

# Chapter 2 Part B:

## OHC engines

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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	
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### Specifications

#### General

Type	Four-cylinder, in-line, water-cooled, single overhead camshaft, transversely mounted	
Engine codes:		
1.3 litre models	13N, 13NB or 13 S	
1.4 litre models	14NV or C14NZ	
1.6 litre models	16SH, 16SV or C16NZ	
1.8 litre models	18E or 18SE	
2.0 litre models	20NE, 20SEH, 20SER or C20NE	
<b>Note:</b> <i>The engine code forms the first digits of the engine number</i>		
Bore x Stroke:		
1.3 litre models	75.0 x 73.4 mm	
1.4 litre models	77.6 x 73.4 mm	
1.6 litre models:		
16SH engine	80.0 x 79.5 mm	
16SV and C16NZ engine	79.0 x 81.6 mm	
1.8 litre models	84.8 x 79.5 mm	
2.0 litre models	86.0 x 86.0 mm	
Capacity:		
1.3 litre models	1297 cc	
1.4 litre models	1389 cc	
1.6 litre models	1598 cc	
1.8 litre models	1796 cc	
2.0 litre models	1998 cc	
Firing order	1-3-4-2 (No.1 cylinder at timing belt end)	
Crankshaft rotation	Clockwise	
Compression ratio:		
13N and 13NB engines	8.2 : 1	
13S, 16SH, 20NE and C20NE engines	9.2 : 1	
14NV or C14NZ	9.4 : 1	
18E engine	9.5 : 1	
16SV, C16NZ, 18SE, 20SEH and 20SER engines	10.0 : 1	
Camshaft toothed belt tension (using gauge KM-510-A):	<b>1.3 and 1.4 litre</b>	<b>1.6, 1.8 and 2.0 litre</b>
New belt, cold	6.0	3.0
New belt, warm	8.0	8.0
Used belt, cold	5.0	3.0
Used belt, warm	7.5	8.0

## 2B•2 OHC engines

### Cylinder head

Material	Light alloy
Maximum permissible distortion of sealing face	0.025 mm
Overall height of cylinder head	95.75 to 96.25 mm
Valve seat width:	
Inlet:	
All 1.3, 1.4, 1.6 litre and 18E engines	1.3 to 1.4 mm
18SE and all 2.0 litre engines	1.0 to 1.5 mm
Exhaust:	
All 1.3, 1.4, 1.6 litre and 18E engines	1.7 to 1.8 mm
18SE and all 2.0 litre engines	1.7 to 2.2 mm

### Valves and guides

Valve clearance	Automatic by hydraulic valve lifters (cam followers)	
Valve length:		
1.3 litre engine	105.3 mm	
1.4 litre engine	105.0 mm	
1.6 litre engines:		
16SH engine	106.5 mm	
16SV and C16NZ engines	101.5 mm	
1.8 litre engines:		
18E engine	106.5 mm	
18SE engine	104.2 mm	
2.0 litre engines	104.2 mm	
Valve stem-to-guide clearance:	<b>Inlet</b>	<b>Exhaust</b>
1.3 and 1.4 litre engines	0.020 to 0.050 mm	0.040 to 0.070 mm
1.6 litre engine:		
16SH and 16SV engines	0.015 to 0.042 mm	0.030 to 0.060 mm
C16NZ engine	0.020 to 0.050 mm	0.020 to 0.050 mm
1.8 litre engine:		
18E engine	0.015 to 0.042 mm	0.030 to 0.060 mm
18SE engine	0.018 to 0.052 mm	0.040 to 0.070 mm
2.0 litre engine	0.018 to 0.052 mm	0.040 to 0.070 mm
Valve guide installed height:		
1.3 and 1.4 litre engines	80.85 to 81.25 mm	
All 1.6 litre and 18E engines	80.95 to 81.85 mm	
18SE and all 2.0 litre engines	83.50 to 83.80 mm	
Valve stem diameter:	<b>Inlet</b>	<b>Exhaust</b>
1.3 litre engine	7.000 to 7.010 mm	6.980 to 6.990 mm
1.4 litre engine	6.998 to 7.012 mm	6.978 to 6.992 mm
1.6 litre engine:		
16SH and 16SV engines	7.795 to 7.970 mm	7.957 to 7.970 mm
C16NZ engine	6.998 to 7.012 mm	6.978 to 6.992 mm
1.8 litre engine:		
18E engine	7.795 to 7.970 mm	7.957 to 7.970 mm
18SE engine	6.998 to 7.012 mm	6.978 to 6.992 mm
2.0 litre engine	6.998 to 7.012 mm	6.978 to 6.992 mm
Oversizes	0.075, 0.150, 0.250 mm	
Valve guide bore diameter:		
1.3 and 1.4 litre engines	7.030 to 7.050 mm	
1.6, 1.8 and 2.0 litre engines	8.000 to 8.017 mm	

### Camshaft

Radial run-out	0.03 mm max
Endfloat	0.09 to 0.21 mm
Camshaft journal diameters:	
1.3, 1.4 and 1.6 (C16NZ) litre engines:	
No 1	39.435 to 39.450 mm
No 2	39.685 to 39.700 mm
No 3	39.935 to 39.950 mm
No 4	40.125 to 40.200 mm
No 5	40.435 to 40.450 mm
1.6 litre (16SH and 16SV), 1.8 and 2.0 litre engines:	
No 1	42.455 to 42.470 mm
No 2	42.705 to 42.720 mm
No 3	42.955 to 42.970 mm
No 4	43.205 to 43.220 mm
No 5	43.455 to 43.470 mm

**Camshaft bearing (direct in housing) diameters:****1.3, 1.4 and 1.6 (C16NZ) litre engines:**

No 1	39.500 to 39.525 mm
No 2	39.750 to 39.775 mm
No 3	40.000 to 40.025 mm
No 4	40.250 to 40.275 mm
No 5	40.550 to 40.525 mm

**1.6 litre (16SH and 16SV), 1.8 and 2.0 litre engines:**

No 1	42.500 to 42.525 mm
No 2	42.750 to 42.775 mm
No 3	43.000 to 43.025 mm
No 4	43.250 to 43.275 mm
No 5	43.500 to 43.525 mm

**Piston rings**

Number of piston rings . . . . . 2 compression, 1 oil control

**Ring end gap:**

Compression	0.3 to 0.5 mm
Oil control (rail)	0.40 to 1.40 mm

Ring gap offset (to gap of adjacent ring) . . . . . 180°

**Gudgeon pins****Length:**

1.3 and 1.4 litre engines	65 mm
1.6, 1.8 and 2.0 litre engines	70 mm

**Diameter:**

1.3 and 1.4 litre engines	20 mm
1.6, 1.8 and 2.0 litre engines	23 mm

**Clearance in piston:**

1.3 and 1.4 litre engines	0.007 to 0.010 mm
1.6, 1.8 and 2.0 litre engines	0.011 to 0.014 mm

Clearance in connecting rod . . . . . None (interference fit)

**Crankshaft and bearings**

Number of main bearings . . . . . 5

**Main bearing journal diameter:**

1.3, 1.4, and 1.6 (16SV and C16NZ) litre engines	54.972 to 54.985 mm
1.6 (16SH), 1.8 and 2.0 litre engines	57.982 to 57.995 mm

**Crankpin diameter:**

1.3, 1.4, and 1.6 (16SV and C16NZ) litre engines	42.971 to 42.987 mm
1.6 (16SH), 1.8 and 2.0 litre engines	48.971 to 48.987 mm

Undersizes . . . . . 0.25 and 0.50 mm

**Crankshaft endfloat:**

1.3, 1.4, and 1.6 (16SV and C16NZ) litre engines	0.1 to 2.0 mm
1.6 (16SH), 1.8 and 2.0 litre engines	0.07 to 0.3 mm

**Main bearing running clearance:**

1.3, 1.4, and 1.6 (16SV and C16NZ) litre engines	0.025 to 0.05 mm
1.6 (16SH), 1.8 and 2.0 litre engines	0.015 to 0.04 mm

**Big-end running clearance:**

1.3, 1.4, and 1.6 (16SV and C16NZ) litre engines	0.019 to 0.071 mm
1.6 (16SH) and 1.8 litre engines	0.019 to 0.063 mm
2.0 litre engine	0.006 to 0.031 mm

**Big-end side-play:**

1.3, 1.4, and 1.6 (16SV and C16NZ) litre engines	0.11 to 0.24 mm
1.6 (16SH), 1.8 and 2.0 litre engines	0.07 to 0.24 mm

