



DEFENDER

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WORKSHOP MANUAL SUPPLEMENT

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West Midlands, B92 8NW
England



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INTRODUCTION

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

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

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

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

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

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

REFERENCES

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

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

DIMENSIONS

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

REPAIRS AND REPLACEMENTS

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

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

POISONOUS SUBSTANCES

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

ASBESTOS

WARNING: Some components on the vehicle, such as gaskets and friction surfaces (brake linings, clutch discs) may contain asbestos. Inhaling asbestos dust is dangerous to your health and the following essential precautions must be **observed:**

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

FUEL HANDLING PRECAUTIONS

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

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

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

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

Always have a fire extinguisher containing **FOAM CO₂ GAS**, or **POWDER** close at hand when handling fuel, or when dismantling fuel systems and in areas where fuel containers are stored.

WARNING: It is imperative that the battery is not disconnected during fuel system repairs as arcing at the battery terminal could ignite fuel vapour in the atmosphere. Always disconnect the vehicle battery BEFORE carrying out work on a fuel system. Whenever fuel is being handled, transferred or stored, or when fuel systems are being dismantled all forms of ignition must be extinguished or removed, any head-lamps used must be flameproof and kept clear of spillage.

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

HOT FUEL HANDLING

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

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

FUEL TRANSFER

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

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

FUEL TANK REMOVAL

A fuel vapour label should be attached to the fuel tank upon removal from the vehicle.

FUEL TANK REPAIR

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

RECOMMENDED SEALANTS

A number of branded products are recommended in this Supplement for use during maintenance and repair work. These items include: **HYLOMAR GASKET AND JOINTING COMPOUND** and **HYLOSIL RTV SILICON COMPOUND**. They should be available locally from garage equipment suppliers. If there is any problem obtaining supplies, contact one of the following companies for advice and the address of the nearest stockist.

Marston Lubricants Limited

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

Tel: 0942 824242
Fax: 0942 826653
Telex: 67230

Northern Adhesives Limited

Prudhoe
Northumberland
NE42 6NP

Tel: 0661 32014
Fax: 0661 35839

USED ENGINE OIL HANDLING PRECAUTIONS

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

Health Protection Precautions

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

DISPOSING OF USED OILS AND FLUIDS

Environmental protection precaution

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

Dispose of used oil through authorised waste disposal contractors.

SPECIFICATION

Purchasers are advised that the specification details set out in this Supplement apply to a range of vehicles and not to any one. For the specification of a particular vehicle, purchasers should contact their Dealer. The Manufacturers reserve the right to vary their specifications with or without notice, and at such times and in such manner as they think fit. Major as well as minor changes may be involved in accordance with the Manufacturer's policy of constant product improvement.

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

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SPECIAL SERVICE TOOLS

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

ACCESSORIES AND CONVERSIONS

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

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

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

ABBREVIATIONS AND SYMBOLS

Across flats (bolt size)	AF	Low tension	l.t.
After bottom dead centre	ABDC	Maximum	max.
After top dead centre	ATDC	Metre	m
Alternating current	a.c.	Millilitre	ml
Ampere	amp	Millimetre	mm
Ampere hour	amp hr	Miles per gallon	mpg
Before bottom dead centre	BBDC	Miles per hour	mph
Before top dead centre	BTDC	Minute (angle)	'
Bottom dead centre	BDC	Minus (of tolerance)	-
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)	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	P.S.I.
Fluid ounce	fl oz	Ratio	:
Foot pounds (torque)	ft lb	Reference	ref.
Fourth	4th	Revolution per minute	r.p.m
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)	HT.	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	SCREW THREADS	
Kilovolts	kV	American Standard Taper Pipe	NPTF
Left-hand steering	LHStg	British Standard Pipe	BSP
Left-hand thread	LHThd	Unified Coarse	UNC
Litres	litre	Unified Fine	UNF



Special Service Tools

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

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

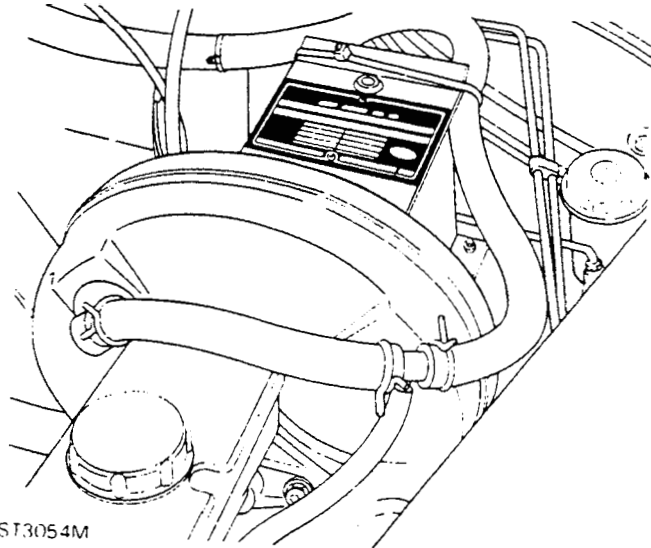
Special tools bulletins will be issued periodically giving details of new tools as they are introduced.

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

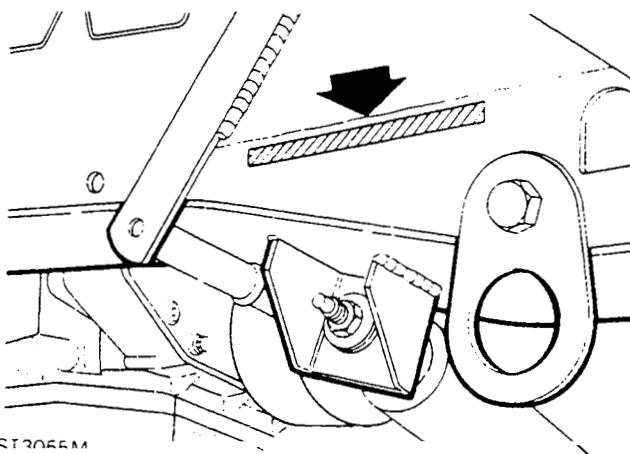
The tools recommended in this Workshop Manual Supplement are listed in a multi-language illustrated catalogue obtainable from Messrs. V. L. Churchill at the above address under publication number VLC 2372/1/87 or from Land Rover Merchandising Service, quoting publication number SMR 681 MI, PO Box 534, Erdington, Birmingham, B24 0Q5.

VEHICLE IDENTIFICATION NUMBER (VIN)

The Vehicle Identification Number and the recommended maximum vehicle weights are stamped on a plate riveted to the top of the pedal box behind the brake servo

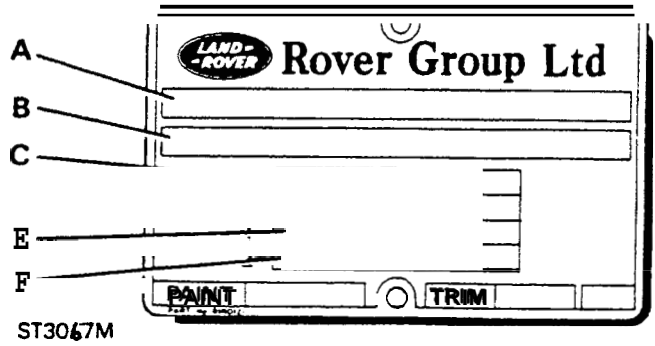


The number is also stamped on the right-hand side of the chassis forward of the spring mounting turret. Always quote this number when writing to Land Rover.



Key to Vehicle Identification Number Plate

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

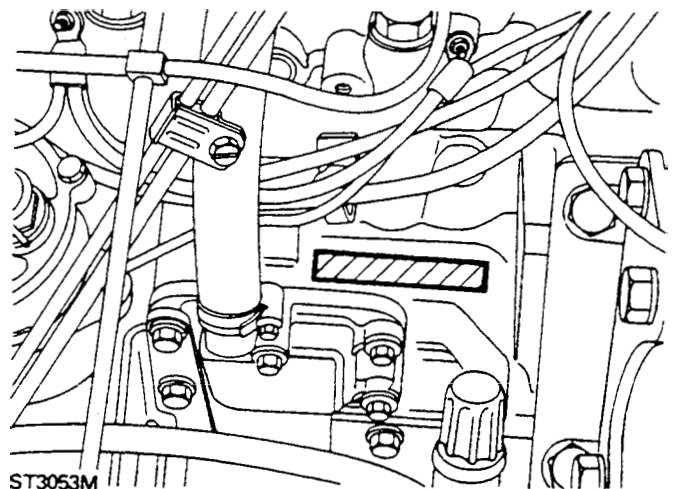


The Vehicle Identification Number identifies the manufacturer, model range, wheel base, body type, engine, steering, transmission, model name and place of manufacture. The following example shows the coding process.

- SAL World manufacturer identifier
- ID Land Rover
- G Class 100 inch
- V ~~Class~~ 90 inch
- H ~~Class~~ 110 inch
- A Basic
- B 2 door
- M 4 door
- H High Capacity
- F Tdi or
- 8 5 speed LHD or
- 7 5 speed RHD
- H 1991 MY
- A Solihull site

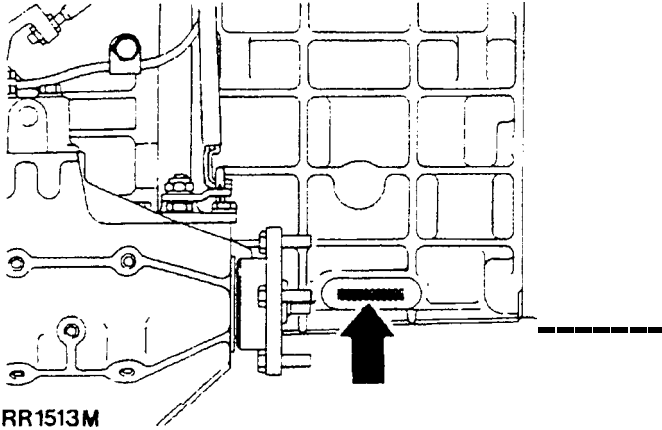
ENGINE SERIAL NUMBER - Tdi ENGINE

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



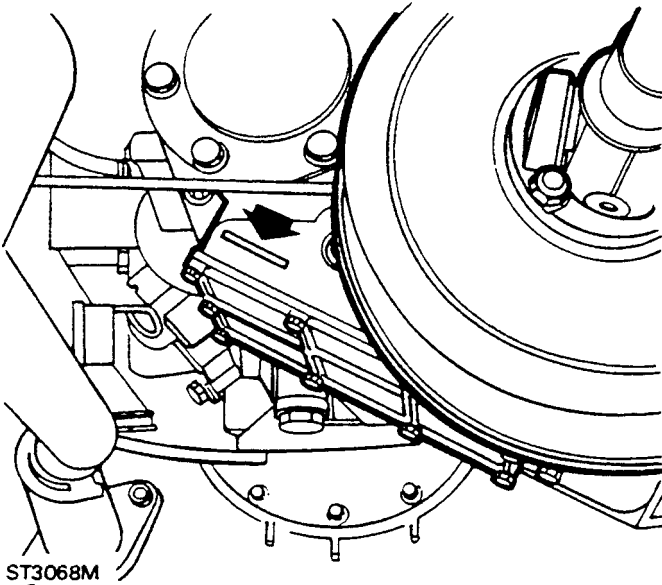
MAIN GEARBOX LT77 • 5 SPEED

The serial number is stamped on a cast pad on the bottom right hand side of the gearbox.



TRANSFER GEARBOX LT230

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



FRONT AND REAR AXLES

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

Tdi ENGINE

Type	Direct injection, turbocharged, intercooled
Number of cylinders	4
Bore	90,47 mm (3.562 in)
Stroke	97,00 mm (3.822 in)
Capacity	2495 cc
Compression ratio	19.5:1 \pm 0.5:1
Valve operation	O.H.V. pushrod operated
Turbo charger	Carrett T25

Crankshaft

Main journal diameter	63,475 - 63,487 mm (2.499 - 2.4993 in)
Regrind dimensions	63,2333 - 63,246 mm (2.4895 - 2.490 in) Use 0.010 in U/S bearings
Crankpin journal diameter	58,725 - 58,744 mm (2.312 - 2.31275 in)
Regrind dimensions	58,4708 - 58,49985 mm (2.30200 - 2.30275 in) Use 0.010 in U/S bearings
Crankshaft end thrust	Taken on thrust washers of centre main bearing
Crankshaft end float	0,05 - 0,15 mm (0.002 - 0.006 in)

Main bearings

Number and type	5 halved shells with oil grooves
Diametrical clearance	0,0792 - 0,0307 mm (0.0031 - 0.0012 in)

Connecting rods

Length between centres	175,38 - 175,43 mm (6.905 - 6.907 in)
Diametrical clearance (big-end bearings)	0,025 - 0,075 mm (0.001 - 0.003 in)
End float on crankpin	0,15 - 0,356 mm (0.006 - 0.014 in)

Pistons

Type	Aluminium alloy, combustion chamber in crown
Skirt diametrical clearance (at right angle to gudgeon pin)	0,025 - 0,05 mm (0.001 - 0.002 in)
Maximum height above combustion face	0,8 mm (0.031 in)

Gudgeon pins

Type	Floating
Fit in piston	Hand push in
Diameter	30,1564 - 30,1625 mm (1.18726 - 1.18750 in)
Clearance in connecting rod	0,0036 - 0,0196 mm (0.00014 - 0.00077 in)

Pistons rings

Type	
- Top	Chamfered friction edge, chrome plated
- Second	Taper faced
- Oil control	Expander and rails
Cap in bore:	
- Top	0,40 - 0,65 mm (0.0157 - 0.0255 in)
- Second	0,30 - 0,50 mm (0.0118 - 0.0196 in)
- Oil control	0,3 - 0,6 mm (0.011 - 0.023 in)
Clearance in piston grooves:	
- Top	0,167 - 0,232 mm (0.0065 - 0.0091 in)
- Second	0,05 - 0,08 mm (0.0019 - 0.0031 in)
- Oil control	0,05 - 0,08 mm (0.0019 - 0.0031 in)

Camshaft

Timing Belt	30 mm (1.2 in dry toothed belt)
Location	Right hand side (thrust side)
End float	0,1 - 0,2 mm (0.004 - 0.008 in)
Number of bearings	4
Material	Steel shell, white metal lined



Valves

Tappet clearance:	
- Inlet and exhaust	0,20 mm (0.008 in)
Seat angle:	
- Inlet	30°
- Exhaust	45°
Head diameter:	
- Inlet	39,35 - 39,65 mm (1.549 - 1.560 in)
- Exhaust	36,35 - 36,65 mm (1.431 - 1.443 in)
Stem diameter:	
- Inlet	7,960 - 7,975 mm (0.313 - 0.314 in)
- Exhaust	7,940 - 7,960 mm (0.212 - 0.313 in)
Valve lift:	
- Inlet	9,93 mm (0.401 in)
- Exhaust	10,26 mm (0.404 in)
Cam lift	
- Inlet	6,81 mm (0.268 in)
- Exhaust	7,06 mm (0,278 in)
Valve head stand down	
- Inlet and exhaust	0,9 - 1,1 mm (0.035 - 0.040 in)
Valve spring length fitted	40,4 mm (1.590 in) at pressure of 29.5 kg (65 lb)



lubrication

System	Wet sump, pressure fed
Pressure, engine warm at normal operating speeds	25- 55 p.s.i. (1.76 - 3.86 kgf/cm ²)
Oil pump:	
- Type	Double gear 10 teeth, sintered iron gears
- Drive	Splined shaft from camshaft skew gear
- End float of both gears	0,026 - 0,135 mm (0.0009 - 0.0045 in)
- Radial clearance of gears	0,025 - 0,075 mm (0,0034 - 0.0067 in)
- Backlash of gears	0,1 - 0,2 mm (0.0034 - 0,0067 in)
Oil pressure relief valve	Non-adjustable
Relief valve spring:	
- Full length	67,82 mm (2.670 in)
- Compressed length at 2.58 kg (5.7 lb) load	61,23 mm (2.450 in)
Oil filter	Screw-on disposable canister
Engine oil cooler	Combined with coolant radiator and intercooler



FUEL SYSTEM - Tdi Engine

injection pump type	Bosch rotary VE4/11F (see section 05)
injection pump timing	see section 05
injectors	see section 05
Heater plugs	see section 05
Fuel lift pump type	Mechanical with hand primer
Fuel lift pump pressure	42 - 55 kpa at 1800 rpm
Fuel filter	Paper element in disposable canister
Air cleaner	Paper element type
Turbo charger	Carrett T25 (see section 05)

COOLING SYSTEM - Tdi engine

System type	Pressurised, spill return, thermostatically controlled water and anti freeze mixture. Pump assisted thermosyphon. Coolant radiator combined with oil cooler and turbo intercooler.
Cooling fan	7 blade axial flow 395 mm diameter. 1.1:1 drive ratio. Viscous coupling.
Pump type	Centrifugal, impellor, belt driven.
Thermostat opening	88°C
Expansion tank cap pressure	15 p.s.i. (system pressure)

CLUTCH - Tdi engine

Type	Valeo iaphragm spring
Centre plate diameter	235 mm (9.25 in)
Facing material	Verto F202 grooved
Number of damper springs	8
Damper spring colour	2 off white/green - suffix 'C' 2 off pigeon blue - suffix 'A' 4 off ruby red - suffix 'B'
Release bearing	Ball journal



**Tdi ENGINE TUNING DATA****ENGINE**

Firing order	1-3-4-2	
injection pump timing	1,54 mm lift at T.D.C.	
Timing marks:		
Valve timing	Slot for peg in flywheel and TDC mark on front pulley	
injection timing	Statically timed with special tool inserted in Bosch pump hub	
Tappet clearances inlet and exhaust	0,20 mm (0.008 in) cold	
Valve timing:		
- Opens	16" B.T.D.C.	Exhaust 51" B.B.D.C.
- Closes	42" A.B.D.C.	13" A.T.D.C.
- Peak	103° A.T.D.C.	109° B.T.D.C.
- Lift	9,93 mm (0.401 in)	10,26 mm (0.404 in)
Maximum governed speeds:		
- Full load (speed cut-off starts)	3800 r.p.m.	
- No load (flight speed)	4100 - 4260 r.p.m.	
- Idle speed	780 - 800 rpm	

INJECTION PUMP

Make/type	Bosch rotary VE 4/11F 1900R 347-1 Type with boost control and negative mechanical torque control. Two speed mechanical governor with speed advance and solenoid electrical shut-off. Tamper proof sealing on flight speed and fuel adjustment screws	
Direction of rotation	Clockwise, viewed from drive end	
Advance box (single stage)	9" advance (7.38 mm)	
Peak pumping pressure	650 bar	

INJECTORS

Make/type	Bosch two spring (0432193879 assembly number)
Nozzle size/type	DSLA 145P208
Nozzle holder	KBEL 98 P52
Opening pressure (working pressure)	initial pressure 200 atmospheres Secondary 280 atmospheres
injector pipe type	Guido high pressure cold drawn steel
Injector pipe size	1,8 mm dia. Length 490 mm

HEATER PLUGS

Make/type	Probe type, Beru 11 volts
Time to reach operating temperature of 850°C	8 seconds

TURBOCHARGER

Make/type	Carrett T25
Maximum boost pressure	0.82 bar (12 P.S.I.G.) measured at wastegate actuator T piece
Fuel specification	Diesel BS2869 (certain levels down to 45 with adjustment)



Tdi ENGINE

	Nm
Bearing cap to cylinder block	130 - 136
Camshaft thrust plate to cylinder block	7 - 10
Clutch cover plate to flywheel	30 - 38
Connecting rod to cap	56 - 62
Dipstick tube assembly to cylinder block	22 - 28
Dipstick mounting bracket to inlet manifold	7 - 10
Earthing strap stud to cylinder block	21 - 30
Engine mounting foot to cylinder block	80 - 90
Housing flywheel to cylinder block	40 - 50
Flywheel to crankshaft	139 - 153
Ladderframe to cylinder block	22 - 28
Oil filter adaptor to cylinder block	40 - 50
Oil pressure switch	15 - 19
Oil pump cover to pump body	20 - 28
Oil pump relief valve plug	27 - 33
Oil pump to cylinder block	22 - 28
Oil pump strainer to oil pump	40 - 50
Oil squirt jet assembly to cylinder block	14 - 20
Oil strainer to mounting bracket	22 - 28
Plug - blanking oil gallery	32 - 42
Plug - drain oil sump	40 - 50
Plug - drain cylinder block	25
Plug - drain flywheel housing	10 - 14
Plug - inlet manifold (boost take-off)	23 - 27
Side cover to cylinder block	23 - 30
Starter motor to flywheel housing	40 - 50
Sump to ladderframe	22 - 28
Sump to ladderframe/cylinder block	22 - 28
Sump to cylinder block/front cover	20 - 24
Support brackets	
- exhaust manifold to cylinder block	22 - 28
Vacuum pump to cylinder block	22 - 28
Vertical drive shaft gear to cylinder block	22 - 28
Alternator and heat shield to mounting bracket	22 - 28
Adjusting link to alternator	22 - 28
Adjusting link to pas pump plate	22 - 28
Cylinder head to cylinder block	See section 12
Breather cylcone to rocker cover	7 - 10
Engine lifting bracket to cylinder head	22 - 28
Electrical hamess clip to cylinder head	22 - 28
Exhaust manifold to cylinder head	20 - 26
Glow plug terminal nut	3 - 5
Glow plug to cylinder head	15 - 30
Heater stud (water) to cylinder head	15 - 30
Injector clamp stud to cylinder head	6 - 10
Injector clamp to injector nut	20 - 25
Inlet manifold to cylinder head	20 - 26
Rocker cover to cylinder head	3,5 - 4,5
Rocker shaft to cylinder head	28 - 32
Tappet adjusting nut	22 - 26
Thermostat housing to cylinder head	22 - 28
Water outlet to thermostat housing	7 - 10
water temperature switch to thermostat housing	75 - 19
Cowl mounting bracket to front cover	22 - 28
Fan assembly to water pump hub	22 - 28
Front cover plate to cylinder block	22 - 28
Front cover plate to front cover	22 - 28
Front cover to cylinder block	22 - 28
injector pump to front cover	22 - 28
Injector pump stud to front cover	6 - 10

Tdi ENGINE (continued)

	Nm
Injector pump to support bracket	22 - 28
Tensioner (timing belt) to cylinder block	40 - 50
Timing pulley to camshaft	40 - 50
Timing pulley to injector pump hub	22 - 28
TV damper pulley to crankshaft	333 - 350
Water pump to cylinder block	23 - 30
Water pump to cylinder block - stud	23 - 30
Water pump to front cover	22 - 28
Oil drain adaptor to cylinder block - Turbo	22 - 28
Oil drain pump to turbo	32 - 48
Oil feed pipe adaptor to cylinder block - Turbo	22 - 28
Oil feed pipe to turbo	15 - 22
Outlet elbow to turbo - nut	21 - 26
Outlet elbow to turbo - stud	22 - 28
Turbocharger to exhaust manifold	21 - 26
Belt tensioner assembly	
to front cover plate compressor	14 - 16
Compressor to mounting bracket	40 - 50
Compressor mounting bracket	
to front cover and plate	40 - 50
Banjo bolt - fuel pump	10 - 14
Banjo bolt - boost pipe	8 - 12
Banjo bolt - spill rail	20 - 30
Banjo bolt - fuel filter	14 - 20
Banjo bolt - injector spill rail	2
Fuel lift pump to fuel filter unions	10 - 14
Fuel lift pump to cylinder block	22 - 28
Injector pipes to injectors and injector pump	22 - 25
P.A.S. pump to mounting plate	14 - 16
P.A.S. pump mounting plate to front cover	22 - 28
P.A.S. pump pulley to hub	14 - 16
Tappet guide retaining screw	13 - 15

**ENGINE OIL - Tdi ENGINES**

The minimum performance level oil required for satisfactory engine performance and protection is defined by specifications BLS 22.0L.09 and CCMC PD1.

The engine oil and filter must be changed every 10,000 km (6000 miles) and it is important that only oils listed below, or clearly marked as meeting the required specification, should be used. Superior engine protection can be obtained by the use of Super High Performance Diesel (SHPD) oils to specification CCMC D3. Some of the oils meeting the above specifications are listed below:-

Oils to BLS 22.0L.09/CCMC PD1

Agip Superdiesel or Sint Turbo Diesel
 BP Vanellus C3 or Visco Diesel
 Caltex RPM Delo 400*
 Castrol Syntrol X, TXT, Dynamax or GTX
 Century Superb
 Duckhams QXR or Hypergrade
 Esso Superlube EX 2, Superlube +, Ultra Oil or Super Oil
 Gulf Super Diesel or Engine Oil T
 Mobil Delvac Super, Mobil 1 Rally Formula or Mobil 1 Formula 15W/50
 Kuwait Q8 Auto-4 or Q8 Auto-7
 Shell Rimula X or Rotella MTX
 Texaco Dieseltex

SHPD oils to CCMC D3

Agip Sigma Turbo
 BP Vanellus C3 Extra
 Castrol Turbomax
 Century Centurion
 Caltex RPM Delo 450
 Duckhams Fleetmaster SHPD or Fleetmaster Extra
 Elf Multiperformance 4D
 Esso Super Diesel Oil TD or Special Diesel Oil
 Fina Kappa LDO
 Gulf Superfleet Special
 Mobil Delvac 1400 Super
 Texaco Ursa Super TD
 Shell Myrina
 Total Rubia TIR or Total Diesel
 Silkolene Turbolene D

In markets where oils to the above specifications are not available use products to MIL-L-2104D or API CD.

Under severe operating conditions, eg. off road in mud, airborne sand, dust, operating at high speeds in high ambient temperatures above 40°C or continual stop/start operation, the oil and filter change period should not exceed 5000 km (3000 miles). Continuous off road operation in mud, dust and wading conditions requires a monthly oil and filter change. Failure to adhere to the recommended service and operating instructions may result in premature engine wear or damage.

Oil Viscosity - Ambient Temperatures Applications Chart

SPECIFICATION	SAE VISCOSITY	AMBIENT TEMPERATURE "C								
		-30°	-20°	-10°	0°	10"	20"	30"	40"	50"
Oils must meet BLS.22.OL.09 or CCMC PD1 or CCMC D3	5W/30 5W/40) 5W/50)	[Bar chart showing application range from -30°C to 30°C]								
	10W/30 10W/40) 10W/50)	[Bar chart showing application range from -20°C to 40°C]								
	15W/40) 15W/50)	[Bar chart showing application range from -10°C to 50°C]								
	20W/40)	[Bar chart showing application range from 0°C to 50°C]								
		[Bar chart showing application range from 10°C to 50°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.

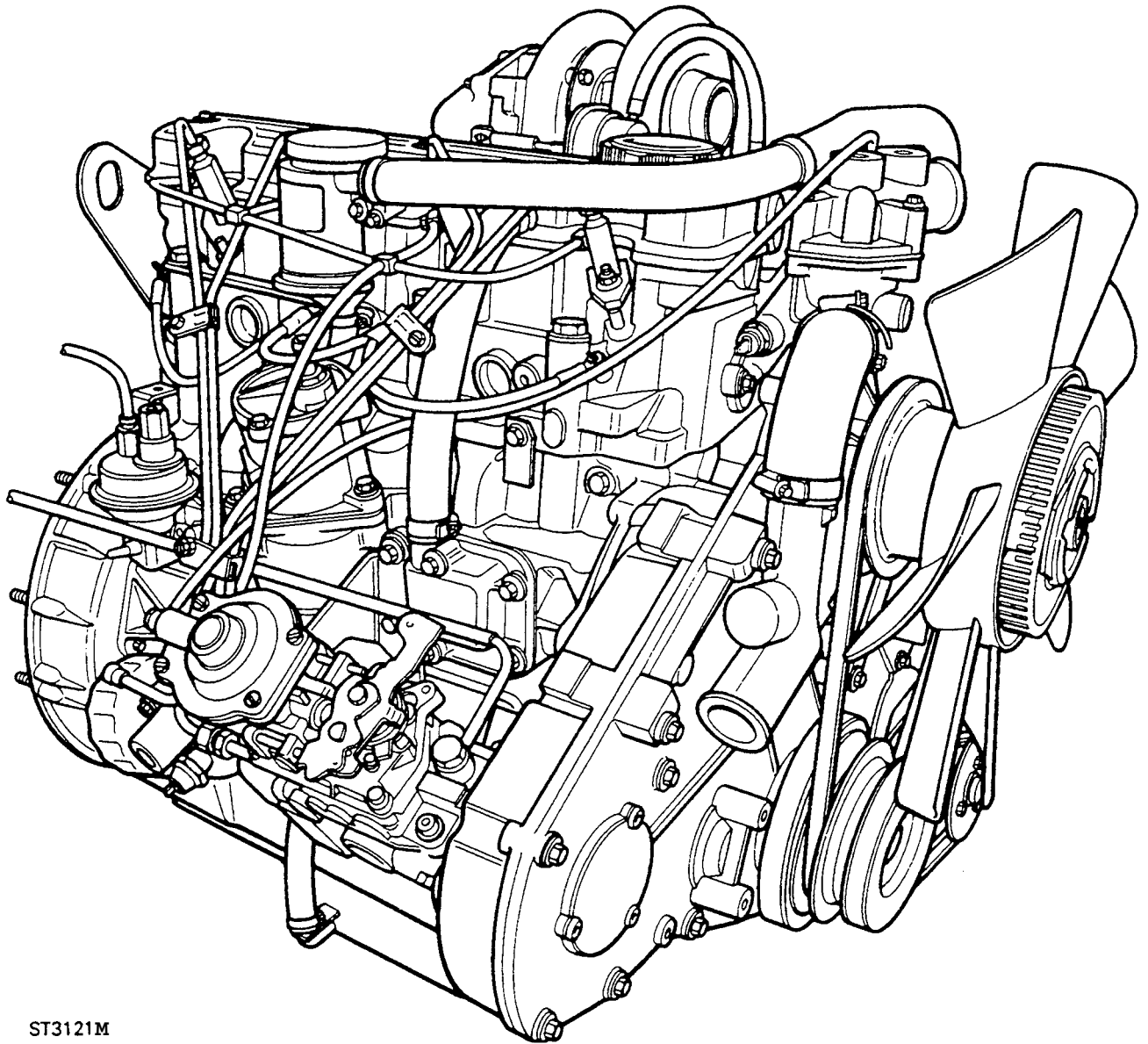
Engine sump oil	6,00 litres (10.56 pints)
Extra when filling following new filter	0,85 litres (1.50 pints)
Transfer box oil	2,30 litres (4 pints)
Cooling system	11,10 litres (20 pints)

Anti-freeze

Ethylene Glycol based anti-freeze (containing no methanol) with non-phosphate corrosion inhibitors only are suitable for use in Tdi engines to ensure protection of the cooling system against frost and corrosion. No inhibitors should be used. Only anti-freeze, summer and winter even in climates where anti-freeze is not necessary.

One part anti-freeze, one part water, i.e. 50% anti-freeze in coolant. Complete protection below -36°C.

See cooling system section 26 for engine protection information.

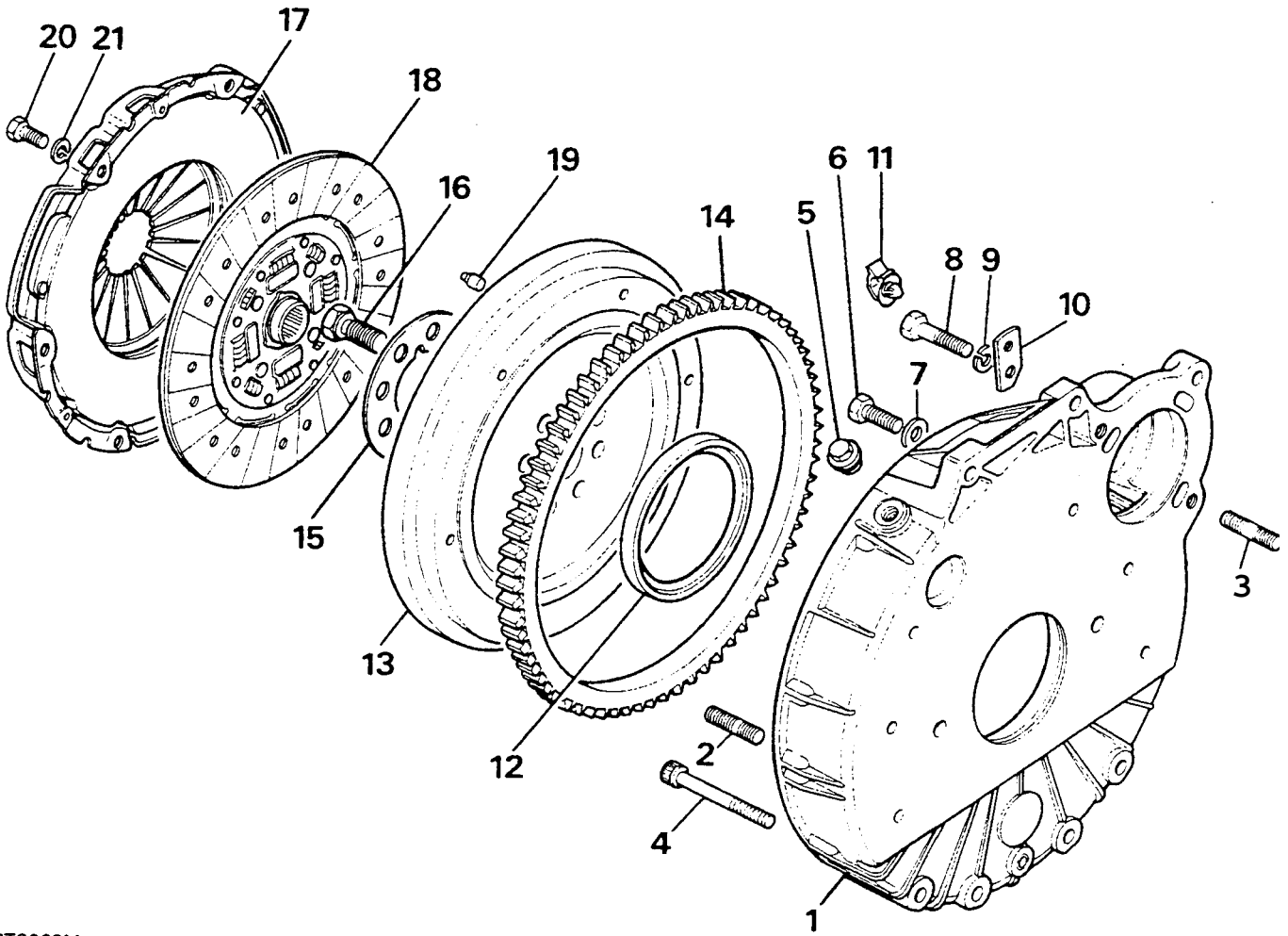


ST3121M

**CLUTCH AND FLYWHEEL HOUSING
COMPONENTS ST3066M •
LAND ROVER Tdi engine**

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



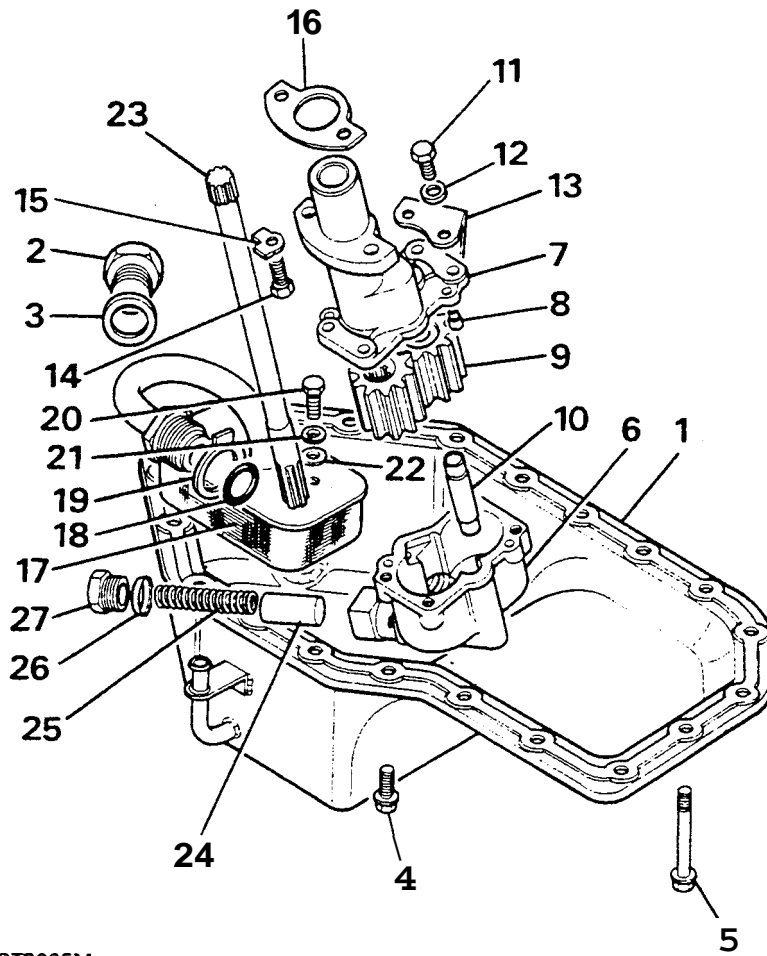


ST3066M

**SUMP AND OIL PUMP COMPONENTS ST3065M -
LAND ROVER Tdi engine**

1. Sump
2. Drain plug
3. Joint washer
4. Flange bolt M8x20 (8)
5. Flange bolt M8x60 (12)
6. Oil pump housing lower
7. Oil pump housing upper
8. Dowel
9. Oil pump gears
10. Spindle
11. Screw
12. Spring washer
13. Support bracket
14. Screw
15. Lock washer
16. Casket
17. Filter
18. O ring
19. Lock washer
20. Screw
21. Spring washer
22. Plain washer
23. Drive shaft
24. Oil relief plunger
25. Spring
26. Joint washer
27. Oil relief plug

