Rover 214 & 414 Service and Repair Manual

Mark Coombs and Christopher Rogers

Models covered *(1689-288-9AA3)*

Rover 214 and 414 models fitted with eight or sixteen-valve 1397 cc ‘K-series’ engine

Covers major mechanical features of Cabriolet

Does not cover Diesel engine models

ABCDE
FGHIJ
KLMNO
PQRST

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Engine in-car repair procedures

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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 

Specifications

General

Type	Four-cylinder in-line, four-stroke, liquid-cooled
Designation:	
1.4 8-valve sohc	K8
1.4 16-valve dohc	K16
Bore	75.00 mm
Stroke	79.00 mm
Capacity	1396 cc
Firing order	1-3-4-2 (No 1 cylinder at timing belt end)
Direction of crankshaft rotation	Clockwise (seen from right-hand side of vehicle)
Compression ratio:	
K8	9.75 : 1
K16	9.50 : 1
Minimum compression pressure	10.3 bar
Maximum compression pressure difference between cylinders	1.4 bar
Maximum power (EEC):	
K8	76 ps (56 kW) @ 5700 rpm
K8 (with catalytic converter)	75 ps (55 kW) @ 5500 rpm
K16	95 ps (70 kW) @ 6250 rpm
K16 (with catalytic converter)	90 ps (66 kW) @ 6250 rpm
Maximum torque (EEC):	
K8	117 Nm (86 lbf ft) @ 3500 rpm
K16	124 Nm (91 lbf ft) @ 4000 rpm
K16 (with catalytic converter)	120 Nm (89 lbf ft) @ 4000 rpm

Cylinder block/crankcase

Note: *Service liners are Grade B*

Material	Aluminium alloy
Cylinder liner bore diameter - 60 mm from top of bore:	
Standard - grade A (Red)	74.975 to 74.985 mm
Standard - grade B (Blue)	74.986 to 74.995 mm
Service limit	75.045 mm

Crankshaft

Number of main bearings	5
Main bearing journal diameter	47.979 to 48.000 mm
Main bearing journal size grades:	
Grade A	47.993 to 48.000 mm
Grade B	47.986 to 47.993 mm
Grade C	47.979 to 47.986 mm
Crankpin journal diameter	42.986 to 43.007 mm
Crankpin journal size grades:	
Grade A	43.000 to 43.007 mm
Grade B	42.993 to 43.000 mm
Grade C	42.986 to 42.993 mm
Main bearing and crankpin journal maximum ovality	0.010 mm
Main bearing and big-end bearing running clearance	0.021 to 0.049 mm
Crankshaft endfloat:	
Standard	0.10 to 0.30 mm
Service limit	0.50 mm
Thrustwasher thickness	2.61 to 2.65 mm

Gudgeon pins

Diameter	18.0 mm
Fit in connecting rod	Interference

Pistons and piston rings

Note: *Service pistons are Grade B*

	Grade A	**Grade B**
Piston diameter:		
K8	74.940 to 74.955 mm	74.956 to 74.970 mm
K16	74.945 to 74.960 mm	74.960 to 74.975 mm
Piston-to-bore clearance:		
K8 - standard	0.015 to 0.045 mm	
K16 - standard	0.010 to 0.040 mm	
Service limit - all	0.080 mm	
Piston ring end gaps (fitted 20 mm from top of bore):		
Top compression ring**:**		
K8	0.25 to 0.45 mm	
K16	0.30 to 0.50 mm	
Second compression ring - all models	0.30 to 0.50 mm	
Oil control ring**:**		
K8 - standard	0.25 to 1.00 mm	
K16:		
standard	0.25 to 0.50 mm	
service limit	0.60 mm	
Piston ring-to-groove clearance:		
Top compression ring**:**		
K8	0.04 to 0.09 mm	
K16	0.04 to 0.07 mm	
Second compression ring**:**		
K8	0.04 to 0.08 mm	
K16	0.04 to 0.07 mm	
Oil control ring - all models	0.02 to 0.06 mm	

Cylinder head

Material	Aluminium alloy
Height	118.95 to 119.05 mm
Reface limit	0.20 mm
Maximum acceptable gasket face distortion	0.05 mm
Valve seat angle	45°
Valve seat width	1.5 mm
Seat cutter correction angle:	
Upper	30°
Lower	60°
Valve stem installed height:	
K8:	
new	38.95 to 40.81 mm
service limit	41.06 mm
K16:	
new	38.93 to 39.84 mm
service limit	40.10 mm

Valves

Seat angle:	
Inlet	45°
Exhaust	44° 30’
Head diameter:	
Inlet:	
K8	34.0 mm
K16	28.0 mm
Exhaust:	
K8	31.0 mm
K16	24.0 mm
Stem outside diameter:	
Inlet:	
K8	6.967 to 6.975 mm
K16	5.952 to 5.967 mm
Exhaust:	
K8	6.952 to 6.967 mm
K16	5.947 to 5.962 mm
Guide inside diameter:	
K8	7.000 to 7.025 mm
K16	6.000 to 6.025 mm
Stem-to-guide clearance:	
Inlet:	
standard	0.03 to 0.04 mm
service limit	0.07 mm
Exhaust:	
standard	0.07 to 0.08 mm
service limit	0.11 mm
Valve timing:	
K8:	
Inlet opens	13° BTDC
Inlet closes	47° ABDC
Exhaust opens	53° BBDC
Exhaust closes	7° ATDC
K16:	
Inlet opens	15° BTDC
Inlet closes	45° ABDC
Exhaust opens	55° BBDC
Exhaust closes	5° ATDC
Valve spring free length:	
K8	46.2 mm
K16	50.0 mm
Valve guide fitted height	6.0 mm

Camshaft

Drive	Toothed belt
Number of bearings	6
Bearing journal running clearance:	
Standard	0.060 to 0.094 mm
Service limit	0.150 mm
Camshaft endfloat:	
Standard	0.060 to 0.190 mm
Service limit	0.500 mm
Valve lift:	
K8	9.0 mm
K16	8.2 mm
Hydraulic tappet outside diameter	32.959 to 32.975 mm

Lubrication system

System pressure	1.0 bar @ idle speed
Oil pump type	Trochoidal, eccentric-rotor
Oil pump clearances:	
Rotor endfloat	0.02 to 0.06 mm
Outer rotor-to-body clearance	0.28 to 0.36 mm
Rotor lobe clearance	0.05 to 0.13 mm
Pressure relief valve operating pressure	4.1 bar
Oil pressure warning lamp lights at	Below 0.3 to 0.5 bar

Torque wrench settings	Nm	lbf ft
Spark plug (HT) lead clip screws - K8	9	7
Air intake duct support bracket-to-cylinder head screws	4	3
Spark plug cover screws - K16	2	1.5
Cylinder head cover bolts	9	7
Camshaft bearing cap/carrier-to-cylinder head bolts	9	7
Cylinder head bolts:		
1st stage	20	15
2nd stage	Tighten through 180°	
3rd stage	Tighten through (a further) 180°	
Timing belt cover fasteners:		
Upper right-hand (outer) cover	4	3
Lower and upper left-hand (inner) covers	9	7
Timing belt tensioner backplate clamp bolt	25	19
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Crankshaft pulley bolt	160	118
Oil pump-to-cylinder block/crankcase bolt and screws	9	7
Alternator mounting bracket-to-cylinder block/crankcase bolts	45	33
Dipstick tube-to-cylinder block/crankcase bolts	9	7
Flywheel bolts	85	63
Transmission-to-engine bolts	85	63
Flywheel cover plate screws	9	7
Flywheel rear cover plate bolt and nut	38	28
Big-end bearing cap bolts:		
1st stage	20	15
2nd stage	Tighten through 45°	
Main bearing ladder-to-cylinder block/crankcase bolts	10	7
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Bracket-to-cylinder block/crankcase bolts	45	33
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Mounting bracket-to-transmission bolt	85	63
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Anti-beaming bracket-to-support bracket bolt	45	33

1 General information and precautions

How to use this Chapter

This Part of the Chapter describes those repair procedures that can reasonably be carried out on the engine whilst it remains in the vehicle. If the engine has been removed from the vehicle and is being dismantled as described in Part B of this Chapter, any preliminary dismantling procedures can be ignored.

Note that whilst it may be possible physically to overhaul items such as the piston/connecting rod assemblies with the engine in the vehicle, such tasks are not usually carried out as separate operations and usually require the execution of several additional procedures (not to mention the cleaning of components and of oilways). For this reason, all such tasks are classed as major overhaul procedures and are described in Part B of this Chapter.

Engine information

The engine is of four-cylinder, in-line type, mounted transversely at the front of the vehicle with the clutch and transmission on its left-hand end. The engine is available in two forms - the K8 engine, which is the eight-valve single overhead camshaft engine fitted to the carburettor-equipped 214 S model, and the K16 engine, which is a sixteen-valve double overhead camshaft engine which is fitted to all fuel-injected models. Apart from the different cylinder head designs, both engines are of identical construction.

Apart from the pressed steel sump, the plastic timing belt covers and the aluminium alloy cylinder head cover, the engine consists of three major castings which are the cylinder head, the cylinder block/crankcase and the crankshaft main bearing ladder. There is also an oil rail underneath the main bearing ladder and the camshaft carrier/bearing caps.

All major castings are of aluminium alloy and are clamped together by ten long through-bolts which perform the dual role of cylinder head bolts and crankshaft main bearing fasteners. Since these bolts pass through the cylinder block/crankcase and the main bearing ladder, the oil rail is secured also to the main bearing ladder (by two nuts) and the main bearing ladder is secured also to the cylinder block/crankcase (by ten smaller bolts) so that the cylinder head can be removed without disturbing the rest of the engine. The passages provided for the bolts in the major castings are used as breather passages or as returns for the oil to the sump.

The crankshaft runs in five main bearings. Thrustwashers are fitted to the centre main bearing (upper half) to control crankshaft endfloat.

The connecting rods rotate on horizontally-split bearing shells at their big-ends. The pistons are attached to the connecting rods by gudgeon pins which are an interference fit in the connecting rod small-end eyes. The aluminium alloy pistons are fitted with three piston rings, comprising two compression rings and an oil control ring.

The cylinder bores are formed by replaceable wet liners which are located from their top ends. Two sealing rings are fitted at the base of each liner to prevent the escape of coolant into the sump.

The inlet and exhaust valves are each closed by coil springs and operate in guides pressed into the cylinder head. The valve seat inserts are pressed into the cylinder head and can be renewed separately if worn.

On the K8 engine, the camshaft is driven by a toothed timing belt and operates the eight valves via self-adjusting hydraulic tappets, thus eliminating the need for routine checking and adjustment of the valve clearances. The camshaft rotates in six bearings that are line-bored direct in the cylinder head and the (bolted-on) bearing caps. This means that the bearing caps are not available separately from the cylinder head and must not be interchanged with others from another engine. The distributor is driven from the left-hand end of the camshaft and the mechanical fuel pump is operated by an eccentric on the camshaft.

Apart from the fact that it has two camshafts, one inlet and one exhaust, each controlling eight valves and both retained by a single camshaft carrier, the same applies to the K16 engine. On the K16 engine, the distributor is driven from the left-hand end of the inlet camshaft. The fuel pump is electrically-operated.

On both engine types, the coolant pump is driven by the timing belt.

Lubrication is by means of an eccentric-rotor trochoidal pump mounted on the crankshaft right-hand end. It draws oil through a strainer located in the sump and then forces it through an externally-mounted full-flow cartridge-type filter into galleries in the oil rail and cylinder block/crankcase, from where it is distributed to the crankshaft (main bearings) and camshaft(s). The big-end bearings are supplied with oil via internal drillings in the crankshaft, while the camshaft bearings and the hydraulic tappets receive a pressurised supply. The camshaft lobes and valves are lubricated by splash, as are all other engine components.

Repair operations possible with the engine in the car

The following work can be carried out with the engine in the vehicle:

a) Compression pressure - testing.
b) Cylinder head cover - removal and refitting.
c) Crankshaft pulley - removal and refitting.
d) Timing belt covers - removal and refitting.
e) Timing belt - removal, refitting and adjustment.
f) Timing belt tensioner and sprockets - removal and refitting.
g) Camshaft oil seal(s) - renewal.
h) Camshaft(s) and hydraulic tappets - removal, inspection and refitting.
i) Cylinder head - removal and refitting.
j) Cylinder head and pistons - decarbonising.
k) Sump - removal and refitting.
l) Oil pump - removal, overhaul and refitting.
m) Crankshaft oil seals - renewal.
n) Engine/transmission mountings - inspection and renewal.
o) Flywheel - removal, inspection and refitting.

Precautions

Note that a side-effect of the above described engine design is that the crankshaft cannot be rotated once the cylinder head and block through-bolts have been slackened. During any servicing or overhaul work the crankshaft always must be rotated to the desired position before the bolts are disturbed.

2 Engine oil and filter - renewal

1 Details of checking the engine oil levels and renewing both the oil and filter are contained in "*Weekly Checks"* and Chapter 1.

3 Compression test - description and interpretation

1 When engine performance is down, or if misfiring occurs which cannot be attributed to the ignition or fuel systems, a compression test can provide diagnostic clues as to the engine's condition. If the test is performed regularly it can give warning of trouble before any other symptoms become apparent.

2 The engine must be fully warmed up to normal operating temperature, the battery must be fully charged and the spark plugs must be removed. The aid of an assistant will be required.

3 Disable the ignition system by disconnecting the ignition HT coil lead from the distributor cap and earthing it on the cylinder block. Use a jumper lead or similar wire to make a good connection.

4 Fit a compression tester to the No 1 cylinder spark plug hole. The type of tester which screws into the plug thread is preferred **(see illustration)**.

5 Have the assistant hold the throttle wide open and crank the engine on the starter motor. After one or two revolutions, the compression pressure should build up to a maximum figure and then stabilise. Record the highest reading obtained.

6 Repeat the test on the remaining cylinders, recording the pressure in each.

7 All cylinders should produce very similar pressures. Any difference greater than that specified indicates the existence of a fault. Note that the compression should build up quickly in a healthy engine. Low compression on the first stroke, followed by gradually increasing pressure on successive strokes, indicates worn piston rings. A low compression reading on the first stroke, which does not build up during successive strokes, indicates leaking valves or a blown head gasket (a cracked head could also be the cause). Deposits on the undersides of the valve heads can also cause low compression.

8 If the pressure in any cylinder is reduced to the specified minimum or less, carry out the following test to isolate the cause. Introduce a teaspoonful of clean oil into that cylinder through its spark plug hole and repeat the test.

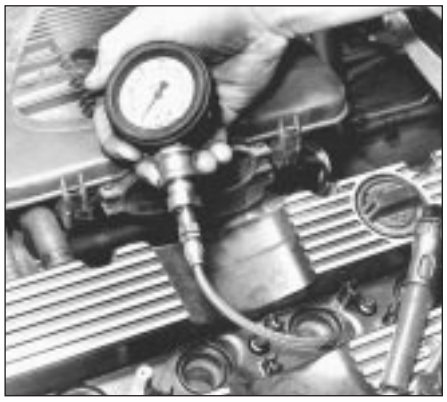
9 If the addition of oil temporarily improves the compression pressure, this indicates that bore or piston wear is responsible for the pressure loss. No improvement suggests that leaking or burnt valves, or a blown head gasket, may be to blame.

10 A low reading from two adjacent cylinders is almost certainly due to the head gasket having blown between them and the presence of coolant in the engine oil will confirm this.

11 If one cylinder is about 20 percent lower than the others and the engine has a slightly rough idle, a worn camshaft lobe could be the cause.

12 If the compression reading is unusually high, the combustion chambers are probably coated with carbon deposits. If this is the case, the cylinder head should be removed and decarbonised.

13 On completion of the test, refit the spark plugs and reconnect the ignition system.



3.4 Measuring compression pressure

4 Top Dead Centre (TDC) for number one piston - locating

General

1 The crankshaft pulley, crankshaft and camshaft sprockets are provided by the factory with clear marks which align only at 90° BTDC. This positions the pistons half-way up the bores so that there is no risk of damage as the engine is reassembled. These marks do not indicate TDC. Use only the ignition timing marks, as described in this Section, to find TDC.

2 Top dead centre (TDC) is the highest point in its travel up-and-down the cylinder bore that each piston reaches as the crankshaft rotates. While each piston reaches TDC both at the top of the compression stroke and again at the top of the exhaust stroke, for the purpose of timing the engine, TDC refers to the piston position (usually No 1) at the top of its compression stroke.

3 While all engine reassembly procedures use the factory timing marks (90° BTDC), it is useful for several other servicing procedures to be able to position the engine at TDC.

4 No 1 piston and cylinder is at the right-hand (timing belt) end of the engine. Note that the crankshaft rotates clockwise when viewed from the right-hand side of the vehicle.

Locating TDC

5 Disconnect the battery negative lead and remove all the spark plugs.

6 Trace No 1 spark plug (HT) lead from the plug back to the distributor cap and use chalk or similar to mark the distributor body or engine casting nearest to the cap's No 1 terminal. Undo the distributor cap retaining screws and remove the cap.

7 Apply the handbrake and ensure that the transmission is in neutral, then jack up the front of the vehicle and support it on axle stands. Remove the right-hand roadwheel.

8 From underneath the front of the vehicle, slacken and remove the three bolts securing the bumper flange to the body. Remove the seven bolts securing the front undercover panel to the body and remove the panel to gain access to the crankshaft pulley and ignition timing marks.

9 Using a spanner, or socket and extension bar, applied to the crankshaft pulley bolt, rotate the crankshaft clockwise until the notch on the crankshaft pulley's inboard (left-hand) rim is aligned with the TDC mark on the timing belt lower cover (see Chapter 1 for details of ignition timing marks).

10 With the crankshaft in this position, Nos 1 and 4 cylinders are now at TDC, one of them on the compression stroke. If the distributor rotor arm is pointing at (the previously-marked) No 1 terminal, then No 1 cylinder is correctly positioned. If the rotor arm is pointing at No 4 terminal, rotate the crankshaft one full turn (360°) clockwise until the arm points at the marked terminal. No 1 cylinder will then be at TDC on the compression stroke.

11 Once No 1 cylinder has been positioned at TDC on the compression stroke, TDC for any of the other cylinders can then be located by rotating the crankshaft clockwise 180° at a time and following the firing order.

5.3a Disconnecting breather hose from cylinder head cover - K8 engine

5.3b Disconnecting breather hoses from cylinder head cover - K16 engine

5 Cylinder head cover - removal and refitting

Removal

1 Disconnect the battery negative lead.

2 Remove the air cleaner assembly and metal intake duct.

3 Using a suitable pair of pliers, release the retaining clip(s) and disconnect the breather hose(s) from the cylinder head cover **(see illustrations)**.

K8 engines

4 Undo the bolts securing the HT lead mounting and air intake support brackets to the cylinder head cover, then remove the brackets and position the HT leads clear of the cover.

5 Remove the two uppermost retaining screws securing the timing belt upper right-hand/outer cover to the cylinder head cover, then slacken the remaining screws and bolts, as necessary, until the timing belt cover can be prised clear of the cylinder head cover without damaging it.

6 Working progressively and in the **reverse** of the tightening sequence **(see illustration 5.14),** slacken and remove the cylinder head cover retaining bolts.

7 Remove the cover, peel off the rubber seal and check it for cuts, other damage or distortion. Renew the seal if necessary.

K16 engines

8 Undo the two spark plug cover retaining screws and lift off the cover. Disconnect the HT leads from the plugs and withdraw them from the cylinder head, along with the clip plate and the grommet which is fitted to the left-hand end of the cylinder head cover.

9 Working progressively and in the **reverse** of the tightening sequence **(see illustration 5.22),** slacken and remove the cylinder head cover retaining bolts, noting the correct fitted position of the air intake duct support bracket.

10 Carefully lift off the cylinder head cover, taking care not to damage the gasket. Check that the gasket sealing path is undamaged and is attached to the gasket all around its periphery. If the sealing path is undamaged, then the gasket is re-usable and should remain in place on the cover until reassembly, unless its removal is necessary for other servicing work.

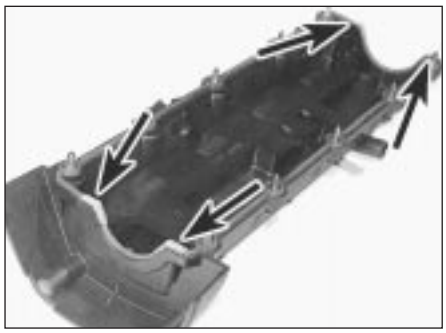
Refitting

K8 engines

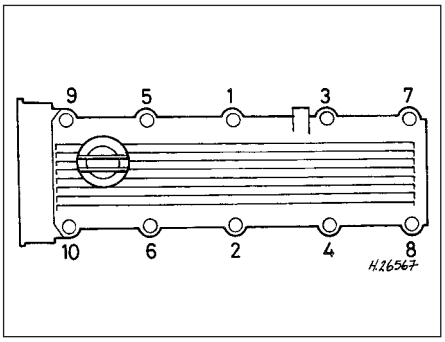
11 On reassembly, carefully clean the cylinder head mating surfaces and the cover seal's groove and remove all traces of oil.

12 Seat the seal in its groove in the cover and refit the bolts, pushing each through the seal, then apply a smear of silicone-RTV sealant to each corner of the seal **(see illustrations)**.

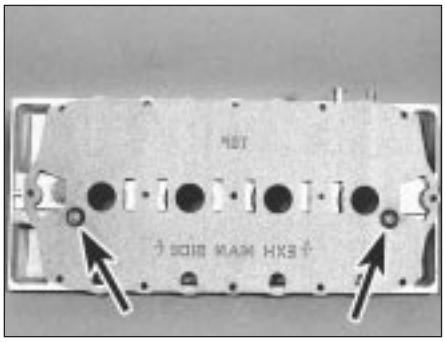
5.12a Ensure seal is correctly seated in cylinder head cover groove . . .



5.12b . . . then refit bolts and apply sealant at locations arrowed - K8 engine



5.14 Cylinder head cover bolt tightening sequence - K8 engine



5.20a Fit gasket to cylinder head cover dowels (arrowed) so that . . .

5.20b . . . stamped markings would appear as shown if gasket were placed on camshaft carrier

13 Refit the cover to the cylinder head, ensuring that the seal remains seated in its groove. Fit all bolts, finger-tight.
14 Tighten the cylinder head cover bolts in the sequence shown to the specified torque wrench setting **(see illustration)**.
15 Refit the timing belt upper right-hand/outer cover to the cylinder head cover and tighten all the disturbed screws and bolts to the specified torque setting.
16 Refit the HT lead mounting clips and air cleaner intake support brackets to the cylinder head, then tighten the retaining bolts to the specified torque. Ensure the HT leads are correctly routed.
17 Connect the breather hose to the cylinder head cover and secure it in position with the retaining clip.
18 Refit the air cleaner housing and reconnect the battery negative lead.

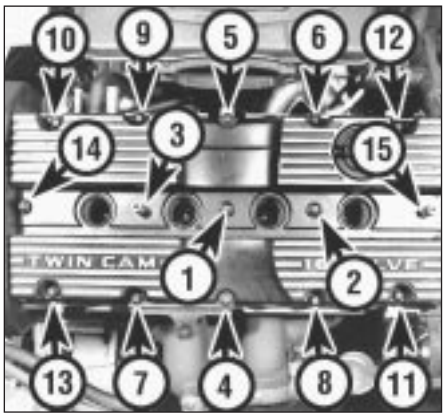
K16 engines

19 On reassembly, carefully clean the mating surfaces, removing all traces of oil. If the gasket has been removed, the oil separator elements can be cleaned by removing them from the cover and washing them in solvent. Use compressed air to blow dry the elements before refitting them to the cover.
20 If a new gasket is to be fitted, press it onto the cover locating dowels so that if it were laid on the camshaft carrier its stamped markings would be legible. The TOP mark should be nearest the inlet manifold and the EXH MAN SIDE mark should have its arrows pointing to the exhaust manifold **(see illustrations)**.
21 Lower the cover onto the cylinder head, ensuring that the gasket is not damaged or displaced. Install the cover retaining bolts, not forgetting to refit the air intake duct support bracket to its original position, and tighten them finger-tight.
22 Working in the sequence shown, tighten the cylinder head cover retaining bolts to the specified torque setting **(see illustration)**.
23 Reconnect the HT leads to the spark plugs, then locate the clip plate and grommet in the left-hand end of the cylinder head cover. Ensure the HT leads are correctly routed then refit the spark plug cover and tighten its retaining screws to the specified torque. Tighten the air intake support bracket screws.
24 Connect both the breather hoses to the cylinder head cover and secure them in position with the retaining clips.
25 Refit the air cleaner housing and reconnect the battery negative lead.

