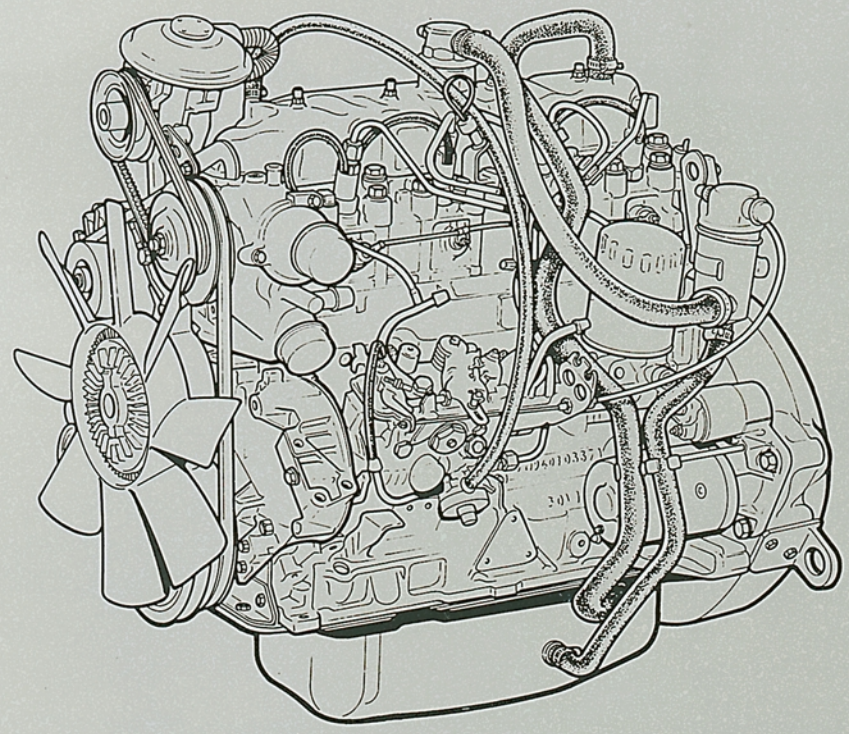
Service Workbook
EN 55 and ET 70 Engines



LEYLAND DAF

EN55 & ET70 ENGINES
Service Workbook

This Service Workbook provides information to service the EN55 and ET70 Diesel engines fitted to 400 models. It is primarily designed to assist skilled technicians in the efficient repair and maintenance of this vehicle, 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.

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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

In all references to engine pistons and valves, number 1 piston and number 1 valve are at the rear of the engine (nearest the flywheel).

References to the left and right hand side in this Service Workbook are made when viewing the vehicle from the rear.

To reduce repetition, operations covered in this Service Workbook do not always 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.

GENERAL PRECAUTIONS

1. When disconnecting the battery, always disconnect the earth return (negative) cable first, and then the positive cable. On twin battery installations, disconnect both earth return (negative) cables first, and then the positive cables.

2. Care must be taken when working underbonnet to avoid rotating pulleys, drive belts and fan when the engine is running.

3. The only approved anti-freeze for this for this engine is LDV part number BBU 9020, and the correct coolant proportions are 50% anti-freeze, 50% water.

REPAIRS AND REPLACEMENTS

When replacement parts are required, it is essential that only genuine LDV Parts are used.

TECHNICAL DATA

ENGINE SPECIFICATION

Type		Water cooled, vertical, four-stroke diesel engine with indirect fuel injection.	
Naturally aspirated engine		EN 55	
Turbocharged engines		ET 70	
Fuel injection pump		Rotary distributor type	
Bore		94 mm	
Stroke		90 mm	
Compression ratio	EN	23:1 (nominal)	
	ET	21:1 (nominal)	
Compression pressure		25 to 30 bar	367 to 441 psi
Min. permissible compression pressure		18 bar	264 psi
Max. compression pressure variation		5 bar	73.5 psi
Number of cylinders		4	
Cubic capacity		2498 cm^3	
Firing order (No.1 cylinder at flywheel end)		1 - 3 - 4 - 2	
Idling speed	EN	775 ± 25 rpm	
	ET	775 ± 25 rpm	
Max. no-load speed	EN	4500 ± 75 rpm	
	ET	4750 +50, -100 rpm	
Direction of rotation		Clockwise when viewed from timing chain end.	
Thread		Metric	
Turbocharger (ET engines)		Garrett	
Type		TO3	
Maximum boost pressure		0.8 bar	11.6 psi
Weight (dry)	EN	203 Kg	447 lbs
	ET	223 Kg	492 lbs

COOLING SYSTEM

Cooling system		Forced circulation	
System capacity (including heater)		9 litres	15.8 pints
Thermostat	opens at	81°C	
	fully open at	93°C	

Expansion tank pressure cap

Pressure cap opens at	1 bar	15 psi

Viscous coupling fan

Fan blade identification	EN	White
	ET	Yellow

The central securing nut has LH thread

V-belt tensions

Deflection using hand pressure midway between pulleys:

- Vacuum pump	6 mm	0.25 in
- Fan (manual steer)	9 mm	0.35 in
(power assisted steer)	5 mm	0.20 in
- Alternator	9 mm	0.35 in

LUBRICATING SYSTEM

General

Capacity including filter:	EN	7,4 litres	13 pints
	ET	7,7 litres	13.5 pints
Oil pressure at 800 rpm (110°C)	EN	1,6 bar	23 psi
	ET	1,2 bar	17 psi
at 4500 rpm (110°C)	EN & ET	3,7 bar	53 psi
Pressure switch set to:		0,8 bar	11 psi

Oil filter

Type		Disposable element
Design		Full flow
Tightening torque		Hand tighten only

Oil cooler

Type	EN	Water cooled
	ET	Air cooled
Location	EN	Between oil filter and filter body
	ET	Below radiator

Oil pump

Type		Gear type
Driven		from camshaft gear
Pump drive end-float		0,1 mm 0.004 in

FUEL SYSTEM

Injection pump		CAV Roto Diesel	
- Type	EN	DPC Type 059	
	ET	DPC Type 053	
- Dynamic timing (at 775±25rpm)	EN	12° BTDC ±1°	
	ET	9° BTDC ±1°	
Injectors		CAV Roto Diesel	
- Type	EN	LCR 67 30 701C	
	ET	LCR 67 30 704C	
- Nozzle	EN	RDN OSDC 6577B	
	ET	RDN 12SDC 6849C	
- Injection pressure	EN	115 bar ± 5	1670 ± 75 psi
	ET	130 bar ± 5	1885 ± 75 psi

CYLINDER HEAD AND VALVE GEAR

Cylinder head

Nominal height	90 mm ± 0,15 mm	3.543 ± 0.006 in
Max. permissible bow	0,15 mm	0.006 in
Min. height after machining	89,45 mm	3.522 in
Head gasket thickness identification		
2 notches	1,60 mm	
3 notches	1,70 mm	
4 notches	1,80 mm	

Valve guides

External diameter	14,02 mm	0.5520 in
- 1st oversize	14,29 mm	0.5626 in
- 2nd oversize	14,59 mm	0.5744 in

Valve seats

Inlet valve seat angle	45°	
- External diameter	44,01 mm	1.7327 in
- 1st oversize	44,31 mm	1.7445 in
- 2nd oversize	44,51 mm	1.7524 in
Exhaust valve seat angle	45°	
- External diameter	37,01 mm	1.4571 in
- 1st oversize	37,31 mm	1.4687 in
- 2nd oversize	37,51 mm	1.4768 in

Inlet valves

Valve seat angle	45°	
Valve face diameter	42,5 mm	1.6732 in
- recession in head	1,05 - 1,45 mm	0.04 - 0.06 in
Valve stem diameter	8,49 mm	0.3342 in
Valve clearance (set cold)	0,15 mm	0.006 in

Exhaust valves

Valve seat angle	45°	
Valve face diameter	35,5 mm	1.3976 in
- recession in head	0,85 - 1,25 mm	0.03 - 0.05 in
Valve stem diameter	8,47 mm	0.3335 in
Valve clearance (set cold)	0,25 mm	0.010 in

Valve springs

Inner spring, free length	40,2 mm	1.5827 in
Outer spring, free length	44,5 mm	1.7520 in

Swirl chamber

External diameter	36,5 mm	1.4370 in
- 1st oversize	36,75 mm	1.4468 in
- 2nd oversize	37,0 mm	1.4567 in

ENGINE BLOCK

Block

Cylinder bore diameters

Standard size	Category A	94,0 mm	3.7008 in
	Category B	94,015 mm	3.7014 in
Oversize	Category E	94,40 mm	3.7165 in
	Category J	94,80 mm	3.7323 in

Block face must NOT be re-machined.

Crankshaft

End float	0,08 - 0,29 mm	0.003 - 0.011 in
Thickness, axial thrust washers	2,30 mm	0.0906 in
- 1st oversize	2,50 mm	0.0984 in

Crankshaft main bearing journals

Number	5	
Diameter of main bearing journals	60,0 mm	2.3622 in

Main bearing shells

Undersizes	Three	0,30, 0,50, 0,80 mm	0.0118, 0.0197, 0.0315 in

Crankpin (connecting rod) journals

Diameter	55,0 mm	2.1653 in

Connecting rods

Connecting rod (big end) bearing shells

Undersizes Two	0,30 & 0,50 mm	0.0118 & 0.0197 in

Pistons

Piston diameter

- standard	Category A	EN	93,883 mm	3.6962 in
		ET	93,893 mm	3.6966 in
	Category B	EN	93,898 mm	3.6968 in
		ET	93,908 mm	3.6972 in
- 1st oversize	Category E	EN	94,283 mm	3.7119 in
		ET	94,293 mm	3.7123 in
- 2nd oversize	Category J	EN	94,683 mm	3.7277 in
		ET	94,693 mm	3.7281 in

Piston rings

Number of piston rings: 3, (2 compression, 1 oil control)

Top ring - fit either way

Second ring taper faced, marked 'TOP'

Ring gaps

EN	Top and second rings	0,30 - 0,60 mm	0.012 - 0.024 in
	Oil control ring	0,15 - 0,40 mm	0.006 - 0.016 in
ET	Top ring	0,25 - 0,50 mm	0.010 - 0.020 in
	Second ring	0,20 - 0,45 mm	0.008 - 0.018 in
	Oil control ring	0,15 - 0,40 mm	0.006 - 0.016 in

Camshaft

Driven by chain		
Number of bearings	3	
End float	0,05 - 0,15 mm	0.002 - 0.006 in

TIMING

Timing gears

Chain tensioner clearance	2,0 mm	0.08 in

HEATER PLUGS

Make	Bosch
Voltage	11 volts
Initial current draw	55 amps
Draw after 20 seconds	12 amps
Tip starts to glow	3 seconds

VACUUM PUMP

Minimum depression: 560 mm Hg at idle speed for 2 minutes

CLUTCH

Type	Diaphragm, single dry plate.
Diameter	235 mm

LUBRICANTS

APPROVED ENGINE OILS

Oils must conform to specification: CCMC PD2
RES.22.OL.PD2

Engine refill and filter change:

EN	7,4 litres	13 pints
ET	7,7 litres	13.5 pints

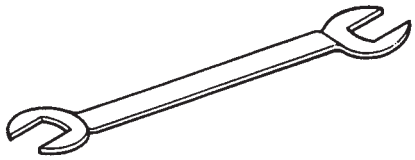
Dipstick MIN to MAX top up 2,5 litres 4.4 pints

SERVICE SUMMARY

	MILES / KILOMETRES					
	PDI	1,000m 1,500km	6,000m 10,00km	12,000m 20,000km	24,000m 40,000km	48,000m 80,000km
RENEW ENGINE OIL AND FILTER	TOP UP ONLY	●	●	●	●	●
CHECK DRIVE BELT TENSIONS	●	●		●	●	RENEW
DRAIN WATER FROM FUEL FILTER			●	●	●	●
CHECK ANTI-FREEZE SOLUTION STRENGTH (50%). TOP UP COOLING SYSTEM	TOP UP	●		●	RENEW	RENEW
PRESSURE TEST COOLING SYSTEM. CHECK HOSES		●		●	●	●
CHECK / ADJUST CLUTCH		●		●	●	●
RENEW FUEL FILTER ELEMENT				●	●	●
CHECK FUEL PIPES & UNIONS FOR LEAKS, CRACKS, CORROSION ETC.	●			●	●	●
RENEW AIR FILTER ELEMENT					●	●
CHECK / ADJUST VALVE CLEARANCES					●	●

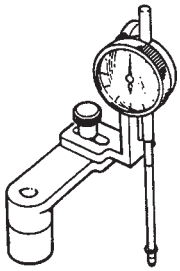
SPECIAL TOOLS

0480034
(MS 1517)



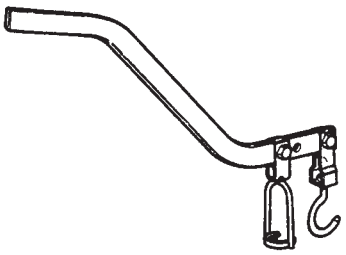
Fan pulley wrench

0480048
(18G 191)



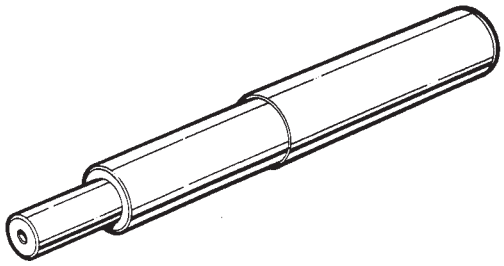
Setting gauge

0480056



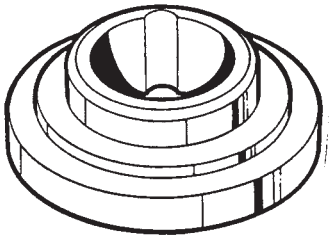
Valve spring compressor

0480057



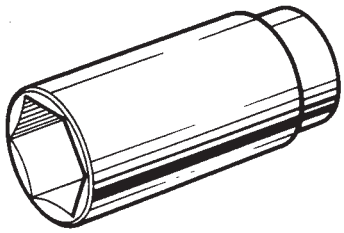
Clutch aligner

0480058



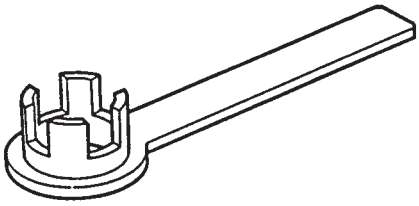
Crankshaft front oil seal replacer

0480059



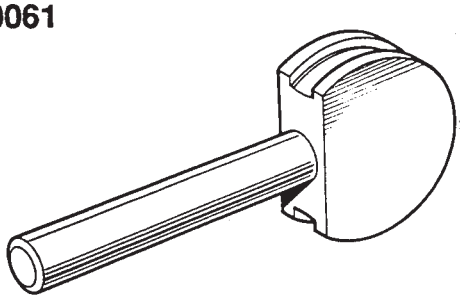
Injector socket

0480060



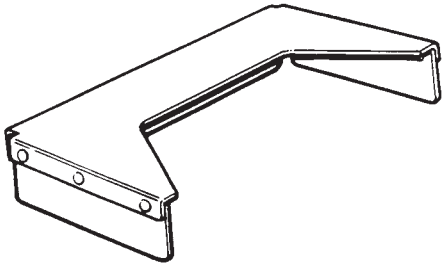
Crankshaft pulley holding tool

0480061



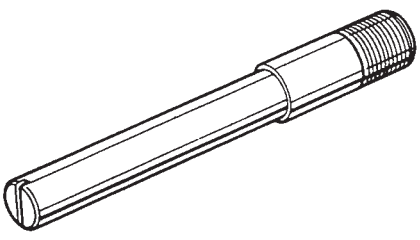
Crank rear seal packing tool

0480062



Rear main cap fitting tool

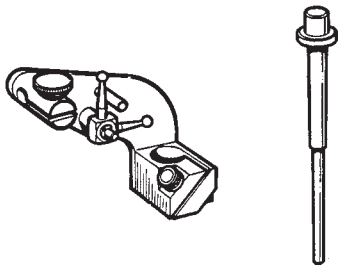
0480063



Dummy cylinder head studs

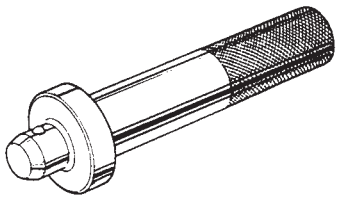
SPECIAL TOOLS (Continued)

0480066



Timing pin and bracket

0499809
(18G 134)



Drive handle

TORQUE WRENCH SETTINGS

	Nm	Lbf ft
Clutch cover	20	15
Connecting rod big end nuts	60	44
Crankshaft main bearing cap bolts	120	89
Crankshaft pulley bolt	55 + 60°	41 + 60°
Crankshaft torque-to-turn (pistons fitted)	60	44
Cylinder head bolts (in correct sequence):		
stage 1	30	22
stage 2	70	52
stage 3 - slacken by 1/4 turn, re-tighten to	70	52
stage 4 - run engine, then allow to fully cool.		
stage 5 - slacken by 1/4 turn, re-tighten to	70	52
stage 6 - tighten	+120°	+120°
Flywheel bolts - pre-tighten	15	11
- tighten	+ 60°	+ 60°
Heater plugs	25	18
Injectors	90	66
Oil pump - Allen screw	12	9
- cap nut	30	22
- thrust cap	90	66
Rocker cover nuts	4	3
Rocker shaft - nuts	45	33
- bolts	20	15
Rocker shaft lubrication pipe unions	18	13
Sump bolts	10	7
Timing chain idler eccentric sprocket bolt	35	26
Timing cover bolts	10	7

ENGINE REMOVE AND REFIT

Remove

The engine is removed through the bonnet aperture complete with the gearbox.

1. Disconnect the battery(s), negative terminal(s) first.

2. Remove the bonnet.

3. Drain the coolant.

4. Detach the fan cowl.

5. Remove:
   - bonnet locking platform,
   - radiator,
   - radiator deflector plates,
   - fan, using tool 0480034 (MS 1517) (note left hand thread), and fan cowl.

6. ET engines only: Position a suitable container and remove the oil cooler, disconnecting the oil pipes at the cooler.

7. Disconnect the throttle cable at the fuel injection pump.

8. Disconnect the air duct at the inlet manifold / turbo.

9. Disconnect the exhaust down pipe at the manifold / turbo.

10. Disconnect electrical connections:
    - wiring at multiplug above battery,
    - starter lead from battery positive terminal,
    - heater plug control multiplug and two eyelets,
    - heater plug control warning light multiplug,
    - cable straps across left hand bulkhead, and place wires across engine.

11. Disconnect hoses:
    - heater supply and return,
    - fuel filter heater supply and return,
    - expansion tank, at engine,
    - top and bottom radiator hoses from engine, if not removed with radiator.

12. Remove the upper gear lever by drifting out the roll pin.

13. Disconnect the reverse detent cable at the gear lever.

14. Support the gearbox and remove the rear cross-member, exhaust strap and bracket. Angle exhaust away from engine/gearbox.

15. Disconnect:
    - propellor shaft,
    - adjustable gearbox link, and remove lower gear lever,
    - speedometer cable.

16. Release the front engine mounting to cross-member nuts.

17. Position suitable lifting tackle to take the weight of the engine and gearbox.

18. Remove the front cross-member.

19. **WARNING: If using the lifting eyes provided on the engine, it may swing towards one side.**
    Lift out the engine/gearbox assembly.

Refit

Refitting is the reverse of the above, but note the following adjustments will be necessary:
- throttle cable at the fuel injection pump,
- clutch cable,
- gearchange linkage.

CYLINDER HEAD

Description / features

The aluminium cylinder head is secured to the block by 22 bolts of two different lengths. The following summarises points to be noted during service / overhaul work.

NOTE: Valve No. 1 (and piston No.1) are located at the rear of the engine (i.e. nearest the flywheel).

CYLINDER HEAD GASKET
Three different thicknesses available for selective fitment, to cater for piston stand-proud variations.

SWIRL CHAMBERS
The ET engine has swirl chambers with larger internal size than the EN engine. External diameter is the same, and identification is by a dimple in the swirl chamber-to-head face of the EN type.

Two oversizes are available (see **'Technical Data'**).

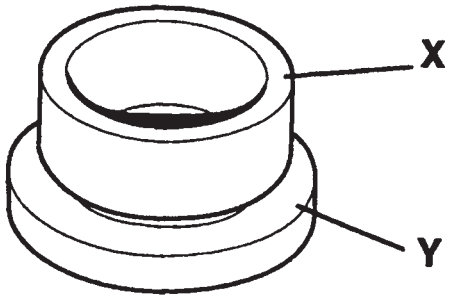


Fig.2 Machining swirl chamber to adjust protrusion

Swirl chamber protrusion:
0 to 0,03 mm (0 to 0.001 in.)

If too great, machine faces 'X' and 'Y' (see fig.2) to restore correct protrusion.

VALVE GUIDES

Valve guides are now made of brass and are interchangeable with cast iron guides originally used in EN engines.

Two oversizes are available (see **Technical Data**).

VALVE SEATS
Valve seats are the same for EN and ET engines.

Two oversizes are available for inlet and exhaust.*

* Standard sizes used only for original manufacture.

VALVES

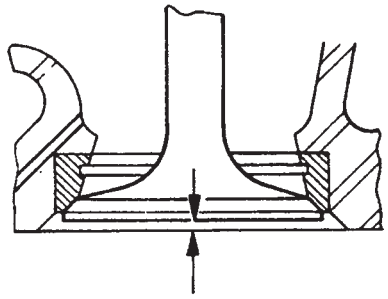


Fig.3 Valve recession

Inlet valves are the same for EN and ET engines, but ET exhaust valves have chromium plated stems.

