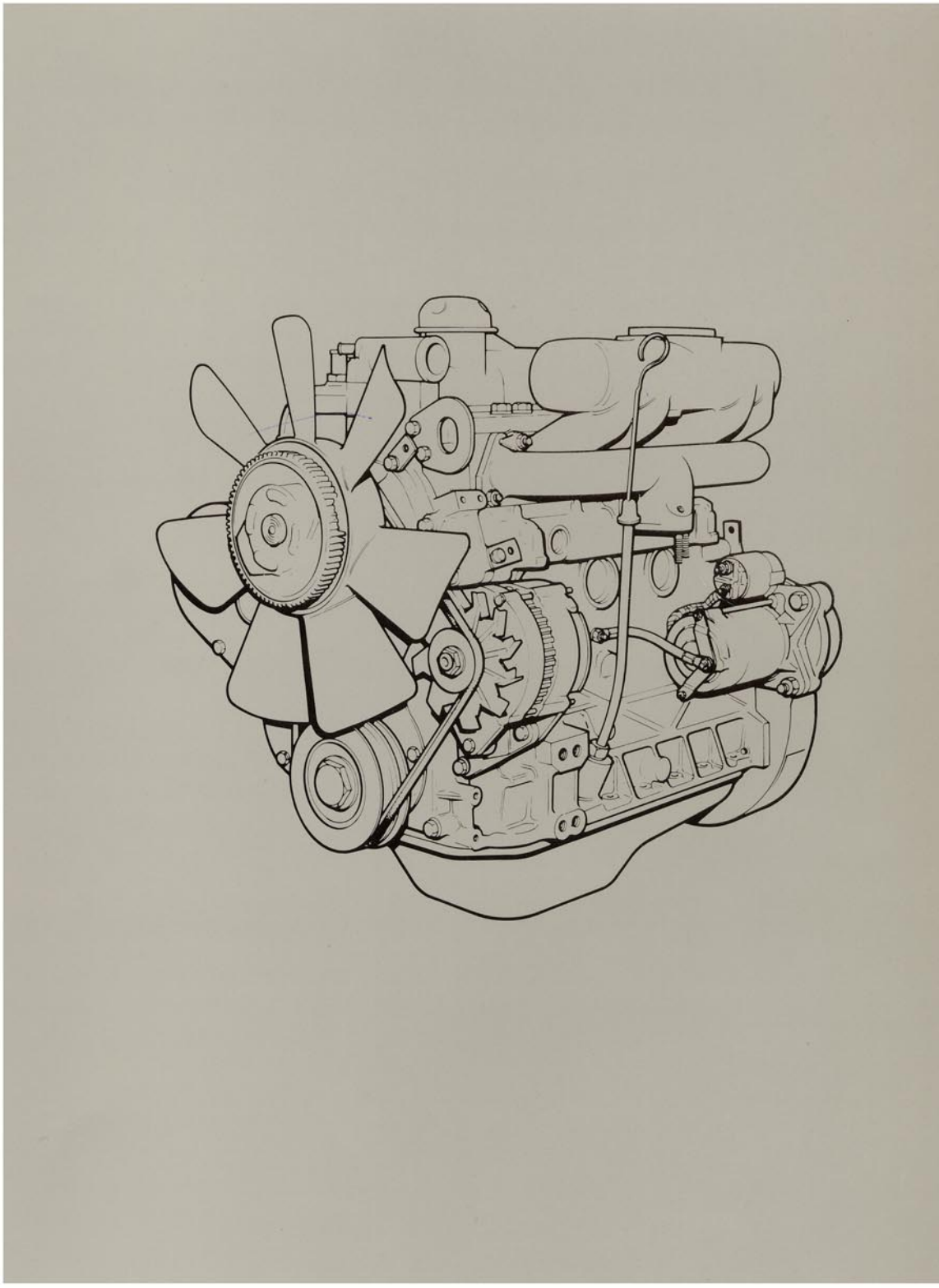
Service Workbook

BN 52 Engines



LEYLAND DAF

BN52 ENGINE
Service Workbook

This Service Workbook is primarily designed to assist skilled technicians in the efficient repair and maintenance of Leyland DAF vehicles, but can also be used as a reference workbook for training purposes.
This Service Workbook should always be consulted prior to servicing or repair work.

SPECIFICATION

Leyland DAF (the Company) reserves the right to change the procedures, material, specification, dimensions or design of the vehicles shown, described or referred to herein at any time and without prior notice in accordance with the Company's policy of constant product improvement.
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CONTENTS

Engine

Overhaul

NOTE: For ease of use the engine overhaul section of this Service Workbook has been broken down into sections as follows:-

A. Cylinder head components
B. Timing cover components
C. Flywheel housing components
D. Cylinder block components

Each section is self-contained in that it covers the remove, overhaul and refit of the components in that section. Cross references are made to other sections where applicable.

Instructions in italics are those necessary to be carried out if the work is being done with the engine in situ.

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INTRODUCTION

WARNINGS and CAUTIONS are given throughout this Service Workbook 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 Service Workbook are made when viewing the vehicle from the rear. With the engine and gearbox assembly removed, the water pump end of the engine is referred to as the front.

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

DIMENSIONS

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

During the period of running-in from new, certain adjustments may vary from the specification figures given in this Service Workbook. These adjustments will be re-set by the Dealer at the After Sales Service, and thereafter should be maintained at the figures specified in the Service Workbook.

REPAIRS AND REPLACEMENTS

When replacement parts are required it is essential that only Leyland DAF Parts are used.

POISONOUS SUBSTANCES

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

FUEL HANDLING PRECAUTIONS

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

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

GENERAL

Petrol/gasoline vapour if highly flammable and in confined spaces is also very explosive and toxic.
When petrol/gasoline evaporates it produces 150 times it 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 easily be distributed throughout a workshop by air current, consequently, even a small spillage of petrol/gasoline is potentially very dangerous.

Always have a fire extinguisher containing FOAM CO_2 GAS, or POWDER close at hand when handling or draining fuel, or when dismantling fuel systems and in areas where fuel containers are stored.

Always disconnect the vehicle battery BEFORE carrying out dismantling or draining work on a fuel system. Whenever petrol/gasoline is being handled, drained or stored, or when fuel systems are being dismantled all forms of ignition must be extinguished or removed, any head-lamps used must be flameproof and kept clear of spillage.

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

FUEL TANK DRAINING

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

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

FUEL TANK REMOVAL

On vehicles where the fuel line is secured to the fuel tank outlet by a spring steel clip, it is recommended that such clips are relaeased before the fuel line is disconnected or the fuel tank unit is removed. This procedure will avoid the possibility of residual petrol fumes in the fuel tank being ignited when the clips are released.

As an added precaution fuel tanks should have a PETROL/GASOLINE VAPOUR warning label attached to them as soon as they are removed from the vehicle.

FUEL TANK REPAIR

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

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

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

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

SPECIFICATION

Purchasers are advised that the specification details set out in this Service Workbook apply to a range of vehicles and not to any one. For the specification of a particular vehicle, purchasers should consult 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 will as minor changes may be involved in accordance with the Manufacturer's policy of constant product improvement.

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

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ABBREVIATIONS AND SYMBOLS USED IN THIS WORKBOOK

Across flats (bolt size)	AF
After bottom dead centre	ABDC
After top dead centre	ATDC
Alternating current	a.c.
Ampere	amp
Ampere-hour	amp hr
Atmospheres	Atm
Before bottom dead centre	BBDC
Before top dead centre	BTDC
Bottom dead centre	BDC
Brake mean effective pressure	BMEP
Brake horse power	bhp
British Standards	BS
Carbon monoxide	CO
Centimetre	cm
Centigrade (Celsius)	C
Cubic centimetre	cm^3
Cubic inch	in^3
Degree (angle)	deg or °
Degree (temperature)	deg or °
Diameter	dia.
Direct current	d.c.
Fahrenheit	F
Feet	ft
Feet per minute	ft/min
Fifth	5th
Figure (illustration)	Fig.
First	1st
Fourth	4th
Gramme (force)	gf
Gramme (mass)	g
Gallons	gal
Gallons (US)	US gal
High compression	h.c.
High tension (electrical)	H.T.
Hundredweight	cwt
Independent front suspension	i.f.s.
Internal diameter	i.dia.
Inches of mercury	in.Hg
Inches	in
Kilogramme (force)	kgf
Kilogramme (mass)	kg
Kilogramme centimetre (torque)	kgf.cm
Kilogramme per square centimetre	kg/cm^2
Kilogramme metres (torque)	kgf.m
Kilometres	km
Kilometres per hour	km/h
Kilovolts	kV
King pin inclination	k.p.i.
Left-hand steering	LHStg
Left-hand thread	LHThd
Litres	litre
Low compression	l.c.
Low tension	l.t.
Maximum	max.
Metre	m
Microfarad	mfd
Midget edison screw	MES
Millimetre	mm
Miles per gallon	mpg
Miles per hour	mph
Minimum	min
minute (angle)	'
Minus (of tolerance)	−
Negative (electrical)	−
Number	No.
Ohms	ohm
Ounces (force)	ozf
Ounces (mass)	oz
Ounce inch (torque)	ozf.in.
Outside diameter	o.dia.
Paragraphs	para.
Part number	Part No.
Percentage	%
Pints	pt
Pints (US)	US pt
Plus (tolerance)	+
Positive (electrical)	+
Pound (force)	lbf
Pounds feet (torque)	lbf.ft.
Pounds inches (torque)	lbf.in.
Pound (mass)	lb
Pounds per square inch	lb/in^2
Radius	r
Rate (frequency)	c/min
Ratio	:
Reference	ref.
Revolution per minute	rev/min
Right-hand	RH
Right-hand steering	RHStg
Second (angle)	"
Second (numerical order)	2nd
Single carburetter	SC
Specific gravity	sp.gr.
Square centimetres	cm^2
Square inches	in^2
Standard	std.
Standard wire gauge	s.w.g.
Synchroniser/synchromesh	synchro.
Third	3rd
Top dead centre	TDC
Twin carburetters	TC
United Kingdom	UK
Vehicle Identification Number	VIN
Volts	V
Watts	W

SCREW THREADS

American Standard Taper Pipe	NPTF
British Association	BA
British Standard Fine	BSF
British Standard Pipe	BSP
British Standard Whitworth	Whit.
Unified Coarse	UNC
Unified Fine	UNF

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TECHNICAL DATA

ENGINE

Type	15J	
Number of cylinders	4 cylinder, in line	
Cubic capacity	2495 cc.	152.26 cu. in.
Bore	90,47 mm.	3.56 in.
Stroke	97,0 mm.	3.82 in.
Compression ratio	21 : 1	
Brake horse power (DIN)	70.4 at 4000 RPM	
Torque (DIN)	156 Nm (115 lbf. ft.) at 1800 RPM	
Valve operation	Overhead by push rods.	

Crankshaft

Number of bearings	5 main bearings	
Main bearing journal diameter	63, 487- 63,5 mm.	2.4995 - 2.500 in.
Main bearing journal clearance	0,018 - 0,061 mm.	0.0007 - 0.0024 in.
Main journal regrind dimensions	63,246 - 63,2333 mm	2.490 - 2.4895 in.
	Use 0.010 in. undersize bearings	
Crankpin journal diameter	58,725 - 58,744 mm.	2.312 - 2.31275 in.
Crankpin regrind dimensions	58,48985 - 58,4708 mm	2.30275 - 2.3020 in.
	Use 0.010 in. undersize bearings	
Crankshaft end-thrust	Thrust washers at centre main bearing	
Crankshaft end-float	0,05 - 0,15 mm.	0.002 - 0.006 in.

Connecting rods

Length between centres	175,38 - 175,43 mm.	6.905 - 6.907 in.
Big end bearing diametrical clearance	0,025 - 0,075 mm.	0,001 - 0,003 in.
Big end end-float	0,15 - 0,356 mm	0.006 - 0.014 in.

Gudgeon pins

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

Pistons

Skirt diametrical clearance in bore	0,025 - 0,050 mm.	0.001 - 0.002 in.
	measured at right angles to gudgeon pin.	
Oversizes - 2 available	0,51 mm./1,02 mm.	0.020 in./0.040 in.
Stand proud	- 0,106 to + 0,053 mm.	- 0.004 to + 0.002 in.

Piston rings

Number of rings	3. (2 compression, 1 oil control)	
Top - Compression	square friction edge. internal chamfer, chrome plated.	
Width	1,975 - 2,01 mm.	0.0778 - 0.079 in.
Groove clearance	0,140 - 0.180 mm.	0.002 - 0.007 in.
Fitted gap	0,30 - 0.50 mm.	0.002 - 0.012 in.
Middle - Compression	taper faced.	
Width	1,975 - 1,99 mm.	0.0778 - 0.0784 in.
Groove clearance	0,040 - 0,080 mm.	0.001 - 0.003 in.
Fitted gap	0,25 - 0.45 mm.	0.009 - 0.017 in.
Bottom - Oil control	expander and rails.	
Width	3,975 - 3,99 mm.	0.1556 - 0.1572 in.
Groove clearance	0,040 - 0,080 mm.	0.001 - 0.003 in.
Ring gap	0,3 - 0,6 mm.	0.012 - 0.024 in.

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Camshaft

Drive	25,4 mm (1 in.) wide dry toothed belt	
Bearings	4	
Journal diameter	46,76 - 46,78 mm.	1.842 - 1.843 in.
Bearing clearance	0,026 - 0,051 mm.	0.001 - 0.002 in.
End-float	0,10 - 0,20 mm.	0.004 - 0.008 in.
Cam lift: inlet	6,81 mm.	0.268 in.
exhaust	7,06 mm.	0.278 in.

Valves

Seat angle	inlet & exhaust	45°	
Valve head diameter:	inlet	39,12 - 39,37 mm.	1.540 - 1.550 in.
	exhaust	33,25 - 33,50 mm.	1.309 - 1.319 in.
Valve stem diameter:	inlet	7,899 - 7,912 mm.	0.3109 - 0.3114.in.
	exhaust	8,682 - 8,694 mm.	0.3418 - 0.3422.in.
Valve length:	inlet	116,26 - 116,74 mm.	4.580 - 4.599 in.
	exhaust	116,79 - 117,25 mm.	4.601 - 4.619 in.
Valve lift:	inlet	9,85 mm.	0.388 in.
	exhaust	10,26 mm.	0.404 in.
Valve guide length:	inlet	46,381 - 46,762 mm.	1.827 - 1.842 in.
	exhaust	56,769 - 57,15 mm.	2.237 - 2.252 in.
Valve stem/guide clearance:	inlet	0,026 - 0,046 mm.	0.001 - 0.0018 in.
	exhaust	0,039 - 0,059 mm.	0.0015 - 0.0023 in.
Valve recession in head (inlet only)		0,71 - 1,27 mm	0.028 - 0.050 in.

Valve springs

Type		Duplex interference double coil	
Outer:	free length	46.28 mm.	1.822 in.
	length, under 21 kg. (46 lb.) load	40.30 mm.	1.587 in.
Inner:	free length	42,67 mm.	1.680 in.
	length, under 8.0 kg. (17.7 lb.) load	40,30 mm.	1.587 in.

Rocker gear

Bush diameter, reamed in position	13,5 - 13,7 mm.	0.53 - 0.531 in.
Shaft clearance in bush	0,101 - 0.127 mm.	0.004 in. - 0.005 in.

Lubrication

System	wet sump, pressure fed.	
Pressure, engine warm, at 2000 rpm	2,5 - 4,57 kgf cm²	35 - 65 lbf in²
Oil pump:		
Type	double gear, 10 teeth, sintered iron gears	
Drive	splined shaft from camshaft gear	
Gear end-float:	0,026 - 0,135 mm	0.0009 - 0.0045 in.
Radial clearance of gears	0,025 - 0,075 mm	0.0008 - 0.0025 in.
Backlash of gears	0,1 - 0,2 mm	0.0034 - 0.0067 in.
Oil pressure relief valve:		
Type	non-adjustable	
Relief valve spring		
Full length	67,82 mm	2.670 in.
Compressed length at 2.58kg (5.7lb)load	61.23 mm	2.450 in.
Oil filter type	screw-on disposable canister	

FUEL SYSTEM

Injection pump		
Type	CAV DPS with mechanical governor, auto advance and solenoid electrical shut-off. Tamperproof sealing on flight speed and fuel adjustment screws.	
Direction of rotation	clockwise, viewed from drive end.	
Fuel lift pump		
Type	mechanical, with hand primer	
Pressure range	0,35 - 0,56 kgf cm²	5 - 8 lbf in²
Fuel filter	paper element	
Air cleaner	paper element type	
Injectors		
Make/type	CAV Pintaux	
Injector pipe type	high pressure multi-bundy	
size	1,94 - 2,06 mm	0.076 - 0.081 in.
length	457,2 mm	18 in.
Heater plugs		
Type	probe type	
Make	Champion CH63 11 volt 90 watts nominal	

COOLING SYSTEM

Type	Pressurised spill return system with thermostat control, pump and fan assisted.	
Thermostat opening temperature	82°C	
Pressure cap	1,0 kgf cm²	15 lbf in²
Anti-freeze solution	50%	

CAPACITIES

Oil - refill and filter change	6,4 litres	11.25 pints
Cooling system (with heater)	8,52 litres	15 pints

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TUNING DATA

Capacity	2495cc (152.76 cu.in)
Compression ratio	21 : 1
Brake horse power (DIN)	70.4 at 4000 RPM
Torque (DIN)	156Nm (115 lbf. ft.) at 1800 RPM
Firing order	1 - 3 - 4 - 2
Valve clearances	0,25mm (0.010 in.)
Valve timing: inlet opens	16° B.T.D.C.
inlet closes	42° A.B.D.C.
inlet peak	103° A.T.D.C.
exhaust opens	51° B.B.D.C.
exhaust closes	13° A.T.D.C.
exhaust peak	109° B.T.D.C.
Injection pump	CAV type DPS 8520A 301A
Injection pump timing	109° static. EP mark on flywheel
Idle speed	670 ± 20 RPM
Maximum governed speed	
full load	4000 RPM
no load	4400 ± 80 RPM
Injectors	CAV Pintaux
Injection pressure	135-140 atmospheres
Nozzle type	BDN OSPC 6209
Nozzle holder type	BKB 35 SD 5 188
Fuel lift pump	AC mechanical
Fuel filter	CAV type FS 5836B400
Cold start system	CAV Micronova type 465-10

APPROVED ENGINE OILS

Multipart	Multipart Multigrade Super 15W/40
Oil must meet specification:	BLS.22.OL.06 and MIL-L-46152 or API service levels CC or CD or SE/CC or SE/CD or SF/CC or SF/CD or the CCMC D1 requirements.

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SERVICE SUMMARY - 2.5 DIESEL

	MILEAGE				
	1,000	6,000	12,000 36,000	24,000	48,000
RENEW ENGINE OIL AND FILTER	NOT ● FILTER	● Δ*	●	●	●
RENEW FUEL FILTER		DRAIN WATER FROM FILTER	●	●	●
CHECK GLOW PLUG OPERATION			●	●	●
CHECK IDLE SPEED			●	●	●
CHECK ALTERNATOR BELT TENSION	●		●	●	RENEW
RENEW ANTI-FREEZE SOLUTION (50%)			CHECK STRENGTH	●	●
RENEW AIR FILTER			●	●	●
CHECK CAMSHAFT DRIVE BELT CONDITION				●	RENEW
CHECK / ADJUST VALVE CLEARANCES	●		●	●	●
REMOVE & WASH ENGINE BREATHER CAP				●	●

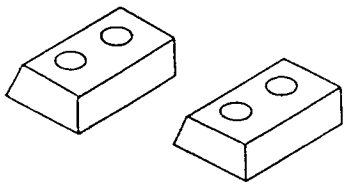
Δ FOR VEHICLES SOLD AFTER 1st OCTOBER 1988, THIS OIL & FILTER CHANGE IS REDUCED TO 4,000 MILES OR 4 MONTHS

* FOR VEHICLES SUBJECTED TO ARDUOUS STOP / START DELIVERIES, REDUCE OIL AND FILTER CHANGE TO 3000 MILE INTERVALS

SPECIAL TOOLS

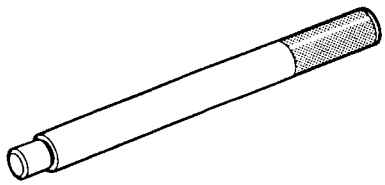
The following tools are required for the 2.5 Diesel engine.

RO 270304



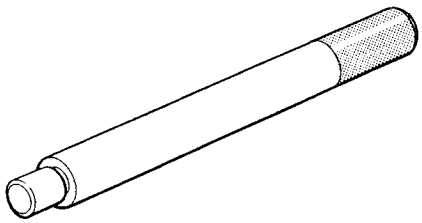
Main bearing cap seal guides

RO 274400



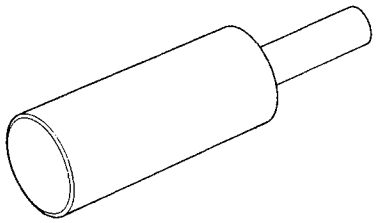
Inlet valve guide remover

RO 274401



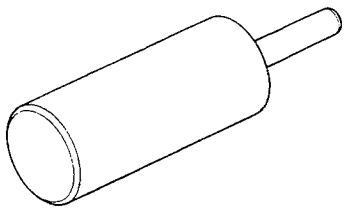
Exhaust valve guide remover

RO 600959



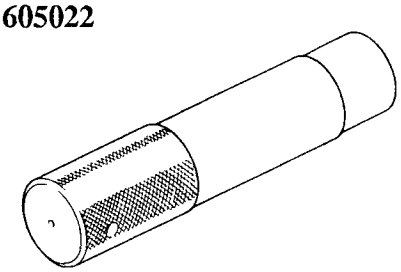
Exhaust valve guide replacer

RO 601508



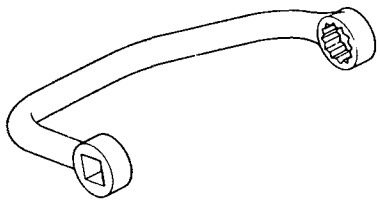
Inlet valve guide replacer

RO 605022



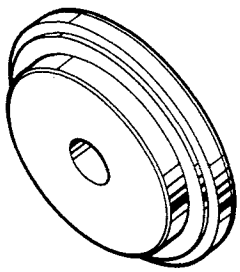
Clutch plate mandrel

RO 606445A

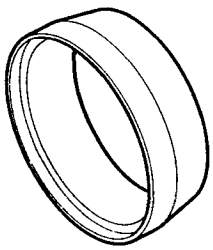


Cylinder head bolt spanner

18G 134-11

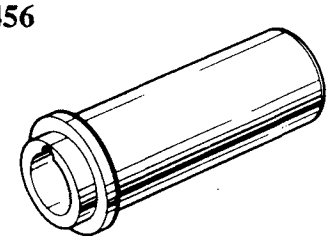


18G 1344



Crankshaft rear oil seal protection sleeve

18G 1456



Crankshaft front oil seal replacer

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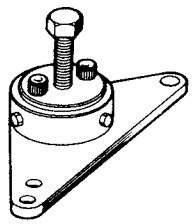
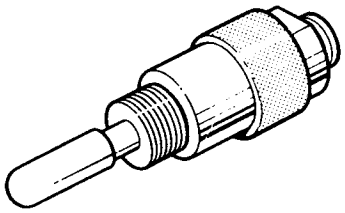
SPECIAL TOOLS (Continued)

18G 1457



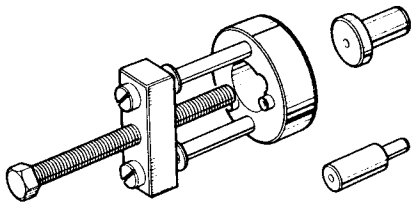
Fuel injection pump drive pulley, remover/retainer

18G 1458



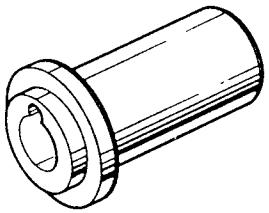
D.P.S. fuel injection pump timing pin

18G 1464



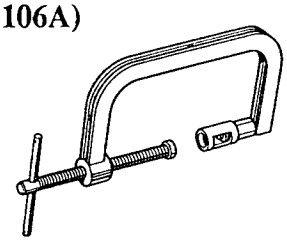
Crankshaft and camshaft pulley remover

18G 1482



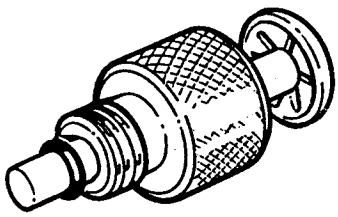
Camshaft oil seal replacer

18G 1519
(alt. 18G 106A)



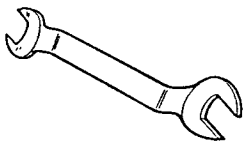
Valve spring compressor

LST 107



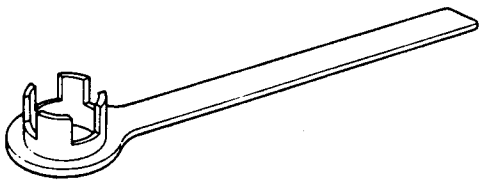
Flywheel timing pin

MS 1517



Viscous fan coupling spanner

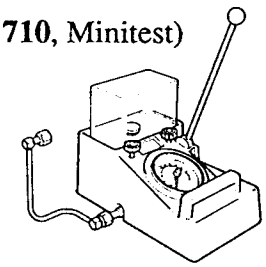
FR 101



Crankshaft holding tool

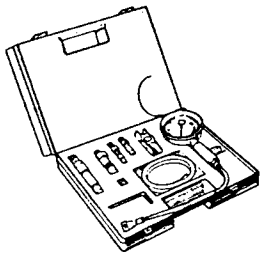
DIAGNOSTIC TOOLS

111
(alt. **DX 710**, Minitest)



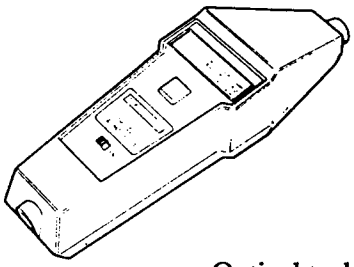
Injector analyser

DX 510



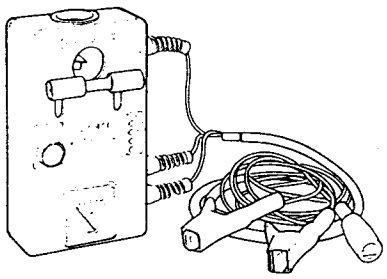
Compression tester

DX 800



Optical tachometer

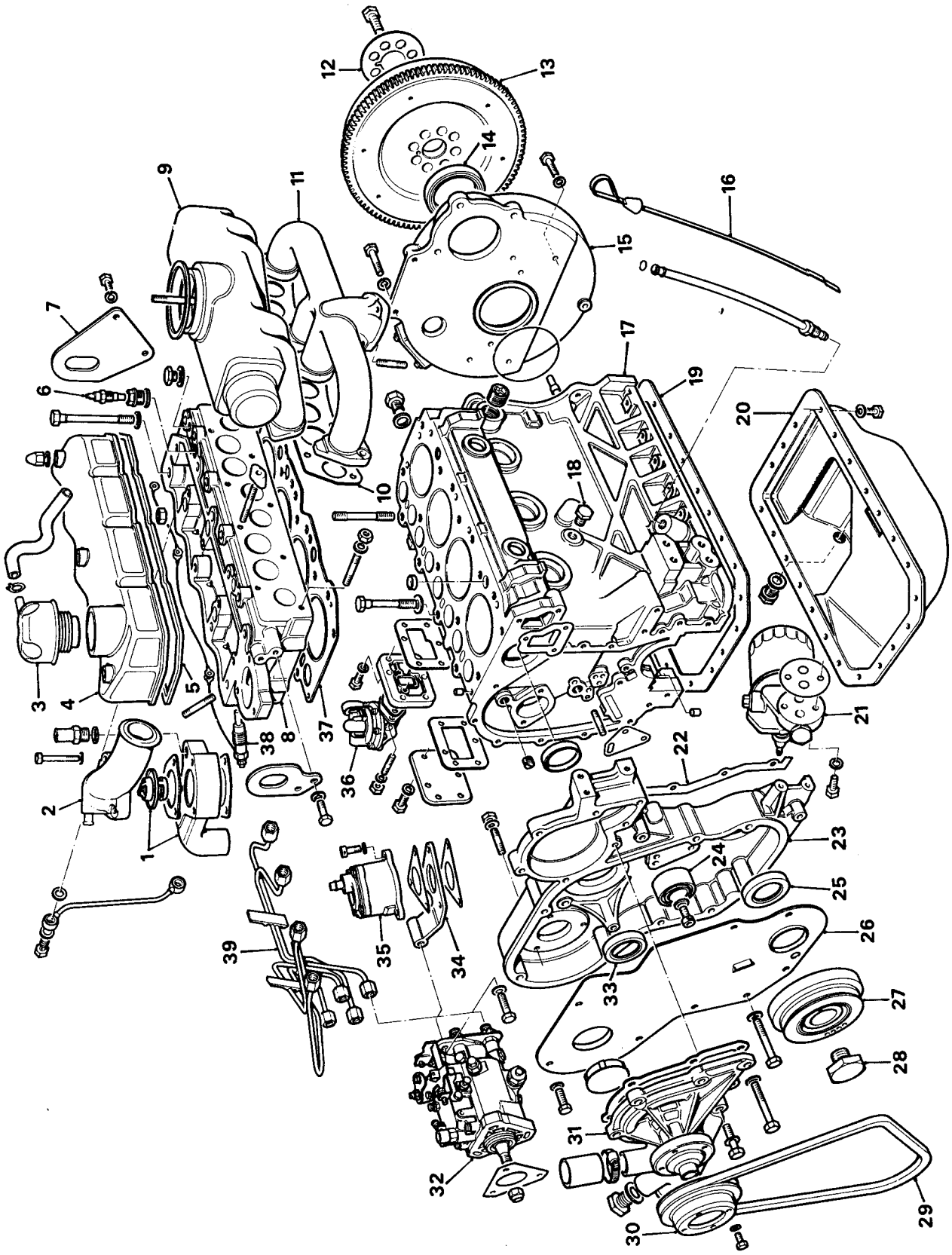
DX 900



Glow plug tester

Basic and Universal Tools

18G 55A (alt. MS 38U3)	Piston ring compressor
18G 134 (alt. MS 550)	Bearing and oil seal replacer - main tool
18G 191	Setting gauge
18G 257	Circlip pliers
18G 372	Torque wrench 30-140 lbf ft
18G 592	Torque wrench 35-225 lbf ft
18G 1004	Circlip pliers - small
18G 1205	Adjustable flange holding wrench
MS 76B	Valve seat cutter handle
MS 150-8	Expandable pilot
MS150-8.5	Expandable pilot
MS 621	Adjustable valve seat cutter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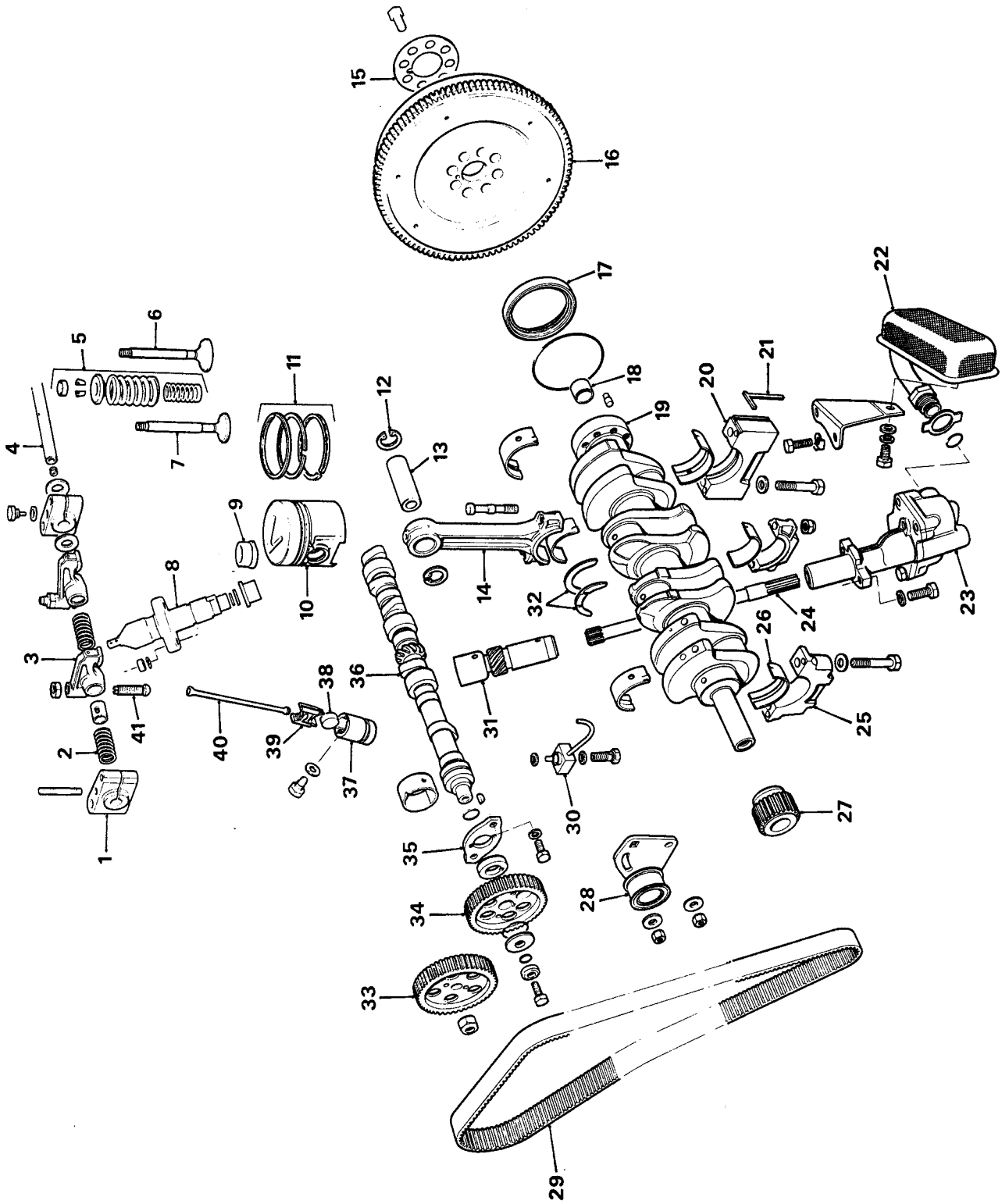
ENGINE EXTERNAL COMPONENTS

