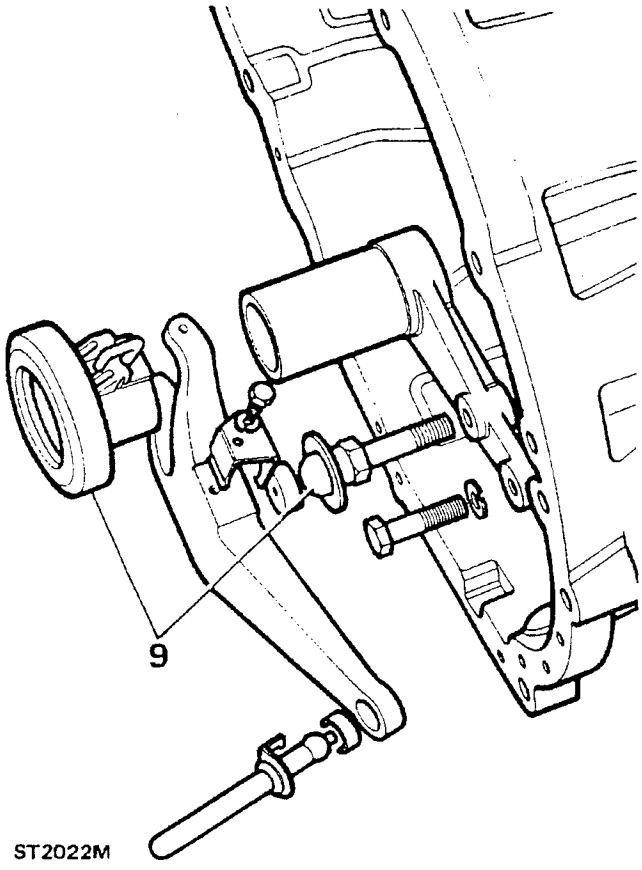
Note: the clip is fitted during assembly to prevent the bearing sliding forward when the gearbox is being fitted to the engine and it may become dislodged in service without detriment.

2. Withdraw the thrust bearing and carrier assembly from the sleeve.
3. Remove the bolt and spring washer securing the operating lever pivot clip to the lever.
4. Remove the operating lever and pivot slotted washer.
5. Remove the operating lever pivot.
6. Unscrew the single bolt and remove the bearing sleeve from the bell housing.



ST1351M

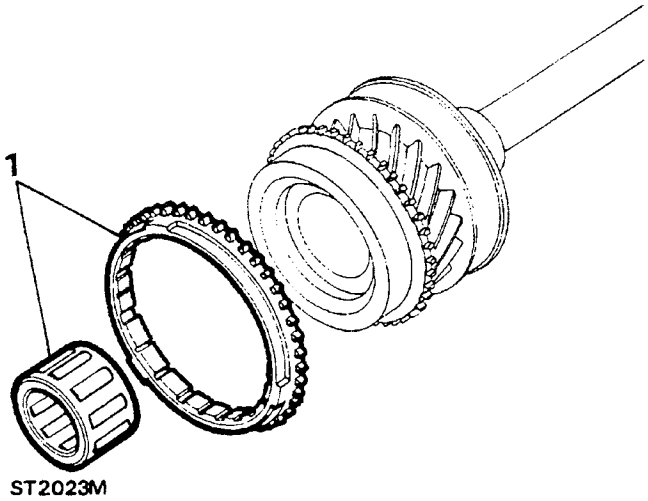
7. If necessary, remove the bearing sleeve dowels.
8. Clean the bell housing exterior and interior and mating faces.
9. Apply grease to the lever pivot and inner diameter of bearing carrier.
10. Reassemble the bell housing in the reverse order of dismantling.



ST2022M

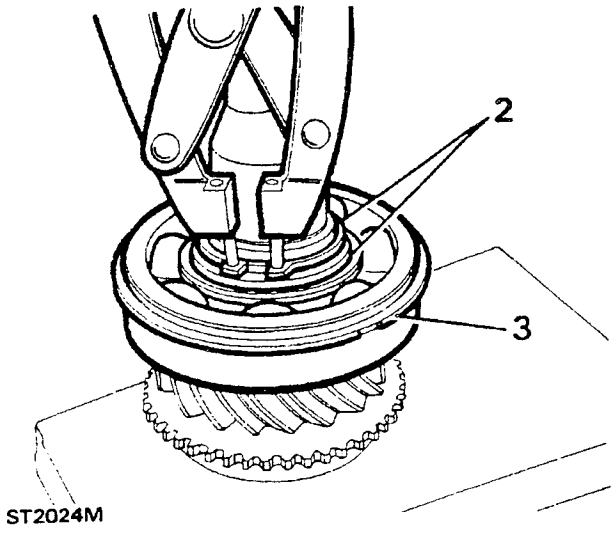
Input shaft

1. Remove the fourth gear baulk ring and needle roller bearing.

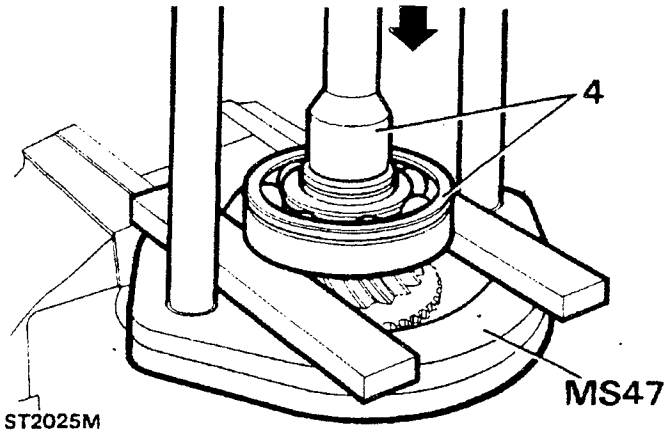


ST2023M

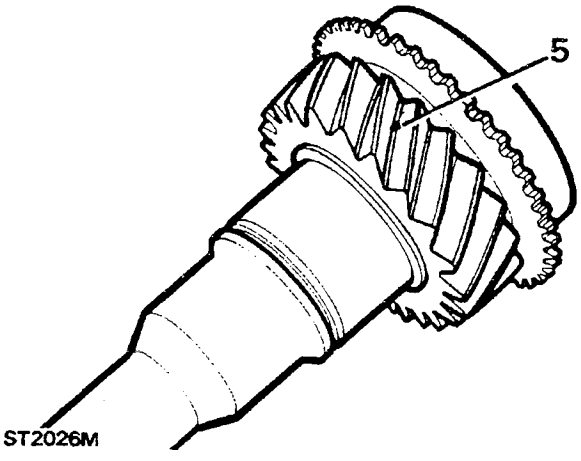
2. Remove the circlip and selective thrust washer.
3. Remove the snap ring from the bearing.



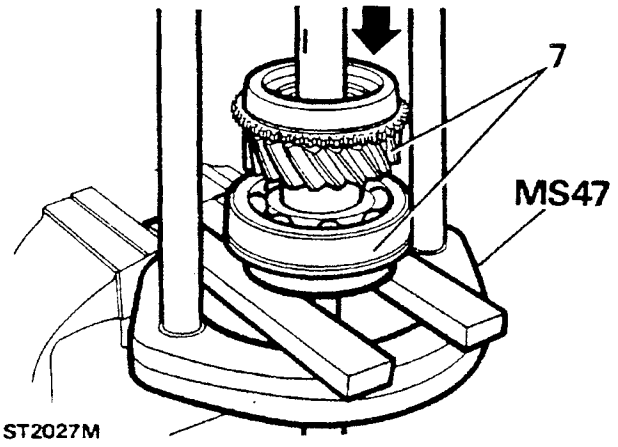
4. Using press MS 47 and two suitable steel blocks, press the input shaft from the bearing.



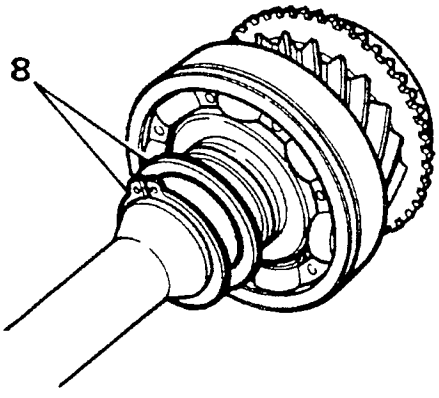
5. Clean all components and ensure that the two oil-ways in the input shaft are clear by blowing through with an air line.



6. Check the input shaft and gear for wear, scores and pits.
7. Using press MS 47 and a suitable tube, fit the input shaft to the bearing with the snap ring groove outwards.

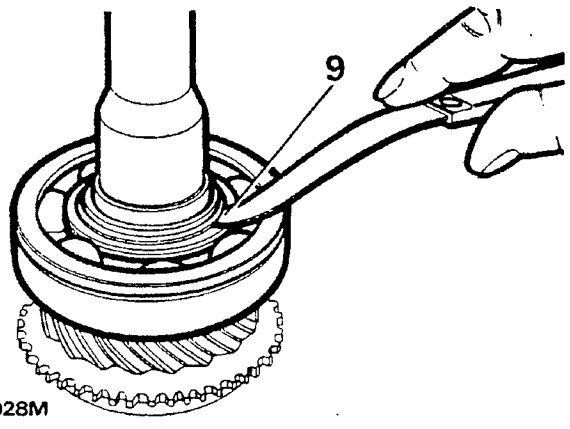


8. Fit the original selective washer and circlip.

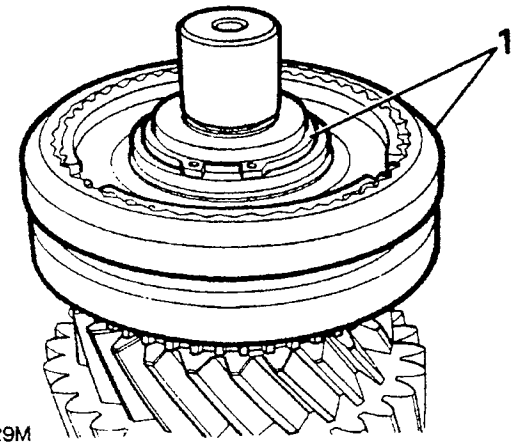


9. Check, with a feeler gauge, the clearance between the bearing and washer. If the clearance is in excess of 0,075mm remove the circlip and washer and select and measure a new washer to take-up the excess clearance.

Continued

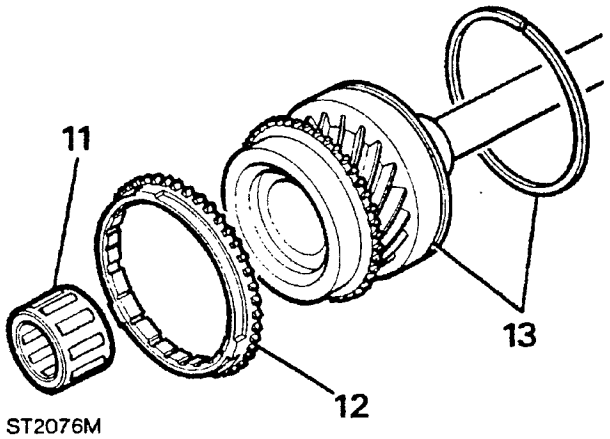


ST2028M

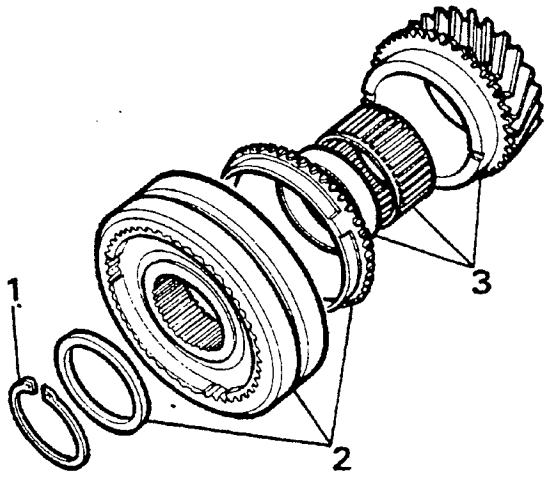


ST2029M

10. Fit the new selective washer,retain with the circlip and recheck that the above clearance is maintained.
11. Lubricate the mainshaft pilot bearing and fit to the mainshaft.
12. Fit the fourth gear baulk ring to the input shaft.
13. Fit the snap ring to the bearing.

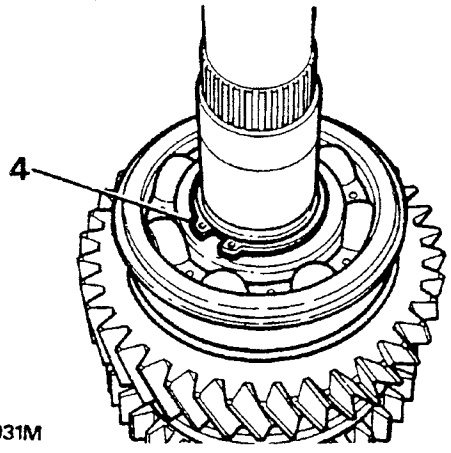


ST2076M



ST2030M

4. Invert the mainshaft assembly, in the vice, and remove the mainshaft rear bearing circlip.



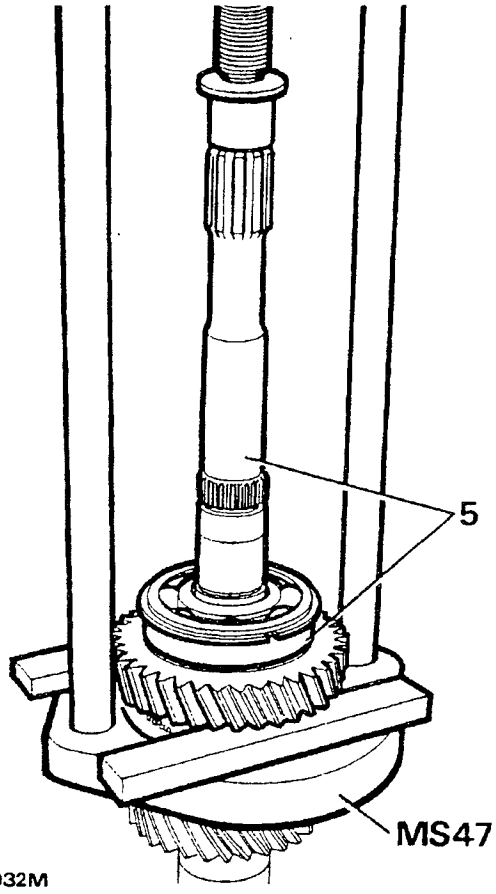
ST2031M

Mainshaft

1. Secure the mainshaft assembly in a vice and remove the circlip retaining the third/fourth synchromech hub and gear assembly.
2. Remove the selective washer, third/fourth synchromesh assembly and baulk ring.
3. Remove the third gear, spacer, and needle roller bearing.

Continued

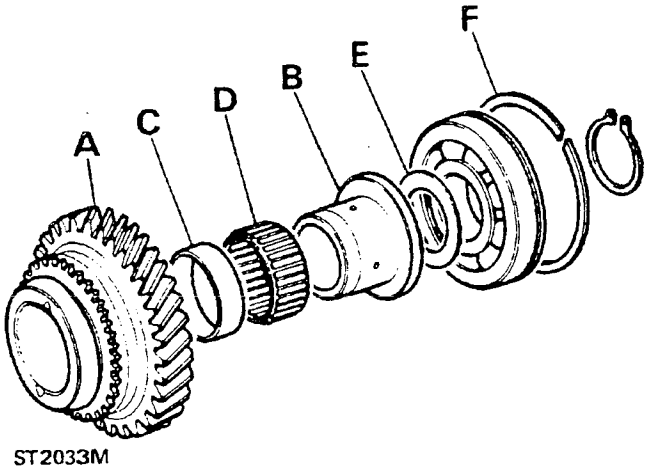
5. Using press MS 47, and a support under the first gear, press the mainshaft assembly from the rear bearing.



ST2032M

6. Separate the following components from the assembly:-

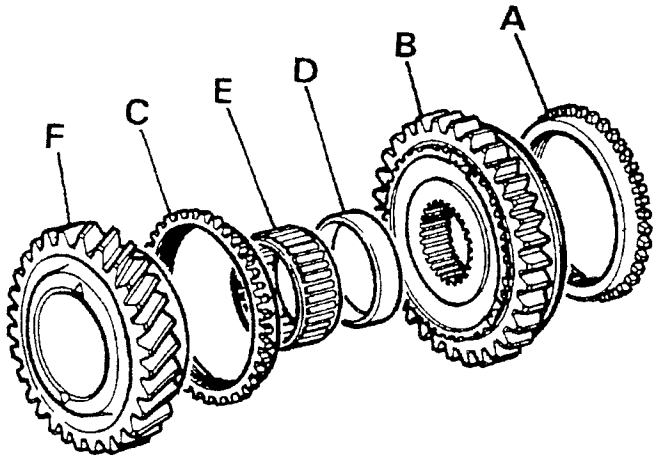
A. First gear.
B. First gear bush.
C. Spacer.
D. needle roller.
E. Selective washer.
F. Rear bearing snap ring.



ST2033M

7. In addition remove the remaining items:-

A. First gear baulk ring.
B. First and second synchromesh.
C. Second gear baulk ring.
D. Second gear spacer.
E. Second gear needle roller bearing.
F. Second gear.

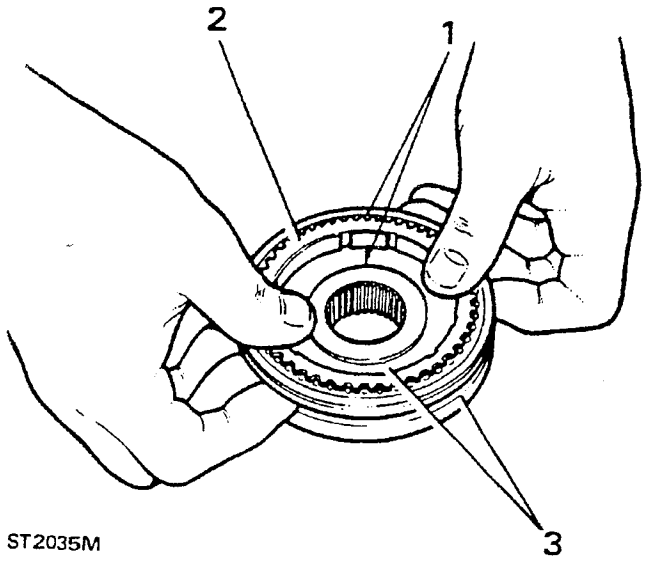


ST2034M

8. Clean the mainshaft and all components and examine for obvious wear.

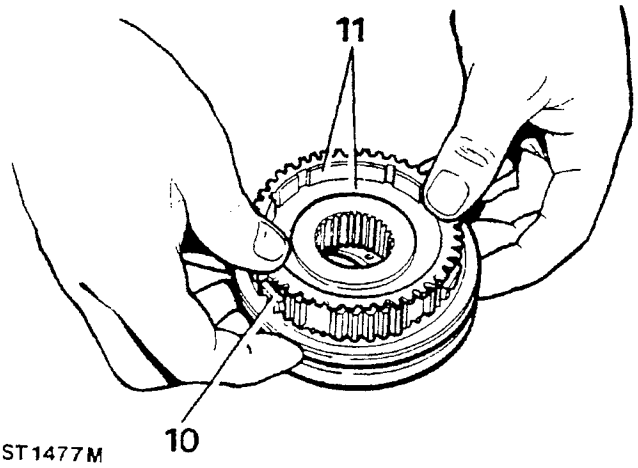
First/second synchromesh assembly.

1. Before dismantling, mark the relationship of the synchromesh hub to the sleeve.
2. Fit the baulk rings to the synchro- mesh assemblies to facilitate dismantling and to prevent damage to the springs.
3. Place the synchromesh assembly in a clear plastic bag, to prevent the components being lost and whilst in the bag, press the sleeve from the hub.



ST2035M

4. Retrieve the synchromesh balls, springs and slipper pads and remove the baulk ring.
5. Clean all the synchromesh assembly components.
6. Before reassembling the synchromesh units carry out the checks for third and second gear end floats as described under the heading "Mainshaft and gear train clearance checks".
7. Fit the synchromesh hub to the sleeve ensuring that the alignment marks line-up.
8. Place the hub and sleeve on a level block.
9. With the hub resting on the block adjust the height of the hub sufficiently to fit the springs.
10. Locate the slipper pads,fit the springs and press the balls down to be retained by the synchromesh sleeve.
11. Fit the baulk ring to the hub and sleeve.



ST1477M

12. Carefully invert the synchromesh assembly and fit the second baulk ring.
13. Press the synchromesh sleeve over the hub to locate the balls in position.
14. Remove the baulk rings.

Third/fourth synchromesh assembly.

1. Repeat the instructions as for the first/second synchromesh assembly but omit the gear end-float checks.
2. when reassembling the synchromesh unit, ensure that the large chamfer on the sleeve faces the small boss on the hub.

Fifth gear sychromesh assembly.

1. Repeat the instructions relating to the first/second synchromesh assembly.
2. Note that when reassembling the fifth gear synchromesh,the chamfer on the hub, faces to the rear.

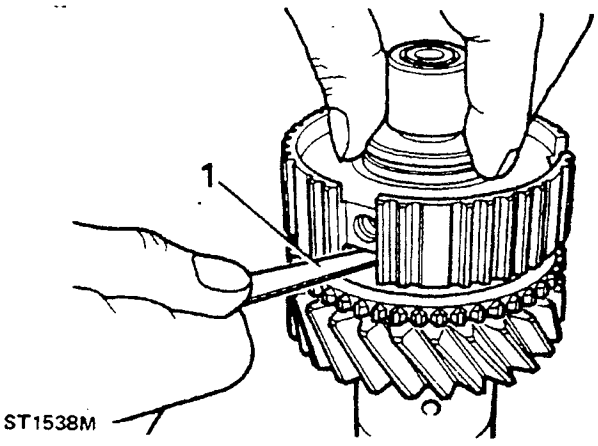
Mainshaft and gears clearance checks.