**Bearing shell identification:****Top shells:**

Main bearings, standard	Brown
Main bearings, 0.25 mm undersize	Brown/blue
Main bearings, 0.5 mm undersize	Brown/white
Big-end bearings, standard	None
Big-end bearings, 0.25 mm undersize	Blue
Big-end bearings, 0.5 mm undersize	White

**Bottom shells:**

Main bearings, standard	Green
Main bearings, 0.25 mm undersize	Green/blue
Main bearings, 0.5 mm undersize	Green/white
Big-end bearings, standard	None
Big-end bearings, 0.25 mm undersize	Blue
Big-end bearings, 0.5 mm undersize	White

Main and big-end bearing journal out-of-round . . . . . 0.04 mm max

Crankshaft radial run-out (at centre journal, shaft in block) . . . . . 0.03 mm max

## 2B•4 OHC engines

### Flywheel

Refinishing limit - depth of material which may be removed from clutch friction surface .....	0.3 mm max
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### Lubrication system

Oil pump tolerances:	
Teeth backlash .....	0.1 to 0.2 mm
Gear-to-housing clearance (endfloat):	
1.3, 1.4 and 1.6 (16SV and C16NZ) litre engines .....	0.08 to 0.15 mm
1.6 (16SH), 1.8 and 2.0 litre engines .....	0.03 to 0.10 mm
Oil pressure at idle (engine warm) .....	1.5 bar

### Torque wrench settings

Torque wrench settings	Nm	lbf ft
Flywheel to crankshaft:		
1.3 litre engine	60	44
1.4 and 1.6 (16SV and C16NZ) litre engines:		
Stage 1	35	26
Stage 2	Angle tighten a further 30 to 45°	
1.6 (16SH), 1.8 (18E) engines:		
Stage 1	50	37
Stage 2	Angle tighten a further 25 to 35°	
1.8 (18SE) and 2.0 litre engines:		
Stage 1	65	48
Stage 2	Angle tighten a further 30 to 45°	
Driveplate to crankshaft	60	44
Main bearing cap bolts:		
1.3 litre engine:		
Bolts Part No. 11 082 602*	65	48
Bolts Part No. 90 215 694:		
Stage 1	50	37
Stage 2	Angle tighten a further 45 to 60°	
1.6 (16SH) and 1.8 (18E) litre engine:		
Bolts Part No. 90 215 047*	65	48
Bolts Part No. 90 234 048:		
Stage 1	50	37
Stage 2	Angle tighten a further 45 to 60°	
1.4 and 1.6 (16SV and C16NZ) litre engines:		
Stage 1	50	37
Stage 2	Angle tighten a further 45 to 60°	
1.8 (18SE) and 2.0 litre engines:		
Stage 1	50	37
Stage 2	Angle tighten a further 40 to 50°	
<i>*Use these bolts only if the angle-tightening bolts are not available</i>		
Oil pump relief valve cap	30	22
Oil pressure switch	30	22
Oil pump bolts	6	4
Oil drain plug	45	33
Sump pan bolts	5	4
Big-end cap bolts:		
1.3, 1.4 and 1.6 (16SV and C16NZ) litre engines		
Bolts with 15 mm thread length	28	21
Bolts with 40 mm thread length:		
Stage 1	25	18
Stage 2	Angle tighten a further 30°	
1.6 (16SH) and 1.8 (18E) engines	45	33
1.8 (18SE) and 2.0 litre engines:		
Stage 1	35	26
Stage 2	Angle tighten a further 45°	
Cylinder head bolts:		
1.3, 1.4 litre and 1.6 (16SV and C16NZ) litre engines:		
Stage 1	25	18
Stage 2	Angle tighten a further 60°	
Stage 3	Angle tighten a further 60°	
Stage 4	Angle tighten a further 30°	
Warm the engine up to normal operating temperature then	Angle tighten a further 30°	
1.6 (16SH), 1.8 and 2.0 litre engines:		
Stage 1	25	18
Stage 2	Turn bolt through 60°	
Stage 3	Turn bolt through 60°	
Stage 4	Turn bolt through 60°	
Warm the engine up to normal operating temperature then	Angle tighten a further 30°	

**Torque wrench settings (continued)**

	Nm	lbf ft
Camshaft sprocket bolt	45	33
Crankshaft pulley bolt:		
1.3, 1.4 and 1.6 (16SV and C16NZ) litre engine:		
Bolt with 23 mm thread length	55	41
Bolt with 30 mm thread length:		
Stage 1	55	41
Stage 2	Angle tighten a further	45 to 60°
1.6, 1.8 and 2.0 litre engine	20	15
Crankshaft sprocket bolt - 1.6 (16SH), 1.8 and 2.0 litre engines:		
Stage 1	130	96
Stage 2	Angle tighten a further	40 to 50°
Starter motor bolts:		
1.3 litre engine	25	18
1.6, 1.8 and 2.0 litre engines	45	33
Engine mounting bracket to crankcase	50	37
Engine mounting bracket to transmission	30	22
Engine mountings to bodyframe	40	30
Alternator bracket to block	40	30
Fuel pump to camshaft housing	18	13

**Note:** All bolts which are angle tightened must be renewed whenever they are disturbed

**1 General description**

The engine is of four-cylinder, in-line overhead camshaft type, mounted transversely at the front of the car.

The crankcase is supported in five shell type main bearings. Thrustwashers are incorporated in the centre main bearing to control crankshaft endfloat.

The connecting rods are attached to the crankshaft by horizontally split shell type main bearings, and to the pistons by gudgeon pins which are an interference fit in the connecting rod small-end bore. The aluminium alloy pistons are fitted with three piston rings: two compression rings and an oil control ring.

The camshaft is driven by a toothed rubber belt from the crankshaft and operates the valves via rocker arms. The rocker arms are supported at their pivot end by hydraulic self-adjusting valve lifters (ball studs) which automatically take up any clearance between the camshaft, rocker arm and valve stems. The inlet and exhaust valves are each closed by a single spring and operate in guides pressed into the cylinder head.

Engine lubrication is by a gear type pump located in a housing attached to the front of the cylinder block. The oil pump is driven by the crankshaft, while the fuel pump (on carburettor models) and the distributor are driven by the camshaft.

**2 Compression test - description and interpretation**

Refer Chapter 2A, Section 2.

**3 Operations requiring engine removal**

The design of the engine is such that great accessibility is afforded and it is only necessary to remove the engine for attention to the crankshaft and main bearings. It is possible to

renew the crankshaft rear oil seal with the engine in the car, but this entails the use of the manufacturer's special tools and it is quite a difficult operation due to lack of working clearance. For this reason this operation is described with the engine removed.

**4 Engine dismantling and reassembly - general information**

Refer to Chapter 2A, Section 5.

**5 Ancillary components - removal and refitting**

Refer to Chapter 2A, Section 6. For fuel injection models, refer to the appropriate Sections of Chapter 4B.

**6 Oil pressure regulator valve - removal and refitting****Removal**

- 1 From just to the rear of the crankshaft pulley, unscrew the pressure regulator valve and extract the spring and plunger.
- 2 Renew the spring if it is distorted or weak (compare it with a new one if possible).
- 3 If the plunger is scored, renew it.



**7.2a** Crankshaft pulley notch and oil pump pointer in alignment (arrowed)

**Refitting**

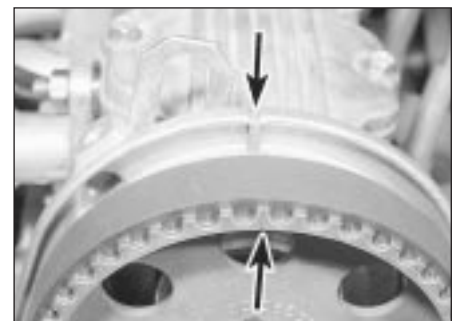
- 4 Clean out the plunger hole and reassemble using a new plug sealing washer.

**7 Camshaft toothed belt - removal, refitting and adjustment**

**Note:** The following procedure will necessitate re-positioning of the water pump which, in turn, is likely to cause leakage from around the sealing flange. Minor leakage can normally be rectified by using a proprietary radiator sealing product in the cooling system, although it is preferable to remove the water pump completely and fit a new sealing ring (for further information see Chapter 3).