6 Crankshaft pulley - removal and refitting

Removal

1 Apply the handbrake then jack up the front of the vehicle and support it on axle stands. Remove the right-hand roadwheel.
2 From underneath the front of the vehicle, slacken and remove the three bolts securing the bumper flange to the body. Remove the seven bolts securing the front undercover panel to the body and remove the panel.
3 If necessary, rotate the crankshaft until the relevant timing marks align.
4 Remove the power steering pump and/or alternator drivebelt(s) (as applicable).
5 To prevent crankshaft rotation while the pulley bolt is unscrewed, select top gear and have an assistant apply the brakes firmly. If the engine has been removed from the vehicle, lock the flywheel using the arrangement shown **(see illustration 18.2)**.
6 Unscrew the pulley bolt, noting the special washer behind it, then remove the pulley from the crankshaft.



5.22 Cylinder head cover bolt tightening sequence - K16 engine

Refitting

7 Align the crankshaft pulley centre notch with the locating lug on the crankshaft timing belt sprocket then refit the washer, ensuring that its flat surface is facing the pulley. Fit the retaining bolt **(see illustration)**.
8 Lock the crankshaft by the method used on removal and tighten the pulley retaining bolt to the specified torque setting.
9 Refit the power steering pump and/or alternator drivebelt(s) (as applicable) and adjust them as described in Chapter 1.
10 Refit the undercover panel and roadwheel then lower the vehicle to the ground.

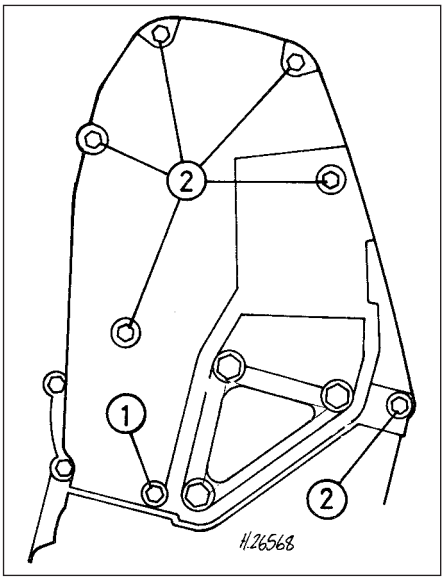
7 Timing belt covers - removal and refitting

Removal

Upper right-hand (outer) cover

1 Slacken the bolt situated at the cover's bottom corner, immediately behind the engine/gearbox unit right-hand mounting bracket.

6.7 Ensure notch in crankshaft pulley centre fits over crankshaft timing belt sprocket locating lug (arrowed)



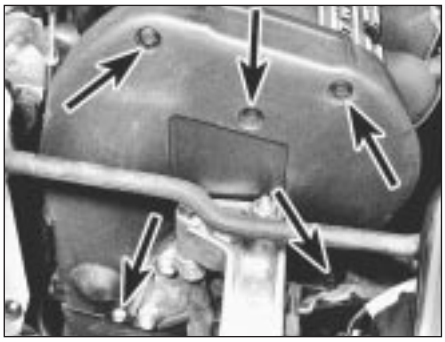
7.2a Timing belt upper right-hand (outer) cover fasteners - K8 engine

1 Slacken screw - cover should be slotted
2 Remove fasteners

2 Unscrew the remaining cover retaining bolts and withdraw the cover, noting the rubber seal fitted to the mounting bracket edge. Note that if the cover is not slotted at the bottom corner screw's location, the screw will have to be removed fully. If this is the case, the cover can be slotted to ease future removal and refitting **(see illustrations)**.

7.9a Timing belt upper left-hand (inner) cover fasteners (arrowed) - K8 engine

7.9b Timing belt upper left-hand (inner) cover fasteners (arrowed) - K16 engine



7.2b Timing belt upper right-hand (outer) cover fasteners (arrowed) - K16 engine, raised for clarity

Lower cover

3 Remove the crankshaft pulley.
4 Remove the cover retaining screws, including the one which also secures the upper cover's bottom front corner. Remove the cover whilst noting the rubber seal fitted to its mounting bracket edge **(see illustration)**.

Upper left-hand (inner) cover

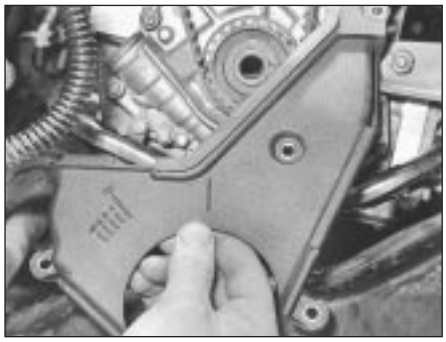
5 Remove the timing belt.
6 Remove the camshaft sprocket(s) and the timing belt tensioner.
7 Unscrew the bolt securing the cover to the coolant pump.
8 On K16 engines, unbolt the engine/gearbox unit right-hand mounting bracket from the cylinder block/crankcase.
9 Remove the remaining cover retaining bolts and withdraw the cover **(see illustrations)**.

Refitting

Upper right-hand (outer) cover

10 Refitting is the reverse of the removal procedure. Ensure that the seal fits correctly between the cover and the mounting bracket and that the cover edges mate correctly with those of the inner cover and (K8 engines only) cylinder head cover **(see illustration)**.
11 Tighten the cover fasteners to the specified torque setting.

7.9c Removing timing belt upper left-hand (inner) cover - K16 engine



7.4 Removing timing belt lower cover

Lower cover

12 Refitting is the reverse of the removal procedure. Ensure that the seal fits correctly between the cover and the mounting bracket and tighten the cover fasteners to the specified torque setting.

Upper left-hand (inner) cover

13 Refitting is the reverse of the removal procedure. Tighten all disturbed fasteners to their specified torque wrench settings.

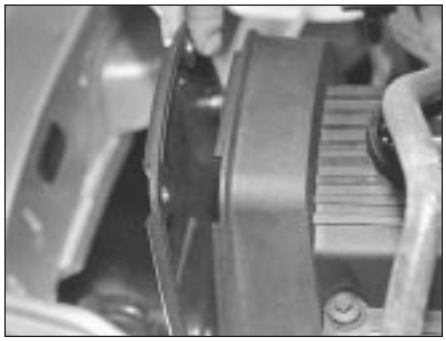
8 Timing belt - removal, inspection, refitting and adjustment

HAYNES HiNT

If the timing belt is to be re-used, use white paint or similar to mark the direction of rotation on the belt.

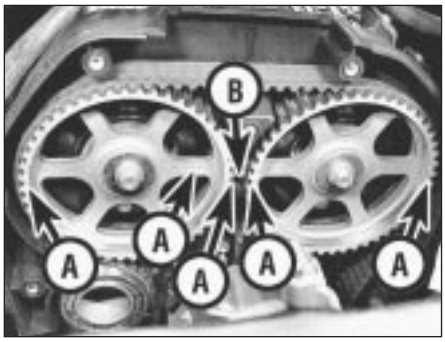
Removal

1 Disconnect the battery negative lead.
2 To improve access to the timing belt, remove the expansion tank mounting bolts then free the coolant hose from any relevant retaining clips and position the tank clear of the engine. On models equipped with power-assisted steering, undo all the power steering hose retaining clip bolts then slide the fluid reservoir out of its retaining clip and position it



7.10 Ensure timing belt upper right-hand (outer) cover engages correctly with cylinder head cover - K8 engine

8.6 Crankshaft pulley mark aligned with timing belt lower cover mark at 90° BTDC



8.7 Camshaft sprocket marks (A) aligned with timing belt upper left-hand (inner) cover mark (B) - K16 engine

8.11 Removing engine/gearbox unit right-hand mounting bracket - K8 engine

clear of the timing belt covers. Take great care not to place any undue strain on hoses and mop up any spilt fluid immediately.

3 Remove the timing belt upper right-hand (outer) cover.

4 Firmly apply the handbrake then jack up the front of the vehicle and support it on axle stands. Remove the right-hand roadwheel

5 From underneath the front of the vehicle, slacken and remove the three bolts securing the bumper flange to the body. Remove the seven bolts securing the front undercover panel to the body and remove the panel to gain access to the crankshaft pulley bolt.

6 Using a suitable spanner or socket on the crankshaft pulley bolt, rotate the crankshaft in a clockwise direction until the long white-painted mark on the crankshaft pulley's outboard (right-hand) face is aligned with the single, separate mark on the timing belt lower cover so that the crankshaft is in the 90° BTDC position (see Chapter 1 for details of the pulley/cover marks) **(see illustration)**.

7 Check that the camshaft sprocket mark(s) align as described in paragraph 15, showing that Nos 1 and 4 cylinders are at 90° BTDC so that there is no risk of the valves contacting the pistons during dismantling and reassembly. If the camshaft sprocket mark(s) are 180° out, rotate the crankshaft through one complete turn (360°) to align the marks as described **(see illustration)**.

8 On K16 engines, use the tool described in Section 9 to lock up the camshaft sprockets so that they cannot move under valve spring pressure when the timing belt is removed.

9 Remove the crankshaft sprocket and timing belt lower cover.

10 Position a trolley jack with a wooden spacer beneath the sump then gently jack it up to take the weight of the engine.

11 Slacken and remove the engine/gearbox unit right-hand mounting through-bolt and nut and the mounting-to-bracket nuts. Remove the mounting, along with the two rubber washers which are fitted on each side of the mounting. On K8 engines only, unscrew the retaining bolts securing the bracket to cylinder block/crankcase and remove it from the engine unit **(see illustration)**.

12 Slacken both the timing belt tensioner pulley Allen screw and the tensioner backplate clamp bolt through half a turn each, then push the pulley assembly downwards to remove all the tension from the timing belt. Hold the tensioner pulley in this position and re-tighten the backplate clamp bolt securely **(see illustration)**.

13 Slip the belt off the sprockets **(see illustration)**. Do not rotate the crankshaft until the timing belt has been refitted.

Inspection

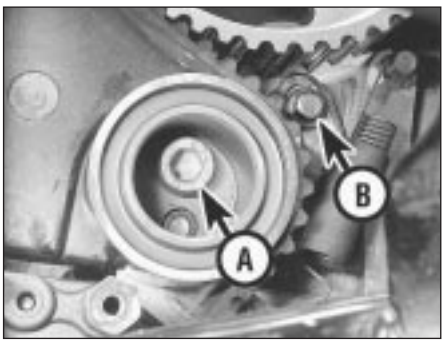
14 Check the timing belt carefully for any signs of uneven wear, splitting or oil contamination and renew it if there is the slightest doubt about its condition. If the engine is undergoing an overhaul and has covered more than 48 000 miles (80 000 km) since the original belt was fitted, renew the belt as a matter of course, regardless of its apparent condition. If signs of oil contamination are found, trace the source of the oil leak and rectify it, then wash down the engine timing belt area and all related components to remove all traces of oil.

Refitting

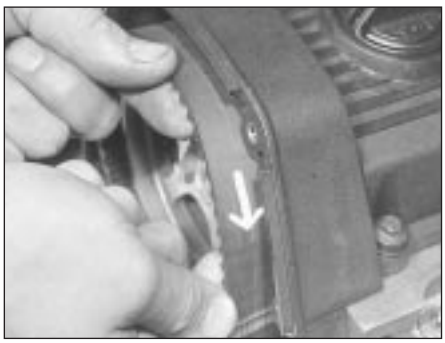
15 On reassembly, thoroughly clean the timing belt sprockets and check that they are aligned as follows. It is most important that these marks are aligned exactly as this sets valve timing. Note that in this position, Nos 1 and 4 cylinders are at 90° BTDC so that there is no risk of the valves contacting the pistons during dismantling and reassembly.

a) Camshaft sprocket on K8 engine - The EX line and the mark stamped on the sprocket rim must be at the front (looking at the sprocket from the right-hand side of the vehicle) and aligned exactly with the cylinder head top surface **(see illustration)**.

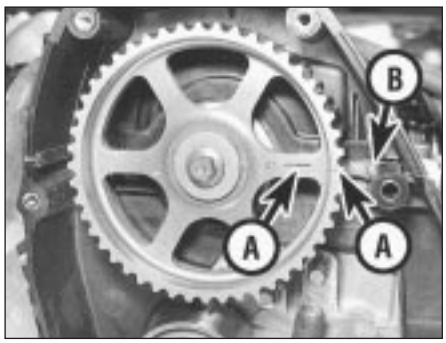
b) Camshaft sprockets on K16 engine - Both EXHAUST arrow marks must point to the rear (looking at the sprockets from the right-hand side of the vehicle) with the IN lines and the sprocket rim marks aligned exactly with the line on the timing belt upper left-hand/inner cover (representing the cylinder head top surface). **See illustration 8.7**.



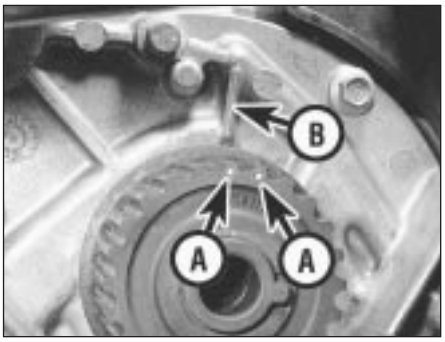
8.12 Timing belt tensioner pulley bolt (A) and tensioner backplate clamp bolt (B)



8.13 Mark direction of rotation of timing belt before removal



8.15a Camshaft sprocket marks (A) aligned with cylinder head top surface (B) - K8 engine



8.15b Crankshaft sprocket dots (A) aligned on each side of oil pump raised rib (B)

8.16 Refitting timing belt - K16 engine

c) Crankshaft sprocket - The two dots must be positioned on each side of the raised rib on the oil pump body **(see illustration)**.

16 If a used belt is being refitted, ensure that the arrow mark made on removal points in the normal direction of rotation. Fit the timing belt over the crankshaft and camshaft sprockets, ensuring that the belt front run (and, on K16 engines, the top run) is taut, ie: all slack is on the tensioner pulley side of the belt, then fit the belt over the coolant pump sprocket and tensioner pulley. Do not twist the belt sharply during refitting and ensure that the belt teeth are correctly seated centrally in the sprockets and that the timing marks remain in alignment **(see illustration)**..

17 Slacken the tensioner backplate clamp bolt and check that the tensioner pulley moves to tension the belt. If the tensioner assembly is not free to move under spring tension, rectify the fault or the timing belt will not be correctly tensioned.

18 On K16 engines, remove the camshaft sprocket locking tool.

19 On K8 engines, refit the engine/gearbox unit right-hand mounting bracket, tightening its bolts to the specified torque wrench setting.

20 On all engines, refit the timing belt lower cover and the crankshaft pulley.

21 Using a suitable spanner or socket, rotate the crankshaft two full turns clockwise to settle and tension the belt. Realign the crankshaft pulley (90° BTDC) mark and check that the sprocket timing mark(s) are still correctly aligned.

22 If all is well, first tighten the tensioner pulley backplate clamp bolt to the specified torque, then tighten the tensioner pulley Allen screw to the specified torque.

23 Reassemble the engine/gearbox unit right-hand mounting, ensuring that the rubber washers are correctly located, then tighten the mounting nuts and bolts to their specified torque settings. Remove the jack from underneath the engine unit.

24 Refit the front undercover panel and roadwheel, then lower the vehicle to the ground.

25 Refit the timing belt upper right-hand (outer) cover.

26 Where necessary, refit the power steering fluid reservoir to the mounting bracket and secure the hydraulic hose clamps in position with the retaining bolts.

27 Refit the coolant expansion tank and tighten the mounting bolts securely. Secure the coolant hose in position with any necessary retaining clips and reconnect the battery negative lead.

Adjustment

28 As the timing belt is a 'fit-and-forget' type, the manufacturer states that tensioning need only be carried out when a belt is (re)fitted. No re-tensioning is recommended once a belt has been fitted and therefore this operation is not included in the manufacturer's maintenance schedule.

29 If the timing belt is thought to be incorrectly tensioned, then adjust the tension as described in paragraphs 1 to 7, 17, 21, 22 and 24 to 27 above.

30 If the timing belt has been disturbed, adjust its tension following the same procedure, omitting as appropriate the irrelevant preliminary dismantling/reassembly steps.

9 Timing belt tensioner and sprockets - removal, inspection and refitting

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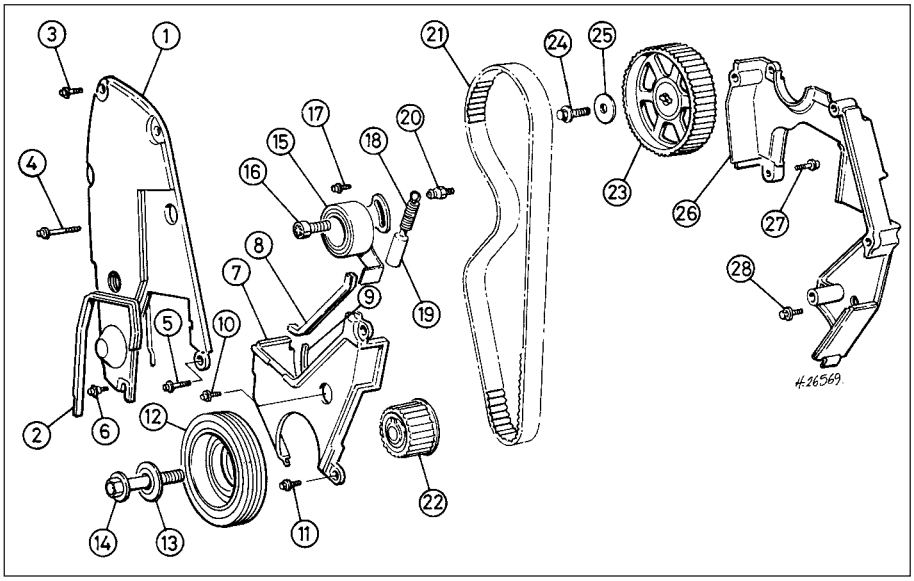
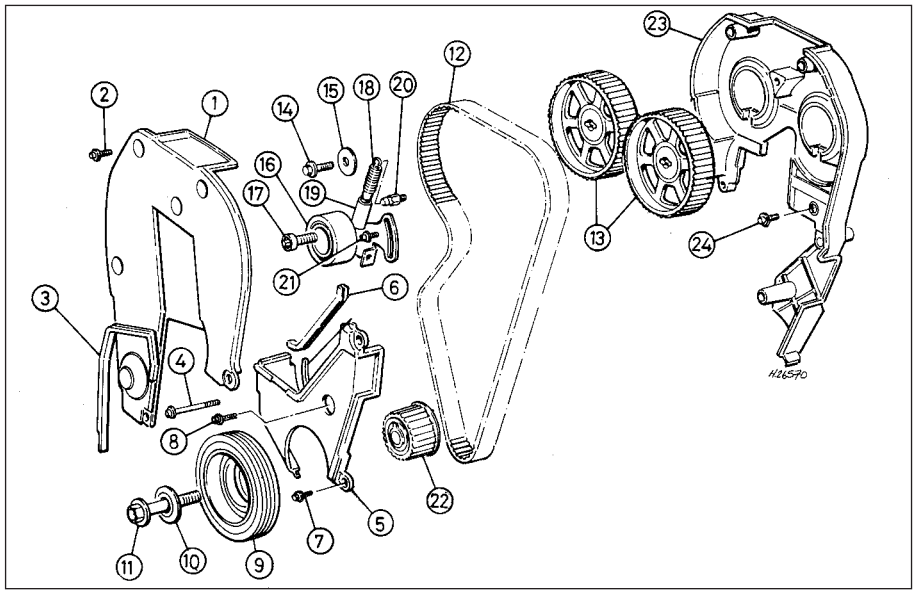
If both camshaft sprockets on K16 engines are to be removed, it is good practice to mark them (inlet or exhaust) so that they can be returned to their original locations on reassembly.

Note: *This Section describes as individual operations the removal and refitting of the components concerned. If more than one*



9.2a Timing belt, sprockets and covers - K8 engine

1 *Timing belt upper right-hand (outer) cover*
2 *Seal*
3 *Bolt*
4 *Bolt*
5 *Bolt*
6 *Shouldered bolt*
7 *Timing belt lower cover*
8 *Seal*
9 *Seal*
10 *Bolt*
11 *Bolt*
12 *Crankshaft pulley*
13 *Washer*
14 *Crankshaft pulley bolt*
15 *Timing belt tensioner pulley assembly*
16 *Tensioner pulley Allen screw*
17 *Tensioner backplate clamp bolt*
18 *Tensioner pulley spring*
19 *Sleeve*
20 *Pillar bolt*
21 *Timing belt*
22 *Crankshaft sprocket*
23 *Camshaft sprocket*
24 *Camshaft sprocket bolt*
25 *Washer*
26 *Timing belt upper left-hand (inner) cover*
27 *Bolt - cover to water pump*
28 *Bolt*



9.2b Timing belt, sprockets and covers - K16 engine

1 *Timing belt upper right-hand (outer) cover*
2 *Bolt*
3 *Seal*
4 *Bolt*
5 *Timing belt lower cover*
6 *Seal*
7 *Bolt*
8 *Bolt*
9 *Crankshaft pulley*
10 *Washer*
11 *Crankshaft pulley bolt*
12 *Timing belt*
13 *Camshaft sprockets*
14 *Bolt*
15 *Washer*
16 *Timing belt tensioner pulley assembly*
17 *Tensioner pulley Allen screw*
18 *Tensioner pulley spring*
19 *Sleeve*
20 *Pillar bolt*
21 *Tensioner backplate clamp bolt*
22 *Crankshaft sprocket*
23 *Timing belt upper left-hand (inner) cover*
24 *Bolt*

component needs to be removed at the same time, start by removing the timing belt, then remove each component as described below whilst ignoring the preliminary dismantling steps.

Removal

1 Disconnect the battery negative lead.

2 To improve access to the timing belt components **(see illustrations)**, remove the expansion tank mounting bolts then free the coolant hose from any relevant retaining clips and position the tank clear of the engine. On models equipped with power-assisted steering, undo all the power steering hose retaining clip bolts then slide the fluid reservoir out of its retaining clip and position it clear of the timing belt covers. Take great care not to place any undue strain on hoses and mop up any spilt fluid immediately.

3 Remove the timing belt upper right-hand (outer) cover.

4 Apply the handbrake then jack up the front of the vehicle and support it on axle stands. Remove the right-hand roadwheel.

5 From underneath the front of the vehicle, slacken and remove the three bolts securing the bumper flange to the body. Remove the seven bolts securing the front undercover panel to the body and remove the panel.

6 Using a suitable spanner or socket on the crankshaft pulley bolt, rotate the crankshaft in a clockwise direction until the long white-painted mark on the crankshaft pulley's outboard (right-hand) face is aligned with the single, separate mark on the timing belt lower cover so that the crankshaft is in the 90° BTDC position (see Chapter 1 for details of the pulley/cover marks).

7 Check that the camshaft sprocket mark(s) align as described in Section 8, paragraph 15 then proceed as described under the relevant sub-heading.

