

ENGINE

REMOVAL OF THE ENGINE FROM THE VEHICLE

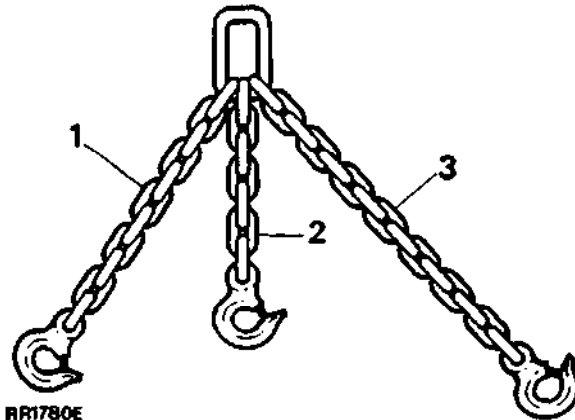
1. Prop the hood open, disconnect the screen washer hose from the reservoir and electrical leads to the engine compartment illumination lamp. Remove the fixings, hinges to hood and lift the hood clear.
2. Set the vehicle on level ground and apply the transmission brake.
3. De-pressurize the fuel system. (See Fuel Injection System, Section 19).
4. Disconnect the battery terminals and remove the battery from the vehicle.
5. Release the hose clamp and remove the radiator bottom hose to enable the cooling system to be drained.
6. Release the hose clamps and remove the radiator top hose and expansion tank hose.
7. Remove the fan cowl, drive belt and viscous unit/fan assembly.
8. Release the fixings and remove the radiator.
9. Place an absorbent cloth around the fuel feed hose at the fuel rail and release the compression nut, remove the feed hose from the rail, seal the end of the pipes with masking tape to prevent ingress of dirt.
10. Release the hose clamp and remove the fuel return hose from the pressure regulator, seal both openings with masking tape to prevent ingress of dirt. Remove the vacuum hose from the rear of the regulator.
11. Detach the throttle lever return springs, remove the fixings securing the kickdown cable anchor bracket to the plenum chamber bracketry and lay the assembly to one side.  
**DO NOT DISTURB THE KICK DOWN CABLE SETTING.**
12. Disconnect the multi-plug from the air bypass valve (stepper motor).
13. Release the hose clamp securing the hose to the inlet neck of the plenum chamber.
14. Disconnect the multi-plug from the air flow sensor, release the two clips securing the air cleaner to the air flow sensor, remove the sensor complete with hose from the engine compartment.
15. Release the fixings and remove the air cleaner assembly from the engine compartment.
16. Release the alternator pivot bolts and remove the drive belt, remove the alternator fixings and withdraw the alternator.
17. Release the idler pulley between the crankshaft pulley and compressor pulley and remove the drive belt.
18. Release the compressor from its mounting and lay to one side. DO NOT discharge the air conditioning system.

**NOTE: Release the bolts securing the compressor mounting bracket to the engine and remove the bracket to enable a temporary lifting eye ETC 5964 to be fitted. Secure the lifting eye to the mounting bracket fixing points with suitable bolts of equivalent size, pitch and thread. Leave the lifting eye attached to the engine until the engine has been reinstalled in the vehicle.**

19. Place a drain tray underneath the vehicle to catch any power steering fluid which may seep from the steering fluid reservoir when the hose is disconnected from the steering pump.
20. Disconnect the hose and secure the end of it above the level of the fluid reservoir to avoid the loss of any more fluid than necessary. Seal the power steering pump and pipe opening with masking tape to prevent ingress of dirt.

Continued

21. Disconnect the power steering pump to power steering box hose, seal the hose and pump opening with masking tape to prevent ingress of dirt. Wipe away any fluid that may have come into contact with the chassis or steering box.
22. Remove the two coolant hoses and one crankcase breather hose from the potentiometer side of the plenum chamber.
23. Disconnect the potentiometer multi-plug.
24. Remove the distributor vacuum hose from the top of the plenum chamber and disconnect the vacuum supply hose to the cruise control actuator.
25. Remove the six bolts and maneuver the plenum chamber off the ram housing.
26. Disconnect the hoses from around the outside of the ram housing and remove the six bolts securing the ram housing to the intake manifold.
27. Lift the ram housing clear of the intake manifold and remove it from the engine compartment. Place a protective cover over the intake manifold openings to prevent ingress of dirt.
28. Disconnect the fuel temperature and coolant temperature sensor multi-plugs.
29. Disconnect the High tension and Low tension leads from the coil.
30. Identify each injector multi-plug for re-assembly and disconnect the plugs from the injectors.
31. Maneuver the harnesses from behind the fuel rails and place aside, clear of the engine assembly.
32. Remove the two clamps securing the automatic gearbox oil cooler pipes to the bottom left hand side of the engine block.
33. Remove the top and bottom nuts securing the engine mountings at either side of the cylinder block.
34. Fit suitable lifting chains to the engine lifting eyes located at the front of both cylinder heads and the rear of the right hand cylinder head. (See illustration for recommended chain lengths).



RR1780E

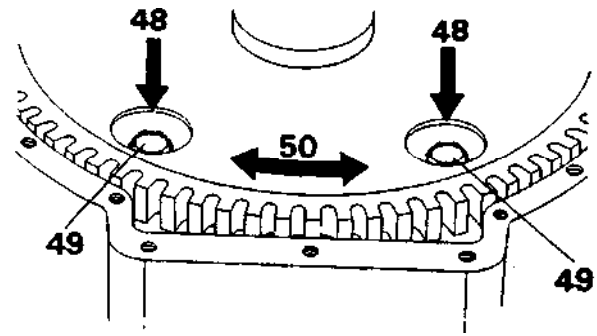
## KEY TO CHAIN LENGTHS

1. L/H Front chain 356mm (14 in.) total overall length.
2. R/H Front chain 330mm (13 in.) total overall length.
3. R/H Rear chain 457mm (18 in.) total overall length.

**NOTE: All chain dimensions are measured from the end of the lifting hook to the end of the last link in the chain.**

35. Fit the chain lifting eye to a suitable hydraulic hoist. Raise the hoist sufficiently high enough to enable the engine mounting rubbers to be removed, and withdraw the rubber mountings.
36. Lower the hoist until the engine rests securely on the engine mounting brackets. Remove the lifting chains and hoist.
37. Disconnect the two heater hoses located on the top of the right hand rocker cover.
38. Remove the ground strap from the rear of the left hand cylinder head.
39. Remove the cylinder block to hood ground strap from the retaining clip at the engine compartment closure panel.
40. Remove all electrical harnesses from the retaining clips on and around the rear of the engine.

41. Remove the gearbox breather pipe from the retaining clip at the rear right hand lifting eye.
42. Remove the top two bolts securing the bell housing to cylinder block.
43. Position a suitable hydraulic floor jack under the front differential casing, raise the front of the vehicle sufficiently to enable two axle stands to be positioned under the front axle, lower the vehicle on to the axle stands.
44. Remove the bolts securing the bell housing bottom cover, detach the cover from the bell housing and remove the gasket from the bell housing face.
45. Remove the transfer box to engine block tie bar.
46. Remove the nuts securing the exhaust downpipes to the manifolds, remove the heat shield from the right hand side downpipe.
47. Remove the electrical leads from the rear of the starter motor solenoid, and disconnect the multi-plug from the oil level sensor on the side of the sump.
48. With the assistance of a second person to rotate the engine at the crankshaft pulley, rotate the crankshaft until two of the access holes in the drive plate/ring gear assembly are visible through the bellhousing bottom cover opening.
49. Remove the two bolts that are visible through the access holes, which secure the flexible drive plate to the torque converter. Mark one of the access holes and one of the bolt holes with some means of identification to enable the unit to be fitted in the same position on re-assembly to maintain the original build setting.
50. Rotate the crankshaft **180°** until the two remaining access holes are visible, and remove the two bolts.



**RR1808E**

51. Remove the remaining bell housing to cylinder block bolts.
52. Raise the vehicle off the axle stands using a suitable hydraulic floor jack under the front axle, remove the stands and lower the vehicle to rest on its road wheels.
53. Fit the engine lifting eyes, locate the chain lifting eye into the floor crane.
54. Remove the starter motor ground strap from the chassis.
55. Place a hydraulic floor jack under the gearbox bell housing to support the gearbox when the engine and gearbox are separated.
56. Carefully raise the crane a little, ease the engine to gearbox joint faces apart, steady the engine on the crane.
57. Ensure there are no restricting electrical harnesses, hoses, pipes, or components that will prevent the engine being raised clear of the engine compartment.
58. Slowly-raise the engine clear of the engine compartment, move the engine away from vehicle and place on a suitable engine stand.

**FITTING THE ENGINE TO THE VEHICLE**

59. Fit the lifting chains to the lifting eyes on the engine as previously described in the removal procedure.
60. Raise the engine on a floor crane and lower it into the engine compartment, ensuring that all harnesses, hoses, pipes and components are clear of the engine assembly.

**Continued**

61. With assistance, maneuver the engine until the bottom two engine bolt holes align with the appropriate two holes in the bell housing. Fit the two bolts and partially tighten. Ensure that the two cylinder block dowels locate in their respective holes in the bell housing.
62. Remove the hydraulic floor jack and lower the hoist until the engine rests securely on the engine mounting brackets.
63. Fit the top two bell housing to engine cylinder block securing bolts. Tighten to the specified torque (see section 06-Torque values).
64. Fit the remaining bell housing to cylinder block bolts, and tighten to the specified torque (including the two bottom bolts).(see section 06-Torque values).
65. With assistance from a second person to rotate the crankshaft pulley, line up the previously marked drive plate access hole with the respective bolt hole in the torque converter. Fit the two bolts and tighten to the specified torque (see section 06-Torque values).
66. Rotate the crankshaft 180° and fit the remaining two bolts to the flexible drive plate, tighten to the specified torque (see section 06-Torque values).
67. Fit new gasket and refit the bottom cover, tighten the bolts to the specified torque (see section 06-Torque values).
68. Fit new exhaust flange gaskets, fit the exhaust to the manifold.
69. Refit all harnesses, ground straps breather pipes and hoses to their correct locations at the rear of the engine.
70. Raise the engine and refit the engine mounting rubbers, tighten the nuts to the specified torque (see section 06-Torque values).
71. Remove the temporary lifting eye ETC 5964 and reverse the instructions 1 to 32, ensuring that all electrical plugs and harnesses are fitted to their correct locations.

## DISMANTLE AND OVERHAUL THE ENGINE

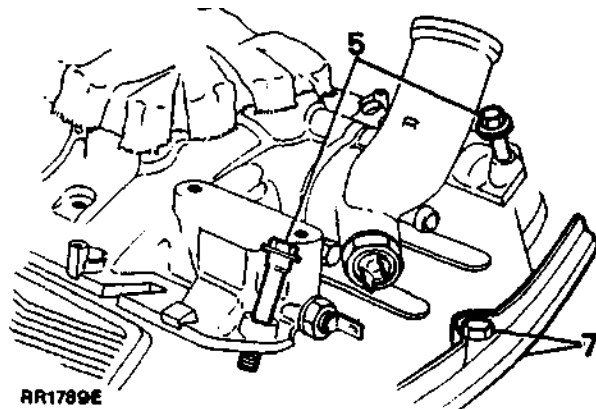
Remove the engine from the vehicle and clean the exterior. In the interests of safety and efficient working secure the engine to an approved engine stand. Drain the sump oil into a suitable container.

## Special tools:

- |           |  |
|-----------|--|
| R0605351  | • Guide bolts  |
| 186537    | • Torque wrench  |
| 18G1150   | • Piston pin remover/replacer • Basic tool             |
| 18G1150E  | • Adaptor remover/replacer • piston pin                |
| 18G106A   | • Spring compressor                                    |
| R0600959  | • Drift • Valve guide replacement • intake and exhaust |
| MS76      | • Valve cutter handle set                              |
| MS621     | • Valve seat cutter                                    |
| RO605774A | • Distance piece for valve guide                       |
| RO274401A | • Drift for guide removal • intake and exhaust         |
| R01014    | • Crankshaft rear seal sleeve                          |

## REMOVE THE INTAKE MANIFOLD

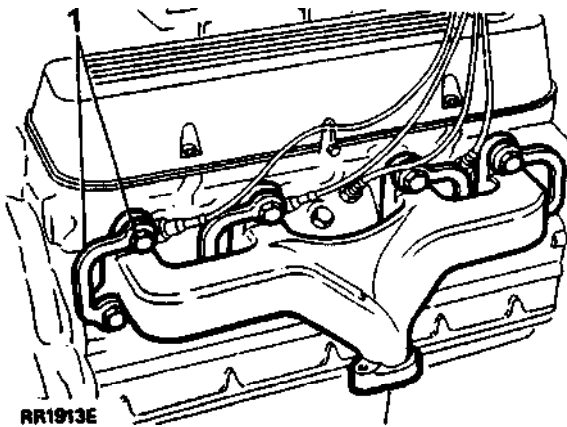
1. Release the hose clamp securing the hose to the rear of the water pump
2. Detach the retaining clips from the top of the injectors.
3. Remove the four bolts securing the fuel rail to the manifold.
4. Withdraw the fuel rail and injectors.



5. Evenly loosen and remove the twelve bolts securing the intake manifold to the cylinder heads.
6. Lift the intake manifold from the cylinder heads.
7. Wipe away any surplus coolant lying on the manifold gasket and remove the gasket clamp bolts and remove the clamps.
8. Lift off the gasket and seals.

**Remove exhaust manifolds**

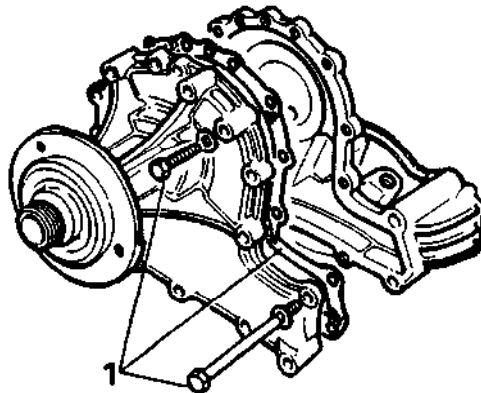
1. Bend back the lock tabs, and remove the eight bolts securing each manifold, and withdraw the manifolds and gaskets.



**Remove water pump**

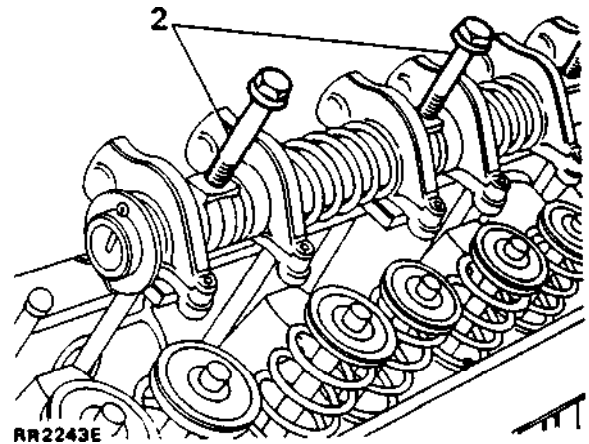
1. Remove the fifteen bolts and withdraw the water pump and joint washer.

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

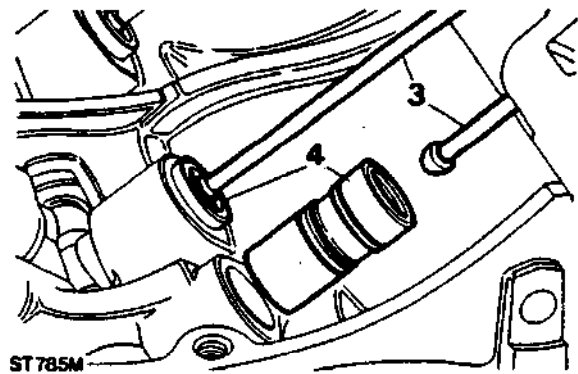


**REMOVE AND OVERHAUL ROCKER SHAFTS AND VALVE GEAR**

1. Remove the spark plug leads from the spark plugs and retaining clips, release the four screws and lift off the rocker covers.
2. Remove the four rocker shaft retaining bolts and lift off the assembly.



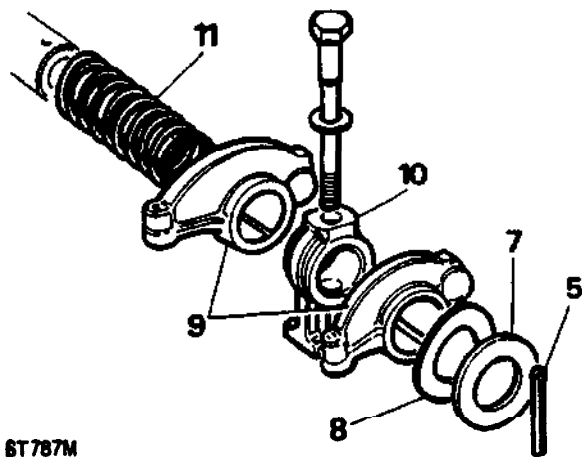
3. Withdraw the **pushrods** and retain in the sequence removed.
4. Remove the hydraulic tappets and place to one side with their respective pushrods. If a tappet cannot be removed leave in position until the camshaft is removed.



Continued'

**Dismantle rocker shafts**

5. Remove the cotter pin from one end of the rocker shaft.
6. Withdraw the following components and retain them in the correct sequence for re-assembly:
  7. A plain washer.
  8. A wave washer.
  9. Rocker arms.
  10. Brackets.
  11. Springs.
12. Examine each component for wear, in particular the rockers and shafts. Discard weak or broken springs.

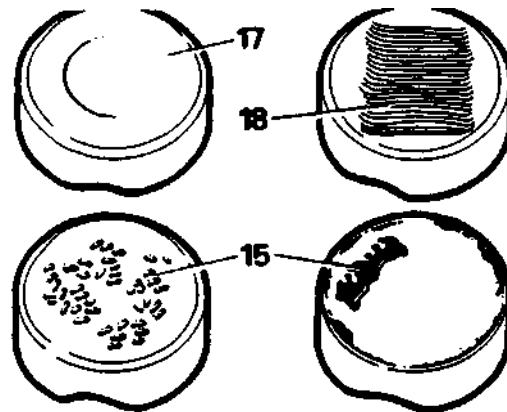


**ST787M**

**Inspect tappets and pushrods**

13. Hydraulic tappet; inspect inner and outer surfaces of the body for blow holes and scoring. Replace hydraulic tappet if body is roughly scored or grooved, or has a blow hole extending through the wall in a position to permit oil leakage from the lower chamber.
14. The prominent wear pattern just above the lower end of the body should not be considered a defect unless it is definitely grooved or scored. It is caused by side thrust of the cam against the body while the tappet is moving vertically in its bore.
15. Inspect the cam contact surface of the tappets. Fit new tappets if the surface is excessively worn or damaged.
16. A hydraulic tappet body that has been rotating will have a round wear pattern and a non-rotating tappet body will have a square wear pattern with a very slight depression near the centre.

17. Tappets **MUST** rotate and a circular wear condition is normal. Tappets with this wear pattern can be refitted provided there are no other defects.
18. In the case of a non-rotating tappet, fit a new replacement and check camshaft lobes for wear; also ensure the new tappet rotates freely in the cylinder block.