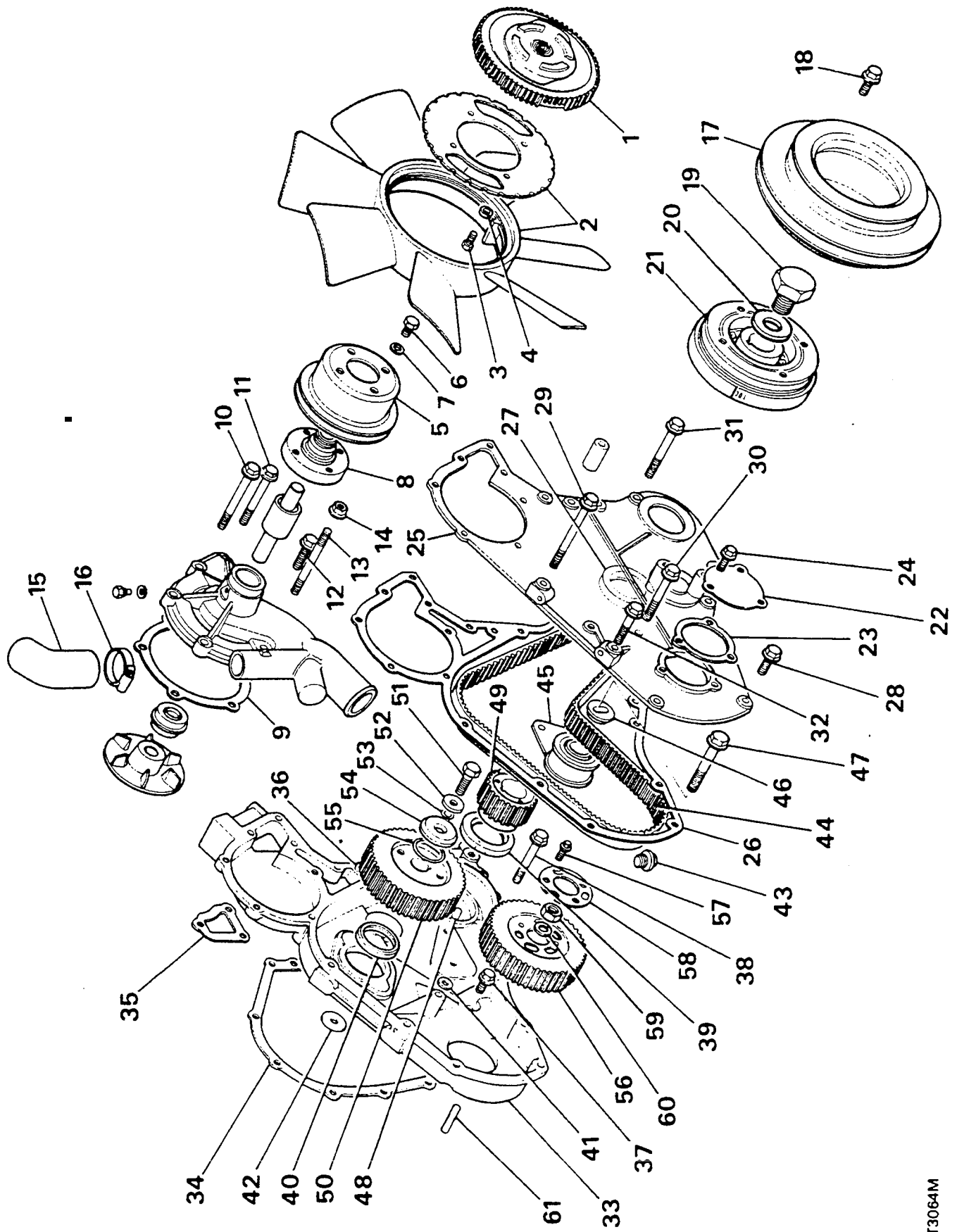




ST3065M

FRONT COVER COMPONENTS ST3064M - LAND ROVER Tdi engine

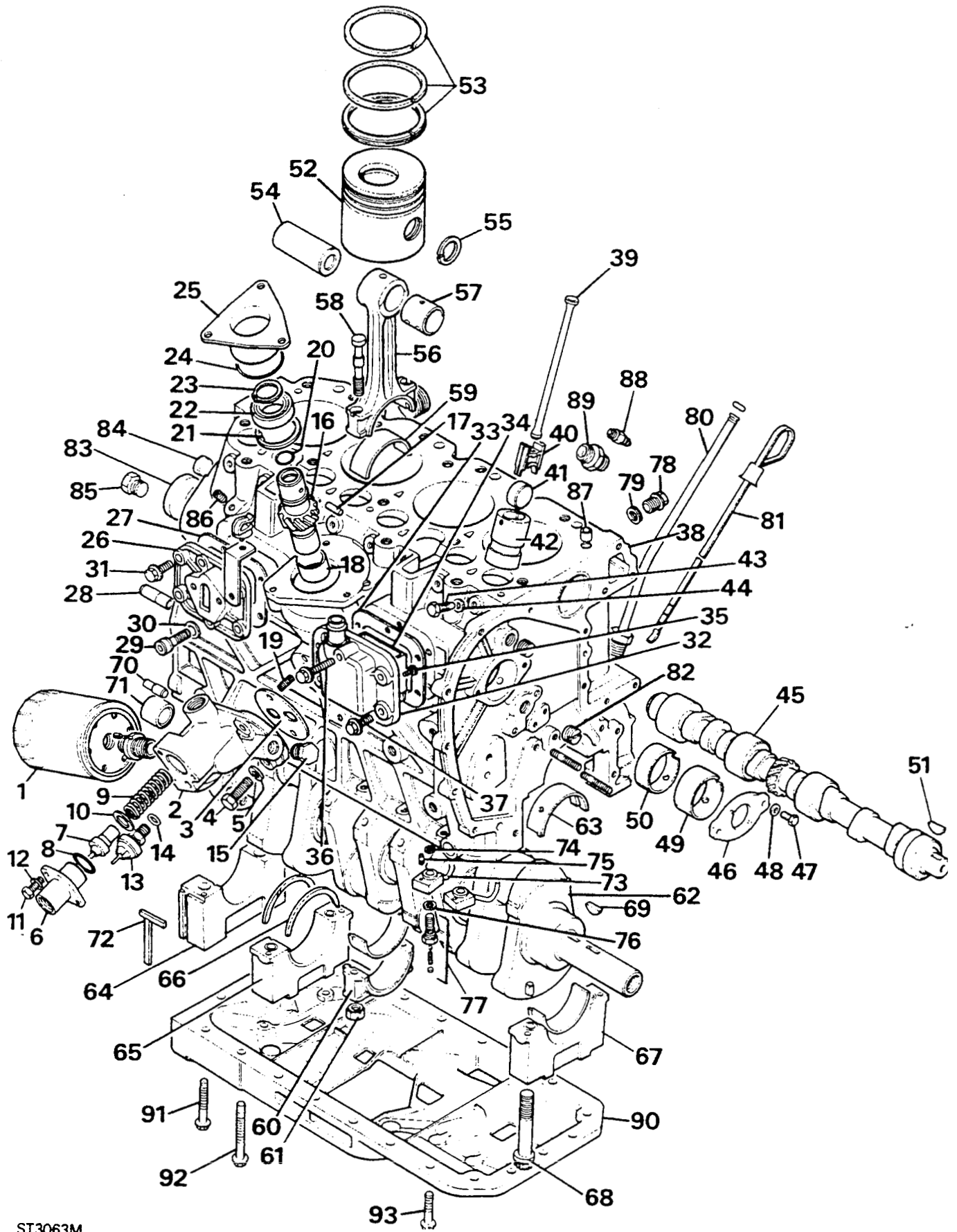
1. Viscous unit
2. Fan assembly
3. Bolt (4)
4. Plain washer (4)
5. Pulley
6. Screw (4)
7. Spring washer (4)
8. Water pump assembly
9. Gasket
10. Flange bolt M8x85 (2)
11. Flange bolt M8x75 (1)
12. Flange screw M8x35 (3)
13. Stud M8
14. Flange nut M8
15. By pass hose
16. Hose clip
17. Crank pulley
18. Flange bolts (4)
19. Crank pulley bolt
20. Washer
21. Torsional vibration damper
22. Inspection plate
23. Gasket
24. Flange screw M6x20 (3)
25. Front cover plate
26. Gasket
27. Cover plate seal
28. Flange screw M8x25 (3)
29. Flange bolt M8x100 (2)
30. Flange bolt M8x70 (2)
31. Flange bolt M8x75 (3)
32. Flange bolt M8x50 (1)
33. Front cover
34. Front cover gasket
35. Front cover/water inlet gasket
36. Front cover dowel
37. Flange screw M8x20 (2)
38. Flange bolt M8x65
39. Crankshaft oil seal
40. Camshaft oil seal
41. Gasket - centre bolt
42. Gasket - block front face
43. Plug
44. Timing belt
45. Timing belt tensioner assembly
46. Slotted washer
47. Flange bolt M10x70
48. Tensioner pivot pin
49. Crankshaft gear wheel
50. Camshaft gear wheel
51. Bolt
52. Washer
53. O ring
54. Retaining plate
55. O ring
56. Injection pump timing gear
57. Flange screw (3)
58. Retaining plate
59. Nut
60. Spring washer (3)
61. Stud injection pump to front cover (3)



ST3064M

**CYLINDER BLOCK COMPONENTS ST3063M -
LAND ROVER Tdi engine**

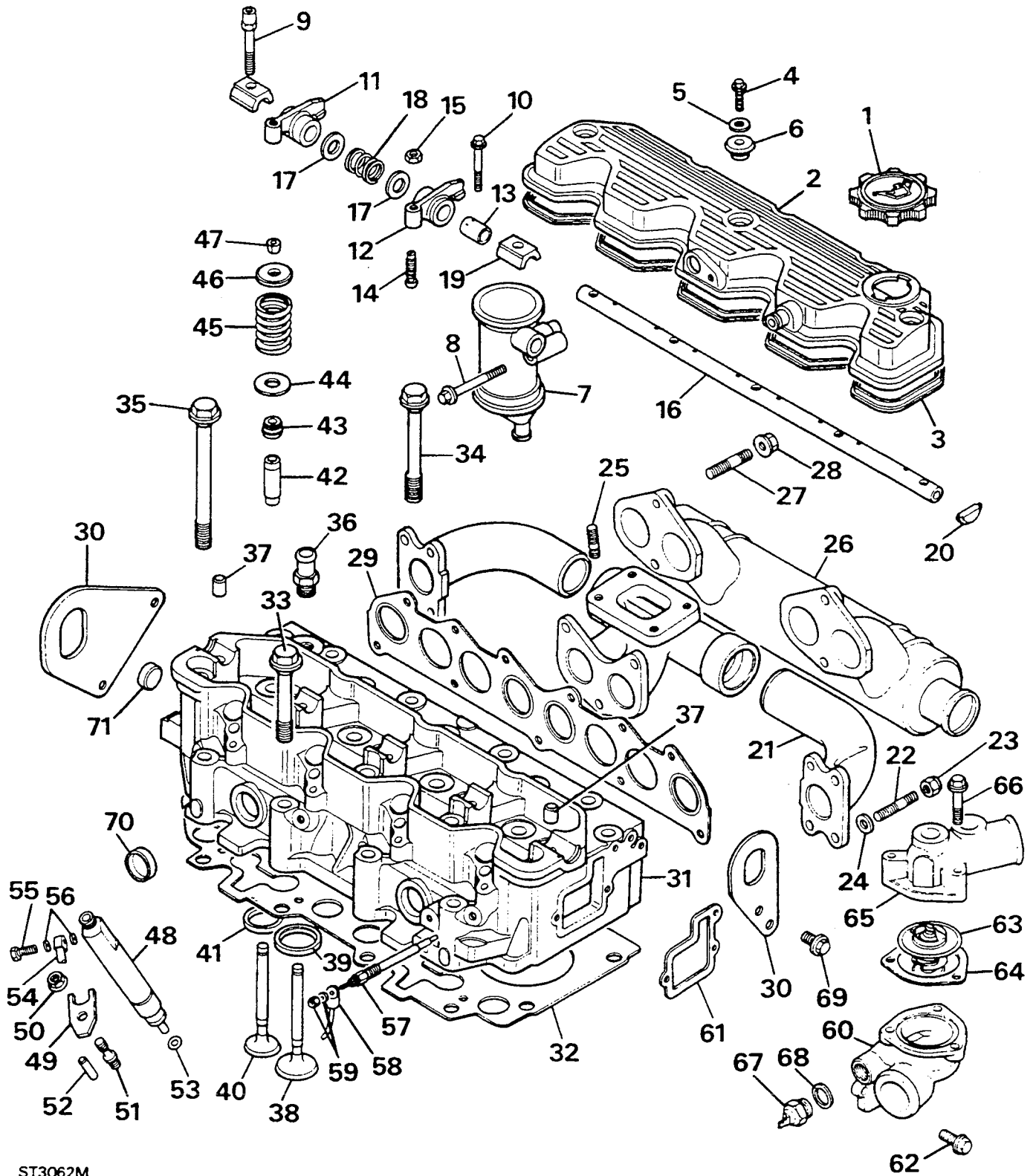
1. Oil filter element
2. Oil filter adaptor
3. Gasket
4. Screw (2)
5. Spring washer (2)
6. Oil cooler adaptor
7. Thermostat bulb
8. O ring
9. Spring
10. Washer
11. Screw (2)
12. Washer (2)
13. Oil pressure switch
14. Copper washer
15. Blanking plug
16. Skew gear
17. Dowel pin
18. Bush
19. Locking screw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



ST3063M

**CYLINDER HEAD COMPONENTS ST3062M • LAND
ROVER Tdi engine**

1. Oil filler cap
2. Rocker cover
3. Rocker cover gasket
4. Flange headed bolt
5. Washer
6. Sealing washer
7. Breather cyclone
8. Flange headed screw
9. Rocker shaft bolt (3)
10. Rocker shaft bolt (2)
11. Rocker arm RH
12. Rocker arm LH
13. Rocker arm bush
14. Tappet adjuster screw
15. Locknut
16. Rocker shaft
17. Rocker shaft spacer
18. Rocker shaft spring
19. Rocker shaft clamp
20. Rocker shaft seal
21. Exhaust manifold
22. Manifold stud - exhaust
23. Self locking nut
24. Plain washer
25. Stud turbocharger mounting
26. Inlet manifold
27. Manifold stud - inlet
28. Flange nut
29. Manifold gasket
30. Engine lifting brackets
31. Cylinder head
32. Cylinder head gasket
33. Head bolts M12 short (4)
34. Head bolts M12 long (10)
35. Head bolts M10 (4)
36. Adaptor cooling system
37. Ring dowel
38. Valve - inlet
39. Valve seat insert
40. Valve - exhaust
41. Valve seat insert
42. Valve guide
43. Valve stem seal
44. Valve spring seat
45. Valve spring
46. Valve spring cup
47. Split cotters
48. Injector
49. Injector clamp
50. Injector clamp nut
51. Injector clamp stud
52. Injector clamp dowel
53. Injector sealing washer
54. Spill return pipe
55. Banjo bolt 6mm
56. Copper washers
57. Glow plug
58. Glow plug cable
59. Nut and washer
60. Thermostat housing
61. Casket
62. Flange screw (3)
63. Thermostat
64. Gasket
65. Thermostat housing cover
66. Flange bolt M6x40 (3)
67. Thermal transmitter
68. Joint washer
69. Flange bolt
70. Cup plug (1)
71. Cup plug (2)



ST3062M

The following list of operations can be carried out with the engine installed using the appropriate sections of the ENGINE OVERHAUL PROCEDURE.

OPERATION	Remove Page	Overhaul Page	Refit Page
Cylinder Head	38	72	76 - 77
Heater plugs	38	-	80
injectors	38	-	80
Rocker cover	39		79
Rocker shaft	39	78	78
Removing cylinder head	40		76
Front cover oil seals/timing belt/camshaft	40	66	62 - 66
Water pump	40		70
Front cover plate or seal	40	-	66
Front pulley damper	40	-	69
Front cover plate	41	-	69
Removing timing belt	41 - 42	-	68
Removing timing belt gears	43	-	66
Removing injection pump	44	-	67
Removing front cover	44		66
Vacuum pump/skew gear/bush/oil filter adaptor	44 - 45	63	63 - 64
Fuel pump and side cover	46	-	65
Front side cover plate	46		65
Camfollowers	46		62
Removing camshaft	47		62
Sump and oil pump	48	70	72
Removing oil pump	48		72

The foregoing list of remove and refit operations are those which can be carried-out with the engine in the vehicle. Cross reference, where necessary, is made to the relevant instructions in the engine overhaul procedure 12.41.05. Each operation is numbered with the appropriate Repair Operation Time Contained in publication SMR 670 EN RT A91.

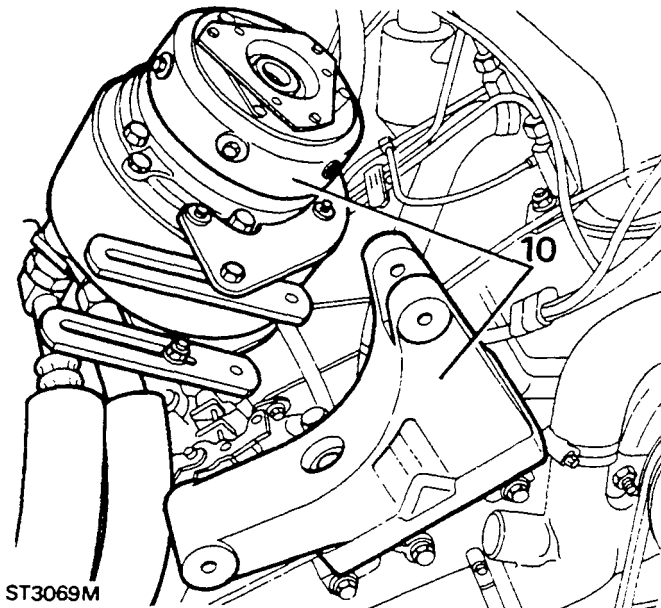
OPERATION	Number	Page
Camshaft	12.13.02	30
Power steering pump bracket	12.35.22	31
Cylinder head	12.29.02	32
Fuel injection pump	19.30.07	81
Air cleaner	19.10.01	84
Turbo charger	19.42.01	35
Inter Cooler	19.42.15	86
Cooling system	26.10.01	87
Fan cowl	26.25.1 1	88
Fan and coupling	26.25.19	88
Radiator	26.40.01	89
Water pump	26.50.01	90
Exhaust and inlet manifolds	30.15.01	91
Power steering pump	57.20.14	93
Alternator	86.10.02	94

CAMSHAFT

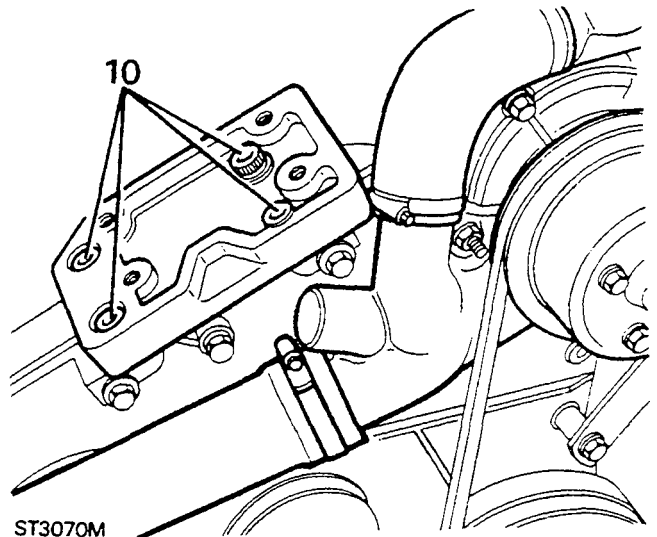
Service Repair No. 12.13.02.

Remove and refit

1. Remove the bonnet and disconnect the battery.
2. Disconnect the radiator bottom hose and allow the coolant to drain and reconnect the hose.
3. Remove the radiator top coolant hose,
4. Remove the fan and viscous coupling assembly, see operation 26.25.19. instructions 4 to 7.
5. Remove the fan cowl.
6. Remove the radiator, see operation 26.40.01. instructions 3 to 5 and 7 to 8.
7. Remove the air cleaner, see operation 19.10.01. instructions 1 to 5.
8. Remove the alternator, see operation 86.10.02. instruction 5 to 9.
9. Remove the power assisted steering pump bracket, see operation 12.25.22 instructions 4 to 9.
10. Remove the air conditioning compressor, where fitted, and the mounting bracket together with the platform secured by four socket headed bolts. Note that the hoses must not be removed from the compressor but it should be carefully secured to one side.



ST3069M

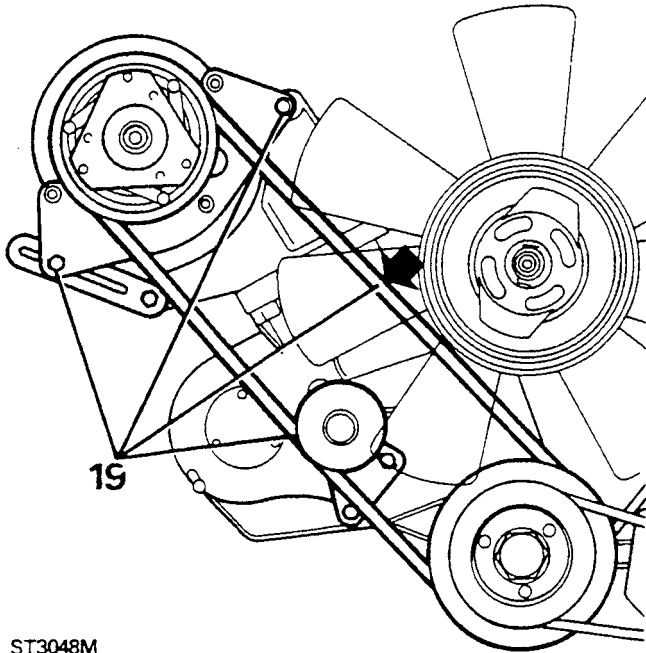


ST3070M

11. Remove the exhaust and inlet manifolds, see operation 30.15.01 instructions 4 to 15.
12. Remove the cylinder head, see operation 12.29.02 instructions 6 to 7 and 9 to 17.
13. Now follow the instructions in ENGINE OVERHAUL section 12. **SEE INDEX:-**
Operations with engine installed in vehicle

Refitting

14. Follow the instructions for fitting the camshaft and assembly of the engine up to the fitting of the rocker cover, crankshaft damper and pulley.
15. Fit the inlet and exhaust manifolds see operation 30.15.01 instructions 16 to 24 and 27.
16. Fit the power assisted steering pump bracket and secure and the four bolts.
17. Fit the power steering pump to the bracket with the single pivot bolt and clamp bolts. Leave the bolts slack at this stage.
18. Fit the alternator to the common bracket, see operation 86.10.02 instructions 10 to 15.
19. Where applicable, fit the air conditioning compressor and tension the drive belt as follows:- Move the compressor clockwise about the pivot bolts (do not use a lever against the pump) until the belt deflects 12 mm (0.5ins.) at the mid point of the run between the compressor and crankshaft pulleys. Tighten the pivot and clamp bolts. Move the drive belt damper so that it is just in contact with the belt or 1,0mm clear of the belt and tighten the damper bolts.



ST3048M

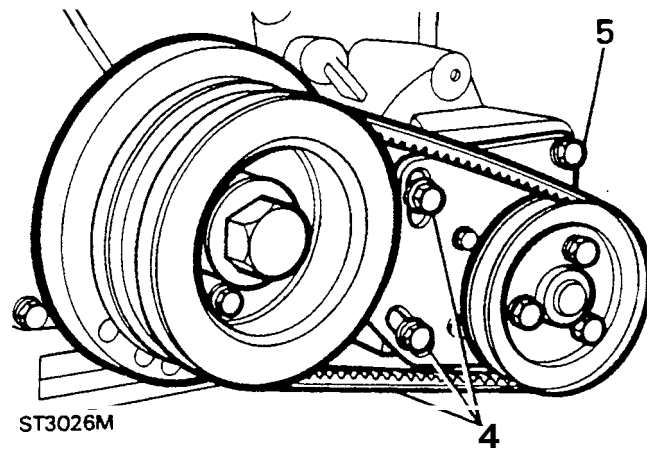
20. Fit and tension the power steering pump drive belt, see operation 57.20.14 instruction 10. Take note of the CAUTION when tensioning the belt.
21. Fit the air cleaner, see operation 19.10.01 instructions 12 to 14.
22. Fit the radiator, see operation 26.40.01 instructions 9 to 15.
23. Fit the fan cowl in position but do not secure to the radiator.
24. Fit the fan and coupling assembly, see operation 26.25.19 instructions 8 to 11.
25. Fill the cooling system, see operation 26.10.01 instructions 5 to 8.

POWER STEERING PUMP BRACKET

Service Repair No. 12.25.22

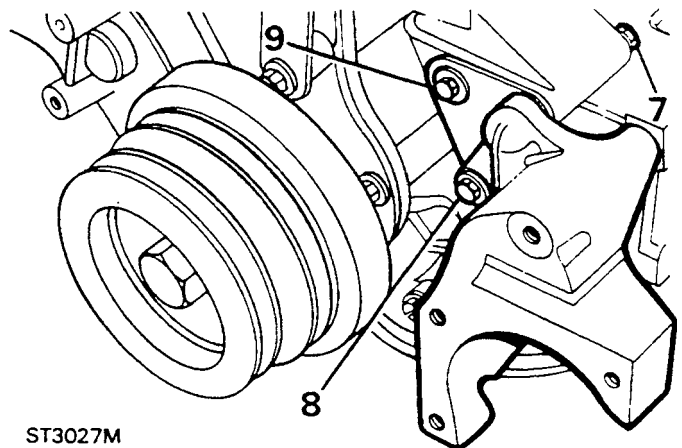
Remove and refit

1. Disconnect the battery.
2. Remove the air cleaner, see operation 19.10.01.
3. Remove the alternator, instructions 2 to 9 operation 86.10.02.
4. Remove the steering pump two adjustment clamp bolts and remove the drive belt.
5. Remove the single pivot bolt.



ST3026M

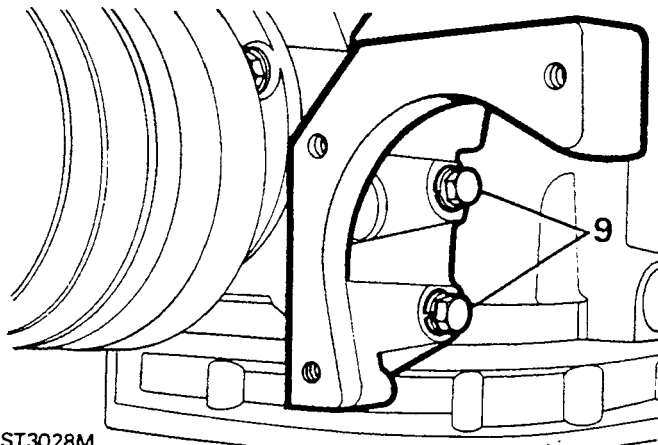
6. Move the pump aside with the two hoses still attached to gain access to the bracket four retaining bolts.
7. Remove the single long bolt through the cylinder block into the bracket.
8. Remove the single bolt from the front into the cylinder block.



ST3027M

Continued

- Remove the two bolts inside the bracket into the front cover and remove the bracket and triangle shaped packing plate.



ST3028M

Refitting

- Fit the bracket to the cylinder block with the four bolts, reversing instructions 7 to 9.
- Loosely secure the pump to the bracket with the three bolts.
- 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.

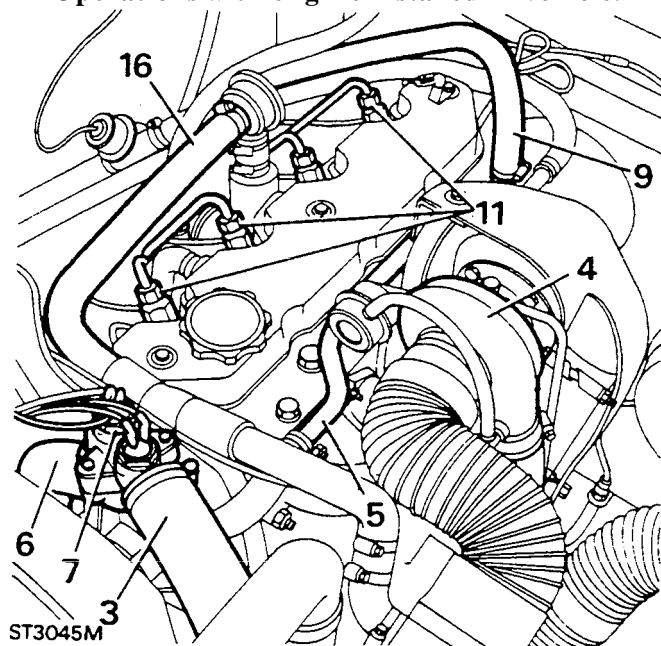
- Tighten the two clamp bolts and single pivot bol. The belt is correctly tensioned when the belt can be deflected by thumb pressure 12 mm (0.5ins.)
- Fit the alternator and tension the drive belt, see operation 86.10.02.
- Fit the air cleaner.
- Connect the battery, run the engine at a fast idle for approximately three to five minutes. Stop the engine and check the drive belt tensions.

CYLINDER HEAD

Service Repair No. 12.29.02.

Remove and refit

- Remove the bonnet and disconnect the battery.
- Drain the coolant.
- Remove the radiator top hose.
- Remove the exhaust and inlet manifolds, complete with turbo charger see operation 30.29.02.
- Remove the heater rail.
- Remove the thermostat to waterpump hose.
- Disconnect the electrical leads from the thermostat housing sensors.
- Disconnect the harness from the alternator.
- Remove the heater hose from the cylinder head.
- Remove the axle breather pipe bracket from the rear of the cylinder head.
- Remove the fuel pipes from the injectors and injector pump.
- Remove the spill return pipes from the injectors.
- Remove the injectors and washers and place in a clean, sealable container, for safe keeping.
- Remove the electrical leads from the heater plugs.
- Remove the heater plugs and store in a safe place.
- Remove the hose from the breather valve.
- Follow the instructions in the ENGINE OVERHAUL section 12. **SEE INDEX:- Operations with engine installed in vehicle.**



ST3045M

Continued

Refitting

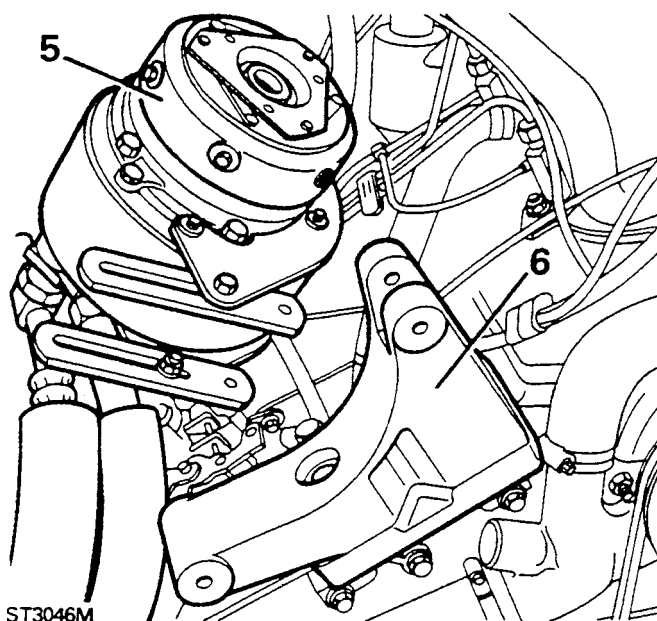
18. Follow the instructions in ENGINE OVERHAUL from "fitting cylinder head" and continue until the rocker cover is fitted.
 19. Fit the heater plugs and connect the electrical leads. Do not allow any part **of** the lead or insulation to touch the cylinder head when fitted.
 20. Fit the injectors - see ENGINE OVERHAUL.
 21. Fit the spill return pipes to the injectors.
 22. Fit the supply pipes to the injectors and pump.
 - 23.** Fit the hose to the breather valve.
 24. Fit the axle breather bracket.
 25. Fit the heater hose to cylinder head.
 - 26.** Connect the harness to the alternator.
 27. Fit the waterpump to thermostat hose.
 28. Connect the leads to the thermostat sensors.
 29. Fit the inlet and exhaust manifolds and heater rail.
 30. Fit the radiator top hose.
 31. Fill the cooling system, see operation 26.10.01.
 32. Fit the bonnet.
-

CAMSHAFT TIMING BELT

Service Repair No. 12.65.18

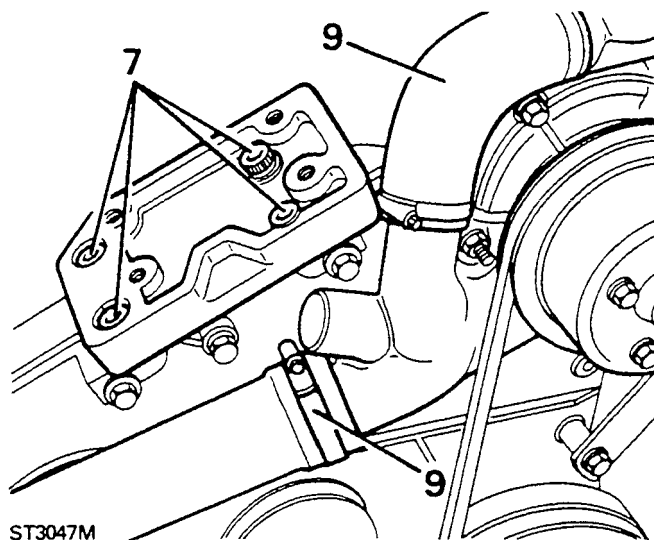
Renew

1. Disconnect the battery.
2. Remove the fan and viscous coupling assembly, see operation 26.25.19.
3. Slacken and remove the power steering pump drive belt, see operation 57.20.14.
4. Slacken and remove the air conditioning compressor drive belt.
5. Remove the air conditioning compressor from the mounting bracket but do not detach the fluid hoses from the compressor. Move the compressor aside taking care not to strain the hoses.
6. Remove the compressor mounting bracket



7. Using an 8,0 mm Allen Key, remove the four socket headed bolts that secure the compressor bracket mounting platform to the front cover and cover plate.
8. Remove the water pump and alternator drive belt, see operation 86.10.02 instructions 4 to 7.
9. Remove the hoses from the water pump.

NOTE: From this stage onwards reference should be made to the instructions in the ENGINE OVERHAUL section 12. **SEE INDEX:- Operations with engine installed in vehicle.** These instructions should be followed to the point when the timing belt has been fitted and the engine and injector pump are correctly timed.



Assembling

10. Fit the front cover plate using a new gasket and a new gasket washer on the centre bolt boss.
11. Secure the cover with the various length bolts tightening evenly to the correct torque. Refer to the bolt length chart in ENGINE OVERHAUL
12. Using a new gasket fit the water pump, see instructions 9 to 12 operation 26.50.01.
13. Connect the hoses to the water pump.
14. Fit the air conditioning compressor bracket mounting platform and secure with the four socket headed bolts.
15. Fit the compressor mounting u bracket.
16. Refer to ENGINE OVERHAUL for the correct method of fitting the crank shaft damper.
17. Fit the pulley to the damper and evenly tighten the four bolts to the correct torque.
18. Fit the water pump pulley and secure with the four bolts. Use a tommy bar in the hole provided to restrain the pulley while tightening the bolts.
19. Fit and tension the water pump/alternator drive belt.
20. Fit and tension the compressor drive belt. SEE OPERATION 12.13.02
21. Fit and tension the power steering pump drive 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.

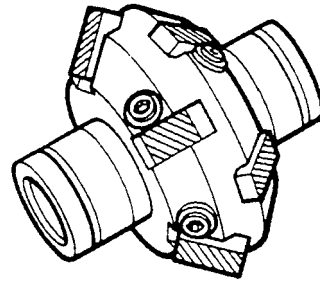
ENGINE OVERHAUL PROCEDURE.

Service Repair No. 12.41.05

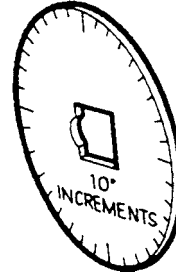
Special service tools

Handle set, seat cutter	MS76B
Pilot, seat cutter	MS150-8
Valve seat cutter	MS621
Cylinder head bolt degree plate	LST122
Adaptor, crankshaft rear seal	18G134-11
Crankshaft rear seal saver	18G1344
Valve spring compressor	MS1519A
Drift, valve guide removal	RO274400
Distance piece, valve guide fitting	RO605774A
Drift, valve guide fitting	LST130
Mandrel, clutch plate	RO605022
Replace, crankshaft front seal	18G1456
Remove. crankshaft/camshaft gear	18G1464
Replace, camshaft oil seal	18G1482
Flywheel timing pin	LST128
Crankshaft damper restraining tool	LST127
Rear main cap seal guide	270304
Crankshaft damper tool	LST136
injection pump timing pin	
- part of LST129 pump remover tool	LST129/2

MS.621

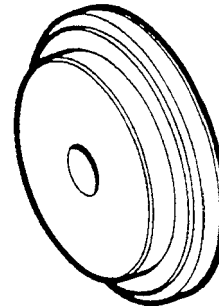


LST. 122

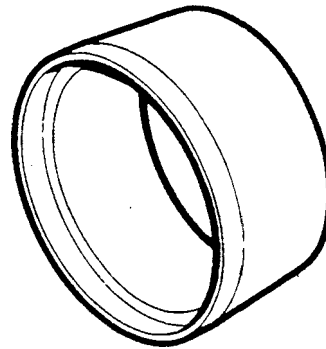


Dia. Range 28.5 mm - 44 mm 15 & 45

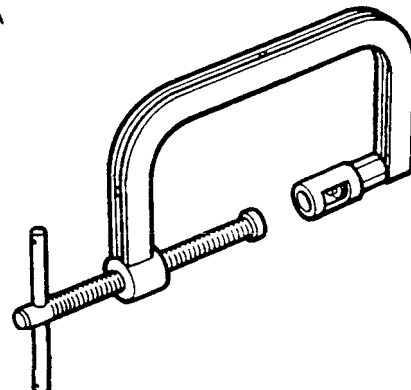
18G.134-11



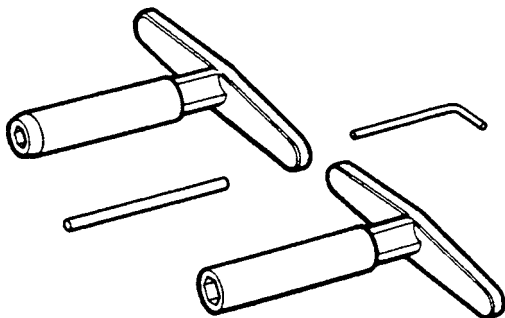
18G.1344



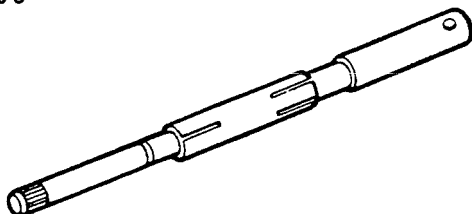
MS. 1519A



MS. 76B



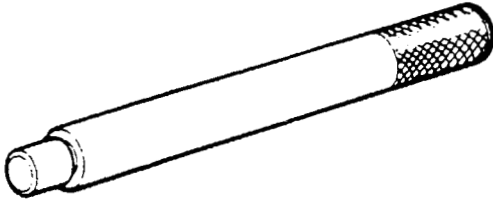
MS. 150-8



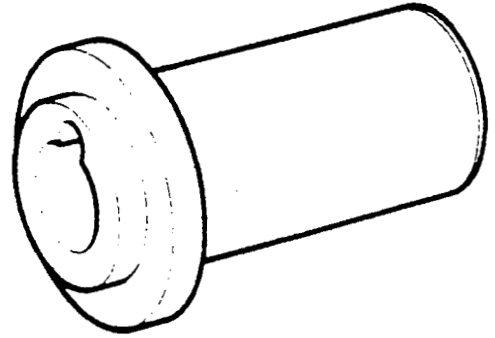
Dia 7.9mm - 8.5mm

SW 5 M

RO.274400



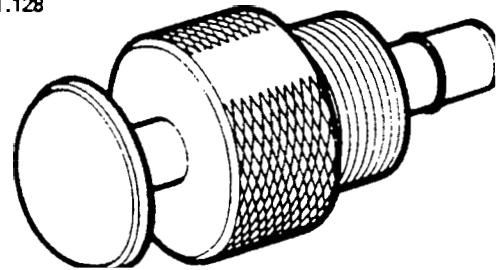
18G.1482



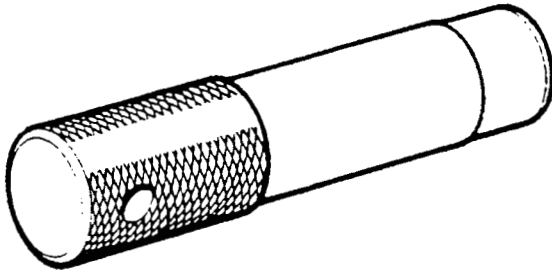
RO.605774A



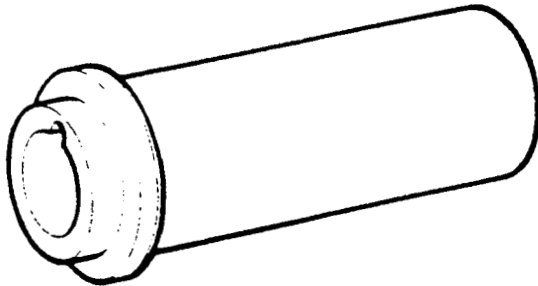
LST.128



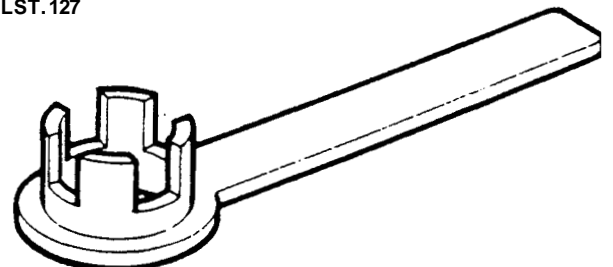
RO.605022



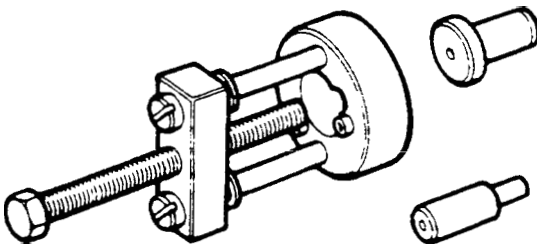
18G.1456



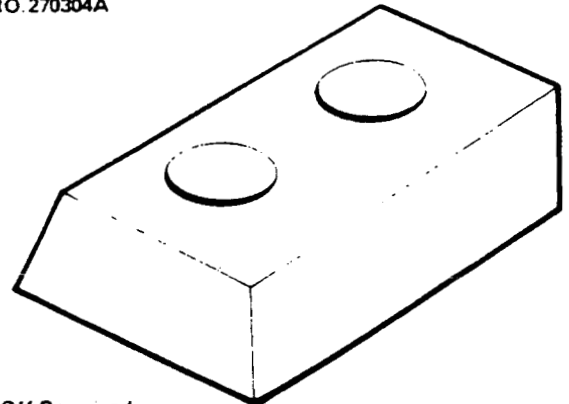
LST.127



18G.1464

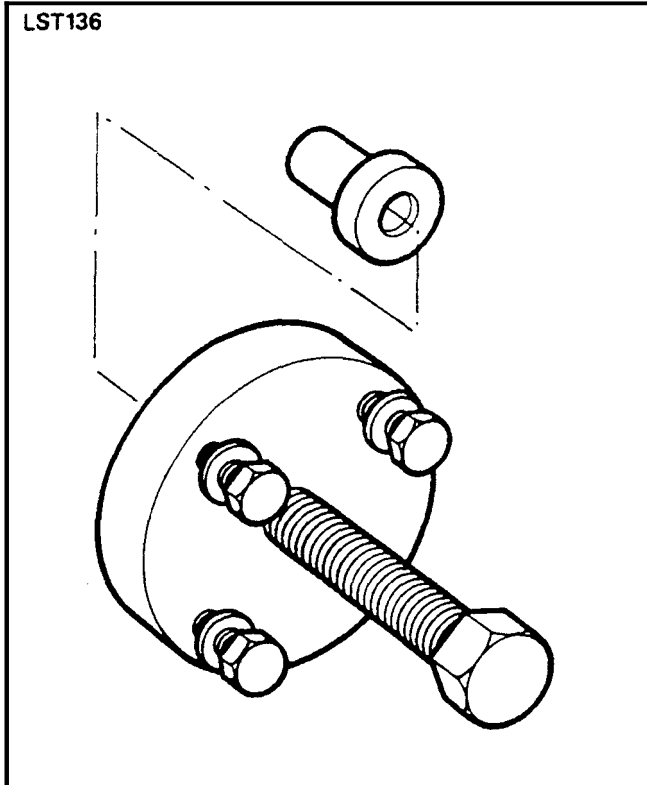


RO.270304A



2 Off Required

ST2944M

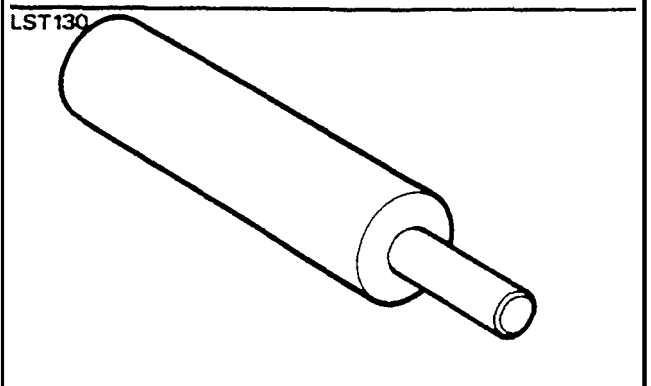
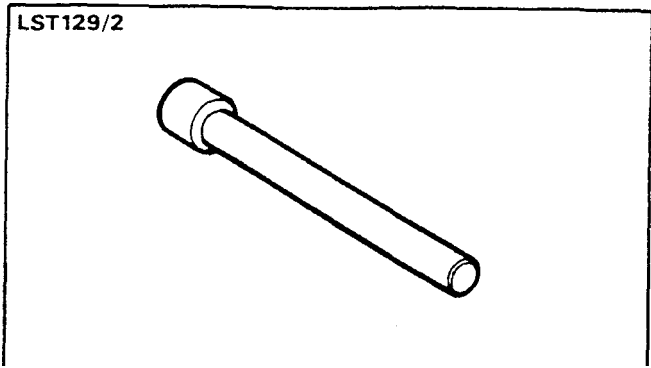


ST2677M

CAUTION AND WARNING

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

WARNING. Where the use of an engine stand is recommended, it is absolutely essential to follow the stand manufactures instructions to ensure safe and effective use of the equipment. in the intrests of safety and efficient working, secure the engine to an engine stand recognised by the garage repair trade. Drain and discared the sump oil whilst strictly observing the the handling and disposal instructions in the Introduction section 01.