Camshaft sprocket(s)

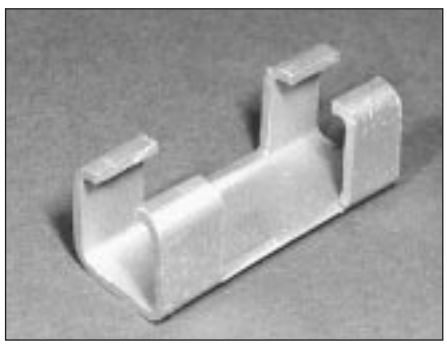
8 Slacken through half a turn each, the timing belt tensioner pulley Allen screw and the tensioner backplate clamp bolt. Push the pulley assembly down to release all tension from the timing belt, then re-tighten the backplate clamp bolt securely.

9 Remove the belt from the camshaft sprocket(s), taking care not to twist it too sharply. Use fingers only to handle the belt. Do not rotate the crankshaft until the timing belt is refitted.

10 On K8 engines, slacken the camshaft sprocket retaining bolt and remove it, along with its washer. To prevent the camshaft from rotating, use Rover service tool 18G 1521 to retain the sprocket. If the tool is not available, then an acceptable substitute can be fabricated from two lengths of steel strip (one long, the other short) and three nuts and bolts. One nut and bolt should form the pivot of a forked tool with the remaining two nuts and bolts at the tips of the forks to engage with the sprocket spokes, as shown in illustration 9.23a.

11 On K16 engines, unscrew the appropriate camshaft sprocket retaining bolt and remove it, along with its washer. To prevent a camshaft from rotating, lock together both sprockets using Rover service tool 18G 1570. This tool is a metal sprag shaped on both sides to fit the sprocket teeth and is inserted between the sprockets. If the tool is not available, then an acceptable substitute can be cut from a length of square-section steel tube or similar to fit as closely as possible around the sprocket spokes **(see illustrations)**.

12 On all engines, remove the sprocket(s) from the camshaft end(s), noting the locating roll pin(s) **(see illustration)**. If a roll pin is a



9.11a Camshaft locking tool cut from steel section . . .

9.11b . . . to fit sprocket spokes as closely as possible - K16 engine

9.12 Removing camshaft sprocket (roll pin arrowed) - K8 engine

loose fit in the camshaft end, remove it and store it with the sprocket for safe-keeping.

Crankshaft sprocket

13 On K16 engines, use the tool described in paragraph 11 to lock together the camshaft sprockets so that they cannot move under valve spring pressure when the timing belt is removed.
14 Remove the crankshaft pulley and timing belt lower cover.
15 Slacken through half a turn each the timing belt tensioner pulley Allen screw and the tensioner backplate clamp bolt, push the pulley assembly down to release all the tension from the timing belt, then re-tighten the backplate clamp bolt securely.
16 Work the belt clear of the crankshaft sprocket, taking care not to twist it too sharply. Use fingers only to handle the belt. Do not rotate the crankshaft until the timing belt is refitted.
17 Remove the sprocket from the crankshaft.

Tensioner assembly

18 On K16 engines, use the tool described in paragraph 11 to lock together the camshaft sprockets so that they cannot move under valve spring pressure when the timing belt is removed.
19 Using a suitable pair of pliers, unhook the tensioner spring from the pillar bolt. Unscrew the tensioner pulley Allen screw and the tensioner backplate clamp bolt then withdraw the tensioner assembly from the engine unit. Do not rotate the crankshaft until the timing belt is re-tensioned.

Inspection

20 Clean thoroughly the camshaft/crankshaft sprockets and renew any that show signs of wear, damage or cracks.
21 Clean the tensioner assembly but do not use any strong solvent which may enter the pulley bearing. Check that the pulley rotates freely on the backplate, with no sign of stiffness or of free play. Renew the assembly if there is any doubt about its condition or if there are any obvious signs of wear or damage. The same applies to the tensioner spring, which should be checked with great care as its condition is critical for the correct tensioning of the timing belt.

Refitting

Camshaft sprocket(s)

22 If removed, refit the roll pin to the camshaft end, ensuring that its split is facing the centre of the camshaft, then refit the sprocket so that the timing marks are facing outwards (to the right). On K16 engines, ensure that the appropriate sprocket keyway engages with the camshaft locating pin (ie: if refitting the inlet camshaft sprocket, engage its IN keyway with the roll pin and so on) then refit the sprocket retaining bolt and washer **(see illustration)**. Where necessary, repeat the procedure for the second sprocket.
23 Prevent the sprocket(s) from rotating by using the method employed on removal, then tighten the sprocket retaining bolt(s) to the specified torque setting. Check that the sprocket timing marks align as described in Section 8, paragraph 15 **(see illustrations)**.
24 Fit the timing belt over the camshaft sprockets, ensuring that the belt front run (and, on K16 engines, the top run) is taut, that is, all slack is on the tensioner pulley side of the belt. Do not twist the belt sharply while refitting it and ensure that the belt teeth are correctly seated centrally in the sprockets and that the timing marks remain in alignment.
25 Slacken the tensioner backplate clamp bolt and check that the tensioner pulley moves to tension the belt. If the tensioner assembly is not free to move under spring tension, rectify the fault or the timing belt will not be correctly tensioned.
26 On K16 engines, remove the camshaft sprocket locking tool.
27 Using a suitable spanner or socket, rotate the crankshaft two full turns clockwise to settle and tension the belt. Realign the crankshaft pulley (90° BTDC) mark and check that the sprocket timing mark(s) are still correctly aligned.
28 If all is well, first tighten the tensioner pulley backplate clamp bolt to the specified torque, then tighten the tensioner pulley Allen screw to the specified torque.
29 Refit the front undercover panel and roadwheel, then lower the vehicle to the ground.
30 Refit the timing belt upper right-hand (outer) cover.
31 Where necessary, refit the power steering fluid reservoir to the mounting bracket and secure the hydraulic hose clamps in position with the retaining bolts.
32 Refit the coolant expansion tank and tighten the mounting bolts securely. Secure the coolant hose in position with any necessary retaining clips and reconnect the battery negative lead.

Crankshaft sprocket

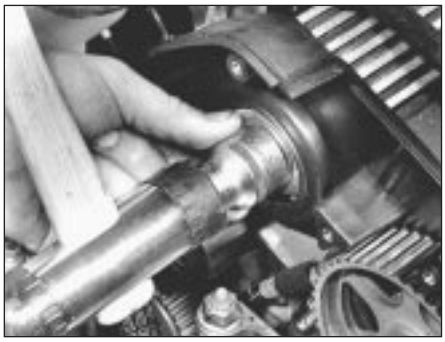
33 Refit the sprocket to the crankshaft so that it locates correctly on the crankshaft's flattened section, noting that the sprocket flange must be innermost so that the two timing marks are on the outside (right-hand side) of the sprocket. Check that the sprocket timing marks align as described in Section 8, paragraph 15.
34 Fit the timing belt over the crankshaft sprocket, ensuring that the belt front run (and, on K16 engines, the top run) is taut, that is, all slack is on the tensioner pulley side of the belt. Do not twist the belt sharply while refitting it and ensure that the belt teeth are correctly seated centrally in the sprockets and that the timing marks remain in alignment.
35 Slacken the tensioner backplate clamp bolt and check that the tensioner pulley moves to tension the belt. If the tensioner assembly is not free to move under spring tension, rectify the fault or the timing belt will not be correctly tensioned.
36 On K16 engines, remove the camshaft sprocket locking tool.
37 Refit the lower timing belt cover and the crankshaft pulley.
38 Carry out the operations described in paragraphs 27 to 32.

9.22 Camshaft sprockets have two keyways. Engage EX keyway with exhaust camshaft roll pin and IN keyway with inlet camshaft roll pin - K16 engine

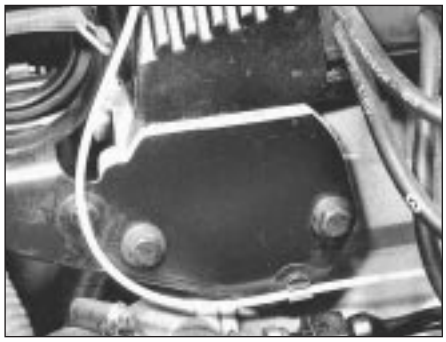
9.23a Using fabricated tool to hold camshaft pulley in position - K8 engine

9.23b Locking camshafts in position with fabricated tool - K16 engine

9.39 Ensure timing belt tensioner spring is correctly hooked onto pillar bolt



10.4 Fitting a new camshaft right-hand oil seal - K16 engine



10.8 Remove air intake duct support bracket to reach exhaust camshaft left-hand oil seal - K16 engine

Tensioner pulley

39 Refit the tensioner pulley assembly and tighten the pulley Allen screw and the backplate clamp bolt lightly. Hook the tensioner spring over the pillar bolt and check that the tensioner is free to move under spring tension and that the pulley bears correctly against the timing belt **(see illustration)**.
40 On K16 engines, remove the camshaft sprocket locking tool.
41 Carry out the operations described above in paragraphs 27 to 32.

10 Camshaft oil seals - renewal

Note: *If a right-hand oil seal is to be renewed with the timing belt still in place, then check that the belt is free from oil contamination. Renew the belt if signs of oil contamination are found. Cover the belt to protect it from contamination while work is in progress and ensure that all traces of oil are removed from the area before the belt is refitted.*

Right-hand seal(s)

1 Remove the camshaft sprocket(s).
2 Punch or drill two small holes opposite each other in the oil seal. Screw a self-tapping screw into each and pull on the screws with pliers to extract the seal.
3 Clean the seal housing and polish off any burrs or raised edges which may have caused the seal to fail in the first place.
4 Lubricate the lips of the new seal with clean engine oil and drive it into position until it seats on its locating shoulder. Use a suitable tubular drift, such as a socket, which bears only on the hard outer edge of the seal **(see illustration)**. Take care not to damage the seal lips during fitting and note that the seal lips should face inwards.
5 Refit the camshaft sprocket(s).

Left-hand seals - K16 engines

6 Disconnect the battery negative lead.
7 To reach the inlet camshaft seal, remove the distributor.
8 To reach the exhaust camshaft seal, unfasten the rubber strap securing the air intake duct to its support bracket, disconnect the vacuum pipe from the air temperature control valve and unclip the pipe from the support bracket. Undo the bracket's retaining bolts and remove the bracket from the cylinder head **(see illustration)**.
9 Remove the old seal and install the new one as described above in paragraphs 2 to 4.
10 On the inlet camshaft, refit the distributor.
11 On the exhaust camshaft, refit the air intake duct support bracket, tightening its screws to the specified torque wrench setting. Reconnect and secure the air temperature control valve vacuum pipe and refit the rubber strap to secure the air intake duct.
12 Connect the battery negative lead.

11 Camshafts and hydraulic tappets - removal, inspection and refitting

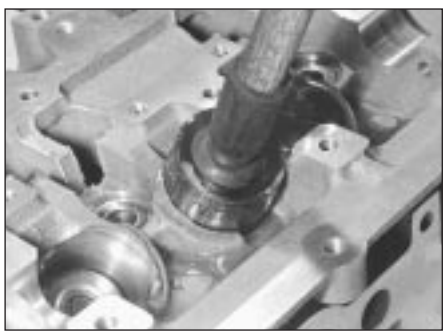
HAYNES HiNT ***If faulty tappets are diagnosed and the engine's service history is unknown, it is always worth trying the effect of renewing the engine oil and filter (using only good quality engine oil of the recommended viscosity and specification) before going to the expense of renewing any of the tappets.***

Note: *Prior to removing the camshaft(s), obtain Rover sealant kit LVV 10002 which also contains a plastic scraper. Read the instructions supplied with the kit and take care not to allow the sealant to contact the fingers, as it will bond the skin. If difficulty is experienced with the removal of hardened sealant from mating surfaces, it will be necessary to use a foam action gasket remover.*

Removal

K8 engines

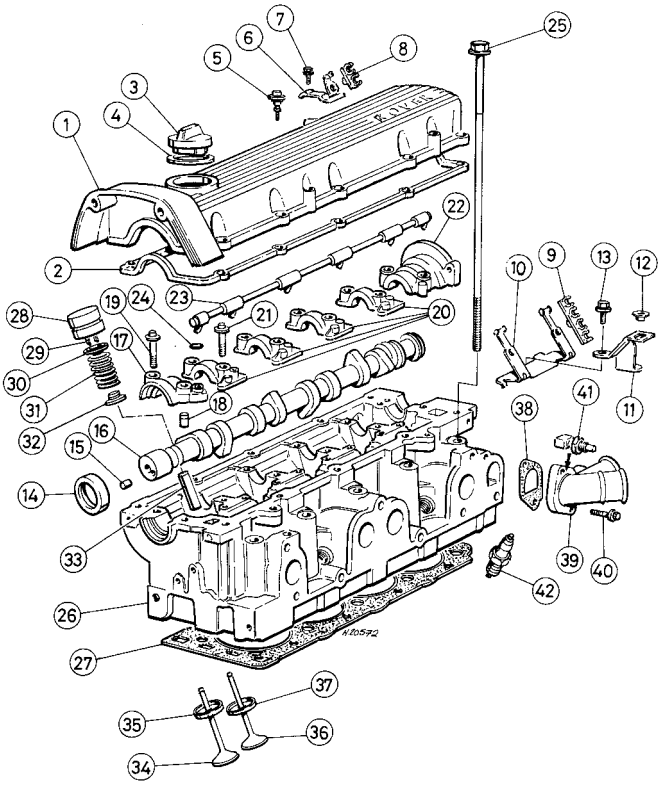
1 Remove the cylinder head cover **(see illustration 11.0a overleaf)**.
2 Remove the distributor.
3 Remove the camshaft sprocket.
4 Carefully prise the oil feed tube away from the camshaft bearing caps and remove it from the head assembly. Remove the O-rings from the oil rail and discard them. The O-rings must be renewed whenever they are disturbed.
5 The camshaft right and left-hand end bearing caps are noticeably different and cannot be confused. The intermediate bearing caps (which are all similar) are marked by the manufacturer with a number (1, 2, 3, or 4) stamped in the boss next to the oil feed hole. Before unbolting any of the caps, make written notes to ensure that each can be easily identified and refitted in its original location.
6 Working in the **reverse** of the tightening sequence **(see illustration 11.29)**, slacken the camshaft bearing cap bolts progressively, by one turn at a time. Work only as described to release the pressure of the valve springs on the bearing caps gradually and evenly.
7 Withdraw the bearing caps, noting the presence of the locating dowels on the end caps, then remove the camshaft and withdraw the oil seal.
8 Obtain eight small, clean plastic containers, number them 1 to 8, and then fill them with clean engine oil. Using a rubber sucker, withdraw each hydraulic tappet in turn **(see illustration)**, and place it in its respective container, to prevent oil loss. Do not interchange the hydraulic tappets or the rate of wear will be much increased and do not allow them to lose oil or they will take a long



11.8 Use a valve-grinding sucker to extract hydraulic tappets

1 Cylinder head cover
2 Seal
3 Engine oil filler cap
4 Seal
5 Bolt
6 HT lead retaining clip bracket
7 Screw
8 HT lead retaining clip
9 HT lead retaining clip
10 HT lead retaining clip bracket
11 Air intake duct support bracket
12 Fastener insert
13 Bolt
14 Oil seal
15 Roll pin
16 Camshaft
17 Camshaft right-hand bearing cap*
18 Dowel
19 Bolt
20 Camshaft intermediate bearing cap*
21 Bolt
22 Camshaft left-hand bearing cap*
23 Oil feed tube
24 O-ring
25 Cylinder head bolt
26 Cylinder head
27 Cylinder head gasket
28 Hydraulic tappet
29 Split collets
30 Spring retainer
31 Valve spring
32 Valve stem seal/ spring lower seat
33 Valve guide
34 Inlet valve
35 Valve seat insert
36 Exhaust valve
37 Valve seat insert
38 Gasket
39 Coolant outlet elbow
40 Bolt
41 Coolant temperature gauge sender unit
42 Spark plug

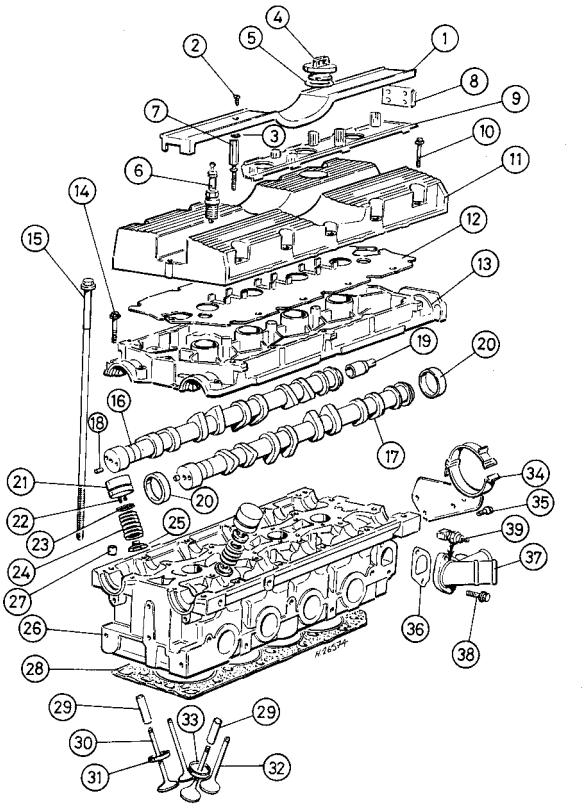
* ***Note***: *Camshaft bearing caps shown for reference only - not available separately from cylinder head*



11.0a Top end components - K8 engine

1 Spark plug cover
2 Screw
3 Retaining washer
4 Engine oil filler cap
5 Seal
6 Spark plug
7 Pillar bolt
8 HT lead grommet
9 HT lead clip plate
10 Bolt
11 Cylinder head cover
12 Gasket
13 Camshaft carrier*
14 Bolt
15 Cylinder head bolt
16 Inlet camshaft
17 Exhaust camshaft
18 Roll pin
19 Rotor arm drive spindle
20 Oil seal
21 Hydraulic tappet
22 Split collets
23 Spring retainer
24 Valve spring
25 Valve stem seal/spring lower seat
26 Cylinder head
27 Dowel
28 Cylinder head gasket
29 Valve guide
30 Inlet valves
31 Valve seat insert
32 Exhaust valves
33 Valve seat insert
34 Air intake duct support bracket
35 Bolt
36 Gasket
37 Coolant outlet elbow
38 Bolt
39 Coolant temperature gauge sender unit

* ***Note***: *Camshaft carrier shown for reference only - not available separately from cylinder head*



11.0b Top end components - K16 engine

11.9 Secure partly-removed timing belt upper left-hand (inner) cover clear of cylinder head - K16 engine

time to refill with oil on restarting the engine, resulting in incorrect valve clearances.

K16 engines

9 Remove both camshaft sprockets, then unscrew the inner cover's upper retaining bolts so that the cover can be pulled away from the cylinder head just far enough for adequate working clearance. Take care not to distort or damage the cover or the timing belt **(see illustration)**.

10 Remove the cylinder head cover **(see illustration 11.0b)**.

11 Remove the distributor.

12 Unclip the air temperature control valve vacuum pipe from the air intake duct support bracket, then unbolt the bracket from the cylinder head.

13 Working in the **reverse** of the tightening sequence **(see illustration 11.36)**, evenly and progressively slacken the camshaft carrier bolts by one turn at a time. Once all valve spring pressure has been relieved, remove the bolts.

14 Withdraw the camshaft carrier, noting the presence of the locating dowels, then remove the camshafts and slide off the oil seals. The inlet camshaft can be identified by the distributor rotor arm drive spindle (or its location), therefore there is no need to mark the camshafts.

15 Obtain sixteen small, clean plastic containers, number them 1 to 16, and then fill them with clean engine oil. Using a rubber sucker, withdraw each hydraulic tappet in turn **(see illustration 11.8)**, and place it in its respective container, to prevent oil loss. Do not interchange the hydraulic tappets or the rate of wear will be much increased and do not allow them to lose oil or they will take a long time to refill with oil on restarting the engine, resulting in incorrect valve clearances.

Inspection

16 Check each hydraulic tappet for signs of obvious wear (scoring, pitting, etc) and for ovality. Renew if necessary.

17 If the engine's valve clearances have sounded noisy, particularly if the noise persists after initial start-up from cold, then there is reason to suspect a faulty hydraulic tappet. Only a good mechanic experienced in these engines can tell whether the noise level is typical, or if renewal is warranted of one or more of the tappets.

18 If any tappet's operation is faulty, then it must be renewed.

19 Carefully remove all traces of old sealant from the mating surfaces of the bearing caps or camshaft carrier and cylinder head by using a plastic scraper. Examine the camshaft bearing journals and the cylinder head bearing surfaces for signs of obvious wear or pitting. If any such signs are evident, renew the component concerned.

20 To check the bearing journal running clearance, remove the hydraulic tappets, carefully clean the bearing surfaces and refit the camshaft(s) and carrier/bearing caps with a strand of Plastigauge across each journal. Tighten the carrier/bearing cap bolts to the specified torque wrench setting whilst taking great care not to rotate the camshaft(s), then remove the carrier/bearing caps and use the scale provided with the Plastigauge kit to measure the width of each compressed strand.

21 If the running clearance of any bearing is found to be worn to the specified service limit or beyond, fit a new camshaft and repeat the check. If the clearance is still excessive, then the cylinder head must be renewed.

22 To check camshaft endfloat, remove the hydraulic tappets, carefully clean the bearing surfaces and refit the camshaft(s) and carrier/bearing caps. Tighten to the specified torque wrench setting the carrier/bearing cap bolts, then measure the endfloat using a Dial Test Indicator (DTI) or dial gauge mounted on the cylinder head so that its tip bears on the camshaft right-hand end.

23 Tap the camshaft fully towards the gauge, zero the gauge, then tap the camshaft fully away from the gauge and note the gauge reading. If the endfloat measured is found to be worn to the specified service limit or beyond, fit a new camshaft and repeat the check. If the clearance is still excessive, then the cylinder head must be renewed.

24 The camshaft itself should show no signs of marks, pitting or scoring on the lobe surfaces. If such marks are evident, renew the camshaft.

25 If a camshaft is renewed, extract the roll pin from the old one and fit the pin to the new camshaft with its split towards the camshaft's centre.

Refitting

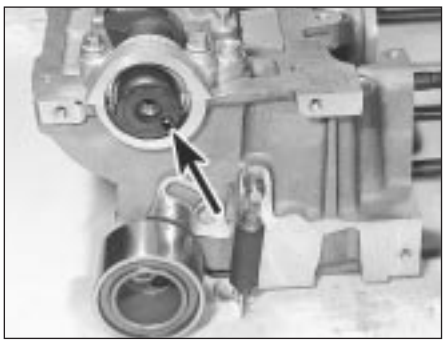
K8 engines

26 Liberally oil the cylinder head hydraulic tappet bores and the tappets **(see illustration)**. Note that if new tappets are being fitted, they must be charged with clean engine oil before installation. Carefully refit the tappets to the cylinder head, ensuring that each tappet is refitted to its original bore and is the correct way up. Some care will be required to enter the tappets squarely into their bores.

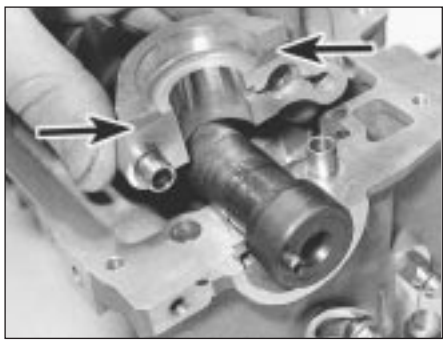
27 Liberally oil the camshaft bearings and lobes then refit the camshaft. Position the shaft so that its No 1 cylinder lobes are pointing away from their valves and the roll pin in the camshaft's right-hand end is in the 4 o'clock position when viewed from the right-hand end of the engine **(see illustration)**.

