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LAND ROVER 90/110/127 ALL VARIANTS
(Excluding APV, [redacted] and 127 Crash Rescue Ambulance)

REPRINTED INCORPORATING AMDTS Nos 1 to 10

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1-3	Engine 2.5 litre, Diesel breather system
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PREFACE

AMENDMENT IDENTIFICATION

1 Amendments are identified by marginal side lining.

COMMENTS ON THIS PUBLICATION

2 Comments on this publication are to be forwarded in accordance with AESP 0100-P-011-013 using a copy of the proforma provided.

ASSOCIATED PUBLICATIONS

EMER Wksp N 111	Preservation, Identification and Packaging of Assemblies (including engines)
EMER Wksp N 345	Split Shell Bearings, Assembly, Techniques using Plastigage Method
EMER T&M A 018 Chap 100 Rover Inst No 9	Testing Internal Combustion Engine
AESP 2910-F-101-302	CAV, Fuel Injection Pump DPS
Equipment Table Scale 06009	Distributor Type Fuel Injection Pump, Special Tools
Equipment Table Scale 03498 and 03499	Land Rover Special Tools
AESP 2920-C-102-302	Generator No 16 Mk 1 90 AMP (Lucas CAV AC 172)

Chapter 1-1

2.5 LITRE DIESEL ENGINE

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INTRODUCTION

1 This Chapter details the Unit and Field repairs for the Land Rover 2.5 litre diesel engine with the exception of the engine fuel and cooling systems which are dealt with in Chapters 11 and 12 respectively.

ENGINE

Removal

2 To remove the engine from the vehicle proceed as follows:

2.1 Disconnect the vehicle battery and on 12/24 volt vehicles the radio batteries (Chap 13).

2.2 Remove the spare wheel from the vehicle bonnet.

2.3 Disconnect the bonding straps and remove the bonnet (Chap 16).

2.4 On 12/24 volt vehicles remove the 90 amp generator (Chap 13).

2.5 Remove the air cleaner to manifold hose (Fig 1 (1)).

2.6 Remove the engine fan cowl and flexible ducting (Chap 12), the radiator cowl should be left in-situ.

2.7 Drain the cooling system (Chap 12 Page 2 Para 7).

2.8 Disconnect the top (2) and bottom (3) hoses at the engine connections.

2.9 Disconnect the heater rail pipes (4) adjacent to the rocker cover.

2.10 Disconnect the vacuum hose (5) to brake servo at the vacuum pump connection.

2.11 Disconnect the electrical leads (6) from the the starter solenoid and earth lead (7) from the rear of the starter motor.

2.12 Disconnect the electrical connector (8) from the 12 volt alternator.

2.13 Disconnect the electrical lead (9) from the heater plugs at the plug nearest to the rear of the engine.

2.14 Disconnect the electrical lead (10) from the DPS pump.

2.15 Disconnect the oil (11) and coolant (12) temperature leads at the engine connections.

2.16 Drain the oil sump using a container of suitable capacity.

2.17 On 12/24 volt vehicles, disconnect the oil cooler inlet and outlet hoses at their connections on the oil filter head.

2.18 Disconnect the throttle linkage (13) including hand throttle linkage on 12/24 volt vehicles.

2.19 Disconnect the fuel inlet (14) and outlet (15) pipes from the mechanical fuel pump.

2.20 Disconnect the fuel inlet (16) and spill return (17) pipes from the DPS pump.

2.21 Disconnect the spill return pipe (18) from the injectors to the top of the fuel filter.

2.22 Blank off pipes, hoses and adaptors from which they have been removed to prevent the ingress of dirt or foreign matter.

2.23 Disconnect any clips retaining pipes and cables to the engine, noting their locations for refitment.

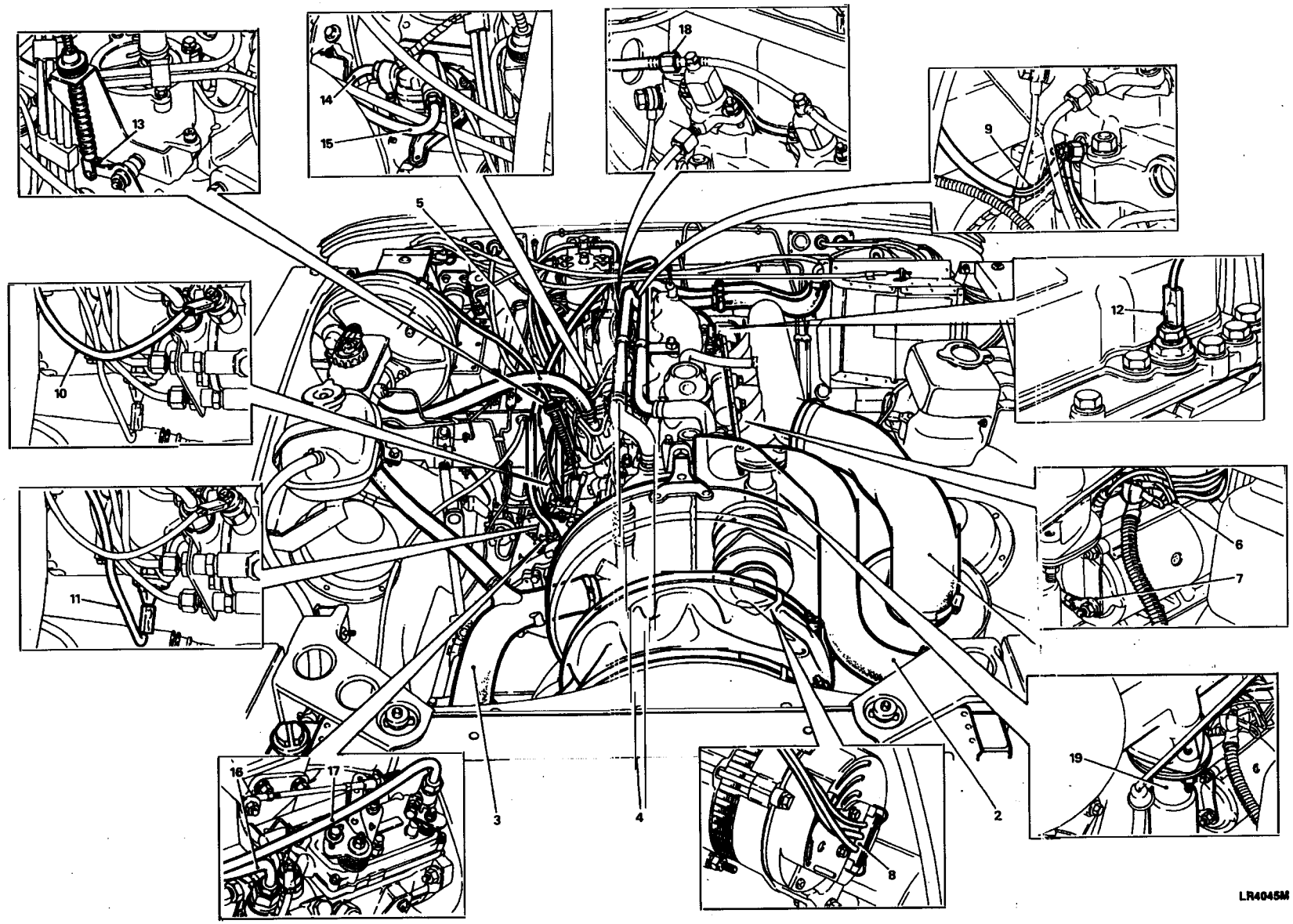
2.24 Secure disconnected pipes and cables to allow free access when slinging the engine.

2.25 Disconnect the exhaust pipe (19) at the manifold.

2.26 Remove the diaphragm panel (Fig 2) from in front of the gear change lever, to allow access to the bell housing to engine fixings.

Key to Fig 1

1	Air cleaner hose	11	Oil temperature lead
2	Top hose	12	Coolant temperature lead
3	Bottom hose	13	Throttle linkage
4	Heater rail pipes	14	Fuel inlet pipe-fuel pump
5	Vacuum hose	15	Fuel outlet pipe-fuel pump
6	Electrical leads-starter	16	Fuel inlet pipe-DPS pump
7	Earth lead-starter	17	Spill return pipe-DPS pump
8	Electrical connection-12V Alternator	18	Spill return-injectors
9	Electrical lead-heater plugs	19	Exhaust pipe
10	Electrical lead-DPS pump		



Engine removal disconnection points

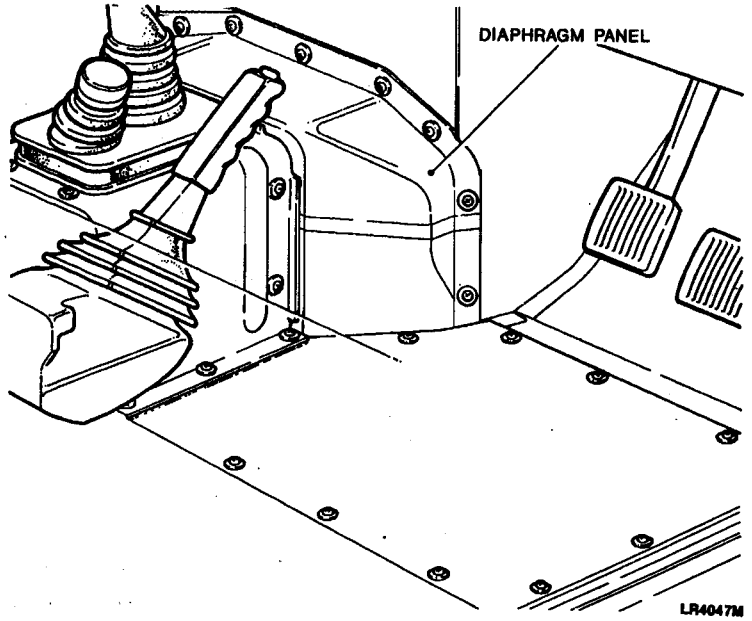


Fig 2 Diaphragm panel removal

2.27 Remove the upper fixings (Fig 3 (1)) from the engine mounting rubbers (2).

2.28 Attach a suitable lifting sling and hoist to the engine lifting brackets.

2.29 Remove the bottom fixings (3) from the engine mounting rubbers (2).

2.30 Tension the hoist sufficient to allow removal of the mounting rubbers, withdraw the rubbers and then lower the engine to its original position to maintain alignment with the gearbox.

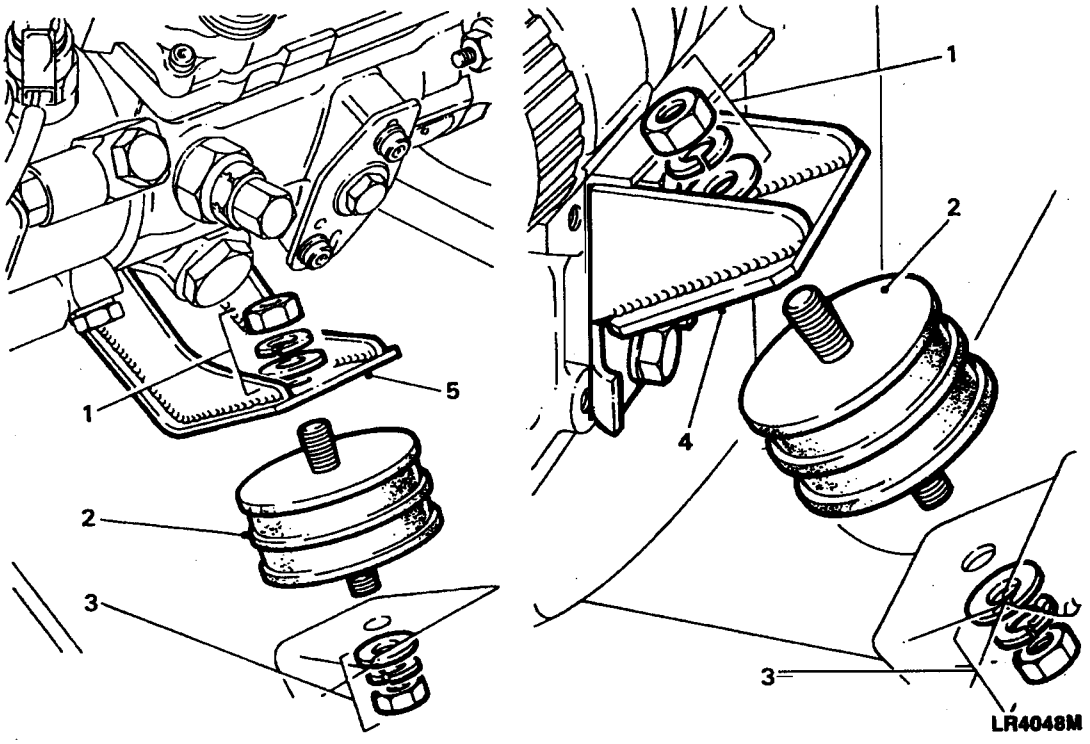
2.31 Support the gearbox assembly, using a suitable jack or by using packing blocks between the gearbox and the chassis cross member.

2.32 Remove the fixings securing the bell housing to the flywheel housing.

2.33 Draw the engine forward to release the studs from the bell housing and clear the primary pinion from the clutch.

2.34 Ensure all pipes, hoses and cables have been disconnected and lift the engine clear.

2.35 Secure the engine to a suitable mounting stand and remove the sling and hoist.



1 Upper fixings-mounting rubbers
2 Mounting rubbers
3 Lower fixings-mounting rubbers
4 LH mounting bracket
5 RH mounting bracket

Fig 3 Engine mountings

Installation

3 The procedure for installing the engine is as follows:

3.1 Attach a suitable lifting sling and hoist to the engine and remove from mounting stand.

3.2 Clean the flywheel and bell housing mating faces of old sealant. Re-coat the faces with Hylomar PL32 sealant.

3.3 Smear the splines of the primary pinion, the clutch centre and the release lever abutment faces with Molybdenum disulphide grease (Rocol MTS 1000).

3.4 Lower the engine into position, locating the primary pinion into the clutch and engaging the flywheel housing studs into the bell housing, secure the housings together with the nuts and washers and tighten to a torque of 45 to 50Nm (33 to 37 lbf ft).

3.5 Remove the jack or packing blocks from supporting the gearbox.

3.6 Tension the hoist sufficient to allow fitment of the mounting rubbers (Fig 3 (2)). New rubbers should be fitted if there is any doubt about the condition of the existing ones.

3.7 Lower the engine and secure the mounting rubbers with their upper and lower fixings.

3.8 Remove the lifting sling and hoist.

3.9 Reverse the removal procedure to reconnect all pipes, hoses, electrical connections, the cooling fan cowl and the exhaust connection to the manifold.

3.10 Fit the 90amp generator and correctly tension the drive belt 12/24 volt vehicles only (Chap 13).

3.11 Refill the cooling system (Cat 601).

3.12 Refill the engine oil system with the correct grade of oil (Cat 601).

3.13 Check, and if necessary replenish the gearbox lubricating oil (Cat 601).

3.14 Reconnect the vehicle battery and on 12/24 volt vehicles the radio batteries.

CAUTION ...

On 12/24 volt vehicles, if the radio batteries are not fitted,ensure that the battery leads are disconnected from the auxiliary terminal box before starting the engine.

3.15 Start the engine. Check that the oil pressure warning light goes out. Check all fuel, oil and coolant connections for leaks.

3.16 Stop the engine, when cool check coolant and oil level's, top up as necessary.

3.17 Refit the bonnet and spare wheel.

Key to Fig 4

1	Heater rail pipes	11	Oil gallery pipe
2	Top hose	12	Exhaust pipe
3	By-pass hose	13	Air hose
4	Bottom hose	14	Spill return pipe
5	Fan cowl	15	Feed pipe-fuel injector
6	Bracket-fan cowl	16	Fuel injector
7	Oil filler cap	17	Spill rail
8	Breather hose	18	Heater plug
9	Lead-coolant temp. sensor	19	Electrical connection
10	Temperature sensor-coolant		

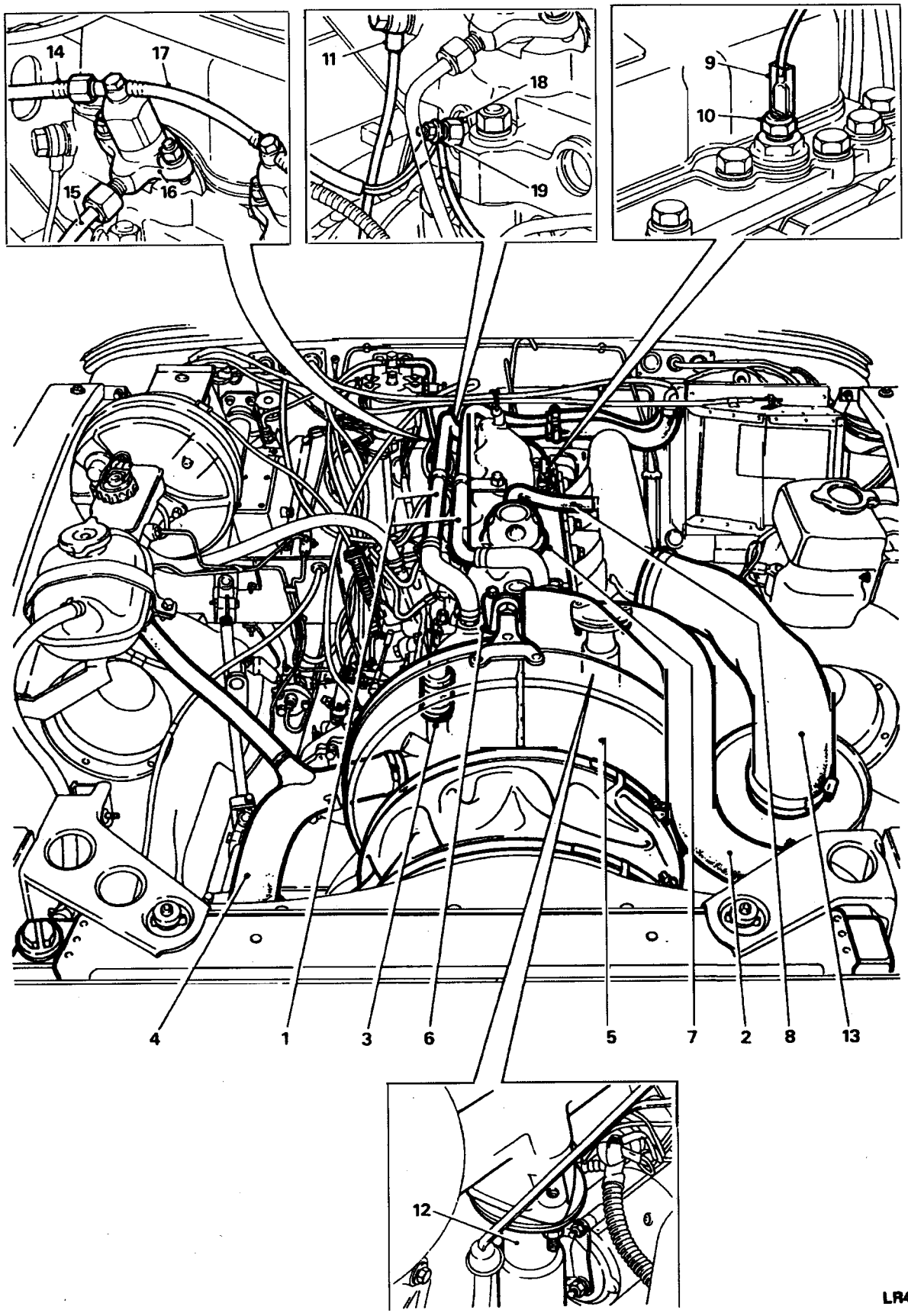


Fig 4 Disconnection points prior to cylinder head removal

CYLINDER HEAD ASSEMBLY

Note ...

The special tools listed in the following table will be referred to in the text, where used, by the serial number shown in the table.

TABLE 1 SPECIAL TOOLS

Ser No (1)	Manufacturers Part No (2)	NSN/Part No where applicable (3)	Designation (4)
1	18G 106A		Valve spring compressor
2	RO 530101A	6MT2/5120-99-782-2722	Tappet guide remover
3	RO 274400	NC	Drift, inlet valve guide removal
4	RO 274401	NC	Drift, exhaust valve guide removal
5	RO 601508	NC	Drift, inlet valve guide fitting
6	RO 600959	NC	Drift, exhaust valve guide fitting
7	MS 150-8		Adjustable pilot, inlet valve
8	MS 150-8-5	6MT2/5120-99-725-6470	Adjustable pilot, exhaust valve
9	MS 621	6MT2/5110-99-835-1921	Adjustable valve seat cutter
10	MS 76B	6MT2/5120-99-726-2735	Handle set, valve seat cutter

Preparation

4 Before the cylinder head can be removed the following ancillary items must be removed for access and safety:

4.1 Disconnect the vehicle battery and on 12/24 volt vehicles the radio batteries.

4.2 Remove the spare wheel and vehicle bonnet (Chaps 9 and 16).

4.3 On 12/24 volt vehicles remove the 90 amp generator (Chap 13).

4.4 Drain the cooling system (Chap 12 Page 2 Para 7).

4.5 Disconnect the heater rail pipes (Fig 4 (1)) from the thermostat housing and move aside.

4.6 Disconnect the top hose (2), by-pass hose (3) and the bottom hose (4) from the thermostat housing.

4.7 Release the fan cowl (5) from the bracket (6) attached to the thermostat housing.

4.8 Remove the oil filler cap (7) and breather hose (8).

4.9 Disconnect the lead (9) from the coolant temperature sensor (10).

4.10 Disconnect the oil gallery pipe (11) at the rear of the engine.

4.11 Disconnect the exhaust pipe (12) from the manifold.

4.12 Remove the air hose (13) connecting the air cleaner to inlet manifold.

4.13 Disconnect the fuel spill return to fuel filter pipe (14).

4.14 Disconnect the fuel feed pipes (15) from the injectors (16).

4.15 Remove the injectors (16) complete with spill rail (17), (Chap 11-2 Para 61).

4.16 Disconnect the heater plug (18) electrical connections (19).

Removal

5. The cylinder head assembly removal procedure is as follows:

5.1 Remove the rocker cover (Fig 5 (2)) and discard the gasket (1).

5.2 Slacken the tappet adjustment screw locknuts (34) and turn the screws (35) to release them from the push rods (27).

5.3 Remove the rocker shaft retaining bolts and lift off the rocker shaft assembly.

Note ...

To prevent the rocker shaft assembly from falling apart, prior to dismantling, invert the assembly and fit to the top of the rock r cover by inserting the studs through the cover fixing holes and securing with the nuts.

5.4 Withdraw the push rods (27) and identify them to the locations from which they were removed.

5.5 Remove the cylinder head retaining bolts in reverse order to the tightening sequence (Fig 24).

5.6 Remove the cylinder head (Fig 5 (12)) complete with exhaust (18) and inlet (4) manifolds. Remove and discard the gasket (13).

Dismantling

Cylinder head

6 To dismantle the cylinder head carry out the following:

6.1 Remove the nuts and clamps and detach the inlet manifold (4) and the exhaust manifold (18). Remove and discard the manifold gasket (11).

6.2 Remove the thermostat housing cover (5), thermostat (7) and housing (9) complete with by-pass adaptors (8) and gaskets (6) and (10).

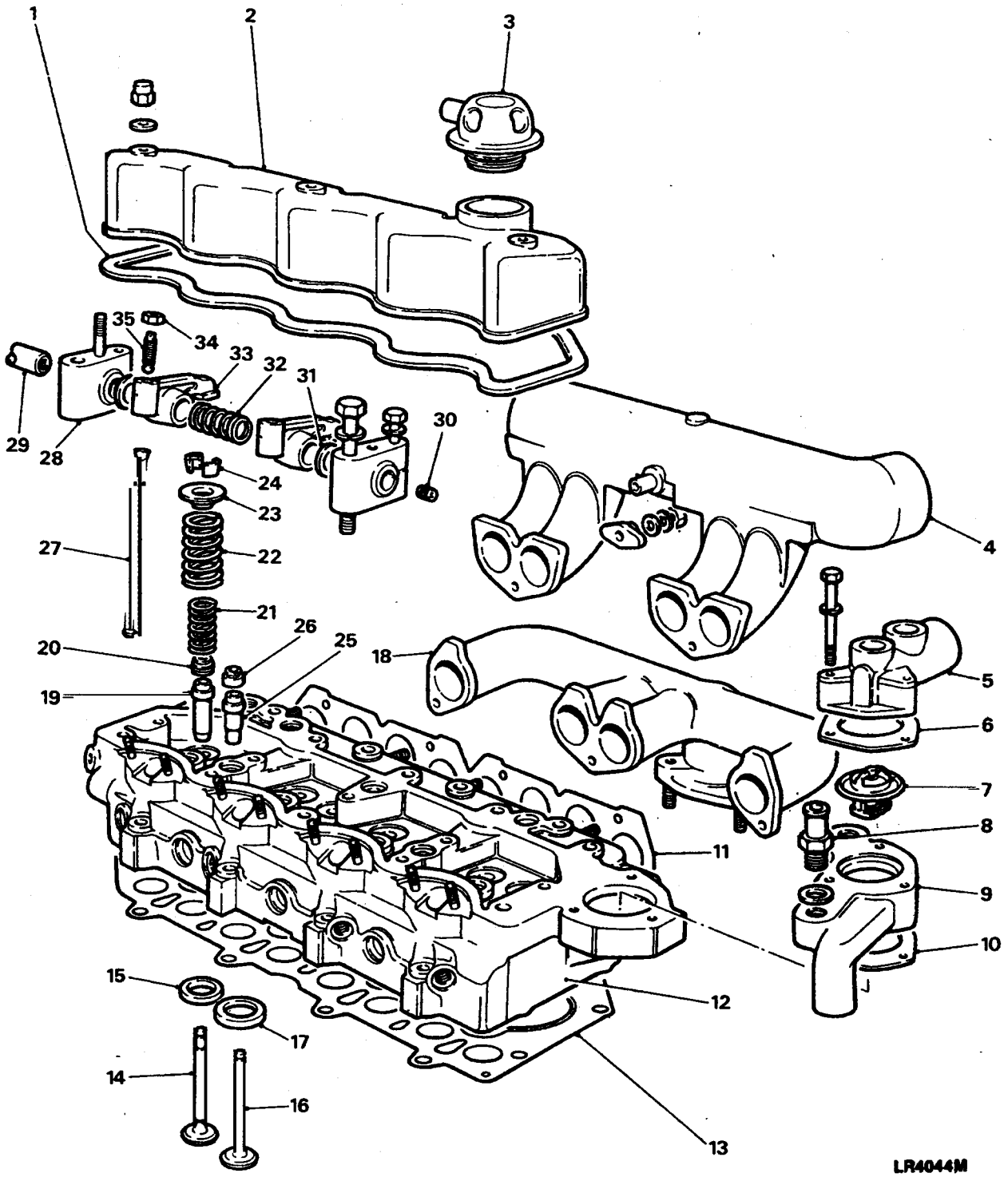


Fig 5 Exploded view of cylinder head

Key to Fig 5

1	Gasket-rocker cover	19	Exhaust valve guide
2	Rocker cover	20	Oil seal-valve guide
3	Oil filler cap	21	Inner valve spring
4	Inlet manifold	22	Outer valve spring
5	Cover-thermostat housing	23	Valve spring retainer
6	Gasket	24	Split collets
7	Thermostat	25	Inlet valve guide
8	By-pass adaptor	26	Oil seal-valve guide
9	Thermostat housing	27	Push rod
10	Gasket	28	Rocker bracket
11	Manifold gasket	29	Rocker shaft
12	Cylinder head	30	Rocker shaft plug
13	Cylinder head gasket	31	Spacer
14	Exhaust valve	32	Spring
15	Exhaust valve seat	33	Rocker lever
16	Inlet valve	34	Locknut
17	Inlet valve seat	35	Adjusting screw
18	Exhaust manifold		

6.3 Remove the coolant temperature sensor (Fig 2 (10)), the heater plugs (18) and the engine lifting brackets.

6.4 Using valve spring compressor (Serial No 1) or a suitable alternative, remove the valves and spring assemblies, keeping them identified with their original locations. Discard the oil seals.

Rocker shaft assembly

7 To dismantle the rocker shaft assembly proceed as follows:

7.1 Remove the locating screw from the number two rocker bracket, withdraw all the components from the shaft and lay them out on a suitable work surface in the same order as removed.

7.2 Remove the adjusting screws (Fig 5 (35)) and locknuts (34) from the rockers (33).

Tappets

8 The procedure for removing the tappet assemblies is as follows:

Note ...

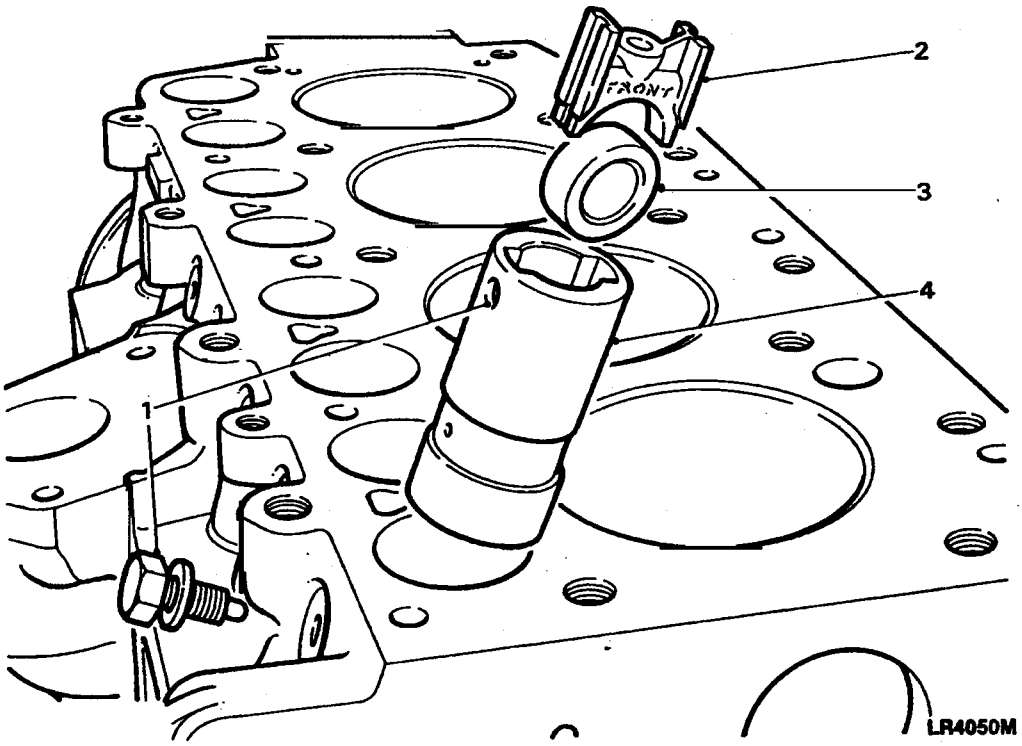
The components from each tappet assembly must be retained in sets and identified to the location in the cylinder block from which they were removed.

8.1 Remove the eight tappet guide locating screws (Fig 6 (1)) from the right-hand side of the cylinder block.

8.2 Using long nosed pliers or a suitable length of bent wire, lift out the tappet slides (2).

8.3 Lift out the tappet rollers (3) and mark the side facing the front of the engine.

8.4 Lift out the guides (4). If the guides are difficult to remove use special tool (Serial No 2).



1	Screw-guide locating	3	Roller
2	Slide	4	Guide

Fig 6 Tappets removal

Cleaning

9 Remove all carbon deposits from the valves and combustion chambers and degrease all components ready for examination. If scaling is apparent in the cylinder head water passages, remove using a proprietary descaling solution in accordance with the manufacturers instructions.

Examination

Cylinder head

10 The cylinder head should be thoroughly inspected for cracks before repair work is carried out.

10.1 Examine the the hot plugs (Fig 10), small surface cracks extending from the opening to approximately 8,00mm (0.315in) in length are acceptable. If severe cracks are evident on the face of the plug, closely examine the cylinder head for cracks particularly between the inlet and exhaust valve seats. Such cracking indicates that the engine has overheated, usually through lack of coolant and the cylinder head should be scrapped.

10.2 Examine the cylinder head for distortion.

10.3 Examine the valve seats for pitting and other damage.

10.4 Check the valve guides for wear by inserting a new valve in the appropriate guide and leaving a gap between the valve face and valve seat of 8,0mm (0.315in). If movement across the head exceeds 0,15mm (0.006in) the guide must be renewed.

Rocker shaft assembly

11 The rocker shaft assembly should be examined as follows:

11.1 Examine the rocker shaft for wear at the bearing surfaces, if the bearing surfaces are worn more than 0,025mm (0.001in) a new shaft must be fitted.

11.2 If the shaft is acceptable for further use ensure that the oil lubrication drillings at the rocker lever locations are not blocked, and that the through bore is clear.

11.3 Examine the rocker levers for wear on the pads, if wear is apparent they must be renewed.

Note ...

It is not permissible to grind the pads in an attempt to reclaim the rocker levers.

11.4 Check the clearance between the rocker lever bushes and the rocker shaft, if clearance exceeds 0,101 to 0,127mm (0.004 to 0.005in) renew the bushes.

11.5 Examine the ball end of the adjusting screws and discard any that are worn. Check the threads for damage.

Valves and valve springs

12 The valves and valve springs should be examined as follows:

12.1 Examine the valves for cracks, damage and wear. Pitting or slight damage to the valve face can be removed by grinding.

12.2 The inner and outer valve springs are an interference fit, if they slide apart new springs must be fitted.

12.3 If the valve springs are to be re-used examine them for squareness of ends, check the free length and the length under load. The free lengths, lengths under load and loads are as follows:

12.3.1 Inner spring, free length 43,0276mm (1.694in). Load to compress to 36,93mm (1.454 in), 7,4 - 8,4 kgf (16.4 - 18.6 lbf).

12.3.2 Outer spring, free length 47,1932mm (1.858in). Load to compress to 40,106mm (1.579in), 20 - 22,6 kgf (44,2 - 49,8 lbf).

Push rods

13 Check the push rods for damage and straightness.

Tappets

14 Examine the components of each tappet assembly for wear. Ensure that the slides move freely in the guides and that the oilways are clear to the tappet bearing surface, the cross drilling and the oil feed to the push rod.

Repairs and replacement

General

15 Gaskets, joints and seals are not to be re-used. Renew these items on reassembly.

16 Valve springs, rocker springs and spacers should be renewed at every major overhaul.

Cylinder head

17 The cylinder head can be refaced, providing that the correct machining facilities are available. Refacing must only be carried out once during the life of the head, to establish if the head has previously been refaced, dimensionally check the overall thickness. If the dimension obtained corresponds with the dimension shown in Fig 7, it is permissible to skim up to 0,250mm (0.010in) from the face of the head to reclaim it. If the dimensional check indicates that the head has previously been refaced a new head must be fitted.

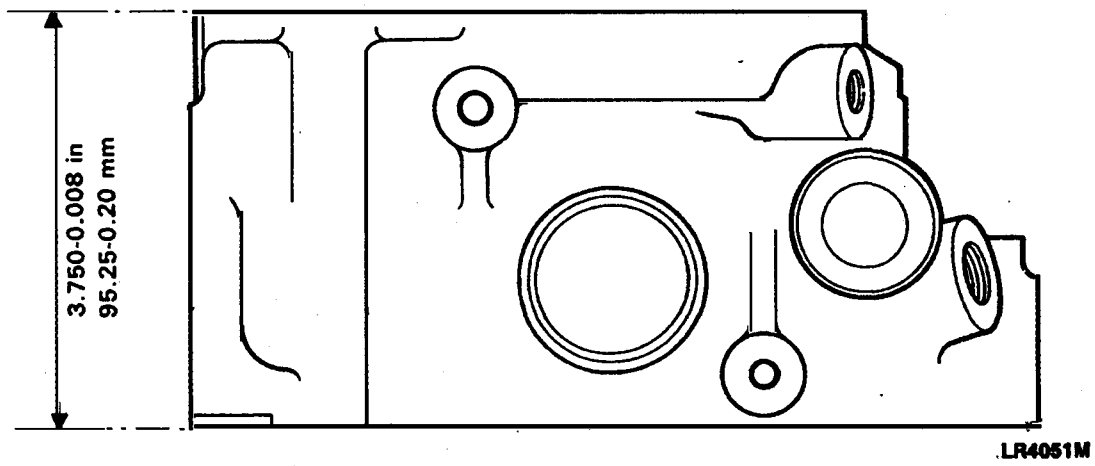


Fig 7 Dimension for refacing cylinder head

Note ...

Refacing the cylinder head must be carried out with the hot plugs fitted. If the existing hot plugs require renewing, they should be renewed before carrying out the refacing operation.

Hot plugs and injector shrouds

18 To renew the hot plugs and injector shrouds proceed as follows:

18.1 To remove a hot plug, insert a thin soft metal drift through the injector shroud and tap out the hot plug (Fig 8) from the inside. Remove the roll pin.