**Remove the following ancillary equipment prior to dismantling the engine.**

Air conditioning compressor-where fitted .

Power steering pump and alternator.

Starter motor

Engine electrical harness.

Air Inlet manifold.

Exhaust manifold and turbo charger.

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

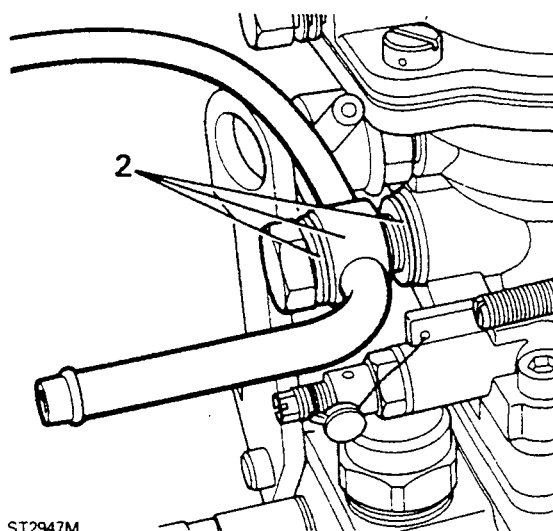
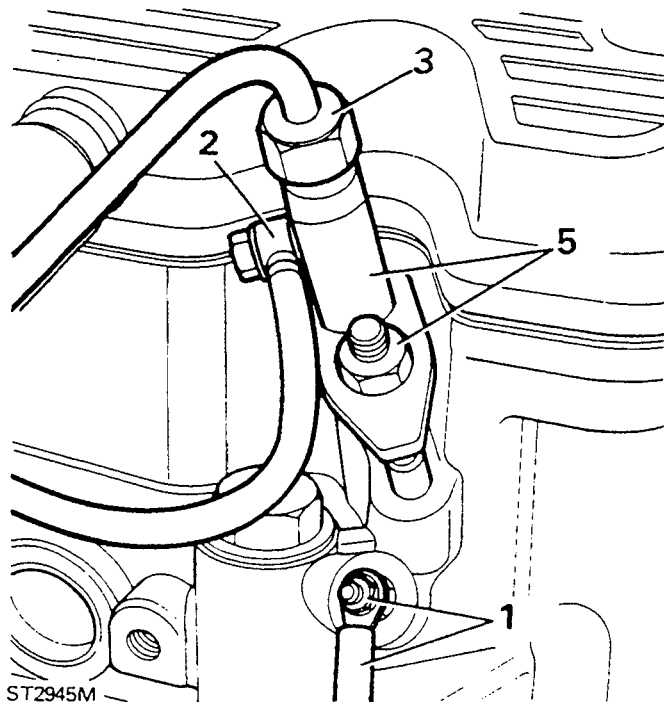
CYLINDER HEAD REMOVE.

CAUTION: Since the injectors and heater plugs protrude below the combustion face of the cylinder head, it is important that they are removed before removing the cylinder head to avoid the possibility of damage to the injectors, heater plugs and pistons.

Heater plugs remove

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

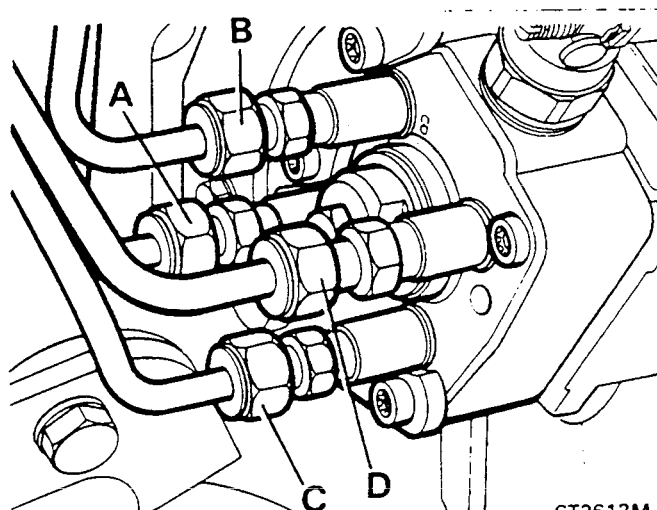
See fitting heater plug



Injectors remove

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

See fitting injectors and pipes



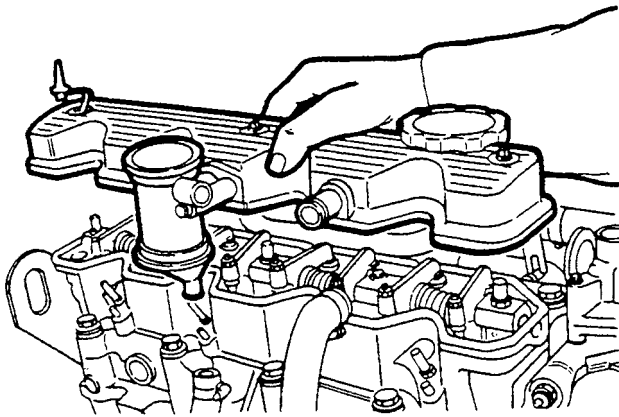
Rocker cover remove.

1. Release the crankcase ventilation hose connections, evenly slacken and remove the three bolts then lift-off the rocker cover.

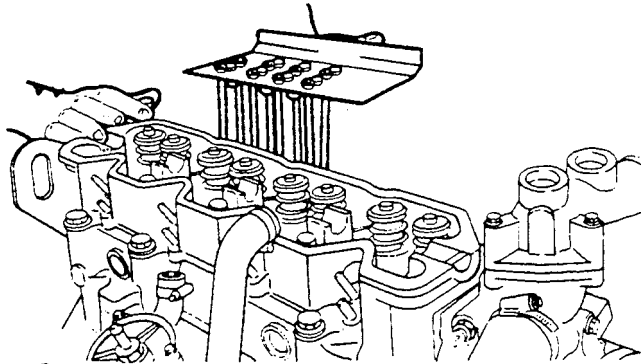
See fitting rocker cover

4. Having removed the rocker shaft, lift-out the push rods and insert them through holes in a piece of card marked from 1 to 8 to ensure assembly to their original locations.

5. Remove the cap from each valve stem.
See fitting rocker shaft



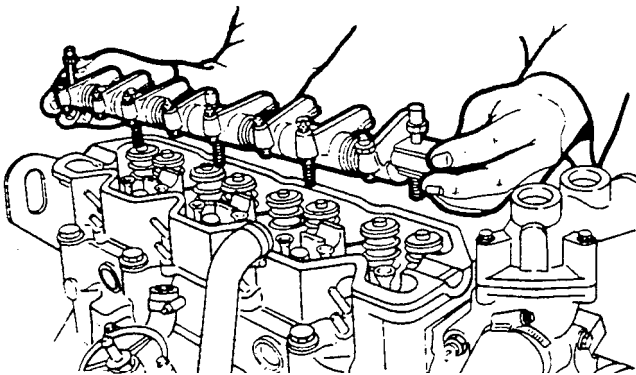
ST2948M



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.

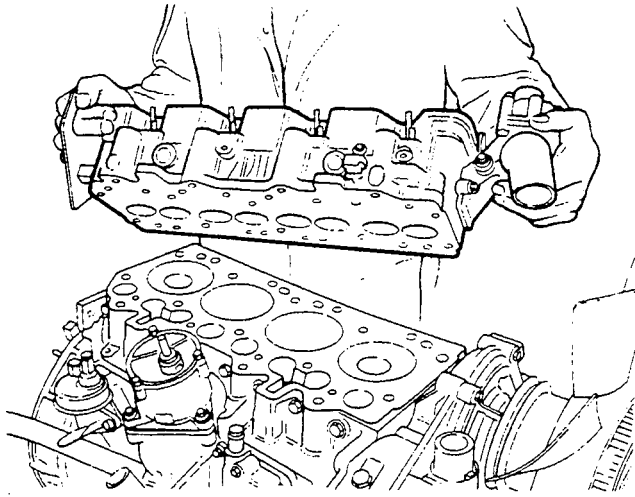


ST2949M

Removing cylinder head

8. Evenly slacken and remove the eighteen bolts retaining the cylinder head and lift the cylinder head from the cylinder block and remove the gasket.

See cylinder head overhaul or see fitting cylinder head



ST2951M

Note:- If necessary, at this stage the cam followers may be removed for inspection. See Cam follower removal

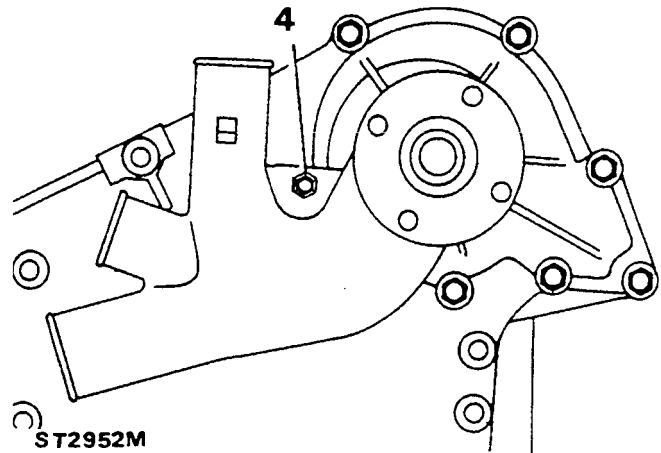
FRONT COVER OIL SEALS/TIMING BELT/CAMSHAFT

See radiator remove/refit

Water pump remove.

1. If necessary remove the viscous coupling complete, with the fan, from the water pump spindle, using a cranked open-ended spanner, noting that it has a left-handed thread.
2. Remove the four screws, to release the pulley from the water pump hub.
3. If necessary release the **two** Jubilee clips and remove the by-pass hose.
4. Evenly release and remove the six bolts and one nut to remove the water pump from the front cover plate.

See water pump inspection and fitting.

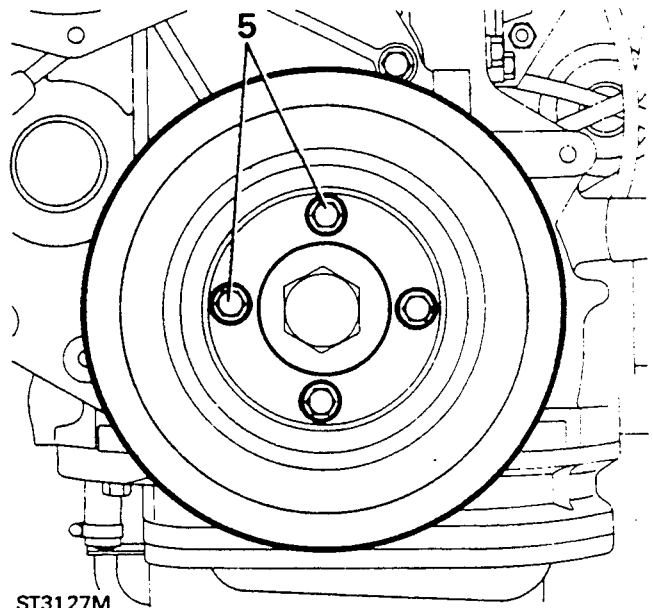


ST2952M

Front cover plate or seal remove

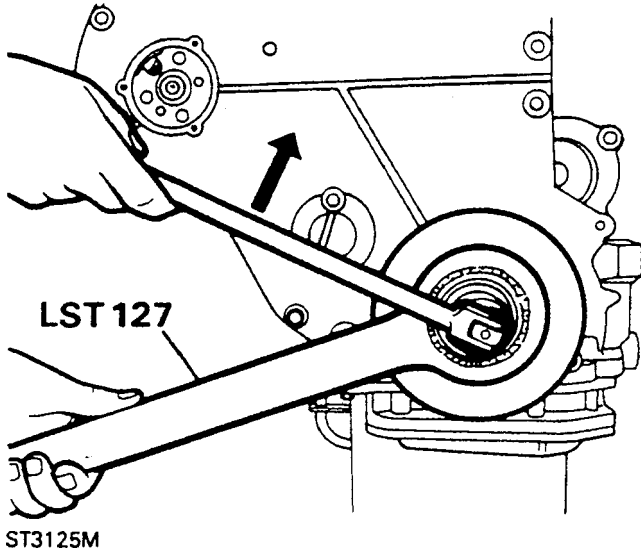
Front pulley and damper.

5. Release the four bolts and remove the crankshaft pulley from the damper.



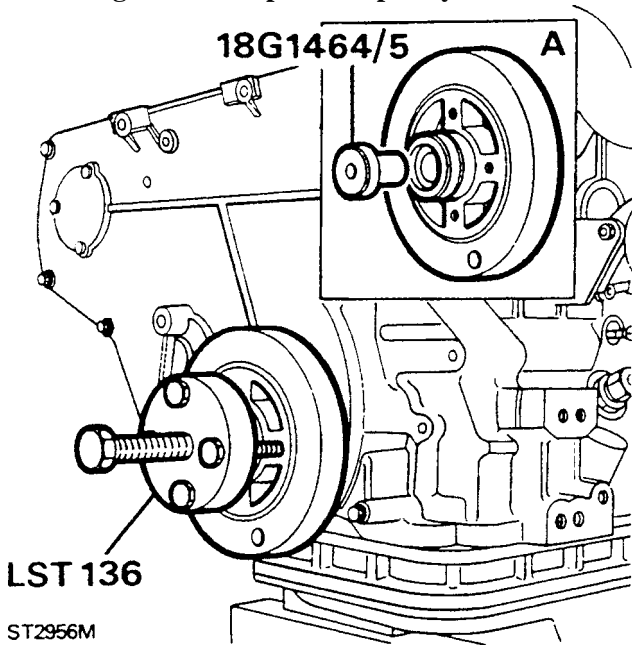
ST3127M

- To remove the crankshaft damper retaining bolt use special service tool FR 101 or LST 127 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 LST 136, extract the damper as illustrated.

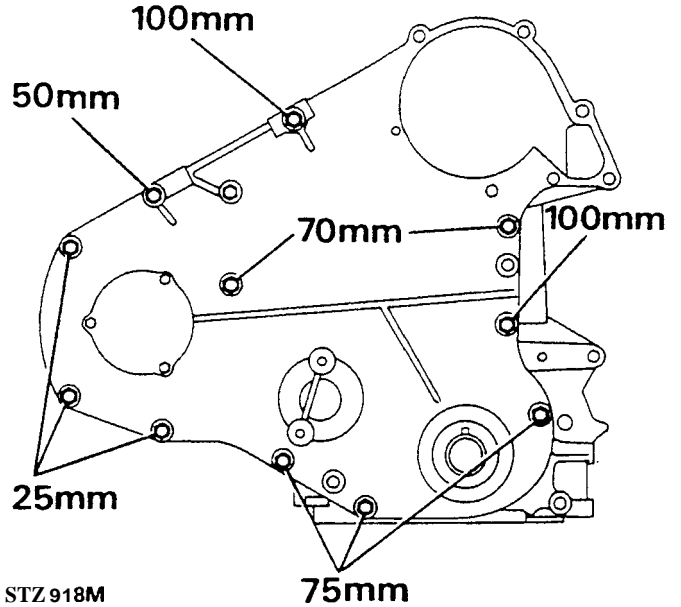
See fitting front damper and pulley



Removing front cover plate.

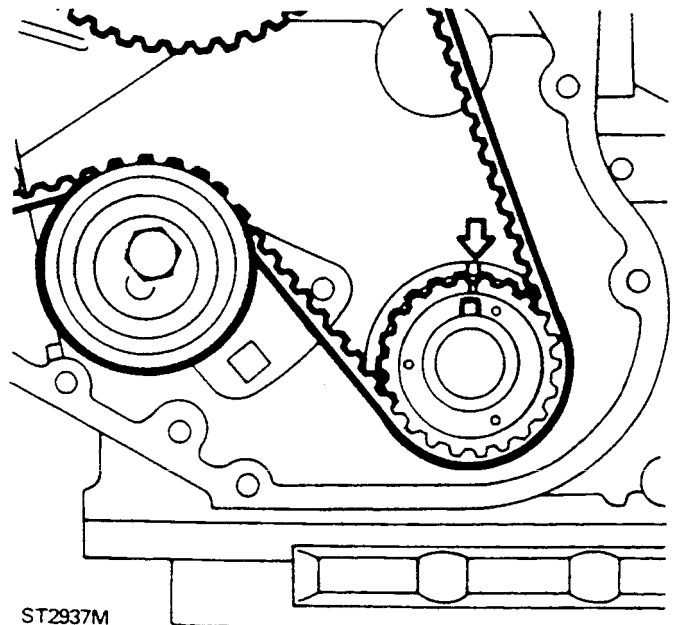
- Unscrew the 11 bolts and one nut to release the cover plate.

See fitting front cover plate

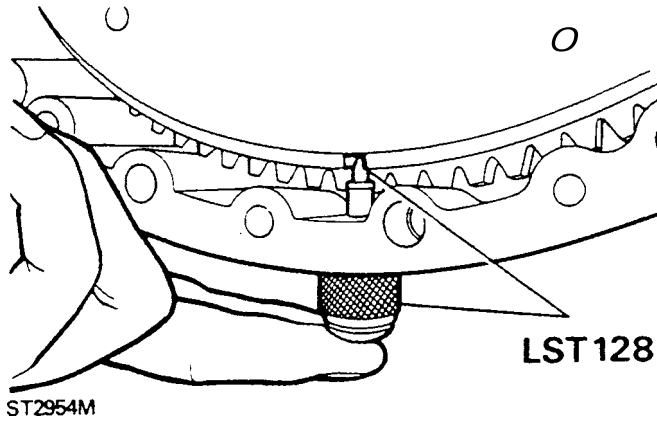


Removing timing belt

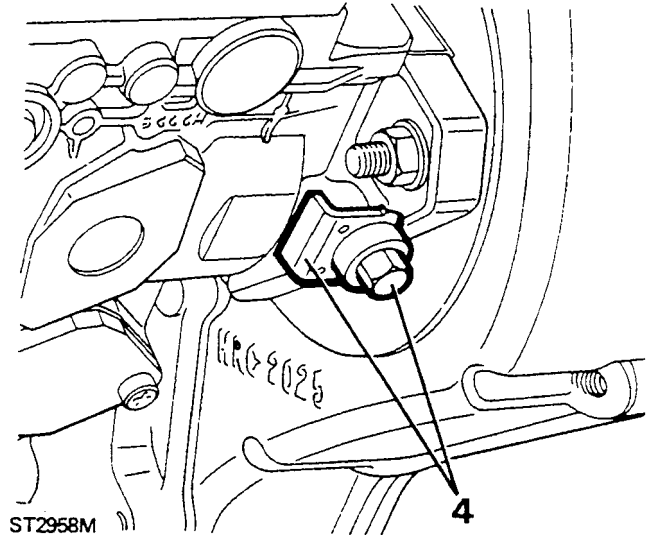
- Use the restraining tool LST 127 to turn the crankshaft in a clockwise direction to TDC so that the valves of number one cylinder are closed with number four cylinder valves on the "rock" and the crankshaft key aligned with the arrow cast into the front cover as illustrated. If the crankshaft is turned inadvertently beyond TDC do not turn it back but continue on round until the above conditions are achieved.



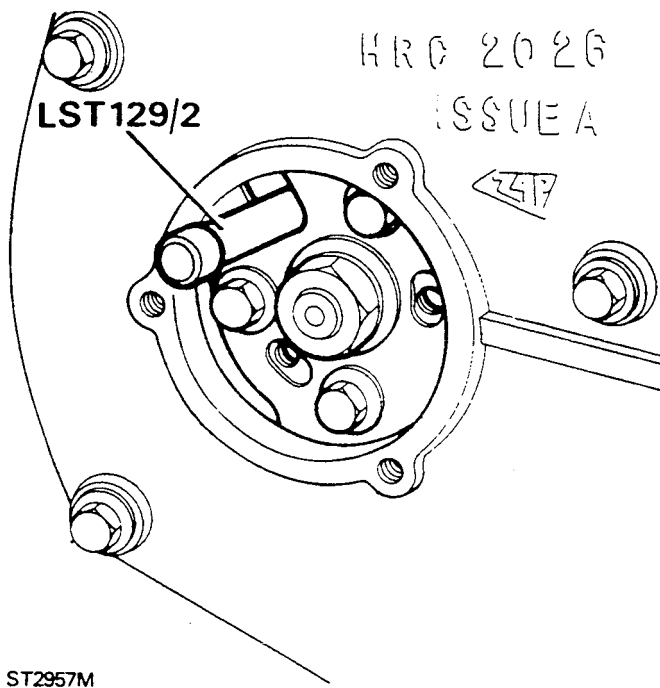
- Now screw the body of the timing pin tool LST 128 into the flywheel housing and check that the pin can be inserted in to the appropriate slot in the flywheel periphery. Note that there are two slots in the flywheel one being wider than the other. The narrowest slot determines TDC for this engine and it is therefore important that the correct slot is used.



- To lock the pump, Slacken the locking screw anticlockwise and remove the inhibiting plate. Turn the screw clockwise to lock the pump shaft. Remove the timing pin from the flywheel housing.



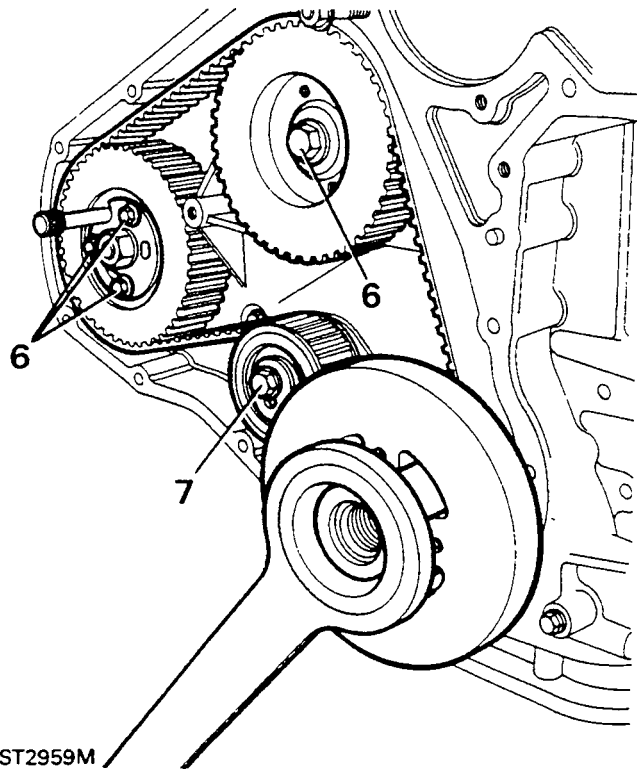
- Remove the three screws to release the injection pump access cover from the front cover plate and insert the locking pin LST129/2 through the "U" shaped cut-out in the pump hub and into the hole in the pump body. This will confirm that the injection pump is correctly timed in relation to the valves 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 FR 101 while the three screws securing the pump timing gear to the pump hub and the camshaft gear wheel retaining bolt is being slackened.
7. Remove the single bolt, special washer and remove the tensioner.
8. If the original belt is to be re-fitted, mark its direction of rotation with soft chalk before removing it.

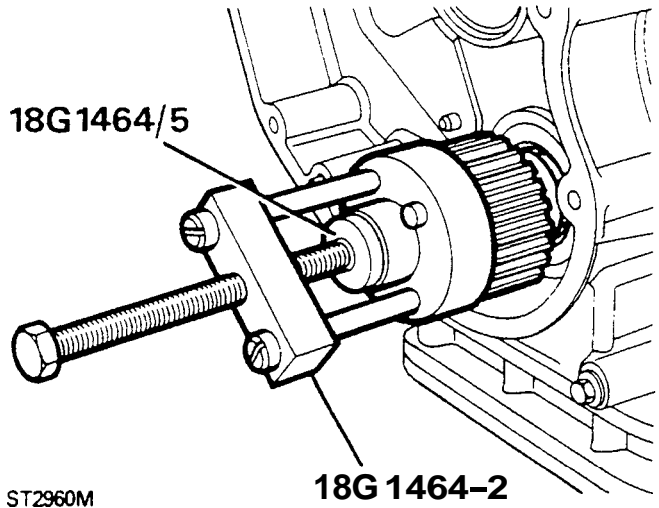


NOTE:- A used drive belt develops a wear pattern relative to the driving loads and its direction of rotation. If the belt is to be re-used it must be refitted so that it continues to operate in the original direction.

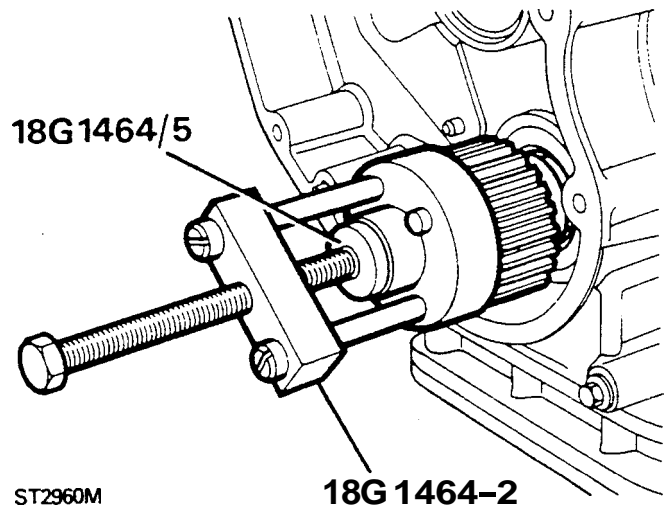
See fitting Timing gears and belt.

Removing timing belt gears

9. If the crankshaft gear wheel cannot be removed by hand, use special service tool 18G 1462-2 and pressure button 18G 1464-5. Assemble the tool and withdraw the gear wheel as illustrated.



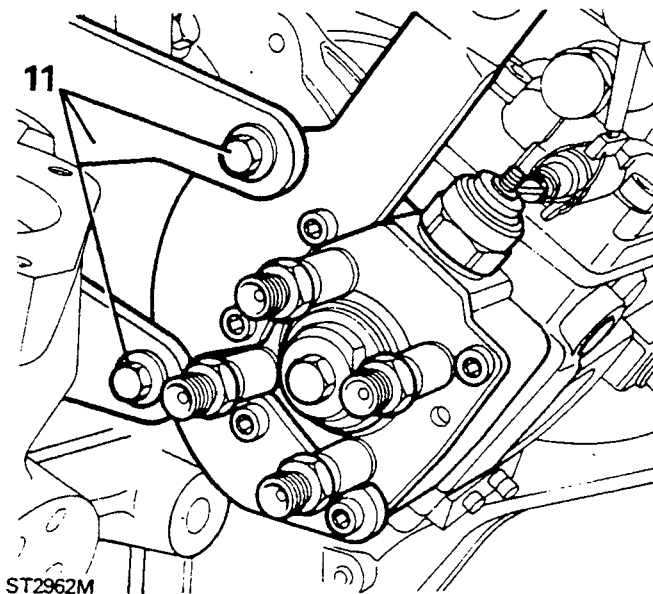
10. Remove the camshaft gear wheel retaining bolt assembly to enable the gear to be removed. Use special service tool 18G 1462-2 and button 18G 1464-6. Assemble as shown and withdraw the the gear.



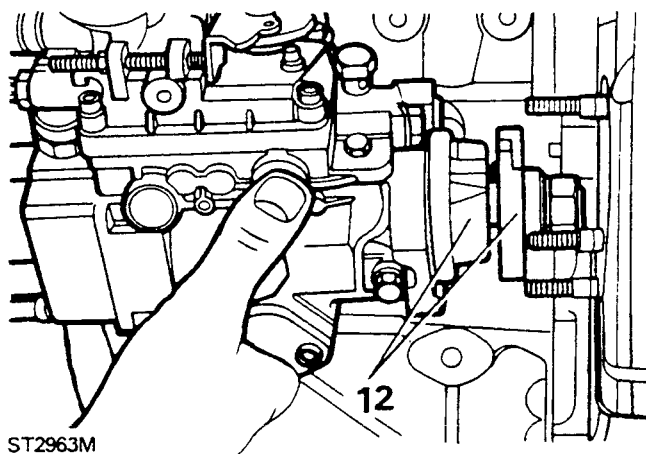
The camshaft and crankshaft oil seals may be renewed at this stage with the engine in the vehicle without removing the front cover.
See fitting front cover seals

Removing injection pump

11. Release the injection pump from the rear support bracket.

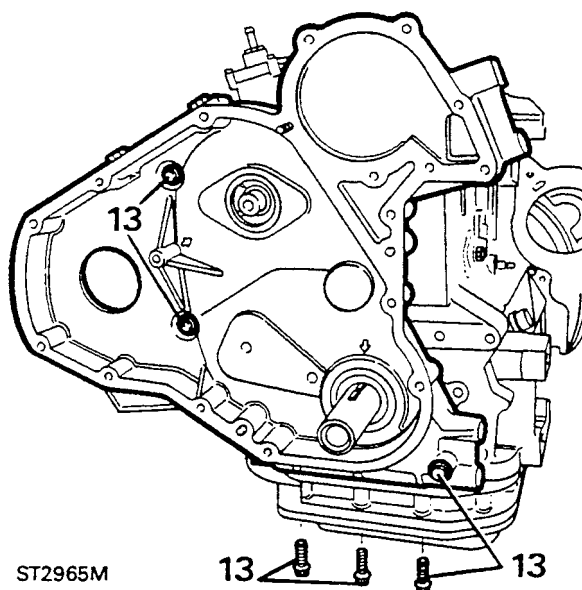


12. Remove the three nuts securing the pump flange to the front cover and withdraw the pump and gasket complete with hub and timing pin.


Removing front cover

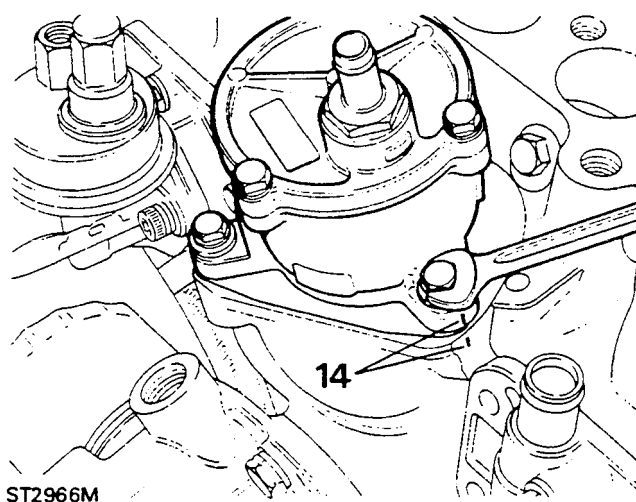
13. To remove the front cover, release the three bolts securing it to the cylinder block front face and the three bolts that pass up through the sump and ladder frame into lower face of the cover.

See fitting front cover timing belt and gears


Removing vacuum pump

14. Mark the position of the brake servo vacuum pump with relation to the cylinder block. Using a 6mm Allen key remove the three screws and lift-out the pump.

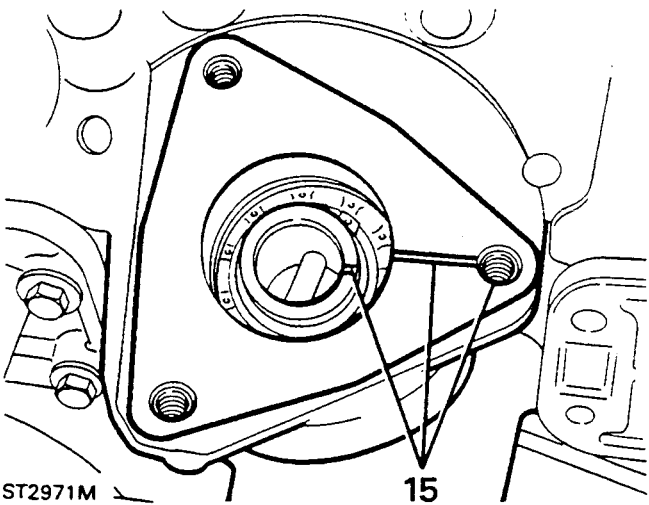
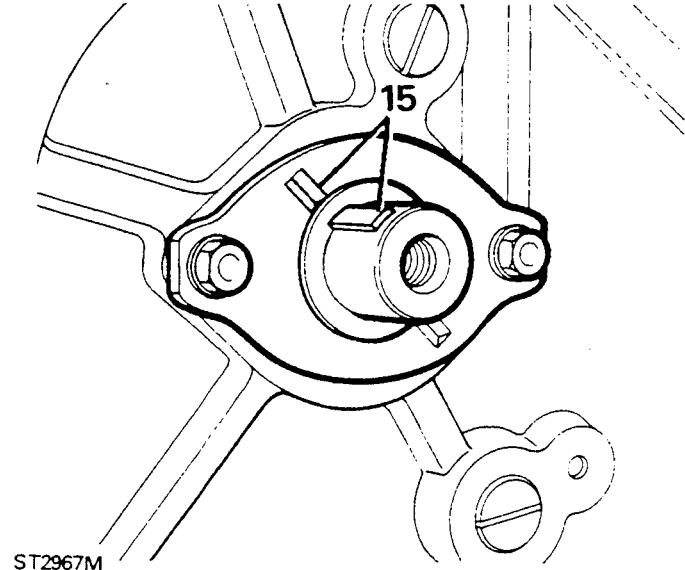
See fitting vacuum pump



Removing skew gear

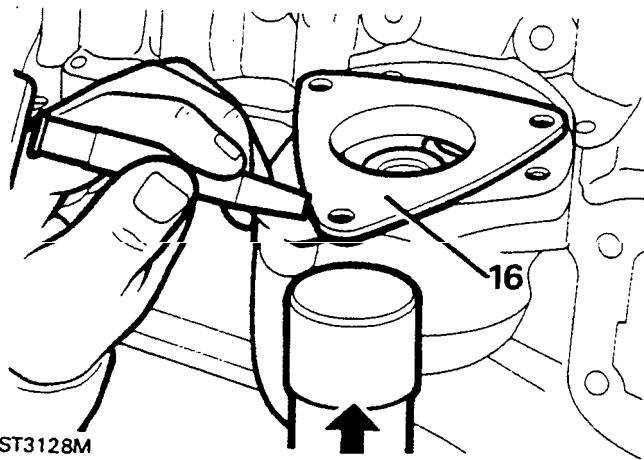
During normal operation of the engine the camshaft and skew gear teeth develop a mated a wear pattern. It is therefore important that if the skew gear is to be re-used it should be fitted so that the teeth on the gear and camshaft engage in the original running position.

15. To ensure orininal re-engagement of the gears turn the camshaft so that the camshaft key is aligned with the oil groove in the thrust plate and mark the position of the skew gear in relation to the one of the three bolt holes for securing the vacuum pump. **Also** mark the skew gear housing flange to the same bolt hole.



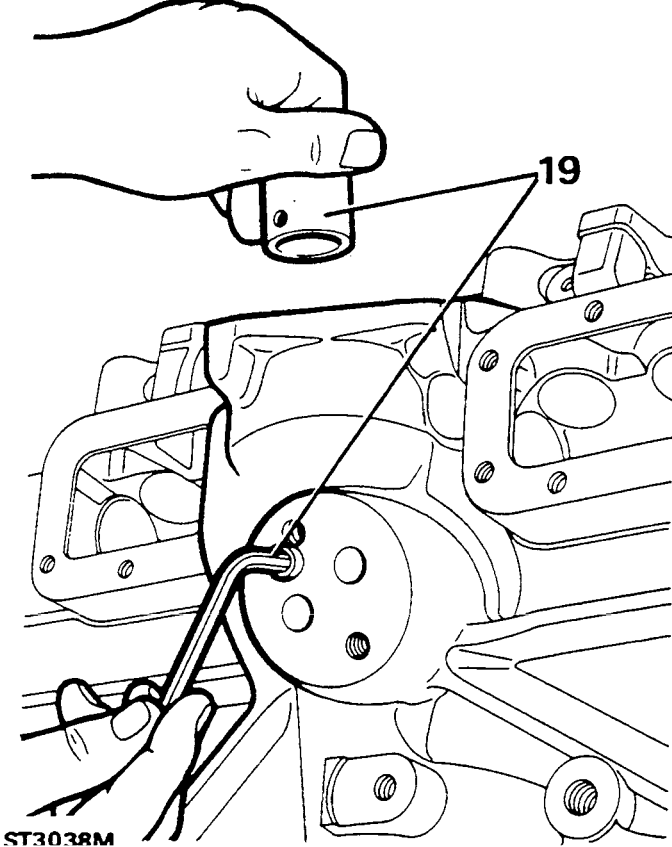
16. To remove the skew gear assembly, tap the flange round so that the edge overlaps the cylinder block, then tap the flange upwards to enable the skew gear assembly to be lifted out.

If necessary the oil pump drive shaft may be removed at this stage



Removing skew gear bush

- 17. Unscrew the oil filter cartridge, anti-clockwise, using a strap wrench. Dispose of the oil safely,
- 18. Release the **two** bolts and remove the oil filter adaptor and gasket from the engine.
- 19. Using a 6 mm allen key remove the retaining screw and bush.



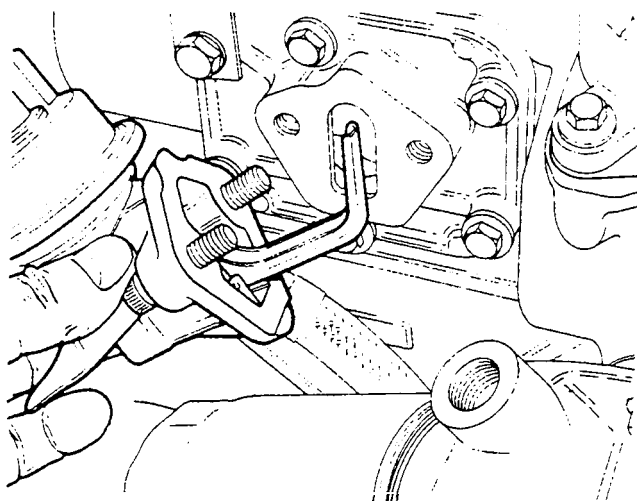
Removing fuel pump and side cover

20. Use a 6 mm allen key to release the fuel lift pump to gain access to the side cover retaining bolts.
21. Release the six bolts and remove the cover plate.

See fitting lift pump.

