



DEFENDER

WORKSHOP MANUAL

PART

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This Workshop Manual covers petrol and diesel powered Defender models from 1993 up to the end of the 1995 model year. Engines covered include the 2.25, 2.5, 3.5 V8 petrol and 2.25, 2.5, 2.5 Turbo and 200 Tdi diesel.

Separate Overhaul manuals are available to
compliment this workshop manual

V8 petrol engine - LZBOMENV8A
300 Tdi diesel engine - LRL 0070
R380 Manual gearbox - LRL 0003
LT230T Transfer gearbox - LRL 0081

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INTRODUCTION

This Workshop Manual covers the Defender 90 • 110 • 130 range of vehicles. It is primarily designed to assist skilled technicians in the efficient repair and maintenance of Land Rover vehicles.

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

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

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

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

NOTE: This calls attention to methods which make a job easier to perform.

REFERENCES

References to the left- or right-hand side in the manual are made when viewing the vehicle from the rear. With the engine and gearbox assembly removed, the water pump end of the engine is referred to as the front. To reduce repetition, operations covered in this manual do not include reference to testing the vehicle after repair. It is essential that work is inspected and tested after completion and if necessary a road test of the vehicle is carried out particularly where safety related items are concerned.

DIMENSIONS

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

REPAIRS AND REPLACEMENTS

When replacement parts are required it is essential that only Land Rover parts are used. Attention is particularly drawn to the following points concerning repairs and the fitting of replacement parts 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.

FUEL HANDLING PRECAUTIONS

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

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

Fuel 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 CO² GAS, or POWDER close at hand when handling or draining fuel, or when dismantling fuel systems and in areas where fuel containers are stored.

WARNING: It is imperative that the battery is not disconnected during fuel system repairs as arcing at the battery terminal could ignite fuel 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 precautions

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

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

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 vehicle. Ensure tank is completely drained.

Fuel tank repair

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

RECOMMENDED SEALANTS

A number of branded products are recommended in this manual for use during maintenance and repair work. These items include: HYLOMAR GASKET AND JOINTING COMPOUND and HYLOSIL RTV SILICON COMPOUND.

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

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

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

POISONOUS AND DANGEROUS SUBSTANCES

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

Engine oils

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

Asbestos

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

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

Synthetic rubber

Many "O" ring seals, flexible pipes and other similar items which appear to be natural rubber, are, in fact, made of synthetic materials called Fluoroelastomers. Under normal operating conditions this material is safe and does not present a health hazard. However, if the material is damaged by fire or excessive heating, it can break down and produce highly corrosive Hydrofluoric acid which can cause serious burns on contact with skin. Should the material be in a burnt or over heated condition, handle only with seamless industrial gloves. Decontaminate and dispose of the gloves immediately after use. If skin contact does occur, remove any contaminated clothing immediately and obtain medical assistance without delay. In the meantime, wash the affected area with copious amounts of cold water or limewater for fifteen to sixty minutes.

DISPOSING OF USED OILS AND FLUIDS

Environmental protection precaution

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

ACCESSORIES AND CONVERSIONS

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

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

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

SPECIFICATION

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

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

Whilst every effort is made to ensure the accuracy of the particulars contained in this Manual, neither the Manufacturer nor the Distributor or Dealer, by whom this Manual is supplied, shall in any circumstances be held liable for any inaccuracy or the consequences thereof.

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**Special Service Tools**

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

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

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

All orders and enquiries from the United Kingdom should be sent direct to V. L. Churchill. Overseas orders should be placed with the local V. L. Churchill distributor, where one exists. Countries where there is no distributor may order direct from V. L. Churchill Limited, P.O. Box 3, Daventry, Northamptonshire, England NN11 4NF.

The tools recommended in this Workshop Manual are listed in a multi-language, illustrated catalogue obtainable from Messrs. V. L. Churchill at the above address under publication number VLC 2561/1/91 or from Land Rover Merchandising Service, P.O. Box 534, Erdington, Birmingham, B24 0Q5.

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ABBREVIATIONS AND SYMBOLS

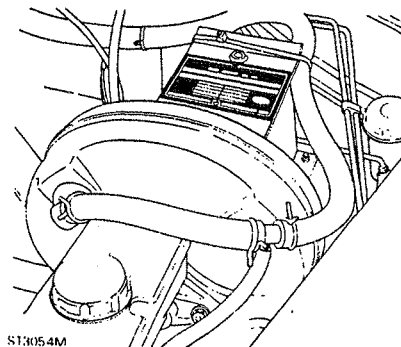
Across flats (bolt size)	AF	Maximum	max.
After bottom dead centre	ABDC	Metre	m
After top dead centre	ATDC	Millilitre	ml
Alternating current	a.c.	Millimetre	mm
Ampere	amp	Miles per gallon	mpg
Ampere hour	amp hr	Miles per hour	mph
Before bottom dead centre	BBDC	Minute (angle)	
Before top dead centre	BTDC	Minus (of tolerance)	-
Bottom dead centre	BDC	Naturally aspirated	N.A
Brake horse power	bhp	Negative (electrical)	-
British Standards	BS	Newton meters (torque)	Nm
Carbon monoxide	CO	Number	No.
Centimetre	cm	Ohms	ohm
Centigrade (Celsius)	C	Ounces (force)	ozf
Cubic centimetre	cm ³	Ounces (mass)	oz
Cubic inch	in ³	Ounce inch (torque)	ozf. in.
Degree (angle)	deg or °	Outside diameter	O.D.
Degree (temperature)	deg or °	Part number	Part No.
Diameter	dia.	Percentage	%
Direct current	d.c.	Pints	pt
Electronic Control Unit	E C U	Pints	US pt
Electronic Fuel Injection	E F I	Plus (tolerance)	+
Fahrenheit	F	Positive electrical	+
Feet	ft	Pound (force)	lbf
Feet per minute	ft/min	Pounds inch (torque)	in.lbf.
Fifth	5th	Pound (mass)	lb
First	1st	Pounds per square inch	1bf.in ²
Fluid ounce	fl oz	Ratio	:
Foot pounds (torque)	ft lb	Reference	ref.
Fourth	4th	Revolution per minute	rev/min
Gramme (force)	gf	Right-hand	RH
Gramme (mass)	g	Second (angle)	"
Gallons	gal	Second (numerical order)	2nd
Gallons (US)	US gal	Specific gravity	sp.gr.
High tension (electrical)	H.T.	Square centimetres	cm ²
Internal diameter	I.D.	Square inches	in ²
Inches of mercury	in. Hg	Standard wire gauge	s.w.g.
Inches	in	Synchroniser/Synchromesh	synchro.
Kilogramme (force)	kgf	Third	3rd
Kilogramme (mass.)	kg	Top dead centre	TDC
Kilogramme centimetre (torque)	kgf.cm	United Kingdom	UK
Kilogramme per square millimetre	kgf/mm ²	Vehicle Identification Number	VIN
Kilogramme per square centimetre	kgf/cm ²	Volts	V
Kilogramme metres (torque)	kgf.m	Watts	W
Kilometres	km		
Kilometres per hour	km/h		
Kilovolts	kV		
Left-hand steering	LHStg	SCREW THREADS	
Left-hand thread	LHThd	American Standard Taper Pipe	NPTF
Litres	litre	British Standard Pipe	BSP
Low tension	l.t.	Unified Coarse	UNC
		Unified Fine	UNF

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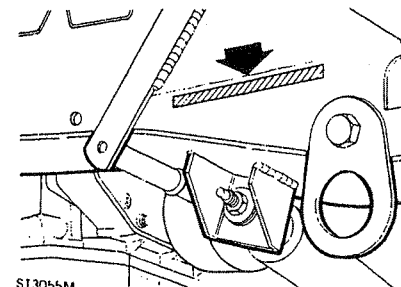
LOCATION OF VEHICLE IDENTIFICATION AND UNIT NUMBERS

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.



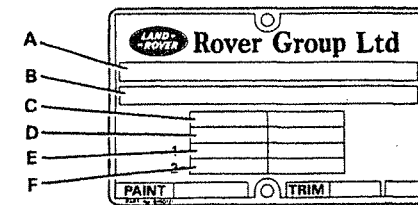
ST3054M



ST3055M

Key to Vehicle Identification Number Plate

- A Type approval
- B VIN (minimum of 17 digits)
- C Maximum permitted laden weight for vehicle
- D Maximum vehicle and trailer weight
- E Maximum road weight 8 front axle
- F Maximum road weight 8 rear axle



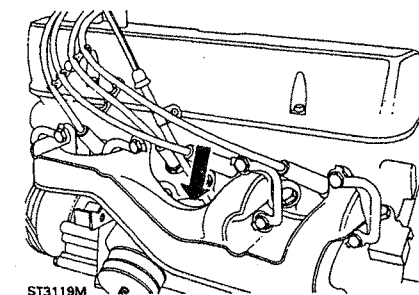
ST3047M

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

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

The last six digits identify build sequence number.

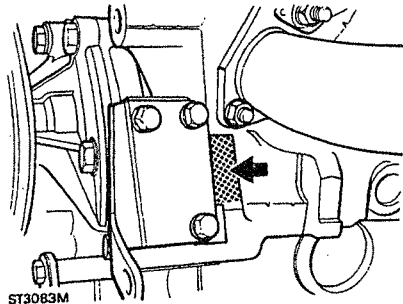
The V8 engine serial number is stamped on a cast pad on the cylinder block between numbers 3 and 5 cylinders.



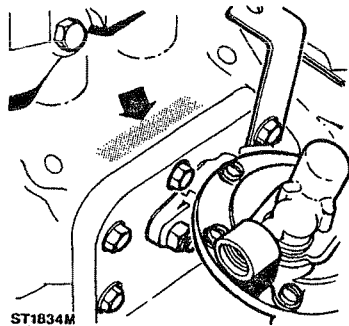
ST3119M

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 lower illustration shows.



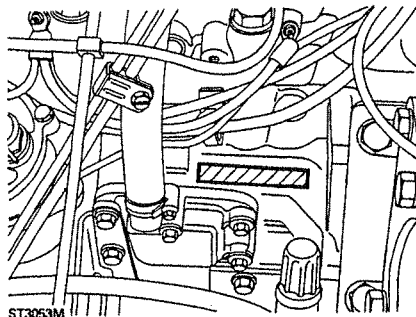
ST3083M



ST1834M

SERIAL NUMBER Tdi ENGINE DEFENDER

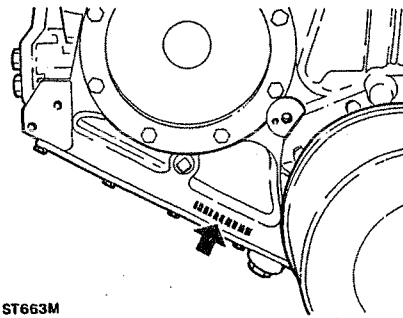
The engine number is stamped on the cylinder block on the right hand side of the engine above the camshaft front cover plate. Commencing Serial Number IIL 00001.



ST3053M

MAIN GEARBOX AND TRANSFER BOX LT95 - V8

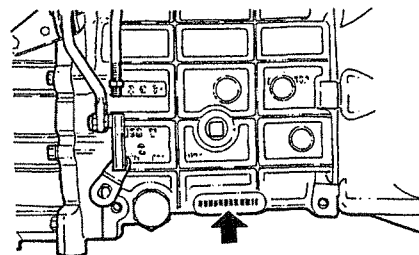
Stamped on the rear of the transfer box on the opposite side to the transmission brake.



ST663M

MAIN GEARBOX LT77 4 CYLINDER VEHICLES

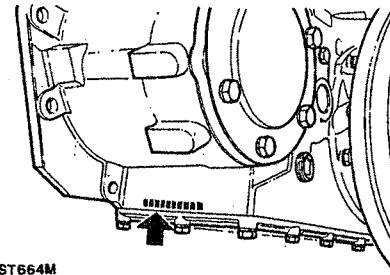
Stamped on a pad on the right-hand side of the gearbox immediately below the oil filler level plug.



ST665M

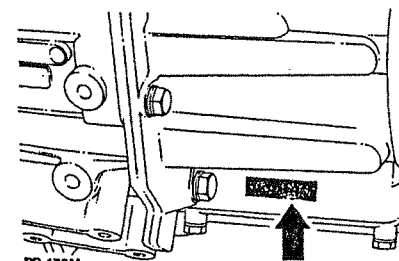
TRANSFER GEARBOX LT230R - 4 CYLINDER VEHICLES

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



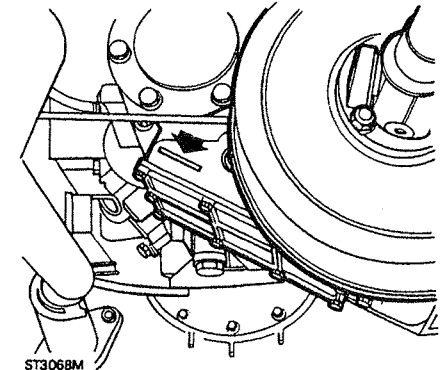
ST664M

TRANSFER GEARBOX LT230T - 4 CYLINDER AND V8 VEHICLES FROM SERIAL NUMBER SUFFIX 'B' ONWARDS



RR 470M

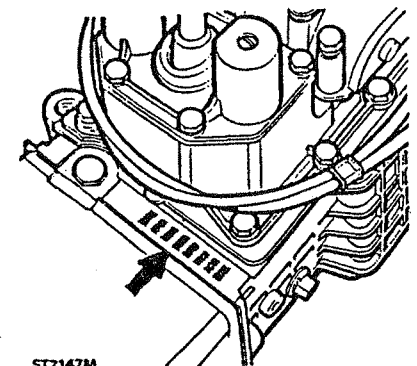
TRANSFER GEARBOX LT230T - 4 CYLINDER AND V8 VEHICLES FROM SERIAL NUMBER SUFFIX 'C' ONWARDS



ST3068M

MAIN GEARBOX LT85 LIGHTWEIGHT DIVIDED CASE - V8 VEHICLES

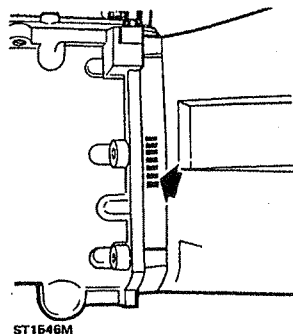
Stamped on the top face of the gearbox behind the gear selector lever housing.



ST2147M

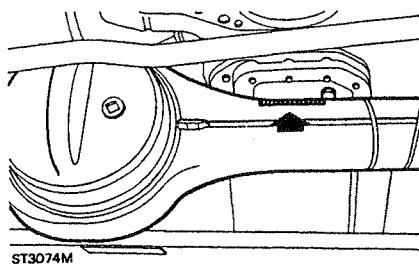
MAIN GEARBOX LT85 INTEGRAL CASE - V8 VEHICLES

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



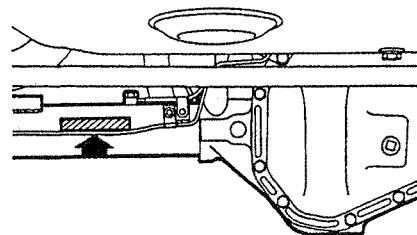
FRONT AXLE

Stamped on top of the left-hand axle tube 90 and 110.



REAR AXLE

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



ST3073M

GENERAL SPECIFICATION DATA

V8 ENGINE

ENGINE

Type	V8
Number of cylinders	Eight, two banks of four
Bore	88,90 mm
Stroke	71,12 mm
Capacity	3528 cc
Valve operation	Overhead by push-rod
Maximum power B H P	113 at 4000 rev/min
Maximum power KW	1983 to 1986 84.6 at 4000 rev/min
Maximum torque	251 Nm at 2500 rev/min
Maximum power B H P	134.5 at 4750 rev/min
Maximum power KW	1986 onwards 100.3 at 4740 rev/min
Maximum torque	253 Nm at 2500 rev/min

Crankshaft

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

Main bearings

Number and type	5, Vandervell shells
Material	Lead-indium
Diametrical clearance	0,010 - 0,048 mm
Undersizes	0,254 mm, 0,508 mm

Connecting rods

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

Big end bearings

Type and material	Vandervell VP lead-indium
Diametrical clearance	0,015 - 0,055 mm
End-float on crankpin	0,15 - 0,36 mm
Undersizes	0,254 mm, 0,508 mm

Gudgeon pins

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

Pistons

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

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
Compression ring gap	0,44 - 0,57 mm
Oil ring type	Perfect circle, type 98-6
Oil ring width	4,811 mm

Camshaft

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

Valves

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

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2400 rev/min	2,1 - 2,8 kgf cm ² @ 50 mph (80 kph)
Oil filter (external)	Full-flow, self-contained cartridge
Oil filter (internal)	Gauze. Pump intake filter
Oil pump type	Gear

Oil pressure relief valve (early models)

Type	Non-adjustable
Relief valve spring:	
Free length	81,2 mm
Compressed length at 4,2 kg load	45,7 mm

Oil filter by-pass valve

Type	Non-adjustable
By-pass valve spring:	
Free length	37,5 mm
Compressed length at 0,34 kg	22,6 mm

2.25 LITRE PETROL ENGINE

ENGINE

Type	4 cylinder
Bore	90,47 mm
Stroke	88,9 mm
Capacity	2286 cm ³
Valve operation	Overhead by push-rod
Compression ratio	8.0:1
Maximum power 4000 rev/min	55.2 Kw (74 bhp)
Maximum torque 2000 rev/min	163 Nm

Crankshaft

Main journal diameter	63,487 - 63,500 mm
Minimum regrind diameter	63,246 - 63,2333 mm
Crankpin journal diameter	58,725 - 58,744 mm
Minimum regrind diameter	58,48985 - 58,47080 mm
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05 - 0,15 mm

Main bearings

Number and type	5 halved shells
Material	Steel shell, tin-aluminium lined
Diametrical clearance	0,020 - 0,063 mm
Undersizes	0,25 mm

Connecting rods

Type	Horizontally split big end, plain small end
Length between centres	175,36 - 175,46 mm

Big end bearings

Type and material	Steel shell, copper-lead lined
Diametrical clearance	0,019 - 0,068 mm
End-float on crankpin	0,20 - 0,30 mm
Undersizes	0,25 mm

Gudgeon pins

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

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
Oversize pistons	0,043 - 0,055 mm

Piston rings

Compression	2
Gap in bore	0,38 - 0,50 mm
Clearance in groove	0,046 - 0,097 mm
Oil control	1
Gap in bore	0,38 - 0,50 mm
Clearance in groove	0,038 - 0,089 mm

Camshaft

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

Valves

Length:	
Inlet	111,20 - 111,66 mm
Exhaust	111,22 - 111,58 mm
Seat angle:	
Inlet	30°
Exhaust	45°
Head diameter:	
Inlet	44,32 - 44,57 mm
Exhaust	34,93 - 35,18 mm
Stem diameter:	
Inlet	7,899 - 7,912 mm
Exhaust	8,682 - 8,694 mm
Stem to guide clearance:	
Inlet	0,033 - 0,048 mm
Exhaust	0,058 - 0,073 mm
Valve lift:	
Inlet	10,236 mm
Exhaust	9,85 mm

Valve springs

Type	Duplex interference coil
Inner:	
Length, free	42,67 mm
Length, under 8,0 kg load	37,13 mm
Outer:	
Length, free	46,28 mm
Length, under 21 kg load	40,30 mm

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2000 rev/min	2,45 - 4,50 kgf cm 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
Aluminium gear	0,07 - 0,15 mm
Radial clearance of gears	0,02 - 0,10 mm
Backlash of gears	0,15 - 0,28 mm

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
Radial clearance of gears	0,025 - 0,075 mm
Backlash of gears	0,1 - 0,2 mm

Oil pressure relief valve

Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm
Compressed length at 2,58 kg load	61,23 mm

2.5 LITRE PETROL ENGINE**ENGINE**

Type	4 cylinder
Bore	90,47 mm
Stroke	97 mm
Capacity	2495 cm ³
Valve operation	Overhead by push-rod
Compression ratio	8.0:1
Maximum power 4000 rev/min	59.5 Kw
Maximum torque 2000 rev/min	175 Nm
Commencing serial no.	17H00011C

Crankshaft

Main journal diameter	63,487 - 63,500 mm
Main bearing journal diameter (later engines)	63,487 - 63,475 mm
Minimum regrind diameter	63,246 - 63,2333 mm
Crankpin journal diameter	58,725 - 58,744 mm
Minimum regrind diameter	58,48985 - 58,47080 mm
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05 - 0,15 mm

Main bearings

Number and type	5 halved shells
Material	Copper-lead lined
Diametrical clearance	0,018 - 0,06 mm
Undersizes	0,25 mm
Diametrical clearance (later engines)	0,0305 - 0,0792 mm

Connecting rods

Type	Horizontally split big end, plain small end
Length between centres	175,36 - 175,46 mm

Connecting rod bearings

Type and material	Steel shell, copper-lead lined
Diametrical clearance	0,025 - 0,075 mm
End-float on crankpin	0,20 - 0,30 mm
Undersizes	0,25 mm

Gudgeon pins

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

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

Piston rings

Compression	2
Gap in bore	0,40 - 0,65 mm
Clearance in groove	0,046 - 0,097 mm
Oil control	1
Gap in bore	0,30 - 0,55 mm
Clearance in groove	0,026 - 0,076 mm

Camshaft

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

Valves

Length:	
Inlet	111,20 - 111,66 mm
Exhaust	111,12 - 111,59 mm
Seat angle:	
Inlet	30°
Exhaust	45°
Head diameter:	
Inlet	44,32 - 44,58 mm
Exhaust	34,43 - 34,18 mm
Stem diameter:	
Inlet	7,899 - 7,912 mm
Exhaust	8,697 - 8,679 mm
Stem to guide clearance:	
Inlet	0,033 - 0,048 mm
Exhaust	0,035 - 0,076 mm
Valve lift:	
Inlet	10,236 mm
Exhaust	9,85 mm
Exhaust valve seat insert:	
External diameter	36,576 - 36,601 mm
Internal diameter	28,448 - 28,702 mm
Width	5,055 - 5,105 mm
Seat angle and depth	45° 0,635 - 0,889 mm

Valve springs

Type	Duplex interference coil
Inner:	
Length, free	42,67 mm
Length, under 8,0 kg load	37,13 mm
Outer:	
Length, free	46,28 mm
Length, under 21 kg load	40,30 mm

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2000 rev/min	2,45 - 4,50 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
Radial clearance of gears	0,025 - 0,075 mm
Backlash of gears	0,1 - 0,2 mm

Oil pressure relief valve

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

2.25 LITRE DIESEL ENGINE**ENGINE**

Type	4 cylinder
Bore	90,47 mm
Stroke	88,9 mm
Capacity	2286 cm ³
Valve operation	Overhead by push-rod
Compression ratio	23:1
Maximum power	44Kw (59 bhp) at 4000 rev/min
Maximum torque	136 Nm at 1800 rev/min

Crankshaft

Main bearing journal diameter	63,487 - 63,500 mm
Regrind dimensions:	
63,246 - 63,2333 mm	Use 0,260 mm undersize bearings
Crankpin journal diameter	58,725 - 58,744 mm
Regrind dimensions:	
58,48985 - 58,4708 mm	Use 0,260 mm undersize bearings
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05 - 0,15 mm

Main bearings

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

Connecting rods

Type	Horizontally split big end, plain small end
Length between centres	175,38 - 175,43 mm

Big end bearings

Type and material	Steel shell, copper-lead lined
Diametrical clearance	0,020 - 0,0635 mm
End-float on crankpin	0,15 - 0,356 mm

Gudgeon pins

Type	Floating
Fit in piston	Push fit by hand
Clearance in connecting rod	0,0196 - 0,0036 mm
Diameter	30,1564 - 30,1625 mm

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
Oversize pistons	0,111 - 0,157 mm

Piston rings

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

Valves

Length:	
Inlet	116,26 - 116,51 mm
Exhaust	116,79 - 117,25 mm
Seat angle:	
Inlet	45°
Exhaust	45°
Head diameter:	
Inlet	39,12 - 39,37 mm
Exhaust	33,25 - 33,50 mm
Stem diameter:	
Inlet	7,912 - 7,899 mm
Exhaust	8,682 - 8,694 mm
Stem to guide clearance:	
Inlet	0,033 - 0,048 mm
Exhaust	0,058 - 0,073 mm
Valve lift:	
Inlet	9,85 mm
Exhaust	10,26 mm

Camshaft

Location	Right-hand side (thrust side) of engine
End-float	0,1 - 0,2 mm
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
Length, under 8,0 kg load	40,30 mm
Outer:	
Length, free	46,28 mm
Length, under 21 kg load	40,30 mm

Lubrication

Type	Wet sump, pressure fed
System pressure, engine warm at 2000 rev/min	2,5 - 4,57 kgf cm ²
Oil pump:	
Type	Double gear
Drive	Splined shaft from camshaft skew gear
End-float of gears:	
Steel gear	0,05 - 0,12 mm
Aluminium gear	0,07 - 0,15 mm
Radial clearance of gears	0,02 - 0,10 mm
Backlash of gears	0,15 - 0,28 mm

Oil pressure relief valve

Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm
Compressed length at 2,58 kg load	61,23 mm

2.5 LITRE DIESEL ENGINE N.A.

ENGINE

Number of cylinders	4
Bore	90,47 mm
Stroke	97,00 mm
Capacity	2495 cc
Compression ratio	21:1
Piston area (total)	257,1 cm ²
Maximum power at 4000 rev/min	50 kW
Maximum torque at 1800 rev/min	155 Nm

Crankshaft

Main bearing journal diameter	63,487 - 63,500 mm
Main bearing journal diameter (later engines)	63,487 - 63,475 mm
Regrind dimensions:	
63,246 - 63,2333 mm	Use 0,260 mm undersize bearings
Crankpin journal diameter	58,725 - 58,744 mm
Regrind dimensions:	
58,48985 - 58,4708 mm	Use 0,260 undersize bearings
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05 - 0,15 mm

Main bearings

Number and type	5 halved shells
Diametrical clearance	0,018 - 0,061 mm
Diametrical clearance (later engines)	0,0305 - 0,0792 mm

Connecting rods

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

Pistons

Type	Aluminium alloy 'V' shaped valve recess in crown
Skirt diametrical clearance (at right angle to gudgeon pin)	0,025 - 0,05 mm

Gudgeon pins

Type	Floating
Fit in piston	Hand push fit
Diameter	30,1564 - 30,1625 mm
Clearance in connecting rod	0,0196 - 0,0036 mm

Piston rings

Type:	
Top	Square friction edge, chrome plated
Second	Taper faced - Marked 'TOP' on upper face
Oil control	Expander and rails
Fitted gap:	
Top	0,30 to 0,50 mm
Second	0,25 to 0,45 mm
Oil control	0,30 to 0,60 mm

Camshaft

Drive	25,4 mm wide dry toothed belt
Location	Right-hand side (thrust side)
End-float	0,1 - 0,2 mm
Number of bearings	4
Material	Steel shell, white metal lined

Valves

Seat angle:	
Inlet	45°
Exhaust	45°
Head diameter:	
Inlet	39,12 - 39,37 mm
Exhaust	33,25 - 33,50 mm
Valve lift:	
Inlet	9,85 mm
Exhaust	10,26 mm
Cam lift:	
Inlet	6,81 mm
Exhaust	7,06 mm
Stem diameter:	
Inlet	7,912 - 7,899 mm
Exhaust	8,682 - 8,694 mm

Valve springs

Type	Duplex Interference double coil
Inner:	
Length, free	42,67 mm
Length, under 8,0 kg load	40,30 mm
Outer:	
Length, free	46,28 mm
Length, under 21 kg load	40,30 mm

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2000 rev/min	2,5 - 4,57 kgf cm 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
Aluminium gear	0,07 - 0,15 mm
Radial clearance of gears	0,02 - 0,10 mm
Backlash of gears	0,15 - 0,28 mm
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
Radial clearance of gears	0,025 - 0,075 mm
Backlash of gears	0,1 - 0,2 mm

Oil pressure relief valve

Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm
Compressed length at 2,58 kg load	61,23 mm

2.5 LITRE TURBO CHARGED DIESEL ENGINE**ENGINE**

Number of cylinders	4
Bore	90,47 mm
Stroke	97,00 mm
Capacity	2495 cm ³
Compression ratio	21:1
Valve operation	O.h.v. pushrod operated
Turbo charge	Garrett T2

Crankshaft

Main bearing journal diameter	63,487 - 63,500 mm
Main bearing journal diameter (later engines)	63,487 - 63,475 mm
Regrind dimensions:	
63,246 - 63,2333 mm	Use 0,260 mm undersize bearings
Crankpin journal diameter	58,725 - 58,744 mm
Regrind diameter:	
58,48985 - 58,4708 mm	Use 0,260 mm undersize bearings
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05 - 0,15 mm

Main bearings

Number and type	5 halved shells without oil grooves
Diametrical clearance	0,018 - 0,0665 mm
Diametrical clearance (later engines)	0,0305 - 0,792 mm

Connecting rods

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

Pistons

Type	Aluminium alloy 'V' shaped valve recess in crown
Skirt diametrical clearance (at right angle to gudgeon pin)	0,025 - 0,05 mm

Gudgeon pins

Type	Floating
Fit in piston	Hand push fit
Diameter	30,1564 - 30,1625 mm
Clearance in connecting rod	0,0196 - 0,0036 mm

Piston rings

Type:	
Top	Chamfered friction edge, chrome plated
Second	Taper faced
Oil control	Expander and rails
Gap in bore:	
Top	0,30 - 0,50 mm
Second	0,25 - 0,45 mm
Oil control	0,3 - 0,6 mm
Clearance in piston grooves:	
Top	0,140 - 0,180 mm
Second	0,040 - 0,80 mm
Oil control	0,04 - 0,080 mm

Camshaft

Drive	24,4 mm (1.0 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
Exhaust	33,25 - 33,50 mm
Stem diameter:	
Inlet	7,912 - 7,899 mm
Exhaust	8,682 - 8,694 mm
Valve lift:	
Inlet	9,85 mm
Exhaust	10,26 mm
Cam lift:	
Inlet	6,81 mm
Exhaust	7,06 mm

Valve springs

Type	Duplex Interference double coil
Inner:	
Length, free	43,03 mm
Min length, under 7,5 kg load	36,93 mm
Outer:	
Length, free	47,19 mm
Min length, under 20 kgf load	40,11 mm

Lubrication

System	Wet sump, pressure fed
System pressure, engine warm at 2000 rev/min	2,5 - 4,57 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
Radial clearance of gears	0,025 - 0,075 mm
Backlash of gears	0,1 - 0,2 mm
Oil pressure relief valve:	
Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm
Compressed length at 2,58 kg load	61,23 mm
Oil filter:	
Type	Screw-on disposable canister

Tdi DEFENDER ENGINE**ENGINE**

Type	Direct injection, turbocharged, intercooled
Number of cylinders	4
Bore	90,47 mm
Stroke	97,00 mm
Capacity	2495 cc
Compression ratio	19,5:1 + 0,5:1
Valve operation	O H.V pushrod operated
Turbo charger	Garrett T25

Crankshaft

Main journal diameter	63,475 - 63,487 mm
Regrind dimensions	63,2333 - 63,246 mm
	Use 0,260 mm undersize bearings
Crankpin journal diameter	58,725 - 58,744 mm
Regrind dimensions	58,4708 - 58,49985 mm
	Use 0,260 mm undersize bearings
Crankshaft end thrust	Taken on thrust washers at centre main bearing
Crankshaft end-float	0,05 - 0,15 mm

Main bearings

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

Connecting rods

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

Pistons

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

Gudgeon pins

Type	Floating
Fit in piston	Hand push in
Diameter	30,1564 - 30,1625 mm
Clearance in connecting rod	0,0036 - 0,0196 mm

Piston rings

Type:	Chamfered friction edge, chrome plated
Top	Taper faced
Second	Expander and rails
Oil control	
Gap in bore:	
Top	0,40 - 0,65 mm
Second	0,30 - 0,50 mm
Oil Control	0,3 - 0,6 mm
Clearance in piston groove:	
Top	0,167 - 0,232 mm
Second	0,05 - 0,08 mm
Oil control	0,05 - 0,08 mm

Camshaft

Timing belt	30 mm (1.2 in dry toothed belt)
Location	Right hand side (thrust side)
End float	0,1 - 0,2 mm
Number of bearings	4
Material	Steel shell, white metal lined

Valves

Tappet clearance:	
Inlet and exhaust	0,20 mm
Seat angle:	
Inlet	60°
Exhaust	45°
Head diameter:	
Inlet	39,35 - 39,65 mm
Exhaust	36,35 - 36,65 mm
Stem diameter:	
Inlet	7,960 - 7,975 mm
Exhaust	7,940 - 7,960 mm
Valve lift:	
Inlet	9,93 mm
Exhaust	10,26 mm
Cam lift:	
Inlet	6,81 mm
Exhaust	7,06 mm
Valve head stand down:	
Inlet and exhaust	0,9 - 1,1 mm
Valve spring length fitted	40,4 mm at pressure of 29.5 kg

Lubrication

System	Wet sump, pressure fed
Pressure, engine warm at normal operating speeds ...	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 gears	0,026 - 0,135 mm
Radial clearance of gears	0,025 - 0,075 mm
Backlash of gears	0,1 - 0,2 mm
Oil pressure relief valve:	
Type	Non-adjustable
Relief valve spring:	
Full length	67,82 mm
Compressed length at 2,58 kg load	61,23 mm
Oil filter	Screw-on disposable canister
Engine oil cooler	Combined with coolant radiator and intercooler

GENERAL DATA - Tdi ENGINE**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 rev/min
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, impeller, belt driven
Thermostat opening	88°C
Expansion tank cap pressur	1,055 kgf cm ² (system pressure)

CLUTCH - Tdi Engine

Type	Valeo diaphragm spring
Centre plate diameter	235 mm
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

TRANSMISSION - Tdi Engine

Main gearbox	5-speed helical constant mesh, with synchromesh on all forward gears		
Type - Manual			
Main gearbox ratios	Fifth (Cruising gear)	0.831:1	
	Fourth	1.000:1	
	Third	1.507:1	
	Second	2.301:1	
	First	3.585:1	
	Reverse	3.701:1	

Transfer gearbox	Two-speed reduction on main gearbox output.		
Type LT230T	Front and rear drive permanently engaged via a lockable differential.		
Ninety and One Ten models	High	1.411:1	
	Low	3.320:1	

Rear axle	Land Rover spiral bevel		
Type - Ninety models	Hypoid; full floating shafts Salisbury 8HA		
Type - One Ten models	3.538		
Ratio - All models			

Front axle	Land Rover spiral bevel		
Differential	Enclosed constant velocity joint		
Front wheel drive	3.538		
Ratio		high trans	low trans
Overall ratio (including final drive) - All Ninety models and One Ten Turbo-charged Diesel	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

GENERAL DATA

FUEL SYSTEM - 2.25 Petrol	See 'ENGINE TUNING DATA'	
Carburetter	Oil bath with built-in centrifugal pre-cleaner	
Air cleaner		

Fuel pump - Early Models 2.25 and 2.5 Petrol	Mechanical with sediment bowl and hand primer	
Type	0.211 to 0.362 kgf/cm	
Pressure range		

Fuel pump - Later Models 2.25 and 2.5 Petrol	Facet, electric. Mounted on R.H. side of chassis	
Make and Type	0.211 to 0.362 kgf/cm	
Pressure range		
Fuel pump - Latest Models - 2.5 Petrol	A C Delco In-tank pump	
Make and Type		

FUEL SYSTEM - 2.25, 2.5 Diesel and 2.5 turbo charged Diesel	See 'ENGINE TUNING DATA'	
Injection pump	Mechanical, with hand primer - Later type not serviceable	
Fuel lift pump type	0.35 - 0.56 kgf/cm ²	
Pressure range	Paper element type	
Fuel filter	Paper element type	
Air cleaner		

FUEL SYSTEM V8 engine	See 'ENGINE TUNING DATA'	
Carburetter	Facet, electric mounted vertically on R.H. side of chassis	
Fuel pump - Make, type - Early type	Cyclone, replaceable element	
Air cleaner	A C Delco - In-tank pump	
Fuel pump - Latest models		

COOLING SYSTEM 2.25 Petrol, 2.25 and 2.5 Diesel	Pressurized spill return system with thermostat control, pump and fan assisted	
Type	82°C	
Thermostat	0.6 kgf/cm ²	
Pressure cap	Centrifugal	
Type of pump		

COOLING SYSTEM - 2.5 Turbo Charged Diesel	Pressurized spill return system with thermostat control, pump and fan assisted.	
Type	82°C	
Thermostat opening temperature	1.0 kgf/cm ²	
Pressure cap	Centrifugal	
Water pump type	7 blade with viscous coupling	
Fan type	Combined engine coolant and oil cooler	
Radiator		

COOLING SYSTEM V8 engine	Pressurized spill return system with thermostat control, pump and fan assisted	
Type	Emission and non-emission 82°C, Australia 88°C	
Thermostat	Centrifugal	
Type of pump		

CLUTCH 2.25 and 2.5 Petrol	Borg and Beck diaphragm spring	
Type	242,1 mm	
Centre plate diameter	Raybestos 1488-05	
Facing material	White/violet on periphery	
Facing material identification colour	6	
Number of damper springs	Dark grey/light green	
Damper spring colour	Ball journal	
Clutch release bearing		

CLUTCH - 2.25 and 2.5 Diesel engine - Early type	Verto diaphragm spring	
Type	242,1 mm	
Centre plate diameter	Raybestos 1488-05	
Facing material	8	
Number of damper springs	2 off white/green	
Damper spring colour	2 off pigeon blue	
	4 off ruby red	
Clutch release bearing	Ball journal	

CLUTCH - Later type 2.5 and 2.5 Turbo Diesels

Type	Verto diaphragm spring
Centre plate diameter (friction plate)	235 mm
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
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	0.831:1
Fourth (direct)	1.000:1
Third	1.507:1
Second	2.301:1
First	3.585:1
Reverse	3.701:1

Transfer box

Type LT230R	Two-speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential
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Ratios:	
High	1.6670
Low	3.3198
Overall ratios (final drive):	
Fifth	In high transfer 4.9042:1 In low transfer 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

Transfer gearbox - 2.5 Petrol and Diesel - Later Models

Type LT230T	Two-speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential	
Ninety models and One Ten Diesel Turbo	High	1.411:1
	Low	3.320:1
One Ten models except Turbo	High	1.667:1
	Low	3.320:1

Rear axle

Type - Ninety models	Spiral bevel
Type - One Ten models	Hypoid; full floating shafts, Salisbury 8HA
Ratio - All models	3.538:1

Front axle

Differential	Spiral bevel	
Front wheel drive	Enclosed constant velocity joint	
Ratio	3.54:1	
Overall ratio (including final drive) - Ninety models and One Ten Diesel Turbo		
	In high transfer	In low transfer
Fifth (Cruising gear)	4.15:1	9.76:1
Fourth	4.99:1	11.75:1
Third	7.52:1	17.70:1
Second	11.49:1	27.03:1
First	17.90:1	42.11:1
Reverse	18.48:1	43.47:1
Overall ratio (including final drive) - One Ten Models except Turbo		
	In high transfer	In low transfer
Fifth (Cruising gear)	4.90:1	9.76:1
Fourth	5.89:1	11.75:1
Third	8.89:1	17.70:1
Second	13.57:1	27.03:1
First	21.14:1	42.11:1
Reverse	21.83:1	43.47:1

TRANSMISSION - V8 Engine - Early models

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
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Ratios:	
High	1.3362
Low	3.3206
Overall ratios (final drive):	
Fourth	In high transfer 4.7281:1 In low transfer 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)	0.795:1
	Fourth	1.000:1
	Third	1.436:1
	Second	2.180:1
	First	3.650:1
	Reverse	3.718:1

Transfer gearbox

Type	LT230T. Two-speed reduction on main gearbox output. Front and rear drive permanently engaged via a lockable differential.	
Ninety models	High	1.222:1
	Low	3.3198:1
One Ten models	High	1.410:1
	Low	3.3198:1
Overall ratio (including final drive) - Ninety models	In high transfer In low transfer	
	Fifth (Cruising gear)	3.34376:1 9.3401:1
	Fourth	4.3240:1 11.7471:1
	Third	6.2102:1 16.8712:1
	Second	9.4282:1 25.6134:1
	First	15.7815:1 42.8734:1
Overall ratio (including final drive) One Ten models	In high transfer In low transfer	
	Fifth (Cruising gear)	3.9665:1 9.3401:1
	Fourth	4.9893:1 11.7471:1
	Third	7.1656:1 16.8712:1
	Second	10.8786:1 25.6134:1
	First	18.2094:1 42.8734:1
Reverse	18.9497:1 44.9233:1	

TRANSMISSION - 2.5 Turbo Diesel

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 - One Ten only

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

Rear Axle - Ninety

Type	Land Rover spiral bevel
Ratio	3.538:1

Front Axle - All Models

Type	Land Rover spiral bevel, enclosed constant velocity joints	
Ratio	3.538:1	
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

PROPELLER SHAFTS - All Models

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

Front	Lockheed Disc
Disc diameter	300 mm
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
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
Lining material	Don 269

BRAKES - 2.25 and 2.5 litre Diesel engine and 2.5 Turbo

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)
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Evacuation pump - 2.25 litre Diesel	
Maximum speed	5000 rev/min. Belt drive
Oil capacity	40 cm ³ SAE 15W-50
Evacuation pump - 2.5 litre Diesel	
Maximum speed	4000 rev/min. Gear drive from camshaft
Lubrication	Oil feed via skew gear
Minimum vacuum level at 2500 rev/min	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	3.48
Camber angle	Zero
Castor angle	3°
Swivel pin inclination	7°
Front wheel toe-out permanent 4-wheel drive	0 - 2,00 mm
Toe out included angle	0° 0' to 0° 16'

Turning circle between kerbs:

Ninety Models	
600 x 16 Tyres	11,5 m
750 x 16 Tyres	12,3 m
205 x 16 Tyres	11,7 m

One Ten Models	
750 x 16 Tyres	12,8 m
Steering wheel diameter	420 mm
Steering damper	Fitted to drag link
Track	1485,90 mm
Steering column type	Collapsible coupling

WHEELS - All Models

Type of wheel	Ventilated disc
Wheel size	139,70 mm F x 406,40 mm
Number of studs	5

ELECTRICAL EQUIPMENT - All Models

System	12 volt, negative earth
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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.2911	90/84/90
Lucas - cold climate 13 plate	B B M S No.389	Designation
Chloride - cold climate 13 plate	B B M S No.3693	15/120/92

Battery - 2.25 litre Diesel engine

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

Battery - 2.5 and 2.5 Turbo Diesel

Type	Chloride Heavy duty 072 L R-Spec. 380/120/90
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Alternator - 2.25 litre Petrol and Diesel and 2.5 Diesel - Early Models

Type	Lucas A115-34
Maximum D.C. output at 6000 rev/min	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
Regulator controlled voltage	13.6 - 14.4 volts measured across battery

NOTE: From the following engine numbers a 45 amp output alternator is fitted. - A127-65

12J05497C	Land Rover 90/110 2.5 litre Diesel and Turbo Diesel
11H05639C	Land Rover 90 2.5 litre Petrol
11H05629C	Land Rover 110 2.5 litre Petrol
	Land Rover 90/110 2.5 litre Petrol and all Diesels, with Air Con., A127-45

Alternator - V8 engine

Type	Lucas A115-45 - later models A127-45
Maximum D.C. output at 6000 rev/min	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
Regulator controlled voltage	13.6 - 14.4 volts measured across battery

Alternator - V8 - with air conditioning

Type	Lucas A127-65
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Starter motor - 2.25 Petrol engine and early 2.5 Petrol models

Type	Lucas 2M100
Brush spring tension	1020 gms
Minimum brush length	9,5 mm

Starter motor - 2.5 Petrol - Later Models

TypeM78R

Starter motor - 2.25 and 2.5 Diesel engine - Early Models

TypeLucas 2M113
 New brush length22.2 mm
 Renew brush at8 mm
 Armature end-float -
 Cast aluminium intermediate bracket 0,03 - 1,4 mm
 Pressed steel intermediate bracket 0,03 - 1,55 mm
 Commutator minimum diameter 38 mm

Starter motor - 2.5 and 2.5 Turbo Diesel - Later Models

TypeParis Rhone type D9R91 12 volt, with reduction gear

Starter motor - V8 engine - Early Models

TypeLucas 3M100 pre-engaged
 Brush spring tension 1020 gms
 Brush minimum length 9,5 mm

Starter motor - V8 engines - Later Models

TypeLucas M78R

Wiper motor - All Models

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

Distributor - All Petrol engines) See 'ENGINE TUNING DATA'

Coil - All Petrol engines)

Fuses - All Models

TypeCartridge fuses, located in a box below the facia panel, protect the electrical components. For further details refer to SECTION 76

REPLACEMENT BULBS AND UNITS

Headlamps:

- UK75/50 W Sealed beam
 - Europe (except France)60/55 W Halogen bulb
 - France and Algeria60/55 W Halogen bulb, yellow
 - Rest of the world, right-hand steering75/50 W Sealed beam unit
 - Rest of the world, left-hand steering60/50 W Sealed beam unit
 Front side lamps12V 5W
 Side repeater lamps12V 4W
 Stop/tail lamps12V 21/5W
 Flasher lamps12V 21W
 Number plate lamp12V 4W
 Reverse lamp12V 21W
 Rear fog guard lamp12V 21W
 Interior lamp12V 21W
 Warning lights (including Diesel Cold Start)12V 1.2W
 Instrument illumination12V 3W
 Hazard switch warning light12V 0.6W

) Local legislative requirements may require fitment of quartz-halogen headlamps in countries outside Europe.

TYRE PRESSURES

WARNING: Tyre pressures must be checked with the tyres cold, as the pressure is about 0,21 bar higher at running temperature. If the vehicle has been parked in the sun or high ambient temperatures, **DO NOT** reduce the tyre pressures, move the vehicle into the shade and wait for the tyres to cool before checking the tyres to cool before checking the pressures.

Tyres - size and type	Normal All load conditions		Emergency soft				
			Unladen		Laden		
	Front	Rear	Front	Rear	Front	Rear	
90 6.00-16 CROSS-PLY	bar	2,4	3,25	1,1	1,1	1,1	1,6
	lb/in ²	35	47	16	16	16	23
7.50-16 CROSS-PLY	bar	1,9	2,4	1,1	1,1	1,1	1,6
	lb/in ²	28	35	16	16	16	23
205R16 RADIAL PLY	bar	1,9	2,4	1,1	1,1	1,1	1,6
	lb/in ²	28	35	16	16	16	23
7.50R16 RADIAL PLY	bar	1,9	2,75	1,1	1,1	1,1	1,6
	lb/in ²	28	40	16	16	16	23
110 7.50-16 CROSS-PLY	bar	1,9	2,9	1,1	1,1	1,1	1,8
	lb/in ²	28	42	16	16	16	26
7.50R16 RADIAL PLY	bar	1,9	3,3	1,1	1,1	1,1	1,8
	lb/in ²	28	48	16	16	16	26

Special Long Wheel Base Crew Cab Model

Tyres - size	Normal loads and road speeds	Emergency soft (25 mph 940 km/h) maximum speed	
		1,1	1,6
130 FRONT (7.50 - 60)	bar lb/in ²	3,03 44	1,1 16
REAR (7.50 - 16)	bar lb/in ²	4,5 65	2,2 32

WARNING: Cross-ply tyres must not be fitted to any model DEFENDER.

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.
16 tyres: 2,4 bar (35 lb/in²)
All other tyre sizes: 1,9 bar (28 lb/in²)
- 110 models Not more than 1250 kg rear axle load.
Cross-ply and radial tyres: 2,2 bar (32 lb/in²)
- Towing: When vehicle is used for towing the reduced rear tyre pressures for extra ride comfort are not applicable.

WHEELS AND TYRES

WARNING: DO NOT replace the road wheels with any type other than genuine Land Rover wheels, as they are designed for multi-purpose on and off road use and have very important relationships with the proper operation of the suspension system and vehicle handling. Replacement tyres should be one of the makes and sizes recommended in this manual and all be the same make, ply rating and tread pattern. If in any doubt, consult Land Rover Service Department for advice.

LAND ROVER TYRE CHARACTERISTICS

TYRE	SIZE	APPLICABLE MODEL	COMMENTS
Michelin XM & S 8 ply rating	205 x 16 Radial	Standard fit 90 and V8 models Optional others	Dual purpose, good traction: snow, mud, adverse conditions, low rolling resistance improves M.P.G.
Avon Ranger 6 ply rating	750 x 16 Radial	Standard fit 2.5 litre 110 Not County Station wagon or V8 Option 2.5 Litre 90	Dual purpose, good traction on and off road, low rolling resistance improves M.P.G.
Avon Flangemaster 6 ply rating	750 x 16 Radial	Option 110 all models Option 90 2.5 Litre models	Dual purpose, good traction on and off road, low rolling resistance improves M.P.G.
Michelin XC Type L 6 ply rating	750 x 16 Radial	Optional all models	Recommended for all off-road conditions, self cleaning. Resistance to accidental damage.
Michelin XS 6 ply rating	750 x 16 Radial	Optional all models	Ideal for sand or similar conditions. Maximum flotation heavy loads at reduced pressures, reasonable on-road life.
Michelin X Type 4 x 4 6 ply rating	750 x 16 Radial	Optional all models	Dual purpose, good on-road life excellent traction off-road protector ply in sidewall for off-road.
Michelin XZY 12 ply rating	750 x 16 Radial	Optional all models	General purpose tyre. Good wear characteristics. Designed to run at low pressures if necessary. Resistance to sidewall intrusion.

WARNING: Cross-ply tyres must not be fitted to any model DEFENDER

VEHICLE WEIGHTS AND PAYLOAD

Payload figures quoted in the accompanying table are normal 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.

EEC KERB WEIGHT = Unladen Weight + Full fuel tank x 75 kg. Driver.
 PAYLOAD = Gross Vehicle Weight - EEC Kerb Weight.

However, individual axle weights must not be exceeded, therefore the actual payload available may be less dependant on load distribution. All weight figures quoted are subject to Local Legal restrictions.

LAND ROVER 90 - Except 2.5 Turbo Diesel													
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	1624	1661	1620	1648	1685	1644	1690	1727	1686
EEC Payload	kg	794	757	798	776	739	780	752	715	766	710	673	714
Unladen Weight	kg	1487	1519	1483	1516	1548	1512	1529	1561	1525	1571	1603	1567
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	1610	1647	1602	1628	1665	1620	1652	1689	1644	1694	1731	1686
EEC Payload	kg	940	903	948	922	885	930	898	861	906	856	819	864
Unladen Weight	kg	1514	1546	1510	1543	1576	1539	1556	1588	1522	1598	1630	1594
Maximum Axle Weights, all Ninety models with High Load Suspension Front Axle 1200 kg Rear Axle 1500 kg													

LAND ROVER 110 - Except 2.5 Turbo Diesel																
Model - Petrol/Diesel	Soft Top			Pick-up			Hard Top			Station Wagon			High Capacity			
	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	1641
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	1588	1609	1573	1599	1610	1574	1652	1663	1627	1762	1773	1737	1688	1726	1653
Maximum Axle Weights, all One Ten models with Levelled Suspension Front Axle 1200 kg Rear Axle 1750 kg																

VEHICLE WEIGHTS AND PAYLOAD

LAND ROVER 90 - 2.5 TURBO CHARGED DIESEL					
Model	Soft Top	Pick-up	Hard Top	Station Wagon	
Gross Vehicle Weight STANDARD SUSPENSION 2400 kg					
EEC Kerb Weight	kg	1643	1661	1685	1727
EEC Payload	kg	757	739	715	673
Gross Vehicle Weight HIGH LOAD SUSPENSION 2550 kg					
EEC Kerb Weight	kg	1647	1665	1689	1731
EEC Payload	kg	903	885	861	819

LAND ROVER 110 - 2.5 TURBO CHARGED DIESEL						
Model	Soft Top	Pick-up	Hard Top	Station Wagon	High Capacity Pick-up	
Gross Vehicle Weight UNLEVELLED SUSPENSION 3050 kg						
EEC Kerb Weight	kg	1742	1743	1796	1906	1859
EEC Payload	kg	1308	1307	1254	1144	1191
Gross Vehicle Weight LEVELLED SUSPENSION 2950 kg						
EEC Kerb Weight	kg	1752	1753	1806	1916	1869
EEC Payload	kg	1198	1197	1144	1034	1081

LAND ROVER 127 CREW CAB		V8	TURBO D
GVW kg	Front Axle	1,580	1,580
	Rear Axle	2,200	2,200
	Total	3,500	3,500
* Unladen kg	Total	1,872	1,936
* EEC Kerb Weight kg	Front Axle	1,027	1,070
	Rear Axle	985	1,015
	Total	2,012	2,085
* EEC Payload kg	Total	1,488	1,415

* Applies to Land Rover 127 Crew Cab with standard rear HCPU body.

NOTE:

- EEC Kerb Weight = Unladen Weight + Full Fuel Tank and 75 kg driver.
- EEC Payload = GVW - EEC Kerb Weight. However individual axle weights must not be exceeded.
- Front and Rear Axle gross weights are non additive.
- For off road use Front Axle is restricted to a maximum capability of 1450 kg.

VEHICLE DIMENSIONS

NINETY MODELS		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
D	Overall Length	3722 mm			3722 mm			3883 mm			3883 mm		
	Overall Width	1790 mm			1790 mm			1790 mm			1790 mm		
I	2400 kg Height*	1965 mm			1963 mm			1972 mm			1963 mm		
	2550 kg Height*	2000 mm			1993 mm			1987 mm			1989 mm		
M	Wheelbase	2360 mm			2360 mm			2360 mm			2360 mm		
	Track Front Rear	1486 mm			1486 mm			1486 mm			1486 mm		
N	Cargo Bed Length	1144 mm			1144 mm			1144 mm			1144 mm		
	Interior Width	1620 mm			1620 mm			1620 mm			1620 mm		
O	Interior Height	1215 mm			-			1215 mm			1215 mm		
	Width between Wheel boxes	925 mm			925 mm			925 mm			925 mm		
S	Seat Capacity	2-7			2-7			2-7			6-7		
	Tyre size fitted	6.00 x 16			205 x 16			7.50 x 16 (except XS)					
P	Minimum Turning Radius (kerb to kerb)	5.75 m			5.85 m			6.15 m					
	Maximum Gradient (EEC kerb weight)	45°			45°			45°					
R	Approach Angle (EEC kerb weight)	47°			48°			51°			52°		
	Departure Angle (EEC kerb weight)	48°			49°			-			146°		
F	Ramp Break Over Angle	149°			150°			-			229 mm		
	Minimum Ground Clearance (unladen)	198 mm			191 mm			-			500 mm		
O	Wading Depth	2.5 PETROL			3.5 PETROL			2.5 DIESEL			2.5 TURBO		
	Towing Weights	750 kg			750 kg			750 kg			750 kg		
M	Unbraked Trailers	3500 kg			3500 kg			3500 kg			3500 kg		
	Trailers with Over Run Brakes	4000 kg			4000 kg			3500 kg			4000 kg		
S	4-wheel Trailers with Coupled Brakes	4000 kg			4000 kg			3500 kg			4000 kg		

ONE TEN MODELS		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
D	Overall Length	4438 mm			4438 mm			4599 mm			4599 mm			4681 mm		
	Overall Width	1780 mm			1790 mm			1790 mm			1790 mm			1790 mm		
I	Height*	2035 mm			2035 mm			2035 mm			2035 mm			2035 mm		
	3050 kg Height*	2079 mm			2064 mm			2073 mm			2059 mm			2076 mm		
M	Wheelbase	2794 mm			2794 mm			2794 mm			2794 mm			2794 mm		
	Track Front Rear	1486 mm			1486 mm			1486 mm			1486 mm			1486 mm		
N	Cargo Bed Length	1900			1900			1900			1900			2010		
	Interior Width	1620 mm			1620 mm			1620 mm			1620 mm			1660 mm		
O	Interior Height	1205			-			1205			-			-		
	Width bet. W/boxes	925			925			925			1090			-		
S	Seat Capacity	2-3-11			2-3-11			2-3-11			9-10-11-12			2-3		
	Tyre size	7.50 x 16			-			6.4 m			-			-		
P	Min. Turning Radius	-			45° max			50° (at EEC kerb weight)			-			-		
	Maximum Gradient	-			35° (at EEC kerb weight)			152°			-			-		
R	Approach Angle	-			-			215 mm			-			-		
	Departure Angle	-			-			500 mm			-			-		
F	Ramp Break Over Angle	-			-			-			2.5 PETROL			3.5 PETROL		
	Min. Grd. Clearance	-			-			-			2.5 DIESEL			2.5 TURBO D		
O	Wading Depth	-			-			-			750 kg			750 kg		
	Towing Weights	-			-			-			3500 kg			3500 kg		
M	Unbraked Trailers	-			-			-			4000 kg			4000 kg		
	Trailers with Over Run Brakes	-			-			-			4000 kg			4000 kg		
S	4-wheel Trailers with Coupled Brakes:	Fully braked			4000 kg			4000 kg			4000 kg			4000 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/cm²
 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.

CARBURETTORS

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 (run in) 700 - 750 rev/min
 Australian (new engine) 550 - 650 rev/min
 Other markets - non-emission 550 - 650 rev/min
 - emission 700 - 750 rev/min (run-in)
 550 - 650 rev/min (new engine)

Fast idle speed (engine hot) 1050 - 1150 rev/min

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 1.2 - 1.4 ohm
 Consumption, ignition on, at 2000 rev/min 1 amp
 Sparking plug type Champion N9YC
 Sparking plug gap 0.72 - 0.88 mm
 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 rev/min 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		
Condenser capacity	0.18 - 0.25 microfarad		
Centrifugal advance range and capsule	2° - 4° at 750 rev/min	1° - 3° at 600 rev/min	
	12°-14° at 2300 rev/min	15.03 7°-9° at 1800 rev/min	ADR
Vacuum advance capsule range	1/2°-4 1/2° at 254 mm Hg	Emission 2 1/2°-4 1/2° at 254 mm Hg	36
	5°-7° at 508 mm Hg	Engines 7°-8° at 608 mm Hg	Emission
Vacuum retard capsule range	5°-7° at 228.60 mm Hg	5°-7° at 228.60 mm Hg	Engines
	5°-7° at 355.60 mm Hg	5°-7° at 355.60 mm Hg	

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	Exhaust	
Valve timing	Inlet	68° B.B.D.C.	
Opens	30° B.T.D.C.	37° A.T.D.C.	
Closes	75° A.B.D.C.	285°	
Duration	285°	105.5° B.T.D.C.	
Valve peak	112.5° A.T.D.C.		

CARBURETTERS - Early Models

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

CARBURETTERS - Later Models

Type	2 SU HIF 44
SU specification number - High Comp	FZX 2006
SU specification number - Low Comp	FZX 2005
Needle - High Comp	BGD
Needle - Low Comp	BGC
Exhaust CO	0.5 to 2.5%
Idle Speed - New Engine	600 to 700 rev/min
Run-in engine	700 to 800 rev/min
Fast idle speed	1100 ± 50 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
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
Spark plug type	Champion N9YC
Spark plug gap	0.72 - 0.88 mm

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	Exhaust	
Valve timing	Inlet	68° B.B.D.C.	
Opens	30° B.T.D.C.	37° A.T.D.C.	
Closes	75° A.B.D.C.	285°	
Duration	285°	105.5° B.T.D.C.	
Valve peak	112.5° A.T.D.C.		

CARBURETTERS - Early Models

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

CARBURETTERS - Later Models

Type	2 SU HIF 44
SU specification number - High Comp	FZX 2006
SU specification number - Low Comp	FZX 2005
Needle - High Comp	BGD
Needle - Low Comp	BGC
Exhaust CO	0.5 to 2.5%
Idle Speed	
New Engine	600 to 700 rev/min
Run-in Engine	700 to 800 rev/min
Fast Idle Speed	1100 ± 50 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
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
Spark plug type	Champion N9YC
Spark plug gap	0,72 - 0,88 mm

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 - Early Models

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

CARBURETTERS - Later Models

Type	2 SU HIF 44
SU specification number - High Comp	FZX 2006
SU specification number - Low Comp	FZX 2005
Needle - High Comp	BGD
Needle - Low Comp	BGC
Exhaust CO	0,5 to 2,5%
Idle speed	
New Engine	600 to 700 rev/min
Run-in Engine	700 to 800 rev/min
Fast Idle Speed	1100 ± 50 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
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
Spark plug type	Champion N9YC
Spark plug gap	0,72 - 0,88 mm

V8 ENGINE TUNING DATA

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

BALL 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 - Early Models

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

CARBURETTERS - Later Models

Type	2 SU HIF 44
SU specification number - High Comp	FZX 2006
SU specification number - Low Comp	FZX 2005
Needle - High Comp	BGD
Needle - Low Comp	BGC
Exhaust CO	0,5 to 2,5%
Idle Speed	
New Engine	600 to 700 rev/min
Run-in Engine	700 to 800 rev/min
Fast Idle Speed	1100 ± 50 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
 Spark plug type Champion N9YC
 Spark plug gap 0,72 - 0,88 mm

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 cm² 300 rev/min cranking speed
 Ignition timing, static and dynamic up to 600 rev/min
 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 Engine hot

Valve timing:

Inlet opens 16° B.T.D.C.
 Inlet closes 42° A.B.D.C. With a 0,38 mm valve clearance.
 Inlet peak 103° A.T.D.C.
 Exhaust opens 51° B.B.D.C. Nominal setting for checking only.
 Exhaust closes 13° A.T.D.C.
 Exhaust peak 109° B.T.D.C.

DISTRIBUTOR - LUCAS

Type Lucas 45D
 Rotation of rotor Anti-clockwise
 Contact breaker gap 0,35 - 0,40 mm
 Dwell angle 46° - 56°
 Centrifugal advance range 1 - 1 at 300 Distributor rev/min
 19 - 21 at 2250 Distributor rev/min
 Vacuum advance capsule range 0° - 1/2° at 89 mm Hg
 11° - 13° at 635 mm Hg

DISTRIBUTOR - DUCELLIER

Type Ducellier Sliding Contact
 Rotation Anti-clockwise
 Contact breaker gap 0,35 - 0,40 mm
 Dwell angle 57°
 Centrifugal advance range 0° - 1° at 300 Distributor
 19 - 21 at 2250 Distributor rev/min
 Vacuum advance capsule range 0° - 1/2° at 89 mm Hg
 11° - 13° at 635 mm Hg

SPARKING PLUGS

8.0:1 compression ratio Champion N12Y or Unipart GSP 131
 Gap 0,75 - 0,80 mm

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
 Needle valve 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 rev/min

2.5 LITRE PETROL ENGINE TUNING DATA

ENGINE

Firing order 1-3-4-2
 Compression pressure (approximately): 11,2 kgf cm² 300 rev/min cranking speed
 Ignition timing dynamic 2000 rev/min 16° B.T.D.C. using 90 octane fuel with vacuum pipe disconnected
 Static, if no dynamic equipment available T D C
 Timing marks On crankshaft pulley
 Valve clearance, inlet and exhaust 0,25 mm Engine hot

Valve timing:

Inlet opens 11° B.T.D.C.
 Inlet closes 47° A.B.D.C. With a 0,38 mm valve clearance.
 Inlet peak 108° A.T.D.C.
 Exhaust opens 46° B.B.D.C. Nominal setting for Checking only
 Exhaust closes 18° A.T.D.C.
 Exhaust peak 104° B.T.D.C.

DISTRIBUTOR - LUCAS

Type Lucas 45D4
 Rotation of rotor Anti-clockwise
 Contact breaker gap 0,35 - 0,40 mm
 Dwell angle 49° - 59°
 Centrifugal advance range 0° - 1° at 500 Distributor rev/min
 18° - 20° at 2250 Distributor rev/min
 Vacuum advance capsule range 0° - 1/2° at 89 mm Hg
 11° - 13° at 635 mm Hg
 Dynamic Ignition Timing 16° B.T.D.C. 2000 rev/min Vacuum disconnected

SPARKING PLUGS

8.0:1 compression ratioChampion N9YC
Gap0.72 - 0.88 mm

IGNITION COIL

Make/typeBosch 0221 119 368
Primary resistance at 20°C (68 F)2.9 ohms
Consumption - Ignition on at engine idle speed2.0 amps approx.

CARBURETTER

Make/typeWeber 32/34 DMTL
Needle valve 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 Conditioning700 rev/min
Idle speed - hot - Air Conditioning800 rev/min ± 50 rev/min
Fast Idle speed setting1,70 ±0,10 mm throttle edge
Float level7 ±0,5 mm

2.25 and 2.5 LITRE DIESEL ENGINE TUNING DATA

ENGINE

Firing order1-3-4-2
Injection timing13° B.T.D.C. (2.25 litre Diesel)
Timing marks:
Valve timingOn engine flywheel and damper on 2.5 Diesel
Injection timingOn engine flywheel and pump flange
Valve clearance inlet and exhaust0,25 mm

Valve timing:

Inlet opens16° B.T.D.C.
Inlet closes42° A.B.D.C.
Inlet peak103° A.T.D.C.
Exhaust opens51° B.B.D.C.
Exhaust closes13° A.T.D.C.
Exhaust peak109° B.T.D.C.
Low idle speed650 ±20 rev/min
High idle speed4200 ±20 rev/min

INJECTORS

Make/typeCAV Pintaux
Nozzle sizeBDNO/SPC 6209 or BDNO/SP 6209
Opening pressure135 Atm

HEATER PLUGS

Make/typeProbe type, Champion CH 63 12 volt

DISTRIBUTOR PUMP

Make/typeCAV DPA-2.25 DPS-2.50 type with mechanical governor and auto advance and solenoid electrical shut-off
Direction of rotationClockwise, viewed from drive end
Maximum speed setting (sealed) 2.25 engine4200 engine rev/min
Maximum speed setting (sealed) 2.50 engine4400 ± 8 rev/min
Back leakage rate 150 - 100 Atm:
New nozzle7 seconds
Original nozzle5 seconds

2.5 LITRE TURBO CHARGED ENGINE TUNING DATA

ENGINE

Firing order1-3-4-2
Injection timing13° B.T.D.C.
Timing marks:
Valve timingSlot for peg in flywheel and T.D.C. mark on front pulley
Injection timingSpecial tool 18G 1458 inserted in D P S pump
Tappet clearances inlet and exhaust0,25 mm
Valve timing:
Inlet opens16° B.T.D.C.
Inlet closes42° A.B.D.C.
Inlet peak103° A.T.D.C.
Exhaust opens51° B.B.D.C.
Exhaust closes13° A.T.D.C.
Exhaust peak109° B.T.D.C.
Valve lift
Inlet9,85 mm
Exhaust10,26 mm
Maximum governed speeds
Full load4000 rev/min
No load (high speed)4400 ±80 rev/min
Idle speed670 ±20 rev/min
Die-down time4 seconds

DISTRIBUTOR PUMP

Make/typeCAV D P S type with boost control and two speed mechanical governor with auto advance and solenoid electrical shut-off. Tamper proof sealing on high speed and fuel adjustment screws.
Direction of rotationClockwise, viewed from drive end
Advance box (two stage)7° advance with 3° start retard
Back leakage rate 150-100 Atm:
New nozzle7 seconds
Original nozzle5 seconds
Despatch nozzle8520A290A

INJECTORS

Make/type CAV Pintaux DES5385001
 Nozzle size BDNO/SPC 6290
 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

HEATER PLUGS

Make/type Probe type, Champion CH63 22 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 measured at wastegate actuator "T" piece

Tdi DEFENDER 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 T.D.C. mark on front pulley
 Injection timing Statically timed with special tool inserted in Bosch pump
 hub
 Tappet clearance inlet and exhaust 0,20 mm 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.

Maximum governed speeds

Full load (speed cut-off starts) 3800 rev/min
 No load (flight speed) 4100 - 4260 rev/min
 Idle speed 780 - 800 rev/min

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 high speed and fuel adjustment screws.
 Direction of rotation Clockwise, viewed from drive end
 Advance box (single stage) 9° advance (7.38 mm)
 Peak pumping pressures 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

TURBO-CHARGER

Make/type Garrett T25
 Maximum boost pressure 0,78 bar measured at wastegate actuator "T" piece
 Fuel specification Diesel BS2869 (certain levels down to 45 with adjustment)

	Nm
ENGINE - 2.5 litre Diesel	
DPS pump studs to front cover	8
DPS pump to front cover	25
DPS pump to support bracket	25
Pulley to DPS pump	45
Distributor pipe banjo bolts	17
Tensioner assembly	25
Vacuum pump to cylinder block	25
Oil squirt to cylinder block	17
Throttle linkage to DPS pump	6
Throttle bracket to DPS pump	6
Front cover to cylinder block	25
Front cover plate to cylinder block	25
Cover plate to front cover plate	25
Cowl mounting bracket to front cover	25
Timing pointer to front cover	25
Drain plate to front cover	9

TURBO-CHARGER FIXINGS- 2.5 LITRE DIESEL

Banjo bolt DPS boost capsule	6,75
Stud-Turbo charger to exhaust manifold	25
Nut-Turbo charger to exhaust manifold	24
Adaptor-Oil feed to cylinder block	25
Adaptor-Oil drain to cylinder block	25
Pipe-Oil feed to cylinder block	19
Pipe-Oil drain	40
Stud-Outlet elbow to turbo charger	25
Nut-Outlet elbow to turbo charger	24
Heat shield support to inlet manifold	25
Stud-Exhaust manifold to cylinder head	35
Nut-Exhaust manifold to cylinder head	32
Screw-inlet and exhaust manifold to cylinder head	35

Tdi DEFENDER ENGINE

Bearing cap to cylinder block	133
Camshaft thrust plate to cylinder block	9
Clutch cover plate to flywheel	34
Connecting rod to cap	59
Dipstick tube assembly to cylinder block	25
Dipstick mounting bracket to inlet manifold	9
Earthing strap stud to cylinder block	26
Engine mounting foot to cylinder block	85
Housing flywheel to cylinder block	45
Flywheel to crankshaft	147
Ladderframe to cylinder block	25
Oil filter adaptor to cylinder block	45
Oil pressure switch	17
Oil pump cover to pump body	24
Oil pump relief valve plug	30
Oil pump to cylinder block	25
Oil pump strainer to oil pump	45
Oil squirt jet assembly to cylinder block	17
Oil strainer to mounting bracket	25
Plug-blanking oil gallery	37
Plug-drain oil sump	45
Plug-drain cylinder block	25
Plug-drain flywheel housing	12
Plug-inlet manifold (boost take-off)	25
Side cover to cylinder block	27

Tdi DEFENDER ENGINE-(continued)

	Nm
Starter motor to flywheel housing	45
Sump to ladderframe	25
Sump to ladderframe/cylinder block	25
Sump to cylinder block/front cover	22
Support brackets-exhaust manifold to cylinder block	25
Vacuum pump to cylinder block	25
Vertical drive shaft gear to cylinder block	25
Alternator and heat shield to mounting bracket	25
Adjusting link to alternator	25
Adjusting link to pas pump plate	25
Cylinder head to cylinder block	25
Breather cyclone to rocker cover	8
Engine lifting bracket to cylinder head	25
Electrical harness clip to cylinder head	25
Exhaust manifold to cylinder head	23
Glow plug terminal nut	4
Glow plug to cylinder head	23
Heater stud (water) to cylinder head	23
Injector clamp stud to cylinder head	8
Injector clamp to injector nut	20
Inlet manifold to cylinder head	23
Rocker cover to cylinder head	4
Rocker shaft to cylinder head	30
Tappet adjusting nut	24
Thermostat housing to cylinder head	25
Water outlet to thermostat housing	9
Water temperature switch to thermostat housing	17
Cowl mounting bracket to front cover	25
Fan assembly to water pump hub	25
Front cover plate to cylinder block	25
Front cover plate to front cover	25
Front cover to cylinder block	25
Injector pump to front cover	25
Injector pump stud to front cover	8
Injector pump to support bracket	25
Tensioner (timing belt) to cylinder block	45
Timing pulley to camshaft	45
Timing pulley to injector pump hub	25
TV damper pulley to crankshaft	341
Water pump to cylinder block	27
Water pump to cylinder block-stud	27
Water pump to front cover	25
Oil drain adaptor to cylinder block-Turbo	25
Oil drain pump to turbo	40
Oil feed pipe adaptor to cylinder block-Turbo	25
Oil feed pipe to turbo	19
Outlet elbow to turbo-nut	24
Outlet elbow to turbo-stud	25
Turbocharger to exhaust manifold	24
Belt tensioner assembly to front cover plate	
compressor	15
Compressor to mounting bracket	45
Compressor mounting bracket to front cover and plate	45
Banjo bolt-fuel pump	12
Banjo bolt-boost pipe	10
Banjo bolt-spill rail	25
Banjo bolt-fuel filter	17
Banjo bolt-injector spill rail	9
Fuel lift pump to fuel filter unions	12

See section 12

Tdi DEFENDER ENGINE (continued)	Nm
Fuel lift pump to cylinder block	25
Injector pipes to injectors and injector pump	28
P.A.S pump to mounting plate	15
P.A.S pump mounting plate to front cover	25
P A S pump pulley to hub	15
Tappet guide retaining screw	14

ENGINE - V8 Petrol engine

Air intake adaptor to carbs	24
Alternator mounting bracket to cylinder head	34
Alternator to mounting bracket	24
Alternator to adjusting link	24
Chainwheel to camshaft	58
Connecting rod bolt	51
Clutch attachment to flywheel	27
Cylinder head:	
Outer row	58
Centre row	92
Inner row	92
Distributor clamp bolt	21
Exhaust manifold to cylinder heads	21
Fan attachment	11
Flywheel to crankshaft	78
Inlet manifold to cylinder heads	51
Lifting eye to cylinder heads	24
Main bearing cap bolts	72
Main bearing cap rear bolts	92
Manifold gasket clamp bolt	17
Oil pump cover to timing cover	13
Oil plug	28
Oil relief valve cap	40
Oil sump drain plug	45
Oil sump to cylinder block	10
Oil sump rear to cylinder block	18
Rocker cover to cylinder head	7
Rocker shaft bracket to cylinder head	37
Spark plug	15
Starter motor attachment	44
Damper to crankshaft	271
Timing cover to cylinder block	27
Tempatrol unit to water pump	38
Water pump pulley to water pump hub	23
Water pump timing cover to cylinder block	27

FUEL LINES

V8, 90 and 110	
Connections at straight connector	16
Pipe connections at filter	16
Hose clips	2

2.5 Petrol 90 and 110

Connections at filter	16
Connections at vapour separator	16
Connections at Tee-piece	16
Hose clips	2

FUEL LINES - (continued)

2.5 Diesel 90 and 110	Nm
Connections at lift pump	20
Connections at sedimenter	20
Connections at side tank	20
Connections at rear tank	20
Changeover tap connections	12
Spill pipe connections to rear tank	16
Hose clips	2

CLUTCH - V8 Petrol engine

Clutch cover bolts	27
Slave cylinder bolts	27

CLUTCH - 4-cylinder Petrol and Diesel engine

Clutch cover bolts	34
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MAIN GEARBOX (FIVE-SPEED) LT 77 mm and LT77S - 4-cylinder Petrol and Diesel engine

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

MAIN GEARBOX (FIVE-SPEED) LT85 - also LT85 divided Case Version V8 engine

Stop - 4th speed adjustment	9
Clip to clutch release lever	9
Spring housing to top cover	9
Plate - lower (retained with Loctite 270)	25
Slave cylinder to clutch housing	25
5th fork bracket	25
Front cover to bearing plate	25
Plate - Lower (upper fixings)	25
Selector fork to shaft and reverse beam to shaft	25

	Nm
MAIN GEARBOX (FIVE-SPEED) LT85 - (continued)	
Top cover to gearbox	25
1st/2nd selector fork to shaft	35
Extension case to gearbox	51
Extension case to gearbox	51
Extension case to gearbox	51
Extension case to gearbox	51
Clutch housing/bearing plate/gearbox	72
Layshaft	27
Reverse lever pivot	72
Gross hole/gearbox casing	17
Filler/top cover	30
Oil level/gear case	30
Filter plug	72
Drain plug	30
Reverse light switch hole-blanking plug	17
Switch reverse light (optional)	17
Divided case retaining bolts	25
TRANSFER BOX LT230R -	
4-cylinder Petrol and Diesel engine	
Pinch bolt, operating arm	9
Gate plate to grommet plate	9
End cover	45
Speedometer cable retainer	9
Speedometer housing/rear output	See note
Locating plate to gear change housing	6
Bottom cover to transfer case	25
Front output housing to transfer case	25
Cross shaft housing to front output housing	25
Gear change housing	25
Pivot shaft	25
Connecting rod	25
Retaining plate intermediate shaft	25
Front output housing cover	25
Gear change housing	25
Bracket to extension housing	25
Finger housing to front output housing	25
Mainshaft bearing housing	25
Brake drum	25
Gearbox to transfer box	45
Bearing housing to transfer gearbox	9
Speedometer housing to transfer gearbox	45
Selector fork to cross shaft	25
Yoke to selector shaft high/low	25
Selector fork high/low to shaft	25
Operating arm high/low	25
Transmission brake	72
Gearbox to transfer case	45
Gearbox to transfer case	See note
Oil drain plug	30
Differential case	60
Output flange	162
Differential case rear and shaft main drive	
2/4-wheel drive	72
Link arm and cross shaft lever to ball	10
Oil filler/level plug	30
Transfer breather	9

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.

	Nm
TRANSFER GEARBOX LT230T -	
4 cylinder Petrol and Diesel engine and V8	
Fixings securing mounting brackets to gearbox	90
Pinch bolt operating arm	9
Gate plate to grommet plate	9
Bearing housing to transfer case	9
Speedometer cable retainer	9
Speedometer housing	See note
Locating plate to gear change	6
Bottom cover to transfer	25
Front output housing to transfer	25
Front output housing to transfer	25
Cross shaft housing to front output housing	25
Gear change	25
Gear change	25
Cross shaft to high/low lever	25
Pivot shaft to link arm	25
Connecting rod	25
Anti-rotation plate intermediate shaft	25
Front output housing cover	25
Pivot bracket to extension housing	25
Finger housing to front output housing	25
Mainshaft bearing housing to transfer case	25
Brake drum to coupling flange	25
Gearbox to transfer case	45
Gearbox to transfer case	45
End cover bearing housing to transfer case	45
Speedometer housing to transfer	45
Selector finger to cross shaft (high/low)	25
Selector fork high/low to shaft	25
Transmission brake to speedometer housing	72
Gearbox to transfer case	45
Transfer case assembly	See note
Oil drain plug	30
Detent plug	Plug to be coated with Hylomar and peened. Screw plug fully in (spring solid) then turn two complete turns back.
Differential casings	60
Front and rear out flange	162
Differential case rear	72
Oil filler and level plug transfer	30
Transfer breather	9
Inner shaft stake nut	135
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	40
Gearbox casing to bell housing 2 off	162
Gearbox casing to bell housing 2 off	95
Gearbox casing to bell housing nuts	95
Gearbox casing to bell housing stud and nuts	162
Output flange - rear - nut and bolts	47
Output shaft - rear - nut	162
Output shaft - front - nut	162
Gear selector spherical seat bolts	15
Propeller shaft to flange bolts	46

GEARBOX AND TRANSFER BOX LT95 - V8 Petrol engine (continued)

All other nuts and bolts:	Nm
M6	11
M8	26
M10	53

FRONT AXLE

Hub driving member to hub	65
Stub axle to swivel pin housing	65
Upper swivel pin to swivel pin housing	65
Lower swivel pin to swivel pin housing	25
Oil seal retainer to swivel pin housing	9
Swivel bearing housing to axle case	72
Pinion housing to axle case	41
Crown wheel to differential case	58
Differential bearing cap to pinion housing	90
U/J flange to prop shaft	7
Mudshield to swivel pin housing	9
Bevel pinion nut	129

REAR AXLE AND FINAL DRIVE

Crown wheel to differential case	160
Rear cover to axle case	24
Ball joint mounting bracket to axle case	133
U/J flange to prop shaft	47
Drum to hub	18
Rear brake assembly and stub axle rear to axle	65
Hub driving member to hub	65

PROPELLER SHAFTS

Coupling flange bolts	46
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REAR SUSPENSION

Bottom link to chassis nut	176
Bottom link to mounting rubber	64
Top link bracket to chassis	47
Bump stop rubber bracket nuts	32
Shock absorber bracket to chassis	64
Shock absorber upper attachment to bracket	82
Anti roll bar bush to chassis nuts	24
Upper link ball joint to axle castle nut	176
Anti roll bar ball joint castle nut	40
Shock absorber lower attachment nuts	75

STEERING AND FRONT SUSPENSION

Tie bar to mounting arm nut	81
Mounting arm to chassis nuts	176
Tie bar to steering box nuts	81
Panard rod to mounting arm nut	88
Panard rod to anchor bracket nut	88
Panard rod mounting bracket to chassis bolts	123
Drop arm to drag link castle nut	81
Steering damper to drag link nut	50
Drop arm to steering box nut	176
Radius arm to axle nuts	176
Steering box to chassis nuts	81
Radius arms to chassis nuts	176

STEERING AND FRONT SUSPENSION - (continued)

Track rod clamp bolt nuts	Nm
Drag link clamp bolt nuts	14
Steering wheel retaining nut - Pre 1992 models	14
Steering wheel retaining nut - 1992 on	25
Road wheel nuts	30
Ball joint nuts	108
Collapsible coupling nuts	41
	25

POWER ASSISTED STEERING

Mounting bracket to front cover	25
Mounting bracket to cylinder block	25
Mounting plate to mounting bracket	25
Pulley to P A S pump	9
P.A.S pump to mounting bracket	25
P.A.S box 16 mm thread	20
P.A.S box 14 mm thread	15
P.A.S pump union 4 cylinder engine	20
P.A.S pump union V8 engine	20
P.A.S pump Jubilee clips	3

BRAKES

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

ELECTRICAL EQUIPMENT V8 engine

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

Lucas 35 DM8 Electronic ignition distributor V8 engine

Pick up bearing plate support pillars	1,2
Pick up barrel nuts	1,2

ELECTRICAL EQUIPMENT 4-cylinder Petrol and Diesel engine

Alternator:	
Shaft nut	60
Through bolts	5
Rectifier bolts	3,5
Heater plugs Diesel	23
Starter motor to engine	45
Petrol models:	
Starter through bolts	10,8

ELECTRICAL EQUIPMENT - 4 cylinder Petrol and Diesel Engine - (continued)	Nm
Solenoid to starter nuts.....	6
Solenoid outer terminal nuts.....	4
Starter yoke terminal outer nut.....	2
Starter through bolts.....	10,8
Starter earth stud nut.....	8
Eccentric pivot pin locknut.....	21
Spark plugs - petrol engine.....	17
24 VOLT ALTERNATORS 35/60/90/100 AMP	
Alternator mounting bracket to front cover.....	45
Alternator to mounting bracket.....	45
Pivot to alternator.....	45
Adjusting arm to mounting bracket.....	45
Pulley to T V damper.....	25
Belt tensioner to mounting bracket.....	25
Tensioner mounting bracket to cylinder block.....	25
Adjusting link to belt tensioner.....	25
AIR CONDITIONING	
Adaptor plate to front cover.....	45
Compressor mounting bracket to adaptor plate.....	45
Mounting plates to compressor.....	25
Compressor to mounting bracket.....	45
Adjusting link to mounting bracket & compressor.....	45
Belt damper to front cover plate.....	36
Pulley to T V damper.....	25

PRECAUTIONS AGAINST DAMAGE

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

SAFETY PRECAUTIONS - (See also SECTION 01 - Poisonous Substances)

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

WARNING: Fume extraction equipment must be in operation when trichloride, 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

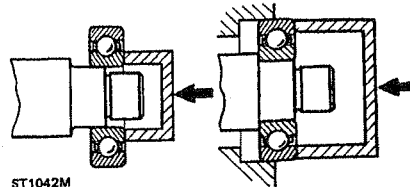
1. Never inspect a component for wear or dimensional check unless it is absolutely clean; a slight smear of grease can conceal an incipient failure.
2. When a component is to be checked dimensionally against figures quoted for it, use correct equipment (surface plates, micrometers, dial gauges, etc.) 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 steps are provided with it.

BALL AND ROLLER BEARINGS

NEVER REFIT 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.

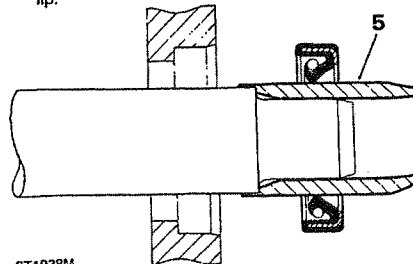


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10. In the case of grease-lubricated bearings (e.g. hub bearings) fill space between bearing and outer seal with recommended grade of grease before fitting seal.
11. Always mark components of separable bearings (e.g. taper roller bearings) in dismantling,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

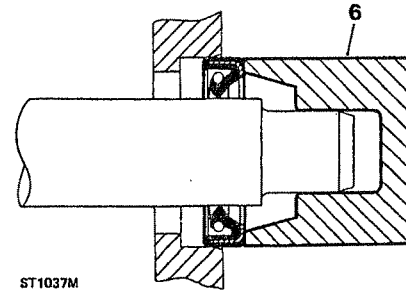
OIL SEALS

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



ST1038M

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



ST1037M

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

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

JOINTS AND JOINT FACES

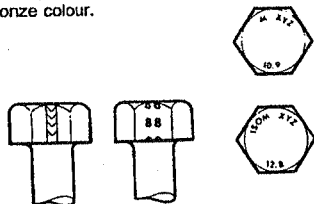
1. Always use correct gaskets where they are specified.
2. Use jointing compound only when recommended. Otherwise fit joints dry.
3. When jointing compound is used, apply in a thin uniform film to metal surfaces; take great care to prevent it from entering oilways, pipes or blind tapped holes.
4. Remove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

FLEXIBLE HYDRAULIC PIPES, HOSES

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

METRIC BOLT IDENTIFICATION

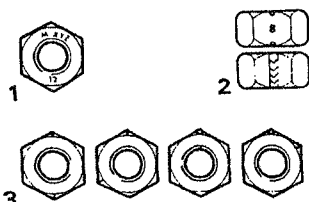
1. An ISO metric bolt or screw, made of steel and larger than 6 mm in diameter can be identified by either of the symbols ISO M or M embossed or indented on top of the head.
2. In addition to marks to identify the manufacture, the head is also marked with symbols to indicate the strength grade e.g. 8.8, 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

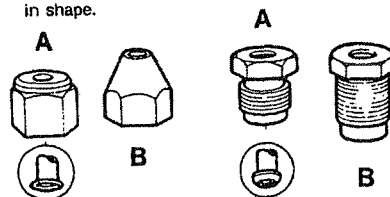
HYDRAULIC FITTINGS - Metrication

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.

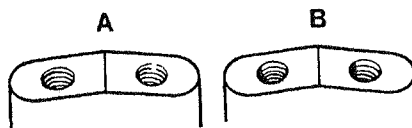
Metric threads and metric sizes are being introduced into motor vehicle manufacture and some duplication of parts must be expected. Although standardisation must in the long run be good, it would be wrong not to give warning of the dangers that exist while UNF and metric threaded hydraulic parts continue 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.



ST1033M



ST1034M

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

4. All metric ports in cylinders and calipers have no counterbores, but unfortunately a few cylinders with UNF threads also have no counterbore. The situation is, all ports with counterbores are UNF, but ports not counterbored are most likely to be metric.
5. The 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:

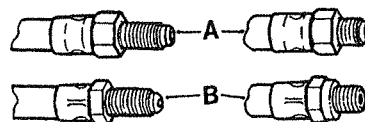
	UNF
RED	3/8 in x 24 UNF
GREEN	7/16 in x 20 UNF
YELLOW	1/2 in x 20 UNF
PINK	7/8 in x 18 UNF
	METRIC
BLACK	10 x 1 mm
GREY	12 x 1 mm
BROWN	14 x 1,5 mm

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

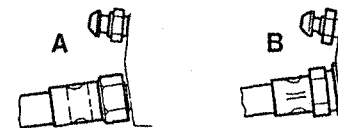
Pipe sizes for UNF are 3/16 in, 1/4 in and 5/16 in outside diameter.

Metric pipe sizes are 4,75 mm, 6 mm and 8 mm. 4,75 mm pipe is exactly the same as 3/16 in pipe. 6 mm pipe is 0,014 in smaller than 1/4 in pipe. 8 mm pipe is 0,002 in larger than 5/16 in pipe.

Convex pipe flares are shaped differently for metric sizes and when making pipes for metric equipment, metric pipe flaring tools must be used.



ST1031M



ST1032M

The greatest danger lies with the confusion of 10 mm and 3/8 in UNF pipe nuts used for 3/16 in (or 4,75 mm) pipe. The 3/8 in UNF pipe nut or hose can be screwed into a 10 mm port but is very slack and easily stripped. The thread engagement is very weak and cannot provide an adequate seal.

The opposite condition, a 10 mm nut in a 3/8 in port, is difficult and unlikely to cause trouble. The 10 mm nut will screw in 1 1/2 or 2 turns and seize. It has a crossed thread 'feel' and it is impossible to force the nut far enough to seal the pipe. With female pipe nuts the position is of course reversed.

The other combinations are so different that there is no danger of confusion.

KEYS AND KEYWAYS

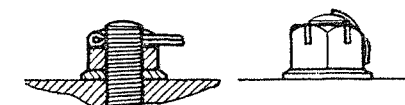
1. Remove burrs from edges of keyways with a fine file and clean thoroughly before attempting to refit key.
2. Clean and inspect key closely; keys are suitable for refitting only if indistinguishable from new, as any indentation may indicate the onset of wear.

TAB WASHERS

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

SPLIT PINS

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



ST1030M

NUTS

- 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.
- 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

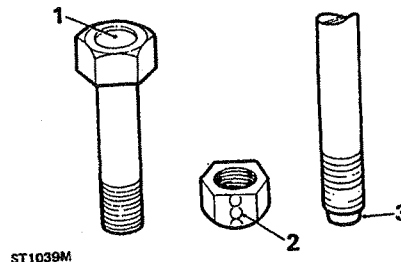
- Fit new locking wire of the correct type for all assemblies incorporating it.
- Arrange wire so that its tension tends to tighten the bolt heads, or nuts, to which it is fitted.

SCREW THREADS

- Both UNF and Metric threads to ISO standards are used. See below for thread identification.
- 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.
- Always ensure that replacement bolts are at least equal in strength to those replaced.
- 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.
- Always tighten a nut or bolt to the recommended torque figure. Damaged or corroded threads can affect the torque reading.
- 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.
- Always oil thread lightly before tightening to ensure a free running thread, except in the case of self-locking nuts.

UNIFIED THREAD IDENTIFICATION

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



RECOMMENDED LUBRICANTS AND FLUIDS
Service instructions for temperate climates - ambient temperature range

COMPONENTS	LAND ROVER	BP	CASTROL	DUCKHAMS	ESSO	MOBIL	PETROFINA	SHELL	TEXACO
4 Cylinder and V8 Petrol Engines, Sump, Carburetter Dashpots and Oil Bath Air Cleaner	Engine Oil (15W/40)	Visco 2000 Plus or Visco 2000	Synton X or GTX-2 or TXT	QRX or Hypergrade	Superlube Plus or Superlube EX-2	1 Rally Formula or Super	Fina First or Supergrade	Gemini or Super	Haveoline X1 or Haveoline Multigrade
4 Cylinder Diesel Engines, Naturally Aspirated and Tdi and Oil Bath Air Cleaner	Engine Oil (15W/40)	Visco 2000 Plus or Visco 2000 Diesel	Synton X or GTX-2 or TXT or RX Super	QRX or Hypergrade	Superlube Diesel or Superlube EX-2	1 Rally Formula or Delvac Super	Fina First or Supergrade	Gemini or Diesel	Haveoline X1 or Haveoline Multigrade
LT77 and LT77S 5 Speed Gearboxes Power steering fluid reservoirs	ATF Type LG	Aurion G	TQF	Q-matic	ATF Type g	ATF 210	Purifinals 33G	Donax TF	Texamatic 4231 A or 5330
LT85 and LT85 4 and 5 Speed Gearboxes	Engine Oil (15W/40)	Visco 2000 Plus or Visco 2000	Synton X or GTX-2 or TXT	QRX or Hypergrade	Superlube Diesel or Superlube EX-2	1 Rally Formula or Delvac Super	Fina First or Supergrade	Gemini or Super	Haveoline X1 or Haveoline Multigrade
LT230R and LT230T Transfer Boxes, Front and Rear Differentials, Swivel Pin Housings, Manual Steering Boxes	EP90 Gear Oil	Gear Oil SAE 90EP	Hypov, SAE 90EP	Hypolid 90	Gear Oil GX 85W/90	Mobilube HD90	Pontonic MP SAE80W/90	Spirax 90 EP	Multigear Lubricant EP85W/90
Lubrication nipples, Prop. Shafts, Hubs, Ball Joints etc.		Energygrease L2	LM Grease	LB10 Grease	Multi purpose Grease H	MP Grease	Mason HTL2	Relinax A	Merfak all Purpose Grease
Top Link Ball Joint Assembly									
Brake and Clutch Reservoirs									
Cooling System Anti-freeze									
Lithium grease containing 3% MOS ₂ e.g. Shell Relinax AM									
Brake fluid having a minimum boiling point of 260°C (500°F) and complying with FMVSS 116 DOT 4									
Universal Anti-freeze (See Anti-freeze, Section 09)									

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	Martak All purpose Grease	NGLI-2 Multi purpose Lithium based Grease
Windscreen washers	All Seasons Screen Washer Fluid								
Bonnet pin/le Door locks (anti-burst) Inertia reels	Graphite Lock Grease Type 'B' DO NOT LUBRICATE. These components are 'lited' 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	METHYLCHLORIDE REGRIGERANTS MUST NOT BE USED								
Regrigerant Compressor Oil	Use only refrigerant 12. This includes 'Freon 12' and 'Arcton 12' Shell Clavus 68 BP Energol LPT68 Sunisco 4GS Texaco Capella E Wax Free 68 Castrol Icematic 99								

RECOMMENDED LUBRICANTS AND FLUIDS

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

SERVICE CLASSIFICATION WORLDWIDE

COMPONENT	SPECIFICATION	VISCOSITY	AMBIENT TEMPERATURE °C							
			-30	-20	-10	0	10	20	30	40
V8 Petrol engines - Sump and carb. dashpots	Oils must meet: RES.22.OL.G-4	5W/30 5W/40 5W/50	[Bar chart showing viscosity performance]							
4 Cylinder petrol engines - Sump, carburetter dashpots and air cleaner.	or CCMC G-4 or API SG	10W/30 10W/40 10W/50 15W/40 15W/50	[Bar chart showing viscosity performance]							
LT95 Four speed gearbox including transfer box.		20W/40 20W/50 25W/40	[Bar chart showing viscosity performance]							
LT85 Five speed gearbox		25W/50	[Bar chart showing viscosity performance]							
4 Cylinder diesel engines naturally aspirated and Tdi. - Sump and air cleaner	Oils must meet RES.22.OL.PD-2 or CCMC PD-2 or RES.22.OLD-5 or CCMC D-5 or API CD	5W/30 5W/40 5W/50 10W/30 10W/40 10W/50 15W/40 15W/50 20W/40 20W/50 25W/40 25W/50	[Bar chart showing viscosity performance]							
LT230R and LT230T Transfer boxes. Front and rear differentials. Swivel pin housings. Manual steering boxes.	Oils must meet API GL4 or MIL-L-2105	90EP 80W EP	[Bar chart showing viscosity performance]							
LT77 and LT77S Gearboxes Power assisted steering reservoirs	ATF Type G		[Bar chart showing viscosity performance]							
Brake and clutch reservoirs	Fluid to FMVSS 116 DOT 4 Minimum boiling point 260°C		[Bar chart showing viscosity performance]							
Lubrication nipples, hubs, ball joints etc.	NLG1-2 Multi-purpose lithium based grease		[Bar chart showing viscosity performance]							

2.5 LITRE TURBO CHARGED FOUR CYLINDER DIESEL ENGINE
RECOMMENDED LUBRICANTS

The following list of recommended engine oils for temperate climates with a temperature range above -10° C should be used for oil changes and topping-up. They are Super High Performance Diesel oils (SHPD) that allow a maximum of 10,000 km (6,000 miles) between oil and filter changes. Use only oils to CCMC D3 service levels.

LAND ROVER	Super High performance Diesel 15W/40
BP	Vanellus C3 Extra 15/40
CASTROL	Turbomax 15/40
CENTURY	Centurion 15W/40
DUCKHAMS	Fleetmaster SHPD
ELF	Multiperformance 4D
ESSO	Super Diesel Oil TD
FINA	Kappa LDO
GULF	Superfleet Special
KUWAIT	Q8 T700
MOBIL	Delvac 1400 Super 15/40
SHELL	Myrina 15/30 or Myrina 15/40
TEXACO	Ursa Super TD
TOTAL	Rubia TIR

In addition to the above oils, listed below, are other suitable SHPD oils available outside the United Kingdom.

AGIP	Sigma Turbo
ARAL	OL P327
AUTAL VALVE	SHP
AVIATICON	Turbo
CALTEX	RPM Delo 450
CHEVRON	Delo 450
DIVINOL	Multimax Extra
DUCKHAMS	Fleetmaster Extra
ECUBSOL OIL	CD Plus
FANAL	Indol X
FUCHS	Titan Truck 1540
IP	Taurus M
VALVOLINE	Super HD LD

The following list of oils are for emergency use only if the foregoing list of 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. Use only oils to RES.22.OLPD-2, CCMC PD-2, MIL-L-2104C/D or API service levels CD or SE/CD-15W/40.

BP	Vanellus C3 15W/40 or Visco Diesel 15W/40
CASTROL	RX Super 15W/40, TXT 10W/40 or GTX 2, Dynamex GFE 10W/30 or Syntron X 15W/50
CENTURY	Sterling
DUCKHAMS	Hypergrade or QXR 10W/40,
ESSO	Essolube XD-3 15W/40 Superlube EX 2, Superlube + or Ultra Oil
GULF	Superdiesel 15W/40
MOBIL	Delvac Super or SHC or Mobil 1 Rally Formula
PETROFINA	Fina Dilano HPD 15W/40
SHELL	Rimula X 15W/40 or Super Diesel
TEXACO	URSA Super Plus 15W/40, Diesetex 15W/40 or Havoline X1

CAUTION: The above listed oils are for emergency use only, they must not be used continuously even if the oil is changed every 5,000 km (3,000 miles). The emergency oils may be used occasionally, but not for consecutive oil changes and must be replaced with one of the approved SHPD Oils as soon as possible but not beyond 5,000 km (3,000 miles).

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. See section 26 for further engine protection information.

Engine	Mixture	Percentage	Concentration Protection
4-Cyl Engines	(One part Anti-freeze two parts water	33%	Down to -20°C
	(One part Anti-freeze one part water	50%	Down to -20°C to -36°C
V8 Engine (Aluminium)	One part Anti-freeze one part water	50%	Down to -36°C

CAPACITIES

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

Component	Litres	Imperial units
Engine sump oil, 4-cylinder	6,00	10.56 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 LT77 and LT77S	2,20	3.90 pints
Transfer box oil, LT230R	2,80	4.90 pints
LT85 five-speed gearbox	3,00	5.2 pints
LT230T transfer gearbox - up to suffix E	2,80	4.90 pints
LT230T transfer gearbox - from suffix D	2,30	4.00 pints
Main gearbox oil, four-speed LT95	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 BHA	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).....	10,80	19.00 pints
Cooling system, 4-cylinder petrol models and naturally aspirated Diesel models	10,80	19.00 pints
Cooling system - 4 cylinder Turbo Diesel	11,10	20 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

Notes

MAINTENANCE SCHEDULES

Land Rover 1983 Model year onwards

Efficient maintenance is one of the main factors in ensuring continued reliability and efficiency of Land Rover vehicles. The following schedules supercede all previous issues and are a copy of those available in pads obtainable from Land Rover Merchandising service, PO Box 534, Erdington, Birmingham B240QS. The schedules are based upon the 10,000 km (6,000 miles), service or every six months, whichever is the sooner.

The 10,000 km (6,000 mile) service must be repeated at this interval or every six months whichever occurs first.

The 20,000 km (12,000 mile) service must be repeated at this interval or every twelve months whichever is first together with any additional maintenance at the intervals specified in the schedule.

WARNING: Two wheel roller test must be restricted to a maximum of five km/h (three m.p.h.) because the Land Rover 90 and 110 is in constant four wheel drive.

CAUTION: All 2.5 litre four cylinder Diesel engines. At every 100,000 km (60,000 miles) it is imperative that the camshaft drive belt is renewed. Failure to do so could result in serious damage to the engine. In adverse operating conditions such as in dusty atmosphere or in high ambient temperatures the belt must be renewed every 40,000 km (24,000 miles) or every two years whichever is the sooner.

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.

RECOMMENDATIONS

At 30,000km (18,000 mile) intervals or every 18 months, whichever is the sooner, the hydraulic brake fluid should be completely renewed. See General Maintenance and adjustment.

At 40,000km (24,000 mile) intervals, if fitted, remove the V8 engine 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, renew any unsatisfactory hoses and refit. See General Maintenance and adjustment.

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. The working surfaces of the master cylinder, wheel cylinders and caliper cylinders should be examined and renewed where necessary. See section 70.

At 60,000 km (36,000 mile) intervals remove all suspension dampers, test for correct operation, refit or renew as necessary. See section 64.

At two yearly intervals or at the onset of the second winter, the cooling system should be drained, flushed and refilled with the required anti-freeze and water mixture. See section 09 and section 26 for engine protection information.

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.

Operations A
10,000 km/6,000 miles
30,000 km/18,000 miles
50,000 km/30,000 miles
70,000 km/42,000 miles

Operations B
20,000 km/12,000 miles
40,000 km/24,000 miles
60,000 km/36,000 miles
80,000 km/48,000 miles

- | A | B | |
|-------------------------|--------------------------|--|
| VEHICLE INTERIOR | | |
| 1 | <input type="checkbox"/> | Check condition and security of seats, seat belt mountings, seat belts, buckles, and operation of interior seat belts |
| 2 | <input type="checkbox"/> | Check operation of foot brake and clutch with engine running; stop engine |
| 3 | <input type="checkbox"/> | Check operation of all lamps, horns, warning indicators |
| 4 | <input type="checkbox"/> | Check operation of front/rear screen wipers and washers and condition of wiper blades |
| 5 | <input type="checkbox"/> | Check security and operation of hand brake, release fully after checking |
| 6 | <input type="checkbox"/> | Remove battery connections: clean and grease - refit |
| 7 | <input type="checkbox"/> | Renew brake servo filter |
| VEHICLE EXTERIOR | | |
| 8 | <input type="checkbox"/> | Check/adjust headlamp alignment using beam settings equipment |
| 9 | <input type="checkbox"/> | Check front wheel alignment using proprietary equipment |
| 10 | <input type="checkbox"/> | Remove road wheels |
| 11 | <input type="checkbox"/> | Check tyres for: compliance with manufacturer's specification: visually for cuts, lumps, bulges, uneven tread wear and depth: tyre pressures including spare, adjust if required - see owners manual |
| 12 | <input type="checkbox"/> | Inspect brake pads for wear, calipers for leaks and discs for condition |
| 13 | <input type="checkbox"/> | Remove road wheel brake drums, wash out dust, inspect shoes for wear and drums for condition |
| 14 | <input type="checkbox"/> | Inspect wheel cylinders for fluid leaks |
| 15 | <input type="checkbox"/> | Refit road wheel brake drums |
| 16 | <input type="checkbox"/> | Adjust road wheel brakes |
| 17 | <input type="checkbox"/> | Refit road wheels to original position |
| 18 | <input type="checkbox"/> | Check operation of all door, bonnet and tailgate locks |
| 19 | <input type="checkbox"/> | Lubricate all hinges and doors check mechanisms |
| UNDER BONNET | | |
| 20 | <input type="checkbox"/> | Check cooling and heater system for leaks, hoses for security and condition |
| 21 | <input type="checkbox"/> | Check brake servo hose for security and condition |
| 22 | <input type="checkbox"/> | Check condition of heater plug wiring for fraying, chafing and deterioration (diesel only) |
| 23 | <input type="checkbox"/> | Check ignition wiring and HT leads for fraying chafing and deterioration |
| 24 | <input type="checkbox"/> | Clean distributor cap, check for cracks and tracking |

- | A | B | |
|----|--------------------------|--|
| 25 | <input type="checkbox"/> | Lubricate distributor rotor spindle with rotor arm removed |
| 26 | <input type="checkbox"/> | Clean/adjust distributor points (if applicable) |
| 27 | <input type="checkbox"/> | Renew distributor points (if applicable) |
| 28 | <input type="checkbox"/> | Clean/adjust spark plugs |
| 29 | <input type="checkbox"/> | Renew spark plugs |
| 30 | <input type="checkbox"/> | Check/adjust valve clearances at the first 6,000 miles, thereafter at every 12,000 miles service (2.5 diesel Turbo and Tdi only) |
| 31 | <input type="checkbox"/> | Check/adjust valve clearances (all models except V8) |
| 32 | <input type="checkbox"/> | Diesel injectors: check for correct spray pattern, not Tdi, ensure no leakage is evident see Part 2 section 19 |
| 33 | <input type="checkbox"/> | Renew fuel filter element (diesel) |
| 34 | <input type="checkbox"/> | Check crankcase breathing system for leaks, hoses for security and condition |
| 35 | <input type="checkbox"/> | Check air injection/pulsair system hoses/pipes for security and condition |
| 36 | <input type="checkbox"/> | Check operation of pulsair check valves |
| 37 | <input type="checkbox"/> | Renew air cleaner element(s) |
| 38 | <input type="checkbox"/> | Check air cleaner dump valve, clean or renew |
| 39 | <input type="checkbox"/> | Renew engine breather filter (V8) |
| 40 | <input type="checkbox"/> | Clean engine breather filter (all models except V8) |
| 41 | <input type="checkbox"/> | Renew engine flame trap(s) (V8) |
| 42 | <input type="checkbox"/> | Check condition of driving belts - adjust if required (not camshaft drive belt - diesel) |
| 43 | <input type="checkbox"/> | Check throttle operation |
| 44 | <input type="checkbox"/> | Top-up carburettor piston dampers |
| 45 | <input type="checkbox"/> | Check/top up cooling system |
| 46 | <input type="checkbox"/> | Check/top up fluid in power steering reservoir |
| 47 | <input type="checkbox"/> | Check/top up steering box (manual steering) |
| 48 | <input type="checkbox"/> | Check/top up clutch fluid reservoir |
| 49 | <input type="checkbox"/> | Check/top up brake fluid reservoir |
| 50 | <input type="checkbox"/> | Check/top up windscreen and rear washer reservoir |
| 51 | <input type="checkbox"/> | Lubricate accelerator control linkages and pedal pivot |
| 52 | <input type="checkbox"/> | Check dwell angle - adjust as necessary (not V8) |
| 53 | <input type="checkbox"/> | Check voltage drop between coil CB and earth |
| 54 | <input type="checkbox"/> | Check/adjust ignition timing |

Operations A
10,000 km/6,000 miles
30,000 km/18,000 miles
50,000 km/30,000 miles
70,000 km/42,000 miles

Operations B
20,000 km/12,000 miles
40,000 km/24,000 miles
60,000 km/36,000 miles
80,000 km/48,000 miles

- | A | B | |
|----------------------|--------------------------|---|
| 55 | <input type="checkbox"/> | Check operation of air intake temperature control system (V8) |
| 56 | <input type="checkbox"/> | Clean diesel intercooler element Tdi engines only |
| 57 | <input type="checkbox"/> | Check/adjust engine idle speed and carburettor mixture settings with engine at normal running temperature. See section 19 |
| 58 | <input type="checkbox"/> | Check/adjust steering box |
| 59 | <input type="checkbox"/> | Check turbo charger boost pressure |
| UNDER VEHICLE | | |
| 60 | <input type="checkbox"/> | Renew engine oil and filter |
| 61 | <input type="checkbox"/> | Renew gearbox oil |
| 62 | <input type="checkbox"/> | Check/top up gearbox oil |
| 63 | <input type="checkbox"/> | Renew transfer box oil |
| 64 | <input type="checkbox"/> | Check/top up transfer box oil |
| 65 | <input type="checkbox"/> | Renew front axle oil |
| 66 | <input type="checkbox"/> | Check/top up front axle oil |
| 67 | <input type="checkbox"/> | Renew swivel pin housing oil |
| 68 | <input type="checkbox"/> | Check/top up swivel pin housing oil |
| 69 | <input type="checkbox"/> | Renew rear axle oil |

Note: It is important that the ignition timing dwell angle and carburettor adjustments are set in accordance with the vehicle engine specification and fuel octane rating. Refer to the relevant repair operation manual for details

- | A | B | |
|----|--------------------------|--|
| 70 | <input type="checkbox"/> | Check/top up rear axle oil |
| 71 | <input type="checkbox"/> | Lubricate rear suspension upper link ball joint (where applicable) |
| 72 | <input type="checkbox"/> | Lubricate propeller shaft sealed sliding joints |
| 73 | <input type="checkbox"/> | Lubricate propeller shaft universal joints |
| 74 | <input type="checkbox"/> | Lubricate hand brake mechanical linkage |
| 75 | <input type="checkbox"/> | Check visually brake, fuel, clutch pipes/unions for chafing, leaks and corrosion |
| 76 | <input type="checkbox"/> | Check exhaust system for leakage, security and damage |
| 77 | <input type="checkbox"/> | Check for fluid leaks from power, manual steering and suspension systems, hydraulic pipes and unions for chafing and corrosion |
| 78 | <input type="checkbox"/> | Check condition and security of steering unit, joints and gaiters |
| 79 | <input type="checkbox"/> | Check tightness of propeller shaft coupling bolts |
| 80 | <input type="checkbox"/> | Ensure front and rear axle breathers are free from obstruction |
| 81 | <input type="checkbox"/> | Check security and condition of suspension fixings |
| 82 | <input type="checkbox"/> | Check for oil leaks from engine and transmission |
| 83 | <input type="checkbox"/> | Clean fuel sedimenter (diesel only) |
| 84 | <input type="checkbox"/> | Renew fuel filter element (petrol) |
| 85 | <input type="checkbox"/> | Drain flywheel housing if drain plug is fitted for wading (refit) |
| 86 | <input type="checkbox"/> | Clean camshaft drive belt housing filter (diesel) |
| 87 | <input type="checkbox"/> | Adjust handbrake if required |
| 88 | <input type="checkbox"/> | Carry out road or roller test. Endorse service record. Report any unusual features of vehicle condition and additional work required |

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Check cooling system coolant	44
Checking battery - non maintenance free type	45
Renew brake servo filter	46
Check and adjust external drive belt tensions - all models	47

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 SECTION 09 for capacities and recommended lubricants.

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

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

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

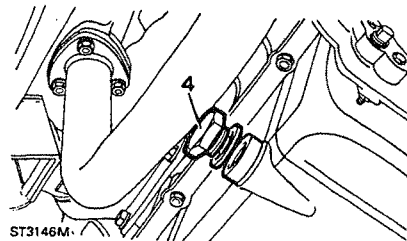
Where possible, always refill with oil of the make and specification recommended in the lubrication charts and from sealed containers.

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

RENEW ENGINE OIL AND FILTER

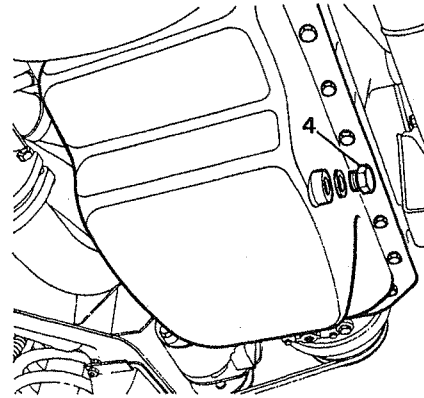
Drain the oil All engines

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. Allow oil to drain away completely and replace the plug and tighten to the correct torque.



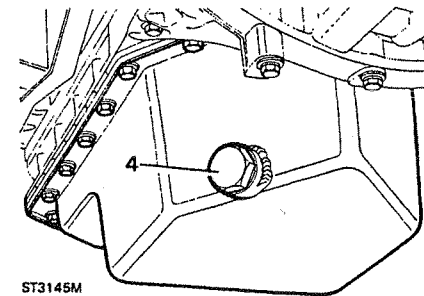
ST3146M

V8 engine sump



ST3139M

2.25, 2.5 and 2.5 turbo charged engines



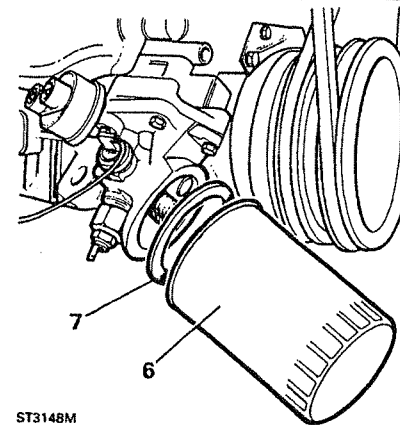
ST3145M

Tdi engine defender sump

Renew oil filter V8 and 2.5 Diesel engines

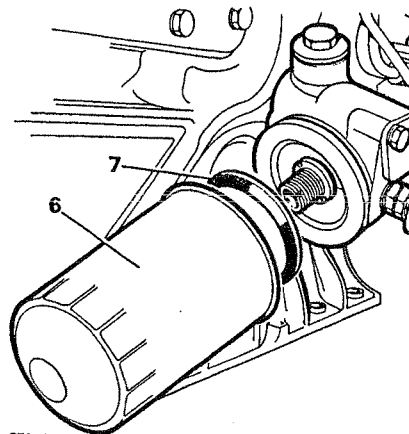
CAUTION: V8 Engines: The engine oil filter must not be removed whilst the sump is empty, otherwise the oil pump may have to be primed.

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.



ST3148M

V8 engine oil filter



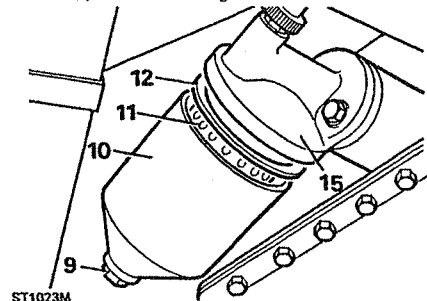
ST3147M

2.5 petrol and diesel engine filter and later 2.25 engines

Renew oil filter - 2.25 petrol and diesel engine

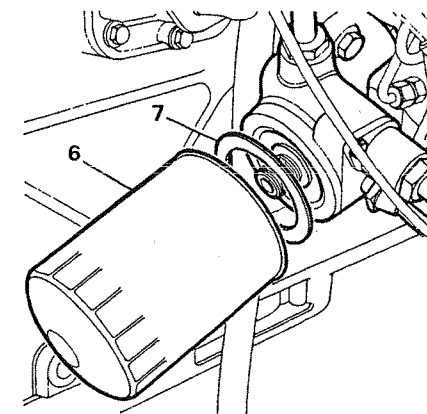
8. Place oil tray under engine.
9. Unscrew filter retaining bolt.
10. Remove the container.
11. Remove the element.
12. Discard the used filter element and large rubber washer.
13. Wash the container in kerosene.
14. Place the new filter element in the container and reassemble the unit, using the new 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

Early 2.25 petrol and diesel engine filter



ST3138M

Tdi engine defender filter

Refill sump with oil - all models

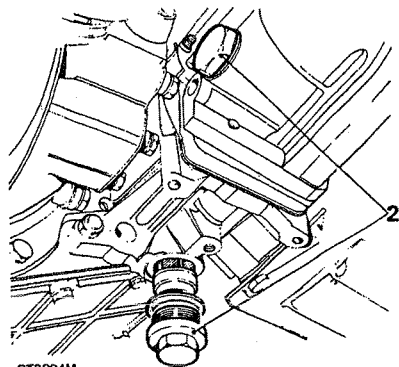
17. Check that the drain plug is tight.
18. Clean the outside of the oil filler cap, remove it from the rocker cover and clean the inside.
19. Pour in the correct quantity of new oil of the correct grade from a sealed container to the high mark on the dipstick and firmly replace the filler cap.
20. Run 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 and LT77S MAIN GEARBOX

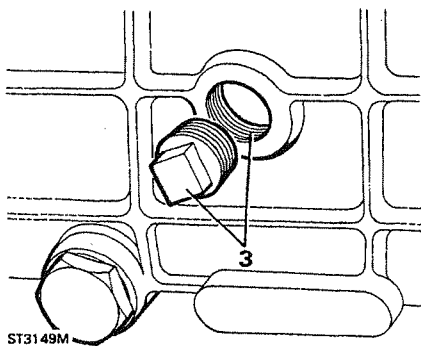
4-cylinder engines

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.



ST3084M

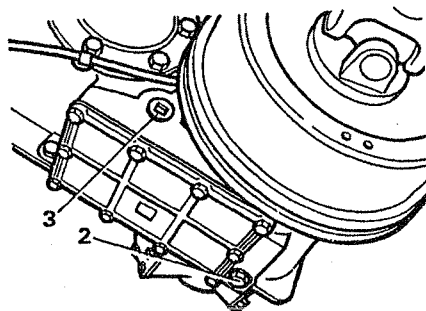
3. Remove the oil filler-level plug and inject the approximate quantity of new oil of the correct make and grade until it begins to run out of the filler-level hole. Fit the plug and tighten to the correct torque. Since the plug has a tapered thread it must not be overtightened. Wipe away any surplus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



ST3149M

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

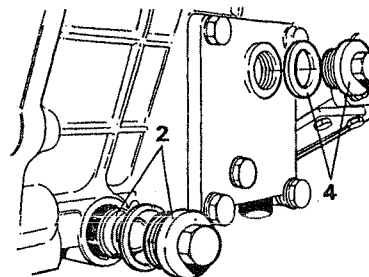
1. Drive the vehicle to level ground and place a container under the gearbox to catch the old oil.
2. Remove the drain plug and allow the oil to drain. Fit the plug using a new washer, if necessary, and tighten to the correct torque.
3. Remove the filler-level plug and inject the approximate quantity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



ST1070M

DRAIN AND RENEW LT95 MAIN GEARBOX (V8 engines)

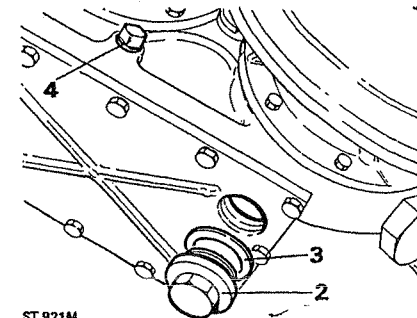
1. Drive the vehicle to level ground and place a container under the gearbox to catch the old oil.
2. Remove the drain plug, washer and filter from the bottom of the gearbox casing and allow the oil to drain completely.
3. Wash the filter in petrol, allow to dry and fit to the casing. Using a new washer, 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.



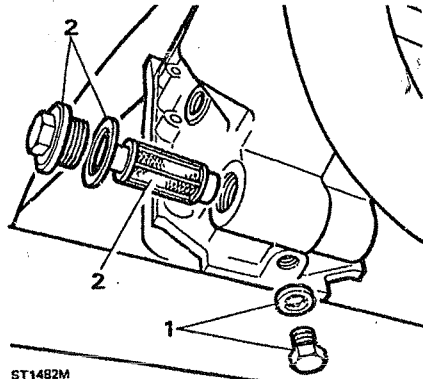
ST 921M

RENEW LT85 MAIN GEARBOX OIL - Heavy duty version with oil pump

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.

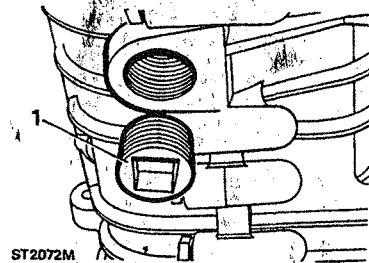


3. Wash the filter in clean fuel; allow to dry and replace.
4. Clean and refit drain plug and washer and refill gearbox through the oil level/filler plug, with the correct grade of oil, to the bottom of the oil level/filler hole. For capacity see SECTION 09.

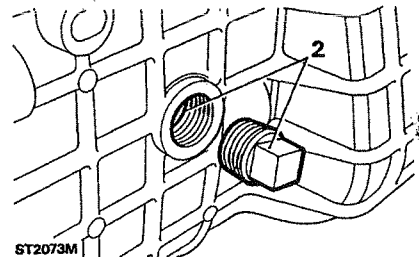
RENEW LT85 DIVIDED CASE GEARBOX OIL

Drain and refill monthly when operating under severe wading conditions.

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 12,7 mm square socket drive. When all the oil is drained, clean and refit the drain plug and tighten to the correct torque.

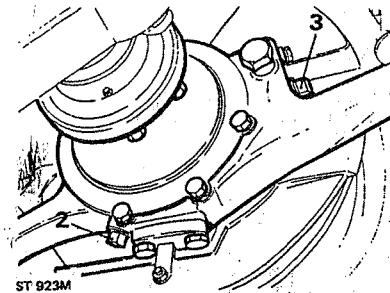


2. Remove the square headed oil level/filler plug from the left-hand side of the gearbox and inject oil of the correct grade, until the oil is level with the filler hole. Clean and fit the level/filler plug and tighten to the correct torque. Wipe away any surplus oil and reconnect the battery.



RENEW SWIVEL PIN HOUSING OIL

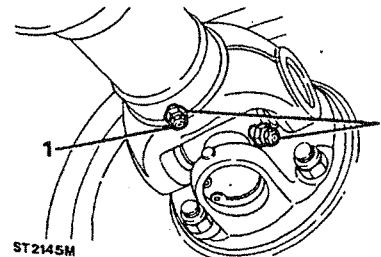
1. Drive the vehicle to level ground and place a container under each swivel housing to catch the used oil.
2. Remove the drain plug and allow the oil to drain completely and clean and refit the plugs.
3. Remove the oil filler-level plug and inject the recommended make and grade of oil until oil begins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



LUBRICATE PROPELLER SHAFTS

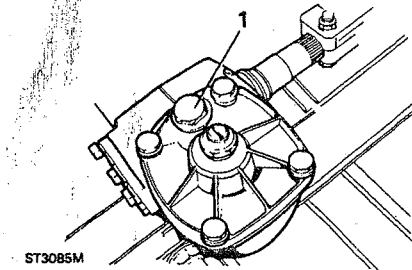
1. Clean all the grease nipples on the front and rear propshaft universal joints, and sliding portion of the rear shaft.
2. Charge a low pressure hand grease gun with grease of a recommended make and grade and apply to the grease nipple, giving two to three strokes of the gun only to each nipples every 40,000 km (24,000 miles) intervals.

NOTE: On some early models it was necessary to remove a screwed plug from the front propeller shaft and fit a grease nipple. Refit the plug after inserting grease.



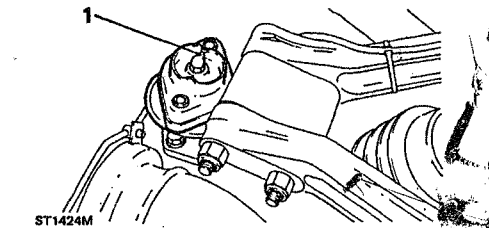
TOP-UP MANUAL STEERING BOX

1. Remove the oil filler plug and observe the oil level which should be 25mm 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.



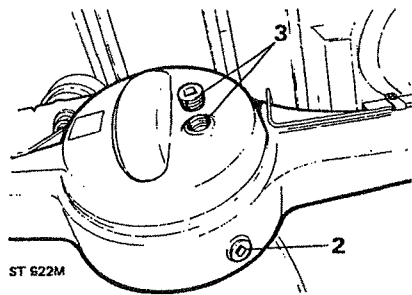
REAR SUSPENSION BALL JOINT - Early models only

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

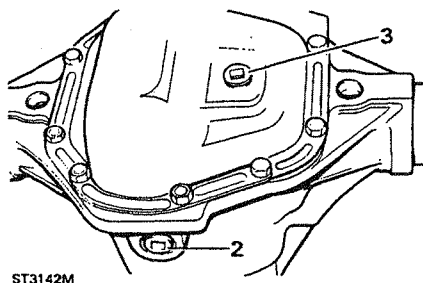


RENEW FRONT AND REAR AXLE OIL

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



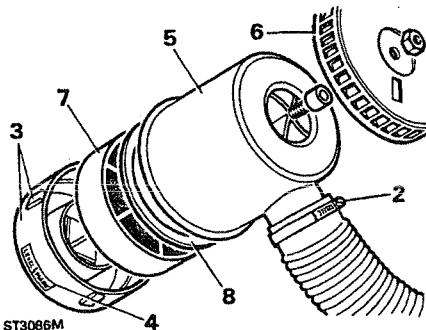
90 front and rear 110 front



110 rear axle

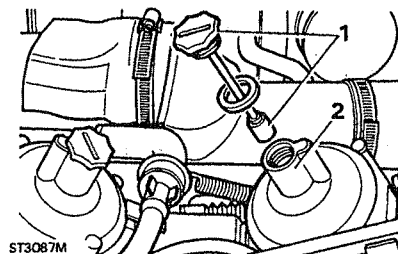
RENEW AIR CLEANER OIL - 2.25 litre engines (early models)

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.
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 seating ring.
9. Refit the complete unit into the vehicle.

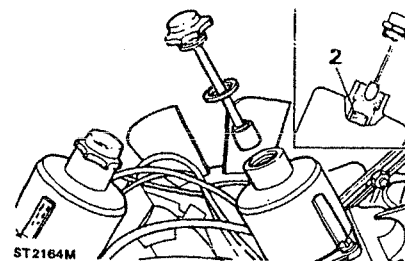


TOP-UP CARBURETTOR PISTON DAMPER - V8 only Strombergs and SU Carburetters

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



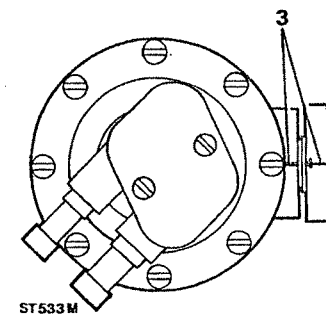
Stromberg carburetters



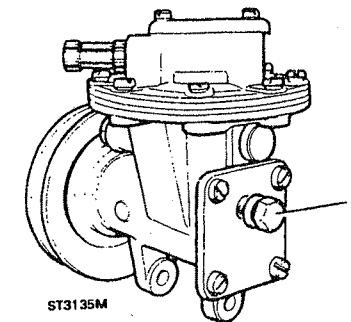
SU carburetters

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 the tension the drive belt.



GENERAL MAINTENANCE AND ADJUSTMENT

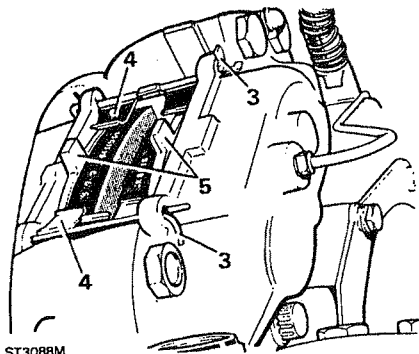
This second part of the maintenance section covers adjustments and items of general maintenance as dictated by the 'MAINTENANCE SCHEDULES'. However, only maintenance operations that are not included in the OVERHAUL SECTIONS of the manual appear in this section.

EXAMINE AND RENEW FRONT BRAKE FRICTION PADS

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

First illustration	Early 110
Second illustration	Latest 110
Third illustration	Latest 90

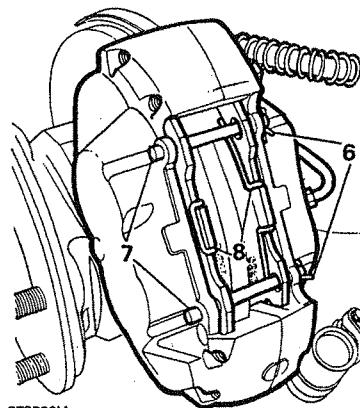
- Slacken both front wheel nuts and jack-up the vehicle and lower onto axle stands, and remove the wheels.
- Clean the exterior of the calipers.
- Straighten the splayed ends of the pad retaining pins and withdraw the pins.
- Remove the anti-rattle springs.
- Withdraw the friction pads.



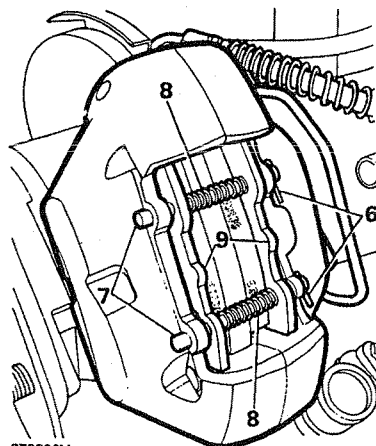
ST3088M

Latest 110 and 90 models

- Remove the split pins from the pad retaining pins.
- Withdraw the pad retaining pins.
- Remove the anti-rattle springs.
- Withdraw the friction pads.



ST3089M

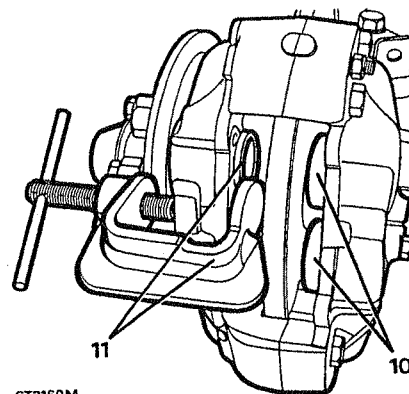


ST3090M

All models

- Clean the exposed surfaces of the pistons with new hydraulic fluid or brake cleaning fluid.

- Using piston clamp (18G 672), press each piston back into its bore, whilst ensuring that the displaced fluid does not overflow from the reservoir.



ST2160M

- Smear the faces of the pistons with Lockheed disc brake lubricant, taking care not to allow any to reach the pad lining material.
- Insert the new friction pads.

Early 110 models

- Place the anti-rattle springs in position and fit new pads retaining pins and splay the ends.

Latest 110 and 90 models

- Place the anti-rattle springs in position, as illustrated, according to the model.
- Insert the pad retaining pins and secure with new split pins.

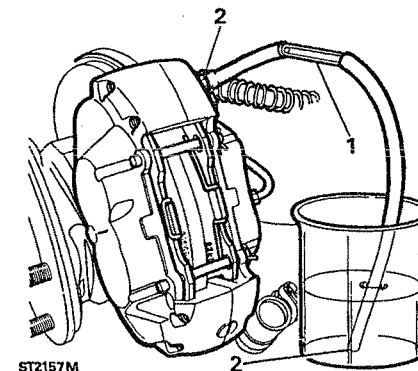
All models

- Apply the foot brake pedal several times to locate the pads.
- Check the fluid reservoir and top up if necessary.
- Fit the road wheels and secure with the nuts. Jack up the vehicle to remove the axle stands and lower the vehicle to the ground. Finally, tighten the road wheel securing nuts evenly, to the correct torque.

CHANGING THE HYDRAULIC BRAKE FLUID

In the service schedule it is recommended that the brake fluid is renewed at 18,000 miles (30,000 km) intervals or every eighteen months. If the following procedure is adopted air should not enter the system.

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

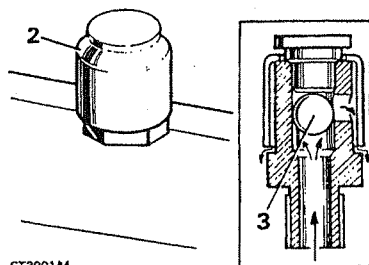


ST2157M

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

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.



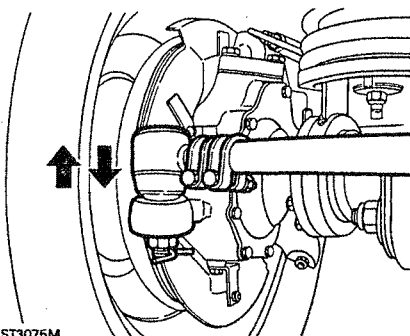
ST3091M

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 breathe whilst the vehicle is traversing mud and water. No maintenance is required except to ensure that the pipes do not become blocked, kinked, or split, or damaged in any other way to prevent proper breathing.

CHECK STEERING BALL JOINTS

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



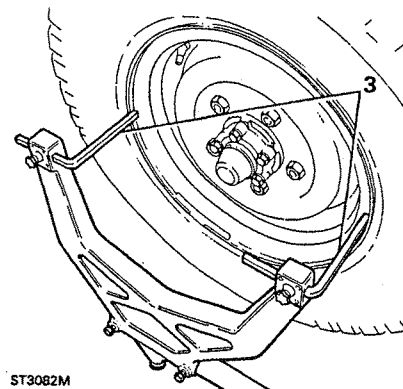
ST3075M

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

CHECK FRONT WHEEL ALIGNMENT

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

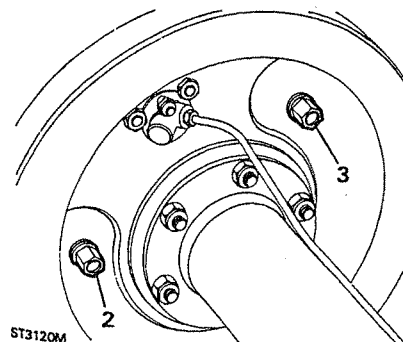
- a. The vehicle is on level ground.
 - b. The vehicle is not loaded.
 - c. The tyre pressures are correct.
 - d. The wheels run true and are not damaged or buckled.
 - e. The track rod is not damaged or bent and the ball joints are not worn. Also check that the joints are assembled in the same angular plain and are central in their housings. See SECTION 57.
1. Set the road wheels to the straight ahead position and move the vehicle forward a short distance at least two revolutions of the wheels.
 2. Set up the tracking equipment to the manufacturers instructions.
 3. Position the trammel probes on the inner face of the wheel, not the rims, if the latter are damaged.
 4. Check the alignment as instructed by the equipment manufacturers and repeat the check on the opposite wheel. If adjustment is required follow the instructions in steering SECTION 57.



ST3082M

ADJUST REAR BRAKES**Land Rover One Ten Vehicles**

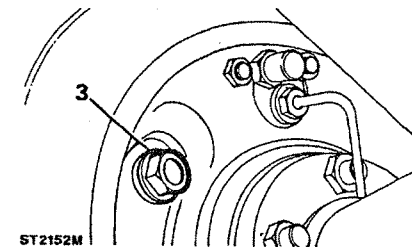
1. Raise up vehicle and lower onto axle stands.
2. Each shoe is independently set by means of a hexagon adjuster. Check that the wheel turns freely and turn one adjuster until the shoe is locked against the drum. Slacken off the adjuster sufficiently for the wheel to turn freely - approximately two serrations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



ST3120M

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.

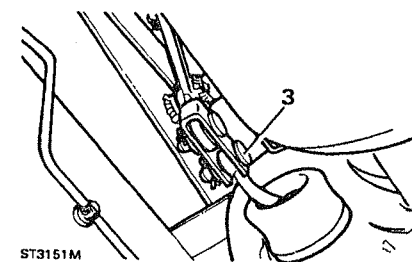
1. Raise-up the vehicle on to axle stands.
2. Check that the wheel rotates freely then turn the adjuster until the brake shoes are in firm contact with the drum.
3. Slacken off the adjuster just sufficiently for the drum to rotate freely.
4. Repeat the procedure for the other wheel.
5. Remove the axle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



ST2152M

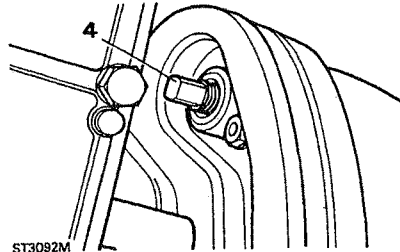
ADJUST TRANSMISSION BRAKE (Handbrake)

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



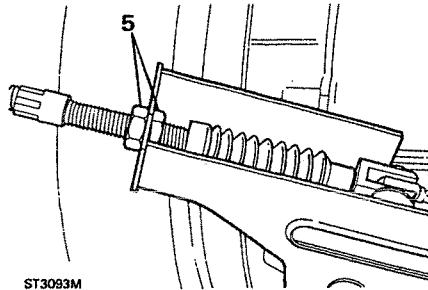
ST3151M

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



ST3092M

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



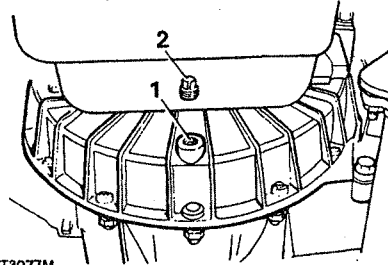
ST3093M

- Fit the clevis pin, washer and a NEW split pin.
- Slacken the adjuster 1 or 2 notches until handbrake shoes just clear the drum.
- 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.

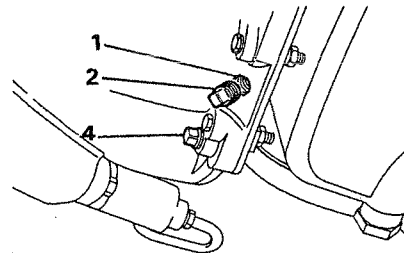
DRAIN FLYWHEEL HOUSING

- 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.
- The plug should only be fitted when the vehicle is expected to do wading or very muddy work.
- When the plug is in use it must be removed periodically and any oil allowed to drain off before the plug is replaced.



ST3077M

4-cylinder engines.



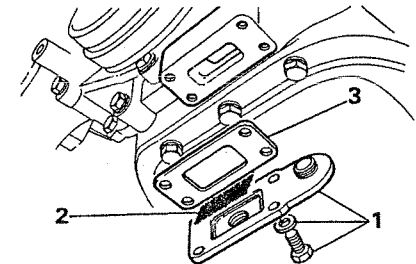
ST3078M

V8 engines

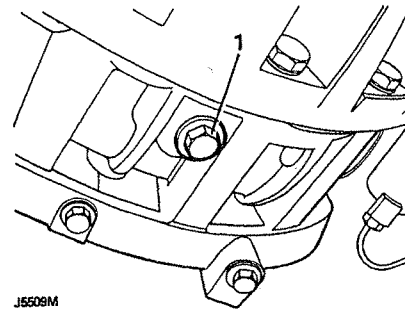
CLEAN ENGINE TIMING COVER FILTER - 2.5 Diesel only

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.

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



ST3080M



J5509M

Tdi engine

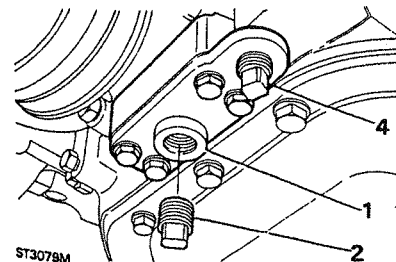
- When the plug is not in use it should be stowed as follows:
4 cylinder models - in tool kit
V8 - screwed into housing near drain hole.

DRAIN ENGINE TIMING COVER - 2.5 Diesel only

- 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.
- The plug should only be fitted when the vehicle is expected to do wading or very muddy work.
- 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.

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

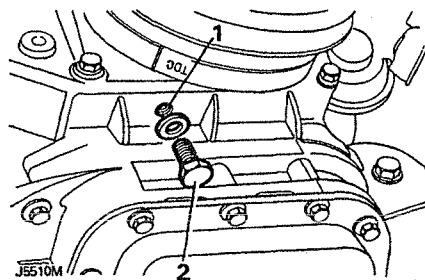


ST3079M

DRAIN ENGINE TIMING COVER - Tdi models

1. The timing cover can be completely sealed to exclude mud and water in the same manner as the flywheel housing.
2. Use of the sealing plug is the same as that for the flywheel housing, for wading and very muddy work only.
3. Periodically drain off any oil that may be present in the timing housing if the plug is in use.

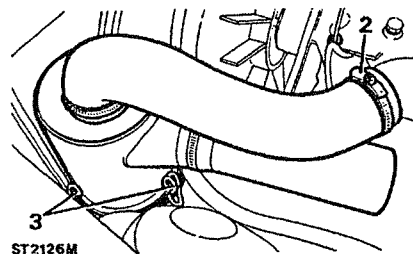
NOTE: There should not be any oil in the timing cover, but if there is, the cause should be investigated as soon as possible, as the timing belt will deteriorate if it becomes contaminated with oil.



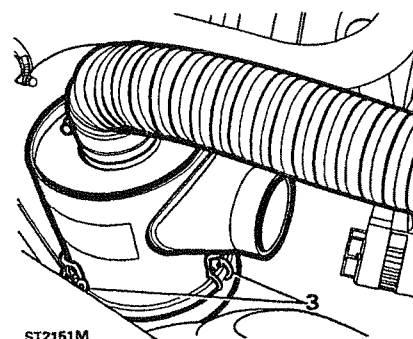
Tdi engine

RENEW OR CLEAN THE AIR CLEANER ELEMENT - 2.5 Diesel (including turbo), 2.25 and 2.5 Petrol engines**Renewing the air cleaner element**

1. Prop open the bonnet.
2. Disconnect all hoses from the air cleaner canister.
3. Pull-up the three clips and lift out the air cleaner canister.



ST2126M



ST2151M

Cleaning the air cleaner element

If a new element is not available the old one can be cleaned provided it is not contaminated with oil or carbon deposits. The element may be cleaned by using compressed air which is the best method, or by washing. The following instructions apply only to elements supplied as original equipment with the vehicle when new or replacements supplied by Land Rover Parts.

Cleaning by compressed air

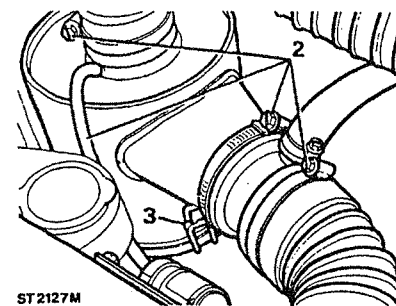
WARNING: Wear safety goggles and a breathing mask when cleaning by compressed air since this method creates airborne dust and flying particles which can cause injury.

1. Direct compressed air through the element in the opposite direction of normal air flow, keeping the nozzle at least 25 mm from the pleated paper and move the nozzle up and down while rotating the element. To avoid damaging the element, the air pressure must not exceed 5.6 kgf cm².

Cleaning by washing

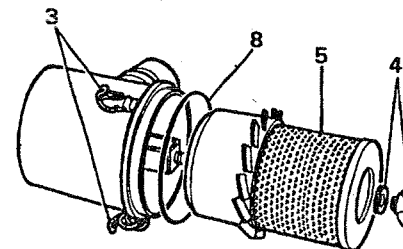
2. Soak the element for 15 to 60 minutes in a detergent powder and water solution. The detergent should be a synthetic, bio-degradable, no sudsing type as used in automatic washing machines. Brands such as Omo or Persil are suitable. The use of any fluid, especially solvents, or detergents other than those specified may damage the element.
3. Rinse the element in running water. The maximum water pressure must not exceed 1,7 kgf cm² to avoid damaging the element.
4. Allow the element to dry naturally. However, drying may be assisted with a maximum temperature of 71°C (160°F). Do not use compressed air or light bulbs for drying.

CAUTION: Do not refit the element while it is wet since suction from the engine will cause it to collapse and damage the engine. Whichever method is used, care must be taken to prevent dirt being re-deposited on the clean side of the element.



ST2127M

4. Unscrew the wing nut and withdraw the element.
5. Discard the old element and clean the interior and exterior of the canister.
6. Insert the new element into the canister and secure with the wing nut and washer.
7. Clean the canister base.
8. If necessary, fit a new sealing ring to the canister.



ST2128M

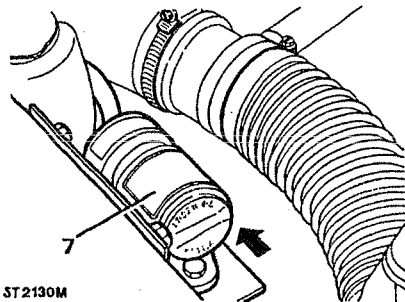
9. Fit the canister to the base and secure with the clips.
10. Connect all hoses and tighten the retaining clips.

Inspection of the cleaned element

5. Hold a bright light in the centre of the element and whilst slowly rotating the element inspect it for holes, thin spots or other damage. If damage is discovered, the element must be renewed.
6. After inspection, mark the end cap to record the number and dates of the times serviced. The element should be renewed after a maximum of six cleanings or annually, whichever occurs first.

Air cleaner element change indicator - Turbo-charged diesel models only

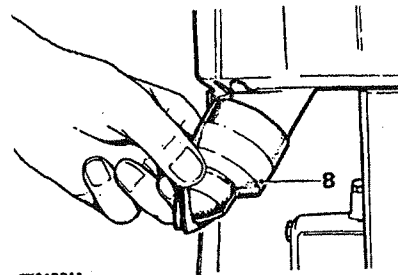
7. Located adjacent to the air filter, this indicator shows, by means of a red band moving across a clear aperture, when the filter has been changed or cleaned reset the indicator by pressing the rounded end until the red band is no longer visible.



ST2130M

Check air cleaner dump valve

8. The dump valve provides a drain for the air cleaner and is located in the base. Squeeze open the valve and check that the interior is clean and the rubber is not perished. Remove and clean the interior of the valve if necessary. Renew the valve if faulty in any way.



ST2129M

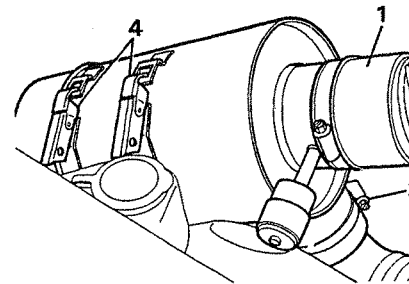
Fit air cleaner

9. Fit new 'O' ring to canister (later models).
10. Fit air cleaner canister and secure with the clips.
11. Connect the air cleaner hose.

REMOVING AIR CLEANER AND RENEWING ELEMENT - Tdi Defender engine

Remove air cleaner

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, and air inlet hose.
4. Release the two retaining fasteners.

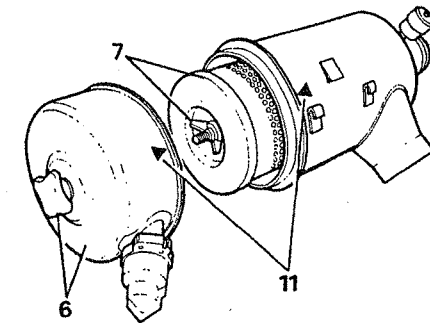


ST3034M

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

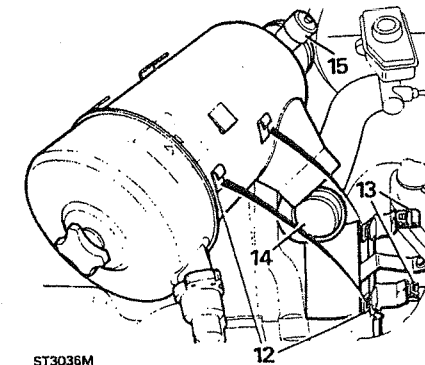
6. Unscrew the handwheel anti-clockwise and remove the end cover.
7. Unscrew the wing nut and withdraw the element.
8. Clean the interior of the casing and cover.
9. Fit a new element, fins leading, into the casing.
10. Secure the element with the wing nut.
11. Fit the end cover and align the two arrows.



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 fasteners.
14. Connect all the hoses, reversing instructions 1 to 3.
15. Finally, reset the element change indicator, where fitted, by depressing the button.

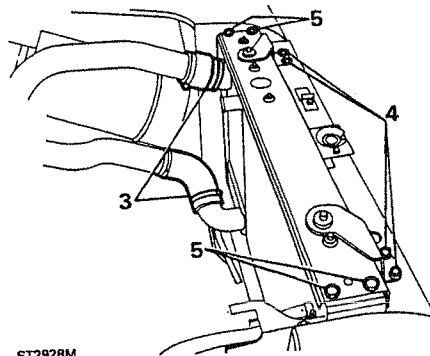


ST3036M

INTERCOOLER - Tdi Defender engine

Remove, clean and refit

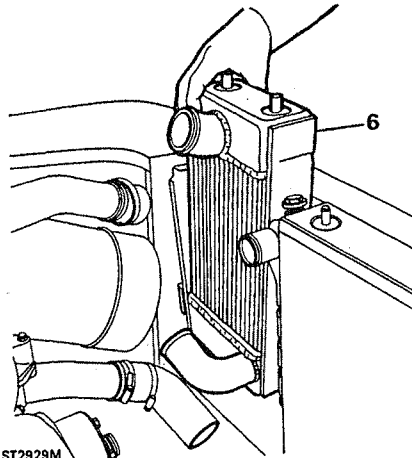
1. Remove the fan and viscous coupling assembly, see SECTION 26 .
2. Remove the fan cowl, see SECTION 26 .
3. Disconnect the top and bottom hoses from the intercooler.
4. Remove the four bolts (two each side) retaining the radiator top support brackets.
5. Remove the bolts (two each end) securing the radiator surround top panel, and remove the panel.
6. Lift out the intercooler.



ST2928M

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.



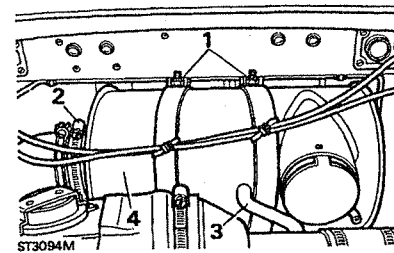
ST2929M

Refitting

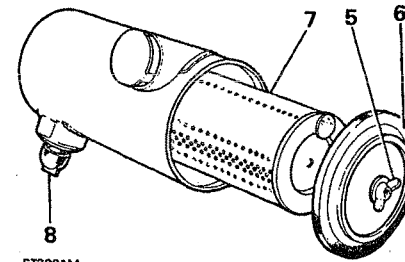
9. Slide the intercooler into position taking care not to damage the insulation material on the sides.
10. Fit the radiator surround top panel and secure with the four bolts.
11. Fit the two top brackets and secure with the four bolts.
12. Connect the top and bottom hoses.
13. Fit the fan cowl.
14. Fit the fan and coupling assembly.

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.
6. Remove the filter seal.
7. Remove and discard the element. DO NOT attempt to clean the element, fit a new one during reassembly and secure with the wing nut.



ST3094M



ST3081M

Check air cleaner dump valve

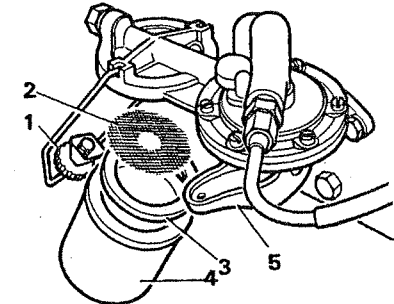
8. Squeeze open the dump valve and check that the interior is clean. Also check that the rubber is flexible and in a good condition.
9. If necessary, remove the dump valve to clean the interior. Fit a new valve if the original is in a poor condition.

Fit air cleaner

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

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

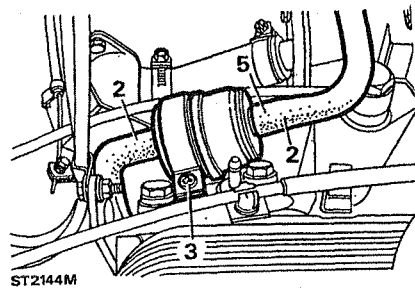
1. Remove the bowl by slackening the thumb screw and swinging the retainer to one side.
2. Remove and clean the filter gauze in clean petrol.
3. Ensure that the sealing washer is in good condition.
4. Replace gauze and refit the bowl.
5. Prime the pump by operating the hand lever.



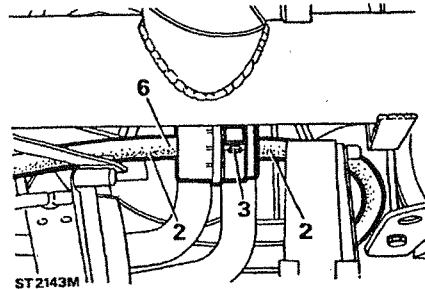
ST3095M

RENEW V8 ENGINE BREATHER FILTER

1. To gain access to the filter, remove the air cleaner, see RENEW AIR CLEANER ELEMENT.
2. Pull-off the two hoses from the engine breather filter.
3. Slacken the filter retaining clip screw and withdraw the filter.
4. Examine the hoses and renew if split, perished or blocked.
5. Early models: fit a new filter with the end marked 'IN' facing forward, towards the front of the engine. Alternatively, if the filter is marked with arrows they must point rearwards.



6. Later models: where the filter is attached to the air inlet duct, fit a new filter with the end marked 'IN' connected to the hose from the air cleaner.

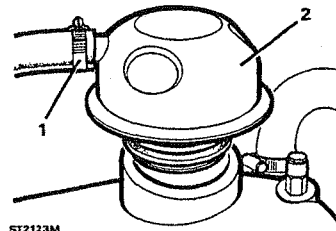


7. Refit the air cleaner.

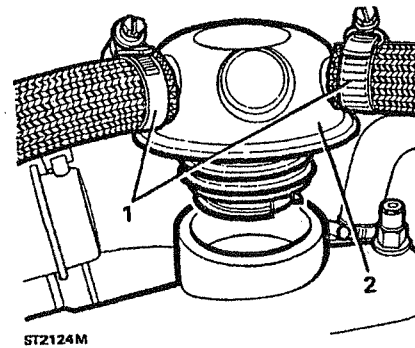
CLEAN ENGINE BREATHER FILTER - all 4 cylinder engines, Petrol and Diesel N A and turbo-charged

The filter is incorporated inside the engine oil filler cap located on the rocker cover and is a push fit.

1. Disconnect the breather hose one on petrol engine and diesels and two on turbo-charged diesels.
2. Pull off the filler/breather cap from the rocker cover.



ST2123M

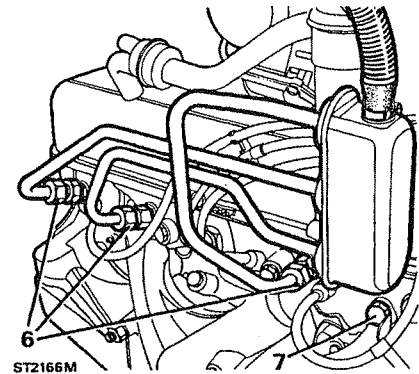


ST2124M

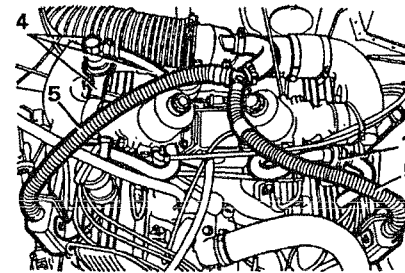
3. Wash the gauze filter in clean fuel and allow to drain and dry.
4. Refit the cap and connect the hoses.

RENEW V8 ENGINE FLAME TRAPS AND CHECK PULSAIR SYSTEM PIPES AND HOSES - Early and later vehicles

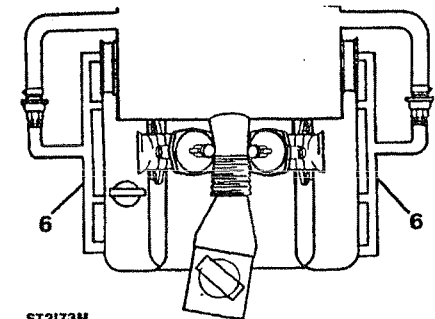
1. Disconnect the hoses from each side of the left- and right-hand flame traps and discard the traps. The right-hand trap is situated beneath the right-hand carburetter inlet elbow.
2. Examine the hoses and renew any that are perished, split or blocked.
3. Fit new flame traps to the original or new hoses.
4. On later models, check the condition of the hoses from the right-hand flame trap to the air inlet duct via the one-way vent valve.
5. Check the condition of the Pulsair hoses and the security of all hose clips connected with the air intake and engine emission and breathing system.



ST2166M



ST2148M

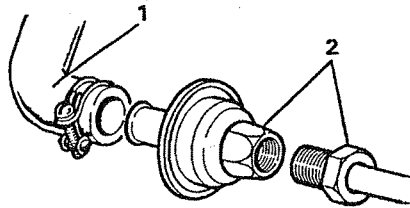


ST2173M

6. Check the condition and security of the pulsair air rails and the union connections to the cylinder heads.
7. Check that the two blanking plugs (one per cylinder head) if fitted are secure and not leaking exhaust gases.

CHECK OPERATION OF PULSAIR ONE-WAY CHECK VALVES - Early V8 vehicle

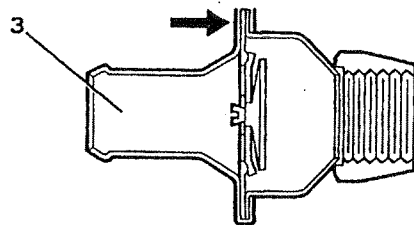
1. Disconnect the air hose from the check valve.
2. Using two open-ended spanners, one on the air rail hexagon to provide support, and the other to remove the valve anti-clockwise.



ST2172M

3. To test the valve, blow air through the valve, orally, in both directions in turn. Air should only pass through the valve when blown from the hose connection end. Should air pass through from the air rail end the valve is faulty and must be renewed.

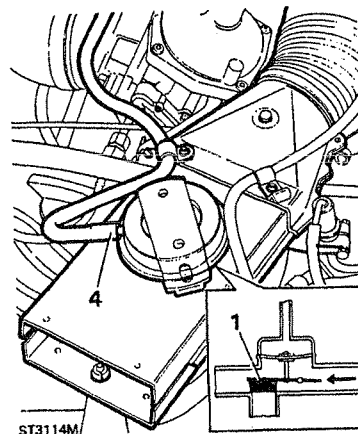
CAUTION: Do not use a pressure air supply for this test.



ST2171M

CHECK AIR INTAKE TEMPERATURE CONTROL SYSTEM - Early V8 vehicles

1. Check operation of the mixing flap valve in the air cleaner air intake by starting the engine from cold and observing the flap valve as the engine temperature rises. The illustration shows the valve in the fully open position.
2. The valve should start to open slowly within a few minutes of a stabilised position being achieved. This position and the speed of operation will be dependent upon prevailing conditions.
3. Failure to operate indicates a faulty flap valve vacuum capsule or the thermostatically controlled vacuum switch or both.
4. Check, by temporarily connecting a pipe from the vacuum source tapped into number eight cylinder inlet port direct to the flap valve thereby by-passing the temperature sensor. Alternatively, a hand held vacuum pump may be used connected direct to the flap valve.



ST3114M

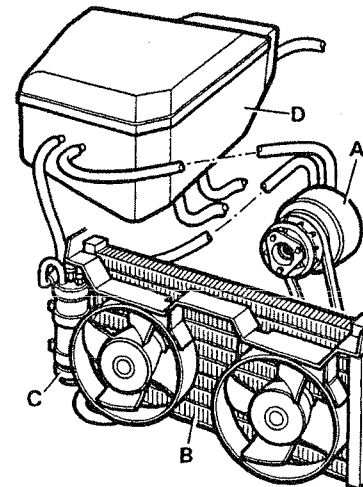
5. If movement of the flap valve is evident the temperature sensor is faulty. If no movement is detected, the vacuum capsule is at fault.
7. Fit new parts as necessary.

AIR CONDITIONING SYSTEM - where fitted

The air conditioning system operates in conjunction with the vehicle heater to provide dried cooled recirculated or fresh air to the vehicle interior.

The system consists of the following units which should be examined at the same mileage intervals as the heater system:

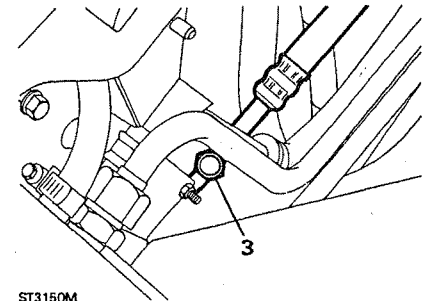
- A. Engine mounted compressor.
- B. Condenser in front of the radiator.
- C. A receiver/drier in front of and to the right of the condenser.
- D. Evaporator/heater unit in engine compartment.



ST321

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

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



ST3150M

4. **Evaporator:** Examine the pipe connections for leaks.

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

CHECK AND ADJUST VALVE CLEARANCES - All 4 cylinder engines

NOTE: During the following procedures the crankshaft must be turned several times and to facilitate this remove the spark plugs or the heater plugs as applicable.

Valve clearances:

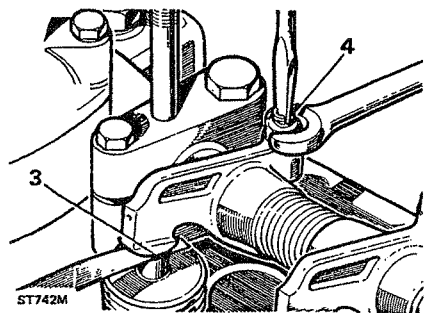
2.25 Petrol and Diesel engines
2.5 Petrol and Diesel engine N A
2.5 Turbo-charged Diesel engine

0.25 mm Hot or cold.

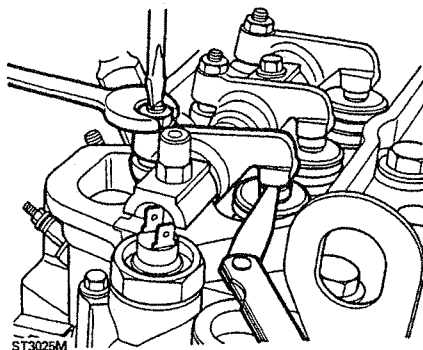
Direct injection Tdi Defender engine

0,20 mm Cold.

1. Remove the rocker cover.
2. Turn the crankshaft until number eight valve, counting from the front of the engine, is fully open.
3. Using an appropriate feeler gauge, check the clearance between the valve tip and rocker pad of number one valve.
4. To adjust the clearance, slacken the locknut and turn the tappet adjusting screw clockwise to increase the clearance. Check the clearance again after tightening the locknut.



2.25 and 2.5 engines



Direct injection Tdi engine

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

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

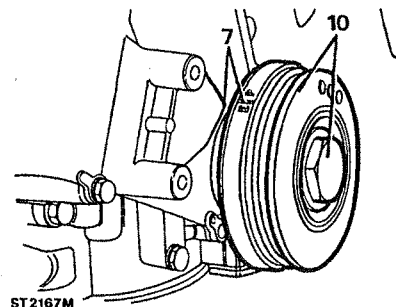
6. Using a new gasket, fit the rocker cover and secure with the special nuts and washers tightening evenly to the correct torque.
7. Fit the spark plugs or heater plugs and tighten to the correct torque.

CAUTION: When fitting heater plugs ensure that the leads, washers and nuts are fitted as illustrated, see SECTION 12 and that the lead is positioned vertically to prevent heat from the cylinder head damaging the cable insulation.

RENEW CAMSHAFT DRIVE BELT - 2.5 Diesel N A. and Turbo-charged

Remove timing belt

1. Disconnect the battery.
2. Drain the coolant.
3. Remove the bonnet.
4. Remove the air cleaner.
5. Remove the radiator and fan cowli assembly.
7. Rotate the crankshaft to align the E P mark on the crankshaft pulley with pointer on timing belt cover plate.

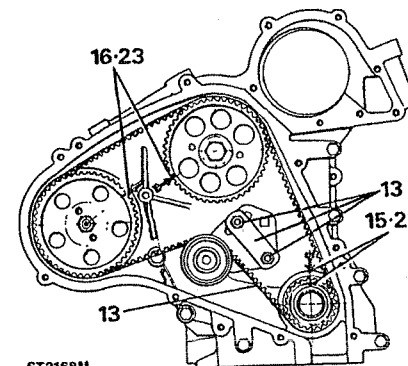


8. Remove the oil filler/breather cap from the rocker cover and check that number one exhaust valve is at its peak (fully open). Refit the filler/breather cap.
9. Raise the vehicle, either with a jack and lower on to axle stands, or on a ramp.
10. Remove the crankshaft pulley special bolt and re-align the E P mark before withdrawing the pulley.
11. Remove the wading plug bracket.
12. Remove the timing belt front cover plate.
13. Slacken the timing belt tensioner nuts release the tension, and remove the belt. Note that on later engines the strap has been deleted.

Fit new timing belt

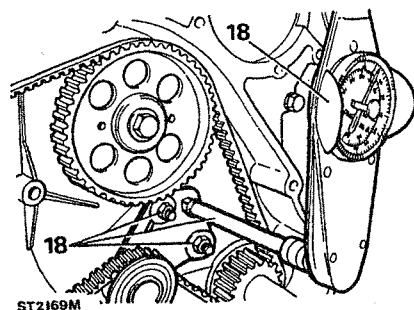
14. Clean the timing pulleys and tensioner assembly.
15. Check that the timing dot on the crankshaft pulley aligns with the cast on arrow on the front cover.

16. If necessary, rotate the camshaft and injector pump pulleys so that the dots line-up with the arrows.
17. Fit the new 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 teeth do not quite mate with the pulley grooves turn the pulley clockwise the required amount whilst keeping the belt tight on the drive side. Feed the belt over the distributor pump pulley and if necessary, turn the pulley clockwise to locate in the grooves. Whilst keeping a firm grip on the belt, pass it over the tensioner wheel.



18. Set a dial type torque wrench to 29,0 to 23,5 Nm 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.
19. Rotate the crankshaft TWO complete revolutions.
20. Slacken the tensioner clamp nuts.
21. Tension the belt again as described in instruction 18 and tighten the clamp nuts to the correct torque.

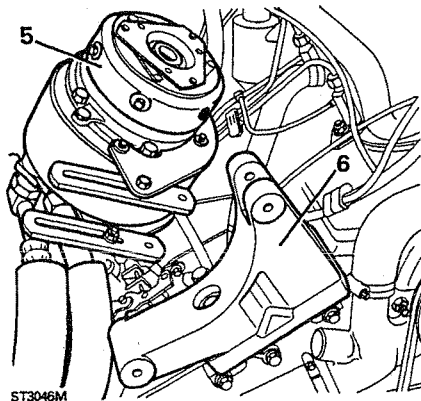
CAUTION: The double tensioning procedure is imperative, otherwise the belt could fail resulting in serious engine damage.



22. Line-up the dot on the crankshaft pulley with the arrow on the rear cover.
23. Check that the dot on the camshaft and distributor pump pulleys coincide exactly with the respective arrows on the front cover.
24. Without moving the crankshaft, fit the front cover and temporarily secure with a couple of bolts. Fit the crankshaft pulley and check that the E P mark on the pulley is aligned with pointer on the cover plate with number one (exhaust valve) at its peak (fully open).
25. If the alignment is correct, remove the pulley and cover and fit a new gasket. Insert the 650mm long bolt into the cover with the fibre washer on the inside and secure with the remaining bolts tightening evenly to the correct torque.
26. Fit the crankshaft pulley with the special bolt and tighten to the correct torque.
27. Fit the wading plug bracket.
28. Lower the vehicle to the ground and reverse instructions 1 to 6.

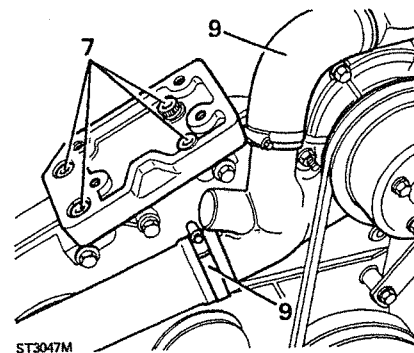
RENEW CAMSHAFT DRIVE BELT -Tdi Defender engine

1. Disconnect the battery.
2. Remove the fan and viscous coupling assembly, see SECTION 26.
3. Slacken and remove the power steering pump drive belt, see SECTION 57.
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 SECTION 86.
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.



ST3047M

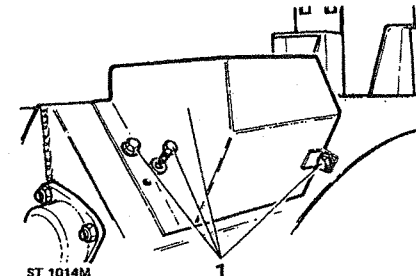
Assembling

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 SECTION 26.
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 SECTION 12.
21. Fit the tension and power steering pump drive belt.
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.

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

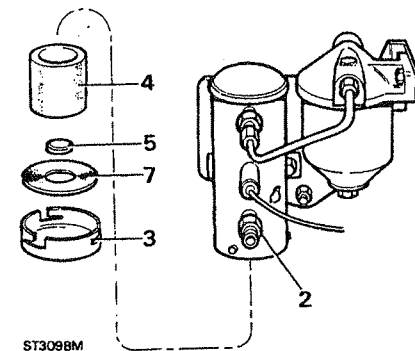
The pump is located mid-way along the right hand side of the chassis.

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



ST 1014M

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.

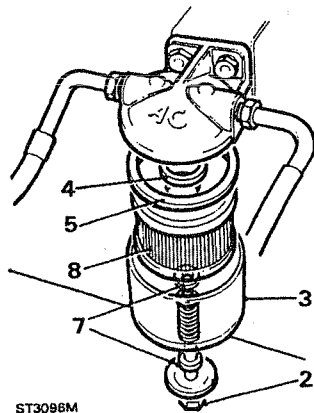


ST3098M

RENEW FUEL FILTER ELEMENT - Petrol engines 4-cylinder and V8. Observe fuel handling precautions SECTION 01

The element provides a filter between the pump and carburettor 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.

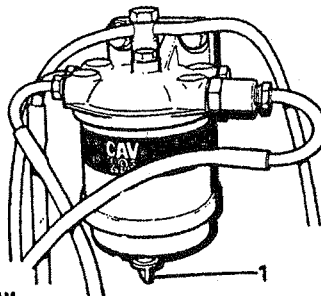


ST3098M

RENEW FUEL FILTER ELEMENT - Diesel engines 2.5 N A and Turbo-charged

Drain off Water

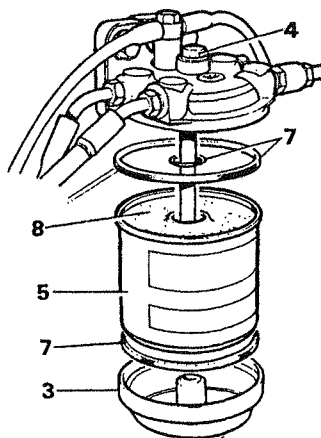
1. Slacken off drain plug to allow water to run out.
2. When pure diesel fuel is emitted, tighten drain plug.



ST2161M

Renew filter

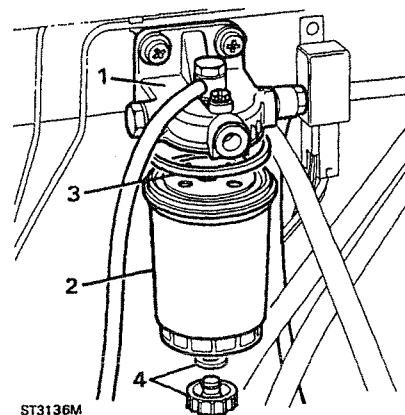
3. Support element holder.
4. Unscrew the special bolt on top of the filter, the element holder can now be removed.
5. Remove and discard the used element.
6. Wash the element holder in petrol or fuel oil.
7. If necessary renew both the large rubber washer and the small rubber washer in the filter top, 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.



ST3076M

RENEW FUEL FILTER ELEMENT - Tdi Defender engine

1. Clean the area round the filter head, and place a container beneath the filter.
2. Using a strap wrench, unscrew the filter and catch the fuel that is released, into the container.
3. Wet the seal of the new filter with diesel fuel and screw the filter into position and tighten.
4. Ensure that the drain tap at the base of the filter is closed.



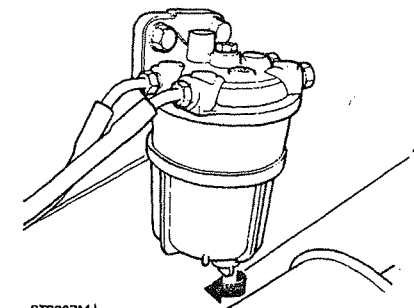
ST3136M

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

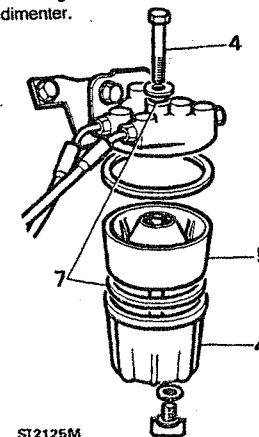
1. Slacken off drain plug to allow water to run out.
2. When pure diesel fuel is emitted, tighten drain plug. Dismantle and clean as detailed below.



ST3097M

Clean element

3. Disconnect fuel inlet pipe at sediment and raise pipe above level of fuel tank to prevent draining from tank. Support in this position.
4. Support sediment bowl and unscrew bolt on top of unit and remove bowl.
5. Remove the sediment 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.

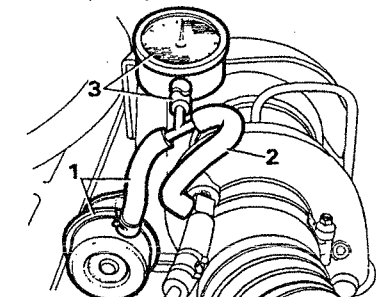


ST2125M

CHECK TURBO-CHARGER BOOST PRESSURE - 2.5 Turbo-charged Diesel and Tdi

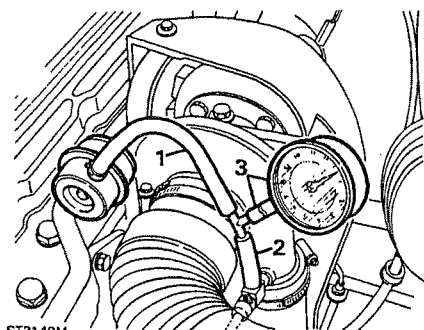
Maximum boost pressure see SECTION 05

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 suitable hose to the turbo-charger and connect the other end to the 'T' piece.
3. Connect a further length of 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.



ST3099M
2.5 Turbo-charged diesel

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 rev/min. If the pressure requires adjustment see diesel SECTION 19.



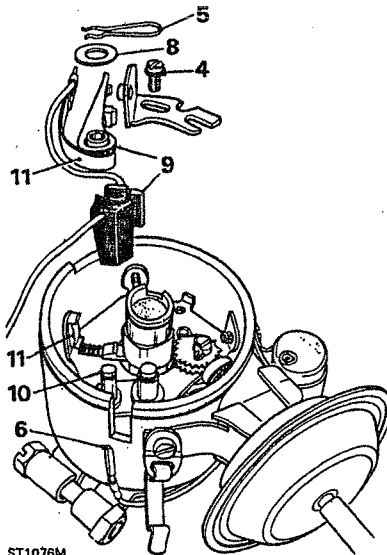
ST3140M

Tdi Defender engine

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.

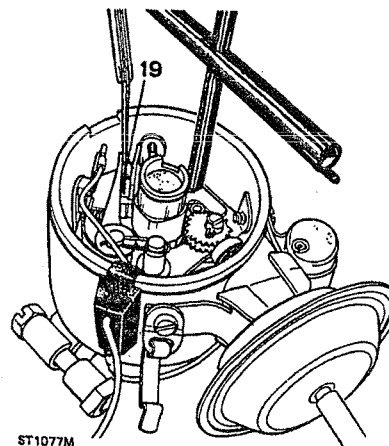


ST1076M

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 ENGINE TUNING 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

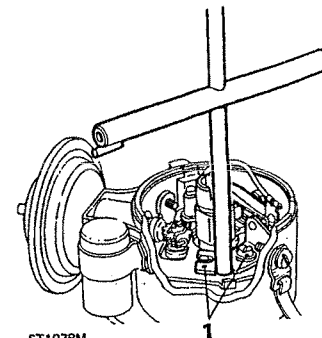
ADJUST DUCELLIER DISTRIBUTOR - 4-cylinder Petrol engine

Service tool: LRT-12-512 (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 ENGINE TUNING 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.



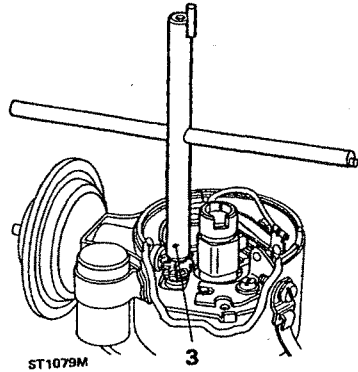
ST1078M

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 2,000 rev/min. A variation outside the tolerance given in data indicates that the distributor has a mechanical fault which cannot be rectified by adjustment.

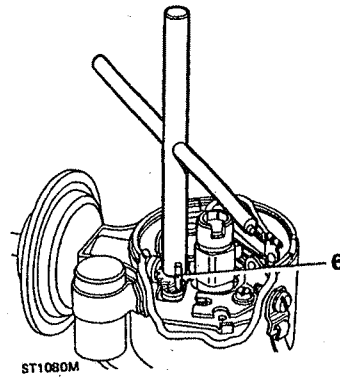
- If the variation is acceptable, reconnect the vacuum pipe, start the engine and increase the engine speed to 2,000 rev/min and release the throttle. Check the dwell variation and if necessary adjust by turning the eccentric 'D' post with the special tool (female 'D' end). Setting the dwell for minimum 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.

- Disconnect the vacuum pipe and connect a vacuum pump to the unit.
- 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.
- 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

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

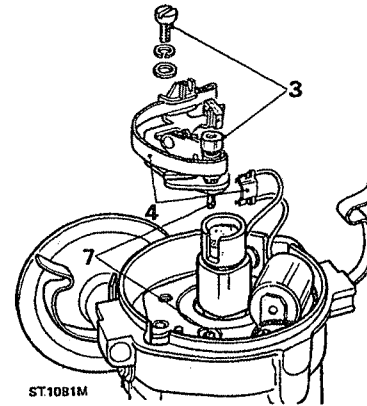
Fit new contacts

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

RENEW DISTRIBUTOR CONTACT SET - V8 engine

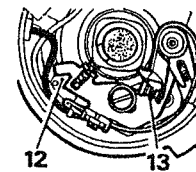
Fixed contact type

- Unclip and remove the distributor cap.
- Withdraw the rotor arm.
- Remove the contact breaker spring anchor nut and lift off:
 - the top-half of insulation bush
 - the low tension lead (black)
 - the capacitor lead (orange)
- Remove the contact breaker retaining screw, plain and spring washer and remove contact set assembly.
- Remove the complete insulation bush.
- 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.
- Assemble the contact breaker spring insulating bushes and electrical leads, as illustrated, in the following sequence:
 - lower bush
 - spring
 - low tension lead
 - capacitor lead
 - top bush
 - and secure with the anchor spring nut.
- Apply a few drops of engine oil to the distributor cam lubrication pad.

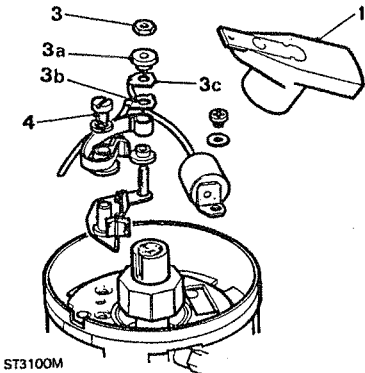
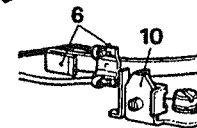


Adjust gap

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



ST1082M

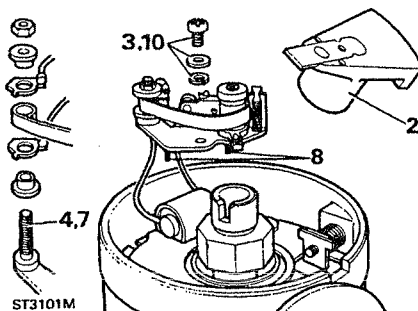


ST3100M

Sliding contact type

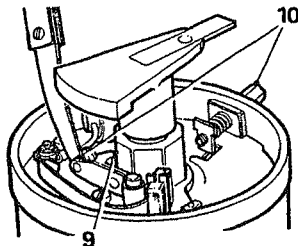
- Release the clips and remove the distributor cap.
- Remove the rotor arm from the cam spindle.
- Remove the retaining screw and washers and lift the complete contact breaker assembly from the moveable plate.

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.



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.
11. At the earliest opportunity check and adjust the dwell angle - see **ENGINE TUNING DATA** - using special turning equipment.
12. Fit the rotor arm and distributor cap ensuring that the H T pick-up brush moves freely.

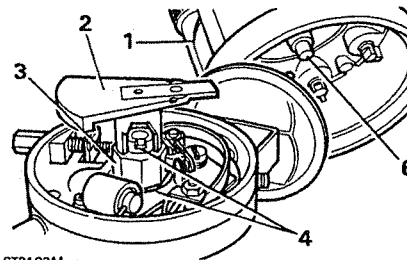


ST1083M

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.



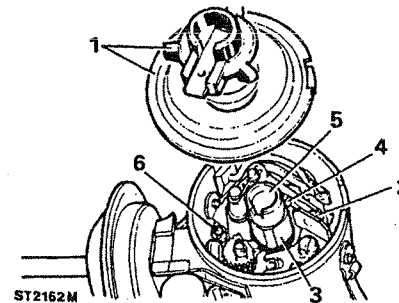
ST3102M

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.

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.

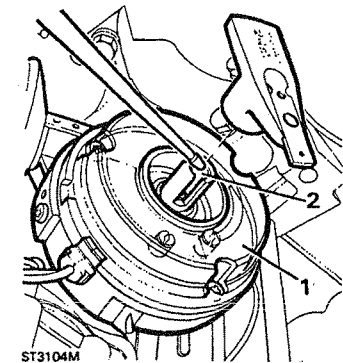


ST2162M

CLEAN AND LUBRICATE V8 ENGINE ELECTRONIC DISTRIBUTOR every 40.000 km (24,000 miles)

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

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

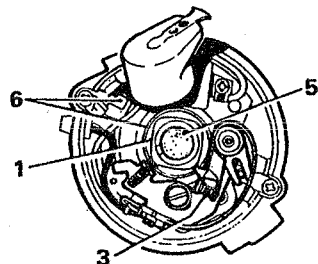


ST3104M

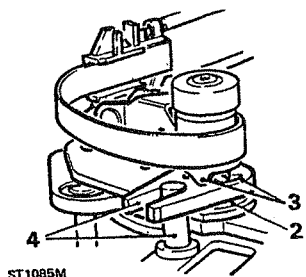
3. Fit the rotor arm and distributor cap and ensure that the cap is properly located and secured with the two clips.

CLEAN AND LUBRICATE LUCAS DISTRIBUTOR - 4 cylinder engines

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



ST1085M

CHECK AND ADJUST V8 ENGINE DISTRIBUTOR TIMING

Using Electronic Timing Equipment

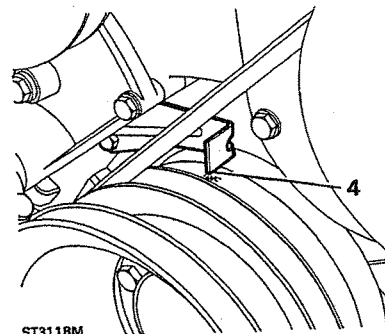
A pointer on the timing cover and marks on the crankshaft pulley indicate positions around T D C. on No. 1 cylinder (i.e. front cylinder on left-hand bank). Refer to 'ENGINE TUNING DATA' for appropriate ignition timing.

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.

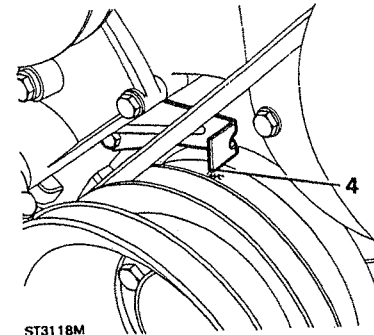
WARNING: Ensure that personnel and equipment are kept clear of the rotating cooling fan while using the timing light.

4. If the timing is correct the pulley mark indicated in the ENGINE TUNING DATA will show. If correct, instruction 5 may be ignored.



ST3118M

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 anti-clockwise to advance and clockwise to retard.
6. Tighten the clamp bolt with the unit in this position.



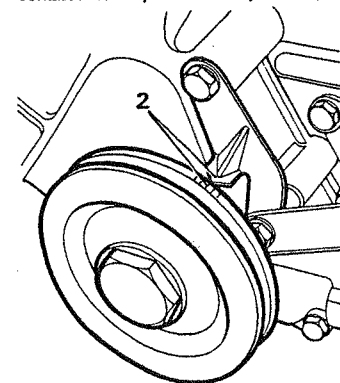
ST3118M

CHECK AND ADJUST IGNITION TIMING - 4 cylinder petrol engine, Lucas 45D4 distributor

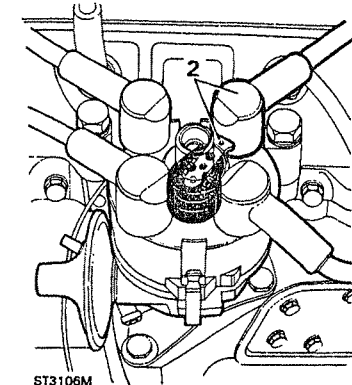
NOTE: The following instructions cover the static timing which is an emergency setting only. At the earliest opportunity the dwell angle, timing, centrifugal and vacuum advance must be set in accordance with the 'ENGINE TUNING DATA' SECTION 05 using engine electronic tuning equipment.

Static timing

1. Remove the distributor cap and if necessary adjust the contact breaker gap.
2. Rotate the crankshaft clockwise, in the normal running direction until number one piston is at TDC with both valves closed and the TDC mark on the crankshaft pulley is aligned with the timing pointer attached to the timing cover. The rotor arm should now be in line with the segment in the distributor cap that feeds number one cylinder spark plug. Also, the contact breaker points should just be opening.

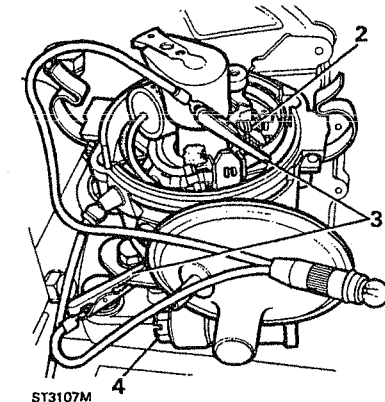


ST3105M



ST3106M

3. If adjustment is required, connect one lead of a test lamp to the distributor low tension terminal and the other to a good earth.
4. Slacken the distributor pinch bolt and the clamp plate anchor bolt.

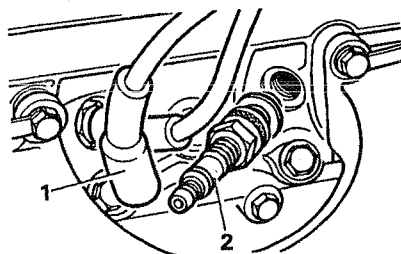


ST3107M

5. Switch-on the ignition and turn the distributor body in the required direction until the lamp just lights indicating that the points are opening. Tighten the pinch bolt and anchor bolt.
6. Switch-on the ignition and rotate the crankshaft two complete revolutions in the normal running direction. The test lamp should light as the timing pointer aligns with the TDC mark on the crankshaft pulley at the completion of the second revolution. If necessary, adjust by slackening the pinch and anchor bolts and turn the distributor body in the required direction.
7. When the timing is correct, tighten the pinch and anchor bolts, remove the test lamp and fit the distributor cap.

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.



ST3108M

Clean and set gaps

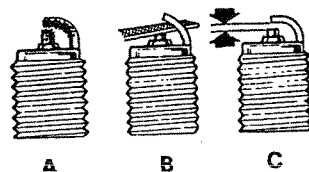
3. Fit plug in plug cleaning machine.
4. Wobble plug with circular motion while operating abrasive blast for a maximum of four seconds.

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

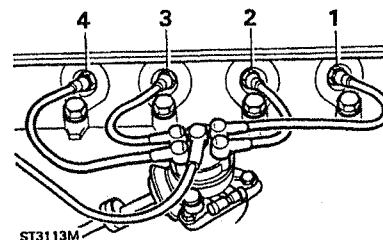


ST051

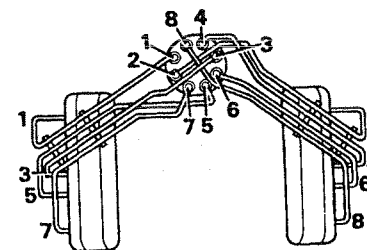
Refit or renew spark plugs

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 over-heating 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.



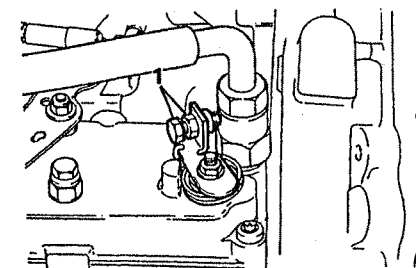
ST3113M



ST2416M

ENGINE SLOW RUNNING - 2.5 Diesel N A and Turbo-charged

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

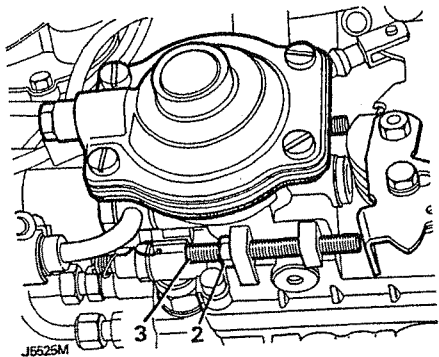
2. If a tachometer is not available adjust the control screw until the slowest speed is obtained consistent with smooth and even running.

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.

ENGINE SLOW RUNNING - Tdi Defender engine

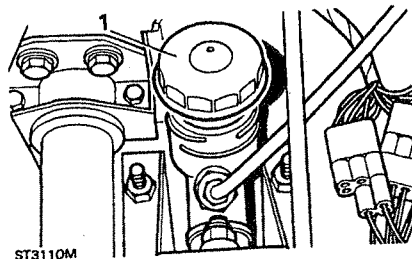
1. Using a suitable tachometer, check the engine slow running speed against the figure given in 'ENGINE TUNING DATA'. The engine should be at normal operating temperature for this check. If no tachometer is available, adjustment should be made to the engine speed until the slowest even running is achieved.
2. If adjustment is necessary, slacken the locknut on the injector pump.
3. Screw the adjuster either clockwise to increase the engine speed or anti-clockwise to decrease the speed. Run the engine at an increased speed for a few seconds then check the slow running speed again.
4. When the correct speed has been achieved, hold the adjuster screw steady while tightening the locknut.

NOTE: The slow running control is the only permitted adjustment in service. Any additional adjustments required must be entrusted to authorised Bosch agents.



CHECK CLUTCH FLUID RESERVOIR

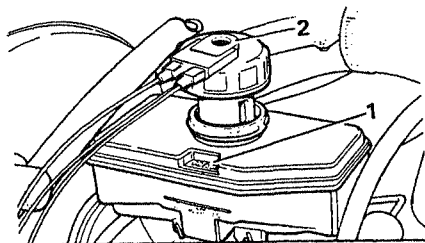
1. Clean and remove the reservoir cap and observe the fluid level in relation to the marks on the side of the reservoir.
2. Top-up if necessary with new, clean fluid from a sealed container and of a recommended specification - see 'RECOMMENDED LUBRICANTS, FLUIDS AND CAPACITIES' section. Refit the cap.



ST3110M

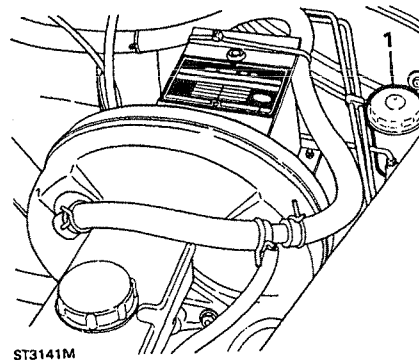
CHECK BRAKE FLUID RESERVOIR

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 'RECOMMENDED LUBRICANTS, FLUIDS AND CAPACITIES'. Refit the cap.



ST3109M

Right-hand drive vehicles



ST3141M

Left-hand drive vehicles

CLEAN AND TEST HEATER PLUGS - Diesel engines

REMOVE THE PLUGS

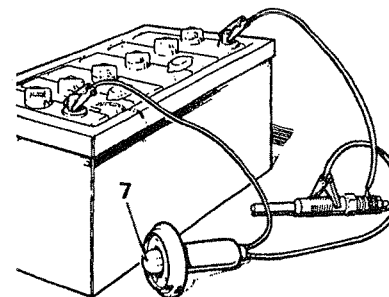
1. Disconnect the battery.
2. Remove the terminal nut from each heater plug.
3. Detach the heater plug lead and washer from each plug.
4. Remove the heater plugs.

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.



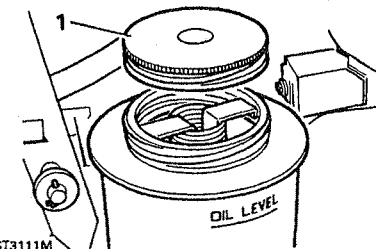
ST1021M

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. Ensure that the lead is fitted so that the insulation does not touch the cylinder head.
11. Connect the battery.

CHECK POWER STEERING FLUID RESERVOIR

Early models

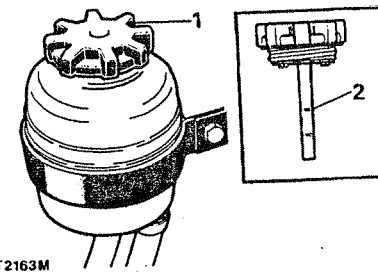
1. Clean and remove the reservoir cap and observe the fluid level in relation to the mark on the side of the reservoir.
2. If necessary top-up with a recommended fluid - see 'RECOMMENDED LUBRICANTS, FLUIDS AND CAPACITIES' - until the fluid is 12 mm above the filter. Refit the cap.



ST3111M

Later models

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



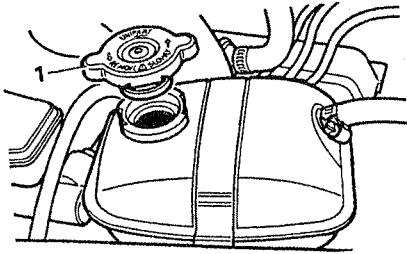
ST2163M

CHECK COOLING SYSTEM COOLANT

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

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

1. To remove the filler cap, first turn it anti-clockwise a quarter of a turn and allow all pressure to escape, before turning further in 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.

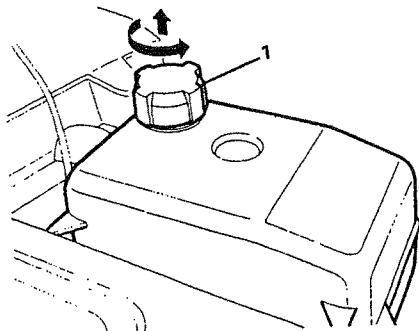


ST3112M

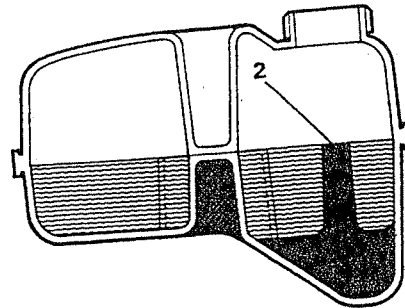
Tdi Defender cooling system

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

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



ST3143M



ST3144M

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

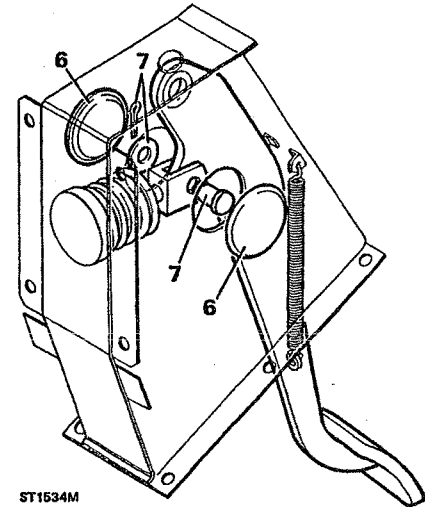
Battery terminals

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

CAUTION: If a new battery is fitted to the vehicle, it should 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.

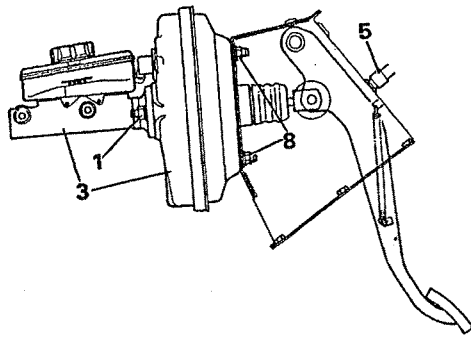
RENEW BRAKE SERVO FILTER

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 Lucas 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.



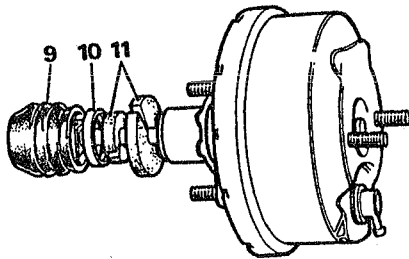
ST1534M

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



ST1533M

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.

CHECK AND ADJUST DRIVE BELT TENSIONS

Drive belts and pulleys - general notes

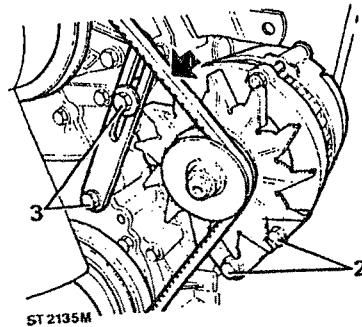
Before checking the tension, examine the pulley and drive belts for condition and renew if damaged or worn. Also check that grit or pebbles are not trapped in the 'V' grooves of the pulleys which could cause damage or misleading tension.

Whenever a new drive belt has been fitted, the tension must be checked after approximately 1,500 km (1,000 miles).

Four cylinder engines - alternator only including Tdi

1. Check, by thumb pressure, the belt deflection at the mid-point between the fan and alternator pulley. If the movement is more or less than 9 mm the belt tension must be adjusted as follows:
2. Disconnect the battery and slacken the alternator pivot bolts and nuts.
3. Slacken the adjusting link pivot bolt and clamp bolt.
4. To increase the tension, move the alternator away from the engine. Move the alternator towards the engine to decrease tension.

CAUTION: When tensioning the belt do not apply pressure to the stator or slip ring end bracket since this will damage the alternator.

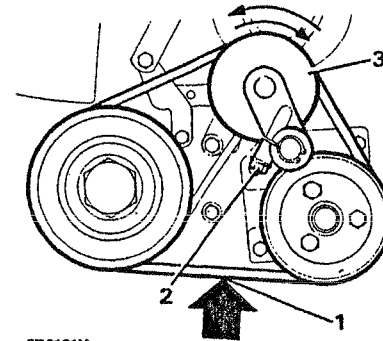


ST 2135M

5. When the tension is correct, tighten the adjusting link clamp and pivot bolts first, then the alternator pivot nut and bolt.
6. Connect the battery, run the engine for three to five minutes at a fast idle, switch-off and recheck the belt tension.

Four cylinder engines with power steering pump and jockey pulley tensioner

1. Check, by thumb pressure, the belt deflection at the mid-point between the crankshaft and power steering pump pulleys. If the movement is more or less than 12 mm adjustment is required as follows:
2. Disconnect the battery and from beneath the vehicle, slacken the jockey pulley pinch bolt.
3. Move the jockey pulley to the left or right, as necessary, to achieve the correct belt tension and tighten the pinch bolt.



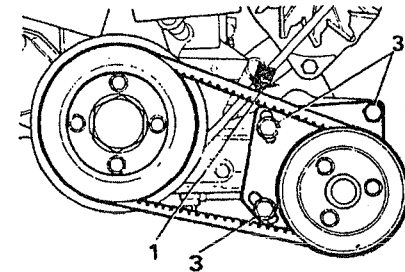
ST 2131M

4. Reconnect the battery, run the engine at a fast idle for three to five minutes switch-off and recheck the belt tension.

Four cylinder engines with power steering pump without jockey pulley tensioner

1. Check, with thumb pressure, the drive belt deflection at the mid-point of the run between the crankshaft and steering pump pulley. If the movement is more or less than 12 mm adjustment is required as follows:
2. Disconnect the battery.
3. Slacken the pump pivot bolt and the two adjustment clamp bolts and move the pump mounting plate either up or down, as necessary, within the elongated holes, to achieve the correct belt tension.

CAUTION: Do not lever or apply pressure to the pump body to tension the belt since this will cause permanent damage to the pump.



ST2134M

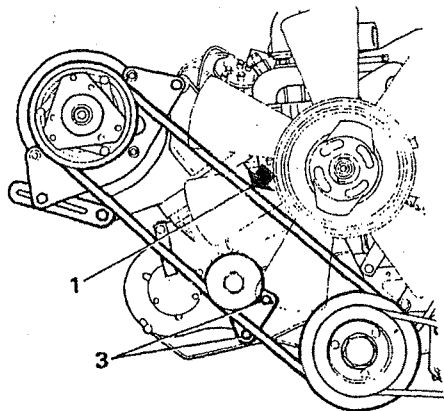
4. Tighten the clamp bolts first and then the pivot bolt.
5. Reconnect the battery, run the engine at a fast idle for three to five minutes switch-off and recheck the belt tension.

Four cylinder engines with air conditioning compressor

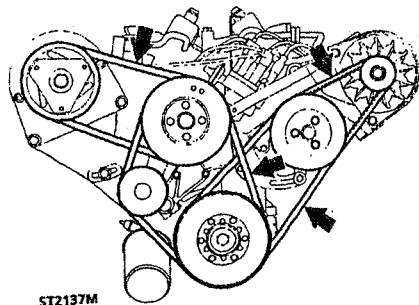
1. With thumb pressure, check the drive belt tension between the compressor and crankshaft pulley at the mid-point of the run on the side opposite the belt damper. If the deflection is greater or less than 12 mm adjustment is required as follows:
2. Disconnect the battery.
3. Slacken the belt damper pivot and clamp bolts and move the damper aside.

V8 engine drive belt tensioning

Deflection points

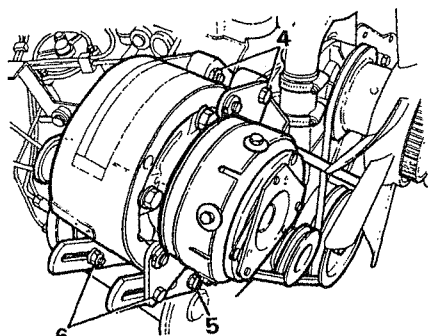


ST2132M

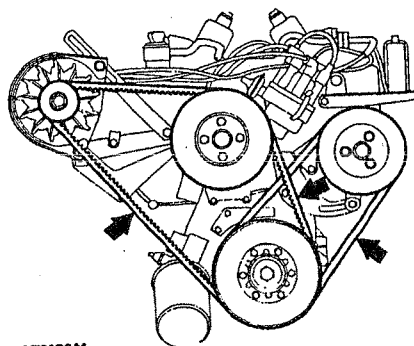


ST2137M

4. Slacken the compressor two pivot bolts and nuts.
5. Slacken the common pivot bolt for the adjustment links.
6. Slacken the two adjustment links clamp bolts and nuts.



ST2133M



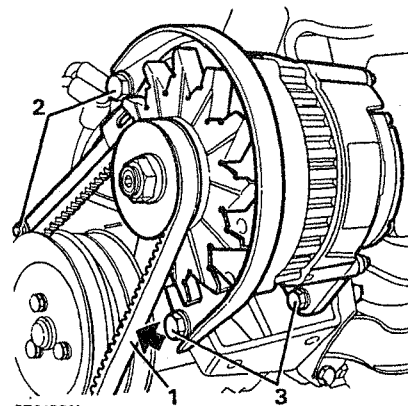
ST2136M

V8 engine alternator drive belt with air conditioning, driven from power steering pump

1. Check the drive belt tension using thumb pressure at the mid point of the run between the power steering pump and alternator pulleys. If the deflection is greater or less than 4 mm to 6 mm adjustment is required as follows:
2. Slacken the adjustment link pivot and clamp bolts.
3. Slacken the alternator two pivot nuts and bolts.

7. Move the compressor clockwise about the pivot bolts until the correct tension is achieved. Tighten the clamp bolts and nuts. Do not use a lever.
8. Tighten the adjustment link bolt.
9. Move the belt damper so that it is just in contact with the belt or 1,0 mm clear of the belt. The purpose of the damper is to prevent the belt from 'flapping' due to the long run between pulleys.

V8 engine alternator drive belt without air conditioning

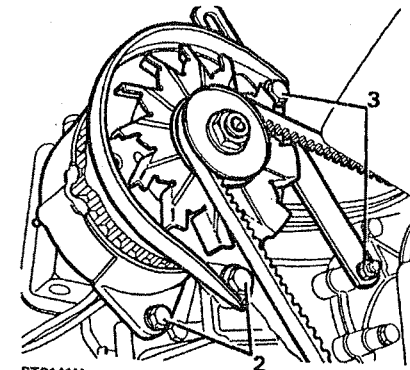


ST2138M

4. Move the alternator towards or away from the engine as necessary until the correct tension is achieved. Tighten the adjustment link bolt and the two pivot nuts and bolts.

CAUTION: To avoid damage to the alternator do not lever or apply pressure to the stator or slip ring end bracket.

5. Connect the battery, run the engine for three to five minutes at a fast idle, switch-off and check the belt tension.



ST2141M

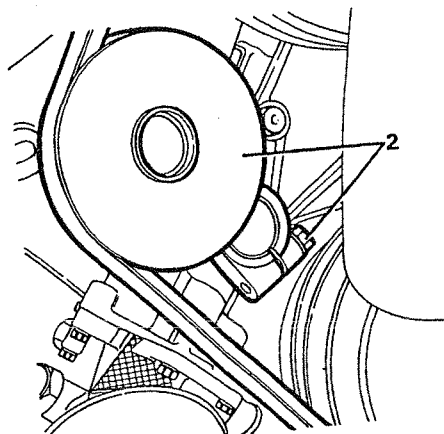
4. Move the alternator towards or away from the engine until the correct tension is obtained. Tighten the adjustment link bolts and the two pivot nuts and bolts and recheck the tension.

CAUTION: To prevent damage to the alternator. When carrying out instruction 4 do not lever or apply pressure to the stator or slip ring end bracket.

5. Connect the battery, run the engine for three to five minutes at a fast idle, switch-off and finally check the belt tension.

V8 engine fan drive belt with air conditioning

1. With thumb pressure, check the fan belt tension at the mid point of the run between the fan and crankshaft pulleys on the side opposite the tensioning pulley. If the deflection is less or greater than 4 mm to 6 mm adjustment is necessary as follows:
2. Disconnect the battery and slacken the tensioning pulley pinch bolt. Move the pulley to the left or right as required to achieve the correct tension and tighten the pinch bolt.

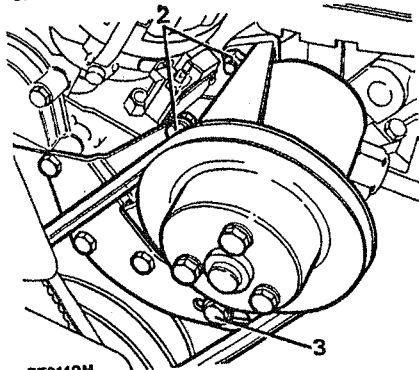


ST2139M

3. Connect the battery, run the engine for three to five minutes at a fast idle, switch-off and check the tension.

V8 engine power steering pump drive belt without air conditioning

1. Check, with thumb pressure, the drive belt tension at the mid point of the run between the crankshaft and power steering pump pulleys. If the deflection is less or greater than 4 mm to 6 mm adjustment is required as follows:
2. Slacken two pivot nuts and bolts.
3. Slacken the pump adjustment clamp bolt.



ST2140M

4. Move the pump in the required direction until the correct tension is obtained. Tighten the clamp bolt and the two pivot nuts and bolts.

CAUTION: Do not lever or apply pressure to the pump body to tension the belt since this will cause permanent damage to the pump.

5. Connect the battery, run the engine for three to five minutes at a fast idle, switch-off and recheck the belt tension.

V8 engine power steering pump drive belt with air conditioning

1. Check, with thumb pressure, the tension of the drive belt at the mid point between the crankshaft and steering pump pulleys. If the deflection is less or in excess of 4 mm to 6 mm the belt requires adjustment as follows:
2. Disconnect the battery and slacken the alternator adjustment link clamp and pivot bolts and the alternator two pivot nuts and bolts; see 'Alternator drive belt with air conditioning, adjustment'.
3. Slacken the power steering pump adjustment clamp bolt.
4. Slacken the steering pump two pivot nuts and bolts.

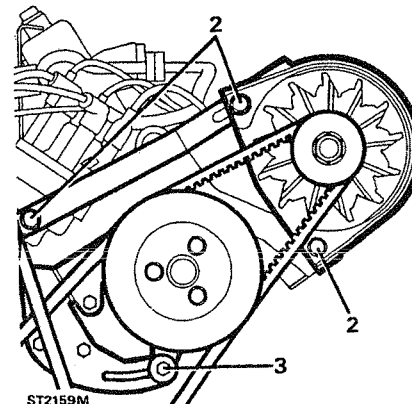
5. Move the steering pump in the required direction to achieve the correct tension. Tighten the link clamp and pivot bolts and the two pivot nuts and bolts.

CAUTION: Do not use a lever or apply pressure to the pump body since this will cause permanent damage to the pump.

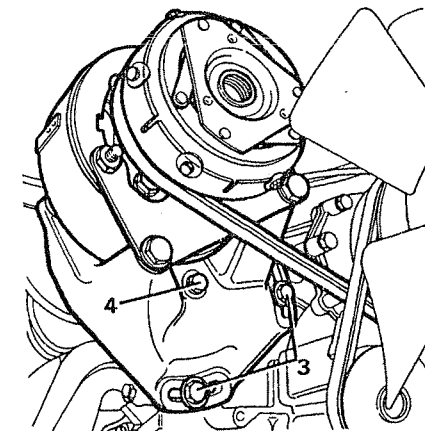
6. Adjust the alternator drive belt, see instruction 4 under 'Alternator drive belt with air conditioning'.
7. Connect the battery, run the engine for three to five minutes at a fast idle, switch-off and check both the steering pump and alternator drive belt tension.

V8 engine air conditioning compressor drive belt

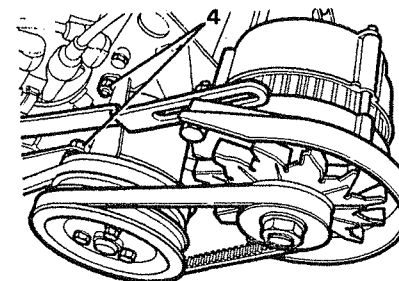
1. With thumb pressure, check the drive belt tension at the mid point of the run between the compressor and fan/water pump pulley. If the deflection is greater or less than 4 mm to 6 mm adjustment is necessary.
2. Disconnect the battery.
3. Slacken the two compressor mounting bracket clamp bolts.
4. Slacken the single pivot bolt in the centre of the bracket.



ST2159M



ST2711M



ST2165M

10 MAINTENANCE

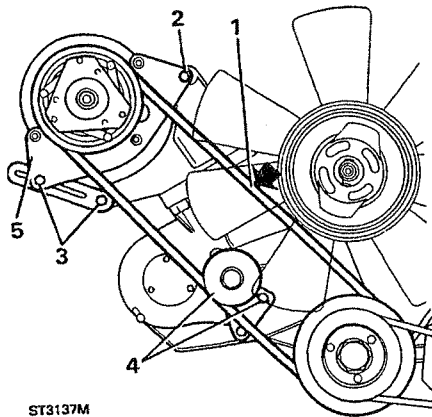
5. Move the compressor towards or away from the engine as necessary to achieve the correct tension. Tighten the clamp and pivot bolts and check the tension.

CAUTION: Do not use a lever or apply pressure to the compressor as this could cause permanent damage. If necessary, lever against the bracket whilst tightening the bolts.

6. Connect the battery, run the engine for three to five minutes at a fast idle, switch-off and recheck the belt tension.

Tdi Defender engine air conditioning drive belt - Check and adjust tension

1. The tension of the belt is correct when, with thumb pressure, the belt deflects 12 mm at the mid point of the run between the pulleys on the opposite side to the damper.
2. If adjustment is required, disconnect the battery and slacken the compressor pivot bolts.
3. Also slacken the clamp and clamp pivot bolts.
4. If the damper is touching the belt slacken the two bolts and move it aside.
5. Using a lever against the compressor bracket, move it away from the engine to tension the belt.
6. Whilst holding it in this position, tighten the clamp and pivot bolts and check the deflection.
7. Adjust the damper so that it just touches the belt or 1 mm clear and tighten the damper bolts.
8. Connect the battery, run the engine for three to five minutes, switch-off and check the tension.



ST3137M

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DISMANTLE AND OVERHAUL

Special tools:

- Chain wheel extractor - RO507231
- Tappet guide remover - RO530101A
- *Camshaft bearing remover - RO274388
- *Camshaft bearing adaptor - RO531760
- *Camshaft bearing guide plug - RO274394
- *Camshaft bearing reamer - RO274389
- Cork - seal guide - LRT-12-035
- Seal guide - rear main bearing - LRT-12-95
- 18G 1344
- Seal replacer - rear main oil seal - LRT-12-008
- 18G 134-11
- Diesel engine timing gauge - LRT-12-042
- RO605863
- Diesel engine timing gauge - LRT-12-500-MS67B
- Clutch centralising tool - LRR-12-040-RO605022

*Whilst these tools are now not obtainable, their use is described for workshops that have them available.

NOTE: Where the use of special service tools is specified, only these tools should be used to avoid the possibility of personal injury and or damage to components.

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.

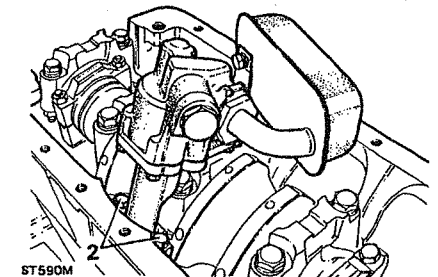
6. Remove the six bolts and withdraw the oil filter tube (early engines only). At the same time remove the two joint washers and the baffle plate with the timing pointer attached. Do not disturb the two bolts retaining the timing pointer. Later engines have a single plate with timing pointer.
7. Remove the vacuum pump.

Petrol and diesel engine

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.

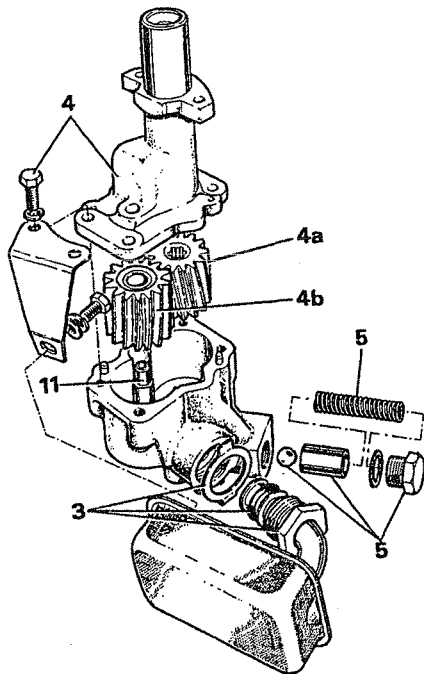
REMOVE AND OVERHAUL OIL PUMP

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.



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.

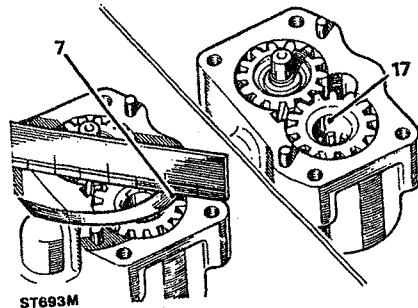


ST591M

Overhaul the oil pump

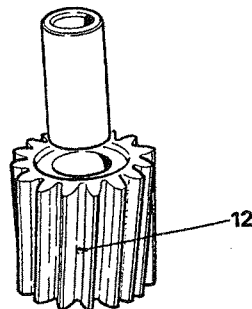
6. Examine the gears for wear, scores and pits. If the gears appear serviceable check for end-float as follows:

7. Clean the pump body and assemble the gears. Place 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 .
 9. Driven gear 0,05 to 0,12 mm .



ST693M

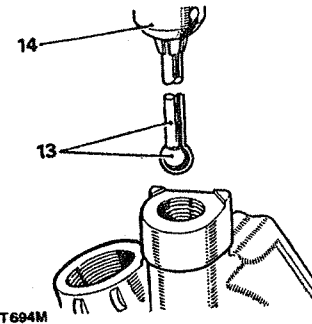
10. Gears must be renewed in pairs. A worn, but serviceable gear, must not be matched with a new one.
11. If necessary renew idler gear spindle by drilling-out the peened over end of the spindle so that the spindle can be withdrawn from the pump body. To ensure squareness when fitting the new spindle, 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 and ream the bush to 12,7 mm diameter.



ST 911M

REMOVE AND OVERHAUL THE TIMING CHAIN, SPROCKETS AND TENSIONER

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 diablo method as for lapping valves.
15. Thoroughly wash the pump body to remove all traces of grinding paste.

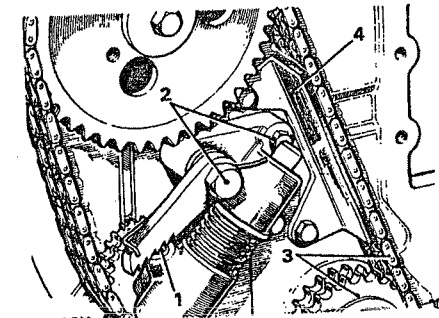


ST694M

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 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.

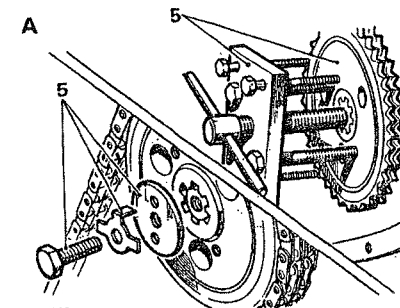
1. Remove the timing cover. Before removing the timing chain tensioner note the ratchet position in relation to the pawl which will give an indication of chain wear. If the last tooth of the ratchet is engaged with the pawl the chain is excessively worn and should be discarded.
2. Remove the ratchet 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.



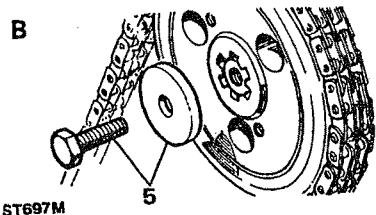
ST695M

5. Remove the camshaft sprocket retaining bolt and washer. Withdraw the sprocket using chain wheel extractor RO507231 or similar.

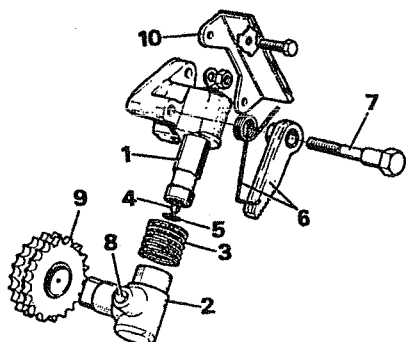
Illustration A shows the early retaining bolt and washer. Illustration B shows the latest bolt and special washer.



ST696M



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

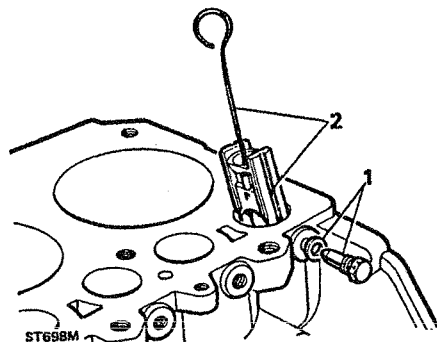
8. Assemble the tensioner as illustrated and compress the assembly ready for fitting to the engine.

REMOVE TAPPETS, ROLLERS AND GUIDES

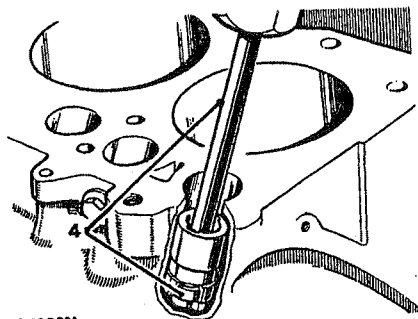
1. Remove the eight tappet guide locating bolts from the right-hand side of the cylinder block.

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.

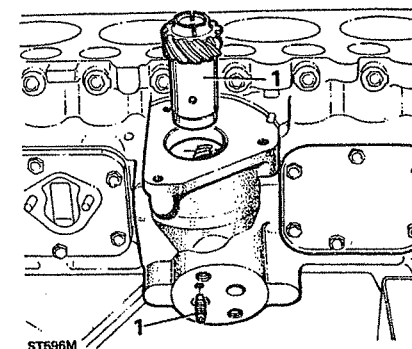


3. Lift out the tappet rollers and mark the side facing the front of the engine for possible reassembly.
4. Lift out the tappet guides and retain with their respective slides and rollers. If the guides are difficult to remove use special tool RO530101A.
5. Carefully examine all parts and discard any that are worn or damaged.



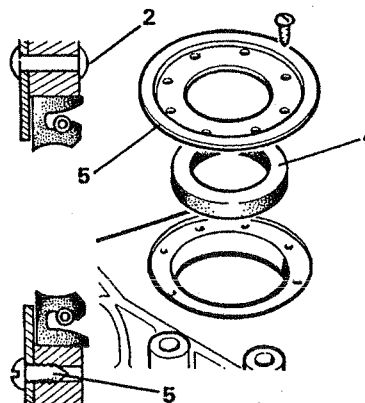
RENEW TIMING COVER OIL SEAL

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.



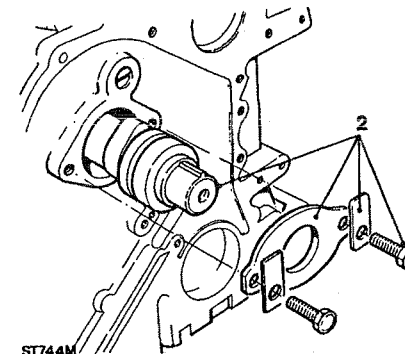
2. Since the camshaft sprocket has already been removed, bend back the lock tabs, remove the two bolts and the camshaft thrust plate. Carefully withdraw the camshaft.

NOTE: Lock tab washers are not used on later engines



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.

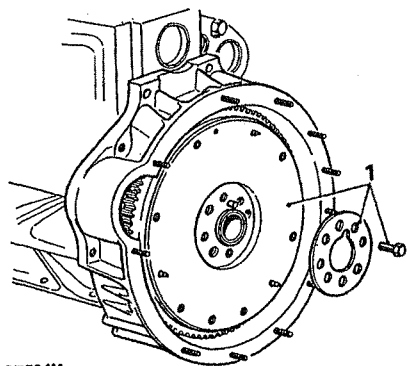


Inspect the camshaft

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 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 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

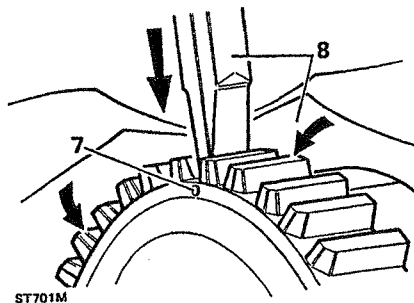
2. Wear or scores on the flywheel clutch face can be corrected by machining provided that the overall width of the flywheel is not reduced below the following dimensions:
Petrol engines 34,72 mm.
Diesel engines 36,96 mm.
3. Check that the flywheel has not been previously machined.
4. Examine the ring 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.

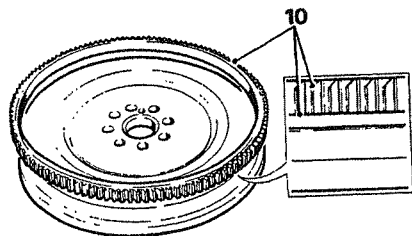
Renew the ring gear

7. Drill a 8,0 mm 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 uniformly 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.

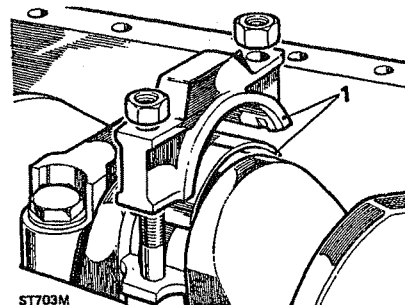


ST928M

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.

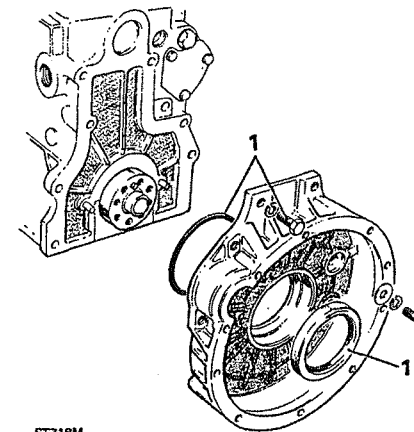


ST703M

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.

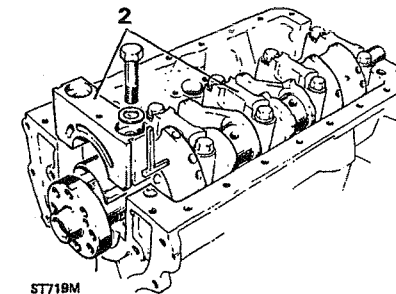
REMOVE, INSPECT AND OVERHAUL CRANKSHAFT

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.



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.

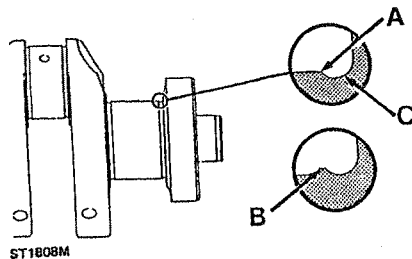
- With a micrometer, measure and note the ovality and taper of each main bearing journal and crankpin as follows:
- Ovality** - Take two readings at right-angles to each other at various intervals. The maximum ovality must not exceed 0,040 mm.

- 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.

- 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 taking into account any ovality in the centre journal. The overall allowable wear limit should not exceed 0,114 mm for main bearing journals and 0,088 mm 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, Section 04.

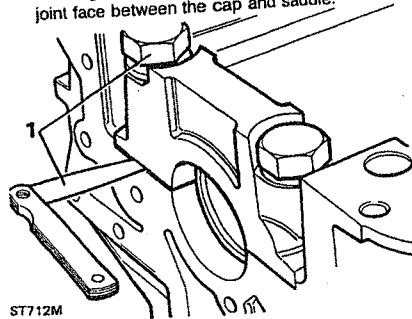
When grinding the crankshaft main bearing and crankpin journals, rotation of the grinding wheel and crankshaft must be in the same direction, anti-clockwise, viewed from the flywheel end of the crankshaft. Final finishing of the journals should be achieved by using a static tapping stone with the crankshaft 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

- 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

- 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. The difference between the two figures is the ovality of the top of the bore. Similar measurements should be made approximately 50 mm 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.
- 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.
Maximum permissible taper 0,254 mm.
Maximum permissible overall wear 0,177 mm

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

- 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 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.

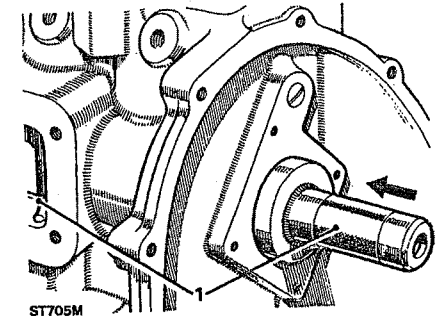
- Machine the cylinder bores to accept the sleeves to 94,425 + 0,012 mm. This will give the sleeve a 0,076 to 0,114 mm interference fit.
- Press the sleeves squarely into the bore using a pressure of two to three tons. Excessive pressure could damage the sleeve and cylinder block. The sleeves must not be proud of the cylinder block top face or more than 2,5 mm below the surface.
- 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.

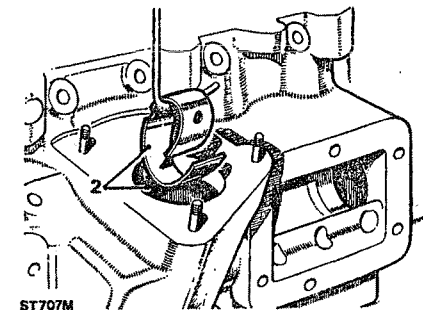
RO605975 Bearing drift and adaptor assembly comprising:
RO274388 Bearing drift and
RO531760 Adaptor.
RO274389 Reamer for bearings which includes:
RO274394 Guide plug.

- Remove the rear bucket type plug and using special tool RO274388 drift out the front and rear bearings and withdraw them through the side cover apertures.



ST705M

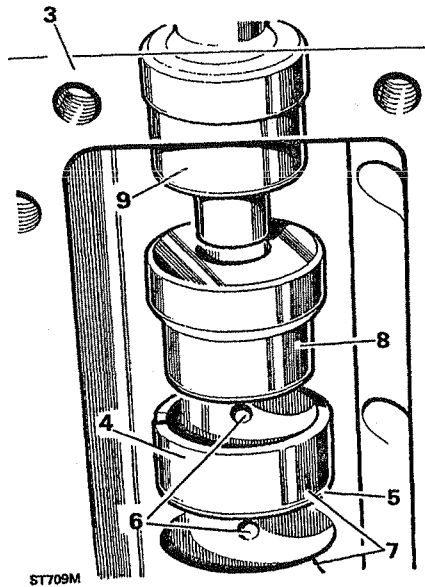
- With the same tool, drift the two centre bearings into the distributor drive chamber and collapse them to assist withdrawal.



ST707M

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.

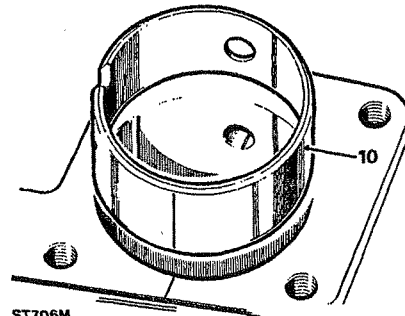
3. Position the cylinder block vertically, rear face down.
4. Place a new bearing into the front camshaft chamber and position it so that it is above the second bearing housing, counting from the front of the block.
5. The chamfer on the bearing edge must be towards the housing bore.
6. Align the oil 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 RO531760.



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

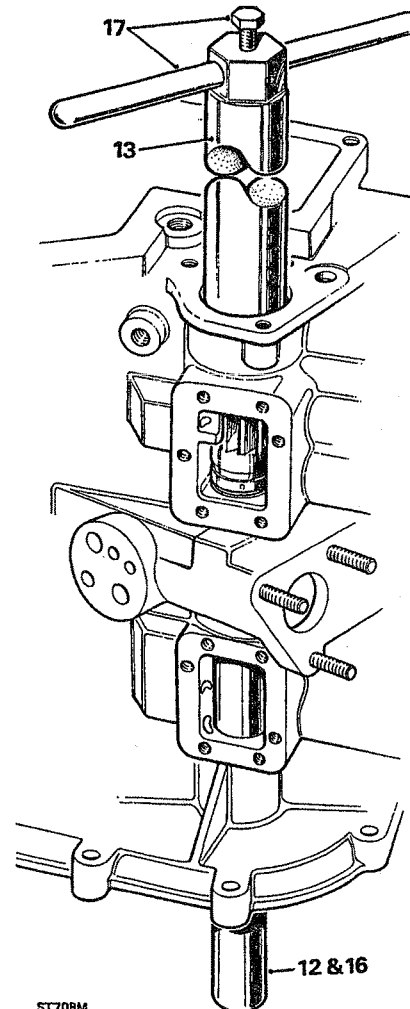
10. Repeat the above instructions for the front bearing. Note that the front bearing is wider and has a small hole in addition to the large oil feed hole. This small hole aligns with a vertical drilling in the block, which in turn feeds a horizontal drilling for the tappet mechanism. Drift this bearing 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 RO274394, 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 RO274389 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 RO274394 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.
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

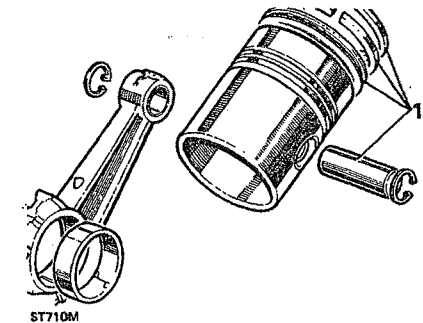
21. Discard scored, pitted, cracked and worn bearing shells.
22. To determine the maximum wear, assemble the main bearing shells and caps to the crankcase and tighten the bolts to the correct torque figure.
23. Using an inside micrometer, measure each bearing at several points and note the greatest figure. 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'.

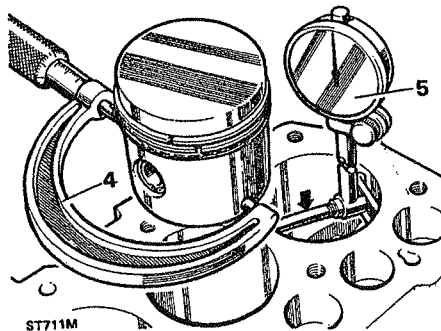
11

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 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 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.

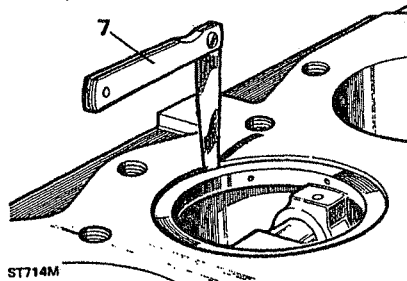
- Using a suitable micrometer measure the pistons at the bottom of the skirt at right angles to the gudgeon pin.
- With an inside micrometer or cylinder gauge measure the diameter of the bore at approximately half-way down and note the reading.
- The clearance is determined by subtracting the piston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



ST711M

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 is felt, the clearance is satisfactory.



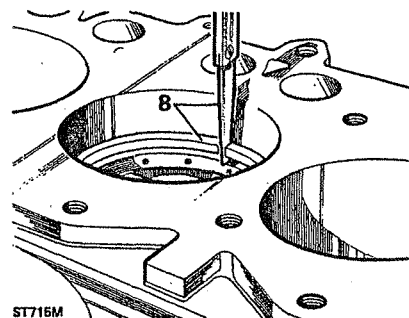
ST714M

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.

- 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.
- 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.



ST716M

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, impairing 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.

- 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 the 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).

- 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.
- After fitting each ring, roll it around the piston groove to ensure that it is free and does not bind.
- Using an appropriate feeler gauge check the clearance between the rings and piston grooves. Clearances in excess of 0,106 to 0,152 mm are unacceptable and the ring and/or the pistons should be renewed.

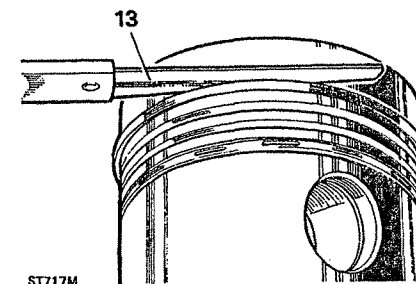
NOTE: Whilst the illustration shows a Diesel piston the method for the petrol is the same.

Side clearance data-petrol engine

Compression rings-0,046 to 0,097 mm.
Oil control ring-0,038 to 0,089 mm.

Side clearance-diesel engine

Compression rings-0,06 to 0,11 mm.
Oil control ring-0,038 to 0,064 mm.



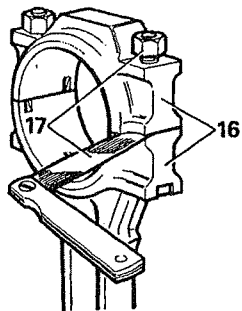
ST717M

Inspect gudgeon pins

- Check the gudgeon pin for wear, cracks, scores and overheating.
- 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

- 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.
- 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.
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.

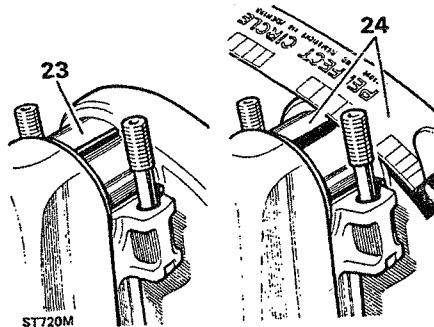
Connecting-rod bearing nip and clearance

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. 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 mm shim paper between the crankpin and one half of the bearing and tightening to the correct torque. The connecting-rod would 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.
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.

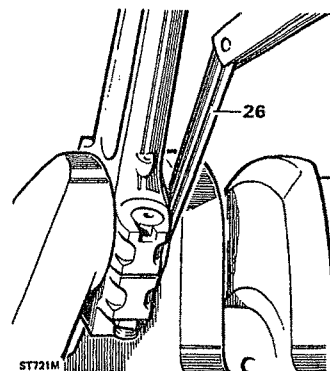
ASSEMBLE ENGINE

FIT CRANKSHAFT

Main bearing nip and clearance

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

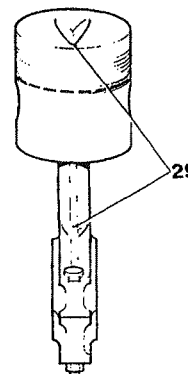
1. Fit the bearing halves in the crankcase saddles and caps and secure the caps to the crankcase and tighten to the correct torque. Slacken the bolts on one side of the caps only and, with a feeler gauge, check the gap between the joint faces. The clearance or nip must be within 0,10 to 0,15 mm. The 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 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.



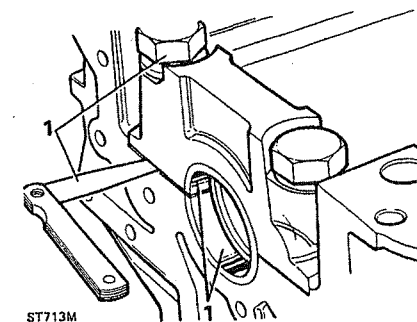
ST721M

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.
30. 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.



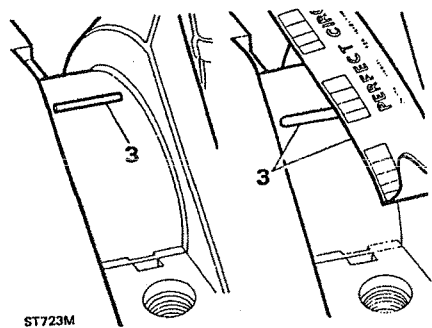
ST722M



ST713M

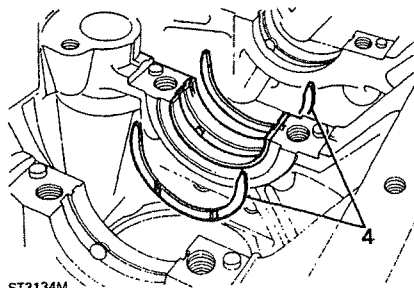
As an alternative 'Plastigauge' may be used to check the clearance in the same manner as with the connecting-rod bearings. This material may also be used to determine the amount of wear in used bearings and journals.

3. Locate the crankshaft in position in 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.

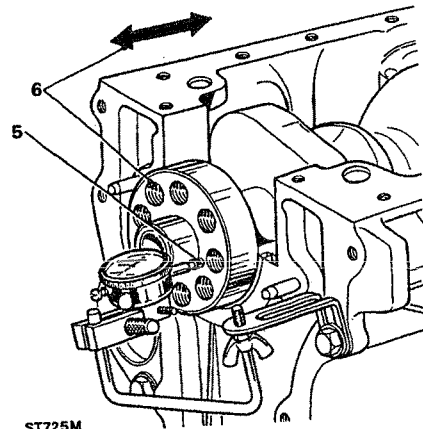


Adjust crankshaft end-float

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.



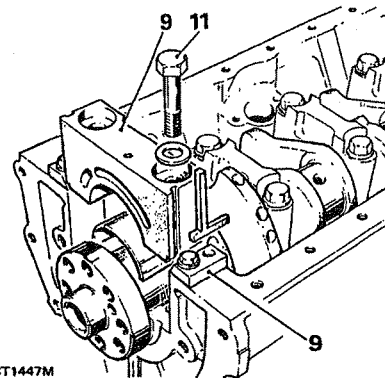
5. Place the crankshaft in position in the crankcase and mount a dial test indicator to read-off the end of the crankshaft. A feeler gauge may be used instead of an indicator.
 6. Determine the end-float by moving the crankshaft away from the indicator and zero the dial. Move the crankshaft in the opposite 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.
 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 to ensure that the crankshaft remains centralised.



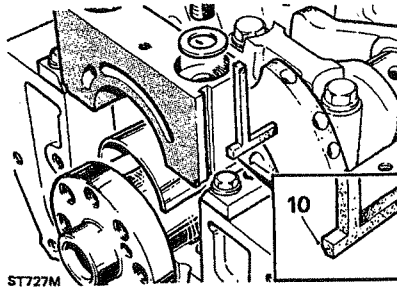
8. Lubricate the crankshaft main journals with clean engine oil and fit the appropriate bearing caps and lower shells to the crankcase with the exception of number five main bearing. Ensure that the caps locate properly over the dowels. Using new bolts and washers evenly tighten to the correct torque 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 RO270304 to the crankcase, as illustrated, and ensure that they are parallel to the crankcase edge.

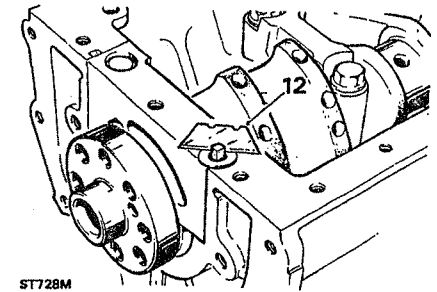


10. To prevent any cork seal material becoming trapped between the bearing cap and crankcase, chamfer the inner edge of the corks 0,40 to 0,80 mm wide as illustrated. Immerse the cork seals in engine oil and fit them to the bearing cap.



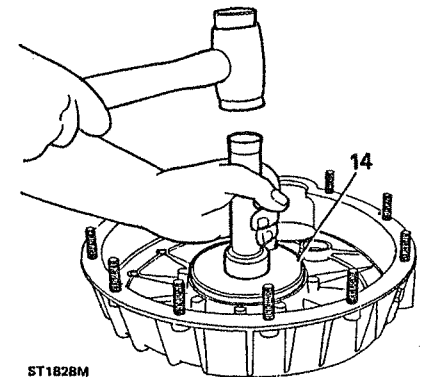
11. Fit the bearing cap and lower shell to the crankcase and secure with new bolts and washers and tighten to the appropriate torque.
 12. To allow for shrinkage after fitting leave the cork seals standing proud of the crankcase-ump face. If possible delay the fitting of the sump for approximately twelve hours and leave the seal protruding 2,40 mm and then place a 6,350 mm 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 proud, that is, the thickness of the above washer.

Apply Hylomar SQ32M to the protruding end of the seals.

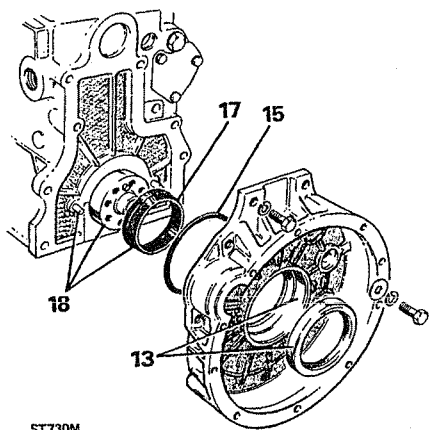


Fit rear main oil seal

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.