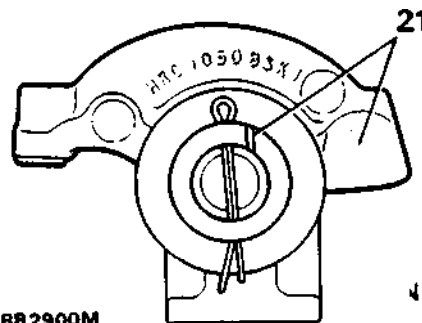


**RR750M**

19. Fit a new hydraulic tappet if the area where the pushrod contacts is rough or otherwise damaged.
20. Fit a new pushrod if it is bent or has a rough or damaged ball end or seat.

**Assemble rocker shafts**

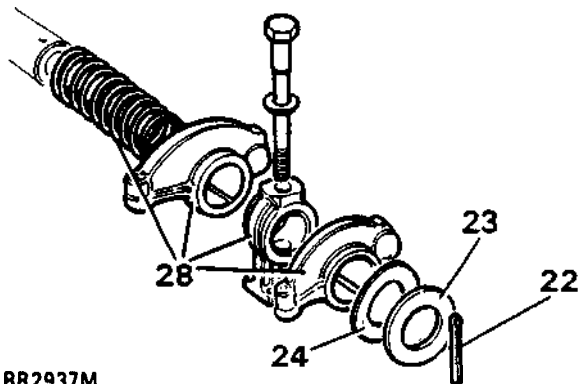
21. Both shafts must be assembled so that the identification groove is at the one o'clock position with the push rod end of the rockers to the right.



**RR2900M**

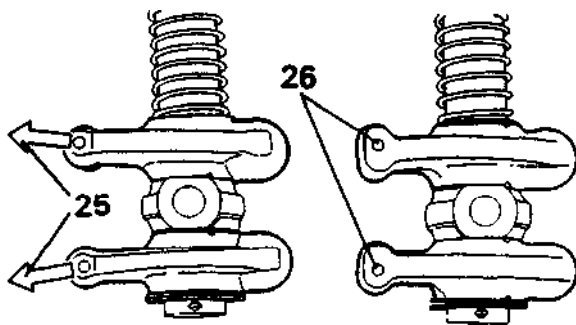
**CAUTION:** If the shafts and rockers are incorrectly assembled and fitted to the engine, the oil supply to the rocker shafts will be restricted.

22. Fit a cotter pin to one end of the rocker shaft.
23. Slide a plain washer over the long end of the shaft to contact the cotter pin.
24. Fit a wave washer to contact the plain washer.



RR2937M

25. Early type rocker arms are angled. They must be fitted so that the valve end of the rocker arms angle away from each other as shown.
26. On later type rocker arms the valve end is offset and must be fitted as shown.
27. Early and late types of rocker arms interchangeable provided the complete set is changed.

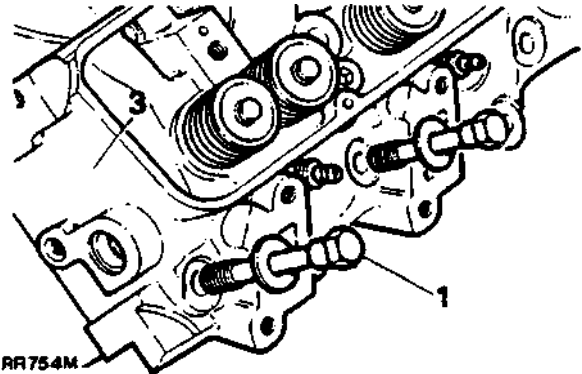


RR2899M

28. Assemble the rocker arms, brackets and springs to the rocker shaft.
29. Compress the springs, brackets and rockers, and fit a wave washer, plain washer and cotter pin to the end of the rocker shaft.
30. Fit the locating bolts through the brackets and place the assemblies to one side.

#### REMOVE AND OVERHAUL THE CYLINDER HEADS

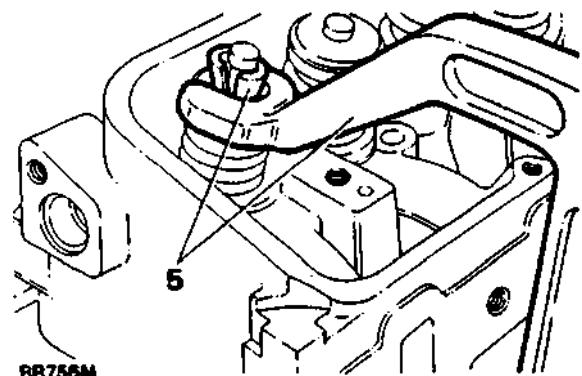
1. Evenly loosen the fourteen cylinder head bolts reversing the tightening order.
2. Before removing the heads mark them relative to the LH and RH side of the engine.
3. Lift off the cylinder heads and discard the gasket.



RR754M

#### Dismantle cylinder heads

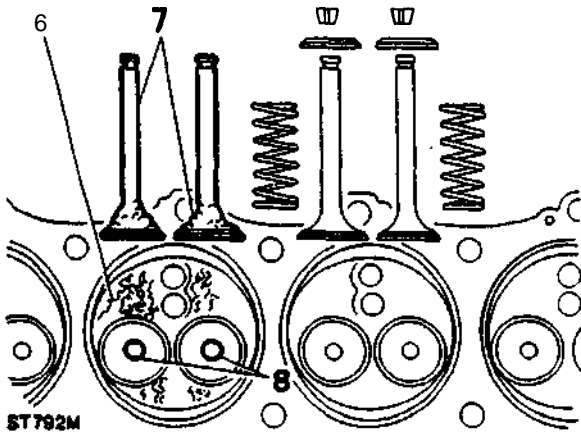
4. Remove the spark plugs.
5. Using the valve spring compressor 18G 106A or a suitable alternative, remove the valves, springs and umbrella seals, retain them in sequence for refitting. Discard the umbrella seals fitted to the inlet valves only.



RR756M

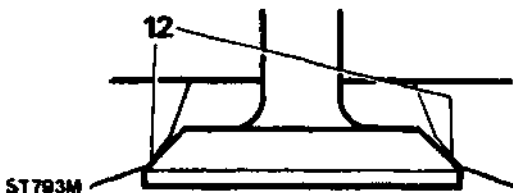
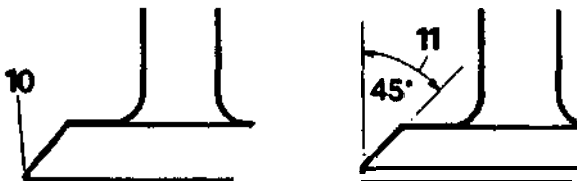
Continued ↓

6. Clean the combustion chambers with a soft wire brush.
7. Clean the valves.
8. Clean the valve guide bores.



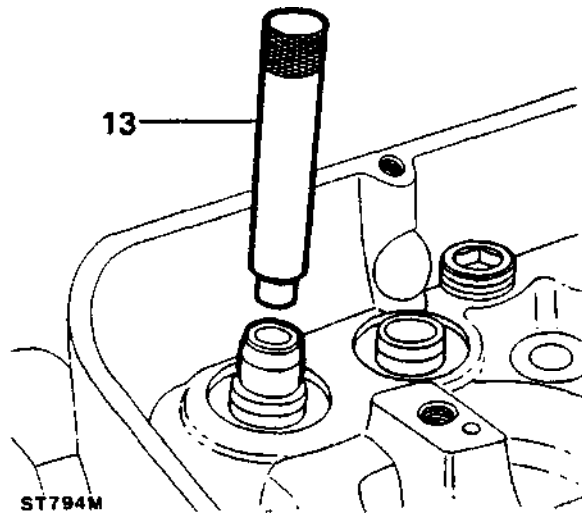
ST792M

9. Regrind or fit new valves as necessary.
10. If a valve must be ground to a knife-edge to obtain a true seat, fit a new valve.
11. The correct angle for the valve seating face is 45 degrees  $\pm$  1/4.
12. The correct angle for the seat is  $46 \pm 1/4$  degrees and the seat witness should be towards the outer edge.



ST793M

13. Check the valve guides and fit replacements as necessary. Using the valve guide remover 274401, drive out the old guides from the valve spring seat face of the cylinder head.

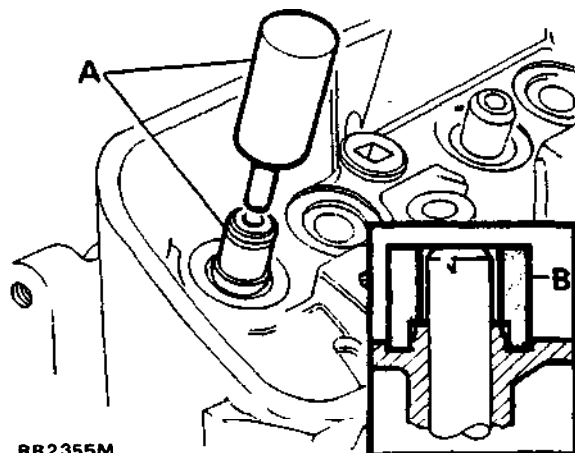


ST794M

Fit new valve guides

**NOTE:** Service valve guides are 0.025 mm (0.001 in) larger on the outside diameter than the original equipment to ensure interference fit.

14. Lubricate the new valve guide and place in position.
  - A. Using guide drift R0600959 partially drive the guide into the cylinder head.
  - B. Remove the drift R0600959 and place distance piece RO605774A over the valve guide, continue to drift the guide into the cylinder until drift contacts the distance piece.
  - C. Alternatively drift the guide into the cylinder head until it protrudes 19 mm (3/4 in) above the valve spring recess in the head.



RR2355M

Examine and fit new valve seats

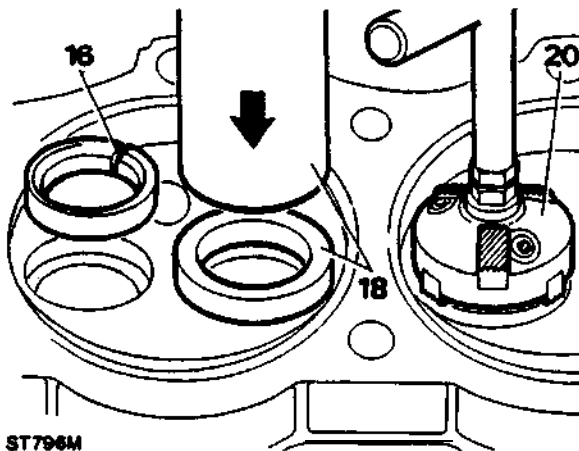
15. Check the valve seats for wear, pits and burning and fit new inserts if necessary.



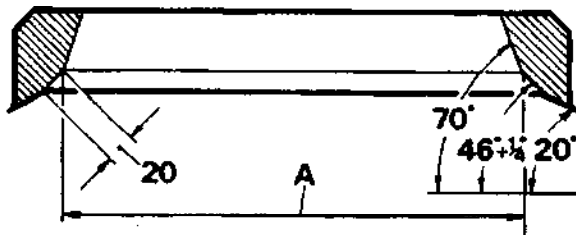
16. Remove the old seat inserts by grinding them away until they are thin enough to be cracked and pried out.
17. Heat the cylinder head evenly to approximately 65°C (150°F).
18. Press the new insert into the recess in the cylinder head.

NOTE: Service valve seat inserts are available in two over-sizes 0.25 and 0.50 mm (0.010 and 0.020 in) larger on the outside diameter to ensure interference fit.

19. Using service tool MS621 if necessary, cut the valve seats to  $46 \pm 1/4$  degrees.
20. The nominal seat width is 1.5 mm (0.059 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.
21. The inlet valve seat diameter: 'A' is 37.03 mm (1.458 in) and the exhaust valve seat is 31.50 mm (1.240).



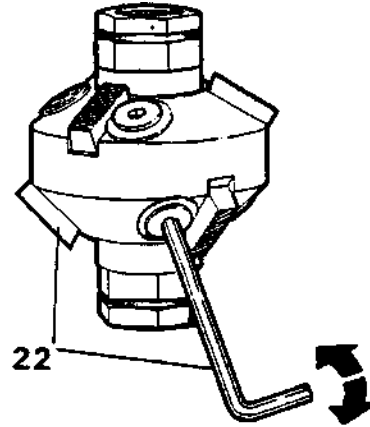
ST796M



ST797M

22. Ensure that the cutter blades are correctly fitted to the cutter head with the angled end of the blade downwards facing the work, as illustrated.

Check that the cutter blades are adjusted so that the middle of the blade contacts the area of material to be cut. Use the key provided in the hand set MS76. Use light pressure and remove only the minimum material necessary.



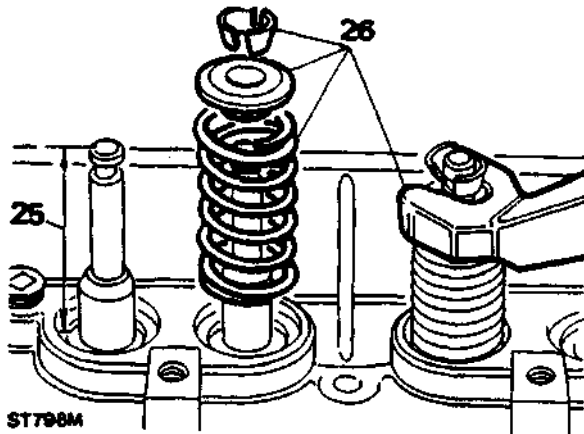
ST1 024M

23. Coat the valve seat with a small quantity of 'engineers' blue, revolve a properly ground valve against the seat. A continuous fine line should appear round the valve. If there is a gap of not more than 12 mm it can be corrected by lapping.
24. 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.

Continued

**Re-Assemble valves to cylinder head**

25. 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 while holding the head firmly against the seat, measure the height of the stem above the valve spring seat surface. This dimension must not exceed 47.63 mm (1.875 in). If necessary fit a new valve or grind the end of the valve stem.
26. Lubricate the valve stems and assemble the valves, fit new umbrella seals and springs, fit the caps, compress the springs and caps using spring compressor 18G 106A and secure the springs in place with the collets. Note that the umbrella seals are only fitted to the inlet valves.



ST790M

**Reclaiming cylinder head threads**

Damaged or stripped threads in the cylinder head can be salvaged by fitting Helicoils as follows:

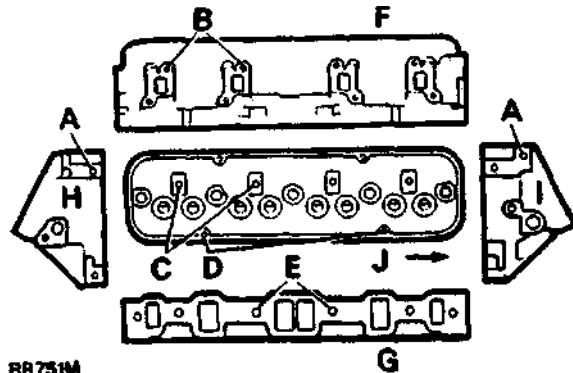
**Holes A** - These three holes may be drilled 0.3906 in dia. x 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.875 in (min) deep (3/8 UNC 1.5D insert).

**Holes B** - These eight holes may be drilled 0.3906 in dia. x 0.812 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CBB 0.749 in (min) deep (3/8 UNC 1.5D insert).

**Holes C** - These four holes may be drilled 0.3906 in dia x 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.875 in (min) deep (3/8 UNC 1.5D insert).

**Holes D** - These four holes may be drilled 0.261 in dia x 0.675 + 0.040 in deep. Tapped with Helicoil Tap No. 4 CPB or 4CS x 0.625 in (min) deep (1/4 UNC 1.5D insert).

**Holes E** - These six holes may be drilled 0.3906 in dia x 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS x 0.875 in (min) deep (3/8 UNC 1.5D insert).



RR751M

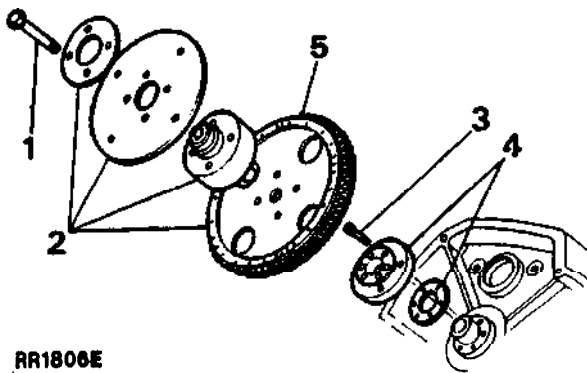
NOTE: Right-hand cylinder head illustrated.

- F Exhaust manifold face
- C Intake manifold face
- H Front face
- I Rear face
- J Front of engine

**REMOVE THE FLEXIBLE DRIVE PLATE AND RING GEAR ASSEMBLY**

**NOTE:** To ensure the following components are re-assembled in their correct radial positions, scribe each component with an identification line to enable each part to be re-assembled in the correct relationship to one another.

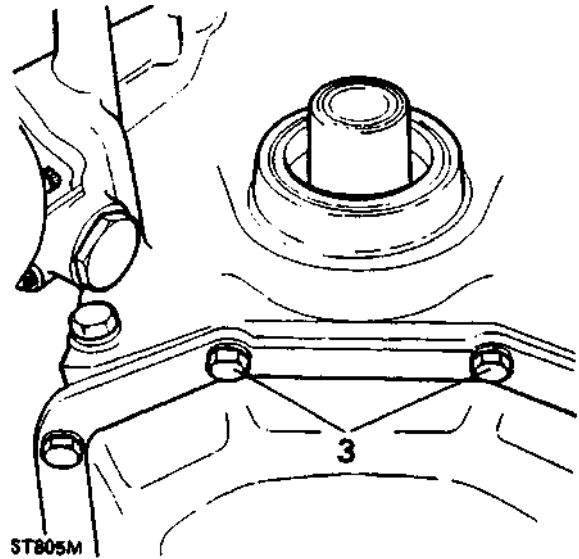
1. Remove the four retaining bolts.
2. Withdraw the clamp ring, flexible drive plate, hub aligner and ring gear assembly.
3. Remove the six socket head bolts securing the crankshaft adaptor plate and shim to the crankshaft flange.
4. Withdraw the crankshaft adaptor plate and shim.
5. Inspect the ring gear assembly for distortion, cracks, chipped or badly worn teeth. If ring gear is in poor condition fit a complete new assembly.



RR1806E

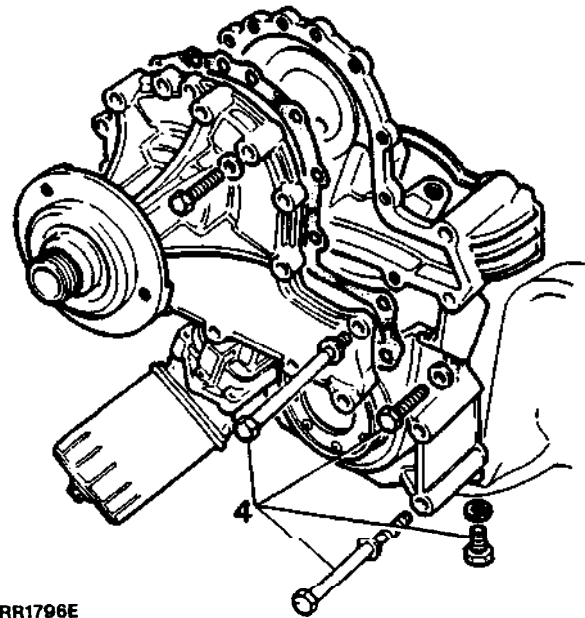
**REMOVE TIMING GEAR COVER AND WATER PUMP**

1. Place an oil drip-tray beneath the timing cover and remove the oil filter element.
2. Remove the crankshaft pulley bolt and special washer and withdraw the pulley.