**Removal**

- 1 Undo the belt cover retaining bolts (early models) or release the retaining clips (later models) and remove the cover.
- 2 Use a socket or spanner on the crankshaft pulley to turn the crankshaft until No 1 piston is at its firing point, indicated by the notch on the crankshaft pulley being in line with the pointer on the oil pump housing, and the mark on the camshaft sprocket being in line with the rib on the camshaft housing (see illustrations).
- 3 Slacken the alternator mounting and adjustment bolts, move the alternator towards the engine and remove its drivebelt. Where



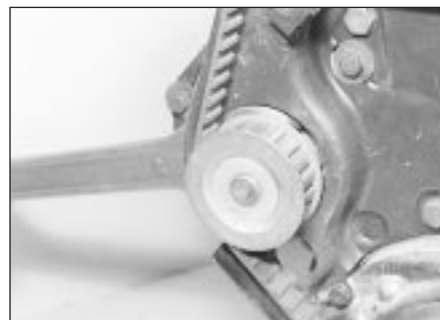
**7.2b** Camshaft sprocket mark and housing rib (both arrowed) should be aligned



7.4 Jamming the flywheel ring gear



7.8 Slackening a water pump bolt



7.9 Swivelling the water pump using a spanner on the flats

necessary, unscrew the union nuts and disconnect the oil cooler pipes from the filter housing to improve access to the crankshaft pulley.

4 On 1.3, 1.4 and 1.6 (16SV and C16NZ) litre engines, release the crankshaft pulley central bolt without disturbing the set position of the crankshaft. To prevent the crankshaft turning it may be sufficient to engage a gear (manual gearbox only) and apply the handbrake; a better way is to remove the flywheel bottom cover plate and jam the flywheel ring gear with a large screwdriver or a tyre lever (see illustration). Remove the bolt and the pulley.

5 On 1.6 (16SH), 1.8 and 2.0 litre engines, remove the four Allen screws which secure the pulley to the sprocket. Remove the pulley.

6 On all models, drain the cooling system as described in Chapter 1.

7 On later (June 1990 onwards) 1.4 litre and 1.6 (16SV and C16NZ) litre engines which are fitted with a spring-loaded automatic tensioner, lock the tensioner in its slackest position. To do this move the tensioner indicator arm clockwise until the holes in the baseplate and arm align and lock the tensioner in position with a suitable rod (see illustration 7.15).

8 On all models, slacken the three bolts which secure the water pump. The bolts are

accessible through holes in the belt backplate (see illustration).

9 Swivel the pump to release the tension on the toothed belt. There are flats behind the pump sprocket for this purpose (see illustration). Note the belt's running direction if it is to be used again, then slip it off the sprockets. At this point, also note the statement at the beginning of this Section.

10 A new belt, or one which is to be re-used, must not be kinked or be contaminated with oil, grease etc

### Refitting

#### Later (June 1990 onwards) 1.4 litre and 1.6 (16SV and C16NZ) litre engines

11 Fit the new belt without disturbing the set position of the crankshaft and camshaft sprockets. Apply some tension by moving the water pump and check that the timing marks are correctly aligned (see illustration).

12 Refit the crankshaft pulley bolt and withdraw the locking rod from the spring-loaded automatic tensioner.

13 Rotate the water pump and set the belt tension so that the automatic tensioner indicator arm and backplate holes are aligned (the tensioner arm will have moved fully

clockwise). Tighten the water pump bolts securely.

14 Rotate the crankshaft smoothly through two complete turns clockwise until the timing marks are realigned (see illustration 7.11).

15 Slacken the water pump bolts and rotate the pump anti-clockwise slightly until the automatic tensioner arm is positioned in the centre of backplate notch (see illustration). When the tensioner is correctly positioned, tighten the water pump bolts to the specified torque setting.

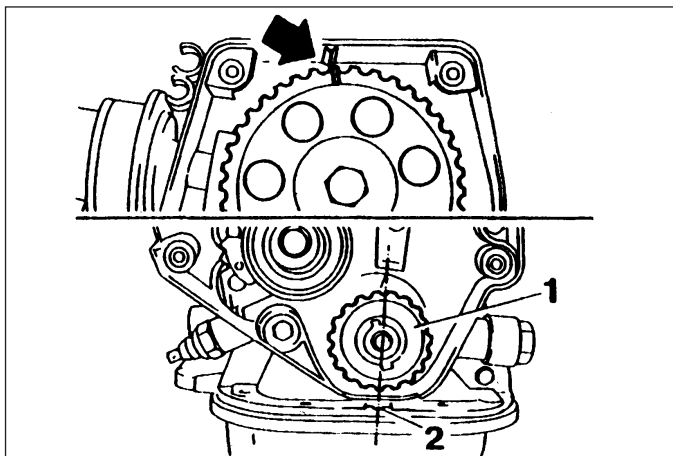
16 Rotate the crankshaft through two more complete turns clockwise (so that the timing marks are aligned again) and check that the tensioner arm and backplate notch are still correctly aligned. If not, repeat the operation in paragraph 15.

17 Once the tensioner position is correct, remove the crankshaft pulley bolt.

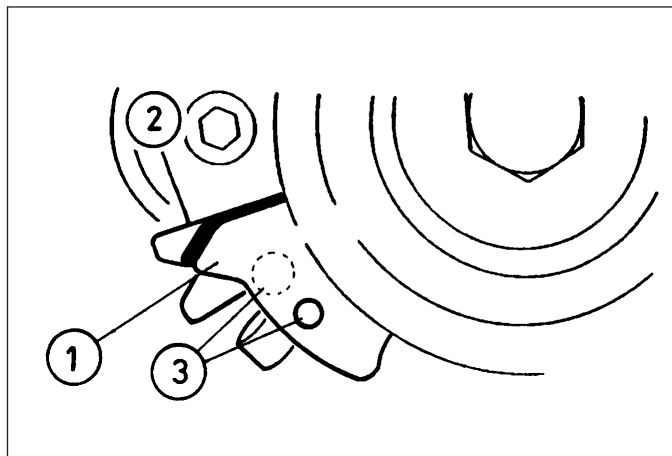
18 Refit all disturbed components by reversing the removal sequence. Adjust the auxiliary drivebelt and refill the cooling system as described in Chapter 1.

#### All other models

19 Fit the new belt without disturbing the set position of the crankshaft and camshaft sprockets. Apply some tension by moving the water pump.

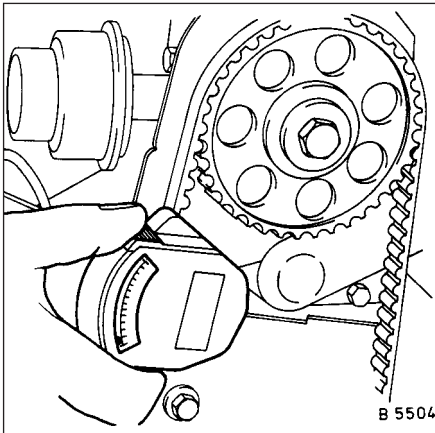


7.11 On 1.4 and 1.6 (16SV and C16NZ) litre engines, align the camshaft sprocket mark with the backplate rib and the crankshaft sprocket (1) is aligned with the backplate/oil pump housing groove (2)



7.15 Camshaft toothed belt tensioner indicator arm (1), baseplate (2) and locking holes - later 1.4 litre and 1.6 (16SV and C16NZ) litre engines





7.21 Checking the camshaft toothed belt tension with gauge KM-510-A

20 Refit the crankshaft pulley and check that the pulley and camshaft sprocket marks are still correctly aligned (paragraph 2). If not, release the belt tension and align the sprockets correctly. Tighten the crankshaft pulley bolt to the specified torque, using locking compound on the bolt threads.

21 To adjust the tension of the belt, ideally the tension gauge specified by the makers (KM-510-A) should be used (see illustration). If this is available, proceed as follows.

22 Turn the crankshaft through at least half a turn in the normal direction of rotation. Set the tension gauge, apply it to the 'slack' side of the belt (above the alternator) and release it. Read the gauge and compare the figure with that given in the Specifications.

23 If adjustment is necessary, move the water pump to increase or decrease belt tension, rotate the crankshaft through one full turn and take another gauge reading. Repeat as necessary until the desired tension is achieved.

24 In the absence of the belt tension gauge, an approximation to the correct tension can be judged by twisting the belt in the middle of its 'slack' side (between water pump and camshaft sprocket). It should just be possible to twist the belt through  $90^\circ$  (a quarter turn) by hand (see illustration). A belt which is too tight will normally be heard to hum or honk when running.



8.19 Removing a rocker arm



7.24 Checking the belt tension by twisting it between the water pump and camshaft sprockets

25 When adjustment is correct, tighten the water pump bolts to the specified torque. Refit and secure the belt cover.

26 Refit and tension the alternator drivebelt and refill the cooling system, both as described in Chapter 1. Refit the flywheel bottom cover if it was removed.