All valves are recessed into the cylinder head.

Inlet	1,05 - 1,45 mm (0.04 - 0.06 in)
Exhaust	0,85 - 1,25 mm (0.03 - 0.05 in)

VALVE SPRINGS
All valve springs are the same.

VALVE STEM SEALS
Valve stem seals are fitted to EN engines, but not to ET.

VALVE CLEARANCE

Check and adjust

1. Detach the oil filler cap, unscrew the four rocker cover retaining nuts and remove the stud harness clips, plain washers and fibre washers.

   Lift off the rocker cover.
   NOTE: On ET engines it is necessary to release the boost control pipe from the manifold and the breather pipe from the rocker cover.

2. Check each valve clearance as follows:
   Turn the engine until No.4 cylinder (nearest the timing cover) inlet and exhaust valves are 'on the rock'.

   Insert a feeler gauge between the valve rocker arm and the valve stem. The gauge (1) should be a sliding fit.

Inlet valves	0,15 mm (0.006 in)
Exhaust valves	0,25 mm (0.010 in)

   Check clearances:
   - No.1 valve (nearest flywheel)
   - No.2 valve
   - No.4 valve
   - No.6 valve

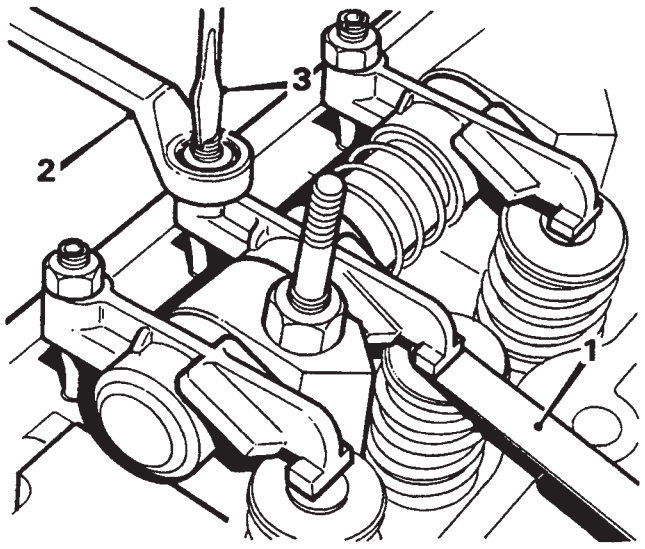


Fig.1 Rocker adjustment
1. Feeler gauge
2. Locknut
3. Adjustment screw

   Turn the engine until No.1 cylinder inlet and exhaust valves are 'on the rock'.
   Check clearances:
   - No.8 valve
   - No.7 valve
   - No.5 valve
   - No.3 valve

Adjusting

3. Slacken the adjusting screw locknut (2).

   Rotate the screw (3) clockwise to decrease or anti-clockwise to increase the clearance.

   Re-tighten the locknut when the clearance is correct, holding the screw against rotation with a screwdriver.

   Re-check the clearance.

4. Clean the rocker cover sealing surfaces and examine the seal bead for damage. If necessary, renew the seal as described in the section **'Rocker Cover Cord Gasket'.**

5. Fit the cover to the cylinder head. Fit the fibre washers,plain washers, harness clips (where applicable) and the securing nuts. Progressively tighten the nuts to 4 Nm (3 lbf ft). Do not overtighten.

6. Fit the oil filler cap.

7. ET engines only:
   Reconnect the boost control pipe to the manifold and the breather pipe to the rocker cover.

ROCKER COVER CORD GASKET

Renew

The rocker cover cord gasket is a pre-formed silicone cord and will, under normal conditions, last the duration of the vehicle. If it is damaged, renew as follows.

1. Remove completely the old cord gasket.

2. Degrease the cylinder head mating face and the rocker cover with a suitable fluid and allow to dry.

3. Secure the rocker cover upside down.

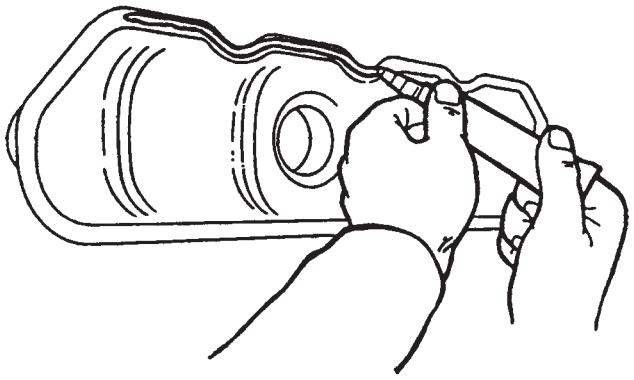


Fig.1 Applying silicone sealant

4. Apply silicone sealant from the tube supplied with the gasket kit in a continuous bead 1,5 to 2,0 mm (0.06 - 0.08 in) in diameter, around the whole of the rocker cover face.

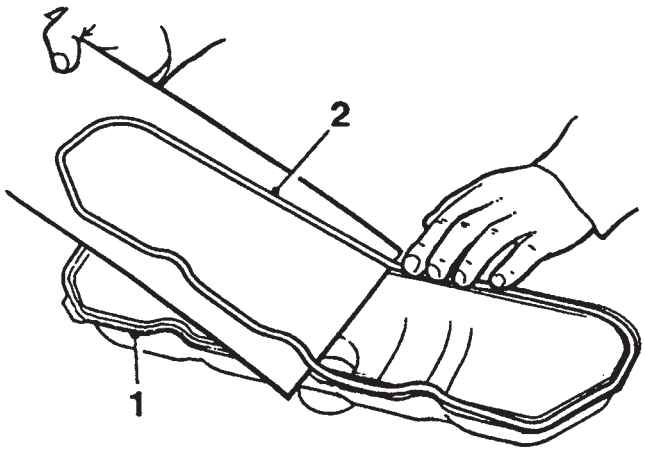


Fig.2 Fitting rocker cover cord gasket
1. Silicone sealant
2. Cord gasket

5. Carefully cut away the shrink wrapping, taking care not to damage the cord gasket. Retain the gasket on its paper backing.
NOTE: It is imperative that the cord gasket is handled with clean, dry hands.

   Slide the cord gasket onto the rocker cover face.

6. Lightly oil the cylinder head mating face.

7. Carefully place the rocker cover on the cylinder head and tighten the nuts only until contact with the cover is made - i.e. the cord gasket is slightly clamped.

8. After a minimum of 45 minutes curing time, tighten the nuts to 4 Nm (3 lbf ft).

CYLINDER HEAD

Remove and refit

Tool required: 0480063

Remove

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

1. *Disconnect the battery(s), negative connection(s) first.*

2. *Remove the pulley guard.*

3. *Drain the coolant from the block, and disconnect the following hoses:*
   - *top radiator hose,*
   - *bottom radiator hose,*
   - *heater supply hose at cylinder head,*
   - *heater return hose at water pump,*
   - *expansion tank hose.*

4. *Disconnect the air cleaner ducting, and remove the oil filler cap.*

5. *Disconnect:*
   - *feed wire to No. 4 heater plug,*
   - *temperature sensor,*
   - *High Engine Temperature warning sensor,*
   - *alternator multiplug,*
   - *cable trunking at rocker cover brackets.*

6. *Disconnect the exhaust pipe at the manifold (EN engines).*

7. *On ET engines:*
   - *disconnect the boost control hose at the inlet manifold,*
   - *remove the inlet manifold,*
   - *remove the bolts securing the exhaust manifold to the cylinder head,*
   - *unclip the breather pipe from its bracket.*

8. Remove the alternator and vacuum pump drive belts, and remove the vacuum pump.

9. Disconnect the fast idle control cable at the fuel injection pump, and unclip the timing sensor cable from the manifold bracket.

10. Remove:
    - injector pipes,
    - lubrication pipe to cylinder head,
    - dipstick support bracket.

11. Disconnect the spill return pipe from No. 4 injector.
    Disconnect the breather hose at the rocker cover (ET engine).

12. Remove the rocker cover, noting the position of the cable brackets and washers.

13. Remove the rocker shaft observing the following:
    - Leave the two end bolts in position so that the rockers cannot spring apart.
    - Note the oil feed to the centre of the shaft, and its sealing ring on the cylinder head.

14. Remove the push rods, and retain them in their fitted sequence.

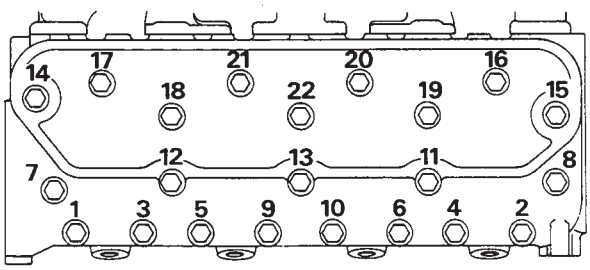


Fig.1 Cylinder head bolt slackening sequence

15 Progressively slacken and then remove the cylinder head bolts in the sequence shown in fig.1. Note that different length bolts are used:

7 longer bolts - numbered 14, 7, 12, 13, 11, 8 and 15 in fig.1.

16. Lift off the cylinder head, noting the position of the dowel.
Discard the cylinder head gasket.
NOTE: Swirl chambers may drop out when head is removed. If so, note their positions to refit in the same locations.

Refitting cylinder head

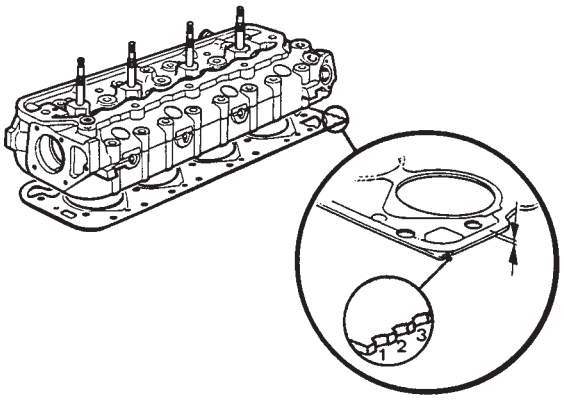


Fig.2 Selecting cylinder head gasket

17. The pistons are designed to protrude above the top face of the cylinder block at TDC. A selection of cylinder head gaskets are available, and the correct gasket thickness must be determined in relation to the protrusion of the highest piston.

    The gasket thicknesses are identified by notches at the end face of the gasket.

    Select the gasket thickness as follows:

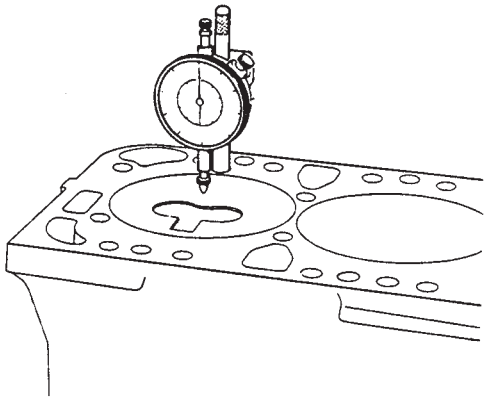


Fig.3 Measuring piston protrusion

Position a suitably mounted dial gauge with its stylus on No.1 piston; turn the engine until TDC is found accurately and then zero the gauge.

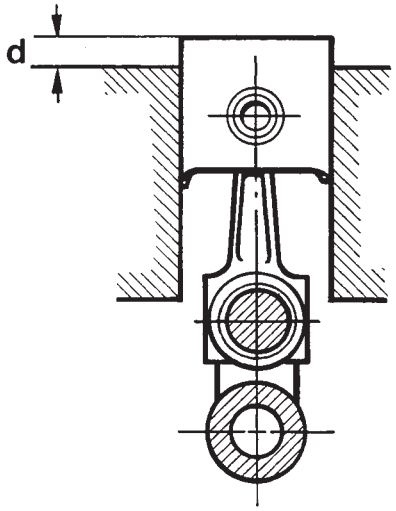


Fig.4 Piston protrusion

Carefully slide the gauge until the stylus rests on the adjacent cylinder block. Note the gauge reading, which will be the protrusion (d) (see fig.4) of the piston above the block.

Repeat the above on the other three pistons, and establish the highest piston.

Select a cylinder head gasket from the following chart:

Engine	Protrusion	Gasket choice	Gasket thickness
EN	up to 0,79 mm (0.031 in.)	2 notches	1,60 mm
	0,79-0,89 mm (0.031-0.035 in)	3 notches	1,70 mm
	over 0,89 mm (0.035 in)	4 notches	1,80 mm
ET	up to 0,72 mm (0.028 in.)	2 notches	1,60 mm
	0,72-0,82 mm (0.028-0.032 in)	3 notches	1,70 mm
	over 0,82 mm (0.032 in)	4 notches	1,80 mm

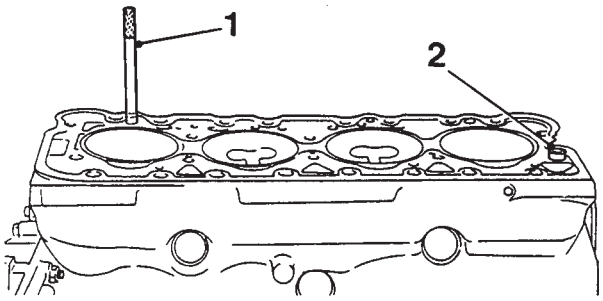


Fig 5 Fitting cylinder head
1. Guide stud
2. Dowel pin

18. Clean the threads in the cylinder block, fit the dowel pin at the rear of the block and fit a guide stud 0480063 at the front.

19. Refit any swirl chambers that may have been removed; retain with grease. Swirl chamber protrusion:
    0 to 0,03 mm (0 to 0.001 in.)

20. Fit the selected cylinder head gasket dry, fit the cylinder head and remove the guide stud.

21. Renew all the cylinder head bolt washers.

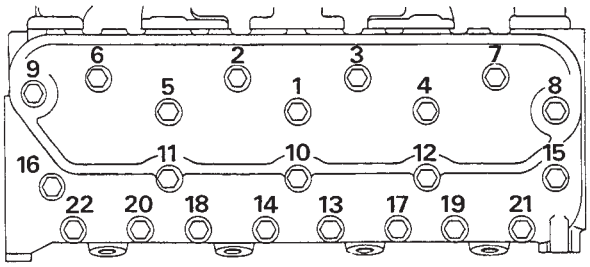


Fig.6 Head bolt tightening sequence

22. Coat all cylinder head bolts with Molycote G Rapid on the threads and under the heads, making sure the Molycote does not get on the cylinder head face. Fit the bolts according to their length; the 7 longer bolts are those numbered 9, 16, 11, 10, 12, 15 and 8 in fig.6.

23. Tighten the cylinder head bolts using the following procedure:

    Pre-tighten all the bolts in the order shown to:
    30 Nm (22 lbf ft)

    Tighten the bolts in the same order to:
    70 Nm (52 lbf ft)

    Taking each bolt in turn and in the same order:
    Slacken it by a quarter turn then re-tighten to 70 Nm (52 lbf ft).

    CAUTION: Additional tightening of the cylinder head must be made after the engine has been run. See end of this section for details.

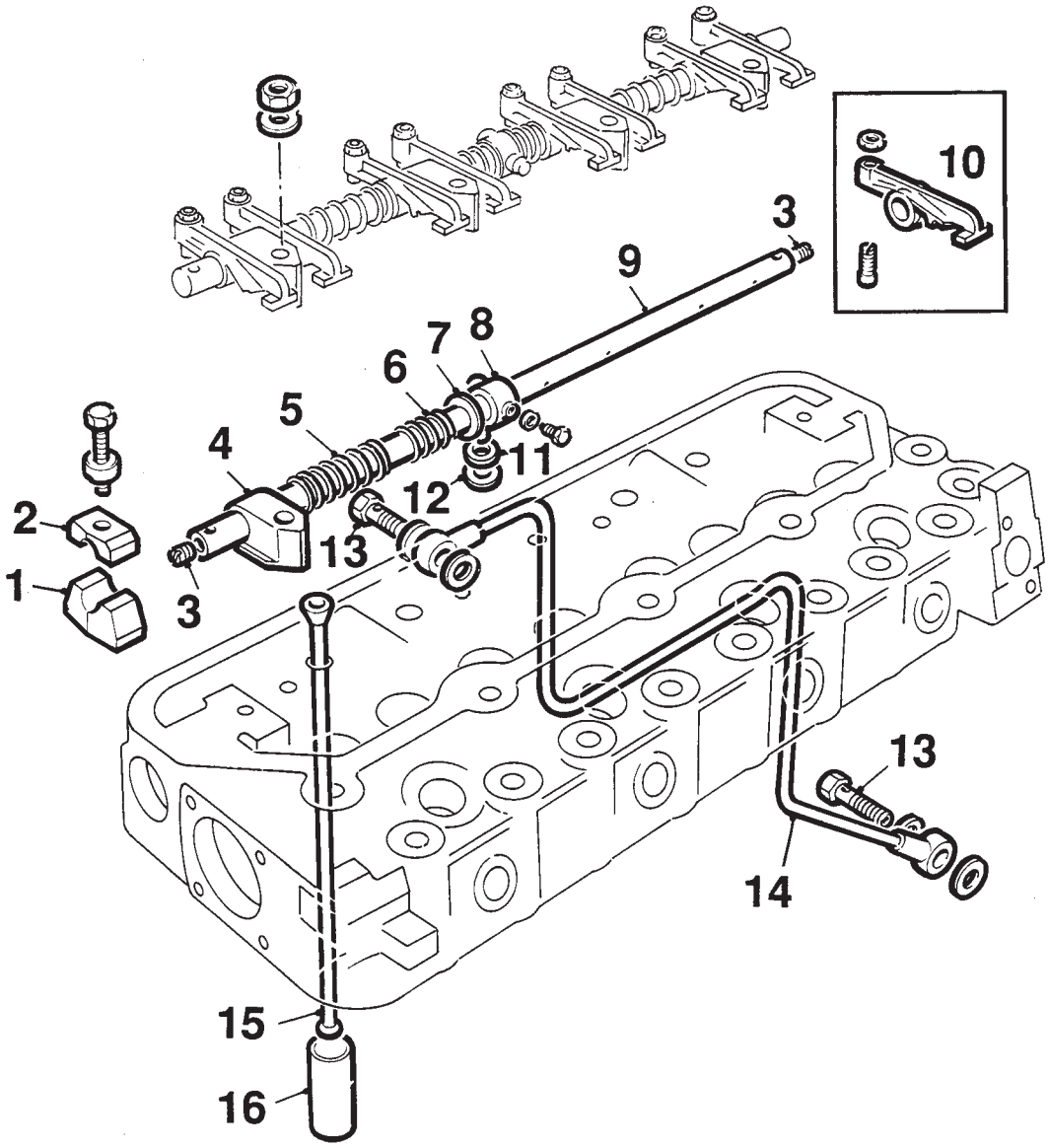


Fig 7 Rocker mechanism

1. Shaft bearing
2. Bearing cap
3. End plug
4. Pedestal
5. Spring
6. Spring
7. Washer
8. Oil supply union
9. Rocker shaft
10. Rocker
11. Washer
12. Sealing washer
13. Banjo bolt
14. Rocker shaft lubrication pipe
15. Pushrod
16. Tappet

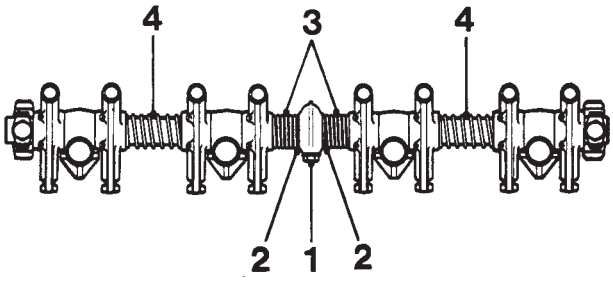


Fig.8 Rocker shaft

1. Oil supply union
2. Washer
3. Light springs
4. Heavy springs

24. If the rocker shaft has been dismantled, assemble it in the sequence shown in fig.8.

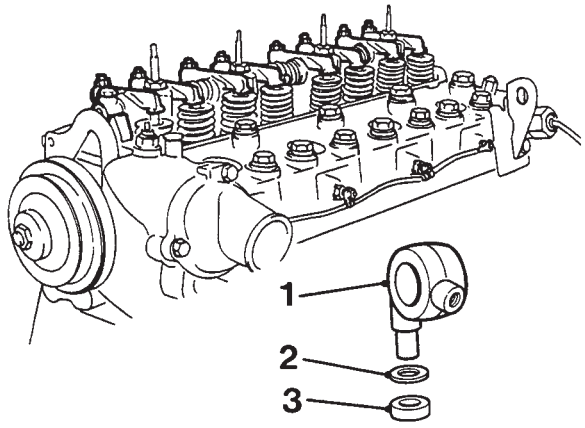


Fig.9 Rocker shaft oil supply union

1. Rocker shaft oil supply union
2. Washer
3. Seal

25. Fit the push rods in the same sequence as before.

    Fit the rocker shaft, ensuring that the oil supply union, fitted with its washer and seal, locates correctly.
    NOTE: Ensure the bevelled side of the shaft bearings face away from the rockers.

    Progressively tighten the rocker shaft pedestal fixings:

Nuts	45 Nm (33 lbf ft)
Bolts	20 Nm (15 lbf ft)

26. Check that there is approximately 0,10 mm (0.004 in) clearance between each end bearing and its rocker. Reposition the end bearings if necessary.