28 Ensure that the locating dowels are pressed firmly into their recesses. Check that the mating surfaces are completely clean, unmarked and free from oil, then apply a thin bead of special Rover sealant to the mating surfaces of the front and rear bearing caps as shown **(see illustration 11.29)**. Carefully follow the instructions supplied with the sealant kit. Refit the bearing caps, using the notes made on removal, to ensure that each is installed correctly and in its original location **(see illustration)**.

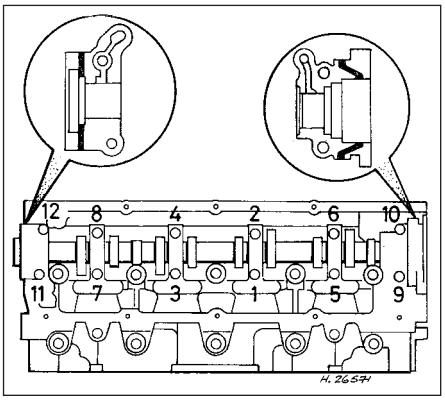
11.26 Lubricate hydraulic tappets thoroughly and refit correct way up - K8 engine



11.27 Camshaft roll pin location at TDC position (for refitting camshaft bearing caps) - K8 engine



11.28 Apply sealant (arrowed) and fit camshaft bearing caps - K8 engine



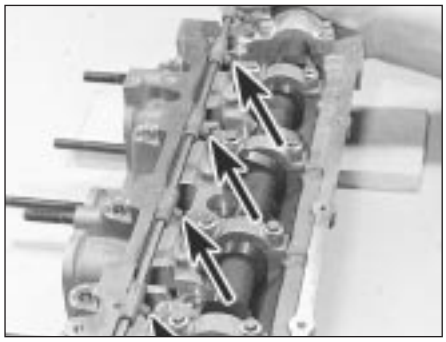
11.29 Camshaft bearing cap bolt tightening sequence - K8 engine

***Note**: Apply thin bead of sealant to end bearing cap mating surfaces along paths shown by heavy black lines*

29 Working in the sequence shown **(see illustration)**, progressively tighten the camshaft bearing cap bolts by one turn at a time until the caps touch the cylinder head evenly. Now go round again, working in the same sequence, and tighten all the bolts to the specified torque setting. Work only as described to impose the pressure of the valve springs gradually and evenly on the bearing caps. Wipe off all surplus sealant so that none is left to find its way into any oilways.

11.31 Fitting a new camshaft right-hand oil seal - K8 engine

11.30a Fill oil holes with clean engine oil - K8 engine



11.30b Renew O-rings (arrowed) before refitting oil feed tube - K8 engine

30 Squirt clean engine oil into each camshaft bearing cap oil hole, then fit new O-rings to each of the oil feed tube stubs **(see illustration)**. Refit the oil feed tube to the cylinder head and press it firmly into position in the camshaft bearing caps.

31 Fit a new camshaft oil seal **(see illustration)**, then refit the cylinder head cover and camshaft sprocket.

32 Refit the distributor.

K16 engines

33 Liberally oil the cylinder head hydraulic tappet bores and the tappets. Note that if new tappets are being fitted, they must be charged with clean engine oil before installation. Carefully refit the tappets to the cylinder head, ensuring that each tappet is refitted to its original bore and is the correct way up. Some care will be required to enter the tappets squarely into their bores.

34 Liberally oil the camshaft bearings and lobes and refit them to the cylinder head. Position each shaft so that its No 1 cylinder lobes are pointing away from their valves. With the shafts in this position, the roll pin in the inlet camshaft's right-hand end will be in the 4 o'clock position when viewed from the right-hand end of the engine, while that of the exhaust camshaft will be in the 8 o'clock position **(see illustration)**.

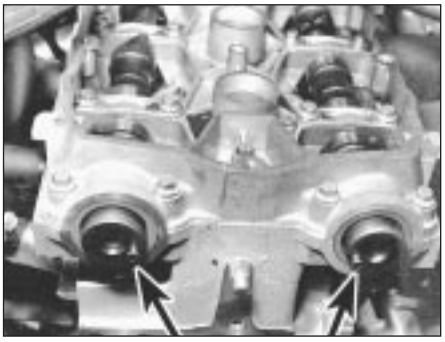
35 Ensure that the locating dowels are pressed firmly into their recesses, check that the mating surfaces are completely clean, unmarked and free from oil, then apply a thin bead of special Rover sealant to the mating surfaces of the camshaft carrier as shown **(see illustration)**. Carefully follow the instructions supplied with the sealant kit. Refit the carrier.

36 Working in the sequence shown **(see illustration)**, progressively tighten the camshaft carrier bolts by one turn at a time until the carrier touches the cylinder head evenly. Now go round again, working in the same sequence, tightening all bolts to the specified torque setting. Work only as described to impose the pressure of the valve springs gradually and evenly on the carrier. Wipe off all surplus sealant so that none is left to find its way into any oilways.

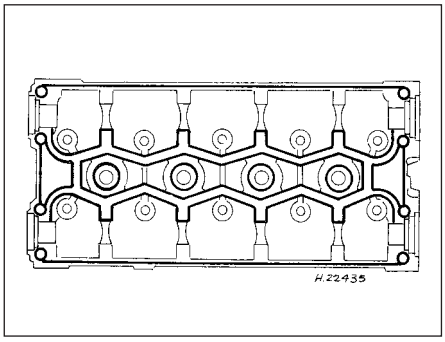
37 Fit new camshaft oil seals, then refit the cylinder head cover, inner timing cover retaining bolts and camshaft sprockets.

38 Refit the distributor.

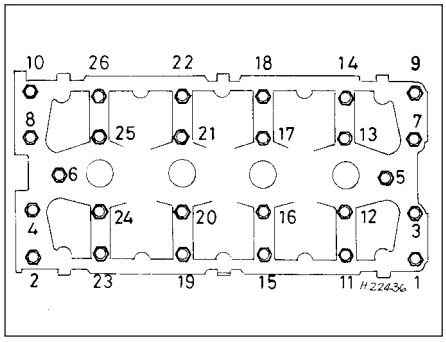
39 Refit the air intake duct support bracket, tightening its screws to their specified torque wrench setting, then reconnect and secure the air temperature control valve vacuum pipe and refit the rubber strap to secure the air intake duct.



11.34 Camshaft roll pin locations at TDC position for refitting camshaft carrier (arrowed) - K16 engine



11.35 Apply thin bead of sealant to camshaft carrier mating surfaces along paths shown by heavy black lines - K16 engine



11.36 Camshaft carrier bolt tightening sequence - K16 engine

12 Valve clearances - general information

1 It is necessary for a clearance to exist between the tip of each valve stem and the valve operating mechanism. This allows for expansion of the various engine components as the engine reaches normal operating temperature.

2 On most older engine designs, this meant that the valve clearances (also known as 'tappet' clearances) had to be checked and adjusted regularly. If the clearances were too slack, the engine would be very noisy, its power output would suffer and its fuel consumption would increase. Conversely, if the clearances were too tight, the engine's power output would be reduced and the valves and their seats could be severely damaged.

3 The engines covered in this Manual employ hydraulic tappets which use engine oil pressure to automatically take up the clearance between each camshaft lobe and its respective valve stem. This means that there is no need for regular checking and inspection of the valve clearances, but it is essential that only good quality oil of the recommended viscosity and specification is used in the engine and that this oil is scrupulously changed at the recommended intervals. If this advice is not followed, the oilways and tappets may become clogged with particles of dirt or deposits of burnt engine oil, so that the system cannot work properly. Ultimately, one or more of the tappets may fail and expensive repairs may be required.

4 On starting the engine from cold, there will be a slight delay while full oil pressure builds up in all parts of the engine, especially in the tappets. The valve clearances, therefore, may well rattle for about 10 seconds or so and then quieten. This is a normal state of affairs and is nothing to worry about, provided that all tappets quieten quickly and stay quiet.

5 After the vehicle has been standing for several days, the valve clearances may rattle for longer than usual as nearly all the oil will have drained away from the engine's top end components and bearing surfaces. While this is only to be expected, care must be taken not to damage the engine by running it at high speed until all the tappets are refilled with oil and operating normally. With the vehicle stationary, hold the engine at no more than a fast idle speed (maximum 2000 to 2500 rpm) for 10 to 15 minutes or until the noise ceases. Do not run the engine at more than 3000 rpm until all tappets are fully recharged with oil and all noise has ceased.

6 If the valve clearances are thought to be noisy, or if a light rattle persists from the engine's top end after it has reached normal operating temperature, take the vehicle to a Rover dealer for expert advice. Depending on the mileage covered and the usage to which each vehicle has been put, some vehicles may be noisier than others. Only a good mechanic experienced in these engines can tell if the noise level is typical for the vehicle's mileage or if a genuine fault exists. If any tappet's operation is faulty, then it must be renewed.

13 Cylinder head - removal and refitting

Note: *Due to engine design, it will become very difficult, almost impossible, to turn the crankshaft once the cylinder head bolts have been slackened. The manufacturer states that the crankshaft will be 'tight' and should not be rotated more than absolutely necessary once the head has been removed. If the crankshaft cannot be rotated, then it must be removed for overhaul work to proceed. With this in mind, the crankshaft always must be rotated to the desired position before the bolts are disturbed.*

Removal

1 Disconnect the battery negative lead.

2 Drain the cooling system.

3 Remove the camshaft sprocket(s).

4 Unscrew the bolts securing the timing belt upper left-hand (inner) cover to the cylinder head, so that the cover can be pulled away from the cylinder head just far enough for adequate working clearance. Take care not to distort or damage the cover or the timing belt.

5 Remove the cylinder head cover.

6 Disconnect the exhaust system front pipe from the manifold and, where fitted, disconnect or release the lambda sensor wiring so that it is not strained by the weight of the exhaust.

7 Note that the following text assumes that the cylinder head will be removed with both inlet and exhaust manifolds attached. This is easier but makes it a bulky and heavy assembly to handle. If it is wished first to remove the manifolds, proceed as described in the relevant Sections of Chapter 4.

8 On carburettor engines, disconnect the following from the carburettor and inlet manifold as described in the relevant Sections of Chapter 4A:

a) Fuel pump feed hose - plug both openings to prevent loss of fuel and entry of dirt into system.
b) Carburettor idle bypass solenoid wires.
c) Accelerator cable.
d) Choke cable.
e) Vacuum servo unit vacuum hose.
f) Inlet manifold PTC heater wire.
g) Inlet manifold heater temperature switch wiring.

9 On fuel-injected engines, refer to the relevant Sections of Chapter 4B or C, and disconnect or remove all throttle body/fuel rail components appertaining to cylinder head removal, noting the following:

a) The fuel system must be depressurised before any component is disconnected.
b) Plug the open ends of all disconnected pipes to prevent loss of fuel and entry of dirt into system.
c) Discard all sealing washers and O-rings, these must be renewed.

10 Working as described in Chapter 3, disconnect the connector plug from the coolant temperature sensor screwed into the coolant outlet elbow, then disconnect the coolant hoses from the (three) inlet manifold unions and from the coolant outlet elbow.

11 Unclip the engine wiring harness from the inlet manifold or its support stays. Slacken the bolts securing the stays to the manifold, then unbolt the support stays and the carburettor metal overflow pipes from the cylinder block/crankcase.

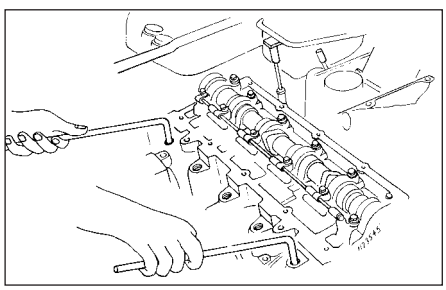
12 Remove the distributor cap, complete with the spark plug HT leads. Remove the spark plugs.

13 On K16 engines equipped with air conditioning, undo the nuts and bolts securing the heat shields to the rear of the alternator and air conditioning compressor and remove both heat shields. Slacken the two lower alternator mounting bolts then remove the upper mounting bolt and pivot the alternator away from the cylinder head.

14 Working in the reverse of the tightening sequence **(see illustrations 13.29a or 13.29b)**, progressively slacken the ten cylinder head bolts by one turn at a time. A female Torx-type socket (No 12 size) will be required. Remove each bolt in turn and store it in its correct fitted order by pushing it through a clearly-marked cardboard template.

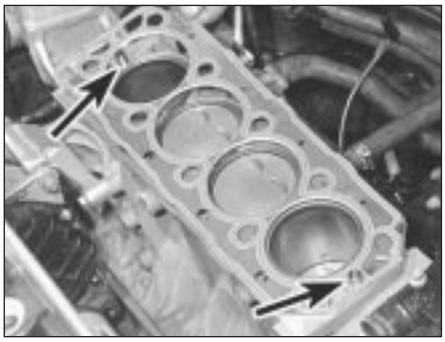
15 The joint between the cylinder head and gasket and the cylinder block/crankcase must now be broken without disturbing the wet liners. Although these liners are better located and sealed than some wet liner engines, there is still a risk of coolant and foreign matter leaking into the sump if the cylinder head is lifted carelessly. If care is not taken and the liners are moved, there is also a possibility of the bottom seals being disturbed, causing leakage after refitting the head.

16 To break the joint, obtain two L-shaped metal bars which fit into the cylinder head bolt holes and gently rock the cylinder head free towards the front of the vehicle **(see illustration)**. Do not try to swivel the head on



13.16 Using two cranked bars to break cylinder head joint

13.20 Checking condition of cylinder head bolt threads - cylinder head removed



13.26a Fit new cylinder head gasket on two locating dowels (arrowed) . . .

13.26b . . . so that TOP mark is upwards and FRONT arrow points to timing belt end

the cylinder block/crankcase as it is located by dowels as well as by the tops of the liners.

17 With the joint broken, lift the cylinder head away, using assistance if possible as it is a heavy assembly, especially if complete with the manifolds. Remove the gasket, noting the two locating dowels, and discard it.

18 Further to the warnings given in the note at the beginning of this Section, do not attempt to rotate the crankshaft with the cylinder head removed, otherwise the wet liners may be displaced. Operations that would normally require the rotation of the crankshaft (eg: cleaning the piston crowns) must be carried out with great care to ensure that no particles of dirt or foreign matter are left behind. If cylinder liner clamps are to be used, they must be clamped in place using spacers fitted under the heads of the cylinder head bolts.

19 If the cylinder head is to be dismantled, remove the camshaft(s) then refer to the relevant Sections of Part B of this Chapter.

Refitting

20 Check the condition of the cylinder head bolts, particularly their threads. Keeping all bolts in their correct fitted order, wash them and wipe dry. Check each bolt for any sign of visible wear or damage, renewing as necessary. Lightly oil the threads of each bolt, carefully enter it into its original hole and screw it in, by hand only until finger-tight. Measure the distance from the cylinder block/crankcase gasket surface to under the bolt's head **(see illustration)**.

21 If the distance measured is under 97 mm, the bolt may be re-used. If the distance measured is more than 97 mm, the bolt must be renewed. Considering the task these bolts perform and the pressures they must withstand, owners should consider renewing all the bolts as a matched set if more than one of the originals fail inspection or are close to the limit set.

22 The mating faces of the cylinder head and cylinder block/crankcase must be perfectly clean before refitting the head. Use a hard plastic or wood scraper to remove all traces of gasket and carbon.

23 Check the mating surfaces of the cylinder block/crankcase and the cylinder head for nicks, deep scratches and other damage. If slight, they may be removed carefully with a file, but if excessive, machining may be the only alternative to renewal.

24 If warpage of the cylinder head gasket surface is suspected, use a straight-edge to check it for distortion. Refer to Part B of this Chapter if necessary.

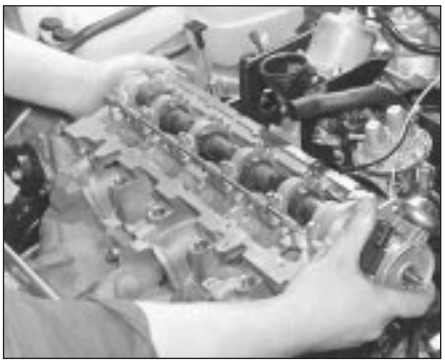
25 Wipe clean the mating surfaces of the cylinder head and cylinder block/crankcase. Check that the two locating dowels are in position at each end of the cylinder block/crankcase surface.

26 Position a new gasket on the cylinder block/crankcase surface so that its TOP mark is uppermost and the FRONT arrow points to the timing belt end **(see illustrations)**.

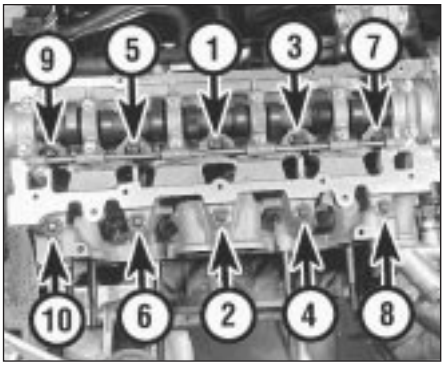
27 Refit the cylinder head, locating it on the dowels **(see illustration)**.

28 Keeping all the cylinder head bolts in their correct fitted order, wash them and wipe dry. Lightly oil under the head and on the threads of each bolt, carefully enter it into its original hole and screw it in, by hand only, until finger-tight.

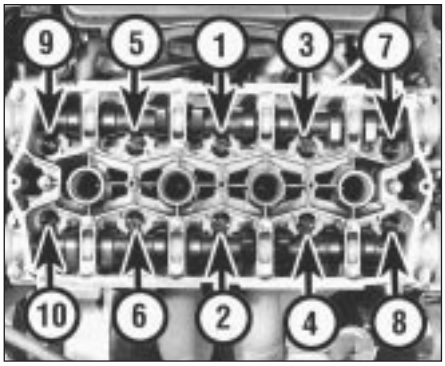
29 Working progressively and in the sequence shown **(see illustrations)**, use first a torque wrench, then an ordinary socket extension bar to tighten the cylinder head bolts through the specified stages. To tighten the bolts through the specified angles, simply use a felt-tip pen or similar to mark the position on the cylinder head of each bolt head's radial mark. The second stage then



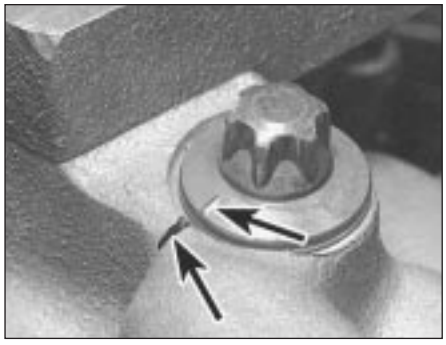
13.27 Refitting the cylinder head



13.29a Cylinder head bolt tightening sequence - K8 engine



13.29b Cylinder head bolt tightening sequence - K16 engine



13.29c Alignment of bolt head radial marks with cylinder head to establish tightening angles (arrowed)

tightens each bolt through half a turn so that the marks face away from each other and the third stage tightens them through another half-turn so that all the bolt-head marks will then align again with their cylinder head counterparts. If any bolt is overtightened past its mark, slacken it through 90°, then re-tighten until the marks align **(see illustration)**.

30 Refit and tighten the inlet manifold support stay bolts, then secure the engine wiring harness using the clips provided.

31 On K16 engines equipped with air conditioning, refit the alternator mounting bolts and tighten them to the specified torque setting. Refit the compressor and alternator heatshields, tightening their retaining bolts and nuts securely.

32 Connect all disturbed coolant hoses, securing them in position with their retaining clips. Reconnect the coolant temperature sensor wiring.

33 Working as described in Chapter 4, connect or refit all disturbed wiring, hoses and control cable(s) to the inlet manifold and fuel system components, then adjust the choke and or accelerator cable(s).

34 Reconnect the exhaust system front pipe to the manifold and (if applicable) reconnect the lambda sensor wiring.

35 Refit the cylinder head cover, inner timing cover retaining bolts and camshaft sprocket(s).

36 Refit the spark plugs and distributor cap then reconnect the battery negative lead.

37 Refill the cooling system.

14 Sump - removal and refitting

Note: *It is essential that new bolts of the Patchlok type are used when refitting the sump.*

Removal

1 Disconnect the battery negative lead.

2 Drain the engine oil then clean and refit the engine oil drain plug, tightening it to the specified torque wrench setting. If the engine is nearing its service interval when the oil and filter are due for renewal, it is recommended that the filter is also removed and a new one fitted. After reassembly, the engine can then be replenished with fresh engine oil.

3 Apply the handbrake, then jack up the front of the vehicle and support it on axle stands. Remove the right-hand roadwheel.

4 From underneath the front of the vehicle, slacken and remove the three bolts securing the bumper flange to the body. Remove the seven bolts securing the front undercover panel to the body and remove the panel.

5 Working as described in Chapter 4, disconnect the exhaust system front pipe from the manifold and, where fitted, disconnect or release the lambda sensor wiring so that it is not strained by the weight of the exhaust.

14.6 Remove flywheel lower cover plate to reach sump bolts

6 Unscrew the three retaining bolts and remove the flywheel lower cover plate **(see illustration)**.

7 Slacken and remove the bolts securing the anti-beaming bracket to the engine and transmission and remove the bracket.

8 Progressively slacken the sump retaining bolts then remove them along with the anti-beaming bracket support. Make a note of the correct fitted position of the support and of the longer bolts at positions 4, 8 and 12 **(see illustration 14.14)** to ensure correct refitment on reassembly.

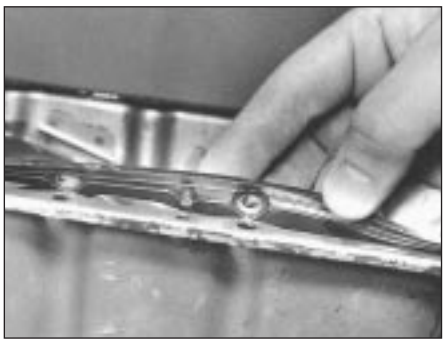
9 Break the joint by striking the sump with the palm of the hand, then lower the sump and withdraw it **(see illustration)**.

10 While the sump is removed, take the opportunity to unbolt the oil pump pick-up/strainer pipe and clean it using a suitable solvent. Inspect the strainer mesh for signs of clogging or splitting and renew if necessary.

Refitting

11 Clean all traces of gasket from the mating surfaces of the cylinder block/crankcase and sump, then use a clean rag to wipe out the sump and the engine's interior. If the oil pump pick-up/strainer pipe was removed, fit a new sealing O-ring to its end and refit the pipe, tightening its retaining bolts to the specified torque setting.

12 If the sump gasket is damaged or shows signs of deterioration, then it must be renewed. Fit the gasket to the sump mating surface so that its 7 locating pegs fit into the sump holes **(see illustration)**.



14.12 Sump gasket pegs must engage with sump mating surface holes

14.9 Removing the sump

13 Offer up the sump to the cylinder block/crankcase then fit the new sump retaining bolts, not forgetting the anti-beaming bracket support. Tighten the bolts finger-tight only.

14 Working in the sequence shown **(see illustration)**, tighten the sump bolts to the specified torque setting.

15 Refit the anti-beaming bracket and tighten the mounting bolts to the specified torque setting.

16 Install the flywheel lower cover plate and tighten the retaining bolts to the specified torque wrench setting.

17 Reconnect the exhaust system front pipe to the manifold and, where necessary, reconnect the lambda sensor wiring.

18 Refit the undercover panel and wheel, then lower the vehicle to the ground and reconnect the battery negative lead.

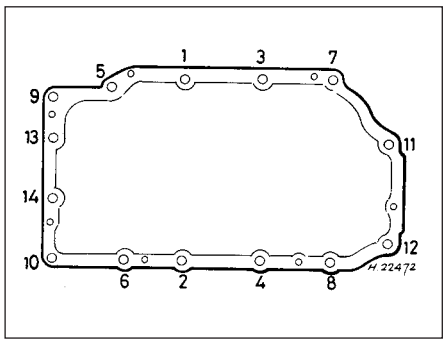
19 Replenish the engine oil.