ST805M

3. Remove the two bolts securing the sump to the bottom of the timing cover.
4. Remove the remaining timing cover retaining bolts and withdraw the cover complete with oil pump.

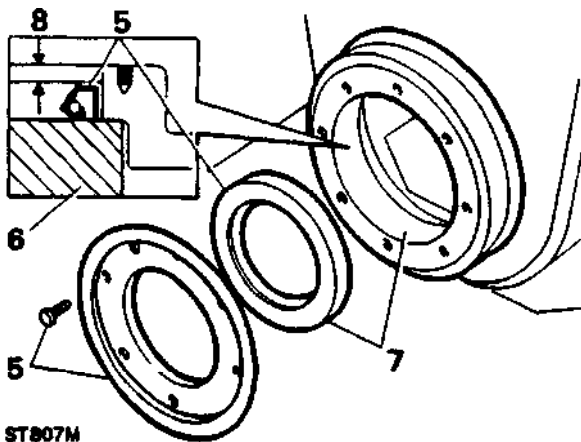


RR1796E

Continued

**Fit a new timing cover oil seal**

5. Remove the seven drive screws and withdraw the mud shield and the oil seal.
6. Position the gear cover with the front face uppermost and the underside supported across the oil seal housing bore on a suitable wooden block.
7. Enter the oil seal, lip side leading, into the housing bore.
8. Press in the oil seal until the plain face is 1.5 mm (0.059 in) approximately below the gear cover face.
9. Fit the mud shield and secure with the screws.



**ST807M**

**REMOVE THE DISTRIBUTOR**

1. Release the single nut securing the distributor clamp.
2. Remove the clamp and withdraw the distributor.
3. If necessary overhaul the distributor, (see distributor overhaul in Section 86 Electrical).

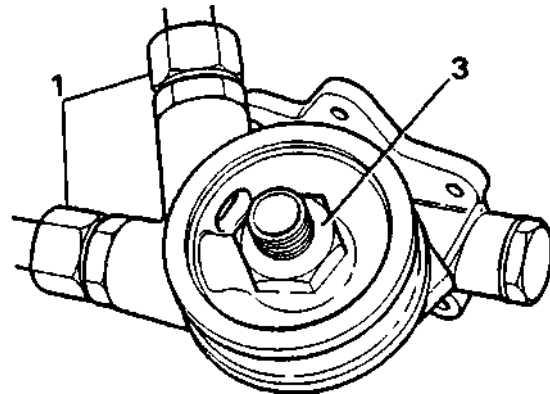
**REMOVE ENGINE OIL COOLER ADAPTOR PLATE**

**1989 Model Year**

1. Remove both oil cooler pipes.
2. Mark the position of the adaptor plate relative to the oil pump cover.
3. Remove the centre fixing and withdraw the adaptor plate.

**Refit**

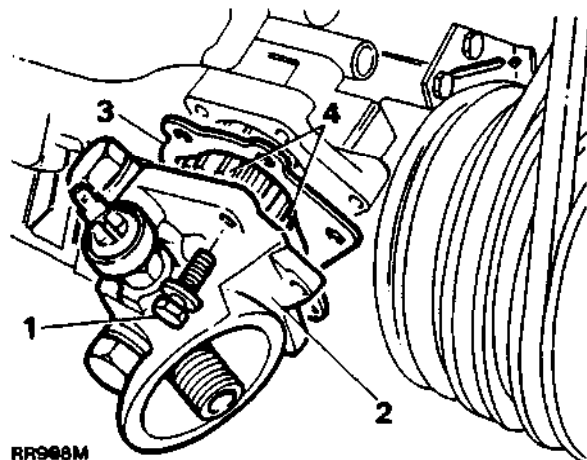
4. Reverse the removal procedure, lining up the location marks to ensure pipe runs are correct. Ensure the pipes and centre fixing are tightened to the specified torque, see Torque values - section 06.



**RR2614E**

**REMOVE AND OVERHAUL THE OIL PUMP**

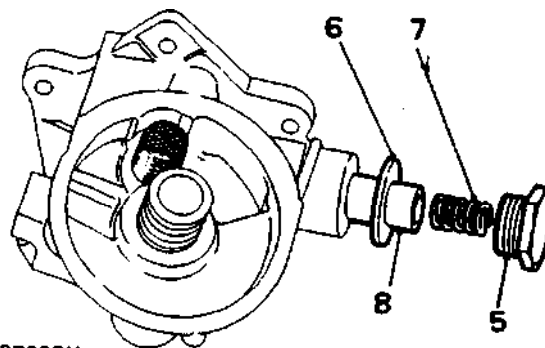
1. Remove the bolts from the oil pump cover.
2. Withdraw the oil pump cover.
3. Lift off the cover and remove the gasket.
4. Withdraw the oil pump gears.



**RR988M**

**Dismantle pump**

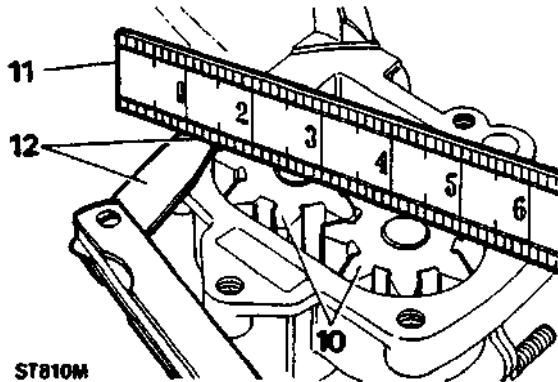
5. Unscrew the plug from the pressure relief valve.
6. Lift the sealing washer from the plug.
7. Withdraw the spring from the relief valve.
8. Withdraw the pressure relief valve.



**ST809M**

Examine pump

9. Check the oil pump gears for wear or scores.
10. Fit the oil pump gears and shaft into the front cover.
11. Place a straight edge across the gears.
12. Check the clearance between the straight edge and the front cover. If less than 0.05 mm (0.002 in), check the front cover gear recess for wear.



ST810M

13. Check the oil pressure relief valve for wear or scores.
14. Check the sides of the relief valve spring for wear or signs of collapse.
15. Clean the wire screen filter for the relief valve.
16. Check the fit of the relief valve in its bore. The valve must be an easy slide fit with no perceptible side movement.

Assemble pump

17. Insert the relief valve spring.
18. Locate the sealing washer on to the relief valve plug.
19. Fit the relief valve plug and tighten to correct torque(see section 06-Torque values).
20. Fully pack the oil pump gear housing with Petroleum Jelly. Use only Petroleum Jelly; no other grease is suitable.
21. Fit the oil pump gears so that the Petroleum Jelly is forced into every cavity between the teeth of the gears.

**IMPORTANT:** Unless the pump is fully packed with Petroleum Jelly it may not prime itself when the engine is started.

22. Place a new gasket on the oil pump cover.
23. Locate the oil pump cover in position.
24. Fit the special fixing bolts and gradually tighten to the specified torque (see section 06-Torque values).

ENGINE OIL PRESSURE TEST

Special tools:

- LST502-1: Adaptor pressure take off
- 18G502A: 0-300 p.s.i. Pressure guage
- 18G502K: Hose and adaptors

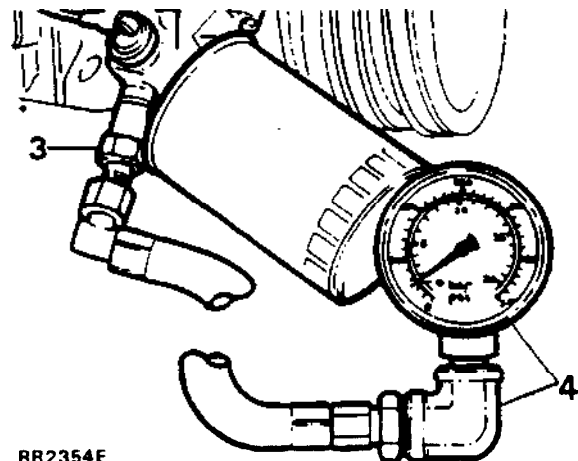
The following procedure applies to engines that have completed in excess of 1,000 miles and are filled with 15W/40 engine oil. The engine must be installed in the vehicle.

**WARNING:** Suitable extraction equipment must be fitted to the exhaust system of the vehicle, if the test is being carried out in the workshop.

**WARNING:** If the vehicle has been running the engine oil will be hot, care must be taken when fitting the equipment to prevent the possibility of personal injury due to scalding.

TEST

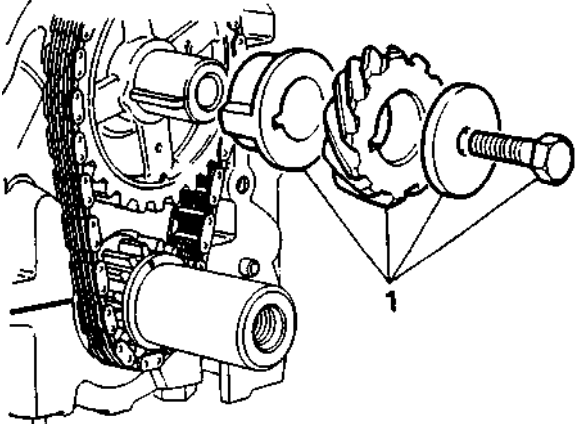
1. Place the vehicle on a suitable hoist.
2. Disconnect the battery negative terminal,
3. Remove the bolt from the oil pump housing and install adaptor LST502-1.
4. Fit pressure guage 18G502A to hose 18G502K, fit the hose and guage to adaptor LST502-1. Tighten all joints securely.
5. Connect the battery terminal and ensuring that the park brake is applied and that 'P' or 'N' is selected in the main gearbox start and run the engine. Run the engine until normal engine operating temperature is achieved (thermostat open).
6. With the engine speed maintained at 2400 rpm there should be a minimum engine oil pressure of 1.76 kg/cm<sup>2</sup> (25 p.s.i.)



RR2354E

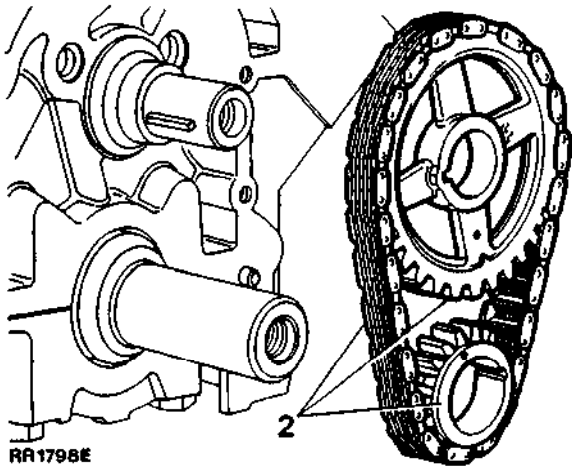
**REMOVE TIMING CHAIN SPROCKET AND CAMSHAFT**

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



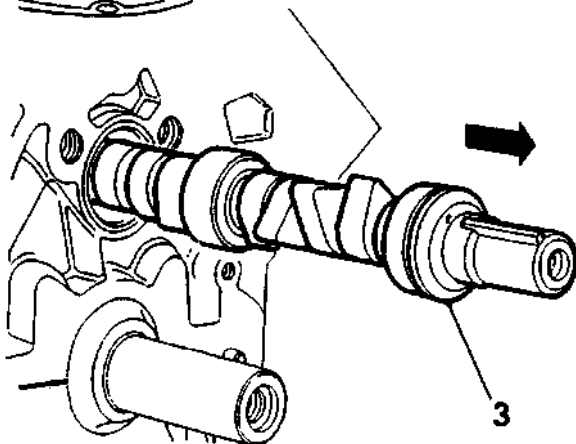
**RR1797E**

2. Withdraw the sprocket complete with timing chain.



**RR1798E**

3. Withdraw the camshaft while taking particular care not to damage the bearings in the cylinder block.



**ST813M**

**Examine components**

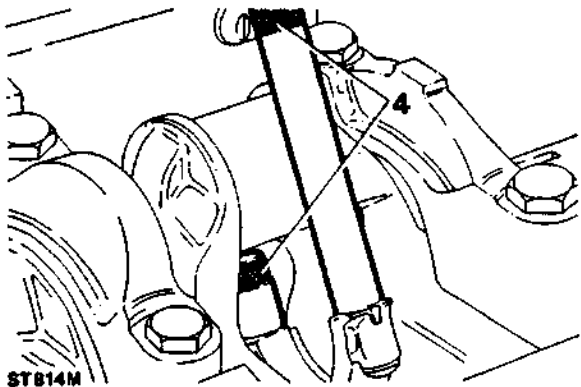
4. Visually examine all parts for wear. Check the camshaft bearing journals and cams for wear, pits, scores and overheating. Should any of these conditions be present fit a new camshaft.
5. Examine the links and pins of the timing chain for wear and compare its condition with that of a new chain. Similarly the teeth of the sprockets should be inspected and if necessary fit a new sprocket.
6. Measure the camshaft journals for overall wear, out of roundness and taper. The diameters of the five journals are as follows starting from the front of the shaft:

- Number 1 journal 1.786 to 1.785 in (45.4 to 45.3 mm)
- Number 2 journal 1.756 to 1.755 in (44.6 to 44.5 mm)
- Number 3 journal 1.726 to 1.725 in (43.84 to 43.81 mm)
- Number 4 journal 1.696 to 1.695 in (43.07 to 43.05 mm)
- Number 5 journal 1.666 to 1.665 in (42.31 to 42.29 mm)

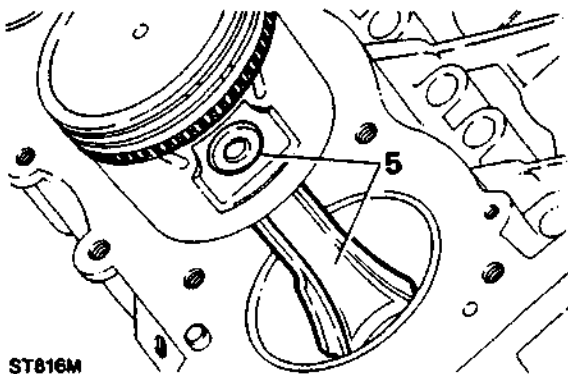
7. To check the camshaft for straightness rest the two end journals i.e. numbers 1 and 5 on 'V' blocks and mount a dial gauge on the centre journal. Rotate the shaft and note the reading. If the run out is more than 0.05 mm (0.002in) fit a new camshaft.

REMOVE AND OVERHAUL CONNECTING RODS AND PISTONS

1. Withdraw the retaining bolts and remove the sump.
2. Remove the sump oil strainer.
3. Remove the connecting rod caps and retain them in sequence for reassembly.
4. Screw the guide bolts 605351 onto the connecting rods.



5. Push the connecting rod and piston assembly up the cylinder bore and withdraw it from the top. Retain the connecting rod and piston assemblies in sequence with their respective caps.
6. Remove the guide bolts 605351 from the connecting rod.



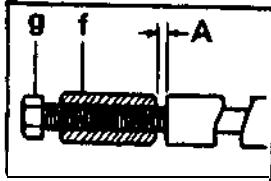
Overhaul

**NOTE:** The connecting rods, caps and bearing shells must be retained in sets, and in the correct sequence. Remove the piston rings over the crown of the piston. If the same piston is to be refitted, mark it relative to its connecting rod to ensure that the original assembly is maintained.

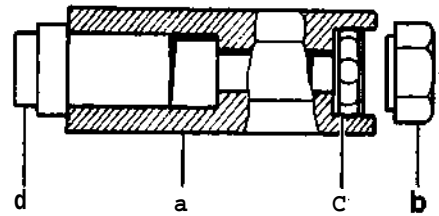
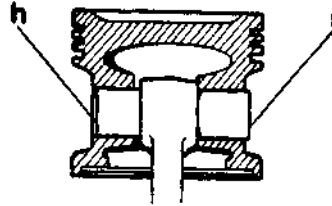
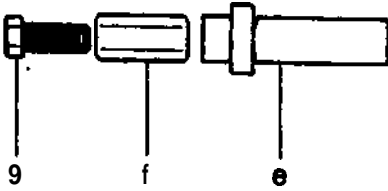
7. Withdraw the piston pin, using tool 18G 1150 as follows:
  - a. Clamp the hexagon body of 18G 1150 in a vice.
  - b. Position the large nut flush with the end of the centre screw.
  - c. Push the screw forward until the nut contacts the thrust race.
  - d. Locate the piston adaptor 18G 1150E with its long spigot inside the bore of the hexagon body.
  - e. Fit the remover/replacer bush of 18G 11 50 on the centre screw with the flanged end away from the piston.
  - f. Screw the stop-nut about half-way onto the smaller threaded end of the centre screw, leaving a gap 'A' of 3 mm (1/8 in) between this nut and the remover/replacer bush.
  - g. Lock the stop-nut securely with the lock screw.
  - h. Check that the remover/replacer bush is correctly positioned in the bore of the piston.
  - i. Push the connecting-rod to the right to expose the end of the piston pin, which must be located in the end of the adaptor 'd'.
  - j. Screw the large nut up to the thrust race.

Continued

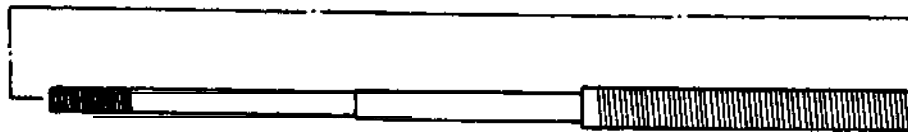
- k. Hold the lock screw and turn the large nut until the piston pin has been withdrawn from the piston. Dismantle the tool.



18G1150



ST77M





**Original pistons**

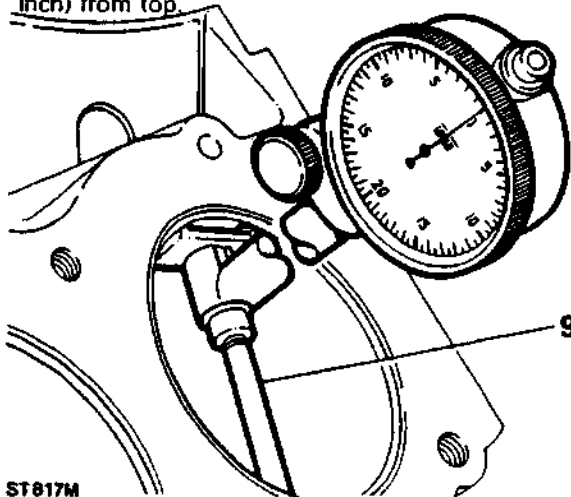
8. Remove the carbon deposits, particularly from the ring grooves. Examine the pistons for signs of damage or excessive wear; refer to 'new pistons' for the method of checking the running clearance. Fit new pistons if necessary.

