Chapter 2 Part C: Engine removal and general engine overhaul procedures

Contents

Degrees of difficulty

Easy, suitable for novice with little experience

Fairly easy, suitable for beginner with some experience

Fairly difficult, suitable for competent DIY mechanic

Difficult, suitable for experienced DIY mechanic

Very difficult, suitable for expert DIY or professional

2C

Specifications

4-cylinder engines

Cylinder head

Valve seat angle (inlet and exhaust)	45º
Valve seat width (inlet and exhaust)	1.5 to 2.0 mm

Valves

	Inlet	Exhaust
Valve stem diameter	7.09 to 7.10 mm	7.07 to 7.09 mm
Valve head diameter	31.7 to 31.9 mm	29.2 to 29.4 mm
Valve stem-to-guide clearance	0.04 to 0.06 mm	0.06 to 0.07 mm
Valve spring free length:		
"M" series engines	41.0 mm	
"T" series engines	46.2 mm	

Pistons and piston rings

Piston-to-cylinder bore clearance:	
"M" series engines:	
Top of skirt	0.08 to 0.10 mm
Bottom of skirt	0.04 to 0.05 mm
"T" series engines	0.01 to 0.03 mm
Piston ring end gap - installed:	
"M" series engines:	
Compression rings	0.30 to 0.50 mm
Oil control ring	0.25 to 0.50 mm
"T" series engines:	
Top compression	0.25 to 0.35 mm
2nd compression	0.30 to 0.50 mm
Oil control	0.30 to 0.50 mm
Piston ring-to-groove clearance:	
Top compression	0.06 to 0.09 mm
2nd compression	0.05 to 0.07 mm

Cylinder block

Cylinder bore diameter	84.456 to 84.469 mm
Maximum cylinder bore taper	0.15 mm
Maximum cylinder bore ovality	0.15
Maximum gasket face distortion	0.10 mm

Crankshaft and bearings

Main bearing journal diameter	54.005 to 54.026 mm
Main bearing journal-to-shell running clearance	0.03 to 0.070 mm
Crankpin (big-end) bearing journal diameter	47.648 to 47.661 mm
Crankpin (big-end) bearing journal-to-shell running clearance	0.04 to 0.08 mm
Crankshaft endfloat	0.03 to 0.20 mm

Note: *Refer to Part A of this Chapter for torque wrench settings.*

V6 engines

Cylinder head

Valve seat angle (inlet and exhaust)	45º
Valve seat width (inlet and exhaust)	2.0 mm maximum

Valves

	Inlet	Exhaust
Valve stem diameter	6.58 to 6.59 mm	6.55 to 6.58 mm
Valve stem-to-guide clearance	0.16 mm maximum	0.22 mm maximum

Cylinder block

Cylinder bore diameter	87.00 to 87.02 mm
Maximum cylinder bore taper	0.05 mm
Maximum cylinder bore ovality	0.05 mm
Maximum gasket face distortion	0.10 mm

Pistons and piston rings

Piston-to-cylinder bore clearance	0.08 mm
Piston ring end gap:	
Top compression	0.35 mm maximum
2nd compression	0.50 mm maximum
Oil control ring	0.70 mm maximum
Piston ring-to-groove clearance	No information available

Crankshaft and bearings

Main bearing journal-to-shell running clearance	0.24 to 0.048 mm
Main bearing journal taper and ovality	0.010 mm maximum
Crankpin (big-end) bearing journal-to-shell running clearance	0.026 to 0.050 mm
Crankpin (big-end) bearing journal taper and ovality	0.010 mm maximum
Crankshaft endfloat	0.10 to 0.30 mm

Note: *Refer to Part B of this Chapter for torque wrench settings.*

1 General information

How to use this Chapter

This Part of Chapter 2 is devoted to engine/transmission removal and refitting, to those repair procedures requiring the removal of the engine/transmission from the vehicle, and to the overhaul of engine components. It includes only the Specifications relevant to those procedures. Refer to Parts A and B for additional Specifications, if required.

General information

The information ranges from advice concerning preparation for an overhaul and the purchase of replacement parts, to detailed step-by-step procedures covering removal and installation of internal engine components and the inspection of parts.

The following Sections have been written based on the assumption that the engine has been removed from the vehicle. For information concerning in-vehicle engine repair, as well as removal and installation of the external components necessary for the overhaul, see Parts A and B of this Chapter and Section 6 of this Part.

When overhauling the engine, it is essential to establish first exactly what replacement parts are available. On some of the engines covered in this Chapter, components such as the piston rings are not available separately from the piston/connecting rod assemblies; pistons, gudgeon pins and valve guides may also not be available separately as may some under- or oversized components. In some cases, depending on the extent of engine wear, it would appear that the easiest and most economically-sensible course of action is to replace a worn or damaged engine with an exchange unit.

2 Engine overhaul - general information

It's not always easy to determine when, or if, an engine should be completely overhauled, as a number of factors must be considered.

High mileage is not necessarily an indication that an overhaul is needed, while low mileage doesn't preclude the need for an overhaul. Frequency of servicing is probably the most important consideration. An engine that's had regular and frequent oil and filter changes, as well as other required maintenance, will most likely give many

thousands of miles of reliable service. Conversely, a neglected engine may require an overhaul very early in its life.

Excessive oil consumption is an indication that piston rings, valve seals and/or valve guides are in need of attention. Make sure that oil leaks aren't responsible before deciding that the rings and/or guides are worn. Perform a cylinder compression check to determine the extent of the work required.

Loss of power, rough running, knocking or metallic engine noises, excessive valve train noise and high fuel consumption rates may also point to the need for an overhaul, especially if they're all present at the same time. If a full service doesn't remedy the situation, major mechanical work is the only solution.

An engine overhaul involves restoring all internal parts to the specification of a new engine. **Note:** *Always check first what replacement parts are available before planning any overhaul operation; refer to Section 1 of this Part. Rover dealers, or a good engine reconditioning specialist/ automotive parts supplier may be able to suggest alternatives which will enable you to overcome the lack of replacement parts.*

During an overhaul, it is usual to renew the piston rings, and to rebore and/or hone the cylinder bores; where the rebore is done by an automotive machine shop, new oversize pistons and rings will also be installed - all these operations, of course, assume the availability of replacement parts. The main and big-end bearings are generally renewed and, if necessary, the crankshaft may be reground to restore the journals. Generally, the valves are serviced as well, since they're usually in less-than-perfect condition at this point. While the engine is being overhauled, other components, such as the starter and alternator, can be renewed as well, or rebuilt, if the parts can be found. The end result should be an as-new engine that will give many trouble-free miles. **Note:** *Critical cooling system components such as the hoses, drivebelt, thermostat and water pump MUST be replaced with new parts when an engine is overhauled. The radiator should be checked carefully, to ensure that it isn't clogged or leaking (see Chapter 3). Also, as a general rule, the oil pump should be renewed when an engine is rebuilt.*

Before beginning the engine overhaul, read through the entire procedure to familiarise yourself with the scope and requirements of the job. Overhauling an engine isn't difficult, but it is time-consuming. Plan on the vehicle being off the road for a minimum of two weeks, especially if parts must be taken to an automotive machine shop for repair or reconditioning. Check on availability of parts, and make sure that any necessary special tools and equipment are obtained in advance. Most work can be done with typical hand tools, although a number of precision measuring tools are required, for inspecting parts to determine if they must be replaced. Often, an automotive machine shop will handle the inspection of parts, and will offer advice concerning reconditioning and replacement. **Note:** *Always wait until the engine has been completely dismantled, and all components, especially the cylinder block/crankcase, have been inspected, before deciding what service and repair operations must be performed by an automotive machine shop. Since the block's condition will be the major factor to consider when determining whether to overhaul the original engine or buy a rebuilt one, never purchase parts or have machine work done on other components until the cylinder block/crankcase has been thoroughly inspected.* As a general rule, time is the primary cost of an overhaul, so it doesn't pay to install worn or sub-standard parts.

As a final note, to ensure maximum life and minimum trouble from a rebuilt engine, everything must be assembled with care, in a spotlessly-clean environment.

3 Engine removal - methods and precautions

If you've decided that an engine must be removed for overhaul or major repair work, several preliminary steps should be taken.

Locating a suitable place to work is extremely important. Adequate work space, along with storage space for the vehicle, will be needed. If a workshop or garage isn't available, at the very least, a flat, level, clean work surface made of concrete or asphalt is required.

Cleaning the engine compartment and engine/transmission before beginning the removal procedure will help keep tools clean and organised.

An engine hoist or A-frame will be necessary. Make sure the equipment is rated in excess of the combined weight of the engine and transmission. Safety is of primary importance, considering the potential hazards involved in removing the engine/transmission from the vehicle.

If this is the first time you have removed an engine, a helper should ideally be available. Advice and aid from someone more experienced would also be helpful. There are many instances when one person cannot simultaneously perform all of the operations required when removing the engine/transmission from the vehicle.

Plan the operation ahead of time. Arrange for, or obtain, all of the tools and equipment you'll need prior to beginning the job. Some of the equipment necessary to perform engine/transmission removal and installation safely and with relative ease, and which may have to be hired or borrowed, includes (in addition to the engine hoist) a heavy-duty trolley jack, a strong pair of axle stands, some wooden blocks, and an engine dolly (a low, wheeled platform capable of taking the weight of the engine/transmission, so that it can be moved easily when on the ground). A complete set of spanners and sockets (as described in the front of this manual) will obviously be needed, together with plenty of rags and cleaning solvent for mopping-up spilled oil, coolant and fuel. If the hoist is to be hired, make sure that you arrange for it in advance, and perform all of the operations possible without it beforehand. This will save you money and time.

Plan for the vehicle to be out of use for quite a while. A machine shop will be required to perform some of the work which the do-it-yourselfer can't accomplish without special equipment. These establishments often have a busy schedule, so it would be a good idea to consult them before removing the engine, to accurately estimate the amount of time required to rebuild or repair components that may need work.

Always be extremely careful when removing and installing the engine/transmission. Serious injury can result from careless actions. By planning ahead and taking your time, the job (although a major task) can be accomplished successfully.

4 Engine/transmission (4-cylinder engine) - removal, separation and refitting

Note: *The engine can be removed from the car only as a complete unit with the transmission; the two are then separated for overhaul. The engine/transmission are removed upwards and out from the top of engine compartment.*

Removal

1 Extract the retaining clips and release the support struts from the bonnet. Tie the bonnet back in the fully-open position.

2 Drain the cooling system, the engine oil, and the transmission oil or fluid as described in Chapter 1.

3 Remove the complete air cleaner and intake trunking assembly, as described in the relevant Part of Chapter 4.

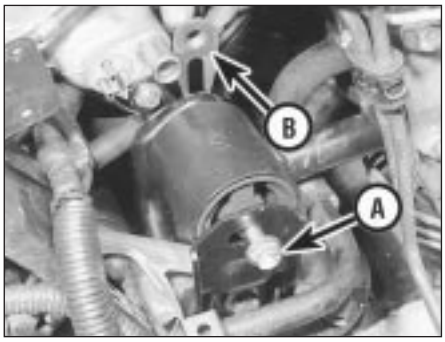
4 Remove the battery as described in Chapter 5, then undo the three bolts and remove the battery tray.

5 Undo the three bolts and remove the air cleaner support bracket, located below the battery tray.

6 On cars with single-point fuel injection, undo the three ignition/fuel ECU mounting bracket bolts, and move the ECU and bracket aside.

7 Slacken the clips and remove the radiator top hose, then disconnect the expansion tank hose at the thermostat housing. On single-point injection models, disconnect the two heater outlet hoses at the inlet manifold.

4.9 Undo the bolt (arrowed) securing the engine rear tie-bar support bracket to the inlet manifold



4.10 Remove the tie-bar through-bolt (A) and recover the forked nut (B)

4.12a Disconnect the radiator hose (arrowed) at the main coolant pipe . . .

8 Disconnect the remaining vacuum hose at the inlet manifold.

9 Undo the bolt securing the engine rear tie-bar support bracket to the inlet manifold **(see illustration)**.

10 Undo the two through-bolts securing the engine rear tie-bar to the engine and body brackets, and recover the special forked nut **(see illustration)**. Note that the forked end of the nut engages with a bracket projection to prevent the nut turning.

11 Withdraw the rear tie-bar from its brackets, noting that it is stamped with the word TOP on the upper face of the larger end, which must be refitted accordingly.