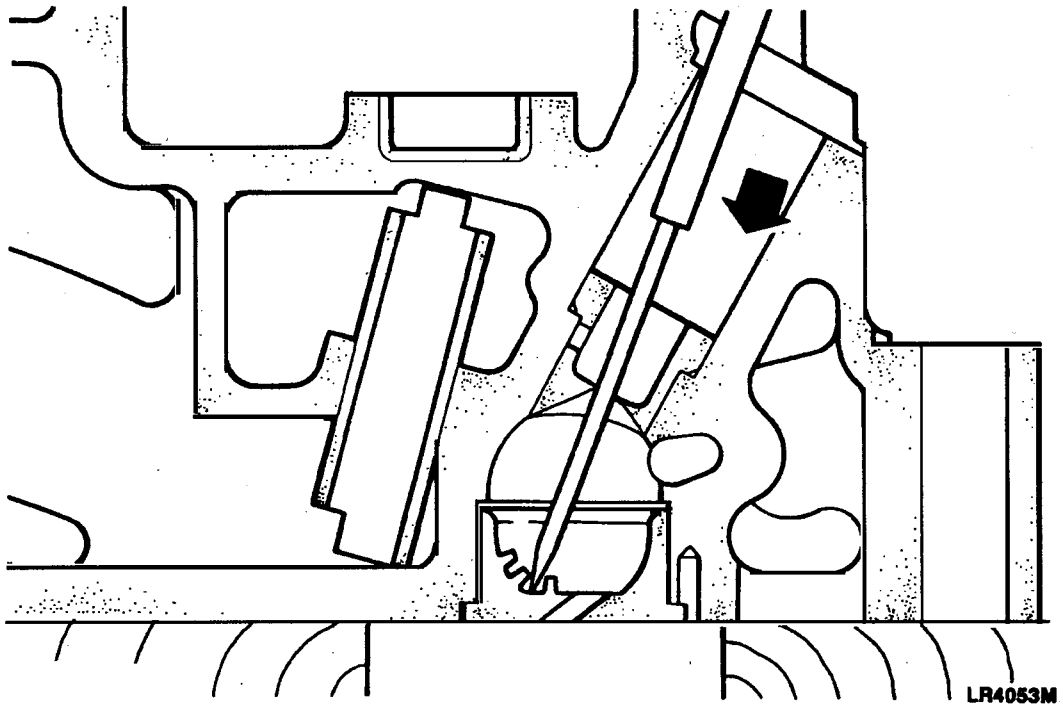


Fig 8 Hot plug removal

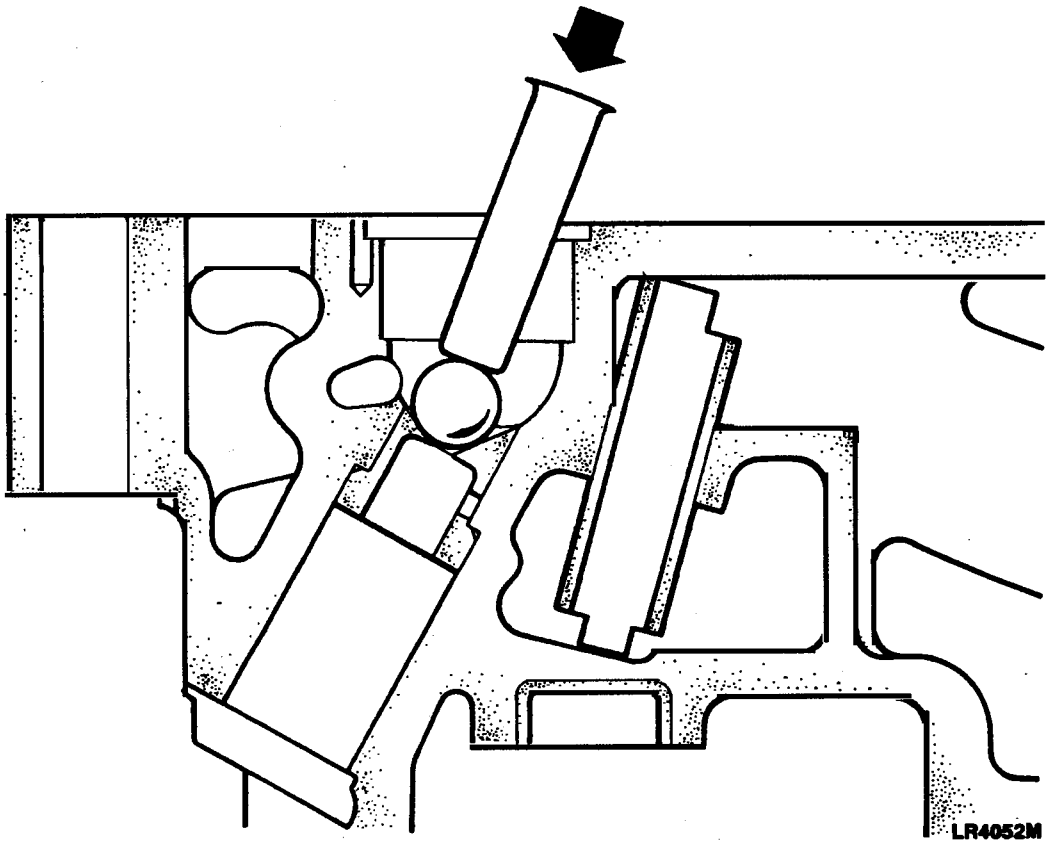


Fig 9 Injector shroud removal

Note ...

When removed the hot plugs are scrap.

18.2 With the hot plug removed check the condition of the face of the injector shroud, if damaged drift out the shroud towards the injector bore, using a 13mm (0.512in) ball bearing and drift (Fig 9).

18.3 Thoroughly clean the combustion chamber.

Note ...

The hole in the side of the injector shroud is for manufacturing purposes only, but can be used as a guide to ensure correct fitting to the head.

18.4 Smear a little oil on the shroud and insert into the cylinder head with the hole pointing towards the centre of the head, and drift into position.

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

18.6 After fitment, the hot plugs must be checked with a dial test indicator (Fig 10) to ensure that they do not protrude above the level of the cylinder head face more than 0,084mm (0.0033in) and are not recessed below the level of the face more than 0,020mm (0.0008in).

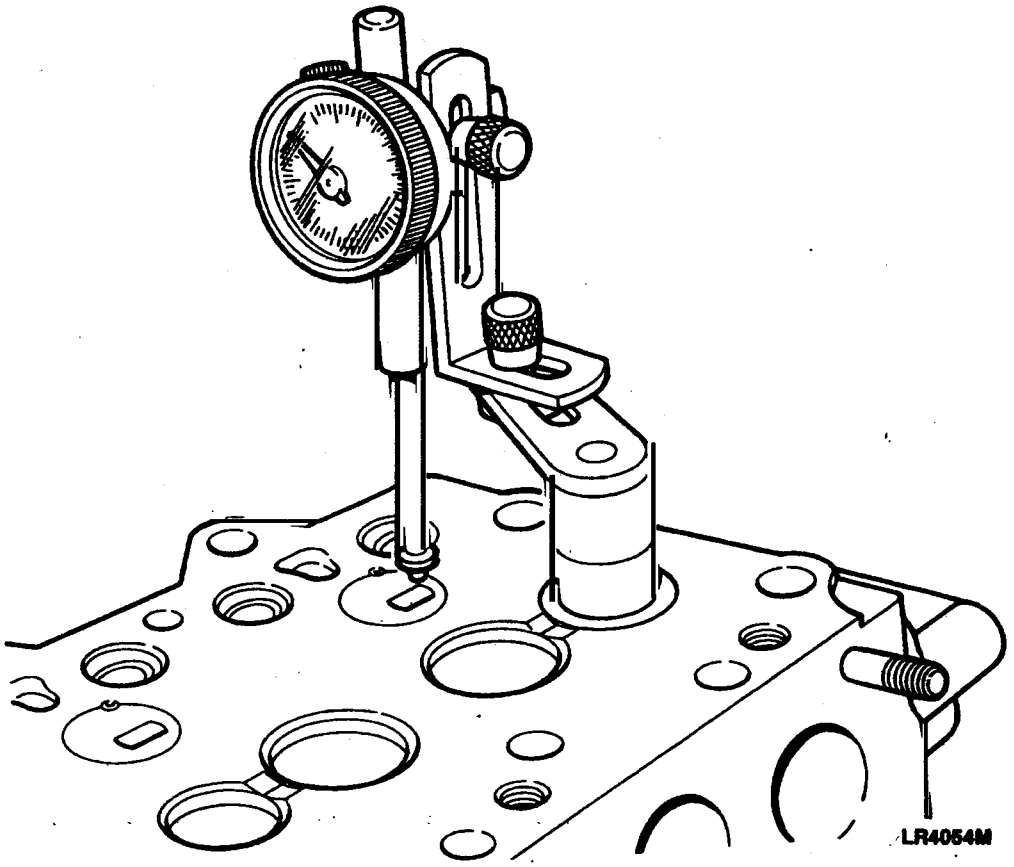


Fig 10 Checking hot plug protrusion

Valve guides

19 To renew the valve guides carry out the following:

19.1 Support the cylinder head, valve seats uppermost on pieces of timber of sufficient thickness to allow clearance for the valve guides to be driven out.

19.2 Using special drifts (Serial No 3) for inlet valves and (Serial No 4) for exhaust valve guides, or suitable alternatives, drive out the guides from the combustion face side (Fig 11).

19.3 Turn the cylinder head over so that the valve seats are face downward.

Note ...

Inlet and exhaust valve guides are dimensionally different, it is important that the correct guides are fitted to the appropriate ports.

19.4 Lubricate the new guides with clean engine oil and using special drifts (Serial No 5) 8 for inlet valve guides and (Serial No 6) for exhaust valve guides, or suitable alternatives, drive in the new guides until the shoulder is flush with the casting (Fig 12).

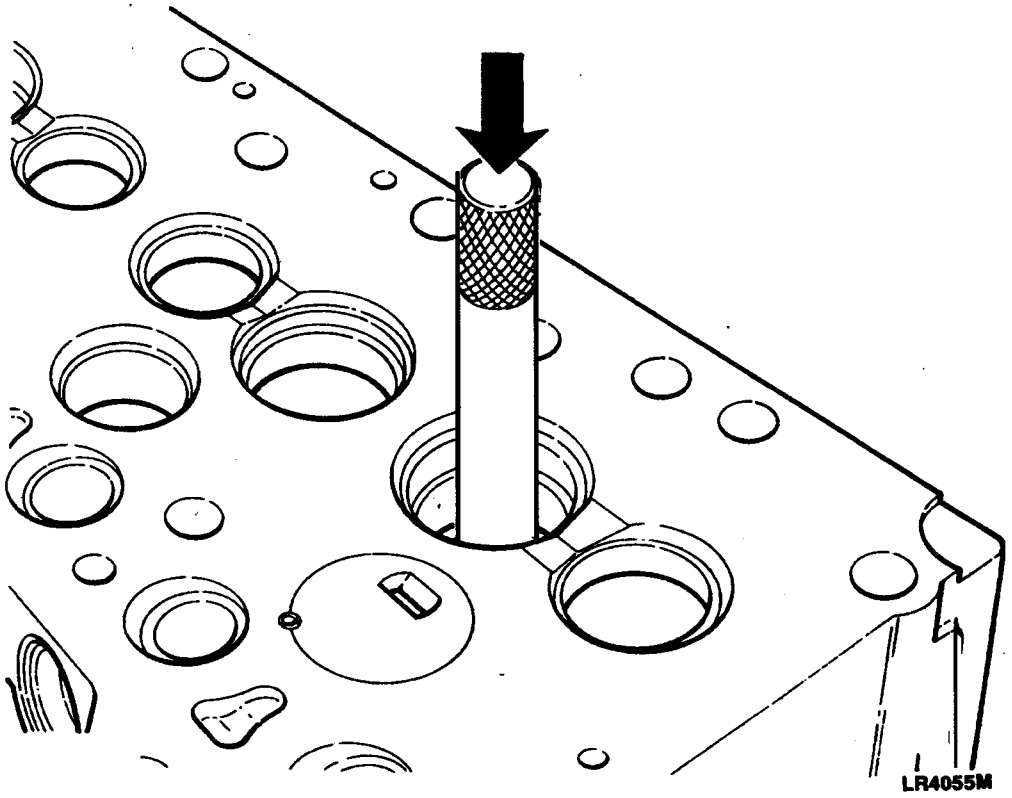


Fig 11 Removing valve guides

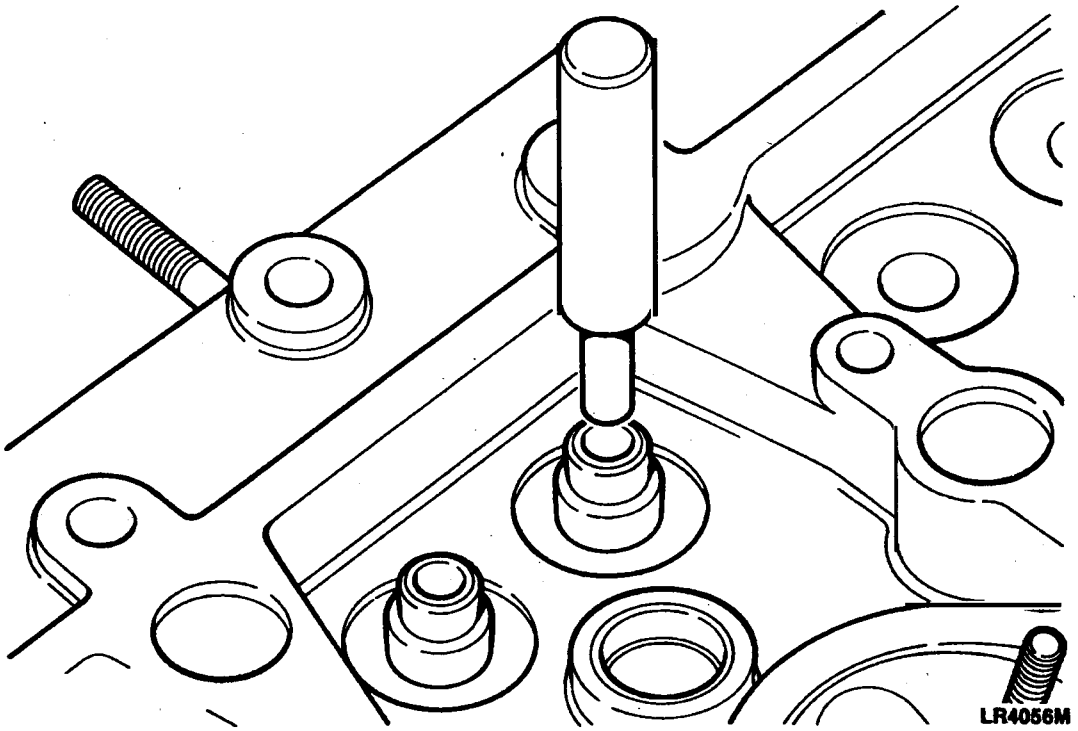


Fig 12 Fitting valve guides

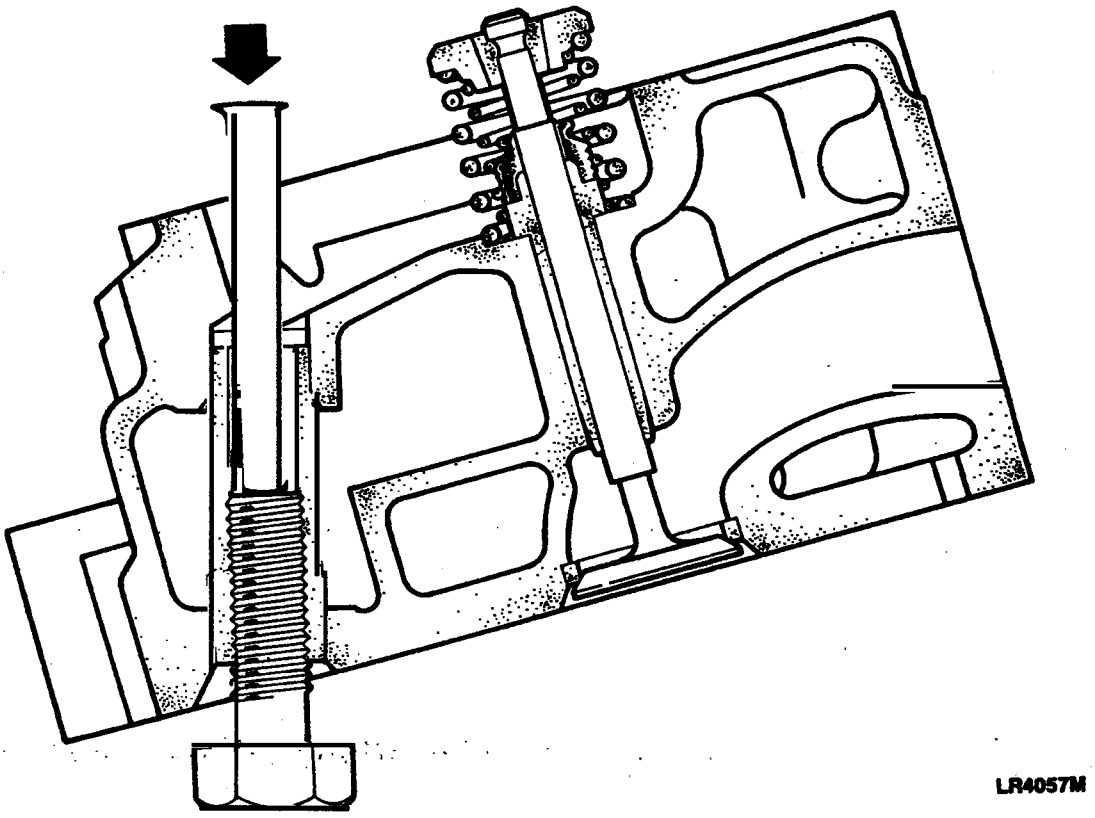


Fig 13 Removing push rod tubes

Push rod tubes

20 Whilst it is rarely necessary to renew push rod tubes, the procedure is as follows:

20.1 Using an 8mm, tap cut a thread 30mm (1.20 in) deep in the combustion face end of the tube to be removed.

20.2 Screw an appropriate bolt into the tube and press out as illustrated (Fig 13).

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

Refacing cylinder head valve seats and inserts

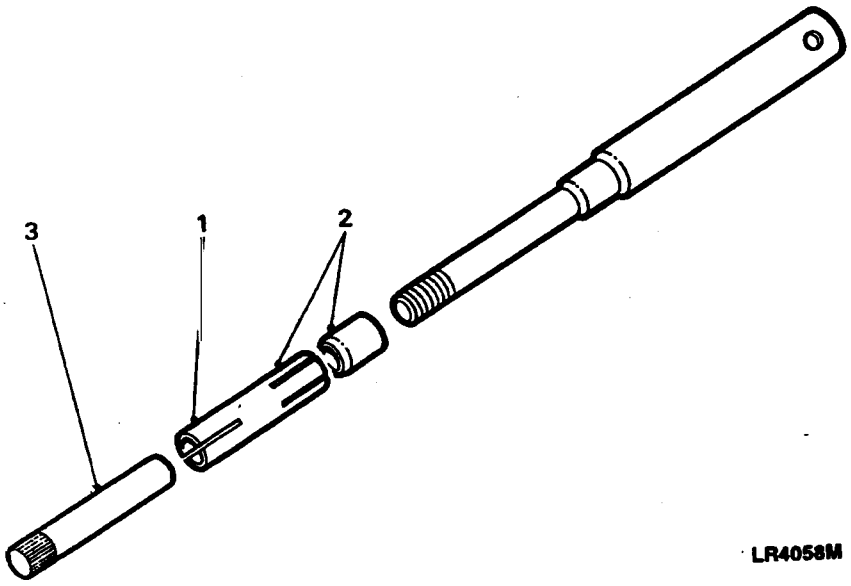
21 Cylinder head valve seat inserts can be refaced provided they are not abnormally wide due to repeated refacing operations. If the inserts are considered unsuitable for refacing, new inserts should be fitted.

22 The special set of hand tools recommended for refacing include expandable pilots that fit tightly into new or worn guides to ensure that the valve seat is concentric with the valve guide.

22.1 Select the correct expandable collet (Fig 14 (1)) for the valve guide concerned i.e. 8mm for inlet guides and 8.5mm for exhaust guides (Table 1).

22.2 Loosely assemble the collet (1), expander (2) and nut (3), ensuring that the chamfered end of the expander is toward the collet.

22.3 Insert the assembled pilot into the valve guide (Fig 15) from the combustion face side of the cylinder head until the shoulder contacts the valve guide and the whole of the collet is inside the valve guide.



1 Collet 2 Expander 3 Nut

Fig 14 Expandable pilot for refacing valve seats

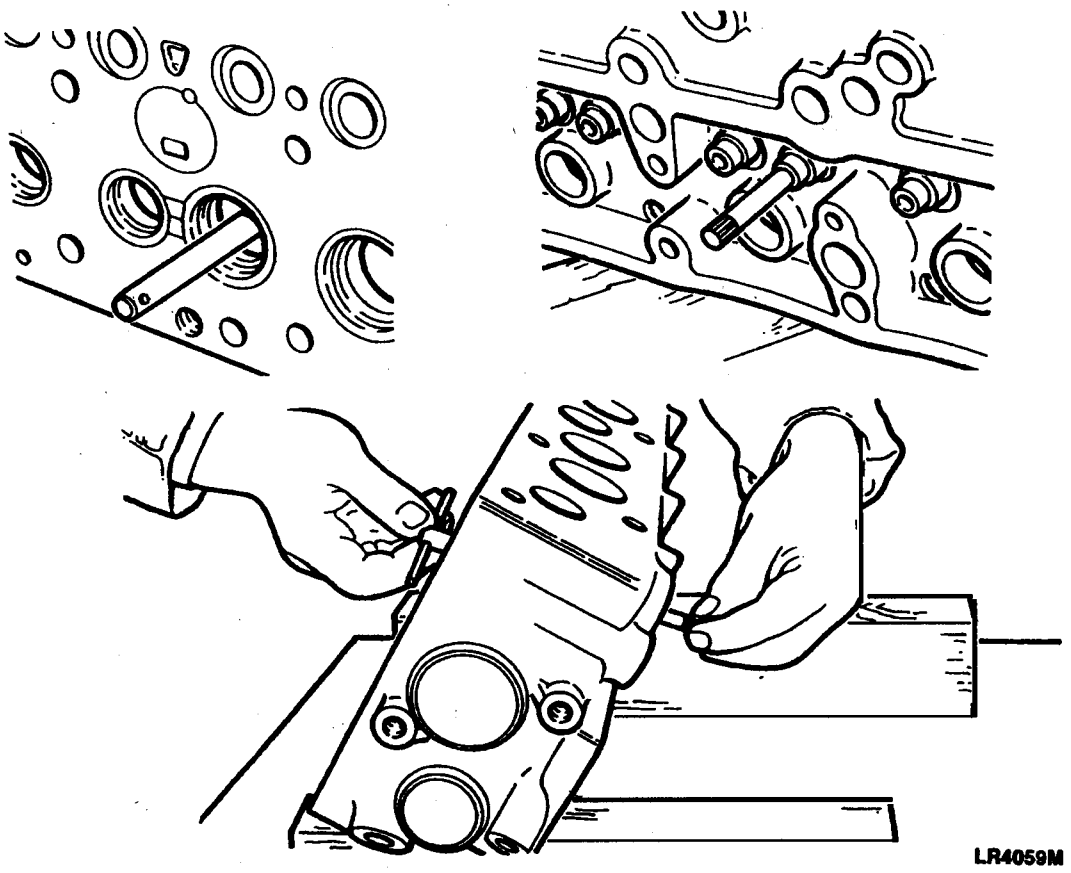


Fig 15 View of pilot fitted to cylinder head

22.4 Using a suitable tommy bar expand the collet in the guide by turning the tommy bar clockwise whilst holding the knurled nut.

22.5 Ensure that the cutter blades on the 45° side of valve cutter (Serial No 9) are correctly fitted to the cutter head with the angled end of the blade downwards, facing the work (Fig 16). Check that the cutter blades are adjusted so that the middle of the blade contacts the area of material to be cut. Use the key provided in the hand set to adjust the cutters.

22.6 Fit the cutter assembly to the pilot, previously fitted to the valve guide, and using the handle (Fig 17) turn the cutter clockwise using only light pressure. Only the minimum amount of material necessary should be removed.

22.7 To check the effectiveness of the cutting operation use engineers blue or a feeler gauge made from cellophane.

22.8 Smear a small quantity of engineers blue round the valve seat and revolve a correctly ground valve against the seat. A continuous line should appear round the valve face. If there is a gap of not more than 12mm it can be corrected by lapping.

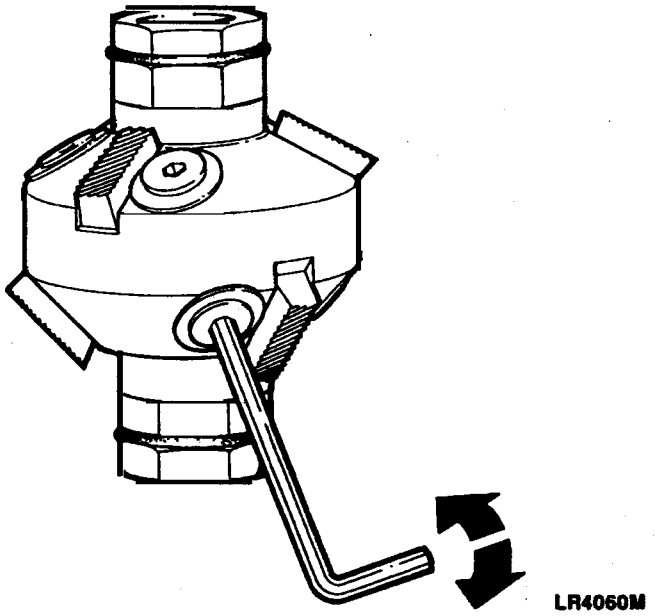


Fig 16 Adjusting cutter blades

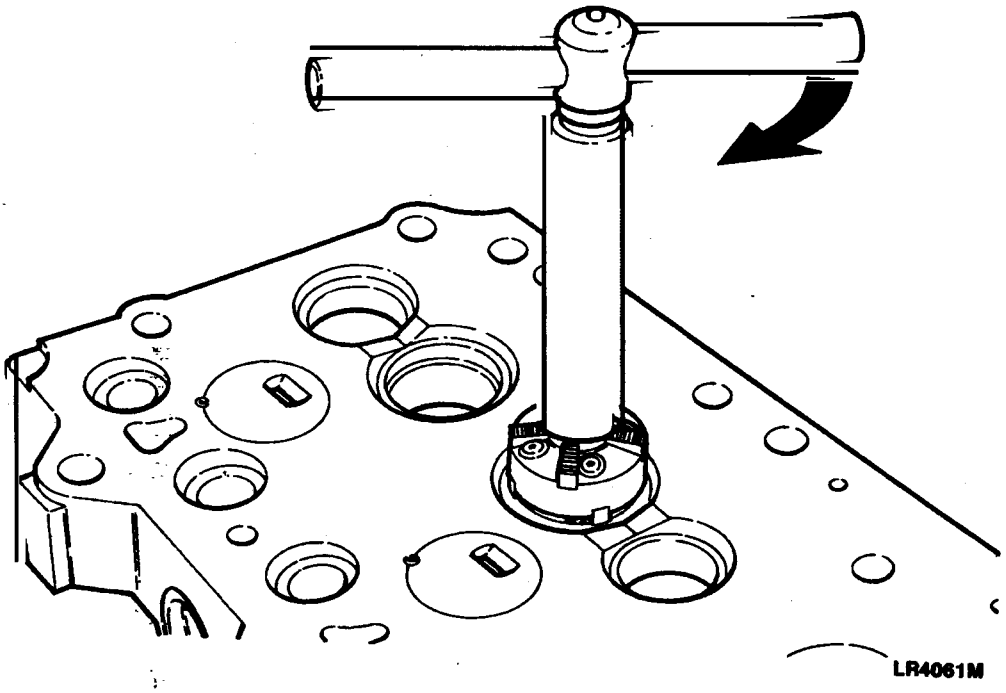


Fig 17 View of cutter fitted to pilot

22.9 Alternatively, insert a strip of cellophane between the valve and seat, hold the valve down by the stem and slowly pull out the cellophane. If there is a drag the seat is satisfactory in that spot, repeat this check in at least eight places. Lapping-in will correct a small open spot.

Renew valve seat inserts

23 To renew cylinder head valve seats carry out the following:

WARNING ...

WHEN REMOVING VALVE SEAT INSERTS FROM THE CYLINDER HEAD PROTECTIVE GOGGLES MUST BE WORN.

23.1 Hold the cylinder head firmly in a vice with the combustion chamber uppermost, grind the insert away until thin enough to be cracked and prised out. Care should be taken to avoid damage to the insert pocket.

23.2 Remove any burrs and swarf from the pocket. Failure to do this could cause the new insert to crack when being fitted.

23.3 Using a suitable valve seat insert replacer (Fig 18), fit the new insert with the chamfered edge leading ensuring, that it is square and properly seated in the pocket.

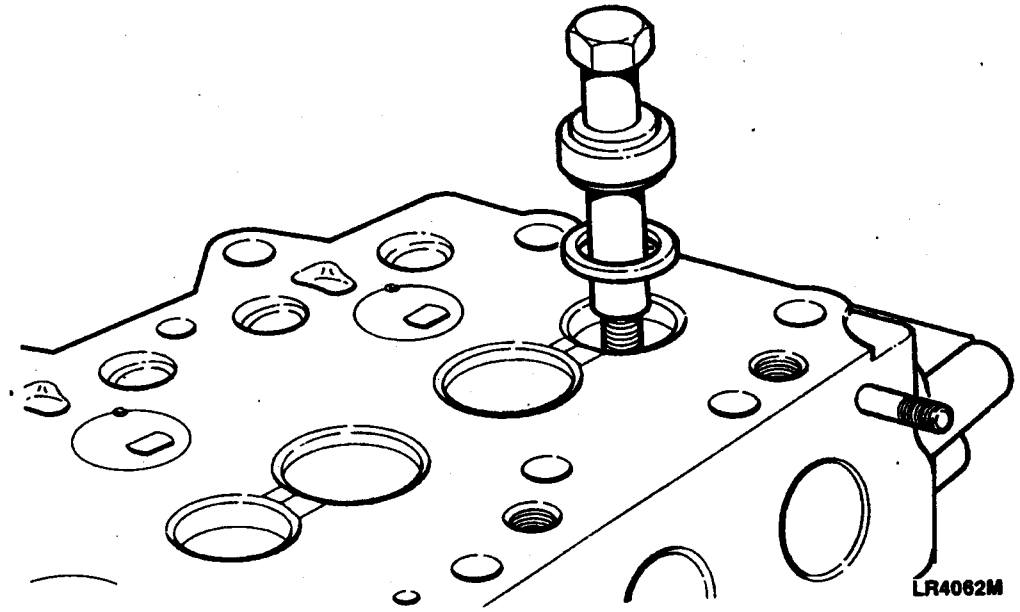


Fig 18 Typical valve seat replacer tool

23.4 Cut a 45° seat using cutter (Serial No 9) or suitable alternative, following the procedure for refacing valve seat inserts (Para 21).

Reface valve seats

24 Valves that are satisfactory for further service can be refaced. This operation should be carried out using a valve grinding machine. Only the minimum amount of material should be removed from the valve face to avoid thinning of the valve edge. The valve is refaced correctly when all pitting is removed and the face concentric with the stem (Fig 19).

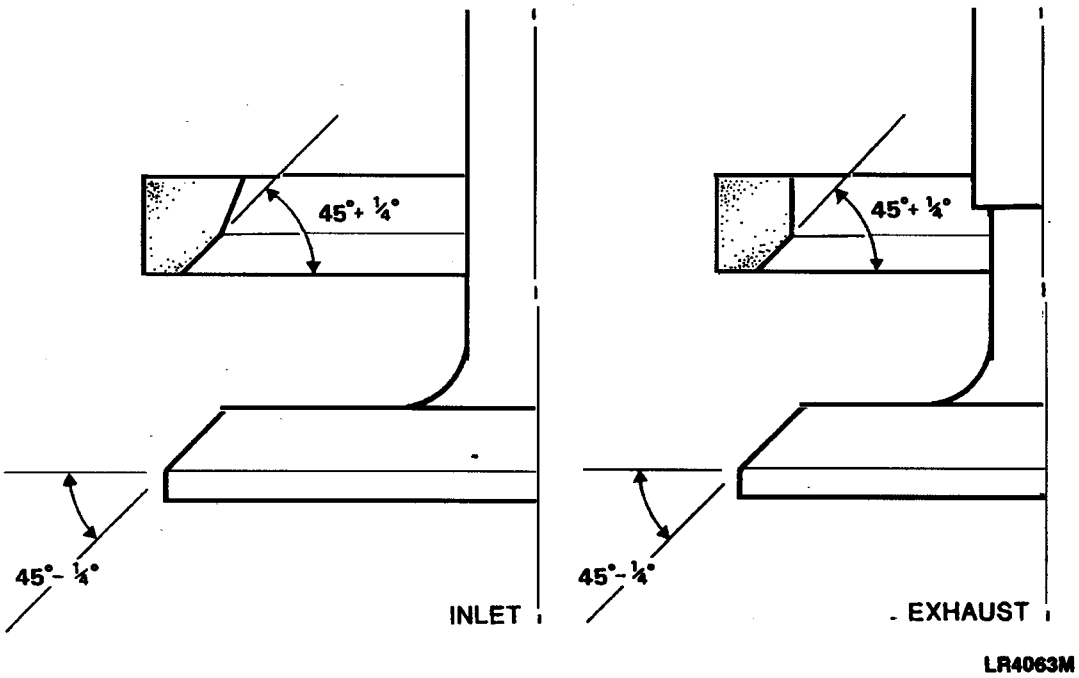


Fig 19 Valve seat regrinding angles

Lap-in valves

25 To ensure a gas tight seal between the valve face and valve seat it is necessary to lap-in the appropriate valve to its seat. It is essential to keep the valve identified with its seat once the lapping-in operation has be n completed.

25.1 Unless the faces to be lapped are in poor condition it should only be necessary to use fine lapping paste. Smear a small quantity of paste on the valve face and lubricate the valve stem with clean engine oil.

25.2 Insert the valve in the appropriate guide and using a suction type valve lapping tool (Fig 20) employ a light reciprocating action while occasionally lifting the valve off its seat and turning it so that the valve returns to a different position on the seat.

25.3 When a continuous matt grey band round the valve face is obtained, wipe off the lapping paste from the valve and seat and make a series of pencil lines across the valve face. Insert the valve into the guide and while pressing the valve onto the seat revolve the valve a quarter of a turn a few times. If all the pencil lines are cut through no further lapping is required.

25.4 Wash off all traces of lapping paste from the valves and cylinder head seats.

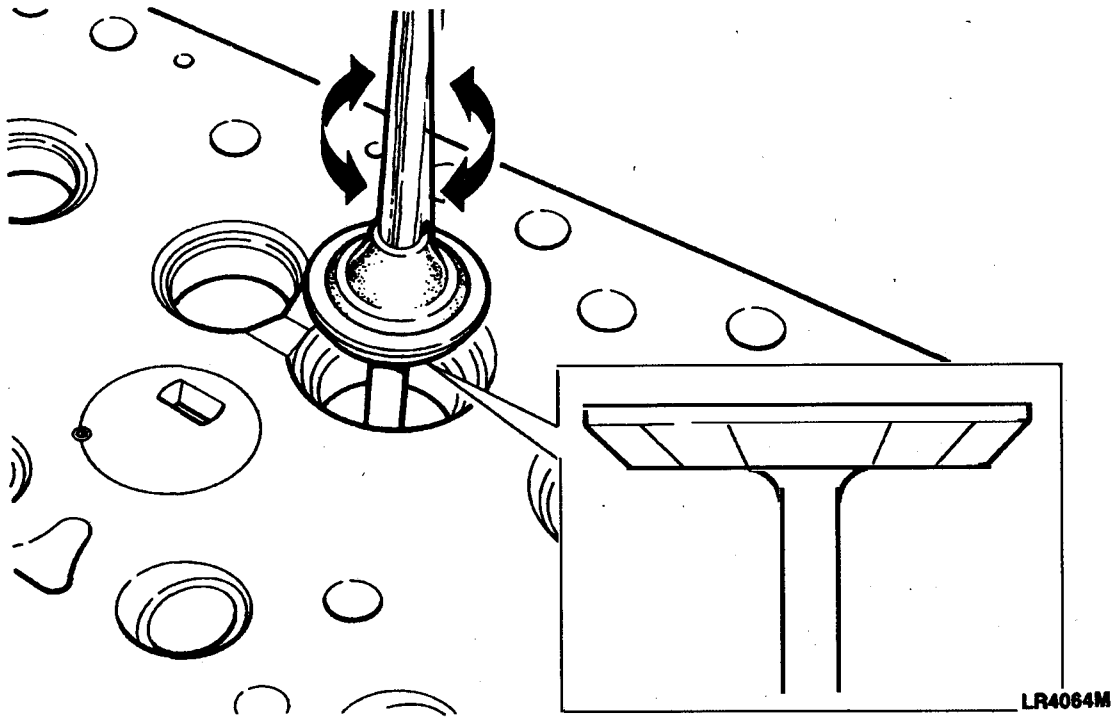


Fig 20 Valve seat lapping-in

Rocker lever bushes

26 To renew the rocker lever bushes:

26.1 Press out the worn bushes.

26.2 Press in the new bushes ensuring that the lubrication drillings in the bushes align with those in the rocker lever (Fig 21).