Remove front side cover plate

22. Release the six bolts and remove the front side cover plate complete with the crankcase ventilation pipe.



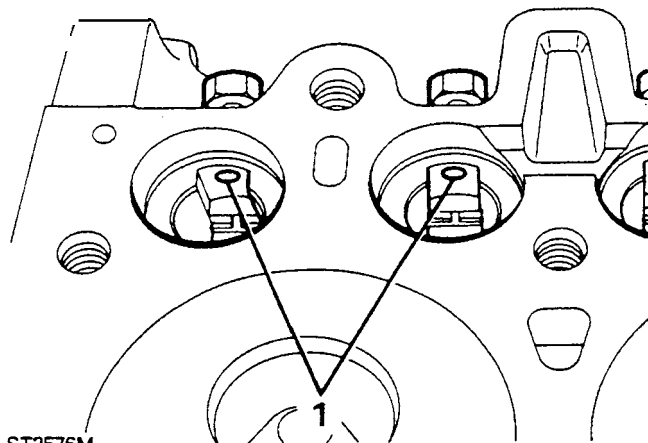
ST3003M

Remove camfollowers

See cylinder head remove

CAUTION: The camfollowers are solid rollers held in position against the cam by a slide inside a fixed guide. If the guide is removed before the roller, it is possible that the roller can fall behind the camshaft and become jammed. Furthermore the roller could slip past the cam and fall into the crankcase. It is therefore important to adopt the following procedure for removal.

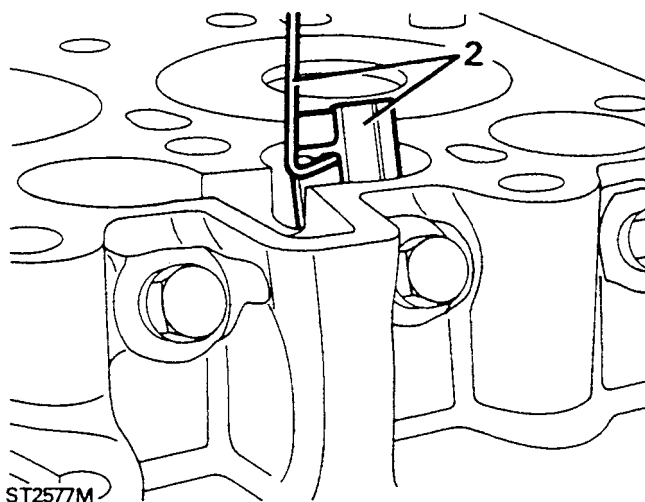
1. Slacken back the guide locating screw so that the end is below the bore of the guide.



ST2576M

2. Using a length of thin wire with a hooked end lift-out the slide.
3. With the same piece of wire remove the roller
4. Remove the guide locating screw and lift-out the guide.
6. As each assembly is removed number it, from one to eight, for refitting to its original location.

See fitting cam followers

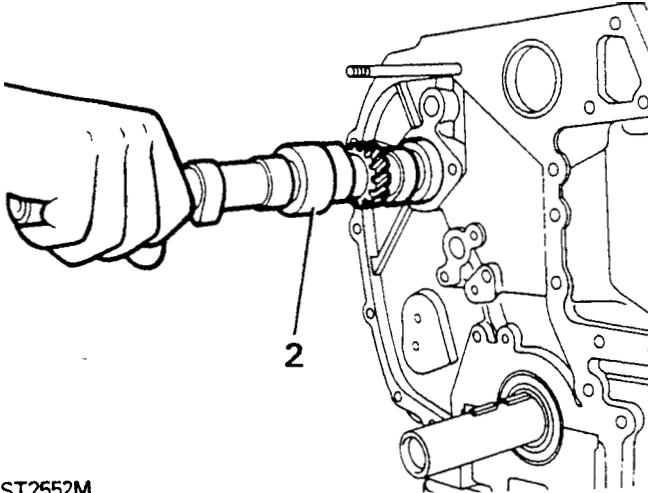


ST2577M

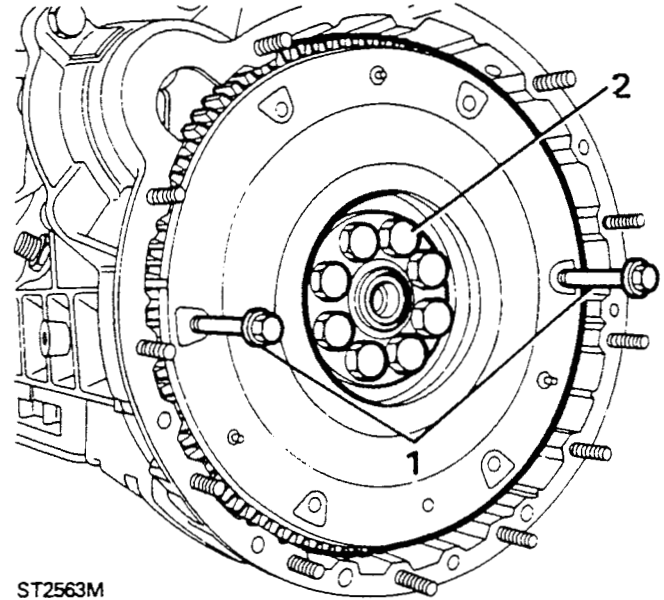
Removing the camshaft.

1. Release the **two** screws and remove the camshaft thrust plate.
2. Carefully Withdraw the camshaft taking care not to allow the end of the shaft to drop on to the bearings as it is removed.

See fitting camshaft



ST2552M



ST2563M

Removing flywheel housing.

1. Remove the eight internal and **two** external and five ladder frame securing bolts, then ease the flywheel housing from the **two** locating dowels and crankshaft.

See fitting rear main oil seal to flywheel housing.

Removing Clutch and Flywheel housing

See engine unit removal

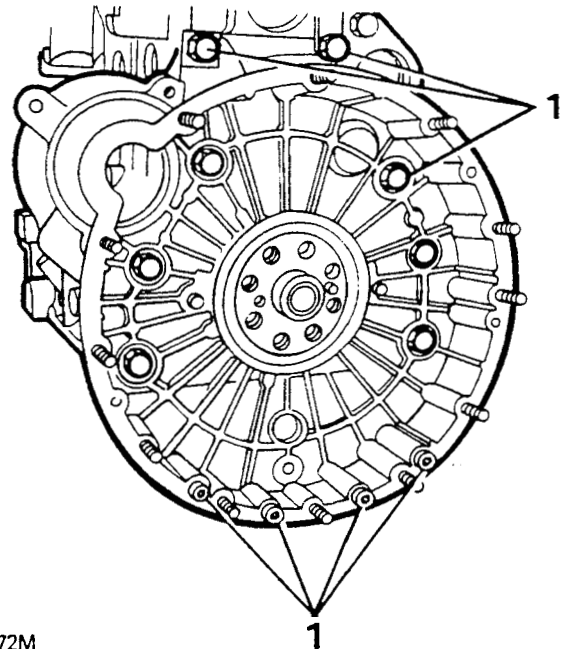
1. Mark the relationship of the cover to the flywheel to ensure original balance is maintained.
2. Evenly slacken and remove the six retaining bolts and washers and remove the assembly complete with the friction plate.

See fitting clutch

Removing flywheel

1. In the 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 the crankshaft damper and use special service tool FR 101 to restrain the crankshaft while slackening the flywheel eight retaining bolts. Remove the bolts and reinforcing plate and lift-off the flywheel.

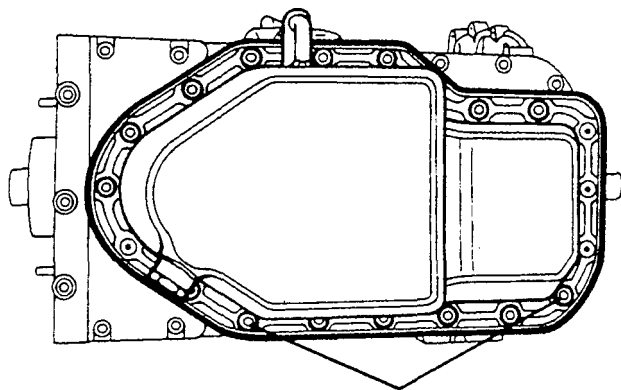
See overhaul and fitting flywheel



ST2972M

Removing sump and oil pump

1. If necessary drain the engine oil. When working with the engine on a work stand, invert the cylinder block so that the sump is uppermost. Remove the screws and ease the sump from the ladder frame to reveal the oil pump.



ST2553M

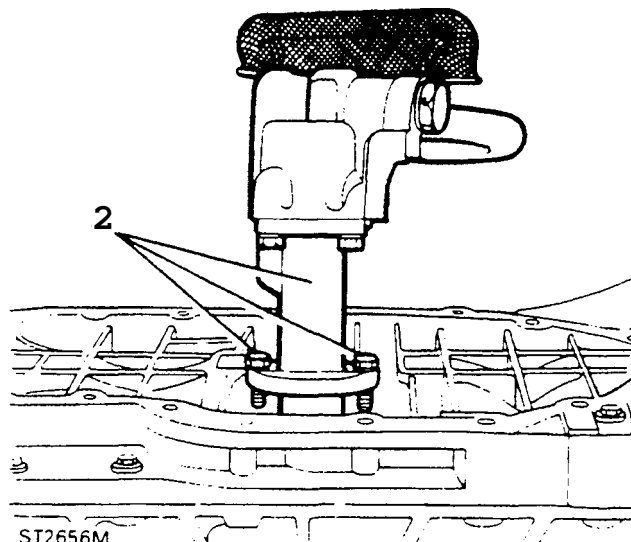
Note: After removing the oil sump when the engine is in the vehicle, refit and tighten **two** of the retaining bolts to the left side of the cylinder block to maintain pressure on the ladder frame cylinder block joint seal.

See fitting sump

Removing oil pump

2. Two bolts secure the oil pump to the crankcase. Access to the right hand bolt may require the use of a socket with a universal joint. Removal of the two bolts will enable the pump to be withdrawn.

See fitting oil pump



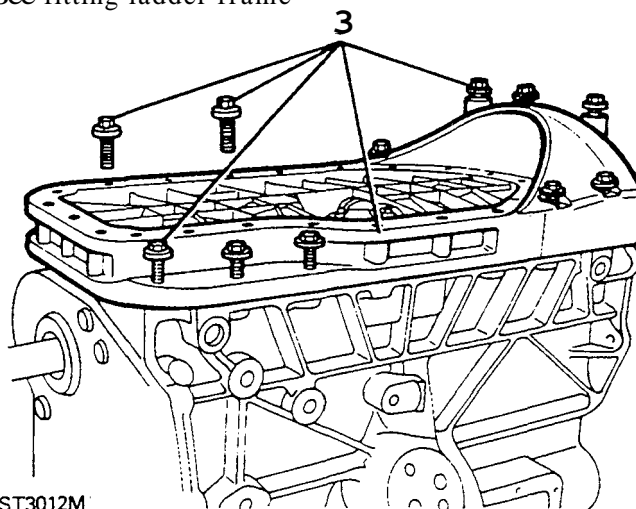
ST2656M

Removing ladder frame

Note: The ladder frame and flywheel housing are secured by five bolts which are 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.

See fitting ladder frame

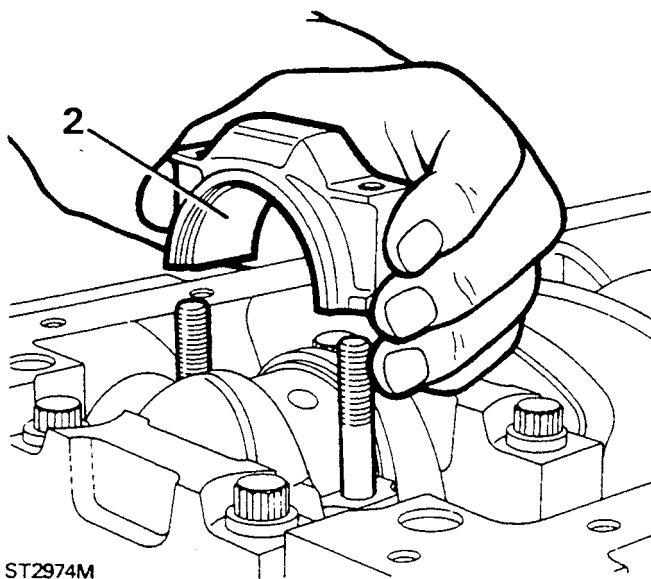
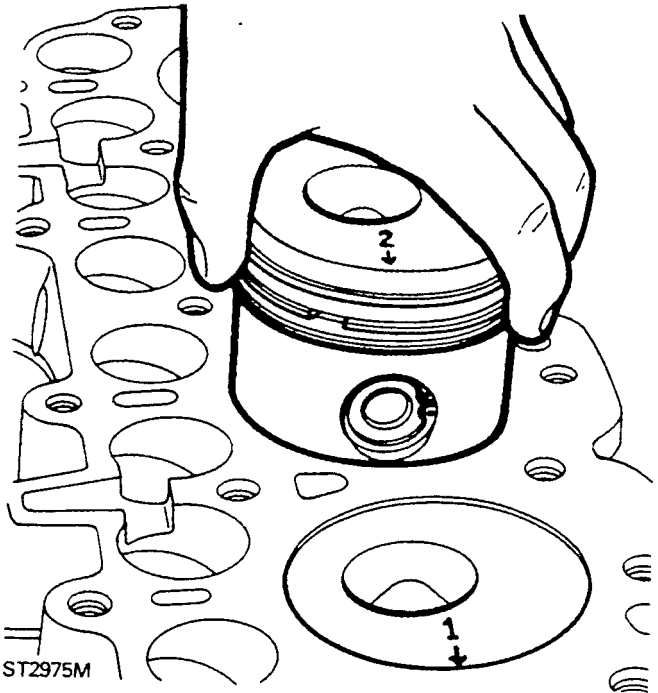


ST3012M

Removing pistons and connecting rods

Note: On this version of the Tdi engine, it is not possible to remove the connecting rods or pistons with the engine in the vehicle because of the method by which the ladder frame is secure. See note under Ladder frame removal.

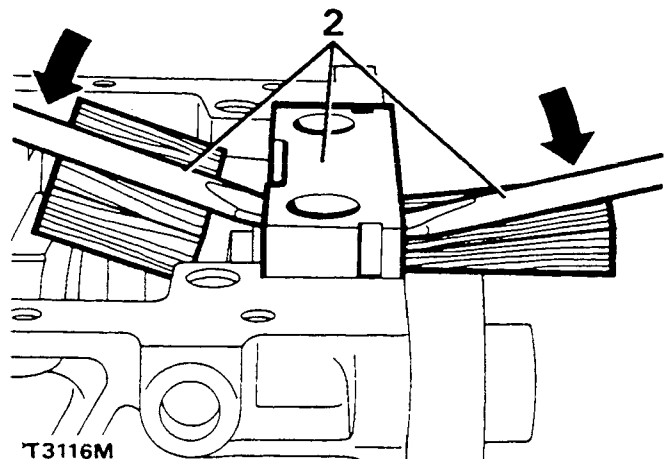
1. Turn the crankshaft to bring all the connecting rod cap nuts to an accessible position and slacken the nuts using a 15mm socket.
2. Remove the connecting rod nuts and remove the caps complete with lower bearing halves.



Removing crankshaft.

1. Slacken the ten mainbearing bolts with a 14mm socket.
2. If difficulty is experienced removing the cap a suggested method is to lever the cap from both sides, as illustrated.
3. Insert a suitable bar in the hole in the inside face of the cap and lever against the crankshaft journal on the outside face. Ensure that blocks of timber are used under the levers particularly to protect the crankshaft.
4. Release the remaining bolts and remove the mainbearing caps complete with the lower bearing shells.

3. Before removing the piston assemblies, number each piston from one to four so that it can be identified with the bore from which it was removed.
4. Taking care not to damage the bores, push each connecting rod and piston, in turn, up the bore until it can be withdrawn from the cylinder block combustion face. As each piston assembly is removed fit the corresponding cap and bearing shell to the connecting rod noting that the shell locating tags are together on the same side as the connecting rod number.



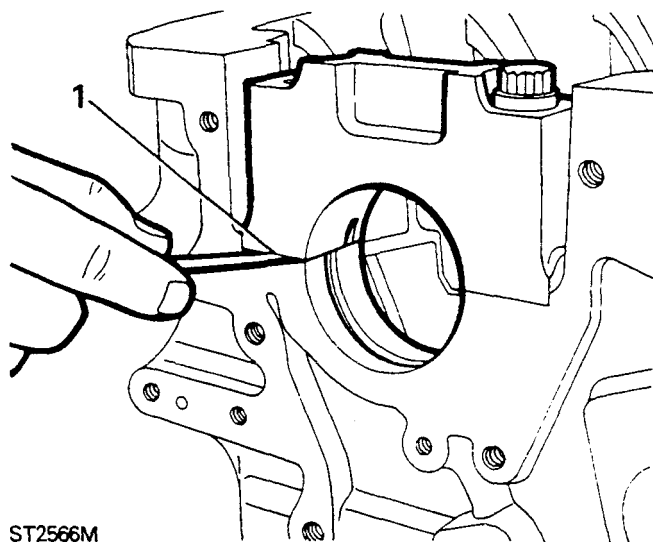
See piston and connecting rods

5. Lift-out the crankshaft either by hand or hoist. If a hoist is used be sure to insert adequate protection between the sling and journals to avoid damage.
6. Remove the mainbearing upper shells from the cylinder block.
7. Remove the **two** thrust washers from each side of the centre bearing location.
8. Remove the four cylinder lubrication, jet tubes.

CYLINDER BLOCK INSPECTION AND OVERHAUL

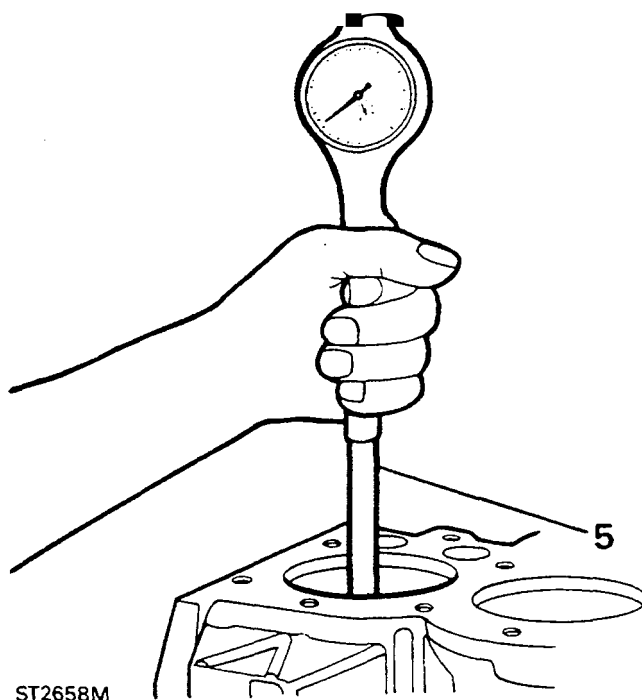
Inspection

1. Degrease the cylinder block and carry out a thorough visual examination checking for cracks and damage. To check each main bearing cap and its location on the cylinder block, fit the bearing caps without the bearing shells.
2. Fit the bolts and tighten to the correct torque, then remove one bolt from each bearing cap and check with a feeler gauge that no clearance exists at the joint face as illustrated.
3. A clearance indicates either a bent bolt, damaged dowl, distortion of the caps or block, or that the cap has been filed or machined in an attempt to reduce any clearance due to wear in the bearings. Main bearing caps are not available separately from the cylinder block therefore any clearance should be investigated and rectified or the block renewed.



Cylinder bores

4. Measure the cylinder bores for ovality, taper and general wear, using any suitable equipment. However, an inside micrometer is best for checking ovality and a cylinder gauge for taper. Check the ovality of each bore by taking measurement at the top of the cylinder just below the ridge at **two** points diametrically opposite.
5. The difference between the **two** figures is the ovality at the top of the bore. Similar measurements should be made approximately 50 mm (2.0 ins) up from the bottom of the bore so that the overall ovality may be determined. The taper of each cylinder is determined by taking measurements at the top and bottom of each bore at right angles to the gudgeon pin line, the difference between the **two** measurements is the taper.



To establish maximum overall bore wear, take measurements at as many points as possible down the bores at right angles to the gudgeon pin line. The largest recorded figure is the maximum wear and should be compared with the original diameter of the cylinder bore.

Maximum permissible ovality
0,127 mm (0.005 in).

Maximum permissible taper
0,254 mm (0.010 in).

Maximum permissible overall wear
0,177 mm (0.007 in).

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

Fitting cylinder sleeves

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

- Machine the cylinder bores to accept the sleeves to $94,425 + 0,012$ mm ($3.7175 + 0.0005$ in). This will give the sleeve a $0,076$ to $0,114$ mm (0.003 to 0.0045 in) interference fit. Press the sleeves squarely into the bore using a pressure of two or three tons. Excessive pressure could damage the sleeve and cylinder block.

The sleeves must not be proud of the cylinder block top face or more than 2,54 mm (0.10 in) below the surface.

- Bore and hone the sleeves to accommodate the pistons with the required clearances, see piston and connecting rod examination.

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 (0.002 in). Or, in any event, if they are scored or pitted. This work should only be entrusted to line boring specialists.

It is vital to thoroughly wash the cylinder block after machining to remove all traces of abrasive material, ensuring that all oil galleries are clean.

Check crankcase main bearings

Discard scored, pitted, cracked and worn bearing shells. To determine the maximum wear, assemble the main bearing shells and caps to the crankcase and tighten the bolts to the correct torque figure.

Using an inside micrometer, measure each bearing at several points and note the greatest figure. The maximum wear is the difference between this figure and the smallest diameter of the corresponding crankshaft journal.

The main bearing running clearance is given in the data section.

CRANKSHAFT

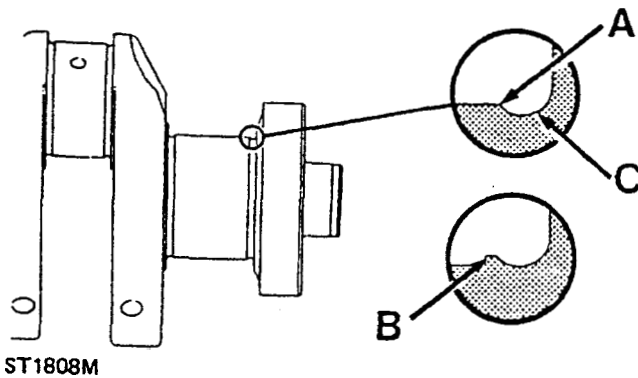
- Degrease the crankshaft and clear out the oil ways which can become clogged after long service.
- Examine visually, the crankpins and main bearing journals for obvious wear, scores, grooves and overheating. A decision at this stage should be made as to whether the condition of the shaft is worth continuing with a more detailed examination.
- 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 (0.0015 in).
- Taper - Take two readings parallel to each other at both ends of the main bearing journal and crankpin. The maximum permissible taper must not exceed $0,025$ mm (0.001 in).
- To check for straightness, support the front and rear main bearing journals in 'V' blocks and position a dial indicator to check the run-out at the centre main bearing journal. Run-out must not exceed $0,076$ mm (0.003 in) taking into account any ovality in the centre journal. The overall wear limit should not exceed $0,114$ mm (0.0045 in) for main bearing journals and $0,088$ mm (0.0035 in) for crankpins.
- A crankshaft worn beyond the limits of maximum taper, ovality and overall wear, can be ground to $0,25$ mm (0.010 in).

When grinding the crankshaft main bearing and crankpin journals, rotation of the grinding wheel and crankshaft must be in the same direction, anti-clockwise, viewed from the flywheel end of the crankshaft.

Final finishing of the journals should be achieved by using a static lapping stone with the crankshaft rotating in a clockwise direction viewed from the flywheel end of the crankshaft.

It is important to ensure that, when grinding, the stone travels beyond the edge of the journal 'A' to avoid formation of a step 'B' as illustrated. Also care must be taken not to machine or damage the fillet radii 'C'.

It is vital to thoroughly wash the crankshaft after machining to remove all traces of abrasive material, ensuring that all oil galleries are clean.

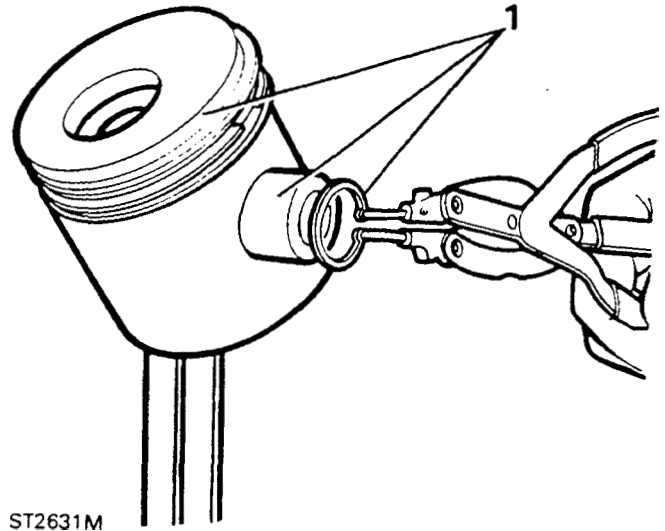


ST1808M

Pistons and connecting rods

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

1. Remove the piston rings and gudgeon pin from each piston and detach the connecting rod.
2. Original pistons - Decarbonise and degrease all components and carry out a visual examination of the piston and rings and discard any which are unserviceable. Pistons which appear serviceable should be subjected to a more detailed examination described under 'New Pistons'.
3. New pistons - Original pistons fitted to new engines at the factory are especially graded to facilitate assembly. The grade letter on the piston crown should be ignored when ordering new pistons.

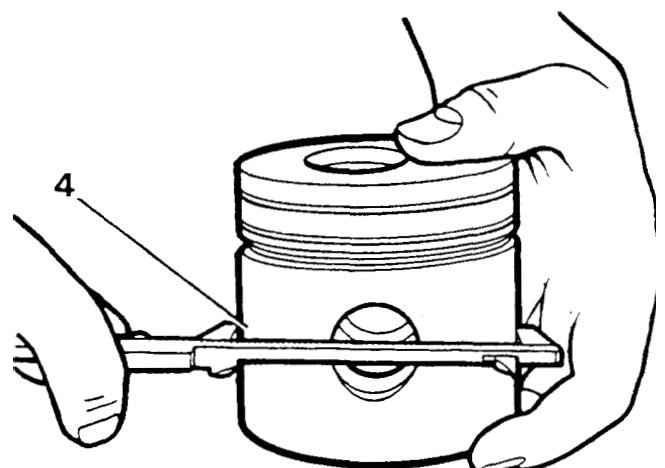


ST2631M

Genuine Land Rover service standard size pistons are supplied 0,025 mm (0.001 in) oversize to allow for production 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. In addition Land Rover pistons are available 0,50 and 1,01 mm (0.020 and 0.040 in) oversize for fitting to rebored cylinders.

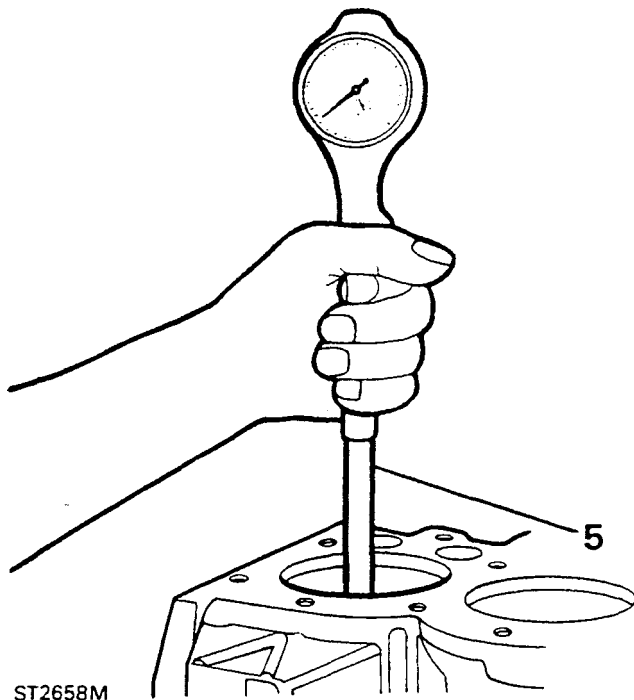
Clearance limits for new standard size pistons in a standard cylinder bore measured at right angles to the gudgeon pin are in the data section. When taking the following measurements the cylinder block and pistons must be the same temperature to ensure accuracy.

4. Using a suitable micrometer or vernier measure the pistons at the bottom of the skirt at right angles to the gudgeon pin.



ST2657M

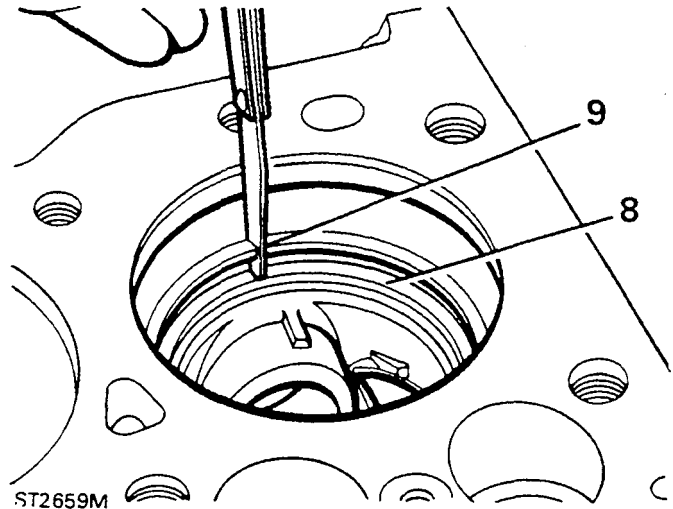
- With an inside micrometer or cylinder gauge measure the diameter of the bore at approximately half-way down and note the reading.



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

Piston ring gaps

- 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.



- With the appropriate feeler gauge check all the ring gaps in turn, including the oil control rings.

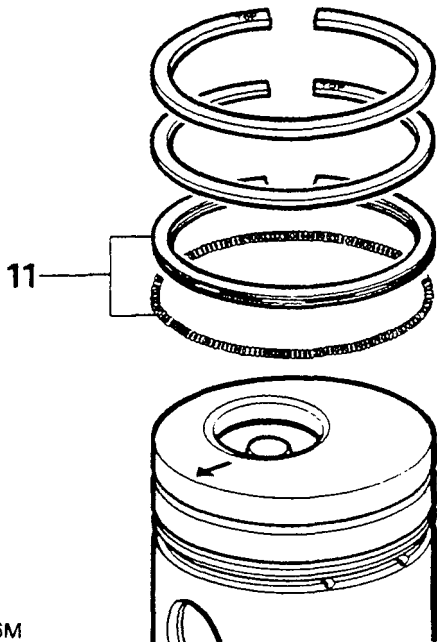
The correct gaps are listed in the data section. If any gap is less than that specified, remove the ring, and file the ends square, whilst holding the ring in a filing jig or vice. Should any gap be excessively wide and not likely to close up to within the specified limits when hot, an oversize ring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

Once the rings have been selected for a particular cylinder and piston ensure that they are not again mixed up.

Piston ring groove clearance

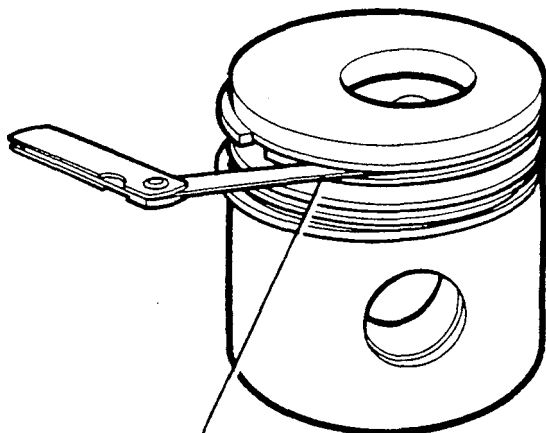
- It is important that the groove clearances are correct. Rings that are too tight may bind or fracture when hot and cause loss of compression. Excessive clearance allows the rings to rock in the groove and may result in a pumping action and excessive oil consumption.

- 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

- After fitting slide each ring around the groove to ensure that it is free and does not bind.
- 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.



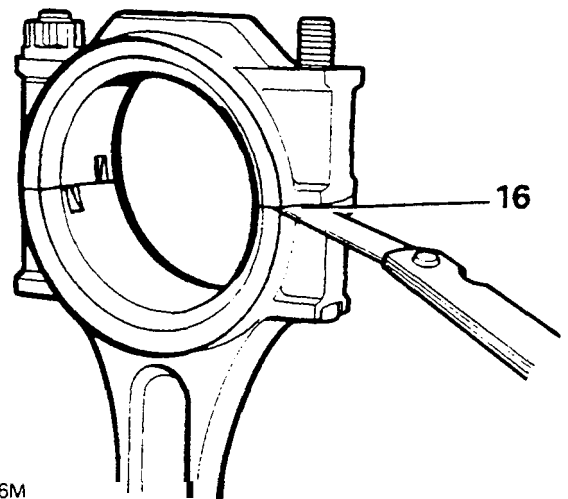
ST2632M

Gudgeon pins

- Examine the gudgeon pin for obvious wear, cracks, scores, or overheating and ovality and taper using a micrometer.

Connecting rods

- 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.
- 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

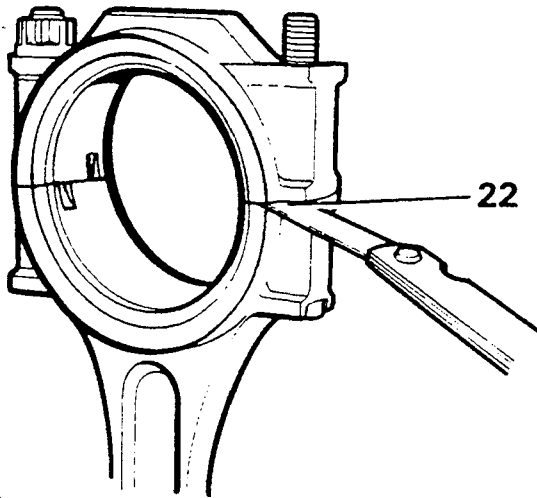
- Use an accurate connecting rod alignment gauge to check the rods for bend and twist. The maximum allowable for both conditions must not exceed 0,127 mm (0.005 in).
- Examine and check the small-end bush for wear. If necessary renew the bush. The correct clearance of the gudgeon pin in the small-end bush is given in the data section.
- 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.

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.

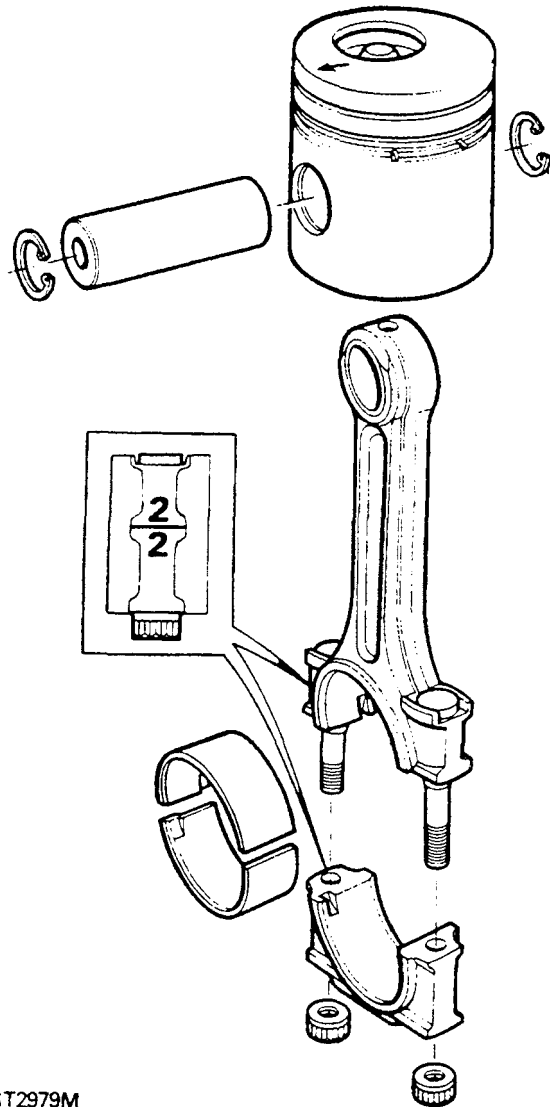
Big end bearing nip and clearance

- 21. Clean the protective coating from new bearings before fitting.
- 22. Fit the bearing shells to each connecting rod and cap ensuring that the location tags are correctly seated and aligned. Fit and tighten both bolts to the correct torque, next release one nut on each cap then check for a nip clearance of between 0,10 to 0,20mm (0.004 to 0.008).



ST2977M

23. Check the joint face of faces of both cap rod and bearing shells if the nip clearance is excessive. Too little nip clearance will allow the shell bearings to move (possibly rotate) inside the connecting rod when the engine is running. After satisfactory fitting of the bearings temporary retain the shells and caps to the appropriate connecting rod.



ST2979M

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).

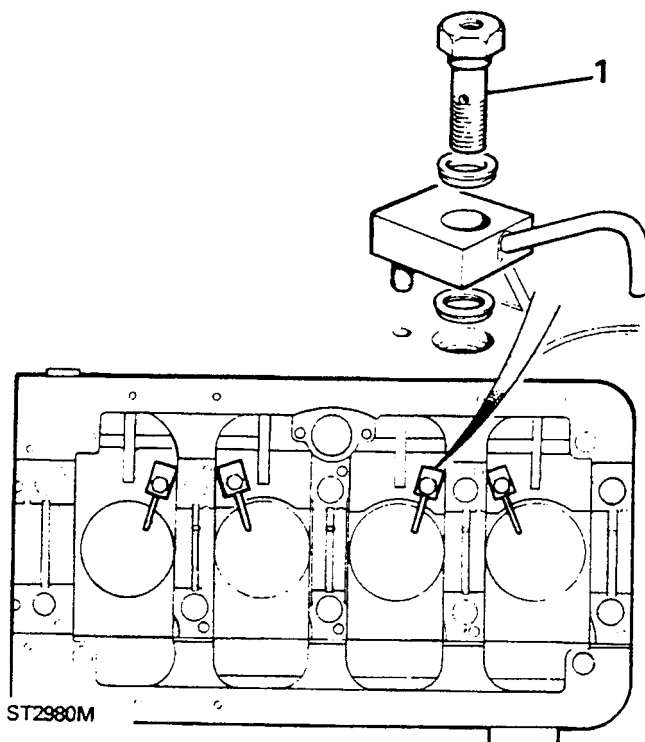
ASSEMBLE ENGINE

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.

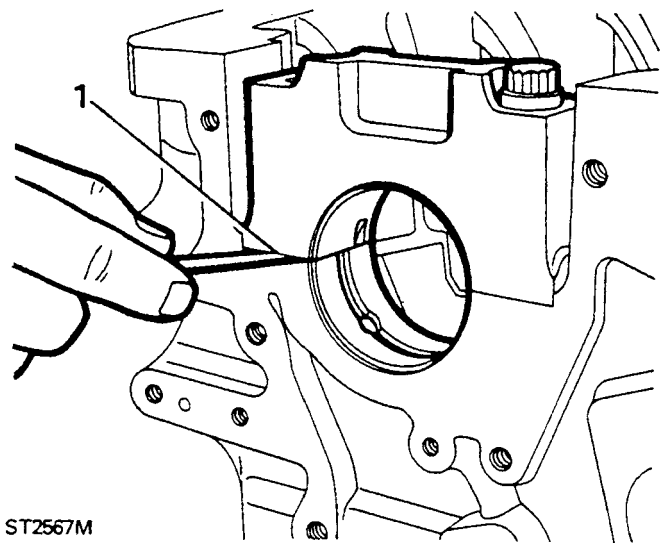


Crankshaft bearings.

Main bearing nip clearance

Clean the protective coating from new bearings before fitting.

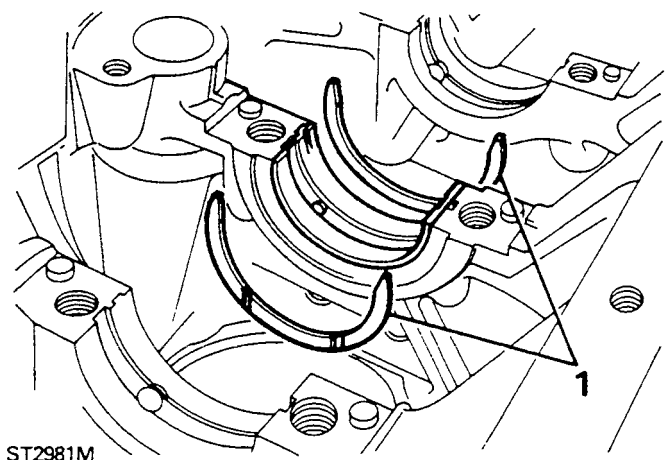
1. Fit the bearing halves to the cylinder block ensuring full engagement of the location tags.
2. Install the other half shells into the main bearing caps, again ensuring that the tags locate correctly.
3. Fit all the main bearing caps to their original locations tightening the bolts to the correct torque, then release one bolt on each cap.
4. Check the clearance between the cap and the block as illustrated.



The nip clearance which ensures that the bearings are correctly clamped, must be within 0,10 to 0,15 mm (0.004 to 0.006 in). Investigate and correct any nip clearance errors before removing the main bearing caps prior to fitting the crankshaft.