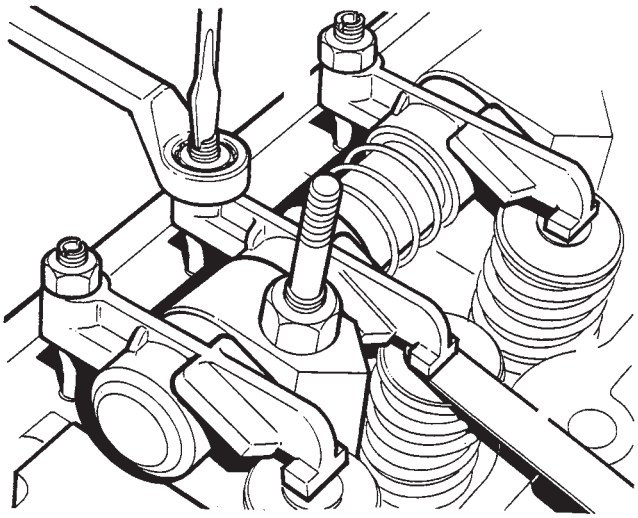


Fig.10 Adjusting valve clearances

27. Adjust the valve clearances as follows:

    Turn the engine until No. 4 cylinder inlet and exhaust valves (nearest the timing cover) are 'on the rock'.

    Adjust - No. 1 valve (nearest flywheel)
    No. 2 valve
    No. 4 valve
    No. 6 valve

    Turn the engine until No. 1 inlet and exhaust valves are 'on the rock'.

    Adjust - No. 8 valve
    No. 7 valve
    No. 5 valve
    No. 3 valve

Valve clearances

inlet	**0,15 mm (0.006 in)**
exhaust	**0,25 mm (0.010 in)**

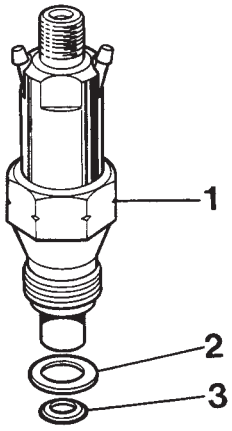


Fig.11 Injector and sealing washers

1. Injector
2. Sealing washer
3. Domed washer

28. Fit the injectors if removed, together with their seals and new domed washers (domed face towards its injector).
    Use socket 0480059 to tighten the injectors to 90 Nm (66 lbf ft).

29. Fit the injector pipes.

30. If removed, fit the heater plugs and their connections.

31. Examine the seal around the sealing face of the rocker cover for damage. Renew if necessary, as described in the section **'Rocker Cover Cord Gasket'**. Fit the rocker cover, positioning the washers, cable brackets etc. as noted during dismantling. Tighten the securing nuts to 4 Nm (3 lbf ft).

32. Fit the rocker shaft lubrication pipe using new sealing washers, and tighten the unions to 18 Nm (13 lbf ft).

33. Fit:
    - spill return pipe to No. 4 injector,
    - injector pipes,
    - dipstick support bracket.

34. Fit the vacuum pump, and fit and adjust the tension of the vacuum pump and alternator drive belts.

35. Clip the timing sensor cable to the manifold bracket.

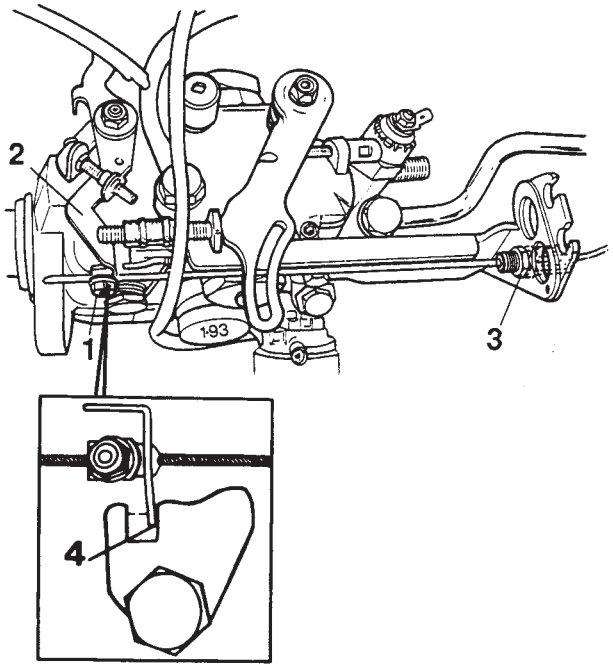


Fig.12 Fast idle cable

1. Inner cable securing clamp
2. Idle lever
3. Outer cable adjusters
4. Idle lever against stop

36. Fit the fast idle control to the cylinder head and attach the cable end to the fuel injection pump.

    Adjust the inner cable at the securing clamp until all slack is eliminated from the cable, with the fast idle lever against its stop.

    If necessary, adjust the cable length at the adjustment nuts until the idle lever is fully backwards against its stop.
    NOTE: This adjustment must be made when the engine is cold.

If the engine is in the vehicle, complete the installation by refitting/reconnecting the following:

37. *ET engines only:*
    Connect/fit:
    - *breather filter to its clip,*
    - *bolts securing the exhaust manifold to the cylinder head (new gaskets),*
    - *inlet manifold,*
    - *boost control hose,*
    - *breather hose to rocker cover.*

38. *Connect the exhaust pipe (EN engines).*

All engines.

39. *Connect/fit:*
    - *cable trunking at rocker cover brackets,*
    - *the High Temperature warning sensor,*
    - *the temperature sensor,*
    - *the feed wire to No. 4 heater plug.*

40. *Fit the air cleaner ducting and the oil filler cap.*

41. *Connect the coolant hoses to the radiator, header tank and heater Fit the fan guard.*

42. *Connect the battery(s), positive connection first.*

43. *Check that the coolant drain plug in the block is fitted and tight, then fill the cooling system with the correct (50%) solution of water and Leyland DAF Parts part number BBU 9020 anti-freeze.*

44. *Start the engine and run it until the thermostat opens. Check the coolant level and top up if necessary.*

Cylinder head re-tightening

45. Warm up the engine and run it for 10 minutes at 3000 RPM; then allow to cool for 3 1/2 hours before re-tightening the cylinder head as follows:

    - Release any pressure from the cooling system.
    - Remove the rocker cover and the rocker shaft.
    - Taking each bolt in turn in the same sequence as before, slacken by a quarter of a turn and then re-tighten to 70 Nm (52 lbf ft).
    - In the same sequence, tighten each bolt a further 120°.
    - Refit the rocker shaft, adjust the valve clearances and refit the rocker cover.

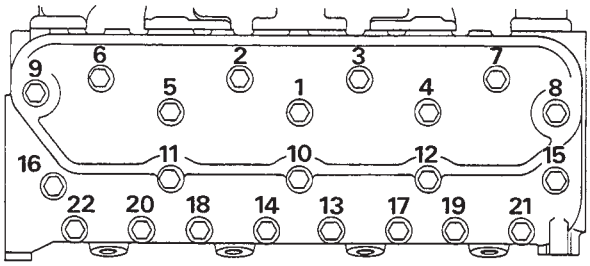


Fig.13 Cylinder head tightening

TIMING COVER

CRANKSHAFT FRONT OIL SEAL

Tools required: 0480034 (MS 1517), 0480058, 0480060.

Remove

The crankshaft front oil seal can be changed with the engine in situ by first carrying out the following operations:

1. *Disconnect the battery(s), negative terminal(s) first.*

2. *Drain the coolant from the radiator, and disconnect the hoses to the engine. Detach the fan cowl.*

3. *Remove:*
   - *bonnet locking platform,*
   - *radiator,*
   - *fan , using tool 0480034 (MS 1517); hub nut has left hand thread,*
   - *fan cowl.*

4. Remove:
   - vacuum pump belt,
   - alternator belt,
   - fan belt.

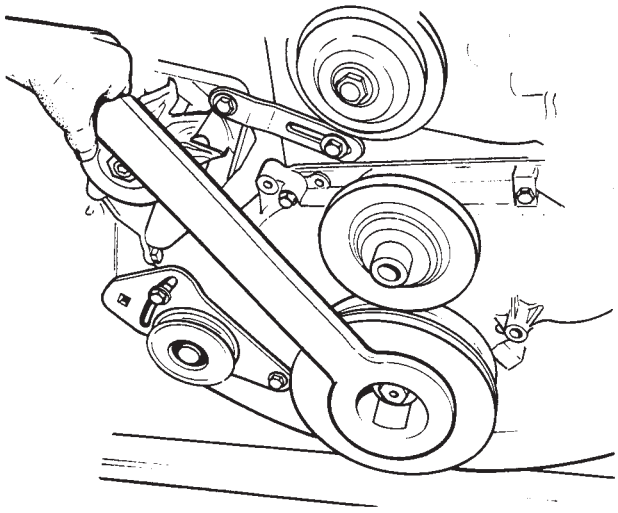


Fig.1 Holding crankshaft with 0480060

5. Use tool 0480060 to hold the crankshaft from turning, then remove the crankshaft pulley securing bolt and plain washer, and pull off the pulley. Note the Woodruff key in the crankshaft nose.

6. Carefully prise out the old seal.

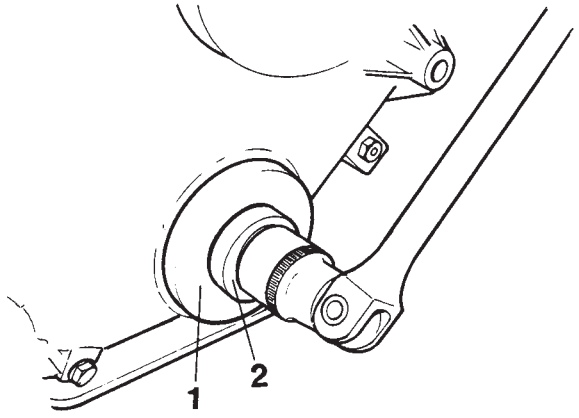


Fig.2 Fitting crankshaft front oil seal
1. Tool 0480058
2. Pulley washer

7. Smear the lip of the new seal with engine oil, and use tool 0480058 with the crankshaft pulley bolt and washer to pull it into the timing chain cover.

   The seal is fitted with its lip facing inwards.

   The tool will position the seal correctly, 1 mm. (0.04 in) in from the outside face of the cover.

8. Check that the Woodruff key is in position in the crankshaft nose, then fit the crankshaft pulley

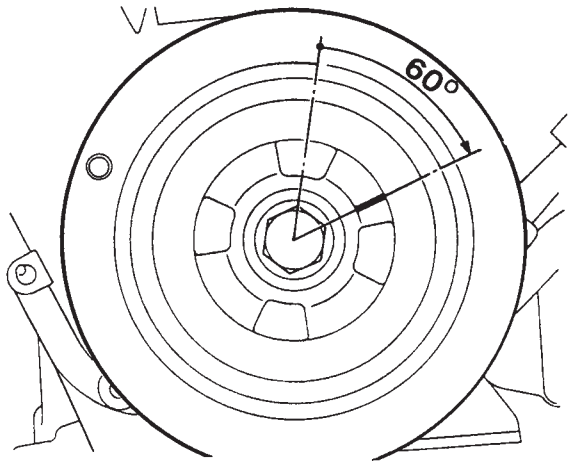


Fig.3 Tightening crankshaft pulley nut

9. Apply Loctite 270 to the pulley securing bolt, and fit it and its plain washer. Tighten the bolt as follows:
   Pre-tighten to 55 Nm (41 lbf ft).
   Mark one corner of the bolt, then tighten it a further 60°, i.e. one flat.

10. Fit:
    - fan belt,
    - alternator belt,
    - vacuum pump belt,

    and adjust these belts to the correct tension.

If the work is being carried out with the engine in situ, the following operations will be necessary:

11. *Position the fan cowl and fit:*
    - *fan,*
    - *radiator,*
    - *bonnet locking platform,*
    - *fan cowl,*
    - *coolant hoses.*

12. *fill the system with the correct 50% water/anti-freeze solution.*

13. *Connect the battery(s), positive terminal(s) first, start the engine and run until the thermostat opens.*

14. *Check for oil or coolant leaks. When the engine has cooled, check the coolant level and top up as necessary.*

TIMING CHAIN AND SPROCKETS

Tools required: 0480034 (MS 1517), 0480058, 0480060.

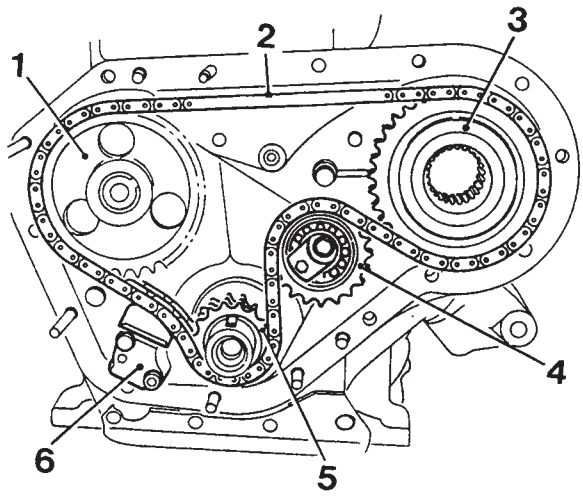


Fig.1 Timing sprockets and chain

1. Camshaft sprocket
2. Timing chain
3. Fuel injection pump sprocket
4. Idler sprocket
5. Crankshaft sprocket
6. Hydraulic tensioner

Description

The camshaft and fuel injection pump drive sprockets are driven by a double open link chain from the crankshaft sprocket.

An eccentrically mounted idler sprocket provides the means of adjusting the timing chain during assembly.

When the engine starts, chain tension is adjusted automatically by a hydraulic tensioner operated by oil pressure.

Timing is indicated by marks on the sprockets and corresponding paint marks on the chain links.

Remove

NOTE: On early engines a metal camshaft sprocket was fitted; it cannot be removed from the camshaft without first removing the camshaft from the engine. To remove the camshaft, the engine must be removed from the vehicle and inverted.
On later engines the camshaft sprocket is a composite synthetic material and cannot successfully be removed from the camshaft.

The timing cover and chain can be removed with the engine in situ by first carrying out the following operations:

1. *Disconnect the battery(s), negative terminal(s) first.*

2. *Drain the coolant from the radiator, and disconnect the hoses to the engine. Detach the fan cowl.*

3. *Remove:*
   - *bonnet locking platform,*
   - *radiator,*
   - *fan, using tool 0480034 (MS 1517), hub has left hand thread,*
   - *fan cowl.*

4. Remove:
   - vacuum pump belt,
   - alternator belt,
   - fan belt.

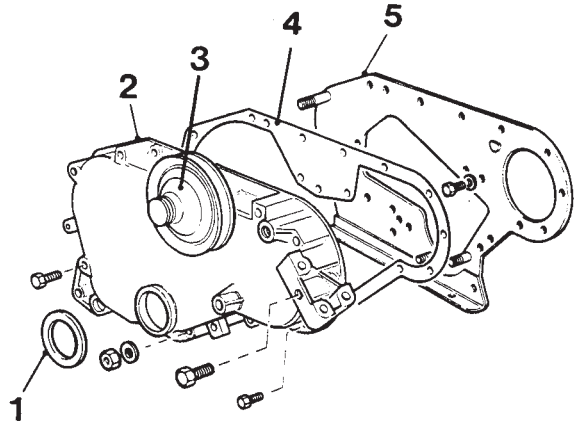


Fig.2 Timing chain cover
1. Crankshaft front oil seal
2. Timing chain cover
3. Fan pulley
4. Gasket
5. Front engine plate

5. Use tool 0480060 to hold the crankshaft from turning, then remove the crankshaft pulley securing bolt and plain washer, and pull off the pulley. Note the Woodruff key in the crankshaft nose and retrieve if necessary.

6. Remove the securing bolts to release the timing chain cover.
   Note one bolt fitted directly below the fan pulley.
   Discard the timing cover gasket.

7. Carefully tap out and discard the timing cover oil seal.

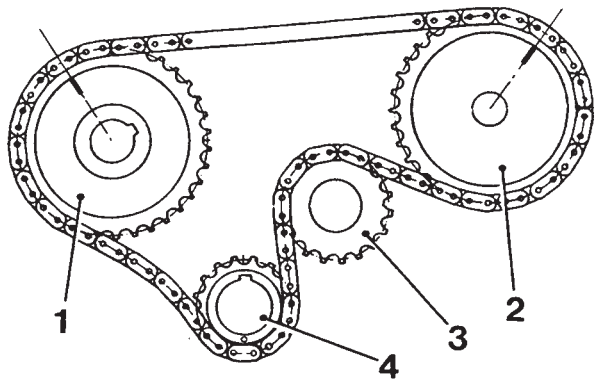


Fig.3 Timing marks
1. Camshaft sprocket
2. Fuel injection pump sprocket
3. Idler sprocket
4. Crankshaft sprocket

8. Temporarily refit the crankshaft pulley bolt.
   Turn the crankshaft clockwise until the key in the crankshaft nose is vertically upwards.

   Check that the position of the timing marks on the camshaft and injection pump sprockets are as shown in fig.3. If not, turn the crankshaft clockwise by one revolution.

   At this stage ignore the position of the paint marks on the chain; they will only align with the sprocket marks once in every 90 crankshaft revolutions.

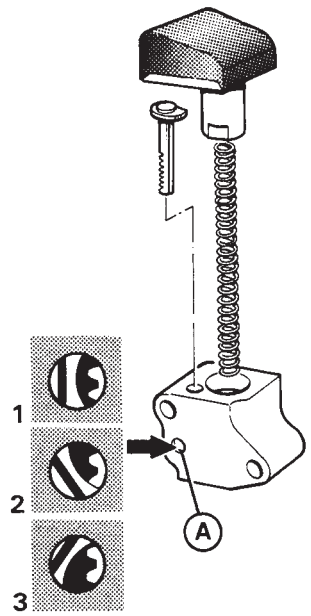


Fig.4 Hydraulic tensioner

A. Locking screw
1. 'Dismantle/assemble' position
2. 'Tensioner locked' position
3. 'Tensioner operational' position

The hydraulic tensioner is fitted with a 3-position locking screw.

Position 1: The slipper pad, spring and adjusting ratchet can be removed. **CAUTION: Do not attempt to remove the locking screw 'A', it cannot be refitted.**
Position 2: The ratchet and slipper pad locked and cannot be removed.
Position 3: Tensioner fitted and operational.

9. Lock the tensioner by turning the screw to position 2 as shown in fig.4.

10. **NOTE**: Before removing the chain tensioner, measure the gap between the tensioner body and its slipper pad. The timing chain should be renewed if the gap exceeds 9 mm (0.35 in).

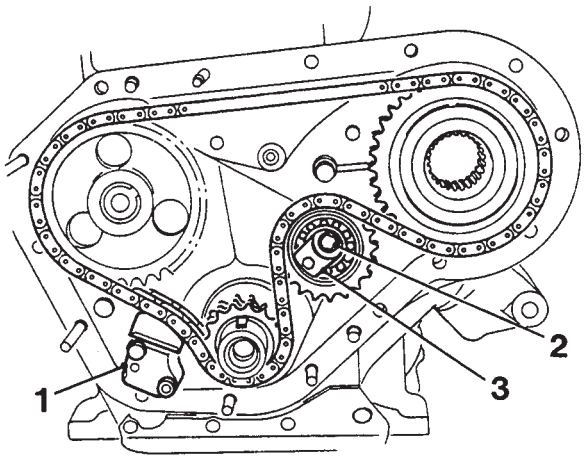


Fig.5 Idler sprocket

1. Tensioner
2. Idler sprocket securing bolt
3. Adjusting bracket

11. Remove:
- the chain tensioner,
- the eccentric idler sprocket,
- the timing chain,
- the fuel injection pump sprocket,
- the crankshaft sprocket.

Note the Woodruff key on the crankshaft nose which locates the sprocket, and retrieve if necessary.

Camshaft sprocket

Examine the camshaft sprocket for wear or damage.

On early engines with a metal sprocket, the sprocket is keyed to the camshaft and fitted by heating and shrinking.
It cannot therefore be removed with the camshaft in situ, and the camshaft can only be removed with the engine removed from the vehicle.
Later engines are fitted with a composite synthetic sprocket which cannot be separated from the camshaft without damage to both components. If renewal of this type of sprocket is required, a replacement sprocket and camshaft assembly must be used.

The engine front plate cannot be removed without removing the camshaft.

Other components

12. Clean all components and examine for wear or damage. Renew as necessary.
    Clean off all gasket traces from the timing cover and the engine plate.

Fuel Injection Pump Support Bearing

Remove

13. If it is necessary to remove the fuel injection pump support bearing, proceed as follows:

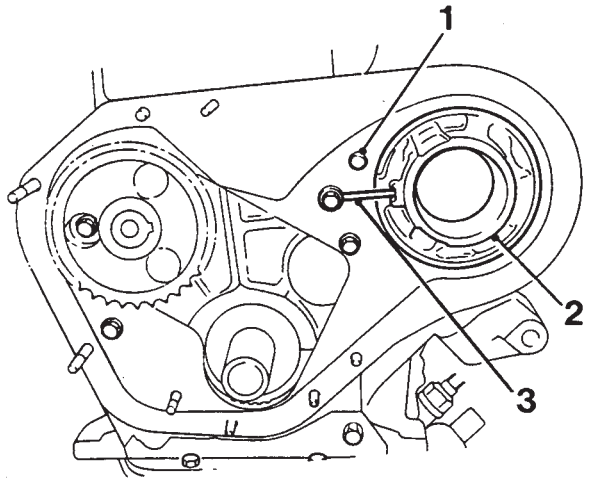


Fig.6 Pump support bearing

1. Pump bearing securing bolt
2. Pump support bearing
3. Lubrication pipe

Remove the fuel injection pump (see section **'Fuel System'** for details).

