






Chapter 2 Part C:

DOHC (16-valve) engine

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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 |  |
|--|---|---|---|---|---|--|---|---|---|

2C

Specifications

General

| | |
|----------------------------------|--|
| Type | Four-cylinder, in-line, water-cooled, double overhead camshaft, transversely mounted |
| Engine code* | 20XE, C20XE* or 20XEJ |
| Bore | 86.0 mm |
| Stroke | 86.0 mm |
| Capacity | 1998 cc |
| Firing order | 1-3-4-2 (No 1 cylinder at crankshaft pulley end) |
| Direction of crankshaft rotation | Clockwise |
| Compression ratio | 10.5: 1 |

Note: The engine code forms the first digits of the engine number

Cylinder block

| | | |
|-------------------------------|-----------------|----------------|
| Cylinder bore diameter: | Diameter | Marking |
| Standard size 1 | 85.98 mm | 8 |
| | 85.99 mm | 99 |
| | 86.00 mm | 00 |
| | 86.01 mm | 01 |
| | 86.02 mm | 02 |
| Standard size 2 | 86.47 mm | 7 + 0.5 |
| Oversize (0.5 mm) | 86.48 mm | 8 + 0.5 |
| | 86.49 mm | 9 + 0.5 |
| | 86.50 mm | 0 + 0.5 |
| Maximum cylinder bore ovality | 0.013 mm | |
| Maximum cylinder bore taper | 0.013 mm | |

2C•2 DOHC (16-valve) engine

Crankshaft

| | |
|---|---------------------|
| Number of main bearings | 5 |
| Main bearing journal diameter | 57.982 to 57.995 mm |
| Crankpin diameter | 48.971 to 48.987 mm |
| Undersizes | 0.25 and 0.50 mm |
| Crankshaft endfloat | 0.07 to 0.3 mm |
| Main bearing running clearance | 0.015 to 0.04 mm |
| Big-end running clearance | 0.019 to 0.063 mm |
| Big-end side-play | 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 |

Pistons and piston rings

| | |
|--------------------------|---------------------------------|
| Piston diameter | 0.03 mm less than bore diameter |
| Piston-to-bore clearance | 0.02 to 0.04 mm |

Gudgeon pins

| | |
|-----------------------------|-------------------|
| Length | 61.5 mm |
| Diameter | 21 mm |
| Clearance in piston | 0.003 to 0.010 mm |
| Clearance in connecting rod | 0.015 to 0.030 mm |

Cylinder head

| | |
|---|---------------------|
| Minimum acceptable height after machining | 135.63 mm |
| Maximum acceptable gasket face distortion | 0.025 mm |
| Camshaft bearing bore diameter | 28.000 to 28.021 mm |
| Valve seat width: | |
| Inlet | 1.0 to 1.4 mm |
| Exhaust | 1.4 to 1.8 mm |

Camshafts

| | |
|-----------------------------------|---------------------|
| Drive | Toothed belt |
| Number of bearings: | |
| Inlet | 5 |
| Exhaust | 6 |
| Bearing journal diameter | 27.939 to 27.960 mm |
| Bearing journal running clearance | 0.061 mm |
| Camshaft endfloat | 0.04 to 0.144 mm |
| Cam lift | 9.5 mm |

Valves

| | |
|---------------------------|--|
| Operation | Bucket tappet incorporating hydraulic adjuster |
| Seat angle | 44° 40' |
| Length: | |
| Production | 105 mm |
| Service | 104.6 mm |
| Head diameter: | |
| Inlet | 33 mm |
| Exhaust | 29 mm |
| Stem diameter (standard): | |
| Inlet | 6.955 to 6.970 mm |
| Exhaust | 6.945 to 6.960 mm |
| Stem diameter (oversize) | 0.075 and 0.150 mm |
| Stem-to-guide clearance: | |
| Inlet | 0.045 mm |
| Exhaust | 0.055 mm |
| Valve clearance | Automatic adjustment by hydraulic adjusters |

Valves (continued)

| | |
|--------------------------------|--------------------|
| Valve guide internal diameter: | |
| Standard | 7.000 to 7.015 mm |
| Oversizes | 0.075 and 0.150 mm |
| Valve guide installed height | 10.70 to 11.00 mm |