15 Oil pump - removal and refitting

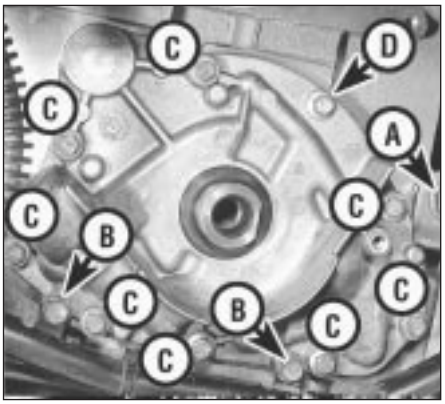
Note: *The oil pressure relief valve can be dismantled without removing the oil pump from the vehicle. See Section 16 for details.*

Removal

1 Remove the crankshaft sprocket and secure the timing belt clear of the working



14.14 Sump bolt tightening sequence



15.4 Alternator adjuster link nut (A) wiring guide screws (B) oil pump bolts (C) and special oil pump bolt (D)

area so that it cannot be contaminated with oil.

2 Drain the engine oil, then clean and refit the engine oil drain plug, tightening it to the specified torque wrench setting. If the engine is nearing its service interval when the oil and filter are due for renewal, it is recommended that the filter is also removed and a new one fitted. After reassembly, the engine can then be replenished with fresh engine oil.

3 Where necessary, unscrew the alternator adjuster link retaining nut and unbolt the engine wiring harness guide retaining screws, then move the link and guide clear of the oil pump.

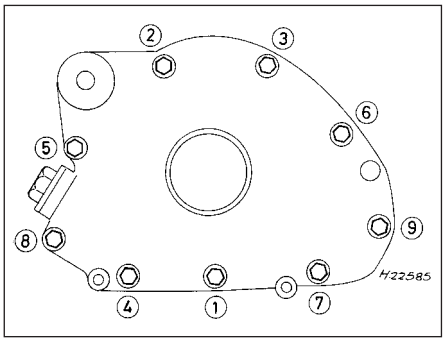
4 Unscrew the oil pump retaining bolts, noting the fitted position of the special bolt, and withdraw the oil pump **(see illustration)**. Recover the pump gasket and discard it, then carefully lever the crankshaft right-hand oil seal out of the oil pump. The oil seal should be renewed whenever it is disturbed.

Refitting

5 Thoroughly clean the mating faces of the oil pump and cylinder block/crankcase. Use grease to stick a new gasket in place.

6 Prime the pump before installation by injecting clean engine oil into it and turning it by hand.

7 Offer up the pump, ensuring that its inner gear engages fully on the crankshaft flats, then push the pump fully into position.



15.8 Oil pump bolt tightening sequence

8 Refit the pump retaining bolts, ensuring that the special bolt is refitted to its original position. Tighten the retaining bolts to the specified torque setting in the order shown **(see illustration)**.

9 If removed, refit the alternator adjuster link and the engine wiring harness guide, then tighten securely the retaining nut and screws.

10 Fit a new crankshaft right-hand oil seal.

11 Remove all traces of surplus oil then refit the crankshaft sprocket.

12 Replenish the engine oil.

16 Oil pump - dismantling, inspection and reassembly

Note: *If oil pump wear is suspected, check the cost and availability of new parts (only available in the form of repair kit LQX 10001) against the cost of a new pump. Examine the pump as described in this Section and then decide whether renewal or repair is the best course of action.*

Dismantling

1 Remove the oil pump.

2 Unscrew the Torx screws (size T25) and remove the pump cover plate. Discard the sealing ring.

3 Note the identification marks on the outer rotor then remove both the rotors from the body.

4 The oil pressure relief valve can be dismantled, if required, without disturbing the pump. If this is to be done with the pump in position and the engine still installed in the vehicle, it will first be necessary to jack up the front of the vehicle and remove the right-hand roadwheel to gain access to the valve **(see illustration)**.

5 To dismantle the valve, unscrew the threaded plug and recover the valve spring and plunger **(see illustration)**. Discard the plug sealing washer.

Inspection

6 Inspect the rotors for obvious signs of wear or damage and renew if necessary. If the pump body or cover plate is scored or damaged, then the complete oil pump assembly must be renewed.

7 Using feeler gauge blades of the appropriate thickness, measure the clearance between the outer rotor and the pump body, then between the tips of the inner and outer rotor lobes (a and b respectively) **(see illustration)**.

8 Using feeler gauge blades and a straight-edge placed across the top of the pump body and the rotors, measure the rotor endfloat (c).

9 If any measurement is outside the specified limits, the complete pump assembly must be renewed.

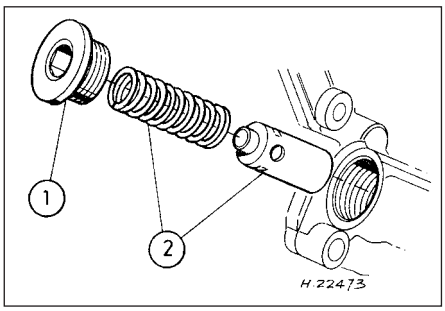
10 If the pressure relief valve plunger is scored, or if it does not slide freely in the pump body bore, then it must be renewed, using all the components from the repair kit.

11 To complete a thorough inspection of the oil pump components, the sump should be removed and the oil pump pick-up/strainer pipe removed and cleaned.

Reassembly

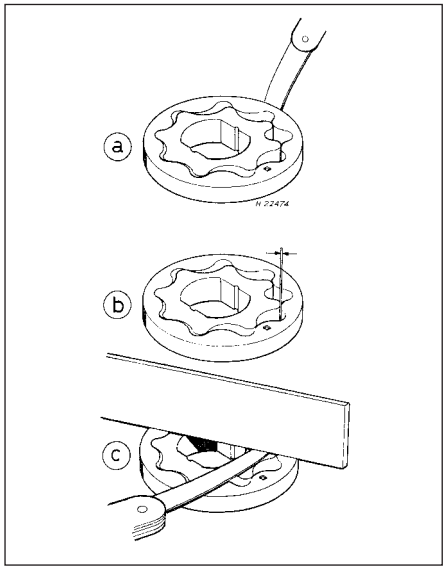
12 Lubricate the pump rotors with clean engine oil and refit them to the pump body,

16.4 Unscrewing oil pressure relief valve threaded plug

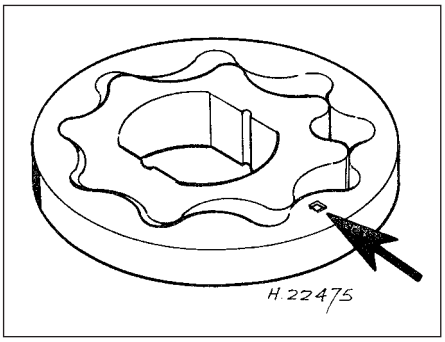


16.5 Oil pressure relief valve assembly

1 Threaded plug
2 Valve spring and plunger



16.7 Checking oil pump rotors for wear - see text for details



16.12 Oil pump outer rotor outside face identifying mark (arrowed)

ensuring that the outer rotor's identification mark faces outwards **(see illustration)**.

13 Fit a new sealing ring to the pump body and refit the cover plate. Apply thread-locking compound to the threads of the cover plate Torx screws and tighten them securely.

14 Check that the pump rotates freely, then prime it by injecting oil into its passages and rotating it. If a long time elapses before the pump is refitted to the engine, prime it again before installation.

15 Refit the oil pressure relief valve plunger, ensuring that it is the correct way up, then install the spring. Fit a new sealing washer to the threaded plug and tighten the plug securely.

17 Crankshaft oil seals - renewal

Right-hand seal

1 Remove the crankshaft sprocket and secure the timing belt clear of the working area so that it cannot be contaminated with oil.

2 Punch or drill two small holes opposite each other in the seal. Screw a self-tapping screw into each and pull on the screws with pliers to extract the seal.

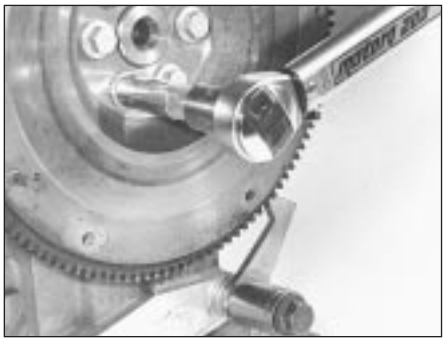
3 Clean the seal housing and polish off any burrs or raised edges which may have caused the seal to fail in the first place.

4 Lubricate the lips of the new seal with clean engine oil and drive it into position until it seats on its locating shoulder. Use a suitable tubular drift, such as a socket, which bears only on the hard outer edge of the seal. Take care not to damage the seal lips during fitting. Use either grease or a thin layer of insulating tape to protect the seal lips from the edges of the crankshaft flats but be careful to remove all traces of tape and to lubricate the seal lips if the second method is used. Note that the seal lips should face inwards.

5 Wash off any traces of oil, then refit the crankshaft sprocket.

Left-hand seal

6 Remove the flywheel.



18.2 Using fabricated tool to lock flywheel in position

7 Taking care not to mark either the crankshaft or any part of the cylinder block/crankcase, lever the seal evenly out of its housing.

8 Clean the seal housing and polish off any burrs or raised edges which may have caused the seal to fail in the first place.

9 Lubricate with grease the lips of the new seal and the crankshaft shoulder, then offer up the seal to the cylinder block/crankcase.

10 Ease the sealing lip of the seal over the crankshaft shoulder by hand only, then press the seal evenly into its housing until its outer flange seats evenly on the housing lip. If necessary, a soft-faced mallet can be used to tap the seal gently into place.

11 Wash off any traces of oil, then refit the flywheel.

18 Flywheel - removal, inspection and refitting

Removal

1 Remove the gearbox and the clutch assembly.

2 Prevent the flywheel from turning by locking the ring gear teeth **(see illustration)** or by bolting a strap between the flywheel and the cylinder block/crankcase.

3 Slacken and remove the flywheel retaining bolts and discard them The bolts must be renewed whenever they are disturbed.

4 Remove the flywheel. Do not drop it, as it is very heavy.

Inspection

5 If the flywheel's clutch mating surface is deeply scored, cracked or otherwise damaged, then the flywheel must be renewed, unless it is possible to have it surface ground. Seek the advice of a Rover dealer or engine reconditioning specialist.

6 If the ring gear is badly worn or has missing teeth, then it must be renewed. This job is best left to a Rover dealer or engine reconditioning specialist. The temperature to which the new ring gear must be heated for installation (350°C - shown by an even light blue colour) is critical and, if not done accurately, the hardness of the teeth will be destroyed.

7 Examine the reluctor ring (fitted to the rear of the flywheel) for signs of damage and check that it is securely fastened by the two retaining screws. If the reluctor ring is damaged, then it must be renewed.

Refitting

8 Clean the mating surfaces of the flywheel and crankshaft. Clean any remaining adhesive from the threads of the crankshaft threaded holes by making two saw cuts at opposite points along the (carefully-cleaned) threads of one of the original flywheel bolts and screwing it into each hole in turn. **Do not** use a tap to clean the threads in this way.

9 Position the flywheel over the crankshaft's locating dowel, press it into place and fit six **new** bolts.

10 Lock the flywheel using the method employed on dismantling, then tighten the retaining bolts to the specified torque wrench setting.

11 Refit the clutch, then remove the locking tool and refit the gearbox.

19 Engine/gearbox mountings - inspection and renewal

Inspection

1 If improved access is required, raise the front of the vehicle and support it securely on axle stands.

2 Check the mounting rubber to see if it is cracked, hardened or separated from the metal at any point. Renew the mounting if any such damage or deterioration is evident.

3 Check that all mounting fasteners are securely tightened. Use a torque wrench to check, if possible.

4 Using a large screwdriver or a pry bar, check for wear in the mounting by carefully levering against it to check for free play. Where this is not possible, enlist the aid of an assistant to move the engine/gearbox unit back and forth or from side to side while you watch the mounting. While some free play is to be expected even from new components, excessive wear should be obvious. If excessive free play is found, check first that the fasteners are correctly secured, then renew any worn components as described below.

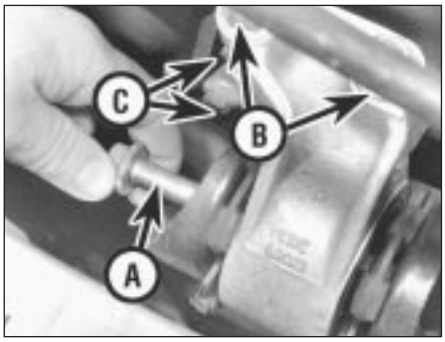
Renewal

Right-hand mounting

5 Disconnect the battery negative lead.

6 To improve access to the mounting, remove the expansion tank mounting bolts then free the coolant hose from any relevant retaining clips and position the tank clear of the engine. On models equipped with power-assisted steering, undo all the power steering hose retaining clamp bolts then slide the fluid

19.7a Use trolley jack with wooden spacer to adjust height of engine/gearbox unit



19.7b Right-hand mounting through-bolt (A), mounting-to-bracket nuts (B), bracket-to-cylinder block/crankcase bolts (two arrowed - C)

19.12 Check rubber washers are correctly installed before tightening through-bolt nut

reservoir out of its retaining clip and position it clear of the timing belt covers. Take great care not to place any undue strain on hoses and mop up any spilt fluid immediately.

7 Support the weight of the engine/gearbox unit by using a trolley jack, with a wooden spacer to prevent damage to the sump. Unscrew the mounting through-bolt and nut and the mounting to bracket nuts. Remove the mounting, noting the two rubber washers **(see illustrations)**.

8 Where necessary, unscrew the retaining bolts and remove the bracket from the cylinder block/crankcase.

9 Check carefully for signs of wear or damage on all components and renew them where necessary.

10 On reassembly, refit the bracket to the cylinder block/crankcase and tighten the retaining bolts to the specified torque setting.

19.18 Slacken and remove gearbox bracket-to-mounting bolts . . .

11 Locate the rubber washers on the mounting, one on each side of its centre boss, then refit the mounting to the bracket and tighten the retaining nuts, finger-tight only.

12 Using the trolley jack to position the engine unit at the correct height, refit from rear to front the mounting-to-body through-bolt, ensuring that the rubber washers are correctly seated, then refit the nut **(see illustration)**.

13 Tighten the mounting to bracket nuts and the through-bolt to the specified torque wrench settings, then lower and remove the jack.

14 Where necessary, refit the power steering fluid reservoir to its mounting bracket and secure the hydraulic hose clamps in position with the retaining bolts.

15 Refit the coolant expansion tank and tighten the mounting bolts securely. Secure the coolant hose in position with any necessary retaining clips and reconnect the battery negative lead.

Left-hand mounting

16 Disconnect the battery negative lead then disconnect the clutch cable.

17 To improve access to the mounting, unclip the engine wiring harness and position it clear of the mounting.

18 Support the weight of the engine/gearbox unit by using a trolley jack, with a wooden spacer to prevent damage to the gearbox casing. Slacken and remove the two bolts securing the gearbox bracket to the mounting **(see illustration)**.

19 Lower the engine/gearbox unit, then remove the four bolts securing the mounting to the body and manoeuvre the mounting out of position. If required, slacken and remove the two bolts which secure the bracket to the gearbox and remove the bracket **(see illustrations)**.

20 Although the mounting rubber is secured by two nuts to a metal outer section, the two parts can be renewed only as a complete assembly. Check all components carefully for signs of wear or damage and renew where necessary.

21 On reassembly, refit the bracket to the gearbox and tighten the retaining bolts to the specified torque setting.

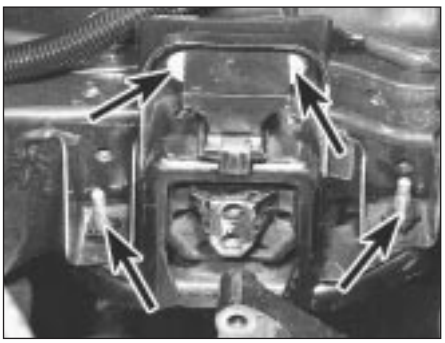
22 Manoeuvre the mounting into position then refit the retaining bolts and tighten them to the specified torque setting.

23 Use the trolley jack to raise the gearbox to the correct height, then refit the mounting bracket to mounting bolts and tighten them to the specified torque setting. Refit the wiring harness to its retaining clip.

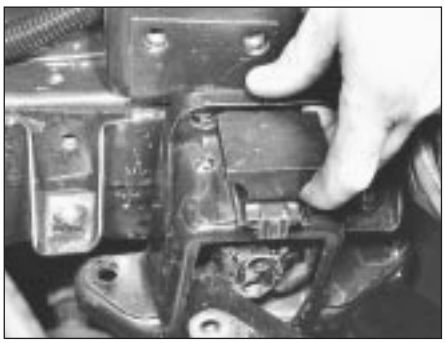
24 Refit the clutch cable and reconnect the battery negative lead.

Rear mounting

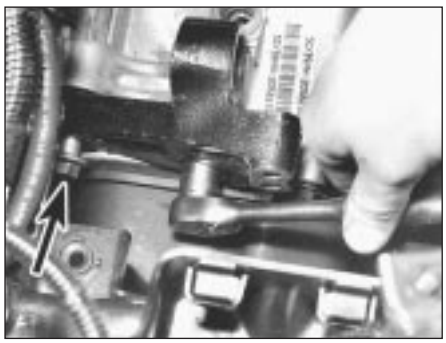
25 Apply the handbrake then jack up the



19.19a . . . then lower gearbox and remove four left-hand mounting-to-body bolts (arrowed) . . .



19.19b . . . and remove mounting



19.19c Gearbox bracket is retained by two bolts (one arrowed)

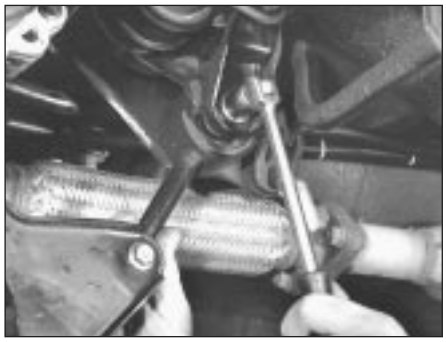
front of the vehicle and support it securely on axle stands.

26 Support the weight of the engine/gearbox unit by using a trolley jack, with a wooden spacer to prevent damage to the transmission casing. Unbolt the mounting bracket from the gearbox and the connecting link from the underbody bracket, then remove the mounting **(see illustrations)**.

27 Unscrew the through-bolt to separate the connecting link from the bracket. Check carefully for signs of wear or damage, paying particular attention to the connecting link rubber bushes. Renew as necessary.

28 Reassembly is the reverse of the removal procedure. Tighten all mounting bolts to the specified torque setting.

19.26a Unbolt rear mounting to gearbox bolts (arrowed) . . .



19.26b . . . then undo connecting link-to-underbody bracket bolt and remove mounting

Chapter 2 Part B Engine removal and general 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 

Specifications

Refer to Part A of this Chapter

1 General information

Included in this part of the Chapter are details of removing the engine/gearbox unit from the vehicle and general overhaul procedures for the cylinder head, cylinder block/crankcase and all other engine internal components.

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

After Section 5, all instructions are based on the assumption that the engine has been removed from the vehicle. For information concerning in-car engine repair, as well as the removal and refitting of those external components necessary for full overhaul, refer to Part A of this Chapter and to Section 5. Ignore any preliminary dismantling operations described in Part A that are no longer relevant once the engine has been removed from the vehicle.

2 Engine overhaul - general information

It is 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 does not preclude the need for an overhaul. Frequency of servicing is probably the most important consideration. An engine which has had regular and frequent oil and filter changes, as well as other required maintenance, should give many thousands of miles of reliable service. Conversely, a neglected engine may require an overhaul very early in its life. If a complete service does not remedy any problems, major mechanical work is the only solution.

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 are not responsible before deciding that the rings and/or guides are worn. Perform a compression test to determine the likely cause of the problem.

Check the oil pressure with a gauge fitted in place of the oil pressure switch and compare it with that specified. If it is extremely low, the main and big-end bearings and/or the oil pump are probably worn out.

Loss of power, rough running, knocking or metallic engine noises, excessive valve gear noise and high fuel consumption may also point to the need for an overhaul, especially if they are all present at the same time.

An engine overhaul involves restoring all internal parts to the specification of a new engine. During an overhaul, the cylinder liners, the pistons and the piston rings are renewed. New main and big-end bearings are generally fitted and, if necessary, the crankshaft may be renewed to restore the journals. The valves are serviced as well, since they are usually in less than perfect condition at this point. While the engine is being overhauled, other components, such as the distributor, starter and alternator, can be overhauled as well. The end result should be an as-new engine that will give many trouble-free miles.

Critical cooling system components such as the hoses, thermostat and coolant pump should be renewed when an engine is overhauled. The radiator should be checked carefully to ensure that it is not clogged or leaking. Also it is a good idea to renew the oil pump whenever the engine is overhauled.

Before beginning the engine overhaul, read through the entire procedure to familiarize yourself with the scope and requirements of the job. Overhauling an engine is not difficult if you follow carefully all of the instructions, have the necessary tools and equipment and pay close attention to all specifications. However, it can be time-consuming. Plan on the vehicle being off the road for a minimum of two weeks, especially if parts must be taken to an engineering works for repair or reconditioning. Check on the 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 renewed. Often the engineering works will handle the inspection of parts and offer advice concerning reconditioning and renewal.

Always wait until the engine has been completely dismantled and all components, especially the cylinder block/crankcase, the cylinder liners and the crankshaft have been inspected before deciding what service and repair operations must be performed by an engineering works. Since the condition of these components will be the major factor to consider when determining whether to overhaul the original engine or buy a reconditioned unit, do not purchase parts or have overhaul work done on other components until they have been thoroughly inspected. As a general rule, time is the primary cost of an overhaul, so it does not pay to fit worn or substandard parts.

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

3 Engine/gearbox removal - methods and precautions

If you have decided that the 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 shop or garage is not available, at the very least a flat, level, clean work surface is required.

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

An engine hoist or A-frame will also be necessary. Make sure the equipment is rated in excess of the combined weight of the engine and gearbox (290 lb/130 kg approximately). Safety is of primary importance, considering the potential hazards involved in lifting the engine/gearbox unit out of the vehicle.

If the engine/gearbox unit is being removed by a novice, a helper should 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 lifting the unit out of the vehicle.

Plan the operation ahead of time. Before starting work, arrange for the hire of or obtain all of the tools and equipment you will need. Some of the equipment necessary to perform engine/gearbox removal and installation safely and with relative ease are (in addition to an engine hoist) a heavy duty trolley jack, complete sets of spanners and sockets as described at the front of this Manual, wooden blocks and plenty of rags and cleaning solvent for mopping up spilled oil, coolant and fuel. If the hoist must 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. An engineering works will be required to perform some of the work which the do-it-yourselfer cannot accomplish without special equipment. These places often have a busy schedule, so it would be a good idea to consult them before removing the engine in order to accurately estimate the amount of time required to rebuild or repair components that may need work.

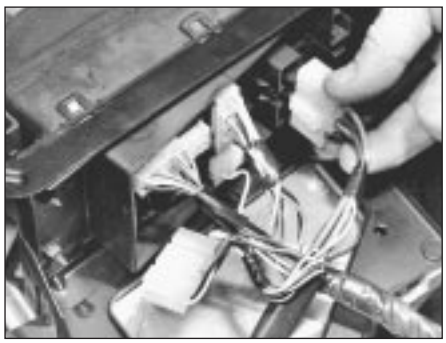
Always be extremely careful when removing and refitting the engine/gearbox unit. Serious injury can result from careless actions. Plan ahead, take your time and a job of this nature, although major, can be accomplished successfully.