12 Slacken the clips and disconnect the radiator bottom hose at the radiator and main coolant pipe, the bottom hose take-off at the expansion tank pipe, the two heater hoses at the heater matrix, and the heater outlet hose at the inlet manifold or throttle housing **(see illustrations)**. On automatic transmission models, disconnect the two coolant hoses at the transmission oil cooler.

13 Place absorbent rags around the fuel filter outlet banjo union bolt on the left-hand side of the filter, then slowly unscrew the bleed screw in the centre of the bolt, or the bolt itself as applicable, to relieve the fuel system pressure. When the pressure is released, remove the bolt and recover the two copper washers. Tighten the bleed screw where fitted.

14 Release the clip and disconnect the fuel return hose from the pipe below the fuel filter. Plug or tape over the disconnected fuel hoses and unions.

15 Disconnect the accelerator cable at the throttle end, as described in the relevant Part of Chapter 4.

16 Undo the brake servo vacuum hose banjo union bolt at the inlet manifold, and recover the two copper washers.

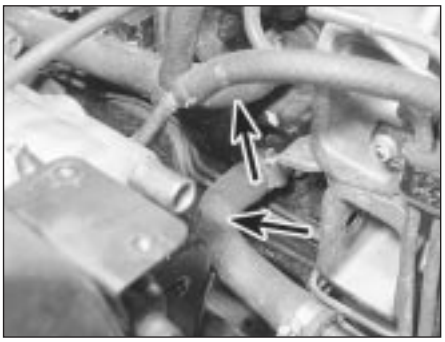
17 On cars with single-point fuel injection, disconnect the wiring multiplug from the ignition/fuel ECU, and remove the relay from its holder behind the ECU location **(see illustration)**.

18 Separate the engine wiring harness from the main wiring harness by disconnecting the large round wiring multiplug located behind the battery. Additionally, on cars with single-point fuel injection, disconnect the adjacent large flat multiplug, and on cars with multi-point fuel injection, the multiplugs at the rear right-hand side of the engine compartment **(see illustrations)**.

19 Disconnect the two sensing leads at the battery clamps, noting their locations, and also the main positive lead to the starter motor at the battery clamp.

20 Remove the cover from the fuse and relay box on the left-hand side of the engine compartment, then lift off the cover over the fusible links.

21 Lift out the engine harness cable retaining clip, undo the cable retaining screw, and remove the cable from the fuse and relay box **(see illustrations)**.

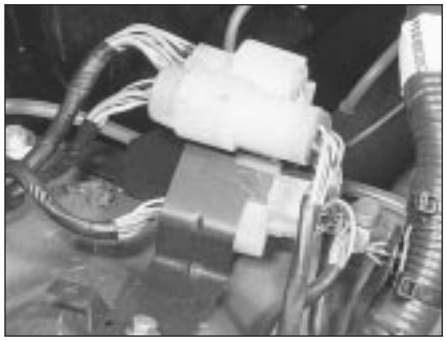


4.12b . . . and the heater hoses at the heater matrix (arrowed)

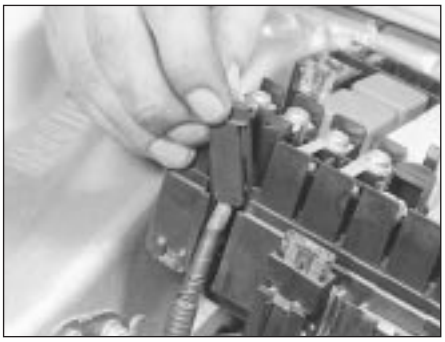
4.17 Remove the relay behind the ignition/fuel ECU

4.18a Disconnect the large round wiring multiplug (arrowed) . . .

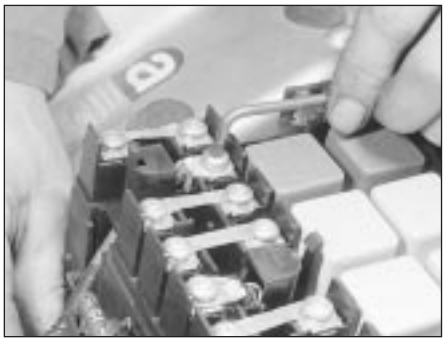
4.18b . . . and the adjacent flat multiplug



4.18c Disconnect the appropriate multi-plugs at the rear of the engine compartment



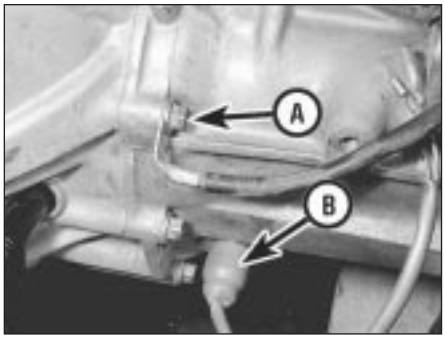
4.21a Lift out the engine harness cable retaining clip . . .



4.21b . . . undo the cable retaining screw . . .

4.21c . . . and remove the cable from the fuse and relay box

22 Disconnect the HT and LT leads at the ignition coil.
23 Disconnect the single cable at the starter solenoid.
24 Undo the bolt and disconnect the earth lead on the side of the transmission, then slide up the rubber boot and disconnect the reversing light switch wires **(see illustration)**.
25 On automatic transmission models, extract the spring clip and withdraw the steel and rubber washers securing the selector cable end to the transmission selector lever. Undo the outer cable retaining nut at the abutment bracket, release the inner and outer cables, and recover the inner cable spacer.
26 Disconnect the speedometer transducer cable at the wiring multiplug.
27 Check that all electrical connections between the engine and the car main wiring harness have been disconnected and moved clear. The engine wiring harness stays *in situ,* and is removed with the engine assembly.
28 Slacken the hose clips and disconnect the two power steering hoses at the fluid reservoir **(see illustration)**. Plug the hoses and the outlets immediately to reduce fluid loss.
29 Undo the two power steering pipe support bracket bolts, and release the pipes from the brackets **(see illustration)**.
30 On cars with a rear-mounted power steering pump, slacken the clip and disconnect the power steering fluid return hose from the pipe, then remove the pipe and hose assembly clear of the engine **(see illustration)**.
31 Jack up the front of the car and support it on axle stands.
32 Refer to Chapter 4 if necessary, and separate the exhaust front section at the manifold or turbocharger, and at the intermediate pipe flange joints. Remove the exhaust front section from the car.
33 On manual transmission models, extract the spring clip and withdraw the clevis pin securing the clutch slave cylinder pushrod to the release arm. Undo the two slave cylinder retaining bolts and move the cylinder aside.
34 On manual transmission models, undo the bolt in the centre of the transmission steady rod. Remove the dished washer, slide off the steady rod and remove the inner flat washer. Remove the spring clip to expose the gearchange rod-to-gearchange shaft retaining roll pin. Using a parallel pin punch, tap out the roll pin and slide the gearchange rod rearwards off the shaft.
35 Undo the eight bolts and remove the longitudinal support member from beneath the engine **(see illustration)**.
36 On cars with a front-mounted power steering pump, undo the pipe union and remove the fluid pipe from the rear of the pump. Plug the unions to prevent fluid loss.
37 Undo the nut securing the right-hand steering knuckle balljoint to the lower suspension arm, then release the balljoint from the arm using a universal balljoint separator tool or two-legged puller.
38 Pull the steering knuckle outwards, then

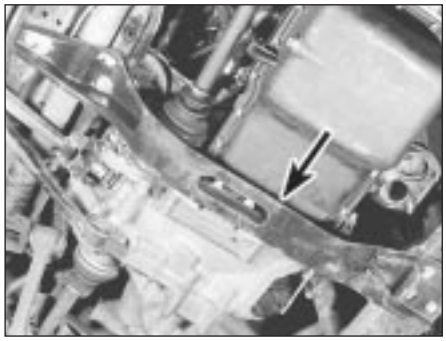


4.24 Disconnect the transmission earth lead (A) and the reversing light switch wires (B)

4.28 Disconnect the two power steering hoses at the fluid reservoir

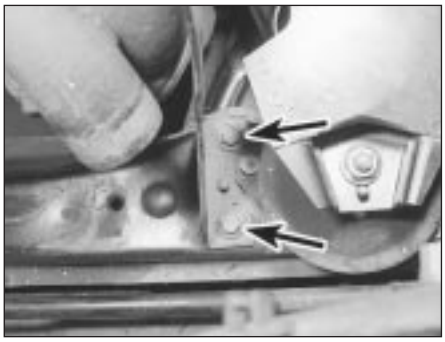
4.29 Undo the power steering pipe support bracket bolts

4.30 Disconnect the power steering fluid return hose (arrowed)



4.35 Undo the bolts and remove the longitudinal support member (arrowed)

4.43 Remove the right-hand engine mounting



4.44 Undo the bolts (arrowed) and remove the air cleaner trunking support bracket

4.45 Undo the nut securing the front engine mounting

using a flat bar or large screwdriver, lever between the driveshaft inner constant velocity joint and the differential housing to release the joint.

39 Move the driveshaft clear, then repeat these operations on the left-hand driveshaft.

40 Attach a hoist to the engine using rope slings, or chains attached to brackets secured to the cylinder head. Adjust the ropes or chains so that the engine will hang at approximately 30º to the horizontal, with the timing belt end uppermost, when it is lifted out.

41 On automatic transmission models, undo the mounting bracket bolts and remove the engine lower tie-bar from under the front of the car, complete with mounting brackets.

42 Undo the right-hand engine mounting through-bolt, and recover the special nut. Note that the forked end of the nut plate locates over a stud on the body bracket.

43 Undo the two bolts securing the engine mounting to its mounting bracket, and remove the mounting **(see illustration)**.

44 Undo the two bolts securing the air cleaner trunking support bracket to the front chassis member, and remove the bracket **(see illustration)**.

45 Undo the nut securing the front engine mounting to its transmission bracket **(see illustration)**.

46 Undo the nut securing the rear engine mounting to its transmission bracket.

47 Raise the engine slightly, then on cars with a rear-mounted power steering pump, undo the power steering pipe union nut at the rear of the pump, and remove the pipe. Plug the unions to prevent loss of fluid.

4.49 Removing the engine and transmission from the car

48 Make a final check that everything connecting the engine and transmission to the car has been disconnected and moved well clear.

49 Carefully lift the power unit upwards, whilst moving and twisting it slightly to clear the various projections **(see illustration)**. When the unit has been raised sufficiently, draw the hoist forwards to bring the engine unit over the front body panel, then lower it to the floor.

Separation - manual transmission models

50 With the engine/transmission removed from the car, undo the starter motor retaining bolts, and remove the unit from the clutch housing.

51 Undo the three bolts and remove the engine snubber bracket from the transmission adaptor plate beneath the engine sump.

52 Undo the two bolts securing the front engine mounting bracket to the transmission, and remove the bracket.

53 Undo the bolts securing the rear engine mounting bracket to the transmission, noting the location of the crankshaft sensor bracket. Move the sensor aside and remove the bracket.

54 Undo all the remaining bolts securing the transmission to the engine.

55 With the transmission well supported, release the locating dowels and draw the unit squarely away from the engine.

Separation - automatic transmission models

56 With the engine/transmission removed from the car, undo the starter motor retaining bolts and remove the unit from the converter housing.

57 Refer to Chapter 7, Part B and release the kickdown cable from the engine.

58 Turn the crankshaft as necessary, using a socket or spanner on the crankshaft pulley bolt, until one of the torque converter retaining bolts becomes accessible through the starter motor aperture. Undo the bolt, turn the crankshaft and remove the remaining two bolts in the same way.

59 Undo the two bolts securing the front engine mounting bracket to the transmission, and remove the bracket.

60 Undo the bolts securing the rear engine mounting bracket to the transmission, noting the location of the crankshaft sensor bracket. Move the sensor aside and remove the bracket.

61 Undo the remaining bolts securing the transmission to the engine.

62 With the transmission well supported, release the locating dowels and draw the unit squarely away from the engine. Ensure that the torque converter stays in place on the transmission.

Attachment - all models

63 Attachment is the straightforward reversal of the separation sequence, but where applicable, tighten all nuts and bolts to the specified torque (Chapter 2, Part A). On manual transmission models, smear the gearbox mainshaft and release bearing face with molybdenum disulphide grease before attachment.

Refitting

64 Refitting is a straightforward reversal of removal, bearing in mind the following points:

(a) Refit all the engine mounting bolts loosely, then tighten them so as not to place any under strain. Ensure that the right-hand mounting bolt is positioned centrally within the elongated slot in the body bracket.