Remove the lubrication pipe with its sealing sleeve, noting the fitted position of the pipe.

Remove the securing bolt to release the pump support bearing. Discard the 'O' ring.

Examine all components for wear or damage and replace as necessary.

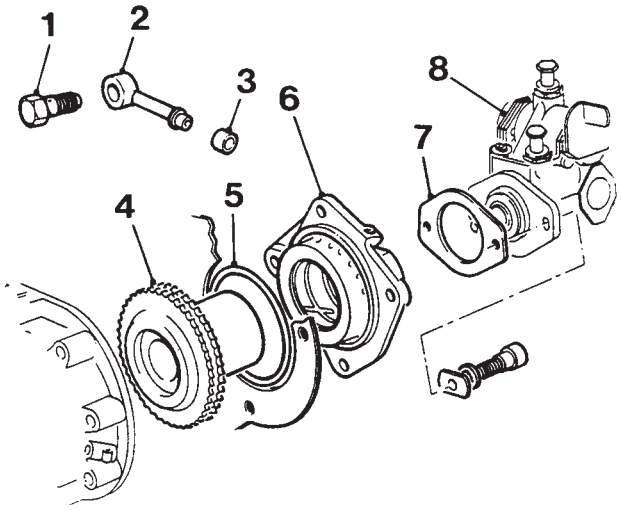


Fig.7 Injection pump drive components

1. Banjo bolt
2. Lubrication pipe
3. Sealing sleeve
4. Injection pump drive sprocket
5. 'O' ring
6. Pump support bearing
7. Gasket
8. Fuel injection pump

Refit

14. Position the pump support bearing, using a new 'O' ring. Fit the bearing securing bolt, having first smeared its threads with Loctite 270.

    Before fitting the lubrication pipe, note the following:
    - fit the sealing sleeve to the pipe,
    - the pipe is offset in the banjo towards the engine plate,
    - after fitting the banjo bolt through the union, carefully apply a smear of Loctite 270 to its threads.
      DO NOT ALLOW LOCTITE NEAR THE OIL PASSAGEWAY.

    Fit the lubrication pipe.

Refitting timing sprockets and chain

15. Loosely fit the fuel injection pump (if removed).

16. Fit the fuel injection pump drive sprocket.

17. If removed, fit the crankshaft sprocket Woodruff key, then fit the sprocket with the shouldered and marked face outwards.

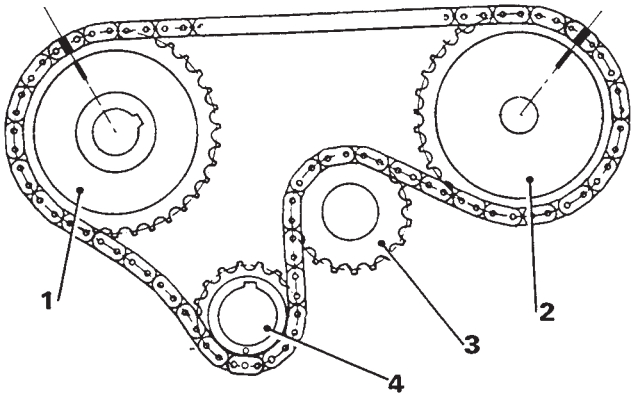


Fig.8 Timing marks

1. Camshaft sprocket
2. Fuel injection pump sprocket
3. Idler sprocket
4. Crankshaft sprocket

18. To fit the timing chain:
    - Check that No. 1 and 4 pistons remain at TDC, i.e.Woodruff key pointing vertically up and 'O' mark vertically down.
    - Position the camshaft and injection pump sprockets so that their scribed timing lines are as shown in fig.8.
    - Fit the timing chain so that the marked chain links align with the timing marks on the sprockets when the chain slack is taken up at the idler sprocket.

19. Fit the idler sprocket.

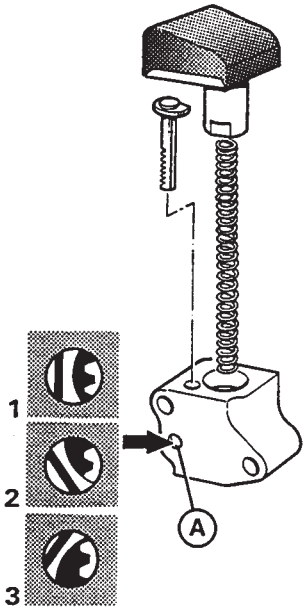


Fig.9 Chain tensioner

20. If the hydraulic tensioner has been dismantled, prepare it as follows:
    - Turn the lock screw to position '1' and assemble the tensioner (see fig.9).
    - Compress the tensioner fully, then lock by turning the screw to position '2'.

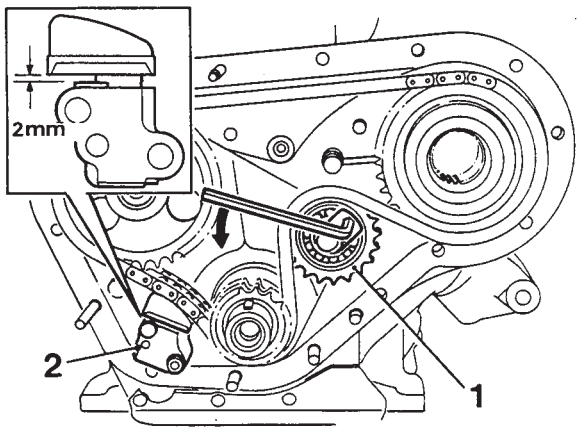


Fig.10 Tensioning chain

1. Idler sprocket
2. Hydraulic tensioner locking screw

21. Fit the hydraulic tensioner.

22. Adjust the idler sprocket by using an Allen key to turn it anti-clockwise until a 2 mm clearance exists between the tensioner slipper and the plunger (see fig.10).

    Tighten the idler sprocket securing bolt to 35 Nm (26 lbf ft).

23. Activate the hydraulic tensioner by turning its lock screw to position '3' (fig.9).

24. Turn the engine against normal rotation by one complete turn, then turn it forward by the same amount and check that the timing marks realign.

25. Use tool 0480058 to fit a new crankshaft oil seal into the timing chain cover. The seal is fitted from the outside with its lip facing inwards. The tool will position the seal correctly, 1 mm in from the outside face of the cover.

26. Use a smear of grease to locate a new timing cover gasket on the engine front mounting plate. Lubricate the lip of the crankshaft front oil seal with engine oil, then fit and secure the timing chain cover.

27. Check that the Woodruff key is in position in the crankshaft nose, then fit the crankshaft pulley.

28. Apply Loctite 270 to the pulley securing bolt, and fit it and its plain washer. Tighten the bolt as follows:
    Pre-tighten to 55 Nm (41 lbf ft).
    Mark one corner of the bolt, then tighten it a further 60°, i.e. one flat.

29. Time the injection pump, as described in the section - **'Fuel System'**.

30. Fit:
    - fan belt,
    - alternator belt,
    - vacuum pump belt,

    and adjust all belts to the correct tension:

If the work is being carried out with the engine in situ, the following operations will be necessary:

31. *Position the fan cowl and fit:*
    - *fan,*
    - *radiator,*
    - *bonnet locking platform,*
    - *fan cowl,*
    - *coolant hoses.*

32. *Fill the system with the correct water/ anti-freeze solution.*

33. *Connect the battery(s), positive terminal(s) first, start the engine and run until the thermostat opens.*

34. *Check for oil or coolant leaks. When the engine has cooled, check the coolant level and top up as necessary.*

CAMSHAFT

Remove / Refit

Tools required: 0480034 (MS 1517), 0480058, 0480060, 0480063.

Remove

To remove the camshaft it is necessary to remove the front engine plate, and the engine must be inverted. Therefore the engine must be removed from the vehicle.

With the engine on the bench, proceed as follows.

1. Drain the oil and remove the sump (see section 'Sump').

2. Remove the oil pump.(see section 'Lubrication').

3. Remove the cylinder head (see section 'Cylinder Head Remove / Refit').

4. Remove (see section 'Timing Chain & Sprockets'):
   - Fan
   - External drive belts
   - Timing cover
   - Chain tensioner
   - Idler sprocket
   - Timing chain
   - Fuel injection pump sprocket

5. Invert the engine so that the tappets will not fall out when the camshaft is removed.

6. Remove the lubrication pipe to the injection pump drive noting its sealing sleeve (see fig.7).

7. Remove the front engine plate securing bolts.
   NOTE: one of the bolts is accessed through a hole in the camshaft gear.

8. Remove / withdraw the front engine plate and the camshaft together.
   NOTE: The plate slots into a groove in the camshaft front bearing to control camshaft end-float (see section 'Timing Chain and Sprockets' for details).

Inspection

See also section 'Camshaft Sprocket' .

9. Clean all components.

   Inspect the camshaft sprocket, journals and lobes, and the cylinder block bearings for wear or damage.

   Note the location of each tappet before removing for inspection. Examine the tappets for dishing, wear, cracks and damage.
   Inspect the tappet bores. If satisfactory, refit each tappet in its original bore.
   NOTE: Two sizes of tappet are available for renewal purposes; establish the correct diameter before obtaining replacement parts.
   Sizes available are:
   24 mm O/D (0.9449 in)
   24,18 mm O/D (0.952 in)

Refit

10. Refitting is the reverse of the removal procedure but the engine has to be timed also. The following points should be noted:

    - Lubricate and fit the tappets before fitting the camshaft.
    - Apply RTV sealant to the cylinder block and front engine plate mating faces.
    - Locate front engine plate into the camshaft groove and fit both together. Check camshaft end float (see 'Technical Data').
    - Banjo union on lubrication pipe is offset and Loctite 270 must be carefully smeared on banjo bolt threads (see fig.7 and operation 14).
    - Fit sprockets, tensioner and chain, and time the engine as described in section 'Timing Chain and Sprockets'.
    - The oil pump drive end-float must be checked and adjusted if necessary when refitting (see section 'Lubrication').

FLYWHEEL

The flywheel is dowelled to the rear face of the crankshaft with a single roll pin, and secured with eight bolts fastened through the reinforcing plate.
The starter ring gear is attached to the outer diameter of the flywheel by a heating/ shrinking process.
The flywheel cannot be refaced.

NOTE: The crankshaft rear oil seal is not accessible by removing the flywheel. To change the seal, the engine must be out of the vehicle and the crankshaft removed.

Remove and refit

Tool required: 0480057

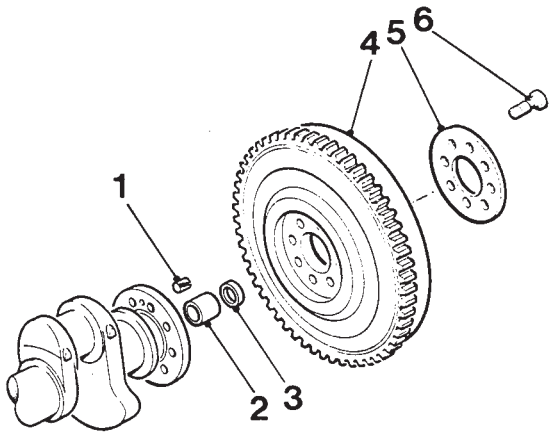


Fig.1 Flywheel
1. Dowel
2. Spigot bush
3. Seal
4. Flywheel and ring gear assembly
5. Reinforcing plate
6. Bolt (8)

Remove

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

1. Remove the clutch assembly.

2. Support the flywheel and remove the eight securing bolts to release it. Note the dowel pin location when the flywheel is removed.

3. Examine the rear of the block for signs of oil leakage from the crankshaft rear oil seal.
   Check the threaded plugs and core plugs for signs of oil leakage. Rectify as necessary.
   Inspect the spigot bush in the rear of the crankshaft for signs of wear or damage. Replace if necessary, together with the seal which retains it.

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:

Replacement of starter ring gear

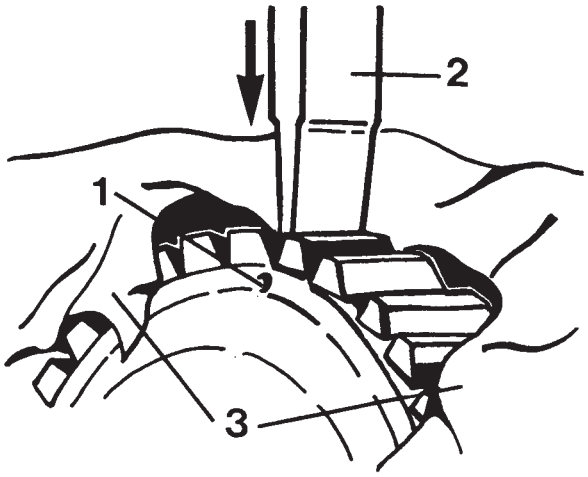


Fig.2 Removing starter ring gear
1. Drilled hole
2. Chisel
3. Protective cloth

5. If the ring gear requires renewal, drill a hole between the roots of any two teeth and the inner diameter of the ring gear deep enough to weaken the gear. Do not drill into the flywheel.

   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.

To fit the new ring gear, heat it uniformly to 170°C (340°F).

Making sure the chamfered side of the teeth will point towards the chamfered teeth on the starter motor pinion when fitted, press the ring gear up to the shoulder on the flywheel.

Hold the ring gear in place until it has cooled sufficiently to contract and grip the flywheel.

Allow the ring gear to cool gradually; do not place in cold water.

Refit

6. Clean the rear face of the crankshaft and the mating face of the flywheel. Check that there are no burrs which could cause run-out of the flywheel.

7. Lubricate the crankshaft spigot bush and seal.

8. Check that the dowel pin is in place, then fit the flywheel with its reinforcing plate and eight securing bolts.

9. Restrain the flywheel from turning and tighten the bolts as follows:

   - Pre-tighten the eight bolts in the sequence shown to 15 Nm (11 lbf ft).

   - Mark one corner of each bolt head, then further tighten in the same sequence by 60°, i.e. one flat.

10. Degrease the flywheel face, then fit the clutch assembly using tool 0480057 to align the driven plate.

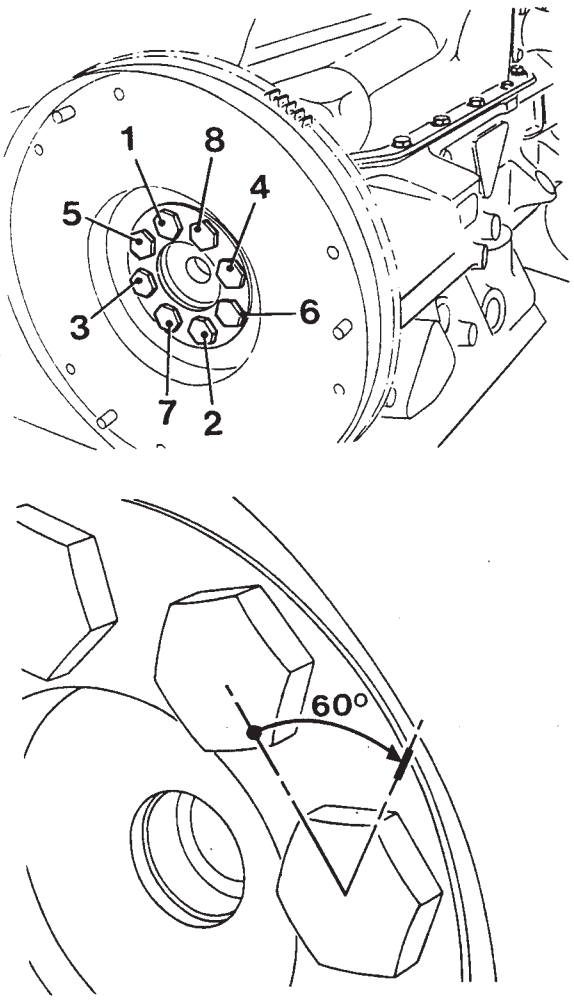


Fig.3 Flywheel bolt tightening sequence

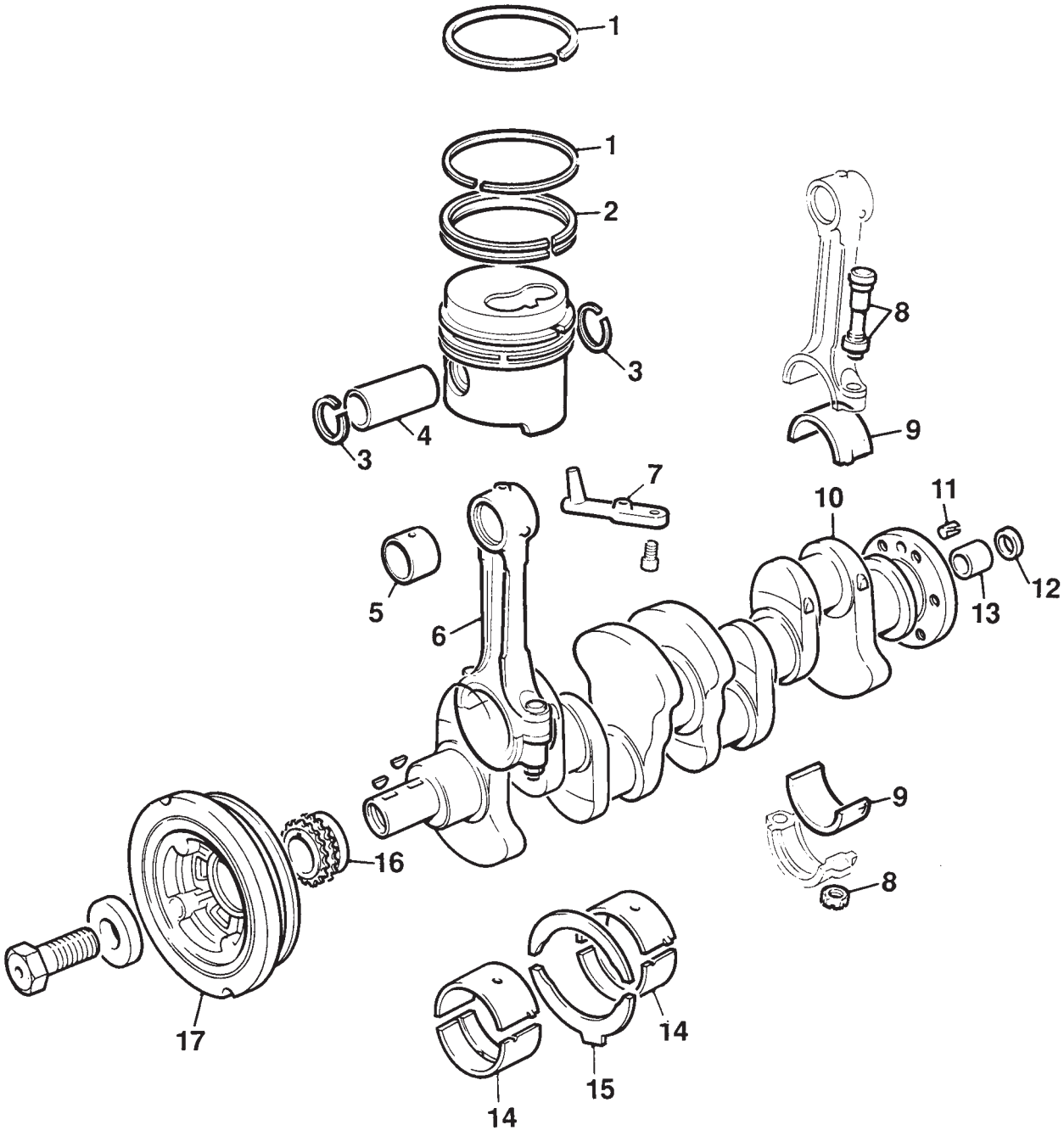


Fig.1 Crankshaft, Connecting rods and pistons

1. Compression rings
2. Oil control ring
3. Gudgeon pin circlips
4. Gudgeon pin
5. Gudgeon pin bush
6. Connecting rod & cap
7. Oil jets (ET engine only)
8. Connecting rod cap bolts & nuts
9. Big end bearings
10. Crankshaft
11. Dowel pin
12. Seal
13. Spigot bush
14. Main bearings (two widths)
15. Thrust washers
16. Crankshaft sprocket
17. Crankshaft pulley

CYLINDER BLOCK ASSEMBLY

Description / Features

The cylinder block is cast iron and the piston bores are direct into the block; i.e. no liners are fitted.

The camshaft journals and tappet bores are also bored directly into the block. One oversize tappet is available for overhaul purposes.

The ET cylinder block is fitted with piston oil jets

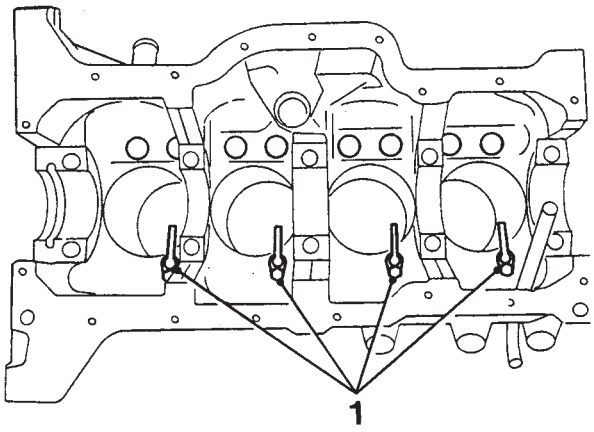


Fig.2 Piston oil jets *(ET engine only)*
1. Oil jets

CRANKSHAFT

A common crankshaft is fitted to EN and ET engines.
End float is controlled by thrust washers fitted to the centre main bearing; the standard size and one oversize set of thrust washers are available.
Machining of main and big ends is permissible:

- big end bearings - standard size
  - two undersizes
- main bearings - standard size
  - three undersizes

PISTONS AND CONNECTING RODS

Pistons

EN and ET pistons are different; ET pistons have an oil gallery inside the skirt for additional cooling. The galleries are supplied by oil jets positioned in the block.