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.

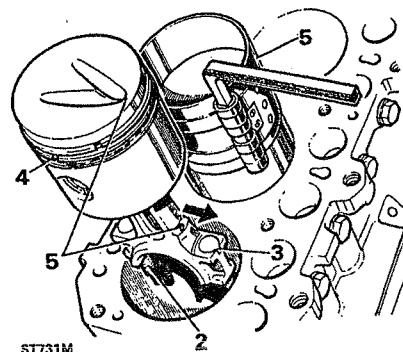


ST730M

FIT THE CONNECTING-RODS AND PISTONS

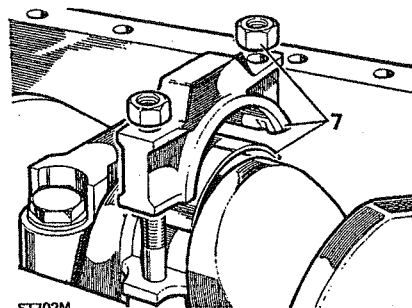
1. Turn the crankshaft to position numbers one and four crankpins at bottom dead centre to facilitate fitting the connecting-rods.
2. When fitting the connecting-rods and pistons ensure that the bolts do not foul and damage the crankpins. As a precaution it is recommended that rubber or soft plastic 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 RO 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

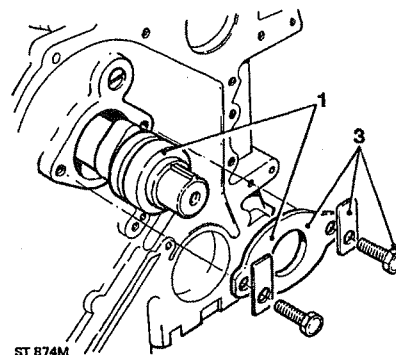
7. Check that the bearing shell is properly located in the connecting-rod and pull the rod onto the crankpin. Locate the bearing shell correctly and fit the cap so that the identification numbers are together on the camshaft side of the engine. Fit and tighten new nuts to the correct torque figure. Repeat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



ST702M

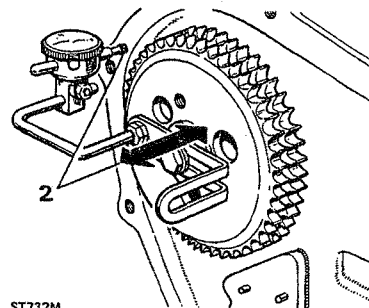
FIT THE CAMSHAFT

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.



ST 874M

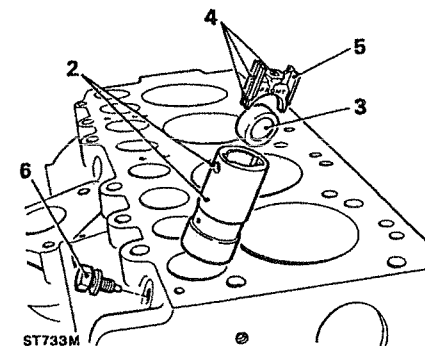
2. To check the camshaft end-float, fit the woodruff key and temporarily fit the camshaft chain wheel and mount a dial test indicator, as illustrated, so that the stylus rests in a loaded condition upon the machined face of the cylinder block. Zero the dial and move the camshaft back and forward and note the reading. The end-float should be within 0.06 to 0.13 mm. 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 omitted on later engines).



ST732M

FIT TAPPETS, GUIDES AND ROLLERS

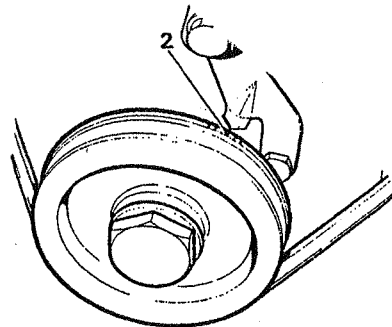
1. If the same parts are being refitted ensure that they are returned to their original positions. Ensure that the tappet slides move freely in the guides.
2. Insert the tappet guides into the cylinder block and align the locating screw holes.
3. Fit the tappet rollers ensuring that they are fitted in 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.



ST733M

FIT THE FLYWHEEL

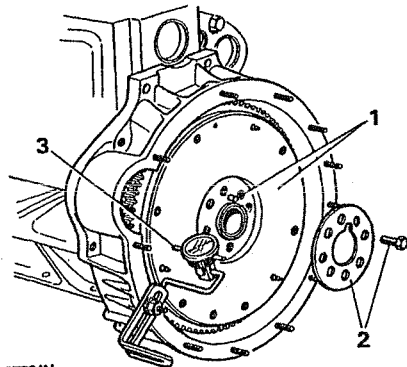
1. Examine the flywheel and crankshaft mating faces and remove any burrs or imperfections that could prevent the flywheel locating correctly. Check that the dowel is in position.
2. Offer up the flywheel to the crankshaft and secure with the reinforcing plate and retaining bolts. Evenly tighten the bolts 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. Turn the flywheel, and check that the run-out does not exceed 0,05 to 0,07 mm. 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

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.

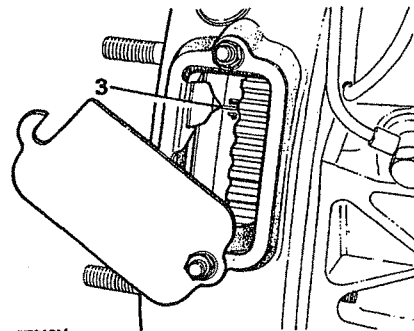


ST734M

FIT CYLINDER HEAD AND ROCKER SHAFT ASSEMBLY

Petrol engine

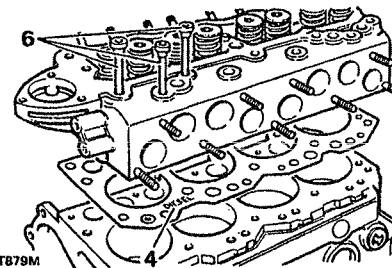
1. Temporarily fit the timing cover with pointer and crankshaft pulley.
2. Turn the crankshaft clockwise, in the normal running direction, to bring numbers one and four pistons to T.D.C. If the crankshaft is inadvertently turned beyond T.D.C do not turn it back, but continue on round until the T.D.C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



ST613M

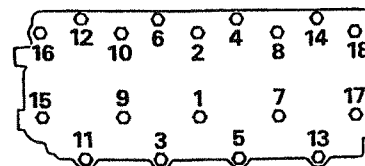
Petrol and Diesel engines

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.



ST879M

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.



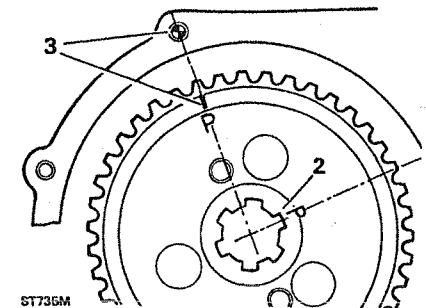
ST 880M

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.

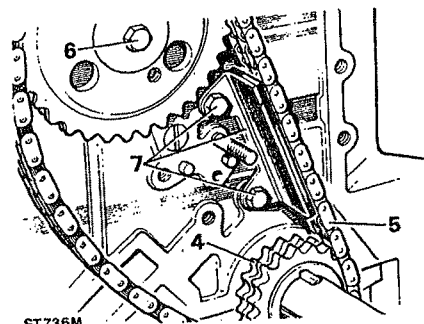


ST736M

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 taut 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.

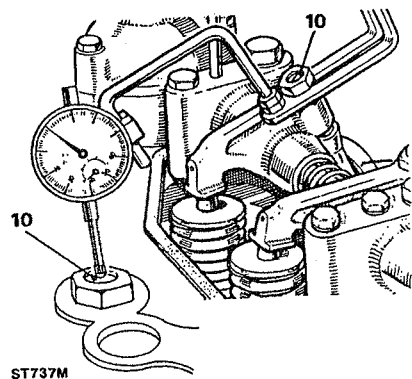
NOTE: Early engines use an ordinary bolt and tab washer.

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

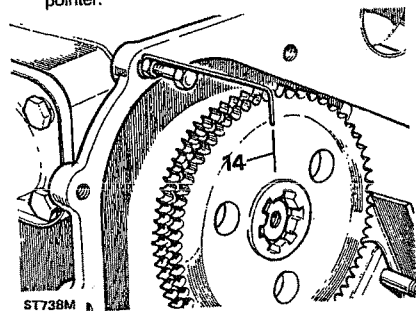


Diesel engines

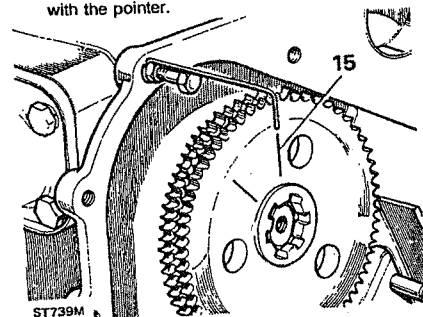
8. Maximum engine performance and efficiency depends upon the care and accuracy exercised during the following instructions.
9. Check that the E.P. mark on the flywheel is still exactly aligned with the pointer on the flywheel housing.
10. The valve timing is based upon the exhaust valve peak of number 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.



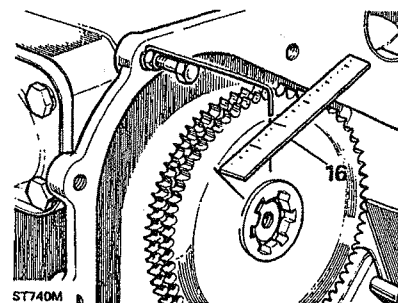
11. Manufacture a suitable pointer, and attach one end to the top bolt hole in the cylinder block and the pointer close to the camshaft chain wheel, as illustrated.
12. Turn the camshaft until the valve is fully open as indicated by maximum reading on the dial gauge.
13. Because the top of the cam is 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 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.



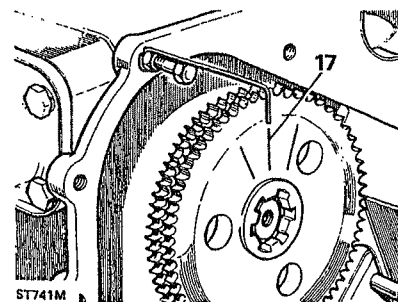
15. Turn the camshaft anti-clockwise and watch the needle move back to zero. Then continue turning until the needle indicates 0,25 mm which represents a point down the right-hand side of the cam and make another mark in line with the pointer.



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

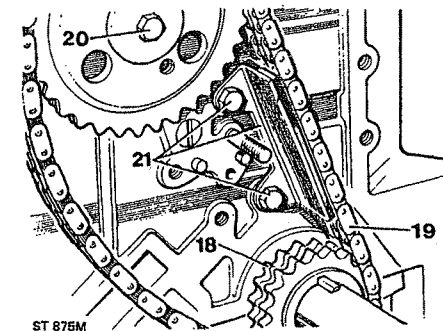


17. Remove the dial indicator, and turn the camshaft until the middle mark lines up with the pointer. The number one cylinder exhaust tappet roller should now be resting in the centre of the four degree flat period of the cam and the camshaft and crankshaft are in their correct relationship.



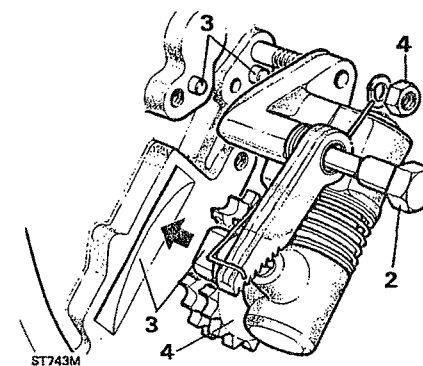
18. Fit the crankshaft chain wheel with the large shoulder towards the cylinder block.
19. Without moving the camshaft and crankshaft fit the timing chain keeping it taut on the drive side. Should it be impossible to obtain a taut fit, remove the chain wheel and position it in one of the five remaining 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 between the timing chain and damper. Tighten the two bolts and secure with new lock tabs.



FIT TIMING CHAIN TENSIONER

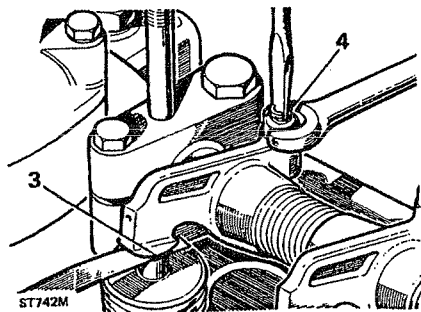
1. Assemble the timing chain tensioner in accordance with the illustration in "Dismantling".
2. Compress the assembly against the spring and fit to the engine whilst engaging the ratchet pivot bolt in the cylinder block.
3. Ensure that the piston housing locates on the dowels and single stud and the 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 side. 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 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.

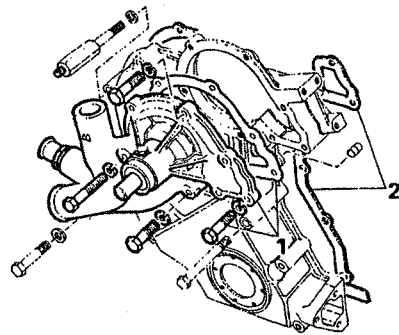


5. Continue to check and adjust the remaining tappets in the following sequence:

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.

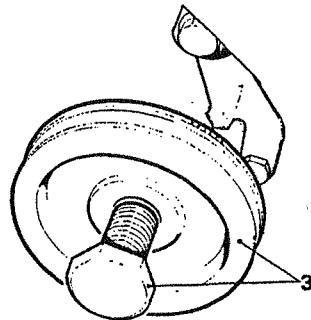
FIT TIMING COVER AND WATER PUMP

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.



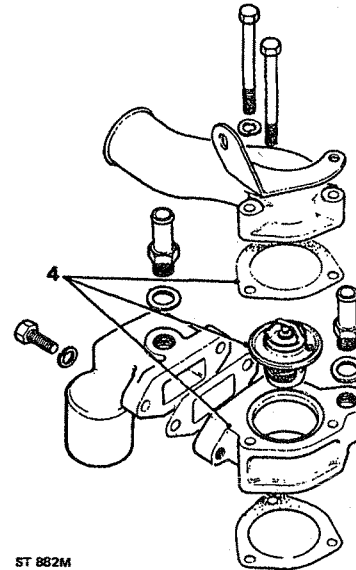
ST1269M

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.



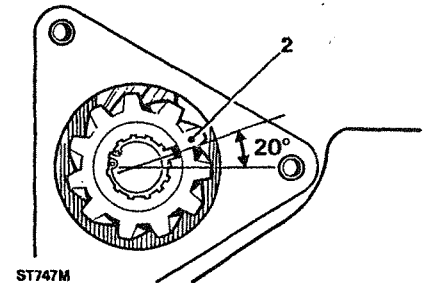
ST 882M

FIT THE SKEW GEAR

Petrol engine

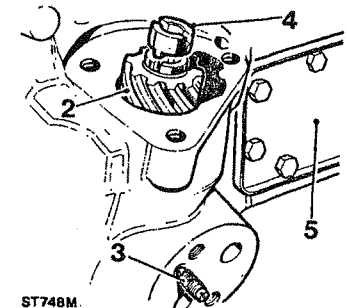
1. Turn the crankshaft to bring number one piston to T. D. C. with number four cylinder valves on the 'rock'. Check that the timing gear pointer coincides with the mark on the crankshaft pulley.

2. Lubricate and insert the skew gear assembly into mesh with the camshaft gear. Due to the helix 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

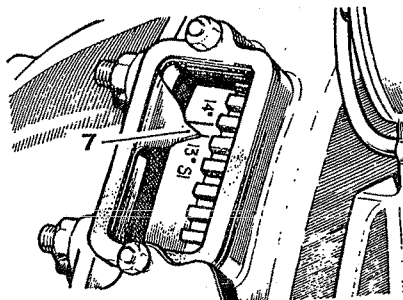
3. The skew gear assembly is located in its final position by a special screw. Without this screw the gear will go deeper into mesh resulting in an incorrect angle when the assembly is lifted up to locate the screw. The angle must therefore be checked again after the screw is fitted. Align the location hole in the bush and fit a new location screw into the cylinder block and re-check the angle. The screw should be tightened to 4 Nm and then backed-off one-eighth of one turn.
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

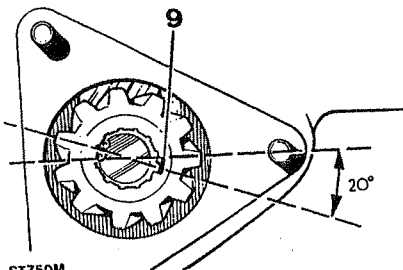
Diesel engine

- 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.
- 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 is inadvertently turned too far and the timing mark goes past the pointer do not turn the flywheel back but repeat the operation.
- 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.



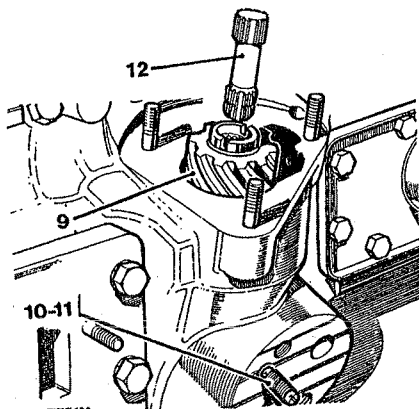
ST749M

- Lubricate and insert the skew gear assembly into mesh with the camshaft gear. Due to the helix 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

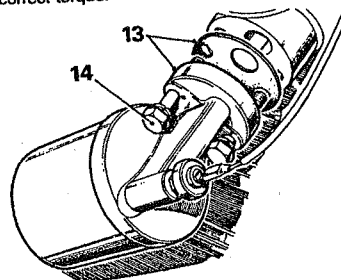
- The skew gear assembly is located in its final position by a special screw. Without this screw the gear will go deeper into mesh resulting in an incorrect angle when the assembly is lifted up to locate the screw. The angle must therefore be checked again after the screw is fitted.
- Align the location hole in the bush and fit a new location screw into the cylinder block and re-check the angle.
- 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

Petrol and Diesel engines

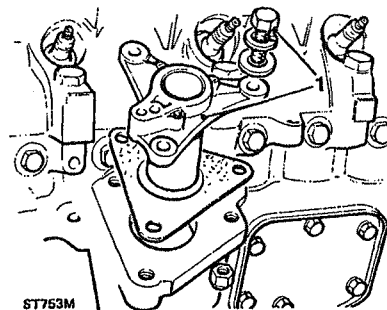
- Using a new joint washer fit the oil filter housing, ensuring that the retaining bolts pass through the two small round holes in the joint washer.
- Tighten the two retaining bolts evenly to the correct torque.



ST752M

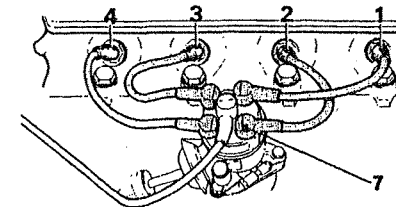
FIT IGNITION DISTRIBUTOR

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



ST753M

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

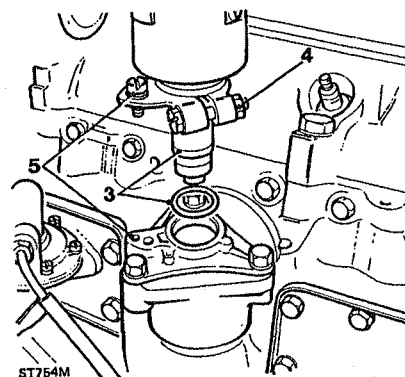


ST877M

FIT FUEL INJECTION PUMP

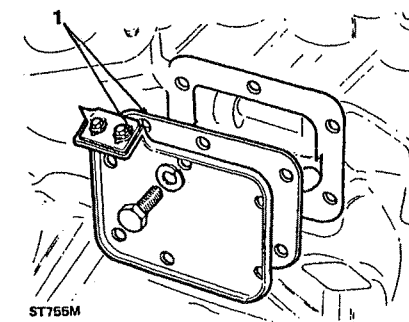
Using timing gauge RO605863

- Check that the distributor drive coupling, locates properly in the off-set slot of the skew gear.
- 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.
- Temporarily tighten the distributor clamp bolt pending final ignition timing adjustment when the engine is fitted to the vehicle.
- Secure the clamp to the adaptor plate with the single bolt.



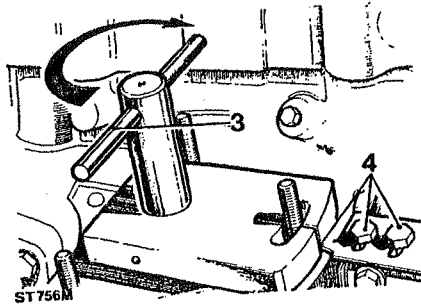
ST754M

- Using a new joint washer fit the camshaft front side cover with the timing pointer. Tighten the retaining bolts evenly to the correct torque.
- 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.

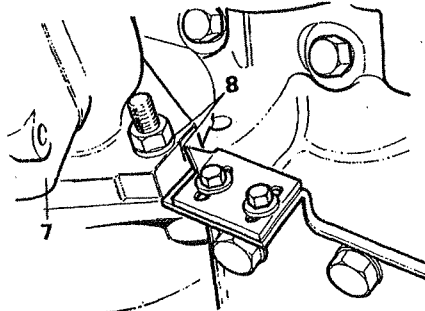


ST755M

3. Insert the timing gauge, RO605863, 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.



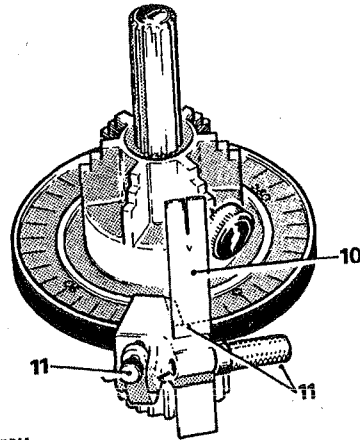
5. Rotate the driving gear on the distributor pump so that the master spline lines up with the master spline on the engine driving gear.
6. Check that the pump drive shaft is correctly located with the longer splines in the skew gear.
7. Fit the distributor pump to the engine engaging the master splines 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

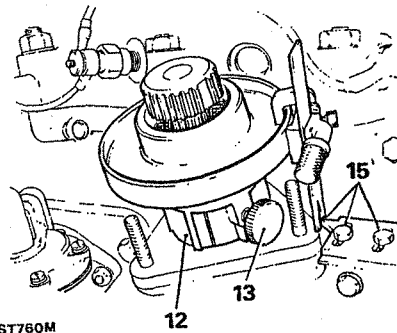
Using timing gauge MS 67B

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

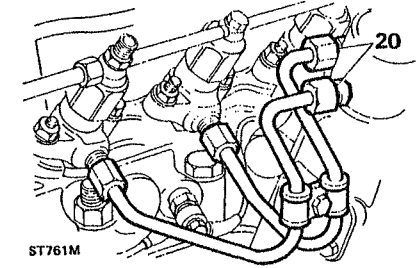
12. Insert the gauge into the vacant injection pump position and engage the gauge gear into injection pump drive splines.



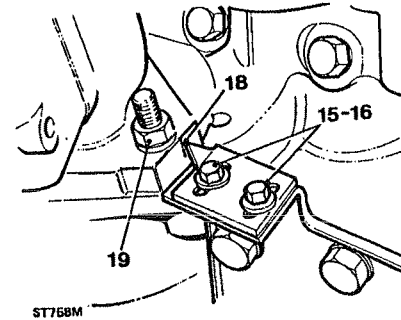
ST760M

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.

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

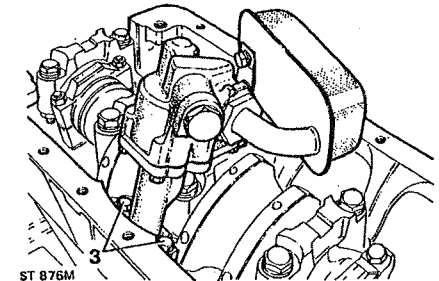


ST758M

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.

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.

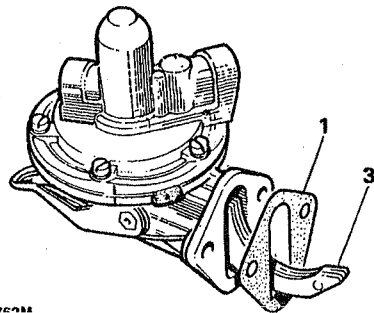


ST 876M

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.

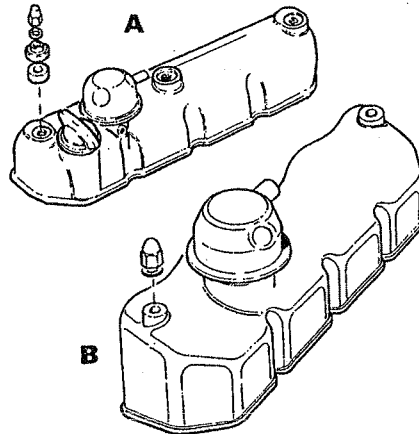


ST762M

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.

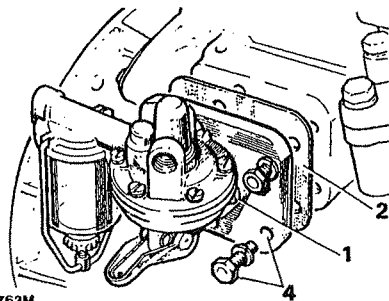
- A. Petrol engine
- B. Diesel engine



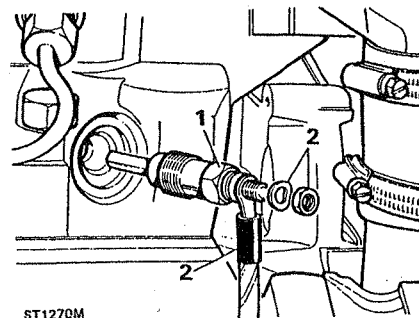
ST 881M

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.



ST763M

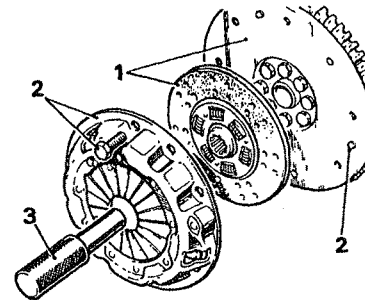


ST1270M

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

FIT THE CLUTCH

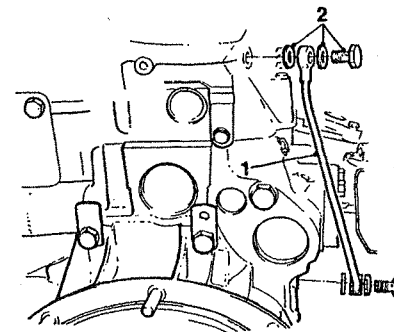
1. Clean the flywheel face and place the centre plate with the side marked 'Flywheel side' towards the flywheel.
2. Fit the clutch assembly locating it over the three dowels and loosely secure with the six bolts.
3. Centralise the centre plate using special tool RO 605022 or a spare primary shaft and 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.

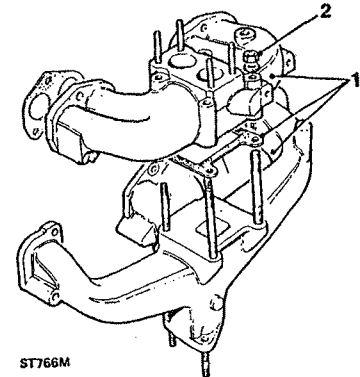


ST765M

FIT INLET AND EXHAUST MANIFOLDS

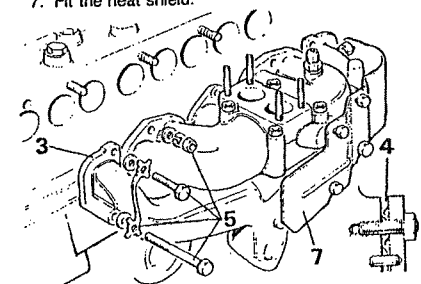
Petrol engine

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

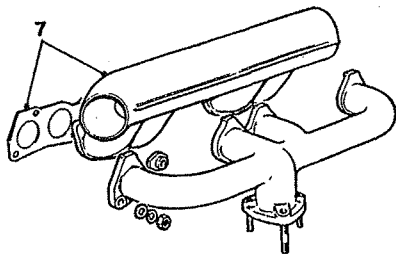
3. Coat the face of the exhaust manifold with Rocol anti-seize compound Foliac J166 (paste) and the corresponding face of the cylinder head.
4. Fit the joint washers of inlet manifold with the raised rings towards the cylinder head.
5. Fit and tighten the securing nuts and bolts to the correct torque 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

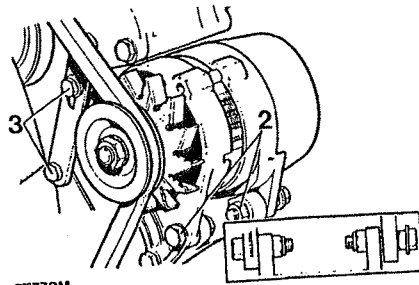
Diesel engine

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



ST768M

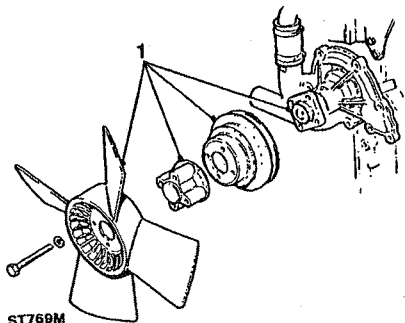
- Assemble the alternator to the engine bracket with the two pivot bolts, distance piece and washers, leaving the bolts slack.
- Fit the adjustment link to the timing cover and attach to alternator with the adjusting clamp bolt.



ST770M

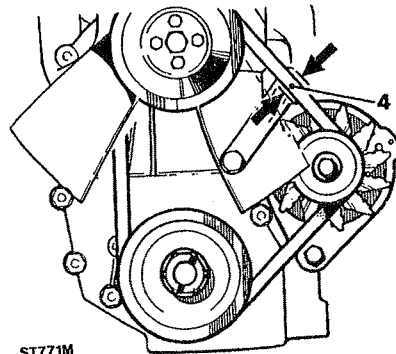
FIT ALTERNATOR, PULLEY AND FAN BLADES

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



ST769M

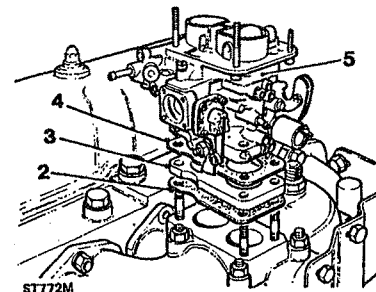
- Fit the drive belt and pivot the alternator away from the engine, but do not apply pressure to the stator or slip-ring end bracket or damage may result. Tighten the clamp bolt and with thumb pressure, check the belt tension between the fan and alternator pulleys which should be 7 to 9 mm at the mid-point.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



ST771M

FIT THE CARBURETTER

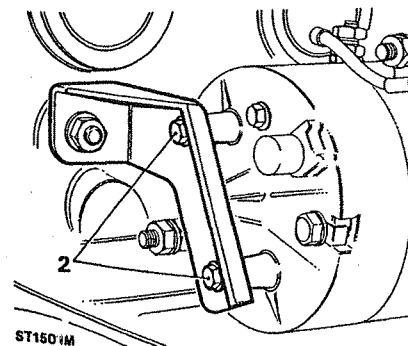
- Clean the carburetter and manifold mating faces.
- Place a joint washer, over the studs to the manifold.
- Fit the packing piece.
- Fit a second joint washer.
- Fit the carburetter and secure with the four nuts and washers tightening evenly to the correct torque.



ST772M

FIT THE STARTER MOTOR

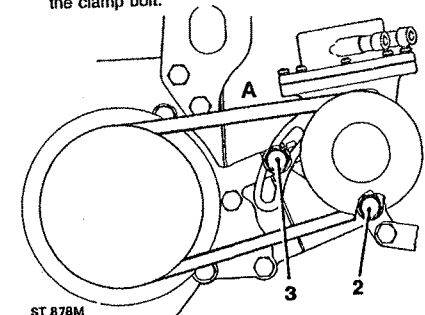
- Secure the starter motor to the flywheel housing noting that the petrol engine starter is held by two studs, nuts and washers. The starter for the diesel engine is retained by one stud, one bolt and one nut and bolt. Tighten the fixings evenly to the correct torque.
- In addition, the rear of the Diesel engine starter motor is secured by two bolts to a support bracket attached to the cylinder block.



ST1501M

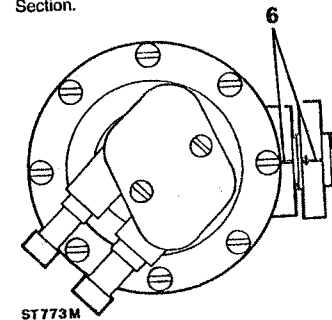
FIT VACUUM PUMP -Diesel engine only

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



ST 878M

- Turn the pump pulley so that the indicating marks on the pulley hub and pump body line up.
- 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.



ST773M

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 CYLINDER HEAD

Special tools:

- Drift inlet valve guides RO274400
- Drift exhaust valve guides RO274401
- Drift exhaust valve guide RO600959
- Drift inlet valve guide RO601508
- Seat cutters MS621 MS627
- Insert replacer RO530625

REMOVE/DISCONNECT ANCILLARY ITEMS

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.

Petrol engine only

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

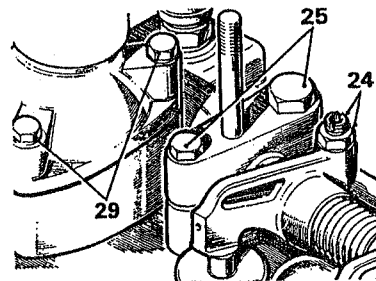
Diesel engine only

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

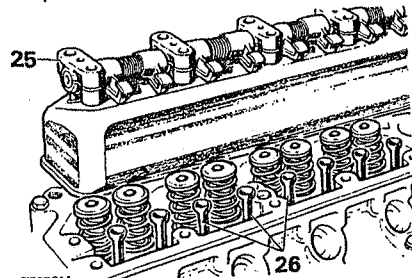
The following instructions for removing and overhauling the cylinder head are common to petrol and diesel engines unless otherwise stated.

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.

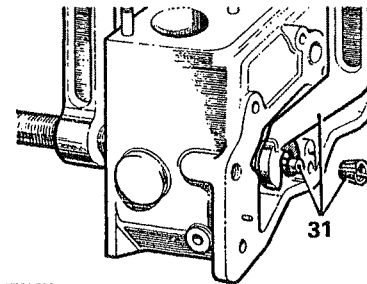


ST674M

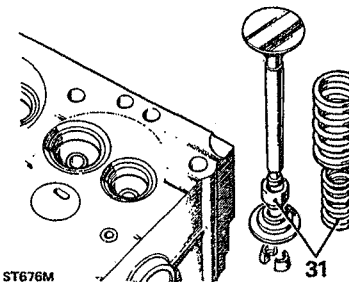
28. Remove the eight bolts and three nuts and remove the inlet and exhaust manifolds complete with carburettor (petrol engine).
29. Remove three bolts and lift-off the thermostat housing, elbow and thermostat.
30. Remove spark plugs, (petrol engine) temperature sensor and engine lifting eyes.
31. Using valve spring compressor RO276102 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



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

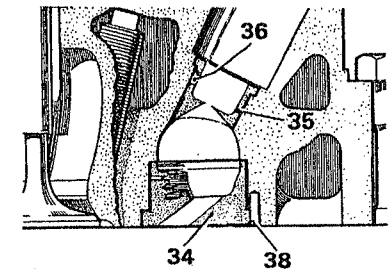
33. Same as for petrol engine and in addition, worn or damaged exhaust seat inserts should be renewed, as described later.

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, ending from the opening to approximately 8,0 mm 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.

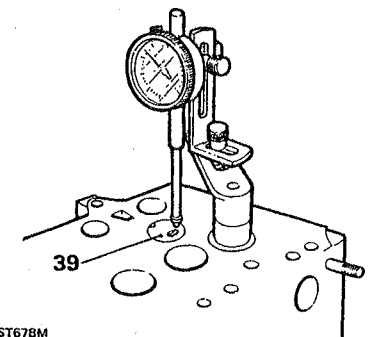
34. To remove a hot plug, insert a thin soft metal drift through the injector shroud throat and tap the hot plug from the inside. Once removed a faulty hot plug cannot be restored and must be renewed.
35. If the injector shroud is damaged, drift the shroud out towards the injector bore.
36. Thoroughly 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 and are not recessed below the level of the cylinder head face more than 0,05 mm.



ST678M

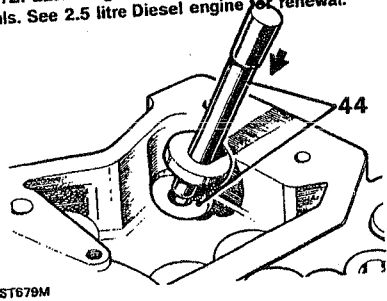
Petrol and diesel engines

40. Check the valve guides for wear by inserting a new valve in the appropriate guide-mm above the seat. If movement across the head exceeds 0,15 mm 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)

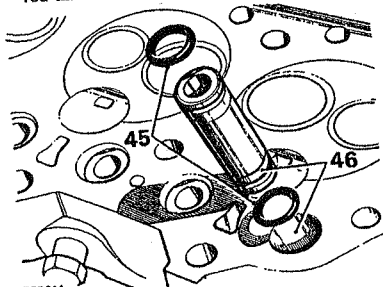
43. Whilst this is rarely necessary the procedure is nevertheless as follows.
44. Drive out the old push rod tubes using a suitable drift.

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



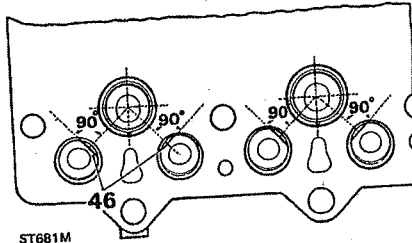
ST679M

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.



ST680M

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.

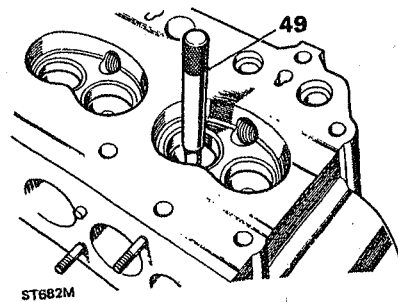


ST681M

Renew valve guide

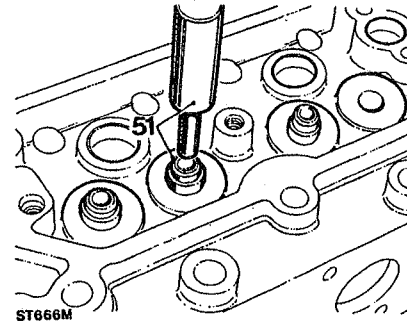
48. Support the cylinder head, combustion chamber uppermost on pieces of timber of sufficient thickness to allow clearance for the valve guides to be driven out.
49. Using special drift RO274400 for inlet guides and RO274401 for exhaust guides or suitable alternatives drive out the old guides from the combustion face side.

NOTE: The illustration shows a petrol engine cylinder head.



ST682M

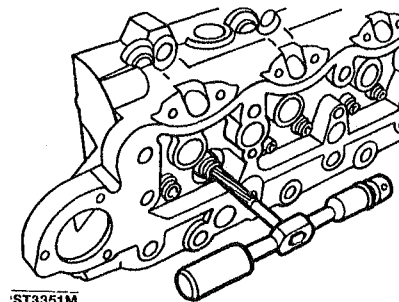
50. Turn the cylinder head over so the combustion chambers face downwards. Since the inlet and exhaust valve guides are dimensionally different it is important that the correct guides are fitted to the appropriate ports.
51. Lubricate new guides with engine oil and using special drift RO600959 for the exhaust and RO601508 for the inlet valve guides or suitable alternatives, drive in the new guides until the shoulder is flush with the casting.



ST666M

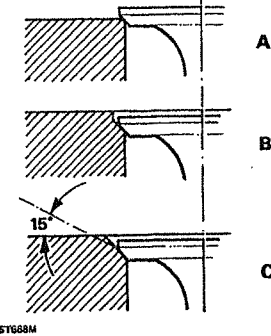
- 51A. To ensure a uniform internal diameter is maintained for the total length of the guide, ream the guides from the valve spring side of the cylinder head, using the following standard size hand reamers.

Exhaust guide reamer 0,3438 in
Inlet guide reamer 0,3125 in
Reamer tolerance + 0,0005 - 0,0000 in



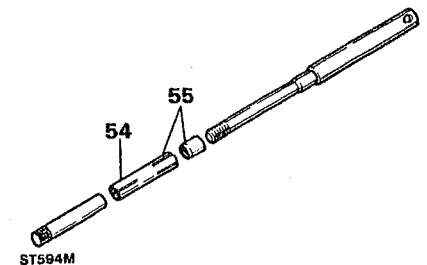
ST3351M

Reface cylinder head valve seats



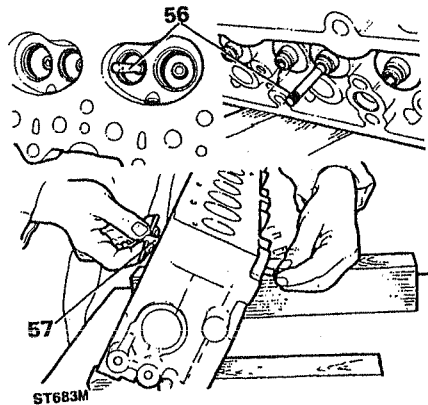
- A. Correctly seated valve
- B. Undesirable condition
- C. Method of refacing

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

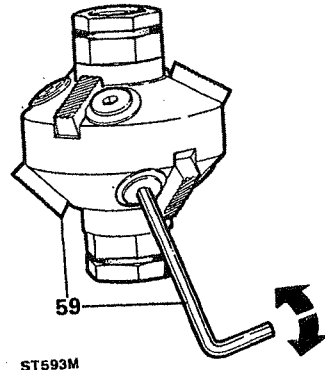


ST594M

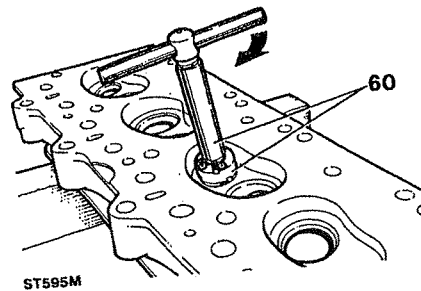
56. Insert the assembled pilot into the valve guide from the combustion face side of the cylinder head until the shoulder contacts the valve guide and the whole of the collet is inside the valve guide.
57. Expand the collet in the guide by turning the tommy bar clockwise whilst holding the knurled nut.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



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.



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.



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.

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

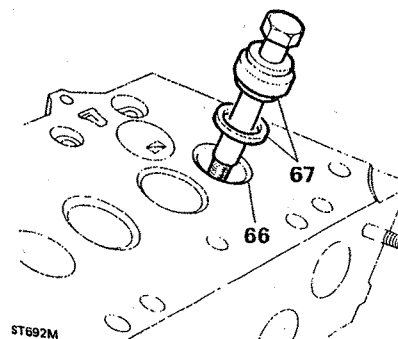
- | | |
|-------------------|--|
| A - Petrol engine | inlet valve seat
30° + 1/4°
exhaust valve seat
45° + 1/4° |
| B - Diesel engine | inlet valve seat
45° + 1/4°
exhaust valve seat
45° + 1/4° |

See illustrations following instruction 68.

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.
67. Assemble the new insert to the replacer tool RO530625 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.

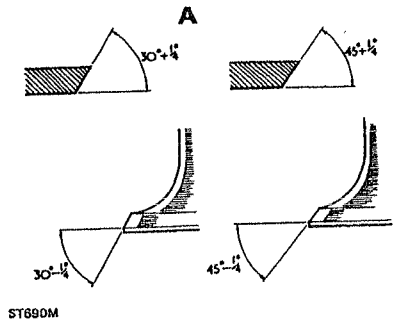


Reface valve faces

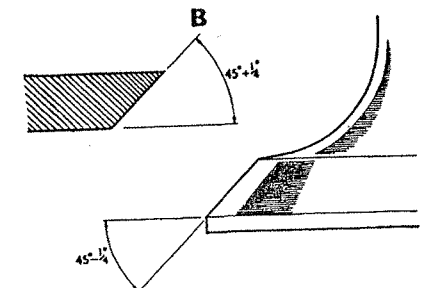
68. Valves that are satisfactory for further service can be refaced. This operation should be carried out using a valve grinding machine. Only the minimum of material should be removed from the valve face to avoid thinning of the valve edge. The valve is refaced correctly when all pits are removed and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

Valve face angles:

- | | |
|-------------------------|--|
| A. Petrol engine | Inlet valve face - 30° - 1/4°
Exhaust valve face - 45° - 1/4° |
| B. Diesel engine | Inlet valve face - 45° - 1/4°
Exhaust valve face 45° - 1/4° |



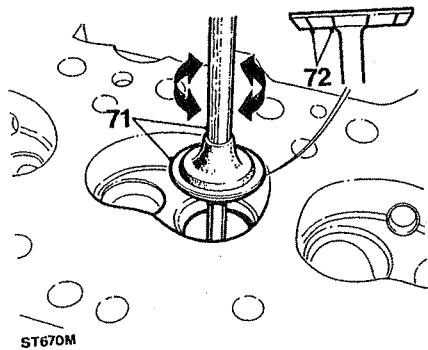
ST690M



ST691M

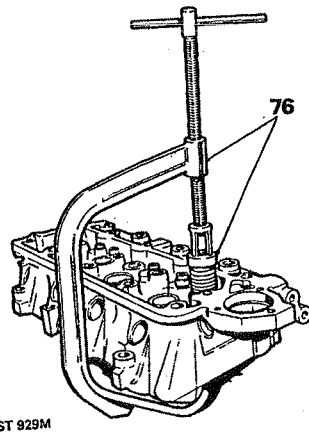
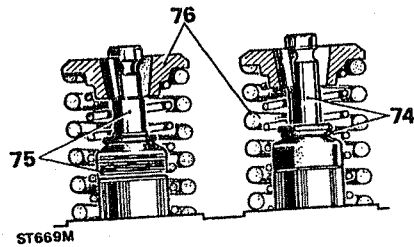
Lap-in valves

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 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 successful, 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.



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.
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.



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.

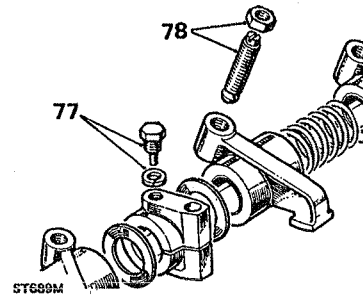
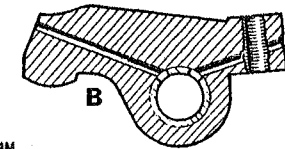
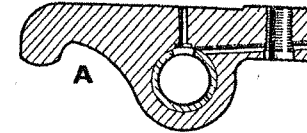


Illustration A. Cross section of petrol engine rocker.

Illustration B. Cross section of diesel engine rocker.



ST684M

79. Examine the rocker shaft for wear and discard if the bearing surface is worn more than 0,025 mm. 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. Press in replacements ensuring that the pre-drilled oil holes coincide with the holes in the rockers.

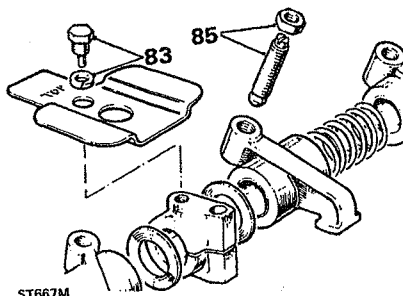
81. Using a reamer finish the bushes to 13,4 mm + 0,02 mm and clear swarf from the oil holes.
82. Examine the ball-end of the adjusting screws and discard any that are worn. Regrinding is not permissible. Check the threads for damage and that the oil relief drilling is clear.

Assemble rocker shaft assembly

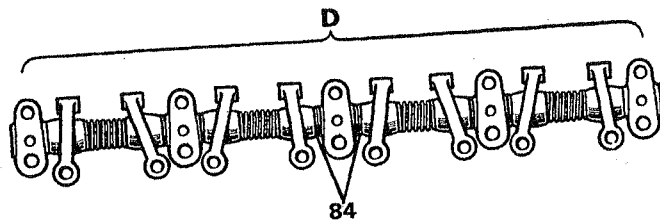
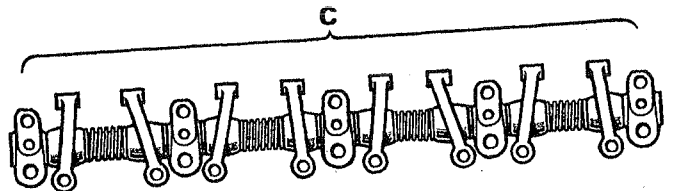
83. Check that the oil-ways in the rocker shaft are clear and fit number two rocker shaft bracket to the shaft and retain with the locating screw and washer. Note that the locating screw on petrol engines also secures the splash plate.
84. Using new spacers and springs, assemble the rockers and brackets 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.

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.



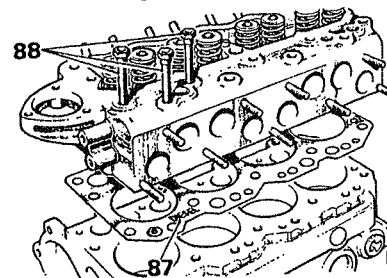
ST667M



ST688M

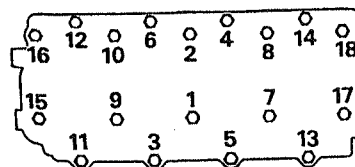
FIT THE CYLINDER HEAD

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.

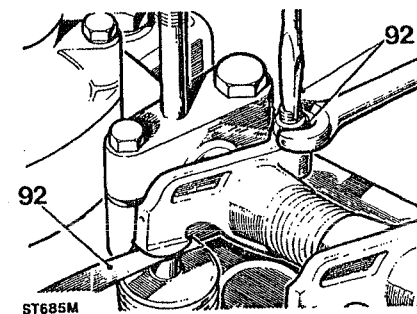


ST686M

92. Adjust the tappet clearances for petrol and diesel engines, inlet and exhaust to 0,25 mm 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.

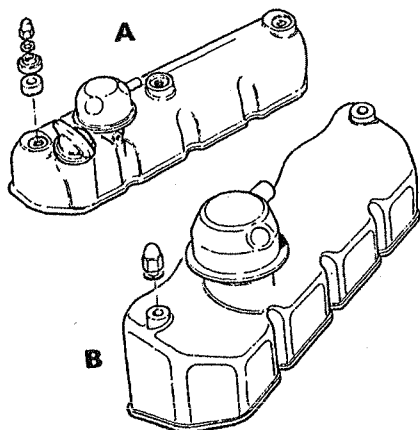
93. Recheck the clearances with the locknuts tightened and adjust as necessary.



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

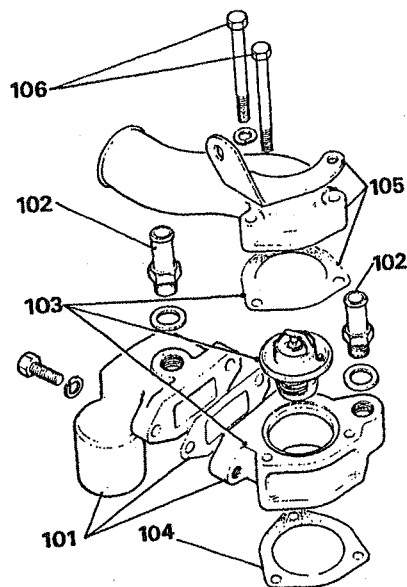


ST671M

95. Fit the inlet and exhaust manifolds complete with carburettor (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

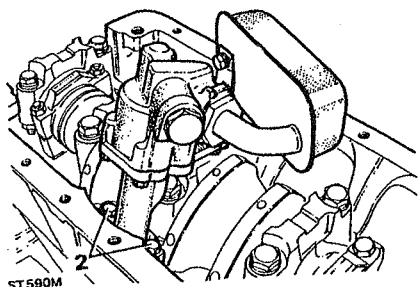
SUPPLEMENT TO THE 2.25 LITRE PETROL ENGINE OVERHAUL PROCEDURES

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.
- Cranksaft 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 valve 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 omitted 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 Hylosil 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.

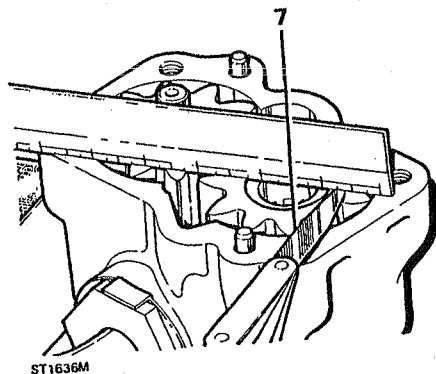


Dismantle oil pump

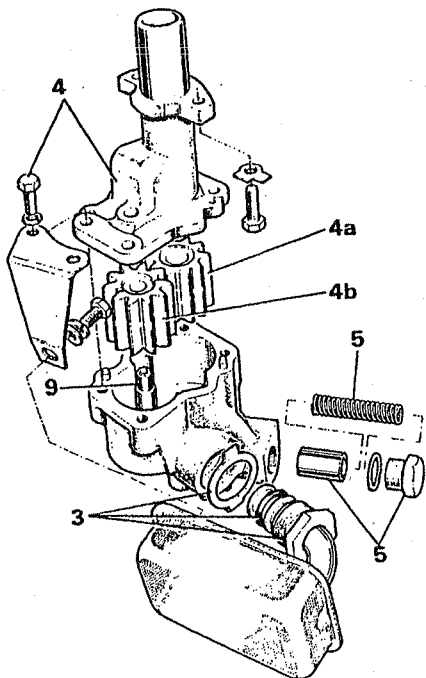
3. Bend back the lock washer and release the nut securing the strainer to the oil pump body and remove the strainer and sealing ring.
4. Remove four bolts and washers and lift off the oil pump cover and lift out the driven and idler gears.
 - (a) driven gear
 - (b) idler gear
5. Remove the oil pressure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



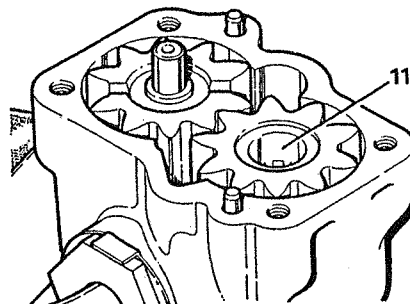
8. Gears must be renewed in pairs. A worn, but serviceable gear, must not be matched with a new one.
9. If necessary renew idler gear spindle by drilling-out the peened over end of the spindle so that the spindle can be withdrawn from the pump body. To ensure squareness when fitting the new spindle, 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.



ST1635M

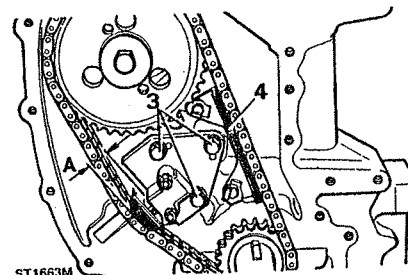
Assemble the oil pump

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



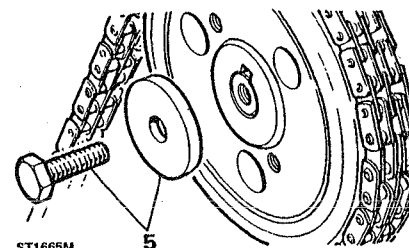
ST1637M

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.



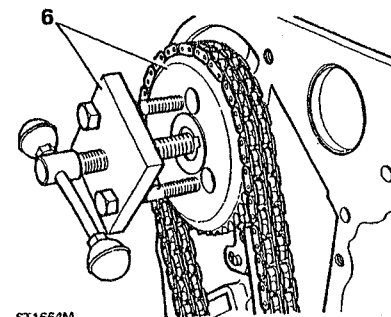
ST1663M

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 RO507231.

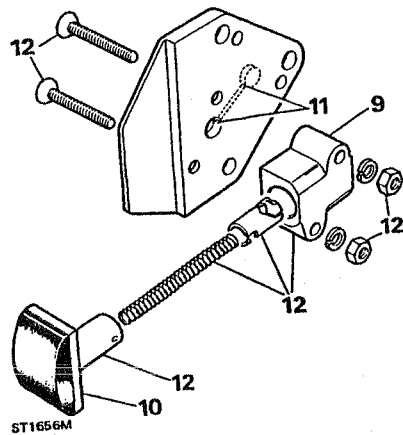


ST1664M

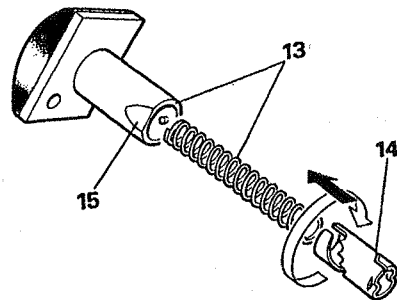
REMOVE AND OVERHAUL THE TIMING CHAIN SPROCKETS AND TENSIONER

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. approximately. This will give an indication of chain wear. The dimension for a fully worn chain is 27 mm.
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.

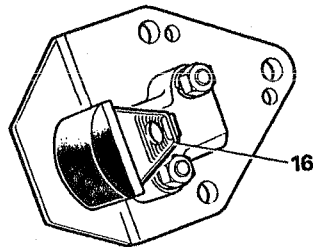
7. Examine the sprockets
8. Dismantle the tensioner assembly and discard if any of the parts are worn.
9. Examine the tensioner body and check that the oil inlet hole is clear.
10. Examine the slipper and check that the oil outlet hole is clear.
11. Check that the oil inlet and exit oil hole in the tensioner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



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.

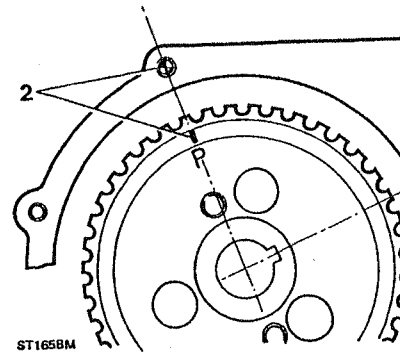


16. To prevent the tensioner releasing, insert a spacer approximately 2.3 mm thick between the tensioner body and back of the slipper prior to fitting to engine.

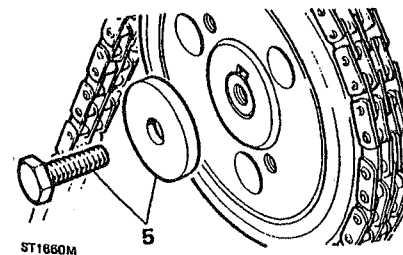


VALVE TIMING

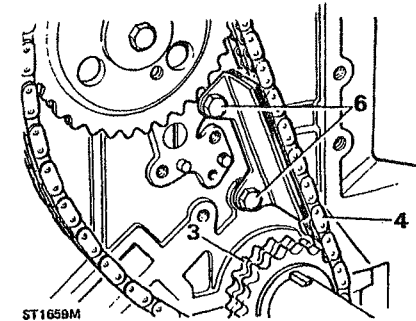
1. Check that numbers one and four pistons are still at T.D.C. and without disturbing the crankshaft, remove the pulley and timing cover.
2. Fit the camshaft sprocket temporarily and rotate the camshaft in a clockwise direction until the line on the tooth, also marked with a letter 'P' is in line with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



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.

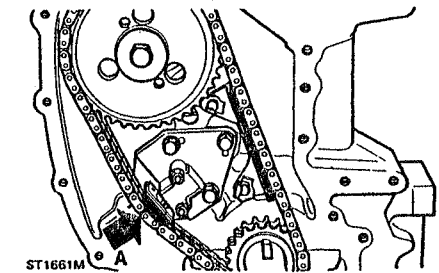


6. Fit and adjust the timing chain damper so that there is a maximum clearance of 0,25 mm between the timing chain and damper. Tighten the retaining bolts and secure with new lock tabs.



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'.



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.

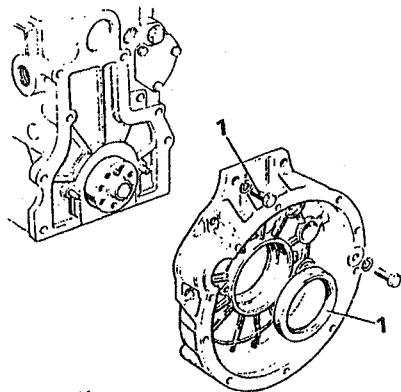
NOTE: Since no special tool is available for fitting a new insert, it is recommended that this work is entrusted to a cylinder head overhaul specialist.

FITTING PISTONS AND CONNECTING RODS

The deletion 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

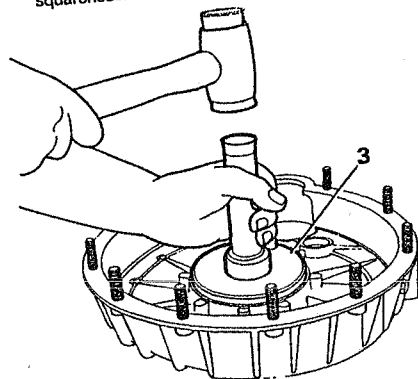
1. Remove the eight bolts securing the flywheel housing to the cylinder block and remove the housing and rear main bearing oil seal.



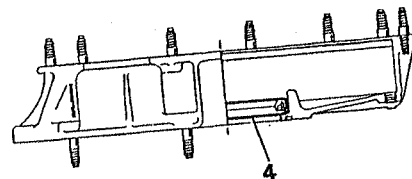
ST11699M

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.

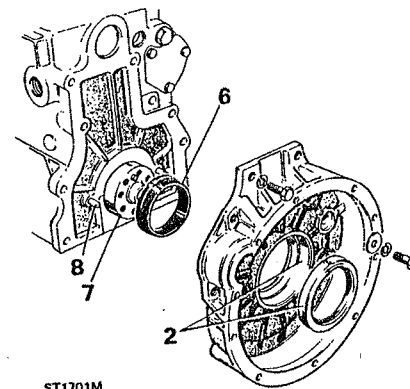


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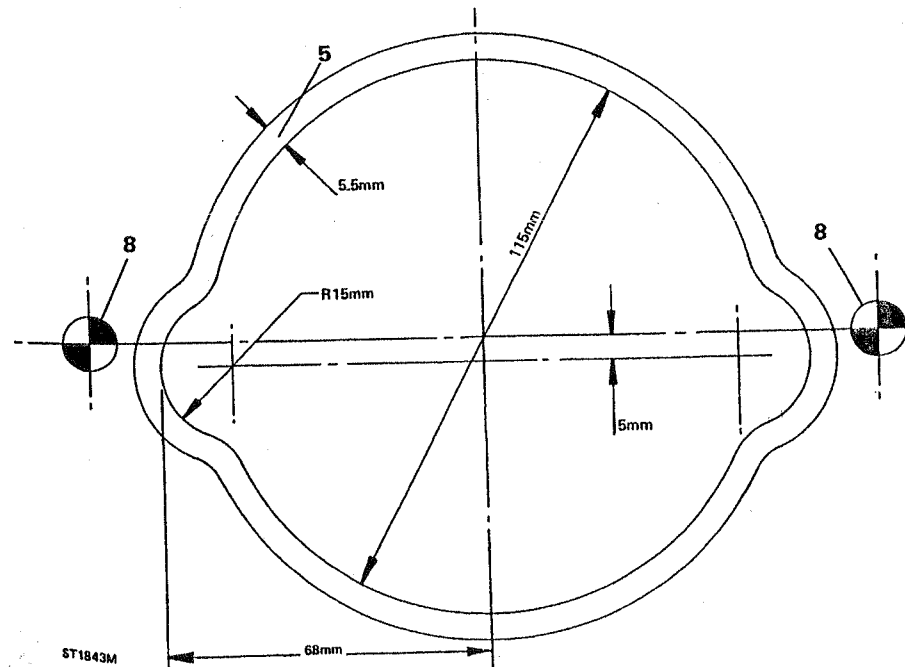


ST1842M

5. Apply a bead of Hylogrip 200 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

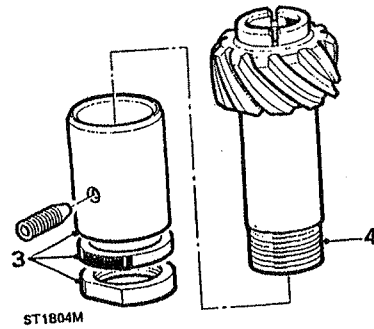


ST1843M

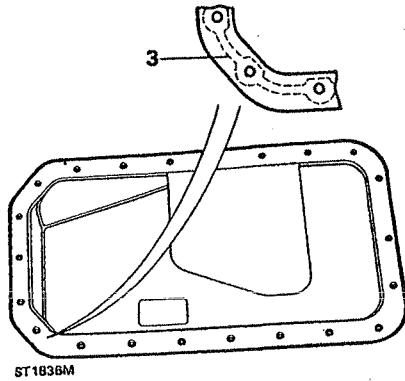
FITTING SUMP

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 3 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.

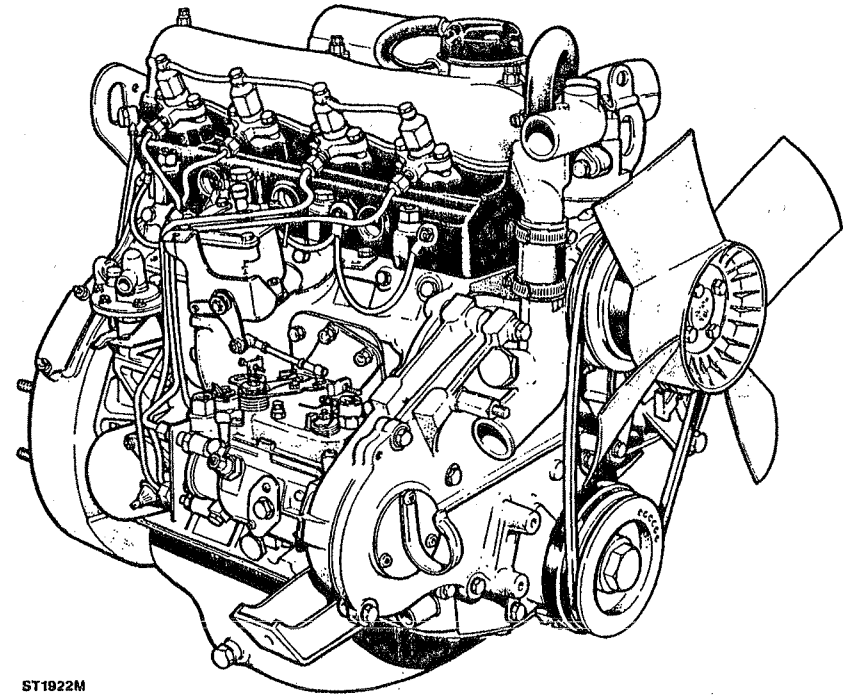


5. The gear should revolve freely in the bush with a clearance of 0,051 to 0,203 mm between thrust washer and bush.



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.



2.5 LITRE DIESEL ENGINE

DISMANTLE AND OVERHAUL

Special tools:

RO274400-LRT-12-036 -Drift inlet valve guides
 RO274401-LRT-12-037 -Drift exhaust valve guides
 RO600959-LRT-12-038 -Drift exhaust valve guide
 RO601508-LRT-12-039 -Drift inlet valve guide
 MS621-LRT-12-504 -Valve seat cutter
 RO530625 - Insert replacer
 RO605022-LRT-12-040 -Clutch centralising tool
 RO270304-LRT-12-035 -Cork-seal guide
 18G 1344-LRT-12-015 -Seal guide-rear main bearing
 18G 134-11-LRT-12-008 -Seal replacer rear main oil seal
 RO530102A-LRT-120-513 -Crankshaft nut spanner
 18G 1457-LRT-12-029 -Dist. pump remover
 18G 1464-LRT-12-031 -Crankshaft pulley remover
 18G 1456-LRT-12-028 -Crankshaft oil seal replacer
 18G 1482-LRT-12-032 -Camshaft oil seal replacer
 18G 1458-LRT-12-030 -Dist. pump timing tool
 MS47-LRT-99-002 -Press
 18G705-1A-LRT-37-010 -Collets
 LST107-LST-12-003 -Flywheel timing pin

NOTE: Where the use of special service tools is specified, only these tools should be used to avoid the possibility of personal injury and or damage to components.

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.

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.
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 RO276102 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.

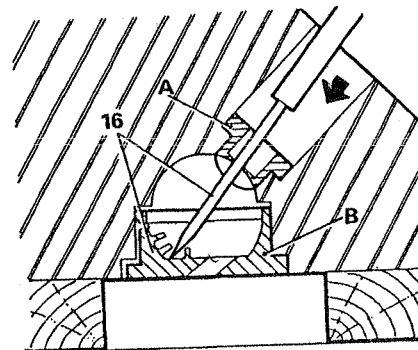
Examine components

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 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.

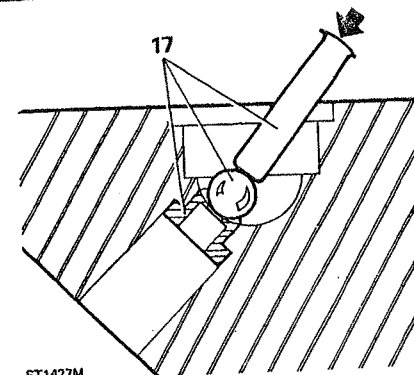
16. To remove a hot plug support the cylinder head, face downwards on two pieces of timber and insert a thin soft metal drift through the injector shroud throat and tap the hot plug from the inside. Once removed, a faulty hot plug cannot be restored and must be scrapped.



A-Shroud

B-Hot Plug

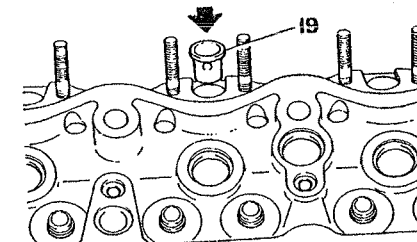
17. If the injector shroud is damaged using a 13 mm ball bearing and drift, drift the shroud out towards the injector bore.



ST1427M

Fitting shrouds

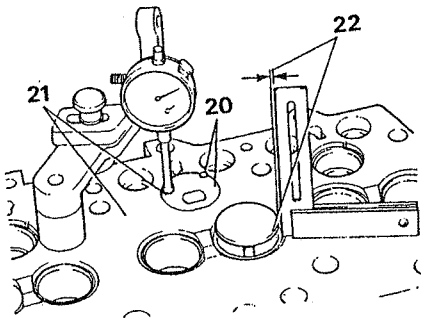
18. Thoroughly clean out the combustion chamber. The hole in the side of the injector shroud is for manufacturing purposes only but at the same time can be used as a guide when refitting the shroud.
19. Turn the cylinder head face down. Smear a little oil on the shroud and insert into the cylinder head 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 and are not recessed below the level of the cylinder head face more than 0,025 mm.

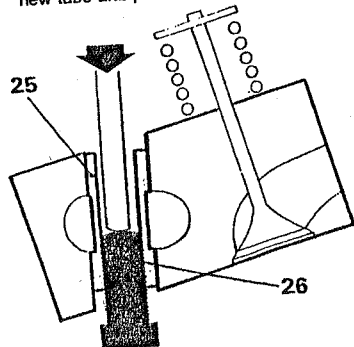


22. Check the valve guides for wear by inserting a new valve in the appropriate guide 8 mm above the seat. If movement across the head exceeds 0,15 mm renew the guide.
23. Inspect the valves and discard any that are burnt, bent or distorted. Check the stems for wear by inserting a new guide. If wear 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

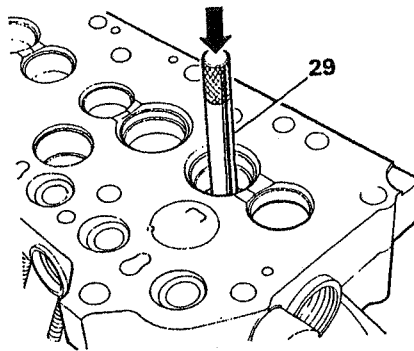
Whilst this is rarely necessary the procedure is nevertheless as follows:

25. Using an 8 mm taper tap, cut a thread 30 mm 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. Apply Loctite 242 to the cylinder head and the new tube and press it into the cylinder head.



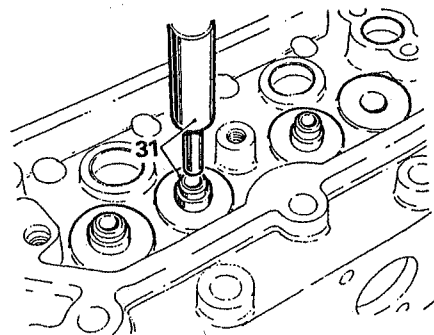
Renew valve guides

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 RO27440 for inlet guides and RO274401 for exhaust guides or suitable alternatives drive out the old guides from the combustion face side.



ST1438M

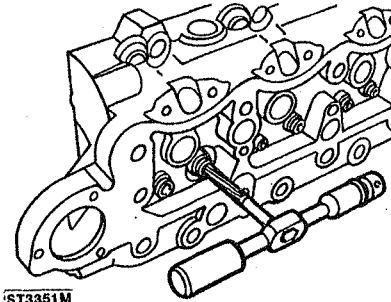
30. Turn the cylinder head over so the combustion chambers face downwards. Since the inlet and exhaust valve guides are dimensionally different it is important that the correct guides are fitted to the appropriate ports.
31. Lubricate new guides with engine oil and using special drift RO600959 for the exhaust and RO601508 for the inlet valve guides or suitable alternatives, drive in the new guides until the shoulder is flush with the casting.



ST1441M

32. To ensure that a uniform internal diameter is maintained for the total length of the guide, ream the guides from the valve spring side of the cylinder head, using the following standard size hand reamers.

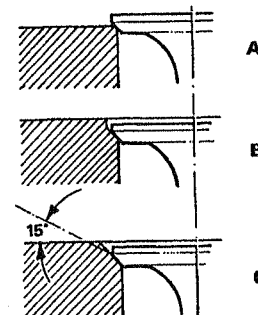
Exhaust guide reamer	0.3438 in
Inlet guide reamer	0.3125 in
Reamer tolerance +	0.0005 - 0.0000 in



ST3351M

Reface cylinder head valve seats

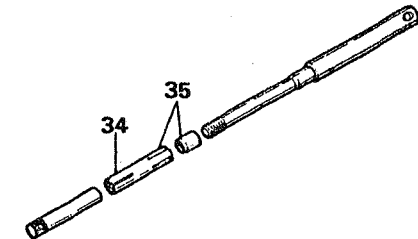
NOTE: Damaged or worn valve seats can be refaced provided they are not abnormally wide due to repeated refacing operations. See instructions 48.



ST668M

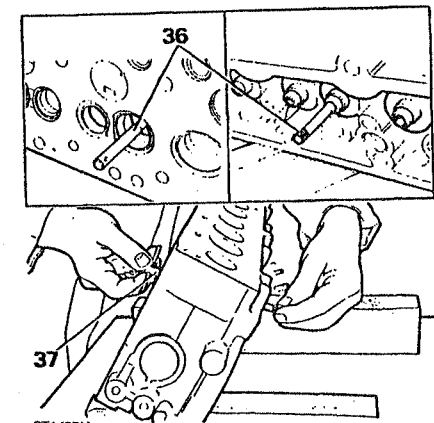
- A. Correctly seated valve
- B. Undesirable condition
- C. Method of rectification

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.



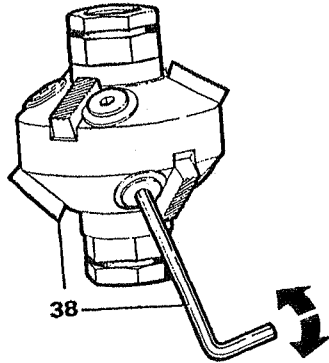
ST1440M

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.



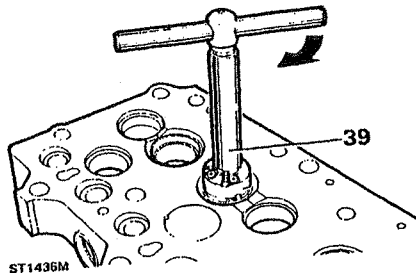
ST1437M

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.



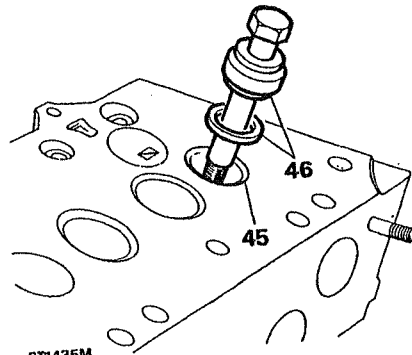
ST1436M

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 round the valve against the seat. A continuous 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.

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

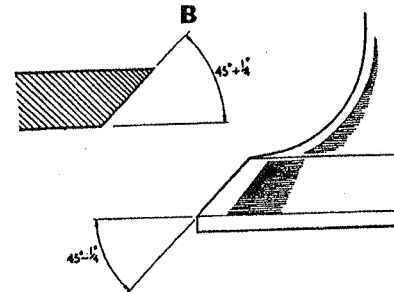
44. Hold the cylinder head firmly in a vice, wear protective goggles and grind the old insert away until thin enough to be cracked and prised out. Take care not to damage the insert pocket.
 45. Remove any burrs and swarf from the pocket. Failure to do this could cause the new insert to crack when being fitted.
 46. Assemble the new exhaust insert to the replacer tool number RO530625 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.



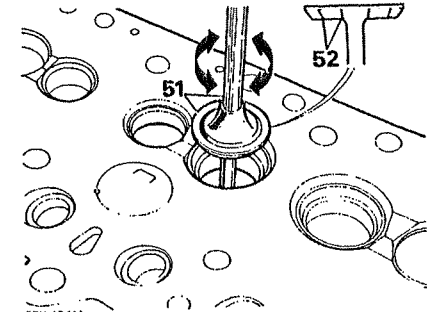
ST691M

Inlet valve seat face - 45° + 1/4°
 Exhaust valve seat face - 45° + 1/4°

Inlet valve face - 45° - 1/4°
 Exhaust valve face - 45° - 1/4°

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.

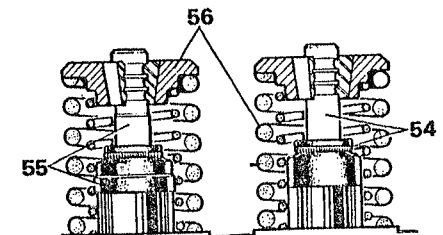


ST1434M

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.

Assemble valves to cylinder head

54. Insert the inlet valves into the guides and fit new oil seals with the plain e erior. 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 e erior. 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, RO276102 or a suitable alternative, secure the assembly with the multi-groove butting cutters.

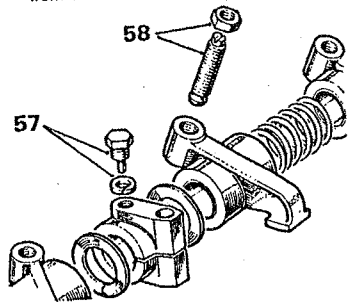


ST1430M

OVERHAUL ROCKER SHAFT ASSEMBLY

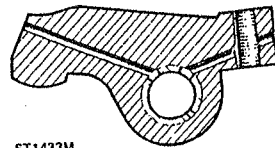
Dismantle and inspection

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.
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.
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.

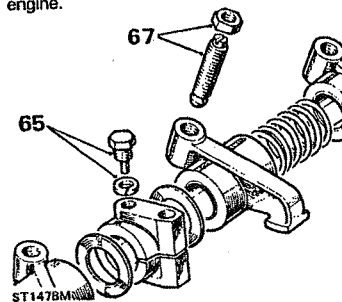


ST1433M

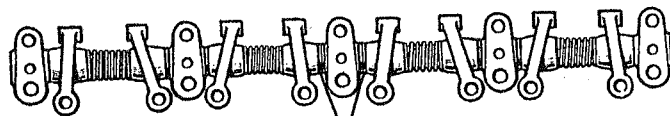
63. Using a 13,5 mm reamer finish the bushes and clear swarf from the oil holes.
64. Examine the ball-end of the adjusting screws and discard any that are worn. Regrinding is not permissible. Check the threads for damage and that the oil relief drilling is clear.

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.



ST1478M

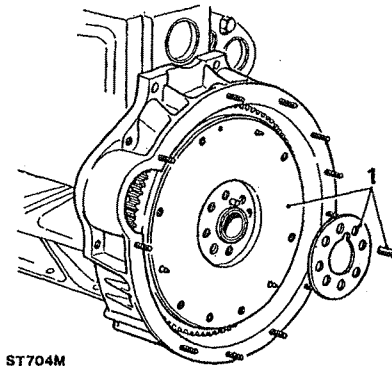


66

ST1432M

REMOVE AND OVERHAUL THE FLYWHEEL

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



ST704M

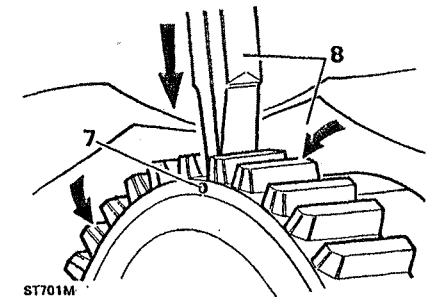
2. Wear or scores on the flywheel clutch face can be corrected by machining provided that the overall width of the flywheel is not reduced below 36,96 mm.
3. Check that the flywheel has not been previously machined.
4. Examine the ring gear teeth and if chipped or worn the gear can be renewed.

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

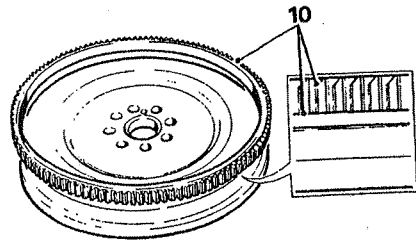
7. Drill a 8, mm hole between the root of any two teeth and the inner diameter of the starter ring deep enough to weaken the ring. Do not allow the drill to enter the flywheel.
8. Secure the flywheel in a soft jawed vice and cover it with a cloth to protect one from personal injury. Place a cold chisel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



ST701M

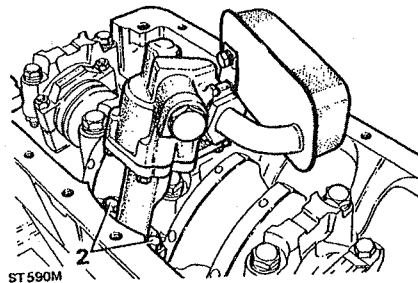
9. Heat the new ring gear uniformly to between 225°C and 250°C but do not exceed the higher figure.

- 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.
- 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.



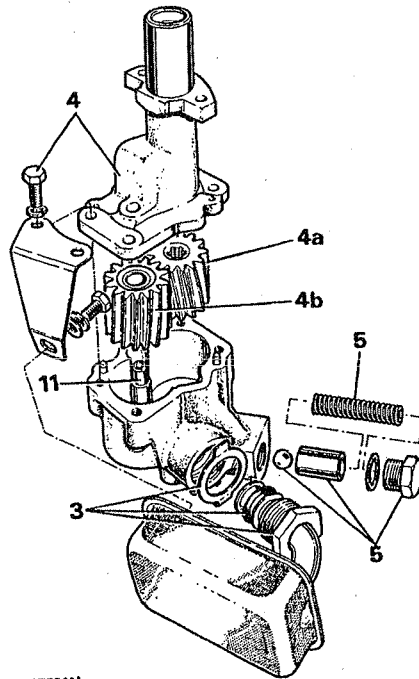
REMOVE AND OVERHAUL OIL PUMP-Early type

- Remove the sump.
- Bend back the lock washers (deleted on later engines) and remove the two bolts securing the oil pump to the crankcase. Withdraw the oil pump complete with strainer and oil pump drive shaft.



Dismantle oil pump

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

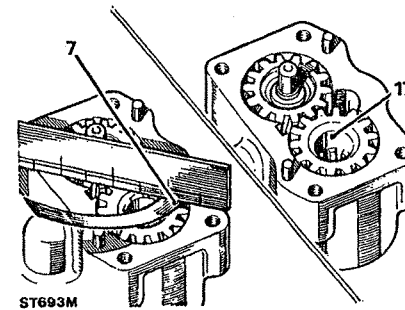


- Remove the oil pressure relief valve plug and sealing washer. Withdraw the relief valve spring, plunger and ball.

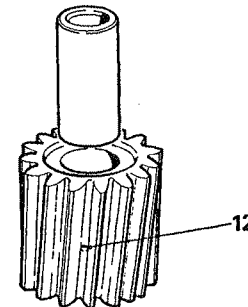
NOTE: Later pumps have ten toothed gears and no relief valve ball.

Overhaul the oil pump

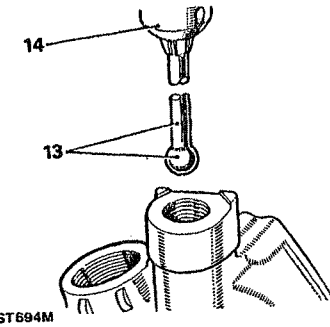
- Examine the gears for wear, scores and pits. If the gears appear serviceable check for end-float as follows:
- Clean the pump body and assemble the gears. Place a straight edge across the pump body face, as illustrated, and using a feeler gauge, measure the clearance between the body and gears. The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



- Gears must be renewed in pairs. A worn, but serviceable gear, must not be matched with a new one.
- 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.
- If worn, remove the idler gear bush and press in a replacement. Drill the lubrication hole 3,17 mm and ream the bush to 12,7 mm diameter.



- A scored ball valve seat can be res tored by using a locally made lapping tool by silver soldering a new ball (part number 3748) onto a length of suitable tube.
- 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.
- Thoroughly wash the pump body to remove all traces of grinding paste.

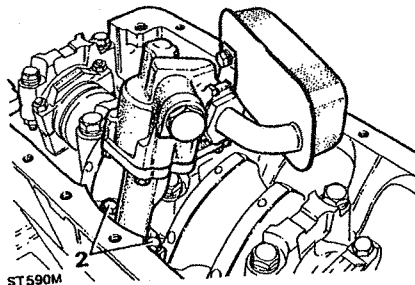


Assemble the oil pump

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

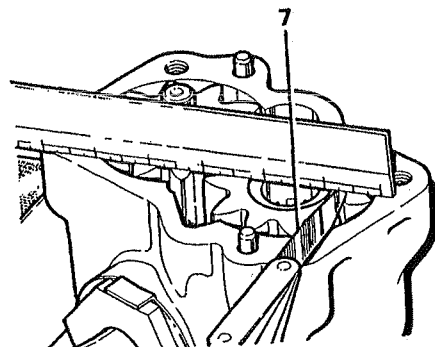


Dismantle oil pump

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. The correct clearances are given in the GENERAL SPECIFICATION DATA.

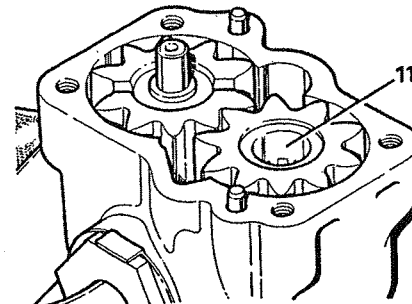


8. Gears must be renewed in pairs. A worn, but serviceable gear, must not be matched with a new one.
9. If necessary renew idler gear spindle by drilling-out the peened over end of the spindle so that the spindle can be withdrawn from the pump body. To ensure squareness when fitting the new spindle, 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.

ST1635M

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.

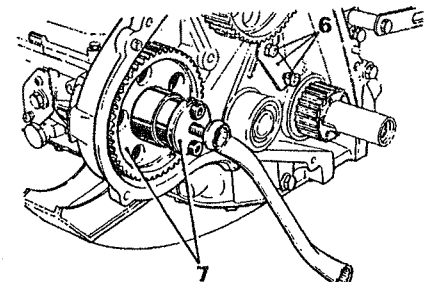
REMOVE TIMING BELT, PULLEYS AND COVERS

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.

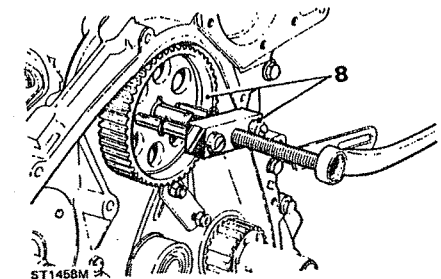
Remove timing belt and pulleys

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 as illustrated, and withdraw the distributor pump pulley.



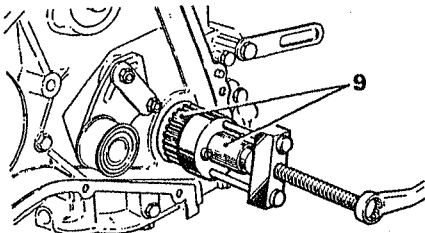
ST1456M

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



ST1458M

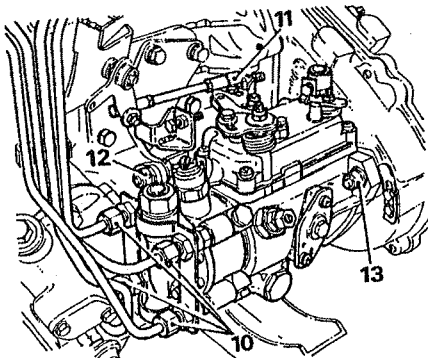
9. Withdraw the crankshaft pulley using complete tool 18G1464 and button 18G1464.



ST1457M

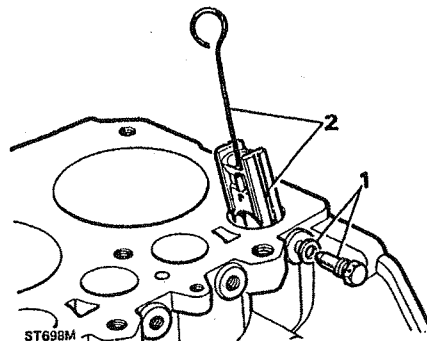
Remove distributor pump (D.P.S. Pump)

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.



ST698M

KEY TO TIMING GEAR AND COVER ASSEMBLY

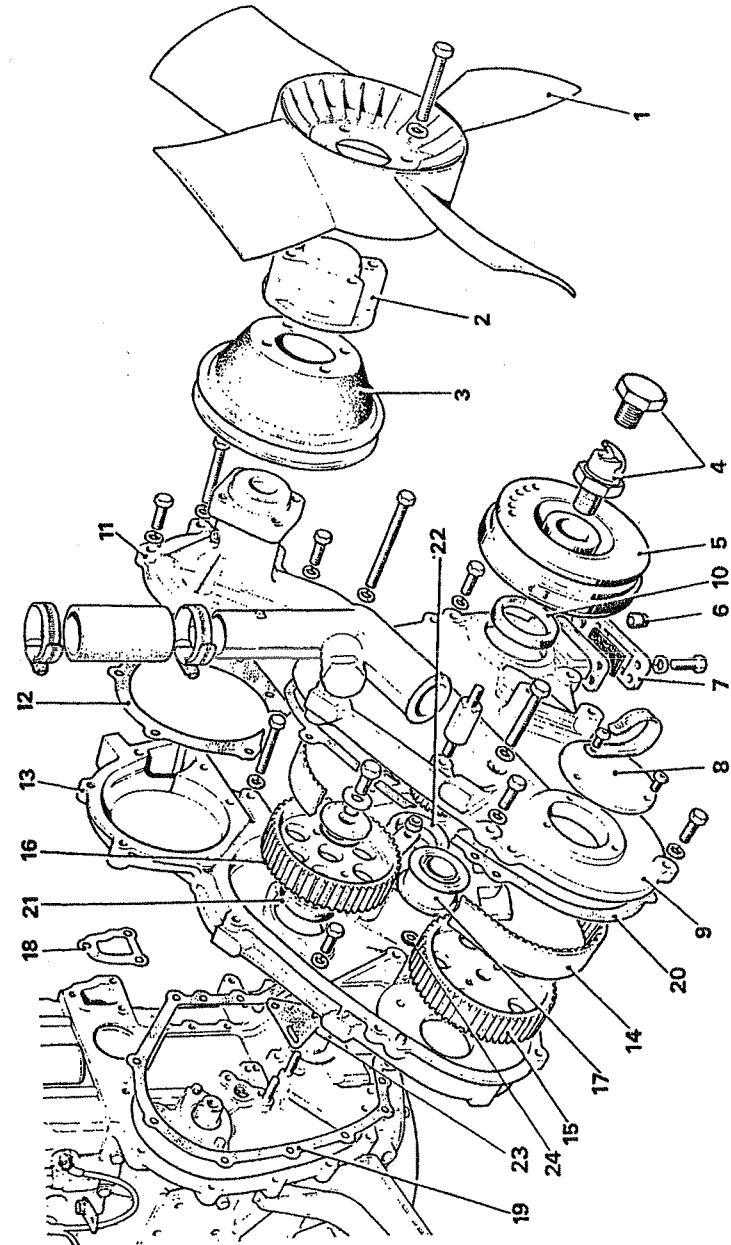
1. Fan blades
2. Spacer
3. Fan pulley
4. Special bolt-Later engines, starter dog early engines.
5. Crankshaft pulley
6. Wading plug
7. Timing cover vent
8. Inspection cover
9. Front cover plate
10. Front cover plate oil seal
11. Water pump
12. Water pump joint washer
13. Cover
14. Timing belt
15. D.P.S. 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.

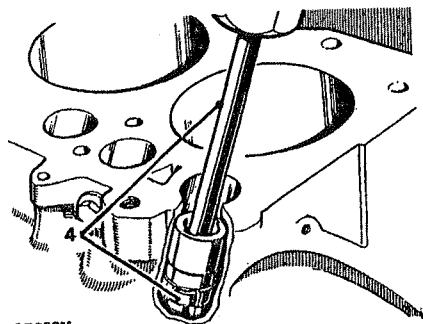
CAUTION: Do not remove the tappet guides before the rollers otherwise the rollers may fall behind the camshaft.

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.



ST559M

- Lift out the tappet rollers and mark the side facing the front of the engine for possible reassembly.
- Lift out the tappet guides and retain with their respective slides and rollers. If the guides are difficult to remove use special tool RO530101A.
- Carefully examine all parts and discard any that are worn or damaged.

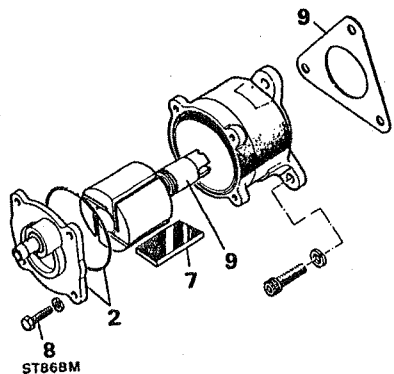


ST699M

REMOVE AND OVERHAUL VACUUM PUMP

Dismantle

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



ST868M

- Inspect the components for wear and damage and renew as necessary.
- 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.
- 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 0,1 to 0,12 mm.

Assemble

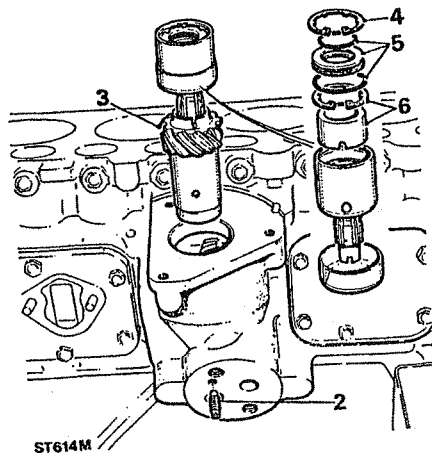
- Fit the rotor blades to the rotor with the radius outwards and insert the rotor into the body.
- Place a new O' ring seal in position in the body groove and fit the end plate and secure with the four bolts tightening evenly.
- When fitting pump to engine use a new joint washer and ensure that the drive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

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



ST614M

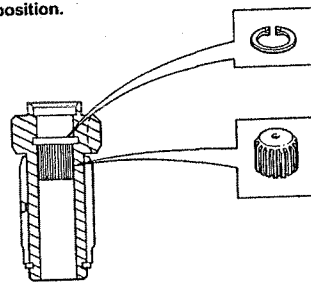
Dismantle

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

Assemble

- Reassemble the coupling with any new parts necessary ensuring that the sleeve fits correctly over the lower cross-pin and secure with the circlip.
- 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.

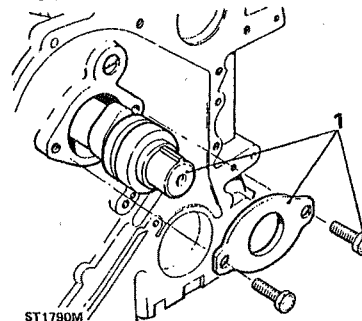
NOTE: The skew gear drive coupling ETC 6141 applicable to the 2.5 Diesel has been discontinued and the drive and coupling are now available under part number ETC 6139 for the drive and ETC 4706 for the coupling to the gear, remove and discard the circlip and plug. Fill the annular groove round the splines of the coupling with silicone rubber sealant and press into position.



ST3173M

REMOVE THE CAMSHAFT

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



ST1790M

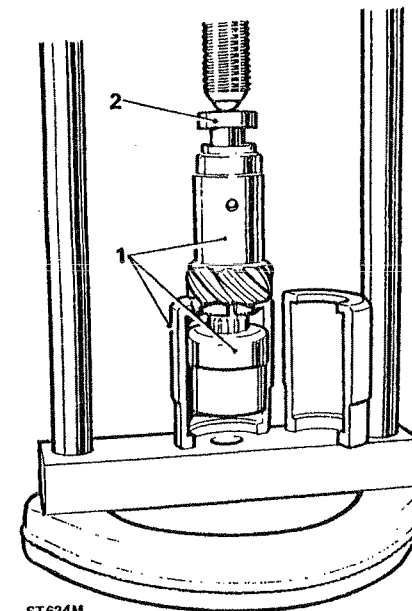
Inspect the camshaft

- 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

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



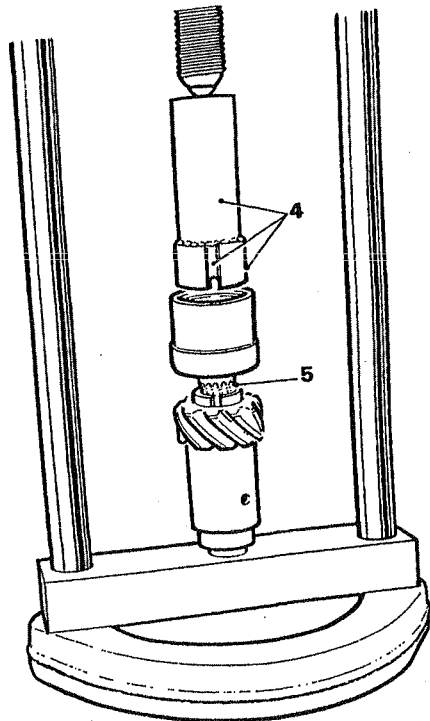
ST624M

Fit new coupling to skew gear

- 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 retention.

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 cylinder block 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.



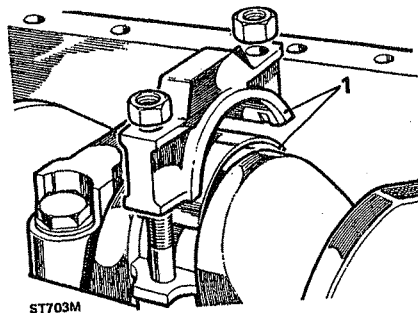
ST625M

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.

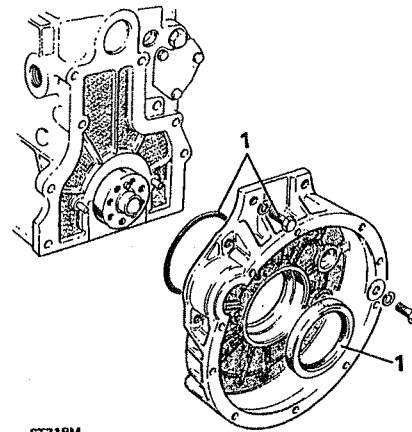


ST703M

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.

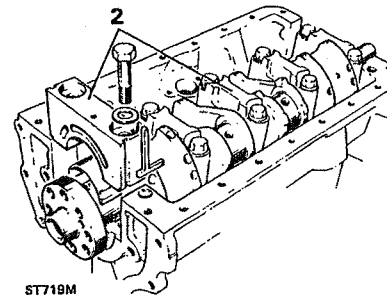
REMOVE AND INSPECT CRANKSHAFT

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

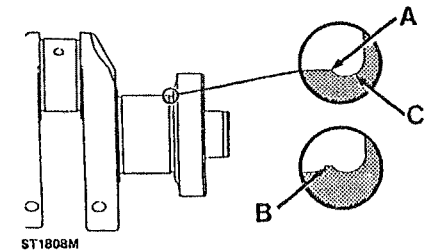
2. Remove the main bearing caps and shells and lift out the crankshaft. Collect the bearing shells from the bearing saddles and the thrust washers from the centre saddle.



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 0,04 mm.
7. **Taper** - 8 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.
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 taking into account any ovality in the centre journal. The overall allowable wear limit should not exceed 0,114 mm for main bearing journals and 0,088 mm for crankpins. A crankshaft worn beyond the limits of maximum taper, ovality and overall wear can be ground to 0.25 mm under size.

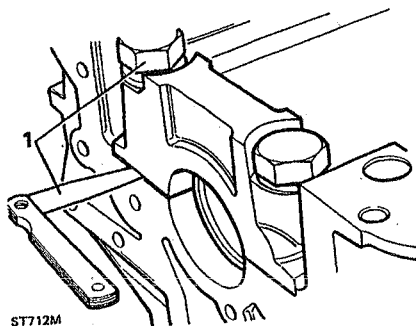
When grinding the crankshaft main bearing and crankpin journals, rotation of the grinding wheel and crankshaft must be in the same direction, anti-clockwise, viewed from the flywheel end of the crankshaft. Final finishing of the journals should be achieved by using a static tapping stone with the crankshaft 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. 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.



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 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.
Maximum permissible taper 0,254 mm.
Maximum permissible overall wear 0,177 mm.

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

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 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.

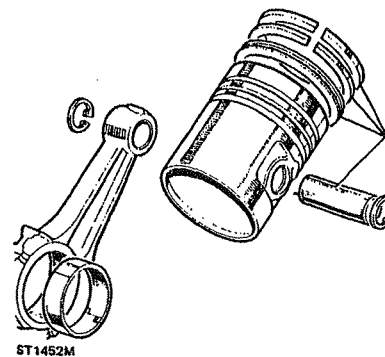
11. Machine the cylinder bores to accept the sleeves to 94,425 + 0,012 mm. This will give the sleeve a 0,076 to 0,114 mm interference fit.
12. Press the sleeves squarely into the bore using a pressure of two to three tons. Excessive pressure could damage the sleeve and cylinder block. The sleeves must not be proud of the cylinder block top face or more than 2,54 mm 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.



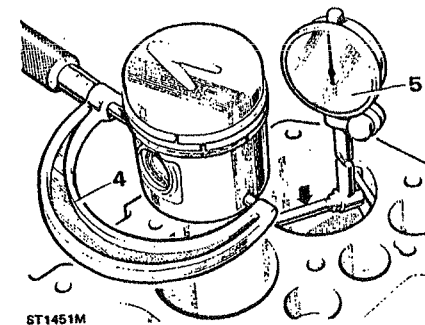
2. Original pistons - Decar bonise and degrease all components and carry out a visual examination of the pistons and rings and discard any which are unserviceable. Pistons which appear serviceable should be subjected to a more detailed examination described under 'New Pistons'.

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 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 0,5 mm and oversize for fitting to rebored cylinder blocks.

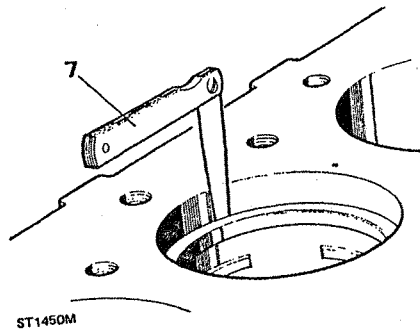
Clearance limits for new standard size pistons in a standard cylinder bore measured at right angles to the gudgeon pin are in the "GENERAL SPECIFICATION DATA" section.

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.



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 is felt, the clearance is satisfactory.



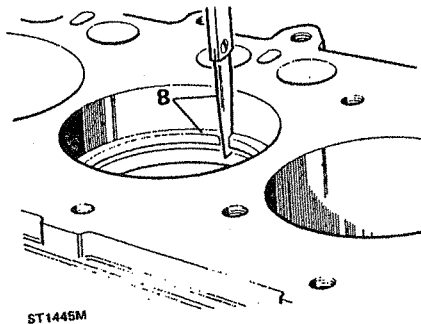
Inspect piston rings

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.

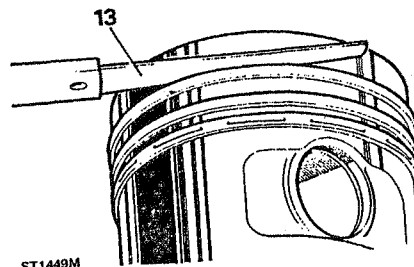
The correct gaps are listed in the **GENERAL SPECIFICATION DATA**. If any gap is less than that specified, remove the ring, and file the ends square, whilst holding the ring in a filing jig or vice. Should any gap be excessively wide and not likely to close-up to within the specified limits when hot, an oversize ring should be fitted.



Check piston ring side clearance

10. It is important that clearances are correct. Rings that are too tight will bind when hot, impairing 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 are unacceptable and the ring and/or the pistons should be renewed.

Compression rings - 0,06 to 0,011 mm.
Oil control ring - 0,038 to 0,064 mm.

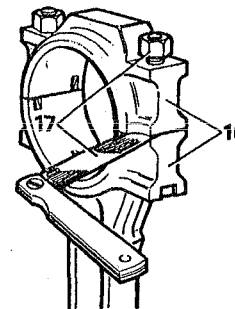


Inspect gudgeon pins

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.



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.
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

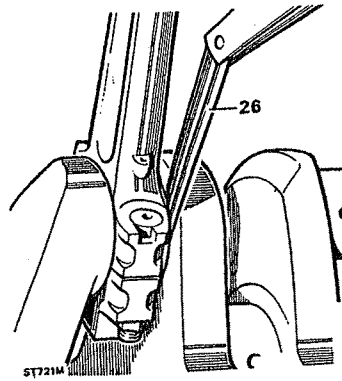
New bearing halves are supplied with a protective coating and must be degreased before fitting.

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 0,1 and 0,2 mm. 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 mm 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.

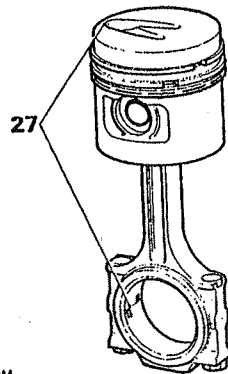
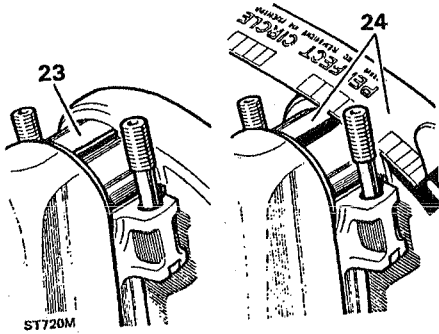
As an alternative, the bearing clearances can be determined by using 'Plastigauge' which consists of a thin piece of plastic material a few hundreds of a millimeter in diameter. When the material is flattened by being squeezed between the bearing and crankpin the width of the plastic is measured by a 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.
25. Wipe off the 'Plastigauge' with an oily rag. Do not scrape off otherwise it may damage the crankpins.



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.



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.

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.

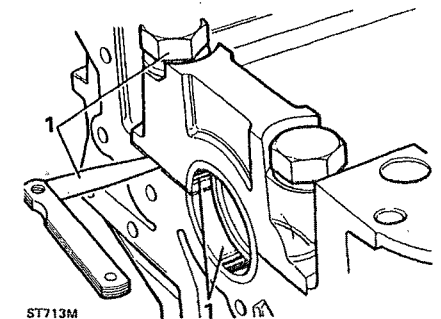
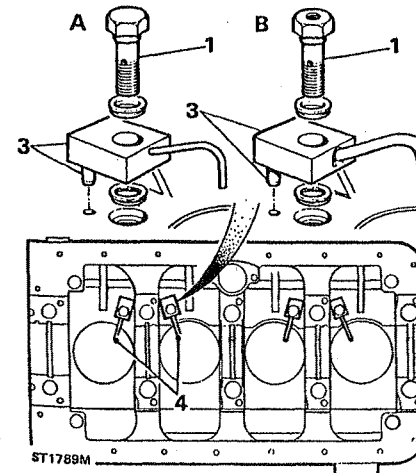
1. The jet tubes are 'Handed' and can only be fitted one way. It is important to note that the jet retaining 'bolt' contains a non-return valve and therefore on no account must an ordinary bolt be used.
2. Clean the recess in the cylinder block using an air line, if available, to remove any swarf.
3. 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

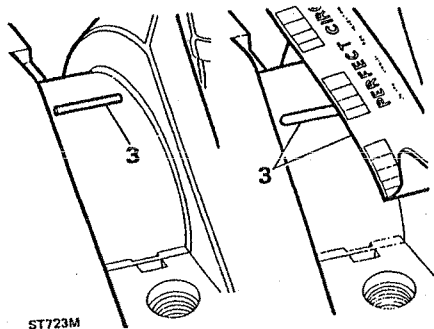
New main bearing halves are supplied with a protective coating and must be degreased before fitting.

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. 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 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.

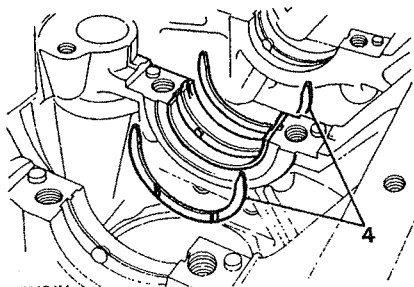
3. Locate the crankshaft in position on the upper bearing halves in the crankcase and wipe any oil from the journals since 'Plastigauge' is soluble in oil. Place a piece of 'Plastigauge' across the lower half of each crankshaft journal or lower bearing cap shell. Fit the cap and tighten to the correct 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

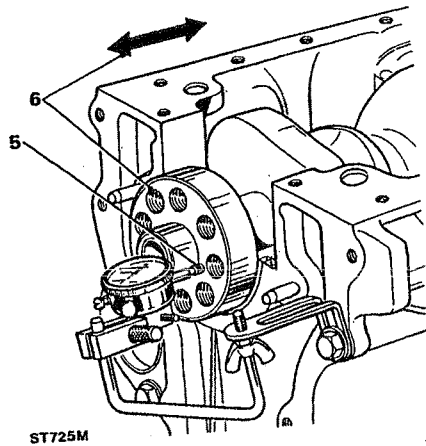
Adjust crankshaft end-float

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.



ST3134M

5. Place the crankshaft in position in the crank case 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.
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 to ensure that the crankshaft remains centralised.



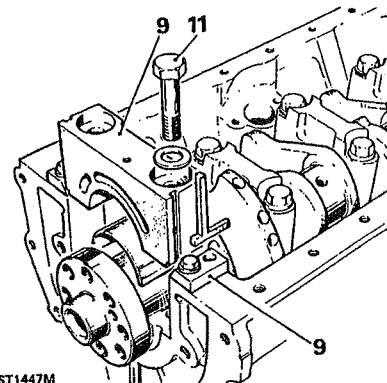
ST725M

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. ak0

NOTE: On later Turbo charged engines the main bearings retention slots are positioned diagonally opposite to the original position, to prevent the bearing shells rotating. Also on all later engines the cork seals are replaced with Neopreme seals. On some engines, prior to the use of Neopreme seals a liquid sealant was used but now discontinued.

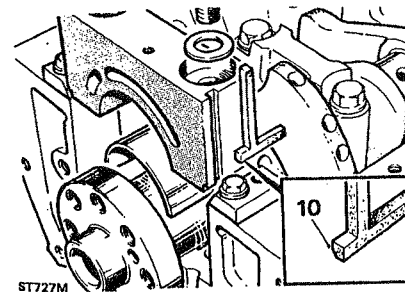
Fit rear main bearing cap

9. Ensure that number five main bearing cap is clean and free from old cork seal material. Attach the cork seal guides number RO270304 to the crankcase, as illustrated, and ensure that they are parallel to the crankcase edge.



ST1447M

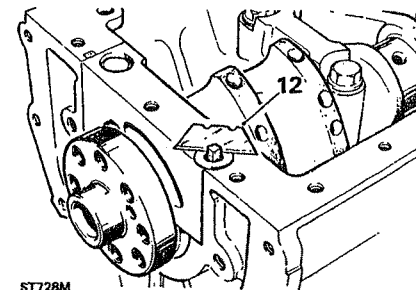
10. To prevent any cork seal material becoming trapped between the bearing cap and crankcase, chamfer the inner edge of the corks 0,40 to 0,80 mm wide as illustrated. Immerse the cork seals in engine oil and fit them to the bearing cap.



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 and then place a 6.35 mm washer over the seal and cut off the

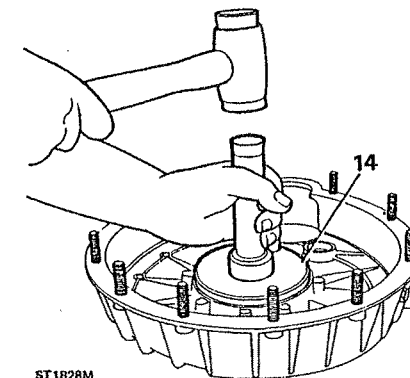
surplus. If it is necessary to fit the sump immediately, trim the seals off leaving 0,8 mm proud, that is, the thickness of the above washer. Apply Hylomar SQ32M to the protruding end of the seals.



ST728M

Fit rear main oil seal

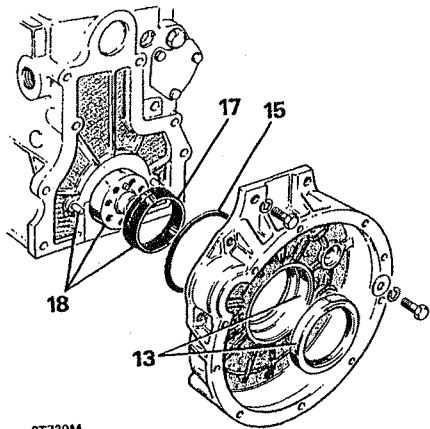
13. Check that the crankshaft oil seal journal is undamaged and clean. Make sure the seal housing is clean and dry and free from burrs. Do not touch the seal lip and ensure that the outside diameter is clean and dry. The P.T.F.E Seal Part No. ETC 5369 which should be used is supplied with a former to 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.

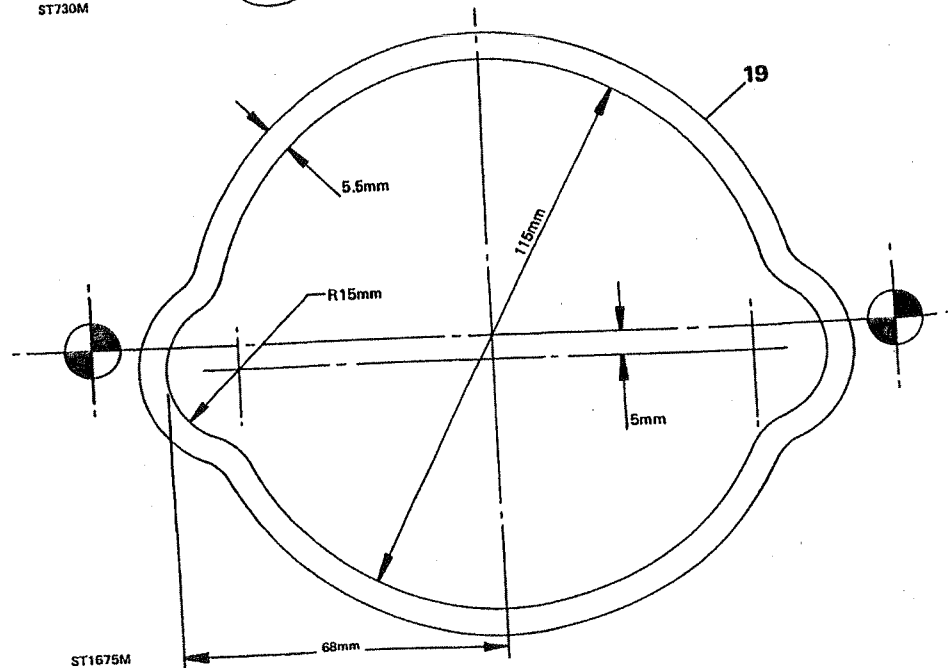


ST730M

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.

FIT FLYWHEEL HOUSING - Later engines

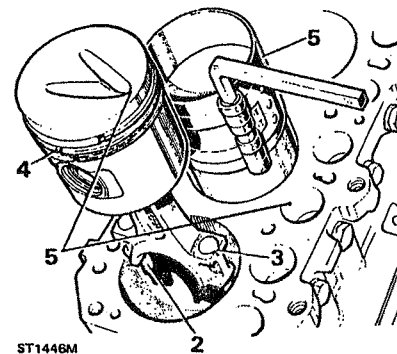
19. In place of the 'O' ring seal a bead of Loctite 518 sealant must be applied to the rear face of the flywheel housing to the dimensions and configuration as illustrated below. The illustration has been produced full size so that a template may be made to facilitate the application of the sealant. The bead should be 5,5 mm wide and 0,25 mm thick.
20. Fit the housing following instructions 17 to 18.



ST1675M

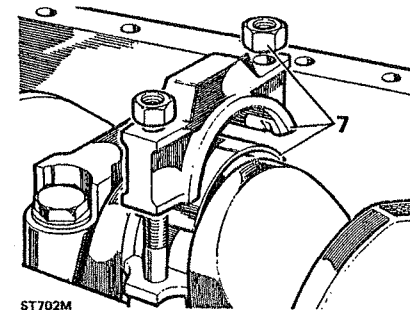
FIT THE CONNECTING-RODS AND PISTONS

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 piston 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

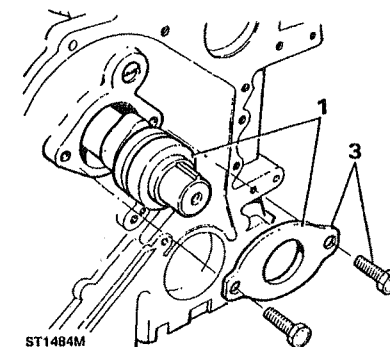
7. Check that the bearing shell is properly located in the connecting-rod and pull the rod onto the crankpin. Locate the bearing shell correctly and fit the cap so that the identification numbers are together on the camshaft side of the engine. Fit and tighten new nuts to the correct torque figure. Repeat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



ST702M

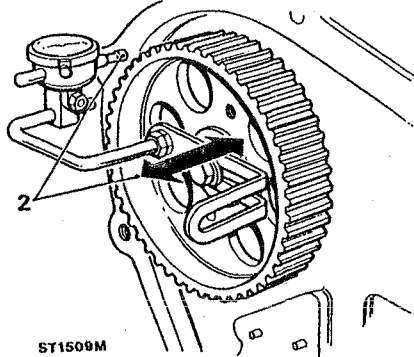
FIT THE CAMSHAFT

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.



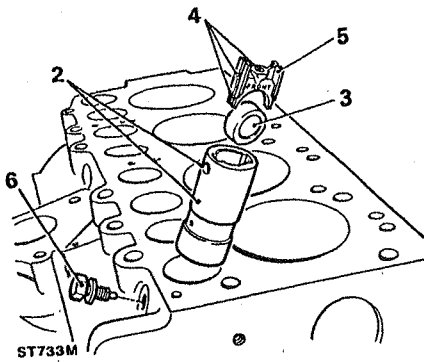
ST1484M

- To check the camshaft end-float, fit the woodruff key and temporarily fit the camshaft 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 0,05 to 0,13 mm. If the end-float is outside these limits, fit different thrust plates until the correct tolerance is achieved.
- Remove the test indicator and pulley, and secure the thrust plate with the two bolts.



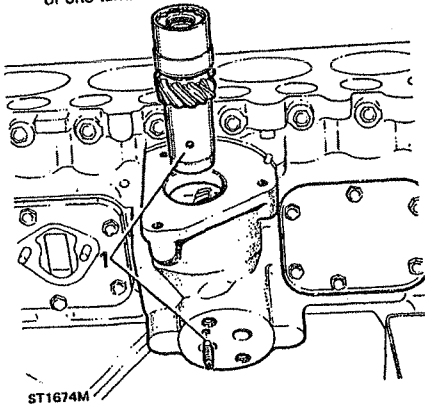
FIT TAPPETS, GUIDES AND ROLLERS

- 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.
- Insert the tappet guides into the cylinder block and align the locating screw holes.
- 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.
- 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.
- Insert the tappet slides with the word 'FRONT' towards the front of the engine.
- 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

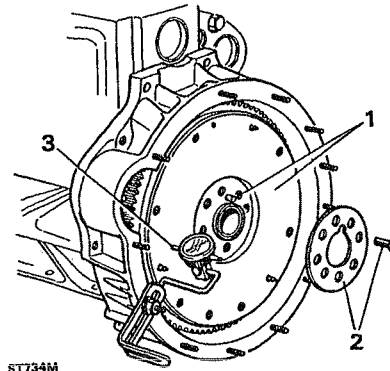
- Lubricate and insert the skew gear and coupling assembly into mesh with the camshaft gear. Align the location hole in the bush and fit a new location screw into the cylinder block. Tighten to 4 Nm and then back-off one eighth of one turn.



FIT THE FLYWHEEL

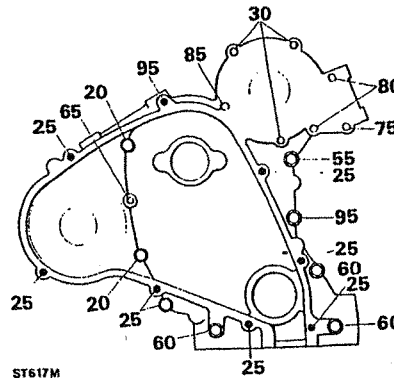
- Examine the flywheel and crankshaft mating faces and remove any burrs or imperfections that could prevent the flywheel locating correctly. Check that the dowel is in position.

- 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.
- 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.
- Turn the flywheel, and check that the run-out does not exceed 0.05 to 0.07 mm. Should the run-out be excessive, remove the flywheel, and check again for irregularities on flywheel and crankshaft mating faces and dowel.



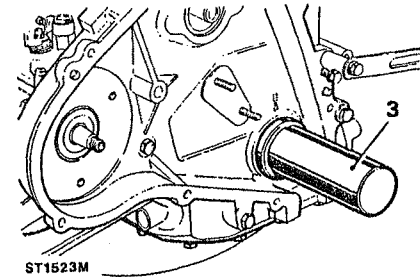
FIT TIMING FRONT COVER, SEALS AND PULLEYS

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



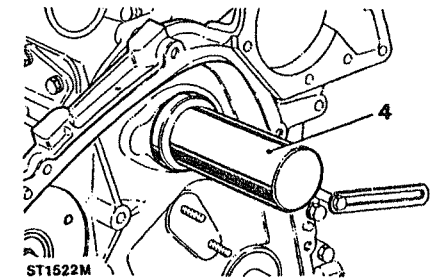
Rear cover - crankshaft seal

- 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.



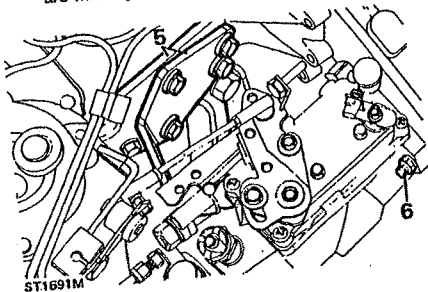
Front cover - camshaft seal

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

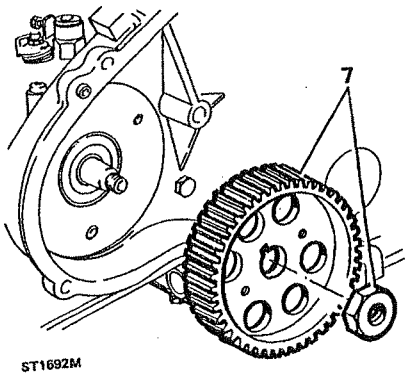


Fit distributor pump (D.P.S.)

5. Fit the camshaft front inspection cover complete with the D.P.S. pump 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.



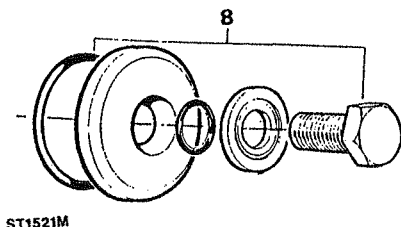
7. Fit D.P.S. pump pulley, and loosely secure with the nut.



ST1692M

Fit camshaft pulley

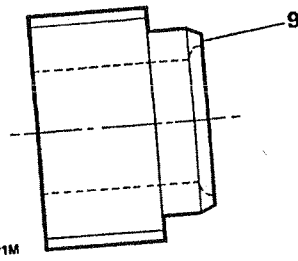
8. Fit pulley, boss towards engine, and loosely secure with special washer, 'O' rings, plain washer and new bolt. DO NOT drive pulley onto camshaft. Draw pulley on with a slave 10 mm diameter metric bolt, plain washer and nut.



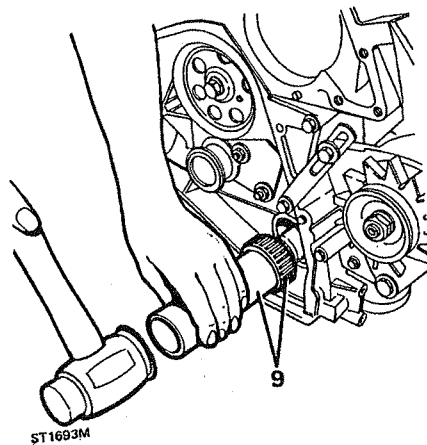
ST1521M

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

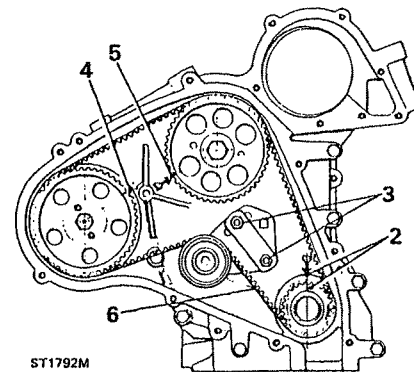


ST1693M

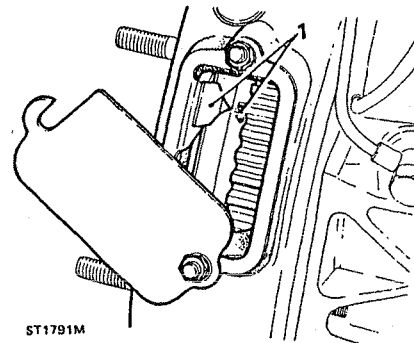
TIME D. P. S. PUMP AND VALVES - Early Engines

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 periphery 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.

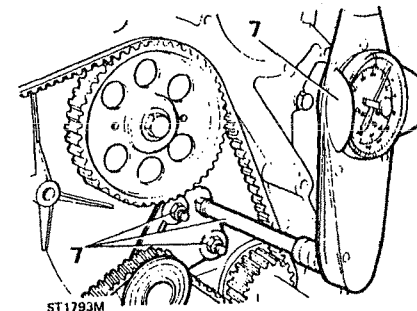


ST1792M



ST1791M

7. Set a dial type torque wrench to 29.0 to 23.5 Nm 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

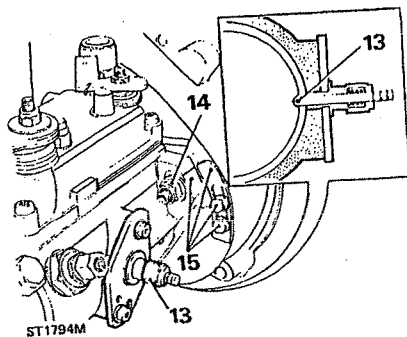
2. Check that the dot on the cranks haft pulley and the cast-on arrow on the rear cover line-up.
3. Fit the timing belt tensioner assembly and loosely secure with the two nuts (strap deleted on later models).
4. Turn the D.P S. pump pulley clockwise until the dot lines up exactly with arrows in the rear 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.

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 35 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.



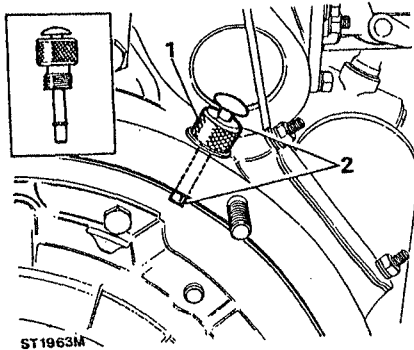
16. Tighten the D P S. pump timing pulley nut and the camshaft pulley retaining bolt to the correct torque.
17. Remove the timing pointer from the flywheel housing, close the cover and secure with the two nuts.

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.

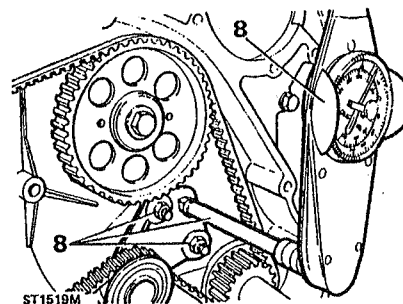
1. Remove the plug from the flywheel housing and fit the body of special tool LST 107 without the pin.

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.

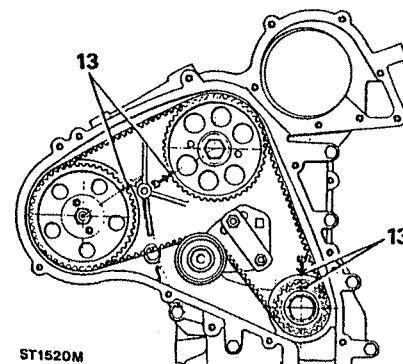


3. Fit the timing belt tensioner assembly and loosely secure with the two nuts.
4. Turn the D P S. pump pulley clockwise until the dot on the pulley lines-up exactly with the cast-on arrow inside the front cover.
5. Similarly, turn the camshaft pulley clockwise until the dot lines-up with the cast-on 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 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 obtainable and it is necessary to refit the old belt it should be only torqued to 19-24 Nm.

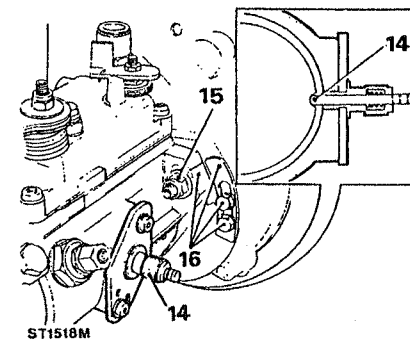


12. Rotate the crankshaft until the pin of the special timing tool can, once again, be inserted into the flywheel E.P. slot.
13. Check that the dots on the camshaft and D.P.S. pump pulleys coincide exactly with their respective cast-on arrows on the rear cover. Should there be any misalignment the foregoing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



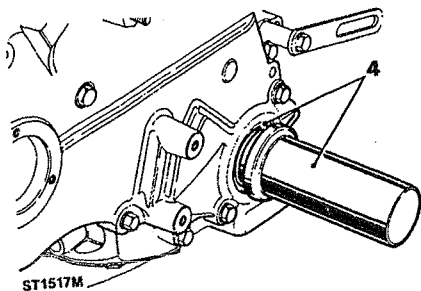
17. Remove the special tool LST 107 and refit the plug to the flywheel housing.
18. Tighten the D.P.S. pump pulley nut and the camshaft pulley retaining bolt to the correct torque.

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 50 mm radius.
2. When a belt is handled, it must not be bent at an acute angle or an arc of less than 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.



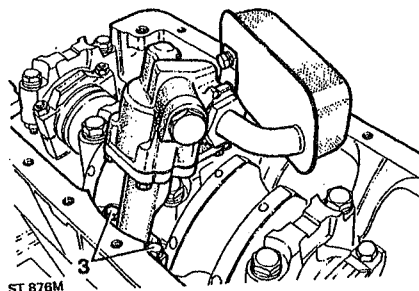
Fit water pump and crankshaft pulley

5. Place a new joint washer in position and offer up the water pump. Fit the different length bolts 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.

NOTE: Lock washers are deleted on later engines and micro encapsulated patch bolts are now used.



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.

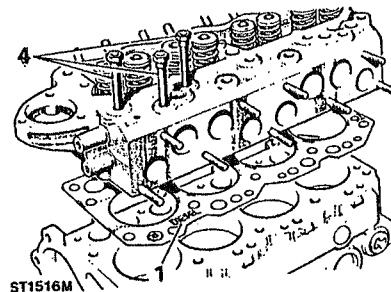
FIT CYLINDER HEAD AND ROCKER SHAFT ASSEMBLY

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.

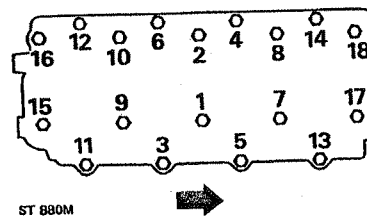
NOTE: Some gaskets may have 'Diesel' stamped on the lower face and 'Top' on the upper face. Always fit gaskets with 'Top' uppermost.

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.

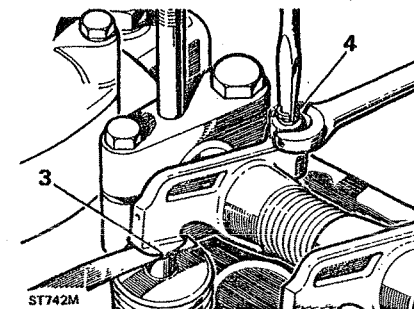


7. Tighten the cylinder head retaining bolts, evenly, to the correct torque figure in the sequence illustrated below.
8. Fit and tighten the rocker shaft, small bolts to the specified torque.



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 0,2 mm 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.



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

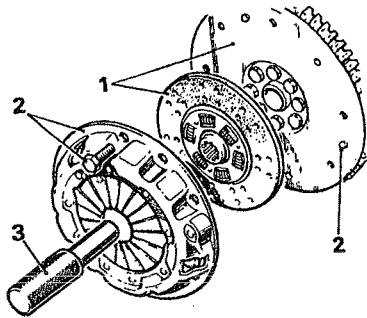
- Set No. 3 tappet with No. 6 valve fully open.
- Set No. 5 tappet with No. 4 valve fully open.
- Set No. 2 tappet with No. 7 valve fully open.
- Set No. 8 tappet with No. 1 valve fully open.
- Set No. 6 tappet with No. 3 valve fully open.
- Set No. 4 tappet with No. 5 valve fully open.
- Set No. 7 tappet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

FIT THE CLUTCH

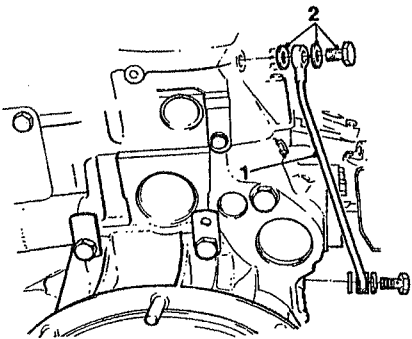
1. Clean the flywheel face and place the centre plate with the side marked 'Flywheel side' towards the flywheel.
2. Fit the clutch assembly locating it over the three dowels and loosely secure with the six bolts.
3. Centralise the centre plate using special tool RO 605022 or a spare primary shaft and 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

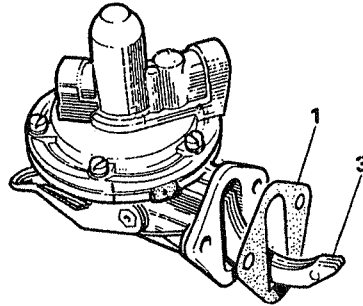
1. Connect the oil feed pipe, for lubrication of the rocker shaft assembly, to the cylinder head
2. Secure with the two banjo bolts and four joint washers.



ST765M

FIT FUEL LIFT PUMP

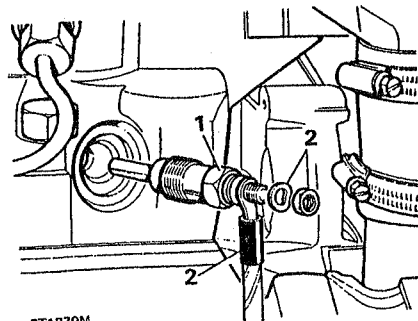
1. If the fuel lift was separated from the side cover, fit the pump to the cover first using a new joint washer between the pump flange and rear cover, evenly tighten the retaining nuts.
2. Place a new cover plate joint washer in position and fit the cover and pump assembly to the cylinder block.
3. 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

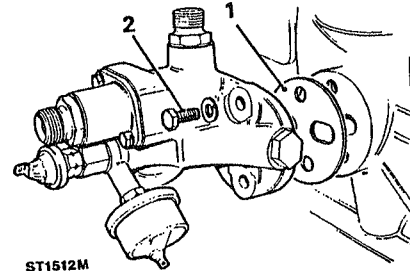
1. Clean and test the heater plugs as described in the MAINTENANCE SECTION. Fit the heater plugs and tighten to the correct torque. Do not over tighten.
2. Fit the leads, washers and nuts as illustrated, ensuring that each cable eyelet is fitted vertically downwards to prevent heat from cylinder head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



ST1270M

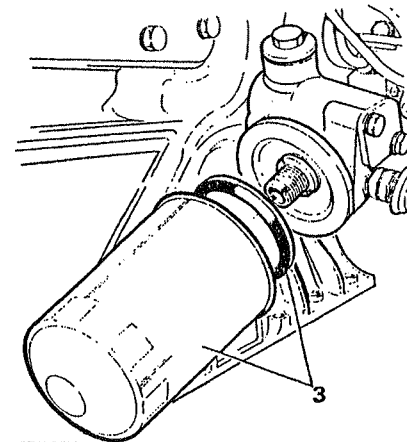
FIT OIL FILTER AND ADAPTOR

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 SECTION.

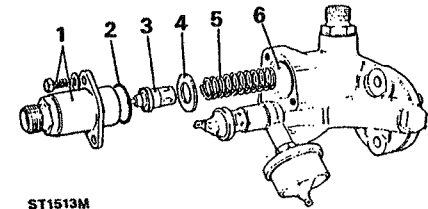


ST1795M

RENEW OIL TEMPERATURE THERMOSTAT

Used when an oil cooler is fitted.

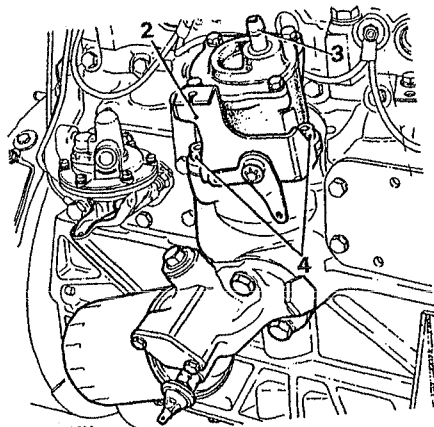
1. Remove the two bolts and carefully withdraw the thermostat extension housing.
2. Remove the O' ring.
3. Withdraw the thermostat.
4. Remove the washer.
5. Remove the spring.
6. Clean the adaptor housing with lint-free cloth.
7. Fit the spring and washer.
8. Fit a new thermostat with the pin uppermost.
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

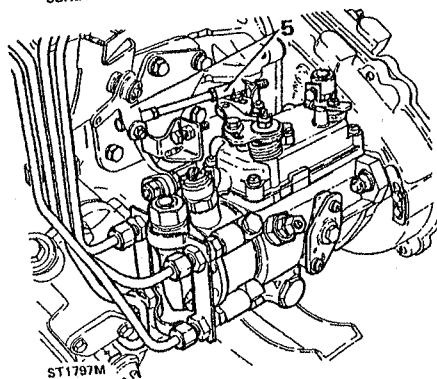
FIT VACUUM PUMP

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.



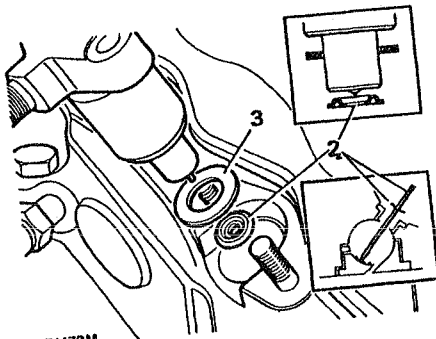
ST1797M

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.

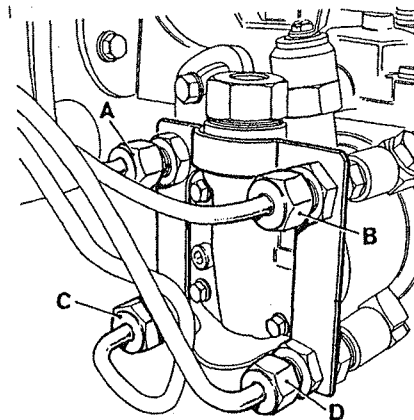


ST1473M

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

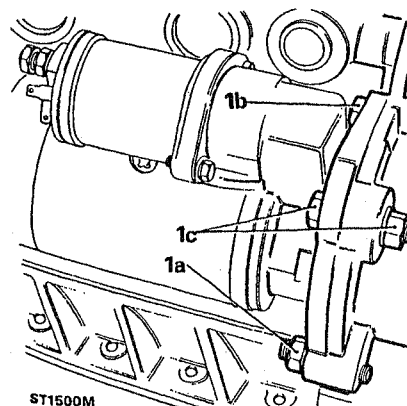
2. Fit the injector pipes to the injectors and D P S. pump. Counting from the front of the engine connect the pipes as follows:
 - A. To number 1 injector.
 - B. To number 2 injector.
 - C. To number 3 injector.
 - D. To number 4 injector.
 Do not overtighten the union nuts.



ST1499M

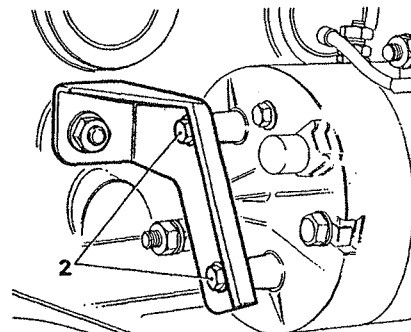
FIT THE STARTER MOTOR

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.



ST1500M

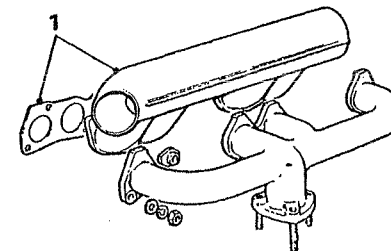
2. Secure the rear of the motor to the bracket with two bolts and tighten to the correct torque.



ST1501M

FIT THE AIR INTAKE AND EXHAUST MANIFOLDS

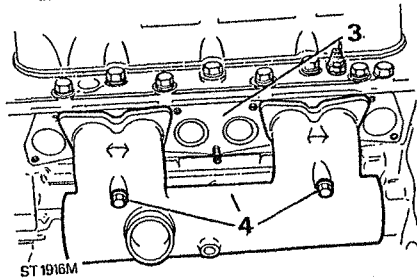
1. Using a new gasket fit the manifolds and secure with the retaining nuts and clamps. Evenly tighten to the specified torque figure.
2. Connect the breather hose to the oil filler cap.



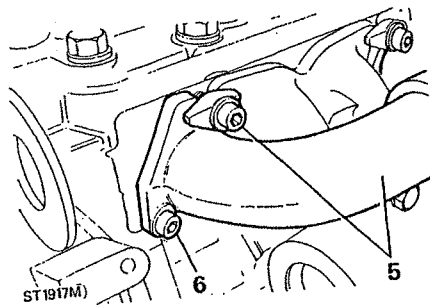
ST1550M

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.

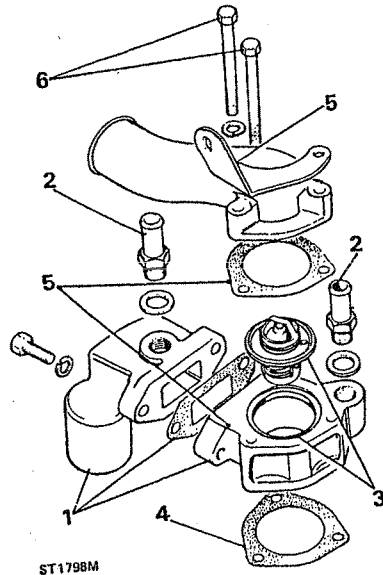


5. Fit the exhaust manifold and secure with the four socket headed bolts and clamps.
6. Fit the exhaust manifold, three lower retaining bolts and tighten to the correct torque.
7. Fit the turbo charger and prime the turbo-charger lubrication system, see Fitting Turbo-Charger, SECTION 19.



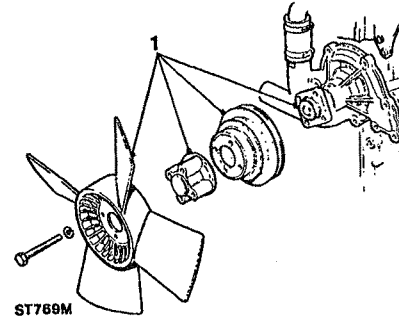
FIT THE THERMOSTAT HOUSING ASSEMBLY

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.



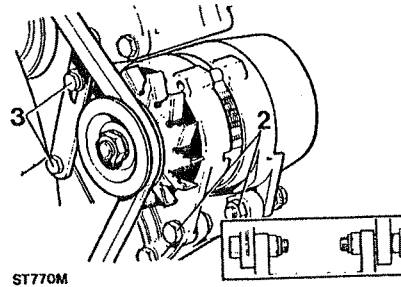
FIT PULLEY AND FAN BLADES

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.



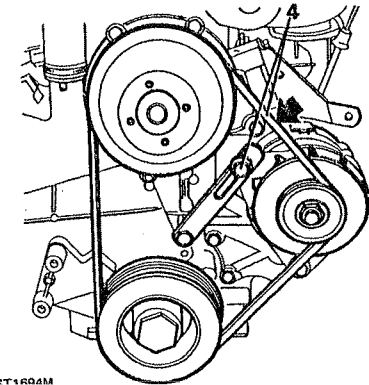
FIT ALTERNATOR - 12 VOLT

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.



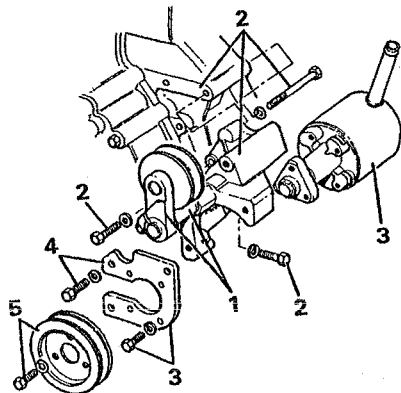
Adjust belt tension

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.



FIT POWER STEERING PUMP

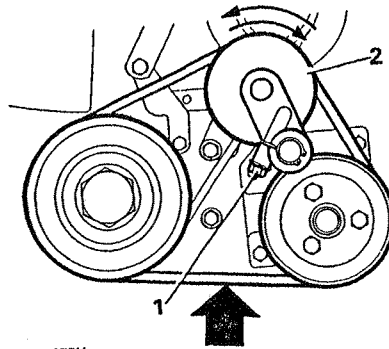
1. If removed, fit the jockey pulley to the spindle.
2. Fit the bracket and jockey pulley assembly to the engine with the three bolts.
3. Fit the power steering pump to the bracket and secure the plate to the pump with the four bolts.
4. Secure the plate to the bracket with the three bolts.
5. Fit the drive pulley to the pump with the three bolts.
6. Fit the drive belt.



ST1687M

ADJUST POWER STEERING PUMP 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.

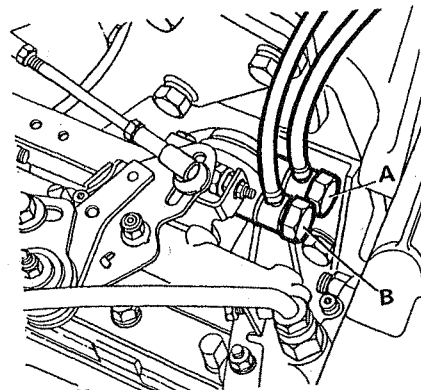


ST1672M

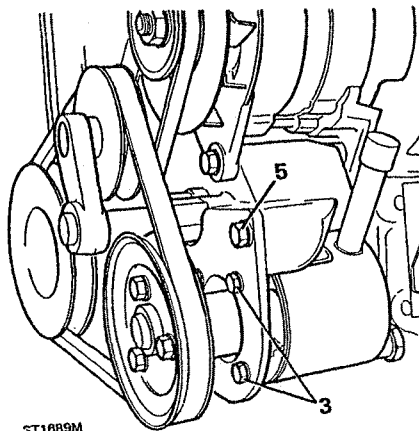
NOTE: Drive belt tensions covering all engine variants and models is included in the MAINTENANCE SECTION.

TURBO - CHARGED ENGINES

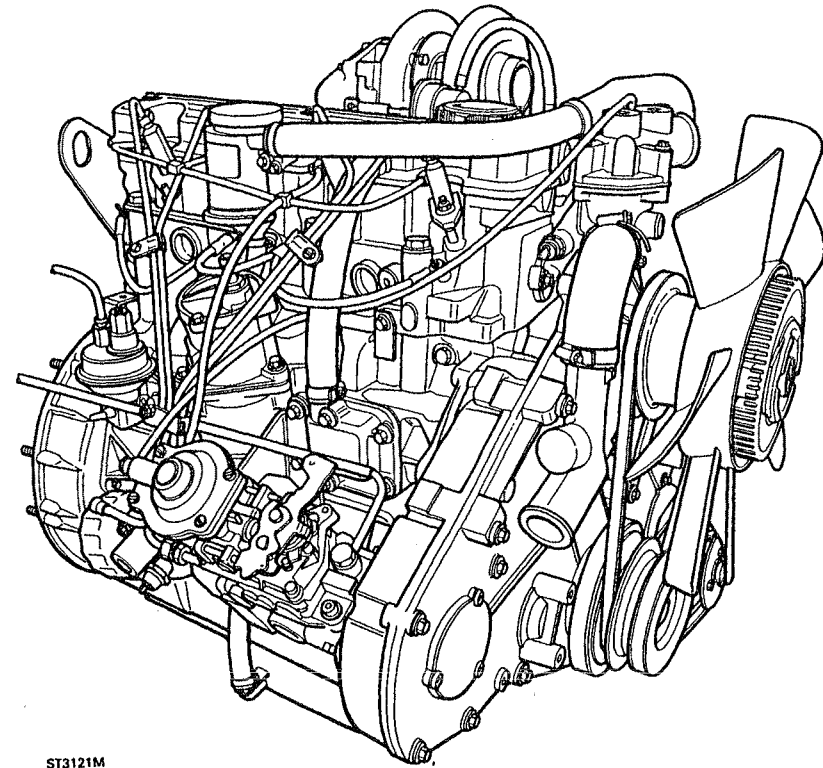
1. Connect pipe union 'A' to turbo charger 'T' piece hose.
2. Connect pipe union 'B' to injector spill rail.



ST2175M



ST1689M



ST3121M

DESCRIPTION AND OPERATION

200 Tdi engine

The four cylinder Tdi Diesel engine which is an optional power unit for the Land Rover Defender is a derivative of the 200 TDi unit installed in Discovery. Only minor modifications to the injection pump location, drive belt arrangement, inlet and exhaust systems was necessary to facilitate installation of the engine in the under bonnet space of Defender.

The power, performance and economy of the engine, is a blend of up to the minute computer technology and well proven Land Rover design features. The retention of design features such as the roller tappet camshaft, ensures continued interchangeability of parts with earlier models, while the aluminium cylinder head is completely new.

The engine is constructed from three main castings. The largest casting is the cylinder block which is made from cast iron and includes the integral cylinders, line bored crankshaft main bearing locations and caps and the bearing locations for support of the camshaft. The ladder frame which is cast from aluminium is bolted to the bottom face of the cylinder block after fitting the crankshaft and pistons to provide extra rigidity and noise suppression.

The direct injection cast aluminium cylinder head is secured to the cylinder block with eighteen bolts. The head gasket is selective from a range of three different thicknesses to ensure optimum combustion efficiency and performance.

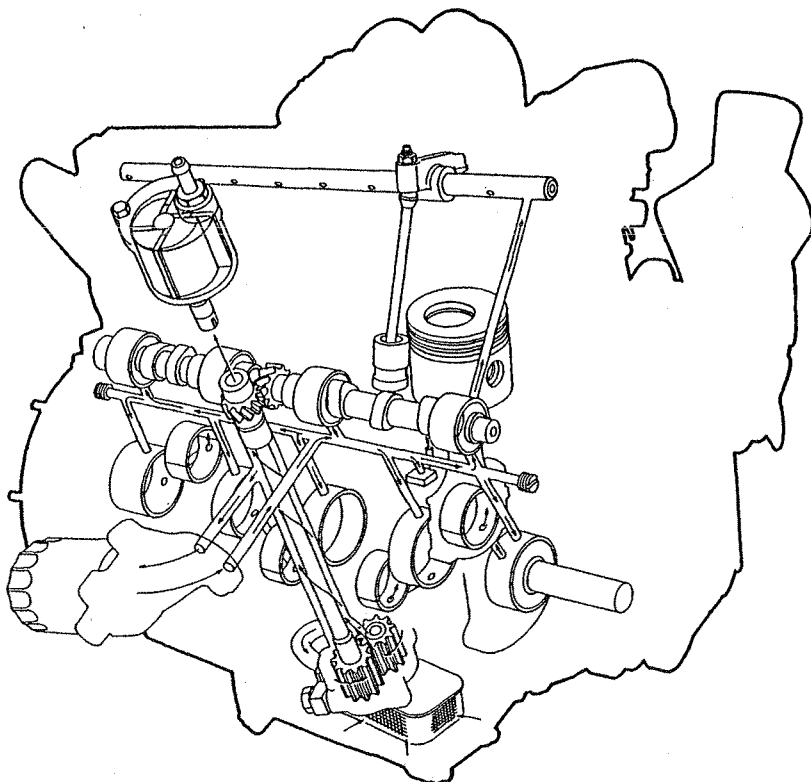
The crankshaft end float is controlled by selective half thrust washers, one each side of the centre main bearing.

The camshaft and fuel injection pump are driven off the front of the crankshaft by a totally enclosed toothed rubber belt.

Lubrication system

The lubrication system is similar to previous four cylinder units and employs a submerged gear pump which is driven by the camshaft and skew gear. Oil which is drawn into the gears through the steel gauze filter is pumped up the cavity between the pump body and the vertical drive shaft to the external filter.

After filtering, the oil continues via the distribution oil gallery and drillings in the cylinder block to lubricate the crankshaft main and big end bearings and the camshaft bearings. The thrust side of the cylinders is lubricated direct from the distribution gallery via separate jet turbos.



ST3190M

Lubrication to the front camshaft bearing continues through more drillings in the cylinder block to lubricate the roller tappets and rocker shaft via a vertical drilling in the cylinder head. The clearance around the pushrods and large ports in the camshaft chamber allows oil drainage to lubricate the skew gear and return to the sump.

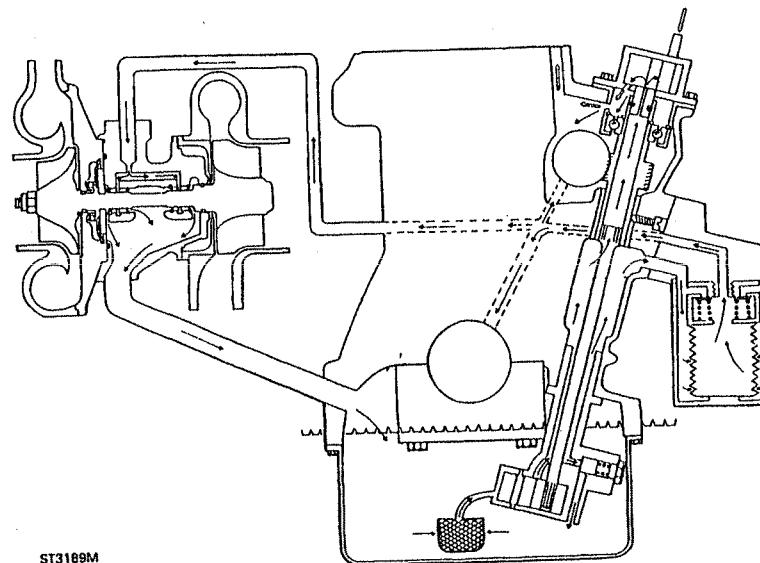
Three of the four camshaft bearing lubrication drillings in the cylinder block are drilled externally. These ports which are visible on the right side of the cylinder block are blanked off by each bearing and sealed with a black silicon sealant.

The oil which is pumped up the cavity between the vertical drive shaft and pump body is unfiltered. This unfiltered oil will not only lubricate the skew gear bush but also passes up the centre of the skew gear to lubricate the brake servo vacuum pump.

The system pressure is controlled by the pressure relief valve which is located in the pump body and is non adjustable.

Turbo Charger Lubrication

The turbo charger bearings are lubricated with filtered oil from the oil gallery in the cylinder block at pump pressure. After lubricating the bearings the oil returns to the sump via a large diameter drain hose. Obviously the turbo bearings which are operating at very high speeds and in a very hot environment need to be well sealed, cooled and lubricated.



ST3189M

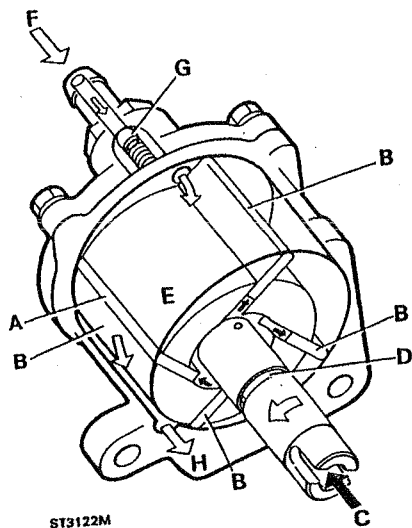
Brake servo Vacuum Pump lubrication

The brake servo vacuum pump rotor A is lubricated with unfiltered oil direct from the engine oil pump. Oil is supplied via the hole up the centre of the skew gear and the vacuum pump shaft C where, it not only lubricates the pump shaft D but is also fed into slots behind each of the four carbon vanes B.

The oil pressure behind the vanes exerts a force which ensures that they follow the contours of the pumping chamber E and form a good seal. An 'O' ring is fitted inside the hollow skew gear to form a seal between the skew gear and the vacuum pump shaft to prevent pressure leakage. In the event of low oil pressure the condition of this 'O' ring should be checked before continuing with further diagnosis.

With the brake servo vacuum hose connected and the vacuum pump operating, the pump will be producing a depression ready to operate the brakes. Each time the brakes are applied and released the pump will draw a small volume of air F from the servo chamber past valve G and discharge it through the pump outlet H into the camshaft/skew gear chamber and engine crankshaft atmosphere.

Provided the vacuum pump is not pumping an excessive volume of air, the crankcase ventilation system will not be affected. If however the engine is operated with a faulty brake servo, damaged vacuum hose or with the hose disconnected, the pump can force an uncontrolled volume of air into the crankcase ventilation system causing pressure to build up.

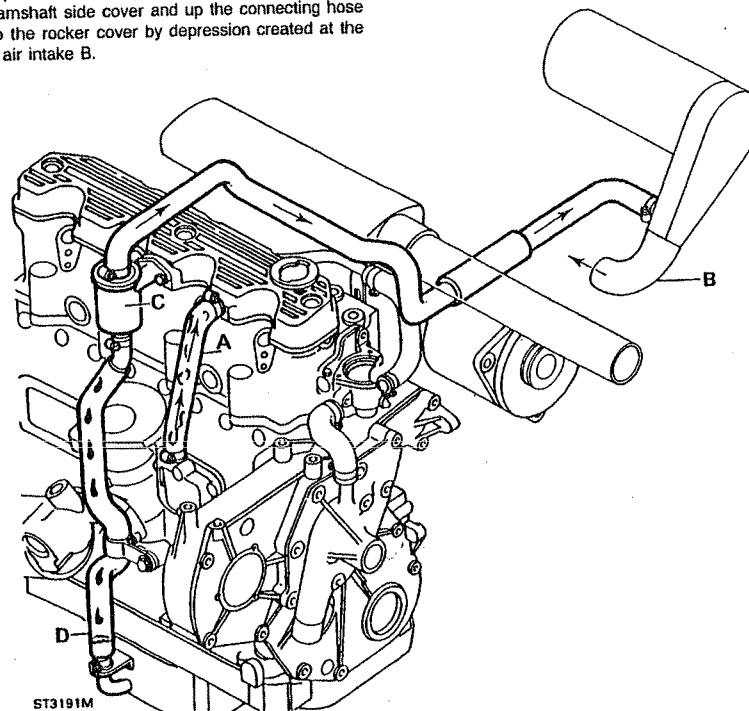


Crankcase Ventilation system

The crankcase ventilation system is of course associated with drainage of lubrication to the sump and is designed to separate the oil from the gaseous atmosphere before the residue is fed into the inlet system and burned in the combustion chamber.

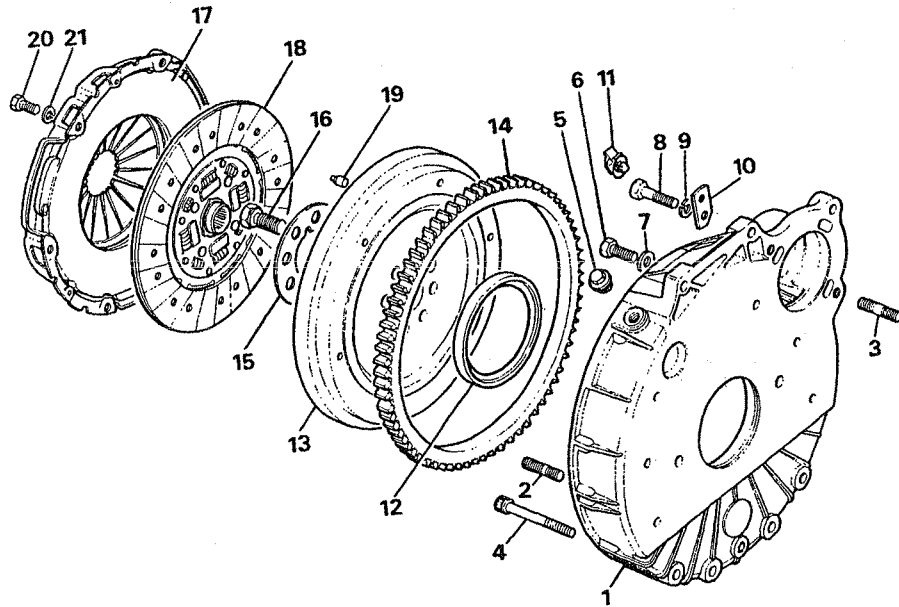
As can be seen in the illustration, oil laden atmosphere in the engine crankcase is drawn from the camshaft side cover and up the connecting hose A into the rocker cover by depression created at the turbo air intake B.

The oil separator C fitted to the rocker cover is designed to control the rate at which the air is purged from the sump and extracts the oil. The oil when extracted, drains back down hose D to the sump and the remaining atmosphere is controlled by a diaphragm valve in C before passing into the engine via the turbo charger, where it is burned.



CLUTCH AND FLYWHEEL HOUSING COMPONENTS - Tdi engine

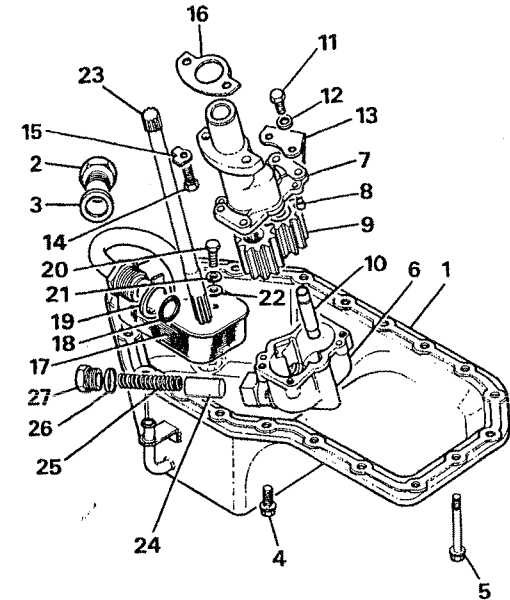
- | | |
|-------------------------------|----------------------------|
| 1. Clutch housing | 12. Oil seal |
| 2. Bell housing stud (9) | 13. Flywheel |
| 3. Starter motor stud (1) | 14. Starter ring |
| 4. Allen bolts (4) | 15. Reinforcing plate |
| 5. Plug (2) | 16. Bolt flywheel to crank |
| 6. Screw housing to block (6) | 17. Clutch cover |
| 7. Washer (6) | 18. Clutch plate |
| 8. Bolt housing to block (2) | 19. Dowel |
| 9. Spring washer (2) | 20. Screw |
| 10. Bracket (2) | 21. Spring washer |
| 11. Harness clip (2) | |



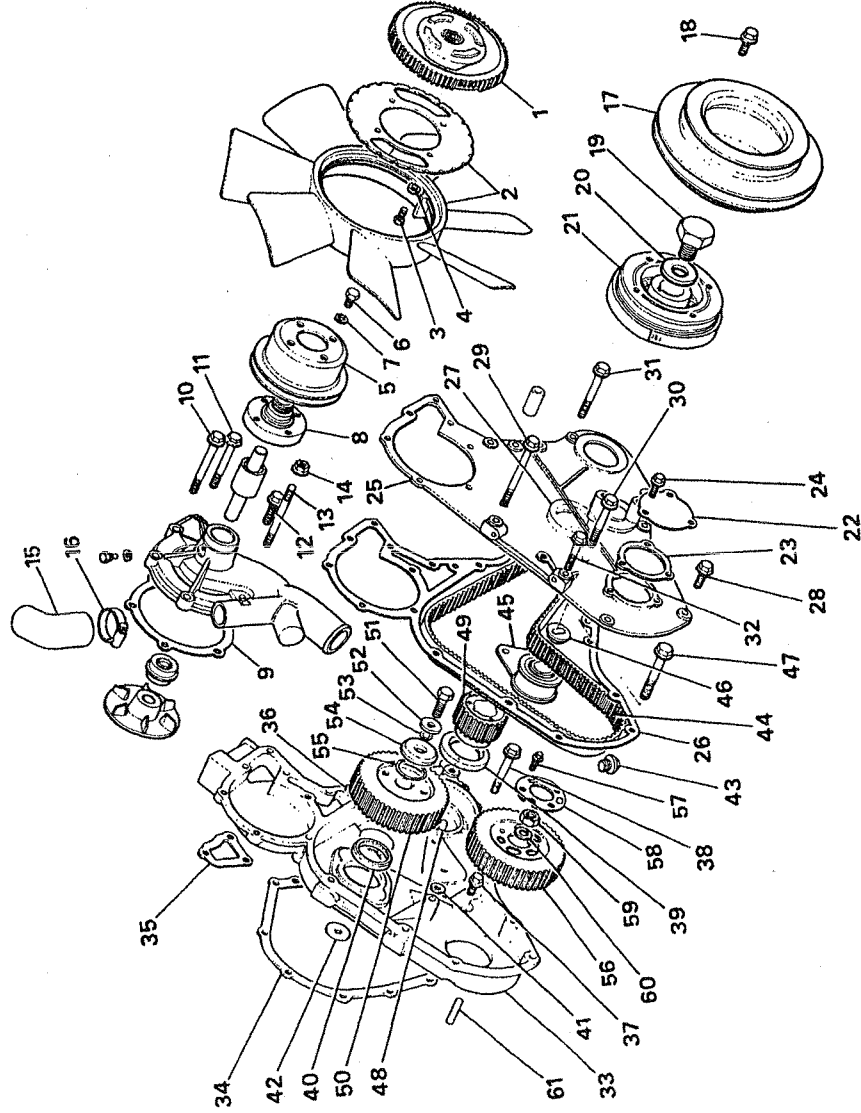
ST3066M

SUMP AND OIL PUMP COMPONENTS - 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



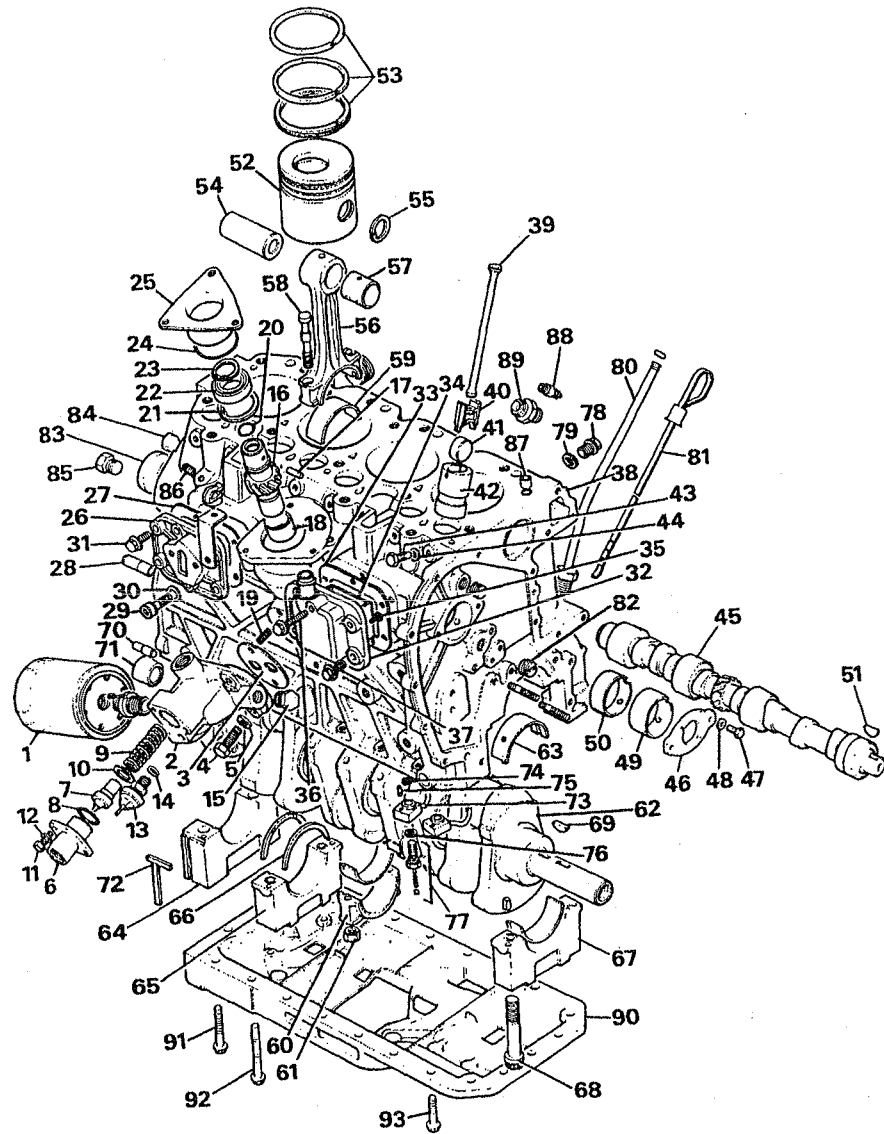
ST3064M

FRONT COVER COMPONENTS - Tdi engine (ST3064M)

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 M8x20 (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. Crankshaft oil seal
41. Gasket centre bolt

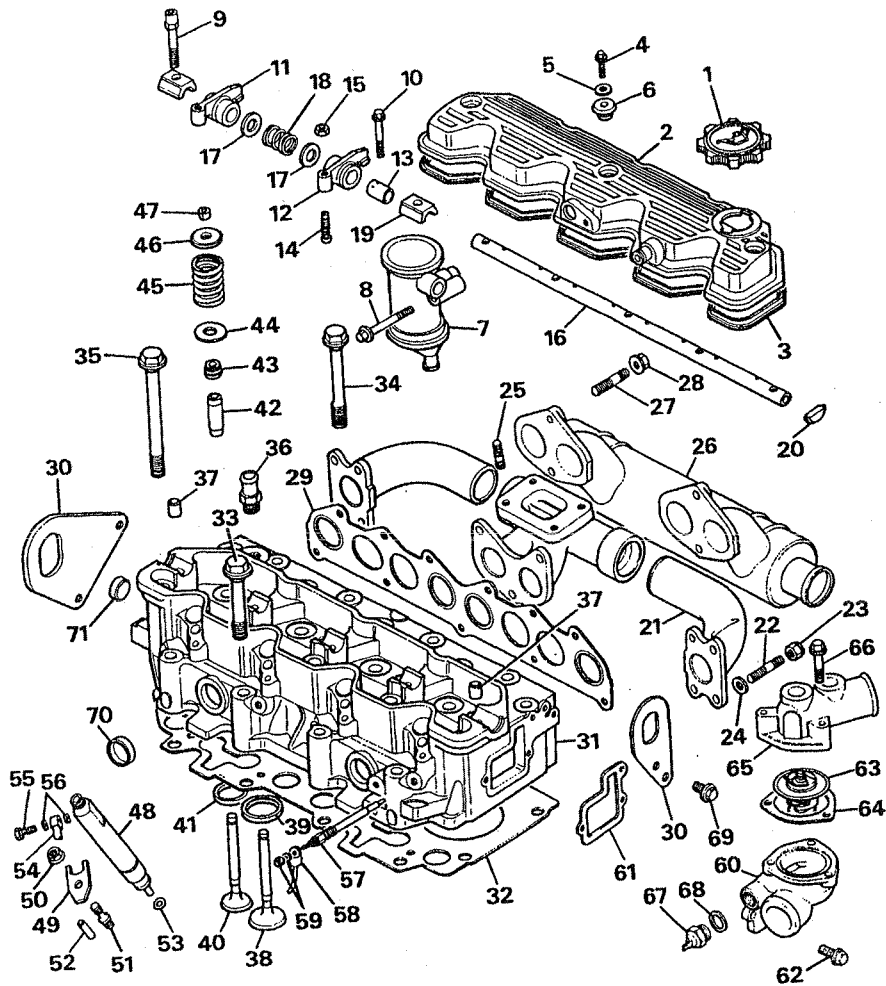
42. Gasket block front face
43. Plug
44. Timing belt
45. Timing belt tensioner assembly
46. Slotted washer
47. Flange bolt M10x70
48. Tensioner pivot pin
49. Crankshaft gear wheel
50. Camshaft gear wheel
51. Bolt
52. Washer
53. O ring
54. Retaining plate
55. O ring
56. Injection pump timing gear
57. Flange screw (3)
58. Retaining plate
59. Nut
60. Spring washer (3)
61. Stud injection pump to front cover (3)



ST3063M

CYLINDER BLOCK COMPONENTS - Tdi engine (ST3063M)

- | | |
|--------------------------------|---------------------------------------|
| 1. Oil filter element | 48. Spring washer (2) |
| 2. Oil filter adaptor | 49. Camshaft bearing - front |
| 3. Gasket | 50. Camshaft bearing - inter/rear (3) |
| 4. Screw (2) | 51. Camshaft key |
| 5. Spring washer (2) | 52. Piston |
| 6. Oil cooler adaptor | 53. Piston rings |
| 7. Thermostat bulb | 54. Gudgeon pin |
| 8. O ring | 55. Circlip (8) |
| 9. Spring | 56. Connecting rod |
| 10. Washer | 57. Gudgeon pin bush |
| 11. Screw (2) | 58. Connecting rod bolt |
| 12. Washer (2) | 59. Big end bearing |
| 13. Oil pressure switch | 60. Big end bearing cap |
| 14. Copper washer | 61. Connecting rod nut |
| 15. Blanking plug | 62. Crankshaft |
| 16. Skew gear | 63. Crankshaft main bearing |
| 17. Dowel pin | 64. Main bearing cap - rear |
| 18. Bush | 65. Main bearing cap - centre |
| 19. Locking screw | 66. Thrust washers |
| 20. O ring | 67. Main bearing cap (3) |
| 21. Snap ring external | 68. Main bearing cap bolt |
| 22. Deep groove bearing | 69. Crankshaft key |
| 23. Snap ring internal | 70. Crankshaft dowel |
| 24. O ring bearing housing | 71. Crankshaft bush |
| 25. Bearing housing | 72. Packing strip |
| 26. Rear side cover | 73. Jet adaptor |
| 27. Gasket | 74. Joint washer |
| 28. Dowel flywheel housing (2) | 75. Dowel |
| 29. Socket screw (2) | 76. Joint washer |
| 30. Washer (2) | 77. Relief valve assembly |
| 31. Flange bolts (6) | 78. Drain plug |
| 32. Front side cover breather | 79. Joint washer |
| 33. Gasket | 80. Dipstick tube |
| 34. Baffle plate | 81. Dipstick |
| 35. Screw No.6 (2) | 82. Oil gallery plug |
| 36. Flange bolt M8x40(1) | 83. Cup plug (5) |
| 37. Flange screw M8x25 (5) | 84. Cup plug |
| 38. Cylinder block | 85. Oil gallery plug |
| 39. Pushrod | 86. Camshaft oil feed plug (3) |
| 40. Tappet slide | 87. Ring dowel (2) |
| 41. Roller follower | 88. Oil feed adaptor |
| 42. Tappet guide | 89. Oil drain adaptor |
| 43. Set bolt | 90. Ladder frame |
| 44. Washer | 91. Flange bolt M8x125 (3) |
| 45. Camshaft | 92. Flange bolt M8x60 (4) |
| 46. Locking plate | 93. Flange screw M8x30 (3) |
| 47. Screw (2) | |



ST3062M

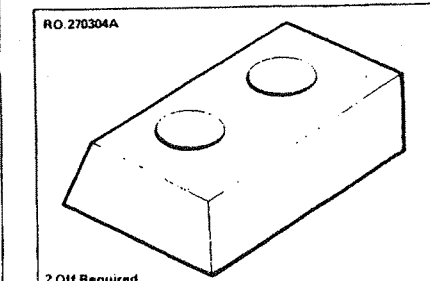
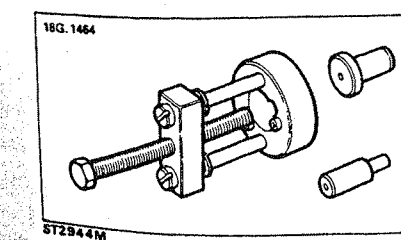
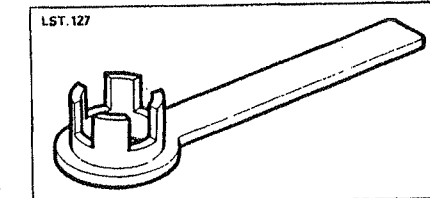
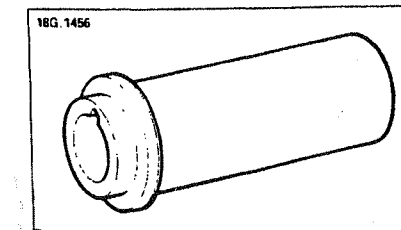
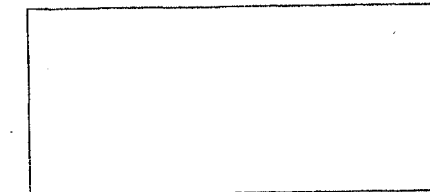
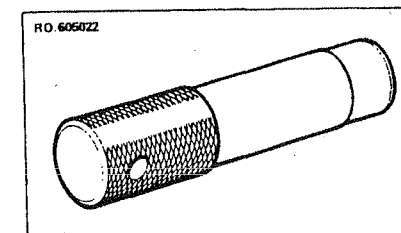
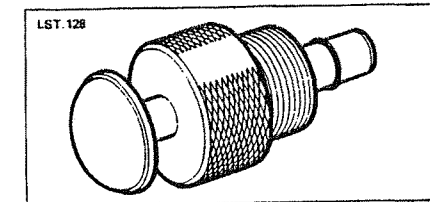
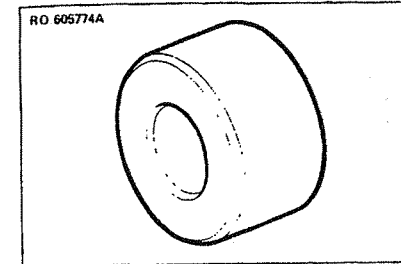
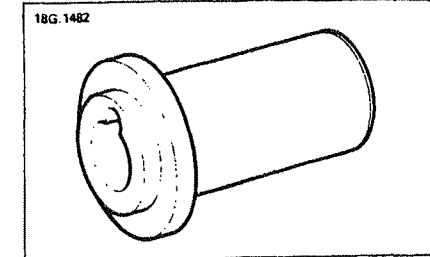
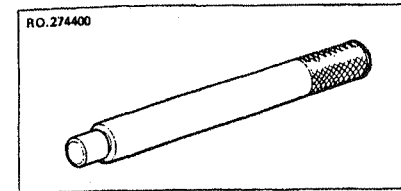
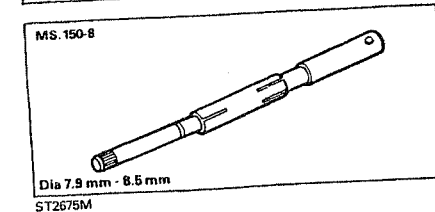
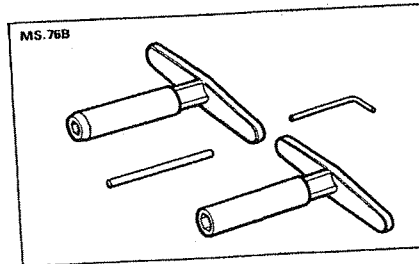
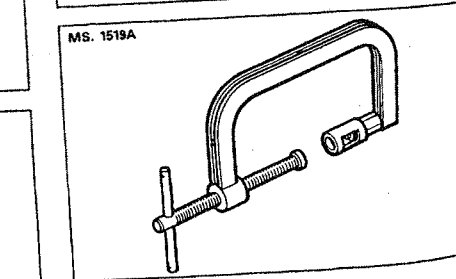
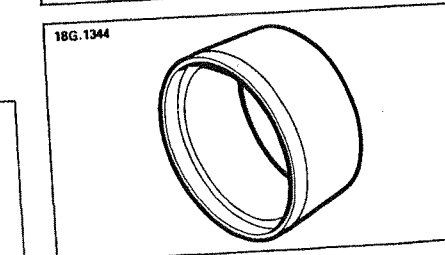
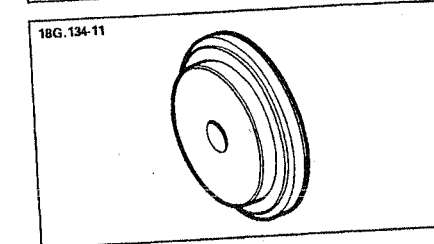
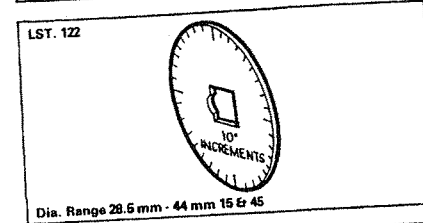
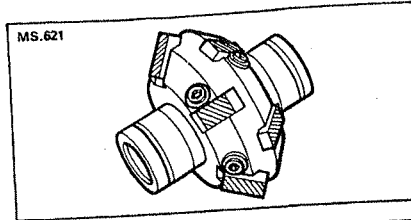
CYLINDER HEAD COMPONENTS - Tdi engine
(ST3062M)

- | | |
|--------------------------------|------------------------------|
| 1. Oil filler cap | 41. Valve seat insert |
| 2. Rocker cover | 42. Valve guide |
| 3. Rocker cover gasket | 43. Valve steam seal |
| 4. Flange headed bolt | 44. Valve spring stud |
| 5. Washer | 45. Valve spring |
| 6. Sealing washer | 46. Valve spring cup |
| 7. Breather cyclone | 47. Splint cotters |
| 8. Flange headed screw | 48. Injector |
| 9. Rocker shaft bolt (3) | 49. Injector clamp |
| 10. Rocker shaft bolt (2) | 50. Injector clamp nut |
| 11. Rocker arm RH | 51. Injector clamp stud |
| 12. Rocker arm LH | 52. Injector clamp dowel |
| 13. Rocker arm bush | 53. Injector sealing washer |
| 14. Tappet adjuster screw | 54. Spill return pipe |
| 15. Locknut | 55. Banjo bolt 6mm |
| 16. Rocker shaft | 56. Copper washer |
| 17. Rocker shaft spacer | 57. Glow plug |
| 18. Rocker shaft spring | 58. Glow plug cable |
| 19. Rocker shaft clamp | 59. Nut and washer |
| 20. Rocker shaft seal | 60. Thermostat housing |
| 21. Exhaust manifold | 61. Gasket |
| 22. Manifold stud exhaust | 62. Flange screw (3) |
| 23. Self locking nut | 63. Thermostat |
| 24. Plain washer | 64. Gasket |
| 25. Stud turbocharger mounting | 65. Thermostat housing cover |
| 26. Inlet manifold | 66. Flange bolt M6x40 (3) |
| 27. Manifold stud inlet | 67. Thermal transmitter |
| 28. Flange nut | 68. Joint washer |
| 29. Manifold gasket | 69. Flange bolt |
| 30. Engine lifting brackets | 70. Cup plug (1) |
| 31. Cylinder head | 71. Cup plug (2) |
| 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 | |

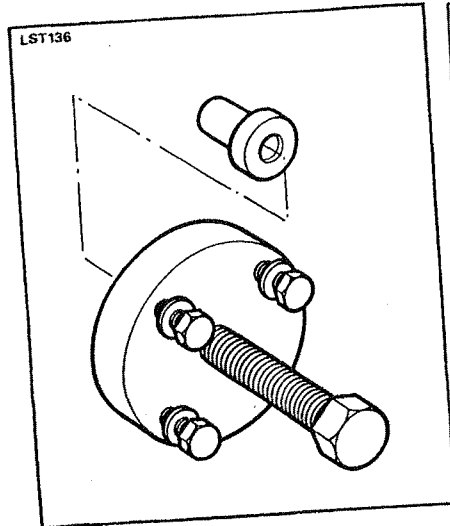
ENGINE OVERHAUL

Service Repair No.12.41.05

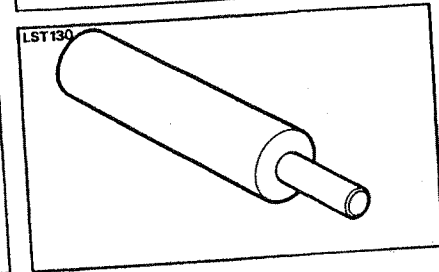
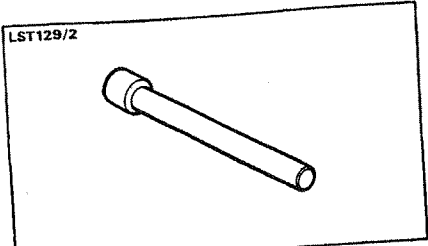
- Special service tools
 Handle set, seat cutter - LRT-12-501/MS76B
 Pilot, seat cutter - LRT-12-502/MS150-8
 Valve seat cutter - LRT-12-504/MS621
 Cylinder head bolt degree plate - LRT-12-007/LST122
 Adaptor, crankshaft rear seal - LRT-12-008/18G134-11
 Crankshaft rear seal saver - LRT-12-015/18G1344
 Valve spring compressor - LRT-12-034/MS1519A
 Drift, valve guide removal - LRT-12-036/RO274400
 Distance piece, valve guide fitting - LRT-12-515/RO605774A
 Drift, valve guide fitting - LRT-12-046/LST130
 Mandrel, clutch plate - LRT-12-040 - RO605022
 Replace, crankshaft front seal - LRT-12-028/18G1456
 Remove, crankshaft/camshaft gear - LRT-12-031/18G1464
 Replace, camshaft oil seal - LRT-12-032/18G1482
 Flywheel timing pin - LRT-12-044/LST128
 Crankshaft damper restraining tool - LRT-12-043/LST127
 Rear main cap seal guide - LRT-12-035/RO270304
 Crankshaft damper tool - LRT-12-049/LST136
 Injection pump timing pin - part of LST129 pump remover tool - LST129/2



2 Oil Required



ST2677M



WARNING: 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 manufacturers instructions to ensure safe and effective use of the equipment. In the interests of safety and efficient working, secure the engine to an engine stand recognised by the garage repair trade. Drain and discard the sump oil whilst strictly observing 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.

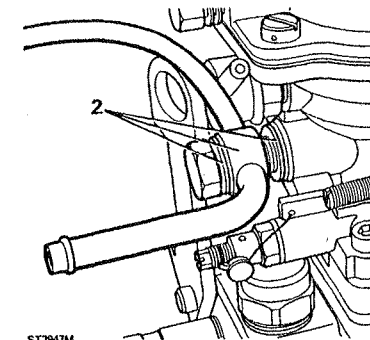
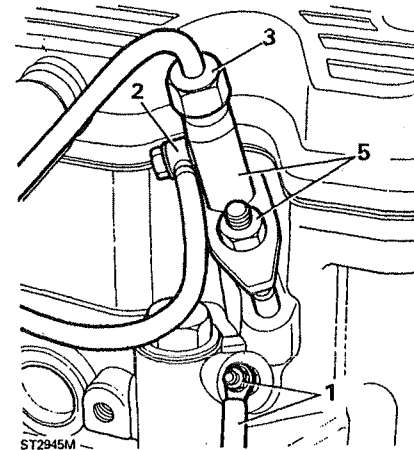
Whilst dismantling, make a note of the position of miscellaneous brackets, clips, harness, pipes, and hoses, that are removed at the same time, and any non standard items, to facilitate assembly.

CYLINDER HEAD REMOVE AND DISMANTLE

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

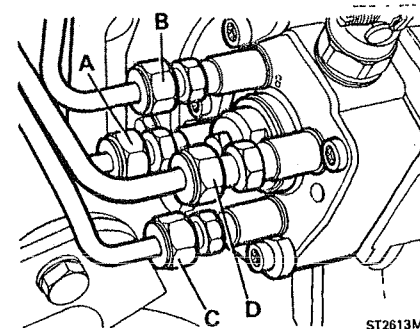
1. Disconnect the wiring, remove the heater plugs and store in a safe place to avoid damage.



ST2947M

Injectors remove

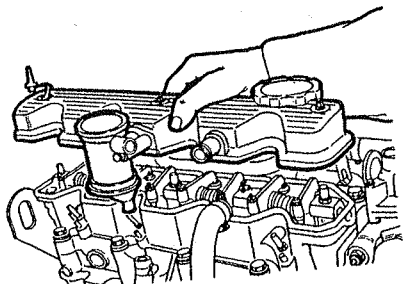
2. Disconnect the spill return at the pump and injectors.
3. Release the pipes at the injectors and at the pump A-B-C and D as illustrated.
4. Remove the pipes and store in a clean plastic bag.
5. Release the injector clamp nuts, remove the injectors and store in separate plastic bags to prevent contamination and damage. Retrieve the sealing washers from the injector seating in the cylinder head.



ST2613M

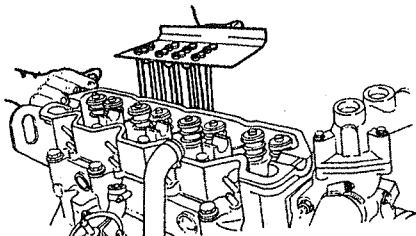
Rocker cover remove.

1. Release the crankcase ventilation hose connections, evenly slacken and remove the three bolts then lift-off the rocker cover.



ST2948M

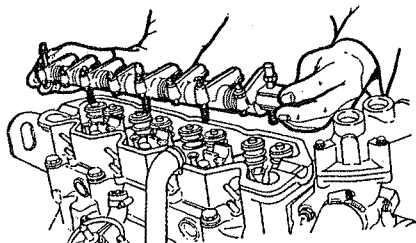
3. Having removed the rocker shaft, lift-out the push rods and insert them through holes in a piece of card marked from 1 to 8 to ensure assembly to their original locations.



ST2950M

Rocker shaft remove

2. Evenly release the five rocker shaft retaining bolts but do not remove the bolts from the shaft, especially the two end ones, to prevent the assembly from falling apart when removed from the cylinder head.



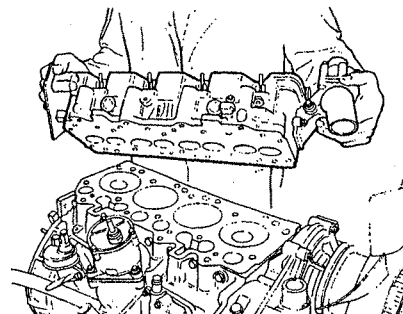
ST2949M

CAUTION: Since the injectors and heater plugs protude 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.

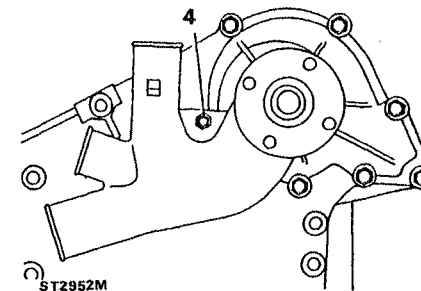
4. Remove the valve stem caps.
5. Mark each injector with the number of the cylinder to which it is fitted. Remove the injector clamp nut and carefully remove the injectors and place each in a separate plastic bag to prevent contamination and damage.
6. Remove the heater plugs and sealing washers and store in a safe place to avoid damage.

Removing cylinder head

7. Evenly slacken and remove the eighteen bolts retaining the cylinder head and lift the cylinder head from the cylinder block and remove the gasket.



ST2951M

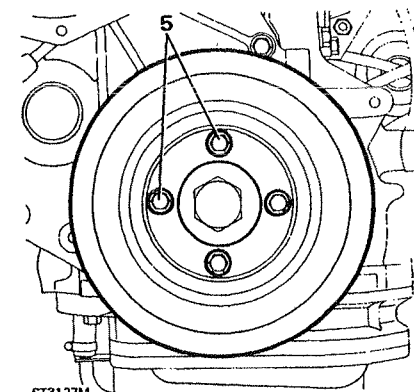


ST2952M

Front cover plate or seal remove

Front pulley and damper

5. Release the four bolts and remove the crankshaft pulley from the damper.



ST3127M

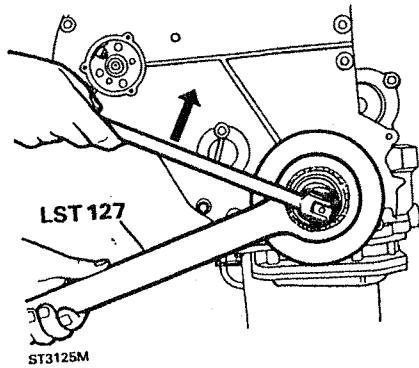
NOTE: If necessary, at this stage the cam followers may be removed for inspection. See Cam follower removal.

FRONT COVER OIL SEALS/TIMING BELT/CAMSHAFT

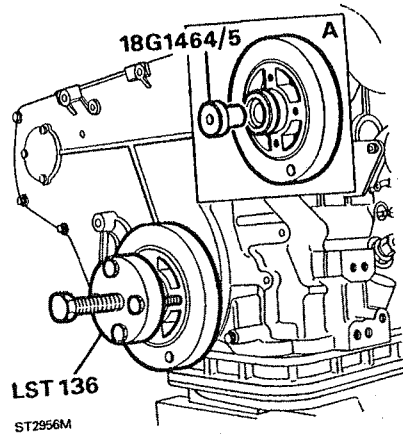
Water pump remove

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.

- To remove the crankshaft damper retaining bolt use Special service tool FR101 or LST127 to restrain the damper and a 30mm socket to remove the special bolt.

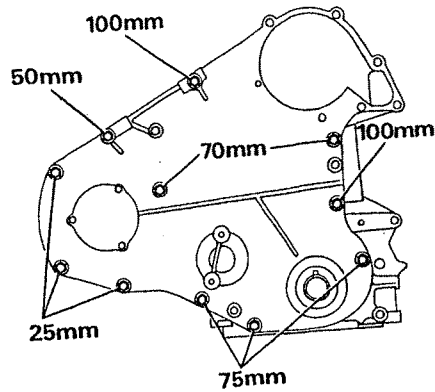


- Fit the pressure button 18G1464/5 to the end of the crankshaft and using service tool LST136, extract the damper as illustrated.



Removing front cover plate

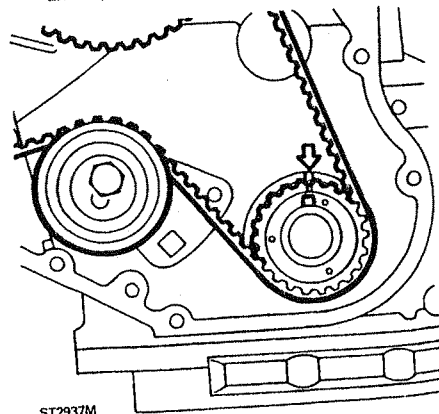
- Unscrew the 11 bolts and one nut to release the cover plate.



ST2918M

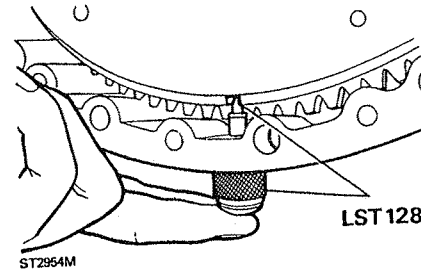
Removing timing belt

- Use the restraining tool LST127 to turn the crankshaft in a clockwise direction to TDC so that the valves of number one cylinder are closed and number four cylinder valves on the rock' and the crankshaft key aligned with the front cast into the front cover as illustrated. If the crankshaft is turned inadvertently beyond TDC do not turn back but continue on round until the above conditions are achieved.



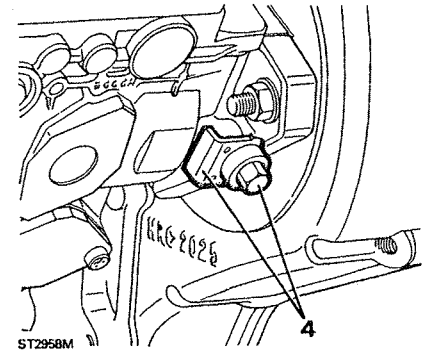
ST2937M

- Now screw the body of the timing pin tool LST128 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 other. The narrowest slot determines TDC for this engine and it is therefore important that the correct slot is used.



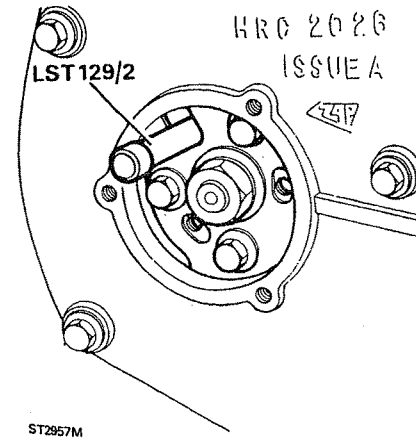
ST2964M

- To lock the pump, slacken the locking screw anti-clockwise and remove the inhibiting plate. Turn the screw clockwise to lock the pump shaft. Remove the timing pin from the flywheel housing.



ST2958M

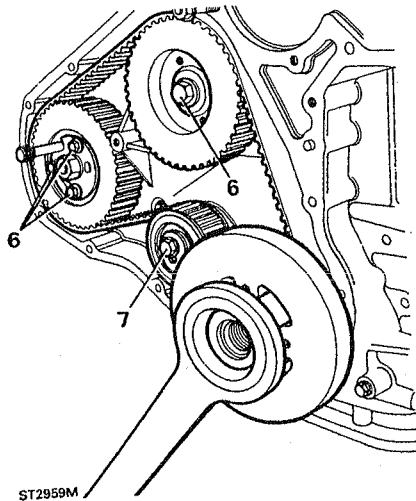
- Remove the three screws to release the injection pump access cover from the front cover plate and insert the locking pin LST129/2 through the U' shaped cut-out in the pump hub and into the hole in the pump body. This will confirm that the injection pump is correctly timed in relation to the valves and crankshaft and can be locked ready for removing. Leave the pin in position in the pump.



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.

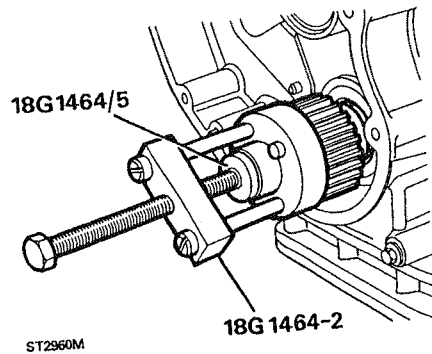
5. To verify any timing error, check that the timing marks inside the front cover line-up with the gear wheels.
6. If necessary temporarily fit the damper and restrain the crankshaft with service tool FR101 while the three screws securing the pump timing gear to the pump hub and the camshaft gear wheel 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.



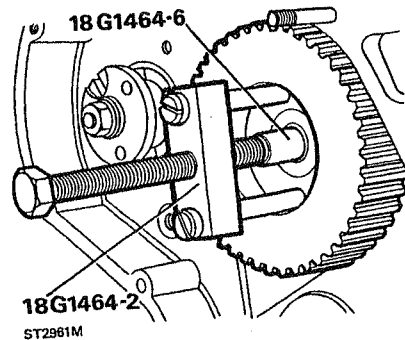
NOTE: A used drive belt develops a wear pattern relative to the driving loads and its direction of rotation. If the belt is to be re-used it must be refitted so that it continues to operate in the original direction.

Removing timing belt gears

9. If the crankshaft gear wheel cannot be removed by hand, use special service tool 18G1462-2 and pressure button 18G 1464-5. Assemble the tool and withdraw the gear wheel as illustrated.



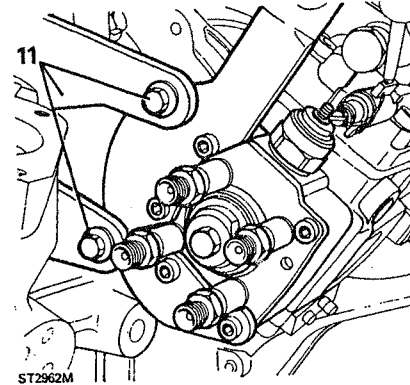
10. Remove the camshaft gear wheel retaining bolt assembly to enable the gear to be removed. Use special service tool 18G 1462-2 and button 18G 1464-6. Assemble as shown and withdraw the gear.



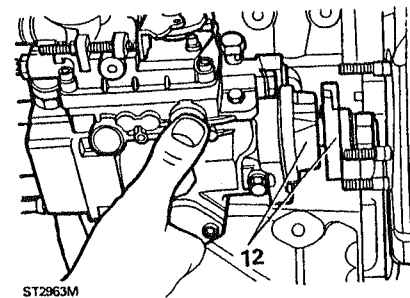
NOTE: The camshaft and crankshaft oil seals may be renewed at this stage with the engine in the vehicle without removing the front cover, See fitting front cover seals.

Removing injection pump

11. Release the injection pump from the rear support bracket.

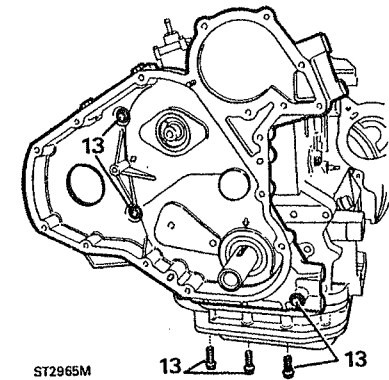


12. Remove the three nuts securing the pump flange to the front cover and withdraw the pump and gasket complete with hub and timing pin.



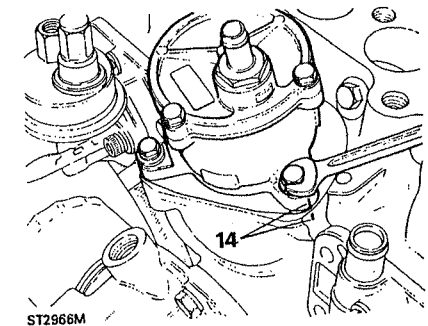
Removing front cover

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.



Removing vacuum pump

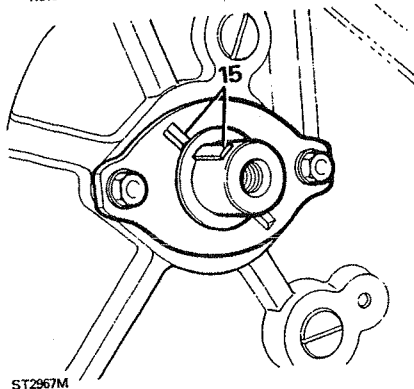
14. Mark the position of the brake servo vacuum pump with relation to the cylinder block. Using a 6mm Allen key remove the three screws and lift-out the pump.



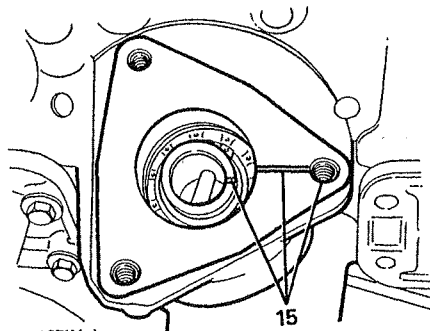
Removing skew gear

During normal operation of the engine the camshaft and skew gear teeth develop a mated and 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 the camshaft engage in the original running position.

- To ensure original 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.



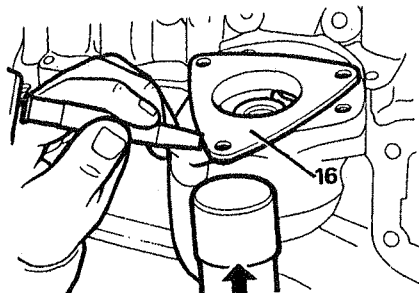
ST2967M



ST2971M

- 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.

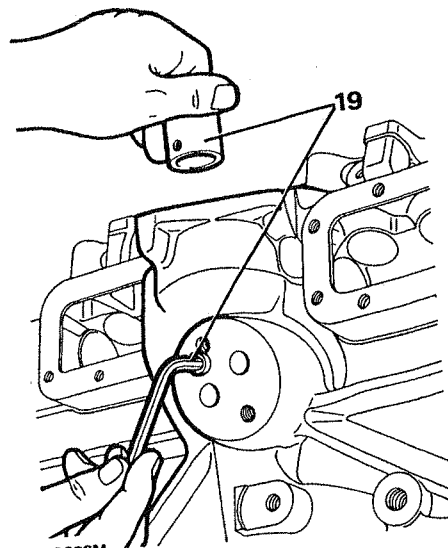
If necessary the oil pump drive shaft may be removed at this stage.



ST3128M

Removing skew gear bush

- Unscrew the oil filter cartridge, anti-clockwise, using a strap wrench. Dispose of the oil safely.
- Release the two bolts and remove the oil filter adaptor and gasket from the engine.
- Using a 6mm allen key remove the retaining screw and bush.



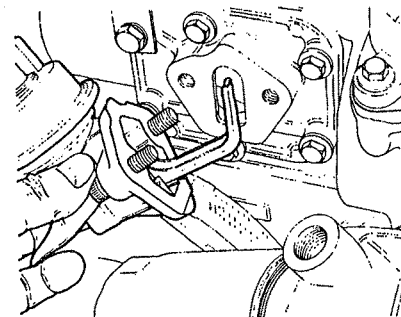
ST3038M

Removing fuel pump and side cover

- Use a 6mm allen key to release the fuel lift pump to gain access to the side cover retaining bolts.
- Release the six bolts and remove the cover plate.

Remove front side cover plate

- Release the six bolts and remove the front side cover plate complete with the crankcase ventilation pipe.

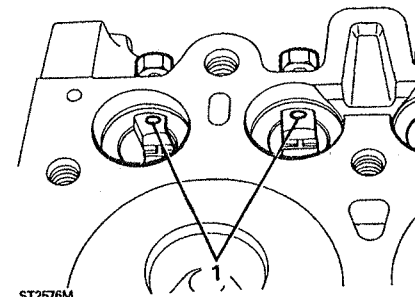


ST3003M

Remove cam followers

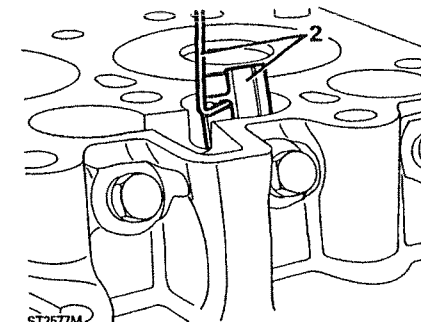
CAUTION: The cam followers are solid rollers held in position against the cam by a slide inside a fixed guide. If the guide is removed before the roller, it is possible that the roller can fall behind the camshaft and become jammed. Furthermore the roller could slip past the cam and fall into the crankcase. It is therefore important to adopt the following procedure for removal.

- Slacken back the guide locating screw so that the end is below the bore of the guide.



ST2576M

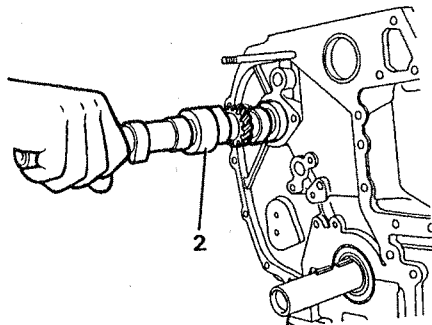
- Using a length of thin wire with a hooked end lift-out the slide.
- With the same piece of wire remove the roller.
- Remove the guide locating screw and lift-out the guide.
- As each assembly is removed number it, from one to eight, for refitting to its original location.



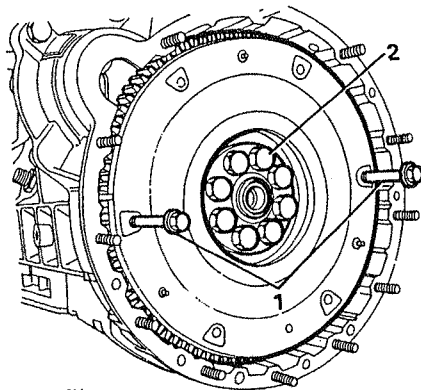
ST2577M

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.



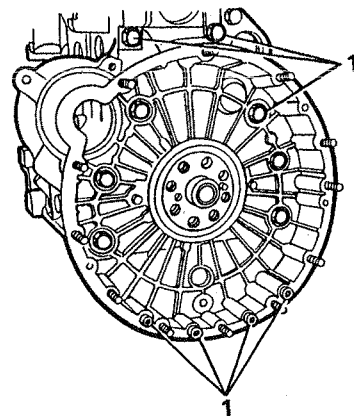
ST2552M



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.



ST2972M

Removing Clutch

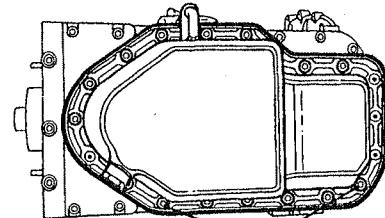
1. Mark the relationship of the cover to the flywheel to ensure original balance is maintained.
2. Evenly slacken and remove the six retaining bolts and washers and remove the assembly complete with the friction plate.

Removing flywheel

1. In the interests 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 crankshaft damper and use special service tool FR101 to restrain the crankshaft while slackening the flywheel eight retaining bolts. Remove the bolts and reinforcing plate and lift-off the flywheel.

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.

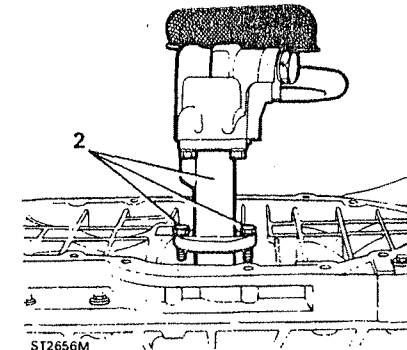


ST2553M

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.

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.

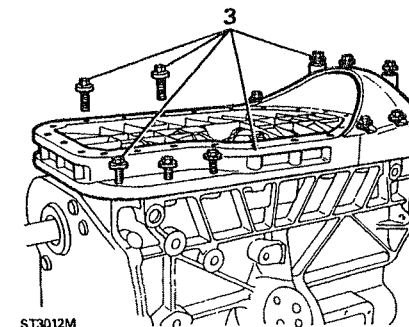


ST2656M

Removing ladder frame

NOTE: The ladder frame and flywheel housing are secured by five bolts which are inaccessible 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.

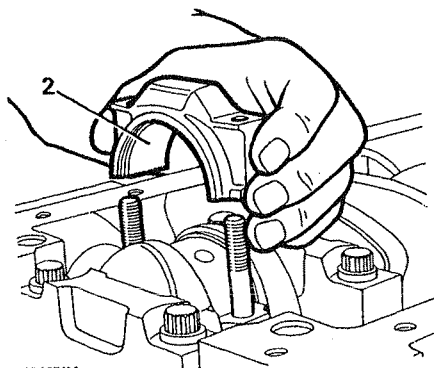


ST3012M

Removing pistons and connecting rods

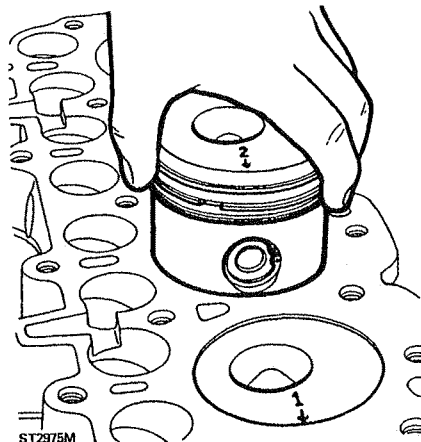
NOTE: On this version of the Tdi engine, it is not possible to remove the connecting rods or pistons with the engine in the vehicle because of the method by which the ladder frame is secured. See note under Ladder frame removal.

1. Turn the crankshaft to bring all the connecting rod cap nuts to an accessible position and slacken the nuts using a 15mm socket.
2. Remove the connecting rod nuts and remove the caps complete with the lower bearing halves.



ST2974M

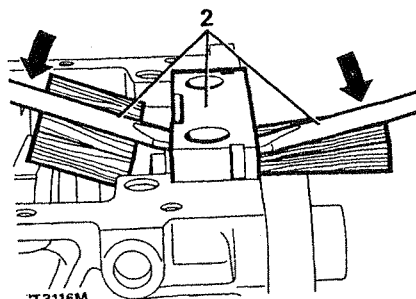
3. Before removing the piston assemblies, number each piston from one to four so that it can be identified with the bore from which it was removed.
4. Taking care not to damage the bores, push each connecting rod and piston, in turn, up the bore until it can be withdrawn from the cylinder block combustion 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.



ST2975M

Removing crankshaft

1. Slacken the ten main bearing 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 main bearing caps complete with the lower bearing shells.



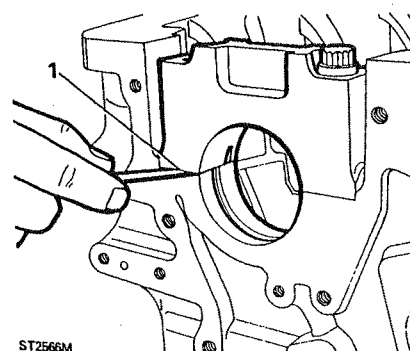
T3116M

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 main bearing 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

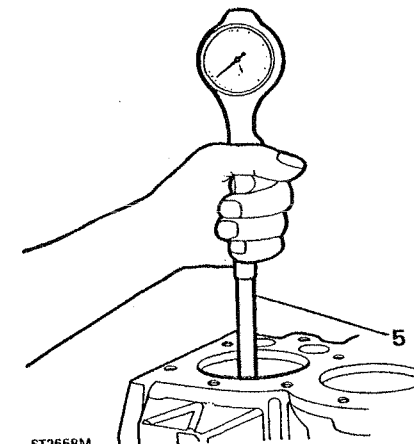
1. Degrease the cylinder block and carry out a thorough visual examination checking for cracks and damage. To check each main bearing cap and its location on the cylinder block, fit the bearing caps without the bearing shells.
2. Fit the bolts and tighten to the correct torque, then remove one bolt from 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 dowel, 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 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

6. To establish maximum overall bore wear, take measurements at as many points as possible down the bore 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.

Maximum permissible taper 0,254 mm.

Maximum permissible overall wear 0,177 mm.

7. If the above figures are exceeded the cylinders can be rebored to a maximum of 0,50 mm 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. It is not permissible to reclaim a cylinder block by fitting cylinder liners to the Tdi engine.

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. 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 GENERAL SPECIFICATION DATA.

CRANKSHAFT

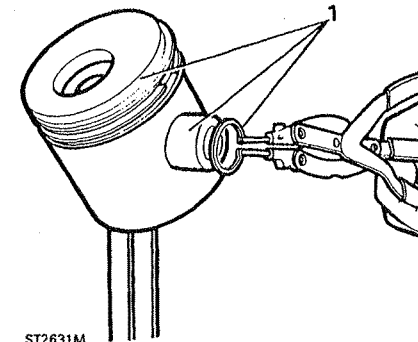
1. Degrease the crankshaft and clear out the oil ways which can become clogged after long service.
2. Examine visually, the crankpins and main bearing journals for obvious wear, scores, grooves and overheating. A decision at this stage should be made as to whether the condition of the shaft is worth 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.
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.
6. 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 taking into account any ovality in the centre journal. The overall wear limit should not exceed 0,114 mm for main bearing journals and 0,088 mm for crankpins.
7. A crankshaft worn beyond the limits of maximum taper, ovality and overall wear, can be ground to 0,25 mm.

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.

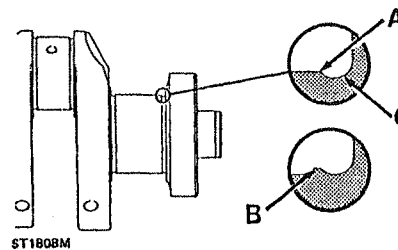


ST2631M

Genuine Land Rover service standard size pistons are supplied 0,025 mm oversize to allow for production tolerance on new engines. When fitting new pistons to a standard size cylinder, the bores must be honed to accommodate the pistons with the correct clearances.

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.

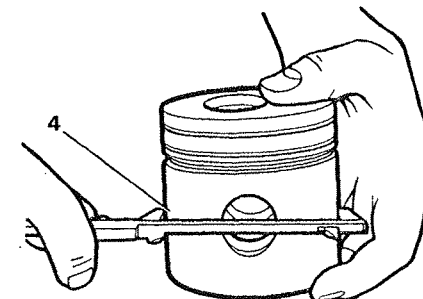


ST1808M

Pistons and connecting rods

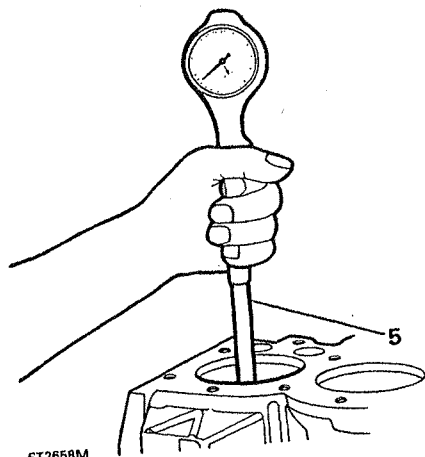
The following checks relating to pistons and rings must also be carried out prior to fitting new pistons to rebored cylinder blocks. Until it is decided if new components are required all parts must be kept in their related sets and the position of each piston to its connecting rod should be noted.

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 are specially graded to facilitate assembly. The grade letter on the piston crown should be ignored when ordering new pistons.

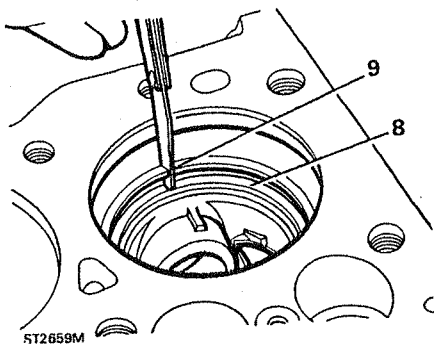


ST2657M

5. With an inside micrometer or cylinder gauge measure the diameter of the bore at approximately half-way down and note the reading.



ST2658M



ST2659M

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 **GENERAL SPECIFICATION DATA**. 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.

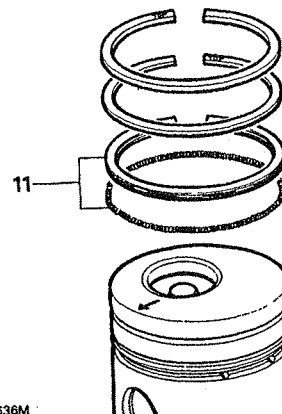
Piston ring groove clearance

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.

Piston ring gaps

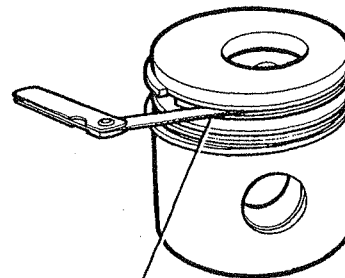
8. When checking the piston ring gap in worn bores which are within the acceptable taper and ovality limits, the ring must be inserted squarely into the bottom of the cylinder at the lowest point of the piston travel. To ensure squareness push the ring to the correct position using a piston.

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.



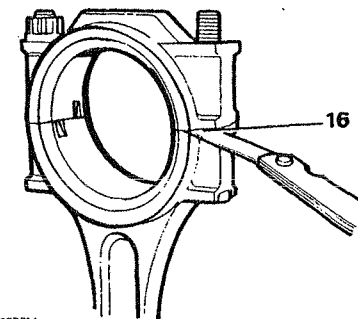
ST2632M

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.



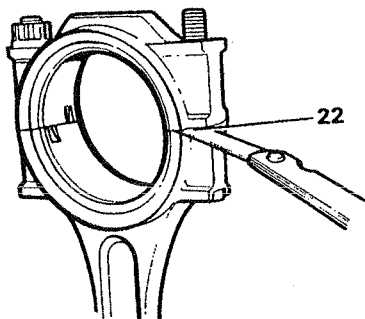
ST2976M

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.
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 renewed. 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 0,20 mm.



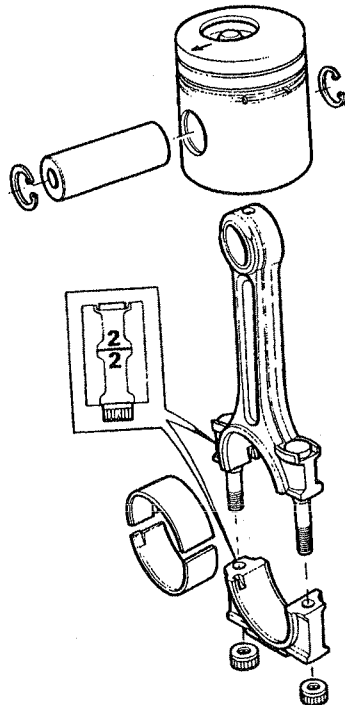
ST2977M

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 fitting 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

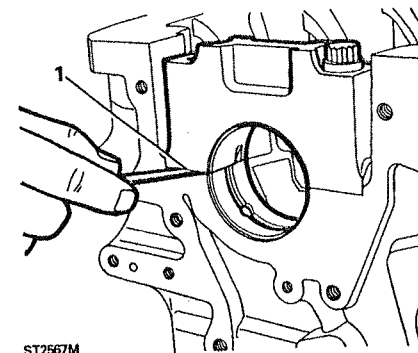
ASSEMBLE ENGINE

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 dowels 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.

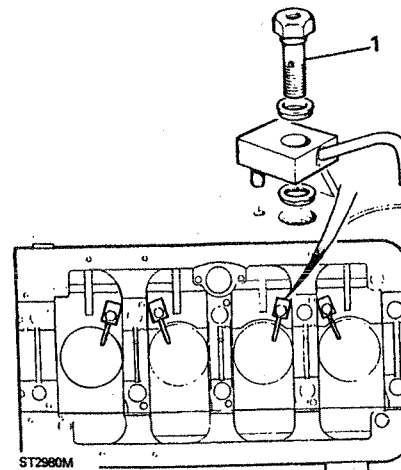


ST2567M

The nip clearance which ensures that the bearings are correctly clamped, must be within 0,10 to 0,15 mm. 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.



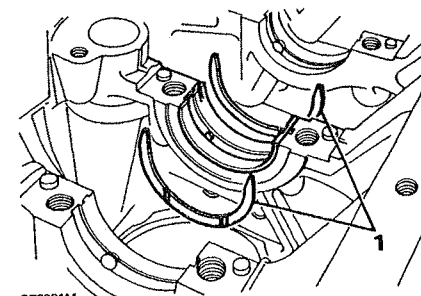
ST2980M

Crankshaft bearings

Main bearing nip clearance

Clean the protective coating from new bearings before fitting.

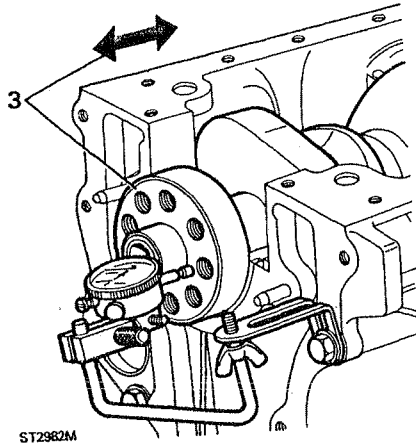
1. Fit the bearing halves to the cylinder block ensuring full engagement of the location tags.
2. Install the other half shells into the main bearing caps, again ensuring that the tags locate correctly.
3. Fit all the main bearing caps to their original locations tightening the bolts to the correct torque, then release one bolt on each cap.
4. Check the clearance between the cap and the block as illustrated.



ST2981M

Crankshaft end-float

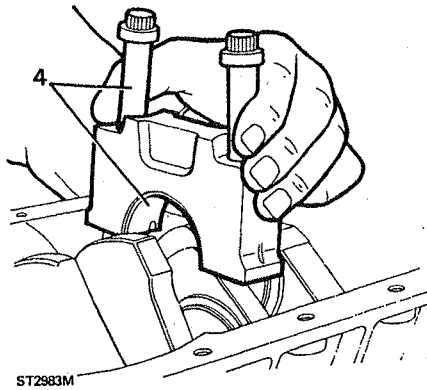
- To determine the crankshaft end-float mount a dial test indicator to read-off the end of the crankshaft. Move the crankshaft away from the indicator and zero the dial, then move the crankshaft in the opposite direction and note the indicator reading. The end-float should be 0,05 to 0,15 mm.



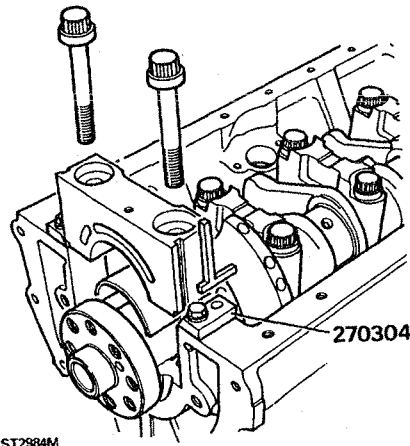
Alternatively measure the clearance with a feeler gauge. If adjustment is required substitute with oversize thrust washers. Variation of thrust washer thicknesses at each side of the crankshaft journal must not exceed 0,08 mm to ensure that the crankshaft remains centralised.

Main bearing caps

- 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.
- Lubricate and fit 1-2 and 4 main bearing caps checking that the shaft is free to rotate after tightening the bolts for each.

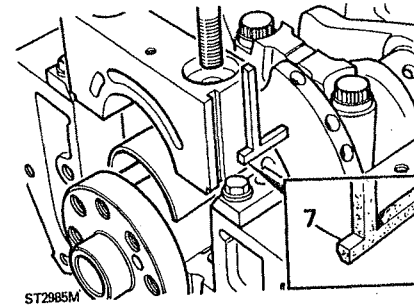


- Ensure that number five main bearing cap is clean and free from old seal material. Attach the seal guides number RO270304 to the crankcase, as illustrated, and ensure that they are parallel to the crankcase edge.

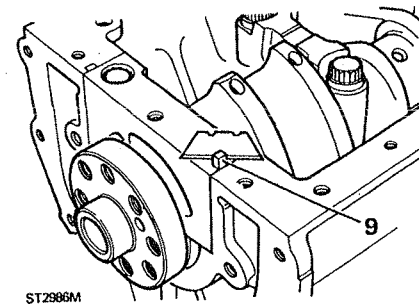


- To prevent any seal material becoming trapped between the bearing cap and crankcase, chamfer the inner edge of the seal 0,40 to 0,80 mm wide as illustrated. Smear the seals with engine oil and fit them to the bearing cap.
- Fit the bearing cap complete with shell bearing to the crankcase and secure with new bolts and tighten to the appropriate torque. Remove seal guides and check that the shaft is free to rotate.

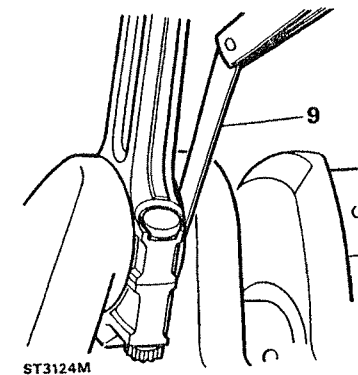
Fitting connecting rods and pistons



- 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.



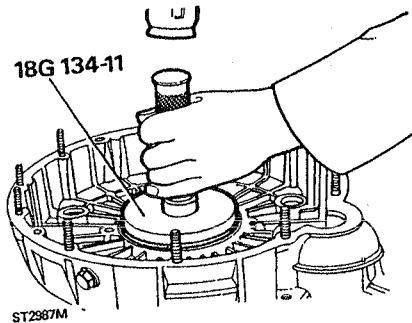
- Ensure that the essentric headed big end bolts and shell bearings are correctly located in the connecting rods and as a precaution against possible damage to the crankshaft journals during installation of the pistons, cover the bolt threads with a layer of adhesive tape. Check that the number on the connecting rod is the same as the piston and cylinder and that they are correctly orientated.
- 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.
- 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.
- Pull both connecting rod big ends on to the journals and fit the caps ensuring the numbers match and orientation is correct. Retain the caps with new nuts but do not tighten at this stage.
- Turn the crankshaft so that 1 and 4 journals are at BDC and install the pistons and connecting rods as previously described.
- 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.
- Investigate and rectify any big end bearing which when tightened restricts the freedom of the crankshaft.
- 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 GENERAL SPECIFICATION DATA.



Fitting rear main oil seal to flywheel housing

The oil seal is manufactured from PTFE and is supplied with a former to maintain the correct shape which must not be removed until the seal is to be fitted.

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.

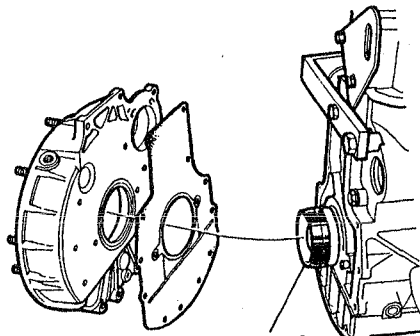


ST2987M

Fitting flywheel housing

NOTE: Later Tdi engines are fitted with a flywheel housing that has a flat joint face with the cylinder block instead of a shallow annular groove round the seal housing. The method of sealing the housing to the cylinder block has also changed. Instead of a bead of sealant a precise configuration, a large special gasket is used. The new gasket is interchangeable and should be used to seal the flywheel housing to the cylinder block on earlier engines but the annular groove must be filled with RTV sealant.

3. Examine the seal guide, number 18G1344 ensuring that it is perfectly smooth and not damaged or scratched. Also check that the crankshaft oil seal journal is smooth and clear.
4. 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.
5. Position the gasket on the cylinder block over the two dowels. The gasket will only fit one way round.
6. Where applicable, fill the annular groove with RTV sealant.
7. Place the seal guide over the crankshaft flange and using the two dowels as a guide to ensure initial squareness, fit the flywheel housing and remove the seal guide.
8. Secure the housing with the retaining bolts and tighten evenly to the correct torque.



ST3133M

18G.1344

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 therefore check that the flywheel has not been previously machined before proceeding further. The ring gear may be renewed if the teeth are chipped or damaged.

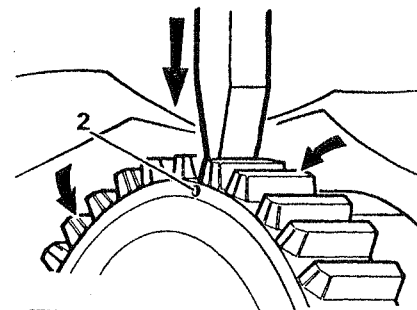
Reface the flywheel

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

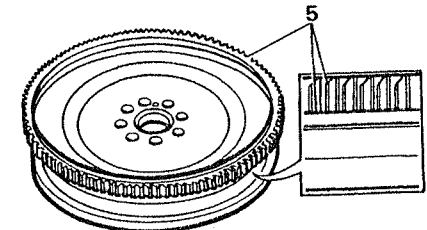
WARNING: Wear industrial goggles to protect the eyes from flying fragments.

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

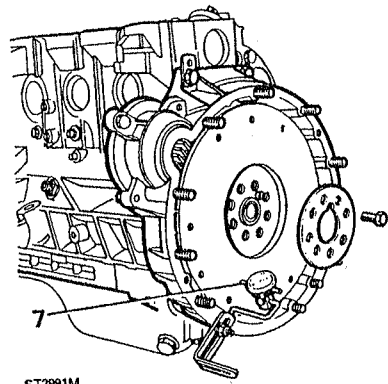
3. Secure the flywheel in a soft jawed vice and cover it with a cloth to avoid personal injury. Place a cold chisel above the drilled hole and strike it sharply to split the ring gear.
4. Heat the new ring uniformly to between 225°C and 250°C but do not exceed the higher figure.
5. Place the flywheel, 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 from the centre of the flywheel.
8. Turn the flywheel, and check that run-out does not exceed 0.05 to 0,07 mm. Should any run-out be excessive, remove the flywheel, and check again for irregularities on flywheel and crankshaft mating faces and dowel.

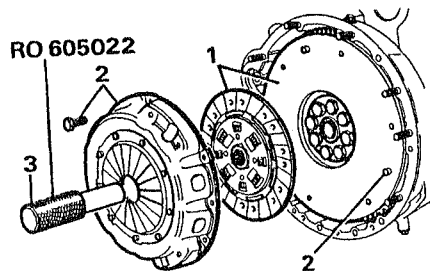


ST2991M

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

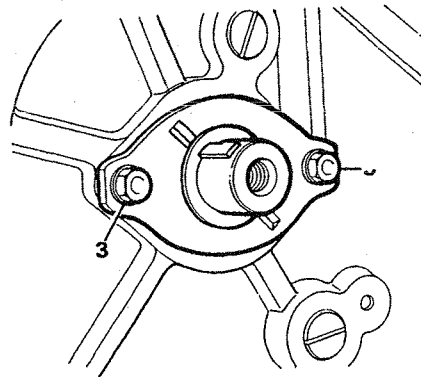
Fitting camshaft

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.

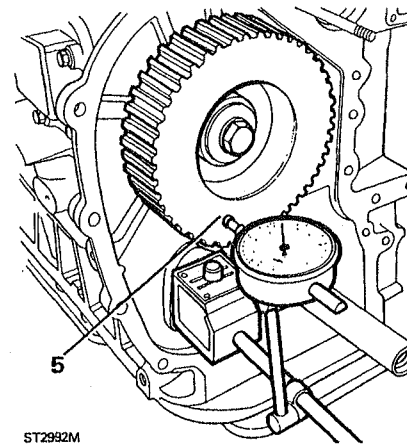
CAUTION: If the skew gear is worn and requires renewal, the camshaft must also be renewed even though the camshaft gear may appear satisfactory. Once the two gears have run together they become a matched pair.

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

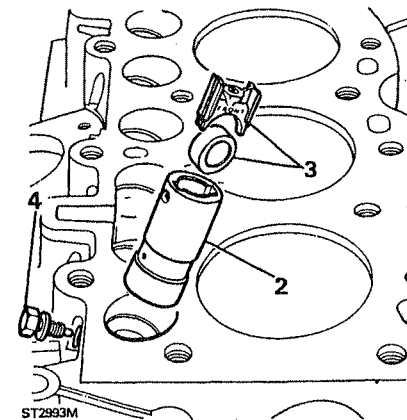
4. To check the camshaft end-float, temporarily fit the camshaft gear and mount a dial test indicator so that the stylus rests in a loaded condition upon the machined face of the gear.
5. Zero the dial and move the camshaft back and forward and note the reading. The end-float should be within 0,06 to 0,13 mm. If necessary fit another thrust plate to achieve the correct end-float.



ST2992M

Fitting cam followers

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.



ST2993M

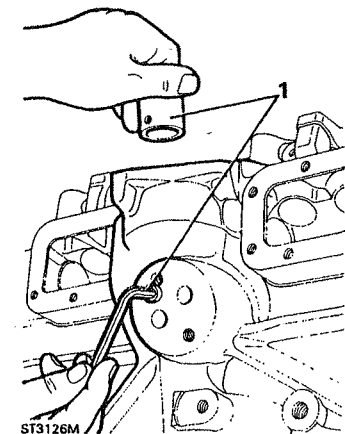
NOTE: The tappet retaining screws have a micro encapsulated locking compound applied to the threads to ensure that they do not become loose. Once the screw has been used the locking ability is lost.

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 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.



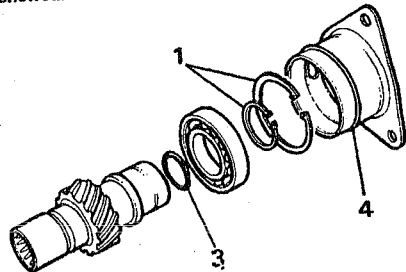
ST3126M

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.

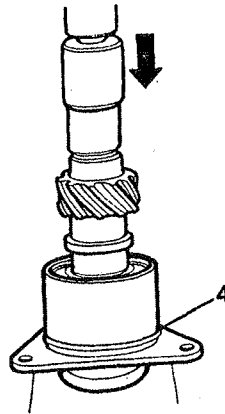
CAUTION: If the original skew gear and camshaft are to be re-used, they must be fitted so that the teeth on each, mesh in the original position. If either the skew gear or the camshaft are renewed, the mating component must also be renewed.



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.

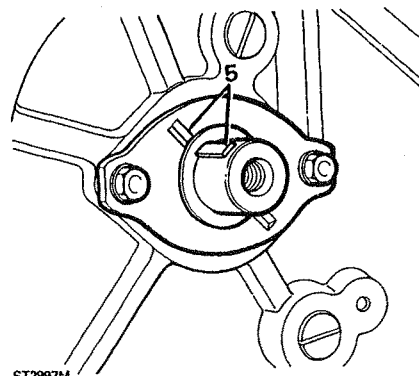


ST2999M

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:

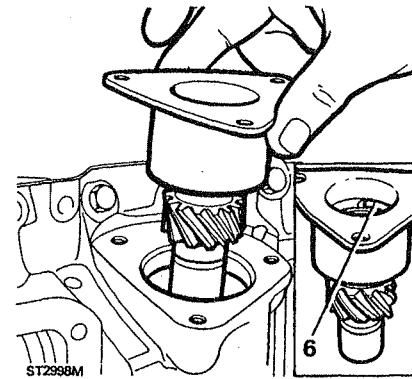
5. Turn the camshaft so that the key aligns with the oil groove as illustrated.



ST2997M

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.

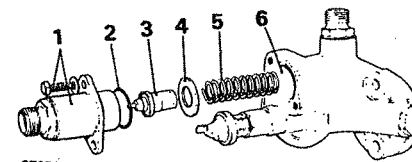


ST2998M

OVERHAUL AND FITTING OIL FILTER ADAPTOR

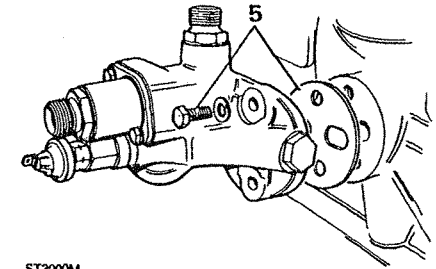
Oil temperature thermostat

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 adaptor. 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.



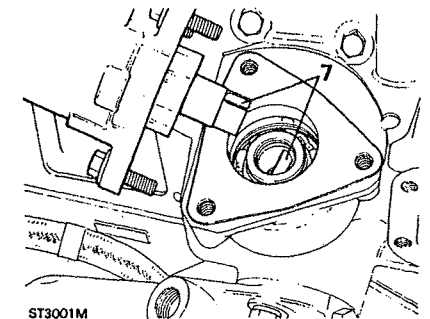
ST3000M

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

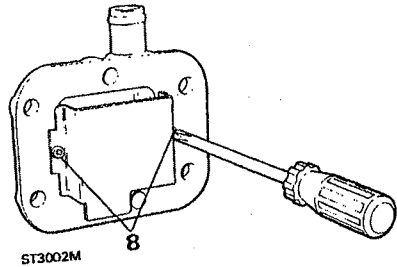
7. Using a new gasket fit the vacuum pump so that the brake servo connection is towards the front of the engine, ensuring that the cross-pin in the skew gear locates in the pump drive shaft then secure with three screws tightened to the correct torque.



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.

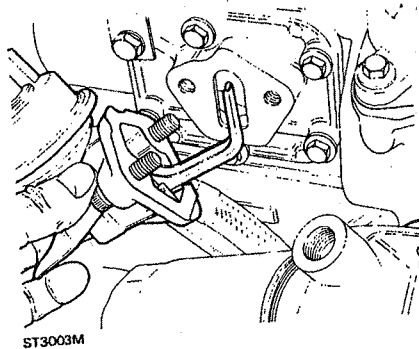


Fitting rear cover

9. Fit the rear cover also using a new gasket and secure with six bolts tightened to the correct torque.

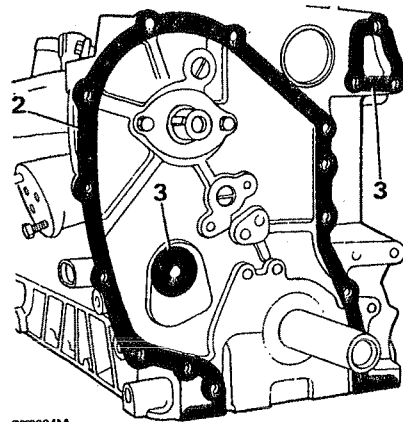
Fitting fuel lift pump

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.