1 Thermostat and housing
2 Water outlet elbow
3 Oil filler cap
4 Rocker cover
5 Rocker cover gasket
6 Temperature transmitter
7 Engine rear lifting bracket
8 Cylinder head
9 Inlet manifold
10 Manifold gasket
11 Exhaust manifold
12 Flywheel reinforcing plate
13 Flywheel
14 Crankshaft rear oil seal
15 Flywheel housing
16 Dipstick
17 Cylinder block
18 Drain plug
19 Oil sump gasket (for service)
20 Oil sump
21 Oil filter
22 Timing cover gasket
23 Timing cover
24 Idler pulley
25 Crankshaft front oil seal
26 Timing case front cover plate
27. Torsional vibration damper
28 Pulley bolt
29 Fan belt
30 Water pump drive pulley
31 Water pump
32 Fuel injection pump
33 Camshaft front oil seal
34 Injection pump bracket
35 Vacuum pump
36 Fuel lift pump
37 Cylinder head gasket
38 Heater plug
39 Fuel injection pipes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ENGINE INTERNAL COMPONENTS

1. Rocker shaft pedestal
2. Rocker shaft spring
3. Valve rocker
4. Rocker shaft
5. Valve spring, cap and collets
6. Inlet valve
7. Exhaust valve
8. Fuel injector and shroud
9. Hot plug
10. Piston
11. Piston rings
12. Circlip
13. Gudgeon pin
14. Connecting rod and big end bearing
15. Flywheel reinforcing plate
16. Flywheel
17. Crankshaft rear oil seal
18. Crankshaft spigot bush
19. Crankshaft
20. Crankshaft rear main bearing cap
21. Cork oil seal
22. Oil pick-up strainer
23. Oil pump
24. Oil pump drive shaft
25. Crankshaft main bearing cap
26. Main bearing shell
27. Crankshaft pulley
28. Timing belt tensioner
29. Timing belt
30. Oil gallery jet adaptor
31. Vacuum pump skew gear
32. Crankshaft thrust washers
33. Fuel injection pump drive pulley
34. Camshaft drive pulley
35. Camshaft thrust plate
36. Camshaft
37. Tappet guide
38. Tappet roller
39. Tappet slide
40. Push-rod
41. Rocker adjusting screw

LEYLAND DAF

TORQUE WRENCH SETTINGS

COMPONENT/FIXING	Nm	lbf/ft	kgf/m
Fuel lift pump to side cover	20-28	15-21	2.1-2.9
Tappet sleeve retaining bolt	23-28	18-21	2.3-2.9
Vacuum pump to cylinder block	22-28	16-21	2.2-2.9
Vacuum pump top cover bolt	23-30	17-22	2.3-3.0
Clutch pressure plate bolt	30-38	22-28	3.0-3.9
Flywheel to crankshaft bolt	139-153	102-113	14.1-15.6
Flywheel housing to cylinder block bolt	40-50	30-37	4.1-5.1
Engine sump pan bolt	20-24	15-18	2.1-2.5
Main bearing cap bolt	130-136	96-100	13.3-13.8
Big end bearing cap nut	37-41	27-30	3.7-4.2
Oil squirt jet bolt	14-20	10-15	1.4-2.1
Oil pump cover bolt	20-28	15-21	2.1-2.9
Oil pump to cylinder block bolt	22-28	16-21	2.2-2.9
Oil filter housing to cylinder block	40-50	30-37	4.1-5.1
Cylinder head oil feed pipe banjo bolt	20-25	15-18	2.1-2.5
Heater plug to cylinder head	15-30	11-22	1.5-3.0
Rocker cover nut	23-27	17-20	2.3-2.7
Cylinder head bolt	115-130	85-96	11.7-13.3
Rocker pedestal to cylinder head bolt	22-28	16-21	2.2-2.9
Rocker shaft securing bolt (in No.2 pedestal)	20-27	15-20	2.1-2.7
Viscous fan coupling to water pump (loctited, LEFT HAND thread)	22-28	16-21	2.2-2.9
Cooling fan to viscous coupling hub nut	7-9	5-6.5	0.7-0.9
Water pump pulley bolt	22-28	16-21	2.2-2.9
Water pump to front cover bolt	22-28	16-21	2.2-2.9
Engine front cover to cylinder block bolt	22-28	16-21	2.2-2.9
Crankshaft pulley bolt	260-280	192-206	26.5-28.5
Camshaft timing gear bolt	40-50	30-37	4.1-5.1
Fuel injection pump timing gear nut	42-48	31-35	4.3-4.8
Timing belt idler pulley bolt	40-50	30-37	4.1-5.1
Timing belt tensioner nut	22-28	16-21	2.2-2.9
Camshaft thrust plate bolt	7-10	5-7	0.7-1.0
Engine side cover bolt	23-30	17-22	2.3-3.0
Injector securing nut	6-8	4.5-6	0.6-0.8

ENGINE REMOVE & REFIT

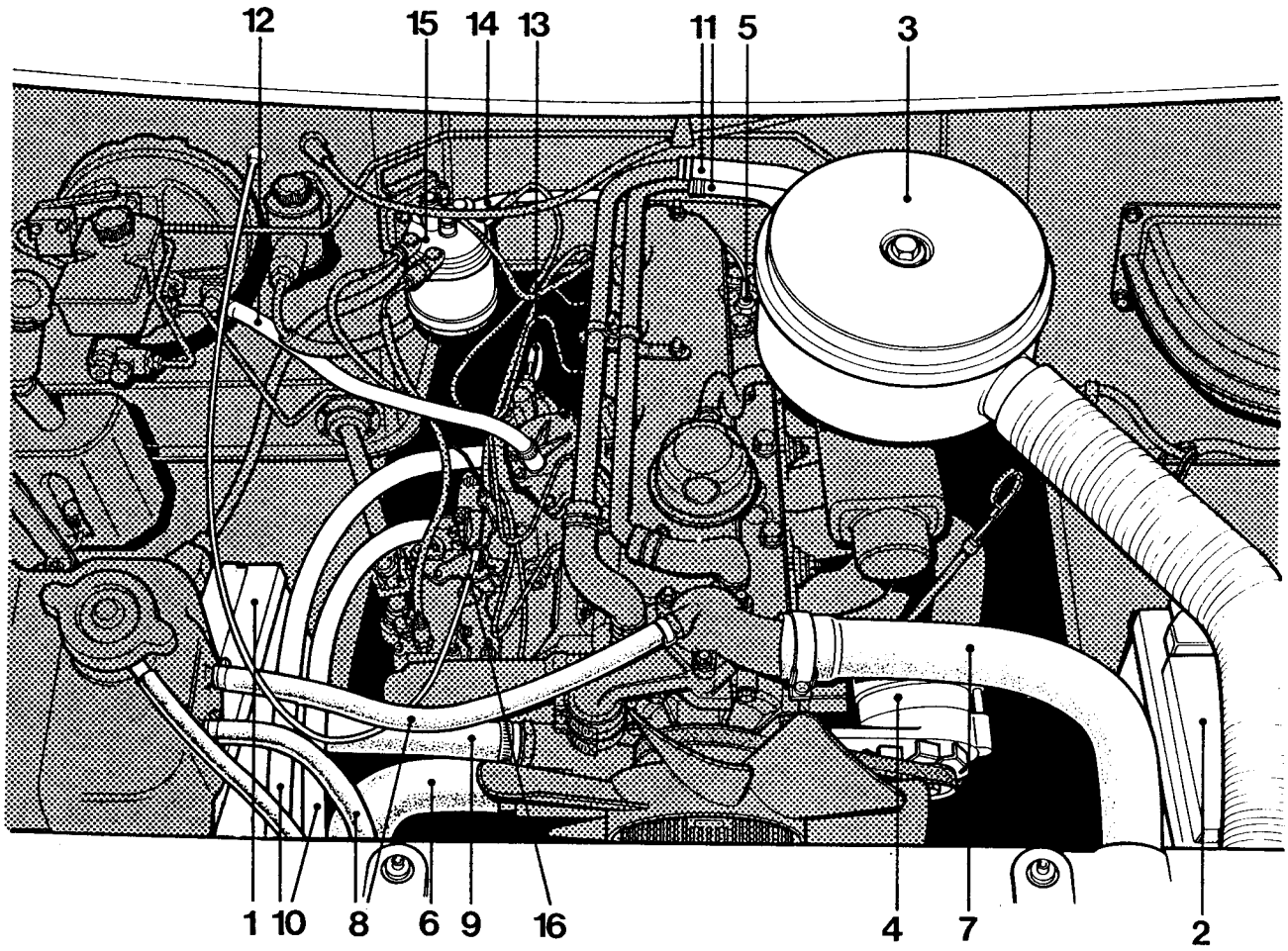


Fig. 1 Underbonnet

1. Battery
2. Battery
3. Air cleaner
4. Alternator
5. Temperature transmitter
6. Bottom radiator hose
7. Top radiator hose
8. Expansion tank hoses
9. Coolant filler hose
10. Oil cooler pipes
11. Heater hoses
12. Brake servo vacuum pipe
13. Fuel lift pump inlet
14. Fuel spill return
15. Fuel filter
16. Throttle cable

Remove

The engine is removed after removing the bonnet and radiator, and disconnection from the gearbox which remains in situ.

CAUTION Engine weight is 270 kilos (595 lbs) excluding oil and water; make sure lifting equipment to be used is rated in excess of this weight.

CAUTION Take care to avoid injury by hot fluids (oil and water) and hot exhaust or other components.

1. Drive the vehicle onto a suitable lift.

Underbonnet

2. Disconnect the battery, earth (negative) terminal (s) first.
   NOTE: Disconnect both batteries if two are fitted.

3. Remove the bonnet.

4. Remove the air intake ducting and the air cleaner.

5. Disconnect the electrics
   - heater plugs
   - oil pressure switch
   - fuel cut-off solenoid
   - alternator
   - temperature transmitter
   - earth strap
   - starter motor

   Release all cables clear of engine.

6. Drain the coolant

7. Remove the bonnet closing panel.

8. Disconnect the radiator hoses at the engine and the expansion tank, and remove the radiator.

9. Remove the hoses to the expansion tank from the engine.

10. Position a suitable drain tray and disconnect the oil cooler pipes; disconnect the lower pipe from the oil cooler and the upper pipe at the pipe centre joint.

11. Disconnect the heater hoses at the engine.

12. Disconnect the brake servo vacuum pipe.

13. Disconnect the fuel pipes
   - fuel lift pump inlet
   - fuel spill return to tank at filter
   - remove filter unit from bulkhead

14. Disconnect the throttle cable.

Raise lift.

Under vehicle.

15. Disconnect the clutch slave cylinder from the bell housing; leave the hydraulic line connected and pull the slave cylinder clear of its push rod.

16. Disconnect the exhaust pipe at the manifold and release from its bell housing securing bracket.

Lower Lift

17. Support the gearbox with a jack.

18. Attach suitable chains with a central lifting eye to the lifting brackets on the engine, and take the weight on the lifting tackle.

19. Remove the bell housing nuts/bolts.

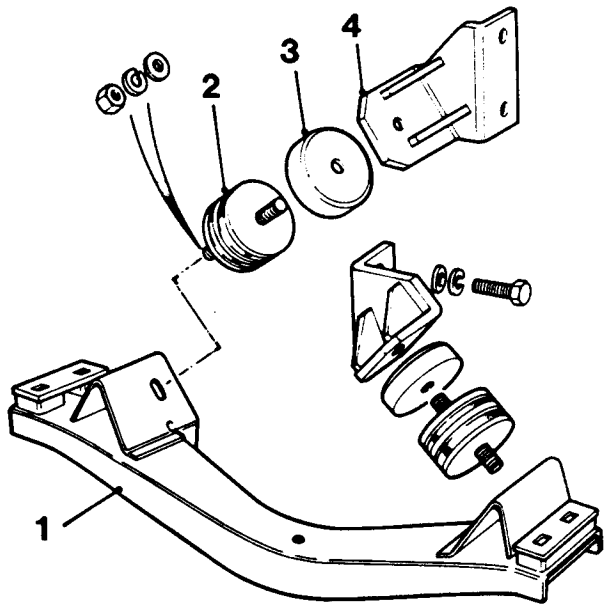


Fig.2 Engine mountings
1. Crossmember
2. Engine mounting
3. Snubber
4. Engine mounting bracket

20. Remove the lower nuts from both front engine mounts.

21. Lift the engine clear.

Refitting

Refitting is the reverse of the removal procedure, but note the following points:

Prior to installation

1. Use centralising tool RO 605022 to check clutch alignment.

2. Ensure the clutch release fork, bearing and push rod are correctly located.

3. Ensure no pipes or cables will interfere with the fitting operation.

During installation

4. Ensure the push rod locates correctly into the slave cylinder piston.

5. Ensure the throttle can return fully after refitting the throttle cable.

6. Ensure the specific gravity of coolant anti-freeze is maintained.

7. Ensure the heater plug cable connections are pointing downwards and are not fouling against the cylinder head.

8. Check the oil level and top-up as necessary.

9. Bleed the fuel system to the fuel injection pump.

10. Ensure all cables, hoses etc are secured in position.

11. Re-connect the battery positive terminal (s) first and then the negative terminal (s).

CYLINDER HEAD

Remove

Tool required: RO 606445A

The cylinder head can be removed with the engine in situ by first carrying out the following 10 operations:

1. *Disconnect the battery.*

2. *Drain the cooling system.*

3. *Support the bonnet to allow the bonnet closing panel to be removed.*

4. *Remove the air cleaner and ducting.*

5. *Disconnect the exhaust pipe at the manifold.*

6. *Disconnect the hose from the oil filler cap.*

7. *Disconnect the heater hoses and remove the retaining bracket from the rocker cover.*

8. *Disconnect the coolant hoses from the thermostat housing.*

9. *Disconnect the fuel spill pipe at No. 4 injector.*

10. *Disconnect the electrical leads to the temperature transmitter and heater plugs.*

11. Ensure the fuel injection pipe area is totally clean, then remove the fuel injection pipes.

12. Slacken the rear engine lifting bracket sufficient to allow the oil feed pipe to the cylinder head to be disconnected.

13. Remove the rocker cover and discard the gasket.

14. Slacken the tappets to release the tension at the push rods.

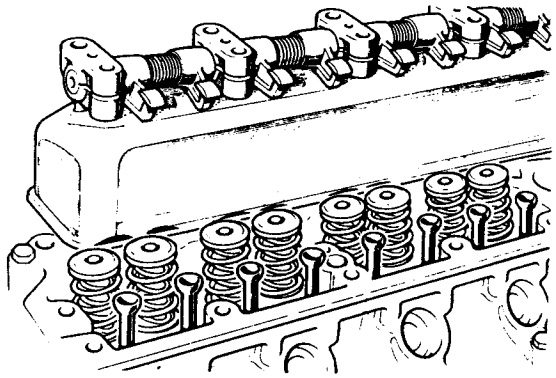


Fig.1 Using the rocker cover to retain the rocker shaft assembly.

15. Remove the five smaller (13mm) bolts retaining the rocker shaft assembly to the cylinder head.

    Progressively loosen the cylinder head retaining bolts and nuts, using tool no. RO 606445A to remove the nuts and bolts under the injectors. Unscrew, but do not remove, the five cylinder head bolts which retain the rocker pedestals.

    Invert the rocker cover and fit it to the rocker cover studs to prevent the rocker shaft assembly from coming apart. Lift off the rocker shaft assembly.

NOTE: It is not possible to fit the cover in this way if the engine is in situ. In this situation hold the rocker shaft assembly together whilst lifting it off, then fit it to the rocker cover.

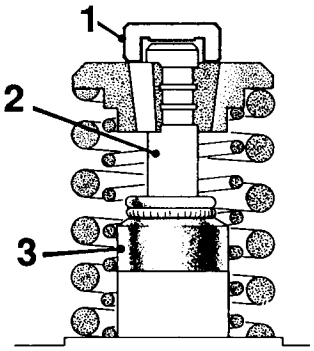


Fig.2 Valve and cap
1. Cap
2. Valve stem
3. Seal

16. A modification introduced from engine no.15J 08955C is the fitment of a valve stem cap on the tip of each valve stem. If fitted, remove the caps as soon as the rocker shaft has been lifted clear and examine for wear. Store in a safe place until required for refitting.

17. Remove the push rods, retaining them in sequence for later rebuild in their original positions.

18. Using suitable lifting tackle, lift off the cylinder head and remove the gasket.

NOTE: The combustion chamber inserts may drop out of the cylinder head as it is lifted. They must be retained in their original locations.

Overhaul

Tools required: 18G 1519 (Alt. 18G 106A), RO 274400, RO 274401, RO 601508, RO 600959, MS 76, MS 150-8, MS 150-8.5, MS 621.

1. Remove the inlet and exhaust manifolds.

2. Remove the fuel spill pipe from the injectors then remove the injectors, discarding their steel and copper sealing washers.

3. Remove the heater plugs.

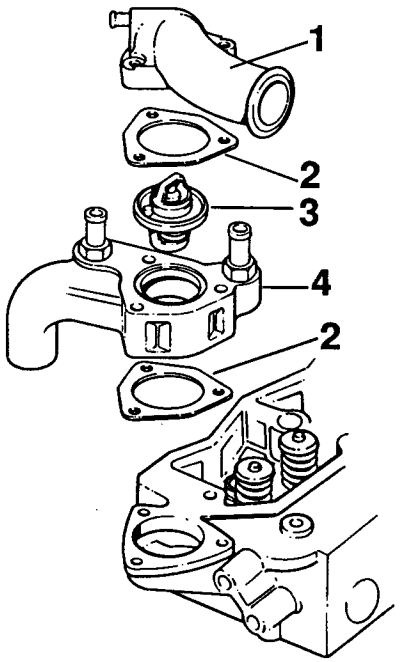


Fig.3 Thermostat housing
1 Outlet pipe
2 Gasket
3 Thermostat
4 Thermostat housing

4. Remove the thermostat housing complete.

5. Use spring compressor tool 18G 1519 (alt. 18G 106A) to remove the valves; retain the components in related sets.

6. Remove and discard the valve guide oil seals.

7. Clean the cylinder head, including the valve seat areas and examine for signs of cracks, damage etc.

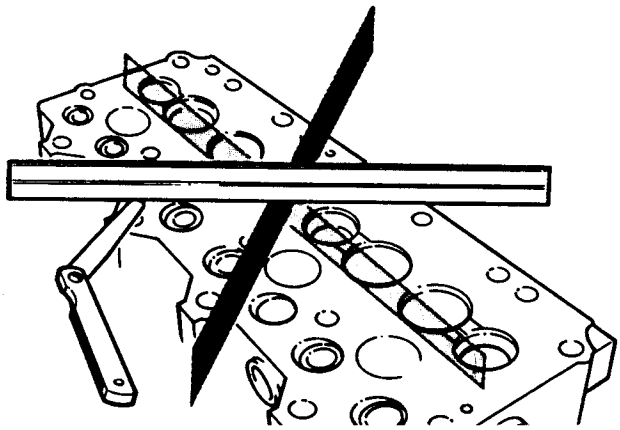


Fig.4 Checking cylinder head distortion.

8. Check for distortion using a straight edge in three different planes. It is permissible to re-face the cylinder head but before carrying out any machining work note the observations to be made regarding hot plug and valve seat cracks and recession of the hot plugs in the cylinder head (see section "Hot plugs and injector shrouds").

9. Maximum re-facing of the cylinder head is 0,25mm (0.010 in) which is carried out with the hot plugs fitted to ensure they do not protrude an excessive amount above the cylinder head face.

Hot plugs and injector shrouds

10. It is not normally necessary to remove either the hot plugs or the injector shrouds, but make an examination of the exposed face of the hot plugs.

Small surface cracks in the hot plug, extending from the opening to approximately 8,00mm (0.312 in) in length can be ignored. However if any severe cracks appear in the face of the hot plug, before attempting to remove it, closely inspect the cylinder head for signs of cracks, particularly between the inlet and exhaust valve seats. Such cracking indicates that the engine has overheated, usually through lack of coolant, and the cylinder head should be replaced.

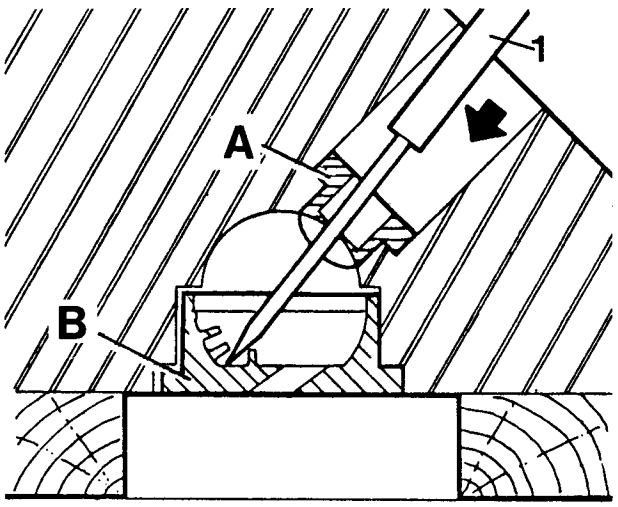


Fig.5 Removing hot plug
A. Shroud
B. Hot plug
1. Soft metal drift

11. To remove a hot plug, support the cylinder head face downwards on two pieces of timber, insert a thin soft metal drift through the injector shroud throat and tap the hot plug from the inside. Once removed in this way the hot plug must not be re-used.

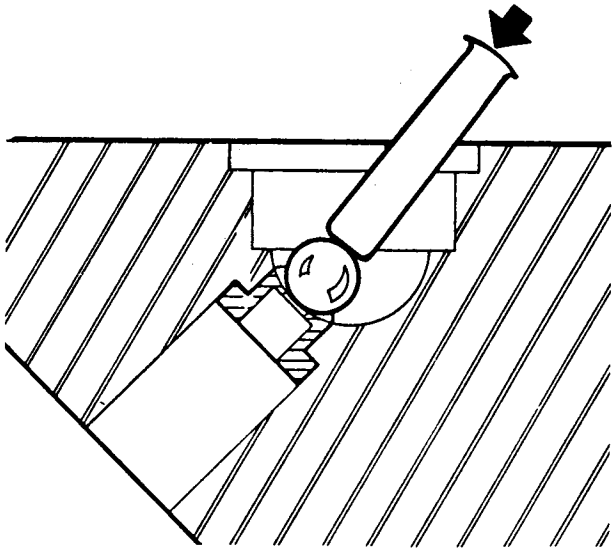


Fig.6 Removing shroud

12. If the injector shroud is damaged, drift it out towards the injector bore using a 13mm (0.5 in) diameter ball and a punch.

Thoroughly clean out the combustion chamber area.

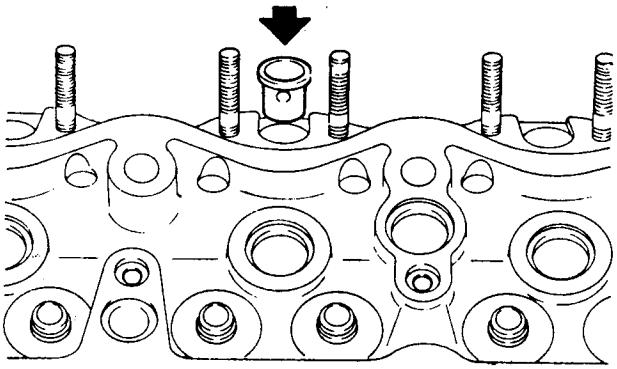


Fig 7 Fitting shroud

13. The hole in the side of the injector shroud is for manufacturing purposes, but is also used as a guide when fitting the shroud. Smear a little oil on the shroud and insert with the hole pointing towards the centre line of the cylinder head.

14. Fit the hot plugs by tapping in with a hide faced mallet, and locate with a new roll pin. If the hot plugs are loose in the cylinder head they may be retained with a little grease.

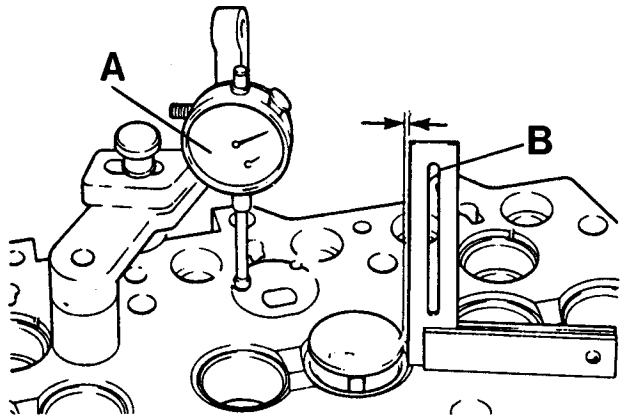


Fig.8 A. Checking stand-proud of hot plug.
B. Checking valve guide wear.

15. When fitted, the hot plugs must be checked with a dial test indicator to ensure they do not protrude above the level of the cylinder head face more than 0,025mm (0.001 in), and are not recessed below the level of the cylinder head face more than 0,05mm (0.002 in).

Push rod tubes

Although rarely necessary the push rod tubes are replaceable as follows.

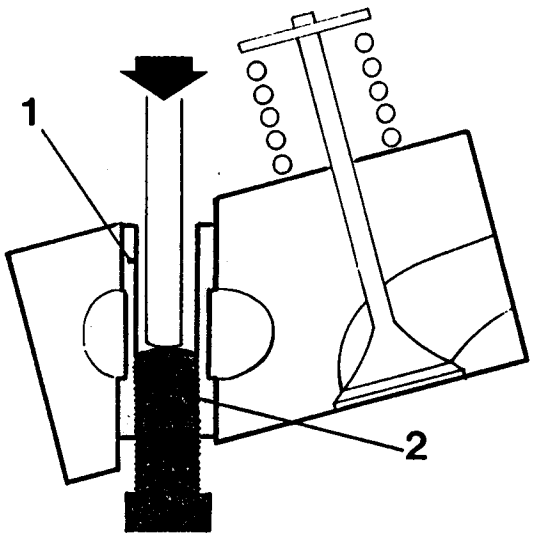


Fig.9 Removing push rod tube.
1. Push rod tube
2. Bolt

16. Use an 8mm taper tap to cut a thread 30mm (1.2 in) deep in the combustion face end of the tube to be removed.

17. Screw an appropriate bolt into the tube and press out the tube in the direction indicated.

18. Smear both ends of a new tube with silicone rubber sealant and press it into the cylinder head.

Valve guides

19. Check the fit of the valves in their guides by inserting a new valve in the appropriate guide 8mm above the seat. Measure the sideways movement of the valve (see Fig.8B); if it exceeds 0,15mm (0.006 in) renew the guide.

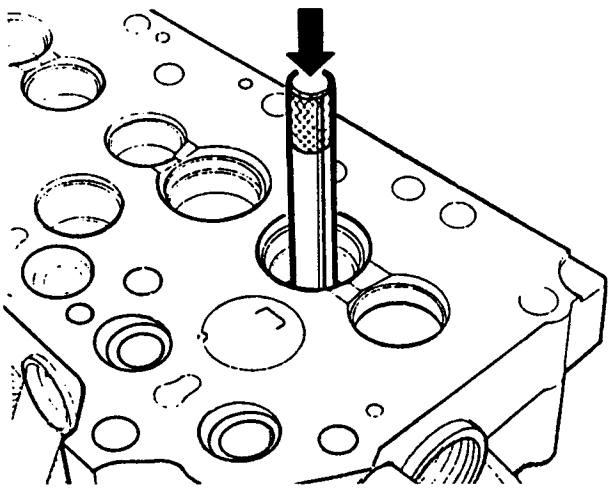


Fig.10 Removing valve guide.

20. To renew the valve guides support the cylinder head on pieces of timber. Drive or press out the old guides using tool RO 274400 for the inlet and RO 274401 for the exhaust.

NOTE: The inlet and exhaust guides have different internal diameters:

Inlet	**8mm**
Exhaust	**8,5mm**

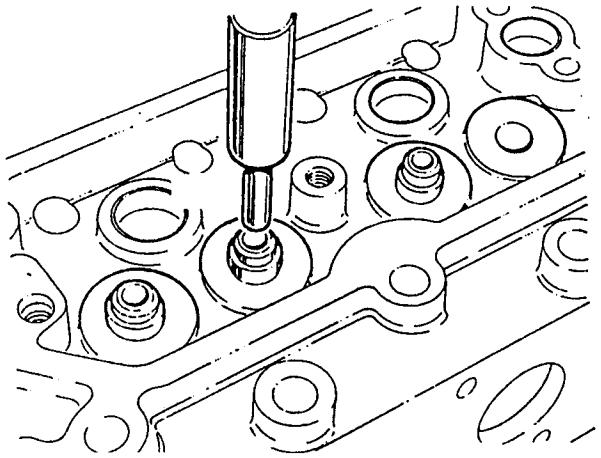


Fig.11 Fitting valve guide.