**New pistons**

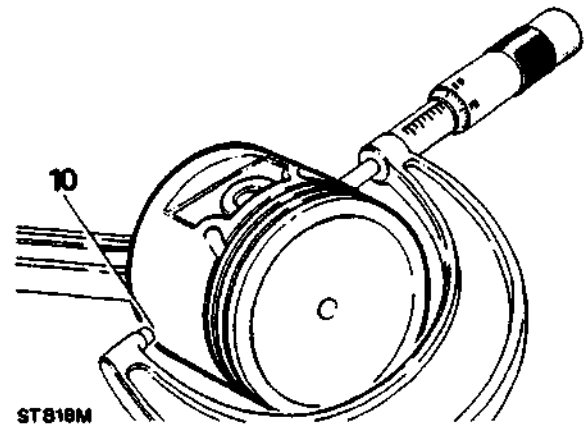
**NOTE:** Pistons are available in service standard size and in oversizes of 0.25 mm (0.010 in) and 0.50 mm (0.020 in). Service standard size pistons are supplied 0.0254 mm (0.001 in) oversize. When fitting new service standard size pistons to a cylinder block, check for correct piston to bore clearance, honing the bore if necessary. Bottom of piston skirt/bore clearance should be 0.016 to 0.033 mm (0.0007 to 0.0013 in).

**NOTE:** The temperature of the piston and cylinder block must be the same to ensure accurate measurement. When reboring the cylinder block, the crankshaft main bearing caps must be fitted and tightened to the correct torque (see section 06-Torque Values).

9. Check the cylinder bore dimension at right angles to the piston pin 40 to 50 mm (1.5 to 2 inch) from top.



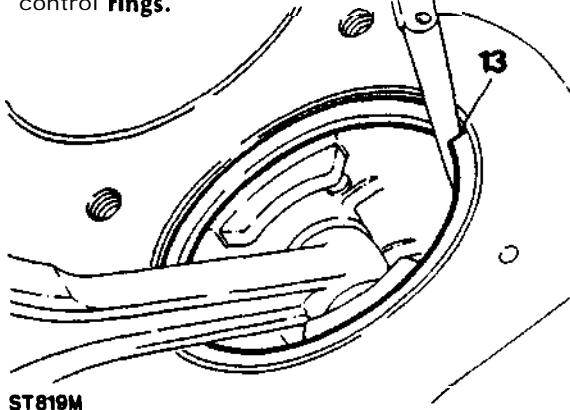
10. Check the piston dimension at right angles to the piston pin, at the bottom of the skirt.



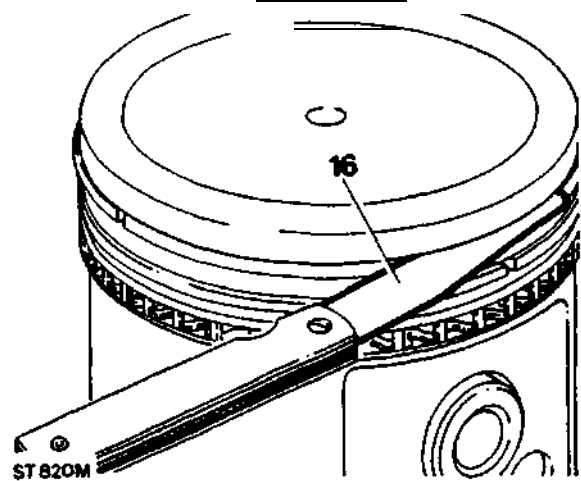
11. The piston dimension must be 0.018 to 0.033 mm (0.0007 to 0.0013 in). smaller than the cylinder.
12. If new piston rings are to be fitted without reboring, deglaze the cylinder walls with a hone, without increasing the bore diameter, to provide a cross-hatch finish. After honing, thoroughly clean the piston bores to remove all traces of foreign matter.

13. Check the compression ring in the applicable cylinder, held square to the bore with the piston. Gap limits: 0.44 to 0.56 mm (0.017 to 0.022 in). Use a fine-cut flat file to increase the gap if required. Select a new piston ring if the gap exceeds the limit.

NOTE: Gapping does not apply to oil control rings.

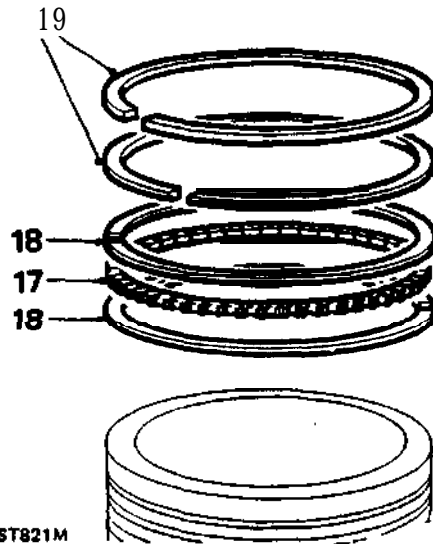


14. Temporarily fit the compression rings to the piston.
15. The ring marked 'TOP' must be fitted with the marking uppermost and into the second groove. The chrome ring is for the top groove and can be fitted either way round.
16. Check the compression ring clearance in the piston groove. Clearance limits: 0.05 to 0.10 mm (0.002 to 0.004).



Fit piston rings

17. Fit the expander ring into the bottom groove making sure that the ends butt and do not overlap.
18. Fit two ring rails to the bottom groove, one above and one below the expander ring.
19. Fit the second compression ring with the marking 'TOP' uppermost and the groove, either way round.



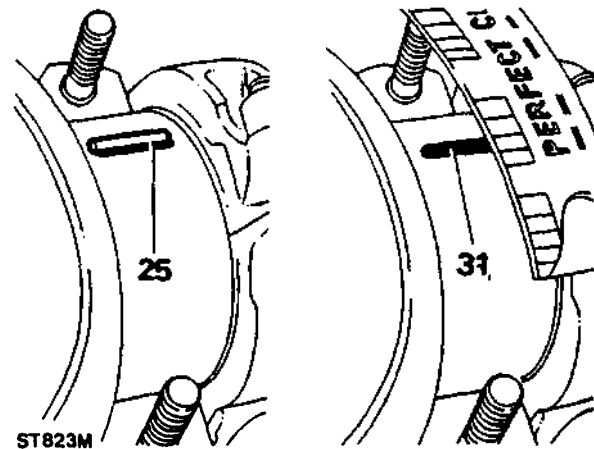
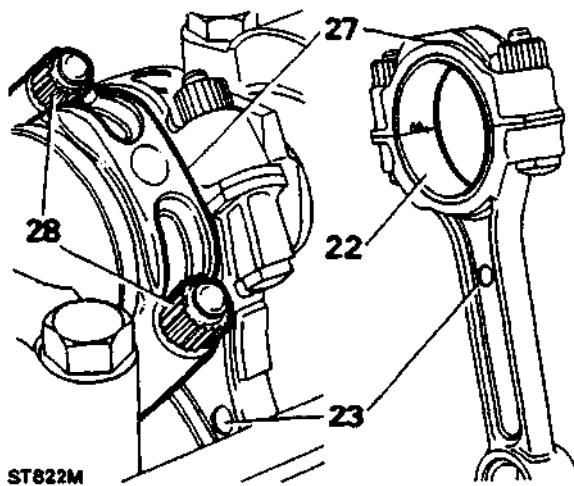
**Examine connecting rods**

20. Check the alignment of the connecting rod.
21. Check the connecting rod small end, the piston pin must be a press fit.

**Check crankshaft bearings**

22. Locate the bearing upper shell into the connecting rod.
23. Locate the connecting rod and bearing onto the applicable crankshaft journal, noting that the domed shape boss on the connecting rod must face towards the front of the engine on the right hand bank of cylinders and towards the rear on the left hand bank.
24. When both connecting rods are fitted, the bosses will face inwards towards each other.

25. Place a piece of Plastigauge (P61) across the centre of the lower half of the crankshaft journal.
26. Locate the bearing lower shell into the connecting rod cap.
27. Locate the cap and shell onto the connecting rod. Note that the rib on the edge of the cap must be *on* the same side as the domed shape boss on the connecting rod.
28. Secure the connecting rod cap. Tighten to the correct torque (**see section 06-Torque** values).
29. Do not rotate the crankshaft or connecting rod while the Plastigauge is in use.



Continued

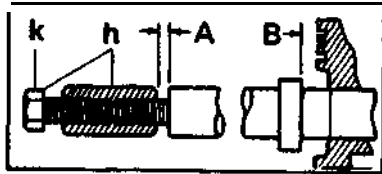
30. Remove the connecting rod cap and shell.
31. Using the scale printed on the Plastigauge packet, measure the flattened Plastigauge at its widest point.
32. The graduation that most closely corresponds to the width of the Plastigauge indicates the bearing clearance.
33. The correct bearing clearance with new or overhauled components is 0.015 to 0.055 mm (0.0006 to 0.0022 in).
34. If a bearing has been in service, it is advisable to fit a new bearing if the clearance exceeds 0.08 mm (0.003 in).
35. If a new bearing is being fitted, use selective assembly to obtain the correct clearance.
36. Wipe off the Plastigauge with an oily rag. DO NOT scrape it off.

**NOTE:** It is important that the connecting rods, caps and bearing shells be retained in sets, and in the correct sequence.

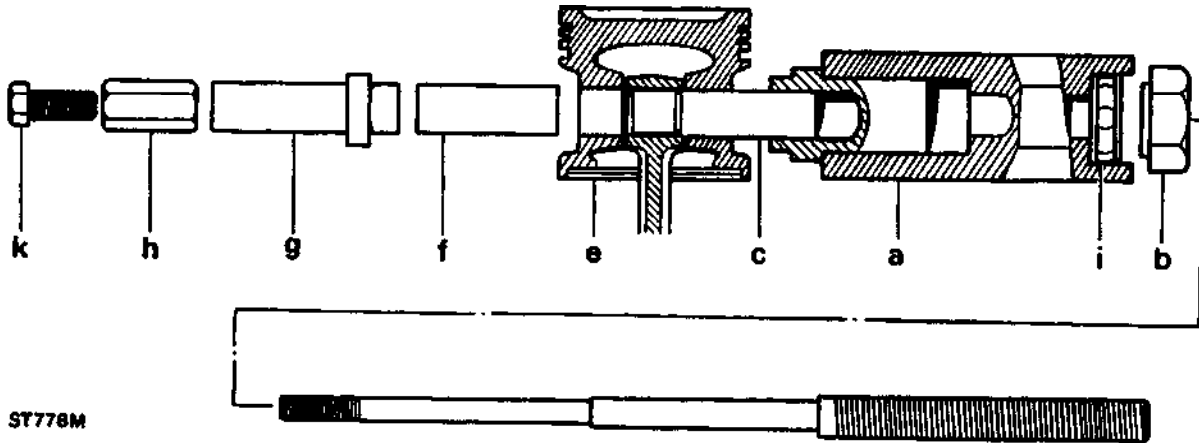
#### Assembling pistons to connecting rods

37. Using tool 18C 1150 refit each piston to its connecting rod as follows:
  - a. Clamp the hexagon body of 1 8C 1150 in a vice, with the adaptor 18C 1150 E positioned as in 7d.
  - b. Remove the large nut of 18C 1150 and push the centre screw approximately 50 mm (2 in) into the body until the shoulder is exposed.
  - c. Slide the parallel guide sleeve, grooved end last, onto the centre screw and up to the shoulder.
    - d. Lubricate the piston pin and bores of the connecting rod and piston with graphited oil (Molykore 2). Also lubricate the ball race and centre screw of 18C 1150.
    - e. Fit the connecting rod and the piston together onto the tool with the markings aligned if the original pair are being used and with the connecting rod around the sleeve up to the groove.
    - f. Fit the piston pin into the piston bore, up to the connecting rod.
    - g. Fit the remover/replacer bush 18C 11 50/3 with its flanged end towards the piston pin.
    - h. Screw the stop nut onto the centre screw and adjust this nut to obtain an 0.8 mm (0.031 in) end float 'A' on the whole assembly, and lock the nut securely with the screw.
    - i. Slide the assembly back into the hexagon body and screw on the large nut up to the thrust race.
    - j. Set the torque wrench 18C 537 to 16 Nm (12 ft lb). This represents the minimum load for an acceptable interference fit of the piston pin in the connecting rod.
    - k. Using the torque wrench and socket 18C 587 on the large nut, and holding the lock screw, pull the piston pin in until the flange of the remover/replacer bush is 4mm (0.157 in) 'B' from the face of the piston. Under no circumstances must this flange be allowed to contact the piston.

CAUTION: If the torque wrench has not reached at least **12 ft.lbs** throughout the **pull**, the fit of the piston pin to the connecting rod is not acceptable and necessitates the fitting of new components. The large nut and centre screw of the tool must be kept well oiled.



18G.1150

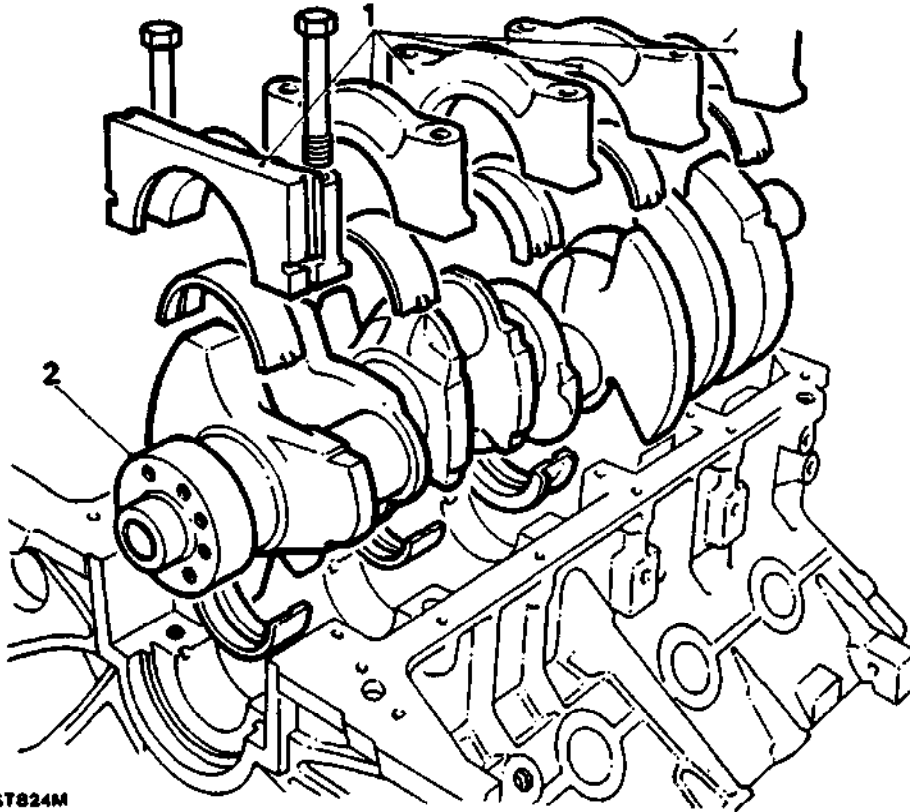


38. Remove the tool and check that the piston moves freely on the piston pin and that no damage has occurred during pressing.

---

**REMOVE AND OVERHAUL CRANKSHAFT**

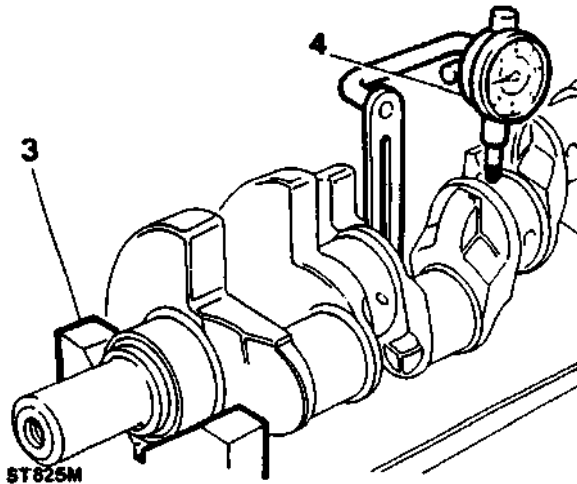
1. Remove the main bearing caps and lower bearing shells and retain in sequence. It is important to keep them in pairs and mark them with the number of the respective journal until it is decided if the bearing shells are to be refitted.
2. Lift out the crankshaft and rear oil seal.



ST824M

Inspect and overhaul crankshaft

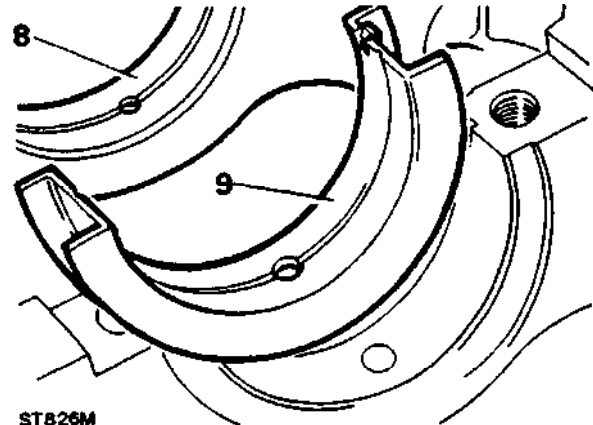
3. Rest the crankshaft on vee-blocks at numbers one and five main bearing journals.
4. Using a dial indicator, check the run-out at numbers two, three and four main bearing journals. The total indicator readings at each journal should not exceed 0.08 mm (0.003 in).



5. While checking the run-out at each journal, note the relation of maximum offset on each journal to the others. The maximum on all journals should all come at very near the same angular location.
6. If the crankshaft fails to meet the foregoing checks it is bent and is unsatisfactory for service.
7. Check each crankshaft journal for out of round. If the out of round exceeds 0.040 mm (0.0016 in) around the crankshaft journal, a reground or new crankshaft should be fitted.
8. Bearings for the crankshaft main journals and the connecting rod journals are available in the following undersizes:

0.25mm (0.010 in)  
0.50mm (0.020 in)

9. The centre main bearing shell, which controls crankshaft thrust, has the thrust faces increased in thickness when more than 0.25 mm (0.010 in) undersize, as shown on the following chart.



10. When a crankshaft is to be reground, the thrust faces on either side of the centre main journal must be machined in accordance with the dimensions in the charts that follow:

Main bearing journal size	Thrust face width
Standard	Standard
0.25 mm (0.010 in) undersize	Standard
0.50 mm (0.020 in) undersize	0.25 mm (0.010 in) oversize

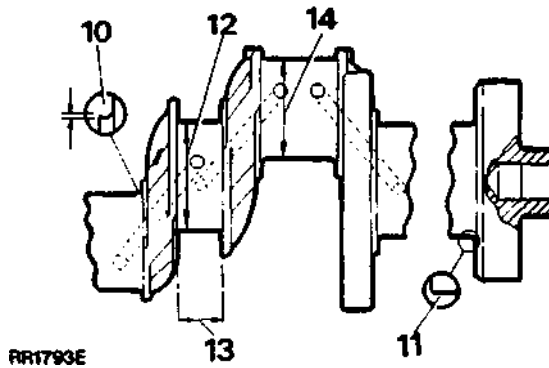
11. For example: If a 0.50 mm (0.020 in) undersize bearing is to be fitted, then 0.12 mm (0.005 in) must be machined off each thrust face of the centre journal, maintaining the correct radius.