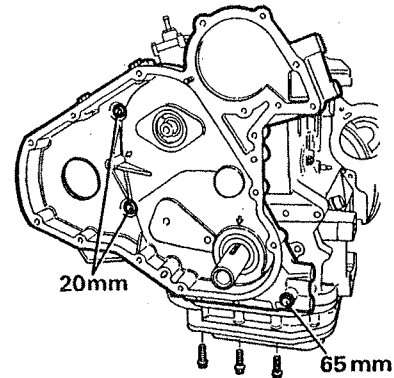


FITTING FRONT COVER TIMING BELT AND GEARS

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.

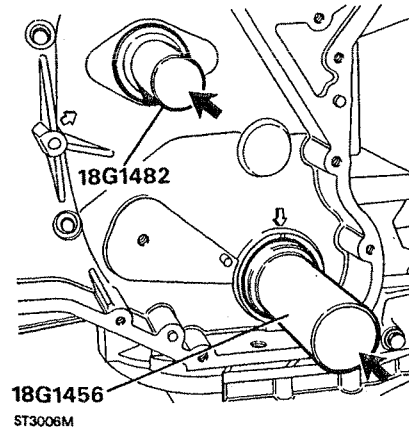


3. Also fit a new joint washer to the coolant aperture and to the tapped hole for the jockey pulley clamp bolt.
4. Fit the front cover locating it over the single stud and secure with the three retaining bolts tightening evenly to the correct torque. The correct bolt length for each hole is given in the following illustration.



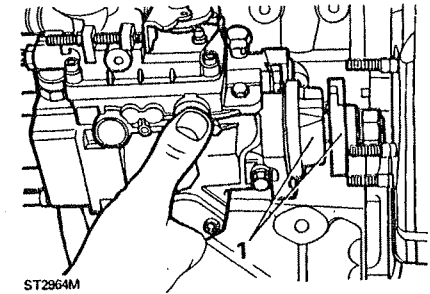
Front cover seals

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.



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 reinforcing plate. Do not overtighten the bolts at this stage.

Injection pump, valve timing and drive belt

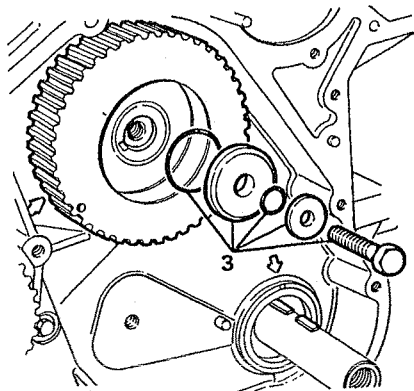
Drive belt

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 radius. Do not bend the belt at an acute angle or radius less than 50 mm otherwise premature failure of the fibre reinforcement could result.

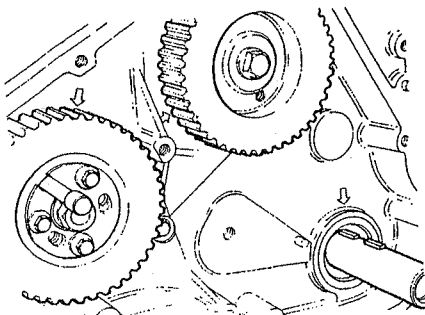
Cleanliness and accuracy are vital when carrying out the timing operations and fitting the drive belt.

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.



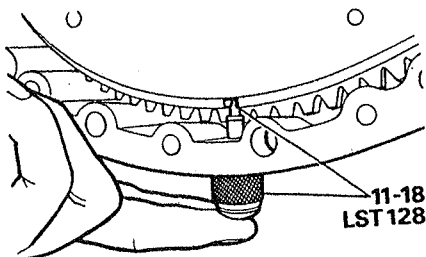
ST3007M

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 the crankshaft so that one and four pistons are at TDC and the crankshaft key is aligned with the arrow in the front cover.



ST3008M

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

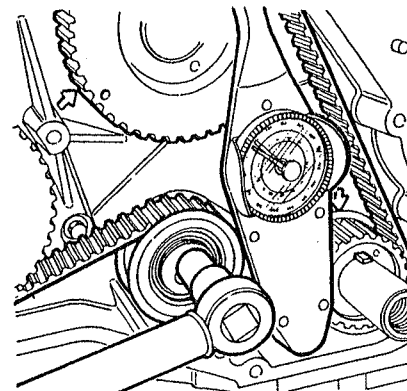
Belt fitting and tensioning

NOTE: It is vitally important that the following belt tensioning procedure is carried out carefully and accurately. The procedure which ensures that the belt is equally tensioned between each of the gears involves tensioning the belt twice. New and original belts are tensioned to different figures.

7. Ensure that the crankshaft, camshaft and the injection pump are correctly aligned with the timing marks as per previous instructions, then carefully fit the belt observing any rotational marks made during removal. Feed the belt over the gears keeping it tight on the drive side.
8. Fit the belt tensioner with the special washer and single bolt screwed in finger tight. Insert a 13 mm (0.5 in) square drive extension into the tensioner plate and with a dial type torque meter with a range not exceeding 60 Nm, apply a tension of 19 Nm for a new belt, or 17 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 torque meter is in the vertical position and the applied tension is correct.

9. Tighten the camshaft drive gear retaining bolt and 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.



ST3009M

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.

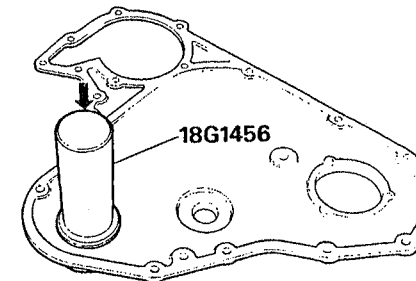
10. Rotate the crankshaft one and three quarter revolutions, then continue to turn the crankshaft slowly in the normal running direction until the injection pump timing peg will slide into position.

CAUTION: To ensure the accuracy of the timing and tensioning of the drive belt, the injection pump hub and crankshaft must only be turned in the normal running direction when carrying out the timing and belt tensioning procedure.

11. Check that the crankshaft and camshaft timing marks are correctly aligned, then slacken the three injection pump pulley bolts and the tensioner clamp bolt. Re-adjust the belt tension, again ensuring that the tension is correct when the torque meter is vertical and the tensioner clamp bolt is tightened.
12. Finally tighten, the tensioner clamp bolt and the three injection pump pulley bolts to the correct torque and remove the timing pin.

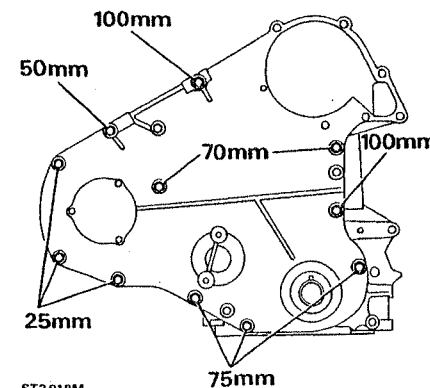
Fitting front cover plate

13. 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

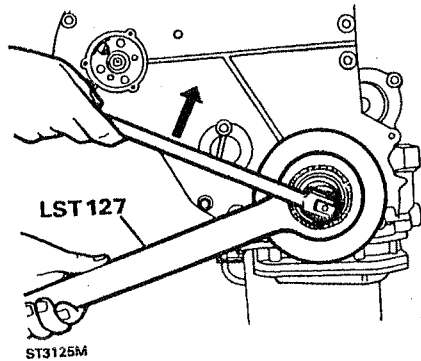
14. Ensure that the front cover and plate joint faces are clean and fit a new gasket to the front cover using a little grease.
15. Fit a new gasket to the centre hole in the cover plate and locate in position by inserting a bolt. Then fit the plate to the cover securing with the eleven retaining bolts using the location chart showing the various lengths. Tighten the bolts evenly to the correct torque.



ST2918M

Fitting front damper and pulley

- 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.
- Refit the pulley securing with the four bolts and tighten to the correct torque.



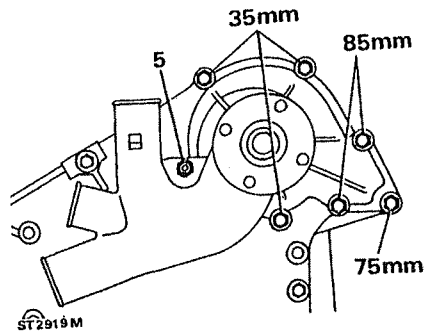
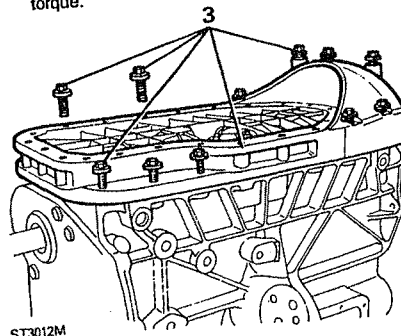
WATER PUMP INSPECTION AND FITTING

The water pump is not a reconditionable unit but its condition can be determined by the following checks.

- 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.
- 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

- Lightly grease a new joint washer and place it in position on the timing cover.
- 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.
- 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.



- 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 sealant cures.

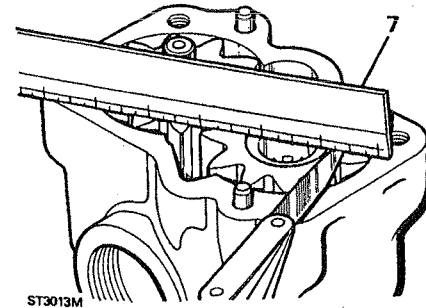
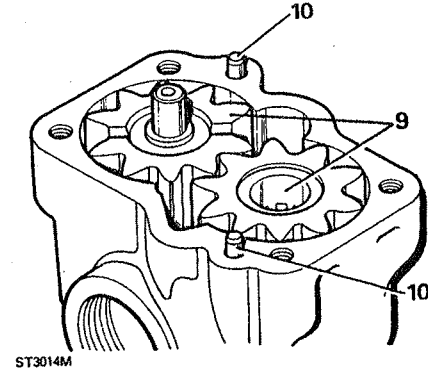
- Clean both sides of the ladder frame and remove all traces of old sealant. Check that the frame is not distorted and is free from burrs and damage on the mating faces that could cause oil or bypass gas to leak.
- Coat both faces with Hyogrip Primer to clean and hasten curing then apply a bead of 'Hyogrip 2000' 3,0 mm wide to the mating face with the crankcase.
- 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

- Bend back the lock washer and release the nut securing the strainer to the oil pump body and remove the strainer and sealing ring.
- Remove the four bolts and washers, lift off the oil pump cover and remove the driving and driven gear.
- Remove the oil pressure relief valve plug and sealing washer. Withdraw the relief valve spring and plunger and examine for wear and scores.
- Examine the gears for wear, scores and pitting and renew if necessary.

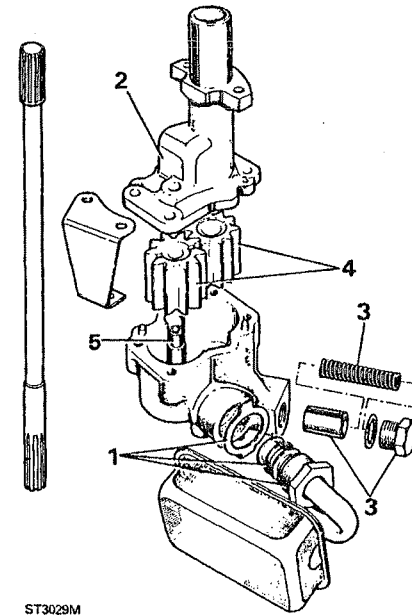
NOTE: Gears must be renewed in pairs only.

- If showing signs of wear the driven gear spindle may be renewed.
- Clean all the components then install both gears into the body ensuring that the recessed end of the driving gear is uppermost.
- 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.
- 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.



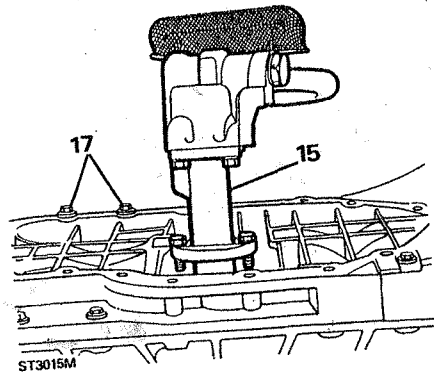
Pump assembly

- With gear tolerances 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.
- Fit the cover locating it over the two dowels and loosely secure with the four bolts until the strainer is fitted.
- 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.



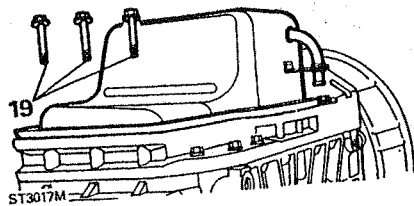
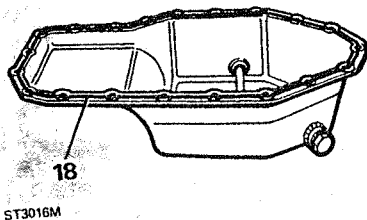
Fitting oil pump

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

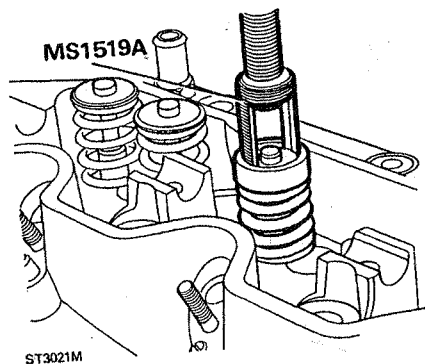
16. Ensure that all traces of old sealant are removed from the sump joint face and that the sump is thoroughly clean inside and out.
17. Remove the two bolts securing the ladder frame to the cylinder block to allow fitting of the sump.
18. Apply a 2,0 mm wide bead of 'Hyosil' RTV102 black to the sump 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.



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.

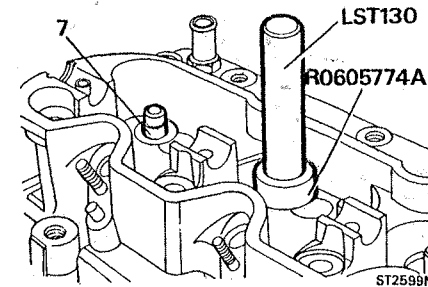
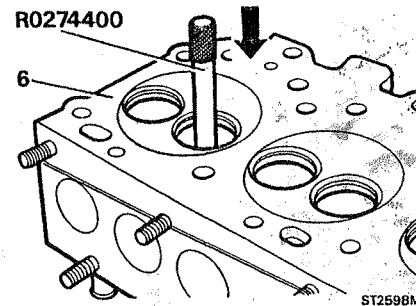
1. Using valve spring compressor MS 1519A or a suitable alternative, remove the valve and spring assemblies identified to their original locations.



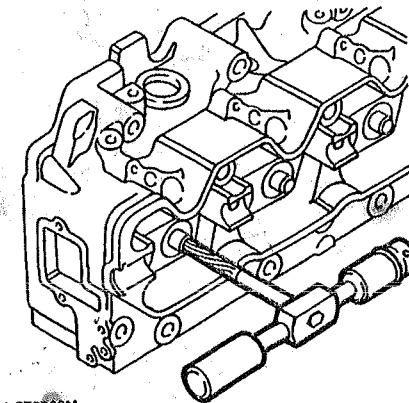
2. Discard the valve springs and valve guide oil seal. Remove carbon deposits from the valves and combustion chambers and degrease all parts ready for examination.
3. Examine the cylinder head for damage and distortion. Inspect the valve seat inserts for damage. Seat inserts that are beyond repair and 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 approximately 1 mm clear of the seat the valve head should not rock more than 0,15 mm. If the valve head movement exceeds 0,15 mm 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 R027440



NOTE: Only service valve guides Part N^o. SFR0035 are to be used for this operation. Standard valve guides are not suitable.



CAUTION: After the cutting edges of the reamer have passed through the guide detach the handle and withdraw reamer from combustion side of head. Under no circumstances should the reamer be withdrawn back through the guide.

Reface valve seat inserts

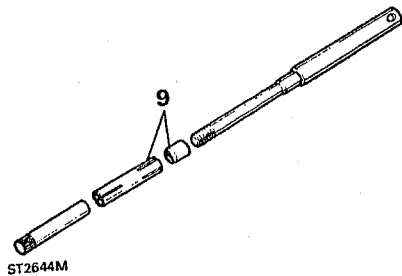
Exhaust valve seat faces should be recut to 45°
Inlet valve seat faces should be recut to 60°

7. Clean the bores and heat cylinder head to a temperature of 120°C. Lubricate the new valve guides and using special tools LST130, height gauge R0605774 and a suitable press, insert them into the cylinder head from the top. To ensure that a uniform internal diameter is maintained for the total length of the guide, ream the bores from the top of the head using hand reamer 18G1636.

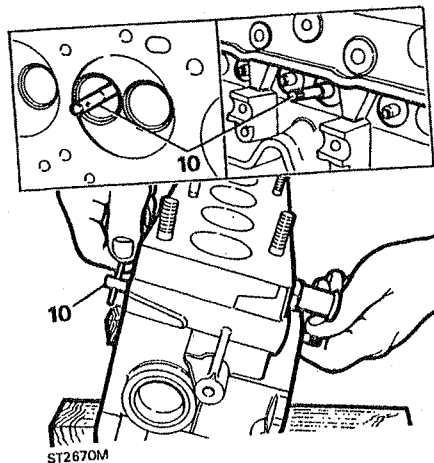
8. The special set of hand tools recommended for refacing valve seat inserts comprise expandable pilots, MS150-8, that fit tightly into new or worn guides to ensure that the valve seat is concentric with the valve guide. The refacing tools MS621 has 45° cutters for use on exhaust valve seats, and MS627 has 60° cutters for use on the inlet valve seats. The handle set MS76B is common to both cutting heads

NOTE: Cutter MS621 is a double ended tool having cutters of 30° and 45°. Ensure that the 45° cutter is used in this application.

- Loosely assemble the pilot in the sequence illustrated. Ensure that the chamfered end of the expander is towards the collet.

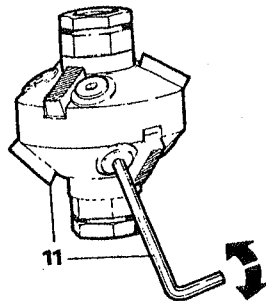


- Insert the assembled pilot into the valve guide from the combustion chamber side of the cylinder head until the shoulder contacts the valve guide and the whole of the collet is inside the guide. To lock the pilot in the guide turn the tommy bar clockwise whilst holding the knurled knob.



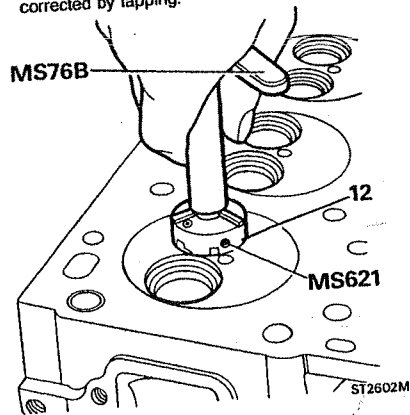
- Using the appropriate cutter for the valve seat being refaced, ensure that the cutter blades are correctly fitted to the head with the angled end of the blade downwards facing the work. Check that the blades are adjusted so that the middle of the blade contacts the area of material to be cut. Use the key provided to make any adjustments.

- 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.



ST2645M

- 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.

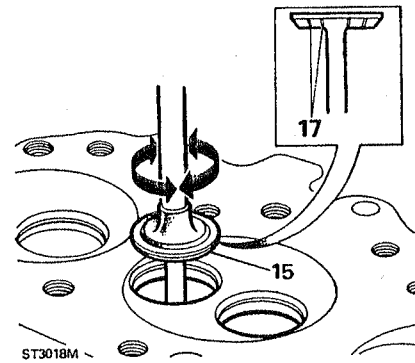


Reface valve head faces

Exhaust valve head faces should be reground to an angle of 45° 00' - 44° 30' to give an included angle of 90°.

Inlet valve head faces should be reground to an angle of 60° 30' - 60° 00' to give an included angle of 120°.

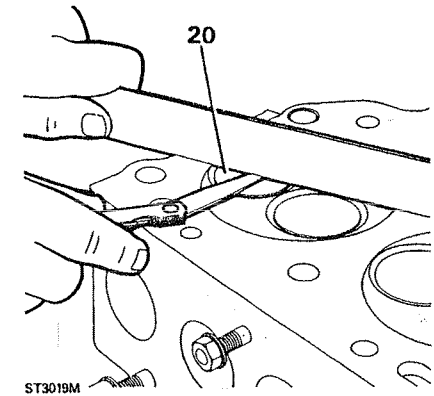
- Valves that are satisfactory for further service can be refaced. This operation should be carried out using a valve grinding machine. Only the minimum of material should be removed from the valve face to avoid thinning of the valve edge. The valve is refaced correctly when all pits are removed and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



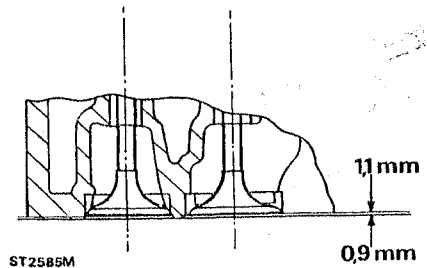
Lapping valves

- 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.
- 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.
- 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 of a 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.
- 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.
- 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. Using a dial gauge zero the gauge on the combustion face then move the stylus across to the valve head and note the reading.



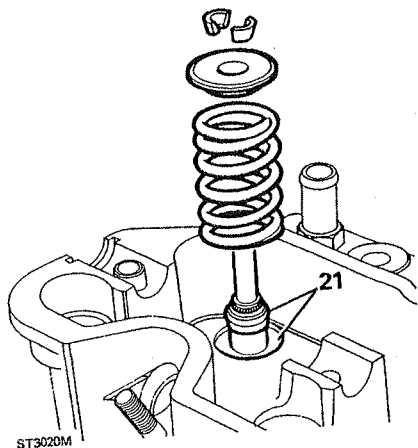
ST3019M



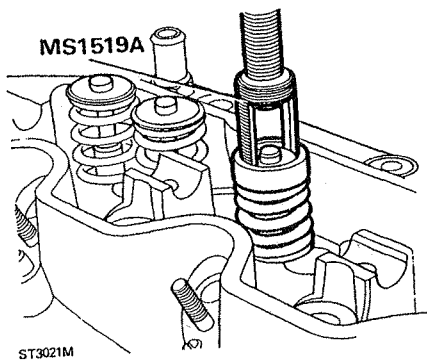
ST2585M

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.

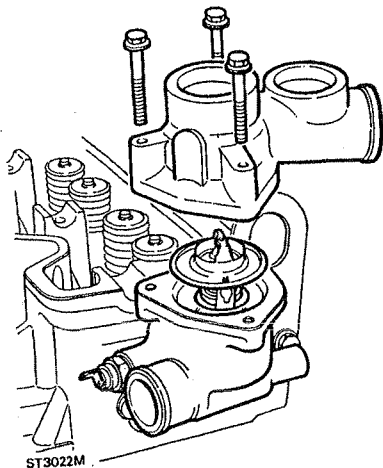


22. Fit a spring and cup to each valve and compress with special service tool MS1519A or a suitable alternative. Retain with the multi-groove cotters ensuring that they are fully located in the valve stem and cup.



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 centre pin of the thermostat, indicates that it is faulty and should be renewed.

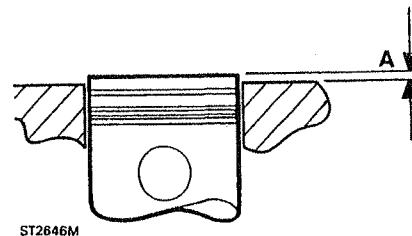


25. The thermostat housing may be removed from the cylinder head at this stage and if necessary the gasket renewed.
 26. The 'jiggle pin' which allows any air to escape from below the thermostat, may be fitted in any position. Renew the gasket when fitting the thermostat and apply a little Hylomar sealant to the threads of temperature sensor and transmitter before screwing into position.

FITTING CYLINDER HEAD

Piston protrusion and gasket selection

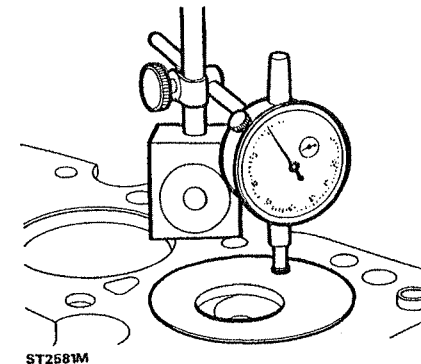
Before fitting the cylinder head, the protrusion of the pistons above the block face must be checked in order that the correct thickness gasket may be selected from the range of three. The height of all the pistons above the cylinder block must be measured and the thickness of the gasket selected is based upon the largest value of dimension 'A', as illustrated. This dimension, however, must not exceed 0,8 mm.



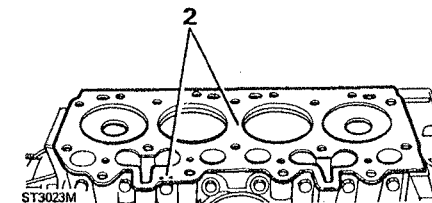
Three thicknesses of gasket are available and each size can be recognised by the number of identification holes punched in the side of the gasket as illustrated. The table below gives the details of the gaskets available. The thickness of gasket fitted can be seen when the cylinder head is fitted since the identification holes can be seen protruding from the right hand side of the engine towards the rear.

Number of holes	Metric	Gasket
1	0,50 to 0,60	ERR0382
2	0,61 to 0,70	ERR038
3	0,71 to 0,80	ERR0384

1. Clean the cylinder block combustion face and turn the crankshaft so that number one and number four pistons are at DC. 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.



2. Place the selected head gasket in position on the cylinder block so that the identification holes are towards the rear on the right-hand side.

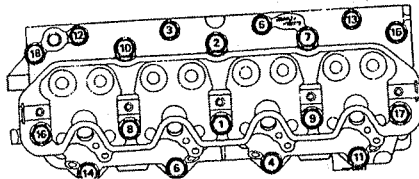


- Clean the cylinder head face and if preferred, guide studs may be fitted to the cylinder block to facilitate the lowering of the head into position. Locate the head over the two dowels.
- Lubricate the threads of new bolts, with light oil, and fit to the positions illustrated according to length and 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

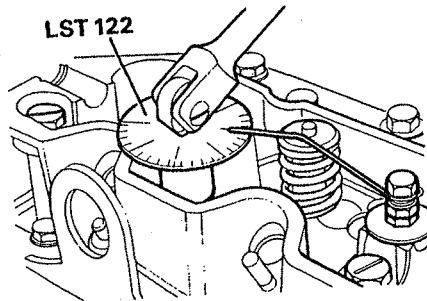
M12 locations 1, 2, 4, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 18



ST2619 M

- Attached 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 hole.
- 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.



ST3024M M

OVERHAUL ROCKER SHAFT

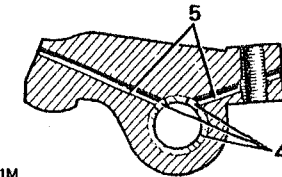
- Remove the five rocker shaft retaining bolts and withdraw the bearing caps, rockers, washers and springs from the shaft.
- Examine the rocker shaft for wear and discard if the bearing surface is worn, scored or pitted. Check also that the oilways are clear.
- Inspect the rockers and discard if the pads are worn. It is not permissible to grind pads in an attempt to reclaim rockers.
- Renew the bushes if the clearance exceeds 0,127 mm. 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.
- Examine the tappet adjustment screws and check that the ball end is not worn or pitted and that the lubrication hole is clear.
- 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.

Push rods

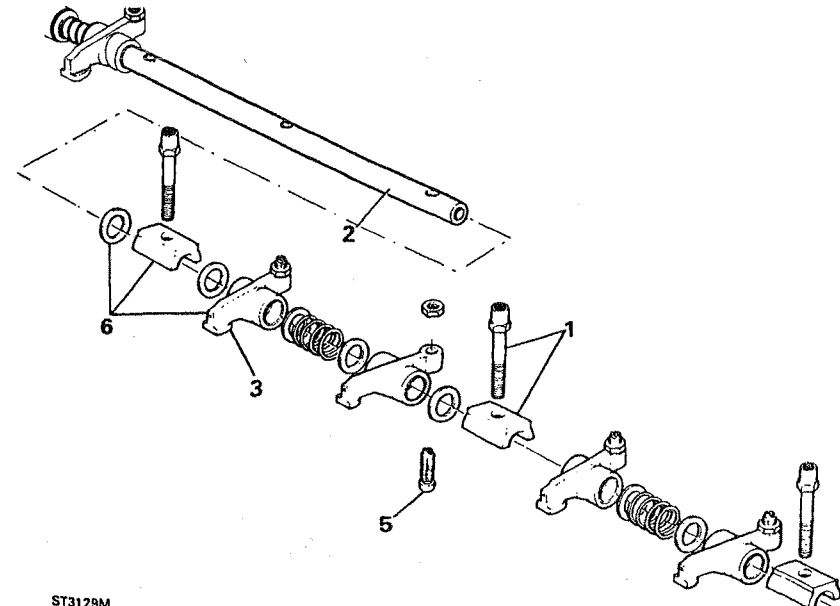
- Examine the push rods and renew any that are bent or where the ball or cup ends are worn or pitted.
- Fit the push rods to the engine ensuring that the ball-end locates properly in each camfollower slide.

FITTING ROCKER SHAFT

- Ensure that a new cap is fitted to each valve stem before fitting the rocker shaft.
- 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



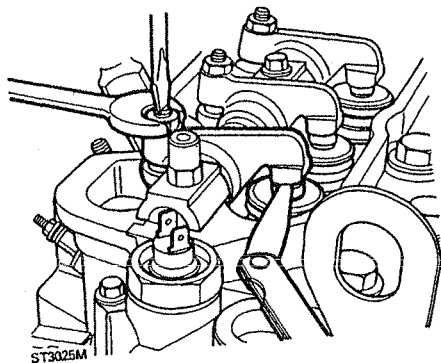
ST3129M

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 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. 5 valve fully open .
- Set No. 7 tappet with No. 2 valve fully open .

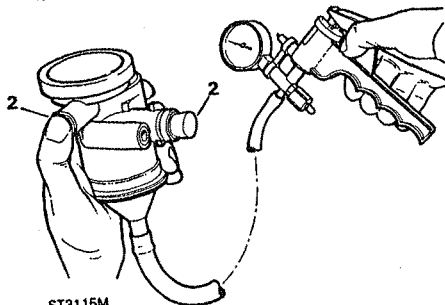
Rocker cover and crankcase ventilator

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

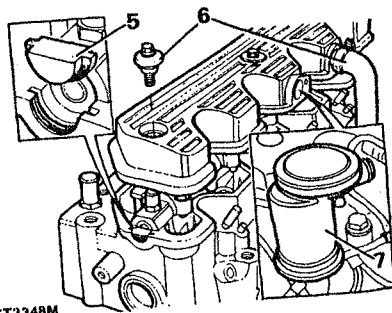
2. With the unit removed from the rocker cover seal off the two ports illustrated and apply a vacuum to the third port. As the vacuum pump is operated the diaphragm valve will be heard to seat. While holding the vacuum unseal either of the other two ports and the diaphragm valve will release.
3. Failure 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 .



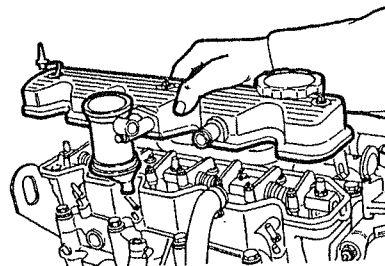
ST3115M

Fitting rocker cover

5. Apply a small blob of RTV sealant in the base of the half-moon groove at both ends of cylinder head and fit seals
6. Locate a new surround seal on 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 connect ventilator hose.
7. Fit the crankcase ventilator and connect the hose.



ST3348M



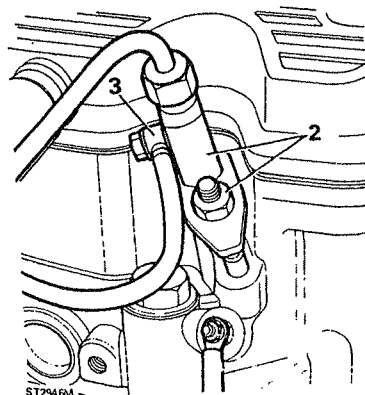
ST2948M

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.

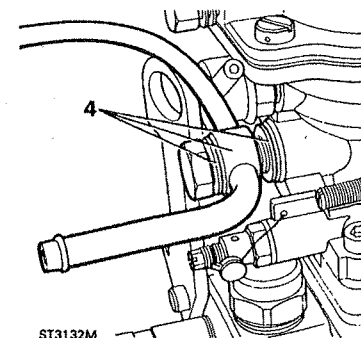
FITTING INJECTORS AND PIPES

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.



ST2948M

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.

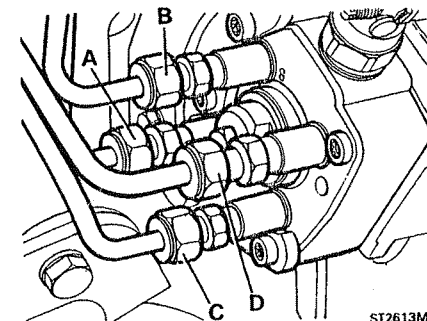


ST3132M

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.



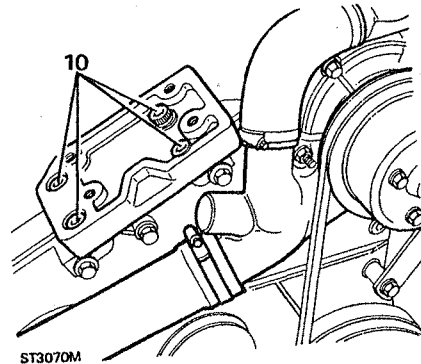
ST2613M

CAMSHAFT - remove with engine in vehicle

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 instructions 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.

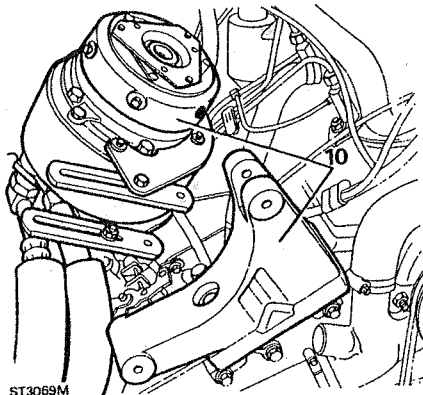


ST3070M

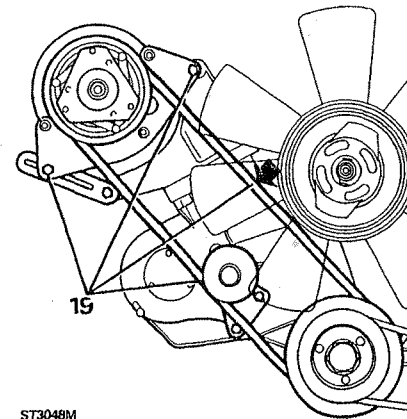
11. Remove the exhaust and inlet manifolds, see operation 30.15.01 instructions 4 to 15.
12. Remove the cylinder head, see operation 12.29.02 instructions 6 to 7 and 9 to 17.
13. Now follow the instructions in **ENGINE OVERHAUL**.

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 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 it is just in contact with the belt or 1,0 mm clear of belt and tighten the damper bolts.



ST3069M



ST3048M

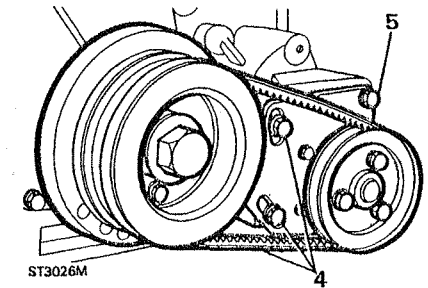
20. Fit and tension the power steering pump drive belt, see operation 57.20.14 instruction 10. Take note of the **CAUTION** when tensioning the belt.
21. Fit the air cleaner, see operation 19.10.01 instructions 12 to 14.
22. Fit the radiator, see operation 26.40.01 instructions 9 to 15.
23. Fit the fan 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 - with engine in vehicle

Service Repair No. 12.25.22

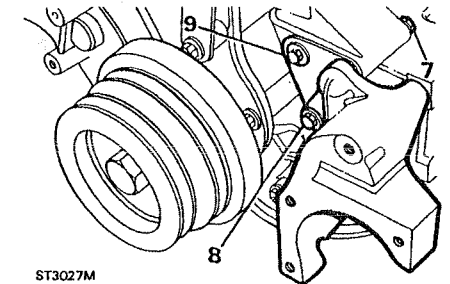
Remove and refit

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.



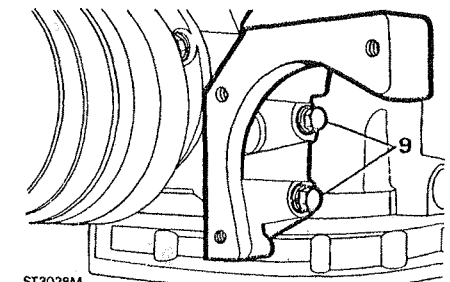
ST3026M

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

9. Remove the two bolts inside the bracket into the front cover and remove the bracket and triangle shaped packing plate.



ST3028M

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 bolt. The belt is correctly tensioned when the belt can be deflected by thumb pressure 12 mm.
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.

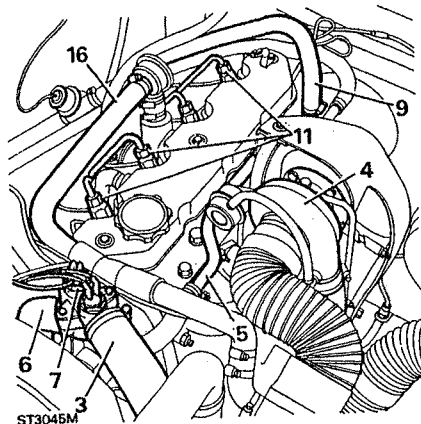
CYLINDER HEAD - remove with engine in vehicle

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 water pump hose.
7. Disconnect the electrical leads from the 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 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**.



Refitting

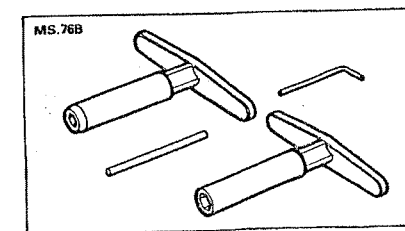
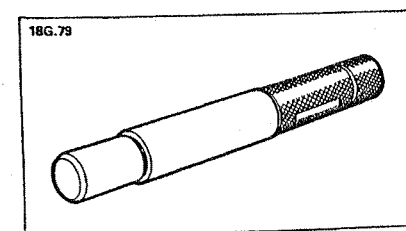
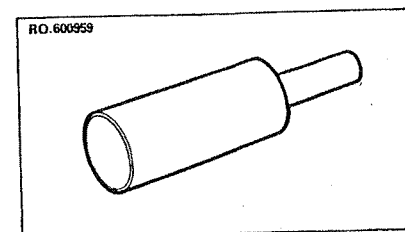
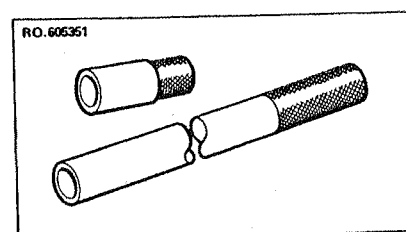
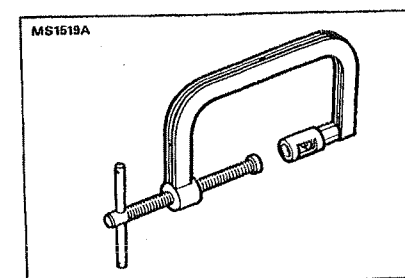
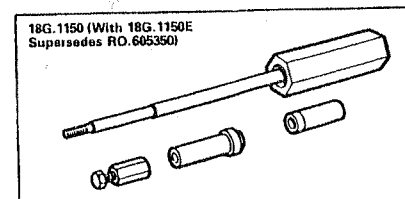
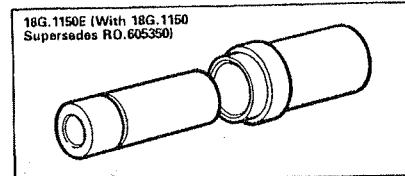
18. Follow the instructions in **ENGINE OVERHAUL** from 'fitting cylinder head' and continue until the rocker cover is fitted.
19. Fit the heater plugs and connect the electrical leads. Do not allow any part of the lead or insulation to touch the cylinder head when fitted.
20. Fit the injectors - see **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 water pump 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.

DISMANTLE, OVERHAUL AND ASSEMBLE

Special tools:

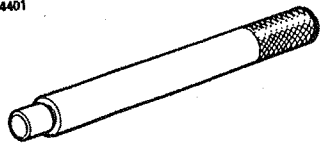
- Guide bolts - RO605351-LRT-12-041
- Clutch centralising tool - 18G79-LRT-12-001
- Gudgeon pin remover/replacer - basic tool - 18G1150-LRT-12-013
- Adaptor remover/replacer - gudgeon pin - 18G1150E or RO605350-LRT-12-013
- Valve spring compressor - 18G106A or RO276102 or MS1519A-LRT-12-034
- Valve guide drift exhaust and inlet RO600959-LRT-12-038
- Valve cutter handle set - MS76B-LRT-12-501
- 8.5 Adjustable pilot - MS150-8.5-LRT-12-503
- Valve seat cutter - MS621-LRT-12-504
- Drift for guide removal - inlet and exhaust - RO274401-LRT-12-037
- Crankshaft rear seal sleeve - RO1014-LRT-12-010

NOTE: Where the use of special service tools is specified, only these tools should be used to avoid the possibility of personal injury or damage to components.



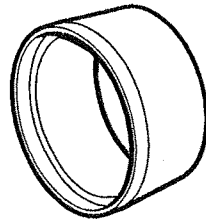
ST2397M

RO.274401

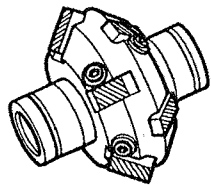


Dia. 8.4mm - 9.0mm

RO.1014



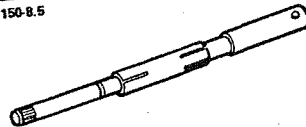
MS.621



Dia. Range 28.5mm - 44mm 15° & 45°

ST2398M

MS.150-8.5



DISMANTLE

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. Observe the precautions concerning used engine oil in the 'introduction' section 01.

WARNING: Where the use of an engine stand is necessary, it is absolutely essential to follow the stand manufacturer's instructions to ensure safe and effective use of the equipment.

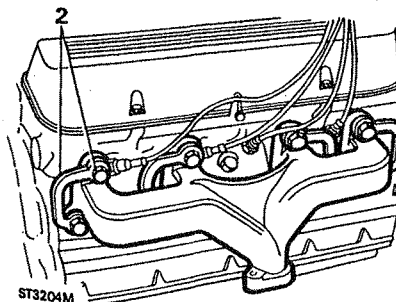
REMOVE ANCILLARY EQUIPMENT

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.

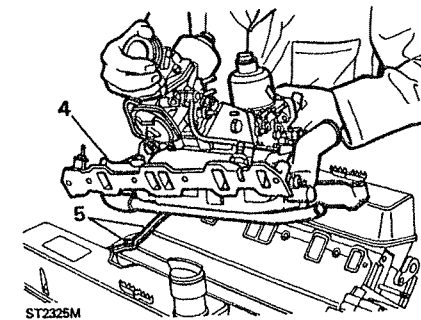
Remove exhaust manifolds

2. Bend back the lock tabs, and remove the eight bolts securing each manifold, and withdraw the manifolds.

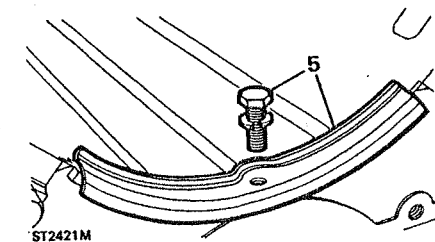


Remove induction manifold

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.



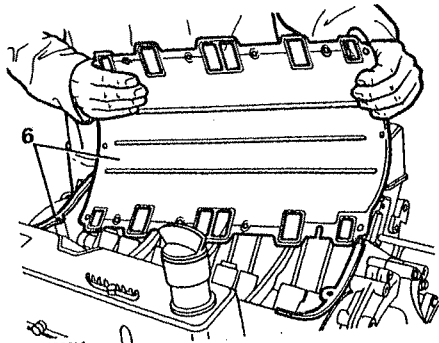
5. Wipe away any surplus coolant lying on the manifold gasket and remove the gasket clamp bolts and remove the clamps.



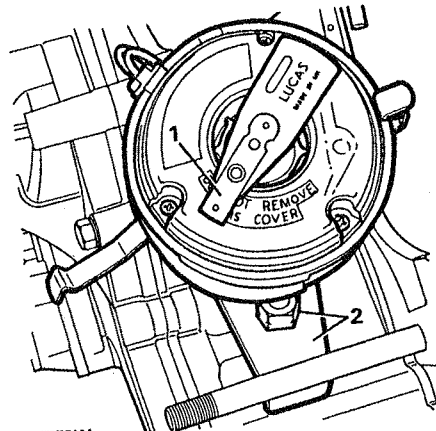
12 V8 CYLINDER ENGINE

DEFENDER

- Lift off the manifold gasket and seals to reveal the tappets and push rods.



ST2326M

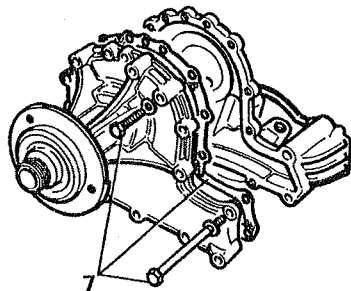


ST2751M

Remove water pump

- Remove the fifteen bolts and withdraw the water pump and joint washer.

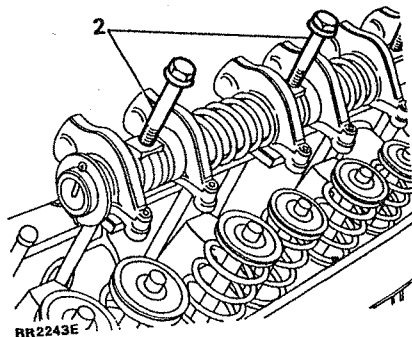
NOTE: The water pump is not a serviceable item, in the event of bearing failure or severe corrosion to the pump impeller vanes. Fit a new water pump assembly.



ST2452M

REMOVE ROCKER SHAFTS AND VALVE GEAR

- Remove the screws and lift-off the rocker covers. Before removing the rocker shaft and valve gear, mark each shaft with the cylinder head from which it was removed, i.e. left-hand or right-hand.
- Remove the four rocker shaft retaining bolts and lift-off the assembly.



RR2243E

REMOVE THE DISTRIBUTOR

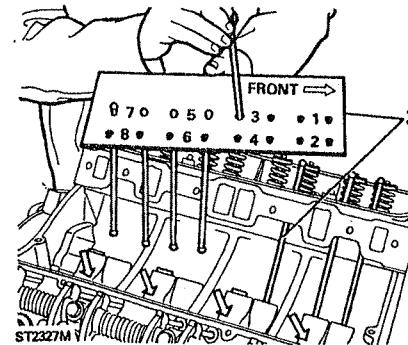
- Remove the distributor cap and turn the crankshaft until the rotor arm is pointing to number one plug lead in the distributor cap.
- Remove the nut securing the distributor clamp and lift-off the distributor.

4

DEFENDER

V8 CYLINDER ENGINE 12

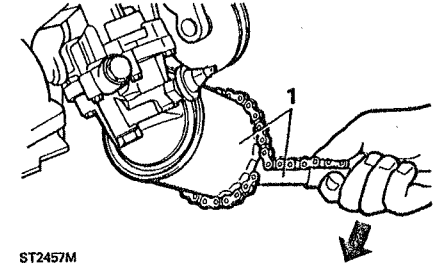
- Withdraw the pushrods and retain in the sequence removed by inserting each rod in a suitable numbered piece of card as illustrated. Take care not to allow the rods to become dislodged and fall into the crankcase through the oil drain holes as shown by the arrows.



ST2327M

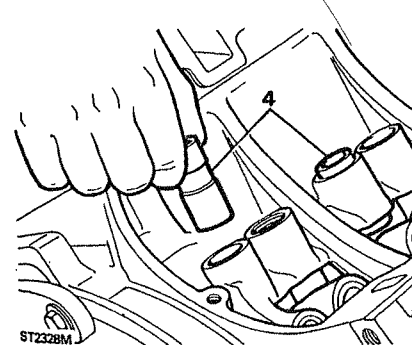
REMOVE TIMING GEAR COVER AND OIL PUMP

- Place an oil drip-tray beneath the timing cover and remove the oil filter cartridge by turning anti-clockwise using, if necessary, a pair wrench to overcome the initial resistance.



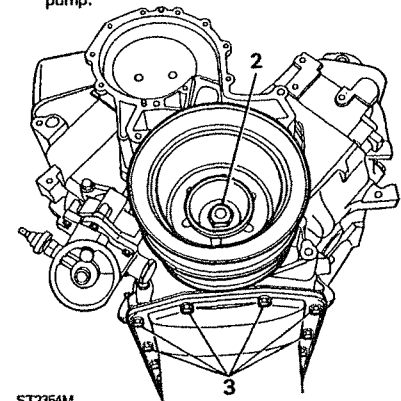
ST2457M

- Remove the hydraulic tappets and immerse in clean engine oil and place to one side.
- If a tappet cannot be removed due to damage and enlargement of the cam face, no attempt should be made to remove the tappet at this stage, but leave in position until the camshaft is removed. Any attempt to force a tappet out will damage the tappet bore in the cylinder block.



ST2328M

- Remove the crankshaft pulley bolt and special washer and withdraw the pulley.
- Remove the two bolts securing the sump to the bottom of the timing cover and slacken the four front side bolts.
- Remove the remaining timing cover retaining bolts and withdraw the cover complete with oil pump.

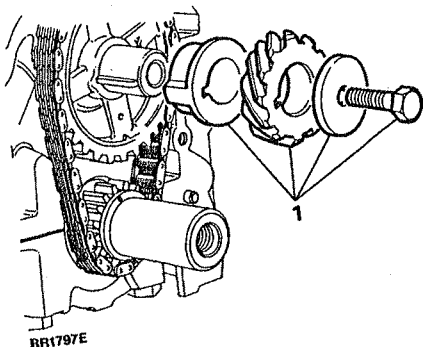


ST2354M

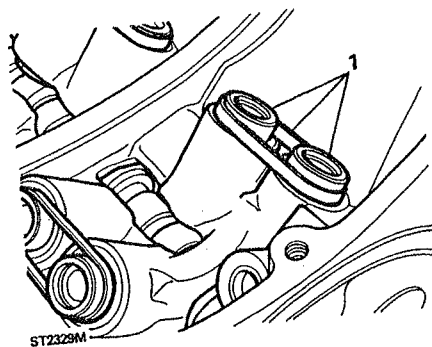
5

REMOVE TIMING CHAIN AND SPROCKETS

1. Remove the retaining bolt and washer and withdraw the distributor drive gear and spacer.



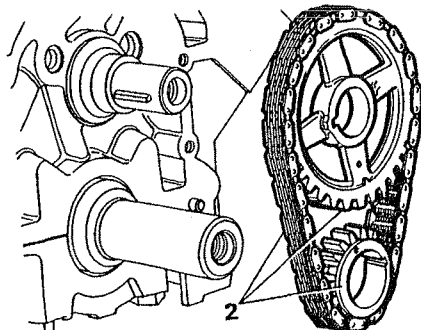
RR1797E



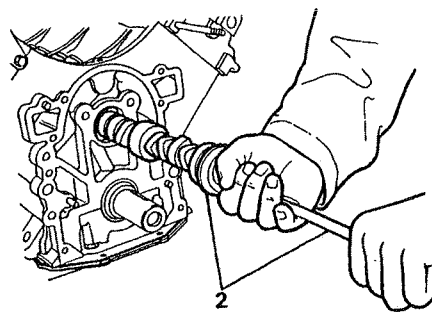
ST2329M

2. Withdraw the camshaft whilst taking care not to damage the bearings in the cylinder block. To assist in keeping the camshaft horizontal whilst withdrawing it from the cylinder block, insert a screw driver or suitable bar into the threaded hole in the end of the shaft to enable it to be supported by both hands to prevent the shaft falling on the bearings as it is released from the rear bearing.

2. Withdraw the camshaft and crankshaft sprockets complete with the timing chain.



RR1798E



ST2330M

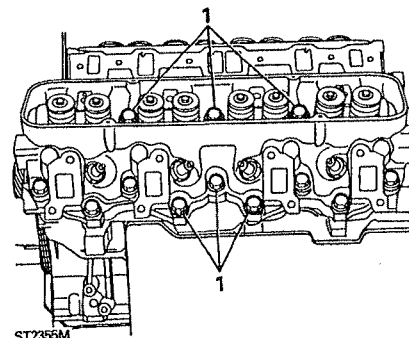
REMOVE THE CAMSHAFT

1. If there are any tappets that could not be removed earlier due to enlarged cam faces, insert the tappet next to the damaged one and lift them both clear of the camshaft and secure together with a rubber band.

3. Remove the sump and retrieve the damaged tappets from the crankcase.

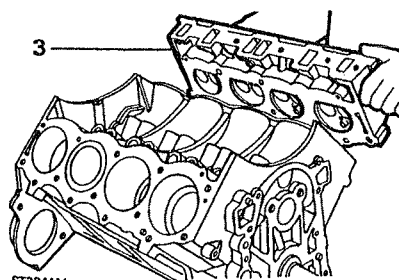
REMOVE THE CYLINDER HEADS

1. Evenly slacken and remove the fourteen cylinder head bolts reversing the tightening order to prevent distortion (nine side bolts and five top bolts).



ST2355M

2. Before removing the heads mark them relative to the LH and RH side of the engine.
3. Lift off the cylinder heads and discard the gasket.

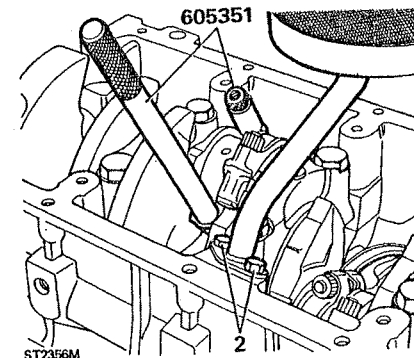


ST2341M

REMOVE CONNECTING RODS AND PISTONS

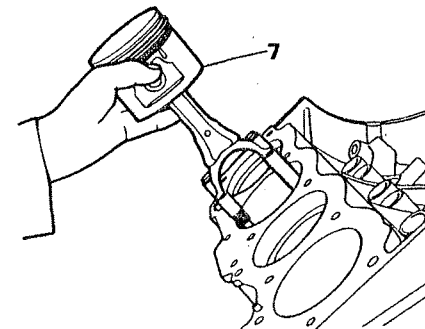
1. Turn the engine over and withdraw the remaining bolts and remove the sump, if not already removed.
2. Remove the sump bolts and oil strainer.
3. Mark each piston assembly with the number of the bore from which it will be removed.

4. Turn the crankshaft so that the first piston to be removed is at bottom dead centre.
5. Remove the connecting rod caps and retain them in sequence for reassembly.
6. Screw the guide bolts RO605351 on to each of the connecting rods in turn. Fit the longer guide bolt to the lowest connecting rod bolt.



ST2356M

7. Check that the connecting rod big-end is aligned exactly with the bore and 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 and bearing shells.
8. Remove the guide bolts from the connecting rod and repeat the above instructions on the remaining connecting rods and pistons.

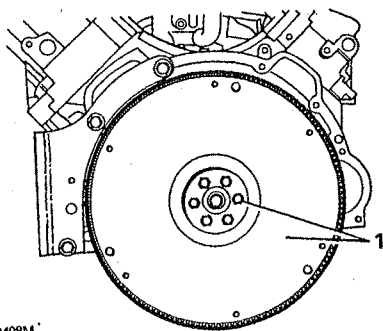


ST2357M

REMOVE THE FLYWHEEL

1. Prevent the camshaft from turning and remove the retaining bolts and withdraw the flywheel from the crankshaft.

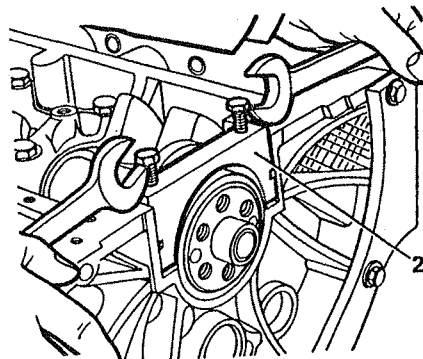
WARNING: Hold the flywheel firmly while the last bolt is being removed to prevent the flywheel falling and causing personal injury.



ST2408M

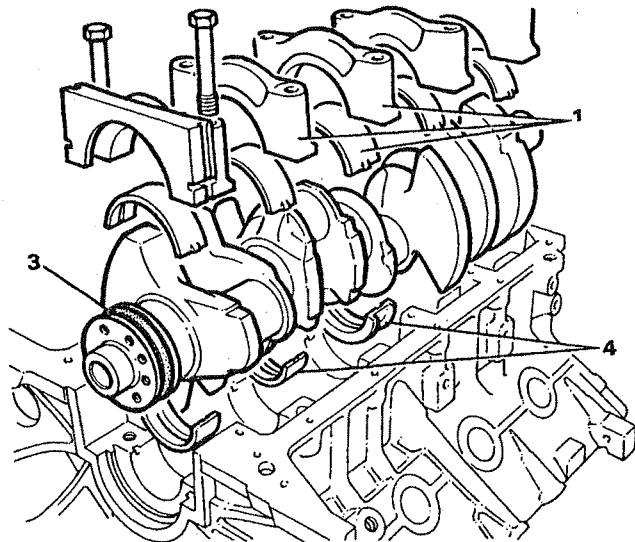
REMOVE THE CRANKSHAFT

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. Remove the rear main bearing cap using two spanners as illustrated below, taking care not to damage the cylinder block face.



ST2332M

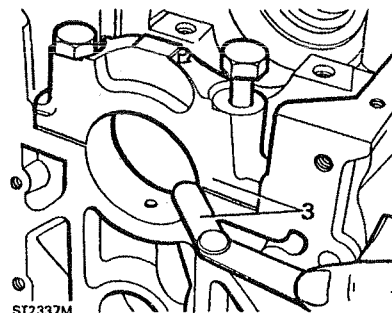
3. Lift out the crankshaft and rear oil seal.
4. Remove the upper bearing shells from the cylinder block.



ST2333M

EXAMINE AND OVERHAUL CYLINDER BLOCK

1. Degrease the cylinder block and carry out a thorough visual examination checking for cracks and damage.
2. The cylinder bores are cast iron lined and are shrunk into the bores. The liners must not be bored out more than 0,508 mm and if they have been bored already beyond this oversize the cylinder block must be renewed.
3. Assuming that, so far, the cylinder block is satisfactory for reconditioning, proceed to the next stage of the examination. To check the main bearing caps and saddles for distortion, fit the main bearing caps 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. A clearance indicates either a bent bolt, distortion of the caps, or block or that the cap has been filed or machined in an attempt to reduce the clearance due to wear in the bearings. Main bearing caps are not available separately from the cylinder block and if a clearance exists the block must be renewed.



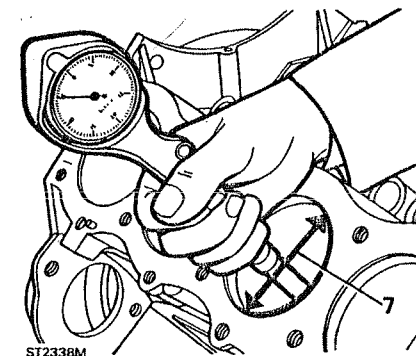
ST2337M

Camshaft bearings

4. Each of the five camshaft bearings is a different diameter, with the smallest at the rear and the largest at the front. If the bearings are excessively worn, pitted, or scored they must be renewed.

Inspect cylinder bores

5. 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.
6. Check the ovality of each bore by taking measurements at the top of the cylinder 40 to 50 mm from the top of the cylinder at two points diametrically opposite. The difference between the two figures is the ovality of the bore. Similar measurements should be made approximately 50 mm up from the bottom of the bore so that the overall ovality may be determined.
7. The taper of the bore 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.



ST2338M

8. 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 to the original diameter of the cylinder bore.

Maximum permissible ovality 0,127 mm
 Maximum permissible taper 0,254 mm
 Maximum permissible overall wear 0,177 mm

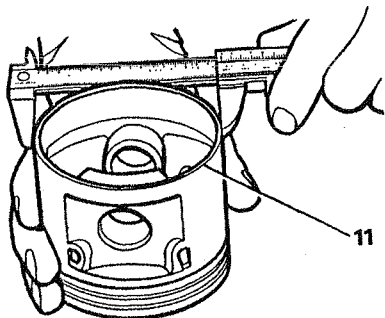
9. If the measurements taken are greater than the above figures the cylinders may be bored to a suitable oversize provided that the maximum oversize of 0,508 mm is not exceeded.

10. When the cylinders are being rebored it is essential to fit the bearing caps and tighten the bolts to the correct torque to prevent distortion during the machining operation.

NOTE: Pistons are available in service standard size and in oversizes of 0,25 mm and 0,50 mm. Service standard size pistons are supplied 0,0254 mm 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 0,040 mm.

NOTE: The temperature of the piston and cylinder block must be the same to ensure accurate measurement.

11. Mark each new piston with the number of the bore to which it will be fitted. Measure each piston at the bottom of the skirt at right angles to the gudgeon pin and bore the cylinder concerned to provide a running clearance of 0,018 to 0,040 mm. Be sure to keep each piston hereafter identified with its cylinder bore.



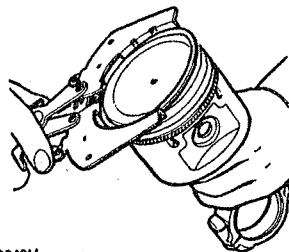
ST2339M

12. 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.

13. After reboring or honing, check the bore-to-piston clearance at the bottom of the bore at right angles to the gudgeon pin in the normal running position of the piston.

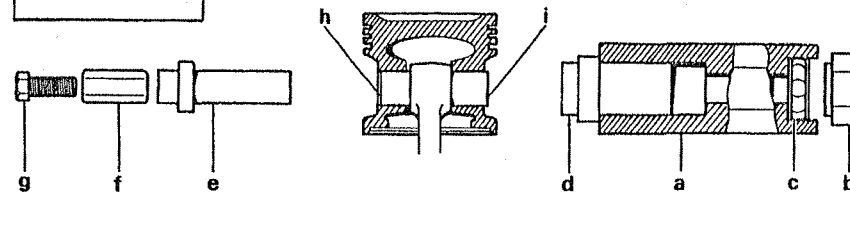
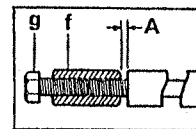
DISMANTLING CONNECTING RODS AND PISTONS

NOTE: The pistons, 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 using a piston ring expander tool. If the same piston is to be refitted, mark it relative to its bore and connecting-rod to ensure that the original assembly is maintained.

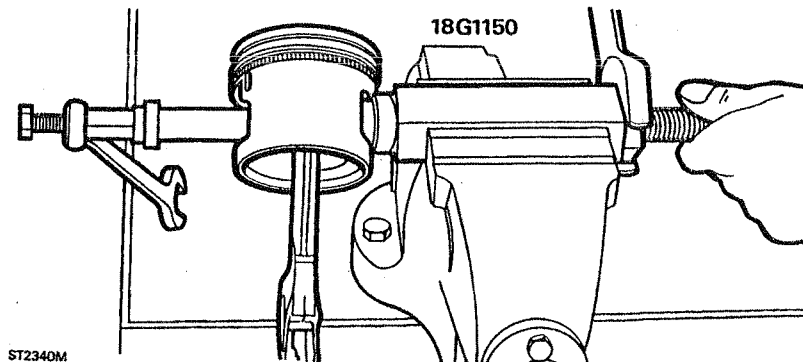
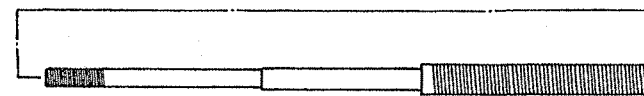


ST2342M

1. Withdraw the gudgeon pin from the connecting rod small end using tool 18G1150 as follows:
 - a. Clamp the hexagon body of 18G1150 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.
 - d. Locate the piston adaptor 18G1150E with its long spigot inside the bore of the hexagon body.
 - e. Fit the remover/replacer bush of 18G1150 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 3,0 mm (0.125 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.

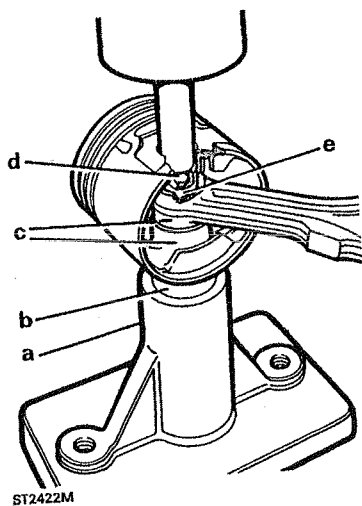


ST777M



ST2340M

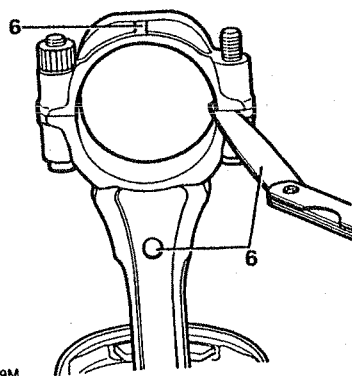
2. As an alternative to tool 18G1150, press the gudgeon pin from the piston using a hydraulic press and the components which comprise tool RO605350 as follows:
 - a. Place the base of the tool RO605350 on the bed of an hydraulic press which has a capacity of 8 tons (8 tonnes).
 - b. Fit the guide tube 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.



4. Having visually examined check that the clearance between the bore and piston skirt at right angles to the gudgeon pin is between 0,018 to 0,040 mm at 50 mm from the bottom at the bore.
5. If it is necessary to fit a new piston to any bore or bores, the above check must also be made. Remember that if the bores are standard size, the bores to which the new pistons are to be fitted must be honed to provide the correct clearance since new standard pistons are supplied 0,0254 mm oversize.

Checking the connecting rods

6. Remove the bearing shells and refit the cap tightening the nuts to the correct torque, and ensure that the dome on the cap and rod are aligned. Slacken the nut on one side and with a feeler gauge, check for clearance between the rod and cap on the side slackened off. A rod in good condition should have no gap.



Examining pistons

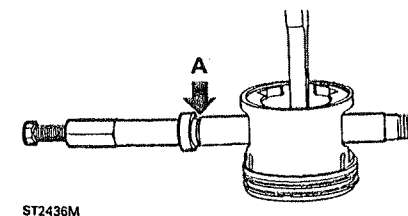
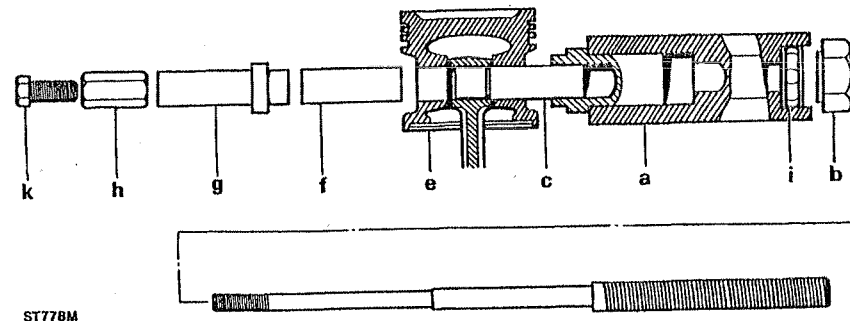
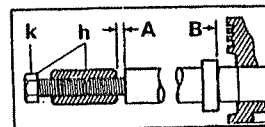
3. If the intention is to refit the original pistons with new rings, degrease and decarbonise the pistons removing all traces of carbon particularly from the piston grooves. Check for excessive wear, scores, burning and cracks especially around the gudgeon pin boss. Check that the gudgeon pin is a push fit in the pistons at a temperature of 68° F (20° C).

7. If the necessary equipment is available the rods should be checked for bend and twist, especially on high mileage engines and ones which show evidence of overheating.

Fitting pistons to connecting rods

8. If tool 18G1150 was used for dismantling, refit each piston to its connecting-rod as follows:
 - a. Clamp the hexagon body of 18G1150 in a vice, with the adaptor 18G1150 E positioned as for piston removal.
 - b. Remove the large nut of 18G1150 and push the centre screw approximately 50 mm (2.0 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 18G1150.

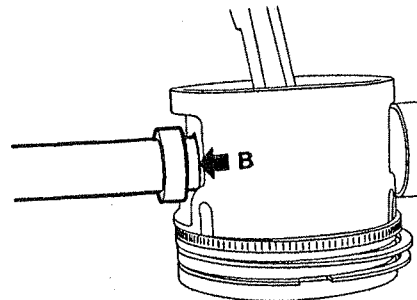
- e. Fit the connecting-rod and the piston together onto the tool with the markings together if the original pair are being used and with the connecting-rod around the sleeve up to the groove.
- f. Fit the gudgeon pin into the piston bore up to the connecting-rod.
- g. Fit the remover/replacer bush 18G 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 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.



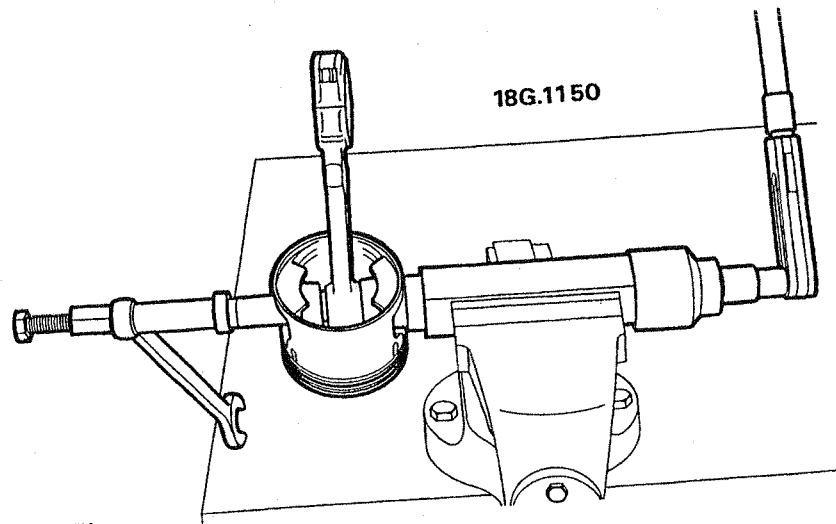
- j. Set the torque wrench to 16.27 Nm. This represents the minimum load for an acceptable interference fit of the gudgeon pin in the connecting-rod.
- k. Using the torque wrench and socket on the large nut, and holding the lock screw, pull the gudgeon pin in until the flange of the remover/replacer bush is 4 mm '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.

- 9. Remove the tool and check that the piston moves freely on the gudgeon pin and that no damage has occurred during pressing.



ST2437M



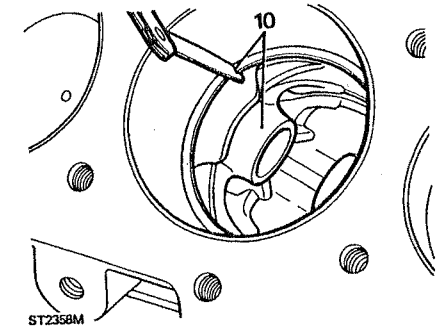
18G.1150

ST2438M

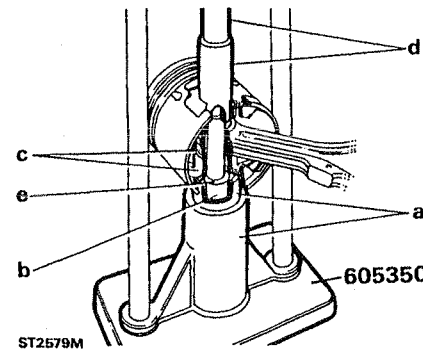
- 10. If an hydraulic press and tool RO605350 was used for dismantling, refit each piston to its connecting-rod as follows:
 - a. Place the base of tool RO605350 on the bed of an hydraulic press which has a capacity of - tons (8 tonnes). Fit the guide tube into the bore of the base with its countersunk 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.
- 11. Remove the tool and check that the piston moves freely on the gudgeon pin and that no damage occurred during pressing.

Fitting piston rings - checking compression ring gaps

- 12. Check the compression ring gaps in the applicable cylinder, held square to the bore with the piston. The gaps must be checked with the ring at the bottom of the piston stroke, about 82 mm down the cylinder. The gap should be within 0,44 to 0,56 mm. To increase the gap use a fine-cut file preferably with the ring held in a filing rig.



ST2358M

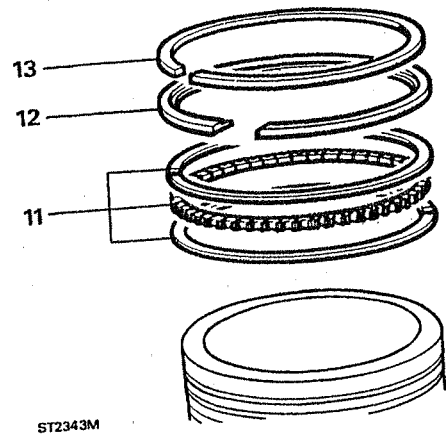


605350

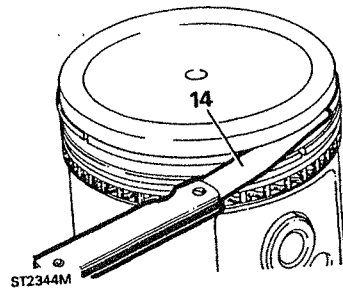
ST2579M

- 13. Once the ring gaps are correct fit the rings to the pistons starting with the oil control ring assembly. Fit the expander ring into the bottom groove making sure that the ends butt and do not overlap. Fit two ring rails to the bottom groove, one above and one below the expander ring. The rail gaps must be 180° distant from each other in such a position that the gaps do not align with the expander joint.
- 14. Preferably, using a piston ring expander tool, fit the stepped second compression ring with the word 'TOP' uppermost.
- 15. The top compression ring can be fitted either way around.

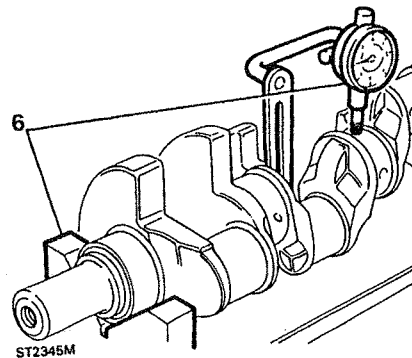
EXAMINE AND OVERHAUL CRANKSHAFT



16. Check the top and second compression ring clearance in the piston grooves with a feeler gauge. The clearance for both rings is 0,05 to 0,10 mm.



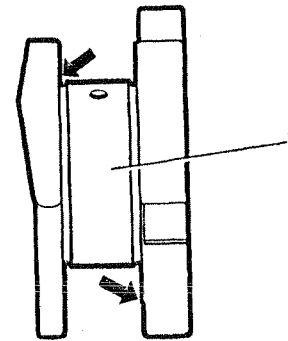
17. Lubricate the piston rings with clean engine oil and place the piston and connecting-rod assemblies aside and cover with clean cloth ready for assembly to the cylinder block.



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 rights angles to each other at various intervals. The maximum ovality must not exceed 0,040 mm.
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.
6. 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 taking into account any ovality in the centre journal. The overall wear limit should not exceed 0,114 mm for main bearing journals and 0,088 mm for crankpins. A crankshaft worn beyond the limits of maximum taper, ovality and overall wear can be ground to 0,254 mm or 0,508 mm. A crankshaft that is bent is not suitable for regrinding and should be renewed.

7. When regrinding the crankshaft, care should be taken not to remove too much material from the thrust faces of the centre main bearing journal. This is because oversize bearings of 0,25 mm are the same width across the thrust face as the standard bearing, whereas the 0,508 mm oversize bearing is 0,25 mm wider. When regrinding the crankshaft, the journals and thrust faces on either side of the centre main journal must be machined in accordance with the dimensions in the following charts.

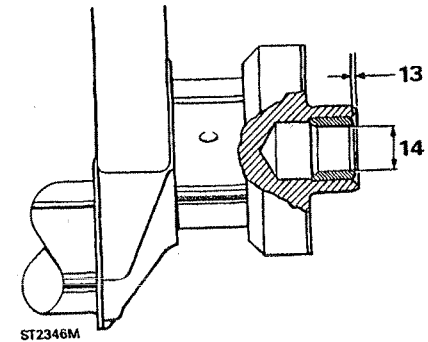
For example: If a 0,50 mm undersize bearing is to be fitted, then 0,12 mm must be machined off each thrust face of the centre journal, maintaining the correct radius.



8. The radius for all journals except the rear main bearing is 1,90 to 2,28 mm.
9. The radius for the rear main bearing journal is 3,04 mm.
10. Main bearing journal diameter, see the chart below.
11. Thrust face width, and connecting-rod journal diameter, see the chart below.

Renew spigot bearing

12. Carefully remove the old bearing.
13. Fit the spigot bearing flush with, or to a maximum of 1,6 mm below the end face of the crankshaft.
14. Ream the spigot bearing to $19,177 + 0,025$ mm inside diameter. Ensure all swarf is removed.



CRANKSHAFT DIMENSIONS-MILLIMETERS

Crankshaft	Diameter	Width	Diameter
Standard	58,400-58,413	26,975-27,-26	50,800-50,812
0,254 U/S	58,146-58,158	26,975-27,026	50,292-50,305
0,508 U/S	57,892-57,904	27,229-27,280	50,292-50,305

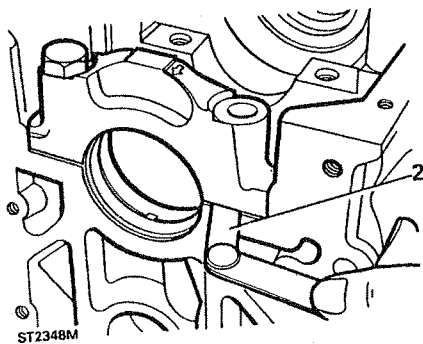
Main bearing journal size	Thrust face width
Standard	Standard
0,25mm undersize	Standard
0,50mm undersize	0,25mm oversize

ASSEMBLING ENGINE

FITTING CRANKSHAFT AND MAIN BEARINGS

Checking main bearing clearance

1. To check the correct fit of the main bearing shells, they should first be installed into the cylinder block and into the main bearing cap locations. Note that the shell bearing with a groove and oil hole must be located in the cylinder block whilst the plain bearing is located in the cap.
2. Fit and secure the main bearing caps, observing the numerical sequence and the arrow stamped on each, tightening the bolts to the recommended torque. Then slacken one bolt on each of the main bearing caps and check the clearance between the cylinder block and cap face on the side that the bolt is slackened. This clearance should be between 0,10 mm and 0,15 mm. Clearances in excess of this tolerance may be corrected either by selective assembly of the shell bearings or by rubbing down the face edge of one half of the shell using very fine emery cloth on a flat surface. It is very unusual to find a clearance less than 0,10 mm but should this be the case the bearing will not be securely clamped in position and is therefore likely to turn during normal engine running. It is therefore important that the correct bearing nip is achieved.

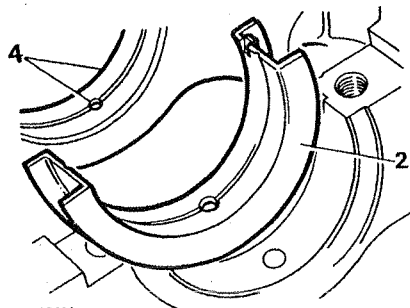


3. If the diameter of the shell bearings is too large for its location the edges may be reduced by gently rubbing on fine emery on a flat surface, but if they are too small and therefore likely to turn in operation, one or both halves of the shell bearing are faulty and should be renewed.

Checking main bearing clearances using Plastigauge

This method may be used instead of the above or as a check, particularly if an incorrect clearance is suspected.

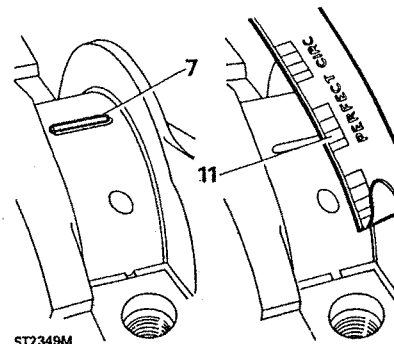
4. Locate the upper main bearing shells into the cylinder block. These must be the shells with the oil drilling and oil grooves.
5. Locate the flanged upper main bearing shell in the centre position.
6. Lower the crankshaft into position on the bearings.



ST2350M

7. Place a piece of Plastigauge across the centre of the crankshaft main bearing journals.
8. Locate the bearing lower shell into the main bearing cap.
9. Fit numbers one to four main bearing caps and shells and tighten to the correct torque.
10. Fit the rear main bearing cap and shell and tighten to the correct torque. Do not allow the crankshaft to be rotated while the Plastigauge is in use.
11. Remove the main bearing caps and shells and using the scale printed on the Plastigauge packet, measure the flattened Plastigauge at its widest point. The graduation that most closely corresponds to the width of the Plastigauge indicates the bearing clearance.
12. The correct bearing clearance with new or overhauled components is 0,010 to 0,048 mm. If the correct clearance is not obtained initially, use selective bearing assembly.

NOTE: On later engines the flanged centre bearing cap shell has been discontinued and is now a plain bearing.

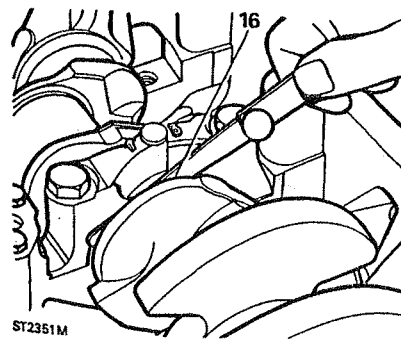


ST2349M

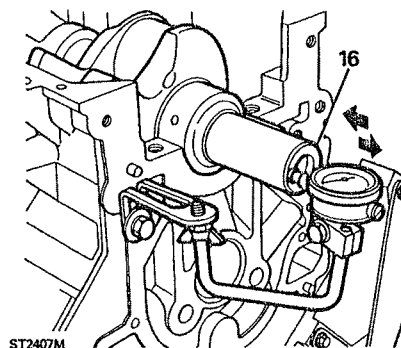
13. Wipe off the Plastigauge with an oily rag. DO NOT scrape it off.
14. Lift out the crankshaft and lubricate the main bearing journals and bearing shells with clean engine oil and over the crankshaft into position again.

Checking crankshaft end-float

15. The end float can be checked with either a dial test indicator or a feeler gauge.
16. Mount a dial test indicator on the cylinder block with the indicator stylus resting on the end of the crankshaft. Push the crankshaft back and zero the gauge. Move the crankshaft forward and note the gauge reading. Similarly, using a feeler gauge, push the crankshaft back and measure the clearance between the bearing flange and crankshaft thrust face. The correct end-float is between 0,10 to 0,20 mm.



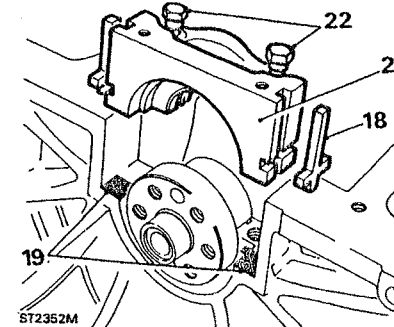
ST2351M



ST2407M

Fitting main bearing caps and rear oil seal

17. 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.
18. Fit the cruciform side seats 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 approximately above the bearing cap parting face.
19. 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.
20. Lubricate the bearing half and bearing cap side seals with clean engine oil.
21. 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.



ST2352M

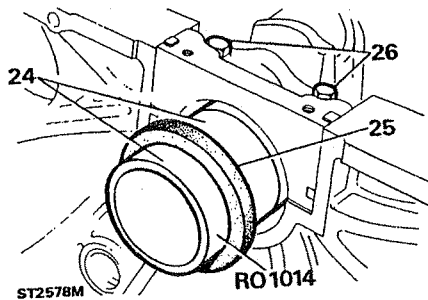
- Tension the cap bolts equally by one-quarter turn approximately, then back off one complete turn on each fixing bolt.

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

- Position the seal guide RO1014 on the crankshaft flange.
- 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.

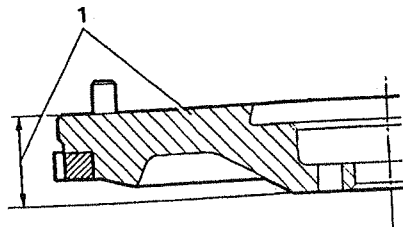
NOTE: The lubricant coating must cover the seal guide outer surface completely to ensure that the oil seal lip is not turned back during assembly. Position the oil seal, lipped side towards the engine, on to the seal guide. The seal outside diameter must be clean and dry.

- 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.
- 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.
- Turn the crankshaft to ensure that it turns freely.



OVERHAUL AND FIT FLYWHEEL

- 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 it can be refaced provided that after machining it will not be below the minimum thickness. Remove the three dowels before machining.

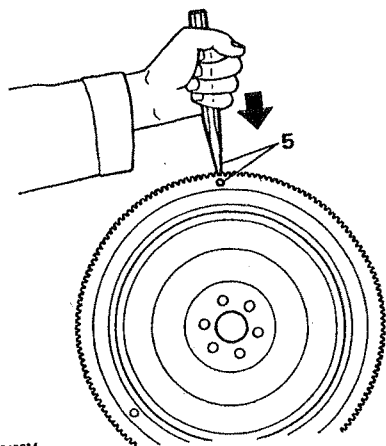


ST2353M

- Examine the ring gear and if worn or the teeth are chipped and broken it can be renewed as follows.
- Drill a 10 mm 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.
- Secure the flywheel in a vice fitted with soft jaws and place a cloth over the flywheel to protect the operator from flying fragments.

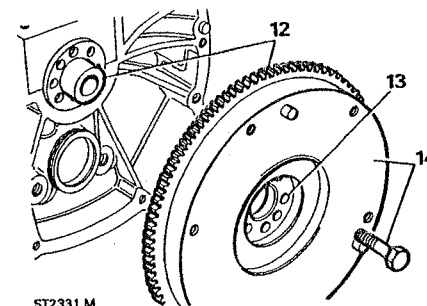
WARNING: Take adequate precautions against flying fragments when splitting the ring gear. Wear protective industrial goggles.

- Place a chisel immediately above the drilled hole and strike it sharply to split the starter ring gear.

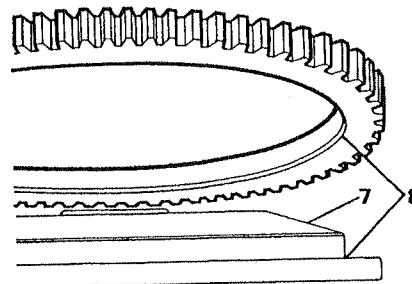


ST2406M

- Heat the new ring gear uniformly to between 170 to 175°C (338 to 347°F) but do not exceed the higher temperature.
- Place the flywheel, clutch side down, on a flat surface.
- Locate the heated starter ring in position on the flywheel, with the chamfered inner diameter towards the flywheel flange. If the starter gear rings is chamfered both sides, it can be fitted either way round.
- Press the starter ring gear firmly against the flange until the ring contracts sufficiently to grip the flywheel.



ST2331M



ST2359M

- Allow the flywheel to cool gradually. Do not hasten cooling in any way or distorting may occur.
- Fit new clutch assembly location dowels to the flywheel.

Fitting flywheel

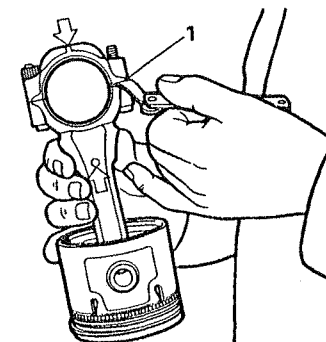
- Locate the flywheel in position on the crankshaft spigot, with the ring gear towards the engine.

WARNING: Hold the flywheel in position until the first retaining bolt is fitted to prevent the flywheel falling and causing personal injury.

- Align the flywheel fixing bolt holes which are off-set to prevent incorrect assembly.
- 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 using a suitable torque wrench.

CHECKING CONNECTING-ROD BEARING RUNNING CLEARANCE

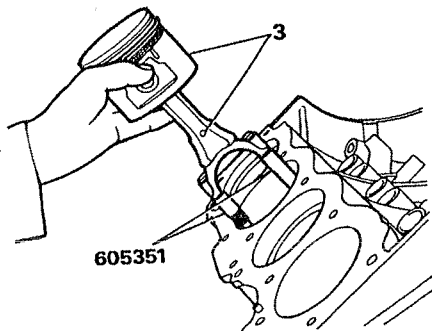
- Fit the new bearing shells to each connecting-rod and tighten both nuts to the correct torque. Slacken one nut on each rod and with a feeler gauge, measure the clearance between the parting face of the rod and the cap. This clearance should be between 0,1 and 0,2 mm. To overcome a clearance in excess of 0,25 mm rub down the edge of the shell with fine emery cloth on a flat surface. Refit the bearing, tighten the nuts, slacken one nut as previously described and check the clearance again. Repeat this procedure if necessary, until satisfied the clearance is correct. Ensure that the dome on the connecting-rod and cap are aligned.



ST2371M

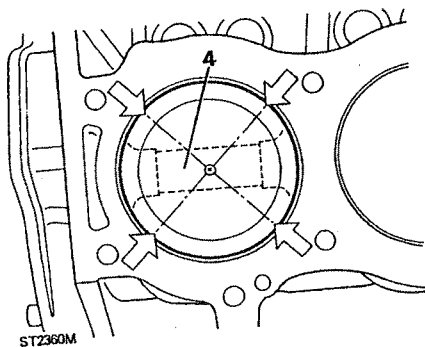
FITTING CONNECTING-RODS AND PISTONS

1. Position the applicable crankshaft journal at B.D.C. and place the bearing upper shell in the connecting-rod.
2. Retain the upper shell by screwing the guide bolts RO605351 on to the connecting-rod bolts.
3. 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.



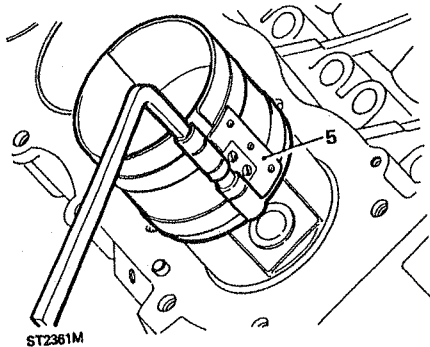
ST2442M

4. Space the piston rings gaps at intervals of 45° avoiding gaps at 90° to the gudgeon pin, see illustration below which shows the correct position of the ring caps in relation to piston in the bore.



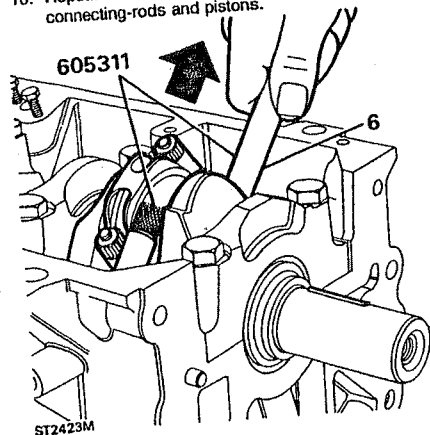
ST2360M

5. Using a piston ring compressor, tap the piston into the cylinder bore, until the piston crown is just below the cylinder block top face.



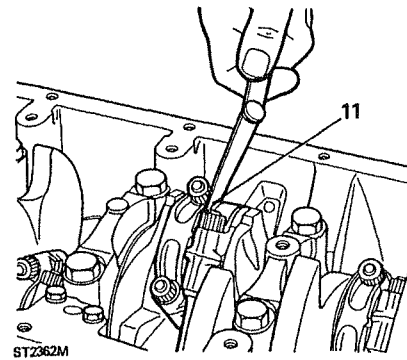
ST2361M

6. Pull the connecting-rod on to the crankpin using the guide rods having first lubricated the bearings.
7. Locate the bearing lower shell in the connecting-rod cap and lubricate.
8. Fit the cap and shell on to the connecting-rod, noticing that the dome 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, pointing in the same direction as the dome on the connecting-rod.
9. Fit and tighten the connecting-rod nuts to the correct torque.
10. Repeat the above procedure for the remaining connecting-rods and pistons.



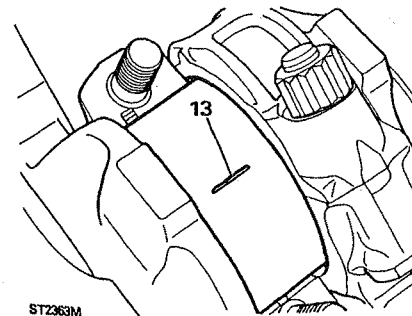
ST2423M

11. Finally, with a feeler gauge, check that the side-play clearance between each pair of connecting-rods on the crankpins is 0,15 to 0,37 mm.



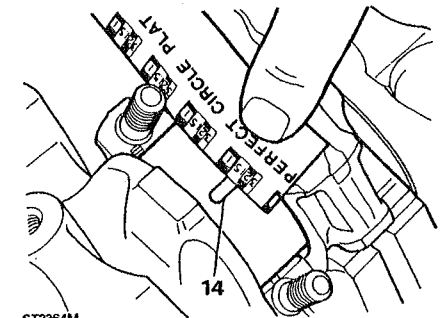
ST2362M

12. Lubricate the cylinder bores and turn the crankshaft to check that there are no tight spots, and that the connecting-rods move freely sideways on the crankshaft.
13. Should any doubt exist about a running clearance between the bearings and crankpin on any connecting-rod being too tight, these may be checked as follows by using Plastigauge type PG1. Release the bearing cap which is suspected of binding and place a small piece of Plastigauge on the journal in-line with its axis as illustrated. Refit the cap and bearing, tighten both the nuts to the correct torque then release and remove the cap and shell once again. Do not allow the crankshaft to be turned while making this check.



ST2363M

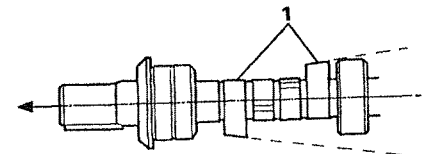
14. The Plastigauge will have been flattened on to the journal. Now compare the width of the Plastigauge with the scale printed on the packet which is shown in inches and mm. To determine the running clearance of the bearing, the graduation that most closely corresponds to the width of the flattened Plastigauge indicates the bearing to crankpin running clearance.



ST2364M

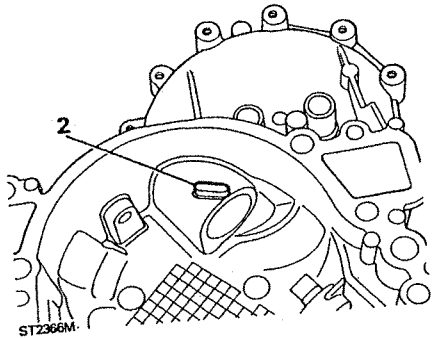
CAMSHAFT INSPECTION

1. Examine each cam lobe for wear or damage. The cam lobes are in fact manufactured with a slight taper with the highest point at the rear as the exaggerated illustration shows. This taper ensures that the tappet rotates in operation thus reducing wear and causes the shaft to be thrust onto the cylinder block.



ST2365M

2. This arrangement also obviates the need for a camshaft thrust plate or retainer. In the event of the camshaft being thrust forward during heavy braking, in an emergency stop for example, the movement of the camshaft is limited by an abutment pad cast into the front cover. If this pad is worn, serious end-float of the camshaft has occurred.



ST2366M

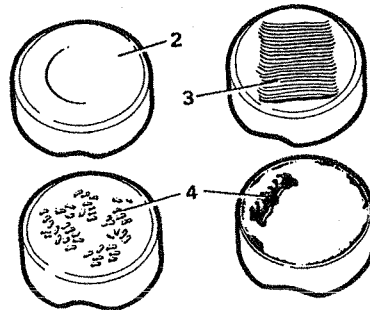
3. Measure the camshaft journals for overall wear, ovality and taper. The diameters of the five journals are as follows commencing from the front of the shaft.

- Number 1 journal 45.339 to 45.364mm
- Number 2 journal 44.577 to 44.602mm
- Number 3 journal 43.815 to 43.840mm
- Number 4 journal 43.053 to 43.078mm
- Number 5 journal 42.291 to 42.316mm

4. 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 it should be renewed.

INSPECTION OF TAPPETS

1. Examine the face of each tappet and compare with the wear patterns illustrated below.
2. Only the top left illustration shows a tappet that has been rotating correctly and is visibly serviceable, the other three should be renewed.
3. The tappet shown at the top right is an indication that it has not been rotating, which could mean that the corresponding cam lobe is worn and should be closely examined.
4. The remaining two tappets show examples of general wear and damage and must be renewed.

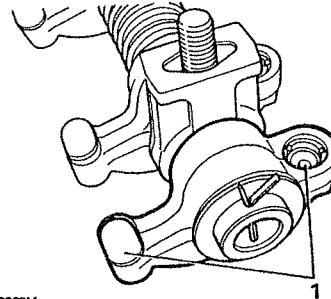


ST2367M

5. The hydraulic performance of the tappets, however, can only be judged when the engine is running so if there is the slightest doubt the tappets should be renewed.

ROCKER SHAFT ASSEMBLY AND PUSH ROD INSPECTION

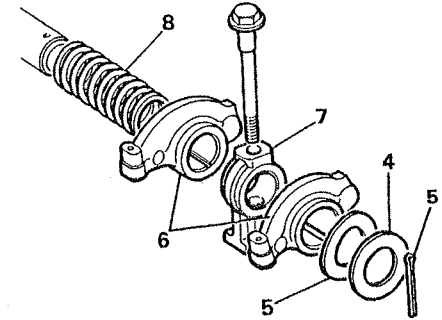
1. Examine the rockers for wear at the push rod and valve pad ends. Rockers that have worn, pitted or scored pads and ball seatings must be renewed.



ST2368M

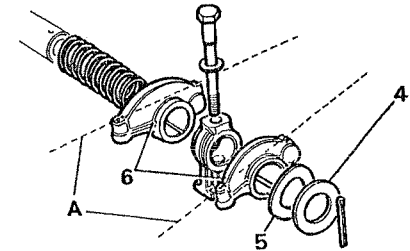
Dismantle rocker shaft assembly

2. Remove the split pin from the end of the rocker shaft that has the identification groove.
3. Withdraw the following components and retain them in the correct sequence for reassembly.
 4. A plain washer
 5. A wave washer
 6. Rocker arms
 7. Brackets
 8. Springs
9. Examine the shafts for wear, scores and pitting. Check that the lubrication drillings are clear.
10. A broken spring should be renewed and if possible sound springs should be checked for tension against a new one.



ST2370M

NOTE: Two different rocker arms were used on early engines and they 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 below.

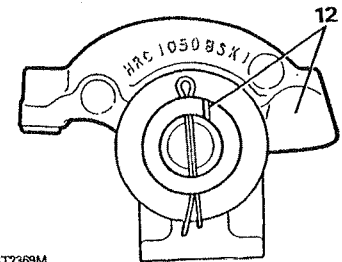


ST3163M

12. Both shafts must be assembled so that the identification groove is at the one o'clock position with the push rod end of the rockers to the right.

Assemble rocker shafts

11. Fit a new split pin to the opposite end of the shaft to the identification groove. Slide a plain washer over the long end of the shaft to abut the split pin. Fit a wave washer to abut the plain washer. Assemble the rocker arms, brackets and springs to the rocker shaft in the sequence illustrated. Compress the springs, brackets and rockers, and fit a wave washer, plain washer and split pin to the end of the rocker shaft.



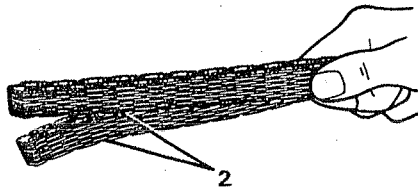
ST2369M

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

13. Examine the push rods and renew any that are bent or have scored, pitted or worn ball ends.

INSPECTION OF TIMING CHAIN AND GEARS

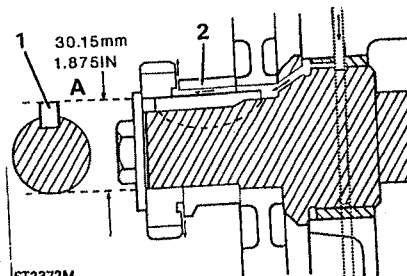
1. Examine the camshaft and crankshaft sprockets for wear and damage and discard if necessary. Also check the condition of the distributor and oil pump drive gears. Do not mate a worn gear with a new one.
2. Inspect the timing chain and if possible compare it with a new one. Alternatively squeeze the chain together and hold it at one end horizontally and if there is a considerable bend, the link pins of the chain are worn and the chain should be renewed.



ST2424M

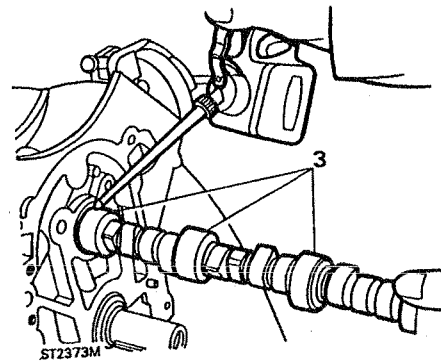
FITTING CAMSHAFT

1. It is very important that the sprocket key in the front of the camshaft is fitted parallel to the shaft and that the overall dimension does not exceed 30,15 mm dimension 'A'.
2. Lubrication for the timing chain and gears is supplied by the front camshaft bearing through a channel along the top of the keyway to an annular groove in the rear face of the oil pump distributor drive gear. Lubrication to the timing chain will be severely restricted if the key is loose enough to be affected by centrifugal force, or is fitted inclined into its groove in the shaft. The key must be securely fitted parallel to the shaft.



ST2372M

3. Lubricate the camshaft journals and carefully insert the camshaft into the cylinder block.

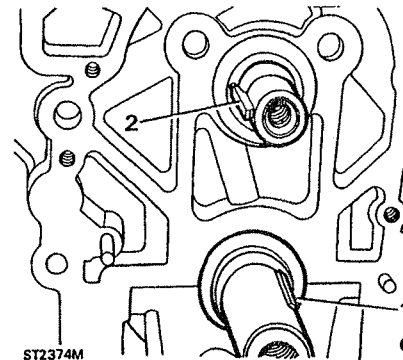


ST2373M

VALVE TIMING

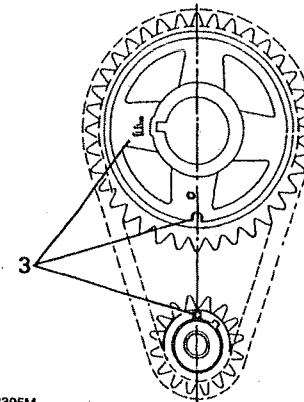
1. Turn the crankshaft to bring number one piston to T.D.C. Looking at the engine from the front, number one piston is the first one in the right-hand bank. The crankshaft key will be at the one o'clock position.

2. Turn the camshaft until the sprocket key is at the nine-o'clock position.



ST2374M

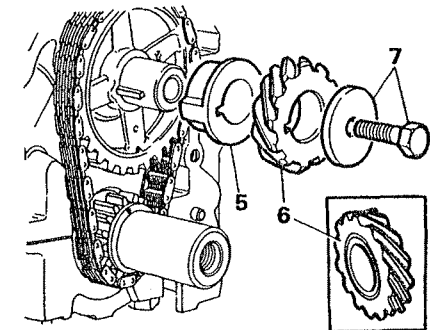
3. Encircle the camshaft and crankshaft sprockets with the chain so that the timing marks on the two sprockets are aligned as illustrated. Ensure that letter 'F' is at the front of the camshaft sprocket.



ST2395M

4. Fit the two sprockets and chain as an assembly to the camshaft and crankshaft respectively. Check the camshaft key is parallel to the shaft and that the two timing marks are still aligned.
5. Fit the spacer with the flange side outwards.
6. Fit the distributor drive gear ensuring that the annular grooved side is fitted towards the spacer.

7. Secure the drive gear and camshaft chain wheel assembly with the bolt and washer and tighten to the correct torque.

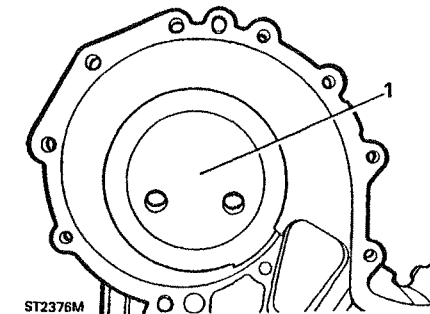


ST2375M

OIL PUMP/TIMING COVER OVERHAUL

Serviceability of the front cover depends upon the condition of the water pump and oil pump recesses.

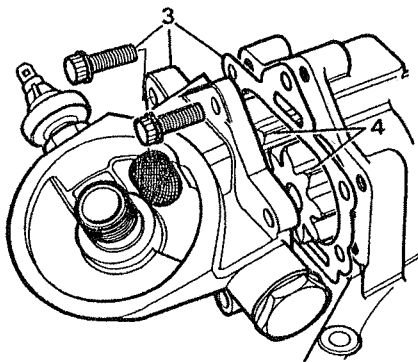
1. Examine the water pump recess for damage and corrosion.



ST2376M

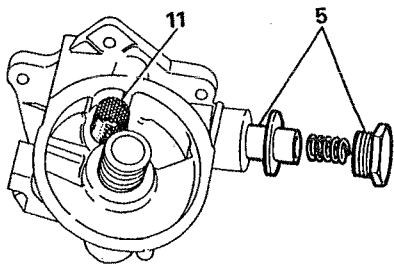
2. Check the camshaft abutment mentioned in 'camshaft inspection' for damage and cracks in this area.
3. Remove the screws and withdraw the oil pump cover and gasket.

4. Remove the oil pump gears.



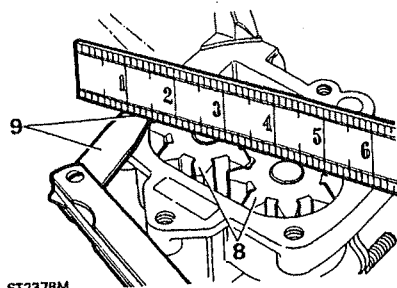
ST2425M

5. Remove the pressure relief valve plug and release the spring, relief valve and plug washer.



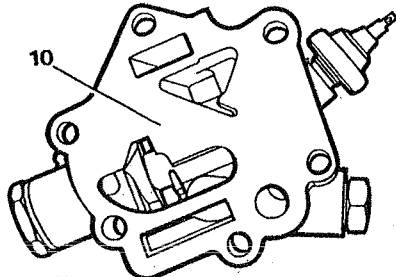
ST2377M

6. Clean all components including the recess in the front cover.
7. Check the oil pump gears for wear or scores.
8. Fit the oil pump gears and shaft into the front cover.
9. Place a straight-edge across the gears and check the clearance between the straight-edge and the front cover. If less than 0,05 mm, it indicates that the gear recess is worn and that the cover should be renewed.



ST2378M

10. Check the pump gear cover thrust face for wear. If scored it may be restored by careful refacing.



ST2379M

11. Check the oil pressure relief valve for wear and scores. Check the relief valve spring for wear at the sides or signs of collapse. Clean the gauze filter for the relief valve. Check the fit of the relief valve in its bore. The valve must be an easy slide fit with no perceptible side movement.
12. Renew any parts if their condition is doubtful.

Assemble pump

13. Insert the relief valve spring.
14. Locate the sealing washer on to the relief valve plug.
15. Fit the relief valve plug and tighten to 61 Nm.
16. Fully pack the oil pump gear housing with petroleum jelly.

CAUTION: Grease must not be used since most greases contain additives which do not dissolve in engine oil and may cause malfunction of the hydraulic tappets, and or block the oil pick-up strainer, unless the pump is fully packed with petroleum jelly it may not prime itself when the engine is started.

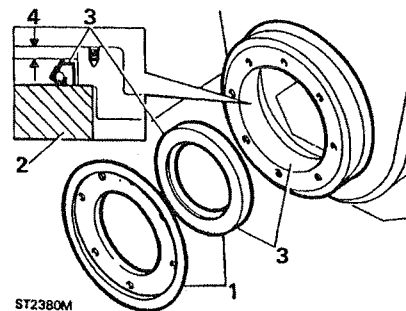
17. Fit the oil pump gears so that the petroleum jelly is forced into every cavity between the teeth of the gears.
18. Place a new gasket on the oil pump cover.

CAUTION: Since it is the thickness of the gasket which determines the clearance of the gears it is vital that only a genuine Land Rover replacement part is used otherwise the end clearance may be reduced sufficiently to cause the pump to seize.

19. Locate the oil pump cover in position and fit the special fixing bolts and tighten alternately and evenly to the correct torque.

TIMING COVER OIL SEAL - Renew

1. Remove the seven drive screws and withdraw the mud shield and the oil seal.
2. Position the gear cover with the front face uppermost and the underside supported across the oil seal housing bore on a suitable wooden block.
3. Enter the oil seal, lip side leading, into the housing bore.
4. Press in the oil seal until the plain face is 1,5 mm approximately below the gear cover face.
5. Fit the mud shield and secure with the screws and a smear of sealing compound.

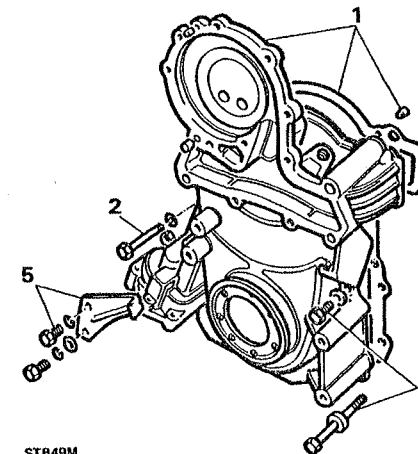


ST2380M

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 the timing cover bolts but do not fully tighten until the water pump is fitted.

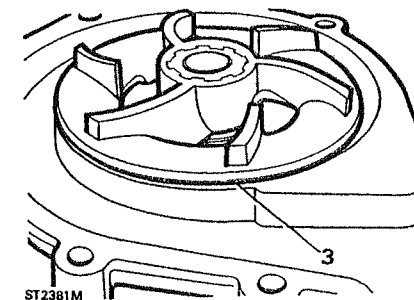
4. Fit the crankshaft pulley and tighten the retaining bolt to the correct torque.
5. Fit the timing pointer.



ST849M

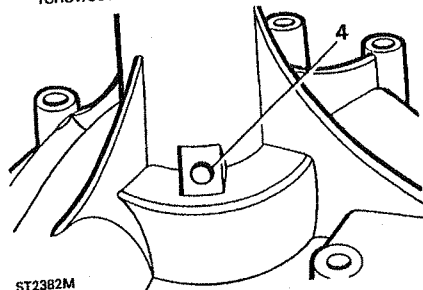
WATER PUMP INSPECTION AND FITTING

1. The water pump is not a reconditionable unit but its condition can be determined by the following checks.
2. Spin the pump spindle and listen for noise. Push and pull the spindle and check for sideways movement. The condition of the bearings can be judged from these checks.
3. During the above checks the clearance between the impeller and the pump body should not vary.



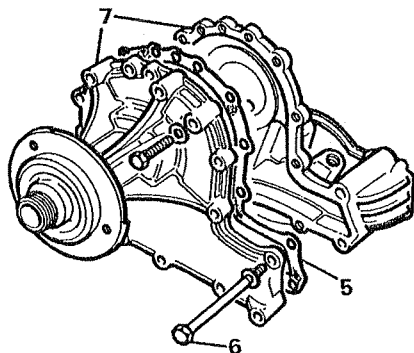
ST2381M

- Inspect the vent hole in the pump body for signs of coolant or oil leaks. If there is any evidence of leakage, the pump should be renewed.



Fitting water pump

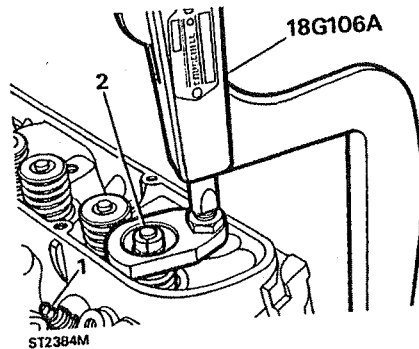
- Lightly grease a new joint washer and place it in position on the timing joint.
- Clean the threads of the four long bolts and smear them with Loctite 572 thread lubricant-sealant.
- Locate the water pump in position and fit any ancillary brackets. Tighten the securing bolts including the timing cover bolts evenly to the correct torque.



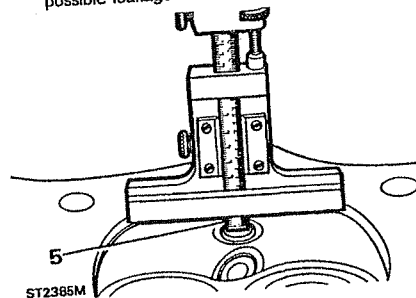
CYLINDER HEAD OVERHAUL

Dismantle cylinder heads

- Remove the spark plugs.
- Using the valve spring compressor RO276102, or 18G106A or MS1519A or a suitable alternative, remove the valves and springs and retain valves in sequence for possible fitting. The springs should be discarded.



- Clean and degrease the cylinder heads and remove carbon from the combustion face and chambers with a soft wire brush. Wear protective goggles.
- Examine both heads for damage, cracks and overheating.
- Using a depth gauge measure the distance between the combustion face and the boss in each combustion chamber. A reading of less than 6,35 mm indicates that the combustion face has previously been machined. It is very important that the measurement is the same on both cylinder heads since any variation will cause misalignment of the inlet manifold and possible leakage at the manifold gasket.



- Examine the condition of all threaded holes and any holes which are stripped and damaged can be salvaged by fitting Helicoils.

Reclaiming cylinder head threads

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 (min.) deep (3/8 UNC 1 1/2 D 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 (min.) deep (3/8 UNC 1 1/2 D insert).

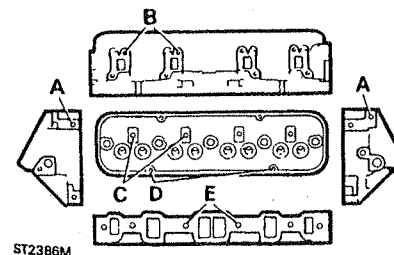
Holes C - These four holes may be drilled 0.3906 in. dia. x 0.937 + 0.040 in. deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.875 in. (min.) deep (3/8 UNC 1 1/2 D insert).

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 (1/2 UNC 1 1/2 D insert).

Holes E - These six holes may be drilled 0.3906 in. dia. x 0.937 + 0.040 in. deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.875 in. (min.) deep (3/8 UNC 1 1/2 D insert).

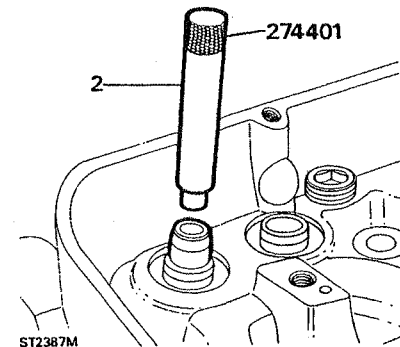
NOTE: Right-hand cylinder head illustrated. American projection.

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



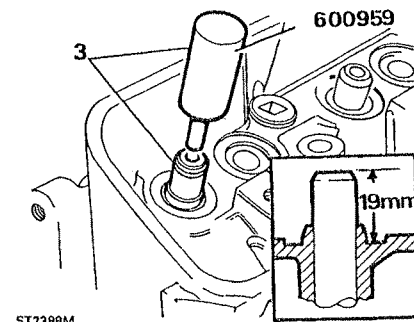
Examine and renew valve guides

- Check the valve guides for wear by inserting a new valve in the guide and holding it 8 mm from the seat. If sideways movement of the valve head exceeds 0,15 mm the guide should be renewed.
- To remove worn guide, use guides removing tool RO274401 and drive-out the guides from the rocker shaft side of the cylinder head through the valve port. Clean away any carbon deposits from the port that were not accessible before the guides were removed.



- Lubricate the new valve guide and place in position. Using guide drift RO600959 and if available, height gauge RO605774A, drive the guide into the cylinder head until it protrudes 19 mm above the valve spring recess in the head or flush with the height gauge.

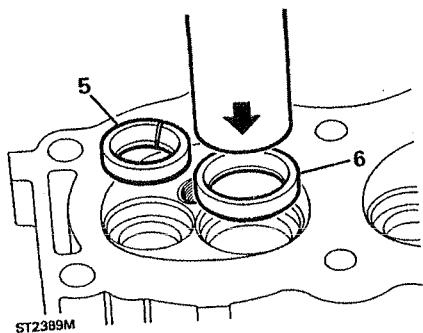
NOTE: Service valve guides are 0,02 mm larger on the outside diameter than the original equipment to ensure interference fit.



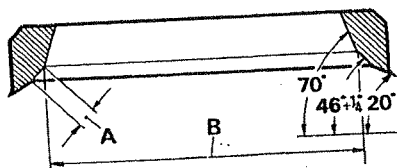
Examine and renew valve seat inserts

4. Check the valve seats for wear, pits and burning or pocketing due to repeated refacing and renew the inserts if necessary.
5. Remove the old seat inserts by grinding them away until they are thin enough to be cracked and prised out. **WEAR GOGGLES.**
6. Heat the cylinder head evenly to approximately 65 degrees C (150 degrees F) and press the new insert into the recess in the cylinder head and allow the cylinder head to cool naturally.

NOTE: Service valve seat inserts are available in two over-sizes: 0,25 and 0,50 mm on the outside diameter to ensure interference fit.

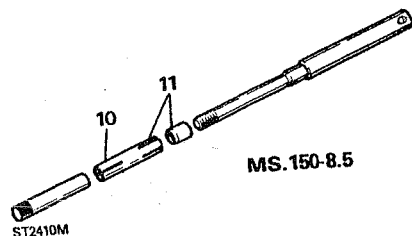


7. If necessary, cut the valve seats to 46.25°. The nominal seat width 'A' is 1,5 mm. If the seat exceeds 2,0 mm it should be reduced to the specified width by the use of 20 and 70° cutters.
8. The inlet valve seat diameter, B is 37,03 mm and the exhaust valve seat is 31,50 mm diameter.

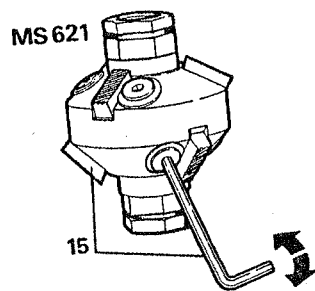


ST2392M

9. 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.
10. Select the correct expandable collet for the valve.
11. Ensure that the chamfered end of the expander is towards the collet.
12. 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. Tommy bar hole combustion face side.
13. Expand the collet in the guide by turning the tommy bar clockwise whilst holding the knurled nut.

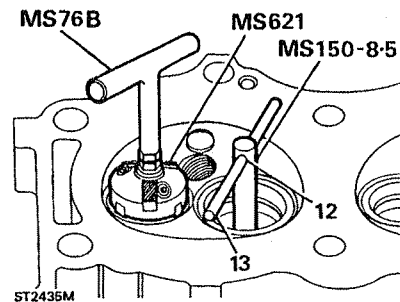


14. Select the appropriate angled cutter for the seats to be cut.
15. Ensure that the cutter blades are correctly fitted to the cutter head with the angled end of the blade downwards facing the work as illustrated.



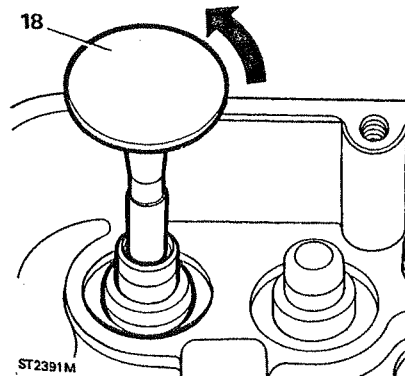
ST2398M

16. 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 to adjust the cutters so that they all contact the seating simultaneously. Use light pressure and remove only the minimum material necessary.

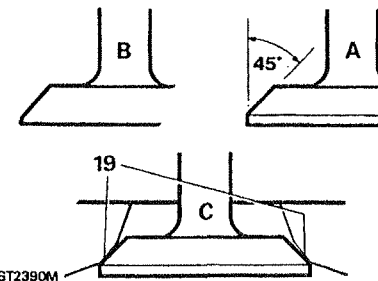


Examine and Replace Valves

17. Examine the valves and discard any which are burnt, cracked or where the head is dished. Also renew valves if the stems are scored, show signs of overheating and seizure. Valves that appear satisfactory should be checked in the guides, using the same method as for checking the valve guides, for stem wear.
18. Revolve valves in the guides to check for bend.



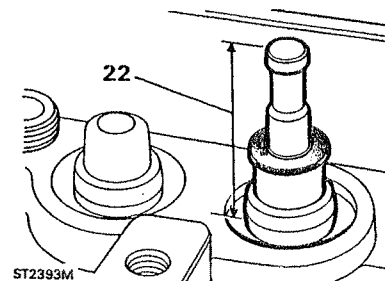
19. Reface serviceable valves to an axle of 45°, example 'A'. Any valve which after refacing resembles 'B' must be renewed.



20. 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.
21. 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. With a correctly finished valve and seat a continuous fine line should appear approximately one third down the valve face width as illustrated in 'C'.

Valve clearance and assembly to head

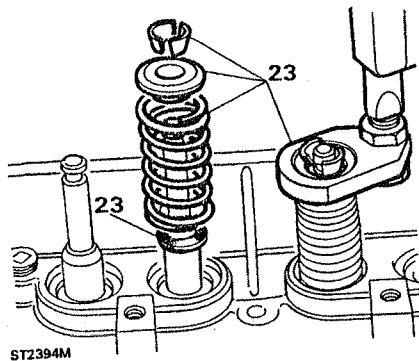
22. Before fitting the valves and springs the height of each valve above the head must be checked. Insert each valve in turn in its guide and whilst holding the head firmly against its seat, measure the height of the stem above the valve spring seat surface. This dimension must not exceed 47,63 mm. If necessary renew the valve or grind the end of the valve stem.



Fitting valves and springs

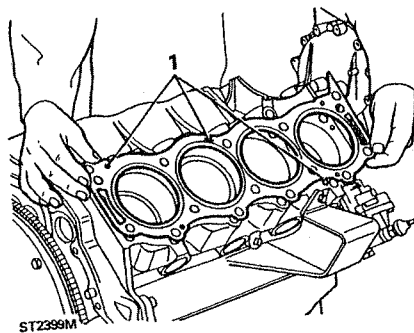
23. Insert each valve in its guide, lubricate with clean oil and place a new seal over the stem of the inlet valves only. Fit a new spring and using spring compressor 18G 106A or RO276102, secure the valve with the cap and collets.

NOTE: Seals are fitted to the inlet valves on later engines, but these can also be fitted to early engines if required.

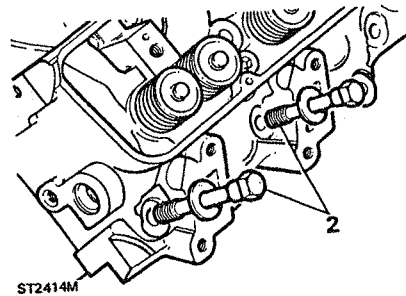


FITTING CYLINDER HEADS

1. Place new genuine Land Rover cylinder head gaskets in position over the dowel pins, on the cylinder block, with the word 'TOP' uppermost. Do not use any sealant.



2. Locate the cylinder heads on the block dowel pins. Clean the threads of the cylinder head bolts then coat them with Thread Lubricant-Sealant Loctite 572.



3. Locate the cylinder head bolts in the position as illustrated and below.

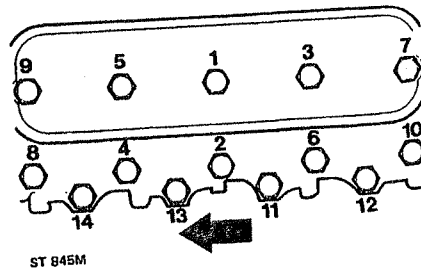
- Long bolts - 1,3 and 5.
- Medium bolts - 2,4,6,7,8,9 and 10.
- Short bolts - 11,12,13 and 14.

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

Tighten the cylinder head bolts a little at a time in the sequence shown below to the following figures:

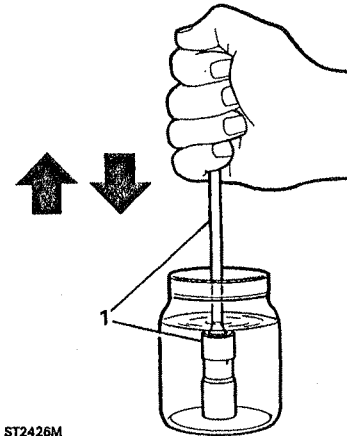
- Bolts 1 to 10 - 88 to 95 Nm.
- Bolts 11 to 14 - 54 to 61 Nm.

When all bolts have been tightened, recheck the torque setting.

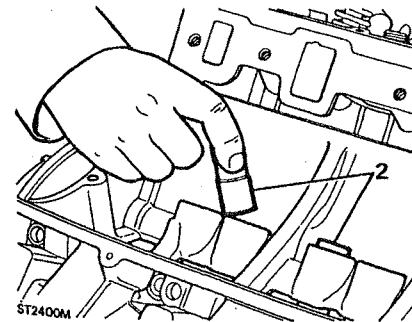


FITTING TAPPETS

1. Place all the tappets into a metal container of clean engine oil and operate the inner member using a push-rod to fill each tappet with oil. This will reduce tappet noise when the engine is first started.

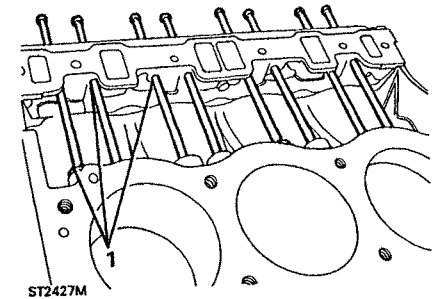


2. Refit any used tappets into their original locations and ensure that they all rotate freely in the bores.



FITTING ROCKER SHAFTS AND PUSH RODS

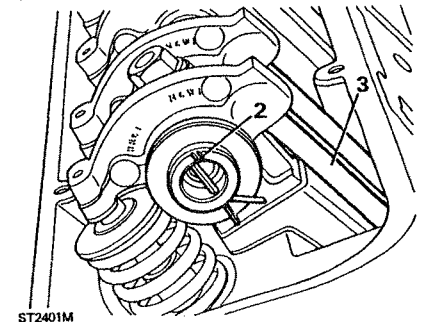
1. Fit the push rods through the guide holes in the cylinder head ensuring that any used ones are returned to their original locations and that all the rods locate properly in the tappets.



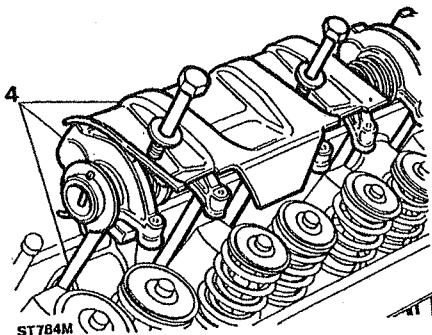
2. The rocker shafts are handed and must be fitted correctly to align the oilways. Each rocker shaft is notched at one end and one side only. If they are correctly assembled then when fitted the notch in the end of each shaft will be at one-O'clock position and towards the front on the right bank and to the rear on the left bank, viewing the engine from the flywheel end.

CAUTION: Incorrectly assembled and fitted rocker shafts will prevent lubrication reaching the shafts and rockers.

3. When fitting the rocker shaft assembly to the cylinder head ensure that the push rods locate correctly in the rocker seats. Tighten the retaining bolts evenly to the correct torque.



4. On early engines baffle plates are bolted onto the pedestals and are fitted to the front on the left-hand side, and to the rear on the right-hand side of the engine.



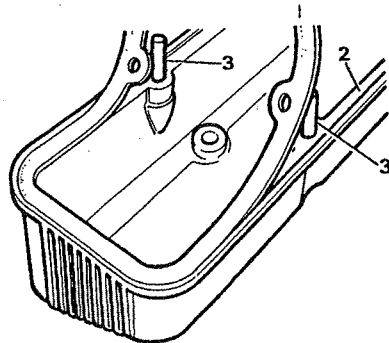
FITTING ROCKER COVERS

1. An oil baffle on later engines is fitted inside each rocker cover and is secured by self tapping screws to enable the baffle to be removed for cleaning if necessary.
2. Remove all traces of old gasket on the covers and cylinder heads. Clean and dry the gasket mounting surface, using Bostik cleaner 6001. Apply Bostik 1777 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, and the gasket.

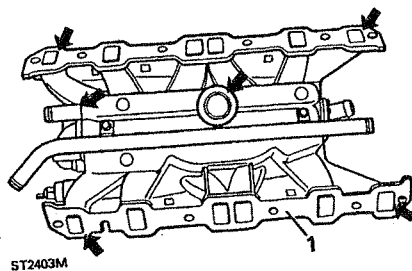
3. Fit pilot studs in the rocker cover fixing holes to guide the gasket on the cover and into the recess. Press the gasket into position ensuring that the outer edge firmly adheres to the recess wall. Remove the pilot studs when the gasket is finally positioned.

4. Allow the covers to stand for thirty minutes before fitting them to the engine, then secure the rocker covers to the engine with the engine with the retaining screws.

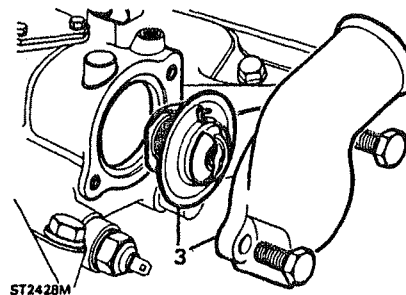


INLET MANIFOLD INSPECTION

1. Examine the manifold for cracks and damage. Check the threaded holes and joint faces.
2. Since the manifold is water heated, a thorough check should be made for signs of coolant leaks from pipes and plugs particularly on the underside of the casting.

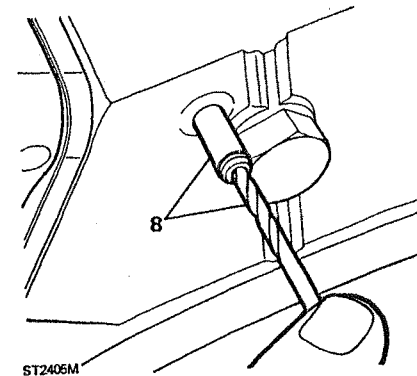


3. Remove the thermostat cover and withdraw the thermostat. Clean any deposits from the housing and the cover.



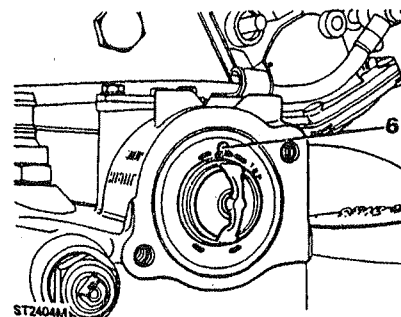
4. The temperature at which the thermostat should be fully open is stamped on the forward end of the thermostat. The following method can be used to determine if the thermostat is satisfactory and suitable for refitting.
5. Place the thermostat and a Centigrade thermometer in a laboratory beaker, or a suitable alternative, half full of water. Heat the water and observe the temperature at which the thermostat opens. If faulty, discard the thermostat.
6. The thermostat has a small vent hole in which is fitted a 'jiggle' pin to keep the hole clear. Fit the thermostat to the housing ensuring that this vent is uppermost at the 12 O'clock position. If fitted in any other way, an air lock could result in the water passages causing overheating and coolant loss from the system.

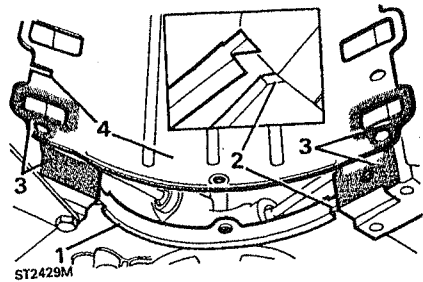
7. Fit the thermostat cover using a new gasket. Coat the threads of the retaining screws with Loctite 572 and tighten the screws evenly to the correct torque.
8. A small diameter vent pipe is located at the side of the manifold penthouse. Disconnect the hose and insert a 2 mm drill and turn it by hand to ensure that the vent is clear. Any blockage at this point will cause overheating and loss of coolant. Check that the hose is also clear.



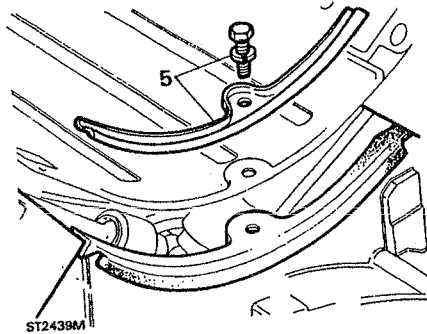
FITTING INLET MANIFOLD

1. Coat both sides of the new manifold gasket seals with silicon grease.
2. Apply a 6 mm diameter globule of loctite super flex in the four notches formed between the cylinder head and block. Locate the seals in position with their ends engaged in the notches formed between the cylinder head and block.
3. Apply 'Hylomar' sealing compound SQ 32M 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.

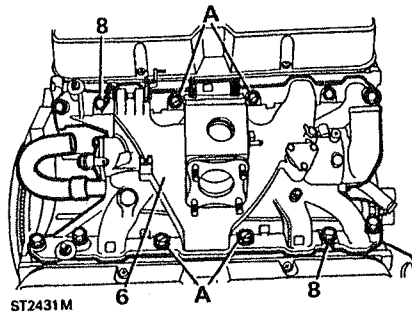




5. Fit the gasket clamps but do not fully tighten at this stage.

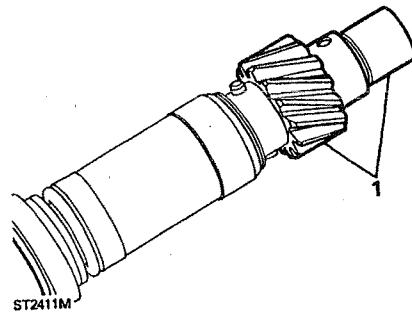


6. Locate the manifold on to the cylinder head.
7. Clean the threads of the twelve manifold securing bolts and apply Loctite 572 to the threads.
8. Fit all the manifold bolts and tighten them a little at a time, evenly, alternate sides working from the centre to each end and finally tighten to the correct torque. Note that the four slotted headed bolts are fitted at the location 'A'.
9. Tighten the gasket clamp bolts to the correct torque.



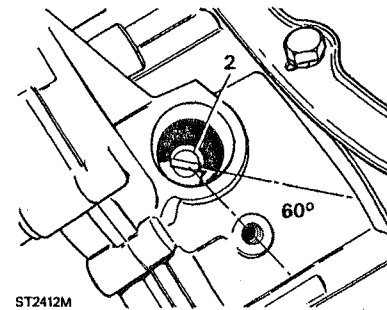
FITTING THE DISTRIBUTOR - Electronic type

1. Examine the distributor drive gear and swivel coupling and renew if necessary.

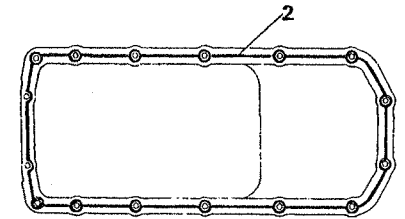
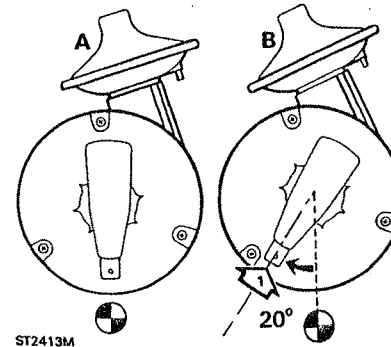


2. Turn the crankshaft to bring number one cylinder piston to T.D.C. with number six cylinder valves on overlap. Turn the oil pump drive shaft so that the tongue is at an angle of 60° to the distributor clamp bolt hole. Insert the distributor into the front cover with the vacuum unit pointing in the direction illustrated and the rotor arm aligned with the clamp hole.

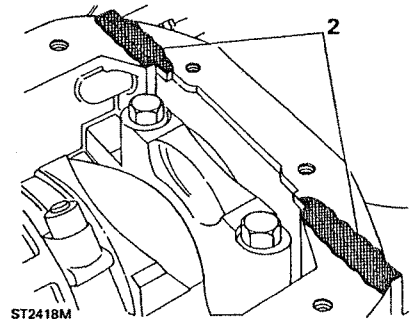
FITTING THE SUMP



3. Insert the distributor into the front cover with the vacuum unit pointing in the direction illustrated and the rotor arm aligned with the clamp hole, illustration A.
4. When the distributor drive engages with the camshaft gear the distributor shaft and rotor arm will turn clockwise approximately 20° and should seat fully into its location with the rotor arm in line with number one cylinder plug lead. If the oil pump drive does not engage with the distributor coupling the distributor can not be pushed fully home. Therefore remove the distributor and reposition the oil pump drive a few degrees and try again. Do not however, use any force to locate the distributor.
5. Fit the clamp and nut but do not fully tighten at this stage.



ST2417M



ST2418M

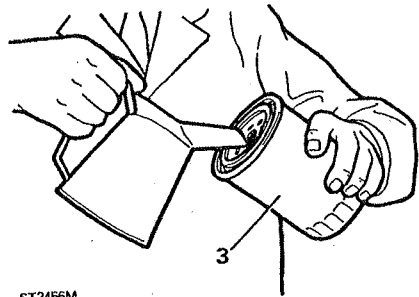
3. Fit the sump and secure with the retaining screws tightening evenly to the correct torque. Allow thirty minutes drying time before starting the engine.

NOTE: The above sealant can be used on earlier engines where a gasket was originally fitted.

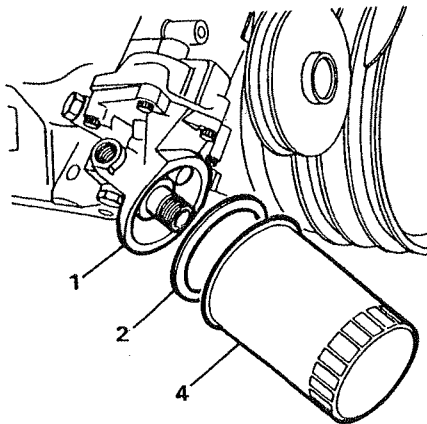
FIT ENGINE OIL FILTER

CAUTION: Use only a genuine Land Rover replacement filter.

1. Clean oil pump cover 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.



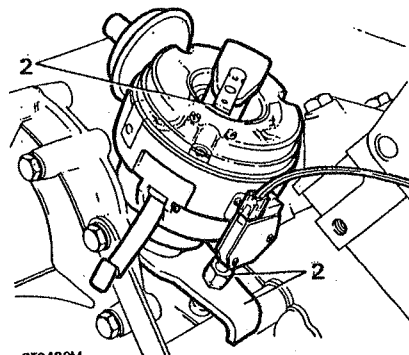
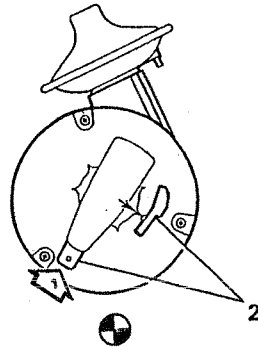
4. Screw on the filter until the sealing ring touches the oil pump cover face, then tighten it a further half turn by hand only. Do not overtighten.
5. Fit the oil pressure and oil temperature transmitters to the oil pump cover.



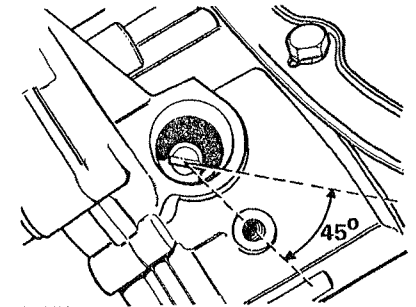
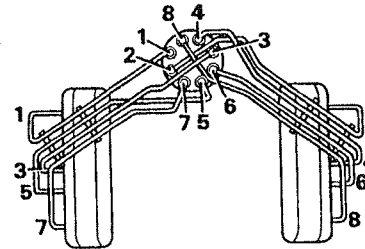
STATIC IGNITION TIMING

1. Ensure that number one cylinder piston is at T.D.C. with both valves closed.
2. Turn the distributor body so that the rotor arm is pointing to number one cylinder plug lead, in the distributor cap, and the reluctor is aligned with the pick-up.

NOTE: The above distributor setting is only provisional to enable the engine to be started. When the engine is refitted to the vehicle the ignition timing must be set using electronic equipment in accordance with the information in ENGINE TUNING DATA Section 05.



3. Fit the distributor cap and spark plugs and connect the distributor leads exactly in accordance with the illustration.

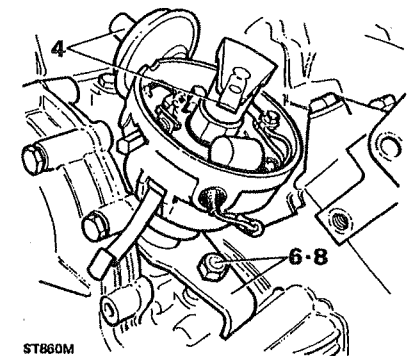


CAUTION: Failure to route the leads correctly, as shown, can cause cross firing between cylinders five and seven, as can be seen by the firing order 18436572. When cylinder 5 is at T.D.C. on the power stroke, cylinder 7 is at 90° before T.D.C. on the compression stroke ready for ignition. If the plug leads for these two cylinders are routed parallel in adjacent clips, HT current to number 5 plug will also be induced in number 7 causing combustion of the mixture in number 7 cylinder to occur 90° B.T.D.C. and again at T.D.C. It is for this reason that the correct clipping of the plug leads is observed to avoid the possibility of severe damage to the engine.

FIT THE DISTRIBUTOR - Contact breaker type

NOTE: The following distributor static 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.

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 the 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 at an angle of 45° to the distributor clamp bolt hole.

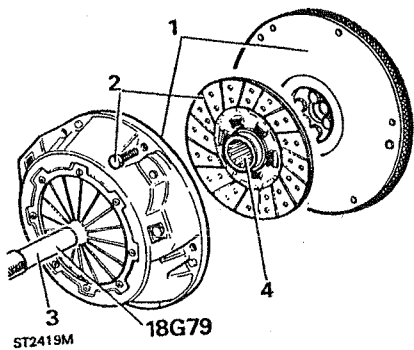


7. Rotate distributor anti-clockwise until contact points just start to open.
8. Secure distributor in this position by tightening clamp bolts.
9. Continue by following instruction 8 as for the electronic distributor.

FIT THE CLUTCH

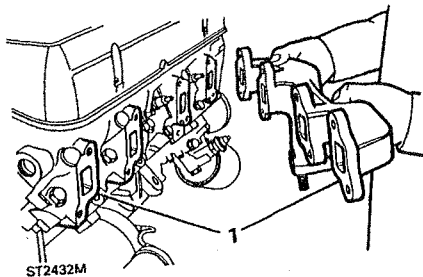
Fit a new clutch assembly complete

1. Clean the flywheel and protective grease from the clutch assembly pressure plate.
2. Fit the centre plate and the clutch assembly, locating on the dowels, and loosely secure to the flywheel with the retaining bolts.
3. Insert clutch centralising tool 18G 79 or a spare primary shaft through the clutch assembly into the flywheel. Finally tighten the clutch assembly retaining bolts in a diagonal sequence, to the correct torque.
4. Smear the centre plate spines with Rocol MV3 or Rocol MTS 1000 grease.

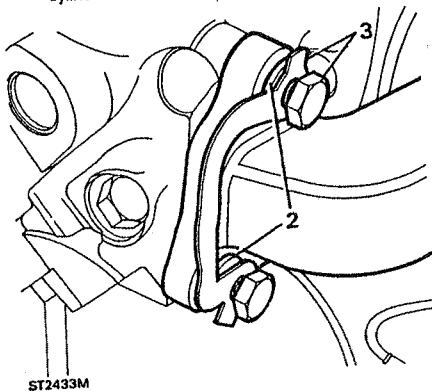


FIT EXHAUST MANIFOLD

1. Ensure that the mating faces 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.

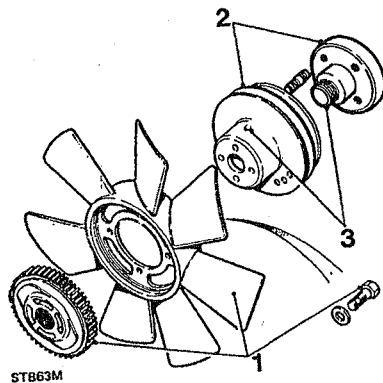


2. Place the manifold in position on the cylinder head and fit the securing bolts, lockplates and plain washers. The plain washers are fitted between the manifold and lockplates.
3. Evenly tighten the manifold bolts to the correct torque figure and bend over the lock tabs.
4. If removed, fit the pulse - air rails to the cylinder heads, - early engines only.



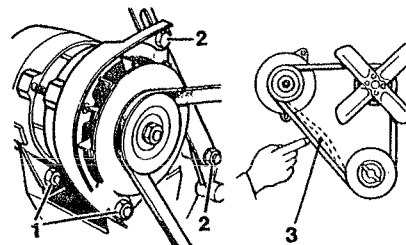
FIT THE FAN PULLEY, VISCOUS COUPLING AND FAN

1. Secure the fan to the viscose 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 left- hand 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.



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. Fit the alternator adjustment strap with the clamp and pivot bolts. 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 for non-air conditioned engines, 4 mm for air conditioned engines, between alternator and the crankshaft pulley. Finally, tighten the fixings and connect the wiring plug to the alternator.



ST855M

NOTE: See maintenance Section 10 for all drive belt variants.

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.

Notes

PETROL ENGINE - FAULT DIAGNOSIS

FAULT	POSSIBLE CAUSE	CURE
ENGINE FAILS TO START	<ol style="list-style-type: none"> 1. Incorrect starting procedure 2. Starter motor speed too slow 3. Faulty ignition system 4. Water or dirt in fuel system 5. Carburettor(s) flooding 6. Defective fuel pump 7. Defective starter motor 8. Starter pinion not engaging 	<p>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</p>
ENGINE STALLS	<ol style="list-style-type: none"> 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 	<p>Adjust carburettor(s) Clean and test, renew if necessary Renew Rectify or renew Adjust carburettor(s) Investigate source of foreign matter and clean as necessary</p>
LACK OF POWER	<ol style="list-style-type: none"> 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 	<p>If the compression is appreciably less than 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</p>
ENGINE RUNS ERRATICALLY	<ol style="list-style-type: none"> 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 	<p>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</p>
ENGINE STARTS, BUT STOPS IMMEDIATELY	<ol style="list-style-type: none"> 1. Faulty electrical connections 2. Foreign matter in fuel system 3. Faulty fuel pump 4. Low fuel level in tank 	<p>Check HT leads for cracked insulation; check low tension circuit Determine source of matter and clean system Remove, overhaul or renew Replenish</p>
ENGINE FAILS TO IDLE	<ol style="list-style-type: none"> 1. Incorrect carburettor setting 2. Faulty fuel pump 3. Sticking valves 4. Faulty cylinder head gasket(s) 	<p>Adjust as necessary Remove, overhaul or renew Overhaul cylinder head(s) Renew</p>
ENGINE MISFIRES ON ACCELERATION	<ol style="list-style-type: none"> 1. Distributor points incorrectly set 2. Faulty coil or condenser 3. Faulty sparking plugs 4. Faulty carburettor(s) 5. Vacuum pipes disconnected at inlet manifold 	<p>Set to correct dwell angle Renew Clean, test or renew Overhaul Check all vacuum connections Renew faulty pipes</p>
ENGINE KNOCKS	<ol style="list-style-type: none"> 1. Ignition timing advanced 2. Excessive carbon deposit 3. incorrect carburettor setting 4. Unsuitable fuel 5. Worn pistons or bearings 6. Distributor advance mechanism faulty 7. Defective sparking plugs 	<p>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</p>
ENGINE BACKFIRES	<ol style="list-style-type: none"> 1. Ignition defect 2. Carburettor 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 	<p>Check all ignition components and timing Overhaul carburettor(s) Overhaul cylinder head Clean and reset Renew faulty gaskets or components</p>

PETROL ENGINE - FAULT DIAGNOSIS (Continued)

FAULT	POSSIBLE CAUSE	CURE
BURNED VALVES	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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 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	<ol style="list-style-type: none"> 1. Oil too heavy for prevailing temperature 2. Excessive varnish in tappet 3. Varnish in tappet 4. Leakage at check ball 5. Excessive leakdown 6. High oil level in sump 7. Leakage at check ball 8. Worn tappet body 9. 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	Overhaul engine

DIESEL ENGINE MECHANICAL FAULTS

FAULT	POSSIBLE CAUSE	CURE
MAIN BEARING RATTLE	<ol style="list-style-type: none"> 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; and or crankshaft Renew and investigate reason for failure Tighten to correct torque
ENGINE OVERHEATING	<ol style="list-style-type: none"> 6. Low coolant level 7. Faulty cooling system 8. Faulty thermostat 9. Cracked cylinder head 10. Defective lubrication system 	Check for leaks, check expansion tank level Check fan and belt, pump, radiator fins not blocked Test and renew, if necessary Renew Renew Filter, Check pump Clean strainer Check oil circulation
LOW OIL PRESSURE WARNING LIGHT REMAINS ON, ENGINE RUNNING	<ol style="list-style-type: none"> 11. Thin or diluted oil 12. Low oil level 13. Choked pump strainer 14. Faulty release valve 15. Excessive bearing clearance 16. Oil pressure switch unserviceable 17. Electrical fault 18. Relief valve plunger sticking 19. Weak relief valve spring 20. Pump rotors excessively worn 21. Excessively worn bearings; main, connecting rod, big end, camshaft, etc. 22. 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	23. Oil pressure relief valve plunger sticking	Remove and clean
NOISY VALVE MECHANISM	<ol style="list-style-type: none"> 24. Sticking valves 25. Weak valve springs 26. Tappet clearance too wide 27. Worn timing chain or chain wheels 	Overhaul cylinder head
MECHANICAL NOISES: Low pitch knock Low pitch thud Intermittent thuds High pitch tap Light tapping Slapping	<ol style="list-style-type: none"> 28. Big-end bearing slack or run 29. Main bearing slack or run 30. Loose flywheel or excessive crankshaft end-float 31. Worn gudgeon pins 32. Excessive valve clearance 33. Excessive piston clearance more apparent when cold 	Overhaul engine

DIESEL ENGINE
FAULT DIAGNOSIS DPA AND DPS PUMPS - 2.25 and 2.5 litre diesel engines

FAULT	POSSIBLE CAUSE	CURE
DIFFICULT STARTING	<ol style="list-style-type: none"> 1. Lack of fuel 2. Stop solenoid faulty 3. Wrong starting procedure 4. Air in fuel system 5. Fuel inlet restriction 6. Fuel contamination 7. Low cranking speed 8. Starting aid ineffective 9. Injection timing incorrect 10. Timing belt slipped 11. Back leakage restricted 12. Fuel circuit incorrect 13. Engine condition 14. Fuel atomisation 15. Fuel tank blockage 16. HP pipe leaking 17. Injection pump defective internally 	Fuel level in tank Audible operation when switched - Check electrical supply, replace solenoid Starting procedure correct - Throttle closed and heater plugs in operation All joints and unions are tight Filter not choked and feed pipes clear Diesel fuel being used, not petrol, free of water, dirt, ice, wax Battery, starter, cable connections Correct engine lubricating oil Correct functioning of heater plugs Pump to engine timing using timing tool Bell condition and tension Pump rotor not seized Tank return clear, flow from cam box valve when cranking Replace pump if blocked Inlet and back leak pipes correct way round. Banjo bolts of correct type for pump injector sealing Cylinder compression, valve timing and clearances Air filter not choked Injectors; correct type, opening pressure, spray condition Tank vent and outlet unrestricted HP pipe joint tightness If all other relevant checks satisfactory, replace pump

FAULT DIAGNOSIS DPA AND DPS PUMPS - 2.25 and 2.5 litre diesel engines (continued)

FAULT	POSSIBLE CAUSE	CURE
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

FUEL SYSTEM - Diesel

FUEL INJECTORS - 2.25 and 2.5 engines only

Checking nozzle assemblies

WARNING: Do not attempt to carry out the following checks on the Tdi engine injectors. This work can only be performed by authorised Bosch Dealers.

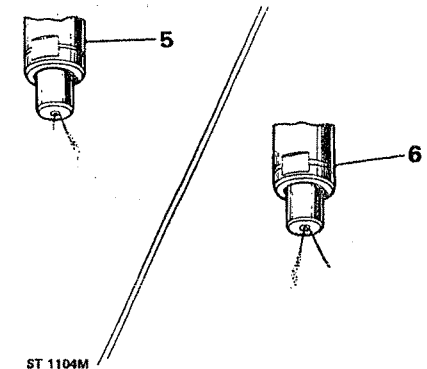
WARNING: Do not allow the fuel spray to contact the person otherwise injury may result from skin penetration.

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.

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.

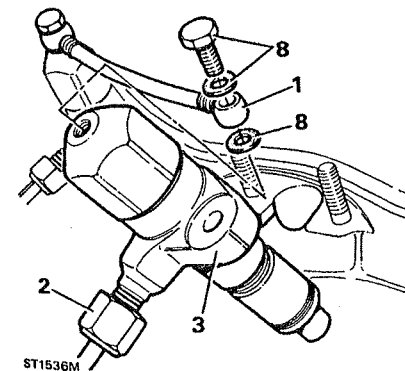


ST 1104M

PRIME FUEL SYSTEM

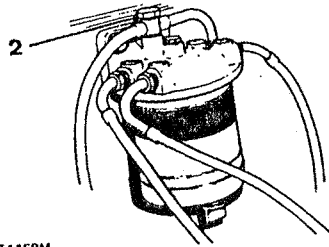
Procedure following fuel filter or sedimentor service

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 may need to be primed as follows:



ST1536M

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.



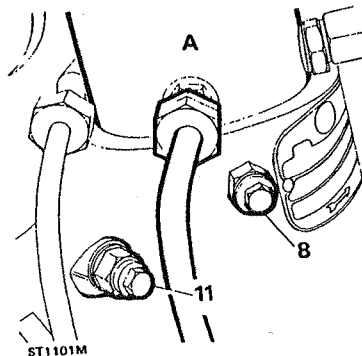
ST 1158M

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.

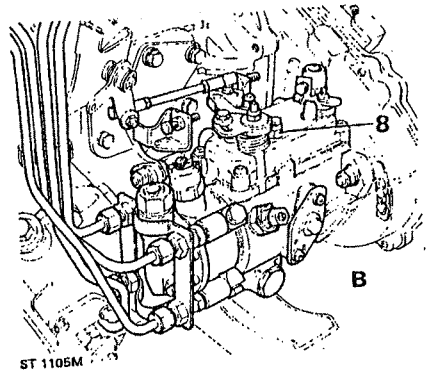
Procedure when fuel system has been drained

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



ST 1101M



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

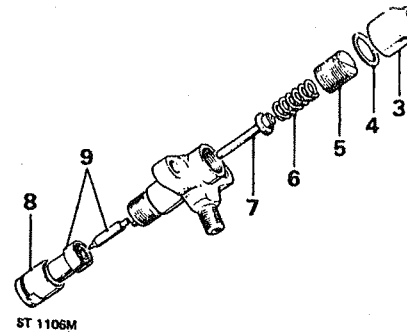
When Diesel engines are operated at high altitude it is recognised that the reduced air density causes a reduction in the weight of air drawn into the engine cylinders, which results in incomplete combustion of the injected fuel at full throttle, unless this is reduced in proportion to the reduction 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 above 990 metres 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, and Bosch Dealer for the Tdi engine.

OVERHAUL FUEL INJECTORS - 2.25 and 2.5 engines only. Tdi injectors not serviceable.

- Service tools:
- RO271483 or 18G109 or Diesel tune III) Injector nozzle testing and setting kit
 - RO278182 or 18G109B or Diesel tune 102) Adaptor Pintaux Injector
 - RO278181 or 18G109E) Injector nozzle flushing tool
 - RO605002 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.

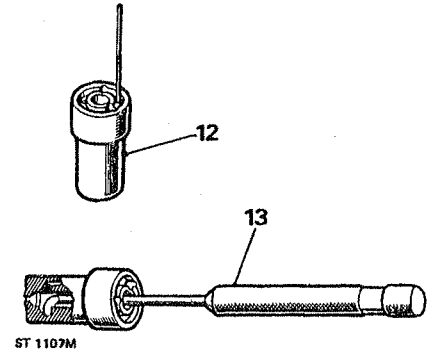


ST 1106M

Cleaning and inspecting

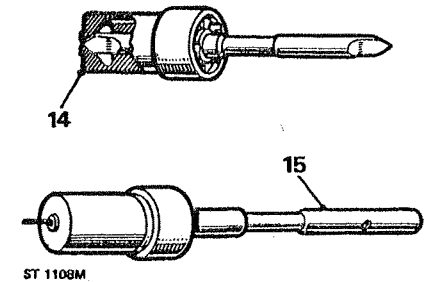
10. Soak the component parts of the assembly in Shell Calibration Fluid to loosen carbon deposits, but do not allow parts of any one assembly to be interchanged with those of another.
11. Brush away all external carbon deposits from component parts with a brass wire brush and return them to the fluid 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 diameter.
13. Remove the carbon from the annular recess with the tool illustrated.



ST 1107M

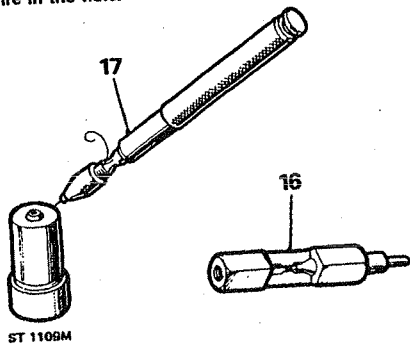
14. Remove the carbon from the valve seat, using the appropriate tool with a rotary motion.
15. Select the appropriate size probe from the pocket of cleaning kit and secure it in the pintle hole cleaner. Insert the probe into the bore of nozzle valve body and allow the end to extend through the main fuel outlet, then turn in a rotary manner to remove carbon.



ST 1108M

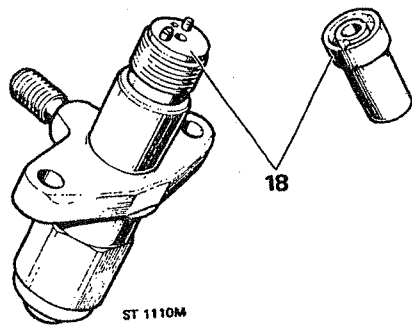
16. Carbon may be removed from the nozzle valve cone by inserting the valve into the tool illustrated and then rotating it alternately in a clockwise then anti-clockwise manner whilst pressing the valve inward. If the nozzle is blued or the seating has a dull circumferential ring indicating pitting or wear, the nozzle body and valve should be returned to a C.A.V. 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 diameter.

NOTE: Allow 1,5 mm 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.



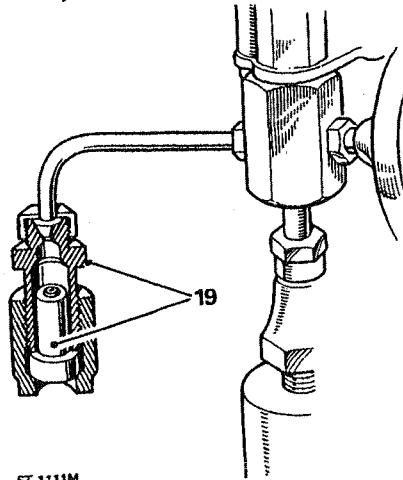
ST 1109M

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 spill 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

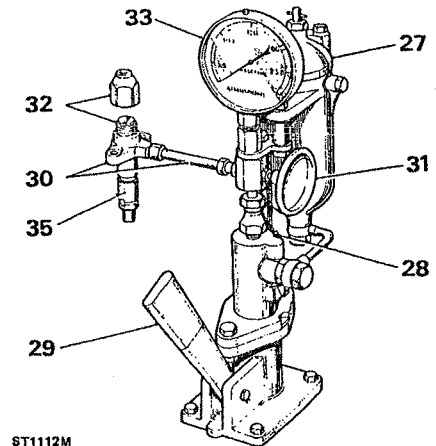
WARNING: The injection nozzle must not be allowed to point towards the operator when spraying and the hands must never be allowed to contact the spray which has a force that can penetrate the flesh.

27. Remove the cap from the setting outfit container and fill with 0,8 litre 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 between the union nuts and of 3 mm 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.



ST1112M

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.

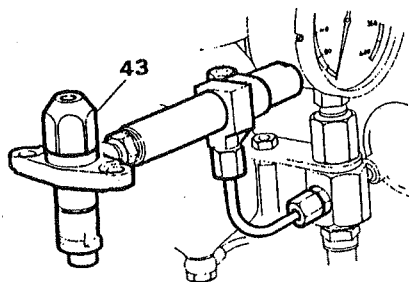
Seat tightness

- 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

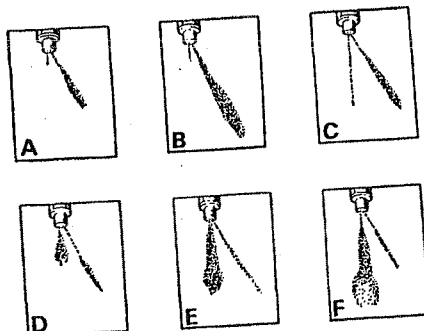
- Fuel delivery to the injection nozzle assembly when testing spray form must be characteristically similar to fuel delivery under normal operating conditions and to effect these conditions an adaptor (C.A.V.Y7044872) must be fitted between the injection nozzle assembly and the pressure pipe.
- The adaptor 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.
- The cap nut is extended, bored and threaded to receive nozzles for testing.
- Connect the adaptor assembly to the pressure pipe.
- Remove the end cap and adjust the opening pressure of the nozzle valve to 220 atmospheres.
- Screw the injection nozzle and holder assembly to be tested, into the adaptor.
- 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.

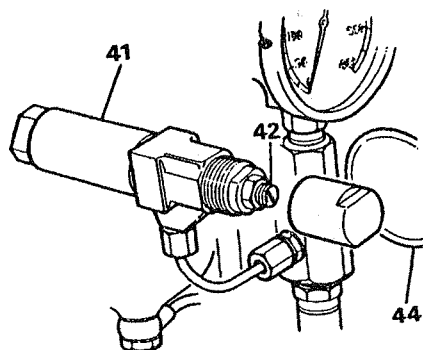


ST1114M

- When satisfactory, fit the combined locknut and end cap, connect the injectors to the fuel spill rail and fit them to the engine.



ST 1115M

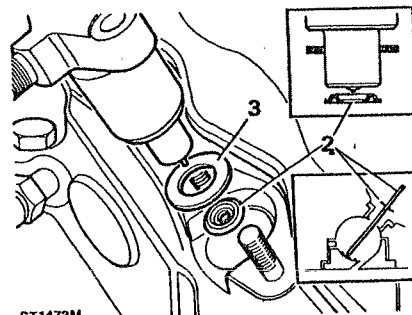


ST1113M

FITTING FUEL INJECTORS - 2.25 and 2.5 engines

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.

- Ensure that the new washers are separated from each other and are clean.
- 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.

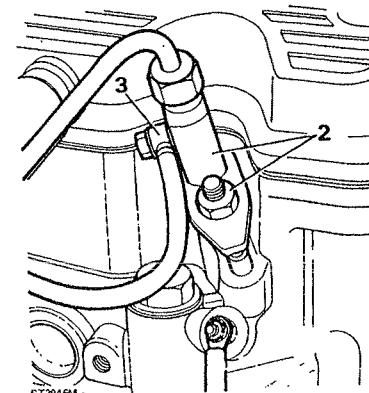


ST1473M

- Lightly grease the copper washer into position on each injector before fitting to the cylinder head.
- Fit the injector and evenly tighten the retaining nuts to the correct torque 6 to 8 Nm. Uneven or overtightening of the injector nuts could distort the nozzle and cause misfiring when normal running temperature is reached.
- Reconnect the injector pipes but do not overtighten the union nuts.

FITTING INJECTORS - Tdi engine

- Ensure that the injector and seating in the cylinder head is clean then lightly grease a new copper washer in position on the injector.
- 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.
- 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.

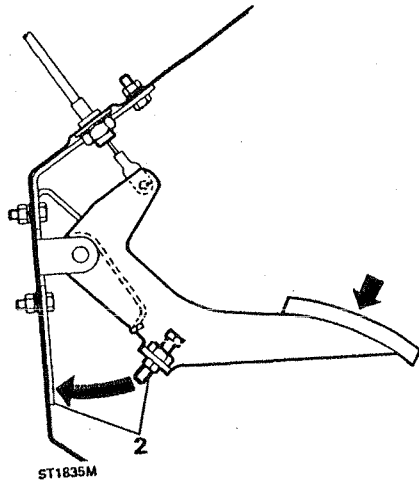


ST2946M

THROTTLE PEDAL ADJUSTMENT

Petrol and Diesel four cylinder engines

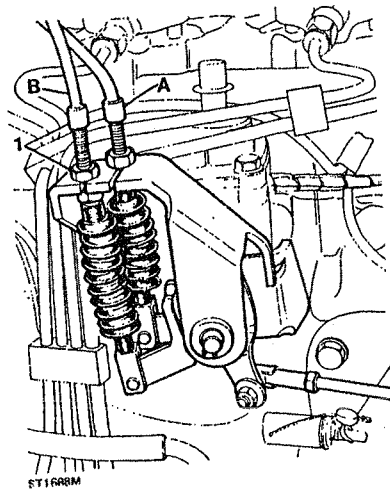
1. After renewing the throttle cable, remove any slack in the cable by adjustment of the cable adjuster at the engine end.
2. Depress the throttle pedal, by hand, to the full extent of the carburettor, DPA or DPS pump linkage, and adjust the pedal stop screw to take up all clearance between the screw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



HAND THROTTLE - where fitted

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.
 - A. Foot pedal cable adjuster
 - B. Hand throttle cable adjuster



FUEL INJECTION PUMP - Tdi engine

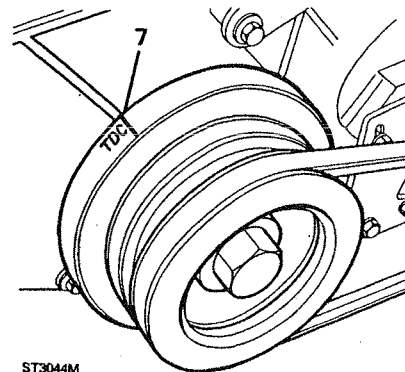
Service Repair No. 19.30.07

Remove and refit

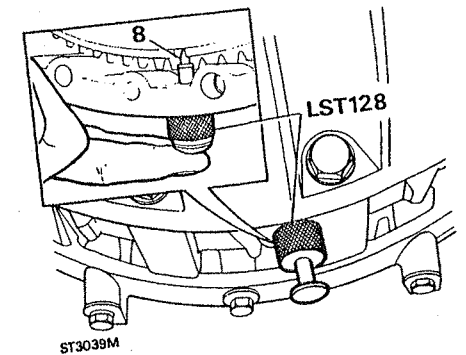
Special tools:-

Flywheel timing pin: LST-128/LRT-128-12-044
 Pump gear retaining tool: LST 129/LRT-12-045

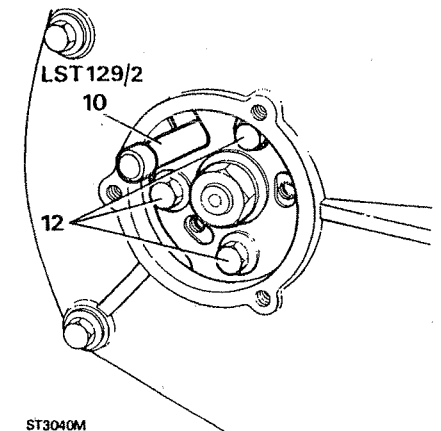
1. Remove the bonnet and disconnect the battery.
2. Drain the cooling system.
3. Remove the fan and viscous coupling assembly see operation 26.25.19.
4. Remove the fan cowl see operation 26.25.11.
5. Disconnect the lower cooling hose from the waterpump.
6. Remove the oil filler cap so that the position 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 web on the front cover plate. At the same time check that the valves of number one cylinder are closed.



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.

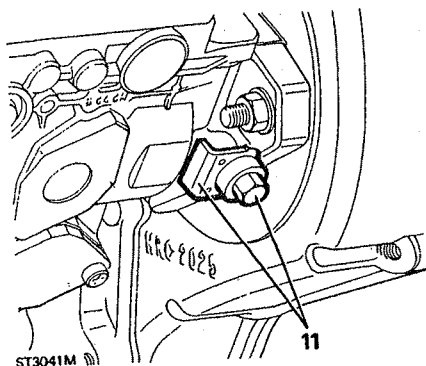


9. Remove the injector pump hub blanking plate.
10. Insert the injector pump timing pin LST 129/2 through the 'U' shaped slot in the pump hub into the pump body. Ensure that the pin fits easily and is fully inserted.

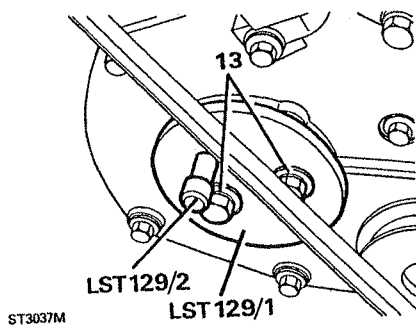


- Slacken the pump locking screw and remove the keeper plate. Tighten the screw to lock the pump.

CAUTION: : Once the timing pin LST 129/2 is inserted and the pump shaft locked, no attempt must be made to rotate the crankshaft.



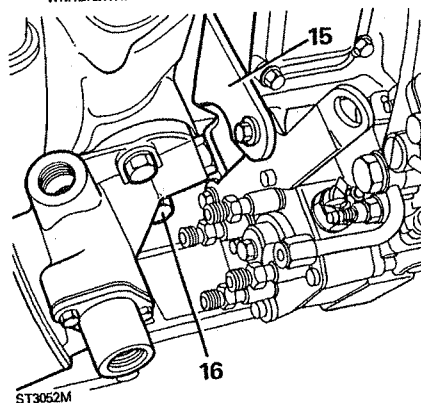
- Remove the pump drive gear three retaining bolts and remove the block plate and timing pin.
- Fit the pump gear retaining tool LST 129/1 and align and tighten the two bolts. Insert the timing pin LST 129/2, again, through the hole provided in the retaining tool.



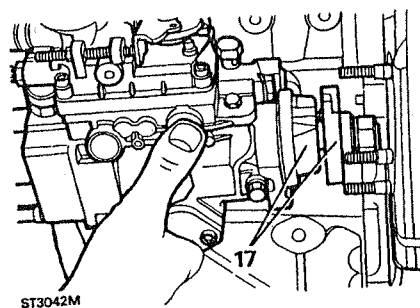
- Remove the injector pipes and disconnect the following items from the injector pump.

Throttle cable.
Stop control solenoid lucar.
Spill return pipe.
Turbo charger boost hose.
Main fuel supply pipe.

- Remove the injector pump rear support bracket.
- Remove the oil filter adaptor rear attachment bolt to allow clearance for the pump to be withdrawn.

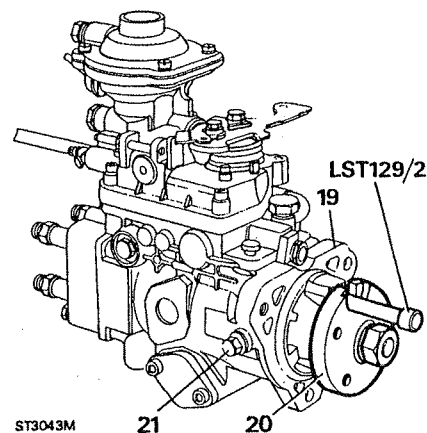


- Remove the pump three retaining nuts and withdraw the pump and gasket, with LST 129/2.
- Fit blanks to the inlet and outlet ports to prevent entry of dirt. Slacken the locking screw, fit the keeper plate and tighten the screw.



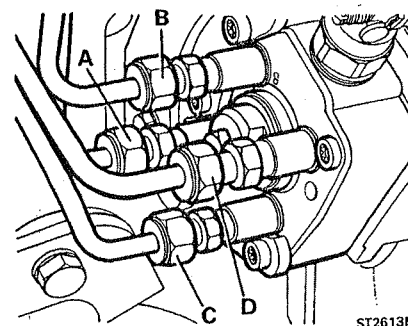
Refitting

- Clean the pump flange and front cover mating face and place a new gasket in position over the studs.
- Fit the timing pin LST 129/2 to the pump, if necessary, rotate the pump to enable the pin to fit easily and fully.
- Slacken the pump locking screw, remove the keeper plate and tighten the screw to lock the pump.



- Fit the pump to the front cover and drive gear and secure with the three nuts tightening evenly to the correct torque.
- Fit the rear support bracket to the cylinder block and secure the pump to the bracket. Tighten all bolts to the correct torque.
- Fit the oil filter adaptor rear attachment bolt.
- Connect the items listed in instruction 14.
- Fit the injector supply pipes securing each end to their respective locations, loosely then tighten evenly but do not overtighten. Commencing at 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.

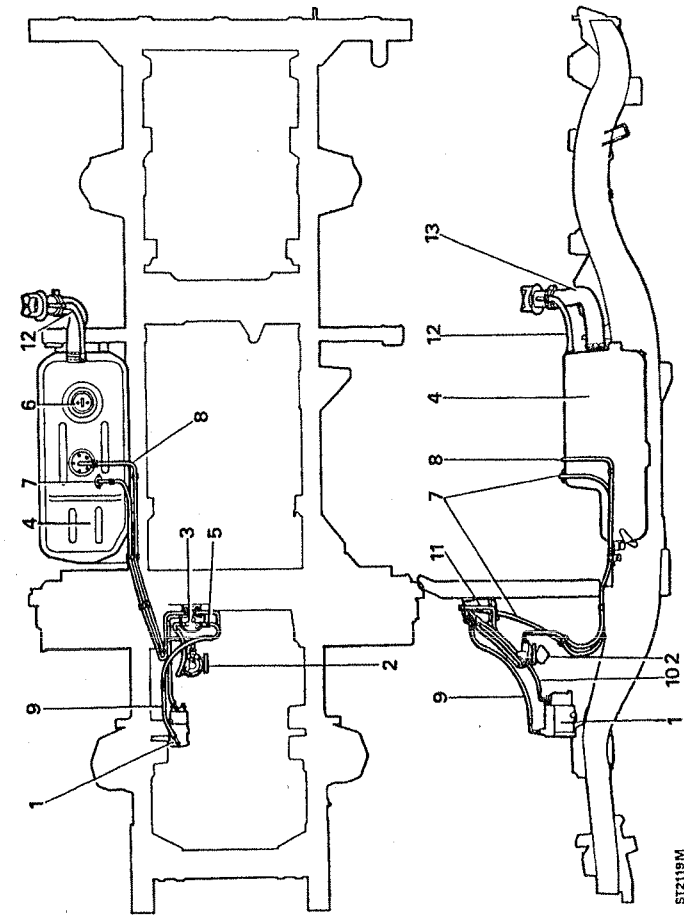


- Remove the pump timing pin and the pump gear retaining tool LST 129/1.
- Insert the pump timing pin again and fit the gear lock plate and secure with the three bolts and tighten to the correct torque.
- Remove the timing pin. Unlock the pump, fit the keeper plate and tighten the bolt.
- To check that 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.
- If, with the flywheel timing pin located, the timing pin cannot be inserted cleanly into the pump, carry out the following instructions:-
 - Turn the crankshaft the small amount necessary to enable the timing pin to be inserted into the pump.
 - Remove the keeper plate and lock the pump.
 - Slacken the three pump gear retaining bolts.
 - Turn the crankshaft to T.D.C.
 - Check that the timing pin is an easy fit in the pump and that the flywheel timing pin locates.
 - Tighten the pump gear retaining bolts to the correct torque.
 - Unlock the pump, fit the keeper plate and tighten the bolt. Remove the timing pin from the pump and the timing pin tool from the flywheel.
- Fit the pump aperture cover with a new gasket and secure with the screws.
- Connect the cooling system bottom hose to the water pump.
- Place the fan cowl in position but do not secure it to the radiator until the fan and coupling is fitted.
- 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.
- Secure the fan cowl to the radiator with the two nuts.
- Fit the top coolant hose.
- Refill the cooling system with the correct concentration of water and anti-freeze see operation 26.10.01.

19 FUEL SYSTEM - Diesel

'90' 2.5 BASIC FUEL SYSTEM WITHOUT SEDIMENTOR

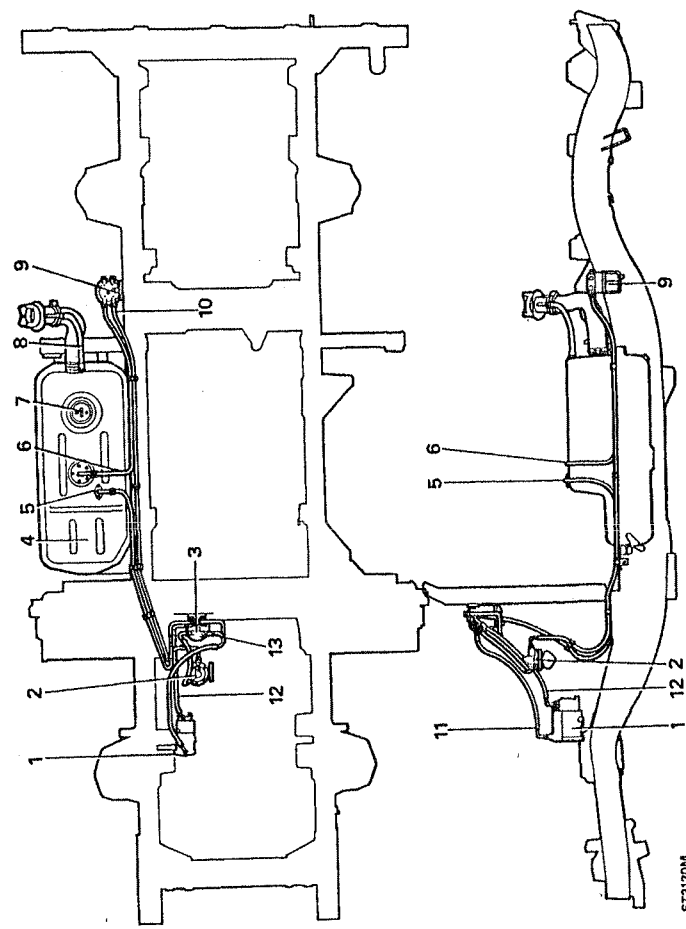
1. Fuel injection D.P.S. pump
2. Fuel lift pump
3. Fuel filter
4. Fuel tank
5. Non-return valve
6. Fuel gauge tank unit
7. Spill return, filter to tank
8. Pipe, tank to fuel tank
9. Spill return, D.P.S. pump to filter
10. Supply pipe, filter to D.P.S. pump
11. Spill return, spill rail to filter
12. Breather hose
13. Filler hose


'90' 2.5 BASIC FUEL SYSTEM WITHOUT SEDIMENTOR

ST2119M

'90' BASIC 2.5 DIESEL FUEL SYSTEM WITH SEDIMENTOR

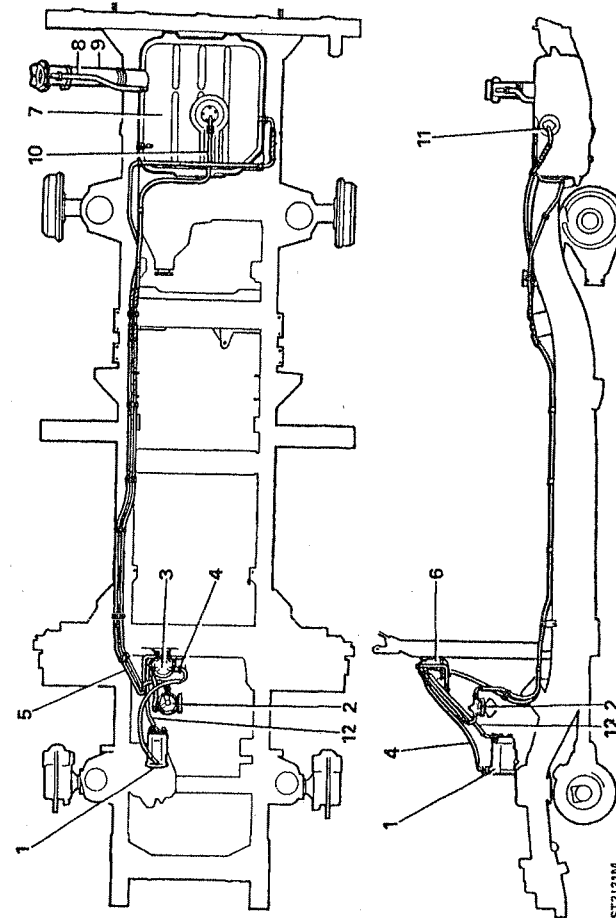
1. Fuel injection D.P.S. pump
2. Fuel lift pump
3. Fuel filter
4. Fuel tank
5. Spill return pipe, tank to filter
6. Pipe, tank to sedimentor
7. Fuel gauge tank unit
8. Breather pipe
9. Sedimentor
10. Pipe, lift pump to sedimentor
11. Spill return, D.P.S. pump to filter
12. Fuel feed pipe, filter to D.P.S. pump
13. Non-return valve
14. Pipe, spill return, spill rail to filter
15. Filler hose.



'90' BASIC SYSTEM WITH SEDIMENTOR

'110' BASIC 2.5 DIESEL FUEL SYSTEM

1. Fuel injection D.P.S. pump
2. Fuel lift pump
3. Fuel filter
4. Spill return pipe, D.P.S. pump to filter
5. Fuel supply pipe, tank to lift pump
6. Pipe, spill return spill rail to filter
7. Fuel tank
8. Breather pipe
9. Filler pipe
10. Spill return pipe filter to tank
11. Fuel gauge tank unit
12. Pipe, fuel supply filter to D.P.S. pump

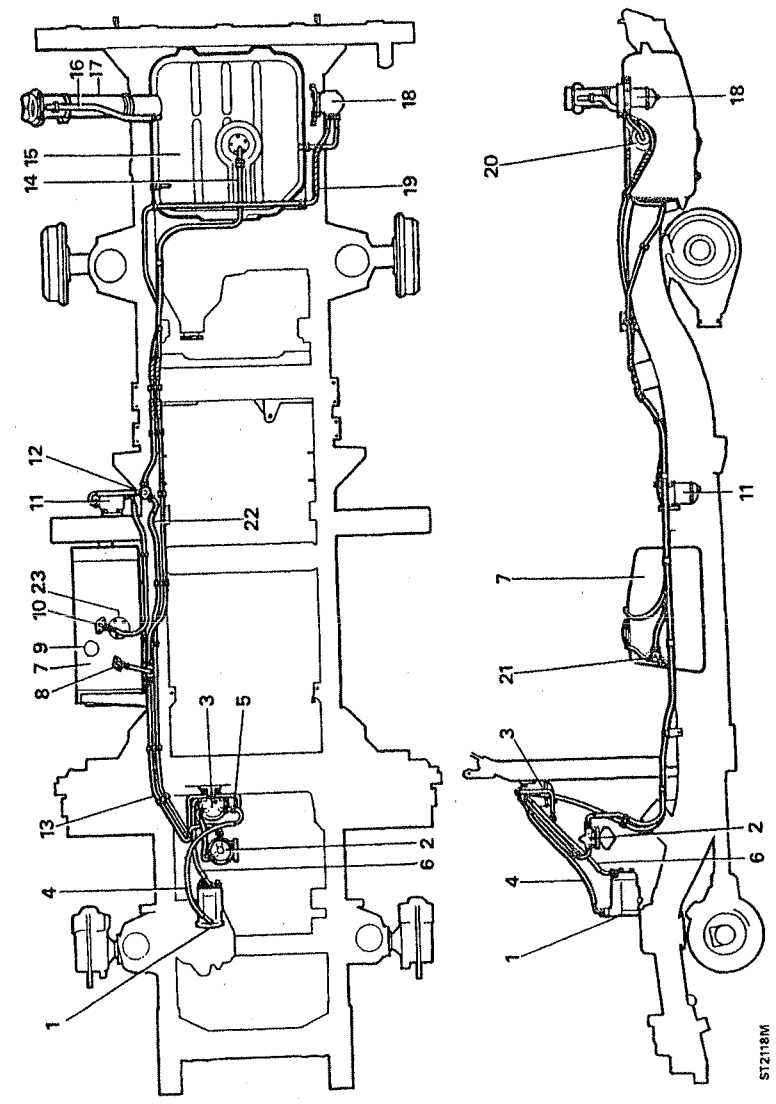


'110' BASIC SYSTEM

ST2121M

'110' 2.5 DIESEL TWIN TANK FUEL SYSTEM

1. Fuel injection D.P.S. pump
2. Fuel lift pump
3. Fuel filter
4. Spill return pipe, D.P.S. pump to filter
5. Non-return valve
6. Fuel supply pipe, filter to D.P.S. pump
7. Side fuel tank
8. Spill return pipe, filter to tank
9. Fuel filler cap
10. Fuel supply pipe to front sedimentor
11. Front sedimentor
12. Fuel cut-off tap
13. Spill return pipe, filter to cut-off tap
14. Spill pipe, cut-off tap to tank- 15. Rear fuel tank
- 16. Breather hose
- 17. Fuel filler hose
- 18. Rear sedimentor
- 19. Sedimentor to cut-off tap
- 20. Fuel gauge unit
- 21. Fuel change over tap
- 22. Pipe, fuel lift pump to cut-off tap
- 23. Gauge unit

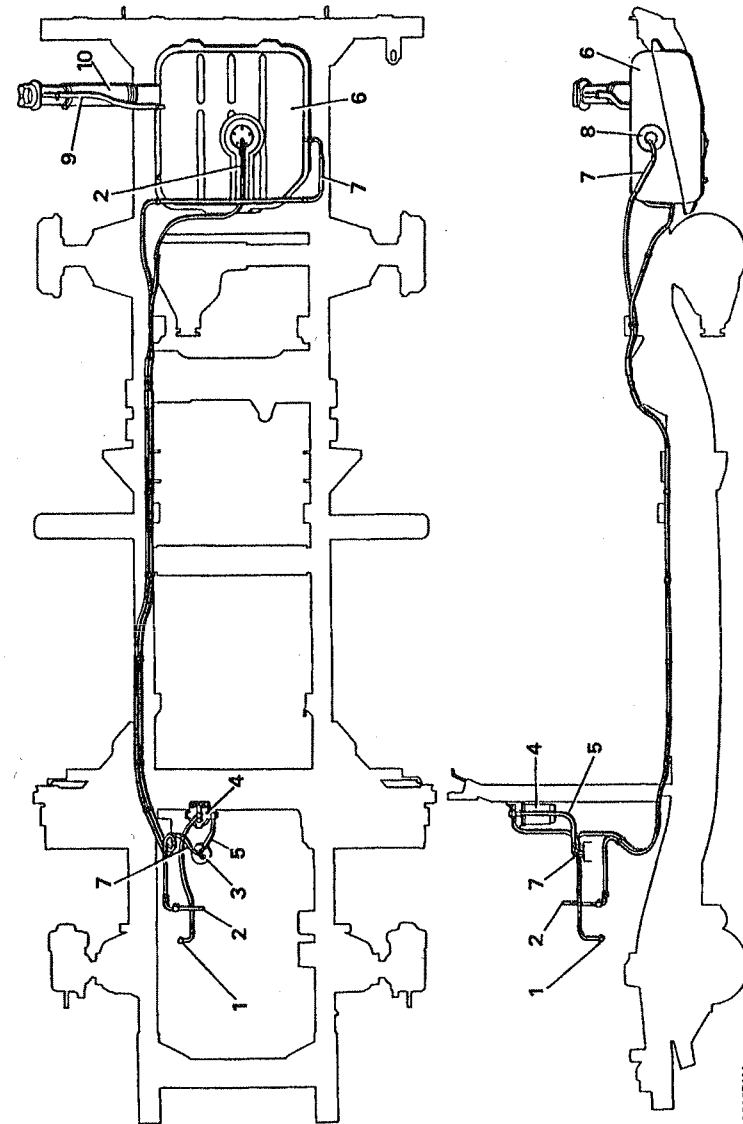


'110' 2.5 DIESEL TWIN TANK SYSTEM

ST2118M

Tdi DEFENDER '110' BASIC FUEL SYSTEM

1. Pipe, filter to injector pump
2. Spill return pipe, injection pump to tank
3. Fuel lift pump
4. Fuel filter
5. Pipe, lift pump to filter
6. Fuel tank
7. Pipe, fuel supply to lift pump
8. Fuel gauge unit
9. Breather pipe
10. Fuel filler hose.



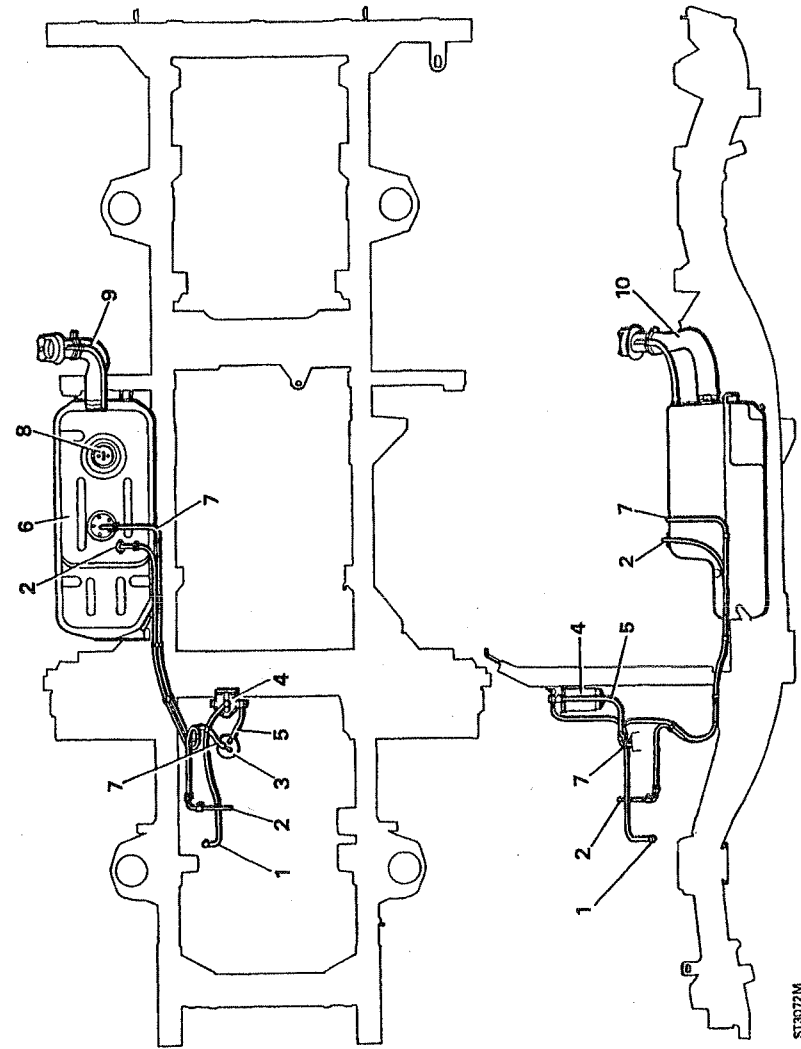
'110' BASIC SYSTEM Tdi DEFENDER

ST3071M

19 FUEL SYSTEM - Diesel

Tdi DEFENDER '90' BASIC FUEL SYSTEM

1. Pipe, filter to injection pump
2. Spill return pipe, injection pump to tank
3. Fuel lift pump
4. Fuel filter
5. Pipe, lift pump to filter
6. Fuel tank
7. Pipe, fuel supply, tank to lift pump
8. Fuel gauge unit
9. Breather pipe
10. Filter hose



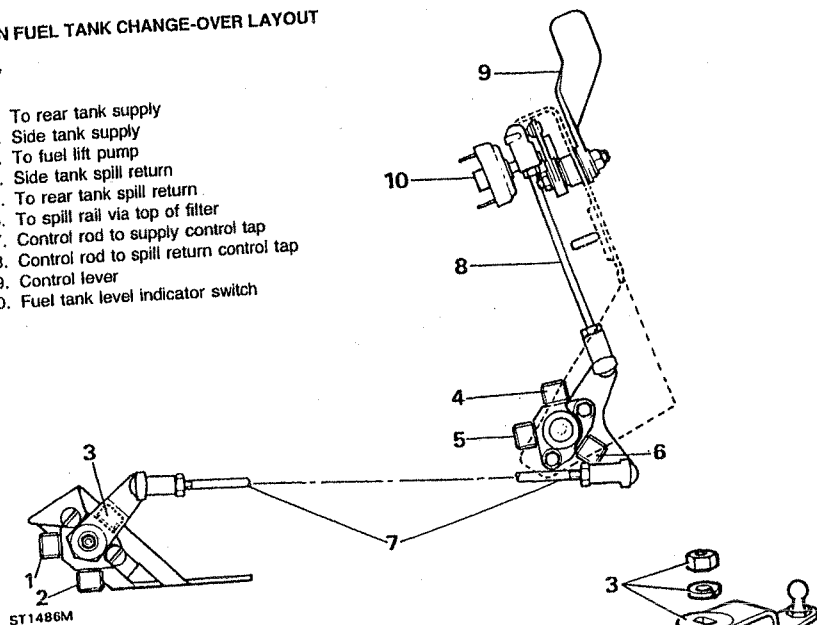
'90' BASIC SYSTEM Tdi DEFENDER

ST3072M

TWIN FUEL TANK CHANGE-OVER LAYOUT

KEY

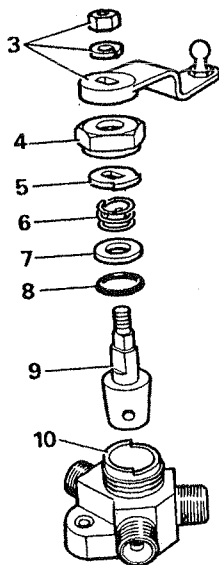
1. To rear tank supply
2. Side tank supply
3. To fuel lift pump
4. Side tank spill return
5. To rear tank spill return
6. To spill rail via top of filter
7. Control rod to supply control tap
8. Control rod to spill return control tap
9. Control lever
10. Fuel tank level indicator switch



OVERHAUL FUEL CHANGE-OVER TAP

Before removing the tap from the vehicle mark the relationship of each pipe union to the tap body to facilitate reassembly.

1. Remove the tap from the vehicle and cover the exposed pipe ends to prevent ingress of dirt.
2. Mark the relationship of the lever to the tap body.
3. Remove the lever retaining nut and washer and lift-off the lever and mark the spindle in relation to the body.
4. Remove the gland nut.
5. Remove the tap stop washer.
6. Remove the spring.
7. Remove the plain washer.
8. Remove the 'O' ring.
9. Lift-out the tap.
10. Clean and examine the body and components.
11. Using a new 'O' ring assemble the components in the reverse order of dismantling.
12. Ensure that the tap stop washer locates properly before fitting and tightening the gland nut.



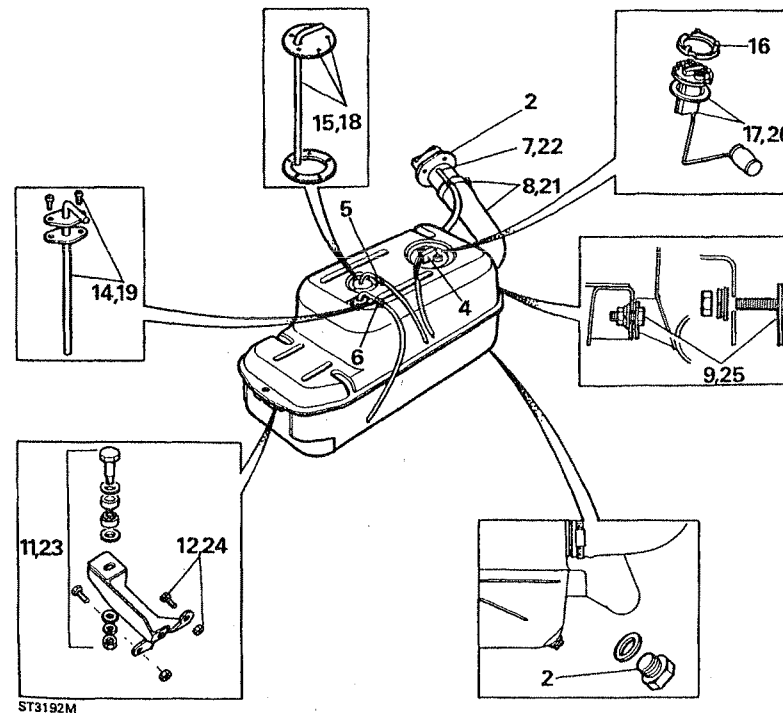
SIDE MOUNTED FUEL TANK - 90 DIESEL

Remove and refit

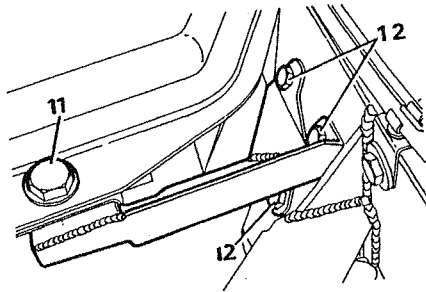
WARNING: Before any attempt is made to proceed with the following instructions, it is vital that the FUEL HANDLING PRECAUTIONS contained in SECTION 01 of this workshop manual are carefully studied and implemented in the interests of safety.

1. Disconnect the battery.
2. Remove the fuel filler cap and working from beneath the vehicle, remove the fuel tank drain plug and allow the fuel to drain in accordance with the above mentioned precautions and refit and tighten the plug.

3. Remove the right hand seat cushion and lift the seat base cover to reveal the fuel tank.
4. Disconnect the plug from the fuel gauge unit.
5. Separate the union connecting the fuel pick-up pipe to the fuel lift pump pipe.
6. Similarly, disconnect the spill return pipe to the tank connection.
7. Disconnect the breather pipe from the fuel filler tube.
8. Release the hose clip and remove the filler hose from the filler tube.
9. From the rear of the tank, remove the two nuts and washers securing the tank mounting captive-headed bolts.



10. Support the rear of the tank and remove the captive bolts.
11. Remove the single bolt fixing assembly securing the tank front mounting to the chassis mounted bracket.
12. Remove the three nuts and bolts securing the tank mounting bracket to the chassis and withdraw the bracket.



ST3196M

13. Lower the front of the tank whilst turning it anti-clockwise and remove it from the vehicle.
14. If necessary, remove the two screws and withdraw the spill return pipe from the tank.
15. Similarly, if required, remove the fuel pick-up pipe by removing the five screws.
16. To remove the fuel gauge unit, turn the locking ring anti-clockwise and remove.
17. Lift-out the gauge unit and sealing ring.

Fitting

Fitting the fuel tank is mainly a reversal of the removal sequence.

18. If removed, refit the fuel pick-up pipe to the tank using a new sealing washer and tighten the five nuts retaining evenly.
19. Also fit the spill return with a new joint washer and evenly tighten the two screws.

20. Using a new sealing ring, fit the gauge unit so that the lugs line-up with the cut-outs in the tank aperture. Fit the locking ring and turn clockwise to lock.
21. Fit the filler hose and clip to the tank but do not fully tighten. Ensure that the screw of the clip is positioned so that it is accessible when the tank is fitted.
22. Fit the breather hose and secure with the clip.
23. Fit the tank into position in the vehicle and loosely secure the mounting bracket to the front of the tank with the special bolt and rubber bushes in the sequence illustrated.
24. Secure the mounting bracket to the chassis with the three bolts and washers and tighten.
25. Secure the rear of the tank with the two captive bolt plates, plain and spring washers and tighten.
26. Finally, tighten the tank front bolt assembly.
27. Connect the spill return and fuel pickup pipes and tighten the union nuts.
28. Connect the electrical plug to the gauge unit.
29. Fit the filler hose to the filler tube and tighten the clip. Also finally tighten the lower clip.
30. Check that the drain plug is tight, fill the tank with fuel, connect the battery and start the engine. Check for fuel leaks and that the gauge operates.
31. Fit the seat base cover and cushion.

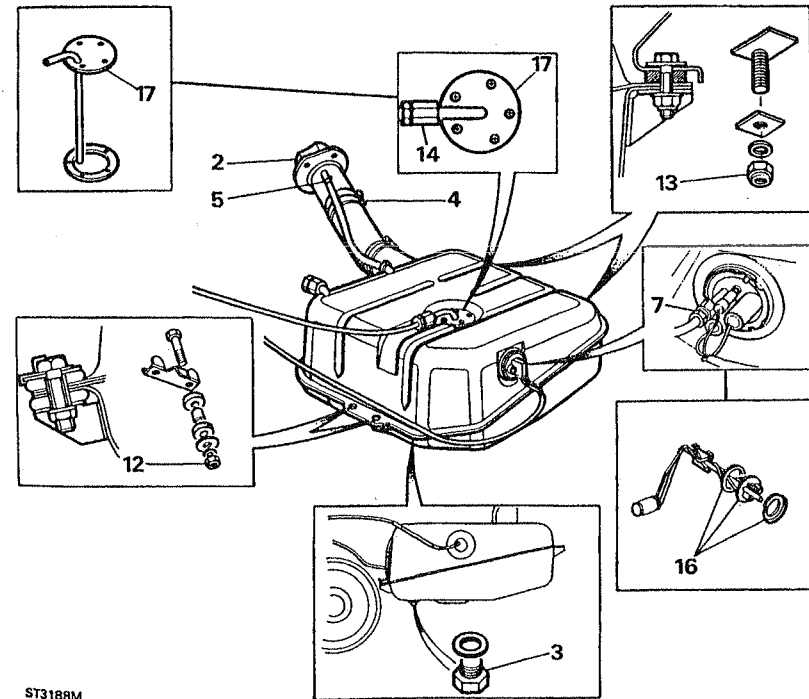
REAR MOUNTED FUEL TANK - 110 DIESEL

Remove and refit

WARNING: Before any attempt is made to proceed with the following instructions, it is vital that the **FUEL HANDLING PRECAUTIONS** contained in SECTION 01 of this workshop manual are carefully studied and implemented in the interests of safety.

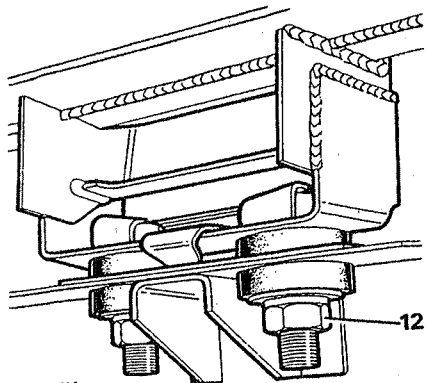
NOTE: Since there are many variants of the fuel system it is not possible to describe in detail all the permutations. Therefore the following instructions cover only the basic system. However, the method of mounting the tank in the chassis is the same for all variants.

1. Disconnect the battery.
2. Remove the fuel filler cap.
3. Remove the drain plug and allow the fuel to drain in accordance with the above mentioned precautions. Refit and tighten the plug.
4. Disconnect the fuel filler hose from the tank.
5. Disconnect the breather hose from the filler tube.
6. From the left-hand side of the tank disconnect the electrical plug from the fuel gauge unit.
7. Also disconnect the fuel supply pipe from the gauge unit.
8. If the vehicle is fitted with a tow ball drop-plate with support bars, the bars must be removed.
9. Remove the eight nuts and bolts securing the anti-roll bar and push the roll bar down to provide access to the tank.



ST3188M

10. Also, remove the left-hand lashing eye to assist access to the tank.
11. Place a support under the tank preferably one that can be progressively lowered.
12. Remove the two nuts that secure the front mounting assembly of the tank.



ST3194M

13. Remove the tank rear mounting nuts.
14. With care, lower the tank sufficiently to enable the nut and olive of the spill return to be disconnected from the elbow in the centre of the tank.
15. Continue to lower the tank until it can be removed from the vehicle.
16. If required, remove the tank gauge unit by turning the locking ring anti-clockwise and withdraw the unit and sealing washer.
17. Also, if necessary, remove the five screws and withdraw the spill return pipe.

Refitting

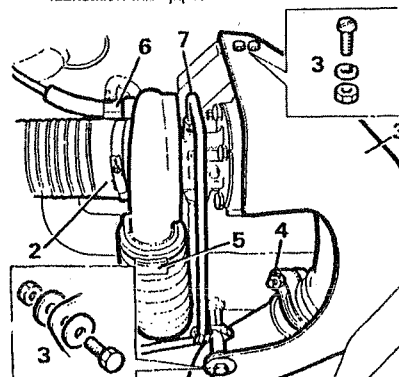
18. If removed, fit the spill return pipe using a new sealing washer.
19. Fit the gauge unit with a new sealing washer. Insert the unit into the tank and line-up the lugs with the cut-outs in the aperture. Fit the locking ring and turn it to lock.

20. Raise the tank into position until it is possible to connect the spill return pipe to the elbow with the nut and olive.
21. Continue to raise the tank so that the front and rear mounting bolts locate in the respective holes.
22. Fit and tighten the nuts to the correct torque.
23. Connect the fuel supply pipe to the tank unit.
24. Secure the fuel filler hose to the filler tube also the breather hose.
25. Reverse instructions 8 to 10. Fill the tank, connect the battery, run the engine, check for leaks and operation of the fuel gauge.

TURBO-CHARGER - Garrett T2 2.25 engine

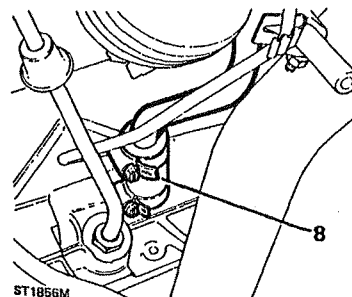
Removing

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.



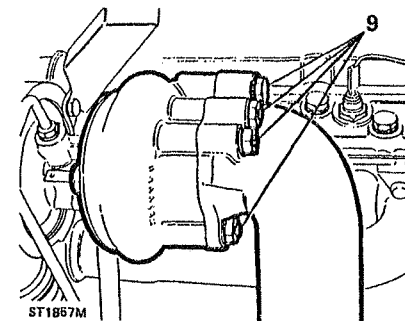
ST1855M

8. Disconnect, at the flexible hose, the lubrication drain pipe from the turbo-charger.



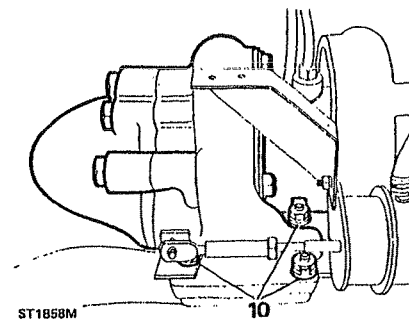
ST1856M

9. Remove the five nuts to release the exhaust elbow and gasket from the turbo-charger.



ST1857M

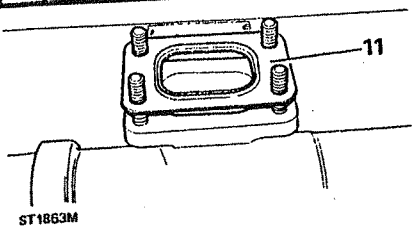
10. Release the lock tabs and remove the four nuts securing the turbo-charger to the exhaust manifold and remove the turbo-charger and gasket.



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.



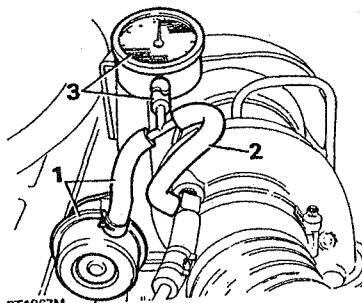
ST1863M

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

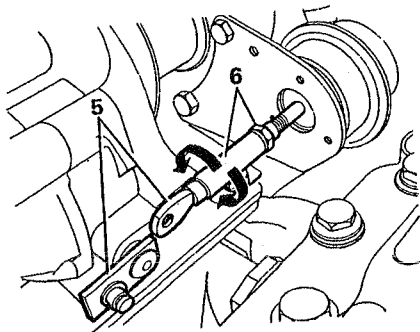
Maximum boost pressure - 50 cmHg
 Minimum boost pressure - 44 cmHg

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 rev/min. Under these circumstances, the boost pressure should be between 44-50 cmHg. 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.



ST1893M

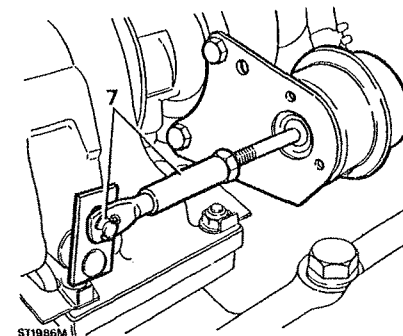
8. Reconnect the actuator rod to the waste gate lever, secure with the clip and tighten the locknut.
9. Road test the vehicle again and if necessary repeat instructions 5 to 8.
10. Disconnect the test equipment and reconnect the hoses.
11. If the correct boost pressure range is not attained after several 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 21-26 Nm.

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 - Garrett T2.25 Diesel

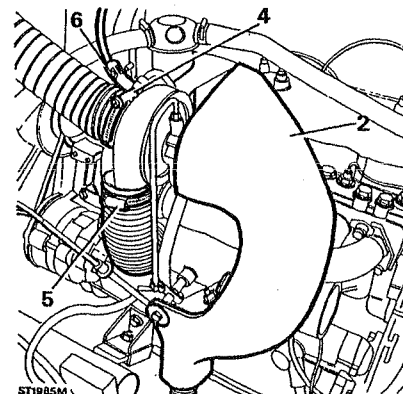
Removing

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.

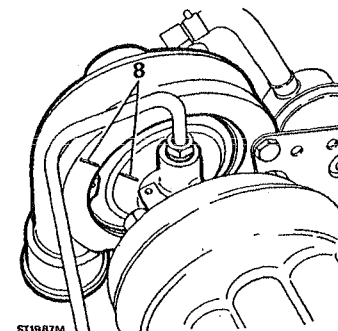


ST1865M

8. Mark the position of the compressor housing in relation to the centre housing with a scribe line to assist reassembly.



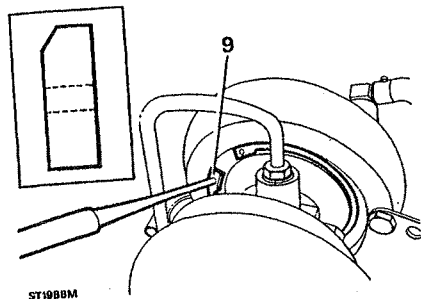
ST1865M



ST1987M

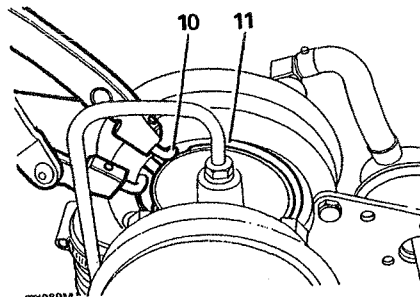
9. The circlip retaining the compressor housing to the centre housing is tapered, in cross section, on one side. It is necessary to 'break' the taper to enable the circlip to be removed in the usual manner. Using a flat nosed punch, carefully tap each ear of the circlip away from the groove in the compressor housing.

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 62 cm Hg is applied to the actuator.



ST1988M

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.

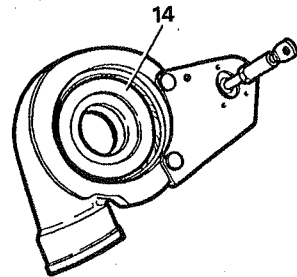


ST1989M

12. Withdraw the compressor housing complete with the actuator. To avoid damaging the compressor wheel withdraw the housing squarely without tilting the housing.

Cleaning

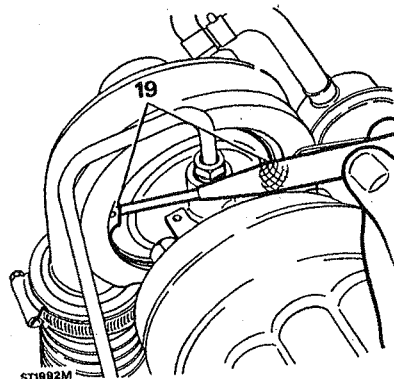
13. Remove the 'O' ring seal from the back plate.
14. Clean the internal surfaces of the compressor housing, the compressor wheel and back plate with a soft brush and a noncaustic solvent. Do not use compressed air to dry the compressor wheel and back plate.
15. Clean the circlip, remove burrs, and repair any damage caused during removal.



ST1991M

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.



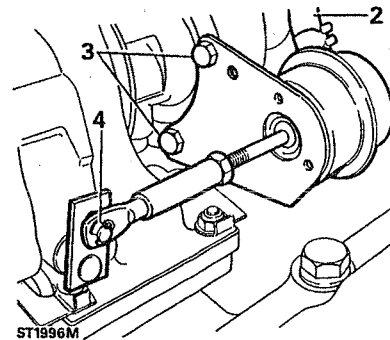
ST1992M

20. Connect the actuator rod to the wastegate lever and secure with the clip.

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

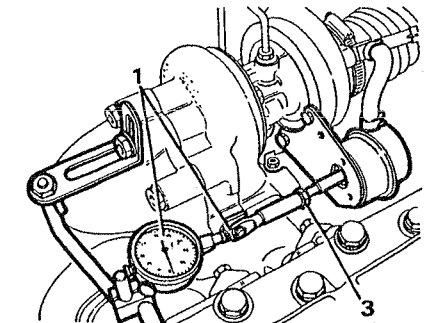
5. Fit the replacement actuator with the two bolts and single nut and bolt. Tighten the bolts to 12.5 to 14.0 Nm
6. Push the wastegate lever as far as possible towards the actuator and apply pressure to keep the lever in this position.
7. Pressurise the actuator to 57 to 62 cm Hg and hold this pressure.

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. At this point the pressure should be 57 to 62 cm Hg.
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

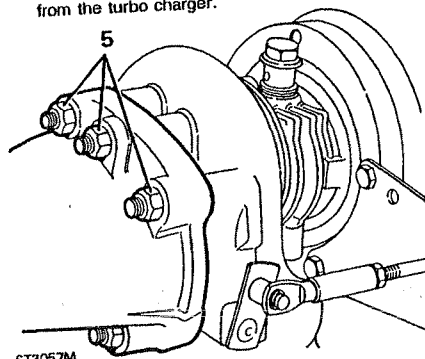
5. Fit the heat shield.
6. Check the boost pressure on the road as previously described.

TURBO CHARGER - Garrett T25 Tdi engine

Service Repair No. 19.42.01

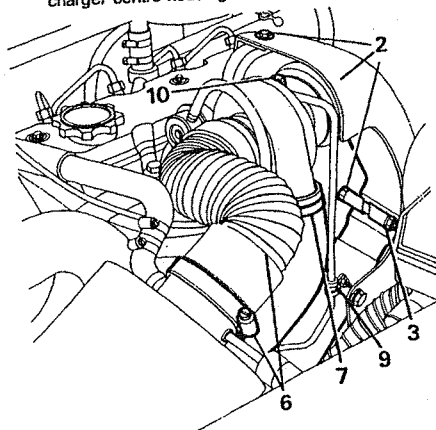
Remove and refit

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.



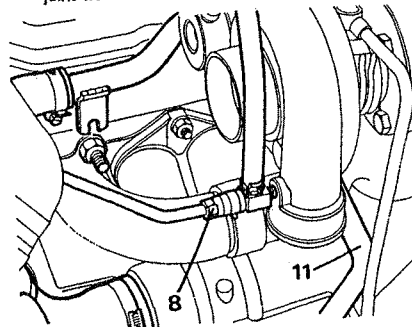
ST3057M

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.



ST3059M
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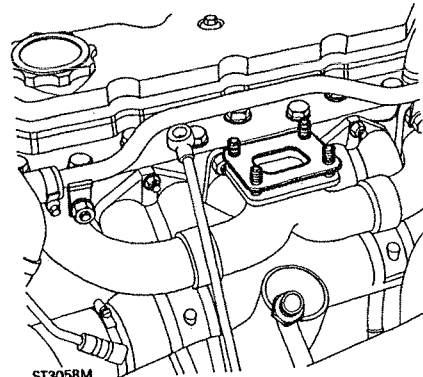
11. Release the oil return drain pipe from the turbo charger.
12. Remove the four nuts and lift the turbo charger from the exhaust manifold and retrieve the steel joint washer.



ST3060M

Refitting

13. Fit the steel joint washer 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 charger.
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.

TURBO-CHARGER FAULT DIAGNOSIS

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 beyond that which is necessary to clean the compressor housing.

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.
4. Tighten loose bolts as required.
5. 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.
6. Check the oil line connections at the centre housing oil inlet and outlet ports for leakage.
7. Tighten loose connections as required. Start engine and recheck connections.
8. Use the following fault diagnosis chart if the trouble cannot be traced. Note that where reference is made to 'excessive oil consumption' this means engine lubricating oil not fuel oil.

TURBO CHARGER FAULT DIAGNOSIS

FAULT	POSSIBLE CAUSE	CURE
1. Engine lacks power 2. Black exhaust smoke 3. Excessive oil consumption 4. Blue exhaust smoke 5. Oil leak from turbo	Clogged air filter element	Renew element
1. Black exhaust smoke 2. Excessive oil consumption 3. Blue exhaust smoke 4. Turbo charger noisy 5. Cyclic sound from turbo 6. Oil leak from compressor seal	Obstructed air intake passage to turbo charger compressor housing	Remove obstruction or renew damaged parts as required
1. Engine lacks power 2. Black exhaust smoke 3. Turbo charger noisy	Obstructed air outlet PasSage from compressor to intake manifold	Remove obstruction or renew damaged parts as required
1. Engine lacks power 2. Black exhaust smoke 3. Turbo charger noisy	Obstruction in intake manifold	Locate and take necessary action to remove obstruction
1. Turbo charger noisy	Air leak in passage from air cleaner to compressor	Correct leak by renewing seals or tightening fixing as required
1. Engine lacks power 2. Black exhaust smoke 3. Excessive oil consumption 4. Blue exhaust smoke 5. Turbo charger noisy	Air leak in passage from compressor housing to intake manifold	Correct leak by renewing seals or tightening fixing as required
1. Engine lacks power 2. Black exhaust smoke 3. Excessive oil consumption 4. Blue exhaust smoke 5. Turbo charger noisy	Air leak in passage from compressor to intake manifold	Correct leak by renewing seals or tightening fixings as required
1. Engine lacks power 2. Black exhaust smoke 3. Excessive oil consumption 4. Blue exhaust smoke 5. Turbo charger noisy	Air leak at intake manifold joint with cylinder head	Renew manifold gasket and tighten fixings to correct torque
1. Engine lacks power 2. Black exhaust smoke 3. Excessive oil consumption 4. Blue exhaust smoke 5. Turbo charger noisy	Obstruction in exhaust manifold	Remove exhaust manifold and obstruction and renew gasket and tighten fixing to correct torque
1. Engine lacks power 2. Black exhaust smoke 3. Oil leak from compressor seal	Obstruction in silencer or exhaust system	Locate and remove obstruction and renew faulty parts as required
1. Engine lacks power 2. Black exhaust smoke 3. Turbo charger noisy 4. Oil leak from compressor seal	Gas leak at joint between exhaust manifold and cylinder head	Renew exhaust manifold gasket and Tighten fixings to correct torque
1. Engine lacks power 2. Black exhaust smoke 3. Turbo charger noisy 4. Oil leak from compressor seal	Gas leak at turbo inlet to exhaust manifold joint	Tighten fixings to correct torque, or if necessary renew steel gasket.

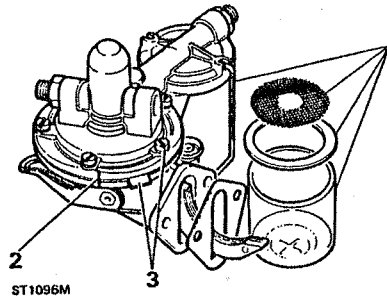
FAULT	POSSIBLE CAUSE	CURE
1. Turbo charger noisy	Gas leak in passage at or beyond turbo outlet	Locate and repair leak
1. Excessive oil consumption 2. Blue exhaust smoke 3. Oil leak from compressor seal 4. Oil leak turbo charger	Obstruction in turbo charger oil drain pipe	Remove obstruction and renew pipe if necessary
1. Excessive oil consumption 2. Blue exhaust smoke 3. Oil leak from compressor seal 4. Oil leak from turbo charger	Engine breathing vent in crankcase obstructed	Locate and clear obstruction
1. Excessive oil consumption 2. Blue exhaust smoke 3. Oil leak from compressor seal 4. Oil leak from turbo charger	Turbo charger centre housing choked with oil sludge and carbon	Change engine oil and filter. Renew turbo charger or overhaul by manufacturer
1. Engine lacks power 2. Black exhaust smoke	Fuel injection pump or injectors faulty or incorrectly adjusted	Adjust injector pump where permitted. Test and if necessary renew injectors
1. Engine lacks power 2. Black exhaust smoke	Engine camshaft timing incorrect	Re-time engine and if necessary renew worn parts
1. Engine lacks power 2. Black exhaust smoke 3. Excessive oil consumption 4. Blue exhaust smoke 5. Oil leak from compressor seal 6. Oil leak from turbo charger	Worn engine piston rings or cylinder bores	Overhaul engine
1. Engine lacks powers 2. Black exhaust smoke 3. Excessive oil consumption 4. Blue exhaust smoke 5. Oil leak from compressor seal 6. Oil leak from turbo charger	Engine internal problem such as faulty valves and/or pistons	Remove and if necessary overhaul cylinder head and check cylinder bores and pistons. Overhaul if required
1. Engine lacks power 2. Black exhaust smoke 3. Excessive oil consumption 4. Blue exhaust smoke 5. Turbo charger noisy 6. Cyclic sound from turbo 7. Oil leak from compressor seal 8. Oil leak from turbo charger	Compressor housing choked with dirt	Clean compressor housing. Locate source of unfiltered air. Change engine oil and filter
1. Engine lacks power 2. Black exhaust smoke 3. Excessive oil consumption 4. Blue exhaust smoke 5. Turbo charger noisy 6. Oil leak from compressor seal 7. Oil leak from turbo charger	Turbo charger damaged internally	Remove and examine Turbo charger and determine cause of failure. Renew Turbo charger or overhaul by manufacturers

Notes

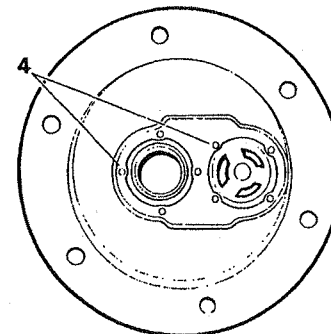
OVERHAUL MECHANICAL FUEL LIFT PUMP

DISMANTLE

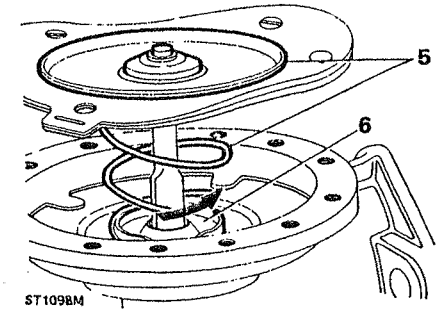
1. Remove the sediment bowl, where fitted, and collect the filter gauze and sealing washer.
2. Mark the upper and lower halves of pump casing to ensure correct alignment on reassembly.
3. Remove top cover fixing screws, and while pressing diaphragm tab against pump body, lift top cover clear.



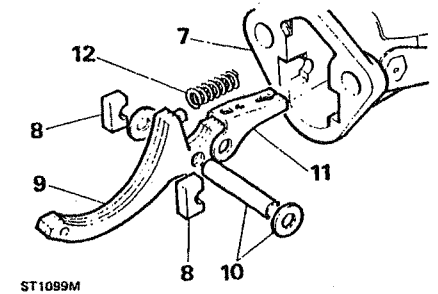
4. If necessary remove the valves by cutting away the retaining stakes with a scraper. Warm the top cover, note the position of the valves and withdraw them from the cover.



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.



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.



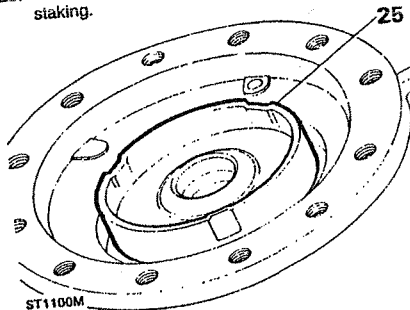
13. It is unlikely that the hand priming mechanism will ever require replacement, but it can be removed by filing the hexagon each side of the operating lever and springing the hand lever clear, withdraw the cork washers and hand rocker.

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.



ST1100M

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 outer edges should be approximately flush with the outer edge of the pump joint faces when fitted.

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.

CARBURETTOR FOUR CYLINDER ENGINE OVERHAUL

DESCRIPTION

The twin bored 32 - 34 DMTL Weber carburettor is a fixed choke instrument with a staggered throttle opening. The carburettor is divided, operationally, into two sections namely the primary and secondary carburettors with 32 mm and 34 mm bores respectively. The delayed throttle opening occurs in the secondary carburettor.

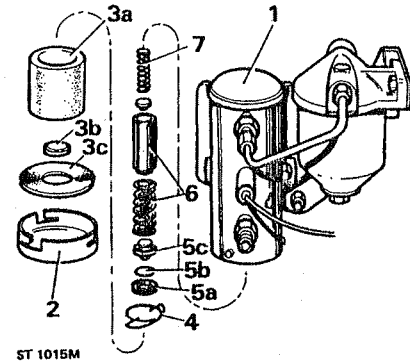
The primary carburettor, which incorporates fuel and air jets for idling, is used for starting, and normal running, up to approximately two thirds throttle opening. Shortly before this stage the secondary carburettor butterfly will begin to open and become increasingly more involved as the throttle is opened further. To ensure a smooth transition during the various stages of throttle opening both sections of the carburettor 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 carburettor 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 carburettor.
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 carburettor 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.

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.

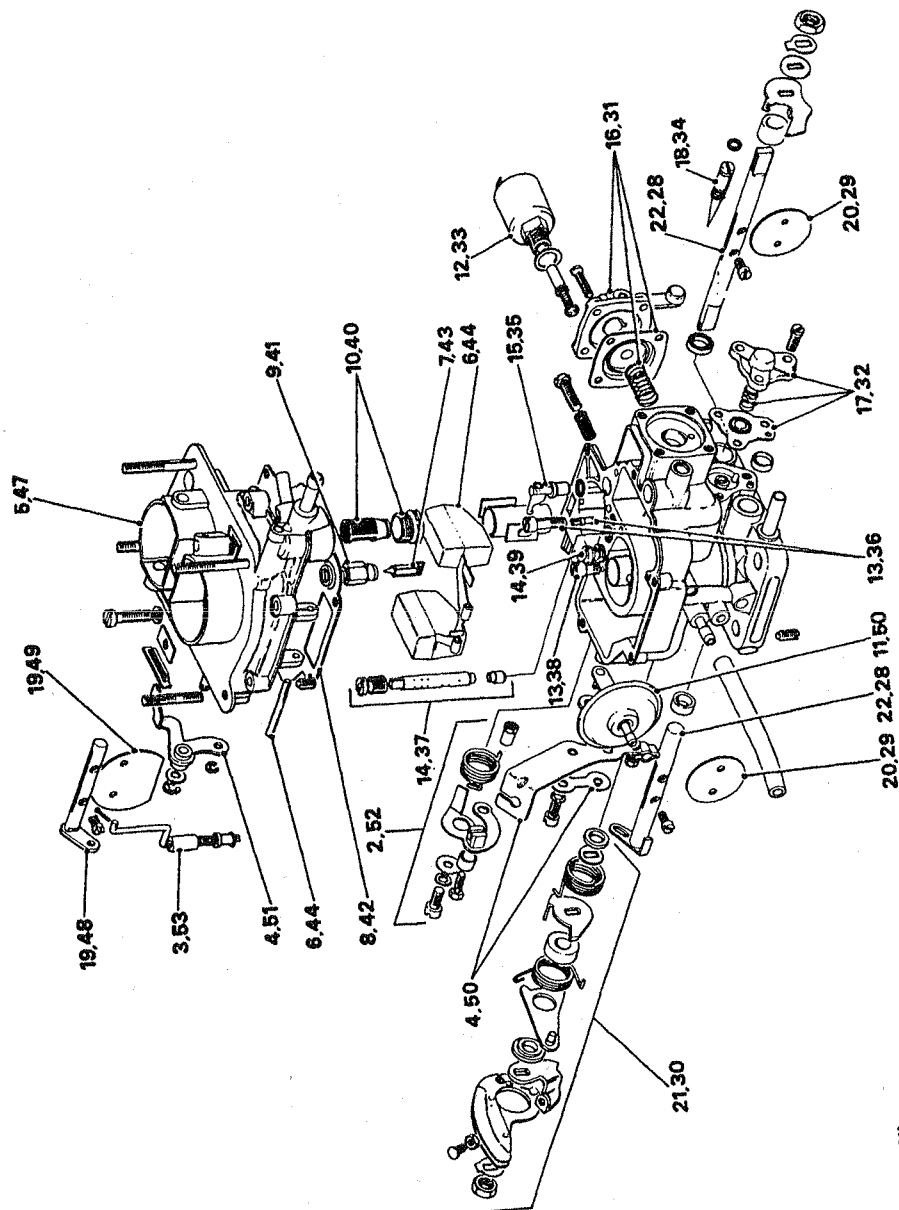
ASSEMBLE

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.



ST 535 M

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.

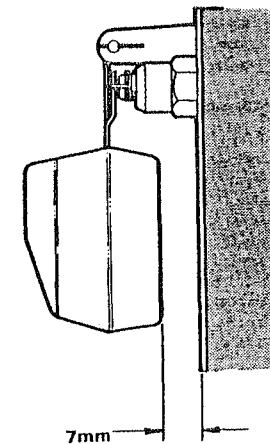
Inspection and cleaning

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 carburettor body show any signs of distortion or the edges are burred, these faces may be reclaimed by flattening, 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 carburettor 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 carburettor 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 carburettor 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 1 1/2 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 carburettor body.
36. Reassemble the primary jet to the jet holder and fit to the carburettor body.
37. Fit the secondary main and air correction jets to the secondary emulsion tube, locate and secure assembly to the carburettor body.
38. Assemble the secondary jet to the jet holder and fit assembly to the carburettor body.
39. Reassemble the primary main and air correction jets to the emulsion tube; and fit assembly to the carburettor 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. Any adjustment must be made by bending the float carrier tag. Adjustments must not be made by bending the float carrier arms.



ST 567 M

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 peening.
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.

FOUR CYLINDER ENGINE CARBURETTER

TUNE AND ADJUST

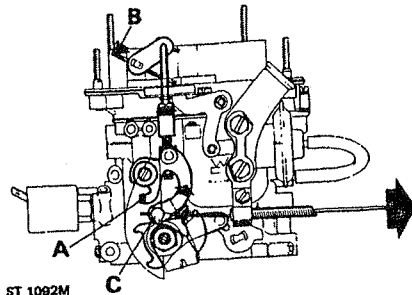
1. Before attempting any carburetter adjustments ensure that cylinder compressions, valve clearances, spark plug gaps and ignition timing are satisfactory. Check also that there is no air leakage into the inlet system through the inlet manifold and carburetter gaskets and brake servo hose connections.

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.

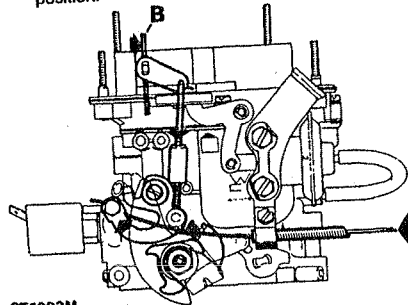
Mixture control (cold start)

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.



ST 1092M

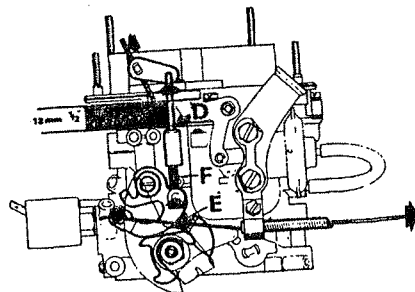
7. Push the mixture control fully in and confirm that flap 'B' is open, that is in the vertical position.



ST 1093M

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. Adjust the fast idle screw 'E' so that it just makes contact with the fast idle cam.

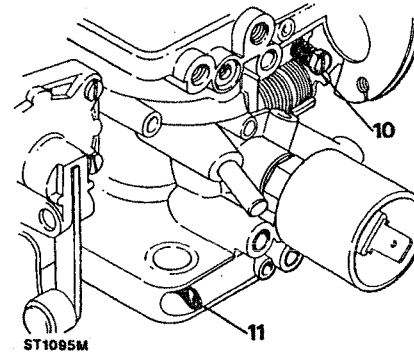


ST 1094M

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 rev/min.
11. Turn the idle mixture adjustment screw clockwise or anti-clockwise by one-quarter turn increments to obtain the highest engine rev/min. When this has been achieved, re-adjust, if necessary, the butterfly adjustment screw to maintain the 600 to 700 rev/min idle speed.
12. Fit the air intake elbow to the carburetter top.



ST 1095M

V8 ENGINE ZENITH - CARBURETTER OVERHAUL

DISMANTLE

Remove the piston assembly

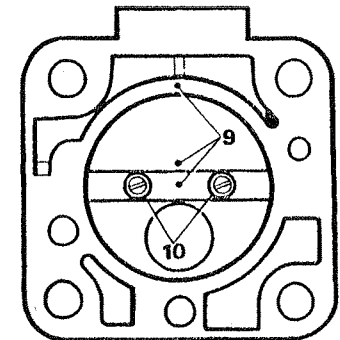
1. Remove the carburetters from the engine.
2. Release the four screws and withdraw the top cover and spring.
3. Withdraw the air valve, shaft and diaphragm assembly.
4. Remove the metering needle retained by a locking screw.
5. Release the four screws and separate the diaphragm from the air valve.

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.

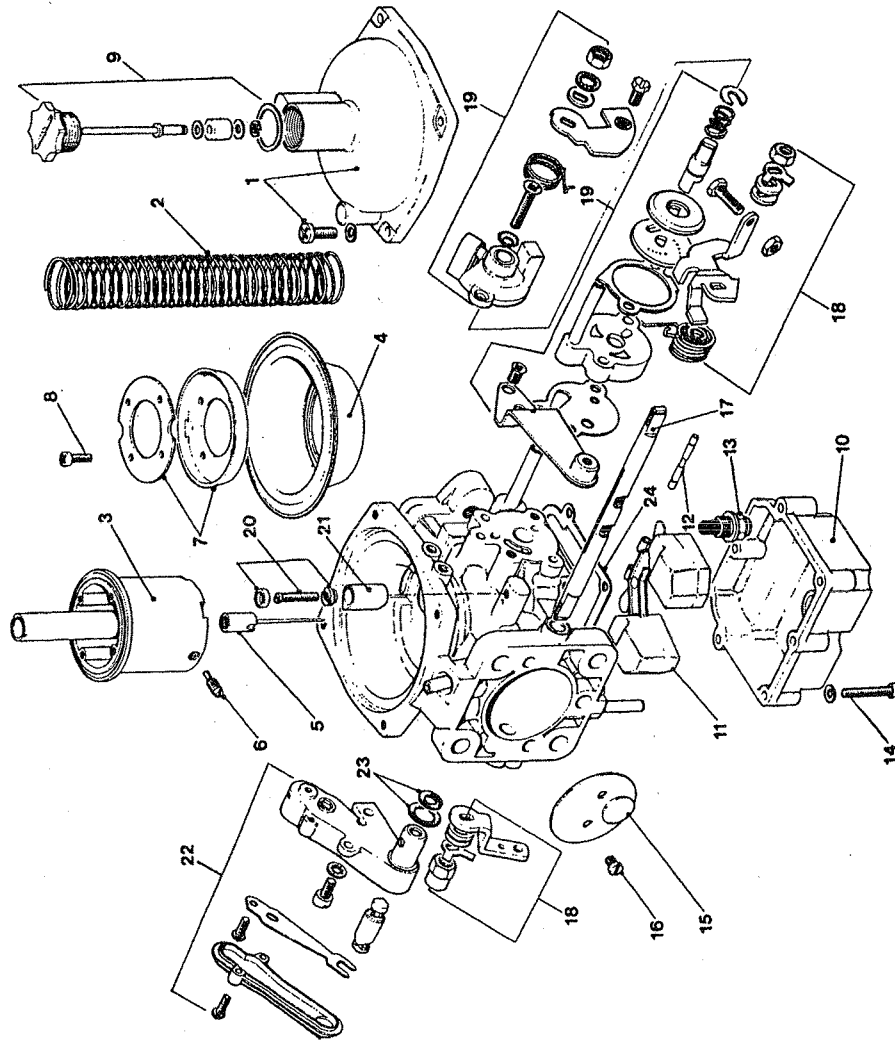
Dismantle carburetter body

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.



ST 1119M

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.



KEY TO L.H. CARBURETTER

- | | | |
|---|--|--|
| 1. Top cover and retaining screws | 10. Float chamber | 19. Cold start assembly (left hand carburettor only) |
| 2. Air valve return spring | 11. Float assembly | 20. Slow running screw assembly |
| 3. Air valve | 12. Needle valve | 21. Tamper-proof sleeve |
| 4. Diaphragm | 13. Needle valve | 22. Temperature compensator assembly |
| 5. Metering needle | 14. Float chamber retaining screws (6 off) | 23. Temperature compensator seals (large and small) |
| 6. Metering needle retaining screw | 15. Butterfly | 24. Float chamber joint washer |
| 7. Diaphragm retaining ring and plate | 16. Butterfly retaining screws (2 off) | |
| 8. Screw (4 off) retaining diaphragm to air valve | 17. Butterfly (throttle) spindle | |
| 9. Damper assembly | 18. Throttle spindle lever assembly | |

- Dismantle the cold start assembly but do not remove the discs from the spindle.
- 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

- Release the two screws and withdraw the temperature compensator unit complete.
- Remove the large and small rubber washers.

CLEANING AND INSPECTION

Cleaning

- 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

- New gaskets and seals should be used throughout carburettor 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.
- Examine the faces for deep scores which would lead to leakage taking place when assembled.

Diaphragm

- Examine the diaphragm for deterioration, damage and punctures. Do not use any cleaning chemicals on the diaphragm only clean lint free rag.

Float assembly

- Examine the two plastic floats and check for punctures and damage.
- Check the spindle and retaining clips for wear.
- Inspect the needle valve assembly for wear. Renew the valve if there is any tendency for the needle to stick.

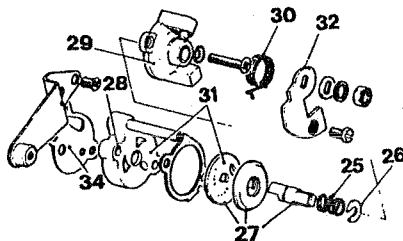
Cold start assembly

- Examine all the cold start components for wear and corrosion and the machined faces for scores.

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

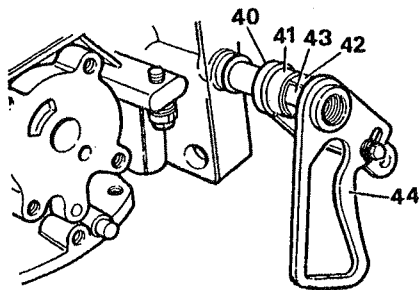
Throttle spindle, L H carburetter

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.

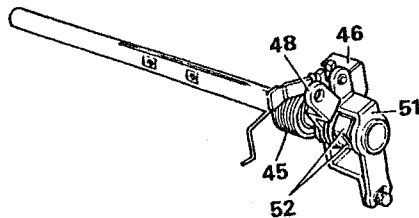
43. Fit the sleeve nut, sleeve end last, and engage the tab washer.
44. Fit the throttle adjusting lever.



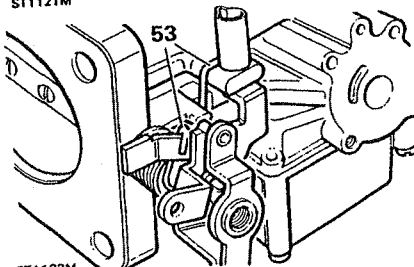
ST1120M

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.



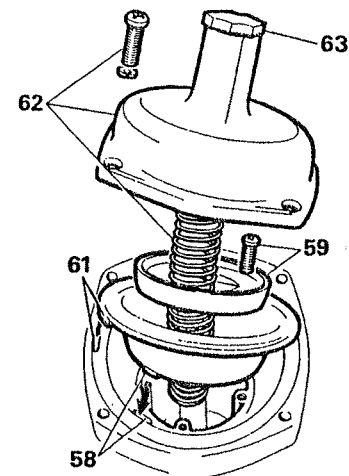
ST1121M



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. 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.



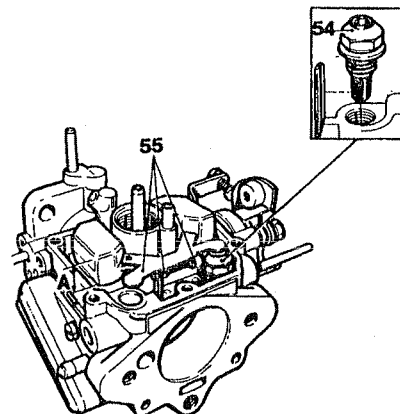
ST1117M

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

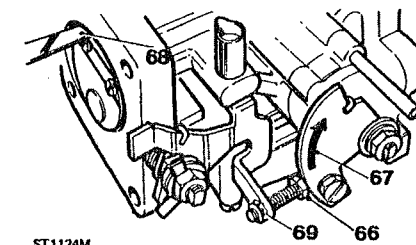
66. Slacken the fast idle adjusting screw.
67. Hold the cold start cam lever in the maximum position.
68. Adjust the fast idle adjusting screw against the cam lever until there is 0,61 to 0,66 mm gap between the top edge of the throttle butterfly and the carburetter barrel wall. Use feeler gauges or 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.



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.