26.3 Ream out the bushes to a diameter of 13,481 to 13,506 mm (0.53075 to 0.53175 in).

26.4 Clear swarf and burrs from the lubrication drillings.

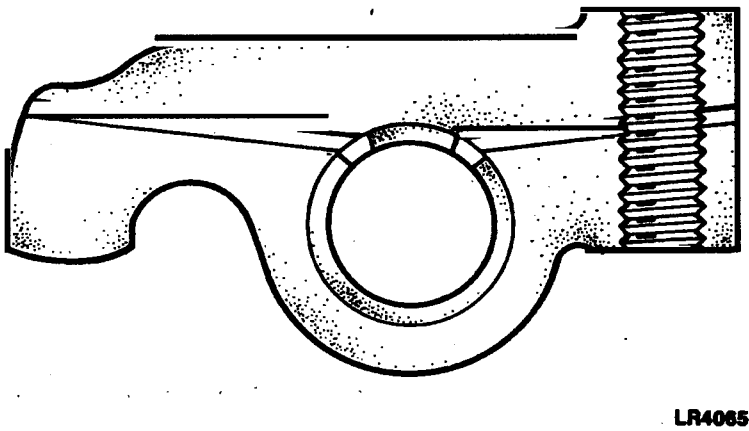


Fig 21 Cross-section through rocker lever

Reassembly

Tappets

27 To fit the tappet assemblies proceed as follows:

Note ...

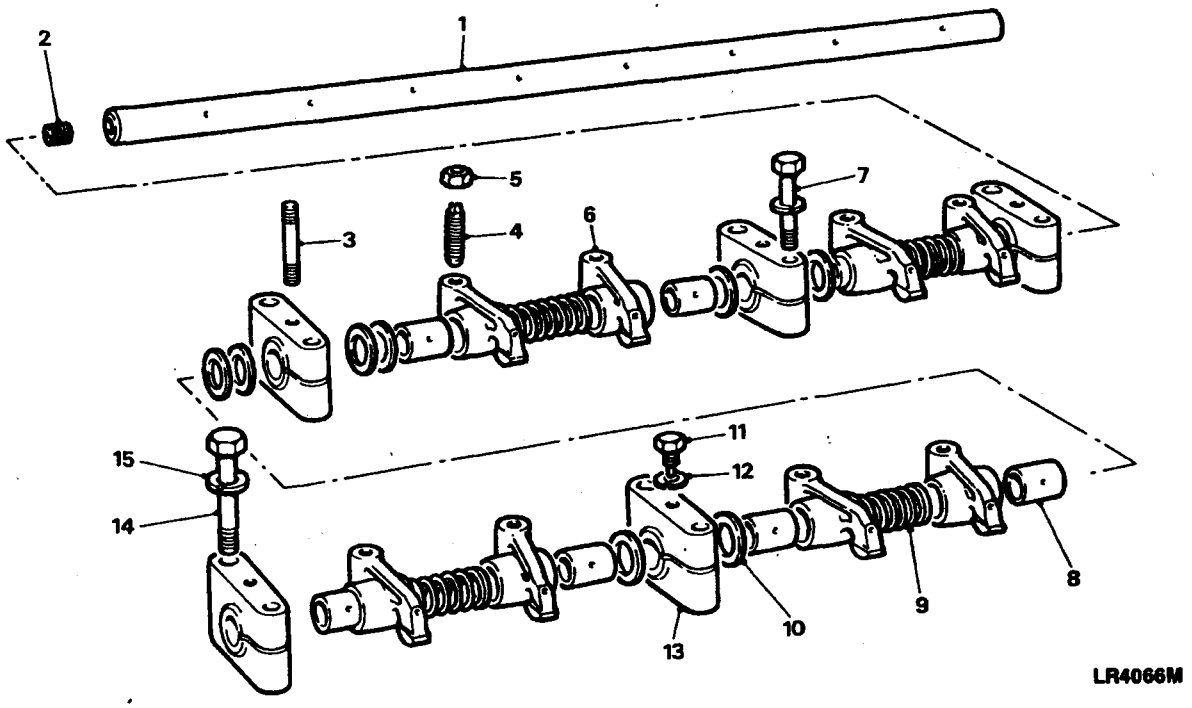
If the original tappet assemblies are being fitted ensure that they are fitted to the locations from which they were removed.

27.1 Insert the tappet guides (Fig 6 (4)) into the cylinder block and align the locating screw holes.

27.2 Fit the rollers (3) ensuring that they are fitted in accordance with the marks made during removal.

27.3 Insert the tappet slides (2) with the word 'FRONT' towards the front of the engine.

27.4 Secure the guides with new micro encapsulated screws (1).



1	Shaft	9.	Spring
2	Plug screw	10.	Spacer
3	Stud	11.	Locating screw
4	Adjusting screw	12.	Spring washer
5	Locknut	13.	Bracket
6	Rocker lever	14.	Securing bolt
7	Securing bolt	15.	Spring washer
8	Bush		

Fig 22 Rocker shaft assembly

Rocker shaft assembly

28 To assemble the rocker shaft assembly proceed as follows:

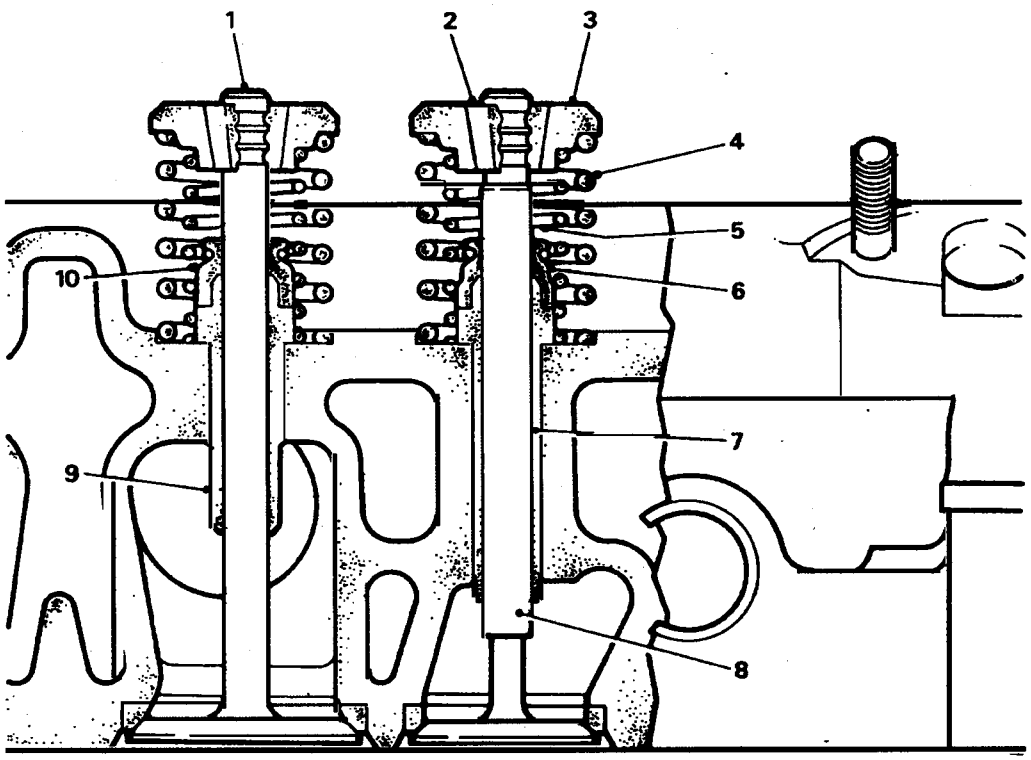
28.1 Fit the number two bracket (Fig 22 (13)) to the shaft (1) and retain with the locating screw (11) and washer (12). Tighten the screw to a torque of 20 to 27Nm (14.7 to 20lbf ft).

28.2 Using new spacers (10) and springs (9) (major overhaul only), assemble the rocker levers (6) and remaining brackets to the locations from which they were removed, ensuring that two spacers are fitted each side of the centre bracket.

28.3 Loosely assemble the tappet adjustment screws (4) and locknuts (5) to the rocker levers (6).

28.4 If the rocker studs (3) have been removed, assemble to their respective brackets.

28.5 Invert the assembly and fit to the top of the rocker cover by inserting the studs through the cover fixing holes, to prevent it from falling apart.



1	Inlet valve	6	Oil seal-exhaust valve
2	Split collets	7	Guide-exhaust valve
3	Spring cap	8	Exhaust valve
4	Outer valve spring	9	Guide-inlet valve
5	Inner valve spring	10	Oil seal-inlet valve

Fig 23 Valve assemblies

Valves to cylinder head

29 To assemble the valves to the cylinder head proceed as follows:

29.1 Insert the inlet valves (Fig 23 (1)) into the guides (9) and fit new oil seals (10) with the plain exterior. Ensure that the seals locate in the grooves in the valve guide.

29.2 Insert the exhaust valves (8) and fit the oil seals (6) with the stepped exterior.

29.3 Fit the valve springs (4) and (5) and the spring caps (3) to each valve in turn and using valve spring compressor (Serial No 1) secure the assemblies with the split collets (2).

Cylinder head assembly to cylinder block

30 To assemble the cylinder head to the cylinder block proceed as follows:

Note ...

When fitting the cylinder head to the cylinder block ensure that the correct type of gasket is being fitted. The correct gaskets are stamped with the word "DIESEL" on one of the faces and with the word "TOP" on the upper face.

30.1 Clean the cylinder head and cylinder block mating faces and fit a new gasket, dry, without grease or sealing compound. Ensure that the gasket is fitted with the word "TOP" fitted uppermost.

30.2 Place the cylinder head assembly in position and engage all the securing bolts, nuts and washers, except those used to secure the rocker shaft assembly, tighten finger tight only.

Note ...

Use new bolts and ensure they are of the correct type for use on diesel engines.

30.3 Insert the push rods in the locations from which they were removed, ensuring that the ball-ends fit correctly into the spherical seats in the tappet slides.

30.4 Fit the rocker shaft assembly ensuring that the front and rear brackets locate correctly with the dowels in the cylinder head, and the ball ends of the adjuster screws seat in the push rod cupped ends.

30.5 Fit the remaining cylinder head securing bolts through the rocker shaft brackets and the rocker shaft bracket to cylinder head securing bolts. Tighten finger tight only.

30.6 Tighten the cylinder head securing bolts and nuts to a torque of 115 to 130Nm (84.8 to 95.8 lbf ft) strictly in the sequence shown in Fig 24, to avoid distortion of the cylinder head.

30.7 Tighten the rocker shaft bracket to cylinder head securing bolts to a torque of 22 to 28mm (16 to 20.6 lbf ft).

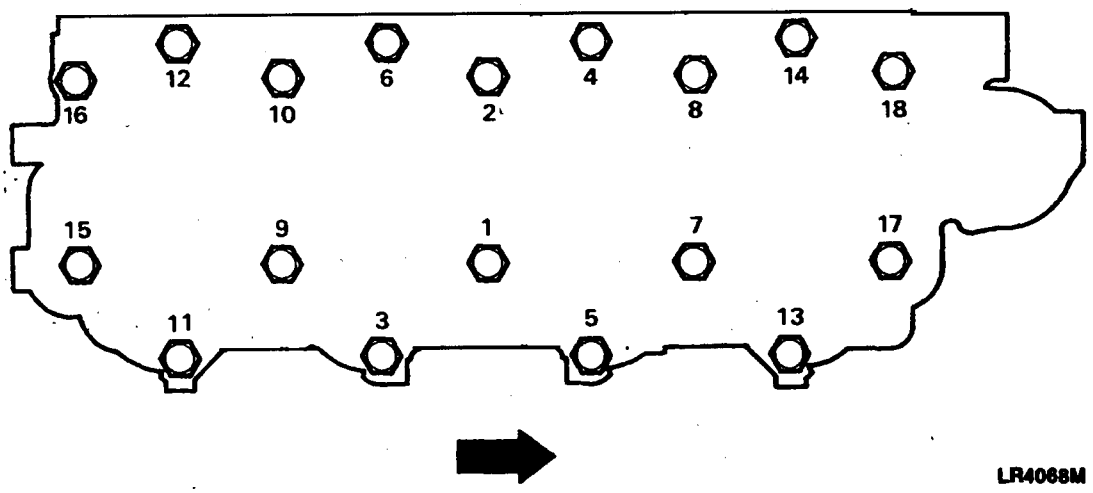


Fig 24 Tightening sequence cylinder head fixings

Valve clearances

31 To set the valve clearances proceed as follows:

31.1 The tappet clearance for inlet and exhaust valves is 0,250mm (0.010in). To adjust the clearance slacken the locknut and turn the adjusting screw clockwise to reduce the clearance and anti-clockwise to increase the clearance (Fig 25).

31.2 Using feeler gauges set the clearances in accordance with the following:

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

31.3 Tighten the adjusting screw locknut to a torque of 22 to 26Nm (16.2 to 19 lbf ft) and recheck the clearances. Adjust as necessary.

Rocker cover

32 Using a new gasket fit the rocker cover and secure with joint washers and dome nuts, tighten the dome nuts to a torque of 8 to 11Nm (5 to 8 lbf ft).

Manifolds

33 Using a new gasket, fit the inlet and exhaust manifolds and secure with the retaining nuts and clamps. Tighten the securing nuts to a torque of 20 to 26Nm (14.7 to 19 lbf ft).

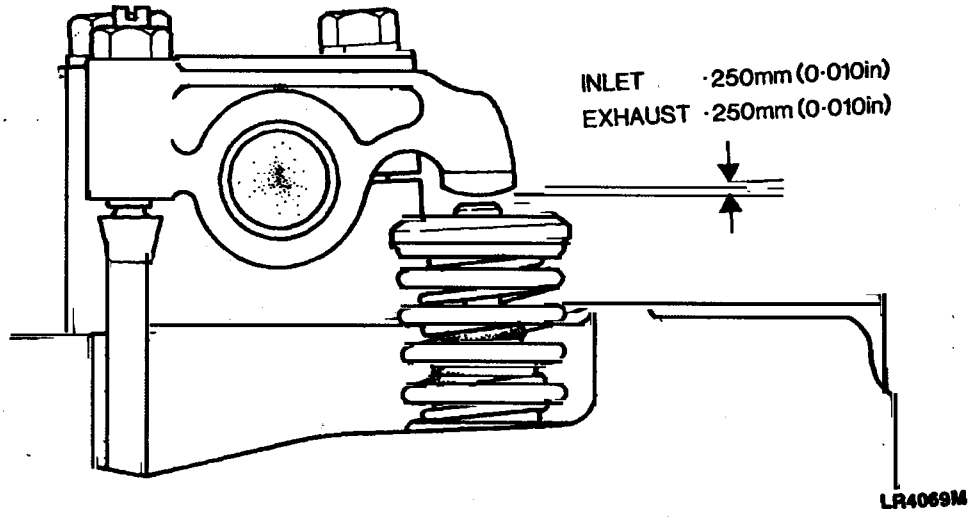


Fig 25 Valve clearances

Thermostat housing

34 Fit the thermostat housing, complete with thermostat and fan cowling bracket, with new gaskets interposed between the housing and cylinder head and housing and cover. Tighten the securing bolts to a torque of 7 to 10Nm (5.1 to 7.3 lbf ft).

Coolant temperature sensor

35 Coat the threads of the sensor adaptor and the sensor with thread sealant, fit the adaptor to the cylinder head and tighten to a torque of 23 to 30Nm (17 to 22 lbf ft), then fit the sensor to the adaptor and tighten to a torque of 15 to 19Nm (11 to 14 lbf ft).

Oil gallery pipe

36 Fit the oil gallery pipe with new joint washers fitted to the faces of the banjo and tighten the banjo bolts to a torque 20 to 25Nm (14.7 to 18.4 lbf ft).

Heater plugs

37 Fit the heater plugs and tighten to a torque of 15 to 30Nm (11 to 22 lbf ft).

Fuel injectors

38 Refer to Chap 11, ensuring that new sealing washers are fitted to the face of the injector shrouds.

Reconnection of parts disturbed

39 Reconnect all pipes, hoses and electrical connections disturbed or removed under preparation (Para 6).

Cooling and lubrication systems

40 Refill the cooling system and check the engine oil level as follows:

40.1 Refill the cooling system using the correct mix of coolant, (Chap 12 Para's 6 & 8).

40.2 Check the engine oil level and top up as necessary with the correct grade of oil, (Cat 601).

CAUTION ...

On 12/24 volt vehicles if the radio batteries are not fitted ensure that the battery leads are disconnected from the auxiliary terminal box before starting the engine.

40.3 Run the engine. Check that the oil pressure warning light goes out. Check all fuel, oil and coolant connections for leaks.

40.4 Stop the engine, when cool check the coolant and oil levels, top up as necessary.

TIMING BELT, PULLEYS AND COVERS

TABLE 2 SPECIAL TOOLS

Ser No (1)	Manufacturers Part No (2)	NSN/Part No where applicable (3)	Designation (4)
1	18G 1457	6MT2/5120-99-725-6475	DPS Pump pulley removal tool
2	18G 1464	6MT2/5120-99-724-4441	Camshaft and crankshaft pulley remover
3	18G 1456	6MT2/5120-99-724-4440	Crankshaft front oil seal replacer
4	18G 1482		Camshaft oil seal replacer
5	18G 1458	6MT2/5120-99-725-6476	DPS pump timing tool
6	LST 107	A/W Codification	Flywheel timing pin

General

41 The following paragraphs cover the repair and replacement of parts within and associated with the timing mechanism and covers.

Dismantling

42 Disconnect the vehicle battery and on 12/24 volt vehicles the radio batteries (Chap 13).

43 Remove the oil cooler 12/24 volt vehicles only (Para 71).

44 Drain th cooling system and remove the radiator complete with top and bottom hoses and cowling assembly (Chap 12 Para 9).

Water pump

45 To remove the water pump proceed as follows:

45.1 On 12/24 volt vehicles, slacken the 90amp generator adjuster and remove the drive belt.

45.2 Slacken the 12 volt alternator adjuster, remove the drive belt and move the alternator aside.

45.3 Remove the fan and viscous coupling assembly (Fig 26 (19)) by inserting a suitable tommy bar in the hole in the pulley (18), restrain the pulley and unscrew the fan assembly (19). Remove the bolts (22), washers (23) and detach the pulley (18).

45.4 Slacken the by-pass hose top clip (13), remove the water pump securing bolts (17), washers (16) and remove the water pump (15) and gasket (12).

Crankshaft pulley

46 To remove the crankshaft pulley proceed as follows:

46.1 Rotate the crank shaft to bring the EP mark on the pulley in line with the mark on the cover.

46.2 Remove the oil filler cap and check that number one exhaust valve is fully open. Do not rotate the crankshaft again when the foregoing has been established.

46.3 Remove the crankshaft pulley securing bolt (24), check that the EP is still in line with the mark on the cover and withdraw the pulley (25).

Front cover

47 To remove the front cover carry out the following:

47.1 Remove the bolts (27), washers (28) and remove the front cover vent and wading plug bracket (30) complete with gauze (32), plug (29) and gasket (31).

47.2 Remove the bolts (33) and washers (35) securing the front cover (36). Do not withdraw the centre bolt (34) from the cover as there is a fibre washer (44) located on the bolt interposed between the front and rear covers.

47.3 Remove the front cover (36), gasket (37) and retrieve the fibre washer (44).

47.4 Prise out the crankshaft seal (26) taking care not to damage the sealing surfaces in the housing.

Timing belt and pulleys

48 To remove the timing belt and pulleys proceed as follows:

48.1 Remove the camshaft pulley retaining bolt (11), plain washer (10), small 'O' ring seal (9), special washer (8) and large 'O' ring seal (6). Discard 'O' ring seals and bolt.

48.2 Slacken the belt tensioner clamp nuts (41) and remove the timing belt (39). Remove the clamp nuts (41), clamp (40) and withdraw the tensioner assembly (42).

48.3 Remove the DPS pump pulley retaining nut. Using the centre part of special tool (Serial No 1), as illustrated (Fig 27), withdraw the pulley.

Key to Fig 26

1	Cylinder block	24	Bolt-crankshaft pulley
2	Gasket-rear cover	25	Crankshaft pulley
3	Gasket-water gallery	26	Oil seal
4	Gasket-triangular	27	Bolt-vent bracket
5	Rear cover	28	Washer-vent bracket
6	'O' ring seal	29	Wading plug
7	Camshaft pulley	30	Bracket-vent
8	Special washer	31	Gasket-vent bracket
9	'O' ring seal	32	Gauze-vent bracket
10	Plain washer	33	Bolt-front cover securing
11	Bolt-camshaft	34	Centre bolt-front cover
12	Gasket-water pump	35	Plain washer
13	Hose clip	36	Front cover
14	By-pass hose	37	Gasket-front cover
15	Water pump	38	Crankshaft timing pulley
16	Plain washer	39	Timing belt
17	Bolt-water pump	40	Clamp belt tensioner
18	Pulley-fan/water pump	41	Nut-belt tensioner clamp
19	Fan and viscous coupling assy.	42	Tensioner
20	Fan	43	DPS pump pulley
21	Viscous coupling	44	Fibre washer
22	Bolt-pulley to water pump	45	Bolt-rear cover
23	Plain washer	46	Plain washer

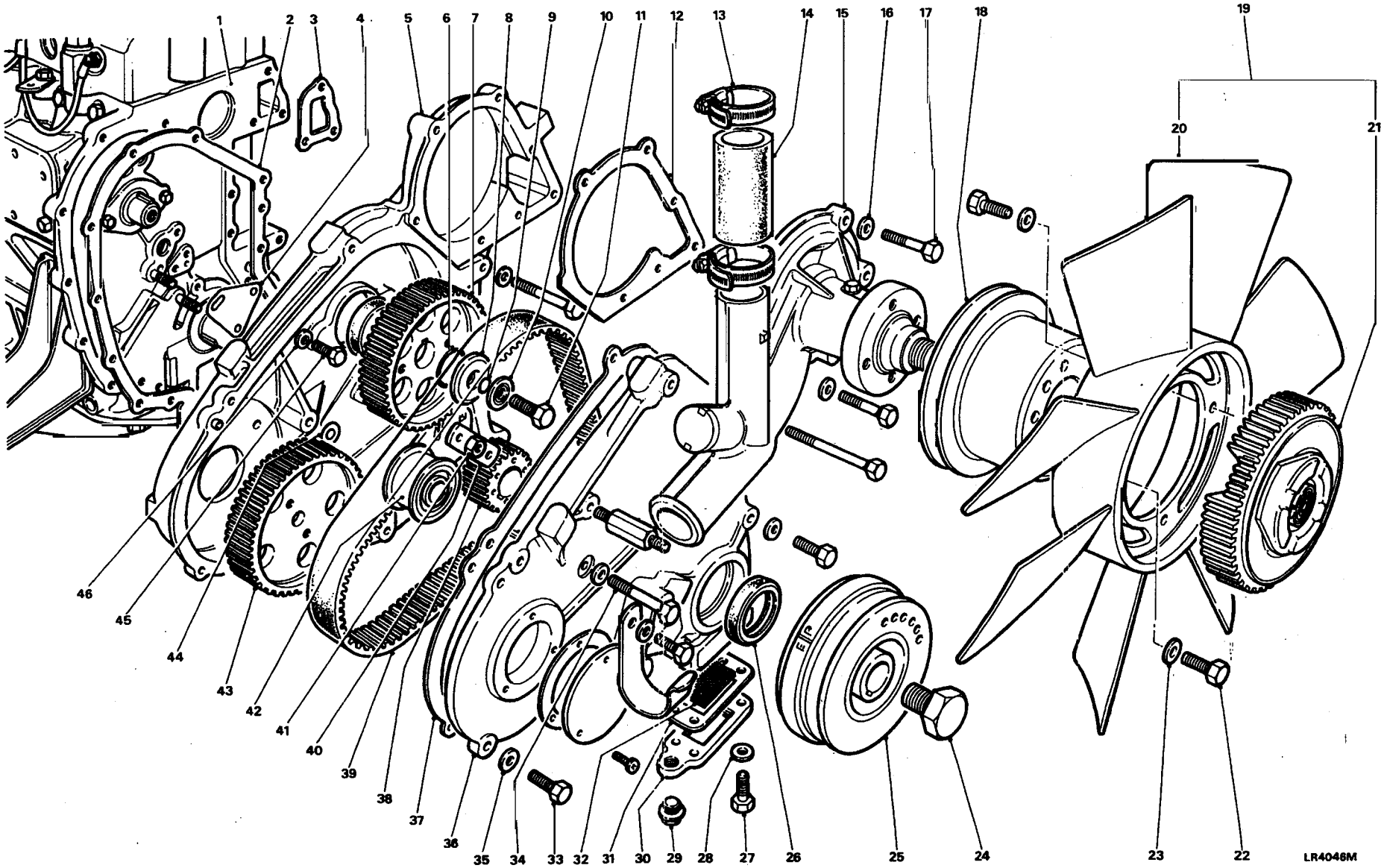


Fig 26

Timing belt, pulleys, covers and water pump

Fig 26

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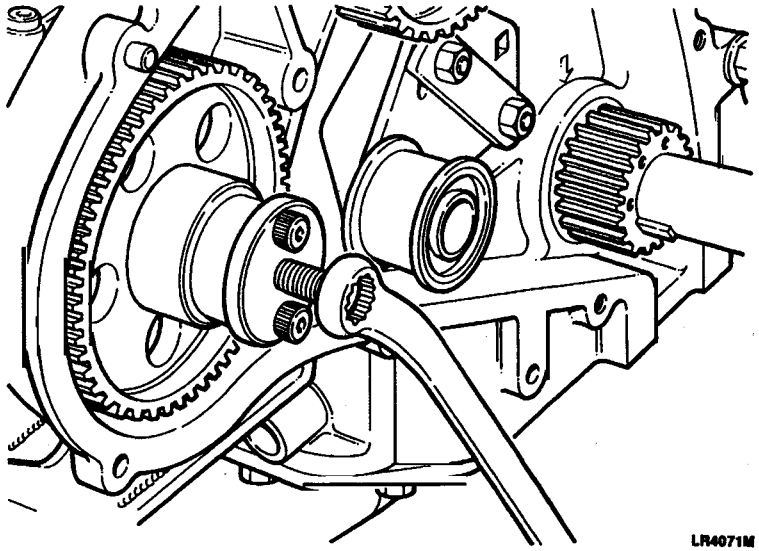

Fig 27 Removing DPS pump pulley

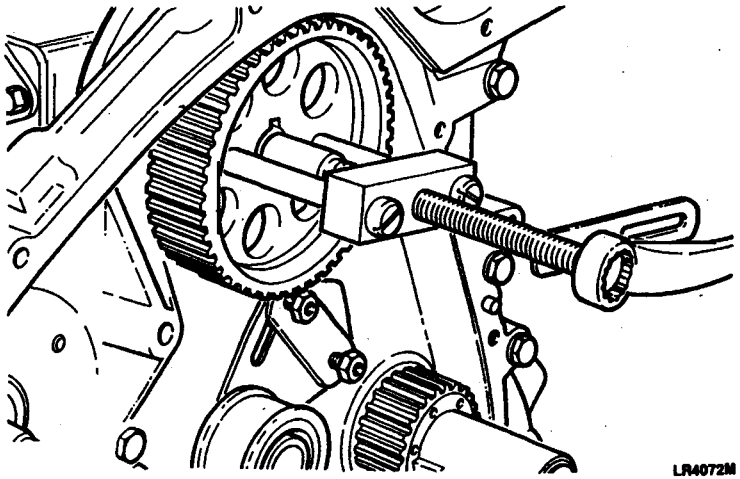

Fig 28 Removing camshaft pulley

48.4 Using special puller tool (Serial No 2) (Fig 28) withdraw the camshaft pulley.

48.5 Withdraw the crankshaft timing pulley using special tool (Serial No 2) (Fig 29).

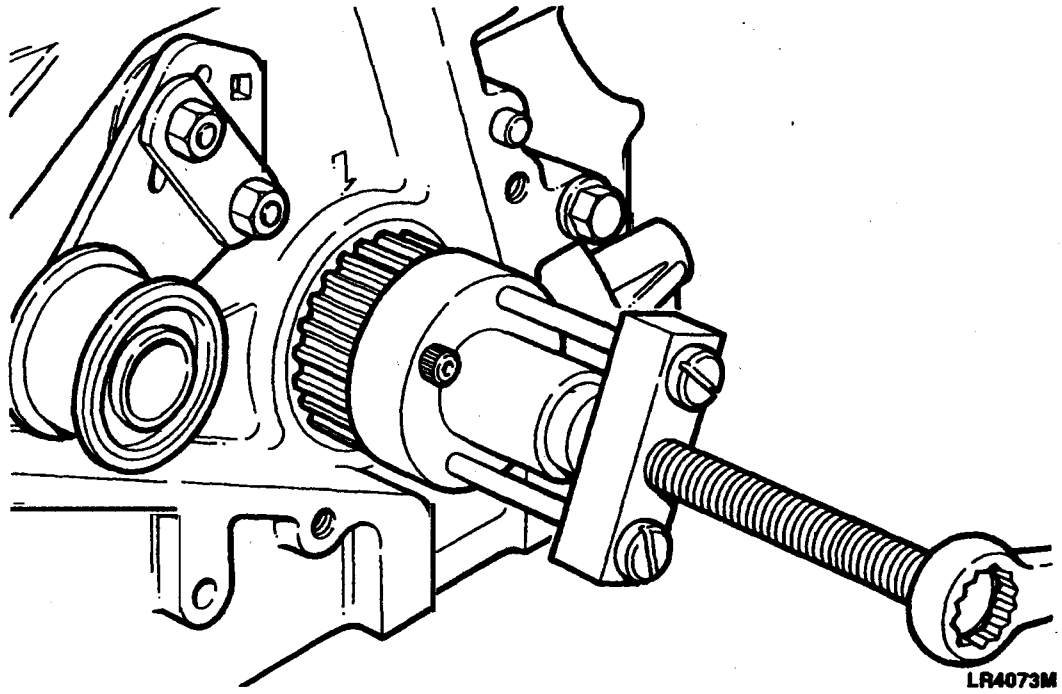

Fig 29 Removing crankshaft timing pulley

Rear cover

49 To remove the rear cover carry out the following:

49.1 Remove the DPS pump (Chap 11-1 Para 3).

49.2 Remove the securing bolts (Fig 26 (45)), washers (46) and withdraw the rear cover (5) taking care not to damage the sump joint gasket.

49.3 Remove the triangular gasket (4), rear cover gasket (2) and water gallery gasket (3).

49.4 Prise out the crankshaft and camshaft oil seals taking care not to damage the housing seal surfaces.

Cleaning

50 Thoroughly clean and degrease all components ensuring removal of gasket material from joint faces.

Examination

51 Examine all components removed for damage and wear, renew as necessary.

Reassembly

Rear cover

52 Using a new rear cover gasket (Fig 26 (2)), triangular gasket (4) and water gallery gasket (3), fit the rear cover (5) to the cylinder block (1) and secure with the eight bolts and washers, refer to Fig 30 for the location of the various length bolts (in mm). Tighten the bolts to a torque 22 to 28Nm (16 to 21 lbf ft).

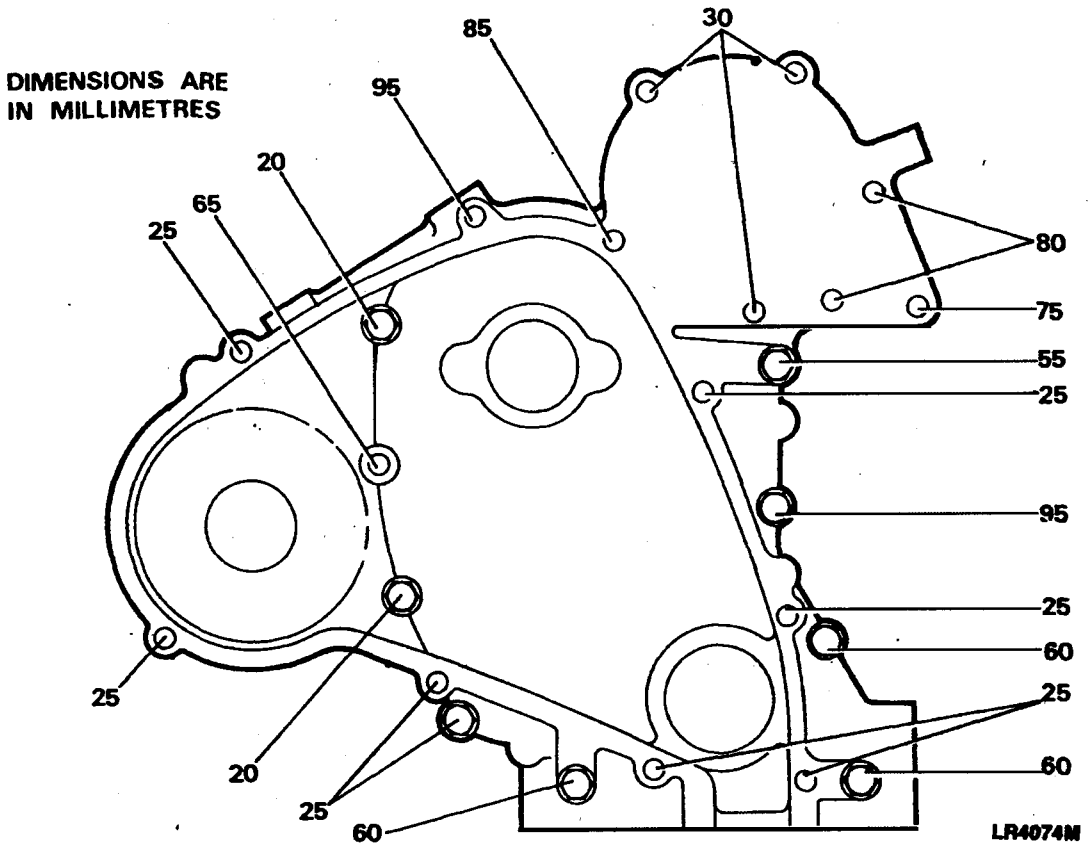

Fig 30 Bolt locations, front and rear timing covers

Rear cover, crankshaft seal

53 Locate th new seal on the crankshaft with the lip side leading. Using special tool (Serial No 3) drive the seal into its housing until it is approximately 0,50mm (0.020in) below the inner face of the cover (Fig 31).

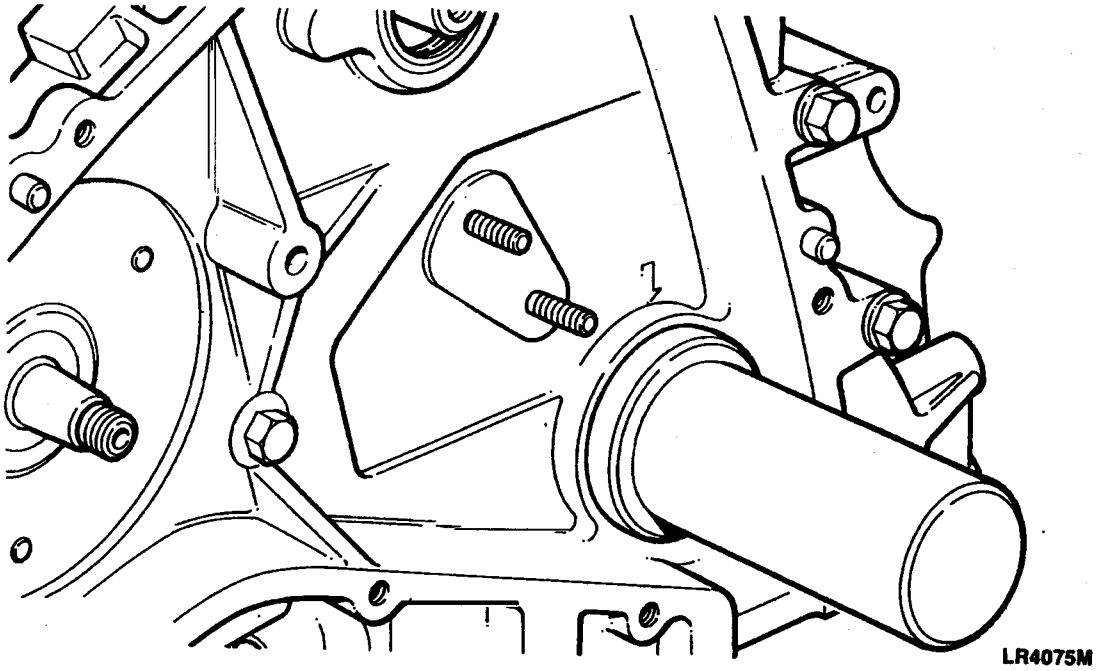

Fig 31 Fitting rear cover crankshaft seal

Rear cover, camshaft seal

54 Locate the new seal on the camshaft with the lip side leading. Using special tool (Serial No 4) drive the seal into its housing until it is flush with, or approximately 1,00mm (0.040in) below, the inner face of the cover (Fig 32).