21. Lubricate the new guides and press or drive into position, using tool RO 601508 for the inlet and RO 600959 for the exhaust. The guides are correctly fitted when their shoulders are flush with the casting.

Valve seats

NOTE: The valve seats are inserts, which are replaceable using specialised equipment (see instruction 26).

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

The special tools recommended for refacing include expandable pilots to fit tightly into new or serviceable guides. Use the tools as follows:

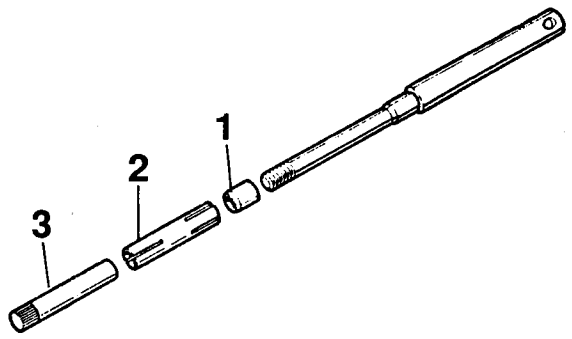


Fig.12 Valve guide pilot.
1. Expander
2. Collet
3. Knurled nut

22. Select the correct expandable collet for the valve guide concerned i.e. MS 150-8 for the 8mm inlet guides and MS 150-8.5 for the 8,5mm exhaust guides. Loosely assemble the collet, expander and nuts, ensuring that the chamfered end of the expander is towards the collet.

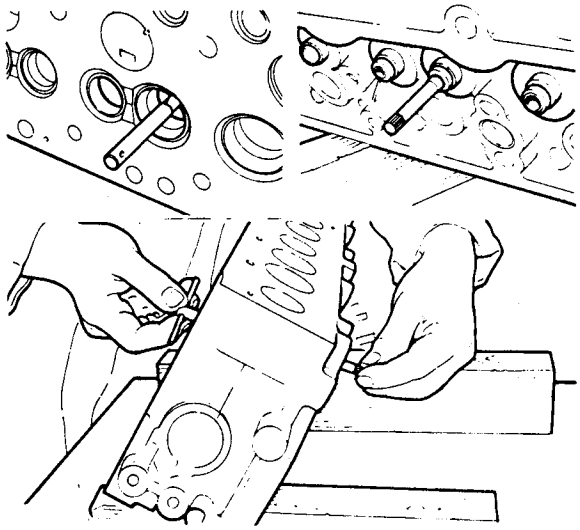


Fig.13 Fitting valve guide pilot.

23. Insert the assembled pilot into the valve guide from the combustion face side until the shoulder of the pilot contacts the valve guide. The whole of the collet is now inside the guide.

Expand the collet by using the tommy bar provided to turn the pilot whilst holding the knurled nut.

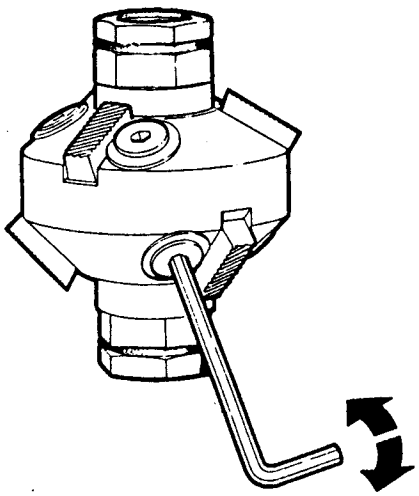


Fig.14 Valve seat cutter MS 621.

24. Cutter MS 621 is fitted with two sets of blades - a 45° angle set to cut the valve seats, and a 15° angle set. Check that the angled end of each blade faces downward towards the work as illustrated in Fig.14; check also that the cutter blades are positioned so that the middle of each blade contacts the material to be cut. Use the Allen key provided to reposition the blades if necessary.

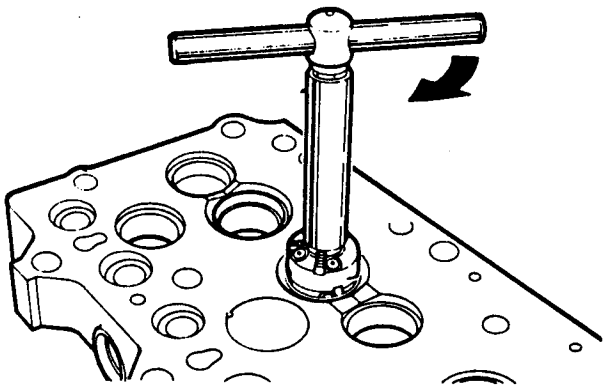


Fig.15 Cutting valve seat.

25. Slide the cutter MS 621 on to the pilot and fit the handle MS 76 to the cutter.

    Turn the asembly clockwise to cut the seat.

    CAUTION: Use very light pressure, and only cut sufficient material to produce a continuous engagement line around the seat face.

Valve seat inserts

NOTE: The valve seats are inserts which are replaceable using specialised equipment.

26. Hold the cylinder head firmly in a vice and grind the old insert away until it is thin enough to be cracked and prised out. Take care not to damage the insert pocket.

    WARNING: Wear protective goggles.

27. Remove any burrs and swarf from the pocket, otherwise the new insert may crack when being fitted.

28. The new insert must be pressed into position with its chamfered edge leading. Cut a new 45° seat using cutter MS 621 as described in the section "Valve seats".

Valves

29. Valves that are satisfactory for further service can be refaced using a valve grinding machine. Remove only the minimum amount of material 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.

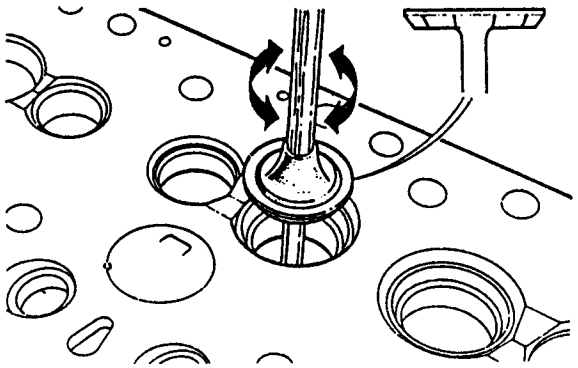


Fig.16 Lapping valve.

30. To ensure a gas tight seal between the valve face and its seat, lap each valve in using a fine lapping paste. Using a suction type valve lapping tool, employ a light reciprocating action whilst occasionally lifting the valve off its seat and turning it so that the valve returns to a different position on the seat. It is essential to keep the valve identified with its seat once the lapping-in operation has been completed.

    CAUTION: Make sure no lapping paste is allowed to get on the valve stems.

31. When lapping is complete, wipe off all valve paste from the valve and from the seat, then use engineers blue to check that the lapping operation is successful.

Alternatively make a series of pencil lines radially on the valve face as shown in Fig.16. Insert the valve and, while pressing it onto its seat, revolve it a quarter of a turn a few times. If all the pencil lines are cut through no further lapping is required.

32. When all valve lapping is complete, wash off any remaining traces of lapping paste from the valves and cylinder head seats.

Valve springs

33. Wash off the valve springs and inspect. They are double springs, opposite wound, and are designed to be an interference fit of the smaller spring inside the larger spring. If they slide apart they must be renewed.
Measure the free and loaded lengths of the springs, and check that they agree with the figures given in Data.

Cylinder head rebuild

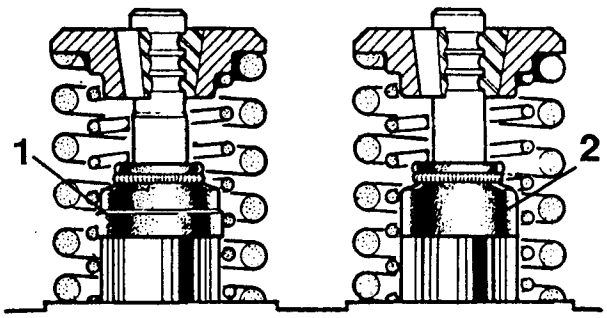


Fig.17 Valve seals
1.Exhaust valve seal
2.Inlet valve seal.

NOTE: The valve stem oil seals fitted to the inlet and exhaust valves have different internal diameters to cater for the larger stems of the exhaust valves. The exhaust valve oil seals are identified by a stepped exterior.(see Fig.17)

34. Smear each valve stem with engine oil before fitting it into its valve guide. Fit new valve stem oil seals making sure each seal locates in its groove in the guide. Plain exterior seals must be fitted to inlet valves and stepped exterior seals to exhaust valves.

35. Progressively fit each double valve spring and cup in removal order to each valve, compress the springs with tool 18G 1519 (alt. 18G 106A) to enable the retaining collets to be fitted.

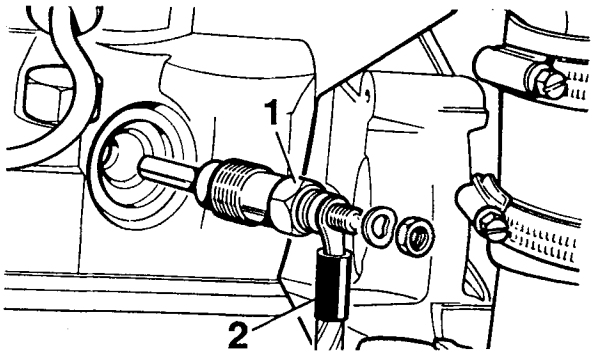


Fig.18 Vertical position of heater plug leads.
1 Heater plug
2 Lead

36. Smear the threads of the heater plugs with PBC grease before fitting them,then tighten to the correct torque. DO NOT OVERTIGHTEN.

Fit the heater plug leads, washers and nuts as illustrated.

CAUTION: Ensure the leads are vertical at their attachment points to the plugs and positioned clear of the cylinder head to prevent overheating and burning of the insulation.

37. Using a new gasket, fit the intake and exhaust manifolds, tightening to the specified torque figure.

38. Fit the injectors and the fuel spill rail noting the following points:

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

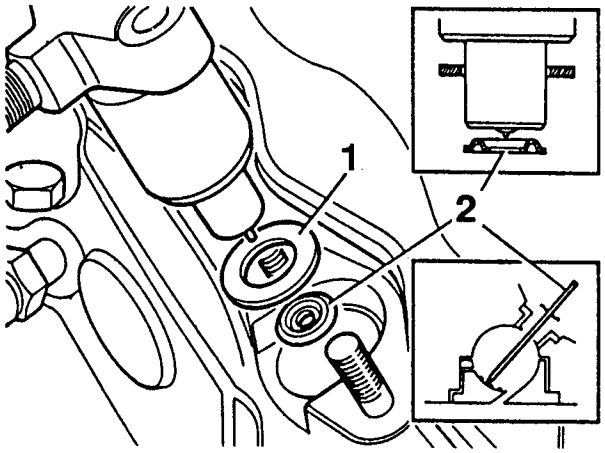


Fig.19 Injector sealing washers
1.Copper washer
2.Steel washer

- Ensure that the new washers are separated from each other and are clean.
- Use a length of welding wire or similar to guide a new steel washer into each injector shroud seat. Make sure only one washer is fitted per port and that it is fitted with the domed side towards the injector as illustrated.
- Lightly grease a new copper washer and fit into position in the injector shroud seat.
- Fit the injector and evenly tighten the retaining nuts to the correct torque. Uneven or overtightening of the nuts could distort the nozzle or steel sealing washer, and cause misfiring when normal running temperature is reached.

Rocker shaft assembly overhaul

1. All rockers, brackets, springs, washers etc. can be freely removed from the rocker shaft with the exception of No. 2 rocker bracket which must be released by removing its locating screw. This locating screw is fitted to position correctly the rocker shaft in all the rocker pedestals.

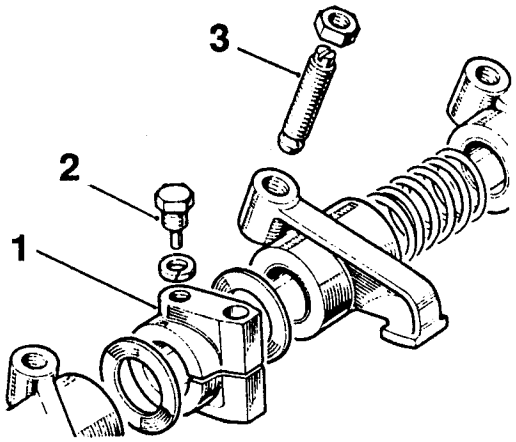


Fig.20 Rocker shaft
1 No.2 rocker pedestal.
2 Locating screw
3 Adjustment screw

2. Examine the rocker shaft for wear; discard if the bearing surface is worn more than 0,025mm (0.001 in).

3. Inspect the rockers and discard if the pads are worn.

NOTE: Do not attempt to reclaim rockers by grinding the pads.

4. Renew the rocker bushes if the clearance between shaft and bush exceeds 0,101 to 0,127mm (0.004 to 0.005 in).

NOTE: Bushes for inlet and exhaust rockers are not the same.

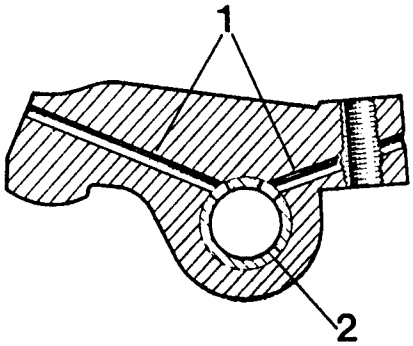


Fig.21 Cross section through rocker
1.Oil holes
2.Rocker shaft bush

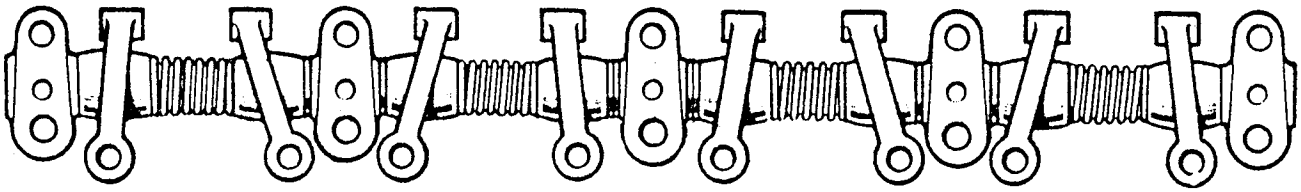


Fig.22 Rocker shaft assembly.

5. Press in the replacement bush ensuring that the pre-drilled oil holes align with the holes in the rockers (see Fig.21).

6. Use a 17/32in.(13,5mm) reamer, and increase the diameter by 0.001in. (0,025mm) to finish the bush. Make sure all swarf is cleared from the oil holes.

7. Examine the ball end of each adjusting screw and discard any that are worn. Check the threads for damage and that the oil relief drilling is clear.

   NOTE: Do not attempt to reclaim the ball-ends by grinding.

Rebuild rocker shaft assembly

8. Fit the tappet adjustment screws and locknuts to the rockers.

9. Check that the oil ways in the rocker shaft are clear. Fit No. 2 rocker shaft bracket to the shaft and retain with the locating screw and washer.

10. Using new spacers and springs, assemble the rockers and pedestals onto the shaft as illustrated in Fig.22. Note the following points:

    - Lubricate all components with engine oil before fitting.
    - Two washers are fitted on either side of the centre pedestal, one on either side of numbers 2 and 4 pedestals, and no washer beside 1 or 5 pedestals.
    - The inlet valve rockers are not the same as the exhaust valve rockers.
    - Check that the rockers move freely on the shaft after fitting.

Refit cylinder head

1. Make sure the cylinder head and cylinder block mating faces are thoroughly clean. Position a new cylinder head gasket on the block with the combustion chamber heat shields on the gasket facing upwards.

2. Carefully lower the cylinder head onto the block.

3. Insert the push rods in removal sequence, ensuring that each ball end locates in the spherical seat of its tappet slide.
   Locate the eight caps on the ends of the valve stems (if fitted).

4. Carefully fit the rocker gear, locating the rocker ball ends in the push rods. Partially tighten the 5 small rocker assembly retaining bolts, ensuring that the dowels in the base of the pedestals locate correctly in the head.

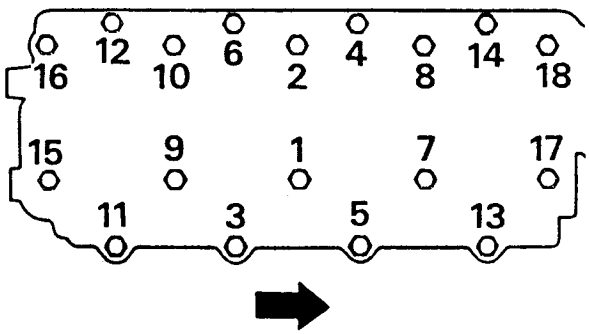


Fig.23 Cylinder head tightening sequence.

5. Tighten the cylinder head bolts and nuts to half the specified torque figure. Tighten the bolts progressively and in the sequence shown in the illustration above.

6. Tighten the five rocker pedestal bolts (13mm A/F) to full specified torque.

7. Progressively tighten all cylinder head bolts and nuts to full specified torque in the same sequence as before.

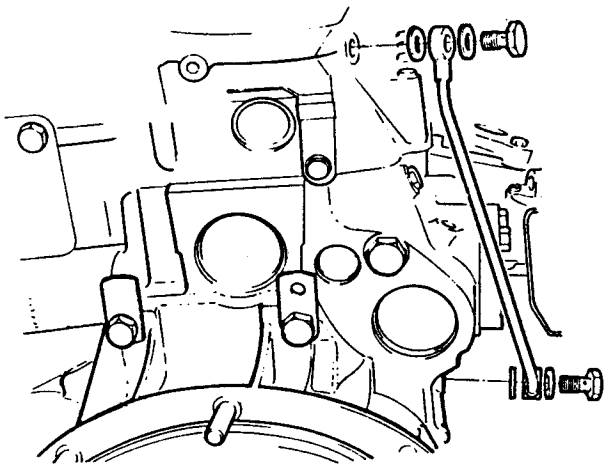


Fig.24 Cylinder head oil feed pipe.

8. Connect the oil feed pipe at the rear of the cylinder head, and tighten the rear engine lifting bracket.

9. **Adjust tappet clearances.**

CAUTION: If the crankshaft is rotated with excessive valve clearances, it is possible for pushrods to become dislodged from their tappet seatings and fracture the tappet slides. To prevent this, eliminate all clearance from any loose rockers before turning the crankshaft to adjust the clearances.

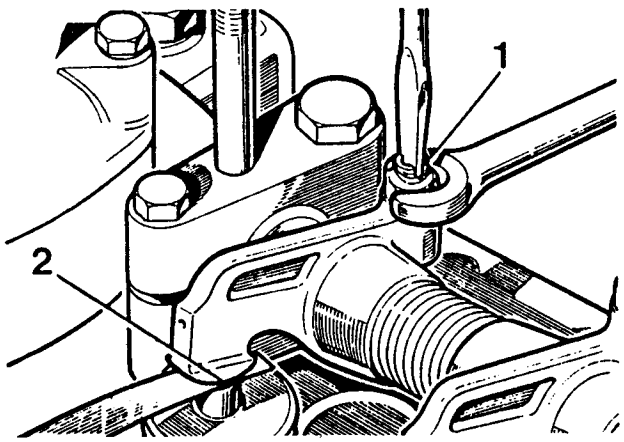


Fig.25 Tappet adjustment
1 Adjusting screw
2 Clearance

a. Turn the engine until number eight valve (rearmost valve) is fully open.

b. Using a 0,25mm (0.010 in) feeler gauge check the clearance between the valve stem (or valve stem cap if fitted) and rocker pad of number one valve.

c. Adjust the clearance by slackening the locknut and turning the tappet adjusting screw clockwise to reduce clearance and anti-clockwise to increase clearance. Recheck the clearance after tightening the locknut.

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

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

10. Fit the rocker cover with a new gasket. Tighten the dome nuts to the correct torque. DO NOT OVERTIGHTEN.

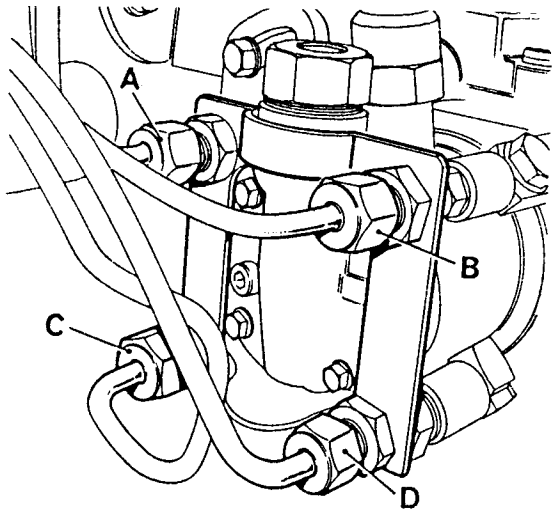


Fig.26 Injector pipe fitting

11. Fit the injector pipes to the D.P.S. pump and to the injectors. Counting from the front of the engine connect the pipes as follows:

    A to number 1 injector.
    B to number 2 injector.
    C to number 3 injector.
    D to number 4 injector.

    CAUTION:
    a. Do not overtighten the union nuts.
    b. Ensure total cleanliness of all fluid passage areas.

If the cylinder head is being refitted in situ the following operations are necessary.

12. *Fit the fuel spill pipe at No. 4 injector.*

13. *Check that the coolant by-pass hose is in position then fit the thermostat housing using a new gasket. Tighten the by-pass hose clips.*

14. *Fit the coolant hoses at the thermostat housing.*

15. *Fit the heater hoses and the retaining bracket at the rocker cover.*

16. *Connect the electrical leads to the temperature transmitter and the heater plugs.*

17. *Fit the breather hose to the oil filler cap.*

18. *Fit the exhaust downpipe to the manifold.*

19. *Fit the air cleaner and ducting.*

20. *Fit the bonnet closing panel.*

21. *Fill the cooling system.*

22. *Connect the battery.*

23. *Start the engine and run until normal temperature is reached. Check the coolant level and top up as necessary.*

    NOTE: The fuel system is self-priming but, because the injector pipes were removed, the system will take a few seconds to prime under cranking before the engine will start. If there is any possibility that this may flatten the battery, it is recommended that the injector pipes be cracked open at the injectors, and progressively tightened as fuel appears at each injector.

LEYLAND DAF

TIMING COVER

FRONT COVER PLATE (Removal for inspection purposes)

Tool required: FR 101

The plate can be removed with the engine in situ as follows:-

1. Disconnect the battery.
2. Remove the fan belt.
3. Use tool FR 101 to hold the crankshaft pulley while removing the pulley securing bolt, then remove the pulley/torsional vibration damper assembly.

   CAUTION; Remove the damper with care to avoid damage to the 'V' belt groove, the deflector or the damper mounting.
   Remove by applying hand load to one side of the damper whilst giving the other side a sharp rap with a soft faced hammer.
4. Remove the bolts securing the front cover plate and pull it clear.
5. Refitting is the reverse procedure, but it is important to fit the crankshaft pulley securing bolt as follows:

   Apply Loctite to the threads of the crankshaft pulley bolt, hold the pulley with tool FR 101 and tighten the bolt to the correct torque.

TIMING BELT

Remove

Tools required: MS 1517, FR 101.

The timing belt can be removed in situ by first carrying out the following two operations.

1. *Disconnect the battery.*
2. *Drain the cooling system, remove the bonnet, bonnet closing panel and radiator.*
3. Remove the fan belt.

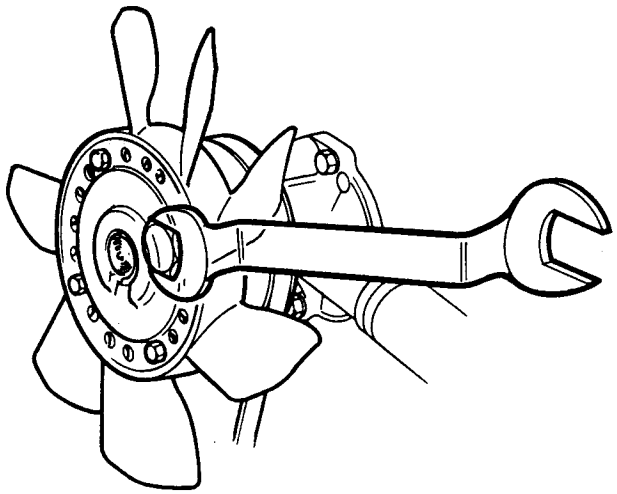


Fig.1 Using tool MS 1517 to release fan assembly

4. Remove the fan by using special tool MS 1517 to release the nut retaining the fan assembly
   NOTE; nut has left hand thread.
   If the special tool is unavailable unscrew the nuts securing the fan to the viscous coupling, slide the fan rearwards to gain access to the nut behind the coupling, release the left hand thread nut and unscrew the coupling to lift the fan clear.
5. Remove the water pump.
6. Use tool FR 101 to hold the crankshaft pulley while removing the pulley securing bolt, then remove the pulley/torsional vibration damper assembly.
7. Remove the front cover plate.
8. Temporarily fit the crankshaft pulley bolt and rotate the crankshaft clockwise until the timing marks on each gear are aligned with the arrows cast in the front cover.

   NOTE: On 14J engines the pop mark on the injection pump pulley is the timing mark.
   15J engines use the scribed line next to the 'F' mark.

9. Release the tensioner fixing nuts and move the tensioner to release the timing belt tension. Remove the tensioner.

CAUTION: If the belt is to be refitted,mark its direction of rotation with chalk or other soft substance before removal.

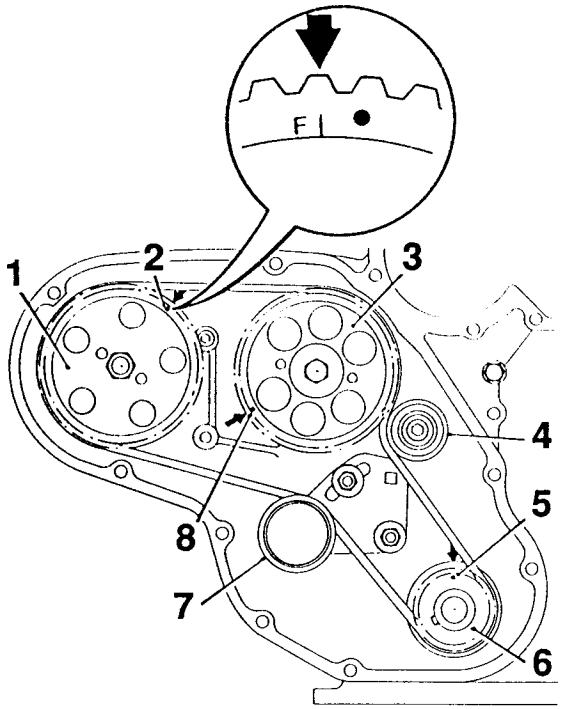


Fig.2 Timing Marks

1. Injector pump pulley
2. Injector pump timing marks
3. Camshaft pulley
4. Idler pulley
5. Crankshaft timing marks
6. Crankshaft pulley
7. Timing belt tensioner
8. Camshaft timing marks

10. Carefully withdraw the belt from the pulleys taking care not to rotate the pulleys.

NOTES RE STORAGE AND HANDLING OF TIMING BELTS.

Correct storage and handling of timing belts is very important, and the following points must be observed.

1. A timing belt is constructed with a reinforcement of glass fibre running circumferentially inside it. Do not attempt to lever a belt on or off its pulleys as this may damage the glass fibre; use finger pressure only.

2. Timing belts must be stored flat and circular; never hang on a peg.

3. A timing belt must be renewed if contaminated with oil, fuel or other detrimental fluids.

4. Correct tensioning procedures are essential.

5. Do not crimp or bend to a diameter of less than 25mm (1 in).

6. Timing belt pulleys have a smooth finish to prolong belt life. If a new wheel is being fitted, make sure it has no burrs or rough surfaces.

TIMING PULLEYS, FRONT COVER AND SEALS

Remove

Tools required: 18G 1464, 18G 1457

The timing pulleys and the front cover can be removed with the engine in situ by first removing the timing belt as described in the section "Timing Belt - removal", then proceed as described from '1' below.

Make sure the timing marks on the injection pump, camshaft and crankshaft pulleys are aligned (see fig.2) before removing the timing belt.

CAUTION: Do not rotate the crankshaft, camshaft or fuel injection pump whilst the timing belt is removed.

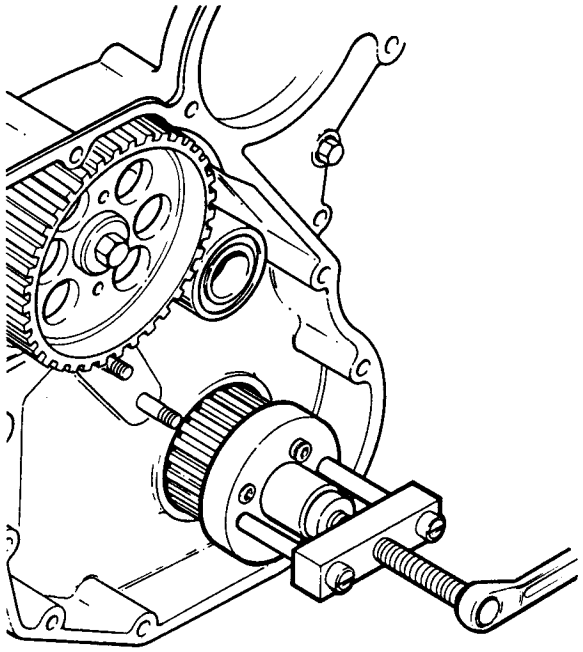


Fig.3 Crankshaft pulley removal with 18G 1464

1. Withdraw the crankshaft pulley using tools 18G 1464/2, 18G 1464/4 and button 18G 1464/6.

   NOTE: Two keys are fitted to the crankshaft.

2. Remove and discard the oil seal behind the crankshaft pulley.

   CAUTION: Do not damage the aluminium cover.

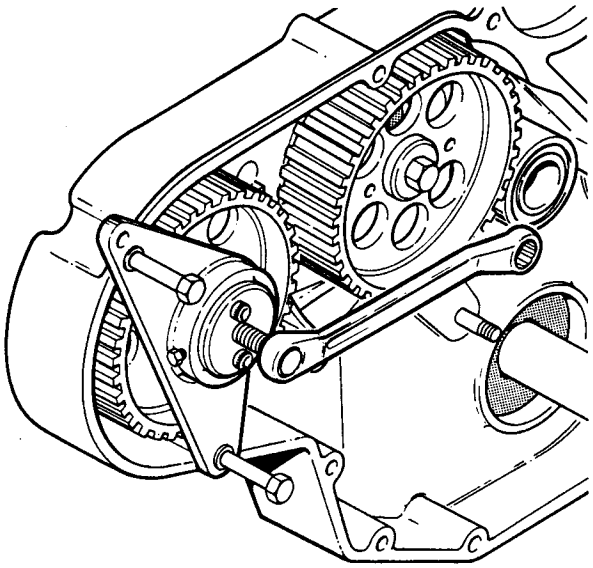


Fig.4 Injection pump pulley removal with 18G 1457

3. Remove the stiff nut securing the injection pump pulley, and withdraw the pulley using tool 18G 1457.

   NOTE: The oil seal behind the pulley is an integral part of the injection pump.