Running clearances

Mainshaft 1st gear	0,075mm maximum
Mainshaft 3rd gear	0,075mm maximum
Mainshaft 5th gear	0,075mm maximum
Input shaft bearing	0,075mm maximum

Third gear end-float.

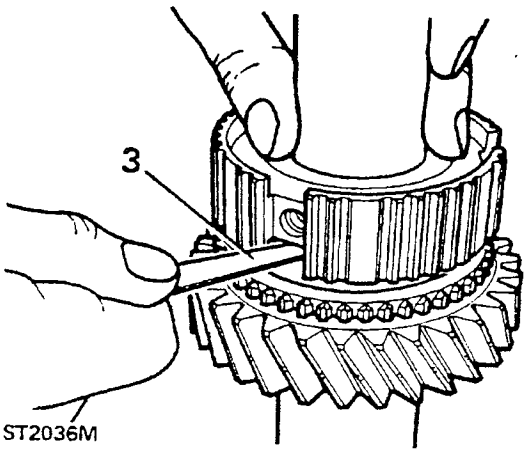
1. Locate the mainshaft in a vertical position as shown. Fit the third gear,needle roller bearing and spacer to the mainshaft and replace the third/fourth synchromesh inner member.Press down on the synchromesh inner member and check the gear running clearance with a feeler gauge.A clearance in excess of 0,19mm (0.008ins.) indicates that the thrust faces are worn and may be the cause of gear noise or transmission back-lash. New or little worn components will usually have a clearance of between 0,075mm and 0,125mm (0.003in to 0.005in)



ST1538M

Second gear end float

2. Invert the mainshaft for assembly of the rear end components.
3. Fit the second gear needle roller bearing, spacer, Second gear and synchromesh inner member. Press down on the synchromesh inner member and check the second gear end float which is the same as the third gear previously described.

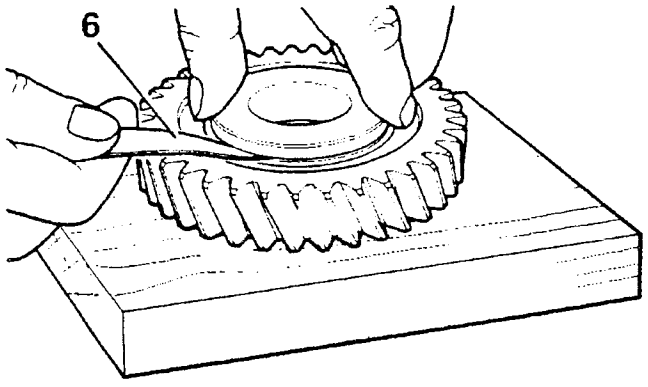


ST2036M

4. Remove the synchromesh inner member and assemble it to the outer member with the slippers, balls and springs.
5. Fit the second gear baulk ring to the mainshaft and the first and second synchromesh hub with the selector groove towards the rear end of the shaft.See items 11 to 17 mainshaft gears,illustration ST2071M page 6.

First gear to bush end-float.

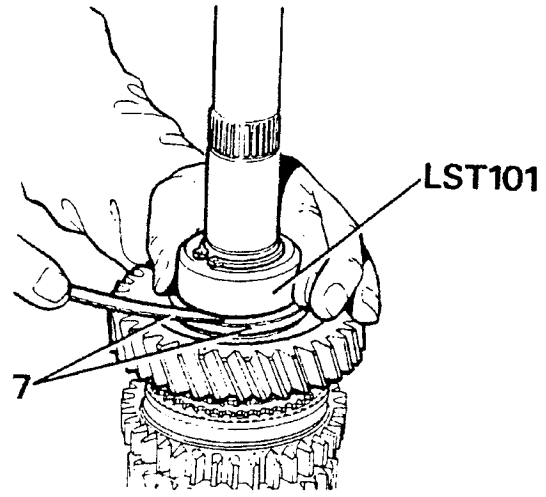
6. To carry-out the first gear check, do not assemble the components to the mainshaft. Assemble the spacer, needle bearing and bush to the first gear and using a suitable straight edge or flat plate, check the end float of the first gear on the bush, as shown.The tolerance is the same as for the third and second gears.



ST2037M

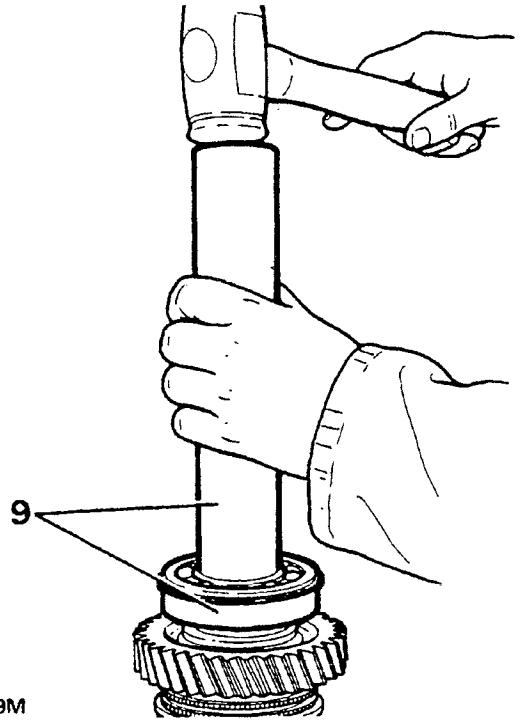
First/second synchromesh end float.

7. Assemble, to the first gear, the spacer, needle roller bearing and first gear bush and fit the assembly to the mainshaft. Fit the original selective washer and dummy mainshaft rear bearing LST 101 and retain with the circlip. With a feeler gauge, check the end-float as shown.Choose a suitable selective washer to obtain a minimum clearance of 0,075mm (0.003ins.)



ST2038M

8. Remove the dummy bearing and fit the selective washer.
9. Start the mainshaft rear bearing squarely on the mainshaft then,

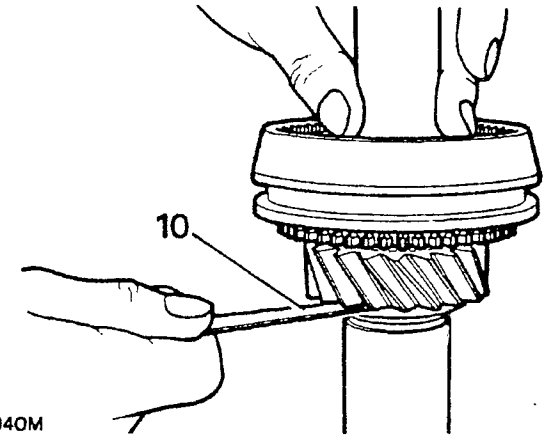


ST2039M

without inverting the shaft, use either a press, capable of accomodating the complete mainshaft assembly,or drive the bearing into position using a suitable tube. Secure the assembly with the circlip.

Fifth gear end-float.

10. Fit the fifth gear thrust washer with the scallop side towards the gear. Fit the fifth gear,needle bearing and spacer followed by the synchromesh assembly, less the baulk ring at this stage. Press down on the synchromesh inner member and check the gear end float, as shown, between the gear and thrust washer. The tolerance is the same as that for the third gear end float.



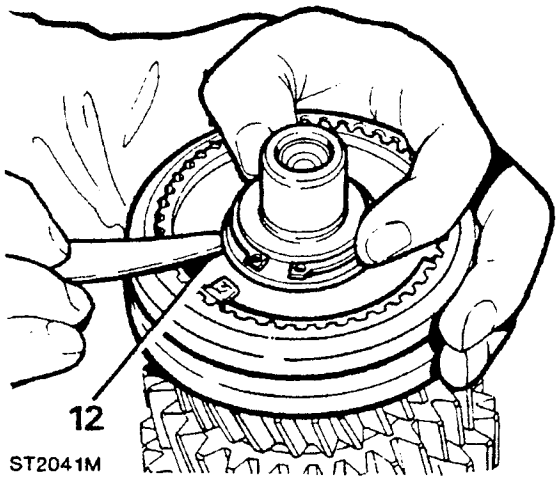
ST2040M

Third- fourth synchromesh end float.

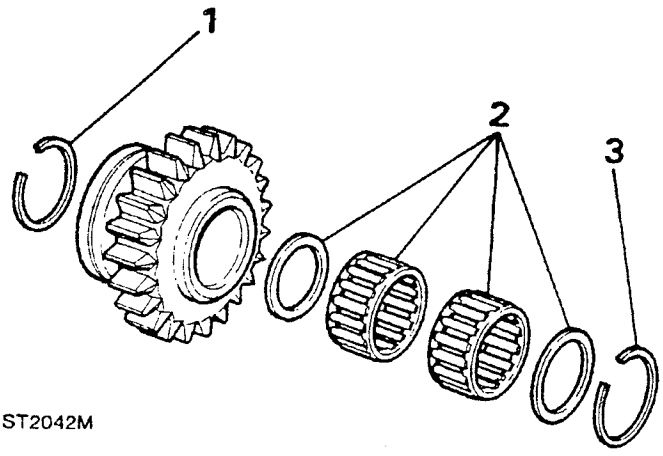
11. Invert the mainshaft to a vertical position,as shown. Fit the third gear needle roller bearing, spacer, third gear,baulk ring and synchromesh with the larger thrust face towards third gear and the chamfer on the outer member towards the front.Fit the original selective washer and retain with the circlip.

Continued

12. Check the clearance between the washer and the synchromesh hub. the clearance must not exceed 0,075mm (0.003ins). The condition is ideal when the selective washer can be just turned by hand.



ST2041M

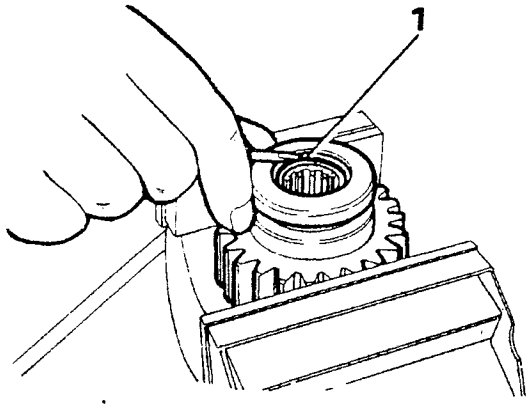


ST2042M

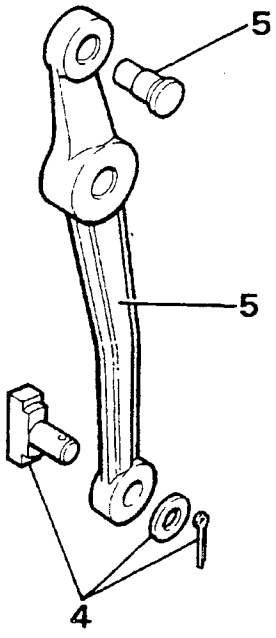
4. If necessary, remove the split pin and withdraw the slipper pads and washer from the reverse gear lever.
5. Press-out the reverse lever cross link pin, if necessary.

Reverse idler gear, shaft and lever.

1. Secure the reverse gear in a vice and remove one of the two circlips retaining the bearings.



ST1359M

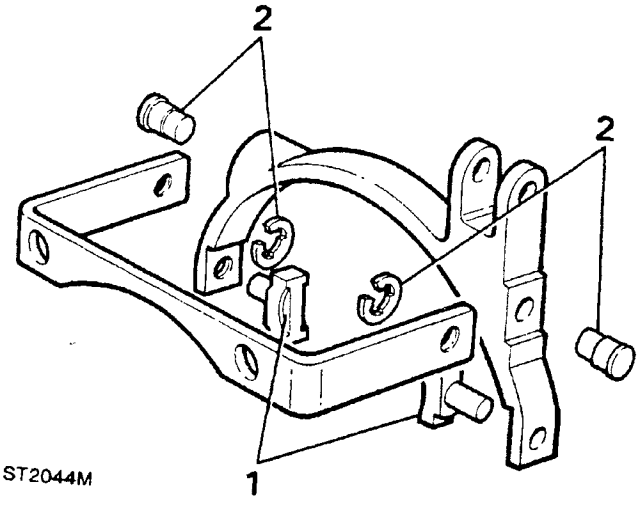


ST2043M

2. Remove the upper thrust washer, two needle roller bearings and lower thrust washer.
3. Invert the reverse gear and remove the second circlip.

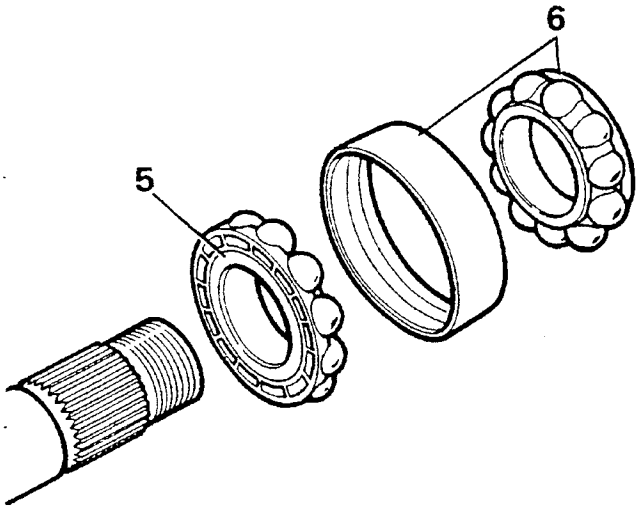
Fifth gear selector fork and bracket.

1. Remove the slipper pads from the selector fork and check for wear.
2. If necessary, remove the circlips and withdraw the pivot pins.
3. Clean all components and refit or renew in reverse order.



ST2044M

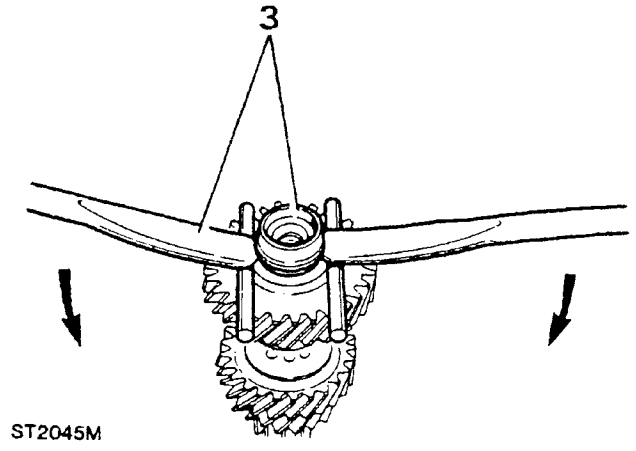
4. Clean the layshaft and bearings and check for wear, pitting and scores.
5. Fit the rear bearing assembly and note that the inner track must be fitted with the identification numbers facing inwards towards the layshaft first gear.
6. Fit the track and outer bearing with the identification numbers facing outwards towards the fifth gear.



ST2046M

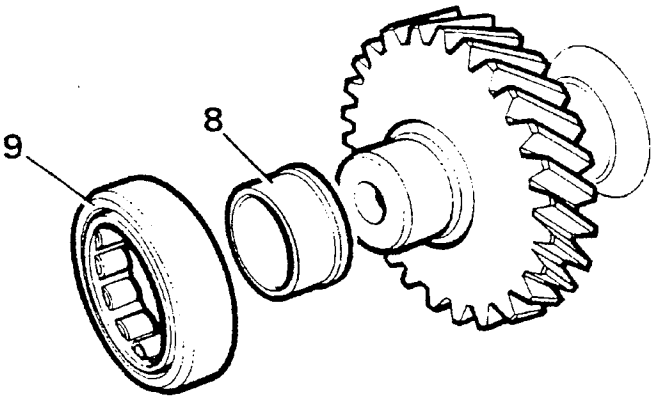
Layshaft.

1. Remove the stake nut and spacer and withdraw the complete rear bearing.
2. Remove the layshaft front bearing.
3. Secure the layshaft in a vice and lever-off the the front bearing inner track.



ST2045M

7. Fit the dummy spacer and stake nut loosely to retain the bearing assembly in position on the shaft.
8. Fit the front bearing inner track with the shoulder towards the gear. carefully tap the track squarely into position with a hide mallet.
9. Fit the front bearing race.

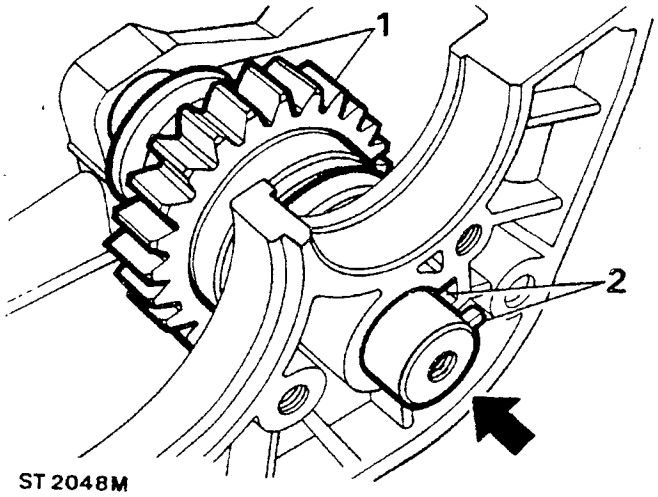


ST2047M

ASSEMBLE.

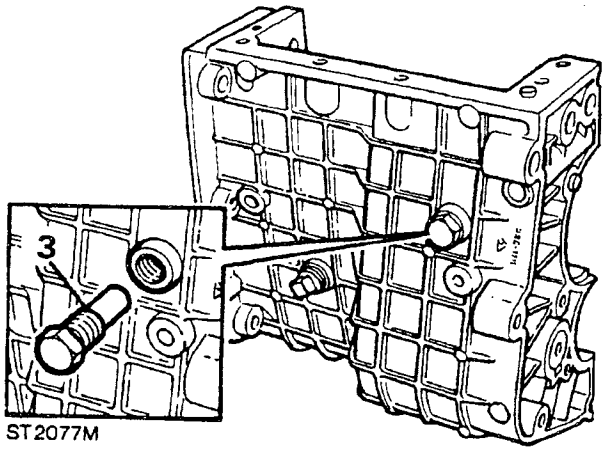
Fitting reverse idler shaft and gear.

1. Position the reverse idler gear and thrust washer in the casing with the thrust washer and the chamfer on the thrust washer, towards the gear.
2. Insert the idler shaft into the casing and through into the idler gear and washer. Ensure that the roll pin in the shaft lines-up with the cut-out in the casting, then drive the shaft fully home.



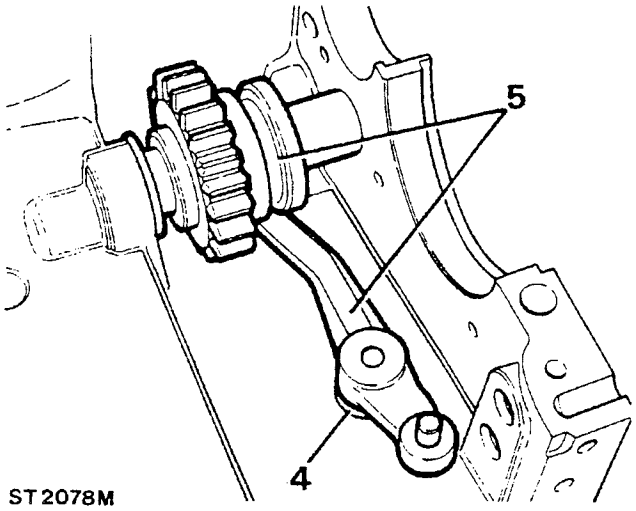
ST 2048M

3. Coat the threads of the reverse lever pivot bolt with Loctite 270 and fit to the casing and tighten to the correct torque.



ST2077M

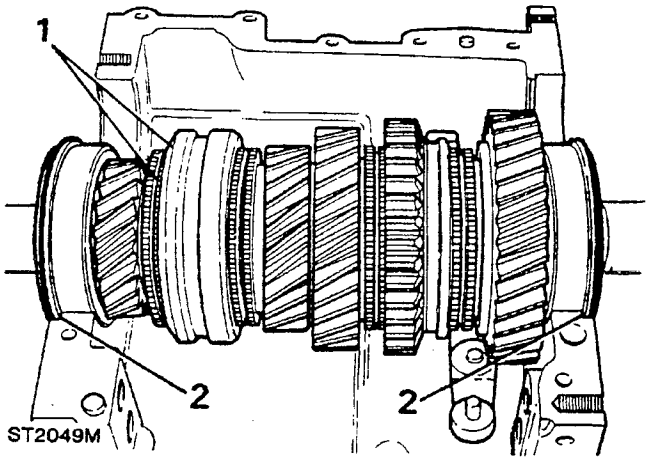
4. Fit the spacer next to the casing.
5. Fit the lever to the pivot whilst ensuring that the slipper locates in the reverse idler gear groove.



ST2078M

Fitting mainshaft and input shaft.

1. Fit the input shaft to the mainshaft assembly ensuring that the baulk ring engages correctly into the third/fourth synchromesh hub.
2. Lower the above assembly into the gear case noting that the snap ring on the front and rear bearings locate against a shoulder in the casing.