4 Engine/gearbox - removal and refitting

Note: *The engine can be removed from the vehicle only as a complete unit with the gearbox.*

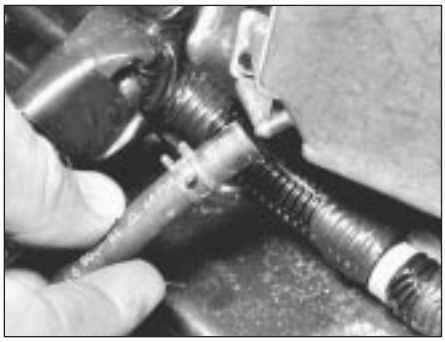
Removal

1 Park the vehicle on firm, level ground then remove the bonnet.
2 If the engine is to be dismantled, drain the oil and remove the oil filter, then clean and refit the drain plug, tightening it to its specified torque setting.
3 Firmly apply the handbrake then jack up the front of the vehicle and support it securely on axle stands. Remove both front roadwheels.
4 From underneath the front of the vehicle, slacken and remove the three bolts securing the bumper flange to the body. Remove the seven bolts securing the front undercover panel to the body and remove the panel.
5 Drain the gearbox oil, then clean and refit the drain plug, tightening it to its specified torque setting.
6 Drain the cooling system.
7 Remove the battery, followed by the battery tray and support bracket.
8 Remove the complete air cleaner assembly, including the intake duct and mounting bracket, intake hose and resonator.
9 Disconnect the ignition coil HT lead from the distributor cap.
10 Undo the nut and disconnect the battery positive lead from the main starter motor solenoid terminal, then carefully disconnect the spade connector from the solenoid.
11 Undo the two bolts securing the engine compartment fusebox to the body, then disconnect the two engine wiring harness block connectors from the underside of the fusebox. Undo the bolt securing the wiring harness earth lead to the bonnet platform, then disconnect the LT wiring connector from the ignition coil. On fuel-injected engines, also disconnect the wiring connector and vacuum pipe from the engine management ECU. Free the engine wiring harness from any relevant clips or ties so that it is free to be removed with the engine/gearbox unit **(see illustrations)**.



4.11a Disconnecting engine harness wiring connectors from underside of fusebox . . .

4.11b . . . and ignition coil LT wiring connector



4.11c Disconnecting vacuum pipe from engine management ECU - fuel-injected engines

12 Trace the clutch cable back from the clutch release lever to the bulkhead and remove the C-clip which retains the outer cable spring in position. Unhook the inner cable from the release lever and free the outer cable from its mounting bracket and position it clear of the gearbox.

13 From underneath the vehicle, pull out the rubber retaining pin which secures the lower end of the speedometer cable to the gearbox housing. Withdraw the cable from the speedometer drive and remove the O-rings from the cable lower end. Renew the O-rings, regardless of their condition.

14 In the absence of the special gearchange linkage balljoint separator (Rover service tool number 18G 1592), use a suitable flat-bladed screwdriver to carefully lever the link rod balljoints off the gearbox upper and lower selector levers, taking care not to damage the balljoint gaiters.

15 Unscrew the reverse interlock cable nut from the top of the gearbox housing. In the absence of the special spanner (Rover service tool number 18G 1591), use a close-fitting spanner to unscrew the plastic nut, noting that it is easily damaged. Plug the gearbox orifice to prevent the entry of dirt.

16 Disconnect the coolant hose from the bottom of the expansion tank, the expansion tank hose from the inlet manifold union, both heater hoses from the heater matrix unions and the radiator top hose from the coolant outlet elbow. Either remove the radiator bottom hose or secure it so that it will not hinder engine/gearbox removal.

17 Slacken and remove the union bolt which secures the vacuum servo unit vacuum hose to the inlet manifold. Discard the sealing washers as they must be renewed whenever they are disturbed.

18 On carburettor engines, disconnect the feed hose from the fuel pump, then disconnect the accelerator and choke cables from the carburettor.

19 On fuel-injected engines, depressurise the fuel system and disconnect the fuel feed and return hoses from the throttle body/fuel rail. Disconnect the accelerator cable from the throttle housing.

20 Remove the expansion tank mounting bolts and position the tank clear of the engine unit.

21 Remove the alternator.

22 On models equipped with power-assisted steering, remove the power steering pump.

23 On models equipped with air conditioning, slacken and remove the two compressor heatshield retaining bolts then remove the heatshield and disconnect the compressor wiring connector. Undo the four bolts securing the compressor to the mounting bracket and the single bolt securing the air conditioning pipe to the mounting bracket. Position the compressor clear of the engine unit. Secure it to the body to avoid placing any strain on the air conditioning pipes and hoses.

24 Disconnect the exhaust system front pipe from the manifold and, where necessary, disconnect the lambda sensor wiring connector.

25 Slacken and remove the bolt and washer securing the anti-roll bar connecting link to the left-hand lower suspension arm, then the two bolts securing the tie bar to the lower suspension arm.

26 Extract the split pins and undo the nuts securing the steering gear track rod end balljoint and the left-hand lower suspension arm balljoint to the swivel hub. Remove the nuts and release the balljoint tapered shanks using a universal balljoint separator.

27 Insert a suitable flat bar in between the left-hand inner constant velocity joint and gearbox housing, then carefully lever the joint out of position, whilst taking great care not to damage the gearbox housing.

28 Withdraw the left-hand inner constant velocity joint from the gearbox and support the driveshaft to avoid damaging the constant velocity joints or gaiters. Repeat the operations described in paragraphs 25 to 28 for the right-hand driveshaft.

29 On K8 engines, the cylinder head has a tapped hole provided at the right-hand rear end (above the dipstick tube) and at the left-hand front end (behind the spark plug lead clips). On K16 engine cylinder heads, the right-hand end hole is in the same place but at the left-hand end, the air intake duct support bracket mounting points must be used. Attach lifting brackets to the engine at these points **(see illustrations)**. Take the weight of the engine/gearbox unit on the engine hoist.

30 From underneath the vehicle, unscrew the two bolts securing the rear engine/gearbox mounting bracket to the gearbox, then slacken the connecting link-to-body through-bolt and pivot the mounting away from the gearbox.

31 Slacken and remove the two bolts securing the left-hand gearbox bracket to the mounting. Lower the gearbox slightly then undo the four bolts securing the mounting to the body and manoeuvre the mounting out of position.

32 Raise the gearbox again then slacken and remove the right-hand engine/gearbox mounting through-bolt and nut. Unscrew the two nuts securing the mounting to the engine bracket and remove it, noting the rubber washers which are fitted on each side of the bracket.

33 Make a final check that all components have been removed or disconnected that will prevent removal of the engine/gearbox unit from the vehicle and ensure that components such as the gearchange linkage link rods are secured so that they cannot be damaged on removal.

34 Lift the engine/gearbox unit out of the vehicle, ensuring that nothing is trapped or damaged. Once the unit is high enough, lift it

4.29a Right-hand engine lifting bracket . . .

4.29b . . . and left-hand engine lifting bracket - K16 engine

out over the front of the body and lower the unit to the ground **(see illustration)**.

35 To separate the engine and gearbox, first remove the starter motor.

36 Unbolt the flywheel front, lower and rear cover plates, then unscrew the four bolts securing the gearbox to the engine and gently prise the gearbox off the two locating dowels (at the front and rear of the main bearing ladder). Move the gearbox squarely away from the engine, ensuring that the clutch components are not damaged.

37 If the engine is to be overhauled, remove the clutch.

Refitting

38 Refitting is the reverse of removal, following where necessary the instructions given in the other Chapters of this Manual. Note the following additional points:

a) Overhaul and lubricate the clutch components before refitting.
b) When the gearbox, starter motor and flywheel cover plates have been refitted, lift the engine/gearbox unit and lower it into the engine compartment so that it is slightly tilted (gearbox down). Engage both driveshafts then return the unit to the horizontal and refit the engine/gearbox mountings.
c) Remove the lifting brackets and refit any components removed to enable them to be fitted.
d) Tighten all nuts and bolts to the specified torque wrench settings.
e) Adjust the choke and/or accelerator cable(s).
f) Refill the engine and gearbox with oil.
g) Refill the cooling system.

5 Engine overhaul - dismantling sequence

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

1 It is much easier to work on the engine if it is mounted on a portable engine stand. These stands can often be hired from a tool hire shop. Before the engine is mounted on a stand, the flywheel should be removed so that the stand bolts can be tightened into the end of the cylinder block/crankcase (not the main bearing ladder).

2 If a stand is not available, it is possible to dismantle the engine with it blocked up on a sturdy workbench or on the floor. Be extra careful not to tip or drop the engine when working without a stand.

3 If you are going to obtain a reconditioned engine, all external components must be removed for transference to the replacement engine (just as if you are doing a complete engine overhaul yourself). These components include the following:

a) Alternator mounting brackets.
b) Power steering pump and air conditioning compressor brackets (where fitted).
c) Distributor, HT leads and spark plugs.
d) Thermostat and housing, coolant rail, coolant outlet elbow.
e) Dipstick tube.
f) Carburettor/fuel injection system components.
g) All electrical switches and sensors.
h) Inlet and exhaust manifolds.
i) Oil filter.
j) Fuel pump.
k) Engine mountings.
l) Flywheel.

4.34 Lifting out engine/gearbox unit

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

5 If you are planning a complete overhaul, the engine can be dismantled and the internal components removed in the following order:

a) Inlet and exhaust manifolds.
b) Timing belt, sprockets, tensioner and timing belt inner cover.
c) Cylinder head.
d) Flywheel.
e) Sump.
f) Oil pump.
g) Piston/connecting rod assemblies.
h) Crankshaft.

6 Before beginning the dismantling and overhaul procedures, make sure that you have all of the correct tools necessary. Refer to the introductory pages at the beginning of this Manual for further information.

6 Cylinder head - dismantling

Note: *New and reconditioned cylinder heads are available from the manufacturer and from engine overhaul specialists. Due to the fact that some specialist tools are required for dismantling and inspection, 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 dismantle, inspect and recondition the original.*

1 Remove the camshaft(s) and hydraulic tappets.

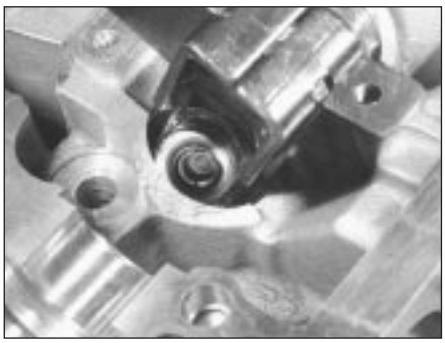
2 Remove the cylinder head.

3 Using a valve spring compressor, compress each valve spring in turn until the split collets can be removed. Release the compressor and lift off the spring retainer and spring, then use a pair of pliers to extract the spring bottom seat/stem seal **(see illustrations)**.

> **HAYNES HiNT** ***If, when the valve spring compressor is screwed down, the spring retainer refuses to free and expose the split collets, gently tap the top of the tool directly over the retainer with a light hammer. This will free the retainer.***

4 Withdraw the valve through the combustion chamber.

5 It is essential that each valve is stored together with its collets, retainer and spring, and that all valves are kept in their correct sequence, unless they are so badly worn that they are to be renewed. If they are going to be kept and used again, place each valve assembly in a labelled polythene bag or

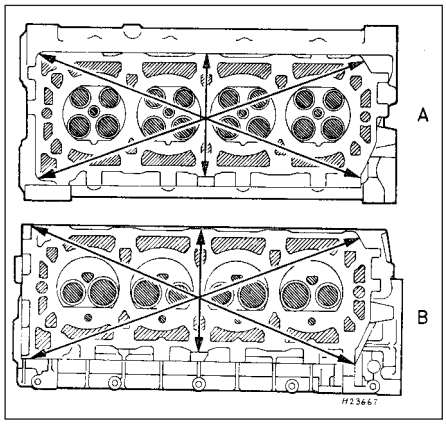


6.3a Using a valve spring compressor to release split collets

6.3b Extracting a valve spring bottom seat/stem seal

6.5 Use a labelled plastic bag to keep together and identify valve components

7.6a Checking a cylinder head gasket surface for warpage



7.6b Check cylinder head gasket surface for warpage along paths shown

A K16 engine B K8 engine

similar small container **(see illustration)**. Note that No 1 valve is nearest to the timing belt end of the engine.

7 Cylinder head and valves - cleaning and inspection

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.*

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.*

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.

Cleaning

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

3 Scrape away all carbon from the combustion chambers and ports, then wash the cylinder head thoroughly with paraffin or a suitable 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

Cylinder head

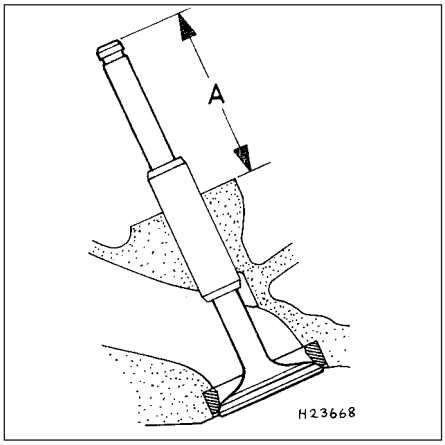
5 Inspect the head very carefully for cracks, evidence of coolant leakage and other damage. If cracks are found, a new cylinder head should be obtained.

6 Use a straight-edge and feeler gauge blade to check that the cylinder head surface is not distorted **(see illustrations)**. If it is, it may be possible to resurface it, provided that the specified reface limit is not exceeded in so doing, or that the cylinder head is not reduced to less than the specified height.

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. To check for excessive wear, refit each valve and measure the installed height of the stem tip above the cylinder head upper surface **(see illustration)**. If the measurement is above the specified limit, repeat the test using a new valve. If the measurement is still excessive, renew the seat insert.

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 Valve guide renewal is best carried out by an engine overhaul specialist. If the work is to be carried out at home, then use a stepped, double-diameter drift to drive out the worn guide towards the combustion chamber. On fitting the new guide, place it first in a deep-freeze for one hour, then drive it into the cylinder head bore from the camshaft side until it projects the specified amount above the spring bottom seat/stem seal surface.



7.7 Check valve seat wear by measuring valve stem installed height (A)

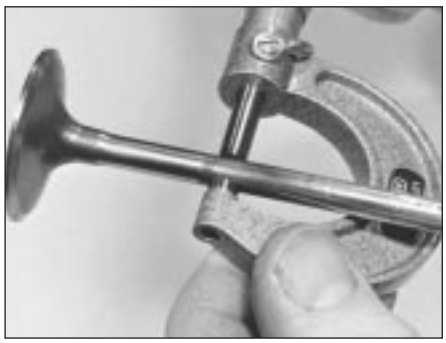
10 If the valve seats are to be re-cut, this must be done only after the guides have been renewed.

Valves

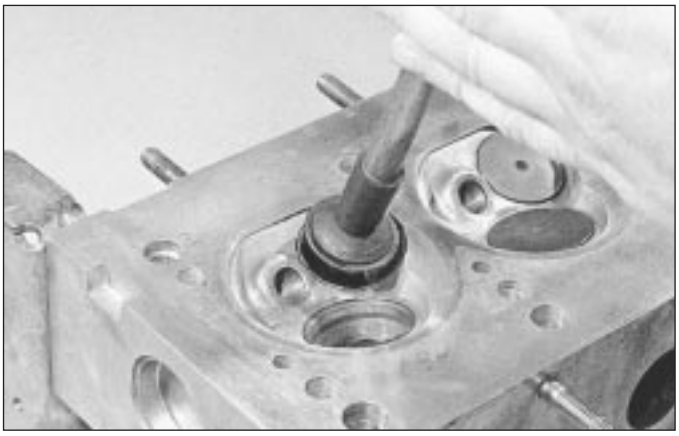
11 Examine the head of each valve for pitting, burning, cracks and general wear, then check the valve stem for scoring and wear ridges. Rotate the valve and check for any obvious indication that it is bent. Look for pits and excessive wear on the tip of each valve stem. Renew any valve that shows any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

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



7.12 Measuring valve stem diameter



7.15 Grinding-in a valve seat

7.19 Measuring valve spring free length

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.

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 **(see illustration)**. A light spring placed under the valve head will greatly ease this 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 To check that the seat has not been over-ground, measure the valve stem installed height, as described in paragraph 7.

18 When all the valves have been ground-in, carefully wash off all traces of grinding compound using paraffin or a suitable solvent.

Valve components

19 Examine the valve springs for signs of damage and discoloration and also measure their free length using vernier calipers or by comparing each existing spring with a new component **(see illustration)**.

20 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, then obtain a complete new set of springs.

21 Check the hydraulic tappets as described in Part A of this Chapter.

8 Cylinder head - reassembly

1 Lubricate the valve stems with clean engine oil and insert each valve into its original location. If new valves are being fitted, insert them into the locations to which they have been ground.

2 Working on the first valve, dip the spring bottom seat/stem seal in clean engine oil then carefully locate it over the valve and onto the guide. Take care not to damage the seal as it is passed over the valve stem. Use a suitable socket or metal tube to press the seal firmly onto the guide **(see illustration)**.

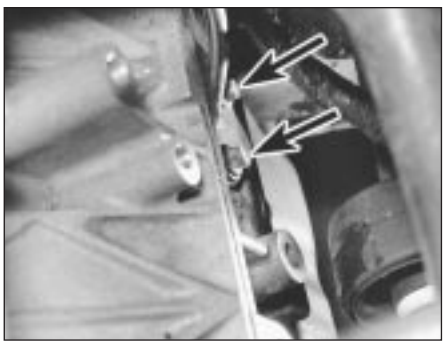
3 Locate the spring on the seat, followed by the spring retainer.

4 Compress the valve spring and locate the split collets in the recess in the valve stem. Use a little grease to hold the collets in place. Release the compressor, then repeat the procedure on the remaining valves.

5 With all the valves installed, place the cylinder head flat on the bench and, using a hammer and interposed block of wood, tap the end of each valve stem to settle the components.

6 Refit the hydraulic tappets and camshaft(s) as described in Part A of this Chapter.

8.2 Using a socket to install valve stem seal



9.6a Dipstick tube mounting bolts (arrowed)

9 Piston/connecting rod assembly - removal

Note: *Due to the design of the engine, it will become very difficult, almost impossible, to turn the crankshaft once the cylinder head bolts have been slackened. The manufacturer accordingly states that the crankshaft will be 'tight' and should not be rotated more than absolutely necessary once the head has been removed. If the crankshaft cannot be rotated, then it must be removed for overhaul work to proceed. With this in mind, during any servicing or overhaul work the crankshaft must always be rotated to the desired position before the bolts are disturbed.*

Removal - without removing crankshaft

1 Remove the timing belt, the camshaft sprocket(s) and tensioner, and the timing belt inner cover.

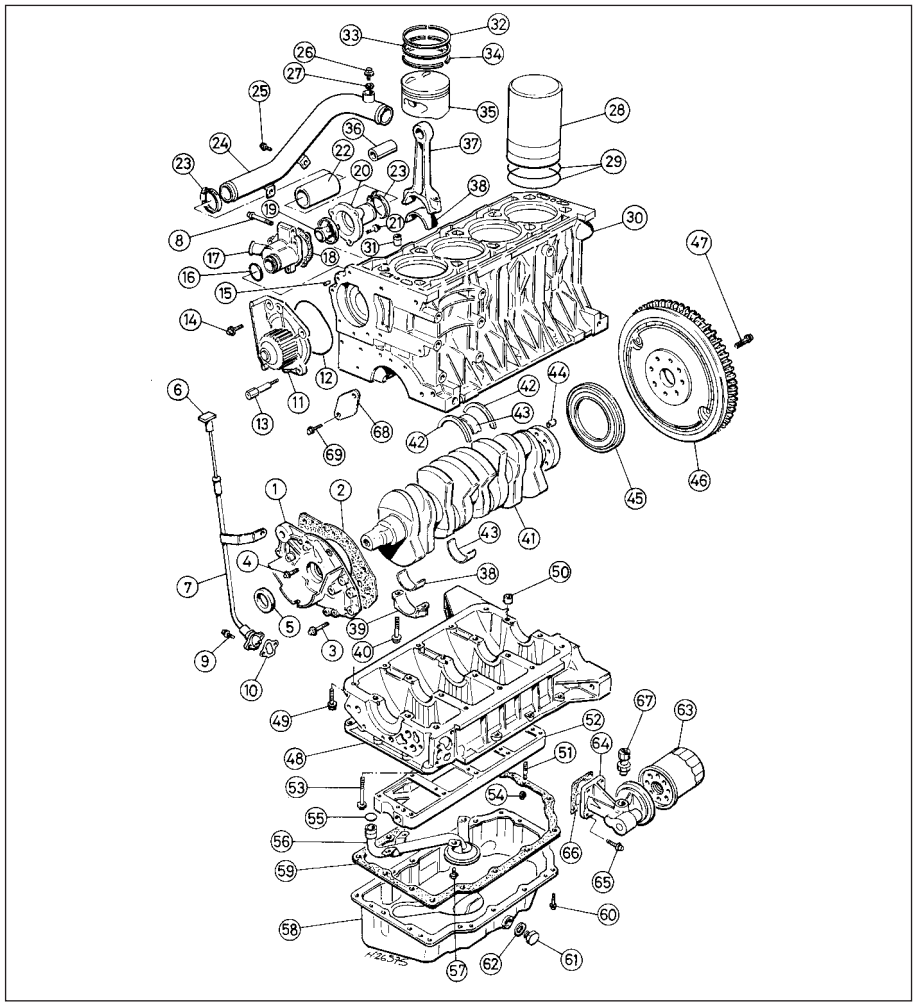
2 Remove the camshaft(s) and hydraulic tappets, being careful to store the hydraulic tappets correctly.

3 If the flywheel has been removed, temporarily refit the crankshaft pulley and apply a spanner to the bolt to rotate the crankshaft.

4 Rotate the crankshaft until Nos 1 and 4 cylinder pistons are at the top of their stroke.

5 Remove the cylinder head. The crankshaft cannot now be rotated.

6 Slacken and remove the two dipstick tube retaining bolts and remove the tube from the cylinder block/crankcase **(see illustrations)**.



9.6b Engine bottom end components

1 *Oil pump*
2 *Gasket*
3 *Bolt*
4 *Bolt*
5 *Oil seal*
6 *Engine oil level dipstick*
7 *Dipstick tube*
8 *Bolt*
9 *Bolt*
10 *Gasket*
11 *Coolant pump*
12 *O-ring*
13 *Pillar bolt*
14 *Bolt*
15 *Dowel pin*
16 *O-ring*
17 *Thermostat housing*
18 *Gasket*
19 *Thermostat*
20 *Thermostat housing*
21 *Bolt*
22 *Coolant hose*
23 *Hose clip*
24 *Coolant rail*
25 *Screw*
26 *Cooling system bleed screw*
27 *Sealing washer*
28 *Liner*
29 *O-rings*
30 *Cylinder block/crankcase*
31 *Dowel*
32 *Top compression ring*
33 *Second compression ring*
34 *Oil control ring*
35 *Piston*
36 *Gudgeon pin **
37 *Connecting rod*
38 *Big-end bearing shell*
39 *Big-end bearing cap*
40 *Big-end bearing cap bolt*
41 *Crankshaft*
42 *Crankshaft thrustwasher*
43 *Crankshaft main bearing shell*
44 *Dowel*
45 *Oil seal*
46 *Flywheel (with reluctor ring)*
47 *Flywheel bolt*
48 *Main bearing ladder **
49 *Bolt*
50 *Dowel*
51 *Stud*
52 *Oil rail*
53 *Bolt*
54 *Nut*
55 *O-ring*
56 *Oil pump pick-up/ strainer pipe*
57 *Bolt*
58 *Sump*
59 *Gasket*
60 *Bolt*
61 *Engine oil drain plug*
62 *Sealing washer*
63 *Oil filter*
64 *Oil filter adaptor*
65 *Bolt*
66 *Gasket*
67 *Oil pressure switch*
68 *Blanking plate - carburettor engines*
69 *Screw*

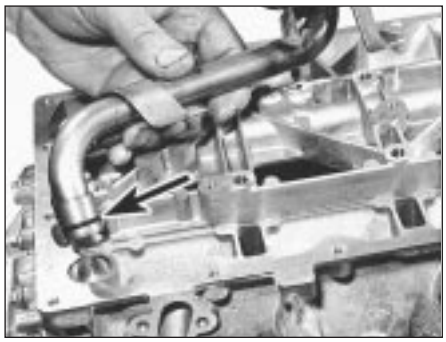
* ***Note**: Main bearing ladder is supplied only with cylinder block/crankcase assembly. Gudgeon pin is supplied only with piston assembly*

7 Remove the sump and unbolt the oil pump pick-up/strainer pipe from the oil rail. Discard the sealing ring **(see illustration)**.