4. Remove the bolt securing the camshaft gear retaining plate. Withdraw the bolt together with the washer, small 'O' ring seal, retaining plate and large 'O' ring seal, noting the relative locations for re-assembly.

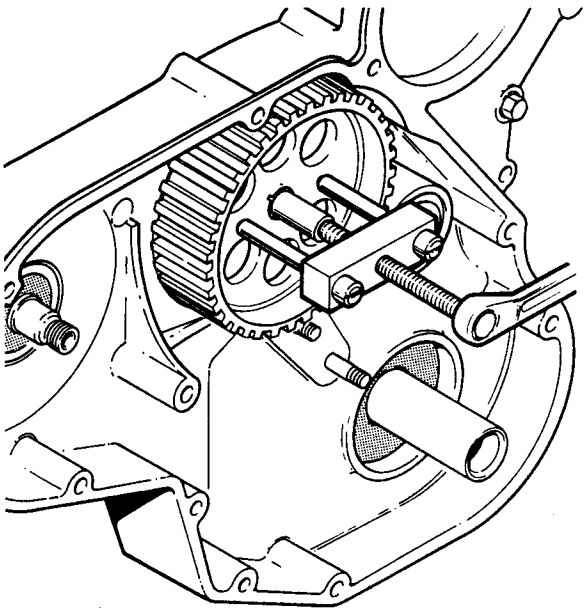


Fig.5 Camshaft pulley removal with 18G 1464

5. Withdraw the camshaft pulley using tool 18G 1464/2/6.

6. Remove and discard the oil seal behind the camshaft pulley without damaging the aluminium front cover.

If the front cover is to be removed, proceed as follows:

7. Remove the three nuts attaching the injection pump to the front cover.

8. Drain the engine oil and remove the sump.

9. Remove the bolts and Allen screw attaching the front cover to the block, and ease the cover from its dowel locations.

10. Remove and discard the gaskets. Note the gasket located on the tensioner mounting bolts.

Fitting front cover and pulleys

Tools required: 18G 1456, 18G 1482, LST 107, 18G 1458, MS 1517, FR 101.

1. Make sure all joint faces are clean and free of old gasket material, then fit a new joint gasket, triangular gasket and water gallery gasket.

2. Fit and secure the front cover with two bolts and an Allen screw. Apply Loctite to the Allen screw

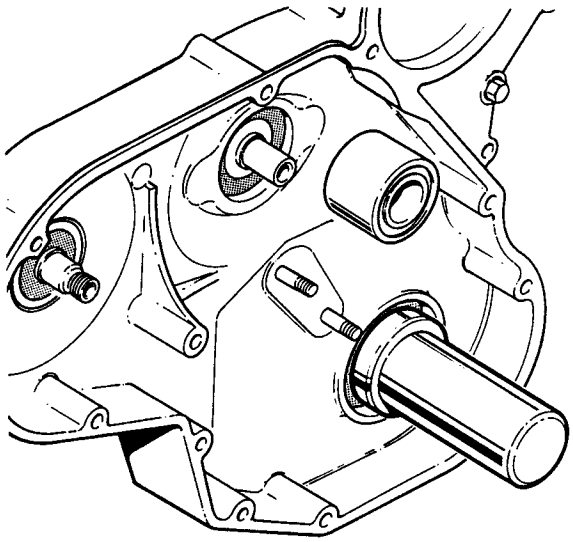


Fig.6 Fitting crankshaft seal with 18G 1456

3. Lubricate the lip of a new crankshaft oil seal, then drive it into position using tool 18G 1456. The seal must be fitted with its lip side leading, and be positioned flush with the front face of the cover.

4. Ensure the two keys are fitted to the crankshaft then use a suitable tubular drift to drive the crankshaft pulley into position.

NOTE: The pulley is fitted with the timing dot outwards.

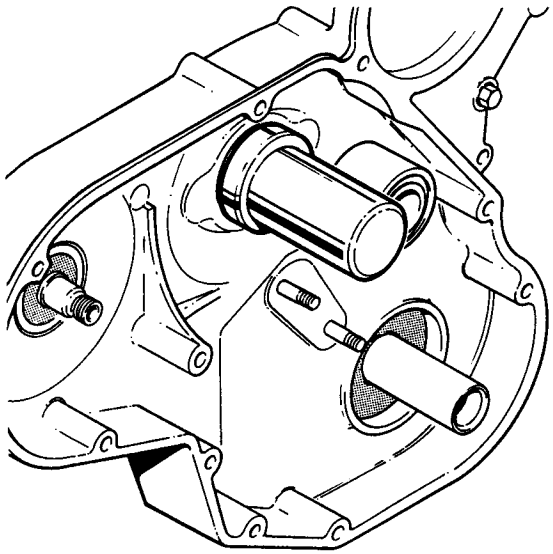


Fig.7 Fitting camshaft seal with 18G 1482

5. Lubricate the lip of a new camshaft seal, then drive it into position using tool 18G 1482. Fit the seal with its lip side leading, and flush with the front face of the cover.

6. Restrain the camshaft from moving rearwards, and fit the camshaft pulley in the following way:

   a. Fit the woodruff key to the camshaft, and lubricate the thrust and seal faces of the camshaft pulley

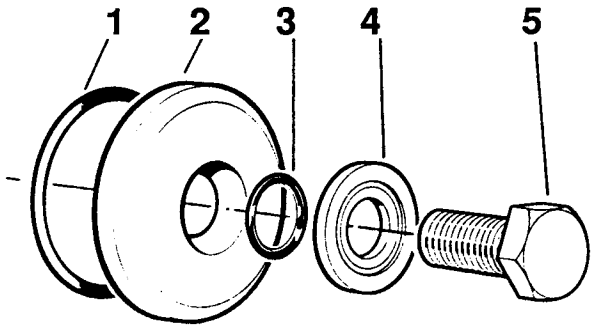


Fig.8 Camshaft pulley fixing
1. 'O' ring
2. Retaining Plate
3. 'O' ring
4. Washer
5. Bolt

b. Position the camshaft pulley, and use the centre bolt with a large flat washer (not the fitted retaining plate) to draw the pulley onto the camshaft. Then remove the bolt, fit to it the retaining plate washer, new 'O' rings and plain washer as illustrated. Refit the bolt, tightening it to the correct torque.

7. Fit the three washers and nuts which hold the injection pump to the front cover.

8. Ensuring that the woodruff key is correctly located, fit the injection pump pulley and tighten the stiff nut to the correct torque.

Timing

The camshaft and the injection pump are both timed to the crankshaft using a specific exhaust valve peak position of number one cylinder. This is known as the 'E.P.' position, which is determined by a slot in the flywheel being aligned with a hole in the flywheel housing.

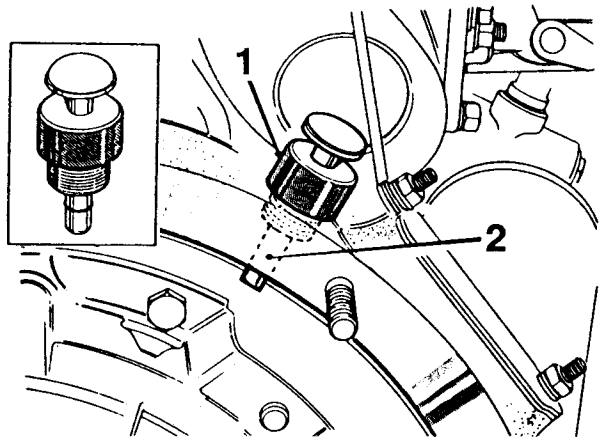


Fig.9 Timing pin LST 107 fitted to flywheel housing
1. LST 107 body
2. LST 107 pin

A special tool LST 107 is used to locate the crankshaft at the E.P. position. The body of the tool locates in the hole in the flywheel housing, and the pin in the tool will drop into the slot in the flywheel at the E.P. position.

Fitting the timing belt

1. Fit the body of tool LST 107, then temporarily fit the crankshaft pulley bolt and turn the engine clockwise until the tool pin drops into the E.P. slot. The timing dot on the crankshaft pulley will now align with the corresponding mark in the front cover.

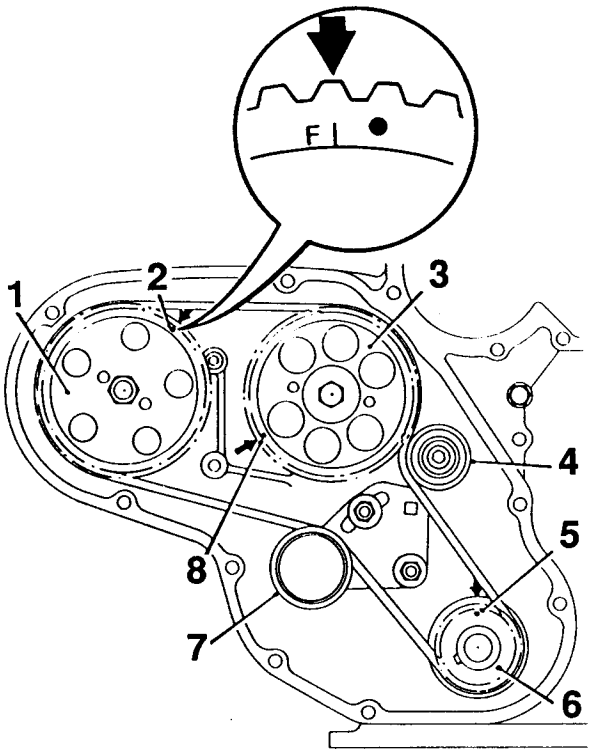


Fig.10 Timing marks
1. Injector pump pulley
2. Injector pump timing marks
3. Camshaft pulley
4. Idler pulley
5. Crankshaft timing marks
6. Crankshaft pulley
7. Timing belt tensioner
8. Camshaft timing marks

2. Turn the injection pump pulley to align the timing marks:
14J engines - pop mark
15J engines - scribed line adjacent to the 'F' mark

3. Turn the camshaft pulley until the timing dot aligns with the cast arrow inside the front cover.

4. Carefully fit the timing belt, using only hand pressure to ease it on to the pulleys. Fit it first over the crankshaft pulley and whilst keeping the belt under tension by hand, run the belt under the idler pulley and over the camshaft pulley. Should the belt not quite mate with the grooves, turn the camshaft pulley the required amount. Feed the belt over the injection pump pulley and, if necessary, turn the pulley slightly to locate the belt.

5. Fit the timing belt tensioner and loosely secure with its washers and nuts.

6. Withdraw the special tool timing pin LST 107 from the flywheel slot.

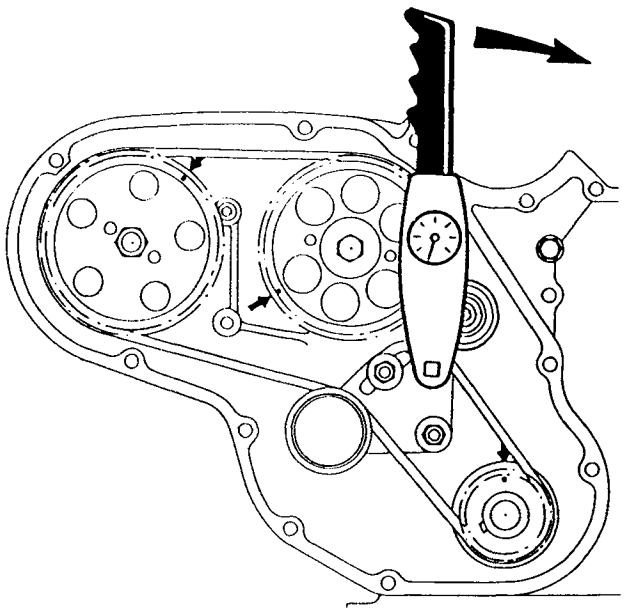


Fig.11 Adjusting belt tension using direct scale read-off torque wrench

7. Using a direct scale read-off torque wrench (not a break-action type) in a **vertical** position, insert the drive peg into into the square hole in the tensioner base plate. Apply a load of 10.5 to 13 Nm (8 to 10 lb.ft.) if a new belt, or 9 to 11 Nm (6.5 to 8 lb.ft) if an old belt and, whilst maintaining this loading, tighten the two tensioner clamping nuts to 22 to 28 Nm (17 to 20 lbf.ft).

8. Rotate the engine clockwise two complete revolutions, then slacken the two tensioner clamping nuts and repeat the tensioning operation described above.

NOTE: Failure to repeat the tensioning procedure in this way will result in incorrect belt tension and may lead to premature belt failure.

9. Check that all the timing marks align - crankshaft, camshaft and timing pulleys. If there is any misalignment the foregoing timing procedure must be repeated.

Timing the injection pump

10. Locate the E.P. position using tool LST 107; ensure that No. 1 cylinder exhaust valve is fully open..

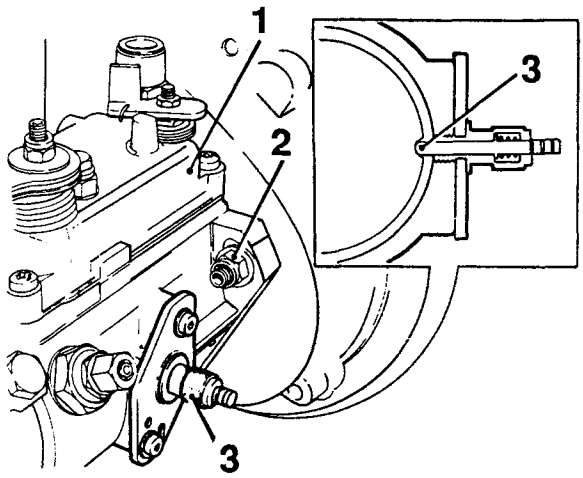


Fig.12 Injection pump timing
1. Injection pump
2. Injection pump mounting nut
3. Timing tool 18G 1458

11. Remove the plug from the side of the injection pump and fit tool 18G 1458.

12. Slacken the three forward pump mounting nuts, the bolt at the rear bracket, (if vacuum pump is fitted at this stage) and the injector pipe unions. Turn the pump in clockwise and anti-clockwise directions, and it will be seen that the tool plunger will move inward and then outward again. Turn the pump until the tool plunger reaches its maximum inward position.

13. Tighten the pump three forward mounting nuts, the bolt at the rear bracket (if fitted at this stage) and the injector pipe unions.

14. Remove tool 18G 1458 and refit the plug to the pump. Remove timing pin LST 107 and refit the plug to the flywheel housing.

15. Remove the crankshaft pulley bolt.

Completion of front end rebuild

16. Fit the front cover plate.

17. Fit the torsional vibration damper to the crankshaft. Apply Loctite to the crankshaft pulley bolt, hold the pulley with tool FR 101 and tighten the bolt to the correct torque.

18. Fit the water pump using a new gasket.

19. Fit the fan using MS 1517.

20. Fit the fan belt and adjust to the correct tension.

21. Fit the sump (if removed) and fill the engine with the correct grade of oil (See cylinder block section for correct sump fitting procedure).

Dependent on the amount of overhaul work that has been carried out, if the work has been done with the engine in situ, some or all of the following operations will be necessary:

22. *Fit the radiator and connect the hoses.*

23. *Fit the bonnet closing panel and the bonnet.*

24. *Fill the cooling system.*

25. *Connect the battery.*

26. *Start the engine and run until normal temperature is reached. Check the coolant level and top up as necessary*

FLYWHEEL HOUSING

FLYWHEEL

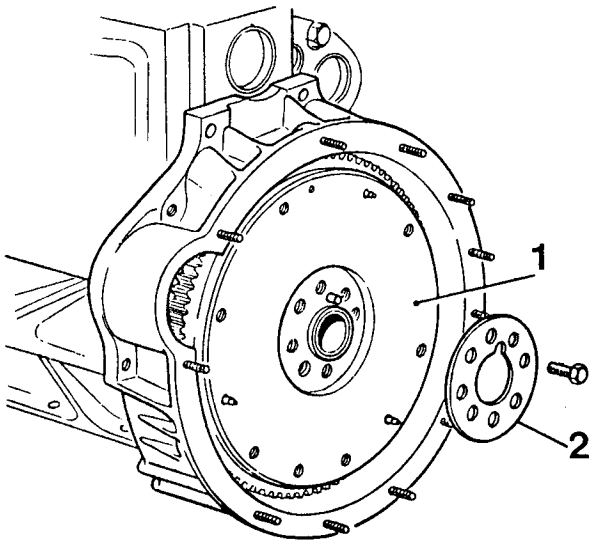


Fig.1 Flywheel location
1 Flywheel
2 Reinforcing plate

Remove

The flywheel can be removed in situ by first removing the gearbox, then proceed as follows.

1. Remove the clutch assembly.

2. Restrain the flywheel with a holding tool, then remove the securing bolts and reinforcing plate and withdraw the flywheel.

Overhaul

3. Inspect for wear or scoring on the clutch pressure face. The flywheel can be machined to restore the clutch pressure face if its thickness is not less than 36,96mm (1.455 in). After machining, the flywheel thickness must still be no less than this figure.

4. Examine the starter ring gear teeth for wear and chips. The ring gear is shrunk on to the flywheel and can be renewed as follows.

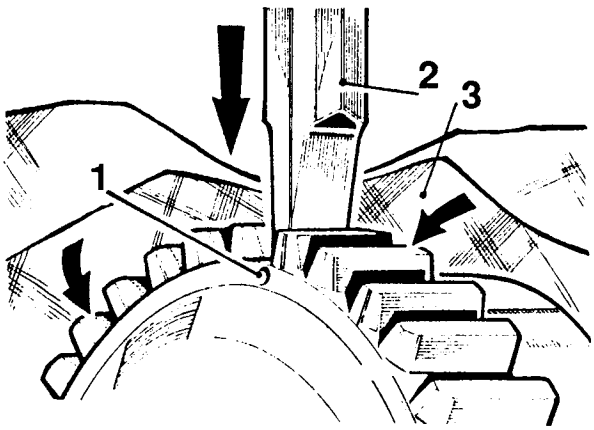


Fig.2 Removing starter ring gear
1 8,0mm drilled hole
2 Chisel
3 Protective cloth

5. Drill a 8,0mm (5/16 in) hole between the root of any two teeth and the inner diameter of the ring gear deep enough to weaken the gear. Do not drill into the flywheel.

6. Secure the flywheel in a soft jawed vice. Use a chisel to split the ring gear at the point at which the hole has been drilled.

   WARNING: Cover the chisel and ring gear area with a cloth to prevent injury from metal fragments.

7. To fit the new starter ring gear, heat it uniformly to between 225°C and 250°C (437°F - 482°F). Do not exceed the higher temperature.

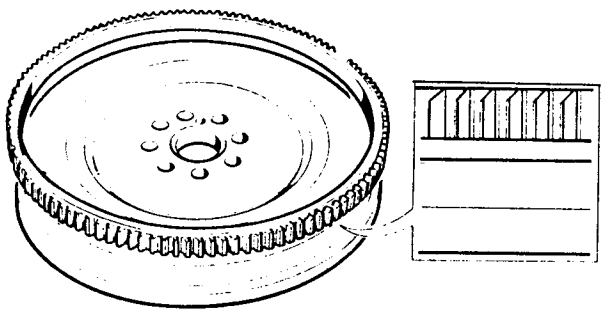


Fig.3 Fitting starter ring gear. (Inset shows squared edge of teeth downwards)

8. Place the flywheel, clutch face down, on a flat surface and locate the heated ring gear with the square edge of the teeth downward towards the flywheel clutch face and the chamfered edge of the teeth uppermost.

9. Press the ring gear firmly against the flange on the flywheel, and hold in place until the ring has cooled sufficiently to contract and grip the flywheel.

10. Allow the ring gear to cool gradually. Do not place in cold water.

Refit

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

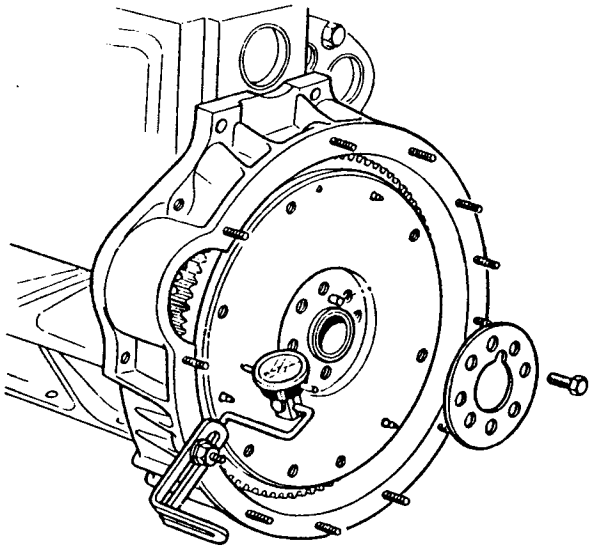


Fig.4 Measuring flywheel run-out

12. Offer up the flywheel to the crankshaft; apply thread sealant to the flywheel retaining bolts then secure the flywheel with the reinforcing plate and the bolts. Tighten the bolts to the correct torque figure.

NOTE: The reinforcing plate is fitted with the chamfered outer edge away from the flywheel.

13. To check flywheel run-out, mount a dial test indicator so that the stylus rests in a preloaded condition on the clutch pressure face at a radius of 114mm (4.5 in).

14. Turn the flywheel and check that the run-out does not exceed 0.05 to 0.07mm (0.002 to 0.003 in). Should the run-out be excessive, remove the flywheel and recheck for any irregularities on the flywheel and crankshaft mating faces and on the dowel.

15. Refit the clutch assembly.

CRANKSHAFT REAR OIL SEAL

Replace

Tools required: 18G 134, 18G 1344, 18G 134-11.

The oil seal can be removed with the engine in situ after first removing the gearbox.

1. Remove the clutch assembly and the flywheel.

2. Remove the flywheel housing complete with the crankshaft oil seal and the 'O' ring seal (if fitted) between the flywheel housing and the cylinder block.

NOTE: On engines from 14J 03541 and on all 15J engines the 'O' ring is no longer fitted.
Instead, sealant is applied between the housing and the block.

3. Remove and discard the oil seals.

4. If sealant is used to seal the flywheel housing to the rear of the block , the old sealant must be cleaned off.

5. Check that the oil seal journal, the seal housing and the seal outer diameter are clean and dry, and free from burrs or damage.

NOTE: The new crankshaft seal to be fitted is supplied with a former to maintain the correct shape of the seal, and to allow it to fit over the crankshaft without damage.
Do not remove the former until the housing and seal have been fitted.

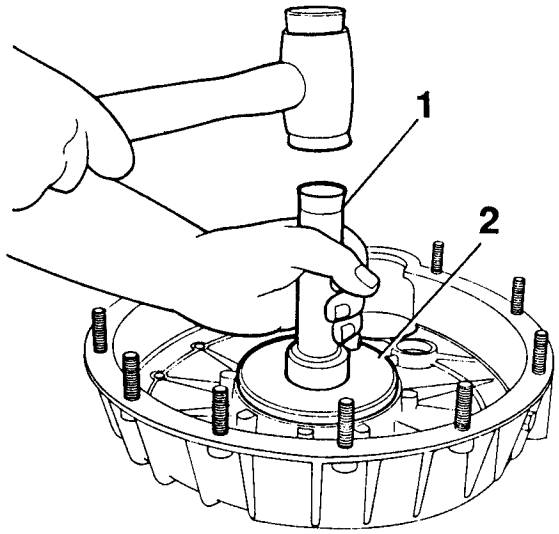


Fig.5 Fitting crankshaft rear oil seal
1 Tool 18G 134
2 Tool 18G 134-11

6. Use special tool 18G 134 and 18G 134-11 to drive in the new seal, keeping it square in the housing; drive the seal in, lip side leading, as far as the tool allows. If the tool is not available, press in the seal to a depth of 2,2 to 2,5mm (0.080 to 0.081in.) below the face of the seal housing.

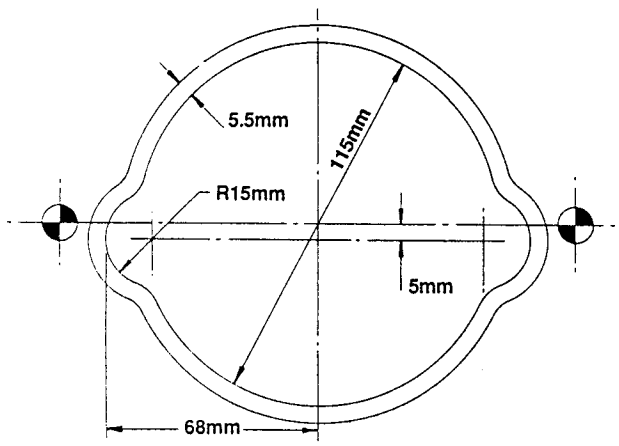


Fig.6 Sealant application - flywheel housing

7. Use a new 'O' ring seal (if fitted) between the flywheel housing and the cylinder block. If no 'O' ring is specified, Hylogrip 2000 sealant **MUST** be applied to the flywheel housing face as shown in the illustration. The bead should be 5,5mm (0.2 in) wide and 0,25mm (0.01 in) thick.

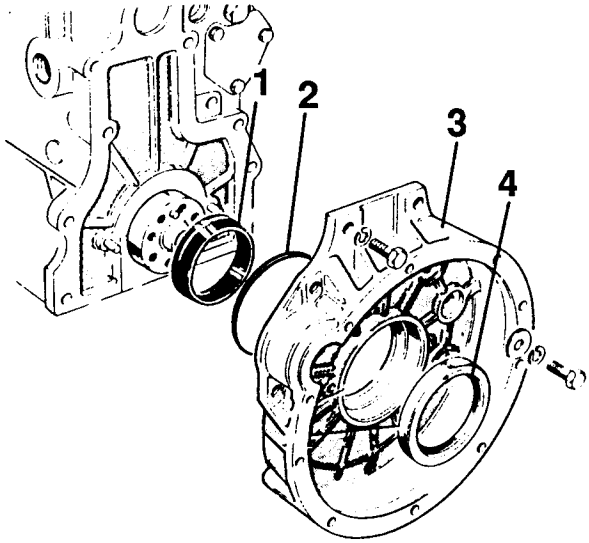


Fig.7 Fitting flywheel housing
1 Tool 18G 1344
2 'O' ring seal (if fitted)
3 Flywheel housing
4 Crankshaft rear oil seal

8. If the crankshaft seal former has been misplaced, special tool 18G 1344 must be used as a seal guide. Examine it carefully for any signs of damage that could destroy the seal lip.

9. Lubricate the outside diameter of the seal guide and the crankshaft journal with concentrated 'Oildag' in a 25% solution with clean engine oil.

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

11. Refit the flywheel and the clutch assembly.

CYLINDER BLOCK

CAMSHAFT

Remove

The camshaft can be removed with the engine in situ by first removing the timing cover and cylinder head as described in the appropriate sections. Then proceed as follows:

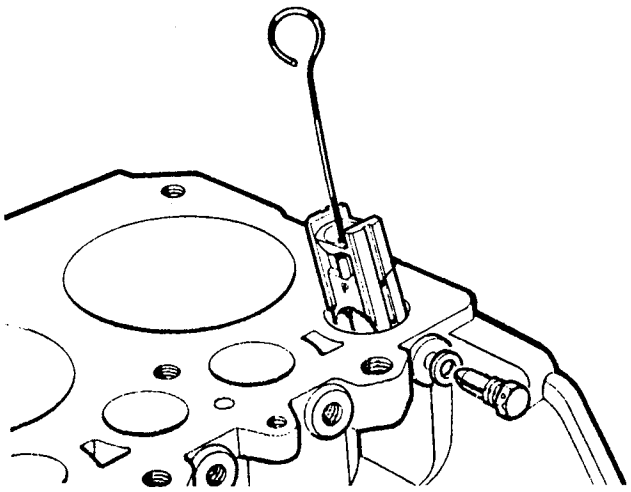


Fig.1 Removing tappets

NOTE; The following tappet removal sequence (2 - 4) must be followed to prevent the possibility of the rollers falling behind the camshaft.

1. Remove the vacuum pump
2. Remove the 8 tappet guide securing bolts.
3. Use long nosed pliers to lift out each tappet slide and then each roller; do not disturb the tappet guides when the rollers are being removed. Retain these components in their fitted sequence. The slides are marked 'FRONT' for reassembly but if the rollers are to be re-used, mark one side of each roller to ensure that when refitted they will turn in the original direction of rotation.
4. Withdraw the tappet guides and retain with their respective slides and rollers.
5. Inspect all tappet components for wear.
6. Remove the fuel lift pump.

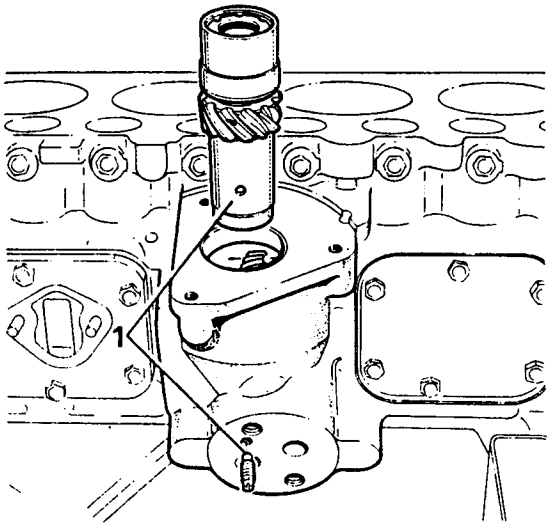


Fig.2 Removing skew gear
1 Grub screw and location

7. Remove the oil filter head and unscrew the grub screw which locates the skew gear bush.
8. Lift out the skew gear.

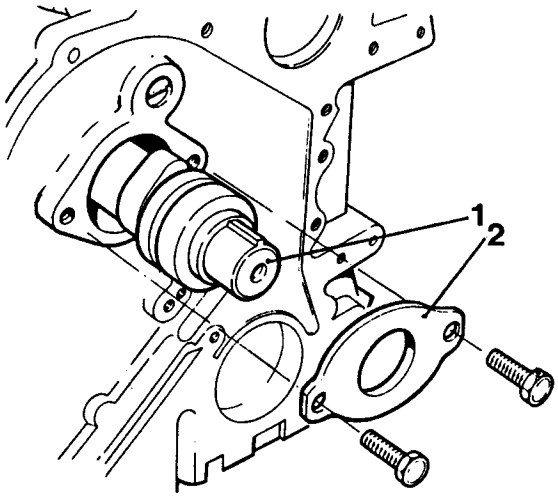


Fig.3 Removing camshaft
1 Camshaft
2 Camshaft thrust plate

9. Remove the camshaft thrust plate and carefully withdraw the camshaft.

10. Inspect the camshaft for the following:-

- Scored, worn, pitted or chipped cams.
- Worn and chipped gear teeth.
- Check the journals for wear, and if more than 0,050mm (0.002 in) the camshaft should be renewed.
- Run-out can be checked by placing the camshaft between 'V' blocks and check the run-out of the intermediate journals with a dial test indicator. Run-out should not exceed 0,050mm (0.002 in)

VACUUM PUMP

Overhaul

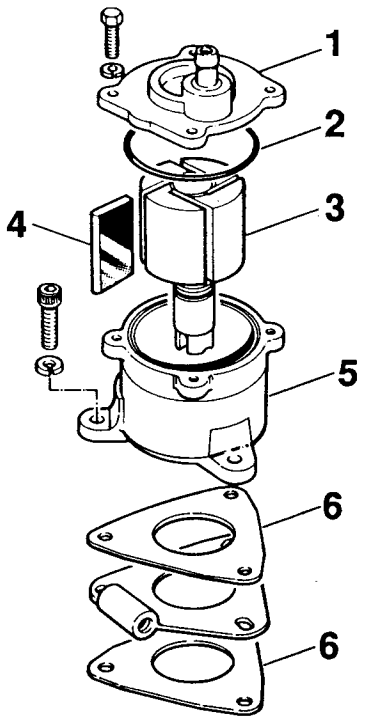


Fig.4 Vacuum pump
1 End plate
2 'O' ring
3 Rotor
4 Rotor blade
5 Housing
6 Gaskets

1. With the pump off the engine, remove the four bolts securing the end plate and withdraw the plate and its 'O' ring seal.
2. Remove the rotor from the pump body.
3. Inspect the components for wear and damage and renew as necessary. The rotor blades, 'O' ring and gaskets are available separately.
4. To check the rotor-to-body clearance, fit the rotor to the body and with feeler gauges measure the clearance at the narrow point between the rotor and body. The correct clearance is 0,05mm (0.002in).
5. Check the clearance between the rotor and end plate by placing a straight edge across the body and, with feeler gauges, measure the clearance between the straight edge and rotor. The correct clearance should be 0,10 to 0,12mm (0.004 to 0.005 in).
6. Commence the re-assembly by fitting the rotor blades to the rotor with the radius outwards and insert the rotor into the body.
7. Place a new 'O' ring seal in position in the body groove, fit the end plate and secure with the four bolts tightening evenly.
8. When fitting the pump to the engine use a new joint washer and ensure that the drive slot fits correctly over the coupling drive pin.