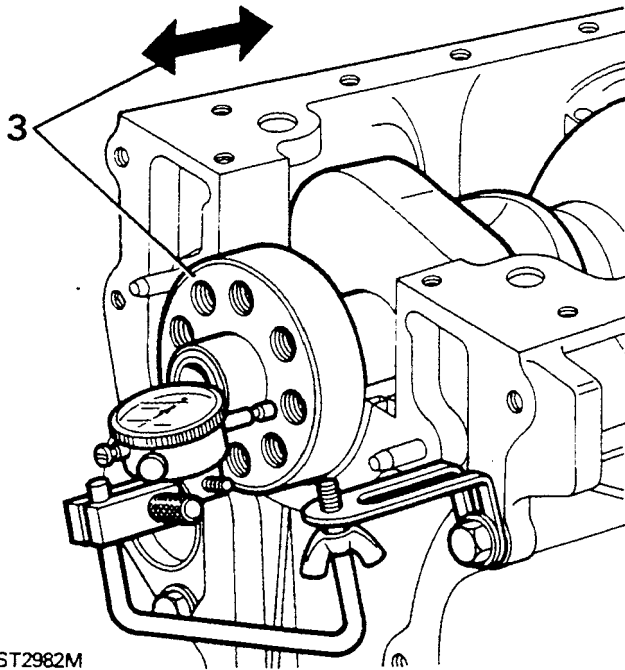
Fitting crankshaft

1. Insert **two** standard thickness thrust washers each side of the centre main bearing location with the oil grooves towards the crank thrust faces.
2. Lubricate the cylinder block bearing shells and carefully install the crankshaft.



Crankshaft end float

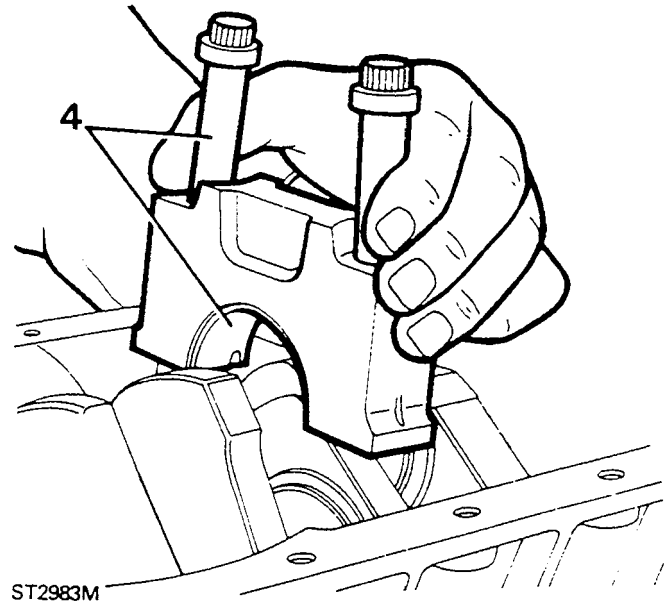
3. To determine the crankshaft end-float mount a dial test indicator to read-off the end of the crankshaft. Move the crankshaft away from the indicator and zero the dial, then Move the crankshaft in the opposite direction and note the indicator reading. The end-float should be 0,05 to 0,15 mm (0.002 to 0.006 in).



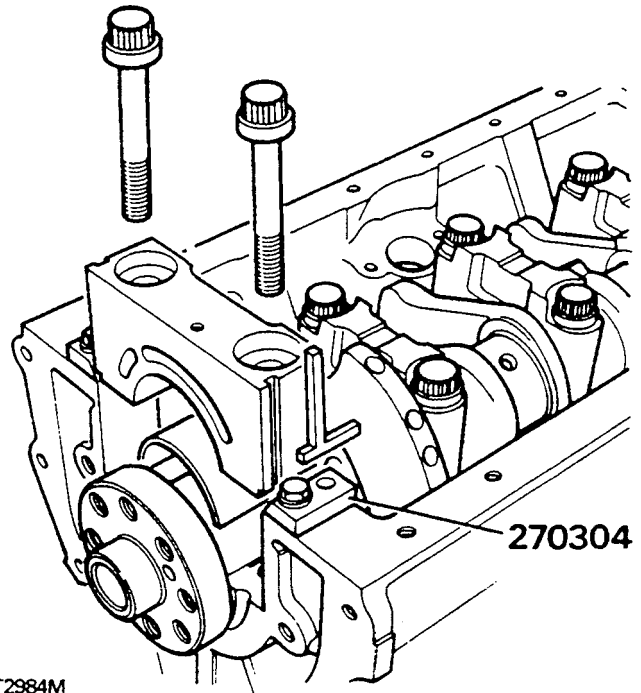
Alternatively measure the clearance with a feeler gauge. If adjustment is required substitute with oversize thrust washers. Variation of thrust washer thicknesses at each side of the crankshaft journal must not exceed 0,08 mm (0.003 in) to ensure that the crankshaft remains centralised.

Main bearing caps

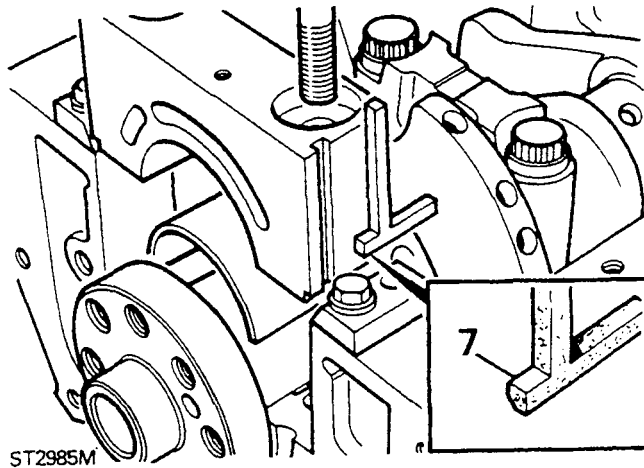
4. Lubricate and fit the centre main bearing cap, tighten both bolts to the correct torque and ensure that the shaft is free to rotate before fitting the next bearing cap.
5. Lubricate and fit 1-2 and 4 main bearing caps checking that the shaft is free to rotate after tightening the bolts for each.



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

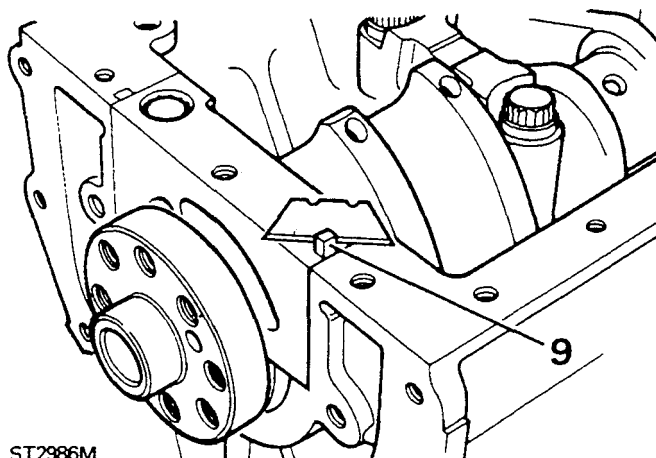


7. To prevent any seal material becoming trapped between the bearing cap and crankcase, chamfer the inner edge of the seal 0,40 to 0,80 mm wide as illustrated. Smear the seals with engine oil and fit them to the bearing cap.
8. Fit the bearing cap complete with shell bearing to the crankcase and secure with new bolts and tighten to the appropriate torque. Remove seal guides and check that the shaft is free to rotate.



ST2985M

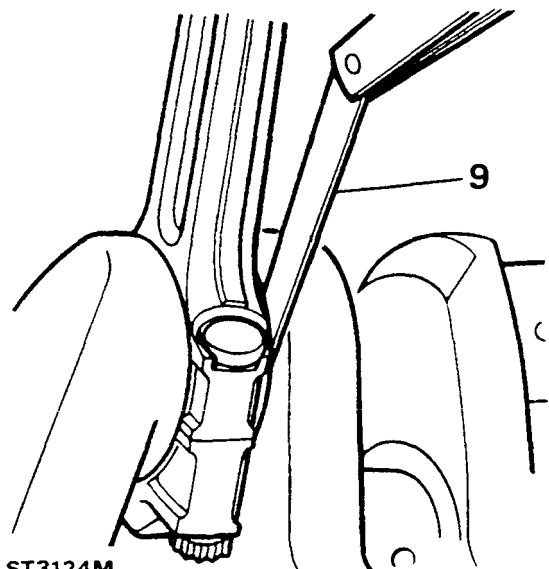
9. To allow for shrinkage after fitting leave the seals standing proud of the crankcase face then using a sharp blade, trim the seals off to approximately 0,80 mm above the crankcase face.



ST2986M

Fitting connecting rods and pistons

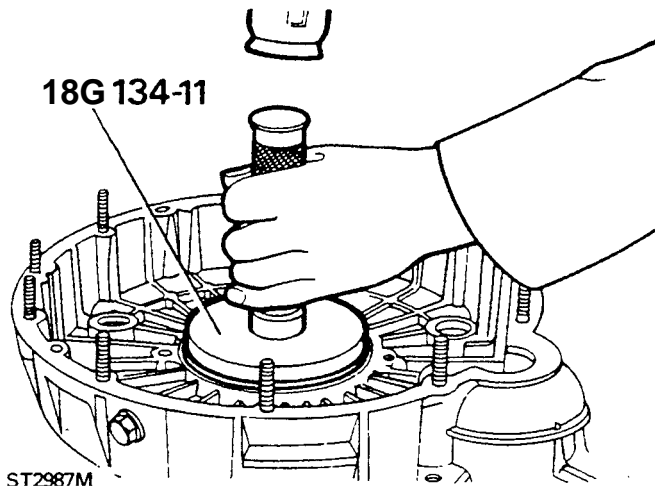
1. Ensure that the essentric headed big end bolts and shell bearings are correctly located in the connecting rods and as a precaution against possible damage to the crankshaft journals during installation of the pistons, cover the bolt threads with a layer of adhesive tape. Check that the number on the connecting rod is the same as the piston and cylinder and that they are correctly orientated.
2. With the cylinder block vertical, and 2 and 3 crankshaft journals at BDC lubricate and install 2 and 3 piston connecting rod assemblies so that the piston rings are resting on the block face.
3. Stagger the piston rings on both pistons as illustrated, then using a suitable tool compress the piston rings and gently push each piston into the cylinder bore.
4. Pull both connecting rod big ends on to the journals and fit the caps ensuring the the numbers match and orientation is correct. Retain the caps with new nuts but do not tighten at this stage.
5. Turn the crankshaft so that 1 and 4 journals are at BDC and install the pistons and connecting rods as previously discribed.
7. Tighten both nuts on one connecting rod to the correct torque and check that the crankshaft is free to rotate before securing the next connecting rod cap nuts.
8. Investigate and rectify any big end bearing which when tightened restricts the freedom of the crank shaft.
9. Check that each big end is free to move sideways on its journal and if necessary check the actual side clearance using a feeler gauge. The correct clearance is given in the data section.



ST3124M

Fitting rear main oil seal to flywheel housing

The oil seal is manufactured from P.T.F.E. and is supplied with a former to maintain the correct shape which must not be removed until the seal is to be fitted.

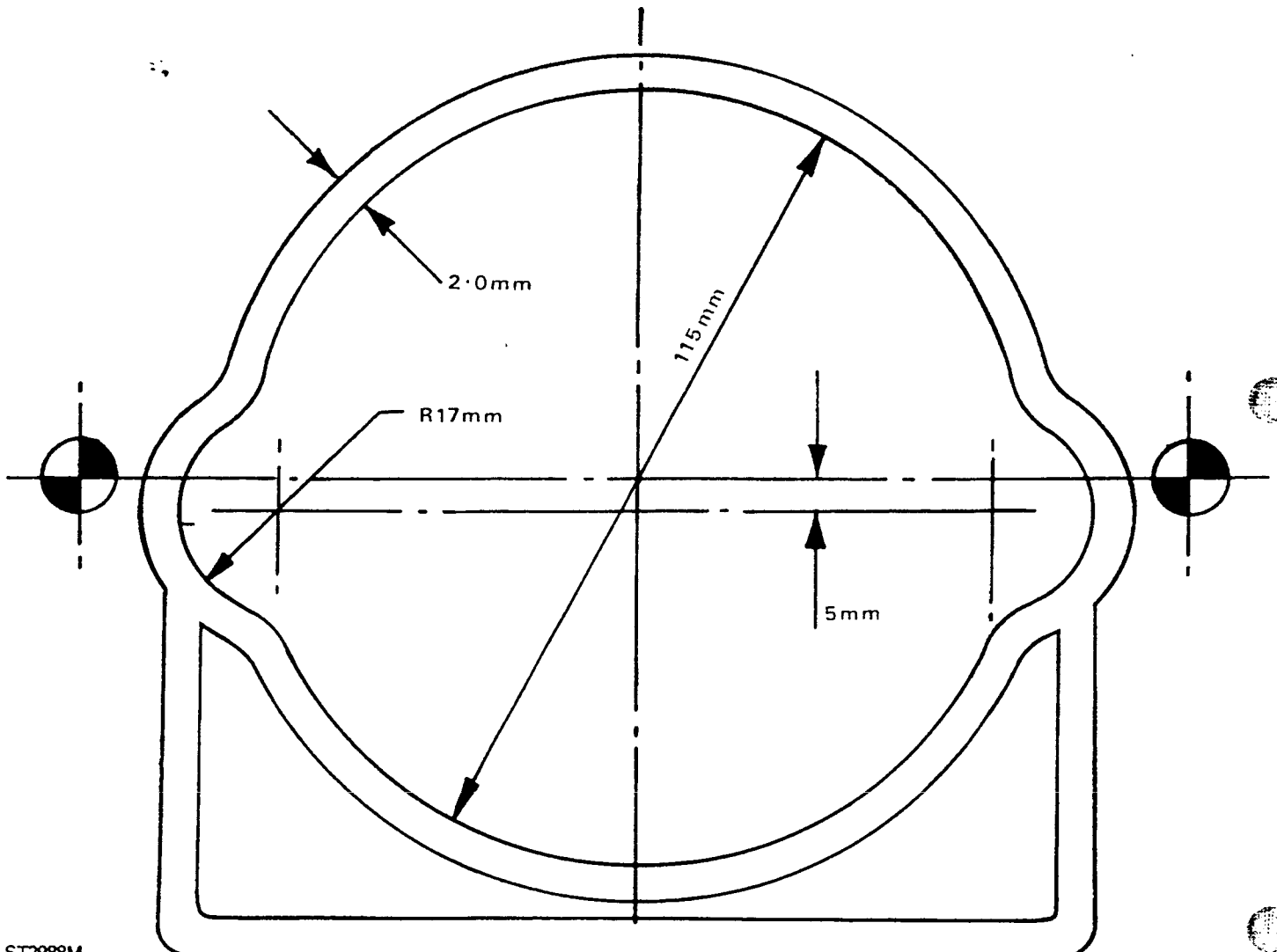


1. Make sure the seal housing is clean and dry and free from burrs. Do not touch the seal lip and ensure that the outside diameter is clean and dry.
2. Using special seal replacer 18G134-11 and with the lip side leading drive-in the seal as far as the tool allows. If the tool is not available fit the seal to the bottom of the housing to ensure squareness.

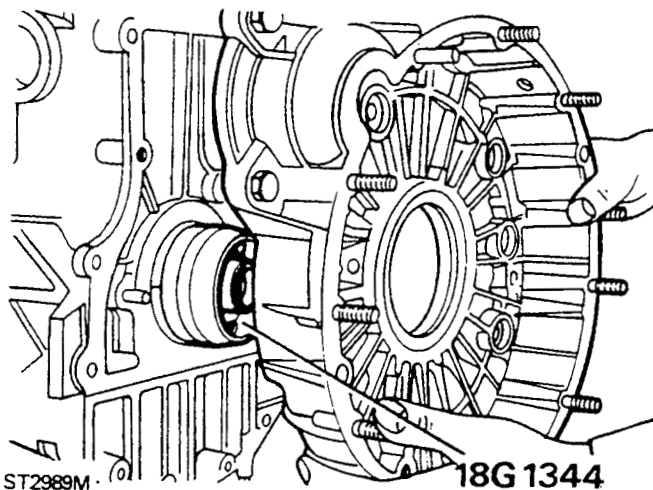
Fitting flywheel housing

3. Clean the rear face of the cylinder block and flywheel housing, then apply a bead of Hylosil 102 sealant to the dimensions and configuration, illustrated.

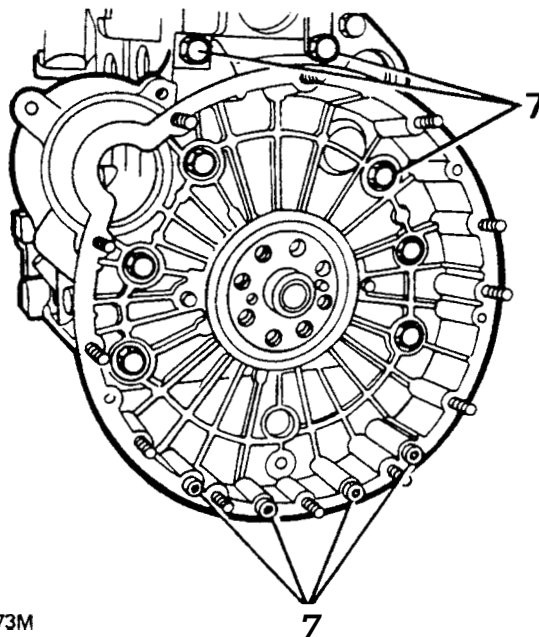
The illustration has been produced full size so that a template may be made to facilitate the application of the sealant. The bead should be 2,0 mm diameter and must extend around the periphery of the bearing cap so that the joint between cap and block is sealed.



4. Examine the seal guide, number 18G1344 ensuring that it is perfectly smooth and not damage or scratched. **Also** check that the crankshaft oil seal journal is smooth and clea.
5. Locate the seal guide on to the crankshaft and lubricate the seal, guide and journal with concentrated 'Oildag' in a 25% solution with clean engine oil.



6. Carefully locate the flywheel housing over the seal and on to the dowels.
7. Remove the seal guide and secure the flywheel housing, evenly tightening the retaining bolts to the correct torque.



OVERHAUL AND FITTING FLYWHEEL

Inspection

Normal wear and scores on the flywheel clutch face can be repaired by machining provided that the overall width of the flywheel is not reduced below 36,96 mm (1.453 in) therefore check that the flywheel has not been previously machined before proceeding further. The ring gear may be renewed if the teeth are chipped or damage.

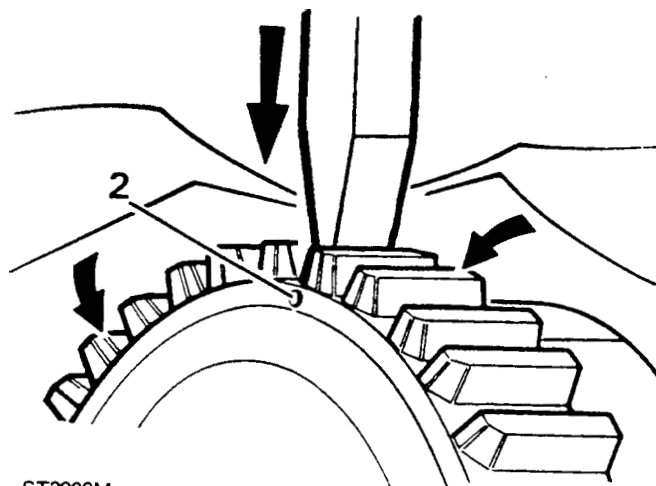
Reface the flywheel

1. Remove the clutch cover locating dowels. Machine the flywheel over the entire clutch face removing only the minimum of material necessary to achieve a smooth surface parallel with the crankshaft mating face within the dimensions given above.

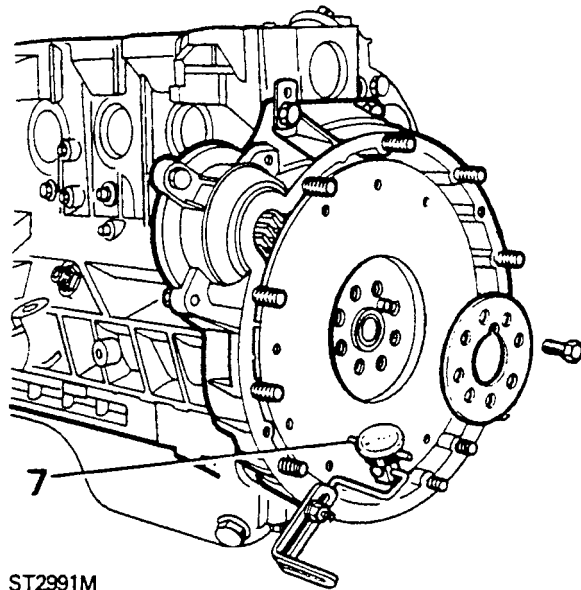
Renew Ring gear

WARNING: Wear industrial goggles to protect the eyes from flying fragments.

2. To renew the ring gear, drill a 8 mm hole between the root of any **two** teeth and the inner diameter of the ring gear deep enough to weaken the gear. Take care not to allow the drill to enter the flywheel.



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.

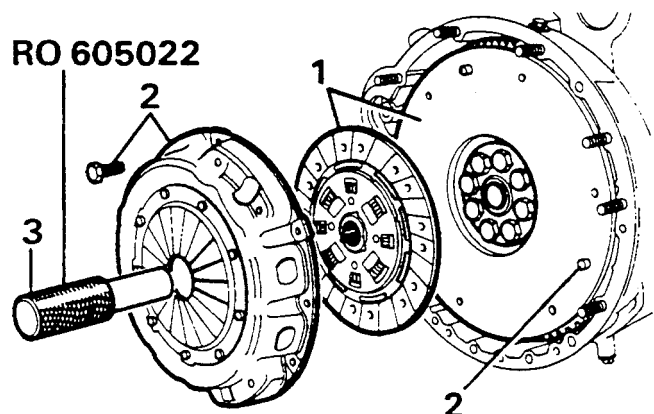


ST2991M

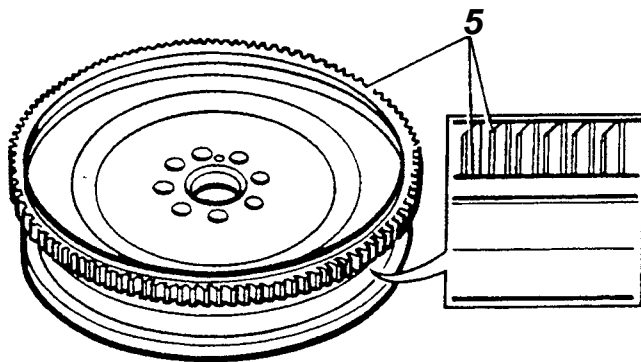
Fitting clutch

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



ST2640M

Fitting flywheel

6. Locate the flywheel on the crankshaft and secure with the reinforcing plate and retaining bolts. Temporarily fit the damper to front of crankshaft and use special service tool FR101 or LST127 to restrain the crankshaft whilst the eight retaining bolts are being tightened to the correct torque.
7. To check the flywheel for possible run-out, mount a dial test indicator so that the stylus rests, in a loaded condition, on the clutch pressure face at a radius of 114 mm (4.5 in) from the centre of the flywheel.
8. Turn the flywheel, and check that run-out does not exceed 0,05 to 0,07 mm (0.002 to 0.003 in). Should any run-out be excessive, remove the flywheel, and check again for irregularities on flywheel and crankshaft mating faces and dowel.

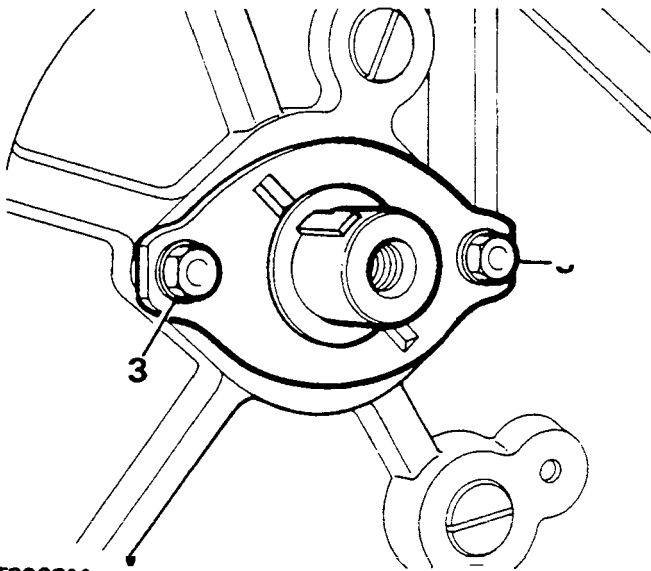
Fitting camshaft

Inspection

1. Mount the camshaft on "v" blocks on a surface plate for convenience and examine the cams for wear, scores, pitting and chipped edges.
2. Examine the journals for obvious wear and scores and signs of overheating, in particular, check the thrust plate. If the journals are visibly serviceable, check with a dial gauge or micrometer for overall wear, ovality, taper and runout.

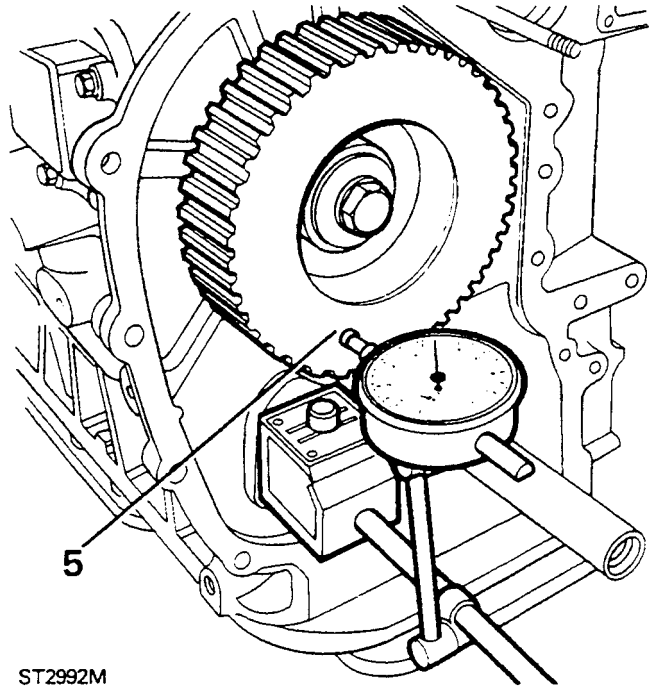
CAUTION: If the skew gear is worn and requires renewal, the camshaft must also be renewed even though the camshaft gear may appear satisfactory. Once the **two** gears have run together they become a matched pair.

3. Lubricate the camshaft bearings and journals with clean engine oil and carefully insert the camshaft into the cylinder block. Fit the thrust plate and secure with the **two** bolts and tighten to the correct torque.



ST2968M

4. To check the camshaft end-float, temporarily fit the camshaft gear and mount a dial test indicator so that the stylus rests in a loaded condition upon the machined face of the gear.
5. Zero the dial and move the camshaft back and forward and note the reading. The end-float should be within 0,06 to 0,13 mm (0.0025) to 0.0055 in) If necessary fit another thrust plate to achieve the correct end float.

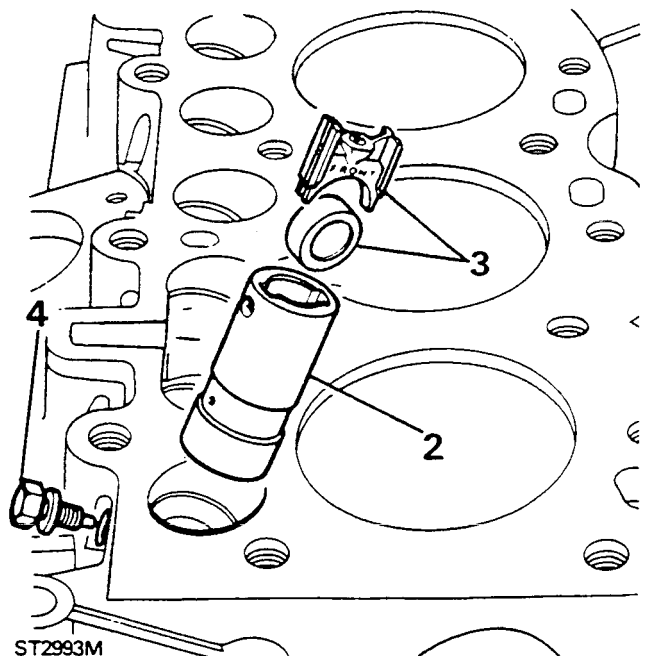


ST2992M

Fitting camfollowers

1. Examine all the components for wear and damage particularly the rollers and pushrod seating in the slides and ensure that the tappet slides move freely in the guides. If the same parts are being refitted, ensure that they are returned to their original positions.

Note: The tappet retaining screws have a micro encapsulated locking compound applied to the threads to ensure that they **do** not become loose. Once the screw has been used the locking ability is lost.



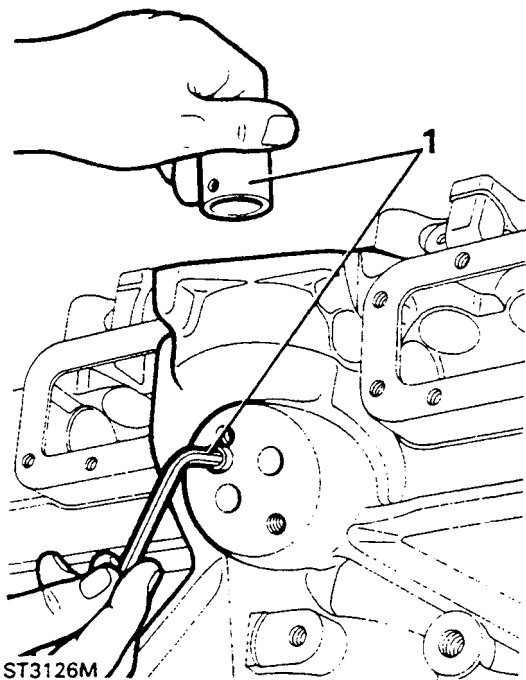
ST2993M

2. Insert the tappet guides into the cylinder block, retaining each with a new screw which should be screwed in sufficiently to allow the rollers and slides to be installed. Ensure the rollers are fitted in accordance with any marks made during removal. New rollers, however, may be fitted either way around.
3. Before fitting the tappet slides make sure the oilways are clear to the running surface of the roller and the pushrod seating. Insert the 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.

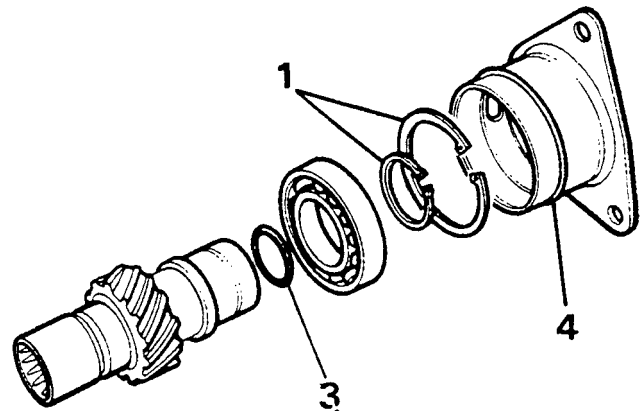


Overhaul and fitting skew gear

1. Remove the circlips retaining the skew gear shaft to the bearing and the bearing in the housing.
2. Press the bearing and shaft assembly from the housing and the shaft from the bearing.

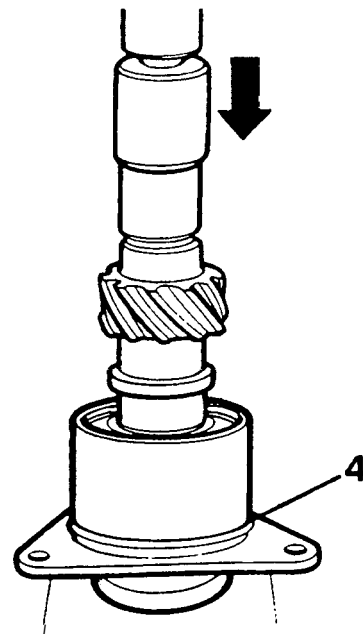
Discard both rubber "O" rings, examine all components especially the bearing and skew gear for wear and damage and renew if necessary.

CAUTION: If the original skew gear and camshaft are to be re-used, they must be fitted so that the teeth on each, mesh in the original position. If either the skew gear or the camshaft are renewed, the mating component must also be renewed.



ST2995M
Assembling

3. Press the bearing into the housing and secure with the circlip. Support the housing and press the shaft into position and secure with the circlip.
4. Fit a new rubber "O" ring to the outside of the housing and to the internal annular groove in the shaft ready for installation.

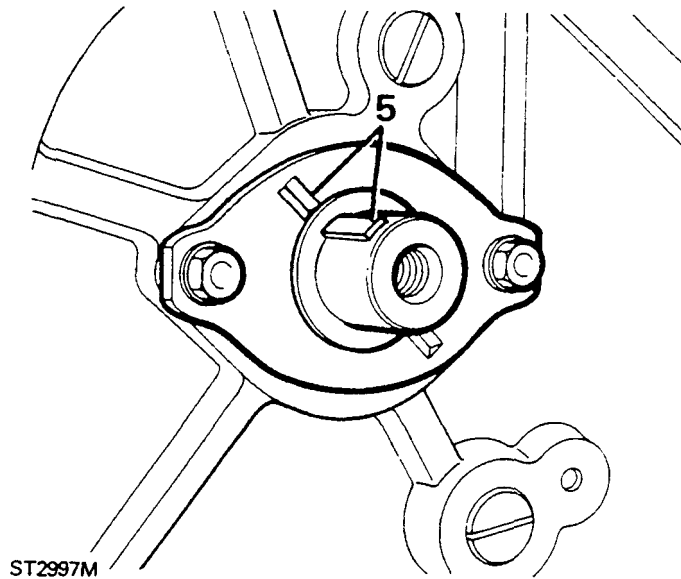


ST2999M

Fitting skew gear

If the original skew gear and camshaft are being re-used it is important that the gear teeth mesh in the original position as follows.

5. Turn the camshaft so that the key aligns with the oil groove as illustrated.



6. Fit the skew gear assembly so that the ventilation slot in the gear housing is towards the front of the engine as illustrated and ensuring that any alignment marks made during dismantling are realigned.

If both components are new it is only necessary to correctly align the ventilation slot as described above.

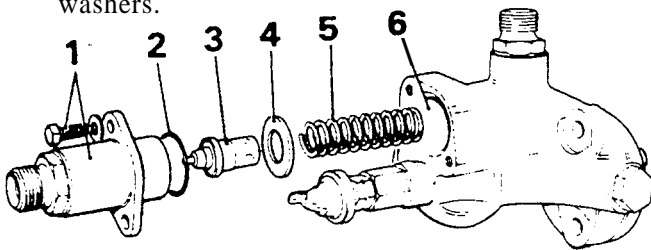
OVERHAUL AND FITTING OIL FILTER ADAPTOR

Oil temperature thermostat

1. Remove the two bolts and carefully withdraw the thermostat extension housing complete with, the 'O'ring (2), thermostat (3), washer (4), and spring (5). 2. Clean the adaptor housing (6) with lint-free cloth.

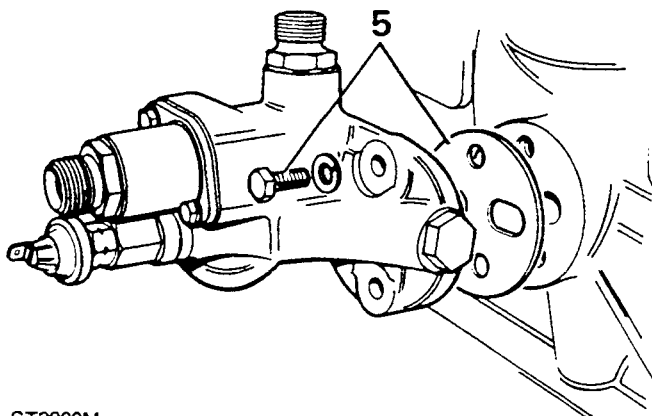
inspect all the parts and renew as necessary.

3. Fit the spring, washer and thermostat with the pin uppermost.
4. Fit the extension housing using a new 'O'ring. Ensure that the pin protruding from the thermostat locates in the hole in the extension housing and secure with the two bolts and washers.



ST2596M

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



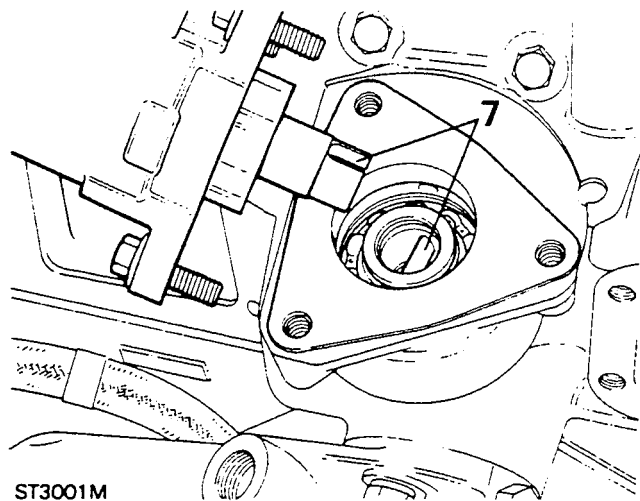
ST3000M

Oil filter

6. Smear the filter sealing ring with oil and screw the filter clockwise until the seal touches the machined face, then tighten the filter a further half turn only. Do not over tighten. see Maintenance operations, section 10.

Fitting vacuum pump

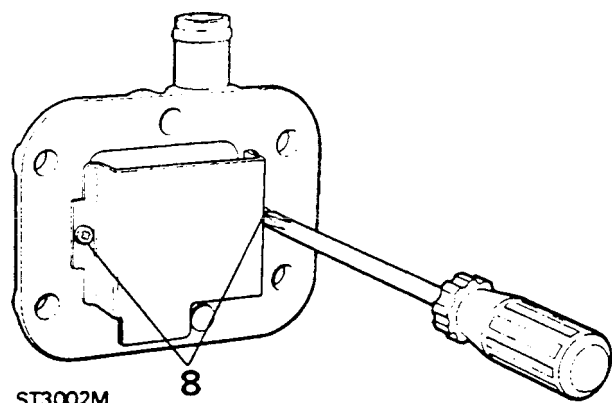
7. Using a new gasket fit the vacuum pump so that the brake servo connection is towards the front of the engine, ensuring that the cross-pin in the skew gear locates in the pump drive shaft then secure with three screws tightened to the correct torque.



ST3001M

Fitting front and rear side covers and fuel lift pump

8. Check that the front side cover baffle plate is secure and fit the cover using a new gasket securing with only four of the six fixing bolts at this stage, leaving out the two which secure the injection pump support bracket as illustrated.



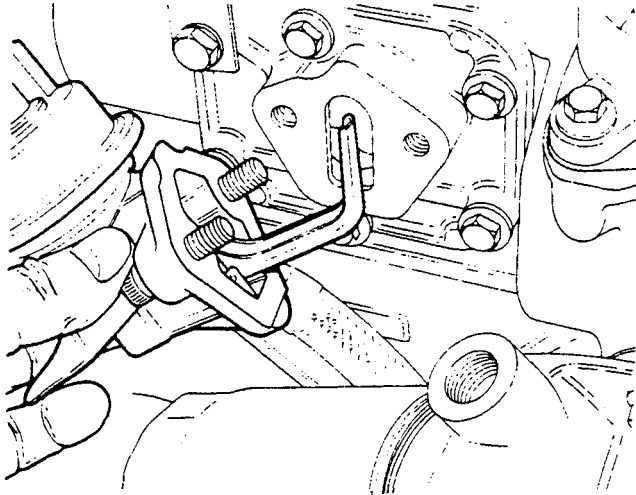
ST3002M

Fitting rear cover

9. Fit the rear cover also using a new gasket and secure with six bolts tightened to the correct torque.

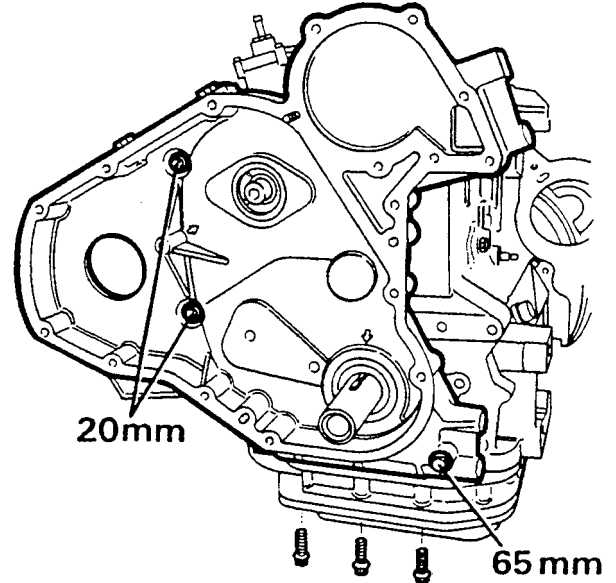
Fitting fuel lift pump

10. Check that the lift pump is serviceable and refit using a new gasket, ensuring that the pump actuating lever locates correctly onto the camshaft.