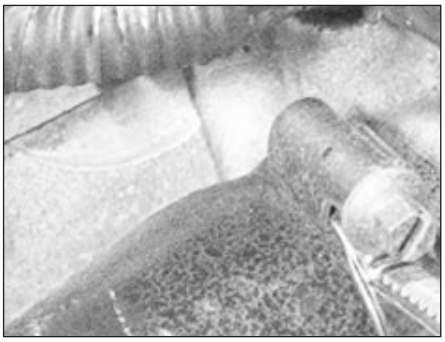
(b) Refill the cooling system as described in Chapter 1.

(c) Refill the transmission as described in Chapter 1.

(d) Fill the engine with oil as described in Chapter 1.

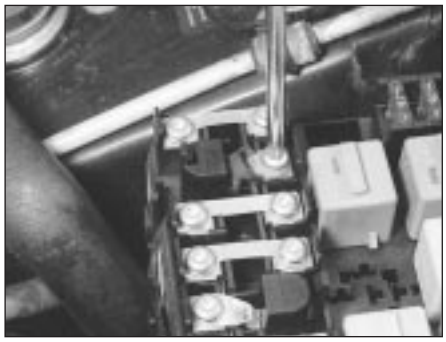
(e) Refill and bleed the power steering system as described in Chapter 10.

(f) Adjust the accelerator cable as described in the relevant Part of Chapter 4, and where applicable, the automatic transmission kickdown cable as described in Chapter 7 Part B.



5.10 Slacken the clips and disconnect the coolant hoses at the thermostat housing

5.14a Lift out the engine harness cable retaining clip . . .



5.14b . . . undo the screw, and remove the cable from the fuse and relay box

5 Engine/transmission (V6 engine) - removal, separation and refitting

Note: *The engine can be removed from the car only as a complete unit with the transmission; the two are then separated for overhaul. The engine/transmission are removed upwards and out from the top of engine compartment.*

Removal

1 Extract the retaining clips and release the support struts from the bonnet. Tie the bonnet back in the fully-open position.
2 Drain the cooling system, the engine oil, and the transmission oil or fluid as described in Chapter 1.
3 Remove the complete air cleaner and intake trunking assembly, as described in Chapter 4 Part D.
4 Remove the battery as described in Chapter 5, then undo the three bolts and remove the battery tray.
5 Refer to Chapter 3 and remove the radiator.
6 Disconnect the accelerator cable at the throttle end (Chapter 4 Part D). Release the cable from its support clips and move it clear.
7 Disconnect the HT lead at the ignition coil.
8 Undo the two through-bolts securing the engine rear tie-bar to the engine and body brackets, and recover the special forked nut. Note that the forked end of the nut engages with a bracket projection to prevent the nut turning. Withdraw the tie-bar from its brackets.
9 Undo the brake servo vacuum hose banjo union bolt at the inlet manifold, and recover the two copper washers.
10 Slacken the clips and disconnect the coolant hoses at the thermostat housing **(see illustration)**. Disconnect the two heater hoses from their connections on the side of the engine. Disconnect any remaining coolant hoses from the engine and move them clear.
11 Undo the bolt and disconnect the earth lead on the front engine side cover.
12 Disconnect the multiplugs and release the harness from the clips on and around the dipstick tube.
13 Remove the cover from the fuse and relay box on the left-hand side of the engine compartment, then lift off the cover over the fusible links.
14 Lift out the engine harness cable retaining clip, undo the cable retaining screw, and remove the cable from the fuse and relay box **(see illustrations)**.
15 Disconnect the two engine wiring harness wiring multiplugs located in a bracket below the battery tray.
16 Disconnect the battery lead at the starter motor.
17 Disconnect the engine earth lead on the transmission casing.
18 Check that all the vacuum hoses at the pipe cluster are numbered with corresponding numbers on their respective pipe stubs. Mark any as necessary, then disconnect all the hoses from the pipe cluster stubs.
19 Disconnect the cruise control vacuum hose and release the hose from the engine clips.
20 Check that all remaining vacuum hoses likely to impede removal of the engine have been removed.
21 Disconnect the hose at the charcoal canister (where fitted).
22 Disconnect the hose at the diverter valve (where fitted).
23 Place absorbent rags around the fuel filter outlet banjo union bolt on the left-hand side of the filter, then slowly unscrew the bleed screw in the centre of the bolt, to relieve the fuel system pressure. When the pressure is released, remove the bolt and recover the two copper washers. Tighten the bleed screw where fitted.
24 Release the clip and disconnect the fuel return hose from the pipe below the fuel filter **(see illustration)**. Plug or tape over the disconnected fuel hoses and unions.
25 Separate the engine wiring harness from the main wiring harness by disconnecting the three large round wiring multiplugs located at the rear right-hand side of the engine compartment **(see illustration)**. Release the harness from the support bracket and move it clear.
26 Wipe clean the area around the pipe and hose unions on the top of the power steering pump. Place absorbent rags around the unions.
27 Undo the two bolts securing the high pressure pipe connector, lift off the connector and recover the O-ring.
28 Slacken the hose clip, then disconnect the return hose from the pump. Plug or tape over the disconnected unions to prevent dirt entry.
29 Release the hoses from the support brackets and move them clear.
30 On cars equipped with air conditioning, remove the auxiliary drivebelt as described in Chapter 1, then remove the compressor from the engine as described in Chapter 3. Don't disconnect any of the refrigerant pipes, just release the mountings. Move the compressor to one side.

5.24 Disconnect the fuel return hose from the pipe below the fuel filter

5.25 Disconnect the three wiring multiplugs at the rear of the engine compartment

31 Undo the three expansion tank retaining bolts and move the expansion tank to one side.
32 Jack up the front of the car and support it on axle stands. Remove the front roadwheels.
33 Undo the bolts and remove the access panel under the right-hand wheelarch and the undertray from beneath the wheelarch.
34 Undo the flange bolts and separate the exhaust front pipes from the manifolds. Collect the gaskets.
35 Remove the engine oil cooler and filter head assembly as described in Part B, Section 18.
36 Undo the retaining bolt and remove the speedometer transducer assembly from the rear of the transmission. Move the assembly clear.
37 Undo and remove the nut from the rear engine mounting.
38 Undo the nut securing the right-hand steering knuckle balljoint to the lower suspension arm, then release the balljoint from the arm using a universal balljoint separator tool or two-legged puller.
39 Pull the steering knuckle outwards, then using a flat bar or large screwdriver, lever between the driveshaft and intermediate bearing assembly to release the joint.
40 Move the driveshaft clear, then repeat these operations on the left-hand driveshaft, but release it from the differential housing.
41 Attach a hoist using chains attached to the engine and transmission lifting eyes. Raise the hoist to just take the weight of the engine.
42 Undo the eight bolts and remove the longitudinal support member from beneath the engine.
43 On manual transmission models, undo the two slave cylinder retaining bolts, collect the pushrod and move the cylinder aside.
44 On manual transmission models, undo the bolt in the centre of the transmission steady rod. Remove the dished washer, slide off the steady rod and remove the inner flat washer. Remove the spring clip to expose the gearchange rod-to-gearchange shaft retaining roll pin. Using a parallel pin punch, tap out the roll pin and slide the gearchange rod rearwards off the shaft.
45 On automatic transmission models, refer to Chapter 7, Part B and disconnect the selector cable at the transmission end.
46 Undo the front engine mounting retaining nut, then undo the three bolts and remove the mounting bracket from the engine.
47 Undo the right-hand engine mounting through-bolt, and recover the special nut. Note that the forked end of the nut plate locates over a stud on the body bracket.
48 Undo the two bolts securing the right-hand engine mounting to the engine, and remove the mounting.
49 Check that all electrical connections between the engine and the car main wiring harness have been disconnected and moved clear. The engine wiring harness stays *in situ,* and is removed with the engine assembly.
50 Make a final check that everything connecting the engine and transmission to the car has been disconnected and moved well clear.
51 Support the engine on a jack with interposed block of wood positioned under the sump. take the weight of the engine/transmission on the jack so that the hoist can be lowered slightly. Reposition the lifting chains so that the engine will adopt approximately a 30º angle to the horizontal as it is lifted out, with the timing belt end uppermost.
52 Carefully lift the power unit upwards, whilst moving and twisting it slightly to clear the various projections **(see illustration)**. When the unit has been raised sufficiently, draw the hoist forwards to bring the assembly over the front body panel, then lower it to the floor.

Separation - manual transmission models

53 With the engine/transmission removed from the car, undo the starter motor retaining bolts, and remove the unit from the clutch housing.
54 Undo the bolts and remove the engine snubber bracket from the transmission adaptor plate beneath the engine sump.
55 Undo the bolts securing the rear engine mounting bracket to the transmission, and remove the bracket.
56 Undo all the remaining bolts securing the transmission to the engine.
57 With the transmission well supported, release the locating dowels and draw the unit squarely away from the engine.

Separation - automatic transmission models

58 With the engine/transmission removed from the car, undo the starter motor retaining bolts and remove the unit from the converter housing.
59 Refer to Chapter 7, Part B and release the kickdown cable from the engine.
60 Turn the crankshaft as necessary, using a socket or spanner on the crankshaft pulley bolt, until one of the torque converter retaining bolts becomes accessible through the opening on the lower face of the torque converter housing. Undo the bolt, then turn the crankshaft and remove the remaining bolts in the same way.
61 Undo the bolts securing the rear engine mounting bracket to the transmission, and remove the bracket.
62 Undo the remaining bolts securing the transmission to the engine.
63 With the transmission well supported, release the locating dowels and draw the unit squarely away from the engine. Ensure that the torque converter stays in place on the transmission.

5.52 Removing the engine and transmission from the car

Attachment - all models

64 Attachment is the straightforward reversal of the separation sequence, but where applicable, tighten all nuts and bolts to the specified torque (Chapter 2, Part A). On manual transmission models, smear the gearbox mainshaft and release bearing face with molybdenum disulphide grease before attachment.

Refitting

65 Refitting is a straightforward reversal of removal, bearing in mind the following points:
(a) Refit all the engine mounting bolts loosely, then tighten them so as not to place any under strain. Ensure that the right-hand mounting bolt is positioned centrally within the elongated slot in the body bracket.
(b) Refill the cooling system as described in Chapter 1.
(c) Refill the transmission as described in Chapter 1.
(d) Fill the engine with oil as described in Chapter 1.
(e) Refill and bleed the power steering system as described in Chapter 10.
(f) Adjust the accelerator cable as described in Chapter 4, Part D and where applicable, the automatic transmission kickdown cable as described in Chapter 7 Part B.

6 Engine overhaul - dismantling sequence

1 The engine dismantling and reassembly tasks are made easier if the engine is mounted on a portable engine stand which can be hired.
2 If a stand is not available, it is possible to dismantle the engine with it supported on a strong workbench or on the floor. Be careful not to tip or drop the engine when working without a stand.
3 If a reconditioned engine is to be fitted, all external components of the original engine must be removed in order to transfer them to the replacement unit (as they will if you are doing a complete engine rebuild). These components include the following, according to engine type.

(a) Alternator and mounting brackets.
(b) Power steering pump and air conditioning compressor.
(c) Distributor, HT leads and spark plugs.
(d) Thermostat and housing.
(e) Fuel injection system components.
(f) Inlet and exhaust manifolds and turbocharger.
(g) Oil filter and housing.
(h) Engine mountings.
(i) Flywheel/driveplate.
(j) Water pump.
(k) All associated pipes, hoses and brackets.

Note: *When removing the external components from the engine, pay close attention to details that may be helpful or important during refitting. Note the fitting positions of gaskets, seals, washers, bolts and other small items.*

4 If you are obtaining a short motor (which consists of the engine cylinder block, crankshaft, pistons and connecting rods all assembled), the cylinder head(s), sump, oil pump and timing belt will have to be removed also.

5 If a complete overhaul is planned, the engine can be dismantled and the internal components removed in the following order.

(a) Inlet and exhaust manifolds.
(b) Timing belt, tensioner and sprockets.
(c) Cylinder head(s).
(d) Flywheel/driveplate.
(e) Sump.
(f) Oil pump.
(g) Pistons (with connecting rods).
(h) Crankshaft.

6 Before starting the dismantling and overhaul procedures, make sure that you have all of the correct tools for the jobs to tackled. Refer to the introductory pages at the start of this manual for further information.