LEYLAND DAF

SKEW GEAR

Overhaul

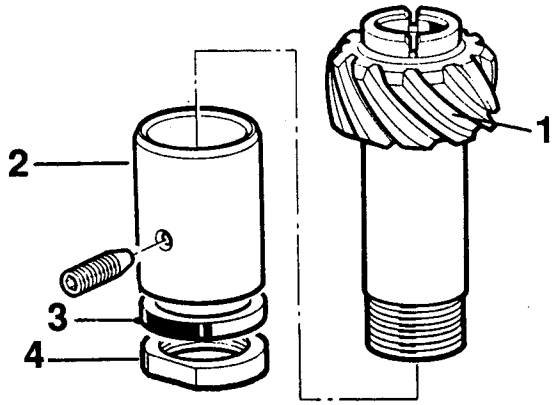


Fig.5 Skew gear assembly
1 Skew gear
2 Bush
3 Thrust washer
4 Lock nut

1. To renew the bush, hold the gear firmly in a vice using soft jaws to avoid damage to the teeth. If possible insert a scrap drive shaft into the gear and grip the scrap shaft.

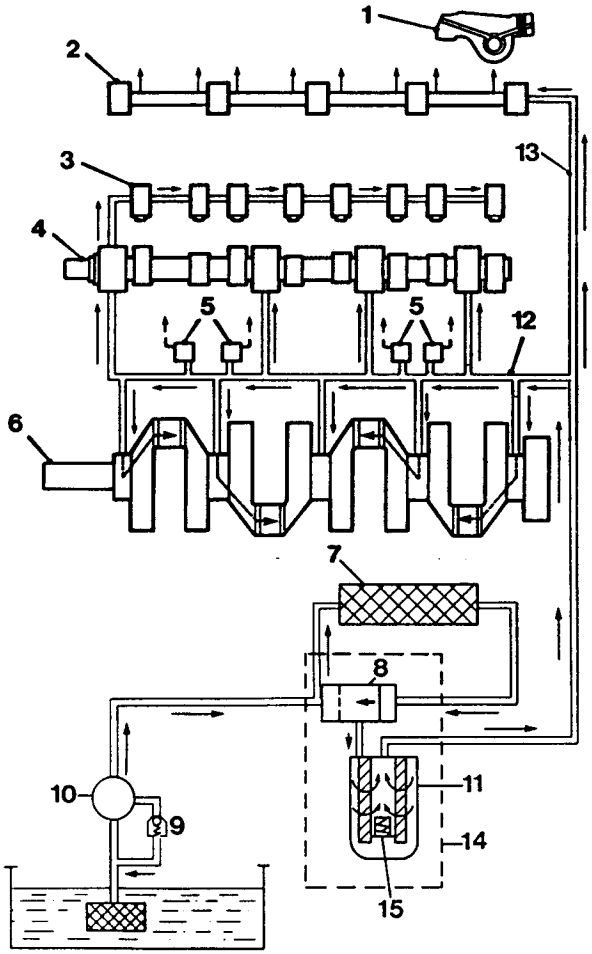
2. Turn the lock nut clockwise (left-hand thread) to remove, and withdraw the thrust washer and bush.

3. Inspect the new bush for burrs, then lubricate and fit the bush with the retaining screw location hole towards the lower end of the gear. The chamfer at one end of the bush will be to the bottom.

4. Fit a new thrust washer if the original is worn or scored. Apply Loctite 601 to the thread and fit the locknut, tightening it to 27 - 34Nm (20 - 25lbf.ft).

5. Check that the gear revolves freely in the bush with a clearance between thrust washer and bush of 0,05 to 0,20mm (0.001 to 0.007 in).

LUBRICATION SYSTEM



Oil circulation

The double gear oil pump (10) is driven by a shaft from a gear on the camshaft, and has a built-in pressure relief valve (9).
The pump draws the oil through a strainer in the sump, and passes it to the main oil gallery (12) via the full flow filter (11)
Drillings in the crankcase allow pressurised oil to pass from the main oil gallery to the five crankshaft main bearings (6), and internal drillings in the crank webs deliver oil from the main bearing journals to the big end bearings.
The four squirt jets (5) also receive pressurised oil from the main oil gallery to lubricate the piston bores. Each squirt jet retaining bolt contains a one-way valve to maintain pressure in the oil gallery.
Four more drillings in the crankcase ensure pressurised oil reaches the four camshaft journals. (4).
Pressurised oil from the front camshaft bearing passes upwards to another longitudinal gallery for lubrication of the tappet slides and rollers (3).

This oil is at a reduced pressure, controlled by a restricted hole in the bearing. A flat on the front camshaft bearing journal gives lubrication to the camshaft thrust plate.
An external oil pipe (13) is connected by a tapping at the rear of the main oil gallery. This pipe supplies pressurised oil to the centre of the rocker shaft (2), from where it can pass out through drillings to the eight rockers (1). Each rocker has internal drillings as illustrated; one drilling directs oil to the top of the push rod, and the other ensures adequate oil is available at the rocker tip to lubricate the valve mechanism beneath it.
The oil passing through the cooler (7) goes to the oil filter (11) via a thermostat valve (8). This thermostat is located in the oil filter assembly (14) and controls the flow of oil through the cooler. The oil filter contains a bypass valve (15) which will open to allow oil to flow to the engine if the filter element should become blocked.

OIL PUMP

Remove

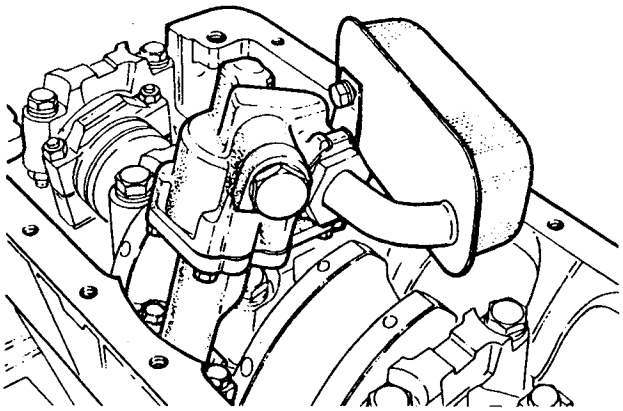


Fig.6 Oil pump location

The oil pump can be removed with the engine in situ, after draining the oil.

1. Remove the sump.

2. Remove the two bolts securing the oil pump to the crankcase. Withdraw the pump, complete with strainer and oil pump drive shaft.

Overhaul

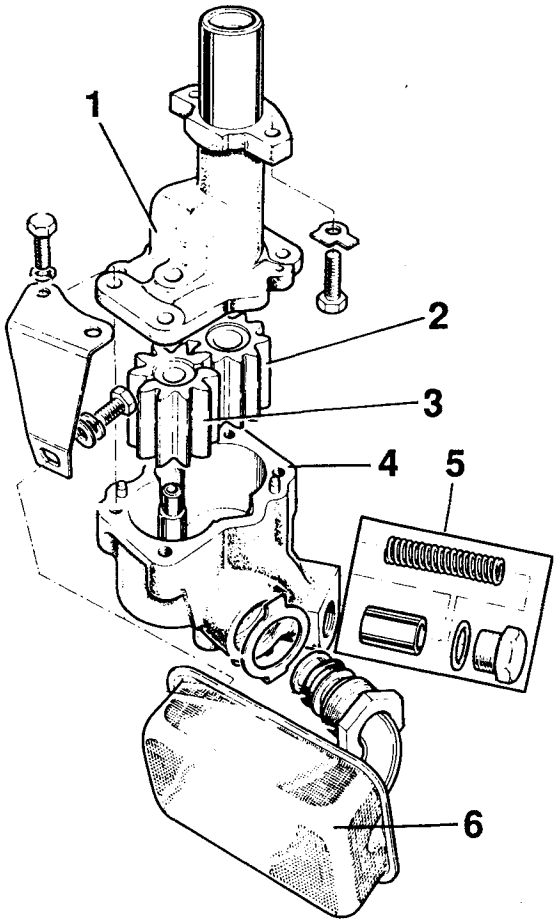


Fig.7 Oil pump
1 Pump cover
2 Driven gear
3 Idler gear
4 Pump body
5 Pressure relief valve
6 Strainer

3. Bend back the lock washer and release the nut securing the strainer to the oil pump body. Remove the bracket bolt, then the strainer and sealing ring, and discard the lock washer.

4. Remove four bolts and washers and lift off the oil pump cover; lift out the driven and idler gears.

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

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

7. Clean the pump body and assemble the gears. Place a straight edge across the pump body face as illustrated and, using a feeler gauge, measure the clearance between the body and gears. The correct clearances are:

   Idler gear 0,07 to 0,15mm (0.003 to 0.006 in).

   Driven gear 0,05 to 0,12mm (0.002 to 0.005 in)

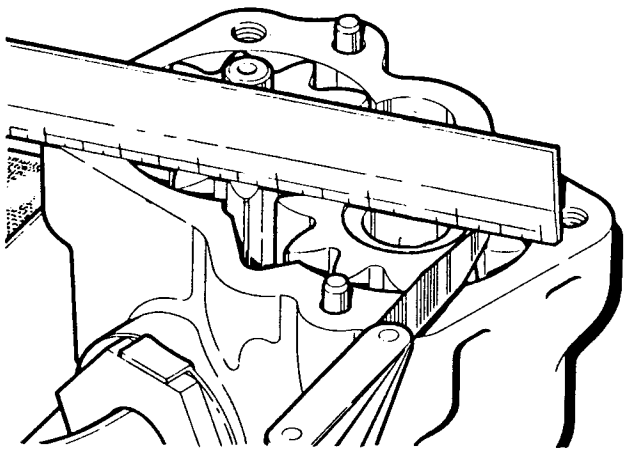


Fig.8 Measuring gear end float.

8. If clearances exceed the above figures the gears must be renewed in pairs.

   NOTE: a worn but serviceable gear must not be matched with a new gear.

9. If necessary renew the idler gear spindle by drilling out the peened-over end of the spindle so that the spindle can be withdrawn from the pump body. To ensure squareness when fitting the new spindle, assemble it into the pump body with the two gears. Fit the cover and secure with the four bolts. Support the pump body and peen over the end of the new spindle. Remove the cover and gears and check security of the spindle.

Assembly

10. Fit the idler gear to the spindle.

11. Fit the driven gear with the plain part of the bore uppermost as shown in the illustration.

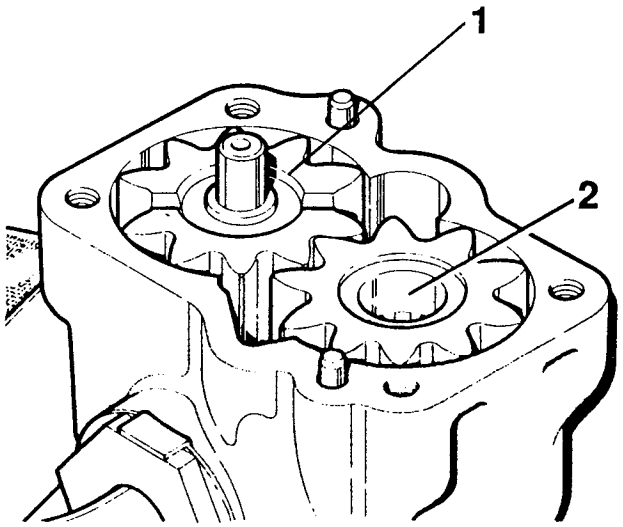


Fig.9 Oil pump gears
1 Idler gear
2 Driven gear

12. Smear the joint face of the body with jointing compound and fit the cover over the dowels and secure with the four bolts and spring washers.

13. Hold the relief valve bore vertically and insert the plunger with the solid end first. Fit the spring, sealing washer and plug.

14. Fit the oil strainer sealing ring to the pump body followed by a new lock washer and the strainer. Tighten the strainer retaining nut so that when fitted the strainer is positioned parallel to the sump baffle plate. Secure the nut with the lock washer tab, and fit the bracket securing bolt.

CONNECTING RODS AND PISTONS

Remove

The connecting rods and pistons can be removed with the engine in situ after first removing the cylinder head and the sump.

NOTE 1. During removal and dismantling of the connecting rods and pistons it is important that all components are kept in related sets, and that the pistons (if being refitted) are identified with their respective bores.

2. To assist identification, each connecting rod cap is numbered 1 to 4 with the number reading from the front. Replacement connecting rods/caps are not numbered.

3. The connecting rod caps are marked on the same side as the 'V' on the piston crowns, i.e. camshaft side.

1. Remove the cylinder head.

2. Drain and remove the sump.

3. Check the connecting rod cap identification numbers and, if unmarked, number them sequentially for correct assembly procedure later.

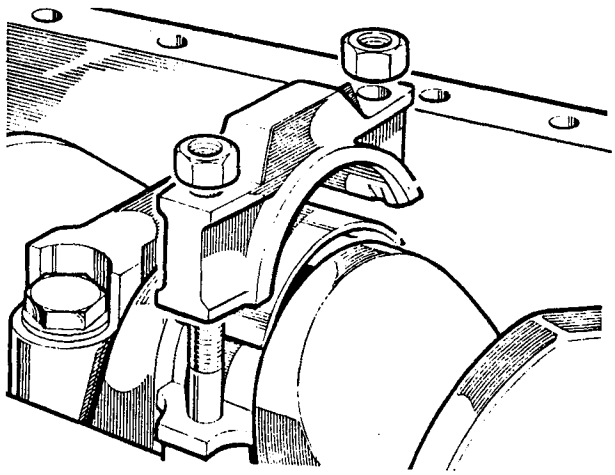


Fig.10 Connecting rod cap and bearing.

4. Remove each big end cap in turn and retain the shell bearing with its respective cap. Push the piston and connecting rod assembly upwards and withdraw it from the top of the cylinder block. Loosely assemble the cap and shell to its connecting rod.

CAUTION: Take care not to damage the oil jet assemblies.

Inspection/Overhaul

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.

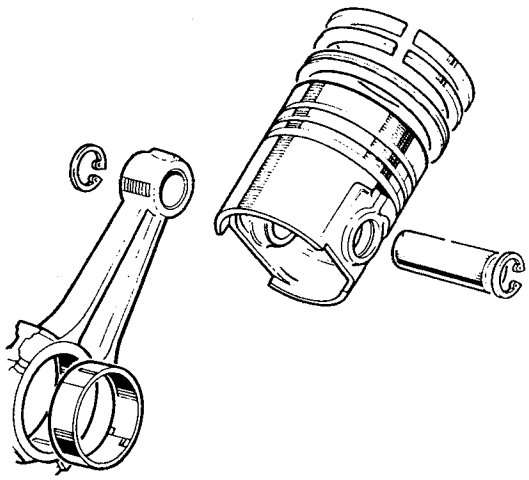


Fig.11 Connecting rod and piston.

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

3. **New pistons** - Original pistons fitted to new engines at the factory are specially graded to facilitate assembly. The grade letter on the piston crown should be ignored when ordering new pistons. Genuine Freight Rover service standard size pistons are supplied 0,025mm (0.001 in) oversize to allow for production tolerances on new engines. When fitting new pistons to a standard size cylinder block the bores must be honed to accommodate the piston with the correct clearances. In addition Freight Rover pistons are available 0,50 and 1,01mm (0.020 and 0.040 in) oversize for fitting to rebored cylinder blocks.

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

   When taking the following measurements the cylinder block and pistons must be at the same temperature to ensure accuracy.

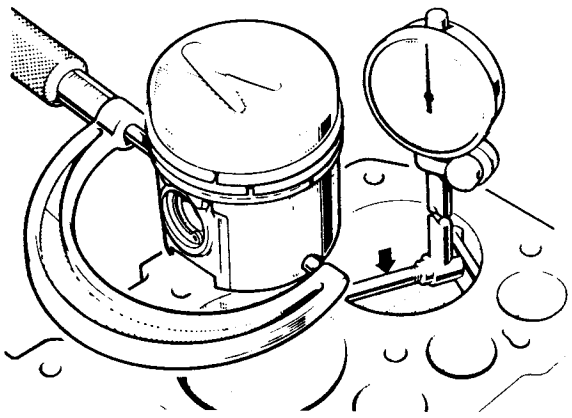


Fig.12 Measuring piston and bore diameters.

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

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

6. The clearance is determined by subtracting the piston diameter from the bore diameter.

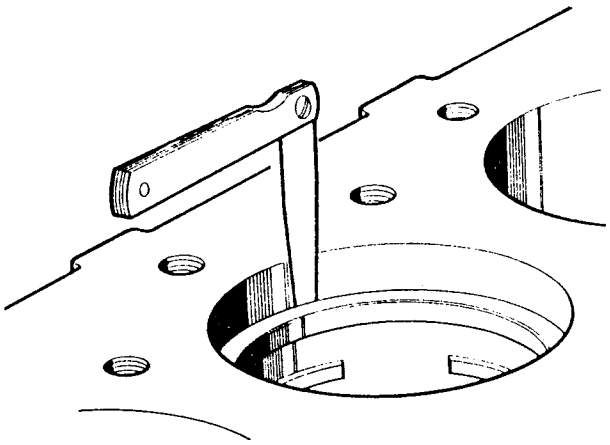


Fig.13 Measuring piston clearance.

7. If gauge equipment is not available the clearance can be assessed by placing a long, suitably sized feeler gauge down the thrust side of the bore, and inserting the appropriate piston 'upside down' in the bore; position it with the gudgeon pin parallel to the crankshaft axis. Push the piston down the bore, stop at the tightest point and, whilst holding the piston still, slowly withdraw the feeler gauge. If a steady resistance of approximately 2.5kg (6lbs) is felt, the clearance is satisfactory.

Inspect piston rings

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

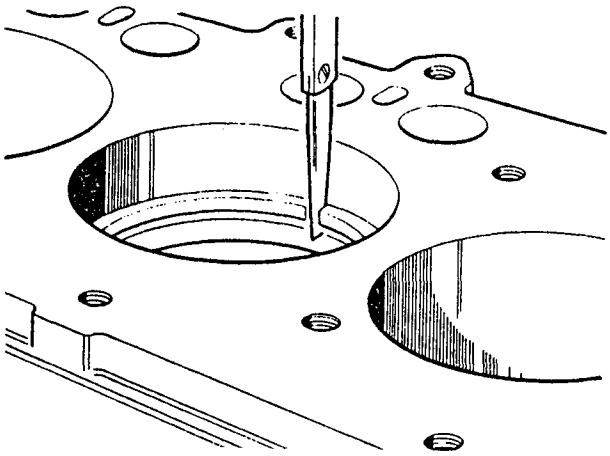


Fig.14 Measuring piston ring gap in bore.

8. **Check gap** When checking the ring gap in worn bores, but nevertheless within acceptable taper and ovality limits, the ring must be inserted squarely into the bottom of the bore at the lowest point of the piston travel. To ensure squareness of the ring, use a piston to push it down into position.. With newly machined bores, the ring may be inserted squarely into any position in the bore.

9. Using an appropriate feeler gauge check the gaps of all the rings in turn, including the oil control ring assembly.

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

Check piston ring side clearance

10. It is important that clearances are correct. Rings that are too tight will bind when hot, imparing the radial pressure causing possible loss of compression. Excessive clearance will allow the rings to rock in the grooves and the resulting pumping action could cause excessive oil consumption and eventually broken rings.

11. Fit the oil control ring to the bottom groove. Fit the unpolished compression ring with the word 'TOP' uppermost to the second groove. Insert the polished chrome ring with an internal chamfer and the word 'TOP' uppermost to the top groove.

12. After fitting each ring, roll it round the piston groove to ensure that it is free and does not bind.

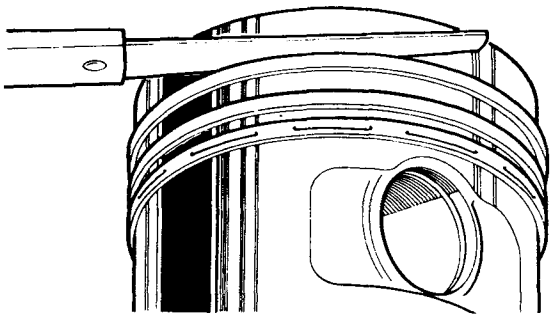


Fig.15 Measuring piston ring side clearance.

13. Using an appropriate feeler gauge check the clearance between the rings and piston grooves. Clearances in excess of 0,10 to 0,15mm (0.004 to 0.006 in) are unacceptable and the ring and/or the pistons should be renewed.
   The following are the manufacturing tolerance clearances for each ring:
   Top- 0,09 to 0,15mm (0.003 to 0.006in)
   Middle- 0,04 to 0,08mm (0.0015 to 0.003in)
   Oil control- 0,04 to 0,08mm (0.0015 to 0.003in)

Gudgeon pin inspection.

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

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

Connecting rod inspection

16. Check the connecting rods and caps for distortion as follows; fit the correct cap, less the bearing shells, to each connecting rod as denoted by the number stamped near the joint faces. This number also indicates the crankshaft journal to which it must be fitted.

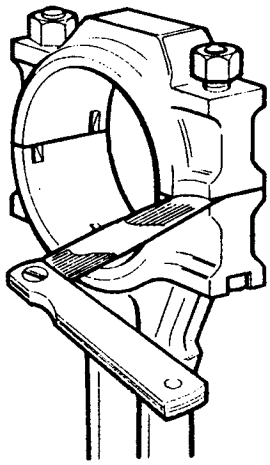


Fig.16 Checking connecting rod/cap for distortion.

17. Tighten the nuts to the correct torque and release the nut on one side only. Check with a feeler gauge that no clearance exists between the joint faces. If there is a gap, the connecting rod is distorted and should be renewed.

18. Use an accurate connecting rod alignment gauge to check the rods for bend and twist. The maximum allowable for both conditions must not exceed 0,127mm (0.005 in).

19. Examine and check the small end bush for wear. If necessary renew the bush. The correct clearance of the gudgeon pin in the small end bush is given in Data.

20. When renewing a bush ensure that the oil hole in the bush lines up with the hole in the connecting rod. Finish the bush to the correct size and clearance.

21. Connecting rod bearings that are worn, pitted, scored and show signs of overheating must be discarded. If more than one of the bearings show these signs they must all be renewed. When fitting new or used bearings to serviceable crankpins the clearances must be checked.

Connecting rod bearing nip and clearance

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

22. Fit the bearing halves to the connecting rod and cap and secure the assembly with the correct torque. Slacken the nut on one side only and check the clearance between the joint faces with a feeler gauge.

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

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

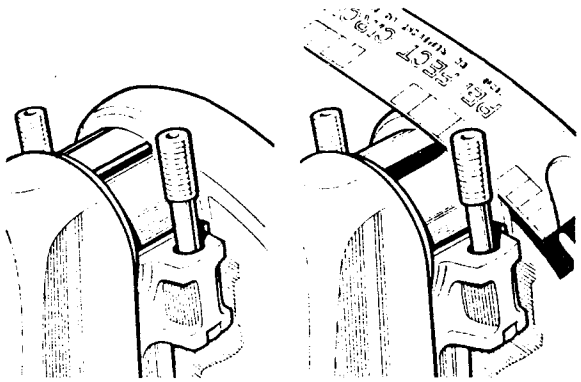


Fig.17 Using Plastigage to measure bearing clearance
1 Plastigage strip
2 Measuring flattened Plastigage

23. Wipe any oil from the crankpins and place a piece of Plastigage across the centre of the bearing in the connecting-rod cap. Assemble the rod to the appropriate crankpin and tighten to the correct torque. Do not rotate the connecting rod or crankshaft during this operation.

24. Remove the connecting rod cap and bearing shell and, using the scale supplied, measure the flattened Plastigage at its widest point. The graduation that most closely corresponds to the width of the Plastigage indicates the bearing clearance.

    The correct clearance with new or overhauled components is 0,043 to 0,063mm (0.0017 to 0.0025 in).

25. Wipe off the Plastigage with an oily rag. Do not scrape off otherwise it may damage the crankpins.

Connecting rod end-float

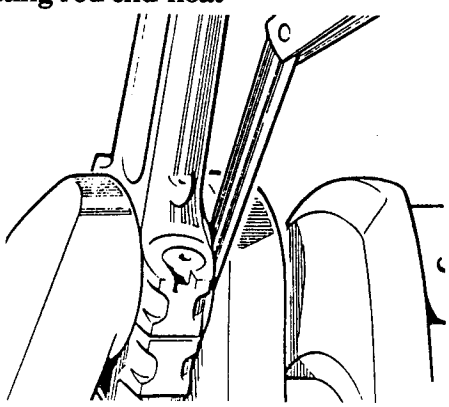


Fig.18 Measuring connecting rod end-float.

26. Fit the connecting rods complete with bearings to their respective crankpins. Move the connecting rod to one side and check the clearance, with a feeler, on the opposite side. The correct clearance is 0,15 to 0,35mm (0.006 to 0.014in)

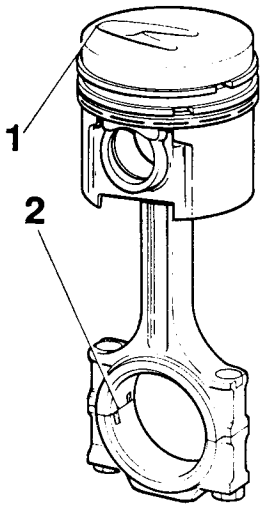


Fig.19 Fitting piston to connecting rod.
1 'V' in crown
2 Shell bearing location

27. The piston must be assembled with the point of the 'V' on the piston crown on the same side as the bearing shell location slots in the connecting rod. Lubricate the gudgeon pin bore in the piston and in the connecting rod.

28. Insert a circlip in one side of the gudgeon pin boss and assemble the piston to the connecting rod with the gudgeon pin. Secure the assembly with a circlip on the opposite side of the piston.

CRANKSHAFT

To remove the crankshaft the engine must first be removed from the vehicle (see engine removal section). It is then necessary to:-

a. Drain the oil, remove the sump and the oil pump.

b. Remove the timing cover (see timing cover section)

c. Remove the flywheel housing (see flywheel housing section)

Note: it is not necessary to remove the cylinder head and withdraw the piston and connecting rod assemblies, although the connecting rod caps will have to be removed. However if a full engine overhaul is being carried out the cylinder head and camshaft will be removed. Then proceed as follows:-

1. Note: the identification number 1 to 4 cast in the main bearing caps which read from the front of the engine; the rear cap is not marked. Remove the main bearing caps and shells and lift out the crankshaft. Collect the bearing shells from the bearing saddles and the end-float thrust washers from the centre saddle.

Crankshaft Inspection

2. Degrease the crankshaft and clear out oil ways, which can become clogged after long service.

3. Examine visually, the crankpins and main bearing journals, for obvious wear, scores, grooves and overheating. A decision at this stage should be made as to whether the condition of the shaft is worth continuing with more detailed examination.

4. With a micrometer, measure and note the ovality and taper of each main bearing journal and crankpin as follows:

5. **Ovality** - take two readings at right angles to each other at various intervals. The maximum permissible taper must not exceed 0,040mm (0.0015 in).

6. **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 0,025mm (0.001 in).

7. 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 0,076mm (0.003 in) taking into account any ovality in the centre journal. The overall allowable wear limit should not exceed 0,114mm (0.0045 in) for main bearing journals and 0,088mm (0.0035 in) for crankpins.

CYLINDER BLOCK EXAMINATION AND OVERHAUL.

1. Carefully remove the four oil jet adaptor assemblies at the base of each bore, making sure the nozzles do not become damaged.

   NOTE:
   a. If these adaptors are removed their retaining 'bolts' must be renewed.
   b. The adaptors are 'handed' and can only be fitted one way.

2. Degrease the cylinder block and carry out a thorough visual examination checking for cracks and damage.

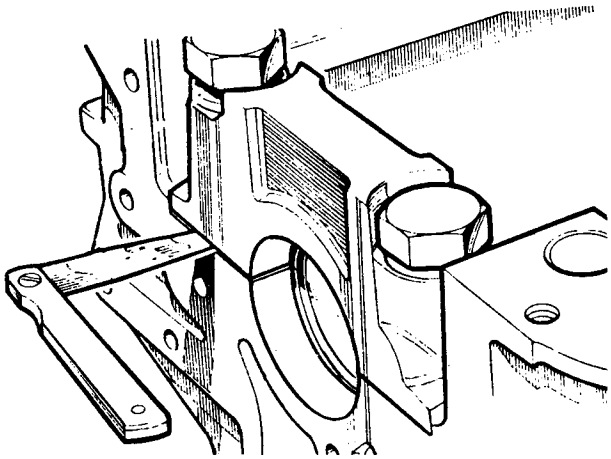


Fig.20 Checking main bearing caps for distortion.

3. To check the main bearing caps and saddles for distortion, fit the main bearing cap without bearing shells and tighten to the correct torque. Slacken and remove the bolt on one side of each bearing cap and check with a feeler gauge that no clearance exists at the joint face between the cap and saddle.

Inspect cylinder bores

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 cylinder gauge for taper.

5. Check the ovality of each bore by taking measurements at the top of the cylinder just below the ridge at two points diametrically opposite. The difference between the two figures is the ovality of the top of the bore. Similar measurements should be made approximately 50mm (2.0 in) up from the bottom of the bore so that the overall ovality may be determined.

6. 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.

7. 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 0,127mm (0.005 in).
   Maximum permissible taper 0,254mm (0.010 in).
   Maximum permissible overall wear 0,177mm (0.007 in).

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

Inspect camshaft bearings

8. The camshaft is supported on four replaceable shell bearings which should be inspected for scoring or pitting.

   Measure the internal diameter of each bearing at several points using an internal micrometer. Take averages and compare them with those of respective camshaft journals to establish the amount of clearance. The bearings should be renewed if the clearance exceeds 0,05mm (0.002 in). If renewal is necessary this work should be entrusted to a line boring specialist.

   On return from repair, check alignment of the oil holes through the bearings and the block, especially the front bearing where a small drilling in the top of the bearing has to align with an oilway which feeds the tappets.

Check crankcase main bearings

9. Discard scored, pitted, cracked and worn bearing shells.

10. To determine the maximum wear, assemble the main bearing shells and caps to the crankcase and tighten the bolts to the correct torque figure.