ST3003M

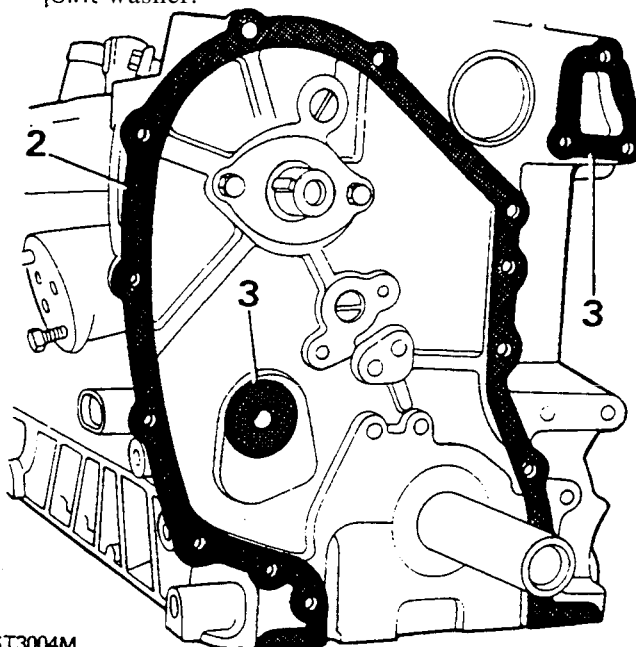
3. Also fit a new joint washer to the coolant aperture and to the tapped hole for the jockey pulley clamp bolt.
4. Fit the front cover locating it over the single stud and secure with the three retaining bolts tightening evenly to the correct torque. The correct bolt length for each hole is given in the following chart.



ST3005M

FITTING FRONT COVER TIMING BELT AND GEARS

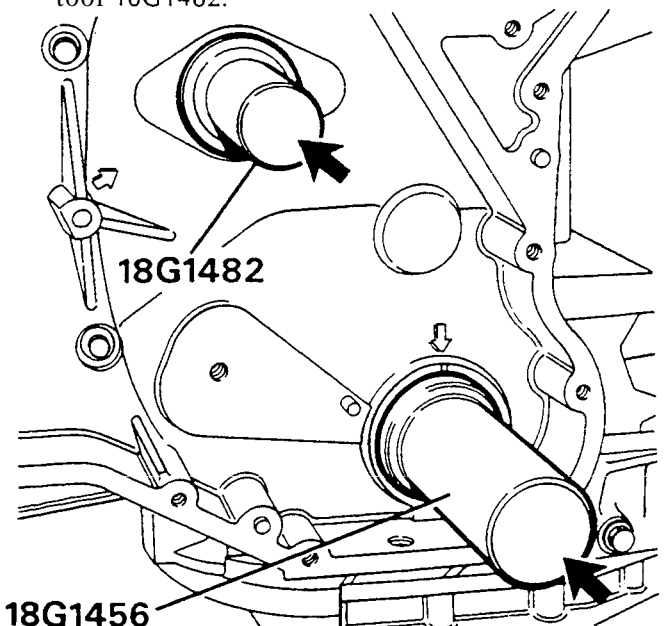
1. Clean the front cover and remove the crankshaft and camshaft oil seals taking care not to damage the seal housing. Examine the cover for damage, cracks and distortion. Check the mating face of the cylinder block and the cover plate for burrs.
2. Clean the front face of the cylinder block and use a little grease to hold in position a new joint washer.



ST3004M

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.

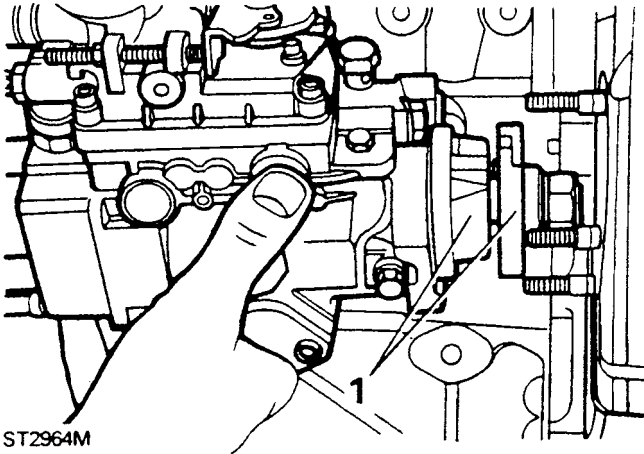


18G1456

ST3006M

Fitting injection pump

1. Insert the timing pin in the pump hub and body. Fit the injection pump and secure with the three nuts and tighten evenly to the correct torque.



ST2964M

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.

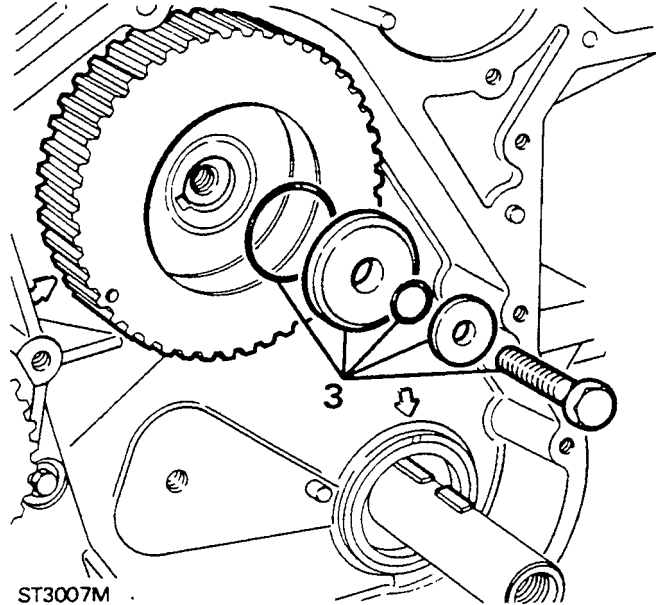
Drive belt.

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 (2 in) radius. Do not bend the belt at an acute angle or radius less than 50 mm (2 in) otherwise premature failure of the fibre reinforcement could result.

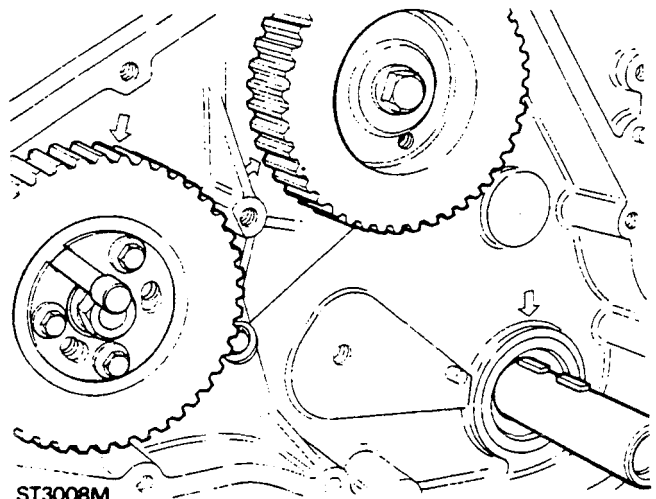
Cleanliness and accuracy are vital when carrying out the timing operations and fitting the drive belt.

1. Check the gear wheels are not damaged or scratched and that they are thoroughly clean and dry.
2. Ensure that the belt adjustment idler bearing is sound and not leaking lubricant.
3. Fit the crankshaft and camshaft gears ensuring that the camshaft gear is retained with the special bolt, washer and new 'O' ring but do not tighten at this stage.



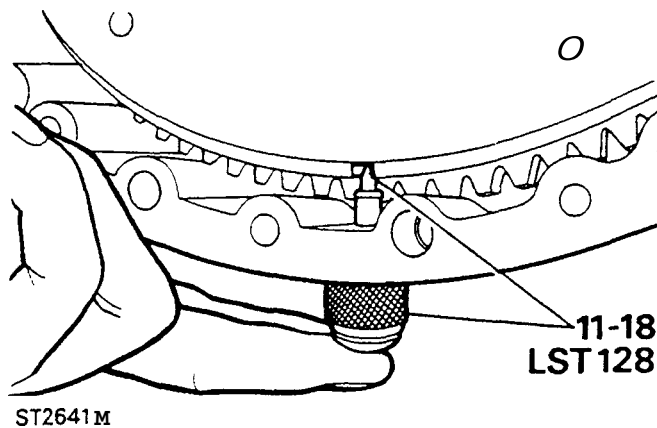
ST3007M

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.

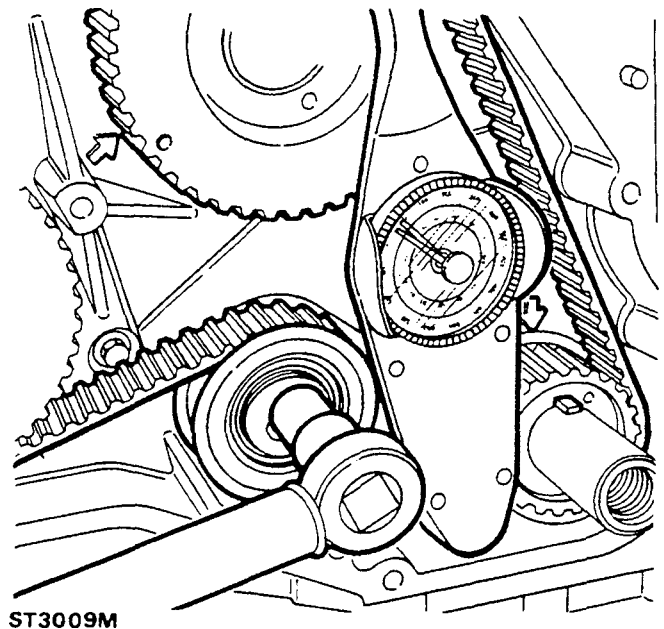


Fitting and tensioning belt drive

Note: It is vitally important that the following belt tensioning procedure is carried out carefully and accurately. The procedure involves tensioning the belt twice. New and original belts are tensioned to different figures.

8. Ensure that the crankshaft, camshaft and injection pump are correctly aligned 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.
9. Fit the belt tensioner with the special washer and single bolt. Insert a 13 mm (0.5 in) square drive extension into the tensioner plate and with a dial type torque meter, apply a tension of 21.7 Nm (16 Lbf ft) for a new belt, or 16.3 Nm for an original belt. When the tension is correct and the meter is in the vertical position, tighten the clamp bolt.

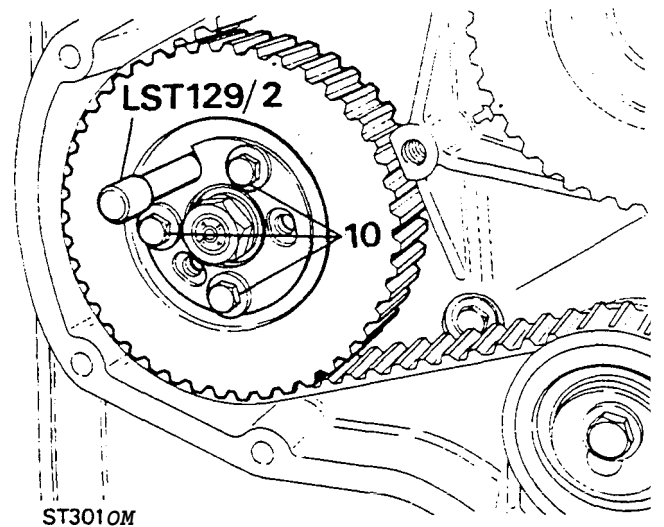
Note: To ensure correct belt tension it is very important that the tensioner is clamped when the torque meter is in the vertical position and the applied tension is correct.



10. Tighten the three bolts that secure the pump gear and reinforcing plate to the pump hub to the correct torque and remove the timing pin LST129/2.

CAUTION: Unlock the injection pump and fit the keeper plate before attempting to turn the crankshaft. Also ensure that the flywheel timing pin LST128 is clear of the flywheel slot.

11. Rotate the crankshaft *two* complete revolutions and slacken the tensioner clamp bolt and tension the belt again, as previously described.



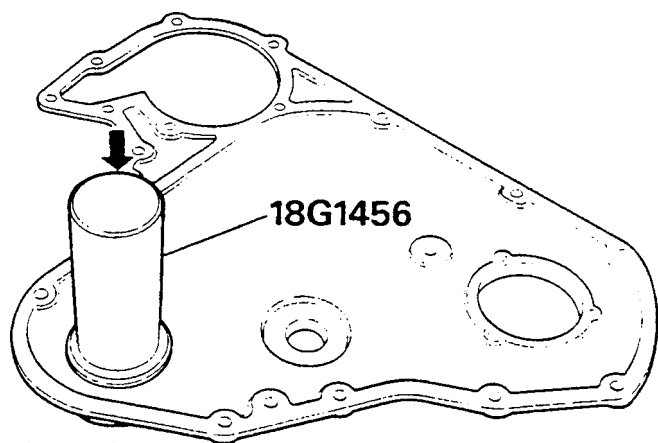
CAUTION:

The double tensioning procedure is vital otherwise the belt could fail resulting in serious damage to the engine.

12. Turn the crankshaft again in a clockwise direction until the flywheel timing pin locates in the T.D.C. slot.
13. Insert the timing pin in the pump hub and check that the crankshaft key aligns with the arrow on the front cover. **Also** check that the dot on the camshaft gear aligns with the arrow. If the timing pin cannot be inserted fully into the pump hub slot, it is necessary to slacken the three pump gear retaining bolts and slightly turn the hub, in the appropriate direction, to allow the pin to locate. Retighten the bolts to the correct torque.

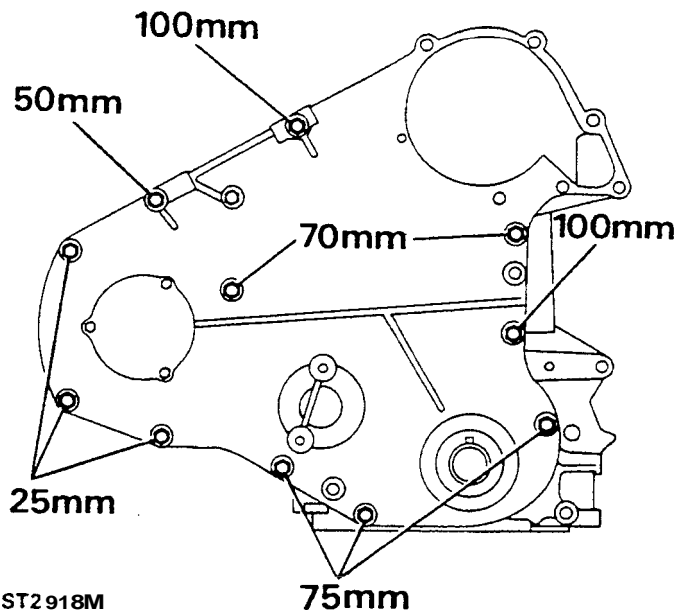
Fitting front cover plate

14. Remove the worm seal from the cover and clean the recess. Support the cover on a flat surface and using service tool 1861456 press in the new seal into the location, lip side leading, so that when fitted the lip faces away from the crankshaft.



ST2917M

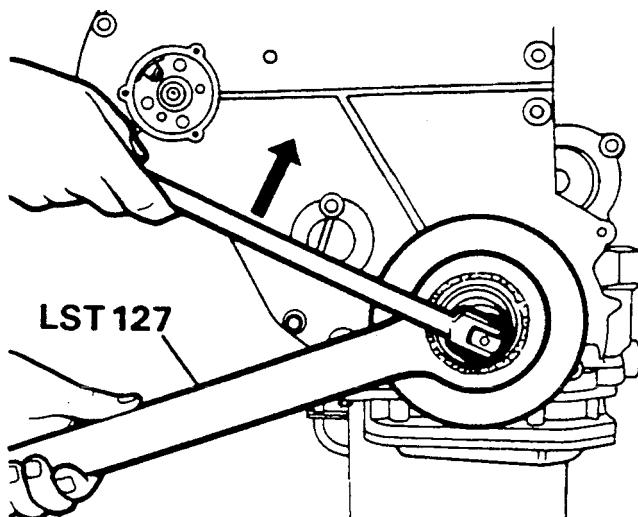
15. Ensure that the front cover and plate joint faces are clean and fit a new gasket to the front cover using a little grease.
16. Fit a new gasket to the centre hole in the cover plate and locate in position by inserting a bolt. Then fit the plate to the cover securing with the eleven retaining bolts using the location chart showing the various lengths. Tighten the bolts evenly to the correct torque.



ST2918M

Fitting front damper and pulley

17. Check that the damper rubber is in good condition then locate the unit on the crankshaft key and secure with the distance piece and special bolt. Apply a little Loctite 242 to the bolt threads and tighten to the correct torque using service tool LST127 to restrain the crankshaft, as illustrated.
18. Refit the pulley securing with the four bolts and tighten to the correct torque.



ST3125M

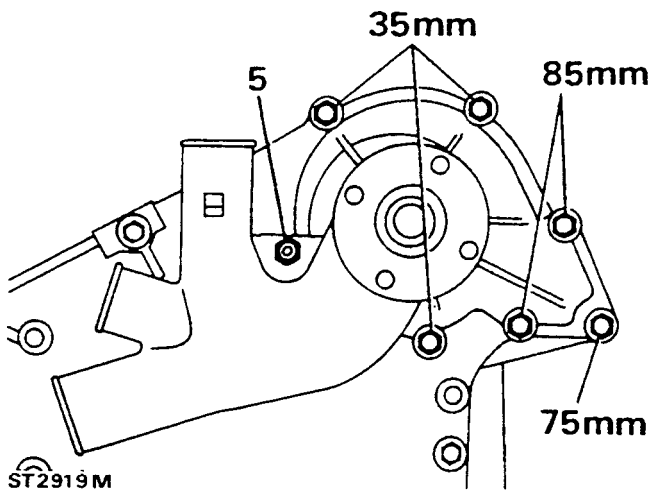
WATER PUMP INSPECTION AND FITTING

The water pump is not a reconditionable unit but its condition can be determined by the following checks.

1. Spin the pump spindle and listen for bearing noise, also push and pull the spindle and check for sideways movement. If the bearing is in good condition the clearance between the impeller and the pump body should not vary.
2. Inspect the vent hole in the pump body for signs of coolant or lubricant leaks. If there is any evidence of leakage, the pump should be renewed.

Fitting water pump

3. Lightly grease a new joint washer and place it in position on the timing cover.
4. Clean the threads of the water pump retaining bolts and apply Loctite 572 thread lubricant sealant to the threads of the long bolts which penetrate into the cylinder block.
5. Fit the pump to the cylinder block and secure in accordance with the bolt chart. Tighten the six bolts and one nut evenly to the correct torque.

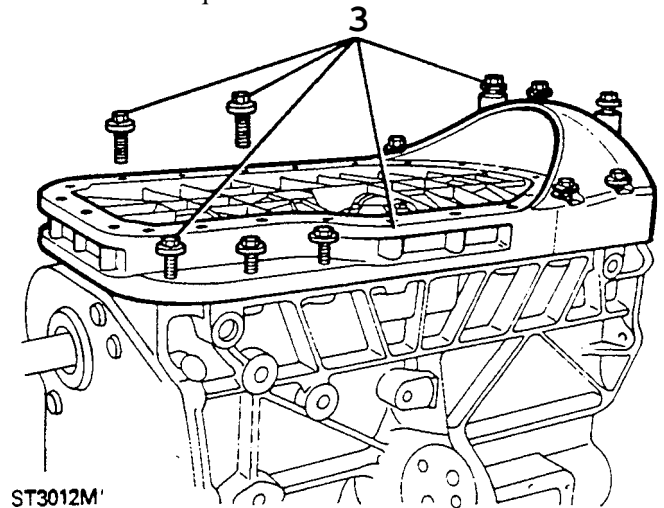


6. If separated, fit the fan blades to the viscous coupling with the four screws. Fit the fan and viscous coupling assembly to the water pump spindle noting that it is secured with a left-hand thread. If air conditioning is fitted do not at this stage fit the drive belt until the compressor belt is fitted.

Fitting ladder frame

Since the sealant specified to seal the ladder frame to the crankcase cures within fifteen minutes it is important to fit sufficient bolts to ensure adequate compression while the sealant cures.

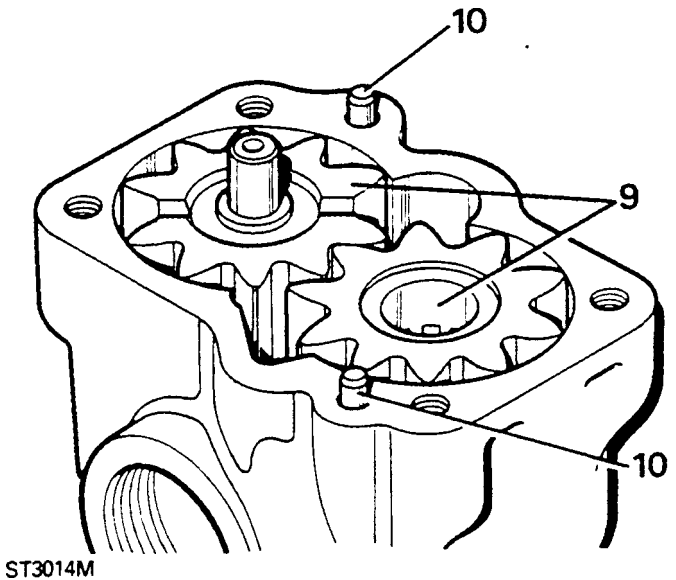
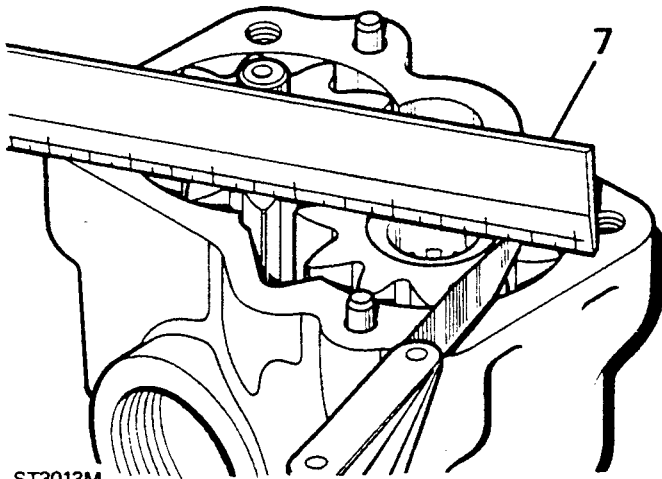
1. Clean both sides of the ladder frame and remove all traces of old sealant. Check that the frame is not distorted and is free from burrs and damage on the mating faces that could cause oil or bypass gas to leak.
2. Coat both faces with Hylogrip Primer to clean and hasten curing then apply a bead of "Hylogrip 2000" 3,0 mm wide to the mating face with the crankcase.
3. Fit ten securing bolts through the ladder frame flange and two more through the sump face as illustrated. Tighten all bolts evenly to the correct torque.



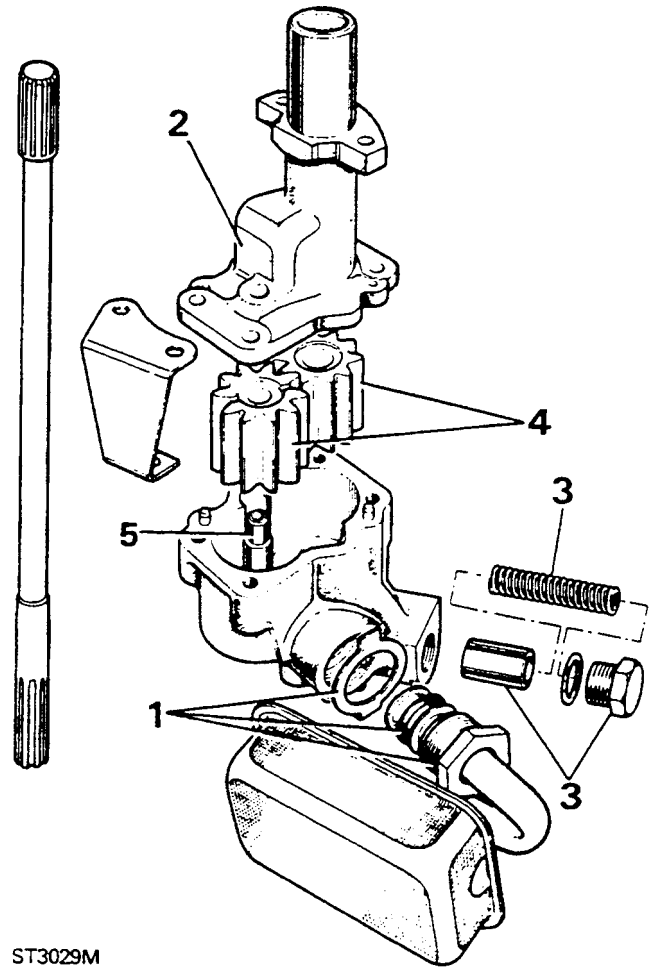
OIL PUMP OVERHAUL

1. Bend back the lock washer and release the nut securing the strainer to the oil pump body and remove the strainer and sealing ring.
2. Remove the four bolts and washers, lift off the oil pump cover and remove the driving and driven gear.
3. Remove the oil pressure relief valve plug and sealing washer. Withdraw the relief valve spring and plunger and examine for wear and scores.
4. Examine the gears for wear, scores and pitting and renew if necessary. Note: Gears must be renewed in pairs only.
5. If showing signs of wear the driven gear spindle may be renewed.

6. Clean all the components then install both gears into the body ensuring that the recessed end of the driving gear is uppermost.
7. Place a straight edge across both gears as illustrated to measure the end float of each using a feeler gauge. **Also** check the gear backlash and the clearance between the gears and pump body. The correct clearances are given in the data section.
8. Examine the gear thrust face on the pump cover, any slight scratches may be erased by rubbing on fine emery cloth on a flat surface.



ST3014M



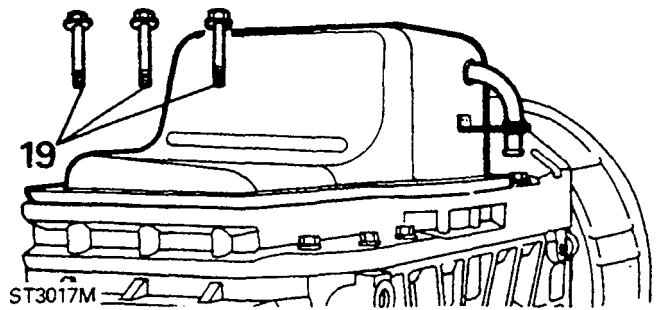
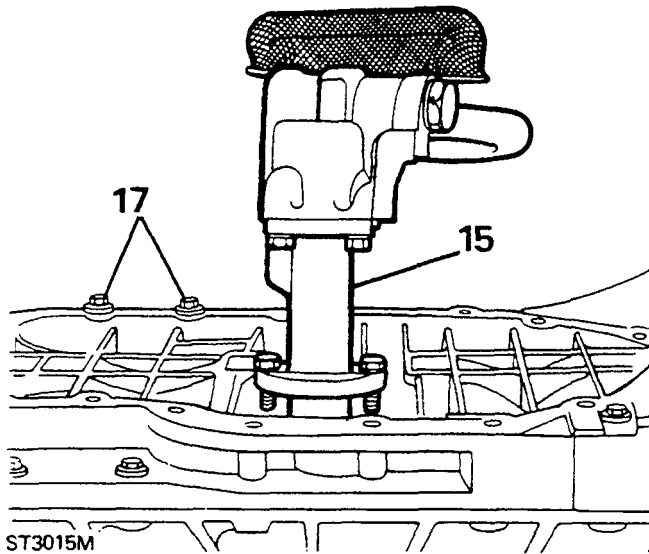
ST3029M

Pump assembly.

9. 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.
10. Fit the cover locating it over the two dowels and loosely secure with the four bolts until the strainer is fitted.
11. Install the spring into the relief valve then lubricate and insert the valve into the relief valve bore retaining with the sealing washer and plug.
12. Fit a new 'O' ring to the oil strainer pipe and insert into the pump body and loosely secure with the lock washer and nut.
13. Secure the strainer bracket to the pump body and tighten the four screws. Tighten the strainer pipe nut and secure with the lock tab.
14. Insert the pump drive shaft and check that the gears are free to operate before refitting to the engine.

Fitting oil pump

15. Ensure that the oil pump drive shaft is located in the appropriate spines and fit the oil pump and strainer assembly into the cylinder block using a new gasket, tighten the two bolts to the correct torque.



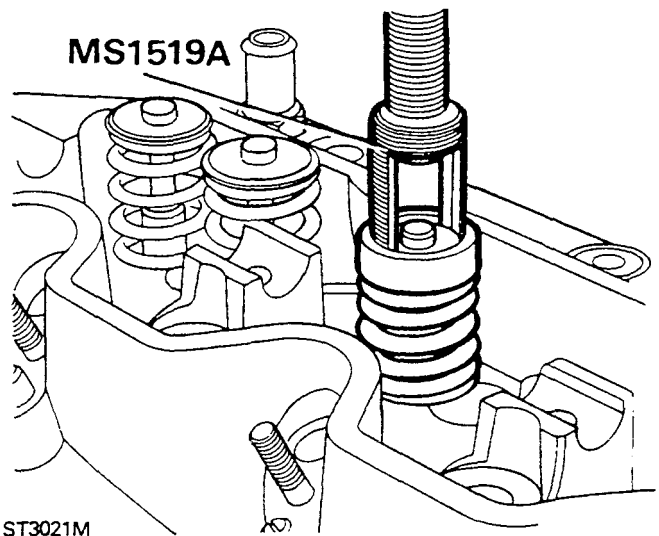
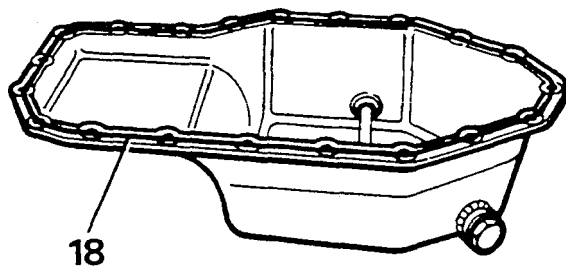
CYLINDER HEAD OVERHAUL

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.

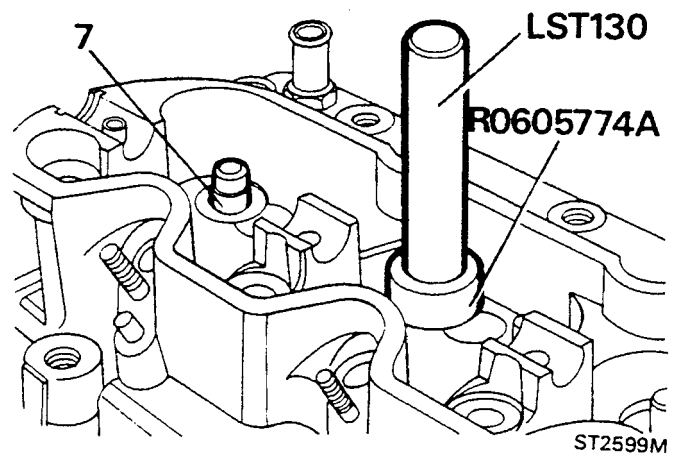
1. Using valve spring compressor **MS 1519A** or a suitable alternative, remove the valve and spring assemblies identified to their original locations.

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 "Hylosil" RTV102 black to the sump face and fit the sump.
19. Install and tighten the twenty remaining bolts to the correct torque. Note that the three long bolts pass through the sump and ladder frame into the front cover.



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 8 mm clear of the seat the valve head should not rock more than 0,15 mm (0.006 in). If the valve head movement exceeds 0,15 mm (0.006 in) the guide should be renewed.
5. inspect the valves for wear and damage. Valve heads that are burnt and cracked should be renewed. So should valves which are bent and distorted. Insert the valve into a new guide and check the side movement as described above to determine the wear on the valve stem.

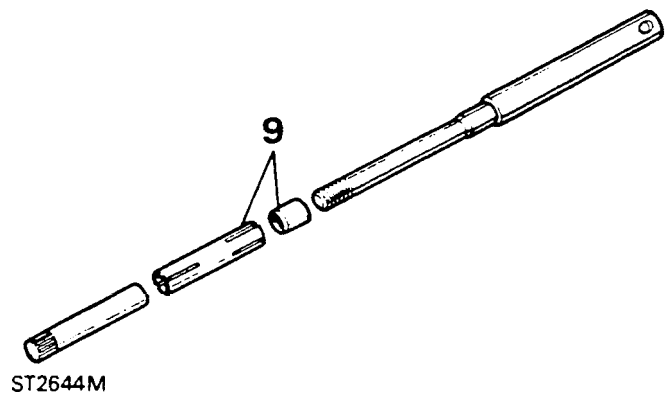
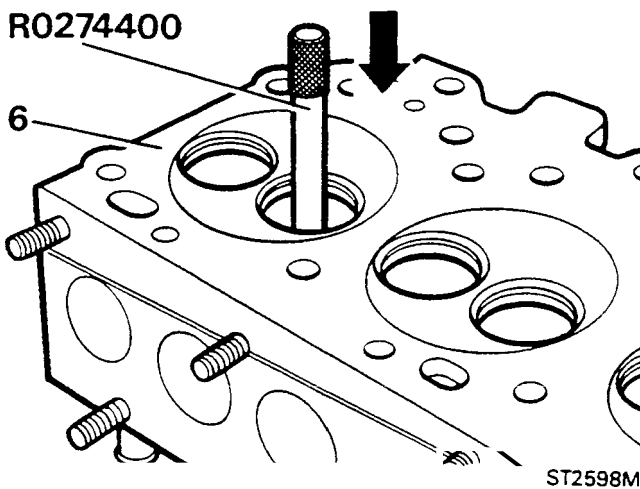


Reface valve seat inserts

8. The special set of hand tools recommended for refacing include expandable pilots that fit tightly into new or worn guides to ensure that the valve seat is concentric with the valve guide. The refacing tool has tungsten carbide cutters and can be used to cut a new seat in the insert. The valve seat cutter is numbered MS621, the handle set MS76B and the pilot MS150-8.
9. Loosely assemble the pilot in the sequence illustrated. Ensure that the chamfered end of the expander is towards the collet.

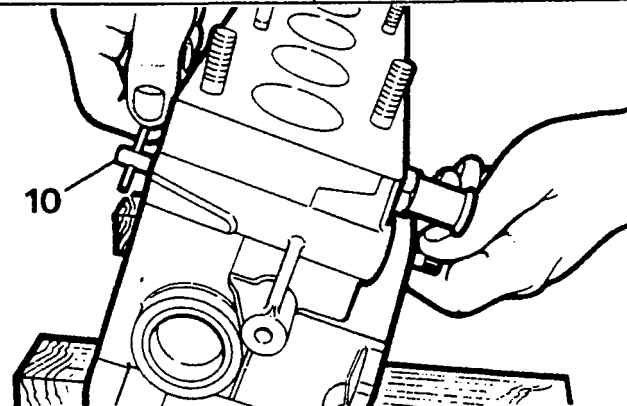
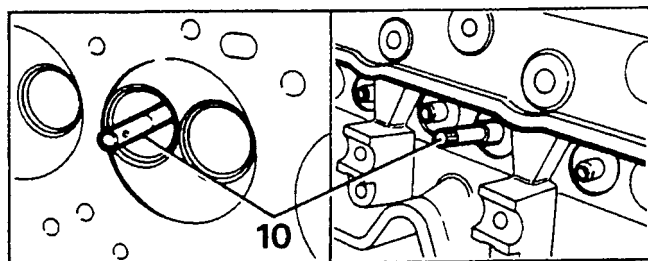
Renew valve guides

6. Support the cylinder head, combustion chamber uppermost on pieces of timber of sufficient thickness to allow clearance for the inlet or exhaust for the valve guides to be driven out using special tool RO274400.



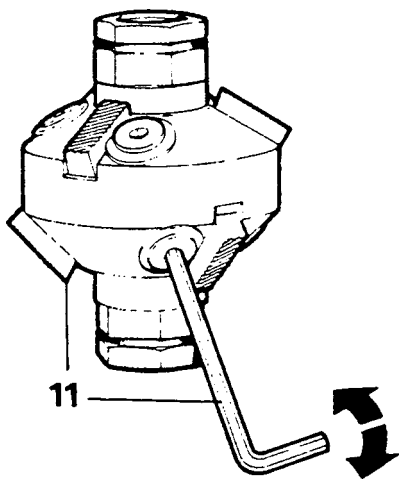
7. Turn the cylinder head over so that the combustion face is downwards. Lubricate the new valve guides and using special service tool LST 130 and depth gauge RO 60774A press the guide into position to the depth determined by the gauge of 19,0 mm (0.748 in).

10. insert the assembled pilot into the valve guide from the combustion chamber side of the cylinder head until the shoulder contacts the valve guide and the whole of the collet is inside the guide. To lock the pilot in the guide turn the tommy bar clockwise whilst holding the knurled knob.



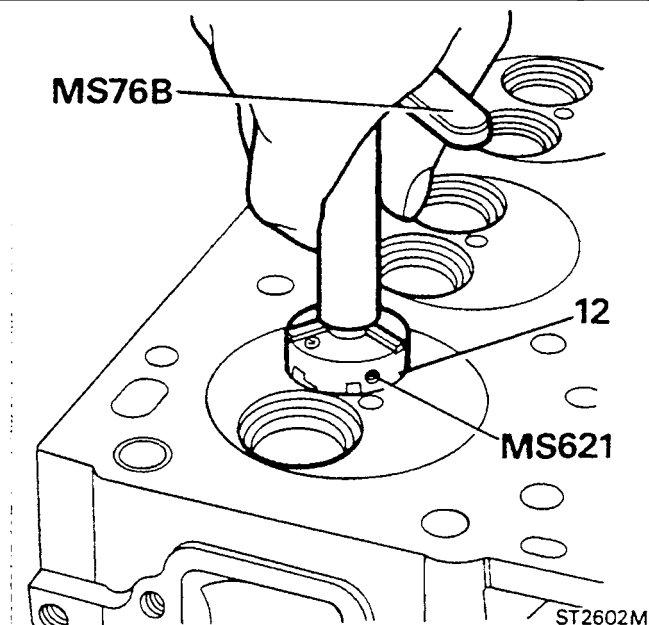
ST2670M

11. Check that the seat cutter MS621 is assembled correctly using the key MS76 ensuring that the angled end of each cutter is towards the seat and set so that the middle of the blade contacts the seat first. One end of the cutter is angled at 45° and the other end is 30°.



ST2645M

12. Using very light pressure turn the cutter clockwise until the angled face is approximately 0,5 mm wide.
13. To check the effectiveness of the cutting operation smear a small quantity of engineers' blue round the valve seat and revolve a correctly ground valve against the seat. A good seating will produce a continuous fine polished line around the valve face. A slight gap of not more than 12 mm in the polished line, can be corrected by lapping.