7 Cylinder head (4-cylinder engine) - dismantling

Note: *New and reconditioned cylinder heads are often available from the manufacturers, and from engine overhaul specialists. Due to the fact that some specialist tools are required for the dismantling and inspection procedures, and new components may not be readily available, it may be more practical and economical for the home mechanic to purchase a reconditioned head, rather than to dismantle, inspect and recondition the original head.*

1 With the cylinder head on the bench, remove the camshafts and tappets, thermostat housing, inlet and exhaust manifolds, and the spark plugs, referring to the applicable Sections and Chapters of this manual as necessary.

2 To remove the valves, compress each spring in turn with a universal valve spring compressor, until the two retaining collets can be removed **(see illustration)**.

3 Release the compressor, and lift off the spring top cup, valve spring, oil seal, valve spring seat and the valve **(see illustrations)**.

4 It is essential that the valves are kept in their correct order, unless they are so badly worn or burnt that they are to be renewed. If they are going to be refitted, place them in their correct sequence, along with the camshaft tappets removed previously. Also keep the valve springs, cups, seats and collets in the same order.

8 Cylinder head and rocker gear (V6 engine) - dismantling

Note: *Refer to the introductory note concerning reconditioned cylinder heads at the beginning of Section 7.*

1 With the cylinder head on the bench, remove the camshafts and tappets, the exhaust manifold, and the spark plugs, referring to the applicable Sections and Chapters of this manual as necessary.

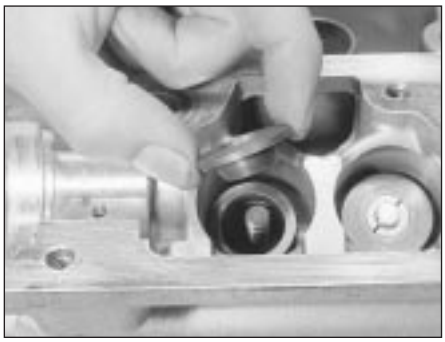
2 If working on the front cylinder head, undo the two bolts and remove the crank/angle sensor (where fitted) **(see illustration)**.

3 Unscrew the two blanking plugs from the cylinder head and collect the sealing washers.

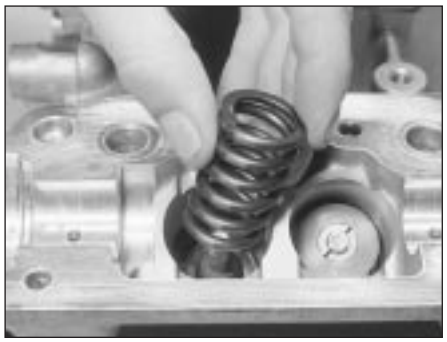
4 Screw a cylinder head bolt into the now exposed transmission end of the rocker shaft and pull the shaft out of the cylinder head.

5 As the shaft is removed, collect the rocker

7.2 Compress the valve springs with a universal valve spring compressor



7.3a Release the compressor, and lift off the spring top cup . . .

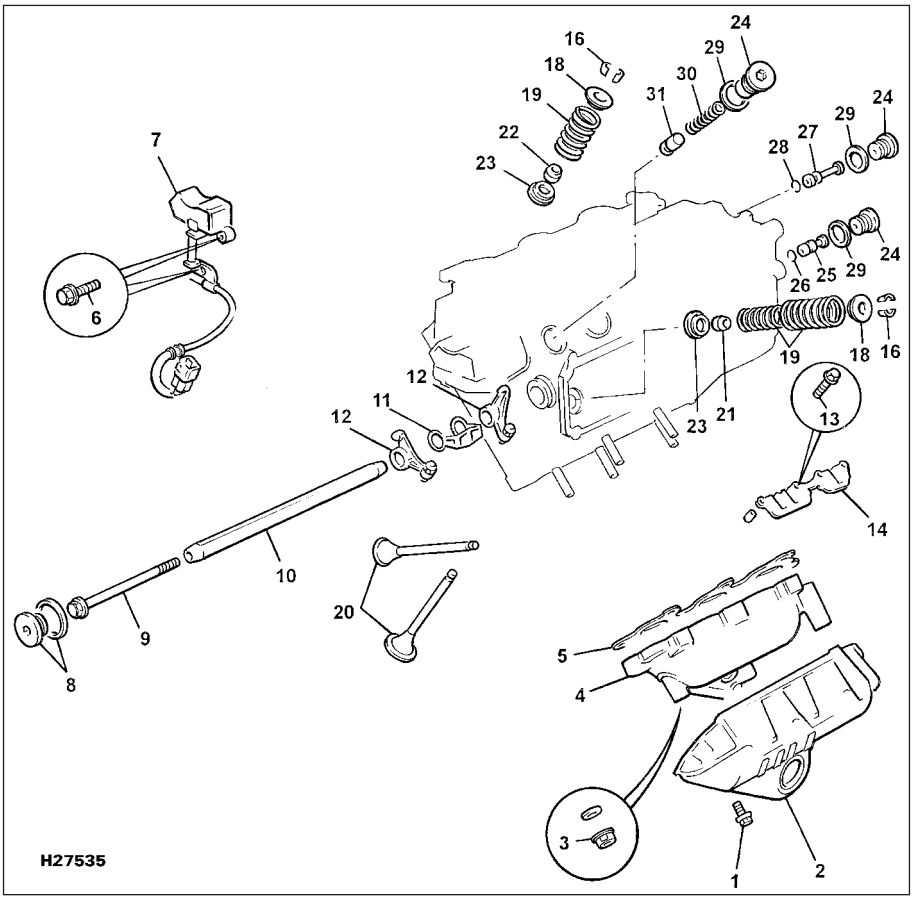


7.3b . . . valve spring . . .

7.3c . . . oil seal . . .

7.3d . . . spring seat . . .

7.3e . . . and the valve



8.2 V6 engine cylinder head and rocker gear components

1 *Exhaust manifold heat shield bolt*
2 *Exhaust manifold heat shield*
3 *Manifold nut*
4 *Exhaust manifold*
5 *Gasket*
6 *Crank/angle sensor bolts*
7 *Crank/angle sensor*
8 *Blanking plug and seal*
9 *Bolt for rocker shaft removal*
10 *Rocker shaft*
11 *Spacer springs*
12 *Rocker arm*
13 *Guide plate bolts*
14 *Guide plates*
16 *Collets*
18 *Spring top cups*
19 *Valve springs*
20 *Valves*
22 *Oil seal*
23 *Spring seats*
24 *Blanking plugs*
25 *Oil restrictor*
26 *O-ring*
27 *Oil plug*
28 *O-ring*
29 *Blanking plugs*
30 *Spring*
31 *Relief valve*

arm spacer springs and the rocker arms, and place them in their appropriate compartments of the marked box that has all the hydraulic tappets and slippers removed previously. Alternatively use labelled plastic bags.

6 Undo the eight bolts securing the guide plates and lift the guide plates off their locating dowels.

7 To remove the valves, compress each spring in turn with a universal valve spring compressor, until the two retaining collets can be removed.

8 Release the compressor, and lift off the spring top cup, valve spring(s), oil seal, valve spring seat and the valve.

9 It is essential that the valves are kept in their correct order, unless they are so badly worn or burnt that they are to be renewed. If they are going to be refitted, place them in their correct sequence, along with the tappets and other parts removed previously. Also keep the valve springs, cups, seats and collets in the same order.

9 Cylinder head, rocker gear and valve assemblies - cleaning and inspection

Note: *Always check first what replacement parts are available before planning any overhaul operation. A Rover dealer, or a good engine reconditioning specialist/automotive parts supplier, may be able to suggest alternatives which will enable you to overcome the lack of replacement parts.*

1 Thorough cleaning of the cylinder head and valve components, followed by a detailed inspection, will enable you to decide how much valve service work must be carried out during the engine overhaul. **Note:** *If the engine has been severely overheated, it is best to assume that the cylinder head is warped, and to check carefully for signs of this.*

Cleaning

2 Scrape away all traces of old gasket material and sealing compound from the cylinder head.

3 Scrape away the carbon from the combustion chambers and ports, then wash the cylinder head thoroughly with paraffin or solvent.

4 Scrape off any heavy carbon deposits that may have formed on the valves, then use a power-operated wire brush to remove deposits from the valve heads and stems.

Inspection

Note: *Be sure to perform all the following inspection procedures before concluding that the services of a machine shop or engine overhaul specialist are required. Make a list of all items that require attention.*

Cylinder head

5 Inspect the head very carefully for cracks, evidence of coolant leakage, and damage. If cracks are found, a new cylinder head should be obtained.

6 Use a straight edge and feeler blade to check that the head gasket surface is not distorted. If it is, it may be possible to re-surface it.

7 Examine the valve seats in each of the combustion chambers. If they are severely pitted, cracked or burned, then they will need to be renewed or re-cut by an engine overhaul specialist. If they are only slightly pitted, this can be removed by grinding-in the valve heads and seats with fine valve-grinding compound, as described below.

8 If the valve guides are worn, indicated by a side-to-side motion of the valve, new guides must be fitted. Measure the diameter of the existing valve stems (see below) and the bore of the guides, then calculate the clearance, and compare the result with the specified value; if the clearance is excessive, renew the valves or guides as necessary.

9 The renewal of valve guides is best carried out by an engine overhaul specialist.

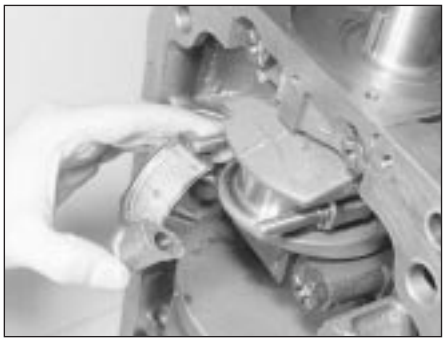
10 If the valve seats are to be re-cut, this must be done *only after* the guides have been renewed.

Valves

11 Examine the head of each valve for pitting, burning, cracks and general wear, and check the valve stem for scoring and wear ridges. Rotate the valve, and check for any obvious indication that it is bent. Look for pits and excessive wear on the tip of each valve stem. Renew any valve that shows any such signs of wear or damage.

12 If the valve appears satisfactory at this stage, measure the valve stem diameter at

9.12 Measuring the valve stem diameter



11.5 Removing the connecting rod cap and big-end bearing shell

11.6 Removing the piston and connecting rod assembly

several points, using a micrometer **(see illustration)**. Any significant difference in the readings obtained indicates wear of the valve stem. Should any of these conditions be apparent, the valve(s) must be renewed.

13 If the valves are in satisfactory condition, they should be ground (lapped) into their respective seats, to ensure a smooth gas-tight seal. If the seat is only lightly pitted, or if it has been re-cut, fine grinding compound *only* should be used to produce the required finish. Coarse valve-grinding compound should *not* be used unless a seat is badly burned or deeply pitted; if this is the case, the cylinder head and valves should be inspected by an expert, to decide whether seat re-cutting, or even the renewal of the valve or seat insert, is required.

14 Valve grinding is carried out as follows. Place the cylinder head upside-down on a bench, with a block of wood at each end to give clearance for the valve stems.

15 Smear a trace of (the appropriate grade of) valve-grinding compound on the seat face, and press a suction grinding tool onto the valve head. With a semi-rotary action, grind the valve head to its seat, lifting the valve occasionally to redistribute the grinding compound.

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A light spring placed under the valve head will greatly ease the grinding operation.

16 If coarse grinding compound is being used, work only until a dull, matt even surface is produced on both the valve seat and the valve, then wipe off the used compound, and repeat the process with fine compound. When a smooth unbroken ring of light grey matt finish is produced on both the valve and seat, the grinding operation is complete. *Do not* grind in the valves any further than absolutely necessary, or the seat will be prematurely sunk into the cylinder head.

17 When all the valves have been ground-in, carefully wash off *all* traces of grinding compound, using paraffin or solvent, before reassembly of the cylinder head.

Valve components and rocker gear

18 Examine the valve springs for signs of damage and discolouration, and also measure their free length by comparing each of the existing springs with a new component.

19 Stand each spring on a flat surface, and check it for squareness. If any of the springs are damaged, distorted, or have lost their tension, obtain a complete set of new springs.

20 Check the spring upper seats and collets for obvious wear and cracks. Any questionable parts should be renewed, as extensive damage will occur if they fail during engine operation. Any damaged or excessively-worn parts must be renewed; the valve spring lower seat/stem oil seals must be renewed as a matter of course whenever they are disturbed.

21 Check the rocker shaft on V6 engines for straightness and for any obvious sign of scoring where the rockers contact. Similarly check the rocker bore and the fit of the rocker on the shaft. Renew any suspect parts.