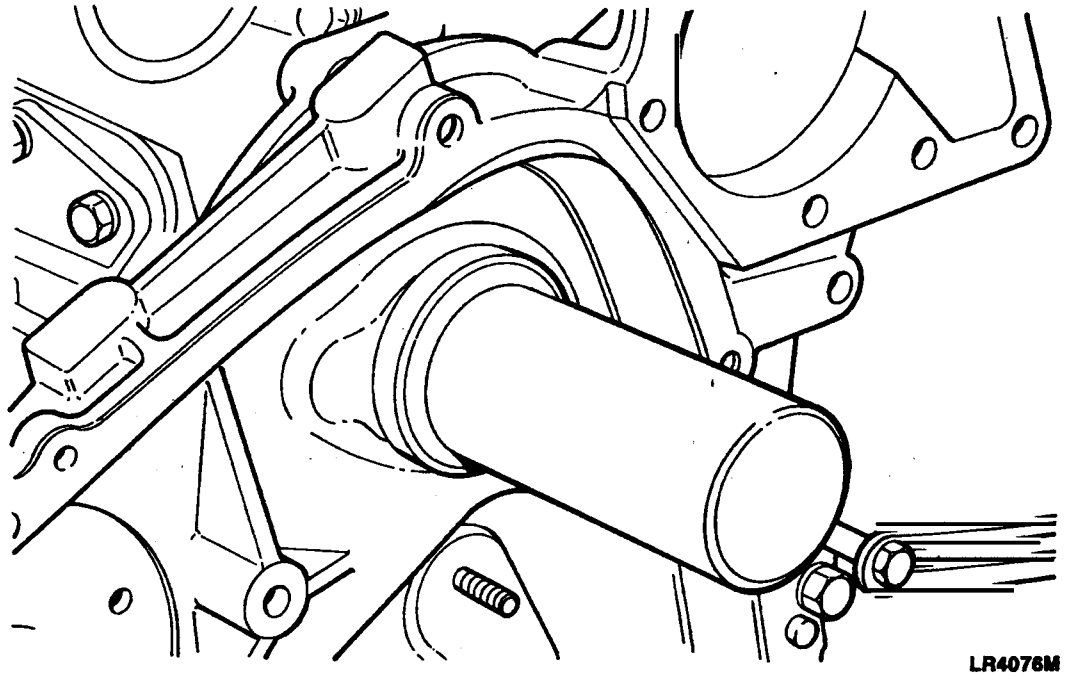

Fig 32 Fitting rear cover camshaft seal

DPS pump

55 Fit new pump gasket and loosely secure the pump to the rear cover with the three nuts and to the rear support bracket with the single nut and bolt. Position the pump so that the retaining studs are mid-way in the flange slots. Do not connect the fuel supply pipes at this stage.

Pulleys

56 To fit the timing pulleys proceed as follows:

56.1 Crankshaft pulley - Fit the crankshaft pulley with the timing dot outwards, and drive into position with a suitable tubular drift.

56.2 Camshaft pulley - Fit the camshaft pulley, boss towards the engine and loosely secure with the special washer, 'O' rings, plain washer and new bolt. Do not drive the pulley onto the camshaft, draw on using a slave 10mm diameter bolt with a plain washer and nut.

56.3 DPS pump pulley - Fit the pulley to the pump shaft, and loosely secure with the nut.

Timing

57 The DPS pump and valves are timed using the exhaust valve peak of number one cylinder. The exhaust peak position is determined by the relationship of a slot in the flywheel periphery and a plugged hole in the flywheel housing through which a flywheel timing pin, special tool (Serial No 6), is inserted to locate in the flywheel slot.

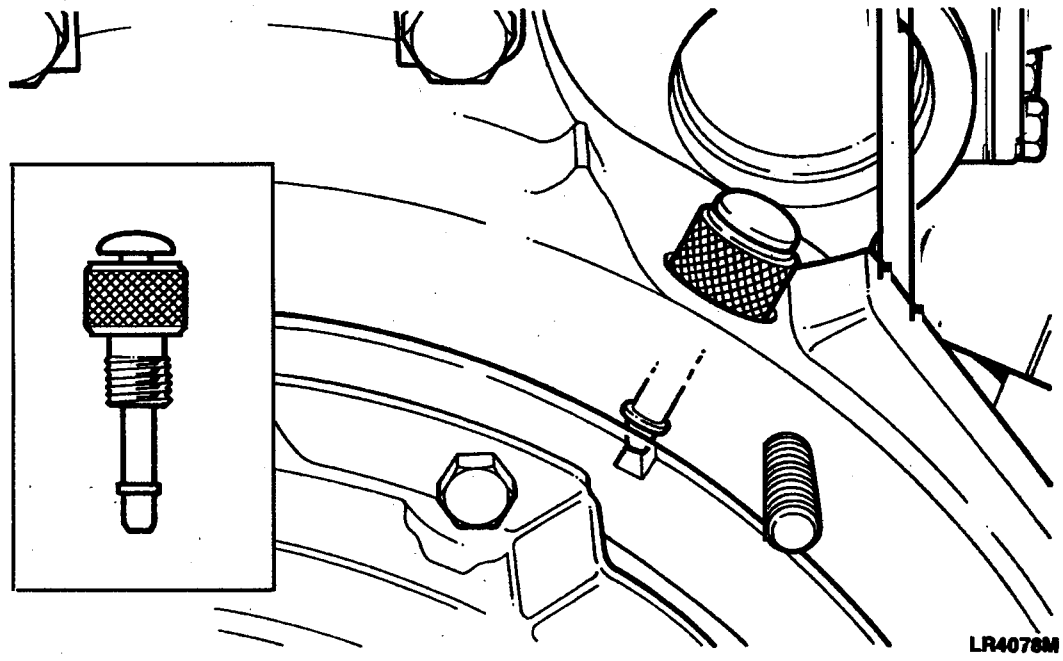

Fig 33 Timing pin located in flywheel housing

57.1 Remove the plug from the flywheel housing and fit the body of tool (Serial No 6) without the pin.

57.2 Turn the crankshaft in a clockwise direction until the EP slot in the flywheel is in-line with the plug hole. If the crankshaft is inadvertently turned beyond the EP slot, do not turn it back but continue on round in a clockwise direction until the pin of the special tool can be fully located in the flywheel slot (Fig 33).

57.3 Fit the timing belt tensioner assembly and loosely secure with the clamp and two nuts. Later engines are fitted with two plain washers under the nuts and no clamping plate.

57.4 Turn the DPS pump pulley clockwise until the dot lines up exactly with the arrow cast in the rear cover (Fig 34).

57.5 Similarly, turn the camshaft pulley clockwise so that the dot coincides with the cast arrow.

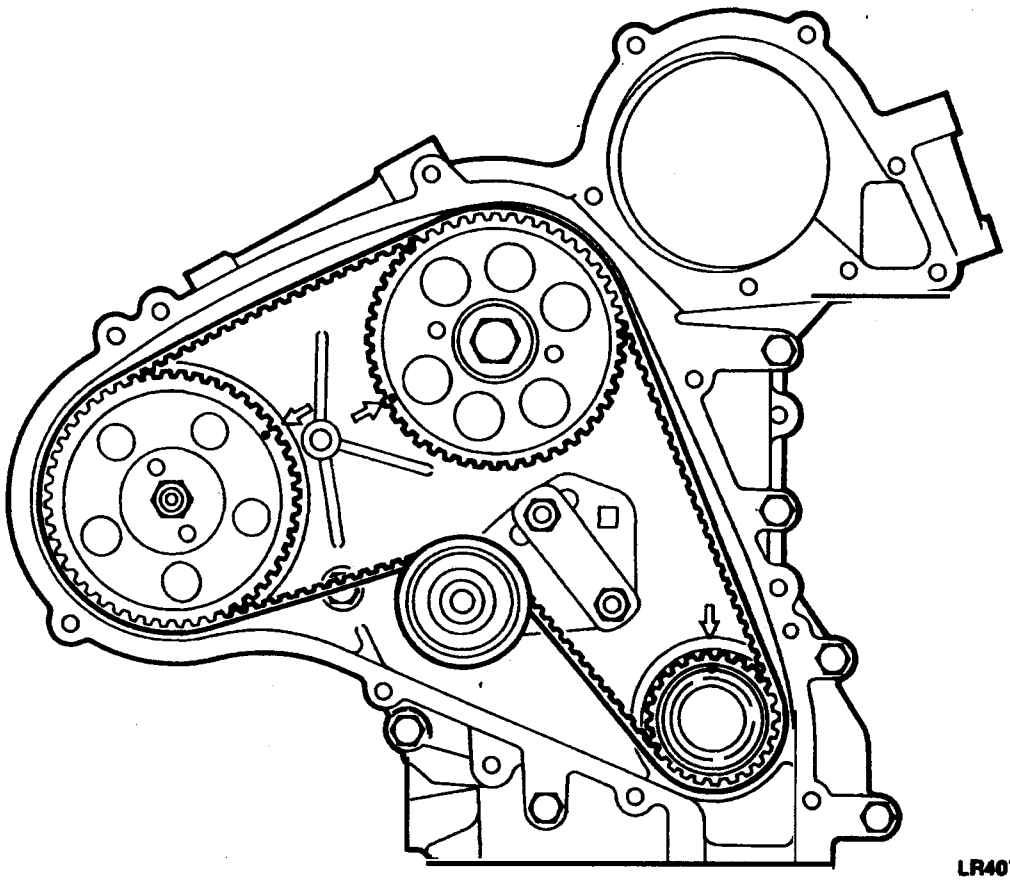

Fig 34 Aligning timing marks with cast arrows

57.6 Fit a new timing belt over the crankshaft pulley and whilst keeping the belt under tension, by hand, run it over the camshaft pulley. If the belt does not quite mate with the grooves, turn the pulley clockwise the necessary amount. Feed the belt over the pump pulley and if n cessary turn the pulley clockwise to locate the grooves. Keeping a firm grip on the belt pass it over the tensioner jockey pulley.

57.7 Remove the flywheel timing pin from the plug hole in the flywheel housing (Fig 34).

57.8 Set a dial type torque meter to 23.5 to 29Nm (17 to 21 lbf ft), and whilst holding it vertically, insert the drive peg in the square hole in the tensioner base plate (Fig 35). Tension the belt and tighten the nuts to a torque of 22 to 28Nm (16 to 20 lbf ft).

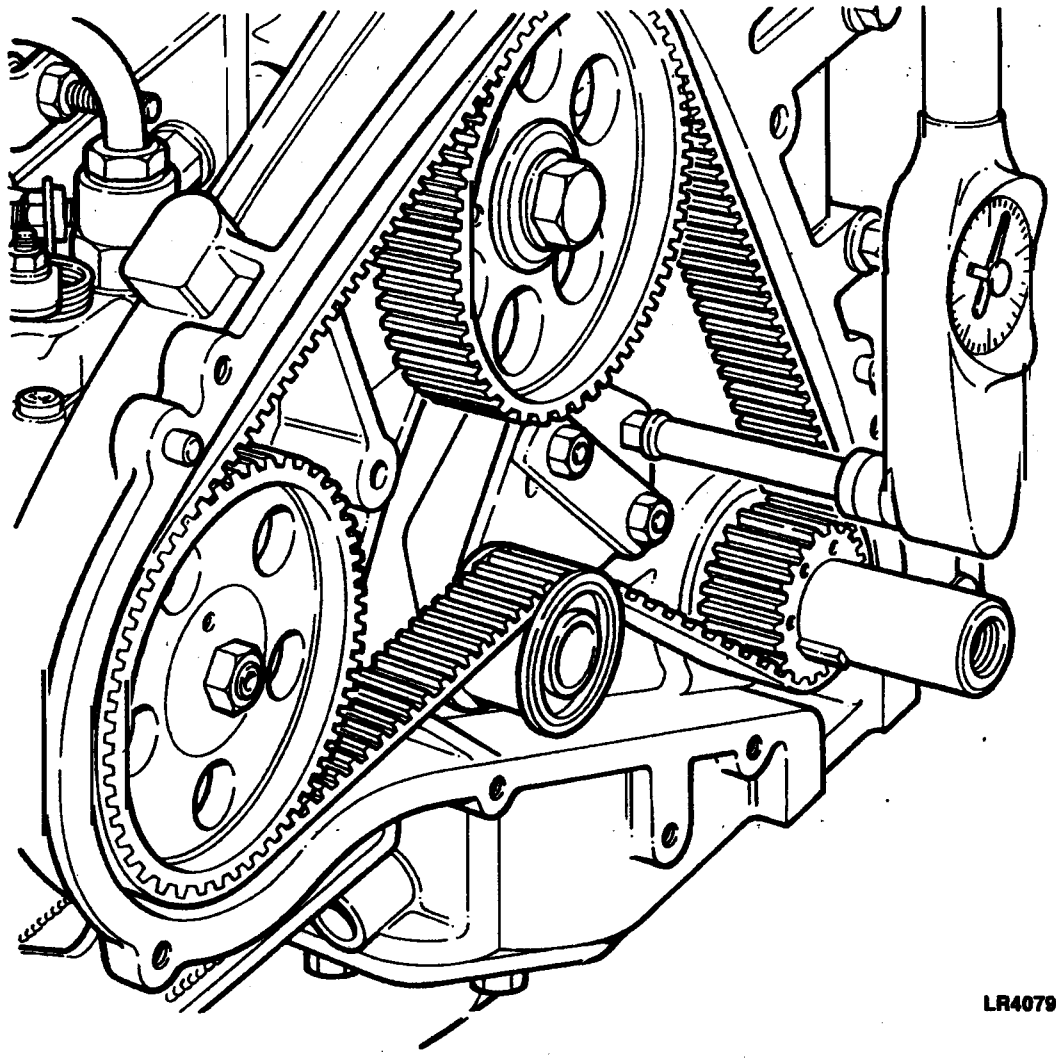

Fig 35 Tensioning timing belt using torque meter

57.9 Rotate the crankshaft two complete revolutions.

57.10 Slacken the belt tensioner clamp nuts and repeat (Para 57.8).

CAUTION ...

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

57.11 Turn the crankshaft, in a clockwise direction, until the flywheel timing pin can be inserted into the EP slot on the flywh el.

57.12 Check that the dots on the camshaft and pump pulleys exactly align with their respective arrows. If there is any misalignment the procedure must be repeated until exact alignment of the timing dots and arrows is achieved.

57.13 Remove the plug from the side of the DPS pump and insert special tool (Serial No 5) (Fig 36), if necessary rotate the pump body until the gauge can be fully inserted and screwed home indicating that the inner disc is centrally positioned with the hole.

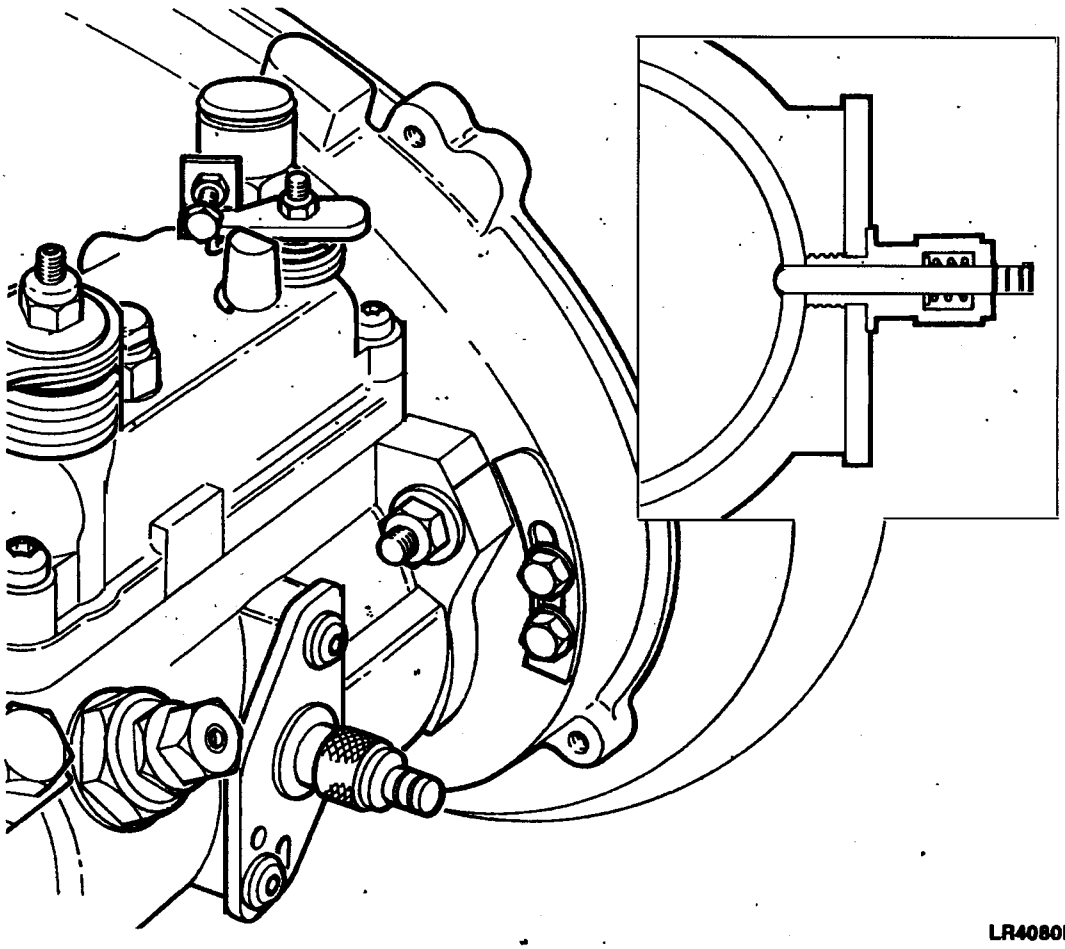

Fig 36 Gauge tool inserted in DPS pump

57.14 Evenly tighten the three nuts securing the pump to the cover and the single nut and bolt to the support bracket.

57.15 Align timing pointer, on rear of cover, with the scribed line on the pump flange and tighten the two screws (Fig 36). If a new pump is being fitted and there is no scribed line, scribe a line in the centre of the machined area of the pump flange. Align the timing pointer and tighten the screws.

57.16 Remove the gauge tool from the side of the DPS pump and refit the plug.

57.17 Remove the flywheel timing pin from the flywheel housing and refit the plug.

57.18 Tighten the pump pulley securing nut to a torque of 42 to 48Nm (31 to 35 lbf ft).

57.19 Tighten the camshaft pulley securing bolt to a torque of 40 to 50 Nm (29.5 to 36 lbf ft).

57.20 Fit the injector pipes and connect the pump operating rod to the lever (Chap 11 Para 57).

Front cover

58 To fit the front cover carry out the following:

58.1 Fit the front cover with a new gasket interposed between the mating faces and a new fibre washer (Fig 26 (44)) fitted on the inside of the 65mm long bolt.

58.2 Fit the remaining various length bolts to their respective locations (Fig 30) and evenly tighten to a torque of 22 to 28Nm (16 to 20.6 lbf ft).

58.3 Fit the vent cover gauze and new gasket, secure with bolts and spring washers, tightening the bolts to a torque of 7 to 10Nm (5 to 7 lbf ft).

58.4 Fit a new crankshaft seal. Using special tool (Serial No 3) and with the lip side leading, drive in the seal up to the shoulder (Fig 37).

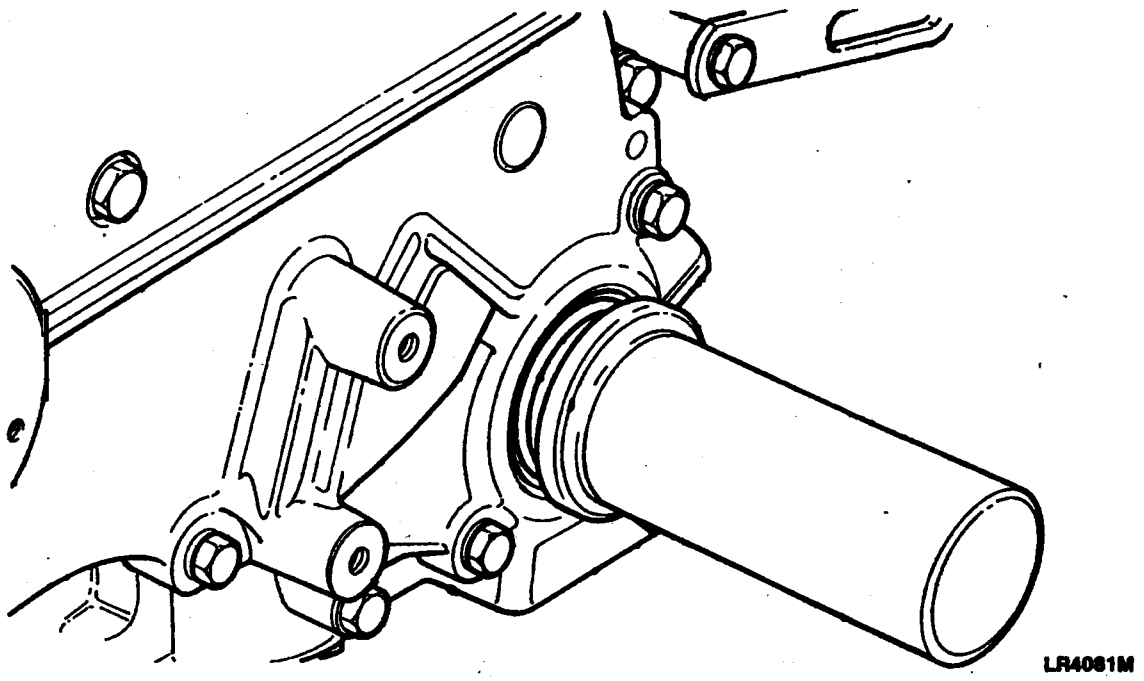

Fig 37 Fitting front cover crankshaft seal

Water pump and pulleys

59 To fit the water pump and pulleys proceed as follows:

59.1 Place a new gasket in position and offer up the water pump, at the same time engaging the by-pass hose. Fit the bolts to their respective locations (Fig 30), and evenly tighten to a torque of 22 to 28 Nm (16 to 20.6 lbf ft). Tighten the by-pass hose clip.

59.2 Fit the fan pulley to the adaptor on the water pump shaft and tighten the securing bolts to a torque of 22 to 28 Nm (16 to 20.6 lbf ft). Refit the fan and viscous coupling assembly using a suitable tommy bar to restrain the pulley while screwing on the fan assembly.

59.3 Fit the crankshaft pulley and tighten the special bolt to a torque of 260 to 280 Nm (191.7 to 206.5 lbf ft).

59.4 Fit the drive belt to the fan pulley, crankshaft pulley and 12 volt alternator pulley. Pivot the alternator away from the engine to tension the belt, tighten the clamp bolt and with thumb pressure check that th deflection at the mid-point between the fan and the alternator pull ys is 7 to 9mm (1/4 to 3/8 in). Tighten the alternator pivot nuts to a torque of 22 to 28 Nm (16 to 20.6 lbf ft).

59.5 On 12/24 volt vehicles fit the 90amp generator drive belt to the crankshaft pulley and to the generator pulley. Adjust the generator to give a belt deflection at the mid-point of 12 to 19 mm (1/2 to 3/4 in).

Radiator

60 Refit the radiator, top and bottom hoses and cowling assembly and refill the cooling system using the correct mix of fluid (Chap 12 Para's 8 & 10).

Oil cooler

61 On 12/24 volt vehicles refit the oil cooler (Para 71) and reconnect the inlet and outlet hoses to their respective adaptors.

Batteries

62 Reconnect the vehicle battery and on 12/24 volt vehicles the radio batteries.

CAUTION ...

On 12/24 volt vehicles, if the radio batteries are not fitted, ensure that the battery leads are disconnected from the auxiliary terminal box before starting the engine.

63 Run the engine and check all oil and coolant connections that have been disturbed for leaks.

64 Stop the engine, when cool check the coolant and oil levels, top up as necessary.

OIL SUMP

Removal

65 To remove the oil sump proceed as follows:

65.1 Remove the sump drain plug and allow the oil to drain into a container of suitable capacity.

65.2 Remove the screws, single nut and washers securing the sump to the crankcase and withdraw the sump.

65.3 Thoroughly clean all components ensuring removal of sealant from the sump and crankcase mating faces.

Refitting

66 To refit the oil sump proceed as follows:

66.1 Apply a bead of RTV HYLOSILL 102 BLACK approximately 7mm wide to the sump mating face (Fig 38). Fit the sump within 30 minutes of applying the s alant.

66.2 Tighten the sump securing screws to a torque of 20 to 24 Nm (14.7 to 17.7 lbf ft).

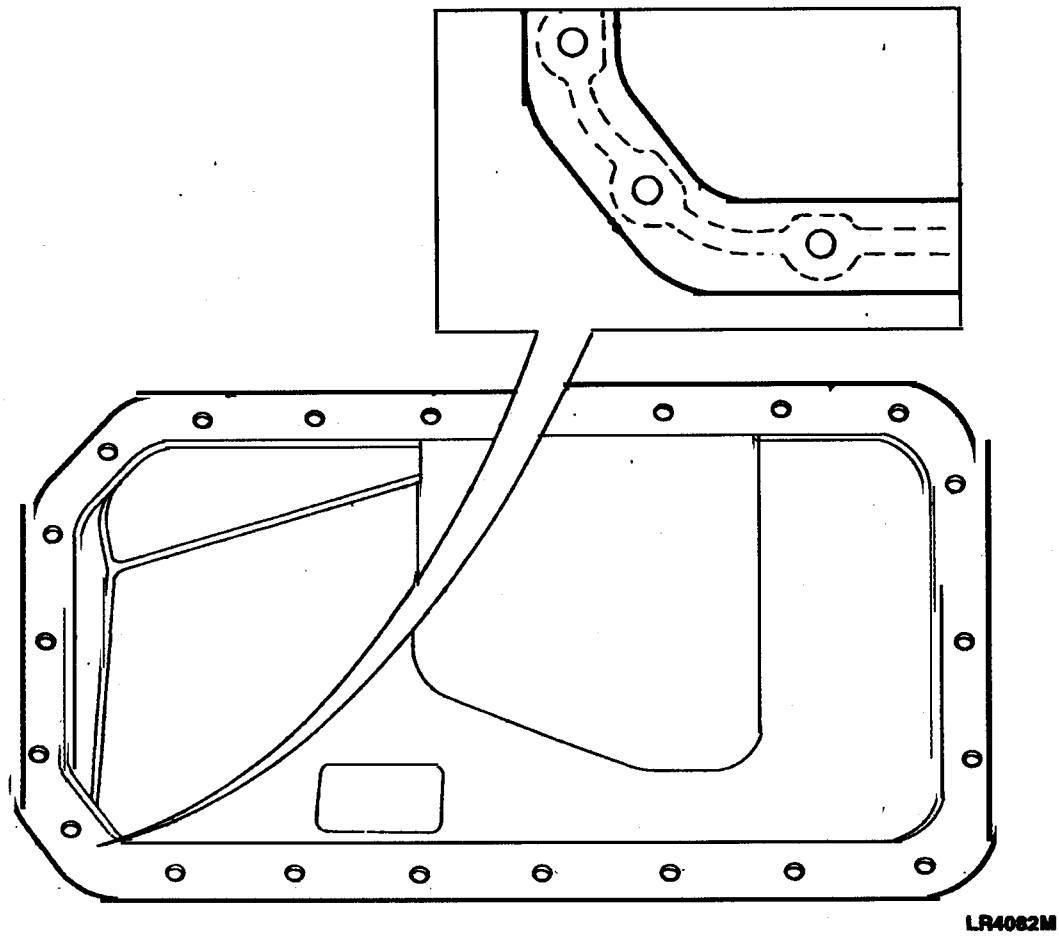

Fig 38 Oil sump sealant location

66.3 Fit and tighten the sump drain plug to a torque of 30 to 40 Nm (22 to 29.5 lbf ft).

66.4 Refill the engine to the correct level with the recommended grade of oil (Cat 601).

OIL PUMP

Removal

67 To remove the oil pump proceed as follows:

67.1 Remove the oil sump (Para 65).

67.2 Bend back the locking tabs and remove the two bolts securing the oil pump to the crankcase (Fig 39). Withdraw the oil pump complete with strainer and drive shaft. Remove drive shaft and discard the gasket and locking washers.

Refitting

68 The procedure for fitting the oil pump is the reverse of the removal procedure using new gaskets and lock washers and tightening the securing bolts to a torque of 22 to 28 Nm (16 to 20.6 lbf ft).

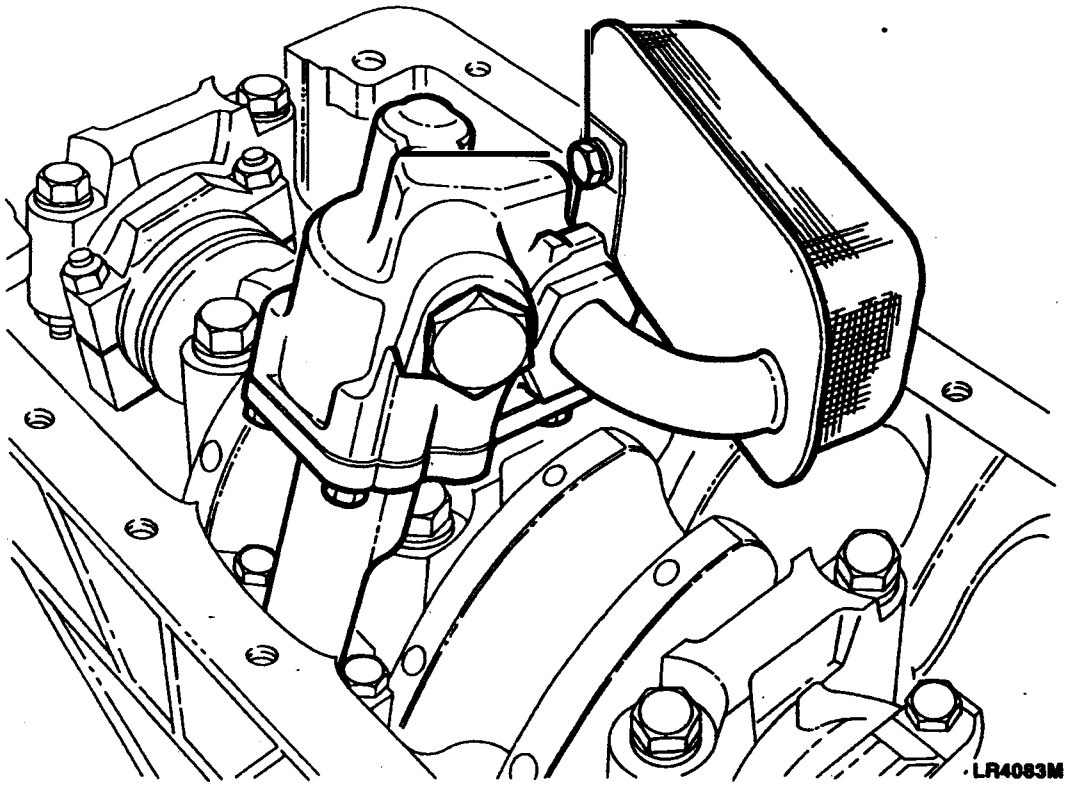

Fig 39 Oil pump removal and installation

OIL STRAINER

Removal

69 To remove the oil strainer proceed as follows:

69.1 Remove the oil sump (Para 65).

69.2 Remove the screw, plain and spring washers securing the support bracket to the strainer.

69.3 Turn back the tab on the locking washer and release the nut securing the strainer to the oil pump. Withdraw the strainer, sealing ring and lockwasher. Discard the sealing ring and lockwasher.

Refitting

70 The procedure for refitting the oil strainer is the reverse of the removal procedure, using new seals and lock washers as applicable. Tighten the strain r to support bracket securing screw to a torque of 22 to 28 Nm (16 to 20.6 lbf ft).

OIL COOLER (12/24 volt vehicles)

Removal

71 To remove the oil cooler carry out the following:

71.1 Remove the radiator grill.

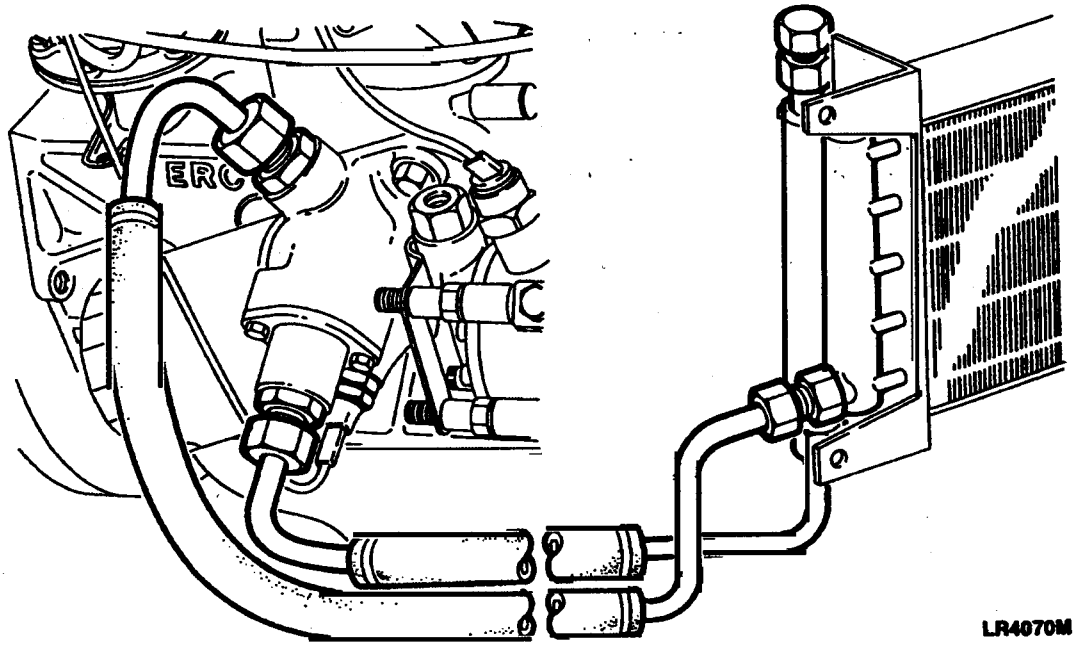

Fig 40 Oil cooler and hoses

71.2 Disconnect the inlet and outlet hoses from the oil cooler (Fig 40). Tape the ends of the hoses and their respective adaptors on the oil cooler to prevent the ingress of dirt.

71.3 Remove the securing screws and withdraw the oil cooler.

Refitting

72 The procedure for refitting the oil cooler is the reverse of the removal procedure.

Chapter 1-2

3.5 LITRE V8 PETROL ENGINE

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		Engine
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	3	Installation
		Cylinder head assembly
	4	Special tools
	5	Preparation
	6	Removal (CAUTION)
		Dismantling
	7	Cylinder head
	8	Rocker shaft assembly
	9	Cleaning
		Examination
	10	Cylinder head
	11	Rocker shaft assembly and push rods
	12	Hydraulic tappets
	13	Inlet manifold
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	14	General
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	28	Cooling and lubrication systems (CAUTION)
		Timing gear cover, camshaft, oil pump, water pump and distributor
	29	Dismantling
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	33	Distributor
	34	Timing gear cover and oil pump
	35	Timing chain and gears
	36	Camshaft
	37	Cleaning
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	39	Timing chain and sprockets
	40	Oil pump and timing cover (CAUTIONS)
	41	Water pump
	42	Camshaft
		Reassembly
	43	Camshaft
	44	Timing cover oil seal

Frame Para

45 Timing gear cover, oil pump and crankshaft pulley (CAUTION)
46 Water pump
47 Distributor (CAUTION)
48 Fan pulley, viscous coupling, fan and drive belts (12 V 110 vehicles only)
49 Fan and drive belt tensioning (12 V) (CAUTION)
50 Power steering pump drive belt tensioning (12 V 127 vehicles only) (CAUTION)
51 Fan and drive belt tensioning (power steering, 12/24 volt 127 vehicles only).(CAUTION)
56 Reconnection of parts disturbed
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INTRODUCTION

1 This Chapter details the Unit and Field repair procedures for the Land Rover 3.5 litre V8 petrol engine fitted to 110 and 127 vehicles. The engine fuel and cooling systems which are dealt with in Chapters 11 and 12 respectively.