Crankshaft dimensions

12. The radius for all journals except the rear main bearing is 1.90 to 2.28 mm (0.075 to 0.090 in).
13. The radius for the rear main bearing journal is 3.04 mm (0.120 in).

Continued

14. Main bearing journal diameter, see the following charts.
15. Thrust face width, and connecting rod journal diameter, see the following charts.



### Crankshaft dimensions-millimetre

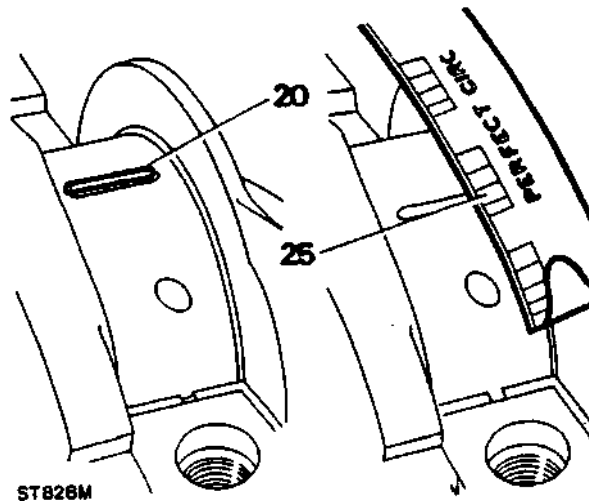
Crankshaft Grade	Diameter '12'	Width '13'	Diameter '14'
Standard	58.400-58.412	26.975-27.026	50.800-50.812
0.254 U/S	58.146-58.158	26.975-27.026	50.546-50.558
0.508 U/S	57.892-57.904	27.229-27.280	50.292-50.304

### Crankshaft dimensions inches

Crankshaft Grade	Diameter '12'	Width '13'	Diameter '14'
Standard	2.2992-2.2997	1.062-1.064	2.0000-2.0005
0.010 U/S	2.2892-2.2897	1.062-1.064	1.9900-1.9905
0.020 U/S	2.2792-2.2797	1.072-1.074	1.9800-1.9805

### Check main bearing clearance

16. Remove the oil seals from the cylinder block and the rear main bearing cap.
17. Locate the upper main bearing shells into the cylinder block. These must be the shells with the oil hole and oil grooves.
18. Locate the flanged upper main bearing shell in the centre position.
19. Place the crankshaft in position on the bearings.
20. Place a piece of Plastigauge across the centre of the crankshaft main bearing journals.
21. Locate the bearing lower shell into the main bearing cap.



22. Fit numbers one to four main bearing caps and shells, tighten to the correct torque (see section 06-Torque values).

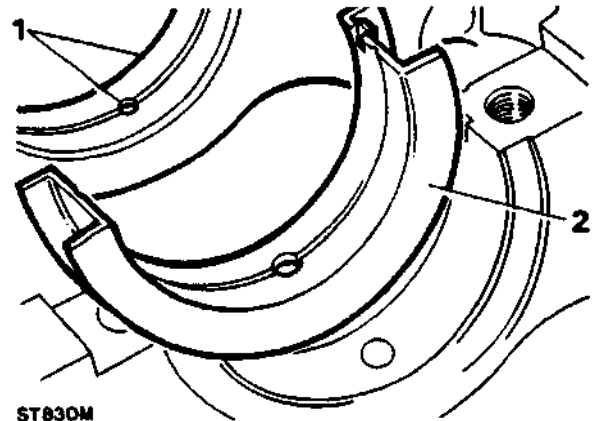


23. Fit the rear main bearing cap and shell and tighten to the correct torque (see section 06-Torque values). Do not allow the crankshaft to be rotated while the Plastigauge is in use.
24. Remove the main bearing caps and shells.
25. Using the scale printed on the Plastigauge packet, measure the flattened Plastigauge at its widest point.
26. The graduation that most closely corresponds to the width of the Plastigauge indicates the bearing clearance.
27. The correct bearing clearance with new or overhauled components is 0.023 to 0.065 mm (0.0009 to 0.0026 in).
28. If the correct clearance is not obtained initially, select a suitable bearing to give the required clearance.
29. Wipe off the Plastigauge with an oily rag. Do NOT scrape it off.
30. Maintain the bearing shells and caps in sets and in the correct sequence.

**ASSEMBLING ENGINE**

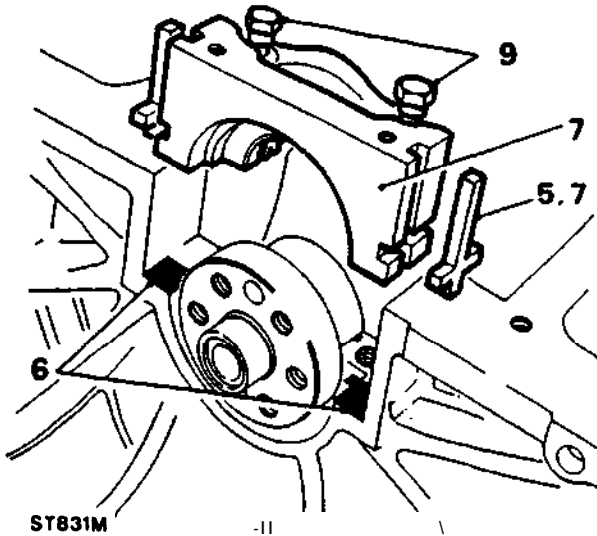
**FIT CRANKSHAFT AND MAIN BEARINGS**

1. Locate the upper main bearing shells into the cylinder block; these must be the shells with the oil holes and oil grooves.
2. Locate the flanged upper main bearing shell in the centre position.
3. Lubricate the crankshaft main bearing journals and bearing shells with clean engine oil and lower the crankshaft into position.



4. Lubricate the lower main bearing shells and fit numbers one to four main bearing caps and shells only, leaving the fixing bolts finger-tight at this stage.
5. Fit the cross shaped side seals to the grooves each side of the rear main bearing cap. Do not cut the side seals to length, they must protrude 1.5 mm (0.062 in) approximately above the bearing cap parting face.
6. Apply Hylomar SQ32M jointing compound to the rearmost half of the rear main bearing cap parting face or, if preferred, to the equivalent area on the cylinder block as illustrated.
7. Lubricate the bearing half and bearing cap side seals with clean engine oil.
8. Fit the bearing cap assembly to the engine. Do not tighten the fixings at this stage but ensure that the cap is fully home and squarely seated on the cylinder block.
9. Tension the cap bolts equally by one-quarter turn approximately, then back off one complete turn on each fixing bolt.

Continued



ST831M

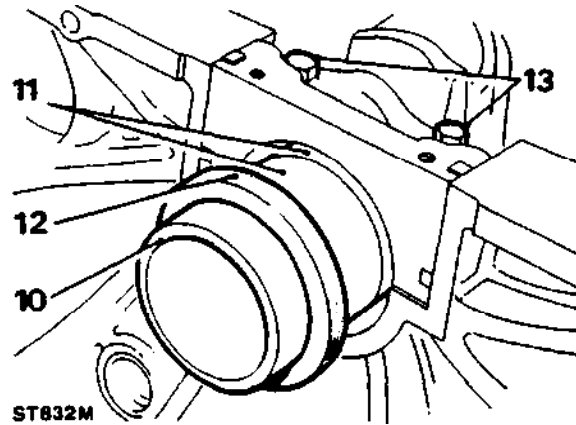
**CAUTION:** Do not handle the oil seal lip, visually check that it is not damaged and ensure that the outside diameter remains clean and dry.

10. Position the seal guide RO 1014 on the crankshaft flange.
11. Ensure that the oil seal guide and the crankshaft journal are scrupulously clean, then coat the seal guide and oil seal journal with clean engine oil.

**NOTE:** The lubricant coating must cover the seal guide outer surface completely to ensure that the oil seal lip is not turned back during assembly.

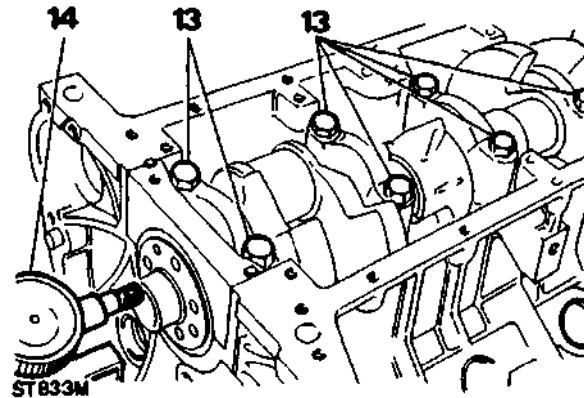
Position the oil seal, lipped side towards the engine, on to the seal guide. The seal outside diameter must be clean and dry.

12. Push home the oil seal fully and squarely by hand into the recess formed in the cap and block until it contacts the machined step in the recess.  
Withdraw the seal guide.



ST832M

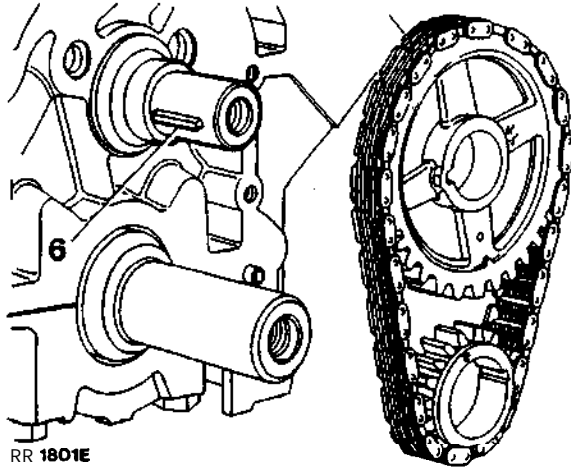
13. Tighten the main bearing cap bolts to the correct torque (see section 06-Torque values) noting that the bolts for numbers one to four bearings have a different torque to number five bearing cap bolts.
14. Using a feeler gauge or a dial indicator check the crankshaft end-float, 0.10 to 0.20 mm (0.004 to 0.008 in).



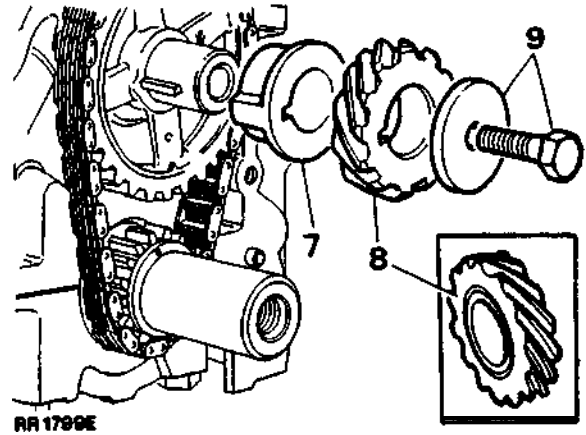
ST833M

**CAUTION:** Do not exceed 1,000 engine rev/min for 15 seconds when first starting the engine, otherwise the crankshaft rear oil seal will be damaged.

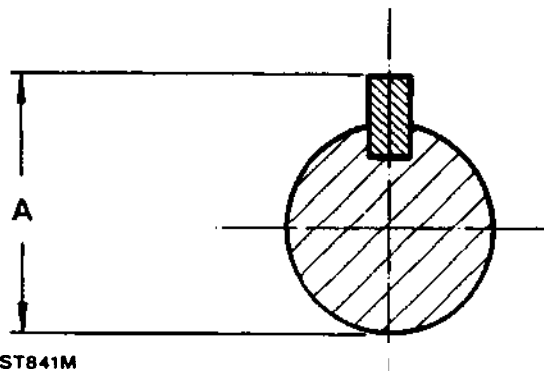
- Engage the sprocket assembly on the camshaft and crankshaft key locations and check that the camshaft key is parallel to the shaft axis to ensure adequate lubrication of the distributor drive gear.



- Fit the distributor drive gear ensuring that the annular grooved side is fitted to the rear, that is towards the spacer.
- Secure the drive gear and camshaft sprocket assembly with the bolt and washer and tighten to the correct torque (see section 06-Torque values).



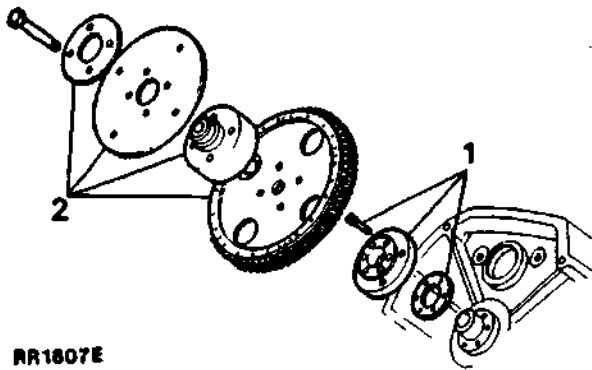
**CAUTION:** The space between the key and keyway acts as an oilway for lubrication of the drive gear. Ensure that the key is seated to the full depth of the keyway. The overall dimension of shaft and key must not exceed 30.15 mm (1.187 in). Dimension A below.



- Check that the timing marks line up and fit the spacer with the flange to the front.

**FIT THE RING GEAR AND FLEXIBLE DRIVE PLATE ASSEMBLY**

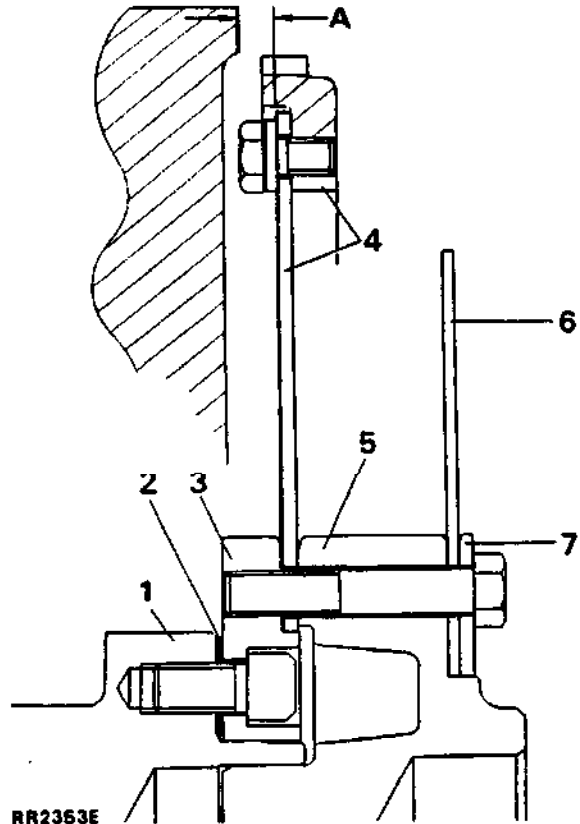
1. Fit the shim and crankshaft adaptor plate to the crankshaft flange noting the previously marked identification lines and secure in position with the six socket head bolts. Do not fully tighten the bolts at this stage.
2. Fit the ring gear assembly, hub aligner, flexible drive plate noting the previously marked identification lines and secure in position with the four bolts and clamping ring. Do not fully tighten the bolts at this stage.



**RR1807E**

3. To ensure that there is no distortion to the flexible drive plate when bolted to the torque converter, check the setting height of the drive plate as follows.
4. To prevent excessive clearance, a shim is fitted between the crankshaft drive flange and crankshaft adaptor plate. The setting height, dimension A, is measured between the front face of the ring gear drive plate and engine cylinder block to gearbox mating face, a dimension of 8.08 to 8.20 mm (0.318 to 0.323 in) is to be maintained. Should this dimension not be achieved a selection of shims in progressive thicknesses is available. Select the appropriate shim to maintain the dimension, as shown below.

PART NO.	DIMENSION (MM)
FRC 7084	1.20 • 1.25
FRC 7085	1.30 • 1.35
FRC 7086	1.40 • 1.45
FRC 7087	1.50 • 1.55
FRC 7088	1.60 • 1.65
FRC 7089	1.70 • 1.75
FRC 7090	1.80 • 1.85
FRC 7091	1.90 • 1.95
FRC 7092	2.00 • 2.05
FRC 7093	2.10 • 2.15

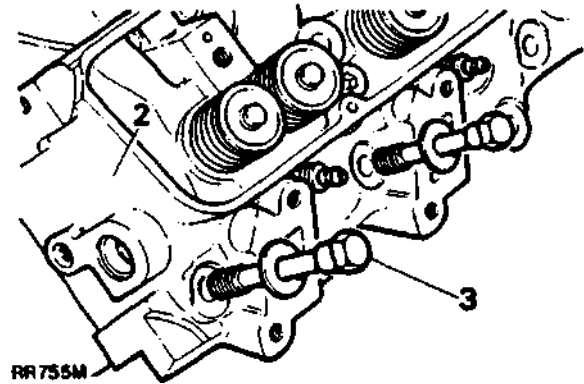


**RR2353E**

**KEY:**

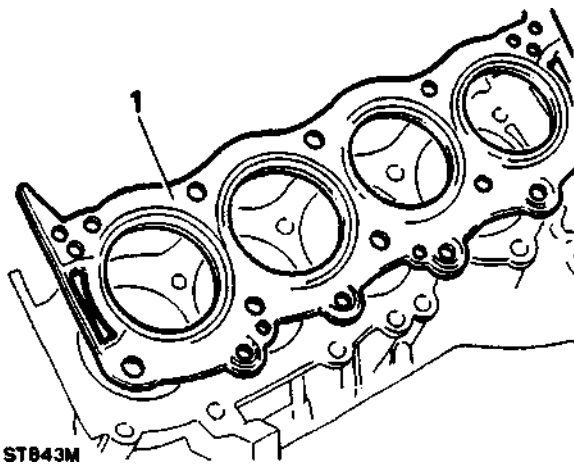
1. Crankshaft flange.
2. Shim.
3. Crankshaft adaptor flange.
4. Drive plate and ring gear assembly.
5. Hub aligner.
6. Flexible drive plate.
7. Clamp ring.

5. Remove the four bolts clamp ring flexible drive plate hub aligner and ring gear assembly.
6. Remove the six socket head bolts and crankshaft adaptor.
7. Fit the appropriate shim, refit the adaptor and six socket head bolts, tighten to the specified torque (see section 06-Torque values).
8. Fit the ring gear assembly, hub aligner, flexible drive plate and clamp ring.
9. Coat the threads of the four securing bolts with Loctite 270 prior to assembly, fit the bolts and tighten to the specified torque (see section 06-Torque values).



**FIT CYLINDER HEADS**

1. Fit new cylinder head gaskets with the word 'TOP' uppermost. Do NOT use sealant.

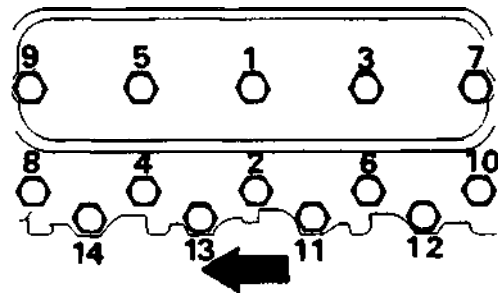


2. Locate the cylinder heads on the block dowel pins.
3. Clean the threads of the cylinder head bolts then coat them with Thread Lubricant-Sealant Loctite 572.