10 Cylinder head - reassembly

1 Before reassembling the cylinder head, first ensure that it is perfectly clean and no traces of grinding paste are left in the head or on the valves and guides. Use compressed air, if available, to blow out all the oil holes and passages.

2 Commence reassembly of the cylinder head by lubricating the valve stems and guides with clean engine oil.

3 With the valves and valve seats prepared, and with the valves in their correct order, commence reassembly, starting with the first valve of No 1 cylinder as follows.

4 Place the valve spring seat in position, then fit a new oil seal over the valve guide, pushing it fully into position.

5 Lubricate the valve stem with engine oil, then insert the valve into its guide.

6 Fit the valve spring(s), and place the top cup over the spring and valve.

7 Using the compressor tool, compress the valve spring until the two collets can be slid into position. Release the compressor carefully, in order not to displace the collets.

8 Refit the remaining valves in the same way. When they are all fitted, tap the end of each valve stem with a plastic mallet to settle the components.

11 Piston/connecting rod assemblies (4-cylinder engine) - removal

Note: *Always check first what replacement parts are available before planning any overhaul operation. A Rover dealer, or a good engine reconditioning specialist/automotive parts supplier, may be able to suggest alternatives which will enable you to overcome the lack of replacement parts.*

1 Remove the cylinder head, the sump, and the oil pick-up pipe as described in Part A of this Chapter.

2 Turn the crankshaft by means of the pulley bolt, until No 1 and No 4 pistons are at the bottom of their stroke.

3 Using a knife or scraper, clean the carbon ridge from the top of the cylinder bore, to facilitate removal of the piston.

4 Mark the No 1 cylinder connecting rod and cap on their sides, using a centre-punch and hammer, to indicate the cylinder the assembly is fitted to, and also the fitted relationship of the cap to the rod. **Note:** *Any markings that may appear on the rod and cap are often cylinder bore size codes and not necessarily the position of the assembly in the engine. Always make your own marks to avoid confusion.*

5 Undo the big-end cap nuts on No 1 connecting rod, then remove the cap, complete with the lower bearing shell **(see illustration)**. If the cap is difficult to remove, tap it from side to side with a plastic mallet.

6 Push the piston/connecting rod upwards with the aid of the wooden handle of a hammer or similar tool, then withdraw the assembly from the top of the cylinder bore **(see illustration)**.

7 Refit the bearing cap and shell to the connecting rod after removal.

8 Repeat paragraphs 3 to 7 for No 4 connecting rod.

9 Turn the crankshaft back through half a turn, until No 2 and No 3 pistons are at the bottom of their stroke.

10 Repeat paragraphs 3 to 7 for No 2 and No 3 connecting rods.

12 Piston/connecting rod assemblies (V6 engine) - removal

The procedure is the same as described in the previous Section for 4-cylinder engines, but turn the crankshaft as necessary until each pair of pistons are at the bottom of their stroke and their connecting rod caps are accessible. On later engines it will be necessary to remove the oil baffle retaining bolts and remove the baffle for access to the crankshaft components.

13 Crankshaft (4-cylinder engine) - removal

Note: *The crankshaft can be removed only after the engine has been removed from the vehicle. It is assumed that the transmission, flywheel/driveplate, adaptor plate, timing belt, cylinder head, sump, oil pump pick-up/strainer, oil pump, and piston/connecting rod assemblies, have already been removed.*

1 Before the crankshaft is removed, check the endfloat. Mount a DTI (Dial Test Indicator, or dial gauge) with the stem in line with the crankshaft and just touching the crankshaft.

2 Push the crankshaft fully away from the gauge, and zero it. Next, lever the crankshaft towards the gauge as far as possible, and check the reading obtained. The distance that the crankshaft moved is its endfloat; if it is greater than specified, check the crankshaft thrust surfaces for wear. If no wear is evident, new thrustwashers should correct the endfloat.

3 Feeler gauges can be used if no dial gauge is available. Lever or push the crankshaft all the way towards the right-hand end of the engine. Slip feeler gauges between the crankshaft and the main bearing incorporating the thrustwashers to determine the clearance **(see illustration)**.

4 Withdraw the crankcase breather tube elbow from the outside of the cylinder block **(see illustration)**.

5 From within the crankcase, remove the crankcase breather extension tube **(see illustration)**. To do this, move the tube from side to side to release the sealing compound, then tap it out using a dowel rod inserted through the elbow aperture.

6 Note that the main bearing caps have their numbers cast on the face of each cap, and in addition, Nos 2, 3 and 4 have arrows indicating their fitted direction **(see illustration)**.

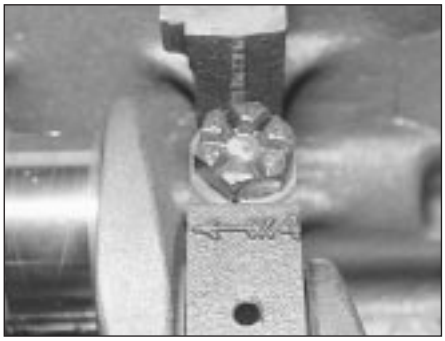
7 Undo the main bearing cap retaining bolts, one turn at a time, then when all are slack, remove the bolts.

8 Lift away each main bearing cap and the bottom half of each bearing shell, taking care to keep the bearing shell with the right cap. If the caps are tight, tap them on their sides with a plastic mallet to release them from the locating dowels.

13.3 Checking crankshaft endfloat using feeler gauges

13.4 Withdraw the crankcase breather tube elbow

13.5 Remove the crankcase breather tube extension tube



13.6 Main bearing cap identification number and direction arrow

9 When removing the centre main bearing cap, note the bottom semi-circular halves of the thrustwashers, one located on each side of the cap. Lay them, with the centre bearing cap, along the correct side.

10 Lift out the crankshaft, followed by the bearing shell upper halves and the thrustwashers. Keep the bearing shells and thrustwashers with their correct caps.

14 Crankshaft (V6 engine) - removal

Note: *The crankshaft can be removed only after the engine has been removed from the vehicle. It is assumed that the transmission, flywheel/driveplate, rear oil seal carrier, timing belt, cylinder head, sump, oil pump pick-up/strainer, oil pump, and piston/connecting rod assemblies, have already been removed.*

1 Before removing the crankshaft, check the endfloat as described in the previous Section.

2 Where fitted, undo the bolts and remove the oil baffle from the bottom of the crankcase. Undo the eight oil gallery retaining bolts and lift the oil gallery off the main bearing caps. Collect the four O-rings from the base of the gallery **(see illustration)**.

3 Using a hammer and centre punch, mark the main bearing caps, 1 to 4 and make a mark to indicate their fitted direction in the crankcase.

4 Undo the main bearing cap retaining bolts, two on the bottom and two on the side, one turn at a time; when all are slack, remove the bolts.

5 Screw in two oil gallery bolts into each main bearing cap and pull up on the bolts to withdraw the caps from their locations **(see illustration)**. Lift away each main bearing cap and the bottom half of each bearing shell, taking care to keep the bearing shell with the right cap. Remove the oil gallery bolts after removing the caps.

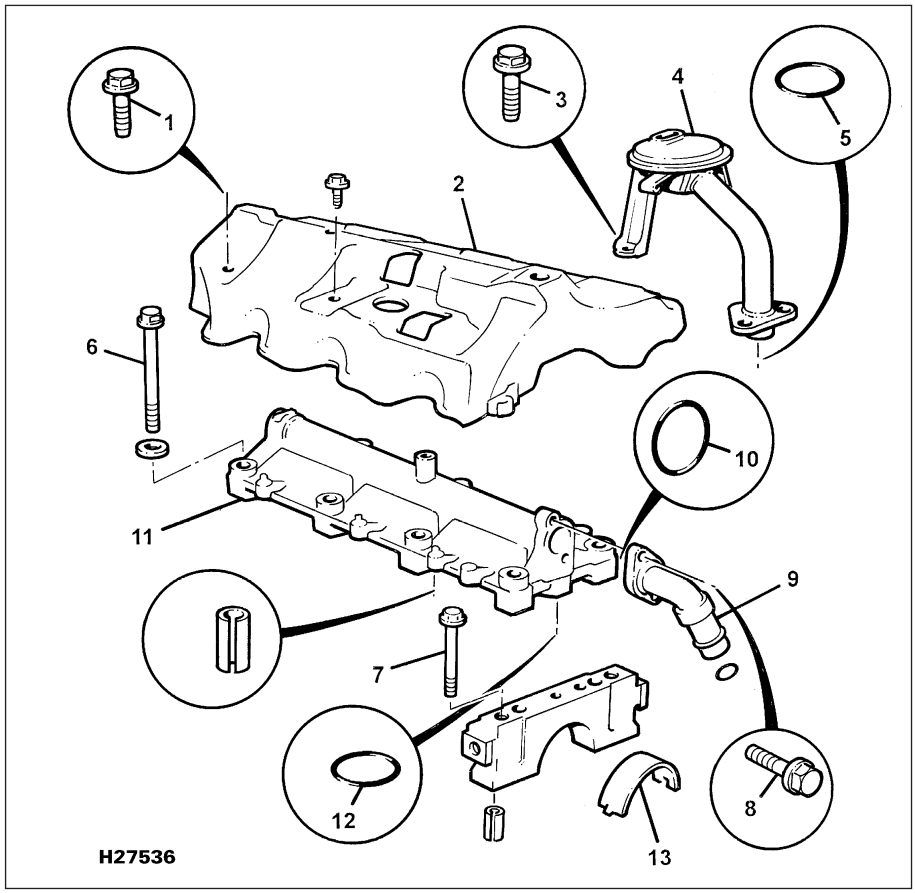
6 Lift out the crankshaft, followed by the bearing shell upper halves and the two thrustwashers from the No 4 journal location. Keep the bearing shells and thrustwashers with their correct caps.

15 Cylinder block/crankcase - cleaning and inspection

Note: *Always check first what replacement parts are available before planning any overhaul operation. A Rover dealer, or a good engine reconditioning specialist/automotive parts supplier may be able to suggest alternatives which will enable you to overcome the lack of replacement parts.*

Cleaning

1 Prior to cleaning, remove all external components and senders, and any gallery plugs or caps that may be fitted.



14.2 Main bearing, oil gallery and related components on V6 engines

1 Oil baffle retaining bolt
2 Oil baffle
3 Pick-up/strainer retaining bolt
4 Oil pump pick-up/strainer
5 O-ring
6 Main bearing/oil gallery bolt
7 Main bearing/oil gallery bolt
8 Pipe elbow bolt
9 Oil pipe elbow
10 O-ring
11 Oil gallery
12 O-ring
13 Main bearing shell

2 If any of the castings are extremely dirty, all should be steam-cleaned.

3 After the castings are returned from steam-cleaning, clean all oil holes and oil galleries one more time. Flush all internal passages with warm water until the water runs clear, then dry thoroughly, and apply a light film of oil to all machined surfaces, to prevent rusting. If you have access to compressed air, use it to speed the drying process, and to blow out all the oil holes and galleries.

Warning: Wear eye protection when using compressed air!

4 If the castings are not very dirty, you can do an adequate cleaning job with hot soapy water (as hot as you can stand!) and a stiff brush. Take plenty of time, and do a thorough job. Regardless of the cleaning method used, be sure to clean all oil holes and galleries very thoroughly, and to dry all components completely; protect the machined surfaces as described above, to prevent rusting.

5 All threaded holes must be clean and dry, to ensure accurate torque readings during reassembly; now is also a good time to clean and check the threads of all principal bolts.

6 When all inspection and repair procedures are complete (see below) and the block is ready for reassembly, refit the main bearing caps, and tighten the bolts finger-tight.

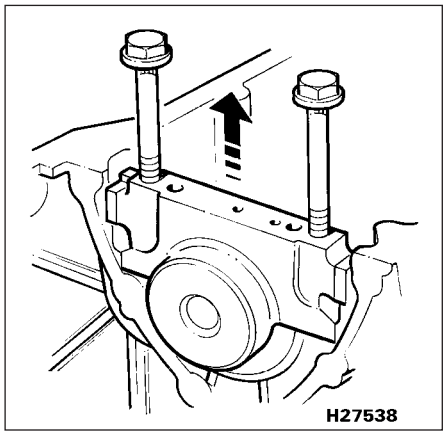
7 If the engine is not going to be reassembled right away, cover it with a large plastic bag to keep it clean; protect the machined surfaces as described above, to prevent rusting.