ENGINE

Removal

2 To remove the engine from the vehicle proceed as follows:

Note ...

Before commencing, and whilst removing the engine, make a careful note of the position of brackets, clips, harnesses, pipes, hoses and any other items to facilitate reassembly.

2.1 Remove the spare wheel from the vehicle bonnet (Cat 522 Chap 9).

2.2 Disconnect the bonding straps and remove the bonnet (Cat 522 Chap I6).

2.3 Disconnect the vehicle battery and on the 12/24 volt vehicles the radio batteries (Cat 522 Chap 13-1 & Chap 13-2).

2.4 On 12/24 volt vehicles remove the 90 amp generator (Cat 522 Chap 13-2).

2.5 Drain the cooling system (Cat 522 Chap 12-2).

2.6 Remove the sump drain plug and drain the oil from the sump into a container of suitable capacity.

2.7 Remove front grille, panel and grille top panel (Cat 522 Chap 16).

2.8 Disconnect the oil cooler supply and return hoses at the oil filter head connections. Disconnect the cross brace tubes and remove complete with oil cooler and hoses (127 vehicles only).

2.9 Remove the air cleaner and air cleaner to manifold hoses (Fig 1 (2)).

2.10 Disconnect the top (11) and bottom (15) hoses at the engine connections.

2.11 Disconnect the penthouse bleed hose (10) at the induction manifold connection.

2.12 Remove the radiator core and cowl (Cat 522 Chap 12).

2.13 Disconnect the air breather filter (6) located below the air cleaner.

Key to fig 1

1	Vacuum hose	10	Penthouse bleed hose
2	Air cleaner to manifold hose	11	Top hose
3	Multi connectors	12	Engine earth lead
4	Throttle cable	13	Coolant temp. sender
5	Choke cable	14	Fuel spill return pipe
6	Air breather filter	15	Bottom hose
7	Heater rails	16	Oil pressure switch
8	Ignition coil	17	Exhaust pipe
9	Fuel supply pipe	18	Starter motor

2.14 Disconnect the heater rails (7) at the rear of the engine.

2.15 Disconnect the throttle cable (4) from the l.h. carburetter.

2.16 Disconnect the vacuum hose (1) to brake servo at the manifold connection.

2.17 Disconnect the choke cable (5) from the l.h. carburettor.

2.18 Disconnect the fuel spill return pipe (14) from the r.h. carburettor.

2.19 Disconnect the engine services multi-connectors (3) at the bulk head.

2.20 Disconnect the earth lead (12) at the r.h. chassis engine mounting.

2.21 Disconnect the leads from the ignition coil (8).

2.22 Disconnect the lead from the oil pressure switch (16) and the coolant temperature sender (13).

2.23 Disconnect the lead from the oil temperature sender (127 vehicles only).

2.24 Disconnect the leads from the starter motor solenoid (18).

2.25 Disconnect the fuel supply pipe (9) from the l.h. carburettor. Seal all pipe and hose ends to prevent the ingress of dirt or foreign matter.

2.26 Disconnect the power steering supply and return hoses at the power steering pump connections (127 vehicles only).

2.27 Disconnect any clips retaining pipes and cables to the engine, recording their locations for reassembly. Ensure that the engine electrical harness, disconnected pipes and cables are drawn clear to allow engine passage on removal.

2.28 Disconnect the exhaust pipes from the exhaust manifolds (17).

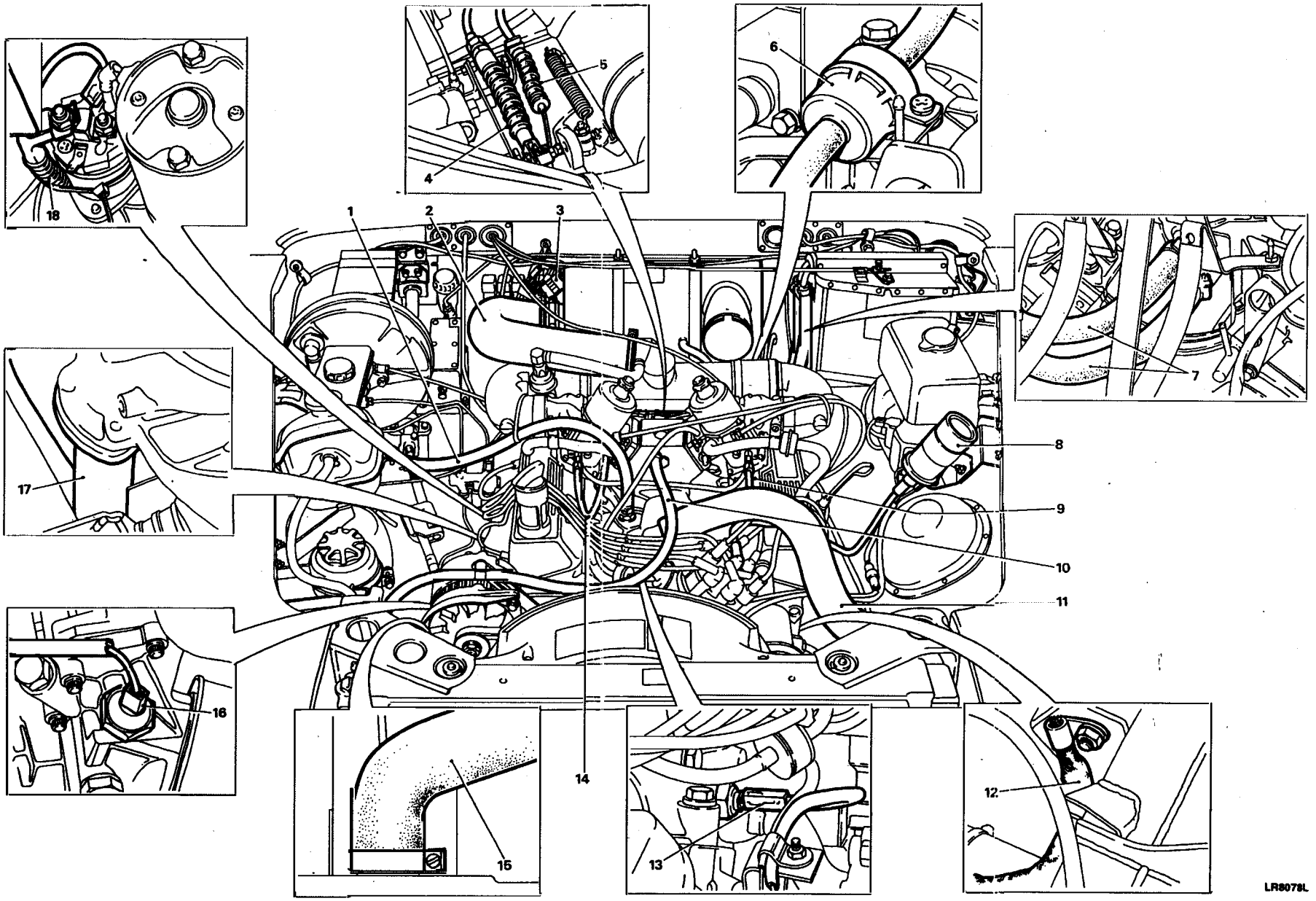


Fig 1

Engine removal disconnection points

2.29 Support the base of the engine using a jack or packing blocks.

2.30 Remove all fasteners from the engine front mounting rubbers.

2.31 Remove the fasteners securing the bell housing to the engine. The lower fasteners are accessible from under the vehicle and the upper fasteners are accessible from the engine compartment.

CAUTION ...

To overcome variations in installation, ensure that any ancillary items are disconnected before proceeding to lift the engine.

2.32 Using suitable lifting tackle attach the sling to the engine lifting points.

2.33 Support the gearbox at the cross member using a jack or packing blocks.

2.34 Tension the hoist sufficiently to lift the engine just clear of the front mounting rubbers.

2.35 Carefully draw the engine forward to disengage from the dowelled bell housing and to clear the primary pinion from the clutch.

2.36 Carefully lift the engine clear.

2.37 Secure the engine to a suitable engine mounting stand and remove the sling and hoist.

WARNING ...

WHEN USING AN ENGINE STAND, IT IS ESSENTIAL TO FOLLOW THE STAND MANUFACTURERS USER INSTRUCTIONS TO ENSURE SAFE AND EFFECTIVE USE OF THE EQUIPMENT.

Installation

3 To install the engine proceed as follows:

3.1 Attach a suitable lifting sling and hoist to the engine and remove from mounting stand.

3.2 Clean the flywheel and bell housing mating faces of old sealant. Re-coat the faces with Hylomar PL32 sealant or approved equivalent.

3.3 Smear the splines of the primary pinion, the clutch centre and the release lever abutment faces with Molybdenum disulphide grease (Rocol MTS 1000 or approved equivalent).

3.4 Lower the engine into position, locating the primary pinion into the clutch and engaging the flywheel housing studs into the bell housing, secure the housing together with the nuts and washers and tighten to a torque of 45 to 50 Nm (29 to 33 lbf ft).

3.5 Remove the jack or packing blocks from supporting the gearbox.

3.6 Tension the hoist sufficient to allow fitment of the mounting rubbers (Fig 2 (4)). New rubbers should be fitted if there is any doubt about the condition of the existing ones.

3.7 Lower the engine and secure the mounting rubbers with their upper and lower fixings.

3.8 Remove the lifting sling and hoist.

3.9 Reverse the removal procedure to reconnect all pipes hoses, electrical connections, the radiator core and cooling fan cowl and the exhaust connection to the manifold.

3.10 Fit the 90 amp generator and correctly tension the drive belt 12/24 volt vehicles only (Cat 522 Chap 13).

3.11 Refill the cooling system (Cat 201).

3.12 Refill the engine oil system with the correct grade of oil (Cat 201).

3.13 Check, and if necessary replenish the gearbox lubricating oil (Cat 201).

3.14 Reconnect the vehicle battery and on 12/24 volt vehicles the radio batteries.

WARNING ...

ON 12/24 VOLT VEHICLES, IF THE RADIO BATTERIES ARE NOT FITTED, ENSURE THAT THE BATTERY LEADS ARE DISCONNECTED FROM THE AUXILIARY TERMINAL BOX BEFORE STARTING THE ENGINE.

3.15 Start the engine. Check the oil pressure warning light goes out. Allow engine to reach operating temperature and check all fuel, oil and coolant connections for leaks.

3.16 Stop the engine, when cool check coolant and oil levels, top up as necessary.

3.17 Refit the bonnet and spare wheel.

Key to fig 2

1 Nut
2 Spring washer
3 Plain washer
4 Engine mounting

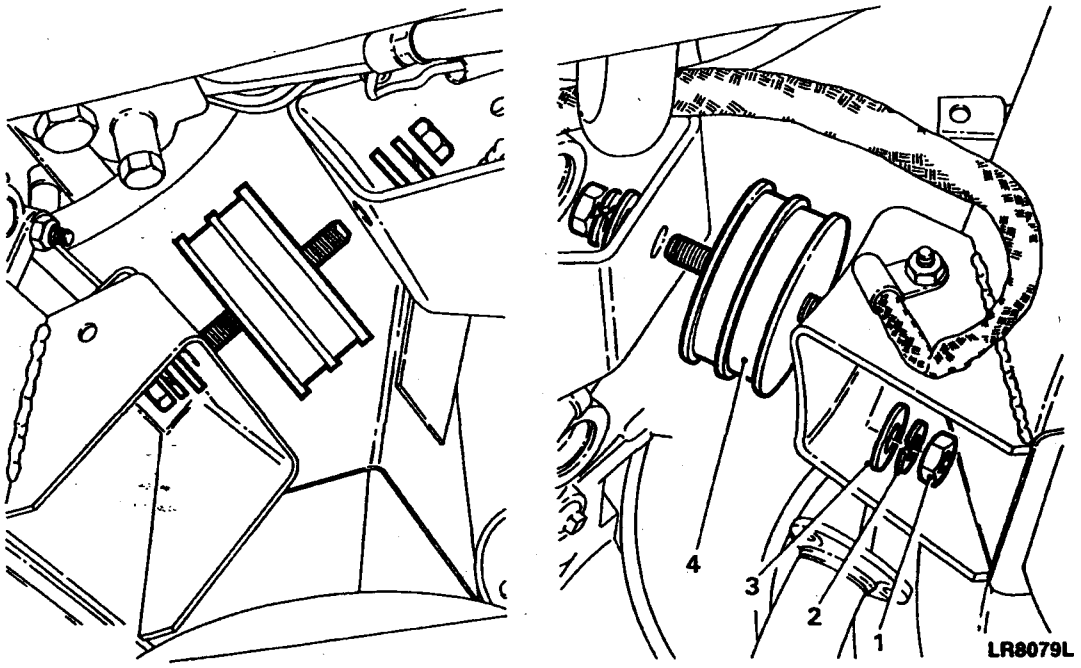


Fig 2 Engine mountings

CYLINDER HEAD

Special tools

4 The following special tools are required to carry out cylinder head overhaul:

TABLE 1 SPECIAL TOOLS

Ser (1)	Part Number (2)	Description (3)
1	18G106A	Spring compressor
2	RO276102	Spring compressor
3	274401	Valve guide removal
4	600959	Valve guide drift
5	RO605774A	Height gauge
6	MS150-8.5	Expandable pilot
7	MS76B	Valve cutter handle
8	MS621	Valve seat cutter
9	RO274401	Valve guide removal

Preparation

5 Before the cylinder head can be removed the following ancillary items must be removed for access and safety:

5.1 Remove the spare wheel from the bonnet (Cat 522 Chap 9).

5.2 Disconnect the bonding straps and remove the bonnet (Cat 522 Chap 16).

5.3 Disconnect the vehicle battery and on the 12/24 volt vehicles the radio batteries (Chap 13-1 & Chap 13-2).

5.4 Drain the cooling system (Cat 201)

5.5 Remove the air cleaner and air cleaner to manifold hoses (Fig 3 (1)).

5.6 On derated engines remove the pulse air rails (14), elbows (15) and associated fixings.

5.7 Disconnect the top (7) and bottom (9) hoses at the engine connections.

5.8 Disconnect the heater rails (4) at the rear of the engine.

5.9 Disconnect the throttle cable (2) from the l.h. carburettor.

5.10 Disconnect the vacuum to brake servo hose (13) at the manifold connection.

5.11 Disconnect the choke cable (3) from the l.h. carburettor.

5.12 Disconnect the fuel spill return pipe (6) from the r.h. carburettor.

5.13 Remove the oil filler cap (11).

5.14 Disconnect the leads (5) from the ignition coil to the distributor.

5.15 Disconnect the lead (8) from the coolant temperature sender.

Key to fig 3

1	Air cleaner to manifold hose	9	Bottom hose
2	Throttle cable	10	Fuel spill return pipe
3	Choke cable	11	Oil filler cap
4	Heater rails	12	Exhaust pipes
5	Ignition coil	13	Vacuum hose
6	Fuel supply pipe	14	Pulse air rails
7	Top hose	15	Pulse air elbows
8	Coolant temp. sender		

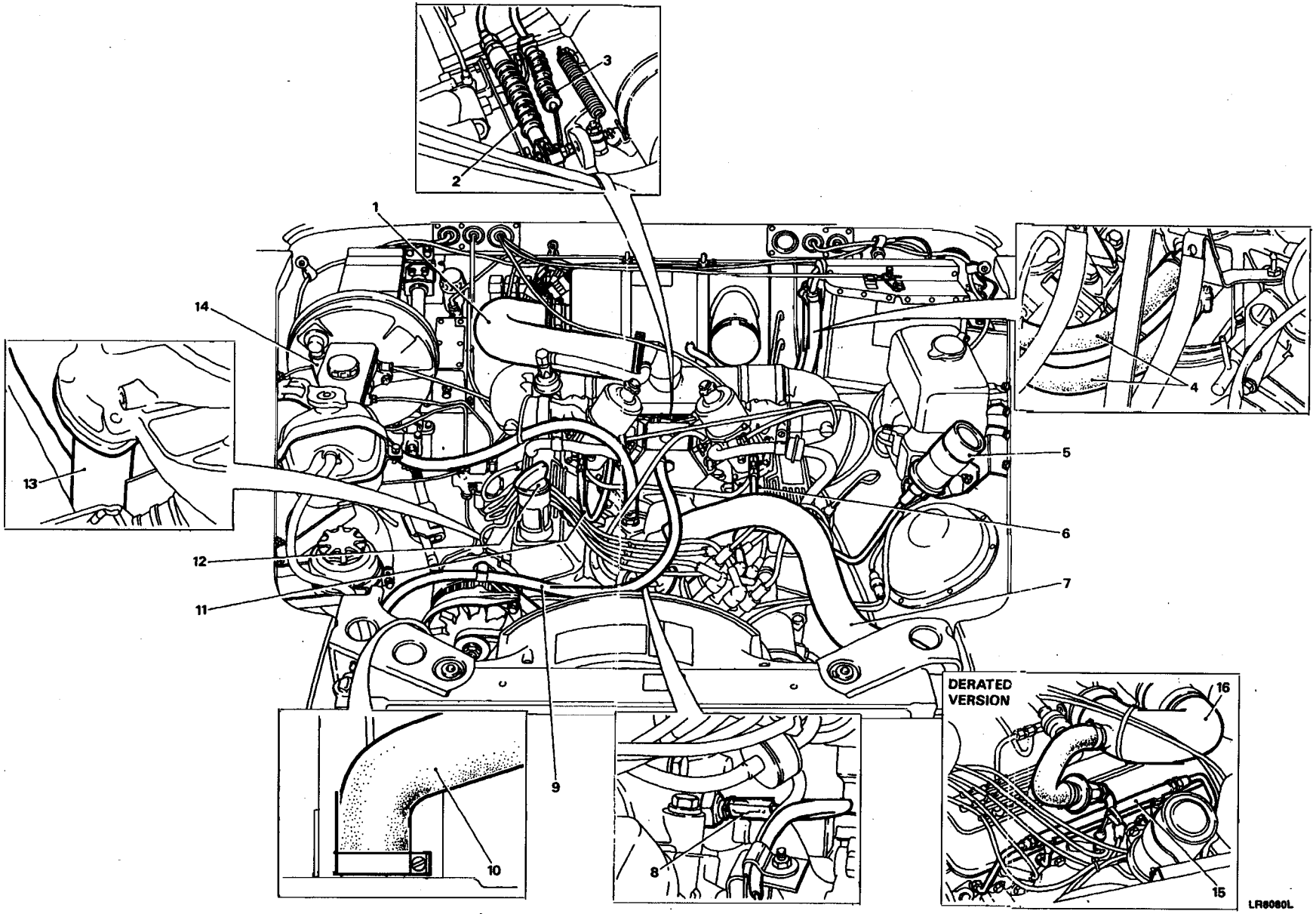


Fig 3

Cylinder head removal disconnection points

5.16 Disconnect the fuel supply pipe from the tank (6). Seal all pipe and hose ends to prevent the ingress of dirt or foreign matter.

5.17 Disconnect any clips retaining pipes and cables to the cylinder head noting their locations for reassembly. Ensure that any disconnected pipes and cables are drawn clear to allow removal of the cylinder head.

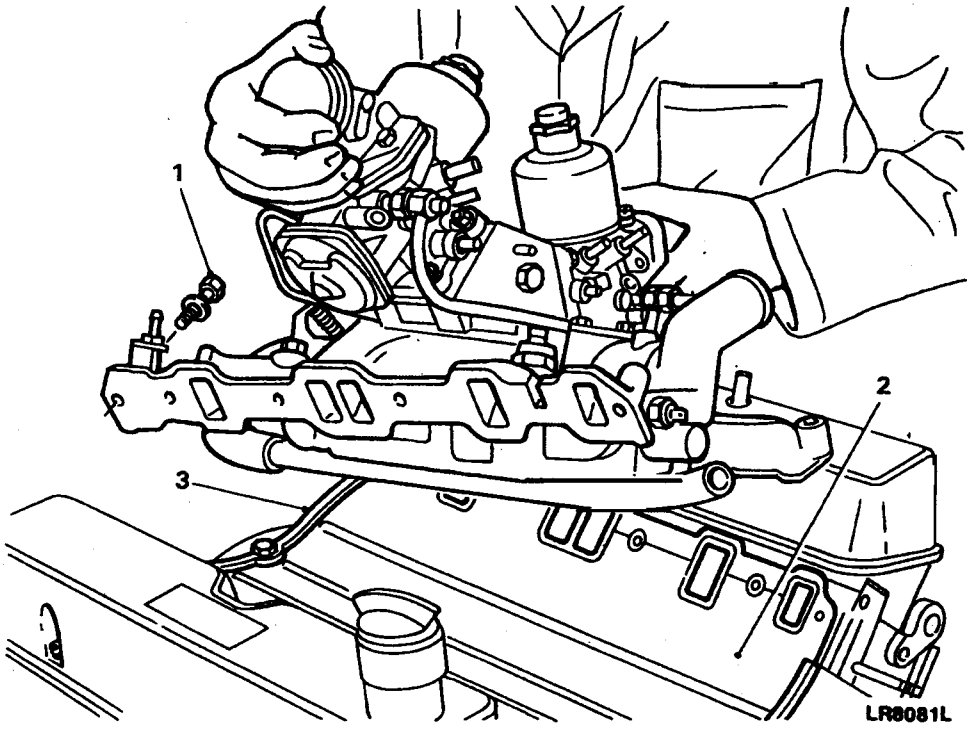
5.18 Disconnect the exhaust pipes (12) from the exhaust manifolds.

Removal

6 To remove the cylinder head assembly proceed as follows:

6.1 Evenly slacken and remove twelve bolts (Fig 4 (1)) that secure the induction manifold to the cylinder head. Lift off the induction manifold complete with carburetters.

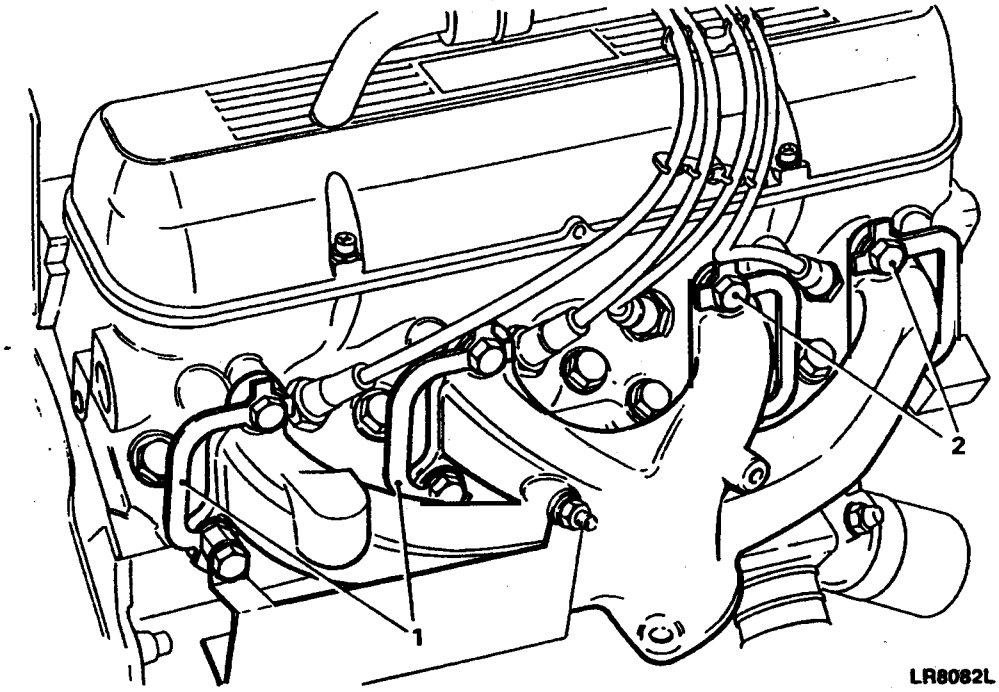
6.2 Wipe away any surplus coolant lying on the manifold gasket (2) and remove the gasket clamp bolts and clamps (3). Lift off the manifold gasket to reveal the tappets and push rods.



1 Bolts
2 Gasket
3 Gasket clamps

Fig 4 Induction manifolds and carburettors removal

6.3 Bend back the lock tabs (Fig 5 (1)), and remove the eight bolts (2) securing each exhaust manifold to the cylinder heads. Withdraw the exhaust manifolds and discard the gaskets.



1 Locktabs 2 Bolts

Fig 5 Exhaust manifold removal

6.4 Remove the four screws (Fig 6 (1)) securing each rocker cover and lift-off the rocker covers (2) and discard the gaskets (3).

6.5 Before removing the rocker shaft and valve gear, mark each shaft (4) with the cylinder head from which it was removed, i.e. left-hand or right-hand.

6.6 Remove the four rocker shaft retaining bolts (35) and lift-off the assembly.

6.7 Withdraw the pushrods (7) and retain in the sequence removed. It is recommended that each rod is inserted in a suitable piece of card numbered relating its original location. Take care not to allow the rods to become dislodged and fall into the crankcase through the oil drain holes.

6.8 Remove the hydraulic tappets (21) and immerse in clean engine oil and store in a safe location. Refer to Fig 7 for tappet removal.

CAUTION ...

If a tappet cannot be removed due to damage and enlargement of the cam face, no attempt should be made to remove the tappet at this stage, but leave in position until the camshaft is removed (Para 36). Any attempt to force a tappet out will damage the tappet bore in the cylinder block.

6.9 Remove the cylinder head retaining bolts from each head, in reverse order to the tightening sequence (Fig 21).

6.10 Remove both cylinder heads (10). Remove and discard the cylinder head gaskets (16).

Dismantling

Cylinder head

7 To dismantle the cylinder head proceed as follows:

7.1 Remove the spark plugs (Fig 6 (15)).

7.2 Using the valve spring compressor RO276102 or 18G106A or a suitable alternative, remove the valves and springs and retain valves in sequence for possible reassembly.

Rocker shaft assembly

8 To dismantle the rocker shaft assembly proceed as follows:

8.1 Remove the split pin (Fig 6 (29)) from the end of the rocker shaft (4) that has the identification groove.

8.2 Withdraw the plain washer (30) and wave washer (31) from the end of the rocker shaft, followed by a spring (5) and a bracket (33) in sequence.

8.3 When springs and brackets are withdrawn remove a plain washer, a wave washer and a split pin from the end of the rocker shaft that has no identification groove.

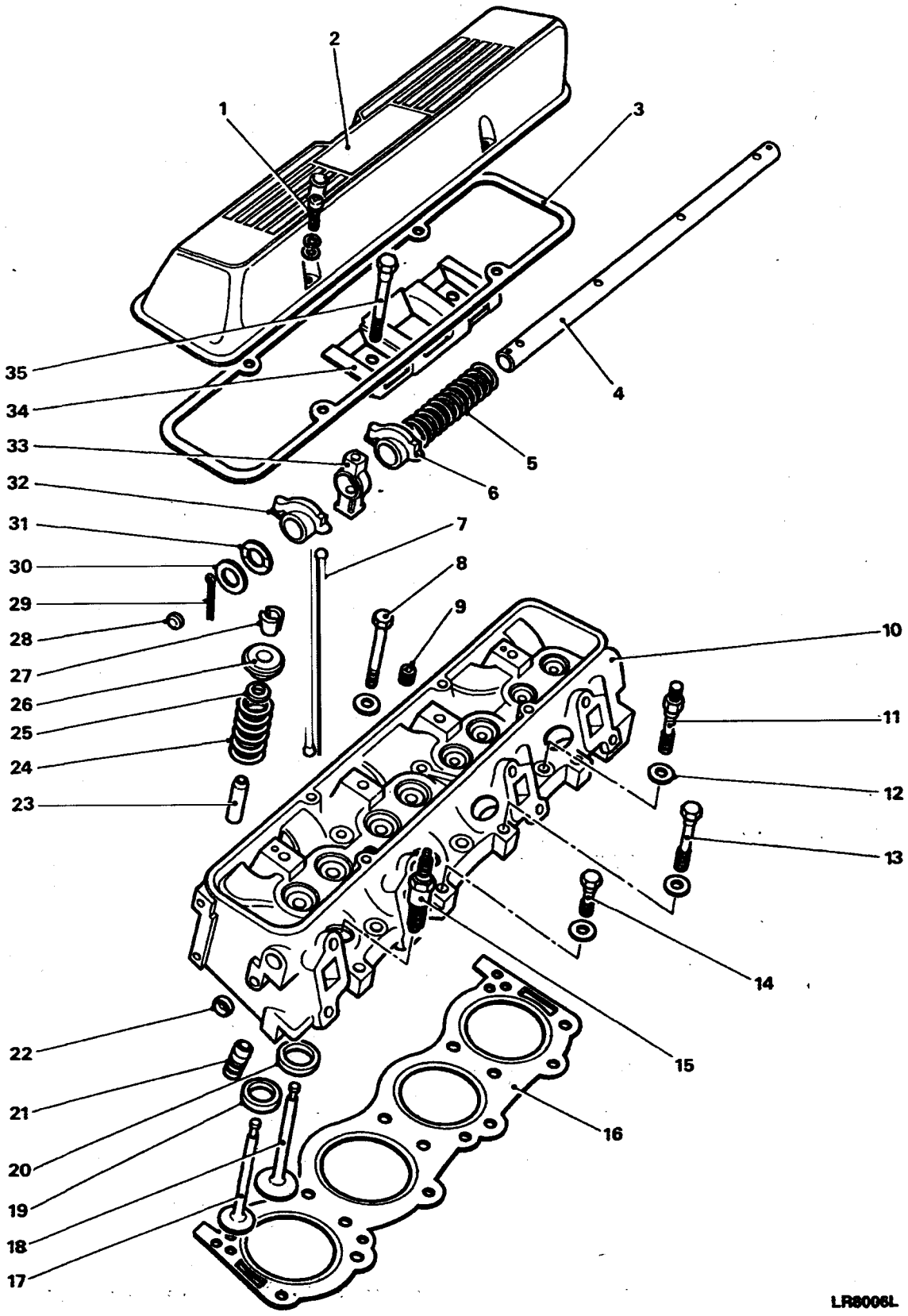
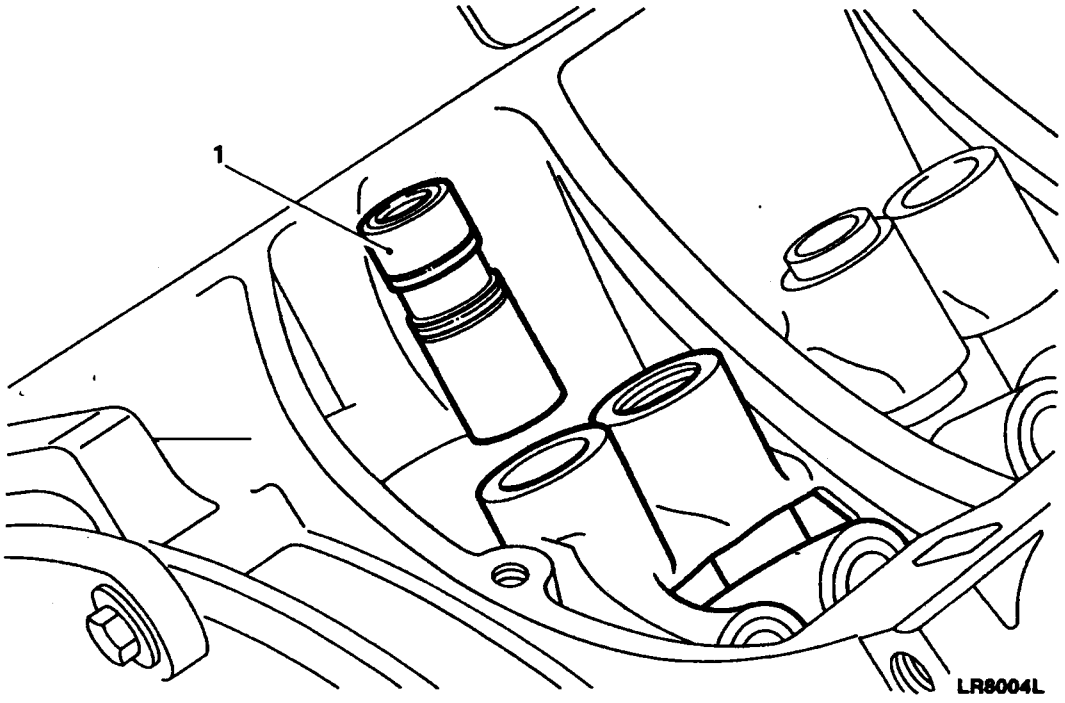


Fig 6 Exploded view of cylinder head

Key to fig 6

1 Bolt
2 Rocker cover
3 Gasket
4 Shaft
5 Spring
6 Rocker assembly r.h.
7 Push rod
8 Bolt
9 Core plug
10 Cylinder head
11 Bolt
12 Washer
13 Bolt
14 Bolt
15 Spark plug
16 Gasket
17 Exhaust valve
18 Inlet valve
19 Exhaust valve seat
20 Inlet valve seat
21 Hydraulic tappet
22 Cup plug
23 Valve guide
24 Valve spring
25 Valve stem seal
26 Valve spring cap
27 Split cotter
28 Shaft end plug
29 Split pin
30 Plain washer
31 Wave washer
32 Rocker assembly l.h.
33 Bracket
34 Baffle
35 Bolt



1 Hydraulic tappet

Fig 7 Tappet removal

Cleaning

9 Clean and degrease the cylinder heads and remove carbon from the combustion face and chambers with a soft wire brush. Wear protective goggles.

Examination

Cylinder head

10 Examine both heads for damage, cracks and overheating.

10.1 Using a depth gauge (Fig 8) measure the distance between the combustion face and the boss in each combustion chamber. A reading of less than 6,35 mm (0.250 in) indicates that the combustion face has previously been machined. It is very important that the measurement is the same on both cylinder heads since any variation will cause misalignment of the inlet manifold and possible leakage at the manifold gasket.

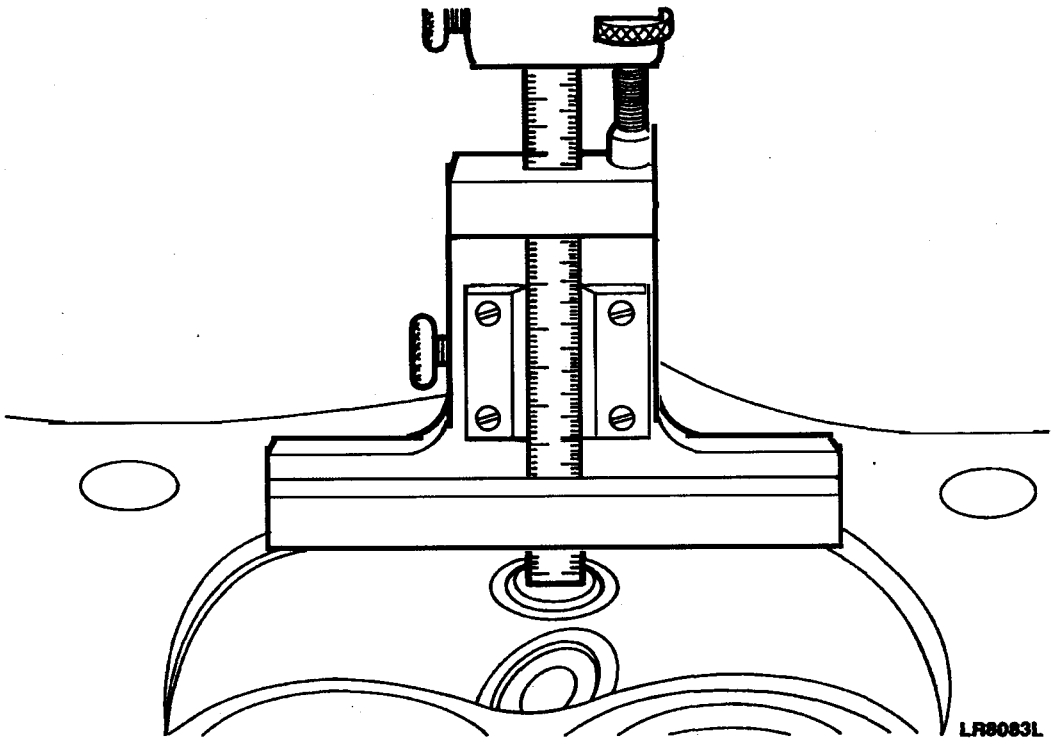


Fig 8 Depth gauge usage

10.2 Examine the condition of all threaded holes and any holes which are stripped and damaged can be salvaged by fitting Helicoils (Refer to Para 16).