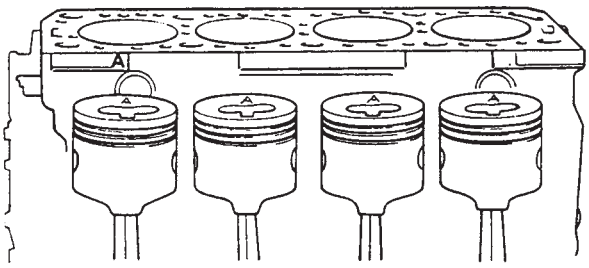


Fig.3 Piston / bore sizes

Two piston sizes (A and B) are selective fitment on initial assembly to allow for bore machining tolerances. They are fitted only as a set of four 'A' or four 'B' pistons.
The piston size is marked on its crown, and the bore size of the four bores is stamped on the block opposite No. 4 piston (i.e. nearest the timing cover).
A piston marked 'B' must not be fitted to an 'A' bore or vice versa.

Two piston oversizes are available +0,40 mm and + 0,80 mm marked E and J respectively.

Two types of piston are used - PDC and AE, and are fitted in engine sets.
CAUTION: Do not mix pistons of different manufacturing origin in the same engine.

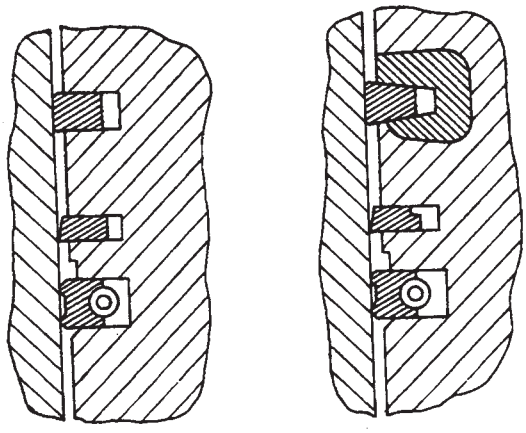
EN engine
- early AE or PDC (standard sizes)
  PDC (oversizes)
- current AE (standard sizes)
  PDC (oversizes)

ET engine AE (standard and oversizes)

Piston identification:
PDC pistons - stamped on crown.
AE pistons - cast inside skirt.

Rings

Different ring designs are used on EN and ET engines as shown in fig.4.



EN ET

Fig.4 Piston ring layout

EN Engine
Top ring - plain ring with square face, and can be fitted either way round.
Second ring - plain ring with taper face; upper face of ring marked 'TOP'.

ET Engine
Top ring - wedge shaped ring with curved face, and can be fitted either way round.
Second ring - stepped internal face, and tapered outer face; upper face of ring marked 'TOP'.

On both engines the third, oil control ring can be fitted either way round.

Piston Ring Gaps

Before fitting new piston rings, check the ring gaps as follows:

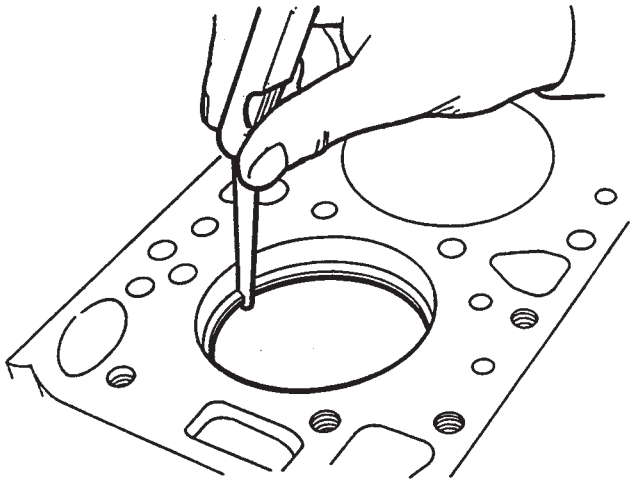


Fig.5 Measuring ring gap

1. Fit each ring in turn in the bore of the cylinder to which it will be fitted. Position it just below the wear ridge. Ensure it is square in the bore by pushing into position with the piston crown.

2. Measure each ring gap with feeler gauges and compare with the figures given in **'Technical Data'**.

   If the gap is too small try another ring; if too large, check for bore wear.

Piston and Connecting Rod Assembly

The gudgeon pin is a slide fit in the piston, and is secured with circlips. If necessary, gudgeon pin removal or fitting can be eased by moderate warming of the piston.

CAUTION: Do not apply heat with a naked flame.

Before assembling a piston to its connecting rod, examine the big end cap bolts and nuts for signs of thread damage, stretching etc. Renew any that are suspect.

Connecting rods are supplied as a matched weight set of four with fitted small end bushes, although the bushes, cap bolts and nuts are available separately.

Connecting rods and small end bushes are different for EN and ET engines.
The ET engine has larger diameter gudgeon pins - 32 mm (EN - 30 mm).

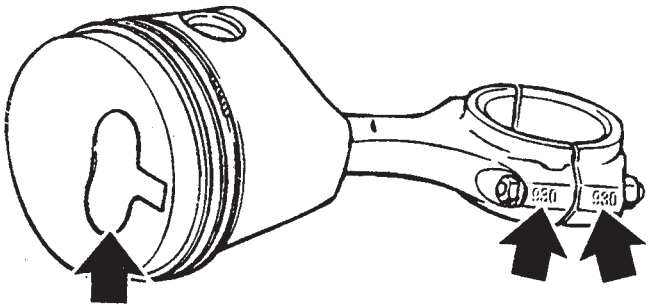


Fig.6 Fitting piston to connecting rod

When fitted, the recess on the piston crown must be on the same side as the stamped identification numbers on the side of the connecting rod and cap (see fig.6).

Lubricate with engine oil and fit each piston and connecting rod assembly in the cylinder block with the recess in the piston crown towards the injection pump side of the engine.

SUMP

Remove and refit

To remove the sump in situ, proceed as follows:

1. *Drain the oil.*
2. *Support the engine at the front, using a jack and a block of wood under the crankshaft pulley.*
3. *Unclip the clutch cable and unbolt the crossmember from the engine mountings and the body.*
4. ET engine only.
   Release the two breather pipes.
5. Remove the securing bolts to release the sump.
6. Clean off all traces of old sealant and gasket from sump and cylinder block mating faces.
7. Apply a dab of RTV sealant between the front engine plate and the block face, and on the slots of the rear main bearing cap.
8. Fit the sump using a new gasket, and tighten the bolts to a torque of 10 Nm (7 lbf ft)
9. ET engine only:
   Fit the two breather pipes.

If the engine is in the vehicle, complete the installation as follows:

10. *Fit the crossmember and remove the support jack.*
    Re-clip the clutch cable.
11. *Fill with the correct grade of engine oil. Start the engine and check for oil leaks.*

CRANKSHAFT REAR OIL SEAL

Tools required: 0480061, 0480062

The crankshaft rear oil seal is in two halves; one half is located in the rear main bearing cap and the other half in the cylinder block.

It is not possible to gain access to the seal by removing the flywheel.
The seal can only be changed by removing the crankshaft after removing the engine from the vehicle.

A new crankshaft rear oil seal is fitted as follows:

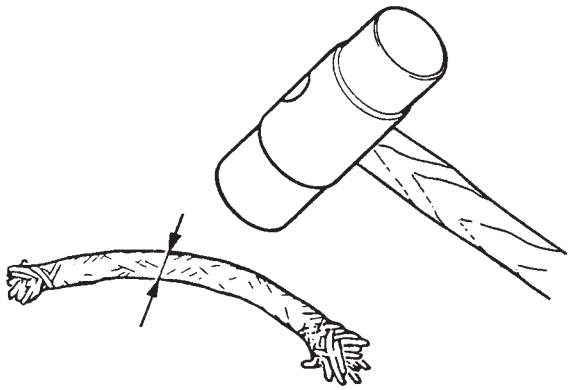


Fig.1 Seal preparation

1. To prepare the rear main bearing packing seals for fitting, flatten to a thickness of 4,5 mm (0.18 in), then smear the halves with engine oil.

2. Hand fit the packings to their locations in the cylinder block and in the bearing cap.

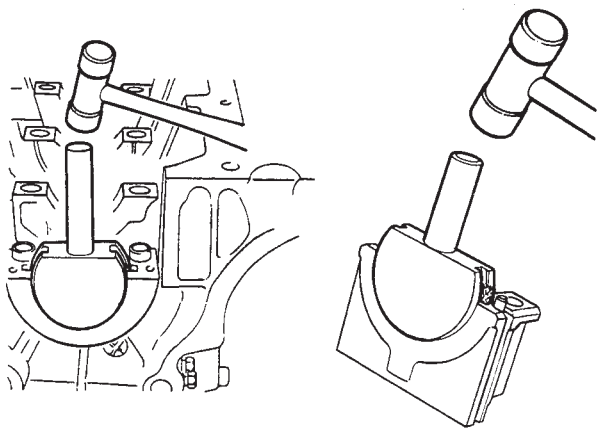


Fig.2 Shaping the seals with tool 0480061

3. Mould the seal halves to shape with tool 0480061 (fig.2).

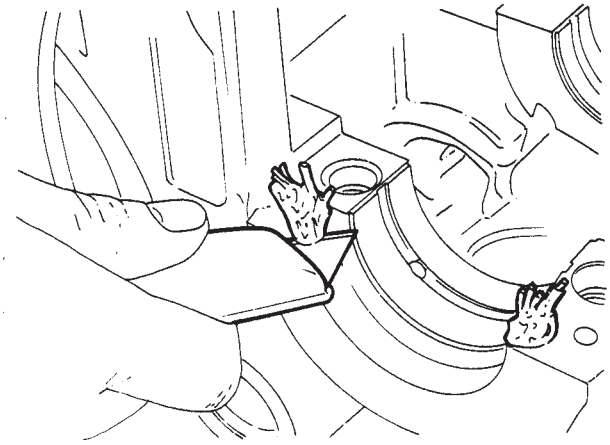


Fig.3 Trimming seal ends

4. Cut off the seal ends flush with the mating faces of cap and block.

5. Lubricate the crankshaft journals and fit the crankshaft into the block.

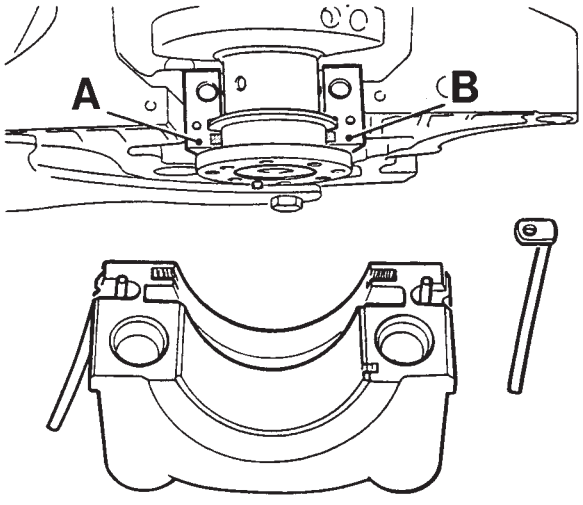


Fig.4 Rear main bearing cap rubber seals

6. Fit new rubber seals to the bearing cap.

7. Apply a drop of Loctite 574 to the mating face of the rear main bearing at 'A' and 'B' (fig.4).

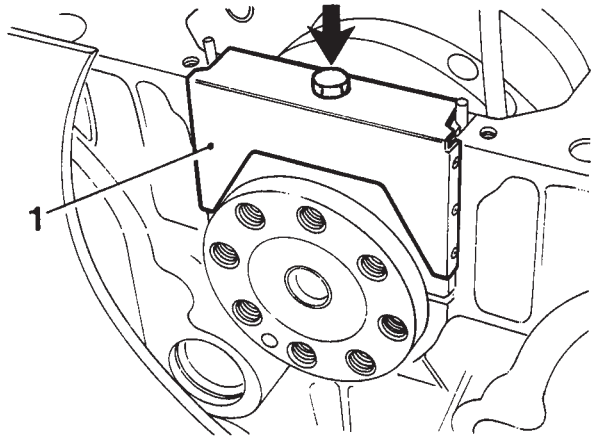


Fig.5 Using tool 0480062 to fit bearing cap
1. Tool 0480062

8. Carefully fit tool 0480062 to the bearing cap, making sure the rubber seals are correctly located. Secure the tool to the cap with a suitable bolt in the position arrowed (fig.5), and lubricate the sides of the tool.
   Fit the bearing cap and tighten the securing bolts to 120 Nm (89 lbf ft).

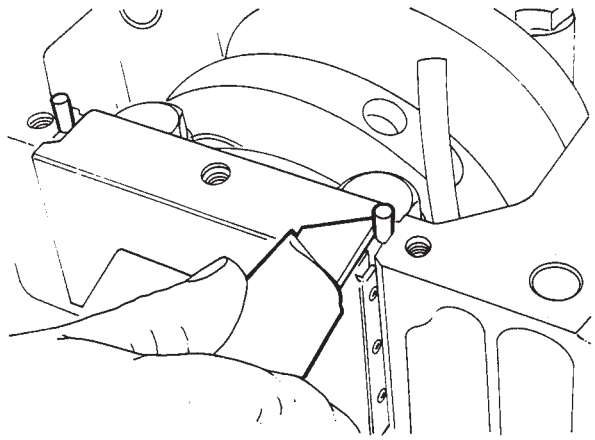


Fig.6 Trimming rubber seals

9. Trim off the ends of the rubber seals to the thickness of the tool.
   The seals should protrude by 0,5 mm (0.02 in) when tool is removed.

CRANKSHAFT TORQUE-TO-TURN

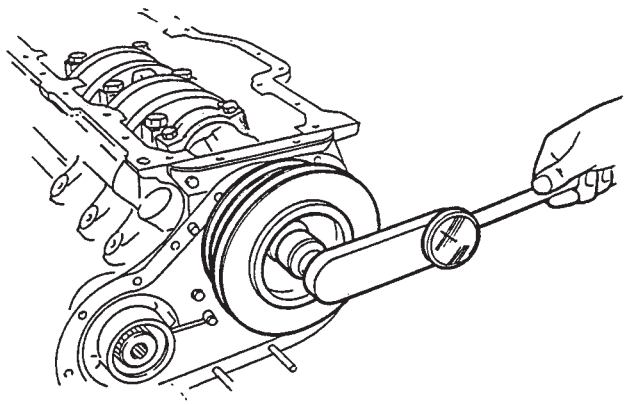


Fig.1 Measuring crankshaft torque-to-turn.

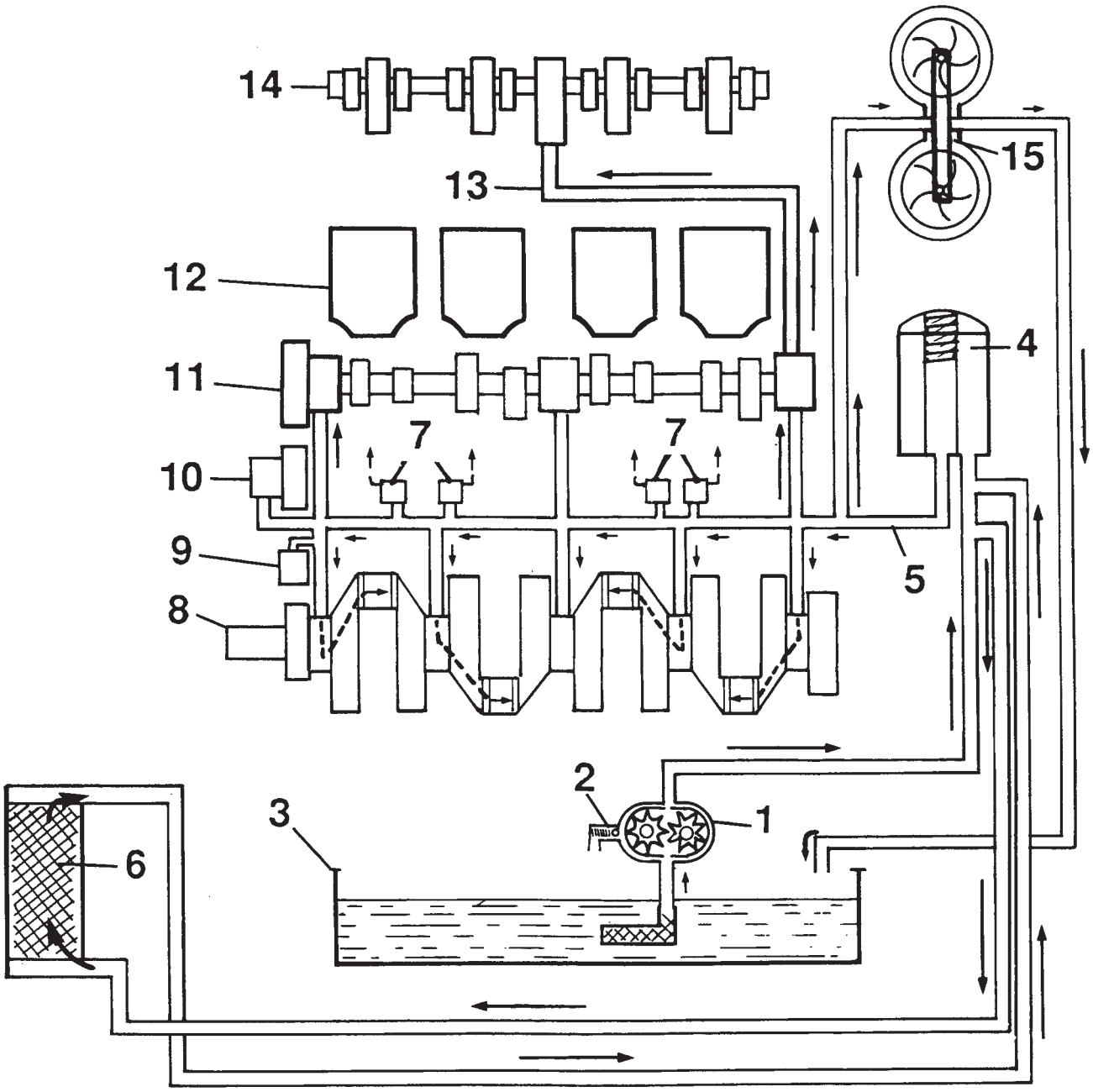
The crankshaft torque-to-turn must be checked after fitting the crankshaft and the piston and connecting rod assemblies, and after tightening the main bearing and big end caps to the correct torque.
Check the torque-to-turn as follows:

1. Temporarily fit:
   - Crankshaft sprocket
   - Crankshaft pulley
   - Crankshaft spacer and securing bolt.

2. Rotate the crankshaft several times.

3. Use a torque wrench to check that the torque required to turn the crankshaft does not exceed 60 Nm (44 lbf ft).

4. Should the torque-to-turn exceed the above figure, investigate and rectify the cause before proceeding.



Lubrication system - ET engine illustrated

1. Oil pump
2. Pressure relief valve
3. Sump
4. Oil filter
5. Main oil gallery
6. Oil cooler (ET engine only)
7. Oil jets (ET engine only)
8. Crankshaft
9. Timing chain tensioner
10. Fuel injection pump bearing
11. Camshaft
12. Pistons
13. External lubrication pipe
14. Rocker shaft
15. Turbocharger (ET engine only)

LUBRICATION

Oil circulation

The double gear oil pump (1) is driven by a shaft from a gear on the camshaft; the oil pump housing contains a pressure relief valve (2) which returns excess oil to the sump (3).

The pump supplies oil to the main oil gallery (5) in the engine via the full flow filter (4). the filter contains a valve arrangement to enable it to be by-passed if the filter should become blocked. On ET engines the oil cooler (6) is connected into the oil supply to the filter.

Oil in the main oil gallery supplies:
- The five crankshaft main bearings (8), which in turn supply the big ends.
- The three camshaft bearings (11).
- The fuel injection pump bearing (10).
- The timing chain hydraulic tensioner (9).

On ET engines the main oil gallery also supplies:
- The turbocharger bearings (15).
- The four jets (7) which direct oil into a gallery in each piston.

The small end bushes are lubricated by splash feed; a drilling in the top of each connecting rod ensures an adequate oil supply to the small end bushes.

The rocker shaft (14) is low pressure lubricated via an external pipe (13) connected to the rear camshaft bearing location.

OIL PUMP

The oil pump components are not available separately, and therefore if unserviceable, the oil pump must be changed as an assembly.

Pressure relief valve.
It is built into the oil pump, and cannot be overhauled.

The turbo oil pump is not the same as the naturally aspirated pump, the turbo has a larger capacity.

Both pumps are changed in the same way.

Remove

1. Drain and remove the sump, and discard the gasket.

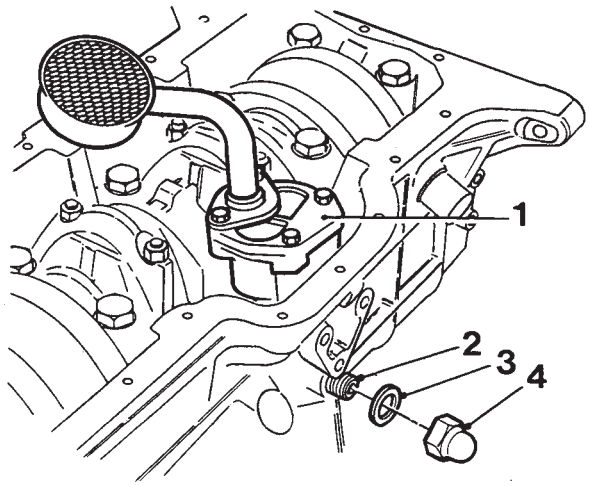


Fig.1 Oil pump
1. Oil pump
2. Oil pump securing Allen screw
3. Washer
4. Cap nut

2. Remove the cap nut and its washer. Remove the oil pump securing Allen screw to release the oil pump.

   NOTE: The oil pump cannot be overhauled; it is renewed as a unit.