Inspection

8 Visually check the castings for cracks and corrosion. Look for stripped threads in the threaded holes. If there has been any history of internal coolant leakage, it may be worthwhile having an engine overhaul specialist check the cylinder block/crankcase for cracks with special equipment. If defects are found, have them repaired, if possible, or renew the assembly.

9 Check each cylinder bore for scuffing and scoring.

10 Noting that the cylinder bores must be measured with all the crankshaft main bearing caps bolted in place (without the crankshaft and bearing shells), to the specified torque wrench settings, measure the diameter of each cylinder at the top (just under the ridge area), centre and bottom of the cylinder bore, parallel to the crankshaft axis. Next, measure each cylinder's diameter at the same three locations across the crankshaft axis. Note the measurements obtained.



14.5 Using oil gallery bolts to withdraw the main bearing caps

11 Measure the piston diameter at right-angles to the gudgeon pin axis, just above the bottom of the skirt; again, note the results.

12 If it is wished to obtain the piston-to-bore clearance, measure the bore and piston skirt as described above, and subtract the skirt diameter from the bore measurement. If the precision measuring tools shown are not available, the condition of the pistons and bores can be assessed, though not quite as accurately, by using feeler gauges as follows. Select a feeler gauge of thickness equal to the specified piston-to-bore clearance, and slip it into the cylinder along with the matching piston. The piston must be positioned exactly as it normally would be. The feeler gauge must be between the piston and cylinder on one of the thrust faces (at right-angles to the gudgeon pin bore). The piston should slip through the cylinder (with the feeler gauge in place) with moderate pressure; if it falls through or slides through easily, the clearance is excessive, and a new piston will be required. If the piston binds at the lower end of the cylinder, and is loose toward the top, the cylinder is tapered. If tight spots are encountered as the piston/feeler gauge is rotated in the cylinder, the cylinder is out-of-round (oval).

13 Repeat these procedures for the remaining pistons and cylinder bores.

14 Compare the results with the Specifications at the beginning of this Chapter; if any measurement is beyond the dimensions specified for that class, or if any bore measurement is significantly different from the others (indicating that the bore is tapered or oval), the piston or bore is excessively-worn.

15 If any of the cylinder bores are badly scuffed or scored, or if they are excessively-worn, out-of-round or tapered, the usual course of action would be to have the cylinder block/crankcase rebored, and to fit new, oversized, pistons on reassembly. See a dealer or engine reconditioning specialist for advice.

16 If the bores are in reasonably good condition and not excessively-worn, then it may only be necessary to renew the piston rings.

17 If this is the case, the bores should be honed, to allow the new rings to bed in correctly and provide the best possible seal. Honing is an operation that will be carried out for you by an engine reconditioning specialist.

18 After all machining operations are completed, the entire block/crankcase must be washed very thoroughly with warm soapy water to remove all traces of abrasive grit produced during the machining operations. When the cylinder block/crankcase is completely clean, rinse it thoroughly and dry it, then lightly oil all exposed machined surfaces, to prevent rusting.

19 The cylinder block/crankcase should now be completely clean and dry, with all components checked for wear or damage, and repaired or overhauled as necessary. Refit as many ancillary components as possible, for safekeeping. If reassembly is not to start immediately, cover the block with a large plastic bag to keep it clean, and protect the machined surfaces as described above to prevent rusting.

16 Piston/connecting rod assemblies - inspection

Note: *Always check first what replacement parts are available before planning any overhaul operation. A Rover dealer, or a good engine reconditioning specialist/automotive parts supplier may be able to suggest alternatives which will enable you to overcome the lack of replacement parts.*

1 Before the inspection process can be carried out, the piston/connecting rod assemblies must be cleaned, and the original piston rings removed from the pistons. The rings should have smooth, polished working surfaces, with no dull or carbon-coated sections (showing that the ring is not sealing correctly against the bore wall, so allowing combustion gases to blow by) and no traces of wear on their top and bottom surfaces. The end gaps should be clear of carbon, but not polished (indicating a too-small end gap), and all the rings (including the elements of the oil control ring) should be free to rotate in their grooves, but without excessive up-and-down movement. If the rings appear to be in good condition, they are probably fit for further use; check the end gaps (in an unworn part of the bore). If any of the rings appears to be worn or damaged, or has an end gap significantly different from the specified value, the usual course of action is to renew all of them as a set. **Note:** *While it is usual always to renew piston rings when an engine is overhauled, this of course assumes that rings are available separately - if not, it follows that great care must be taken not to break or damage any of the rings during the following procedures, and to ensure that each ring is marked on removal so that it is refitted* ***only*** *the original way up, and* ***only*** *to the same groove.*

2 Using a piston ring installation tool, carefully remove the rings from the pistons. If such a tool is not available, the rings can be removed by hand, expanding them over the top of the pistons. The use of two or three old feeler blades will be helpful in preventing the rings dropping into empty grooves. Be careful not to nick or gouge the pistons in the process, and mark or label each ring as it is removed, so that its original top surface can be identified on reassembly, and that it can be returned to its original groove.

3 Scrape all traces of carbon from the top of the piston. A hand-held wire brush or a piece of fine emery cloth can be used, once the majority of the deposits have been scraped away. *Do not*, under any circumstances, use a wire brush mounted in a drill motor to remove deposits from the pistons - the piston material is soft, and may be eroded away by the wire brush.

4 Use a piston ring groove-cleaning tool to remove carbon deposits from the ring grooves. If a tool isn't available, but replacement rings have been found, a piece broken off the old ring will do the job. Be very careful to remove only the carbon deposits - don't remove any metal, and do not nick or scratch the sides of the ring grooves. Protect your fingers - piston rings are sharp!

5 Once the deposits have been removed, clean the piston/rod assemblies with solvent, and dry them with compressed air (if available). Make sure the oil return holes in the back sides of the ring grooves, and the oil hole in the lower end of each rod, are clear.

6 If the pistons and cylinder walls aren't damaged or worn excessively, and if the cylinder block/crankcase is not rebored, new pistons won't be necessary. Normal piston wear appears as even vertical wear on the piston thrust surfaces, and slight looseness of the top ring in its groove.

7 Carefully inspect each piston for cracks around the skirt, at the pin bosses, and at the ring lands (between the ring grooves).

8 Look for scoring and scuffing on the thrust faces of the skirt, holes in the piston crown, and burned areas at the edge of the crown. If the skirt is scored or scuffed, the engine may have been suffering from overheating and/or abnormal combustion, which caused excessively-high operating temperatures. The cooling and lubrication systems should be checked thoroughly. A hole in the piston crown is an indication that abnormal combustion (pre-ignition) was occurring. Burned areas at the edge of the piston crown are usually evidence of spark knock (detonation). If any of the above problems exist, the causes must be corrected, or the damage will occur again. The causes may include intake air leaks, incorrect fuel/air mixture or incorrect ignition timing.

9 Corrosion of the piston, in the form of small pits, indicates that coolant is leaking into the combustion chamber and/or the crankcase. Again, the cause must be corrected, or the problem may persist in the rebuilt engine.

10 Check the piston-to-rod clearance by twisting the piston and rod in opposite directions. Any noticeable play indicates excessive wear, which must be corrected. On 4-cylinder "T"-series engines and V6 engines, the piston/connecting rod assemblies should be taken to a Rover dealer or engine reconditioning specialist to have the pistons, gudgeon pins and rods checked, and new components fitted as required.

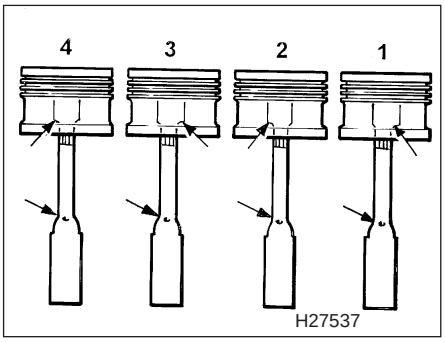
11 On these engines, *don't* attempt to separate the pistons from the connecting rods (even if non-genuine replacements are found elsewhere). This is a task for a Rover dealer or similar engine reconditioning specialist, due to the special heating equipment, press, mandrels and supports required to do the job. If the piston/connecting rod assemblies do require this sort of work, have the connecting rods checked for bend and twist, since only such engine repair specialists will have the facilities for this purpose.

12 On 4-cylinder "M" series engines, the gudgeon pins are retained by circlips and the pistons and connecting rods can be separated.

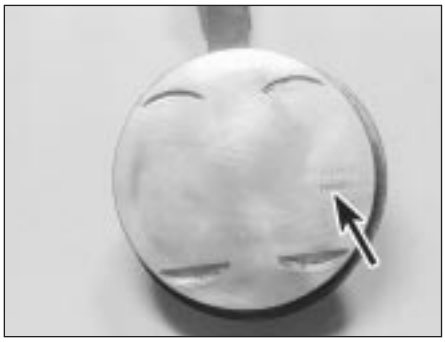
13 To remove the pistons from the connecting rods, extract the two gudgeon pin retaining circlips, using a small screwdriver, then push out the gudgeon pin **(see illustration)**. If the pin is tight, warm the piston in hot water, which will expand the piston slightly, enabling the gudgeon pin to be pushed out. As each piston is removed, mark it on the inside with a punch, indicating its cylinder number.

14 Check the connecting rods for cracks and other damage. Also on 4-cylinder engines, check that the oilway in the base of the

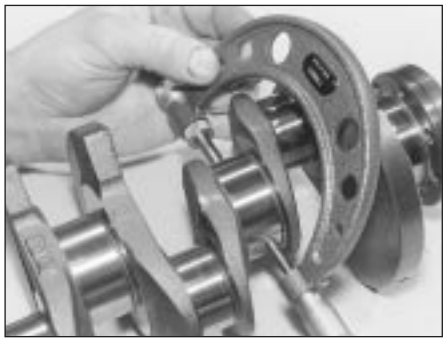
16.13 Using a small screwdriver to extract the gudgeon pin circlip



16.15a Connecting rod offset and oil squirt hole relationship on "M" series 4-cylinder engines



16.15b The pistons are marked FRONT on their top face (arrowed) on "M" series 4-cylinder engines



17.4 Measuring the main bearing journal diameters

connecting rod is clear by probing with a piece of wire. Temporarily remove the big-end bearing caps and the old bearing shells, wipe clean the rod and cap bearing recesses, and inspect them for nicks, gouges and scratches. After checking the rods, replace the old shells, slip the caps into place, and tighten the bolts finger-tight.

15 To refit the pistons to their connecting rods on "M" series engines, start with No 1 and insert the connecting rod into the piston, so that the offset at the gudgeon pin end of the rod is towards the side of the piston marked FRONT on its top face **(see illustrations)**. Insert the gudgeon pin, and refit the retaining circlips. Ensure that the circlips fully enter their grooves.

16 Assemble the No 3 piston and connecting rod in the same way.

17 Assemble the No 2 and No 4 pistons and connecting rods in the same way, but with the offset at the gudgeon pin end of the rod away from the side of the piston marked FRONT.

17 Crankshaft - inspection

Note: *Always check first what replacement parts are available before planning any overhaul operation. A Rover dealer, or a good engine reconditioning specialist/automotive parts supplier, may be able to suggest alternatives which will enable you to overcome the lack of replacement parts.*

1 Clean the crankshaft, and dry it with compressed air if available.

Warning: Wear eye protection when using compressed air! Be sure to clean the oil holes with a pipe cleaner or similar probe.

2 Check the main and crankpin (big-end) bearing journals for uneven wear, scoring, pitting and cracking.

3 Remove all burrs from the crankshaft oil holes with a stone, file or scraper.

4 Using a micrometer, measure the diameter of the main bearing and crankpin (big-end) journals, and compare the results with the Specifications at the beginning of this Chapter **(see illustration)**.

5 By measuring the diameter at a number of points around each journal's circumference, you will be able to determine whether or not the journal is out-of-round. Take the measurement at each end of the journal, near the webs, to determine if the journal is tapered.

6 If the crankshaft journals are damaged, tapered, out-of-round, or worn beyond the limits specified in this Chapter, the crankshaft must be taken to an engine overhaul specialist, who will regrind it, and who can supply the necessary undersize bearing shells.

7 Check the oil seal journals at each end of the crankshaft for wear and damage. If either seal has worn an excessive groove in its journal, consult an engine overhaul specialist, who will be able to advise whether a repair is possible, or whether a new crankshaft is necessary.