Torque wrench settings

| | Nm | lbf ft |
|--|------------------------------------|--------|
| Starter motor-to-block bolts | 45 | 33 |
| Starter motor bracket-to-block bolts | 25 | 18 |
| Manifold nuts | 20 | 15 |
| Alternator mounting-to-block bolts | 40 | 30 |
| Steering pump mounting-to-block bolts | 40 | 30 |
| Crankshaft pulley-to-sprocket screws with splined heads | 20 | 15 |
| Crankshaft sprocket central bolt (greased threads): | | |
| Stage 1 | 250 | 184 |
| Stage 2 | Angle-tighten a further 40° to 50° | |
| Main bearing caps: | | |
| Stage 1 | 50 | 37 |
| Stage 2 | Angle-tighten a further 40° to 50° | |
| Big-end bearing caps: | | |
| Stage 1 | 35 | 26 |
| Stage 2 | Angle-tighten a further 45° to 60° | |
| Engine mountings (use thread-locking compound) | 75 | 55 |
| Camshaft bearing caps: | | |
| M8 nuts | 20 | 15 |
| M6 nuts | 10 | 7 |
| Oil drain plug | 45 | 33 |
| Oil pump housing-to-block bolts | 6 | 4 |
| Sump bolts (use thread-locking compound) | 15 | 11 |
| Flywheel bolts (use thread-locking compound): | | |
| Stage 1 | 65 | 48 |
| Stage 2 | Angle-tighten a further 30° to 45° | |
| Water pump-to-block bolts | 25 | |
| Camshaft sprocket bolts: | | |
| Stage 1 | 50 | 37 |
| Stage 2 | Angle-tighten a further 40° to 50° | |
| Camshaft drivebelt tensioner and idler rollers-to-block bolts: | | |
| Stage 1 | 25 | |
| Stage 2 | Angle-tighten a further 45° to 60° | |
| Camshaft cover screws | 8 | 6 |
| Cylinder head bolts: | | |
| Stage 1 | 25 | 18 |
| Stage 2 | Angle-tighten a further 65° | |
| Stage 3 | Angle-tighten a further 65° | |
| Stage 4 | Angle-tighten a further 65° | |
| Warm the engine up to normal operating temperature then | Angle tighten a further 30° to 45° | |

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

1 General description

The 2.0 litre 16-valve engine differs from the other 2 litre engines fitted to the range in the areas of the cylinder head, camshaft drive and associated components. The block, crankshaft and pistons are essentially unchanged, except for the use of fully floating gudgeon pins secured by circlips.

The cylinder head carries two camshafts, both driven by the same toothed belt. The front camshaft operates the exhaust valves, the rear camshaft the inlet valves. The cam lobes bear directly onto bucket tappets which incorporate hydraulic adjuster mechanisms. The front camshaft also drives the distributor.

There are four valves per cylinder, two inlet and two exhaust. The exhaust valves are sodium-filled; at operating temperature the

sodium melts and improves the conduction of heat away from the valve head. The combustion chambers are of pent roof pattern, with the spark plugs centrally placed between the valve rows.

The camshaft toothed belt also drives the water pump, as in the other engines, but a separate roller is used to adjust belt tension. An idler roller is used to complete the belt run.

The engine is pleasing in appearance and obviously well-engineered. Extensive use has been made of aluminium castings, not only for components such as the sump and camshaft toothed belt cover but even for the flywheel cover and spark plug lead cover.

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.

4 Engine dismantling and reassembly - general

Refer to Chapter 2A, Section 5.

5 Ancillary components - removal and refitting

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

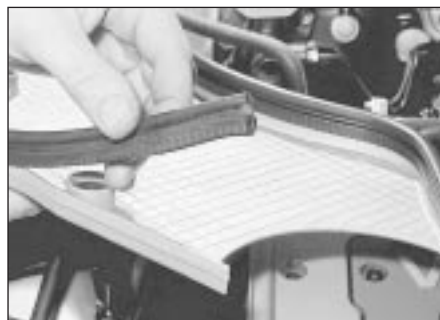




7.6a Removing a belt cover bolt . . .



7.6b . . . and the rubber bush



7.6c The belt cover seal

6 Oil pressure regulating valve - removal and refitting

Refer to Chapter 2B, Section 6.