ST1124M

FIT THE CARBURETTERS

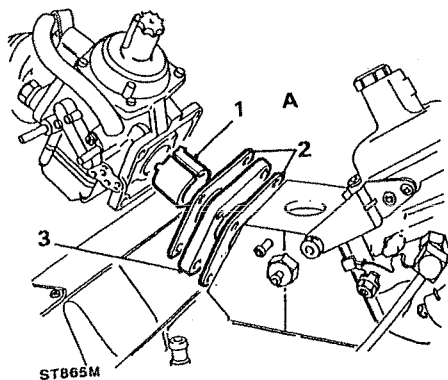
Fit the carburetters to the induction manifold, using new joint washers in the correct sequence as illustrated according to the engine serial number.

Illustration A from serial number 1400001A Non-detoxed.

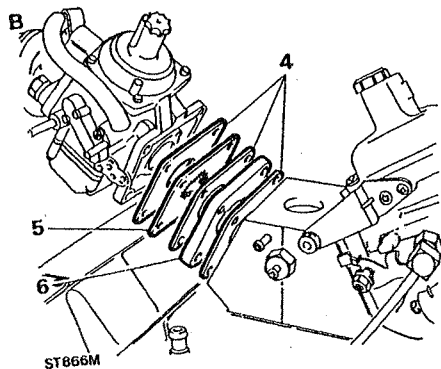
1. Fit the liner.
2. Fit the joint washers.
3. In between the washers fit the insulator.

Illustration B from serial number 15G00001A detoxed.

4. Fit the three joint washers.
5. Fit the saw toothed deflector.
6. Fit the insulator.



ST865M



ST866M

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 carburettor 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

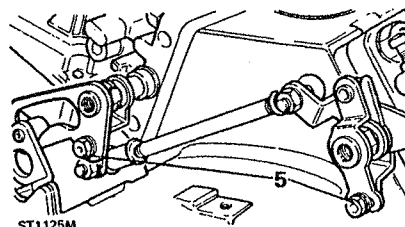
All carburetters fitted to the Land-Rover conform at the time of manufacture to particular territory requirements in respect of exhaust and evaporative emissions control. However, in some cases changes to the basic carburetters may have been necessary to achieve this.

Service tools:
 RO605330 - Carburettor balancer
 MS80 - Mixture adjusting tool
 MS86 or B25243 - Tamper-proofed throttle adjustment tool

The service tool RO605330 carburettor 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:

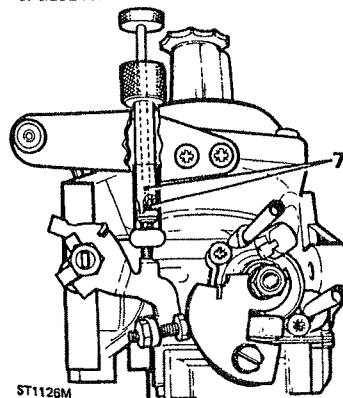
Slow running (idle) adjustment

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

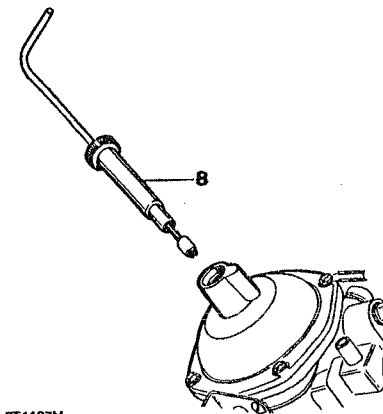
6. Start the engine and check the idle speed using a reliable proprietary tachometer.
7. If necessary, adjust the slow running screw to give the correct idle speed, see 'ENGINE TUNING DATA'. If a tamper-proof sleeve is fitted over this screw the slow running speed can only be adjusted using special tool MS86 or B25243.



ST1126M

Mixture setting and balance carburetters

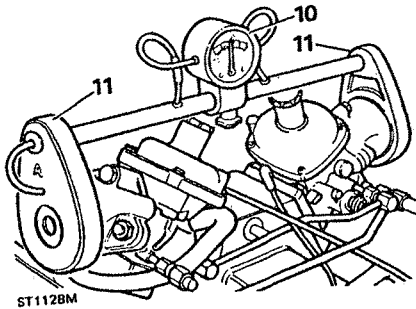
8. Remove the piston damper plug, and using special tool MS80 adjust the mixture. Locate the outer sleeve of the tool to engage a machined slot to prevent the air valve twisting. Turn the inner tool clockwise to enrich the mixture and anti-clockwise to weaken it. After every adjustment the tool should be removed from the carburettor 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.



ST1127M

10. Check, and if necessary, zero the gauge on balancing tool RO605330.
11. Place balancer on the carburettor 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 carburettor by unscrewing the slow running screw or increase the air-flow through the right-hand carburettor 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.

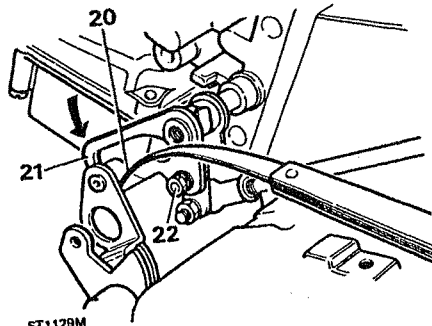
17. Remove balancer. With the mixture setting and carburetter balance correctly adjusted the difference in engine rev/min with the tool RO 605330 on or off will be negligible, approximately plus or minus 25 rev/min.



ST1128M

Adjust throttle linkage

20. On the left-hand carburetter, place a 0,15 mm 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.

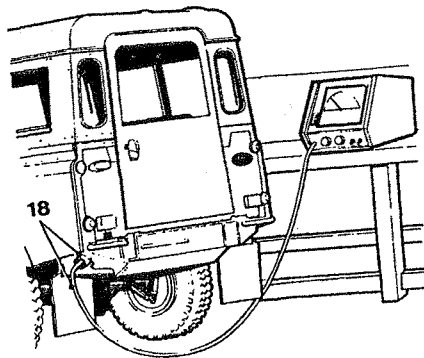


ST1129M

Check CO level

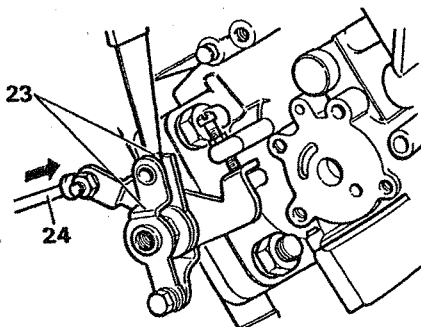
Use a proprietary non-dispersive infra-red exhaust gas analyser.

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

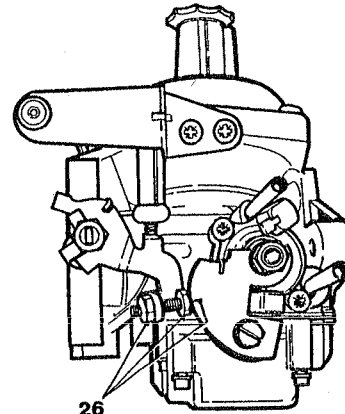
23. On the right hand carburetter, place a 0,15 mm feeler between the left leg of the fork on the adjusting lever and the pin on the throttle lever.
 24. Apply light pressure to the linkage to hold the feeler.
 25. Tighten the screw to secure the throttle adjusting lever, then withdraw the feeler.



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 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 separate 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 lever from the throttle butterfly spindle and remove the return spring.
26. Hold the butterfly closed and mark the relationship of the butterfly to the carburettor flange.
27. Remove the butterfly two retaining screws and withdraw the butterfly from the spindle.
28. Withdraw the throttle butterfly spindle from the carburettor 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 carburettor 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.

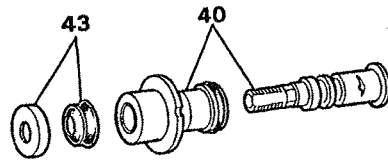
ASSEMBLE

Fit throttle butterfly

38. Fit the throttle spindle to the carburettor 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.

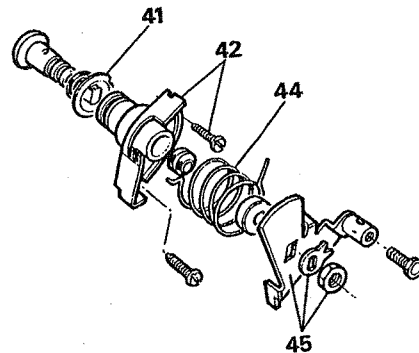
Fit cold start assembly

40. Fit a new 'O' ring to the valve body and assemble the valve spindle to the valve body.



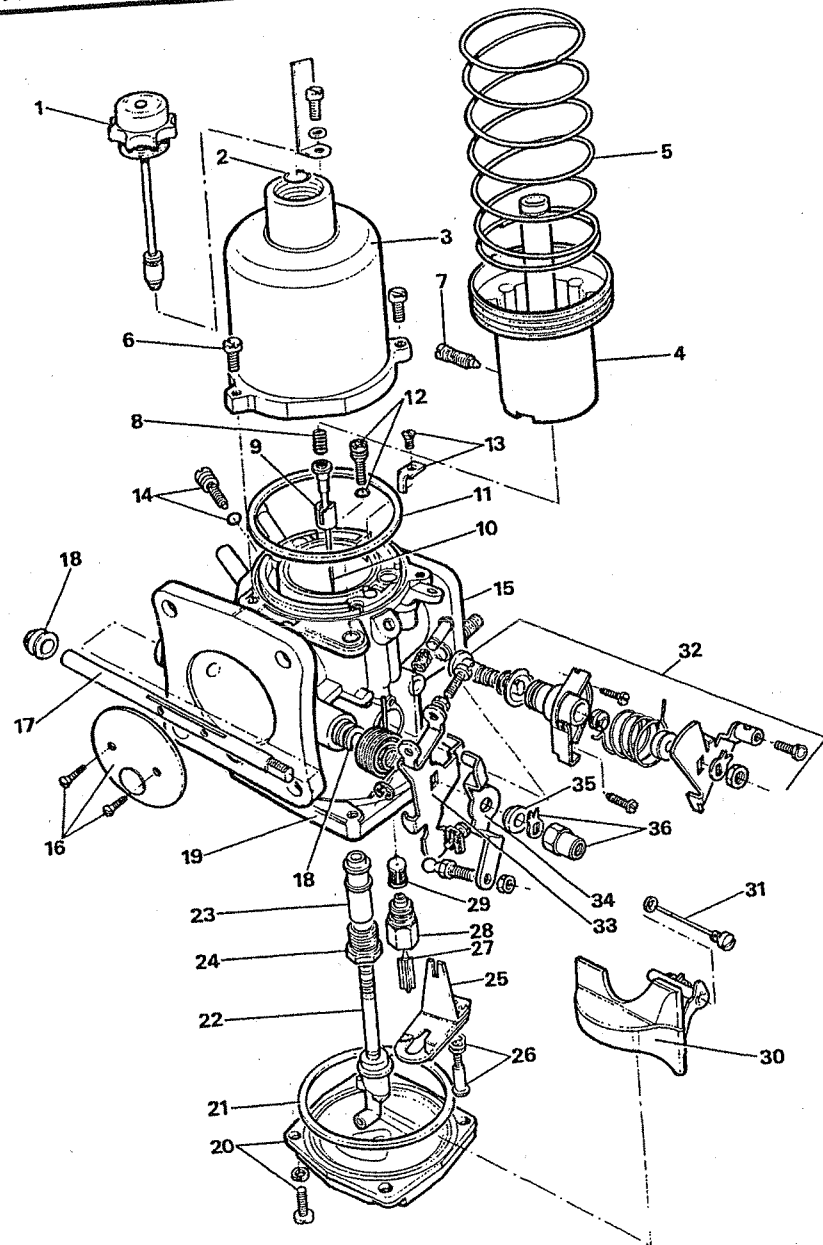
ST1873M

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.
42. Fit the starter assembly to the carburettor 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

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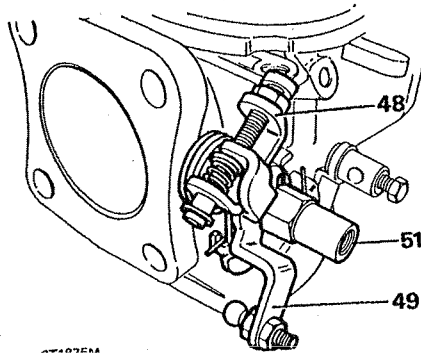
ST1804M

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.

Fit throttle lever assembly

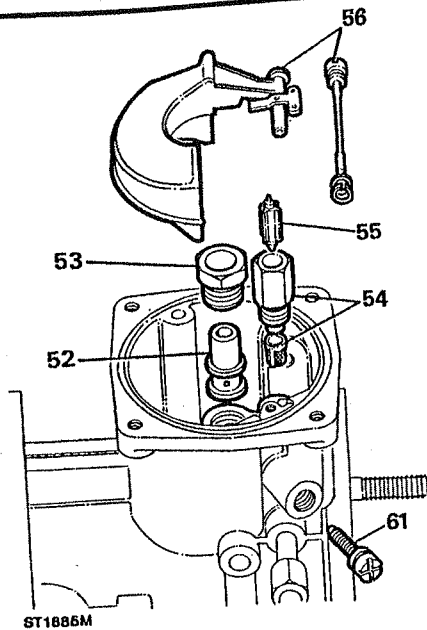
47. Fit the return spring so that the longest leg rests against the throttle adjusting screw housing.
48. Fit the throttle adjusting lever and lost motion assembly and tension the return spring.
49. Fit the throttle actuating lever.
50. Fit the bush washer and lock washer.
51. Fit and tighten the special nut and bend the lock tabs over a convenient flat.



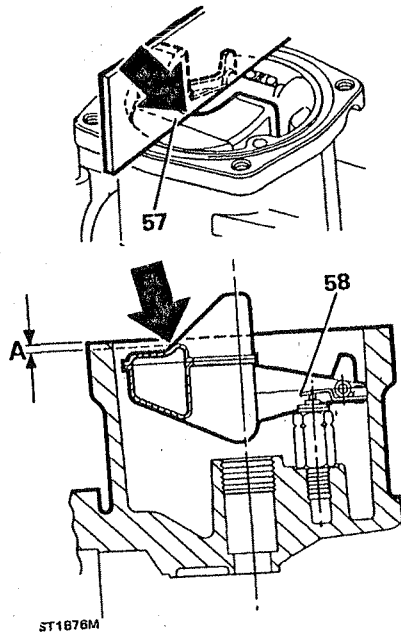
ST1875M

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 carburettor 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 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.



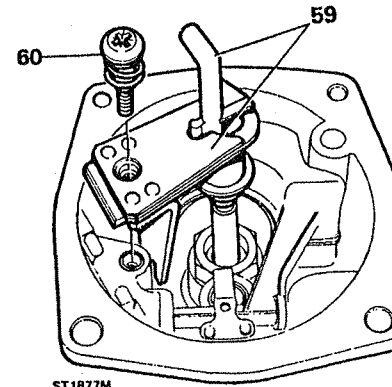
ST1886M



ST1876M

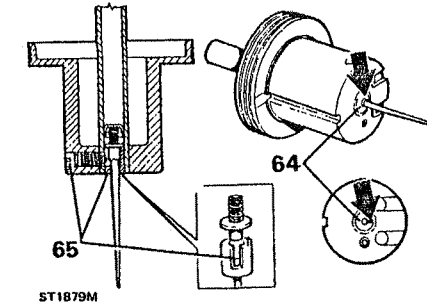
Fit piston and suction chamber

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 carburettor and secure with the spring loaded jet retaining screw.
61. Fit the mixture adjusting screw.



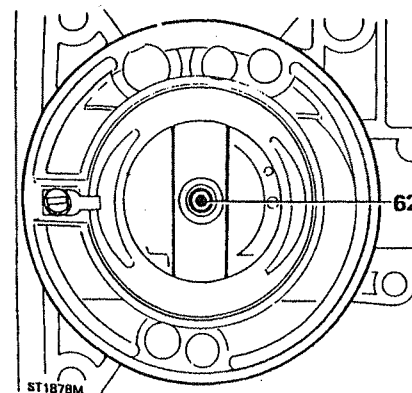
ST1877M

62. Adjust the mixture screw until the jet is flush with the carburettor bridge, then turn the screw a further three and one half turns clockwise.



ST1879M

66. Fit the piston key to the carburettor 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 carburettor 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.

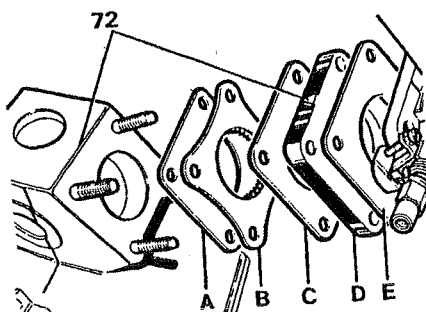


ST1878M

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.

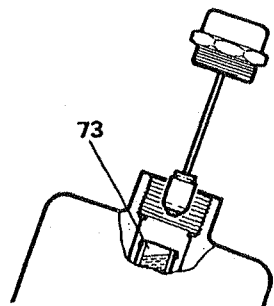
72. Fit the carburetters to the inlet manifold ensuring that the joint washers, deflector and insulator are fitted in the sequence illustrated. The insulator must be fitted with the arrow head uppermost and pointing inwards towards the manifold. Secure with the four nuts and spring washers and tighten evenly to the correct torque.

- A. Joint washer.
- B. Deflector-teeth pointing inwards.
- C. Joint washer.
- D. Insulator.
- E. Joint washer.



ST1890M

- 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 RO 605330 or B89
- Non-dispersive infra-red exhaust gas analyser.

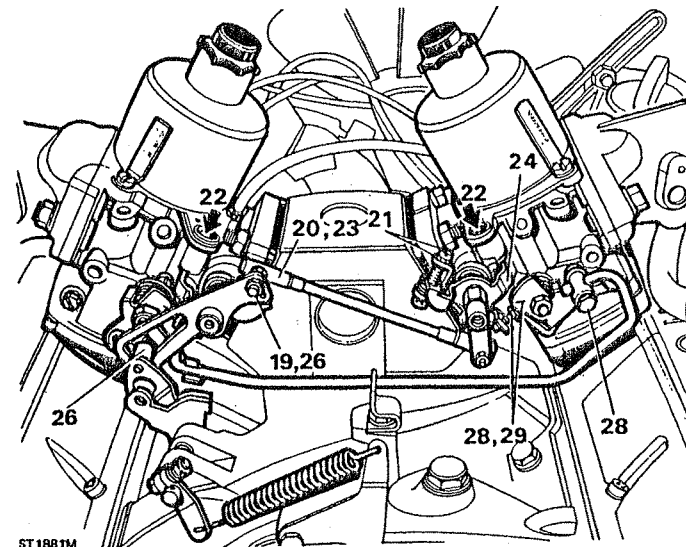
General Requirements Prior to Tuning Carburetters.

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 2° 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 8 JZX 1258 must be fitted into the mixture screw recess and a red cap; Part number JZX 1197 fitted over the idle adjustment screw (throttle adjustment screw).



ST1881M

TUNE AND ADJUST

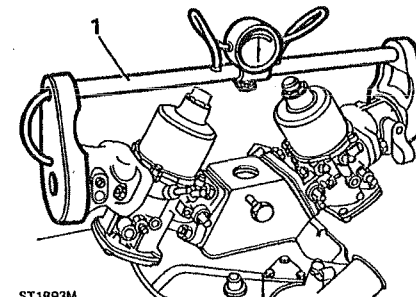
The following instructions apply to both carburetters unless otherwise stated.

Before commencing the following instructions, remove the air cleaner, air intake elbows, mixture adjustment screw plug and idle adjustment screw cap.

CARBURETTER BALANCE

Using balancer RO605330

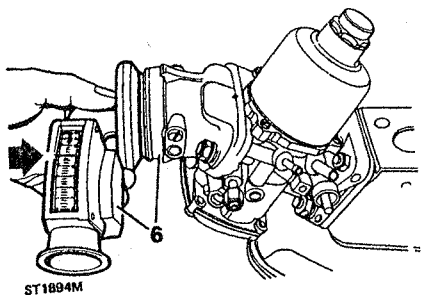
1. Disconnect the interconnecting link between the two carburetters. Fit the balancer to the carburetter intakes and ensure that there are no air leaks, if necessary, zero the gauge with the adjustment screw.
2. Start the engine, and if necessary allow it to reach normal operating temperature. If the 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.
3. Disconnect the inter-connecting throttle link between the two carburetters.



ST1893M

Using balancer B89

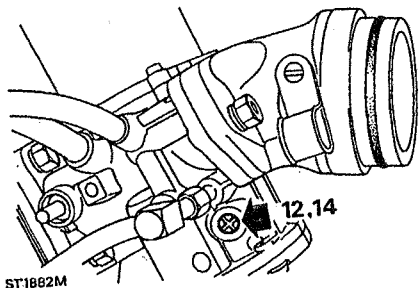
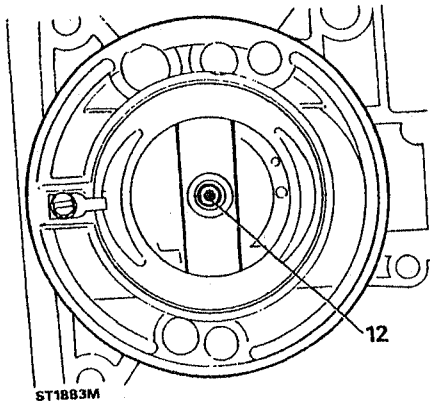
4. Back-off the idle adjusting screw on each carburetter, clear of the throttle lever.
5. Turn each throttle adjusting screw so that it touches the throttle lever, then turn the screws by equal amounts to achieve an approximate idle speed of 700 to 800 rev/min.
6. Press the balancer firmly over the carburetter 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.
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.



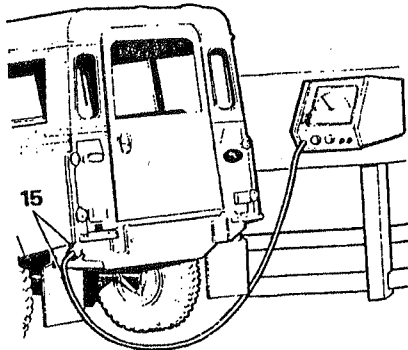
8. Alternatively, adjust and check the balance of both carburetters until an idle speed of 700 to 800 rev/min is obtained.
9. Reconnect the throttle inter-connecting link, and again check the idle speed and balance.

Mixture setting

10. Ensure that the engine is still at normal operating temperature.
11. Mark the relationship of the suction chamber to the carburettor 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 carburettor 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.



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.



Idle speed and linkage adjustment

18. Check that the engine is at normal operating temperature.
19. Slacken the nut, at the left hand carburettor securing the inter-connecting link ball to the throttle cam lever.

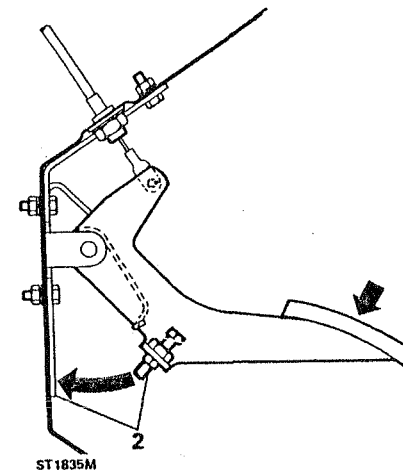
20. Disconnect the inter-connecting link between the carburetters at the left hand carburettor.
21. At the right hand carburettor, release the lock nut and slacken off the lost motion adjustment screw, until it is well clear of the spring loaded pad.
22. If necessary adjust the idle screw to maintain the correct idle speed. Check the CO level and carburettor balance, adjust if required.
23. Re-connect the inter-connecting link to the left hand carburettor.
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 carburettor 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 carburettor, until just clear of the cam.
30. Turn the fast idle screw of the leading (left-hand) carburettor down (clockwise) until a slight change in engine speed is noted.
31. Similarly turn the fast idle screw of the second carburettor (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 carburettor air intake elbows and air cleaner.

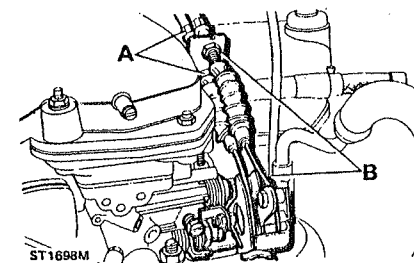
THROTTLE PEDAL ADJUSTMENT

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 carburettor 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 carburettor linkage.



HAND THROTTLE ADJUSTMENT

1. Slacken the lock nut on the cable adjuster and turn the adjuster to remove all slack from the cable and tighten the locknut.
 - A) Foot pedal cable adjuster
 - B) Hand throttle cable adjuster



V8 ENGINE CARBURETTER

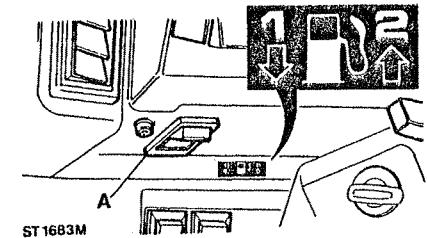
FAULT DIAGNOSIS

FAULT	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	
	No fuel supply to carburetter	Fuel pump pressure too high Float level too high 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 Fit new air cleaner elements	
	Blocked air cleaner 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	
	Water in fuel	Check diaphragm for cracks or porosity - Zenith 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	Float level too low	Check float chamber level	
STALLING ON DECELERATION	Incorrect jet setting	Check for needle valve sticking Check and reset jet settings in accordance with carburetter overhaul instructions	
	Carburetter air leaks Manifold air leaks	Check throttle spindle and bearings for wear 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 Air valve sticking	Check and refill to correct level with oil specified Clean and check freedom	
EXCESSIVE FUEL CONSUMPTION	Blocked air cleaner Damper oil too thick Incorrectly adjusted carburetter	Fill new air cleaner elements Replace with correct grade Check and reset slow running in accordance with carburetter tune and adjust instructions Check and reset float level	
	Float level too high Worn jets and needle Incorrect needle Choke sticking 'on'	Check and replace as necessary Check needle type Check to ensure choke is returning to fully 'off' position, reset as necessary See Engine Fault diagnosis	
	Engine fault		

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.



ST1683M

FUEL TANK SELECTION SWITCH

A. Fuel tank switch

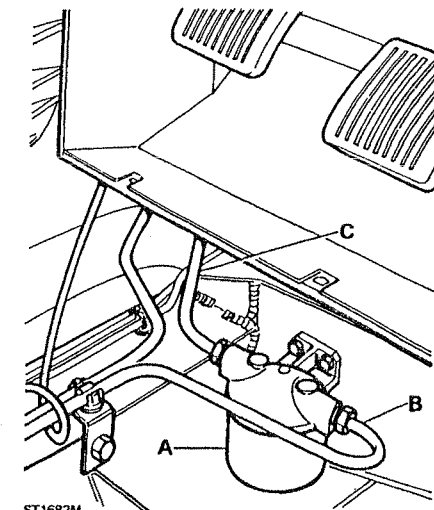
The valve, which is energised by the tank selection switch, closes the port to the tank not in use and simultaneously opens the port to the selected tank. The restrictor is necessary to prevent fuel by-passing the carburetter and flowing back to the selected tank through the spill return system.

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.

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.

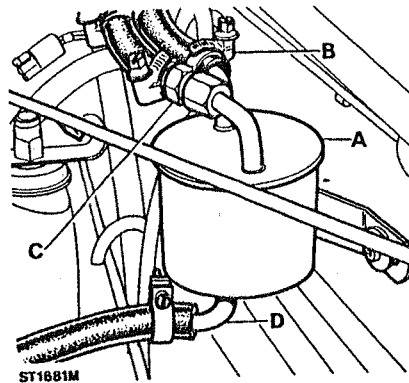


ST1682M

FUEL FILTER

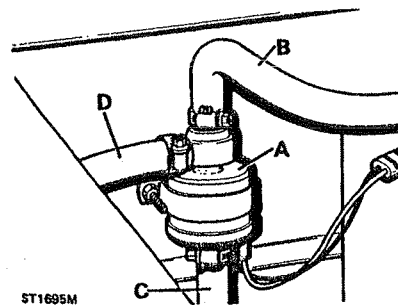
- A. Fuel filter
- B. From fuel pump to filter pipe
- C. From fuel filter to carburetter via vapour separator

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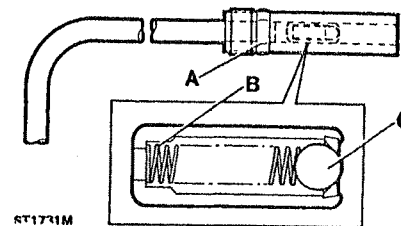
VAPOUR SEPARATOR

- A. Vapour separator
- B. Spill return to side tank
- C. Restrictor and spill return to solenoid valve
- D. Outlet from separator to carburetter



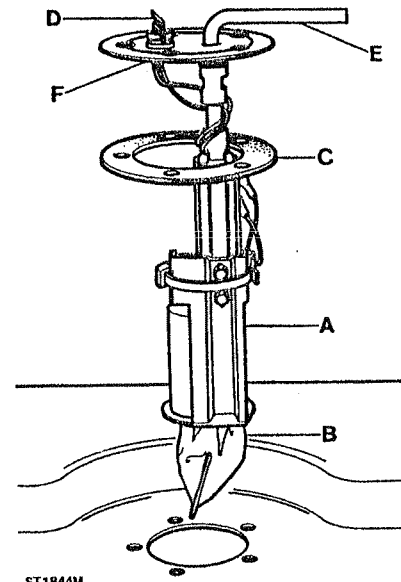
SPILL RETURN SOLENOID VALVE

- A. Solenoid valve
- B. Spill return to side tank
- C. Spill return to rear tank
- D. To carburetter via filter and vapour separator



NON-RETURN VALVE

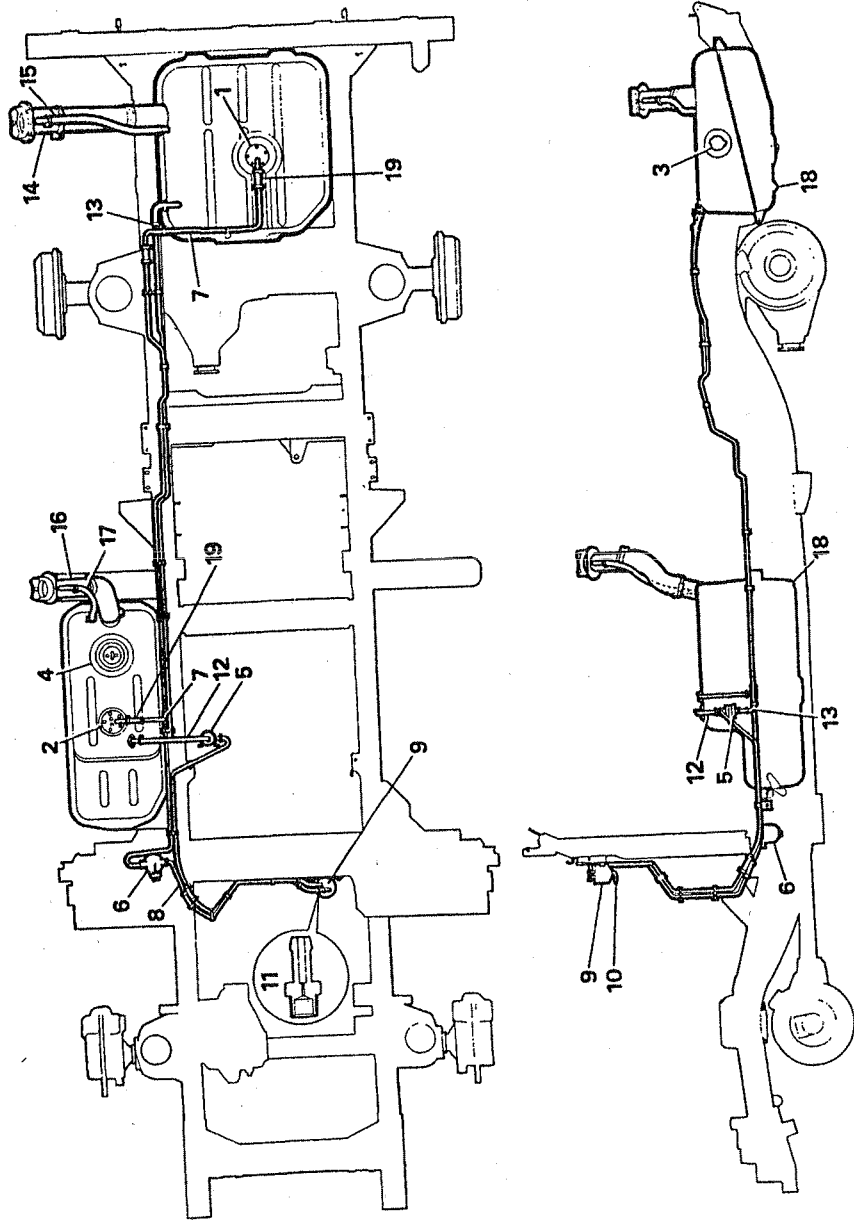
- A. Non-return valve
- B. Spring
- C. Ball



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 refill pump

DEFENDER 110 TWIN TANK FUEL SYSTEM



ST1671M

DEFENDER 110 TWIN TANK FUEL SYSTEM

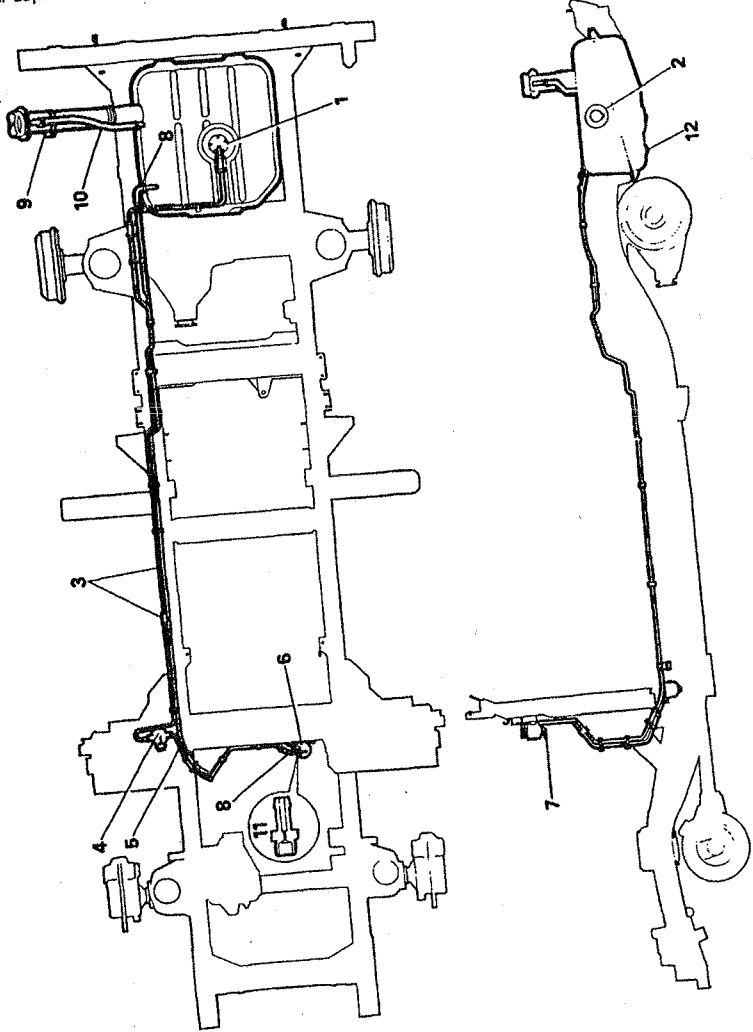
KEY TO FUEL LINE INSTALLATION

- | | | |
|--|---|--|
| 1. In-tank fuel pump - rear tank. | 9. Vapour separator. | 14. Fuel filler - rear tank. |
| 2. In-tank fuel pump - side tank. | 10. Vapour separator outlet to carburettor. | 15. Breather pipe - rear tank. |
| 3. Fuel gauge tank unit - rear tank. | 11. Spill return pipe to fuel tank via restrictor and solenoid valve. | 16. Fuel filler - side tank. |
| 4. Fuel gauge tank unit - side tank. | 12. Spill return pipe to side tank from solenoid. | 17. Breather pipe - side tank. |
| 5. Spill return solenoid. | 13. Spill return pipe to rear tank from solenoid. | 18. Drain plugs side and rear tanks. |
| 6. Fuel filter. | | 19. Non return valve incorporated in hose. |
| 7. Fuel supply pipe - rear tank to filter via T-piece. | | |
| 8. Pipe, filter to vapour separator. | | |

DEFENDER 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 carburettor.
8. Spill return pipe to fuel tank via restrictor.
9. Fuel filler.
10. Breather hose.
11. Restrictor.
12. Fuel tank drain plug.

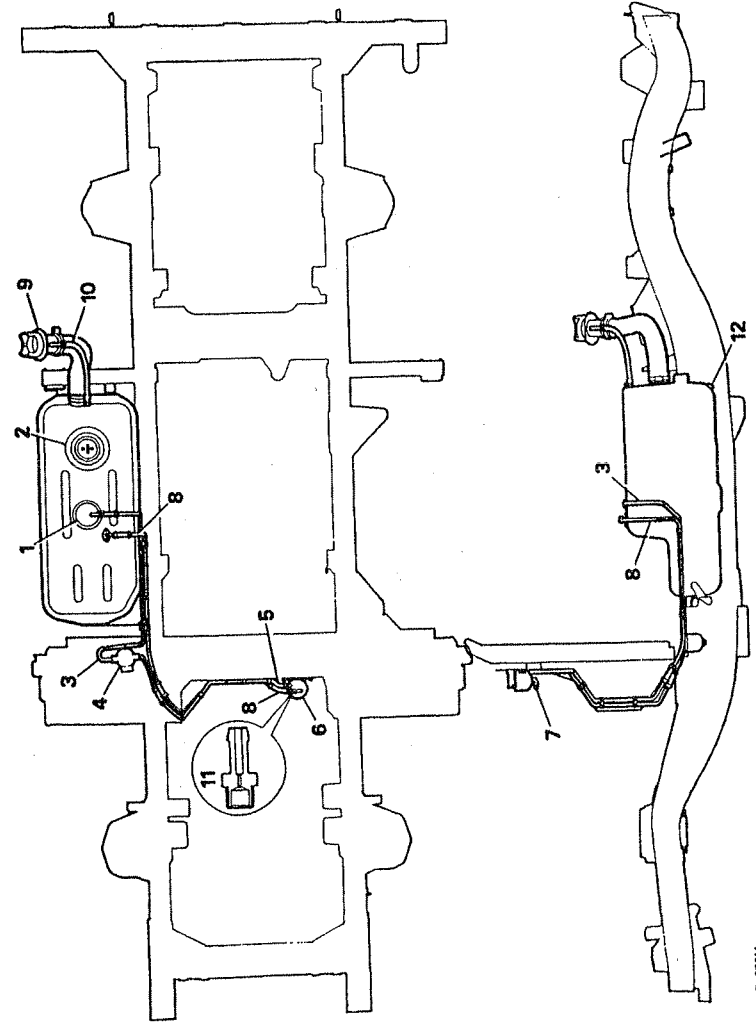


ST16620M

DEFENDER 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 carburettor.
8. Spill return pipe to fuel tank via restrictor.
9. Fuel filler.
10. Breather hose.
11. Restrictor.
12. Fuel tank drain plug.



ST1670M

REMOVE REAR TANK AND FUEL PUMP - Petrol vehicles

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 SECTION** of this Workshop Manual.

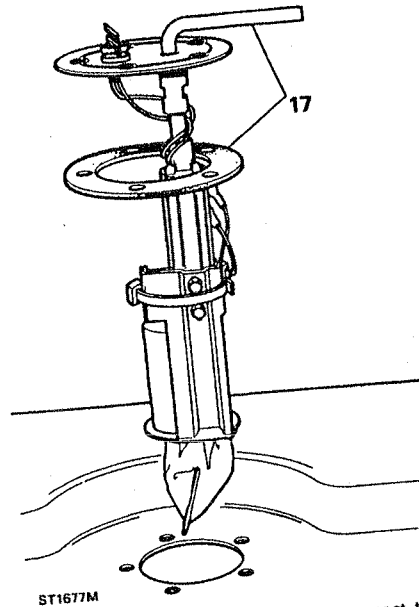
1. Move vehicle to well ventilated area and disconnect the battery. Clean area around pump.
2. Remove the fuel tank drain plug and allow the fuel to drain into a suitable receptacle that can be sealed afterwards and refit the plug.
3. Working from the right-hand side of the vehicle disconnect the fuel 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 disconnected.
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 and escape of fuel vapours.

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.

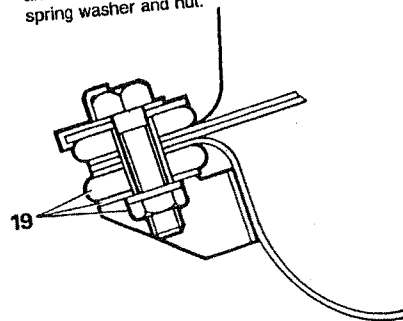
If the fuel tank only is being renewed and the original pump is being re-fitted, ensure that the tie clip is correctly positioned.

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.



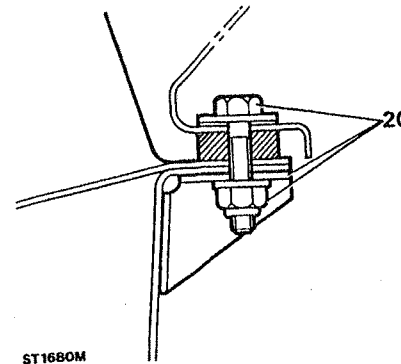
ST1677M

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.



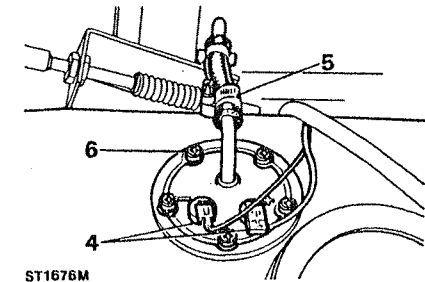
ST1680M

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

WARNING: Before attempting the following instructions, read and implement the **FUEL HANDLING PRECAUTIONS** in Section 01.

1. Move the vehicle to a well ventilated area, extinguish all naked lights and disconnect the vehicle batteries. Drain or syphon at least 9 litres (2 gallons) of fuel from the fuel tank using a suitable container that can be sealed afterwards.
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 and the escape of fuel vapours.

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

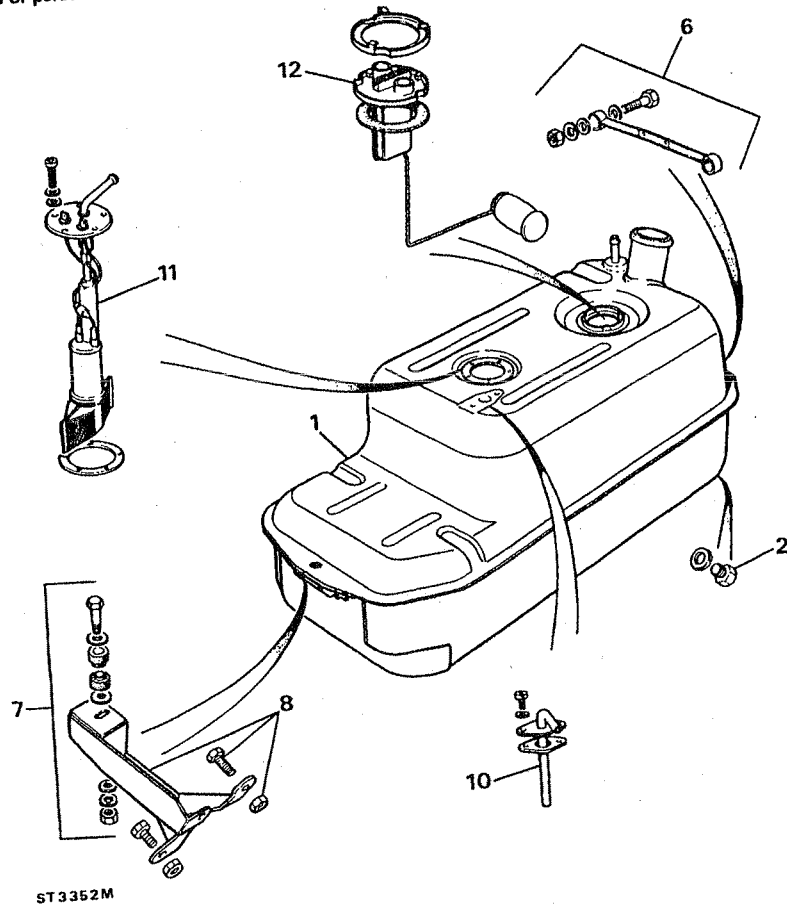
8. Insert the pump and new sealing washer into the tank so that the outlet pipe is directed towards the left-hand side of the vehicle and the electrical connections to the right.
9. Secure the pump with the five screws tightening evenly.
10. Fit the supply pipe to the pump outlet and tighten the hose 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. Run engine and check all connections for fuel leaks.
13. Switch off ignition, fit the seat base cover and carpet and refit the seat cushion.

SIDE MOUNTED FUEL TANK - 110 PETROL -

Remove and refit

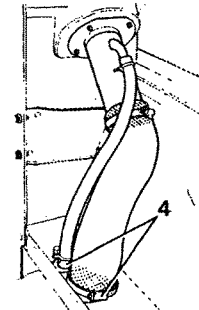
WARNING: Before any attempt is made to proceed with the following instructions it is vital that the FUEL HANDLING PRECAUTIONS contained in Section 01 of this workshop manual are carefully studied and implemented in the interests of personal and vehicle safety.

1. Disconnect the battery.
2. Remove the fuel filler cap and working from beneath the vehicle remove the fuel tank drain plug and allow the fuel to drain strictly in accordance with the above mentioned precautions. Refit and tighten the drain plug.



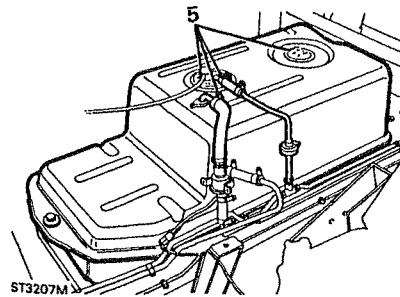
ST3352M

3. Remove the right hand seat cushion and seat base cover to reveal the fuel tank.
4. Move the seat squab forward and disconnect the fuel filler hose and breather hose from the fuel tank.



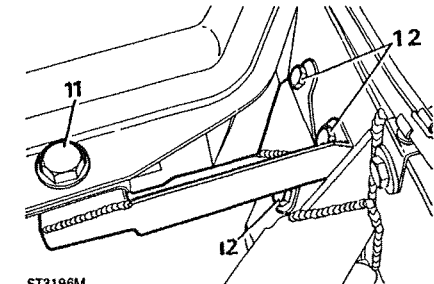
ST3208M

5. Disconnect, from the tank, all the electrical and fuel connections shown in the following illustration.



ST3207M

6. Support the tank and from the rear of the tank remove the two nuts and bolts and spacer tube that secure the tank to the chassis out-rigger bracket.
7. Remove the single bolt fixing assembly securing the tank front mounting to the chassis mounted bracket.
8. Remove the three nuts and bolts that secure the tank mounting bracket to the chassis and withdraw the bracket.



ST3196M

9. Lower the front of the tank whilst turning it anti-clockwise and remove it from the vehicle.
10. If required, remove the two screws and withdraw the spill return pipe from the tank.
11. Also, if required, remove the five screws and lift-out the fuel pump.
12. Finally, remove the fuel gauge unit by turning the locking ring anti-clockwise to enable the gauge unit and sealing ring to be withdrawn.
13. Cover tank apertures to prevent ingress of foreign matter and escape of fuel vapours.

Fitting

14. Using a new sealing ring fit the gauge unit. Turn the locking ring clockwise to secure.
15. Fit the spill return pipe with a new gasket and secure with the two screws.
16. Fit a new sealing ring and insert the fuel pump into the tank and retain with the five screws.
17. Fit the tank front attachment bracket with the three nuts and bolts to the chassis.
18. Secure the tank with the single bolt and rubber bush assembly.
19. Fit the rear of the tank to the chassis out-rigger bracket with the two nuts and bolts and spacer tube.
20. Connect the tank filler hose and breather pipe.
21. Connect all the fuel and electrical connections, reversing instruction 5.
22. Before fitting the seat base cover and cushion, check that the drain plug is tight, fill the tank with a known quantity of fuel. Connect the battery, run the engine and check for fuel leaks and that the fuel gauge operates correctly.

Notes

COOLING SYSTEM

Engine Protection

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

Use only Universal anti-freeze or permanent type ethylene base, without methanol containing, a suitable inhibitor for aluminium engine parts. Use one part of anti-freeze to one part water. Anti-freeze should be used even in climates where is it not necessary as a corrosion inhibitor. No other corrosion inhibitor should be used. A concentration of at least 33% should be maintained.

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

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

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

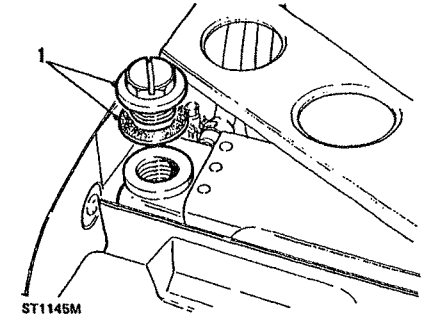
After the second winter the system should be drained and thoroughly flushed. Before adding new anti-freeze examine all joints and renew defective hoses to make sure that the system is leak proof.

See SECTION 09 for protection quantities.

DRAIN AND FILL V8 ENGINE COOLING SYSTEM

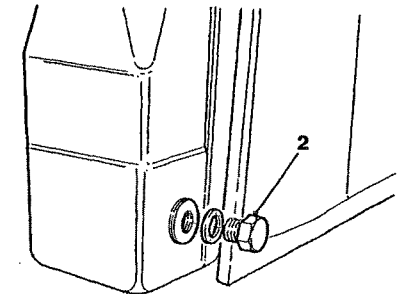
WARNING: Do not remove the radiator filler cap when the engine is hot because the cooling system is pressurized and personal scalding could result.

1. Remove the radiator filler plug.

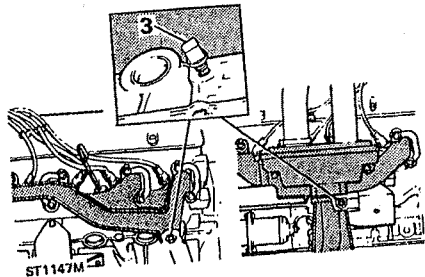


2. Remove the radiator drain plug early models only and allow the coolant to drain, if necessary, into a suitable container. Refit the drain plug and new washer. The drain plug is situated on the left-hand side of the radiator towards the bottom facing the engine compartment.

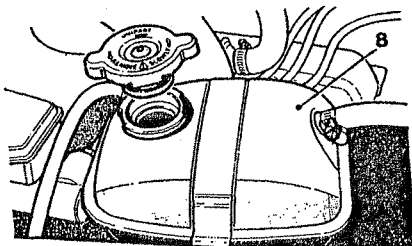
NOTE: Disconnect bottom hose to drain on radiators without a drain plug. Connect hose after draining.



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. Although anti-freeze may not be required it should be used as an inhibitor see under 'Engine Protection'.
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.



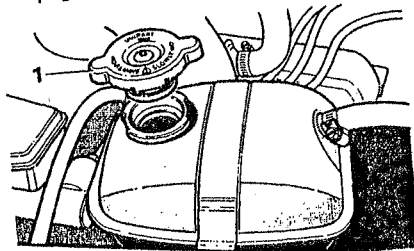
ST1148M

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

DRAIN AND FILL 2.25 AND 2.5 LITRE PETROL AND DIESEL COOLING SYSTEMS

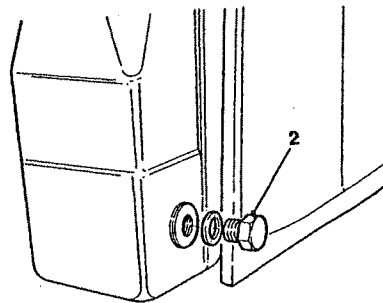
WARNING: Do not remove the radiator or expansion tank filler caps when the engine is hot because the cooling system is pressurized and personal scalding could result.

1. Remove the expansion tanks and radiator filler plug.



ST040

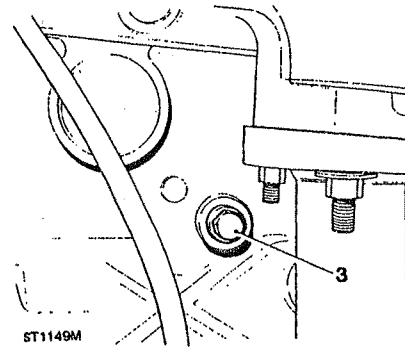
2. Remove the radiator drain plug and allow the coolant to drain, if necessary into a suitable container. Refit the drain plug with a new washer. The plug is located on the left-hand side of the radiator facing the engine compartment.



ST1146M

NOTE: Radiator without a drain plug, disconnect 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.



ST1149M

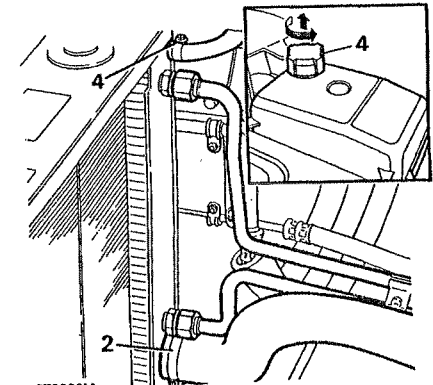
4. To drain the expansion tank, disconnect the hose from the tank to the water pump. Drain and flush and reconnect the hose.
5. Make up a solution of anti-freeze and water in a separate container in the concentration required. The cooling system capacity can vary so refer to 'Capacities' under 'General specification data'. To allow for topping up and the expansion tank prepare a quantity in excess of the capacity of the system concerned.
6. Although anti-freeze may not be required it should be used as an inhibitor see 'Engine Protection'.
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 correct torque

DRAIN AND FILL Tdi DEFENDER COOLING SYSTEM

Service Repair No. 26.10.01

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.

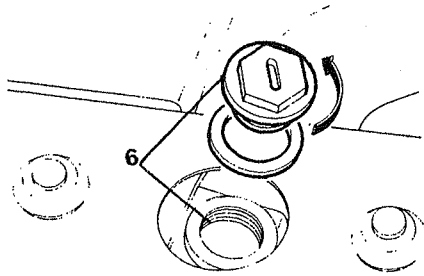
1. Disconnect the battery.
2. Disconnect the bottom coolant hose from the radiator. Allow to drain and reconnect the hose.
3. To drain the cylinder block, remove the drain plug which is situated on the left hand side of the engine immediately below front core plug. Refit the plug, with a new washer, 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.



ST3030M

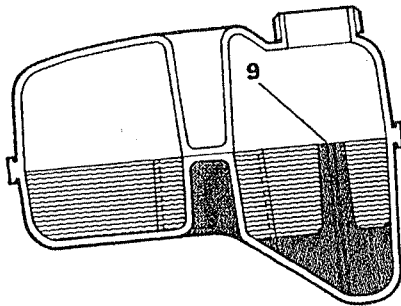
Refilling

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.



ST3032M

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.
9. Allow the engine to cool completely and remove the radiator and expansion tank caps. If necessary, top-up the radiator to just below the filler neck. Top-up the expansion tank to top of the level indicator and fit both filler caps.



ST3206M

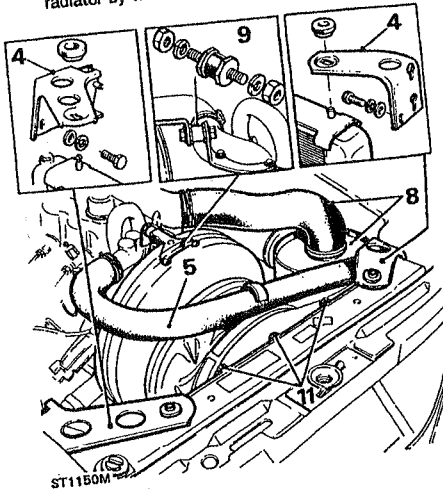
RADIATOR ASSEMBLY (2.25 and 2.5 litre petrol and diesel)

Remove

1. Disconnect the battery.
2. Drain the radiator by removing the drain plug at the bottom left-hand side of the radiator and the bottom left-hand side of the radiator and releasing the expansion tank filler cap. See releasing the expansion tank filler cap and fill the 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 cowl.

Petrol engine

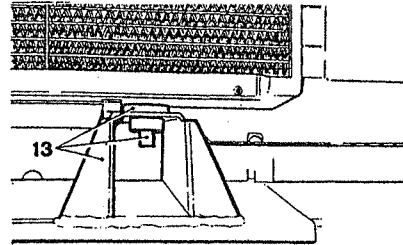
8. Disconnect the air cleaner hose from the carburettor and remove the air cleaner.
9. Release the three fixings securing cowl to the engine.
10. Pull back the cowl towards the radiator and lift radiator and cowl.
11. Remove the five screws securing the cowl to the radiator and separate the two units noting that the cowl is held to the bottom of the radiator by two clips.



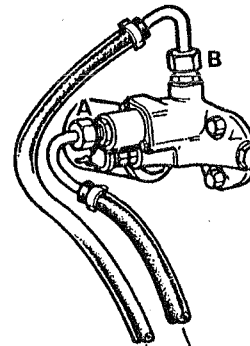
ST1150M

Fitting the Radiator

12. Locate the cowl 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.



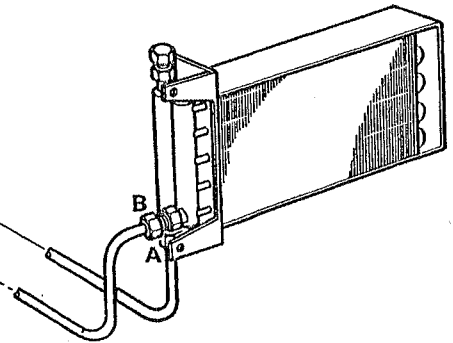
ST1151M



14. Secure the top of the radiator with the two brackets and bolts.
15. Secure the cowl 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 cowl.
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.

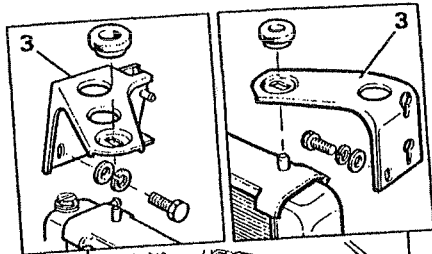
ST11684M



RADIATOR ASSEMBLY - Turbo-Charged 2.5 Diesel

Removing

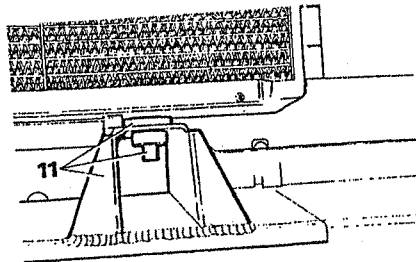
1. Disconnect the battery.
2. Remove the split pin and clevis pin securing the lower end of the bonnet stay and lift-off the bonnet.
3. Remove the three screws each side securing the radiator left-hand and right-hand retaining brackets and remove the brackets.
4. Remove the four screws and withdraw the 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.



ST1868M

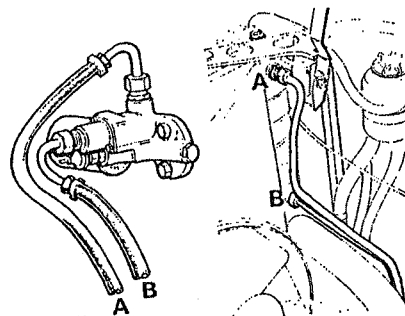
Fitting

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.

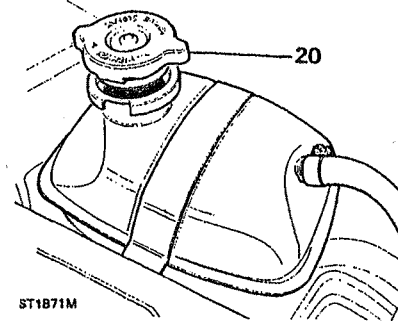


ST1807M

18. Fit the bonnet and stay securing with the clevis pin and new split pin.

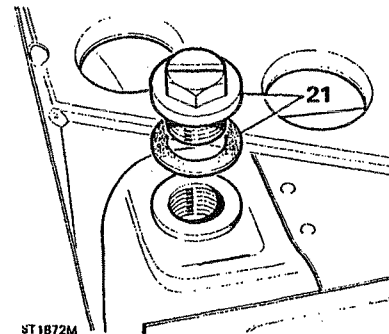
Filling radiator

19. Check that all hose clips are tight.
20. Remove the expansion tank cap.



ST1871M

21. Remove the radiator plug.



ST1872M

22. Fill the system with coolant using a mixture of water and anti-freeze through the expansion tank until 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 54 to 68 Nm.
24. Check the engine oil level in sump and top-up.

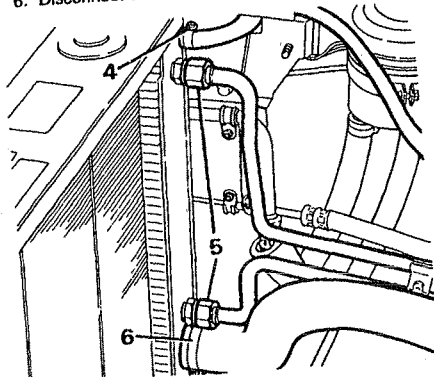
25. Connect the battery and run the engine until normal running temperature is attained whilst checking for coolant leaks.
26. Stop the engine and allow it to cool completely.
27. Remove the radiator plug and check the level and fit and tighten plug.
28. Top-up level of expansion tank and fit the cap.

RADIATOR - Tdi Defender

Service Repair No. 26.40.01

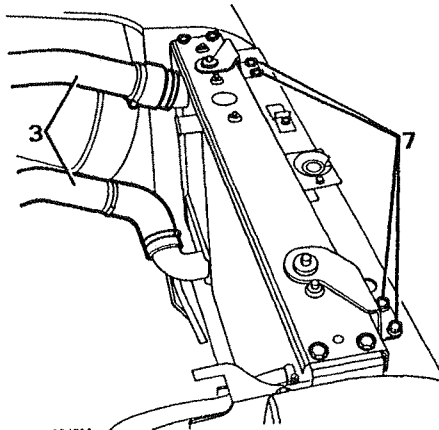
Remove

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.

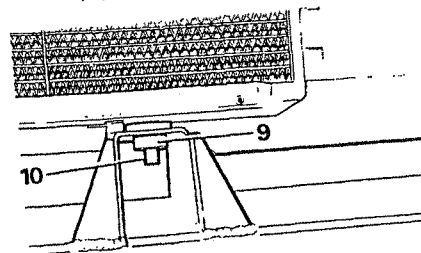


ST3049M

8. Lift out the radiator complete with the intercooler.

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.

FAN COWL - Tdi Defender

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

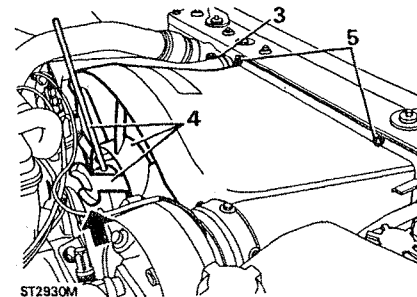
3. Reverse instructions 1 and 2.

FAN AND COUPLING ASSEMBLY - Tdi Defender

Service Repair No. 26.25.19

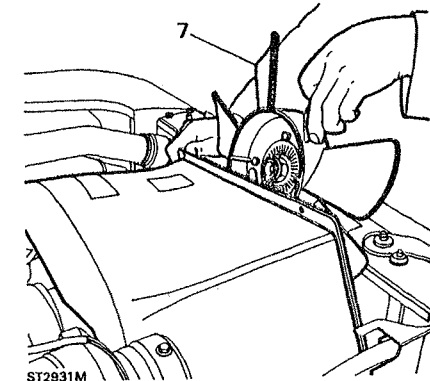
Remove

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.



ST2930M

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.



ST2931M

Refitting

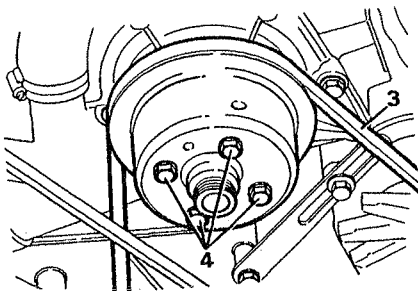
8. Insert the fan and coupling into the base of the cowl reversing the removal procedure.
9. Fit the coupling to the water pump spindle noting that it has a left hand thread. Tighten the coupling using the restraining bar and cranked spanner.
10. Fit the cowl and secure with the two nuts. Ensure that 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.

WATER PUMP - Tdi Defender

Service Repair No. 26.50.01

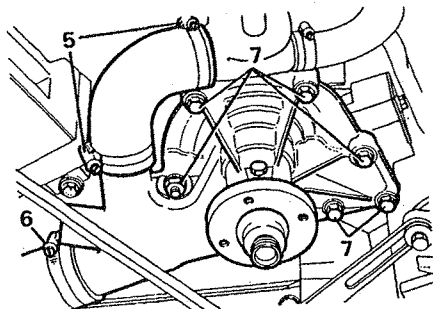
Remove

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.

NOTE: Further information relating to the water pump is contained in the Tdi Engine Overhaul Section 12.

WATER PUMP V8 ENGINE Remove and refit

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

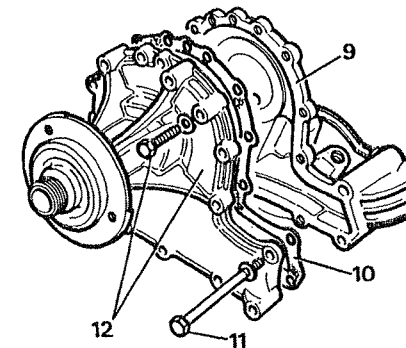
Removing

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

NOTE: Information relating to the inspection of the water pump is contained in the V8 engine overhaul section 12.

Fitting

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



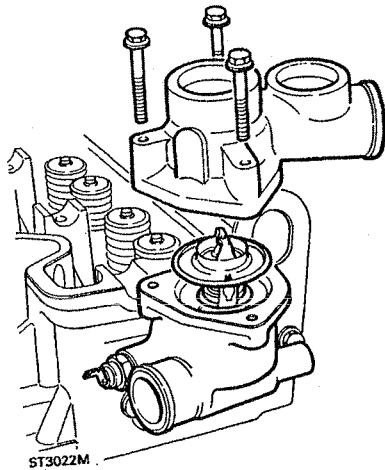
ST3166M

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

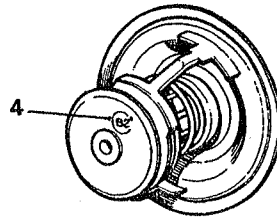
FOUR CYLINDER ENGINE THERMOSTAT, RENEW

NOTE: Although the design of the thermostat housing varies according to the engine, the principle is the same for all the engines.

1. Disconnect the battery and drain the cooling system.
2. Disconnect or remove any pipes or hoses that could inhibit access to the thermostat housing.
3. Remove the three bolts securing the housing cover and lift-off the cover and remove the thermostat.



4. 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 base. Any leakage of wax (which is the colour of copper) from around the centre pin of the thermostat, indicates that it is faulty and should be renewed.



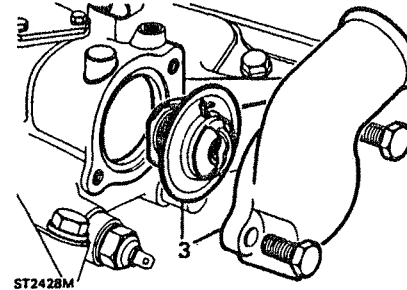
ST857M

Refitting

5. Clean the thermostat housing and cover and fit the thermostat. The "jiggle" pin which allows air to escape from below the thermostat, can be fitted in any position.
6. Fit a new gasket and apply Hylomar to the threads of the bolts. Fit the bolts and evenly tighten to the correct torque.
7. Reconnect any pipes and hoses and other items removed to gain access.
8. Refill the cooling system in accordance with the instructions in this section.

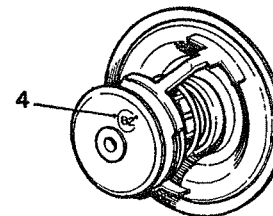
V8 ENGINE THERMOSTAT, RENEW

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



ST2428M

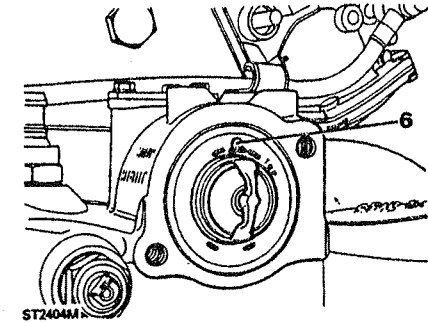
4. The temperature at which the thermostat should be fully open is stamped on the forward end of the thermostat. The following method can be used to determine if the thermostat is satisfactory and suitable for refitting.



ST857M

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

6. The thermostat has a small vent hole in which is fitted a "jiggle" pin to keep the hole clear. Fit the thermostat to the housing ensuring that this vent is uppermost at the 12 o'clock position. If fitted in any other way, an air lock could result in the water passages causing overheating and coolant loss from the system.



ST2404M

7. Fit the thermostat cover using a new gasket. Coat the threads of the retaining screws with Loctite 572 and tighten the screws evenly to the correct torque.
8. Connect all pipes and hoses and refill the cooling system in accordance with the instructions in this section.

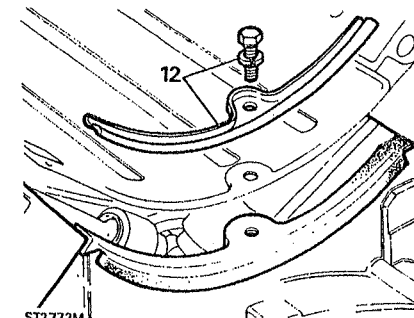
COOLING SYSTEM FAULT DIAGNOSIS

FAULT	POSSIBLE CAUSE	CURE
A-EXTERNAL LEAKAGE	<ol style="list-style-type: none"> Loose hose clips Defective rubber hose Damaged radiator seams Excessive wear in the water pump Loose core plugs Damaged gaskets Leaks at the heater connections or plugs Leak at the water temperature gauge plug 	<ol style="list-style-type: none"> Tighten Renew Rectify Renew Renew Renew Rectify Tighten
B-INTERNAL LEAKAGE	<ol style="list-style-type: none"> Defective cylinder head gasket Cracked cylinder wall Loose cylinder head bolts 	<ol style="list-style-type: none"> Renew. Check engine oil for contamination and refill as necessary Renew cylinder block Tighten. Check engine for oil contamination and refill as necessary
C-WATER LOSS	<ol style="list-style-type: none"> Boiling Internal or external leakage Restricted radiator or inoperative 	<ol style="list-style-type: none"> Ascertain the cause of engine overheating and correct as necessary See items A and B Flush radiator or renew the thermostat as necessary
D-POOR CIRCULATION	<ol style="list-style-type: none"> Restriction in system Insufficient coolant Inoperative water pump Loose fan belt Inoperative thermostat 	<ol style="list-style-type: none"> Check hoses for crimps, reverse-flush the radiator, and clear the system of rust and sludge Replenish Renew Adjust Renew
E-CORROSION	<ol style="list-style-type: none"> Excessive impurity in the water Infrequent flushing and draining of system Incorrect anti-freeze mixtures 	<ol style="list-style-type: none"> Use only soft, clean water together with correct anti-freeze or inhibitor mixture The cooling system should be drained and flushed thoroughly at least once a year Certain anti-freeze solutions have a corrosive effect on parts of the cooling system. Only recommended solutions should be used.
F-OVERHEATING	<ol style="list-style-type: none"> Poor circulation Dirty oil and sludge in engine Radiator fins choked with chaff, mud, etc. Incorrect ignition timing Insufficient coolant Low oil level Tight engine Choked or damaged exhaust pipe or Dragging brakes Overloading vehicle Driving in heavy sand or mud Engine labouring on gradients Low gear work Excessive engine idling Inaccurate temperature gauge Defective thermostat 	<ol style="list-style-type: none"> See item D Refill Use air pressure from the engine side of the radiator and clean out passages thoroughly Check using electronic equipment See item D Replenish New engines are very tight during the 'running-in' period and moderate speeds should be maintained for the first 1,000 miles (1500 km) Rectify or renew silencer Adjust brakes In the hands of the operator In the hands of the operator In the hands of the operator In the hands of the operator Renew Renew
G-OVERCOOLING	<ol style="list-style-type: none"> Defective thermostat Inaccurate temperature gauge 	<ol style="list-style-type: none"> Renew Renew

V8 ENGINE INLET MANIFOLD

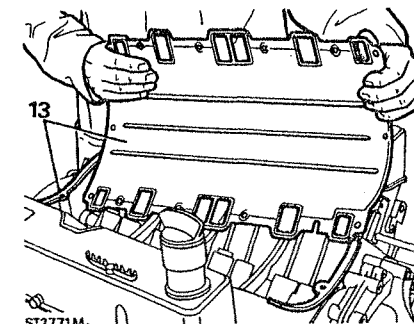
Remove

- Release the bottom hose from the radiator to partially drain the cooling system. Refit and tighten hose clip. Disconnect the battery.
- Remove the air cleaner and elbows from the carburetters and engine breather hoses.
- Disconnect the heater hoses from the rear of the manifold.
- Disconnect the throttle cable from the carburetter linkage.
- Disconnect the radiator top hose from thermostat housing.
- Disconnect the brake servo hose from the manifold.
- Disconnect the fuel supply and spill return pipes from the carburetters.
- Disconnect the H.T. leads from the spark plugs and remove the distributor cap. Cover the exposed distributor to prevent damage and entry of dirt.
- Remove or disconnect any other pipes, hoses and electrical leads and make note of the positions to assist assembly.
- Evenly slacken and withdraw the twelve bolts securing the manifold to the cylinder block. Carefully lift-off the manifold complete with carburetters.



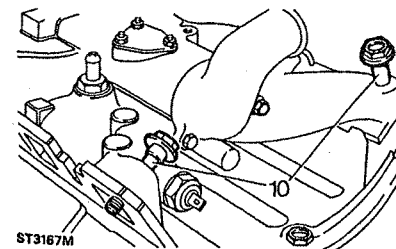
ST2772M

13. Lift-off the gasket and remove the seals.



ST2771M

Fitting manifolds



ST3167M

- If required release the eight nuts and remove the carburetters whilst noting the sequence of the joint washers, deflector and insulator.

Removing manifold gasket

- If it is necessary, to renew the gasket, wipe away surplus coolant from the gasket and remove the gasket clamps.

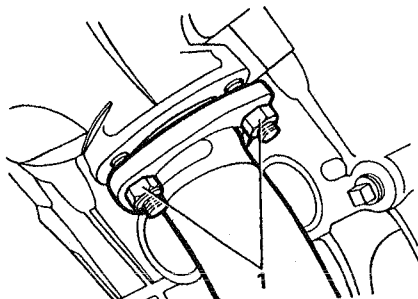
- Coat both sides of new gasket seals with silicon grease.
- Apply a 6 mm diameter globule of Loctite Super Flex in the four notches formed between the cylinder head and block. Locate the seals in position with the ends engaged in the notches.
- Apply Hylomar sealing compound SQ32M at the corners of the cylinder heads, gasket, and manifold, round the water passage joints.
- Fit the manifold gasket with the word 'FRONT' towards the front of the engine and the slotted bolt hole at the front right hand side.

V8 ENGINE EXHAUST MANIFOLDS

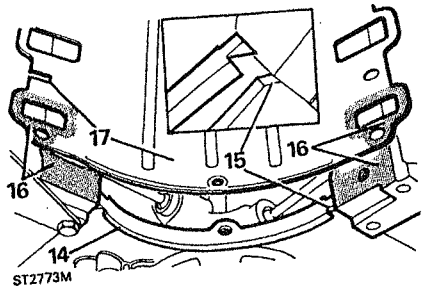
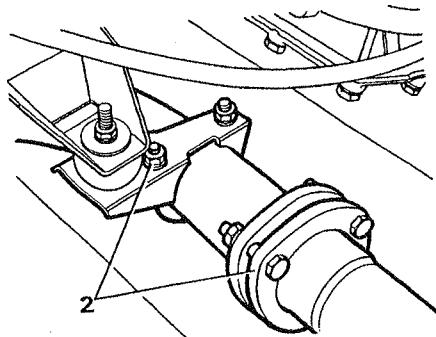
Remove

CAUTION: It is important to ensure that when renewing or disturbing any part of the exhaust system that the various joints are checked for leaks. A leaking system could allow dangerous fumes to enter the vehicle, contravene emission regulations and adversely affect vehicle engine performance.

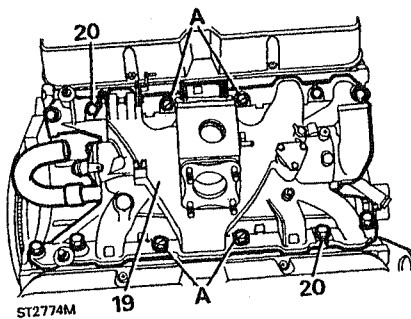
1. Disconnect the battery and from beneath the vehicle, remove the six nuts, three each side, securing the exhaust front pipes to the manifolds.



2. To prevent any strain on the pipe system, slacken the front pipe fixings at the gearbox bracket and flanged joints.



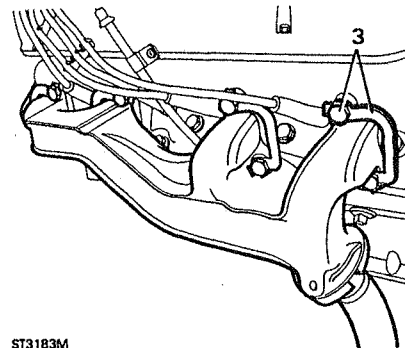
18. Fit the gasket clamps but do not dully tighten the securing bolts at this stage.
19. Fit the manifold to the cylinder heads. Clean the threads of the twelve manifold securing bolts and apply Loctite 572 to the threads.
20. Fit the manifold bolts noting that the four with the slotted heads are fitted at the positions 'A'. Tighten the bolts a little at a time at alternate sides working from the centre to the outside. Finally, tighten to the correct torque. Also, tighten the clamp bolts to the correct torque.



21. If removed, refit the carburetters see SECTION 19
22. Reverse instructions 2 to 9 and refill the cooling system with the required concentration of anti-freeze, see SECTION 26.
23. Connect the battery, start the engine and check for coolant leaks.

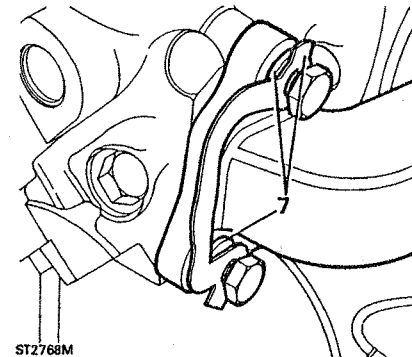
NOTE: In order to gain access to the manifolds, it may be necessary to remove other items depending upon the particular model variant. Moreover, the design of the manifolds may also differ from one model to another. The method of attachment, however is the same.

3. From within the engine compartment, bend back the lock tabs and remove the eight bolts securing each manifold to the cylinder head.
4. Withdraw the manifolds.



Fitting manifolds

5. Ensure that the mating faces on the cylinder head and exhaust manifolds are clean and smooth.
6. Coat the manifold and cylinder head faces with Foliac J166 or Moly Paul anti-seize compound. Foliac J 166 is manufactured by Rocal Ltd, Rocal House, Swillington, Leeds, England. Moly Paul is made by K.S. Paul Products Ltd, Nobel Road, London N18.
7. Offer-up the manifolds to the cylinder head and secure with the bolts, lock plates and plain washers. The plain washers are fitted between the manifold and lock plates. Evenly tighten the manifold bolts to the correct torque and bend the tabs over a convenient flat.



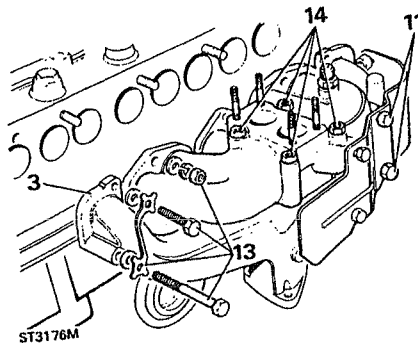
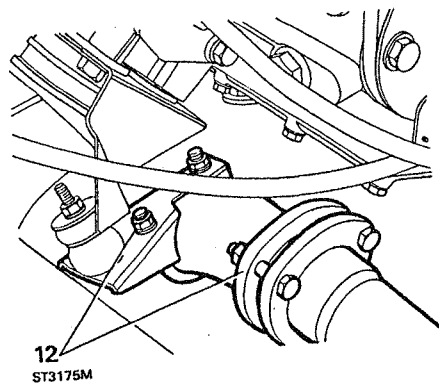
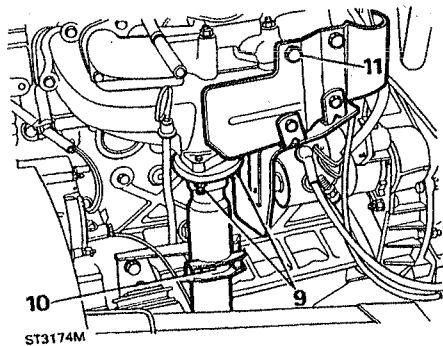
8. Without imposing any strain upon the exhaust pipe system, assemble the front pipes to the manifold and secure with the nuts whilst ensuring that the two flanges are parallel to each other. Tighten the nuts evenly to the correct torque.
9. Tighten the front pipe fixings at the gearbox bracket.
10. Refit any items removed to gain access to the manifolds.
11. Connect the battery, run the engine and check for exhaust gas leaks.

FOUR CYLINDER PETROL ENGINE MANIFOLDS

Remove and refit

Removing

1. Disconnect the air intake hose to the carburettor intake cover.
2. Disconnect the fuel supply pipe.
3. Remove the breather pipes from the carburettor.
4. Release the mixture control and throttle cables from the carburettors.
5. Remove the advance and retard vacuum pipe.
6. Disconnect the fuel cut-off valve lucar.
7. Remove the brake servo hose from the inlet manifold.
8. Remove the four nuts and lift-off the carburettor.
9. Remove the three nuts securing the front pipe to the exhaust manifold flange.
10. Release the front pipe from the engine mounted support bracket.
11. Remove the five bolts to remove the heat shield.



Refitting

12. Disconnect the front exhaust pipe from the gearbox mounted support bracket and flanged joint.
13. Bend-back the four lock tabs and remove the eight bolts and three nuts retaining the inlet and exhaust manifold assembly from the cylinder head.
14. If necessary, remove the four nuts and separate the two manifolds.

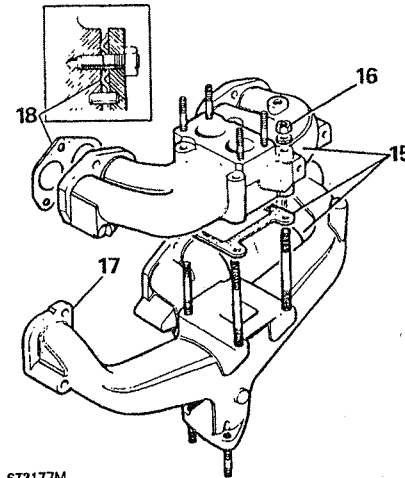
15. If separated, assemble the inlet manifold to the exhaust manifold using a new 'hot spot' joint washer.
16. Secure the two manifolds together with the four nuts tightening evenly to the correct torque, then slacken the nuts off but retain the 'nip'.
17. Coat the face of the exhaust manifold with Rocol anti-sieze compound Foliac J166 (paste) and the corresponding face of the cylinder head.
18. Fit the joint washers of inlet manifold with the raised rings towards the cylinder head.
19. 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.
20. Finally tighten the four 'hot spot' joint nuts evenly to correct torque.
21. Fit the heat shield.

DIESEL ENGINE MANIFOLDS 2.25 and 2.5 NA.

Remove and refit

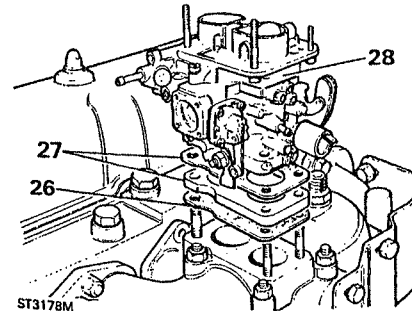
Removing

1. Disconnect the battery for safety.
2. Remove the air hose from the air inlet manifold.
3. If fitted, disconnect the breather hose from the air inlet manifold.
4. Remove the six common nuts and clamps that secure the air inlet and exhaust manifolds to the cylinder head and withdraw the air inlet manifold.
5. Release the front exhaust pipe from the engine mounted support bracket.
6. Release the front exhaust pipe from the gearbox mounted support bracket.
7. Remove the three nuts that attach the front pipe to the exhaust manifold flange.
8. Remove the remaining three nuts and withdraw the manifold and common gasket.



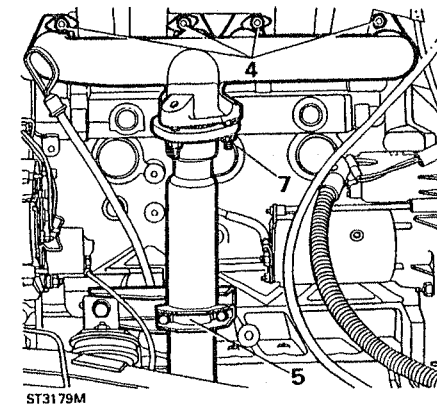
ST3177M

22. Secure the front pipe to the exhaust manifold and tighten the three nuts evenly to the correct torque.
23. Loosely secure the front pipe to the engine mounted support bracket.
24. Similarly, secure the front pipe to the gearbox mounted support bracket.
25. Without imposing any strain on the manifold to front pipe joint, tighten the fixings on both support brackets.



ST3178M

26. Clean the carburettor and manifold mating faces and place a new joint washer on the manifold over the studs.
27. Fit the insulation block and second joint washer.
28. Fit the carburettor and secure with the four nuts and washers tightening evenly to the correct torque.
29. Reverse instructions 1 to 7.



ST3179M

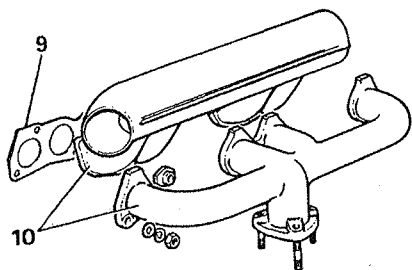
Refitting

9. Clean the manifold and cylinder head mating faces and place a new gasket in position on the cylinder head.
10. Fit the exhaust and air inlet manifolds and secure with the nuts and clamps. Tighten evenly to the correct torque.

**TURBO CHARGED 2.5 DIESEL ENGINE
MANIFOLDS - Remove and refit**

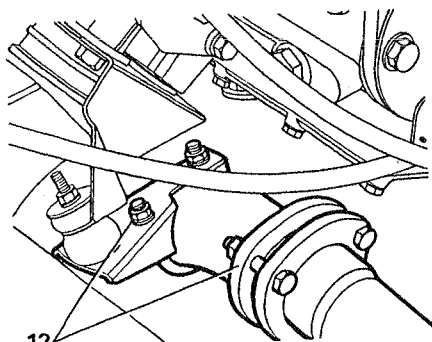
Removing

1. Remove the Turbo Charger (Garrett T2) see, SECTION 19 FUEL SYSTEM - Diesel
2. Remove any other items that could impede access to the manifolds.
3. Remove the nuts and clamps and socket headed bolts securing the exhaust manifold to the cylinder head and remove the manifold.



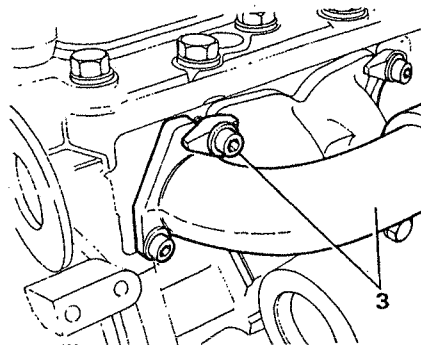
ST3180M

11. Secure the front pipe to the exhaust manifold with the three nuts tightening evenly to the required torque. Ensure that the two flanges are parallel to each other.
12. Loosely secure the front pipe to the engine mounted support bracket and likewise to the gearbox mounted support bracket.



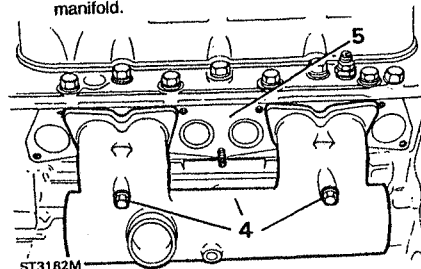
ST3175M

13. Without imposing any strain on the manifold joint, tighten the two support bracket fixings.
14. Connect the air hose and breather pipe to the air inlet manifold.
15. Connect the battery, run the engine and check for leaks.



ST3181M

4. Remove the two bolts retaining the inlet manifold.



ST3182M

Refitting

5. Clean the manifold and cylinder head mating faces and fit a new gasket.
6. Fit the inlet manifold and secure with the two bolts.
7. Fit the exhaust manifold and retain with the three nuts, five socket headed bolts and clamps. Tighten evenly to the correct torque.
8. Fit the Turbo Charger in accordance with the instructions in SECTION 19 - FUEL SYSTEM - Diesel. Prime the Turbo Charger Centre housing before starting the engine.

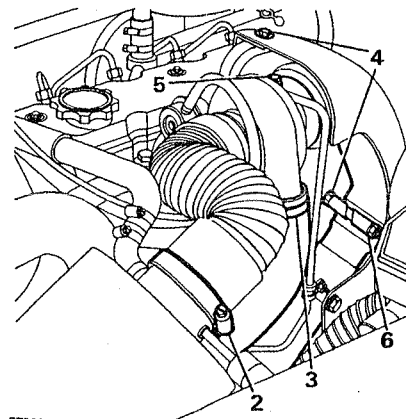
EXHAUST AND INLET MANIFOLDS Tdi ENGINE

Service Repair No. 30.15.01

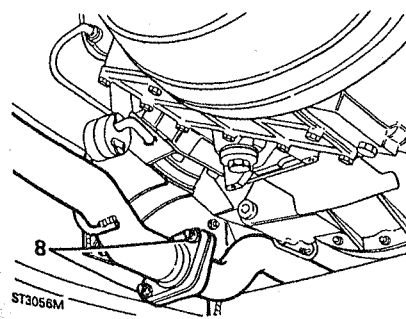
Remove and refit

NOTE: To remove the inlet manifold, the exhaust manifold 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.

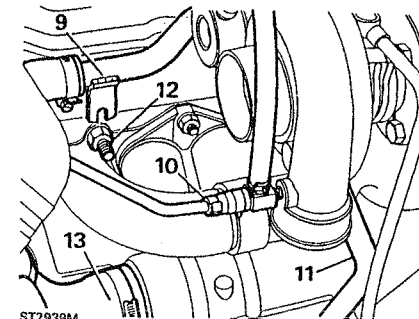


ST2938M



ST3056M

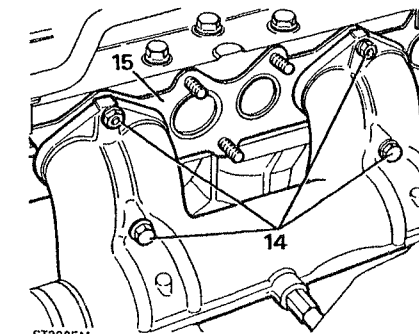
7. Release the front exhaust pipe bracket from the cylinder block.
8. Disconnect the front exhaust pipe from the forward silencer pipe.
9. Release the heater rail from the exhaust manifold studs.
10. Disconnect the boost pressure pipe from the turbo charger.
11. Disconnect the turbo charger oil drain pipe from the cylinder block.
12. Remove the exhaust manifold nuts and withdraw the manifold complete with the turbo charger.



ST2939M

Inlet manifold

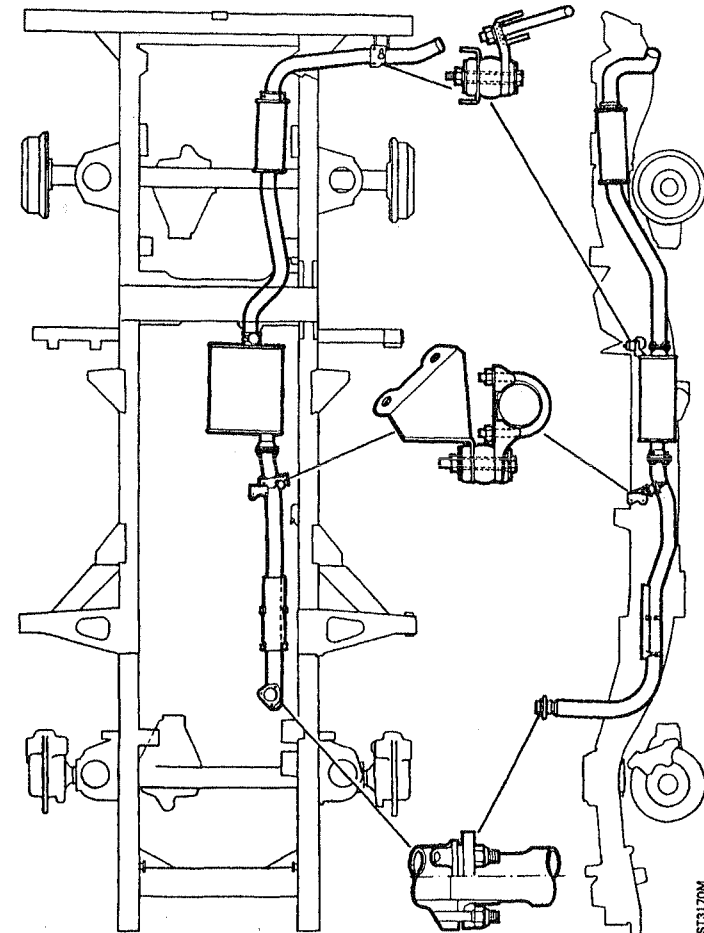
13. Disconnect hose form inlet manifolds.
14. Remove the two bolts and two nuts and withdraw the inlet manifold and remove the common gasket.



ST2935M

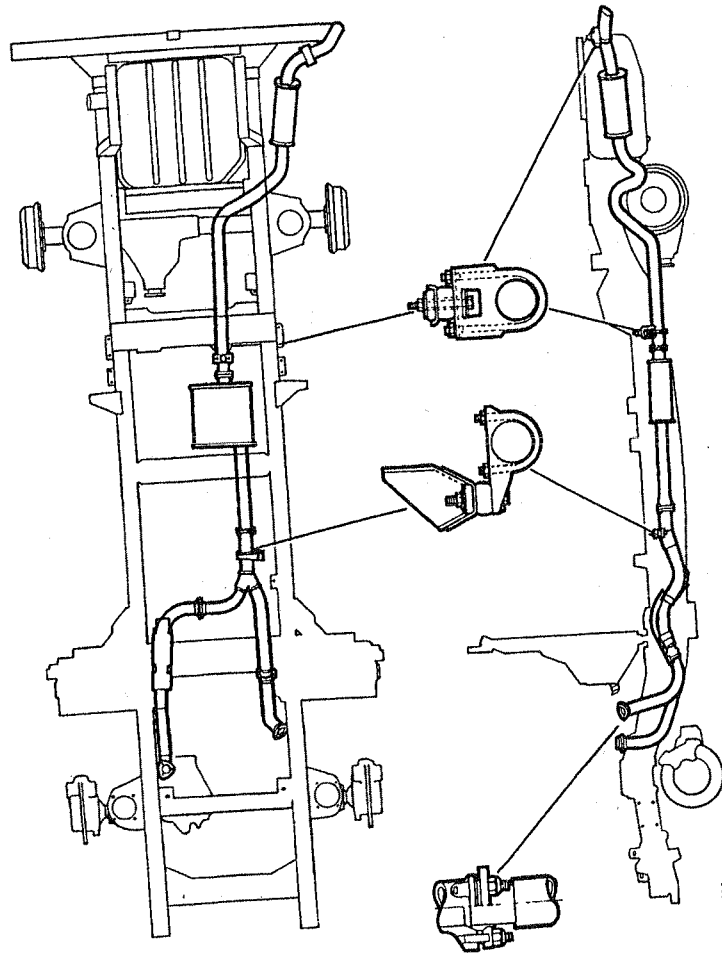
Refitting

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 charger heat shield.
27. Connect the battery, run the engine and check for exhaust gas leaks.

LAND ROVER 90
4 CYLINDER PETROL ENGINE EXHAUST SYSTEM

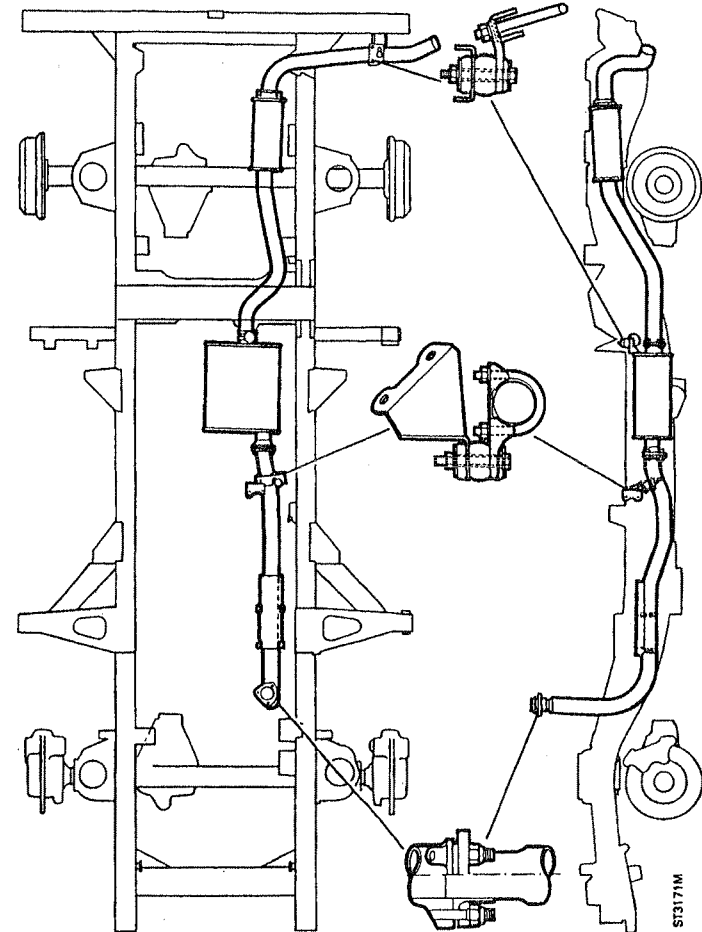
ST3170M

LAND ROVER V8 110
EXHAUST SYSTEM



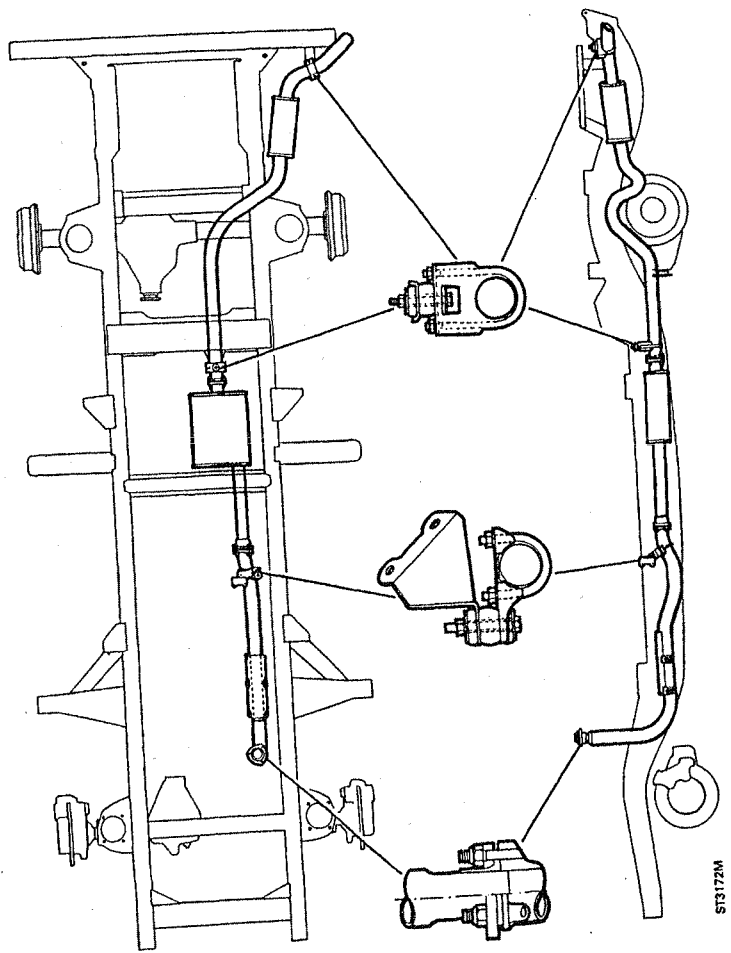
ST3169M

LAND ROVER 90
4 CYLINDER DIESEL ENGINE EXHAUST SYSTEM (NOT Tdi)

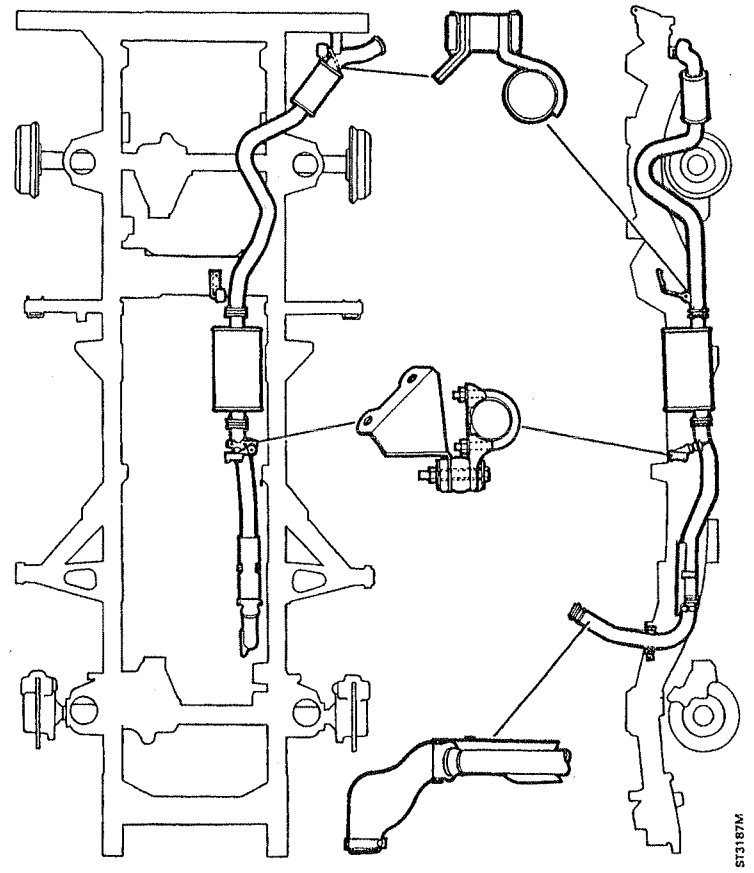


ST3171M

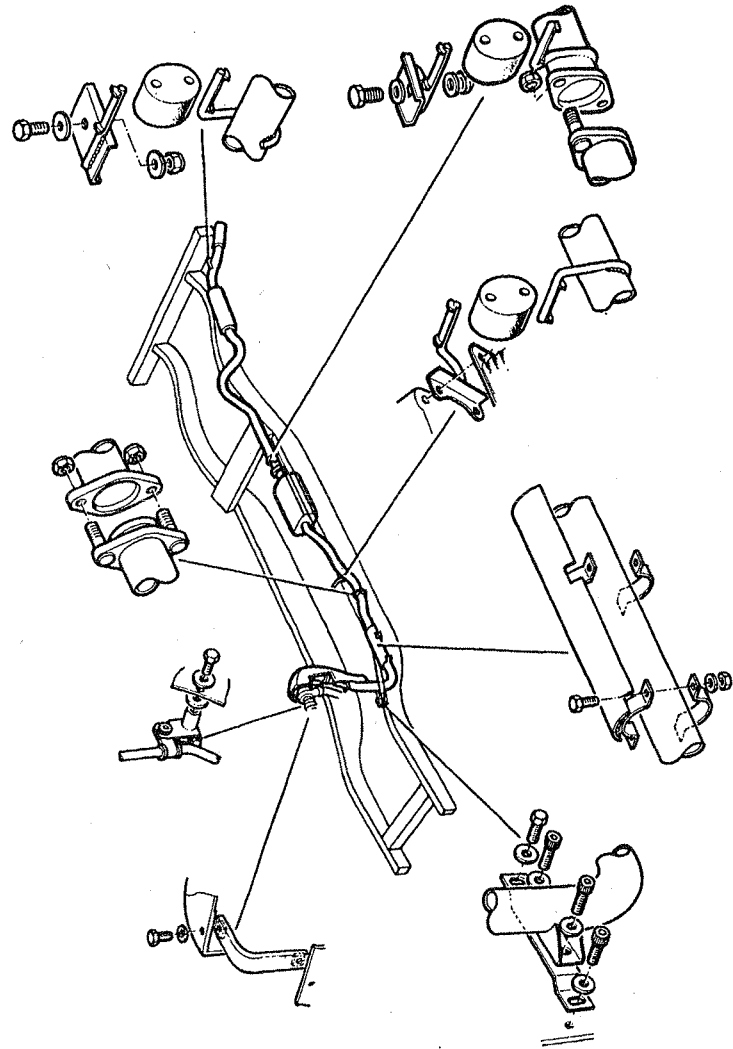
LAND ROVER 110
4 CYLINDER PETROL ENGINE EXHAUST SYSTEM



LAND ROVER 90
TURBO DIESEL ENGINE EXHAUST SYSTEM (NOT Tdi)

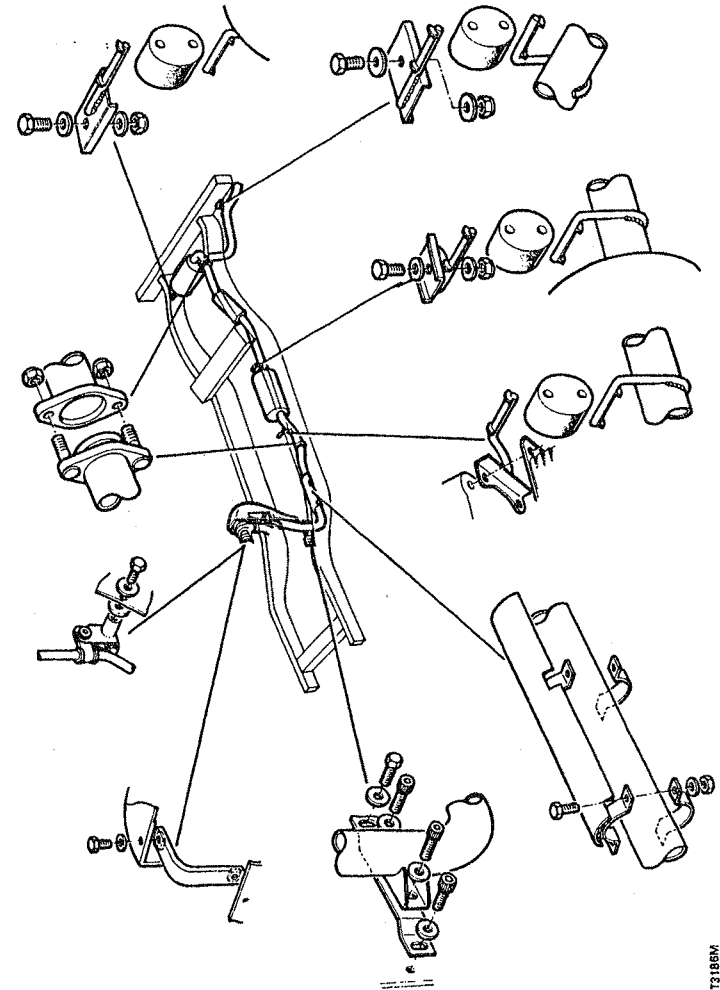


110 DIESEL DEFENDER Tdi
EXHAUST SYSTEM



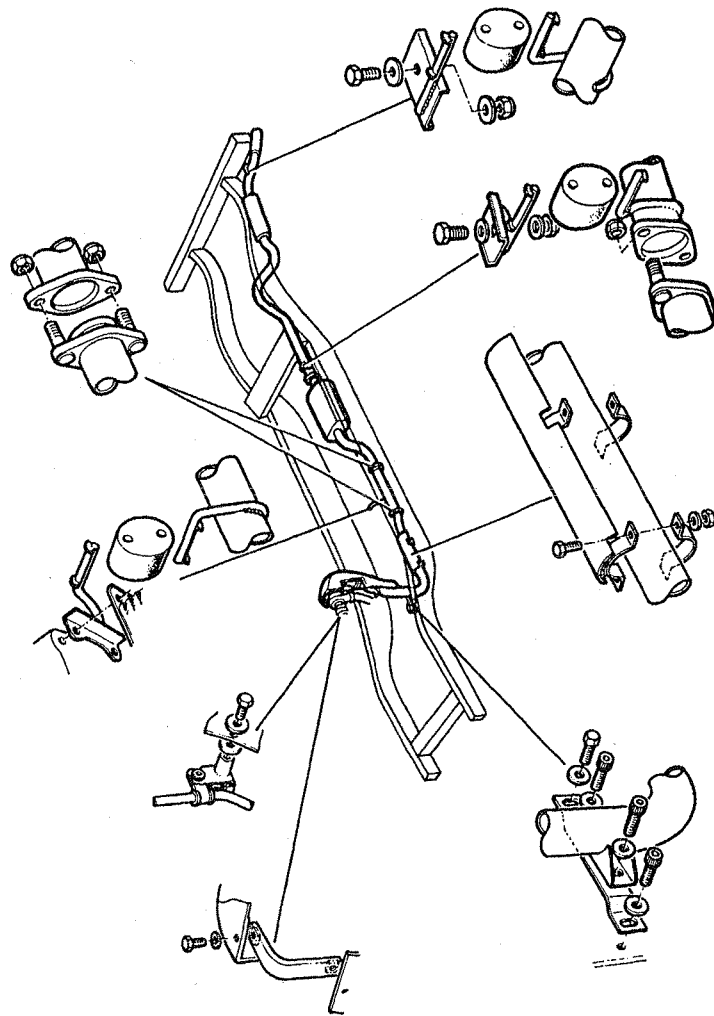
5T3185M

90 DIESEL DEFENDER
Tdi EXHAUST SYSTEM



5T3185M

LAND ROVER 127 DIESEL HIGH CAPACITY PICK-UP



ST3184M

CLUTCH ASSEMBLY RENEWAL

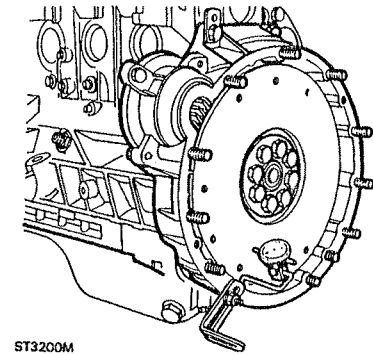
The major part of clutch assembly renewal is the removal of the transmission to gain access to the clutch. Because of the considerable combined weight of the main gearbox and transfer box and the off-set centre of gravity, it is vital that clutch replacement must only be undertaken by organisations or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

Renewal of the clutch assembly, once the transmission has been removed, is included in the appropriate engine overhaul in SECTION 12.

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

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

If the clutch has been allowed to slip for a length of time, excessive heat will have been created and the flywheel, apart from the clutch assembly, may well be burnt, cracked, scored and distorted and must be renewed or refaced as described in SECTION 12. Also, the ring gear should be examined and if worn, chipped, or has teeth missing, it must be renewed. Once the new or reconditioned flywheel has been fitted and the bolts tightened to the correct torque, it should be checked for run-out with a dial test indicator. Run-out must not exceed 0,05 to 0,07 mm.

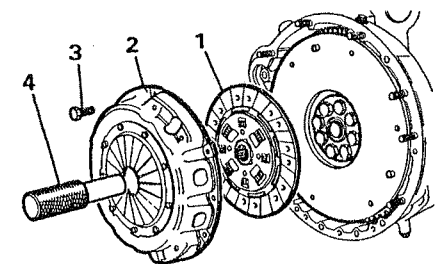


ST3200M

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

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

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



ST3201M

- 1. Friction plate
- 2. Clutch cover
- 3. Cover bolts
- 4. Centralising tool

CLUTCH FAULT DIAGNOSIS

CLUTCH SLIPPING

NOTE: Ensure that the pedal return stop is correctly adjusted. Start with check No. 1 and proceed as directed.

CLUTCH JUDDER AND NOISE WHEN PEDAL IS RELEASED

Start with check No. 8 and proceed as directed.

CLUTCH FIERCE

Start with check No. 15 and proceed as directed.

CLUTCH DRAGS

Start with check No. 20 and proceed as directed.

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

OVERHAUL RELEASE BEARING ASSEMBLY

1. Remove the clutch slave cylinder from the bell housing.
2. Withdraw the retaining staple, if fitted.
3. Remove the release bearing assembly.
4. Remove the spring clip retaining bolt and spring - V8 engines.
5. Remove the slipper pads - 4 cylinder engines.
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 engines.
9. Smear the release bearing sleeve inner diameter with Molybdenum disulphide base grease.
10. Fit the slipper pads - 4 cylinder engines.
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.

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.

Illustration A. V8 engine.

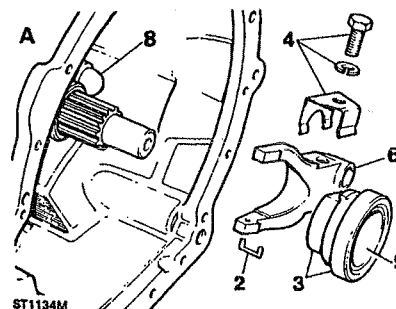
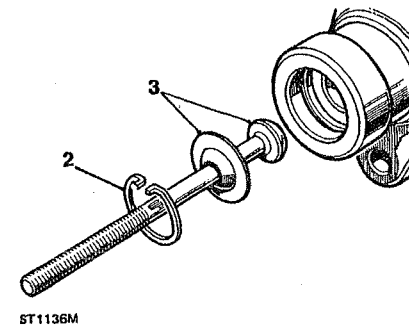
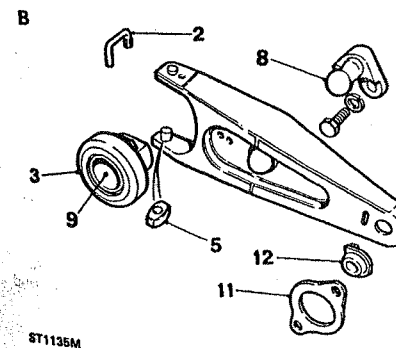
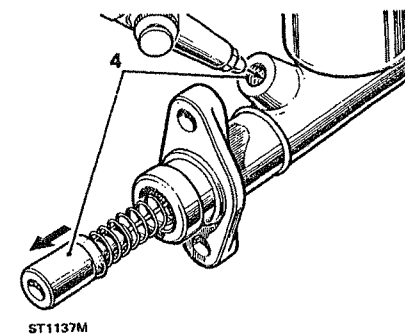


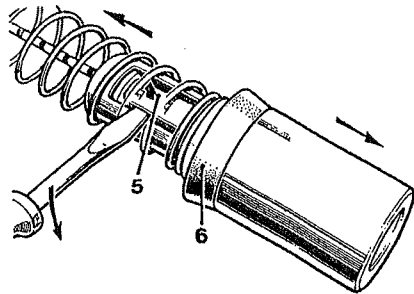
Illustration B. 4-cylinder engine.



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

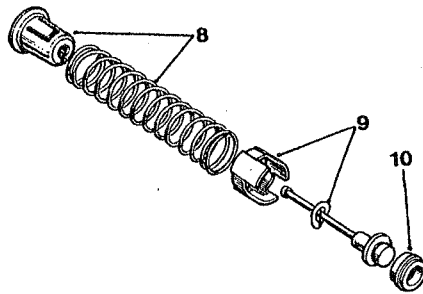


5. Prise the locking prong of the spring retainer clear of the piston shoulder and withdraw the piston.
6. Withdraw the piston seal.
7. Compress the spring and position the valve stem to align with the larger hole in the spring retainer.



ST1138M

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



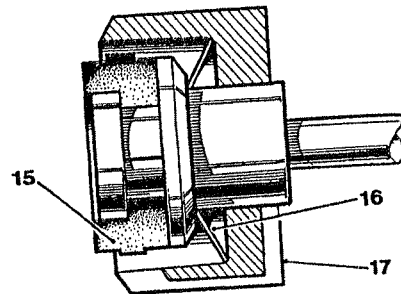
ST1139M

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.

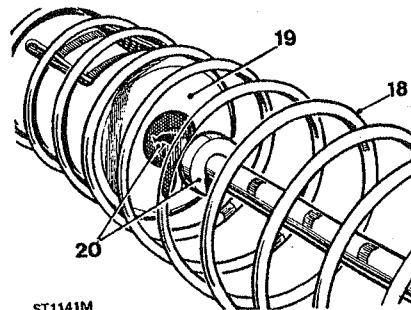
Assemble

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.



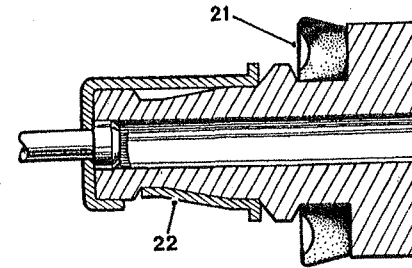
ST1141M

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

OVERHAUL SLAVE CYLINDER

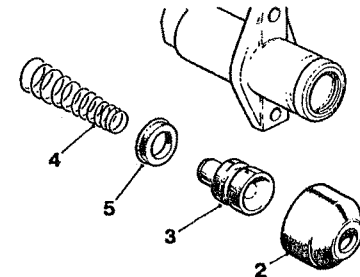
Dismantle

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.



ST1142M

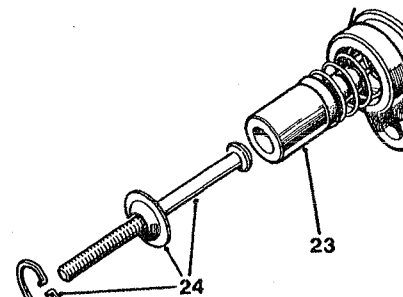
23. Smear the piston with Castrol-Girling rubber grease and insert the assembly, valve end first, into the cylinder.
24. Fit the push-rod, retaining washer and circlip.



ST1144M

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.



ST1143M

Assemble

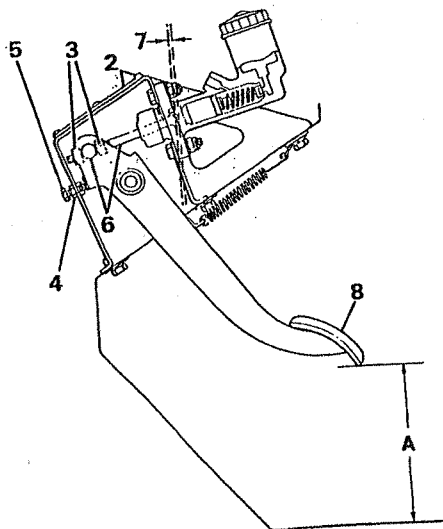
9. Smear the seal with Castrol-Girling rubber grease and the remaining internal items with Castrol-Girling brake and clutch fluid.
10. Fit the seal, large diameter last, to the piston.
11. Locate the conical spring, small diameter first, over the front end of the piston.
12. Smear the piston with Castrol-Girling 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, dimension 'A'.

Adjust

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



ST1535M

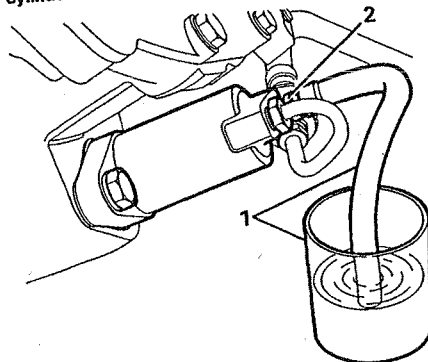
BLEED CLUTCH HYDRAULIC SYSTEM

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

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

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

NOTE: The illustration shows a V8 engine slave cylinder.



ST3199M

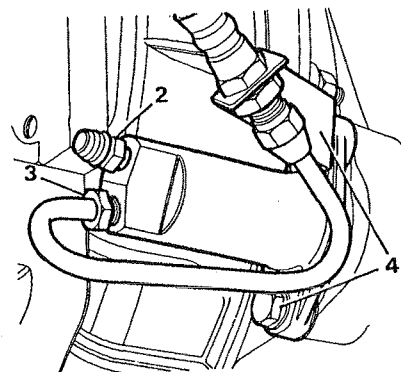
RENEW CLUTCH SLAVE CYLINDER

Fitting

1. Disconnect the battery.
2. Working from beneath the vehicle, remove the dust cap and turn the bleed screw anti-clockwise to release the hydraulic fluid into a suitable container.
3. Disconnect the fluid supply pipe from the slave cylinder.

NOTE: The example shown in the illustration below is a four cylinder engine slave cylinder.

4. Remove the two bolts securing the slave cylinder to the bell housing and withdraw the slave cylinder and flexible hose support bracket.



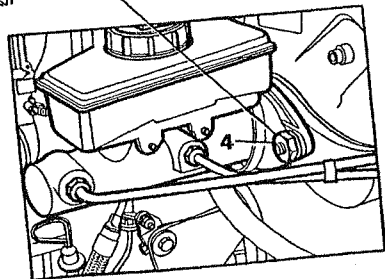
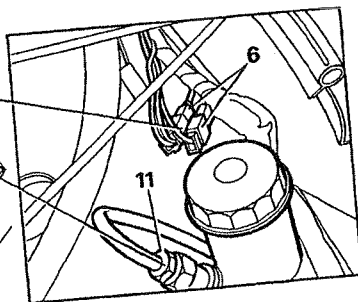
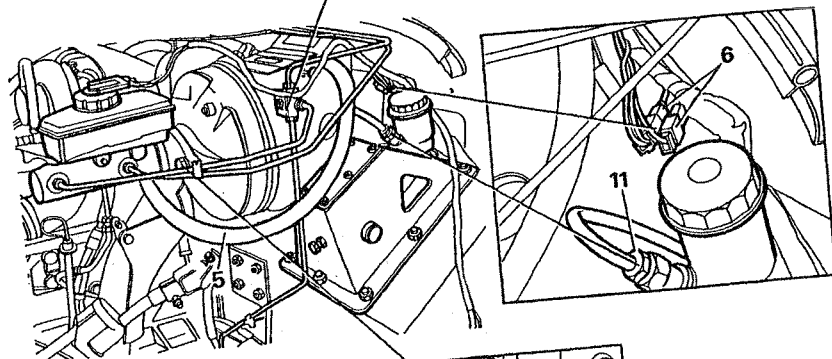
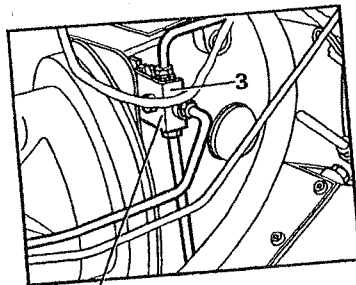
ST3202M

RENEW CLUTCH MASTER CYLINDER

Left hand drive vehicles

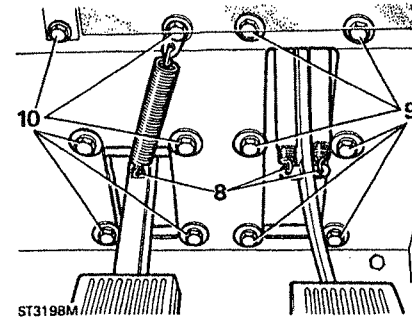
1. Disconnect the battery.
2. Remove the bonnet.
3. Where fitted, on '90' models, release the bracket from the servo that secures the three way hydraulic union.
4. Remove the two nuts securing the master cylinder to the servo and carefully ease the master cylinder away from the servo without imposing any strain upon the brake fluid pipes.

5. Disconnect the vacuum hose from the servo and move aside.
6. Disconnect the two brake lamp lucars.
7. From inside the vehicle, remove the fibre board closing panel.



ST3197M

8. Release the two return springs from the brake pedal and single spring from the clutch pedal.
9. Remove the six bolts securing the brake pedal box to the bulkhead and carefully withdraw the pedal box with the servo sufficiently to allow clearance for the clutch master cylinder and pedal box to be withdrawn.
10. Remove the six bolts securing the clutch pedal box to the bulkhead.

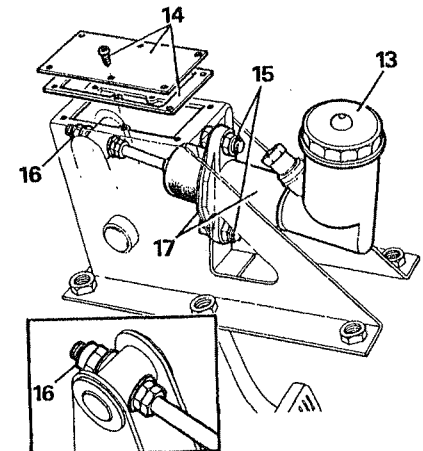


ST3198M

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

Refitting

18. Fit the two locknuts and plain washer to the push-rod.
19. Fit the master cylinder and steel gasket to the pedal box and insert the push-rod through the bush and trunion and loosely fit the single nut to the end of the push-rod.



ST3195M

20. Secure the master cylinder with the two nuts and bolts to the pedal box.
21. Fit the pedal box to the bulkhead resealing with Bostik adhesive and secure with the six bolts.
22. Check the clutch pedal height and free play, see page 6 of this section, adjust if necessary, and tighten the push-rod end nut. Connect the return spring to the pedal.
23. Fit the pedal box cover with a new gasket and secure with the six screws.
24. Connect the fluid pipe to the master cylinder.
25. Fit the brake servo and pedal box assembly, reseal with Bostik adhesive and secure with the six bolts.
26. Connect the return springs to the pedal.
27. Fit the brake master cylinder to the servo and tighten the two nuts.
28. Fit the fibre board closing panel.
29. Connect the stop lamp lucars.
30. Attach the three way pipe union bracket to the servo (90 models).
31. Connect the vacuum hose to the servo.
32. Fill the clutch master cylinder with new fluid from a sealed container of the recommended grade to the level mark on the side of the reservoir.
33. Bleed the clutch hydraulic system and fit the reservoir cap.
34. Connect the battery, fit the bonnet and road test the vehicle.

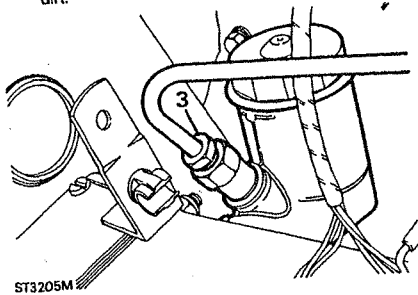
33 CLUTCH

DEFENDER

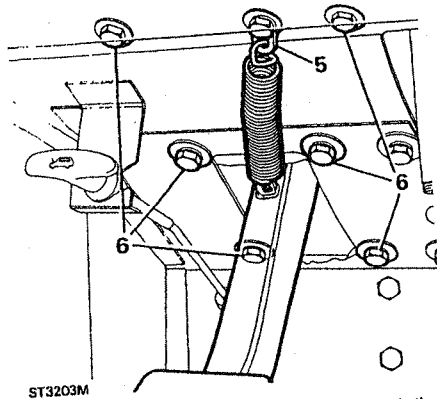
RENEW CLUTCH MASTER CYLINDER

Right hand drive vehicles

1. Disconnect the battery.
2. Remove the bonnet.
3. Disconnect the hydraulic pipe from the master cylinder and cover the end to prevent entry of dirt.

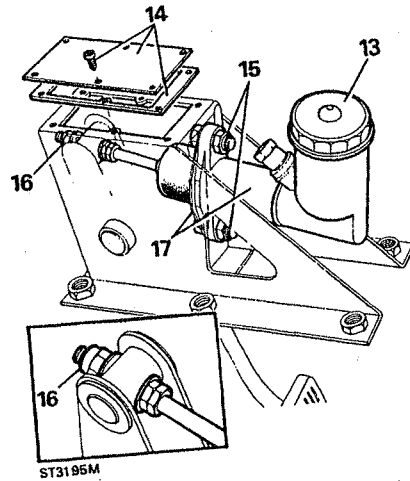


4. Remove the fibre board closing panel above the pedals.
5. Release the spring from the clutch pedal.
6. Remove the six bolts securing the clutch pedal box to the bulkhead.
7. From within the engine compartment remove the pedal box and master cylinder assembly from the vehicle.



8. Remove the reservoir cap and discaed the fluid.
9. Remove the six screws and lift off the pedal box top cover and gasket.
10. Remove the two nuts and bolts that secure the master cylinder to the pedal box.

11. Remove the nut and washer from the end of the master cylinder push-rod.
12. Withdraw the master cylinder and steel gasket.



13. Fit the two locknuts and plain washer to the push-rod.
14. Fit the master cylinder and steel gasket to the pedal box and insert the push-rod through the bush and trunnion and loosely fit the single nut to the end of the push-rod.
15. Secure the master cylinder with the two nuts and bolts to the pedal box.
16. Fit the pedal box to the bulkhead resealing with Bostik adhesive and secure with the six bolts.
17. Check the clutch pedal height and free-play, see page 6 of this section, adjust if necessary, and tighten the push-rod end nut. Connect the return spring to the pedal.
18. Fit the pedal box top cover with a new gasket and secure with the six screws.
19. Connect the fluid pipe to the master cylinder.
20. Fit the brake pedal return spring.
21. Fit the fibre board closing panel.
22. Fill the clutch master cylinder with new fluid from a sealed container of the recommended grade to the level mark on the side of the reservoir.
23. Bleed the clutch hydraulic system and fit the reservoir cap.
24. Connect the battery, fit the bonnet and road test the vehicle.

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51 REAR AXLE AND FINAL DRIVE

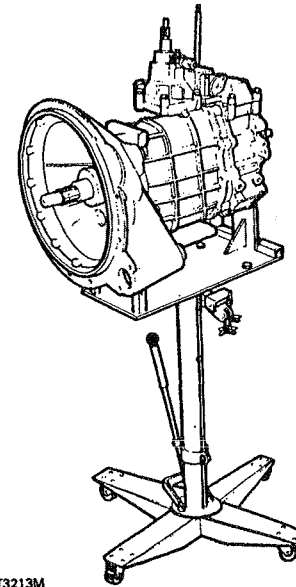
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**REMOVE LT77 FIVE SPEED GEARBOX AND
LT230 TRANSFER BOX - FOUR CYLINDER
MODELS**

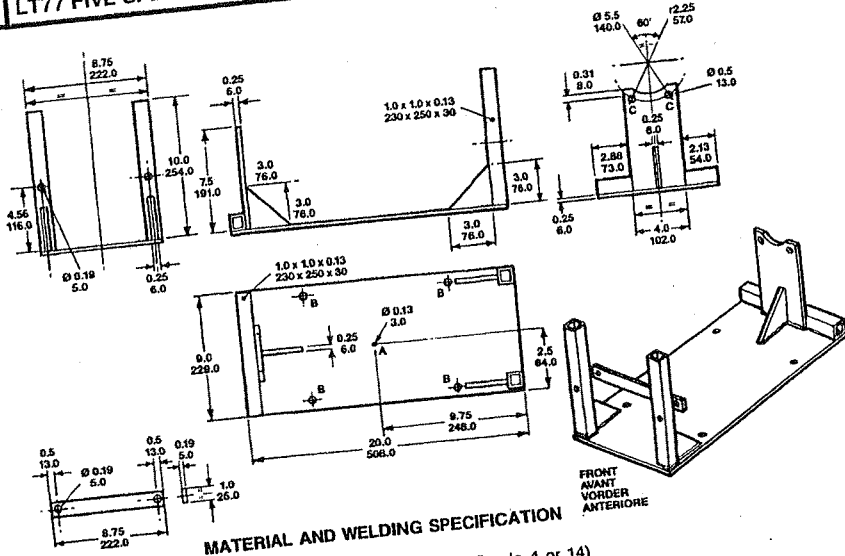
WARNING: Where the use of a transmission hoist is necessary, it is absolutely essential to follow the manufacturers' instructions to ensure safe and effective use of the equipment.



ST3213M

1. Install the vehicle on a ramp.
2. Disconnect the battery.
3. Remove the gear lever knob.
4. Remove the transfer and differential lock knob.
5. Remove the gear lever cover.
6. Remove the 10 mm Nyloc nut and plain washer. Mark the gear lever spline setting and detach the gear lever and gaiter from the splined lower gear lever.
7. Select high range to prevent the transfer gearbox selector lever fouling the tunnel when removing the gearbox.
8. Remove the bonnet.
9. Remove the nuts and bolts retaining the fan cowl to the engine and move the cowl 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).



MATERIAL AND WELDING SPECIFICATION

ST3211M

Steel Plate
Tube
Arc Welding

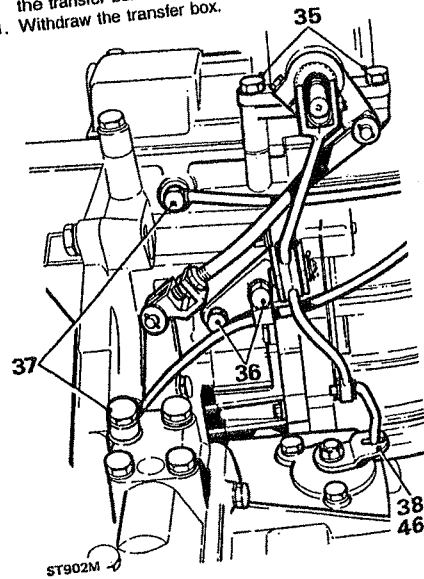
BS 1449 (Grade 4 or 14)
BS 4848 (Part 2)
BS 5135

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 - Early Models

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.

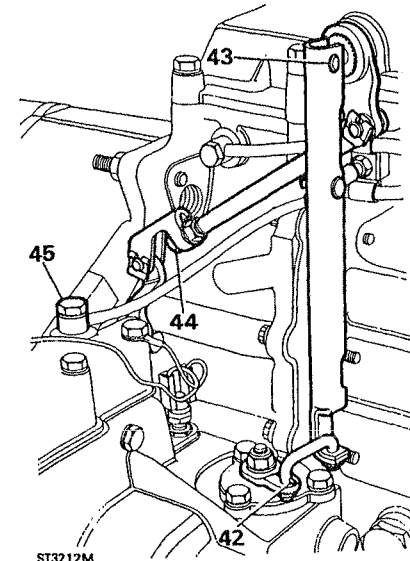
40. Remove the two nuts and four bolts retaining the transfer box to the extension housing.
41. Withdraw the transfer box.



ST902M

Separating transfer box - later models

42. Release the connecting link from the differential lock lever.
43. Disconnect the pivot arm from the high/low shaft.
44. Remove the lower locknut from the high/low operating rod.
45. Remove the breather pipe from the cross shaft housing.



ST3212M

Assembling transfer box to main gearbox - Early Models

46. 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.
47. Fit the transfer selector housing to the main gearbox remote gear change housing with the four bolts. (The right hand rear bolt is longer).
48. Fit the breather pipes.
49. Fit the differential lock cross shaft lever pivot bracket to the extension housing with the two bolts.
50. 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).

Assembling transfer box to main box - later models

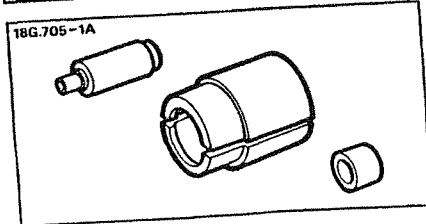
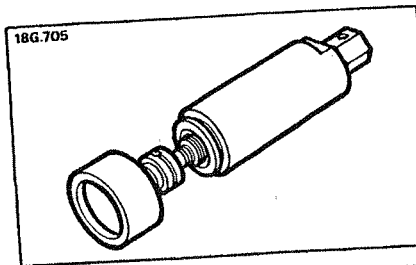
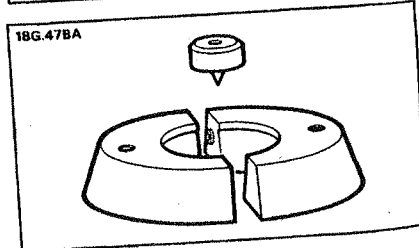
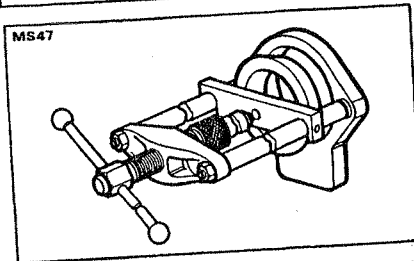
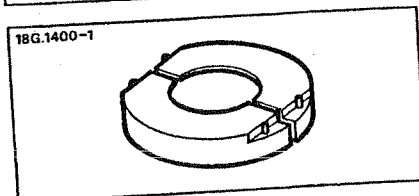
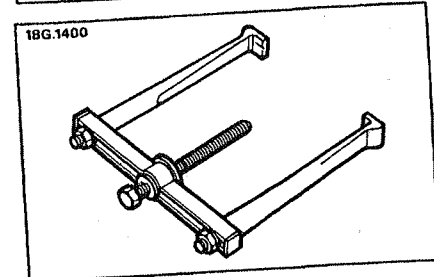
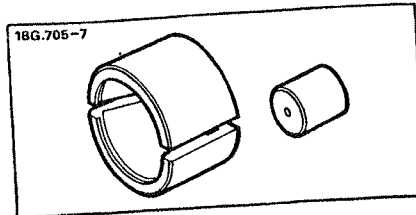
51. Hoist the transfer box into position ensuring that the loose upper dowel is fitted. Assemble to the main gearbox extension housing and secure with the four bolts and two nuts.
52. Reverse instructions 42 to 45.

Fitting main gearbox and transfer box to engine

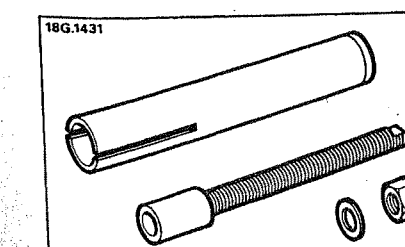
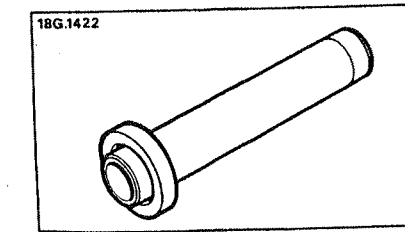
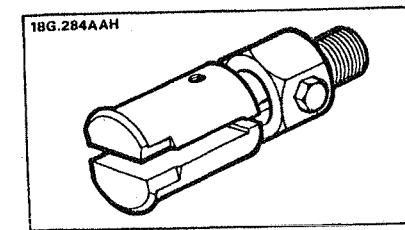
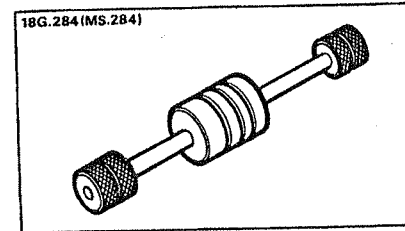
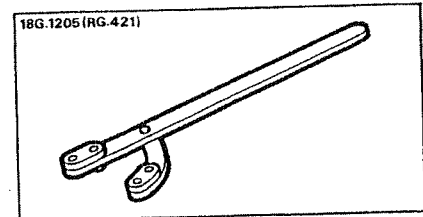
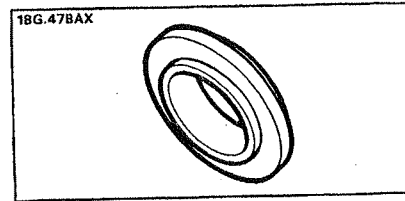
53. Fit the cradle to the transmission hoist and the transmission to the cradle as described in instruction 23. Smear Hylomar on bell housing face mating with engine.
54. Locate the gear lever temporarily and select any gear in the main gearbox to facilitate entry of the primary shaft.
55. Position and raise hoist and fit the transmission to the engine whilst keeping wires and pipes clear to prevent trapping.
56. Secure the transmission to the engine with the eleven nuts, noting that the top R H nut holds a clip for the speedometer cable.
57. Position the reverse light wires to the R H side of the main gearbox and secure with a cleat to the breather pipes.
58. Connect the reverse light wire to the switch at the top rear of the selector housing.
59. Connect the differential lock indicator wires (bullet connection).
60. Raise the transmission to line-up with the engine and ensure that the transfer lever clears the tunnel aperture.
61. Fit the transfer box L H and R H mounting brackets but only partially tighten the securing nuts and bolts.
62. Loosely fit the rubber mounting nuts and lower the transmission onto the mountings. Fully tighten all the securing nuts and bolts.
63. Remove the supporting jack from under the engine sump.
64. Remove the two bolts securing the cradle to the transfer box and remove the cradle and hoist.
65. Refit the two bolts using Loctite 290 on the threads and note that the L H bolt holds a clip for the speedometer cable.
66. Fit the slave cylinder using Hylosil on the gasket and tighten the two bolts evenly to 22 to 28 Nm.
67. Fit the handbrake cable using a new split pin to secure the clevis pin. Grease the clevis and tighten the outer cable lock nuts.
68. Connect the speedometer cable.

69. Check that the three drain plugs are tight and remove the main gearbox and transfer box filler level plugs. Fill the main gearbox with a recommended oil until it begins to run out of the filler level hole. Fit and tighten the filler plug. Similarly remove the transfer filler level plug and inject a recommended oil until it runs out of the filler hole. Apply Hylosil to the threads and fit the plug and wipe away any surplus oil.
70. Line up the marks and fit the front and rear propeller shafts to the transfer box.
71. Fit the exhaust system, and evenly tighten the flange nuts and bolts. Fit the 'U' bolt and secure to the bracket.
72. Expand the chassis side members, fit the cross member and secure with the eight nuts and bolts (four each side).
73. Fit the heater pipe clamp.
74. Clip the breather pipes, speedometer cable and starter motor harness to rear of engine.
75. Fit the fan cowl.
76. Fit the bonnet.
77. Fit main gear lever gaiter and lever, to previously marked spline setting. Secure with the 10 mm 'Nylloc' nut (with plain washer) to the correct torque.
78. Fit the cover to both gear levers and the knobs.

SPECIAL TOOLS - for gearbox overhaul



ST2317M



ST2318M

37 LT77 FIVE SPEED GEARBOX

OVERHAUL LT77 GEARBOX

This overhaul covers the early and latest versions of the gearbox.

Special Service Tools:

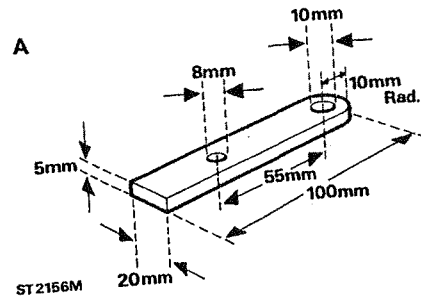
- 18G705-LRT-37-009 - Puller, bearing remover
- 18G705-1A-LRT-37-010 - Adaptor, for mainshaft oil seal track and layshaft fifth gear. Also fifth gear collar for early models
- 18G705-5-LRT-37-011 - Adaptor for layshaft small bearings
- 18G705-7-LRT-37-017 - Adaptor for layshaft large bearings
- 18G1400-LRT-37-012 - Remover synchroneshub and gear cluster
- 18G1400-1-LRT-37-013 - Adaptor mainshaft fifth gear
- MS47-LRT-99-002 - Hand press
- 18G47-BA-LRT-37-001 - Adaptor, input shaft bearing
- 18G47-BAX-LRT-99-002 - Conversion kit
- 18G284-LRT-37-004 - Impulse extractor
- 18G284-AAH-LRT-37-004 - Adaptor for input shaft pilot bearing track
- 18G1422-LRT-37-014 - Mainshaft rear oil seal replacer
- 18G1431-LRT-37-015 - Mainshaft fifth gear and oil seal collar replacer
- 18G1205-LRT-51-003 - Flange holder

NOTE: Where the use of special service tools is specified, only these tools should be used to avoid the possibility of personal injury or damage to components.

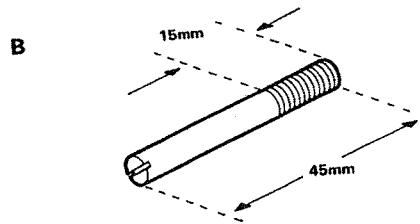
Locally manufactured tools

In addition to the above 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 shaft falling-out when gearbox is inverted. Also, layshaft fifth gear restrainer, to hold the fifth gear whilst releasing or tightening the retaining stake nut. Use 5 mm mild steel. When using the tool for the layshaft nut, a suitable spacer is required 20 mm diameter, 23 mm long with a 8 mm diameter hole.

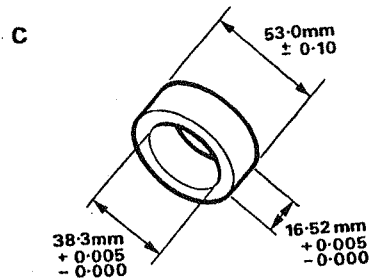


Tool B. Four pilot studs for locating in the four countersunk blind holes in the gearbox workstand. 8 mm thread.



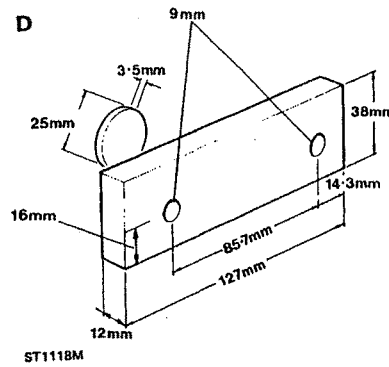
ST 2155M

Tool C. Dummy centre bearing for selection of first gear bush. Mild steel.



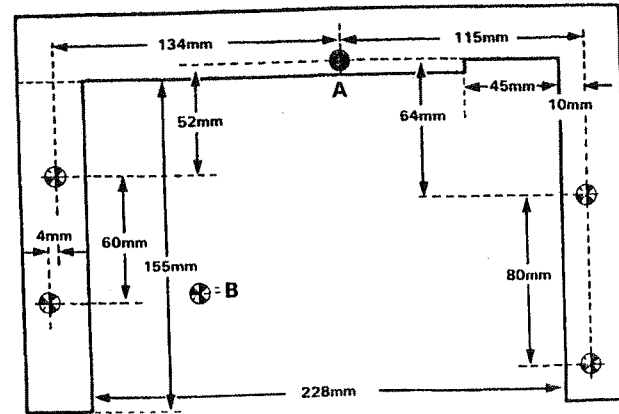
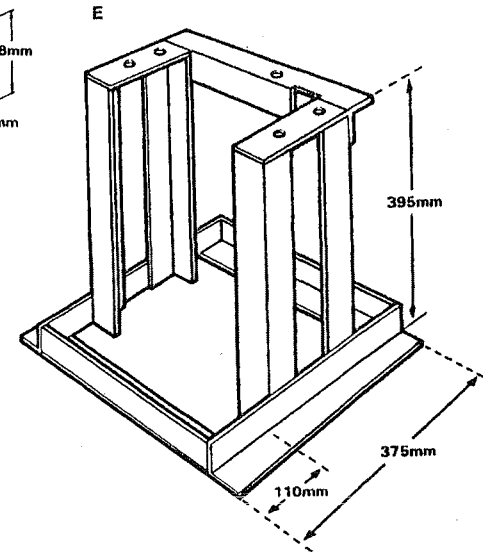
ST2154M

Tool D. Layshaft support plate is fitted using two 8 x 25 mm bolts and washers to the front of the gearbox case, it also supports the input shaft bearing outer track.



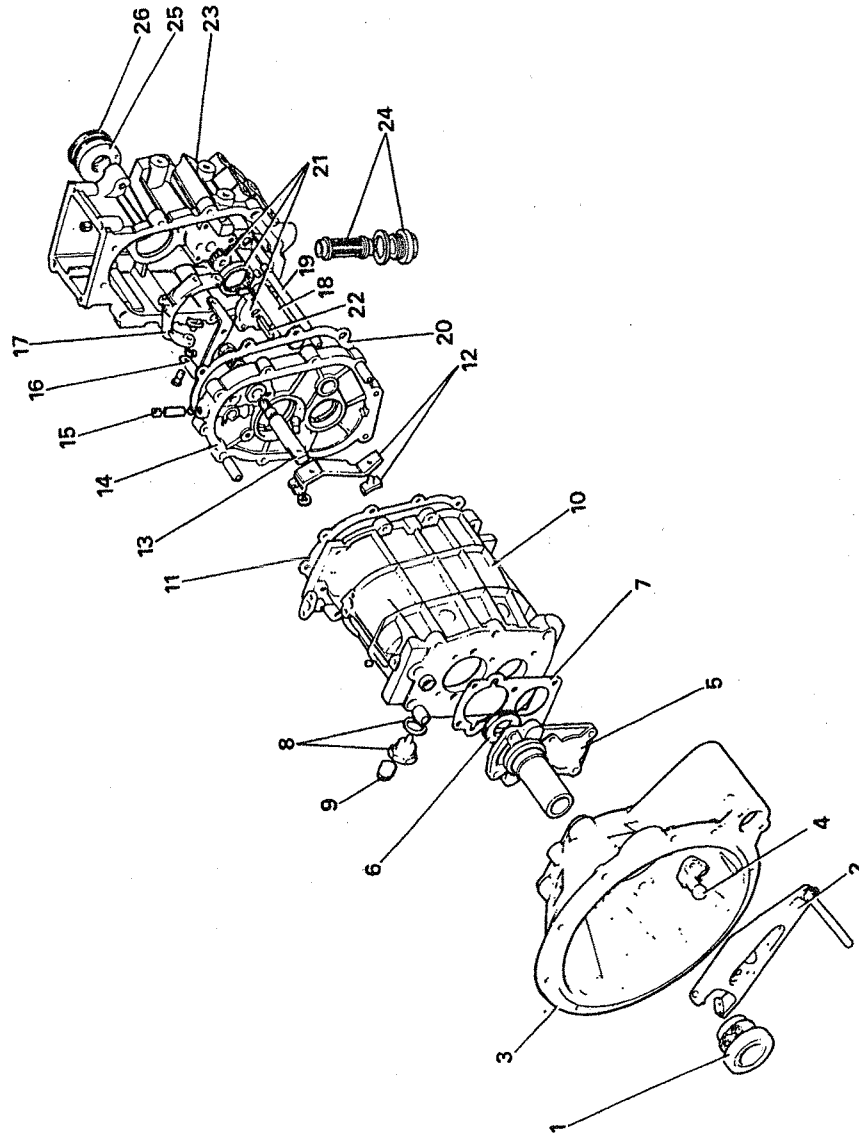
ST1118M

Tool E. Workstand, for securely locating the gearbox during overhaul. 30 mm x 30 mm angle iron. The single hole marked 'A' should be drilled through the material with a 10 mm drill. The four counter sunk blind holes marked 'B' should also be made with a 10 mm drill, but must not be drilled through the material.



ST2192M

GEARBOX CASINGS



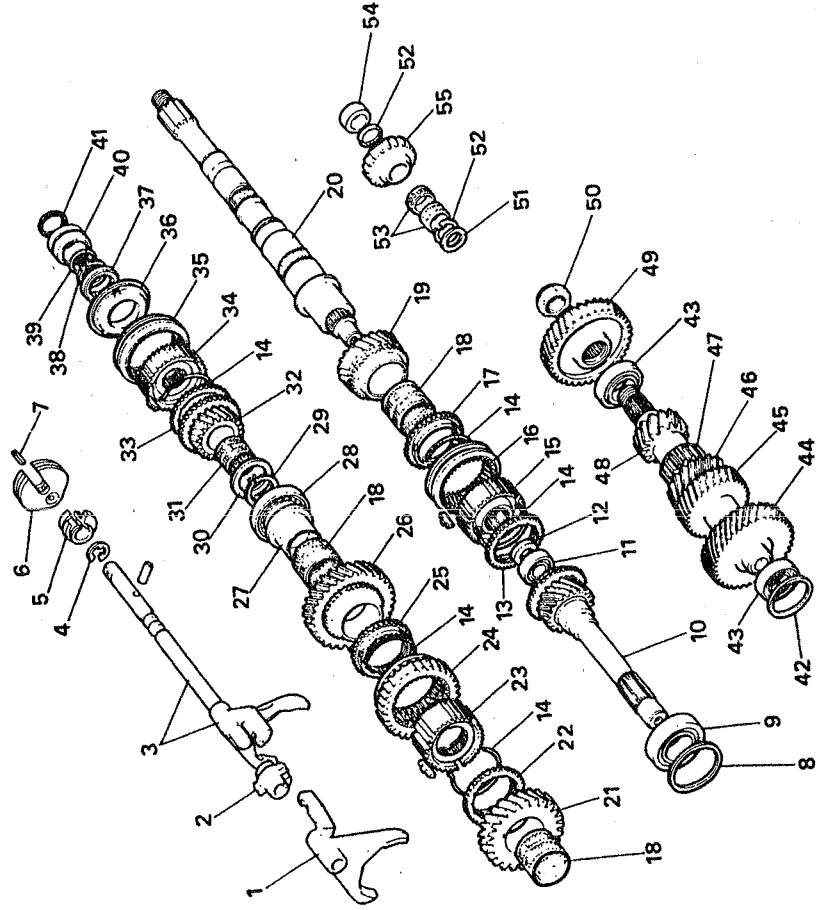
STZ169K

GEARBOX CASINGS

- 1. Clutch release bearing
- 2. Clutch release lever
- 3. Bell housing
- 4. Clutch release lever pivot post
- 5. Front cover
- 6. Front cover oil seal
- 7. Front cover gasket
- 8. Oil drain plug and washer
- 9. Oil level plug

- 10. Gearbox main casing
- 11. Gasket
- 12. Reverse lever and slipper
- 13. Reverse lever pivot post
- 14. Centre plate
- 15. Selector plug and detent ball
- 16. Fifth gear selector bracket
- 17. Fifth gear selector fork
- 18. Reverse gear shaft

- 19. Oil pick-up pipe
- 20. Gasket
- 21. Oil pump gears and cover
- 22. Oil pump drive shaft
- 23. Fifth gear extension housing
- 24. Fifth gear extension housing drain plug and filter
- 25. Ferrobestos bush
- 26. Oil seal



ST2190M

GEARS AND SHAFTS

- 1. Third/fourth selector fork
- 2. Interlock spool
- 3. First/second fork and selector rail assembly
- 4. 'E' stop clip
- 5. Fifth gear spool
- 6. Quadrant
- 7. Roll pin
- 8. Selective shim
- 9. Taper bearing
- 10. Input shaft
- 11. Spigot bearing
- 12. Thrust washer
- 13. Baulk ring fourth gear
- 14. Retaining spring clips
- 15. Third/fourth synchromesh member
- 16. Third/fourth synchromesh member
- 17. Baulk ring third gear
- 18. Needle roller bearings

- 19. Third gear
- 20. Main shaft
- 21. Second gear baulk ring
- 22. First/second synchromesh member
- 23. First/second synchromesh member
- 24. First/second synchromesh member
- 25. Baulk ring first gear
- 26. First gear
- 27. First gear bush
- 28. Taper bearing
- 29. Retaining circlip
- 30. Thrust washer
- 31. Split roller bearing
- 32. Fifth gear mainshaft
- 33. Fifth gear baulk ring
- 34. Fifth gear synchromesh inner member
- 35. Fifth gear synchromesh outer member
- 36. Retainer plate

- 37. Selective washer
- 38. Circlip
- 39. 'O' ring
- 40. Retaining collar
- 41. Snap ring
- 42. Selective shim
- 43. Taper bearings
- 44. Layshaft cluster input gear
- 45. Layshaft cluster third gear
- 46. Layshaft cluster second gear
- 47. Layshaft cluster reverse gear
- 48. Layshaft cluster first gear
- 49. Layshaft fifth gear
- 50. Layshaft fifth gear retaining stake nut
- 51. Thrust washer
- 52. Snap rings
- 53. Needle roller bearing
- 54. Spacer
- 55. Reverse idler gear

NOTE: For reverse gear shaft see 'gearbox casings', item 18.

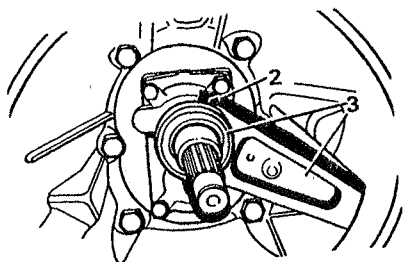
37 LT77 FIVE SPEED GEARBOX

DEFENDER

DISMANTLE

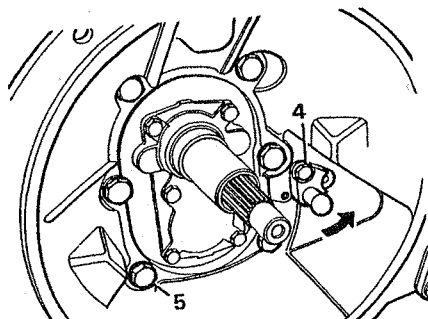
Removing bell housing assembly

1. Place the gearbox on a bench with the transfer box removed and ensure that the oil has been drained.
2. If fitted, remove the clutch release bearing clip.
3. Slide the clutch release lever and bearing off the pivot post.



ST2179M

4. Remove one of the pivot post retaining bolts and slacken the other and swivel the post aside.
5. Remove the six bolts and withdraw the bell housing from the gearbox.

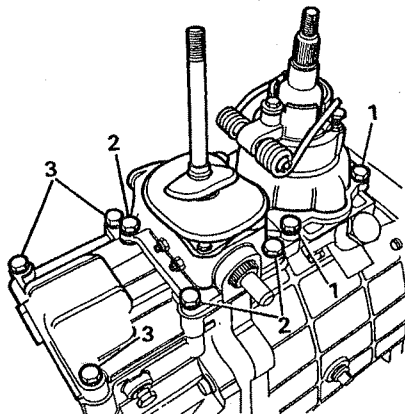


ST2177M

Removing gear selector housing and fifth gear extension housing.

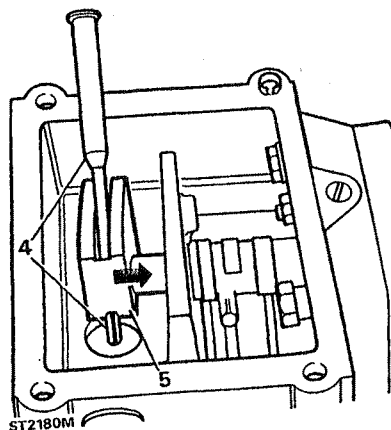
1. Remove the four bolts and lift-off the gear selector housing.
2. If not already removed, withdraw the four bolts securing the transfer gear change housing to the remote gear change housing.

3. Remove the three bolts securing the remote gear lever housing to the fifth gear extension housing. Remove the gear housing and discard the gasket.



ST2176M

4. Using a suitable pin punch, drive out the roll pin retaining the selector quadrant.
5. Push the selector shaft forward to engage a gear and remove the quadrant from the shaft and return the shaft to neutral.

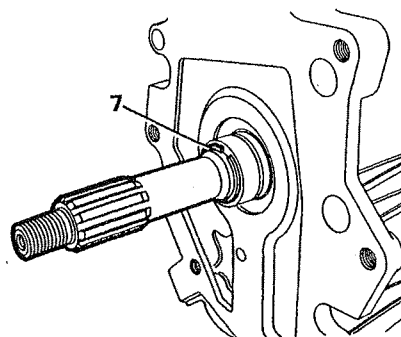


ST2180M

DEFENDER

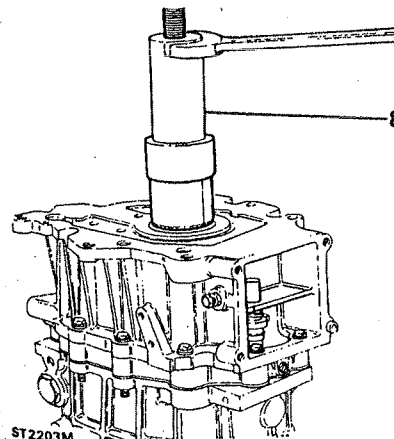
LT77 FIVE SPEED GEARBOX 37

6. Remove the dowel tubes from the front of the casing and secure the gearbox to the manufactured workstand Tool 'A' with one nut and bolt.
7. Remove the snap ring retaining the mainshaft oil seal collar in the fifth gear extension housing



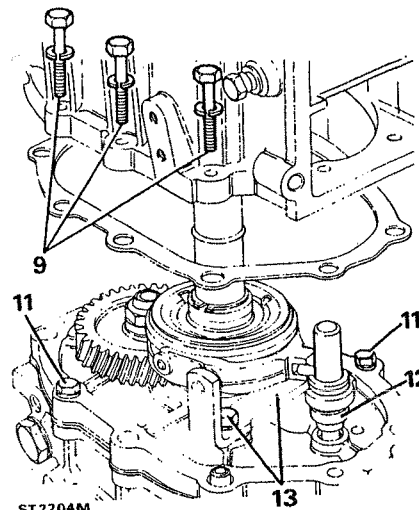
ST2178M

8. Using service tools 18G 705 and 18G 705-1A, withdraw the oil seal collar.



ST2203M

9. Remove the ten bolts and spring washers securing the fifth gear extension housing and withdraw the housing and gasket taking care not to damage the oil pick-up pipe.
10. Retrieve the oil pump drive shaft and remove the oil seal collar 'O' ring from the mainshaft.
11. Fit two dummy bolts (8 x 35 mm) to the casing to retain the centre plate to the main case.
12. Remove the fifth gear selector spool.
13. Remove the two bolts and spring washers securing the fifth gear selector bracket and fork.

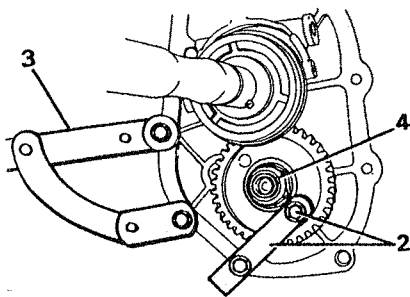


ST2204M

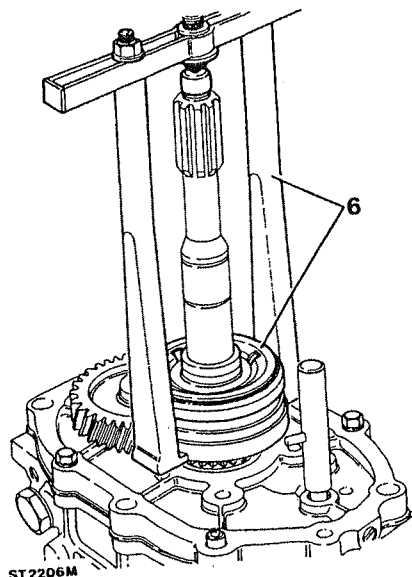
Removing mainshaft and layshaft fifth gears

1. Early models: Remove the circlip retaining the layshaft fifth gear and use service tool 18G 705 and 18G 705-1A to withdraw layshaft collar.

2. Later models: Where the layshaft is retained by a nut, use manufactured tool 'B' and spacer. Bolt the tool to the gearcase with the spacer between the gearcase and tool. Insert a suitable length of bar or a 10 mm bolt through the hole in the gear to prevent rotation.
3. Secure the flange holder 18G 1205 to left hand side of gearcase.
4. De-stake and remove the fifth gear layshaft retaining nut.



ST2205M



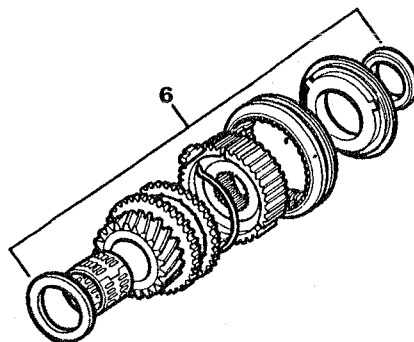
ST2206M

All models

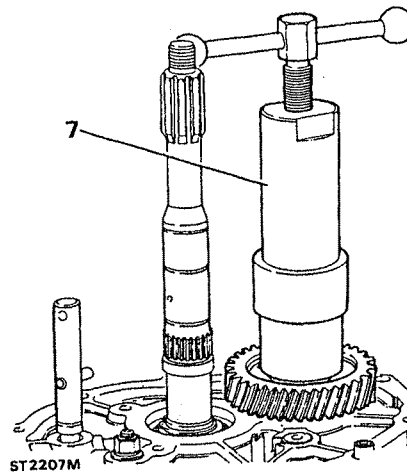
5. Release the circlip retaining the fifth gear synchromesh assembly to the mainshaft.
6. Using special tools 18G 1400-1 and 18G 1400 withdraw the selective washer, fifth gear synchromesh hub and baulk ring, fifth gear (driven), spacer and split roller bearing from the mainshaft.

NOTE: On later gearboxes with the wider fifth gear, the collect 18G 1400-1 cannot be used. The gear is withdrawn using puller 18G 1400 only.

7. Remove the layshaft spacer (if fitted) and withdraw the layshaft fifth gear using special tools 18G 705 and 18G 705-1A.
8. Remove the selector shaft circlip (where fitted).



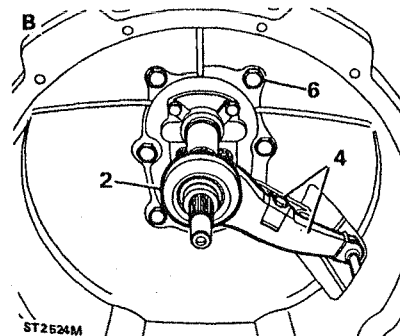
ST3224M



ST2207M

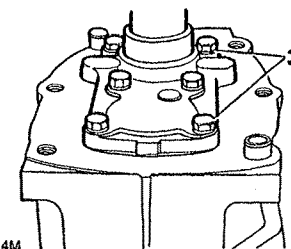
Main gearbox case

1. Fit the reverse shaft retainer using one of the fifth gear bracket mounting bolts. Fit the four guide studs to the main gearbox case to locate in the workstand.



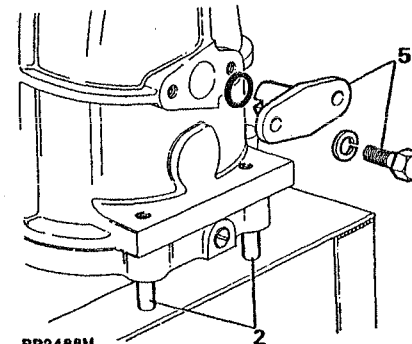
ST2524M

2. Release the gearbox from the workstand, invert the assembly and locate the four studs on the workstand.
3. Remove the six bolts and spring washers from the front cover, withdraw the cover and discard the gasket.



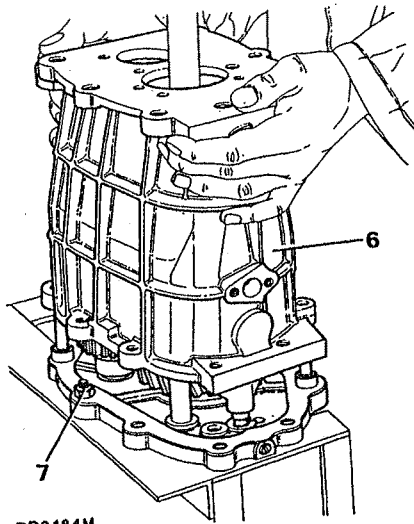
ST3214M

4. Retrieve the input shaft and layshaft selective washers from the gearcase.
5. Remove the two bolts and washers and withdraw the retainer for the selector shaft front spool. Note that later models have an O-ring with a counterbore in the gearcase.



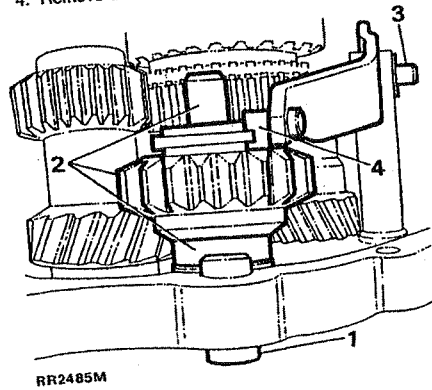
RR2468M

6. Remove the slave bolts and carefully lift the gearcase, leaving the centre plate and gear assemblies in position.
7. Secure the centre plate to the workstand with a nut and bolt when the plate and casing have separated. Discard the gasket.



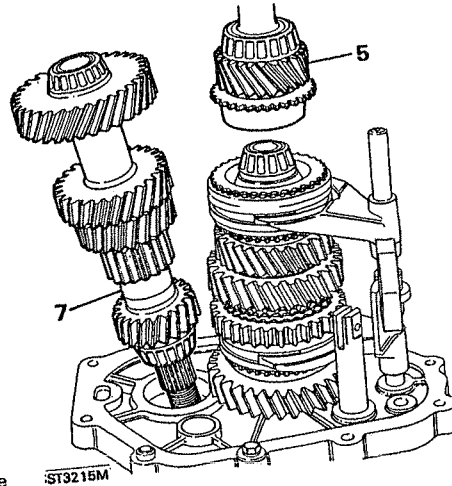
Reverse shaft, layshaft and mainshaft

1. Release the reverse shaft retainer and remove the shaft.
2. Lift off the thrust washer, reverse gear and spacer from the centre plate.
3. Remove the pivot pin securing the reverse lever without removing the 'E' clip.
4. Remove the reverse lever and slipper pad.



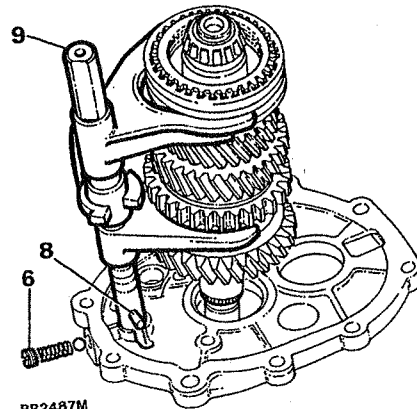
RR2485M

5. Remove the input shaft and fourth gear baulk ring.
6. Withdraw the selector plug, spring and detent ball from the centre plate.
7. Lift off the layshaft cluster by tilting it away from the mainshaft, simultaneously lifting the mainshaft slightly to clear the rear layshaft bearing.



ST3215M

8. Rotate the fifth gear selector shaft anti-clockwise (viewed from above) to align the fifth gear selector pin with the slot in the centre plate.
9. Remove the mainshaft and selector fork assemblies from the centre plate together.

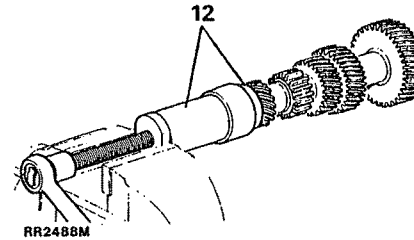


RR2487M

10. Detach the selector fork assembly from the mainshaft gear cluster.
11. Remove the nut and bolt and release the centre plate from the workstand.

Layshaft

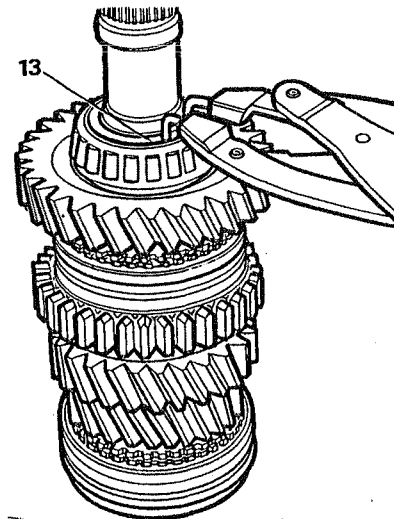
12. Using press 18G705 and tool 18G705-5 (18G705-7 if the increased capacity bearings are fitted) remove the layshaft bearings.



RR2488M

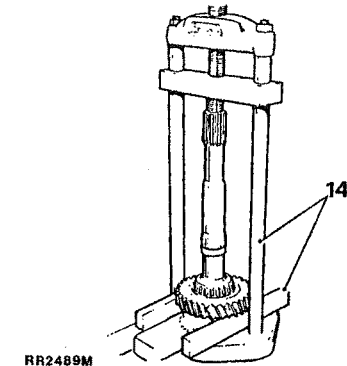
Mainshaft

13. Remove the centre bearing circlip.

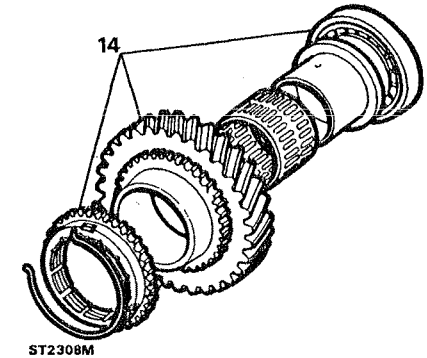


ST3216M

14. Using press MS47 and two suitable metal bars to support first gear, remove the centre bearing, first gear bush, first gear and needle bearings and first gear baulk ring.

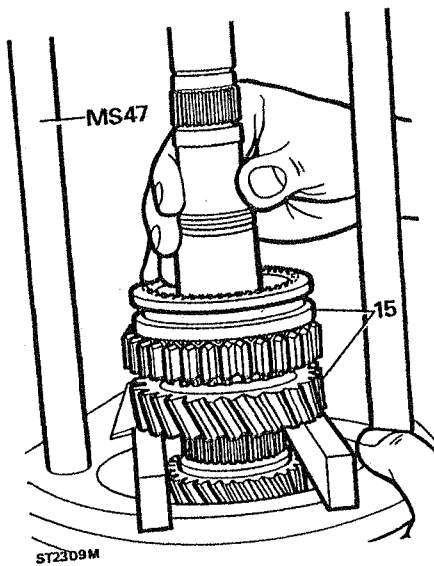


RR2489M

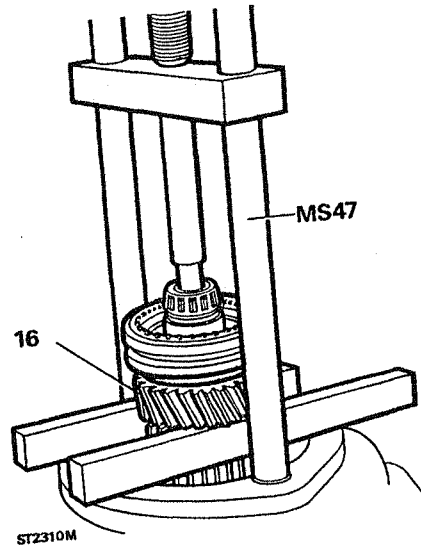


ST2308M

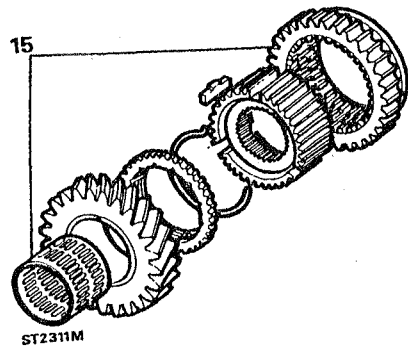
15. If a difficulty is experienced in removing the first and second gear synchroneshub, support the second gear with the bars, and operate the press to release the first/second synchroneshub unit, second gear, baulk ring and needle bearings.



ST2309M

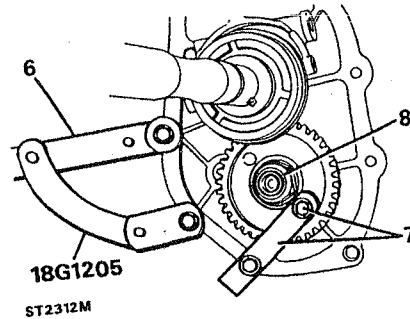


ST2310M



ST2311M

16. Turn the mainshaft through 180° and repeat the operation using press MS47 and a suitable extension. Support third gear, press the mainshaft through the pilot bearing spacer, third and fourth synchromesh unit, third gear baulk ring, third gear and needle bearings.



ST2312M

INSPECTION AND PREPARING FOR REBUILDING

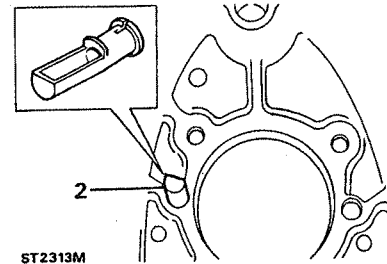
NOTE: It is essential that all components are thoroughly cleaned and inspected before the rebuild is commenced. During the rebuild it is recommended that new bearings are fitted.

Main gearbox casing

1. Remove the mainshaft and layshaft bearing tracks from the main casing.
2. Remove the plastic oil trough from the front of the casing.

Centre plate

1. Remove the mainshaft and layshaft bearing tracks from the centre plate.
2. Inspect the plate for damage and check the selector rail bore for wear.
3. Check the security and position of the pivot post by temporarily fitting the reverse shaft, reverse gear and lever. Using a feeler gauge, check that the clearance between the slipper pad and lever is not in excess of 0.20 mm.

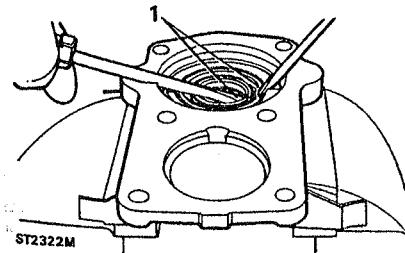


ST2313M

3. 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.
4. Insert a new plastic oil scoop inside the front of the casing, ensuring that the scoop side faces the top of the casing.

Front cover

1. Carefully prise the oil seal from the cover. To avoid damage to the seal housing, insert a thin screw driver blade between the seal and housing and another beneath the seal and lever-out the seal. Do not at this stage fit a new seal.

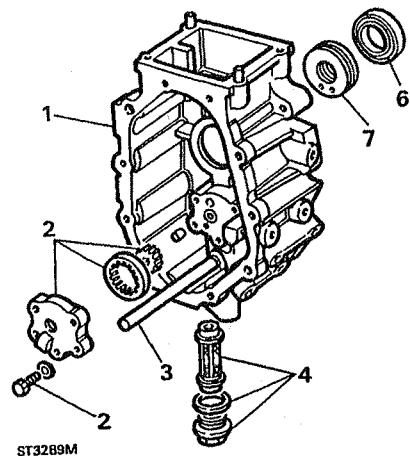


ST2322M

Extension case

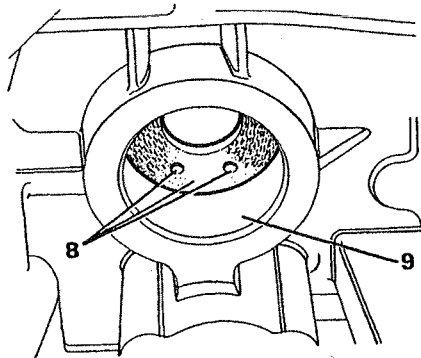
1. Examine the extension case for obvious signs of damage to threads and joint faces.
2. Remove the three oil pump housing bolts, spring washers and oil pump gears and housing. Inspect gears, renew if necessary.
3. Do not withdraw oil pick-up pipe.
4. Remove the plug, washer and filter.
5. Ensure that the oil pick-up pipe is free of contamination or blockage.
6. Invert casing and extract the oil seal.
7. Press out the ferrobestos bush from the casing.

WARNING: The ferrobestos bush contains asbestos. DO NOT use an air line when cleaning, as breathing asbestos dust is dangerous to your health. Use methylated spirit or denatured alcohol to clean asbestos components, and gloves should be worn while cleaning for additional protection.



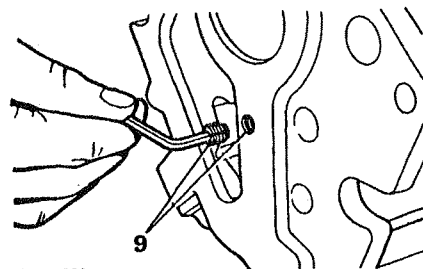
ST3269M

8. Press a new or the original ferrobestos bush fully into position ensuring that the two drain holes are towards the oil pump. If this precaution is not followed oil will build-up behind the oil seal and may cause an oil leak.



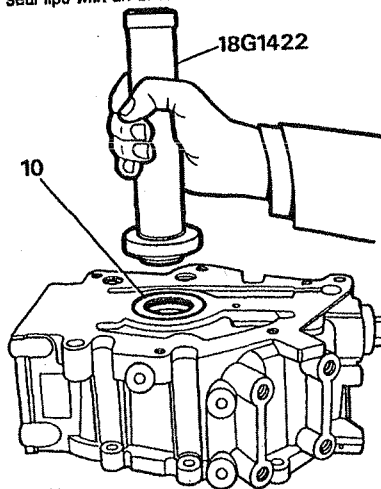
ST3217M

9. If a new extension housing is being fitted, it is vital that the grub screw from the old housing is transferred to the new housing main oilway located at the rear of the housing. Threads should first be coated with Loctite.



ST2319M

10. Fit a new oil seal to the rear of the housing with the lip side towards the ferrobestos bush. To ensure the seal is fitted squarely, use special tool 18G 1422. After fitting, lubricate the seal lips with an SAE 140 oil.

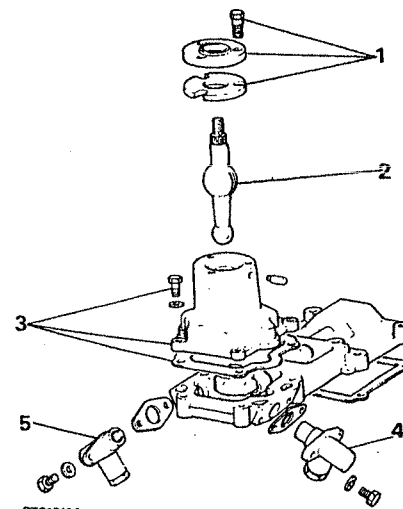


ST3219M

11. Assemble and fit the fibre oil pump gears to the oil pump cover, whilst ensuring the centre rotor square drive faces the layshaft.
12. Fit the three bolts and spring washers to secure the oil pump cover, and tighten to the correct torque.
13. Fit a new oil filter, fibre gasket and tighten plug to the correct torque.

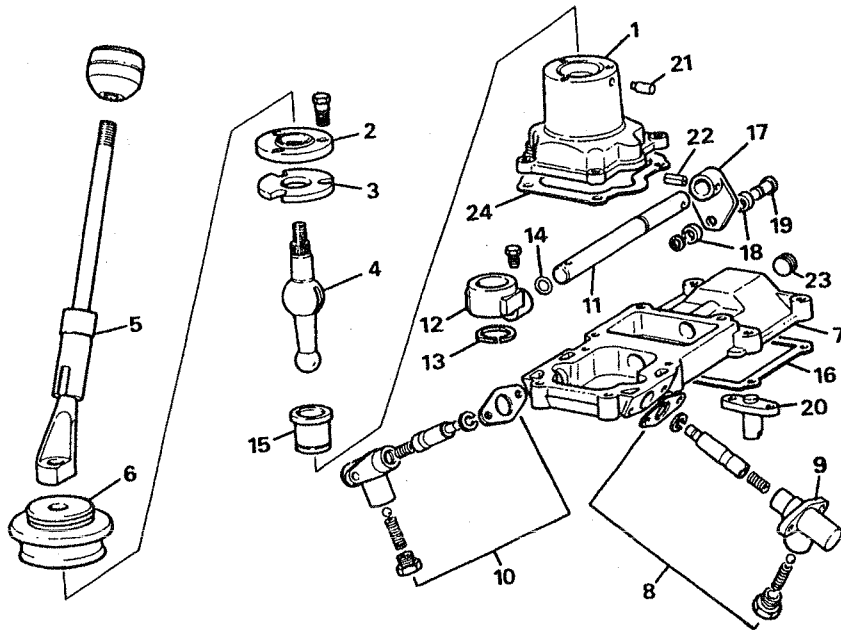
Gear selector housing - early models

1. Remove the gear lever gaiter and three bolts holding the gear lever retaining plate and anti-vibration pad.
2. Remove the gear lever from the housing.
3. Remove the four bolts retaining the gear selector housing to the remote housing. Remove the housing and discard the gasket.
4. Remove the two bolts and washers and remove the fifth gear plunger assembly and shims from the remote housing.
5. Remove the two bolts and remove the reverse gear plunger assembly from the remote housing.
6. Clean and examine all components and renew any that are worn or damaged. Whilst it is not normally necessary to dismantle the reverse and fifth gear plunger assemblies, it will be noted that overhaul of these are covered under separate headings. Overhaul of the remote housing assembly is also covered separately.



ST2181M

GEAR LEVER SELECTOR HOUSING - Early models

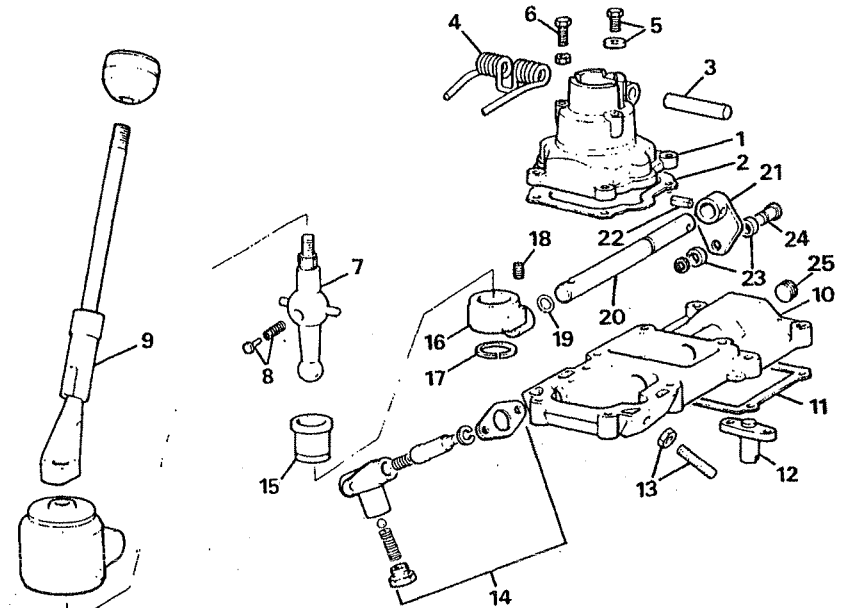


ST2187M

- 1. Gear selector housing
- 2. Gear lever retaining plate
- 3. Anti-vibration pad
- 4. Gear lever
- 5. Gear lever extension
- 6. Gaiter
- 7. Remote housing
- 8. Fifth gear plunger assembly
- 9. Fifth gear plunger housing
- 10. Reverse gear plunger assembly
- 11. Selector shaft
- 12. Trunnion

- 13. Circlip
- 14. 'O' ring
- 15. Gear lever seating
- 16. Gasket
- 17. Quadrant
- 18. Rollers
- 19. Pin
- 20. Spool guide
- 21. Gear lever locating peg
- 22. Roll pin
- 23. Blanking plug
- 24. Gasket

GEAR SELECTOR HOUSING - Later models



ST2186M

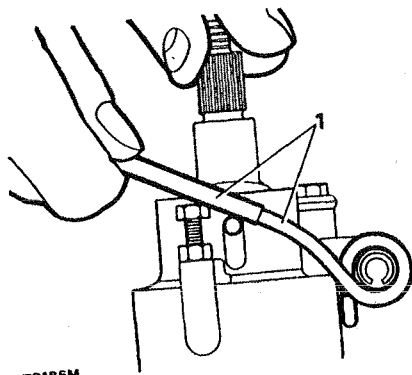
- 1. Gear selector housing
- 2. Gasket
- 3. Roll pin
- 4. Bias spring
- 5. Gear lever retaining screw and washer
- 6. Selector housing screws
- 7. Gear lever
- 8. Nylon pad and spring
- 9. Gear lever extension
- 10. Remote housing
- 11. Gasket
- 12. Fifth gear spool guide

- 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

- Assemble the above components in the reverse order of dismantling using new gaskets. Leave the bolts loose that secure the fifth and reverse gear plunger assemblies until assembly to the gearbox. Note that the reverse gear plunger is fitted on the right-hand side of the remote housing and the fifth gear plunger on the left. Use a multi-purpose grease on the upper and lower spheres when fitting the gear lever.

Gear selector housing - later models

- Using a length of tube, as illustrated, release both ends of the bias spring from the adjusting screws.

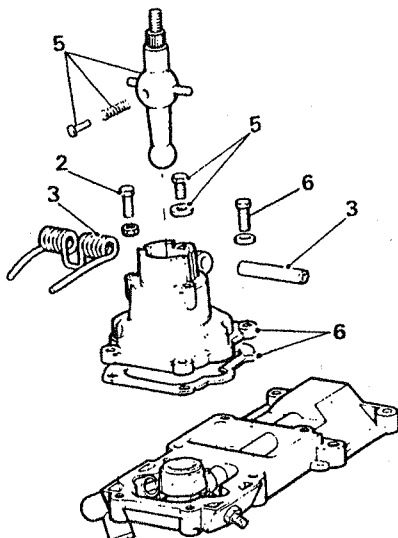


ST21B6M

- If necessary, remove the bias spring adjusting screws.
- If necessary, drive-out the roll pin to remove the bias spring.
- If not already removed, detach the gear lever extension from the lower gear lever O secured by one nut.
- Remove the bolt and special washer to release the gear lever from the housing.

WARNING: Take care when withdrawing the lever since there is a spring loaded nylon pad located in the upper sphere of the lever in the side opposite to the bias spring.

- Remove the four bolts and lift-off the gear selector housing from the remote housing and discard the gasket.

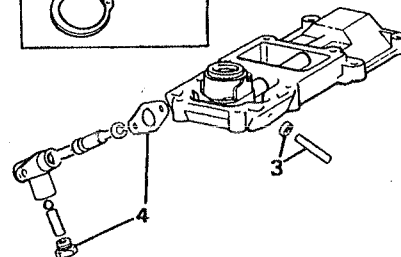
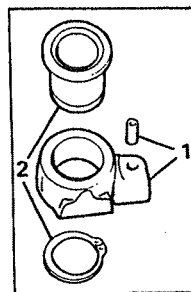


ST21B2M

- Clean and examine all components and renew where necessary. Examine the gear lever upper and lower spheres and the condition of the cross pins and location slots in the housing. Check the spring and Nylon pad.
- Assemble the above components in reverse order of dismantling. Use a recommended multi-purpose grease when fitting the gear lever, see SECTION 09 Also ensure that the spring loaded Nylon 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 the bias spring adjusting screws slack until assembly to the gearbox

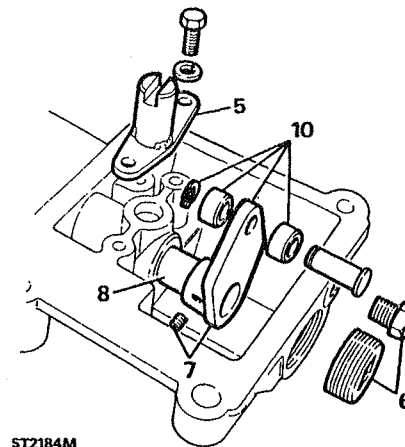
Remote gear lever housing - all models

- Remove the socket-headed screw (square-headed on earlier models) securing the trunnion to the selector shaft. Push the shaft rearwards and remove the trunnion.
- Remove the circlip to release the Nylon seating from the trunnion.
- Remove the fifth gear locknut and stud. (Stop plate and shims on earlier models).
- Remove the two bolts and withdraw the reverse gear plunger assembly and shim.



ST21B3M

- Remove the two bolts and the fifth gear spool guide.
- Remove the two blanking plugs from the rear of the casing.
- Drift-out the roll pin securing the selector quadrant to the shaft.
- Withdraw the selector through the large hole.
- Remove and discard the selector shaft 'O' ring.
- Release the circlip and remove the rollers and pin from the quadrant.



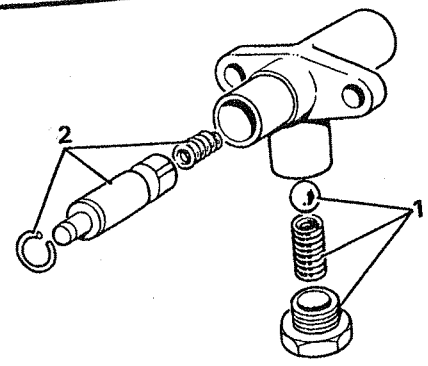
ST21B4M

- Clean and examine all components and renew if worn or damaged. Certainly the selector shaft 'O' ring and the Nylon seating should be renewed. Check also the condition of the selector shaft and quadrant. Renew the quadrant pin and rollers if worn. Inspect the fifth gear spool guide and discard if worn or damaged. Whilst it is not normally necessary to dismantle the reverse gear plunger assembly, the overhaul of this item is covered under a separate heading.
- To assemble the housing components, commence by fitting a new 'O' ring seal to the selector shaft. Lubricate the shaft with a recommended LT77 gearbox oil and insert through the large hole in the rear of the housing.
- Fit the selector quadrant and secure to the shaft with a new roll pin.
- Fit the rollers to the quadrant and retain with a new circlip.
- Fit the fifth gear spool retainer and coat the threads of the retaining bolts with Loctite 290 and tighten to the correct torque.
- Apply Loctite 290 to the threads of the reverse switch and large blanking plugs and tighten to the correct torque.

17. Fit a new Nylon seating to the trunnion and secure with the circlip.
18. Fit the trunnion to the selector shaft. Secure with the special bolt or socket headed screw, having first applied Loctite 290 to the threads. Ensure that the screw locates in the indent in the shaft.
19. Fit the reverse gear plunger and original shims and loosely secure with the two bolts or depending on the model:-
 - a. the fifth gear stop plate, or
 - b. the fifth gear plunger assembly.
20. Fit the fifth gear stud-stop (latest version) and loosely fit the locknut.
21. Using a new gasket, fit the gear selector housing and secure with the four bolts and tighten evenly to the correct torque. Place the assembly aside for fitting to the gearbox at a later stage.

Fifth gear plunger assembly - early models

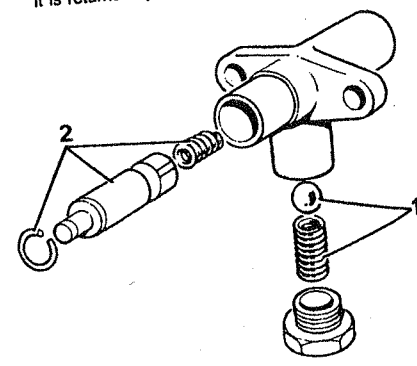
1. Remove the plug, long spring and ball from the fifth gear plunger.
2. Remove the circlip which retains the fifth gear plunger. Pull out the plunger and short spring.
3. Clean and examine all parts for wear, and damage and renew any faulty items.
4. To assemble, lubricate the short spring and plunger with a recommended multi-purpose grease. Insert the spring and plunger into the housing and secure with the circlip. Ensure that the spring is not trapped; the detent groove should be visible down the detent hole.
5. Lubricate the detent ball with light oil and fit to the bore.
6. Fit the long spring, apply Loctite 290 to the plug threads and fit the plug.
7. Check that the plunger can be pushed inwards and is returned by the spring.



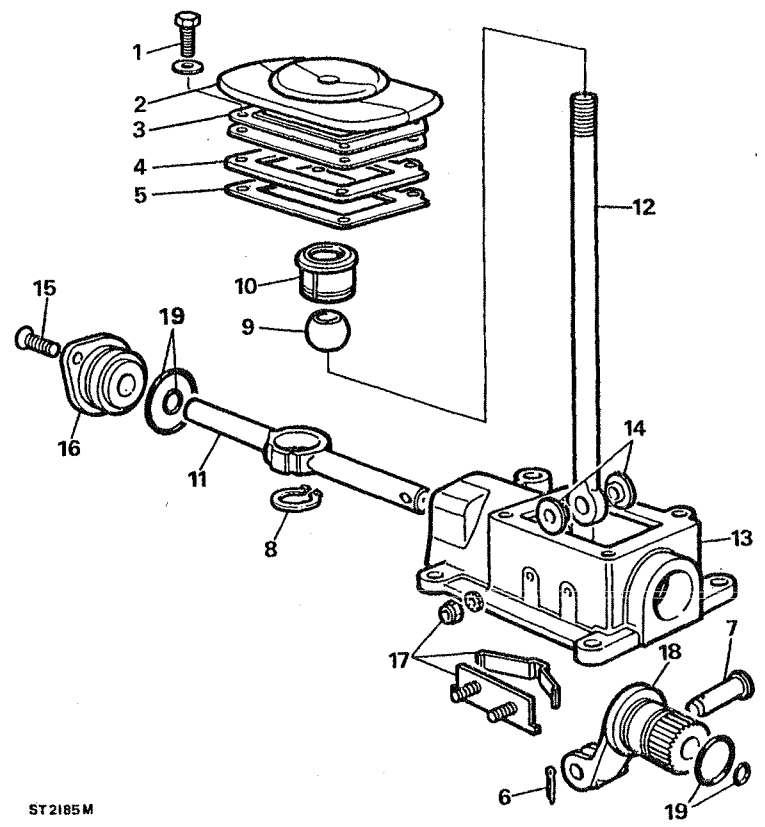
ST2200M

Reverse gear plunger assembly

1. Remove the plug, long spring and detent ball from the plunger assembly.
2. Release the circlip and withdraw the plunger and spring.
3. Clean and examine all components for wear and damage and renew where necessary.
4. To assemble, lubricate the short spring and plunger with a recommended multi-purpose grease and fit the spring followed by the plunger to the housing and secure with the circlip.
5. Lubricate the detent ball with light oil and insert in the bore followed by the spring. Coat the threads of the plug with Loctite 290 and fit the plug.
6. Check that when the plunger is pushed inwards it is returned by the spring.



ST2201M



ST2185M

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

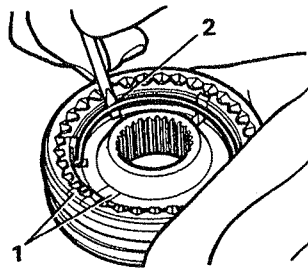
Transfer gear change housing

1. Remove the four screws and lift-off the gaiter and support plate together with the gate plate and gasket.
2. Remove the split pin and clevis pin connecting the selector fork to the gear lever.
3. Collect the two non-metallic bushes from the gear lever.
4. Remove the circlip retaining the nylon seat to the cross-shaft and withdraw the gear lever and seat.
5. Remove the two counter sunk screws from the end cover and withdraw the cover and cross-shaft.
6. Remove the selector fork.
7. Remove the detent spring and if necessary, the spring mounting plate.
8. Clean and examine all items and renew where necessary. Place aside ready for assembly as follows, using a multi-purpose grease recommended in SECTION 09.
9. Fit new internal and external 'O' rings to the fork assembly.
10. Fit the detent spring.
11. Fit new internal and external 'O' rings to the end cover and fit over the short end of the cross-shaft.
12. Insert the shaft into the fork assembly and secure the end cover, with the two counter sunk screws, to the housing.
13. Fit a new nylon seat to the gear lever, groove downwards.
14. Insert gear lever and seat into the cross-shaft and secure with the circlip.
15. Fit the two bushes to the lower end of the gear lever and secure with the clevis pin and new split pin.
16. Place the assembly aside for fitting to the gearbox.

Synchromesh assemblies

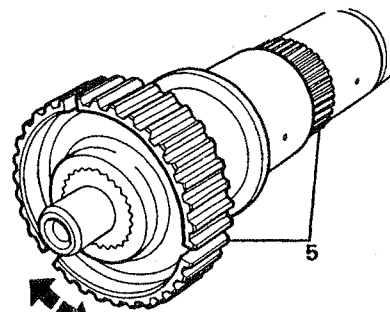
Except for the fifth gear synchromesh assembly which has a retainer plate, the dismantling procedure is the same for all units.

1. Mark the relationship of the synchromesh inner and outer members to assist assembly. Lever the retainer plate off the fifth gear synchromesh assembly.
2. Prise the retaining spring clip from both sides of each synchromesh assembly.

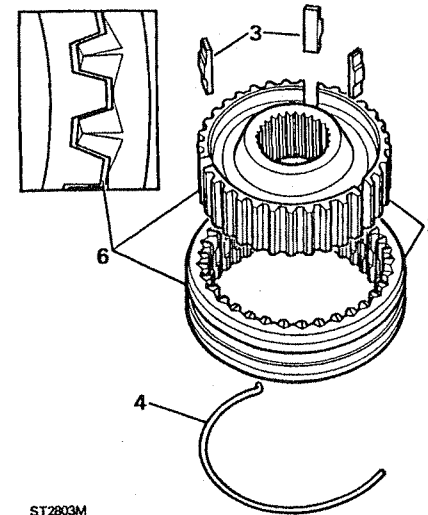


ST2445M

3. Remove the slippers and slide the inner member from the sleeve.
4. Examine the springs and slippers for damage and wear and discard all unsatisfactory parts.
5. Check the fit of each synchromesh inner member on the splines of the mainshaft. Hold the inner member and attempt to turn the mainshaft to check that no radial movement is present.



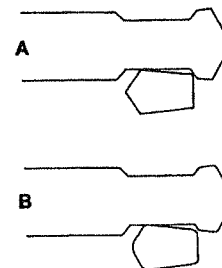
ST2469M



ST2803M

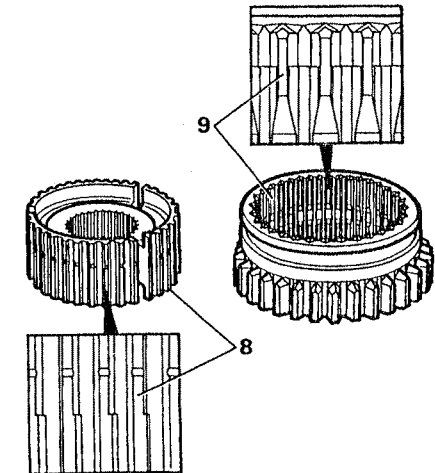
NOTE: The above illustrations show the third-fourth synchromesh assembly.

6. Carefully examine the inner the outer member splines for wear on the third-fourth synchromesh.
7. Inspect the dog teeth on the first, second, third and fifth gears and the fourth gear on the input shaft. Illustration A shows a tooth in good condition where the corners are sharp. Example B shows the rounded corners of a worn tooth.



ST2449M

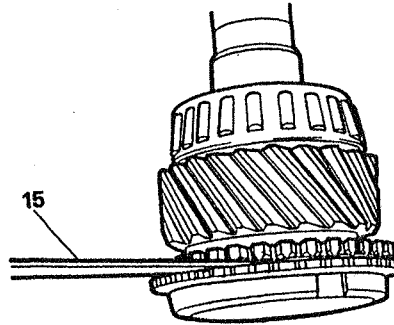
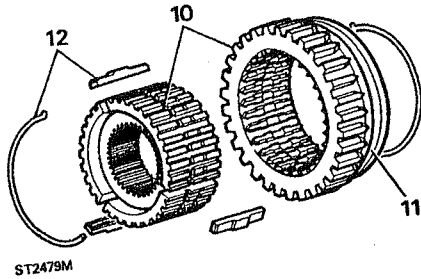
8. Examine the step in each of the outer splines of the first-second synchromesh inner member. Since the step is part of the gear locking system, it is important that the outer edge of the step is sharp and not rounded.



ST2473M

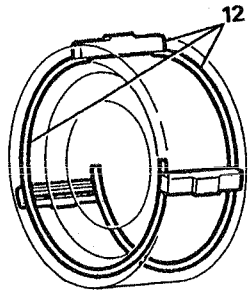
9. Check also that the step on both sides of each of the internal splines of the outer member are likewise sharp and not worn and rounded. Note that this applies only to the splines on the selector groove side of the member.
10. The radial groove encircling the inner member round the narrowest part of the splines is for ensuring that the inner and outer members are assembled correctly. Insert the inner member into outer with the radial groove towards the gear teeth on the outer member.
11. Note that the selector fork groove in the outer member is towards first gear and the rear of the gearbox.
12. Fit the slippers, open side inwards, into the slots and secure with the two springs one each side of the assembly. It is important that the hooked end of both springs locate in the same side of the assembly but that the free end of the springs should run in opposite directions and rest against the other two slippers.

15. Check the clearance between all the baulk rings and gears by pressing the baulk ring against the gear and measuring the gap between the baulk ring and gear. The minimum clearance should be 0,38 mm.



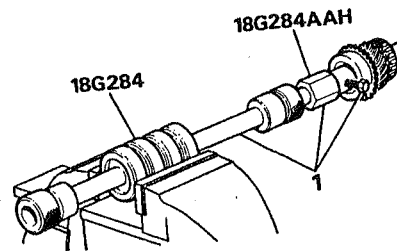
Input shaft

1. Examine the input shaft for wear and damage and if necessary polish the oil seal track with fine emery cloth. If the shaft is satisfactory and only the bearings require renewal proceed as follows. Secure the service tool 18G 284 impulse extractor in a vice and attach to it service tool 18G-284AAH. Assemble the jaws of the tool behind the track, adjust with the screw and extract the spigot bearing track.

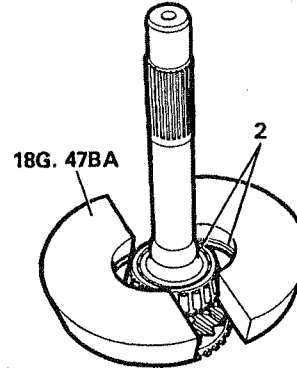


13. Assemble the components of the third-fourth synchromesh lining up the marks made on the inner and outer members when dismantled. Fit the slippers and secure with the springs ensuring that the hooked end locate in the same slipper and that the free ends run in opposite directions and make contact with the remaining slippers, as instruction 12.
14. In the same manner assemble the fifth gear synchromesh components as in instruction 13 above. In addition, fit the backplate to the rear of the assembly making sure that the tag on the backplate locates in the slot in the inner member.

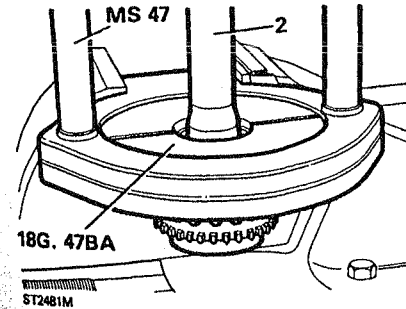
NOTE: With the outer member supported, a push through load applied to the outer face of the synchromesh inner member should register 8,2 to 10 kgf m to overcome the spring detent in both directions.



2. To remove the input shaft taper bearing, use service tool 18G 47BA and assemble it under press MS 47, as shown, so that the bearing is supported by the lip inside the tool. Using the protective button, press the shaft from the bearing.

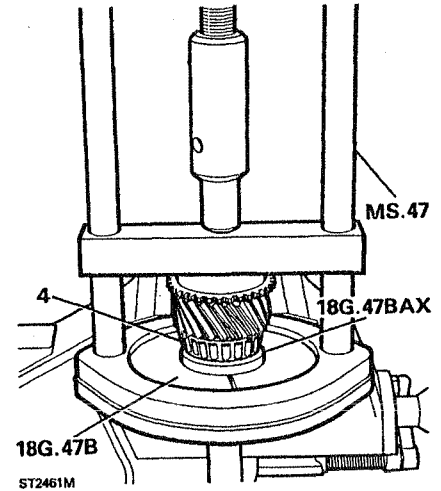


ST2490M



ST2481M

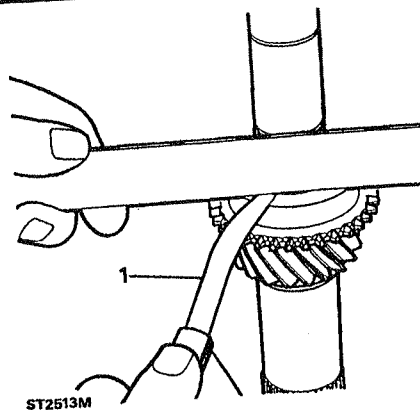
3. To fit a new spigot bearing track, support the shaft under press MS 47 and using a suitable adaptor lubricate and press the track squarely into the shaft.
4. Fit the input shaft taper bearing using press MS 47 with 18G 47BA and adaptor 18G 47BAX supporting the bearing with the smallest diameter towards the bearing. Lubricate and press the shaft slowly and squarely onto the bearing.



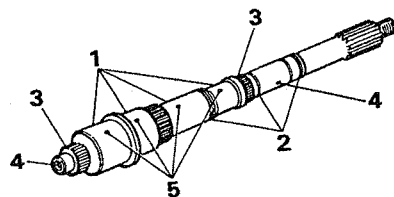
ST2461M

Mainshaft

1. Examine the roller bearing journals for wear and scores.
2. Check the condition of the three circlip grooves.
3. Inspect all the mainshaft splines for wear and damage particularly if it was noticed that any of the synchromesh units were a loose fit when dismantling.
4. Use an air line to check that the main feed from the pump is clear also the feed to the spigot bearing.
5. Also, check that the four oil feed holes to the roller bearings and gears are clear and finally, ensure that the roll pin pressed into each of these oil holes, to restrict oil flow, is fitted well below the surface of the journal.



ST2513M



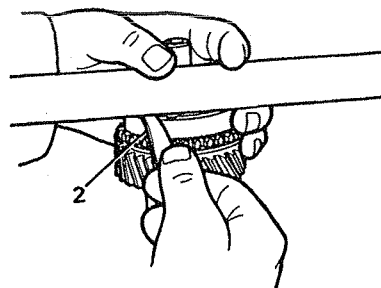
ST2446M

Mainshaft end float checks

The numbers in brackets in the following checks refer to the items in the key and illustration of "Gears and shafts".

Fifth gear

1. Fit the thrust washer (30) split roller bearing (31) and fifth gear (32) to the mainshaft. Place a straight edge across the mainshaft shoulder and measure the clearance between the straight edge and gear with a feeler gauge. The clearance, which is the end float, should not be in excess of 0,20 mm.



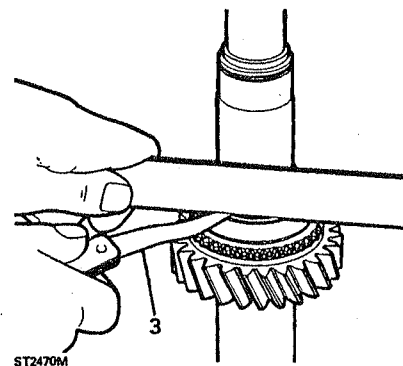
ST2520M

Third gear

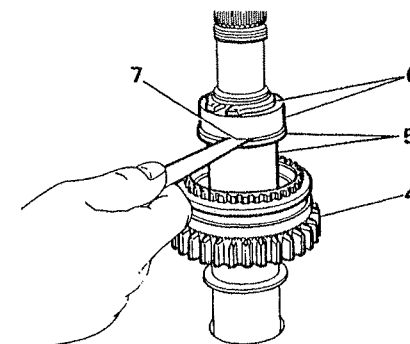
2. Fit the third gear (19) and the roller bearing (18) to the mainshaft. Place a straight edge across the shoulder and measure the clearance, with a feeler gauge, between the straight edge and gear. The end float should not be more than 0,20 mm.

Second gear

3. TD0101,254,254 Lubricate and fit the needle roller bearing (18) and second gear (21) and place a straight edge across the mainshaft shoulder. With a feeler gauge, check the clearance between the straight edge and gear. The end float must not exceed 0,20 mm.



ST2470M



ST2471M

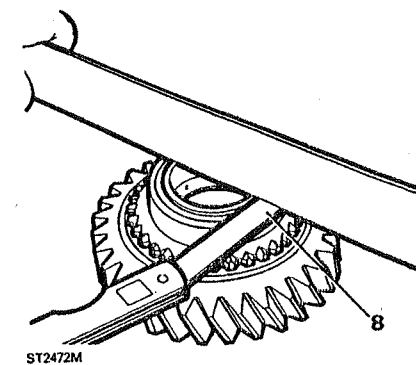
Part number	Length (mm)
FRC 5243	40,16 - 40,21
FRC 5244	40,21 - 40,26
FRC 5245	40,26 - 40,31
FRC 5246	40,31 - 40,36
FRC 5247	40,36 - 40,41

First gear bush end float

4. Fit the first and second gear synchromesh inner and outer members (23, 24) with the selector groove towards the rear of the mainshaft.
5. Fit the first gear bush (27) with the flange towards the rear of the mainshaft.
6. Next, fit the locally manufactured dummy bearing tool "C" and secure with a new circlip. Take care not to open the circlip more than is necessary to pass over the shaft.
7. Press the dummy bearing against the circlip and with a feeler gauge, measure the clearance between the flange of the first gear bush and the dummy bush. The correct clearance should not be more than 0,75 mm and should be free to rotate easily. If the clearance is not correct replacement bushes of different flange thicknesses are available, as detailed below, and one should be selected to give the required end float.

First gear end float

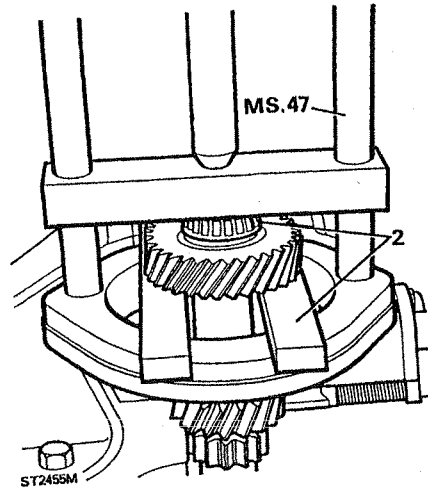
8. It is not necessary to fit the first gear to the mainshaft to check the end float. Assemble the roller bearing (18) and gear (26) to the bush (27) and place the assembly on a flat clean surface with the bush flange downwards. Place a straight edge across the bush and with a feeler gauge, measure the clearance between the gear and straight edge. The end-float should not be greater than 0,20 mm.



ST2472M

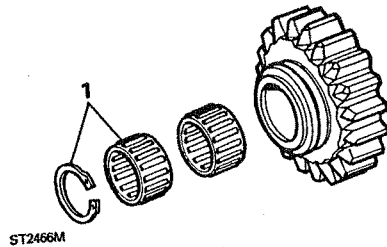
Layshaft

1. Examine the layshaft for wear, damaged or broken teeth and renew if necessary.
2. If the shaft is serviceable fit new bearings. Using press MS 47 support the layshaft with suitable bars and press the bearings squarely on to the shaft.

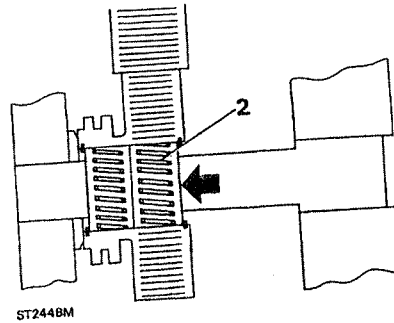


Reverse gear and shaft

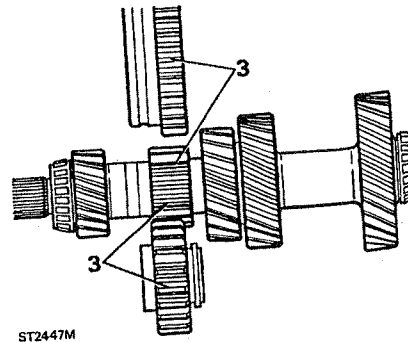
1. Remove the circlip from the reverse idler gear and remove both needle roller bearings. It is not necessary to remove both circlips.



2. It should be noted that the needle bearing cage is twisted during manufacture. The twist causes the gear to be tilted on the shaft and at the same time forces the gear towards the front of the gearbox into engagement where it runs against the thrust washer. The bearings must be renewed if the gear jumps out of engagement, or if the bearings show visible signs of wear. The bearings, which can be fitted either way round, should first be lubricated before fitting. Secure with a new circlip.



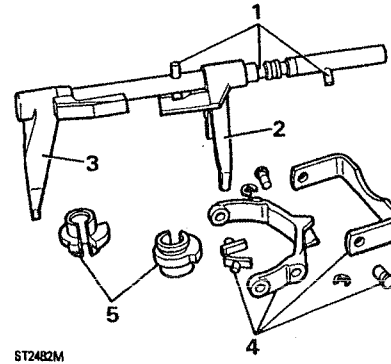
3. Check the condition of the reverse idler gear and its mating teeth on the layshaft and synchronmesh outer member.



4. Examine the reverse shaft for wear, scores and pitting and renew if necessary.

Selectors

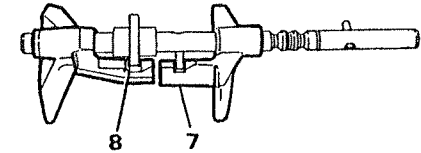
1. Check the condition of the selector rail and that the pins are not worn or loose.
2. Also examine the first-second selector fork for wear, cracks and damage. Note that the selector rail and fork is only supplied as a complete assembly so if the pins are worn or loose or the fork is unsatisfactory renew the complete unit.
3. Examine the third-fourth selector fork for damage and wear.
4. Examine the fifth gear selector bracket and fork together with the pads and pivot pins.
5. Check also the first-second, third-fourth and reverse gear interlock spool and the fifth gear spool for wear and damage.



6. Remove the snap ring and inspect the selector yoke assembly components and renew any worn or damaged parts.

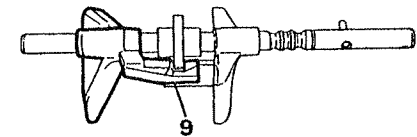
Assembling selectors

7. Place the first-second selector fork and shaft assembly on a flat surface and locate the selector pin in the jaw of the fork.
8. Fit the interlock spool and the third-fourth selector fork and engage the spool in the jaw of the fork.



ST2488M

9. Slide the spool and fork towards the first-second selector until the slot in the spool locates over the selector pin while the spool remains engaged in the third-fourth selector fork jaw. Put the assembly aside ready for fitment at the appropriate stage.



ST2487M

The fitting of the fifth gear selector components is described at a later stage in the assembly of the gearbox.

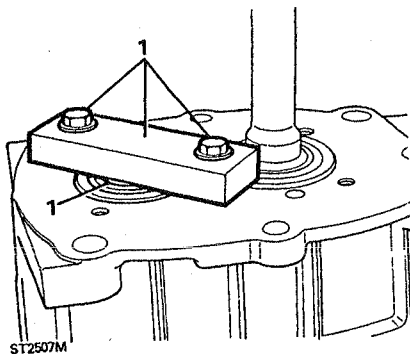
ASSEMBLE

Mainshaft rear end assembly

NOTE: The figures in brackets relate to the items in the illustration and key of "Gears and shafts" to assist identification of the components for assembly.

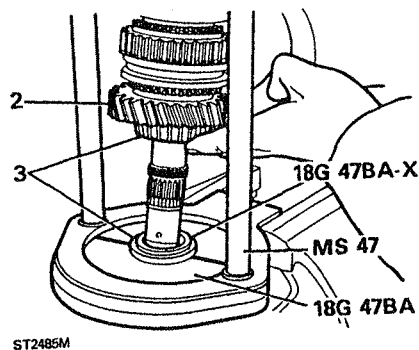
Lubricate the needle roller bearings before assembly.

1. Fit the second gear (21) and needle roller bearing to the mainshaft followed by the baulk ring (22) and first/second synchromesh assembly (23, 24). The synchromesh assembly may require gently tapping onto the splines using a plastic hammer.



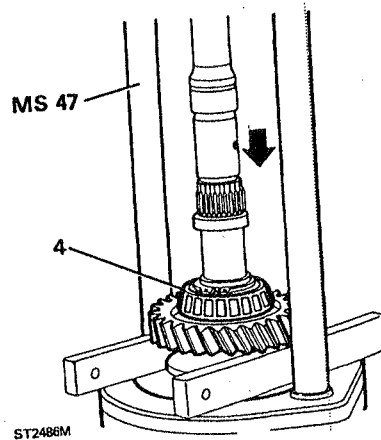
2. Fit the first gear baulk ring (25), first gear (26), needle roller bearing and first gear selected bush (27) to the mainshaft.
3. Fit the centre bearing (28) using special service press MS47, collets 18G 47BA and adaptor 18G 47BA-X. Note that the larger diameter of the adaptor must locate in the bearing cage. Ensure that the slots in the baulk ring align with the synchromesh slipper blocks when pressing the shaft on to the bearing.

NOTE: The following illustration shows the bearing having been started on the shaft and being lowered into position on the adaptor prior to the shaft and gear assembly being pressed on to the bearing.



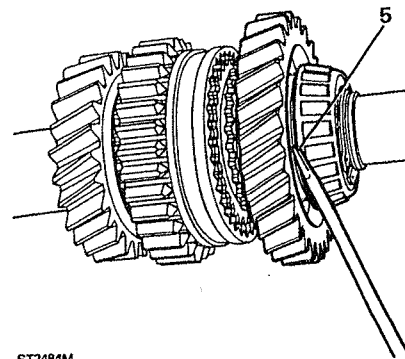
ST2485M

4. Secure the assembly with a new circlip. Since the bearing is a very tight fit on the mainshaft, it is probable it will have clamped the first gear bush preventing it from turning as it should. To allow the bush to turn and to maintain the required bush end float the bearing must be pressed back against the circlip. This can be achieved by supporting first gear on two bars under press MS47 and pressing the shaft so that the bearing is forced against the circlip sufficiently to allow the bush to turn.



ST2486M

5. To check if the bush is free, attempt to turn it by the flange with a screw driver blade between the gear and bearing.



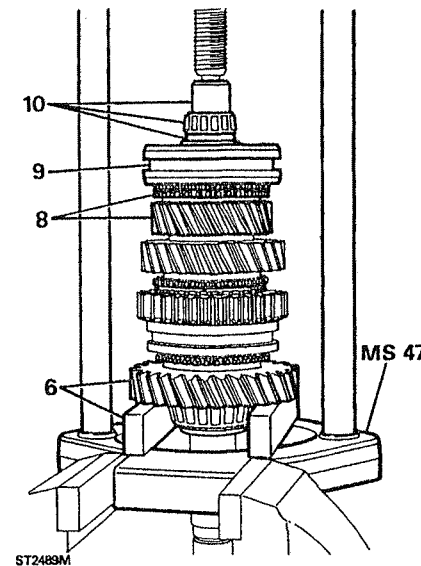
ST2484M

Mainshaft front-end assembly

6. Invert the mainshaft and support it on bars under first gear beneath press MS47.

CAUTION: It is vital that the mainshaft assembly is indeed supported under first gear to ensure that the position of the first gear bush is not altered and clamped when the spigot bearing is pressed on to the shaft.

7. Fit the needle roller bearing (18).
8. Fit the third gear (19) and the baulk ring (17), flat side towards the gear.
9. Fit the third-fourth synchromesh assembly (15,16) with the raised centre boss of the inner member towards the spigot bearing journal. Ensure that the baulk ring locates correctly.
10. Fit the thrust washer (12) and using a suitable sleeve, press the spigot bearing (11) squarely on to the shaft.

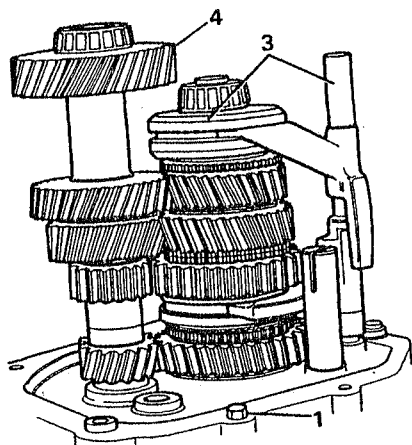


ST2483M

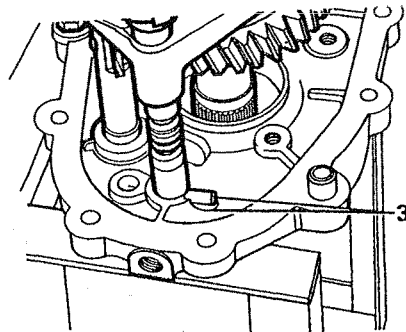
Fitting gears to centre plate

Lubricate all components with light oil before fitting.

1. Secure the centre plate to the workstand with a bolt and nut and fit the mainshaft and layshaft bearing tracks.
2. Check that both synchromesh units are in neutral and fit the selector shaft assembly to the mainshaft engaging the selector forks in their respective synchromesh outer members.
3. Fit the mainshaft and selector assembly to the centre plate whilst rotating the selector shaft to align the fifth gear selector pin with the slot in the centre plate to allow the shaft to pass through.
4. Fit the layshaft to the centre plate while lifting the mainshaft assembly enough to clear the rear layshaft bearing.



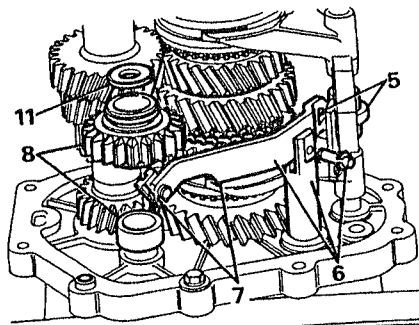
ST2490M



ST2495M

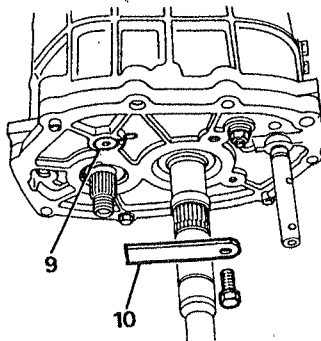
5. Turn the selector shaft and interlock spool to enable the forked end of the reverse lever to engage over the flange of the spool.
6. Insert the reverse lever into the slot in the reverse lever pivot post and secure the lever with the pivot pin and spring clip, or on earlier models, a circlip.
7. Fit the slipper pad to the reverse lever.
8. Partially insert the reverse gear shaft from underneath the centre plate and fit the reverse gear spacer and reverse gear, flanged side uppermost, on the shaft.

9. Engage the slipper on the reverse gear flange and push the reverse shaft up to its final position ensuring that the roll pin engages in the slot in the centre plate.



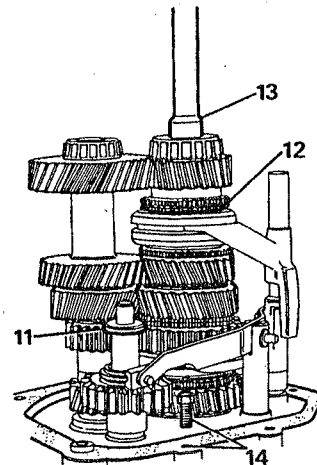
ST2491M

10. Whilst holding the reverse shaft to prevent it falling, secure it with the manufactured tool "A".



ST2492M

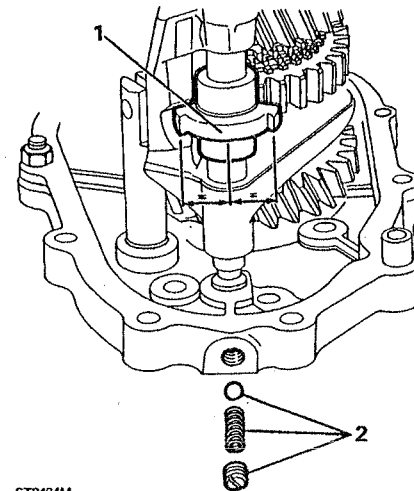
11. Fit the reverse gear thrust washer to the reverse shaft.
12. Fit and engage the fourth gear baulk ring (13) to the third-fourth synchromesh assembly.
13. Lubricate the spigot bearing and fit the input shaft.
14. Remove the nut and bolt securing the centre plate to the workstand and fit a new gasket.



ST2493M

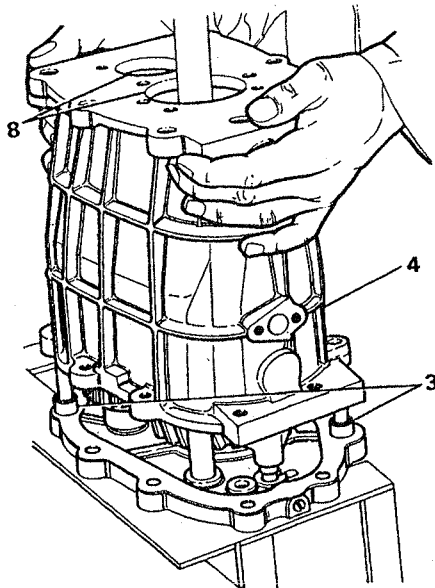
Fitting main gearbox casing

1. If necessary, turn the selector shaft and spool so that they are in the neutral position.
2. Lubricate and temporarily fit the detent ball and spring and secure with the plug tightening fully to ensure that the selector shaft does not move when the gear case is fitted.



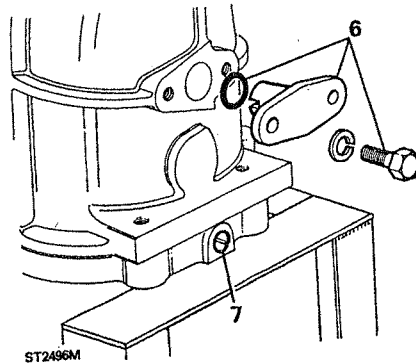
ST2494M

3. Fit two guide studs to the casing, one each side. Also check that the oil scoop is fitted and in the correct position.
4. Without using any force, carefully lower the gearcase into position over the gear assemblies. Ensure that the centre plate dowels and selector shaft are properly engaged in their locations.
5. Secure the centre plate and gearcase assembly, again, to the workstand with two 8 x 35 mm bolts. Use plain washers under the nuts to prevent damage to the rear face of the centre plate.



ST2515M

6. Lubricate and fit the interlock spool retainer with a new 'O' ring and apply Hylomar PL 32 on the joint face and on the threads of the two retaining bolts. Do not use force when fitting the spool retainer. Provided the spool has not been disturbed the retainer will slide easily into position. If the selector shaft has been moved or rotated it will be necessary to remove the gearcase and rectify to enable the retainer to be fitted. Fit the bolts with spring washers and tighten to the correct torque.
7. Remove the detent plug, smear the threads with Loctite 290 or Hylomar PL 32 and screw in until flush with the case. Stake the plug with a suitable punch to prevent it rotating.
8. Fit the layshaft and input shaft outer bearing tracks.

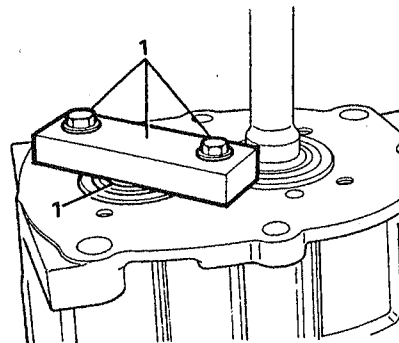


ST2496M

Fitting fifth gear

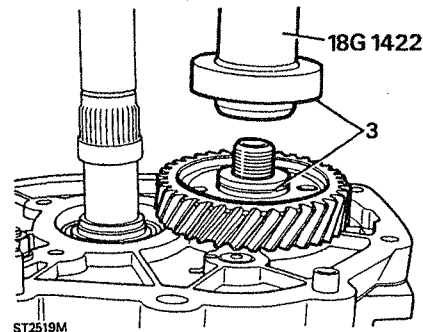
CAUTION: Since the fifth gear is a tight fit on the layshaft, it is important that when pressing the gear on to the layshaft the force must not be transferred to the layshaft front bearing. To prevent this happening it is recommended that Tool D is locally manufactured to the dimensions given.

1. Secure the locally manufactured layshaft support plate, tool D, to the front of the gearbox with two 8 x 25 mm bolts and washers with the 3.5 mm thick disc inserted between the plate and layshaft. Note that the plate also retains the input shaft bearing outer track.



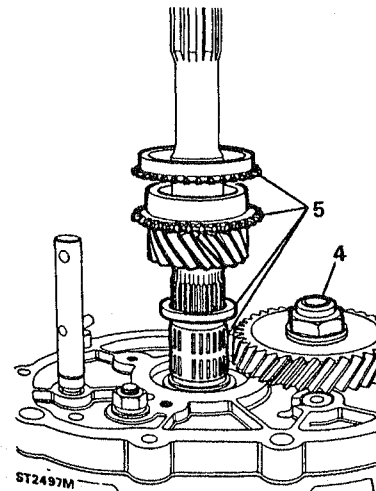
ST2507M

2. Release the assembly from the workstand, invert and secure it again to the workstand with rear of the gearbox uppermost. Remove the reverse shaft retainer plate.
3. With the annular extraction groove uppermost, press or drive the fifth gear on to the layshaft, with service tool 18G 1422.



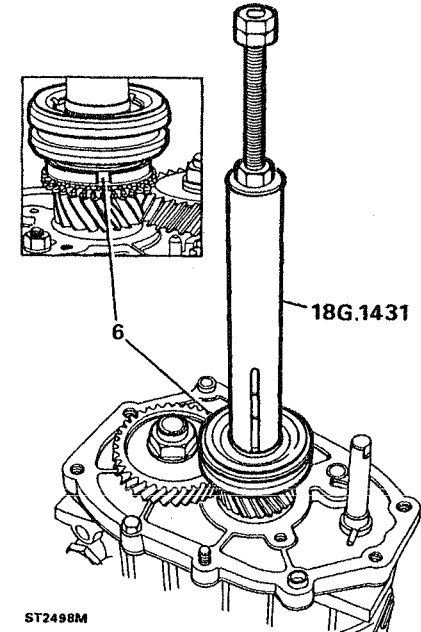
ST2519M

4. Fit a new 22 mm stake nut to the layshaft but do not tighten at this stage. On early gearboxes, without the retaining nut, fit the layshaft collar and secure with a new circlip.
5. Assemble the fifth speed thrust washer, roller bearing, fifth gear and baulk ring to the mainshaft.



ST2497M

6. Press the fifth gear synchromesh inner and outer members and retainer plate on to the mainshaft using service tool 18G 1431. Before pressing the synchromesh fully home, ensure that the slipper pads locate in the three slots in the baulk ring.

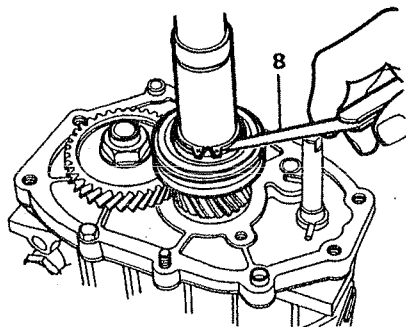


ST2498M

7. Since only limited movement of the synchromesh inner member on the mainshaft splines is permissible a range of selective washers is available for fitment between the inner member and retaining circlip as listed following this instruction.

Part Number	Thickness (mm)
FRC5284	5,10
FRC5286	5,16
FRC5288	5,22
FRC5290	5,28
FRC5292	5,34
FRC5294	5,40
FRC5296	5,46
FRC5298	5,52
FRC5300	5,58
FRC5302	5,64

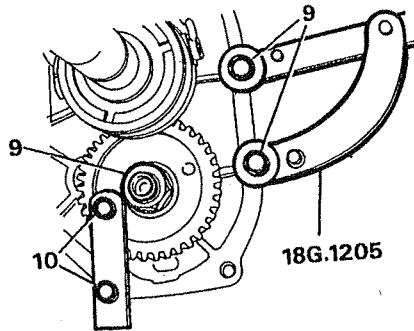
8. Start by fitting the thinnest washer and secure with a new circlip. Measure, with a feeler gauge, the clearance between the circlip and washer. The maximum permitted clearance is 0,005 to 0,050 mm. Continue selection until the clearance is correct.



ST2499M

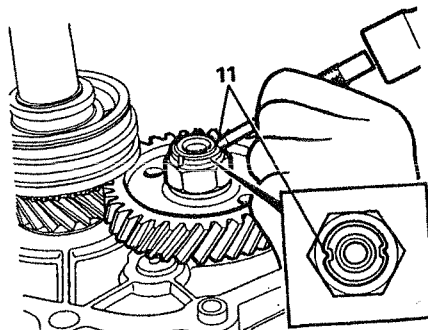
9. At this stage the layshaft gear stake nut must be tightened to the correct torque. The practice of locking gears to provide a restraint to tighten the nut is not acceptable in view of the high torque figure necessary. The following method must therefore be adopted to avoid damage to the gears. Secure the flange holder service tool 18G 1205 to the gearcase.

10. To restrain the fifth gear, secure one end of manufactured tool "A" to the gear and the other to the gear case. Using a suitable torque wrench, tighten the stake nut to the correct torque.



ST2500M

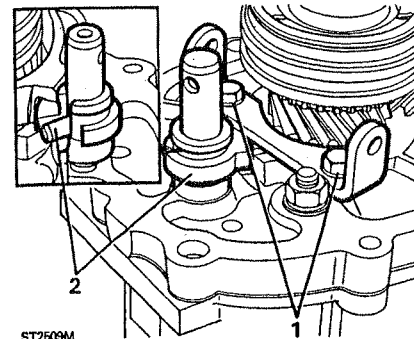
11. Using a round nose punch, neatly and with care, form the collar into the layshaft slots.



ST2508M

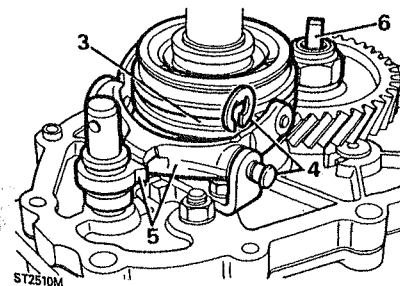
Fifth gear selector fork assembly

1. Fit the fifth gear selector fork bracket to the centre plate with the two bolts and spring washers and tighten to the correct torque.
2. Fit the fifth gear spool, long end towards the centre plate, over the selector shaft and peg.



ST2509M

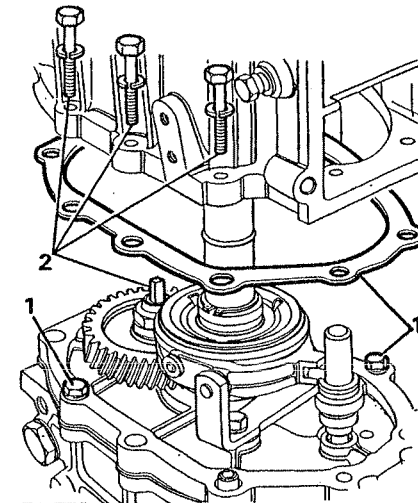
3. Fit the bronze pads to the selector fork and if necessary hold in position with Vaseline.
4. Assemble the selector fork to the synchromesh outer member groove and attach it to the bracket with the two pins. Before securing with the 'E' clips, cover, with cloth, all the holes into the main casing to prevent an 'E' clip accidentally falling into the casing.
5. Engage the tongue of the spool in the selector fork groove.
6. Fit the oil pump drive shaft to the layshaft.



ST2510M

Fifth gear extension case

1. Remove the two bolts securing the centre plate and place a new gasket on the joint face.
2. Carefully lower the extension case with the oil pick-up pipe into position on the centre plate. If it does not locate correctly, first time, do not use force but remove the case and re-align the oil pump and drive shaft. Refit the case, remove the guide studs and secure the case with the bolts and tighten evenly to the correct torque.



ST3222M

3. Cover the mainshaft splines with smooth tape and fit a new 'O' ring oil seal to the mainshaft groove. Remove the protective tape.

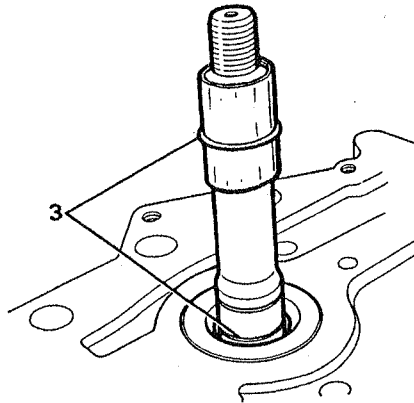
Input-mainshaft bearing adjustment

1. Turn the gearbox over and secure it to the workstand. Remove the layshaft support plate and packing disc.

NOTE: Correct shimming of the input shaft bearing is important to ensure that the mainshaft assembly has the design intended end float and that the taper bearings are not pre-loaded.

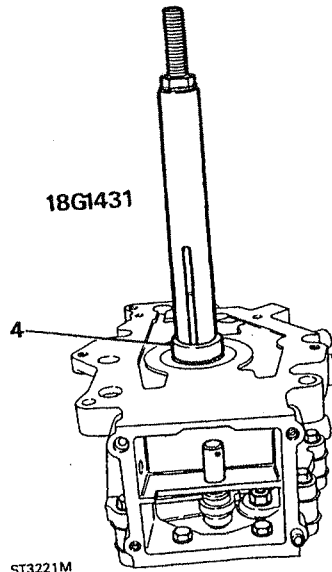
2. Measure and note the thickness of a new front cover gasket. Place the original shim washer on the mainshaft bearing and secure the cover, without the gasket, with the four bolts and spring washers, finger tight only, which surround the input shaft. Do not fit the layshaft shim washer at this stage.

3. Measure the clearance between the front cover and gearcase with two sets of feeler gauges on opposite sides of the cover as illustrated. If necessary, change the selective washer to obtain a clearance of 0,035 mm to 0,085 mm less than the thickness of the gasket. This will ensure that when the gasket and cover is fitted and secured to the correct torque, the input shaft and therefore the mainshaft assembly and bearings will have no pre-load and not more than 0,06 mm end float.

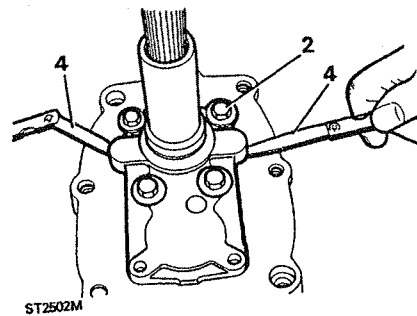


ST2512M

4. Fit a new oil seal collar to the mainshaft using service tool 18G 1431. The slot in the tool is so that it can be seen when the collar has been pushed on to the shaft sufficiently to enable the retaining snap ring to be fitted to the groove.



ST3221M



ST2502M

4. Remove the front cover and keep the selective washer and gasket safely for the final assembly of the cover when the following layshaft bearing adjustment is completed.