Refit

3. Fit the oil pump, turning the crankshaft if necessary to engage the drive teeth. Align the pump locating hole with the threaded hole in the block.

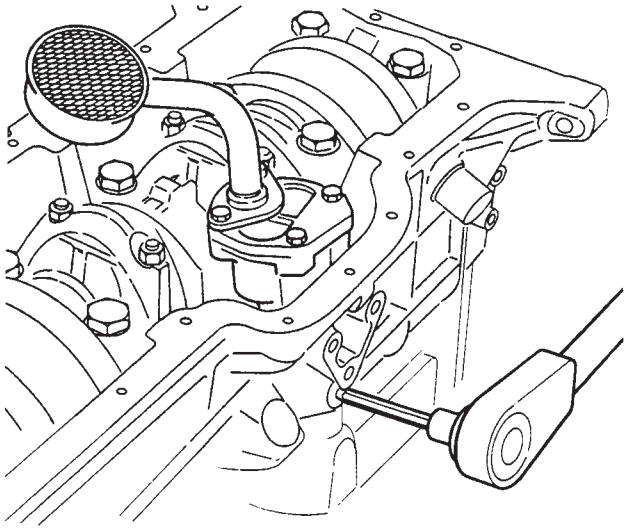


Fig.2 Fitting oil pump

4. Fit the tapered oil pump securing Allen screw and tighten it to 12 Nm (9 lbf ft). Fit the cap nut with a new washer, and tighten the nut to 30 Nm (22 lbf ft).

Oil pump drive end-float

If the cylinder block has been renewed, or if the oil pump or its drive has been removed, the oil pump drive end-float must be checked as follows:

5. Remove the oil pump thrust cap, and the spacer washer(s) underneath the cap.

6. Fit the thrust cap without the spacer washer(s), and tighten it to 10 Nm (7 lbf ft).

7. Use a feeler gauge to measure the gap between the cap and the cylinder block.

8. Select a spacer washer(s) of the same thickness as the measured clearance plus 0,1 mm (0.004 in).
   If necessary, select a washer immediately above the calculated thickness, or use two washers.

9. Fit the thrust cap and the washer(s) just selected, and tighten cap to 90 Nm (66 lbf ft).
   Washer thicknesses available:

   0,1 0,2 0,5 1,0 mm.

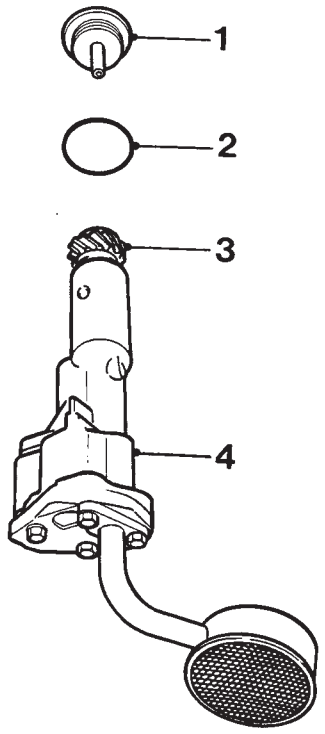


Fig.3 Oil pump end-float control

1. Thrust cap
2. Spacer washer
3. Oil pump drive gear
4. Oil pump

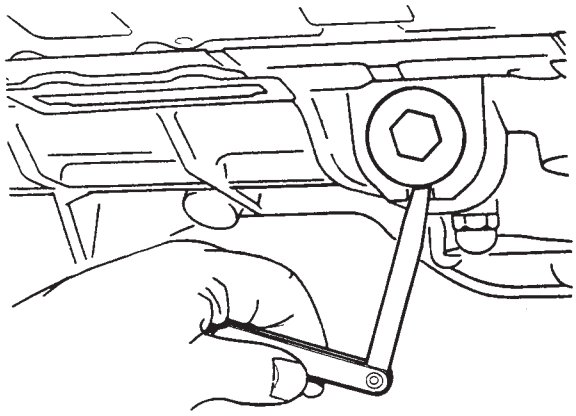
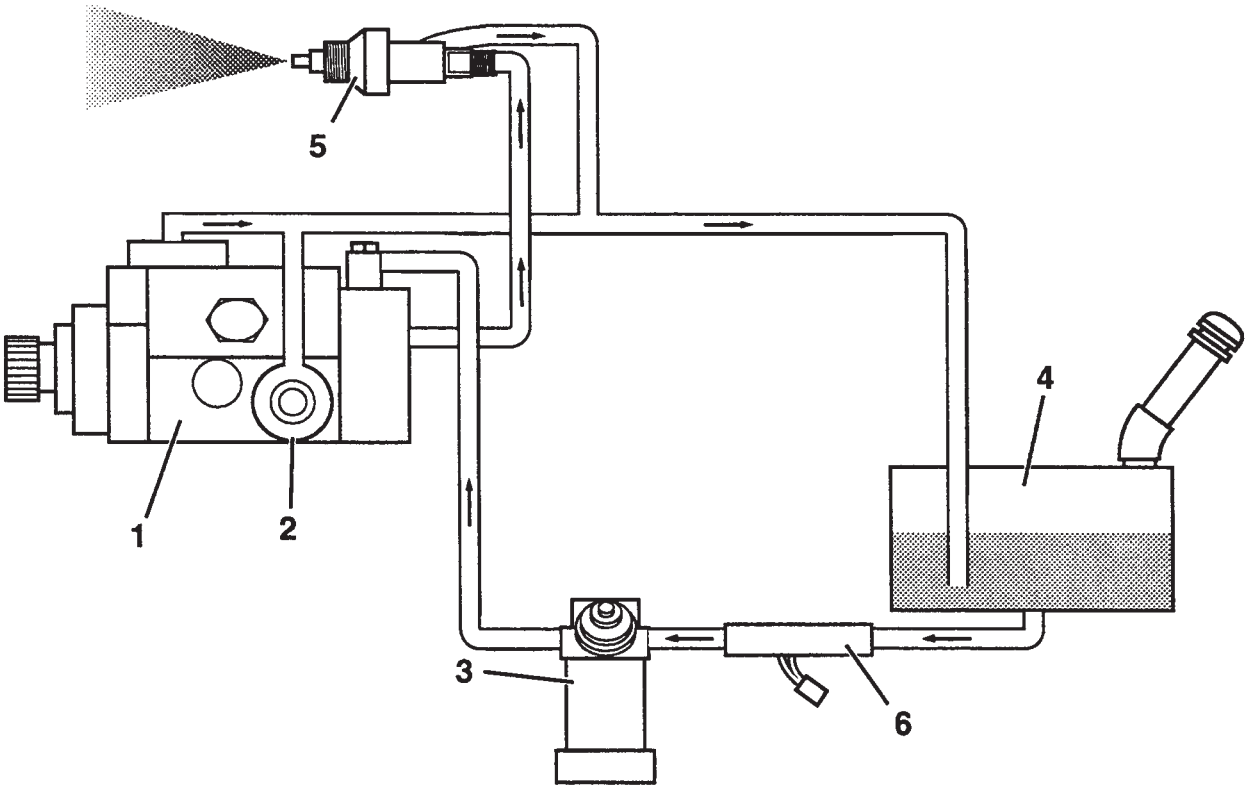


Fig.4 Measuring thrust cap gap

10. Apply a dab of RTV sealant between the front engine plate and the block face, and on the slots of the rear main bearing cap.

11. Fit the sump using a new gasket, and tighten the bolts to a torque of 10 Nm (7 lbf ft).

FUEL SYSTEM



Fuel system layout

1. Fuel injection pump
2. Boost control valve
3. Fuel filter
4. Fuel tank
5. Injector
6. Fuel heater (not early vehicles)

OPERATION

A separate fuel lift pump is not necessary in the system, as fuel is drawn into the system by the transfer pump inside the fuel injection pump.

The fuel injection pump (1) is driven by the timing chain; it draws fuel from the fuel tank (4), through the replaceable element filter (3). The filtered fuel enters the pump via a banjo connection on the hydraulic head; the banjo is fitted with a fine mesh filter. The transfer pump raises the fuel to a pressure controlled to a pre-determined level by a regulator valve.

The pump rotor in the hydraulic head distributes the fuel to each injector (5), the settings of which provide the final pressure rise. The quantity of fuel delivered into each combustion chamber is dependent on throttle position and engine speed, and also on boost pressure on turbo engines

Excess fuel from the injectors and from the injection pump passes through a return pipe directly to the fuel tank.

The turbo version of the pump is fitted with a boost control valve (2) which provides additional fuel metering dependent on manifold pressure. Excess fuel from the valve passes externally to the return line to the tank.

The injectors are preset to open at 115 bar (EN engine) and at 130 bar (ET engine).

The fuel is heated by an electrical heating element (6) in the supply line and located on the longitudinal chassis member. On early models this fuel heating was carried out by a coolant supply from the cylinder block to a water jacket in the base of the fuel filter.

FUEL INJECTION PUMP ADJUSTMENTS

Throttle Cable

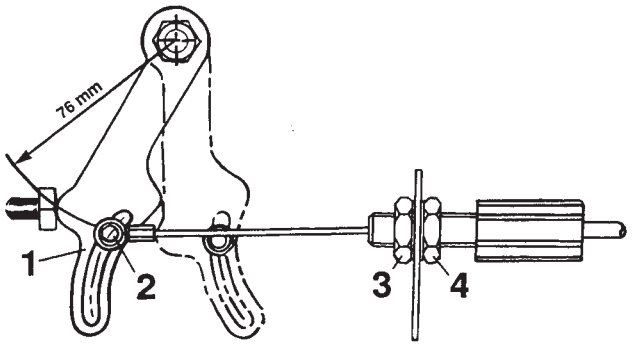


Fig.1 Throttle cable

1. Throttle lever
2. Throttle cable securing pin
3. Outer cable lock nut
4. Outer cable adjuster nut

Check the throttle cable adjustment as follows:

1. Check the position of the cable securing pin in the elongated slot of the throttle lever; it should be 76 mm (3 in) from the centre of the throttle lever pivot as shown.
   Adjust if necessary.

2. Slacken the outer cable lock nut.

3. Turn the adjuster nut until all slack is removed from the cable, but without causing movement of the throttle lever.

4. Slacken the adjuster nut by 3 flats, then tighten the lock nut.

5. Check that there is 3 - 4 mm (1/8 in approx) free play at the pedal pad.

Automatic Fast Idle

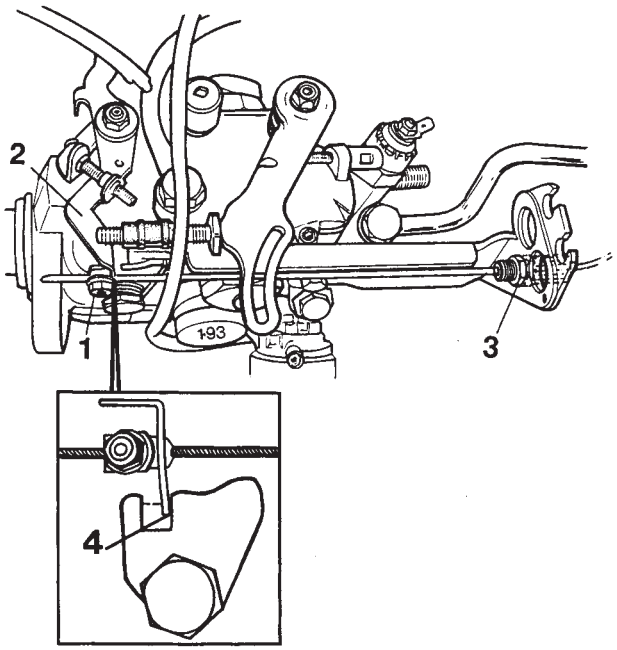


Fig.2 Fast idle cable

1. Inner cable securing clamp
2. Idle lever
3. Outer cable adjusters
4. Idle lever against stop

6. Adjust the inner cable at the securing clamp until all slack is eliminated from the cable, with the idle lever back against its stop.

7. If necessary, adjust the cable length at the adjustment nuts until the idle lever is fully backwards against its stop.
   NOTE: This adjustment must be made when the engine is cold.

To check Automatic Fast Idling when the engine is warm, move the idle lever back against its stop; the speed should increase by 400 ± 50 RPM.

Anti-stall

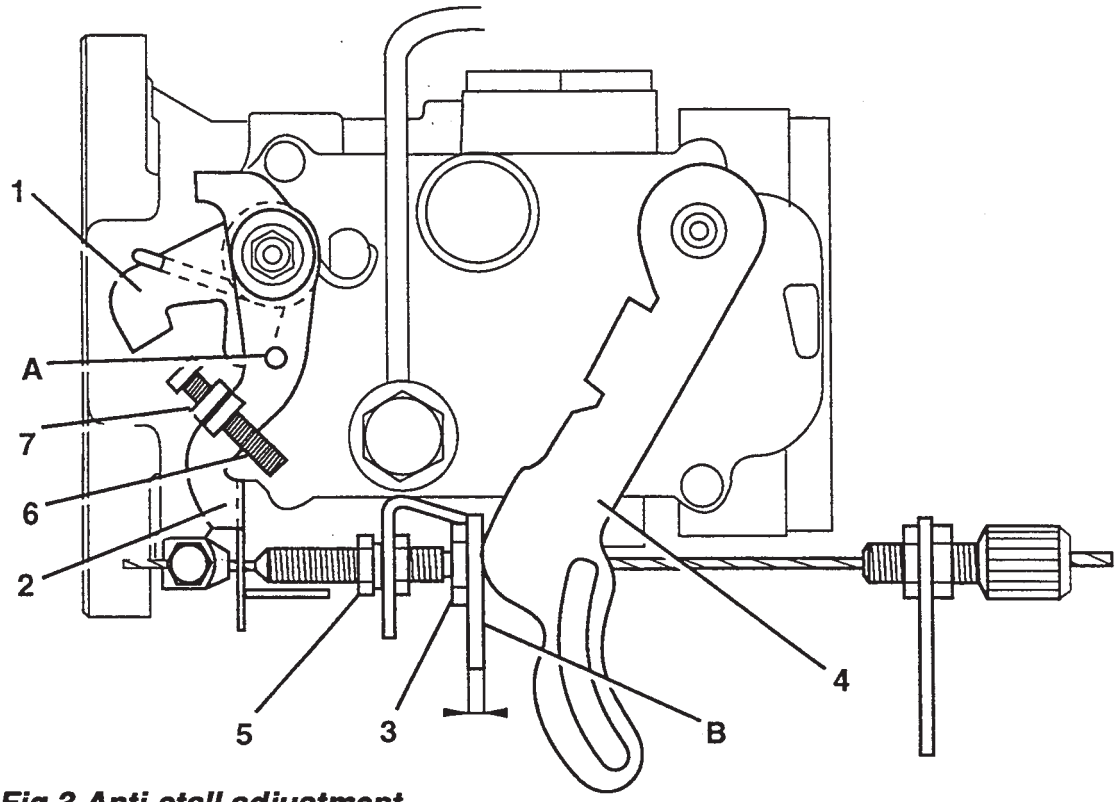


Fig.3 Anti-stall adjustment

A. Rod, diameter 3 mm
B. Spacer, 3 mm thick
1. Stop lever
2. Idling lever
3. Non-stalling stop screw
4. Throttle lever
5. Lock nut, non-stalling screw (3)
6. Idling screw
7. Lock nut, idling screw (6)

8. Allow the engine to warm up fully then adjust the anti-stall setting as follows:

   - Disconnect the throttle cable.
   - Place 3 mm (0.12 in.) spacer 'B' between screw (3) and lever (4).
   - Turn stop lever (1) against spring pressure and hold it by fitting rod 'A' in hole in idling lever (2).
   - Loosen lock nut (5), adjust speed to 900 ± 50 RPM with screw (3), then re-tighten the lock nut.
   - Remove rod 'A', and check that the lever (1) returns to its stop.
   - Remove spacer 'B'.
   - Loosen lock nut (7) and adjust the idle speed to 800 RPM using idle screw (6). Re-tighten the lock nut.
   - Pull lever (1) from its stop by 0,5-1 mm; the engine speed should drop. If not, repeat all the above adjustment instructions.
   - Connect the throttle cable and adjust its length as described in operations 1 to 5..

FUEL INJECTION PUMP - TIMING

Check and Adjust

Dynamic Timing Check

Tool required: Diesel Tune AVL 876

The fuel injection pump timing can be checked using the Diesel Tune AVL Tester and adaptors to connect to the flywheel sensor and to No.4 injector pipe.
NOTE: No.4 injector pipe is nearest to water pump.

With the engine running at idle speed (775 ± 25 RPM), the timing should be as follows:

EN engine	12° ± 1° BTDC
ET engine	9° ± 1° BTDC

For the greatest accuracy, Leyland DAF recommend that the pump timing check is carried out using the static timing method described below.

Static Timing Check

Tools required: 0480034, 0480056, 0480048 (18G 191), 0480060, 0480066.

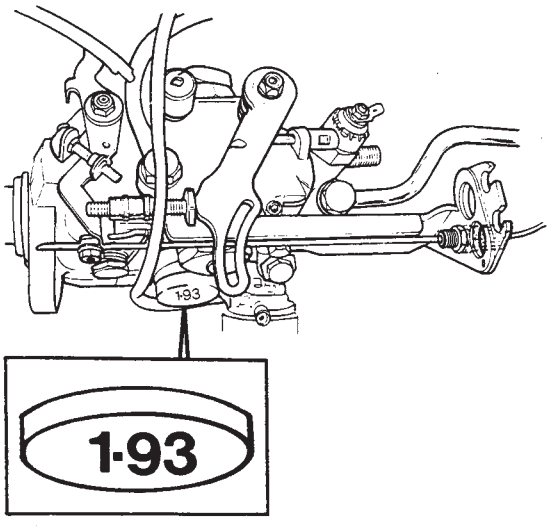


Fig.1 Fuel injection pump timing setting

There are no external timing marks, therefore to check the injection pump timing, the engine is set to a specific position before TDC by taking a measurement at the top of No.4 piston, using one of its valves to measure from.

The position of the injection pump is then checked with the engine at that position.

Each pump is individually timed, and the timing setting is marked on the plastic cap as shown in fig.1.

NOTE: No.1 piston and valve are at the rear (flywheel) end of the engine.

The static timing check procedure is as follows:

1. Disconnect the battery(s), negative terminal(s) first.

2. Remove the rocker cover.

3. Gain access to the crank pulley by removing the fan using 0480034 (MS 1517) and the fan cowl.

4. Use tool 0480060 to turn the engine over until No.4 piston (nearest to timing cover) is at TDC (No.1 and 2 push rods will be 'on the rock').

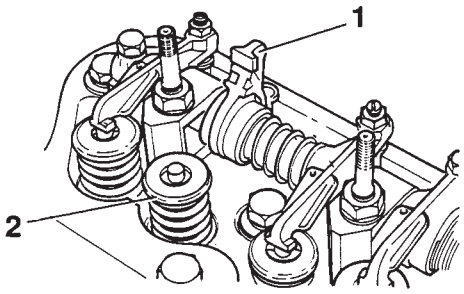


Fig.2 No.7 rocker released
1. Rocker arm turned through 90°
2. Number 7 valve

5. Fully slacken No.7 rocker adjusting screw; release No.7 rocker from its push rod by pushing the rocker rearwards and turning it back through 90° to expose the end face of the valve stem (see fig.2).

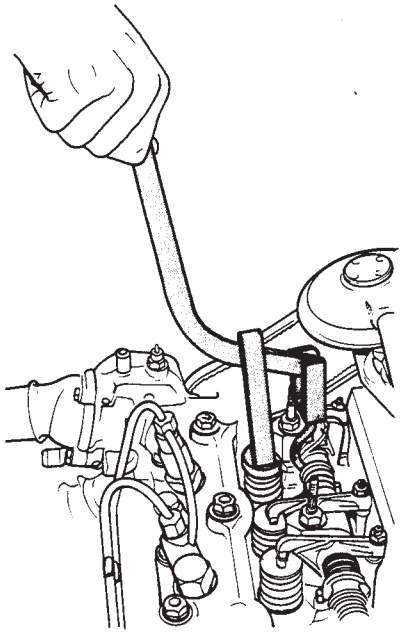


Fig.3 Using tool 0480056

CAUTION: Do not release the valve collets until No.4 piston is at the top of its bore to support the valve.

6. Use special valve spring compressor No. 0480056 to remove the valve springs from No.7 valve.

7. Position 0480048 (18G 191) dial gauge on a convenient bolt head, so that the stylus rests on the end of the valve stem.