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

12. The bearing clearances may also be determined by using Plastigage. Since this method requires the crankshaft to be fitted to the crankcase, the procedure is described under engine assembly.

Fit cylinder sleeves

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

13. Machine the cylinder bores to accept the sleeves to 94,425 + 0,012mm (3.7175 + 0.0005 in). This will give the sleeve a 0,076 to 0,114mm (0.003 to 0.0045 in) interference fit.

14. Press the sleeves squarely into the bore using a pressure of two to three tons. Excessive pressure could damage the sleeve and cylinder block. The sleeves must not be proud of the cylinder block top face or more than 2,54mm (0.10 in) below the surface.

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

CYLINDER BLOCK REBUILD.

Tools required: RO 270304, MS 38U3

Fit jet adaptors.

The jet adaptors are fitted to lubricate the pistons and bores directly from the main oil gallery.

NOTE: The adaptor retaining 'bolt' contains a non-return valve, and therefore on no account must an ordinary bolt be used. New 'bolts' must be fitted any time the adaptors are removed.

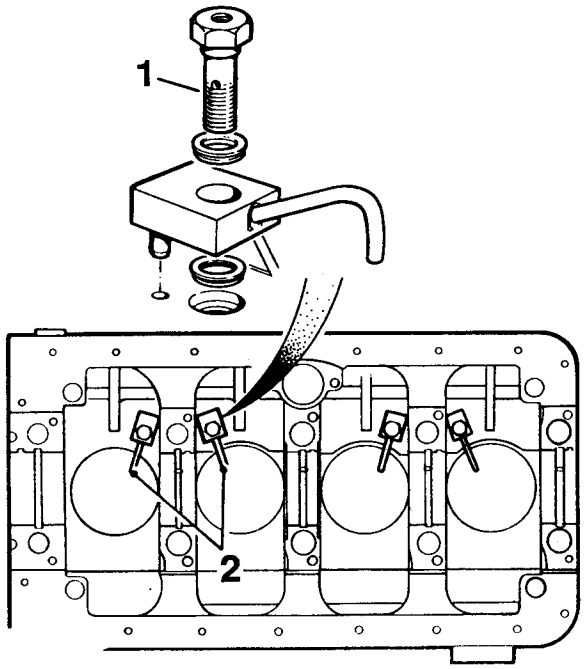


Fig.21 Jet adaptor locations
1 Adaptor retaining 'bolt'
2 Jet adaptors

1. Make sure adaptor locations in the block are thoroughly clean. Use an air line to blow through all the oil passageways.

2. Assemble the adaptors using new 'bolts' and fit the assemblies back into their original locations. Ensure that the larger diameter washer is fitted under the 'bolt' head, and that the dowel pegs locate correctly in the cylinder head.

3. Before tightening the assemblies down, make sure that the squirt pipes will not foul the crankshaft or the pistons. To do this hold the assembly away from the cylinder bore wall to the full extent of the 'bolt' clearance whilst tightening it.

4. The dowels may be a tight fit in their locations. It is important to make sure that each dowel is fully home, and that there is no sideways distortion on the retaining 'bolts'; tighten each 'bolt' as follows:
   a. Tighten the 'bolt'.
   b. Use a tube slightly larger than the 'bolt' to tap the adaptor down onto the cylinder block
   c. Re-tighten the 'bolt'.

5. When the crankshaft and pistons have been fitted, slowly turn the crankshaft to check that no fouling occurs.

Fit crankshaft

Main bearing nip and clearance

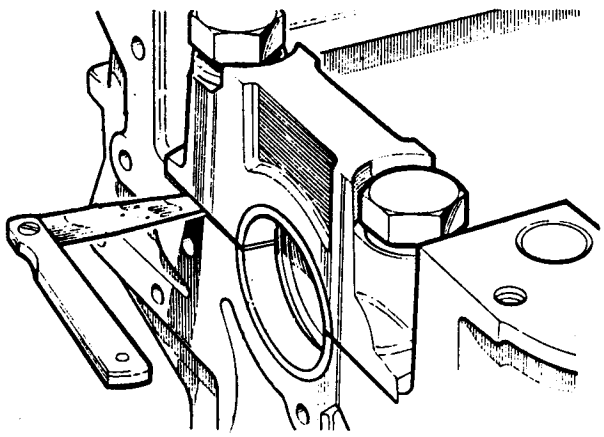


Fig.22 Checking main bearing cap nip.

1. Fit the bearing halves in the crankcase saddles and caps, secure the caps to the crankcase and tighten to the correct torque. Slacken the bolts on one side of the caps only and, with a feeler gauge, check the gap between the joint faces. The clearance or nip must be within 0,10 to 0,15mm (0.004 to 0.006 in). The bearing nip can be adjusted by selective assembly of the bearing halves available in varying thicknesses. Do not file or machine the caps or saddles to achieve the correct clearance. Note that the rear main bearings are wider than the remaining four.

2. To make a final check that the clearance is correct, leave the bearing halves in the crankcase saddles and carefully lower the crankshaft into position. Check each bearing in turn by inserting 0,063mm (0.0025 in) shim paper between the bearing cap and crankshaft journal and tighten the bolts to the correct torque. If the clearance is correct, there should be a slight increase in the resistance to rotation of the crankshaft.

3. Alternative Plastigage method

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

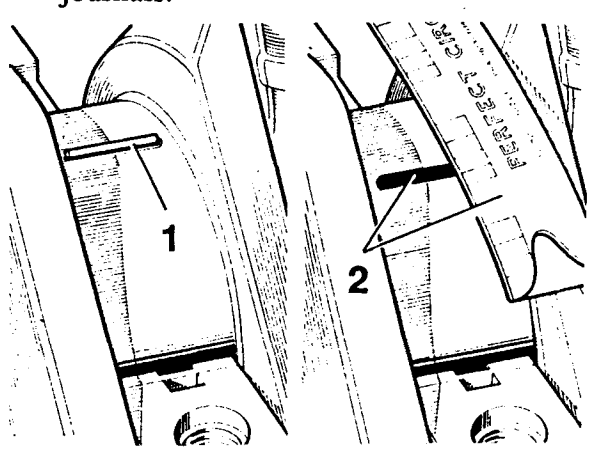


Fig.23 Using Plastigage to measure bearing clearance.
1 Plastigage strip
2 Measuring flattened Plastigage

   Locate the crankshaft in position on the upper bearing halves in the crankcase and wipe any oil from the journals since Plastigage is soluble in oil. Place a piece of Plastigage across the lower half of each crankshaft journal or lower bearing cap shell. Fit the cap and tighten to the correct torque. Remove the cap and bearing and, using the scale supplied with the Plastigage, measure the flattened Plastigage at its widest point. The graduation that most closely corresponds with the width of the Plastigage indicates the bearing clearance.

   The correct clearance with new or overhauled components is included in the Data section. If new bearings are being fitted, use selective assembly to obtain the correct clearance. Wipe off the Plastigage with an oily rag from the journals or bearings. NOTE: Do not attempt to scrape off the plastigage.

Adjust crankshaft end float

Crankshaft end-float is controlled by thrust washers on both sides of the centre main bearing. Oversize thrust washers are available if it is necessary to reduce end-float which is checked and adjusted as follows:-

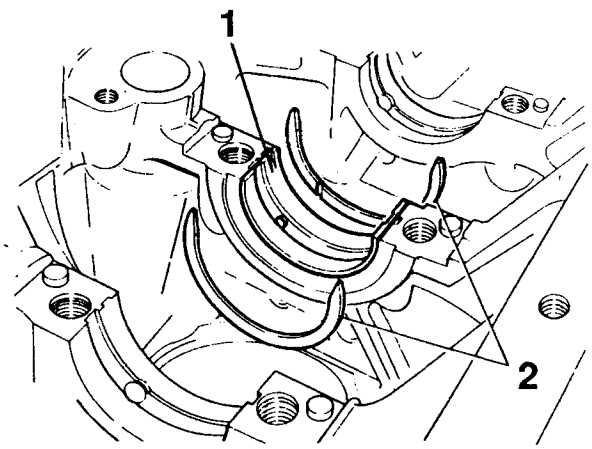


Fig.24 Crankshaft thrust washers.
1 Centre main bearing
2 Thrust washers

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

5. Place the crankshaft in position in the crankcase and mount a dial test indicator to read-off the end of the crankshaft. A feeler gauge may be used instead of an indicator.

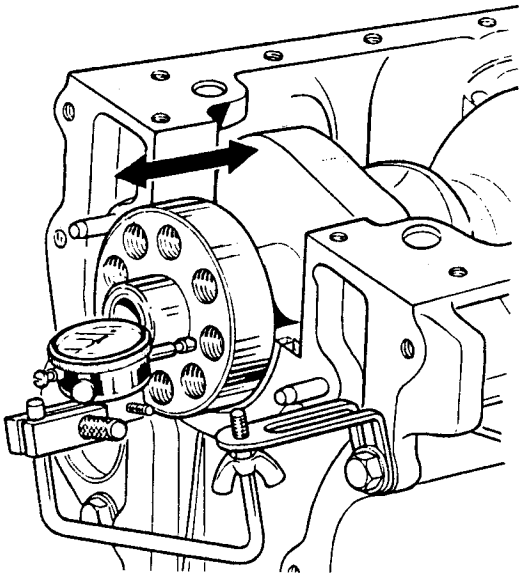


Fig.25 Measuring crankshaft end float.

6. Determine the end-float by moving the crankshaft away from the indicator and zero the dial. Move the crankshaft in the opposite direction and note the indicator reading. Alternatively measure the clearance with a feeler gauge. The end-float should be 0,05 to 0,15mm (0.002 to 0.006 in)

7. If the end-float is excessive, oversize thrust washers are available in four sizes. It is permissible to vary the thrust washer thickness on either side of the crankshaft journal for fine adjustment, but the variation in thickness must not exceed 0,08mm (0.003 in) to ensure that the crankshaft remains centralised.

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

Fit rear main bearing cap

The new main bearing cap locates cork seals in cutaways on either side . It is important that the following procedure is carried out to ensure correct fitment.

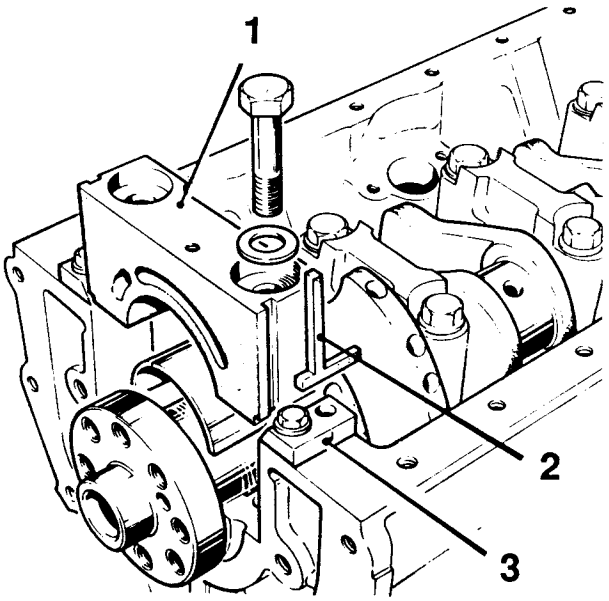


Fig.26 Fitting rear main bearing cap.
1 Rear main bearing cap
2 Cork seal
3 Tool RO 270304

9. Ensure that number five main bearing cap is clean and free from old cork seal material. Attach the two cork seal guides special tool number RO 270304 to the crankcase, as illustrated, and ensure that they are parallel to the crankcase edge. (NOTE: Ref. cork seals, see note after paragraph 12.)

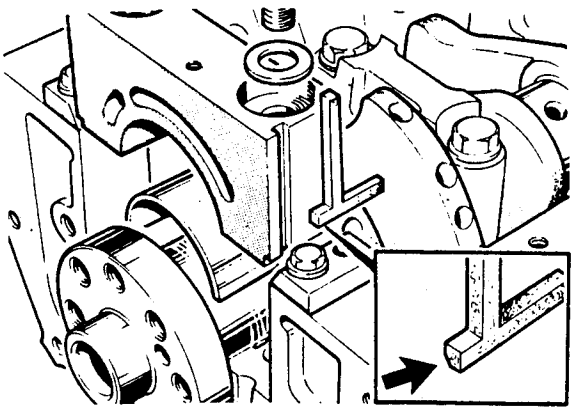


Fig.27 Fitting rear main bearing cap (inset shows chamfer on the cork seal).

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

11. Fit the bearing cap and lower shell to the crankcase and secure with new bolts and washers and tighten to the appropriate torque.

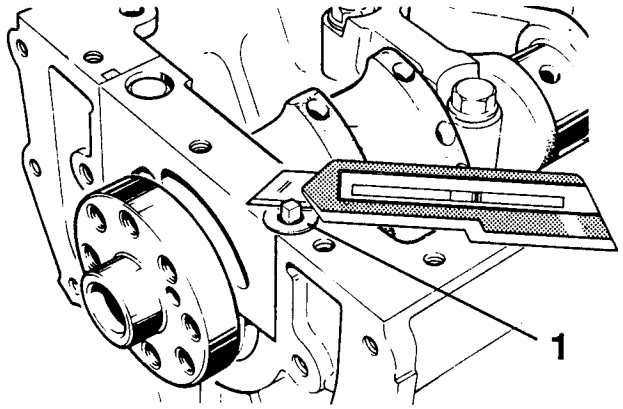


Fig.28 Trimming cork seal.
1. 2mm washer

12. To allow for shrinkage after fitting, leave the cork seals standing proud of the crankcase sump face. If possible delay the fitting of the sump for approximately twelve hours, then trim the seal to protrude by 2mm (0.080in). This can be cut accurately by placing a 2mm washer over the protruding seal, then cut off the seal to the thickness of the washer as illustrated.
Apply Hylomar SQ32M to the protruding end of the seals.

NOTE: From Engine No. 15J 01387 the 'T' cork seals have been deleted and RTV sealant introduced.
RTV sealant can be used on engines prior to 15J 01387 by ensuring the main bearing cap bolts are to the specified torque, discarding the cork seals and pump RTV into the seal area.

Fit the connecting rods and pistons

1. Turn the crankshaft to position numbers one and four crankpins at bottom dead centre to facilitate fitting the connecting-rods.

2. When fitting the connecting-rods and pistons ensure that the bolts do not foul and damage the crankpins. As a precaution it is recommended that rubber or soft plastic sleeves are placed over the threads.

3. The connecting-rod bolts have eccentric heads which locate in a recess in the connecting-rod. It is essential that the head of each new bolt is properly located before tightening.

4. Stagger the compression rings so that the gaps are equidistantly spaced round the piston, but so arranged that no gap is positioned on the thrust side of the piston i.e. opposite the camshaft. Turn the oil control ring so that the gap is in line with the gudgeon pin.

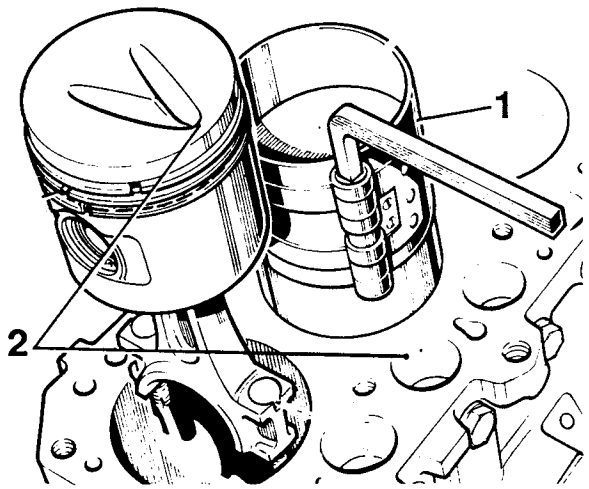


Fig.29 Fitting piston and connecting rod assembly.
1 Tool MS 38U3
2 Piston 'V' pointing to camshaft side

5. Lubricate the cylinder walls, piston rings and crankpins. Compress the piston rings with tool MS 38U3 and carefully lower the connecting rod and piston assembly into the bore.
The pistons must be fitted so that the 'V' in the piston crowns are pointing towards the camshaft side of the engine.

6. Using a soft mallet, sharply tap the piston into the bore so that the whole of the piston is just below the surface of the cylinder block.

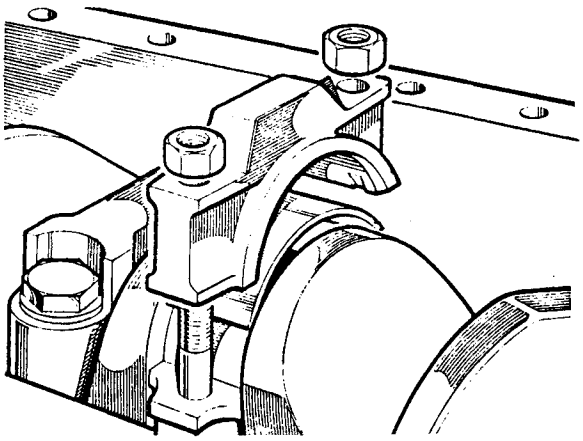


Fig.30 Fitting connecting rod cap.

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

Refit camshaft

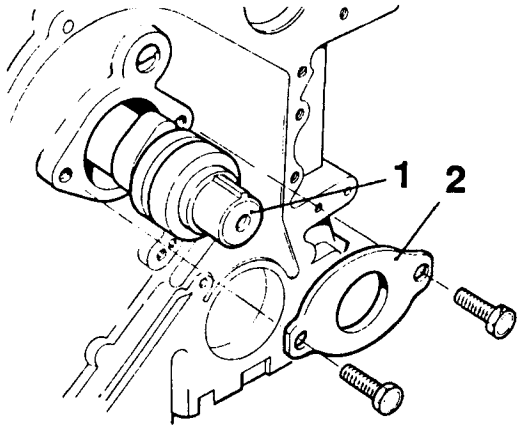


Fig.31 Fitting camshaft.
1 Camshaft
2 Thrust plate

1. Lubricate the camshaft journals, take care when inserting the camshaft into the cylinder block not to damage the camshaft bearing surfaces.

   NOTE: When carrying out this and subsequent operations, do not allow the camshaft to move too far rearwards; it may drop behind its bearing locations.

2. Temporarily secure the camshaft thrust plate with the two bolts. The thickness of the thrust plate governs camshaft end-float which must now be checked.

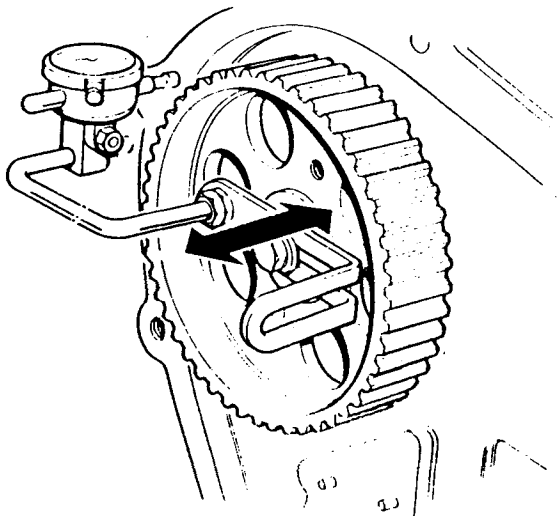


Fig.32 Measuring camshaft end-float.

3. Temporarily fit the camshaft pulley, and mount a dial test indicator as illustrated so that the stylus rests in a loaded condition on the machined face of the cylinder block. Move the camshaft fully back or forward and zero the dial, then move the camshaft in the opposite direction and note the gauge reading; it should be within 0,06 to 0,13mm (0.0025 to 0.0055 in). If the end-float is outside these limits, fit a new thrust plate and recheck the end-float. If it is still excessive, check the pulley and the camshaft for wear and replace as necessary.

4. When the correct tolerance is achieved, remove the test indicator and the pulley and secure the thrust plate with its two bolts.

5. Fit the fuel lift pump using a new gasket.

Fit the skew gear

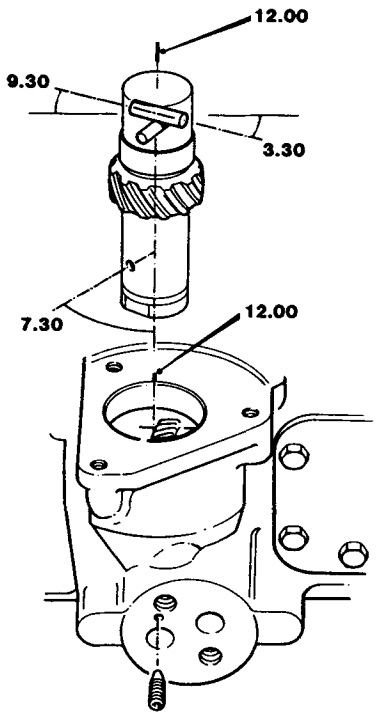


Fig.33 Fitting the skew gear.

1. To fit the skew gear assembly correctly, the locking screw locating hole in the bush must align with the screw hole in the crankcase after the gear has dropped into mesh with the camshaft drive.

   To do this set the crankshaft to the EP position, lubricate the skew gear assembly then hold it above its location and turn until the top bar in the vacuum pump drive is at 9.30/3.30 (clock hands) position. Now turn the bronze tubular bush until the screw locating hole is at the 7.30 position.

2. Carefully lower the gear assembly into position and the hole in the bush will align with the screw hole in the block just before the gear drops fully down.

3. Align the hole if necessary with a thin screwdriver then fit a new locking screw coated with a locking agent. Turn the screw in fully then back it off by 1/2 turn.

Fit the oil pump.

1. Insert the oil pump drive shaft into the oil pump and fit the pump to the crankcase.Tighten the bolts to the correct torque.

2. Fit the oil filter and housing using a new gasket.

Fit the sump.

NOTE: On production engines from engine no. 14J 03093C no sump gasket is fitted, and the sump is sealed by RTV sealant. In service RTV or a gasket may be used and, if using RTV, proceed as follows:

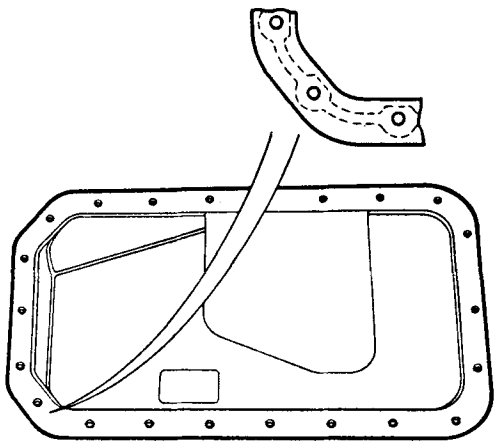


Fig.34 Applying sealant to sump.

1. Clean off all traces of the old sealant from the sump and cylinder block mating faces.

2. Apply a bead of RTV HYLOSIL 102 sealant approximately 7mm (1/4 in) wide to the cylinder block or sump mating face. Ensure the sealant is applied all round each stud hole as shown in the illustration.

3. Fit the sump within 30 minutes of applying the sealant; secure with the bolts and tighten them to the correct torque.

Fit the tappets

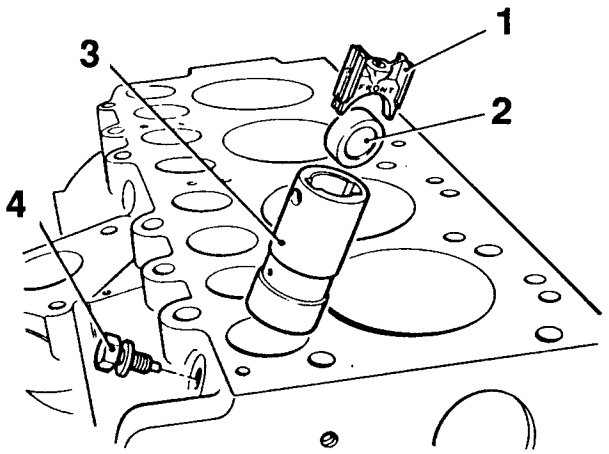


Fig.35 Tappets
1 Tappet slide
2 Roller
3 Tappet guide
4 Guide fixing screw

1. If the same parts are being refitted, ensure that all components are returned to their original positions. Lubricate all parts and make sure the tappet slides move freely in the guides.

2. Fit the tappet guides into the cylinder block, aligning the securing screw locating holes.

3. Fit the tappet rollers ensuring they are the same way round as prior to removal. New rollers may be fitted either way round.

4. Before fitting the tappet slides check that the oilways are clear to the tappet bearing surface, the cross drilling and the oil feed to the push rod.

5. Fit the tappet slides with the marking FRONT towards the front of the engine.

6. Secure the tappet guides with NEW micro-encapsulated screws, and tighten to the correct torque.

7. Refit the vacuum pump using a new gasket; make sure the drive slot locates correctly over the coupling pin.

That completes the rebuild of the cylinder block assembly.

The complete engine rebuild continues by fitting the following: (as detailed in separate sections).

1. *Timing cover, pulleys, timing belt and timing cover plate.*

2. *Flywheel housing, flywheel and clutch.*

3. *Cylinder head assembly.*

CLUTCH

INTRODUCTION

The diaphragm clutch design incorporates a 241 mm (9.5 in) driven plate. The system is operated hydraulically by a direct acting master cylinder to the slave cylinder attached to the clutch housing. A short push rod from the slave cylinder applies leverage to the clutch release fork which pivots on a ball joint inside the clutch housing to engage the clutch via a ball mounted release bearing.

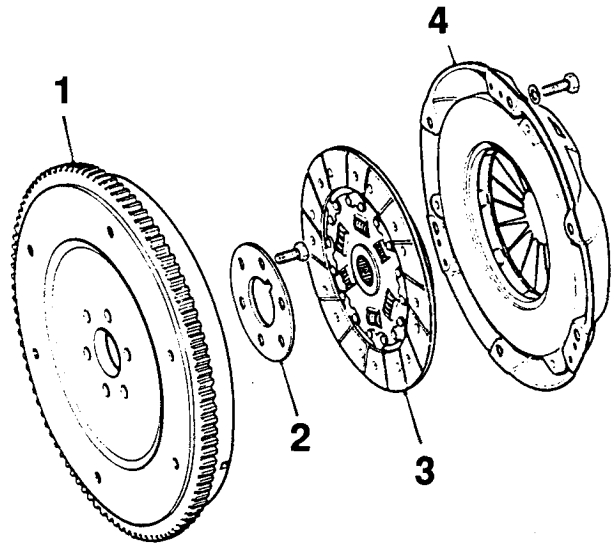


Fig 1 Clutch Assembly
1. Flywheel
2. Reinforcing plate
3. Driven plate
4. Clutch cover

CLUTCH ASSEMBLY

Remove

The clutch can be removed in situ after removing the gearbox, then proceed as follows:

1. Working in a diagonal sequence, slacken the six clutch cover retaining bolts progressively until all spring tension is released.

   NOTE: To maintain engine balance if the cover is to be re-used, make correlation marks on the cover and on the flywheel prior to removal.

2. Remove the six bolts and their spring washers, remove the clutch cover assembly and the clutch driven plate.

Inspect

3. Inspect the clutch driven plate linings for contamination, burning, and excessive or uneven wear. Check the springs for tightness in their locations. Fit the driven plate to the gearbox input shaft and check the hub splines for wear. Renew the clutch plate if necessary.

4. Renew the clutch cover if the diaphragm spring fingers are worn, or if the pressure plate surface shows signs of wear, cracks or burning.

5. Inspect the crankshaft spigot bush and replace if worn.

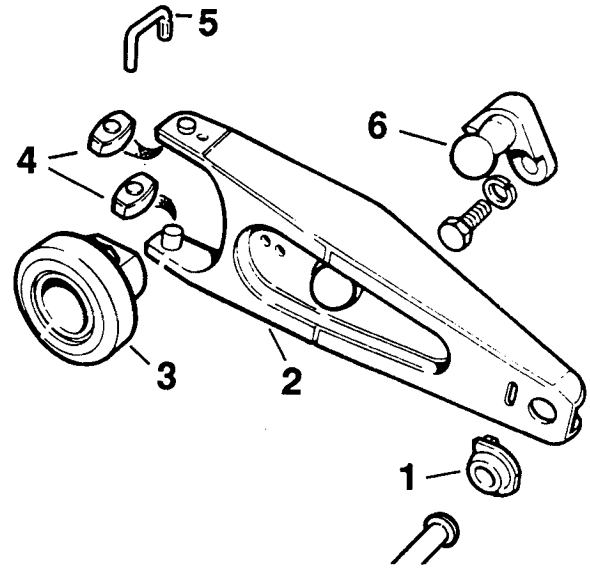


Fig.2 Clutch release mechanism.
1. Push rod retaining clip
2. Clutch operating lever
3. Clutch release bearing and sleeve
4. Slipper pads
5. Staple - operating lever/sleeve
6. Operating lever pivot

6. Examine the release bearing for wear and bearing noise; if it requires replacement proceed as follows:

7. Detach the slave cylinder push rod from its clip.

8. Withdraw the staple locating the release bearing sleeve to the operating lever, then remove the bearing and sleeve assembly. Recover the two slipper pads.

9. Release the operating lever from its pivot, taking care not to strain the retaining spring.

10. Refitting is the reverse of the removal operations, but make sure all moving parts are lubricated with molybdenum disulphide based grease.

Clutch refit

Tool required: RO 605022

11. Using tool RO 605022 to centralise the clutch driven plate, fit the plate to the flywheel. Ensure the spring housing side of the plate is adjacent to the clutch cover assembly.

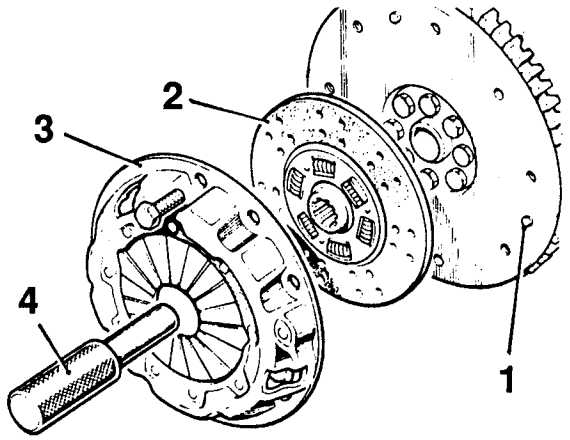


Fig.3 Centralising the clutch plate
1. Flywheel
2. Clutch driven plate
3. Clutch cover
4. Tool RO 605022

12. Position the clutch cover assembly on the flywheel aligning any correlation marks, fit the retaining bolts and tighten them progressively to the correct torque.

13. Remove the centralising tool RO 605022.

14. Ensure the clutch release bearing and push rod are correctly located, then refit the gearbox.

MASTER CYLINDER

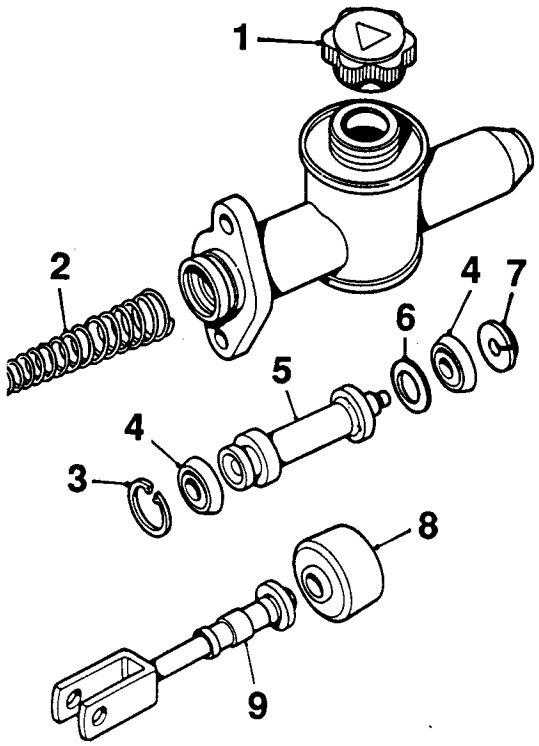


Fig.4 Clutch master cylinder components
1. Reservoir cap
2. Spring
3. Circlip
4. Seal
5. Piston
6. Dished washer
7. Spring retainer
8. Rubber boot
9. Push rod

CAUTION: The fluid used in the clutch hydraulic system is harmful to vehicle paintwork. Care must be exercised when handling hydraulic fluid.