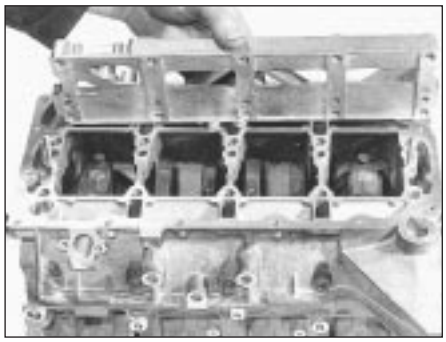
8 Unscrew the two retaining nuts and remove the oil rail **(see illustration)**.

9 Using a hammer and centre punch, paint or similar, mark each connecting rod big-end bearing cap with its respective cylinder number on the flat, machined surface provided. If the engine has been dismantled before, note carefully any identifying marks made previously **(see illustration)**. Note that No 1 cylinder is at the timing belt end of the engine.

10 Unscrew and remove the big-end bearing cap bolts and withdraw the cap, complete with bearing shell, from the connecting rod. If only the bearing shells are being attended to,



9.7 Removing oil pump pick-up/strainer pipe from oil rail - renew O-ring (arrowed)



9.8 Removing oil rail to reach big-end bearings

9.9 Mark big-end bearing caps before removal - No 4 cylinder cap shown

2B

push the connecting rod up and off the crankpin, ensuring that the connecting rod big-ends do not mark the cylinder bore walls, then remove the upper bearing shell. Keep the cap, bolts and (if they are to be refitted) the bearing shells together in their correct sequence.

11 With Nos 2 and 3 cylinder big-ends disconnected, repeat the procedure (exercising great care to prevent damage to any of the components) to remove Nos 1 and 4 cylinder bearing caps.

12 Remove the ridge of carbon from the top of each cylinder bore. Push each piston/connecting rod assembly up and remove it from the top of the bore, and ensure that the connecting rod big-ends do not mark the cylinder bore walls.

13 Note that the number stamped by you on each bearing cap should match the cylinder number stamped on the front (alternator bracket side) of each connecting rod. If any connecting rod number does not match its correct cylinder, mark or label it immediately so that each piston/connecting rod assembly can be refitted to its original bore.

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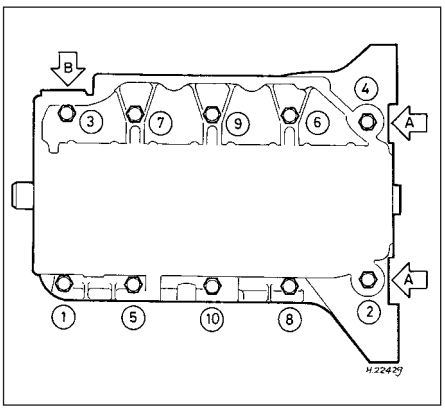
Fit the bearing cap, shells and bolts to each removed piston/connecting rod assembly, so that they are all kept together as a matched set.

Removal - alternative methods

14 If the engine is being completely dismantled and the cylinder head has been removed, either unbolt the main bearing ladder so that the crankshaft can be rotated with care, or remove the crankshaft completely and then remove the connecting rods and pistons.

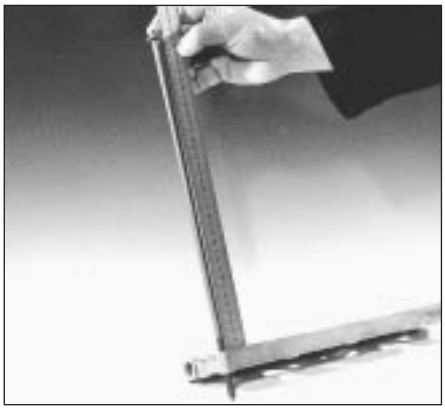
Cylinder head bolts - condition check

15 Check the condition of the cylinder head bolts and particularly their threads whenever they are removed. If the cylinder head only is removed, check the bolts as described in Part A of this Chapter. If the cylinder head and the oil rail are removed, check as follows.



10.8a Crankshaft main bearing ladder bolt slackening sequence

A Bolts hidden in ladder flanges
B Location of single longer bolt

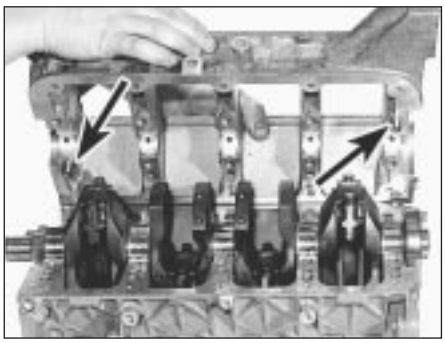


9.16 Checking length of cylinder head bolts

16 Keeping all the bolts in their correct fitted order, wash them and wipe dry, then check each for any sign of visible wear or damage. Renew any bolt if necessary. Lightly oil the threads of each bolt, carefully enter it into the original hole and screw it in, by hand only until finger-tight. If the full length of thread is engaged, the bolt may be re-used. If the full length of thread is not engaged, measure the distance from the oil rail gasket surface to under the bolt head **(see illustration)**.

17 If the distance measured is less than 378 mm, then the bolt may be re-used. If the distance measured is more than 378 mm, the bolt must be renewed. Considering the task these bolts perform and the pressures they must withstand, owners should consider renewing all the bolts as a matched set if more than one of the originals fail inspection or are close to the limit set.

18 Note that if any of the cylinder head bolt threads in the oil rail are found to be damaged, then the oil rail must be renewed. Thread inserts are not an acceptable repair in this instance.



10.8b Removing main bearing ladder (two locating dowels arrowed)

10 Crankshaft - removal

Note: *The following procedure assumes that the crankshaft alone is being removed and therefore uses a slightly different sequence of operations to that given in Section 9. Depending on the reason for dismantling, either sequence may be adapted as necessary. If the crankshaft endfloat is to be checked, this must be done when the crankshaft is free to move. If a dial gauge is to be used, check after paragraph 1, but if feeler gauges are to be used, check after paragraph 9.*

1 Remove the timing belt, sprocket(s) and tensioner, and the timing belt inner cover.

2 Slacken and remove the two dipstick tube retaining bolts and remove it from the cylinder block/crankcase.

3 Remove the cylinder head. The crankshaft cannot now be rotated.

4 Remove the oil pump.

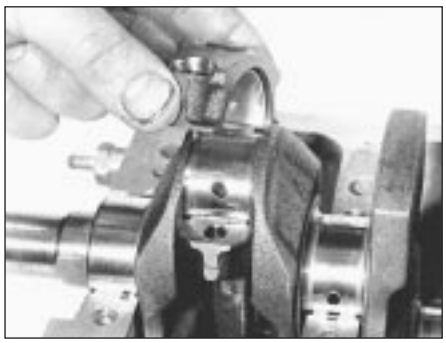
5 Remove the crankshaft left-hand oil seal.

6 Remove the sump and unbolt the oil pump pick-up/strainer pipe from the oil rail. Discard the sealing ring.

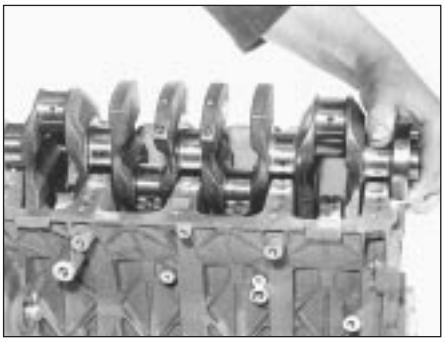
7 Unscrew the two retaining nuts and remove the oil rail.

8 Working in the sequence shown **(see illustration)**, progressively unscrew the main bearing ladder retaining bolts by a turn at a time, then withdraw the ladder. Note the two locating dowels and the main bearing shells, which should be removed from the ladder and stored in their correct fitted order **(see illustration)**.

9 Mark the big-end bearing caps, then unscrew and remove the big-end bearing cap bolts and withdraw the cap, complete with the lower bearing shell, from each of the four connecting rods **(see illustration)**. Push the connecting rods up and off their crankpins, then remove the upper bearing shell. Keep the cap, bolts and (if they are to be refitted) the bearing shells together in their correct sequence.



10.9 Removing No 1 cylinder big-end bearing cap and lower bearing shell



10.10 Removing the crankshaft

10 Remove the crankshaft **(see illustration)**.
11 Withdraw the two thrustwashers from the No 3 main bearing upper location. Noting the position of the grooved shells, remove the upper main bearing shells, which must be kept with their correct respective partners from the main bearing ladder so that all shells can be identified and (if necessary) refitted in their original locations.
12 Check the condition of the cylinder head bolts, as described in Section 9.

11 Cylinder block/crankcase - cleaning and inspection

Warning: Wear eye protection when using compressed air!

Note: *During any cleaning operations, take care not to score the mating surfaces of the cylinder block/crankcase, bearing ladder and oil rail. It may be necessary to use a foam action gasket remover.*

Cleaning

1 For complete cleaning, remove the cylinder liners, all external components and all electrical switches/sensors.
2 Scrape all traces of gasket from the cylinder block/crankcase, bearing ladder and oil rail, taking care not to damage the gasket/sealing surfaces.
3 Remove all oil gallery plugs (where fitted). The plugs are usually very tight and may have to be drilled out and the holes re-tapped. Use new plugs when the engine is reassembled.
4 If any of the castings are extremely dirty, all should be steam cleaned.
5 After the castings are returned, 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 liner surfaces to prevent rusting. If you have access to compressed air, use it to speed up the drying process and to blow out all the oil holes and galleries.
6 If the castings are not very dirty, you can do an adequate cleaning job with hot soapy water 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 well. Protect the liners as described above to prevent rusting.
7 All threaded holes must be clean to ensure accurate torque readings during reassembly. To clean all threads **except** those of the flywheel retaining bolts, run the proper size tap into each of the holes to remove rust, corrosion, thread sealant or sludge and to restore damaged threads. If possible, use compressed air to clear the holes of debris produced by this operation. A good alternative is to inject aerosol-applied water-dispersant lubricant into each hole, using the long spout usually supplied. Always wear eye protection when cleaning out holes in this way. The flywheel retaining bolt threads must be cleaned by using the procedure described in Section 18, in Part A of this Chapter. Now is a good time to check the condition of the cylinder head bolts.
8 Apply suitable sealant to the new oil gallery plugs and insert them into the holes in the block. Tighten them securely.
9 If the engine is not going to be reassembled right away, cover it with a large plastic bag to keep it clean. Protect the liners as described above to prevent rusting.

Inspection

10 Inspect all castings for cracks and corrosion. Look for stripped threads. If there has been any history of internal coolant leakage, it may be worthwhile having an engine overhaul specialist check the cylinder block/crankcase with special equipment. If defects are found, have them repaired, if possible, or renew the assembly.
11 Check the bore of each cylinder liner for scuffing and scoring.
12 Measure the diameter of each cylinder liner bore 60 mm from the top of the bore, both parallel to the crankshaft axis and at right angles to it.
13 Compare the diameter with that specified. If any measurement exceeds the service limit then the liner must be renewed.
14 Measure the piston diameter at right angles to the gudgeon pin axis, 16 mm up from the bottom of the skirt. Compare the results with those specified.
15 To measure the piston-to-bore clearance, either measure the bore and piston skirt as described above and subtract the skirt diameter from the bore measurement, or insert each piston into the original bore, select a feeler gauge and slip it into the bore along with the piston. The piston must be aligned exactly in its normal attitude and the feeler gauge must be between the piston and bore on one of the thrust faces, 20 mm up from the bottom of the bore.
16 If the clearance is excessive, then a new piston will be required. If the piston binds at the lower end of the bore and is loose towards the top, then the bore is tapered. If tight spots are encountered as the piston/feeler gauge is rotated in the bore, then the bore is out-of-round.
17 Repeat this procedure for the remaining pistons and cylinder liners.
18 If the cylinder liner walls are badly scuffed or scored, or if they are excessively worn, out-of-round or tapered, obtain new cylinder liners. New pistons will also be required.
19 If the bores are in reasonably good condition and not worn to the specified limits, and if the piston-to-bore clearances can be maintained properly, then it may only be necessary to renew the piston rings.
20 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. The conventional type of hone has spring-loaded stones and is used with a power drill. You will also need some paraffin, or honing oil, and rags. The hone should be moved up and down the bore to produce a crosshatch pattern and plenty of honing oil should be used. Ideally the crosshatch lines should intersect at approximately a 60° angle. Do not take off more material than is necessary to produce the required finish. If new pistons are being fitted, the piston manufacturers may specify a finish with a different angle, so their instructions should be followed. Do not withdraw the hone from the bore while it is still being turned, but stop it first. After honing a bore, wipe out all traces of the honing oil. If equipment of this type is not available, or if you are not sure whether you are competent to undertake the task yourself, an engine overhaul specialist will carry out the work at moderate cost.

12 Cylinder liners - removal and refitting

Removal

1 Invert the cylinder block/crankcase and support it on blocks of wood, then use a hard wood drift to tap out each liner from the crankshaft side. When all the liners are released, tip the cylinder block/crankcase on its side and remove each liner from the cylinder head side. Discard the two sealing rings from the base of each. If the liners are to be re-used, mark each one by sticking masking tape on its right-hand (timing belt) face and writing the cylinder number on the tape.

Refitting

2 To install the liners, thoroughly clean the liner mating surfaces in the cylinder block/crankcase and use fine abrasive paper to polish away any burrs or sharp edges which might damage the liner sealing rings. Clean the liners and wipe dry, then fit new sealing rings to the two grooves at the base of each liner and apply a thin film of oil to the

12.2 Renew liner O-rings

12.3 Tap liner onto locating shoulder - ensuring O-rings are not displaced

13.1 Measuring piston diameter

rings and to the liner surface on each side of the rings **(see illustration)**.

3 If the original liners are being refitted, use the marks made on removal to ensure that each is refitted the same way round into its original bore. Insert each liner into the cylinder block/crankcase, taking great care not to displace or damage the sealing rings, and press it home as far as possible by hand. Using a hammer and a block of wood, tap each liner lightly but fully onto its locating shoulder **(see illustration)**. Wipe clean, then lightly oil all exposed liner surfaces to prevent rusting.

13 Piston/connecting rod assembly - inspection

1 Examine all pistons for ovality, scoring and scratches, and for wear of the piston ring grooves. Use a micrometer to measure the pistons **(see illustration)**.

2 If the pistons or connecting rods are to be renewed, it is necessary to have this work carried out by a Rover dealer or suitable engine overhaul specialist who will have the necessary tooling to remove and install the gudgeon pins.

3 If new rings are to be fitted to the original pistons, expand the old rings over the top of the pistons. The use of two or three old feeler gauge blades will be helpful in preventing the rings dropping into empty grooves **(see illustration)**.

4 When the original piston rings have been removed, ensure that the ring grooves in the piston are free of carbon by cleaning them with a ring cleaning tool or an old ring. Break a ring in half to do this.

5 When measuring new rings, lay out each piston set with a piston/connecting rod assembly and keep them together as a matched set from now on.

6 Check the ring-to-groove clearance by inserting each ring from the outside together with a feeler gauge blade between the ring's top surface and the piston land. Check the ring end gaps by inserting each ring into the cylinder bore and pushing it in with the piston crown to ensure that it is square in the bore, 20 mm from the top. Use feeler gauges to measure the gap **(see illustrations)**.

7 If the end gap of a new ring is found to be too large or too small, double-check to ensure that you have the correct rings. 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 service limit is exceeded, in which case very careful checking is required of the dimensions of all components as well as of the new parts.

8 Note that each piston should be considered as being matched to its respective liner and they must not be interchanged.

14 Crankshaft - inspection

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

Checking endfloat

1 If crankshaft endfloat is to be checked, this must be done when the crankshaft is still installed in the cylinder block/crankcase but is free to move.

2 Check endfloat by using a dial gauge in contact with the end of the crankshaft. Push the crankshaft fully one way and then zero the gauge. Push the crankshaft fully the other way and check the endfloat. The result can be compared with the specified amount and will give an indication as to whether new thrustwashers are required.

3 If a dial gauge is not available, feeler gauges can be used. First push the crankshaft fully towards the flywheel end of the engine, then use feeler gauges to measure the gap between the web of No 3 crankpin and the thrustwasher.

Inspection

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

5 Check the main and crankpin (big-end)

13.3 Removing piston rings with feeler blades

13.5a Measuring piston ring-to-groove clearance

13.5b Measuring piston ring end gap

14.6 Using a penny to check crankshaft journal condition

14.8 Measuring crankshaft journal diameter

bearing journals for uneven wear, scoring, pitting and cracking.

6 Rub a penny across each journal several times. If a journal picks up copper from the penny, it is too rough **(see illustration)**.

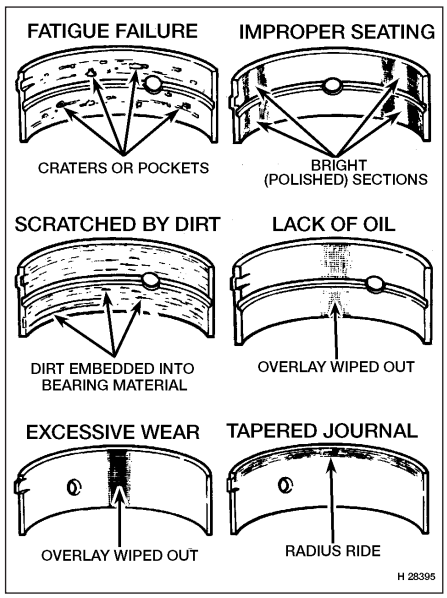
7 Remove any burrs from the crankshaft oil holes with a stone, file or scraper.

8 Using a micrometer, measure the diameter of the main bearing and crankpin (big-end) journals and compare the results with those specified **(see illustration)**. Check carefully that each journal's diameter is within the tolerances of the size grade corresponding to the code number on the crankshaft right-hand web (main bearing) or indicated by the code letter on the left-hand web (crankpin/big-end bearing). If any diameter measured is incorrect for the grade indicated, re-check the measurement carefully. If the journal is fit for further service, the correct grade code should be substituted when selecting new bearing shells.

9 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.

10 If the crankshaft journals are damaged, tapered, out-of-round or worn beyond the limits specified, the crankshaft must be renewed unless an engine overhaul specialist can be found who will regrind it and supply the necessary undersize bearing shells.

11 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.



15.2 Typical bearing shell failures

15 Main and big-end bearings - inspection

1 Even though the main and big-end bearings should be renewed during the engine overhaul, the old bearings should be retained for close examination, as they may reveal valuable information about the condition of the engine. The bearing shells are graded by thickness, the grade of each shell being indicated by the colour code marked on it.

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 **(see illustration)**.

3 When examining the bearing shells, remove them from the cylinder block/crankcase, the main bearing ladder, the connecting rods and the connecting rod 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 and other foreign particles get into the engine in a variety of ways. It may be left in the engine during assembly, or it may pass 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 by 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 bearing but will score or gouge the bearing and journal. The best prevention for this cause of bearing failure is to clean all parts thoroughly and 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 interrelated 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 oil starve a bearing and destroy it. When lack of lubrication is the cause of bearing failure, the bearing material is wiped or extruded from the steel backing of the bearing. 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 bearings 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 the 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 bearing installation during engine assembly will lead to bearing failure as well. Tight fitting bearings 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 as there is a risk of scratching the delicate surface or of depositing particles of dirt on it.

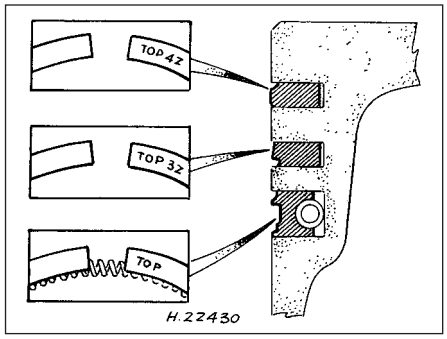
16 Engine overhaul - reassembly sequence

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, it will be necessary to obtain the Rover sealant kit LVV 10002. Carefully read the instructions supplied with the sealant kit and take care not to allow the sealant to contact the fingers, as it will bond skin.

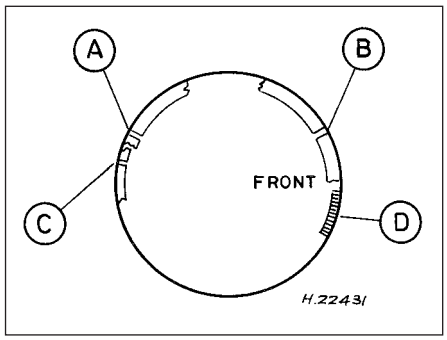
2 In order to save time and avoid problems, engine reassembly can be carried out in the following order:

a) Crankshaft.
b) Piston/connecting rod assemblies.
c) Oil pump.
d) Sump.
e) Flywheel.
f) Cylinder head.
g) Timing belt inner cover, tensioner and sprockets, and timing belt.
h) Engine external components.

3 At this stage, all engine components should be absolutely clean and dry, with all faults repaired, and should be laid out (or in individual containers) on a completely clean work surface.



17.3 Piston ring fitting details and top surface markings



17.4 Piston ring end gap locations

A Top compression ring
B Second compression ring
C Oil control ring
D Oil control ring spring

17 Piston rings - refitting

1 Refer to Section 13 for inspection details.

2 Once all rings have been checked, they can be installed. Ensure that each ring is refitted only to its matched piston and bore.

3 Install the new rings by fitting them over the top of the piston, starting with the oil control ring spring. Note that all rings must be fitted with the word TOP uppermost **(see illustration)**.

4 With all the rings in position, space the ring gaps as shown **(see illustration)**, noting that the FRONT marking shown is usually in fact an arrow mark on the piston crown and indicates the timing belt end of the engine.

18 Crankshaft - refitting and main bearing running clearance check

Selection of bearing shells

1 The main bearing running clearance is controlled in production by selecting one of three grades of bearing shell. The grades are indicated by a colour-coding marked on the edge of each shell which governs the shell's thickness, as follows:

a) Green - Thin.
b) Blue - Intermediate.
c) Red - Thick.

2 If shells of differing grades are to be fitted to the same journal, the thicker shell must always be fitted to the main bearing ladder location. Bear this carefully in mind when ordering replacement shells for Nos 2, 3 and 4 bearings.