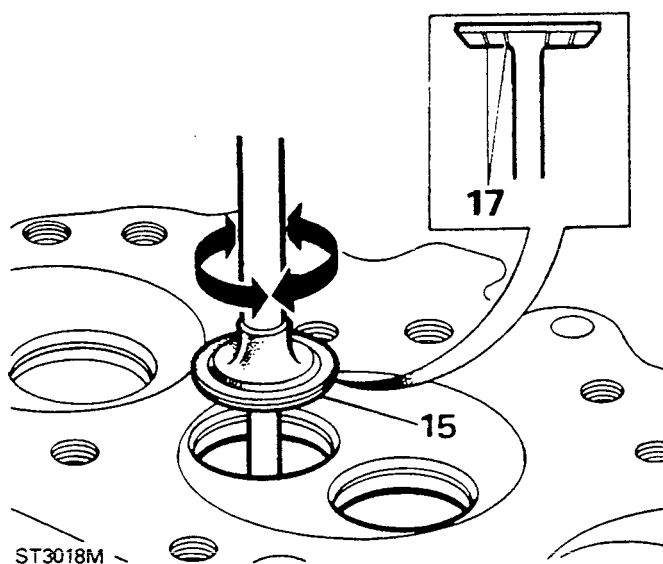


Valve refacing

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

Inlet valve seat face -	30° + 0,25°
Exhaust valve seat face -	45° + 0,25°

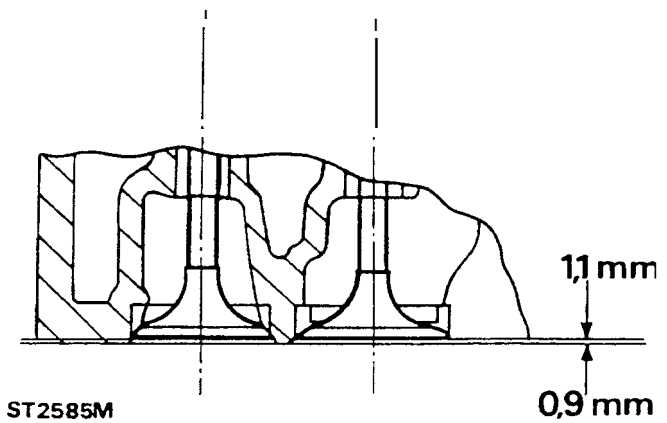
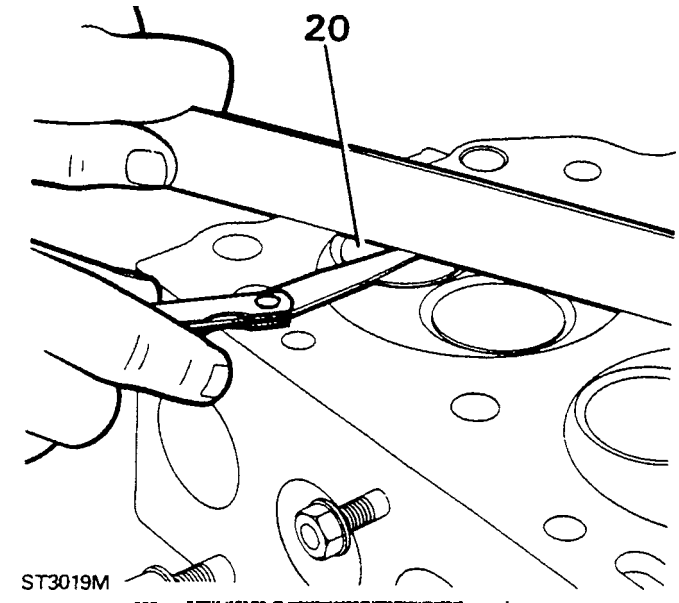
Inlet valve face -	30° - 0,25°
Exhaust valve face -	45° - 0,25°



ST3018M

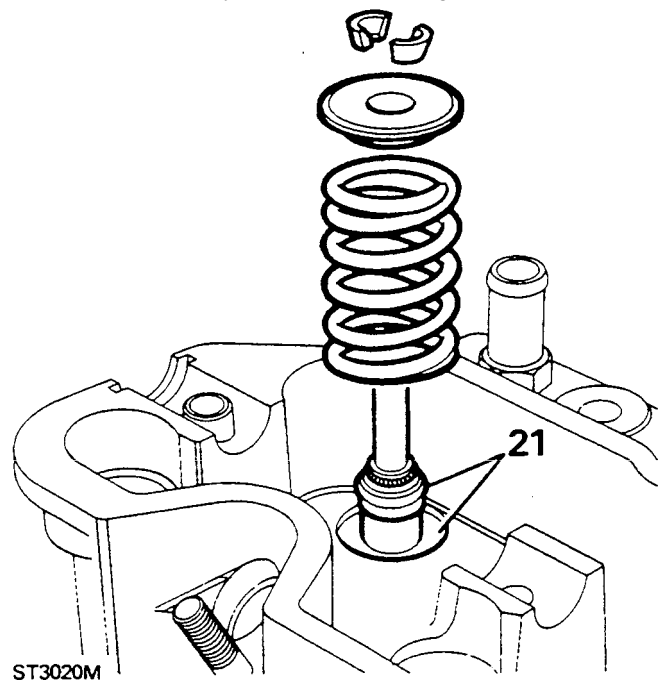
Lapping valves

15. To ensure a gas tight seal between the valve face and valve seat it is necessary to lap-in the appropriate valve to its seat. It is essential to keep the valve identified with its seat once the lapping-in operation has been completed. Unless the faces to be lapped are in poor condition it should only be necessary to use fine valve lapping paste.
16. Smear a small quantity of paste on the valve face and lubricate the valve stem with engine oil. Insert the valve in the appropriate guide and using a suction type valve lapping tool employ a light reciprocating action while occasionally lifting the valve off its seat and turning it so that the valve returns to a different position on the seat.
17. Continue the operation until a continuous matt grey band round the valve face is obtained. To check that the lapping operation is successful, wipe off the valve paste from the valve and seat and make a series of pencil lines across the valve face.
18. Insert the valve into the guide and while pressing the valve onto the seat revolve the valve a quarter of turn a few times. If all the pencil lines are cut through no further lapping is necessary. Thoroughly wash the cylinder head ensuring no lapping paste remains before fitting the valves.
19. Position the cylinder head with the combustion face uppermost, lubricate and insert the valves into their respective guides. To check the valve head stand-down or the correct dimension of the valve head below the combustion face, use either a dial test indicator or a straight edge and feelergauge as follows.
20. Hold the straight edge across the centre of each valve in turn and measure the gap between the valve head and straight edge. The correct dimension should be 1,1 to 0,9 mm (0.040 to 0.035 in). Using a dial gauge zero the gauge on the combustion face then move the stylus across to the valve head and note the reading.

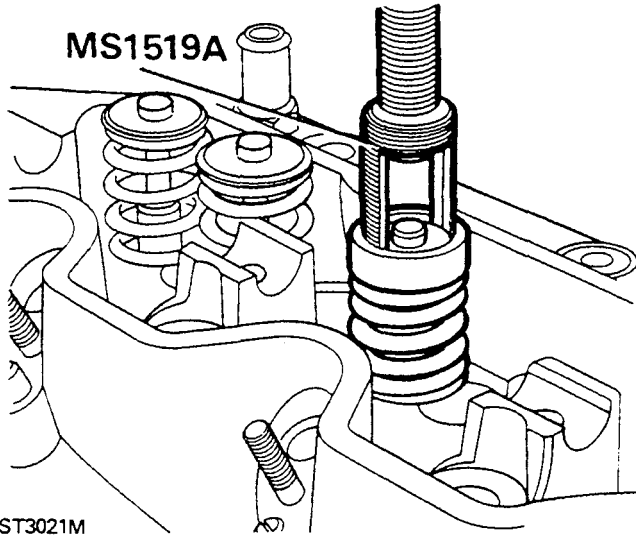


Assembling valves to cylinder head

21. Insert the valves to their respective guides and locate a spring protection washer over each guide. Fit new oil seals to all the valve guides with the garter spring uppermost. Ensure that the seals fully locate on valve guides.

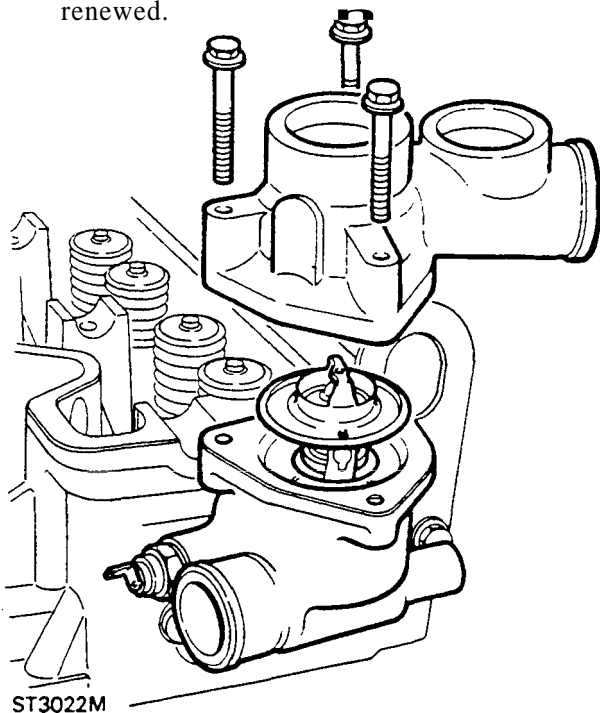


- Fit a spring and cup to each valve and compress with special service tool MS1519A or a suitable alternative. Retain with the multi-groove cotters ensuring that they are fully located in the valve stem and cup.



Thermostat and housing

- If necessary remove the temperature transmitter and temperature sensor from the housing.
- Release the three bolts securing the thermostat cover and lift out the thermostat. The thermostat may be tested by immersing it in hot water of a known temperature and comparing its operation with the temperature range stamped on the flange. Any leakage of wax (which is the colour of copper) from around the center pin of the thermostat, indicates that it is faulty and should be renewed.

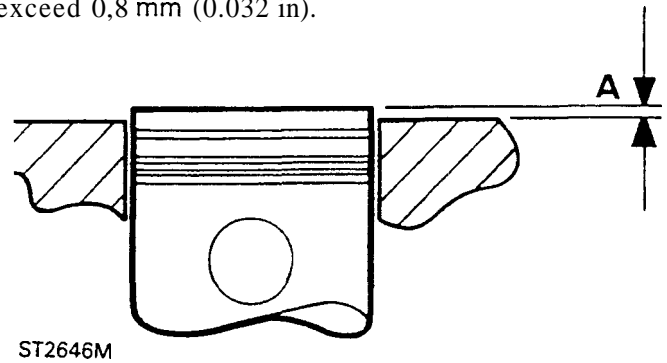


- The thermostat housing may be removed from the cylinder head at this stage and if necessary the gasket renewed.
- The "jiggle pin" which allows any air to escape from below the thermostat, may be fitted in any position. Renew the gasket when fitting the thermostat and apply a little Hylomar sealant to the threads of temperature sensor and transmitter before screwing into position.

FITTING CYLINDER HEAD

Piston protrusion and gasket selection

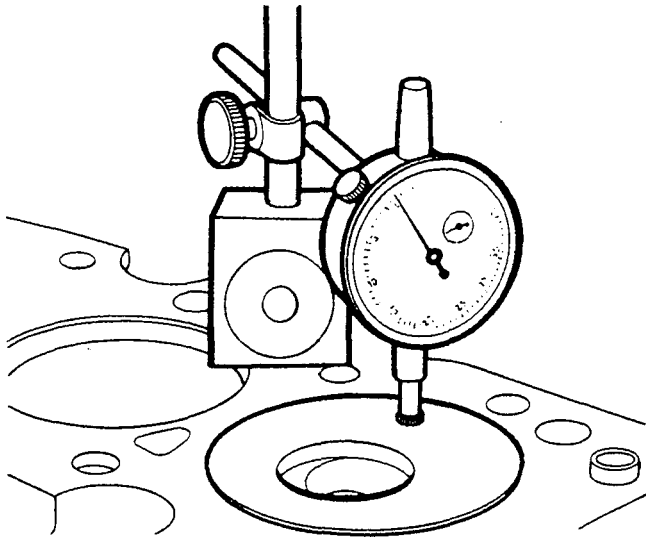
Before fitting the cylinder head, the protrusion of the pistons above the block face must be checked in order that the correct thickness gasket may be selected from the range of three. The height of all the pistons above the cylinder block must be measured and the thickness of the gasket selected is based upon the largest value of dimension 'A', as illustrated. This dimension, however, must not exceed 0,8 mm (0.032 in).



Three thicknesses of gasket are available and each size can be recognised by the number of identification holes punched in the side of the gasket as illustrated. The table below gives the details of the gaskets available. The thickness of gasket fitted can be seen when the cylinder head is fitted since the identification holes can be seen protruding from the right hand side of the engine towards the rear.

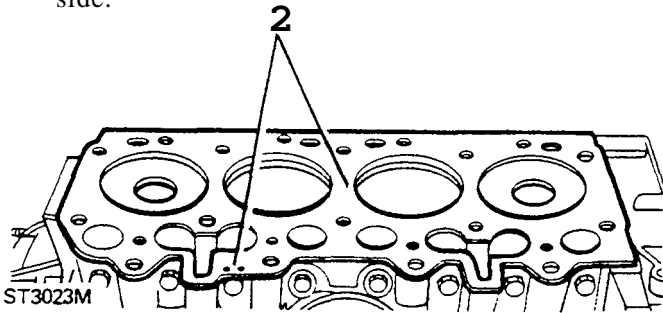
Number of holes	Metric	Imperial	Gasket
2	0.70 to 0.61	0.024 to 0.0275	ERR0382
			ERR038
3	0.80 to 0.71	0.0279 to 0.0314	ERR0384

Clean the cylinder block combustion face and turn the crankshaft so that number one and number four pistons are at . D.C. Use a dial test indicator to determine the highest travel of the piston then zero the gauge and move the stylus over to the cylinder block and note the reading. Repeat the procedure on the remaining pistons. The highest figure obtained will determine the gasket selected.



ST2581M

- Place the selected the head gasket in position on the cylinder block so that the identification holes are towards the rear on the right-hand side.



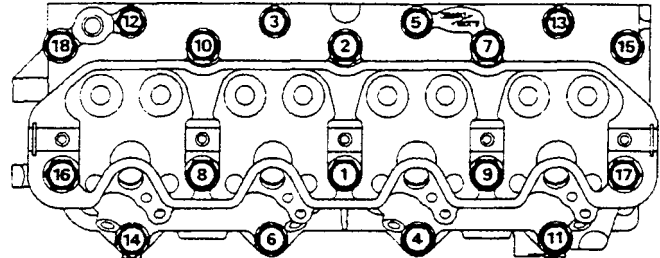
ST3023M

- 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



ST2619M

- Attach the special service tool degree disc LST122 to a power bar. Make a suitable pointer from welding rod and attach it to a bolt screwed into a rocker shaft securing bolt hol.
- Tighten all the bolts down through an angle of 60° strictly in the sequence illustrated. As each bolt is tightened scribe a line across the head with a piece of chalk or crayon to identify which bolts have been tightened, then tighten each bolt a further 60° again in the correct sequence to complete the tightening procedure. Re-positioning of the pointer will, no doubt, be necessary to reach all bolts.

CAUTION: It is important that the double torquing procedure is observed and that on no account should the total angle of 120° be performed in one operation otherwise damage and distortion of the cylinder head may occur.

OVERHAUL ROCKER SHAFT

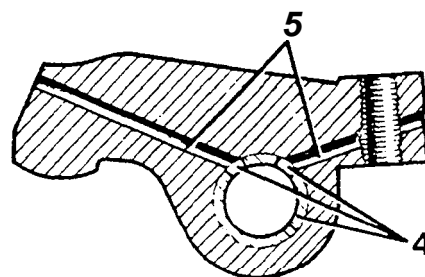
1. Remove the five rocker shaft retaining bolts and withdraw the bearing caps, rockers, washers and springs from the shaft.
2. Examine the rocker shaft for wear and discard if the bearing surface is worn, scored or pitted. Check also that the oilways are clear.
3. Inspect the rockers and discard if the pads are worn. It is not permissible to grind pads in an attempt to reclaim rockers.
4. Renew the bushes if the clearance exceeds 0,127 mm (0.005 in). Press in replacements ensuring that the pre-drilled holes align with those in the rockers and machine the inside bore of the bushes to 18,018 mm. The rocker arm and bush oil drillings are shown in the cross section illustration.
5. Examine the tappet adjustment screws and check that the ball end is not worn or pitted and that the lubrication hole is clear.
6. Assemble the rockers, bearing caps, new springs and washers to the shaft noting where the washers are fitted. Hold the assembly together with the five rocker shaft retaining bolts.

Push rods

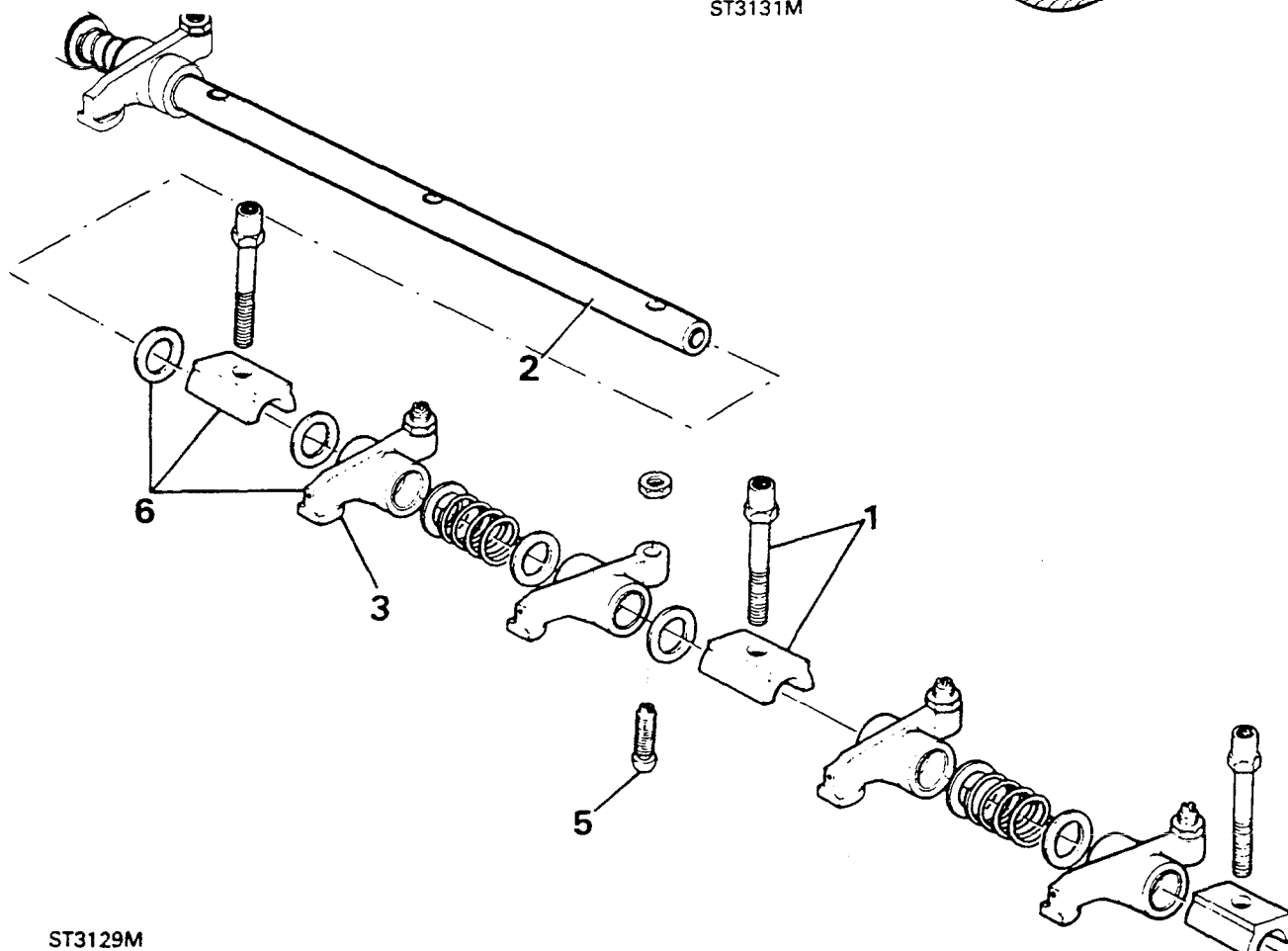
1. Examine the push rods and renew any that are bent or where the ball or cup ends are worn or pitted.
2. Fit the push rods to the engine ensuring that the ball-end locates properly in each camfollower slide.

FITTING ROCKER SHAFT

1. Ensure that a new cap is fitted to each valve stem before fitting the rocker shaft.
2. Fit the rocker shaft to the cylinder head ensuring that the retaining bolts and push rods are correctly located then evenly tighten the bolts to correct torque.



ST3131M



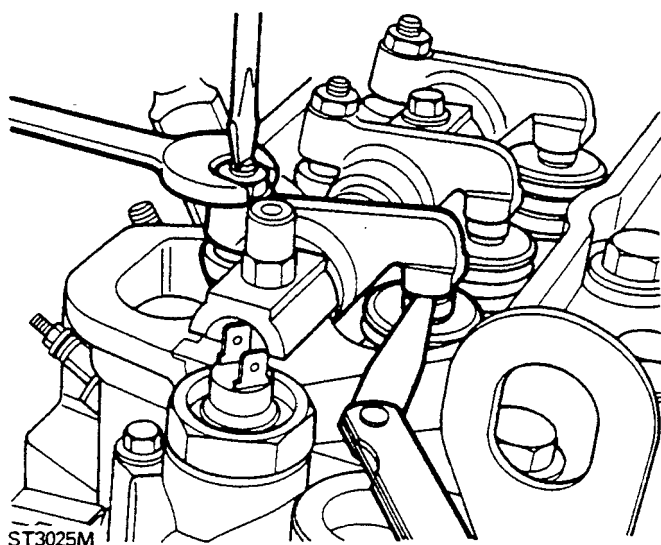
ST3129M

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 tuning the crankshaft to adjust clearances.

1. Turn the engine over until number eight valve (counting from front of engine) is fully open.
2. Using a 0,20 mm (0.008 in) feeler gauge adjust the clearance of number one valve.



Continue to adjust the remaining tappets in the following sequence:

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

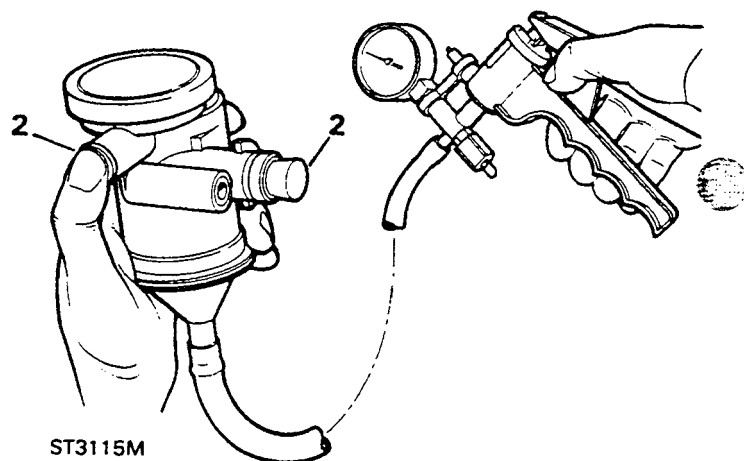
Rocker cover and crankcase ventilator

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.

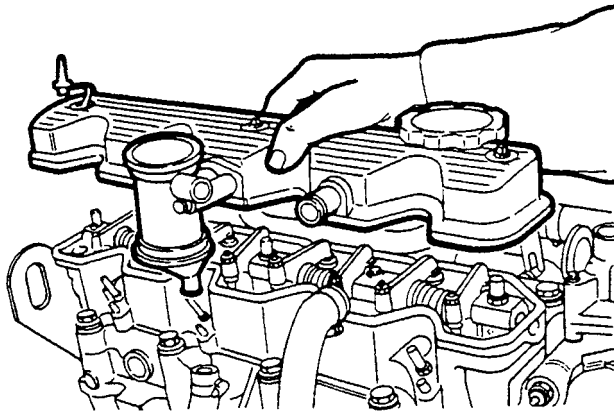
Test procedure crankcase ventilator

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.



Fitting rocker cover

5. Apply a continuous bead of RTV Hylosil which starts and finishes 10 mm each side of the half moon grooves at both ends of the rocker shaft and press the seals into position.
6. Locate a new seal in the rocker cover and fit the cover to the cylinder head securing with the three special bolts and conical washers. Tighten the bolts evenly to the correct torque and reconnect the ventilation hoses.



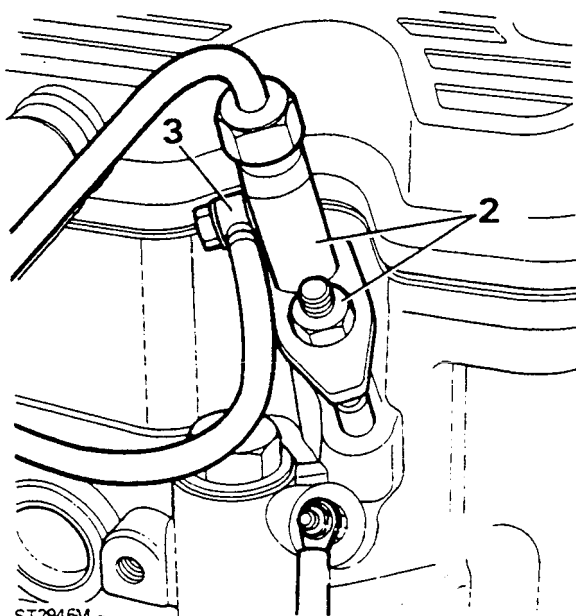
ST2948M

FITTING HEATER PLUGS

1. If necessary check the operation of each heater plug before fitting and tighten to the correct torque, do not over-tighten.
2. Connect the electrical harness to the plugs and secure with the single nut and washer. Ensure that each spade terminal is fitted so that neither the terminal nor the insulation touches the cylinder head, or oil separator.

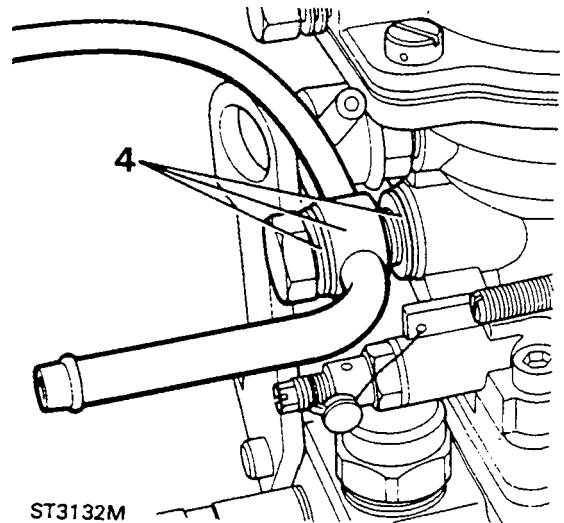
FITTING INJECTORS AND PIPES

1. Ensure that the injector and seating in the cylinder head is clean then lightly grease a new copper washer in position on the injector.
2. Fit the injectors with the spill return outlet facing towards the rear of the engine and secure each with a clamp and nut. The clamps are slightly curved and the convex side should be fitted uppermost. Tighten the nuts to the correct torque.
3. Fit the spill return rail to the injectors, noting that there are **two** copper washers and one must be fitted each side of the retaining union screw. The in-board washer locates in a recess in the injector. Do not over-tighten the screws.



ST2946M

4. Fit the banjo-union end of the spill return rail to the rear of the injector pump and secure with a copper washer each side of the banjo and the union bolt.

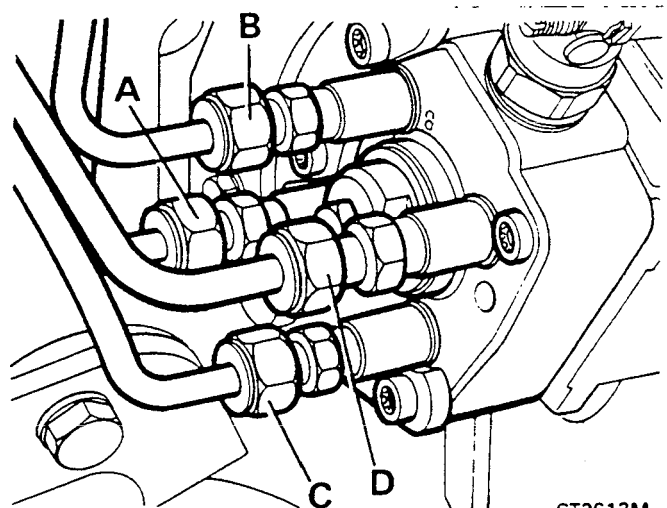


ST3132M

5. Fit the injector fuel supply pipes securing each end of the pipes to their respective locations loosely, then tighten evenly. Do not, however, over-tighten.

Commencing at the front of the engine connect the pipes as follows:

- A. To number 1 injector.
- B. To number 2 injector.
- C. To number 3 injector.
- D. To number 4 injector.



ST2613M

FUEL INJECTIONPUMP

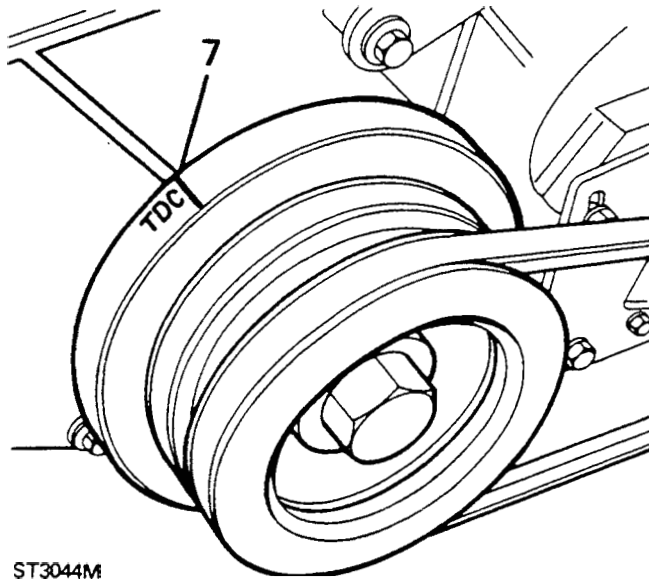
Service Repair No. 19.30.07

Remove and refit

Special tools:-

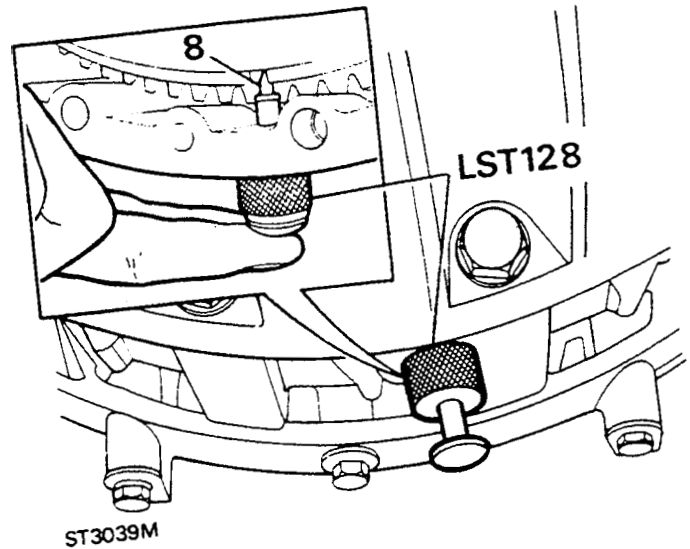
Flywheel timing pin	LST 128
Pump gear retaining tool	LST 129/1
Pump timing pin	LST 129/2

1. Remove the bonnet and disconnect the battery.
2. Drain the cooling system.
3. Remove the fan and viscous coupling assembly see operation 26.25.19
4. Remove the fan cowl see operation 26.25.11.
5. Disconnect the lower cooling hose from the waterpump.
6. Remove the oil filler cap so that the position of number one cylinder valve rockers can be seen to assist in obtaining T.D.C.
7. Turn the crankshaft to align the T.D.C mark on the crankshaft damper with the the web on the front cover plate. At the same time check that the valves of number one cylinder are closed.



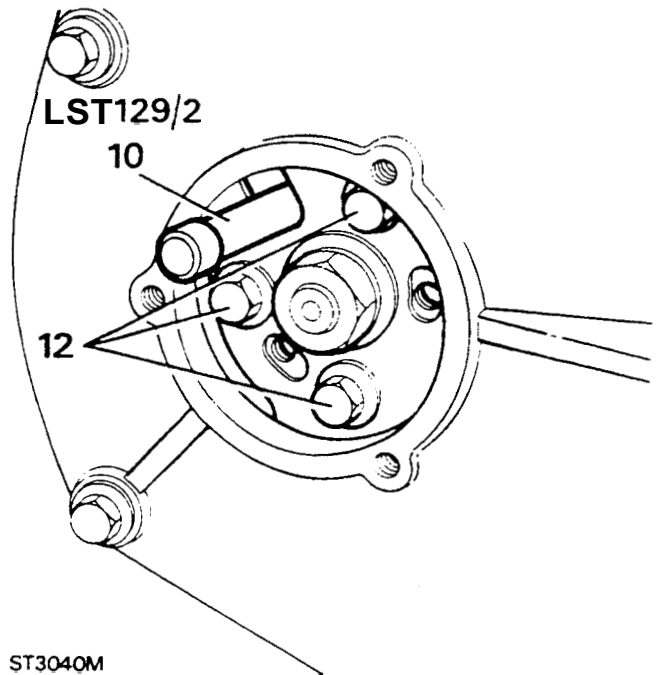
ST3044M

8. Remove the blanking plug from the bottom of the flywheel housing and fit the timing pin LST 128. Check that the pin can be inserted into the appropriate slot in the flywheel. Note that there are two slots in the flywheel the narrowest one being that which determines T.D.C. for this engine.



ST3039M

9. Remove the injector pump hub blanking plate.
10. Insert the injector pump timing pin LST 129/2 through the "U" shaped slot in the pump hub into the pump body. Ensure that the pin fits easily and is fully inserted.

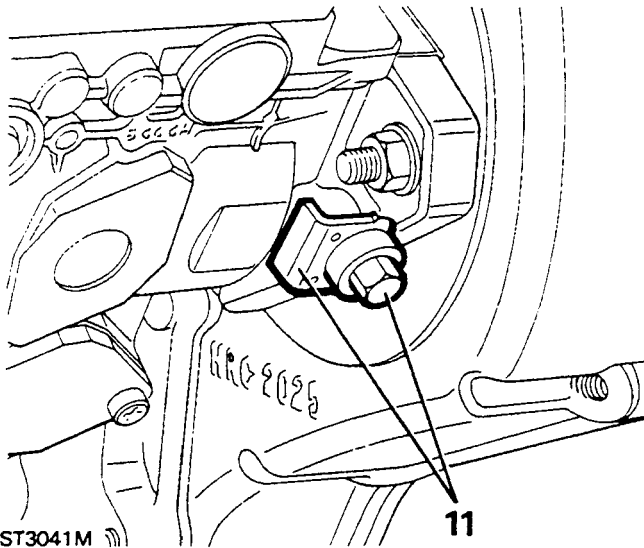


ST3040M

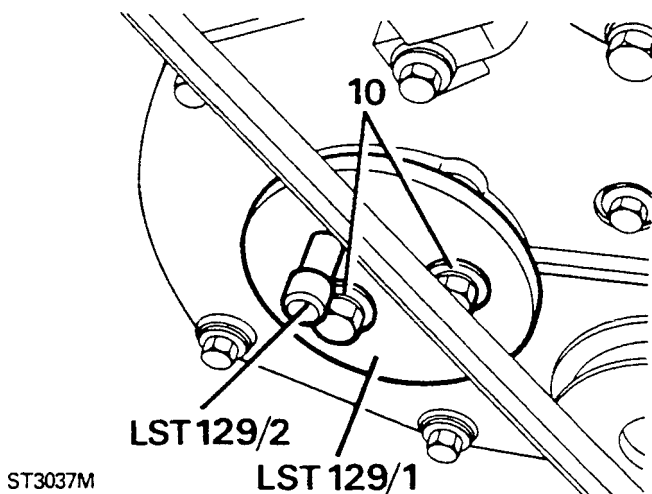
Continued

- 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.

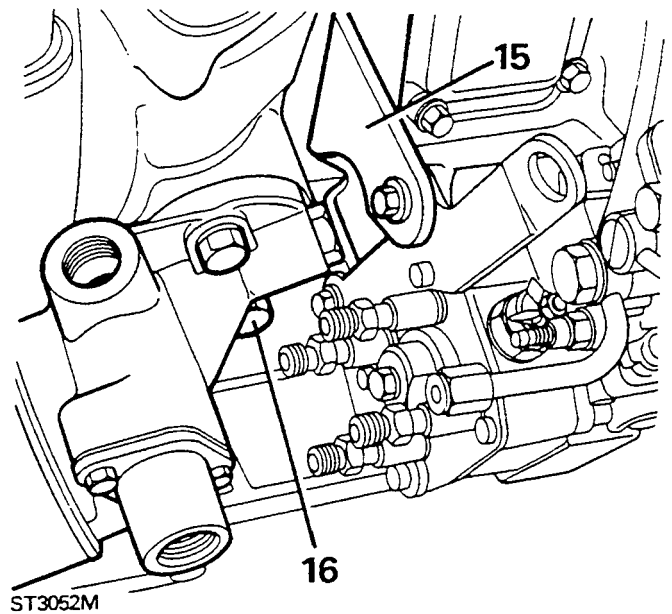


- Remove the pump drive gear three retaining bolts and remove the lock plate and timing pin.
- Fit the pump gear retaining tool LST 129/1 and align and tighten the two bolts. insert the timing pin LST 129/2, again, through the hole provided in the retaining tool.

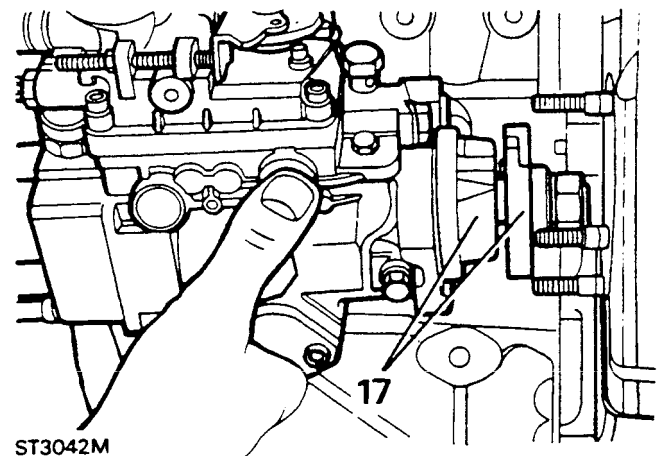


- Remove the injector pipes and disconnect the following items from the injector pump.
 - Throttle cable.
 - stop control solenoid lucar.
 - Spill return pipe.
 - Turbo charger boost hose.
 - Main fuel supply pipe.

- Remove the injector pump rear support bracket.
- Remove the oil filter adaptor rear attachment bolt to allow clearance for the pump to be withdrawn.

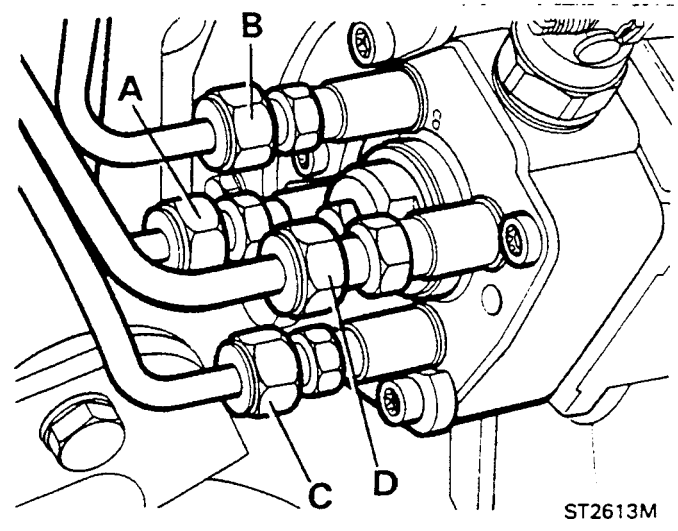
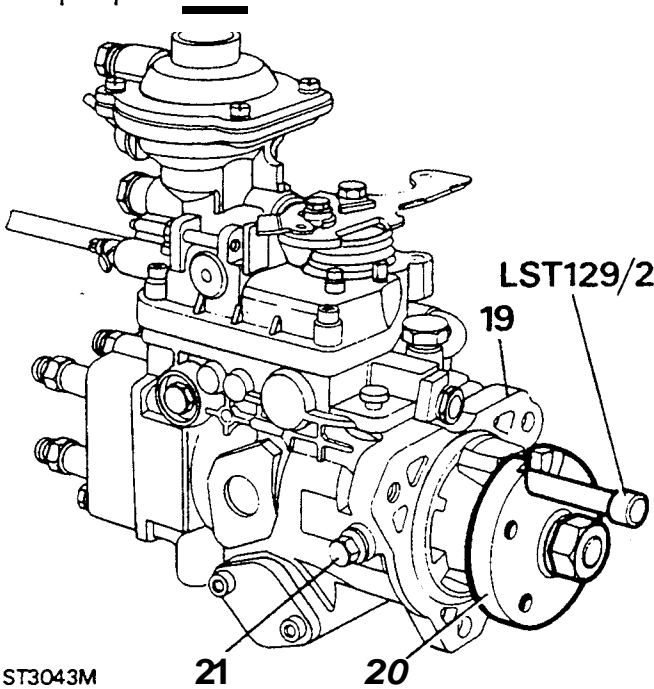


- Remove the pump three retaining nuts and withdraw the pump and gasket, with LST 129/2
- Fit blanks to the inlet and outlet ports to prevent entry of dirt. Slacken the locking screw, fit the keeper plate and tighten the screw.



Reffiting

19. Clean the pump flange and front cover mating face and place a new gasket in position over the the studs.
20. Fit the timing pin LST 129/2 to the pump, if necessary, rotate the pump to enable the pin easily and fully.
21. Slacken the pump locking screw, remove the keeper plate and tighten the screw to lock the pump.



27. Remove the pump timing pin and the pump gear retaining tool LST 129/1.
28. insert the pump timing pin again and fit the gear lock plate and secure with the three bolts and tighten to the correct torque.
29. Remove the timing pin. Unlock the pump, fit the keeper plate and tighten the bolt.
30. To check that the pump timing is correct, turn the crankshaft two complete revolutions and check that the timing pin LST 129/2 can be inserted easily and fully into the pump. at the same time check that the flywheel timing pin can also be inserted in the flywheel slot.
31. If, with the flywheel timing pin located, the timing pin cannot be inserted cleanly into the pump, carry out the following instructions:-

1. Turn the crankshaft the small amount necessary to enable the timing pin to be inserted into the pump.
2. Remove the keeper plate and lock the pump.
3. Slacken the three pump gear retaining bolts.
4. Tum the crankshaft to T.D.C.
5. Check that the timing pin is an easy fit in the pump and that the flywheel timing pin locates.
6. Tighten the pump gear retaining bolts to the correct torque.
7. Unlock the pump, fit the keeper plate and tighten the bolt. Remove the timing pin from the the pump and the timing pin tool from the flywheel.