10.3 Check the valve guides for wear by inserting a new valve in the guide and holding it 8 mm from the seat. If sideways movement of the valve head exceeds 0,15 mm (0.006 in) the guide should be renewed.

10.4 Check the valve seats for wear, pits and burning or pocketing due to repeated refacing and renew the inserts if necessary.

10.5 Examine the valves and discard any which are burnt, cracked or where the head is dished. Also renew valves if the stems are scored, show signs of overheating and seizure. Valves that appear satisfactory should be checked in the guides, using the same method as for checking the valve guides, for stem wear.

10.6 Revolve valves in the guides to check for bend.

Rocker shaft assembly and push rods

11 To examine the rocker shaft assemblies and push rods proceed as follows:

11.1 Examine the shafts for wear, scores and pitting. Check that the lubrication drillings are clear.

11.2 Examine the rockers for wear at the push rod and valve pad ends. Rockers that have worn, pitted or scored pads and ball seatings must be renewed.

11.3 A broken spring should be renewed and if possible undamaged springs should be checked for tension against a new one.

Hydraulic tappets

12 The hydraulic tappets should be examined as follows:

12.1 Examine the face of each tappet and compare with the wear patterns shown on Fig 9.

12.2 View A shows a tappet that has been rotating correctly and is visibly serviceable, views B and C indicate that the tappet should be renewed.

12.3 View B shows a tappet that has not been rotating, which could mean that the corresponding cam lobe is worn and should be closely examined.

12.4 View C indicate tappets showing examples of general wear and damage.

12.5 The hydraulic performance of the tappets, however, can only be judged when the engine is running so if there is the slightest doubt the tappets should be renewed.

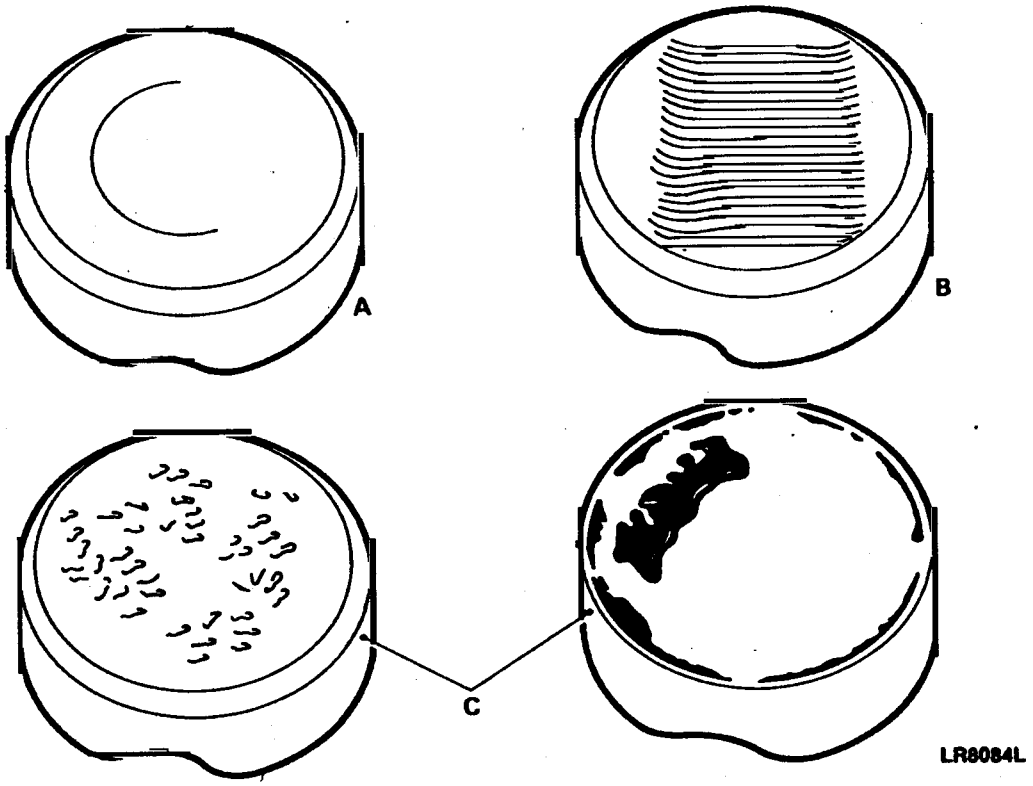


Fig 9 Tappet wear patterns

Inlet Manifold

13 The inlet manifold should be examined as follows:

13.1 Examine the manifold for cracks and damage. Check the threaded holes and joint faces.

13.2 Since the manifold is water heated, a thorough check should be made for signs of coolant leaks from pipes and plugs particulary on the underside of the casting.

13.3 Remove the thermostat cover and withdraw the thermostat. Clean any deposits from the housing and the cover.

13.4 The temperature at which the thermostat should be fully open is stamped on the forward end of the thermostat. The following method can be used to determine if the thermostat is satisfactory and suitable for refitting.

13.5 Place the thermostat and a Centigrade thermometer in a laboratory beaker, or a suitable alternative, half full of water. Heat the water and observe the temperature at which the thermostat opens. If faulty, discard the thermostat.

13.6 The thermostat has a small vent hole in which is fitted a 'jiggle' pin to keep the hole clear. Fit the thermostat to the housing ensuring that this vent is uppermost at the 12 o'clock position. If fitted in any other way, an air lock could result in the water passages causing overheating and coolant loss from the system.

13.7 Fit the thermostat cover using a new gasket. Coat the threads of the retaining screws with Loctite 572 and tighten the screws evenly to the correct torque.

13.8 A small diameter vent pipe is located at the side of the manifold penthouse. Disconnect the hose and insert a 2 mm drill and turn it by hand to ensure that the vent is clear. Any blockage at this point will cause overheating and loss of coolant. Check that the hose is also clear.

Repairs and replacements

General

14 Gaskets, joints and seals are not to be re-used. Renew these items on reassembly.

15 Valve springs, rocker springs and spacers should be renewed at every major overhaul.

Cylinder head threads

16 To reclaim cylinder head threads (Fig 10) proceed as follows:

16.1 Holes A - These three holes may be drilled 0.3906 in dia. x 0.937 + 0.040 in deep. Tapped with helicoil Tap No. 6CPB or 6CS x 0.875 in (min.) deep (3/8 UNC 1 1/2D insert).

16.2 Holes B - These eight holes may be drilled 0.3906 in dia. x 0.812 + 0.040 in deep. Tapped with helicoil Tap No. 6CBB 0.749 in (min.) deep (3/8 UNC 1 1/2D insert).

16.3 Holes C - These four holes may be drilled 0.3906 in dia. x 0.937 + 0.040 in deep. Tapped with helicoil Tap No. 6CPB or 6CS x 0.875 in (min.) deep (3/8 UNC 1 1/2D insert).

16.4 Holes D - These four holes may be drilled 0.261 in dia. x 0.675 + 0.040 in deep. Tapped with helicoil Tap No. 4CPB or 4CS x 0.625 in (min.) deep (1/2 UNC 1 1/2D insert).

16.5 Holes E - These six holes may be drilled 0.3906 in dia. x 0.937 + 0.040 in deep. Tapped with helicoil Tap No. 6CPB or 6CS x 0.875 in (min.) deep (3/8 UNC 1 1/2D insert).

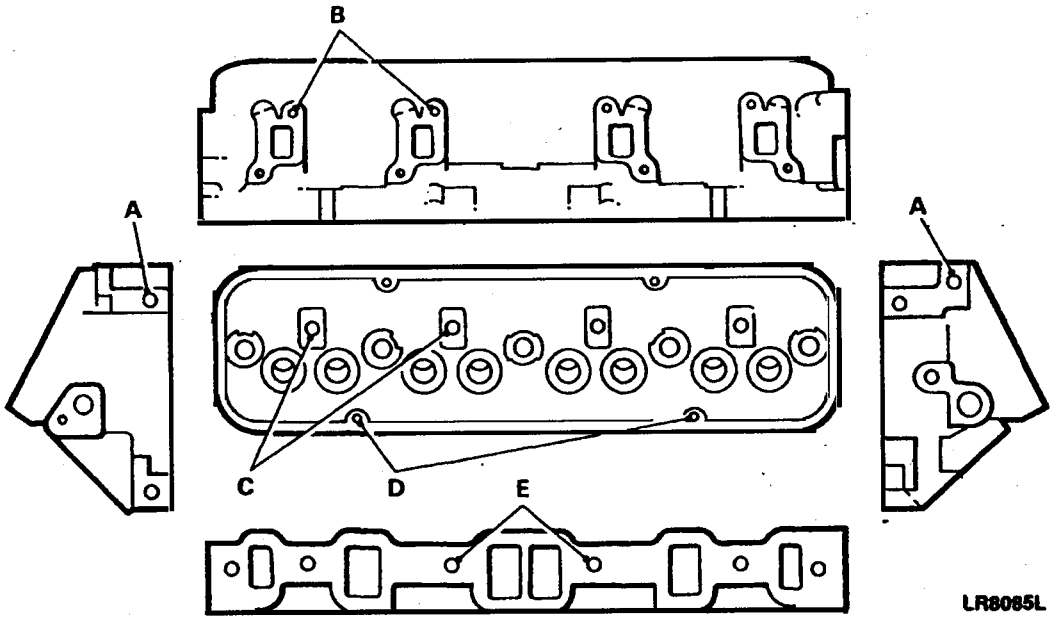


Fig 10 Cylinder head (r.h.) thread reclamation

Valve guides

17 To renew the valve guides proceed as follows:

17.1 To remove worn guides, use guide removing tool 274401 (Fig 11) and drive-out the guides from the rocker shaft side of the cylinder head through the valve port. Clean away any carbon deposits from the port that were not accessible before the guides were removed.

17.2 Lubricate the new valve guide and place in position. Using guide drift 600959 (Fig 12) and if available, height gauge RO605774A, drive the guide into the cylinder head until it protrudes 19 mm above the valve spring recess in the head or flush with the height gauge.
Note ...

Service valve guides are 0,02 mm (0.001 in) larger on the outside diameter than the original equipment to ensure an interference fit.

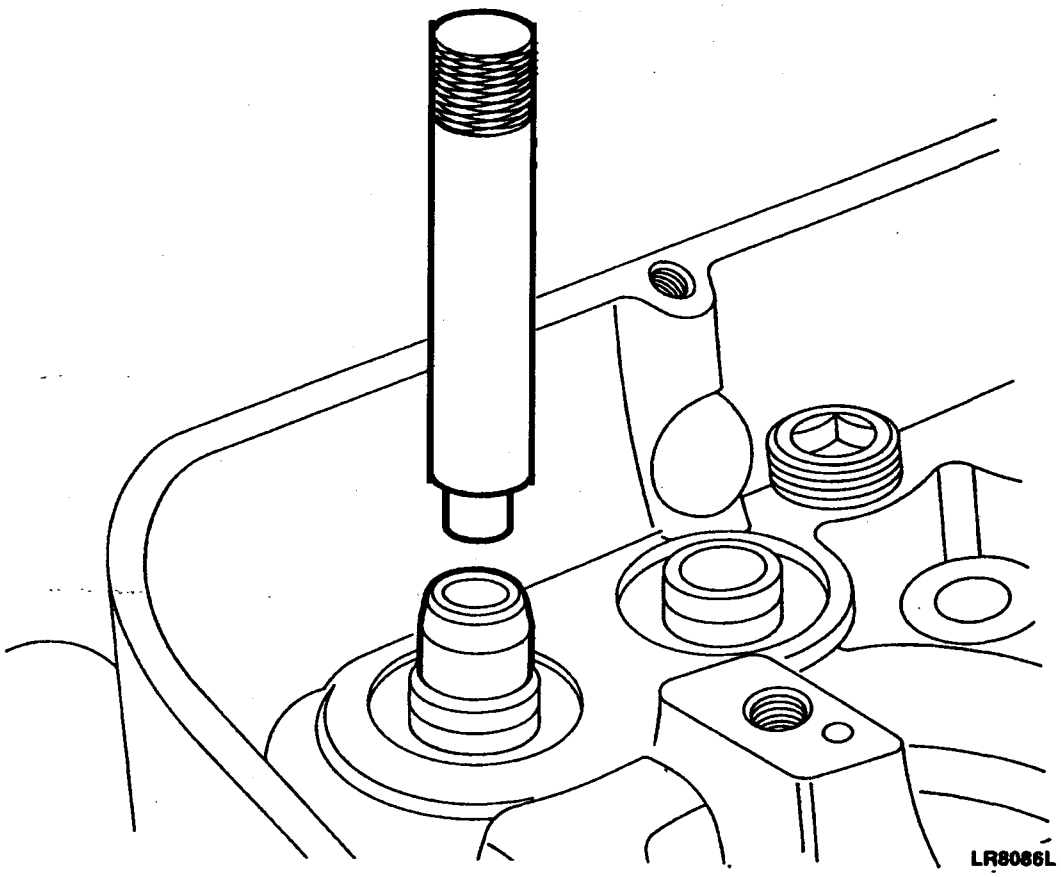


Fig 11 Valve guide removal

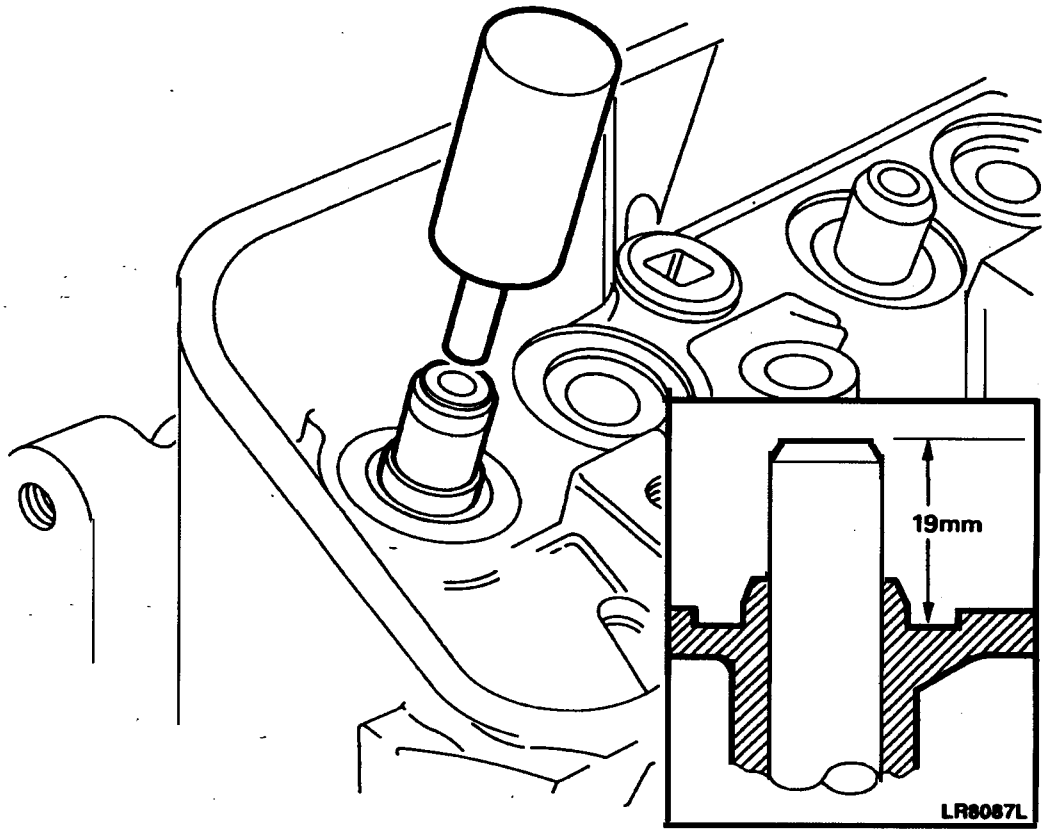


Fig 12 Fitting valve guides

Valve seat inserts

18 To renew the valve seats proceed as follows:

WARNING ...

WHEN REMOVING VALVE SEAT INSERTS FROM THE CYLINDER HEAD PROTECTIVE GOGGLES MUST BE WORN

18.1 Remove the old seat inserts by grinding them away until they are thin enough to be cracked and prized out.

18.2 Heat the cylinder head evenly to approximately 65°C (150°F) and press the new insert into the recess in the cylinder head (Fig 13) and allow the cylinder head to cool naturally.

Note ...

Service valve seats are available in two sizes: 0,25 mm and 0,50 mm (0.010 in and 0.020 in) larger on the outside diameter to ensure interference fit.

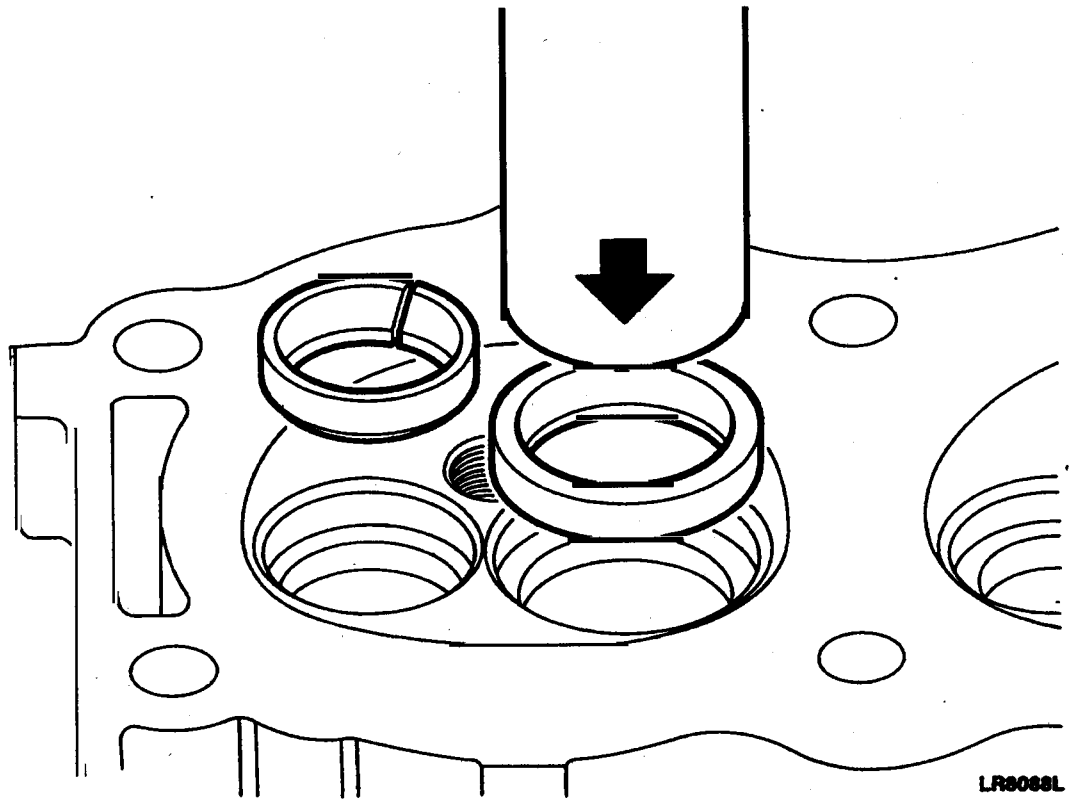


Fig 13 Typical valve seat replacer tool

18.3 If necessary, cut the valve seats to 46.25° (Fig 14). The nominal seat width 'A' is 1,5 mm (0.031 in). If the seat exceeds 2,0 mm (0.078 in) it should be reduced to the specified width by the use of 20 and 70° cutters.

18.4 The inlet valve seat diameter, B is 37,03 mm (1.458 in) and the exhaust valve seat is 31,50 mm (1.240 in) diameter.

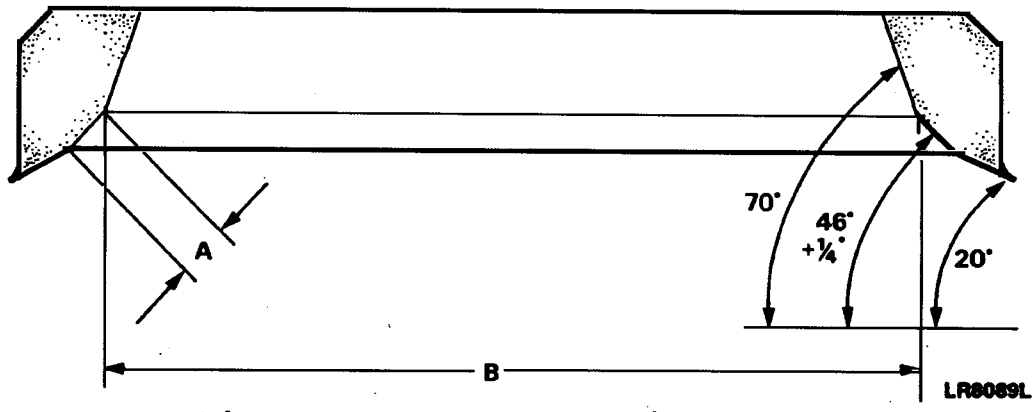
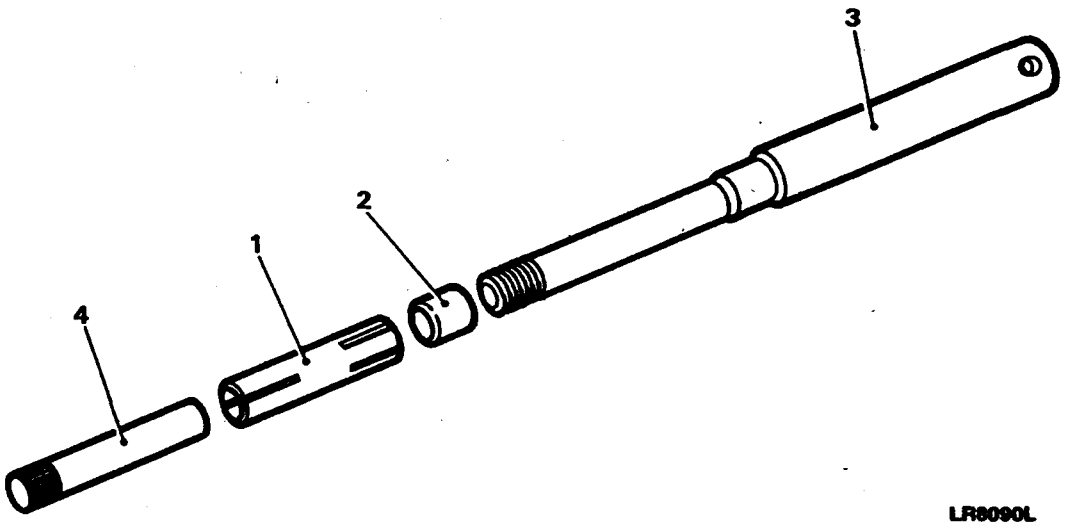


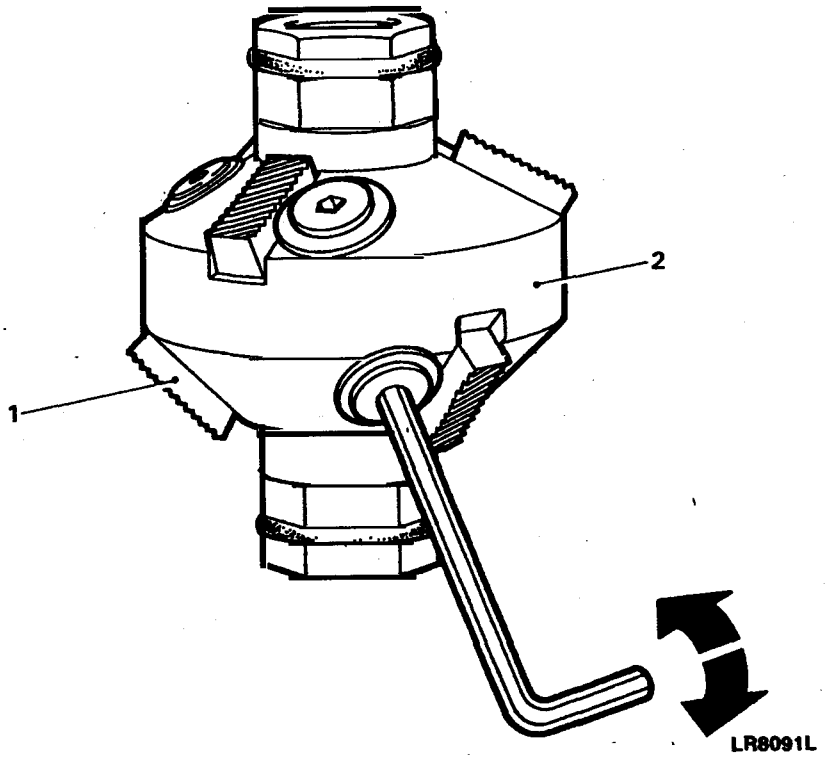
Fig 14 Valve seat refacing angle

18.5 The following special hand tools or equivalent must be used for fitting and refacing a valve seating: Expandable pilot tool MS 150-8.5 (Fig 15) ensures that the new valve seat inserts are fitted concentric with valve guide. The facing tool MS 621 (Fig 16) which incorporates tungsten carbide cutters is used to cut a seat in a valve seat insert.



1 Collet
2 Expander
3 Expander bar
4 Knurled nut

Fig 15 Expandable pilot for refacing valve seats



1 Cutter blades 2 Cutter head

Fig 16 Adjusting facing tool cutter blades

18.6 Select the expandable pilot tool MS 150-8.5 (Fig 15) and the appropriate expandable collet (1) for the valve seat insert to be fitted.

18.7 Ensure that the chamfered end of the expander (2) is towards the collet.

18.8 Insert the assembled pilot into the valve guide from the combustion face side of the cylinder head (Fig 17) until the shoulder contacts the valve guide and the whole of the collet is inside the valve guide.

18.9 Expand the collet in the guide by turning the expander bar (Fig 15 (3)) clockwise using a suitable tommy bar whilst holding the knurled nut (4).

18.10 Select the appropriate facing tool MS 621 (Fig 16) and hand turning tool MS 76B for the angle of the seats to be cut.

18.11 Ensure that the cutter blades (1) are correctly fitted to the cutter head (2) with the angled end of the blade downwards facing the work.

18.12 Check that the cutter blades are adjusted so that the middle of the blade contacts the area of material to be cut. Use the key provided with the hand turning tool MS 76B to adjust the cutters so that they all contact the seating simultaneously. Use light pressure and remove only the minimum material necessary.

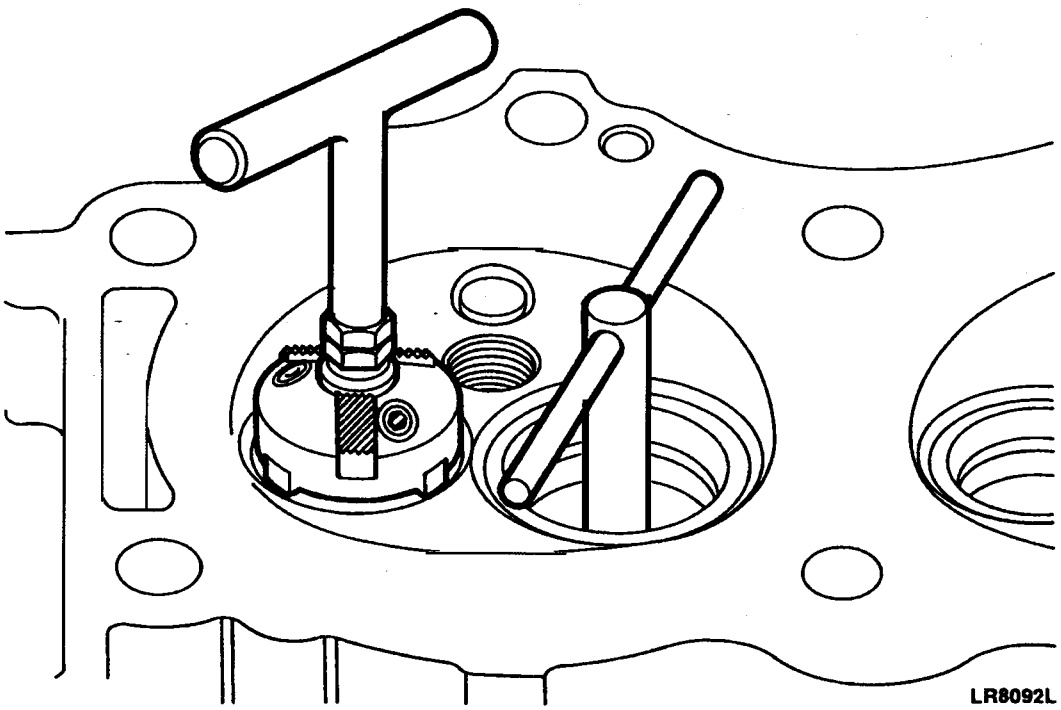


Fig 17 View of cutter fitted to pilot

18.13 Reface serviceable valves to an angle of 45°, Fig 18 'A'. Any valve which after refacing resembles 'B' must be renewed.

18.14 Smear a small quantity of engineers blue round the valve seat and revolve a properly ground valve against the seat. A continuous fine line should appear around the valve at approximately one third down the valve face 'C'. If there is a gap of not more 12 mm the valve can be corrected by lapping.

18.15 Alternatively, insert a strip of cellophane between the valve and seat, hold the valve down by the stem and slowly pull out the cellophane. If there is a drag the seal is satisfactory in that spot. Repeat this in at least eight places. Lapping-in will correct a small open spot.

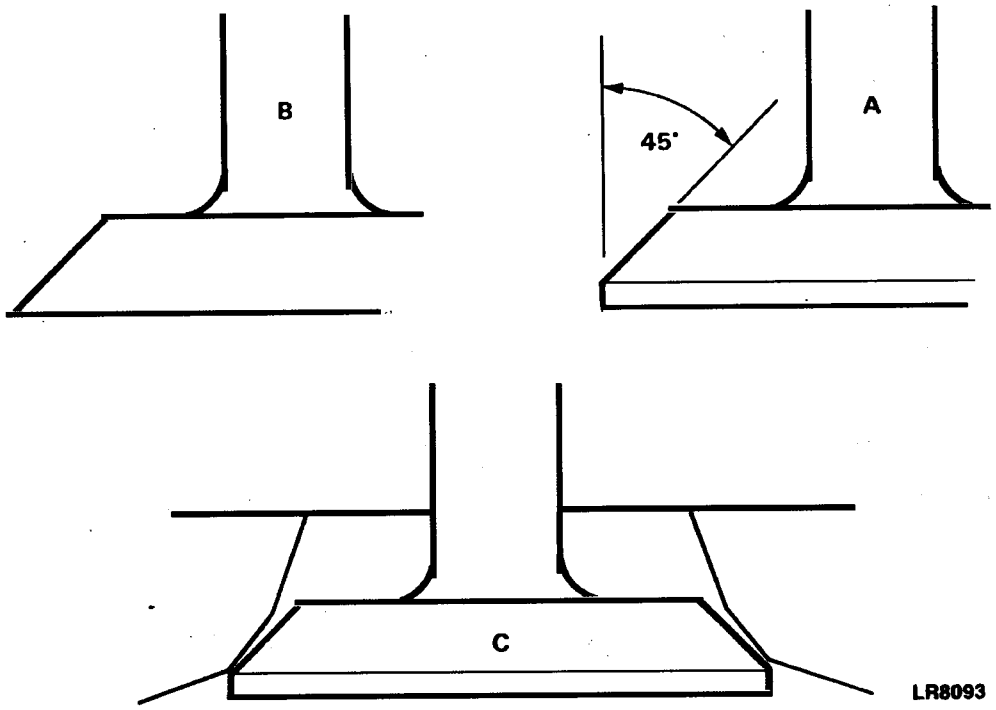


Fig 18 Valve seat lapping-in

Reassembly

Rocker shafts

19 To assemble the rocker shafts proceed as follows:

19.1 Fit a new split pin (Fig 19 (7)) to the end of the rocker shaft with no identification groove.

19.2 Slide a plain washer (6) over the long end of the shaft to abut the split pin.

19.3 Fit a wave washer (5) to abut the plain washer.

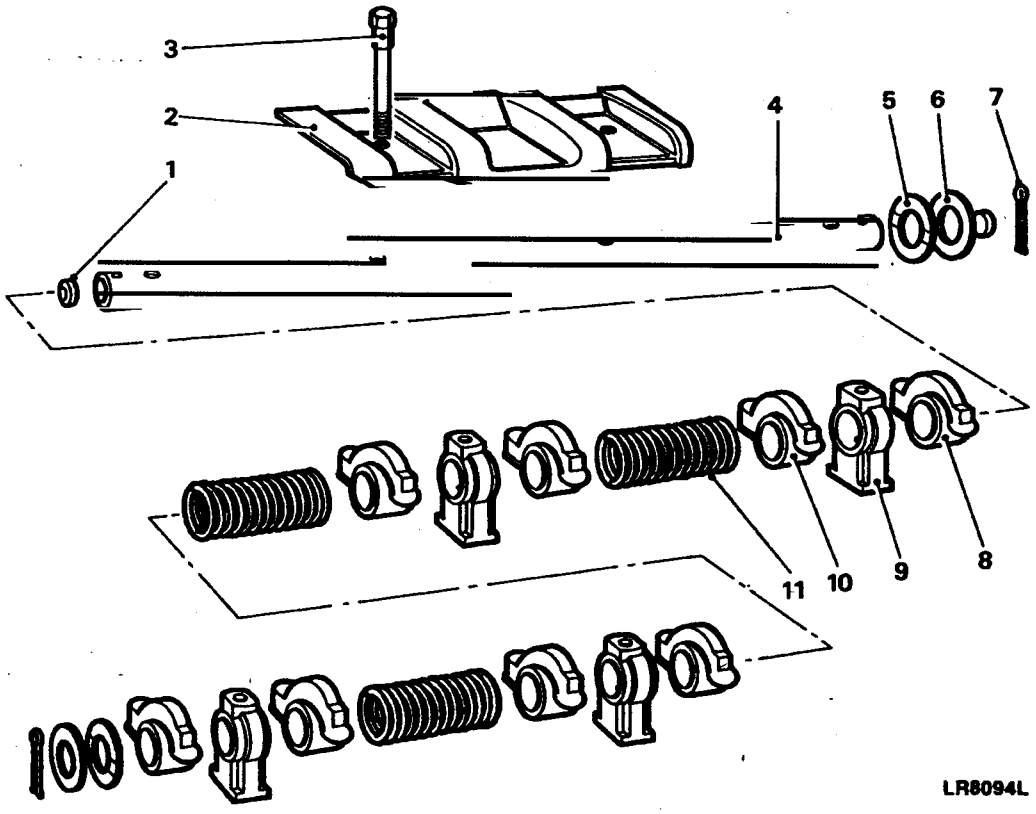
19.4 Assemble the rocker arms (8),(10), bracket (9) and spring (11) to the rocker shaft in the sequence illustrated.

19.5 Compress the springs, brackets and rocker arms, and fit a wave washer, plain washer and split pin to the end of the rocker shaft.

19.6 Both shafts must be assembled so that the identification groove is at the one-o'clock position with the push rod end of the rockers to the right.

CAUTION ...

If the shafts and rockers are incorrectly assembled and fitted to the engine, the oil supply to the rocker shafts will be restricted.



1	Shaft plug	7	Split pin
2	Baffle	8	Rocker assembly r.h.
3	Bolt	9	Bracket
4	Shaft	10	Rocker assembly l.h.
5	Wave washer	11	Spring
6	Plain washer		

Fig 19 Rocker shaft assembly

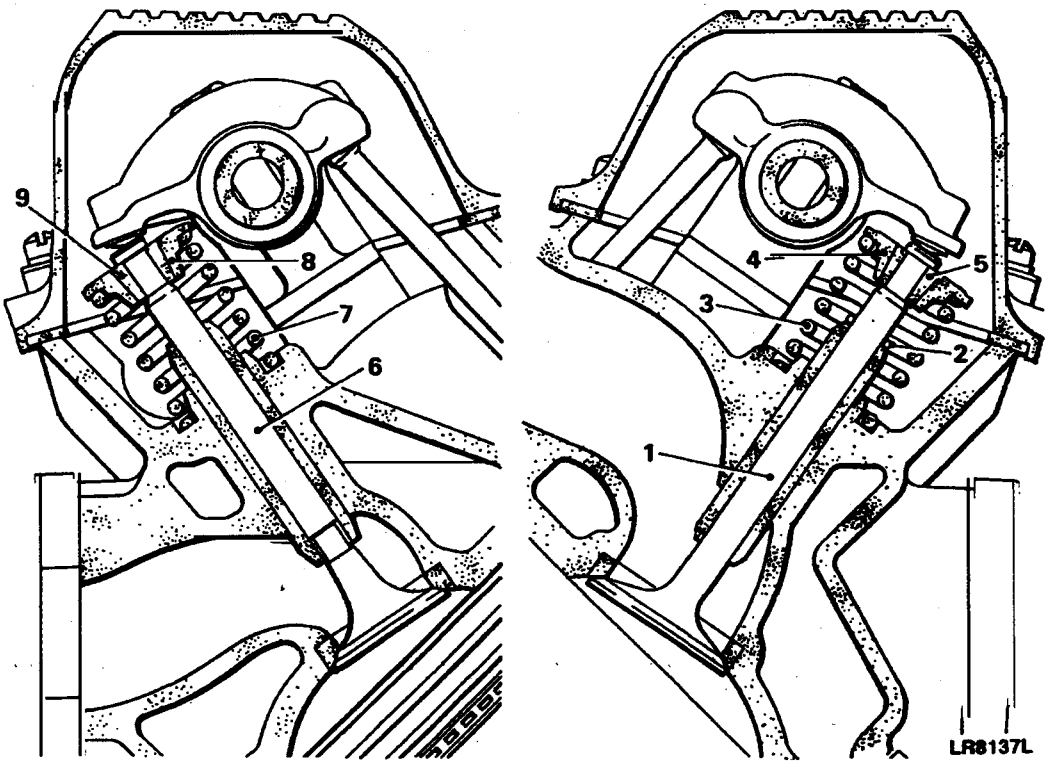
Valve assemblies

20 To assemble the valves to the cylinder head proceed as follows:

20.1 Before fitting the valves and springs the height of each valve above the head must be checked. Insert each valve in turn in its guide and whilst holding the head firmly against it's seat (Fig 20), measure the height of the stem above the valve spring seat surface. This dimension must not exceed 47,63 mm (1.875 in).