## 8 Cylinder head - removal and refitting

### Removal

**Note:** The procedure given here is for carburettor models. The procedure for fuel injection models is similar; refer to Chapter 4B for details of fuel injection component removal and wiring disconnection.

1 The cylinder head may only be removed when the engine is cold, otherwise there is a risk of distortion.

2 Disconnect the battery earth lead.

3 Remove the air cleaner, (Chapter 4).

4 Drain the cooling system, (Chapter 1).

5 Disconnect the radiator and heater hoses from the cylinder head and inlet manifold.

6 Disconnect and plug the fuel lines and unbolt the fuel pump. Also disconnect the fuel return line from the T-piece or carburettor. Be prepared for fuel spillage.

7 Unbolt and remove the camshaft cover, noting the location of the clips which secure the HT leads and fuel lines. Also disconnect the breather hose (when fitted). Recover the gasket.

8 Disconnect the control cables and electrical cables (as applicable) from the carburettor, referring to Chapter 4A if necessary.

9 Release the coolant pipe bracket at the inlet manifold.

10 Disconnect the brake servo vacuum hose from the inlet manifold.

11 Slacken the alternator pivot bolt, remove the adjusting strap bolt at the engine end and remove the alternator drivebelt.

12 Align the timing marks, slacken the camshaft toothed belt and remove it from the camshaft sprocket, as described in Section 7. Unless it is wished to remove the belt entirely, there is no need to remove the crankshaft pulley.

13 Disconnect the HT leads, identifying them if necessary. Remove the distributor cap and the distributor itself, (Chapter 5).

14 Disconnect the temperature gauge wire from the sender on the thermostat housing or inlet manifold.

15 Unbolt the exhaust downpipe(s) from the exhaust manifold.

16 Following the reverse sequence to that shown in illustration 8.26a, slacken each cylinder head bolt by a quarter turn. Following the same order, slacken each bolt by a half turn, then remove them completely. The bolts should be discarded, and new ones used for refitting.

17 Lift off the camshaft housing and camshaft, disconnecting any breather hoses which are connected to the housing.

18 Lift off the cylinder head using the manifolds as handles if it is stuck. Do not prise between the head and block or damage may result.

19 Remove the rocker arms and thrust pads from the cylinder head. Withdraw the hydraulic valve lifters and immerse them in a container of clean engine oil to avoid any possibility of them draining. Keep all components in their original order if they are to be refitted (see illustration).

20 If the cylinder head has been removed for decarbonising or for attention to the valves, hydraulic valve lifters and springs, reference should be made to Sections 10 and 11.

### Refitting

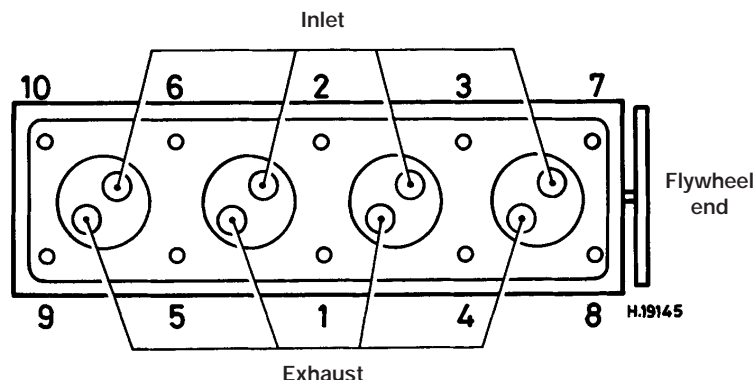
21 Before refitting the cylinder head, ensure that the block and head mating faces are spotlessly clean and dry with all traces of old gasket removed. Use a scraper to do this, but take care to cover the water passages and other openings with masking tape or rag to prevent dirt and carbon falling in. Remove all traces of oil and water from the bolt holes otherwise hydraulic pressure created by the bolts being screwed in could crack the block or give inaccurate torque settings. Ensure that the bolt threads are clean and dry.

22 When all is clean locate a new gasket on the block so that the word OBEN or TOP can be read from above (see illustration). Do not use any jointing compound on the gasket.

23 Refit the hydraulic valve lifters, thrust pads and rocker arms to the cylinder head in



8.22 Head gasket must be fitted with the word OBEN (or TOP) uppermost



8.26a Cylinder head bolt tightening sequence

their original positions. If new hydraulic valve lifters are being used, or if they were dismantled for cleaning, immerse each one in a container of clean engine oil and compress it (by hand) several times to charge it.

**24** Locate the cylinder head on the block so that the positioning dowels engage in their holes.

**25** Apply a uniform bead of jointing compound to the mating face of the cylinder head and lower the camshaft housing into place. Position the sprocket with the timing marks aligned.

**26** Fit the new cylinder head bolts and tighten them in the order shown, in the stages given in the Specifications. The required angular measurement can be marked on a card and then placed over the bolt as a guide to the movement of the bolt (see illustrations).

**27** Refit the distributor, as described in Chapter 5.

**28** Refit and secure the exhaust downpipe(s). Apply a little anti-seize compound to the bolts.

**29** Refit the camshaft cover, using a new gasket. Tighten the bolts in diagonal sequence, remembering to fit the HT lead and fuel line brackets (see illustrations).

**30** Reconnect the HT leads and refit the distributor cap.

**31** Refit the fuel pump, using new gaskets on

each side of the spacer. Reconnect the fuel supply and return lines.

**32** Refit and tension the camshaft toothed belt, as described in Section 7, then refit the belt cover.

**33** Refit and tension the alternator drivebelt, as described in Chapter 1.

**34** Refit the coolant hoses and refill the cooling system, as described in Chapter 1. Secure the coolant pipe bracket to the inlet manifold.

**35** Reconnect the throttle and choke cables to the carburettor, as described in Chapter 4A. On models with automatic choke, reconnect the electrical lead to the choke.

**36** Refit the brake servo vacuum hose, the temperature gauge wire and the crankcase breather hose(s).

**37** Check that nothing has been overlooked, then refit the air cleaner.

**38** Reconnect the battery and start the engine. There may be considerable valve gear noise until the hydraulic tappets pressurise with oil.

**39** Run the engine until it reaches normal operating temperature, then check the ignition timing, as described in Chapter 5.

**40** Switch off the engine, immediately remove the air cleaner and tighten the cylinder head bolts through the final specified angle, following the outward spiral pattern previously used. No further tightening is necessary.



8.26b Using a marked card to measure angular rotation when tightening cylinder head bolts

## 9 Camshaft - removal and refitting



### Removal

**1** The camshaft can only be removed without disturbing the housing if special tool 603 850, or equivalent, is available to depress the cam followers whilst the camshaft is withdrawn.

**2** Assuming that the special tool is not available, the camshaft housing must be removed. Since the cylinder head bolts will be removed, it would certainly be good practice to fit a new cylinder head gasket; however, if the cooling system is drained and the housing is removed gently, there is a good chance that the head gasket seal will not be broken. It is the reader's choice whether to undertake the extra work of renewing the head gasket as a precaution, or to risk the vexation of finding that the old gasket has 'blown' after reassembly.

**3** With the camshaft housing removed, as described in Section 8, clamp the cylinder head with four head bolts and some spacers if the head is not to be disturbed (see illustration).

**4** Undo the camshaft sprocket bolt, using an open-ended spanner on the flats of the camshaft to stop the shaft turning. Remove the bolt, washer and sprocket.

**5** At the other end of the housing, remove the two Allen screws which secure the thrust



8.29a Fitting a new camshaft cover gasket



8.29b HT lead bracket is secured by one of the camshaft cover bolts



9.3 Cylinder head bolt, with washers and nuts for spacers, used to clamp head

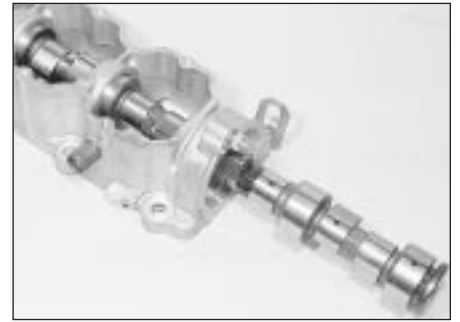




**9.5a Removing the Allen screws which secure the camshaft thrust plate**



**9.5b Removing the camshaft thrust plate**



**9.6 Removing the camshaft from the housing**

plate. Push the camshaft rearwards and extract the plate (see illustrations).