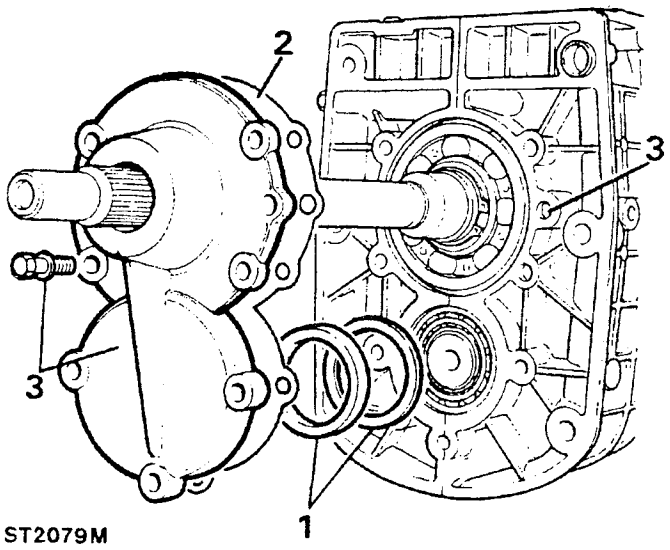
ST2049M

Fitting layshaft.

1. Hold the layshaft above the mainshaft assembly and engage the two sets of gears into mesh and roll the layshaft into position in the case. Check that the rear bearing locates against the shoulder in the case.
2. Wipe clean the mating faces of both cases and apply Loctite Instant Gasket in accordance with the manufacturers instructions.
3. Lower the empty case into position over the gears locating on the dowels.
4. Loosely secure the cases with the seven bolts and tighten evenly to the correct torque 22 to 28 Nm. (16 to 21 lbs.ft.). Clean away any surplus sealant.
5. Refit the stand to the gearbox and secure in the vice.

Fitting front cover

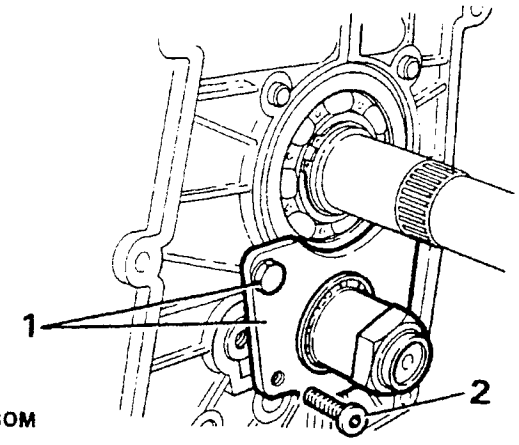
1. Fit the original shim and spacer to the layshaft front bearing.
2. Fit a new joint washer to the cover and lubricate the oil seal lip.
3. Taking care not to damage the seal lip, fit the cover to the gearbox locating it over the dowels. Secure with the seven bolts and spring washers and tighten evenly to the correct torque.



ST2079M

Fitting rear retainer plate

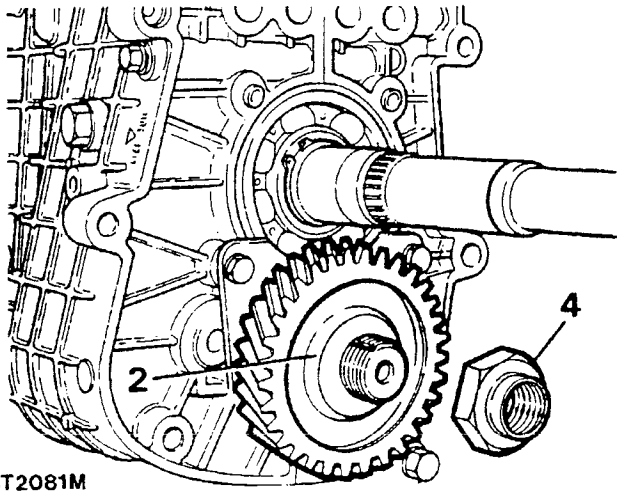
1. Fit the retainer plate to the gearbox and secure the top of the plate with the two bolts and spring washers.
2. Apply Loctite 270 (stud and bearing fit) to the socket headed screw threads and secure the lower end of the retaining plate.



ST2080M

Fitting layshaft fifth gear.

1. Remove the nut and dummy spacer from the layshaft.
2. Fit the fifth gear to the layshaft with the large boss to the rear.
3. To facilitate the next instruction, lock the gearbox by engaging first and fourth gears.
4. Fit a new fifth gear retaining nut and tighten to the correct torque. Do not stake the nut at this stage.

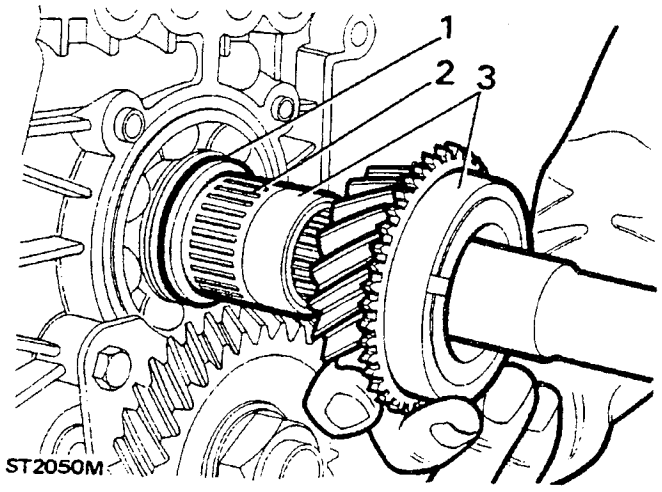


ST2081M

5. Disengage the first and fourth gears.

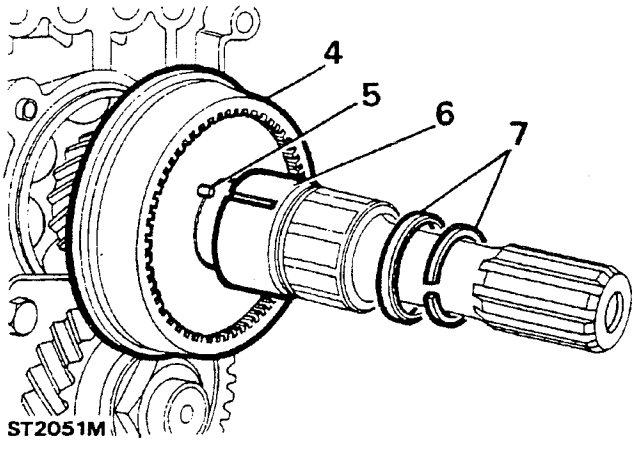
Fifth gear synchromesh end float.

1. Fit the thrust washer, grooves outwards, towards fifth gear.
2. Lubricate and fit the needle roller bearing to the mainshaft.
3. Fit the spacer and fifth gear.



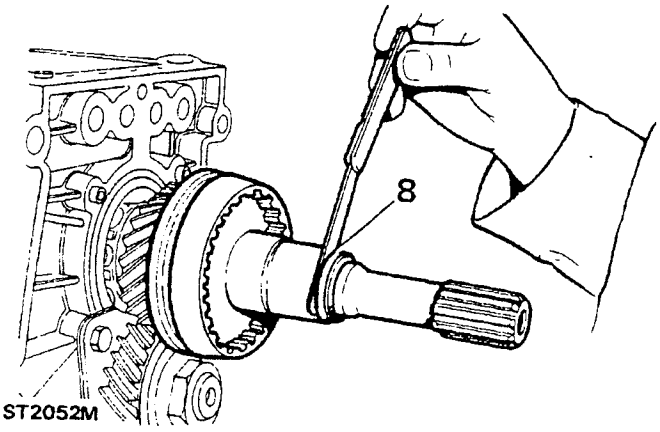
ST2050M

4. Fit the fifth gear synchromesh cone and hub assembly.
5. Fit the fifth gear synchromesh hub retaining plate, peg outwards.
6. Omit the "O" ring and fit the sleeve with the slot over the peg.
7. Fit the original selective washer and retain with the snap ring.



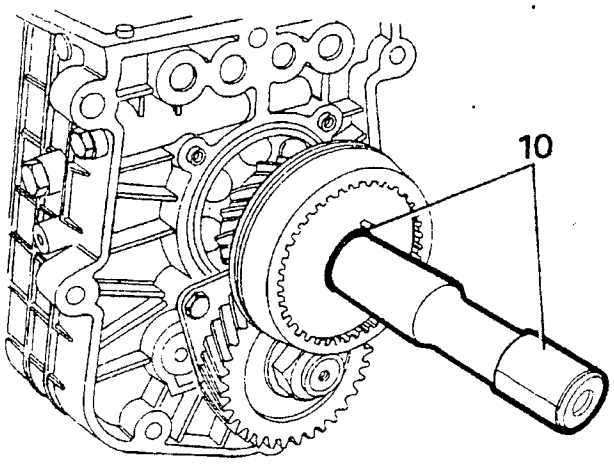
ST2051M

8. Using a feeler gauge, measure the clearance between the washer and the sleeve. If necessary exchange the washer for one that will provide a clearance of 0,075mm (0.003ins.)



ST2052M

9. Remove the snap ring, selective washer and sleeve.
10. Wind protective tape round the mainshaft splines and fit the "O" ring seal against the synchromesh hub retaining plate.

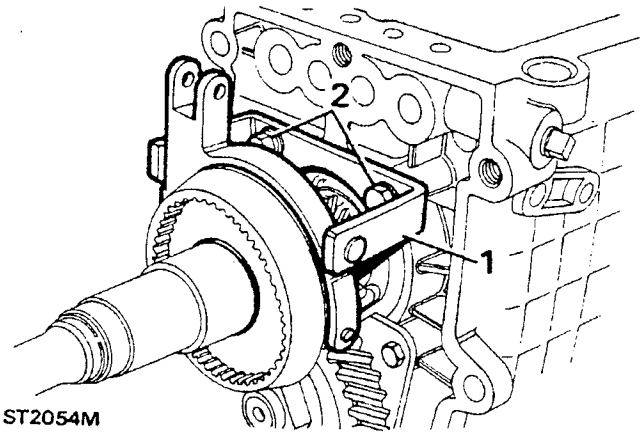


ST2053M

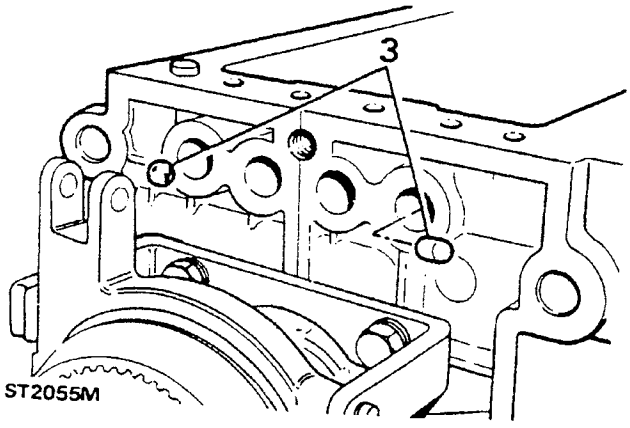
11. Refit the sleeve, selective washer and snap ring and remove the protective tape.

Fitting selector rails and forks.

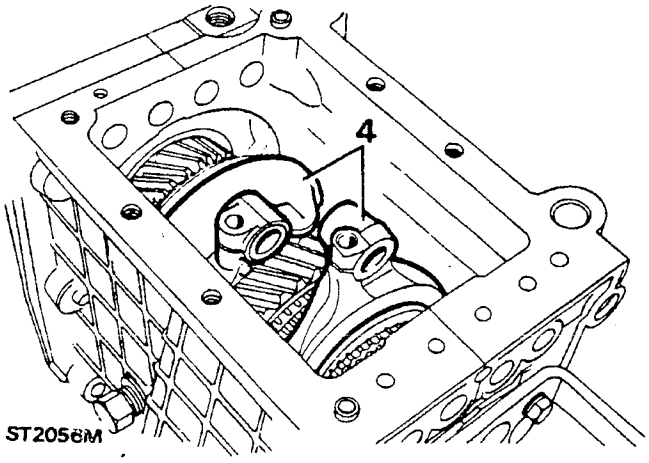
1. Locate the fifth gear fork and bracket on to the synchromesh hub and gearbox dowels.
2. Secure the fork bracket to the gearbox with two bolts and plain washers.



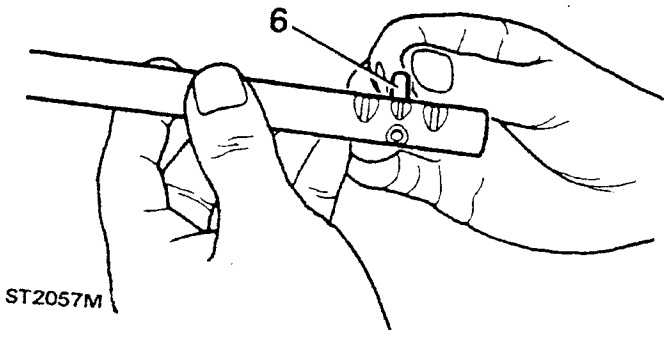
3. Fit the selector rail interlock plungers to the gearbox case.



4. Fit the first/second and third/fourth selector forks.



5. Place the reverse gear cross-over lever in position in the gearbox locating the fork end over the reverse lever operating pin.
6. Insert the interlock plunger into the first/second selector rail.

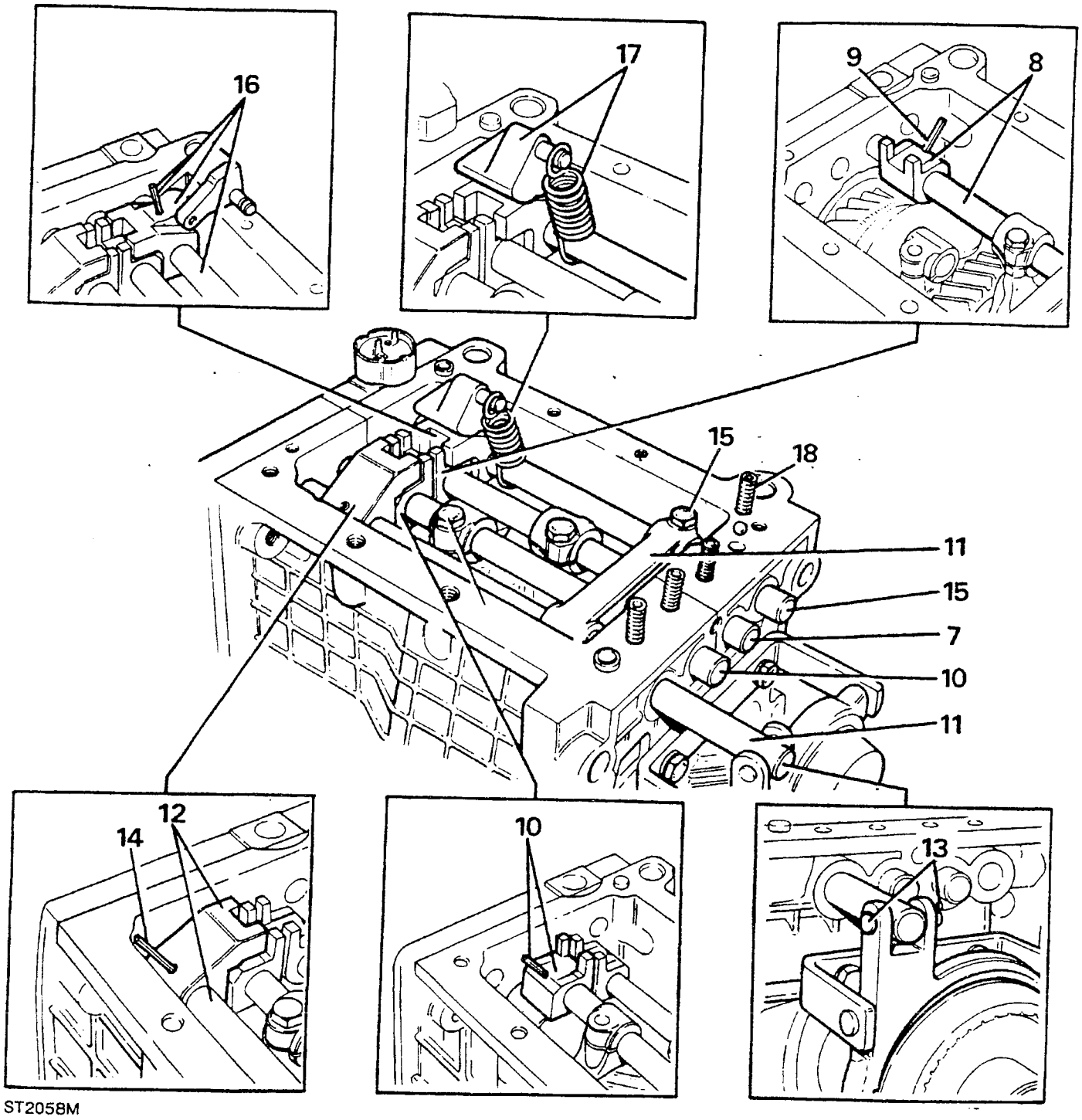


7. Push the first/second selector rail into the gearbox and locate in the reverse cross-over lever and selector fork. Do not tighten the fork clamp bolt at this stage.

Note: the first/second fork clamp bolt is not a set bolt unlike the third/fourth fork clamp bolt.

8. Fit the first/second selector jaw to the rail and align to accept the retaining roll pin.
9. Using a suitable drift, tap-in the roll pin to secure the jaw and rail.
10. Repeat instruction 9 for the third/ fourth selector rail and jaw.
11. Push the fifth gear selector rail through the gearbox and the reverse cross-over lever.
12. Fit the fifth gear selector jaw to the rail and align to accept the roll pin.
13. Locate the selector rail into the fifth gear selector fork and secure with the clevis pin, washer and split pin.
14. Secure the jaw to the fifth gear selector rail with the roll pin.
15. Push the reverse selector rail through the gearbox and reverse cross-over lever but do not tighten the lever clamp bolt at this stage.

Continued

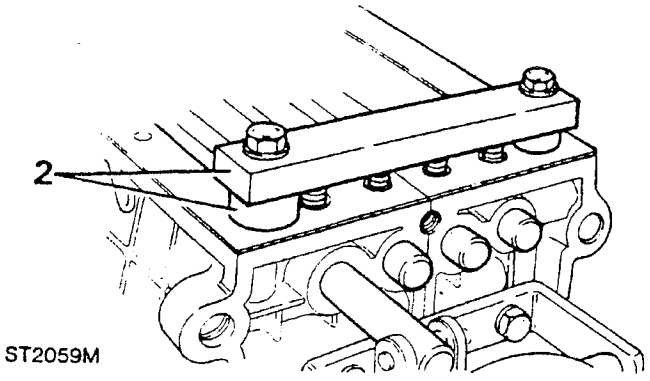


ST2058M

16. Fit the jaw to the reverse selector rail, align the holes, and secure with the roll pin using a suitable drift. The pin must be inserted so that it is flush with the underside of the jaw to ensure that the jaw is adequately retained.
17. Fit the reverse gate spring to the selector rail and knock-over lever.
18. Fit the detent balls and springs.

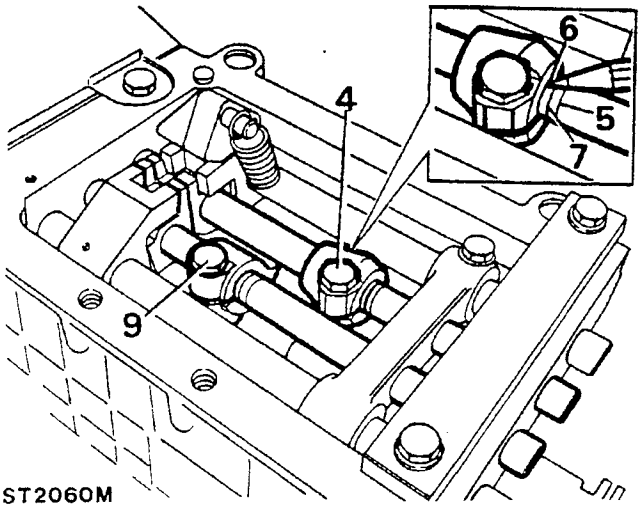
Selector fork adjustment.

1. Fit the top cover gasket.
2. Secure the detent spring retaining tool and spacers (manufactured tool) to the gearbox with two 8 x 50mm bolts and plain washers.



ST2059M

3. Tighten the bolts to compress the detent springs until the retaining plate contacts the two spacers.
4. Ensure that the first/second selector rail and synchromesh sleeve are in the neutral position. Tighten the clamp bolt sufficiently to eliminate any rock in the selector fork and move the selector fork rearwards.
5. Scribe a pencil line on the rail at the rear of the fork yoke.
6. Move the fork forwards, to the original position and scribe another line at the rear of the yoke.
7. Now scribe a line midway between the two lines on the selector shaft.
8. Move the selector fork rearwards so that the yoke coincides with the centre line and tighten the clamp bolt.



ST2060M

9. Repeat instructions 4 to 8 to adjust the third/fourth selector fork and rail.

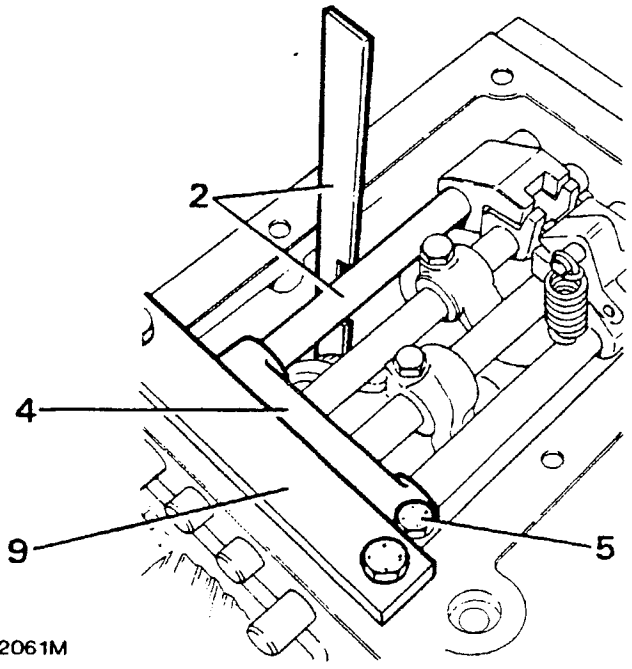
Reverse cross-over lever adjustment.