22. Fit the pump to the front cover and drive gear and secure with the three nuts tightening evenly to the correct torqu.
23. Fit the rear support bracket to the cylinder block and secure the pump to the bracket. Tighten all bolts the the correct torque.
24. Fit the oil filter adaptor rear attachment bolt.
25. Connect the items listed in instruction 14.
26. Fit the injector supply pipes securing each end to their respective locations, loosely then tighten evenly but do not over tighten. Commencing at the the front of the engine connect the pipes as follows:-

- A to number one injector.
- B to number two injector.
- C to number three injector.
- D to number four injector.

32. Fit the pump aperture cover with a new gasket and secure with the screws.
33. Connect the cooling system bottom hose to the waterpump.

Continued

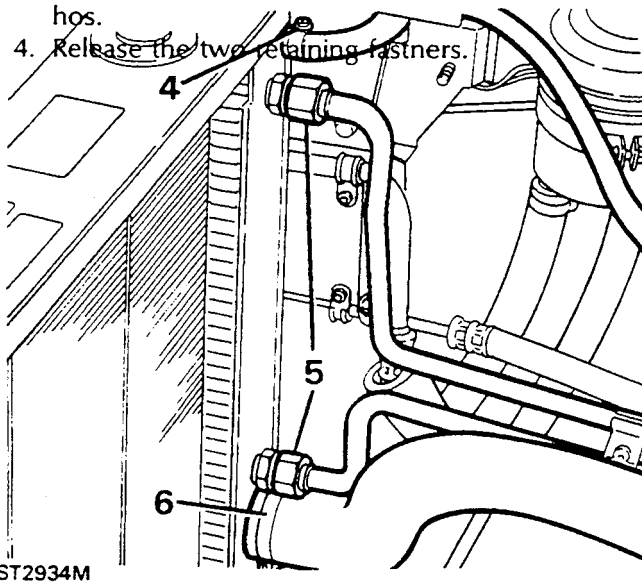
34. Place the fan cowl in position but do not secure it to the radiator until the fan and coupling is fitted.
35. Fit the fan and viscous coupling assembly to the waterpump spindle. Tighten the left hand thread to the correct torque using a Tommy bar in the hole provided in the fan pulley to restrain the coupling.
36. Secure the fan cowl to the radiator with the **two** nuts.
37. Fit the top coolant hose.
38. Refill the cooling system with the correct concentration of water and anti-freeze see operation 26.10.01.

AIR CLEANER

Service Repair No. 19.10.01

Remove and refit

1. Disconnect the hose from the turbo charger compressor housing to air cleaner.
2. Disconnect, from the air cleaner, the engine breather hose.
3. Disconnect from the air cleaner, the air inlet hos.
4. Release the two retaining fasteners.

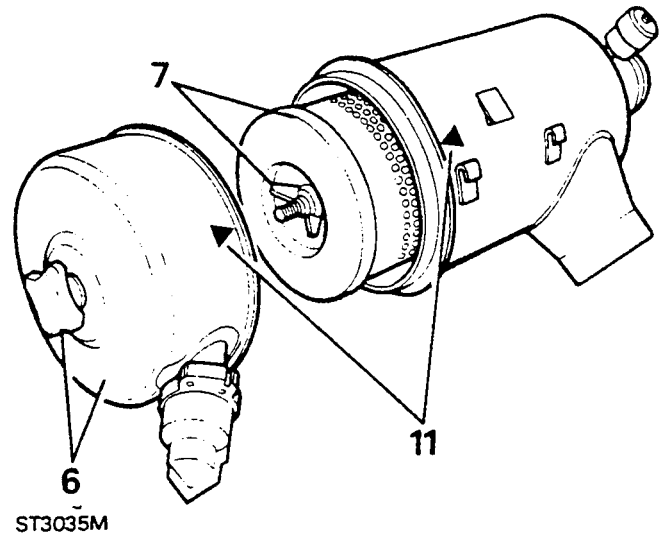


5. To release and remove the air cleaner from its mounting cradle, twist the body of the air cleaner anti-clockwise (viewing it from the front of the engine) and remove it from the vehicle.

Renewing element

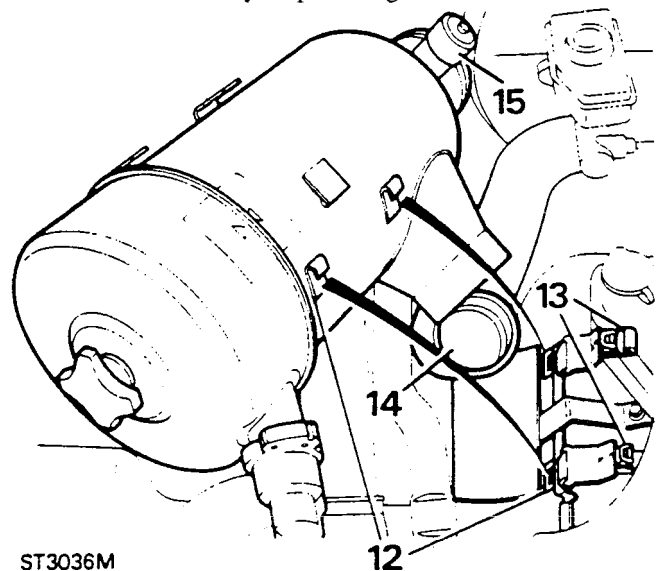
6. Unscrew the handwheel anti-clockwise and remove the end cover.

7. Unscrew the wing nut and withdraw the element.
8. Clean the interior of the casing and cover.
9. Fit a new element, fins leading, into the casing.
10. Secure the element with the wing nut.
11. Fit the end cover and aline the two arrows.



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.

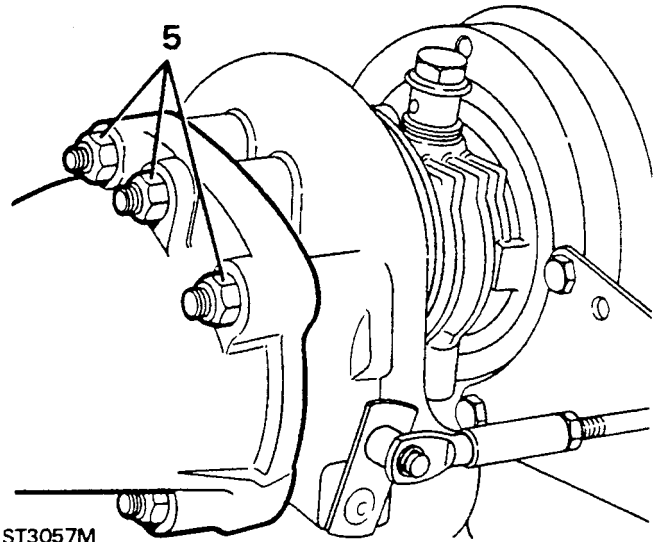


TURBO CHARGER

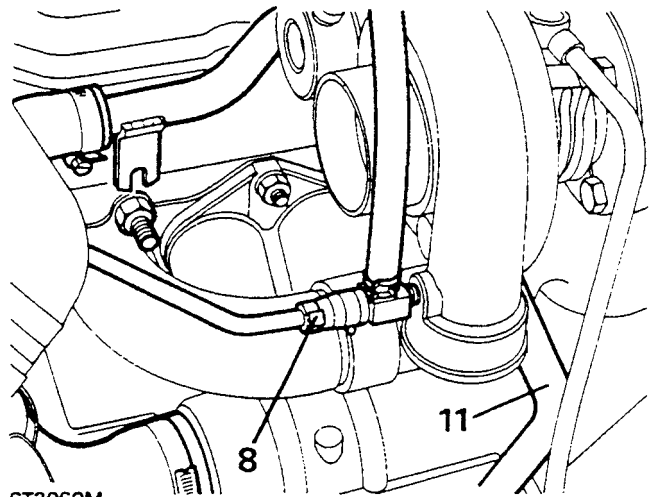
Service Repair No. 19.42.01

Remove and refit

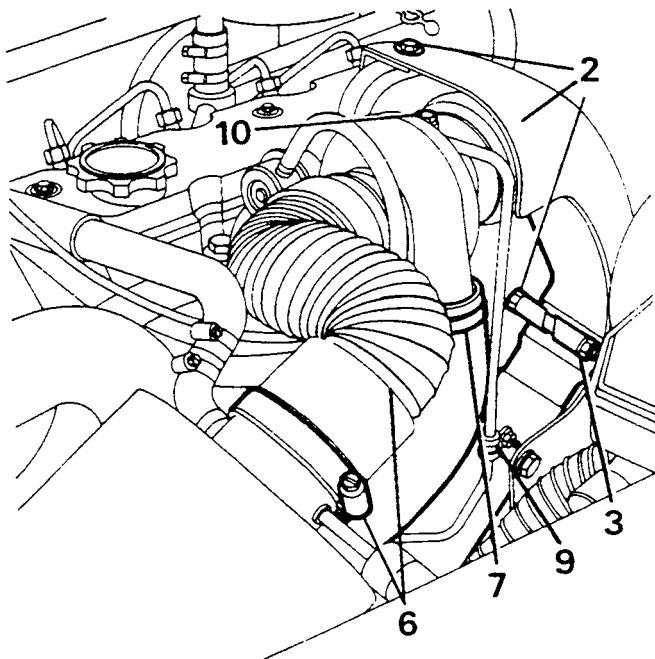
1. Remove the bonnet and disconnect the battery.
2. Remove the turbo charger heat shield.
3. Disconnect the exhaust front pipe from the turbo charger elbow.
4. Release the front exhaust pipe from the support bracket attached to the cylinder block.
5. Remove the five nuts and remove the elbow from the turbo charger.
6. Remove the air inlet hose from the air cleaner and turbo charger.
7. Disconnect, from the turbo charger, the bottom hose from the intercooler.
8. Remove the boost pressure pipe from the turbo "T" piece.
9. Slacken the turbo charger oil feed pipe clamp.
10. Disconnect the oil supply pipe from the turbo charger centre housing.
11. Release the oil return drain pipe from the turbo charger.
12. Remove the four nuts and lift the turbo charger from the exhaust manifold and retrieve the steel joint washer.



ST3057M



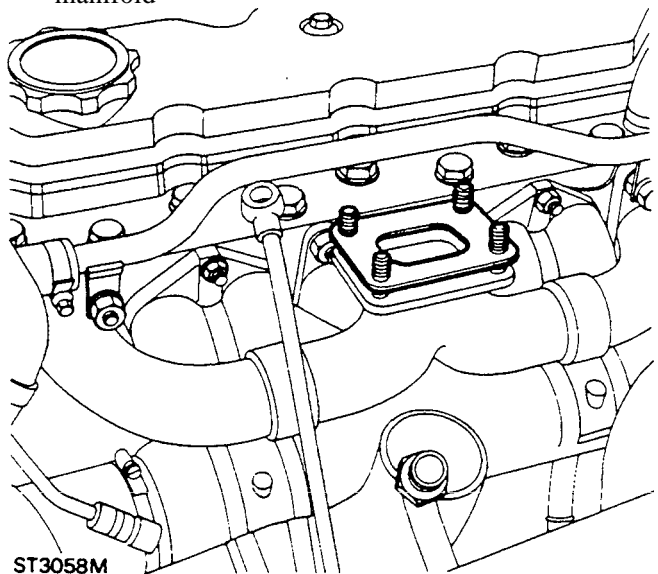
ST3060M



ST3059M

Refitting

13. Fit the steel joint washer to the to the exhaust manifold



ST3058M

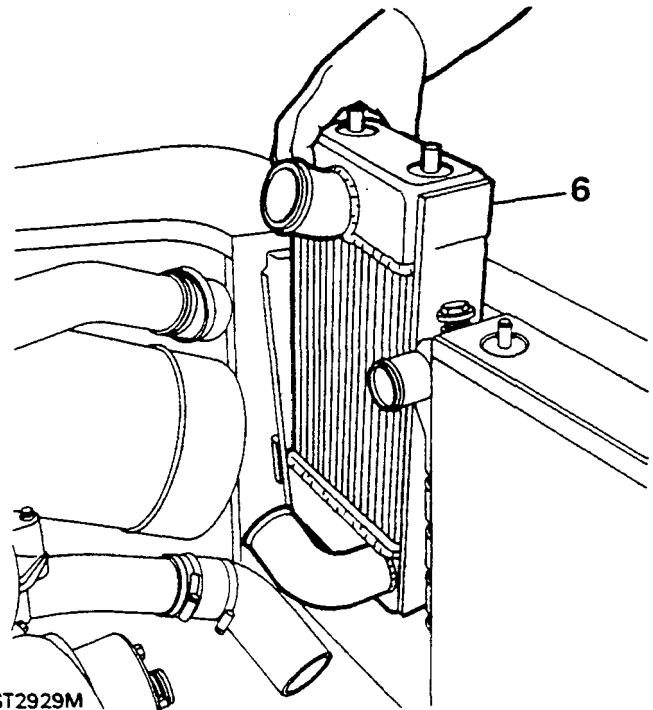
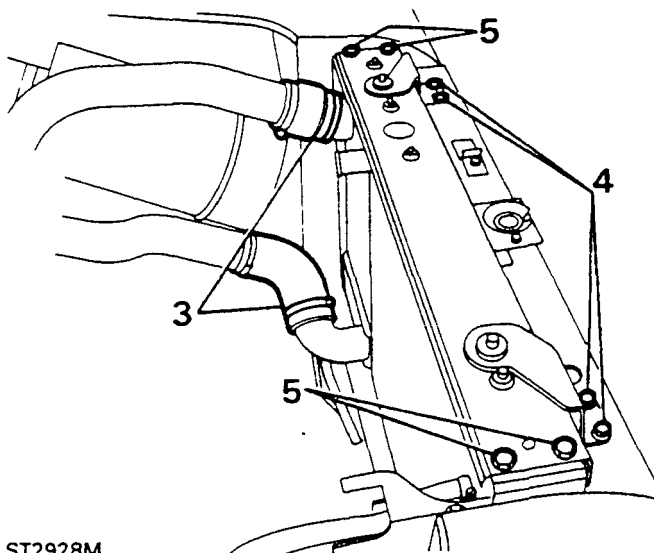
14. Fit the turbo charger and secure with the four nuts and tighten evenly to the correct torque.
15. connect the oil feed and return pipes to the turbo charger and tighten the feed pipe clamp.
16. Connect the boost pressure pipe to the "T" piece and secure with the clip.
17. Connect the intercooler hose to the turbo inlet.
18. Fit the hose to air cleaner and turbo charger.
19. Fit the turbo charger elbow.
20. Connect the exhaust front pipe to the elbow using Holts "Firegum" to seal the joint.
21. Fit the heat shield and secure at the **two** fixing points.
22. Fit the bonnet and connect the battery.

INTERCOOLER

Service Repair No. 19.42.15

Remove, clean and refit.

1. Remove the fan and viscous coupling assembly, see operation 26.25.19.
2. Remove the fan cowl, see operation 26.25.11.
3. Disconnect the top and bottom hoses from the Intercooler.
4. Remove the four bolts (**two** each side) retaining the radiator top support brackets.
5. Remove the four bolts (**two** each end) securing the radiator surround top panel, and remove the panel.
6. Lift out the Intercooler.



Cleaning.

7. Flush the intercooler with ICI "GENKLENE" propriety cleaner, following the manufacturers instructions.
8. **Dry** the Intercooler completely ensuring that no liquid remains in the element.

Refitting.

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

COOLING SYSTEM

Engine protection

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

Use only Universal anti-freeze or permanent type ethylene base, without methanol, containing, a suitable inhibitor for aluminium engine parts. Use one part of anti-freeze to one part water. Anti-freeze should be used even in climates where it is not necessary.

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

Land Rovers leaving the factory have the cooling system filled with a 50% anti-freeze mixture. This gives protection down to minus 47 degrees Centigrade (minus 53 degrees Fahrenheit).

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

See section 09 for protection quantities.

Service Repair No. 26.10.01

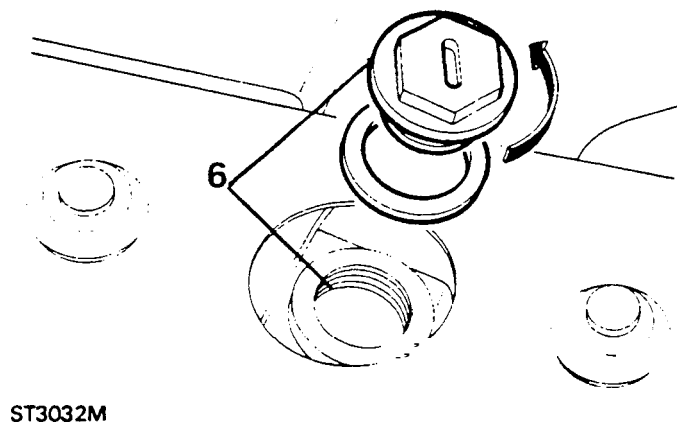
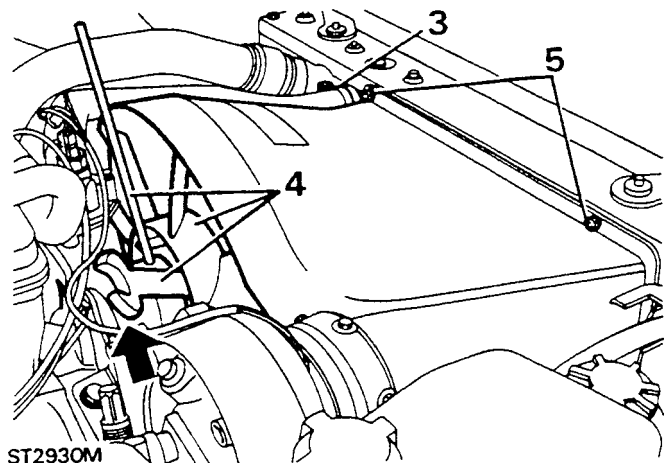
Drain and refill

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

1. Disconnect the battery.
2. Disconnect the bottom coolant hose from the radiator. Allow to drain and reconnect the hose.
3. To drain the cylinder block, remove the drain plug which is situated on the left hand side of the engine immediately below front core plug. Refit the plug, with a new washer, when the draining is completed.
4. To drain the expansion tank, remove the cap and disconnect the expansion hose from the radiator and allow it to drain into a suitable container. Flush the tank with clean water and reconnect the hose.

Refilling.

5. Make up a solution of anti-freeze and water in a separate container in the concentration required. To allow for topping-up, and for filling the expansion tank, prepare a quantity in excess of the cooling system capacity.
6. Remove the radiator filler cap and fill the radiator until the coolant level is just below the filler neck and refit the cap.
7. Fill the expansion tank to approximately half full and refit the cap.
8. Connect the battery and run the engine until normal operating temperature is attained. Allow the engine to cool completely and 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 about half full. Fit both filler caps.



FAN COWL

Service Repair No. 26.25.11

Remove and refit.

1. Follow instructions 1 to 7 operation 26.25.19.
2. Remove the cowl from the engine compartment.

Refitting.

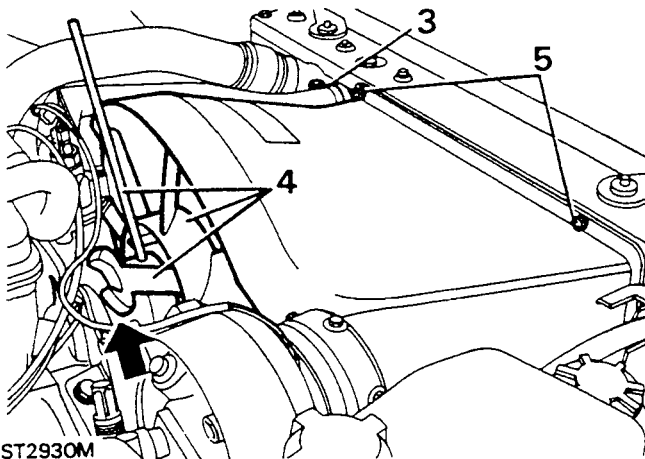
3. Reverse instructions 1 and 2.

FAN AND COUPLING ASSEMBLY

Service Repair No. 26.25.19

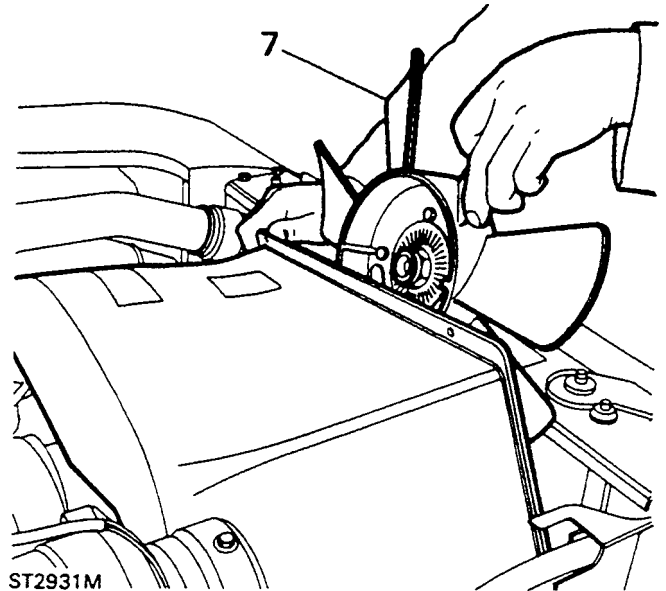
Remove and refit.

1. Disconnect the battery for safety reasons.
2. Drain the coolant by disconnecting the radiator bottom hose and reconnect when coolant has drained.
3. Remove the top hose.
4. Using a cranked open ended spanner and a restraining bar in the hole in the pulley hub, release anti-clockwise, the viscous coupling from the water pump spindle. Lower the fan and coupling assembly into the base of the cowl.
5. Remove the **two** nuts securing the cowl to the radiator.



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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

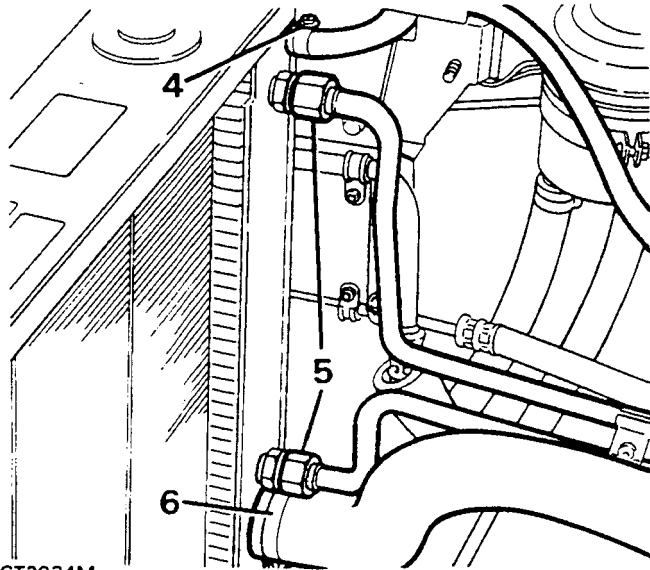
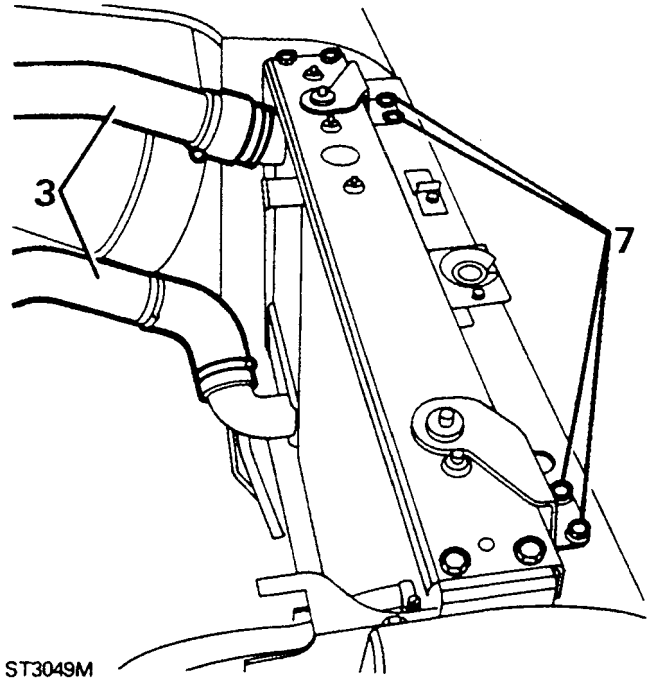
8. Insert the fan and coupling into the base of the cowl reversing the removal procedure.
9. Fit the coupling to the water pump spindle noting that it has a left hand thread. Tighten the coupling using the restraining bar and cranked spanner.
10. Fit the cowl and secure with the two nuts. Ensure that 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.

RADIATOR

Service Repair No. 26.40.01

Remove and refit

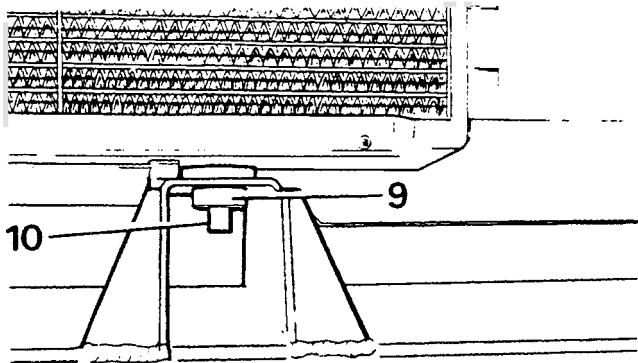
1. Remove the fan and viscous coupling assembly, see operation 26.25.19.
2. Remove the fan cowl, see operation 26.25.11.
3. Disconnect the hoses from the intercooler.
4. Disconnect the expansion tank hose from the radiator.
5. Disconnect the oil cooler pipes from the radiator and cover the ends to prevent entry of dirt.
6. Disconnect the bottom hose from the radiator.



7. Remove the four bolts, two each side, retaining the radiator top securing brackets, and remove the brackets.
8. Lift out the radiator complete with the intercooler.

Refitting

9. Check that the rubber grommets on the radiator locating pegs and beneath the radiator mounting brackets on the chassis cross member are in position.
10. Lower the radiator into position ensuring that the pegs locate in the mounting brackets.



ST3033M

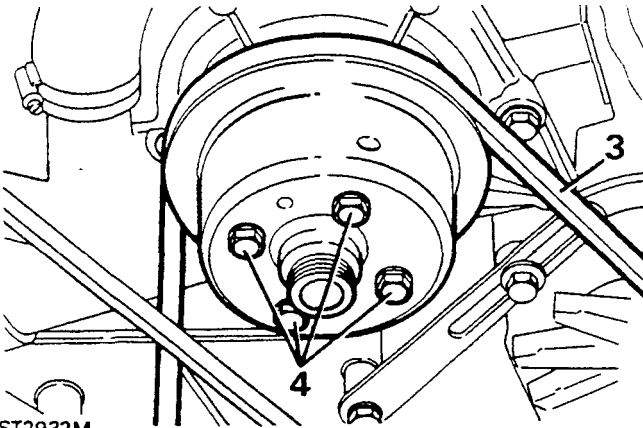
11. Fit the radiator top mounting brackets and secure with the four bolts.
12. Connect the radiator bottom hose.
13. Fit the oil cooler pipes to the radiator.
14. Connect the expansion tank hose.
15. Connect the top and bottom hoses to the intercooler.
16. Place the fan cowl in position but do not secure at this stage.
17. Fit the fan and viscous coupling and secure the cowl with the two nuts.
18. Check that all the coolant hose clips are tight and refill the cooling system with the correct concentration of water and anti-freeze, see operation 26.10.01.

WATER PUMP

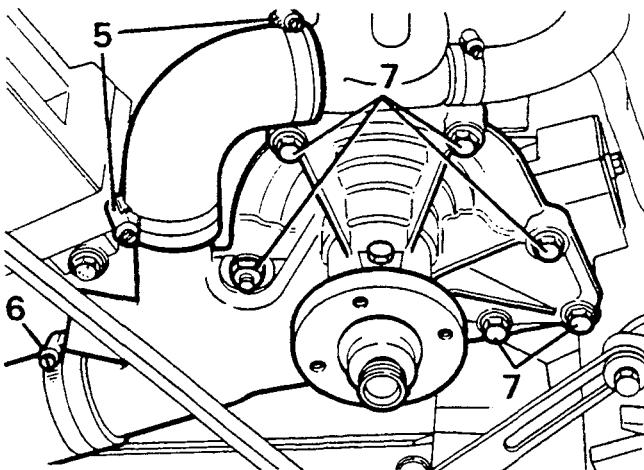
Service Repair No. 26.50.01

Remove and refit

1. Remove the fan and coupling assembly operation 2. 25.19.
2. Remove the fan cowl operation 26.25.11.
3. Slacken the fan belt tension and remove it from the pulley.
4. Remove the four bolts securing pulley to hub.



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.



Refitting

9. Clean the water pump and front cover plate mating faces.
10. Lightly grease a new gasket and place in position on the cover plate.
11. Clean the threads of the water pump retaining bolts and apply Loctite 572 thread lubricant sealant to the threads of all the bolts.
12. Fit the pump to the engine and secure with the six bolts and one nut in accordance with the chart below. Tighten the fixings evenly and to the correct torque.
13. Connect the bottom hose to the water pump.
14. Fit the pulley to the water pump hub and secure with the four bolts.
15. Fit and tension the water pump/alternator belt.
16. Fit the fan cowl.
17. Fit the fan and coupling assembly.
18. Check that all the coolant hose clips are tight and refill the cooling system with the correct concentration of water and anti-freeze, see operation 26.10.01.
19. Connect the battery, run the engine and check for coolant leaks.

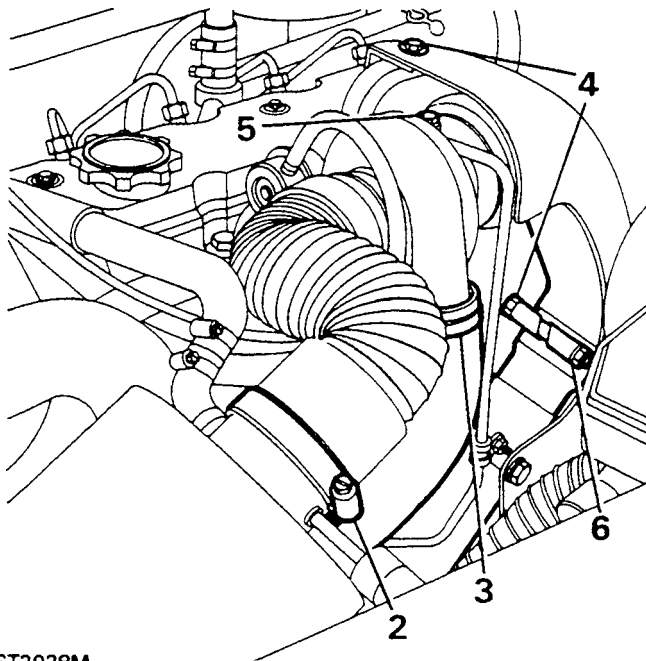
EXHAUST AND INLET MANIFOLDS

Service Repair No. 30.15.01

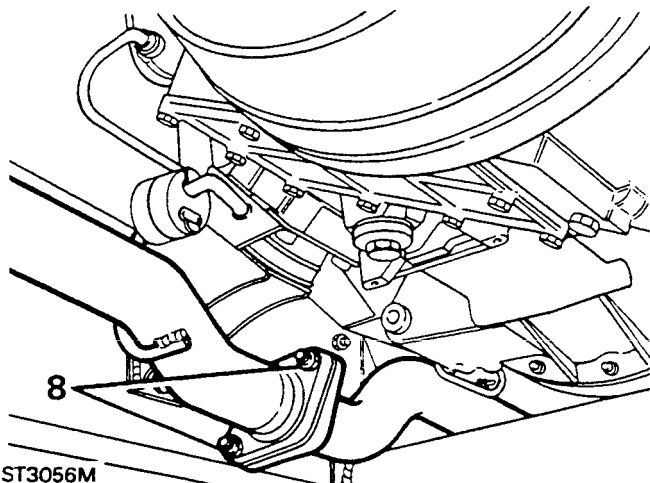
Remove and refit

Note: to remove the inlet manifold, the exhaust 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.

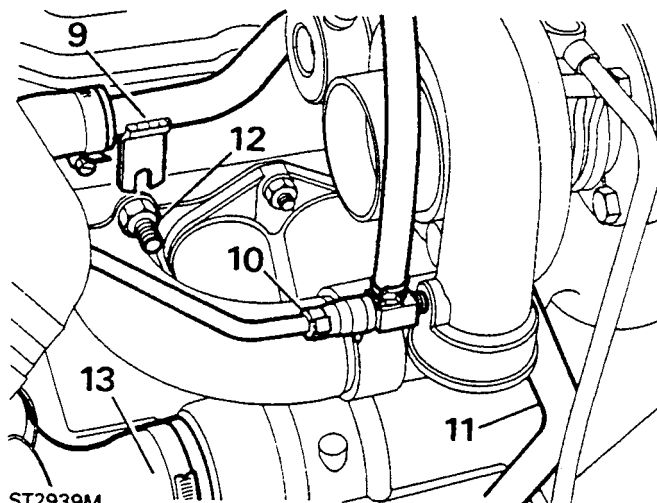


ST2938M



ST3056M

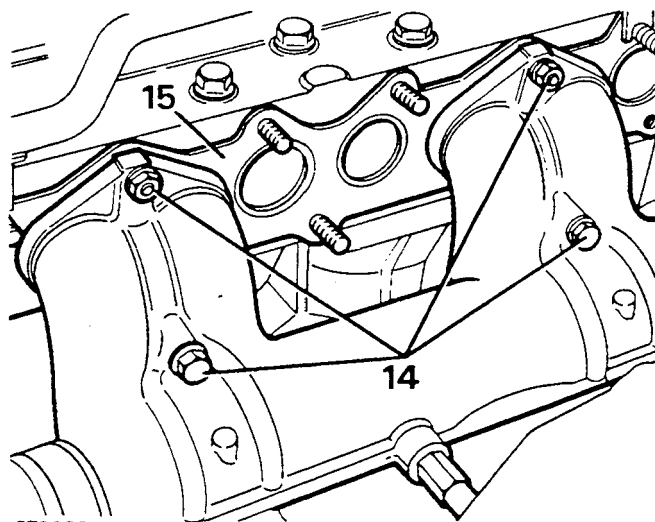
7. Release the front exhaust pipe bracket from the cylinder block.
8. Disconnect the front exhaust pipe from the forward silencer pipe.
9. Release the heater rail from the exhaust manifold studs.
10. Disconnect the boost pressure pipe from the turbo charger.
11. Disconnect the turbo charger oil drain pipe from the cylinder block.
12. Remove the exhaust manifold nuts and withdraw the manifold complete with the turbo charger.



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Inlet manifold

13. Disconnect hose from inlet manifold
14. Remove the two bolts and two nuts and withdraw the inlet manifold.
15. Remove the common gasket.



ST2935M

Continued

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 charge heat shield.
27. Connect the battery, run the engine and check for exhaust gas leaks.

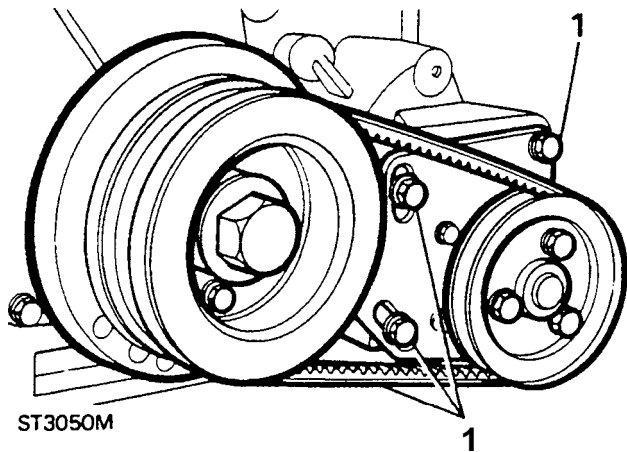


POWER STEERING PUMP

Service Repair No. 57.20.14

Remove and refit

1. Working from beneath the vehicle, release the drive belt tension by slackening the two adjustment clamp bolts and the single pivot bolt and remove the belt.



2. Disconnect from the pump, the supply hose from the fluid reservoir and drain into a suitable container.
3. Remove the banjo union bolt from the rear of the pump and allow fluid to drain into a container.
4. Remove the three bolts slackened in instruction 1 and remove the pump complete with adjustment plate and pulley.
5. Remove the four bolts to release the drive pulley from the pump hub.
6. Since the adjustment plate can be fitted in more than one position on the pump, mark the relationship of the pump to the plate before removing the four attachment bolts.

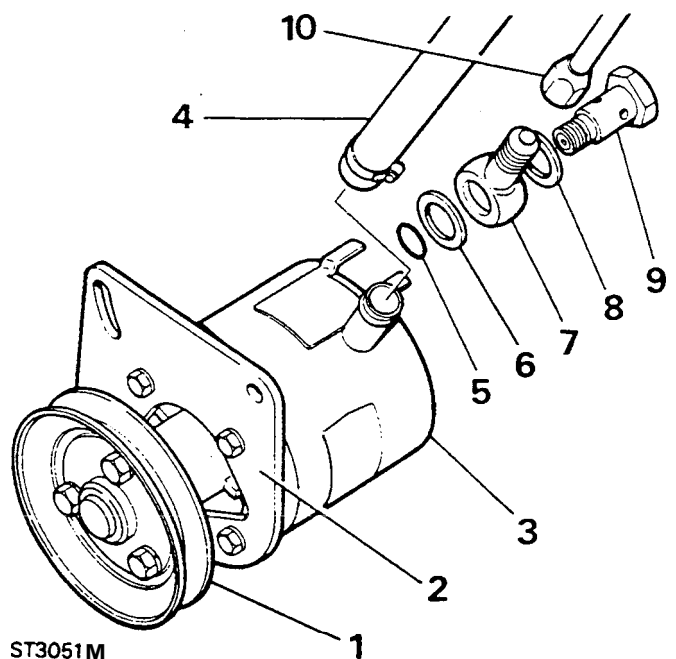
Refitting

7. Fit the adjustment plate to the pump aligning the marks made when dismantling and secure with the four bolts.
8. Fit the drive pulley and retain with the four screw.
9. Fit the pump and adjustment plate to the engine bracket and loosely secure with the pivot bolt and two adjustment clamp bolts.
10. Fit the drive belt and lever the pump away from the engine to tension the belt and tighten the two clamp bolts and single pivot bolt. The belt is correctly tensioned when, at the mid-point of its run it can be deflected by thumb pressure 12mm (. 5ins.)

CAUTION: Do not apply any pressure against the pump casing when tensioning the drive belt since it will damage the casing permanently, beyond repair.

11. Connect the fluid hose and secure with the clip.
12. Fit the banjo bolt ensuring that a special steel washer is fitted each side of the banjo.
13. Top up the fluid reservoir with the correct make and grade of fluid, see section 09.
14. Run the engine and turn the steering from lock to lock. Re-check the fluid level and the drive belt tension. **Also** examine for fluid leaks.

- | | |
|---------------------|--------------------|
| 1. Pulley | 6. Washer(special) |
| 2. Adjustment plate | 7. Banjo |
| 3. Pump | 8. Washer(special) |
| 4. inlet hose | 9. bolt |
| 5. 'O' rings | 10. Union nut |



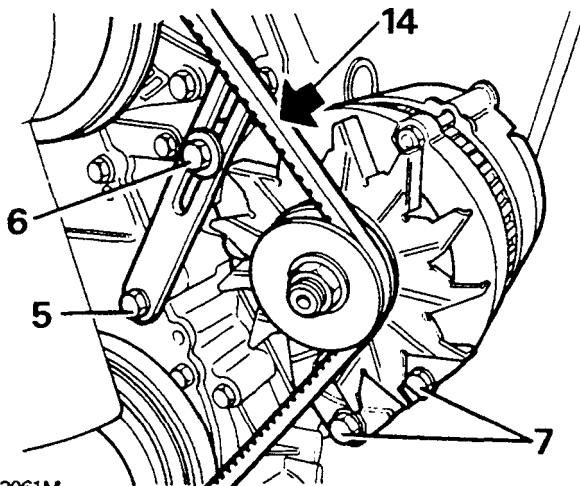


ALTERNATOR

Service Repair No. 86.10.02

Remove and refit

1. Disconnect the battery.
2. Remove the air cleaner, see operation 19.10.01.
3. Remove the intercooler top hose assembly to the inlet manifold.
4. Remove the intercooler bottom hose assembly to the compressor housing.
5. Slacken the adjustment strap pivot bolt.
6. Remove the adjustment strap clamp bolt.
7. Remove the alternator two pivot bolts.
8. Release the drive belt from the alternator pulley. Note, to renew the drive belt, the power assisted steering pump and air conditioning compressor drive belts must first be removed.
9. Disconnect the electrical leads and remove the alternator.



ST3061M

Refitting

10. Connect the electrical leads to the alternator before placing it in position on the common bracket.
11. Secure the alternator with the *two* pivot bolts and nuts, but leave slack at this stage.
12. Fit the adjustment strap clamp bolt and leave slack.
13. Fit the drive belt to the pulleys.
14. Tension the drive belt by levering the alternator away from the engine, taking care not to damage the alternator, and then tighten the adjustment strap clamp bolt. The tension is correct when the belt can be deflected 12mm (0.5ins.) at the the mid-point of the longest run between the pulleys.
15. Tighten the adjustment strap pivot bolt and the alternator two pivot nuts and bolts.
17. Reconnect the battery, run the engine and recheck the fan drive belt tension.