**6** Carefully withdraw the camshaft from the distributor end of the housing. Be careful not to damage the bearing surfaces in the housing (see illustration).

**7** Where necessary, undo the bolts which secure the belt cover backplate and remove the plate (see illustration).

### Refitting

**8** Prise out the oil seal with a screwdriver. Drive in a new seal until it is flush with the housing, using a piece of wood or a suitably sized socket (see illustrations).

**9** Liberally lubricate the camshaft bearings and the oil seal lip. (If special lubricant has been supplied with a new camshaft, use it; otherwise use clean engine oil, perhaps with a molybdenum disulphide additive.) Carefully insert the camshaft.

**10** Refit the thrust plate and tighten its screws. Check the camshaft endfloat using a feeler blade (see illustration). If the endfloat exceeds that specified, renew the thrust plate.

**11** Refit the belt backplate (where necessary).

**12** Refit the camshaft sprocket, engaging the peg on the shaft with the hole in the sprocket. Tighten the sprocket bolt to the specified torque, holding the camshaft as before (see illustrations).

**13** Refit the camshaft housing, (Section 8).

**14** If a new camshaft has been fitted, it is most important to observe the following running-in schedule (unless otherwise specified by the manufacturer) immediately after start-up:

*One minute at 2000 rpm*

*One minute at 1500 rpm*

*One minute at 3000 rpm*

*One minute at 2000 rpm*

**15** Change the engine oil (but not the filter, unless due in any case) approximately 1000 km after fitting a new camshaft.

## 10 Cylinder head - overhaul

**1** With the cylinder head removed, clean away external dirt.

**2** Remove the valves, springs and associated components, as described in Section 9 of Chapter 2A. Note that both inlet and exhaust valve springs have seats, but they are different (see illustration).

**3** Inspect the valves, valve seats, guides and springs, also as described in Section 9, Chapter 2A. Regrind or renew as necessary.

**4** Check the head sealing surface for warping by placing in on a piece of plate glass, or using a straight-edge and feeler blades. Slight



**9.7 Camshaft belt cover backplate (1.3 litre engine shown)**



**9.8a Prising out the camshaft housing oil seal**



**9.8b Fitting a new camshaft housing oil seal**



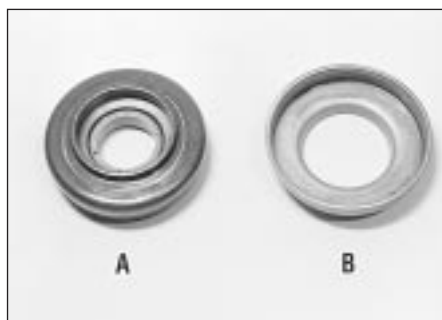
**9.10 Checking the camshaft endfloat**



**9.12a Fitting the camshaft sprocket. Peg locating hole is arrowed**



**9.12b Tightening the camshaft sprocket bolt**

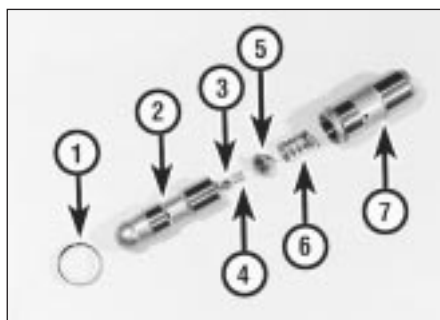


**10.2 Exhaust valve spring rotator seat (A) and inlet valve spring seat (B)**

distortion, or corrosion, may be corrected by machining. Seek expert advice if this is necessary: the removal of too much metal will render the head useless.

**5** Check the valve lifter bores in the cylinder head for wear which, if evident, will mean renewal of the cylinder head. Also check the valve lifter oil supply holes in the cylinder head for any sign of contamination.

**6** On engines which have covered a high mileage, or for which the service history (particularly oil changes) is suspect, it is possible for the valve lifters to suffer internal contamination, which in extreme cases may result in increased engine top-end noise and wear. To minimise the possibility of problems occurring later in the life of the engine, it is advisable to dismantle and clean the hydraulic valve lifters as follows whenever the cylinder head is overhauled. Note that no spare parts are available for the valve lifters, and if any of



**10.6 Hydraulic valve lifter components**

- 1 Collar
- 2 Plunger
- 3 Ball
- 4 Small spring

- 5 Plunger cap
- 6 Large spring
- 7 Cylinder

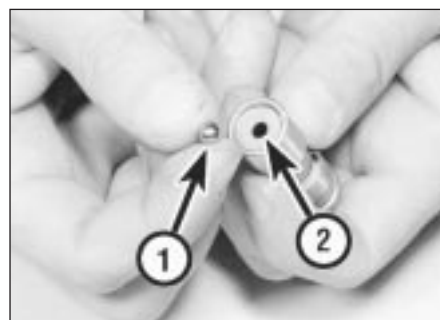
the components are unserviceable, the complete assembly must be renewed (see illustration).

**7** Carefully pull the collar from the top of the valve lifter cylinder. It should be possible to remove the collar by hand—if a tool is used, take care not to distort the collar.

**8** Withdraw the plunger from the cylinder, and recover the string.

**9** Using a small screwdriver, carefully prise the cap from the base of the plunger. Recover the spring and ball from under the cap, taking care not to lose them as the cap is removed.

**10** Carefully clean all the components using paraffin or a suitable solvent, paying particular attention to the machined surfaces of the cylinder (internal surfaces), and piston



**10.12 Locate the ball (1) on its seat (2) in the base of the plunger**

(external surfaces). Thoroughly dry all the components using a lint-free cloth. Carefully examine the springs for damage or distortion—the complete valve lifter must be renewed if the springs are not in perfect condition.

**11** Lubricate the components sparingly with clean engine oil of the correct grade, then reassemble as follows.

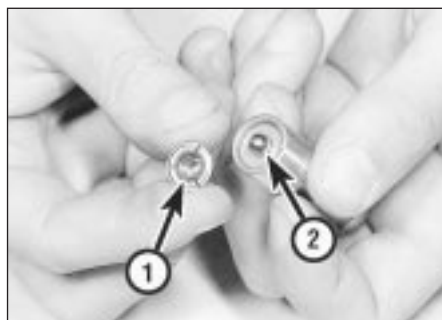
**12** Invert the plunger, and locate the ball on its seat in the base of the plunger (see illustration).

**13** Locate the smaller spring on its seat in the plunger cap, then carefully refit the cap and spring, ensuring that the spring locates on the ball. Carefully press around the flange of the cap, using a small screwdriver if necessary, until the flange is securely located in the groove in the base of the plunger (see illustrations).

**14** Locate the larger spring over the plunger cap, ensuring that the spring is correctly seated, and slide the plunger and spring assembly into the cylinder (see illustrations).

**15** Slide the collar over the top of the plunger, and carefully compress the plunger by hand, until the collar can be pushed down to engage securely with the groove in the cylinder (see illustration).

**16** On some engines an oil pressure regulating valve in the head stabilises the oil pressure applied to the valve lifters (see illustration). To renew the valve, access is gained via the circular plug covering the end of the valve. The old valve must be crushed and its remains extracted, and a thread (M10) cut in the valve seat to allow removal using a suitable bolt. A new valve and plug can then



**10.13a Spring (1) located in plunger cap, and ball (2) located on seat in plunger**



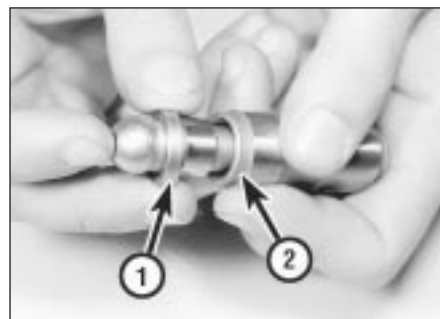
**10.13b Locate the cap flange in the plunger groove**



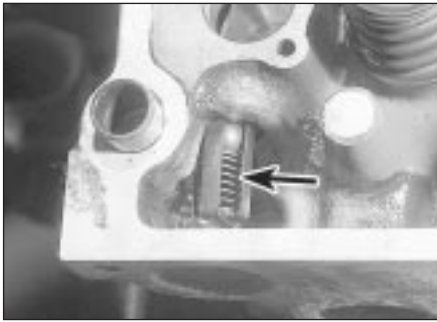
**10.14a Locate the spring over the plunger cap . . .**



**10.14b . . . then slide the plunger and spring assembly into the cylinder**



**10.15 Slide the collar (1) over the top of the plunger and engage with the groove (2)**



10.16 Cylinder head oil pressure regulating valve (arrowed)

be driven into position. Care must be taken to keep foreign matter and swarf out of the oilways; it is probably best to have the valve renewed by a GM dealer if necessary.