18 Main and big-end bearings - inspection

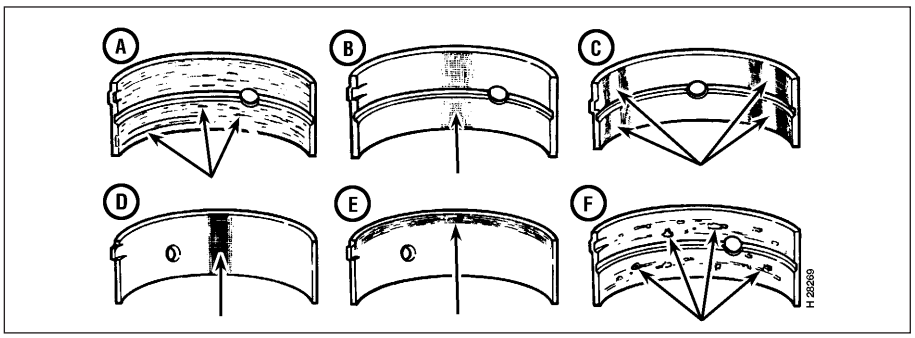
Note: *Always check first what replacement parts are available before planning any overhaul operation. A Rover dealer, or a good engine reconditioning specialist/automotive parts supplier, may be able to suggest alternatives which will enable you to overcome the lack of replacement parts.*

1 Even though the main and big-end bearing shells should be renewed during the engine overhaul, the old shells should be retained for close examination, as they may reveal valuable information about the condition of the engine **(see illustration)**.

2 Bearing failure occurs because of lack of lubrication, the presence of dirt or other foreign particles, overloading the engine, and corrosion. Regardless of the cause of bearing failure, it must be corrected before the engine is reassembled, to prevent it from happening again.

3 When examining the bearing shells, remove them from the cylinder block/crankcase and main bearing caps, and from the connecting rods and the big-end bearing caps, then lay them out on a clean surface in the same general position as their location in the engine. This will enable you to match any bearing problems with the corresponding crankshaft journal. *Do not* touch any shell's bearing surface with your fingers while checking it, or the delicate surface may be scratched.

4 Dirt or other foreign matter gets into the engine in a variety of ways. It may be left in the engine during assembly, or it may pass



18.1 Typical bearing failures

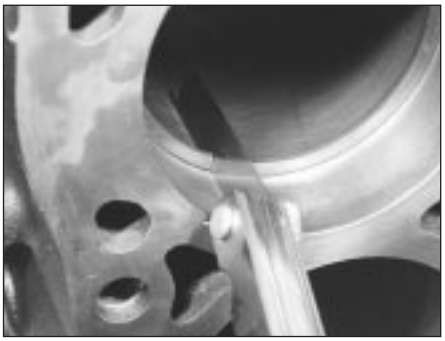
A Scratched by dirt; dirt embedded in bearing material
B Lack of oil; overlay wiped out
C Improper seating: bright (polished) sections
D Tapered journal; overlay gone from entire surface
E Radius ride
F Fatigue failure: craters or pockets

through filters or the crankcase ventilation system. It may get into the oil, and from there into the bearings. Metal chips from machining operations and normal engine wear are often present. Abrasives are sometimes left in engine components after reconditioning, especially when parts are not thoroughly cleaned using the proper cleaning methods. Whatever the source, these foreign objects often end up embedded in the soft bearing material, and are easily recognized. Large particles will not embed in the material, and will score or gouge the shell and journal. The best prevention for this cause of bearing failure is to clean all parts thoroughly, and to keep everything spotlessly-clean during engine assembly. Frequent and regular engine oil and filter changes are also recommended.

5 Lack of lubrication (or lubrication breakdown) has a number of inter-related causes. Excessive heat (which thins the oil), overloading (which squeezes the oil from the bearing face) and oil leakage (from excessive bearing clearances, worn oil pump or high engine speeds) all contribute to lubrication breakdown. Blocked oil passages, which usually are the result of misaligned oil holes in a bearing shell, will also starve a bearing of oil, and destroy it. When lack of lubrication is the cause of bearing failure, the bearing material is wiped or extruded from the shell's steel backing. Temperatures may increase to the point where the steel backing turns blue from overheating.

6 Driving habits can have a definite effect on bearing life. Full-throttle, low-speed operation (labouring the engine) puts very high loads on bearings, which tends to squeeze out the oil film. These loads cause the shells to flex, which produces fine cracks in the bearing face (fatigue failure). Eventually, the bearing material will loosen in pieces, and tear away from the steel backing. Short-distance driving leads to corrosion of bearings, because insufficient engine heat is produced to drive off condensed water and corrosive gases. These products collect in the engine oil, forming acid and sludge. As the oil is carried to the engine bearings, the acid attacks and corrodes the bearing material.

7 Incorrect shell refitting during engine assembly will lead to bearing failure as well. Tight-fitting shells leave insufficient bearing running clearance, and will result in oil starvation. Dirt or foreign particles trapped behind a bearing shell result in high spots on the bearing, which lead to failure. *Do not* touch any shell's bearing surface with your fingers during reassembly; there is a risk of scratching the delicate surface, or of depositing particles of dirt on it.



20.3 Measuring piston ring end gap

19 Engine overhaul - reassembly sequence

1 Before reassembly begins ensure that all new parts have been obtained and that all necessary tools are available. Read through the entire procedure to familiarise yourself with the work involved, and to ensure that all items necessary for reassembly of the engine are at hand. In addition to all normal tools and materials, jointing and thread locking compound will be needed in some areas during engine reassembly. In all other cases, provided the relevant mating surfaces are clean and flat, new gaskets will be sufficient to ensure joints are oil-tight. *Do not* use any kind of silicone-based sealant on any part of the fuel system or inlet manifold, and *never* use exhaust sealants upstream of the catalytic converter.

2 In order to save time and avoid problems, engine reassembly can be carried out in the following order (as applicable).

(a) Crankshaft and main bearings.
(b) Engine adaptor plate or rear oil seal carrier.
(c) Pistons and connecting rods.
(d) Oil pump.
(e) Sump.
(f) Flywheel/driveplate.
(g) Cylinder head(s).
(h) Camshafts and hydraulic tappets.
(i) Timing sprockets, tensioners and belt.
(j) Engine external components.

3 Ensure that everything is clean prior to reassembly. As mentioned previously, dirt and metal particles can quickly destroy bearings and result in major engine damage. Use clean engine oil to lubricate during reassembly.

20 Piston rings - refitting

1 Before installing new piston rings, check the end gaps. Lay out each piston set with a piston/connecting rod assembly, and keep them together as a matched set from now on.

2 Insert the top compression ring into the first cylinder, and square it up with the cylinder walls by pushing it in with the top of the piston. The ring should be near the bottom of the cylinder, at the lower limit of ring travel.

3 To measure the end gap, slip feeler gauges between the ends of the ring, until a gauge equal to the gap width is found **(see illustration)**. The feeler gauge should slide between the ring ends with a slight amount of drag. Compare the measurement to the value given in the Specifications Section of this Chapter; if the gap is larger or smaller than specified, double-check to make sure you have the correct rings before proceeding. If you are assessing the condition of used rings, have the cylinder bores checked and measured by a Rover dealer or similar engine reconditioning specialist, so that you can be sure of exactly which component is worn, and seek advice as to the best course of action to take.

4 If the end gap is still too small, it must be opened up by careful filing of the ring ends using a fine file. If it is too large, this is not as serious, unless the specified limit is exceeded, in which case very careful checking is required of the dimensions of all components, as well as of the new parts.

5 Repeat the procedure for each ring that will be installed in the first cylinder, and for each ring in the remaining cylinders. Remember to keep rings, pistons and cylinders matched up.

6 Refit the piston rings as follows. Where the original rings are being refitted, use the marks or notes made on removal, to ensure that each ring is refitted to its original groove and the same way up. New rings generally have their top surfaces identified by markings (often an indication of size, such as "STD", or the word "TOP") - the rings must be fitted with such markings uppermost. **Note:** *Always follow the instructions printed on the ring package or box - different manufacturers may require different approaches. Do not mix up the top and second compression rings, as they usually have different cross-sections.*

7 The oil control ring (lowest one on the piston) is usually installed first. It is composed of three separate elements. Slip the spacer/expander into the groove. If an anti-rotation tang is used, make sure it is inserted into the drilled hole in the ring groove. Next, install the lower side rail. Don't use a piston ring installation tool on the oil ring side rails, as they may be damaged. Instead, place one end of the side rail into the groove between the spacer/expander and the ring land, hold it firmly in place, and slide a finger around the piston while pushing the rail into the groove. Next, install the upper side rail in the same manner.

8 After the three oil ring components have been installed, check that both the upper and lower side rails can be turned smoothly in the ring groove.

9 The second compression (middle) ring is installed next, followed by the top compression ring - ensure their marks are uppermost, and be careful not to confuse them. Don't expand either ring any more than necessary to slide it over the top of the piston.

10 When all the rings are in place set the ring gaps as follows:

4-cylinder "M" series engines - set the compression ring gaps at 90º to each other, and away from the thrust side of

21.4 Fitting the main bearing shell upper halves

21.5 Fitting the crankshaft thrustwashers

21.7 Plastigage in place on a crankshaft main bearing journal

the piston. Position the gaps of the two oil control rails and the expander at 90º to each other.

4-cylinder "T" series engines - set the compression ring gaps at 120º to each other and away from the inlet valve cut-out side of the piston. Position the gaps of the two oil control rails at 120º to each other and the gap of the expander at 120º to the rail gaps. On turbocharged engines, position the oil control rail gap and spring gap at 30º on opposite sides of the gudgeon pin axis.

V6 engines - set the compression ring gaps at 90º to each other and the oil control expander gap at 90º to the top ring gap. Position the oil control rail gaps at 15º either side of the expander gap.

21 Crankshaft - refitting and main bearing running clearance check

1 It is assumed at this point that the cylinder block/crankcase and crankshaft have been cleaned, inspected and repaired or reconditioned as necessary. Position the engine upside-down.

2 Remove the main bearing cap bolts, and lift out the caps. Lay the caps out in the proper order, to ensure correct installation.

3 If they're still in place, remove the old bearing shells from the block and the main bearing caps. Wipe the bearing recesses of the block and caps with a clean, lint-free cloth. They must be kept spotlessly-clean!

Main bearing running clearance check

4 Wipe clean the main bearing shell seats in the crankcase and clean the backs of the bearing shells. Insert the respective upper shells (dry) into position in the crankcase and the lower shells into their respective caps. On the V6 engines, the shells with the oil groves are fitted to the crankcase, and the plain shells are fitted to the caps. Where the old main bearings are being refitted, ensure that they are located in their original positions. Make sure the tab on each bearing shell fits into the notch in the block or cap **(see illustration)**.

Caution: Don't hammer the shells into place, and don't nick or gouge the bearing faces. No lubrication should be used at this time.

5 Place the crankshaft thrustwashers into position in the crankcase so that their oil grooves are facing outwards (away from the central web) **(see illustration)**.

6 Clean the bearing surfaces of the shells in the block, and the crankshaft main bearing journals with a clean, lint-free cloth. Check or clean the oil holes in the crankshaft, as any dirt here can go only one way - straight through the new bearings.

7 Once you're certain the crankshaft is clean, carefully lay it in position in the main bearings. Trim several pieces of the appropriate-size Plastigage (they must be slightly shorter than the width of the main bearings), and place one piece on each crankshaft main bearing journal, parallel with the crankshaft centre-line **(see illustration)**.

8 Clean the bearing surfaces of the cap shells, and install the caps in their respective positions (don't mix them up) with the arrows pointing to the timing belt end of the engine or positioned according to the marks made during removal. Don't disturb the Plastigage.

9 Working on one cap at a time, from the centre main bearing outwards (and ensuring that each cap is tightened down squarely and evenly onto the block), tighten the main bearing cap bolts to the specified torque wrench setting (Chapter 2, Part A). Don't rotate the crankshaft at any time during this operation!

10 Remove the bolts, and carefully lift off the main bearing caps (on V6 engines, use the oil gallery bolts as before). Keep them in order. Don't disturb the Plastigage or rotate the crankshaft.

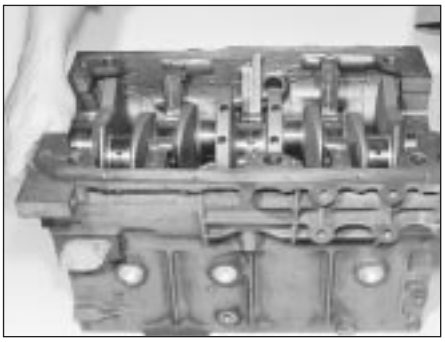
11 Compare the width of the crushed Plastigage on each journal with the scale printed on the Plastigage envelope to obtain the main bearing running clearance **(see illustration)**. Check the Specifications to make sure that the clearance is correct.