Input/main shaft selective washers

Part No.	Thickness (mm)	Part No.	Thickness (mm)
FRC4327	1,51	FRC4349	2,17
FRC4329	1,57	FRC4351	2,23
FRC4331	1,6	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

Layshaft selective washers: - Early models

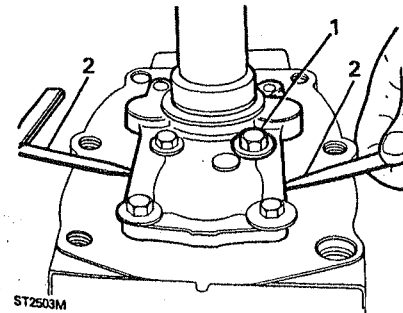
Part No.	Thickness (mm)	Part No.	Thickness (mm)
TKC4633	1,69	TKC4649	2,17
TKC4635	1,75	TKC4651	2,23
KC4637	1,81	TKC4653	2,29
KC4639	1,87	TKC4655	2,35
KC4641	1,93	TKC4657	2,41
KC4643	1,99	TKC4659	2,47
KC4645	2,05	TKC4661	2,53
KC4647	2,11	TKC4663	2,59

Layshaft selective washers increased capacity bearings: - Later models

Part No.	Thickness (mm)	Part No.	Thickness (mm)
FTC0262	1,36	FTC0280	1,90
FTC0264	1,42	FTC0282	1,96
FTC0266	1,48	FTC0284	2,02
FTC0268	1,54	FTC0286	2,08
FTC0270	1,60	FTC0288	2,14
FTC0272	1,66	FTC0290	2,20
FTC0274	1,72	FTC0292	2,26
FTC0276	1,78	FTC0294	2,32
FTC0278	1,84	FTC0296	2,38

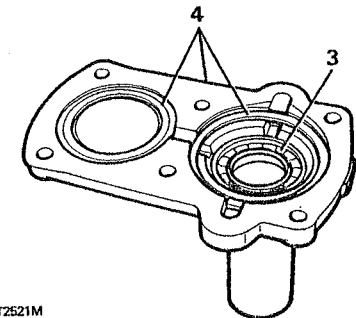
Layshaft bearing adjustment

1. Place the original selective washer on the layshaft bearing and fit the front cover without a gasket. Secure the cover with the four bolts and plain washers finger tight only. Ensure that the washer locates correctly in the front cover register.
2. Measure the clearance, with two sets of feeler gauges, between the cover and gearcase. Select a shim washer 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. This will ensure that the layshaft bearings have no end float and not more than 0,025 mm pre-load once the gasket and cover is fitted and the bolts tightened to the correct torque.



ST2503M

3. Remove the front cover and layshaft selective washer. Drive or press in a new oil seal to the front cover. Ensure that the seal lips face towards the gearcase and that the garter spring is in position. Lubricate with SAE 40 oil.
4. Fit the mainshaft and layshaft selected washers to the front cover and retain in position with petroleum jelly. Also, fit a new cover gasket.

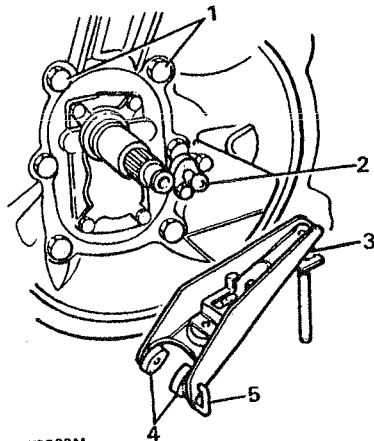


ST2521M

5. Wrap smooth tape round the input shaft splines to protect the new oil seal. Apply Hylomar PL 32 to the threads of the six bolts and secure the cover tightening the bolts and spring washers evenly to the correct torque.

Bell housing, clutch withdrawal, drain and level plugs

1. Fit the hollow dowels to the gearbox casing and locate the bell housing over the dowels and secure with the two long bolts 12 x 45 mm through the dowel holes and the four 12 x 30 mm bolts in the remaining positions. Tighten evenly to the correct torque.
2. Move the pivot post back into position and secure with the three bolts.
3. Apply molybdenum disulphide grease to the pivot post and corresponding socket in the lever and slipper pads and pins.
4. Fit the slipper pads to the lever and fit the assembly to the bearing. Slide the bearing and lever over the sleeve and locate the lever on to the pivot post.
5. Fit a new Nylon staple to the release bearing assembly (short leg into the lever). The staple is merely an aid to assembly and has no other purpose. It may become lost or dislodged in service without detriment.

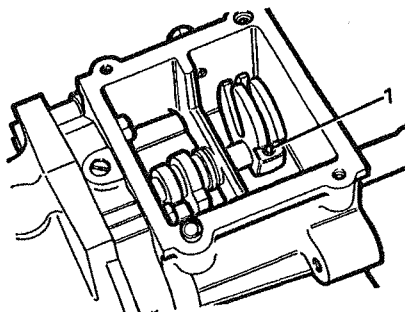


ST2202M

6. Fit and tighten to the correct torque the gearbox drain and level plugs. Use a new selaing washer on the drain plug.

Gear lever and remote housing assembly

1. Before fitting the above assembly, fit the quadrant to the main selector shaft, which is a reversal of the removal instructions. It is important, however, to ensure the quadrant is fitted the correct way round with ledge towards the left-hand side (as seen from the driver's seat) of the gearbox. Push the shaft forward to provide space for the quadrant to be fitted and secure with a new roll pin. Return the shaft to the neutral position.



ST2191M

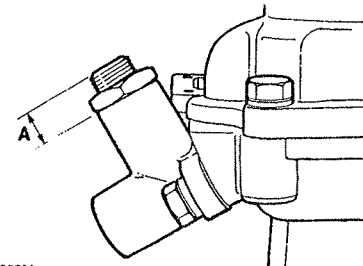
2. Place a new gasket in position on the extension case and fit the remote housing, over the two hollow dowels, ensuring that the rollers locate in the fork of the main selector quadrant. Secure the housing with the three bolts tightening evenly to the correct torque.
3. If required, the transfer gear change housing may be fitted at this stage.

Gear change mechanism adjustments

NOTE: The illustrations accompanying the following adjustments all show the gear lever housing with the bias spring. However, the relevant adjustment methods are the same for the earlier gearboxes, without the bias spring. To facilitate these adjustments the gear change extension lever should be temporarily fitted.

Reverse gear plunger adjustment - early models

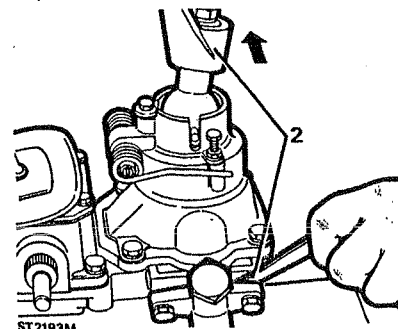
1. Remove the plunger assembly and shims from the remote housing and refit the plunger without shims. On the latest version release both legs of the bias spring from the cross pins.
2. Select first or second gear and whilst applying light pressure to the gear lever towards the left, turn both plunger retaining bolts clockwise, by hand, a little at a time until the plunger is felt to contact the trunnion. Then, with a feeler gauge, measure the clearance between the plunger housing face and the remote housing. Select shims equal to the clearance plus 0,050 mm more. Do not fit a shim pack of a lesser thickness than that measured. Move the gear lever to neutral, remove the plunger assembly, refit with the shims and tighten the bolts evenly to the correct torque.



ST3223M

Fifth gear stop plate adjustment - later models

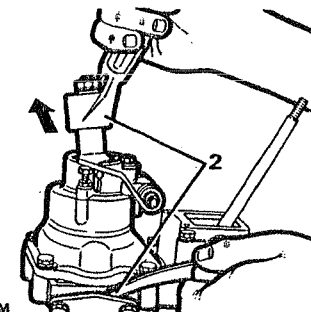
1. Loosely fit the stop plate without shims.
2. Select fifth gear and whilst applying light pressure to the gear lever towards the right, tighten the stop plate retaining bolts by equal amounts, until the stop is felt to contact the yoke. Then, measure the clearance between the stop plate and remote housing with a feeler gauge. Add shims equal to the clearance plus further shims to the value of 0,050 mm. Finally, tighten the retaining bolts.



ST2193M

Reverse gear plunger adjustment - later models

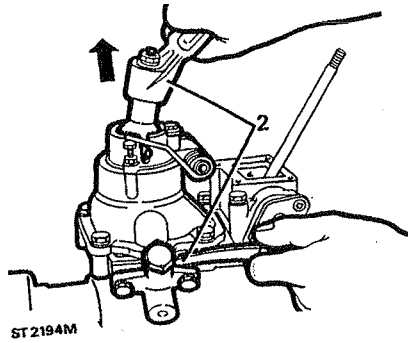
1. Fit the plunger and original shims and tighten the two retaining bolts.
2. Slacken the locknut and turn adjuster screw so that dimension 'A' is approximately 12 mm and tighten locknut. Final adjustment, if necessary, can be made when gearbox is fitted to vehicle. To increase pull-over load turn screw clockwise or anti-clockwise to reduce load.



ST2195M

Fifth gear plunger adjustment - early models

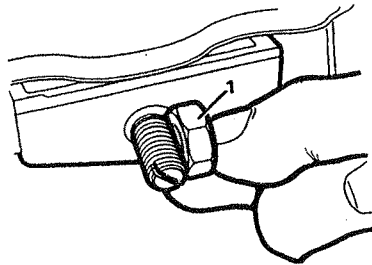
1. Loosely fit the plunger assembly without shims.
2. Engage fourth gear and whilst applying light pressure to the gear lever to the right, tighten the plunger retaining bolts by equal turns, by hand, until the plunger is felt to contact the yoke. Then, with a feeler gauge, measure the clearance between the plunger and remote housing. Fit shims equal to the clearance and then add further shims to the value of 0,050 mm.



3. Finally fit and tighten the retaining bolts.

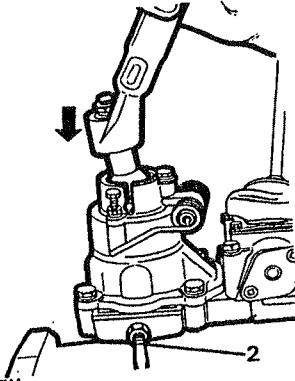
Fifth gear stop screw adjustment - latest models

1. Temporarily adjust the screw so that it protrudes from the remote housing the distance across the corners of the locknut. This is only an approximate setting which will limit the travel of the selector yoke but will allow the fifth gear to be selected.



ST3225M

2. Select fifth gear and whilst applying light pressure to the gear lever towards the right, turn the screw clockwise until it contacts the selector yoke. Now, turn the screw anti-clockwise half-a-turn and secure the setting with the locknut.

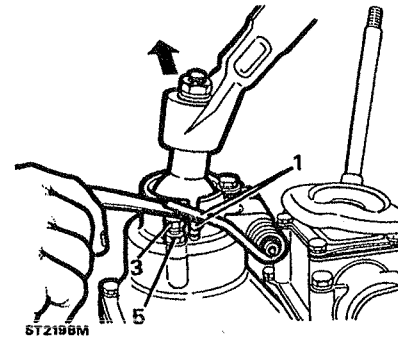


ST2197M

Bias spring adjustment

The purpose of this adjustment is to set both adjusting bolts so that the bias spring legs apply an equal pressure on both ends of the gear lever cross pin when third or fourth gear is engaged. This will ensure that when the gear lever is in neutral the gear change mechanism is automatically aligned for third or fourth gear selection.

1. Select fourth gear and lift both legs of the spring over the cross pin.
2. If necessary, turn the adjustment bolts so that the heads just touch the spring legs.
3. Apply light pressure to the gear lever to the right and adjust the left hand bolt, as illustrated, to provide a clearance of 0,05 mm between the spring leg and bolt head.
4. Move the lever in the opposite direction, to the left, and adjust the other bolt to give the same clearance between the spring leg and bolt head.
5. Secure the setting by tightening the two locknuts without moving the screw.



ST2198M

Lubrication

1. Check the tightness of the gearbox and transfer housing drain plugs. Move the gearbox to a level position and remove the filler level plug. Inject 2.20 litres of a recommended oil from a sealed container into the gearbox and tighten the plug. Wipe-away surplus oil.
2. Assemble the transfer gearbox to the main gearbox and fit the complete assembly to the vehicle.
3. Before running the vehicle, it should be moved to level ground, the filler level plug removed and if necessary, inject sufficient of the same above recommended oil until it just begins to run from the level hole. Refit the plug, tighten to the correct torque and wipe-away surplus oil.
4. At the same time, check the transfer gearbox oil level and top-up, if necessary, with a recommended oil from a sealed container.

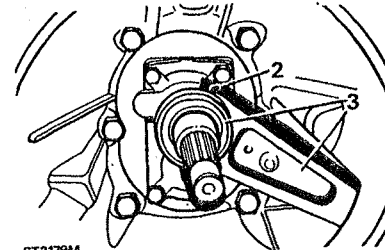
Notes

DISMANTLE

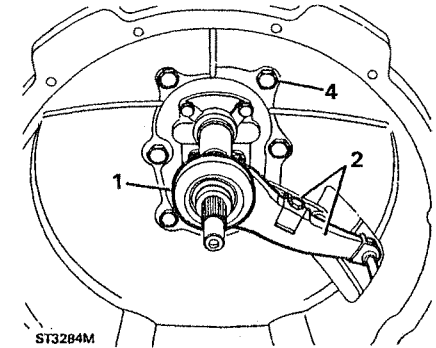
Bell housing

Four cylinder engine

1. Remove transfer box, drain oil and clean exterior.
2. If fitted, clutch release bearing clip.
3. Remove clutch release assembly.

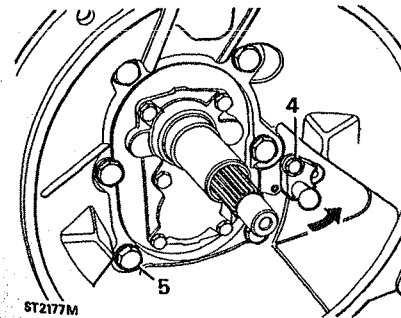


ST2179M



ST3284M

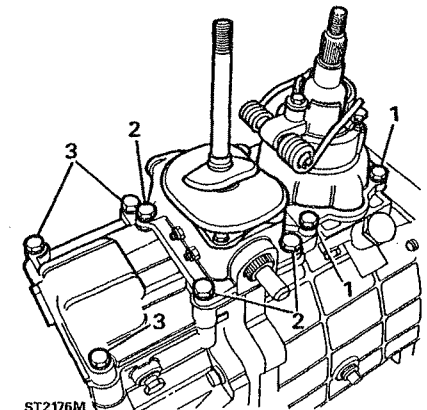
4. Remove one pivot post bolt, slacken the other and move post aside.
5. Remove six bolts and withdraw bell housing.



ST2177M

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.

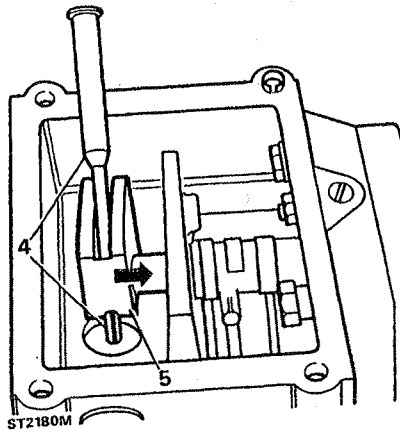


ST2176M

V8 engine

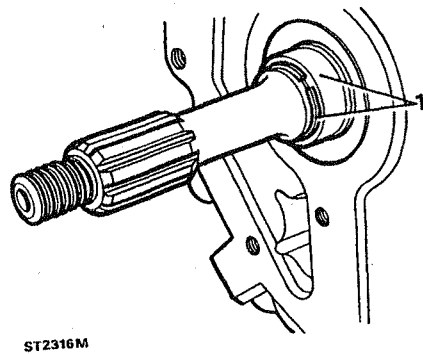
1. Remove clutch release bearing.
2. Remove screw and spring clip and remove release lever.
3. Remove "C" clip from pivot post.
4. Remove six bolts and bell housing.

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

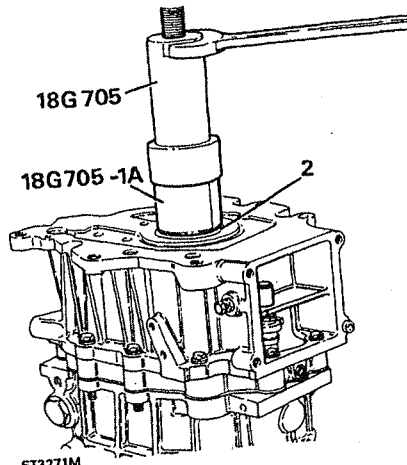


Extension housing

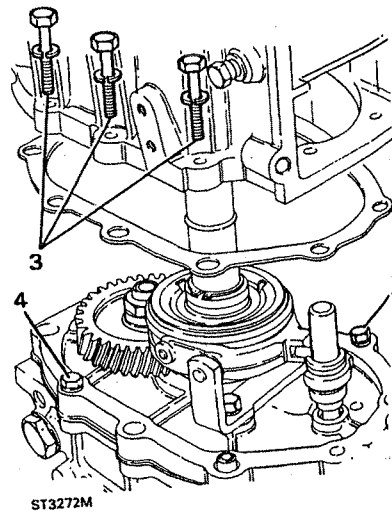
1. Remove snap ring retaining oil seal collar.



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

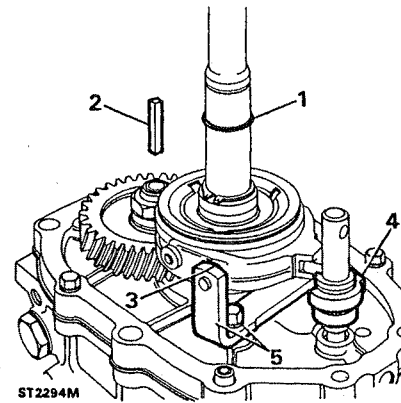


3. Remove the fifth gear extension housing.
4. Secure the centre plate to the gearcase with two 8 x 35mm bolts.

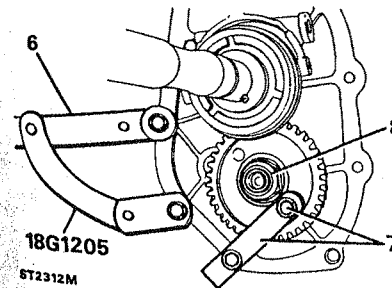


Mainshaft and layshaft fifth gears

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.

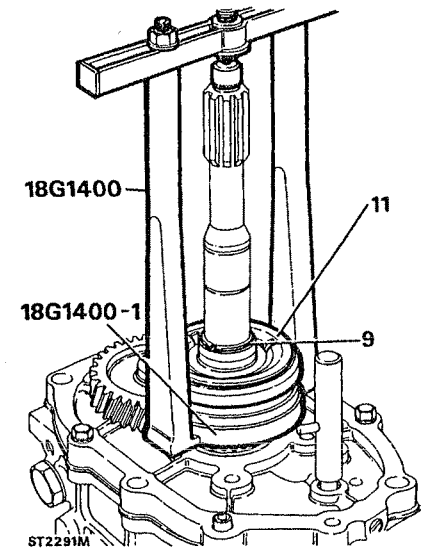


6. Locate flange holder tool 18G 1205.
7. Fit manufactured tool "A" and spacer to restrain layshaft fifth gear.
8. De-stake and remove fifth gear nut.

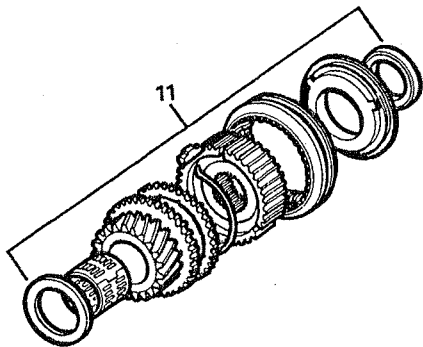


9. Remove circlip retaining mainshaft fifth gear synchromesh.
10. Fit special tool 18G 1400-1 and 18G 1400 as illustrated.

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

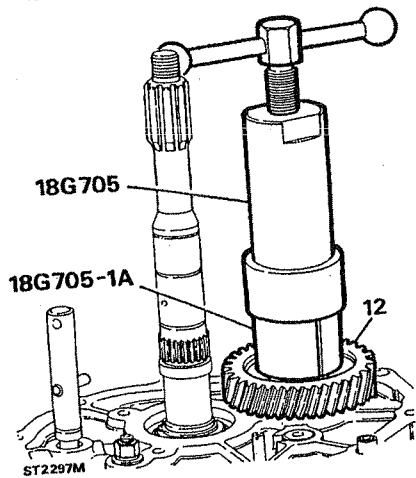


11. Remove fifth gear synchromesh.



ST2296M

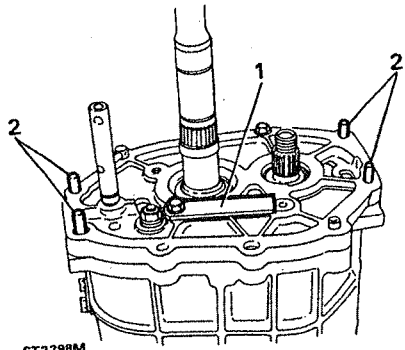
12. Remove layshaft fifth gear using special tools 18G 705 and 18G 705-1A.



ST2297M

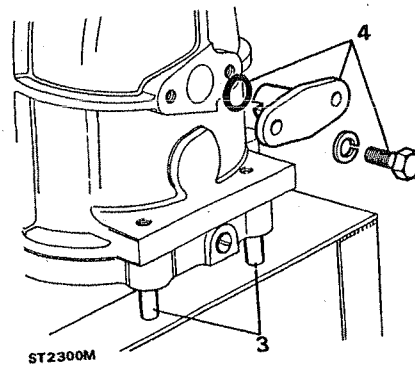
Main gear case.

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



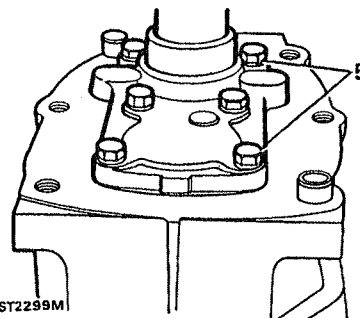
ST2298M

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



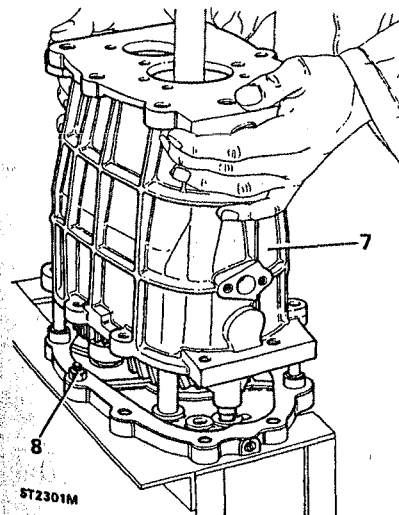
ST2300M

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



ST2299M

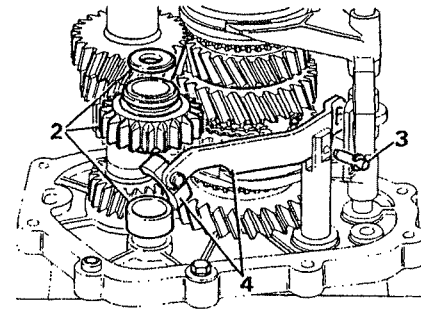
7. Remove bolts and lift-off gear case.
8. Secure centre plate with nut and bolt.



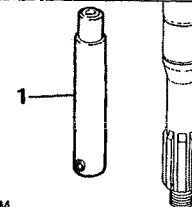
ST2301M

Reverse shaft, layshaft and mainshaft

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

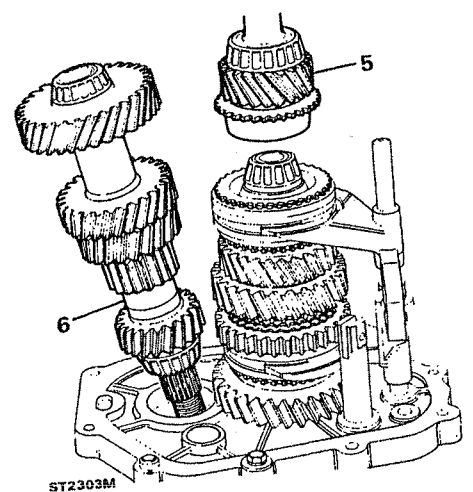


ST3237M

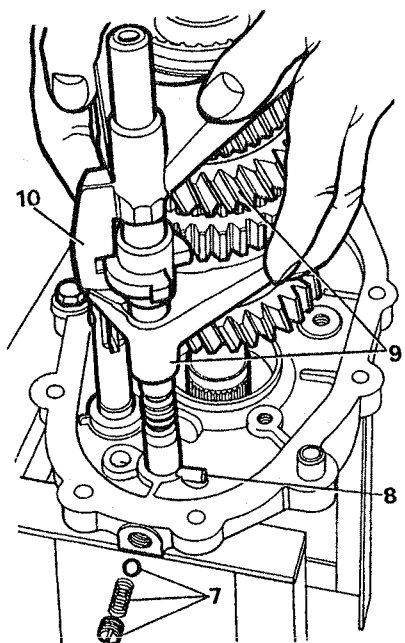


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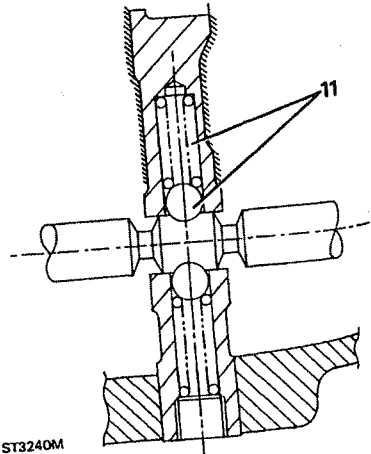
5. Remove input shaft and fourth gear baulk ring.
6. Remove layshaft by tilting, as illustrated and lifting mainshaft.



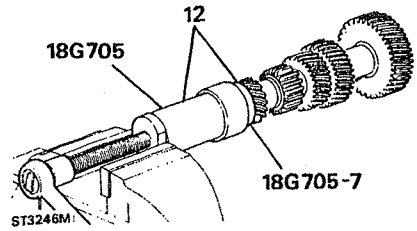
7. Unscrew plug and remove spring and outboard detent ball.
8. Align fifth gear selector pin with centre plate slot.
9. Remove mainshaft, gears, selectors and forks.
10. Remove selector fork assembly from gears.



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

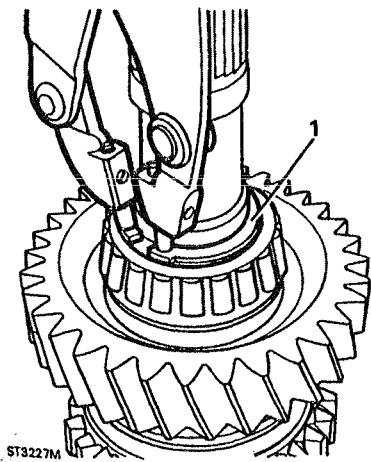


12. Using extractor tool 18G 705 and collets 18G 705-7, withdraw layshaft bearings.

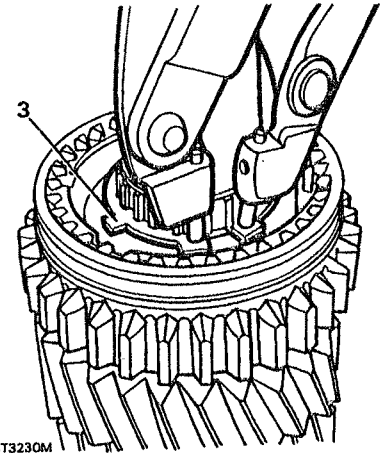


Mainshaft

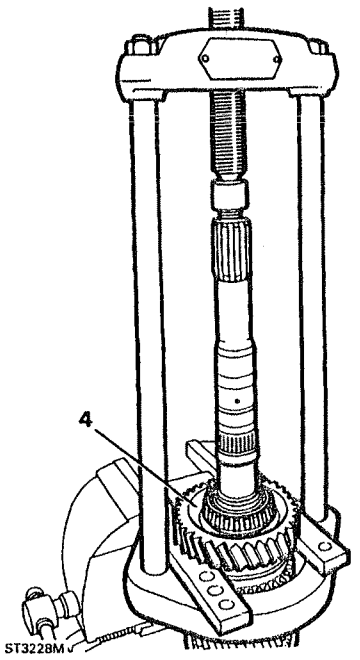
1. Remove circlip retaining first gear assembly.



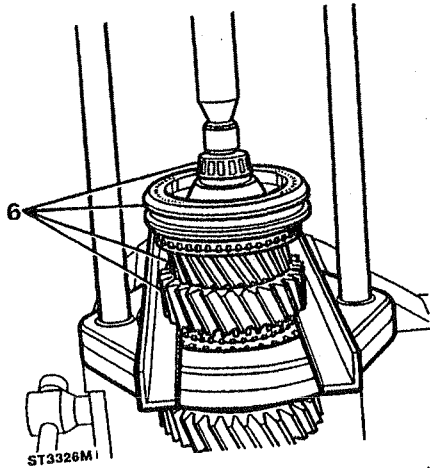
2. Remove taper bearing, bush, needle bearing, first gear spacer, cone, inner and outer baulk rings.
3. Remove circlip to release first and second gear synchromesh assembly.



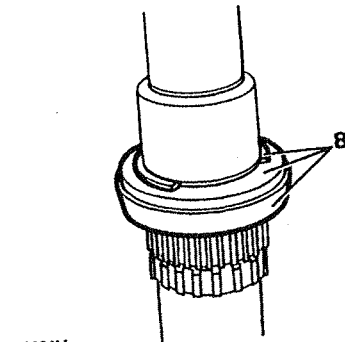
4. With MS 47 press first gear assembly from mainshaft.



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



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



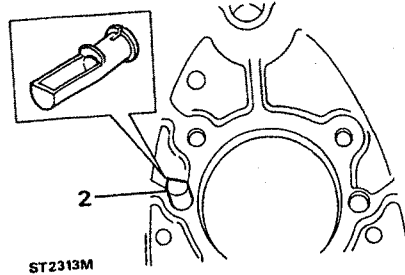
ST3234M

Gearbox casings and oil pump

Degrease and clean all components and discard gaskets and seals.

Gearbox casing

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

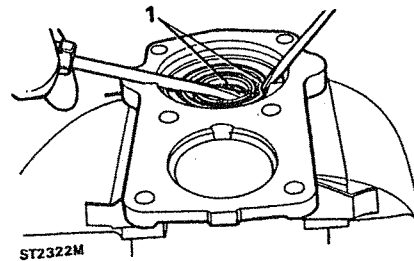


ST2313M

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

Front cover

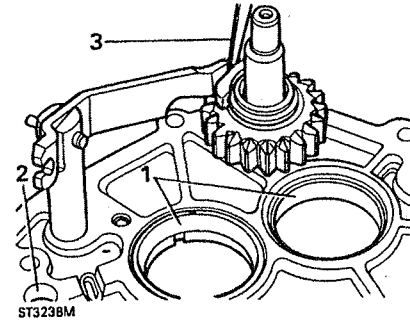
- Remove oil seal from cover. Do not fit a new seal at this stage



ST2322M

Centre plate

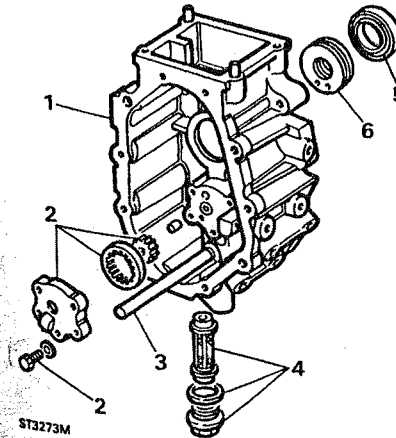
- Remove bearing tracks.
- Inspect for damage and selector rail bore for wear.
- Temporarily fit reverse shaft gear and lever and check clearance between slipper and lever does not exceed 0,20 mm (0.008 in).



ST3238M

Extension case and oil pump

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



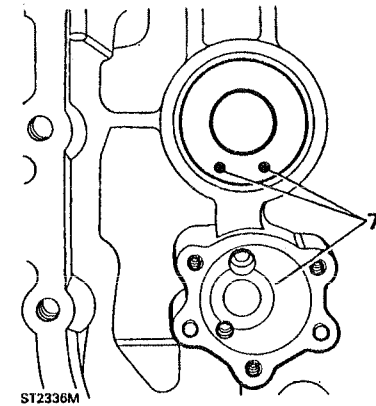
ST3273M

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

WARNING: This bush contains asbestos. Do not attempt to clean it. See INTRODUCTION, information, Poisonous substances.

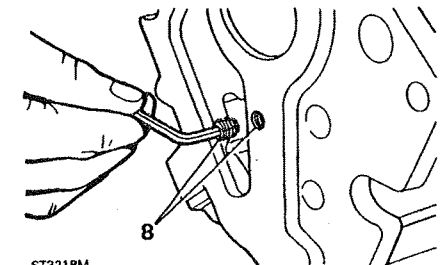
- Fit new bush with drain holes towards bottom of casing.

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



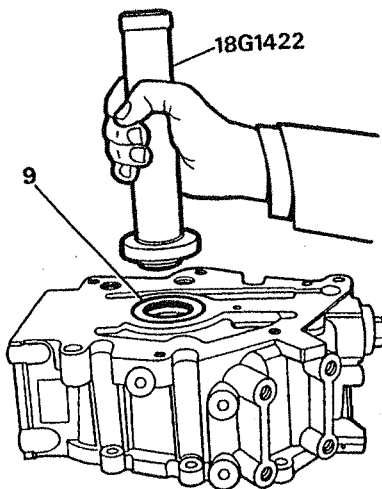
ST2336M

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



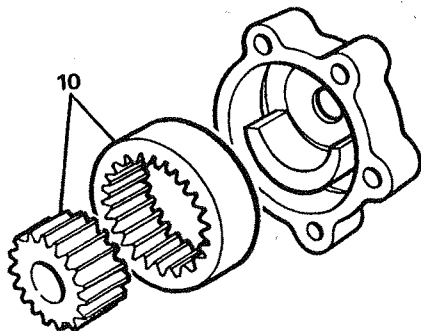
ST3218M

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



ST2334M

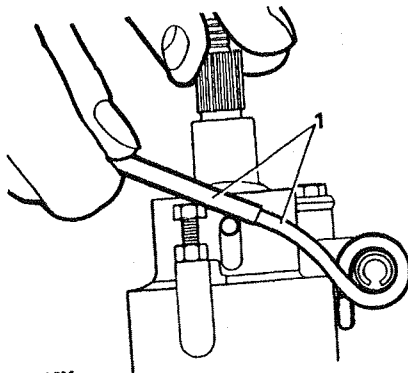
- Assemble gears to oil pump and fit cover.



ST3254M

Gear change housing

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

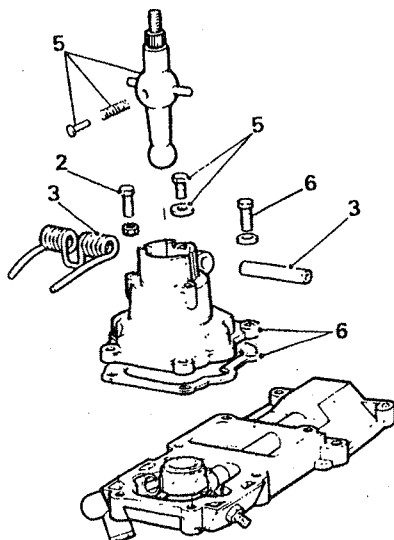


ST2186M

- Drive-out roll pin to remove bias spring.
- Remove gear lever extension from lower gear lever.
- 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.

- Remove gear selector housing from remote housing.



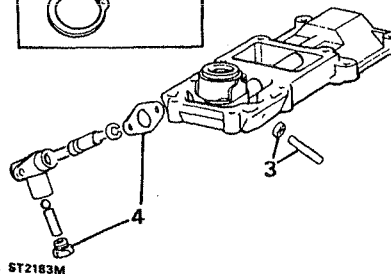
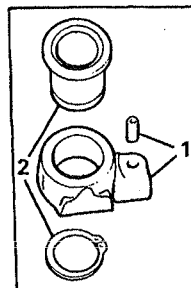
ST2182M

- Clean and examine all components and renew where necessary.
- 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.

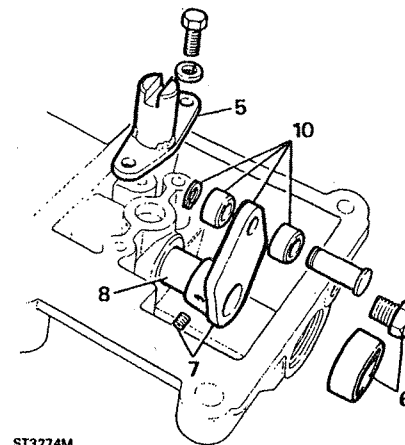
- Release socket headed screw to remove trunnion.
- Remove circlip to release seating from trunnion.
- Remove fifth gear locknut and stud.
- Remove reverse gear plunger and shim.



ST2183M

- Remove fifth gear spool guide.
- Remove blanking plug.
- Drift-out roll pin securing quadrant to shaft.
- With selector through hole.
- Remove selector shaft "O" ring.

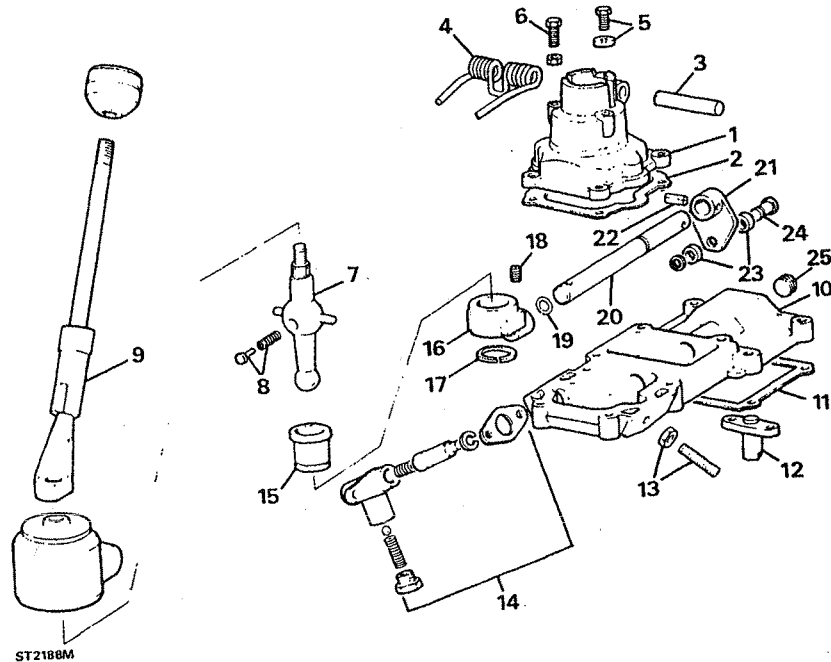
- Remove circlip to release rollers and pin from quadrant.



ST3274M

- Clean and examine all components and renew where necessary.
- Assemble housing by first fitting "O" ring to shaft.
- Fit quadrant and secure with roll pin.
- Fit rollers and secure with circlip.
- Fit fifth gear spool retainer and apply Loctite 290 to bolt threads.
- Apply Loctite 290 to reverse switch threads.
- Fit seating to trunnion and secure with circlip.
- Fit trunnion to shaft and apply Loctite to retaining screw threads.
- Fit reverse gear plunger and original shims.
- Fit fifth gear stud stop and locknut.
- Fit new bucket plug with Hylomar PL 32.
- Fit gear selector housing to remote housing.

GEAR SELECTOR HOUSING



ST2188M

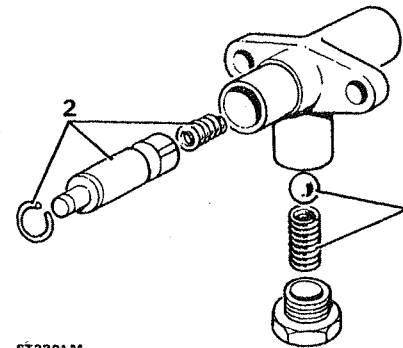
- | | |
|--|------------------------------|
| 1. Gear selector housing | 14. Reverse gear plunger |
| 2. Gasket | 15. Gear lever seating |
| 3. Roll pin | 16. Trunnion |
| 4. Bias spring | 17. Circlip |
| 5. Gear lever retaining screw and washer | 18. Trunnion retaining screw |
| 6. Selector housing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

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.

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

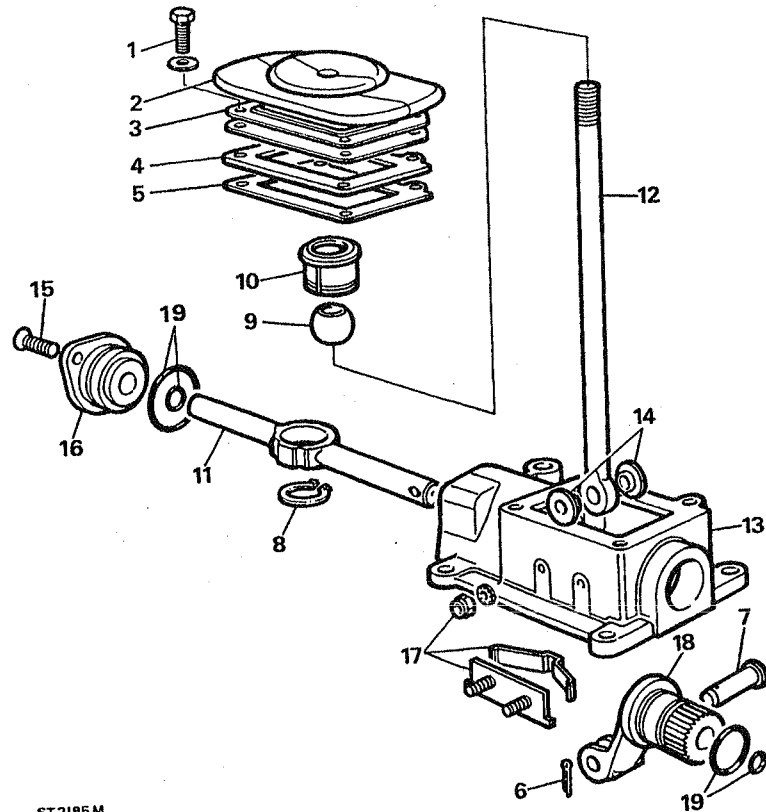
9. Fit internal and external "O" rings to fork assembly.
10. Fit detent spring.
11. Fit "O" rings to end cover and fit to short end of cross shaft.
12. Insert shaft into fork and secure end cover with screws.
13. Fit Nylon seat, groove downwards, to gear lever.
14. Fit gear lever and seat to cross shaft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



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.



ST2185 M

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-metallic bushes.
15. Counter sunk screws.
16. End cover.
17. Detent spring and plate.
18. Selector fork.
19. "O" rings.

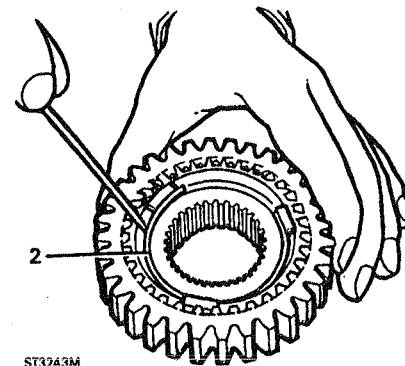
EXAMINATION

Synchromesh assemblies

Third-fourth and fifth gear synchromesh.

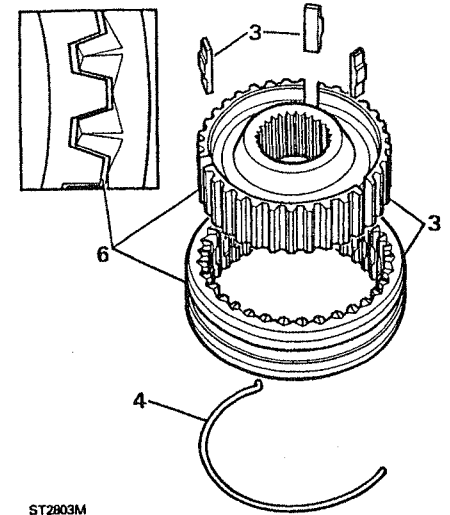
NOTE: the above assemblies are the same except that fifth gear synchromesh has a retainer plate.

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



ST3243M

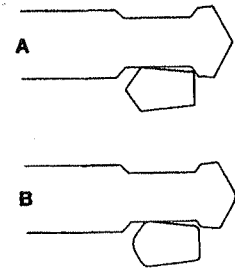
3. Remove slippers and separate the two members.
4. Examine all parts for damage and wear including wire clips for tension.
5. Check no radial movement exists between inner members and mainshaft splines. (except fifth gear synchromesh).
6. Examine inner and outer splines for wear.



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.

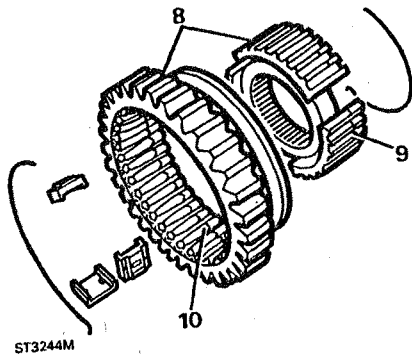


ST2449M

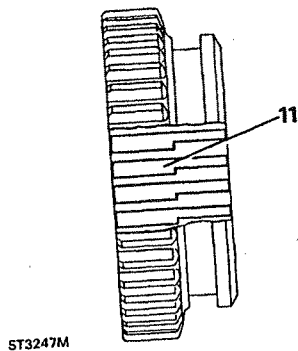
First-second synchronmesh

8. Repeat instructions 1 to 6 for third-fourth synchronmesh.
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.

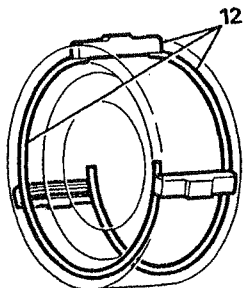


11. Fit inner member to outer so that the wide splines of inner member are under the spur gear teeth.



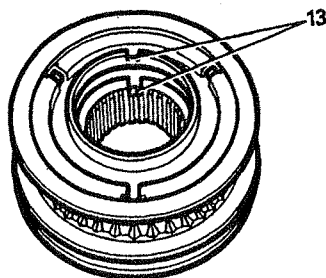
12. Fit the slippers and secure with a spring each side of the synchronmesh.

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.



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

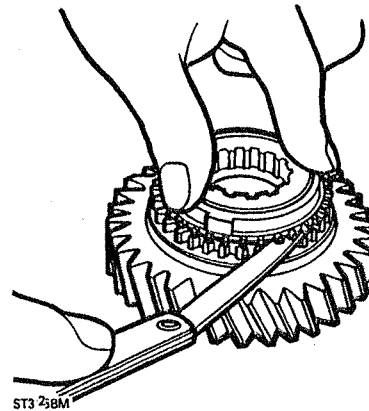
NOTE: The back plate for fifth gear is fitted to the rear of the assembly with the single tag locating in a slot in the inner member.



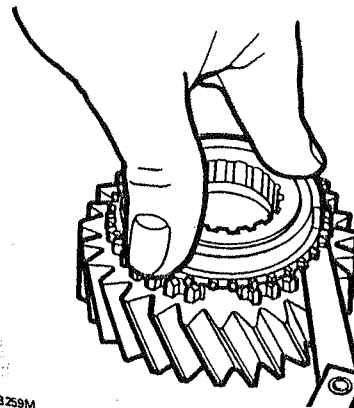
Checking baulk ring clearances

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

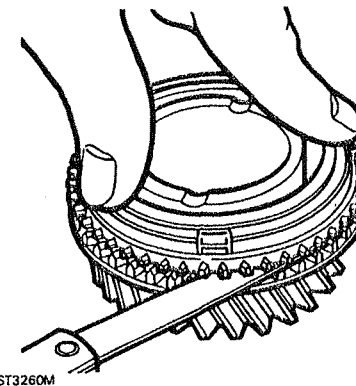
First gear



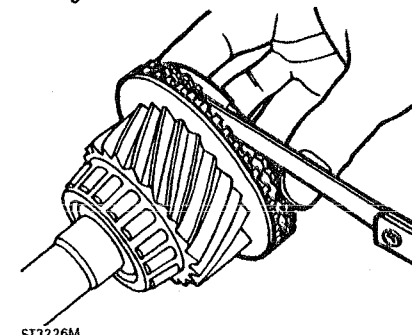
Second gear



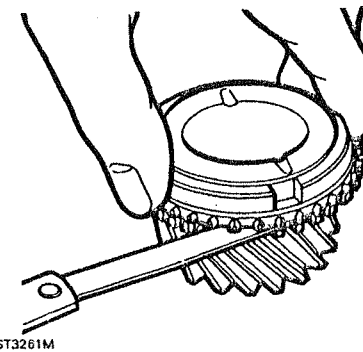
Third gear



Fourth gear

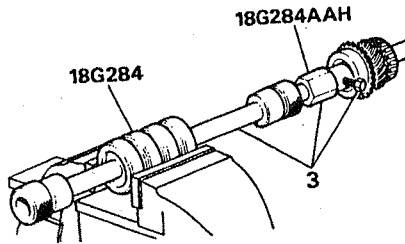


Fifth gear



Input shaft

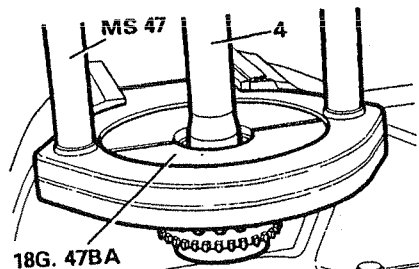
1. Examine the gear and dog teeth for wear and damage.
2. Polish oil seal track if necessary.
3. Using 18G 284 AAH and 18G 284 remove pilot bearing track.



ST3278M

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

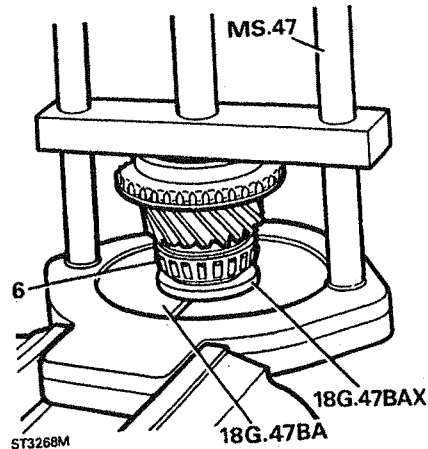
NOTE: ensure that the bearing is supported by the lip inside 18G 47 BA.



ST3279M

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

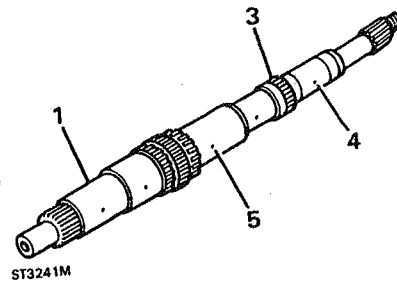
6. Using Press MS 47, Collets 18G 47B and adaptor 18G 47 BAX fit a new taper bearing.



ST3268M

Mainshaft

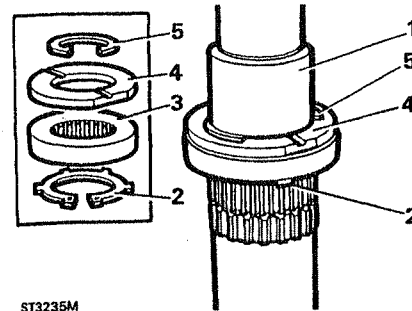
1. Examine bearing journals for wear and scores.
2. Check condition of circlip grooves.
3. Examine splines for wear and damage.
4. Use an air line to check that the main oil feed from the pump is clear and feed to spigot bearing.
5. Check oil feed holes to roller bearings are clear.



ST3241M

Mainshaft gear end float checks

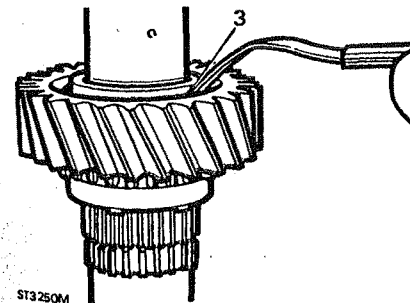
1. Hold mainshaft in vice front end downwards.
2. Fit front circlip for first-second synchronesh.
3. Fit second gear cone.
4. Fit spacer.
5. Fit snap ring.



ST3235M

Second gear end-float.

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

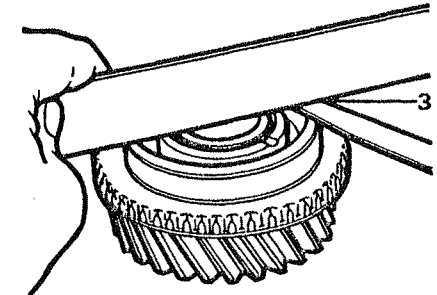


ST3250M

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

Third gear end-float.

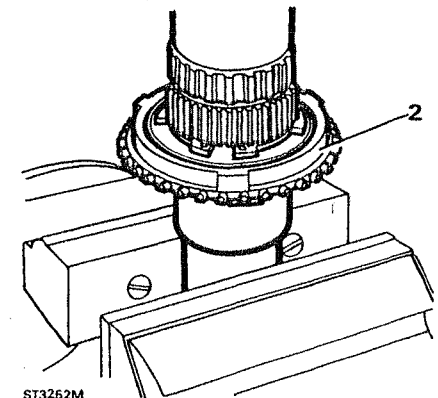
1. Fit needle roller to third gear.
2. fit third gear bush to third gear.
3. Place gear on flat surface, bush flange downwards, and with a straight edge across gear check clearance between straight edge and gear. Not to exceed 0,20 (0.008in).



ST3251M

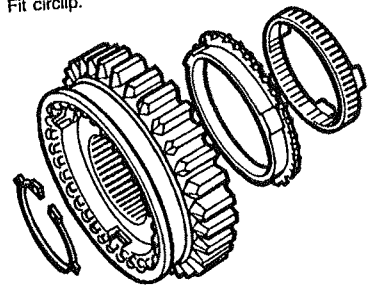
First gear bush end-float.

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

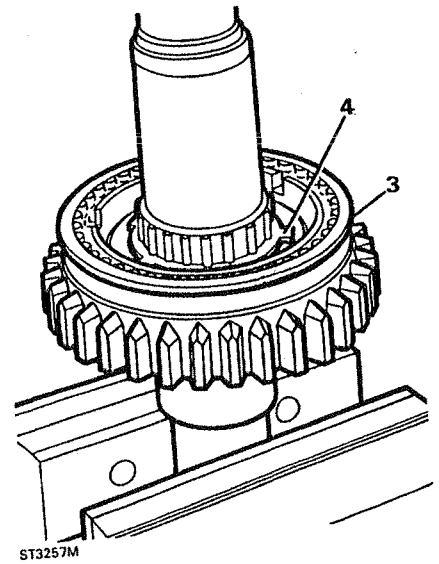


ST3252M

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



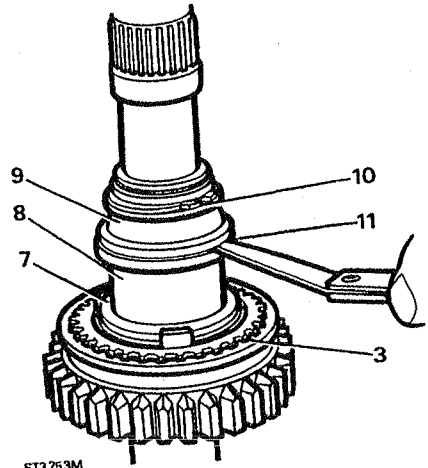
ST3231M
First-second synchromesh assembly



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.



ST3259M

Selective first gear bush

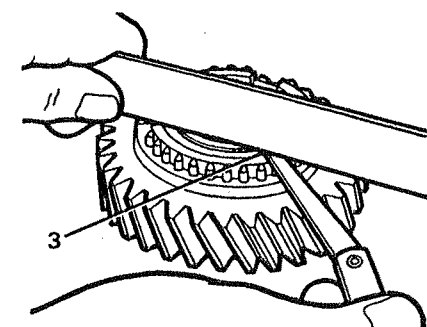
Part number	Thickness
FTC2005	30,905/30,955
FTC2006	30,955/31,005
FTC2007	31,005/31,055
FTC2008	31,055/31,105
FTC2009	31,105/31,155

Check first gear to bush end-float.

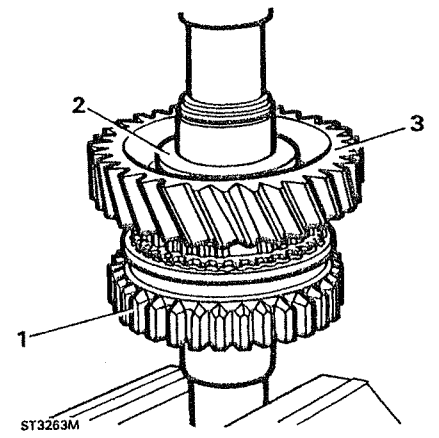
1. Fit roller bearing and bush to first gear.
2. Place bush flange side downwards on a raised block on a flat surface.

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

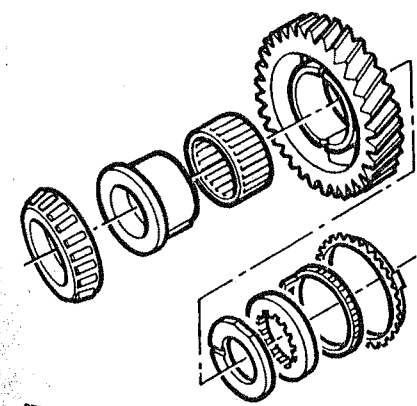


ST3263M

ASSEMBLY

Mainshaft

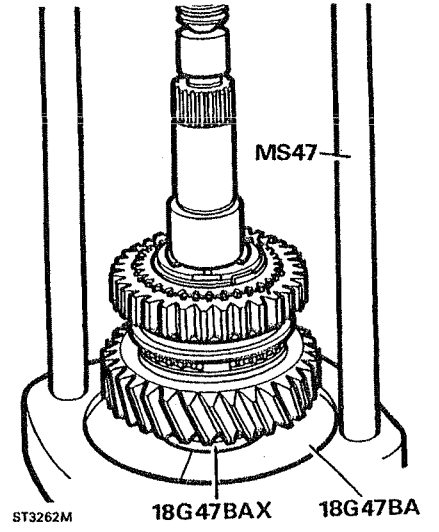
1. With the first-second synchromesh hub and spacer in position, assemble the rear end of the shaft.
2. Fit the roller bearing and bush to first gear.
3. Fit first gear to mainshaft.



ST3229M

First gear assembly

4. Fit the taper bearing to mainshaft using MS 47, collets 18G 47 BA and adaptor 18G 47 BAX.



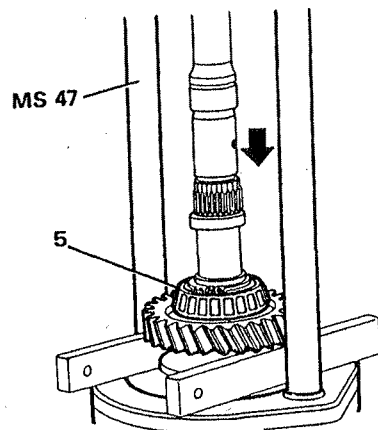
ST3262M

18G 47 BAX

18G 47 BA

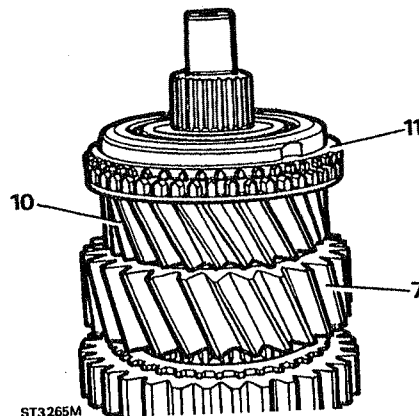
CAUTION: Ensure that the slots in the baulk ring align with the synchromesh slippers while pressing on the bearing.

- Invert mainshaft and press assembly back against circlip.



ST3264M

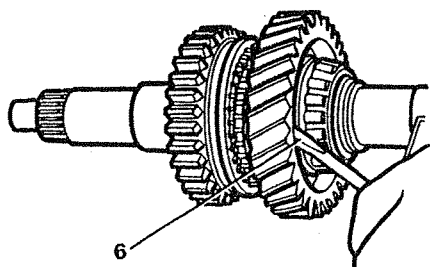
- Position mainshaft in vice, rear end downwards and fit second gear needle roller, and second gear.
- Fit third gear bush.
- Fit third gear needle rollers.
- Fit third gear.
- Fit third gear baulk ring.



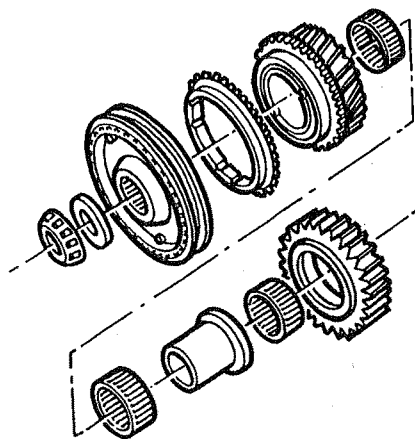
ST3265M

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.

- Reposition mainshaft in vice and using a screw driver blade check that the first gear bush is free to turn.



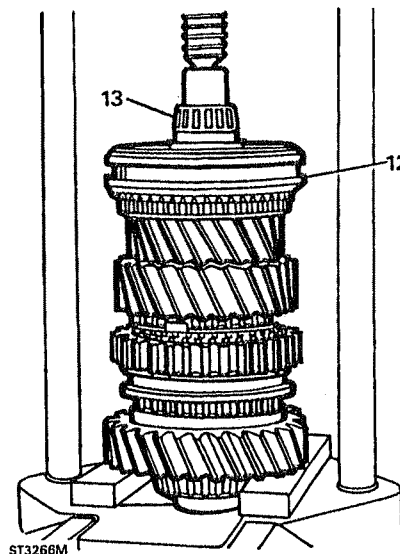
ST3256M



ST3233M

Third-fourth synchromesh assembly

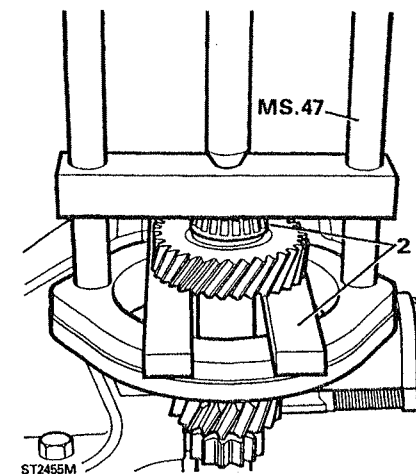
- Fit third-fourth gear synchromesh hub.
- Using MS 47 with supports under first gear, press the spigot bearing on to shaft.



ST3266M

Layshaft

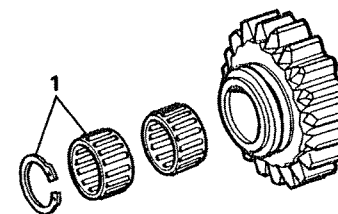
- Examine the layshaft for wear and damage.
- Press bearings on to layshaft using MS 47 and supporting bars.



ST2455M

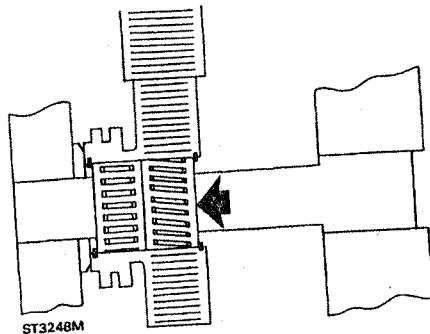
Reverse gear and shaft

- Remove one circlip from the idler gear and remove bearings.



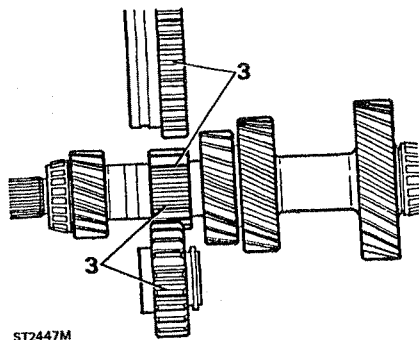
ST2466M

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 synchronesh outer member.



ST2447M

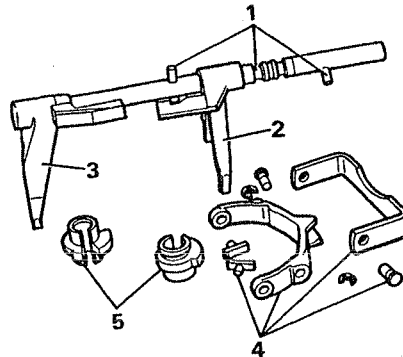
4. Examine idler shaft for wear, scores and pitting.

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.

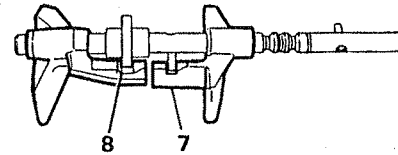


ST2482M

6. Renew retaining circlips if distorted.

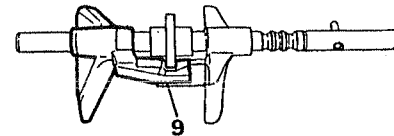
Assembling selectors.

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.

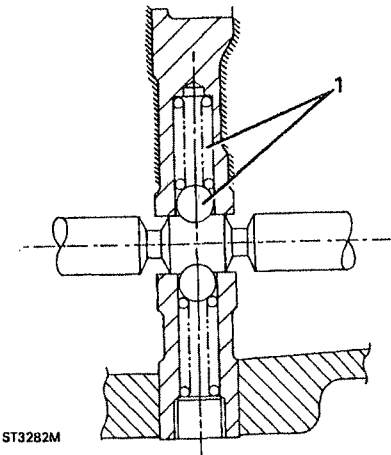


ST2487M

Assembling gearbox shafts to centre plate

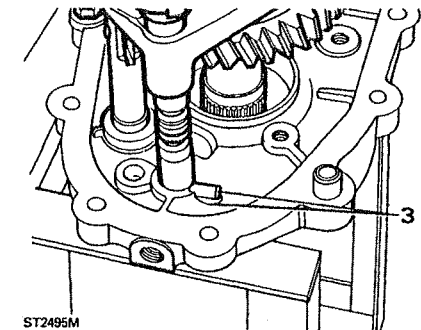
Fitting gears to centre plate

1. Secure centre plate to workstand, fit bearing tracks and inboard detent ball and spring.



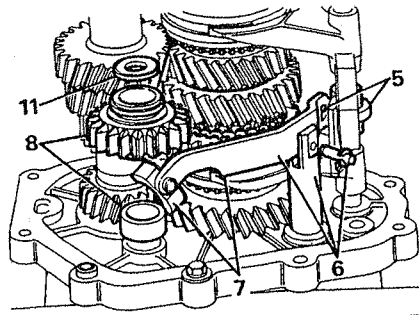
ST3282M

2. Check both synchronesh units are in neutral and fit selector shaft assembly.
3. Fit mainshaft and selectors to centre plate and align-pin with slot in plate.

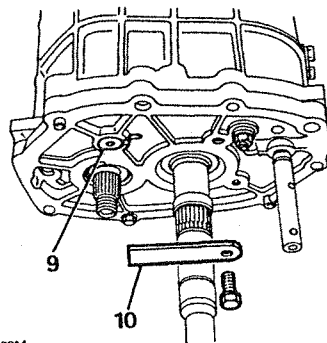


ST2495M

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.

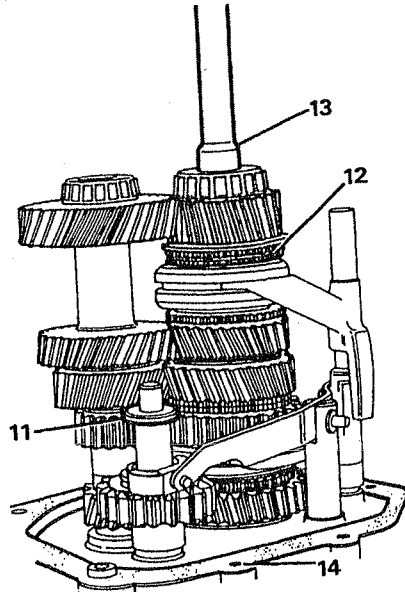


ST3239M



ST2492M

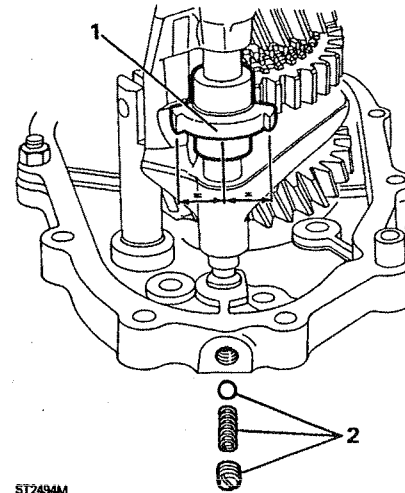
10. Secure reverse shaft with manufactured tool "A".
11. Fit reverse gear thrust washer to shaft.
12. Fit fourth gear bauk ring.
13. Lubricate spigot bearing and fit input shaft.
14. Remove centre plate workstand bolt and fit gasket.



ST3267M

Gearbox casing

1. Turn selector shaft and spool to neutral position.
2. Fit out-board detent ball and spring and secure with plug.

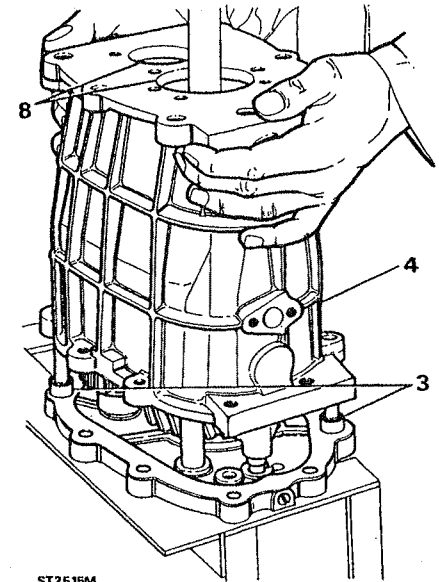


ST2494M

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.

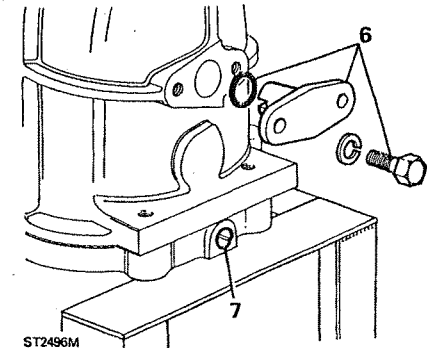
5. Secure centre plate and gearcase to workstand with two 8 x 35mm bolts.
6. Apply PL 32 to joint face and bolt threads and fit spool retainer.



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.

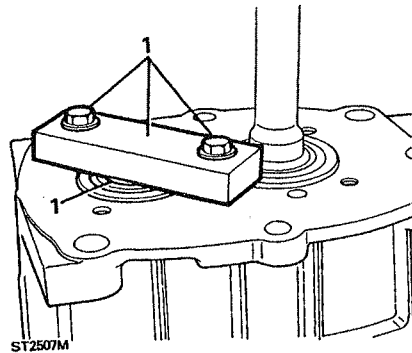


ST2496M

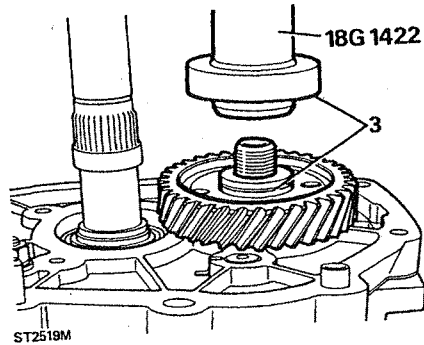
Fifth gear

CAUTION: Since the fifth gear is a tight fit on the layshaft, the force, when pressing the gear, must not be transferred to the layshaft front bearing. Tool "D" and packing disc should be made to the dimensions given to absorb the force. The plate also retains the input shaft bearing outer track.

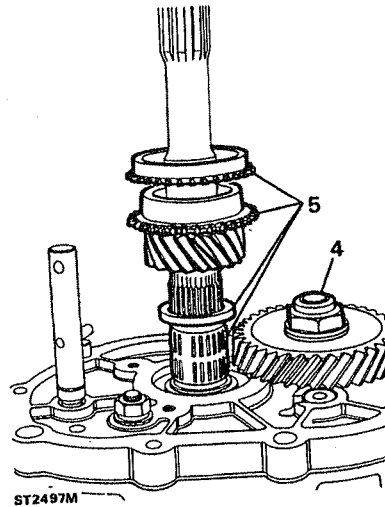
1. Secure the plate with two 8x25mm bolts. Insert disc between plate and layshaft.



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.

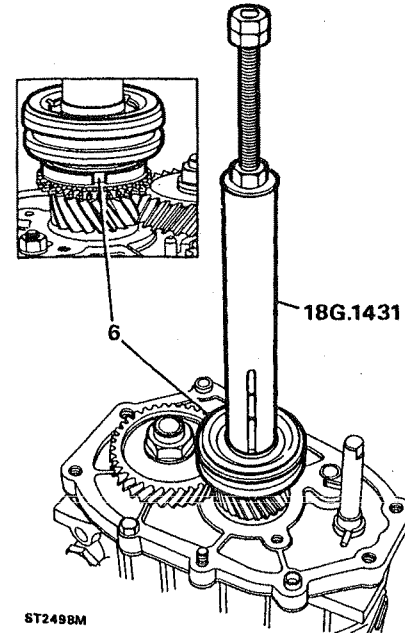


4. Fit a new stake nut but do not tighten.
5. Fit fifth gear assembly to mainshaft.



6. Press fifth gear synchromesh assembly to mainshaft using 18G 1431.

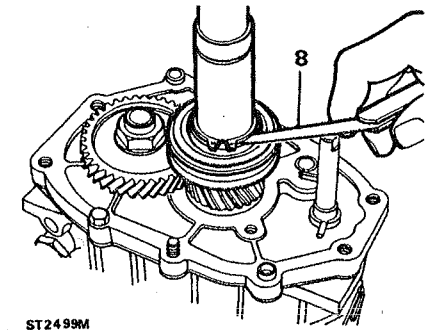
CAUTION: Before pressing the assembly fully home, ensure that the slipper pads locate in the baulk ring slots.



NOTE: Only limited movement of the synchromesh inner member on the main-shaft is permissible. The maximum clearance is 0,005mm to 0,055mm 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

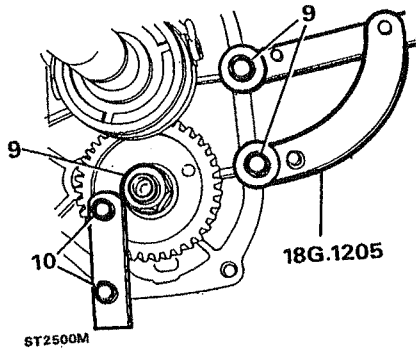
7. Fit the thinnest washer and secure with circlip.
8. Measure clearance between circlip and washer.



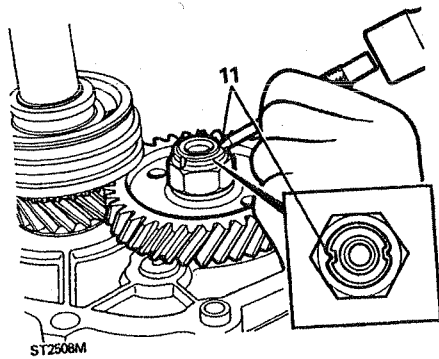
9. Tighten layshaft stake nut using 18G 1205.

CAUTION: The practice of locking gears to provide a restraint to tighten the nut is not acceptable due to high torque figure required.

10. Secure tool "A" to gear and gear case and using a suitable torque wrench tighten the nut to the correct torque.

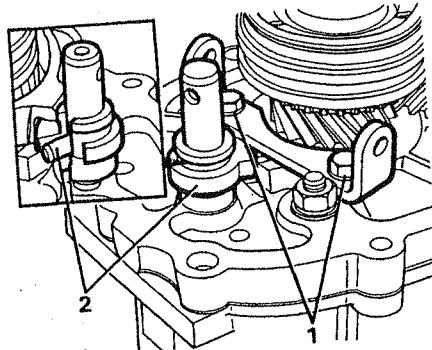


11. Using a round nose punch, form the collar into the layshaft slots.



Fifth gear selector fork

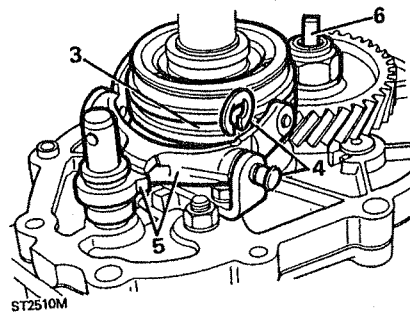
1. Fit fifth gear selector fork bracket.
2. Fit the fifth gear spool long end towards centre plate.



3. Fit slippers to selector fork.
4. Fit fork to synchronesh and secure with pins and "E" clips.

NOTE: Before fitting pins and clips cover holes in centre plate to prevent them falling into casing.

5. Engage tongue of spool in selector fork.
6. Fit oil pump drive to layshaft.



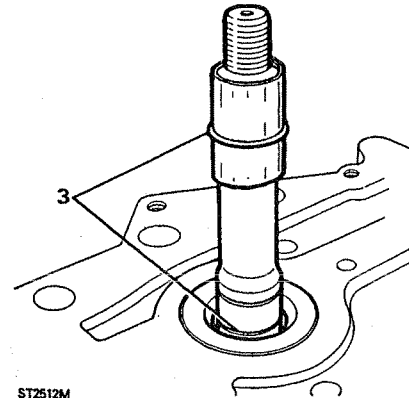
Extension case

1. Release centre plate from workstand and fit gasket on joint face.
2. Fit extension case while aligning oil pick-up pipe. Remove guide studs and secure to main case.

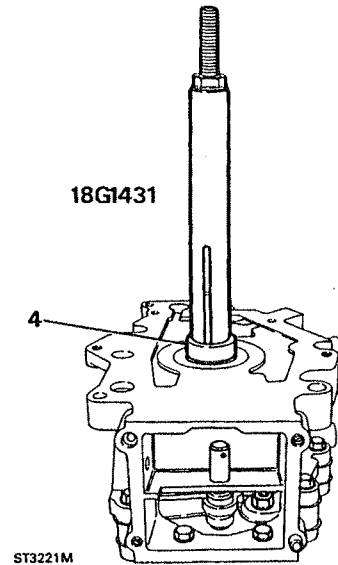
NOTE: Do not use force, if necessary remove case and re-align oil pump drive if case does not fit first time.

CAUTION: To protect "O" ring while fitting, cover mainshaft splines with smooth tape.

3. Fit "O" ring to mainshaft groove.



4. Fit "O" ring collar to mainshaft using 18G 1431.

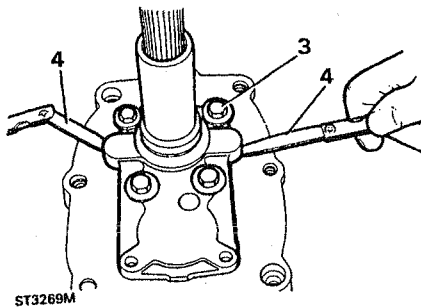


Input-mainshaft bearing adjustment

1. Turn gearbox over with input shaft uppermost. Remove layshaft support plate.

NOTE: Correct shimming of the input shaft bearing is vital to ensure that the mainshaft assembly has the design intended end float, and the bearings are not pre-loaded.

2. Measure the thickness of a new front cover gasket.
3. Place the original shim on mainshaft bearing and finger tighten the bolts.
4. Measure the clearance between front cover and gearcase with two feeler gauges.



5. If required, change the selective washer to provide a clearance of 0,35mm to 0,085mm (0.001 to 0.003ins) less than the gasket thickness.

NOTE: This will ensure that when the gasket and cover is fitted to the correct torque, the input and mainshaft bearings will have no pre-load and not more than 0,06mm (0.0025in) end float.

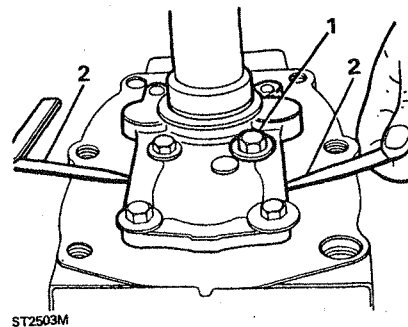
6. Remove front cover and keep gasket and selective washer together.

Mainshaft selective washers

Part number	Thickness(mm)
FRC 4327	1,51
FRC 4329	1,57
FRC 4331	1,63
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

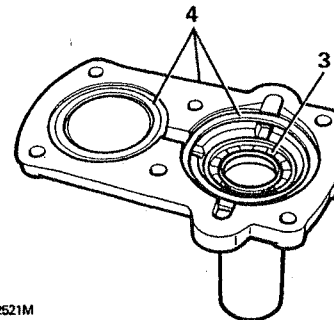
Layshaft bearing adjustment

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.



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.

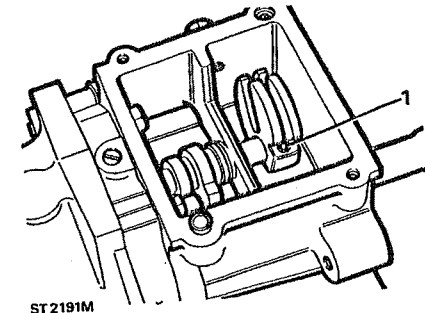
Layshaft selective washers.

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

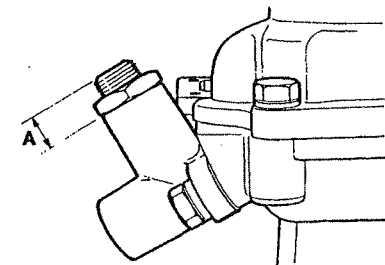
2. With a new gasket, fit remote housing locating over dowels.

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.



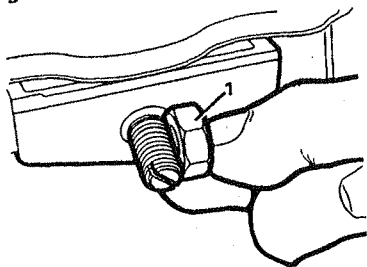
ST3223M

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.

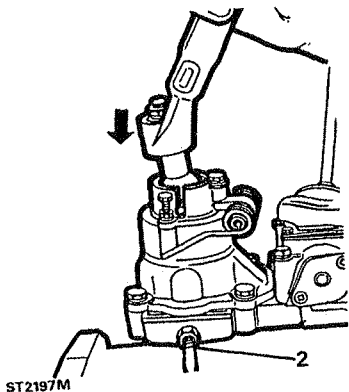
1. Adjust screw to protrude from housing the distance across corners of locknut.

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

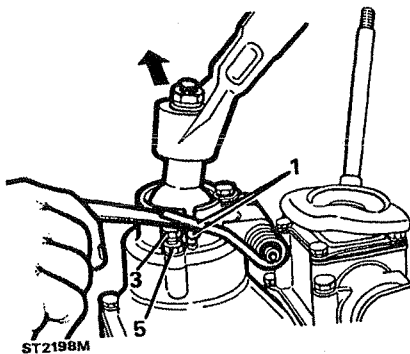
Bias spring adjustment

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 housings

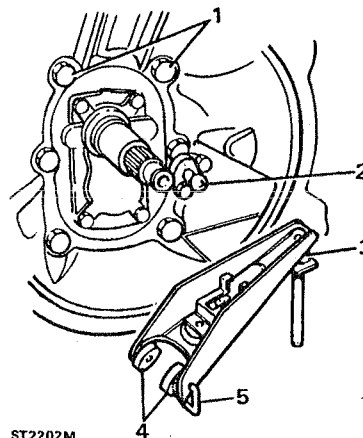
Four cylinder engine

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

V8 Engine

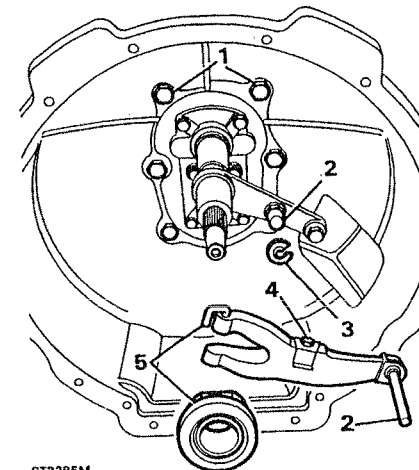
1. Fit bell housing locating on hollow dowels.

NOTE: Fit the 12 x 45mm bolts through dowels and 12 x 30mm bolts in remaining positions.

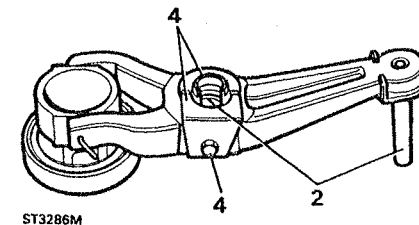
2. Apply molybdenum disulphide grease to pivot post, release lever, socket and push rod. Not the bearing guide.
3. Fit 'C' washer to pivot post.
4. Fit spring clip to lever and fit lever to pivot post.

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
- Synchronmesh 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.....	0,075 mm
- First gear bush end float.....	0,20 mm
- First gear end float.....	0,005 to 0,055 mm
- Fifth gear synchronmesh end float.....	0,005 to 0,055 mm

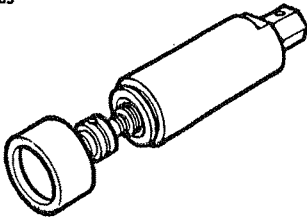
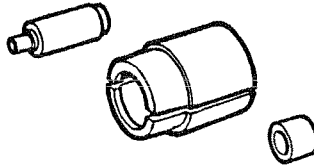
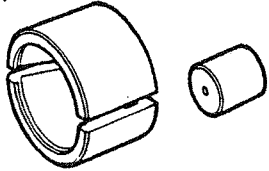
TORQUE VALUES

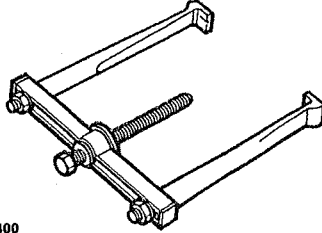
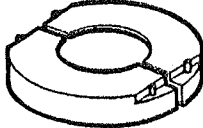
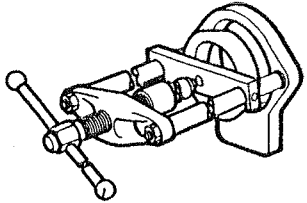
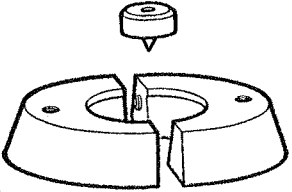
NOTE: Torque wrenches should be regularly checked for accuracy to ensure that all fixings are tightened to the correct torque.

	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	22 - 28
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	7 - 10
Gear lever retainer	40 - 47
Lower gear lever to extension nut	22 - 28
Reverse lever pivot post nut	65 - 80
Clutch housing to gearbox bolts	22 - 28
Plug, detent spring and ball	47 - 54
Oil drain plug	65 - 80
Oil filter plug	25 - 35
Oil filler - level plug	14 - 16
Breather	204 - 231
Fifth gear layshaft stake nut	7 - 10
Bottom cover to clutch housing	

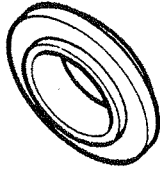
SERVICE TOOLS

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.

<p>18G.705</p>  <p>18G 705 Puller, bearing remover</p>
<p>18G.705-1A</p>  <p>18G 705-1A Adaptor for mainshaft oil seal track and layshaft fifth gear</p>
<p>18G.705-7</p>  <p>18G 705-7 Adaptor for layshaft bearings</p>

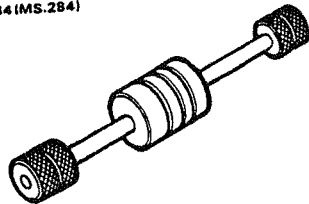
<p>18G1400</p>  <p>18G 1400 Remove synchronmesh hub and gear cluster</p>
<p>18G.1400-1</p>  <p>18G 1400-1 Adaptor mainshaft fifth gear</p>
<p>MS47</p>  <p>MS 47 Hand press</p>
<p>18G47BA</p>  <p>18G 47BA Adaptor input shaft bearing</p>

18G.47BAX

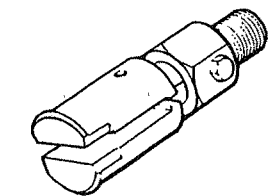


18G 47BAX Conversion kit

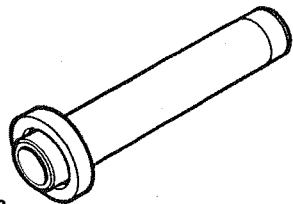
18G.284 (MS.284)



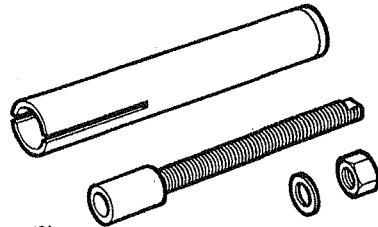
18G 284 Impulse extractor



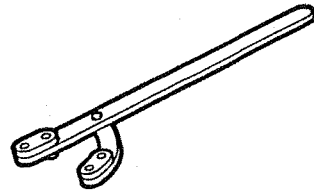
18G284AAH
18G 284AAH Adaptor for input shaft pilot bearing track



18G1422
18G 1422 Mainshaft rear oil seal replacer



18G1431
18G 1431 Mainshaft rear oil seal replacer

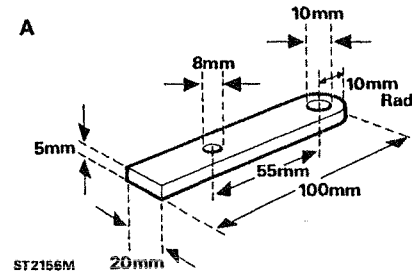


18G1205
18G 1205 Flange holder

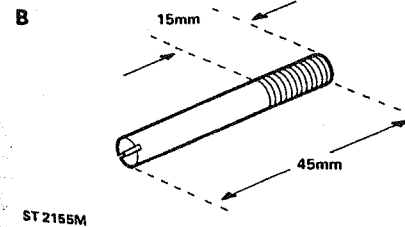
LOCALLY MANUFACTURED TOOLS

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.

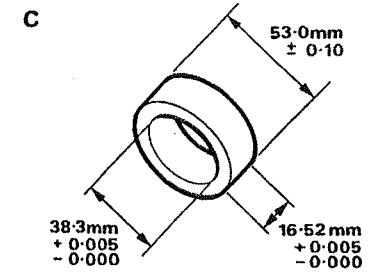
Tool 'A'. Dual purpose tool. Reverse shaft retainer to prevent the shaft falling out when the gearbox is inverted. Also, a layshaft fifth gear retainer to hold the fifth gear whilst releasing stake nut. Use 5mm mild steel to manufacture the tool. When using the tool for the layshaft nut, a suitable spacer is required 20mm diameter 23mm long, with an 8mm diameter clearance hole.



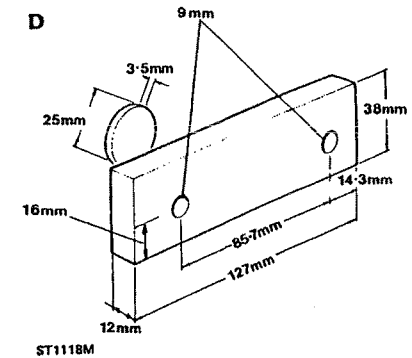
Tool 'B'. Four pilot studs with an 8mm thread for locating in the four counter sunk blind holes in the workstand.



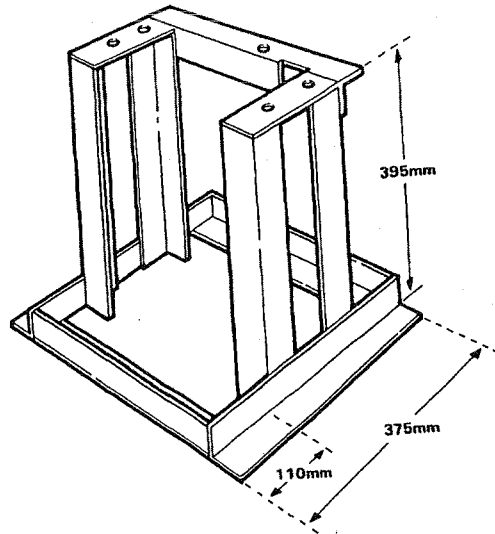
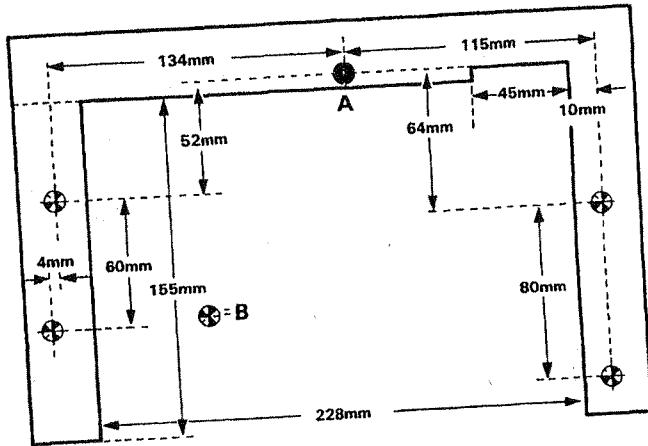
Tool 'C'. Mild steel dummy centre bearing for the selection of first gear bush.



Tool 'D'. Layshaft support plate is fitted with two 8 x 25mm bolts and washers to the front of the gearbox case. It also supports the input shaft bearing outer track.



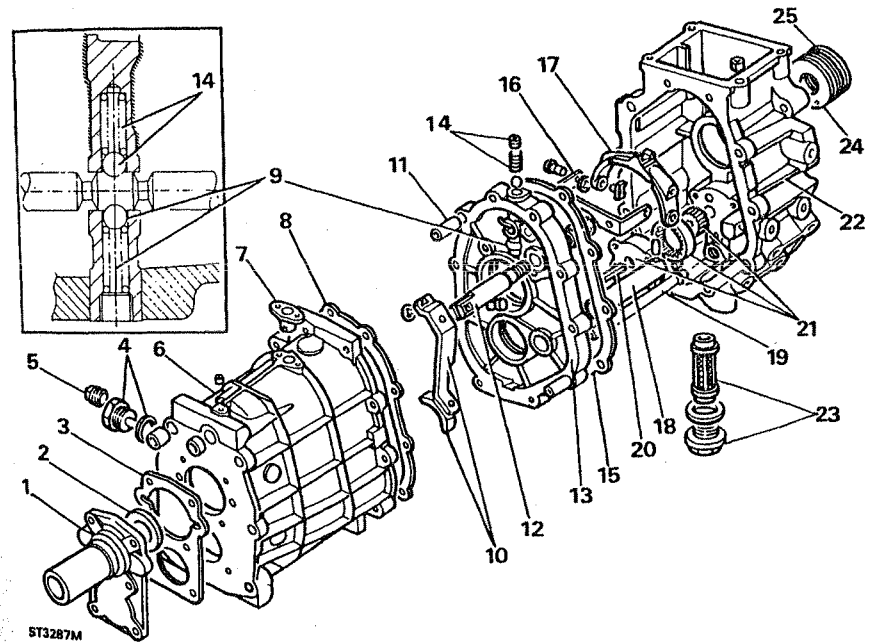
Tool 'E'. Workstand for securely locating the gearbox during overhaul. Manufacture from 30mm x 30mm angle iron. The single hole marked 'A' should be drilled through the material with a 10mm drill. The four counter sunk blind holes marked 'B' should also be made with a 10mm drill, but must not be drilled through the material.



ST2153M

GEARBOX CASING

- | | |
|---|---|
| 1. Front cover. | 14. Selector plug, detent ball and spring. |
| 2. Front cover oil seal. | 15. Gasket. |
| 3. Front cover gasket. | 16. Fifth gear selector bracket. |
| 4. Oil drain plug and washer. | 17. Fifth gear selector fork. |
| 5. Oil level plug. | 18. Reverse gear shaft. |
| 6. Gearbox main casing. | 19. Oil pick-up pipe. |
| 7. Spool retainer. | 20. Oil pump drive shaft. |
| 8. Gasket. | 21. Oil pump gears and cover. |
| 9. Inboard detent ball and spring. | 22. Fifth gear extension housing. |
| 10. Reverse lever and slipper. | 23. Fifth gear extension housing drain plug and filter. |
| 11. Locating dowels - centre plate to maincase. | 24. Ferrobestos bush. |
| 12. Reverse lever pivot post. | 25. Oil seal. |
| 13. Centre plate. | |

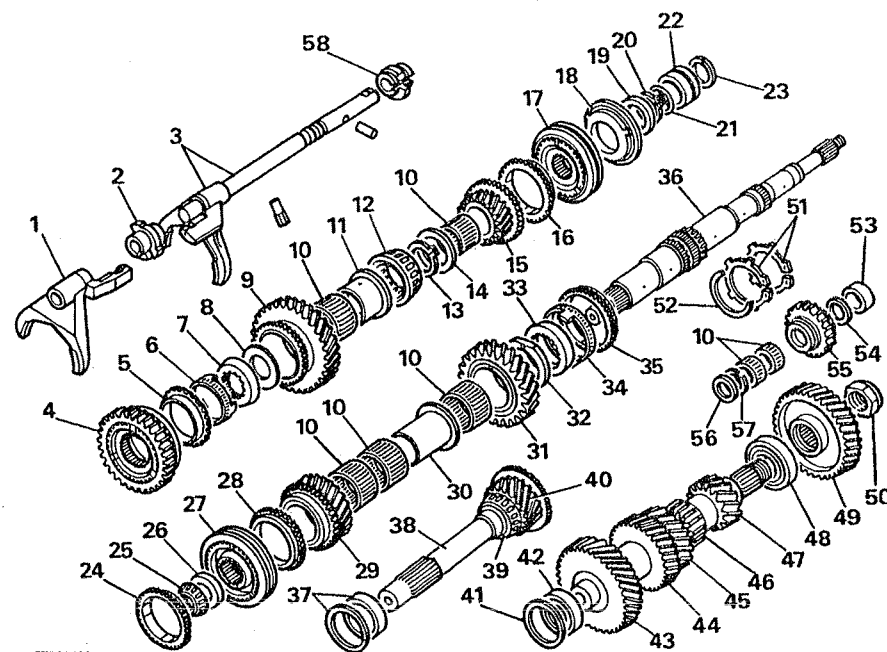


ST3287M

GEARS AND SHAFTS

1. Third - fourth selector fork.
2. Interlock spoon.
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.



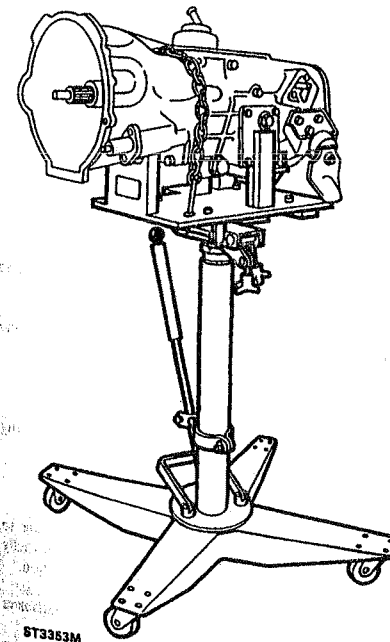
ST3281M

LT 95 FOUR SPEED GEARBOX WITH INTEGRAL TRANSFER BOX**REMOVAL FROM ONE TEN V8 MODELS****Service tools:**

RO1001 - 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, of the type shown in illustration ST3353M, is manufactured by Blackhawk Automative Limited and a special adaptor plate is available from Straight Set Engineering. The adaptor plate can be manufactured locally in accordance with the details given in illustration ST2199M.

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:-

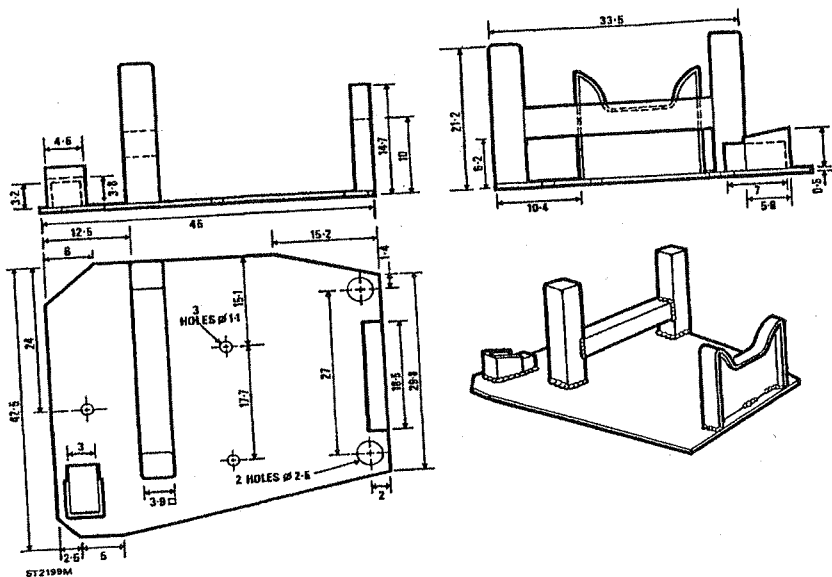
Transmission Hoist Manufacturer

Blackhawk Automative Limited
Brookfield Industrial Estate
Leacon Road
Ashford
Kent England
Telephone 0233 632151

**Gearbox Adaptor Plate (Type DS RT)
Manufacturer**

Straight Set Engineering
Clayland Avenue
Worksop England
Telephone 0909 480055
Fax 0909 500128

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



MATERIAL AND WELDING SPECIFICATION

PLATE TO BS1449 (GRADE 4 OR 14)
 STEEL TUBE TO BS4848 (PART 2)
 ARC WELDING TO BS5135

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.

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.

Refitting

Refit the gearbox to the vehicle in reverse order to removal. Ensure that all connections are correctly made and bolts are tightened to the correct torque.

After refitting, refill the main and transfer gearboxes with the correct grade oil.

OVERHAUL

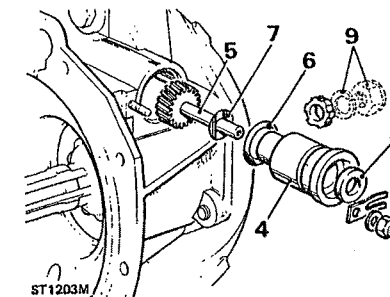
The following overhaul instructions assume that the gearbox is removed from the vehicle and the oil drained.

Remove the clutch slave cylinder, release mechanism and bearing assembly, stand the gearbox on a wooden block on the bell housing end.

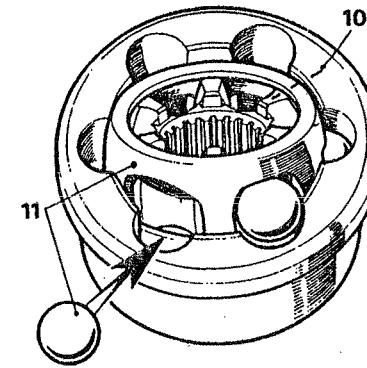
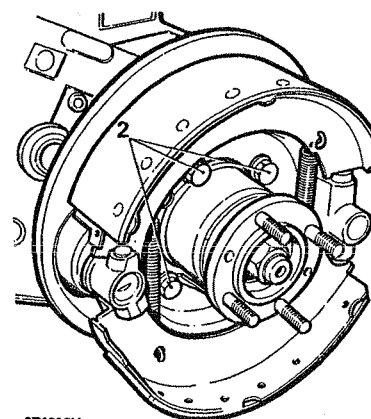
Speedometer drive housing

Remove

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.

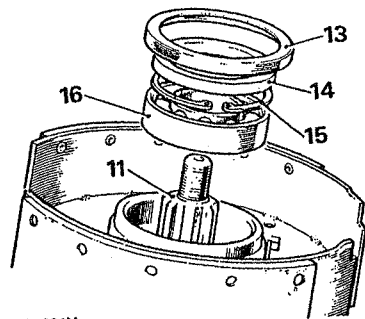


11. Drive out the rear output shaft, using a hide mallet on the threaded end.
12. Slide off the spacer and speedometer worm.



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.

13. Withdraw the oil shield.
14. Prise-out the oil seal.
15. Remove the circlip.
16. Tap out the ball bearing race.

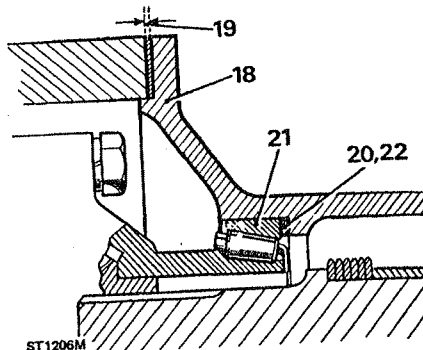


ST1204M

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 more than the recorded thickness of the new joint washer. With the gasket fitted and the bolts tightened to 30 Nm a final rolling resistance check should be made using a spring balance and string wrapped round the differential case. The resistance should be 6.35 to 7.25 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 in 0,05 mm (0.002 in) stages.



ST1206M

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 75 to 81 Nm noting that plain washers are fitted.

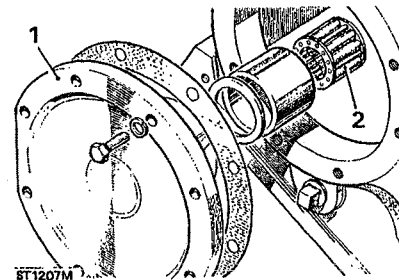
Mainshaft transfer gear

Special tools:
18G1388 LRT-37-506 - mainshaft output gear puller

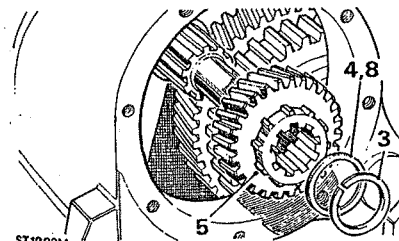
Remove

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.



ST1207M



ST1208M

Assembling

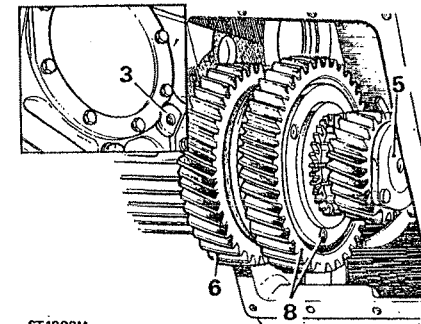
6. Fit the transfer gear to the mainshaft.
7. Fit the shim washer and snap-ring.
8. Check the end-float between the shim washer and snap-ring. End-float to be 0,050 mm maximum. Shim washer range 1,8 to 2,0 mm in 0,05 mm stages.
9. Fit the roller bearing and rear bearing housing.

Intermediate gears assembly

Special tool:
RO1003 - LRT-37-502 slave intermediate shaft puller

Remove

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.

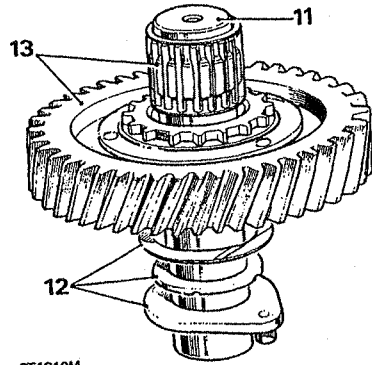


ST1209M

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.

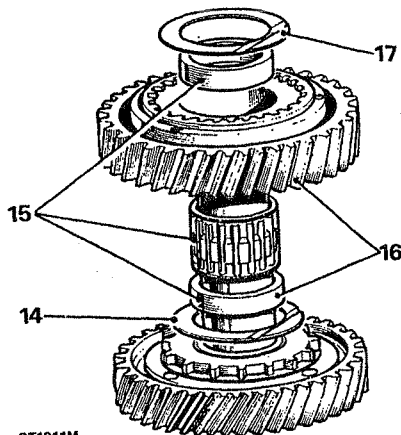
Assemble intermediate gears

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.



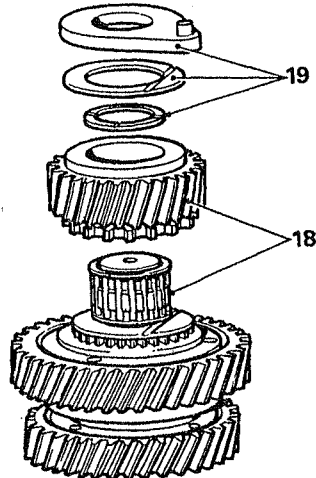
ST1210M

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.



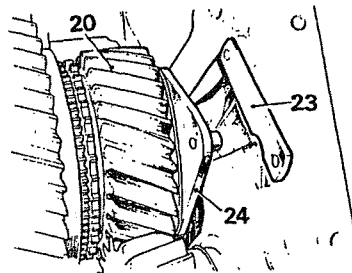
ST1211M

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.
24. Adjustment is carried out by substituting one or both of the thrust washers. The washers are available in 3,55 mm, 3,59 mm, 3,67 mm 3,75 mm and 3,79 mm thicknesses.
25. Refit the gearbox bottom cover.
26. Refit the speedometer drive housing.



ST1213M

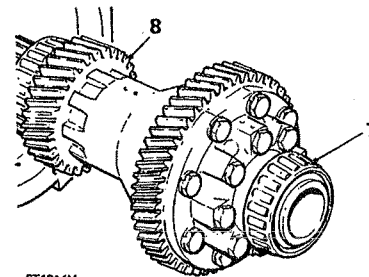
Differential unit

Special tool:
18G47BB - LRT-37-001 bearing extractor

Remove

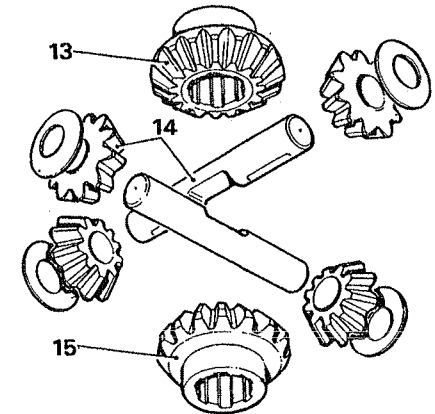
1. Select the differential lock.
2. Remove the differential lock actuator assembly.
3. Remove the front output shaft and housing.
4. Remove the speedometer drive housing.
5. Remove the intermediate cluster assembly.
6. Remove the differential assembly.

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.



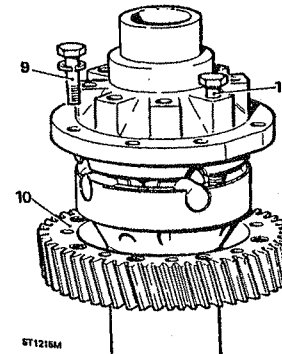
ST1214M

7. Press off the roller bearings using tool 18G47BB.
8. Withdraw the high-speed gear, which is secured by Loctite.



ST1216M

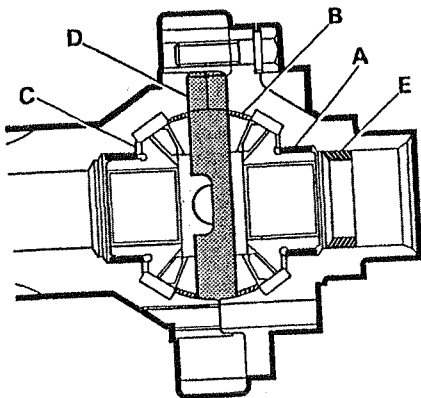
NOTE: From gearbox numbers 1300 3481A and 1700 0007A the following modifications have been made to the differential.



ST1215M

- 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.



ST1789M

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.

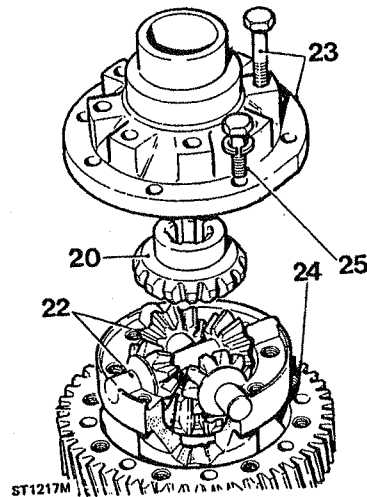
NOTE: The differential case halves are a matched pair, and halves must not be changed individually.

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.



ST1217M

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.

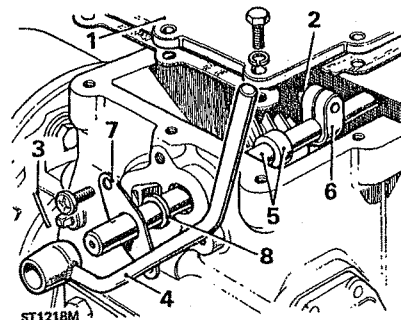
NOTE: If a replacement differential unit is being fitted, carry out the Differential bearing pre-load check', described in Speedometer drive housing - Overhaul'.

Transfer gear lever and cross-shaft

Remove

- 1. Remove the top cover.
- 2. Slacken the selector finger pinch bolt.

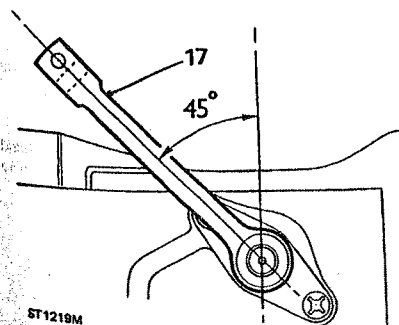
- 3. Drive out the retaining pin, gear lever to cross-shaft.
- 4. Withdraw the gear lever.
- 5. Withdraw the cross-shaft and spacer.
- 6. Lift out the selector finger.
- 7. Remove the retaining plates.
- 8. Withdraw the sealing rings.



ST1218M

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.



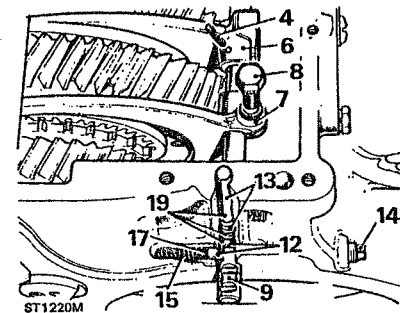
ST1219M

- 18. Tighten the selector finger pinch bolt.
- 19. Fit the top cover using a new joint washer and evenly tighten the retaining bolts.

Transfer box selectors and shaft

Remove

- 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.

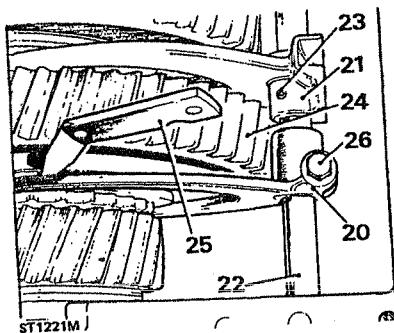


ST1220M

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 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.

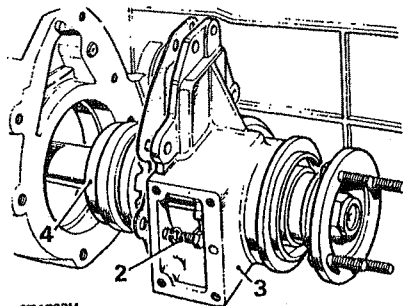


27. Fit the blanking plug to the cross drilling.
28. Fit the transfer box top cover using a new joint washer and evenly tighten the bolts to the correct torque.
29. Fit the speedometer drive housing.

Front output shaft and housing

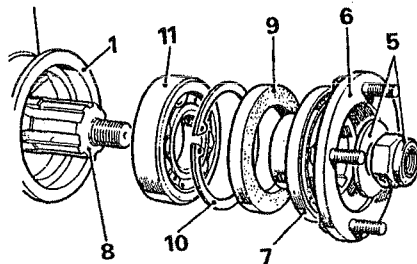
Remove

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.
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.



ST1222M

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

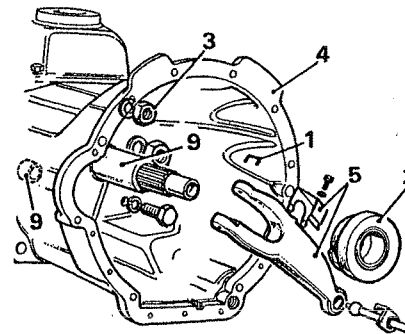
Assemble

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.

Bell housing and clutch release

Remove

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

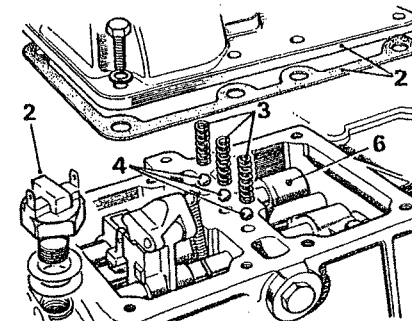
6. If removed, fit the release lever spring clip.
7. Apply a thin film of Unipart Universal or other suitable jointing compound around the three selector shaft holes in the bell housing rear face.
8. Fit the bell housing, locating on the dowels.
9. Apply a thin film of molybdenum disulphide grease onto 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.

Gear change selectors

Remove

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.

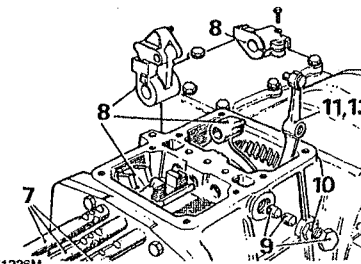


ST1225M

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

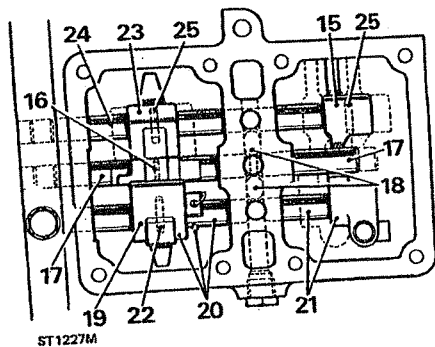
Examine all parts and renew if worn. Renew the detent springs. Ensure that the retaining pins are an interference fit, if not, renew.



ST1226M

Assemble

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.

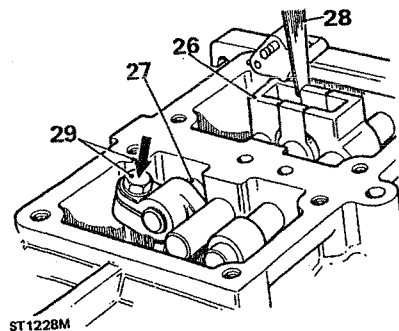


23. Position the first/second gear selector jaw in the gearbox.

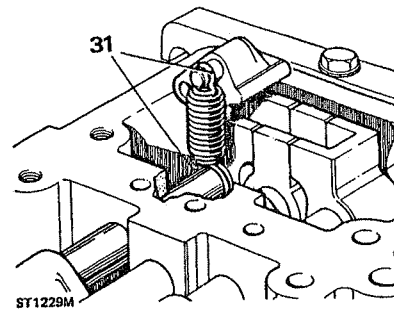
24. Fit the first/second gear selector shaft; engage the selector jaw and selector fork as the shaft is pushed home.
25. Fit the retaining pins, fitting the rear pin first.
26. Move the reverse shaft forward until the selector jaw abuts the casing.
27. Holding the reverse shaft as described in the previous 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 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.



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.



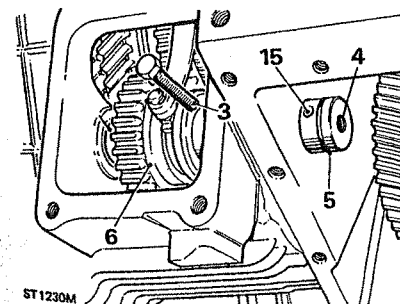
32. Fit the detent balls and springs.
33. Select neutral and using a new joint washer, fit the gearbox top cover and secure with the eight bolts, and evenly tighten to the correct torque.
34. Fit the reverse light switch.
35. Fit the bell housing.

Reverse idler gear and shaft

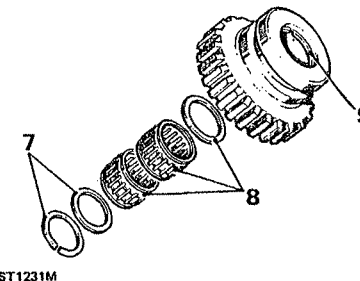
Special tool:
18G1335 - extractor for shaft

Remove

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

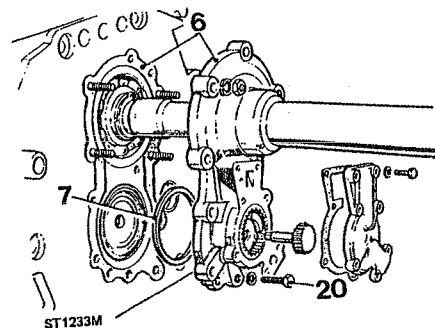
10. If removed, fit the shaft support bush, using Locquic primer grade 'T' and 'AVV' grade.
11. Fit the circlip to selector groove end of the gear.
12. Fit the plain washer and two needle roller bearings.
13. Fit the outer plain washer and secure with circlip.
14. Fit a new 'O' ring seal to the idler 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.

Front cover and oil pump

Service tools:
 RO1005 - Centralising tool
 18G134 - LRT-99-003 guide and
 18G134DG - assembly tool for fitting oil seal and
 oil feed ring.

Remove

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.

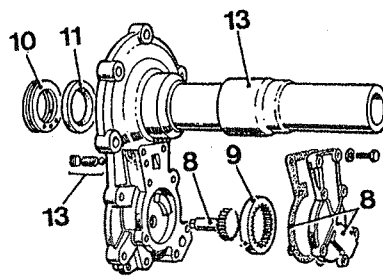


Overhaul

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.

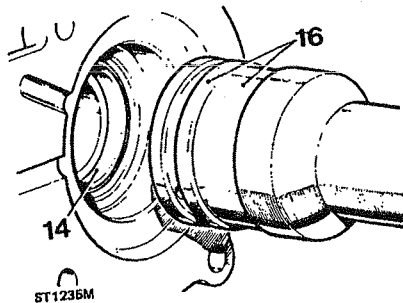
Assemble

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.

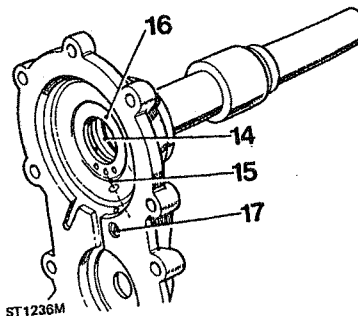


ST1234M

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 below the front cover rear face.
18. Fit the oil pump ring gear.

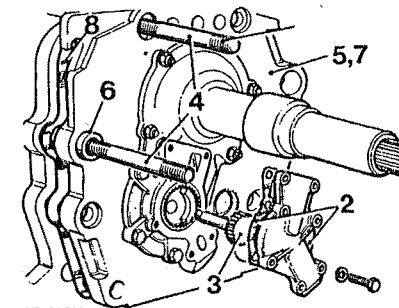


ST1235M



ST1236M

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.

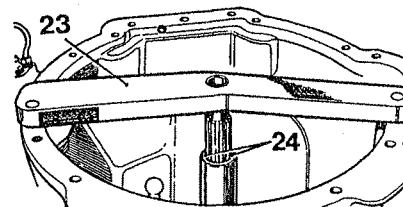


ST1238M

Assemble

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 synchronesh 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.



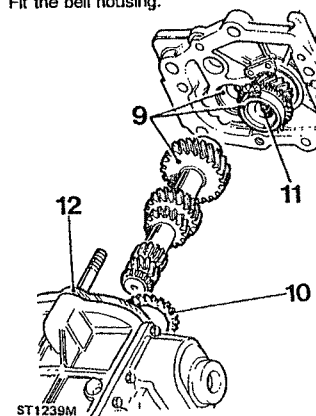
ST1237M

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 plug.
29. Fit the retainer staple to the clutch release bearing assembly and lever.

Bearing plate assembly

Remove

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.

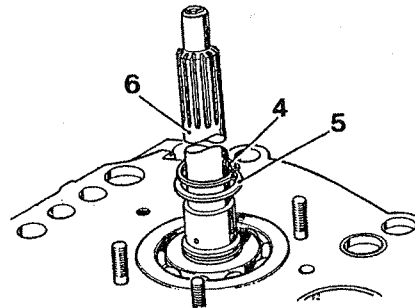


ST1239M

Primary pinion

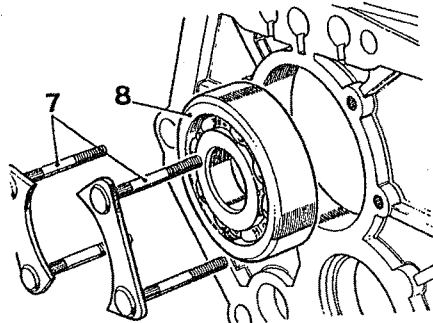
Remove

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

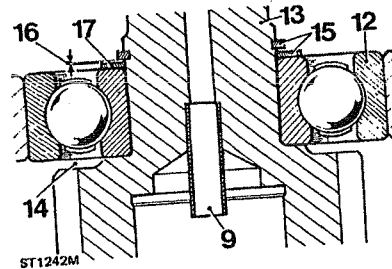
7. Withdraw the bearing retaining plates and serrated bolts.
8. Press out the primary pinion bearing.



ST1241M

Assemble

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 maximum.
17. If required, adjust the clearance by fitting a replacement shim washer. Shim range is 2,0 to 2,15 mm in 0,05 mm stages.



ST1242M

18. Fit the bearing plate assembly.
19. Fit the front cover and oil pump assembly.
20. Fit the bell housing.

Mainshaft assembly

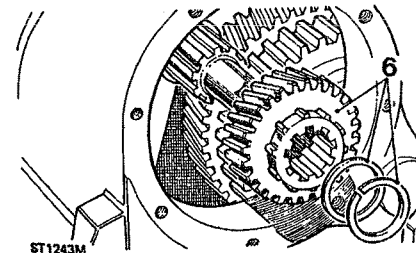
Special tool:
18G1388 - LRT-37-506 extractor for mainshaft spacer and gear

Remove

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.

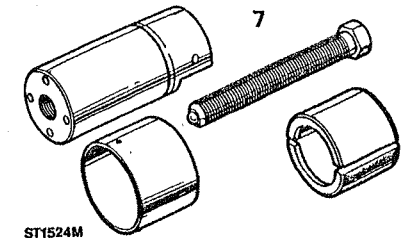
NOTE: At this stage in the dismantling, on early gearboxes only, it is necessary to remove the transfer top cover selector finger and shaft. On later gearboxes the cross-shaft is machined to enable the spacer to be completely withdrawn. Also the main shaft spacer and transfer gear are secured by Loctite 275 to the main shaft.

6. Remove the snap-ring, shim washer and mainshaft transfer gear, using special tool 18G1388.



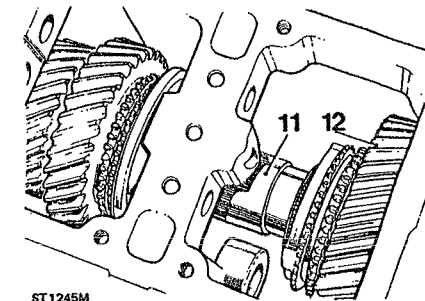
ST1243M

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 scoliop.
10. When the spacer is free on the mainshaft remove the extractor.



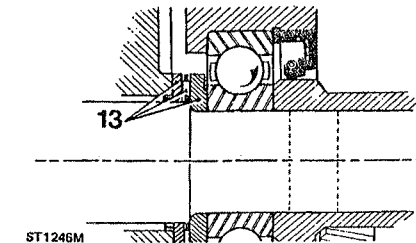
ST1245M

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.



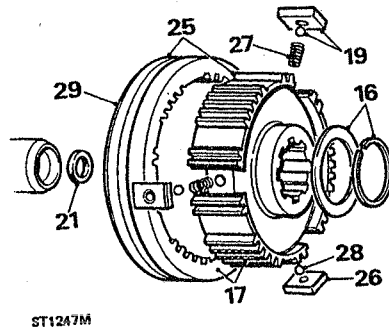
ST1245M

13. Refit the first-speed gear, scalloped thrust washer, thrust needle bearing and stepped thrust washer, stepped face outwards.
14. Withdraw the mainshaft spacer.



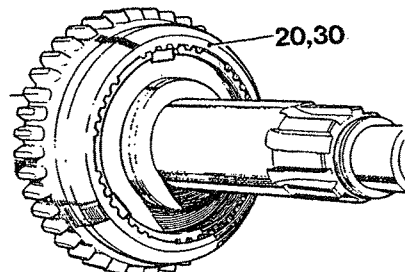
ST1246M

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

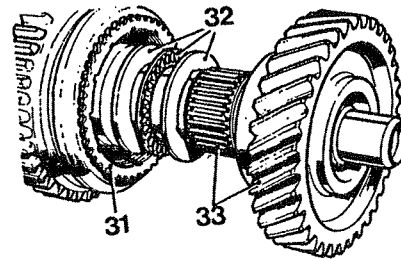
22. Replacement thrust washers and roller bearings must not be degreased.
23. Lubricate all items before assembly, using clean main gearbox oil.
24. Fit the oil seal to the mainshaft front end.

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.

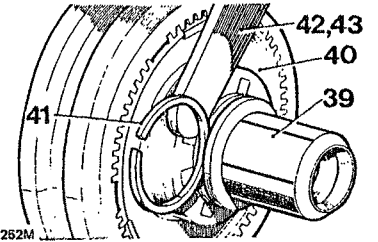
Assemble mainshaft front end

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.

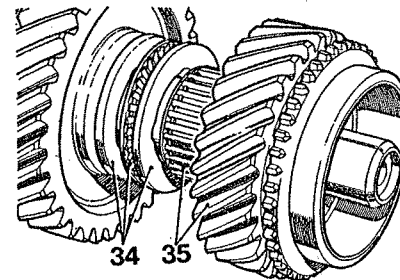


ST1249M

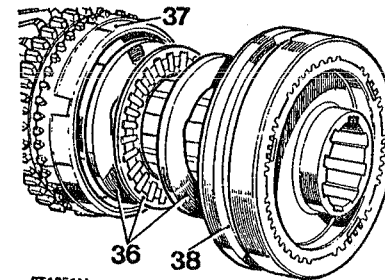
34. Fit a scalloped thrust washer, a thrust needle bearing and a further scalloped thrust washer.
35. Fit a radial needle bearing and the third-speed gear.
36. Fit a scalloped thrust washer, a thrust needle bearing and a further scalloped thrust washer.
37. Position a synchromesh cone onto the third-speed gear.
38. Fit the synchromesh unit, coned face to rear.



ST1252M



ST1250M



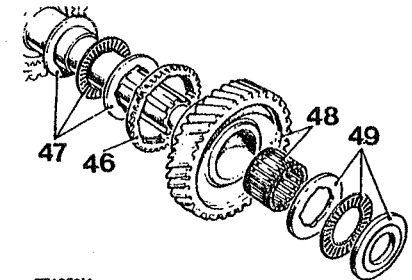
ST1251M

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 when fitted.
44. Shim range is 1,85 to 2,45 mm in 0,15 mm increments.
45. Fit the selected shim washer and the snap-ring.

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.

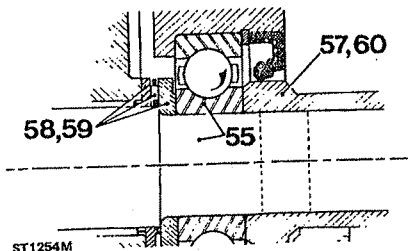


ST1253M

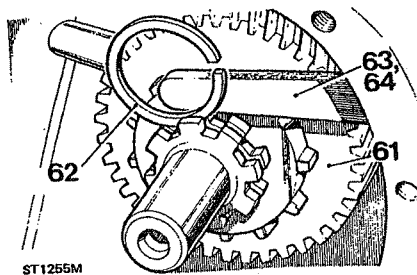
Assemble mainshaft assembly to gearbox

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.



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 maximum clearance between the snap-ring and transfer gear when fitted. Shim range 1,8 to 2,0 mm in 0,05 mm increments.



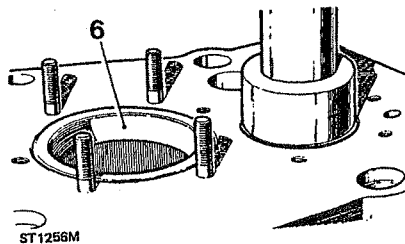
65. Temporarily remove the snap-ring and the mainshaft transfer gear.
66. Slide back the mainshaft spacer as far as the transfer gear lever cross-shaft will allow.
67. Apply a thin coating of Loctite 275 grade to the exposed area of the mainshaft.
68. Push home the mainshaft spacer.
69. Fit the mainshaft 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.

Layshaft bearings

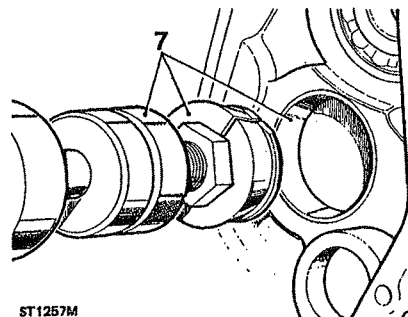
Special tools:
 RO1004 - Extractor mainshaft spacer
 18G284 - LRT-99-004 Extractor and 18G284AR - LRT-37-501 Adaptor, extractor layshaft rear bearing outer member
 18G47 - LRT-99-002 Press and 18G47BA - LRT-37-001 Collars, extractor for layshaft bearing inner members

Remove

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.

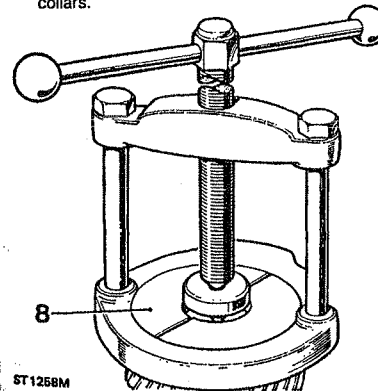


7. Extract the layshaft rear bearing outer member from the gearbox casing, extractor 18G284 and adaptor 18G284AR.



ST1257M

8. Withdraw the bearing inner members from the layshaft. Extractor 18G47 press and 18G47BA collars.

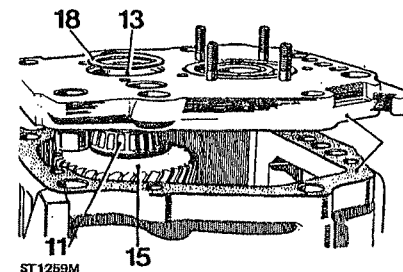


ST1258M

Check bearing pre-load

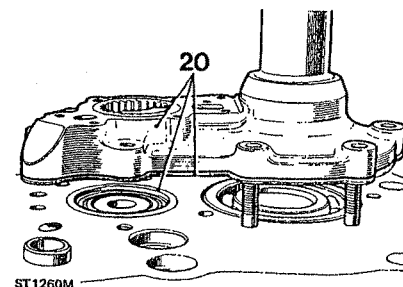
9. Replacement bearings inner and outer members are supplied as matched pairs and not as separate items.
10. The replacement bearings must not be degreased. Before fitting, lubricate with correct grade gearbox oil. Refer to lubrication chart.
11. Press the bearing inner members onto the layshaft.

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.



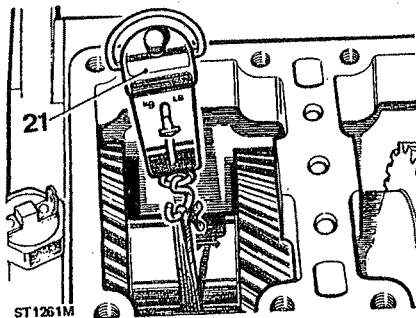
ST1259M

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 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 3 to 4 kg.



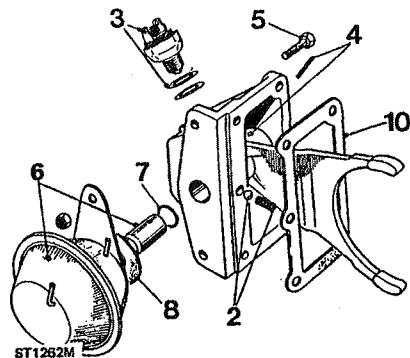
ST1261M

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 to 2,50 mm in 0,05 mm 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.

Differential lock actuator assembly

Remove

1. Remove the four bolts and withdraw the assembly from front output shaft housing.
2. Remove the detent spring and ball.



ST1262M

Dismantle

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.

Refit

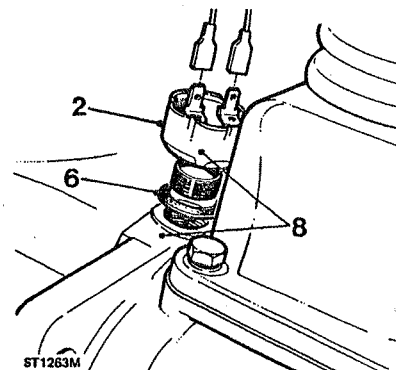
14. Fit the ball and detent spring.
15. Apply Hylomar PL32M jointing compound to both sides of a new actuator housing joint washer.
16. Fit and secure the assembly to the gearbox and evenly tighten the four retaining bolts.

The following operations can be carried out with the gearbox assembly in position in the vehicle.

Reverse light switch

Remove

1. Disconnect the electrical leads.
2. Unscrew the reverse light switch.



ST1263M

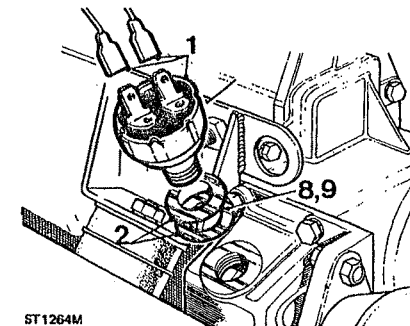
Refit

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 and 0,127 mm.
10. Fit the selected shim washer(s) and switch. Tighten to a torque of 20 to 27 Nm.

Differential lock actuator switch

Remove

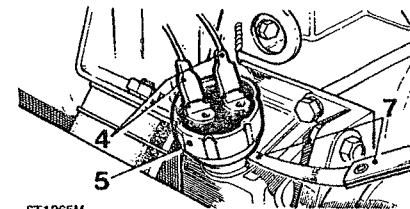
1. Disconnect the electrical leads, and unscrew the switch.
2. Collect the shims.



ST1264M

Refit

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.



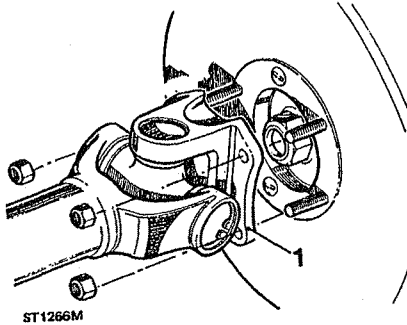
ST1265M

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 and 0,127 mm.
9. Fit the selected shim washer(s) and the switch.
10. Re-position control valve and stop engine.

Rear output shaft oil seal

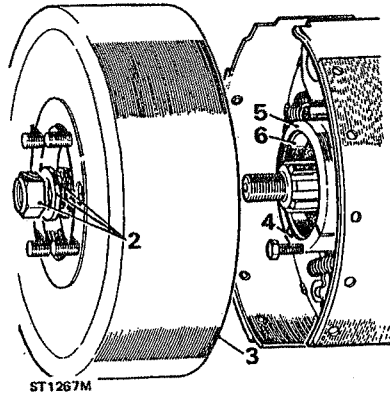
Remove

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

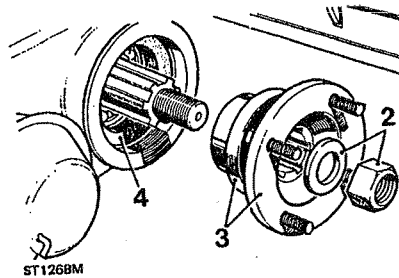
Refit

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.

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

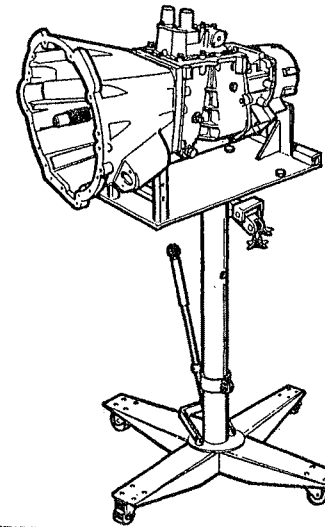
Refit

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.

LT85/LT230T GEARBOX AND TRANSFER BOX

Cradle for removing gearbox

Remove



ST1547M

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.

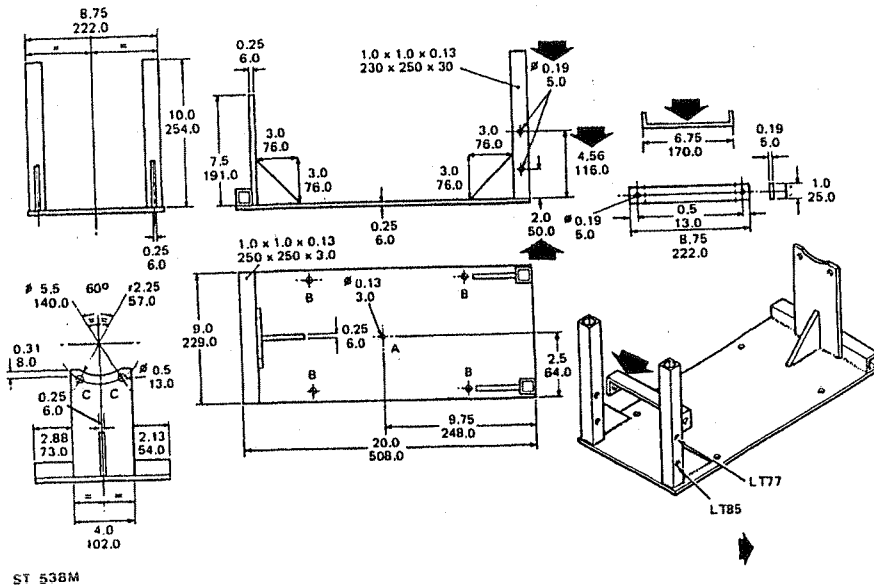
Manufacture a cradle to the dimensions given in the drawing and attach it to a transmission hoist. To achieve balance of the transmission unit when mounted on the transmission hoist, it is essential that point A is situated over the centre of the lifting hoist ram. Drill fixing holes B to suit hoist 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. 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. See WARNING on opposite page.

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

NOTE: It may be necessary to remove the transmission brake drum to allow removal of the gearbox assembly.



MATERIAL AND WELDING SPECIFICATION

Steel plate to BS1449 (Grade 4 or 14)
 Steel tube to BS4848 (Part 2)
 Arc Welding to BS5135

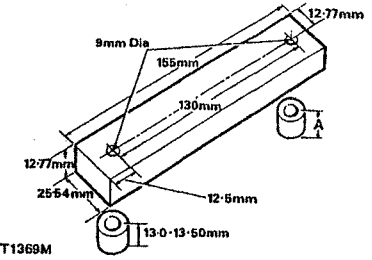
OVERHAUL LT85 FIVE SPEED GEARBOX
 (Integral case and oil pump)

- Ninety and One Ten V8 models

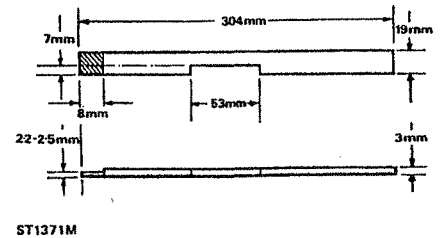
- Service Tools:**
 18G 1294-Guide studs
 18G 1400-LRT-37-012 - Two legged puller
 18G 1431-LRT-37-015 - Replacer, mainshaft bearings
 MS 284-LRT-99-004 - Slide hammer
 MS 550 - Driver handle
 LST 101-LRT-37-003 - Gauge, first gear end float
 LST 102-LRT-37-500 - Remove-Replacer, mainshaft rear oil seal
 LST 284-1-LRT-37-005 - Adaptor-Remove, reverse idler shaft
 LST 550-1-LRT-37-006 - Adaptor-Remove-Replacer, layshaft front bearing roller
 LST 550-2-LRT-37-007 - Adaptor-Remove-Replacer, layshaft rear bearing outer track
 LST 550-3-LRT-37-008 - Adaptor-Remove-Replacer, mainshaft front and rear bearing
 LST 1431-1-LRT37-016 - Remove-Replacer, front plate and mainshaft

Locally manufactured tools

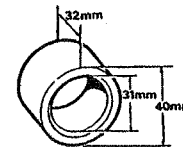
In addition to the above Service Tools, the following five items should be manufactured locally to facilitate dismantling and reassembly of the gearbox.



Selector detent spring retaining tool and spacers.
 A - Spacers can be made up from washers

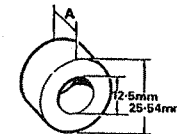


Gauge for reverse cross-over lever adjustment.



ST1476M

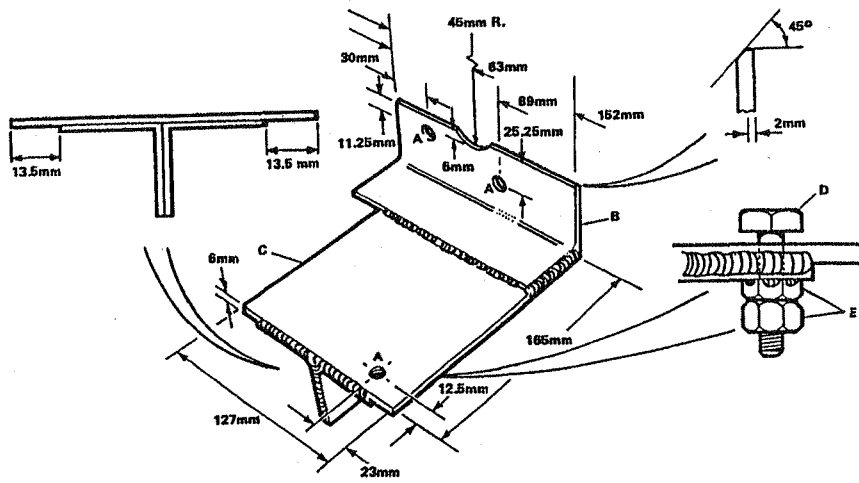
Spacer for retaining layshaft rear bearing



ST1475M

Spacers for retaining front bearing plate. Two required.

A - This dimension must be more than 12 mm.



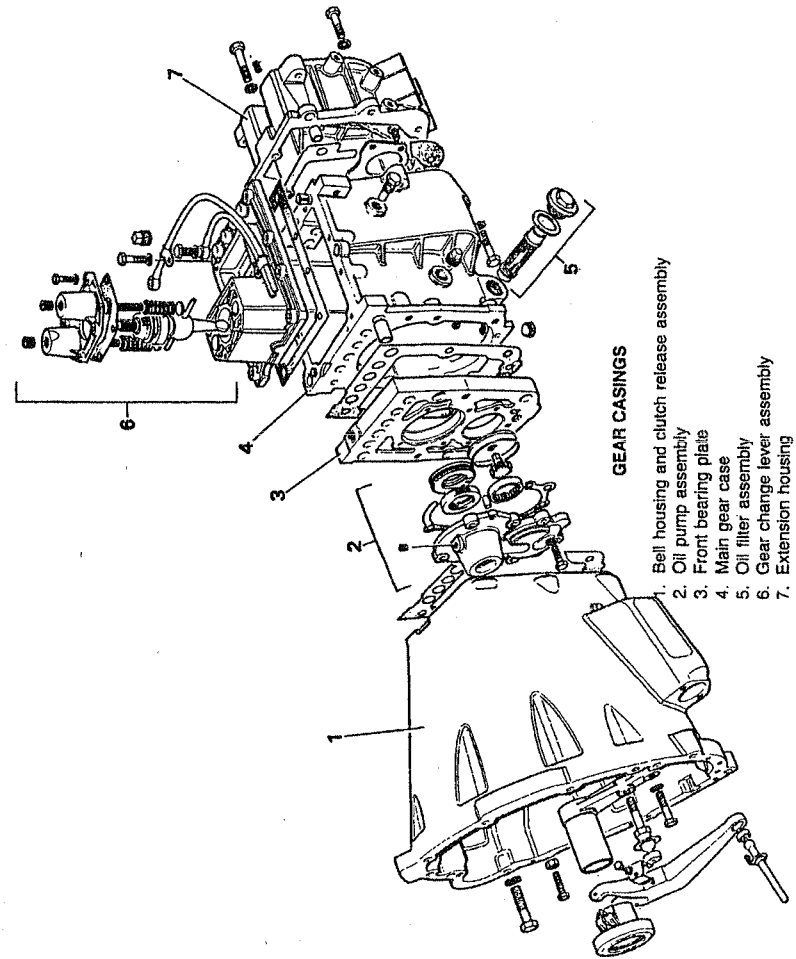
ST1321M

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

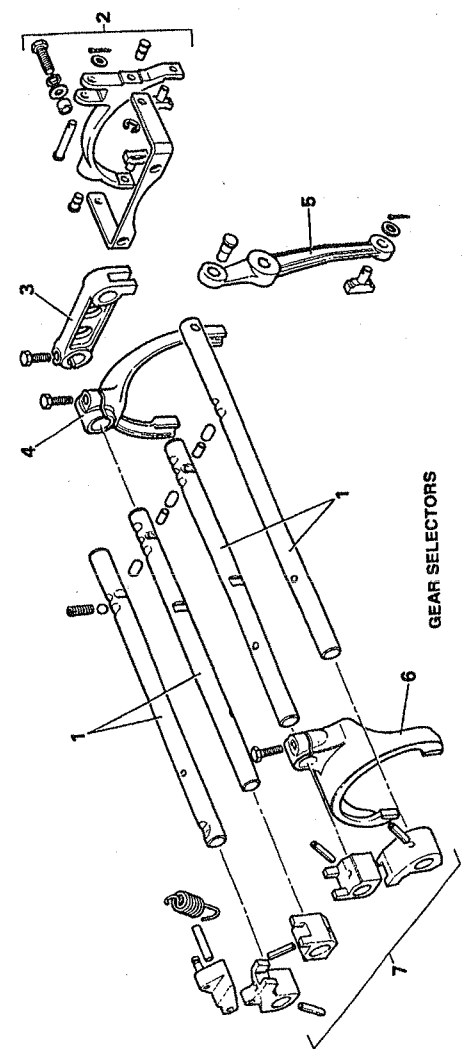
Steel Plate BS 1449 (Grade 4 or 14)
Arc Welding BS 5135



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

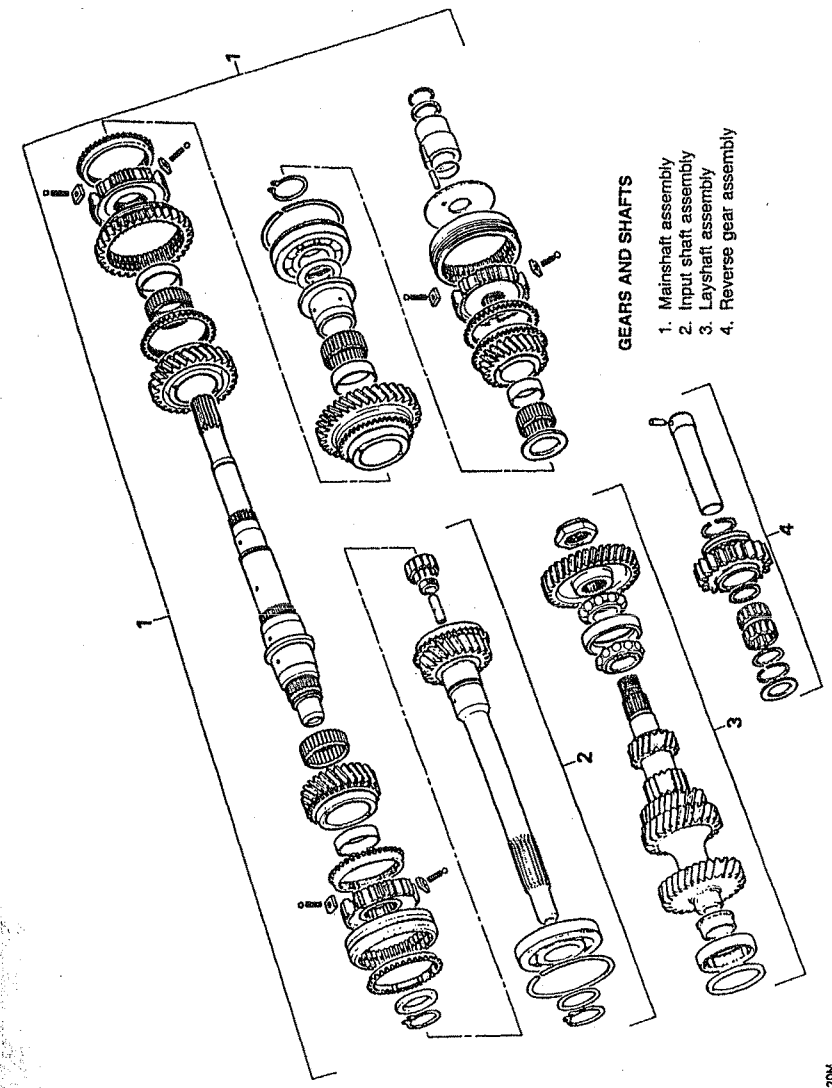
ST1319M



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

ST1460M



GEARS AND SHAFTS

1. Mainshaft assembly
2. Input shaft assembly
3. Layshaft assembly
4. Reverse gear assembly

ST1320M

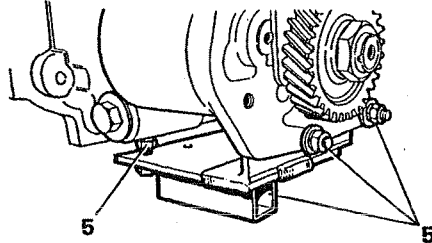
GEARBOX DATA

Mainshaft first speed gear running clearance
Mainshaft third speed gear running clearance
Mainshaft fifth speed gear running clearance
Input shaft bearing running clearance

0,075 mm maximum
0,075 mm maximum
0,075 mm maximum
0,075 mm maximum

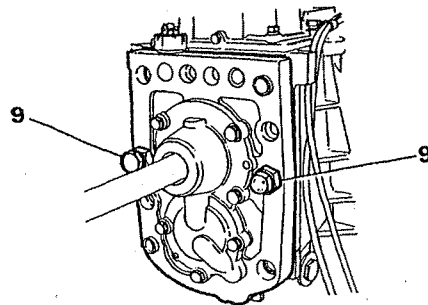
DISMANTLING

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

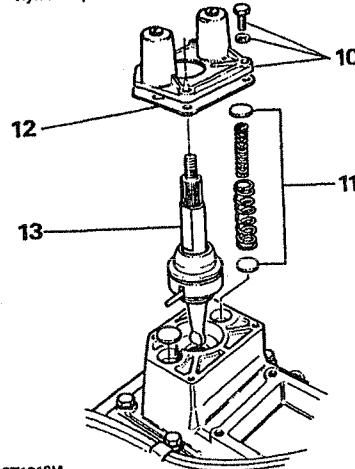
6. With assistance, fit gearbox and stand into a suitable vice and firmly secure.
7. Remove six bolts and washers and lift bell housing, complete with clutch release lever, sleeve and thrust bearing, from gearbox.
8. Remove bell housing gasket.
9. Fit two bell housing fixing bolts, with spacers to front 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.



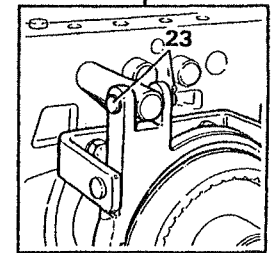
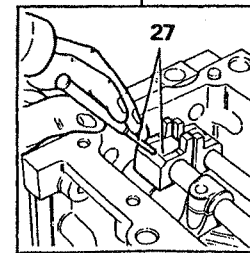
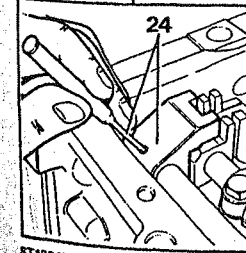
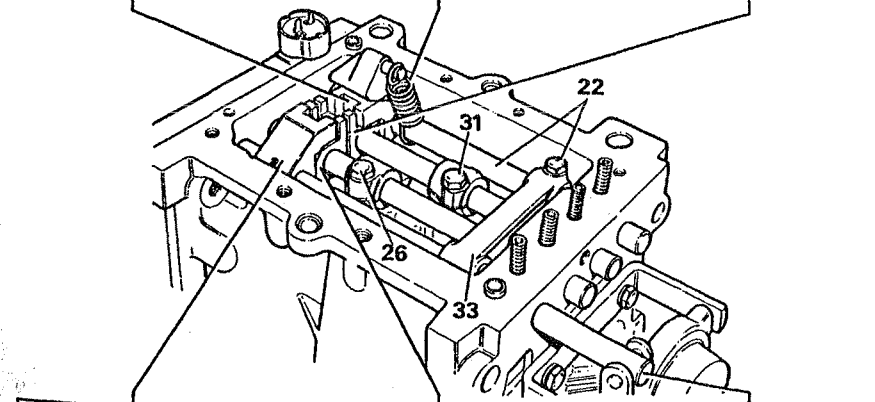
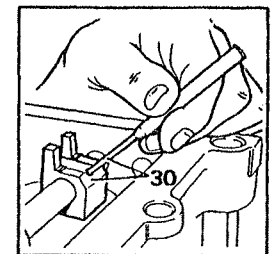
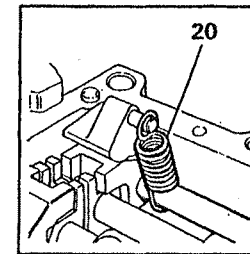
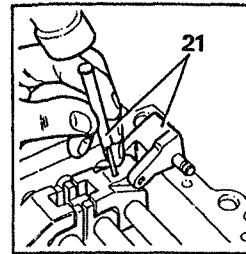
ST1318M

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.

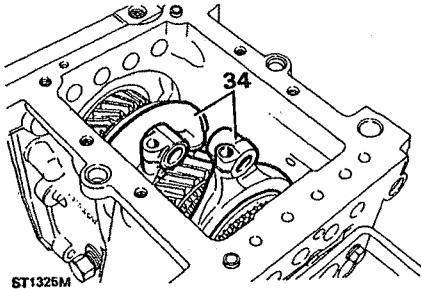
Selector rails and forks

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.

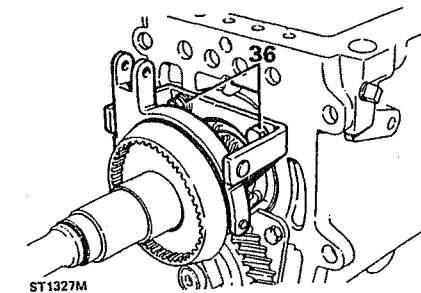
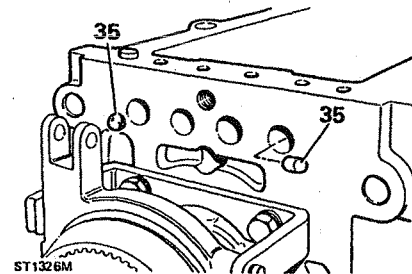


ST1324M

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.



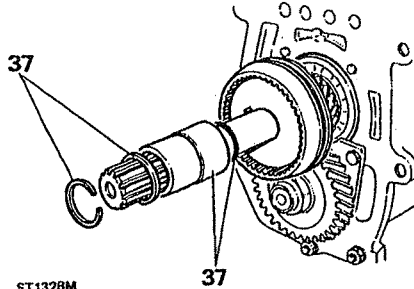
35. Remove interlock plungers and also detent balls if not removed in operation 19.



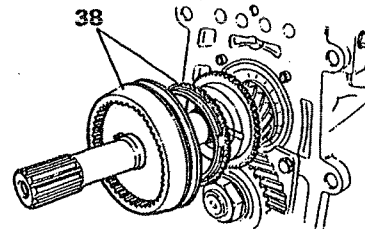
36. Remove two bolts, spring washers and plain washers securing 5th gear fork and bracket assembly to gearbox. Do not displace selector fork slipper pads when removing fork.

Reverse idler shaft, mainshaft and layshaft

37. Remove circlip, selective washer, oil seal collar and 'O' ring from mainshaft.

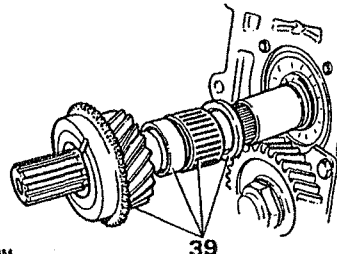


ST1328M

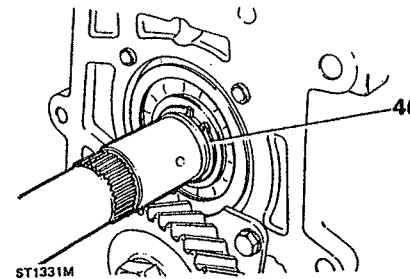


ST1329M

38. Remove 5th gear synchro hub and baulk ring.
39. Remove 5th gear, spacer, needle roller bearing and thrust washer.



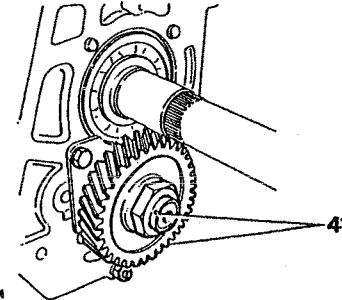
ST1330M



ST1331M

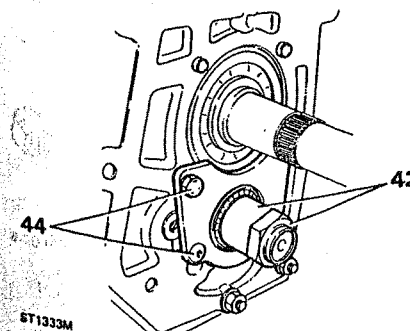
40. Remove mainshaft rear bearing circlip.
41. Release stake nut collar from recess in layshaft, remove stake nut and 5th gear from layshaft.

NOTE: To facilitate this operation lock gearbox by engaging both 1st and 4th gears.



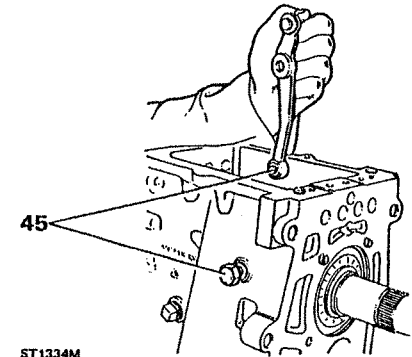
ST1332M

42. Fit manufactured spacer to layshaft to retain rear bearing and secure in position with stake nut finger-tight only.



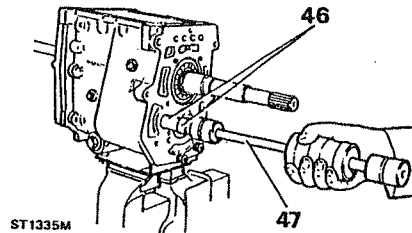
ST1333M

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.



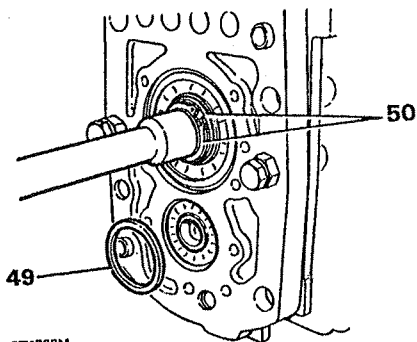
ST1334M

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.



ST1335M

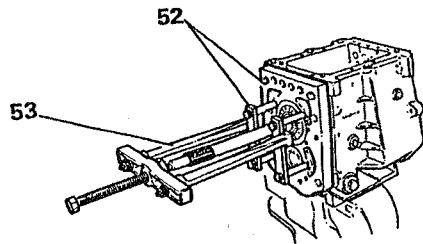
49. Remove layshaft front bearing spacer.
50. Remove input shaft bearing circlip and selective washer.
51. Remove bolts and spacers retaining front bearing plate to gearbox.



ST1338M

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.

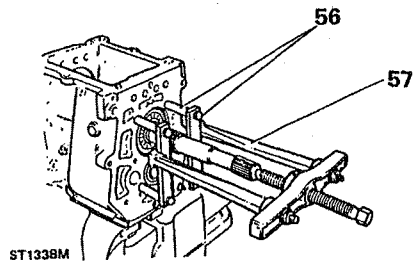
NOTE: Centre bolt and legs of puller must be aligned squarely with input shaft.



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.



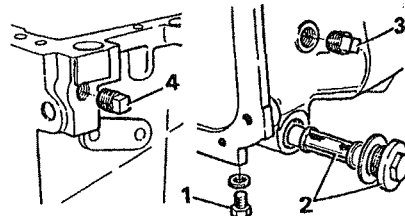
ST1338M

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

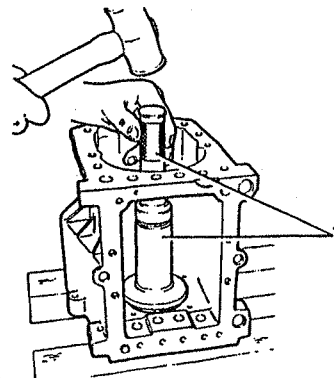
1. Remove drain plug.
2. Remove retaining plug and oil filter.
3. Remove filler/level plug.
4. Remove interlock cross drilling plug.



ST1339M

5. Remove top cover location dowels and 5th gear fork bracket dowels, if necessary.
6. Remove gearbox stand.

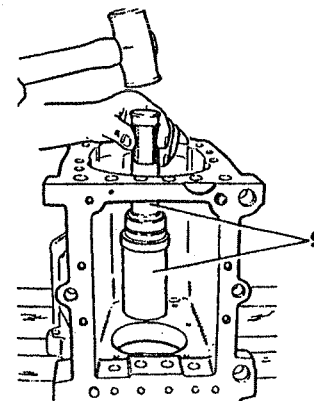
7. Position gearbox on suitable wooden blocks and remove mainshaft rear bearing using Tool Nos. LST 550-3 and MS 550.



ST1340M

8. Remove rear bearing circlip and clean.
9. Using Tool Nos. LST 550-2 and MS 550 remove layshaft rear bearing outer track.

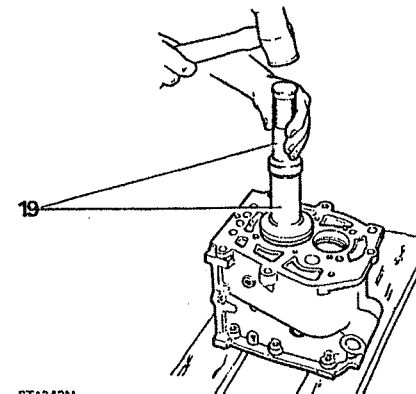
NOTE: Use rounded end of tool.



ST1341M

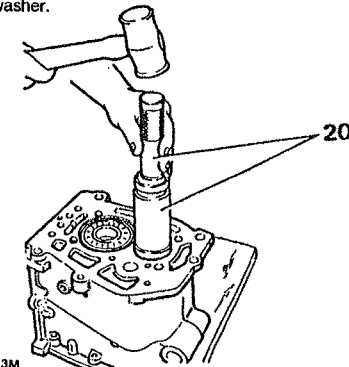
10. Clean gearbox case gasket faces, interior and exterior and inspect for cracks and obvious signs of damage etc.
11. Clean magnetic drain-plug, oil filter retaining plug, level/filler plug and oil filter.
12. Clean mainshaft and layshaft bearing seatings.
13. Clean reverse gear idler shaft seating, 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

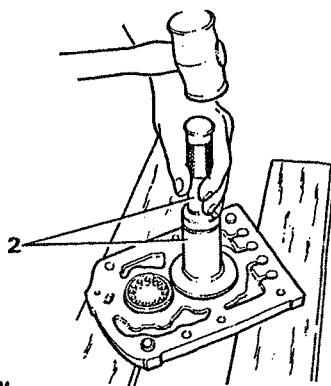
20. With gearbox still warm fit layshaft rear bearing outer track using Tool Nos. LST 550-2 and MS 550.
21. Refit interlock drilling plug.
22. Refit level/filler plug - do not tighten at this stage.
23. Refit oil filter and retaining plug using new copper washer.
24. Refit magnetic drain plug and new copper washer.



ST1343M

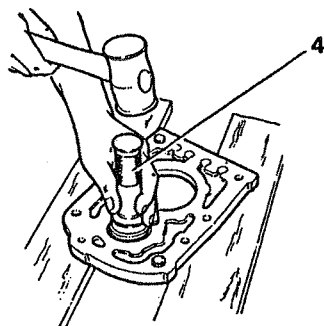
Front bearing plate

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

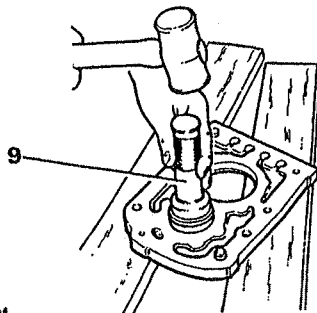
3. Remove circlip from bearing.
4. Remove layshaft front bearing from bearing plate using Tool No. LST 550-1.



ST1345M

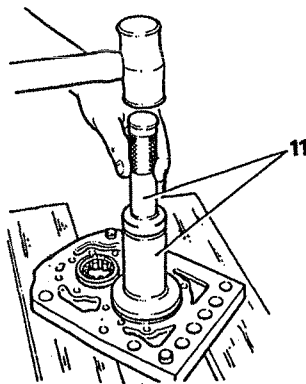
5. If necessary, replace bearing plate dowels.
6. Clean bearing plate, gasket forces and input shaft and layshaft bearing seatings.
7. Using an air line blow out oil-way in bearing plate.
8. Heat front bearing plate to facilitate refitting of input shaft and layshaft bearings.

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

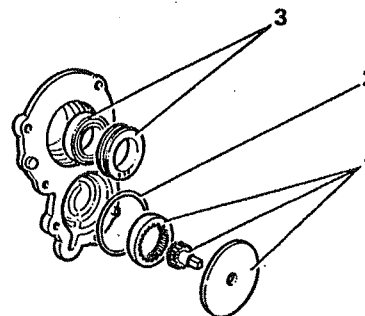
10. Fit circlip to input shaft bearing.
11. With the front bearing plate still warm fit input shaft bearing, using Tool Nos. LST 550-3 and MS 550.



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.

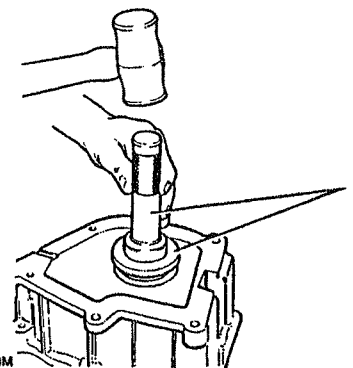


ST1348M

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.



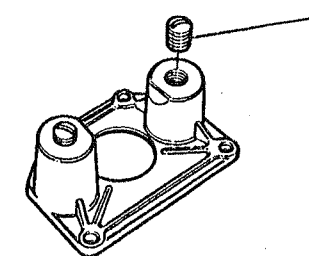
ST1348M

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.

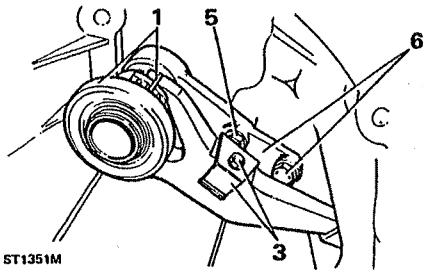


ST1350M

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.

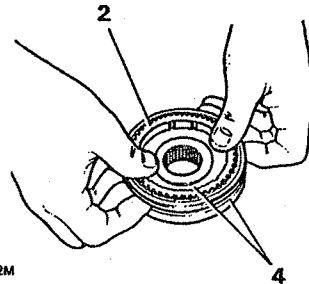
Mainshaft

1. Remove shim and first gear bush.
2. Remove first gear, needle roller bearing and bearing spacer.
3. Remove first gear baulk ring, first/second gear synchro assembly and second gear.
4. Remove second gear baulk ring, second gear, needle roller spacer and needle roller bearing.
5. Fit mainshaft into vice and remove circlip retaining third/fourth synchromesh hub and gear assembly.
6. Remove selective washer, third/fourth synchro assembly and baulk ring.
7. Remove third 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.

First/second synchromesh assembly

1. Before dismantling, mark relationship of synchromesh hub to sleeve.
2. Fit synchromesh baulk rings.
3. Place synchromesh assembly and baulk rings into a plastic bag to ensure none of the components are lost during next operation.
4. Press sleeve from hub.

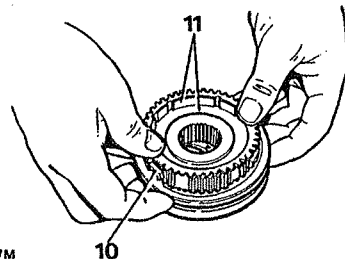


ST1352M

5. Retrieve synchromesh balls, springs and slipper pads and remove baulk ring.
6. Clean all synchromesh assembly components.

NOTE: Before reassembling the synchromesh assembly, carry out the checks for third and second gear end floats, as described in the following paragraphs under the heading 'Mainshaft and gear train'.

7. Fit synchromesh 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 synchromesh sleeve.
11. Fit baulk ring to hub and sleeve.



ST1477M

12. Invert synchromesh assembly, carefully, and fit second baulk ring.
13. Press synchromesh sleeve over hub to locate balls in position.
14. Remove baulk rings.

Third/fourth synchromesh assembly

1. Repeat operation as for first/second synchromesh assembly (omitting the gear end float checks).

NOTE: When reassembling third/fourth synchromesh the large chamfer on synchromesh sleeve faces the small boss on the hub.

Fifth gear synchromesh assembly

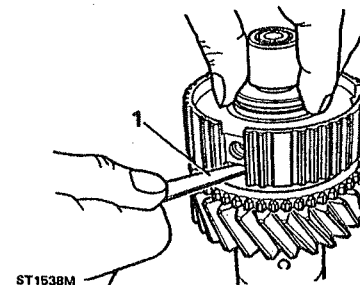
1. Repeat operation as for first/second synchromesh assembly.

NOTE: When reassembling fifth gear synchromesh the chamfer on the hub faces to the rear.

Mainshaft and gear train

Third gear end float

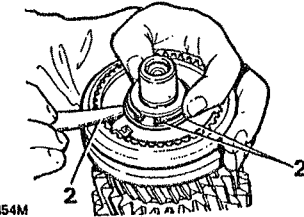
1. Locate the main shaft in a vertical position as shown. Fit third gear and needle roller bearing to the shaft and replace the third/fourth synchromesh inner member. Press down on the synchromesh inner member and check the gear running clearance with a feeler gauge, as shown. A clearance in excess of 0,19 mm 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.



ST1538M

Third/fourth synchromesh end float

2. Maintain the mainshaft in a vertical position as shown. Fit third gear needle roller bearing, spacer, third gear, baulk ring and synchromesh with the large area thrust face towards third gear and the chamfer on the outer member towards the front.



ST1354M

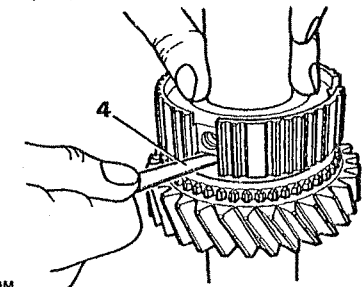
Next fit the original selective washer and retain with the circlip. Check the clearance between the washer and the synchromesh hub which must not exceed 0,075 mm. The condition is ideal when the selective washer can be just turned by hand, i.e. minimum end float. Finally secure components with a new 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.

Second gear end float

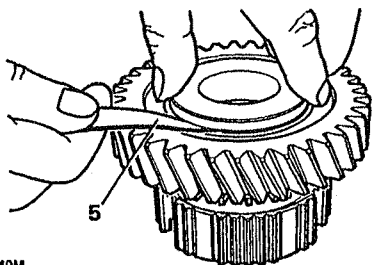
4. Fit second gear needle roller bearing, spacer, second gear and synchromesh inner member with the selector groove towards the rear as shown. Press down on the synchromesh inner member and check second gear end float tolerance which is identical to third gear previously described.



ST1539M

First gear to bush end float

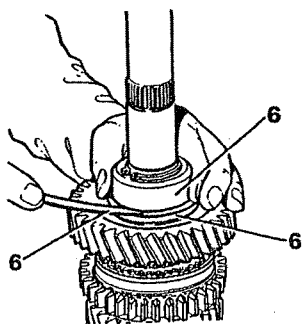
- To carry out first gear check, it is not necessary to assemble the components on to the mainshaft. Assemble first gear on to the bush and using a suitable straight edge or flat plate (the oil pump back plate is ideal) check the end float of first gear on the bush as shown. The tolerance is identical to third and second gear end floats.



ST1540M

First/second synchromesh end float

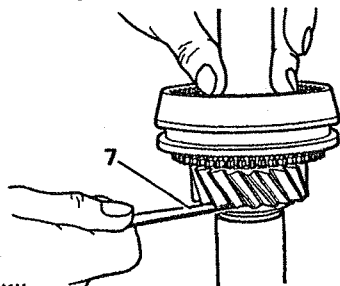
- Next fit the first gear baulk ring, first gear bush and gear, original selective washer, dummy bearing LST 101 and circlip onto the shaft, then check the end float as shown. Choose a suitable selective shim washer to obtain the correct tolerance which is identical with third/fourth synchromesh, i.e. minimum to 0,075 mm.



ST1353M

Fifth gear end float

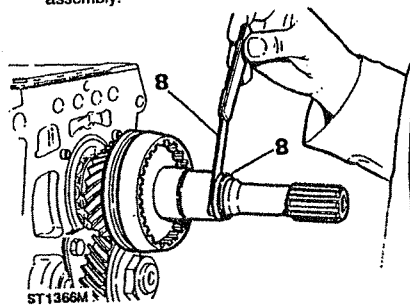
- Fit fifth gear thrust washer, fifth gear, needle bearing and spacer followed by synchromesh unit but leaving out the baulk ring at this stage. Press down on the synchromesh inner member and check the gear end float as shown; this tolerance, again is identical to third gear.



ST1541M

Fifth gear synchromesh end float

- Fit the fifth 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 first/second and third/fourth synchromesh units. With all the mainshaft adjustments correct, remove the fifth gear components ready for assembly.



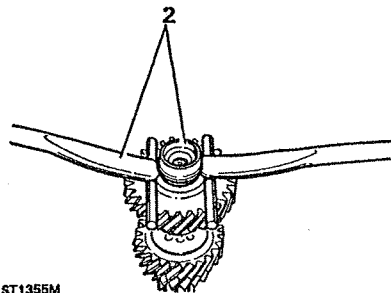
ST1366M

Fifth gear selector fork and bracket assembly

- Remove slipper pads from selector fork and check for wear.
- If necessary, remove circlips and remove selector fork pivot pins.
- Clean all components and refit in reverse order.

Layshaft

- Remove layshaft rear bearing inner race.
- Fit layshaft to vice and lever off front bearing inner track.



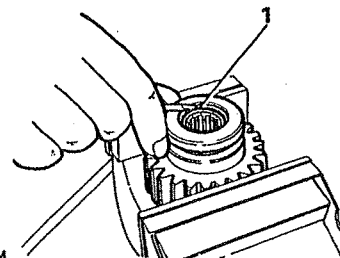
ST1355M

- Clean layshaft, bearings and tracks and check for wear.
- Fit layshaft front bearing track.
- 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

- Secure reverse gear in vice and remove circlip retaining bearings.



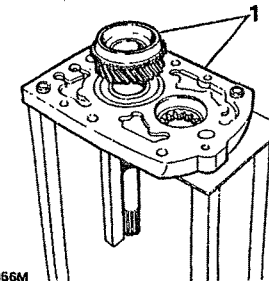
ST1359M

- Remove upper thrust washer, two needle roller bearings and lower thrust washer.
- Invert reverse gear and remove second circlip.
- If necessary, remove split pin and withdraw slipper pads and washer from reverse gear lever.
- Press out reverse lever cross link operating pin, if necessary.
- Clean all components and check for wear.
- Lubricate needle roller bearings and reassemble reverse idler gear assembly and lever in reverse order.

REASSEMBLING GEARBOX

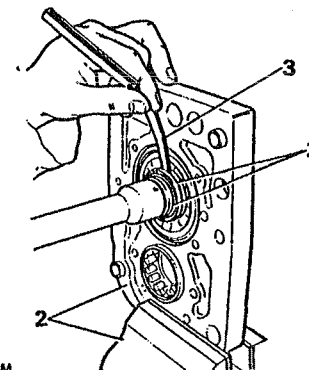
Input shaft, mainshaft and layshaft

- Position front bearing plate on suitable stand and fit input shaft into bearing.



ST1356M

- Secure bearing plate in vice, fit original selective washer and retain with circlip.
- Measure the clearance between washer and input shaft bearing. If a measurement in excess of 0,075 mm is obtained remove circlip and washer.

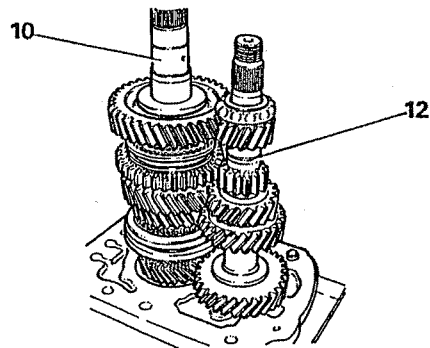


ST1357M

- Select and measure new washer to take up the excessive running clearance.
- Fit new selective washer and retain with circlip.
- Recheck to ensure a running clearance of 0,075 mm is obtained between washer and bearing.
- Position front bearing plate on suitable stand.
- Lubricate mainshaft pilot bearing and fit to input shaft.
- Fit fourth 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 third 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 third/fourth synchromesh hub to neutral.

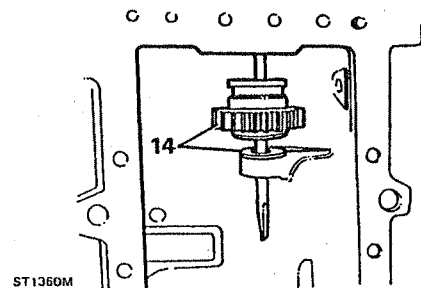


ST1358M

13. Remove the rear bearing circlip and dummy bearing.

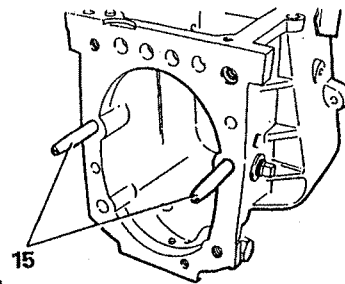
Reverse gear

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

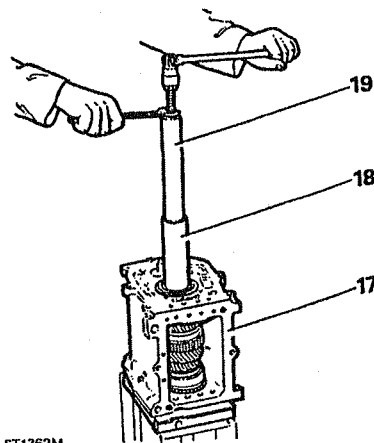
15. Fit guide studs 18G 1294 to gearbox.



ST1361M

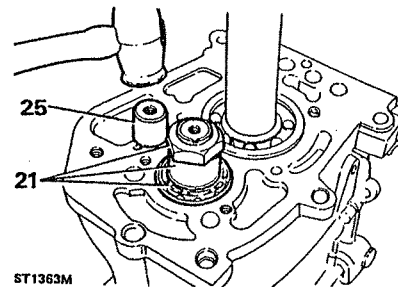
Gearbox case and reverse shaft

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.



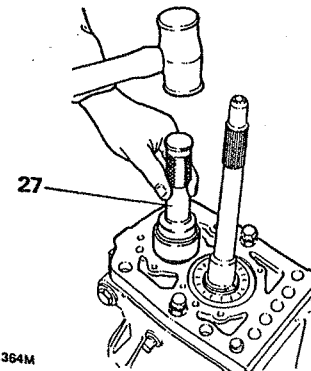
ST1362M

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.



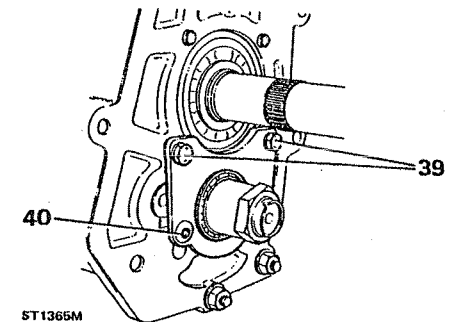
ST1364M

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 fourth 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.

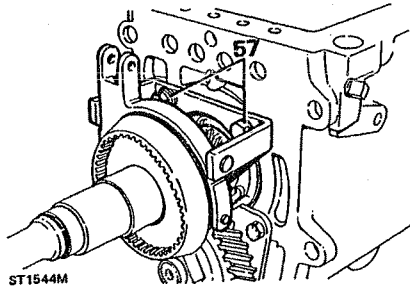
Fifth gear, layshaft and mainshaft

41. Remove nut from layshaft and remove dummy spacer.
42. Fit fifth 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 first and fourth gears.

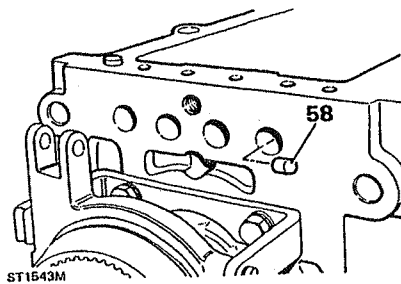
45. Fit a new fifth gear retaining nut and tighten to the specified torque.
46. Stake retaining nut collar into recess in layshaft.
47. Return first and fourth synchromeshes to neutral.
48. Fit mainshaft rear bearing circlip.
49. Fit thrust washer.
50. Lubricate needle roller bearings and fit to mainshaft followed by spacer and fifth gear.
51. Fit fifth gear synchromesh cone and synchromesh 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 fifth gear end float check and retain with circlip.
55. Remove tape.

Selector rails and forks

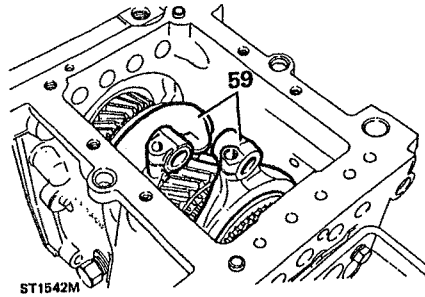
56. Locate fifth gear fork and bracket on to synchromesh hub and gearbox dowels.
57. Secure fork bracket to gearbox with two bolts, plain washers and spring washers.



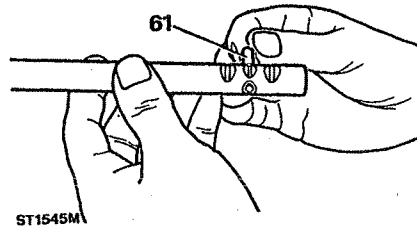
58. Fit selector rail interlock plungers into the cross-drilling in the gearbox case.



59. Fit first/second and third/fourth selector forks.



60. Fit reverse cross-over lever.
61. Insert interlock into first/second selector rail.



62. Push first/second selector rail through gearbox seating and locate in reverse cross-over lever and selector fork; do not tighten fork clamp bolt.

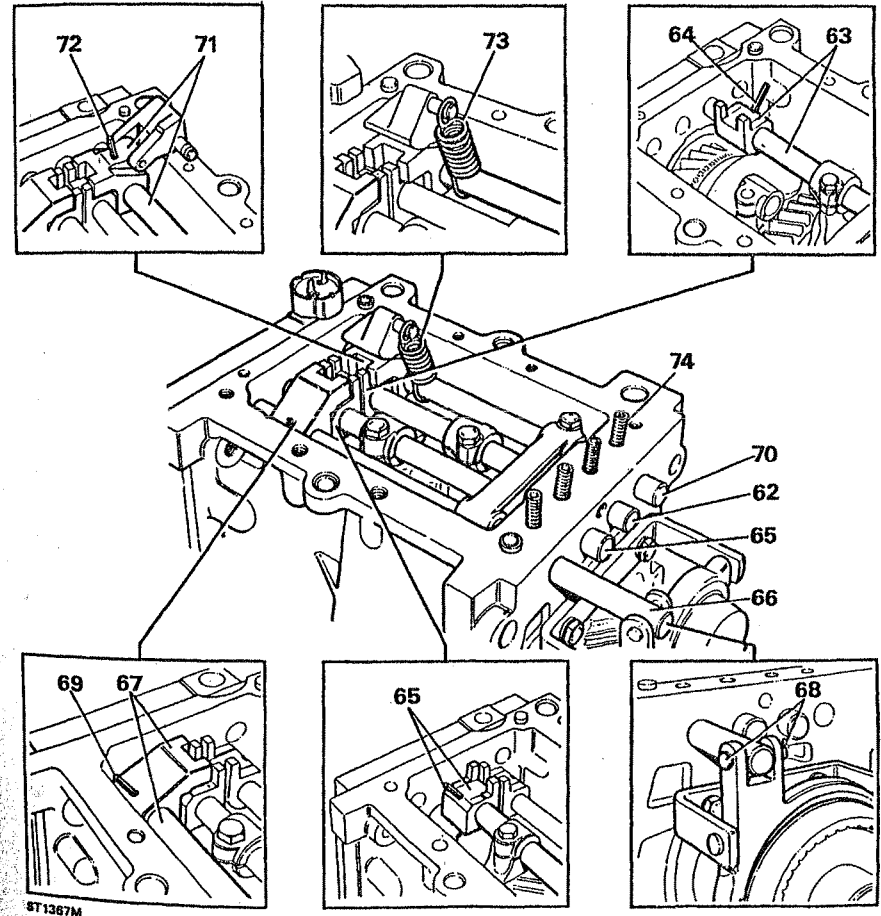
NOTE: First/second fork clamp bolt is not a set bolt.

63. Fit first/second 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 third/fourth selector rail and jaw.

66. Push fifth gear selector rail through gearbox seating and locate in reverse cross-over lever.
67. Fit fifth gear selector jaw to rail, align for roll pin.
68. Locate selector rail into fifth 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.

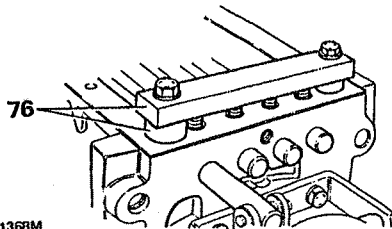
NOTE: The roll pin must be inserted sufficiently to be flush with the underside face of the selector jaw.



- 73. Fit reverse gate spring to selector rail and knock-over lever.
- 74. Fit detent balls and springs.

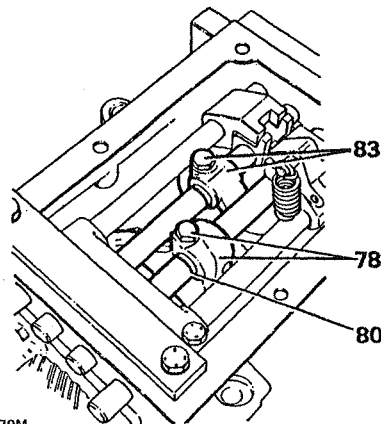
Selector fork adjustment

- 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 first/second selector rail and synchromesh 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 third/fourth selector fork and rail.

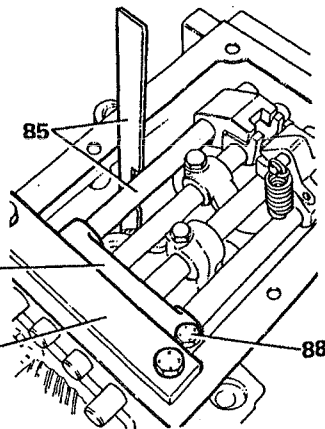


ST1370M

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 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 first/second 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 first/second synchromesh sleeve. If there is not enough clearance, readjust the reverse cross-over lever.
- 90. Return first/second 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.

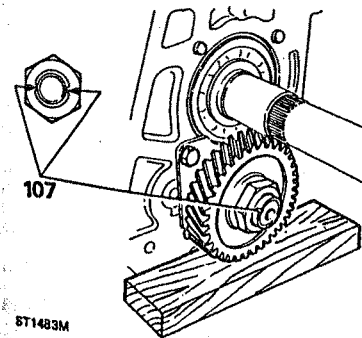
Lower gear lever/bias spring housing

- 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

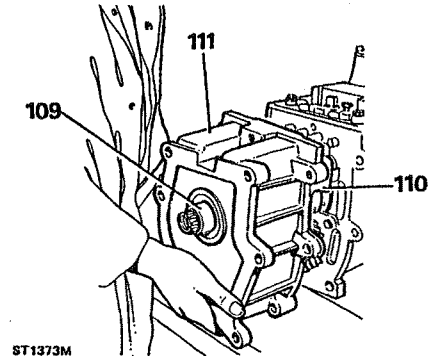
- 107. The special nut retaining the fifth gear to the layshaft must be secured in position, by carefully forming the collar of the nut into the layshaft slots, as illustrated.

CAUTION: A round nose tool must be used for this operation to avoid splitting the collar of the nut. Also, the fifth 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

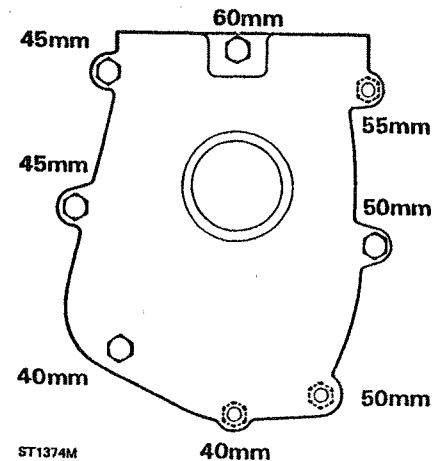
- 108. Support underside of gearbox with wooden block.
- 109. Lubricate oil seal protection sleeve Tool No. LST 102 and fit to oil seal from inside extension housing.
- 110. Fit new gasket to extension housing.
- 111. Carefully manoeuvre extension housing over mainshaft and position squarely on dowels.



ST1373M

- 112. Remove oil seal protection sleeve.
- 113. Secure extension housing to gearbox with eight bolts, spring washers and single nut.

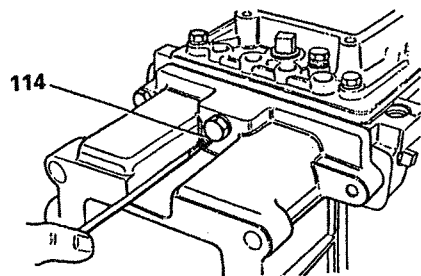
NOTE: Illustration shows correct bolt lengths and their locations in extension housing.



ST1374M

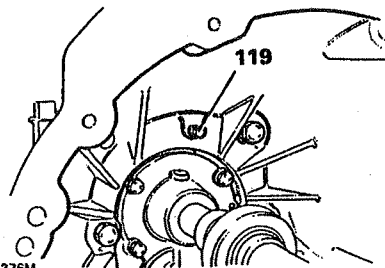
Third/fourth gear selector rail adjustment

- 114. Slacken third/fourth stop screw in extension housing.



ST1375M

- 115. Select third gear.
- 116. Tighten stop screw until it makes contact with third /fourth selector rail.
- 117. Turn back stop screw one turn. Retighten locknut.
- 118. Return gear lever to neutral.
- 119. Slacken locknut on third/fourth stop bolt inside bell housing.

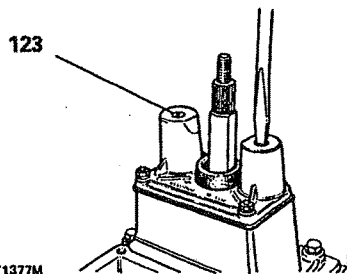


ST1376M

- 120. Unscrew stop bolt.
- 121. Select fourth gear and screw in stop bolt until contact is made with third/fourth 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.

INTRODUCTION

This 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, interchangeable 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.

GEARBOX AND TRANSFER BOX REMOVAL

This operation is the same as that described for the heavy duty version.

In the interests of safety, 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.

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

LT85 LIGHT WEIGHT DIVIDED CASE GEARBOX

- Service Tools:
- 18Q284-LRT-99-004 - Impulse extractor
 - LST284-1-LRT-37-005 - Reverse idler shaft remover adaptor
 - LST101-LRT-37-003 - Gauge first gear end-float
 - LST102-LRT-37-500 - Mainshaft oil seal remover, replacer
 - MS47-LRT-99-002 - Hand press

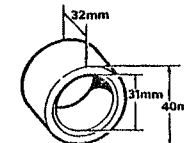
With the exception of MS47 the above are existing tools used on the heavy duty LT85 integral case gearbox.

Special sockets and spanners

41 mm socket - Layshaft fifth gear retaining nut
5 mm Allan key - Reverse shaft retaining plate

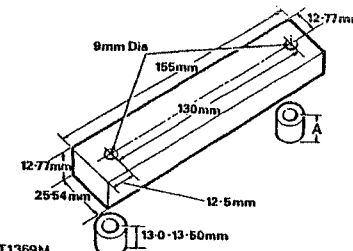
Locally manufactured tools

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.



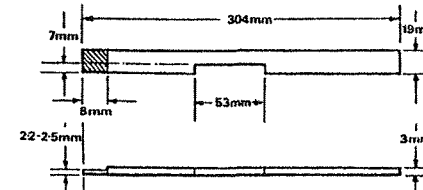
ST1476M

Spacer for retaining layshaft rear bearing.



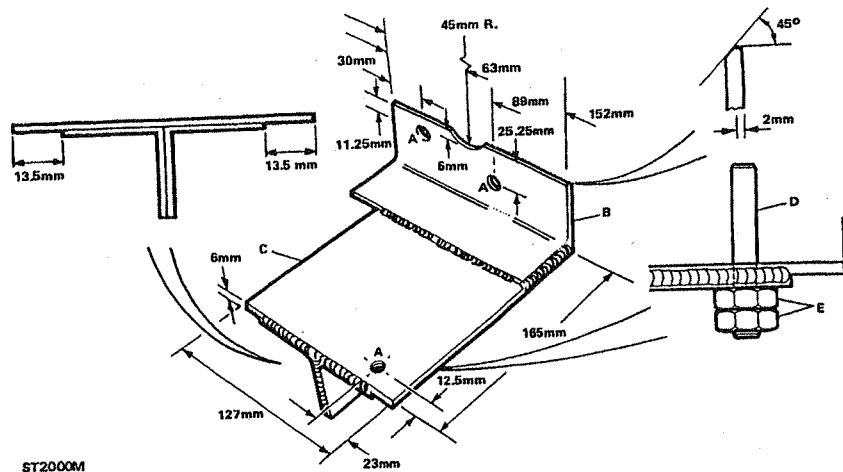
ST1369M

Selector detent spring retaining tool and spacers.



ST1371M

Gauge for reverse cross-over lever adjustment.



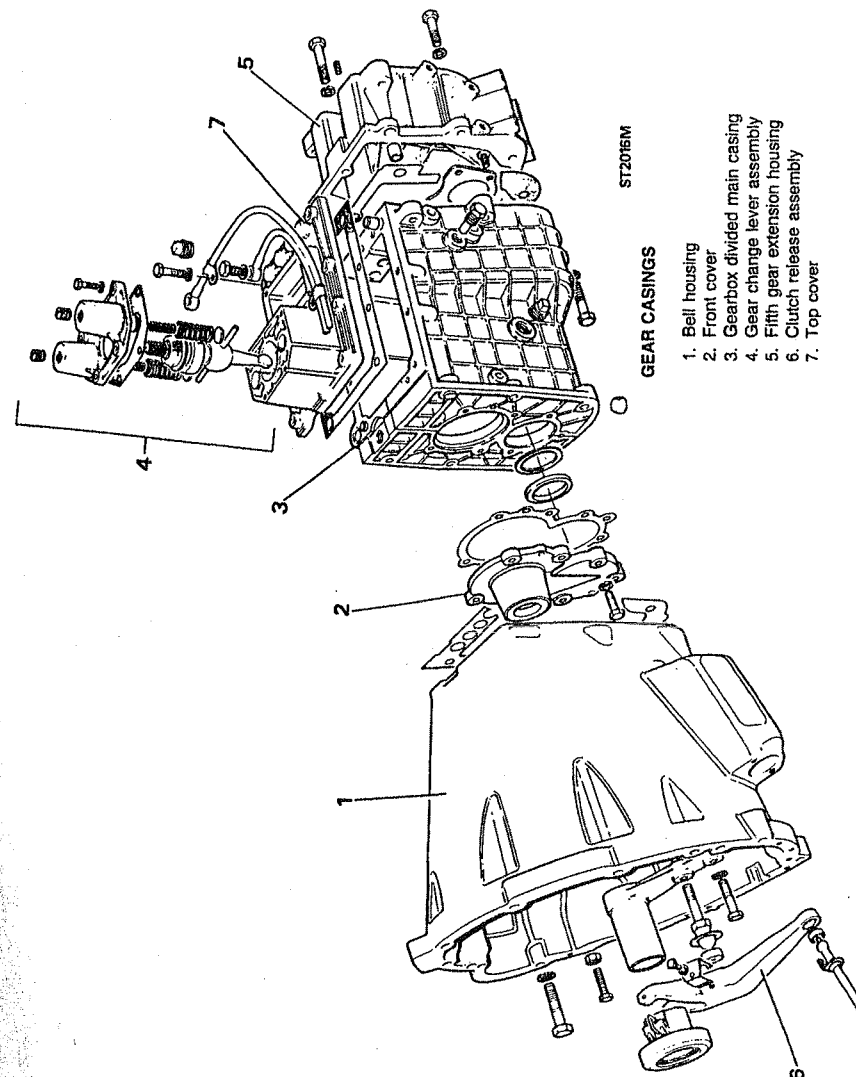
Stand for securing the gearbox in a vice

- 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 stud 70 mm long with 25 mm of thread for adjustment.
- E. 10 mm nuts.

NOTE: Item D is where the modification to the original stand is necessary.

Material and welding specification

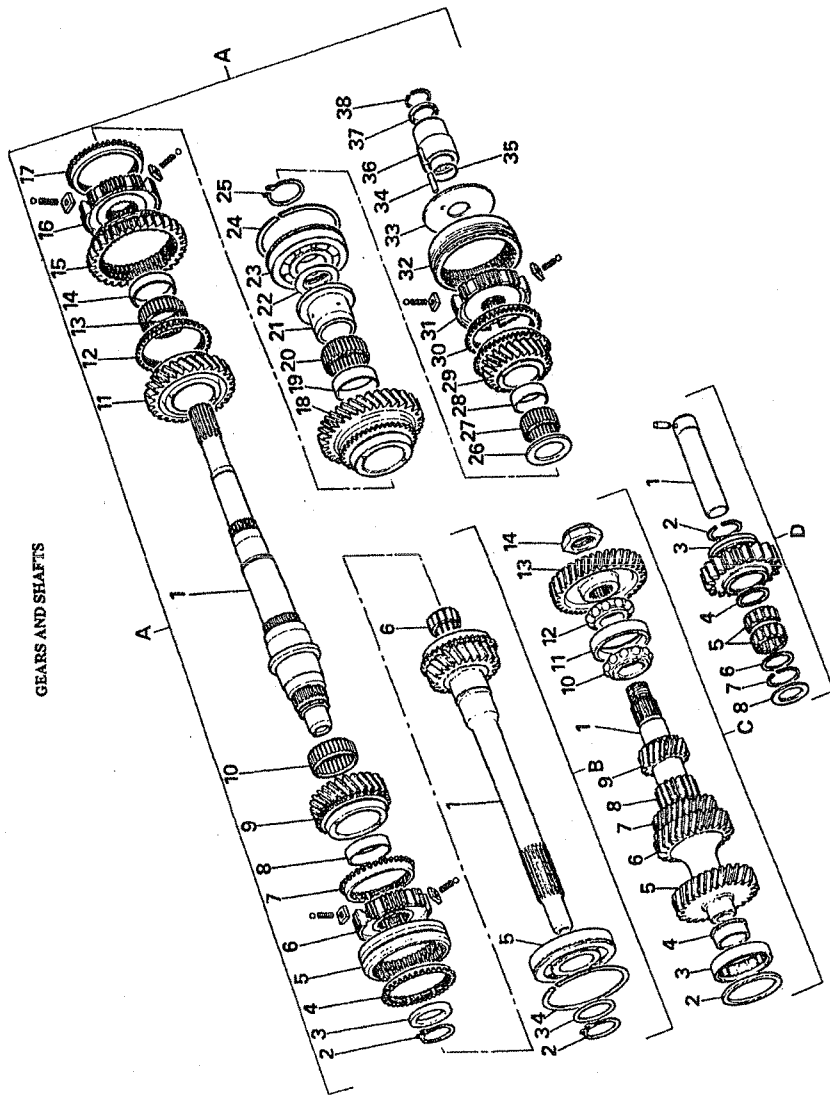
Steel plate BS 1449 Grade 4 or 14.
Arc welding BS 5135.



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



ST2071N

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

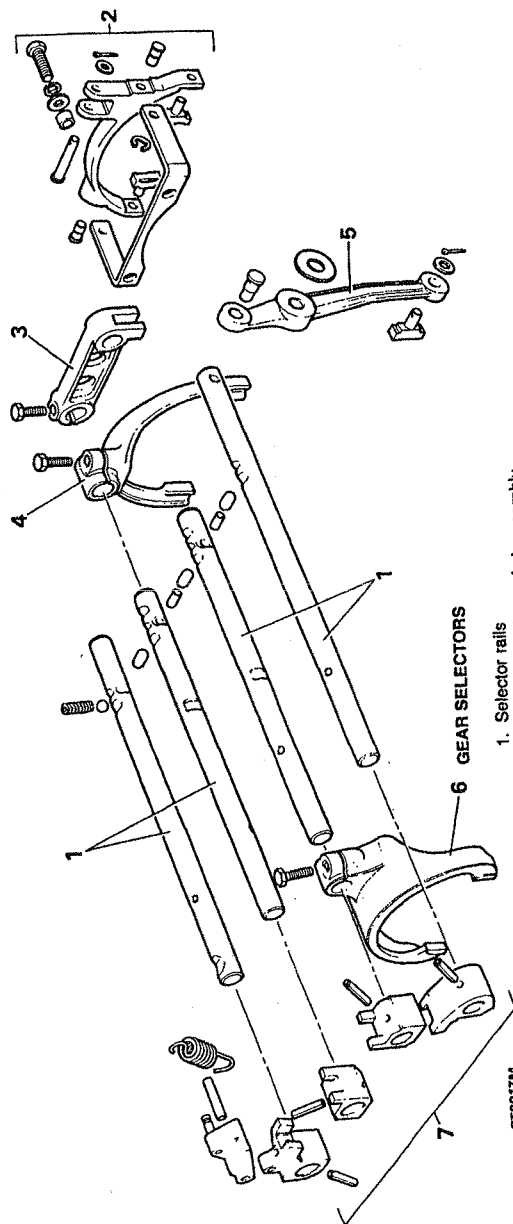
1. Input shaft and 4th gear
2. Circlip
3. Selective washer
4. Snap ring
5. Ball bearing
6. Needle roller bearing

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

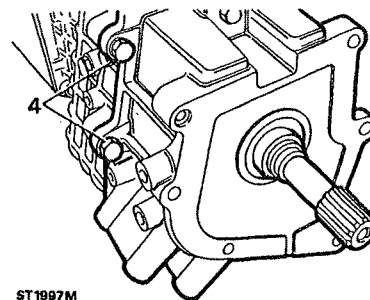


1. Selector rails
2. Fifth gear selector fork assembly
3. Reverse gear cross-over lever
4. First and second gear selector fork
5. Reverse gear lever
6. Third and fourth gear selector fork
7. Selector jaws

ST2017M

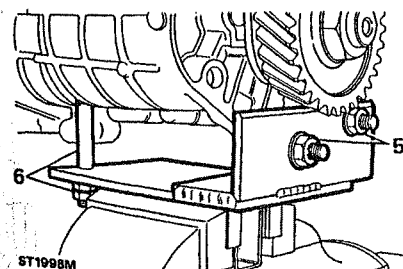
DISMANTLE

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 left-hand mounting bracket.
4. Remove the eight bolts, four forward facing and four rearward facing and withdraw the extension housing and gasket.



ST1997M

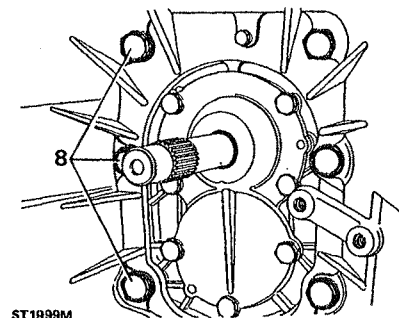
5. Fit the locally manufactured stand to the gearbox and secure with two bolts, nuts, spring and plain washers.
6. Adjust the stud under the gearbox case as necessary so that it just contacts the case to provide support.



ST1998M

7. Secure the gearbox and stand in a vice.

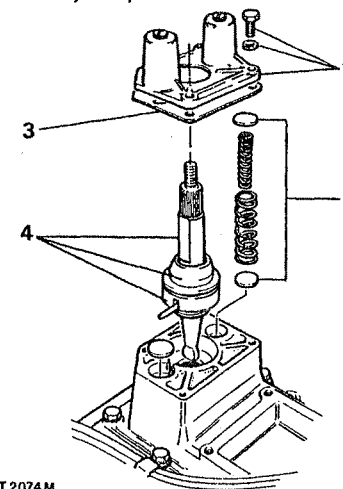
8. Remove the six bolts and withdraw the bell housing complete with clutch release lever, sleeve and thrust bearing from the gearbox.
9. Remove the bell housing gasket.



ST1999M

Bias spring housing and gear lever

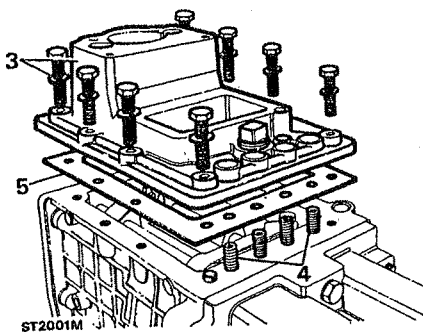
1. Remove the four bolts and lift the bias spring housing from gearbox.
2. Remove the bias springs and shims. Take care not to allow the lower shims to slip under the gear lever pivot bar into the gearbox.
3. Remove the bias spring housing gasket.
4. Remove the gear lever complete with gaiter and nylon cup.



ST 2074 M

Gearbox top cover

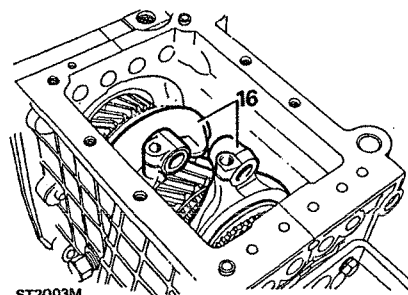
1. Remove the reverse light switch, if fitted.
2. Remove breather pipe banjo union fixing bolt.
3. Remove the eight bolts and lift the top cover and breather pipes from gearbox whilst taking care not to allow the detent springs to fall into the gearbox.
4. Remove the detent springs.
5. Remove the top cover gasket.



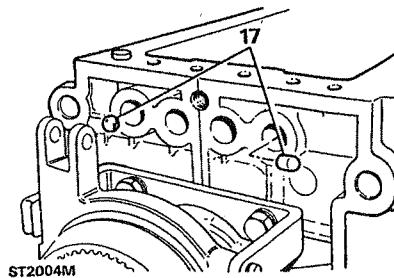
Selector rails and forks

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.

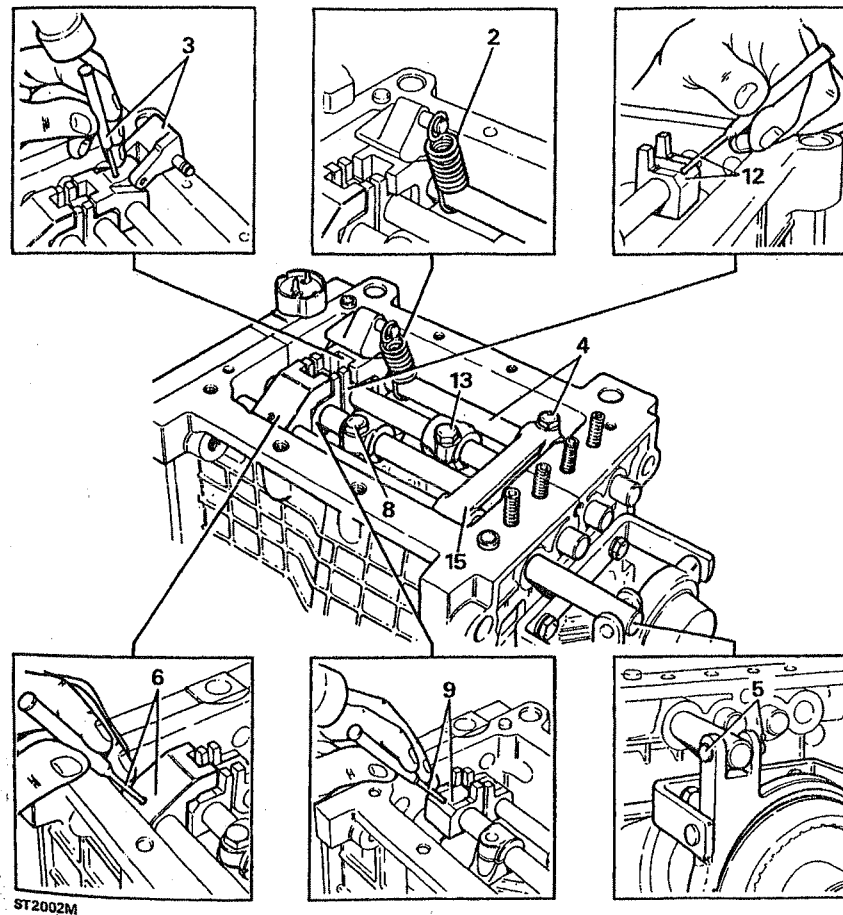
8. Remove the clamp bolt from the third/fourth selector fork and move the selector rail forward.
9. Tap-down the third/fourth jaw roll pin until jaw is free on the selector rail.
10. Withdraw the third/fourth selector rail and jaw.
11. Remove the interlock from the third/fourth selector rail.
12. Tap-down 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.



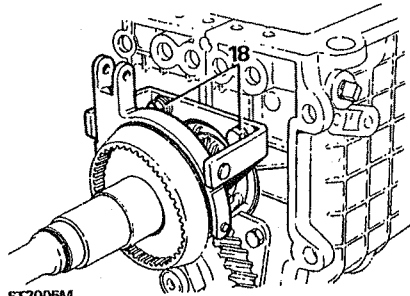
17. Remove the interlock plungers, and the detent balls, if the latter were not removed in instruction 1.



SELECTOR RAILS AND FORKS



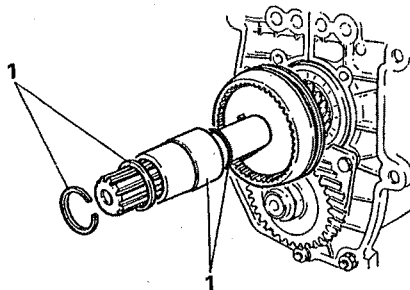
18. Remove the two bolts securing the fifth gear fork and bracket assembly to the gearbox. Do not displace the selector fork slipper pads when removing the fork.



ST2005M

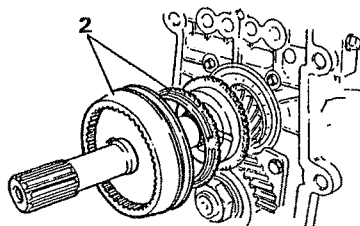
Reverse shaft, mainshaft, and layshaft

1. Remove the circlip, selective washer, oil seal collar and 'O' ring from the mainshaft.



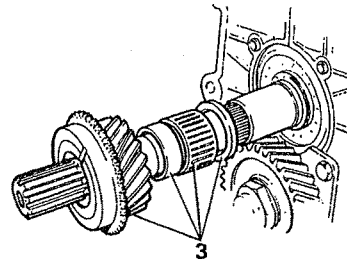
ST2006M

2. Remove the fifth gear synchromesh hub and baulk ring.



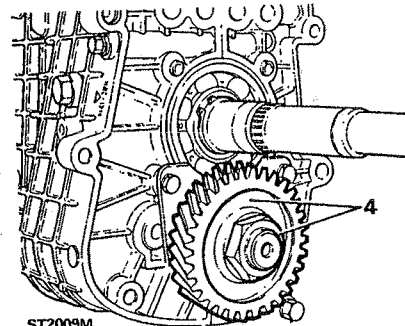
ST2007M

3. Remove the fifth gear, spacer, needle roller bearing and thrust washer.



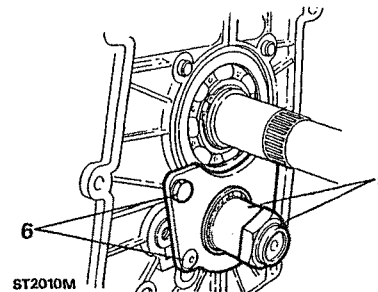
ST2008M

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.



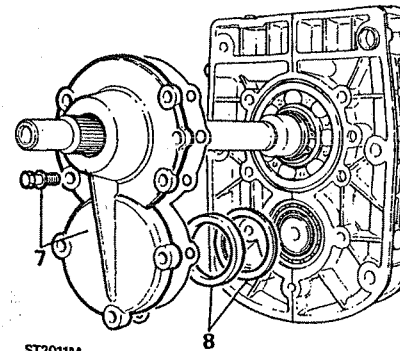
ST2009M

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.



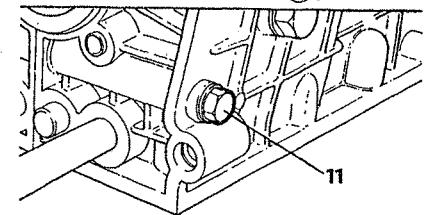
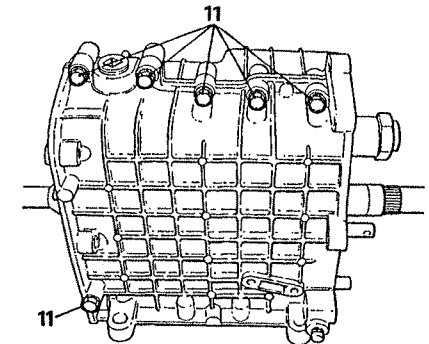
ST2010M

7. Remove the seven bolts and withdraw the front cover and gasket.
8. Remove the layshaft front bearing spacer and shims.



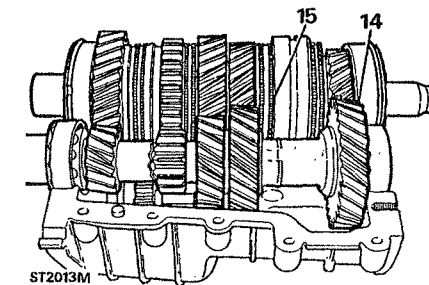
ST2011M

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.



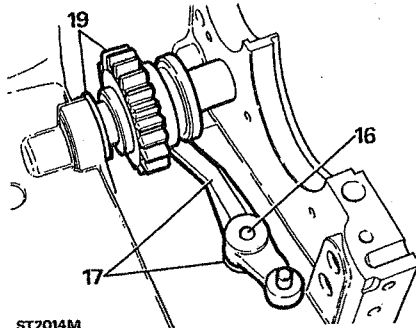
ST2012M

14. Lift-out the layshaft assembly.
15. Remove the mainshaft assembly.



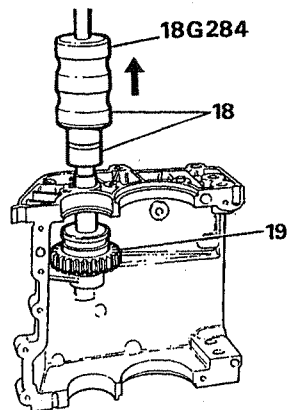
ST2013M

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 18G284 and adaptor LST284-1.
19. Remove the reverse idler gear and thrust washer.



ST2015M

INSPECTION AND OVERHAUL

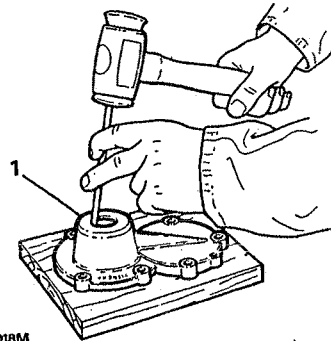
Main gearbox case

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.

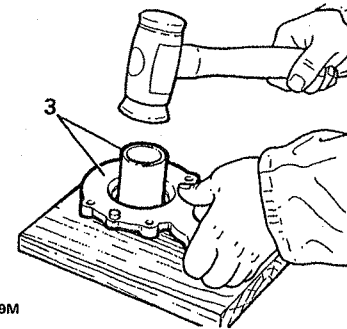
Front cover

1. Place the front cover on a block of timber and drift-out the oil seal.



ST2018M

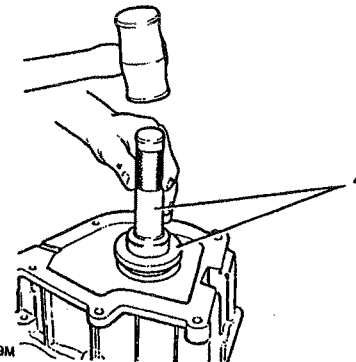
2. Clean the cover and check for damage or burrs.
3. Lubricate the outer diameter of a new seal and using a suitable tube, drift-in the seal, lip side trailing, squarely into the cover.



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 exterior and interior and the mating faces.
4. Using service tool LST102 fit a new seal to the extension housing.



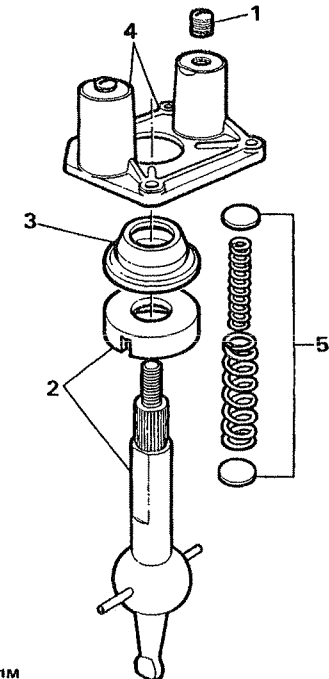
ST1349M

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.



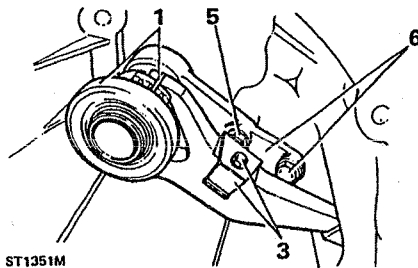
ST2021M

Bell housing

1. Remove the clip retaining the thrust bearing carrier to the clutch operating lever fork if still in position.

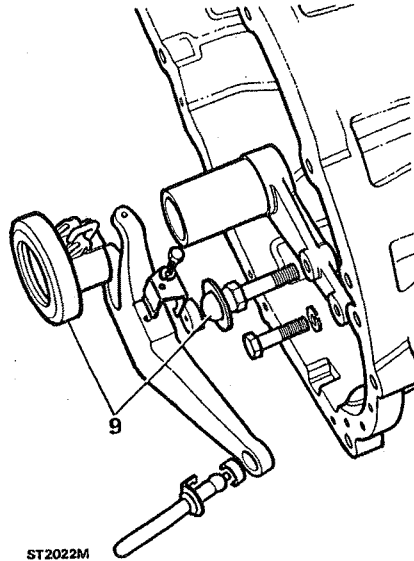
NOTE: The clip is fitted during assembly to prevent the bearing sliding forward when the gearbox is being fitted to the engine and it may become dislodged in service without detriment.

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

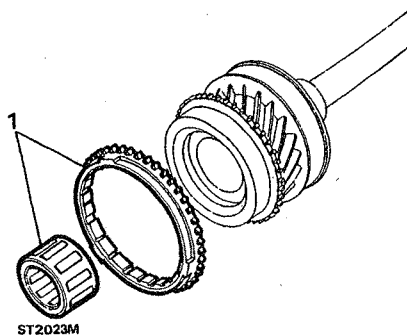
7. If necessary, remove the bearing sleeve dowels.
8. Clean the bell housing exterior and interior and mating faces.
9. Apply grease to the lever pivot and inner diameter of bearing carrier.
10. Reassemble the bell housing in the reverse order of dismantling.



ST2022M

Input shaft

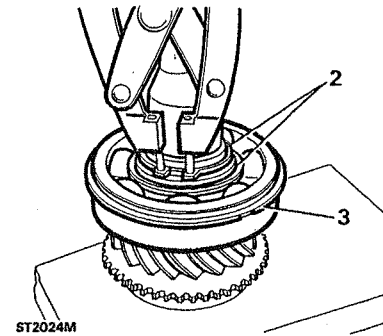
1. Remove the fourth gear baulk ring and needle roller bearing.



ST2023M

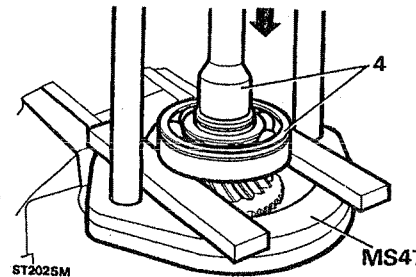
2. Remove the circlip and selective thrust washer.
3. Remove the snap ring from the bearing.

6. Check the input shaft and gear for wear, scores and pits.
7. Using press MS47 and a suitable tube, fit the input shaft to the bearing with the snap ring groove outwards.



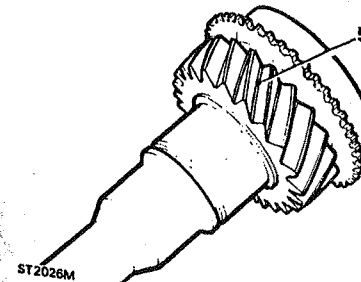
ST2024M

4. Using press MS47 and two suitable steel blocks, press the input shaft from the bearing.

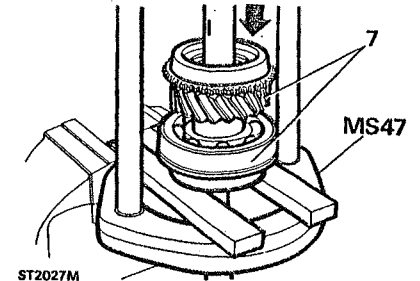


ST2025M

5. Clean all components and ensure that the two oil-ways in the input shaft are clear by blowing through with an air line.

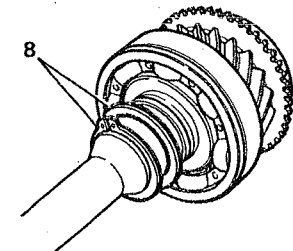


ST2026M



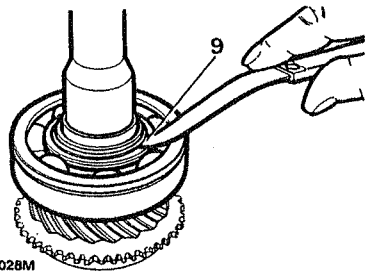
ST2027M

8. Fit the original selective washer and circlip.

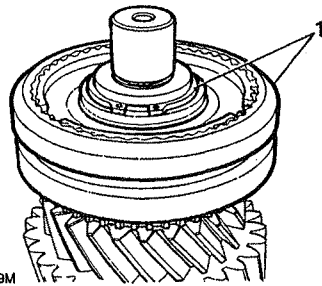


ST2075M

9. Check, with a feeler gauge, the clearance between the bearing and washer. If the clearance is in excess of 0,075 mm remove the circlip and washer and select and measure a new washer to take-up the excess clearance.

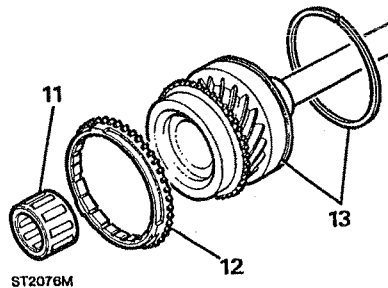


ST2028M

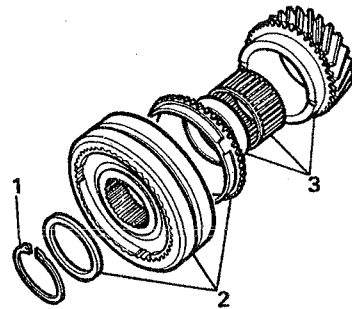


ST2029M

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.

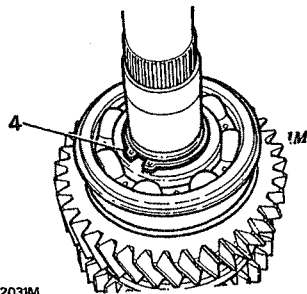


ST2076M



ST2030M

4. Invert the mainshaft assembly, in the vice, and remove the mainshaft rear bearing circlip.

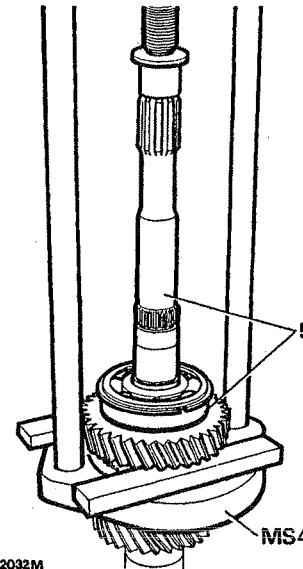


ST2031M

Mainshaft

1. Secure the mainshaft assembly in a vice and remove the circlip retaining the third/fourth synchromesh 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.

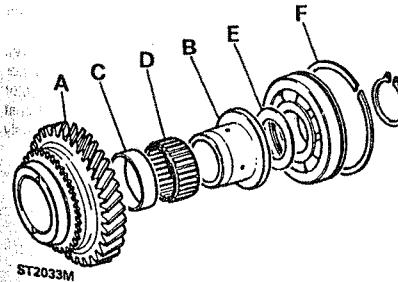
5. Using press MS47, and a support under the first gear, press the mainshaft assembly from the rear bearing.



ST2032M

6. Separate the following components from the assembly:

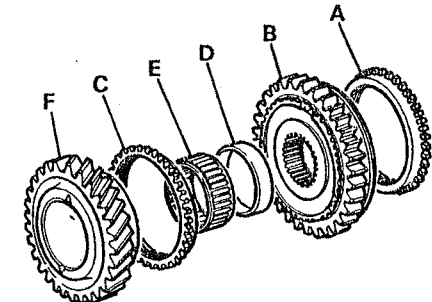
- A. First gear
- B. First gear bush
- C. Spacer
- D. Needle roller
- E. Selective washer
- F. Rear bearing snap ring



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

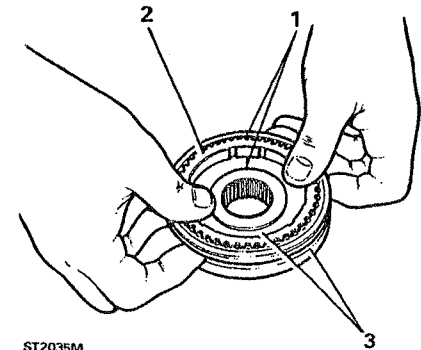


ST2034M

8. Clean the mainshaft and all components and examine for obvious wear.

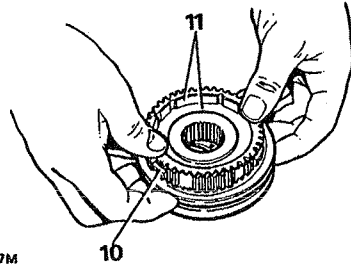
First/second synchromesh assembly

1. Before dismantling, mark the relationship of the synchromesh hub to the sleeve.
2. Fit the baulk rings to the synchromesh 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 synchromesh 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.

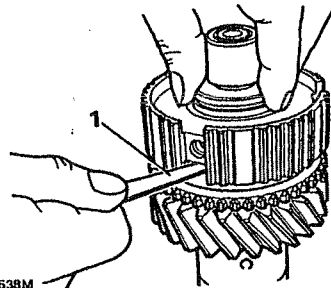
Mainshaft and gears clearance checks

Running clearances

Mainshaft 1st gear	0,075 mm maximum
Mainshaft 3rd gear	0,075 mm maximum
Mainshaft 5th gear	0,075 mm maximum
Input shaft bearing	0,075 mm maximum

Third gear end-float

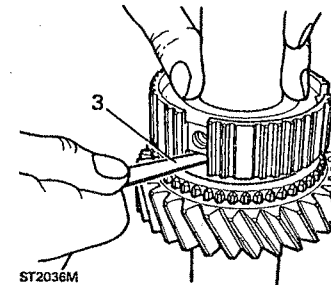
1. Locate the mainshaft in a vertical position as shown. Fit the third gear, needle roller bearing and spacer to the mainshaft and replace the third/ fourth synchromesh inner member. Press down on the synchromesh inner member and check the gear running clearance with a feeler gauge. A clearance in excess of 0,19 mm 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.



ST1638M

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.

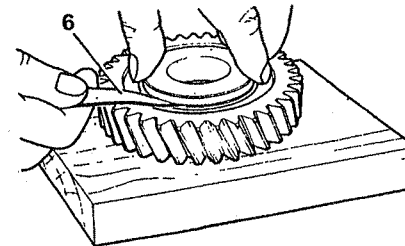


ST2036M

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

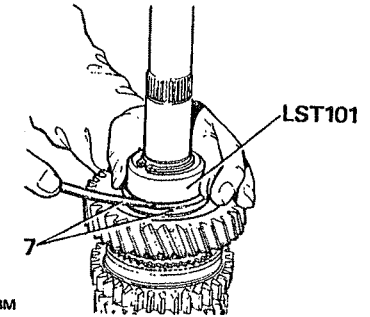
6. To carry-out the first gear check, do not assemble the components to the mainshaft. Assemble the spacer, needle bearing and bush to the first gear and using a suitable straight edge or flat plate, check the end-float of the first gear on the bush, as shown. The tolerance is the same as the for third and second gears.



ST2037M

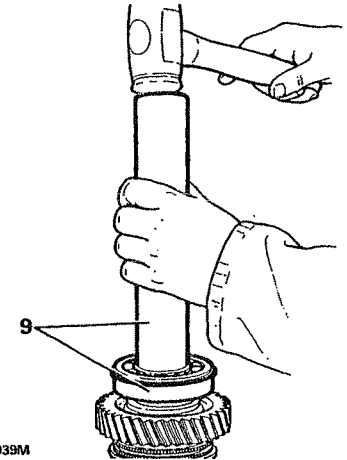
First/second synchromesh end-float

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 LST101 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 0,075 mm.



ST2038M

8. Remove the dummy bearing and fit the selective washer.

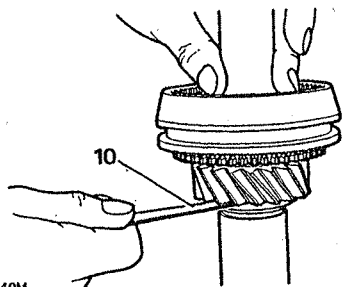


ST2039M

9. Start the mainshaft rear bearing squarely on the mainshaft then, without inverting the shaft, use either a press, capable of accommodating the complete mainshaft assembly, or drive the bearing into position using a suitable tube. Secure the assembly with the circlip.

Fifth gear end-float

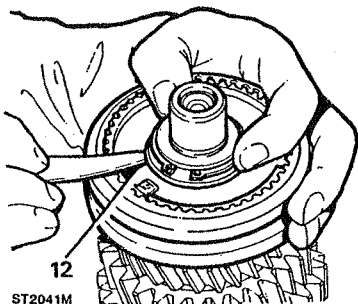
10. Fit the fifth gear thrust washer with the scallop side towards the gear. Fit the fifth gear, needle bearing and spacer followed by the synchromesh assembly, less the baulk ring at this stage. Press down on the synchromesh inner member and check the gear end-float, as shown, between the gear and thrust washer. The tolerance is the same as that for the third gear end-float.



ST2040M

Third/fourth synchromesh end-float

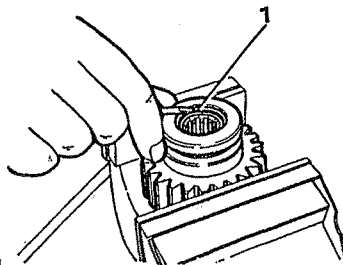
11. Invert the mainshaft to a vertical position, as shown. Fit the third gear needle roller bearing, spacer, third gear, baulk ring and synchromesh with the larger thrust face towards third gear and the chamfer on the outer member towards the front. Fit the original selective washer and retain with the circlip.
12. Check the clearance between the washer and the synchromesh hub. The clearance must not exceed 0,075 mm. The condition is ideal when the selective washer can be just turned by hand.



ST2041M

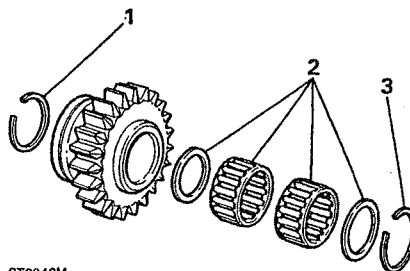
Reverse idler gear, shaft and lever

1. Secure the reverse gear in a vice and remove one of the two circlips retaining the bearings



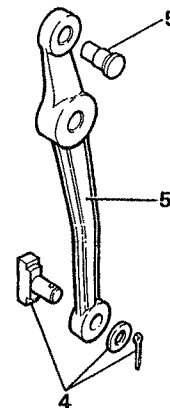
ST1359M

2. Remove the upper thrust washer, two needle roller bearings and lower thrust washer.
3. Invert the reverse gear and remove the second circlip.



ST2042M

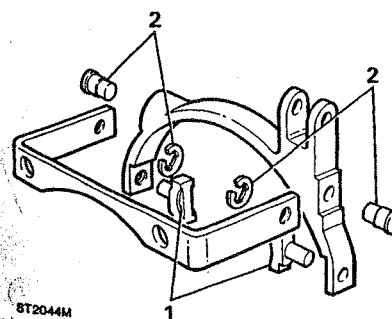
4. If necessary, remove the split pin and withdraw the slipper pads and washer from the reverse gear lever.
5. Press-out the reverse lever cross link pin, if necessary.



ST2043M

Fifth gear selector fork and bracket

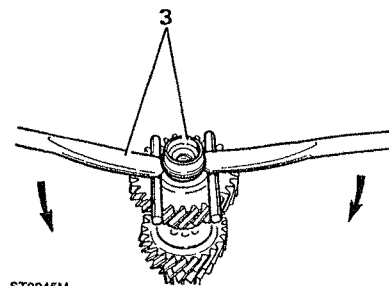
1. Remove the slipper pads from the selector fork and check for wear.
2. If necessary, remove the circlips and withdraw the pivot pins.
3. Clean all components and refit or renew in reverse order.



ST2044M

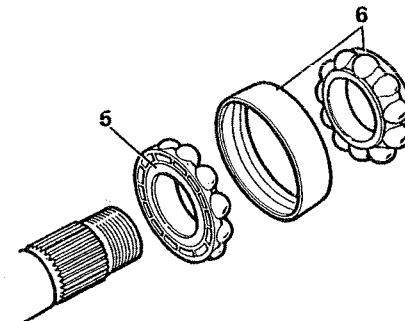
Layshaft

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 front bearing inner track.



ST2045M

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.



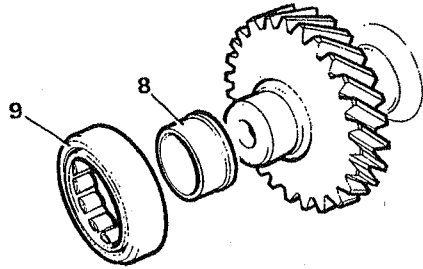
ST2046M

7. Fit the dummy spacer and stake nut loosely to retain the bearing assembly in position on the shaft.

37 LT85 LIGHTWEIGHT DIVIDED CASE GEARBOX

DEFENDER

- Fit the front bearing inner track with the shoulder towards the gear. Carefully tap the track squarely into position with a hide mallet.
- Fit the front bearing race.

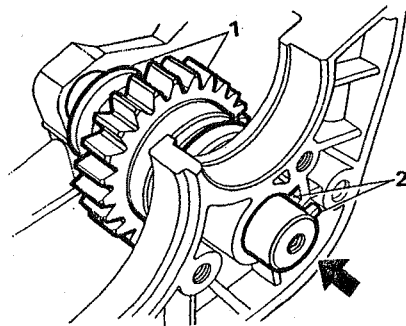


ST2047M

ASSEMBLE

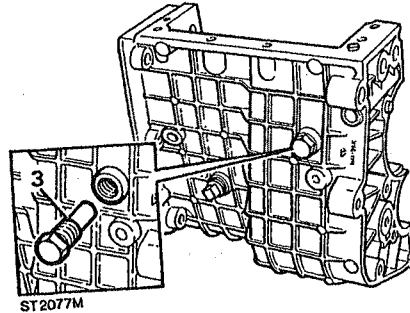
Fitting reverse idler shaft and gear

- 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.
- 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.



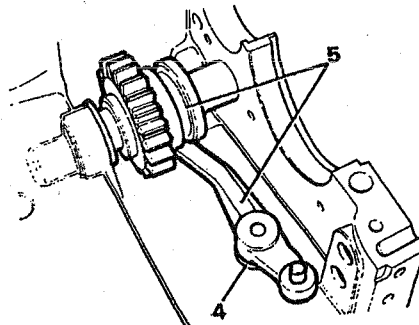
ST 2048M

- Coat the threads of the reverse lever pivot bolt with Loctite 270 and fit to the casing and tighten to the correct torque.



ST2077M

- Fit the spacer next to the casing.
- Fit the lever to the pivot whilst ensuring that the slipper locates in the reverse idler gear groove.



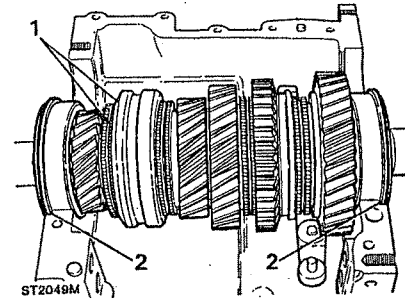
ST2078M

Fitting mainshaft and input shaft

- Fit the input shaft to the mainshaft assembly ensuring that the baulk ring engages correctly into the third/fourth synchromesh hub.
- 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.

DEFENDER

LT85 LIGHTWEIGHT DIVIDED CASE GEARBOX 37



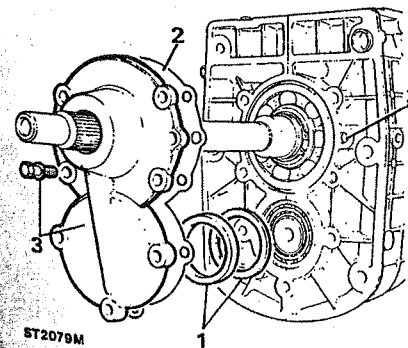
ST2049M

Fitting layshaft

- 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.
- Wipe clean the mating faces of both cases and apply Loctite Instant Gasket in accordance with the manufacturers instructions.
- Lower the empty case into position over the gears locating on the dowels.
- Loosely secure the cases with the seven bolts and tighten evenly to the correct torque 22 to 28 Nm. Clean away any surplus sealant.
- Refit the stand to the gearbox and secure in the vice.