20.2 Insert the inlet valves (Fig 20 (1)) in their guides lubricate with clean oil and fit a new seal (2) over the stem. Fit a new spring (3) and using spring compressor 18G106A or RO276102, secure the valve with the cap (4) and collets (5).

20.3 Insert the exhaust valves (6) in their guides and lubricate with clean oil. Fit a new spring (7) and using spring compressor 18G106A or RO276102, secure the valve with the cap (8) and collets (9). No seal is required for the exhaust valves.



1 Inlet valve
2 Seal
3 Spring
4 Valve cap
5 Collet
6 Exhaust valve
7 Spring
8 Valve cap
9 Collet

Fig 20 Valve assemblies

Cylinder head assemblies to cylinder block

21 To assemble the cylinder head assemblies to the cylinder block proceed as follows:

21.1 Clean the cylinder heads and cylinder block mating faces and fit new dry cylinder head gaskets (Fig 6 (16)) without grease or sealing compound in position over the dowel pins on the cylinder block. Ensure that the word 'TOP' is uppermost.

21.2 Locate the cylinder heads on the block dowel pins. Clean the threads of the cylinder head bolts and coat them with Thread Lubricant-Sealant Loctite 572.

21.3 Locate the cylinder head bolts in the positions illustrated (Fig 21) and tighten bolts finger tight only.

Long bolts - 1, 3 and 5.
Medium bolts - 2, 4, 6, 7, 8, 9 and 10.
Short bolts - 11, 12, 13 and 14.

Note ...

Left hand cylinder head illustrated. Arrow points to front of vehicle.

21.4 Tighten the cylinder head bolts in sequence (Fig 21) a little at a time. Final bolt torque figures are as follows:

Bolts 1 to 10 - 65 to 70 lbf ft (88 to 95 Nm).
Bolts 11 to 14 - 40 to 45 lbf ft (54 to 61 Nm).

21.5 When all bolts have been tightened, recheck the torque settings.

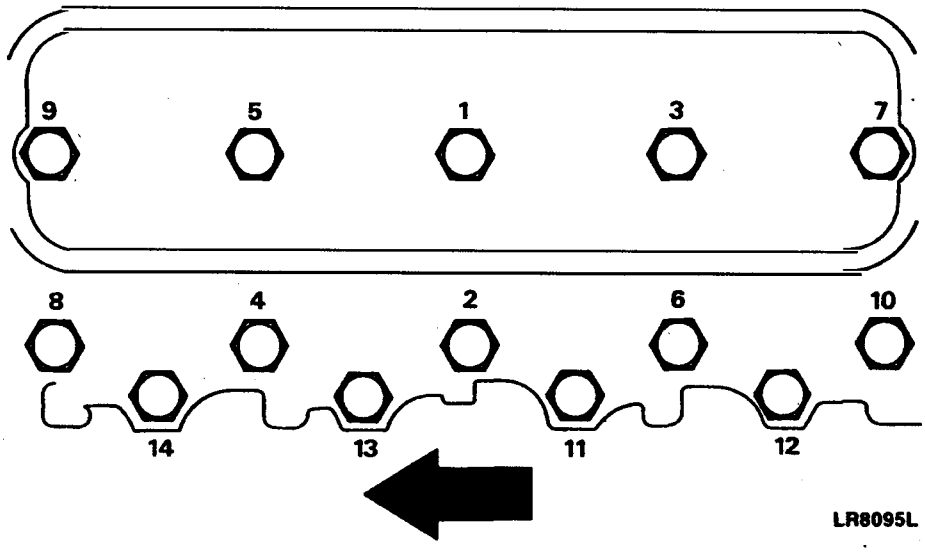


Fig 21 Tightening sequence for cylinder head fixings

Tappets

22 To fit the tappets proceed as follows:

22.1 Place all the tappets into a metal container of clean engine oil and operate the inner member using a push rod to fill each tappet with oil. This will reduce tappet noise when the engine is first started.

22.2 Refit any used tappets into their original locations and ensure that they all rotate freely in the bores.

Rocker shafts and push rods

23 To fit the rocker shafts and push rods proceed as follows:

23.1 Fit the push rods through the guide holes in the cylinder head ensuring that any used ones are returned to their original locations and that all the rods locate properly in the tappets.

23.2 The rocker shafts are handed and must be fitted correctly to align the oilways. Each rocker shaft is notched at one end and on one side only (Fig 22 (1)). If they are correctly assembled, when fitted, the notch in the end of each shaft will be at one-o'clock position and towards the front on the right bank and to the rear on the left bank, viewing the engine from the flywheel end.

CAUTION ...

Incorrectly assembled and fitted rocker shafts will prevent lubrication reaching the shafts and rockers.

23.3 When fitting the rocker shaft assembly to the cylinder head ensure that the push rods (2) locate correctly in the rocker seats. Tighten the retaining bolts evenly to the correct torque.

Rocker covers

24 To fit the rocker covers proceed as follows:

24.1 If the oil baffle has been removed for cleaning fit the clean oil baffle inside each rocker cover and secure with self tapping screws.

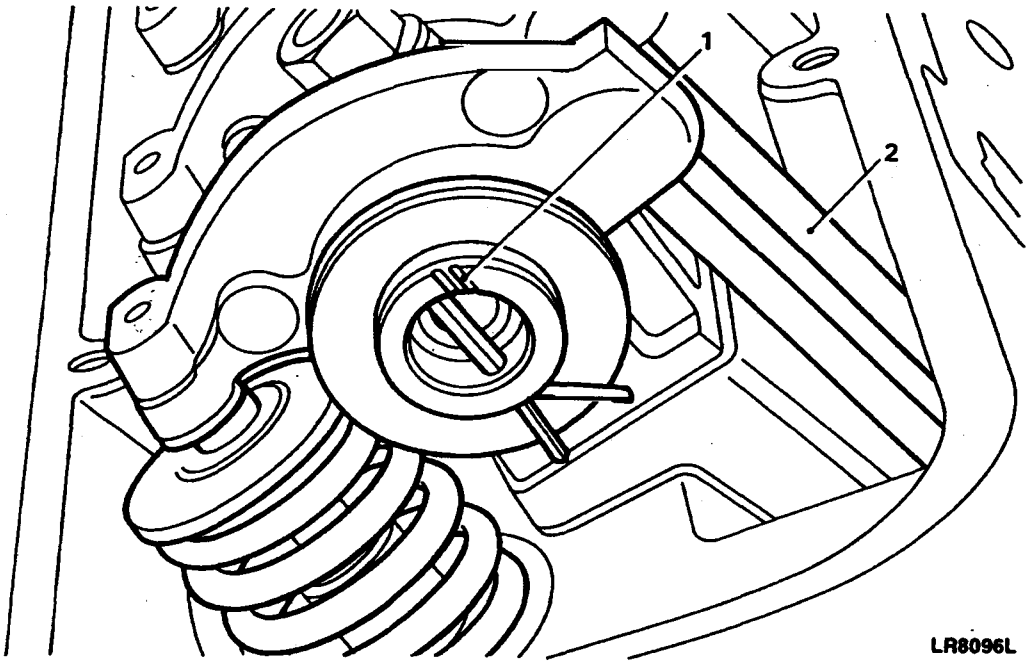
24.2 Remove all traces of old gasket on the covers and cylinder heads. Clean and dry the gasket mounting surface, using Bostik cleaner 6001 or an approved equivalent. Apply Bostik 1777 impact adhesive or its equivalent to the seal face and the gasket, using a brush to ensure an even film. Allow fifteen minutes for the adhesive to become touch-dry.

Note ...

The gasket fits one way round only and must be fitted accurately first time as any subsequent movement would destroy the bond, and the gasket.

24.3 Fit pilot studs in the rocker cover fixing holes to guide the gasket on to the cover and into the recess. Press the gasket into position ensuring that the outer edge firmly adheres to the recess wall. Remove the pilot studs when the gasket is finally positioned.

24.4 Allow the covers to stand for thirty minutes before fitting, then secure to the engine with the retaining screws.



1 Rocker shaft 'notch' 2 Push rods

Fig 22 Valve clearances

Exhaust manifold

25 To fit the exhaust manifold proceed as follows:

25.1 Ensure that the mating faces of the cylinder head and exhaust manifold are clean and smooth and coat the faces with 'Foliac J 166' or approved equivalent.

25.2 Place the manifold in position on the cylinder head and fit the securing bolts, lockplates and plain washers. The plain washers are fitted between the manifold and lockplates.

25.3 Evenly tighten the manifold bolts to the correct torque figure and bend over the lock tabs.

Inlet manifold

26 To fit the rocker covers and inlet manifold proceed as follows:

26.1 Coat the new manifold gasket sides with silicon grease.

26.2 Apply a 6 mm (0.25 in) diameter globule of loctite super flex in the four notches formed between the cylinder head and block. Locate the seals in position with their ends engaged in the notches formed between the cylinder head and block.

26.3 Apply 'Hylomar' sealing compound SQ32M on the corners of the cylinder head, manifold gasket and manifold, around the water passage joints.

26.4 Fit the manifold gasket with the word 'FRONT' to the front and the open bolt hole at the front r.h. side.

26.5 Fit the gasket clamps but do not fully tighten at this stage.

26.6 Locate the manifold on to the cylinder head.

26.7 Clean the threads of the twelve manifold securing bolts and apply Loctite 572 to the threads.

26.8 Fit all the manifold bolts and tighten them a little at a time, evenly, alternative sides working from the centre to each end and finally tighten to the correct torque. Note that the four slotted headed bolts are located in the centre.

26.9 Tighten the gasket clamp bolts to the correct torque.

Reconnection of disturbed parts

27 Reconnect all pipes, hoses, electrical connections and equipment removed or disturbed under preparation (Para 5).

Cooling and lubrication systems

28 Refill the cooling system and check the engine oil level as follows:

28.1 Refill the cooling system using the correct mix of coolant, (Cat 201).

28.2 Check the oil level and top up as necessary with the correct grade of oil, (Cat 201).

CAUTION ...

On 12/24 volt vehicles if the radio batteries are not fitted ensure that the battery leads are disconnected from the auxiliary terminal box before starting the engine.

28.3 Run the engine. Check that the oil pressure warning light goes out. Check all fuel, oil and coolant connections for leaks.

28.4 Stop the engine, when cool check the coolant and oil levels, top up as necessary.

TIMING GEAR COVER, CAMSHAFT, OIL PUMP, WATER PUMP AND DISTRIBUTOR

Dismantling

29 Disconnect the vehicle battery and on 12/24 volt vehicles the radio batteries (Cat 522 Chap 13).

30 Remove the oil cooler on 12/24 volt vehicles only (Para 2.8).

31 Drain the cooling system and remove the radiator complete with top and bottom hoses and cowling assembly (Cat 522 Chap 12).

Water pump

32 To remove the water pump proceed as follows:

32.1 On 12/24 volt vehicles, slacken the fan belt tensioner and remove the outer belt, slacken the 24 volt generator belt tensioner and remove the drive belt and the inner fan belt (Cat 522 Chap 13-3).

32.2 Slacken the 12 volt alternator adjuster bolts and remove drive belt (Cat 522 Chap 13-1).

32.3 Slacken the power steering pump adjuster bolts and remove the drive belt (127 vehicles only). (Cat 522 Chap 7-2).

32.4 Remove the fan assembly (Fig 23 (12),(13)).

32.5 Remove the fifteen bolts (6),(8) and withdraw the water pump (4) and joint (3).

Note ...

The water pump is not a serviceable item, in the event of bearing failure or severe corrosion to the pump impeller vanes. Fit a new water pump assembly.

Distributor

33 To remove the distributor proceed as follow:

33.1 Remove the distributor cap and turn the crankshaft until the rotor arm is pointing to number one plug lead in the distributor cap.

33.2 Remove the nut securing the distributor clamp and lift-off the distributor.

Timing gear cover and oil pump

34 To remove the timing gear cover and oil pump proceed as follows:

34.1 Place an oil drip tray beneath the timing cover and remove the oil filter cartridge by turning anti-clockwise using a strap wrench to overcome the initial torque.

34.2 Remove the crankshaft pulley bolt (Fig 23 (16)) and special washer (17) and withdraw the pulley (21).

34.3 Remove the two bolts securing the sump to the bottom of the timing cover and slacken the four front side bolts.

34.4 Remove the remaining timing cover retaining bolts and withdraw the cover (2) complete with oil pump.

Timing chain and sprockets

35 To remove the timing chain and sprockets proceed as follows:

35.1 Remove the retaining bolt and washer and withdraw the distributor drive gear and spacer.

35.2 Withdraw the crankshaft and crankshaft sprockets (Fig 24 (2),(3)) complete with the timing chain (1).

Camshaft

36 To remove the camshaft proceed as follows:

36.1 If not previously removed, remove the induction manifold complete with carburetters, rocker gear, push rods and tappets. If there are any tappets that could not be removed due to enlarged cam faces, insert the tappet next to the damaged one and lift them both clear of the camshaft and secure together with a rubber band.

36.2 Withdraw the camshaft whilst taking care not to damage the bearings in the cylinder block. To assist in keeping the camshaft horizontal whilst withdrawing it from the cylinder block, insert a screw driver or suitable bar into the threaded hole in the end of the shaft to enable it to be supported by both hands to prevent the shaft falling on the bearings as it is released from the rear bearing.

36.3 Damaged tappets can only be retrieved by removal of the sump and retrieving the damaged tappets from the crankcase. For sump removal refer to (Para 58).

Key to fig 23

1	Gasket	16	Setscrew
2	Timing cover	17	Spacer
3	Gasket	18	Pin
4	Water pump	19	Bolt
5	Plain washer	20	Reinforcing plate
6	Setscrew	21	Pulley
7	Plain washer	22	Pulley
8	Bolt	23	Vibration damper
9	Pulley	24	Balance rim
10	Setscrew	25	Nut
11	Plain washer	26	Deflector
12	Cooling fan	27	Seal retainer
13	Viscous coupling	28	Seal
14	Setscrew	29	Bolt
15	Spring washer	30	Bolt

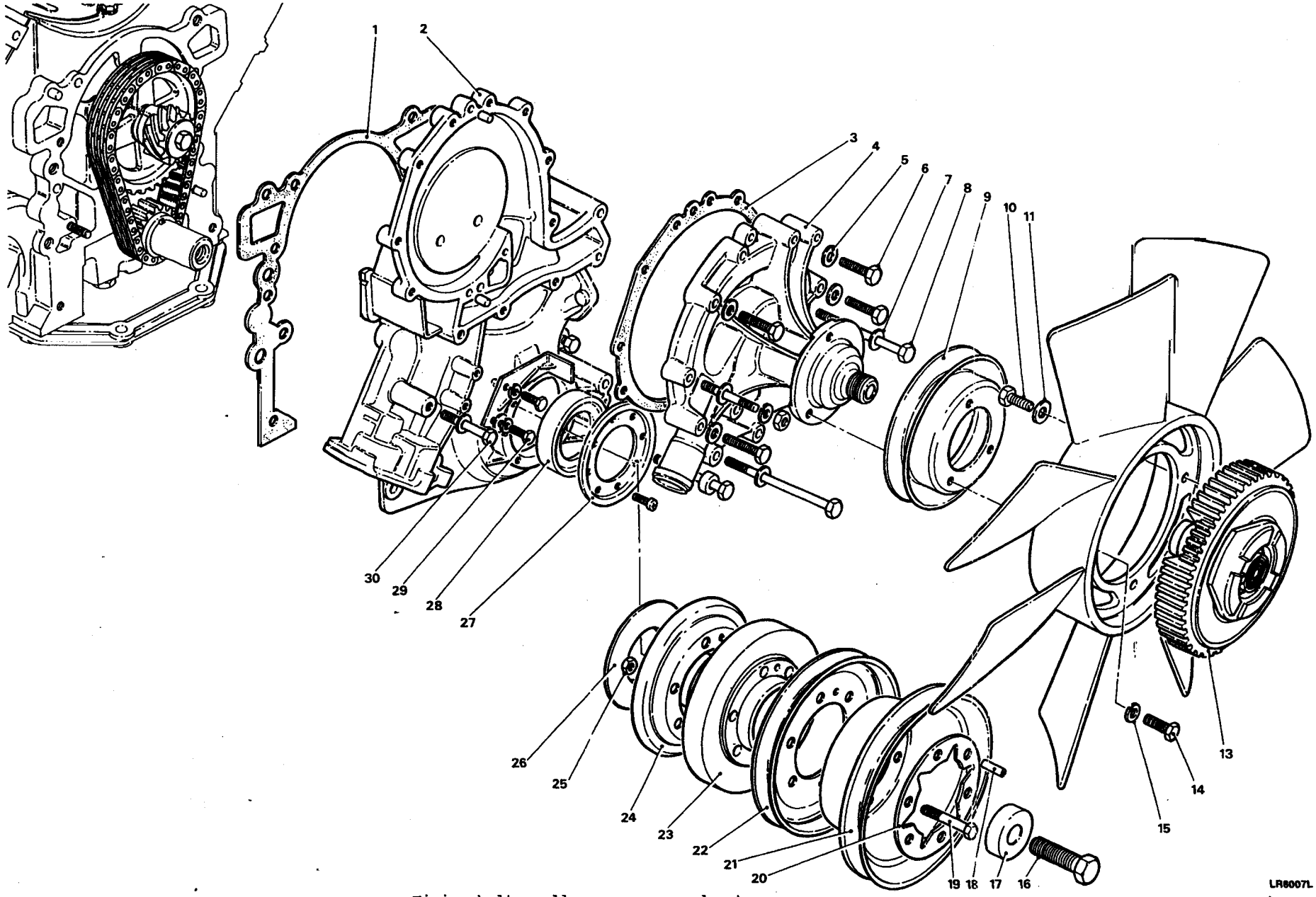
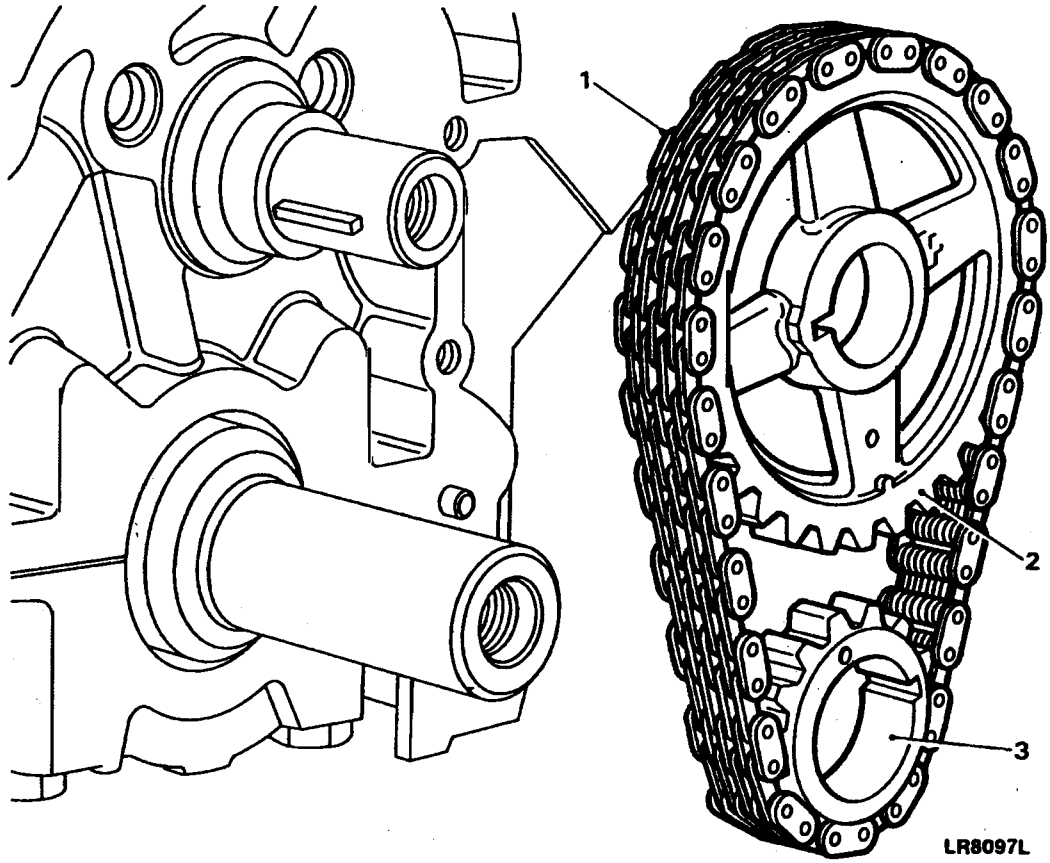


Fig 23

Timing belt, pulleys, covers and water pump

Fig 23



1 Timing chain
2 Camshaft sprocket
3 Crankshaft sprocket

Fig 24 Crankshaft and camshaft sprocket removal

Cleaning

37 Thoroughly clean and degrease all components ensuring that all gasket materials are removed from the joint faces.

Examination

38 Examine all components removed for damage and wear, renew as necessary.

Timing chain and gears

39 To examine the timing chain and gears proceed as follows:

39.1 Examine the camshaft and crankshaft sprockets for wear and damage and discard if necessary. Also check the condition of the distributor and oil pump drive gears. Do NOT mate a worn gear with a new one.

39.2 Inspect the timing chain and if possible compare it with a new one. Alternatively squeeze the chain together and hold it at one end horizontally and if there is a considerable bend, the link pins of the chain are worn and the chain should be renewed.

Oil pump and timing cover

40 To examine the oil pump and timing cover proceed as follows:

40.1 Examine the water pump recess for damage and corrosion.

40.2 Check the camshaft abutment refered to in camshaft examination (Para 42) for damage and cracks in this area.

40.3 Remove the screws (Fig 25 (2)) and withdraw the oil pump cover (3) and gasket (4).

40.4 Remove the oil pump gears (5).

40.5 Remove the pressure relief valve plug (9) and release the spring (8), relief valve (7) and plug washer (6).

40.6 Clean all components including the recess in the front cover.

40.7 Check the oil pump gears (5) for wear or scores.

40.8 Fit the oil pump gears (5) and shaft into the front cover.

40.9 Place a straight-edge across the gears and check the clearance between the straight-edge and the front cover. If less than 0.05 mm (0.0018 in), it indicates that the gear recess is worn and that the cover should be renewed.

40.10 Check the pump gear cover thrust face for wear. If scored it may be restored by careful refacing.

40.11 Check the oil pressure relief valve (7) for wear and scores.

40.12 Check the relief valve spring (8) for wear at the sides or signs of collapse.

40.13 Clean the gauze filter for the relief valve.

40.14 Check the fit of the relief valve in its bore. The valve must be an easy slide fit with no perceptible side movement.

40.15 Renew any parts if their condition is doubtful.

40.16 Insert the relief valve spring (8).

40.17 Locate the sealing washer (6) on to the relief valve plug (9).

40.18 Fit the relief valve plug (9) and torque tighten to 61 Nm (45 lbf ft).

40.19 Fully pack the oil pump gear housing with petroleum jelly.

CAUTION ...

Grease must not be used since most greases contain additives which do not dissolve in engine oil and may cause malfunction of the hydraulic tappets, and or block the oil pick-up strainer. Unless the pump is fully packed with petroleum jelly it may not prime itself when the engine is started.

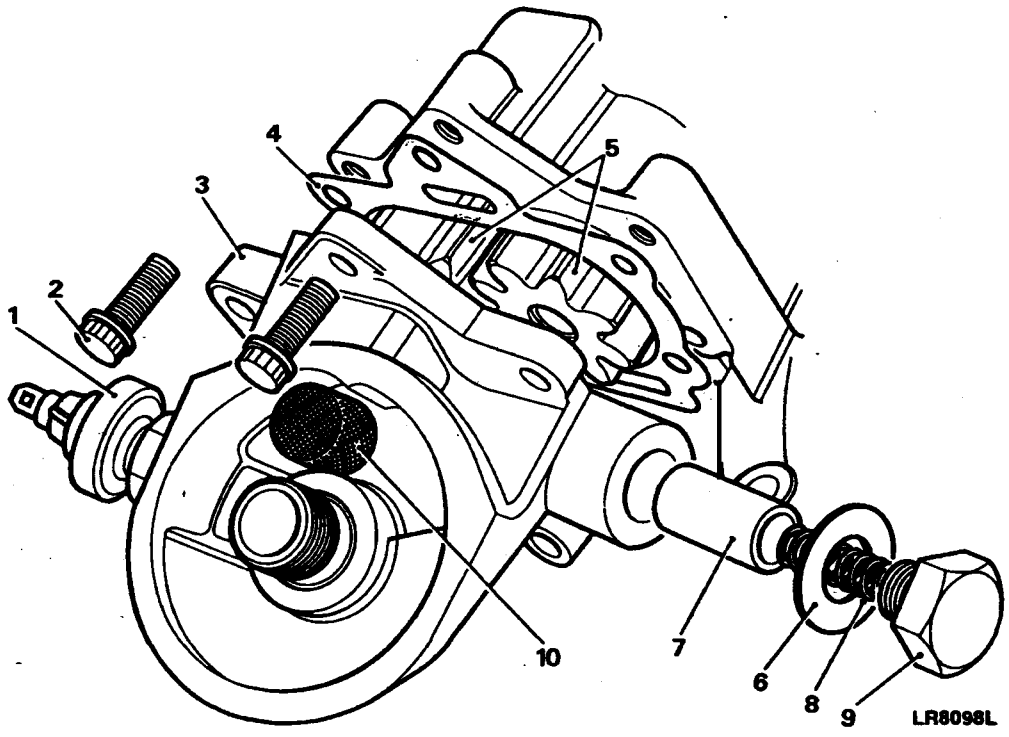
40.20 Fit the oil pump gears so that the petroleum jelly is forced into every cavity between the teeth of the gears.

40.21 Place a new gasket on the oil pump cover.

CAUTION ...

Since it is the thickness of the gasket which determines the clearance of the gears it is vital that only a genuine Land Rover replacement part is used, otherwise, the end clearance may be reduced sufficiently causing pump seizure.

40.22 Locate the oil pump cover in position and fit the special fixing bolts and tighten alternately and evenly to the correct torque.



1	Sender unit	6	Washer
2	Screw	7	Relief valve
3	Oil pump cover	8	Spring
4	Gasket	9	Plug
5	Gears	10	Strainer

Fig 25 Oil pump removal and installation

Water pump

41 To examine the water pump proceed as follows:

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

41.2 Spin the pump spindle and listen for noise. Push and pull the spindle and check for sideways movement. The condition of the bearing can be judged from these checks.

41.3 During the above checks the clearance between the impeller and the pump body should not vary.

41.4 Inspect the vent hole in the pump body for signs of coolant or oil leaks. If there is any evidence of leakage, the pump should be renewed.

Camshaft

42 To examine the camshaft proceed as follows:

42.1 Examine each cam lobe for wear or damage. The cam lobes are in fact manufactured with a slight taper with the highest point at the rear. This taper ensures that the tappet rotates in operation thus reducing wear and causes the shaft to be thrust onto the cylinder block.

42.2 This arrangement also obviates the need for a camshaft thrust plate or retainer. In the event of the camshaft being thrust forward during heavy breaking, in an emergency stop for example, the movement of the camshaft is limited by an abutment pad cast into the front cover. If this pad is worn, serious end float of the cam shaft has occurred.

42.3 Measure the camshaft journals for overall wear, ovality and taper. The diameters of the five journals are as follows commencing from the front of the shaft.

Number 1 journal 1.786 in to 1.785 in
Number 2 journal 1.756 in to 1.755 in
Number 3 journal 1.726 in to 1.725 in
Number 4 journal 1.696 in to 1.695 in
Number 5 journal 1.666 in to 1.665 in

42.4 To check the camshaft for bow, rest the two end journals i.e. numbers 1 to 5 on 'V' blocks and mount a dial gauge on the centre journal. Rotate the shaft and note the reading. If the run out is more than 0,05 mm (0.002 in) it should be renewed.

Reassembly

Camshaft

43 To fit the camshaft proceed as follows:

43.1 It is very important that the sprocket key in the front of the camshaft is fitted parallel to the shaft (Refer to Cat 524 Chap 1-2).

Note ...

Lubrication for the timing chain and gears is supplied by the front camshaft bearing through a channel along the top of the keyway to an annular groove in the rear face of the oil pump distributor drive gear. Timing chain Lubrication will be severely restricted if the key is loose enough to be affected by centrifugal force, or is fitted inclined into its groove in the shaft. The key must be securely fitted parallel to the shaft.

43.2 Lubricate the camshaft journals and carefully insert the camshaft into the cylinder block.

43.3 Fit the tappets, rocker gear and pushrods and induction manifold complete with carburetters (Para 22 to 26).

43.4 If the sump has been removed fit the sump (Para 59).

43.5 Turn the crankshaft to bring number one piston to T.D.C. Looking at the engine from the front, number one piston is the first one in the right-hand bank. The crankshaft key will be at the one-o'clock position (Fig 26 (3)).

43.6 Turn the camshaft until the sprocket key is at the nine-o'clock position (2).

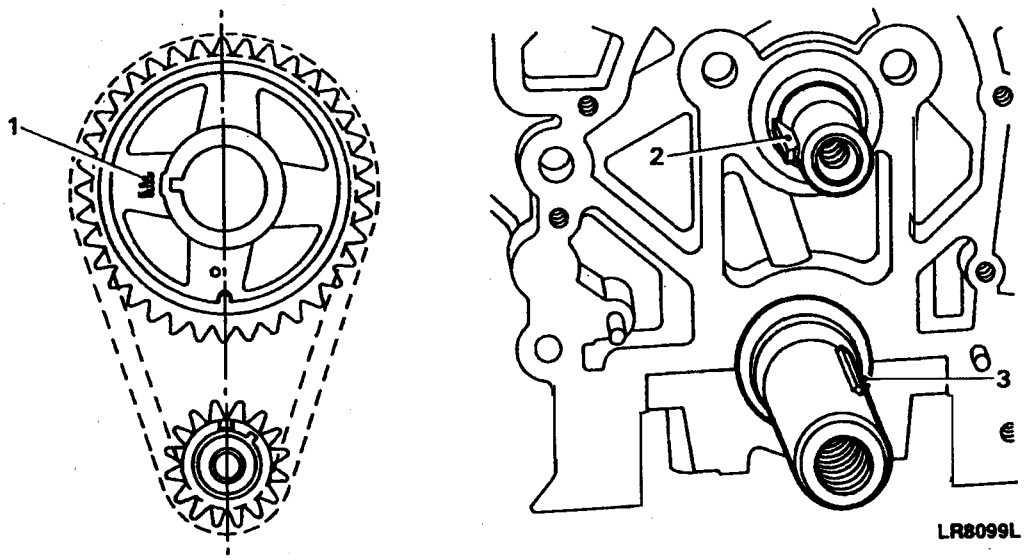
43.7 Encircle the camshaft and crankshaft sprockets with the chain so that the timing marks on the two sprockets are aligned as illustrated. Ensure that letter 'F' (1) is at the front on the camshaft sprocket.

43.8 Fit the two sprockets and chain as an assembly to the camshaft and crankshaft respectively. Check that the camshaft key is parallel to the shaft and that the two timing marks are still aligned.

43.9 Fit the spacer with the flange side outwards.

43.10 Fit the distributor drive gear ensuring that the annular grooved side is fitted towards the spacer.

43.11 Secure the drive gear and camshaft chain wheel assembly with the bolt and washer and tighten to the correct torque.



1 Camshaft sprocket 'front'
2 Camshaft sprocket key
3 Crankshaft sprocket key

Fig 26 Aligning timing marks

Timing cover oil seal

44 Fit the timing cover oil seal as follows:

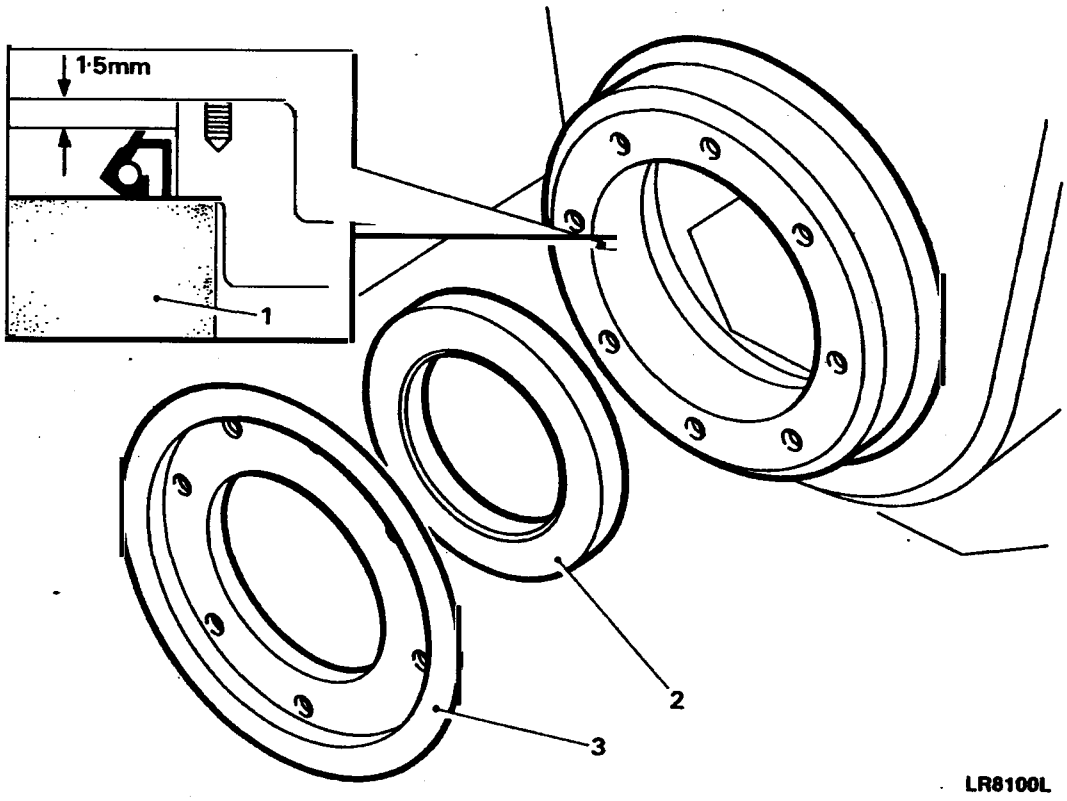
44.1 Remove the seven drive screws and withdraw the mud shield (Fig 27 (3)) and the oil seal (2).

44.2 Position the gear cover with the front face uppermost and the underside supported across the oil seal housing bore on a suitable wooden block (1).

44.3 Enter the oil seal (2), lip side leading, into the housing bore.

44.4 Press in the oil seal until the plain face is 1,5 mm (0.062 in) approximately below the gear cover face.

44.5 Fit the mud shield (3) and secure with the screws and a smear of sealing compound.



1 Wooden support block
2 Oil seal
3 Mud shield

Fig 27 Fitting timing cover oil seal

Timing gear cover, oil pump and crankshaft pulley

45 To fit the timing gear cover, oil pump and crankshaft pulley proceed as follows:

45.1 Check that all traces of gasket material or sealant has been removed from the timing gear cover to block and sump joint faces. Smear a coating of silicone rubber sealant (Hylosil 102 or approved equivalent) about 13 mm to 19 mm wide at the joint between the timing cover and crankcase. Fit timing gear cover within 30 minutes of applying the sealant.