4. Locate the cylinder head bolts in position as illustrated and fit dipstick tube.

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

5. Tighten the cylinder head bolts a little at a time in the sequence shown. (See section OC-Torque values for correct tightening torque).
6. When all bolts have been tightened, recheck the torque values.



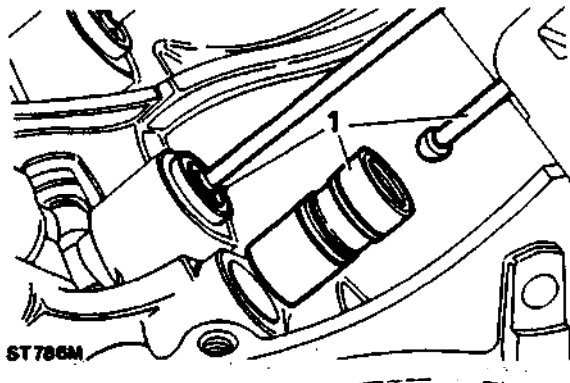
STB45M

**NOTE:** left-hand cylinder head illustrated. Arrow points to front of vehicle.

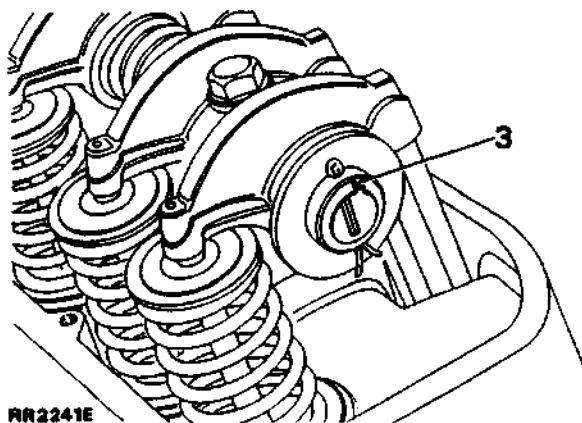
Continued

**FIT TAPPETS, PUSH RODS AND ROCKER ASSEMBLIES****Fit tappets and push rods**

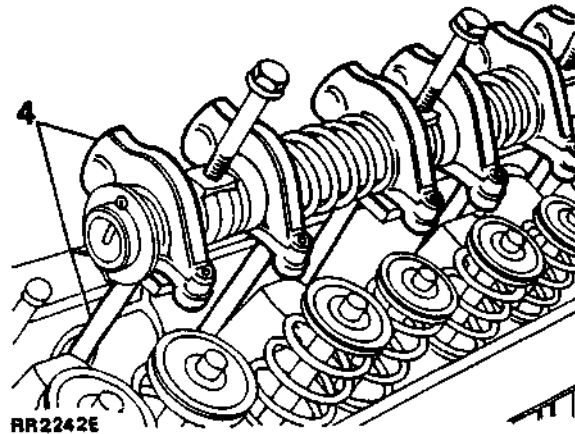
1. Fit the tappets and push rods to their original locations. Ensure that the tappets move freely in their respective bores. Before fitting the tappets immerse them in clean engine oil to reduce tappet noise when the engine is first started after the overhaul.

**Fit the rocker assemblies**

2. The rocker shafts are handed and must be fitted correctly to align the oilways.
3. Each rocker shaft is notched at one end and on one side only. The notch must be uppermost and towards the front of the engine on the right hand side, and towards the rear on the left hand side.



4. Fit the rocker shaft assemblies. Ensure that the pushrods engage the rocker cups. Tighten the bolts to the correct torque (see Section 06 • Torque Values).

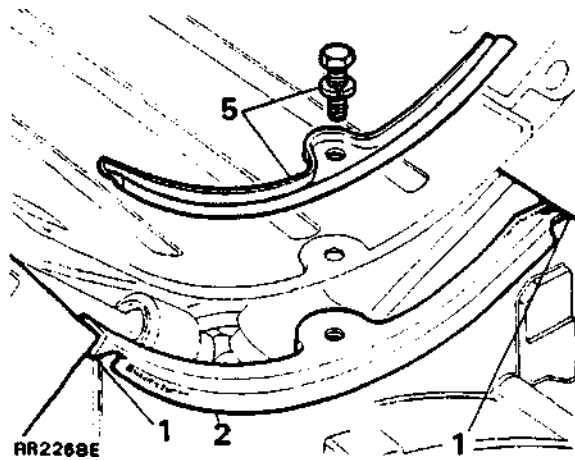


It should be noted that tappet noise can be expected on initial starting up after an overhaul due to oil drainage from the tappet assemblies or indeed if the vehicle has been standing over a very long period. If excessive noise should be apparent after an overhaul, the engine should be run at approximately 2,500 rev/min for a few minutes (subject to the following caution), when the noise should be eliminated.

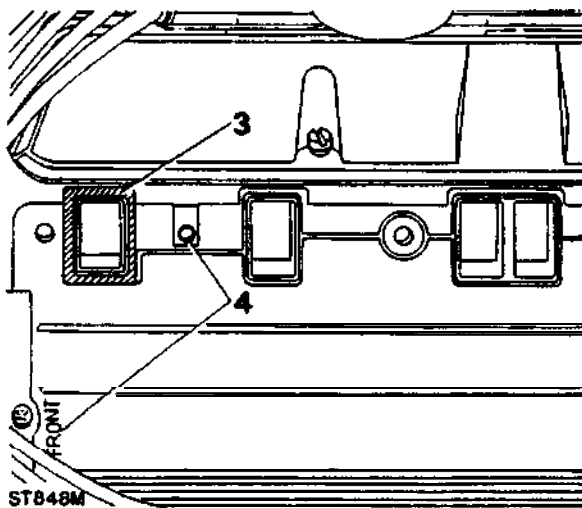
**CAUTION:** Do not exceed 1,000 engine rev/min for 15 seconds when first starting the engine, otherwise the crankshaft rear oil seal will be damaged.

FIT THE INTAKE MANIFOLD

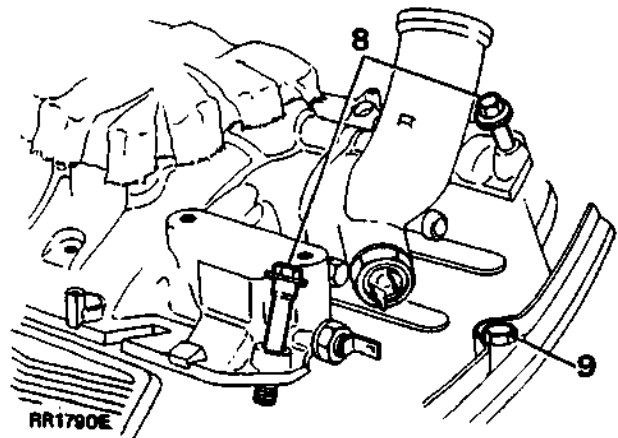
1. Apply a globule of Hylomar SQ32M sealing compound to the notches formed between the cylinder head and block.
2. Locate the NEW seals in position with their ends engaged in the notches formed between the cylinder heads and block.



3. Apply 'Hylomar' SQ32M sealing compound on the corners of the cylinder head, manifold gasket and manifold, around the water passage joints.
4. Fit the manifold gasket with the word 'FRONT' to the front and the open bolt hole at the front R.H. side.
5. Fit the gasket clamps but do not fully tighten the bolts at this stage.

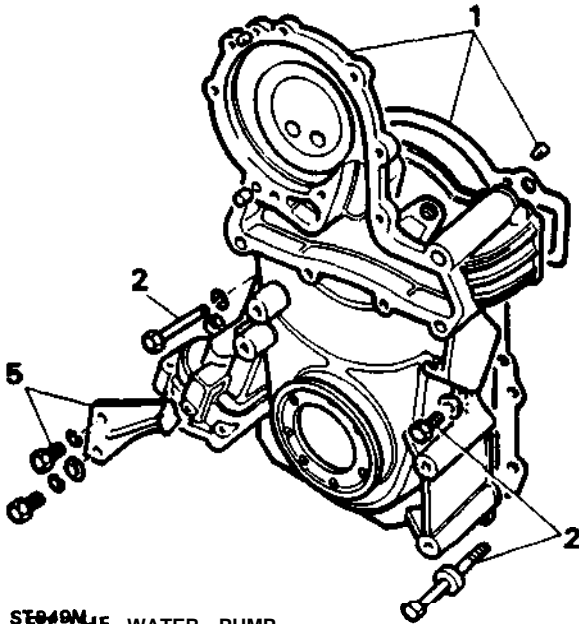


6. Locate the manifold on to the cylinder head.
7. Clean the threads of the manifold securing bolts.
8. Fit all the manifold bolts and tighten them a little at a time, evenly, alternate sides working from the centre to each end and finally tighten to the correct torque (see section 06-Torque values).
9. Tighten the gasket clamp bolts to the correct torque (see section 06-Torque values).



**FIT THE TIMING COVER AND CRANKSHAFT PULLEY**

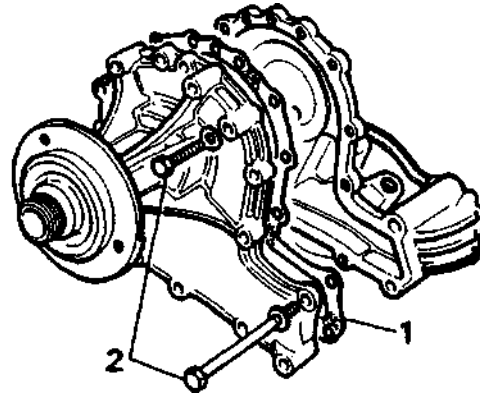
1. Place a new timing cover joint washer in position and fit the timing cover locating it on the two dowels.
2. Clean the threads of the timing cover securing bolts, then coat them with Thread Lubricant-Sealant Loctite 572.
3. Fit and evenly tighten the timing cover bolts to the correct torque (see section 06-Torque values).
4. Fit the crankshaft pulley and tighten the retaining bolt to the correct torque (see section 06-Torque values).
5. Fit timing pointer,



**STEP 5: FIT THE WATER PUMP**

1. Lightly grease a new joint washer and place it in position on the timing cover.
2. Clean the threads of the four long bolts and coat them with Loctite 572 thread lubricant sealant.  
Locate the water pump in position.
3. Locate the alternator adjusting link on the water pump.

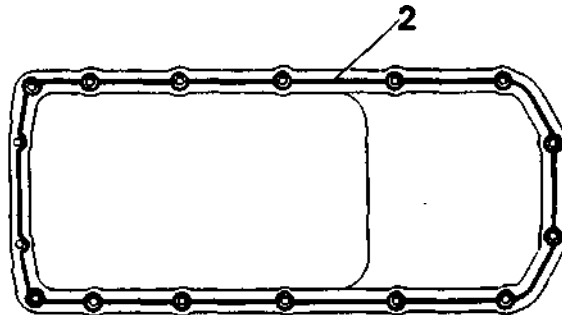
4. Leave the alternator adjusting link loose and tighten the remaining water pump housing bolts evenly and to the correct torque (see section 06-Torque values).



RR1795E

**FIT THE SUMP**

1. Remove any traces of previous sealant from the sump and cylinder block joint faces.
2. Apply a 2 mm (0.08 in) wide bead of Hylsil 102 to the joint face of the sump as shown in the illustration below.



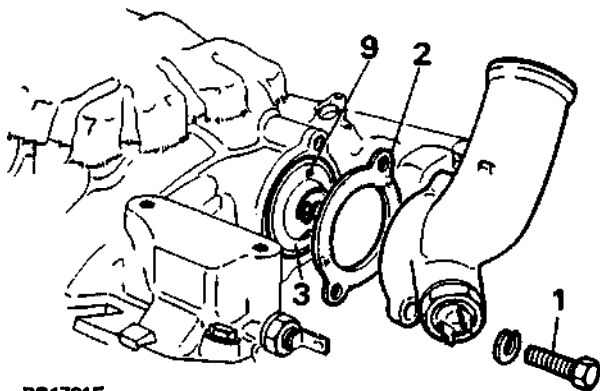
RR1867E

3. Place the sump in position, fit the sump bolts and evenly tighten the bolts to the specified torque (see section 06-Torque values).
4. Allow the vehicle to stand for a period of 30 minutes to ensure that the Hylsil is cured. Failure to do so could possibly result in repeating the sump fitting operation.



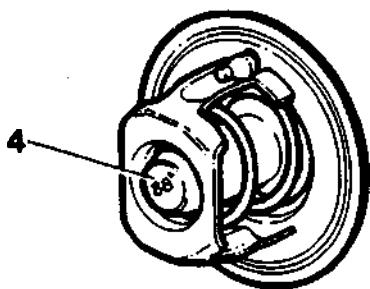
**TEST AND FIT THE THERMOSTAT**

1. Remove the two bolts securing the thermostat housing to the intake manifold.
2. Remove the housing gasket.
3. Withdraw the thermostat.



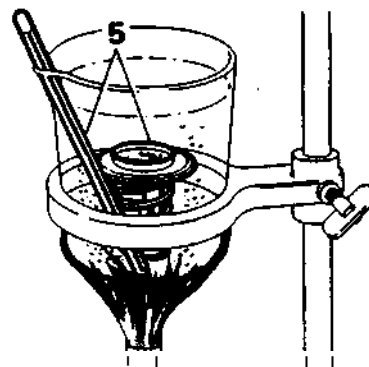
RR1791E

4. Note the temperature stamped on the thermostat at which it should be fully open, 88°C (190°F).



RR799M

5. Place the thermostat and a Centigrade thermometer in a laboratory beaker, or a suitable alternative, half full of water.
6. Heat the water and observe the temperature at which the thermostat opens.
7. If faulty discard the thermostat.
8. Clean the intake manifold and thermostat housing mating faces.

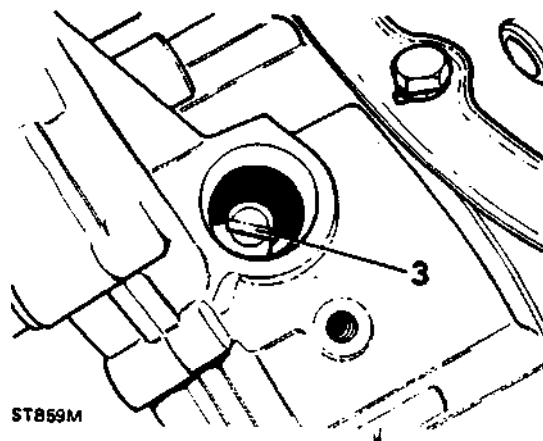


ST858M

9. Fit the thermostat with the jiggle pin uppermost at 12 o'clock.
10. Fit the housing using a new gasket, and tighten the two bolts to the correct torque (see section 06-Torque values).

**FIT THE DISTRIBUTOR**

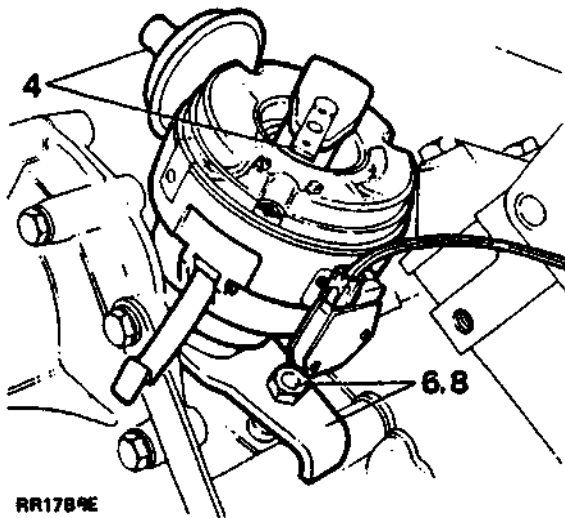
1. Turn the crankshaft to bring number one piston to 6" BTDC on the compression stroke (both valves closed number one cylinder).
2. Turn distributor drive until rotor arm is approximately 30" counter-clockwise from number one spark plug lead position on cap.
3. Turn the oil pump and distributor common drive shaft so that the tongue is in the approximate position as illustrated.



ST859M

Continued

4. Fit the distributor to the engine and check that the centre line of the rotor arm is now in line with number one spark plug lead position in the distributor cap. Reposition distributor if necessary. The vacuum capsule should be at approximately 90° to the camshaft.
5. If distributor does not seat correctly in front cover, oil pump drive is not engaged. In this event, remove distributor, reset oil pump drive tongue as necessary, and repeat operation.
6. Fit the clamp and nut leaving both loose at this stage.



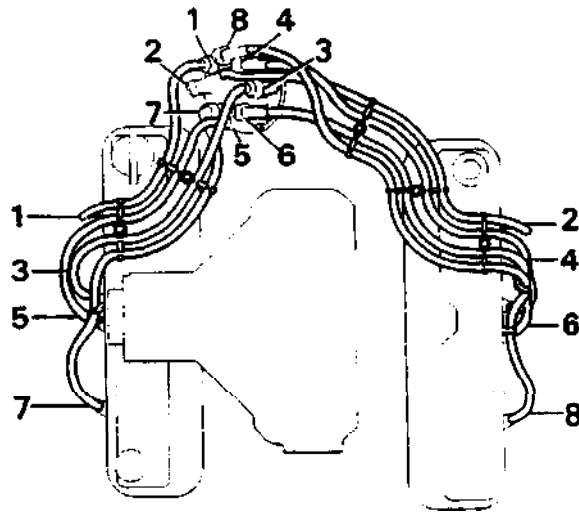
RR1784E

7. Rotate the distributor until the peak on the pick-up lines up with a peak on the reluctor ring. The rotor arm may be removed to afford a better view.

**CAUTION:** On no account must the engine be started before this operation is carried out.

8. Secure the distributor in this position by tightening the clamp nut.
9. Fit the distributor cap and spark plugs and connect the H.T. leads in accordance with illustration RR. 1876E.

**NOTE:** The above distributor setting is to enable the engine to be run so that the correct setting given in 'Engine Tuning Data' can be achieved once the engine is refitted to the vehicle.

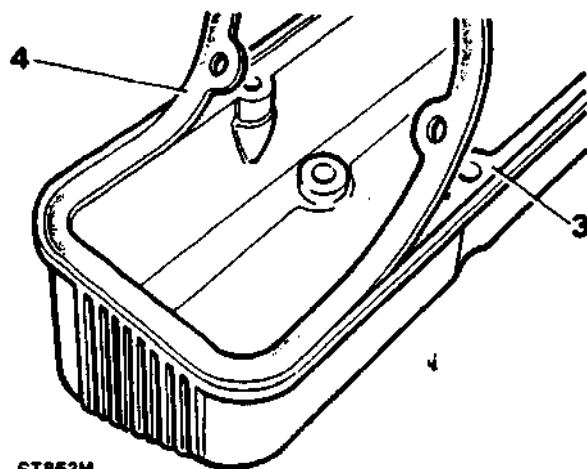


RR1876E

**FIT ROCKER COVERS**

1. Remove all traces of old gasket and sealant from the covers and cylinder heads.
2. Clean and dry the gasket mounting surface, using Bostik cleaner 6001.
3. Apply Bostik 1775 impact adhesive to the seal face and the gasket, using a brush to ensure an even film. Allow the adhesive to become touch-dry, after approximately fifteen minutes.