7 Camshaft toothed belt - removal and refitting

Note: The camshaft toothed belt must be renewed every time it is removed, even if it is apparently in good condition.

Removal

- 1 Raise and support the front of the vehicle (see "Jacking and Vehicle Support"). Remove the engine undertray and the wheel arch splash shields as a unit.
- 2 Disconnect the battery negative lead.
- 3 Unclip the throttle cable from the air

cleaner-to-air mass meter trunking. Slacken the clips and remove the trunking.

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

5 Remove the steering pump drivebelt (when applicable) and the alternator drivebelt.

6 Remove the three bolts and rubber bushes which secure the camshaft toothed belt cover. Remove the cover and its seal (see illustrations).

7 Working through the wheel arch, slacken the six screws with splined heads which secure the crankshaft pulley to the sprocket. For better access, unbolt the oil cooler hose clip from the inner wing.

8 Turn the crankshaft until the timing mark on the pulley is in line with the pointer and the timing marks on the camshaft sprockets are in line with the notches on the backplate (see illustrations). (To turn the crankshaft by means of the central bolt, a Torx socket, size

E20, will be needed. If this is not available, engage 4th or 5th gear and turn the crankshaft by turning a front wheel. It is easier to do this smoothly if the spark plugs are removed).

9 Remove the six screws with splined heads and lift off the crankshaft pulley. The screw holes are offset so it will only fit one way.

10 Slacken the camshaft belt tensioner screw using a 6 mm Allen key (see illustration). Move the tensioner to slacken the belt and slip the belt off the sprockets and rollers.

11 Do not turn the crankshaft or camshafts while the belt is removed, or piston/valve contact may occur.

Refitting

12 Commence refitting by checking that the pulley and sprocket timing marks are still correctly aligned. Temporarily refit the pulley and secure it with two screws to do this. When satisfied, remove the pulley.

13 Fit the new belt over the sprockets and rollers, being careful not to kink it. Observe any arrows or other indication of running direction.

14 Refit the crankshaft pulley. Secure it with the six screws with splined heads, tightened to the specified torque (see illustration).

15 The belt tension must now be set. The makers specify the use of a special tool (KM-666); if this is available, proceed as follows (see illustration).

16 Fit the special tool to the tensioner. Make sure the tensioner is free to move.

17 Make a mark on the exhaust camshaft sprocket, seven teeth anti-clockwise from the timing mark. Turn the crankshaft clockwise



7.8a Pulley notch and pointer must be aligned . . .



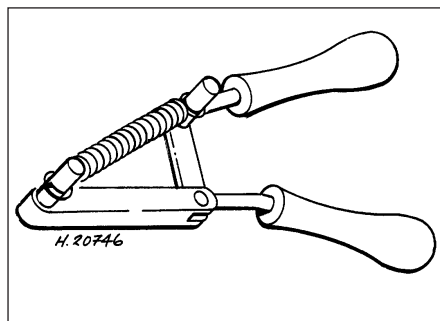
7.8b . . . and sprocket marks align with backplate notches (arrowed)



7.10 Slackening the camshaft belt tensioner screw



7.14 Tightening one of the crankshaft pulley screws



7.15 Special tool KM-666 for tensioning the camshaft toothed belt



7.18 Checking the belt tension using a spring balance and ruler

until the new mark is aligned with the notch on the belt backplate. In this position tighten the tensioner screw to the specified torque, then remove the special tool.

18 If the special tool is not available, belt tension must be set by hand. Move the tensioner using a square drive in the hole provided, nip up the screw and check the tension. As a guide, tension is correct when the belt cannot quite be twisted through 90° by hand in the middle of the run between the exhaust camshaft sprocket and the idler roller. If a spring balance is available, correct tension is indicated when in the same place the belt is deflected 10 mm by a load of 9 kg (see illustration). When tension is correct, tighten the tensioner screw to the specified torque.

19 It must be emphasised that the method of setting belt tension without the special tool is given as a guide only. The consequences of a belt slipping or breaking in service could be



10.3a Removing a camshaft sprocket bolt and washer



10.3b Removing a camshaft sprocket

serious. The only way to be certain that tension is correct is to use the maker's tool, or to have a Vauxhall garage carry out the work.