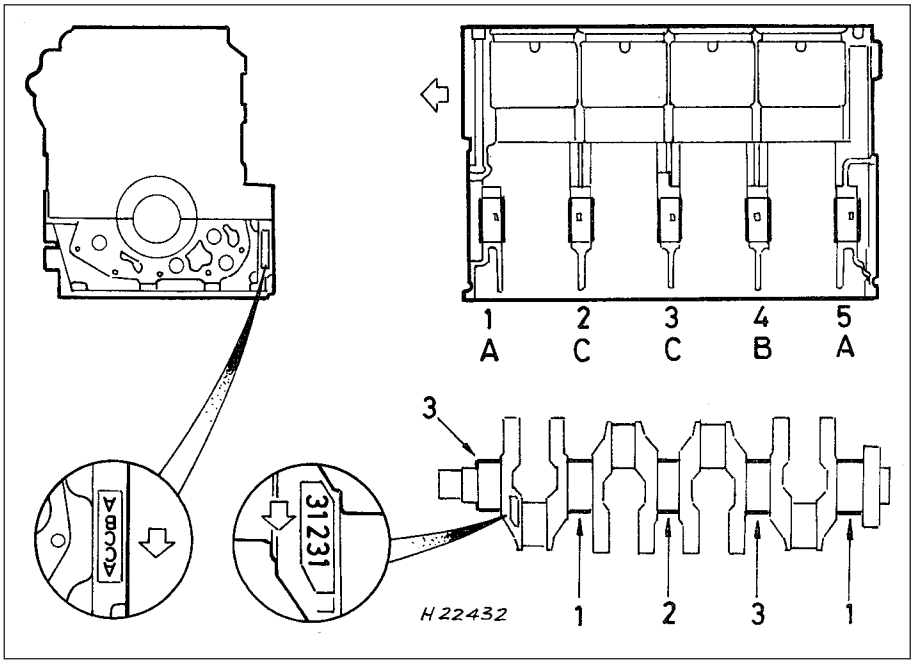
3 If the bearing shells are to be renewed, first check and record the main bearing code letters stamped on the right-hand front face of the main bearing ladder **(see illustration)**. The letters are read with the ladder inverted, No 1 bearing's code letter then being at the top and the remainder following in order from the engine's timing belt end.

4 Secondly, check and record the crankshaft journal code numbers stamped on the crankshaft's right-hand web, No 1 journal's code number being the first. If the original crankshaft is to be re-used, the size grade can be checked by direct measurement, as described in Section 14.

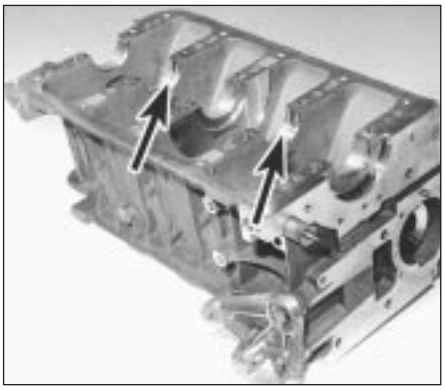
5 Note that if the crankshaft is found to be excessively worn, then it must be renewed and the code numbers of the new component must be used instead to select a new set of bearing shells.

6 Matching the codes noted to the following table, select a new set of bearing shells.

Ladder code letter	Crankshaft code number	Shells
A	1	Blue, Blue
A	2	Red, Blue
A	3	Red, Red
B	1	Blue, Green
B	2	Blue, Blue
B	3	Red, Blue
C	1	Green, Green
C	2	Blue, Green
C	3	Blue, Blue



18.3 Crankshaft main bearing size code locations



18.9 Ensure grooved bearing shells (arrowed) are installed exactly as described in text - early engine shown

18.14 Lay length of Plastigauge on journal to be measured, parallel to crankshaft centre-line

18.18 Using scale on Plastigauge envelope to check (at widest point) width of crushed Plastigauge

Main bearing running clearance check

7 Clean the backs of the bearing shells and the bearing locations in both the cylinder block/crankcase and the main bearing ladder.

8 Press the bearing shells into their locations, ensuring that the tab on each shell engages in the notch in the cylinder block/crankcase or main bearing ladder location. Take care not to touch any shell bearing surface with your fingers.

9 Press the bearing shells with the oil grooves into the upper locations (in the cylinder block/crankcase). Note the following points **(see illustration)**:

a) On all engines, grooved bearing shells are fitted to Nos 2, 3 and 4 upper bearing locations. Note the central locating tabs of the grooved shells.

b) On early engines, grooved bearing shells were fitted only to Nos 2 and 4 upper bearing locations at the factory. On reassembly of one of these units, a grooved shell must be fitted at No 3 upper bearing location as well, instead of the plain item originally used. Note, however, that this will require a grooved shell with an offset locating tab instead of the central tab that is used on all other grooved shells. See your Rover dealer for details.

c) If bearing shells of differing grades are to be fitted to the same journal, the thicker shell must always be fitted to the main bearing ladder location (see paragraph 1).

d) On all engines, if the original main bearing shells are being re-used, these must be refitted to their original locations in the cylinder block/crankcase and main bearing ladder.

10 The main bearing running clearance should be checked if there is any doubt about the amount of crankshaft wear that has taken place, if the crankshaft has been reground and is to be refitted with non-Rover undersized bearing shells, or if non-genuine bearing shells are to be fitted. If the original crankshaft or a Rover replacement part is to be installed, the shell selection procedure given above will produce the correct clearances and a further check will not be necessary. If the clearance is to be checked, it can be done in either of two ways.

11 The first method (which will be difficult to achieve without a range of internal micrometers or internal/external expanding calipers) is to refit the main bearing ladder to the cylinder block/crankcase, with bearing shells in place. With the ladder retaining bolts tightened to the specified torque, refit the oil rail and the cylinder head, then measure the internal diameter of each assembled pair of bearing shells. If the diameter of each corresponding crankshaft journal is measured and then subtracted from the bearing internal diameter, the result will be the main bearing running clearance.

12 The second (and more accurate) method is to use product known as Plastigauge. This consists of a fine thread of perfectly round plastic which is compressed between the bearing shell and the journal. When the shell is removed, the plastic is deformed and can be measured with a special card gauge supplied with the kit. The running clearance is determined from this gauge. Plastigauge is sometimes difficult to obtain but enquiries at one of the larger specialist quality motor factors should produce the name of a stockist in your area. The procedure for using Plastigauge is as follows.

13 With the main bearing upper shells in place, carefully lay the crankshaft in position. Do not use any lubricant. The crankshaft journals and bearing shells must be perfectly clean and dry.

14 Cut several lengths of the appropriate size Plastigauge (they should be slightly shorter than the width of the main bearings) and place one length on each crankshaft journal axis **(see illustration)**.

15 With the main bearing lower shells in position, refit the main bearing ladder (see below) and the oil rail, tightening the fasteners to the specified torque wrench settings. Take care not to disturb the Plastigauge.

16 Refit the cylinder head (using the original gasket, to save over-compressing the new one). Tighten the bolts to the specified torque in the approved sequence. **Do not** rotate the crankshaft at any time during this operation.

17 Remove the cylinder head, the oil rail and the main bearing ladder. Do not disturb the Plastigauge or rotate the crankshaft.

18 Compare the width of the crushed Plastigauge on each journal to the scale printed on the Plastigauge envelope to obtain the main bearing running clearance **(see illustration)**.

19 If the clearance is not as specified, the bearing shells may be the wrong grade (or excessively worn if the original shells are being re-used). Before deciding that different grade shells are needed, make sure that no dirt or oil was trapped between the bearing shells and the ladder or cylinder block/crankcase when the clearance was measured. If the Plastigauge was wider at one end than at the other, the journal may be tapered.

20 Carefully scrape away all traces of the Plastigauge material from the crankshaft and bearing shells using a fingernail or other object which is unlikely to score the shells.

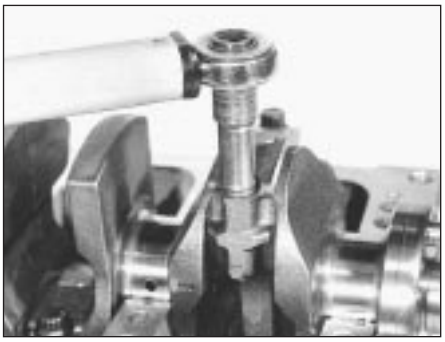
Final crankshaft refitting

21 Carefully lift the crankshaft out of the cylinder block once more.

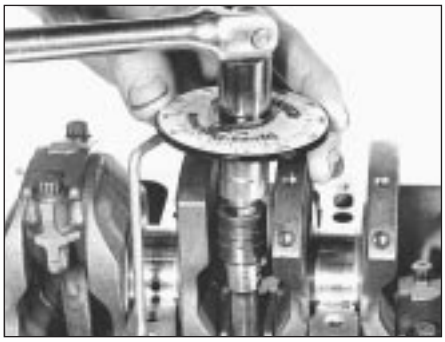
22 Using a little grease, stick the thrustwashers to each side of the No 3 main bearing upper location. Ensure that the oilway grooves on each thrustwasher face outwards.

23 Place the bearing shells in their locations, as described in paragraphs 7 to 9. If new shells are being fitted, ensure that all traces of the protective grease are cleaned off using paraffin. Wipe dry the shells and connecting rods with a lint-free cloth. Liberally lubricate each bearing shell in the cylinder block/crankcase, then lower the crankshaft into position so that Nos 2 and 3 cylinder crankpins are at TDC.

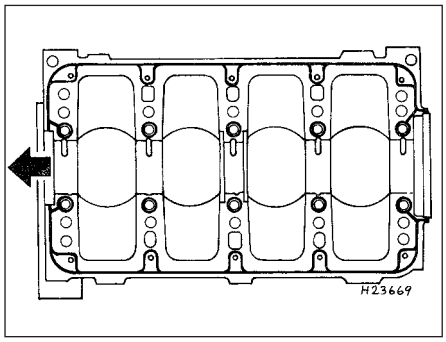
24 Refit the piston/connecting rod



18.24a If piston/connecting rod assemblies are refitted before main bearing ladder . . .



18.24b . . . care is required to hold crankshaft steady while connecting rod big-end cap bolts are tightened



18.25 Apply thin bead of sealant to cylinder block/crankcase mating surface along paths shown by heavy black lines, then spread to an even film

assemblies **(see illustrations)**. Leave No 1 and 4 cylinders at the TDC position

25 Thoroughly degrease the mating surfaces of the cylinder block/crankcase and the main bearing ladder. Apply the special Rover sealant to the mating surface of the cylinder block/crankcase as shown **(see illustration)**. Carefully follow the instructions supplied with the sealant kit. If the Rover sealant is being used, assembly must be completed as soon as possible after the sealant has been applied (maximum of 20 minutes). If another sealant is being used, follow the manufacturer's instructions.

26 Lubricate the bearing shells, then refit the main bearing ladder, ensuring that the shells are not displaced and that the locating dowels engage correctly. Working progressively, by a turn at a time and in the sequence shown **(see illustration)**, tighten the ladder bolts to the specified torque wrench setting. The crankshaft cannot now be rotated.

27 Thoroughly degrease the mating surfaces of the oil rail and the main bearing ladder. Apply the special Rover sealant to the oil rail mating surface as shown **(see illustration)**. Carefully follow the instructions supplied with the sealant kit.

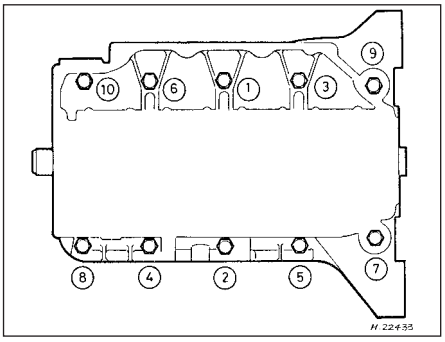
28 Refit the oil rail, tightening the nuts to the specified torque wrench setting.

29 Using a new sealing ring, refit the oil pump pick-up/strainer pipe to the oil rail, then refit the sump. Tighten all nuts and bolts to the specified torque wrench settings.

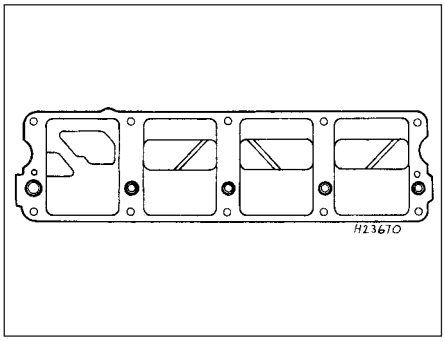
30 Fit a new crankshaft left-hand oil seal, then refit the flywheel **(see illustrations)**.

31 Refit the oil pump and install a new crankshaft right-hand oil seal **(see illustrations)**.

32 Refit the cylinder head. Rotate the crankshaft to the 90° BTDC position so that the crankshaft sprocket timing marks align.

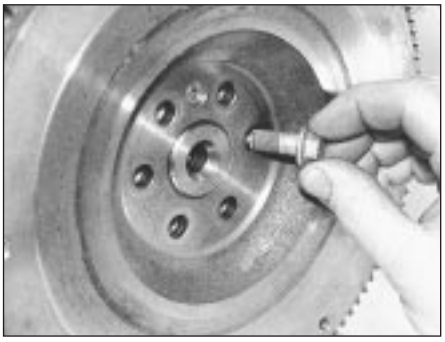


18.26 Crankshaft main bearing ladder bolt tightening sequence

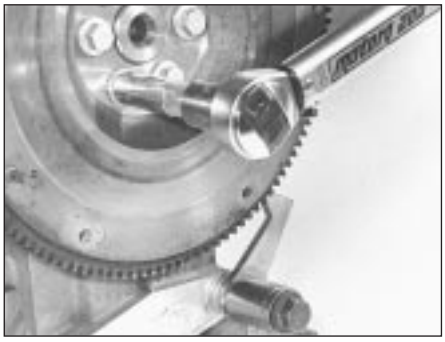


18.27 Apply thin bead of sealant to oil rail mating surface as shown by heavy black lines, then spread to an even film

18.30a Fitting a new crankshaft left-hand oil seal



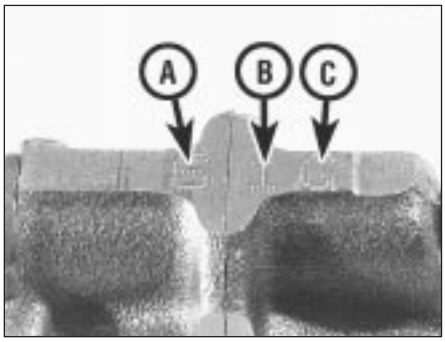
18.30b Always use new bolts when refitting flywheel



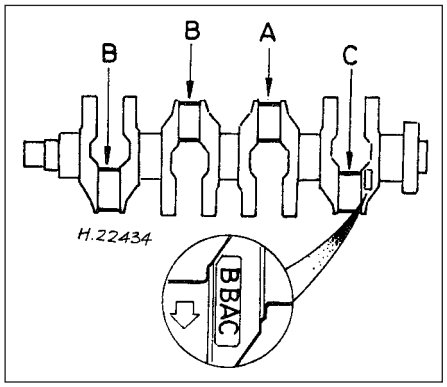
18.30c Use fabricated tool to lock flywheel while slackening or tightening flywheel bolts

18.31a Use grease to stick new gasket in place when refitting oil pump

18.31b Fitting a new crankshaft right-hand oil seal



19.3 Big-end bearing size code number (A - on cap) piston/connecting rod assembly cylinder number (B) and connecting rod weight code letter (C)



19.4 Crankpin (big-end) journal size code location

33 Refit the dipstick tube to the cylinder block/crankcase, tightening the bolts to the specified torque wrench setting.
34 Refit the timing belt inner cover, the sprocket(s) and tensioner, and the belt itself.
35 Using a torque wrench, check that the amount of force required to rotate the crankshaft does not exceed 31 Nm. If the effort required is greater than this, the engine must be dismantled again to trace and rectify the cause. This value takes into account the increased friction of a new engine and is much higher than the actual pressure required to rotate a run-in engine, so do not make allowances for tight components.

19 Piston/connecting rod assembly - refitting and big-end bearing running clearance check

Selection of bearing shells

1 The big-end bearing running clearance is controlled in production by selecting one of three grades of bearing shell. The grades are indicated by a colour-coding marked on the edge of each shell which governs the shell's thickness, as follows:
a) Yellow - Thin.
b) Blue - Intermediate.
c) Red - Thick.
2 If shells of differing grades are to be fitted to the same journal, the thicker shell must always be fitted to the big-end bearing cap location.
3 If the bearing shells are to be renewed, first check and record the codes stamped on the front face of each big-end bearing cap and connecting rod. The number stamped on the big-end bearing cap is the bearing size code, the number stamped on the connecting rod is the piston/rod assembly's cylinder number and the letter stamped on the connecting rod is the weight code **(see illustration)**.
4 Secondly, check and record the crankpin/big-end journal code letters stamped on the crankshaft's left-hand web **(see illustration)**, No 1 journal's code letter being the first. If the original crankshaft is to be re-used, the code letter can be checked by direct measurement.
5 If the crankshaft is found to be excessively worn, then it must be renewed and the code letters of the new component must be used instead to select a new set of bearing shells.
6 Matching the codes noted to the following table, select a new set of bearing shells:

Cap code number	Crankshaft code letter	Shells
5	A	Blue, Blue
5	B	Red, Blue
5	C	Red, Red
6	A	Blue, Yellow
6	B	Blue, Blue
6	C	Red, Blue
7	A	Yellow, Yellow
7	B	Blue, Yellow
7	C	Blue, Blue

Big-end bearing running clearance check

7 The big-end bearing running clearance should be checked if there is any doubt about the amount of crankshaft wear that has taken place, if the crankshaft has been reground and is to be refitted with non-Rover undersized bearing shells, or if non-genuine bearing shells are to be fitted. If the original crankshaft or a Rover replacement part is to be installed, the shell selection procedure given above will produce the correct clearances and a further check will not be necessary. If the clearance is to be checked, it can be done in either of two ways.
8 The first method is to refit the big-end bearing cap to the connecting rod, with bearing shells in place. With the cap retaining bolts tightened to the specified torque, use an internal micrometer or vernier caliper to measure the internal diameter of each assembled pair of bearing shells. If the diameter of each corresponding crankshaft journal is measured and then subtracted from the bearing internal diameter, the result will be the big-end bearing running clearance.
9 The second method is to use Plastigauge. Place a strand of Plastigauge on each (cleaned) crankpin journal and refit the (clean) piston/connecting rod assemblies, shells and big-end bearing caps, tightening the bolts to the specified torque wrench settings. Take care not to disturb the Plastigauge. Dismantle the assemblies without rotating the crankshaft and use the scale printed on the Plastigauge envelope to obtain the big-end bearing running clearance. On completion of the measurement, carefully scrape off all traces of Plastigauge from the journal and shells using a fingernail or other object which will not score the components.

Final piston/connecting rod assembly refitting

10 Note that the following procedure assumes that the cylinder liners have been refitted to the cylinder block/crankcase and that the crankshaft and main bearing ladder are in place. It is of course possible to refit the piston/connecting rod assemblies to the cylinder bores, to refit the crankshaft and to reassemble the piston/connecting rods on the crankshaft before refitting the main bearing ladder (see Section 18).
11 Clean the backs of the bearing shells and the bearing recesses in both the connecting rod and the big-end bearing cap. If new shells are being fitted, ensure that all traces of the protective grease are cleaned off using paraffin. Wipe dry the shells and connecting rods with a lint-free cloth.
12 Press the bearing shells into their locations, ensuring that the tab on each shell engages in the notch in the connecting rod or big-end bearing cap and taking care not to touch any shell's bearing surface with your fingers. Note the following points:
a) If bearing shells of differing grades are to be fitted to the same journal, the thicker shell must always be fitted to the big-end bearing cap location (see paragraph 1).
b) On all engines, if the original big-end bearing shells are being re-used, these must be refitted to their original locations in the connecting rod and big-end bearing cap.

19.15a Arrow or FRONT marking (arrowed) on piston crown must point to timing belt end of engine

18.15b Using piston ring compressor to clamp piston rings

13 Lubricate the cylinder bores, the pistons and piston rings, then lay out each piston/connecting rod assembly in its respective position.

14 Starting with assembly No 1, make sure that the piston rings are still correctly spaced, then clamp them in position with a piston ring compressor.

15 Insert the piston/connecting rod assembly into the top of liner No 1, ensuring that the arrow (or FRONT marking) on the piston crown faces the timing belt end of the engine. Note that the stamped marks on the connecting rod and big-end bearing cap should face the front (alternator bracket side) of the engine. Using a block of wood or hammer handle against the piston crown, tap the assembly into the liner until the piston crown is flush with the top of the liner **(see illustrations)**.

16 Ensure that the bearing shell is still correctly installed. Taking care not to mark the liner bores, liberally lubricate the crankpin and both bearing shells, then pull the piston/connecting rod assembly down the bore and onto the crankpin. Noting that the faces with the stamped marks must match (which means that the bearing shell locating tabs abut each other), refit the big-end bearing cap, tightening the bolts finger-tight at first.

17 Use a torque wrench to tighten the bolts evenly to the (first stage) torque wrench setting specified, then use an angular torque gauge to tighten the bolts evenly through the (second stage) angle specified **(see illustrations)**.

18 Repeat the procedure for the remaining three piston/connecting rod assemblies, but do not attempt to rotate the crankshaft.

19 Thoroughly degrease the mating surfaces of the oil rail and the main bearing ladder. Apply the special Rover sealant to the oil rail mating surface (see illustration 18.27). Carefully follow the instructions supplied with the sealant kit.

20 Refit the oil rail, tightening the nuts to the specified torque wrench setting.

21 Refit the oil pump pick-up/strainer pipe and sump.

22 Refit the cylinder head. Rotate the crankshaft to the 90° BTDC position so that the crankshaft sprocket timing marks align.

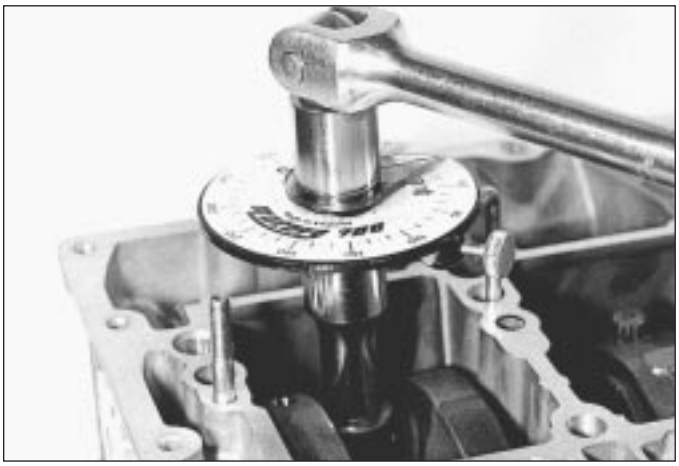
23 Refit the dipstick tube to the cylinder block/crankcase, tightening the bolts to the specified torque wrench setting.

24 Refit the hydraulic tappets and camshaft(s).

25 Refit the timing belt inner cover, sprocket(s) and tensioner, and the belt itself.

26 Using a torque wrench, check that the amount of force required to rotate the crankshaft does not exceed 31 Nm. If the effort required is greater than this, the engine must be dismantled again to trace and rectify the cause. This value takes into account the increased friction of a new engine and is much higher than the actual pressure required to rotate a run-in engine, so do not make allowances for tight components.

19.17a Tighten connecting rod big-end bearing cap bolts to specified torque wrench setting (first stage) . . .



19.17b . . . then use angular torque gauge to tighten bolts through angle specified (second stage)

20 **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 With the spark plugs removed and the ignition system disabled by earthing the ignition HT coil distributor spark plug (HT) lead with a jumper lead, turn the engine over on the starter until the oil pressure warning lamp goes out.

3 Refit the spark plugs and connect all the spark plug (HT) leads.

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

5 While the engine is idling, check for fuel, coolant and oil leaks. Do not 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.

6 Keep the engine idling until hot coolant is felt circulating through the top hose, check the ignition timing and idle speed and mixture (as appropriate), then switch it off.

7 After a few minutes, recheck the oil and coolant levels and top up as necessary.

8 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.

9 If new 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.