Removal

1. Remove the split pin, washer and clevis pin securing the master cylinder push rod to the clutch pedal.

2. Disconnect the hydraulic pipe from the master cylinder, taking care not to allow fluid to contaminate the vehicle paintwork. Fit plugs to the pipe end and to the master cylinder

3. Remove the two nuts, spring and flat washers which secure the master cylinder to the bulkhead and withdraw the master cylinder.

Overhaul

A seal replacement kit is available and, should it be decided to overhaul the master cylinder, proceed as follows:

4. Pull back the boot from the body and slide it along the push rod, extract the circlip and remove the push rod.

5. Withdraw the piston complete with the secondary seal, the piston washer, main seal, spring retainer and spring from the cylinder body.

6. Remove the secondary seal from the piston by carefully stretching it over the end of the piston, taking care not to damage the piston.

7. Renew the master cylinder assembly if the piston bore is ridged or scored. Otherwise, clean the cylinder body and all internal parts in clean brake fluid. Fit new seals, making sure they are the correct type for the assembly. Check that the inlet and outlet ports are free of obstruction.

8. Fit the secondary seal to the piston with the lip of the seal facing the same direction as the main seal.

9. Insert the piston assembly fully into the cylinder bore; carefully ease the lip edges of the seals into the bore. Fit the push rod assembly and secure with the circlip. Slide the boot on the push rod and fit the boot to the cylinder body.

Refitting

10. To refit, reverse the removal operations, then bleed the system as follows:

Bleeding

11. Thoroughly clean the master cylinder reservoir cap and the slave cylinder bleed screw. Ensure that the master cylinder reservoir is topped up.

12. Attach one end of a bleed tube to the slave cylinder bleed screw and immerse the other end in a transparent vessel containing brake fluid.

13. Slacken the bleed screw approximately three-quarters of a turn. Depress and release the clutch pedal, pausing momentarily at the beginning of each downward stroke, until fluid free of air flows from the tube. Tighten the bleed screw with the pedal depressed.

14. Release the pedal. Care must be taken to ensure that the level of fluid in the reservoir is not permitted to fall to less than half capacity.

15. Remove the bleed tube and top up the reservoir.

SLAVE CYLINDER

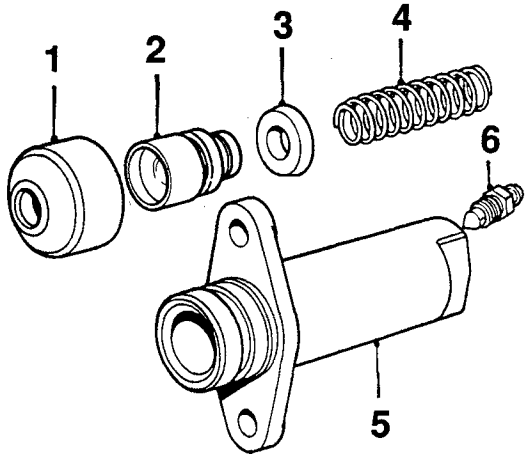


Fig.5 Slave cylinder components
1. Rubber boot
2. Piston
3. Piston seal
4. Spring
5. Slave cylinder body
6. Bleed screw

Removal

1. Raise the vehicle on a lift or jack up and support on suitable stands.

2. Disconnect the fluid pipe from the slave cylinder, and plug the pipe and the cylinder.

3. Remove the two bolts and washers securing the cylinder to the bell housing, and withdraw the cylinder carefully to avoid dislodging the push rod.

Overhaul

A seal replacement kit is available and, should it be decided to overhaul the slave cylinder, proceed as follows:

4. Remove the rubber boot and extract the piston and spring. Remove the seal from the piston.

5. Using clean brake fluid thoroughly clean and examine all components. If the cylinder bore and/or the piston shows signs of scoring or corrosion, renew the slave cylinder.

6. Fit a new seal to the piston ensuring the seal lip is towards the spring, lubricate the piston, seal and cylinder bore with clean brake fluid. Fit the spring to the piston with the smaller diameter coil next to the piston seal. Insert the spring and piston assembly into the cylinder, smear the end of the piston and the inside of a new rubber boot with rubber grease and fit the new boot.

Refitting

7. To refit, reverse the removal operations; then bleed the system as described in the section "Clutch master cylinder."

COOLING SYSTEM

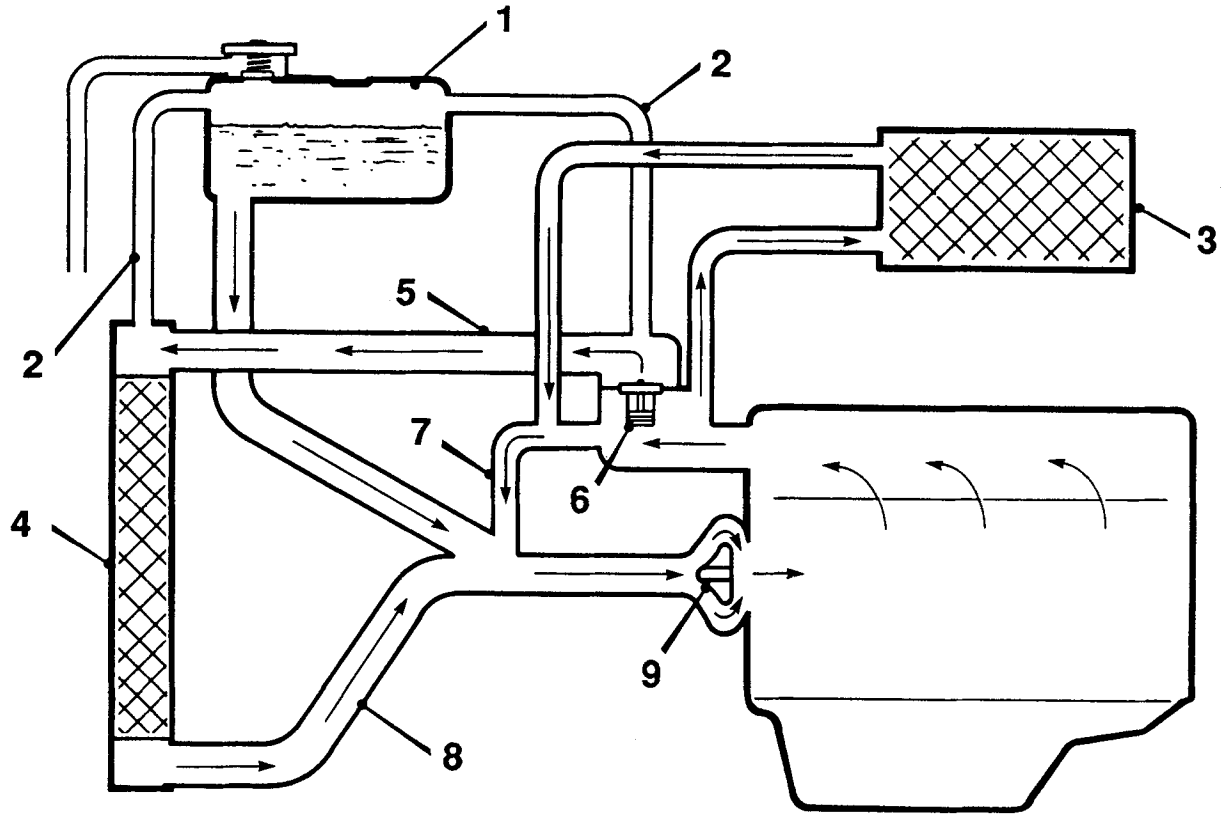


Fig.1 Coolant circulation

1. Header tank.
2. Vent pipes.
3. Heater matrix.
4. Radiator.
5. Top hose.
6. Thermostat.
7. By-pass hose.
8. Bottom hose.
9. Water pump.

CIRCULATION

The cooling system is a pressurized spill return system with thermostatic control. The thermostat is located in a housing fitted to the front of the cylinder head.

Coolant circulation is assisted by a pump fitted to the front of the cylinder block and driven by the fan belt. Cooling is by a cross flow radiator fitted at the front of the vehicle.. Air is pulled through the radiator by a fan fitted to a spindle on the water pump. The fan is mounted on a viscous coupling to reduce engine power loss when the vehicle is moving.

When the system is cold, the thermostat (6) is closed as shown in the illustration. Coolant rises through the engine block into the cylinder head, passes to the underside of the closed thermostat, down the by-pass hose (7) to the water pump (9) and back to the cylinder block.

Coolant can flow to and return from the heater matrix (3) via ports tapped into the thermostat housing, below the thermostat.

When the coolant reaches the thermostat opening temperature it will open, and allow coolant to pass along the top hose (5) to the cross-flow radiator (4). Coolant cooled by passing through the radiator, returns to the block via the bottom hose (8) and the water pump.

The system is filled with coolant from the header tank (1). There are two vent pipes (2) into the header tank to allow air to bleed from the system; one from the top of the thermostat housing and the other from the top of the radiator.

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PRESSURE TEST

1. Warm the cooling system to normal running temperature, stop the engine and remove the expansion tank cap very carefully to release the pressure slowly. Top up the coolant if necessary.

   WARNING Place a thick cloth over the cap and expansion tank before attempting to remove the cap, to avoid the possibility of scalding if the engine is hot.

2. Fit the pressure tester to the expansion tank, and pump up to the pressure indicated on the expansion tank cap.

   CAUTION Do not exceed the indicated pressure.

3. Observe the gauge on the tester and check that pressure is held for a minimum of 10 seconds. If the pressure drops, examine all areas affected by the cooling system for leaks. e.g. cylinder head gasket, hoses and their connections, heater pipes and matrix, radiator, etc.

   If the pressure drops but there are no visible signs of leakage, then an internal leak such as a cracked cylinder head or leaking cylinder head gasket must be suspected. In this case examine the oil on the dipstick for water contamination.

   If any leaks are evident as a result of the pressure test, rectify as required.

4. Test the expansion tank cap by cleaning it and fitting it to the tester. Pressurize with the tester and check that the cap 'blows off' at the pressure indicated on it.

   Check that it will hold the indicated pressure; if the pressure drops, suspect the vacuum valve in the centre of the cap.

COOLANT

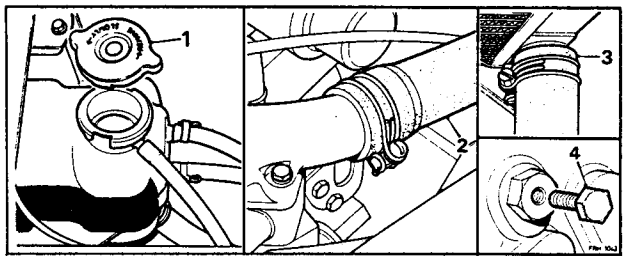

Fig.2 Coolant draining
1. Pressure relief cap
2. Top radiator hose
3. Bottom radiator hose
4. Cylinder block drain plug

Drain and Refill

1. Remove the pressure relief cap from the expansion tank.

   WARNING Place a thick cloth over the cap and expansion tank before attempting to remove the cap, to avoid the possibility of scalding if the engine is hot.

2. Position a container to collect the coolant if it is to be re-used, and disconnect the bottom hose.

3. Drain the cylinder block by removing the cylinder block drain plug located on the left hand side of the engine adjacent to the dipstick tube. Deflect the coolant away from the starter motor.

4. After draining, flush the system through with water if necessary.

5. Refit the drain plug and connect the bottom hose. Slowly fill the system through the expansion tank with 50% anti-freeze solution, and fit the pressure relief cap.

6. Run the engine until normal operating temperature is reached and examine for leaks. Rectify as necessary.

7. Stop the engine and allow the system to cool. Recheck the coolant level.

NOTE Ensure that the specific gravity of coolant anti-freeze content is maintained.

THERMOSTAT

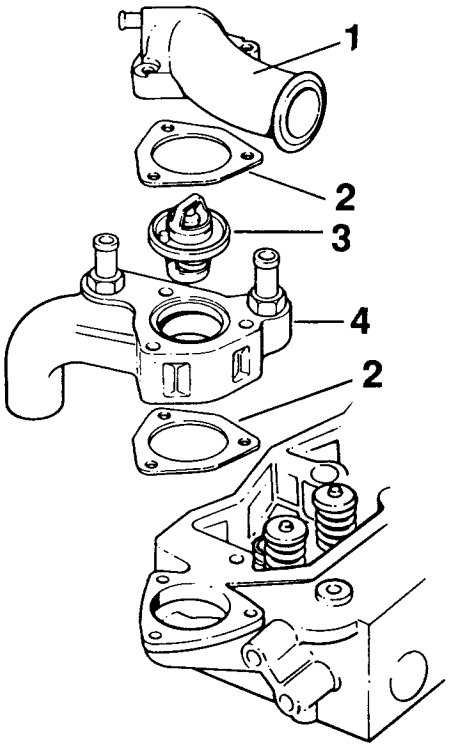

Fig.3 Thermostat housing
1. Outlet pipe
2. Gasket
3. Thermostat
4. Thermostat housing

Remove

1. Disconnect the battery and drain the cooling system.

2. Disconnect the hoses at the water outlet pipe.

3. Remove the bolts securing the outlet pipe to the thermostat housing. Lift away the outlet pipe.

4. Withdraw the thermostat.

Test

5. Place the thermostat in a container of water.

6. Heat the water and note the temperature at which the thermostat commences to open; this is stamped on the thermostat. Renew the thermostat if it does not open at approximately the stamped temperature, or if it is stuck in the open position.

Refit

7. Clean all traces of the old gasket from the mating faces of the thermostat housing and the outlet pipe, then fit the thermostat in the housing.

8. Smear both sides of a new joint gasket with grease and locate on the housing.

9. Fit the water outlet pipe and secure with the bolts, then refit the hoses.

10. Fill the cooling system and check the anti-freeze concentration, replenishing if necessary. Reconnect the battery. Run the engine until normal operating temperature is reached and top up if necessary. Check for leaks.

FAN UNIT

Remove

Tool required: MS 1517

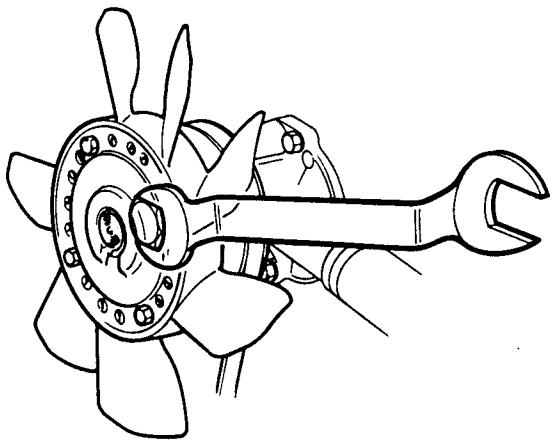

Fig.4 Using tool MS1517 to release the fan assembly

1. Disconnect the battery.

2. Remove the fan and viscous coupling assembly by using tool MS 1517 to release the hub nut.

   NOTE The hub nut has a left hand thread

3. Remove four bolts to dismantle the fan blades from the viscous coupling

Refit

4. Refitting is the reverse of the removal operations, but apply Loctite on the fan hub threads before fitting.

WATER PUMP

Tool required: MS 1517

Remove

1. Drain the cooling system and disconnect the battery.

2. Use tool MS 1517 to release the viscous fan coupling hub nut, then remove the fan and viscous coupling assembly.

   NOTE The hub nut has a left hand thread

3. Slacken the alternator adjusting link screw and the alternator pivot bolts, and remove the fan belt.

4. Disconnect the coolant hoses at the pump.

5. Remove the water pump, noting the position and length of the pump fixing bolts.

Refit

6. Clean the joint faces, position a new joint gasket and fit the pump, making sure the differing length bolts go in their correct locations.

7. Connect the hoses.

8. Fit the fan belt and adjust the alternator to give the correct fan belt tension.

9. Apply Loctite on the fan hub threads then fit the fan and viscous coupling assembly (hub nut has left hand thread). Tighten the hub nut with tool MS 1517.

10. Refill the cooling system and reconnect the battery.

11. Start the engine and warm to normal running temperature. Top up the coolant if necessary. Examine the system for any signs of leakage.

RADIATOR

Remove

1. Disconnect the battery and drain the coolant.

2. Remove the bonnet, grille panel and bonnet lock platform.

3. Disconnect the coolant hoses at the radiator, and lift the radiator off its lower mountings.

Refit

4. Refitting is the reverse of the removal operations. Then fill the system and check the anti-freeze concentration, replenishing if necessary. Run the engine to normal running temperature and top up if required. Check for leaks in the system.

FUEL SYSTEM

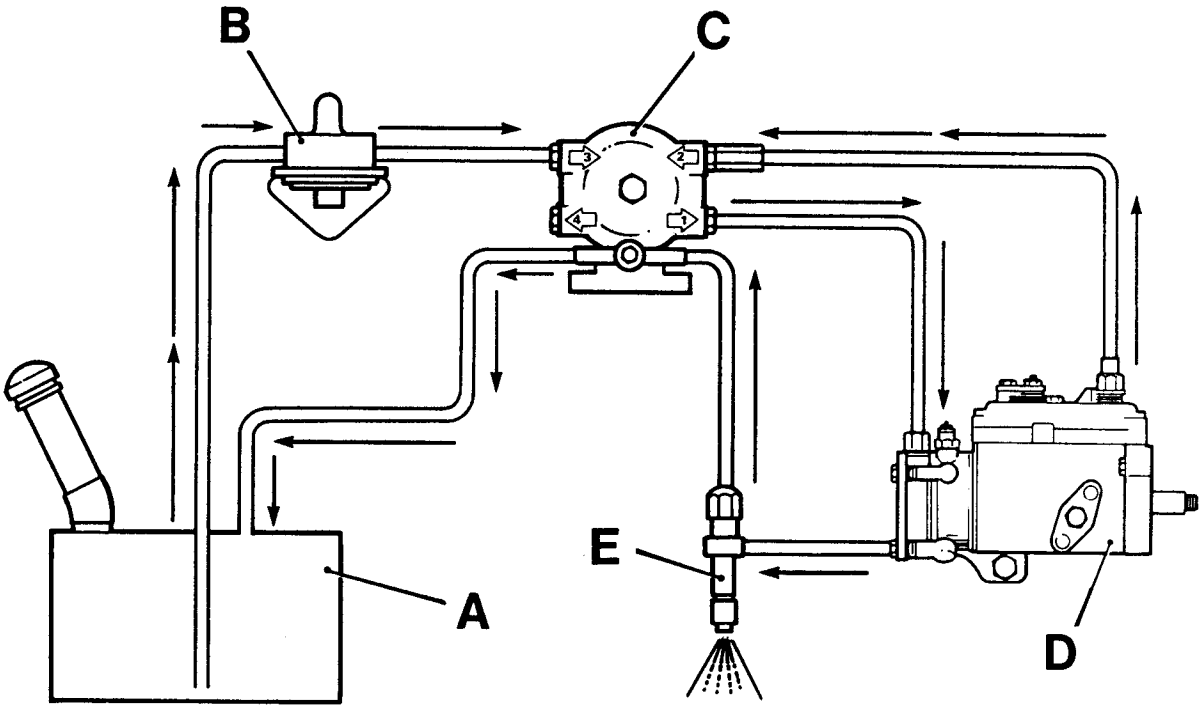

Fig 1 Fuel system layout
A. Fuel tank
B. Lift pump
C. Filter
D. Injection pump
E. Injector

OPERATION

The mechanical fuel lift pump 'B' operated by a lobe on the camshaft, draws fuel from the fuel tank 'A'. This fuel enters the filter 'C' at connection No 3 in the head, passes through the filter element and out through connection No 1. The filtered fuel is delivered to the injection pump 'D' at approximately 0.42 kg/cm^2 (6lb/in^2) and this pressure is boosted inside the unit by its transfer pump to approximately 2.5 kg/cm^2 (35 lb/in^2). This pressure ensures that the fuel circulates inside the injection pump to lubricate all the working parts.

The fuel used to lubricate the pump returns to the filter head at connection No 2 via a one-way valve.

A very much higher fuel pressure is required from the injection pump to open the injectors 'E', which occurs at 135-140 atmospheres.

The pump is driven by a toothed belt from the engine crankshaft and delivers fuel to the injectors in metered quantities dependant on throttle position and engine speed.

Excess fuel from the injectors passes along the spill return to a banjo connection on the top of the filter 'C'; and from the same connection excess fuel in the system returns to the fuel tank 'A'.

INJECTORS

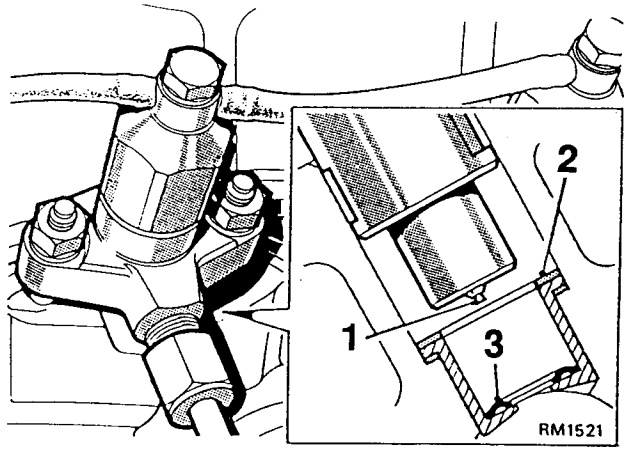

Fig 2. Injector seals
1. Injector
2. Copper washers
3. Steel washers

Remove

1 Slacken the injector feed pipes at the injection pump and disconnect the pipes at the injectors.

2. Disconnect the spill rail from the injectors.

3. Remove the nuts and washers securing the injectors and withdraw the injectors.

4. Remove the two sealing washers from each injector position.

Overhaul

Tools required: 18G 109E, 111, 18G 210

5. Remove the cap nut and sealing washer.

6. Unscrew the pressure adjusting screw and withdraw the pressure spring and valve spindle.

7. Unscrew the nozzle nut using 18G 210, and withdraw the nozzle valve and body.

NOTE: Retain the components of each injector in sets, do not interchange parts.

8. Soak the components in Shell Calibration Fluid to loosen carbon deposits, then carefully clean the nozzle and valve. Reverse flush the nozzle using tool 18G 109E.

9. Examine all components for excessive wear or damage; renew any defective parts.

10. Rebuild the injector in the reverse procedure to the dismantling.

11. Test and adjust the injector as follows:

WARNING: The injection nozzle must not be allowed to point towards the operator when spraying, and the hands must never be allowed to contact the spray which has great penetrating force.

a. Fit the injector to the test equipment,tool 111.

b. Adjust the injector to open at 135 atm.by screwing the pressure adjusting screw clockwise to increase pressure or anti-clockwise to reduce pressure. Check that the auxilliary and main spray patterns are satisfactory.

c. Increase the injector pressure to open at 160-170 atm. Carry out a timed pressure drop test from 150 atm down to 100 atm. This should be not less than 5 seconds for the original nozzle, or 7 seconds for a new nozzle, and not more than 36 seconds for either with oil at 10° to 21° C (50° to 70°F).

d. Readjust the injector to open at 135 atm.,and allow the pressure to return to zero. Wipe the bottom face of the injector nozzle, then slowly raise the pressure to 125 atm and examine the bottom face. A slight dampness is permissible, but any blob formation or dripping indicates a badly seated valve which must be rectified.

Refit

12. Locate a new steel sealing washer into the injector bore, with the raised corrugation uppermost. (A piece of welding wire or a thin bladed screwdriver may be helpful to guide the washer into its correct position.)

13. Apply a light coating of grease to the copper sealing washer and position it in the injector bore. Fit the injector, secure with the nuts and washers and progressively tighten the nuts to the correct torque.

14. Refit the spill rails and injector feed pipes.

15. Start the engine and check for leaks.

INJECTION PUMP

The camshaft and the injection pump are both timed using a specific exhaust valve peak position of number one cylinder; this is known as the 'E.P' position.

The 'E.P' position is determined by a mark on the crankshaft pulley being aligned with a mark on the timing cover plate or, more positively, by a slot in the flywheel being aligned with a hole in the flywheel housing. A special tool LST 107 is used to align the flywheel position.

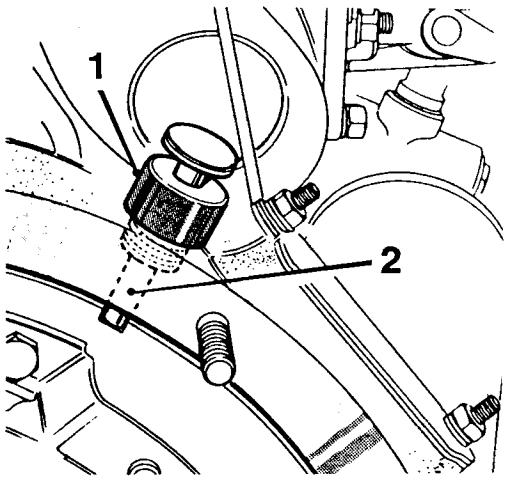

Fig 3 Timing pin LST 107 fitted to flywheel housing
1. LST 107 body
2. LST 107 pin

To use LST 107, locate the body of the tool in the hole in the flywheel housing and turn the engine over until the tool pin drops into the slot in the flywheel. Check that number one exhaust valve is fully open; if so, the engine is now correctly at the 'E.P' position for timing purposes. If No. 1 exhaust valve is not open, turn the crankshaft one complete revolution and realign the 'EP' position with tool LST 107.

WARNING: Do not attempt to turn the engine with tool LST 107 in place, as the tool will be damaged beyond repair.

Remove

Tools required: 18G 1457, LST 107

1. Disconnect the battery.

2. Turn the engine to the 'E.P' position with No. 1 exhaust valve fully open.

3. Disconnect and remove the fuel injection pipes.

4. Disconnect the fuel inlet and return pipes.

5. Release the throttle cable and disconnect the stop solenoid cable.

6. Remove the engine vacuum pump to release the injection pump rear mounting bracket.

7. Remove the rubber plug from the timing cover plate.

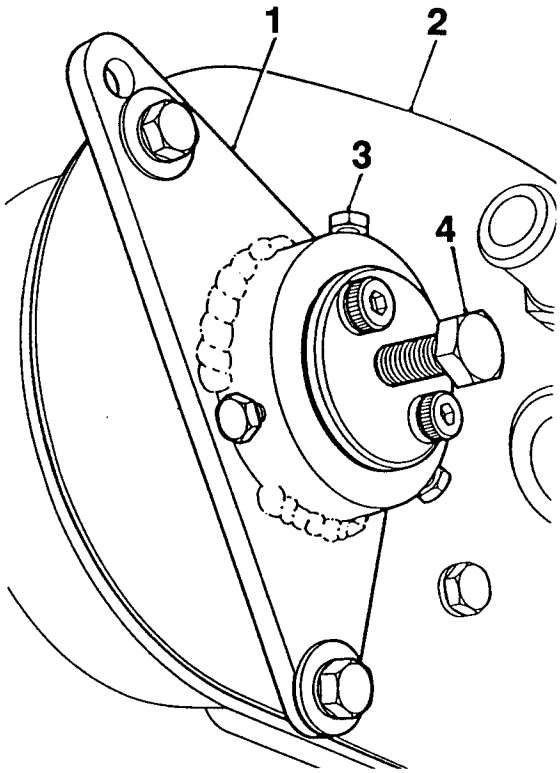

Fig 4 Tool 18G 1457 in position
1. 18G 1457
2. Timing cover plate
3. Attaching screws
4. Centre bolt

8. Remove the injector pump pulley nut; screw the centre bolt of tool 18G 1457 outwards then fit the tool as illustrated. The attaching screws must be tightened progressively and evenly to ensure the pulley cannot turn.

   NOTE: DO NOT rotate the engine after this point until the pump is refitted securely and the tool is removed.

9. Remove the three nuts and washers which secure the pump to the timing cover.

10. Use the centre bolt of tool 18G 1457 to push the injection pump rearwards free of its pulley, then lift the pump clear. Screw the tool centre bolt outwards.

Refit

Tools required: 18G 1457, 18G 1458, LST 107

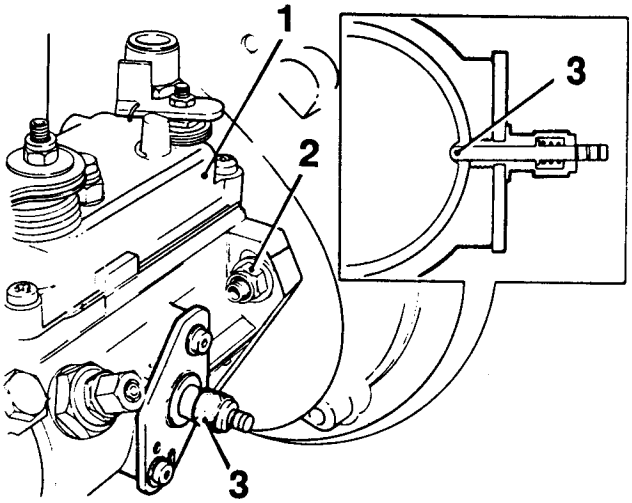

Fig 5 Tool 18G 1458 in position
1. Fuel injection pump
2. Pump securing nut
3. Tool 18G 1458

11. Clean the injection pump and timing cover faces.

12. Remove the blanking plug from the injection pump casing and fit timing tool 18G 1458 as illustrated. Turn the pump drive shaft until the spring loaded plunger of the tool drops into the groove in the pump.
    The pump is now timed to the 'E.P' position.

13. Offer up the pump to the timing cover aperture, ensuring that the drive shaft key and the pulley keyway are aligned. Loosely secure the pump to the timing cover with three nuts and washers.

14. Remove tool 18G 1457 and fit the pump pulley securing nut, tightening it to the correct torque. Refit the timing cover plate rubber plug.

15. Check that the engine is still at the 'E.P' position, then rotate the pump slightly in clockwise and anti-clockwise directions whilst observing the plunger of timing tool 18G 1458, until the plunger is in its maximum inward position. Tighten the three pump securing nuts.

16. Remove flywheel timing pin tool LST 107, remove pump timing tool 18G 1458 and refit the blanking plug.

17. Refit the vacuum pump with new gaskets, at the same time securing the pump rear mounting bracket.

18. Refit the throttle cable, ensuring that the pump mechanism is up against the anti-stall screw. Refit the stop solenoid cable.