Fitting front cover

- Fit the original shim and spacer to the layshaft front bearing.
- Fit a new joint washer to the cover and lubricate the oil seal lip.

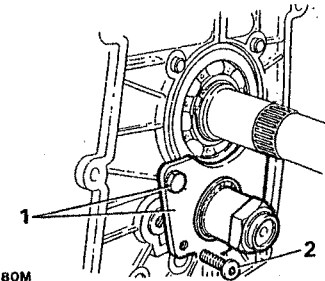


ST2079M

- 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.

Fitting rear retainer plate

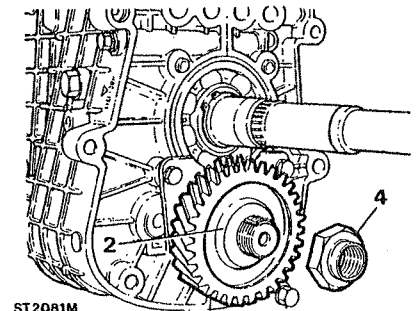
- Fit the retainer plate to the gearbox and secure the top of the plate with the two bolts and spring washers.
- Apply Loctite 270 (stud and bearing fit) to the socket headed screw threads and secure the lower end of the retaining plate.



ST2080M

Fitting layshaft fifth gear

- Remove the nut and dummy spacer from the layshaft.
- Fit the fifth gear to the layshaft with the large boss to the rear.
- To facilitate the next instruction, lock the gearbox by engaging first and fourth gears.

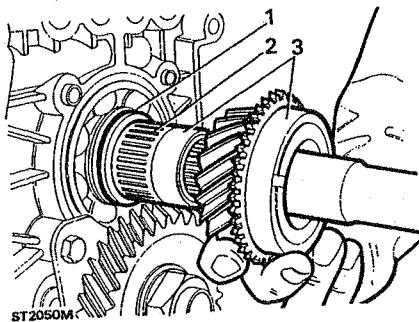


ST2081M

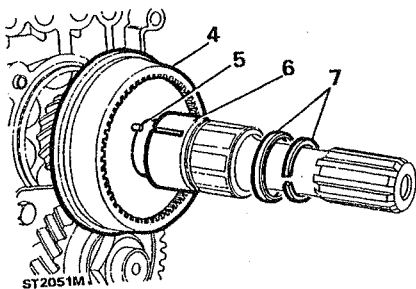
4. Fit a new fifth gear retaining nut and tighten to the correct torque. Do not stake the nut at this stage.
5. Disengage the first and fourth gears.

Fifth gear synchromesh end-float

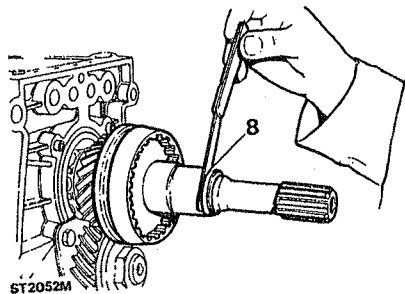
1. Fit the thrust washer, grooves outwards, towards fifth gear.
2. Lubricate and fit the needle roller bearing to the mainshaft.
3. Fit the spacer and fifth gear.



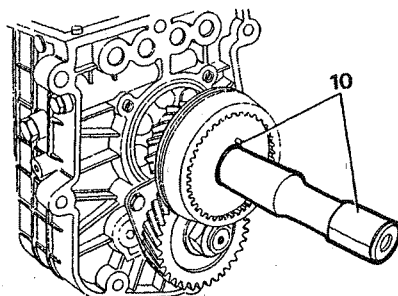
4. Fit the fifth gear synchromesh cone and hub assembly.
5. Fit the fifth gear synchromesh hub retaining plate, peg outwards.
6. Omit the 'O' ring and fit the sleeve with the slot over the peg.
7. Fit the original selective washer and retain with the snap ring.



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 0,075 mm.



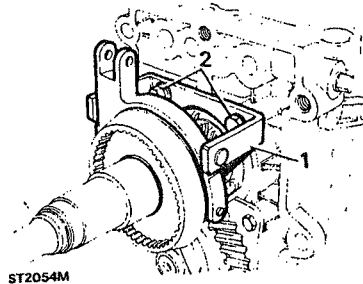
9. Remove the snap ring, selective washer and sleeve.
10. Wind protective tape round the mainshaft splines and fit the 'O' ring seal against the synchromesh hub retaining plate.



11. Refit the sleeve, selective washer and snap ring and remove the protective tape.

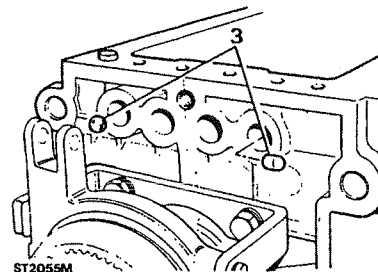
Fitting selector rails and forks

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.



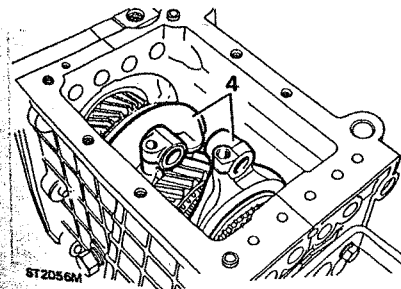
ST2054M

3. Fit the selector rail interlock plungers to the gearbox case.



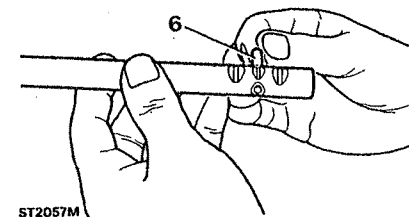
ST2055M

4. Fit the first/second and third/fourth selector forks.



ST2056M

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.



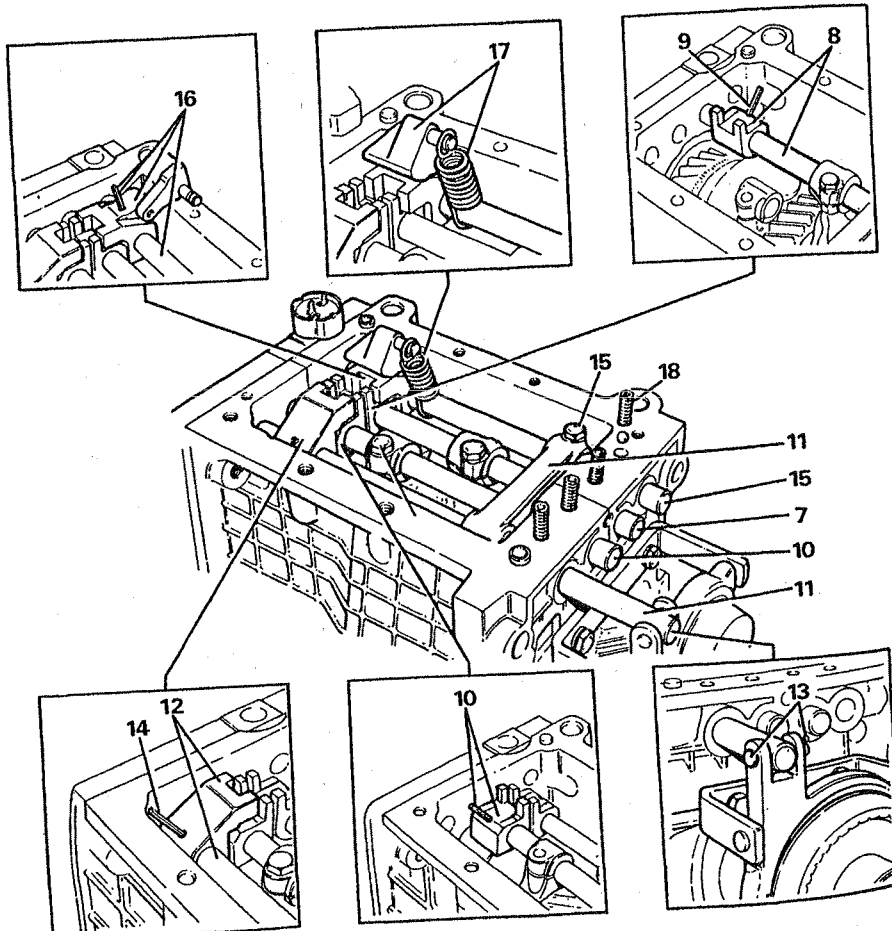
ST2057M

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.

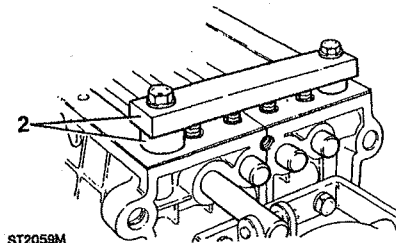


ST2058M

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.

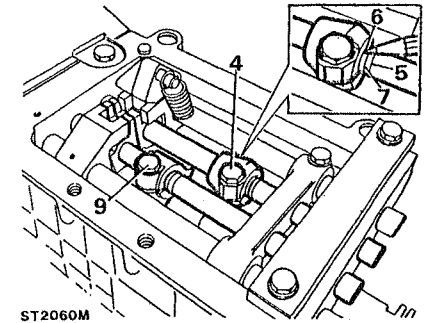
Selector fork adjustment

1. Fit the top cover gasket.
2. Secure the detent spring retaining tool and spacers (manufactured tool) to the gearbox with two 8 x 50 mm bolts and plain washers.



ST2058M

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 synchronesh 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

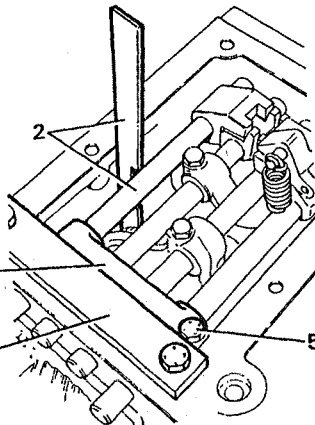
9. Repeat instructions 4 to - to adjust the third/fourth selector fork and rail.

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 synchronesh 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.

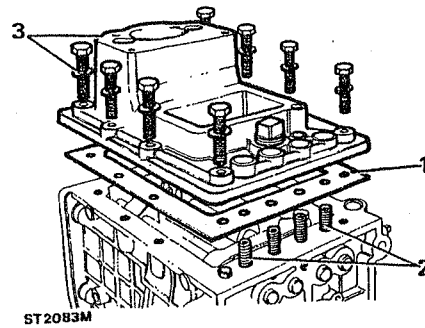
7. Check that a minimum clearance of 1,0 mm exists between the front face of the reverse idler gear and the rear face of the reverse gear on the first/second synchromesh sleeve. If the clearance is insufficient, adjust the cross-over lever again.
8. Return the first/second selector rail back to neutral.
9. Remove the detent spring retaining tool and spacers.



ST2061M

Gearbox top cover

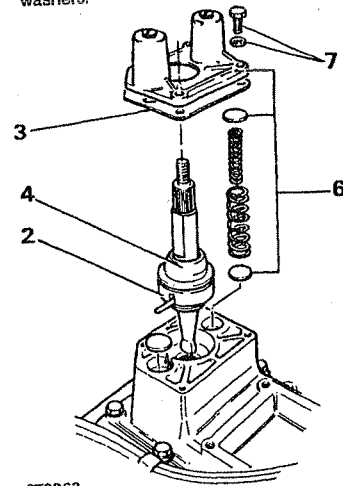
1. Fit the top cover gasket.
2. Fit the top cover locating it over the detent springs.
3. Position the breather pipe, locate retaining clips and secure the top cover with the eight bolts and spring washers.
4. Fit the breather pipe banjo union and fibre washers.
5. Fit the reverse light switch.
6. Place clean rag in top cover gear lever aperture 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

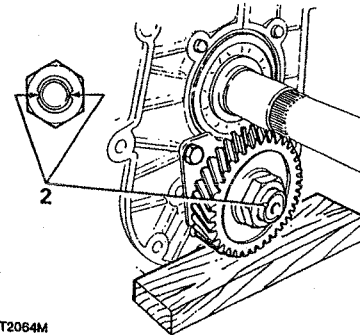
Bell housing

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.

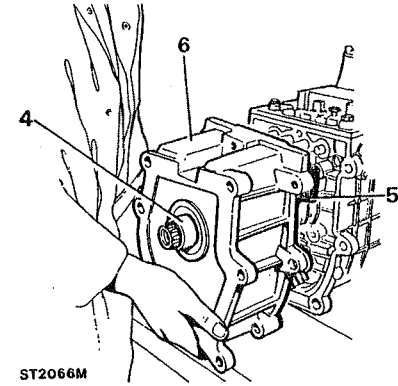
CAUTION: A round nose tool must be used for this operation to avoid splitting the collar of the nut. Also, the layshaft fifth gear should be supported by a block of timber whilst the nut is being deformed to prevent damage to the adjacent bearing.



ST2064M

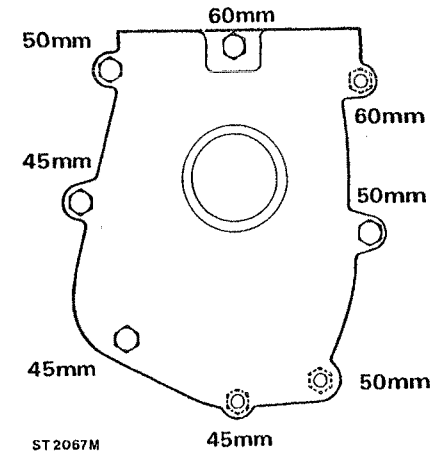
3. Support the underside of the gearbox with a block of timber.
4. Lubricate the oil seal protection sleeve LST102 and insert it into the oil seal from inside the extension housing.
5. Fit a new gasket to the extension housing.

6. Carefully slide the extension housing, with the seal protection sleeve in position, over the mainshaft and locate on the dowels.



ST2066M

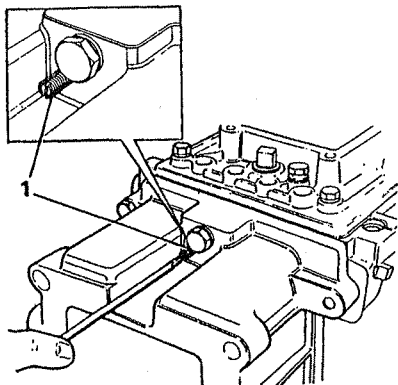
7. Withdraw the oil seal protection sleeve.
8. Secure the extension housing with the eight bolts, spring washers and single nut. The illustration below shows the correct length of bolt for each of the eight locations.



ST2067M

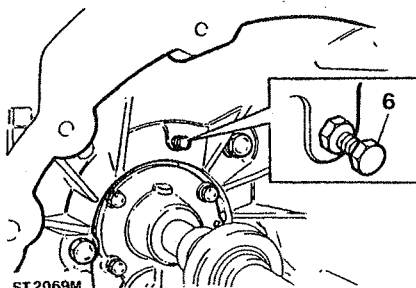
Third/fourth selector rail adjustment

- Slacken the third/fourth stop screw in the extension housing.



ST 2068M

- Select third gear.
- Tighten the stop screw until it makes contact with the third/fourth selector rail.
- Turn back the stop screw one turn.
- Return the gear lever to the neutral position.
- Slacken the locknut on the third/fourth stop bolt inside the bell housing.

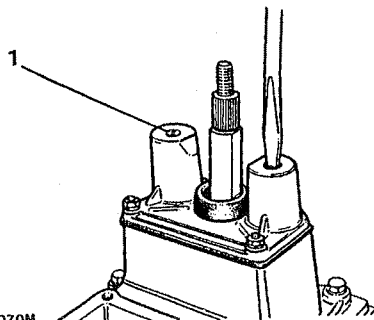


ST 2069M

- Unscrew the stop bolt.
- Select fourth gear and screw-in the stop bolt until contact is made with the third/fourth selector shaft.
- Turn back the stop bolt one turn and tighten the locknut.
- Return the gear lever to the neutral position.

Bias spring adjustment

- 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

- Fit the mounting to the extension housing and secure with the four bolts.

REPAIR OPERATIONS

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

- Raise the vehicle on a ramp.
- Remove the speedometer drive clamp and nut and withdraw the cable.
- Prise out the drive pinion assembly.
- 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

- Disconnect the battery for safety.
- Disconnect the rear propshaft from the output flange.
- Remove the brake drum retaining screws and withdraw the drum.
- 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.

- Remove the output shaft nut and washer and withdraw the flange.
- Using the slot provided, lever off the dust cover.
- Prise out the output shaft oil seal(s).
- 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.

- Fit the dust cover.
- 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.

- Secure the flange with the nut and washer and tighten to 146 to 179 Nm.
- Fit the oil catcher to the back plate using silicone rubber sealant and secure with the two back plate bolts (with plain washers).
- Fit the brake drum and retain with the two screws.
- Reconnect the propeller shaft.

Renew front output shaft oil seal

Special tool: 18G1422

- Disconnect the front propeller shaft from the flange and move to one side.
- Remove the output shaft nut and washer and withdraw the flange.
- Remove the oil seal shield.
- Prise out the oil seal(s).

NOTE: The double-lipped oil seal supersedes the two oil seals used on early production.

- 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.
- Lubricate the running surface of the flange and fit it together with the oil seal shield.
- Secure the flange with the nut and washer and tighten to 146 to 179 Nm.
- Refit the propeller shaft.

Remove intermediate shaft and gears

Special tool: RO605862

- Drain the transfer gearbox oil.
- Disconnect the rear propshaft from the output flange.
- Remove the two screws and withdraw the brake drum.
- 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.

- Remove the intermediate shaft keeper plate, retained by a single bolt.
- Remove the ten bolts and remove the bottom cover plate.
- 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.
- Remove the two 'O' rings, one from the shaft, the other from the casing.

Fit intermediate shaft gears

- Fit the 'O' ring to the intermediate shaft.
- Fit the 'O' ring into the front of the transfer case.
- Lubricate thrust washers, bearings, shaft and spacer.
- Fit needle bearings with spacer interposed.
- 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.
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.
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:
 RO605862/LRT-41-501-Intermediate shaft removal
 18G1271-Seal remover
 18G1205/LRT-51-003-Flange wrench
 18G257-Circlip pliers
 18G1422/LRT-37-014-Oil seal replacer
 18G1423/LRT-41-007-Stake nut remover
 MS47/LRT-99-002-Hand press
 18G47BB/1/LRT-41-001-Collars
 18G47BB/3/LRT-41-001-Button
 18G47BB/2/LRT-41-001-Collars
 18G1424/LRT-41-008-Differential centre bearing drift
 18G47-7/LRT-41-003-Collars and buttons
 LST47-1/LRT-41-002-Collars

REMOVE ASSEMBLIES FOR OVERHAUL

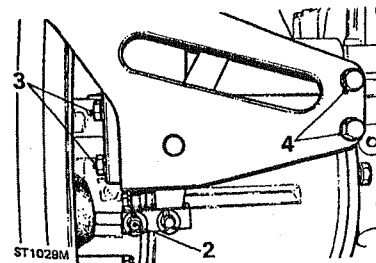
(Instructions 1 to 33)

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 dismantled in a safe and efficient manner.

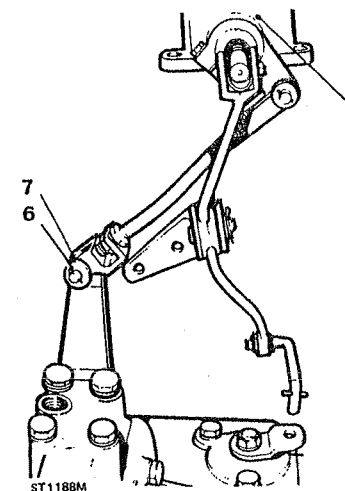
Hand brake linkage removal

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.



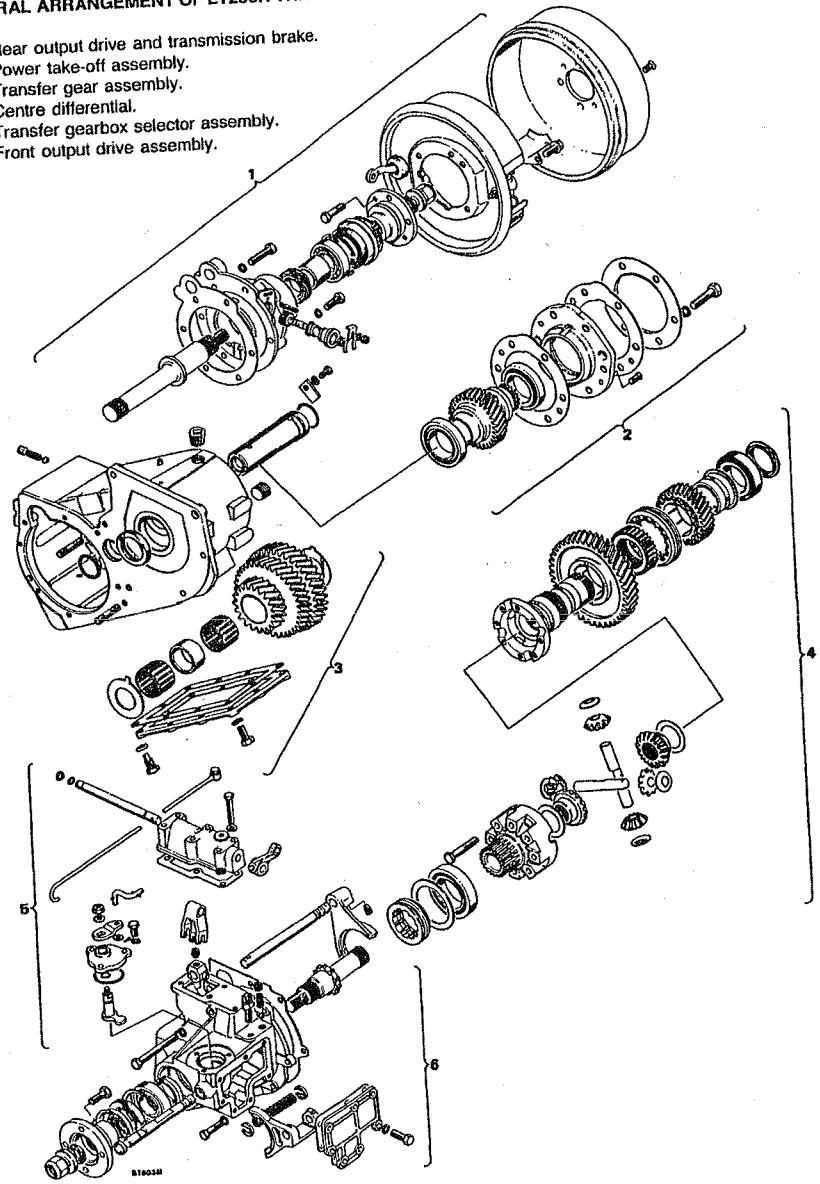
Transfer box mounting removal

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.



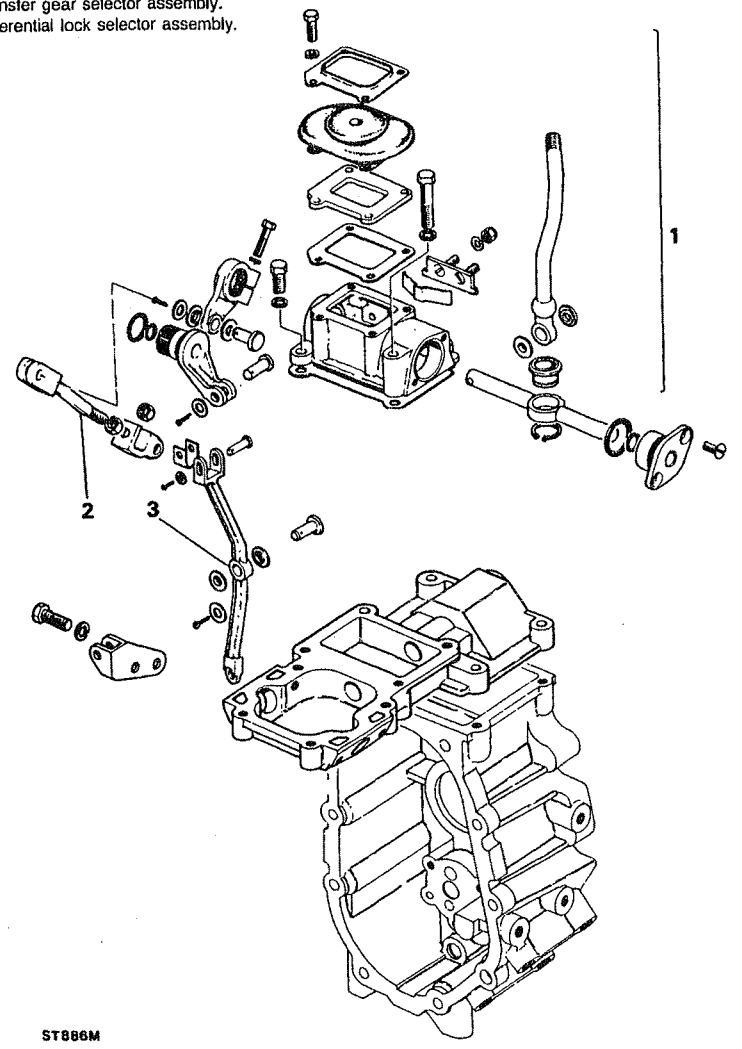
GENERAL ARRANGEMENT OF LT230R TRANSFER GEARBOX

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.



ST886M

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.

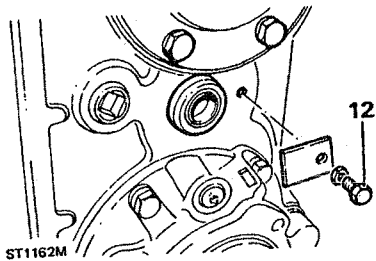
NOTE: An hexagonal type socket should be used for these bolts.

Bottom cover removal

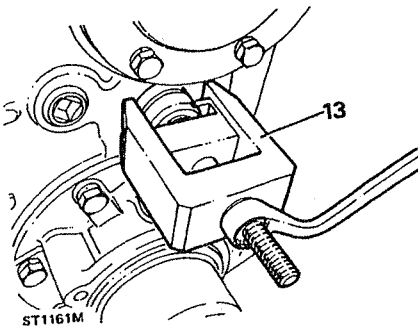
11. Remove the ten bolts retaining the bottom cover.

Intermediate shaft removal

12. Remove the shaft lock plate retained by a single bolt at the rear face of the transfer box.

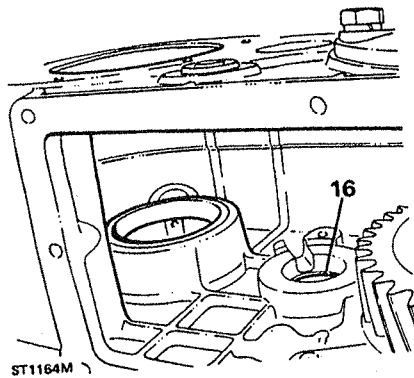


13. Withdraw the intermediate shaft, using a screw driver in the slotted end. Where the shaft cannot be easily withdrawn use extractor RO605862.



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.

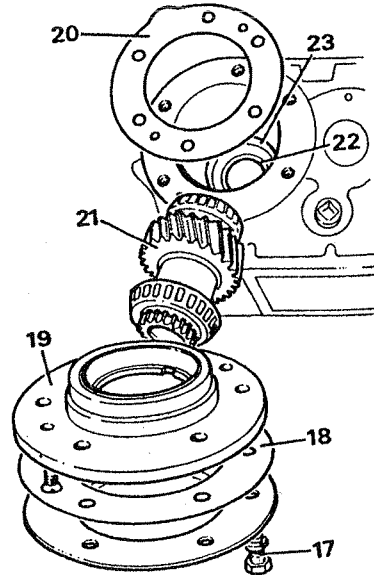
6



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.



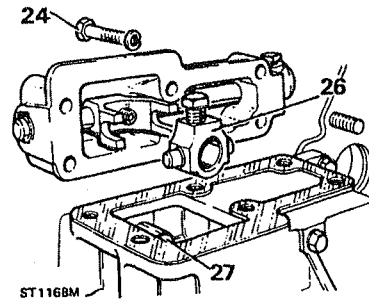
ST1163M

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.



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.

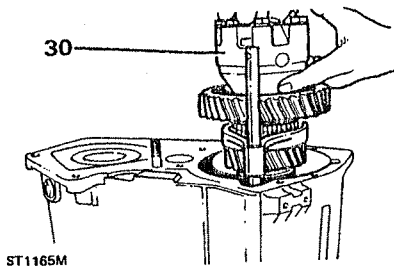
NOTE: The 'radial' dowel in the transfer box face should not be disturbed.

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, filter 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.

7

Reassembling

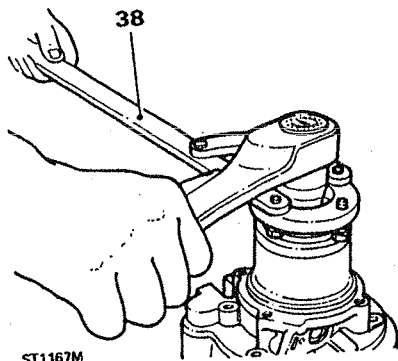
34. Ensure that all faces of the transfer box are clean.
35. Check that level/filler and drain plugs are in position.
36. Fit the two studs which are used for part retention of the extension housing.
37. Screw in the 'radial' dowel. It is important that its projecting blade is set radially in line with the tapped fixing hole centres in the transfer box casing.

Rear output shaft housing - Overhaul

Dismantling

38. Using flange wrench 18G1205 remove the flange nut, steel and felt washers.

NOTE: Ensure flange bolts are fully engaged in the wrench.



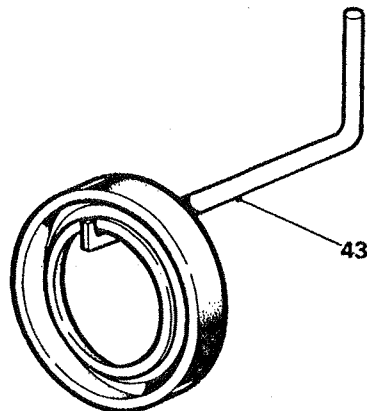
ST1167M

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.



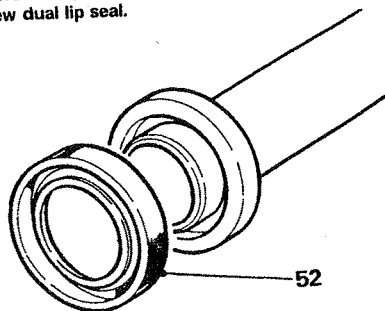
ST1174M

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 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.

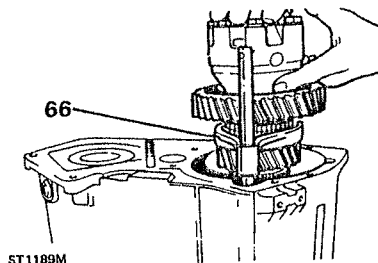
NOTE: If the differential rear main bearing track has been correctly fitted there will be a gap between the housing face and the gasket at this stage.

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

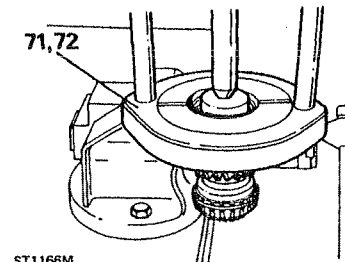
Dismantling

66. Detach the high/low selector shaft and fork.



ST1189M

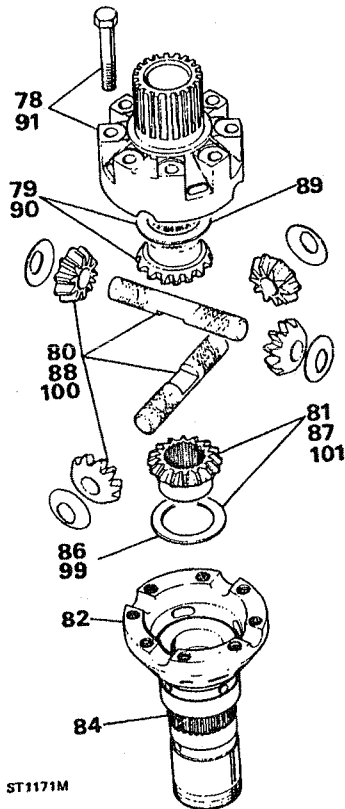
67. Using soft jaws secure the differential unit in a vice with the 'stake' nut uppermost.
68. Remove the peened-over metal to facilitate removal of the nut.
69. Remove the 'stake' nut using tool 18G1423.
70. Remove the differential unit from the vice.
71. Secure hand press MS47 in vice with collars 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.

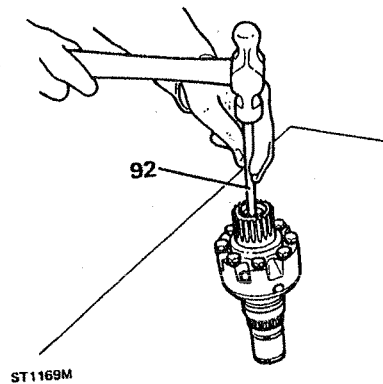
77. Using soft jaws secure the differential unit in the vice by gripping the inner hub splines.
78. Remove the eight retaining bolts and lift off the front differential case.
79. Lift off the front (upper) bevel gear and thrust washer.
80. Remove both pairs of side gears with their respective shafts 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.



Obtaining differential backlash by checking bevel gear end-float

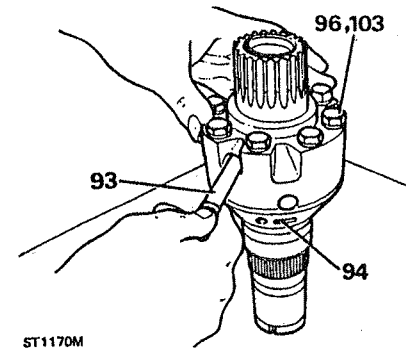
84. Using soft jaws secure the rear differential case in the vice by gripping the inner hub splines.

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.



ST1169M

92. Ensure that the front bevel gear is fully in mesh by tapping it down, using a punch through the front differential case.
93. Measure the front bevel gear end-float with feeler gauges through the slots provided in the front differential case. This must be between 0,025 to 0,075 mm 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.
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.



ST1170M

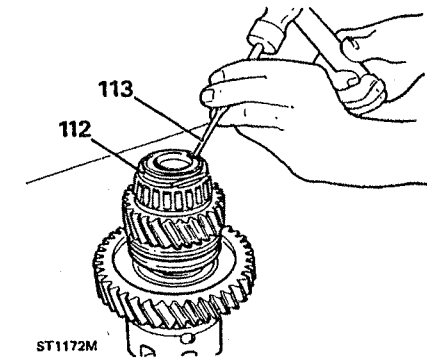
Reassembling

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.

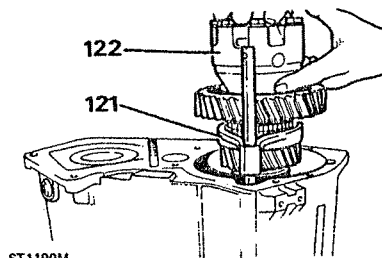
111. Place the rear differential bearing on the rear differential case and press into position using the smaller end of tool 18G1424.

112. Fit the 'stake' nut using tool 18G1423 and tighten to the specified torque.
113. Peen the nut flange into the slot provided.



ST1172M

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.



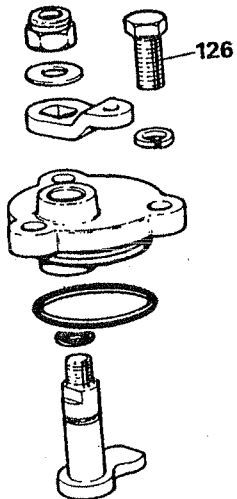
ST1190M

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.

Front output shaft housing

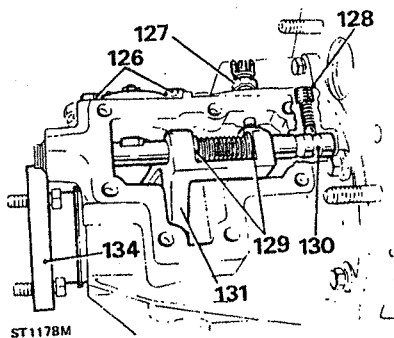
Dismantling

- 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.
- 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.

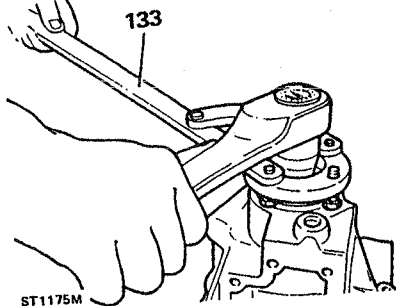


ST1178M

NOTE: Ensure that flange bolts are fully engaged in the wrench.

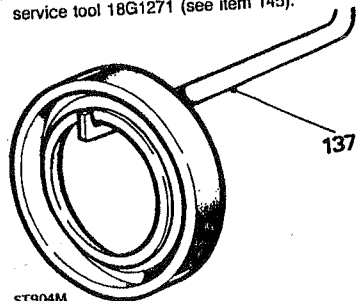
- 134. Remove the output shaft flange with oil seal shield.

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).



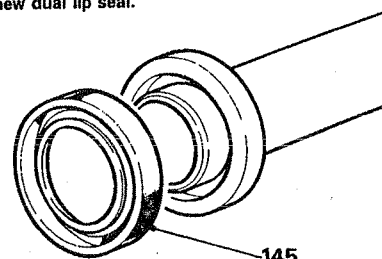
ST904M

- 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

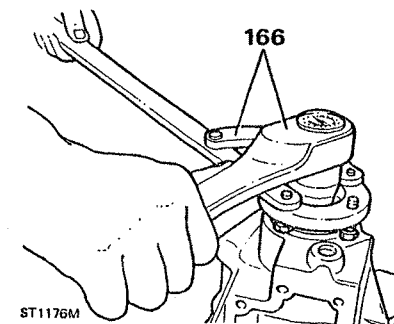
- 146. Carefully charge the lips of the seal with grease.
- 147. Slide the collar onto the front of the output shaft with its chamfered edge to the front.
- 148. Fit the output shaft through the back of the housing.
- 149. Examine the flange seal track to check for any damage that may harm the seal.

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.

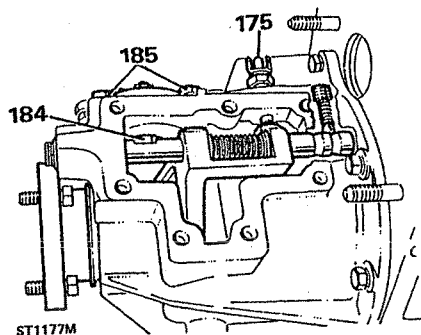
- 155. Engage high or low gear.
- 156. Check the rolling resistance of the differential, using a spring balance and a piece of string wound around the exposed splines on the high/low hub. Little or no resistance will register.
- 157. Tighten the bolts a little at a time, occasionally checking the rolling resistance. With the correct shim selected and the bolts tightened to the specified torque a pull of 1,8 to 4,5 Kg 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.



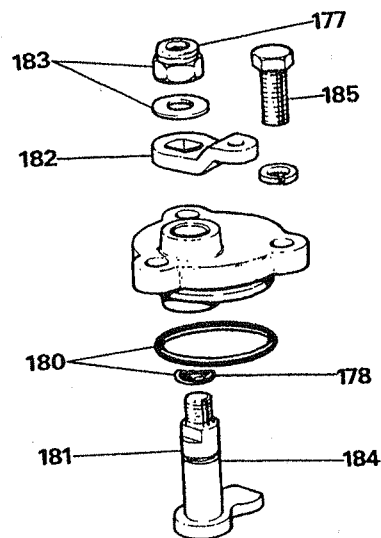
ST1177M

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

Dismantling

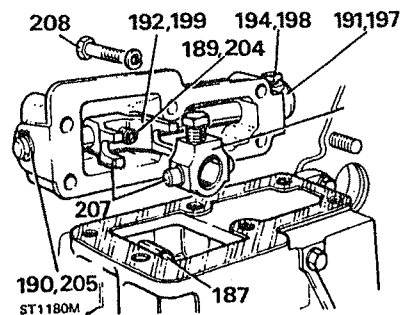
177. Remove and discard the Nyloc nut and release the lock lever and selector 'finger' from the 'finger' housing.
178. Remove and discard the 'O' rings from the selector finger and the selector finger housing.
179. Clean remaining parts, examine for wear or damage, renew as necessary.



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.



190,205
ST1180M

High/low selector housing

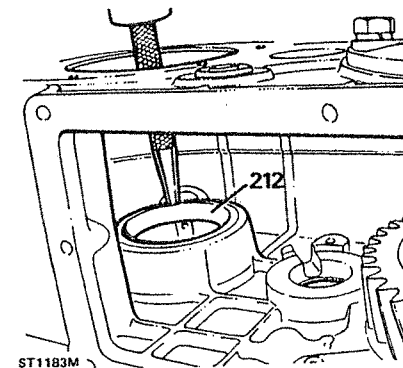
Dismantling

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.

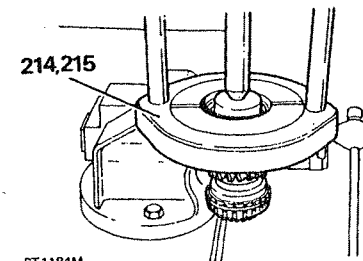


ST1183M

Input gear

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.



ST1184M

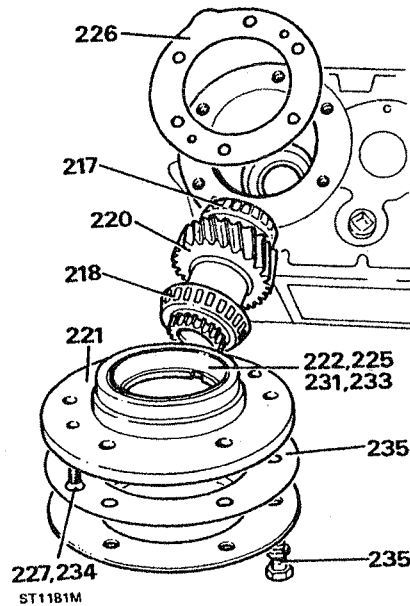
Reassembly

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.



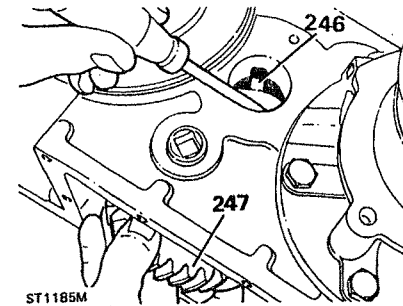
228. Wind sufficient string around the gear teeth to rotate the input gear. A pull of 1,4 to 3,6 Kg is required on the spring balance. This applies to new or used bearings.

NOTE: The pre-load can only be measured while the Transfer gearbox is separated from the main gearbox.

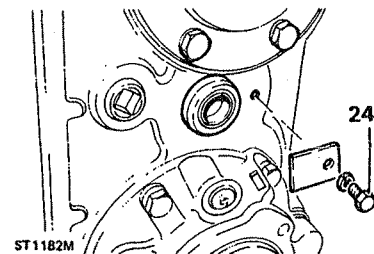
229. If the reading obtained is outside the above limits the original shim must be changed accordingly.
230. Remove the two screws retaining the mainshaft bearing housing.
231. Press out the rear bearing cup from the bearing housing and remove and discard the original shim.
232. Select a shim to the required thickness to obtain the correct pre-load of 0,02 to 0,07 mm 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

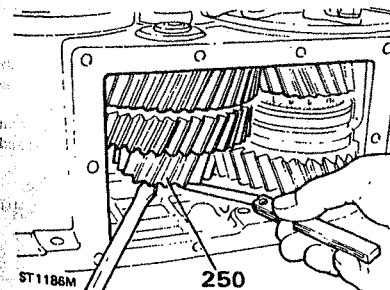
236. First remove the needle roller bearings and spacer from the gear assembly.
237. Clean the parts, including the thrust washers and lock plate and examine for wear or damage, renew as necessary. Refer to DATA at end of section for thrust washer thickness.
238. Fit the 'O' ring to the intermediate 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.
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.



251. Grease and fit the bottom cover gasket.

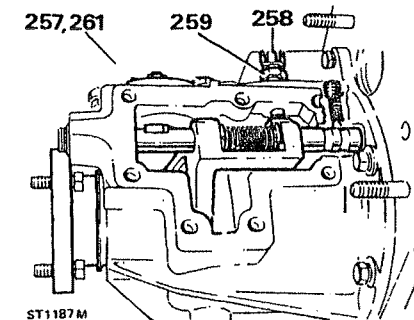
252. Apply Loctite 290 to the ten bottom cover fixing bolts only.
253. Clean and fit the bottom cover, using the ten bolts (with spring washers).

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 Durluk 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.

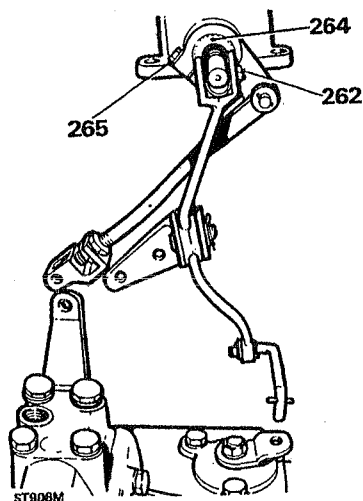


High/low selector housing

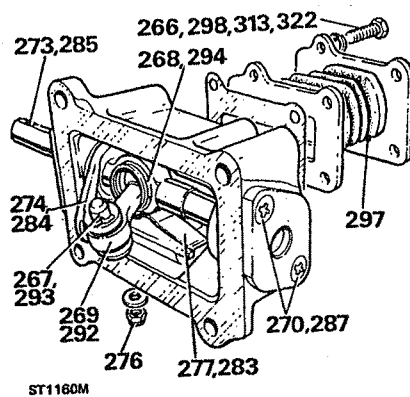
Dismantling

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, 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.



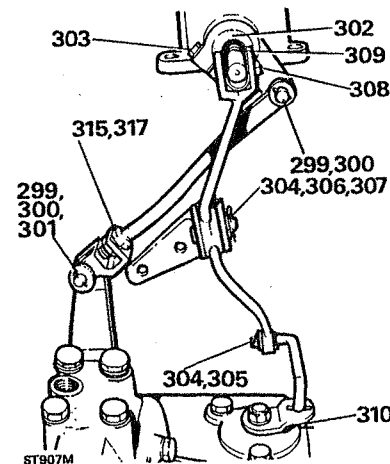
270. Remove the two countersunk screws from the housing end cover.
271. Remove the housing end cover.
272. Remove the two 'O' rings from the end cover.
273. Remove the cross shaft from the housing.
274. Compress the detent spring and remove the gear change arm from inside the housing.
275. Remove the two 'O' rings from the crank arm.
276. Remove and discard the two Nyloc nuts retaining the detent plate.
277. Remove the detent spring 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

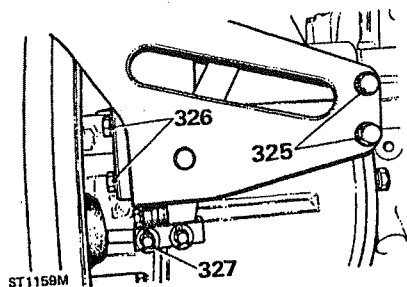
323. Fit the rubber mounting plate to the right side of the front output housing by fitting the four securing bolts (with new lock tabs).

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
Intermediate gear end-float	0,08 to 0,35 mm
Intermediate gear thrust washer thickness	2,70 to 2,75 mm
Centre differential rolling resistance - minus intermediate gear cluster and output shaft flange	1,8 to 4,5 Kg
Input gear rolling resistance - minus intermediate gear cluster	1,4 to 3,6 Kg
Differential pinions backlash	0,02 to 0,07 mm
Output shaft bearing pre-load	0,02 to 0,07 mm
Low range gear end-float	0,05 to 0,15 mm
High range gear/bush running clearance diameter	0,03 to 0,09 mm

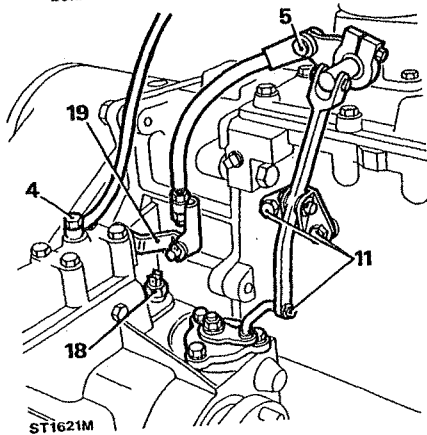
TORQUE VALUES Nm

Pinch bolt operating arm	9
Gate plate to grommet plate	9
End cover	45
Speedometer cable retainer	9
Speedometer housing/rear output	See note
Locating plate to gear change housing	6
Bottom cover to transfer case	25
Front output housing to transfer case	25
Cross shaft housing to front output housing	25
Gear change housing	25
Pivot shaft	25
Connecting rod	25
Retaining plate intermediate shaft	25
Front output housing cover	25
Gear change housing	25
Bracket to extension housing	25
Finger housing to front output housing	25
Mainshaft bearing housing	25
Brake drum	25
Gearbox to transfer box	45
Bearing housing to transfer gearbox	9
Speedometer housing to transfer gearbox	45
Selector fork to cross shaft	25
Yoke to selector shaft high/low	25
Selector fork high/low to shaft	25
Operating arm high/low	25
Transmission brake	72
Gearbox to transfer case	45
Gearbox to transfer case	See note
Oil drain plug	30
Differential case	60
Output flange	162
Differential case rear and shaft main drive	72
2/4-wheel drive	10
Link arm and cross shaft lever to ball joint	10
Oil filler/level plug	30
Transfer breather	9

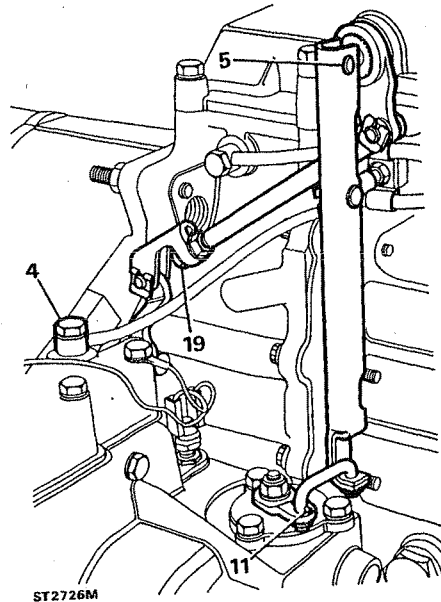
NOTE: Studs to be assembled into casings with sufficient torque to wind them fully home, but this torque must not exceed the maximum figure quoted for the associated nut on final assembly.

Removing

1. Install the vehicle on a ramp.
2. Disconnect the battery.
3. Remove the cover panel from the right-hand seat base.
4. Remove the breather pipe union from the transfer gearbox high/low cross-shaft housing.
5. Disconnect the high/low lever.
6. Disconnect the transmission brake cable at the clevis joint.
7. Raise the vehicle on the ramp and drain the oil from the transfer box.
8. Remove the centre section of the exhaust system.
9. Disconnect the front and rear propeller shafts from the gearbox and move them aside.
10. Disconnect the speedometer cable from the transfer gearbox.
11. Remove the split pin at the lower end of the pivot arm for the differential lock control. Then, remove the two bolts securing the pivot arm to allow the link to be disconnected. Later models disconnect the connecting link from the differential lock lever.
12. Manufacture an adaptor plate in accordance with the drawing, to attach to the gearbox hoist and transfer box to facilitate removal (RR244M).
13. Place four, 30 mm (1.250 in) long spacers between the top of the hoist and the adaptor plate at the securing points and secure the adaptor plate to the hoist.
14. Remove the four central bolts from the transfer box bottom cover, move the hoist into position and secure the adaptor plate to the transfer box.
15. Adjust the hoist to take the weight of the transfer box.
16. Remove three nuts and bolts securing the right-hand gearbox mounting bracket to the chassis, then remove the nut from the rubber mounting and withdraw the bracket.
17. Place a suitable wooden block between the main gearbox and chassis cross-member, then lower the hoist until the gearbox contacts the wooden block.
18. Disconnect the electrical lead from the differential lock switch.
19. Move the small crank lever, for the high/low selector; upward to allow access to the adjacent nut securing the transfer box to the main gearbox extension case. Later models remove the lower lock nut from the high-low operating rod.



ST1621M

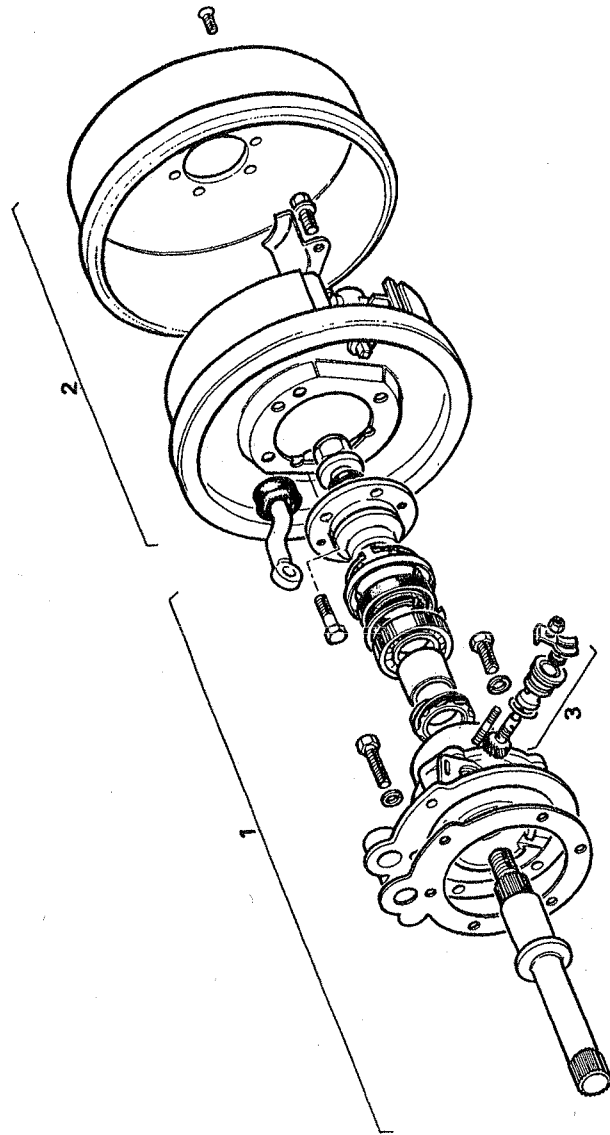


ST2726M

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.

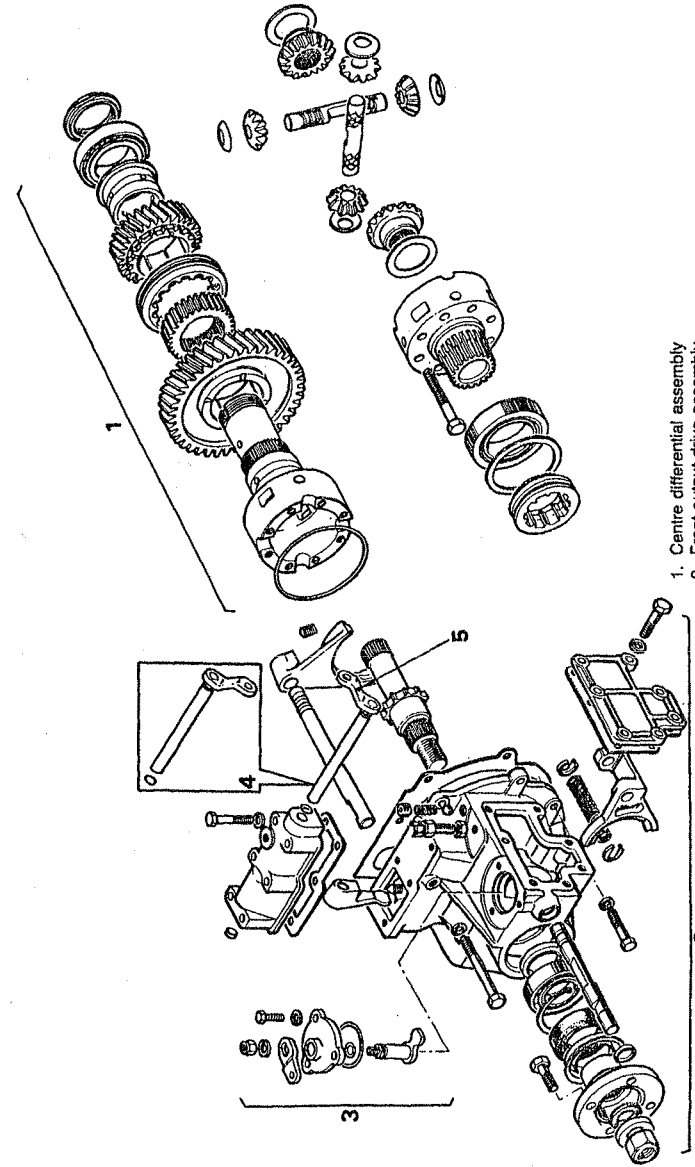
Refitting

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.



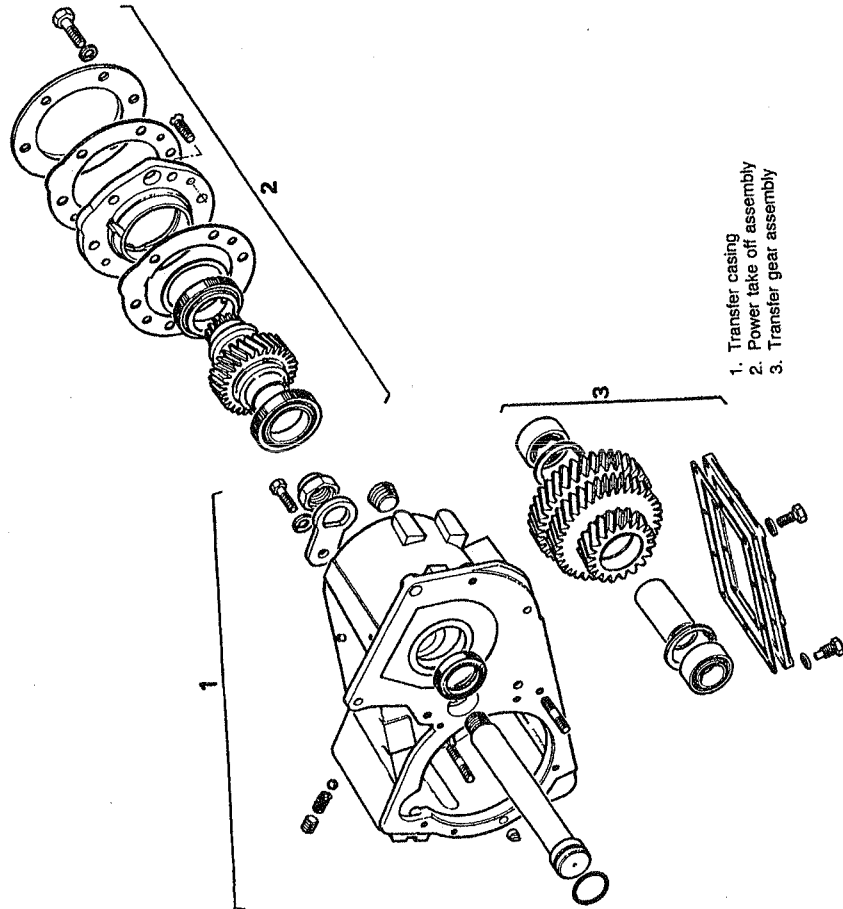
1. Rear output drive
2. Transmission brake
3. Speedometer drive assembly

ST1650M



1. Centre differential assembly
2. Front output drive assembly
3. Selector and differential lock assembly
4. Selector cross shaft (LT 65)
5. Selector cross shaft (LT 77)

ST1651M



1. Transfer casing
2. Power take off assembly
3. Transfer gear assembly

ST1562M

OVERHAUL

Service Tools:

- 18G47-7/LRT-41-003 - Input gear cluster bearing cones remover/ replacer
- 18G47BB/LRT-41-001 - Adaptor centre differential bearing remover
- 18G257 - Circlip pliers
- 18G1205/LRT-51-003 - Prop flange wrench
- 18G1271 - Oil seal remover
- 18G1422/LRT-37-014 - Mainshaft rear oil seal replacer

- 18G1423/LRT-41-007 - Adaptor/socket centre differential stake nut remover/replacer
- 18G1424/LRT-41-008 - Centre differential bearing replacer
- MS47/LRT-89-002 - Hand press
- MS550 - Bearing and oil seal replacer handle
- LST47-1/LRT-41-002 - Adaptor centre differential bearing remover
- LST104/LRT-41-004 - Intermediate gear dummy shaft
- LST105/LRT-41-005 - Input gear mandrel
- LST550-4/LRT-41-006 - Intermediate gear bearing replacer

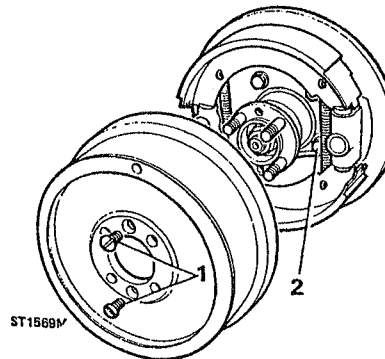
DATA

Front bevel gear end-float	0,025 to 0,075 mm
Rear bevel gear end-float	0,025 to 0,075 mm
Rear output housing clearance	1,00 mm
High range gear end-float	0,05 to 0,15 mm
Front differential bearing pre-load	1,36 to 4,53 kg
Input gear bearing pre-load	2,26 to 6,80 kg
Intermediate shaft bearing pre-load	1,81 to 4,53 kg

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.

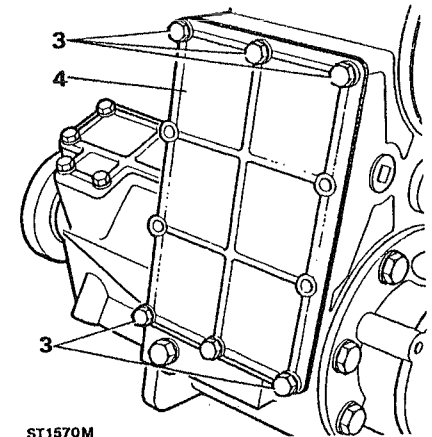
NOTE: An hexagonal type socket should be used for these bolts.



ST1568M

Bottom cover removal

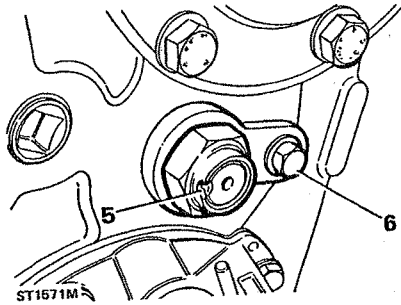
3. Remove the six bolts and washers retaining the bottom cover.
4. Remove the gasket and bottom cover.



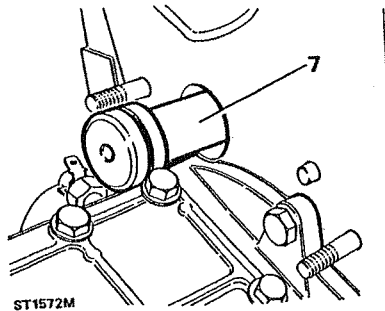
ST1570M

Intermediate shaft and gear cluster removal

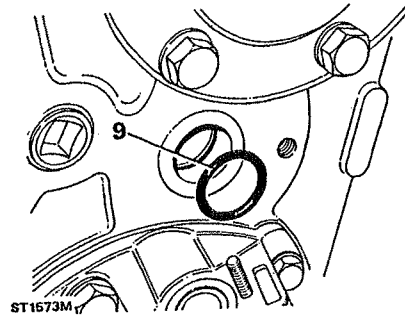
5. Release stake nut from recess in intermediate shaft and remove stake nut and discard.
6. Unscrew the single bolt and remove anti-rotation plate at the rear face of the transfer box.



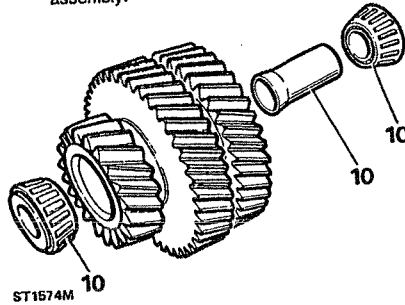
7. Tap the intermediate gear shaft from the transfer box.



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.

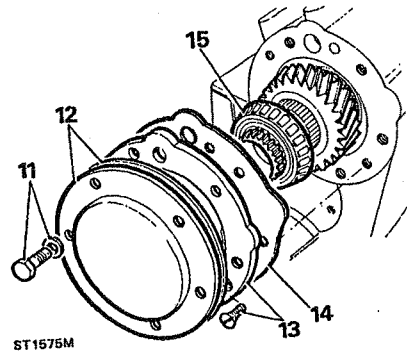


10. Remove taper roller bearings and bearing spacer from the intermediate gear cluster assembly.



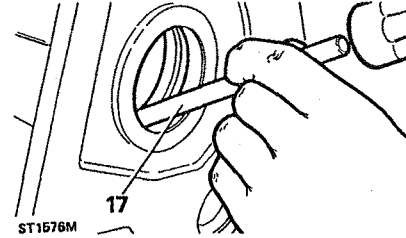
Power take-off cover removal

11. Remove six bolts and washers retaining the take-off cover and speedo cable clips.
12. Remove the gasket and cover.



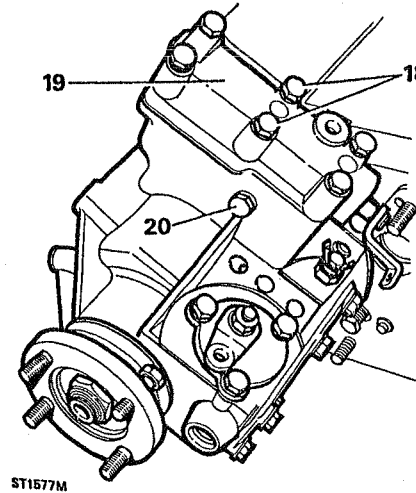
Input gear removal

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.

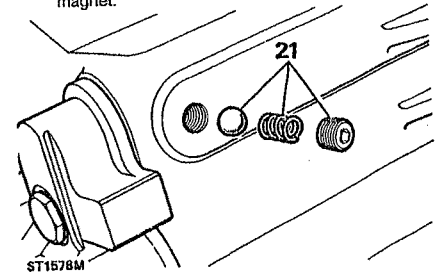


Front output housing removal

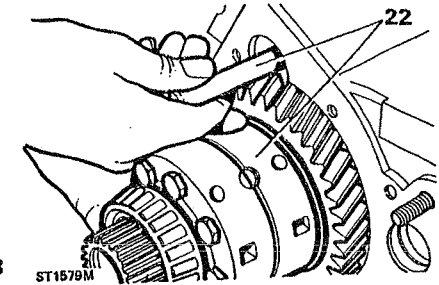
20. Remove the eight bolts and washers and detach the output housing from the transfer box casing, taking care not to mislay the dowel.

Centre differential removal

21. Remove high/low selector shaft detent plug, spring and retrieve the ball with a suitable magnet.

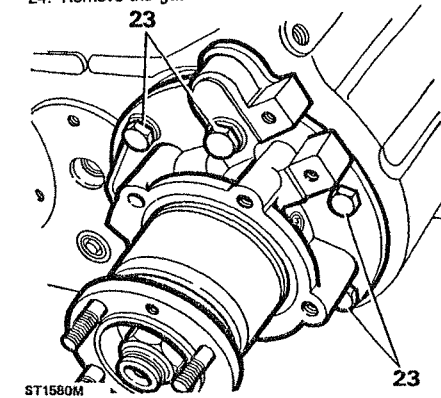


22. Withdraw the centre differential and selector shaft/fork assembly.



Rear output housing removal

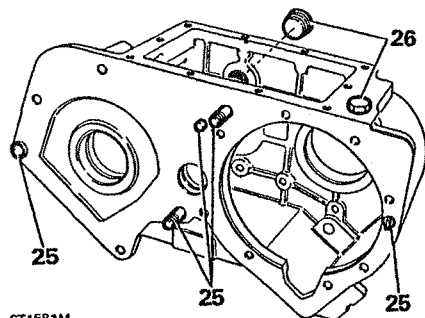
23. Remove six bolts and washers and detach the rear output housing and shaft assembly from the transfer casing.
24. Remove the gasket.



Transfer case

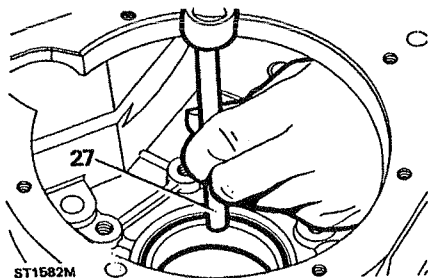
Dismantling

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.



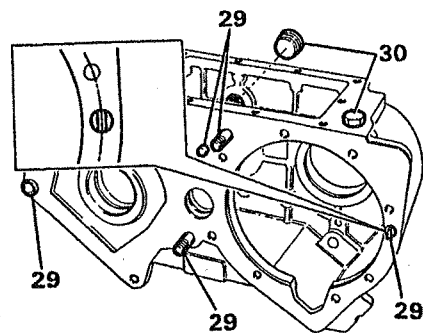
ST1582M

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.



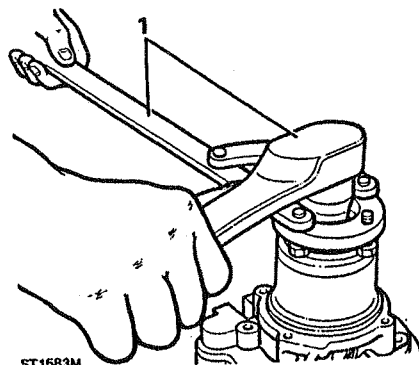
ST1639M

Rear output housing

Dismantling

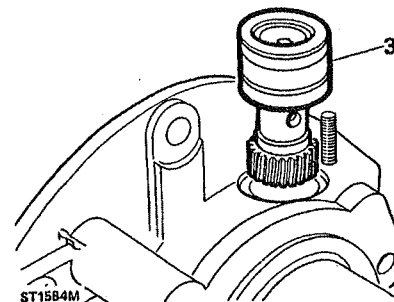
1. Using flange wrench 18G1205 and socket spanner, remove the flange nut, steel and felt washers. Ensure flange bolts are fully engaged in the wrench.
2. Remove output flange with circlips attached. If necessary, use a two-legged puller.

NOTE: The circlip need only be released if the flange bolts are to be renewed.



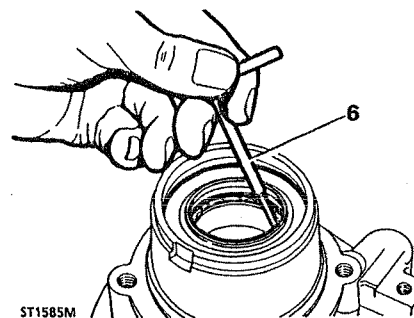
ST1583M

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.



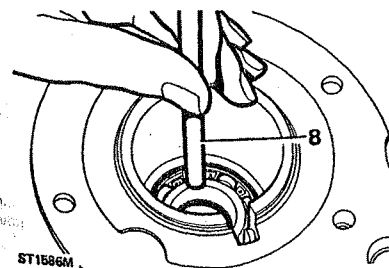
ST1584M

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.



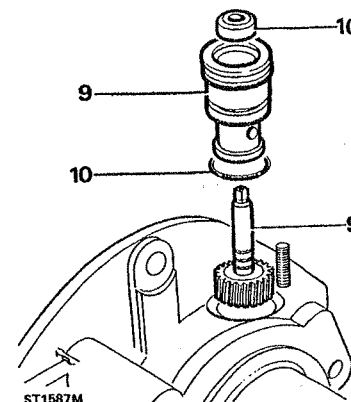
ST1585M

8. Drift out the bearing from the rear of the housing.



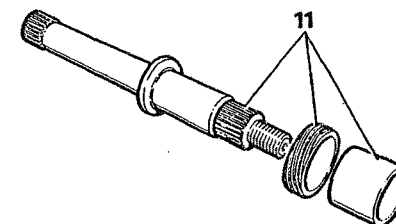
ST1586M

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

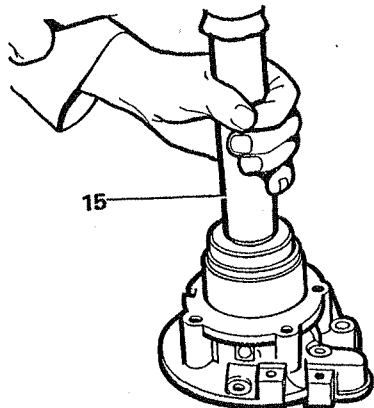
Reassembling

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.

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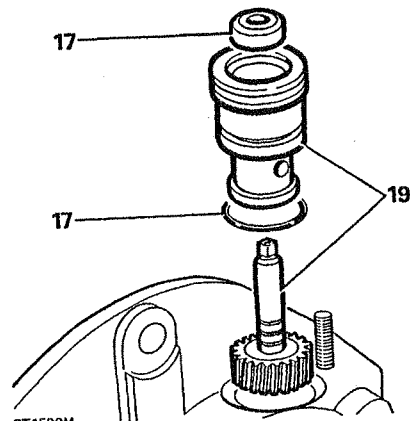
DEFENDER

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.



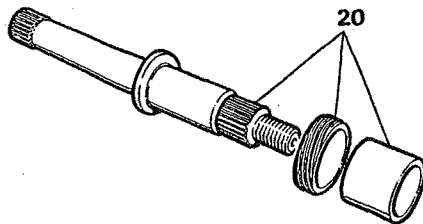
ST1589M

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.

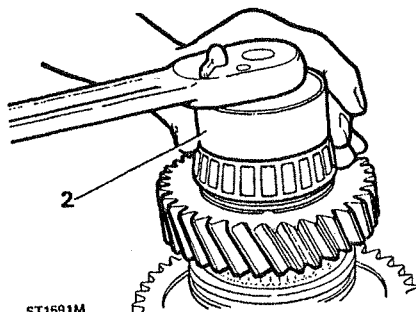


ST1640M

Centre differential unit

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.

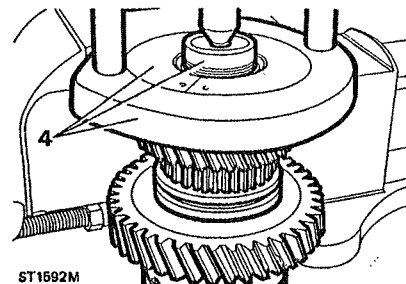


ST1591M

4. Secure hand press MS47 in vice with collars 18G47BB and using button 1847BB/3 remove the rear taper bearing and collars.

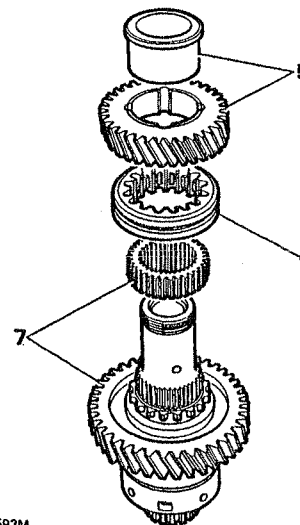
DEFENDER

LT230T TRANSFER GEARBOX 41



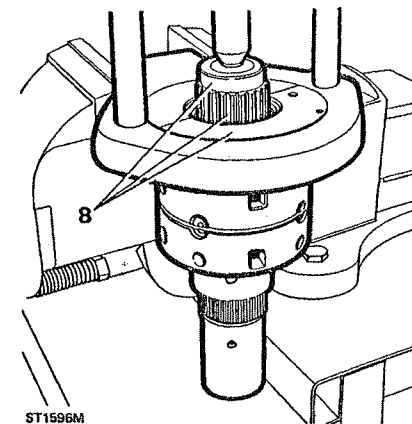
ST1592M

5. Remove the high range gear and bush, taking care not to disturb the high/low sleeve.



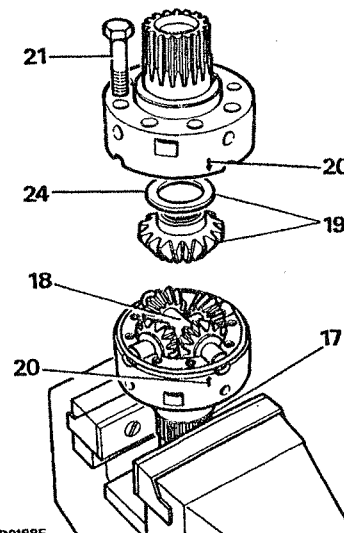
ST1593M

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.
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.
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.



ST1596M

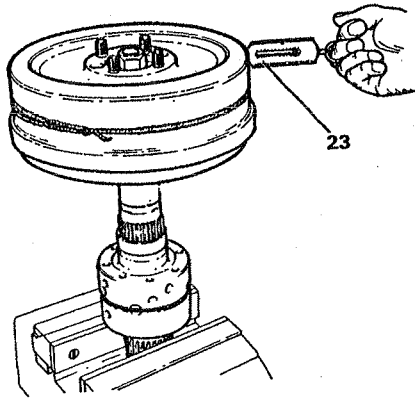
13. Remove the pinion gears and dished washers along with the cross shafts.
14. Remove the rear lower bevel gear and thrust washer from the rear part of the differential unit.



RR218BE

15. Remove the rear differential unit from the vice and clean all components.
16. Inspect all components for damage or wear, fit new components if necessary.
17. Using soft jaws secure the rear (longest half) of the differential unit in the vice by gripping the hub splines.

18. Lubricate and install the cross splines and pinion gears with new thrust washers. Do not fit the rear bevel gear at this stage.
19. Lubricate and fit the front bevel gear and thinnest thrust washer (FRC6956 1.05 mm).
20. Fit front half of the differential casing ensuring that the two engraved arrows are aligned.
21. Fit securing bolts and tighten to the correct torque (see Section 06 Torque Figures).
22. Lubricate and insert the rear output shaft into the bevel gear and check that the gears are free to rotate.
23. Fit the handbrake drum to the output drive flange and check the torque required to rotate the gears. Tie a length of string around the brake drum, attach a spring balance to the string and carefully tension the string until a load to turn is obtained. Alternatively use a torque wrench applied to the brake drum flange nut. Rotate the drum slowly by hand to overcome initial load when using either method. Note that illustration RR2332E shows checking torque at rear bevel gear.



RR2332E

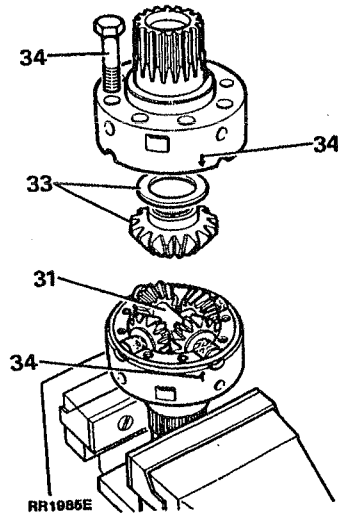
NOTE: Gears that have been run will rotate smoothly and will require a torque of 0.56 Nm. Equivalent force using spring balance: 0.45 kg. New gears will rotate with a notchy feel and will require a torque of not more than 2.26 Nm. Equivalent force using spring balance: 1.72 Nm. Keep all components well lubricated when carrying out these adjustments.

24. Change the thrust washer for a thicker one if the torque reading is too low. Five thrust washers are available in 0.10 mm steps ranging from 1.05 mm to 1.45 mm.

25. Dismantle the unit when the front bevel gear thrust washer is selected.
26. Remove and retain the front bevel and thrust washer combination.
27. Reassemble the unit with the rear bevel gear and thinnest thrust washer in position.
28. Using soft jaws secure the front (shortest half) of the differential unit in the vice by gripping the hub splines.
29. Repeat the above procedure to obtain the correct thrust washer for the rear bevel gear.

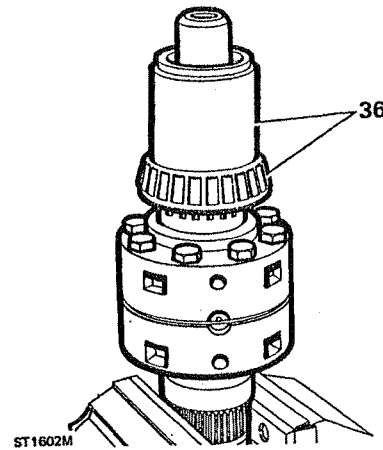
Re-assembling

30. Fit the selected thrust washer and bevel gear into the rear differential unit.
31. 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.
32. Lubricate all the components.
33. Fit the selected thrust washer and bevel gear into the front upper differential unit.



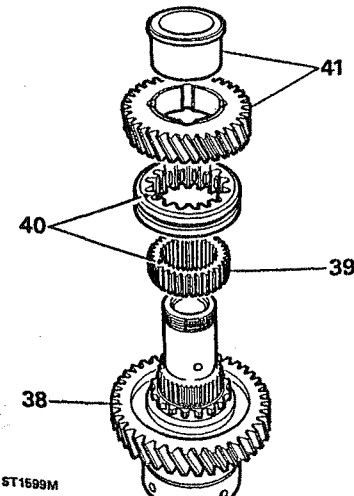
RR1985E

34. Align both units as previously described and secure with the eight bolts to the specified torque (SECTION 6).
35. Check the overall torque required to turn the differential. This should be approximately equal to the resistance of both bevel gears added together.



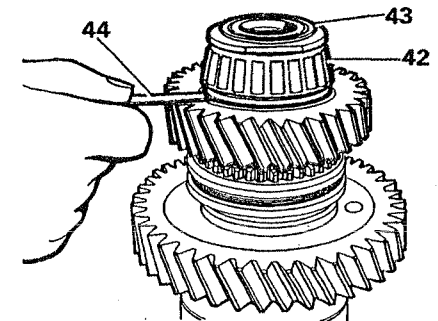
36. Locate the front differential bearing onto the front, upper differential shaft and press into position using larger end of tool 18G1424 as shown.
37. Invert the differential unit and secure in the vice.

NOTE: During the following sequences all parts should be lubricated as they are fitted.



ST1599M

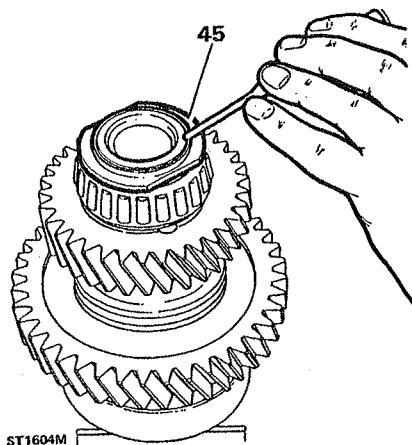
38. Fit the low range gear, with its dog teeth uppermost to the differential assembly.
39. Press the high/low hub on to the differential splines.
40. Slide the high/low selector sleeve on to the high/ low hub ensuring that the alignment marks are opposite each other.
41. Fit the bush into the high range gear so that the flange is fitted on the opposite side of the gear to the dog teeth. Slide the bushed gear on to the differential assembly with the dog teeth down.
42. Locate the rear differential bearing on to the hub and press it into position using the smaller end of tool 18G1424.
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.



ST1603M

NOTE: If the clearances vary from those specified in the data, the assembly must be rebuilt using the relevant new parts.

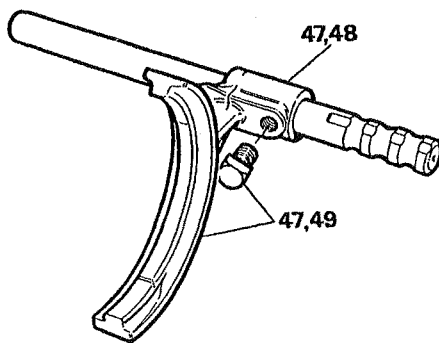
45. Peen the stake nut collar by carefully forming the collar of the nut into the slot as illustrated.



ST1604M

CAUTION: A round nose tool must be used for this operation to avoid splitting the collar of the nut.

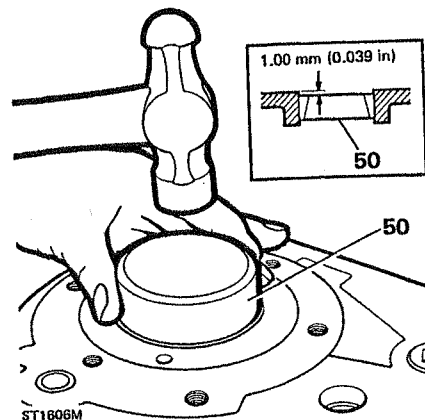
46. Clean and check high/low selector fork assembly for wear and renew if necessary.
47. To renew the selector fork remove the square set screw and slide the fork from the shaft.
48. Fit the new selector fork with its boss towards the three detent grooves. Align the tapped hole in the fork boss with 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

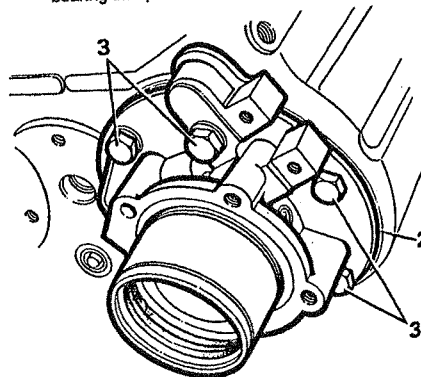
50. Fit the differential rear bearing track 1,00 mm below the outer face of casing using a suitable tool as shown.



ST1606M

Rear output housing - refit

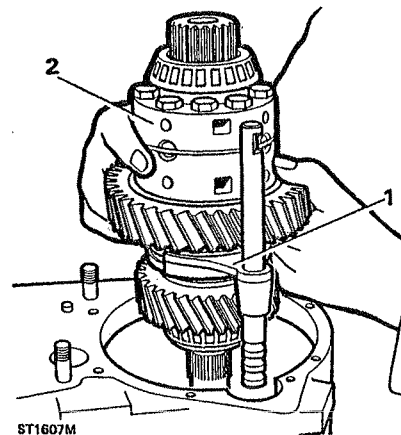
1. Grease output housing gasket and position on to the rear face of the transfer box casing.
2. Fit output housing and ensure clearance of 1,00 mm between housing face and gasket.
3. Fit the six output housing bolts with Loctite 290 on the threads, with washers and tighten evenly to the correct torque, which will pull the rear bearing into position.



ST1594M

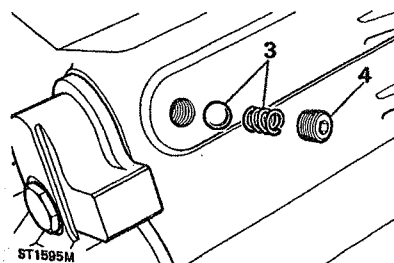
Centre differential unit refit

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.

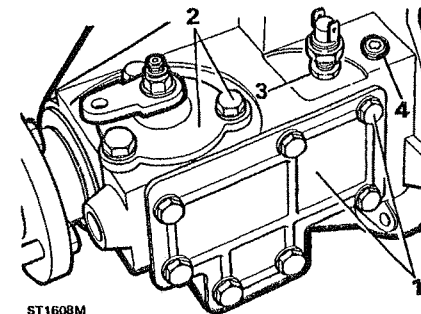


ST1595M

4. Apply Loctite 290 to detent plug; fit and locate, by screwing gently fully home and then unscrewing two turns.

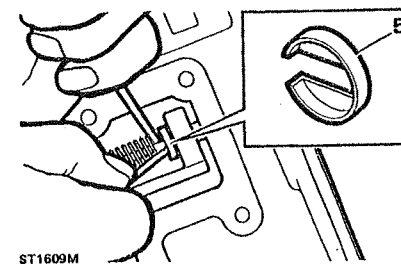
Front output housing-dismantling

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.



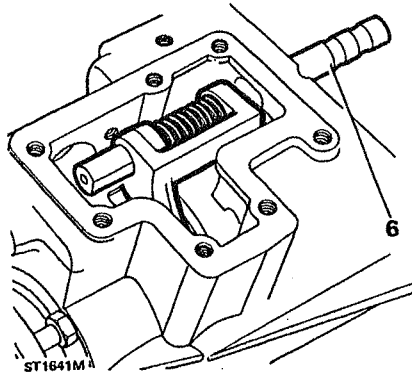
ST1608M

5. Compress the selector fork spring and remove the two spring retaining caps.

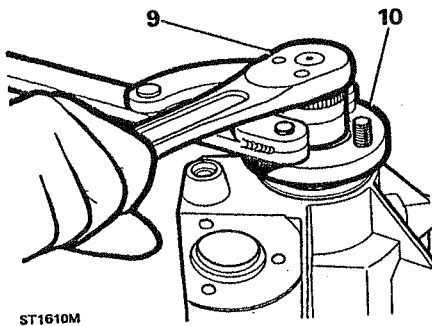


ST1609M

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.



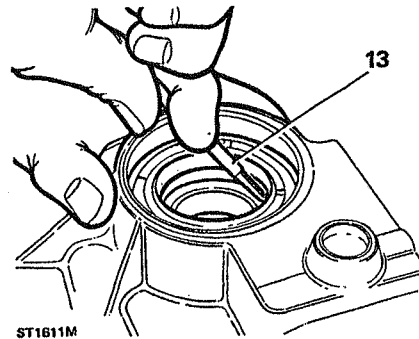
NOTE: Ensure that flange bolts are fully engaged in the wrench

10. Remove the output flange with oil seal shield.

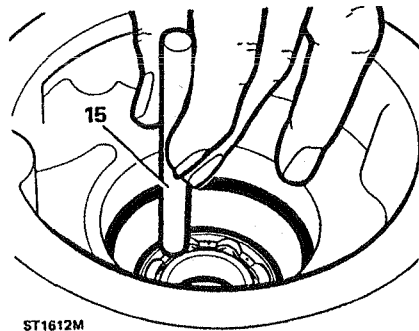
NOTE: These parts need not be separated unless the flange bolts are to be renewed.

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.

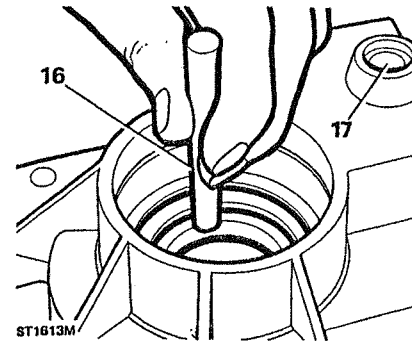


16. Drift out centre differential front taper roller bearing track and shim.
17. Drift out selector shaft cup plug from housing.
18. Clean all components ensuring all traces of "Loctite" are removed from faces and threads.
19. Examine components for wear or damage and renew if necessary.

NOTE: Renew oil seal, felt seal and flange nut.

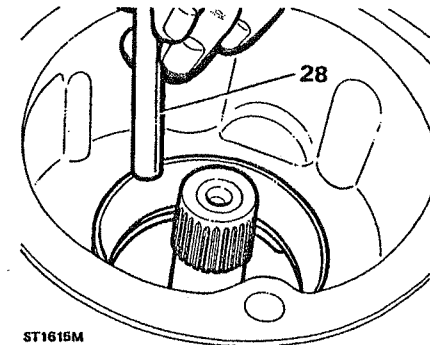
Adjusting front differential bearing pre-load

26. Measure original differential front bearing track shim.
27. Refit original shim into input housing.
28. Drift differential front bearing track into the housing.



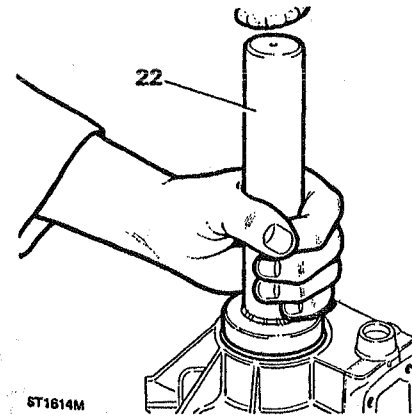
Reassembling

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.



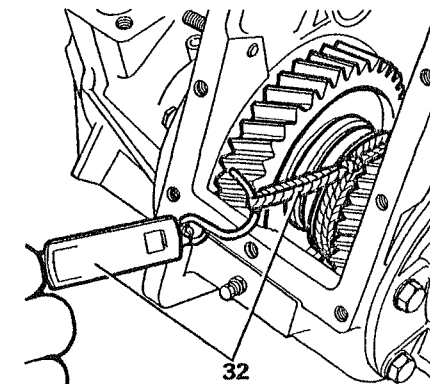
ST1615M

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.



ST1614M

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.



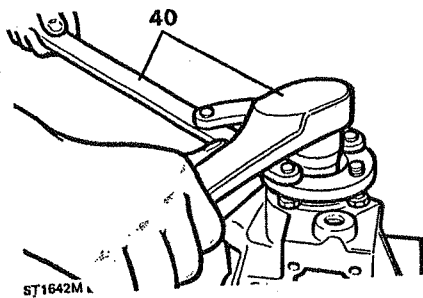
ST1616M

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.

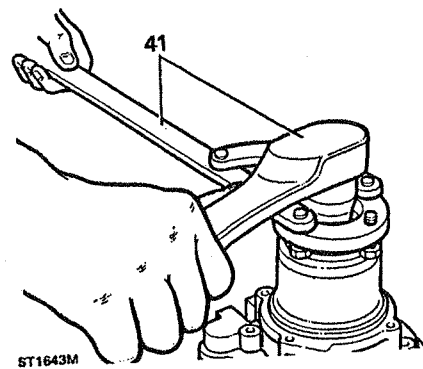
41 LT230T TRANSFER GEARBOX

33. With the correct shim fitted the load to turn should be 1.36 kg to 4.53 kg. 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.
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.

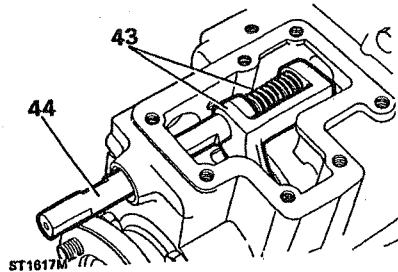
NOTE: Ensure that the flange bolts are fully engaged in the wrench.



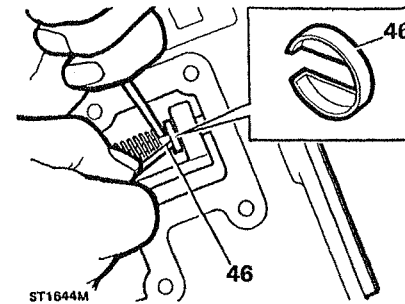
41. Repeat the above operation for the rear output flange.



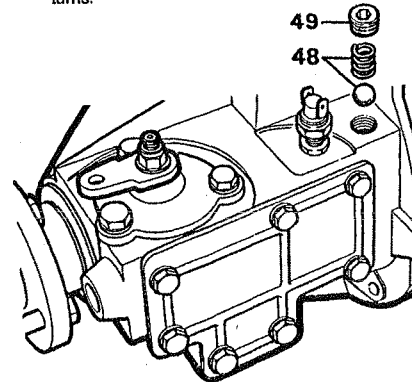
42. Compress the selector shaft spring and fit to the selector fork.
43. Locate selector fork through front output housing side cover aperture, ensuring that the fork engages in the groove of the lock-up sleeve.
44. Fit selector shaft through the aperture in the front of the output housing and pass it 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.



ST1645M

Differential lock finger housing

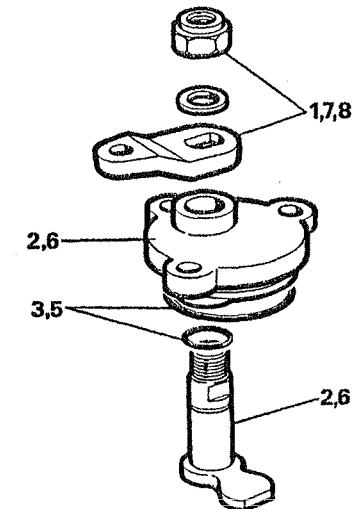
Dismantling

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

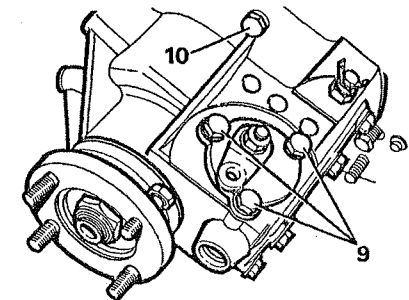
5. Fit new 'O' rings on to pivot shaft and lock finger housing and lubricate with oil.
6. Locate the pivot shaft in the housing.

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

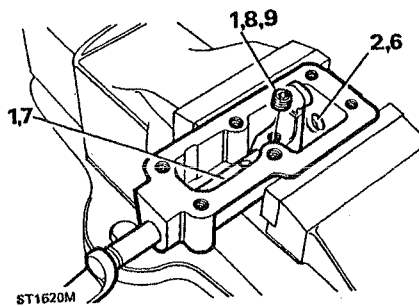
9. Fit the differential lock finger housing into its seating on the front output housing, ensuring that the selector finger is located in the flat of the selector shaft.
10. Apply Loctite 290 to the bolt threads and retain the lock finger housing with the three bolts and washers to the specified torque.



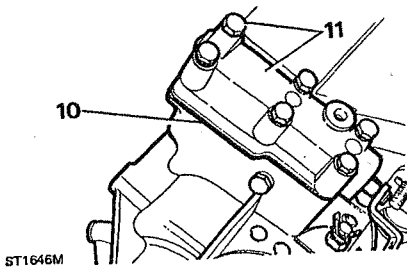
ST1619M

High/low cross-shaft housing

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.



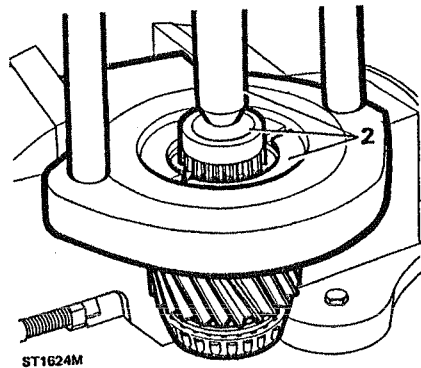
10. Grease and fit the high/low selector housing gasket on the front output housing.
11. Fit high/low cross-shaft housing, ensuring that the selector finger locates in the slot of the selector shaft, and secure with six bolts and washers to the specified torque.



Input gear overhaul

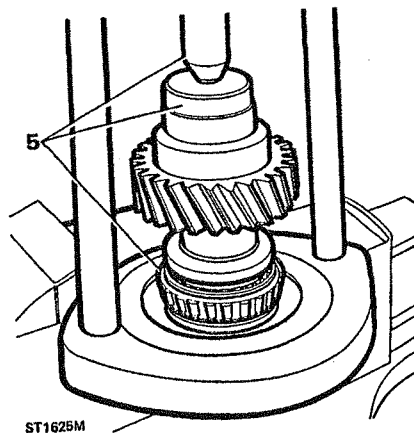
Dismantling

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.

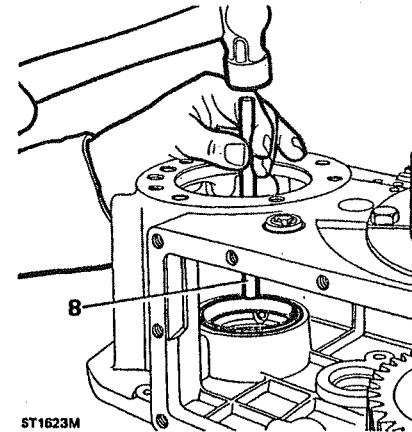


Reassembling

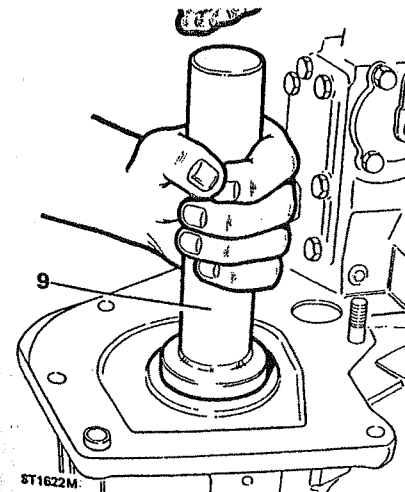
5. Position rear taper roller bearing on input gear and using hand press MS47 and collars 18G47-7 press the bearing fully home.



6. Invert input gear and fit the front taper roller bearing using the press and collars.
7. Prop up the transfer box casing on the bench with the rear face uppermost.
8. Drift in the front taper bearing track.



9. Reposition transfer box casing so the front face is uppermost and fit oil seal (open side inwards) using replacer tool 18G1422.

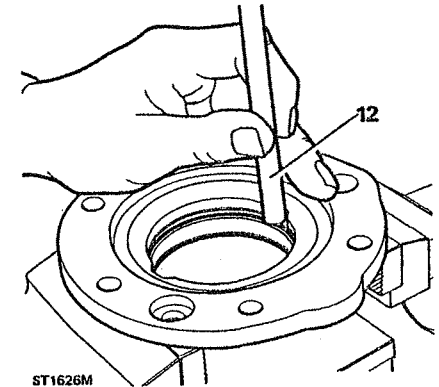


10. Lubricate both bearings with clean oil.

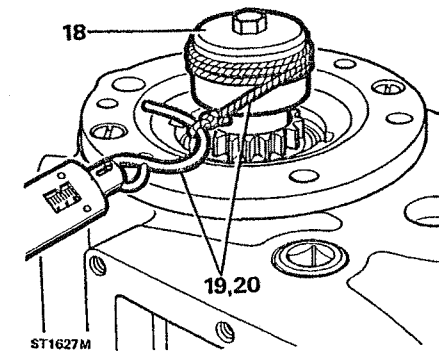
11. Fit the input gear assembly into the transfer box casing with the dog teeth uppermost.

Checking input gear bearing pre-load

12. Secure bearing support plate in the vice. Drift out input gear bearing track, and remove shim.

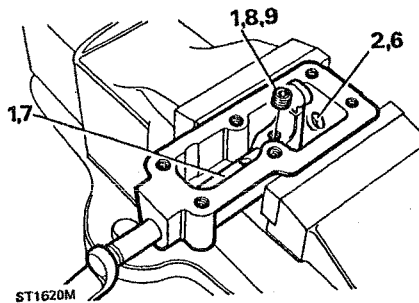


13. Clean bearing support plate and shim. Measure original shim and note its thickness.
14. Fit the original shim to the support plate.
15. Locate the bearing track in the support plate and press fully home.
16. Apply grease to the gasket and fit on to the transfer box casing.
17. Fit the bearing support 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.

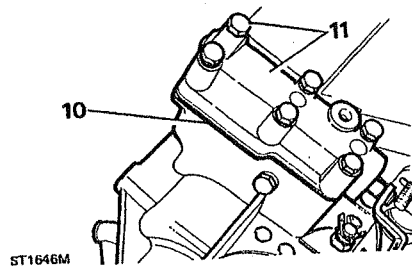


High/low cross-shaft housing

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.



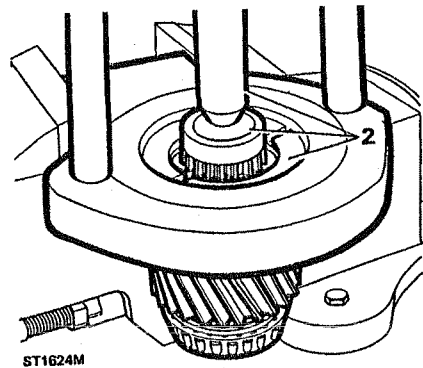
10. Grease and fit the high/low selector housing gasket on the front output housing.
11. Fit high/low cross-shaft housing, ensuring that the selector finger locates in the slot of the selector shaft, and secure with six bolts and washers to the specified torque.



Input gear overhaul

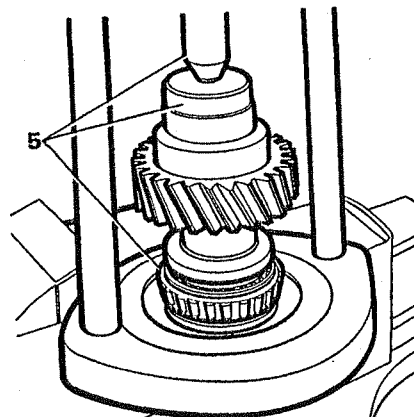
Dismantling

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.

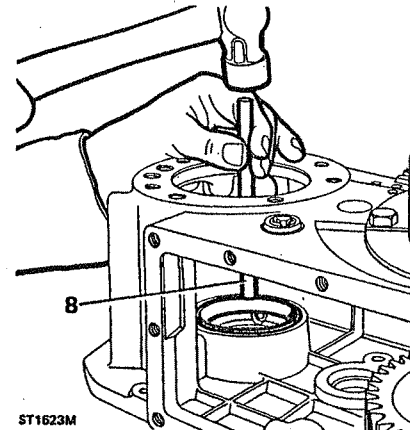


Reassembling

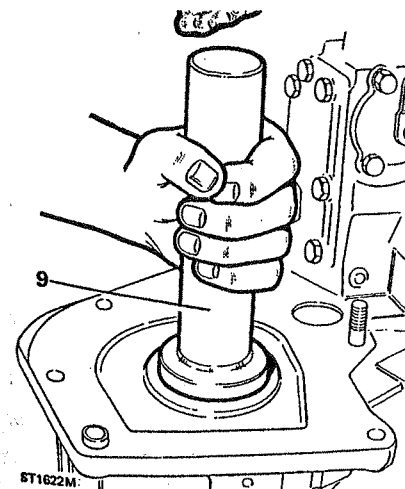
5. Position rear taper roller bearing on input gear and using hand press MS47 and collars 18G47-7 press the bearing fully home.



6. Invert input gear and fit the front taper roller bearing using the press and collars.
7. Prop up the transfer box casing on the bench with the rear face uppermost.
8. Drift in the front taper bearing track.



9. Reposition transfer box casing so the front face is uppermost and fit oil seal (open side inwards) using replacer tool 18G1422.

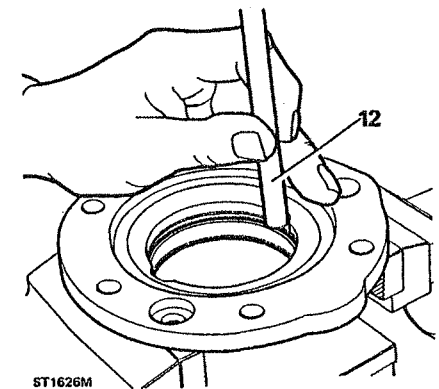


10. Lubricate both bearings with clean oil.

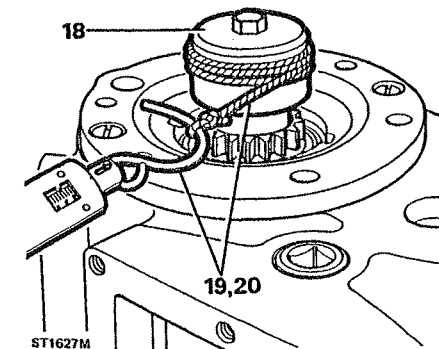
11. Fit the input gear assembly into the transfer box casing with the dog teeth uppermost.

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.
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.

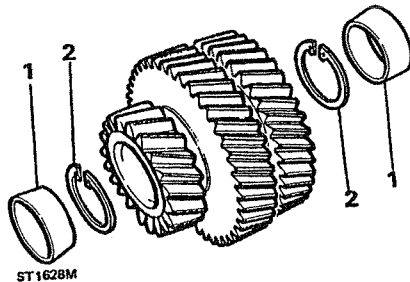


19. Tie a length of string to the split pin and fit it to the service tool as shown.
20. Attach a spring balance to the string and carefully tension the spring until a load to turn the input gear is obtained. A pull of 2.26 kg to 6.80 kg is required.
21. If the reading obtained is outside the above limits, the original shim must be changed.
22. Remove the spring balance, string and service tool.
23. Remove the six bolts and the bearing support plate.
24. Drift out the input gear bearing track from the support plate and discard original shim.
25. Select the correct size shim to obtain a load to turn of 2.26 kg to 6.80 kg.
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

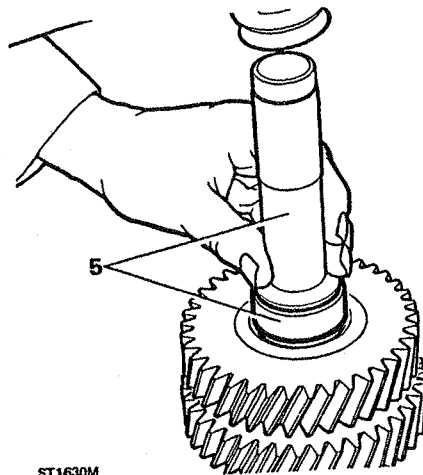
Dismantle

1. Drift out intermediate gear bearing tracks.
2. Remove circlips.



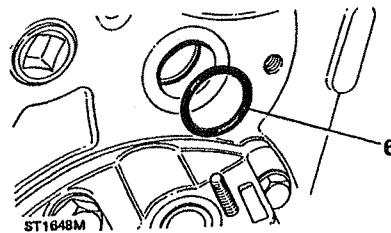
3. Clean all intermediate gear components and lock plate. Check for damage or wear and replace as necessary.
4. Fit new circlips into the intermediate gear cluster.

5. Using tools LST550-4 and MS550 fit bearing tracks into the intermediate gear cluster.



ST1630M

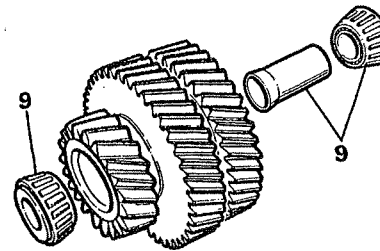
6. Fit the 'O' rings to the intermediate shaft and into the intermediate shaft bore at the front of the transfer box casing.



ST1648M

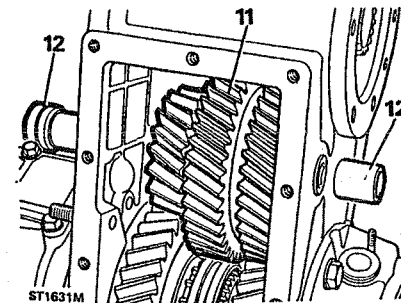
Reassembly

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.



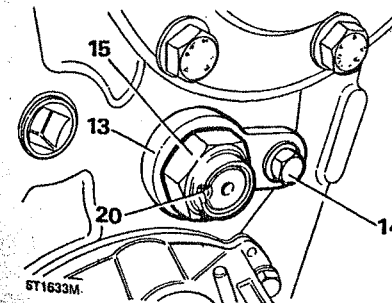
ST1649M

10. Fit dummy shaft LST104 into the intermediate gear cluster.
11. Locate the gear assembly into the transfer box casing from the bottom cover aperture.
12. Insert intermediate shaft from the front of the transfer box casing, pushing the dummy shaft right through as shown and remove. (Making sure that the intermediate gear cluster meshes with the input gear and high range and low range gears).



ST1631M

13. Turn the intermediate shaft to allow fitting of retaining plate.



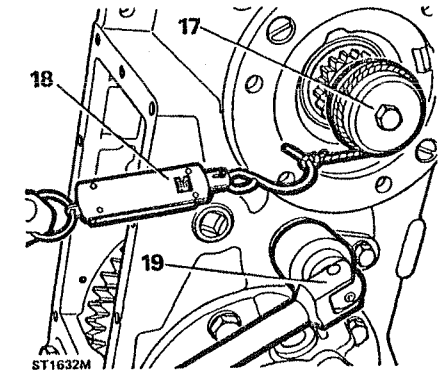
ST1633M

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 ± 1.63 kg on that noted when checking input shaft load-to-turn. The torque to tighten the retaining nut will be approximately 203 Nm.
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.



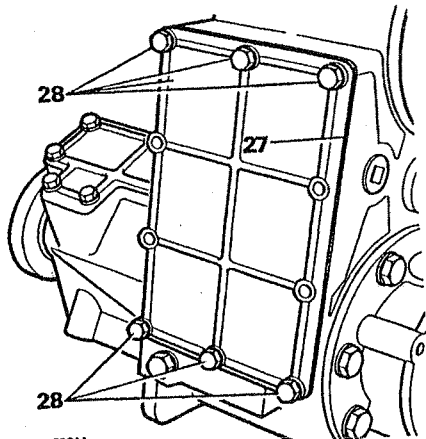
ST1632M

Power take-off cover - reassemble

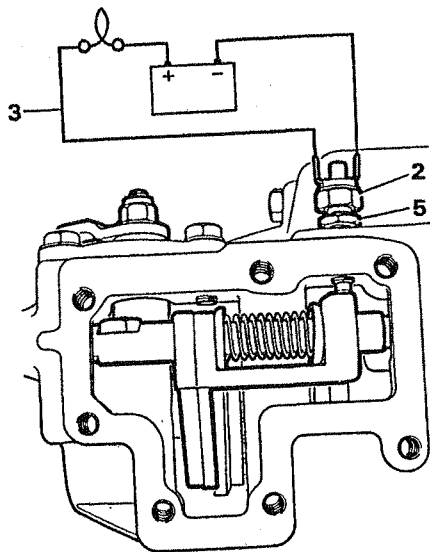
21. Clean power take-off cover and gasket face.
22. Fit the two countersunk screws and tighten.
23. Remove the six bolts from the bearing support plate.
24. Apply sealant to the cover plate gasket and fit it to the bearing support plate.
25. Apply Loctite 290 to bolt threads and secure the power take-off 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



ST1634M

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.

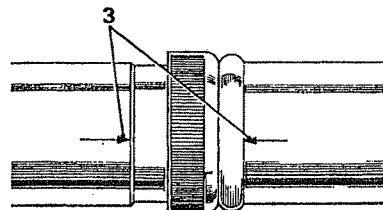
Differential lock switch adjustment

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.
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.

OVERHAUL PROPELLER SHAFTS

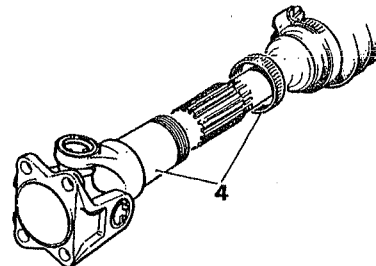
Dismantle

1. Remove the propeller shaft from the vehicle.
2. If a gaiter encloses the sliding member release the two securing clips. Slide the gaiter along the shaft to expose the sliding member.
3. Note the alignment markings on the sliding member and the propeller shaft. See NOTE following instruction 22.



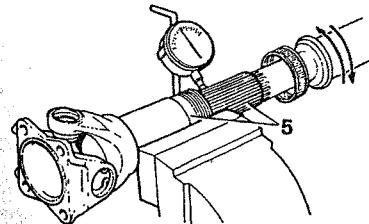
ST1000M

4. Unscrew the dust cap and withdraw the sliding member.



ST1001M

5. Clean and examine the splines for wear. Worn splines or excessive back-lash will necessitate propeller shaft renewal.

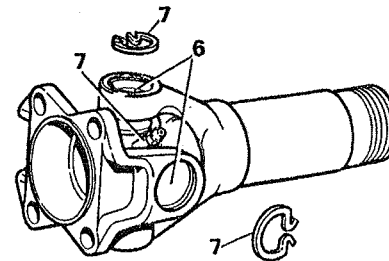


ST1002M

6. Remove paint, rust, etc. from the vicinity of the universal joint bearing cups and circlips.

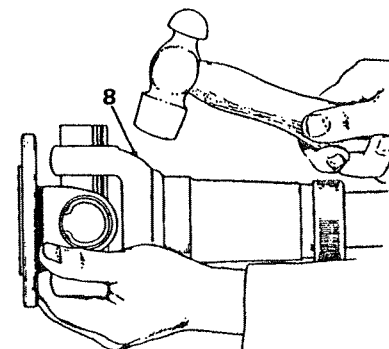
NOTE: Before dismantling the propeller shaft joint, mark the position of the spider pin lubricator relative to the journal yoke ears to ensure that the grease nipple boss is re-assembled in the correct running position to reduce the possibility of imbalance.

7. Remove the circlips, and grease nipple.



ST1003M

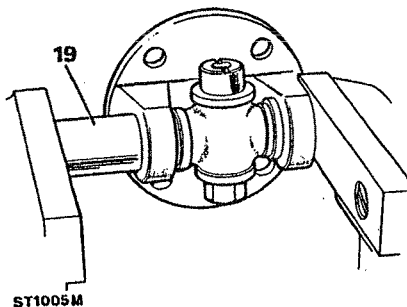
8. Tap the yokes to eject the bearing cups.
9. Withdraw the bearing cups and spider and discard.
10. Repeat instructions 5 to 8 at opposite end of propeller shaft.
11. Thoroughly clean the yokes and bearing cup locations.



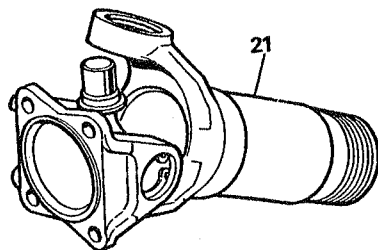
ST1004M

Assemble

12. Remove the bearing cups from the new spider.
13. Check that all needle rollers are present and are properly positioned in the bearing cups.
14. Ensure bearing cups are one third full of fresh lubricant. See **RECOMMENDED LUBRICANTS**.
15. Enter the new spider complete with seals into the yokes of the sliding member flange. Ensure that the grease nipple hole faces away from the flange.
16. Partially insert one bearing cup into a flange yoke and enter the spider trunnion into the bearing cup taking care not to dislodge the needle rollers.
17. Insert the opposite bearing cup into the flange yoke. Using a vice, carefully press both cups into place taking care to engage the spider trunnion without dislodging the needle rollers.
18. Remove the flange and spider from the vice.
19. Using a flat faced adaptor of slightly smaller diameter than the bearing cups press each cup into its respective yoke until they reach the lower land of the circlip grooves. Do not press the bearing cups below this point or damage may be caused to the cups and seals.



20. Fit the circlips.
21. Engage the spider in the yokes of the sliding member. Fit the bearing cups and circlips as described in instructions 15 to 20.

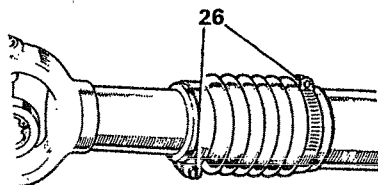


ST1006M

22. Lubricate the sliding member spines and fit the sliding member to the propeller shaft ensuring that the markings on both the sliding member and propeller shaft align.

NOTE: The Universal joints on the front propeller shaft are, by design, not assembled in-line with one another. Nevertheless, the alignment marks on the sliding member and propeller shaft must coincide when assembling.

23. Fit and tighten the dust cap.
24. Fit the grease nipples to the spider and the sliding member and lubricate.
25. Slide the gaiter (if fitted) over the sliding member.
26. Locate the sliding member in the mid-position of its travel and secure the gaiter clips. Note that the gaiter clips must be positioned at 180° to each other so that they will not influence propeller shaft balance.



ST1007M

27. Apply instructions 15 to 20 to the opposite end of the propeller shaft.
28. Fit the grease nipple and lubricate.
29. Fit the propeller shaft to the vehicle.

REAR HUB ASSEMBLY (EARLY MODELS)

Hubs fitted to axles up to and including the following numbers:

- 90 22S08283B
- 110 21S22954B

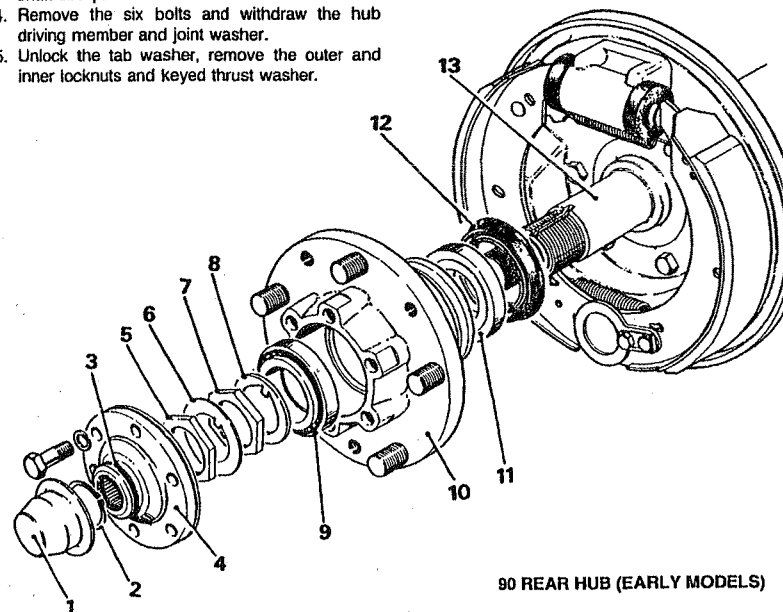
Special tool:

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.



ST775M

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

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.

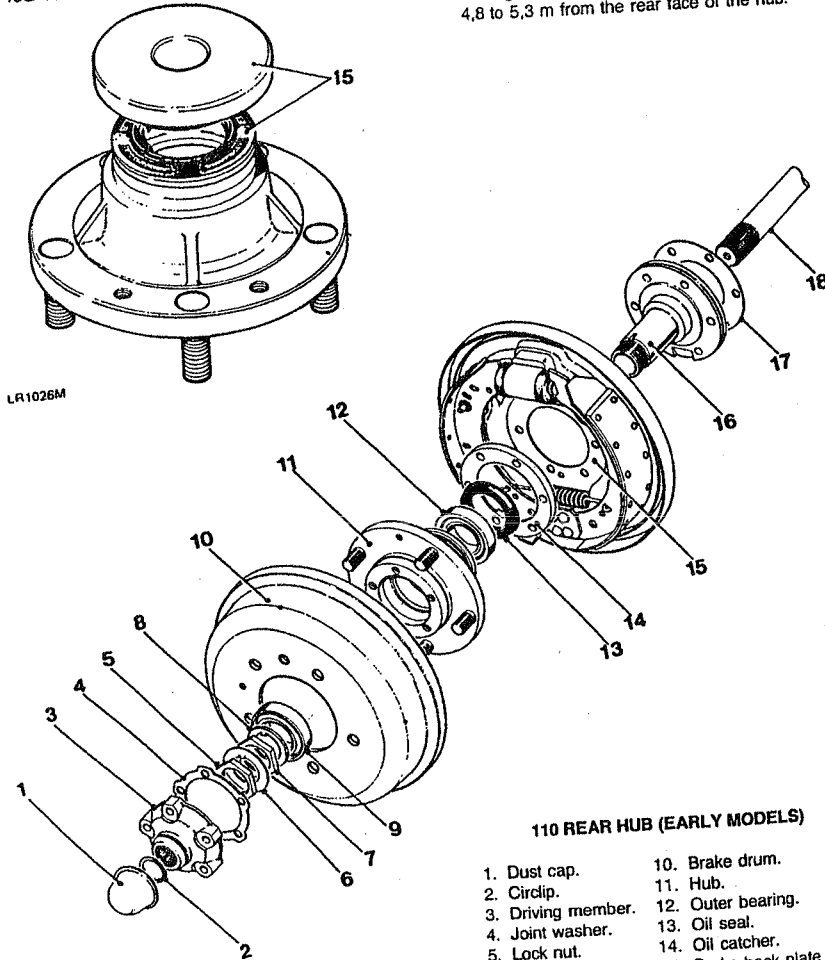
90 REAR HUB (EARLY MODELS)

- | | |
|---------------------------|---------------------------|
| 1. Hub cap. | 7. Inner adjusting nut. |
| 2. Circlip. | 8. Keyed thrust washer. |
| 3. Hub cap 'O' ring seal. | 9. Outer roller bearing. |
| 4. Driving member. | 10. Hub. |
| 5. Outer locknut. | 11. Inner roller bearing. |
| 6. Lock washer. | 12. Dual lipped seal. |
| | 13. Bearing sleeve. |

51 REAR AXLE AND FINAL DRIVE

DEFENDER

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

ST626M

110 REAR HUB (EARLY MODELS)

- | | |
|--------------------|--------------------------------|
| 1. Dust cap. | 10. Brake drum. |
| 2. Circlip. | 11. Hub. |
| 3. Driving member. | 12. Outer bearing. |
| 4. Joint washer. | 13. Oil seal. |
| 5. Lock nut. | 14. Oil catcher. |
| 6. Lock washer. | 15. Brake back plate assembly. |
| 7. Adjusting nut. | 16. Stub axle. |
| 8. Key washer. | 17. Joint washer. |
| 9. Outer bearing. | 18. Half-shaft. |

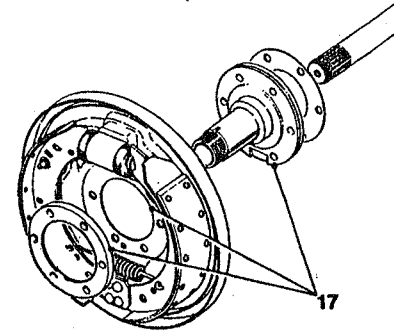
16. If this tool is not available obtain a suitable tube that will fit exactly on the four diametrically opposed pads in the channel round the seal on the opposite side to the lip and with the lip leading press-in the seal so that it is recessed 4,8 to 5,3 mm from the rear face of the hub.

DEFENDER

REAR AXLE AND FINAL DRIVE 51

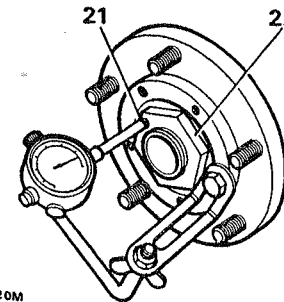
Reassemble hub to axle

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.
22. Fit the tab washer and outer locknut. Tighten the locknut, re-check the end-float and lock the nuts.



ST2620M

23. Using a new joint washer, fit the hub driving member and tighten the retaining bolts and spring washers to 60 to 70 Nm.
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 HUB ASSEMBLY (LATER MODELS)

With inner and outer seals. From the following axle numbers onwards

- 90 22S08284B
- 110 21S22955B

Special tools:

- LST 550-5/LRT-54-001 Oil seal replacer
- MS 550 or 18G134/LRT-99-003 Drift for seal replacer
- RO606435A/LRT-54-002 Hub nut spanner

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 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

9. Remove the seal track spacer and outer seal.
10. Remove the outer bearing cone.
11. Remove the inner seal and bearing cone.
12. If new bearings are to be fitted drift or press out the old cups.

13. Degrease and examine the hub for cracks and damage and renew if necessary. Renew hub if wheel studs are faulty.

Assemble

14. If removed, fit the stub axle to the axle casing with a new joint washer and secure with the six nuts and bolts and tighten to the correct torque.
15. Fit new inner and outer bearing cups to the hub, ensuring that they are drifted or pressed squarely into position.
16. Fit the inner bearing cone and pack with one of the recommended hub greases.

Fitting inner oil seal

17. Clean the hub oil seal housing and ensure that the seal locating surface is smooth and the chamfer on the leading edge is also smooth and free from burrs.
18. Examine the new seal and ensure that it is clean, undamaged and that the garter spring is properly located. Even a small scratch on the seal lip could impair its efficiency.
19. Although the new seal is already pre-greased by the manufacturer, apply one of the recommended hub bearing greases to the outside diameter of the seal, before fitting, taking care not to damage the lip.
20. Place the seal, lip side leading, squarely on the hub and using the 76 mm end of seal replacer tool 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

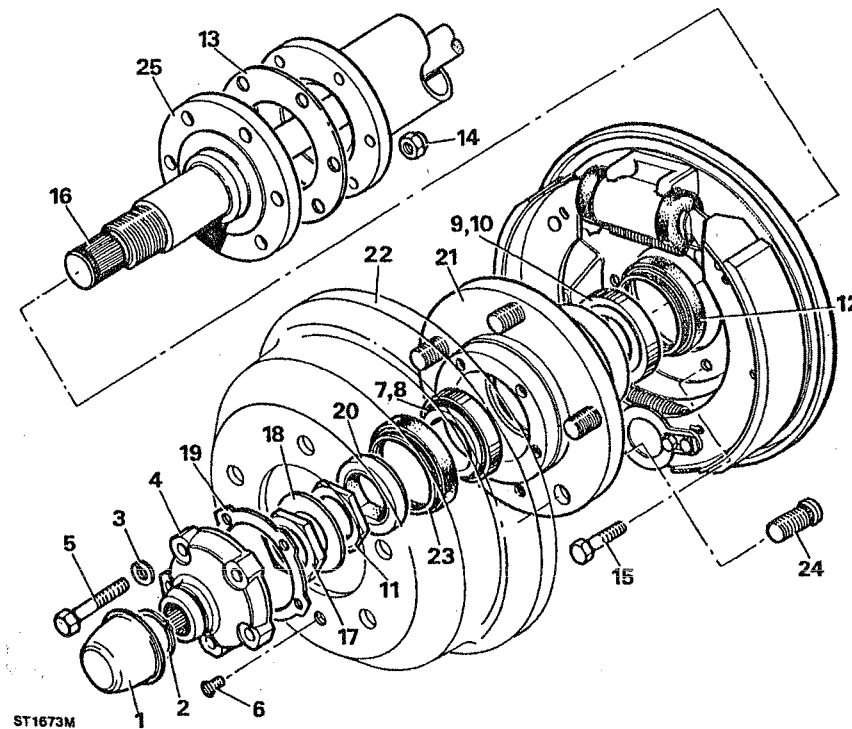
24. Smear the lips of both seals with one of the recommended greases. This is important since a dry seal can be destroyed during the first few revolutions of the hub.
25. Select a new seal track spacer and check that the outer diameter is smooth and free from blemishes and that there are no burrs on 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.

NOTE: Instruction 28 is applicable to hubs that have been fitted with new components throughout. If original components are being refitted instruction 29 must be followed using the adjustment nut to achieve the required end-float.

28. Fit the hub inner nut and using wrench RO 606435 tighten the adjusting nut while slowly revolving the hub to seat the bearings and to remove all end-float, back-off the nut approximately half a turn and retighten the nut to 1,5 Nm in which will automatically allow for compression of the rubber on the new seal track spacer giving the required hub end-float of 0.013 to 0.10 mm.
29. If the rubber on the seal track spacer has previously been compressed the hub end-float can be checked by mounting a dial indicator and bracket on the hub so that the trace pin rests in a preloaded condition on the nut. Rotate the hub to settle the bearings and check the end-float by pushing and pulling the hub. End-float must fall within the limits given in the previous instruction.
30. Fit a new lock washer and locknut. Restraining the inner adjustment nut, tighten the outer lock nut to 95 to 108 Nm.
31. If original components have been refitted rotate the hub several times to settle the bearings then recheck the end-float, refer to previous note and instruction 29.
32. Bend one segment of the locker washer over the adjusting nut and another, diametrically opposite, over the locknut.
33. Using a new joint washer, fit the hub driving member and secure with the five bolts and tighten evenly to the correct torque.
34. Fit the circlip to the axle shaft ensuring that it is properly seated in the groove.
35. Fit the hub cap.
36. Fit the road wheels and secure with the nuts. Jack-up the vehicle, remove axle stands and lower vehicle to ground. Finally tighten the road wheel nuts to the correct torque.

90 AND 110 REAR HUBS (LATER MODELS)



ST1673M

KEY TO HUB COMPONENTS

- | | |
|---|---------------------------------------|
| 1. Hub cap. | 14. Locknut) |
| 2. Circlip. | 15. Bolt.) stub axle to axle casing. |
| 3. Spring washer - hub driving member bolt. | 16. Axle shaft. |
| 4. Hub driving member. | 17. Locknut. |
| 5. Hub driving member bolts. | 18. Lock washer. |
| 6. Brake drum retaining screws. | 19. Joint washer. |
| 7. Outer bearing cone. | 20. Seal track spacer. |
| 8. Outer bearing cup. | 21. Hub casting. |
| 9. Inner bearing cup. | 22. Brake drum. |
| 10. Inner bearing cone. | 23. Outer oil seal. |
| 11. End-float adjusting nut. | 24. Road wheel stud. |
| 12. Inner oil seal. | 25. Stub axle. |
| 13. Joint washer. | |

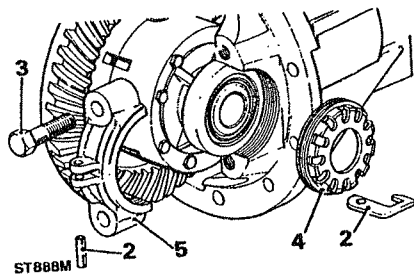
REAR AXLE DIFFERENTIAL ASSEMBLY - Ninety Heavy Duty

Special tools:
 18G1205/LRT-51-003 Flange holder tool.
 18G191 Pinion height setting gauge.
 18G191-4/LRT-54-503 Universal setting block.
 18G47-6/LRT-54-502 Pinion head bearing remover/replacer.
 LST106/LRT-54-504 Oil seal replacer.
 RO262757A/LRT-54-505 Extractor for pinion bearing caps.
 RO262757-1/LRT-54-506 Replacer - use with RO262757A.
 RO262757-2/LRT-54-507 Adaptor tail bearing cap replacer.
 RO530105/LRT-54-508 Spanner - differential flange and carrier bearing nuts.
 RO530106/LRT-54-503 Bracket for dial gauge and indicator.
 MS47/LRT-99-002 Press

DISMANTLE

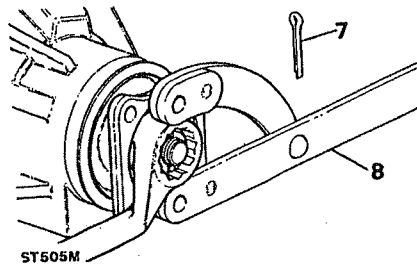
It is essential that differential components are marked in their original positions and relative to other components so that, if refitted, their initial setting is maintained. Note that the bearing caps must not be interchanged.

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 RO530105, remove the bearing adjusting nuts.
5. Remove the bearing cap bolts and bearing caps.
6. Lift out the crown wheel, differential unit and bearings.

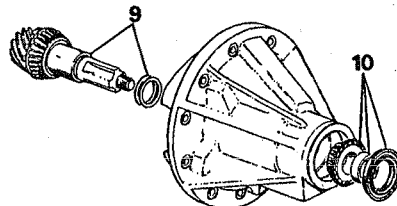


7. Remove the split pin securing the pinion flange nut.

8. Remove the pinion flange nut using service tool 18G1205, to restrain the flange.

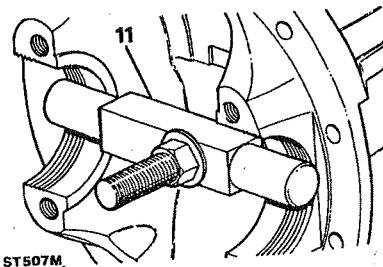


9. Withdraw the pinion complete with pinion head bearing and outer bearing shims. Withdraw the shims.
10. Remove the pinion flange oil seal, spacer and bearing. Discard the oil seal.



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.

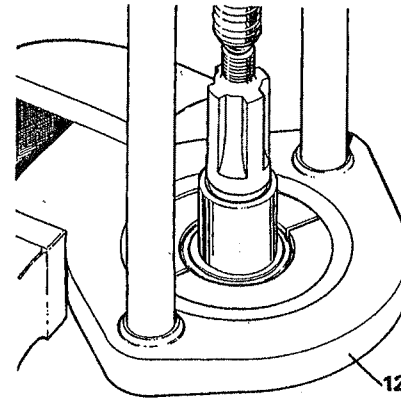


ST507M

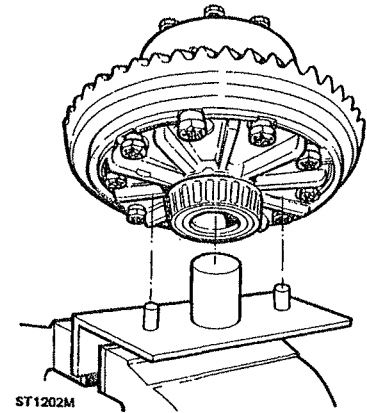
12. Remove the pinion head bearing with service tool MS47 and adaptor 18G47-6.
13. For reassembly purposes, add alignment marks to the crown wheel and differential case halves.

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.

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.



ST508M



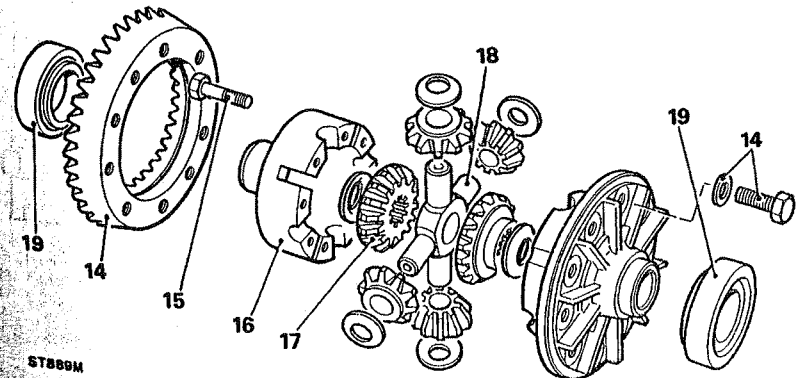
ST1202M

INSPECTING

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.

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.



ST889M

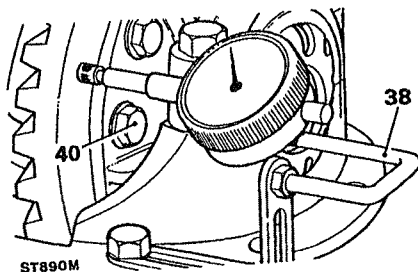
24. The differential case halves are a matched set and must not be interchanged separately. New screws for securing the case halves are already coated with a dry locking compound and do not require the application of Loctite. If the old screws are being reused, the threads must be cleaned and coated with Loctite 'Studlock' just prior to assembly.

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 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. 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.

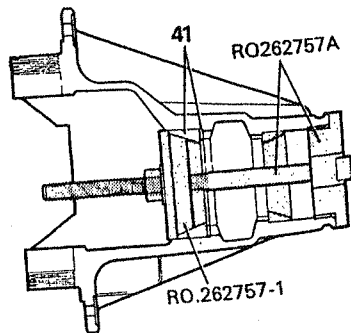


ST890M

39. When satisfied that run-out is within the specified limits remove the differential housing from the pinion housing.
40. Remove the crown wheel bolts and refit them using Loctite 'Studlock'. Evenly tighten the bolts to 54 to 61 Nm.

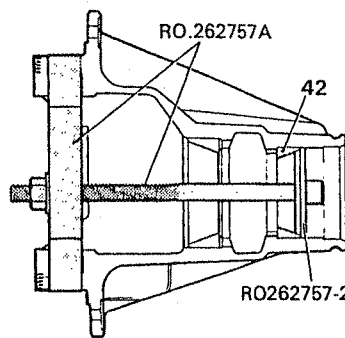
Drive pinion

41. Fit the pinion head bearing track and the original shim to the pinion housing using service tools RO262757A and RO262757-1. If the original shim was damaged or mislaid use a new shim of at least 1,27 mm thickness.



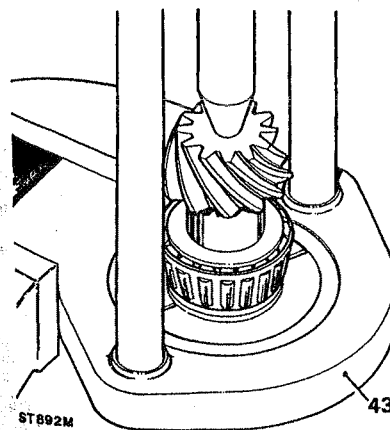
ST2713M

42. Fit the pinion outer bearing track to the pinion housing with service tool RO262757A and RO262757-2.



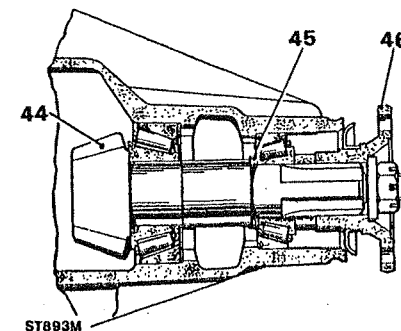
ST2714M

43. Fit the pinion head bearing to the pinion using service tool 18G47-6.



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.
47. Do not fit the oil seal at this stage.



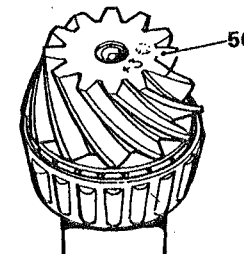
ST893M

48. Tighten the pinion flange nut slowly until the force required to rotate the pinion is 23 to 40,5 kgf cm. 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.

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.

51 REAR AXLE AND FINAL DRIVE

DEFENDER

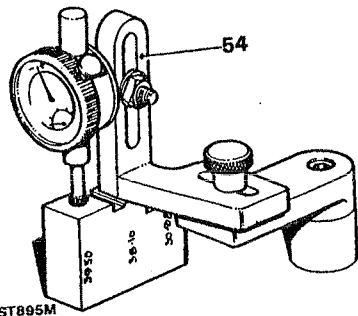
Drive pinion adjustment

52. Ensure that the pinion end face is free of raised burrs around the etched markings.
53. Remove the keep from the magnetised base of dial gauge tool 18G191.
54. Place the dial gauge and setting block on a flat surface and zero the dial gauge stylus on the setting block.

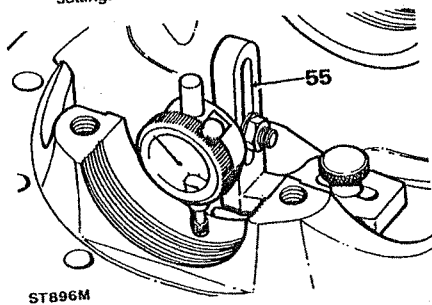
NOTE: The setting block has three setting heights as follows:

- 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.



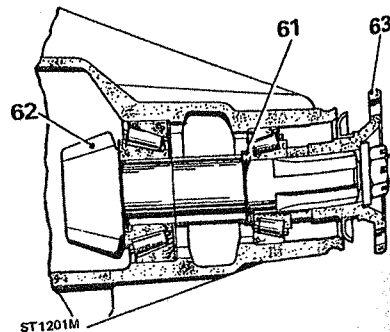
55. Position the dial gauge centrally on the pinion end face with the stylus registering on the lowest point on one differential bearing bore. Note the dial gauge deviation from the zeroed setting.



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 in.

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 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.



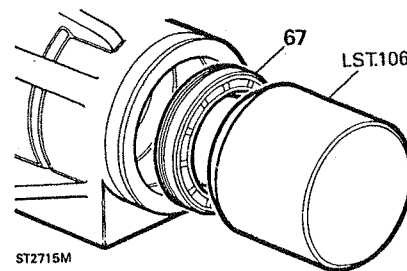
DEFENDER

REAR AXLE AND FINAL DRIVE 51

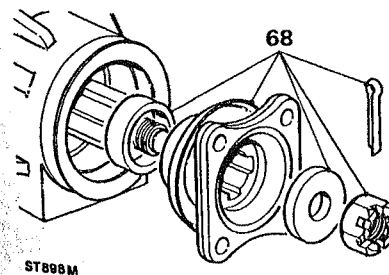
65. With the pinion flange nut tightened to a torque of 95 to 163 Nm the force required to rotate the pinion shaft should be within 23 to 40,25 kgf cm when initial inertia has been overcome. Change the bearing pre-load shim as necessary to obtain this requirement. A thicker shim will reduce pre-load; 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.

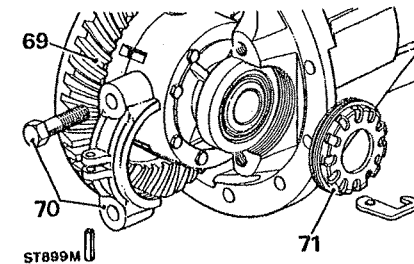
66. Remove the pinion flange.
67. Fit the oil seal (seal lips towards the pinion), using service tool LST 106 oil seal replacer.



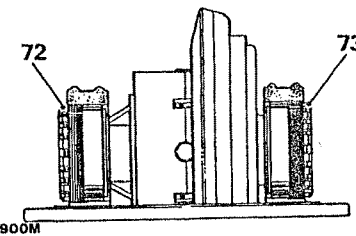
68. Lubricate the seal lips with EP90 oil. Fit the distance piece and flange and secure with washer and nut. Tighten the nut to 95 to 163 Nm. Fit a new split pin.



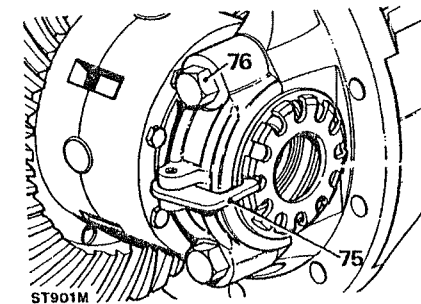
69. Place the differential housing in the pinion housing.
70. Fit the bearing caps and bolts. Do not fully tighten the bolts.
71. Fit the bearing adjusting nuts.



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.
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 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
Crown wheel run-out	0,10 mm
Crown wheel/pinion backlash	0,10 to 0,17 mm

REAR AXLE DIFFERENTIAL ASSEMBLY - One Ten Models (SALISBURY)

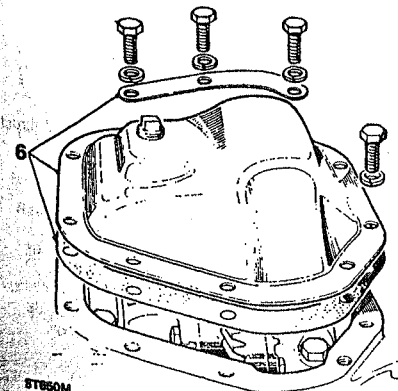
Service tools:

- MS47/LRT-99-002 Screw press.
- 18G131C/LRT-51-503 Axle spreader or axle compressor GKN 131.
- 18G191 Dial gauge, bracket and base.
- 18G1122/LRT-99-502 Screw press.
- 18G1205/LRT-51-003 Spanner for drive coupling.
- S123A/LRT-51-502 Pinion bearing cup remover.
- 18G47/LRT-51-500 BK pinion bearing cone remover/replacer.
- 18G47/LRT-51-5-1 BL differential bearing remover.
- 18G1122G/LRT-51-502 Pinion bearing cup replacer.
- 18G134DP/LRT-51-504 Differential bearing replacer.
- 18G191-4/LRT-54-503 Universal setting block.
- 18G131F Pegs for axle spreader.
- RO 1008/LRT-51-002 Oil seal replacer

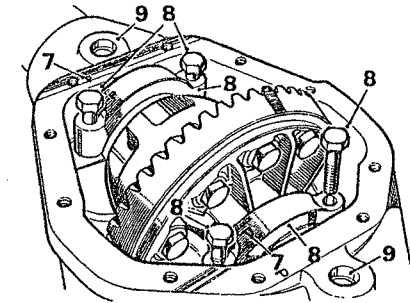
DISMANTLE

NOTE: All fixing bolts used on the differential assembly and differential cover have metric threads.

1. Drain off the differential lubricating oil, and refill plug.
2. Remove the rear axle assembly from the vehicle.
3. Remove the hub driving member fixings.
4. Withdraw the driving member and axle shaft sufficiently to disengage the differential.
5. Repeat instruction 4 for the other axle shaft.
6. Remove the fixings and support strip at the differential cover and withdraw the cover and joint washer.

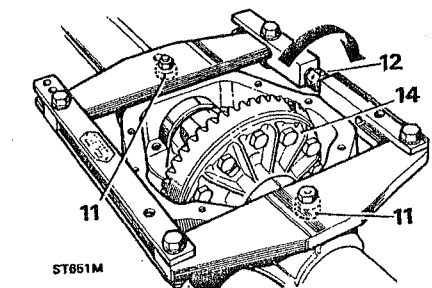


7. Note the relationship marking on the bearing caps and axle casing to ensure correct refitting.
8. Remove the fixings and withdraw the differential bearing caps.



Using axle spreader 18G131C

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 18G131C, Adaptor pegs 18G131F.
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.



51 REAR AXLE AND FINAL DRIVE

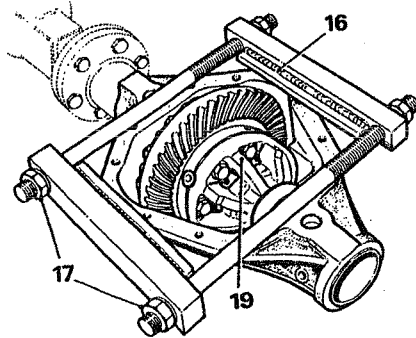
DEFENDER

CAUTION: To prevent permanent damage to the gear carrier case, it must not be over-stretched. Each flat on the turnbuckle is numbered to enable a check to be made on the amount turned. The maximum stretch permitted is 0,30 mm, equivalent to three flats.

15. Ease off the adjuster and remove the spreader.

Using axle compressor GKN 131

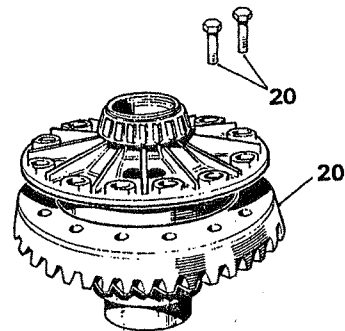
16. Place the tool on to the differential casing, as illustrated, with the weld seam uppermost. Ensure that the plates rest squarely on the differential machined surface and the end bars butt against the edges of the casing.
17. Tighten the adjusting nuts by hand only, until all slack is taken up.
18. Continue to tighten both nuts alternately with a spanner, one flat at a time, to a maximum of three flats.
19. Carefully lever-out the differential assembly.



ST657M

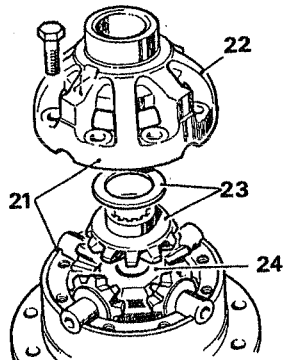
Dismantle differential

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

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.

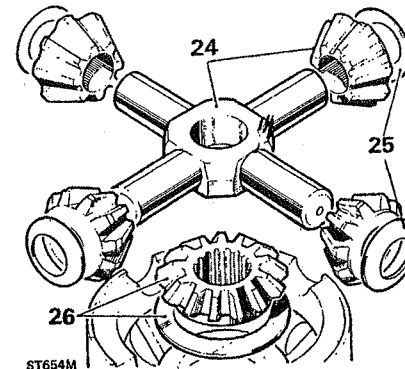


ST653M

24. Lift out the cross-shaft and pinions.
25. Withdraw the four dished thrust washers.
26. Withdraw the lower differential wheel and thrust washer.

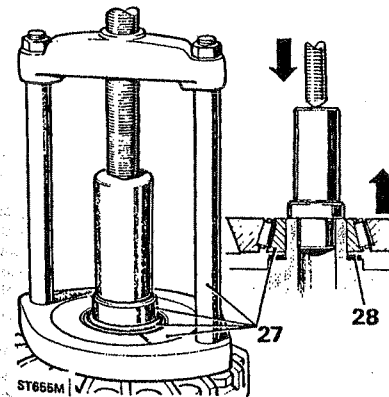
DEFENDER

REAR AXLE AND FINAL DRIVE 51



ST654M

27. Remove the differential bearing cones using remover 18G47BL and adaptors 1 and 2 and press MS47.
28. Withdraw the shim washers fitted between the bearing cones and the differential casings.

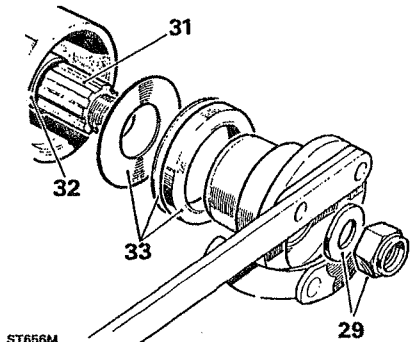


ST655M

Remove final drive pinion

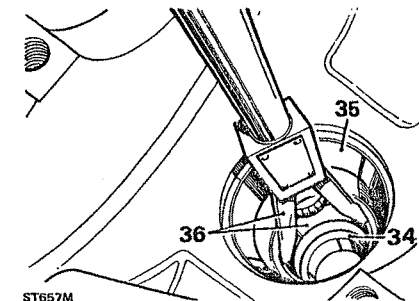
29. Prevent the coupling flange from rotating and remove the flange locknut and plain washer. Spanner 18G1205.
30. Support the drive pinion and remove the coupling flange by tapping with a hide hammer.

31. Withdraw the drive pinion together with the inner bearing cone.
32. Withdraw and discard the collapsible bearing spacer.
33. Withdraw the oil seal, gasket and oil thrower.



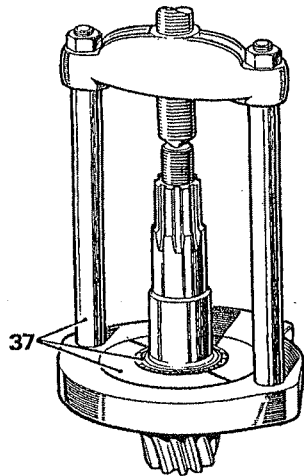
ST656M

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 S123A.
36. Extract the pinion outer bearing cup from the casing. Remover S123A.



ST657M

37. Remove the inner bearing cone from the pinion. Remover 18G47BK and Press MS47.



ST658M

INSPECTION

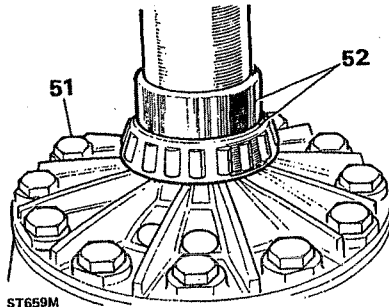
38. Examine all components for obvious wear or damage.
 39. The bearing cones must be a press fit on their locations, except the drive pinion flange and bearing which is a slide fit.
 40. The crown wheel and pinion are supplied as a matched pair and must not be interchanged separately. A new crown wheel and pinion matched pair may be fitted to an original gear carrier casing if sound. The original crown wheel and pinion, if sound, may be fitted into a replacement casing.
 41. The two parts of the differential unit casing are matched and must not be replaced separately.
 42. Discard and renew all thrust washers.
 43. Differential housings with worn thrust washer seatings must be replaced as a pair.
 44. Examine the differential case to crown wheel joint face for burrs and damage which could lead to crown wheel run-out when fitted.

ASSEMBLE

Differential

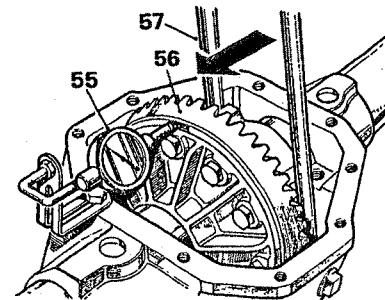
45. Fit the differential lower wheel and thrust washer to the differential case. See illustration following instruction 23.
 46. Fit the dished thrust washers.
 47. Fit the cross-shaft and pinions.
 48. Fit the differential upper wheel and thrust washer.

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 89 to 101 Nm.
 51. Fit the crown wheel to the differential casing. Use Loctite 'Studlock' grade CVX on the fixing bolt threads and tighten to the correct torque.
 52. Press on the differential roller bearing cones less shim washers, using 18G134DP, and leave to one side until required for instruction 96.
 53. Fit the bearing cups to the differential.
 54. Fit the differential unit and bearings to the gear carrier casing, and rotate unit to centralize the bearings. Do not fit the bearing caps.



ST659M

55. Position a suitable dial gauge indicator on the casing with the stylus registering on the back face of the crown wheel.
 56. Rotate the differential and check the total indicated run-out on the crown wheel back face. This must not exceed 0,05 mm. If run-out is excessive, check the mating faces for dirt and damage; if necessary, select a new radial position for the crown wheel. When satisfactory, continue with the following check.



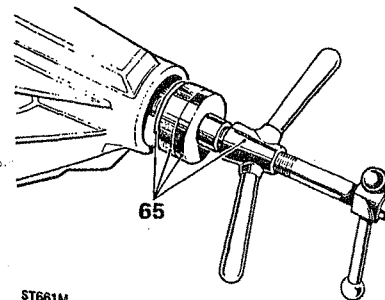
ST660M

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.
 61. Add 0,127 mm, for bearing pre-load, to the total noted in the preceding instruction. The sum is then equal to the nominal value of shims required for the differential bearings. Shims are available in the range 0,07 mm, 0,12 mm, 0,25 mm and 0,76 mm. Select the total value of shims required.
 62. Remove the differential unit and bearings and place aside. Do not fit the shim washers until the subsequent 'Differential backlash' checks have been made, instructions 96 to 102.

Fit drive pinion

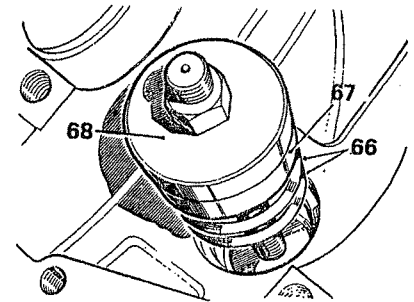
63. Select shim washers of the same thickness value as those removed from under the pinion inner cup, instruction 35, and place ready for fitting.
 64. Position the outer bearing replacer 18G1122G detail 2, and the outer bearing cup on the press tool 18G 1122.
 65. Locate the assembly into the pinion housing nose.



ST661M

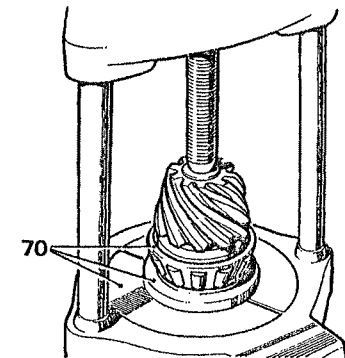
66. Place the selected shim washers on to the inner bearing cup seating.
 67. Position the inner bearing cup in the casing.

68. Position the inner bearing replacer 18G1122G detail 1, onto 18G1122 and secure with the fixing nut.
 69. Hold still the centre screw and turn the butterfly lever to draw in the bearing cups.



ST662M

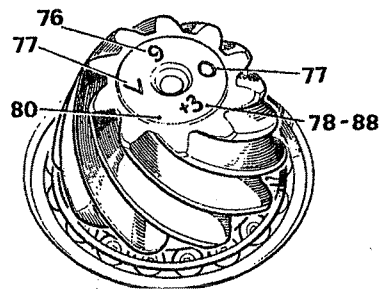
70. Press the inner bearing cone onto the drive pinion. 18G47BK, details 1 and 2 and press MS47.
 71. Position the pinion and bearing in the casing; omit the collapsible spacer at this stage.
 72. Fit the outer bearing cone onto the pinion.
 73. Fit the coupling flange and plain washer and loosely fit the flange nut.
 74. Tighten the coupling flange locknut to remove end-float from the pinion.
 75. Rotate the pinion to settle the bearings and slowly tighten the flange locknut. Use a spring balance to obtain a torque resistance of 9,25 to 13,8 kgf cm. to rotate the pinion.



ST638M

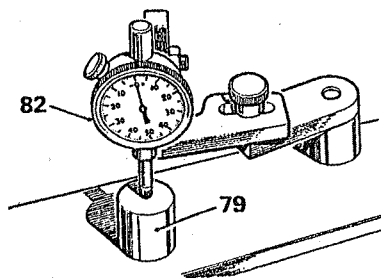
Drive pinion markings

- 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 18G191P or 18G191-4, which is referenced from the pinion end face to the bottom radius of the differential bearing bore. The latter gauge is illustrated following instruction 85.

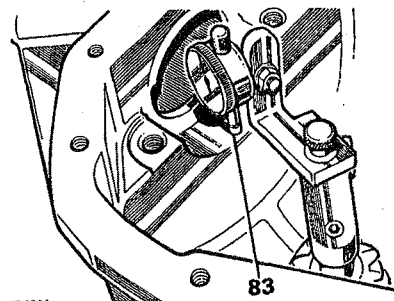


ST1380M

Drive pinion adjustment

- 80. Ensure that the pinion end face is free of raised burrs around the etched markings.

- 81. Remove the keep disc from the magnetized base of dial gauge tool 18G191.
- 82. Place the dial gauge and setting gauge 18G191P or 18G191-4 on a 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 + 0.1524mm
 Reading obtained R H side - 0.0762mm

Add + 0.1524mm
 - 0.0762mm
 + 0.0762mm

Divide by 2 (0.0762 divided by 2) = 0.0381mm

Therefore subtract 0.0381mm from the shim thickness behind the pinion inner bearing track.

Example 2

Reading obtained L H side + 0.1524mm
 Reading obtained R H side - 0.2032mm

Add + 0.1524mm
 - 0.2032mm
 - 0.0508mm

Divide by 2 (0.0508 divided by 2) = 0.0254mm

Therefore add 0.0254mm from the shim thickness behind the pinion inner bearing track.

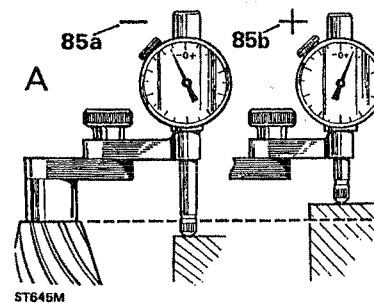
- 85. Where the stylus has moved down (85a), the amount is equivalent to the thickness of shims that must be removed from under the pinion inner cup to bring the pinion down to the nominal position. Where the stylus has moved up (85b), the amount is equivalent to the additional thickness of shims required to bring the pinion up to the nominal position.

Illustration A. Using setting gauge 18G191P.

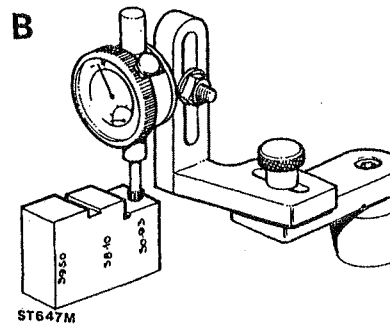
Illustration B. Using universal setting block 18G191-4. This setting block has three setting heights as follows:

- 39.50 mm Rationalised axle
- 38.10 mm Pre-Rationalised axle
- 30.93 mm Salisbury axle

Ensure that the height marked 30.93 mm is used for this differential.

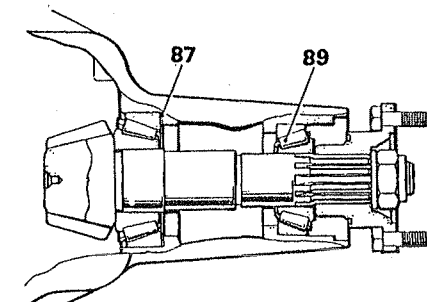


ST645M



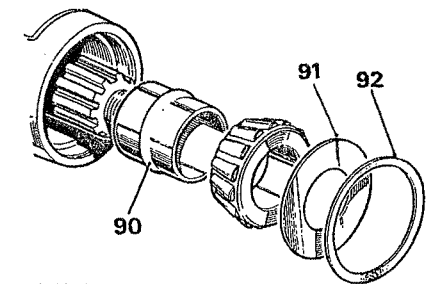
ST647M

- 86. Before adjusting the shim thickness, check the pinion face marking and if it has a plus (+) figure, subtract that from the shim thickness figure obtained in the previous instruction. Alternatively if the pinion has a minus (-) figure, add the amount to the shim thickness figure.
- 87. Adjust the shim thickness under the pinion inner cup as necessary, by the amount determined in instructions 85 and 86.
- 88. Recheck the pinion height setting instructions 82 to 84. If the setting is correct, the mean reading on the dial gauge will agree with the figure marked on the pinion end face. For example, with an end face marking of +3, the dial gauge reading should indicate that the pinion is 0.003 in (0.0762 mm) below nominal.
- 89. When the pinion setting is satisfactory, temporarily remove the pinion outer bearing.



ST646M

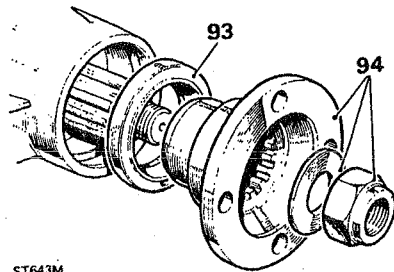
- 90. Fit a new collapsible bearing spacer, flared end outward, to the drive pinion and refit the outer bearing.
- 91. Fit the pinion oil slinger.
- 92. Fit the oil seal gasket.



ST644M

93. Fit the pinion oil seal, lipped side first, using general purpose grease or, where available, a molybdenum disulphide based grease on the seal lip, using RO1008 to drift in the seal.
94. Fit the coupling flange and plain washer and loosely fit a new flange nut. Secure 18G1205 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.
 - b. Assemblies with new pinion bearings: 34,5 to 46,0 kgf cm.

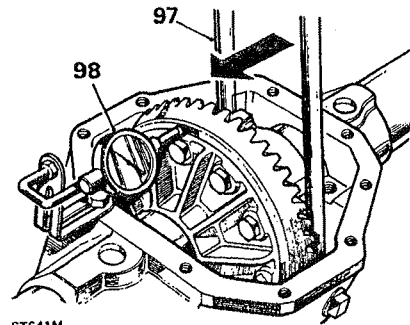
NOTE: Once the bearing spacer has started to collapse the torque resistance build-up is rapid, therefore check frequently, using a spring balance, to ensure the correct figures are not exceeded, otherwise a new collapsible bearing spacer will be required.



ST643M

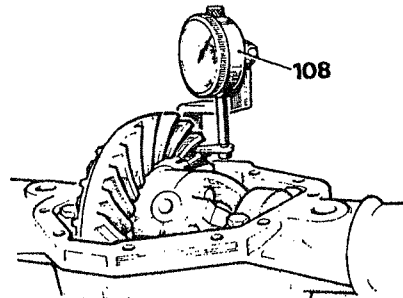
Differential backlash checks

96. Pick up the differential unit as left after instruction 52.
97. Fit the differential unit and lever the unit away from the drive pinion until the opposite bearing cup is seated against the housing. Do not tilt the unit.
98. Install a dial gauge on the casing with its stylus resting on the back face of the crown wheel. Zero the gauge.
99. Lever the differential unit to engage the crown wheel teeth in full mesh with the drive pinion teeth. Do not tilt the unit.
100. Note the total reading obtained on the dial gauge.
101. From this figure subtract 0,25 mm 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.



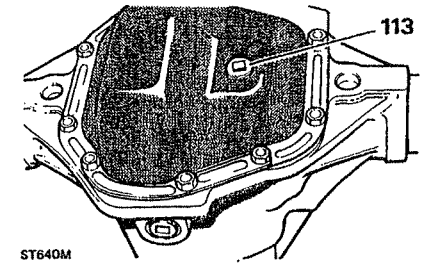
ST641M

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 18G47BL details 1 and 2, press MS47, 18G134DP.
103. Fit the remaining shims from instruction 101 to the opposite side of the differential. 18G47BL details 1 and 2, press MS47, 18G134DP.
104. Fit the differential unit with shims and bearings to the axle casing, using the axle spreader 18G131 C with pegs 1831F.
105. Remove the axle spreader.
106. Fit the bearing caps in their correct position, referring to the relationship markings on the caps and on the axle casing.
107. Tighten the bearing caps fixings to 126 to 142 Nm.
108. Mount a dial gauge on the axle casing with the stylus resting on a crown wheel tooth.



ST642M

109. Prevent the drive pinion from rotating and check the crown wheel backlash which must be 0,15 to 0,27 mm. If the backlash is not within the specified limits, repeat the differential backlash checks, instructions 96 to 102 looking for possible errors.
110. Fit the differential cover and new gasket, coating both sides of the gasket with Hylomar PL 32M or an equivalent non-setting sealant. Torque load for fixings is 27 to 33 Nm.
111. Reverse instructions 3 to 5 and coat the threads of the hub driving member bolts with Loctite 'Studlock' grade CVX and fit and tighten the bolts evenly to the correct torque.
112. Fit the rear axle assembly to the vehicle.
113. Replenish the differential lubricating oil, (see Lubrication chart). After the initial axle run, check the oil level and replenish as necessary to the filler/level plug hole.



ST640M

114. Where major running parts have been replaced during servicing, it is a recommended practice to allow the axle assembly to 'run in' by avoiding, where possible, heavy loads and high speeds during initial running.

DATA

Crown wheel backlash	0,15 to 0,27 mm
Differential bearings pre-load	0,127 mm
Pinion height setting	Set using gauge 18G191P or 18G191-4

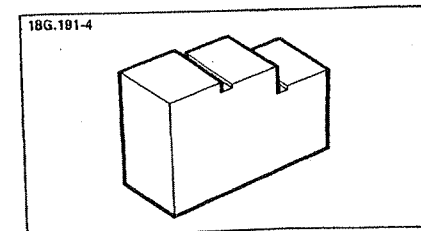
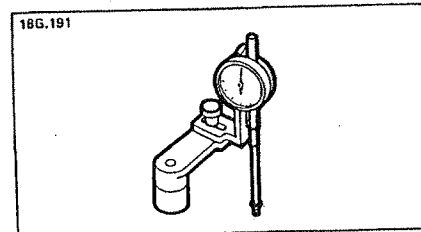
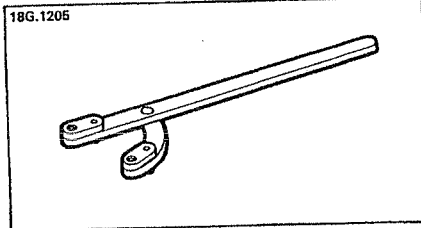
Torque resistance initial setting figures

Torque to turn drive pinion and new pinion bearings.....	34,5 to 46 kgf cm
Torque to turn drive pinion re-using the original bearings	17,3 to 34,5 kgf cm

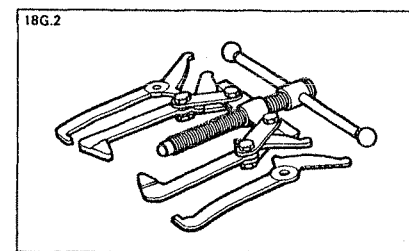
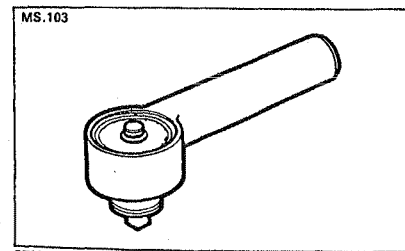
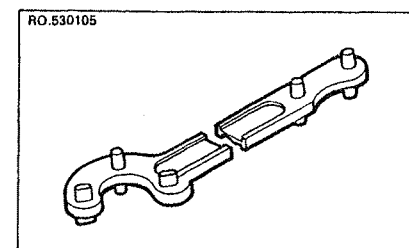
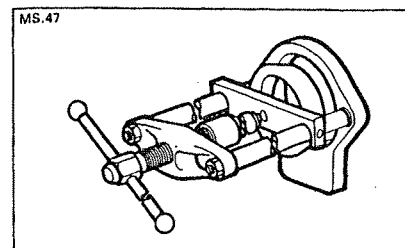
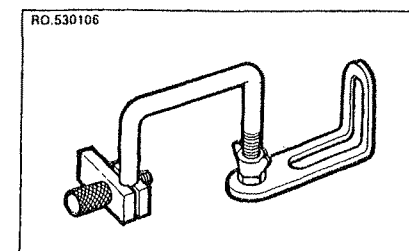
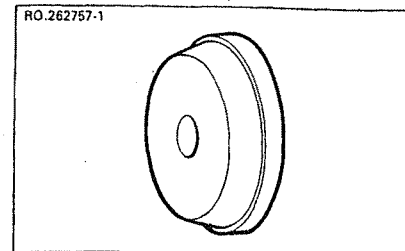
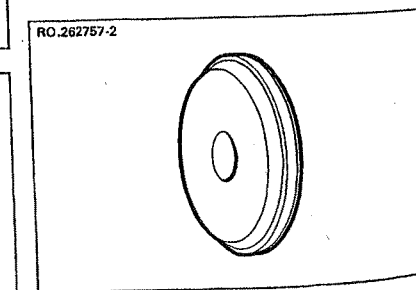
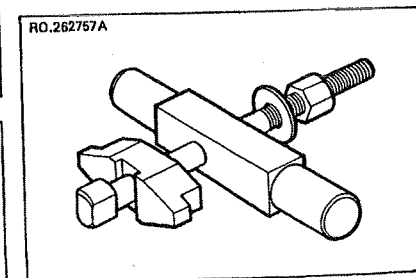
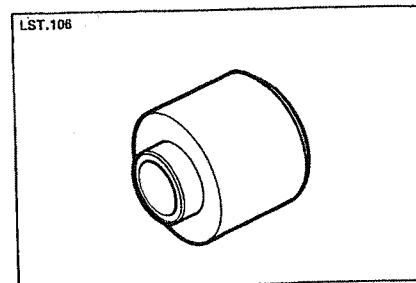
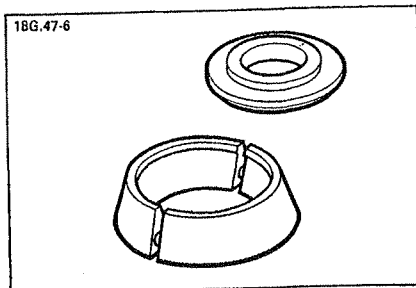
REAR AXLE DIFFERENTIAL ASSEMBLY - Ninety

Special service tools

- 18G1205/LRT-51-003 Flange restrainer tool
- 18G191 Pinion height setting gauge
- 18G191-4/LRT-54-503 Universal setting block
- 18G47-6/LRT-54-502 Pinion head bearing remover/replacer
- LST106/LRT-54-504 Oil seal replacer
- RO262757A/LRT-54-505 Extractor for pinion bearing caps
- RO262757-1/LRT-54-506 Replacer, use with RO262757A
- RO262757-2/LRT-54-507 Adaptor, tail bearing cap replacer
- RO530105/LRT-54-508 Spanner, diff, flange and carrier bearings
- RO530106/LRT-99-503 Bracket for dial gauge
- MS47/LRT-99-002 Press
- 18G 2/LRT-99-500 General purpose puller
- MS103 Torque meter

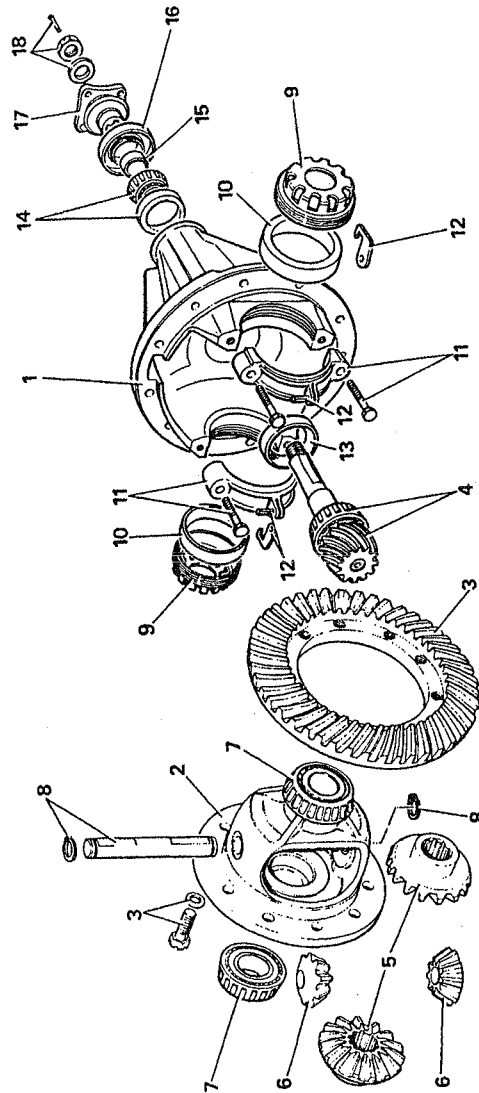


ST2253M



ST2254M

REAR AXLE DIFFERENTIAL



ST2293M

1. Pinion housing
2. Differential carrier
3. Crown wheel and retaining bolts
4. Pinion and head bearing
5. Sun gears
6. Plant gears

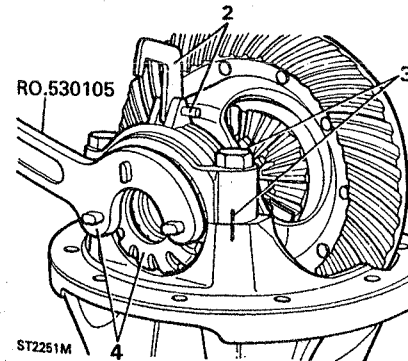
7. Carrier bearings
8. Cross shaft and circlips
9. Carrier bearing adjusting nuts
10. Carrier bearing tracks
11. Carrier bearing caps and bolts
12. Locking fingers and roll pins

13. Pinion head bearing track
14. Pinion tail bearing track
15. Spacer
16. Oil seal
17. Drive flange
18. Drive flange washer, nut and split pin

DISMANTLE

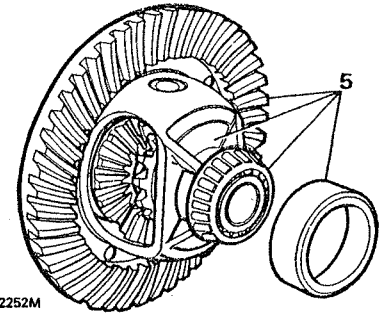
It is important that when dismantling the differential the relationship of the components are marked relative to each other and to their position in the pinion housing and differential carrier so that if refitted, the original settings are maintained to avoid the possibility of noise and premature wear of the overhauled axle. In particular wear of the gears must not be interchanged and new gears should never be matched with worn ones.

1. Drain the oil from the axle and refit and tighten the drain plug. Withdraw the axle shafts and remove the differential assembly from the vehicle. Clean and degrease the exterior of the pinion housing and secure the assembly in a vice in a vertical position.
2. Remove the two bearing nut locking fingers, by driving out the retaining roll pins from the bearing caps using a suitable punch.
3. Mark the caps in relation to the housing and slacken the four bolts securing the two bearing caps.
4. Using special service tool RO530105 or a suitable alternative, unscrew the bearing nuts anticlockwise.



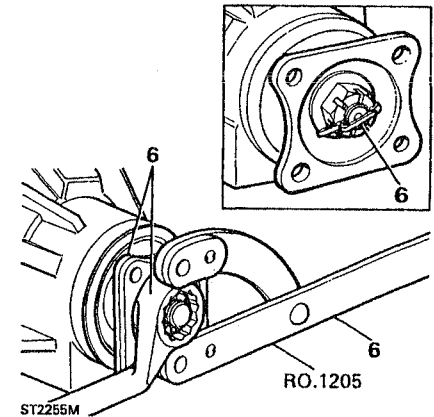
ST2251M

5. Lift-out the crown wheel and differential carrier assembly together with the taper bearings and tracks.



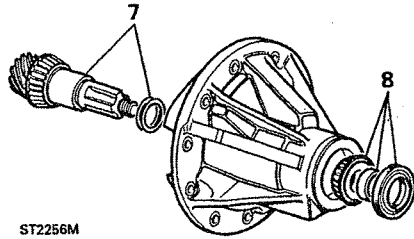
ST2252M

6. Reposition the pinion housing in the vice so that the pinion flange nut is accessible. Remove the split pin from the pinion nut and using special tool RO1205 or the reverse end of RO530105, to restrain the flange, remove the nut anti-clockwise using a socket or ring spanner.



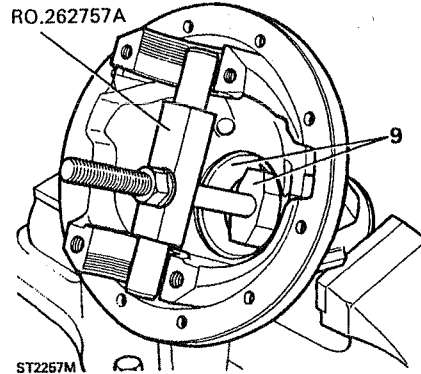
ST2255M

7. Withdraw the pinion complete with the pinion head bearing and shims.
8. Also, remove the oil seal, spacer and pinion tail bearing.

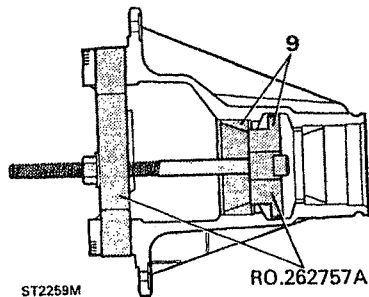


ST2256M

9. To remove the pinion head bearing track use special service tool RO262757A ensuring that the lower end of the tool locates in the two cut outs in the housing. Using a ring spanner turn the nut clockwise and draw out the track and shim.

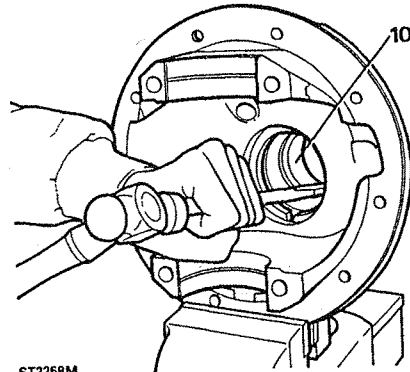


ST2257M



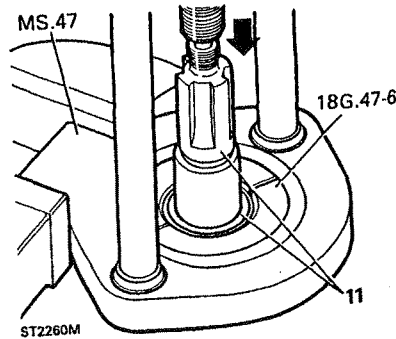
ST2259M

10. Using a suitable drift, drive out the tail bearing track locating the drift in the housing cut outs.



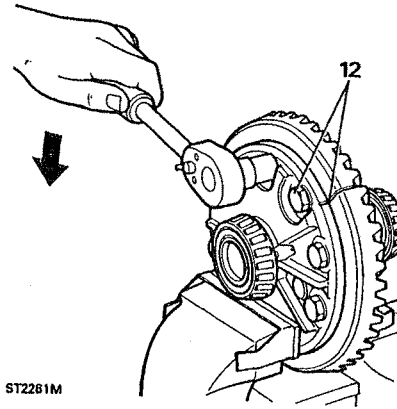
ST2268M

11. Now that all the components have been removed from the pinion housing, the main assemblies can now be dismantled. To remove the pinion head bearing, secure the press tool MS47 in the vice. Encircle the bearing with the adaptor collets 18G47-6 ensuring that the ends of the bearing rollers locate against the internal shoulder of the tool. Insert the assembly into the press tool and press the pinion from the bearing. Remember to hold the pinion to prevent it falling when released from the bearing.



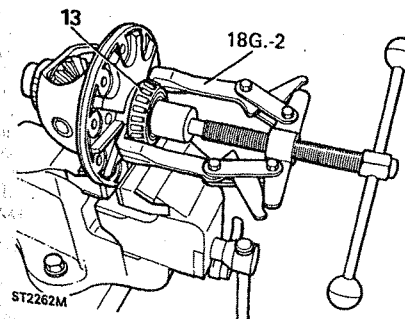
ST2260M

12. Mark the relationship of the crown wheel to the differential carrier and firmly secure the assembly in a soft jawed vice. Remove the ten bolts and washers and withdraw the crown wheel from the carrier. Since the bolt threads are secured with Loctite, it is possible that they will be tight for the entire length.



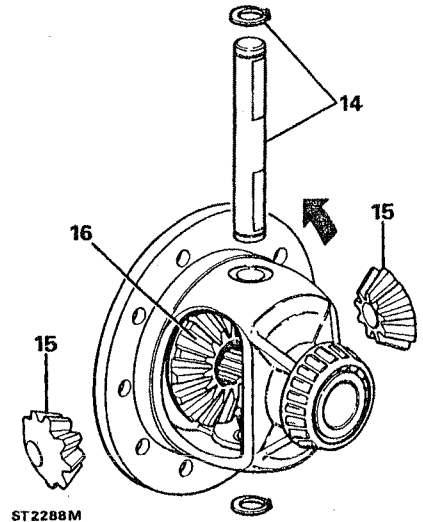
ST2261M

13. Remove the carrier bearings with the general purpose tool 18G2 or a suitable alternative. It is possible, however, to drift-off the bearing from the gear housing side of the carrier by positioning a drift in the two cast indentations behind the bearing. The bearing on the crown wheel side can only be withdrawn with a puller.



ST2262M

14. To remove the differential gears, release one of the two clips securing the cross shaft and push out the shaft.
15. Turn the gear assembly 90 degrees to enable the two planet gears to be withdrawn through the carrier aperture.
16. Finally, remove the two sun gears.

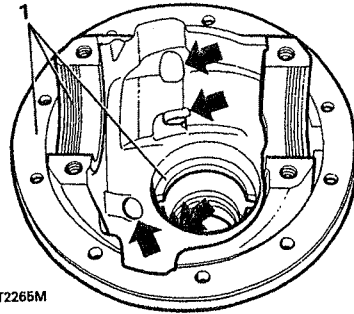


ST2288M

17. Clean and degrease all components ready for inspection. Clean the threads of the crown wheel bolts with a wire brush to remove the old locking compound.

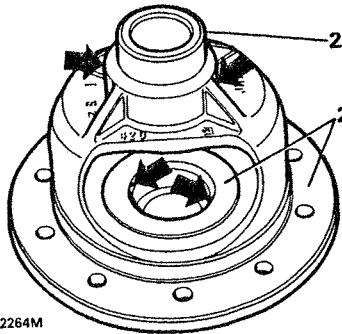
INSPECTION

1. Examine the pinion housing for damage. Check the machined surfaces and remove any burrs. Check the carrier bearing nut threads in the housing and caps and adjusting nuts for damage and repair as necessary. Make sure that the cast-in lubrication passages (arrowed) including the passage to the tail bearing, are completely clear of any obstruction.



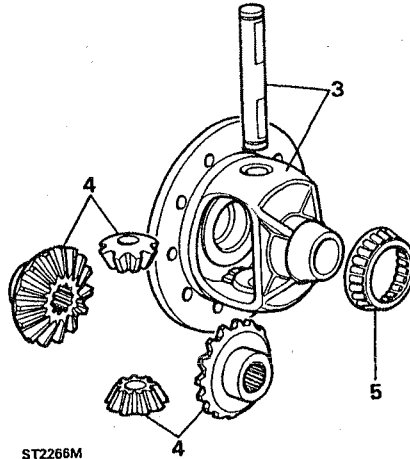
ST2265M

2. Examine the machined surfaces of the differential carrier for damage, pitting, scores and wear and in particular the surfaces on which the sun and planet gears run. Also, ensure that the four lubrication holes (arrowed) are clear. Any obstruction here could cause future bearing failure.



ST2264M

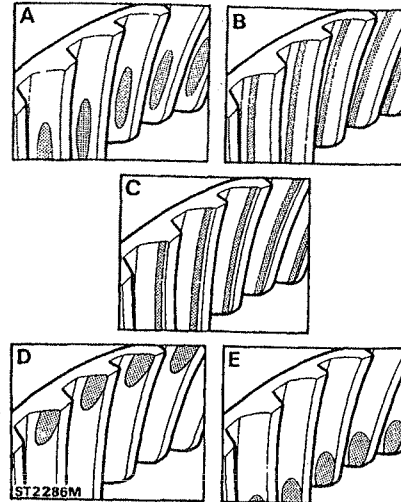
3. Check the cross shaft for scores and pitting. Insert the shaft in the carrier to check for excessive wear.
4. Carefully examine the sun and planet gears for wear on the teeth and the running surfaces in contact with the carrier. Check also for signs of over heating.
5. Inspect all the bearings for wear, pitting, flats on the rollers and overheating. If the bearings are serviceable they can be refitted but if new ones are available they must be renewed together with the tracks.



ST2266M

6. Examine the crown wheel and pinion for excessive and abnormal wear and signs of over-heating. Compare the tooth contact on the crown wheel driving side with the examples illustrated below. These examples, however, are for the rear axle crown wheel where the pinion is driven clockwise. Tooth contact for the front axle crown wheel, where the pinion is driven anticlockwise, is the same but on the opposite side of the tooth. The first example "A" shows the marks that should be made by a correctly meshed crown wheel and pinion. The remaining examples show incorrect tooth contact.

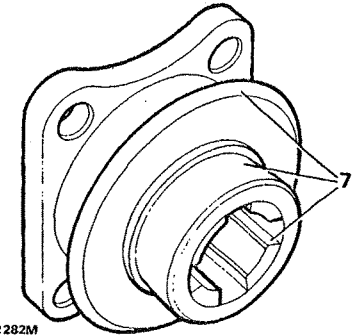
- A. Correct contact.
- B. Root contact - Pinion too far in mesh.
- C. Peak contact - Pinion too far out of mesh.
- D. Toe contact - Excessive backlash.
- E. Heel contact - Insufficient backlash.



ST2286M

NOTE: The crown wheel and pinion are only supplied as a matched set likewise the sun and planet differential gears.

7. Finally, check the condition of the pinion and driving flange splines and ensure that the machined outer diameter of the flange is free from any damage that could destroy a new oil seal. Check that the mud deflector is not damaged or buckled to the extent that it cannot deflect mud and water away from the oil seal.

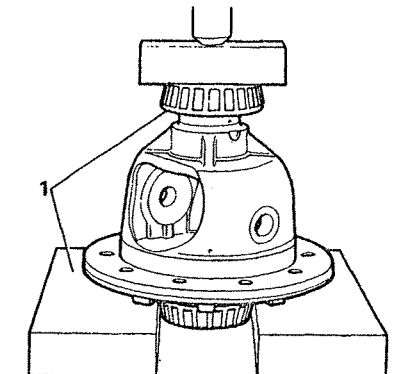


ST2282M

ASSEMBLE

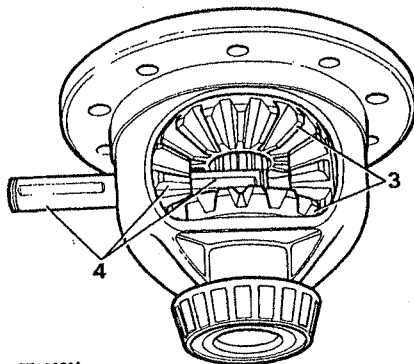
Differential carrier and crown wheel

1. Lubricate the carrier bearing journals with clean oil and start the bearing squarely on to one side of the carrier, largest diameter towards the carrier. It does not matter which bearing is fitted first. Mount the carrier squarely under, a suitable press, supporting it under the flange, as close a possible to the journals. Slowly press the bearing fully home against the carrier shoulder.
2. Repeat the above procedure to fit the second bearing.



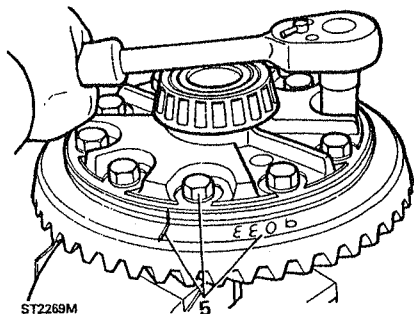
ST2267M

- Lubricate and fit the two sun gears followed by the planet gears.
- Align the planet gears with the carrier holes and fit the cross shaft. Secure the shaft with new circlips. Check the gears for freedom of rotation and that there are not tight spots. Only nominal backlash should be present but if excessive, the gears or the carrier or both should be changed since there is no provision for adjustment.



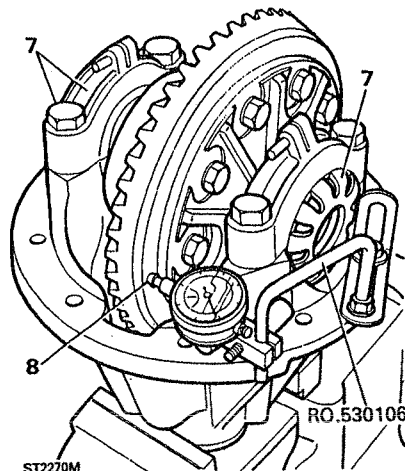
ST2283M

- Check that the serial number etched on the pinion end face is the same as that marked on the crown wheel. Clean the crown wheel and carrier mating faces and check that there are no burrs or any other damage that could cause excessive run-out of the crown wheel. If the original crown wheel and pinion is being refitted ensure that the marks made when dismantling line up. Since the crown wheel is a fairly tight fit on the carrier, the bolt holes should be lined up first while locating the crown wheel squarely on the carrier. Fit and tighten the bolts evenly, a little at a time, until the crown wheel has pulled down on to the carrier flange. Tighten the bolts temporarily to the correct torque.



ST2269M

- To check the crown wheel for run out, secure the pinion housing in the vice in a vertical position. Fit the tracks to the carrier bearings and lower the assembly into the pinion housing.
- Fit the bearing caps, lining up the marks and just nip the bolts. Do not fully tighten. Fit the bearing adjuster nuts and tighten using service tool RO530105 until there is no end float between the bearings. Now, tighten the bearing cap bolts evenly to the correct torque.

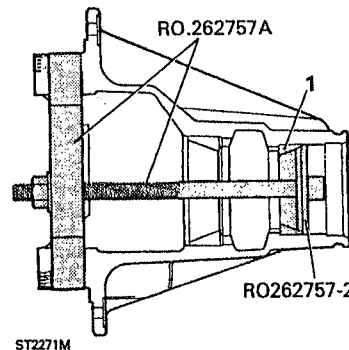


ST2270M

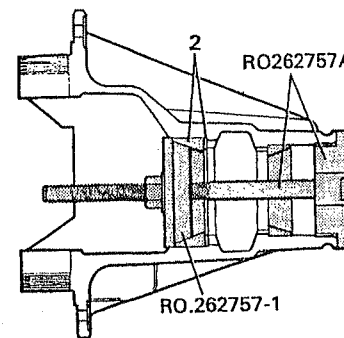
- Mount a dial test indicator on the flange of the pinion housing using bracket RO 530106 so that the stylus rests on the back of the crown wheel. Turn the crown wheel and if the run out exceeds 0,10mm remove the crown wheel from the carrier and check again that there are no burrs, dirt or damage of any kind that could account for excessive run out. Fit the crown wheel again to the carrier and should the run out still persist, the crown wheel and carrier should be individually checked for run out on a lathe or similar equipment where the parts can be accurately turned and measured.
- When satisfied that the run out is within the specified limit, remove the crown wheel bolts, one at a time, coat the threads with Loctite Studlock and refit the bolts tightening evenly to the correct torque.

Fitting pinion bearing tracks

- To fit the pinion tail bearing track, lubricate and start the track squarely in the pinion housing. Assemble the special tool RO262757A and adaptor RO262757-2 as illustrated below. Slowly turn the nut clockwise until the track is fully home against the housing shoulder.



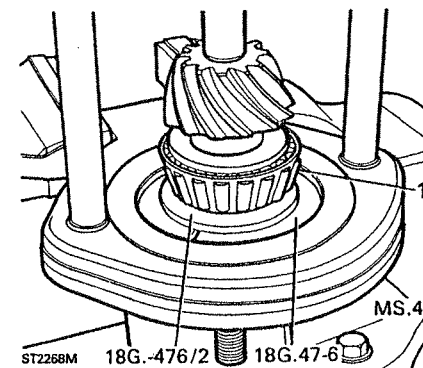
ST2271M



ST2272M

Pinion height setting

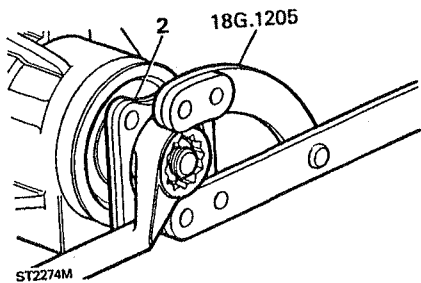
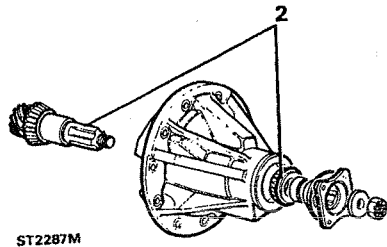
- Fit the pinion head bearing to the pinion with press MS 47 and collets 18G 47-6 and 18G 47-6/2. Note that the smaller register on 18G 47-6/2 must be uppermost against the bearing. Ensure that the larger diameter of the bearing is towards the gear. Lubricate the pinion and press it slowly on to the bearing.



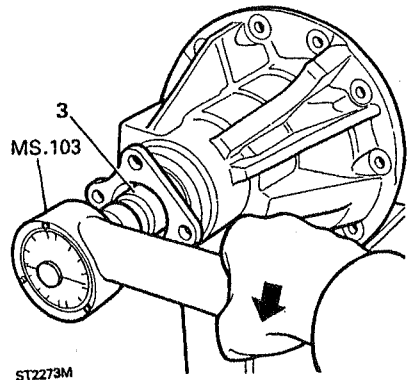
ST2268M

The object of the following instructions is to establish the correct height of the pinion, in the pinion housing, so that it will mesh correctly with the crown wheel. This may entail raising or lowering the pinion by adjusting the value of the shims behind the pinion head bearingtrack. In order to achieve this, the pinion bearings must be temporarily pre-loaded to the same figure as they will be when the differential is finally assembled.

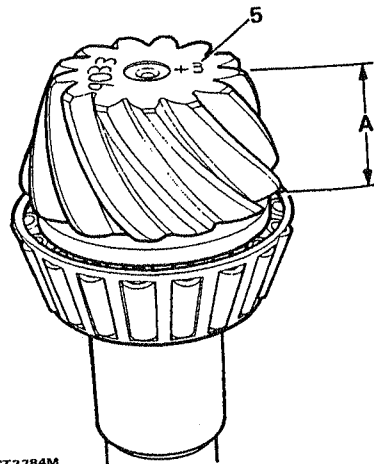
2. Insert the pinion into the housing and fit the tail bearing without any pre-load shims. Fit the spacer and drive flange, omit the oil seal, and secure the assembly with the washer and nut. Restrain the flange with service tool 18G 1205 or the reverse end of RO530105, and slowly tighten the nut a little at a time and remove the flange restrainer.



3. Fit a suitable socket to the torque pre-load meter MS103 or a suitable alternative, and check the pre-load figure by turning the pinion, with the meter, in a clockwise direction. Continue to tighten the nut until the gauge reads 2 to 4 Nm.
4. Note that if the original, bedded-in, bearings are being refitted the pre-load figure should be 1.2 to 1.7.

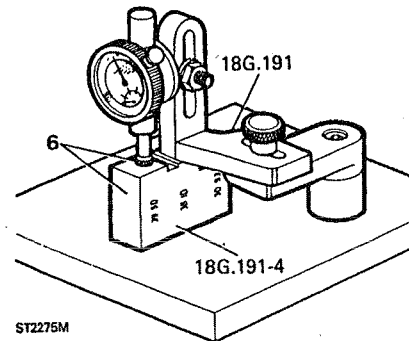


5. Secure the pinion housing vertically in the vice so that the pinion is uppermost. It will be noted that in addition to the serial number etched on the pinion end face there may be a figure with a minus (-) or a plus (+) sign before it. This figure indicates, in thousandths of an inch, whether the depth of the pinion head, (dimension A), is under or oversize from the designed dimension. A pinion without these figures must be set in the pinion housing at the nominal height dimension. The nominal height dimension is represented by the pinion height setting block 18G191-4. The dimension is taken from the pinion end face to the lowest point in the differential carrier bearing saddle in the pinion housing.

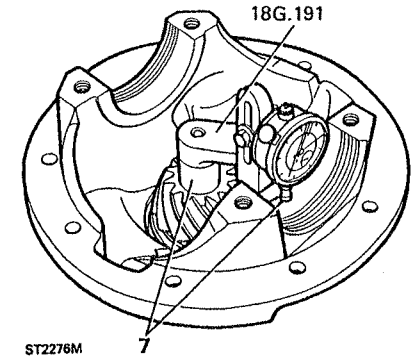


6. Remove the keep disc from the magnetic base of the pinion height setting dial gauge 18G 191 and position the setting block 18G 191-4 and gauge on a surface plate as illustrated. It will be noted that the setting block has three setting heights. It is essential that the correct setting is used for the differential concerned. Rest the stylus on the setting and load the gauge to read approximately 0,40 mm and zero the gauge.

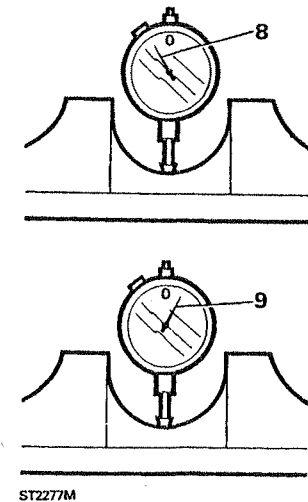
NOTE: The setting block dimensions are as follows:
 39,50 mm Rationalised axle - Latest current axle metric threaded bearing cap bolts.
 38,10 mm Pre-Rationalised axle - recognized by the A/F threaded bearing cap bolts.
 30,93 mm Salisbury axle only.



7. Ensure that the pinion head is clean and smooth. Transfer the gauge to the pinion housing so that the magnetic base sits centrally on the pinion end face and the stylus rests on the lowest point in one of the carrier bearing saddles. Make a note of the dial gauge reading from the zeroed setting and whether the gauge needle moved up or down. Now move the dial gauge across to the other saddle and again note the reading from the zeroed setting. Now add the two readings together and divide by two to obtain a mean reading.



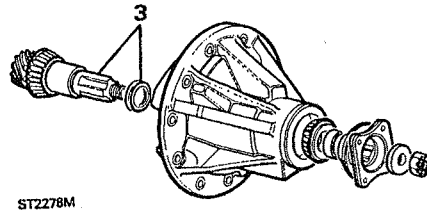
8. If the dial indicator needle did not reach the zeroed setting, the difference between this setting and the position of the needle is the thickness of shims that must be removed from behind the pinion head bearing track to lower the pinion to the nominal dimension.
9. If the indicator needle moved beyond the zeroed setting, the difference between this setting and the position of the needle is the thickness of shims that must be added to those behind the pinion head bearing track to raise the pinion to the nominal dimension.



10. Before actually adjusting the shim thickness, the plus or minus figure, if any, on the pinion face must be taken into consideration when calculating the final thickness of shims that must be removed or added. If the pinion has a plus (+) figure etched on the pinion face subtract this figure, in thousandths of an inch, from the figure obtained in instruction 8 or 9. If the pinion has a minus (-) figure on the pinion face add this to that obtained in instructions - or 9. A pinion without a plus or minus figure must be adjusted to the nominal dimension and shims to the value indicated by the dial test indicator in instruction - or 9 should be added or removed.
11. Remove the pinion from the housing and withdraw the pinion head bearing track as previously described. Adjust the shim thickness as required by the above calculations. Refit the bearing track and shims and ensure that once again the track is pressed fully home.
12. Having made the necessary adjustments the pinion height setting must be checked again to ensure that the calculations and adjustments are correct. Refit the pinion to the housing and pre-load the bearings, as before, repeating instructions 2 and 3 above. Now set up the dial gauge and carry out the pinion height check again exactly as described in instructions 6 and 7. If the pinion height setting is correct, the mean reading obtained will agree with the figure etched on the pinion end face. For example, a pinion with an end face figure of +3 the dial gauge reading should indicate that the pinion head depth is indeed 0.003 in (0.0762 mm) oversize.

Pinion bearing pre-load adjustment

1. Position the pinion housing horizontally in the vice. From the pinion housing remove the drive flange, spacer, tail bearing and pinion.
2. Fit a new shim or shims of the same thickness as the originals to the pinion. If these are lost and the thickness is unknown fit shims to the value of at least 4,06 mm.
3. Fit the pinion, with the shims, to the housing, then the tail bearing followed by the spacer and driving flange. Omit the oil seal at this stage and secure the assembly with the washer and castle nut.



ST2278M

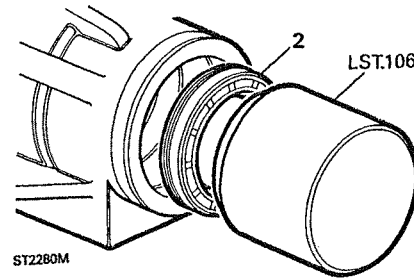
4. Tighten the flange nut to the specified torque whilst holding the flange with service tool 18G1205, as before. The torque now required to turn the pinion, if new bearings have been fitted, should be between 2 to 40 Nm once the initial inertia has been overcome. If the original, bedded-in, bearings have been refitted, the figure should be between 1.2 to 1.7 Nm. To check the torque or pre-load, use the Torque meter MS 103 and a socket and turn the pinion whilst noting the meter reading. If necessary, dismantle the pinion assembly and change the bearing pre-load shims in order to achieve the correct torque figure. As a guide, thicker shims will reduce the torque or pre-load and thinner shims will increase the torque. Reassemble the pinion again and recheck the torque.

Fitting pinion oil seal

1. Having established the correct thickness of shims the pinion drive flange must be removed to fit the oil seal. Examine the seal before fitting to ensure that it is clean and undamaged, since even a small scratch on the seal lips could impair its ability to prevent oil leaking. Also check that the garter spring is properly located. Whilst the distance piece can be inserted after the seal has been fitted, the tail bearing will not pass through the seal, so it is important to check that the bearing is in position.

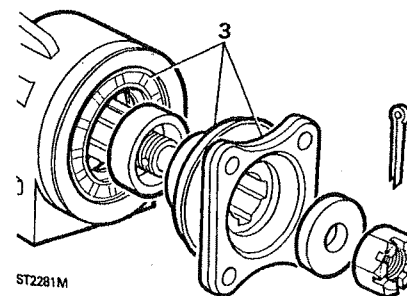
CAUTION: When fitting the latest type oil seal FRC 8220 in place of the early type FRC 4586 the latest mudshield FRC 8154 must be fitted in place of the early type 236072. Also seal replacer 18G1382 must be used to fit the early type oil seal FRC4586. This tool must not be used to fit latest seal FRC8220.

2. Smear the outer diameter of the new seal with a recommended all purpose grease and with the lip side leading, start is squarely into the pinion nose housing. Using special service tool LST106, drive the seal home to the depth determined by the tool.



ST2280M

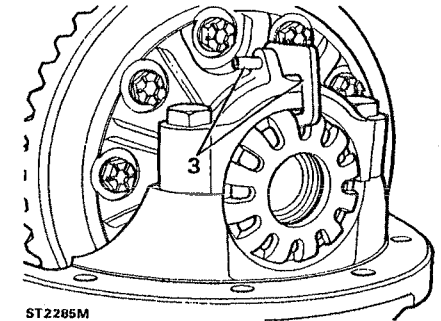
3. Lubricate the seal lips with a recommended axle oil. Check that the flange seal running surface is clean, smooth and free from imperfections that could damage the seal. Carefully fit the drive flange and secure with the washer and nut. Tighten the nut to the correct torque whilst holding the flange with restraining tool 18G 1205. If necessary continue to tighten the nut to line up the split pin hole and fit a new split pin.



ST2281M

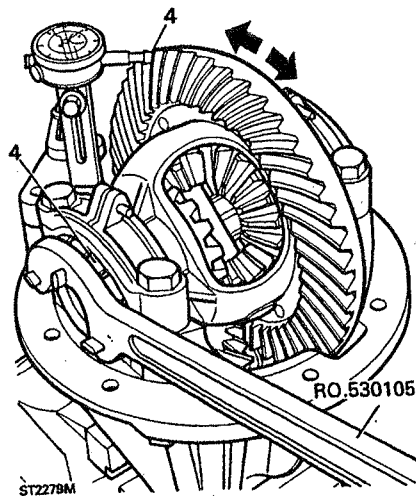
Adjust crown wheel and pinion backlash

1. Return the pinion housing to the vertical position and lower the Crown wheel and differential assembly into the pinion housing. Lubricate the carrier bearings and fit the tracks. Fit the bearing caps so that the assembly marks line up and fit the bolts, finger tight only.
2. Move the crown wheel into mesh with the pinion and fit the bearing adjusting nut on the crown wheel side. Using wrench RO530105 tighten the nut with just sufficient nip to remove any backlash between the crown wheel and pinion.
3. Line up the centre of the locking finger lug with a slot in the adjusting nut. Fit the locking finger and secure with the roll pin. Fit the opposite nut and tighten, with the above wrench, until resistance is felt.



ST2285M

4. Mount the pinion height setting gauge, with the magnetic base on the pinion housing flange and the stylus resting against a crown wheel tooth. Continue to tighten the nut, on the carrier side, until a backlash of 0,10 to 0,17 mm is achieved. Do not slacken the crown wheel side nut otherwise the backlash and bearing pre-load will be lost. Line up the locking finger lug with a slot in the nut.



PINION PRE-LOAD SHIMS

PART No.	MM
FRC1193	1.52
FRC1195	1.57
FRC1197	1.63
FRC1199	1.68
FRC1201	1.73
FRC1203	1.78
539718	1.83
539720	1.88
539722	1.93
539724	2.03

- After evenly tightening the bearing cap bolts to the correct torque, check the backlash again to ensure that it has not altered the setting. Fit the locking finger and secure with the roll pin.
- Locate a new joint washer over the axle casing studs, liberally lubricate the bearings and gears and refit the differential assembly to the axle. Fit and tighten the retaining nuts evenly to the correct torque.
- Check that the drain plug is tight and remove the axle oil filler level plug. Inject approximately 1,70 litres of a recommended axle oil until it begins to run from the level hole. Fit and tighten the plug and wipe away any surplus oil.

PINION HEIGHT SHIMS

PART No.	MM
549230	0.97
549232	1.02
549234	1.07
549236	1.12
549238	1.17
549240	1.22
549242	1.27
549244	1.32
549246	1.37
549248	1.42
549250	1.47
549252	1.52
576236	1.57
576237	1.60
576238	1.63
576239	1.65

DATA

Pinion bearing pre-load:

New bearings	2.0 - 4.0 Nm
Bedded-in bearings	1.2 - 1.7 Nm
Crown wheel run-out	0.10 mm
Crown wheel and pinion backlash	0.10 - 0.17 mm

TORQUE FIGURES

Pinion housing to axle case	36 - 46 Nm
Crown wheel to differential case	55 - 61 Nm
Bearing cap to pinion housing	80 - 100 Nm
Drive flange to propeller shaft	41 - 52 Nm
Bevel pinion nut	95 - 163 Nm

Notes

DEFENDER

FRONT AXLE AND FINAL DRIVE 54

FRONT HUB ASSEMBLY

OVERHAUL

Service tools:

- 18G 134/LRT-99-003 Bearing and oil seal replacer
- 18G 1349/LRT-54-501 Hub oil seal replacer
- RO 530106/LRT-99-503 Dial gauge bracket

DISMANTLE

1. Slacken road wheel nuts.
2. Jack up the vehicle and lower onto axle stand.
3. Remove the road wheel.
4. Slacken the lock nuts securing the jump hose to the retaining bracket.
5. Remove the two bolts securing the brake caliper, see section 70 - brake disc renewal - and whilst withdrawing the caliper from the brake disc release the jump hose from the bracket. Tie the caliper securely to one side.

NOTE: Since the bracket on later vehicles is not open-ended, the caliper must be removed completely, which involves disconnecting the jump hose.

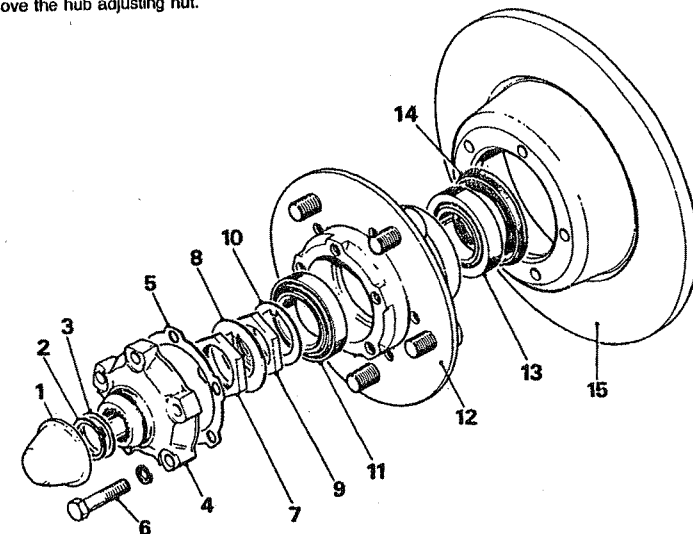
6. Lever-off the dust cap.
7. Remove the circlip from the drive shaft.
8. Remove the drive shaft shim.
9. Remove the five bolts and withdraw the driving member and joint washer.
10. Bend back the lock washer tab.
11. Remove the locknut and tab washer.
12. Remove the hub adjusting nut.

13. Remove the key washer.
14. Withdraw the hub and brake disc assembly complete with bearings.
15. Remove the outer bearing.
16. Mark, for reassembly, the relationship between the hub and brake disc, if original hub is to be refitted.
17. Remove the five bolts and separate the hub from the brake disc.

NOTE: The road wheel retaining studs must not be renewed. Should any studs be unserviceable a new hub complete with studs must be obtained.

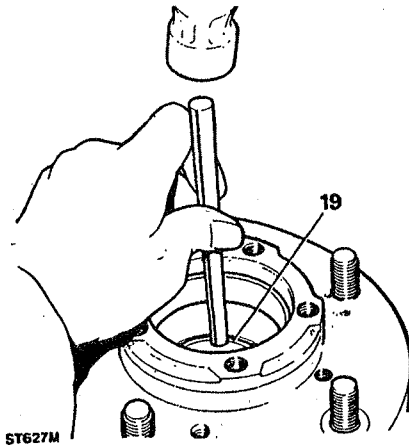
KEY TO HUB ASSEMBLY

1. Dust cap.
2. Drive shaft circlip.
3. Drive shaft shim.
4. Drive member.
5. Drive member joint washer.
6. Drive member retaining bolt (five off).
7. Lock nut.
8. Lock washer.
9. Hub adjusting nut.
10. Keyed washer.
11. Outer bearing.
12. Hub.
13. Inner bearing.
14. Grease seal.
15. Brake disc.



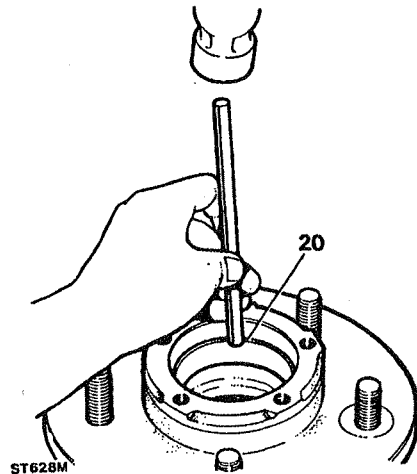
ST633M

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.



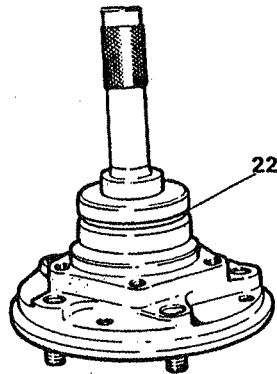
Assemble

20. Clean and degrease the hub and drift-in the inner and outer bearing tracks.

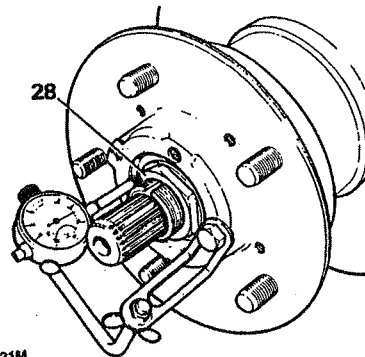


21. Pack the hub inner bearing with a grease recommended in the lubrication chart and fit to the hub. Use a minimum of 8,5 grams of grease.

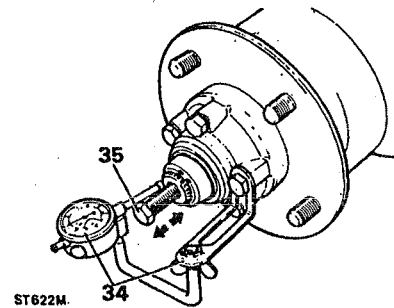
22. With the lip side leading fit a new seal to the hub using special tool 18G 1349 grease seal replacer and drift 18G 134. Drive-in the seal so that it is recessed 4,83 to 5,33 mm below the rear face of the hub. Apply grease liberally between the seal lips and springs.



23. Assemble the brake disc to the hub lining up the marks made during dismantling. Fit and tighten the five retaining bolts to 65 to 80 Nm.
24. Grease as in instruction 21 and fit the outer bearing to the hub.
25. Clean the stub axle and drive shaft and fit the hub assembly to the axle.
26. Fit the key washer.
27. Fit the hub adjusting nut and tighten by hand whilst rotating the hub until all end-play is taken up.
28. Mount a dial gauge using bracket RO 530106 and rest the stylus in a loaded condition on the adjusting nut.



29. Slacken off the adjusting nut until an end-play of 0,1270 to 0,1016 mm is obtained.
30. Fit a new keyed lock tab washer.
31. Fit and tighten the hub adjusting nut and re-check the end-play before bending the lock tab over.
32. Fit a new joint washer to the driving member and fit the member to the hub and secure with the five bolts tightening evenly to 60 to 70 Nm.
33. Fit the original drive shaft shim and secure with the circlip.
34. To check the drive shaft end-play mount a dial 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.



36. If the end-play requires adjustment, remove the circlip, measure the shim thickness and fit an appropriate selective shim to give the required end-play.
37. Remove the bolt from the drive shaft, fit the circlip and dust cap.
38. Fit the brake caliper and tighten the two bolts to the correct torque.
39. Locate the jump hose in the bracket and tighten the locknuts or see caution below.

CAUTION: If the jump hose was disconnected as is necessary on later vehicles the brake hydraulic system must be bled.

40. Fit the road wheel, remove the axle stand and finally tighten the road wheel nuts.
41. Operate the footbrake several times to locate the brake pads before taking the vehicle on the road.

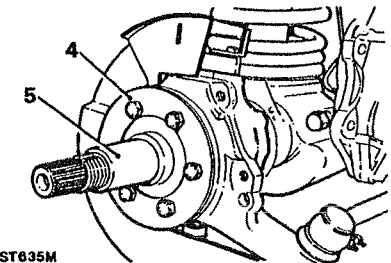
STUB AXLE, AXLE SHAFT, CONSTANT VELOCITY JOINT AND SWIVEL ASSEMBLY

OVERHAUL

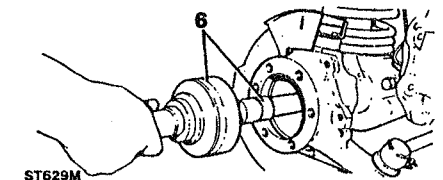
Special tool:
18G 284AAH /LRT-37-004 bush extractor

Remove stub axle, axle shaft and constant velocity joint

1. Remove the hub complete as described in the operation to overhaul the hub assembly instructions 1 to 14.
2. Drain the swivel pin housing and refit plug.
3. Remove the six bolts retaining the stub axle to the swivel housing.
4. Remove the mud shield.
5. Remove the stub axle and joint washer.

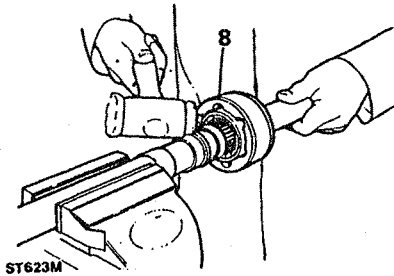


6. Pull-out the axle shaft and constant velocity joint from the axle casing.



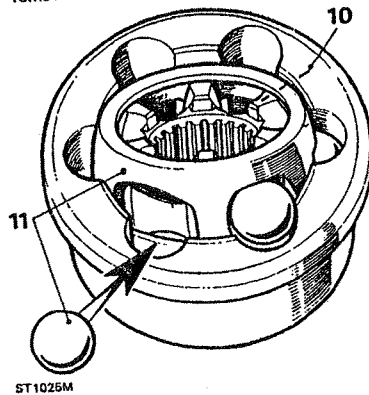
Remove constant velocity joint from axle shaft

7. Hold the axle shaft firmly in a soft jawed vice
8. Using a soft mallet drive the constant velocity joint from the shaft.
9. Remove the circlip and collar from the axle shaft.



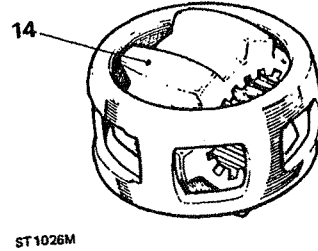
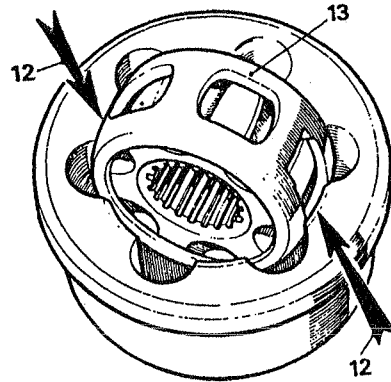
Dismantle the constant velocity joint

10. Mark the relative positions of the constant velocity joint inner and outer race and the cage for correct reassembly.
11. Tilt and swivel the cage and inner race to remove the balls.



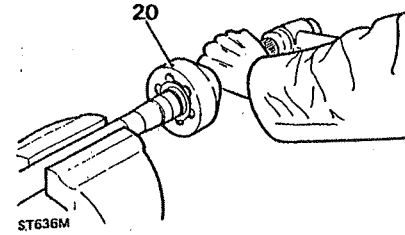
12. Swivel the cage into line with the axis of the joint and turn it until two opposite windows coincide with two lands of the joint housing.

13. Withdraw the cage.
14. Turn the inner track at right angles to the cage with two of the lands opposite the cage openings and withdraw the inner race.
15. Degrease and examine all components for general wear and condition.
16. Examine the inner and outer track, cage balls and bearing surfaces of the constant velocity joint for damage and excessive wear.
17. To assemble the constant velocity joint, reverse the dismantling instructions and lubricate with a recommended EP oil.
18. Check that the end-float of the assembled joint does not exceed 0,64 mm.



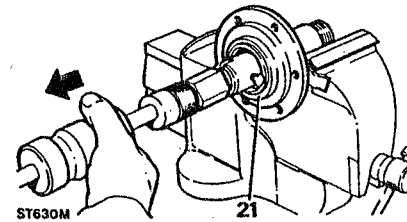
Fit constant velocity joint to axle

19. Fit the collar and a new circlip.
20. Engage the constant velocity joint on the axle shaft splines and using a soft mallet, drive the joint home.



Renew stub axle intermediate oil seal and bush

21. To remove the bronze bush and oil seal use special tool 18G 284AAH and a slide hammer. Ensure that the fingers of the tool locate behind the bush, not the oil seal. Drive-out the bush, then extract the oil seal.



22. Lubricate the seat 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

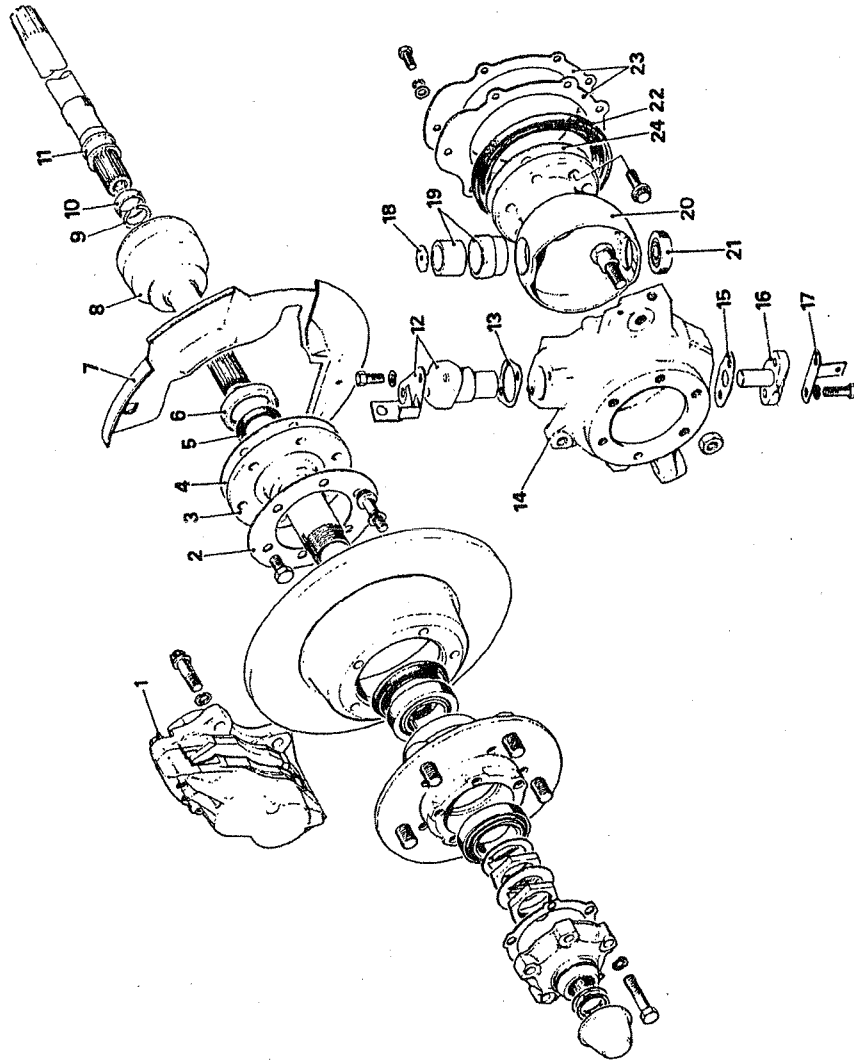
36. Prise-out the oil seal from the back of the housing.
37. Drift-out the lower swivel pin bearing track.
38. Press-out the upper swivel pin in Railko bush housing.
39. If worn, pitted or damaged, renew the housing.
40. Press-in the lower swivel pin bearing track.
41. Press-in the Railko bush housing 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.

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.
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.



51634H

KEY TO DRIVE SHAFT AND SWIVEL ASSEMBLY

- | | | |
|--|--|---|
| <ul style="list-style-type: none"> 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. | <ul style="list-style-type: none"> 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. | <ul style="list-style-type: none"> 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. |
|--|--|---|

54 FRONT AXLE AND FINAL DRIVE

DEFENDER

52. Lubricate the Railko bush with an EP oil and fit the top swivel pin with existing shims and fit the securing bolts and jump hose bracket (do not tighten).
53. Coat the threads of the lower swivel pin bolts with Loctite 270 and fit, together with the brake disc shield bracket, and tighten to 22 to 28 Nm.
54. Tighten the top swivel pin securing bolts to 60 to 70 Nm.
55. To check the top swivel pin pre-load attach a spring balance to the track-rod ball joint bore and pull the balance to determine the effort required to turn the swivel. The resistance, once the initial inertia has been overcome, should be 3,60 to 4,50 Kg. If necessary, adjust by removing or adding shims to the top swivel pin as required.



ST637M

56. Liberally apply - but do not pack - a recommended grease between the lips of the swivel oil seal (2,5 to 4,0 grams).
57. Secure the oil seal and joint washer with the retaining plate and securing bolts tightening evenly to 7 to 10 Nm.
58. Fit the track-rod and drag link and secure with new split pins.
59. Fit the brake disc shield.
60. Loosely fit the lock stop bolt and nut for later adjustment.

Fit drive shaft and stub axle

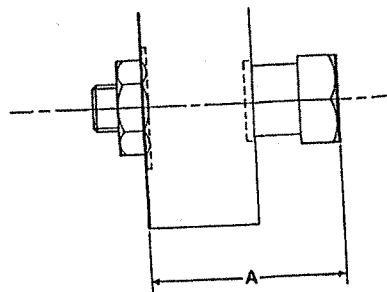
61. Place a new joint washer in position on the swivel pin housing to stub axle mating face.
62. Taking care not to damage the axle shaft oil seals, insert the axle shaft, and when the differential splines are engaged, push the assembly home.
63. Fit the stub axle with the keyway uppermost at 12 o'clock. At this stage it is most important to ensure that the constant velocity joint bearing journal engages fully into the bronze bush in the rear of the stub axle before the stub axle is secured with bolts. Damage to the bush can occur if this

precaution is not observed. To ensure proper engagement, grasp the stub axle with one hand and with the other pull the axle shaft into the bush. The shaft and bush are correctly engaged when the end of the axle shaft splines are flush with the end of the stub axle. This condition must be maintained during all ensuing assembly operations.

64. Place the mud shield in position and secure the stub axle to the swivel pin housing with the six bolts using Loctite 270 and evenly tighten to 60 to 70 Nm.
65. To complete the reassembly, follow instructions 25 to 41 covering front hub overhaul.
66. Check that the swivel pin housing drain plug is tightly fitted and remove the filler level plug.
67. Inject approximately 0,28 litres of recommended EP oil until the oil begins to run out of the filler hole. Fit and tighten the plug and wipe away any surplus oil.
68. Set the steering lock-stop bolts to provide a clearance between the tyre wall and radius arm in accordance with the dimensions below. This dimension however, must be set to 56 mm, irrespective of tyre size and type where steering gaiters are fitted.

Tyre Size	Dim 'A'
750x16 Michelin XS	54,00 mm
750x16 Avon Rangers	54,00 mm
(All others)	51,00 mm

The clearance should be set to a minimum of 20 mm on vehicles fitted with 205R X 16 or 600 X 16 tyres.



ST1801M

Front axle differential

Overhaul

The overhaul procedure for the front differential is identical to the procedure for the standard ninety rear differential, therefore refer to SECTION 51 page 22.

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* Adwest early models

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DEFENDER

STEERING 57

GEMMER MANUAL STEERING BOX OVERHAUL

Special tool:
RO 1016/LRT-57-017 Torque setting tool

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. 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

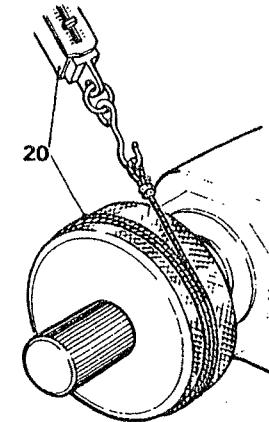
13. Clean and degrease all parts and examine for wear and damage.
14. Renew the bearings (if worn), oil seals and joint washers and any other unsatisfactory parts.
15. If the bearing in the top cover is worn renew the complete cover with bearing.
16. Check that no end-play exists in the sector shaft adjuster. If end play is evident renew sector shaft assembly.

Assembling

Cleanliness, during the following instructions, is essential.

17. 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.
18. Lubricate and fit the bearing to the shaft and insert the shaft into the box.
19. Lubricate and fit the opposite bearing and track to the worm.
20. Fit the cover plate, joint washer and original shims. Secure with the four bolts and evenly tighten to 25 to 30 Nm.
21. Check the worm shaft bearing pre-load by attaching special tool RO1016 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 Kgf (5 to 6 lbs f). 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.

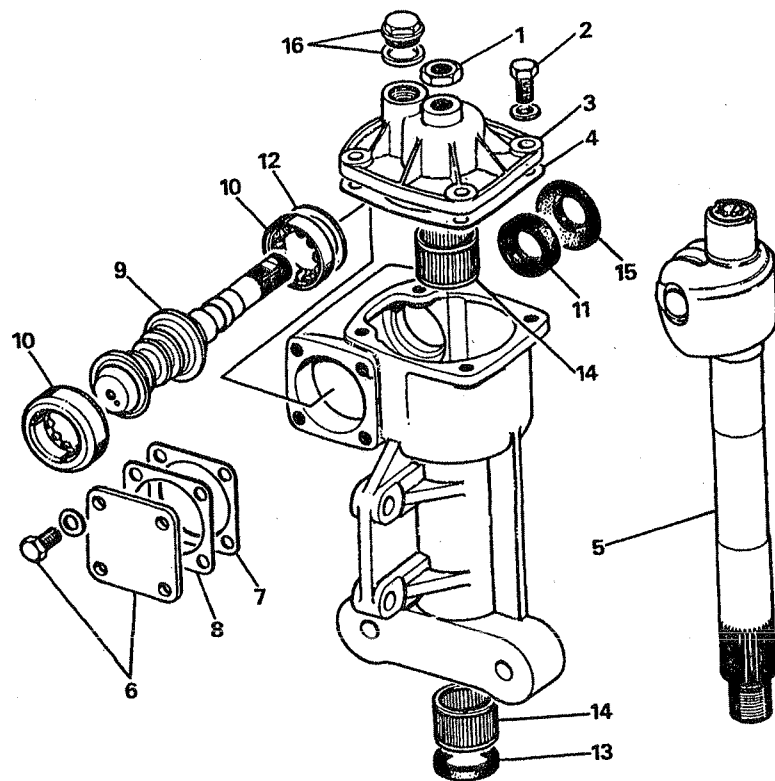


ST 8874A

22. With the lip side leading fit the worm shaft oil seal and grommet to the shaft-end of the box.

NOTE: When performing instructions 22, 23 pressure must only be applied to the hardened square end of the bearings.

23. Press in the sector shaft top bearing to a depth of 83 mm from the top machined face of the steering box.
24. Press in the sector shaft lower bearing 1,00 mm below the chamfer.
25. Fit the sector shaft so that the roller is in the centre of the worm in the straight ahead position.
26. Screw the top cover onto the adjuster and secure with the four bolts and evenly tighten to 25 to 30 Nm.
27. Loosely fit the adjuster locknut.
28. 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.
29. Fit the sector shaft oil seal.
30. Remove the oil filler plug and pour in 0.43 litres of the appropriate recommended oil to a minimum level of 25 mm below the top of the filler hole. Refit the plug and tighten to 20 Nm.



ST3354M

KEY TO MANUAL STEERING BOX

- | | |
|--|--|
| 1. Adjuster lock nut. | 8. Worm shaft joint washer. |
| 2. Top cover retaining bolts. | 9. Worm shaft. |
| 3. Top cover. | 11. Worm shaft oil seal. |
| 4. Top cover joint washer. | 12. Worm shaft bearing track shim. |
| 5. Sector shaft. | 13. Sector shaft oil seal. |
| 6. Worm shaft retaining plate and bolts. | 14. Sector shaft needle roller bearings. |
| 7. Worm shaft shim(s). | 15. Worm shaft grommet. |
| | 16. Oil filler plug and washer. |

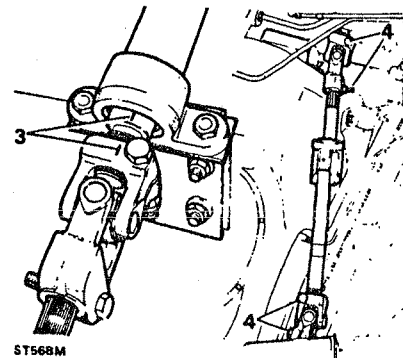
REMOVE AND OVERHAUL STEERING COLUMN

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

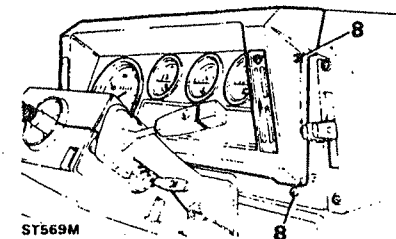
Remove the steering wheel

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.

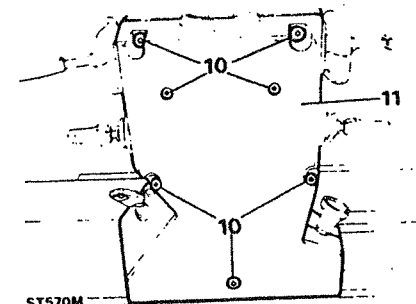
8. Remove the four screws securing the instrument panel and pull panel away from facia to enable the speedometer cable to be disconnected.
9. Also disconnect two block connectors, one multiplug connector and one white wire and withdraw the panel complete with instruments.



ST569M

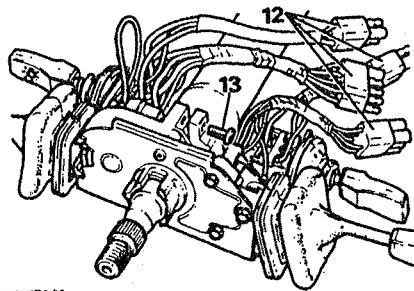
Remove the steering column switches

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

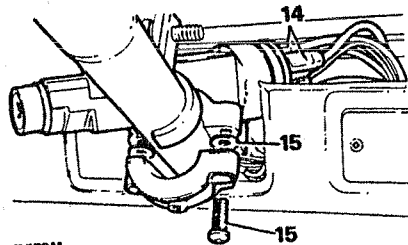
12. Disconnect the four multi-plugs, one for each switch making note of their positions.
13. Remove one clamp screw on top of the switch cluster and withdraw the switches.



ST571M

Remove the steering column lock-switch

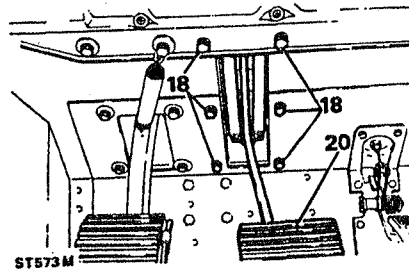
14. Note the position of the wires on the back of the lock switch and disconnect the lucars.
15. Using a punch or stud extractor remove the two shear bolts securing the switch to the column. Remove the switch and collect the two plain washers between the switch and clamp.



ST572M

Remove the brake pedal box

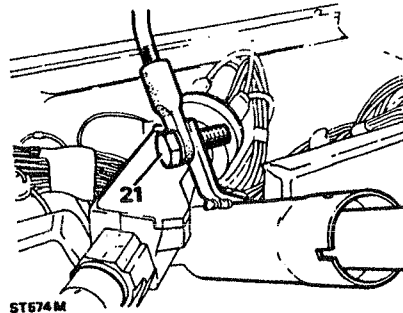
16. Remove the vent cover and the strip retaining the mill board trim covering the brake pedal mechanism and remove the trim, to expose the pedal box bolts.
17. Remove the two nuts securing the brake master cylinder to the servo and disconnect the vacuum hose from the servo.
18. Remove the six bolts 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.



ST573M

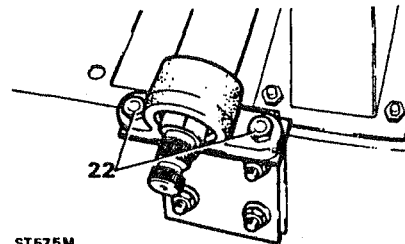
Remove the steering column

21. Remove the bolt securing the tie-bar to the steering column, behind the instrument panel.



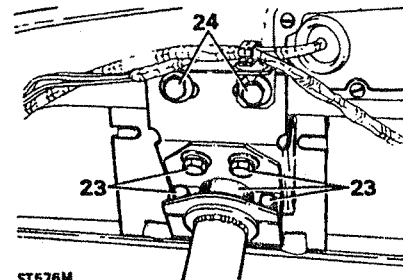
ST574M

22. Remove the two bolts securing the lower end of the column.



ST575M

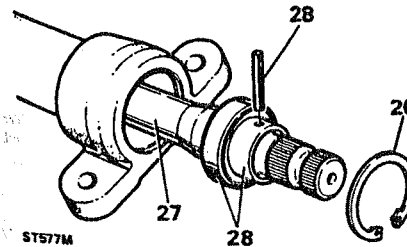
23. Remove the two bolts securing the two halves of the top clamp and the two bolts that secure the top half of the clamp to the bulkhead and remove the clamp and rubber packing.
24. Remove the two bolts securing the column main support bracket to the bulkhead.
25. Remove the steering column and main support bracket from the vehicle.



ST576M

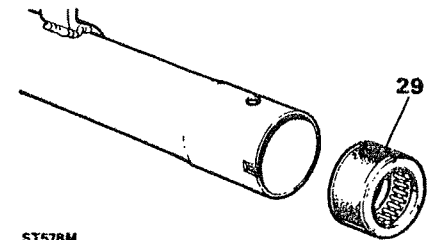
Overhaul the steering column

26. Remove the circlip from the lower end of the steering column.
27. Drift out the inner shaft complete with bearing from the top end of the column.
28. Remove the roll pin from the bearing retaining collar and drive the collar and bearing from the inner shaft.



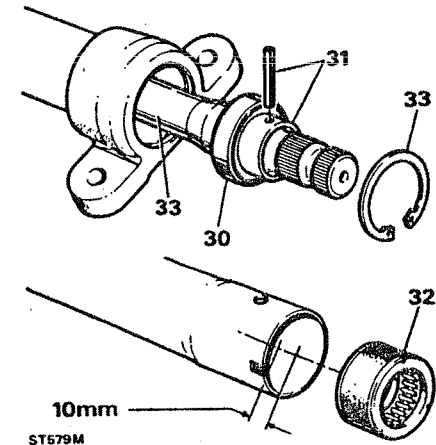
ST577M

29. Drive the needle bearing from the outer column.



ST578M

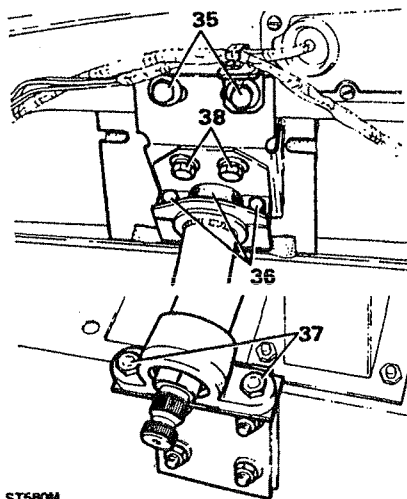
30. Fit a new bearing to the lower end of the inner shaft.
31. Fit the retaining collar, ensuring that it butts against the bearing and that the roll pin holes line up. Secure with the roll pin.
32. Fit a new roller bearing to the top end of the outer column to a depth of 10 mm.
33. Fit the inner shaft and bearing assembly to the outer column and secure with the circlip.



ST579M

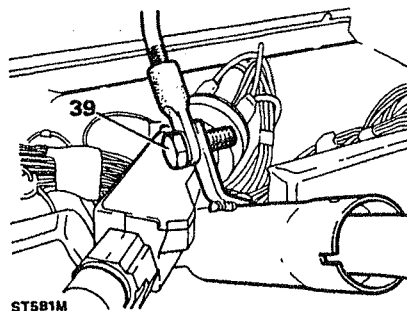
Fitting steering column

34. Fit the main support bracket and padding to the steering column and manoeuvre the column into position in the vehicle.
35. Loosely secure the main support bracket and harness bracket to the bulkhead with two bolts.
36. Loosely fit the clamp and rubber packing strip to the column and retain with two bolts.
37. Loosely secure the lower end of the column to the lower support bracket with two nuts and bolts.
38. Loosely secure the clamp bracket to the main support bracket with two bolts.



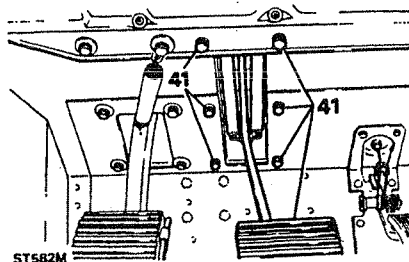
ST580M

39. Working inside the vehicle cab, fit the tie-bar to the column bracket and secure with the single bolt.
40. Finally tighten the main support bracket bolts, clamp bracket bolts, upper clamp bolts and the lower support bracket nuts and bolts.