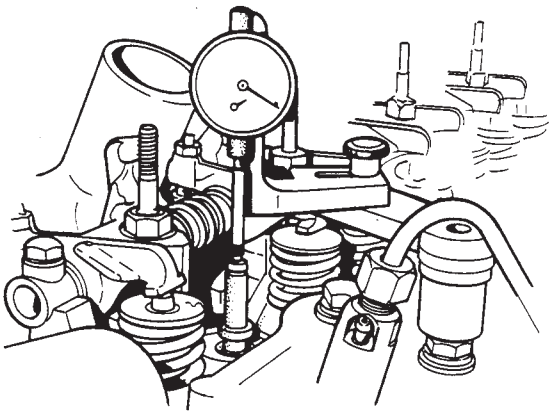


Fig.4 Dial gauge on No.7 valve

8. Establish the exact TDC position by slowly 'rocking' the crankshaft until the gauge shows maximum deflection.

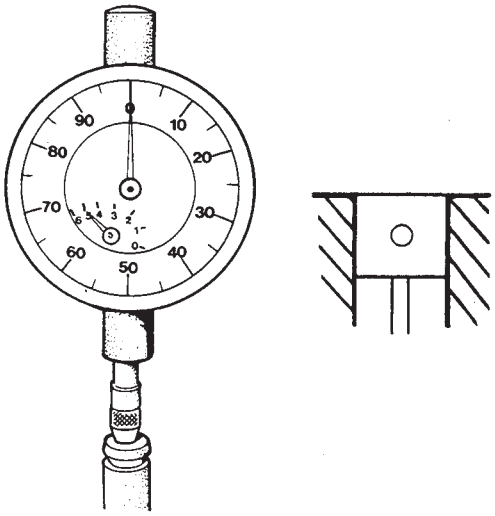


Fig.5 Piston gauge reading - stage 1

9. Adjust the height of the gauge body on its mounting bracket until the stylus is capable of moving at least 5 mm travel downwards.
Zero the gauge. (stage 1)
NOTE: The gauge readings shown in the following illustrations are examples based on the description.

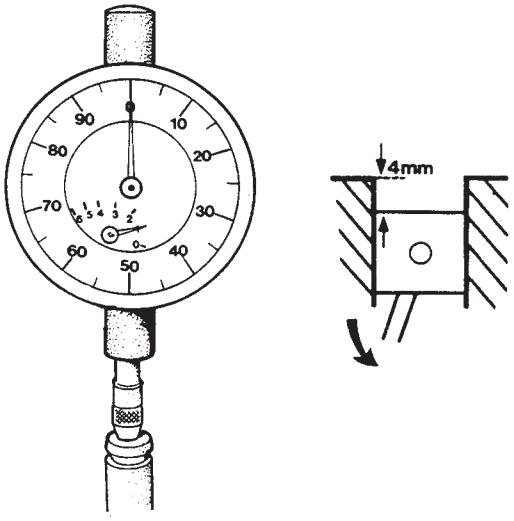


Fig.6 Piston gauge reading - stage 2

10. Turn the crankshaft anti-clockwise until the piston and valve has dropped 4 mm from TDC as indicated on the dial gauge. (stage 2)

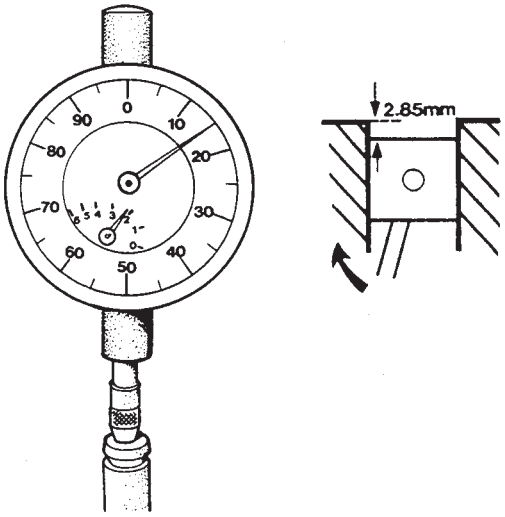


Fig.7 Piston gauge reading - stage 3

11. Turn the crankshaft clockwise until the piston and valve has moved the gauge upwards by 1,15 mm. (stage 3)

    NOTE: If the piston moves up too far, return to the 4 mm down position and start again. Do not approach the 1,15 mm position from above.

    The piston is now at its correct timing position 2,85 mm Before Top Dead Centre.

    (4 - 1,15 = 2,85 mm B.T.D.C.)

12. Make a note of the precise gauge reading, i.e. the position of both pointers.

    It may be useful to make temporary marks on the gauge to record the position of both pointers.

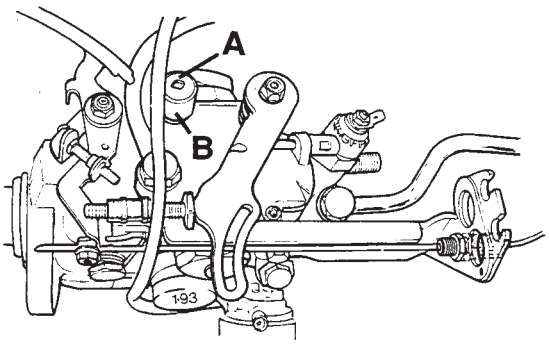


Fig.8 Fuel injection pump
A. Threaded plug
B. Connector

13. **CAUTION: In the following operation do not allow the connector 'B' (fig.8) to turn, as this will affect timing.** Securely grip the connector 'B' on the top of the pump so that it cannot turn, then undo the threaded plug 'A' in the top to gain access to the timing hole.

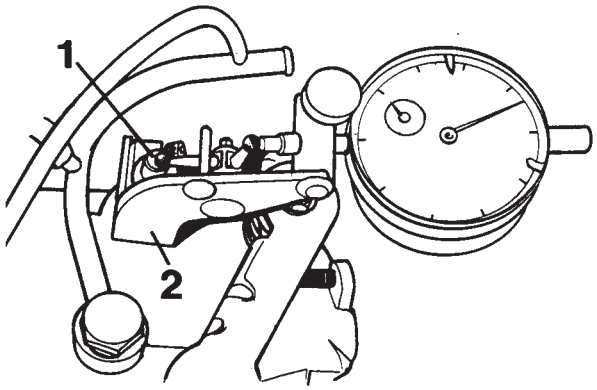


Fig.9 Fitting tool 0480066 & dial gauge
1. Pin of tool 0480066
2. Body of tool 0480066

14. Insert the pin of tool 0480066 into the pump timing hole.

15. Turn the engine anti-clockwise until the pin stops moving into the hole.

16. Fit and secure the body of tool 0480066 to the connector so that one arm of the tool crank rests on the pin already fitted.

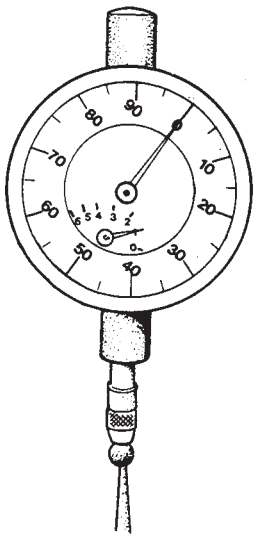
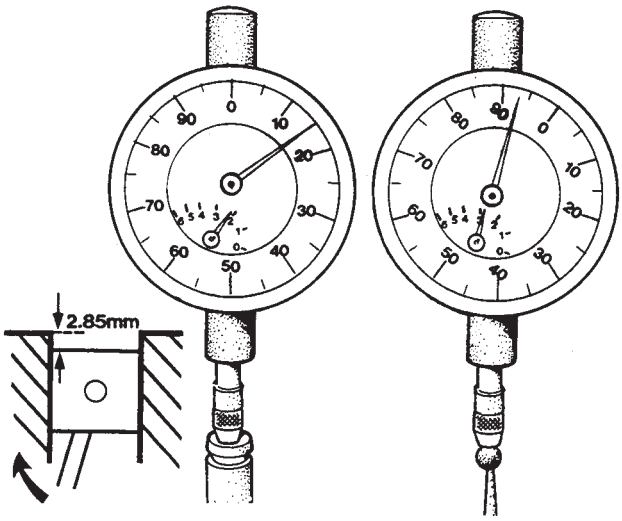


Fig.10 Pump gauge reading - stage 4

17. Fit a dial gauge to the tool, pushing the gauge in until it is preloaded by approximately 1 mm before tightening the clamping screw.
Zero the gauge, and note the position of the small pointer. (stage 4)



Piston gauge **Pump gauge**

Fig.11 Gauge readings - stage 5.

18. Observing the valve stem dial gauge, slowly turn the crankshaft clockwise until the gauge regains its reading of 2,85 mm B.T.D.C. as noted previously at stage 3.
Note the reading on the pump gauge. (stage 5)

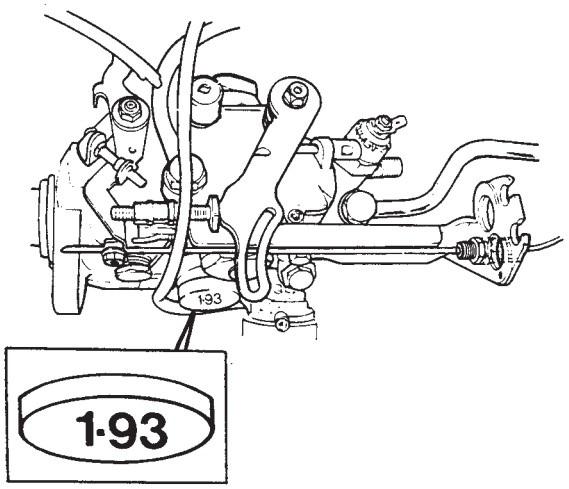


Fig.12 Fuel injection pump timing setting

If the timing is correct, the pump gauge reading should correspond with the timing setting stamped on the plastic cap on the side of the injection pump (see fig 12), bearing in mind that the 1 mm preload should be subtracted from the pump gauge reading.

Example

Gauge reading	2,93 mm
Subtract gauge preload	1,00 mm
Pump timing	1,93 mm

Timing - Adjust

19. If the timing is incorrect, proceed as follows:

- Slacken the injector pipes at the injectors and at the pump.
- Slacken the front and rear pump mountings.
- Check that the piston dial gauge reading remains at 2,85 mm B.T.D.C.
- Turn the pump slowly until the pump dial gauge reads the timing setting stamped on the plastic cap, again remembering the gauge preload of 1 mm.
Ensure that when turning the pump, it is turned so that the dial gauge moves from a lower reading up to the required reading. This is to take account of any wear in the timing chain mechanism.
- Tighten the pump securing bolts.
- Check that the timing is correct by first turning the crankshaft anti-clockwise until the pointer on the pump gauge stops moving. Now turn the crankshaft clockwise, and check that when the piston dial gauge reaches 2,85 mm B.T.D.C. position, the pump dial gauge reads the correct timing setting.

Readjust if necessary until the timing is correct.

20. Remove the timing tool from the pump and refit the threaded plug.

21. Refit the injector pipes.

22. Remove the dial gauge at No.7 valve, refit the valve springs and collets, reposition the rocker arm and adjust the valve clearance.
Refit the rocker cover, renewing the seal if necessary as described in the section **'Rocker Cover Cord Gasket'**.

23. Refit the fan cowl and fan.

24. Connect the battery(s), positive terminal(s) first.

25. Start the engine and warm to normal running temperature.
Adjust the idle speed if necessary.

FUEL BLEEDING

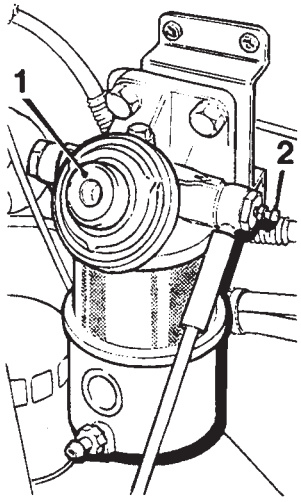


Fig.1 Bleeding the filter

To bleed the filter:

1. Open the bleed screw (2).

2. Operate the pump button (1) until air-free fuel flows from the bleed screw, then tighten the bleed screw.

3. Operate the pump button until resistance is felt.

4. Start the engine and check for fuel leaks.

FUEL INJECTION PUMP

Remove and refit

Remove

1 Disconnect the battery(s), negative connection first.

2. Disconnect:
   - feed wire to the fuel cut-off solenoid,
   - fast idle control cable,
   - throttle cable,
   - boost control hose (ET engine),
   - spill return pipe, and cap it,
   - fuel inlet pipe, and cap it,
   - hose bracket.

3. Remove the injector pipes.

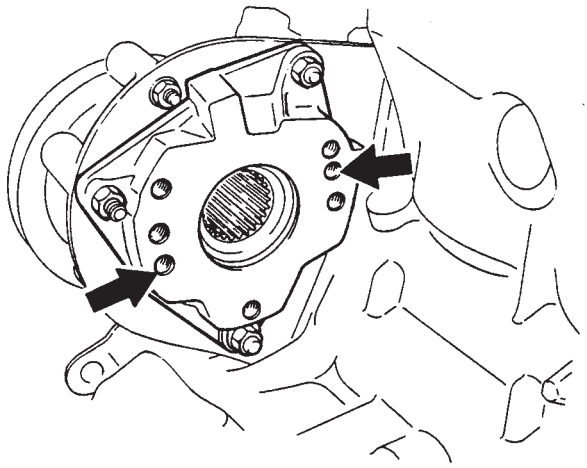


Fig.1 Fuel injection pump mounting

4. Remove the injection pump rear mounting bracket and front securing Allen screws to detach the pump. Note which pair of front mounting bolt holes are used.

5. Discard the joint gasket.

Refit

6. Smear a new injector pump joint gasket with grease and position it on the pump attachment plate; make sure the correct pair of pump mounting bolt holes are exposed.

7. Fit the pump, aligning the master splines. Fit and lightly nip the securing Allen screws and the rear mounting bracket.

8. There are no external timing marks, therefore to time the injection pump, the engine is set to a specific position before TDC by taking a measurement at the top of No.4 piston, using one of its valves to measure from.

9. Carry out the timing procedure as described in **'Timing check and adjust'.**

10. On completion, check that the pump mountings are secure then remove the timing tool from the pump and refit the threaded plug.

11. Remove the dial gauge at No.7 valve, refit the valve springs and collets, reposition the rocker arm and adjust the valve clearance.
Refit the rocker cover.

12. Refit the fan cowl and fan.

13. Refit the injector pipes.

14. Fit the throttle cable and fast idle cable, and adjust as described in the section - **Fuel injection pump - adjustments**

15. Connect:
    - feed wire to the fuel cut-off solenoid,
    - spill return pipe,
    - fuel inlet pipe,
    - hose bracket,
    - boost control hose (ET engine).

16. Connect the battery(s), positive terminal(s) first.

17. Start the engine and warm to normal running temperature.
Check for leaks.

18. Adjust the idle speed if necessary.

INJECTORS

Remove and refit

Tool required: 0480059

Remove

1. Disconnect the appropriate injector pipe at the injector and at the fuel injection pump.

2. Detach the spill return pipes.

3. Remove the injector with tool 0480059.

4. Extract the domed sealing washer from the injector aperture, and discard it and the copper washer.

Refit

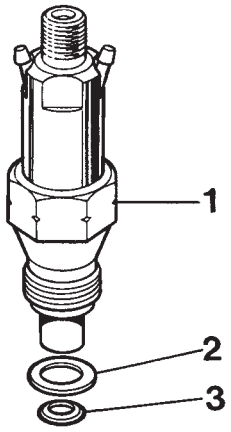


Fig.1 Injector
1. Injector
2. Copper washer
3. Domed washer

5. Locate a new domed washer in the injector aperture with the domed face uppermost.

6. Fit the injector with a new copper washer and tighten to the correct torque using tool 0480059.

7. Injector tightening torque- 90 Nm (66 lbf ft).

8. Fit the spill return pipes and reconnect the injector pipe.

9. Start the engine and check for fuel leaks.

TURBOCHARGER

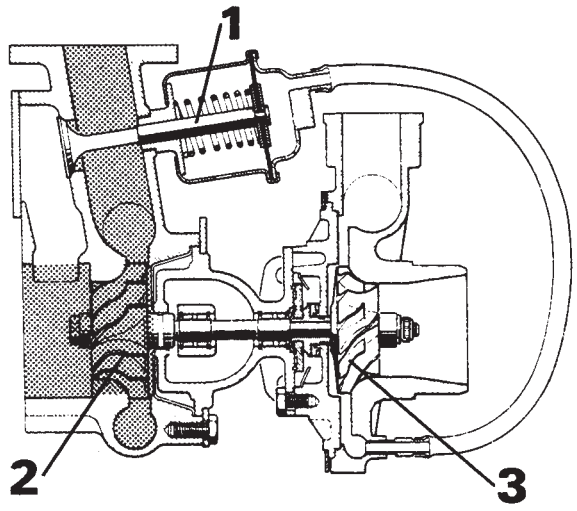


Fig.1 Turbocharger
1. Waste gate
2. Turbine
3. Compressor

The turbocharger fitted to ET70 engines is a Garrett Air Research type TO3, with a rotation speed of up to 100,000 rpm.
It produces a maximum boost pressure of 0.8 bar above 2000 engine rpm, and is governed by a non-adjustable relief valve (waste gate).

Under full load conditions the turbocharger operates from 1,000 engine rpm on.

The turbocharger cannot be overhauled, it is only available as an assembly.

Remove and refit

Remove

1. Disconnect the air duct at the support stay and at the turbocharger.
2. Remove the air duct between the turbocharger and the inlet manifold.
3. Remove the oil feed pipe.
4. Remove the oil return pipe.
5. Disconnect the exhaust pipe.
6. Support the turbocharger while removing four bolts securing it to the exhaust manifold. Lift the turbocharger clear.

Refit

7. Refitting is the reverse of the removal procedure, checking the following points:

   - **CAUTION: Before connecting the oil feed pipe, prime the turbocharger shaft bearings with clean engine oil.**
   - Ensure there is no foreign matter in the oil supply pipe, and that there is no restriction to the turbocharger oil supply.
   - Renew the gasket between the turbocharger elbow and the down pipe, and the oil return pipe gasket.

8. **WARNING: Never run the engine with the air intake duct disconnected.**
   Start the engine, check for exhaust leaks and for oil leaks at the oil pipe connections.
9. Check the engine oil level.

Turbocharger Fault Diagnosis

The turbocharger is maintenance free and, with care, will give reliable service. Most failures are caused by one of the following:

- Lack of lubrication
- Contamination of oil
- Incorrect oil specification
- Ingestion of foreign objects

Lack of lubrication will show up first as bearing failure, and at high operating speeds this will take place in seconds. It can also lead to turbine and compressor wheel rub, seal damage or even shaft breakage.

Contaminated oil will cause scoring of the shaft journals and bearings, block the oil ways and render the seals ineffective, resulting in oil leakage.

Ingestion of foreign objects will damage turbine and compressor wheel blades. This can cause wheel imbalance and rotational instability, which will result in damage to seal bores and bearings.

Some of the common symptoms which may indicate possible turbocharger troubles are:

- Engine lacks power.
- Black smoke.
- Blue smoke and excessive oil consumption.
- Noisy operation of the turbo.

Engine lacks power / black smoke evident

These faults may be caused by insufficient air reaching the engine.
Check air intake system for blockage or air leaks in the exhaust or intake system.

Familiarity with the sound of the turbocharger can be useful when diagnosing faults. In practice, it is possible to identify an air leak between the compressor outlet and engine, or an exhaust leak between engine and turbocharger by a higher pitched sound.

A blocked air filter or loose material in the compressor inlet ducts may cause the sound of the turbocharger cycle to change noticeably.

Check for dirty air filter element.

WARNING: If the engine has just been running, components will be hot to the touch.
With the engine stopped, remove the ducting pipe between air filter and turbo and check for foreign objects or build-up of dirt.

NOTE: If any evidence of foreign bodies, check compressor blades for damage.

Check clamp security at compressor outlet.

Check tightness of manifold bolts and sealing of manifold to the head.

Check that the turbine shaft rotates freely.

Check for signs of the compressor or turbine wheels rubbing against housing walls, or for damage to wheels.

Blue smoke

Blue smoke is an indication of oil consumption; it may be caused by leakage of the seals in the turbocharger, or by an internal engine problem.

Check the air intake system for restrictions.
NOTE: A higher than normal restriction can cause leakage from the compressor oil seal.

WARNING: If the engine has just been running, components will be hot to the touch.
With the engine stopped, remove the turbocharger ducts and check the shaft assembly for free rotation, damage to turbine and compressor wheels, or rubbing against housing walls.

Check the turbo oil drain tube for blockage.

Check for excessive crankcase pressure.

Excessive oil consumption (without smoke indication)
Check the air intake system for restrictions.

Check security of the compressor outlet duct.

Check that the turbocharger shaft rotates freely and that wheel rub is not evident.

Check for excessive crankcase pressure.

Noisy turbocharger operation
Check security of all pressure connections and exhaust manifold.

Check that the turbocharger shaft rotates freely; examine for signs of wheel rub and for damage to wheel blades from foreign material.