The purpose of the following adjustment is to ensure that when first gear is selected the outer member of the first/ second synchromesh unit is not also engaged with the reverse idler gear.

1. Move the reverse idler gear thrust washer fully forward.
2. Fit the manufactured gauge to the reverse idler gear shaft so that it is between the idler gear and thrust washer.
3. Move the reverse gear selector rail rearwards to engage reverse gear.
4. Move the cross-over lever rearwards to lightly nip the gauge between the reverse gear and thrust washer.
5. Tighten the reverse cross-over lever clamp bolt and return the selector rail to the neutral position and remove the gauge.
6. Move the first/second selector rail rearwards to select first gear.

Continued

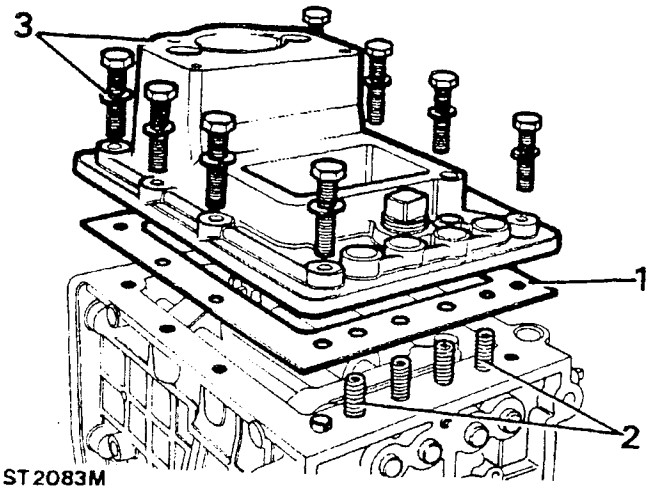
7. Check that a minimum clearance of 1,0mm exists between the front face of the reverse idler gear and the rear face of the reverse gear on the first/second synchromesh sleeve. If the clearance is insufficient, adjust the cross-over lever again.
8. Return the first/second selector rail back to neutral.
9. Remove the detent spring retaining tool and spacers



ST2061M

Gearbox top cover.

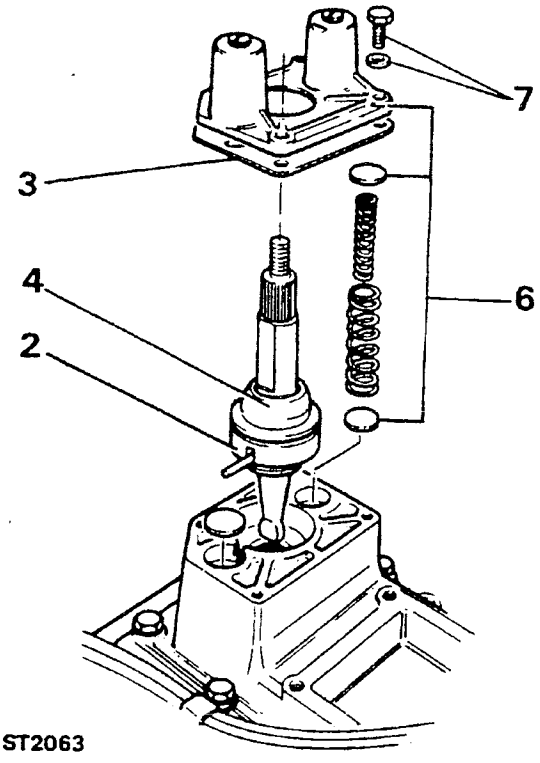
1. Fit the top cover gasket.
2. Fit the top cover locating it over the detent springs.
3. Position the breather pipe, locate retaining clips and secure the top cover with the eight bolts and spring washers.
4. Fit the breather pipe banjo union and fibre washers.
5. Fit the reverse light switch.
6. Place clean rag in top cover gear lever aperature to prevent the entry of dirt.



ST2083M

Lower gear lever and bias spring housing

1. Remove the rag from gearbox top cover.
2. Lubricate and fit the gear lever ball lower yoke and nylon cup.
3. Fit a new gasket to the housing.
4. Fit the rubber grommet.
5. Apply grease to the bias springs.
6. Fit the shims and bias springs, followed by the spring housing.
7. Secure with the four set screws and spring washers.



ST2063

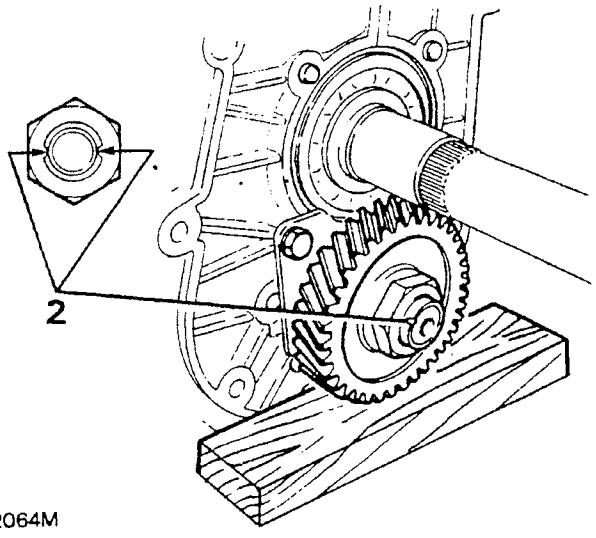
Bell housing.

1. Fit a new bell housing gasket.
2. Locate the bell housing squarely on the dowels and secure to the gearbox with the six bolts and spring washers.

Gearbox extension housing.

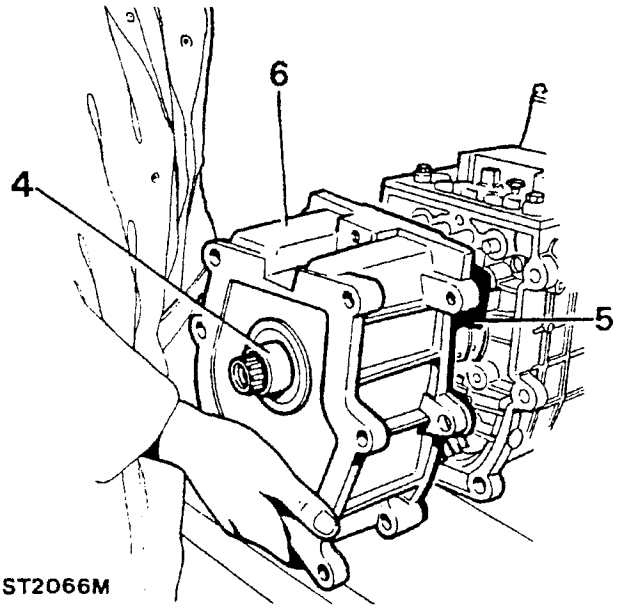
1. Remove the gearbox assembly from the vice and detach the stand.
2. The special nut retaining the fifth gear to the layshaft must be secured by carefully forming the collar of the nut into the layshaft slots, as illustrated.

CAUTION: A round nose tool must be used for this operation to avoid splitting the coller of the nut. Also, the layshaft fifth gear should be supported by a block of timber whilst the nut is being deformed to prevent damage to the adjacent bearing.



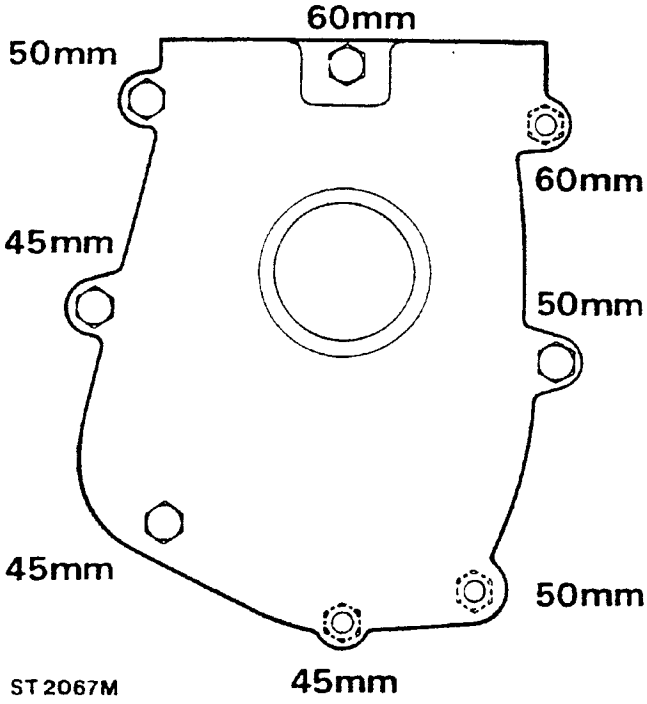
ST2064M

3. Support the underside of the gearbox with a block of timber.
4. Lubricate the oil seal protection sleeve LST 102 and insert it into the oil seal from inside the extension housing.
5. Fit a new gasket to the extension housing.
6. Carefully slide the extension housing, with the seal protection sleeve in position, over the mainshaft and locate on the dowels.



ST2066M

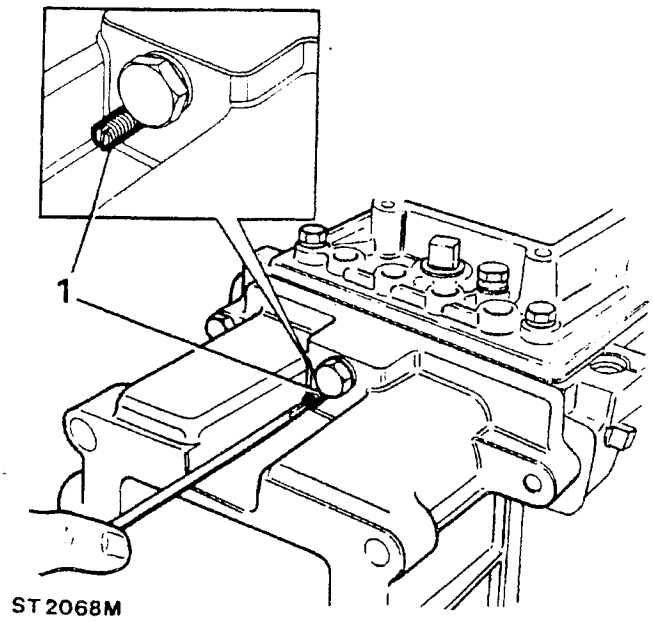
7. Withdraw the oil seal protection sleeve.
8. Secure the extension housing with the eight bolts, spring washers and single nut. The illustration below shows the correct length of bolt for each of the eight locations.



ST 2067M

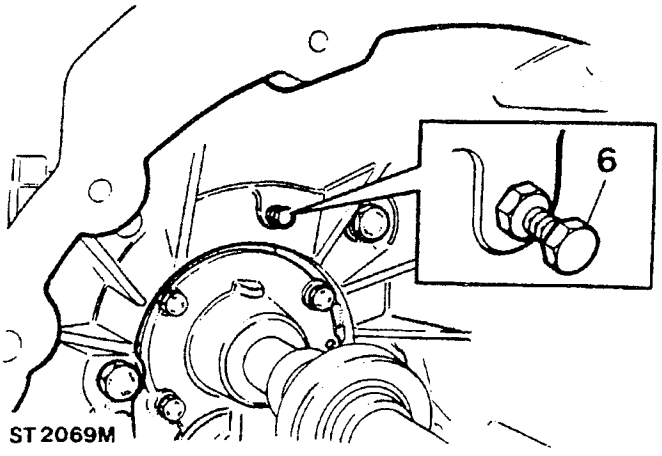
Third/fourth selector rail adjustment

1. Slacken the third/fourth stop screw in the extension housing.



ST 2068M

2. Select third gear.
3. Tighten the stop screw until it makes contact with the third/fourth selector rail.
4. Turn back the stop screw one turn.
5. Return the gear lever to the neutral position.
6. Slacken the locknut on the third/fourth stop bolt inside the bell housing.

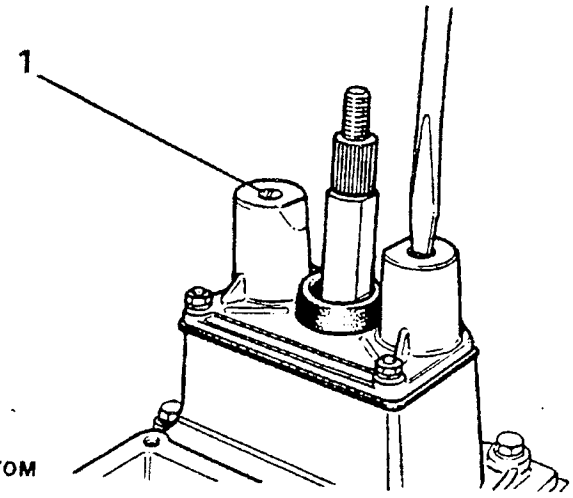


ST 2069M

7. Unscrew the stop bolt.
8. Select fourth gear and screw-in the stop bolt until contact is made with the third/fourth selector shaft.
9. Turn back the stop bolt one turn and tighten the locknut.
10. Return the gear lever to the neutral position.

Bias spring adjustment.

1. Apply Loctite stud and bearing fit 270 to the bias spring screws and turn the screws clockwise until the heads are flush with the top face of the bias spring housing.



ST 2070M

Gearbox mounting

1. Fit the mounting to the extension housing and secure with the four bolts.

Land Rover
Range Rover

Workshop Bulletin

ATTENTION SERVICE MANAGER

FEBRUARY 1988
BULLETIN NUMBER SLR621ENWB4

LAND ROVER
1988 MODEL IMPROVEMENTS

Further supplies of this Bulletin can be obtained, free of charge, from:

Land Rover Merchandising Service
P.O. Box 534, Erdington Birmingham B24 0QS

01 INTRODUCTION

INTRODUCTION

Also included in the 1988 Year Land Rover model improvements are the following items which are fully described to assist the workshop. The first operation, whilst not being part of the improvement programme is, nevertheless, a continuation of the policy to replace material gaskets, where practicable, with liquid sealants. The opportunity has, therefore been taken to include, in this Bulletin, the latest, most significant change under this policy.

12 ENGINE

ALL LAND ROVER FOUR CYLINDER ENGINES

Rear main bearing cap sealing.

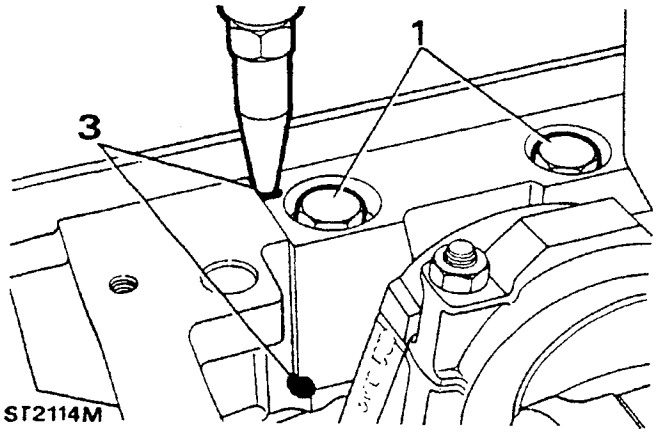
A change has recently been introduced to the method of sealing the rear main bearing cap. Hitherto sealing was accomplished using "T" shaped cork packing strips one each side of the cap. Sealing is now achieved by injecting "Hylosil" 102 (black) into the slots formally occupied by the packing strips. This material may also be used on all earlier engines where the caps were sealed with packing strips.

The method is as follows:-

1. With the sump removed, fit the main bearing cap and tighten the bolts to the correct torque, 130-136 Nm (96- 100 lbf.ft.).

2. Turn the crankshaft to bring numbers two and three pistons to Top Dead Centre so that the crankshaft webs will not obscure the rear bearing cap.

3. Using a suitable applicator, inject the sealant into the main bearing cap slot adjacent to the bearing cap bolt recess until it emerges from the upper end of the slot.



4. Repeat instruction 3 on the opposite side of the bearing cap.

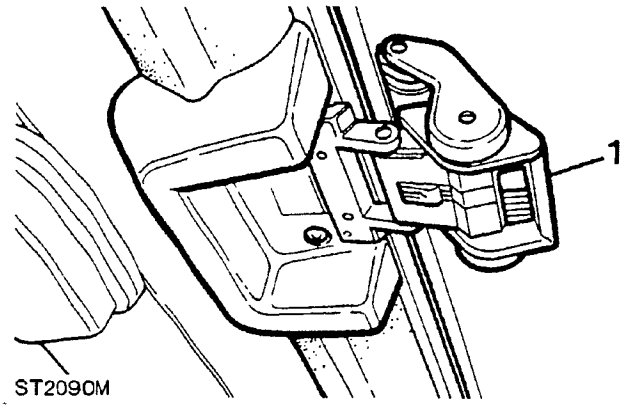
5. Remove surplus sealant and fit the sump.

Note: When removing surplus sealant from the sump gasket face, ensure that the sealant is cleaned-off level to the cylinder block machined face.

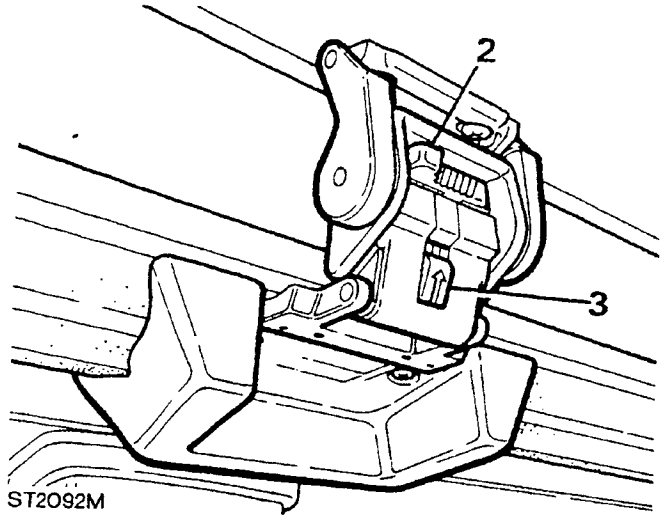
SUN ROOF LAND ROVER "90"and"110".

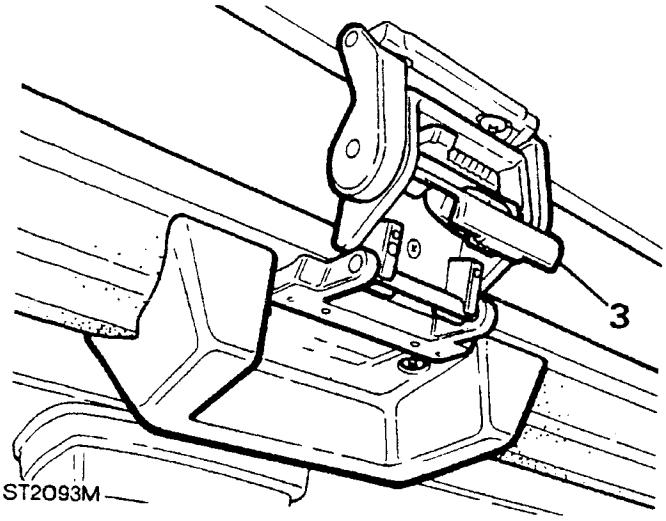
To remove

1. Open the roof panel to its fullest extent by pulling the latch handle down to the first open position.

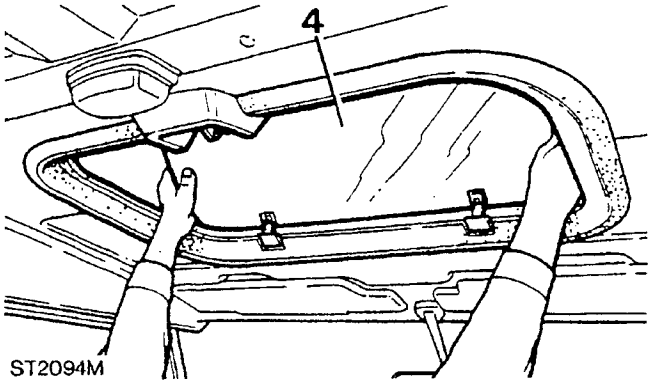


2. Then move the green button to the right and push the panel up as far as the latch will allow to the fully open position.
3. Move the red button upwards and open the retaining hasp.