17 Refit the valves, springs etc, as described in Section 9 of Chapter 2A. Remember to fit new valve stem seals.

18 On 1.6 (16SH), 1.8 and 2.0 litre engines, take the opportunity to renew the thermostat housing sealing ring whilst the head is removed.

## 11 Cylinder head and pistons - decarbonising

Refer to Chapter 2A, Section 10; bearing in mind also that the head is of light alloy construction and is easily damaged.

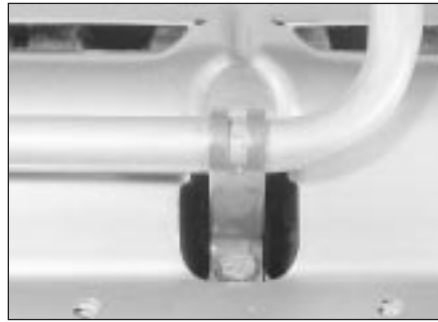
## 12 Sump - removal and refitting

### Removal

- 1 Jack up the front of the car and support it on axle stands (see "Jacking and Vehicle Support").
- 2 Drain the engine oil into a suitable container and refit the plug after draining.
- 3 Unbolt the exhaust downpipe(s) from the exhaust manifold.
- 4 Undo the bolts securing the flywheel cover plate to the transmission bellhousing and remove the plate.
- 5 Undo the retaining bolts and lift away the sump. It will probably be necessary to tap the



12.7b . . . while this one has one double-sided rubber gasket



12.6 Oil pick-up support bracket

sump from side to side with a hide or plastic mallet to release the joint face.

6 On later models, where necessary, unbolt the oil pick-up pipe support bracket (see illustration). If the engine is in the car, it will be easier to remove the baffle plate if the oil pick-up pipe is removed completely.

7 Remove the baffle plate and recover the gasket(s). On some models a double-sided rubber gasket is used; on other models there are two cork gaskets (see illustrations).

### Refitting

8 On later models, where the baffle plate has been removed, ensure that the surfaces are clean and dry and refit the plate using new gasket(s) (as applicable). Refit the oil pick-up pipe bracket and securely tighten its retaining bolts.

9 On all models, thoroughly clean the sump in paraffin or a suitable solvent and remove all traces of external dirt and internal sludge. Scrape away the remains of the old gasket from the sump and crankcase faces and ensure that they are clean and dry.

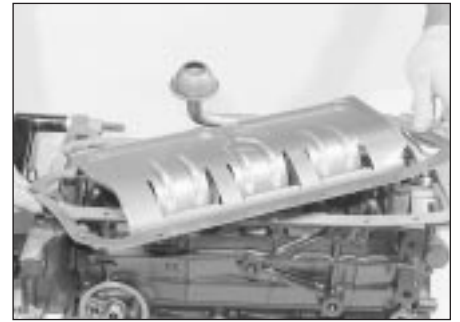
10 Apply jointing compound to the oil pump housing joint, the crankcase mating face and the rear main bearing cap joint, then place a new gasket in position.

11 Apply jointing compound to the sump face and retaining bolt threads, place the sump in position and refit the bolts. Progressively tighten the bolts in a diagonal sequence.

12 Refit the exhaust downpipe(s) and flywheel cover plate, lower the car to the ground and fill the engine with oil.



13.2a Removing the crankshaft sprocket



12.7a Removing the oil baffle plate. This model has two cork gaskets . . .

## 13 Oil pump - removal and refitting

### Removal

1 Remove the camshaft toothed belt and the sump, as described in earlier Sections of this Chapter.

2 Slacken and remove the crankshaft sprocket centre bolt (if not already done - see Section 7, paragraph 4) and remove the sprocket and spacers, noting their correct fitted locations. Extract the Woodruff key (where fitted) (see illustrations).

3 Undo the retaining bolts and remove the toothed belt cover backplate. On later models, in order to remove the backplate it will first be necessary to remove the remaining camshaft toothed belt sprockets to allow this.

4 Undo the two bolts securing the oil pick-up pipe to the oil pump housing and the bolt securing the support bracket to the centre main bearing cap (see illustration). Remove the pick-up pipe. On models with an oil cooler, slacken the union nuts and disconnect the pipes from the oil pump housing.

5 Undo the retaining bolts and withdraw the oil pump housing from the front of the engine.

### Refitting

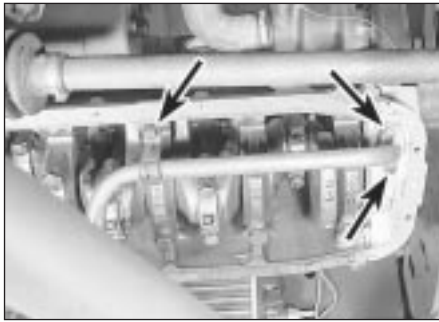
6 Refitting is the reverse of removal, noting the following points.

- a) Ensure that the pump housing mating faces are clean and place a new gasket which is smeared with jointing compound on both sides in position.



13.2b Woodruff key (arrowed) in crankshaft nose





13.4 Oil pick-up pipe retaining bolts (arrowed)

- b) Steps must be taken to protect the seal lips from damage or turning back on the shoulder at the front end of the crankshaft. To do this, grease the seal lips and then bind tape around the crankshaft to form a gentle taper (see illustration).
- c) Refit the sump and camshaft toothed belt and sprockets as described in earlier Sections of this Chapter.

## 14 Oil pump - overhaul

- 1 With the oil pump removed from the vehicle, withdraw the rear cover. The cross-head fixing screws are very tight and an impact driver will be required to remove them (see illustration).
- 2 Check the backlash between the inner and outer gear teeth (see illustration).



14.2 Checking oil pump gear teeth backlash



13.6 Tape the crankshaft nose

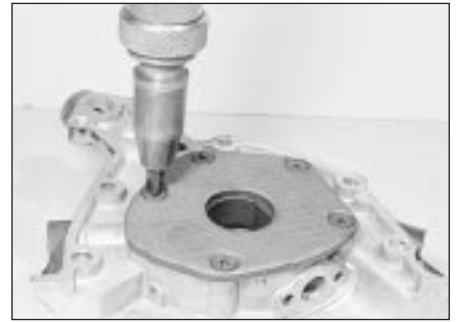
- 3 Check the endfloat between the gear outer faces and the housing (see illustration).
- 4 If any of the clearances are outside the specified tolerance, renew the components as necessary. Note that the outer gear face is marked for position (see illustration).
- 5 The pressure regulator valve can be unscrewed from the oil pump housing and the components cleaned and examined (see illustration).
- 6 Always renew the oil seal; a socket is useful to remove and install it (see illustration).

## 15 Pistons and connecting rods - removal and refitting

Proceed as described in Chapter 2A, noting also that the piston crowns are not marked to show their direction of fitting, but the underside of the piston is (see illustration).



14.3 Checking oil pump gear endfloat



14.1 Using an impact screwdriver to undo the oil pump rear cover screws

## 16 Flywheel - removal and refitting

Refer to Chapter 2A, noting that the flywheel securing bolts are hexagon-headed. On 1.6 (16SV and C16NZ), 1.8 (18SE) and all 2.0 litre engines note that it will be necessary to remove the transmission or engine in order to remove the flywheel. On all engines, on refitting, use thread locking compound on the flywheel bolts and tighten them to the specified torque.

## 17 Crankshaft front oil seal - removal and refitting

### Removal

- 1 Remove the camshaft toothed belt, as



14.4 Gear outer face identification mark (arrowed)



14.5 Oil pressure regulator valve components



14.6 Fitting a new front oil seal



15.1 Large land (arrowed) faces the flywheel end of the engine

described in Section 7. On 1.6 (16SH), 1.8 and 2.0 litre models, note that it will also be necessary to undo the crankshaft sprocket centre bolt (see Section 7, paragraph 4) and remove the sprocket and spacers, noting their correct fitted locations.

2 On later models, remove the remaining camshaft toothed belt sprockets then undo the retaining bolts and remove the toothed belt cover backplate.

3 Remove the crankshaft sprocket, using two screwdrivers to lever it off if it is tight. Remove the Woodruff key.

4 Punch or drill a small hole in the metal face of the oil seal, screw in a self-tapping screw and use this to lever out the seal. Several attempts may be necessary. Be careful not to damage the sealing face of the crankshaft.