**NOTE:** The gasket fits one way round only and must be fitted accurately first time; any subsequent movement would destroy the bond.



ST853M

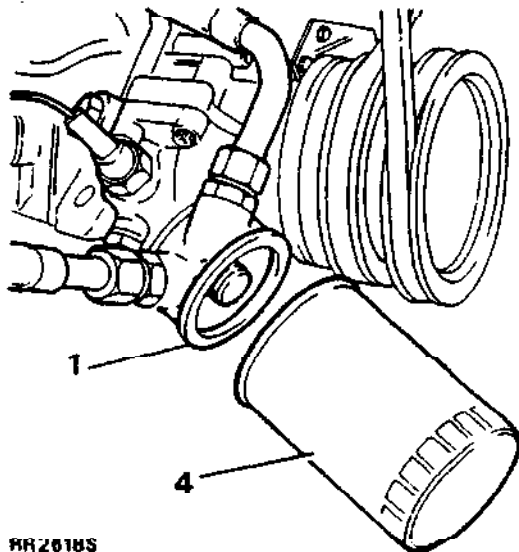
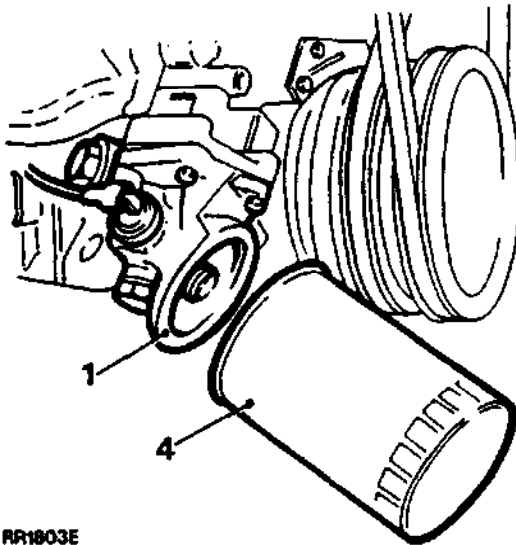
Continued

4. Place one end of the gasket into the cover recess with the edge firmly against the recess wall; at the same time hold the remainder of the gasket clear; then work around the cover, pressing the gasket into place ensuring that the outer edge firmly contacts the recess wall.
5. Allow the cover to stand for thirty minutes before fitting it to the cylinder heads.
6. Secure the rocker covers to the cylinder heads with the four screws. Short screws inboard, long screws outboard.

**FIT ENGINE OIL FILTER**

**RR2618S** shows 1989 Model Year condition

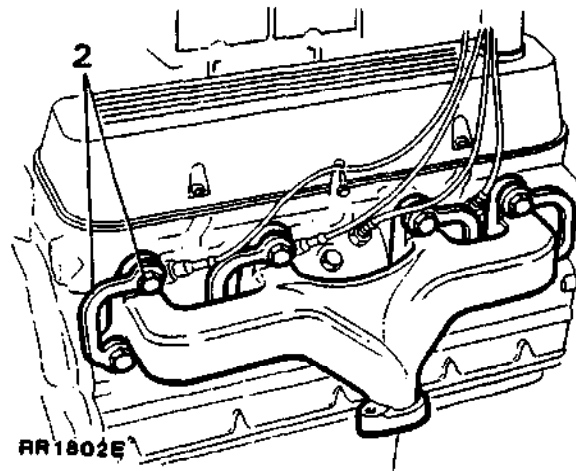
1. Clean the oil pump/oil cooler adaptor mating face.
2. Coat the sealing ring of the new filter with clean engine oil.
3. Fill the filter with new oil as far as possible, noting the angle at which the filter is to be fitted.



4. Screw on the filter until the sealing ring touches the oil pump/oil cooler mating face, then tighten it a further half turn by hand only. Do not over-tighten.
5. Refill the engine with the specified grade and quantity of oil.

**FIT EXHAUST MANIFOLD**

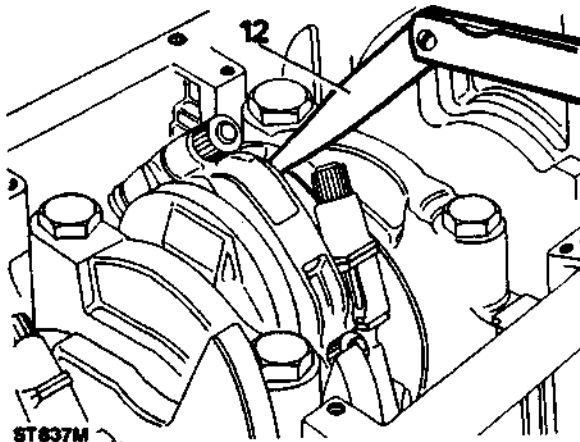
1. Ensure that the mating surfaces of the cylinder head and exhaust manifold are clean, fit new gaskets to the exhaust manifold and coat the threads of each bolt with anti-seize compound.
2. Place the manifold in position on the cylinder head and fit new lockplates, securing bolts, and plain washers. The plain washers are fitted between the manifold and lockplates. Evenly tighten the manifold bolts to the correct torque (see section 06-Torque values) and bend over the lock tabs.



**MISCELLANEOUS AND NON-STANDARD ITEMS**

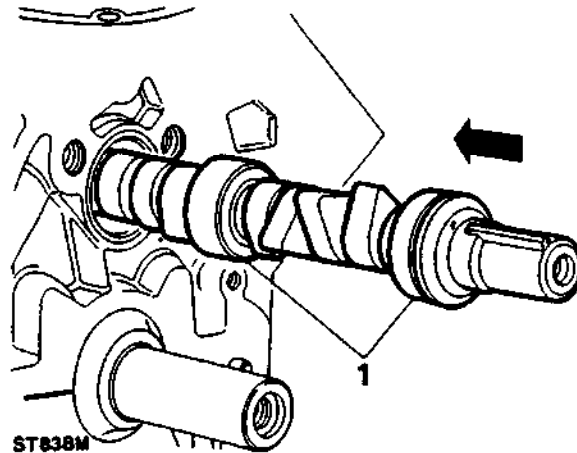
Fit any other items of equipment and miscellaneous hoses, pipes, filters, clips and brackets to the positions noted during dismantling.

9. Place the bearing lower shell in the connecting rod cap.
10. Locate the cap and shell onto the connecting rod, noting that the rib on the edge of the cap must be towards the front of the engine on the right hand bank of cylinders and towards the rear on the left hand bank.
11. Check that the connecting rods move freely sideways on the crankshaft. Tightness indicates insufficient bearing clearance or a misaligned connecting rod.
12. Check the end-float between the connecting-rods on each crankshaft journal. Clearance limits: 0.15 to 0.37 mm (0.006 to 0.015 in).
13. Tighten the connecting rod nuts to the correct torque (see section 06-Torque values). Fit the oil strainer and joint washer.

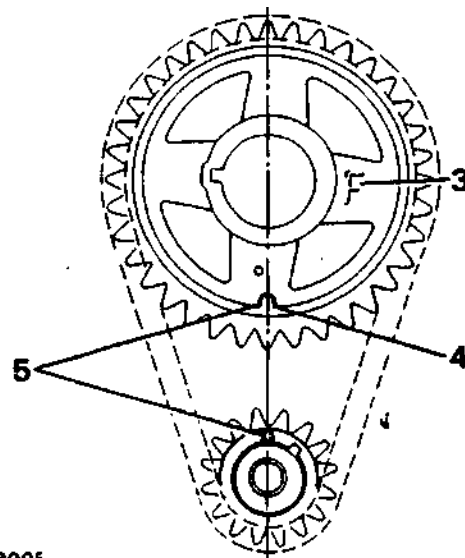


## FIT CAMSHAFT TIMING CHAIN AND SPROCKET

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

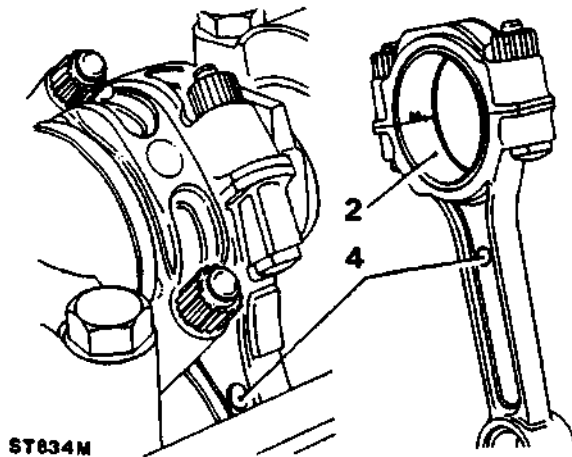


2. Turn the crankshaft to bring number one piston to TDC.
3. Temporarily fit the camshaft sprocket with the marking 'F' or 'FRONT' outward.
4. Turn the camshaft until the mark on the camshaft sprocket is at the six o'clock position, then remove the sprocket without disturbing the camshaft.
5. Encircle the sprockets with the chain keeping the timing marks aligned.

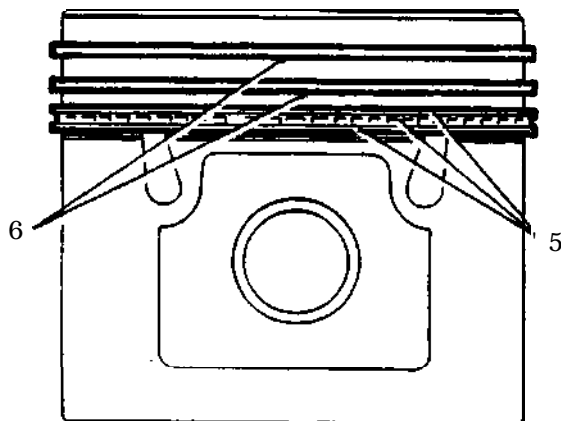


FIT CONNECTING RODS AND PISTONS

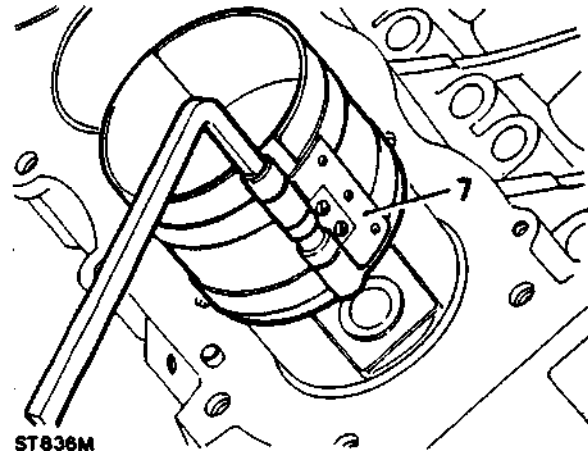
1. Locate the applicable crankshaft journal at B.D.C.
2. Place the bearing upper shell in the connecting rod.
3. Retain the upper shell by screwing the guide bolts 605351 onto the connecting rods.
4. Insert the connecting rod and piston assembly into its respective bore, noting that the domed shape boss on the connecting rod must face towards the front of the engine on the right hand bank of cylinders and towards the rear on the left hand bank. When both connecting rods are fitted, the bosses will face inwards towards each other.



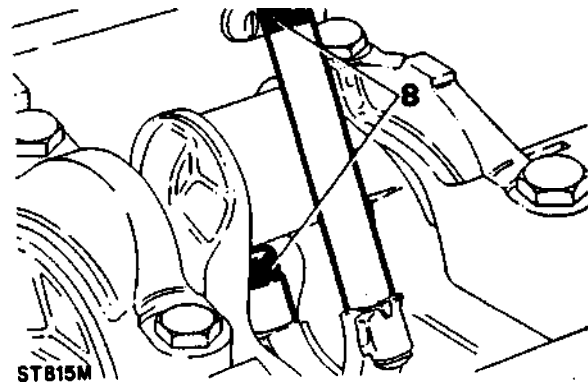
5. Position the oil control piston rings so that the ring gaps are all at one side, between the piston pin and piston thrust face. Space the gaps in the ring rails approximately 25 mm (1 in) each side of the expander ring joint.
6. Position the compression rings so that their gaps are on opposite sides of the piston between the piston pin and piston thrust face.



7. Using a piston ring compressor, locate the piston into the cylinder bore, until the piston crown is just below the cylinder block top face.



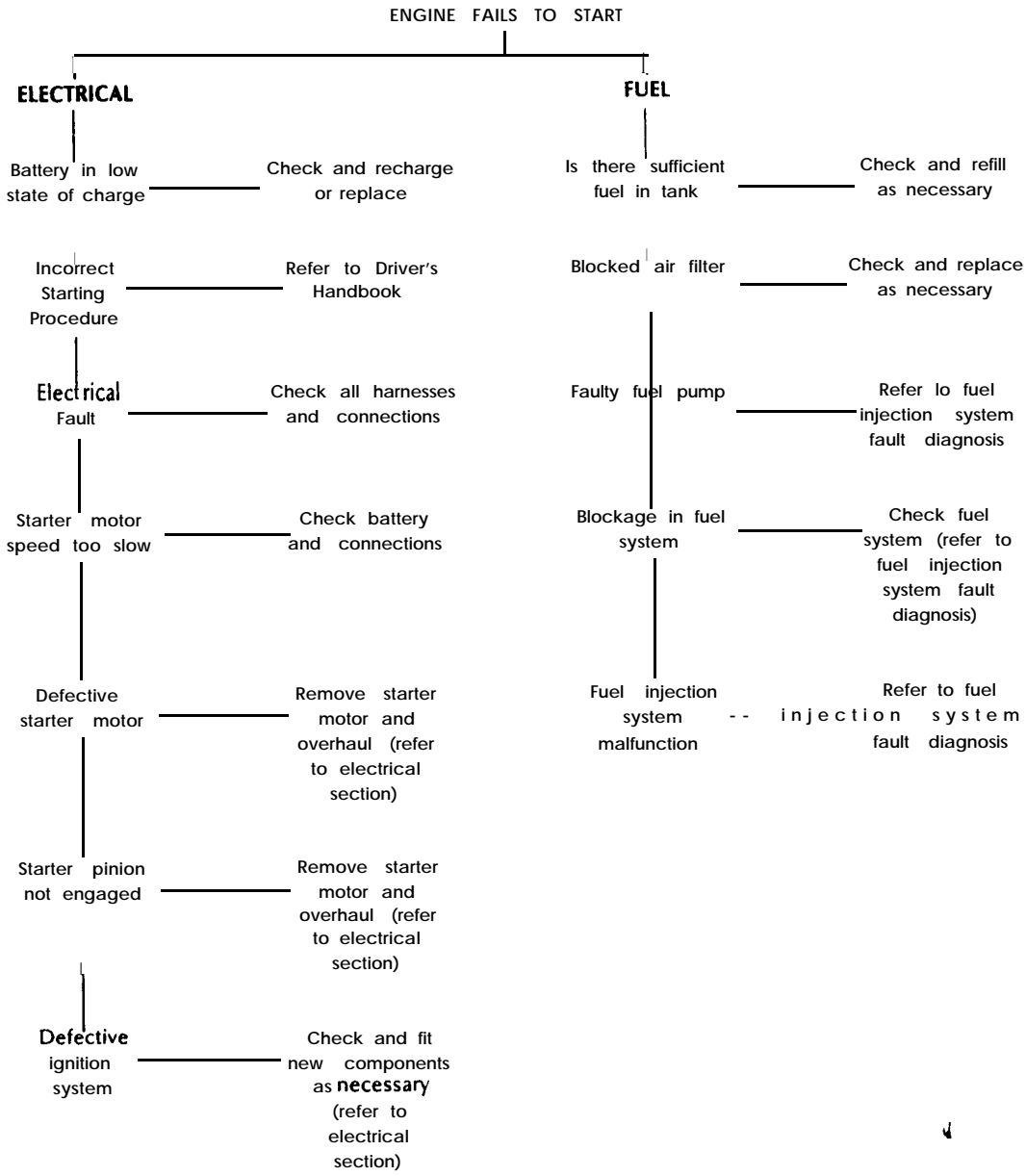
8. Pull the connecting rods on to the crankpins using the guide rods. Use extreme care when pulling the pistons down their respective bores to prevent scratching the crank pins.

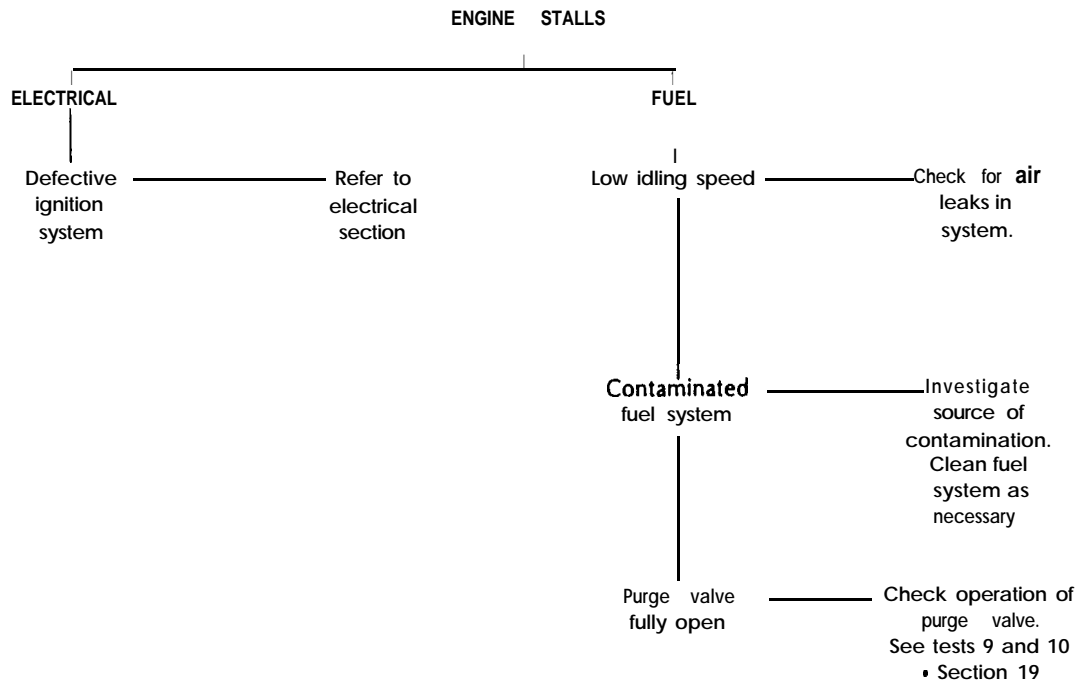
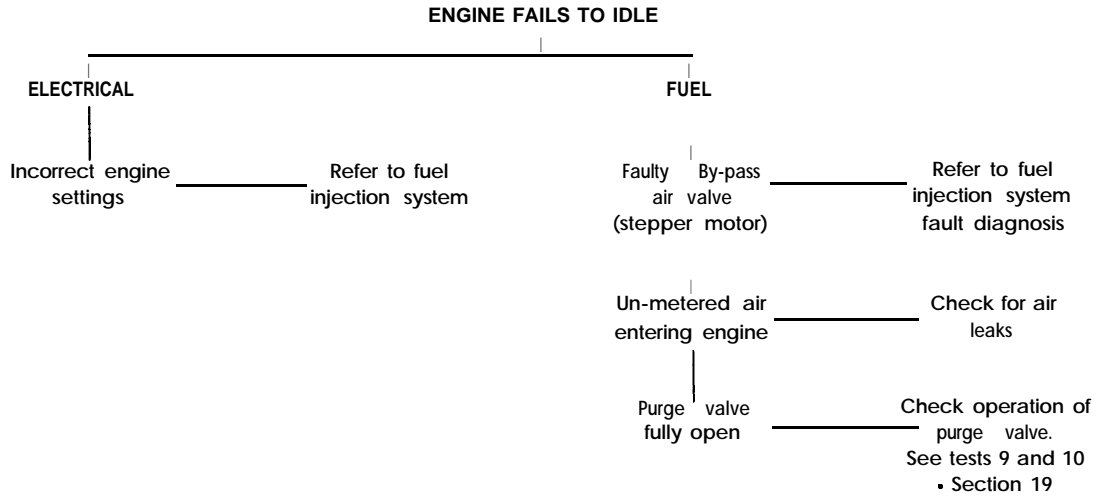


Continued

**FAULT DIAGNOSIS**

**NOTE:** The following fault diagnosis charts are intended as a guide only, having determined the possible fault refer to the appropriate section within the manual. The charts have been updated to include 1989 Model Year charcoal canister and purge valve. Refer to Emission Control • Section 17 and Fuel Injection System • Section 19 for full details of charcoal canister/purge valve.