12 If the clearance is not as specified, seek the advice of a Rover dealer or similar engine reconditioning specialist - if the crankshaft journals are in good condition, it may be possible simply to renew the shells to achieve the correct clearance. If this is not possible, the crankshaft must be reground by a specialist who can supply the necessary undersized shells. First though, make sure that no dirt or oil was between the bearing shells and the caps or block when the clearance was measured. If the Plastigage is noticeably wider at one end than the other, the journal may be tapered.

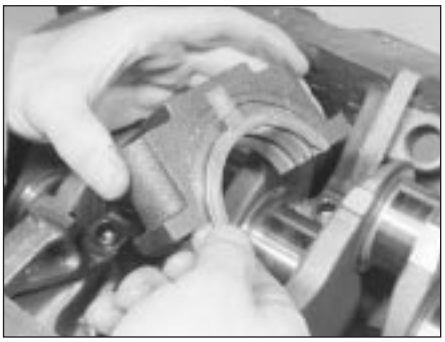
13 Carefully scrape all traces of the Plastigage material off the main bearing journals and the bearing surfaces. Be very careful not to scratch the bearing - use your fingernail or the edge of a credit card.

21.11 Measuring the width of the deformed Plastigage using the scale on the card provided

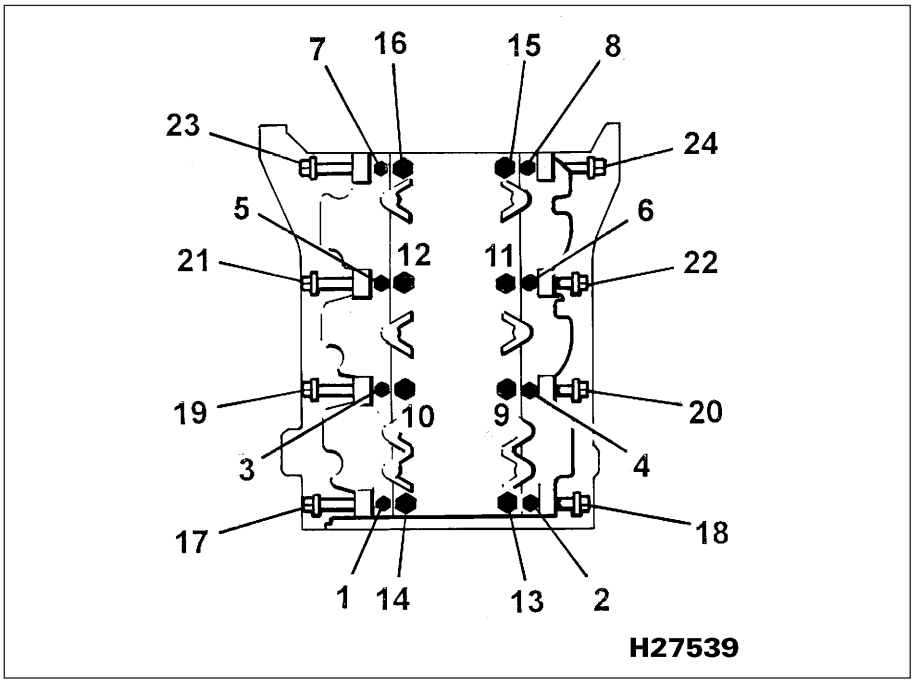
21.14 Thoroughly lubricate the crankshaft journals



21.16a Crankshaft installation



21.16b Fitting the crankshaft thrustwasher lower halves to the centre bearing cap on 4-cylinder engines



21.18 Main bearing cap retaining bolt tightening sequence on V6 engines

Final refitting

14 Carefully lift the crankshaft out of the engine. Clean the bearing surfaces of the shells in the block, then apply a thin, uniform layer of clean molybdenum disulphide-based grease, engine assembly lubricant, or clean engine oil to each surface **(see illustration)**. Coat the thrustwasher surfaces as well.

15 Lubricate the crankshaft oil seal journals with molybdenum disulphide-based grease, engine assembly lubricant, or clean engine oil.

16 Make sure the crankshaft journals are clean, then lay the crankshaft back in place in the block **(see illustration)**. Clean the bearing surfaces of the shells in the caps, then lubricate them. Install the caps in their respective positions, with the arrows pointing to the timing belt end of the engine or the previously made marks positioned correctly. When fitting the centre main bearing cap on 4-cylinder engines, ensure that the thrustwashers, generously lubricated, are fitted with their oil grooves facing outwards, and the locating tab of each is engaged with the slot in the main bearing cap **(see illustration)**. Apply RTV sealant into the vertical grooves on the edges of Nos 1 and 5 main bearing caps, then fit these caps to their locations.

17 On 4-cylinder engines, working on one cap at a time, from the centre main bearing outwards (and ensuring that each cap is tightened down squarely and evenly onto the block), tighten the main bearing cap bolts to the specified torque wrench setting (Chapter 2, Part A).

18 On V6 engines, tighten the bolts to the specified torque (Chapter 2, Part A) in the sequence shown **(see illustration)**.

19 Rotate the crankshaft a number of times by hand, to check for any obvious binding.

20 Check the crankshaft endfloat. It should be correct if the crankshaft thrust faces aren't worn or damaged.

21 On 4-cylinder engines, apply sealer to the crankcase breather tube extension, then fit the tube to its location. Apply sealant to the breather tube elbow, and fit the elbow, ensuring that it is tapped down until the shoulder contacts the crankcase.

22 On V6 engines, refit the oil gallery, use new O-ring seals and secure with the bolts tightened to the specified torque (Chapter 2, Part A).

23 Refit the engine oil seal carrier, or adaptor plate and install a new seal (see Part A or B of this Chapter according to engine type).

22 Piston/connecting rod assemblies - refitting and big-end bearing running clearance check

1 Before refitting the piston/connecting rod assemblies, the cylinder bores must be perfectly clean, the top edge of each cylinder must be chamfered, and the crankshaft must be in place.

2 Remove the big-end bearing cap from No 1 cylinder connecting rod (refer to the marks noted or made on removal). Remove the original bearing shells, and wipe the bearing recesses of the connecting rod and cap with a clean, lint-free cloth. They must be kept spotlessly-clean!

Big-end bearing running clearance check

3 Clean the back of the new upper bearing shell, fit it to the connecting rod, then fit the other shell of the bearing set to the big-end bearing cap. Make sure the tab on each shell fits into the notch in the rod or cap recess.

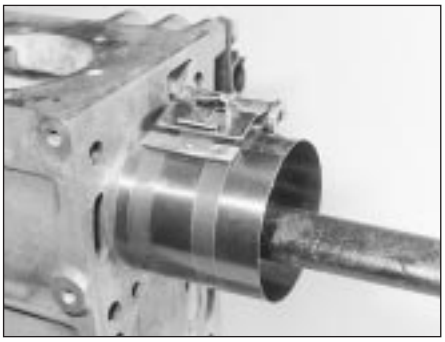
Caution: Don't hammer the shells into place, and don't nick or gouge the bearing face. Don't lubricate the bearing at this time.

4 It's critically important that all mating surfaces of the bearing components are perfectly clean and oil-free when they're assembled.

5 Position the piston ring gaps as described in Section 16, lubricate the piston and rings with clean engine oil, and attach a piston ring compressor to the piston. Leave the skirt protruding about a quarter-inch, to guide the piston into the cylinder bore. The rings must be compressed until they're flush with the piston.

6 Rotate the crankshaft until No 1 crankpin (big-end) journal is at Bottom Dead Centre, and apply a coat of engine oil to the cylinder walls.

7 Arrange the No 1 piston/connecting rod assembly so that the word FRONT or the arrow on the piston crown points to the timing belt end of the engine. Gently insert the assembly into the No 1 cylinder bore, and rest the bottom edge of the ring compressor on the engine block.



22.9 Refitting the piston and connecting rod assemblies, with the aid of a ring compressor

8 Tap the top edge of the ring compressor to make sure it's contacting the block around its entire circumference.

9 Gently tap on the top of the piston with the end of a wooden hammer handle **(see illustration)**, while guiding the connecting rod's big-end onto the crankpin. The piston rings may try to pop out of the ring compressor just before entering the cylinder bore, so keep some pressure on the ring compressor. Work slowly, and if any resistance is felt as the piston enters the cylinder, stop immediately. Find out what's binding, and fix it before proceeding. *Do not*, for any reason, force the piston into the cylinder - you might break a ring and/or the piston.

10 To check the big-end bearing running clearance, cut a piece of the appropriate-size Plastigage slightly shorter than the width of the connecting rod bearing, and lay it in place on the No 1 crankpin (big-end) journal, parallel with the crankshaft centre-line.

11 Clean the connecting rod-to-cap mating surfaces, and refit the big-end bearing cap. Tighten the cap bolts to the specified torque (Chapter 2, Part A). Don't rotate the crankshaft at any time during this operation!

12 Unscrew the bolts and detach the cap, being very careful not to disturb the Plastigage.

13 Compare the width of the crushed Plastigage to the scale printed on the Plastigage envelope, to obtain the running clearance. Compare it to the Specifications, to make sure the clearance is correct.

14 If the clearance is not as specified, seek the advice of a Rover dealer or similar engine reconditioning specialist - if the crankshaft journals are in good condition, it may be possible simply to renew the shells to achieve the correct clearance. If this is not possible, the crankshaft must be reground by a specialist, who can also supply the necessary undersized shells. First though, make sure that no dirt or oil was trapped between the bearing shells and the connecting rod or cap when the clearance was measured. Also, recheck the crankpin diameter. If the Plastigage was wider at one end than the other, the crankpin journal may be tapered.

15 Carefully scrape all traces of the Plastigage material off the journal and the bearing surface. Be very careful not to scratch the bearing - use your fingernail or the edge of a credit card.

Final piston/connecting rod refitting

16 Make sure the bearing surfaces are perfectly clean, then apply a uniform layer of clean molybdenum disulphide-based grease, engine assembly lubricant, or clean engine oil, to both of them. You'll have to push the piston into the cylinder to expose the bearing surface of the shell in the connecting rod.

17 Slide the connecting rod back into place on the crankpin (big-end) journal, refit the big-end bearing cap, and then tighten the bolts as described above.

18 Repeat the entire procedure for the remaining piston/connecting rod assemblies.

19 The important points to remember are:

(a) Keep the backs of the bearing shells and the recesses of the connecting rods and caps perfectly clean when assembling them.

(b) Make sure you have the correct piston/rod assembly for each cylinder.

(c) The arrow on the piston crown or the word FRONT must face the timing belt end of the engine.

(d) Lubricate the cylinder bores with clean engine oil.

(e) Lubricate the bearing surfaces when refitting the big-end bearing caps after the running clearance has been checked.

20 After all the piston/connecting rod assemblies have been properly installed, rotate the crankshaft a number of times by hand, to check for any obvious binding.

21 Continue with the engine reassembly in the sequence given in Section 19.

23 Engine - initial start-up after overhaul

1 With the engine refitted in the vehicle, double-check the engine oil and coolant levels. Make a final check that everything has been reconnected, and that there are no tools or rags left in the engine compartment.

2 Refit the spark plugs, and connect all the spark plug (HT) leads (Chapter 1). Switch on the ignition and listen for the fuel pump; it will run for a little longer than usual, due to the lack of pressure in the system.

3 Start the engine, noting that this also may take a little longer than usual, due to the fuel system components being empty.

4 While the engine is idling, check for fuel, coolant and oil leaks. Don't be alarmed if there are some odd smells and smoke from parts getting hot and burning off oil deposits. If the hydraulic tappets have been disturbed, some valve gear noise may be heard at first; this should disappear as the oil circulates fully around the engine, and normal pressure is restored in the tappets.

5 Keep the engine idling until hot water is felt circulating through the top hose, check that it idles reasonably smoothly and at the usual speed, then switch it off.

6 After a few minutes, recheck the oil and coolant levels, and top-up as necessary (Chapter 1).

7 If they were tightened as described, there is no need to re-tighten the cylinder head bolts once the engine has first run after reassembly.

8 If new components such as pistons, rings or crankshaft bearings have been fitted, the engine must be run-in for the first 500 miles (800 km). Do not operate the engine at full-throttle, or allow it to labour in any gear during this period. It is recommended that the oil and filter be changed at the end of this period.