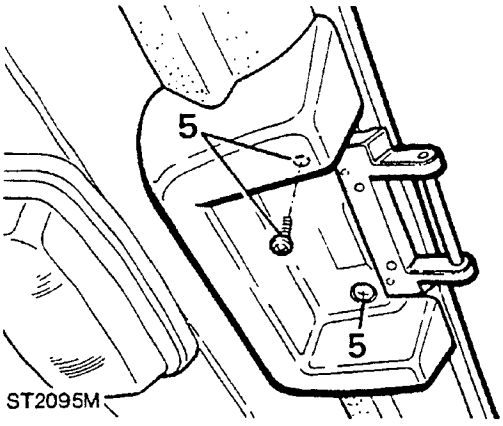




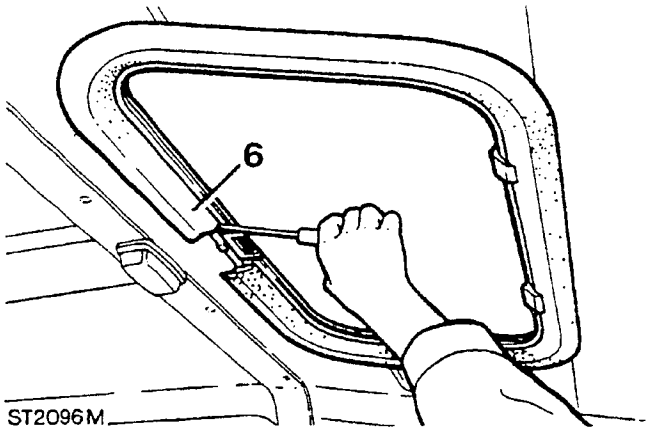
4. Raise-up the rear of the panel and withdraw it rearwards from the sun roof exterior surround.



5. Remove the two screws and withdraw the latch finisher.



6. The sun roof interior finisher is secured by fourteen dowels to the sun roof outer frame retainer. To remove the finisher, carefully lever the finisher away from the retainer using a screwdriver with a broad blade.



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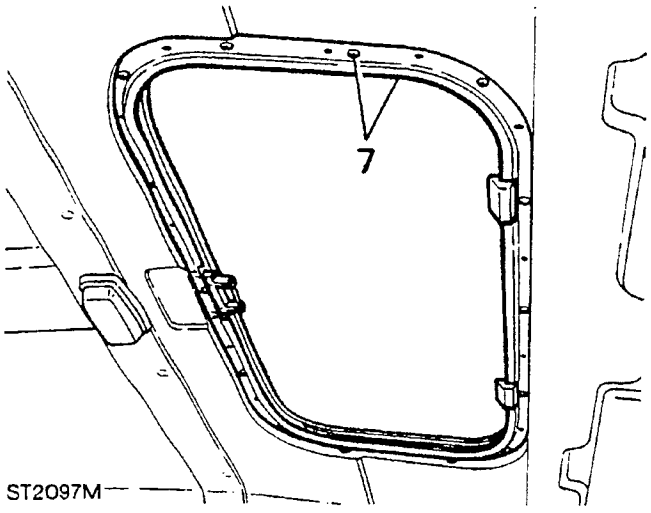
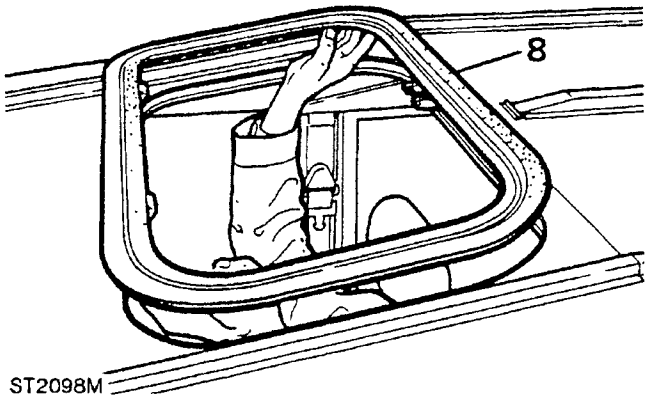
7. Remove the fifteen screws and withdraw the outer frame retainer.

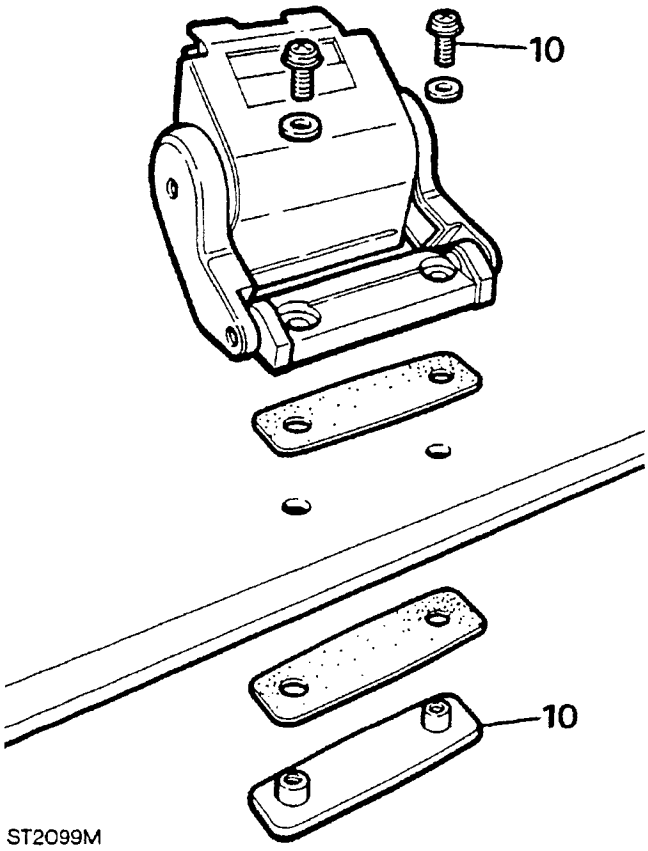


8. Lift the sun roof external frame from the vehicle.



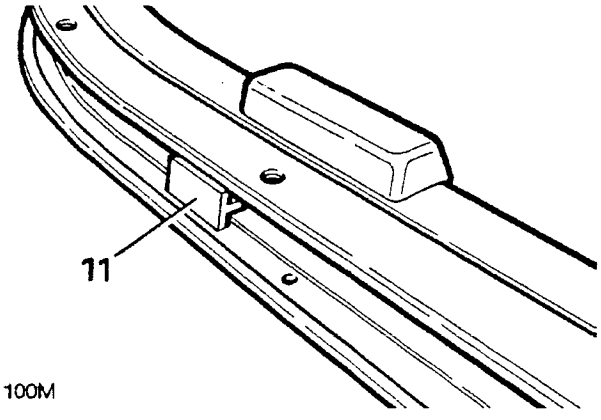
9. If necessary, remove the adhesive- backed seal, from the inner edge of the frame, that seals it to the vehicle roof.

10. To release the latch from the glass panel,remove the two screws and withdraw the latch and backing plate.



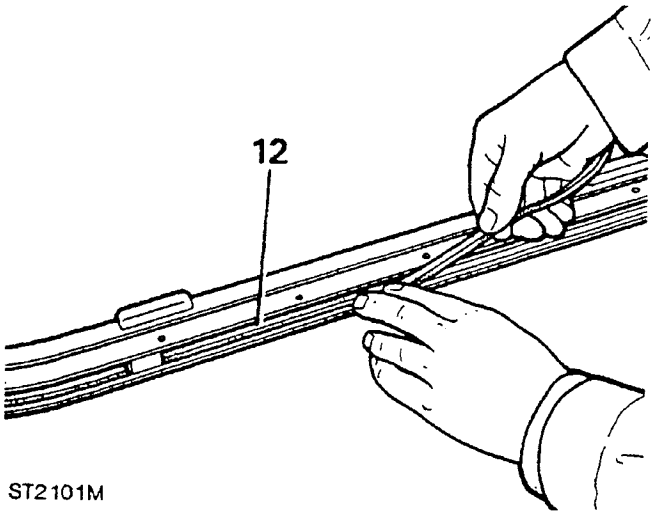
To refit

11. If, removed, fit the two centralising blocks to the outer frame and secure with adhesive.



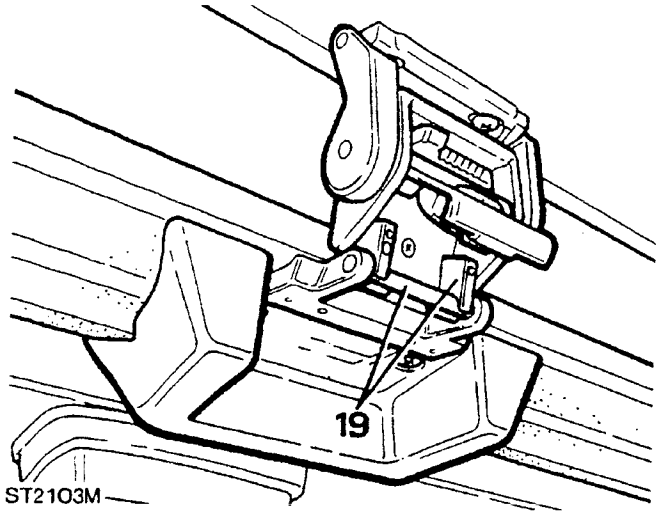
12. Secure a new seal to the outer closing edge of the frame avoiding a join along the hinge side.

Continued



ST2101M

13. Clean the area of contact on the vehicle roof then Lower the frame into position on the roof.
14. From inside the vehicle, offer-up the retaining frame and secure to the outer frame with the fifteen screws.
15. If removed, fit the latch to the glass panel with the backing plate and two screws,reversing instruction 10.
16. Secure the interior finisher to the retaining frame with the fourteen dowels.
17. Fit and secure the latch finisher with the two screws.
18. Fit the glass panel and latch assembly squarely to the outer frame.
19. Lower the latch on to the pivot bar, ensuring that the bar locates in its cradle, and whilst pushing the red button upwards, close the latch hasp over the bar until it locks reversing instruction 3.



ST2103M

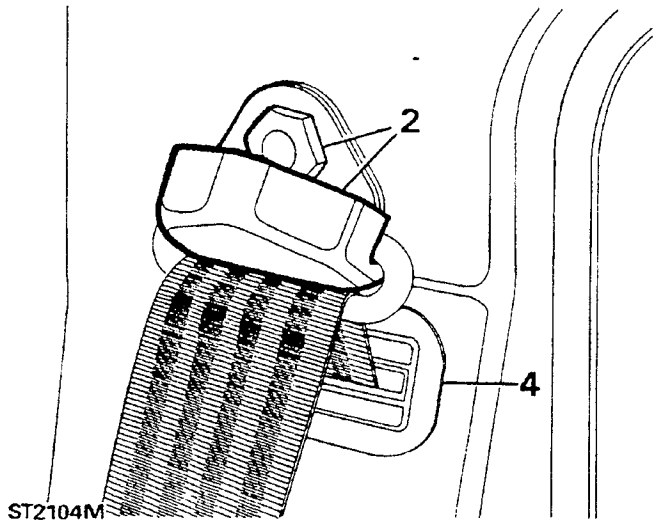
20. To check the operation and to close the panel,move the green button to the right whilst pulling the latch handle downwards until it snaps into the locked position.

LANDROVER "110" STATION WAGON.

Rear side window trim.

To remove

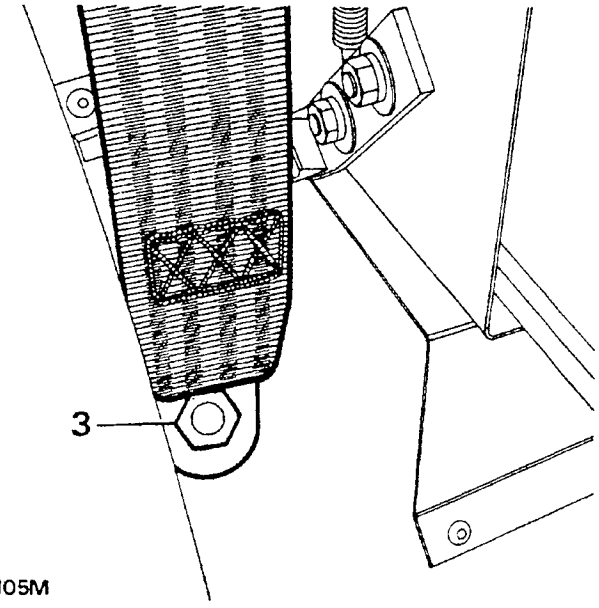
1. To gain access to the trim lower fixings remove the rear seat and squab frame complete.
2. Remove the plastic cover and the seat belt anchorage bolt from the "C" post.



ST2104M

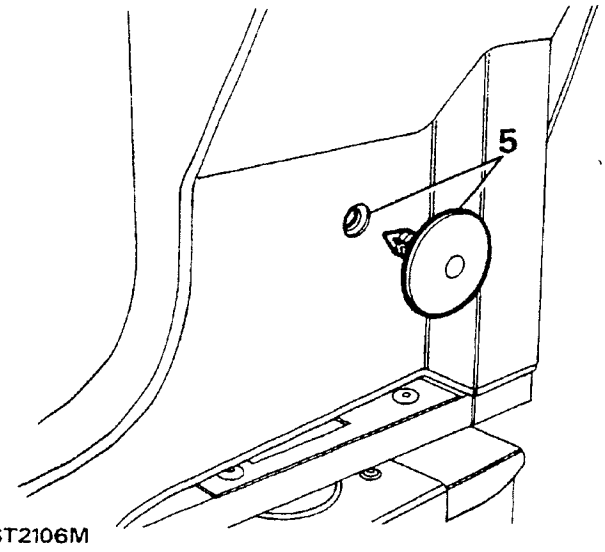
3. Remove the lower anchorage bolt for the same seat belt.
4. Remove the seat belt aperature finisher from the trim panel and remove the rear quarter light trim from the side concerned.

Continued



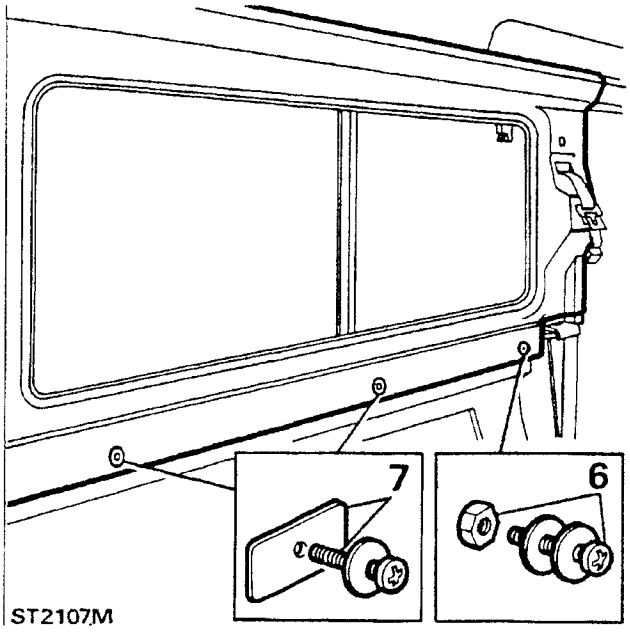
ST2105M

5. Using a screwdriver, carefully lever the trim retaining button from the "C" post.The button is held by a "fir-tree" type peg.



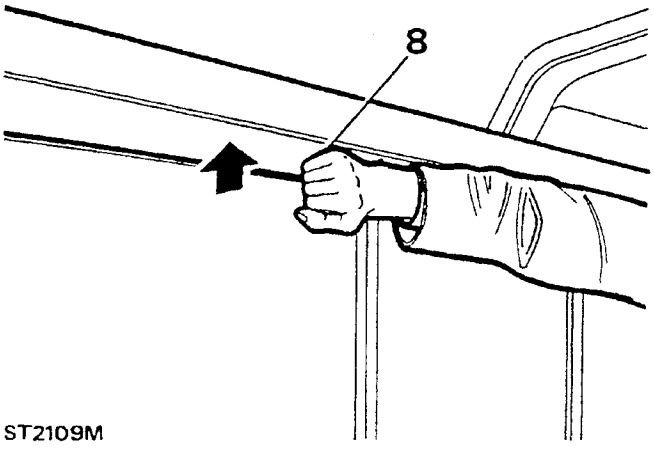
ST2106M

6. Remove the trim lower three fixings. The forward fixing is a screw, two washers and a nut.
7. The rear and centre fixings are a screw, washer and a nut 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.



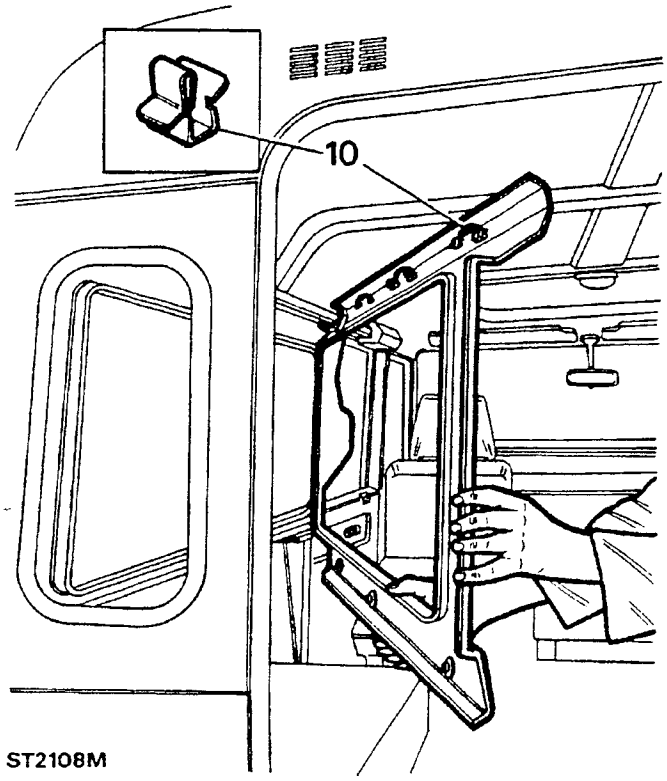
ST2109M

9. Feed the seat belt through the aperature and remove the trim from the vehicle.

Continued

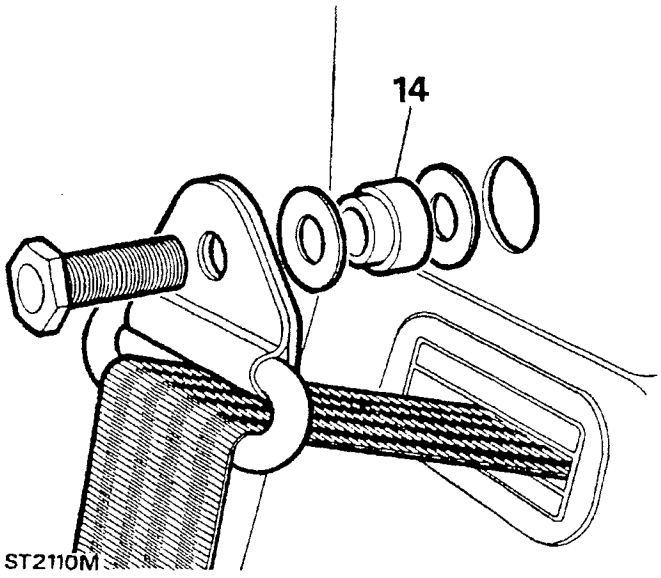
To refit.

10. Feed the seat belt through the trim aperature. 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 20,3Nm. (15ft.lbs.)
14. Similarly, fit the seat belt upper anchorage and tighten the special bolt to 20,3 Nm (15ft.lbs.).Fit the finisher to the seat belt aperature in the trim panel and the plastic cover to the anchorage bolt.



ST2110M

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.

"B" Post trim Land Rover "110" only.

To 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.

To 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.

LAND ROVER"90"STATION WAGON

Rear side window trim.

The rear side trim on the Land Rover "90" is secured in a similar manner to that of the "110" station wagon.Since the fixings are common, removal of the inward facing seats will release the lower attachment of the trim to the side rail. The squab frames of the individual inward facing seats are each attached at two points to the side rail.The bench type seat squabs are also secured at two points.

To remove the rear side trim of vehicles fitted with individual seats, the squabs only need to be removed.When bench type seats are fitted the complete seat and squab frame must be removed in order to release the trim lower attachment.

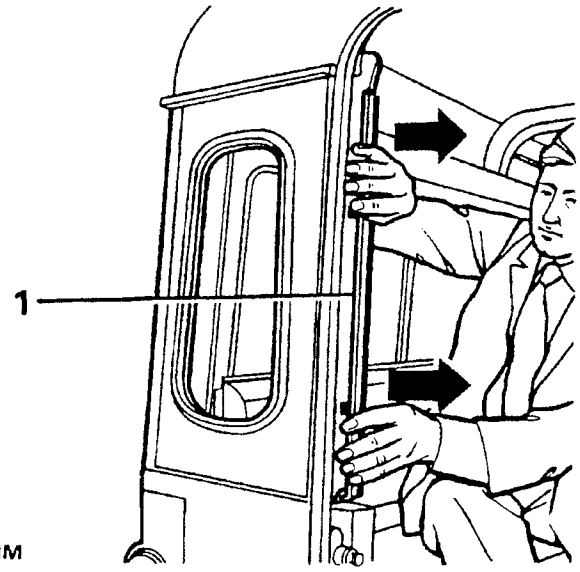
Once the trim lower fixings have been released and the rear quarter light trim removed, the seat belt upper anchorage bolt assembly must be removed together with the plastic button retaining the trim to the "B" post. The trim upper fixings are the same as the "110" and an upward tap with the hand will release it from the inner cant rail enabling the trim to be removed.

Fitting the trim is a reversal of the removal procedure.It is, however, most important that the seat belt upper anchorage fixing assembly is fitted correctly as described and illustrated under instruction 14 of the Land Rover "110" trim refitting instructions. The bolt must also be tightened to 20,3 Nm (15ft.lbs.) Note that the foremost bushed hole in the trim, nearest the "B" post, is not used.

Rear quarter light trim."90"and "110"

To remove.