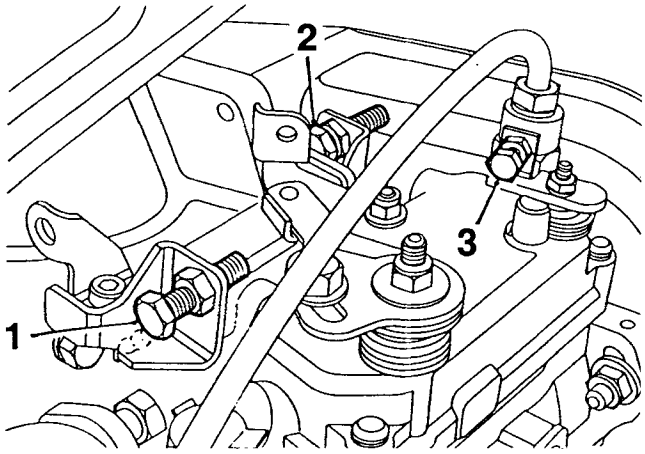

Fig 6 Injection pump adjusting points
1. Maximum speed screw
2. Anti-stall screw
3. Idling speed screw

19. Reconnect the fuel inlet and outlet pipes and refit the fuel injection pipes.

20. Reconnect the battery and start the engine. If the engine fails to start, bleed the system.

21. When normal running temperature has been reached, check the idle speed and adjust the idle speed screw if necessary.

FUEL LIFT PUMP

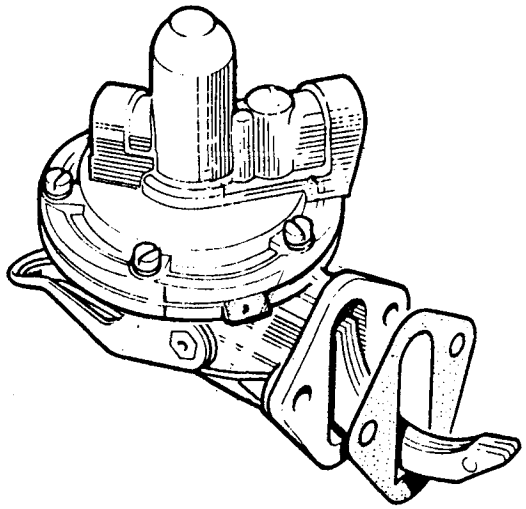

Fig 7 Fuel lift pump.

Remove

1. Disconnect the fuel pipes at the pump.

2. Remove the fixings and withdraw the pump from the engine.

Overhaul

1. Mark the upper and lower halves of the pump casing to ensure correct alignment on reassembly. Remove the top half securing screws and, while pressing the diaphragm tab against the pump body, lift the top clear.

2. Ease the diaphragm from the body, slightly depress the metal part of the diaphragm and turn through 90° to allow the spring to push the diaphragm clear.

3. File the peening marks from the oil seal housing, lever out the seal and retainer.

4. Remove the rocker arm retainers, rocker arm, rocker arm pin and washers. Detach the operating link and withdraw the spring.

5. Inspect all parts for damage, wear or corrosion, renew the diaphragm assembly if any sign of hardening, cracking or porosity is present.

6 Locate the spring and operating link, fit the rocker arm, rocker arm pin and washers and the retainers.

7. Fit a new oil seal and retainer, peen the retainer to secure the seal.

8. Locate the diaphragm assembly into the body and lock by turning the assembly 90°.

9. Place the top cover in position and align the marks made before dismantling. Fit the securing screws but do not tighten; using the hand priming lever, fully depress the diaphragm then tighten the securing screws.

Refit

1. Position the pump and gasket on the engine and secure with the nuts and washers.

2. Reconnect the fuel suction pipe and prime the pump with the hand lever; then fit the pressure pipe.

FUEL FILTER

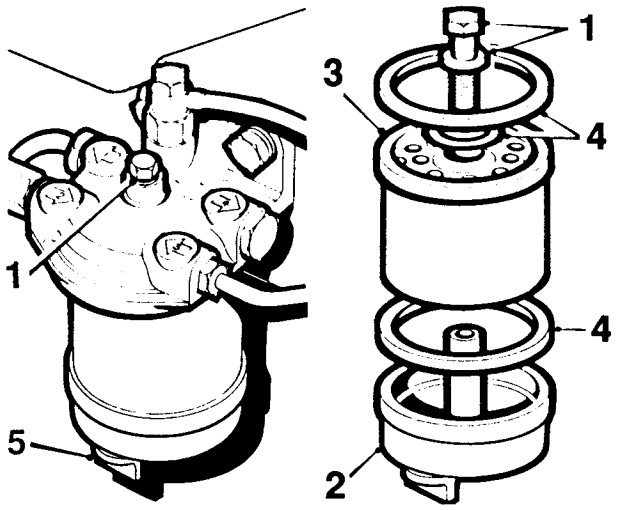

Fig 8 Fuel filter.
1. Centre bolt and washer
2. Base
3. Element
4. Sealing washers (three)
5. Drain plug

Element renewal

1. Drain the filter (latest vehicles have a drain plug in the base). Support the filter base and remove the centre bolt and plain washer.

2. Detach the base and twist the element to remove it from the filter head.

3. Remove the three sealing washers from the head and base.

4. Clean the filter base, and reassemble the unit using a new filter element and sealing washers. Make sure the sealing washers are correctly positioned.

BLEEDING

The system will self-bleed if minor disconnections to pipe lines etc., have only introduced small amounts of air to the system. However a major change, eg. injection pump replacement, or in any case if the battery is not fully charged, the system may require bleeding as follows:

1. Make sure there is adequate fuel in the fuel tank (check by dipping if in doubt), and check all pipes and connections for leakage. Check that the ignition switch is off.

2. Operate the fuel lift pump priming lever to check that a full stroke can be felt: if not, turn the engine over by hand to reposition the camshaft and allow a full stroke.

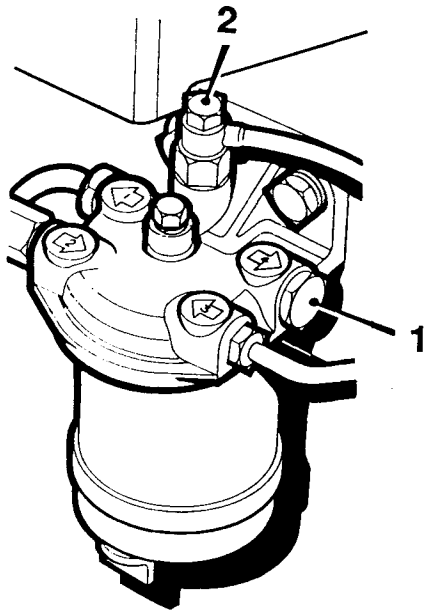

Fig 9 Fuel filter
1. Blanking plug
2. Spill return banjo bolt

3. Place a clean tray beneath the fuel filter to catch vented fuel and loosen the blanking plug at No 4 port in the filter head by approximately one and a half turns. Operate the lift pump priming lever to prime the system until air-free fuel is seen to flow from the plug. Tighten the plug.

4. Loosen the spill return pipe banjo bolt in the filter head. Operate the lift pump priming lever again until air-free fuel is seen to flow, then tighten the bolt.

5. Place the tray beneath the injection pump. Loosen the pump inlet pipe connections, and operate the lift pump priming lever to expel all air before tightening the connection.

6. Crank the engine using **NO** throttle until the engine fires and runs.

   CAUTION: To avoid damage to the starter motor and to prevent rapid discharge of the battery, crank the engine for 6 second periods only; then allow a further 6 seconds to elapse before cranking again.

7. If the engine fails to start, loosen the vent screw on the injection pump. Turn on the ignition and operate the lift pump priming lever until air-free fuel flows from the vent screw. Tighten the screw and start the engine.

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HEATER PLUG SYSTEM

Introduction

Two systems are used on vehicles fitted with the 2.5 Diesel engine, and are not interchangeable with one another. One system is fitted to 285, 310 and 350 models, while a Micronova system is fitted to models designated 300 Series.

285, 310, 350 Models.

Starting Procedure

Engine Cold.
Turn the key to position 'II' to switch on the heater plugs; the orange warning light will glow until the heater plugs are hot.

The time lapse before the heater plugs are hot will normally be 10-15 seconds but in extremely cold conditions, the time lapse will be 25-30 seconds.

When the heater plugs are hot, operate the starter. DO NOT depress the accelerator pedal.

Check that the red no charge and oil pressure warning lights are extinguished when the engine is running.

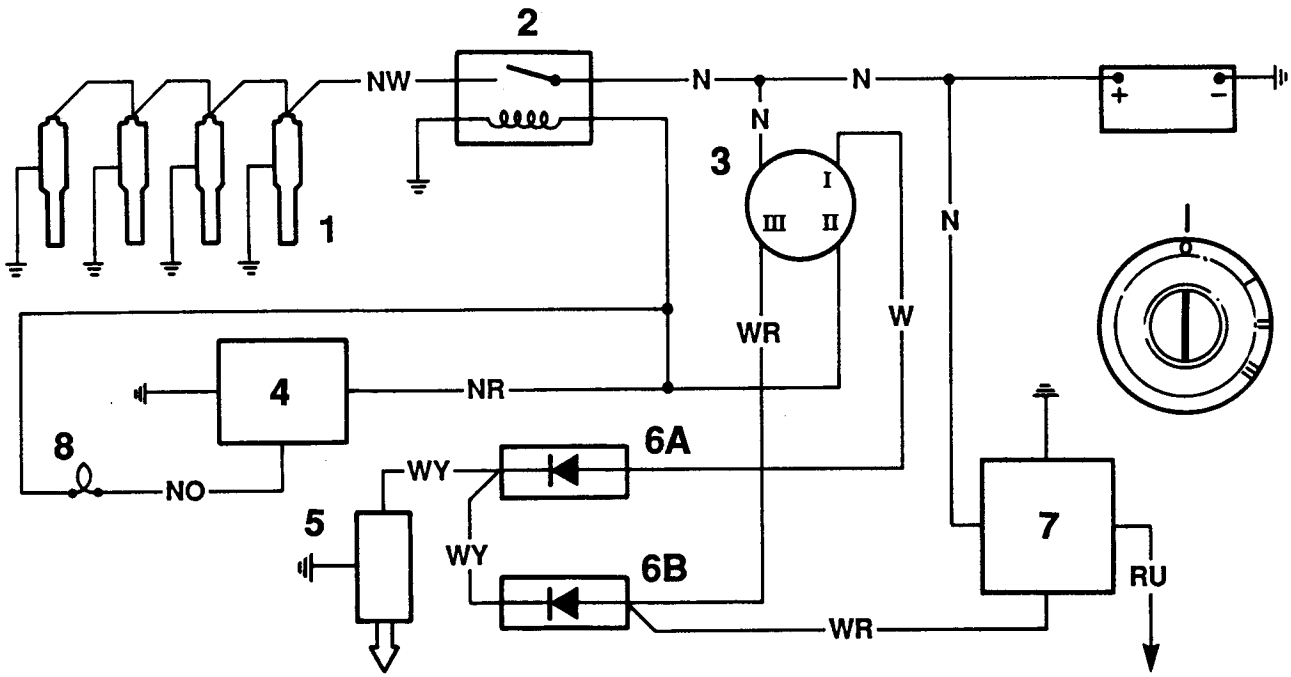

Fig.1 Heater plug circuit.

Key to diagram
1 - Heater plugs
2 - Heater plug relay
3 - Ignition switch
4 - Heater plug warning light unit
5 - Fuel cut-off solenoid
6 - Blocking diodes
7 - Starter relay
8 - Heater plug dash light

Wiring colour codes
N - Brown
NO - Brown/Orange
NR - Brown/Red
NU - Brown/Blue
NW - Brown/White
W - White
WR - White/Red
WY - White/Yellow

System Components.

The components of the heater plug system are as follows:-

1. **The Heater Plugs.**
The heater plugs are located in the engine cylinder head and they require a time of approximately 15 seconds to reach normal temperature. As will be seen from the wiring diagram, the heater plugs are connected in parallel, so if one heater plug fails open circuit the other three will continue to operate.

2. **Heater Plug Relay.**
A "Black Box" located on the near side front bulkhead, having four wires attached to it. (see wiring diagram)

This relay is switched by the driver operation of the ignition switch key, and, when energised, switches on the heater plugs.

3. **Ignition Switch.**
Doubling as the steering column lock and "Ignition" switch, this unit is key operated by the driver.

The switch has four positions as follows:-

POSITION O
Steering locked - All ancilliary circuits switched off.

POSITION I
Steering unlocked - Normal engine run position - Auxiliary circuits switched on.

POSITION II
Key must be held against spring loading - in this position heater plugs are on at all times.

POSITION III
Key must be held against spring loading - Engine start position - the key, when released will return to position I.

4. **Heater Plug Warning Light Unit**
A "Black Box" located on the nearside front bulkhead, having three wires attached to it. (see wiring diagram)

This unit is basically a timer to indicate to the driver when the heater plugs are hot enough to enable the engine to start. It does this by illuminating the heater plug dash light when the ignition switch is turned to position II. Holding the key in this position, after approximately fifteen seconds, the heater plug dash light will be switched off by the heater plug warning light unit. The heater plugs will not be switched off by this unit, only the dash light, so if the ignition switch is held in position II after the dash light has gone out, the heater plugs will still be operating.

5. **Fuel Cut-off Solenoid.**
The fuel cut-off solenoid is situated in the transfer pump housing of the fuel injection pump, the engine can run only when the unit is energised. When the ignition switch is turned off, spring pressure returns a plunger, which blocks the fuel passage between the fuel injection pump transfer pump and the metering valve, thereby stopping the engine.

6. **Blocking Diodes.**
Two diodes, shown on the wiring diagram as 6A and 6B are taped to the wiring harness below the heater plug relay and heater plug warning light unit. One diode, 6A, is used to energise the fuel cut-off solenoid in ignition switch positions I and II, the other diode, 6B, is used to energise the fuel cut-off solenoid whilst the engine is cranking.

7. **Starter Relay.**
The starter relay is located on the nearside bulkhead between the heater plug relay and heater plug warning light unit. The starter relay is a bright anodised colour.

It is energised when the ignition switch is in position III, this relay in turn energises the starter motor solenoid.

8. **Heater Plug Dash Light.**
The heater plug dash light is located in the fascia, and is operated by the heater plug warning light unit. It is fitted with an orange lens with a coiled wire symbol.

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System Operation.

A brown wire, permanent live feed, goes from the vehicle battery positive terminal to the ignition switch, heater plug relay and starter relay.

The following diagrams will assist in understanding the system operation. The heavy lines indicate live wires.

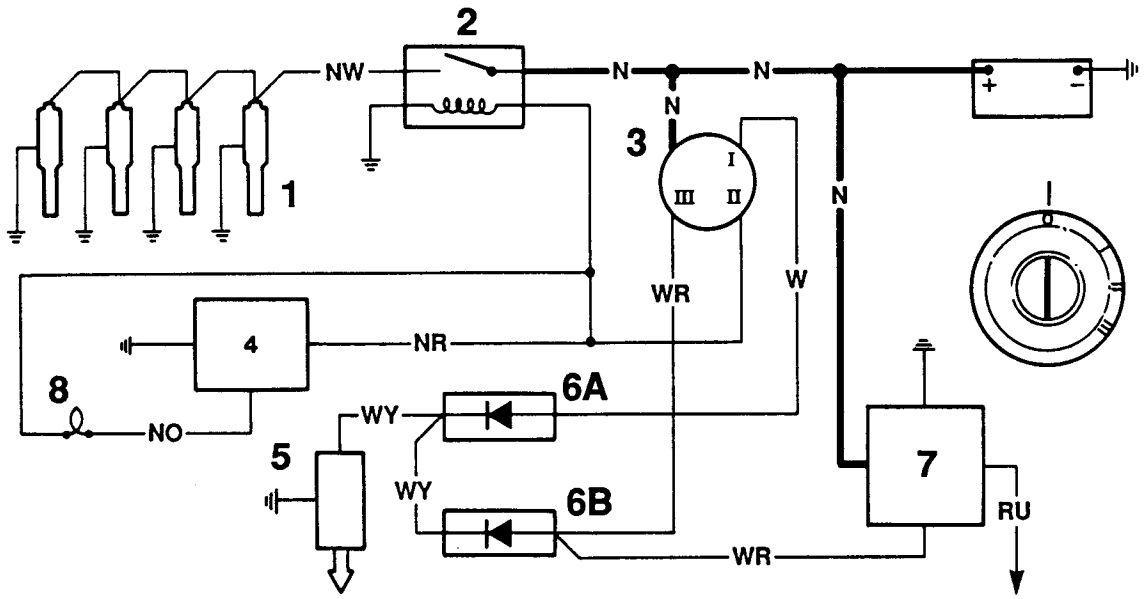

Fig.2

IGNITION SWITCH POSITION 0 (see Fig.2)
Steering locked, nothing is energised from the ignition switch.

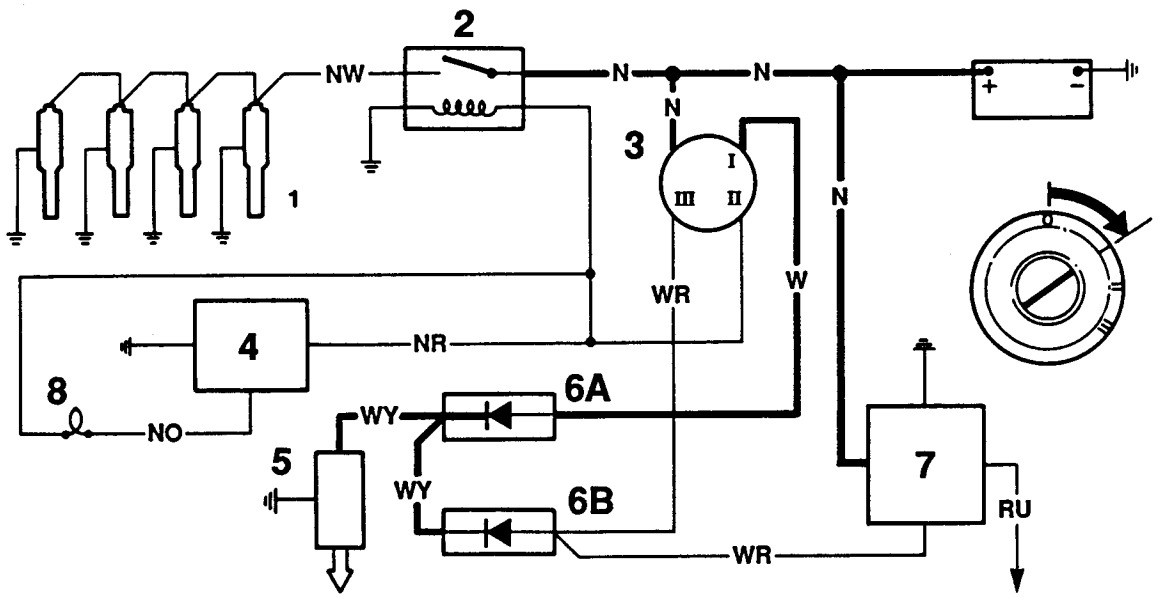

Fig.3

IGNITION SWITCH POSITION I (see Fig.3)
Steering unlocked, normal engine run position. In position I (shown on the switch in the wiring diagram), the white wire becomes live, feeding to diode 6A, through this diode to the fuel cut-off solenoid, 5, down the white/yellow wire linking diodes 6A and 6B is also live, but diode 6B prevents a live feed passing to the starter relay via the white/red wire. (If diode 6B fails closed circuit, the starter motor will operate all the time the ignition switch is in position I)

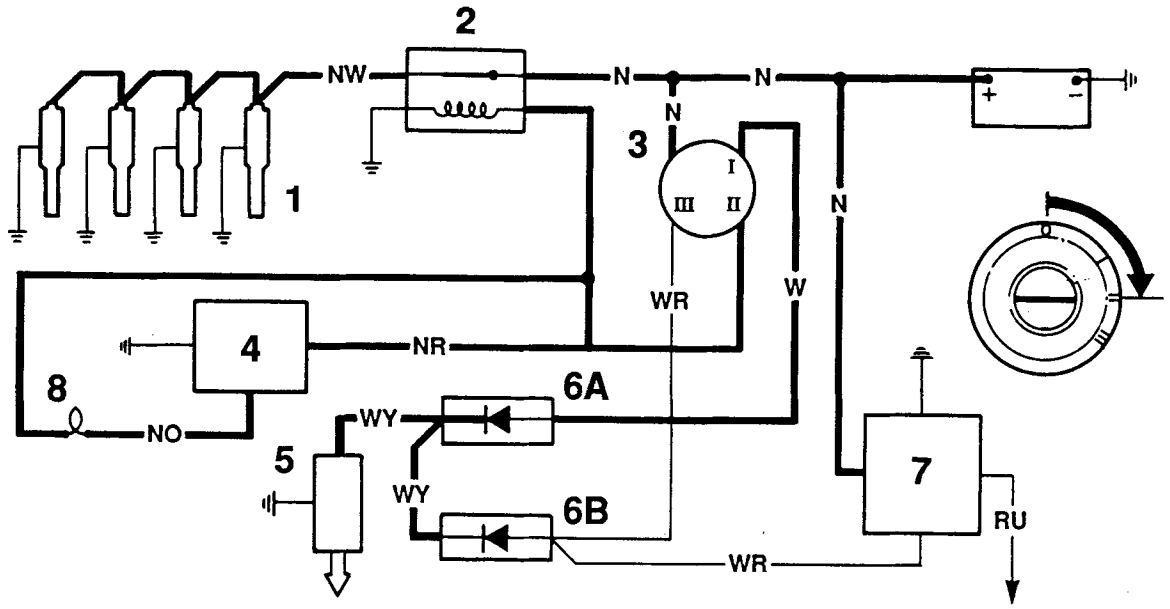

Fig.4

IGNITION SWITCH POSITION II - Heater plugs on (see Fig.4)

The ignition switch must be held against a spring loading. The fuel cut-off solenoid is energised as before (see previous diagram)

In addition, the heater plugs are now energised by feeding from position II on the ignition switch to the heater plug relay (2) down the Brown/Red wire. This activates the relay, the contacts close, and the heater plugs are fed from the relay by the Brown/White wire.

At the same time in position II, the heater plug warning light unit (4) is switched on by a feed from the Brown/Red wire. This unit in turn switches on the heater plug dash light (8). After a period of approximately fifteen seconds the heater plug dash light is switched off by the heater plug warning light unit. All the time the ignition switch is held in position II, even after the heater plug dash light has gone out, the heater plugs are still operating.

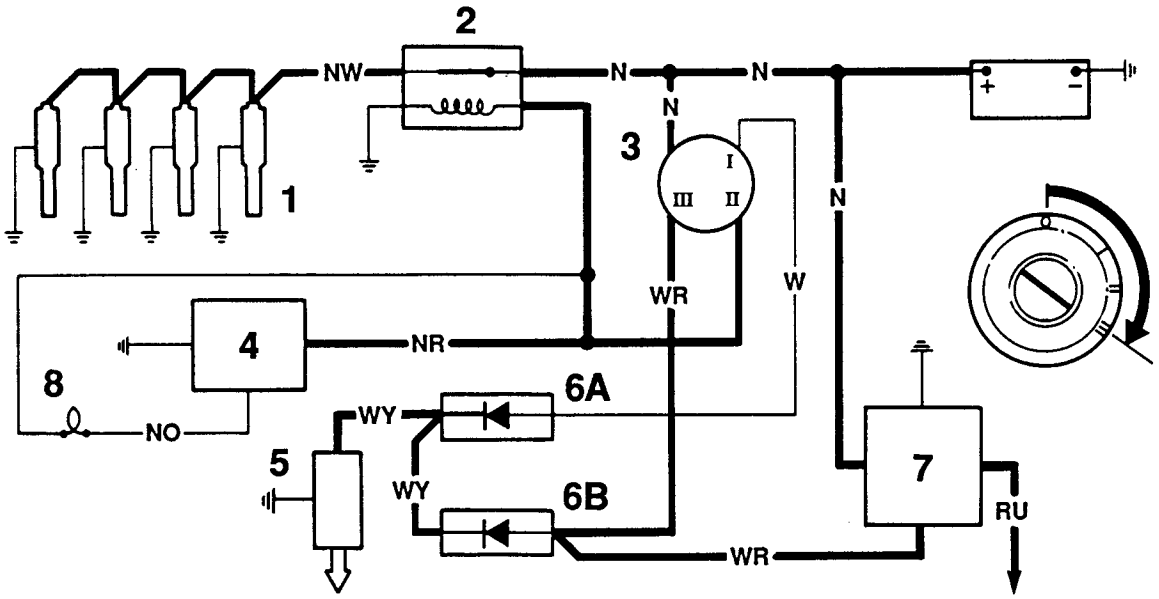

Fig.5

IGNITION SWITCH POSITION III - Cranking
(see Fig.5)
In this position, the circuit in position I is now switched off, by virtue of the ignition switch design. Consequently, the fuel cut-off solenoid cannot be energised through blocking diode 6A. Instead, from position III on the ignition switch, a live feed comes down the White/Red wire to diode 6B, feeding to the fuel cut-off solenoid down the White/Yellow wire. Diode 6A prevents the white wire to terminal I of the ignition switch becoming live.

A feed is also taken from diode 6B, a White/Red wire, to the starter relay (7) which energises the starter by closing the contacts and feeding from the Brown wire to the starter through the Brown/Blue wire. In position III the heater plugs are operating as before (see Fig.4). Upon releasing the key, it will return by spring action to postion I.

300 Series

The 2.5 engine installed in 300 Series vehicles uses a Micronova heater plug system, details of which are as follows.

Starting Procedure

Cold start
Turn the master switch key to postion III; **DO NOT** depress the accelerator pedal. With the key at position III the starter motor will operate. As soon as the engine is running, release the key and 'blip' the accelerator pedal as necessary to keep the engine running. Check that the RED no charge and oil pressure warning lights are extinguished when the engine is running.

Hot start
Insert the master switch key and turn it to position III **DO NOT** depress the accelerator pedal until the engine is running. As soon as the engine is running, release the key and check that the RED no charge and oil pressure warning lights are extinguished.

System Components

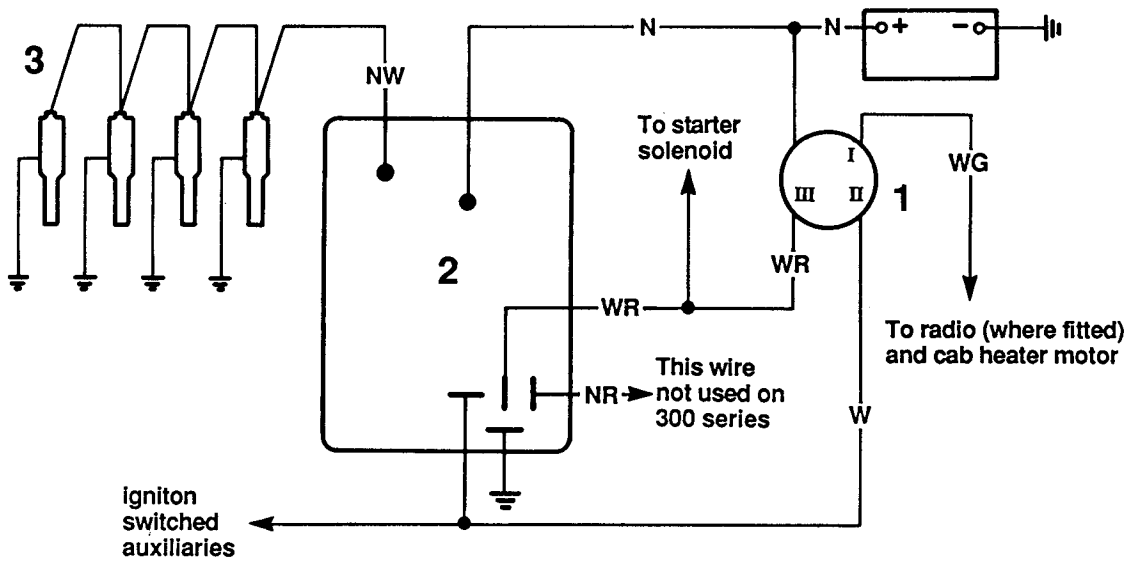

Fig.6 Micronova System Circuit
1. Ignition switch
2. Micronova control unit
3. Heater plugs

Wiring colour code

B	Black
N	Brown
NR	Brown/Red
NW	Brown/White
W	White
WR	White/Red
WG	White/Green

System Components

The Heater Plugs

The exposed element of the heater plug projects into the pre combustion chamber of the cylinder head. This allows the spray from the fuel injector to be sprayed onto the hot element whilst cranking to assist starting. Under normal circumstances the element will attain a temperature of 850°C in less than two seconds.

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The Controller

The controller is situated on the bulkhead on the left hand side of the vehicle adjacent to the battery. It is identified by its blue plastic casing.

The unit is non serviceable, incorporating an integrated circuit which removes the control of the heater plugs from the driver. The integrated circuit includes a facility to automatically switch the starting aid relay which is integrally mounted in the controller. Incorporated inside the unit integrated circuit is a thermistor which senses under bonnet ambient temperature; this is a necessary requirement to ensure the heater plugs remain energised after the engine has started from cold for a short period of time to avoid the engine mis-firing. This period is called 'post heat'. As ambient temperature rises, the unit will energise the starting aids to give a shorter 'post heat', until ambient temperature reaches a pre determined temperature, after which no post heat is provided.

System Operation

The Ignition Switch

Functions are as follows:

The brown wire is the live (battery positive) feed to the switch.

Position O	-	Ignition switch off - steering locked - no electrical output.
Position I (Auxiliary)	-	Steering not locked - radio (if fitted) and cab heater motor energised from white/green wire.
Position II (Engine run)	-	Steering not locked - radio and cab heater motor on - all ignition controlled units energised from white wire.
Position III (Engine cranking)	-	Steering not locked - radio and cab heater motor off - all ignition controlled units energised from white wire - starter motor energised from white/red wire.

THE MICRONOVA CONTROLLER

The Micronova Controller operates as follows in the respective ignition switch positions, under normal conditions:

The brown wire is the live (battery positive) feed to the unit.

The black wire provides the unit earth connection.

A brown/red wire is fitted to the harness and connector but is not used in this application.

a) IGNITION SWITCH POSITION O - no signal from the ignition switch to the unit - heater plugs not energised.

b) IGNITION SWITCH POSITION I - no signal from the ignition swich to the unit heater plugs not energised.

c) IGNITION SWITCH POSITION II - Ignition 'ON' only - engine not running - signal from the ignition switch to the white wire on the controller.

Engine cold - cold ambient temperature - the controller will be heard to 'click', pulsing the heater plugs on and off intermittently for a period of up to six seconds. (This is a short period of time to allow pre heating of the heater plugs - if desired the key can be turned directly to the crank position but starting times may be increased due to no pre-heating of the heater plugs).

Engine hot - as ambient temperature increases the pre-heat time is reduced accordingly - an engine at normal operating temperature will not require pre-heat of the heater plugs and can be switched directly to cranking.

d) IGNITION SWITCH POSITION III - Engine cranking - signal from the ignition switch to white/red wire on controller.

While the engine is cranking, the heater plugs are energised constantly to ensure the engine fires readily. **NOTE: Do not use the accelerator if the engine is cold.**

e) IGNITION SWITCH POSITION II - after cranking, if the engine has fired and is running - the controller will perform as follows:

Engine cold - cold ambient temperature - to ensure steady running of the engine, the controller will be heard to 'click', pulsing the heater plugs on and off intermittently for a maximum period of approximately 20 seconds. (post heat period).

As ambient temperature rises, this post heat period reduces. If the engine is at normal operating temperature or if a high ambient temperature is sensed by the controller, a very short or no post heat period is provided.

After cranking, if the engine fails to start, return the key to position I and repeat starting sequence.

NOTE; Should the battery voltage be low, instead of the Micronova control unit 'pulsing' the heater plugs during pre-heat and post heat periods, the heater plugs will be held 'on' for these periods.

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