ST581M

41. Fit the pedal box and secure with the six bolts. Fit the pedal assembly mill board trim and secure with retaining strip, vent cover and screws.
42. Fit the master cylinder to the servo and connect the servo vacuum hose.
43. Connect the stop lamp switch leads.

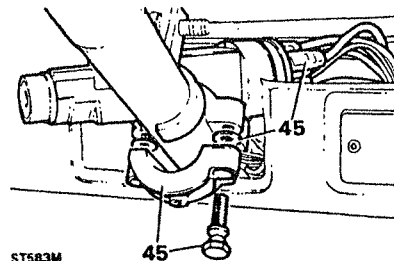


ST582M

Fit steering column lock switch

44. Place lock switch in position and rotate the steering column inner shaft to line up the slot with the switch plunger.

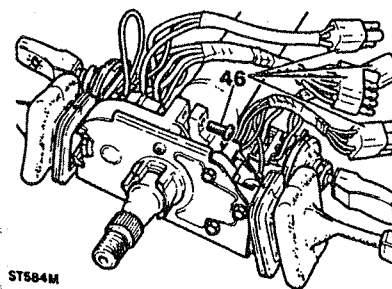
45. Secure the lock to the column with the clamp and shear bolts, whilst inserting two plain washers between the switch and clamp. Temporarily fit the steering wheel and operate the switch and lock mechanism several times to ensure it functions properly before finally tightening the bolts until the heads shear. Connect the electrical leads to the rear of the switch.



ST583M

Fit steering column switch assembly

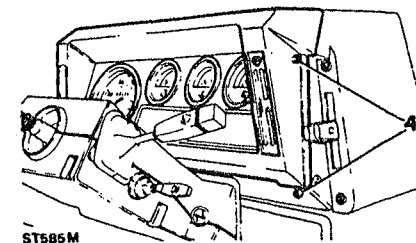
46. Fit the steering column switch assembly and secure with the single screw. Connect the four multi-plugs to the main harness.



ST584M

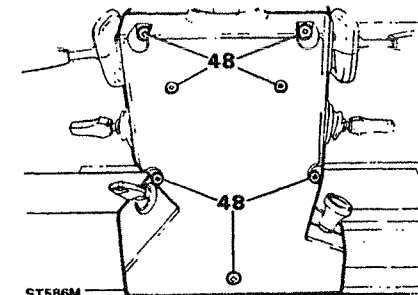
Fit instrument panel and nacelle

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

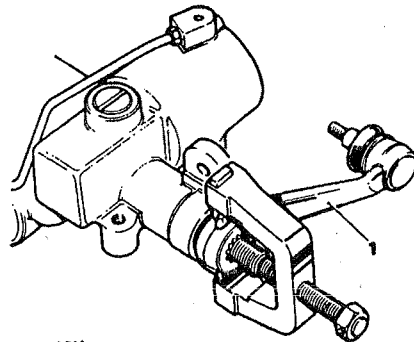
49. Turn the cancelling ring so that the slots are vertical and the lug with the arrow points to the left, in the direction of the indicator switch. Engage the steering lock.
50. Fit the steering wheel with the finisher attachment lug at the bottom. Ensure that the indicator cancelling forks locate in 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.

POWER STEERING BOX OVERHAUL - Adwest heavy duty - early vehicles

Service tools:
 'C' Spanner - RO 606600 / LRT-57-501
 Peg Spanner - RO 606601 / LRT-57-502
 Ring expander - RO 606602 / LRT-57-019
 Ring compressor - RO 606603 / LRT-57-020
 Seal saver, sector shaft - RO 606604 / LRT-57-021
 Seal saver, valve and worm - RO 1015 / LRT-57-016
 Torque setting tool - RO 1016 / LRT-57-017

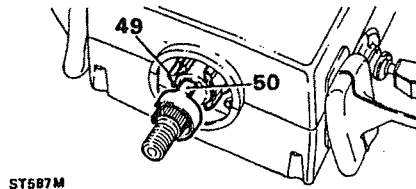
DISMANTLE

1. Remove the steering box from the vehicle, and withdraw the drop arm.



ST1043M

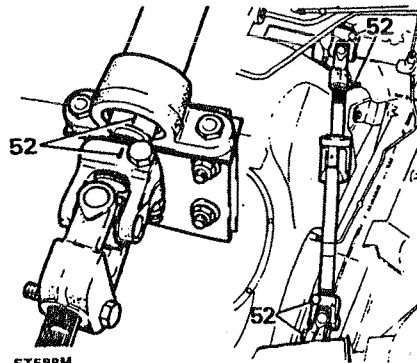
2. Rotate the retainer ring, as necessary, until one end is approximately 12 mm from the extractor hole.
3. Lift the cover retaining ring from the groove in the cylinder bore, using a suitable pointed drift applied through the hole provided in the cylinder wall.
4. Complete the removal of the retainer 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).



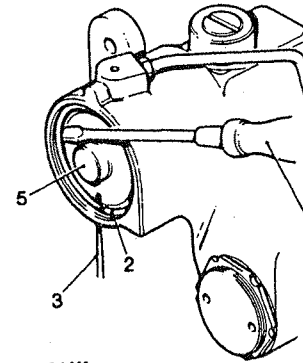
ST587M

Fit collapsible steering shaft

51. If necessary, fit new universal joints to the support. Note that the long joint is fitted to the short length of shaft and short joint to the long end. The joints can only be fitted one way to the shaft.
52. With the steering lock engaged and the road wheels in the straight ahead position line-up the marks made in instruction 2 and fit the collapsible shaft assembly with the long leg of the shaft to the steering box. Fit the pinch bolts and tighten to the correct torque figure 22 - 28 Nm.

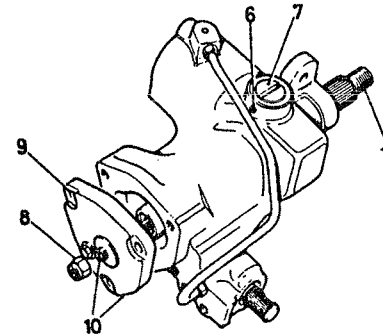


ST588M



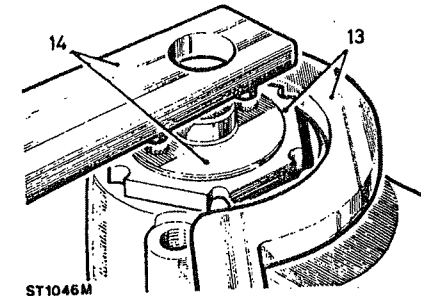
ST1044M

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.



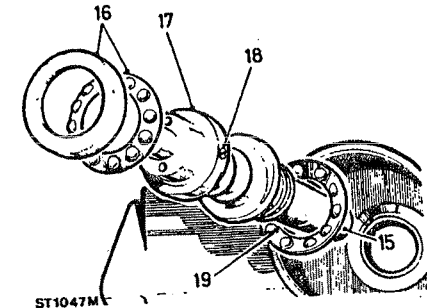
ST1045M

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 RO 606600.
14. Remove the worm adjusting screw using peg spanner RO 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

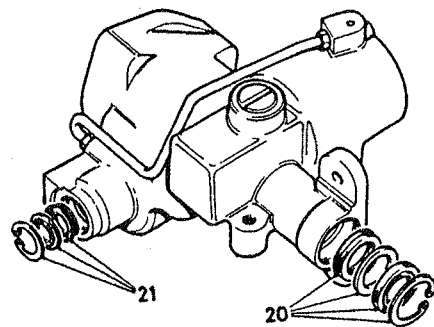
Steering box seals

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.

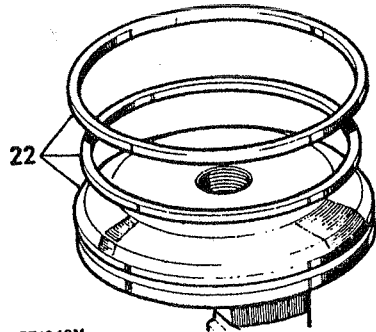


ST1048M

Inspecting

22. Discard all rubber seals and provide replacements.

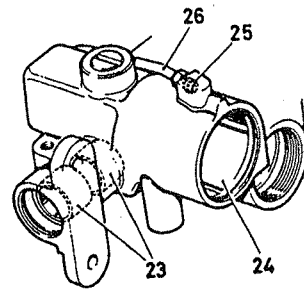
NOTE: A rubber seal is fitted behind the plastic ring on the rack piston. Discard the seal also the plastic ring and provide replacements.



ST1049M

Steering box casing

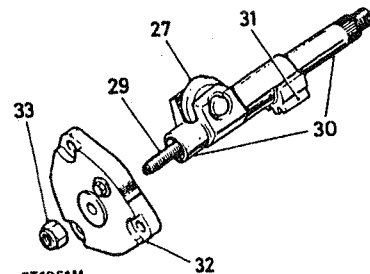
23. If necessary, replace the sector shaft bush, using suitable tubing as a drift.
 24. Examine the piston bore for traces of scoring and wear.
 25. Examine the inlet tube seat for damage. If replacement is necessary this can be undertaken by using a suitable tap.
 26. Examine the feed tube for signs of cracking.



ST1050M

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.



ST1051M

Sector shaft cover assembly

32. The cover, bush and seat are supplied as a complete assembly for replacement purposes.

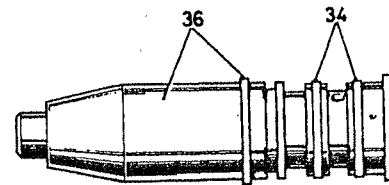
Sector shaft adjuster locknut

33. The locknut functions also as a fluid seal and must be replaced at overhaul.

Valve and worm assembly

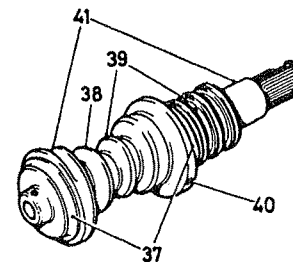
34. Examine the valve rings which must be free from cuts, scratches and grooves. The valve rings should be a loose fit in the valve grooves.
 35. Remove the damaged rings ensuring that no damage is done to the seal grooves.
 36. If required, fit replacement rings, using the ring expander RO 606602. Both rings and tool may be warmed if found necessary. Use hot water for this purpose. Then insert into the ring compressor RO606603 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.
 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.



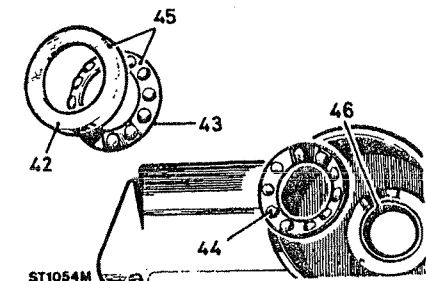
ST1053M

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.

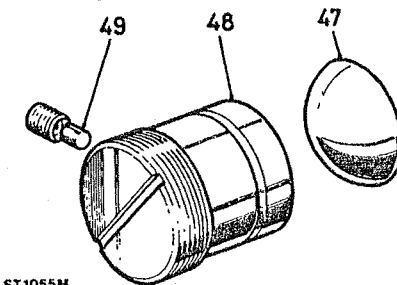
NOTE: Should difficulty be experienced at this stage, warm the casing and the bearing assembly. Cool the bearing cup using a suitable mandrel and jar the steering box on the bench.



ST1054M

Rack thrust pad and adjuster

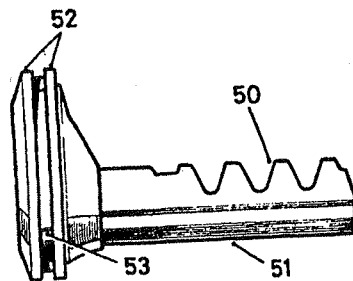
47. Examine the thrust pad for scores.
 48. Examine the adjuster for wear in the pad seat.
 49. Examine the nylon pad and adjuster grub screw assembly for wear.



ST1055M

Rack and piston

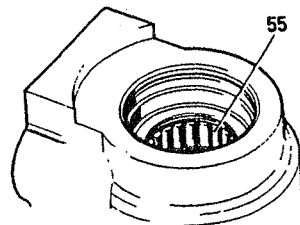
50. Examine for excessive wear on the rack teeth.
51. Ensure the thrust pad bearing surface is free of scores and wear.
52. Ensure that the piston outer diameters are free from burrs and damage.
53. Examine the seal and ring groove for scores and damage.
54. Fit a new rubber ring to the piston. Warm 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.



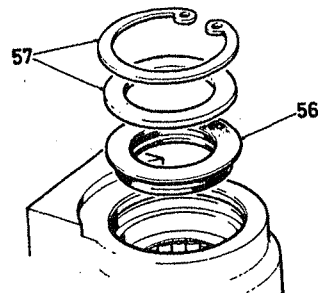
ST1057M

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

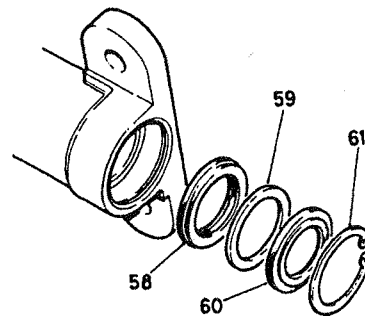
56. Fit the seal, lipped side first, into the housing. When correctly seated, the seal backing will lie flat on the bore shoulder.
57. Fit the extrusion washer and secure with the circlip.



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.



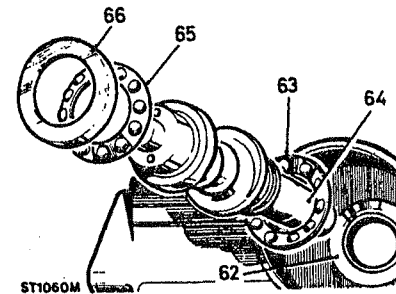
ST1059M

Fitting the valve and worm assembly

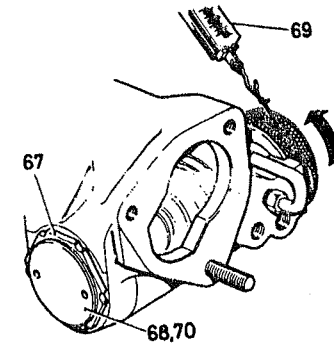
62. If removed, refit the original shim washer(s) and the inner bearing cap. Only vaseline must be used as an aid to assembling the bearings.

NOTE: If the original shims are not available, fit shim(s) of 0.76 mm nominal thickness.

63. Fit the inner cage and bearings assembly.
64. Fit the valve and worm assembly, using seal saver RO1015 to protect the input shaft seal.
65. Fit the outer cage and bearings assembly.
66. Fit the outer bearing cup.



ST1060M

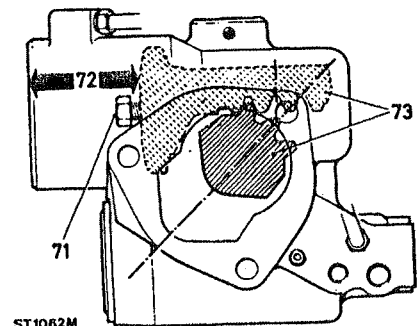


ST1061M

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 approximately from the outer end of the bore.
73. Feed in the sector shaft using seal saver RO60604 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.

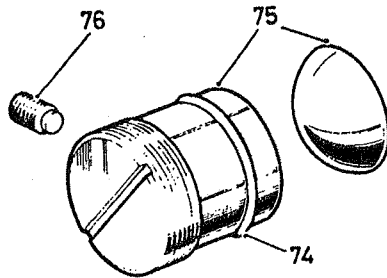
67. Renew the worm adjuster sealing ring and loosely screw the adjuster into the casing. Fit the locknut, but do not tighten.
68. Turn in the worm adjuster until the end-float at the input is almost eliminated.
69. Measure and record the maximum rolling distance of the valve and worm assembly, using 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 at 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 only, with the locknut tight. Use peg spanner RO60601 and 'C' spanner RO60600.



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.



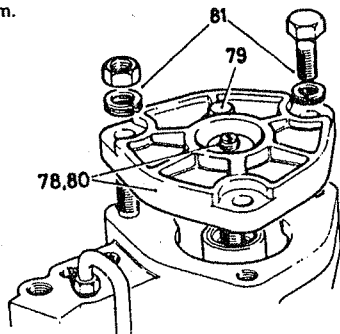
ST1063M

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.

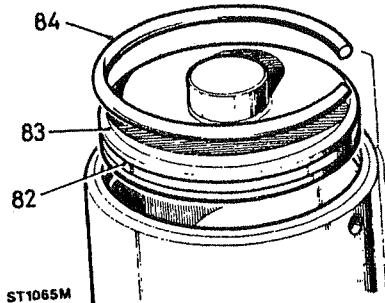
81. Fit the cover fixings and torque load to 23 to 28 Nm.



ST1064M

Fitting the cylinder cover

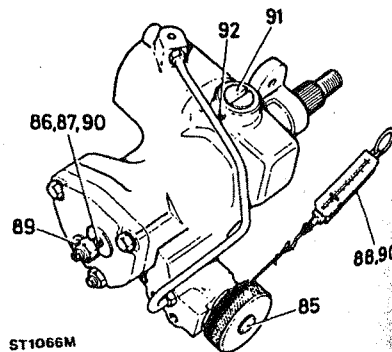
82. Fit the square section seal to the cover.
83. Remove the slave bolt and press the cover into the cylinder just sufficient to clear the retainer ring groove.
84. Fit the retainer ring to the groove with one end of the ring positioned 12 mm approximately from the extractor hole.



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 RO1016.
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 with the locknut tightened.



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. The final figure may be less than but must not exceed 7,25 kg.
92. Lock the rack adjuster in position with the grub screw.

Torque peak check

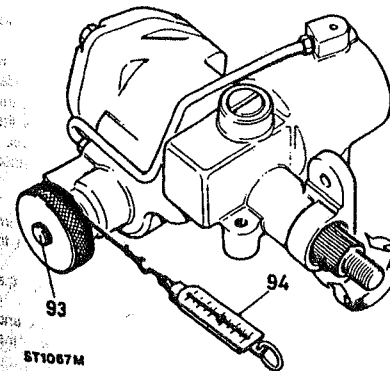
With the input shaft rotated from lock-to-lock, the rolling resistance torque figures should be greatest across the centre position (one and one half turns approximately from full lock) and equally disposed about the centre position.

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 LH and RH boxes. However, the procedure for shim adjustment where necessary, differs between LH and RH steering boxes and is described under the applicable LH and RH steering 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 RO1016.



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:

LH 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.

RH 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.

NOTE: Adjustment of 0,07 mm to the shim value will move the torque peak area by 2 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.

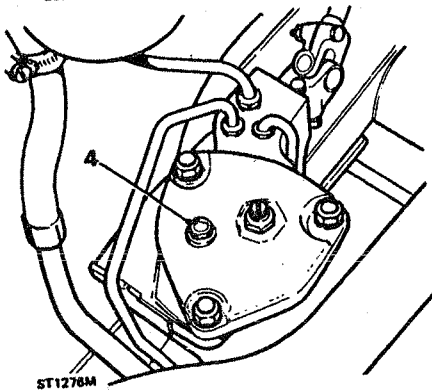
100. Road test the vehicle.

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/LRT-57-002
 Adaptor - JD10-6/1
 Adaptor - JD10-6/2

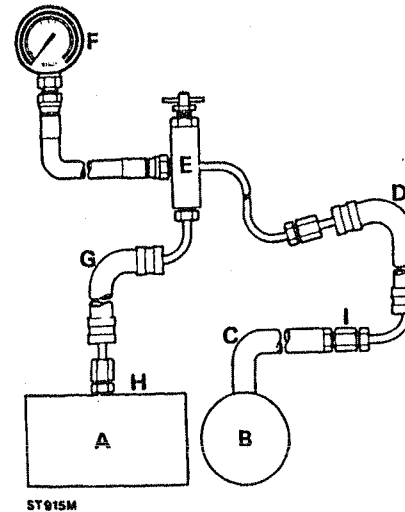
If there is a lack of power assistance for the steering the pressure of the hydraulic pump should be checked first before renewing any components of the system. The fault diagnosis chart should also be used to assist in tracing faults in the power steering.

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/cm² and the normal pressure which may be expected in the power steering system is 60 kgf/cm².
2. Under certain fault conditions of the hydraulic pump it is possible to obtain pressures up to 105 kgf/cm². Therefore, it is important to realise that the pressure upon the gauge is in direct proportion to the pressure being exerted upon the steering wheel. When testing, apply pressure to the steering wheel very gradually while carefully observing the pressure gauge.
3. Check, and if necessary replenish, the fluid reservoir.
4. Examine the power steering units and connections for leaks. All leaks must be rectified before attempting to test the system.
5. Check the steering pump drive belt for condition and tension, rectify as necessary. The pump used on the V8 engine vehicle is different from that fitted to the four cylinder engine 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/cm².
 - (b) With the engine idling and the steering wheel held hard on full lock, the pressure should be 28 kgf/cm² minimum.

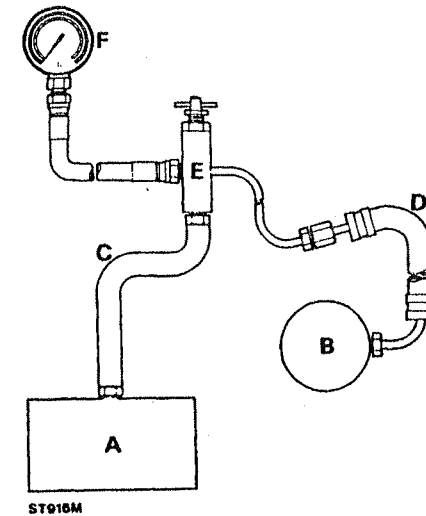
These checks should be carried out first on one lock, then on the other.

CAUTION: Under no circumstances must the steering wheel be held on full lock for more than 30 seconds in any one minute, otherwise there will be a tendency for the oil to overheat and possible damage to the seals may result.



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.



V8 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.

10. Release the steering wheel and allow the engine to idle. The pressure should be: 7 kgf/cm².
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.

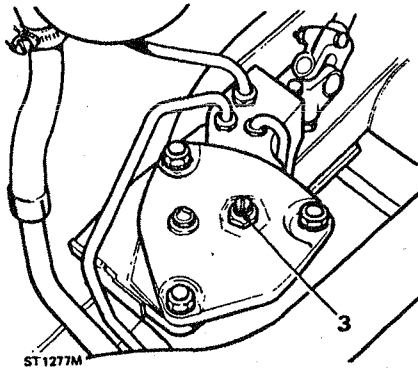
ADJUST POWER STEERING BOX

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.
3. Continue the rocking action whilst an assistant slowly tightens the steering box adjuster screw after slackening the locknut until the rim movement is reduced to 9,5 mm maximum.
4. Tighten the locknut, then turn the steering wheel from lock to lock and check that no excessive tightness exists at any point.



- 5 Lower the vehicle to ground level and remove the wheel chocks.
- 6 Road test the vehicle.

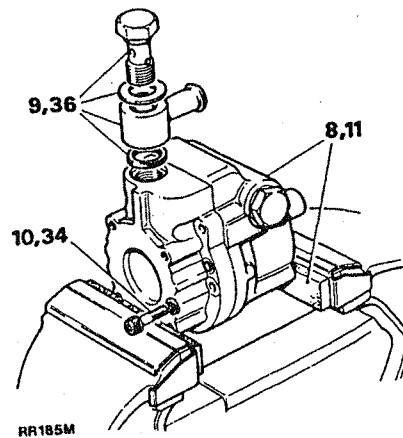
V8 ENGINE POWER STEERING PUMP OVERHAUL
- Series 30

Dismantle

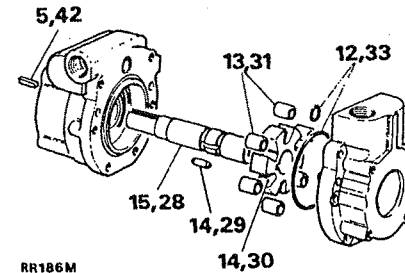
1. Remove the steering pump from the vehicle.
2. Clean the exterior of the pump and drain off any oil.
3. Remove the bolt, spring washer and large plain washer securing the pulley to the pump shaft.
4. Using a suitable puller, withdraw the pulley. Do not attempt to hammer the shaft from the pulley, or 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.

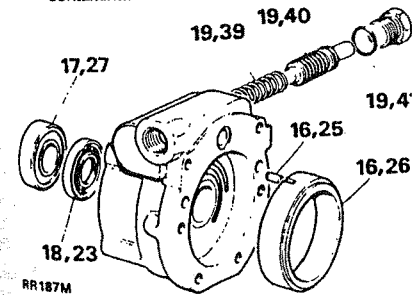
10. Remove the six Allen screws securing the cover to the pump body. Separate the cover from the body vertically to prevent the parts falling out.
11. Remove the pump from the vice.



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.



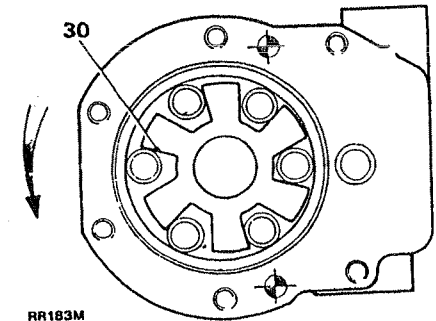
Inspection

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.

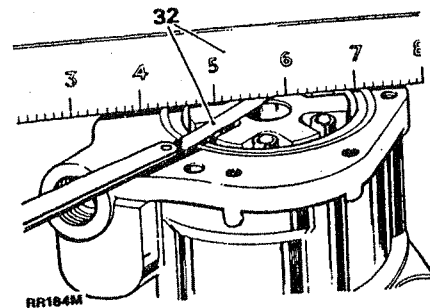
NOTE: Ensure that the aluminium restrictor in the output port is thoroughly cleaned but not dislodged.

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 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.



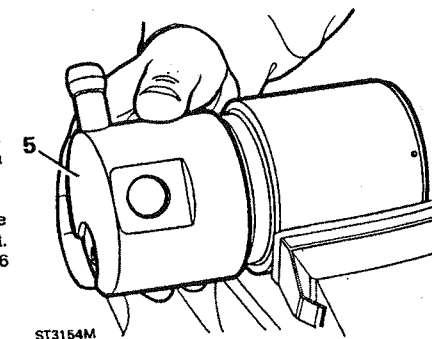
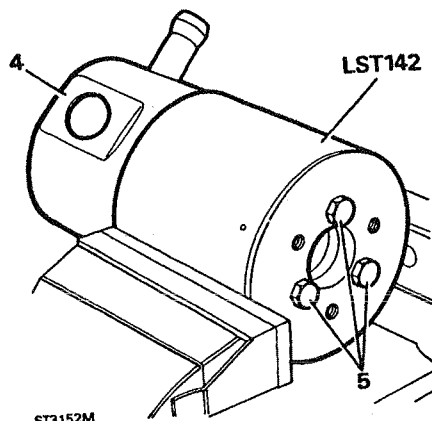
31. Inspect the rollers, paying particular attention to the finish on the end. Renew the rollers if scored, damaged or oval. Refit the rollers to the carrier.
32. Using a straight edge across the cam surface, and a feeler gauge, check the end clearance of the carrier and rollers in the pump body. If the end clearance is more than 0,05 mm renew the carrier and rollers.



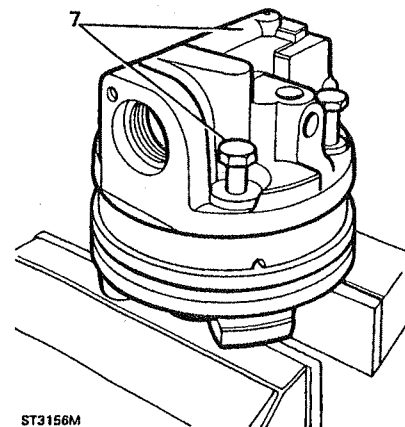
33. Smear a fine trace of Loctite 275 to the pump body in a figure of 8 outside the 'O' rings and inside the bolt holes. Install new 'O' rings to the body of the pump.
34. Refit the cover on the pump body and secure with six Allen screws and spring washers.
35. Tighten the Allen screws, in diagonal sequence, checking that the shaft rotates freely and does not bind. Final torque to be 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 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 - to 11 to 12 Nm at 21 mm. 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 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 13 to 26 Nm.
44. Refit the steering pump to the vehicle.

**POWER ASSISTED STEERING PUMP - 200 Series
- OVERHAUL V8 engines**

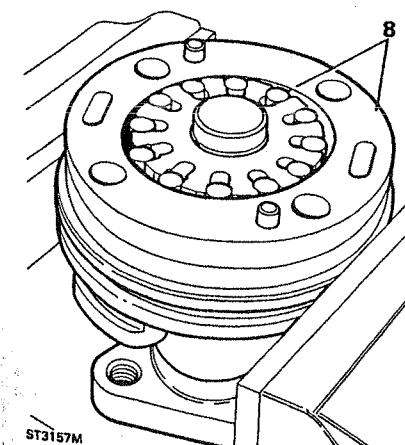
1. Disconnect the battery and remove the pump from the vehicle.
2. Clean the exterior of the pump and remove the drive pulley.
3. Remove, from the outlet port, the union nut, two 'O' rings, spring and valve.
4. Secure the pump cover removal tool LST 142 in a vice and insert the pump in the tool.
5. Fit the three 6 mm bolts through the tool into the pump hub. Tighten the bolts evenly until the cover is released from the sealing ring and can be removed from the pump.



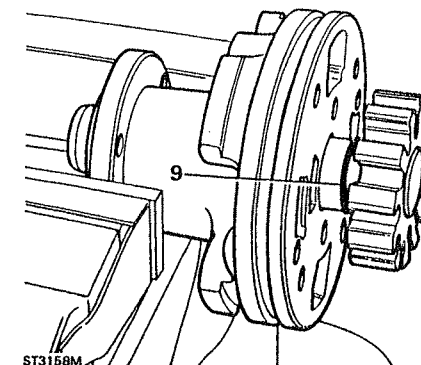
6. Remove the large 'O' ring and secure the pump in a vice.
7. Remove the swarf collection magnet and the four bolts and lift off the valve housing.



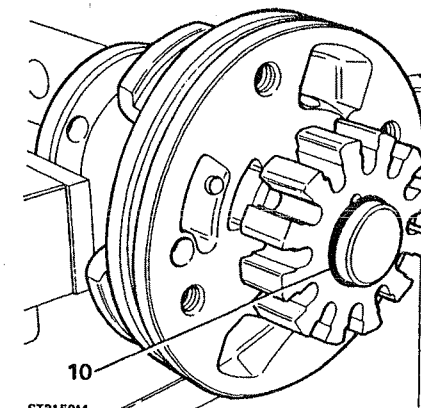
8. Remove the pump outer member and the rollers.



9. Release the spring ring from the groove behind the vane and push it back towards the drive shaft housing.



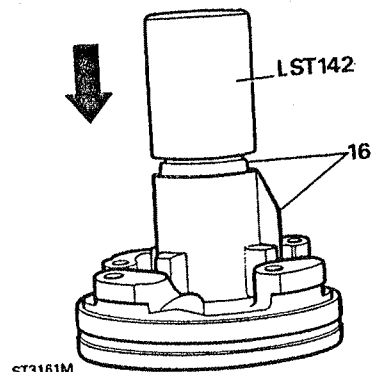
10. Move the vane back to reveal and remove the spring ring from the front of the vane.



11. Remove the vane and drive key and rear spring ring.
12. Withdraw the drive shaft.
13. Prise-out the oil seal and if necessary press-out the bush from the drive shaft housing.
14. Clean and examine all parts for wear.

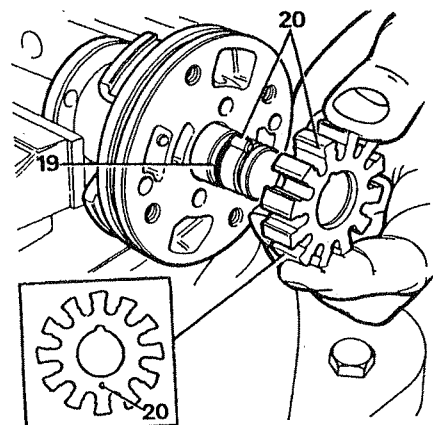
Assemble

15. If removed, press-in a new bush in the drive shaft housing to 5 mm below the machined face.
16. Using the seal replacer part of tool number LST 142, drive-in a new seal, lip side leading, into the drive shaft housing.



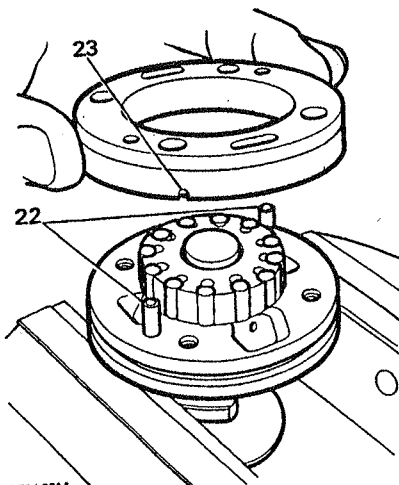
ST3161M

17. Wrap a smooth surface tape round the end of the drive shaft to protect the seal lip.
18. Lubricate the seal lip with power steering fluid and insert the drive shaft.
19. Fit the inner spring ring to the shaft but not into the groove at this stage.
20. Fit the drive key and the vane with the arrow towards the drive shaft housing and with the raised leading edge of the vanes facing left.



ST3160M

21. Fit the outer spring ring to the groove then slide the inner spring ring into the rear groove.
22. Fit the two dowels to the drive shaft housing.
23. Insert the twelve rollers in the vane and fit the pump outer member with the milled cut towards the drive shaft housing.



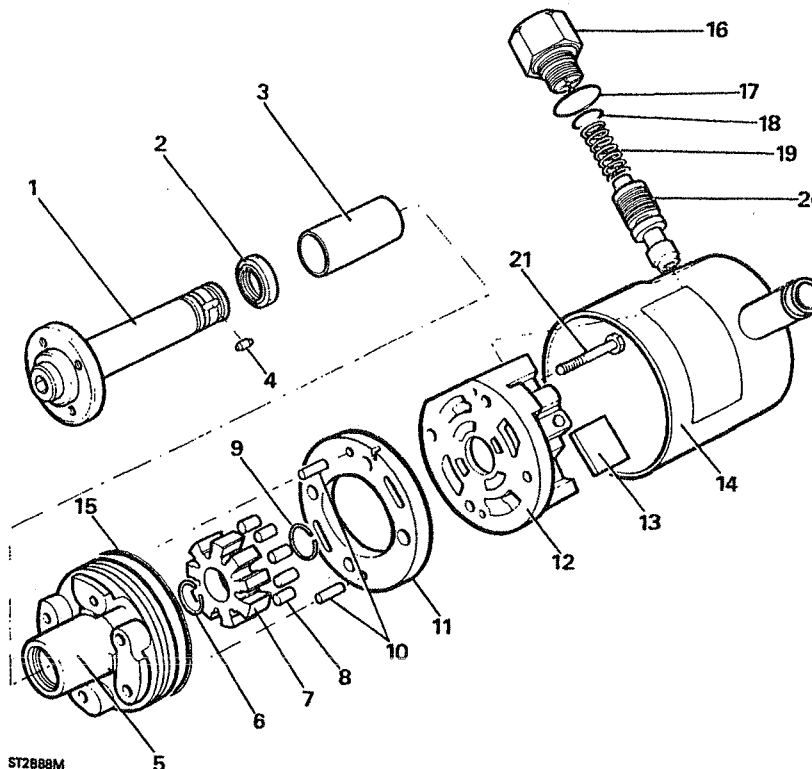
ST3162M

24. Fit the valve housing and secure with the four bolts. Check that the pump revolves freely.
25. Insert the magnet into the slot provided.
26. Lubricate and fit the large "O" ring and fit the cover ensuring that the hole for the valve is aligned with the outlet port in the valve housing before the cover is finally pushed home over the seal.
27. Lubricate and fit the valve, spring, large and small "O" rings and the union nut.
28. Finally, fit the drive pulley with the three bolts and washers.
29. Fit dust caps to inlet and outlet connections.

Power assisted steering pump connections - V8

It is important that the following procedure is observed when fitting a new or overhauled pump to the vehicle.

1. Remove dust caps.
2. Fit clip to large to large feed hose.
3. Push hose fully on to pump connection.
4. Hold clip in position and tighten clip screw to 3 Nm.
5. Screw high pressure union in to pump finger tight.
6. Hold pipe in correct position and tighten union to 20 Nm.
7. Check that the hose clip screws securing hoses to fluid reservoir are tightened to 3 Nm.



ST2888M

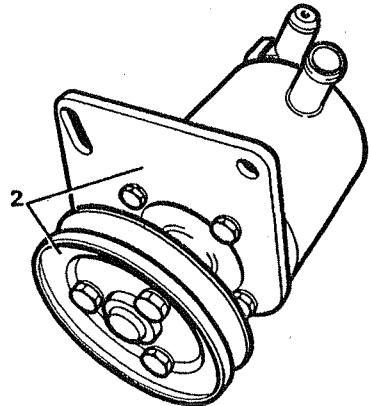
KEY TO V8 ENGINE PAS PUMP

- | | |
|-------------------------------------|----------------------------------|
| 1. Drive shaft and flange assembly. | 11. Pump outer member. |
| 2. Oil seal. | 12. Valve housing. |
| 3. Drive shaft bush. | 13. Magnet. |
| 4. Drive shaft key. | 14. Pump cover. |
| 5. Drive shaft housing. | 15. Pump cover 'O' ring seal. |
| 6. Inner spring ring. | 16. Outlet pipe union pipe. |
| 7. Vane. | 17. Large 'O' ring. |
| 8. Vane rollers. | 18. Small 'O' ring. |
| 9. Outer spring ring. | 19. Spring. |
| 10. Locating dowels. | 20. Valve assembly. |
| | 21. Pump assembly bolts (4 off). |

POWER ASSISTED STEERING PUMP 200 SERIES OVERHAUL - Four cylinder engines

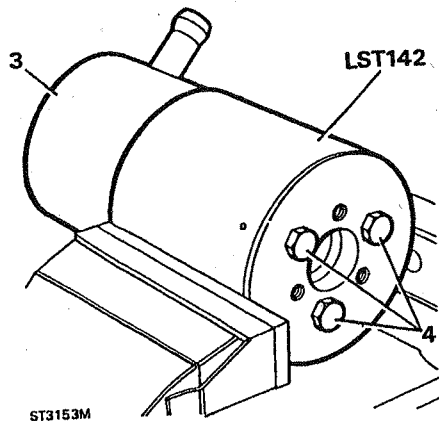
Dismantle

1. Disconnect the battery and remove the pump from the vehicle.
2. Clean the exterior of the pump and remove the drive pulley and mounting plate.



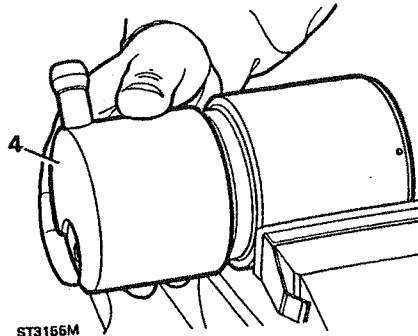
ST3290M

3. Secure the pump cover removal tool LST 142 in a vice and insert the pump into the tool.

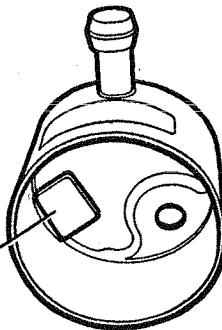


ST3153M

4. Fit the three 8 mm bolts through the tool into the hub. Tighten the bolts evenly until the cover is pushed off the pump. Remove the bolts and tool and the swarf collection magnet from inside the cover.



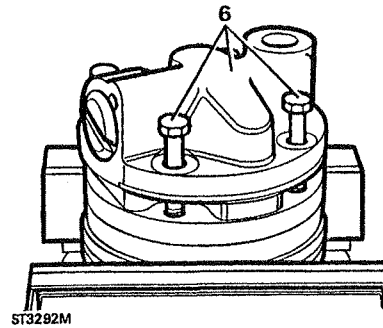
ST3156M



ST3291M

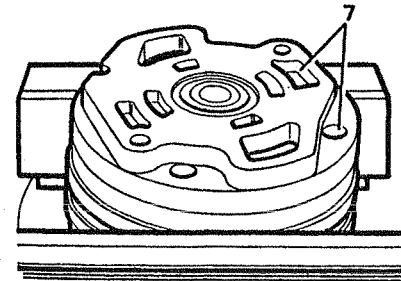
5. Remove the 'O' ring and secure the pump in the vice.
6. Remove the four bolts and lift the valve body from the pump.

9. Remove the drive key to enable the drive shaft to be withdrawn. Remove the dowels.



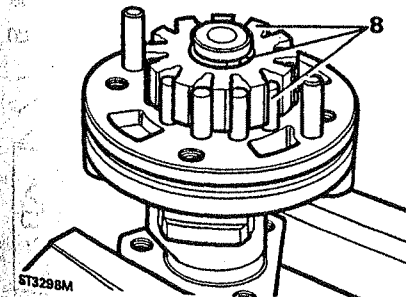
ST3292M

7. Remove the pressure plate and pump outer member.

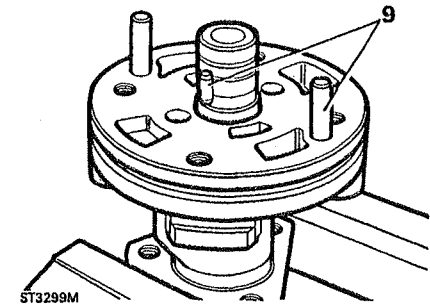


ST3293M

8. Remove the rollers and the spring ring securing the vane to the drive shaft and remove the vane.

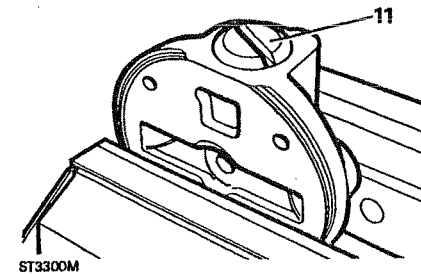


ST3298M



ST3299M

10. Remove and discard the oil seal from the drive shaft housing and if necessary, press-out the plain bearing.
11. Secure the valve housing in the vice and remove the plug, spring, piston valve and ball.

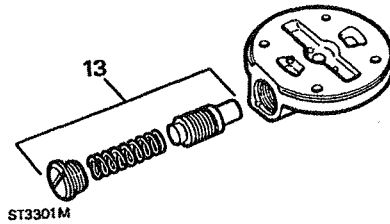


ST3300M

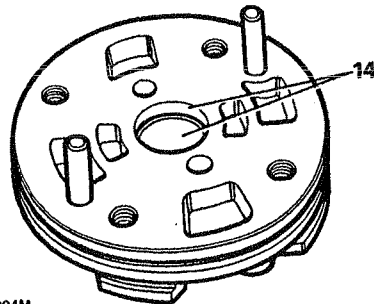
12. Clean and degrease all parts and examine for wear.

Assemble

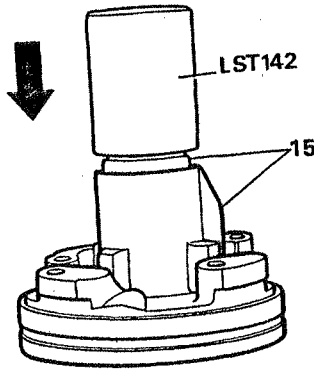
13. Fit the ball, valve, spring and plug to the valve housing noting that the valve is fitted with the grooved diameter to the rear.



14. If removed, press a new plain bush into the drive shaft housing so that it is 5 mm below the machined face of the housing.

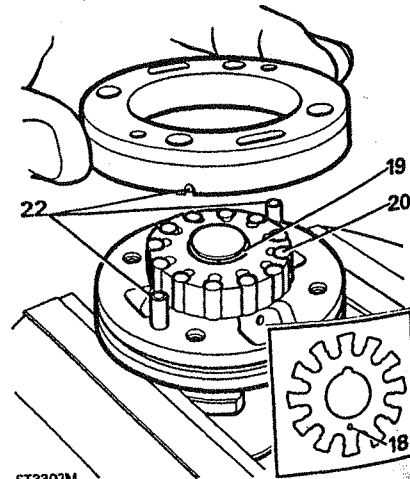


15. Lubricate the drive shaft and seal lip with power steering fluid. Using the seal replacer part of tool number LST 142 and with the lip side leading, drive the new seal into the housing.
16. Wrap a smooth surface tape round the end of the drive shaft to protect the seal lip and fit the shaft to the housing.



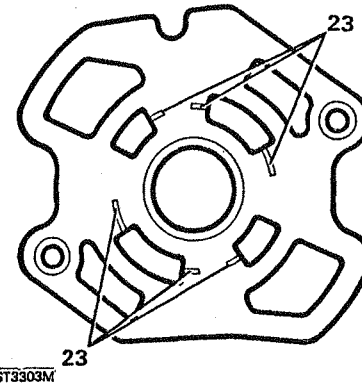
ST3295M

17. Remove the tape and fit the vane drive key to the shaft.
18. Fit the vane with the arrow towards the bearing housing and with the leading edge of the vanes facing left.
19. Secure the vane to the shaft with the spring ring.
20. Fit the twelve rollers to the vane.
21. Fit the two locating dowels to the bearing housing.
22. Fit the pump outer member, locating it over the dowels and with the milled cut-out towards the bearing housing.



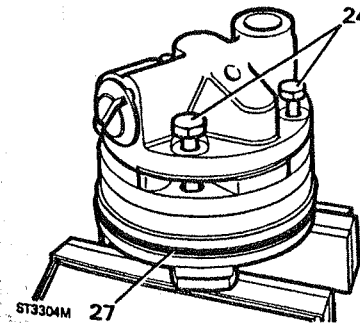
ST3302M

23. Fit the pressure plate locating it over the two dowels and with the small milled cuts towards the vane.



ST3303M

24. Fit the valve housing, reversal of instruction 6, and secure the assembly with the four bolts and tighten evenly.
25. Check that the drive shaft turns freely.
26. Fit the magnet to the inside of the pump cover.
27. Lubricate and fit a new 'O' ring seal to the groove in the bearing housing. Fit the cover into position over the pump whilst ensuring that the hole in the end of the cover aligns with the outlet port in the valve housing before finally pushing it fully home over the seal.



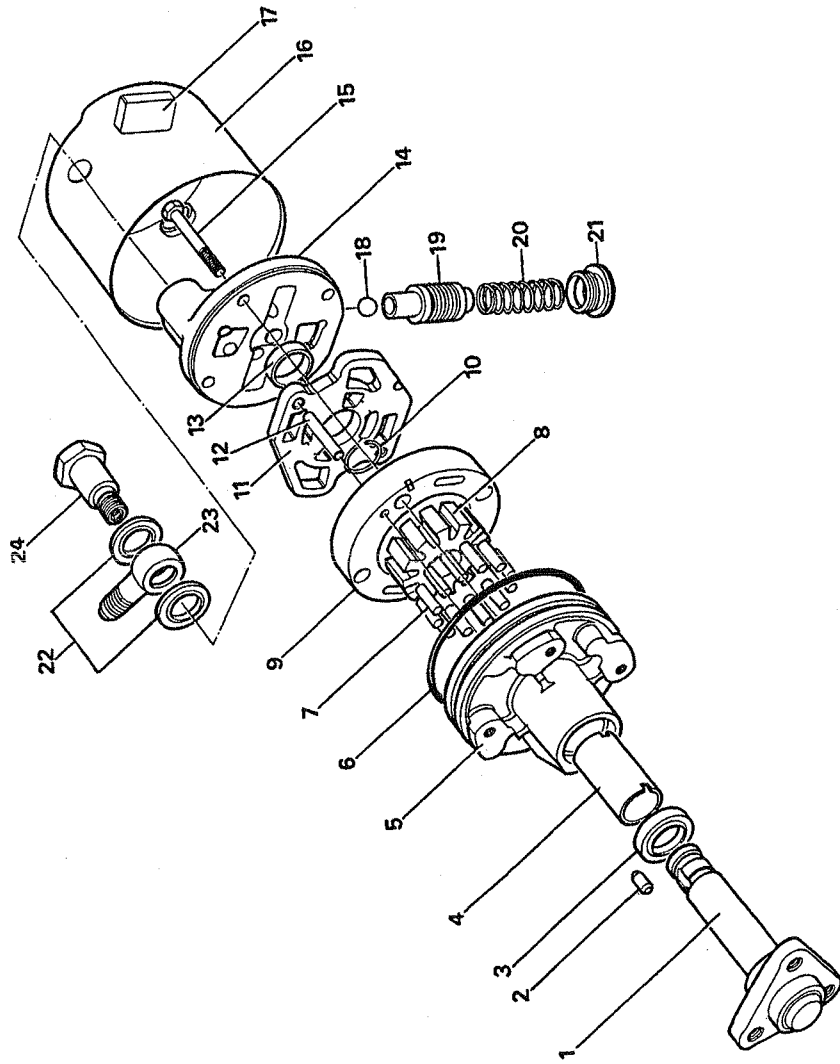
ST3304M

28. Fit the mounting plate and drive pulley.
29. Fit dust caps to the inlet and outlet connections.

Power assisted steering pump connections - 4 cylinder engine vehicles

It is important that the following procedure is observed when fitting a new or overhauled pump to a vehicle.

1. Remove dust caps from pump connections.
2. Fit clip to large feed hose.
3. Push hose fully on to pump.
4. Hold clip into position and tighten clip screw to 3 Nm.
5. Screw high pressure union into pump with a dowty washer each side of the banjo.
6. Hold pipe in correct position and tighten special union bolt to 20 Nm.
7. Check that the hose clip screws securing the hoses to the fluid reservoir are tightened to 3 Nm.



ST2887M

KEY TO FOUR CYLINDER ENGINE PAS PUMP

- 1. Drive shaft and flange assembly.
- 2. Vane drive key.
- 3. Oil seal.
- 4. Drive shaft housing bush.
- 5. Drive shaft housing seal.
- 6. Pump cover O ring seal.
- 7. Vane rollers.
- 8. Vane.

- 9. Pump outer member.
- 10. Spring ring.
- 11. Pressure plate.
- 12. Locating dowels.
- 13. Pressure plate bush.
- 14. Valve housing.
- 15. Pump assembly bolts.
- 16. Pump cover.

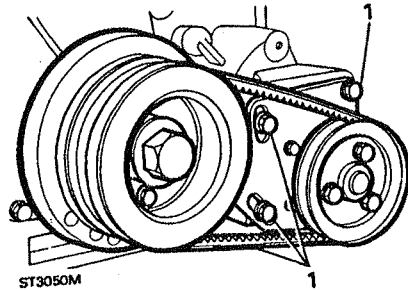
- 17. Magnet.
- 18. Valve ball (2 off cannot be removed).
- 19. Valve.
- 20. Valve spring.
- 21. Valve assembly retaining plug.
- 22. Special Dowty sealing washers.
- 23. Banjo union.
- 24. Special bolt.

POWER STEERING PUMP - Defender Tdi

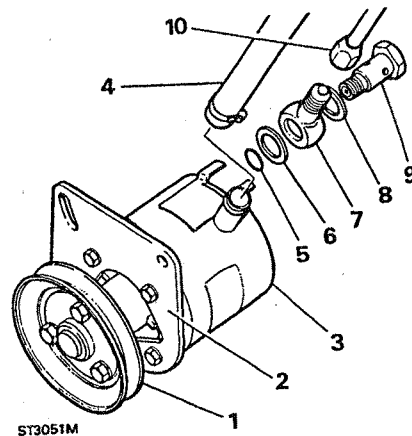
Service Repair No. 57.20.14

Remove and refit

- 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.



- Disconnect from the pump, the supply hose from the fluid reservoir and drain into a suitable container.
- Remove the banjo union bolt from the rear of the pump and allow fluid to drain into a container.
- Remove the three bolts slackened in instruction 1 and remove the pump complete with adjustment plate and pulley.
- Remove the four bolts to release the drive pulley from the pump hub.
- 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

- Fit the adjustment plate to the pump aligning the marks made when dismantling and secure with the four bolts.
- Fit the drive pulley and retain with the four bolts.
- Fit the pump and adjustment plate to the engine bracket and loosely secure with the pivot bolt and two adjustment clamp bolts.
- 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 12 mm by thumb pressure.

CAUTION: Do not apply any pressure against the pump casing when tensioning the drive belt since it will damage the casing permanently, beyond repair.

- Connect the fluid hose and secure with the clip.
- Fit the banjo bolt ensuring that a special steel washer is fitted each side of the banjo.
- Top up the fluid reservoir with the correct make and grade of fluid, see SECTION 09.
- 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.

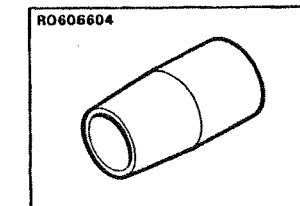
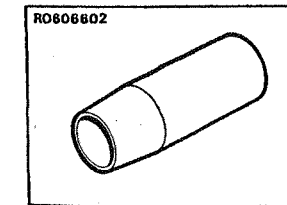
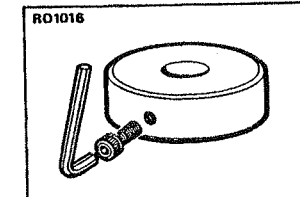
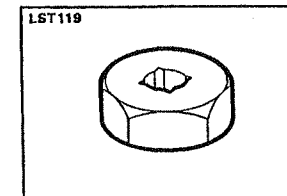
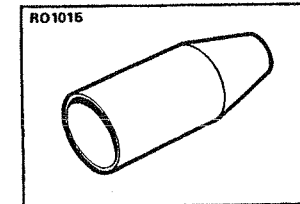
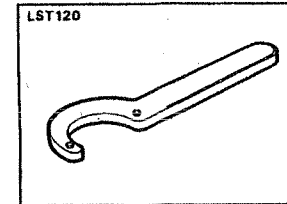
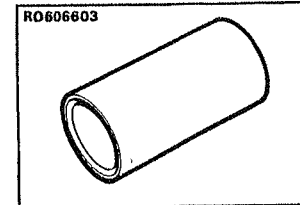
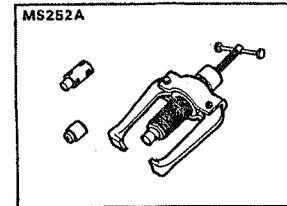
- | | |
|---------------------|---------------------|
| 1. Pulley | 6. Washer (special) |
| 2. Adjustment plate | 7. Banjo |
| 3. Pump | 8. Washer (special) |
| 4. Inlet hose | 9. Bolt |
| 5. 'O' rings | 10. Union nut |

POWER STEERING BOX OVERHAUL

Adwest Lightweight

- Special service tools
 Drop arm extractor
 "C" spanner
 Worm adjusting socket
 Ring expander
 Ring compressor
 Seal saver, valve and worm
 Torque setting tool
 Seal saver, sector shaft

- MS 252A /LRT-57-012
 LST 120 /LRT-57-007
 LST 119 /LRT-57-006
 RO 606602 /LRT-57-019
 RO 606603 /LRT-57-020
 RO 1015 /LRT-57-016
 RO 1016 /LRT-57-017
 RO 606604 /LRT-57-021



ST2233M

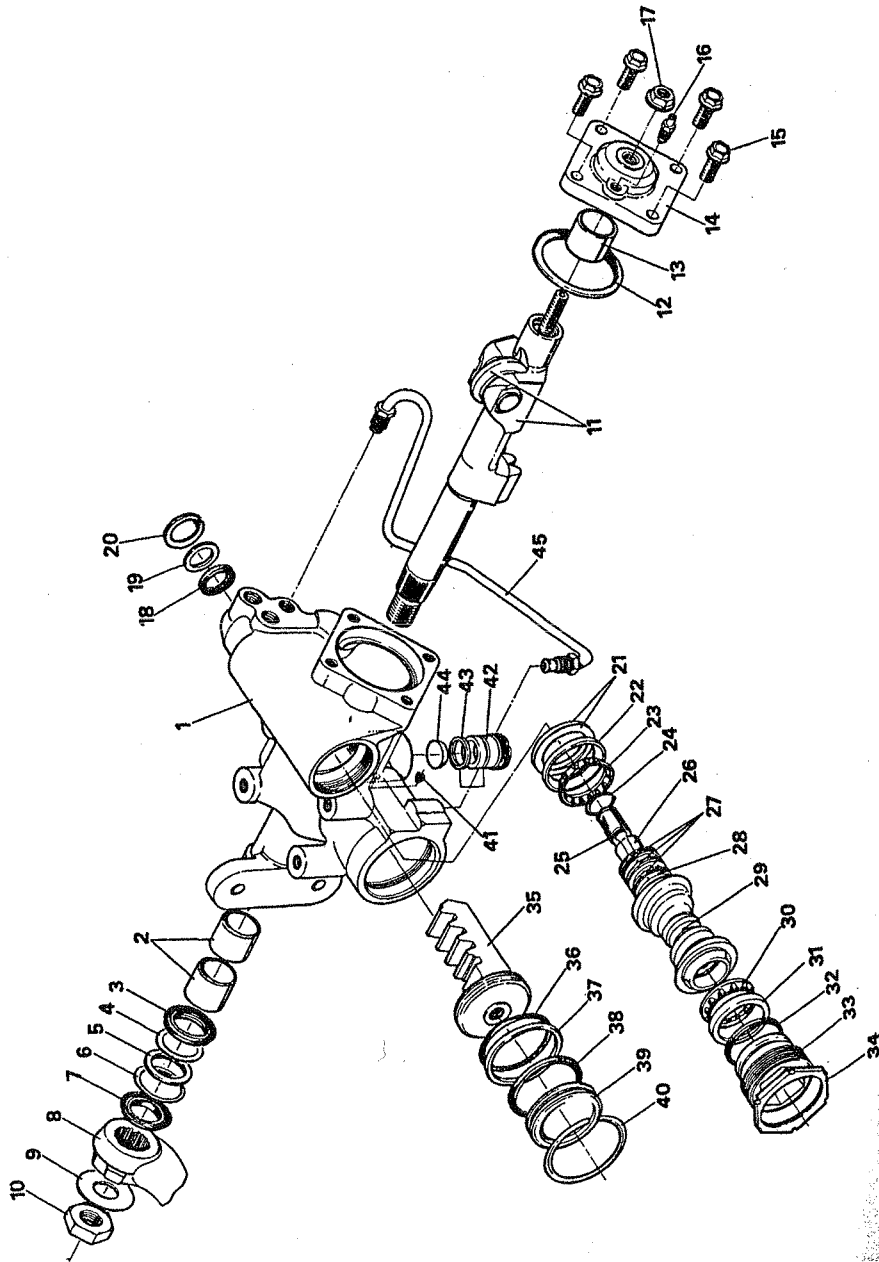
TORQUE FIGURES	Nm
Drop arm nut	176
Steering wheel nut	38
Sector shaft cover to steering box	22
Top cover bolts	50
Top cover bolts from serial No: LJ0001	75

Pipe connections to steering box

When fitting a new or overhauled steering box observe the following procedure.

1. Remove dust caps from ports.
2. Immediately fit pipes finger tight.
3. Tighten the 16 mm union nut to 20 Nm.
4. Tighten the 14 mm union nut to 15 Nm.

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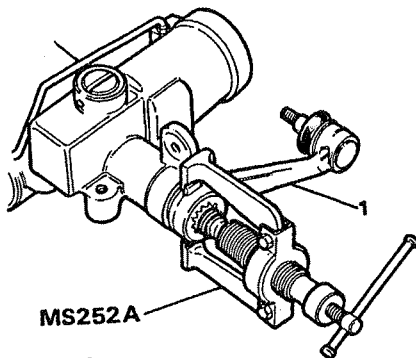


KEY TO ADJUSTMENT LIGHTWEIGHT POWER STEERING BOX

- | | |
|--|--------------------------------|
| 1. Housing bushes. | 31. Bearing track. |
| 2. Seal. | 32. Seal. |
| 3. Back-up washer. | 33. Worm adjusting screw. |
| 4. Back-up seal. | 34. Lock nut. |
| 5. Circlip. | 35. Piston. |
| 6. Drop seal. | 36. Piston O' ring. |
| 7. Dust arm. | 37. Piston Teflon seal. |
| 8. Tab washers. | 38. Cylinder cover seal. |
| 9. Sector shaft and follower assembly. | 39. Cylinder cover. |
| 10. Seal. | 40. Cylinder cover retainer. |
| 11. Bush. | 41. Screw. |
| 12. Cover plate. | 42. Rack adjusting screw. |
| 13. Self locking screws - 4 off. | 43. Rack adjusting screw seal. |
| 14. Bleed screw. | 44. Rack pad. |
| 15. Lock nut. | 45. Fluid line. |
| 16. Rotor seal. | |
| 17. Seal washer. | |
| 18. Circlip. | |
| 19. Shims. | |
| 20. Bearing track. | |
| 21. Bearing cage. | |
| 22. Circlip. | |
| 23. Seal torsion bar. | |
| 24. Rotor. | |
| 25. Teflon rings - 3 off. | |
| 26. Stop-off rings. | |
| 27. Worm. | |
| 28. Bearing cage and balls. | |

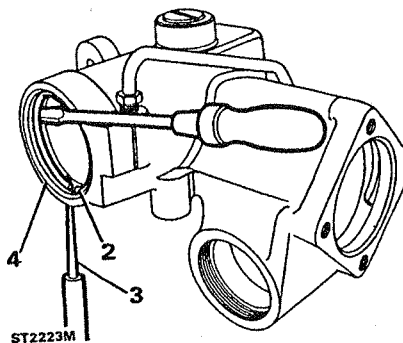
Dismantle

1. To assist assembly, turn the input shaft to bring the steering to the straight ahead position and mark the relationship of the drop arm to the casing. Using special service tool MS 252A withdraw the drop arm and remove the outer dust seal.

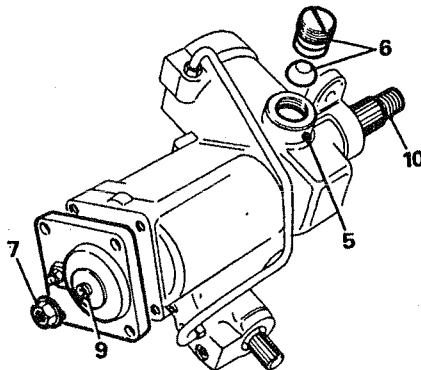


ST2222M

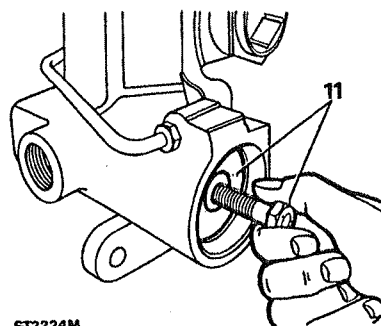
2. Rotate the piston cover retaining ring until one end is about 12 mm from the extractor hole in the side of the cylinder housing.
3. Lever the retaining ring from its locating groove by inserting a suitable pointed drift through the extractor hole. Complete the removal of the ring using a screw driver.



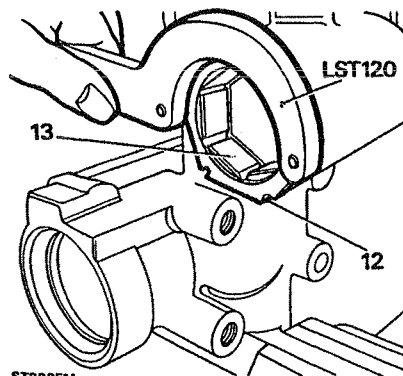
4. To remove the cover, turn the input shaft, in the appropriate direction, until the piston pushes out the cover. For a left-hand steering box, position the sector shaft on the left-hand lock and for a right-hand box on the right-hand lock.
5. Slacken the grub screw locking the rack pad adjuster.
6. Remove the rack pad adjuster clockwise and withdraw the pad.
7. Remove the sector shaft lock nut. The nut, which has a seal moulded inside it, also acts as a fluid seal. The nut should therefore be discarded and a replacement new nut obtained for reassembly.
8. Remove the sector shaft cover bolts.
9. Turn the sector shaft adjuster clockwise with a 6 mm Allen key whilst holding the cover, to prevent it turning, until the cover is removed.
10. The sector shaft can now be removed from the casing.



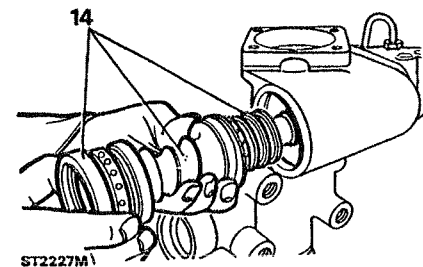
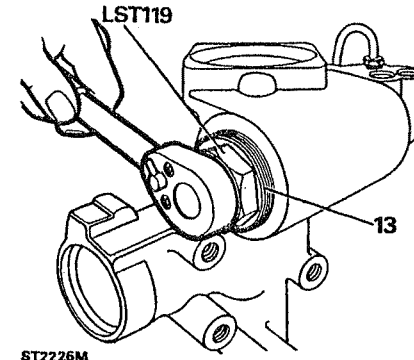
11. To remove the piston, screw a suitable bolt into the piston crown and use it to pull the piston from the casing.



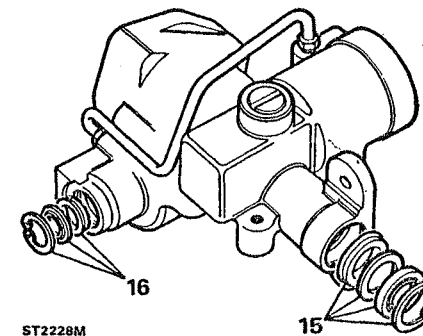
12. Remove the worm shaft adjuster lock nut using special service tool LST 120.



13. Using service tool LST 119 remove the worm shaft adjuster.
14. To withdraw the shaft and bearings tap the splined end of the shaft and lift-out the assembly.



15. Remove the circlip from the sector shaft bore to enable the seal assembly to be withdrawn.
16. Similarly, remove the circlip from the input shaft (worm shaft) bore and remove and discard the seals.

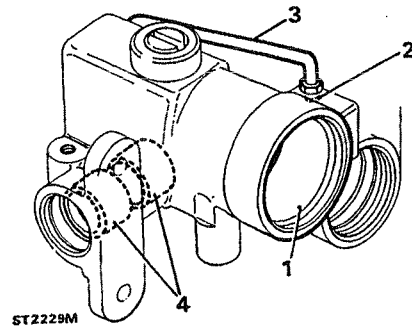


NOTE: The steering box has now been dismantled except for the sector shaft bushes, shown dotted. Since replacement bushes are not available, they should not be removed. The input shaft inner bearing cup and shims may also still be in position if jarring of the box has not already dislodged them and instructions for removing these appear later.

INSPECTION

Steering box casing

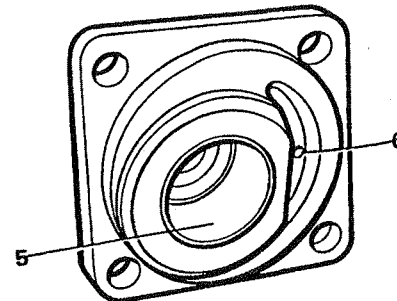
1. Examine the piston bore for wear, scores and pitting.
2. Examine the inlet pipe thread in the side of the cylinder tube for damage and if necessary repair using a suitable tap.
3. Check the feed pipe for damage especially for cracks and dents and renew if in any way faulty.
4. Since it is very unusual for the sector shaft bushes to wear they are not available as replacements. However, they should nevertheless be checked for damage.



ST2229M

Sector shaft and cover assembly

1. Check that there is no side play on the roller. If excessive play does exist the sector shaft should be renewed likewise if any of the following checks are unsatisfactory.

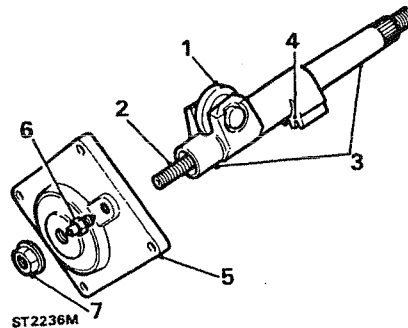


ST2241M

2. Check the condition of the adjuster thread and that there is no excessive vertical play. A movement of 2 mm is acceptable. Side play, however, is of no significance.
3. Examine the bearing surfaces of the shaft for wear, scores and pitting.
4. Check the gear teeth for excessive or uneven wear, scores and pitting.
5. Examine the cover for damage and burrs. Remove and discard the seal. Check the bush for wear and scores. Also check the adjuster thread for damage.
6. Check the bleed nipple and threads and that the bleed hole in the inside of the cover is clear.

NOTE: For replacement purposes, the cover, bush and seal are supplied as a complete assembly.

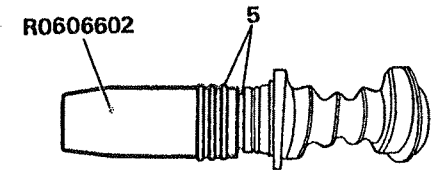
7. The locknut, which should be discarded, also acts as a fluid seal and a new one should be fitted on assembly.



ST2236M

Valve and worm assembly

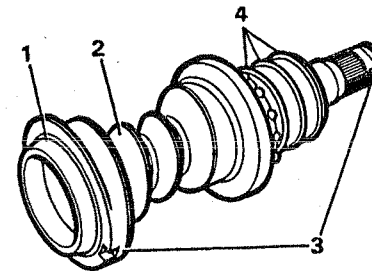
1. Examine the bearing areas for wear. The surfaces must be smooth and free from indentations, scores and pitting.
2. Examine the worm for wear which must also be smooth and free of scores and indentations.
3. Check for any wear on the torsion bar assembly pins. Grip the splined end of the input shaft in a soft jawed vice and by hand twist the worm end. No free movement should exist between the input shaft and worm.



ST2220M

NOTE: If any wear does appear in the above areas it is essential that a new valve and worm assembly is fitted.

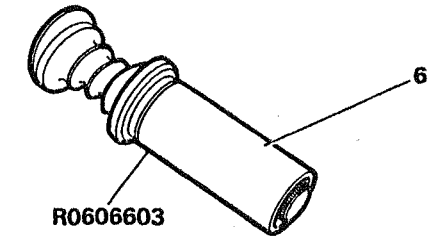
4. Examine the valve rings which must be free from cuts, scratches and grooves. The valve rings must be a loose fit in the valve grooves. If any one of the rings is faulty, all the rings must be renewed. Take care not to damage the ring grooves when removing the rings.



ST2219M

5. Fit replacement rings using expander tool RO 606602. Expand the rings by immersing them in hot water until pliable then carefully slide the rings over the tool, from the chamfered end. Place the tool over the ring grooves and slide the first ring into the groove nearest to the worm and so on until the third ring is in place. It is important to fit the rings in this sequence since the tool will not pass over the rings.

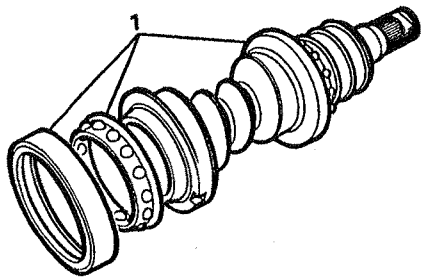
6. Remove the expander tool and slide the compressor tool RO 606603 over the rings, internal chamfered end leading and leave until cool.



ST2217M

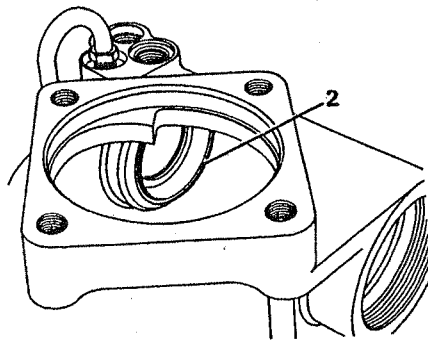
Ball bearing and cage assemblies

1. Examine the valve and worm inner and outer ball races and cups and if either is worn, pitted or damaged in any way, both the cups and the ball races must be renewed.



ST2230M

2. To remove the inner bearing cup and shims jar the casing on the work bench or use a suitable extractor. Alternatively, if difficulty is being experienced, warm the casing universally in an oven or in boiling water. Do not, however, attempt to apply local heat since distortion of the casing may result. Whilst the casing is being heated, cool a suitable mandrel or round bar to fit inside the bearing cup. Insert the cooled bar in the heated casing to retract the cup to enable it to be withdrawn together with the shims which must be retained for reassembly.

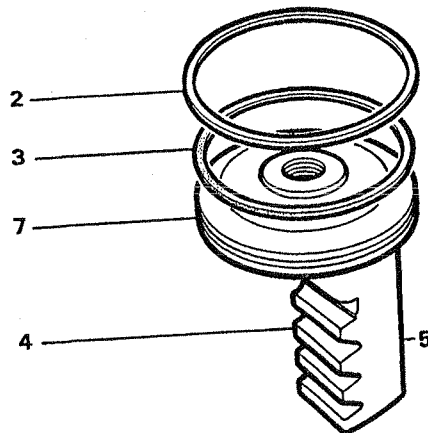


ST2216M

Rack and piston

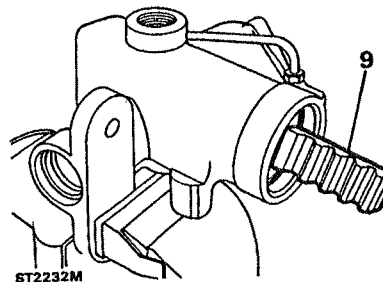
NOTE: That beneath the visible white Nylon ring in the piston groove, there is a rubber seal.

1. Examine the outer seal and if worn or damaged in any way it must be renewed along with the rubber ring.
2. Taking care not to damage the piston outer diameter remove the plastic seal.
3. Likewise, carefully remove the rubber ring.
4. Examine the rack teeth for wear and damage.
5. Check that the thrust pad bearing surface is free from wear and scores.
6. Check the piston outer diameters for burrs and damage and repair as necessary using a fine file and emery cloth.
7. Ensure that the bottom of the groove and the inside walls are not damaged or burred. Repair where necessary in the same way as above.



ST2211M

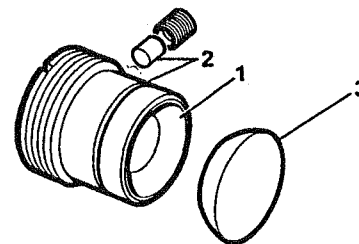
8. Fit a new rubber ring to the piston groove. Warm a new white Nylon seal in hot water and fit to the piston. Immediately, whilst still warm, carefully insert the piston squarely into the casing bore with the rack outwards, as illustrated, and leave until cool.



ST2232M

Rack thrust pad and adjuster

1. Examine the rack pad adjuster for general condition particularly the pad bearing surface.
2. Renew the seal and if necessary the nylon thrust pad behind the grub screw.
3. Check the thrust pad for wear in particular the flat side which slides on the reverse side of the piston rack.



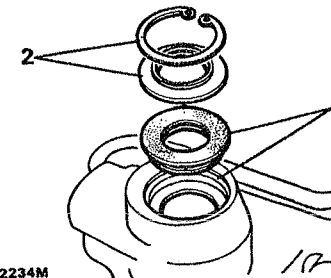
ST2231M

ASSEMBLE

NOTE: When fitting replacement oil seals, these must be lubricated, before fitting, with the recommended steering box fluid. Also ensure that absolute cleanliness is observed throughout the following assembly instructions.

Fitting input shaft oil seal

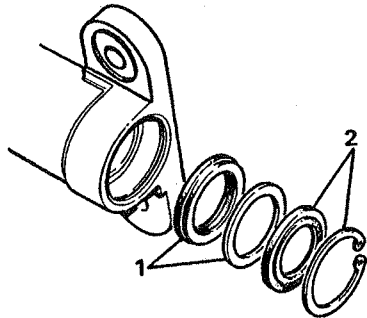
1. Fit a new seal, lipped side first, into the housing noting that when correctly fitted the seal backing will seat on the first shoulder in the bore.
2. Insert the extrusion washer with the flat side downwards facing the seal. Secure the assembly with the circlip and to ensure that it is properly located, tap the circlip into the groove with a punch.



ST2234M

Fitting sector shaft seal

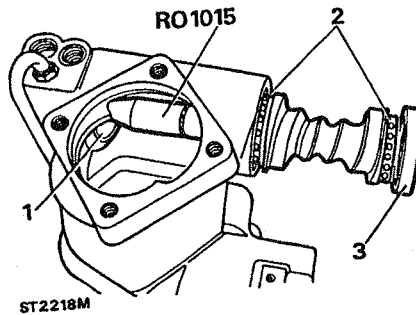
1. With the lipped side leading, fit the oil seal to the casing followed by a plain fibre washer.
2. Fit the steel backed dust seal, flat side downwards towards the oil seal. Secure with the circlip ensuring that it is properly located in the groove.



ST2235M

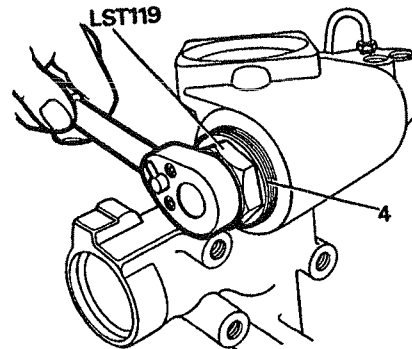
Fitting valve and worm assembly

1. Fit the inner bearing cup and the original shims to the casing. Use a suitable bar approximately 57 mm diameter to tap the cup squarely into position. If the original shims are not available fit shims to the value of 0,76 mm to provide a nominal thickness.
2. Fit the inner and outer bearing cages to the worm using petroleum jelly only to hold the cages in position. Do not use grease for this purpose since it does not dissolve in the steering box lubricating fluid and could block the fluid passages in the valve assembly.
3. Cover the input shaft splined area with seal saver RO1015 and carefully insert the shaft into the casing followed by the outer bearing cup.



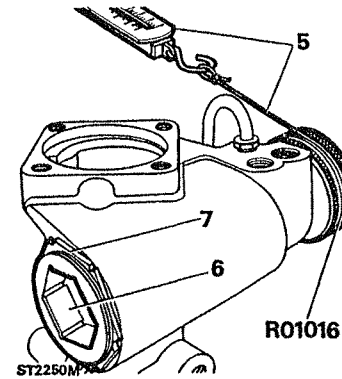
ST2218M

4. Fit a new sealing ring to the worm adjuster screw and turn the adjuster clockwise into the housing using special tool LST 119 until the end float in the input shaft is almost eliminated. Fit the lock-nut but do not tighten until the following instructions for setting the input shaft preload are completed.



ST2248M

5. Fit the torque setting tool RO 1016 to the input shaft and secure with the grub screw. Coil a length of cord round the tool and attach a spring balance to the free end. Measure and record the rolling resistance of the shaft as the spring balance is pulled.



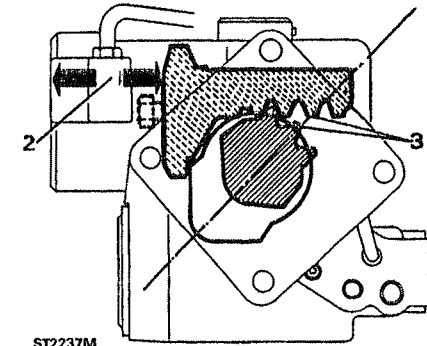
ST2250M

6. To settle the bearings, turn the worm adjuster again, clockwise, to increase the resistance over that recorded in the previous instruction by 1.8 to 2,2 kg (at a radius of 31,7 mm which is determined by the setting tool).
7. Now, back-off the worm adjuster anti-clockwise so that the rolling resistance recorded in instruction 5 is only 0,9 to 1,3 kg. Tighten the locknut using special tool LST 119. Check the rolling resistance again in case tightening the lock-nut has altered the setting.

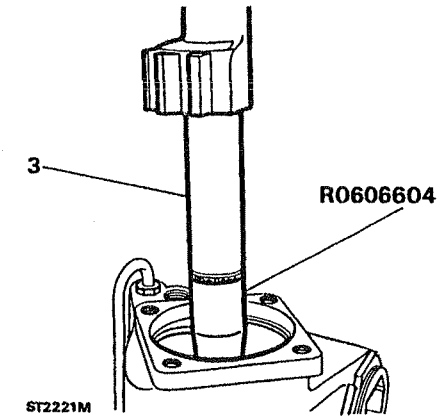
Fitting rack, piston and sector shaft

1. Screw a suitable bolt into the piston crown to assist the fitting and positioning of the piston as was recommended for removing the piston.
2. Insert the piston, rack end first, into the casing so that the piston crown is approximately 63,5 mm from the outer end of the bore.

3. Fit seal saver RO 606604 over the thread and splines of the sector shaft and carefully insert the shaft into the casing. Align the centre gear pitch on the rack with the centre gear tooth on the sector shaft and at the same time rotate the input shaft about a small arc to allow the sector roller to engage the worm.

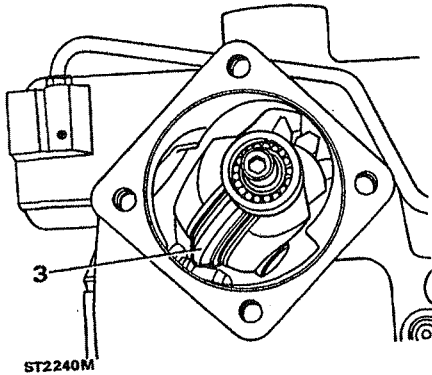


ST2237M



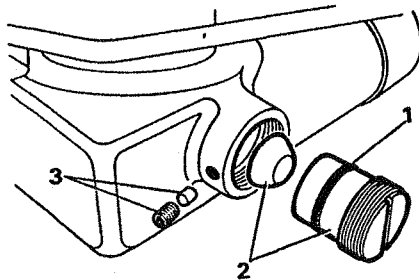
ST2221M

4. The illustration below shows the position in which the sector shaft and roller should be in relation to the casing aperture when the shaft is being inserted.



Fitting rack adjuster

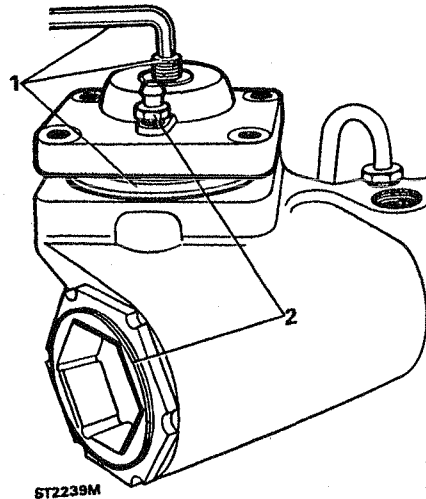
1. Fit a new sealing ring to the rack adjuster.
2. Fit the adjuster pad with the flat side towards the rack and screw in the adjuster until solid contact is made with the rack. Now back-off the adjuster half a turn.
3. Insert the Nylon locking pad and fit the grub screw, leaving it slack at this stage.



ST2242M

Fitting sector shaft cover

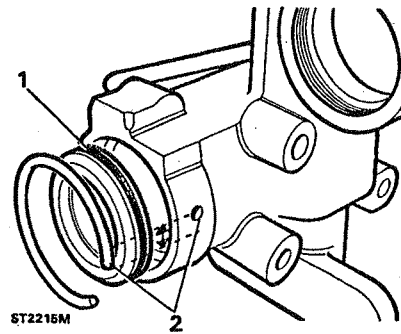
1. Fit and lubricate a new sealing ring to the inside of the cover and screw the cover fully on to the sector shaft adjuster screw. If necessary, use an Allen key to hold the screw to prevent it turning.
2. Locate the cover on the casing noting that it can only be fitted one way, that is, with the bleed nipple towards the worm adjuster. Tap the cover into place and if necessary, back off the adjuster screw a few turns to allow the cover to seat properly on the casing. Fit the cover retaining screws but do not tighten.
3. Using the torque setting tool RO1016 for convenience, rotate the input through a small arc, in both directions, to ensure that the sector roller is free to move in the worm. Tighten the four screws evenly to the correct torque.



ST2239M

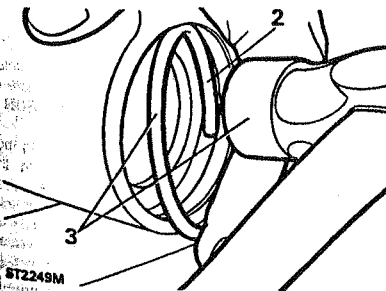
Fitting cylinder cover

1. Fit and lubricate a new seal to the cylinder cover and press the cover squarely into the cylinder just far enough to clear the retaining ring groove.
2. Secure the cover with the retaining ring by inserting one end of the ring into the cylinder groove so that it is positioned 12 mm beyond the ring extractor hole in the side of the cylinder.



ST2215M

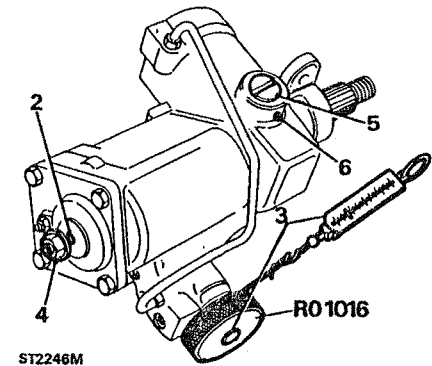
3. Now, compress the ring, by hand, whilst feeding the ring into the groove by striking it with a hammer until the ring finally springs into position in the groove. Ensure that the ring is fully seated by tapping it round with a punch.



ST2249M

Setting the sector shaft and rack adjuster pre-loads

1. Turn the input shaft to set the sector shaft roller at the mid point of its travel between the left and right hand locks.
2. Using a 6 mm Allen key, turn the sector shaft adjusting screw anti-clockwise to obtain backlash between the input shaft and sector shaft. Now, turn the adjusting screw clockwise until the backlash is just eliminated.
3. Using the tool RO 1016 and spring balance, measure and record the maximum rolling resistance at the input shaft.
4. Fit a new locknut to the adjuster screw but do not tighten. Continue to rotate the input shaft, with the spring balance, whilst turning the adjuster screw until the figure recorded in instruction 3 is increased by 0,9 to 1,3 kg. Tighten the locknut and check the above figures again.
5. Turn the rack adjuster clockwise to impart pressure upon the rack and back-off half a turn. Again, using special tool RO 1016 and the spring balance, rotate the input shaft whilst turning the rack adjuster until the figure recorded in instruction 4 is increased by a further 0,9 to 1,3 kg. Note that the final rolling resistance figure, recorded on the spring balance, must not exceed 7,25 kg.



ST2246M

6. When satisfied that the pre-load figures are satisfactory, lock the rack adjuster in position with the grub screw.

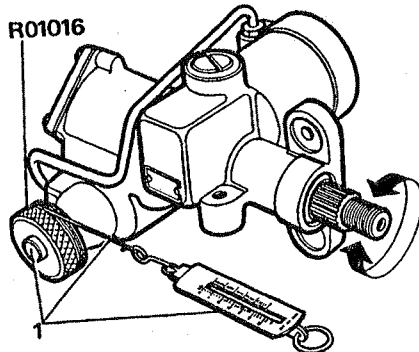
Torque peak check

The purpose of this check is to determine the point at which the rolling resistance is the greatest when the steering is turned from lock to lock. This resistance, which must be equally distributed, should be when the sector shaft roller is positioned along the centre portion of the worm approximately two revolutions of the input shaft from either the left or right hand lock.

The correct position of the resistance depends upon the amount of shimming behind the input shaft inner bearing cup. Provided that the original shim pack has been refitted, the torque peak position should be correct unless major components have been renewed. The procedure for checking and adjusting the torque peak is contained in the following instructions.

1. Attach the torque setting tool RO 1016 to the input shaft and turn it fully anti-clockwise. Wind cord round the tool and fasten a spring balance to the free end as before. Turn the input shaft by pulling the spring balance and note the position where the highest figure is obtained. If the highest figures are not recorded along the middle portion of the travel as explained above adjustment is necessary.
2. Adjustment involves the dismantling of the steering box and removal of the input shaft inner bearing cup and shims. If the torque peak (highest figure) occurred before the centre position, add shims to the pack. Remove shims if the torque peak occurs after the centre position.

RO1016

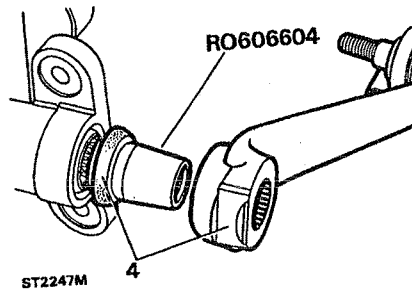


ST2238M

NOTE: That the addition or subtraction of a 0,07 mm shim will move the torque peak area by approximately one quarter of a turn of the input shaft.

Shim washers are available from Land Rover Parts and Equipment in the following sizes: 0,03 mm, 0,07 mm, 0,12 mm and 0,24 mm.

3. Having added or subtracted shims as necessary, reassemble the steering box and check that the torque peak position is now correct.
4. Using seal saver RO 606604, fit a new outer dust seal over the sector shaft. Fit the drop arm to the sector shaft and a new lock washer. Fit and tighten the retaining nut to the correct torque and bend the lock tab over a flat of the nut.



Fitting steering box to vehicle and testing

1. Fit the steering box to the vehicle and replenish the system with the correct make and grade of fluid. For this information refer to SECTION 9 and bleeding the power steering system.
2. To test the effectiveness of the steering box overhaul and the system for leaks, run the engine and hold the steering hard on full lock in both directions whilst a second person checks for fluid leaks.

CAUTION: Do not hold the steering on full lock for more than thirty seconds in any one minute to avoid overheating the fluid and possibly damaging the seals.

3. Finally road test the vehicle.

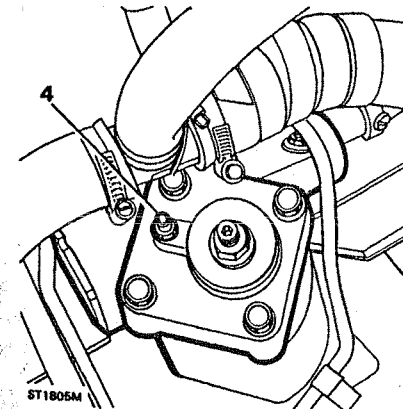
POWER STEERING SYSTEM - Adwest Lightweight box and Gemmer

Bleed

1. Fill the steering fluid reservoir to the mark on the side of the reservoir with one of the recommended fluids.
2. Start and run the engine until it attains normal operating temperature.
3. Check and correct the reservoir fluid level.

NOTE: During the carrying out of items 4, 5 and 6, ensure that the steering reservoir is kept full. Do not increase the engine speed or move the steering wheel.

4. Run the engine at idle speed, slacken the bleed screw. When fluid seepage past the bleed screw is observed, retighten the screw.



5. Ensure that the fluid level is in alignment with the mark on the reservoir dipstick.
6. Wipe off all fluid released during bleeding.
7. Check all hose joints, pump and steering box for fluid leaks under pressure by holding the steering hard on full lock in both directions.

CAUTION: Do not maintain this pressure for more than 30 seconds in any one minute, to avoid causing the oil to overheat and possible damage to the seals. The steering should be smooth lock-to-lock in both directions, that is, no heavy or light spots when changing direction when the vehicle is stationary.

8. Carry out a short road test. If necessary, repeat the complete foregoing procedure.

POWER STEERING SYSTEM - Adwest Lightweight box and Gemmer

Test

If there is a lack of power assistance for the steering the pressure of the hydraulic pump should be checked first before renewing any components of the system. The fault diagnosis chart should also be used to assist in tracing faults in the power steering.

Procedure

1. The hydraulic pressure test gauge is used for testing the power steering system. This gauge is calibrated to read up to 140 kgf/cm² and the normal pressure which may be expected in the power steering system is 77 kgf/cm².
2. Under certain fault conditions of the hydraulic pump it is possible to obtain pressures up to 105 kgf/cm². Therefore, it is important to realise that the pressure upon the gauge is in direct proportion to the pressure being exerted upon the steering wheel. When testing, apply pressure to the steering wheel very gradually while carefully observing the pressure gauge.
3. Check, and if necessary replenish, the fluid reservoir.
4. Examine the power steering units and connections for leaks. All leaks must be rectified before attempting to test the system.
5. Check the steering pump drive belt for condition and tension, rectify as necessary.
6. Assemble the test equipment and fit to the vehicle as illustrated.
7. Open the tap in the adaptor.
8. Bleed the system but exercise extreme care when carrying out this operation so as not to overload the pressure gauge.
9. With the system in good condition, the pressures should be as follows:
 - (a) Steering wheel held hard on full lock and engine running at 1,000 rev/min, the pressure should be 70 to 77 kgf/cm².
 - (b) With the engine idling and the steering wheel held hard on full lock, the pressure should be 28 kgf/cm² minimum.

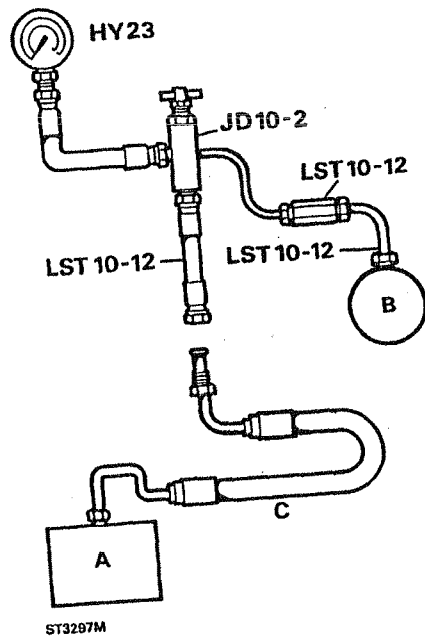
These checks should be carried out first on one lock, then on the other.

CAUTION: Under no circumstances must the steering wheel be held on full lock for more than 30 seconds in any one minute, otherwise there will be a tendency for the oil to overheat and possible damage to the seals may result.

10. Release the steering wheel and allow the engine to idle. The pressure should be below 7 kgf/cm².

11. If the pressures recorded during the foregoing test are outside the specified range, or pressure imbalance is recorded, a fault exists in the system. To determine if the fault is in the steering box or the pump, close the adaptor tap for a period not exceeding five seconds.
12. If the gauge fails to register the specified pressures, the pump is inefficient and the pump relief valve should be examined and renewed as necessary.
13. Repeat the foregoing test after renewing the relief valve and bleeding the system. If the pump still fails to achieve the specified pressures, the pump should be overhauled or a new unit fitted.
14. If pump delivery is satisfactory and low pressure or marked imbalance exists, the fault must be in the steering box valve and worm assembly.

TEST EQUIPMENT



- A. Steering box
- B. Steering pump
- C. Existing hose from steering box

ADJUST POWER STEERING BOX - Adwest Lightweight box and Gemmer

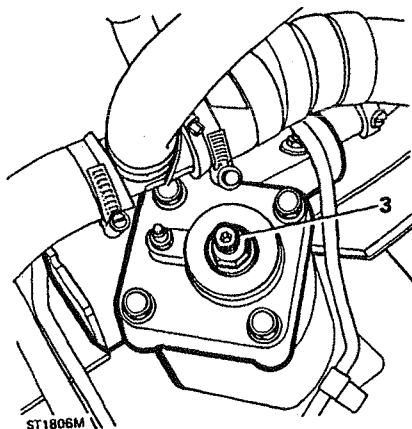
NOTE: The condition of adjustment which must be checked is one of minimum backlash without overtightness when the wheels are in the straight-ahead position.

1. Jack up the front of the vehicle until the wheels are clear of the ground.

WARNING: Wheels must be chocked in all circumstances.

2. Gently rock the steering wheel about the straight-ahead position to obtain the 'feel' of the backlash present. This backlash must not be more than 9,5 mm.

3. Continue the rocking action whilst an assistant slowly tightens the steering box adjuster screw after slackening the locknut until the rim movement is reduced to 9,5 mm maximum.



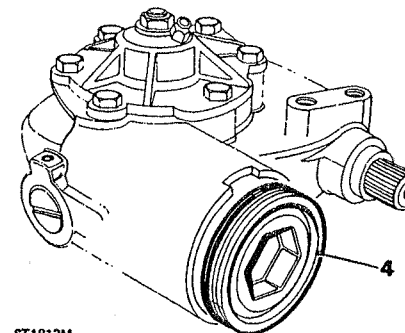
4. Tighten the locknut, then turn the steering wheel from lock to lock and check that no excessive tightness exists at any point.
5. Lower the vehicle to ground level and remove the wheel chocks.
6. Road test the vehicle.

GEMMER POWER STEERING BOX OVERHAUL

Special tools:
 Drop arm puller MS 252 A / LRT-57-012
 Input shaft oil seal installer LST124 / LRT-57-009
 Sector shaft oil seal installer LST125 / LRT-57-010
 Valve seal installer and valve ring compressor LST126 / LRT-57-011
 Preload setting tool RO1016 / LRT-57-017

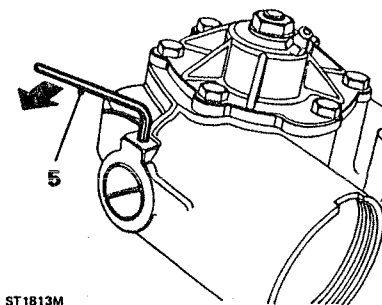
Dismantle

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. Remove the dust seal, if fitted.
3. Using a suitable tool turn the cylinder cover anti-clockwise to expose end of the locking ring. Now turn the cover clockwise to extract the ring.

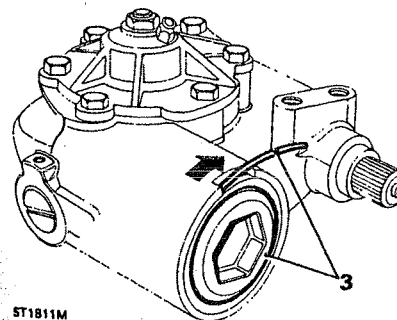


ST1812M

5. Slacken the grub screw securing the rack pad adjuster.

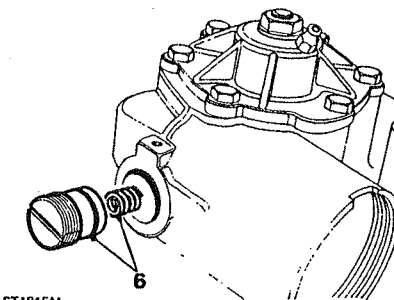


ST1813M



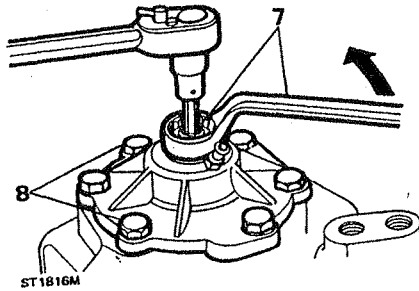
ST1811M

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.

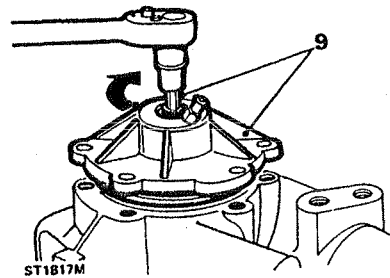


ST1815M

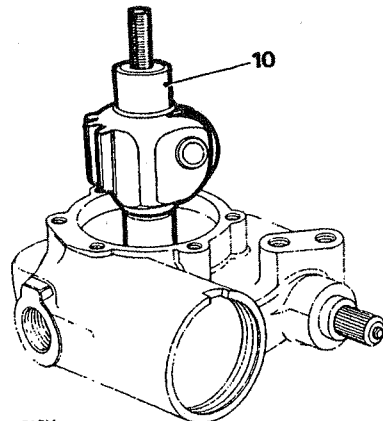
7. Restrain the sector shaft adjuster with a 6 mm hexagonal key and remove the locknut.
8. Remove the six bolts securing the sector shaft cover.



9. Hold the sector shaft cover and turn the adjuster and screw clockwise until the cover can be removed.

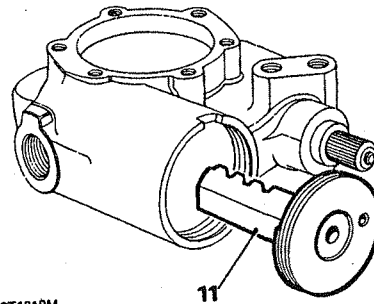


10. Lift-out the sector shaft.



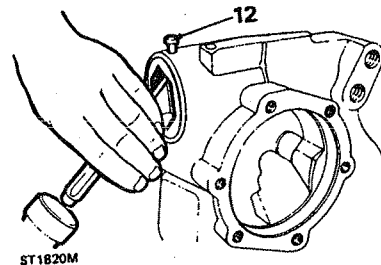
ST1818M

11. Remove the rack and piston assembly and collect the rack adjuster thrust pad.



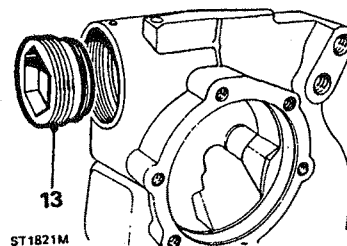
ST1819M

12. Drive-out the worm adjusting screw locking pin.



ST1820M

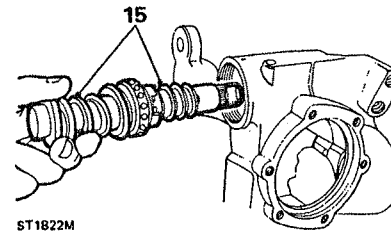
13. Using a suitable tool, remove the input shaft worm adjusting screw anti-clockwise.



ST1821M

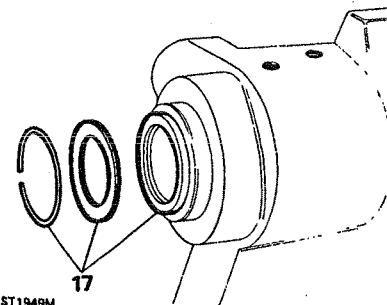
14. Tap the splined end of the input shaft to free the outer bearing. Remove the bearing track and ball cage assembly.

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.

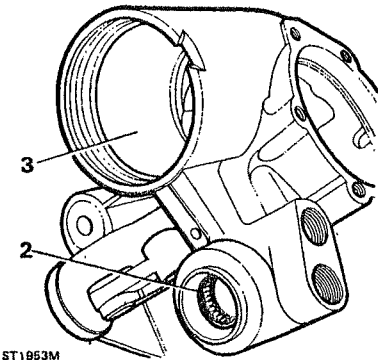


ST1949M

INSPECTION AND OVERHAUL OF COMPONENTS

Steering box housing

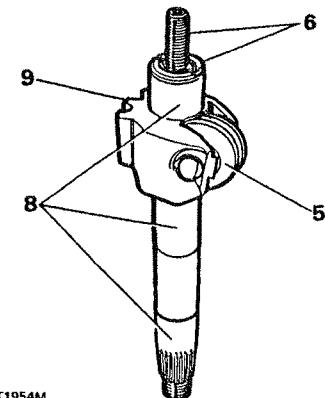
1. Examine the sector shaft upper and lower needle roller bearings and if necessary drive them from the housing with a suitable drift.
2. Inspect the input shaft needle bearing and if worn drive it from the housing and press-in replacement.
3. Examine the piston bore for wear and scores.
4. Check the 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.
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.



ST1954M

Valve and worm assembly

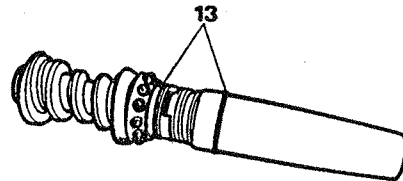
NOTE: If the inner ball race is faulty and unfit for further service it cannot be renewed and a new valve and worm assembly must be obtained and fitted. Should this be the case, the following checks of the valve and worm can be ignored.

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 collar.
- c. Ring compressor.

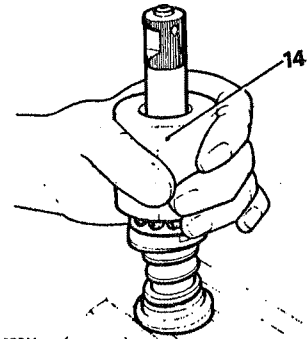
Before using the tool lubricate each part with the recommended power steering fluid.

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.



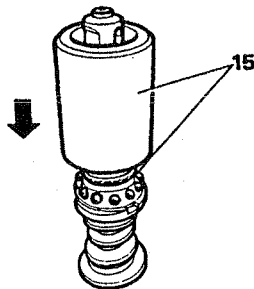
ST1941M

14. Encircle the ring with the split collar and squeeze the collar together, by hand, and hold for approximately thirty seconds.



ST1958M

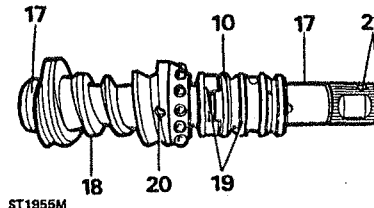
15. Remove the split collar and with care, ease the compressor tool over the ring and leave for a few minutes to cool before carefully removing the tool.



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 collar 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.

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.
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.

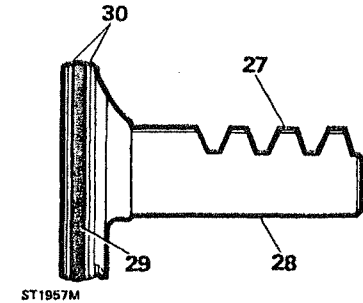
Thrust pad and adjuster

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

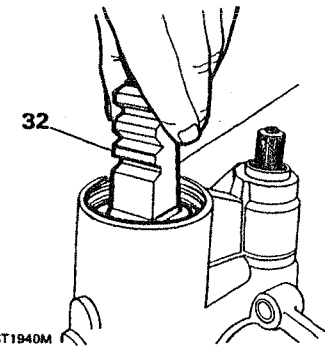
27. Examine the rack teeth for wear and pitting.
28. Check that the surface on which the thrust pad bears is not worn and scored.

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.

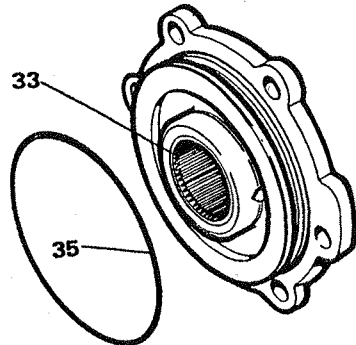


ST1940M

Sector shaft cover

33. Examine the sector shaft cover needle bearing and if necessary extract the bearing taking care not to damage the housing.

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.

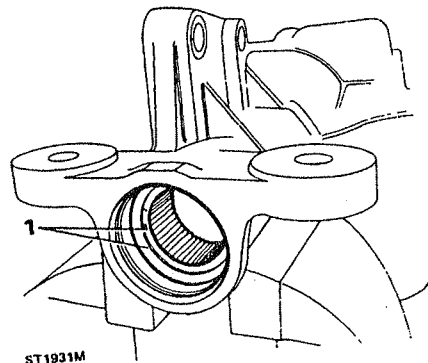


ST1946M

Assemble

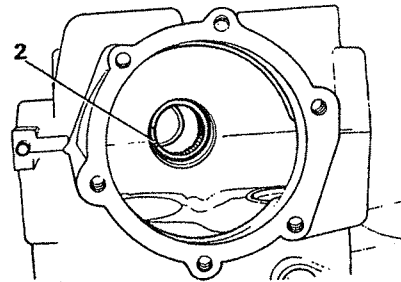
During the following assembly instructions absolute cleanliness must be observed. Also when fitting components and oil seals they must only be lubricated with the recommended fluid, or petroleum jelly.

1. If removed, fit the sector shaft lower needle bearings, numbers outwards, to the steering box to just below the chamfer.



ST1931M

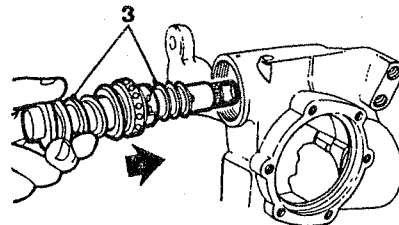
2. Fit the sector shaft upper needle bearings, number outwards, up to the shoulder.



ST1932M

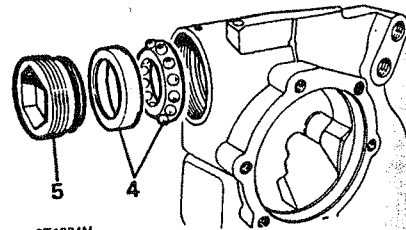
Fitting the valve and worm assembly (input shaft)

3. Fit the input shaft to the steering box housing and lubricate with the recommended fluid. Turn the shaft to the straight ahead position.

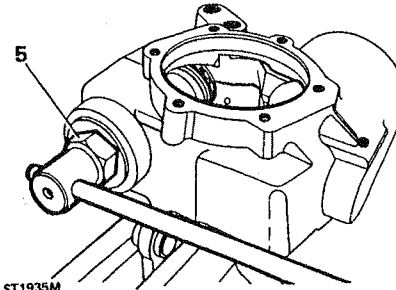


ST1933M

4. Fit the input shaft outer bearing and track.
5. Lubricate and fit the input shaft cover and 'O' ring seal using a suitable tool.

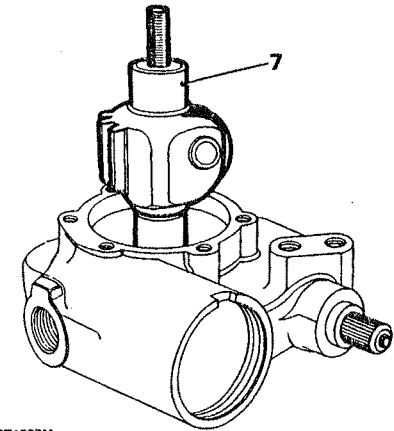


ST1934M

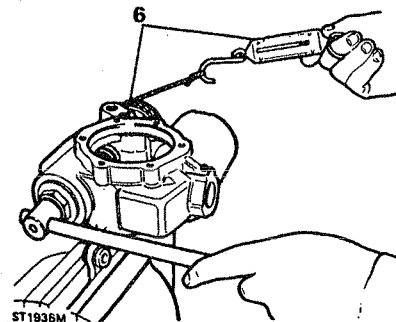


ST1935M

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.



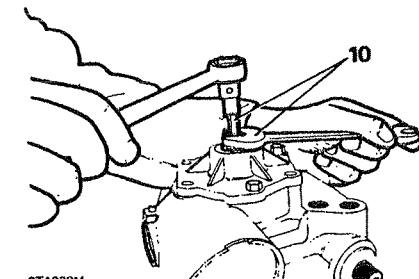
ST1937M



ST1936M

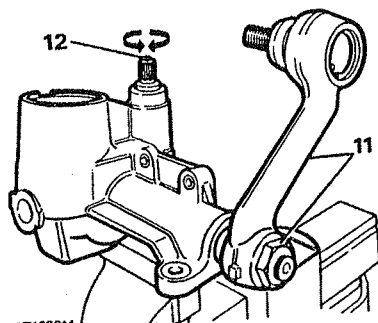
Fitting sector shaft and piston-rack assembly

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.



ST1938M

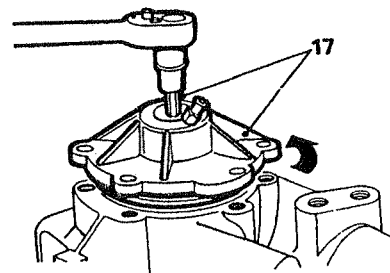
11. Temporarily fit the drop arm and tighten the locknut until no clearance is felt between the sector shaft and drop arm.
12. Rotate the input shaft one turn clockwise, then turn the shaft back to the straight ahead position whilst noting the point at which the backlash to the drop arm disappears or 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° (1/4 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.

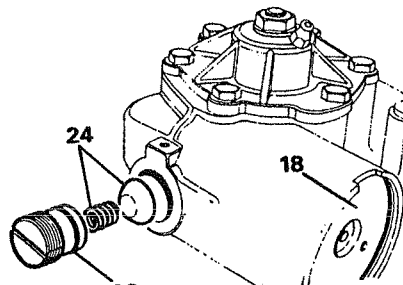
NOTE: If it is necessary to perform instruction 15, instructions 3 to 13 must be repeated afterwards.

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.



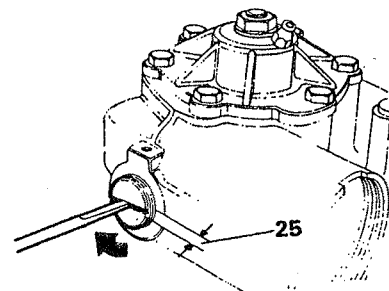
ST1943M

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.
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.



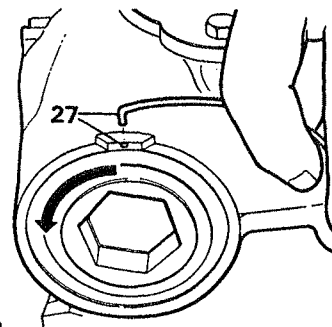
ST1944M

25. Screw-in the rack pad adjuster until the head is 4 mm from the steering box face.



ST1945M

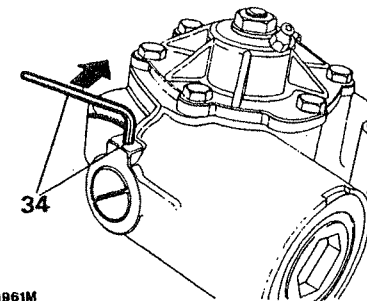
26. Lubricate and fit an 'O' ring seal to the piston-rack cover.
27. Fit the piston cover to steering box. Align the retaining ring hole in the cover with the cut-out in steering box housing and insert hooked end of the retaining ring in the hole. Using a suitable tool, rotate the cover anti-clockwise 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

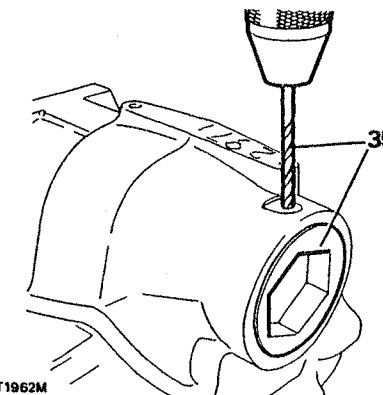
28. Temporarily fit the drop arm and secure with the nut so that no backlash is present between the arm and sector shaft. Set the steering in the straight ahead position.
29. Fit the preload setting tool RO1016 to the input shaft and secure with the grub screw. Rotate the input shaft in both directions clockwise and anti-clockwise 4 to 6 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.
34. Secure the rack adjuster with the grub screw, reversing the dismantling procedure instruction 5.



ST1961M

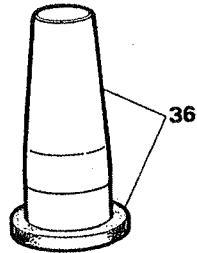
35. Secure the worm adjuster with a new pin. If necessary, drill a new 4 mm hole in the adjuster through the hole in the steering box housing to locate the pin. Check, before drilling that the new hole will not break into the side of the existing hole.



ST1962M

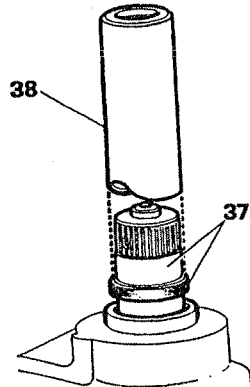
Fitting input shaft oil seal

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.



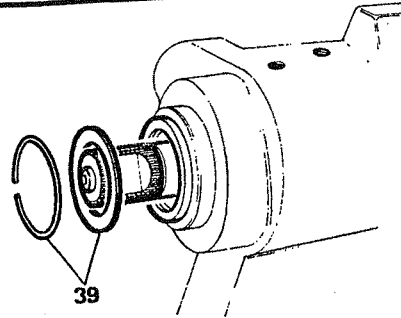
ST1947M

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

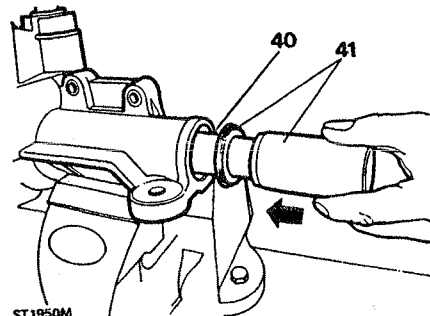
39. Fit the anti-extrusion washer and secure the assembly with the wire circlip.



ST1952M

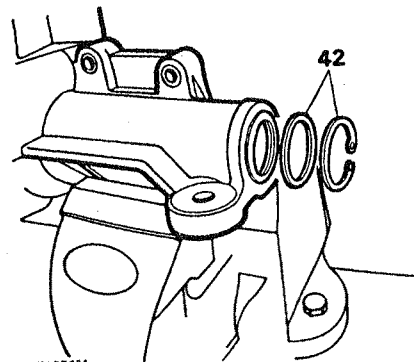
Fitting sector shaft oil seal

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, and fit outer dust seal.



ST1951M

43. Fit the drop arm, tab washer and nut. Tighten the nut to 170 to 180 Nm. 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.

Pipe connections to steering box

When fitting a new or overhauled steering box observe the following procedure.

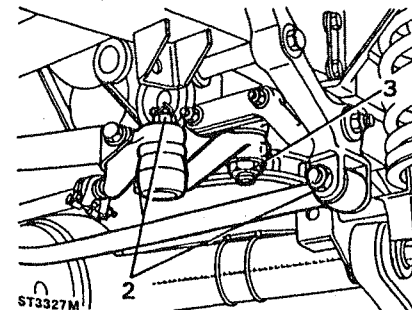
1. Remove dust caps from ports.
2. Immediately fit pipes finger tight.
3. Tighten the 16 mm union nut to 20 Nm.
4. Tighten the 14 mm union nut to 15 Nm.

STEERING BOX SECTOR SHAFT SEAL - renew with steering box fitted to vehicle

Special tools

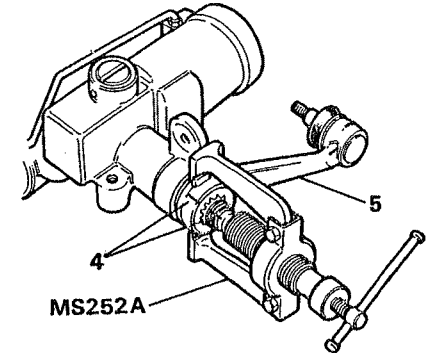
Drop arm puller MS 252A / LRT-57-012
Seal replacer LST 125A / LRT-57-010

1. Working from beneath the vehicle set the steering in approximately the straight ahead position.
2. Release the ball pin from the drag link, and one end of Panhard rod.
3. Release the lock tab from the drop arm retaining nut and remove the nut.



ST3327M

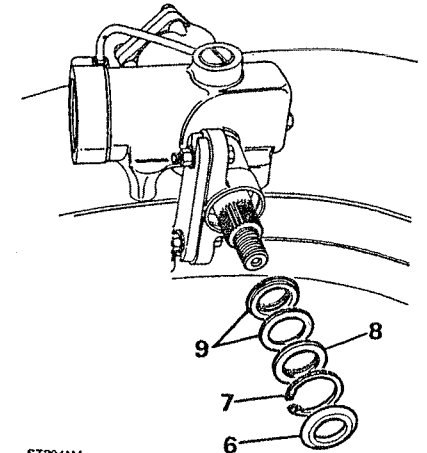
4. Before removing the drop arm, mark its relationship to the sector shaft to assist assembly.
5. Using pulley MS 252A or a suitable alternative, withdraw the drop arm.



MS252A

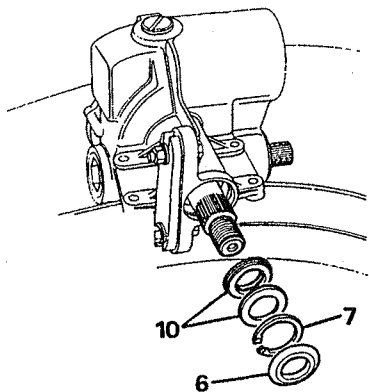
ST3296M

6. Remove the dust seal, if fitted, and clean the area around the sector shaft seal.
7. Remove the circlip.
8. Adwest steering box only; to remove the seal pack, drill two 3.0 mm holes diametrically opposite into the metal dirt seal. Insert a 4 mm self tapping screw in each hole then, with pliers pull the seal from the box.
9. Remove the extrusion washer and inner seal.



ST2941M

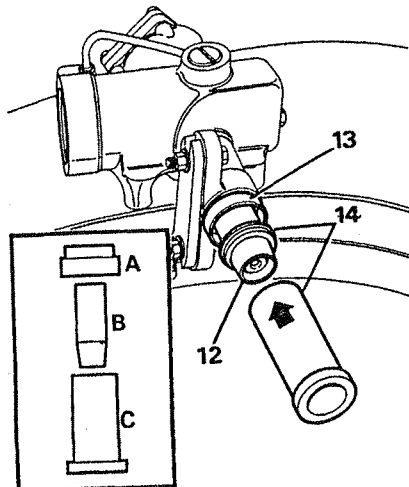
10. Adwest and Gemmer box; with a suitable probe, remove the anti-extrusion washer and inner seal.



ST2942M

Fitting new seals

11. Clean the seal housing and around the sector shaft.
12. Lubricate, and place the seal saver part 'B' of the tool over the shaft.
13. Lubricate and fit part 'A' of the tool with the shoulder against the face of the box.
14. Lubricate and slide the seal, lip side leading, over the seal saver and with part 'C' of the tool, drive the seal into position.
15. Adwest box only; fit the anti extrusion washer, dirt seal, and secure with the circlip. Finally fit the dust seal so the the lip is flat against the face of the box.
16. Gemmer box only; the same as instruction 15 except that no dirt seal fitted.



ST2943M

17. Fit the drop arm, aligning the assembly marks.
18. Fit the tab washer and drop arm nut and tighten to the correct torque using a suitable restraining bar between the chassis and drop arm.
19. Bend the tab of the washer over a convenient flat.
20. Fit the ball pin to the drag link, tighten the nut and secure with a new split pin.

POWER STEERING

FAULT DIAGNOSIS

SYMPTOM	CAUSE	TEST ACTION	CURE
INSUFFICIENT POWER ASSISTANCE WHEN PARKING	(1) Lack of fluid. (2) Engine idling speed too low. (3) Driving belt slipping. (4) Defective hydraulic pump and/or pressure relief valve.	Check hydraulic fluid tank level. Try assistance at fast idle. Check belt tension. (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 (b) Release steering wheel and allow engine to idle. See 'Power steering pump test'.	If low, fill and bleed the system. If necessary, reset idle speed. Adjust the driving belt. If pressure is outside limits (high or low) after checking items 1 and 3, see Note 2 below. If pressure is greater, check steering box for freedom and self-centring action
POOR HANDLING WHEN VEHICLE IS IN MOTION	Lack of castor action. Steering too light and /or over sensitive.	This is caused by over-tightening the rocker shaft backlash adjusting screw on top of steering box. Check for loose torsion bar fixings on steering box valve and worm assembly.	It is most important that this screw is correctly adjusted. See instructions governing adjustment. 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. (2) Noise from hydraulic pump.	Check the loose runs of the hoses. Check oil level and bleed system.	Alter hose route or insulate as necessary 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.

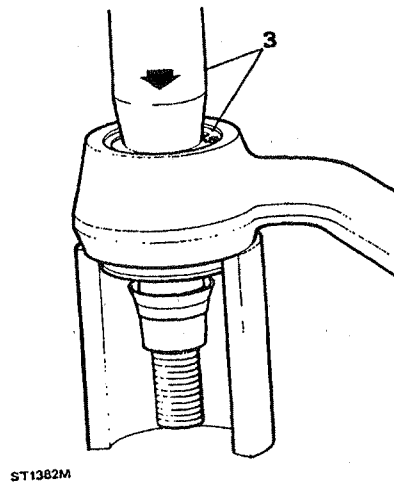
- | | |
|-----------------|-------------------|
| Ball Pin | Ball lower socket |
| Retainer | Spring |
| Spring rings | 'O' ring |
| Dust cover | Cover plate |
| Ball top socket | Circlip |

Dismantle

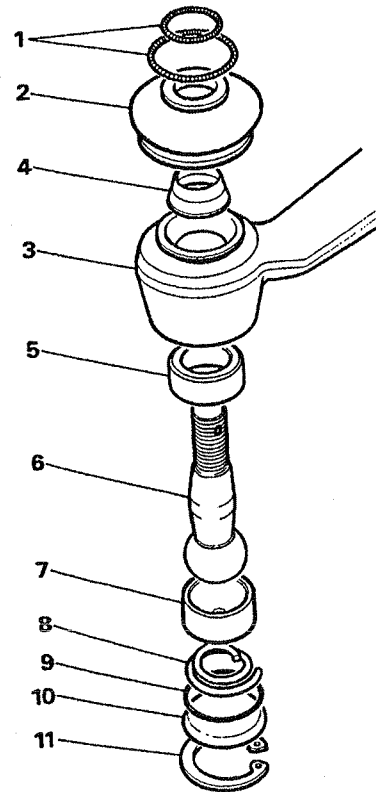
1. Remove the drop arm from the vehicle and clean the exterior.
2. Remove the spring rings and prise-off the dust cover.
3. In the interests of safety, position the ball joint under a press to relieve the spring tension and support the housing both sides of the ball pin, as illustrated. Apply pressure 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

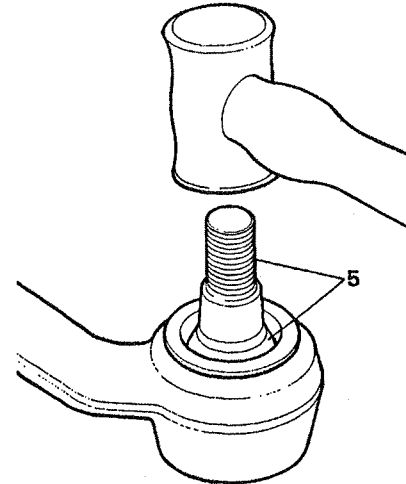


ST1381M

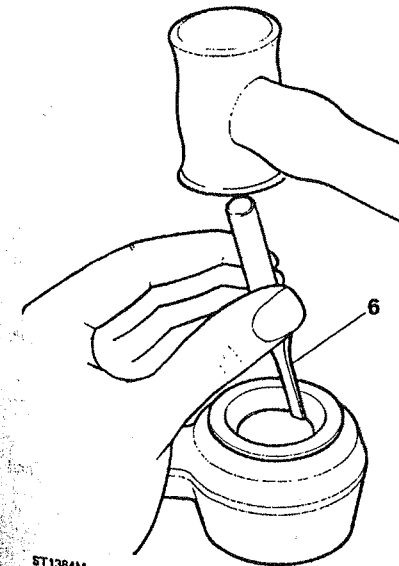
KEY TO BALL JOINT

- | | |
|-------------------|-----------------|
| 1. Spring rings. | 7. Top socket |
| 2. Dust cover. | 8. Spring. |
| 3. Ball housing. | 9. 'O' ring. |
| 4. Retainer. | 10. Cover plate |
| 5. Bottom socket. | 11. Circlip. |
| 6. Ball pin. | |

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

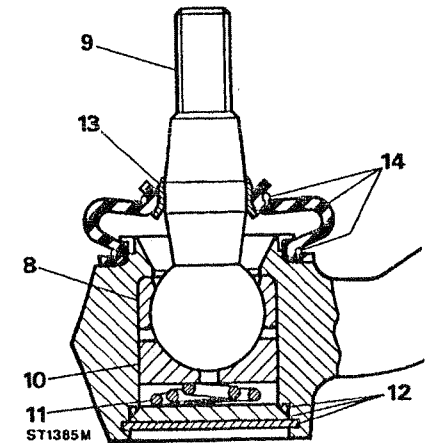


ST1384M

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, 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.

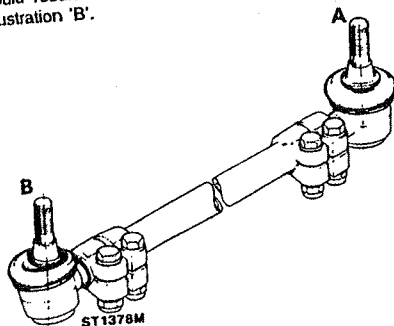


ST1385M

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.

FRONT WHEEL ALIGNMENT - Check and adjust

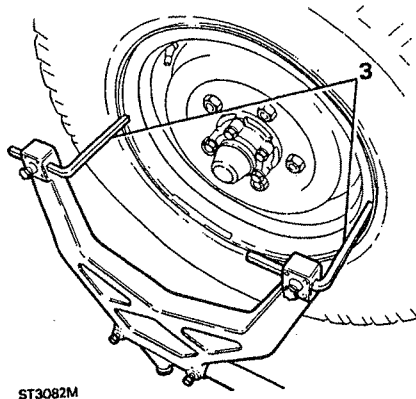
Checking

NOTE: Recognised front wheel alignment tracking equipment should be used to perform this operation. Only the use of basic equipment is described below. See section 04 for alignment data.

Make the following checks before commencing:

- The vehicle is on level ground.
- The vehicle is not loaded.
- The wheels run true and are not damaged or buckled.
- The track rod is not damaged or bent.
- The ball joints are not worn and boots are not split.
- The joints are set in the same angular plane and central in their housings. See "Track rod and drag link".

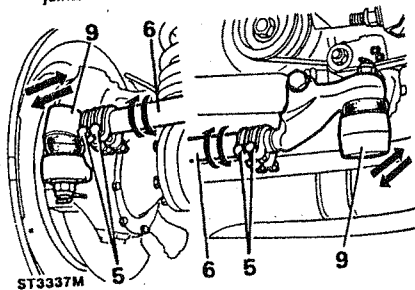
1. Set the road wheels in the straight ahead position and move the vehicle forward a short distance for at least two revolutions of the wheels.
2. Set up the equipment to the manufacturers instructions.
3. Position the trammel probes on the inner face of the wheel, not the rims, if the latter are damaged.



4. Check the alignment as advised by the equipment supplier.

Adjusting

5. Slacken the clamps at both ends of the track rod.
6. Turn the track rod to increase or decrease its effective length until the toe-out is correct.
7. Push the vehicle rearwards turning the steering wheel from side to side to settle the ball joints. Then, with the road wheels in the straight ahead position, push the vehicle forward a short distance.
8. Recheck the track and if required, adjust as necessary.
9. When the alignment is correct, tap the ball joints in direction of the arrows to the maximum of their travel to ensure full unrestricted movement of the track rod. Then return the joints to a central position and in line.



10. Finally, tighten the ball joint clamp nuts and bolts to the correct torque.

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 forward 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.

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 proprietary tool remove the ball joint from the axle bracket.
23. Remove the pivot bracket complete with the ball joint and if fitted, the lower ball joint of the levelling unit.
24. Remove the two bolts securing the ball joint to the pivot bracket and press the ball joint from the bracket.

NOTE: Replacement ball joints are supplied as complete assemblies packed with grease.

25. Using two bolts as a guide to ensure correct alignment press the knurled ball joint into the pivot bracket and secure with the two nuts and bolts.

Assemble upper links and ball joints

26. Fit the pivot bracket ball joint and bracket to the axle and secure with the plain washer castle nut and split pin. Tighten the nut to 176 Nm.
27. Fit the levelling unit, if used.
28. Assemble the upper links to the chassis attachment brackets but do not at this stage fully tighten the pivot nut and bolt.
29. Fit the upper link assemblies to the chassis with the six nuts and bolts, (three each side). Note the positions of the bolt heads. Tighten the nuts to 47 Nm.
30. Secure the rear ends of the upper links to the pivot bracket and tighten the two nuts and bolts to 115 Nm.
31. Remove the jack from the chassis, allow the suspension to settle and tighten upper link pivot bolts.

Renew anti-roll bar bushes and ball joints

32. Remove the two nuts and bolts securing the anti-roll bar to the axle link.
33. Remove the eight nuts and bolts (four each side) retaining the anti-roll bar to the chassis and remove the bar from the vehicle.
34. Remove the split pin and castle nut and remove the ball joint and link from the axle location.
If the ball joint requires replacement the complete link must be renewed.
35. Renew the rubbers and fit the anti-roll bar to the chassis and secure with the eight bolts and nuts tightening to 24 Nm.
36. Fit the ball joint and link to the axle location and tighten the castle nut to 176 Nm 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.

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.

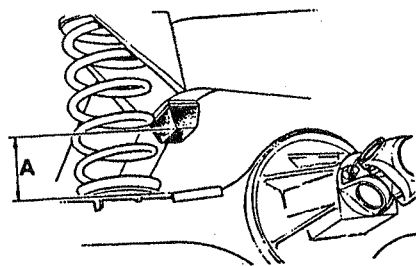
If the vehicle is overloaded the unit will fail to level fully and more frequent bump stop contact will be noticed.

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.
3. If the bump stop clearance is less than the above figure remove the rear springs and check the free length against the following data in the chart.
4. Renew any spring where the free length is more than 20 mm shorter than the figures in the chart.



5. Having refitted or renewed any springs repeat the clearance check as described above. If the average bump clearance is still less than 67 mm renew the levelling unit.
6. Load weights to the value of 650 kg evenly over the rear load area of the vehicle and leave it to settle undisturbed for minimum period of thirty minutes.
7. With the driving seat occupied or with an approximate equivalent weight of 75 kg check the bump stop clearance and note the measurement.
8. Drive the vehicle on a test route approximately 5 km in length over undulating roads or graded tracks. At the completion of the drive bring the vehicle to rest by light brake application so as not to disturb the vehicle loading.
9. Without disturbing the vehicle load and with the driving seat occupied, check the bump stop clearance and note the reading, which must be in excess of 45 mm (average).
10. Subtract the reading obtained under Instruction 7 from that obtained under Instruction 9. If the change in clearance is in excess of 10 mm the levelling unit is functioning correctly.
11. If the figures obtained in Instructions 9 and 10 do not exceed 45 mm and 10 mm respectively unload the vehicle and renew the levelling unit.

LAND ROVER COIL SPRING SPECIFICATION

PART NO.	DESCRIPTION	COLOUR CODE	VEHICLE	LOCATION	SPECIFICATION	FREE LENGTH
NRC 8044	Drivers	Double White Stripes	110	Front	Basic	384.3 mm
NRC 8045	Passengers	Double Yellow Stripes	110	Front	Basic	368.1 mm
NRC 6389	Drivers Heavy Duty	Red Stripe	110	Rear	Basic	407.0 mm
NRC 6904	Passengers Heavy Duty	Red & Green Stripes	110	Rear	Basic	395.0 mm
NRC 6388	Drivers Levelled	Blue Stripe	110	Rear	Suspension Levelled	42.0 mm
NRC 7000	Passengers Levelled	Green & White Stripes	110	Rear	Suspension Levelled	400.0 mm
NRC 9446	Drivers	Blue & Green Stripes	90	Front	Basic	373.02 mm
NRC 9447	Passengers	Blue & Yellow Stripes	90	Front	Basic	368.82 mm
NRC 9448	Drivers 2400 kg	Blue & Red Stripes	90	Rear	Basic	376.0 mm
NRC 9449	Passengers 2400 kg	Yellow & White Stripes	90	Rear	Basic	387.57 mm
NRC 9462	Drivers 2500 kg	Green, Yellow & Red Stripes	90	Rear	Heavy Duty Unlevelled	376.27 mm
NRC 9463	Passengers 2550 kg	Green, Yellow & White Stripes	90	Rear	Heavy Duty Unlevelled	376.27 mm

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.
13. Fit the levelling unit to the lower ball joint and secure the gaiter.
14. Attach the webbing strap to the chassis cross member.
15. Fit the upper links to the pivot bracket and retain with the two bolts and nuts but do not tighten at this stage.
16. Remove the jack in support of the axle and the support from under the chassis.
17. Allow the suspension to settle and then tighten the two bolts and nuts retaining the upper links to the pivot bracket to the correct torque.

SPRINGS AND SHOCK ABSORBERS

Remove rear springs

1. Slacken the rear road wheel nuts and raise the rear of the vehicle and lower the chassis on the axle stands or similar supports and remove the road wheels.
2. Support the weight of the axle with a jack.
3. Disconnect the shock absorbers at the lower end.
4. Remove the spring retainer plate.
5. Lower the axle sufficiently to withdraw the spring, but take care not to stretch the flexible brake hose by lowering the axle too far.
6. Remove the spring pan.

Fit rear springs

7. Fit the spring pan and retainer plate.
8. Fit the spring into the chassis top location and using a turning motion fit the spring to the axle pan.
9. Secure the shock absorbers with the rubbers correctly located.
10. Remove the axle support, fit the road wheels and lower the vehicle to ground.
11. Finally tighten the road wheel nuts.

Remove shock absorbers

12. Slacken the road wheel nuts, raise the rear of the vehicle and support it under the axle and remove the road wheels.
13. Remove the shock absorber upper and lower retaining nuts and rubbers.
14. Remove the shock absorber from the top locating shaft and withdraw it from the vehicle.

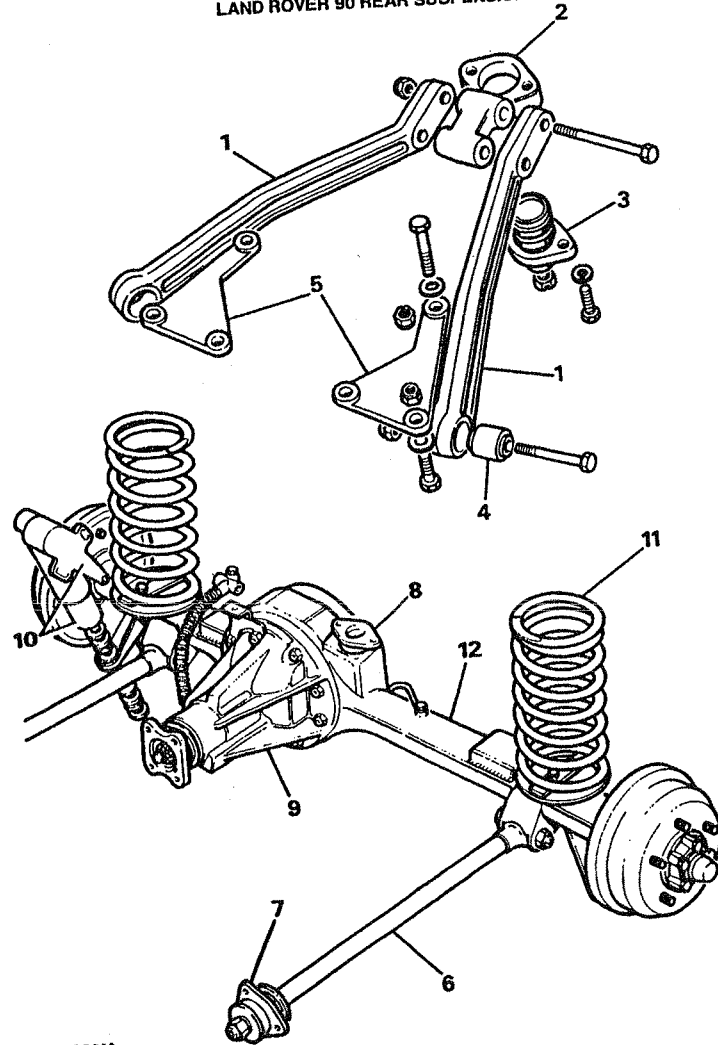
Test shock absorbers (front and rear)

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.

LAND ROVER 90 REAR SUSPENSION

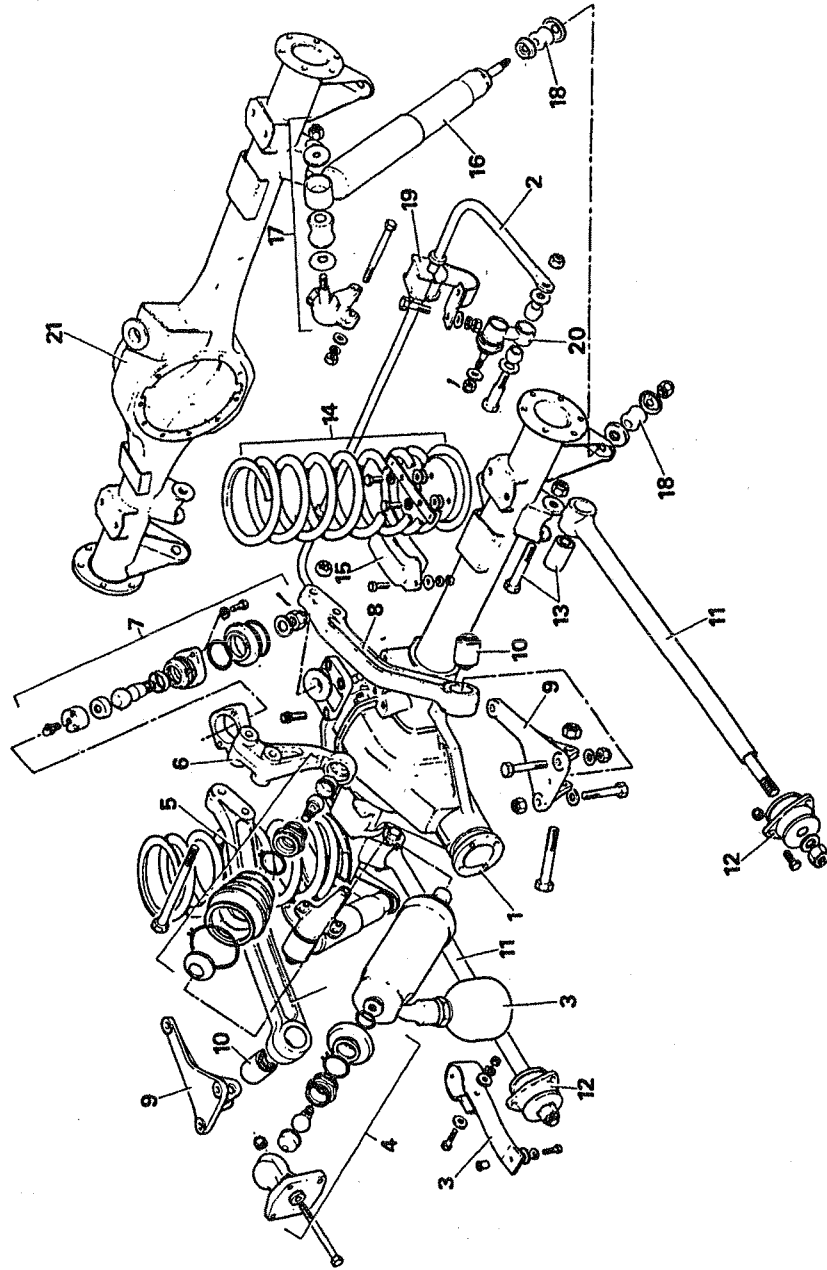


ST2289M

- 1. Top links
- 2. Ball joint bracket
- 3. Ball joint
- 4. Top link bushes
- 5. Top linking mounting bracket
- 6. Lower links

- 7. Lower link mounting bushes
- 8. Ball joint axle bracket
- 9. Differential pinion housing
- 10. Shock absorbers and bracket
- 11. Coil springs
- 12. Fully floating rear axle

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LAND ROVER 110 REAR SUSPENSION

- 1. Satisfury axle casing
- 2. Anti-roll bar
- 3. Bogie 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

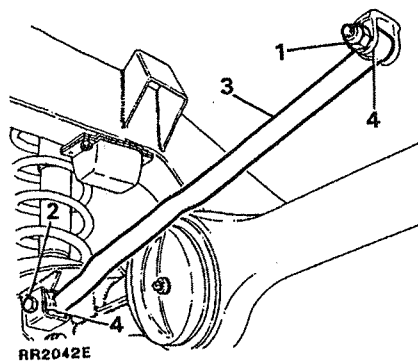
- 8. Suspension top links
- 9. Top link mounting brackets
- 10. Top link bushes
- 11. Lower links
- 12. Lower link flexible bush assembly
- 13. Lower link bush and bolt assembly
- 14. Coil spring assembly
- 15. Bump stop

- 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 assembly

PANHARD ROD

Remove

1. Remove fixings at mounting arm.
2. Remove fixings at axle bracket.
3. Remove Panhard rod.
4. Press out flexible bushes. Ensure the steel tubing locates on the outer edge of the bush and not on the rubber inner.



Refit

5. Fit replacement bushes.

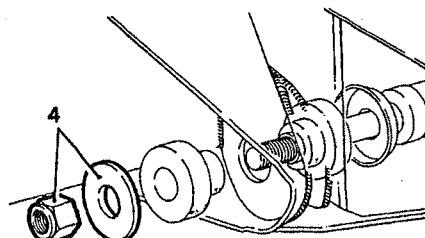
CAUTION: Apply pressure to outer edge of bush, and not rubber inner.

6. Reverse 1 to 4. Tighten fixings to 88Nm.

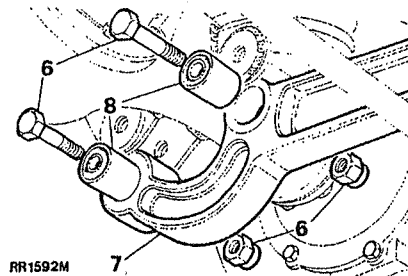
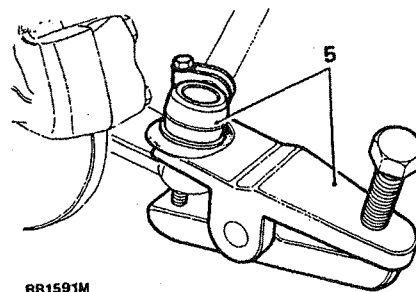
RADIUS ARM

Remove

1. Loosen road wheel retaining nuts.
2. Raise front of vehicle. Support chassis on stands and remove wheel.
3. Support front axle weight with jack.
4. Remove radius arm to chassis side member fixings.



5. Disconnect track rod at ball joint.
6. Remove fixings, radius arm to axle.
7. Lower radius arm front end to clear axle and remove from vehicle.



8. Press out flexible bushes.

Refit

9. Press in replacement bushes.

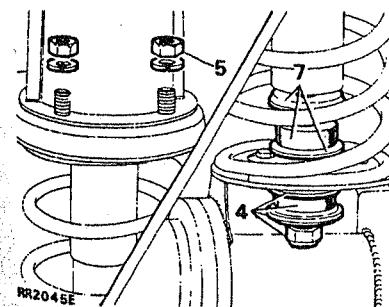
CAUTION: When pressing in new bushes press on outer edge of bush and not rubber inner.

10. Reverse 1 to 7. Tighten fixings to following torques:
Radius arm to chassis 176Nm.
Radius arm to axle 197Nm.

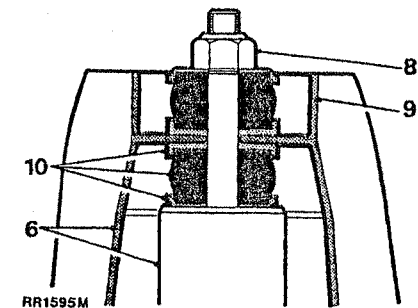
FRONT SHOCK ABSORBER

Remove

1. Loosen road wheel retaining nuts.
2. Support chassis on stands and remove road wheel.
3. Support axle weight with jack.



4. Remove shock absorber lower fixing and withdraw the cupwasher, rubber bush and seating washer.
5. Remove four shock absorber bracket fixings.
6. Withdraw shock absorber and bracket complete.



7. Withdraw lower seating washer, rubber bush and cupwasher.
8. Remove fixings, shock absorber to mounting bracket.
9. Withdraw mounting bracket.
10. Lift off top seating washer, rubber bush and cupwasher.

Refit

11. Reverse instructions 1 to 10.

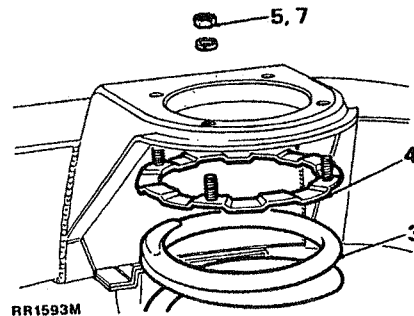
FRONT ROAD SPRING

Remove

1. Remove front shock absorber.

CAUTION: Avoid over stretching brake hoses. If necessary loosen hose connector locknuts to allow hoses to follow axle.

2. Lower axle sufficient to free road spring.
3. Withdraw road spring.
4. Withdraw shock absorber bracket securing ring.



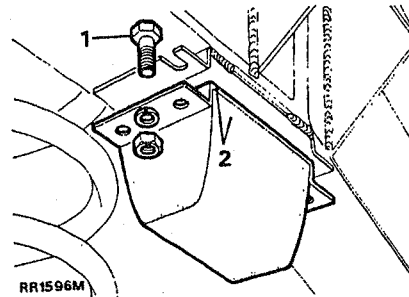
Refit

5. Fit shock absorber bracket retaining ring. Retain in position with a nut.
6. Reverse 2 and 3.
7. Remove nut retaining securing ring.
8. Fit front shock absorber.

BUMP STOP

Remove

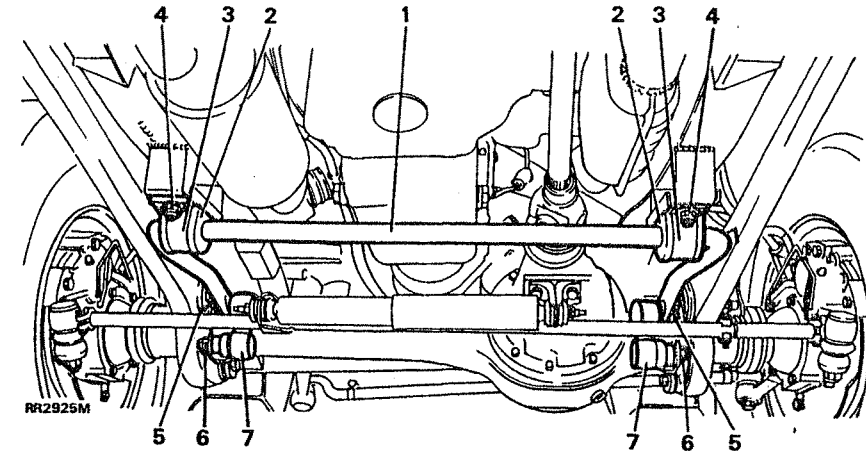
1. Remove fixings.
2. Remove bump stop.



Refit

3. Position bolts in slots in chassis brackets.
4. Fit bump stop, secure with washers and nuts.

ANTI-ROLL BAR ASSEMBLY



KEY

- | | |
|----------------------|-----------------------------------|
| 1. Anti-roll bar | 5. Nut and washer |
| 2. Rubber bush | 6. Castellated nut and cotter pin |
| 3. Strap | 7. Ball joint link arm |
| 4. Nut, bolt, washer | |

FRONT ANTI-ROLL BAR

Remove

1. Mark for reassembly position of rubber bushes on anti-roll bar.
2. Remove four nuts, bolts and washers securing two bush straps.
3. Remove nuts, bolts, washers and rubber bushes from ball joint links and remove anti-roll bar.

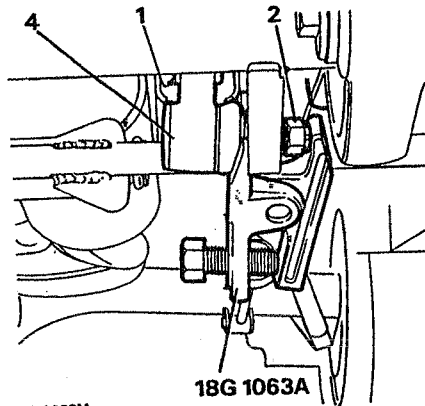
Refit

4. Position bushes on anti-roll bar. Ensure split points towards axle.
5. Fit anti-roll bar with two straps. To ensure correct fit angled sides of bar should point down as shown. Loosely fit the bolts, washers and nyloc nuts.
6. Fit bolt, washers and rubber bushes. Using new nuts fit anti-roll bar to ball joint links. Tighten to 68Nm.
7. Tighten nuts securing straps to 30Nm

ANTI-ROLL BAR BALL JOINT LINKS

Remove

1. Remove two nuts, bolts, washers and rubber bushes from ball joint links.
2. Remove cotter pin and loosen castellated nut a few turns.
3. Release ball joint using special tool 18G 1063A as shown.
4. Remove castellated nut and ball joint link.



RR2926M

Refit

5. Fit ball joint link and castellated nut. Ensure ball joint link arm points up. Tighten to 40Nm and fit new cotter pin.
6. Align anti-roll bar to ball joint links.
7. Fit bolts, washers and rubber bushes using new self locking nuts secure anti-roll bar to ball joint links. Tighten to 68Nm.

BRAKES

DESCRIPTION - subject to changes from 1991 year onwards. See Rationalisation of braking system overleaf.

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 circuit 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 illuminate momentarily when the starter motor is actuated, indicating that the brake warning circuit is functioning correctly. A hydraulic failure in the primary or secondary circuits will result in fluid loss and cause the warning bulb to illuminate, in such an event, the driver must stop the vehicle immediately and investigate the cause. In some territories, alternative and additional switches and controls may be fitted (as described in the following for 110 models) to meet legal legislation.

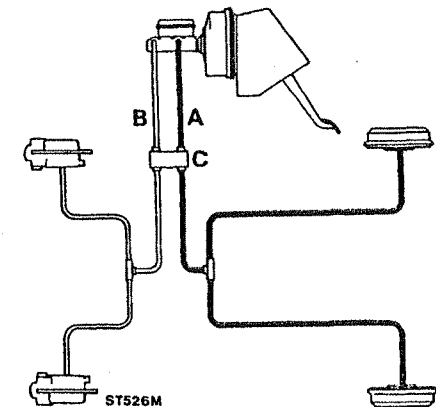
Land Rover 110 models have a Pressure Differential Warning Actuator Valve (P.D.W.A. Valve) or in some cases a combined P.D.W.A. Valve and a Pressure Conscious Reducing Valve (P.C.R. Valve) situated between the master cylinder and the front and rear brakes.

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 vehicle 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.

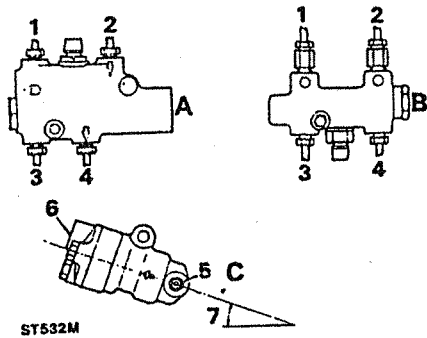
Should a pressure failure occur in the front brake circuit (secondary) the piston in the P.D.W.A. valve will move in the direction of the failed circuit causing the switch to operate and the warning bulb to illuminate. At the same time full fluid pressure in the primary circuit to the rear brakes will 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. When 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.



- A. Combination valve.
- B. P.D.W.A. valve.
- C. G. valve.

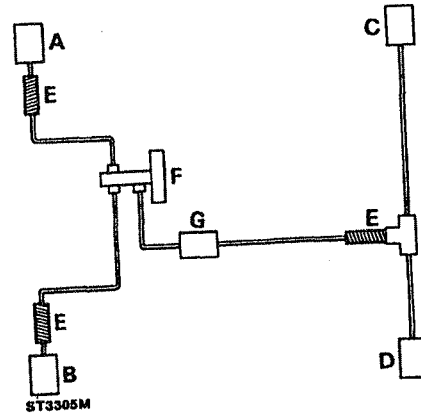
1. Inlet from master cylinder to secondary circuit.
2. Inlet from master cylinder to primary circuit.
3. Outlet to front calipers via 'T' junction.
4. Outlet to rear brakes via 'T' junction.
5. Inlet port.
6. Outlet port.
7. Angle of inclination (20°).

RATIONALISATION OF BRAKING SYSTEM 90, 110 AND 130 1991 YEAR ONWARDS

Changes to the braking system mainly involve commonisation of components so that all models employ the same basic system of operation. Rationalisation commenced at the following VIN numbers: Defender '90' LD701010 and Defender '110' LD901220.

1. The P.D.W.A. valve and P.C.R. valve system discontinued.
2. All models now fitted with a brake fluid loss switch incorporated in the master cylinder reservoir cap as on the original '90' model.
3. Front brake caliper assembly as fitted to the current '110' model now common to all vehicles.
4. A new Lucas Girling L.S.C. 80 (Light weight short compact) servo and master cylinder assembly fitted and common to all models.
5. A 'G' valve, as standard, fitted to '90' models.
6. A 'G' valve fitted to '110' passenger carrying vehicles subject to prevailing regulations.
7. Internal diameter of '90' rear brake wheel cylinders increased.
8. Brake fluid uprated to DOT 4.

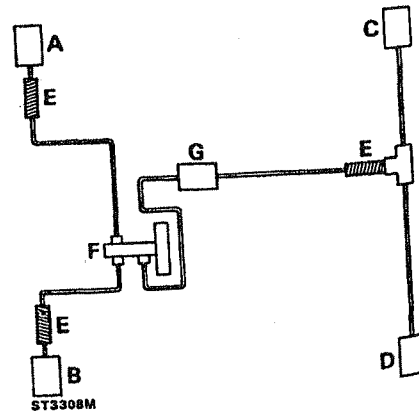
Defender '90' and '110' right hand drive



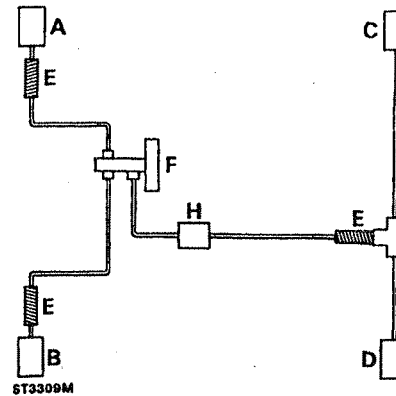
Key to diagrammatic layout of rationalised braking system

- A. Right hand front caliper
- B. Left hand front caliper
- C. Right hand rear drum brake
- D. Left hand rear drum brake
- E. Jump hose
- F. L.S.C 80 servo and master cylinder assembly
- G. 'G' valve
- H. Connector

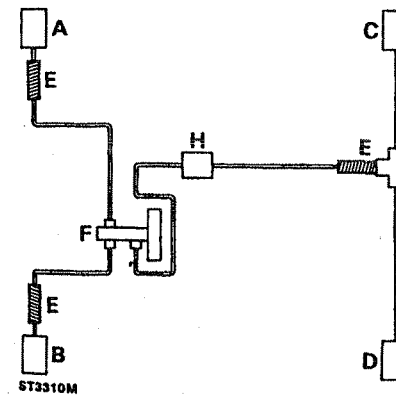
Defender '90' and '110' left hand drive



Defender '130' right hand drive



Defender '130' left hand drive



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.

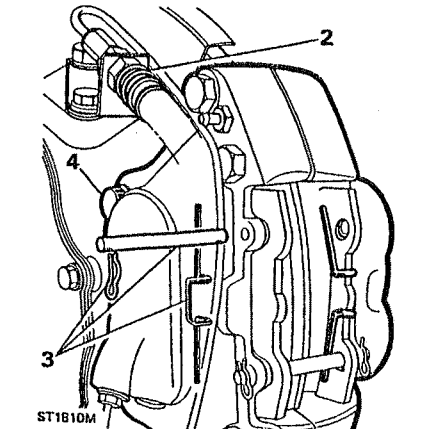
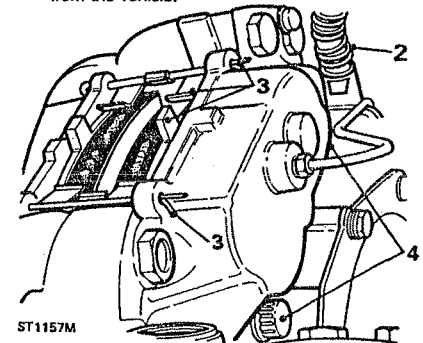
3. Removing friction pads - early type

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 hold down 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.



REMOVE AND OVERHAUL FRONT BRAKE CALIPERS

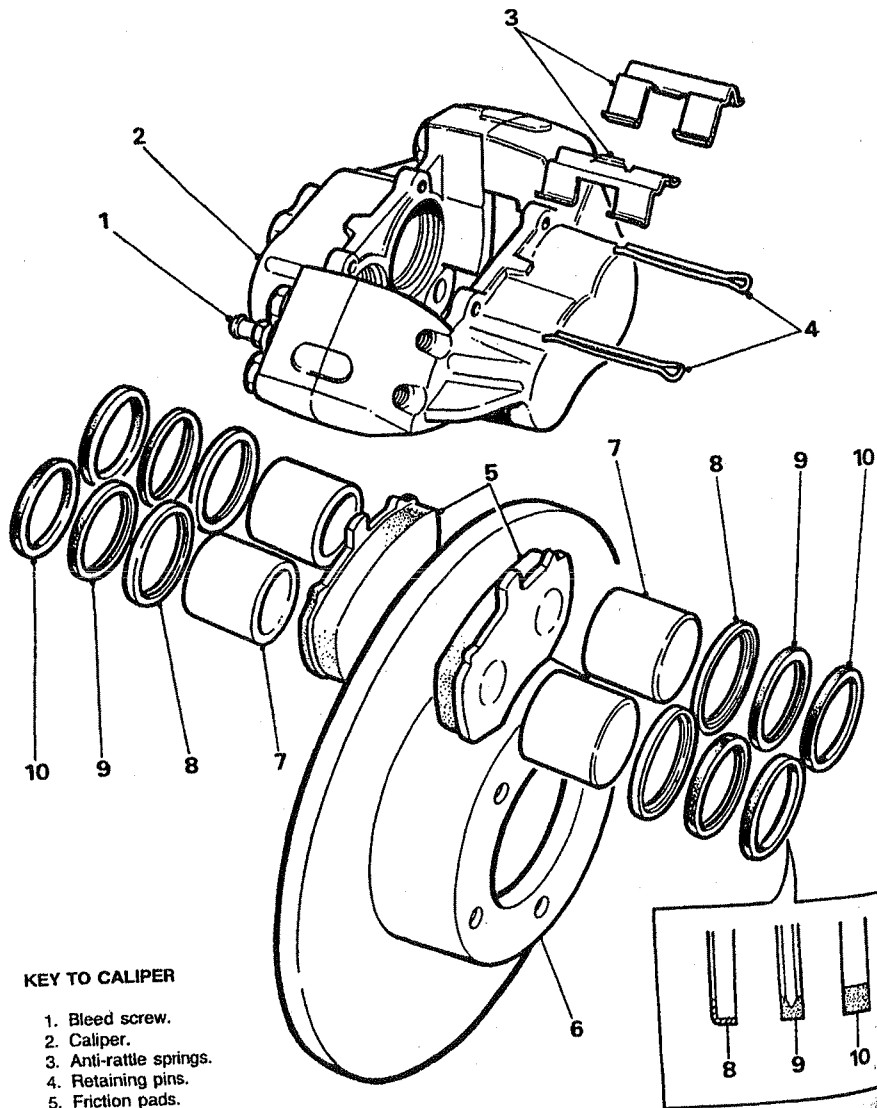
Special tool:
18G 672 - LRT-70-500 - Piston clamp

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. Also the '90' has coil type anti-rattle springs, prior to rationalisation.

Remove caliper

1. Slacken the front wheel retaining nuts, jack-up the vehicle and lower onto axle stands and remove the wheels.

FRONT BRAKE CALIPER ASSEMBLY (EARLY TYPE)

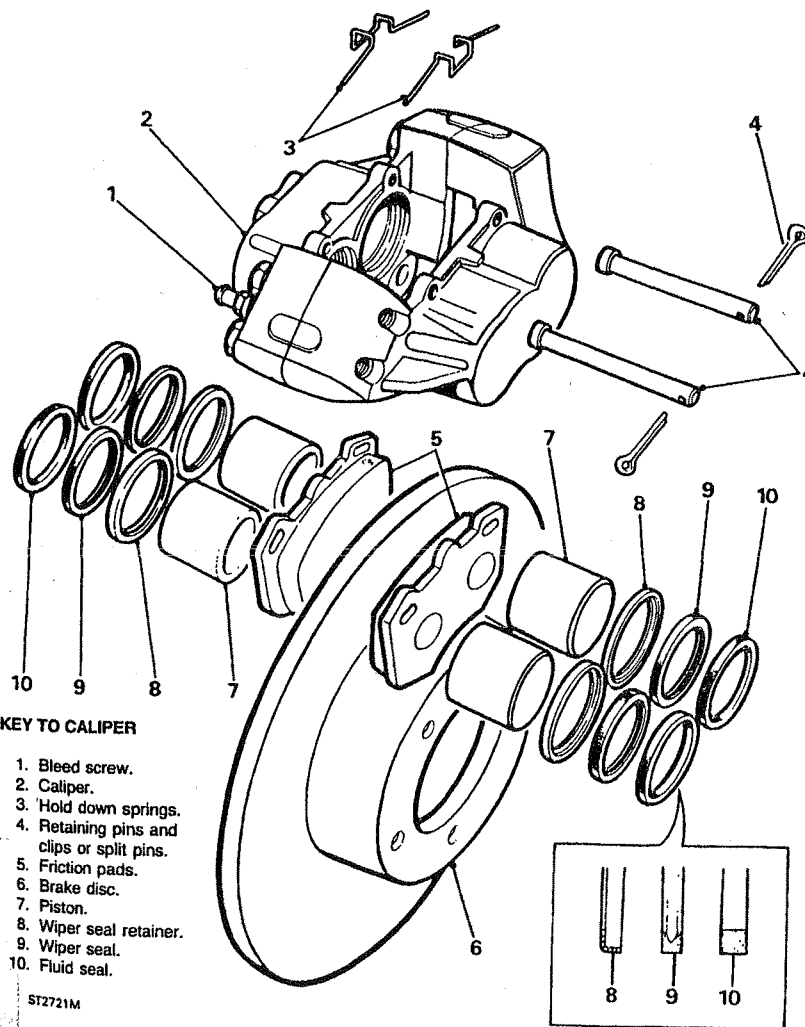


KEY TO CALIPER

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.

ST1271M

FRONT BRAKE CALIPER ASSEMBLY (LATER TYPE) ONE TEN (and rationalised '90')

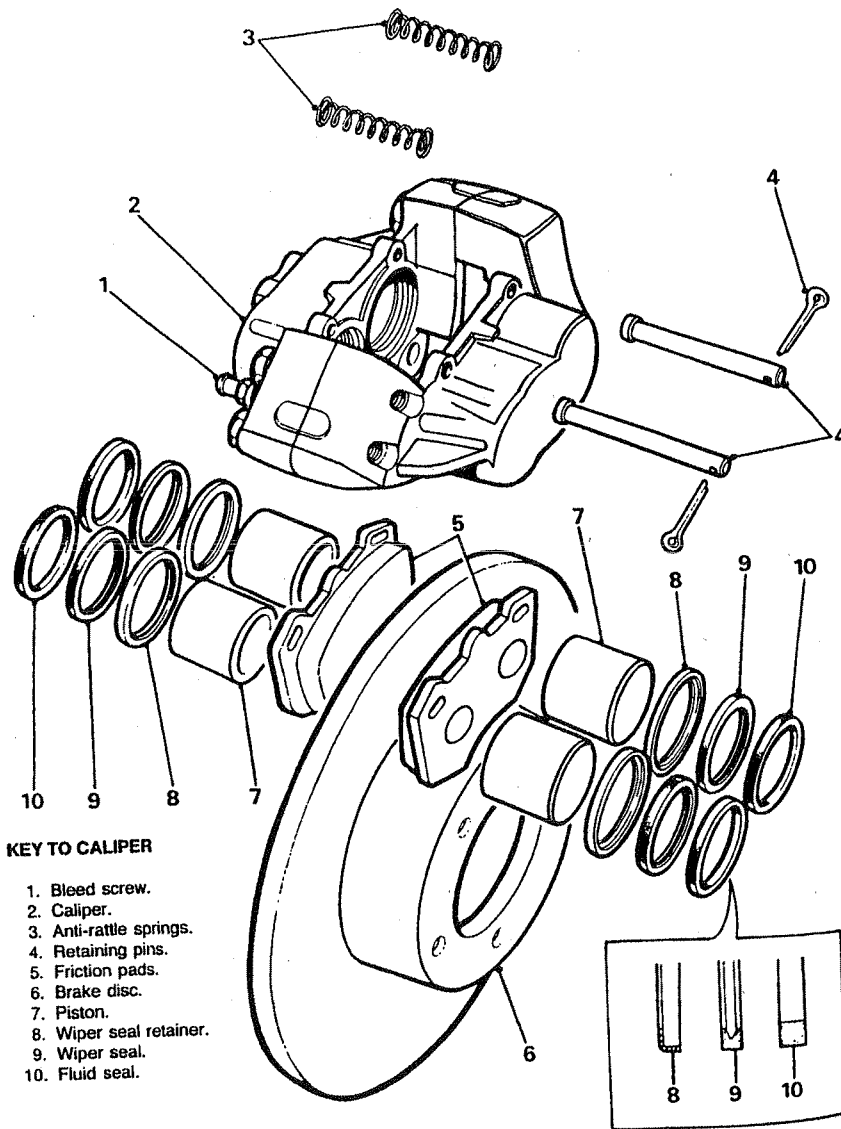


KEY TO CALIPER

1. Bleed screw.
2. Caliper.
3. Hold down springs.
4. Retaining pins and clips or split pins.
5. Friction pads.
6. Brake disc.
7. Piston.
8. Wiper seal retainer.
9. Wiper seal.
10. Fluid seal.

ST2721M

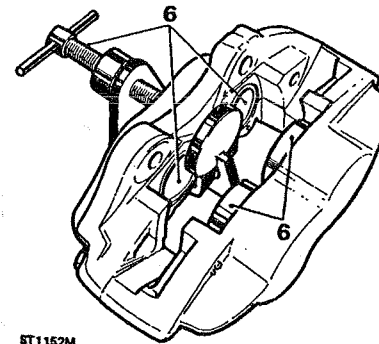
FRONT BRAKE CALIPER ASSEMBLY - NINETY (Pre-rationalisation)



ST2720M

Do not separate the caliper halves.

5. Clean the outer surfaces of the caliper with methylated spirit.
6. Using special tool 18G 672, 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 hydraulic 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.

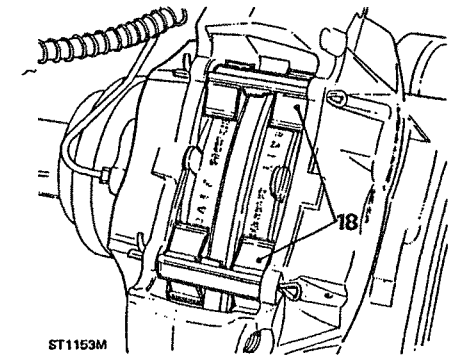
12. Smear the appropriate piston with hydraulic brake lubricant and insert it squarely into the bore by hand only. Do not tilt the piston during insertion and leave approximately 8 mm projecting from the bore.
13. Coat a new wiper seal with hydraulic brake lubricant and fit it to a new seal retainer. Slide the assembly, seal first, over the protruding piston and into the bore recess. Remove the piston clamp from the mounting half and use the clamp to press home the seal retainer and piston.

Mounting-half pistons

14. Clamp the rim-half pistons and carry out the same procedure as for removing and fitting the rim half pistons and seals, instructions 6 to 13.

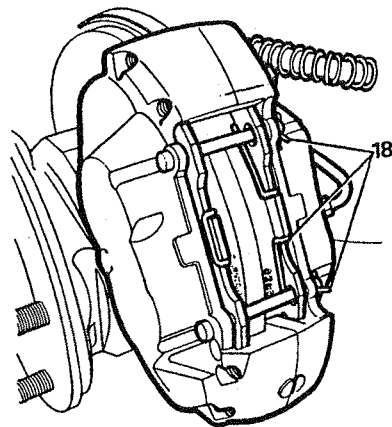
Fit calipers and pads to vehicle

15. Fit the caliper to the axle and secure with the two bolts tightening evenly to the correct torque, see data.
16. Connect the brake flexible hose to the caliper and remove the hose clamp.
17. Lightly smear the back and edges of the pads with disc brake lubricant carefully avoiding the friction material.
18. Fit the friction pads and secure using new pins and split pins and anti-rattle springs. Splay the ends of the early type retaining pins.



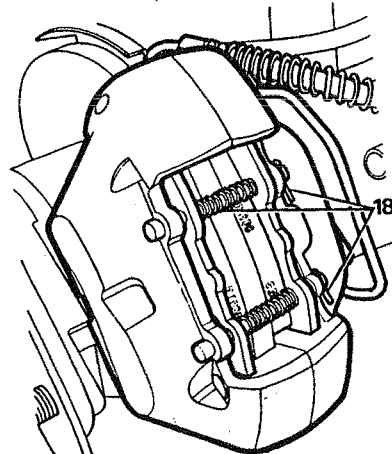
ST1153M

EARLY ONE TEN



ST2722M

ONE TEN (and rationalised '90')



ST2723M

NINETY (Pre-rationalisation)

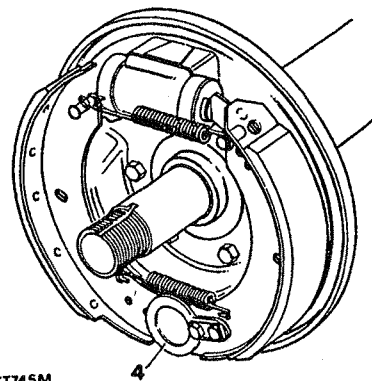
19. Bleed the brake hydraulic system as described later in this section.
20. When the foregoing instructions have been completed on both callipers, depress the brake pedal firmly several times to locate the friction pads.
21. Fit the road wheels, remove the axle stands and finally tighten the road wheel nuts, see data.
22. Road test the vehicle, remembering that if new friction pads have been fitted they are not 'bedded-in' and may take several hundred miles before the brakes are at maximum efficiency.

OVERHAUL REAR BRAKES - 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 (early models).
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.

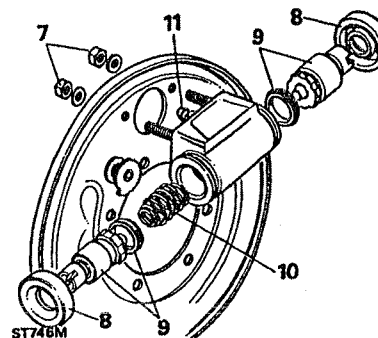


ST745M

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.

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.

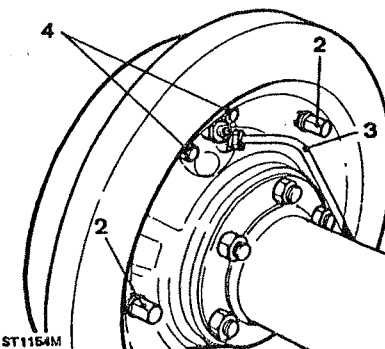
6. Connect the brake fluid pipe to the wheel cylinder.
7. Examine the brake drum for internal scoring and ovality. If required, the interior of the drum can be machined to a maximum diameter of 255,52 mm.
8. Fit the brake drum and ensure that it seats correctly on the hub register and secure with the 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

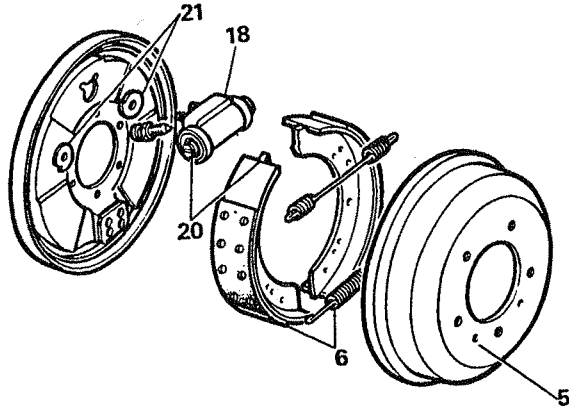
WARNING: Do not use an air line to blow dust from the brake assemblies - asbestos dust from brake linings can be a serious health risk if inhaled.

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

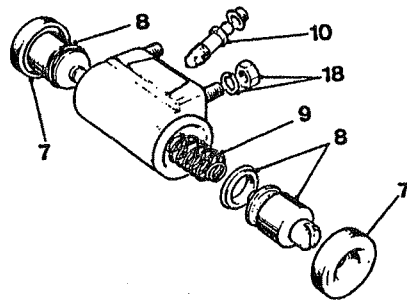
5. Remove the single retaining screw and withdraw the brake drum.
6. Lever off the brake shoes whilst noting the position of the pull-off springs.



ST2719M

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 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 brake fluid.
15. Fit the spring between the two pistons.

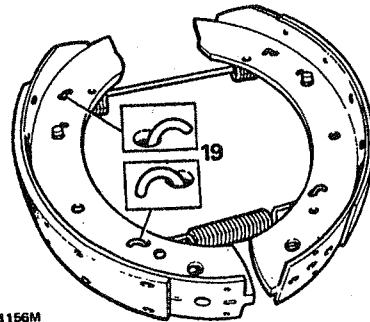


ST619M

16. Fit the dust covers.
17. Fit the bleed screw and tighten to 0,5 to 0,8 kgf m.

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 new brake shoes as illustrated.



ST1156M

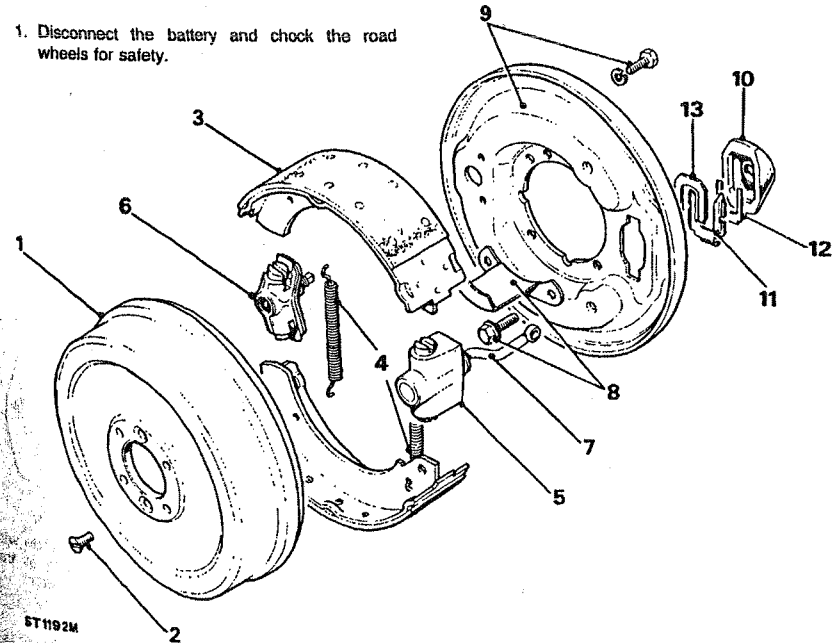
20. The shoes in the wheel cylinder piston slots and lever the opposite ends into the pivot block.
21. Operate the snail cams to check that the shoes respond.
22. Connect the brake fluid pipe to the wheel cylinder.
23. Fit the brake drum and secure with the single screw.
24. Adjust each brake shoe independently as follows: turn one adjuster until the shoe is locked against the drum. Back off approximately two serrations of the snail cam so that the drum revolves freely.
25. Repeat instruction 24 on the second shoe and carry out the same procedure for the opposite brake.
26. Bleed the brakes.
27. Fit the road wheels, remove the axle stands and finally tighten the road wheel nuts to the correct torque.

OVERHAUL TRANSMISSION BRAKE

WARNING: Do not use an air line to remove dust from the brake assembly. Asbestos dust from the brake linings can be a serious health risk, if inhaled.

DISMANTLING

1. Disconnect the battery and chock the road wheels for safety.



ST1192M

2. Disconnect the propeller shaft from the output flange.
3. Remove the two screws and withdraw the brake drum. Skim if excessively scored or oval.
4. Remove the split pin and clevis pin connecting the drawlink to the actuating lever.
5. Remove the brake shoes complete with pull-off springs. Note position of springs in relation to the shoes.
6. Remove the four bolts securing back-plate to transfer box and withdraw the back-plate complete with oil catcher.

KEY TO TRANSMISSION BRAKE

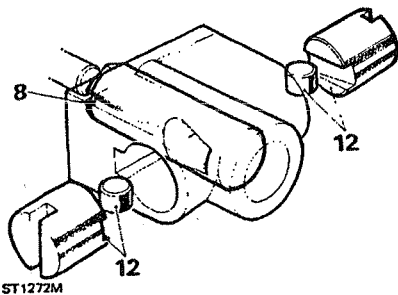
1. Brake drum.
2. Brake drum retaining screws.
3. Brake shoes.
4. Brake shoes pull-off springs.
5. Expander assembly.
6. Adjuster assembly.
7. Draw link.
8. Oil catcher.
9. Back plate and retaining bolts.
10. Dust cover.
11. Locking plate.
12. Packing plate.
13. Spring plate.

Remove and overhaul expander assembly

7. Remove the rubber dust cover.
8. Remove the expander and draw link.
9. Remove the retainer spring plate.
10. 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 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.



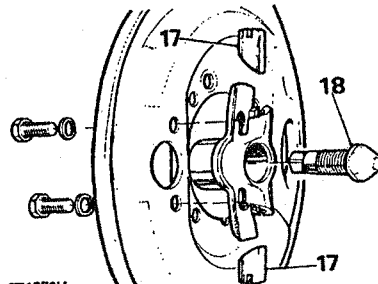
ST1272M

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 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.

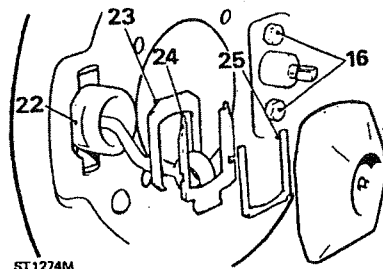


ST1273M

ASSEMBLE

NOTE: If the brake linings are oil-soaked check and if necessary renew the output shaft oil seal.

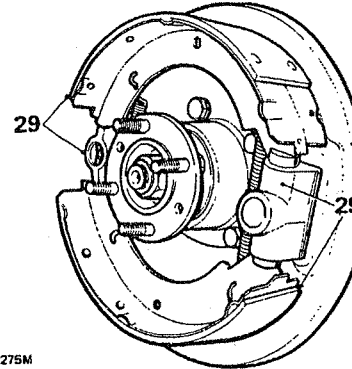
22. Position the expander assembly on the inside of the back-plate and secure with the following plates at the rear of the back-plate.
23. Locking plate.
24. Retaining plate.
25. Packing plate.
26. Fit the rubber dust cover.



ST1274M

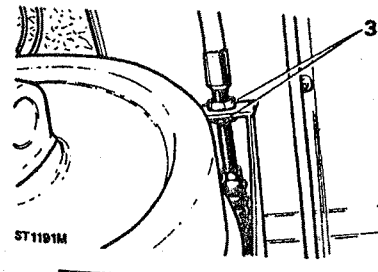
27. Fit the adjuster assembly to the back-plate with the two bolts but do not fully tighten at this stage.

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 new brake shoes and fit to the back-plate. Note that the fully lined end of the lower shoe must be toward the expander assembly and the fully lined end of the upper shoe towards the adjuster assembly.



ST1275M

30. Fit the brake drum and secure with the two screws.
31. Connect the expander drawlink to the actuating lever with a new clevis pin, washer and split pin.
32. Turn the adjuster cone fully in and tighten the two retaining bolts left slack in instruction 27.
33. Slacken off the adjuster two 'clicks' and firmly apply the hand lever to centralise the shoes. The drum should then rotate freely after releasing the hand lever.
34. Adjust the handbrake cable to give the pawl two 'clicks' free movement on the ratchet before the third 'click' fully expands the shoes against the drum.
35. Connect the propeller shaft and evenly tighten the retaining nuts to the correct torque.
36. Remove chocks from wheels and connect the battery.



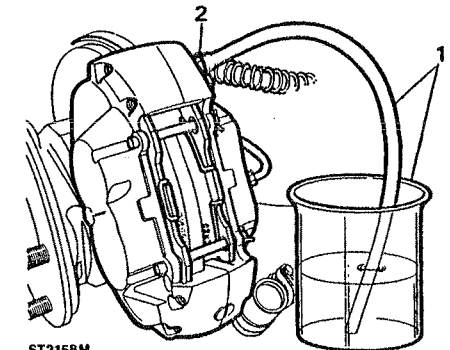
ST1181M

BLEEDING THE BRAKES

Primed System

Bleed the front brakes first starting with the wheel nearest to the master cylinder.

1. Attach a rubber tube to the bleed screw and immerse the other end in a glass jar containing a quantity of clean, new recommended brake fluid.
2. Check that the fluid reservoir is full to the maximum mark.
3. Unscrew the bleed screw approximately half-a-turn, enough to allow fluid to be pumped out. Do not open the screw too far or air will be drawn back into the system around the threads.
4. Smartly depress the foot pedal, pause and then allow the pedal to rapidly return, pause again before repeating the procedure.
5. Continue with the above sequence until all air bubbles cease whilst ensuring that the reservoir is kept topped-up.
6. Close the bleed screw immediately after the last down stroke, whilst the pedal is depressed.



ST2158M

Unprimed System

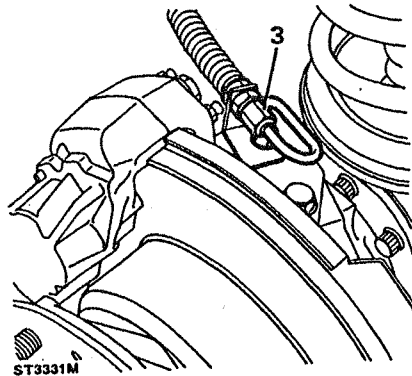
To bleed a replacement master cylinder or a fully drained system.

7. Top up the fluid reservoir to the maximum mark.
8. Open a bleed screw in both circuits and allow fluid to prime both circuits of the master cylinder by gravity for approximately five minutes, then bleed as for a primed system.

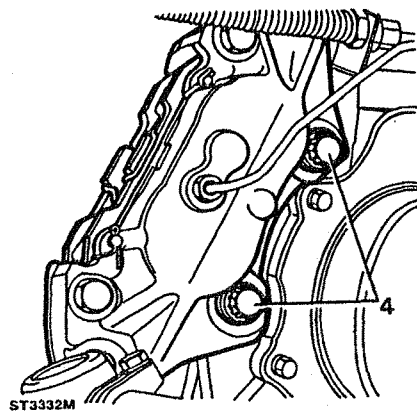
RENEWING FRONT BRAKE DISCS

Removing

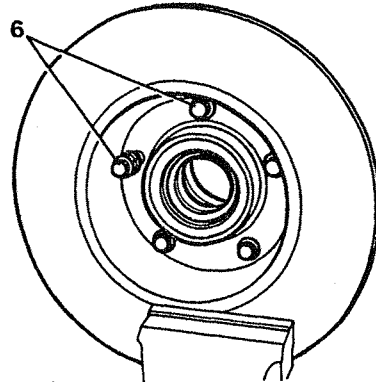
1. Disconnect the battery.
2. Jack-up vehicle, lower on to axle stands and remove road wheels.
3. Disconnect the brake pipe union from the jump hose at the swivel housing bracket. Cover pipe to prevent entry of dirt.



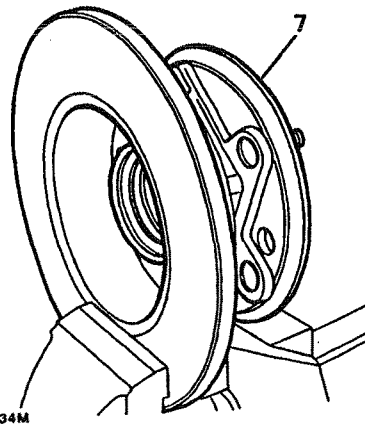
4. Remove the two bolts securing brake caliper to the swivel housing and withdraw the caliper.



5. Remove the front hub complete with brake disc by following instructions 6 to 14 in SECTION 54 for front hub overhaul.
6. Remove the five bolts to separate the disc from the hub.

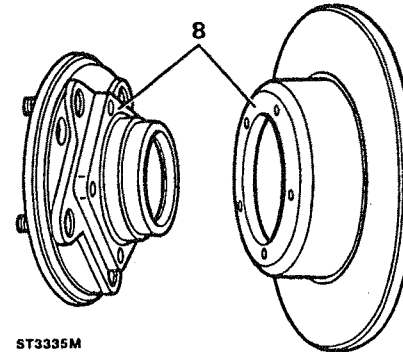


7. The hub will require tapping with a mallet to finally release it from the disc.

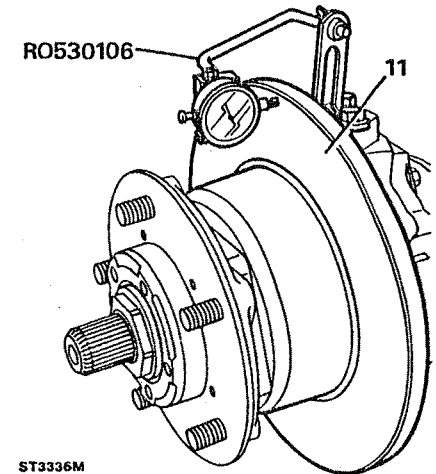


Fitting

8. Make sure that disc and hub mating faces are clean and free from burrs or any other irregularities that could cause the disc to run out excessively.
9. Assemble the disc to the hub with the five bolts and tighten evenly to the correct torque.



10. Fit the hub and disc assembly to the axle by following instructions 24 to 31, SECTION 54.
11. Mount the dial test indicator bracket RO 530106 or a suitable alternative on the top swivel and rest the stylus of the dial indicator on the disc face near to the periphery. The maximum run out must not exceed 0,15 mm.



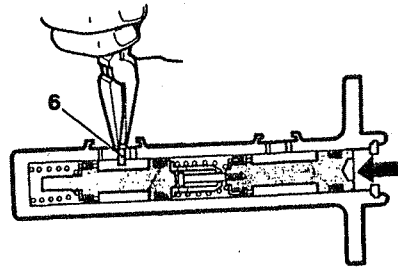
12. Continue with instructions 32 to 41, SECTION 54.

OVERHAUL THE MASTER CYLINDER - Early models

WARNING: Use only unused brake fluid to clean all parts of the brake system. Do not use petrol, kerosene or other mineral based fluids.

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.

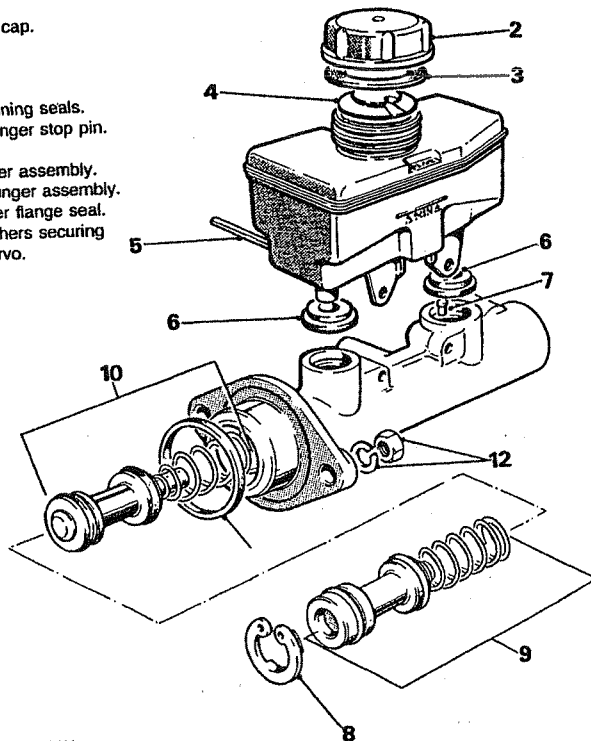
6. Secure the master cylinder in a vice and push the primary plunger down the bore and withdraw the secondary plunger stop pin.



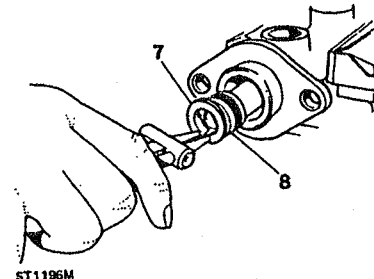
ST1184M

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.

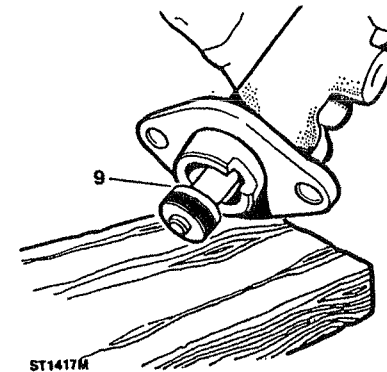


7. Press down the primary plunger and remove the plastic circlip.
8. Withdraw the primary plunger assembly.



ST1196M

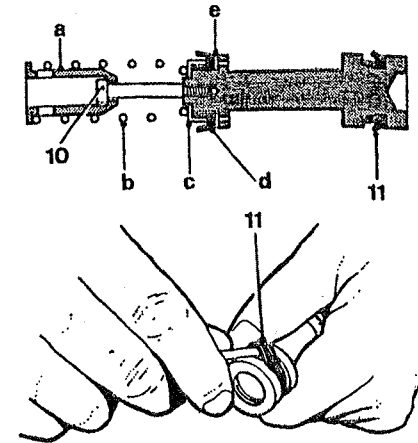
9. Tap the master cylinder sharply on a soft or wooden surface to remove the secondary plunger assembly.



ST1417M

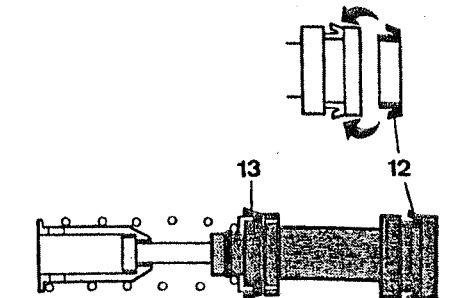
Renewing primary plunger seals

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 seat
 - (e) washer
11. Taking care not to damage the plunger, prise off the outer seal.



ST1195M

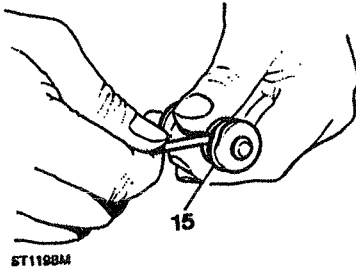
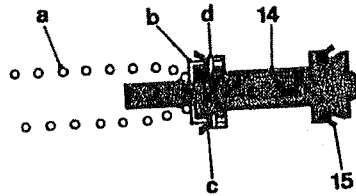
12. Fit a new outer seal into its groove by squeezing the seal between the finger and thumb into an ellipse and press the raised part of the seal over the flange using the fingers of the other hand.
13. Fit the recuperating seal and assemble parts in the reverse order of removal. Compress the spring and secure the assembly with the bolt tightening to 2 to 3 Nm. Do not overtighten.



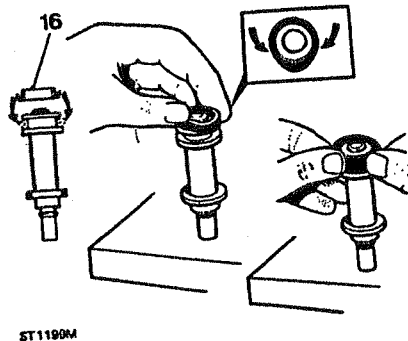
ST1197M

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.



16. Fit a new 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.

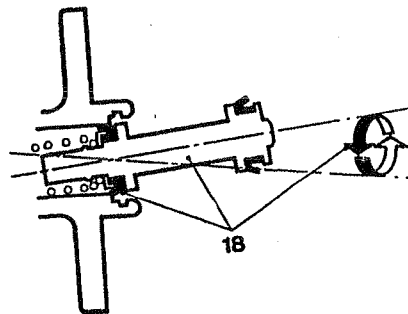


17. Fit the recuperating seal assembly parts in the reverse order of removal.

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 clip.
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.

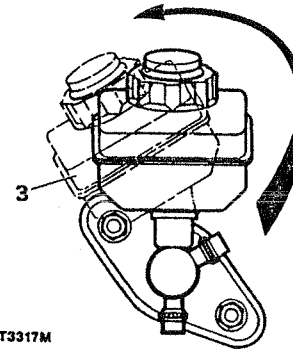
OVERHAUL MASTER CYLINDER - Lucas Girling - Type 25.4 mm AS/AS

Dismantling master cylinder

1. Disconnect the battery and remove the master cylinder from the servo.

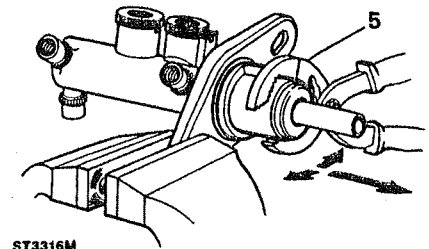
WARNING: Use only unused brake fluid to clean all parts of the brake system. Do not use petrol, kerosene or other mineral based fluids.

2. Before commencing the overhaul procedure thoroughly clean the master cylinder and inspect the outer surfaces for damage and condition, renew the complete assembly if necessary.
3. The reservoir is a push fit in the master cylinder and secured by seals. Carefully ease the reservoir from the master cylinder by rolling it from the seals as illustrated.



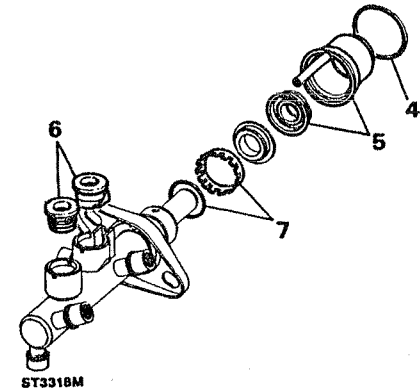
ST3317M

4. Using soft jaws, one either side of the master cylinder flange and clamp the flange in a suitable vice. Remove the water ingress 'O' ring seal from the master cylinder to servo flange and discard.
5. Hold the outside of the transfer housing with a suitable pair of grips, carefully pull, while working the pliers in a backwards and forwards rocking motion to ease the housing off the master cylinder, discard the housing and vacuum seal.



ST3316M

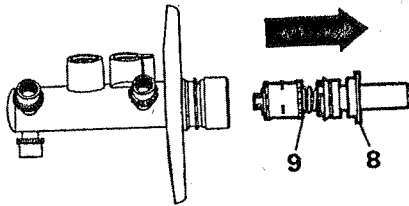
6. Withdraw the two reservoir seals from the master cylinder inlet ports the seals are different and should be noted for assembly, discard both of the seals.
7. Remove the retaining ring and 'O' ring seal from the machined outer surface of the master cylinder, discard both the seal and retaining ring.



ST3318M

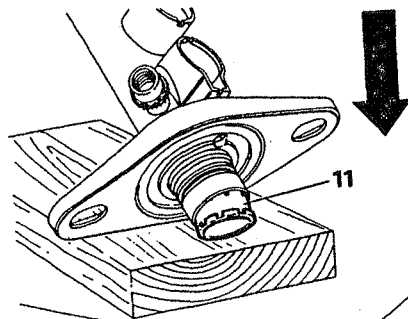
8. Remove the guide ring from the mouth of the master cylinder which supports the primary plunger assembly and place to one side, this component is not part of the master cylinder service kit and is to be refitted on assembly of the unit.
9. Pull the primary plunger assembly out of the master cylinder.

NOTE: The primary plunger assembly cannot be broken down any further and is serviced as a complete unit. Discard the assembly.



ST3319M

10. The secondary plunger assembly will remain at the bottom of the master cylinder bore, the plunger can be easily expelled by tapping the assembly on a piece of timber until the plunger appears at the cylinder mouth, carefully pull the plunger out of the master cylinder.
11. If the swirl tube was not expelled at the same time as the secondary plunger, repeat the above operation to expel it from the bottom of the master cylinder bore and discard.



ST3320M

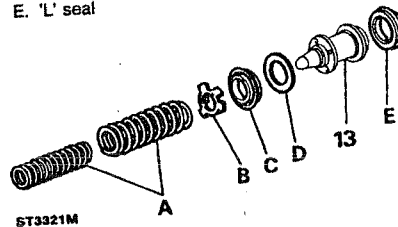
12. Clean all parts with Girling cleaning fluid or unused brake fluid and place the cleaned parts on to a clean sheet of paper. Inspect the cylinder bore and plungers for signs of corrosion, ridges and score marks. Provided the working surfaces are in perfect condition, new seals from a Girling Service repair kit may be used.

Renewing secondary plunger seals

13. Remove the following components from the secondary plunger and discard:

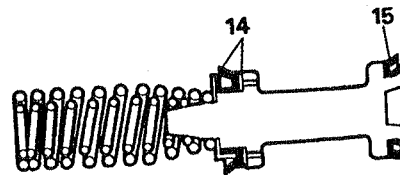
NOTE: A small screwdriver with the end rounded and polished is required to remove the 'L' seal. DO NOT damage the secondary plunger.

- A. Springs
- B. Seal retainer
- C. Recuperating seal (primary cup)
- D. Washer
- E. 'L' seal



ST3321M

14. Coat the new seals in unused brake fluid and firstly fit the 'L' seal to the plunger.
15. Fit the washer followed by the recuperating seal. Fit the seal retainer and springs, ensure the springs are correctly seated.

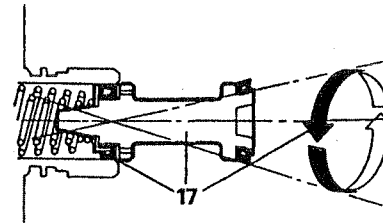


ST3322M

Assembling master cylinder

CAUTION: It is important that the following instructions are carried out precisely, otherwise damage could be caused to the new seals when 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. Also thoroughly check that no debris of any description is lodged in any of the fluid passageways and drillings. If debris is found, carefully remove, clean the cylinder and re-check.

16. Fit the new swirl tube to the bottom of the cylinder bore.
17. Lubricate the secondary plunger and cylinder bore. Offer the plunger assembly to the cylinder until the recuperation seal is resting centrally in the mouth of the bore. Gently introduce the plunger with a circular rocking motion, as illustrated. Ensuring that the seal does not become trapped, ease the seal into the bore and slowly push the plunger down the bore in one continuous movement.

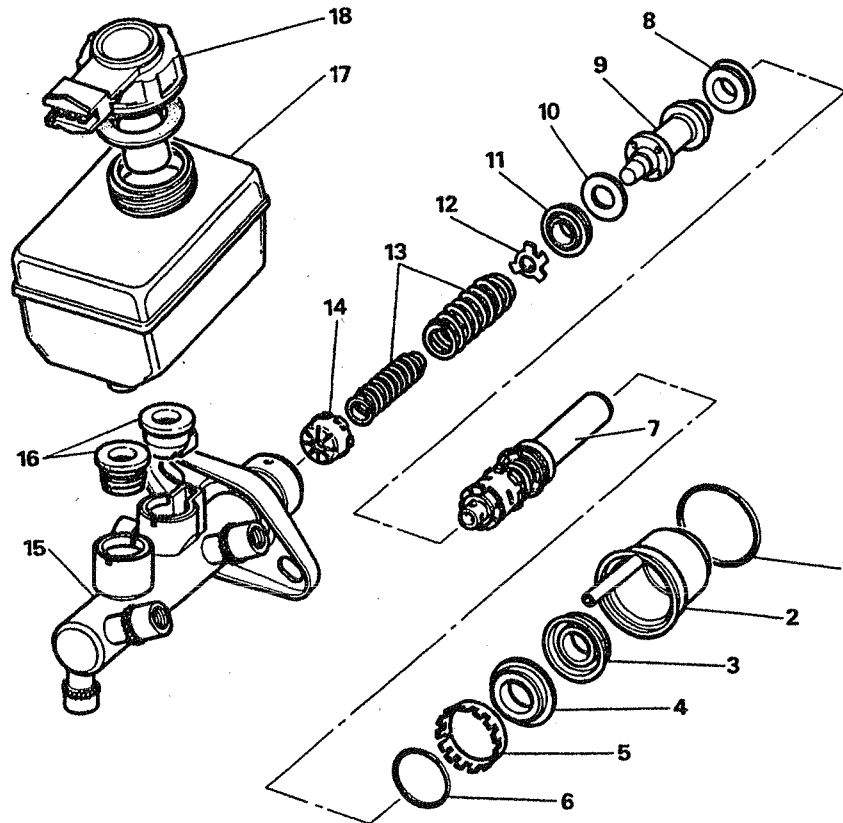


ST3323M

18. Fit the primary plunger assembly using the same method as for the secondary plunger, push the plunger down the bore.
19. Fit the original guide ring to support the primary plunger.
20. Coat a new 'O' ring with brake fluid and fit to its respective groove on the outer location surface of the master cylinder.

NOTE: The 'O' ring should not be rolled down the outer location surface of the master cylinder but should be slightly stretched and eased down the cylinder and into its groove. Do not over stretch the seal.

21. Fit a new retaining ring on the outer surface of the master cylinder ensuring that the serrations of the ring are facing the mounting flange.
22. Fit the two new reservoir seals in their respective ports.
23. Fit a new vacuum seal to either the primary plunger or to the bottom of the transfer housing bore, open face of the seal towards the primary plunger guide ring.
24. Lubricate the vacuum seal with brake fluid, fit the transfer housing to the master cylinder, push the housing fully up to the cylinder mounting flange. Do not adjust the transfer housing after fitting.
25. Lubricate a new water ingress seal with brake fluid, slightly stretch the seal and ease it down the housing until the seal is in the correct position between the housing and flange.
26. Roll the reservoir into the top of the master cylinder, reversing the procedure described in instruction 3.
27. Fit the master cylinder to the servo, connect the battery, and road test the vehicle.



ST3324M

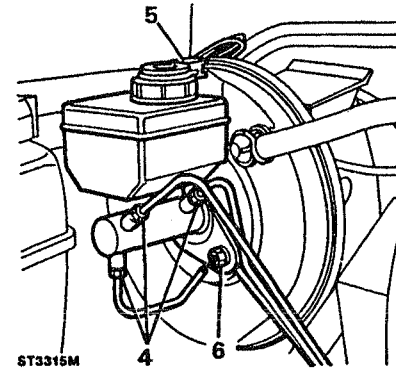
KEY TO MASTER CYLINDER

- | | |
|-----------------------------|-------------------------------------|
| 1. Water ingress seal | 10. Washer |
| 2. Transfer housing | 11. Recuperating seal (primary cup) |
| 3. Vacuum seal | 12. Seal retainer |
| 4. Guide ring | 13. Springs (2 off) |
| 5. Retaining ring | 14. Swirl tube |
| 6. 'O' ring seal | 15. Master cylinder body |
| 7. Primary plunger assembly | 16. Reservoir seals |
| 8. 'L' seal | 17. Reservoir |
| 9. Secondary plunger | 18. Low fluid level switch and cap |

RENEW BRAKE MASTER CYLINDER - Lucas
Girling type 25,4 mm AS/AS

Removing

1. Disconnect the battery.
2. Place a container under the master cylinder to catch escaping brake fluid.
3. Clean area round master cylinder ports.
4. Disconnect the pipes from master cylinder ports. Cover, not plug, the pipe ends to prevent entry of dirt.
5. Disconnect electrical leads from reservoir cap.
6. Remove the two nuts securing master cylinder to servo and withdraw cylinder.



ST3315M

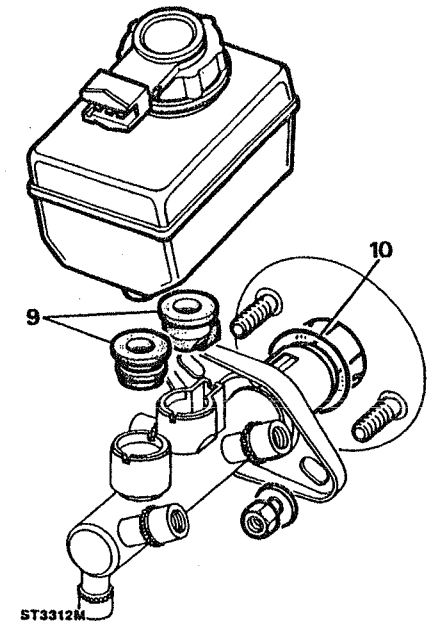
7. Remove reservoir cap and drain fluid into container for disposal.

WARNING: Do not use fluid drained or bled from the system. Dispose of fluid as instructed in SECTION 01 in a container marked "Used brake fluid".

8. The reservoir is a push fit in the master cylinder and secured by seals. Carefully ease the reservoir from the master cylinder by rolling it from the seals, as illustrated in Master Cylinder Overhaul. Note that the two seals are different in size.

Fitting new master cylinder

9. Insert new reservoir seals in the master cylinder ports and fit the reservoir by reversing the removal method.
10. Ensure that the water ingress seal is in position between master cylinder flange and servo and fit master cylinder to servo and secure with the two nuts tightening evenly to the correct torque 11 to 17 Nm.



ST3312M

11. Connect the brake pipes to the master cylinder ports and tighten to 16 Nm.
12. Fill the reservoir with the correct grade of new fluid, see SECTION 09, taken from a sealed container.
13. Bleed the brake system.
14. Connect the battery and road test vehicle.

RENEW 'G' VALVE - where fitted

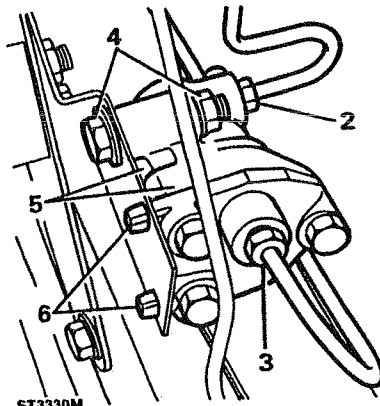
The 'G' valve is situated on the right-hand side of the chassis, within the engine compartment, attached to a bracket, at the commencement of the front axle arch.

Removing

1. Disconnect the battery.
2. Disconnect from the 'G' valve the pipe union from the master cylinder.
3. Disconnect from the 'G' valve the pipe union to the rear wheel cylinders.
4. Remove the nut and bolt securing the 'G' valve to the bracket.
5. Release the valve from the bracket.

Fitting

6. Fit the 'G' valve to the bracket locating the lugs in the holes which are to ensure that the valve is installed at the correct angle.



ST3330M

7. Secure the valve to the bracket with the single bolt and nut.
8. Connect the two pipes to the valve and tighten to 16 Nm.
9. Bleed the brake hydraulic system and road test the vehicle.

RENEW SERVO NON RETURN VALVE

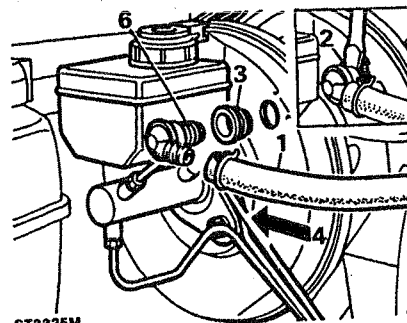
Remove

1. Disconnect the brake vacuum hose from the servo non return valve.
2. The valve is a push fit in the servo and to remove it, carefully prise the valve out with a screwdriver blade between the valve and grommet. Take care not to exert too much pressure on the vacuum chamber.
3. Remove the rubber grommet but be careful not to allow it to fall into the vacuum chamber.
4. Check the valve for correct operation; it should not be possible to pass air through into the servo in direction of arrow. Do not use compressed air.

NOTE: The illustration shows the latest valve fitted to the L.S.C. 80 servo but the principle of removal and fitting is the same for earlier types.

Fitting new valve

5. Fit the rubber grommet.
6. Smear the ribs of the valve with Lucas Girling grease to assist assembly, and push valve fully home.



ST3325M

7. Connect the vacuum hose to the valve.
8. Road test vehicle.

RENEW BRAKE SERVO - L.S.C. 80

NOTE: Whilst the following instructions describe the renewal of the latest servo the principle is the same for earlier servos.

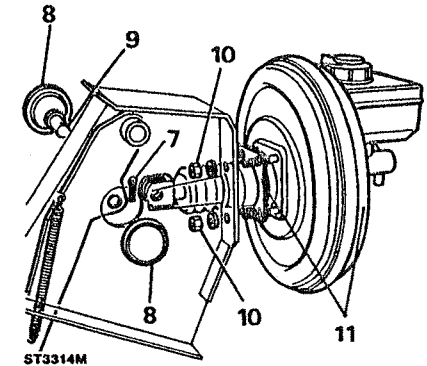
Removing

1. Disconnect the battery.
2. Disconnect the electrical leads from reservoir cap.

NOTE: See operation for renewing the master cylinder for the following instructions 3 to 6.

3. Disconnect the vacuum hose from servo.
4. Clean the master cylinder round the area of the outlet ports.
5. Remove the brake pipes from the master cylinder and cover, not plug, each pipe as it is released to prevent entry of dirt.
6. Remove the two nuts securing the master cylinder to the servo and carefully remove the master cylinder. Cover the ports to prevent fluid loss and entry of dirt.
7. From inside the vehicle, release the two brake pedal return springs.

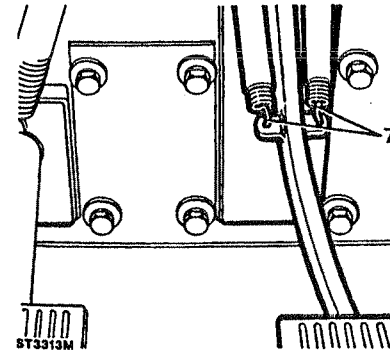
8. Remove the two plugs from each side of the pedal box.
9. Remove the split pin, washer and clevis pin securing the servo push rod to the brake pedal.
10. Remove the four nuts (two each side) retaining the servo to the pedal box and remove the servo and rubber washer from vehicle.



ST3314M

Fitting servo

11. Fit the servo and rubber washer to the pedal box and secure with the four nuts. Tighten evenly to the correct torque.
12. Connect the brake pedal to the servo with the clevis pin and a new split pin. A washer was fitted on earlier installations.
13. Fit plugs to each side of pedal box.
14. Attach the pedal return springs.
15. Connect the vacuum hose to the servo non return valve. Ensure that the hose is in good condition.
16. Fit the master cylinder to the servo and secure with the two nuts. Tighten to the correct torque.
17. Fit the fluid pipes to the master cylinder and tighten to 16 Nm.
18. Top-up the reservoir with new fluid from a sealed container and bleed the brake system.
19. Connect the electrical leads to the reservoir cap.
20. Connect the battery and road test the vehicle.



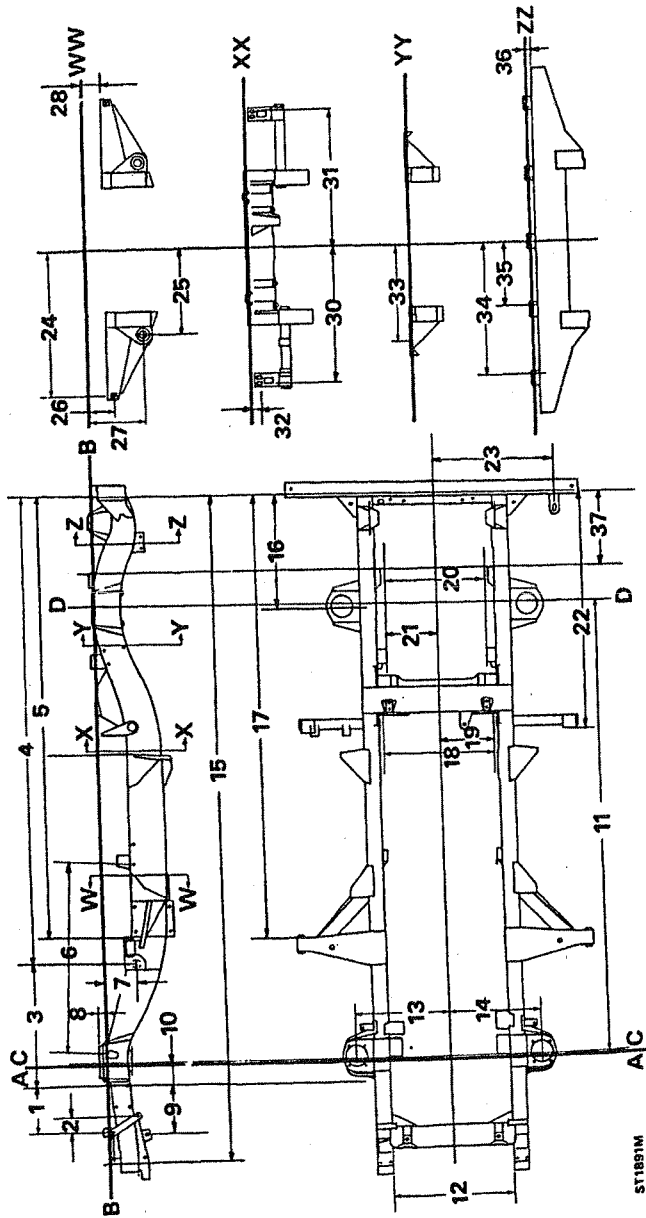
ST3313M

**BRAKING SYSTEM
FAULT DIAGNOSIS**

FAULT	CAUSE	REMEDY
FADE	Incorrect linings. Badly lined shoes. Distorted shoes. Overloaded vehicle. Excessive braking. Old hydraulic fluid.	Replace the shoes, decrease vehicle load or renew hydraulic fluid as necessary.
SPONGY PEDAL	Air in system. Badly lined shoes. Shoes distorted or incorrectly set. Faulty drums. Weak master cylinder mounting.	Check for air in the system using a Hose Clamp and bleed if necessary. Check the master cylinder mounting, lined shoes and drums and replace as necessary. Renew the hydraulic fluid if applicable.
LONG PEDAL	A. Disc Brakes 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. Seized pistons. Shoe springs weak or broken. Servo faulty.	Check the brake adjustment. Check for clearance at the master cylinder, seized 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. Seized caliper pistons. Worn shock absorbers causing wheel bounce.	Replace the shoes, or if glazed, use a proprietary brake lining cleaner. Check caliper for damage and repair as necessary. Check servo. Fit new shock absorbers.
BRAKES PULLING	Seized pistons. Variation in linings. Unsuitable tyres or pressures. Worn shock absorbers. Loose brakes. Greasy linings. Faulty drums, suspension or steering. Contaminated seals.	Check the tyres and pressures, seized pistons, greasy linings, or loose brakes; then check suspension, steering and drums. Repair or replace as necessary. Fit new shock absorbers. Rectify contamination, fit new seals and hoses.
FALL IN FLUID LEVEL	Worn disc pads. External leak. Leak in Servo Unit.	Check the pads for wear and for hydraulic fluid leakage.
DISC BRAKE SQUEAL - PAD RATTLE	Worn retaining pins. Worn discs.	Renew the retaining pins, or discs. Apply disc brake lubricant to back of pads.
UNEVEN OR EXCESSIVE - PAD WEAR	Disc corroded (by salt). Disc badly scored. Pads scored. Pads require interchanging. Incorrect friction material.	Check the disc for corrosion, or scoring and replace if necessary. Alternatively, interchange pads. Fit new pads with correct friction material.

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LAND ROVER 90



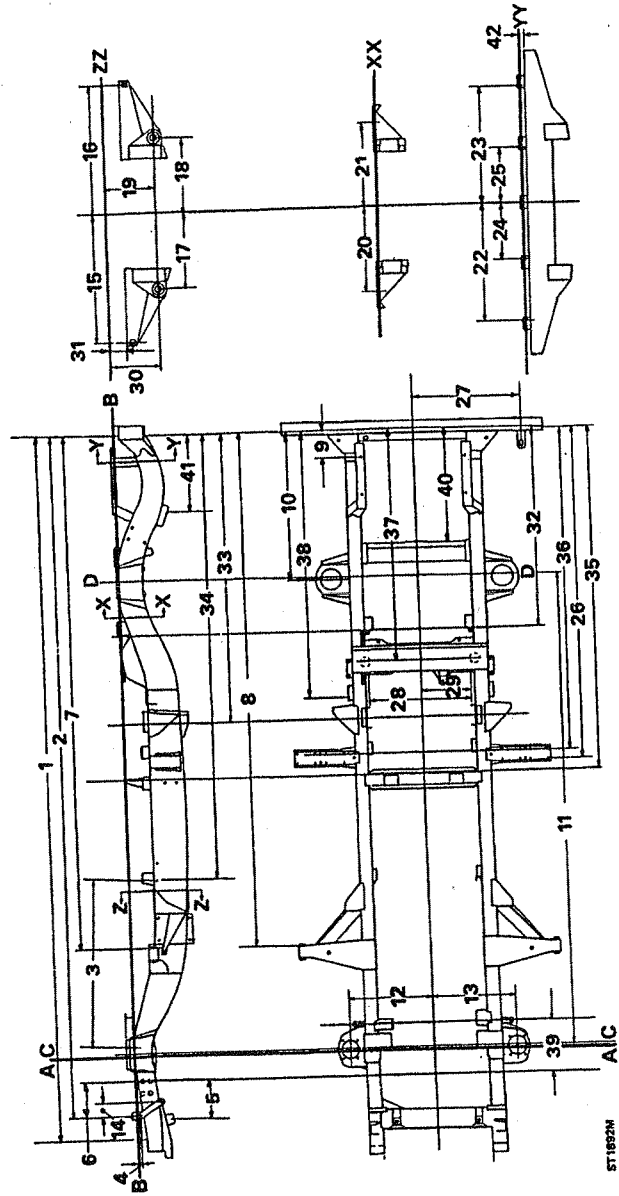
ST1891M

LAND ROVER 90

CHASSIS ALIGNMENT DIMENSIONS

A	Front Datum	10.	110 mm
B	Chassis Datum	11.	2360mm - Wheelbase
C	Front axle centre line	12.	636 - 634 mm
D	Rear axle centre line	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.	439,5 - 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.	481 - 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

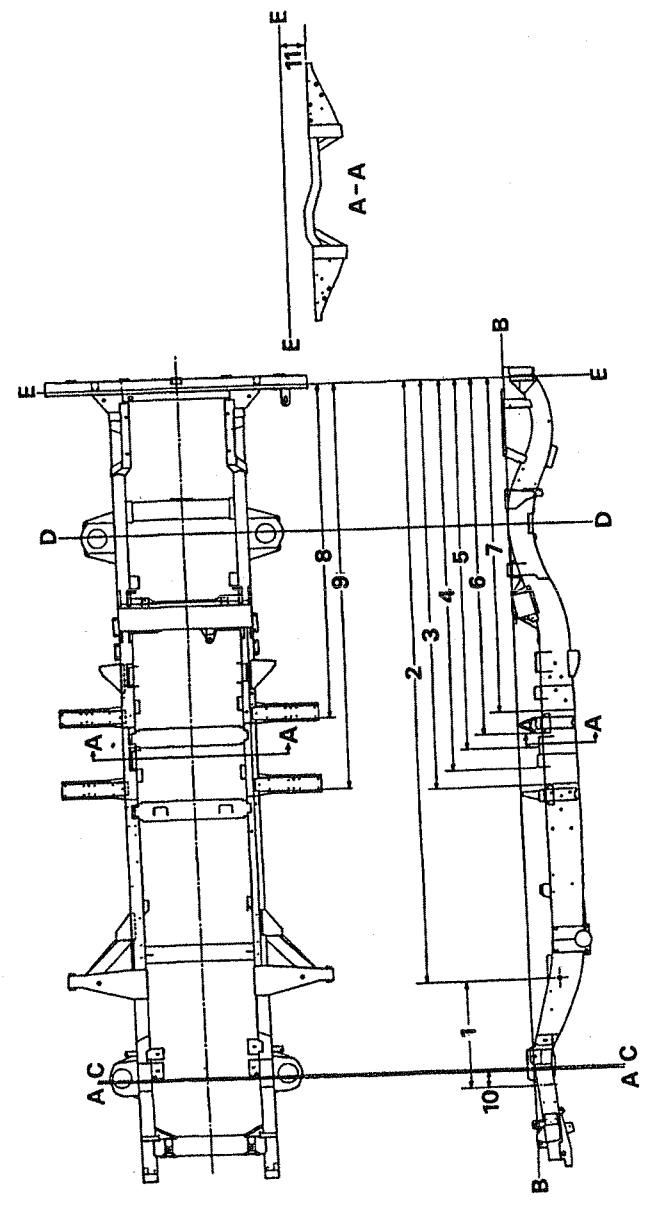


ST1852M

LAND ROVER 110 CHASSIS ALIGNMENT DIMENSIONS

<p>A Front Datum B Chassis Datum C Front axle centre line D Rear axle centre line</p>	<p>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</p>	<p>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</p>	<p>28. 590,5 mm 29. 295,25 mm 30. 299,5 - 295,5 mm 31. 103 - 100 mm 32. 1177,5 - 1175,5 mm 33. 1692,5 - 1689,5 mm 34. 2610 - 2606 mm 35. 2040,5 - 2037,5 mm 36. 1912,5 - 1909,5 mm 37. 1359 - 1357 mm 38. 1573 - 1571 mm 39. 270 - 268 mm 40. 665,5 - 633,5 mm 41. 440 - 438 mm 42. 32,25 - 31,25 mm</p>
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LAND ROVER 127 (130)



ST3349M

LAND ROVER 127 (130) CHASSIS ALIGNMENT DIMENSIONS

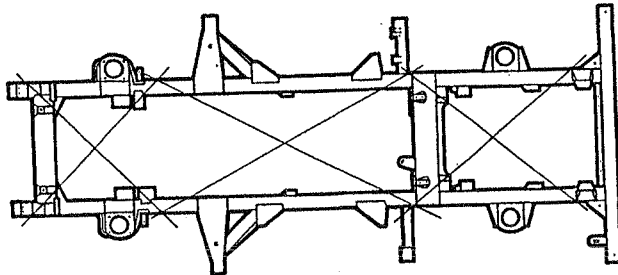
- | | | | |
|---|------------------------------|-----|---------------------------------------|
| A | Front Datum | 7. | 1990 - 1988 mm |
| B | Chassis Datum | 8. | 1970 - 1966 mm |
| C | Front axle centre line | 9. | 2401,8 - 2399,8 mm |
| D | Rear axle centre line | 10. | 110,0 reference dimension. |
| E | Chassis Datum, section A - A | 11. | 149,7 - 146,7 mm reference dimension. |

NOTE: The above dimensions are for the Land Rover 127 (130) chassis frame. For additional measurements, refer to the Land Rover 110 chassis frame drawing and alignment dimensions.

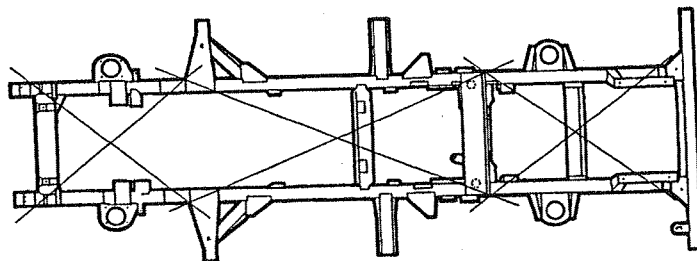
Frame alignment

With the vehicle assembled a check for chassis squareness can be made as follows:

1. Place the vehicle on a level floor.
2. Mark measuring points at approximately the locations shown in Fig. 1 ensuring that the marks are exactly opposite on each side of the chassis frame.
3. Hold a plumb line against each of the measuring points in turn and mark the floor directly beneath the plumb-bob.
4. Move the vehicle and measure diagonally between the marks made on the floor, if the chassis is square the diagonals between the related measuring points should agree within 9,50 mm.
5. Chassis frame dimensional checks can be made, with the vehicle upper structure removed, referring to the applicable illustration and associated key.



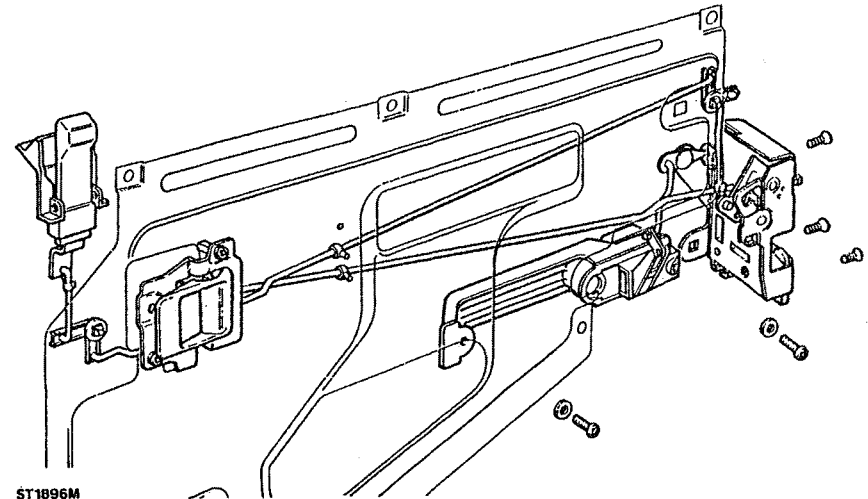
LAND ROVER 90



LAND ROVER 110

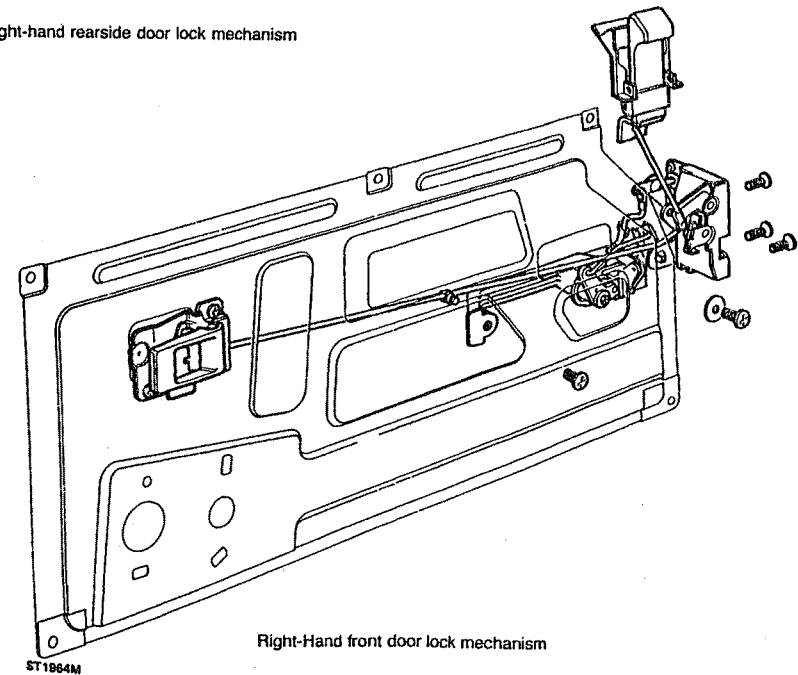
LR4412M

DOORS - 1986 ONWARDS



ST1896M

Right-hand rear side door lock mechanism

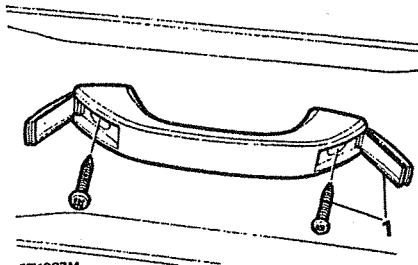


ST1884M

Right-Hand front door lock mechanism

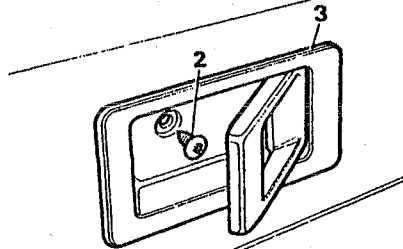
REMOVING THE DOOR TRIM - Front and rear doors

1. Prise off the two finishers and remove the two screws securing the door pull.



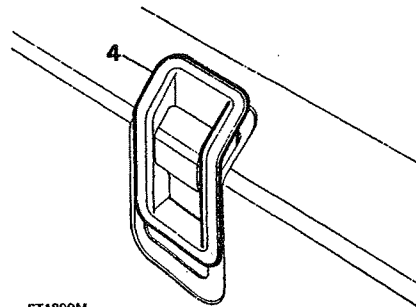
ST1897M

2. Remove the single screw behind the remote control lever.
3. Prise off the remote control lever bezel.



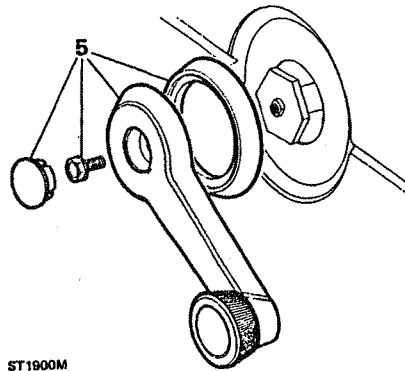
ST1898M

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.

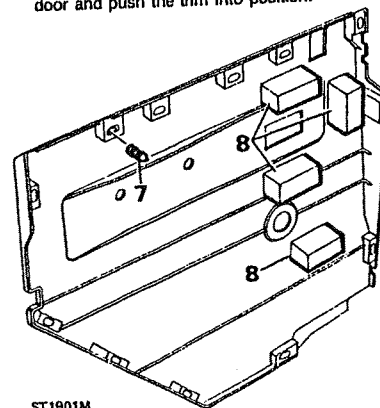


ST1900M

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.



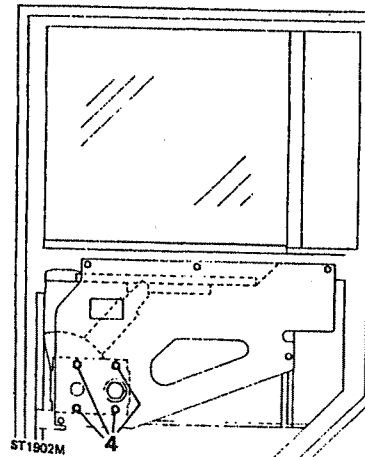
ST1901M

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

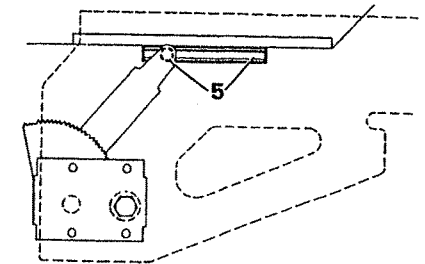
1. Remove the door trim.
2. Remove the protective weather sheet.
3. Temporarily fit the handle and wind the window up to its fullest extent and support the glass in this position, with a length of timber, to prevent it falling when removing the regulator.
4. Remove the four screws retaining the regulator 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.

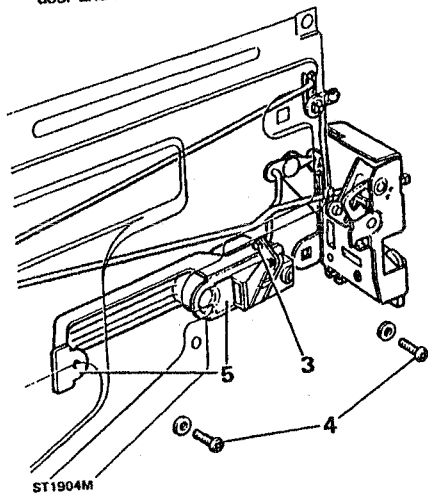
REMOVING EXTERIOR HANDLE - rear side door

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.

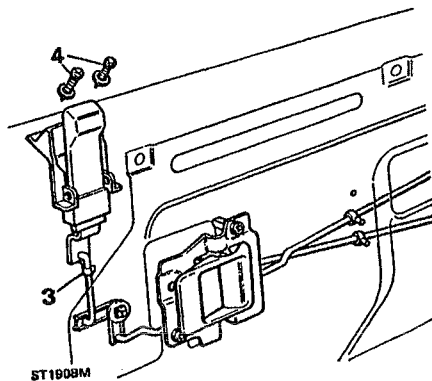


6. Connect the actuating rod to the handle operating lever and secure with spring clip.
7. Re-seal the weather protection sheet.
8. Fit the door trim, regulator handle, door pull and bezels.

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.



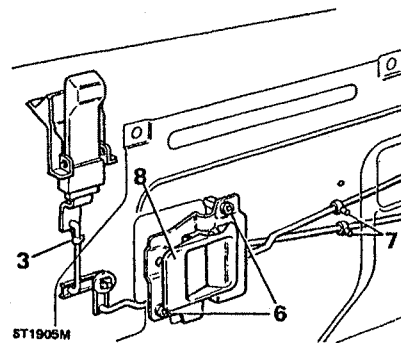
Fitting locking button

5. Secure the locking button assembly to the door panel with the two screws.
6. Fit the operating rod to the button assembly and secure with the spring clip.
7. Re-seal the weather protection sheet and fit the door trim, door pull, regulator handle and bezels.

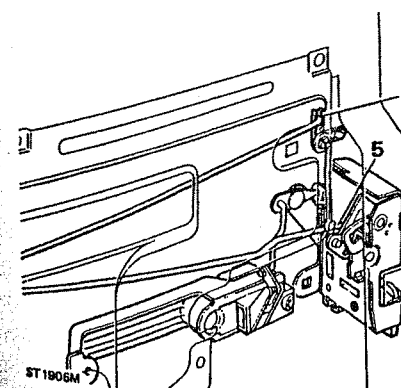
RENEW REMOTE CONTROL LEVER - rear side door

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.



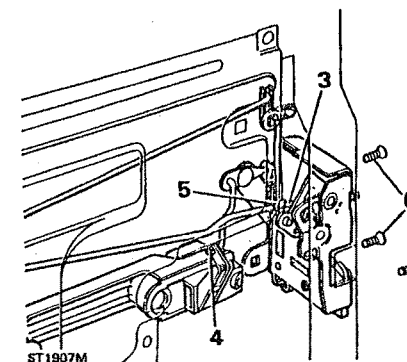
Fitting control lever

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.



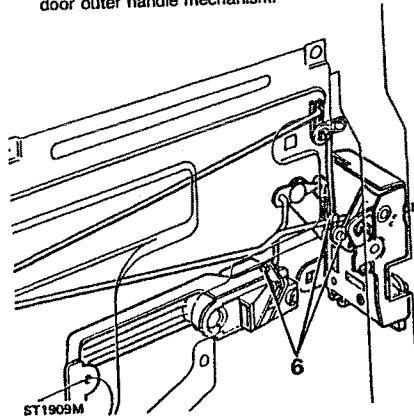
Fitting the latch

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

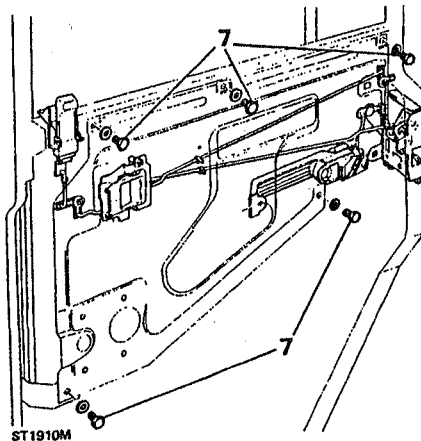
To remove

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.



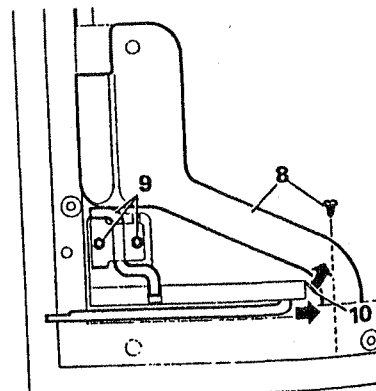
ST1909M

7. Remove the four screws retaining the mounting panel to the door and remove the panel complete with rods and control lever.



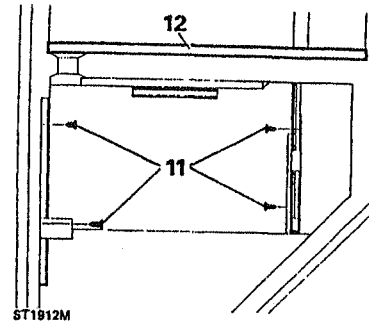
ST1910M

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.

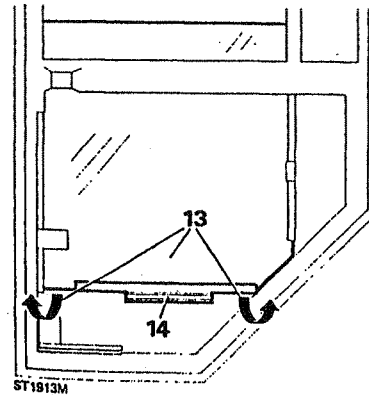


ST1912M

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.

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

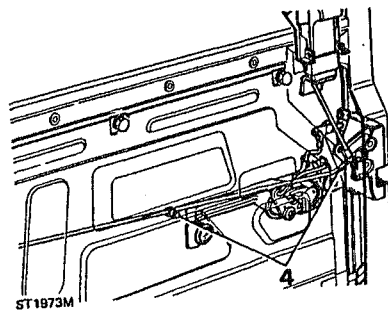
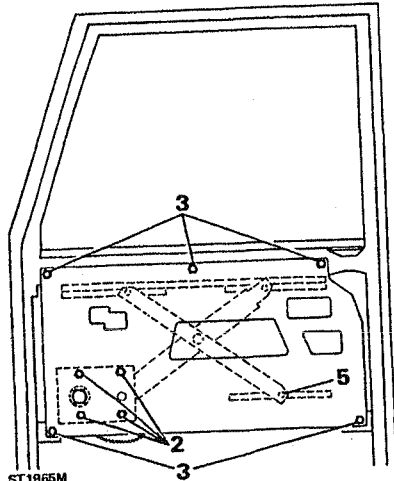
Fitting glass

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.

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.



5. Slide the window regulator arm from the mounting panel channel and remove the panel with the remote control lever and rod.

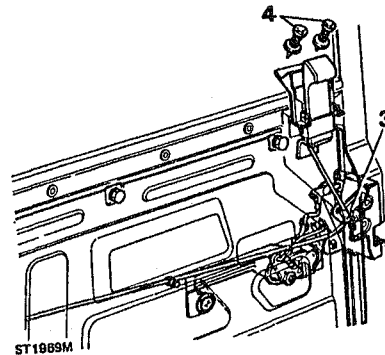
Fitting mounting panel

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.



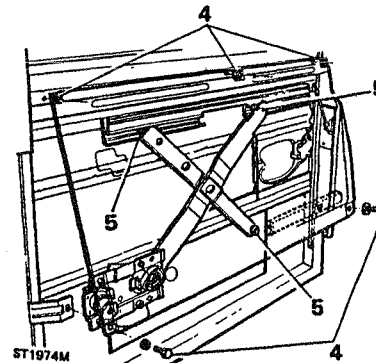
Fitting locking button

5. Secure the locking button assembly to the door with the two screws.
6. Connect the operating rod to the latch mechanism and secure with the spring clip.
7. Re-seal the weather protection sheet and fit the door trim, door pull, regulator handle, and bezels.

REMOVING WINDOW REGULATOR - front doors

To remove

1. Remove the door trim.
2. Remove the weather protection sheet.
3. Temporarily fit the handle and position the window half open and support with a length of timber.
4. Remove the two lower screws securing the mounting panel to the door and slacken the three upper screws.
5. Remove the four screws retaining the window regulator to the mounting panel and slide the operating arms from the channels attached to the glass and mounting panel and remove the regulator.



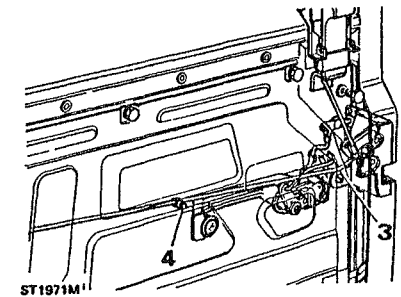
Fitting regulator

6. Insert the regulator operating arms into the channels.
7. Fit and tighten the mounting panel lower screws and tighten the upper screws.
8. Position the holes in the regulator to line-up with the holes in the mounting panel and secure with the four screws.
9. Temporarily 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.