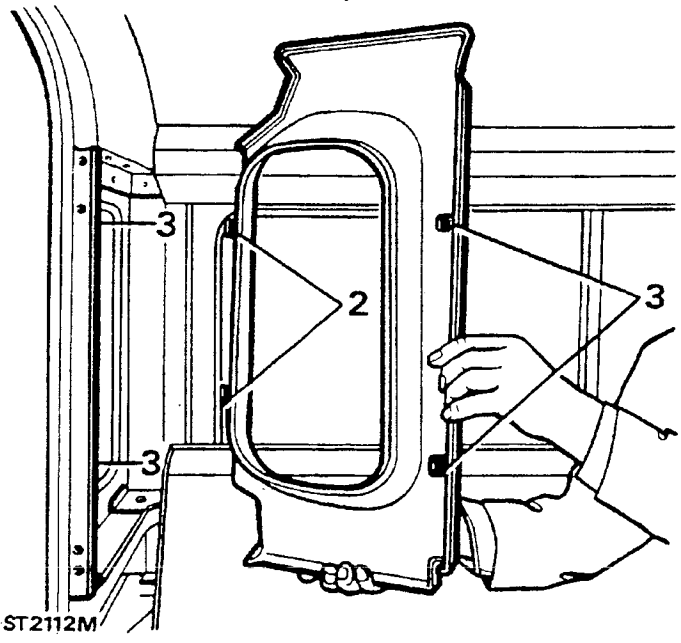
1. Pull the trim panel away from the quarter light with the fingers thereby releasing the retaining spring clips from the vertical rail and withdraw the panel.



ST2111M

To 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.

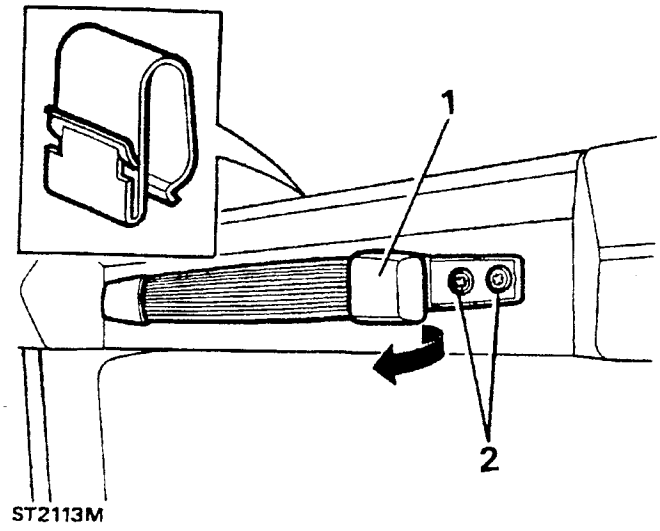


ST2112M

Grab handles.

To remove.

1. Lift the plastic finishers to expose the securing screws.
2. Remove the four screws to release the grab handle.



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.

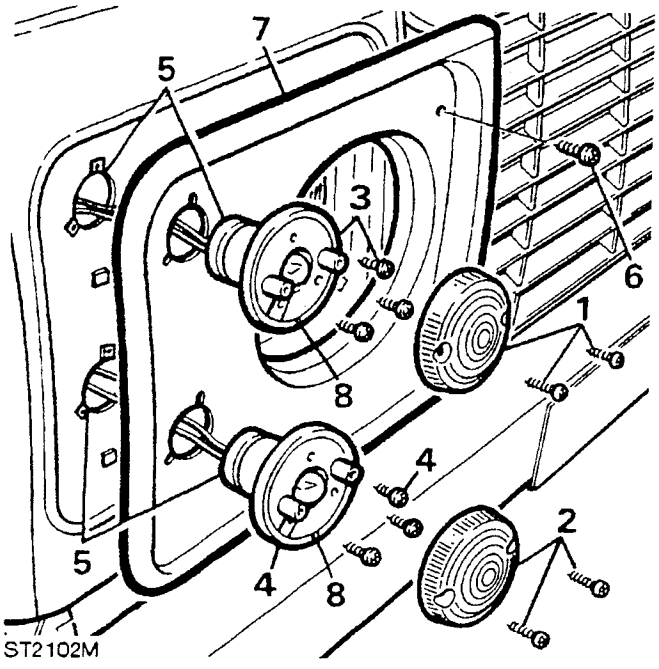
To refit.

4. Reverse instructions 1 and 2.

HEADLAMPS.

To remove or renew bulb or light unit.

1. Remove the two screws and withdraw the front side lamp lens.
2. Simillarly, remove the front flasher lens.
3. Remove the three screws retaining the side lamp to the wing.
4. Also remove the 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 two screws retaining the plastic bezel to the wing.
7. Withdraw the bezel sufficiently to gain access to the the headlamp retaining screws.



NOTE:- From this stage onwards the procedure for renewing the headlamp bulb or light unit or removing and overhauling the headlamp, is the same as that described in section 86 page 48 of the current Land Rover Workshop Manual SLR 621 EN WM. (English).

To refit.

8. 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.
9. 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.

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INTRODUCTION

This Workshop Manual covers the Land Rover Ninety and One Ten range of vehicles. It is primarily designed to assist skilled technicians in the efficient repair and maintenance of Land Rover vehicles.

Using the appropriate service tools and carrying out the procedures as detailed will enable the operations to be completed within the time stated in the 'Repair Operation Times'.

The Manual has been produced in separate books; this allows the information to be distributed throughout the specialist areas of the modern service facility.

A table of contents in Book 1 lists the major components and systems together with the section and book numbers. The cover of each book details the sections contained within that book.

The title page of each book carries the part numbers required to order replacement books, binders or complete Service Manuals. This can be done through the normal channels.

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 and accessories:
Safety features embodied in the vehicle may be impaired if other than Land Rover parts are fitted. In certain territories, legislation prohibits the fitting of parts not to the vehicle manufacturer's specification. Torque 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.

POISONOUS SUBSTANCES

Many liquids and other substances used in motor vehicles are poisonous and should under no circumstances be consumed and should as far as possible be kept away from open wounds. These substances among others include antifreeze, brake fluid, fuel, windscreen washer additives, lubricants and various adhesives.

FUEL HANDLING PRECAUTIONS

The following information provides basic precautions which must be observed if petrol (gasoline) 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.

GENERAL

Petrol/gasoline vapour is highly flammable and in confined spaces is also very explosive and toxic.
When petrol/gasoline evaporates it produces 150 times its own volume in vapour, which when diluted with air becomes a readily ignitable mixture. The vapour is heavier than air and will always fall to the lowest level. It can readily be distributed throughout a workshop by air current, consequently, even a small spillage of petrol/gasoline is potentially 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.
Always disconnect the vehicle battery BEFORE carrying out dismantling or draining work on a fuel system.
Whenever petrol/gasoline is being handled, drained or stored, or when fuel systems are being dismantled all forms of ignition must be extinguished or removed, any head-lamps used must be flameproof and kept clear of spillage.

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

FUEL TANK DRAINING

WARNING: PETROL/GASOLINE MUST NOT BE EXTRACTED OR DRAINED FROM ANY VEHICLE WHILST IT IS STANDING OVER A PIT.

Draining or extracting petrol/gasoline from vehicle fuel tank must be carried out in a well ventilated area.
The receptacle used to contain the petrol/gasoline must be more than adequate for the full amount of fuel to be extracted or drained. The receptacle should be clearly marked with its contents, and placed in a safe storage area which meets the requirements of local authority regulations.
WHEN PETROL/GASOLINE HAS BEEN EXTRACTED OR DRAINED FROM A FUEL TANK THE PRECAUTIONS GOVERNING NAKED LIGHTS AND IGNITION SOURCES SHOULD BE MAINTAINED.

FUEL TANK REMOVAL

On vehicles where the fuel line is secured to the fuel tank outlet by a spring steel clip, it is recommended that such clips are released before the fuel line is disconnected or the fuel tank unit is removed. This procedure will avoid the possibility of residual petrol fumes in the fuel tank being ignited when the clips are released.
As an added precaution fuel tanks should have a PETROL/GASOLINE VAPOUR warning label attached to them as soon as they are removed from the vehicle.

FUEL TANK REPAIR

Under no circumstances should a repair to any tank involving heat treatment be carried out without first rendering the tank SAFE, by using one of the following methods:

STEAMING: With the filler cap and tank unit removed, empty the tank. Steam the tank for at least two hours with low pressure steam. Position the tank so that condensation can drain away freely, ensuring that any sediment and sludge not volatised by the steam, is washed out during the steaming process.

BOILING: With the filler cap and tank unit removed, empty the tank. Immerse the tank completely in boiling water containing an effective alkaline degreasing agent or a detergent, with the water filling and also surrounding the tank for at least two hours.

After steaming or boiling a signed and dated label to this effect should be attached to the tank.

SPECIFICATION

Purchasers are advised that the specification details set out in this 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 specifications with or without notice, and at such times and in such manner as they think fit. Major as well as minor changes may be involved in accordance with the Manufacturer's policy of constant product improvement.

Whilst every effort is made to ensure the accuracy of the particulars contained in this Manual, neither the Manufacturer 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.

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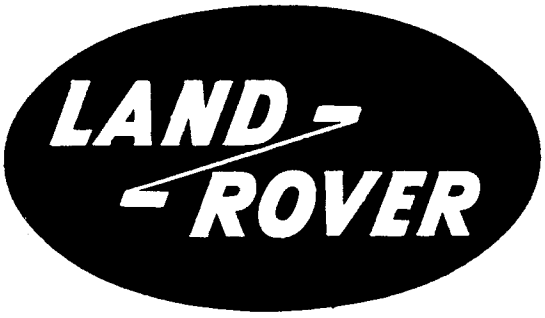


Special Service Tools

The use of approved special service tools is important. They are essential if service operations are to be carried out efficiently, and safely. The amount of time which 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.

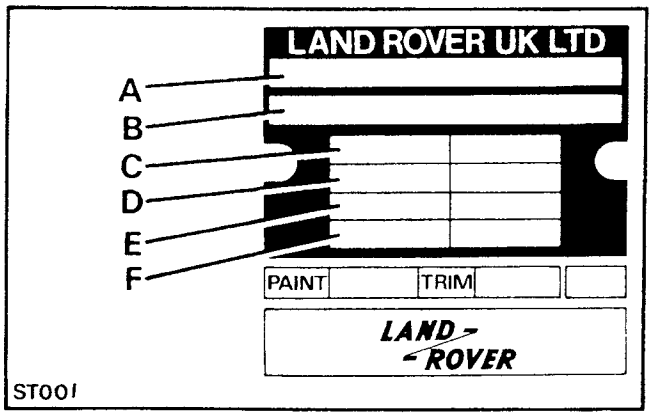
The tools recommended in this Workshop Manual are listed in a multi-language, illustrated catalogue obtainable from Messrs. V. L. Churchill at the above address under publication number 2217/2/84 or from Land Rover Ltd., under part number LSM0052TC from the following address, Land Rover Limited, Service Department, Lode Lane, Solihull, West Midlands, England B92 8NW.

VEHICLE IDENTIFICATION NUMBER (VIN)

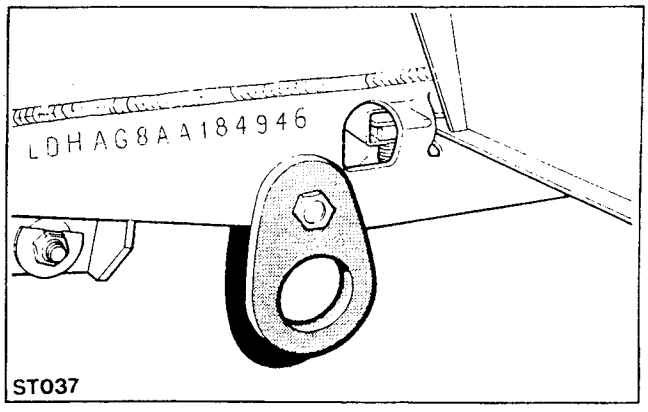
The Vehicle Identification Number and the recommended maximum vehicle weights are stamped on a plate riveted to the top of the brake pedal box in the engine compartment.
The number is also stamped on the right-hand side of the chassis forward of the spring mounting turret.
Always quote this number when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

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



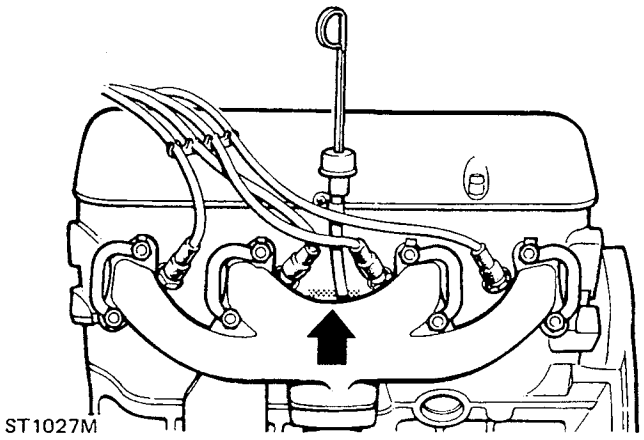
ST001



ST037

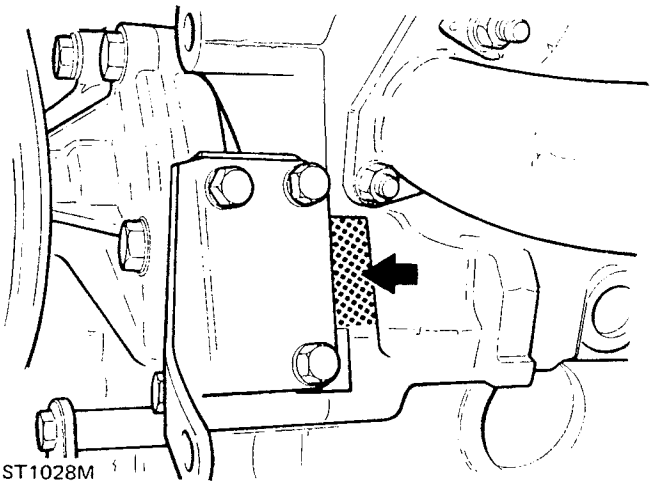
ENGINE SERIAL NUMBER — V8 ENGINE

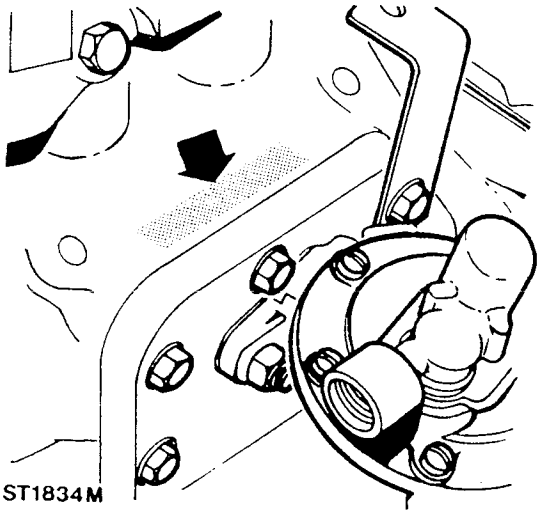
The V8 engine serial number is stamped on a cast pad on the cylinder block between numbers 3 and 5 cylinders.


ST1027M

ENGINE SERIAL NUMBER — 4 CYLINDER ENGINES

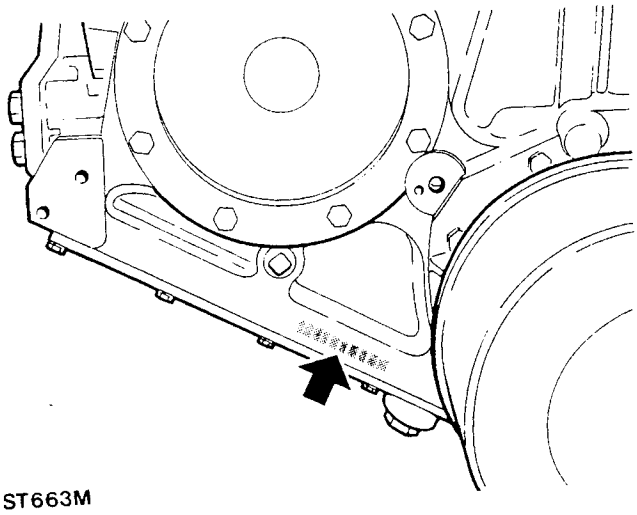
The 4 cylinder engine number is stamped on a machined surface at the front left-hand side of the engine adjacent to the exhaust manifold front flange. On later engines the number is stamped above the rear side cover, as the second illustration shows.


ST1028M


ST1834M

MAIN GEARBOX AND TRANSFER BOX LT95 — V8

Stamped on the rear of the transfer box on the opposite side to the transmission brake.



ST663M

FRONT AXLE

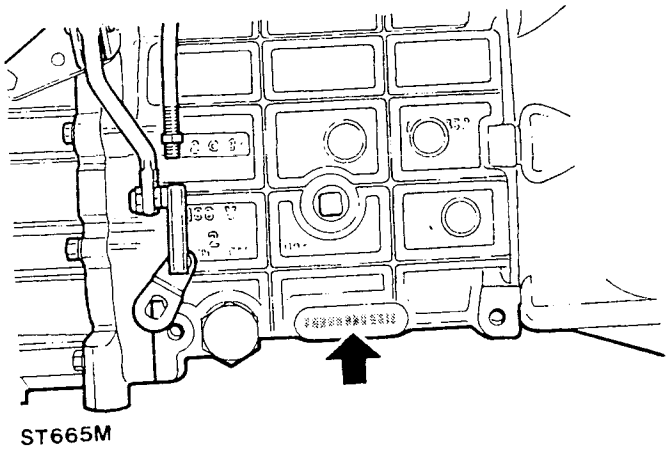
Stamped on top of the left-hand axle tube.

REAR AXLE

Stamped on rear of left-hand axle tube.

MAIN GEARBOX LT77 — 4 CYLINDER VEHICLES

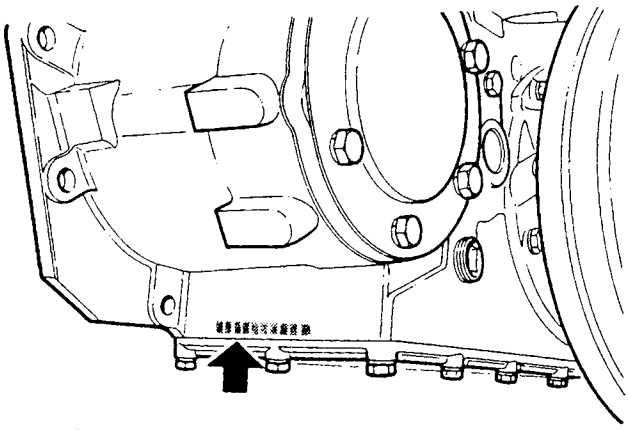
Stamped on a pad on the right-hand side of the gearbox immediately below the oil filler level plug.



ST665M

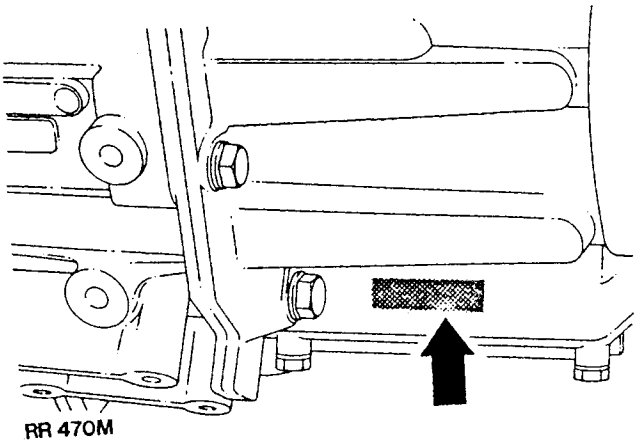
TRANSFER GEARBOX LT230R — 4 CYLINDER VEHICLES

Stamped on the casing on the left-hand side of the gearbox below the mainshaft rear bearing housing adjacent to the bottom cover.



ST664M

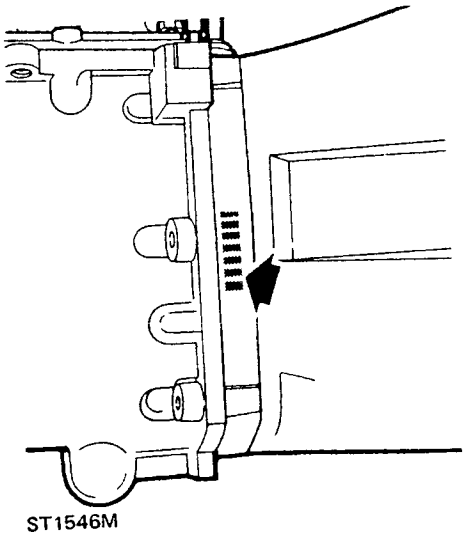
TRANSFER GEARBOX LT230T — 4 CYLINDER AND V8 VEHICLES FROM SERIAL NUMBER SUFFIX 'B' ONWARD



RR 470M

MAIN GEARBOX LT85 FIVE SPEED — V8 VEHICLES

Stamped on the right-hand side of the front bearing plate.