### Refitting

5 Apply PVC tape to the step on the crankshaft nose to protect the seal lip as it is fitted.

6 Lubricate the lip of the seal and, using a suitable tube, tap the seal into its location. Remove the masking tape.

7 Refit the toothed belt cover backplate, sprockets and belt as described in the earlier Sections of this Chapter.

## 18 Engine/transmission mountings - removal and refitting

Refer to Chapter 2A, Section 17.

## 19 Crankshaft rear oil seal - removal and refitting

Remove the engine from the car, as described in Section 23 and renew the oil seal, as described in Chapter 2A, Section 19.

## 20 Crankshaft and main bearings - removal and refitting

### Removal

1 With the engine removed from the car, as described in Section 23, and all the



20.3 Identification number on No 3 main bearing cap

components removed from it, as described in earlier Sections, the crankshaft can be removed as follows.

2 Invert the engine so that it is standing on the top surface of the cylinder block.

3 The main bearing caps are numbered 1 to 4 from the toothed belt end of the engine. The rear cap is not marked. To ensure that the caps are fitted the correct way round, note that the numbers are read from the water pump side when the crankcase is inverted (see illustration).

4 Unscrew and remove the main bearing cap bolts and tap off the caps. If the bearing shells are to be used again, keep them with their respective caps. The original shells are colour-coded and if used again must be returned to their original locations.

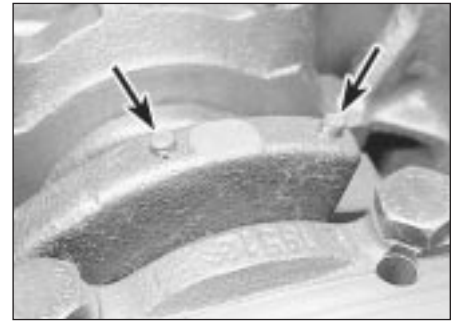
5 Note that the centre bearing shell incorporates thrust flanges to control crankshaft endfloat.

6 Lift the crankshaft from the crankcase. Extract the upper half shells and again identify their position in the crankcase if they are to be used again.

7 The rubber plug location adjacent to the bellhousing flange on the crankcase covers the aperture for installation of a TDC sensor. This sensor when connected to a suitable monitoring unit, indicates TDC from the position of the contact pins set in the crankshaft counterbalance weight (see illustration).

### Refitting

8 Ensure that the crankcase and crankshaft are thoroughly clean and that all oilways are



20.7 TDC sensor contact pins (arrowed) in crankshaft web

clear. If possible blow the drillings out with compressed air, and then inject clean engine oil through them to ensure that they are clear.

9 Wipe the shell seats in the crankcase and bearing caps clean and then fit the upper halves of the main bearing shells into their seats.

10 Note that there is a tag on the back of each bearing which engages with a groove in the shell seating in both crankcase and bearing cap (see illustration).

11 Wipe away all traces of protective grease on the new shells.

12 The central bearing shell also takes up the crankshaft endfloat (see illustration). Note that the half shells fitted to the cylinder block all have oil duct holes, while only the centre main bearing cap half shell has an oil duct hole.

13 When the shells are fully located in the crankcase and bearing caps, lubricate them with clean engine oil.

14 Fill the lips of a new crankshaft oil seal with grease and fit it to the end of the crankshaft (see illustration).

15 Carefully install the crankshaft into position in the crankcase (see illustration).

16 Lubricate the crankshaft main bearing journals and then refit the centre and intermediate main bearing caps. Tighten the retaining bolts to the specified torque wrench setting (see illustrations).

17 Coat the inner surfaces of the rear main bearing cap with sealant to GM spec 15 04 200/8 983 368. (This sealant is available in 200 ml tubes from GM parts departments.) Fill the side grooves of the bearing cap with RTV



20.10 Main bearing shell correctly fitted, with tag and groove (arrowed) engaged



20.12 Centre main bearing shell, showing thrust flanges



20.14 Crankshaft rear oil seal





20.15 Fitting the crankshaft



20.16a Fitting a main bearing cap



20.16b Tightening a main bearing cap bolt



20.17 Inject jointing compound into the cap side grooves



20.19 Checking crankshaft endfloat

jointing compound. After fitting the bearing cap and tightening its securing bolts, inject further RTV jointing compound into the side grooves until it is certain that they are full (see illustration).

**18** Fit the front main bearing cap, but before fitting the retaining bolts, smear them with jointing compound, and then tighten to the specified torque wrench setting. Check that the bearing cap is exactly flush with the end face of the crankcase as it is tightened.

**19** Now rotate the crankshaft and check that it turns freely, and shows no signs of binding or tight spots. Check that the crankshaft endfloat is within the limits specified, using a dial gauge or with feeler blades inserted between the flange of the centre bearing shell and the machined surface of the crankshaft (see illustration). Before measuring, make sure that the crankshaft has been forced fully towards one end of the crankcase to give the widest gap at the measuring location. Incorrect endfloat will most likely be due to wear or to incorrect regrinding (assuming that the correct shells have been fitted).

## 21 Engine components - examination and renovation

**1** Refer to Chapter 2A Section 21, noting the following additional information

### Camshaft

**2** With the camshaft removed, examine the bearings for signs of obvious wear and pitting. If evident, a new camshaft housing will

probably be required.

**3** The camshaft itself should show no marks or scoring on the journal or cam lobe surfaces. If evident, renew the camshaft. When renewing a camshaft, it should be noted that, in some instances, a camshaft with undersize bearing journals and appropriately-machined carrier journals may have been fitted by the manufacturer. Where applicable, such camshafts are colour-coded violet for identification, and this should be checked to ensure that the correct replacement is obtained.

**4** The retaining plate should appear unworn and without grooves. In any event, check the camshaft endfloat and fit a new plate where necessary.

**5** The housing front oil seal should always be renewed at major overhaul.

### Camshaft toothed belt

**6** Closely inspect the belt for cracking, fraying or tooth deformation. Where evident, renew the belt.

**7** If the belt has been in use for 30 000 miles or more, it is recommended that it is renewed even if it appears in good condition.

**8** Whenever the original belt is to be removed, but is going to be used again, always note its running direction before removing it. It is even worthwhile marking the tooth engagement points on each sprocket. As the belt will have worn in a set position, refitting it in exactly the same way will prevent any increase in noise which might otherwise occur when the engine is running.

### Valve lifters, rockers and thrust pads

**9** Any signs of wear in a hydraulic lifter can only be rectified by renewal, the unit cannot be dismantled.

**10** Inspect the rockers and thrust pads for wear or grooving. Again, renew if evident.

### Piston/bore grade marks

**11** The number or code denoting the piston and bore grade (see Specifications) will be found on the sump sealing surface of the smaller engines, and near the engine number on the larger engines.

## 22 Engine lubrication and crankcase ventilation systems - general description

**1** Oil pressure for all moving components is provided by a gear type oil pump which is driven from the front end of the crankshaft. The crankshaft has flats for this purpose.

**2** The pump draws oil from the sump through a pick-up pipe and strainer and pumps it through the oil filter and oil galleries to the engine friction surfaces.

**3** A pressure regulator valve is screwed into the body of the oil pump. A relief valve, located in the oil filter mounting base, opens should the filter block due to clogging caused by neglected servicing. An oil pressure switch is screwed into the pump casing.

**4** The cylinder bores are lubricated by oil splash from the sump.

**5** The hydraulic valve lifters are pressurised with oil to maintain optimum valve clearance at all times.

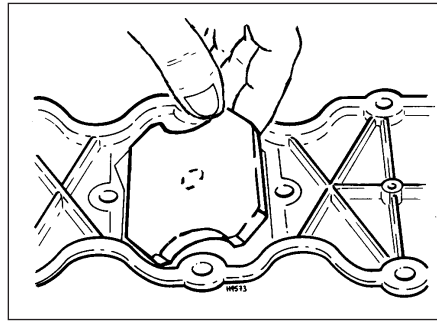
**6** The crankcase ventilation system is designed to draw oil fumes and blow-by gas (combustion gas which has passed the piston rings) from the crankcase into the air cleaner, whence they are drawn into the engine and burnt during the normal combustion cycle.

**7** On larger engines, one of the crankcase ventilation hoses is attached to the camshaft cover. Inside the cover is a filter which should be cleaned in paraffin periodically (see illustrations).

**8** On smaller engines, the ventilation system incorporates an oil separator bolted to the



22.7a Crankcase ventilation hose attached to camshaft cover (1.8 litre engine shown)



22.7b Camshaft housing filter



22.8 Crankcase ventilation system oil separator - 1.3 litre engine

block. Although it is not a specified maintenance task, the separator can be removed for cleaning (see illustration).