45.2 Place a new timing cover joint washer in position, and fit the timing cover locating it on the two dowels.

45.3 Clean the threads of the timing cover securing bolts, then coat them with Thread Lubricant-Sealant Loctite 572.

45.4 Fit the timing cover bolts but do not fully tighten until the water pump is fitted.

45.5 Fit the two bolts securing the sump to the bottom of the timing cover.

45.6 Fit the crankshaft pulley and tighten the retaining bolt to the correct torque.

45.7 Fit the timing pointer.

45.8 Clean oil pump cover mating face.

45.9 Smear clean engine oil on the rubber washer of the new filter.

45.10 Fill the filter with new oil, noting the angle at which the filter is to be fitted.

45.11 Screw on the filter until the sealing ring touches the oil pump cover face, then tighten it a further half turn by hand only.

CAUTION ...

Do not overtighten the filter.

45.12 Fit the oil pressure and oil transmitters to the oil pump cover.

Water pump

46 To fit the water pump proceed as follows:

46.1 Lightly grease a new joint washer and place it in position on the timing gear cover.

46.2 Clean the threads of the four long bolts and smear them with loctite 572 thread lubricant-sealant.

46.3 Locate the water pump in position and fit any ancillary brackets. Torque tighten the securing bolts including the timing cover bolts and sump to timing gear cover evenly to the correct torque.

Distributor

47 To fit the distributor proceed as follows:

47.1 Examine the distributor drive gear and swivel coupling and renew if necessary.

47.2 Turn the crankshaft to bring number one cylinder piston to T.D.C. with number six cylinder valves on overlap. Turn the oil pump drive shaft so that the tongue is at an angle of 60° to the distributor into the front cover with the vacuum unit pointing in the direction illustrated (Fig 28) and the rotor arm aligned with the clamp hole.

47.3 Insert the distributor into the front cover with the vacuum unit pointing in the direction illustrated (Fig 29) and the rotor arm aligned with the clamp hole (view A).

47.4 When the distributor drive engages with the camshaft gear the distributor shaft and rotor arm will turn clockwise approximately 20° and should seat fully into its location with the rotor arm in line with number one cylinder plug lead (view B). If the oil pump drive does not engage with the distributor coupling the distributor can not be pushed fully home. Therefore remove the distributor and reposition the oil pump drive a few degrees and try again. Do not however, use any force to locate the distributor.

47.5 Fit the clamp and nut but do not fully tighten at this stage.

47.6 Ensure that number one cylinder piston is at T.D.C. with both valves closed.

47.7 Turn the distributor body so that the rotor arm is pointing to number one cylinder plug lead, in the distributor cap (view C), and the reluctor is aligned with the pick-up. Finally tighten the clamp-nut.

Note ...

The above distributor setting is only provisional to enable the engine to be started. When the engine is refitted to the vehicle the ignition timing must be set using electronic equipment.

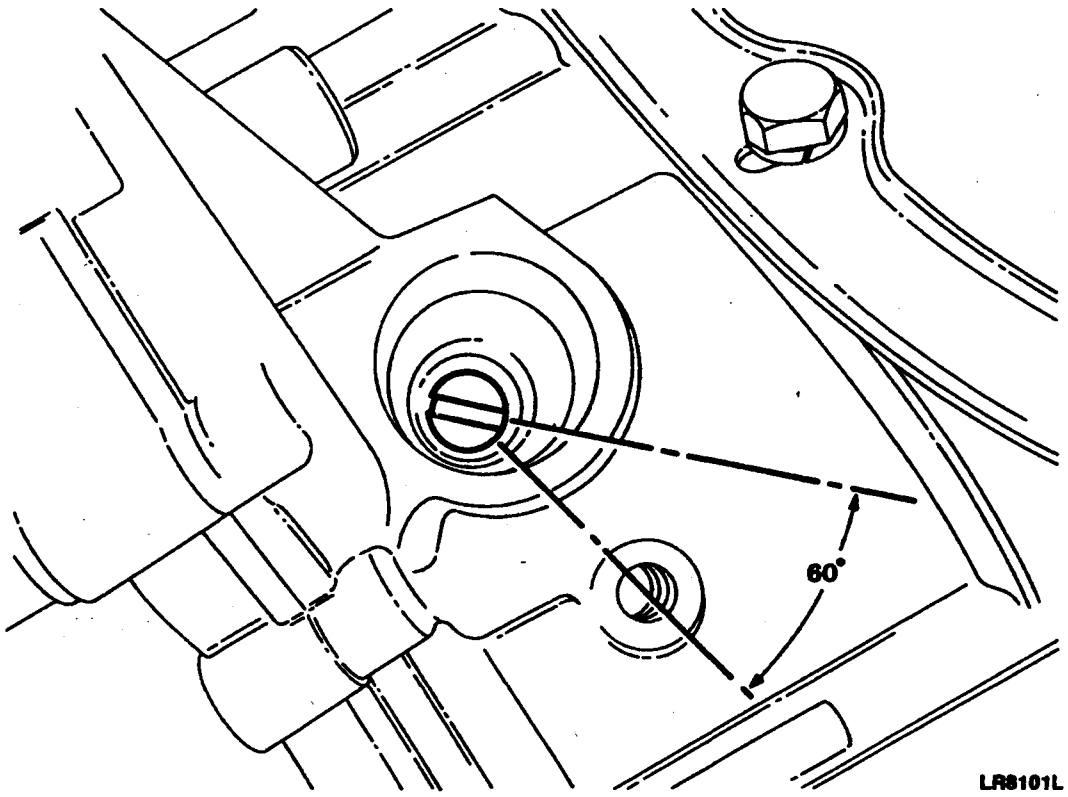


Fig 28 Positioning oil pump drive shaft

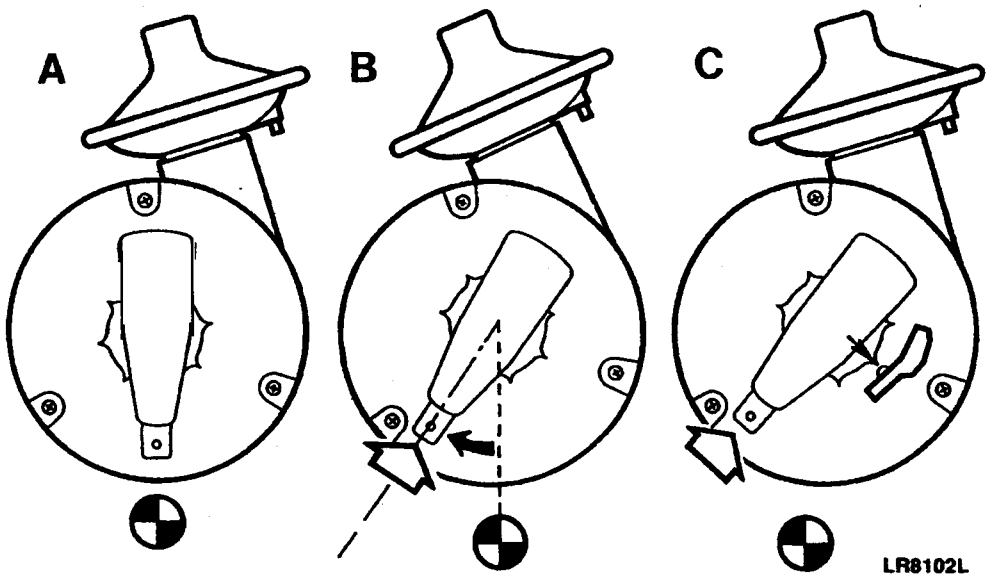


Fig 29 Fitting the distributor

47.8 Fit the distributor cap and spark plugs and connect the distributor leads exactly in accordance with Fig 30.

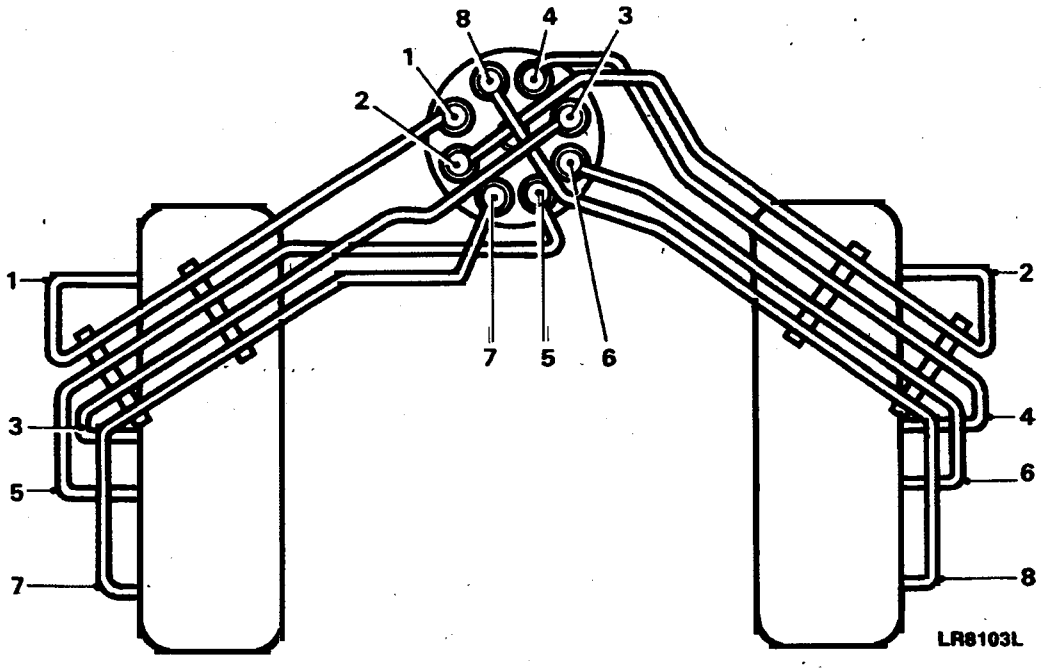


Fig 30 Distributor lead connections

CAUTION ...

Failure to route the leads correctly, (Fig 30), can cause cross firing between cylinders five and seven, as can be seen by the firing order 18436572 when cylinder 7 is at 90° before T.D.C. on the compression stroke ready for ignition. If the plug leads for these two cylinders are routed parallel in adjacent clips, HT current to number 5 plug will also be induced in number 7 causing combustion of the mixture in number 7 cylinder to occur 90° B.T.D.C. and again at T.D.C. It is for this reason that the correct clipping of the plug leads is observed to avoid the possibility of severe damage to the engine.

Fan pulley, viscous coupling, fan and drive belts (12 Volt 110 vehicles only)

48 To fit the fan pulley, viscous coupling, fan and drive belts proceed as follows:

48.1 Secure the fan (Fig 23 (12)) to the viscous coupling (13) with the four screws and tighten evenly.

48.2 If removed fit the pulley (9) to the water pump (4) and secure with the three screws (10).

48.3 Screw the viscous coupling onto the adaptor thread. Note that the adaptor and viscous coupling have a left-hand thread.

48.4 Fit the fan and drive belts to the correct tension (Para 49).

Fan and drive belt tensioning (12 Volt vehicles only)

49 To tension the alternator drive belt proceed as follows:

49.1 Check the drive belt tension using thumb pressure at the mid point of the run between the crankshaft pulley (Fig 31 (1)) and the alternator (3). The correct amount of free play should be approximately 9 mm (3/8 in.). If the movement is greater or less than this figure, adjustment is required.

49.2 Slacken the alternator pivot bolt (2), adjustment bolt (4) and the adjustment bracket bolt (5).

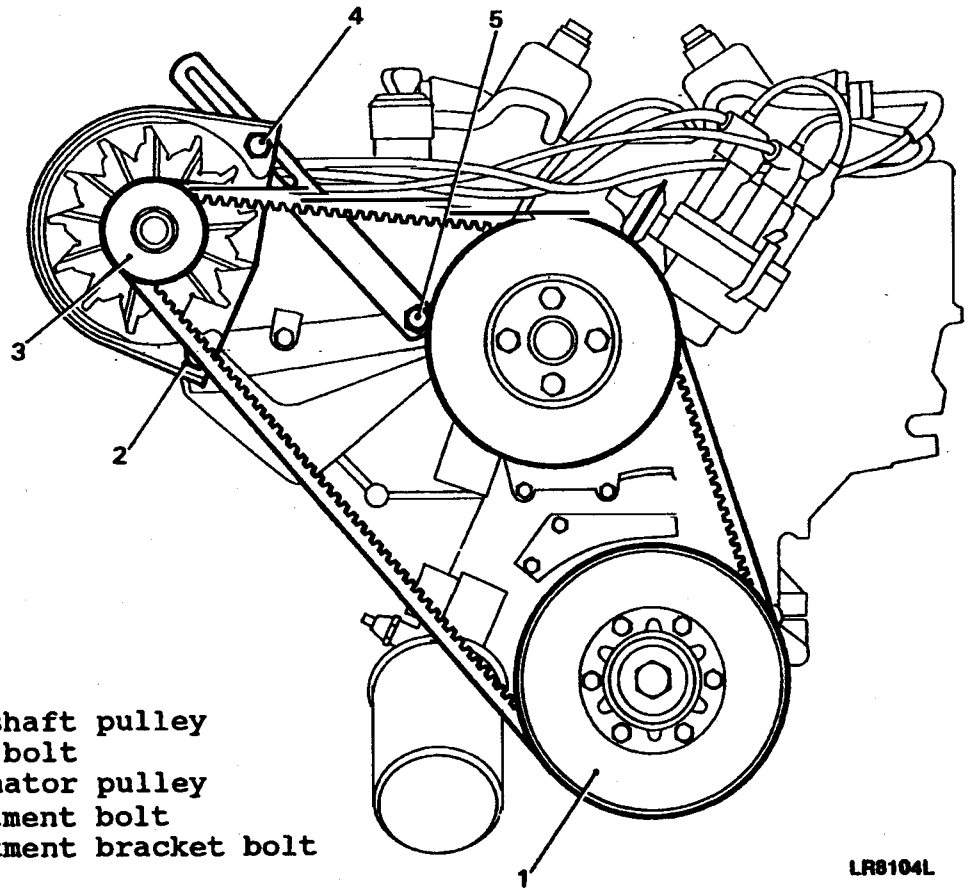
49.3 Pivot the alternator away from or towards the engine to achieve the tension adjustment required.

49.4 Tighten the alternator pivot bolt, adjustment bolt and the adjustment bracket bolt.

CAUTION ...

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

49.5 Run the engine for three to five minutes at a fast idle, switch-off and re-check the belt tension.



1 Crankshaft pulley
2 Pivot bolt
3 Alternator pulley
4 Adjustment bolt
5 Adjustment bracket bolt

Fig 31 Alternator drive belt tensioning (12 V)

Power steering pump drive belt tensioning (12 volt 127 vehicles only)

50 To tension the power steering pump drive belt, proceed as follows:

50.1 Check the drive belt tension using thumb pressure at the mid point of the run between the crankshaft pulley (Fig 32 (4)) and the power steering pump pulley (1). If the deflection is greater than 6 mm or less than 4 mm, adjustment is required.

50.2 Slacken the steering pump adjustment clamp bolt (3).

50.3 Slacken the steering pumps two pivot nuts and bolts (2).

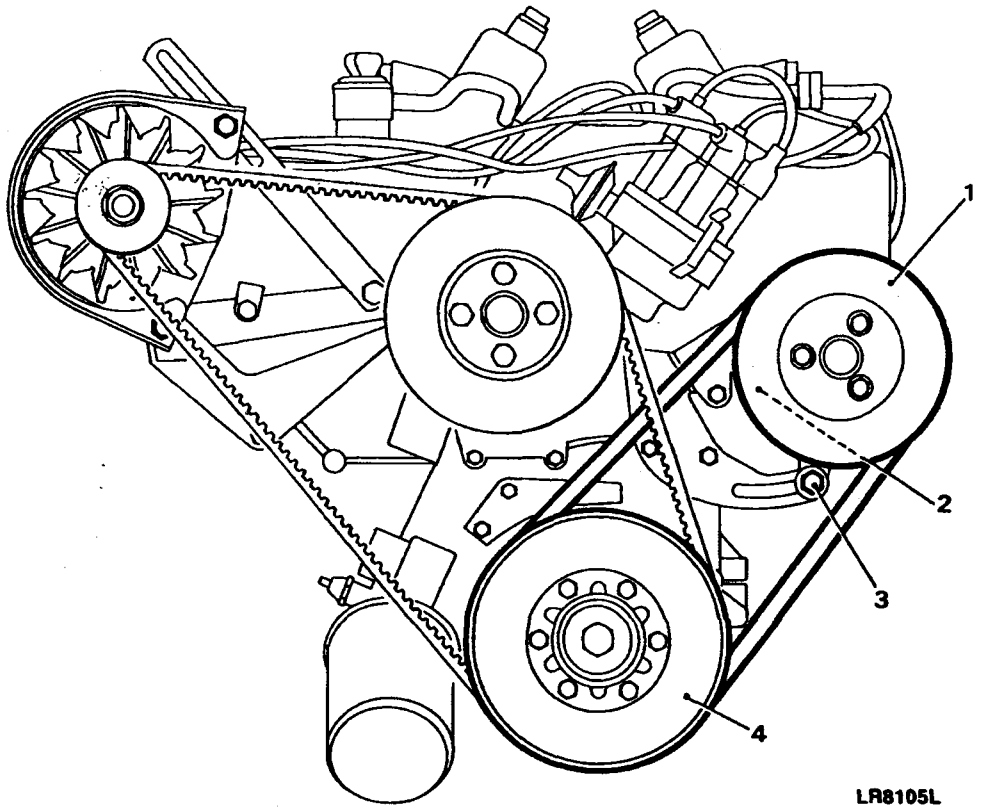
50.4 Move the steering pump towards or away from the engine as necessary until the correct tension is achieved.

50.5 Tighten the adjustment clamp bolt and the two pivot nuts and bolts.

CAUTION ...

To avoid damage to the power steering pump do not lever or apply pressure to the pump body.

50.6 Run the engine for three to five minutes at a fast idle, switch-off and re-check the belt tension.



1 Power steering pump pulley
2 Pivot nuts and bolts
3 Adjustment clamp bolt
4 Crankshaft pulley

Fig 32 Steering pump drive belt tensioning (12 V)

Fan and drive belt tensioning (power steering, 12/24 volt 127 vehicles only).

51 To adjust the tension of the drive belts on 12/24 volt 127 vehicles only, fitted with power steering, proceed as instructed in Paras 52 to 55.

CAUTION ...

On 12/24 volt engines with power steering pumps (127 vehicles only), the water pump and fan have a double belt drive. These double belts are supplied as a set and must be replaced as a pair. The use of a new belt in conjunction with an old belt would produce an uneven load on the drive mechanism.

52 Fan drive belts. Check the tension as follows:

52.1 Check the tension of the belts using thumb pressure at the mid-point of the run between the crankshaft pulley (Fig 33A (1)) and the fan (4). The deflection should be 9.5 mm. If this figure is incorrect, the belts require adjustment.

52.2 Slacken the tensioner fixing bolt (3).

52.3 Release the locknut (5) on the tensioner screw (6) of the tensioner pulley.

52.4 Slacken the tension pulley pivot bolt (2).

52.5 Turn the tensioner screw clockwise to increase the tension of the belt or anti-clockwise to reduce the tension as necessary.

52.6 Tighten the tensioner screw locknut, fixing bolt and pulley pivot bolt.

53 Alternator 90 amp drive belt. Check the tension as follows:

53.1 Check the drive belt tension using thumb pressure at the mid-point of the run between the fan (Fig 33B (6)) and alternator pulleys (2). The deflection of the belt should be approximately 9.5 mm. If this figure is incorrect, the belt requires adjustment.

53.2 Slacken the tensioner fixing bolt (3).

53.3 Release the locknut (5) on the tensioner screw (4) of the tensioner pulley.

53.4 Slacken the tensioner pivot bolt (1).

53.5 Turn the tensioner screw clockwise to increase the tension of the belt or anti-clockwise to reduce the tension as necessary.

53.6 Tighten the tensioner screw locknut, the fixing bolt and tensioner pivot bolt.

54 Power steering pump drive belt. Check the tension as follows:

54.1 Check the power steering pump drive belt tension using thumb pressure at the mid-point of the run between the crankshaft (Fig 33C (1)) and the steering pump pulleys (4). If the deflection is less or in excess of 4 to 6 mm the belt requires adjustment.

54.2 Disconnect the battery and slacken the alternator adjustment-link clamp and pivot bolts (2) and the alternator two pivot nuts and bolts (5).

54.3 Slacken the power steering pump adjustment clamp bolt (6).

54.4 Slacken the steering pump two pivot nuts and bolts (3).

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

CAUTION ...

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

54.6 Adjust the alternator drive belt.

55 Alternator drive belt driven from power steering pump. Check the tension as follows:

55.1 Check the drive belt tension using thumb pressure at the mid point of the run between the power steering pump (Fig 33D (2)) and alternator pulleys (4). If the deflection is greater or less than 4 to 6 mm adjustment is required.

55.2 Slacken the adjustment link pivot (1) and clamp bolts (3).

55.3 Slacken the alternator two pivot nuts and bolts (5).

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

CAUTION ...

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

55.5 When the engine is refitted to the vehicle connect the battery, run the engine for three to five minutes at a fast idle, switch-off and re-check both the steering pump and alternator drive belt tension.

Key to fig 33

Fan drive belt arrangement 'A'

1 Crankshaft pulley
2 Tension pulley pivot bolt
3 Tensioner fixing bolt
4 Fan pulley
5 Tensioner locknut
6 Tensioner screw

Alternator 90 amp drive belt arrangement 'B'

1 Tension pulley pivot bolt
2 Alternator pulley
3 Tensioner fixing bolt
4 Tensioner screw
5 Tensioner locknut
6 Fan pulley

Power steering drive belt arrangement 'C'

1 Crankshaft pulley
2 Link clamp and pivot bolts
3 Steering pump pivot bolts
4 Steering pump pulley
5 Alternator pivot bolts
6 Adjustment clamp bolt

Alternator drive belt from power steering pump arrangement 'D'

1 Link pivot bolt
2 Steering pump pulley
3 Link clamp bolt
4 Alternator pulley
5 Alternator pivot bolts

Reconnection of parts disturbed

56 Reconnect all pipes, hoses, electrical connections and equipment removed or disturbed under preparation (Paras 29 to 31).

Cooling and lubrication systems

57 To refill the cooling system and check the engine oil level proceed as follows:

57.1 Refill the cooling system using the correct mix of coolant, (Cat 201).

57.2 Check the engine oil level and top up as necessary with the correct grade of oil, (Cat 201).

CAUTION ...

On 12/24 volt vehicles if the radio batteries are not fitted ensure that the battery leads are disconnected from the auxiliary terminal box before starting the engine.

57.3 Run the engine. Check that the oil pressure warning light goes out. Check fuel, oil and coolant connections for leaks.

57.4 Stop the engine, when cool check the coolant and oil levels, top up as necessary.

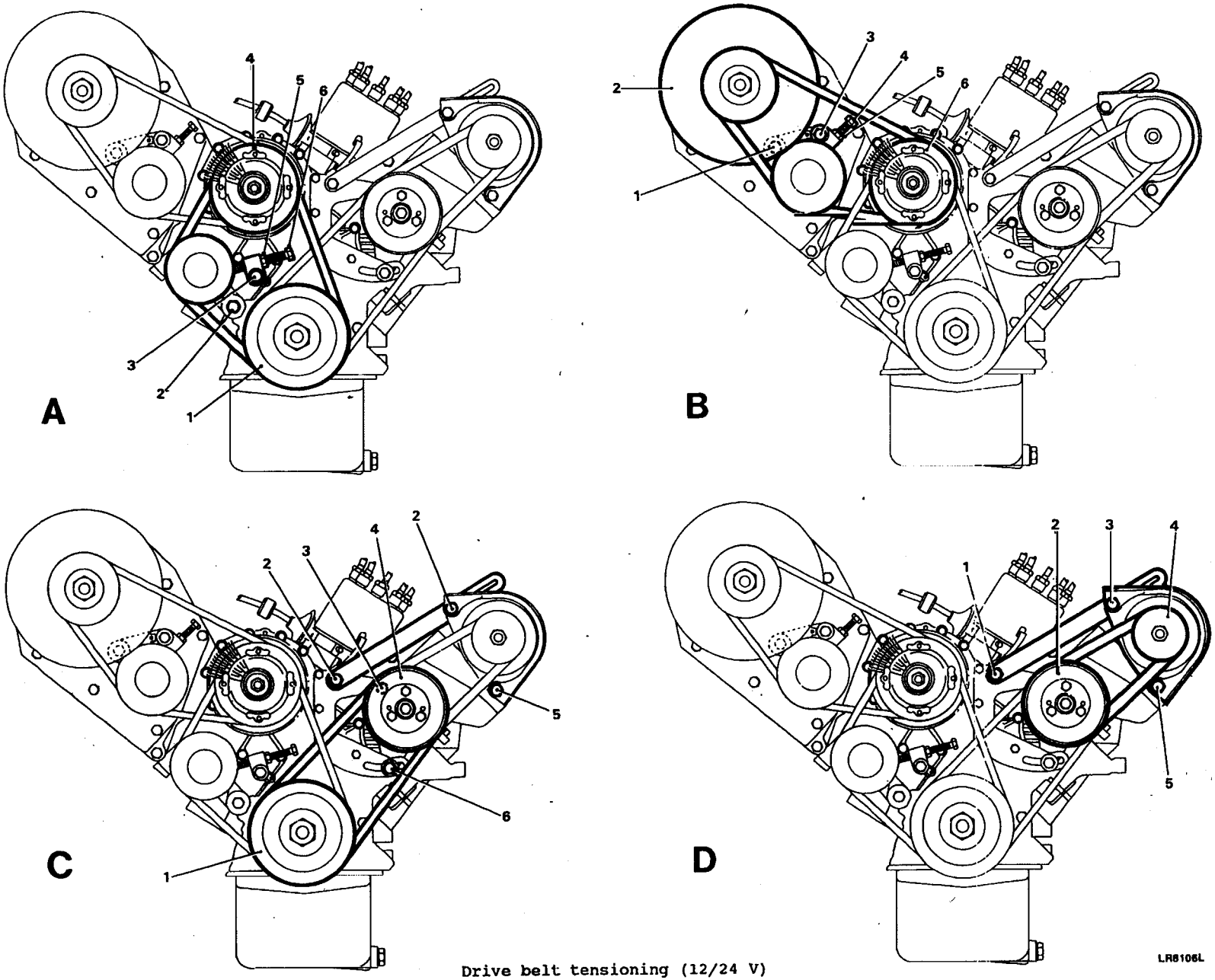


Fig 33

Drive belt tensioning (12/24 V)

Fig 33

OIL SUMP

Removal

58 To remove the sump proceed as follows:

58.1 Remove the sump drain plug and allow the oil to drain into a container of suitable capacity.

58.2 Remove the screws which secure the sump to the crankcase and withdraw the sump.

58.3 Remove the two screws which secure the oil strainer to the crankcase.

58.4 Thoroughly clean the strainer and sump ensuring that all sealant is removed from the sump and crankcase mating faces.

Refitting

59 To refit the sump proceed as follows:

59.1 Fit the oil strainer to the crankcase.

59.2 Check that all traces of gasket material or sealant has been removed from the joint faces. Apply a 2 mm wide bead of silicone rubber sealant (Hylosil 102 or approved equivalent) to the joint face of the sump. Also smear a coating of the above sealant about 13 to 19 mm wide at the joint between the timing cover and crankcase (Fig 34). Fit sump within 30 minutes of applying the sealant.

59.3 Fit the sump and secure with the retaining screws torque tightening evenly to 20 to 24 Nm (14.7 to 17.7 lbf ft).

59.4 Fit and tighten the sump drain plug to a torque of 30 to 40 Nm (22 to 29.5 lbf ft).

59.5 Refill the engine to the correct level with the recommended grade of engine oil (Cat 601).

Note ...

Allow thirty minutes sealant drying time before starting the engine.

59.6 Run the engine. Check that the oil pressure warning light goes out. Check the sump and crankcase mating faces for leaks.

59.7 Stop the engine, when cool check the engine oil levels, top up as necessary.

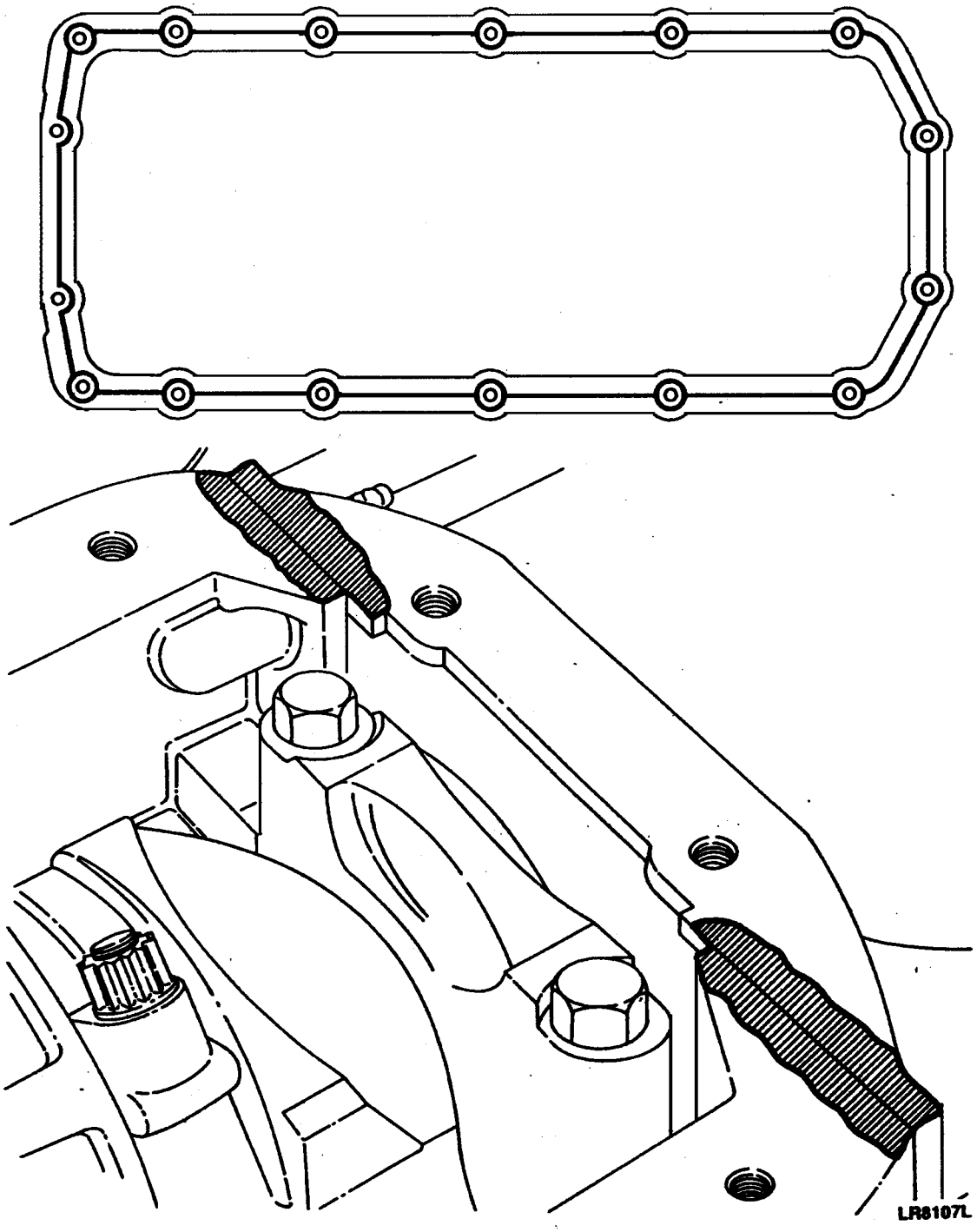


Fig 34 Oil sump sealant location

Chapter 1-3

2.5 LITRE DIESEL ENGINE BREATHER SYSTEM

UNIT AND FIELD REPAIRS

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INTRODUCTION

1 This chapter details the Unit and Field repair procedures for the 2.5 litre diesel engine breather system fitted to Land Rover 90 and 110 vehicles.

Cyclone unit

Removal

2 To remove the cyclone unit from the engine proceed as follows:

2.1 Remove the clip and withdraw the inlet hose (Fig 1 (2)) from the cyclone unit (5).

2.2 Remove the clip and withdraw the air outlet hose (4) from the cyclone unit.

2.3 Remove the clip and withdraw the oil return to sump hose (7) from the cyclone unit.

2.4 Withdraw the fixings from the support bracket (6) and remove the cyclone unit from the engine.

Cleaning

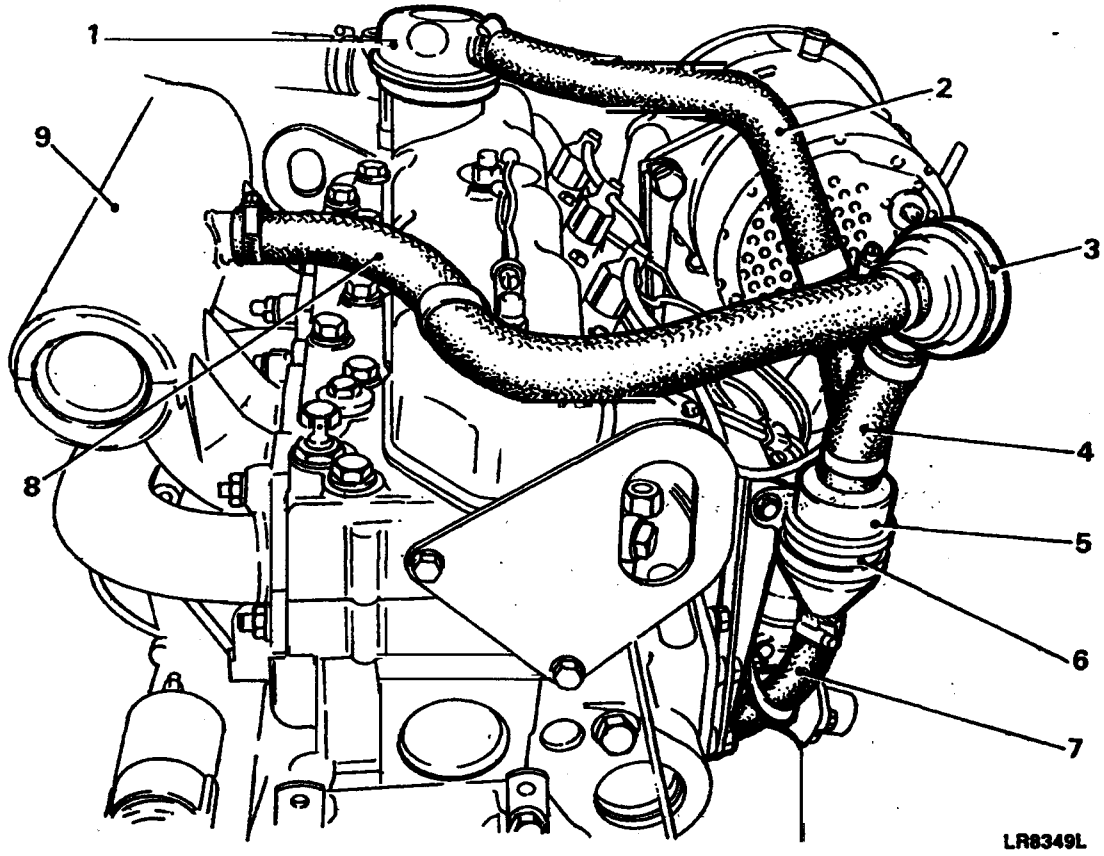
3 The cyclone unit should be periodically checked to ensure that the chamber has not become clogged with congealed oil. The unit should be removed from the engine and throughly cleaned and dried with a lint free cloth.

Note ...

This cleaning procedure is particularly important when the vehicle is subjected to servere low temperatures, causing an increase in oil viscosity.

Refitting

4 To refit the cyclone unit to the engine, reverse the removal procedures instructed in Para 2.



1 Filler/breather cap
2 Cyclone unit inlet hose
3 Depression regulator
4 Cyclone unit air outlet hose
5 Cyclone unit
6 Support bracket
7 Oil return to sump hose
8 Induction inlet hose
9 Induction manifold

Fig 1 2.5 litre diesel engine breather system

Depression regulator

Removal

5 To remove the depression regulator from the engine proceed as follows:

5.1 Remove the clip and withdraw the induction inlet hose (Fig 1 (8)) from the depression regulator (3).

5.2 Remove the clip and withdraw the air outlet hose (4) from the depression regulator and remove the depression regulator from the engine.

Refitting

6 To refit the depression regulator to the engine, reverse the removal procedures instructed in Para 5.

Inspection

7 Inspect the oil return to sump hose (Fig 1 (7)) and clips for evidence of damage or wear.

CAUTION ...

The induction of atmospheric pressure into the oil return hose could result in oil being forced back up through the cyclone unit and consequently entering the induction manifold.