ST1546M

GENERAL SPECIFICATION DATA

V8 ENGINE

ENGINE

Type	V8
Number of cylinders	Eight, two banks of four
Bore	88,90 mm (3.500 in)
Stroke	71,12 mm (2.800 in)
Capacity	3528 cc (215 in^3)
Valve operation	Overhead by push-rod
Maximum power — B.H.P.	113 } at 4000 rpm
Maximum power — KW	84.6 } at 4000 rpm
Maximum torque	251 Nm (185 lb ft) at 2500 rpm

Crankshaft

Main journal diameter	58,409 - 58,422 mm (2.2996 - 2.3001 in)
Minimum regrind diameter	57,393 - 57,406 mm (2.2596 - 2.2601 in)
Crankpin journal diameter	50,800 - 50,812 mm (2.0000 - 2.0005 in)
Minimum regrind diameter	49,784 - 49,797 mm (1.9600 - 1.9605 in)
Crankshaft end thrust	Taken on thrust washers of centre main bearing
Crankshaft end-float	0,10 - 0,20 mm (0.004 - 0.008 in)

Main bearings

Number and type	5, Vandervell shells
Material	Lead-indium
Diametrical clearance	0,010 - 0,048 mm (0.0004 - 0.0019 in)
Undersizes	0,254 mm, 0,508 mm (0.010 in, 0.020 in)

Connecting rods

Type	Horizontally split big end, plain small end
Length between centres	143,81 - 143,71 mm (5.662 - 5.658 in)

Big end bearings

Type and material	Vandervell VP lead-indium
Diametrical clearance	0,015 - 0,055 mm (0.0006 - 0.0022 in)
End-float on crankpin	0,15 - 0,36 mm (0.006 - 0.014 in)
Undersizes	0,254 mm, 0,508 mm (0.010 in, 0.020 in)

Gudgeon pins

Length	72,67 - 72,79 mm (2.861 - 2.866 in)
Diameter	22,215 - 22,22 mm (0.8746 - 0.8749 in)
Fit-in connecting rod	Press fit
Clearance in piston	0,002 - 0,007 mm (0.0001 - 0.0003 in)

Pistons

Clearance in bore, measured at bottom of skirt at right angles to gudgeon pin	0,018 - 0,033 mm (0.0007 - 0.0013 in)

Piston rings

Number of compression	2
Number of oil	1
No. 1 compression ring	Chrome parallel faced
No. 2 compression ring	Stepped to 'L' shape and marked 'T' or 'TOP'
Width of compression rings	1,56 - 1,59 mm (0.0615 - 0.0625 in)
Compression ring gap	0,44 - 0,57 mm (0.017 - 0.022 in)
Oil ring type	Perfect circle, type 98-6
Oil ring width	4,811 mm (0.1894 in) max
Oil ring gap	0,38 - 1,40 mm (0.015 - 0.055 in)

Camshaft

Location	Central
Bearings	Non-serviceable
Number of bearings	5
Drive	Chain 9,52 mm (0.375 in) pitch x 54 pitches

Valves

Length:	
Inlet	116,59 - 117,35 mm (4.590 - 4.620 in)
Exhaust	116,59 - 117,35 mm (4.590 - 4.620 in)
Seat angle:	
Inlet	45° - 45½°
Exhaust	45° - 45½°
Head diameter:	
Inlet	39,75 - 40,00 mm (1.565 - 1.575 in)
Exhaust	34,226 - 34,480 mm (1.3475 - 1.3575 in)
Stem diameter:	
Inlet	8,664 - 8,679 mm (0.3411 - 0.3417 in)
Exhaust	8,651 - 8,666 mm (0.3406 - 0.3412 in)
Stem to guide clearance:	
Inlet	0,025 - 0,066 mm (0.0010 - 0.0026 in)
Exhaust	0,038 - 0,078 mm (0.0015 - 0.0031 in)
Valve lift (inlet and exhaust)	9,49 mm (0.374 in)
Valve spring length fitted	40,4 mm (1.590 in) at pressure of 29,5 kg (65 lbs)

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2400 rpm	2,1 - 2,8 kgf cm^2 (30 - 40 lbf in^2)
Oil filter (external)	Full-flow, self-contained cartridge
Oil filter (internal)	Gauze. Pump intake filter
Oil pump type	Gear

Oil pressure relief valve

Type	Non-adjustable
Relief valve spring:	
Free length	81,2 mm (3.200 in)
Compressed length at 4,2 kg (9.3 lb) load	45,7 mm (1.800 in)

Oil filter by-pass valve

Type	Non-adjustable
By-pass valve spring:	
Free length	37,5 mm (1.48 in)
Compressed length at 0,34 kg (0.75 lb)	22,6 mm (0.89 in)

2.25 LITRE PETROL ENGINE

ENGINE

Type	4 cylinder
Bore	90,47 mm (3.562 in)
Stroke	88,9 mm (3.500 in)
Capacity	2286 cm^3 (139.500 in^3)
Valve operation	Overhead by push-rod
Compression ratio	8.0:1
Maximum power @ 4000 rpm	55.2 Kw (74 bhp)
Maximum torque @ 2000 rpm	163 Nm (120 lbf ft)

Crankshaft

Main journal diameter	63,487 - 63,500 mm (2.4995 - 2.500 in)
Minimum regrind diameter	63,246 - 63,2333 mm (2.4900 - 2.4895 in)
Crankpin journal diameter	58,725 - 58,744 mm (2.312 - 2.31275 in)
Minimum regrind diameter	58,48985 - 58,47080 mm (2.30275 - 2.30200 in)
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05 - 0,15 mm (0.002 - 0.006 in)

Main bearings

Number and type	5 halved shells
Material	Steel shell, tin-aluminium lined
Diametrical clearance	0,020 - 0,063 mm (0.0008 - 0.0025 in)
Undersizes	0,25 mm (0.010 in)

Connecting rods

Type	Horizontally split big end, plain small end
Length between centres	175,36 - 175,46 mm (6.904 - 6.908 in)

Big end bearings

Type and material	Steel shell, copper-lead lined
Diametrical clearance	0,019 - 0,068 mm (0.00075 - 0.0027 in)
End-float on crankpin	0,20 - 0,30 mm (0.007 - 0.012 in)
Undersizes	0,25 mm (0.010 in)

Gudgeon pins

Type	Floating
Fit in piston	Push fit by hand
Clearance in connecting rod	0,007 - 0,015 mm (0.0003 - 0.0006 in)

Pistons

Type 8.0:1 compression ratio	Aluminium alloy, flat top
Clearance in bore, measured at bottom of skirt at right angles to gudgeon pin:	
Standard size pistons	0,06 - 0,07 mm (0.0023 - 0.0027 in)
Oversize pistons	0,043 - 0,055 mm (0.0017 - 0.0022 in)

Piston rings

Compression	2
Gap in bore	0,38 - 0,50 mm (0.015 - 0.020 in)
Clearance in groove	0,046 - 0,097 mm (0.0018 - 0.0038 in)
Oil control	1
Gap in bore	0,38 - 0,50 mm (0.015 - 0.020 in)
Clearance in groove	0,038 - 0,089 mm (0.0015 - 0.0035 in)

Camshaft

Location	Right-hand side (thrust side) of engine
End-float	0,06 - 0,13 mm (0.0025 - 0.0055 in)
Number of bearings	4
Material	Steel shell, white metal lined
Drive	Chain

Valves

Length:	
Inlet	111,20 - 111,66 mm (4.378 - 4.396 in)
Exhaust	111,22 - 111,58 mm (4.388 - 4.412 in)
Seat angle:	
Inlet	30°
Exhaust	45°
Head diameter:	
Inlet	44,32 - 44,57 mm (1.744 - 1.755 in)
Exhaust	34,93 - 35,18 mm (1.378 - 1.380 in)
Stem diameter:	
Inlet	7,899 - 7,912 mm (0.3109 - 0.3115 in)
Exhaust	8,682 - 8,694 mm (0.3418 - 0.3422 in)
Stem to guide clearance:	
Inlet	0,033 - 0,048 mm (0.0013 - 0.0019 in)
Exhaust	0,058 - 0,073 mm (0.0023 - 0.0029 in)
Valve lift:	
Inlet	10,236 mm (0.403 in)
Exhaust	9,85 mm (0.388 in)

Valve springs

Type	Duplex interference coil
Inner:	
Length, free	42,67 mm (1.680 in)
Length, under 8,0 kg (17.7 lb) load	37,13 mm (1.462 in)
Outer:	
Length, free	46,28 mm (1.822 in)
Length, under 21 kg (46 lb) load	40,30 mm (1.587 in)

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2000 rpm	2,45 - 4,50 kgf cm^2 (35 - 65 lbf in^2)
Oil pump: Early type	
Type	Double gear
Drive	Splined shaft from camshaft skew gear
End-float of gears:	
Steel gear	0,05 - 0,12 mm (0.002 - 0.005 in)
Aluminium gear	0,07 - 0,15 mm (0.003 - 0.006 in)
Radial clearance of gears	0,02 - 0,10 mm (0.001 - 0.004 in)
Backlash of gears	0,15 - 0,28 mm (0.006 - 0.012 in)

Lubrication (continued)

Oil pump: Latest type	
Type	Double gear, 10 teeth, sintered iron gears
Drive	Splined shaft from camshaft skew gear
End-float of both gears	0,026 - 0,135 mm (0.0009 - 0.0045 in)
Radial clearance of gears	0,025 - 0,075 mm (0.0008 - 0.0025 in)
Backlash of gears	0,1 - 0,2 mm (0.0034 - 0.0067 in)

Oil pressure relief valve

Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm (2.670 in)
Compressed length at 2,58 kg (5.7 lb) load	61,23 mm (2.450 in)

2.5 LITRE PETROL ENGINE

ENGINE

Type	4 cylinder
Bore	90,47 mm (3.562 in)
Stroke	97 mm (3.82 in)
Capacity	2495 cm^3 (152.25 in^3)
Valve operation	Overhead by push-rod
Compression ratio	8.0:1
Maximum power @ 4000 rpm	59.5 Kw (80 bhp)
Maximum torque @ 2000 rpm	175 Nm (129 lbf ft)
Commencing serial no	17H00011C

Crankshaft

Main journal diameter	63,487 - 63,500 mm (2.4995 - 2.500 in)
Minimum regrind diameter	63,246 - 63,2333 mm (2.4900 - 2.4895 in)
Crankpin journal diameter	58,725 - 58,744 mm (2.312 - 2.31275 in)
Minimum regrind diameter	58,48985 - 58,47080 mm (2.30275 - 2.30200 in)
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05 - 0,15 mm (0.002 - 0.006 in)

Main bearings

Number and type	5 halved shells
Material	Copper-lead lined
Diametrical clearance	0,018 - 0,06 mm (0.0007 - 0.0026 in)
Undersizes	0,25 mm (0.010 in)

Connecting rods

Type	Horizontally split big end, plain small end
Length between centres	175,36 - 175,46 mm (6.904 - 6.908 in)

Connecting rod bearings

Type and material	Steel shell, copper-lead lined
Diametrical clearance	0,025 - 0,075 mm (0.001 - 0.003 in)
End-float on crankpin	0,20 - 0,30 mm (0.007 - 0.012 in)
Undersizes	0,25 mm (0.010 in)

Gudgeon pins

Type	Floating
Fit in piston	Push fit by hand
Clearance in connecting rod	0,007 - 0,015 mm (0.0003 - 0.0006 in)

Pistons

Type 8.0:1 compression ratio	Aluminium alloy. Recessed crown.
Clearance in bore measured @ 17 mm from bottom of skirt at right angles to gudgeon pin:	
Standard and oversize pistons	0,043 - 0,067 mm (0.0017 - 0.0026 in)

Piston rings

Compression	2
Gap in bore	0,40 - 0,65 mm (0.016 - 0.026 in)
Clearance in groove	0,046 - 0,097 mm (0.0018 - 0.0038 in)
Oil control	1
Gap in bore	0,30 - 0,55 mm (0.012 - 0.022 in)
Clearance in groove	0,026 - 0,076 mm (0.0012 - 0.003 in)

Camshaft

Location	Right-hand side (thrust side) of engine
End-float	0,06 - 0,13 mm (0.0025 - 0.0055 in)
Number of bearings	4
Material	Steel shell, white metal lined
Drive	76 link chain

Valves

Length:	
Inlet	111,20 - 111,66 mm (4.377 - 4.396 in)
Exhaust	111,12 - 111,59 mm (4.374 - 4.393 in)
Seat angle:	
Inlet	30°
Exhaust	45°
Head diameter:	
Inlet	44,32 - 44,58 mm (1.744 - 1.755 in)
Exhaust	34,43 - 34,18 mm (1.355 - 1.345 in)
Stem diameter:	
Inlet	7,899 - 7,912 mm (0.3109 - 0.3115 in)
Exhaust	8,697 - 8,679 mm (0.3424 - 0.3416 in)
Stem to guide clearance:	
Inlet	0,033 - 0,048 mm (0.0013 - 0.0019 in)
Exhaust	0,035 - 0,076 mm (0.0014 - 0.0022 in)
Valve lift:	
Inlet	10,236 mm (0.403 in)
Exhaust	9,85 mm (0.388 in)
Exhaust valve seat insert:	
External diameter	36,576 - 36,601 (1.440 - 1.441 in)
Internal diameter	28,448 - 28,702 mm (1.120 - 1.130 in)
Width	5,055 - 5,105 mm (0.199 - 0.201 in)
Seat angle and depth	45°. 0,635 - 0,889 mm (0.025 - 0.035 in)

Valve springs

Type	Duplex interference coil
Inner:	
Length, free	42,67 mm (1.680 in)
Length, under 8,0 kg (17.7 lb) load	37,13 mm (1.462 in)
Outer:	
Length, free	46,28 mm (1.822 in)
Length, under 21 kg (46 lb) load	40,30 mm (1.587 in)

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2000 rpm	2,45 - 4,50 kgf cm^2 (35 - 65 lbf in^2)
Oil pump:	
Type	Double gear, 10 teeth, sintered iron gears
Drive	Splined shaft from camshaft skew gear
End-float of both gears	0,026 - 0,135 mm (0.0009 - 0.0045 in)
Radial clearance of gears	0,025 - 0,075 mm (0.0008 - 0.0025 in)
Backlash of gears	0,1 - 0,2 mm (0.0034 - 0.0067 in)

Oil pressure relief valve

Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm (2.670 in)
Compressed length at 2,58 kg (5.7 lb) load	61,23 mm (2.450 in)

2.25 LITRE DIESEL ENGINE

ENGINE

Type	4 cylinder
Bore	90,47 mm (3.562 in)
Stroke	88,9 mm (3.500 in)
Capacity	2286 cm^3 (139 in^3)
Valve operation	Overhead by push-rod
Compression ratio	23:1
Maximum power	44Kw (59 bhp) at 4000 rpm
Maximum torque	136 Nm (100 lbf ft) at 1800 rpm

Crankshaft

Main bearing journal diameter	63,487 - 63,500 mm (2.4995 - 2.500 in)
Regrind dimensions:	
63,246 - 63,2333 mm (2.490 - 2.4895 in)	Use 0.010 in U/S bearings
Crankpin journal diameter	58,725 - 58,744 mm (2.312 - 2.31275 in)
Regrind dimensions:	
58,48985 - 58,4708 mm (2.30275 - 2.30200 in)	Use 0.010 in U/S bearings
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05 - 0,15 mm (0.002 - 0.006 in)

Main bearings

Number and type	5 halved shells
Material	Steel shell, copper-lead lined, tin plated
Diametrical clearance	0,020 - 0,063 mm (0.0008 - 0.0025 in)

Connecting rods

Type	Horizontally split big end, plain small end
Length between centres	175,38 - 175,43 mm (6.905 - 6.907 in)

Big end bearings

Type and material	Steel shell, copper-lead lined
Diametrical clearance	0,020 - 0,0635 mm (0.0008 - 0.0025 in)
End-float on crankpin	0,15 - 0,356 mm (0.006 - 0.014 in)

Gudgeon pins

Type	Floating
Fit in piston	Push fit by hand
Clearance in connecting rod	0,0196 - 0,0036 mm (0.0007 - 0.00014 in)
Diameter	30,1564 - 30,1625 mm (1.18726 - 1.1875 in)

Pistons

Type	Aluminium alloy, with V shape recess in crown
Clearance in bore, measured at bottom of skirt at right angles to gudgeon pin:	
Standard size pistons	0,111 - 0,134 mm (0.0044 - 0.0053 in)
Oversize pistons	0,111 - 0,157 mm (0.0044 - 0.0062 in)

Piston rings

Compression No. 1 (top):	
Type	Square friction edge, chrome plated
Gap in bore	0,35 - 0,50 mm (0.014 - 0.019 in)
Clearance in groove	0,06 - 0,11 mm (0.0025 - 0.0045 in)
Compression Nos. 2 and 3:	
Type	Bevelled friction edge. Marked 'T' or 'TOP' on upper side
Gap in bore	0,25 - 0,38 mm (0.010 - 0.015 in)
Clearance in groove	0,06 - 0,11 mm (0.0025 - 0.0045 in)
Oil control No. 4:	
Type	Ring and spring
Gap in bore	0,279 - 0,406 mm (0.011 - 0.016 in)
Clearance in groove	0,038 - 0,064 mm (0.0015 - 0.0025 in)

Valves

Length:	
Inlet	116,26 - 116,51 mm (4.377 - 4.587 in)
Exhaust	116,79 - 117,25 mm (4.598 - 4.616 in)
Seat angle:	
Inlet	45°
Exhaust	45°
Head diameter:	
Inlet	39,12 - 39,37 mm (1.540 - 1.550 in)
Exhaust	33,25 - 33,50 mm (1.309 - 1.318 in)
Stem diameter:	
Inlet	7,912 - 7,899 mm (0.3114 - 0.3109 in)
Exhaust	8,682 - 8,694 mm (0.3418 - 0.3422 in)
Stem to guide clearance:	
Inlet	0,033 - 0,048 mm (0.0013 - 0.0019 in)
Exhaust	0,058 - 0,073 mm (0.0023 - 0.0029 in)
Valve lift:	
Inlet	9,85 mm (0.388 in)
Exhaust	10,26 mm (0.404 in)

Camshaft

Location	Right-hand side (thrust side) of engine
End-float	0,1 - 0,2 mm (0.004 - 0.008 in)
Number of bearings	4
Material	Steel shell, white metal lined
Drive	Chain

Valve springs

Type	Duplex Interference double coil
Inner:	
Length, free	42,67 mm (1.680 in)
Length, under 8,0 kg (17.7 lb) load	40,30 mm (1.587 in)
Outer:	
Length, free	46,28 mm (1.822 in)
Length, under 21 kg (46 lb) load	40,30 mm (1.587 in)

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2000 rpm	2,5 - 4,57 kgf cm^2 (35 - 65 lbf in^2)
Oil pump:	
Type	Double gear
Drive	Splined shaft from camshaft skew gear
End-float of gears:	
Steel gear	0,05 - 0,12 mm (0.002 - 0.005 in)
Aluminium gear	0,07 - 0,15 mm (0.003 - 0.006 in)
Radial clearance of gears	0,02 - 0,10 mm (0.001 - 0.004 in)
Backlash of gears	0,15 - 0,28 mm (0.006 - 0.012 in)

Oil pressure relief valve

Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm (2.670 in)
Compressed length at 2,58 kg (5.7 lb) load	61,23 mm (2.450 in)

2.5 LITRE DIESEL ENGINE

ENGINE

Number of cylinders	4
Bore	90,47 mm (3.562 in)
Stroke	97,00 mm (3.819 in)
Capacity	2495 cc
Compression ratio	21:1
Piston area (total)	257,1 cm^3 (39.86 in^3)
Maximum power at 4000 rpm	65.5 bhp
Maximum torque at 1800 rpm	113 lbf ft

Crankshaft

Main bearing journal diameter	63,487 - 63,500 mm (2.4995 - 2.5000 in)
Regrind dimensions:	
63,246 - 63,2333 mm (2.490 - 2.4895 in)	Use 0.010 in U/S bearings
Crankpin journal diameter	58,725 - 58,744 mm (2.312 - 2.31275 in)
Regrind dimensions:	
58,48985 - 58,4708 mm (2.30275 - 2.30200 in)	Use 0.010 in U/S bearings
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05 - 0,15 mm (0.002 - 0.006 in)

Main bearings

Number and type	5 halved shells
Diametrical clearance	0,018 - 0,061 mm (0.0007 - 0.0024 in)

Connecting rods

Length between centres	175,38 - 175,43 mm (6.905 - 6.907 in)
Diametrical clearance (big-end bearings)	0,025 - 0,075 mm (0.001 - 0.003 in)
End-float on crankpin	0,15 - 0,356 mm (0.006 - 0.014 in)

Pistons

Type	Aluminium alloy 'V' shaped valve recess in crown
Skirt diametrical clearance (at right angle to gudgeon pin)	0,025 - 0,05 mm (0.001 - 0.002 in)

Gudgeon pins

Type	Floating
Fit in piston	Hand push fit
Diameter	30,1564 - 30,1625 mm (1.18726 - 1.18750 in)
Clearance in connecting rod	0,0196 - 0,0036 mm (0.00077 - 0.00014 in)

Piston rings

Type:	Top	Square friction edge, chrome plated
	Second	Taper faced
	Oil control	Expander and rails

Camshaft

Drive	25,4 mm (0.1 in) wide dry toothed belt
Location	Right-hand side (thrust side)
End-float	0,1 - 0,2 mm (0.004 - 0.008 in)
Number of bearings	4
Material	Steel shell, white metal lined

Valves

Seat angle:	
Inlet	45°
Exhaust	45°
Head diameter:	
Inlet	39,12 - 39,37 mm (1.540 - 1.550 in)
Exhaust	33,25 - 33,50 mm (1.309 - 1.319 in)
Valve lift:	
Inlet	9,85 mm (0.388 in)
Exhaust	10,26 mm (0.404 in)
Cam lift:	
Inlet	6,81 mm (0.268 in)
Exhaust	7,06 mm (0.278 in)
Stem diameter:	
Inlet	7,912 - 7,899 mm (0.3114 - 0.3109 in)
Exhaust	8,682 - 8,694 mm (0.3418 - 0.3422 in)

Valve springs

Type	Duplex Interference double coil
Inner:	
Length, free	42,67 mm (1.680 in)
Length, under 8,0 kg (17.7 lb) load	40,30 mm (1.587 in)
Outer:	
Length, free	46,28 mm (1.822 in)
Length, under 21 kg (46 lb) load	40,30 mm (1.587 in)