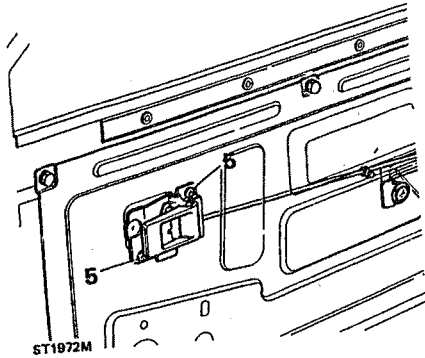
REMOVE REMOTE CONTROL LEVER - front doors

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.



- Remove the two screws securing the remote control lever to the mounting panel and withdraw the lever and control rod.



Fitting remote control lever

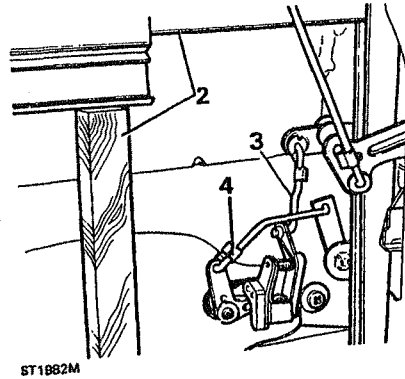
- Feed the control rod into position and loosely secure the lever to the mounting panel with the two screws.
- Connect the control rod to the latch mechanism and secure with the spring clip.
- Tighten the control lever retaining screws.
- Secure the control rod to the plastic clip in the mounting panel.
- Secure the weather protection sheet with adhesive.
- Fit the door trim, regulator handle, door pull and bezels.

REMOVING EXTERIOR DOOR HANDLE - front doors

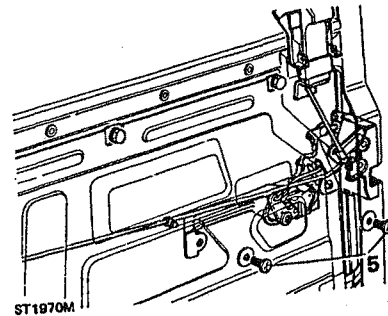
To remove

- Remove the regulator handle, door pull, bezels and door trim.
- To gain access to the handle mechanism, remove the mounting panel and support the glass with timber.

- Disconnect the operating rod from the handle mechanism.
- Disconnect the rod from the locking barrel lever.



- Remove the two screws and withdraw the handle assembly.



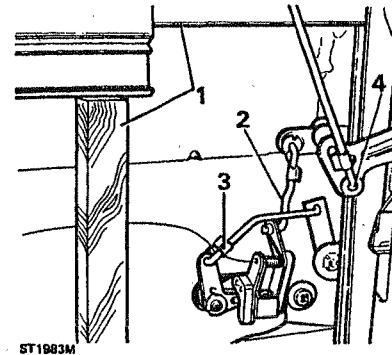
Fitting the handle

- 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.
- Connect the rod to the handle operating lever and secure with the spring clip.
- Connect the rod to the locking barrel lever and retain with the spring clip.
- Carry-out instructions for fitting the mounting panel and door trim and fittings.

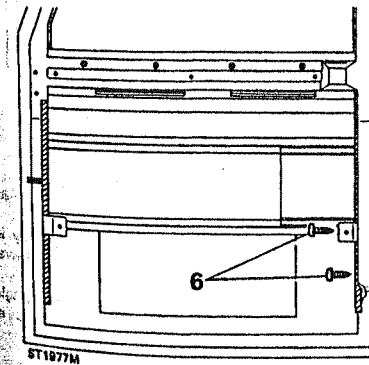
REMOVING THE DOOR LATCH ASSEMBLY - front doors

To remove

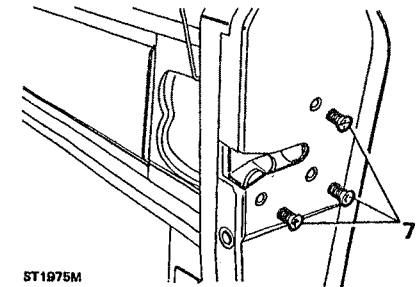
- Carry out the instructions to remove the mounting panel and support the glass with timber.
- Disconnect the control rod from the handle operating lever.
- Disconnect the control rod from the locking lever on the handle.
- Disconnect the locking button control rod from the latch mechanism.



- Remove the two screws and remove the handle assembly from the door. See REMOVING EXTERIOR DOOR HANDLE.
- Remove the two self-tapping screws retaining the lower end of the window glass runner.



- Remove the three screws securing the latch assembly to the door.
- Whilst taking care not to damage the runner, ease it away from the latch and manoeuvre the latch assembly from the door.



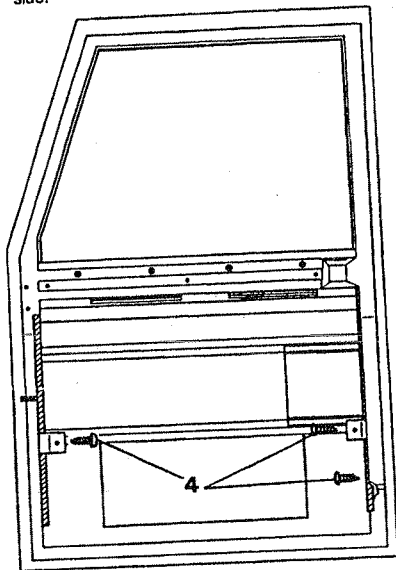
Fitting latch assembly

- Carefully ease the window runner away, sufficiently to enable the latch to be located into position.
- Secure the latch to the door with the three screws.
- 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.
- Fit the handle with the two screws, ensuring that the bezels are in position.
- Connect the control rod to the handle operating lever and secure with the spring clip.
- Connect the control rod to the locking lever and retain with the spring clip.
- Connect the locking button control rod to the latch lever and secure with the spring clip.
- Carry-out the instructions to fit the mounting panel.
- Fit the door trim, regulator handle, door pull, and bezels.

REMOVING GLASS - front doors

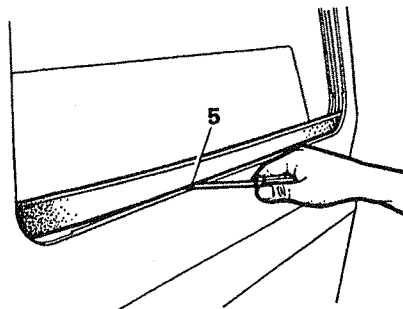
To remove

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.



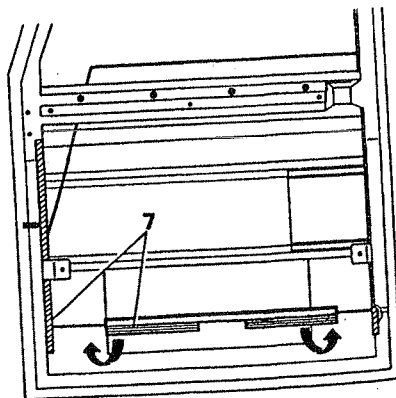
ST1978M

5. Taking care not to damage the paint work, prise the exterior waist weather strip from the door.
6. Remove the timber support and lower the glass to the bottom of the door.



ST1966M

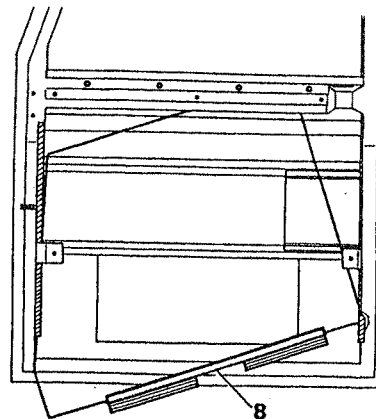
7. Ease the runner from the glass at the hinge side of the door, lift the glass over the bottom edge of the door and withdraw.



ST1968M

Fitting glass

8. Insert the glass into the runners at an angle as illustrated.
9. Whilst lifting 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.



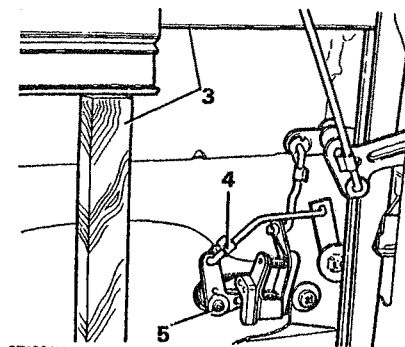
ST1967M

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

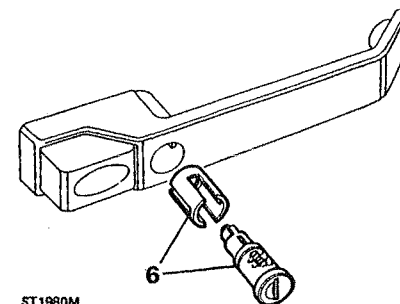
To remove

1. Remove the regulator handle, door pull, bezels, door trim and wather 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.



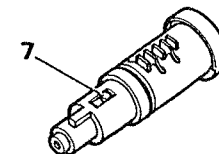
ST1981M

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.

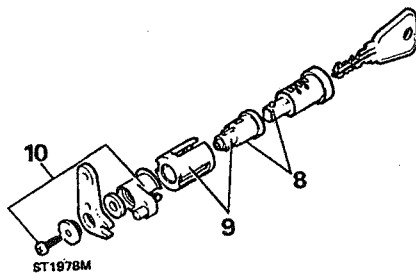


ST1979M

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 accompanying 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.

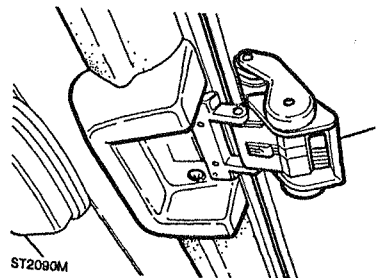


11. Connect the operating rod to the lock lever and secure with the spring clip, reversing instruction 4.
12. Fit the mounting panel and weather protection sheet. Fit the door trim, regulator handle, door pull and bezels.

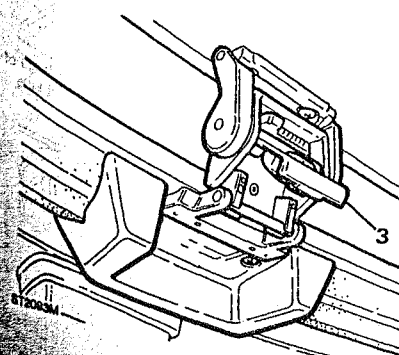
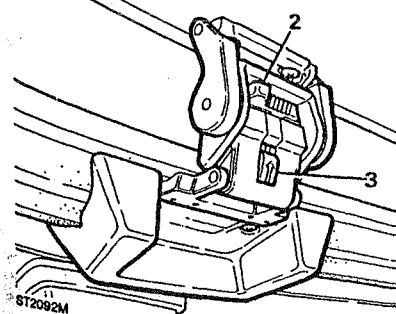
SUN ROOF LAND ROVER '90' and '110' - 1988 Model Year onwards

To remove

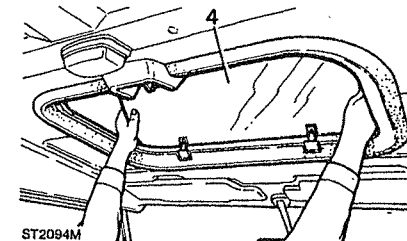
1. Open the roof panel to its fullest extent by pulling the latch handle down to the first open position.



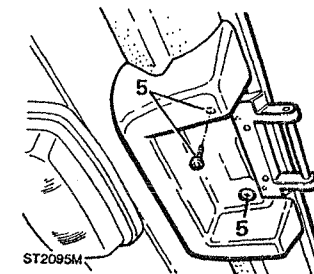
2. Then move the green button to the right and push the panel up as far as the latch will allow to the fully open position.
3. Move the red button upwards and open the retaining hasp



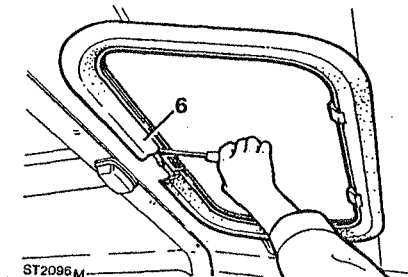
4. Raise-up the rear of the panel and withdraw it rearwards from the sun roof exterior surround.



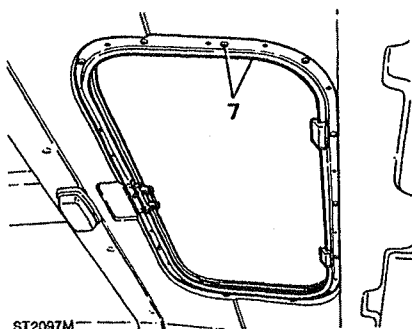
5. Remove the two screws and withdraw the latch finisher.



6. The sun roof exterior 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.

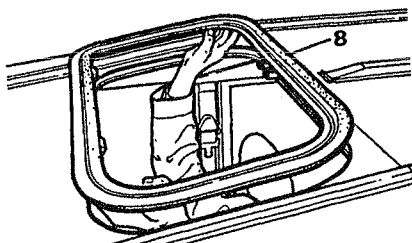


7. Remove the fifteen screws and withdraw the outer frame retainer.



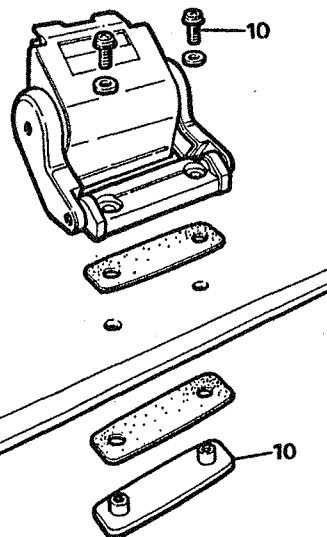
ST2097M

8. Lift the sun roof external frame from the vehicle.



ST2098M

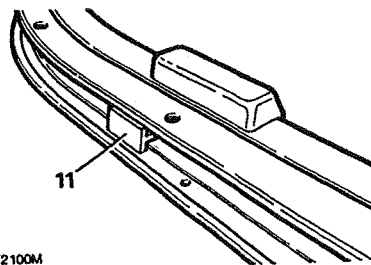
9. If necessary, remove the adhesive-backed seal, from the inner edge of the frame, that seals it to the vehicle roof.
 10. To release the latch from the glass panel, remove the two screws and withdraw the latch and backing plate.



ST2099M

To refit

11. If removed, fit the two centralising blocks to the outer frame and secure with adhesive.



ST2100M

12. Secure a new seal to the outer closing edge of the frame avoiding a join along the hinge side.

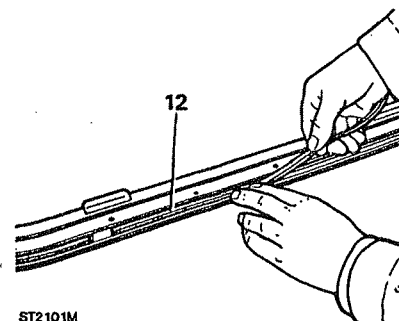
20. To check the operation and to close the panel, move the green button to the right whilst pulling the latch handle downwards until it snaps in the locked position.

LAND ROVER '110' STATION WAGON - 1988
 Model year onwards

Rear side window trim

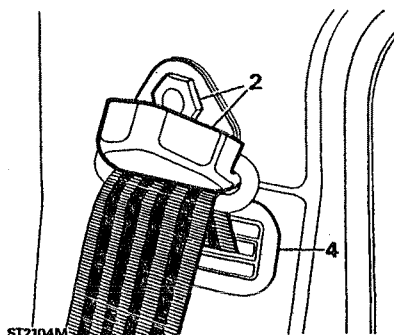
To remove

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.



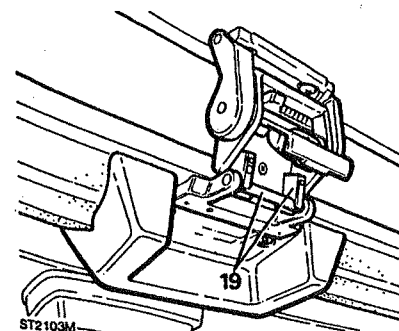
ST2101M

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 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.

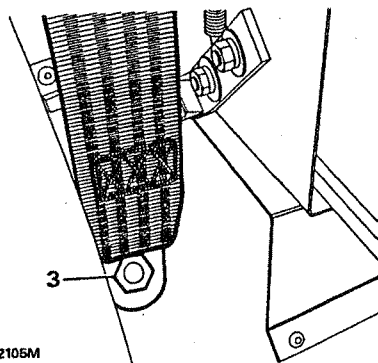


ST2104M

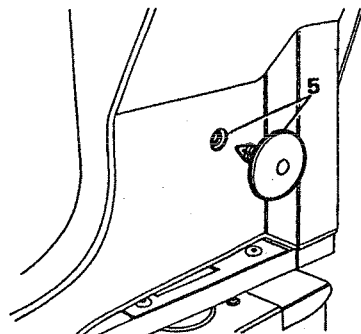
3. Remove the lower anchorage bolt for the same seat belt.
 4. Remove the seat belt aperture finisher from the trim panel and remove the rear quarter light trim from the side concerned.



ST2103M

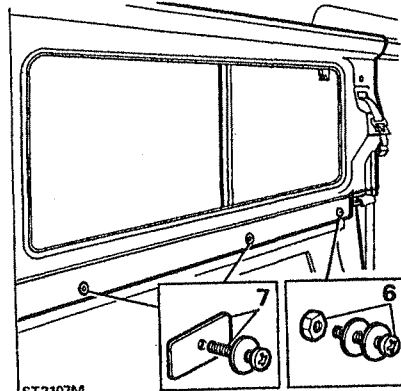


5. Using a screwdriver, carefully lever the trim retaining button from the 'C' post. The button is held by a 'fir-tree' type peg.



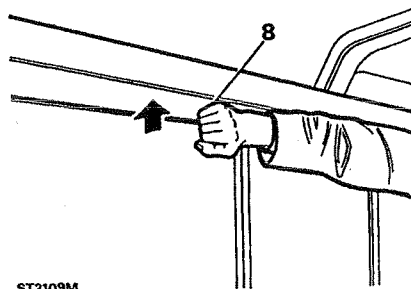
ST2106M

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.

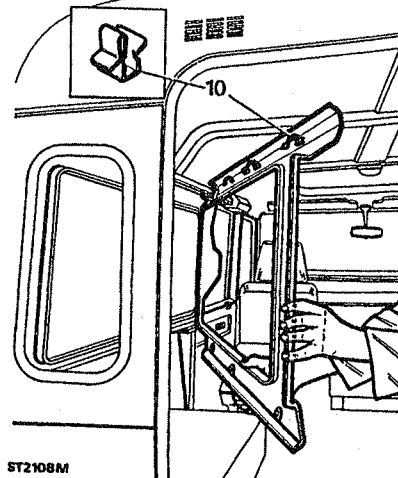


ST2109M

9. Feed the seat belt through the aperture and remove the trim from the vehicle.

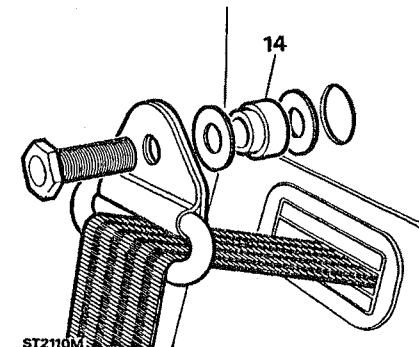
To refit

10. Feed the seat belt through the trim aperture. Fasten the top edge of the trim to the inner cant rail with the three spring clips.



ST2108M

11. Secure the lower edge of the trim with the three screws by reversing the removal process. Secure the rear and centre screws first and note that the nut is to the rear, the plate towards the trim.
12. Fit the plastic retaining button.
13. Fit the seat belt lower anchorage and secure with the special bolt, spacer and washers, as illustrated. Tighten the bolt to 20,3 Nm.
14. Similarly, fit the seat belt upper anchorage and tighten the special bolt to 20,3 Nm. Fit the finisher to the seat belt aperture in the trim panel and the plastic cover to the anchorage bolt.



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 1988 Model Year onwards

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 - 1988 Model
Year onwards**

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.

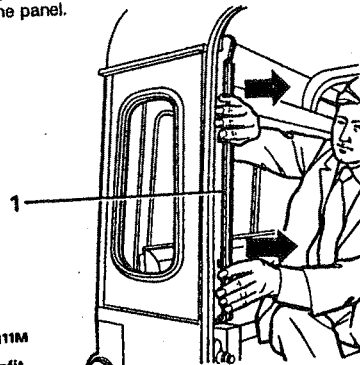
Once the trim lower fixings have been released and the rear quarter light trim removed, the seat belt upper anchorage bolt assembly must be removed together with the plastic button retaining the trim to the 'B' post. The trim upper fixings are the same as the '110' and an upward tap with the hand will 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. 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

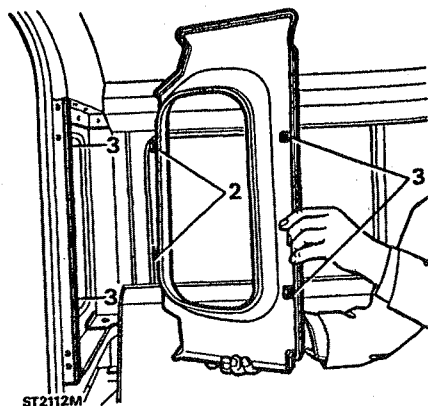
1. Pull the trim panel away from the quarter light with fingers thereby releasing the retaining spring clips from the vertical rail and withdraw the panel.



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.

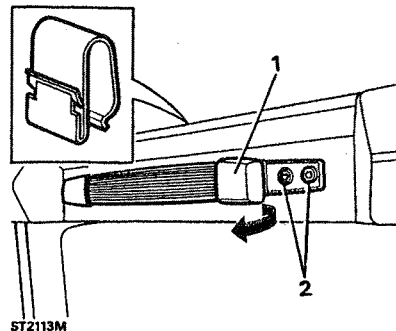


ST2112M

Grab handles

To remove

1. Lift the plastic finishers to expose the securing screws.
2. Remove the four screws to release the grab handle.



ST2113M

NOTE: In order to remove the trim above the door between the 'B' and 'C' post on '110' Station Wagons, the 'B' post trim as well as the grab handle must be removed. The trim above the door is held by clips, the same as used for the side trim.

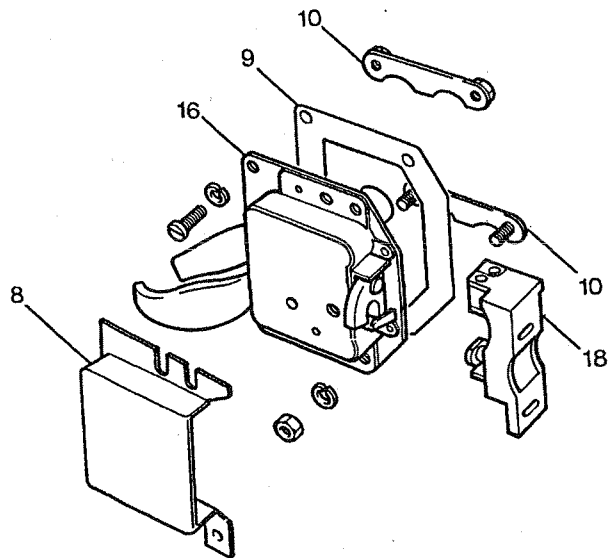
To refit

3. Reverse instructions 1 and 2.

Rear door lock

Remove

1. Remove the grab handle from the rear door.
2. Remove the rear wiper motor cover.
3. Remove the harness cover from the rear door.
4. Remove the rear door trim pad.
5. Remove the screws, washers and nut retainer securing the top of the lock to the door.
6. Remove the nuts, washers and screw retainer securing the bottom of the lock to the door.
7. Withdraw the lock complete with trim.
8. Remove the trim from lock.
9. Remove the door lock gasket.
10. Clean sealant from the retainer plates.



ST3428

Barrel removal

11. Insert the key in the barrel.
12. Depress the lock barrel plunger.
13. Withdraw the barrel from the lock.

Barrel refitting.

14. Refit the barrel in reverse of removal.

Refitting

15. Apply sealant to the lock retainer plates.
16. Fit the lock to the door with a new gasket and complete with the lock trim.
17. Secure with the retainer plates, screws, washers and nuts.
18. Close the door and check for correct latching with the striker. Adjust the striker as necessary.
19. Refit the trim pad, the harness and wiper motor covers and the grab handle.

Striker adjustment

NOTE: Before carrying out adjustment to the striker ensure that the dovetail is correctly adjusted.

1. Loosen the striker securing screws.
2. Adjust the striker and retighten screws.
3. Close the door and check for correct latching with the door lock.
4. Carry out further adjustment as necessary. If full adjustment cannot be achieved carry out the following:
5. Remove the striker and nut plate.
6. Elongate the holes in the body metal which is sandwiched between the striker and nut plate.
7. If interference between the striker and the dovetail is evident it is permissible to lightly grind the bottom of the striker casting.
8. Refit the striker and adjust as necessary.

Dovetail adjustment

1. Lift and hold the lock handle in the open position while opening and closing the door.
2. Adjust the dovetail guide as necessary to eliminate lifting, dragging or binding as the dovetail enters the guide.
3. Grease can be used as an aid to adjustment.

86 ELECTRICAL continued

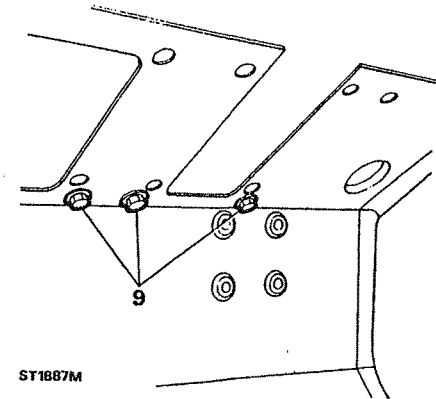
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HEATER/FAN UNIT

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.

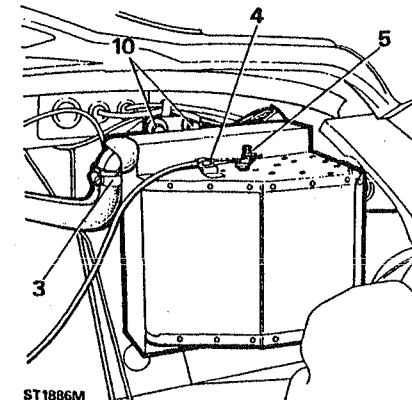


ST1887M

OVERHAUL

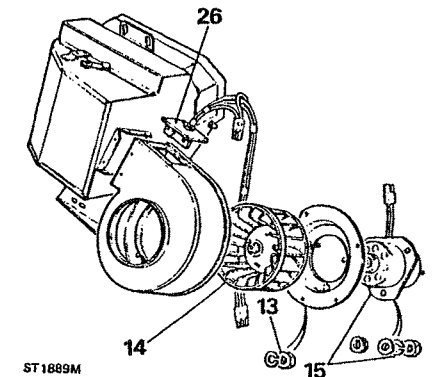
Fan Motor Assembly

12. Remove the nuts securing the angled bracket to the heater unit, and remove the bracket.
13. Remove the five nuts securing the fan assembly to the heater unit. Unplug the connector and remove the fan assembly from the heater unit.
14. Remove circlip holding the impeller to the drive shaft and remove the impeller.
15. Remove the three nuts securing the fan motor to the mounting plate and release the motor from the plate.



ST1886M

9. Remove lower nuts and bolts securing the heater unit to the bulkhead.
10. Slacken heater unit upper retaining bolts.
11. Manoeuvre heater unit clear of engine bay.

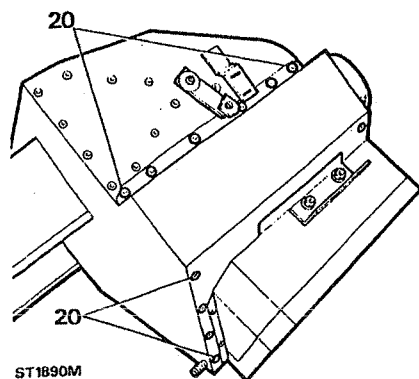


ST1889M

16. Fit fan motor into mounting plate, apply Bostik 1261 adhesive to mating faces, and secure with the three nuts.
17. Refit impeller to fan drive shaft and fit circlip.
18. Refit fan assembly to casing and secure with the five nuts.
19. Plug in connector to resistor harness and refit angled bracket.

Heater Matrix

20. Drill out rivets holding the air duct and top cover to the casing. (Three of the rivets are concealed by the rubber seal).



ST1890M

21. Lift off cover, air duct and seal.
22. Lift heater matrix out of casing.
23. Fit foam rubber to heater matrix casing and position matrix in casing.
24. Check that flap valves operate correctly and without sticking.
25. Refit top cover and rivet into place.

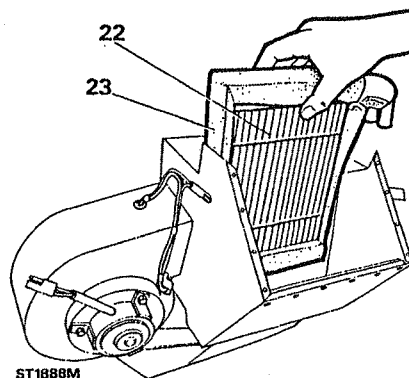
Resistor Unit

26. Drill out the four rivets retaining the resistor mounting plate, and lift out plate with resistor.
27. Apply Bostik adhesive to resistor plate and secure in position with rivets.

REFIT TO VEHICLE

28. Smear heater unit sealing rubber with a suitable impact adhesive, and locate to heater.
29. Place heater unit into engine bay and manoeuvre into position on bulkhead.
30. Loosely fit lower heater unit nuts and bolts.
31. Tighten heater unit upper securing bolts.
32. Tighten lower nuts and bolts.

33. Refit interior bulkhead trim.
34. Locate heater wiring harness into securing loop, and tighten nut.
35. Connect harness multi-plug.
36. Refit control cable outer clip and inner cable pinch bolts.
37. If necessary, prime heater matrix with coolant mixture.



ST1888M

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.

Servicing equipment

The following equipment is required for full servicing of the air conditioning system.

Charging trolley
Leak detector
Tachometer
Safety goggles
Refrigerant charging line gaskets
Thermometer -20°C to -60°C
Valve Core Removers

SERVICING MATERIALS

Refrigerant: Refrigerant 12, which includes Freon 12 or Arcton 12.

CAUTION: Methylchloride refrigerants must not be used.

Nominal charge weight: 1,09 kg (38 ozs).
Compressor oil: See Recommended Lubricants.

PRECAUTIONS IN HANDLING REFRIGERANT

The refrigerant used in the air conditioning system is Refrigerant 12, and is transparent and colourless in both the gaseous and liquid state. It has a boiling point of -29.8°C (-21.7°F) at atmospheric pressure and at all normal pressures and temperatures it becomes a vapour. The vapour is heavier than air, non-flammable, and non-explosive. It is non-poisonous except when in contact with an open flame, and non-corrosive until it comes in contact with water.

The following precautions in handling Refrigerant 12 should be observed at all times.

- DO NOT -
- leave refrigerant drum without its heavy cap fitted.
 - carry refrigerant drum inside a vehicle.
 - subject refrigerant drums to high temperature.
 - weld or steam clean near an air conditioning system.
 - expose eyes to liquid refrigerant, ALWAYS wear goggles.
 - discharge refrigerant vapour into an area with an exposed flame or into an engine intake. Heavy concentrations of refrigerant in contact with naked flame produces a toxic gas.
 - allow liquid refrigerant to contact bright metal, it will tarnish metal and chrome surfaces, and combined with moisture can seriously corrode all metal surfaces.

PRECAUTIONS IN HANDLING REFRIGERANT LINES

WARNING: Always wear safety goggles when opening 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.
- (i) A new compressor contains an initial charge of 312,5 ml (11 UK fluid ozs) of oil when received, part of which is distributed throughout the system when it has been run. The compressor contains a holding charge of gas when received which should be retained until the hoses are connected.
- (k) The receiver/drier should be the last component connected to the system to ensure optimum dehydration and maximum moisture protection of the system.
- (l) All precautions must be taken to prevent damage to fittings and connections. Slight damage could cause a leak with the high pressures used in the system.
- (m) Always use two spanners of the correct size, one on each hexagon, when releasing and tightening refrigeration unions.
- (n) Joints and 'O' rings should be coated with refrigeration oil to aid correct seating. Fittings which are not lubricated with refrigerant oil are almost certain to leak.
- (o) All lines must be free of kinks. The efficiency of the system is reduced by a single kink or restriction.
- (p) Flexible hoses should not be bent to a radius less than ten times the diameter of the hoses.
- (q) Flexible connections should not be within 50 mm of the exhaust manifold.
- (r) Completed assemblies must be checked 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 changing 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

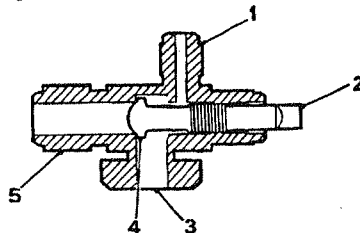
Examine the refrigeration connections at the unit. If the system should develop a fault, or if erratic operation is noticed, refer to the fault diagnosis chart.

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.



ST1387M

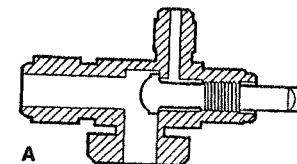
Stem type service valve

- 1. Service port
- 2. Valve stem
- 3. Compressor port
- 4. Valve seat
- 5. Hose connector

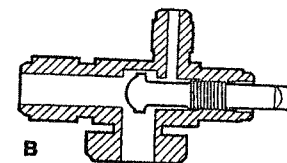
NOTE: A special wrench should be used to adjust the valve to prevent damage to the stem.

The stem type service valve has three positions, the operation of which is explained as follows.

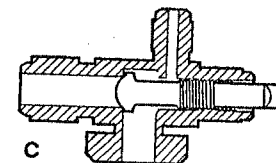
A. ON: FULLY ANTICLOCKWISE - Normal operating position, and the position which is used for connecting and disconnecting the manifold gauge set, is the on position. The stem is turned fully anticlockwise. This seals the service gauge port from receiving any refrigerant flow.



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.



ST1386M

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

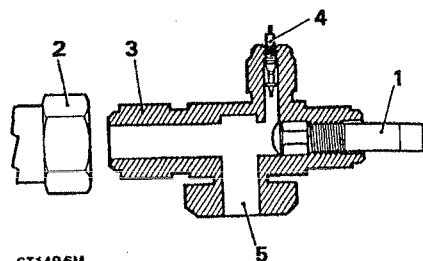
These are secured to the head of the compressor, and the suction and discharge flexible end connections are secured to them by unions.

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



ST1496M

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

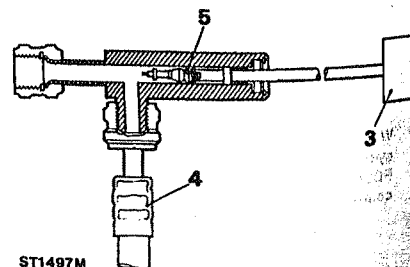
Where Schrader Valve depressors are not fitted to the Testing equipment lines Valve core removers can be used.

Valve Core Removal

The use of valve core removers will facilitate servicing operations and should be used as follows:

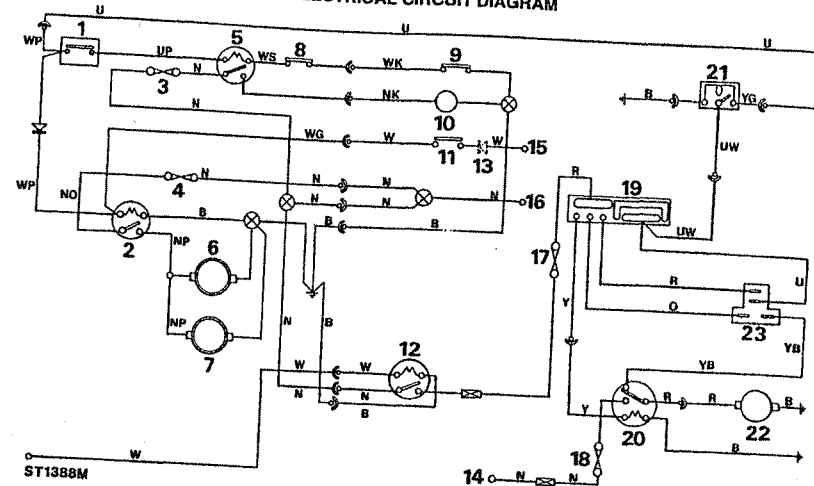
1. Close all valves on the charging trolley.
2. Remove the service valve cap and seals from the valve core remover.
3. Withdraw the plunger as far as possible and connect the core remover to the service valve.
4. Connect the hose to the core remover.
5. Depress the plunger until it contacts the valve 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.



ST1497M

ELECTRICAL CIRCUIT DIAGRAM



ST1388M

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

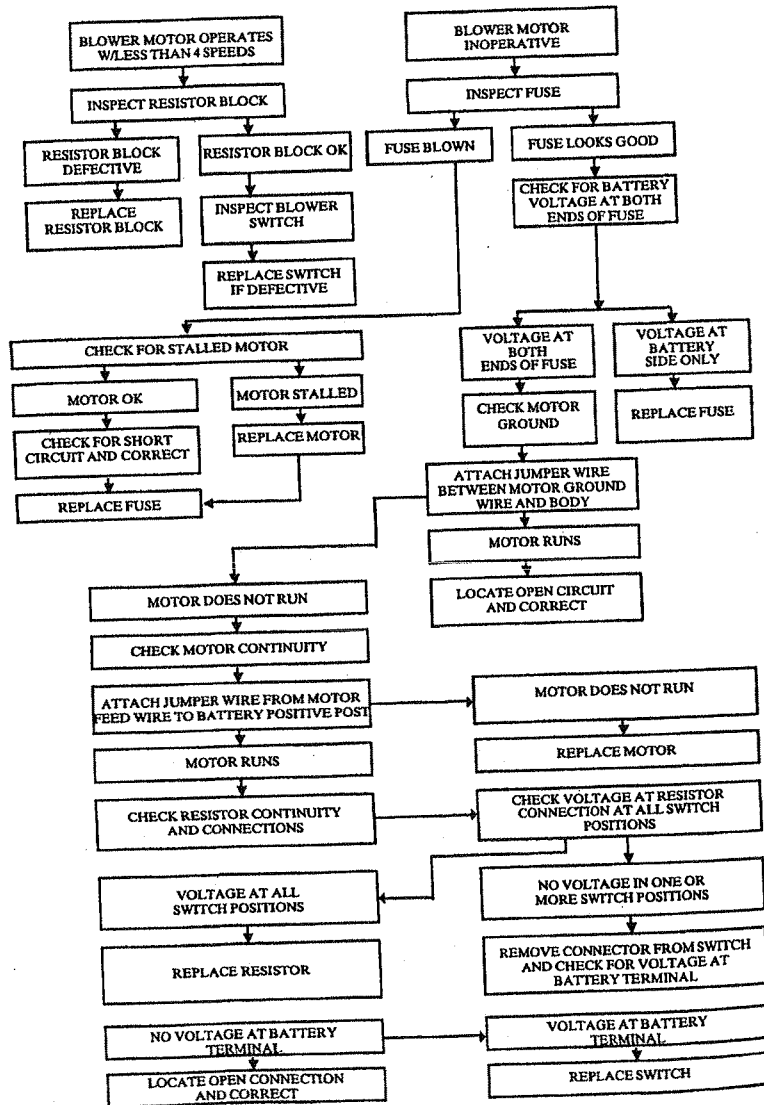
NOTE: R.H. steering models have only three fan speeds

20. Relay
 21. Air conditioning on/off switch
 22. Evaporator motor
 23. Resistor block

* 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

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:

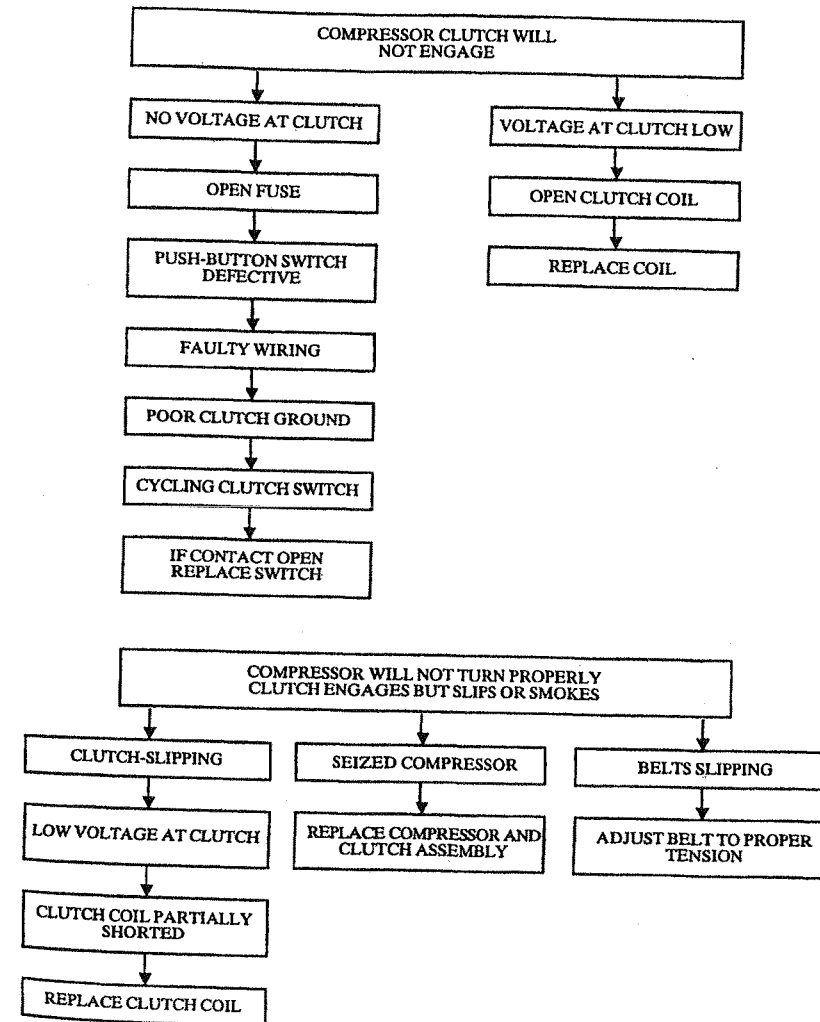
1. All high side lines and components should be warm to the touch.
2. All low side lines should be cool to the touch.
3. Inlet and outlet temperatures at the receiver/drier should be at the same temperature (warm). Any very noticeable temperature difference indicates a blocked receiver/drier.
4. Heavy 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/in ² (Kg/cm ²)	High Side Pressure Lb/in ² (Kg/cm ²)
Cool Day 70°F - 80°F (21°F - 27°C)	35-45°F (1.7-7.2°C)	15-20 1.1-1.4	160-200 11.2-14
Warm Day 80°F - 90°F (27°F - 32°C)	40-50°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

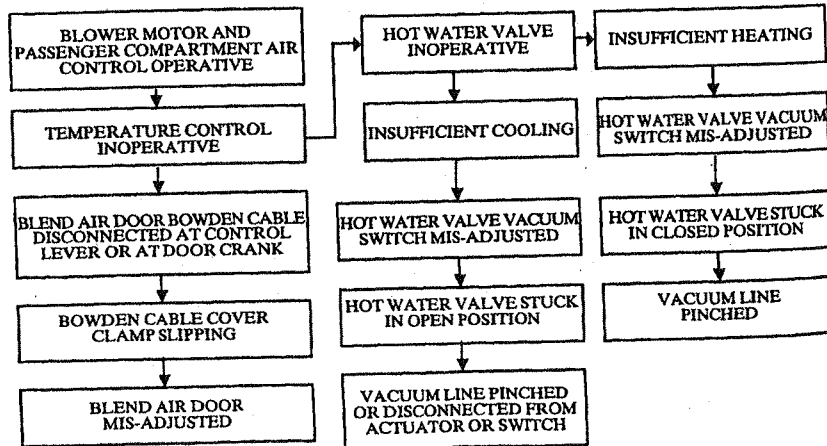
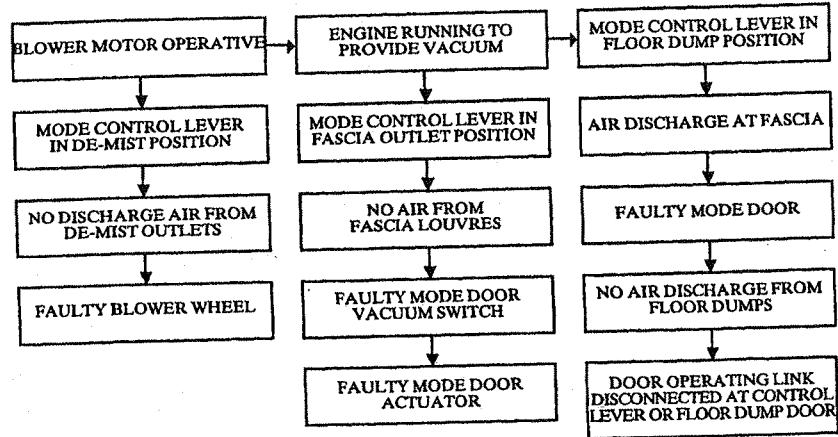
NOTE
 1. Low and high side pressures are guides not specific limits.
 2. Evap. air temperatures will be lower on dry days, higher on humid days.

FAULT	CAUSE	REMEDY
A. HIGH HEAD PRESSURE	<ol style="list-style-type: none"> Overcharge of refrigerant. Air in system. Condenser air passage clogged with dirt or other foreign matter. Condenser fan motor defective. 	<ol style="list-style-type: none"> Purge with bleed hose until bubbles start to appear in sight glass; then, add sufficient refrigerant gas to clear sight glass. Slowly blow charge to atmosphere. Install new drier; evacuate and charge system. Clean condenser of debris. Replace motor.
B. LOW HEAD PRESSURE	<ol style="list-style-type: none"> Undercharge of refrigerant; evident by bubbles in sight glass while system is operating. Split compressor gasket or leaking valves. Defective compressor. 	<ol style="list-style-type: none"> Evacuate and recharge the system. Check for leakage. Replace gasket and install new drier, evacuate, and charge the system. Replace compressor.
C. HIGH SUCTION PRESSURE	<ol style="list-style-type: none"> Slack compressor belt. Refrigerant flooding through evaporator into suction line; evident by ice on suction line and suction service valve. Expansion valve stuck open. Compressor suction valve strainer restricted. Leaking compressor valves, valve gaskets and/or service valves. Receiver/drier stopped; evident by temperature difference between input and output lines. 	<ol style="list-style-type: none"> Adjust belt tension. Check thermobulb. Bulb should be securely clamped to clean horizontal section of copper suction pipe. Replace expansion valve. Replace compressor. Replace valves and/or gaskets. Install new drier, evacuate, and charge the system. Install new drier, evacuate and charge the system.
D. LOW SUCTION	<ol style="list-style-type: none"> Expansion valve thermobulb not operating. Expansion valve sticking closed. Moisture freezing in expansion valve orifice. Valve outlet tube will frost while inlet hose tube will have little or no frost. System operates with little or no frost. System operates with dust, paper scraps, or other debris restricting evaporator blower grille. Dust, paper scraps, or other debris restricting evaporator blower motor, wiring, or blower switch. 	<ol style="list-style-type: none"> Warm thermobulb with hand. Suction should rise rapidly to 20 lbs. or more. If not, replace expansion valve. Check inlet side screen. Clean if clogged. Refer to C-2 and C-3. Install new drier, evacuate and charge the system periodically. Clean grilles as required. Refer to Fault Diagnosis for Electrical System.
E. NOISY EXPANSION VALVE (steady hissing)	<ol style="list-style-type: none"> Low refrigerant charge; evident by bubbles in sight glass. 	<ol style="list-style-type: none"> Leak test. Repair or replace components as required.
F. INSUFFICIENT COOLING	<ol style="list-style-type: none"> Expansion valve not operating properly. Low refrigerant charge; evident by bubbles in sight glass. Compressor not pumping. 	<ol style="list-style-type: none"> Refer to C-2, C-3, D-2, D-3 and E. Refer to B-1 and E. Refer to B-2 and B-3.
G. COMPRESSOR BELT	<ol style="list-style-type: none"> Belt tension. Excessive head pressure. Incorrect alignment of pulleys or worn belt not riding properly. Nicked or broken pulley. Frozen compressor. 	<ol style="list-style-type: none"> With tension gauge adjust to 100 lbs. (45 kg); tighten until depression of about 1/2 inch (1.25 cm) occurs across longest span. Refer to A-1 through A-4 and C-6. Repair as needed. Replace pulley. Replace compressor.
H. ENGINE NOISE AND/OR VIBRATION	<ol style="list-style-type: none"> Loose or missing mounting bolts. Broken mounting bracket, idler bracket, or brace. Loose flywheel or clutch retaining bolt. Rough idler pulley bearing. Bent, loose, or improperly mounted engine drive pulley. Incorrect installation of clutch bearing seal. Insecure mountings of accessories: generator, power steering, air filter, etc. Excessive head pressure. Incorrect compressor oil. 	<ol style="list-style-type: none"> Repair as necessary. Replace defective part. Repair as necessary. Replace bearing. Repair as necessary. Replace bearing. Repair as necessary. Refer to A-1, A-2, A-3, A-4 and C-6. Refer to Compressor Oil Level Check.

COMPRESSOR CLUTCH DIAGNOSIS



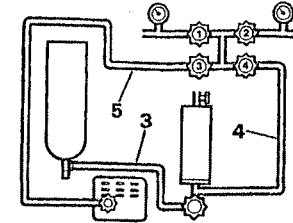
MECHANICAL
AIR CONDITIONER BLOWER MOTOR AND CONTROL SYSTEM DIAGNOSIS



CHARGING AND TESTING EQUIPMENT

Connecting the gauge set

NOTE: 1: There are two methods of connecting the charging and testing equipment, depending on the operation to be carried out. The method described for 'evacuating or charging with liquid refrigerant' also applies to 'pressure test' and 'compressor oil level check' operations.

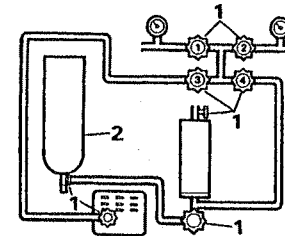


ST 1393M

NOTE: 2: Various types of charge and test equipment are available depending upon the manufacturer chosen by the user. The equipment illustrated may differ slightly in layout to that possessed by the user, however, it is recommended that the user adheres to the appropriate manufacturer's instructions for the charge and test equipment used in their workshop.

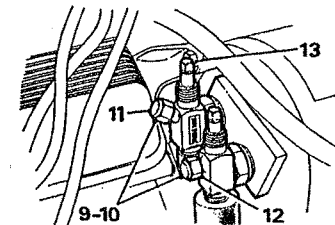
Fitting

1. Ensure that all the valves on the charging and testing equipment are closed. Control valves on the particular equipment selected are numbered 1 to 4 as illustrated. The sequence may vary on other proprietary equipment.
2. Mount a 11,3 kg drum of refrigerant upside down on the support at the rear of the charging equipment, and secure with the strap.



ST 1392M

3. Connect the hose from the bottom of the charging cylinder to the refrigerant drum valve.
4. Connect the hose between the bottom of the charging cylinder and the refrigerant control valve (No. 4).
5. Connect the hose between the vacuum pump valve and the vacuum control valve (No.3).



ST 1412M

14. After the valve is fully closed, turn the stem (anti-clockwise) half the number of turns counted, this should position the valve seat in the mid (test) position.

15. Turn the stem on the discharge valve clockwise until the pressure rises on the discharge pressure gauge. If the system is to be evacuated, the discharge service valve seat must be in the mid (test) position.
16. The charging and testing equipment is now connected and ready for proceeding with the required operation.

Removing

17. If the engine has been operated, it must be stopped prior to disconnecting the charging and testing equipment.
18. Close both service ports (turn fully anti-clockwise) until fully closed.
19. Close all valves on the charging and testing equipment.
20. Disconnect the charging lines from the service ports.
21. Refit the blanking caps to the compressor valve stems and service ports, and to the charging lines.
22. Close the bonnet.

AIR CONDITIONING SYSTEM OPERATIONS

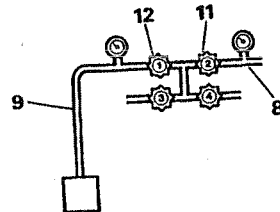
Depressurising

NOTE: The air conditioning refrigeration system contains 'Refrigerant 12' under pressure, and before any component is disconnected or removed, the system must be discharged of all pressure.

Refrigerant 12 evaporates so rapidly at normal atmospheric pressures and temperatures that it tends to freeze anything it contacts. Extreme care must be taken to prevent any liquid refrigerant from contacting the skin and especially the eyes. Should any liquid refrigerant get into the eyes, use a few drops of sterile mineral oil to wash them out and then wash the eyes with a weak solution of boric acid. Seek medical attention immediately even though the initial irritation has ceased after first aid treatment. Always wear safety goggles when opening refrigerant connections.

WARNING: Open connections slowly, keeping the hands and face well clear, so that no injury occurs if there is liquid in the line. If pressure is noticed allow it to bleed off slowly.

1. Place the vehicle in a ventilated area away from open flames and heat sources.
2. Stop the engine.
3. Open and secure the bonnet.
4. Remove the caps from the compressor service ports.
5. Check that both compressor service valves are fully opened (turned anti-clockwise).
6. Close all valves on the charging and testing equipment.
7. Put on safety goggles.
8. Connect the high pressure charging line (red) from valve No. 2 to the compressor discharge service port.
9. Run the (blue) hose to an open tapped container of approximately one litre capacity. Attach the hose to the container so that it will not blow out of the container. The purpose of the container is to collect any oil carried by the refrigerant.
10. Open the compressor discharge service port a quarter of a turn.
11. Open valve No. 2 fully.
12. Slowly open the valve No. 1 one turn to allow the refrigerant to escape, if necessary, adjust the refrigerant flow so that the oil captured in the container is not blown out of the container.

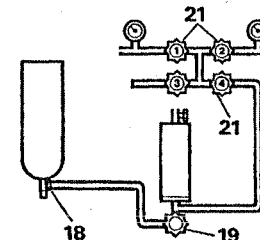


ST 1413M

13. Measure the amount of oil discharged from the system so that an equal amount of new oil can be returned to the system during the charging operation. Discard the old oil.
14. When the gauge pressure is below 50 psi, slowly open the valve No. 1 to maintain refrigerant flow.
15. When the pressure has been reduced, and the system has been completely discharged, close the valves Nos. 1 and 2 on the charging and testing equipment.
16. Close the compressor discharge service port (turn anti-clockwise).
17. Disconnect the high pressure charging line from the compressor service port.

NOTE: If it is necessary to disconnect the compressor hoses, the compressor should be sealed by fully closing the relevant service valve (turn fully clockwise). It is essential to ensure that both service valves are open before operating the compressor. Similarly any other component of the refrigeration system should be capped immediately when disconnected.

18. Open the refrigeration drum valve.
19. Open the valve at the base of the charging cylinder and allow approximately 0,25 kg of refrigerant to enter the cylinder.
20. Close the refrigeration drum valve and the valve at the base of the charging cylinder.
21. Open the refrigerant control valve (valve No. 4) and flush out the high and low pressure lines by opening valves Nos. 1 and 2 momentarily until a white stream of refrigerant is observed.



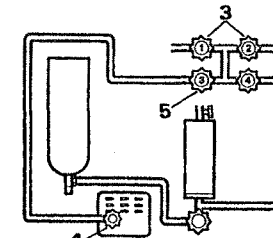
ST 1414M

22. Close all valves on the charging and testing equipment, and fit the blanking caps.
23. The air conditioning system is now depressurised.

Evacuating

Whenever the system has been opened to the atmosphere it is necessary that the system be evacuated to remove all air and moisture. It is also an essential preliminary operation to charging the system with Refrigerant 12. The evacuate operation also provides a check for leaks due to faulty connections.

1. Depressurise the air conditioning system as previously described, then connect the gauge set as detailed under 'Charging and Testing Equipment'.
2. Adjust both service valve seats to the mid (Test) position.
3. Open the low and high pressure valves Nos. 1 and 2.
4. Start the vacuum pump and check that the vacuum pump valve is open.
5. Slowly open the vacuum control valve No. 3. If the vacuum is applied to the system too quickly, the residual oil may be drawn out.

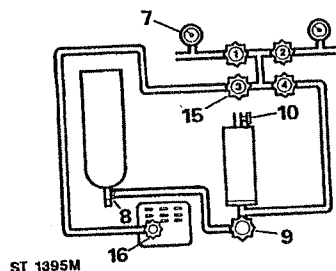


ST 1394M

6. In evacuating the system it is necessary to lower the pressure so that the boiling point of water in the system is lower than the surrounding air temperature. At an ambient temperature of 23.8°C (75°F), it is necessary to lower the system pressure to 29.5 in Hg vacuum to bring the boiling point of water to 22°C (72°F). Atmospheric pressure (and vacuum gauge readings) decrease as altitude increases by approximately 25 mm Hg per 300 m. The following chart provides a guide to the various gauge readings at differing altitudes, for the same 10 mm Hg absolute pressure.

Altitude, ft	m	Vacuum Reading in Hg	
		mm	mm
0	0	29.5	750
1,000	300	28.5	725
2,000	600	27.4	695
3,000	900	26.4	670
4,000	1200	25.4	645
5,000	1500	24.5	622
6,000	1800	23.5	596
7,000	2100	22.6	574
8,000	2400	21.8	554
9,000	2700	20.9	530
10,000	3000	20.1	510

7. The low side gauge should indicate a vacuum of 660 mm Hg within five minutes.
8. Whilst the system is evacuating, fill the charging cylinder by opening the refrigerant drum valve.
9. Open the valve at the base of the charging cylinder and fill the cylinder with 1.0 kg of refrigerant. Liquid refrigerant will be observed rising in the sight glass.
10. As the refrigerant stops filling the cylinder, open the valve at the top of the cylinder (behind the control panel) intermittently, to relieve the head pressure and allow the refrigerant to continue filling the cylinder.
11. When the refrigerant reaches the desired level in the sight glass, close both the valve at the base of the cylinder and the valve at the bottom of the refrigerant tank.
12. Ensure the top cylinder valve is fully closed. If bubbling is present in the sight glass, reopen the cylinder base valve momentarily to equalise the drum and cylinder pressures.
13. If 660 mm Hg of vacuum is not achieved within five minutes, it signifies either the system has a leak or the vacuum pump is defective. Initially check the vacuum pump, if the pump proves to be functioning properly then investigate for a leak in the air conditioning system.
14. Close the vacuum control valve No. 3.
15. Stop the vacuum pump and allow the vacuum to hold for fifteen minutes, then check that there is no pressure rise (a loss of vacuum) evident on the compound gauge. Any pressure rise denotes a leak which must be rectified before proceeding further. Refer to the heading titled 'Leak Detection' later in this section.
16. With the system satisfactorily evacuated, the system is ready for charging with refrigerant.

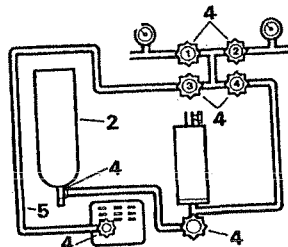


ST 1395M

Sweeping

NOTE: This operation is in addition to evacuating, and is to remove moisture from systems that have been open to atmosphere for a long period, or that are known to contain excessive moisture.

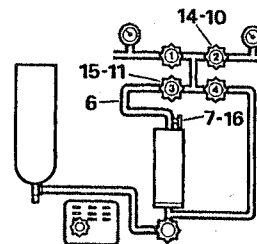
1. Fit a new liquid receiver/drier, as detailed under the heading "Receiver/Drier".
2. Ensure that a full drum of refrigerant is fitted on the charging and testing equipment.
3. Fit the charging and testing equipment as previously described for evacuating and evacuate the air conditioning system, allowing 0.25 to 0.45 kg of refrigerant to enter the charging cylinder.
4. Close all valves on the charging and testing equipment.
5. Disconnect the intake hose from the vacuum pump.



ST 1396M

6. Connect the intake hose to the valve at the top of the charging cylinder.
7. Open the valve at the top of the charging cylinder.
8. Put on safety goggles.
9. Crack open the hose connection at valve No. 3 and allow some refrigerant to purge the hose, then close the connection.
10. Open the high pressure valve (No.2).
11. Slowly open valve No. 3, which is now connected to the top valve of the charging cylinder, and allow gas to flow into the system until the reading on the compound gauge remains steady. Between 0.25 and 0.45 kg of refrigerant will enter the system.
12. Allow the dry refrigerant introduced into the system to remain for 10 minutes.

13. Crack the suction valve charging line at the service port on the compressor to allow an escape of refrigerant, at the same time observing the sight glass in the charging cylinder. A slight drop in the level should be allowed before closing the connection at the compressor.
14. Close the high pressure valve (No.2).
15. Close valve No.3.
16. Close the valve at the top of the charging cylinder.



ST 1397M

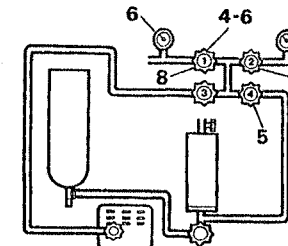
17. Reconnect the charging and testing equipment, as described for evacuating and evacuate the air conditioning system.
18. Maintain the vacuum for twenty minutes. The air conditioning system is now ready for charging with refrigerant.

Charging

CAUTION: Do not charge liquid refrigerant into the compressor. Liquid cannot be compressed; and if liquid refrigerant enters the compressor inlet valve, severe damage is possible; in addition, the oil charge may be absorbed into the refrigerant, causing damage when the compressor is operated.

1. Fit the charging and testing equipment as previously described for evacuating.
2. Evacuate the air conditioning system allowing 1.09 kg of refrigerant to enter the charging cylinder.
3. Put on safety goggles.
4. Close the low pressure valve (No.1).
5. Open the refrigerant control valve (No. 4) and release liquid refrigerant into the system through the compressor discharge valve port (high pressure). The pressure in the system will eventually balance.

6. If the full charge of 1,09 kg of liquid refrigerant will not enter the system, then close the high pressure valve (No.2) and open the low pressure valve (No.1), ensuring that the low pressure gauge does not exceed 18.14 kg/cm².
7. Start and run the engine at 1,000-1,500 rev/min and allow refrigerant to be drawn through the low pressure valve (No. 1) until the full charge has been drawn into the system.
8. Close valve No.1.



ST 1398M

9. Check the air conditioning system is operating satisfactorily by carrying out a pressure test, as described later in the Section.

CAUTION: Do not overcharge the air conditioning system as this will cause excessive head pressure.

Leak test

The following instructions refer to an electronic type refrigerant leak detector which is the safest, most sensitive and widely used.

1. Place the vehicle in a well ventilated area but free from draughts, as leakage from the system could be dissipated without detection.
2. Follow the instructions issued by the manufacturer of the particular leak detector being used. Certain detectors have visual and audible indicators.
3. Commence searching for leaks by passing the detector probe around all joints and components, particularly on the underside, as the refrigerant gas is heavier than air.
4. Insert the probe into an air outlet of the evaporator. Switch the air conditioning blower on and off at intervals of ten seconds. Any leaking refrigerant will be gathered in by the blower and detected.

5. Insert the probe between the magnetic clutch and compressor to check the shaft seal for leaks.
6. Check all service valve connections, valve plate, head and base plate joints and back seal plate.
7. Check the condenser for leaks at the pipe connections.
8. If any leaks are found, the system must be depressurised before attempting rectification. If repairs by brazing are necessary, the component must be removed from the vehicle and all traces of refrigerant expelled before heat is applied.
9. After repairs check the system for leaks and evacuate prior to charging.

Pressure test

1. Fit the charging and test equipment as previously described.
2. Start the engine.
3. Run the engine at 1,000 to 1,200 rev/min with the heat control set to cold (blue) zone, air distribution to the central position, recirculation control to recirculation and the air conditioning control 'ON' with fan speed to maximum.
4. Note the ambient air temperature control in the immediate test area in front of the vehicle, and check the high pressure gauge readings - discharge side - against table 1.

Table 1

Ambient Temperature		Compound Gauge Readings		High Pressure Gauge Readings	
°C	°F	kgf/cm ²	lb/in ²	kgf/cm ²	lb/in ²
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.

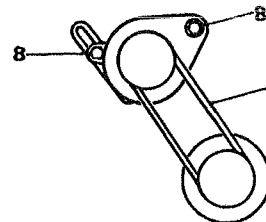
7. Start the engine.
8. Set the temperature control switch to maximum cooling and switch the air conditioner blower control on and off several times, checking that the magnetic clutch on the compressor engages and releases each time.
9. With the temperature control at maximum cooling and the blower control 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

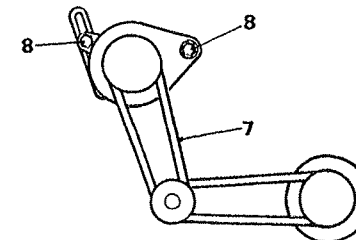
1. Place the vehicle in a ventilated area away from open flames and heat sources.
 2. Stop the engine and secure the bonnet in an open position.
 3. Remove the caps from the compressor service valves and connect the gauge set for evacuating.
 4. Evacuate the system as previously described.
 5. Open fully (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 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

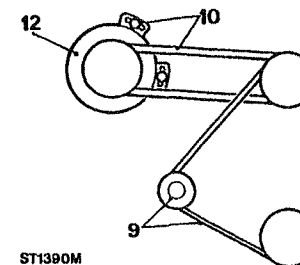
Petrol model



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

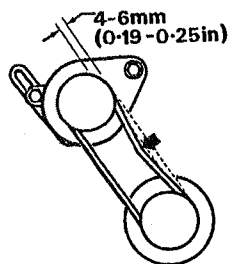
14. No servicing is recommended to the compressor, therefore a new unit must be fitted.
15. Reverse procedure as appropriate 13 to 9 and 6 to 3 for V8 models or 8 to 3 for 4-cylinder models noting the procedure for adjusting the compressor drive belts.

Refitting

Drive belt adjustment

Diesel only

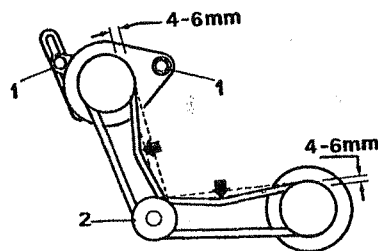
- Ensure all adjustment bolts associated with the compressor are slack.
- Alter the position of the compressor to provide a belt tension of 4-6 mm. Secure all compressor adjustment bolts and recheck the tension.



ST1408M

4-cylinder Petrol only

- Ensure all adjustment bolts associated with the compressor (1) and the lower pulley pivot fixing (2) are slack.
- Adjust the position of the lower pulley to give a belt tension of 4-6 mm.
- Tighten the pivot bolt and recheck the tension.
- Alter the position of the compressor to provide a belt tension of 4-6 mm.
- Secure all compressor adjustment bolts and recheck the tension.

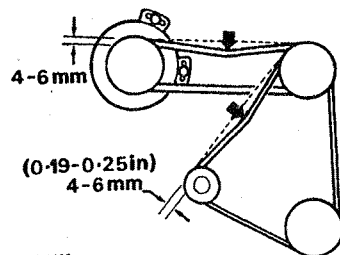


ST1409M

V8 Petrol only

- Ensure all adjustment bolts associated with the compressor are slack.

- Alter the position of the compressor to provide a belt tension of 4-6 mm. Secure all compressor adjustment bolts and recheck the tension.
- Ensure the jockey pulley adjustment bolts are slack.
- Alter the position of the jockey pulley to give a belt tension of 4-6 mm. Secure the adjustment bolts and recheck tension.

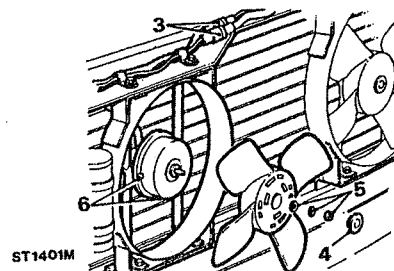


ST1391M

CONDENSER FAN MOTORS

Removal

- Open and secure the bonnet.
- Release the six self tapping screws securing the front nose and grille assembly, lift clear.
- Disconnect the electrical leads to the fans.
- Remove the blanking caps from the fan centres.
- Remove the 8 mm securing nuts, star and spring washers from the fan blade centres, pull blade from its respective fan motor shaft.
- Release the two fan motor retaining bolts and remove the motor whilst feeding the fan motor through the appropriate aperture.



ST1401M

Refitting

- Reverse procedures 1 to 6 ensuring the fan supply wiring is routed and securely clipped so that the wiring does not foul the fan blades.

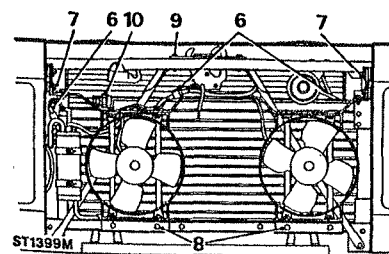
CONDENSER AND RECEIVER/DRIER

Removal

- Place the vehicle in a well ventilated area.
- Stop the engine, open and secure the bonnet.
- Remove the caps from the compressor service valves. Connect the gauge set for evacuation, and evacuate as detailed earlier.
- 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.
- Release the four top and two side fixings securing the grille and nose assembly and remove.
- 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.
- Release the four bolts and large packing washers securing the cowling to the wing sides.
- Remove the four nuts securing the fan cowling to the bottom bracket and lift clear.
- Remove the two bolts securing the bonnet striker support plate.

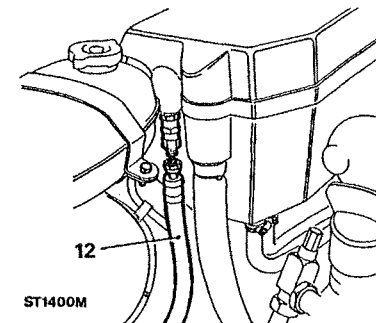
Condenser removal only

- Release the top air conditioning hose and cap the ends to prevent moisture and dirt entering the system.



ST1399M

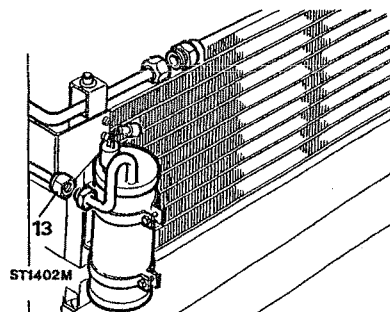
- Lift the condenser from the bottom mounting lugs and carefully ease the condenser forwards as far as possible.
- Release the high pressure air conditioning hose complete with the sight glass, at the evaporator connection. Cap the ends to prevent dirt or moisture entering the system.



ST1400M

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.

- Release the high pressure pipe from the receiver/drier, cap the pipe end connections.

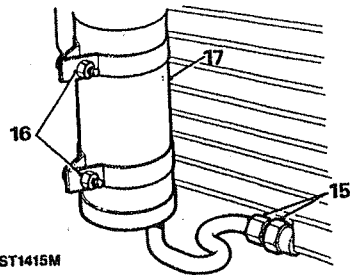


ST1402M

- Release both air conditioning pipes from the condenser extension plate. Lift the condenser clear.

Receiver/drier removal

- 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.
- Release the receiver/drier clamp bolts and allow the assembly to drop clear of the condenser.
- Lift the receiver/drier from the condenser and discard. It is NOT recommended to refit the old unit.



ST1415M

Refitting

18. Reverse procedures 15 to 17 using a new receiver/drier unit.
19. Connect the high pressure pipe to the receiver/drier. Using two spanners on each union, tighten the union noting that the sight glass remains in the vertical position.
20. Carefully locate the condenser into position, refit the fixings securing the condenser to the extension plate.
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 - L.H. steering models

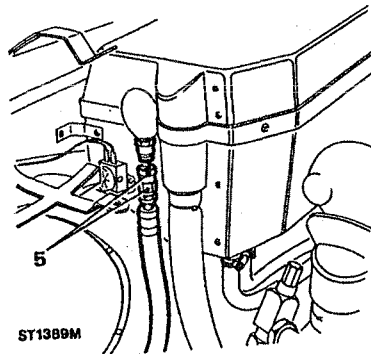
NOTE: It is only necessary to evacuate the air conditioning system when removing the evaporator matrix or to change the expansion valve.

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.

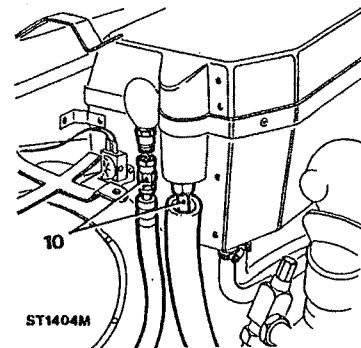


ST1389M

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.

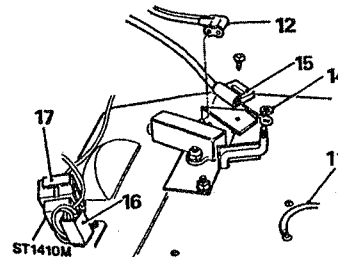
10. Whilst supporting both unions with suitable spanners unscrew the high and low pressure air conditioning pipes to the evaporator. Cap the pipe ends and evaporator inlets to prevent dirt or moisture entering the system.



ST1404M

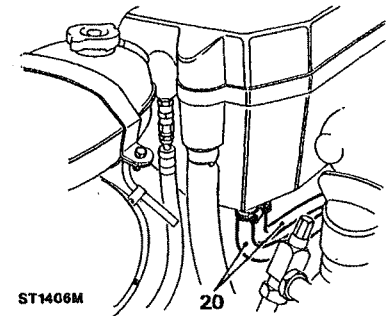
Evaporator unit

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.



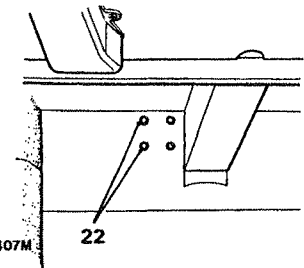
ST1410M

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.



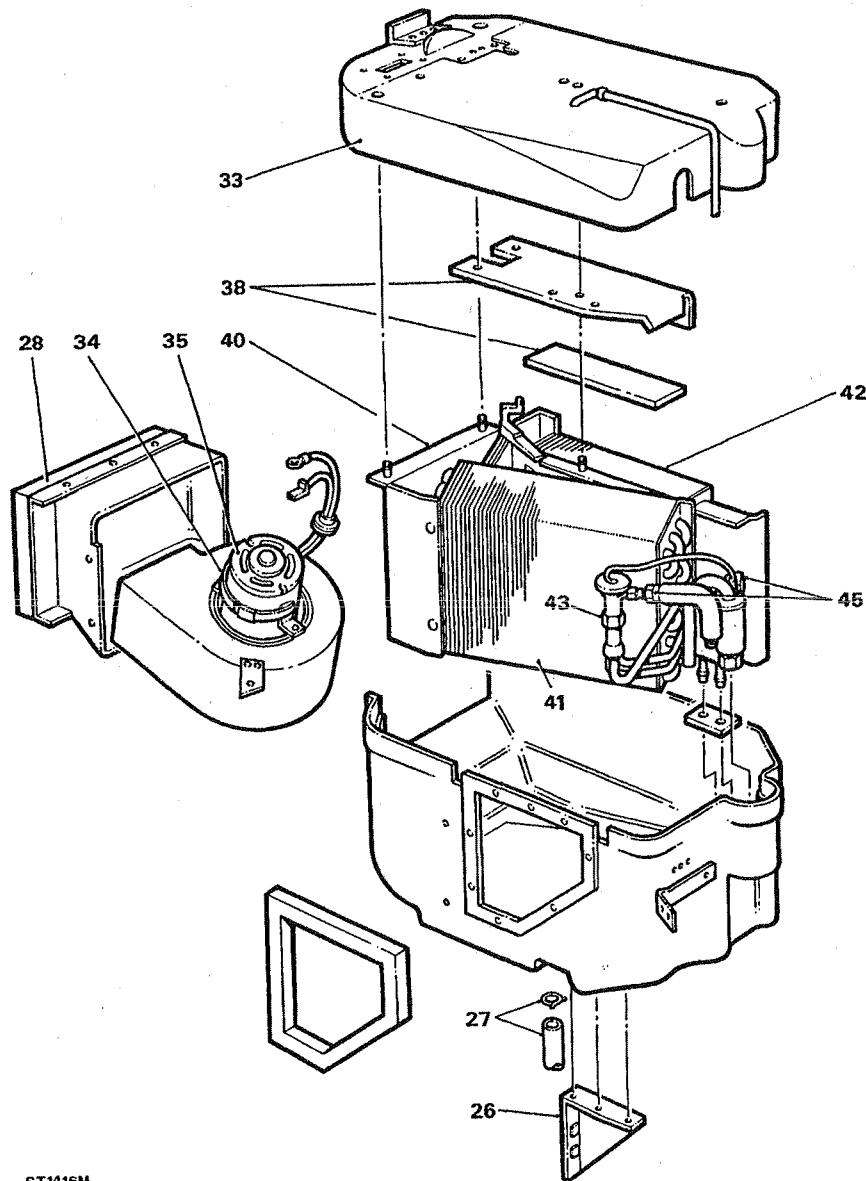
ST1406M

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.



ST1407M

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.

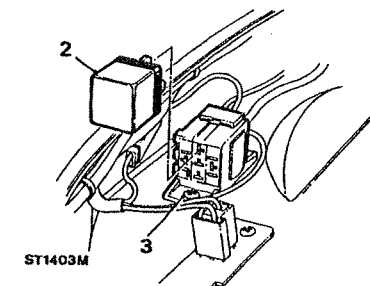
Refitting

47. Reverse procedures 11 to 46 noting that all threads, unions, 'O' rings are coated with refrigerant oil prior to fitting.

NOTE: Depending upon which unit has been refitted reverse the appropriate procedures: Heater Matrix or Blower Motor 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.

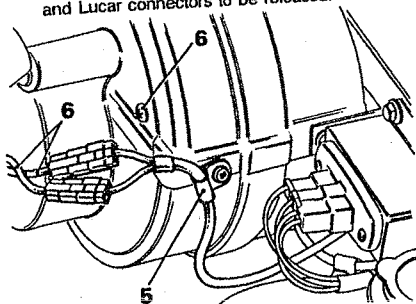
**Refitting**

4. Reverse procedures 1 to 3.

EVAPORATOR BLOWER MOTOR - R.H. Steering models

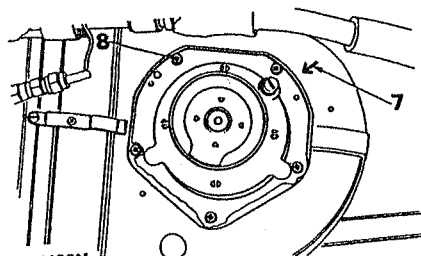
Removal

1. Open and secure the bonnet.
2. Release the plastic tie retaining the carburettor 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 1 to 9 ensuring that all seals are replaced.

24

Evaporator remove and refit - R.H. steering models

For removal of the blower motor only, see 'Evaporator Blower Motor'.

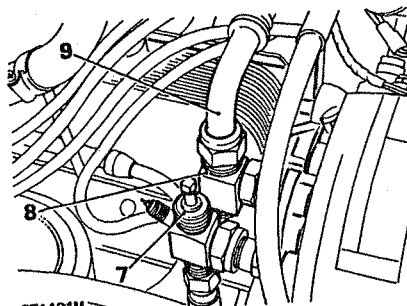
NOTE: It is only required to evacuate the air conditioning system when removing the evaporator matrix or changing the expansion valve.

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.

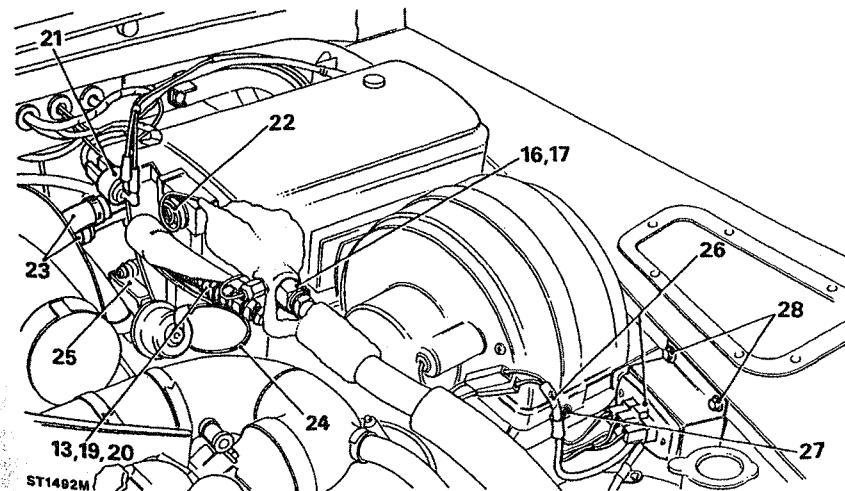
Evaporator matrix and expansion valve only

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 to the 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 'Ronco' 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.



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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 21 to 51, 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 2 to 20. Heater matrix 2 to 13.

ELECTRICAL PRECAUTIONS

The following guidelines are intended to ensure the safety of the operator whilst preventing damage to electrical and any electronic components fitted to the vehicle.

Before commencing any test procedure on a vehicle ensure that the test equipment is working correctly and any harness or connectors are in good condition, this particularly applies to mains leads and plugs.

WARNING: Before commencing work on an ignition system, all high tension terminals, adaptors and diagnostic equipment for testing should be inspected to ensure that they are adequately insulated and shielded to prevent accidental personal contacts and minimize the risk of shock. Wearers of surgically implanted pacemaker devices should not be in close proximity to ignition circuits or diagnostic equipment.

Polarity

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

High voltage circuits

Whenever disconnecting live high tension circuits always use insulated pliers and never allow the open end of a high tension lead to come into contact with other components particularly electronic control units. Exercise caution when measuring the voltage on the coil terminals while the engine is running, since, high voltage spikes can occur on these terminals.

Connectors and harness

Always ensure that these items are dry and oil free before disconnecting and connecting test equipment. Never force connectors apart either by using tools or by pulling on the wiring harness. Always ensure locking tabs are disengaged before removal and note orientation to enable correct reconnection. Ensure that any protective covers and substances are replaced if disturbed. Having confirmed a component to be faulty switch-off the ignition and disconnect the battery. Remove the component and support the disconnected harness. When replacing the component keep oily hands away from electrical connection areas and push connectors home until any locking tabs fully engage.

Battery disconnecting

Before disconnecting the battery, switch off all electrical equipment.

Battery charging

Recharge the battery out of the vehicle and keep the top well ventilated. While being charged or discharged, and for approximately fifteen minutes afterwards, batteries emit hydrogen gas which is flammable. Always ensure any battery charging area is well ventilated and that every precaution is taken to avoid naked flames and sparks. See SECTION 10 for battery maintenance.

GENERAL PRECAUTIONS

Switch-off ignition prior to making any connection or disconnection in the system as electrical surge caused by disconnecting 'live' connections can damage electronic components.

Ensure hands and work surfaces are clean and free of grease, swarf, etc. as grease collects dirt which can cause tracking or high-resistance contacts.

When handling printed circuit boards, treat them as you would a hi-fi record - hold by the edges only.

Prior to commencing a test, and periodically during a test, touch a good earth, for instance, a cigar lighter socket, to discharge body static as some electronic components are vulnerable to static electricity.

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

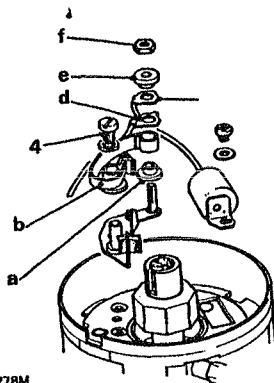
11. Examine the parts for wear and replace as necessary. Renew the capacitor and contact set. Examine the distributor cap for cracks and tracking. Renew the cap if the electrodes are worn and burned. If the cap is serviceable fit a new H.T. pick-up brush and spring. Renew the rotor arm if cracked and 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.

ASSEMBLE

When assembling, smear the centrifugal cover-plate and vacuum lever with Chevron SR1 grease or equivalent.

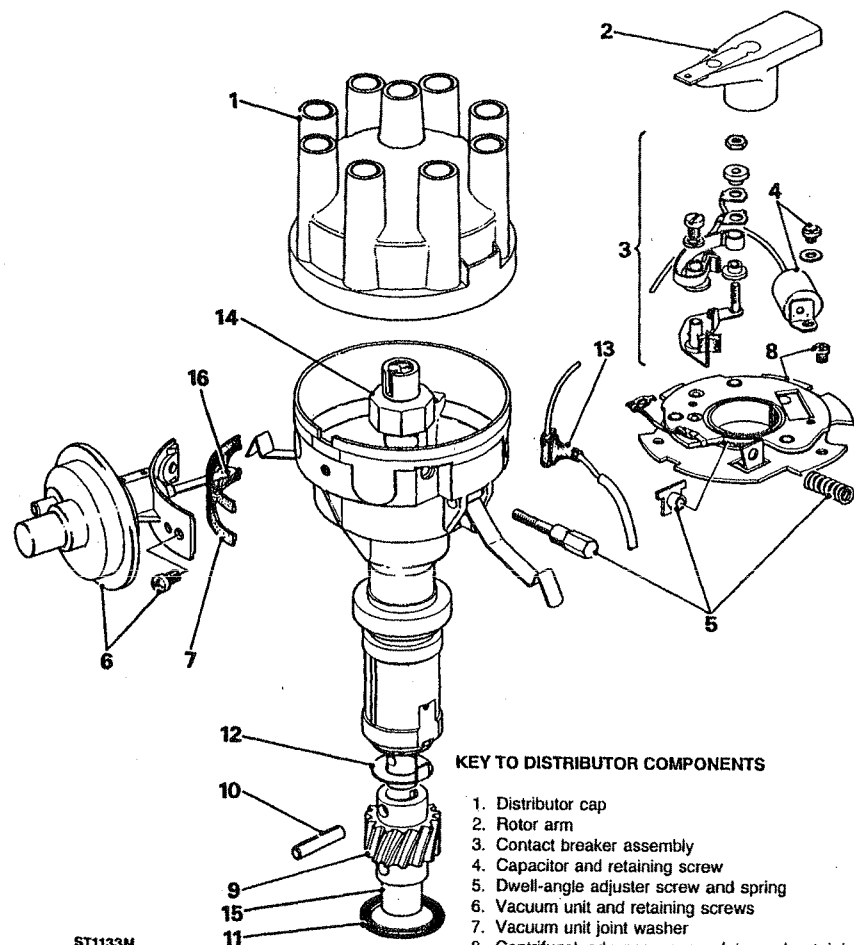
12. Fit the tab washer and drive pinion and secure with a new roll pin.
13. Fit the centrifugal advance cover-plate and secure with the three screws noting that one screw is used to retain the centrifugal advance cover plate earth lead.
14. Fit the vacuum unit and rubber joint washer and ensure that the operating lever is inserted between the two plates which make up the centrifugal cover plate assembly.

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

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. 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 HT 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)

ST1133M

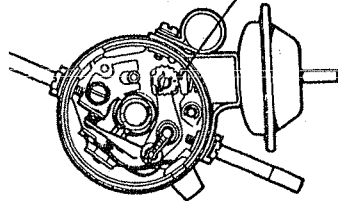
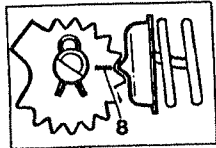
KEY TO DISTRIBUTOR COMPONENTS

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.



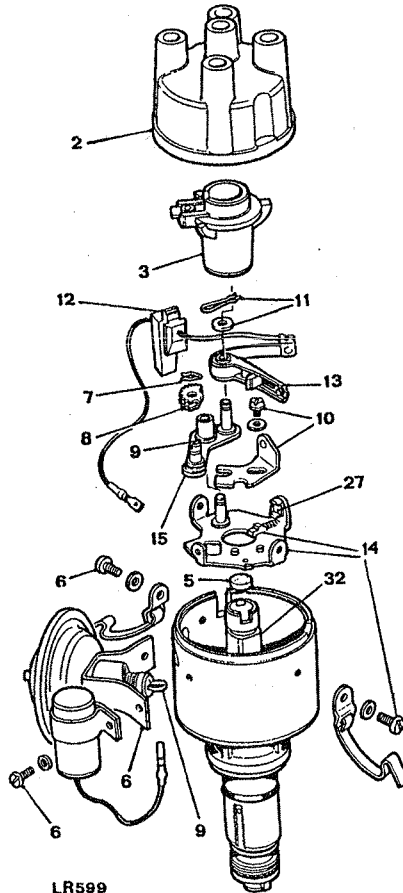
ST1279M

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.



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 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

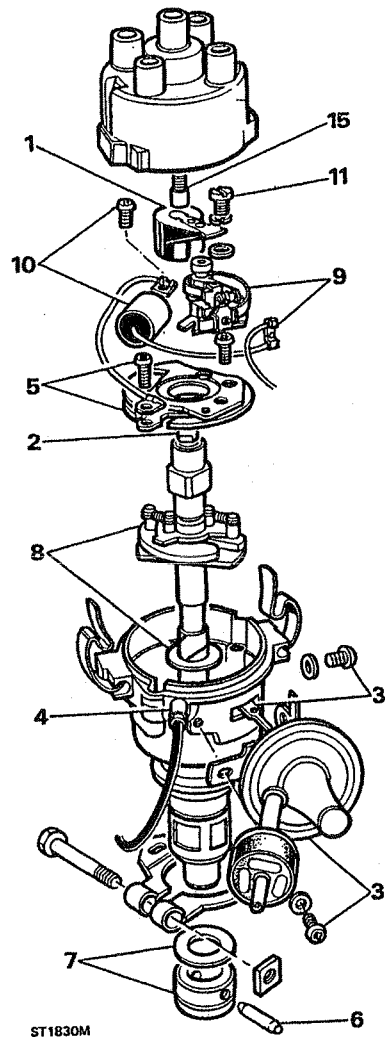
1. Remove the rotor arm.
2. Extract the felt pad, if fitted, from the cam.
3. Remove the two vacuum unit retaining screws, tilt the unit to disengage the operating arm and remove the vacuum unit.
4. Push the low tension lead and grommet into the inside of the body.
5. Remove the securing screws and lift 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

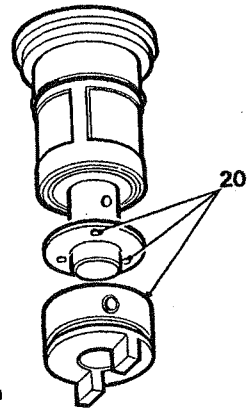
12. Do not dismantle the advance mechanism beyond removing the control springs. If any of the moving parts or the cam are worn or damaged, renew the complete shaft assembly.
13. Check the fit of the shaft in its bearing: if the bearing allows excessive side play, renew the complete distributor.
14. Check 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 (Molybdenum).
20. Fit the thrust washer with its raised lips towards the drive dog.

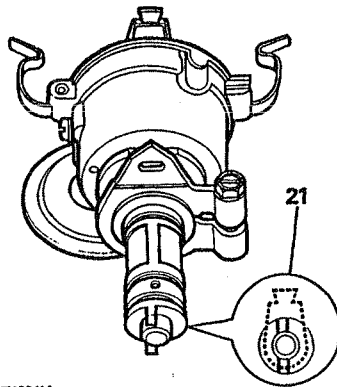


ST1830M



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

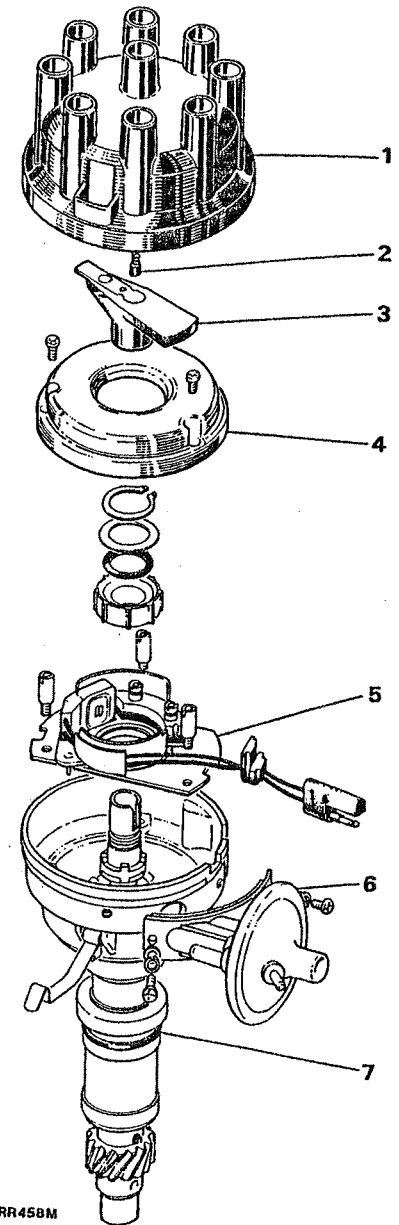
- 22. If a new shaft is fitted it must be drilled through the hole in the drive dog using a 4.76 mm (3/16) drill.
- 23. During drilling, push the shaft from the cam end, pressing the drive dog and washer against the body shank.
- 24. Secure the pin in the drive dog by ring-punching the holes. If the 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



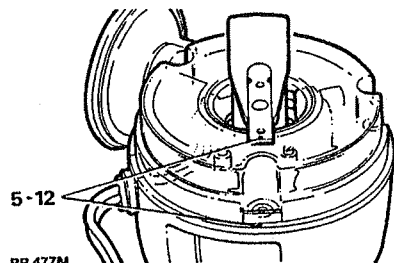
RR458M

DISTRIBUTOR - ELECTRONIC IGNITION - V8 ENGINES 35DM8

Remove and refit

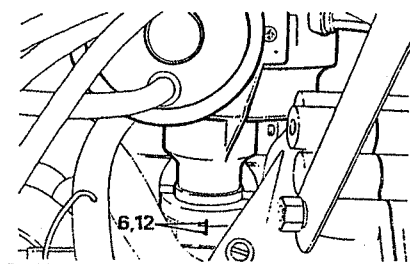
Removing

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.



RR477M

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.

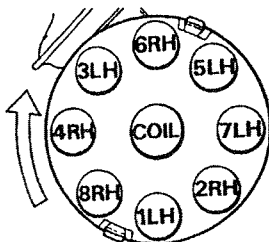
Refitting

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 following 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 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 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 rev/min, 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

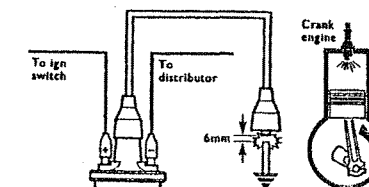
- The ignition must be switched on for all checks.
- Key to symbols used in charts for Tests 2
OK = Correct reading.
H = High reading.
L = Low reading.
- Use feeler gauges manufactured from a non-magnetic material when setting air gaps.

TEST 1:

Check HT Sparking

Remove coil/distributor HT lead from distributor cover and hold approximately 6 mm 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:-

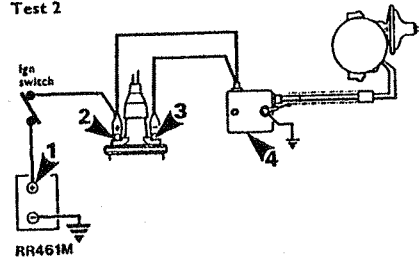
EXPECTED READINGS

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'.

1	2	3	4	SUSPECT
L	OK	OK	OK	Discharged battery
OK	L	L	OK	Ign. switch and/or wiring
OK	OK	L	OK	coil or amplifier
OK	OK	OK	H	Amplifier earth

Test 2



TEST 3:

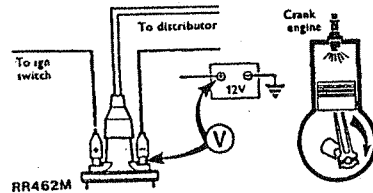
Check Amplifier Switching

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



TEST 4:

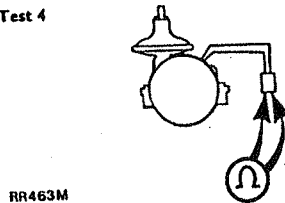
Pick-Up Coil Resistance. Applications with Separate Amplifier

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



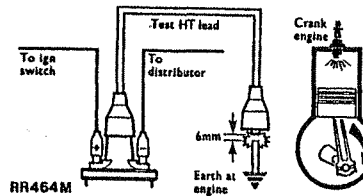
TEST 5:

Check HT Sparking

Remove existing coil/distributor HT lead and fit test HT lead to coil chimney. Hold free end about 6 mm 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



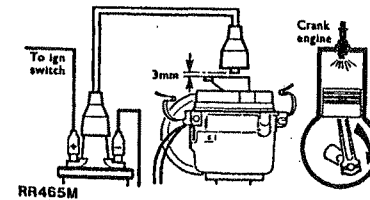
TEST 6:

Check Rotor Arm

Remove distributor cover. Disconnect coil HT lead from cover and hold about 3 mm 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 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 retractor on rotor shaft.
10. Remove the flat washer and then the 'O' ring recessed in the top of the retractor.
11. Insert the blade of a small screwdriver beneath the retractor 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 retractor.

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

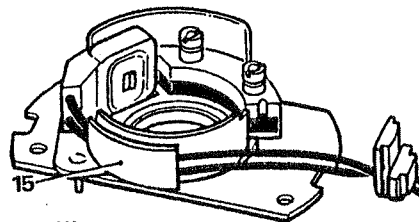
Apply clean engine oil:

- (a) 3 drops to felt pad reservoir in rotor shaft.
 - (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 retractor. 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/retractor tooth)	0.20 mm - 0.35 mm
Pick up winding resistance	2k - 5k ohms

Refitting Retractor

16. Slide retractor as far as it will go on rotor shaft, then rotate retractor until it engages with the coupling ring beneath the pick up base plate. The distributor shaft, coupling ring and retractor are 'keyed' and rotate together.

Pick Up Air Gap Adjustment

17. The air gap between the pick up limb and retractor teeth must be set within the specified limits, using a non-ferrous feeler gauge.

NOTE: 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.

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.

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 retractor inside the distributor body, generates timing signals. These are applied to an electronic ignition amplifier module mounted on the side of the distributor body.

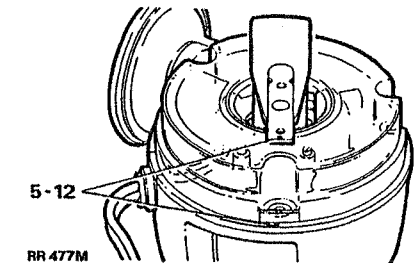
NOTE: The pick-up air gap is factory set. Do not adjust the gap unless the pick-up is being changed or the base plate has been moved. Use a non-ferrous feeler gauge to set the air gap.

DISTRIBUTOR - 35DLM8

Remove and refit

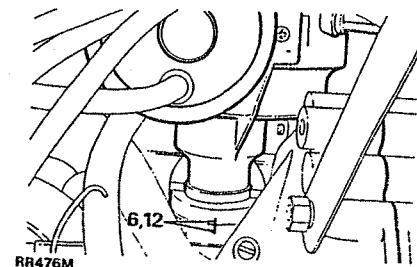
Removing

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.



RR 477M

6. Add alignment marks to distributor and front cover.



RR476M

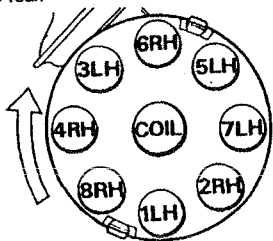
NOTE: Marking distributor enables refitting in exact original position, but if engine is turned while distributor is removed, complete ignition timing procedure must be followed.

- 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.

- 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

- If engine has not been turned whilst distributor has been removed, proceed as follows (items 10 to 17).
- Fit new 'O' ring seal to distributor housing.
- Turn distributor drive until centre line of rotor arm is 30° anti-clockwise from mark made on top edge of distributor body.
- 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.

- Fit clamp and bolt. Secure distributor in exact original position.
- Connect vacuum pipe to distributor and low tension lead to coil.
- Fit distributor cap.

- Reconnect battery.
- Using suitable electronic equipment, set the ignition timing. See IGNITION TIMING - Adjust.
- If, with distributor removed, engine has been turned it will be necessary to carry out the following procedure.
- Set engine - No. 1 piston to static ignition timing figure (see data section) on compression stroke.
- Turn distributor drive until rotor arm is approximately 30° anti-clockwise from number one sparking plug lead position on cap.
- Fit distributor to engine.
- Check that centre line of rotor arm is now in line with number one sparking plug lead on cap. Reposition distributor if necessary.
- If distributor does not seat correctly in front cover, oil pump drive is not engaged. Engage by lightly pressing down distributor while turning engine.
- Fit clamp and bolt leaving both loose at this stage.
- Set the ignition timing statically to within 2° -3° of T.D.C.
- Connect the vacuum pipe to the distributor.
- Fit low tension lead to coil.
- Fit distributor cap.
- Reconnect the battery.
- Using suitable electronic equipment set the ignition timing. See IGNITION TIMING - Adjust.

DISTRIBUTOR - LUCAS 35DLM8

Overhaul

DISTRIBUTOR COVER

- Unclip and remove the cover.
- Renew the cover if known to be faulty.
- Clean the cover and HT brush with a nap free cloth.

ROTOR ARM

- Pull rotor arm from keyed shaft.
- Renew rotor arm if known to be faulty.

INSULATION COVER (Flash shield)

- Remove cover, secured by three screws.
- Renew cover if known to be faulty.

VACUUM UNIT

- 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

- Remove two screws and withdraw the module.
- Remove the gasket.
- 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

- Use circlip pliers to remove the circlip retaining the reluctor on rotor shaft.
- Remove the flat washer and then the 'O' ring recessed in the top of the reluctor.
- Gently withdraw the reluctor from the shaft, taking care not to damage the teeth.

NOTE: Coupling ring fitted beneath reluctor.

- 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.

- 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

- This is mainly a reversal of the dismantling procedure, noting the following points:

LUBRICATION

Apply clean engine oil:

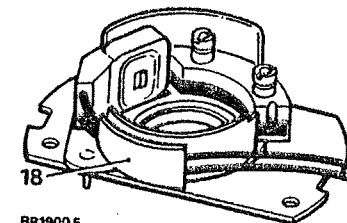
- Three drops to felt pad reservoir in rotor shaft.

Apply Chevron SR1 (or equivalent) grease.

- Auto advance mechanism.
- Pick-up plate centre bearing.
- Pre tilt spring and its rubbing area (pick-up and base plate assy).
- Vacuum unit connecting peg (pick-up and base plate assy) and
- the connecting peg hole in vacuum unit connecting rod.

FITTING PICK-UP AND BASE PLATE ASSEMBLY

- 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.



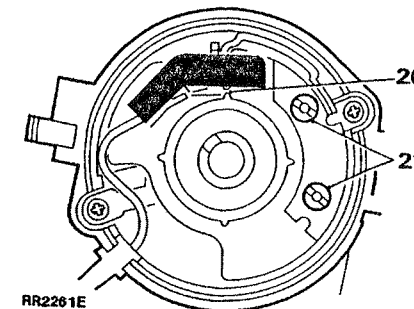
RR1900 E

REFITTING RELUCTOR

- 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.

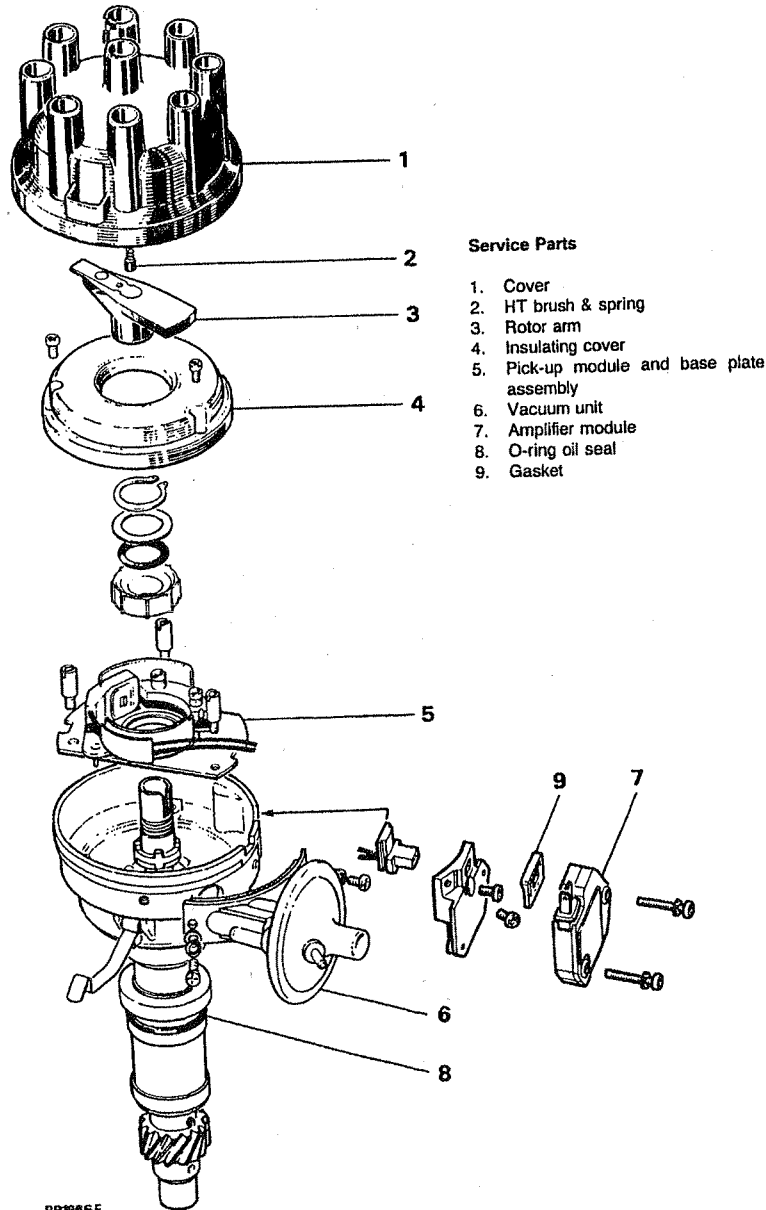
PICK-UP AIR GAP ADJUSTMENT

- The air gap between the pick-up limb and reluctor teeth must be set within the specified limits, using a non-ferrous feeler gauge.
- If adjustment is necessary, slacken the two barrel nuts to set the air gap. See Engine Tuning Data.



RR2261 E

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. Insulating cover
5. Pick-up module and base plate assembly
6. Vacuum unit
7. Amplifier module
8. O-ring oil seal
9. Gasket

RR1866E

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

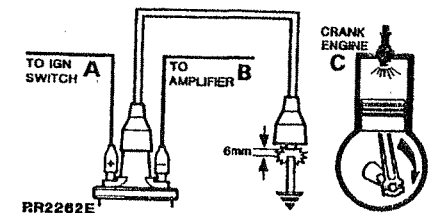
Check air gap with a non-ferrous feeler gauge.

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 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:

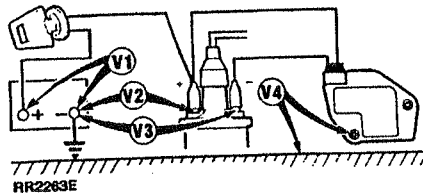
L. T. Voltage

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



RR2263E

- (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.

	2	3	4	SUSPECT
L	OK	OK	OK	Discharged battery
OK	L	L	OK	Ign. switch and/or wiring
OK	OK	L	OK	coil or amplifier
OK	OK	OK	H	Amplifier earth

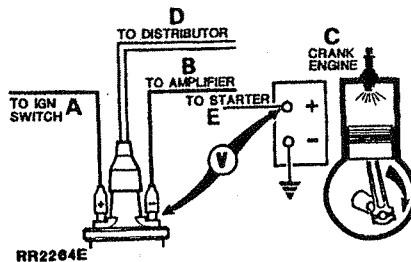
KEY

- OK Expected Voltage.
- H Voltage higher than expected.
- L Voltage lower than expected.

TEST 3:

Check Amplifier Switching

Connect the voltmeter between battery position (+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.



RR2264E

- A. To ignition switch
- B. To amplifier
- C. Crank engine
- D. To distributor
- E. To starter

TEST 4:

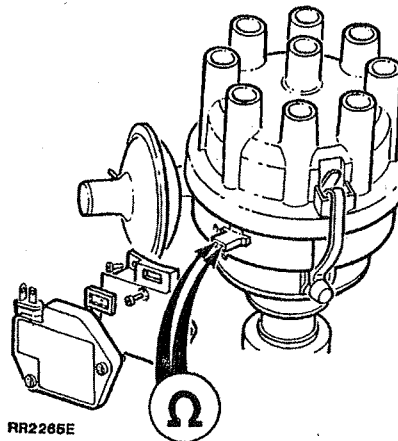
Pick-Up Coil Resistance.

Disconnect the pick-up leads at the harness connector. Connect the ohmmeter leads to the two pick-up leads in the plug. The ohmmeter should register between 2k and 5k ohms if pick-up is satisfactory. If the ohmmeter reading is correct, check all connections between pick-up and amplifier, if satisfactory, fit new amplifier. If the engine still does not start carry out Test 5. Change the pick-up if ohmmeter reading is incorrect. If the engine still does not start proceed to Test 5.

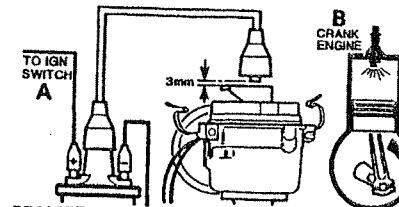
TEST 6:

Rotor Arm

Remove distributor cover. Disconnect coil HT lead from cover and using insulated pliers, hold about 3 mm above rotor arm electrode and crank the engine. There should be no HT sparking between rotor and HT lead. If satisfactory carry out Test 7. If HT sparking occurs, an earth fault on the rotor arm is indicated. Fit new rotor arm. If engine will not start carry out Test 7.



RR2265E

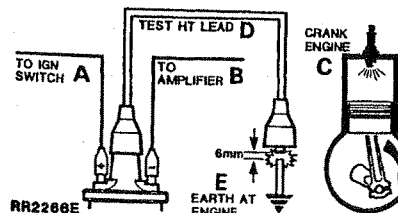


RR2267E

TEST 5:

Coil HT Sparking

Remove existing coil/distributor HT lead and fit test HT lead to coil tower. Using suitable insulated pliers, hold free end about 6 mm from the engine block and crank the engine. There should be a good HT spark. If weak or no sparking, fit new coil, repeat test. HT sparking good, carry out Test 6. If weak or no sparking, fit new HT lead, if engine will not start carry out Test 6.



RR2266E

- A. To ignition switch
- B. To amplifier
- C. Crank engine
- D. Test HT lead
- E. Earth at engine

- A. To ignition switch
- B. Crank engine

TEST 7:

Visual and HT Cable Checks

Examine:	Should be:
1. Distributor Cover	Clean, dry, no tracking marks
2. Coil Top	Clean, dry, no tracking marks
3. HT Cable Insulation	Must not be cracked chafed or perished
4. HT Cable Continuity	Must not be open circuit
5. Sparking Plugs	Clean, dry, and set to correct gap.

NOTE:

- 1. Reluctor Must not foul pick-up or leads
- 2. Rotor and Flash Must not be cracked or show signs of tracking marks.

ALTERNATOR 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.

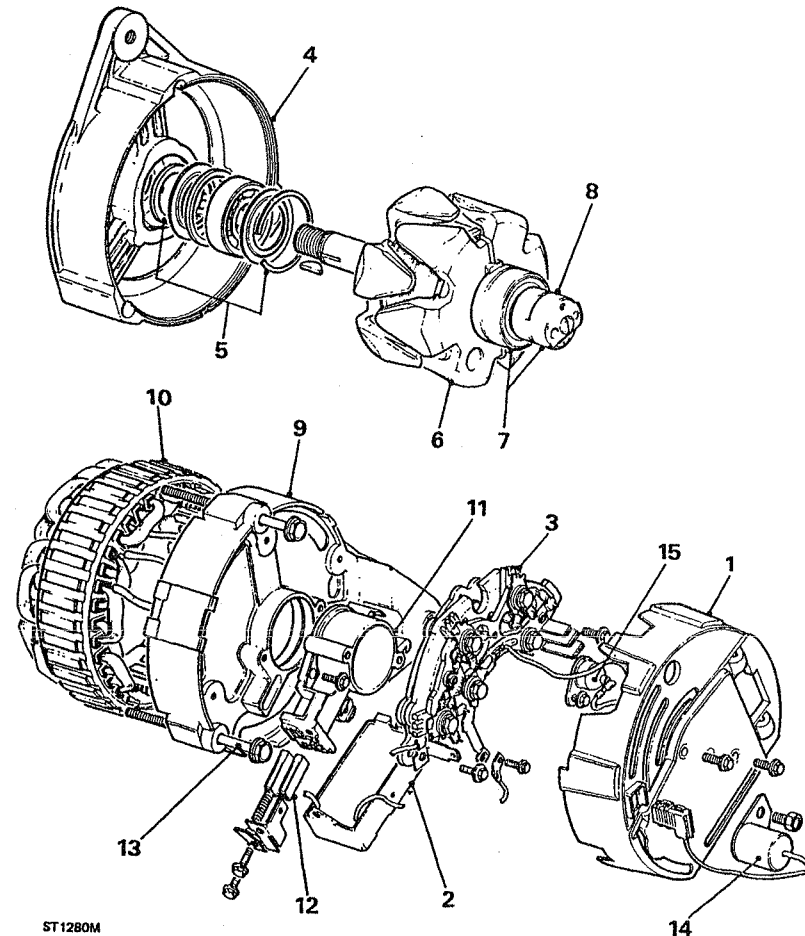
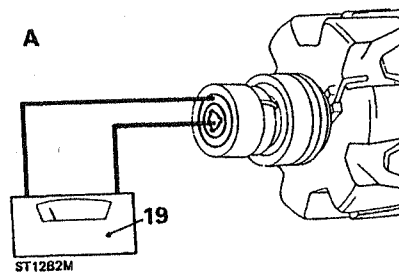
Whilst carrying out the above two instructions take care not to damage the insulation covering the winding leads.

ELECTRICAL TEST OF COMPONENTS

The illustrations for the following tests show the components separated from the alternator, for clarity.

Rotor field winding

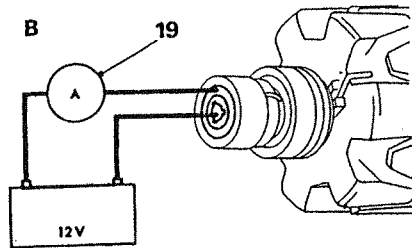
19. Check field winding continuity and resistance simultaneously, by connecting either a battery-operated ohmmeter (illustration A) or a 12 volt battery and moving coil ammeter (illustration B) between the slip rings. The ohmmeter should indicate the appropriate resistance given in the data, or it should indicate a current approximate to the figure obtained by dividing the appropriate resistance of the rotor into the battery voltage.



ST1280M

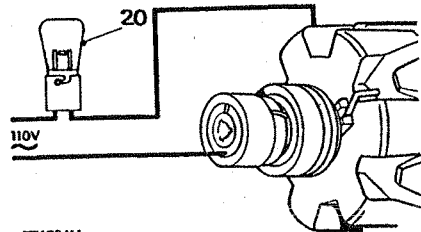
KEY TO ALTERNATOR

- | | |
|--------------------------|--|
| 1. Cover | 9. Slip ring end bracket |
| 2. Regulator | 10. Stator |
| 3. Rectifier | 11. Brush box |
| 4. Drive-end bracket | 12. Brush set |
| 5. End bearing kit | 13. Fixing bolt - slip ring end bracket to drive-end bracket |
| 6. Rotor assembly | 14. Suppression capacitor |
| 7. Slip ring end bearing | 15. Surge protection diode |
| 8. Slip rings | |



ST1283M

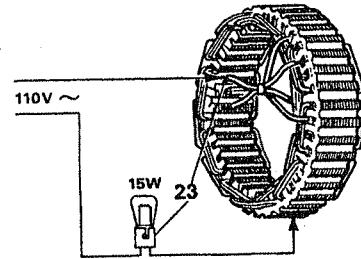
20. Check for satisfactory field winding insulation by connecting a 110 V A C 15-watt test lamp between either of the slip rings and the rotor body. The lamp should not light.



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.

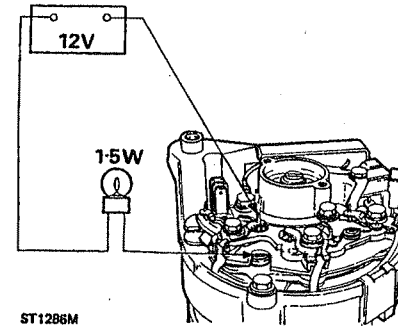
Regulator

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.



ST1286M

TIGHTENING TORQUES

Through bolts	4.5 - 6.2 Nm
Shaft nut	27.2 - 47.5 Nm
Rectifier fixing bolts	3.4 - 3.96 Nm
Sundry screws:	
SRE Cover	1.7 - 2.25 Nm
Brush Box	3.4 - 3.96 Nm
Surge Diode	3.4 - 3.96 Nm
Capacitor	3.61 - 4.74 Nm
Brush and Regulator fixing	1.7 - 2.25 Nm
D/E Bearing Plate	4.7 - 5.7 Nm
Reg 'IND' Lead	1.1 - 1.36 Nm
NUTS:	
Main output terminal	3.96 - 5.08 Nm
'IND' terminal nuts	3.61 - 4.74 Nm

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

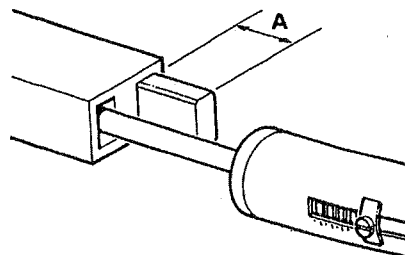
Battery polarity is **NEGATIVE EARTH**, which must be maintained at all times.

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.

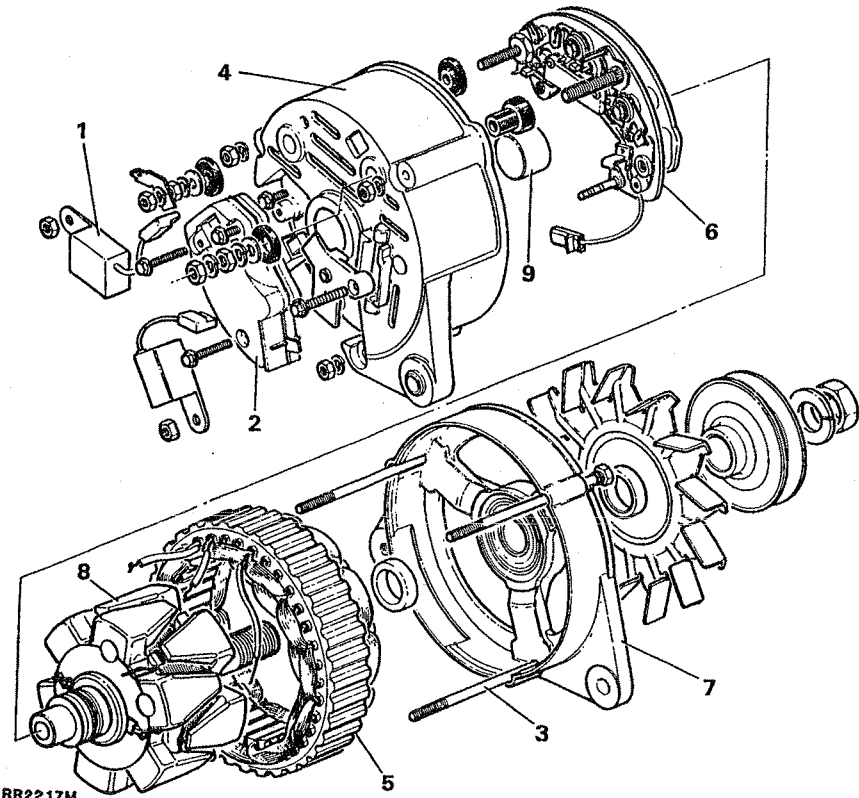
DISMANTLE

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 or less, change the assembly.



RR2218M

ALTERNATOR - LUCAS A127-65

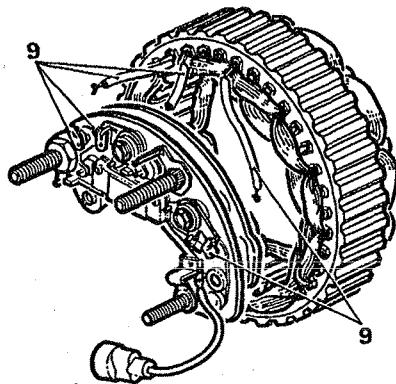


RR2217M

Service parts

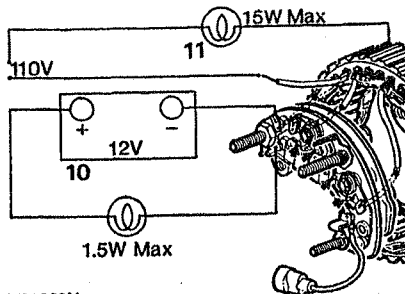
1. Suppression capacitors - 2 off
2. Regulator/Brushbox assembly
3. Through bolts
4. Slip ring end (SRE) bracket
5. Stator
6. Rectifier
7. Drive end bracket (DRE)/bearing assembly
8. Rotor
9. Slip ring end bearing

- 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.
- 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.
- 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.



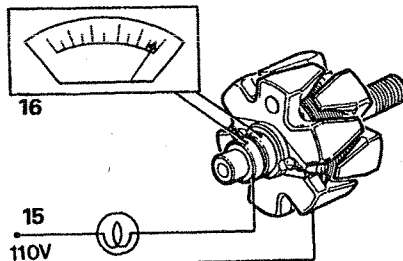
RR2219M

- 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.
- 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.
- 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.
- 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

- Clean surfaces of slip rings using a solvent moistened cloth.
- 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.
- 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

- 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.
- Check condition of bearings. If signs of rubbing between rotor poles and stator is evident, both bearings are excessively worn, and must be renewed.
- 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

- 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.
- Fit the stator and rectifier assembly to the drive end bracket in the position previously marked.
- 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.
- Fit and tighten the through bolt nuts evenly and to the correct torque.
- 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.
- Fit both suppression capacitors.
- 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
Renew regulator/brushbox assembly at	5 mm
Brush spring pressure - flush with brushbox moulding	1.3-2.7N (4.7-9.8oz)

TORQUE WRENCH SETTING

	Nm
Alternator shaft nut	50-70
Alternator through bolts	5.5
Alternator rectifier screws	3.5
Regulator/brushbox screws	2.5
Terminal nut - main output	4.0
Terminal nut - phase	4.0

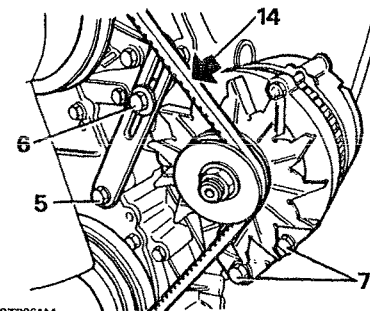
ALTERNATOR - Tdi Defender

Service Repair No. 86.10.02
Remove and refit

- Disconnect the battery.
- Remove the air cleaner, see maintenance section 10.
- Remove the intercooler top hose assembly to the inlet manifold.
- Remove the intercooler bottom hose assembly to the compressor housing.
- Slacken the adjustment strap pivot bolt.
- Remove the adjustment strap clamp bolt.
- Remove the alternator two pivot bolts.
- 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.

- Disconnect the electrical leads and remove the alternator.



ST3061M

Refitting

- Connect the electrical leads to the alternator before placing it in position on the common bracket.
- Secure the alternator with the two pivot bolts, and nuts, but leave slack at this stage.
- Fit the adjustment strap clamp bolt and leave slack.
- Fit the drive belt to the pulleys.
- 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 12 mm at the mid-point of the longest run between the pulleys.
- Tighten the adjustment strap pivot bolt and the alternator two pivot nuts and bolts.
- Reconnect the battery, run the engine and recheck the fan drive belt tension.

ALTERNATOR FUNCTIONAL CHECK

The alternator contains polarity sensitive components that could be permanently damaged if subjected to incorrect polarity.

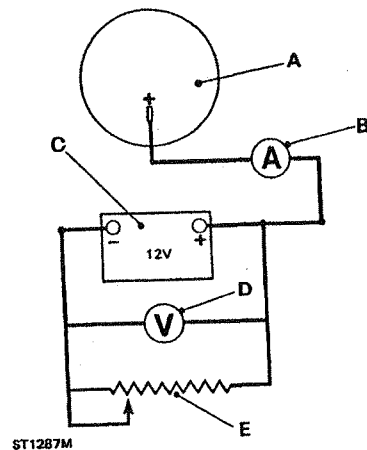
Do not connect or disconnect any part of the charging circuit - including the battery leads - while the engine is running. Run the alternator with all connections made or with the unit disconnected.

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



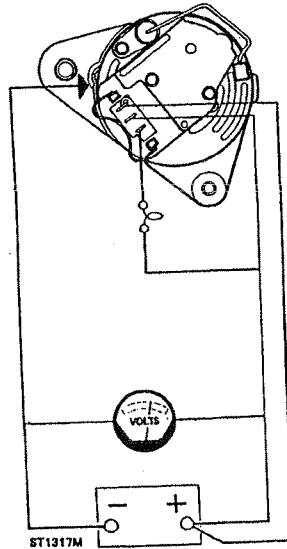
5. Do not connect the variable resistor across the battery for longer than is necessary to perform the check.
6. Run the engine.
7. Gradually increase the speed. At 1550 alternator rev/min (775 engine rev/min) the light should be extinguished.

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.



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	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

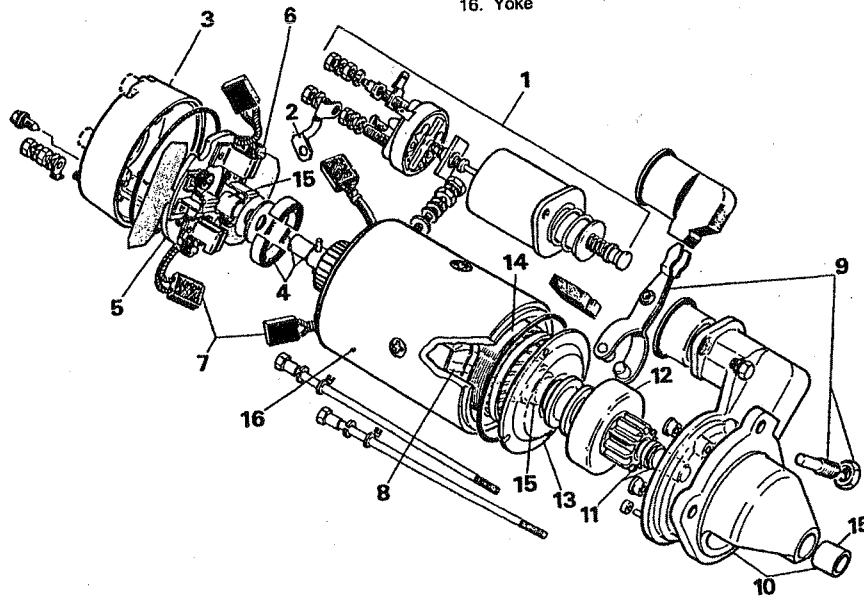
8. Withdraw the yoke assembly complete with field coils, brushes and seal (if fitted).

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.

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.
29. Finally, finish the commutator with fine emery cloth.

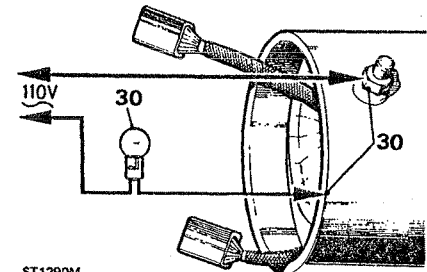
Do not undercut the commutator segments.

Insulation test

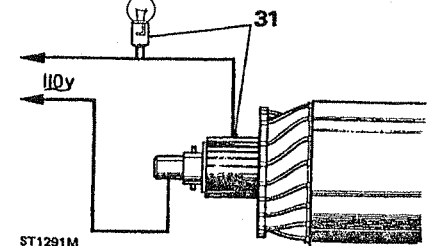
Check the insulation of the following components using a 110 V A C 15 watt test lamp:
Field coils, armature commutator and windings, insulated brush boxes.

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.

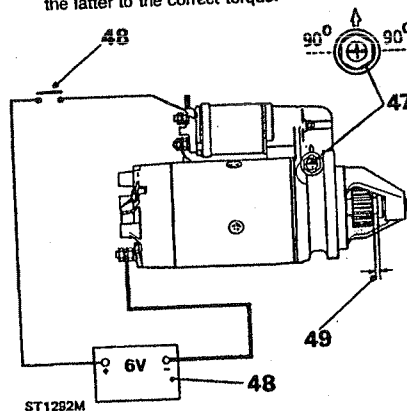
45. Check that the through bolts are aligned with the threaded holes in the drive-end bracket.

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.
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 940 A max at 6.5 V min
Torque at 1000 rev/min	14.9 Nm 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	0.145-0.165 ohms measured between small unmarked Lucar terminal and main terminal marked 'STA'.
Hold-on winding resistance	0.46 - 0.56 ohms measured between small unmarked Lucar terminal and earth point on solenoid body.

Brushgear

New brush length	22.2 mm
Renew brush at	8 mm

Armature end-float

Cast aluminium intermediate bracket.....	0.03 - 1.4 mm
Pressed steel intermediate bracket.....	0.03 - 1.55 mm

Commutator

Commutator minimum diameter	38 mm
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TIGHTENING TORQUES

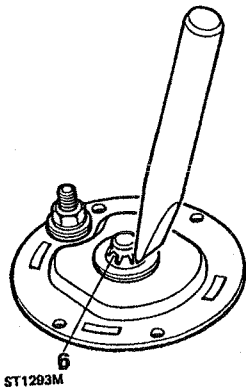
Solenoid main 'BAT' terminal cable fixing nut	3.9 Nm
Solenoid/starter link terminal fixing nuts	3.5 Nm
Solenoid end cover fixing screws	2.82 Nm
Solenoid unit fixing screws	6 Nm
Brush plate fixing screws	7 Nm
Starter earth stud, nuts	6 Nm
Pole shoe fixing screws	40.68 Nm
Through bolts	10.84 Nm
Eccentric pivot pin locknut.....	20 Nm

V8 ENGINE STARTER MOTOR (3M100PE)

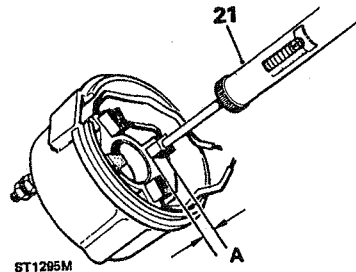
DISMANTLE TEST AND OVERHAUL

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.



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 OVERHAUL

Clutch

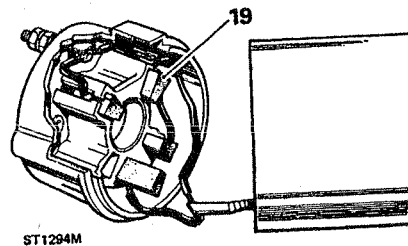
16. Check that the clutch gives instantaneous take-up of the drive in one direction and rotates easily and smoothly in the other direction.
17. Ensure that the clutch is free to move round and along the shaft splines without any tendency to bind.

NOTE: The roller clutch drive is sealed in a rolled steel cover and cannot be dismantled.

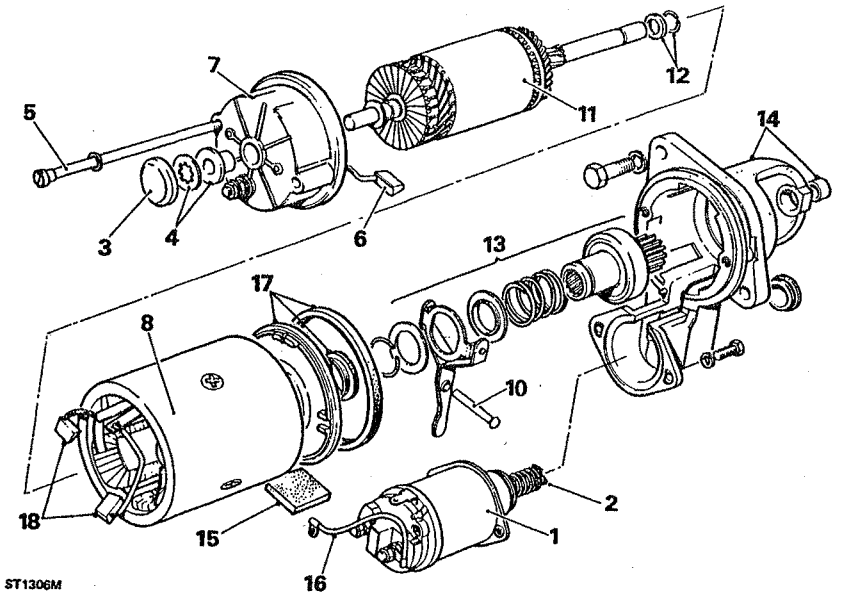
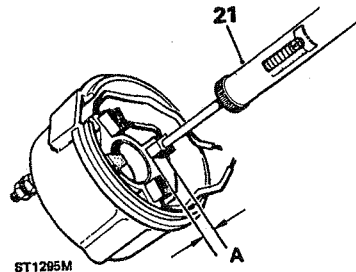
18. Lubricate all clutch moving parts with Shell SB 2628 grease for cold and temperate climates or Shell Retinax 'A' for hot climates.

Brushes

19. Check that the brushes move freely in the brush box moulding. Rectify sticking brushes by wiping with a petrol-moistened cloth.



20. Fit new brushes if they are damaged or worn to approximately 9,5 mm.
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 from the brush box moulding, dimension A, the spring pressure reading should be 1,0 kgf.

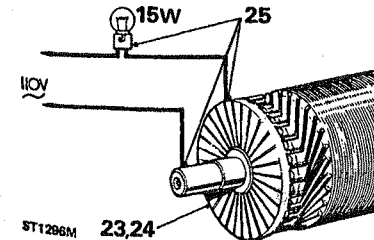


ST1306M

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 otherwise a new armature must be fitted. Do not undercut the insulation slots.

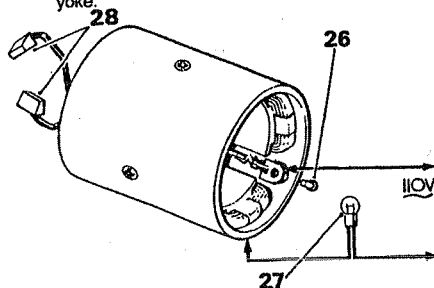


KEY TO STARTER MOTOR COMPONENTS

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

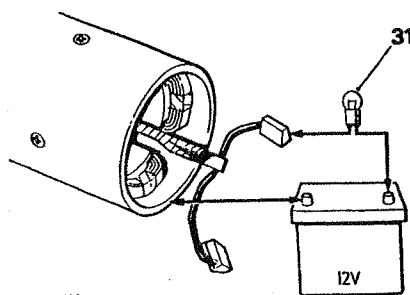
26. Disconnect the end of the field winding where it is riveted to the yoke, by filing away the riveted over end of the connecting-eyelet securing rivet, sufficient to enable the rivet to be tapped out of the yoke.
27. Connect a 110 V A C 15 W test lamp between the disconnected end of the winding and 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

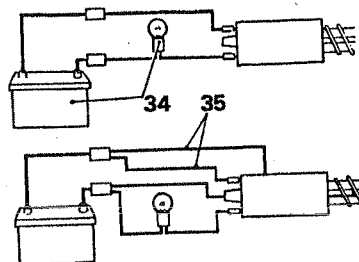
31. Connect a 12 V battery-operated test lamp between each of the brushes in turn and a clean part of the yoke.
32. The lamp should light; if it does not light, fit a new field coil assembly.



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.



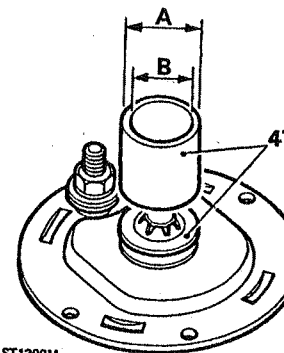
ST1298M

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.

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 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
Dimension B 19 mm



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.

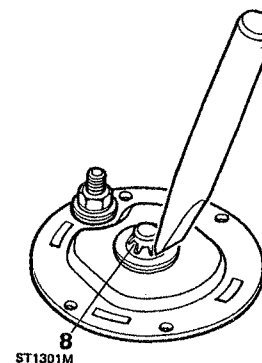
DISMANTLE TEST AND OVERHAUL

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.

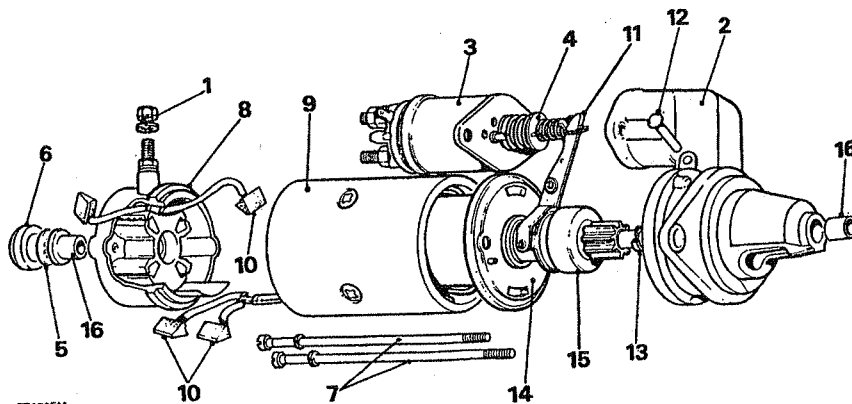
IMPORTANT: The commutator segment insulators must not be undercut.

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.

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.

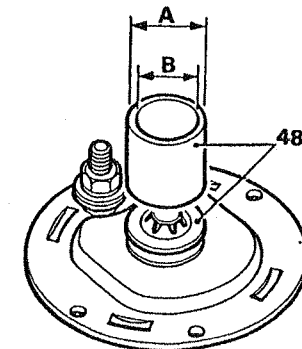
Roller clutch drive

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 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
Dimension B 19 mm



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.

TECHNICAL DATA

Brush spring tension	1,02 kg
Minimum brush length	9,5 mm
Minimum commutator thickness	3,5 mm
Lock torque	2,02 kgm with 463 amps
Torque at 1,000 r.p.m.	1,02 kgm with 300 amps
Light running current	40 amp at 6,000 rev/min (approx.)
Maximum armature end-float	0,25 mm

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
Through bolts	10 Nm
Pole-shoe screws	40 Nm
Solenoid base assembly screws	2 Nm

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.

STARTER MOTOR - Paris Rhone - 4 cylinder Diesel

Dismantle and Test

DISMANTLE

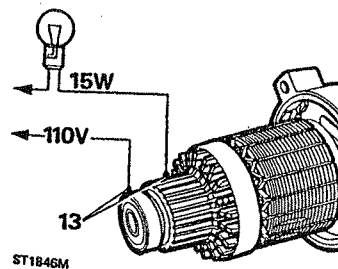
1. Remove starter motor from engine.
2. Disconnect field winding lead from the solenoid.
3. Remove the two nuts and withdraw the solenoid, and spring, leaving the plunger in place.
4. Remove the terminal strap.
5. Remove the two through-stud nuts.
6. Remove the brush plate cover.
7. Withdraw the yoke 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 and detach the solenoid plunger from the lever.
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

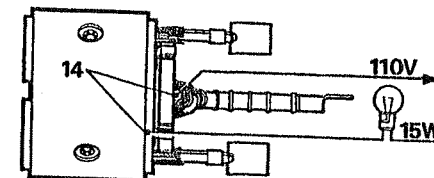
12. Using very fine glass paper, clean the commutator and wipe the surface with a petrol-moistened cloth. Do not undercut the insulation slots.
13. Check the armature insulation by connecting a 110 V.A.C. 15 W test lamp between each commutator segment in turn and the armature shaft. The lamp should not light.



ST1846M

Field coil insulation

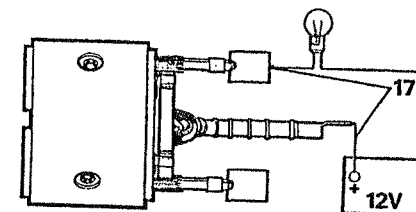
14. Connect a 110 V.A.C. 15 W test lamp between the disconnected end of the winding and a clean part of the yoke.
15. Ensure that the brushes or leads do not touch the yoke during the test.
16. The lamp should not light; if it does light, fit a new field coil assembly.



ST1847M

Field coil continuity

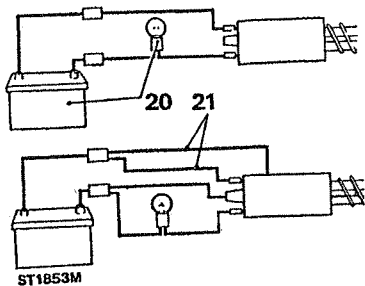
17. Connect a 12 V battery-operated test lamp between each brush in turn and a link lead.
18. The lamp should light; if it does not light, fit a new field coil assembly.



ST1848M

Solenoid

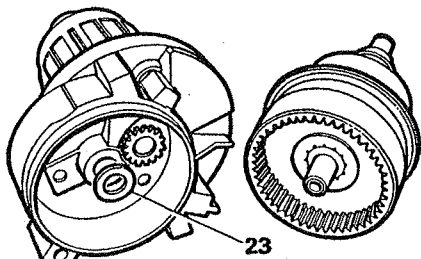
19. Disconnect all cables from the solenoid terminals and connectors.
20. Connect a 12 V battery and a 12 V 60 W test lamp across the solenoid main terminals. The lamp should not light; if it does light, fit a new solenoid complete.
21. Leave the test lamp connected and, using the same 12 V battery supply, 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.



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, locate the solenoid plunger in the end of the lever and fit the assembly 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.



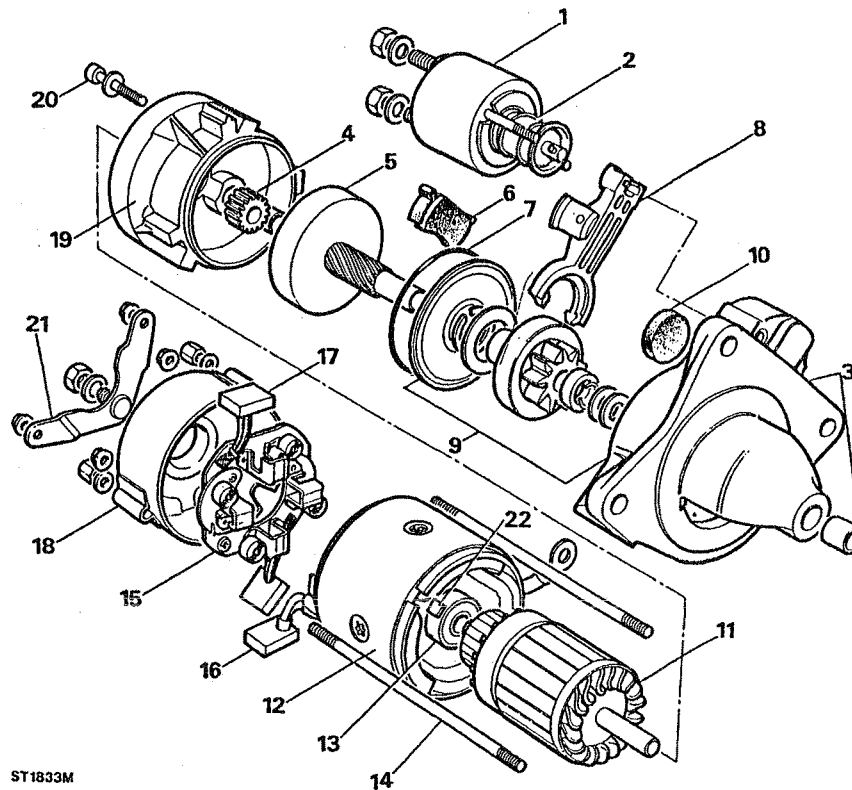
ST1849M

- 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



ST1833M

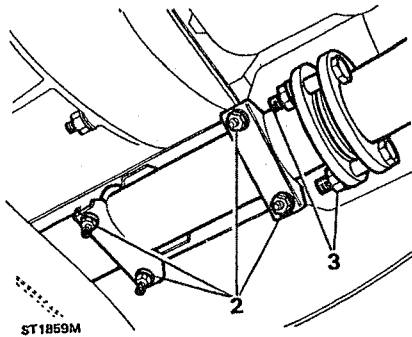
KEY TO STARTER MOTOR

- | | |
|-------------------------------------|----------------------------|
| 1. Solenoid | 13. Roller bearing |
| 2. Solenoid plunger and spring | 14. Through-studs |
| 3. Drive-end bracket and bush | 15. Brush plate |
| 4. Reduction gear pinion | 16. Field coil brushes |
| 5. Reduction gear | 17. Armature brushes |
| 6. Rubber pad | 18. Brush plate cover |
| 7. 'O' ring seal | 19. Reduction gear housing |
| 8. Lever | 20. Socket-headed screw |
| 9. Clutch drive and pinion assembly | 21. Terminal strap |
| 10. Rubber pad | 22. Yoke location key |
| 11. Armature | |
| 12. Yoke | |

STARTER MOTOR - Paris Rhone, Turbo charged 2.5 Diesel engine.

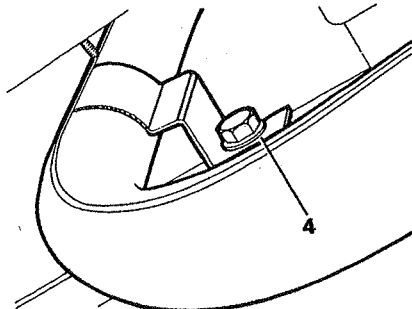
Removing

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.



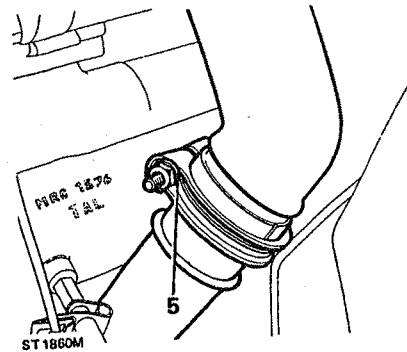
ST1859M

4. Remove the bolt securing the front downpipe to the cylinder block.

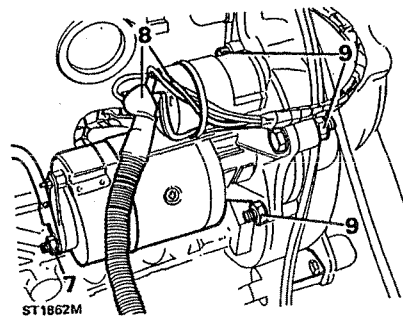


ST1861M

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.



ST1862M

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.

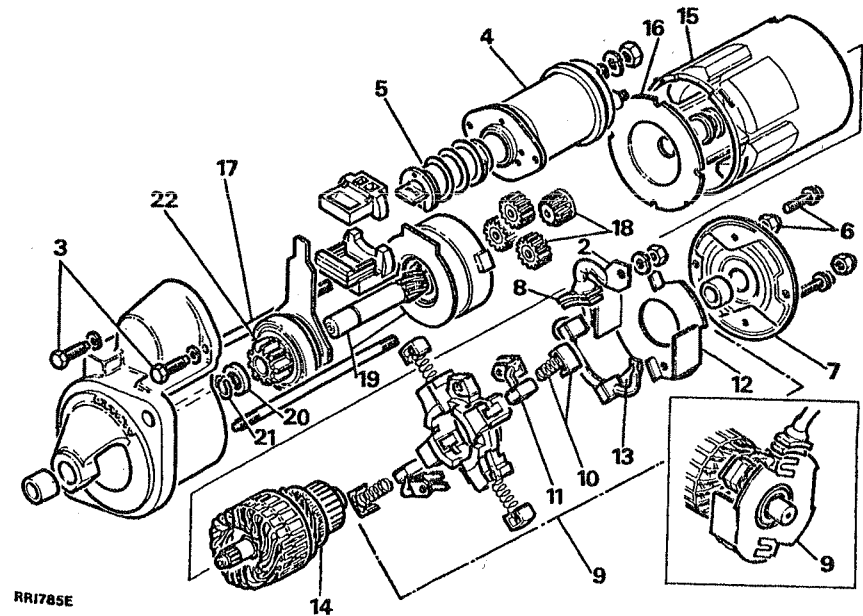
STARTER MOTOR - Lucas M78R - V8 Engine.

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.

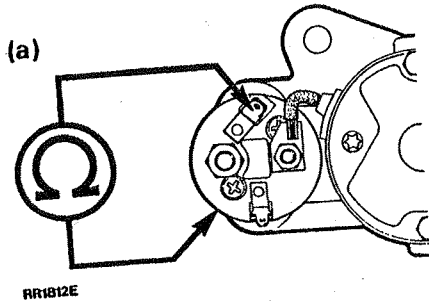


RR1785E

Inspecting

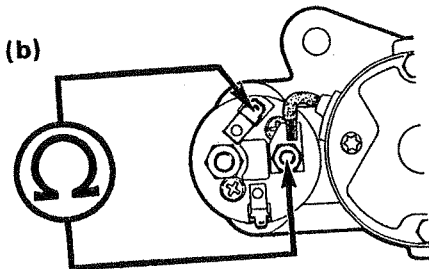
Solenoid

23. Check the continuity and resistance value of windings by connecting an ohmmeter as shown.



RR1812E

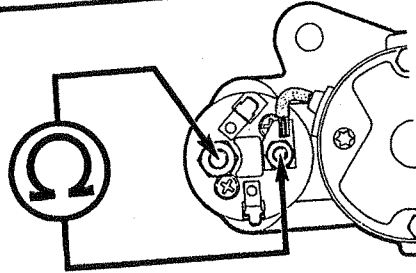
(a) Resistance value should be: 1.074 ± 0.035 ohms



RR1813E

(b) Resistance value should be: 0.298 ± 0.015 ohms

If test results are unsatisfactory replace the solenoid.
If results are correct proceed to 24.
24. Check the contacts by connecting an ohmmeter as shown. Solenoid plunger removed, ohmmeter should read infinity.



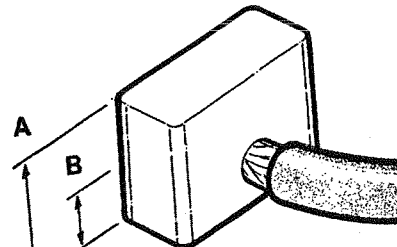
RR1814E

Solenoid plunger operated by hand, ohmmeter should read zero.
If test results are unsatisfactory, replace the solenoid.
If results are correct proceed to 25.

25. Check operation of spring for freedom of movement.

Brush gear

26. Check brush springs and ensure that the brushes move freely in their holders. Clean the brushes with a petrol moistened cloth, if required.

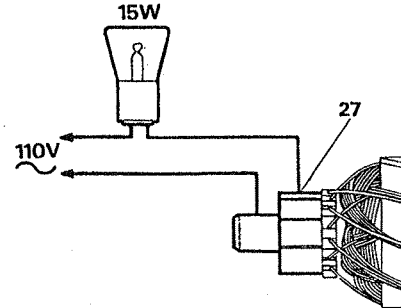


RR1815E

Brush length new, Dimension A is 9 mm.
Minimum brush length, Dimension B is 3.5 mm.

Armature

27. Check the armature insulation using suitable test equipment. Connect the tester between any one commutator segment and the shaft. The method illustrated uses a 110 V, 15 W test lamp. If the lamp illuminates the armature is faulty, and a replacement component is required.



RR1827E

28. If necessary, the commutator may be machined, providing a finished surface can be obtained without reducing the diameter below 28.8 mm otherwise a new commutator must be fitted. Finish the surface with fine emery cloth. Do not undercut the insulation slots.

Drive assembly

29. Test the roller clutch. The pinion should rotate in one direction only, independent of the clutch body. Replace the unit if unsatisfactory or if teeth are damaged or worn.

Bearings

30. Renew the bearing bushes if there is evidence of armature fouling magnets or if there is perceptible side play between the shaft and bush.
31. Drive end/intermediate end bracket: press out the bush using a suitable press and mandrel.
32. Press the new bush in, ensuring that on the drive end bracket, the bush is flush with the casting.

33. Commutator end bracket; thread a 9/16 Whitworth or suitable similar tap firmly into the bush. Extract the bush with the tap using a power press in reverse.

NOTE: Soak new bushes in engine oil for thirty minutes before fitting.

Reassembly

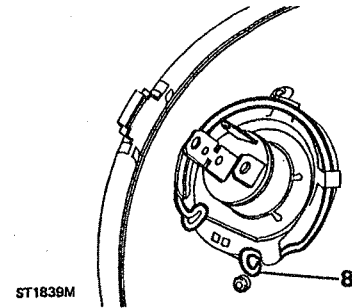
34. Reverse the instructions 1 to 22. Smear the teeth and operating collar of the roller clutch with Shell Retinax 'A' grease. Smear the pivot lever of the drive assembly with Mobil 22 grease. Smear the drive shaft sun and planet gears with Rocol BRB1200 grease.
35. Tighten all the fixings to the correct torque - see Torque Wrench Settings.

REMOVE AND OVERHAUL HEADLAMPS

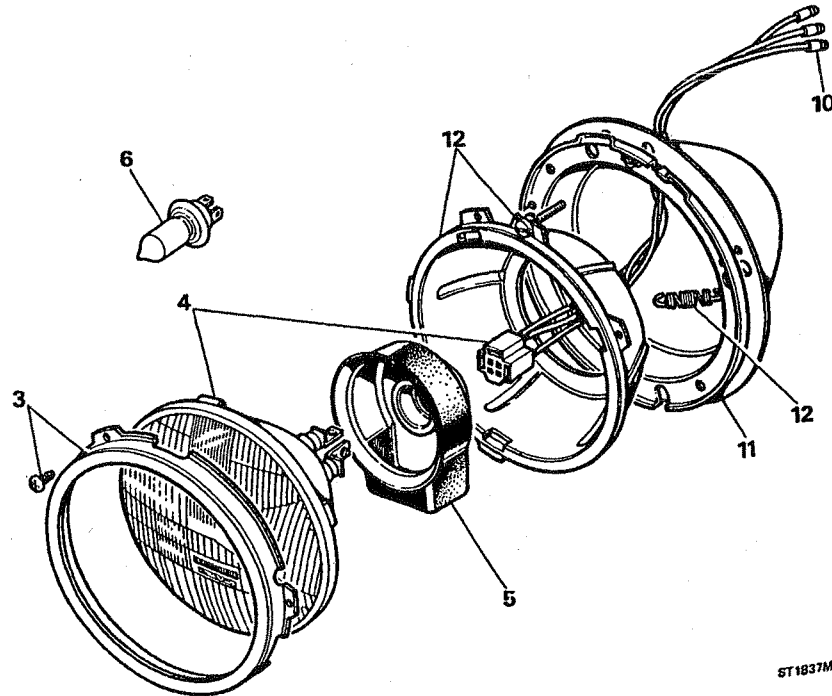
Remove and dismantle

NOTE: Instructions 1 to 8 cover renewal of the bulb or light unit only.

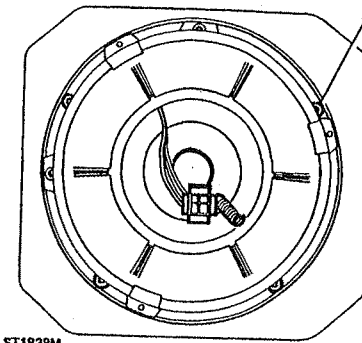
1. Disconnect the battery for safety.
2. Remove the six screws and remove the plastic bezel surrounding the head, side and flasher lamps.
3. Remove the three screws retaining the rim and light unit, and remove the rim.
4. Withdraw the light unit or reflector and pull-off the electrical connector.
5. 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.



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.



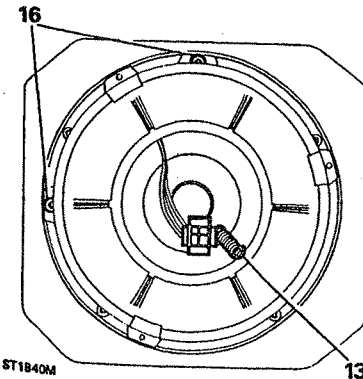
ST1837M



ST1838M

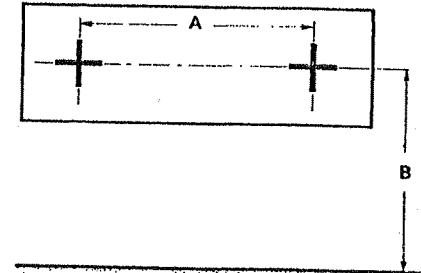
Assemble and refit

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.



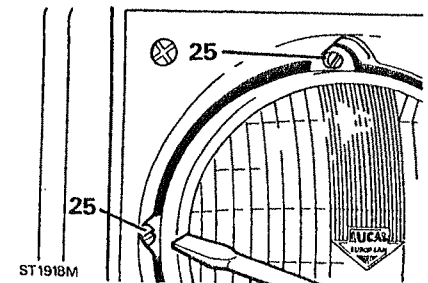
ST1840M

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.



ST11719M

25. Switch-on the main beam and adjust the setting as necessary with the trimmer screws.

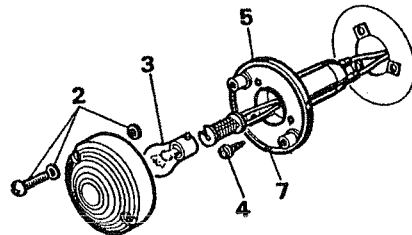


ST1918M

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.
5. 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.
6. If necessary remove the rubber bulb holder cover.



ST1841M

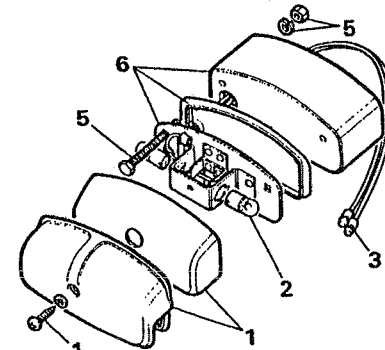
Refitting lamp and bulbs

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

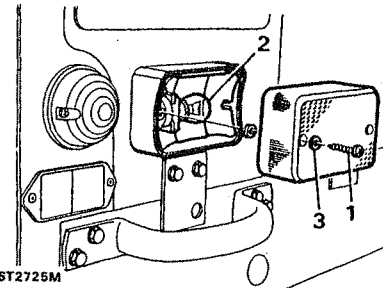
Refitting lamp and bulbs

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.

REVERSE AND FOG GUARD LAMP

Renew bulb

1. Remove the two screws securing the lens to the lamp body.
2. Release the bulb from the holder and clean the interior of the lamp and lens. Fit a new bulb of the correct wattage to the holder.
3. Fit the lens and secure it to the lamp body with the two screws and sealing washers.

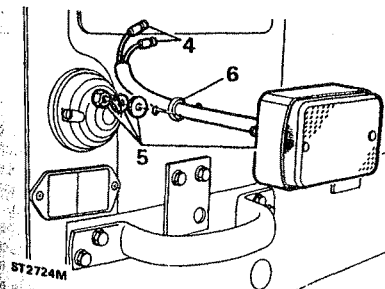


ST2725M

Renew the lamp

The lamp is secured to the vehicle by two nuts and is accessible from beneath the vehicle. A mud flap protects the lamp fixing and cable.

4. Lift the mud flap and separate the lamp cable bullet connectors from the harness.
5. Remove the two nuts and washers and withdraw the lamp complete with the cable assembly from the vehicle.
6. To fit the lamp, feed the cable through the hole in the body and secure with the two nuts and connect the lamp cable to the vehicle harness.



ST2724M

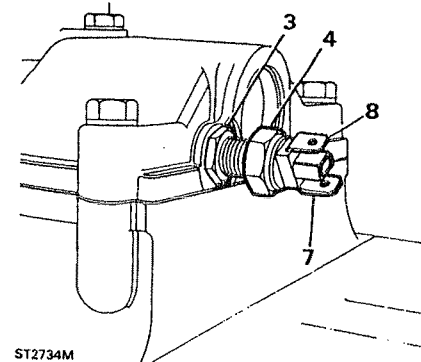
REVERSE LIGHT SWITCH

Remove and refit

The reverse light switch for the LT77 gearbox is located at the rear of the gear change housing and is accessible from underneath the vehicle. Later gearboxes, from VIN No. 414649, are fitted with non-adjustable switches. Loctite thread locking fluid should be used when fitting this switch.

Removal

1. Disconnect the battery negative lead.
2. Disconnect the electrical leads from the reverse switch.
3. Release the locknut securing the switch.
4. Unscrew the switch from the gear selector housing.



ST2734M

Refitting

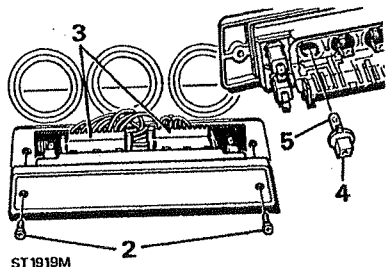
NOTE: The reverse light switch will require re-setting on reassembly.

5. Select reverse gear.
6. Loosely assemble the reverse light switch to the gearbox selector housing.
7. Connect a 12-volt supply to either of the switch terminals.
8. Connect a test lamp to the remaining terminal.
9. Screw the switch into the housing until the test lamp illuminates; then turn the switch a further half-turn. Use Loctite 290 on threads of non-adjustable switch and tighten to 12 Nm.
10. Secure with the locknut ensuring that the switch is not rotated.
11. Remove the test lamp and reconnect the switch electrical leads.
12. Connect the battery negative lead.

WARNING LAMPS

Renew the bulbs

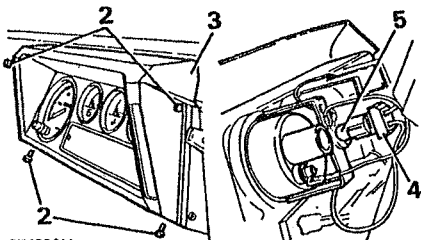
1. Disconnect the battery.
2. Remove two screws and withdraw the warning light module from the front of the instrument panel.
3. Pull off the plug connector to give access to warning light bulbs.
4. Twist the bulb holder and pull it from its socket.
5. Pull the bulb from the holder.
6. Fit a new bulb and refit the holder and plug connector.
7. Refit the module.
8. Connect the battery.



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.

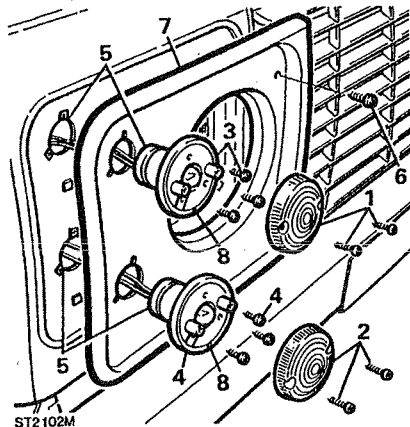


ST1920M

HEADLAMPS - 1988 Model Year onwards

To remove or renew bulb or light unit

1. Remove the two screws and withdraw the front side lamp lens.
2. Similarly, 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 headlamp retaining screws.



ST2102M

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 on page 48.

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.

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 in length, fit a new brush gear assembly.
15. Using a push type gauge, check that the brush spring pressure is 140 to 200 g when the bottom of the brush is level with the bottom of the slot in the brush box. Fit a new brush gear assembly if the springs are not satisfactory.
16. Test the armature for insulation and open- or short-circuits. Use a 110 V 15 W test lamp. Fit a new armature if faulty.
17. Examine the gear wheel for damage or excessive wear.

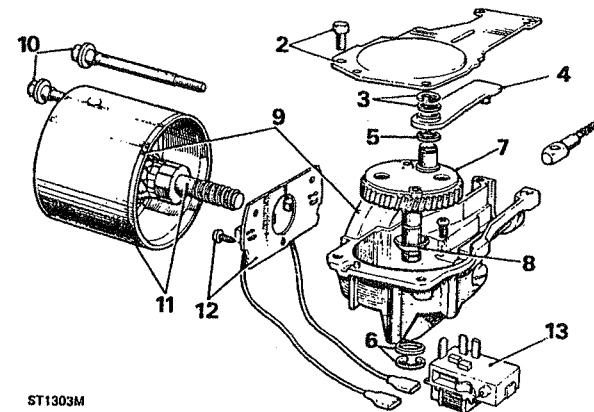
ASSEMBLE

Use Ragosine Listate Grease to lubricate the gear wheel teeth, armature shaft worm gear, connecting rod and pin, cable rack and wheelbox gear wheels. Use Shell Turbo 41 oil sparingly to lubricate the bearing bushes, armature shaft bearing journals, gear wheel shaft and wheelbox spindles. Thoroughly soak the felt washer in the yoke bearing with oil.

18. Fit the limit switch.
19. Fit the brush gear assembly.

KEY TO WIPER MOTOR COMPONENTS

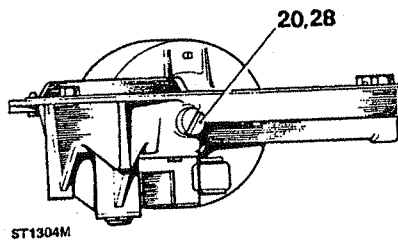
1. Flexible drive
2. Gearbox cover
3. Connecting-rod retaining washer and circlip
4. Connecting-rod
5. Flat washer
6. Gear shaft retaining washer and circlip
7. Drive gear
8. Dished washer
9. Alignment marks - yoke to body
10. Yoke securing bolts
11. Armature and yoke
12. Brush gear assembly
13. Limit 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. 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.



DATA

Windscreen wiper motor Armature end-float	0,1 to 0,2 mm
Brush length, minimum	4,8 mm
Brush spring tension	140 to 200 g
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
Speed, 60 seconds from cold - High speed	65 ±5 rev/min

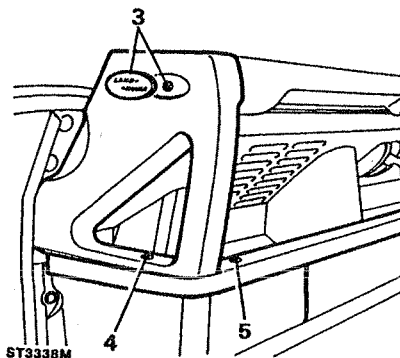
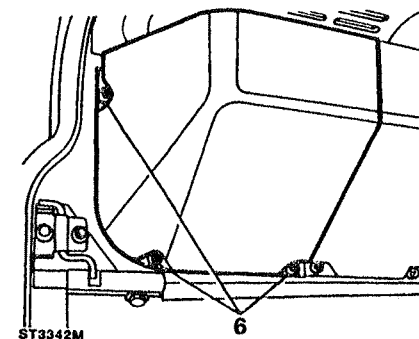
RENEW WIPER MOTOR AND DRIVE RACK - left and right hand drive vehicles

Removing wiper motor

1. Disconnect the battery.
2. Remove the wiper arms.

NOTE: The following instructions 3 to 5 concern right hand drive vehicles only.

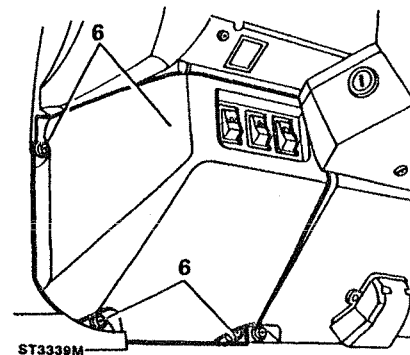
3. Prise the Land Rover motif from the grab handle and remove the screw behind it.
4. Remove the screw from inside the handle and withdraw the handle upwards.
5. Remove the retaining screws and finisher.



6. Remove the three screws to release the fascia lower panel to expose the wiper motor.

NOTE:

First illustration, right hand drive.
Second illustration, left hand drive.

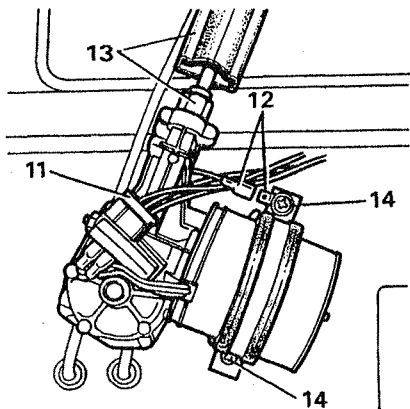


7. Disconnect the multi-plug from the wiper motor.
8. Disconnect the wiper motor earth lead.
9. Lift the rubber sleeve and slacken the wiper motor to drive tube nut.
10. Remove two screws to remove the wiper motor retaining strap.
11. Finally, release the tube nut.
12. Pull the wiper motor and drive rack clear of the tube and retrieve mounting pad and earth tag.

RENEW WIPER MOTOR AND DRIVE RACK - air conditioned left-hand drive

Removing wiper motor

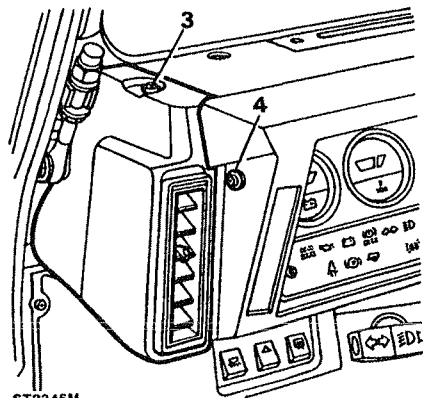
1. Disconnect the battery.
2. Remove the wiper arms.
3. Remove the single screw and remove the fascia side panel.
4. Remove the five screws and withdraw the instrument panel as far as possible without straining the wires and cables.



ST3341M

Fitting wiper motor

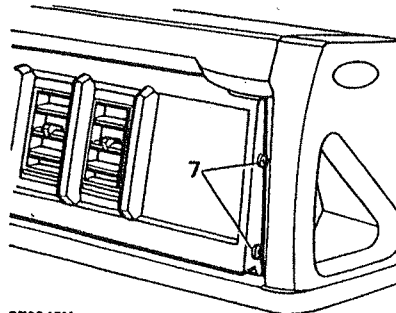
13. Feed the wiper motor drive rack into the tube until fully seated.
14. Loosely fit the drive tube securing nut.
15. Fit the wiper motor securing strap, earth tag and mounting pad. Align the motor and tighten fixing screws.
16. Tighten the tube nut and fit rubber sleeve.
17. Connect the earth lead and multiplug.
18. Before fitting panels, fit the wiper blades, connect the battery and test operation of the wiper motor and drive assembly and if necessary adjust position of wiper blades.
19. Fit the fascia lower panel.
20. Fit the finisher and grab handle - right hand drive vehicles only.



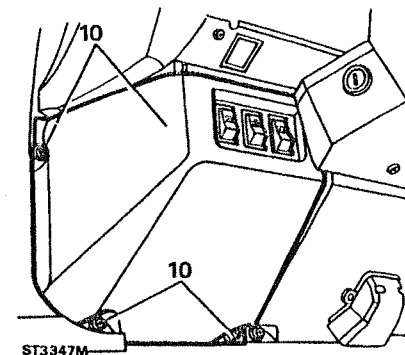
ST3346M

5. Remove the single screw securing steering wheel centre pad.
6. Turn steering wheel to straight ahead position and mark the relationship of the steering wheel to the column and remove the nut. Withdraw the wheel using special tool 18G 1014 or a suitable alternative puller.

7. To remove the air conditioning panel and controls, remove the two screws at the right hand side of the panel and the single screw at the left-hand side, inside the instrument cowl.



ST3345M



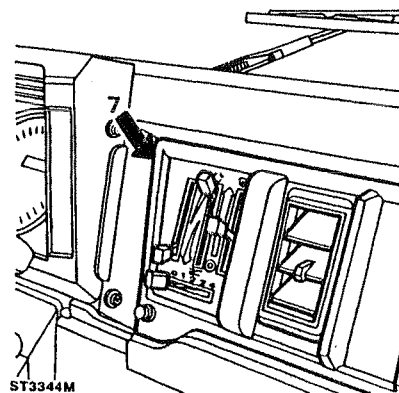
ST3347M

NOTE: See illustration ST3341M for the following instructions 11 to 15.

11. Disconnect the wiper motor wiring multiplug.
12. Remove earth lead.
13. Lift rubber sleeve from wiper motor and slacken wiper motor to drive tube nut.
14. Remove the wiper motor retaining strap screws and remove strap together with mounting pad and earth tag.
15. Pull the wiper motor and drive rack clear of the drive tubes.

Fitting wiper motor

16. Feed the drive rack into the drive tube until fully located in the wheel boxes.
17. Finger tighten the drive tube nut.
18. Position the motor mounting pad and secure the assembly with the strap and screws not forgetting the earth tag.
19. Tighten the drive tube nut and position the rubber sleeve over the nut.
20. Connect the multiplug to the motor and the earth lead to the tag on motor retaining strap.
21. Before fitting the fascia panels, fit the wiper blades, connect the battery and test the wiper operation.
22. Refit the fascia panels noting that the air conditioning panel must be located and secured, on the left side, with the single screw, before the instrument panel is fitted.
23. Fit the steering wheel ensuring that the marks made during removal coincide. Fit and tighten the securing nut to the correct torque.
24. Fit the steering wheel centre pad with the single screw.



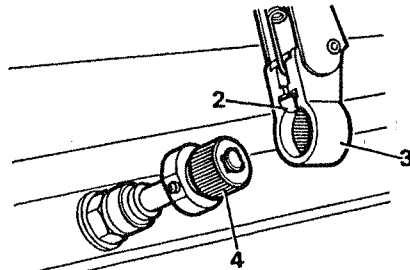
ST3344M

8. Release the fascia panel left-hand support bracket.
9. Remove fascia lower panel finisher.
10. Remove fascia lower panel.

RENEW WINDSCREEN WIPER ARMS

Remove

1. Pull the wiper arm away from the windscreen.
2. using a small screwdriver, hold back the spring clip which retains the arm to the spindle adaptor.
3. Pull the wiper arm from the splined adaptor.



ST3340M

Fitting new arm

4. Switch the wiper motor to the 'park' position with the grub screw, retaining the adaptor, uppermost.
5. Push the arm on to the adaptor so that the wiper blade is just clear of the windscreen surround rubber.
6. Operate the wipers and if necessary adjust the position of the arms.

RENEW WINDSCREEN WIPER WHEELBOXES - air conditioned vehicles

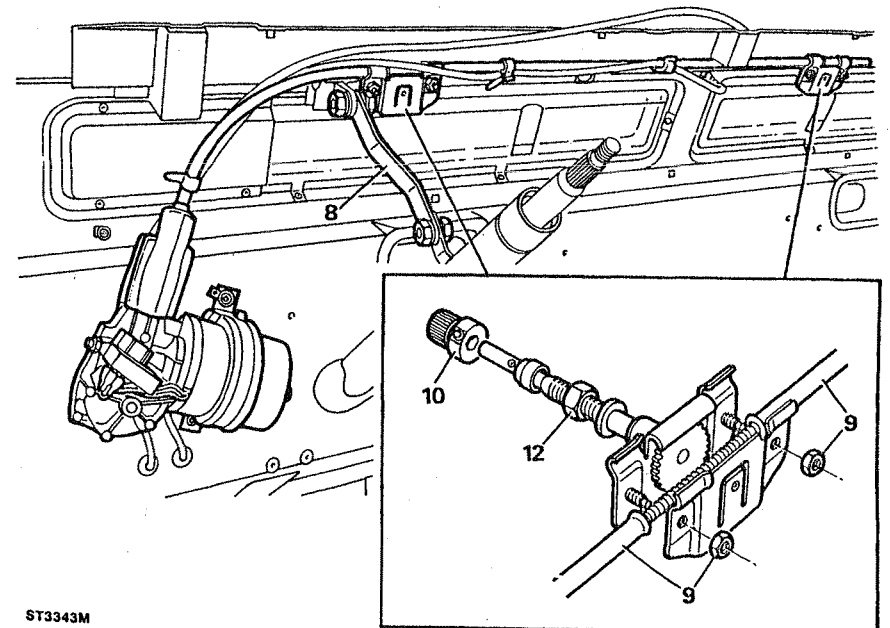
Remove

1. Disconnect the battery.
2. Carry-out the instructions to remove the wiper motor and drive rack for air conditioned vehicles, that is:
Wiper arms
Fascia side panel
Instrument housing
Fascia top crash rail
Steering wheel
Fascia panel air conditioning controls
Wiper motor and drive rack
3. Remove centre and left-hand fascia top crash rail support bracket fixings.
4. Remove left and right-hand demister vents from ducts.
5. Remove right-hand demister vent hose from duct.

6. Remove right-hand vent demister vent fixing and pivot vent and hose aside.
7. Remove demister vent top duct.
8. Release the steering column upper and lower support rods.
9. Slacken the left and right-hand wheelbox nuts and remove drive tubes from wheelboxes.
10. Remove wiper arm splined adaptor.
11. Remove spacer, where fitted, early vehicles only.
12. Remove nuts securing left and right-hand wheel boxes and withdraw wheelboxes from bulkhead.

Fitting wheelboxes

NOTE: It is important that during the following assembly the fixings related to the wiper motor and wheelboxes are finger tightened only until all the components are correctly aligned.



ST3343M

13. Fit the wheelboxes to the bulkhead and loosely secure with the nut and washer.
14. Loosely fit the drive tubes to the wheelboxes.
15. Feed the drive rack through the tubes until fully seated in both wheelboxes.
16. Loosely secure drive tube nut to wiper motor.
17. Loosely fit the wiper motor strap and earth lead.
18. When all components are correctly aligned, tighten the wheelboxes nuts to secure the drive tubes. Tighten the wheelbox to bulkhead nuts.
19. Finally tighten the drive tube nut to wiper motor and motor strap screws.
20. Connect the multiplug to wiper motor and earth lead to strap tag.
21. Fit the spacer, where used, early vehicles only.
22. Fit the wiper arm adaptors.
23. Connect the battery and check the operation of the motor and drive assembly and wheelboxes.
24. Disconnect the battery and reverse instructions 2 to 10. Ensure that the steering column upper and lower support rod fixings are tightened to the correct torque.
25. Reconnect the battery and check wiper operation again and adjust arms if necessary.

RENEW WINDSCREEN WIPER WHEEL BOXES - non air conditioned vehicles

1. Disconnect the battery.
2. Remove the wiper arms.
3. Carry out the instructions to remove the wiper motor and drive.
4. In addition, remove the instrument housing, fascia top crash pad, and ventilator grille panel.

Refer to illustration ST3343M for air conditioned vehicles, for the remaining instructions.

5. Slacken steering column support rod lower fixing.
6. Remove steering column upper support fixing.
7. Slacken the nuts to release the back plates from the left-hand and right-hand wheel boxes.
8. Remove the drive rack tubes.
9. Slacken the grub screws and remove the wiper arm adaptors.
10. Remove the spacer, where fitted, early vehicles only.
11. Remove the left-hand and right-hand wheelbox spindle nuts.
12. Remove the wheel box assemblies from the vehicle.

Fitting wheelboxes

NOTE: It is important that during the following assembly the fixings related to the wiper motor and wheelboxes are finger tightened only until all the components are correctly aligned.

13. Fit the wheelboxes to the bulkhead and loosely secure with the retaining nuts and washers.
14. Fit the drive rack tubes to the wheelboxes and 'nip' tubes by loosely tightening the four back plate nuts.
15. Apply grease to the wheelboxes and feed a greased drive rack through tubes into wheelboxes until fully home.
16. Align the wiper motor and mounting pad and secure with the strap and tighten the drive tube nut.
17. Tighten the wheelbox back plate nuts.
18. Tighten both wheelbox spindle nuts.
19. Fit spacers, where used, early vehicles only.
20. Fit the wiper arm adaptors and secure with grub screw.
21. Before refitting the panels fit the wiper blades, connect the multiplug and earth lead, connect the battery and check the wiper operation.
22. If satisfactory, secure the steering column upper and lower fixings and tighten to the correct torque.
23. Refit the fascia panels removed necessary to gain access to the wiper motor and wheelboxes.

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

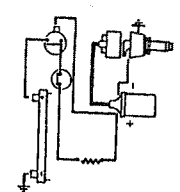
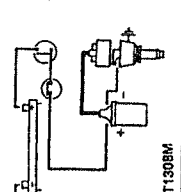
ABBREVIATIONS

A	Amperes	%	Percentage
L T	Low tension	in	Inch
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		

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 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	Clean, renew as necessary						
		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. <table border="1"> <tr> <td>Climate normally below 25°C</td> <td>Climate normally above 25°C</td> </tr> <tr> <td>(i) 1.260-1.280</td> <td>Battery full charged</td> </tr> <tr> <td>(ii) 1.230-1.250</td> <td>Battery 70% charged</td> </tr> <tr> <td>(iii) 1.110-1.230</td> <td>Battery discharged</td> </tr> </table> (iv) A variation of 0.040 between cells indicates a suspect battery For every 10°C below 15°C subtract 0.007. For every 10°C above 15°C add 0.007.	Climate normally below 25°C	Climate normally above 25°C	(i) 1.260-1.280	Battery full charged	(ii) 1.230-1.250	Battery 70% charged	(iii) 1.110-1.230
Climate normally below 25°C	Climate normally above 25°C								
(i) 1.260-1.280	Battery full charged								
(ii) 1.230-1.250	Battery 70% charged								
(iii) 1.110-1.230	Battery discharged								
		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 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 charger, measure overall voltage and 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. (ii) Battery voltage below 15.5 V, inter cell voltage variation less than 0.15 V - Battery satisfactory but discharged. (iii) Battery voltage above 15.5 V, inter cell voltage variation less than 0.15 V - Battery discharged and may be sulphated.	Carry out Test 4 Renew battery Charge battery Charge battery and re-test						

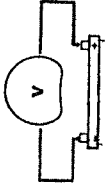
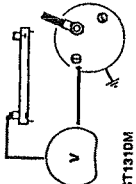
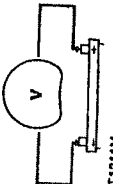
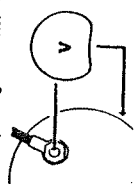
Fault	Check	Test	Rectification
Battery not being charged CAUTION: The vehicle battery must never be disconnected while the engine is running. Warning light stays on Warning light does not function when ignition switched on TEST EQUIPMENT Voltmeter 0-20 V moving coil Ammeter 5-0-50A moving coil Hydrometer	1, 2, 3, 4, 5 1, 2, 3, 4, 5 1, 2, 3, 4, 8, 9 10, 11, 12, 13, 14, 15	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. (i) Ammeter reading Zero - Fault alternator (ii) Ammeter reading below 10A, voltmeter reading between 13.6 and 14.6 V and battery in low state of charge (iii) Ammeter reading below 10A, voltmeter reading below 13.6V (iv) Ammeter reading above 10A, voltmeter reading above 14.6 V 6. Drive belt: Check the drive belt is not broken or slipping 7. IND lead: (i) Disconnect the IND lead from the alternator, start engine and run above idle speed. (ii) Warning light stays on - short circuit to earth between IND lead and warning light (iii) Warning light goes out 8. Warning light bulb: (i) Check warning lamp bulb (ii) Bulb faulty (iii) Bulb not faulty 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 (ii) Voltmeter does not read 12V - cable circuits faulty	Overhaul alternator Bench test and overhaul Renew voltage regulator Renew voltage regulator Adjust or renew Repair or renew Carry out Test 5 Renew Carry out Test 9 Carry out Test 5 Check cable continuity; repair or renew
		10. Engine cranking speed: Too low 11. Sparking plugs: Check for dirty electrodes or incorrect gaps and for fault operation on pressure test equipment 12. Contact breaker points: Check for incorrect gap, burning or pitting 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	See STARTING SYSTEM Clean, set gaps or renew contact breaker distributors carry out Test 12 Clean, adjust or renew Rectify or replace. Carry out Test 14.

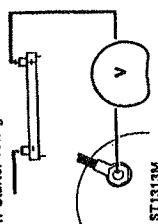
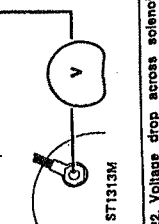
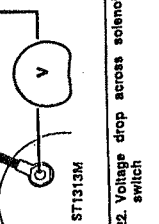
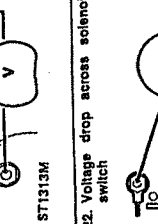
Fault	Check	Test	Rectification
IGNITION SYSTEM		a. Connect 0-1 V voltmeter as in Test 15b, fit a jumper lead from earth to distributor body, with ignition on and contact breaker points closed.	Remake earth connections between distributor body and earth Check/repair or renew contact breaker points, base plate screws earth lead or supply lead as necessary Carry out Test 15g Carry out Test 15f Carry out Test 15i Check contact breaker points correctly fitted, adjust coil in condenser (or capacitor) lead, ballast resistor (fitted) or supply lead; repair or renew carry out Test 15g Renew coil Fault elsewhere Rectify and recheck Carry out Test 14h Repair or renew lead then re-test Carry out Test 15j Renew and re-test. If satisfactory Rectify and re-test. If satisfactory fault elsewhere
		(i) Below 0.2V	
		(ii) Above 0.2V - High resistance or open circuit in distributor	
		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	
		(ii) Zero - open circuit lead to coil, open circuit primary windings, open circuit ballast resistor if fitted or short circuit in distributor or coil negative lead	
		c. Connect 0-20 V voltmeter 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	
		(ii) Zero - reconnect coil negative lead	
		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	
		(ii) 11.5-12 V without ballast resistor 5V - 7V with ballast resistor if result of Test 15i was above 12V L.T. circuit is satisfactory	
		(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.	
		(iv) Below 5V or zero with ballast resistor - Excessive resistance or open circuit in supply to coil	
		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 - or above 12V - Fault in the ballast resistor to coil lead			
(ii) Below 5V or zero - Excessive resistance or open circuit between battery and coil			
f. Connect 0-20 V voltmeter between earth lead lead to ballast resistor, with ignition on and contact breaker points closed:			
(i) Above 12V - Fault in ballast resistor 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			

Fault	Check	Test	Rectification
IGNITION SYSTEM		14. H.T. Circuit	Carry out test 14e Carry out Test 14b Renew main H.T. lead, carry out Test 14e Carry out Test 14d Renew condenser. Carry out Test 14e Carry out Test 14c Renew coil, refit original H.T. lead and condenser and repeat Tests 14a and b, or carry out Test 14e Renew rotor arm Carry out Test 15 See STARTING SYSTEM Carry out Test 15e Carry out Test 15c Renew lead Carry out Test 15d
			
		a. Disconnect main H.T. lead from distributor cap, rod approximately 6 mm 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	
		(ii) Poor or no spark	
		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	
		(ii) Poor or no spark	
		c. Replace condenser with a known good one and repeat Test	
		(i) Good healthy spark - Original condenser faulty	
		(ii) Poor or no spark	
		d. Replace ignition coil with a known good coil and repeat Test	
		(i) Good healthy spark - original coil faulty	
			
		15. L.T. circuit continuity check:	
a. Check battery voltage and state of charge			
b. Connect voltmeter 0-1V between earth and coil negative terminal with ignition on and contact breaker points closed.			
(i) Below 0.2V			
(ii) Above 0.2V - resistance or open circuit			
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			
(ii) Above 0.2V - Resistance or open circuit between earth and distributor L.T. terminal			

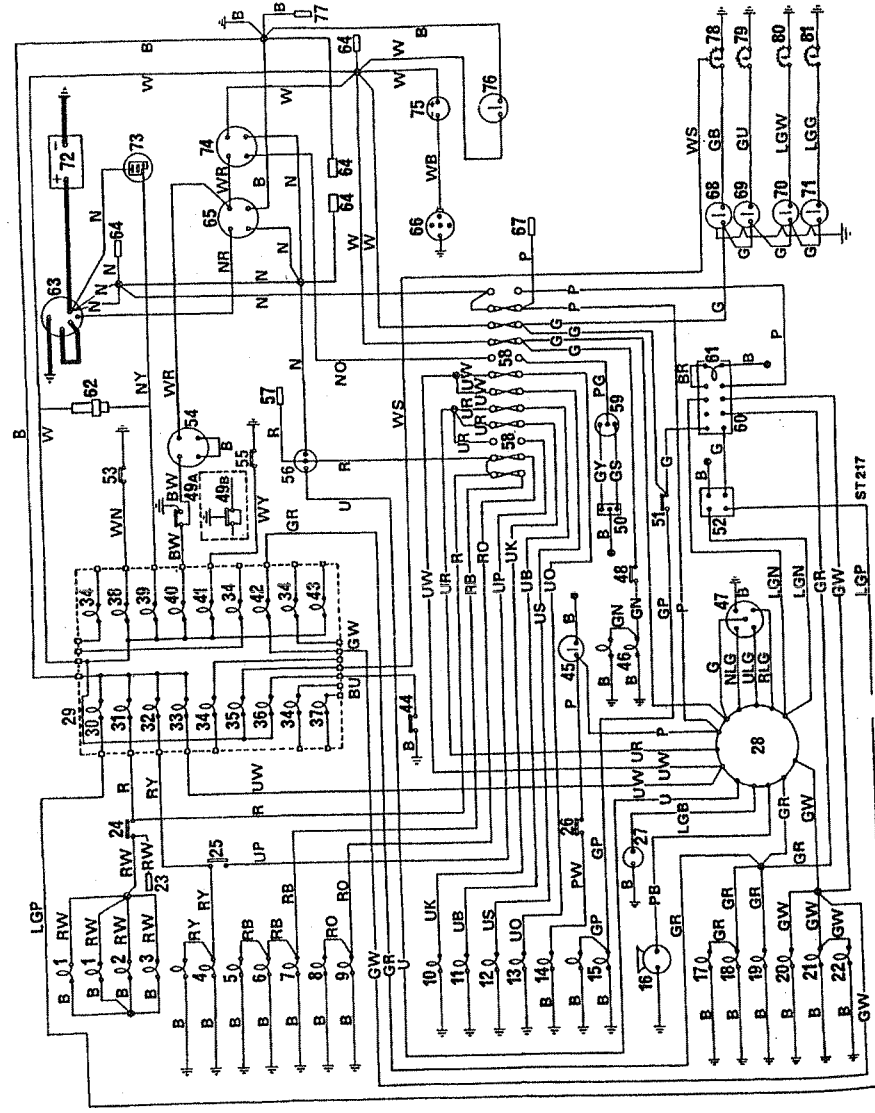
TEST EQUIPMENT
Voltmeter 0-20 V moving coil
Voltmeter 0-1 V moving coil
Ohmmeter

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 (ii) Above 0.2V - High resistance or open circuit in distributor	Remake earth connections between distributor body and earth Check/repair or renew contact breaker points, brass jumper screws, earth lead or supply lead as necessary Carry out Test 15g Carry out Test 15f
		e. Connect voltmeter (A) as in Test 15b, with ignition on and contact breaker points open: Above 12V - Continuity in primary windings or coil, supply line and ballast resistor, if fitted (i) Zero - open circuit lead to coil, open circuit primary windings, open circuit ballast resistor if fitted or short circuit in distributor or coil -ve lead. (ii) Connect voltmeter (A) as in Test 15b, with ignition on and contact breaker points open. Remove coil -ve lead from coil and recheck voltage. (iii) Above 12V - Short circuit in coil, -ve lead or distributor	Check contact breaker points correctly fitted, short circuit when in contact with coil or distributor (if fitted) or supply lead; repair or renew Carry out Test 15g
		(ii) Zero - reconnect coil -ve lead	Renew coil
		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	Fault elsewhere Rectify and recheck
		(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	Carry out Test 15h
		(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. (iv) Below 5V or zero with ballast resistor - Excessive resistance or open circuit in supply to coil	Repair or renew lead then re-test Carry out Test 15j
		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 (ii) Below 5V or zero - Excessive resistance or open circuit between battery and coil	Renew and re-test. If satisfactory fault elsewhere
		i. Connect voltmeter (A) between earth lead lead to ballast resistor, with ignition on and contact breaker points closed: (i) Above 12V - Fault in ballast resistor	Rectify 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	

Fault	Check	Test	Rectification
STARTER SYSTEM Starter will not operate Engine cranking speed to low Engine will not start Starter operates but crankshaft stationary	16, 17, 18, 19, 20, 21, 22 16, 17, 18, 19, 23, 24, 25 16, 17, 18, 19, 24, 25 23, 24, 25	16. Battery voltage Connect voltmeter between battery terminals: Below 12V  ST1309M	Charge or renew battery
		17. Battery charge Take hydrometer readings. Below 70% charged - 1.230 at 15°C 18. Wiring a. Check that all connections are clean and tight b. Disconnect coil negative lead. Voltmeter between battery negative and starter end bracket bolt. Operate starter: Above 0.5V  ST1310M	a. Renew wiring and connectors b. Clean and tighten all earth connections, battery, starter terminals. Tighten starter through bolts Remove starter, clean motor and backplate faces
		19. Battery - on load  ST1311M	a. Check circuit Overhaul or renew starter b. Carry out Test 20
TEST EQUIPMENT Voltmeter 0-20V moving coil Ammeter 5.0-50A moving coil Hydrometer Lock torque clamps and spring balance		20. Battery voltage at starter - on load Disconnect coil negative lead. Voltmeter starter terminal to earth on motor. Operate starter  ST1312M	a. Check solenoid Test 23 b. Carry out Test 21 c. Carry out Test 25

Fault	Check	Test	Rectification	
STARTER SYSTEM		<p>21. Starter voltage - on load</p>  <p>ST1313M</p>	<p>Voltmeter starter terminal to battery positive. Switch on ignition, battery voltage Disconnect coil positive lead Operate starter</p> <p>a. Below 0.5V - cable and connections satisfactory</p> <p>b. Above 0.5V - Resistance between battery and starter</p>	<p>a. Carry out Test 23</p> <p>b. Check all connections and cables</p>
		<p>22. Voltage drop across solenoid switch</p>  <p>ST1314M</p>	<p>Voltmeter between starter solenoid terminals. Switch on ignition, battery voltage Disconnect coil negative lead. Operate starter</p> <p>a. Below 0.5V</p> <p>b. Above 0.5V</p>	<p>a. Carry out test 23</p> <p>b. Faulty switch or connections</p>
		<p>23. Voltage at Solenoid - on load</p>  <p>ST1315M</p>	<p>Disconnect coil negative lead. Voltmeter between solenoid lead terminal and battery positive Operate starter</p> <p>a. 9V-10V - and result of Test 22 was 'b' (below 9V with ballast resistor circuit)</p> <p>b. Above 12V - Starter does not operate (above 9V with ballast resistor circuit)</p>	<p>a. Change solenoid</p> <p>b. Clean earth, re-test - renew solenoid</p>
		<p>24. Voltage drop in earth line</p>  <p>ST1316M</p>	<p>Disconnect coil negative lead. Voltmeter between starter through bolt and battery negative terminal Operate starter. Above 0.5V</p>	<p>i. Clean and tighten all earth connections, battery, starter, coil etc. ii. Tighten starter, through bolts iii. Remove starter, clean motor and backplate faces</p>

Fault	Check	Test	Rectification
STARTER SYSTEM		<p>25. Drive faulty</p> <p>a. Remove starter: check condition of pinion and starter ring gear</p> <p>b. Inertia drive, check that pinion rotates freely</p> <p>c. Check that crankshaft rotates freely</p> <p>d. Lock torque, free running speed and current</p> <p>26. Ignition circuit fault</p>	<p>a. Renew pinion or ring gear</p> <p>b. Renew inertia drive</p> <p>c. Check for engine fault, tight or sized</p> <p>d. Check brushes - overhaul starter</p> <p>See IGNITION SYSTEM</p>

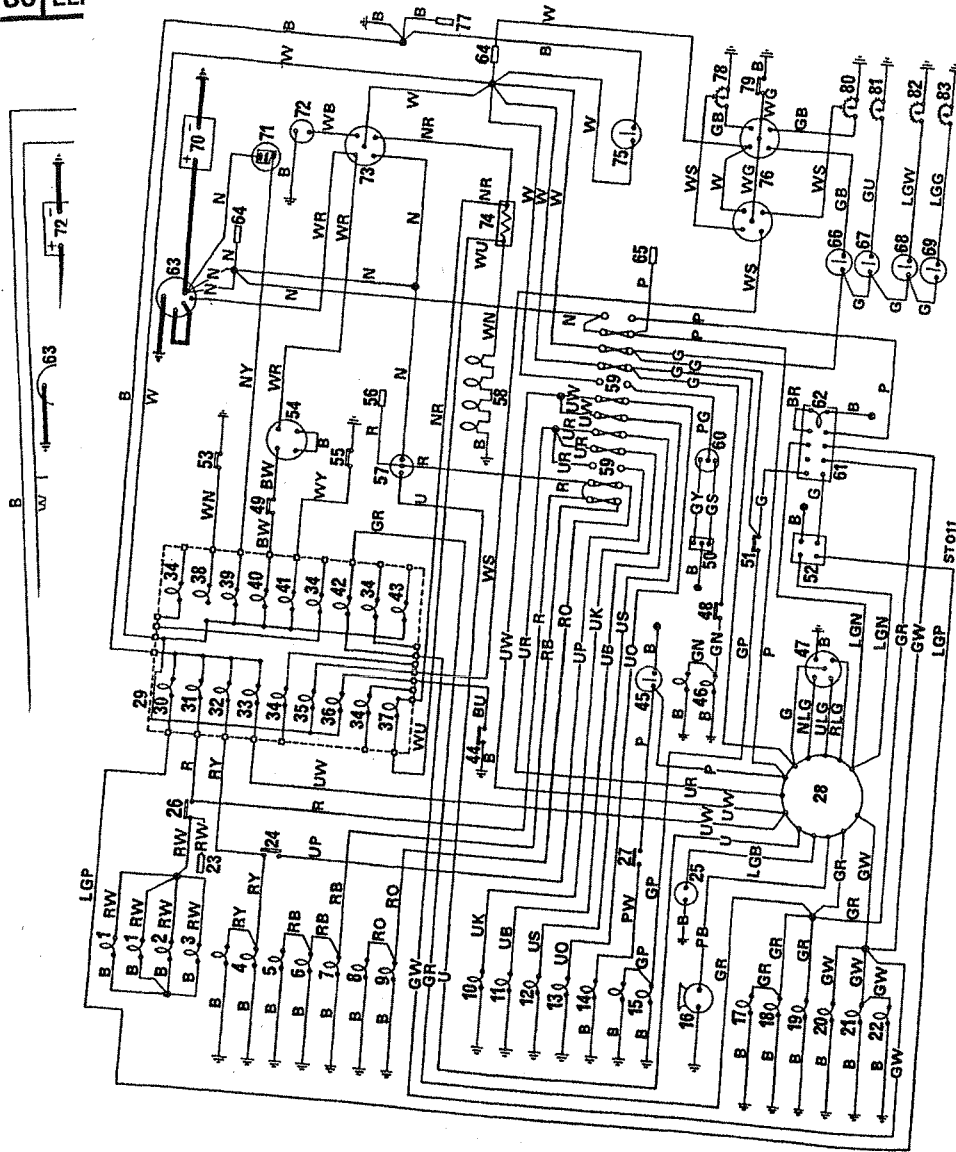


KEY TO FOUR CYLINDER PETROL DIAGRAM

- | | |
|--|---|
| 1. Speedometer illumination | 56. Light switch |
| 2. Fuel indicator illumination | 57. Pick-up point for front fog lamps |
| 3. Water temperature illumination | 58. Fuses |
| 4. Rear fog lamps | 59. Heater motor |
| 5. Number plate lamp | 60. Hazard switch |
| 6. LH tail lamp | 61. Hazard switch illumination |
| 7. LH side lamp | 62. Ignition light resistor |
| 8. RH side lamp | 63. Starter solenoid |
| 9. RH side lamp | 64. Spare pick-up point |
| 10. LH headlamp dip beam | 65. Start relay |
| 11. RH headlamp dip beam | 66. Distributor |
| 12. LH headlamp main beam | 67. Pick-up point for auxiliary trailer |
| 13. RH headlamp main beam | 68. Fuel indicator |
| 14. Interior lamp | 69. Water temperature indicator |
| 15. Stop lamp | 70. Oil pressure indicator |
| 16. Horn | 71. Oil temperature indicator |
| 17. LH side repeater | 72. Battery |
| 18. LH front indicator | 73. Alternator |
| 19. LH rear indicator | 74. Start switch |
| 20. RH front indicator | 75. Coil |
| 21. RH rear indicator | 76. Battery condition indicator |
| 22. RH side repeater | 77. Pick-up point for auxiliary instrument illumination |
| 23. Auxiliary instrument illumination | 78. Fuel tank unit |
| 24. Panel illumination switch | 79. Water temperature transmitter |
| 25. Rear fog switch | 80. Oil pressure transmitter |
| 26. Interior lighting switch | 81. Oil temperature transmitter |
| 27. Washer pump | |
| 28. Steering column switches | |
| 29. Grouped warning lights (comprising | |
| 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 | |

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 column

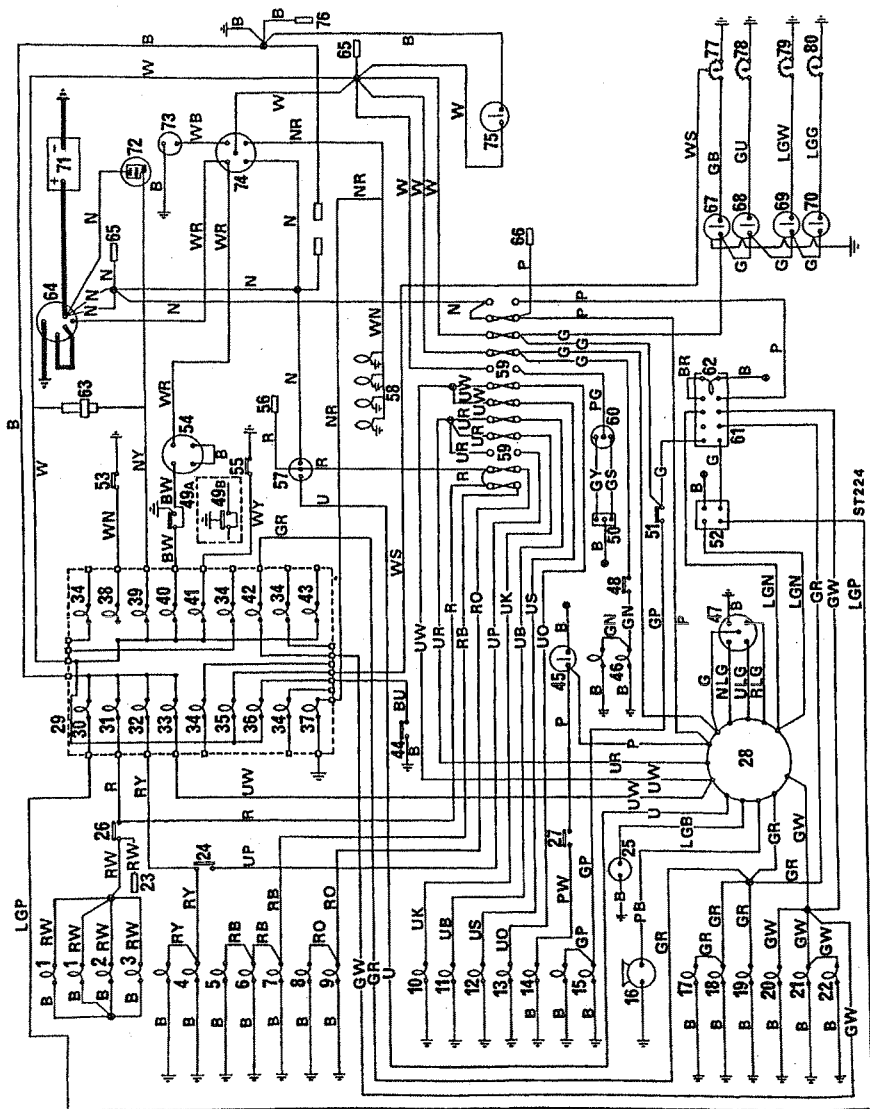


KEY TO FOUR CYLINDER 2.25 LITRE DIESEL DIAGRAM

- | | | |
|--|--|---|
| 1. Speedometer illumination | 29. Grouped warning lights (comprising items 30 to 49) | 57. Light switch |
| 2. Fuel indicator illumination | 30. Trailer warning light | 58. Heater plugs |
| 3. Water temperature illumination | 31. Side light warning light | 59. Fuses |
| 4. Rear fog lamps (when fitted) | 32. Rear fog warning light | 60. Heater motor (when fitted) |
| 5. Number plate lamp | 33. Main beam warning light | 61. Hazard switch (when fitted) |
| 6. LH tail lamp | 34. Spare | 62. Hazard switch illumination (when fitted) |
| 7. LH side lamp | 35. Low fuel warning light | 63. Starter solenoid |
| 8. RH tail lamp | 36. Locked four-wheel drive warning light | 64. Spare pick-up point for auxiliary trailer |
| 9. RH side lamp | 37. Cold start warning light | 65. Fuel indicator |
| 10. LH headlamp dip beam | 38. Oil warning light | 67. Water temperature indicator |
| 11. RH headlamp dip beam | 39. Charge warning light | 68. Oil pressure indicator (when fitted) |
| 12. LH headlamp main beam | 40. Brake warning light | 69. Oil temperature indicator (when fitted) |
| 13. RH headlamp main beam | 41. Park brake warning light | 70. Battery |
| 14. Interior lamp | 42. Direction indicator warning light | 71. Alternator |
| 15. Stop lamp | 43. Seat belt warning light | 72. Fuel shut off valve |
| 16. Horn | 44. Locked four-wheel drive switch | 73. Heat/Start switch |
| 17. LH side repeater (when fitted) | 45. Clock (when fitted) | 74. Ballast resistor |
| 18. LH front indicator | 46. Reversing lamps (when fitted) | 75. Battery condition indicator |
| 19. LH rear indicator | 47. Wiper motor | 76. Fuel changeover relays (when fitted) |
| 20. RH front indicator | 48. Reversing lamp switch (when fitted) | 77. Pick-up point for auxiliary instrument illumination (when fitted) |
| 21. RH rear indicator | 49. Pressure differential warning actuator switch | 78. Rear tank unit |
| 22. RH side repeater (when fitted) | 50. Heater switch (when fitted) | 79. Fuel cock switch (when fitted) |
| 23. Pick-off point for auxiliary instrument illumination (when fitted) | 51. Stop lamp switch | 80. Side tank unit |
| 24. Rear fog switch (when fitted) | 52. Flasher unit | 81. Water temperature transmitter |
| 25. Washer pump | 53. Oil pressure switch | 82. Oil pressure transmitter (when fitted) |
| 26. Panel illumination switch | 54. Brake check relay | 83. Oil temperature transmitter (when fitted) |
| 27. Interior light switch | 55. Park brake switch (when fitted) | |
| 28. Steering column switches | 56. Pick-off point for front fog lamps (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 column

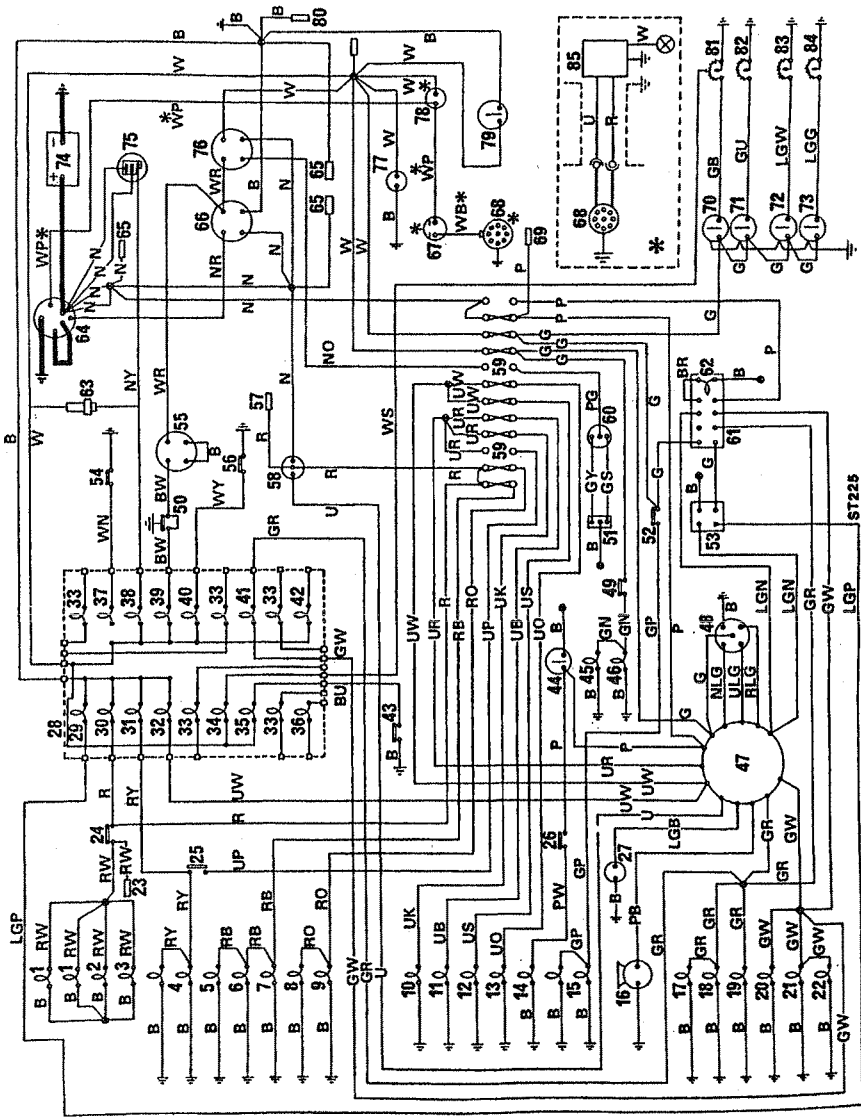


KEY TO FOUR CYLINDER 2.5 LITRE DIESEL DIAGRAM

- | | | |
|--|--|---|
| 1. Speedometer illumination | 30. Trailer warning light | 54. Brake check relay |
| 2. Fuel indicator illumination | 31. Side light warning light | 55. Park brake switch |
| 3. Water temperature illumination | 32. Rear fog warning light | 56. Pick-off point for front fog lamps (when fitted) |
| 4. Rear fog lamps | 33. Main beam warning light | 57. Light switch |
| 5. Number plate lamp | 34. Spare | 58. Heater plugs |
| 6. LH tail lamp | 35. Low fuel warning light | 59. Fuses |
| 7. LH side lamp | 36. Locked four-wheel drive warning light | 60. Heater motor |
| 8. RH tail lamp | 37. Cold start warning light | 61. Hazard switch |
| 9. RH side lamp | 38. Oil warning light | 62. Hazard switch illumination |
| 10. LH headlamp dip beam | 39. Charge warning light | 63. Ignition light resistor |
| 11. RH headlamp dip beam | 40. Brake warning light | 64. Starter solenoid |
| 12. LH headlamp main beam | 41. Park brake warning light | 65. Spare pick-up point |
| 13. RH headlamp main beam | 42. Direction indicator warning light | 66. Pick-off point of auxiliary trailer |
| 14. Interior lamp | 43. Seat belt warning light | 67. Fuel indicator |
| 15. Stop lamp | 44. Locked four-wheel drive switch | 68. Water temperature indicator |
| 16. Horn | 45. Clock | 69. Oil pressure indicator |
| 17. LH side repeater | 46. Reversing lamps | 70. Oil temperature indicator |
| 18. LH front indicator | 47. Wiper motor | 71. Battery |
| 19. LH rear indicator | 48. Reversing lamp switch | 72. Alternator |
| 20. RH front indicator | 49a. Brake fluid loss switch (Ninety models only) | 73. Fuel shut off valve |
| 21. RH rear indicator | 49b. Pressure differential warning actuator switch (One Ten models only) | 74. Heat/Start switch |
| 22. RH side repeater | 50. Heater switch | 75. Battery condition indicator |
| 23. Pick-off point for auxiliary instrument illumination | 51. Stop lamp switch | 76. Pick-up point for auxiliary instrument illumination |
| 24. Rear fog switch | 52. Flasher unit | 77. Fuel tank unit |
| 25. Washer pump | 53. Oil pressure switch | 78. Water temperature transmitter |
| 26. Panel illumination switch | | 79. Oil pressure transmitter |
| 27. Interior lighting switch | | 80. Oil temperature transmitter |
| 28. Steering column switches | | |
| 29. Grouped warning lights (comprising items 30 to 43) | | |

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 first letter of a colour code denotes the tracer column



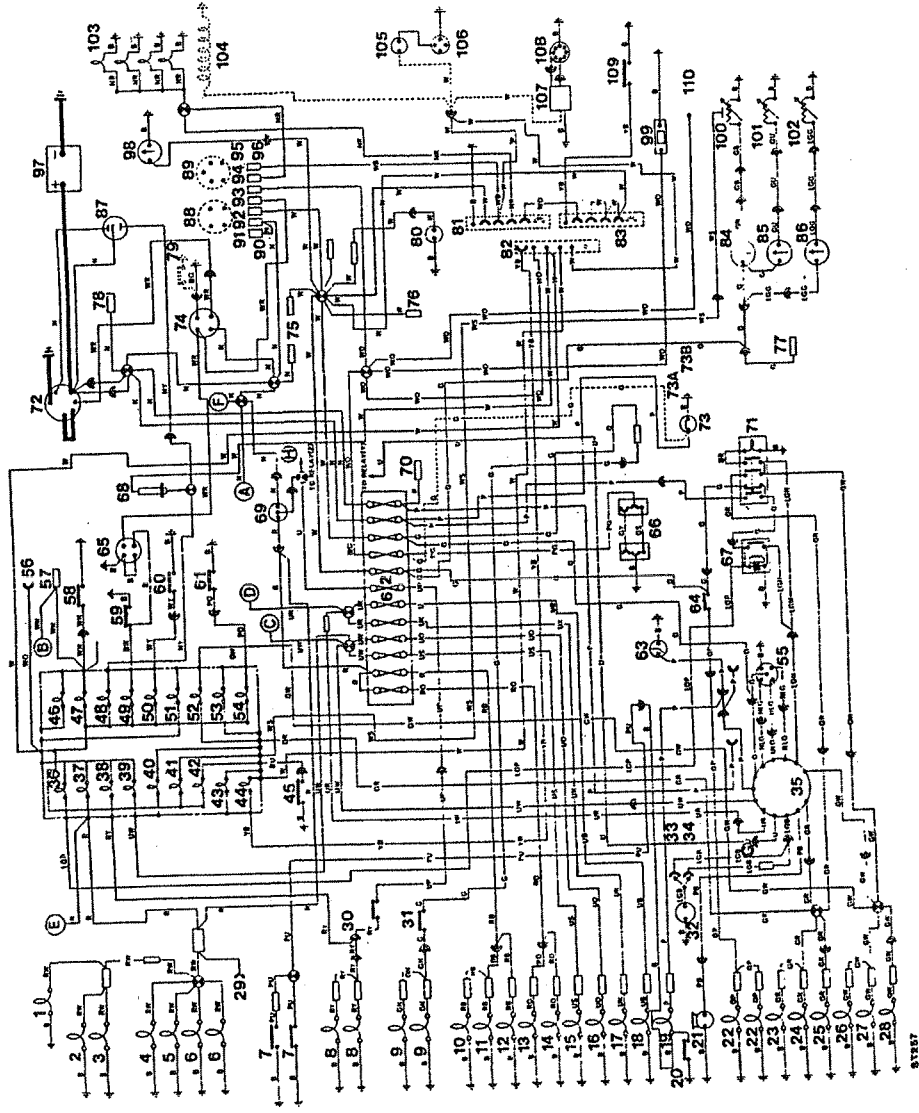
KEY TO V8 CYLINDER PETROL DIAGRAM

1. Speedometer illumination
2. Fuel indicator illumination
3. Water temperature illumination
4. Rear fog lamps
5. Number plate lamp
6. LH tail lamp
7. RH tail lamp
8. LH side 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 point 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 column



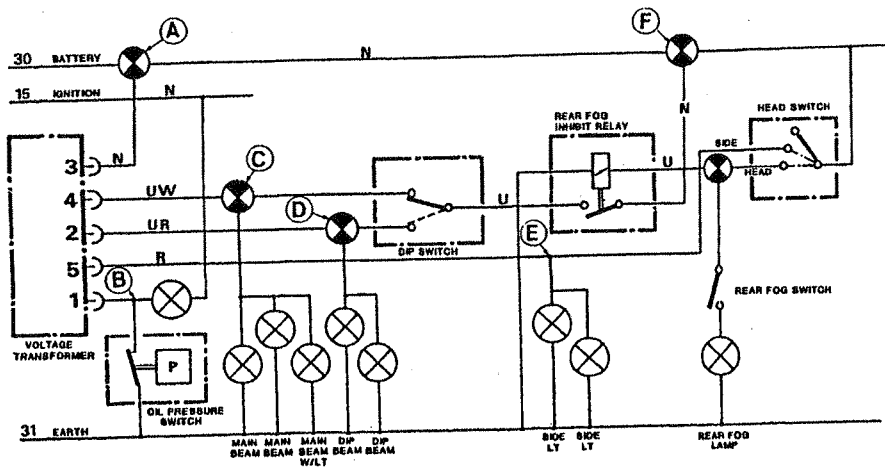
KEY TO COMPOSITE CIRCUIT DIAGRAM - ALL MODELS 1986/1991

- | | |
|---|--|
| 1. Battery condition indicator illumination | 74. Start relay |
| 2. Cigar lighter illumination | 75. Spares |
| 3. Oil temperature indicator illumination | 76. Auxiliary instrument illumination |
| 4. Water temperature indicator illumination | 77. Spare auxiliary instrument |
| 5. Fuel indicator illumination | 78. Spare |
| 6. Speedometer illumination | 79. Starter inhibitor switch (auto only) |
| 7. Door switches (when fitted) | 80. Fuel pump (petrol only) |
| 8. Rear fog lamp | 81. Connector - Diesel |
| 9. Reverse lamp | 82. Connector - petrol |
| 10. Number plate lamp | 83. Fuel indicator |
| 11. LH tail lamp | 84. Water temperature indicator |
| 12. LH side lamp | 85. Oil temperature indicator |
| 13. RH tail lamp | 86. Alternator |
| 14. RH side lamp | 87. Petrol ignition switch |
| 15. LH headlamp main beam | 88. Diesel ignition switch |
| 16. RH headlamp main beam | 89. Feed snap connector |
| 17. LH headlamp dip beam | 90. Feed snap connector |
| 18. RH headlamp dip beam | 91. Ignition snap connector |
| 19. Interior lamp (when fitted) | 92. Starter snap connector |
| 20. Interior lamp switch | 93. Auxiliary snap connector |
| 21. Horn | 94. Heater snap connector |
| 22. Stop lamp | 95. Fuel shut-off snap connector |
| 23. LH side repeater | 96. Battery |
| 24. LH front indicator | 97. Battery condition indicator (when fitted) |
| 25. LH side repeater | 98. Radio (when fitted) |
| 26. RH side repeater | 99. Tank unit - for twin tanks system |
| 27. RH front indicator | 100. Water temp transmitter |
| 28. RH rear indicator | 101. Oil temperature transmitter (when fitted) |
| 29. Front fog feed | 102. Glow plugs (Diesel only) |
| 30. Rear fog switch | 103. Fuel shut off solenoid |
| 31. Reverse lamp switch | 104. Distributor (4 cylinder petrol only) |
| 32. Washer pump | 105. 2 CE unit - V8 only |
| 33. RH washer pump connection | 106. Distributor - V8 only |
| 34. LH washer pump connection | 107. Choke switch (petrol only) |
| 35. Steering column switches | 108. Air conditioning feed (when fitted) |
| 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 | |

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 column

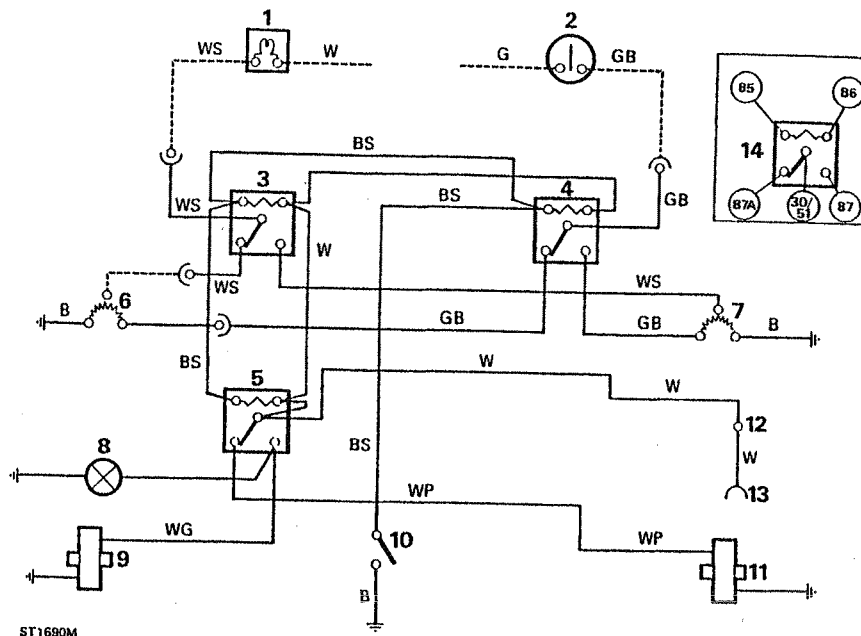
DIM-DIP CIRCUIT - UNITED KINGDOM ONLY



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

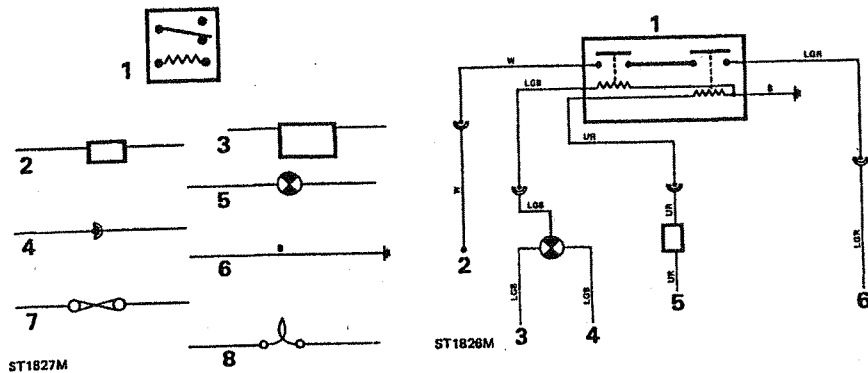


ST1690M

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

OPTIONAL EQUIPMENT CIRCUIT DIAGRAMS

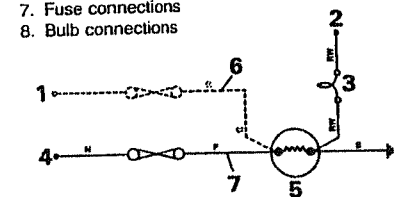


KEY TO TERMINATIONS

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

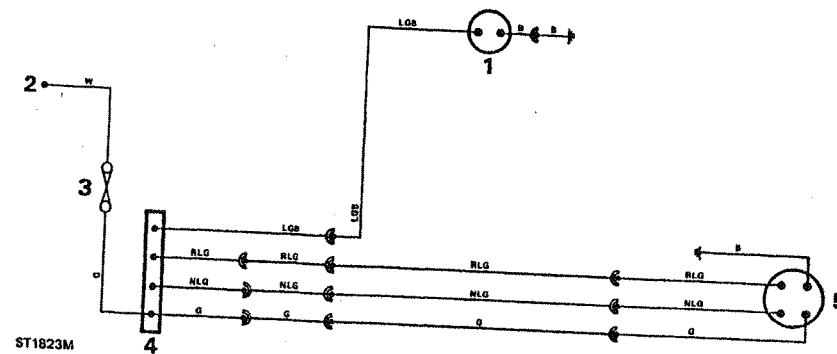
POWER WASH SYSTEM

1. Power wash timer
2. Ignition feed
3. Screen wash pump
4. Screen wash switch
5. Dip switch
6. Power wash pump



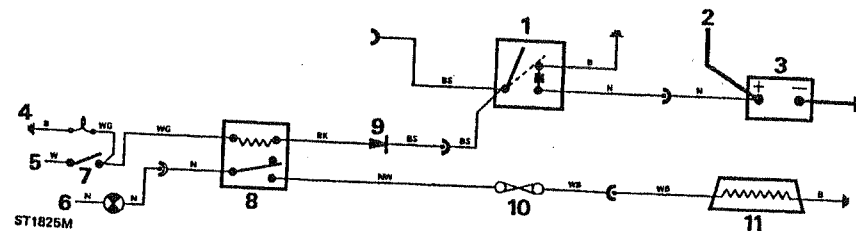
ST1824M
CIGAR LIGHTER

1. Ignition feed
2. Side light circuit
3. Cigar lighter bulb
4. Battery positive
5. Cigar lighter
6. Australia Only (dotted line)
7. 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

DEFENDER CIRCUIT DIAGRAM - 1991 ONWARDS

KEY TO CIRCUIT DIAGRAM ST 3353

1. Glow plugs (see diagram ST361)
2. Seat belt switch
3. Park brake switch
4. Choke switch - petrol only
5. Reler engine circuit connector (see relevant diagram)
6. Air conditioning feed
7. Rear fog inhibit relay-link to be removed when voltage transformer module is required
8. Voltage transformer when fitted
9. Rear lamp relay
10. Main lighting switch
11. Left hand stop lamp
12. Right hand stop lamp
13. Right hand direction indicator repeat lamp
14. Right hand front repeat lamp
15. Left hand direction indicator repeat lamp
16. Left hand front direction indicator lamp
17. Left hand rear direction indicator lamp
18. Right hand direction indicator lamp
19. Left indicator dip beam
20. Right hand headlamp dip beam
21. Right hand lamp main beam
22. Left hand headlamp beam
23. Right hand tail lamp
24. Number plate lamp
25. Left hand tail lamp
26. Left hand front side lamp
27. Right hand front side lamp
28. Right hand reverse lamp
29. Left hand reverse lamp
30. Right hand rear fog lamp
31. Left hand rear fog lamp
32. Auxiliary feed
33. Power wash connector (see diagram ST353)
34. Connector incorporating ignition feed, oil temperature transmitter fuel pump
35. Diode
36. Ignition warning light resistor

37. Petrol ignition switch
38. Common ignition switch
39. Diesel ignition switch
40. Fuel pump isolation relay
41. Warning light incorporating
42. Spare
43. Oil pressure warning light
44. Ignition warning light
45. Brake warning light
46. Direction indicator warning light
47. Main beam warning light
48. Low fuel warning light
49. Locked four wheel drive warning light
50. Spare
51. Spare
52. Seat belt warning light
53. Park brake warning light
54. Trailer
55. Spare
56. Side light warning light
57. Rear fog warning light
58. Cold start warning light
59. Spare
60. 20 way fuse box
61. Stop lamp switch
62. Reverse lamp switch
63. Rear fog switch
64. Petrol ignition switch
65. Diesel heater/start switch
66. Glow plug timer connection (see diagram ST361)
67. Pressure differential warning actuator switch (110 only - pre-rationalisation)
68. Low level warning actuator switch (90 only prior to rationalisation)
69. Start relay
70. Brake check relay
71. Heated rear window connections (see diagram ST352)
72. Heated rear window and rear wash wiper connection
73. Air conditioning connector
74. Low fuel level unit
75. Spare
76. Fuel system (see relevant diagram)
77. Spares
78. Spare connector
79. Power wash connector (see diagram ST353)
80. Horn
81. Additional horn (when fitted)
82. Cigar lighter
83. Wiper delay unit
84. Split charge connection (Battery see relevant diagram)
85. Fuel gauge
86. Water temperature gauge
87. Hazard switch
88. Radio feed (see diagram ST354)
89. Interior lamp
90. Door switches
91. Instrument illumination
92. Spare
93. Locked four wheel drive
94. Power wash motor
95. Horn/direction indicator/headlamp flash/dip switch
96. Hazard/direction indicator lamp
97. Wipe wash switch
98. Wiper motor
99. Rear wiper switch (see diagram ST352)
100. Washer motor rear
101. Washer motor front
102. Power wash connection (see diagram ST353)
103. Heated rear window connection
104. Voltage sensitive switch
105. Heater motor switch

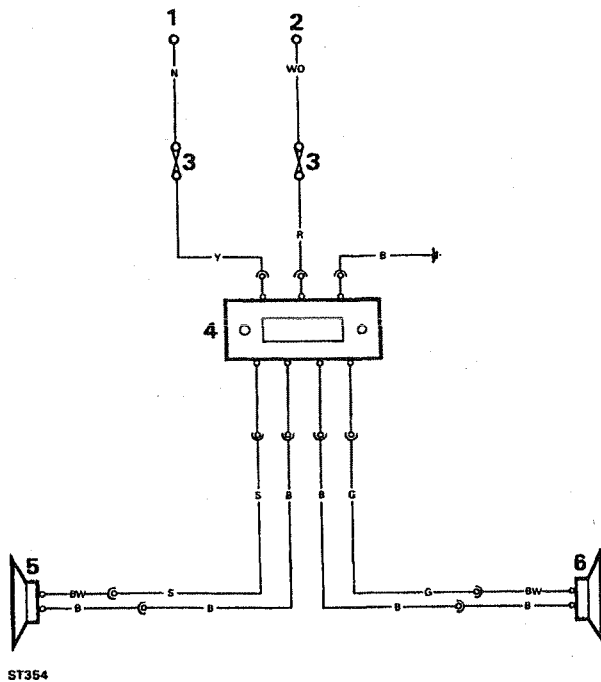
Key to cable colours

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 column

DEFENDER - 1991 ONWARDS

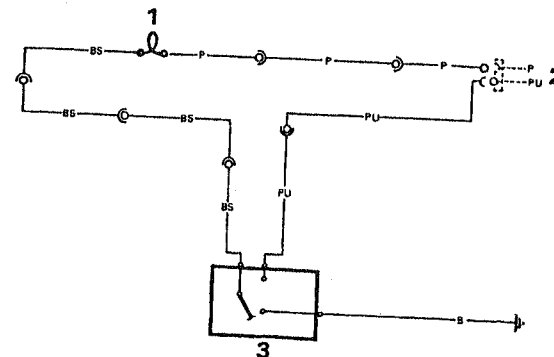
RADIO CASSETTE AND SPEAKERS

1. Spare connection - see main circuit diagram
2. Radio feed - see main circuit diagram
3. Fuse 5 amp
4. Radio cassette
5. Speaker left hand
6. Speaker right hand



INTERIOR LIGHT - ST351

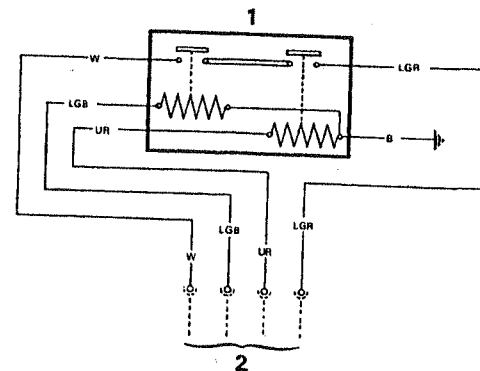
1. Interior light
2. Door switch connections - see main circuit diagram
3. Interior light switch



ST351

POWER WASH TIMER - ST353

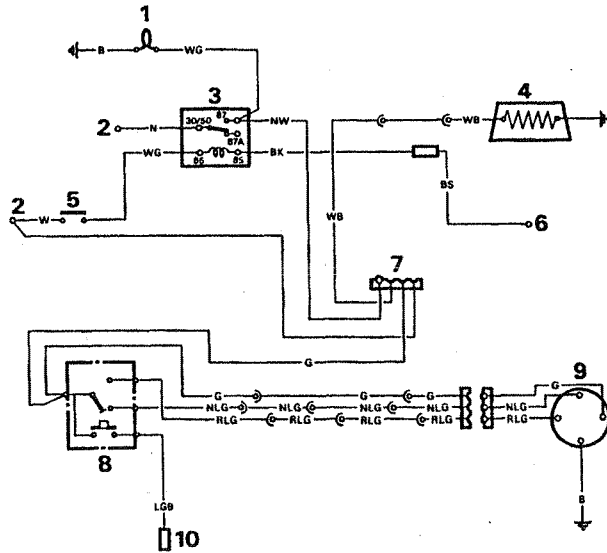
1. Power wash timer
2. Power wash connections - see main circuit diagram



ST353

HEATED REAR WINDOW ST352

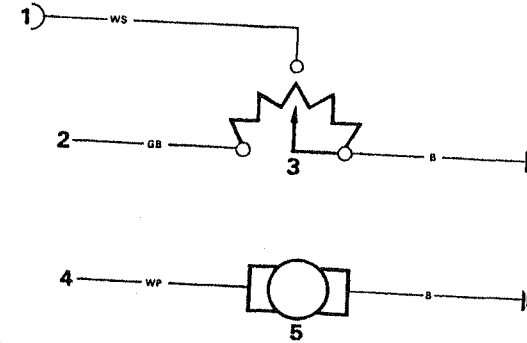
1. Heated rear window warning light
2. Instrument connection - see main circuit diagram
3. Heated rear window relay
4. Heated rear window
5. Heated rear window switch
6. Voltage sensitive switch connection - see main circuit diagram
7. Heated rear window/rear wash/wipe connection - see main circuit diagram
8. Rear wash/wipe switch
9. Rear wiper motor
10. Washer pumps - see main circuit diagram



ST352

SINGLE FUEL TANK - petrol and diesel engines - ST355

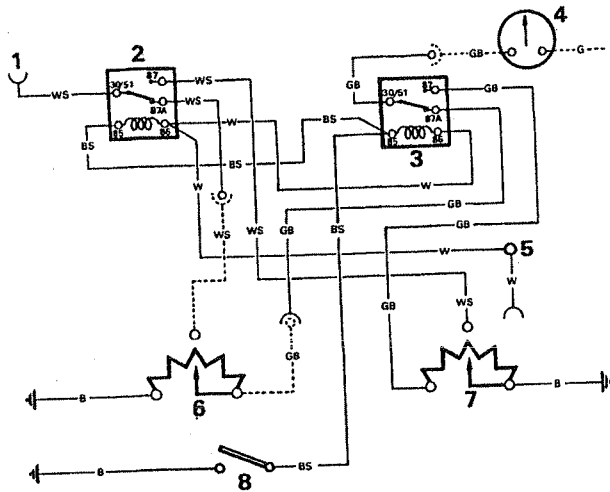
1. Connection not used
2. Fuel gauge - see main circuit diagram
3. Rear/side tank unit
4. Fuel pump feed - petrol only - see main circuit diagram
5. Fuel pump rear/side tank - petrol only



ST355

TWIN FUEL TANKS - Diesel engine - ST356

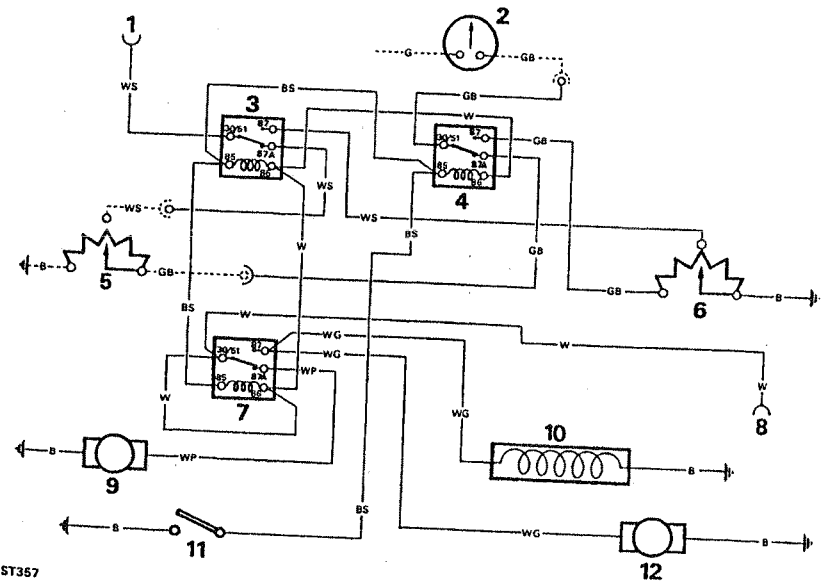
1. Connection not used
2. Low fuel warning light relay
3. Fuel gauge relay
4. Fuel gauge
5. Ignition feed, main harness
6. Rear tank unit
7. Side tank unit
8. Fuel change over switch



ST356

TWIN FUEL TANKS - petrol engine - ST357

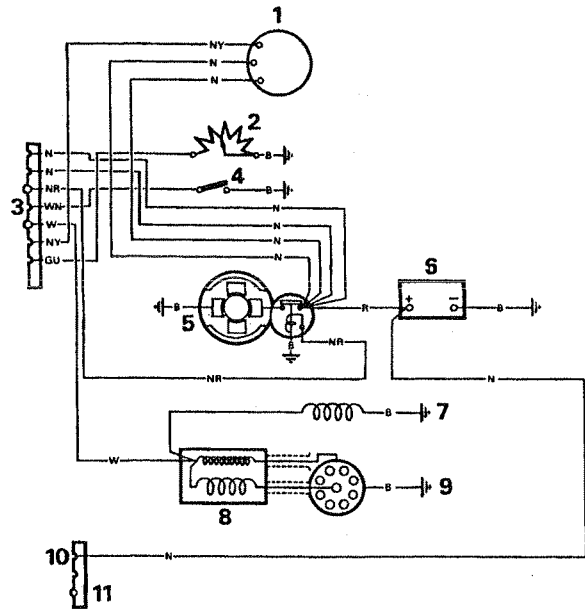
1. Connection not used
2. Fuel gauge
3. Low fuel warning light relay
4. Fuel gauge relay
5. Rear tank unit
6. Side tank unit
7. Relay, fuel pumps
8. Ignition feed main harness
9. Fuel pump, rear tank
10. Solenoid valve
11. Fuel change-over switch
12. Fuel pump, side tank



ST357

ENGINE COMPARTMENT HARNESS - Diesel engine - ST359

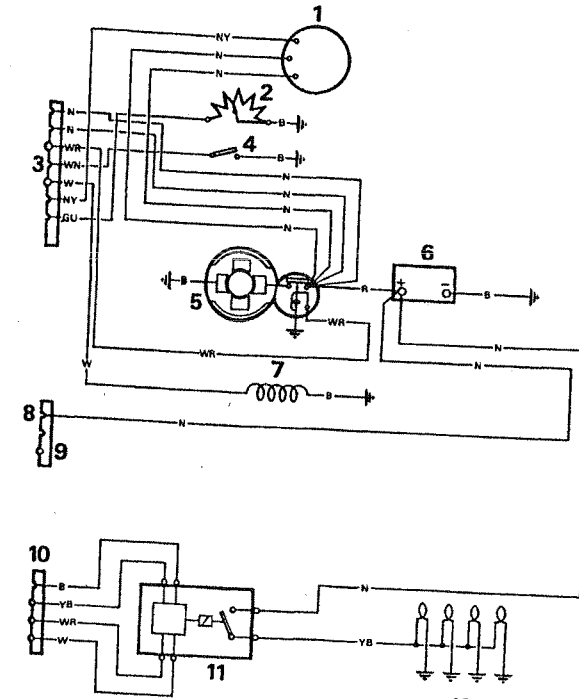
1. Alternator A127/45A
2. Coolant temperature transmitter
3. Engine connector
4. Oil pressure switch
5. Starter motor solenoid
6. Vehicle battery
7. Fuel shut-off solenoid
8. Voltage sensitive switch connections
9. Split charge connections
10. Glow plug lead - see main circuit diagram
11. Glow plugs



ST359

ENGINE COMPARTMENT HARNESS - 4 cylinder turbo diesel - ST361

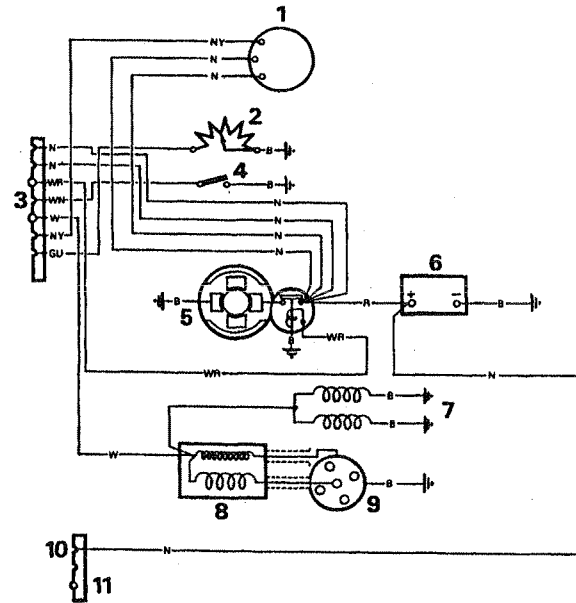
1. Alternator A127/45A
2. Water temperature transmitter
3. Engine connector
4. Oil pressure switch
5. Starter motor/solenoid
6. Vehicle battery
7. Fuel shut-off solenoid
8. Voltage sensitive switch connections
9. Split charge connection
10. Glow plug timer connection
11. Glow plug timer
12. Glow plugs



ST361

ENGINE COMPARTMENT HARNESS - 4 cylinder petrol - ST360

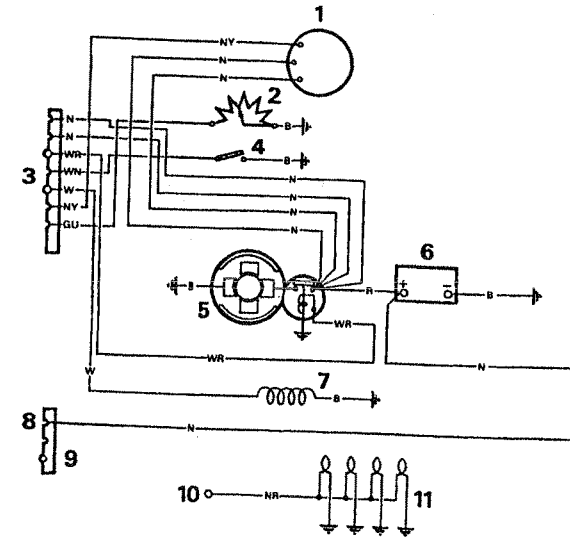
1. Alternator A127/45A
2. Water temperature transmitter
3. Engine connector
4. Oil pressure switch
5. Starter motor/solenoid
6. Vehicle battery
7. Carburettor solenoids
8. Ignition coil
9. Distributor
10. Voltage sensitive switch
11. Split charge connection



ST360

ENGINE COMPARTMENT HARNESS - V8 engine - ST359

1. Alternator A127/45A
2. Coolant temperature transmitter
3. Engine connector
4. Oil pressure switch
5. Starter motor/solenoid
6. Vehicle battery
7. Carburettor solenoid
8. Ignition coil
9. Distributor
10. Voltage sensitive switch
11. Split charge connection



ST359