9 On all engines, the breather hoses should be cleaned out periodically and renewed if necessary. Investigate the cause of any build-up of white sludge - sometimes this indicates a cooling system fault or a blown head gasket, although it may simply mean that the engine is not reaching operating temperature (eg short runs in winter).

10 The lubrication system of some larger engines incorporates an oil cooler. Oil leaves and returns via an adapter mounted between the oil filter and its housing (see illustrations). The adapter contains a thermostatic valve which prevents the oil from circulating in the cooling circuit until it has warmed up. The oil cooler itself is mounted in front of the radiator.

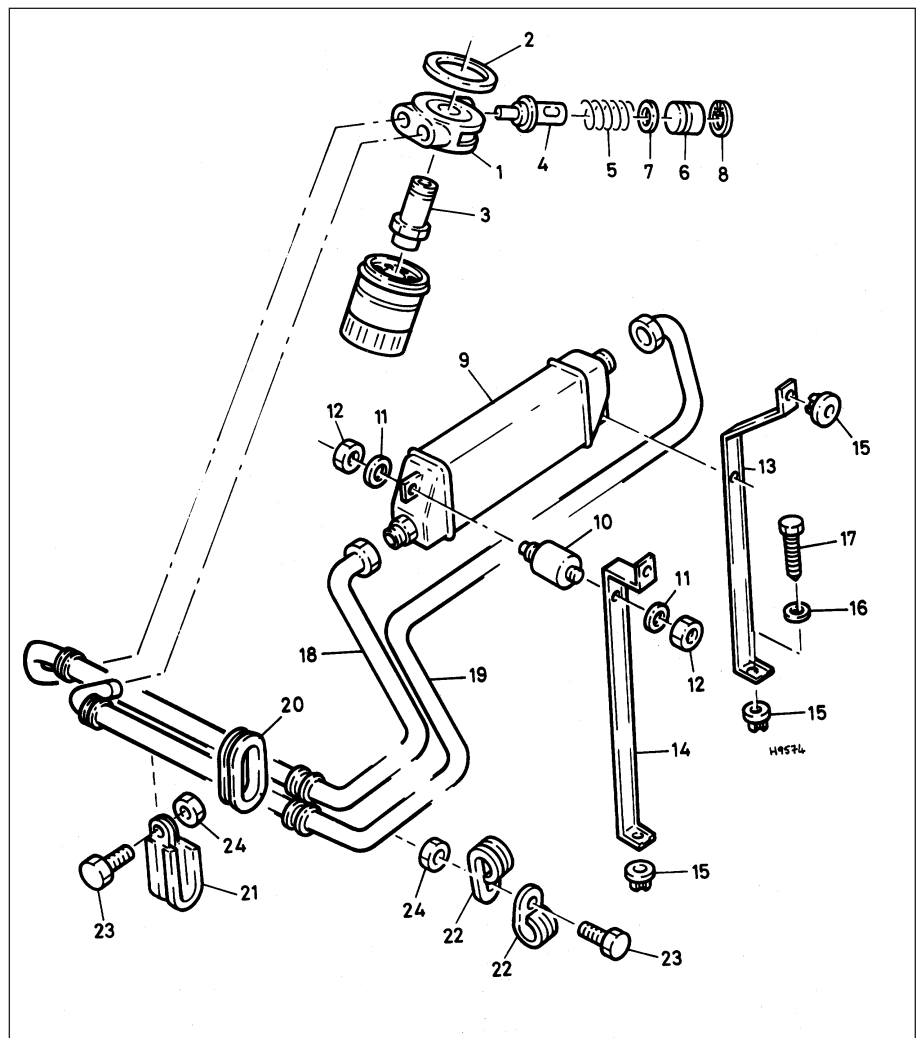
11 The oil cooler pipes and hoses should be inspected regularly for signs of deterioration or leakage. The oil cooler fins will benefit from an occasional cleaning with solvent, followed if possible by blowing through the fins with compressed air.

12 At time of engine overhaul, consideration should be given to renewing the oil cooler, especially if major mechanical failure has occurred. If the old cooler is to be re-used it should be flushed with several changes of clean oil in an attempt to remove metal particles and other contaminants.

13 Access to the oil cooler is gained by removing the radiator (Chapter 3) or the front trim panel (Chapter 11).



22.10a Oil cooler adapter (arrowed) above oil filter



22.10b Oil cooler and associated components

- |                      |                    |                |
|----------------------|--------------------|----------------|
| 1 Adapter            | 9 Oil cooler       | 17 Screw       |
| 2 Sealing ring       | 10 Mounting rubber | 18 Flow pipe   |
| 3 Hollow screw       | 11 Washer          | 19 Return pipe |
| 4 Thermostatic valve | 12 Nut             | 20 Grommet     |
| 5 Spring             | 13 Bracket         | 21 Clamp       |
| 6 Plug               | 14 Bracket         | 22 Clamps      |
| 7 Seal               | 15 Nuts            | 23 Screws      |
| 8 Circlip            | 16 Washer          | 24 Nuts        |

## 23 Engine - removal and refitting



### Removal

1 The OHC engines may be removed either with or without the manual gearbox. To remove the engine alone, proceed as described in Chapter 2A, Section 23, making allowances for differences in the attachment of components such as the carburettor or fuel injection items.

2 Removal of the engine and automatic transmission together may be possible, but it is not recommended because of the weight and unwieldiness of the combined units.

3 To remove the engine and manual gearbox together, first disconnect both battery terminals. Remove the bonnet (Chapter 11).

4 Remove the air cleaner, as described in Chapter 4.

5 Drain the cooling system as described in Chapter 1. Disconnect all coolant hoses from the engine, not forgetting the heater hoses and (if fitted) the inlet manifold/carburettor heating hoses.

6 Disconnect the throttle cable and (if fitted) the choke cable, as described in Chapter 4.

7 Disconnect the brake servo vacuum hose. Either remove the hose completely, or secure it so that it will not be damaged.

8 Disconnect and plug the fuel feed and return lines. Be prepared for some fuel spillage.

9 Disconnect the engine wiring harness plug. On models so equipped, disconnect the dipstick sensor wiring also (see illustrations).

10 Disconnect the HT lead, LT leads and multi-plug from the ignition coil and module.

11 Disconnect the gearchange remote control rod at the pinch-bolt.

12 Disconnect the speedometer cable at the gearbox end.

13 Disconnect the clutch cable, as described in Chapter 6.



23.9a Engine wiring harness plug



23.9b Dipstick sensor plug

14 Slacken the front wheel bolts, raise and securely support the front of the car and remove the front wheels.

15 Unbolt and remove the exhaust downpipe(s). Also disconnect the earth strap from the gearbox.

16 Where applicable, disconnect the oil cooler hoses from the oil filter housing. Be prepared for some oil spillage and plug the hoses.

17 Separate the control arm balljoints from the steering knuckles. See Chapter 10 for details.

18 Separate the driveshafts from the final drive housing, as described in Chapter 8. Be prepared for some oil spillage; plug the driveshaft holes and tie the shafts up out of the way.

19 Attach the lifting tackle to the engine and gearbox and take the weight of the assembly.

20 Unbolt the engine/transmission mountings from the body members (see illustrations).

21 Carefully lower the assembly through the engine bay to the ground. Depending on the type and reach of the vehicle lifting gear, it may be necessary to lift the vehicle off the engine to enable it to be withdrawn.

22 To separate the engine and gearbox, support the latter and unbolt the starter motor and flywheel bottom cover. Remove the

remaining engine-to-bellhousing bolts and carefully withdraw the gearbox from the engine. Do not allow the weight of the gearbox to hang on the clutch input shaft.

### Refitting

23 When refitting, tighten the engine/transmission mounting bolts finger tight at first, then to the specified torque, in the following order:

- a) *RH front mounting.*
- b) *LH front mounting.*
- c) *Rear mounting.*

24 The remainder of the refitting process follows the reverse order to removal. Refer to the appropriate Chapters for guidance if necessary. Remember to replenish the gearbox oil after refitting.

## 24 Engine - initial start-up after overhaul

Refer to Chapter 2A, Section 24. There is no need to adjust the valve clearances, but remember to tighten the head bolts (Section 8) if the head has been disturbed. Expect some initial noise from the hydraulic valve lifters, until they are properly pressurised with oil.



23.20a Engine/transmission left-hand mounting



23.20b Engine/transmission right-hand mounting