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2000 rpm	2,5 - 4,57 kgf cm^2 (35 - 65 lbf in^2)
Oil pump: Early type	
Type	Double gear
Drive	Splined shaft from camshaft skew gear
End-float of gears:	
Steel gear	0,05 - 0,12 mm (0.002 - 0.005 in)
Aluminium gear	0,07 - 0,15 mm (0.003 - 0.006 in)
Radial clearance of gears	0,02 - 0,10 mm (0.001 - 0.004 in)
Backlash of gears	0,15 - 0,28 mm (0.006 - 0.012 in)
Oil pump: Latest type	
Type	Double gear, 10 teeth, sintered iron gears
Drive	Splined shaft from camshaft skew gear
End-float of both gears	0,026 - 0,135 mm (0.0009 - 0.0045 in)
Radial clearance of gears	0,025 - 0,075 mm (0.0008 - 0.0025 in)
Backlash of gears	0,1 - 0,2 mm (0.0034 - 0.0067 in)

Oil pressure relief valve

Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm (2.670 in)
Compressed length at 2,58 kg (5.7 lb) load	61,23 mm (2.450 in)

GENERAL DATA

FUEL SYSTEM — 2.25 Petrol

Carburetter	See **'ENGINE TUNING DATA'**
Air cleaner	Oil bath with built-in centrifugal pre-cleaner

Fuel pump — Early Models

Type	Mechanical with sediment bowl and hand primer
Pressure range	3 - 5 psi

Fuel pump — Latest Models

Make and Type	Facet, electric. Mounted on R.H. side of chassis
Pressure range	3 - 5 psi

FUEL SYSTEM — 2.25 and 2.5 Diesel

Injection pump	See **'ENGINE TUNING DATA'**
Fuel lift pump type	Mechanical, with hand primer
Pressure range	0,35 - 0,56 kgf cm^2 (5 - 8 lbf ft^2)

FUEL SYSTEM — V8 engine

Carburetter	See 'ENGINE TUNING DATA'
Fuel pump — Make, type	Facet, electric mounted vertically on R.H. side of chassis
Air cleaner	Cyclone, replaceable element

COOLING SYSTEM — 2.25 Petrol, 2.25 and 2.5 Diesel

Type	Pressurized spill return system with thermostat control, pump and fan assisted
Thermostat	82°C
Pressure cap	0,6 kgf cm^2 (9 lbf in^2)
Type of pump	Centrifugal

COOLING SYSTEM — V8 engine

Type	Pressurized spill return system with thermostat control, pump and fan assisted
Thermostat	Emission and non-emission 82°C, Australia 88°C
Type of pump	Centrifugal

CLUTCH — 2.25 Petrol

Type	Borg and Beck diaphragm spring
Centre plate diameter	242,1 mm (9.500 in)
Facing material	Raybestos 1488-05
Facing material identification colour	White/violet on periphary
Number of damper springs	6
Damper spring colour	Dark grey/light green
Clutch release bearing	Ball journal

CLUTCH — 2.25 and 2.5 Diesel engine — Early type

Type	Verto diaphragm spring
Centre plate diameter	242,1 mm (9.500 in)
Facing material	Raybestos 1488-05
Number of damper springs	8
Damper spring colour	2 off white/green 2 off pigeon blue 4 off ruby red
Clutch release bearing	Ball journal

CLUTCH — Later type

Type	Verto diaphragm spring
Centre plate diameter (friction plate)	235 mm (9.25 in)
Facing material	Verto 791
Number of damper springs	8
Damper spring colour	2 off white/green — suffix 'C' 2 off pigeon blue — suffix 'A' 4 off ruby red — suffix 'B'
Clutch release bearing	Ball journal

CLUTCH — V8 engine

Type	Borg and Beck diaphragm spring
Centre plate diameter	267 mm (10.5 in)
Facing material	Raybestos 1488-05. Grooved. White/violet
Damper spring colour	Light blue/dark blue
Release bearing	Ball journal
Number of damper springs	6

TRANSMISSION — 2.25 Petrol, 2.25 and 2.5 Diesel engine

Main gearbox

Type LT77	Single helical constant mesh
Speeds	5 forward 1 reverse
Synchromesh	All forward speeds
Ratios:	
Fifth	0.8314:1
Fourth (direct)	1.0000:1
Third	1.5074:1
Second	2.3008:1
First	3.5850:1
Reverse	3.7007:1

Transfer box

Type LT230R	Two-speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential	
Ratios:		
High	1.6670	
Low	3.3198	
Overall ratios (final drive):	**In high transfer**	**In low transfer**
Fifth	4.9042:1	9.7666:1
Fourth	5.8987:1	11.7471:1
Third	8.8917:1	17.7075:1
Second	13.5715:1	27.0272:1
First	21.1472:1	42.1138:1
Reverse	21.8293:1	43.4723:1
Input gear	26 Teeth	
Intermediate gear	19 x 41 x 35 Teeth	
Output gear	40 x 37 Teeth	

TRANSMISSION — V8 Engine

Main gearbox

Type LT95	Single helical constant mesh
Speeds	4 forward 1 reverse
Synchromesh	All forward speeds
Ratios:	
Fourth (direct)	1.0000:1
Third	1.5049:1
Second	2.4480:1
First	4.0691:1
Reverse	3.6643:1

Transfer box

Type LT95	Two-speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential	
Ratios:		
High	1.3362	
Low	3.3206	
Overall ratios (final drive):	**In high transfer**	**In low transfer**
Fourth	4.7281:1	11.7497:1
Third	7.1154:1	17.6822:1
Second	11.5745:1	28.7634:1
First	19.2390:1	47.8101:1
Reverse	27.3250:1	43.0538:1

TRANSMISSION — Ninety and One Ten V8 with 5-speed gearbox

Main gearbox

Type — Manual	LT85 5-speed helical constant mesh, with synchromesh on all forward gears	
Main gearbox ratios	Fifth (Cruising gear)	0.7951
	Fourth	1.0000
	Third	1.4362
	Second	2.1804
	First	3.6497
	Reverse	3.8242

Transfer gearbox

Type	LT230T. Two-speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential.	
— Ninety models	High	1.1923
	Low	3.3198
— One Ten models	High	1.410
	Low	3.3198

Overall ratio (including final drive) — Ninety models

	In high transfer	**In low transfer**
Fifth (Cruising gear)	3.3544	9.3401
Fourth	4.2189	11.7471
Third	6.0592	16.8712
Second	9.1989	25.6134
First	15.3977	42.8734
Reverse	16.1339	44.9233

Overall ratio (including final drive) — One Ten models

	In high transfer	**In low transfer**
Fifth (Cruising gear)	3.9695	9.3401
Fourth	4.9925	11.7471
Third	7.1702	16.8712
Second	10.8856	25.6134
First	18.2210	42.8734
Reverse	19.0922	44.9233

REAR AXLE — One Ten only

Type	Salisbury 8HA
Ratio	3.538
Track	1485,90 mm (58.50 in)

FRONT AXLE — All models and Ninety rear

Type	Spiral bevel, enclosed constant velocity joints
Ratio	3.538

PROPELLER SHAFTS — All Models

Type: Front and rear	Single Hookes universal needle roller joints. Sliding portion on front shaft gaitered, rear shaft open

SUSPENSION — All Models

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

BRAKES 2.25 Petrol and V8 Engine

System	Direct acting servo assisted dual braking system with Girling tandem master cylinder and pressure differential warning actuator, combination valve, or G. valve

Footbrake — All Models

Front	Lockheed Disc
Disc diameter	300 mm (11.81 in)
Number of pistons per wheel	4
Total lining area	232 cm^2
Lining material	Don 230
Rear	Girling single cylinder drum brake
Drum diameter	280 mm (11 in)
Total lining area	493 cm^2
Brake drum width	63.9 mm
Lining material	Ferodo 2629

Handbrake — All Models

Type	Transmission drum brake cable operated
Drum diameter	254 mm (10 in)
Lining material	Don 269

BRAKES — 2.25 and 2.5 litre Diesel engine

System	Direct acting servo assisted dual braking system with Girling tandem master cylinder and pressure differential warning actuator, combination valve, or G. valve. Servo assistance initiated by an engine driven air evacuation pump and sustained by a vacuum tank (vacuum tank deleted on 2.5)

Evacuation pump — 2.25 litre Diesel

Maximum speed	5000 rpm. Belt drive
Oil capacity	40 cm^3 (2.4 in^3) SAE 15W-50

Evacuation pump — 2.5 litre Diesel

Maximum speed	4000 rpm. Gear drive from camshaft
Lubrication	Oil feed via skew gear
Minimum vacuum level at 2500 rpm	0,8 bar

STEERING — All Models

Type:	
Manual — Early Models only	Burman recirculating ball
Manual	Gemmer Hour-glass worm and wheel
Optional power assisted — Early Models	Adwest Varamatic
Optional power assisted — Later Models	Adwest Lightweight or Gemmer
Ratios:	
Manual Burman straight ahead	20,55:1
Manual Gemmer	20,2:Constant
Power assisted straight ahead	17.5:1
Number of turns lock to lock:	
Manual	4.75
Power assisted	3.49
Camber angle	Zero
Castor angle	3°
Swivel pin inclination	7°
Front wheel toe-out — permanent 4-wheel drive	1,19 - 2,38 mm ($\frac{3}{64}$ - $\frac{3}{32}$ in)
Turning circle between kerbs:	
Right-hand drive	14,0 m (45.67 ft)
Left-hand drive	13,28 m (43.58 ft)
Steering wheel diameter	420 mm (16.5 in)
Steering damper	Fitted to drag link
Track	1485,90 mm (58.50 in)
Steering column type	Collapsible coupling

WHEELS AND TYRES — All Models

Type of wheel	Ventilated disc
Wheel size	5.50 in F x 16 in
Number of studs	5
Tyre size	7.50 x 16

ELECTRICAL EQUIPMENT — All Models

System	12 volt, negative earth

Battery — 2.25 litre Petrol and V8 engine

Type:		
Lucas — standard 9 plate	B.B.M.S. No. 371	Designation
Chloride — standard 9 plate	B.B.M.S. No. 291	190/84/90
Lucas — cold climate 13 plate	B.B.M.S. No. 389	Designation
Chloride — cold climate 13 plate	B.B.M.S. No. 369	315/120/92

Battery — 2.25 and 2.5 litre Diesel engine

Type	Chloride B.B.M.S. No. 243 15 plate designation 395/175/90

Alternator — 2.25 litre Petrol and Diesel and 2.5 Diesel

Type	Lucas A115-34
Maximum D.C. output at 6000 rpm	34 amps
Rotor — winding resistance	3.27 ohms at 20°C ± 5%
Stator — winding resistance per phase	0.138 ohms at 20°C ± 5%
New brush length	20 mm
Renew brush at	10 mm
Brush spring pressure	1.3 - 2.7 N (4.7 - 9.8 oz)
Regulator controlled voltage	13.6 - 14.4 volts measured across battery

Note: From the following engine numbers a 45 amp output alternator is fitted.

12J05497C	Land Rover 90/110 2.5 litre Diesel
11H05639C	Land Rover 90 2.3 litre Petrol
11H05629C	Land Rover 110 2.3 litre Petrol

Alternator — V8 engine

Type	Lucas A115-45
Maximum D.C. output at 6000 rpm	45 amps
Rotor — winding resistance	3.2 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 (4.7 - 9.8 oz)
Regulator controlled voltage	13.6 - 14.4 volts measured across battery

Starter motor — 2.25 Petrol engine

Type	Lucas 2M100
Brush spring tension	1020 gms (36 ozs)
Minimum brush length	9,5 mm (0.375 in)

Starter motor — 2.25 and 2.5 Diesel engine

Type	Lucas 2M113
New brush length	22.2 mm (0.875 in)
Renew brush at	8 mm (0.312 in)
Armature end-float —	
Cast aluminium intermediate bracket	0,03 - 1,4 mm (0.001 - 0.056 in)
Pressed steel intermediate bracket	0,03 - 1,55 mm (0.001 - 0.061 in)
Commutator minimum diameter	38 mm (1.5 in)

Starter motor — V8 engine

Type	Lucas 3M100 pre-engaged
Brush spring tension	1020 gms (36 ozs)
Brush minimum length	9,5 mm (0.375 ins)

Wiper motor — All Models

Type	Lucas 14W uprated two-speed
Armature end-float	0,1 - 0,20 mm (0.004 - 0.008 in)
Minimum brush length	4,8 mm (0.190 in)

Distributor — All Petrol engines ..... } See **'ENGINE TUNING DATA'**

Coil — All Petrol engines ..... }

Fuses — All Models

Type	12 cartridge fuses of the following values: Three 10 amp Six 8 amp One 12 amp Two 2.5 amp

Starter motor — 2.5 litre Diesel — Later Models

Type	Paris Rhone D9R91 12 volt

TYRE PRESSURES

Tyres — size and type		Normal All load conditions		Emergency soft Unladen		Emergency soft Laden	
		Front	Rear	Front	Rear	Front	Rear
6.00-16 **CROSS-PLY**	bar	2,4	3,25	1,1	1,1	1,1	1,6
	lbf/in²	35	47	16	16	16	23
	kgf/cm²	2,5	3,3	1,1	1,1	1,1	1,6
7.50-16 **CROSS-PLY**	bar	1,9	2,4	1,1	1,1	1,1	1,6
	lbf/in²	28	35	16	16	16	23
	kgf/cm²	2,0	2,5	1,1	1,1	1,1	1,6
205R16 **RADIAL-PLY**	bar	1,9	2,4	1,1	1,1	1,1	1,6
	lbf/in²	28	35	16	16	16	23
	kgf/cm²	2,0	2,5	1,1	1,1	1,1	1,6
7.50R16 **RADIAL-PLY**	bar	1,9	2,75	1,1	1,1	1,1	1,6
	lbf/in²	28	40	16	16	16	23
	kgf/cm²	2,0	2,8	1,1	1,1	1,1	1,6
7.50-16 **CROSS-PLY**	bar	1,9	2,9	1,1	1,1	1,1	1,8
	lbf/in²	28	42	16	16	16	26
	kgf/cm²	2,0	3,0	1,1	1,1	1,1	1,8
750R16 **RADIAL-PLY**	bar	1,9	3,3	1,1	1,1	1,1	1,8
	lbf/in²	28	48	16	16	16	26
	kgf/cm²	2,0	3,4	1,1	1,1	1,1	1,8

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.
- For extra ride comfort at part load the normal rear tyre pressures may be reduced to following:
  90 models — Not more than 1050 kg rear axle load.
  6.00-16 tyres: 2,4 bar (35 lbf/in²) 2,5 kgf/cm²
  All other tyre sizes: 1,9 bar (28 lbf/in²) 2,0 kgf/cm²
  110 models — Not more than 1250 kg rear axle load.
  Cross-ply and radial tyres: 2,2 bar (32 lbf/in²) 2,25 kgf/cm²
- Towing: When vehicle is used for towing the reduced rear tyre pressures for extra ride comfort are **not** applicable.

REPLACEMENT BULBS AND UNITS

Headlamps:	
— UK and Europe (except France)	60/55 W Halogen bulb
— France and Algeria	60/55 W Halogen bulb, yellow
— Rest of world, right-hand steering	75/50 W Sealed beam unit
— Rest of world, left-hand steering	60/50 W Sealed beam unit
Front side lamps	12V 5W
Side repeater lamps	12V 4W
Stop/tail lamps	12V 21/5W
Flasher lamps	12V 21W
Number plate lamp	12V 4W
Reverse lamp	12V 21W
Rear fog guard lamp	12V 21W
Interior lamp	12V 21W
Warning lights	12V 12W
Instrument illumination	12V 3W
Hazard switch warning light	12V 0.6W

VEHICLE WEIGHTS AND PAYLOAD

Payload figures quoted in the accompanying table are nominal values for a base specification vehicle and will in general represent the maximum, as any options or extras fitted to the vehicle will increase its unladen weight and hence decrease its allowable payload.

When loading a vehicle to its maximum (Gross Vehicle Weight), consideration must be taken of the unladen vehicle weight and the distribution of the payload to ensure that axle loadings do not exceed the permitted maximum values. It is the customer's responsibility to limit the vehicle's payload in an appropriate manner such that neither maximum axle loads nor Gross Vehicle Weight are exceeded.

Land Rover Ninety													
Model — Petrol/Diesel		Soft Top			Pick-up			Hard Top			Station Wagon		
		2.5P	2.5D	3.5P	2.5P	2.5D	3.5P	2.5P	2.5D	3.5P	2.5P	2.5D	3.5P
Gross Vehicle Weight	STANDARD SUSPENSION 2400 kg												
EEC Kerb Weight	kg	1606	1643	1602	1635	1672	1631	1648	1685	1644	1690	1727	1686
EEC Payload	kg	794	757	798	765	728	769	752	715	756	710	673	714
Unladen Weight	kg	1487	1519	1483	1516	1548	1512	1529	1561	1525	1571	1603	1567
Payload	kg	913	881	917	884	852	888	871	839	875	829	797	833
Maximum Axle Weights, all Ninety models with Standard Suspension Front Axle 1200 kg Rear Axle 1380 kg													
Gross Vehicle Weight	HIGH LOAD SUSPENSION 2550 kg												
EEC Kerb Weight	kg	1633	1670	1629	1662	1699	1658	1675	1712	1671	1717	1754	1713
EEC Payload	kg	917	880	921	888	851	892	875	838	879	833	796	837
Unladen Weight	kg	1514	1546	1510	1543	1575	1539	1556	1588	1522	1598	1630	1594
Payload	kg	1036	1004	1040	1007	975	1011	994	962	998	952	920	956
Maximum Axle Weights, all Ninety models with High Load Suspension Front Axle 1200 kg Rear Axle 1500 kg													

Land Rover One Ten																
Model — Petrol/Diesel		Soft Top			Pick-up			Hard Top			Station Wagon			High Capacity Pick-up		
		2.5P	2.5D	3.5P	2.5P	2.5D	3.5P	2.5P	2.5D	3.5P	2.5P	2.5D	3.5P	2.5P	2.5D	3.5P
Gross Vehicle Weight	UNLEVELLED SUSPENSION 3050 kg															
EEC Kerb Weight	kg	1723	1742	1698	1724	1743	1699	1777	1796	1752	1887	1906	1862	1813	1859	1778
EEC Payload	kg	1327	1308	1352	1326	1307	1351	1273	1254	1298	1163	1144	1188	1237	1191	1272
Unladen Weight	kg	1588	1599	1563	1589	1600	1564	1642	1653	1617	1752	1763	1727	1678	1716	1643
Payload	kg	1462	1451	1487	1461	1450	1486	1408	1397	1433	1298	1287	1323	1372	1334	1407
Maximum Axle Weights, all One Ten models with Unlevelled Suspension Front Axle 1200 kg Rear Axle 1850 kg																
Gross Vehicle Weight	LEVELLED SUSPENSION 2950 kg															
EEC Kerb Weight	kg	1733	1752	1708	1734	1753	1709	1787	1806	1762	1897	1916	1872	1823	1869	1788
EEC Payload	kg	1217	1198	1242	1216	1197	1241	1163	1144	1188	1053	1034	1078	1127	1081	1162
Unladen Weight	kg	1598	1609	1573	1599	1610	1574	1652	1663	1627	1762	1773	1737	1688	1726	1653
Payload	kg	1352	1341	1377	1351	1340	1376	1298	1287	1323	1188	1177	1213	1262	1224	1297
Maximum Axle Weights, all One Ten models with Levelled Suspension Front Axle 1200 kg Rear Axle 1750 kg																

V8 PETROL ENGINE TUNING DATA
(with 4-speed gearbox and without electronic ignition)

ENGINE

Compression ratio	9.35:1 or 8.13:1 Dependent upon market
Firing order	1—8—4—3—6—5—7—2
Cylinder numbering system, front to rear:	
Left bank	1—3—5—7
Right bank	2—4—6—8
Compression pressure (minimum)	9,5 kgf cm^2 (135 lbf in^2)
Timing marks	On crankshaft pulley vibration damper
Valve clearance	Not adjustable
Valve timing:	
Inlet opens	36° B.T.D.C.
Inlet closes	64° A.B.D.C.
Inlet duration	280°
Inlet peak	99° A.T.D.C.
Exhaust opens	74° B.B.D.C.
Exhaust closes	26° A.T.D.C.
Exhaust duration	280°
Exhaust peak	119° B.T.D.C.

CARBURETTERS

Type	Two Solex
European Australian	175 CDSE
Other markets — non-emission	175 CD3
Needle:	
Australian	BIFH
Other markets — non-emission	BIFQ
— emission	BIFK
Idle speed (engine hot):	
Australian	700 - 750 rpm (run-in) 550 - 650 rpm (new engine)
Other markets — non-emission	550 - 650 rpm
— emission	700 - 750 rpm (run-in) 550 - 650 rpm (new engine)
Fast idle speed (engine hot)	1050 - 1150 rpm
Mixture setting — CO at idle:	
Australian	2% - 3.5% Pulsair connected
Other markets	1.5% - 3% Pulsair connected

IGNITION

Coil make/type	AC Delco with ballast resistor
Primary resistance at 20°C (68°F)	1.2 - 1.4 ohms
Consumption, ignition on, at 2000 rpm	1 amp
Sparking plug type	Champion N12Y or Unipart GSP131
Sparking plug gap	0,71 - 0,84 mm (0.028 - 0.033 in)
Ignition timing, dynamic or static	5° to 7° B.T.D.C.
Fuel octane rating Australia	97 RON minimum
Non-emission	97 RON minimum
Emission	90 RON minimum
Engine idle speed	750 rpm maximum with vacuum pipe disconnected