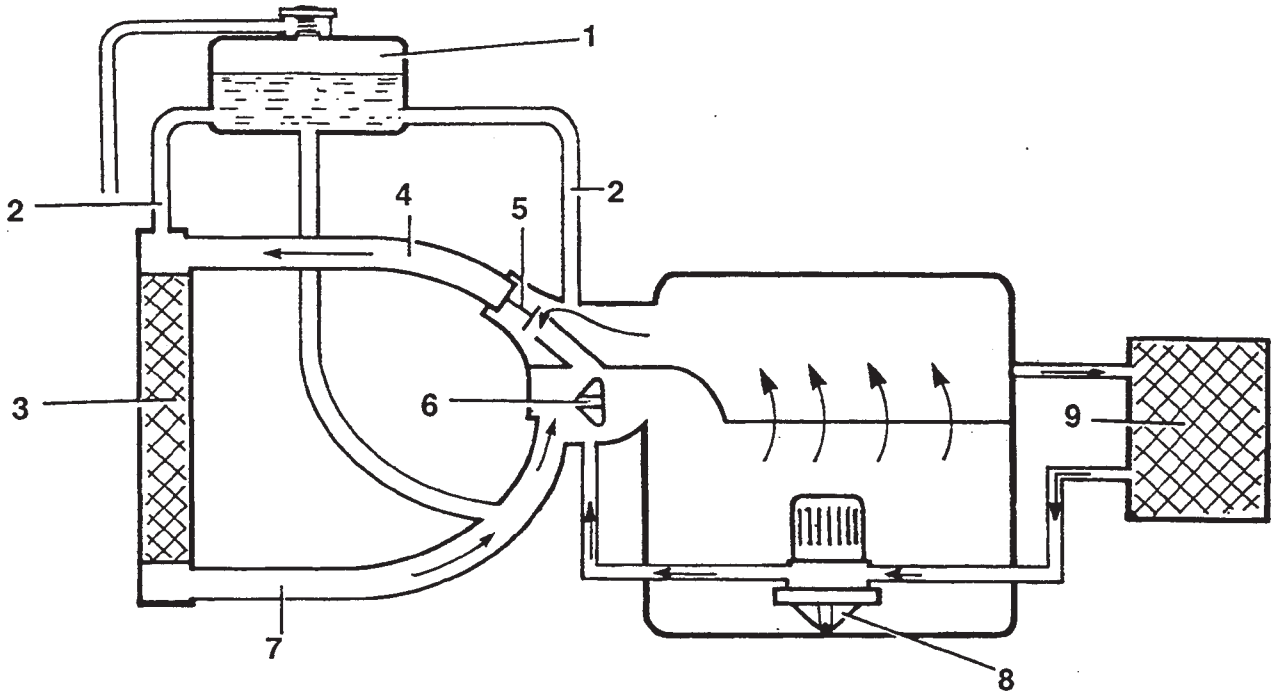
NOTE: If wheel rubbing or damage is evident, it is necessary to renew the turbocharger assembly.

CAUTION: Before installing a new turbocharger, it is essential that the unit is pre-lubricated and the oil system primed with clean engine oil.

TURBOCHARGER FAULT DIAGNOSIS

SYMPTOM						
Black smoke	Loss of power	Blue smoke	Unusual noises/vibrations	Rubbing of wheels on housings	Oil leakage from compressor side	POSSIBLE CAUSE
						Make certain that trouble is not due to engine components, especially to injection system, before attempting corrective action on turbocharger.
●	●	●				Lack of air
●	●				●	Boost pressure too low
●	●	●			●	Clogged air filter
●	●				●	Deformations or sharp elbows at air intake system
●	●					Clogged exhaust pipe or silencer
●	●					Waste gate valve defective in operation
	●		●			Air or gas leak in intake or exhaust system
	●		●			Compressor or turbine wheels rubbing on casings
	●		●	●		Poor lubrication
	●		●	●		Low oil pressure
●	●	●	●	●	●	Turbocharger defective

NOTE: This fault diagnosis chart is not exhaustive and is for general guidance only.



Cooling system circulation
(1991 MY naturally aspirated layout illustrated)

1. Expansion tank
2. Vent pipes
3. Radiator
4. Top radiator hose
5. Thermostat
6. Water pump
7. Bottom radiator hose
8. Oil filter
9. Heater

COOLING SYSTEM

Description

The cooling system is a pressurised system with thermostatic control. The thermostat is located in the water pump housing fitted to the front of the cylinder head. The water pump and fan is driven by an external drive belt; the fan is mounted on a viscous coupling to reduce engine power loss when the vehicle is moving.

The illustration shows the coolant circulation of the normally aspirated engine.

When the system is cold, the thermostat (5) is closed as shown in the illustration. Coolant rises through the cylinder block into the cylinder head; it cannot pass the thermostat to the radiator (3) and is therefore drawn back into the cylinder block, assisted by the water pump (6).

When the coolant reaches a predetermined temperature the thermostat will open. This allows coolant to pass along the top hose (4) to the radiator, be cooled by passing down through the radiator, and return to the cylinder block via the bottom hose (7) assisted by the water pump.

Coolant can flow to the heater matrix (9) via a hose tapped into the rear of the cylinder head; it returns to the block via the return hose and the water pump housing.

On EN engines the return flow of coolant from the heater matrix passes through the base of the oil filter (8) This coolant acts as an oil cooler; it operates on the principle that at running temperature the oil is hotter than the coolant, and therefore the coolant passing through the base of the oil filter will reduce oil temperature.
The ET engine is not fitted with this device, it has a larger capacity oil cooler fitted under the radiator.

NOTE: On early engines a tapping from the rear of the cylinder block supplies coolant to the oil filter (EN engines only) and to the fuel filter. This warms the fuel during the engine warm-up period, and maintains the fuel temperature in cold weather. When the coolant reaches a pre-determined temperature, a valve fitted in the filter base closes to shut off the flow of coolant. Fuel is now heated by an electrical, in-line fuel heater; however the coolant supply to the oil filter is retained for oil cooling.

The coolant system is filled with coolant from the expansion tank (1). Two vent pipes (2) into the expansion tank allow air to bleed from the system; one from the top of the radiator and the other from the top of the water pump housing.

Circulation in the ET engine is the same, except that there is not the cooler facility in the base of the oil filter as already described.

COOLANT

Drain and Refill

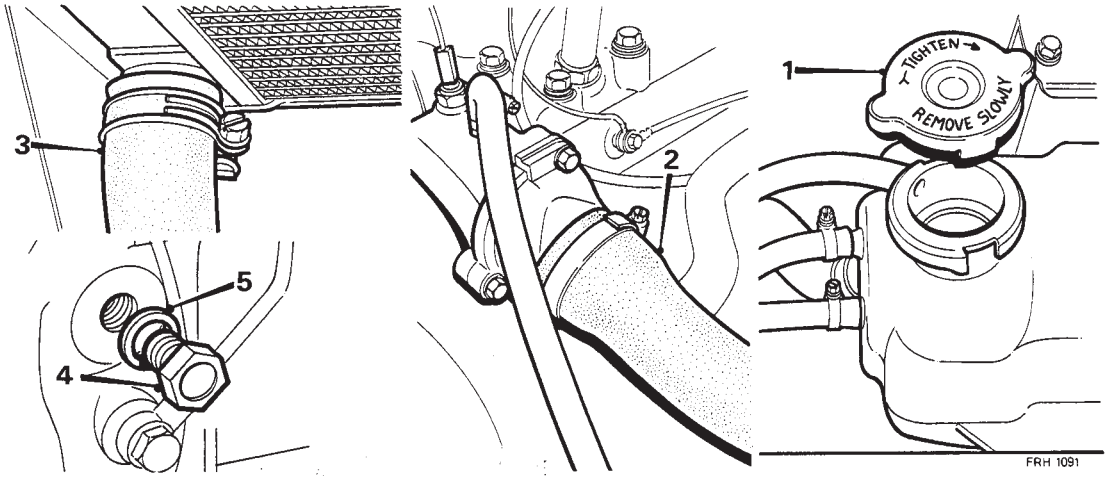


Fig.1 Coolant drain and refill

1. Filler cap
2. Top radiator hose
3. Bottom radiator hose
4. Cylinder block drain plug
5. Sealing washer

Complete draining of the system (except the heater matrix) is achieved by removing the drain plug at the rear right hand side of the cylinder block and by removing the bottom hose at the radiator.

After filling the system is self-bleeding, but the coolant level must be checked after the engine has been run until the thermostat has opened, and allowed to cool again.

Leyland DAF Parts part number BBU 9020 anti-freeze must be used for topping-up and for filling.

The correct proportions are 50% anti-freeze, 50% water.

FAN AND FAN DRIVE

Fan Identification:

EN55 engine - white blades
ET70 engine - yellow blades

NOTE: The viscous fan drive is different for EN and ET engines, and must not be interchanged.
Refer to parts information.

Fan remove and refit

Tool required: 0480034 (MS 1517)

1. Remove the pulley guard.

2. Use tool 0480034 (MS 1517) to release the fan securing nut from the pulley (left hand thread).

3. Refitting is the reverse of the removal procedure.

Fan Drive (Viscous Coupling)

Description
There are two main parts to the viscous fan drive, the drive member and the driven member. The drive member consists of a shaft attached to the threaded fan pulley, the shaft passing through a bearing into a clutch plate. The driven member consists of a body to which the fan attaches, and a temperature sensing mechanism and pump plates.

A fan drive has to be engaged for only a small amount of time, normally between 5 and 10%, because the rest of the time the vehicle cools itself due to ram air cooling.

To engage and disengage the fan drive, the bi-metal coil on the front of the fan drive senses air temperature behind the radiator. When a pre-determined temperature is reached, the coil opens a valve which allows fluid to enter the drive area and, due to centrifugal force, circulates to the outer annular drive area.

There are two sets of annular grooves, one in the drive clutch and the other in the drive body, and a specific clearance being provided between the two sets of grooves. When this clearance is filled with viscous fluid, a shearing action caused by the speed differential between the two drive components transmits torque to the fan. The fluid is thrown to the outside of the unit by centrifugal force, from where it is then re-circulated to the reservoir via a pump plate adjacent to the drive member.

When the air temperature from the radiator drops sufficiently, the bi-metal coil closes the valve and prevents fluid entering the drive area. The fluid that is in the drive area will gradually pump out into the reservoir and the fan will return to an idle condition.

Fan Drive Diagnosis

When investigating an overheating problem, and before suspecting a possible viscous fan drive fault, all other checks must be made:

- Incorrect fan belt tension.
- Incorrect coolant level.
- Coolant leak(s).
  (Check for internal engine fault by carrying out pressure check.)
- Faulty pressure cap.
- Faulty thermostat.
- Blocked radiator and/or hoses.
- Blocked engine coolant passages.
- Check correct fan is fitted:
  EN55 engine - white blades
  ET70 engine - yellow blades

The following points will be of assistance when checking the viscous fan drive operation, but should not be regarded as exhaustive and must be used as a guide only.

1. When cold, turn the fan and check that a slight resistance exists.

2. When the engine is operating at normal running temperature the fan will turn in an idle condition. This dis-engagement can be detected as follows:

   - Lack of fan noise.
   - The fan should turn approximately at engine speed when the engine is idling. At higher speeds, fan rpm will fall below engine speed.
   - A reduced air flow will be felt in the engine bay.
   - If the engine is stopped, the fan will continue to spin for a few seconds.
   - When the engine is stationary, little resistance can be felt on the fan.

3. **CAUTION: Do not allow engine to overheat.**
   Temporarily blank off part of the radiator, run the engine above idle speed and note changes to the fan operation when it engages, after the thermostat opens and coolant temperature rises.

   - Fan noise will increase and an increased air flow will be felt in the engine bay when the fan cuts in.
   - When the engine is stationary, resistance can be felt on the fan similar to or greater than the resistance noted when cold.

   If these symptoms are evident, this will indicate the viscous fan drive is cutting in correctly.

4. Allow the engine to return to normal running temperature. Check that the fan drive disengages.

RADIATOR

Remove and refit.

1. Disconnect the battery(s), negative terminal(s) first.
2. Drain the coolant by disconnecting the bottom hose at the radiator.then disconnect the top hose and radiator air bleed hose.
3. Detach the fan cowl.
4. Remove the bonnet locking platform.
5. Remove the radiator.
6. Refitting is the reverse of the removal operations.
7. The cooling system must be filled with the correct (50%) solution of water and anti-freeze, and the anti-freeze used must be the specified type.
8. After filling, run the engine to normal operating temperature and check for leaks.
   Allow to cool and top up if required.

WATER PUMP

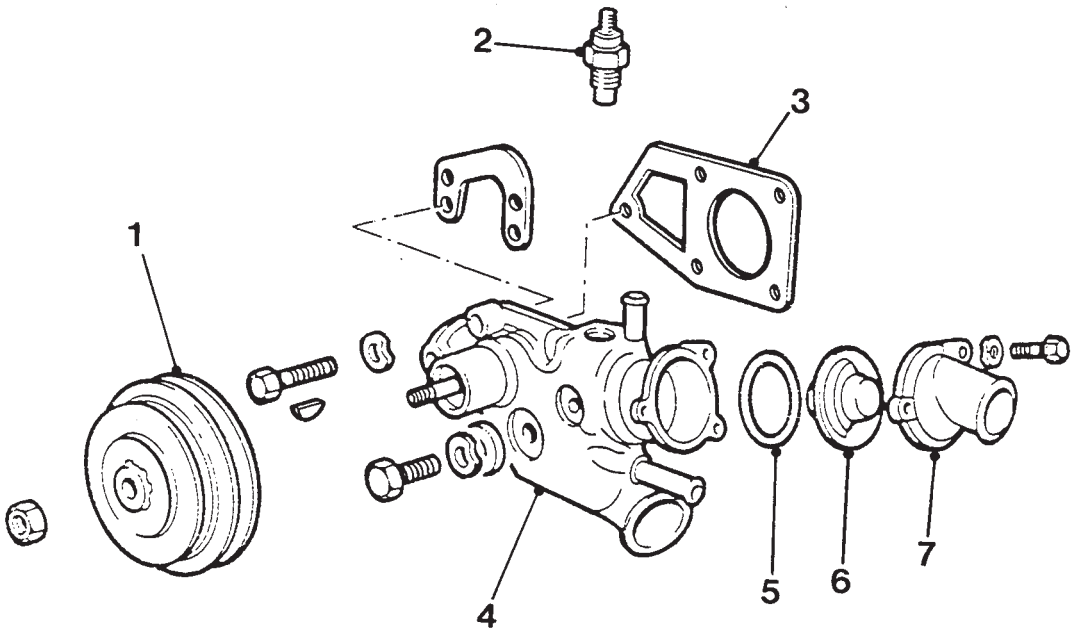


Fig.2 Water pump

1. Water pump pulley
2. Temperature transmitter
3. Water pump gasket
4. Water pump assembly
5. Thermostat gasket
6. Thermostat
7. Top hose union

The water pump is only available as an assembly with the water pump housing. The thermostat is located in the top radiator hose connection of the housing.

Remove

1. Disconnect the battery(s), negative terminal(s) first.

2. Drain the coolant by disconnecting the bottom hose at the radiator.

3. Disconnect:
   - the top hose,
   - radiator air bleed hose,
   - temperature transmitter connection.

4. Remove:
   - pulley guard,
   - water pump pulley nut,
   - vacuum pump belt,
   - alternator belt,
   - water pump pulley.

5. Disconnect:
   - bottom radiator hose at water pump,
   - heater return hose.

6. Remove the top radiator hose union and remove the thermostat. Discard the gasket.

7. Remove the water pump and discard the gasket.

Refit

8. Refitting is the reverse of removal procedures, noting the following:

   - Fit the thermostat with its crossbar vertical.
   - Renew gaskets.
   - Adjust drive belts to correct tension.

9. Refill with the correct solution of specified anti-freeze.

10. Run the engine and check for coolant leaks. After fully warming up, allow to cool and check the coolant level. Top-up if necessary.

THERMOSTAT

The thermostat is located in the union connection of the water pump housing to the top radiator hose.

Remove and refit

1. Drain sufficient coolant.

2. Disconnect the top radiator hose at the water pump housing union.

3. Remove the union and lift out the thermostat. Discard the 'O' ring seal.

4. Clean the aperture in the housing on which the thermostat seats when 'open'.

5. **NOTE:** The thermostat must be fitted with its crossbar aligned vertically. Fit the thermostat using a new union 'O' ring seal.

6. Fit the union and the radiator hose.

7. Refill with the correct solution of specified anti-freeze.

8. Run the engine and check for coolant leaks. After fully warming up, allow to cool and check the coolant level. Top-up if necessary.

HEATER PLUG SYSTEM

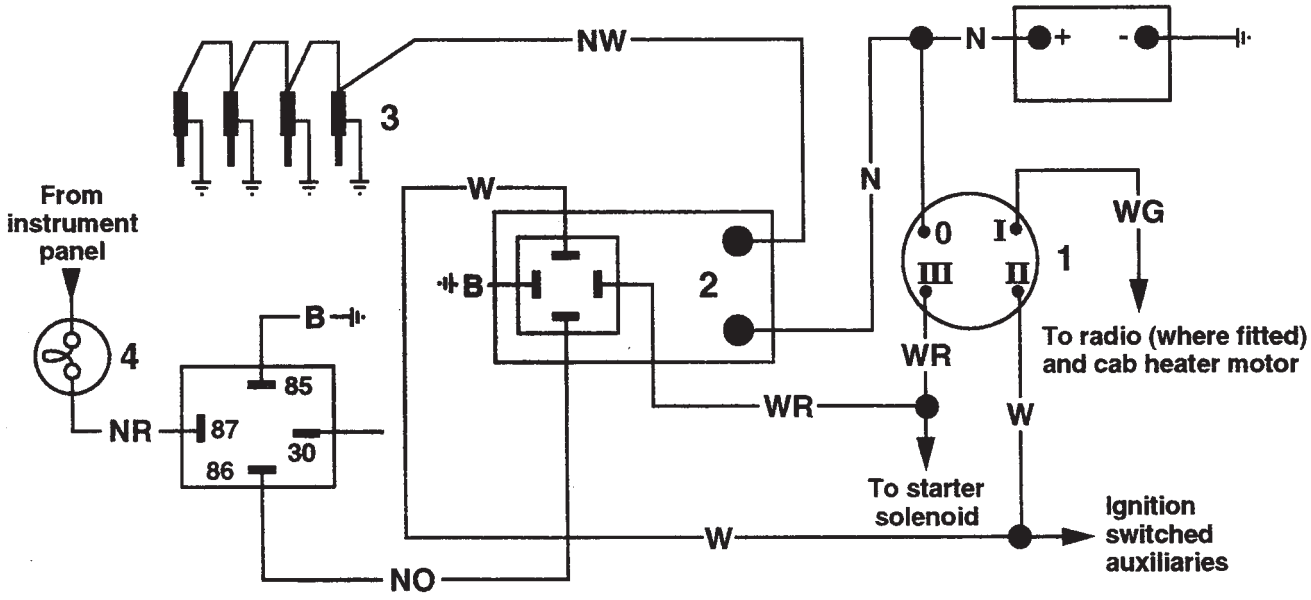


Fig.1 Heater plug circuit

1. Ignition switch
2. Heater plug controller
3. Heater plugs
4. Heater plug warning light
5. Warning light relay

Wiring colour code

B	Black
N	Brown
NR	Brown/red
NW	Brown/white
NO	Brown/orange
W	White
WG	White/green
WR	White/red

SYSTEM COMPONENTS

Heater Plugs

The sheathed element of the heater plug projects into the swirl chamber area of the engine cylinder head. The purpose of the heater plug is to assist in heating the air inside the swirl chamber to a high enough temperature during pre-heat and cranking in order that fuel will burn when injected. This ensures easy cold starting.

The temperature of the plug tip reaches approximately 850°C during operation.

Heater Plug Controller

Secured to the left hand side bulkhead inside the engine compartment, the controller is a sealed, non-serviceable unit. The controller comprises an integrated circuit and relay which switches the heater plugs on and off.

The circuit also operates the warning light via the warning light relay.

SYSTEM OPERATION

The Ignition Switch

Functions are as follows:
Position O
Ignition switch off - steering locked - no electrical output.
Position I (Auxiliary)
Steering not locked - radio (if fitted) and cab heater motor supplied from white/ green wire.
Position II (Ignition on)
Steering not locked - radio (if fitted) and cab heater motor supplied as before - heater plug controller energised - heater plugs energised to give pre-heating - heater plug warning light on.
After approximately 8 seconds pre-heat (at 0°C ambient air temperature) heater plug warning light goes out - engine can now be started (see position III).

The pre-heat period becomes shorter as ambient air temperature increases.

If an attempt is made to start the engine before the heater plug warning light goes out, the engine cranking period will be extended and the engine will prove difficult to start.

If the engine is not cranked after the heater plug warning light goes out, the heater plugs remain switched on for a further period of approximately 7 seconds. Therefore if the ignition is switched on but the engine not cranked, the heater plugs will be switched on only for the time the warning light is on plus approximately 7 seconds.
This prevents unnecessary battery discharge and prolongs heater plug life.

Position III (Engine cranking)
Steering not locked - radio (if fitted) and cab heater motor not supplied.
After the heater plug warning light goes out, engine can be started without using the accelerator (the fuel injection pump has an automatic excess fuel device which operates during cranking, and an automatic cold engine fast idle control).

CAUTION: It is imperative that the accelerator is NOT used when starting a turbocharged engine as this may lead to premature turbocharger failure.

At all times when the starter motor is cranking the engine, the heater plugs are energised to assist starting.

Once the engine has been cranked on the starter, the heater plugs are then switched off. If the engine has failed to start, the starting procedure must be repeated.

This system does not give any post-heat after the starter motor has cranked the engine. The automatic cold engine fast idle control will keep the engine running smoothly during the warm-up period.

Heater Plug Testing

Tool required: 1210515 (DX 900)

Remove the heater plugs and test using tool 1210515 (DX 900) as follows:

- Place heater plug into the clamp at the end of the tester.
- Connect tester leads as follows:
  - Red lead to battery positive
  - Black lead to battery negative
  - Yellow lead to heater plug centre terminal
- **WARNING: After testing, heater plugs will be hot. Do not handle, use pliers or similar to remove from tester. Leave in a safe place until sufficiently cool to handle.**
  Depress the 'TEST' button; note the initial current draw and how long the current takes to stabilise, by observing the LED's which illuminate at 5 second intervals.
  Also note whether the heater plug glows at the tip first; if it does not, it must be renewed.
- Compare the results with the information in 'Technical Data'..
- Repeat and record results on all the heater plugs. Replace any which prove defective.
- Refit serviceable / new heater plugs (smear the threads with PBC grease). Tighten to correct torque:
  25 Nm (18 lbf ft)