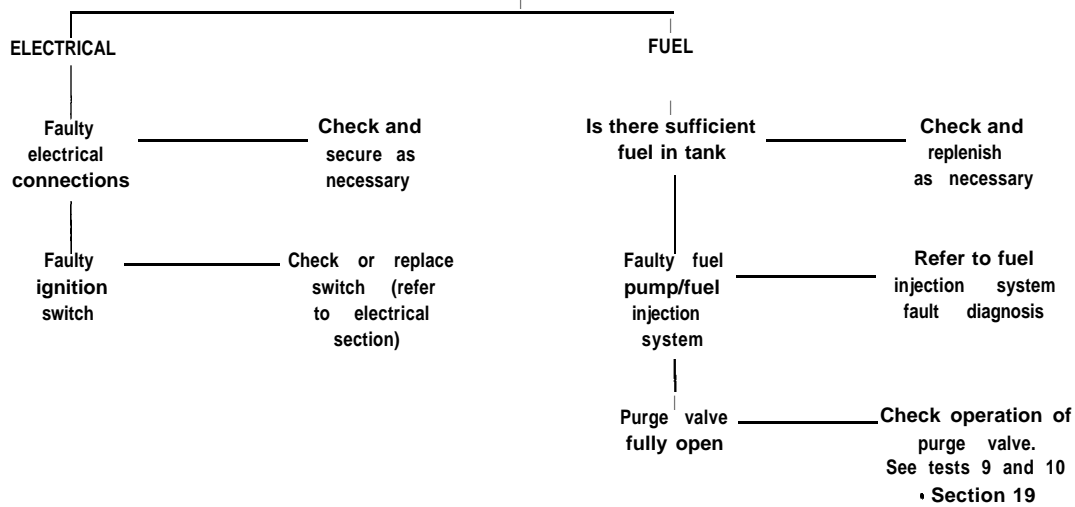




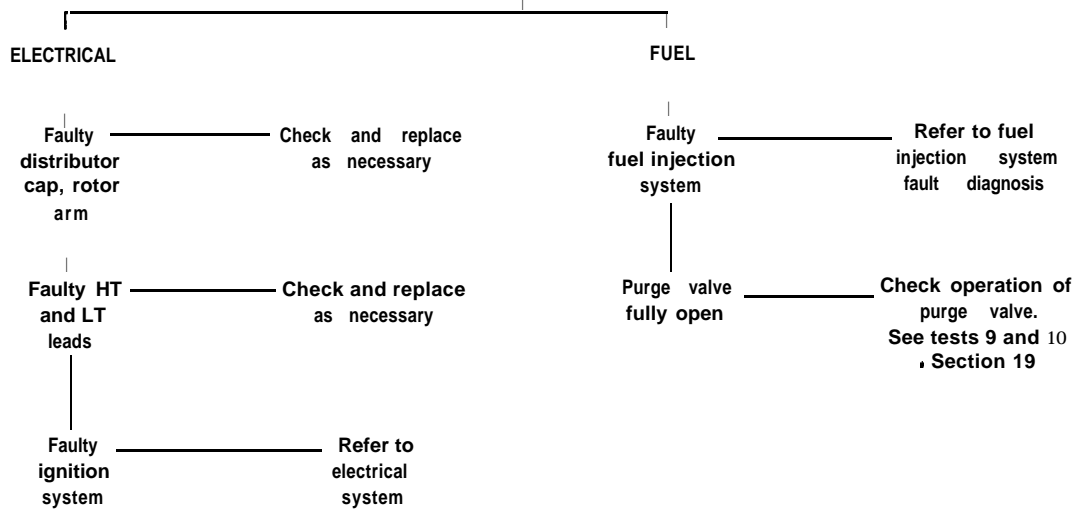
**NOTE: SMELL OF PETROL IN ENGINE COMPARTMENT, POSSIBLE CAUSE: PURGE VALVE STUCK CLOSED (NO PURGE ON CHARCOAL CANISTER) See tests 9 and 10 • Section 19.**

Continued

**ENGINE STARTS, BUT STOPS IMMEDIATELY**



**ENGINE MISFIRES ON ACCELERATION**





ENGINE RUNS ERRATICALLY

ELECTRICAL

Faulty electrical connections ————— Check, repair or secure as necessary

Defective distributor ————— Refer to Electrical Section

Incorrect ignition timing ————— Check and adjust as necessary

FUEL

Blocked air filter ————— Check and replace as necessary

Faulty pressure regulator (high and low pressure) ————— Refer to fuel injection system

Contaminated fuel ————— Flush system and replace fuel

Fuel system malfunction ————— Refer to fuel injection system fault diagnosis

Purge valve fully open ————— Check operation of purge valve. See tests 9 and 10 • Section 19

MECHANICAL

Vacuum hoses disconnected or damaged ————— Reconnect or replace as necessary

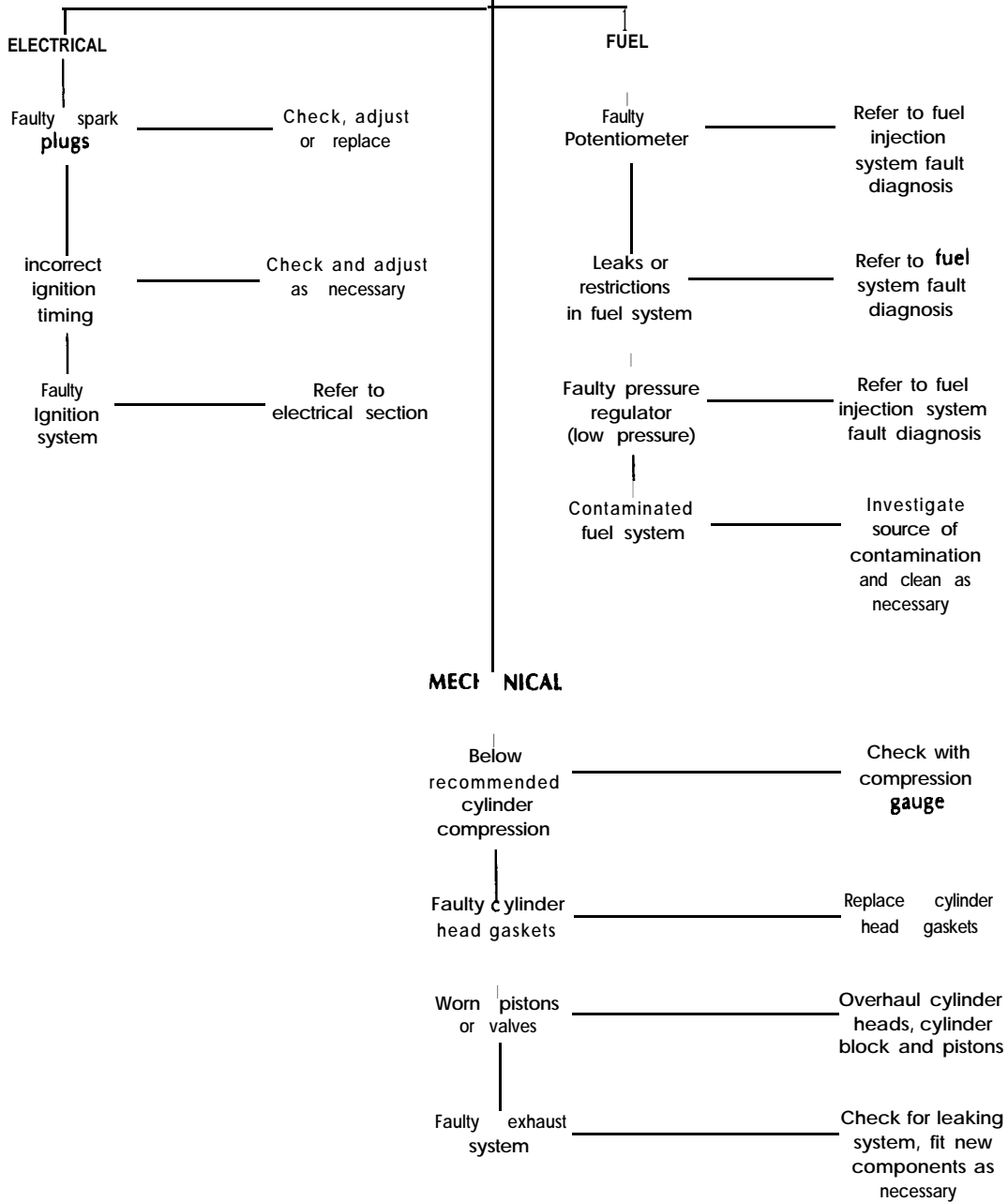
Below recommended cylinder pressure ————— Check with compression gauge

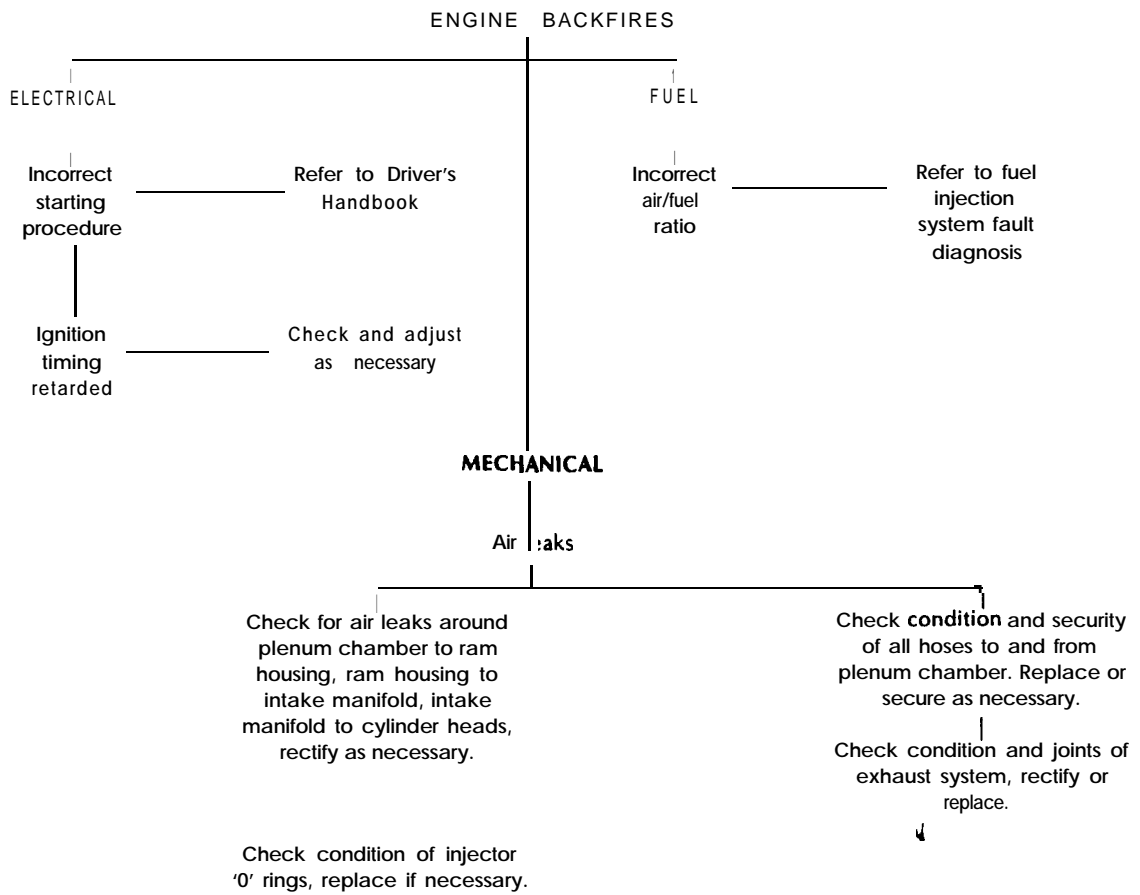
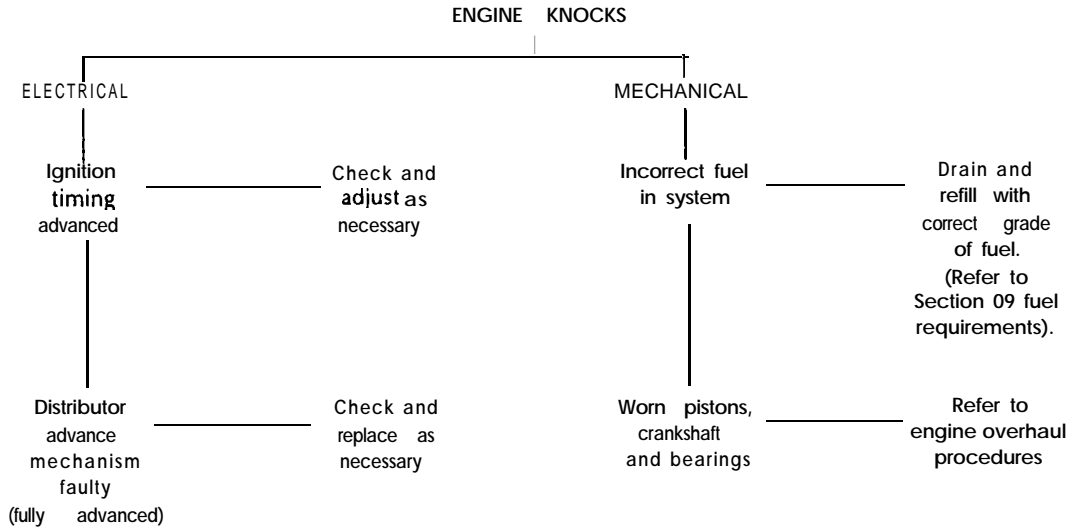
Faulty cylinder head gaskets ————— Replace cylinder head gaskets

Worn valve or valve guides ————— Overhaul cylinder heads

Continued

**LACK OF POWER**





Continued

NOISY VALVE MECHANISM

MECHANICAL

Worn or scored parts in valve operating mechanism — Overhaul cylinder head

Weak valve springs — Overhaul cylinder head

Tapping noise when engine is started and continues at idle — Check oil pressure

Worn tappet body  
faulty hydraulic tappet(s) — Investigate  
replace as necessary

Worn camshaft — Investigate  
replace as necessary

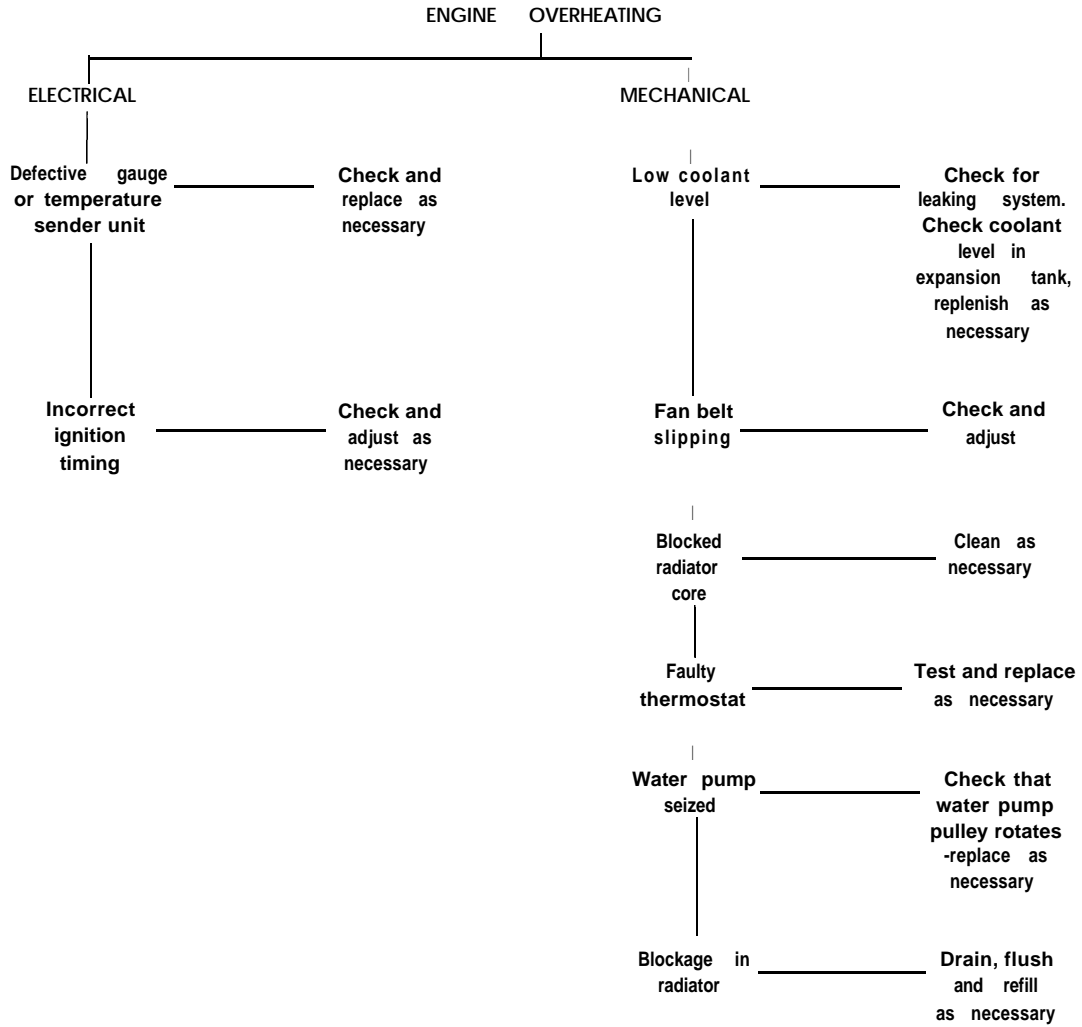
MAIN BEARING RATTLE

MECHANICAL

Low oil level in sump — Check and replenish as necessary

Low oil pressure — Check oil pressure

Worn bearings /excessive clearance — Check/overhaul cylinder block and crankshaft



Continued

OIL PRESSURE WARNING LIGHT REMAINS ON, ENGINE RUNNING