20 Whichever tensioning method was used, now turn the crankshaft through two full turns clockwise and check that the pulley and sprocket timing marks come back into correct alignment. If they do not, remove the belt and start again.

21 The remainder of refitting is the reverse of the removal procedure.

8 Camshaft toothed belt tensioner and idler rollers - removal and refitting



Removal

1 Remove the toothed belt as described in Section 7.

2 Remove the Allen screw which secures the belt tensioner. Lift off the tensioner and its mounting plate and recover the spacer sleeve.

3 Similarly unbolt and remove the idler roller and recover its sleeve.

4 Renew the rollers if they show roughness when spun, or if they have been noisy in operation.

Refitting

5 Refitting is the reverse of the removal procedure, noting the following points:

- Make sure the spacer sleeves are the right way round. The smaller diameter of the tensioner sleeve goes towards the block. The smaller diameter of the idler sleeve goes away from the block.*
- Tighten the screws to the specified torque.*
- Fit a new camshaft toothed belt.*

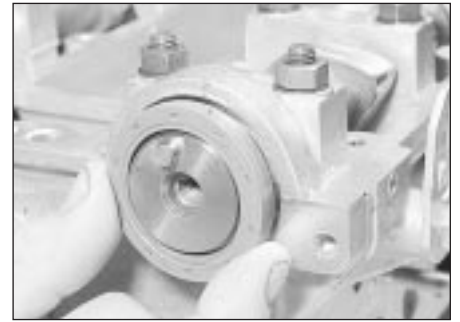
9 Camshaft sprocket oil seals - renewal



1 Remove the camshaft toothed belt as described in Section 7.

2 Remove the camshaft cover and the camshaft sprockets, as described in paragraphs 1 to 4 of Section 10.

3 Punch or drill a small hole in the face of one of the oil seals. Screw in a self-tapping screw



9.4a Fitting a new camshaft oil seal



9.4b Seating a camshaft oil seal

and use this to lever the seal out. Clean the seal seat.

4 Grease the lips of a new seal and fit it, lips inwards. Seat the seal by tapping it home using a mallet and a large socket or a piece of tube (see illustrations).

5 Repeat the operations on the other oil seal.

6 The remainder of refitting is the reverse of the removal procedure. Fit a new camshaft toothed belt as described in Section 7.

10 Camshafts - removal and refitting



Removal

1 Remove the camshaft toothed belt as described in Section 7.

2 Remove the spark plug cover, which is retained by two Allen screws. Disconnect the breather hoses from the camshaft cover, remove the 20 Allen screws and the camshaft cover itself.

3 Hold a camshaft using an open-ended spanner on the flats provided towards the sprocket end. Without allowing the camshaft to move (risk of piston-to-valve contact) slacken the sprocket bolt. Remove the bolt, washer and sprocket (see illustrations).

4 Repeat the operation on the other camshaft. Although both sprockets appear to be identical, it is good practice not to get them mixed up. The exhaust sprocket on the engine shown here is marked 'L'; the inlet sprocket is unmarked (see illustration).

5 Remove the distributor (Chapter 5C).



10.4 Exhaust camshaft sprocket is marked 'L'



10.6 Matching numbers on bearing cap and cylinder head

6 Check that the camshaft bearing caps carry identification numbers, and note which way round they are fitted. The inlet camshaft caps are numbered 1 to 5, the exhaust camshaft caps 6 to 10. Corresponding numbers are cast in the cylinder head (see illustration).

7 Progressively slacken the bearing cap nuts, half a turn at a time until the valve spring pressure has been released. Do not overlook the two extra nuts on the cap which forms part of the distributor housing (see illustration). Remove the nuts and washers and lift off the caps. Be careful that a camshaft does not spring up suddenly when removing the caps.

8 Remove the camshafts with their oil seals. Be careful when handling them, as the edges of the lobes are sharp. Remove the oil seals.

Refitting

9 Commence refitting by generously oiling the camshaft bearing surfaces and lobes. If fitting new camshafts, apply the special assembly lubricant provided.

10 Apply sealant to the mating faces of the bearing caps which house the oil seals (Nos 1 and 6) and to the one which houses the distributor drive (No 11).

11 Place the camshafts in position with the sprocket locating pins uppermost. Fit the bearing caps, in their correct positions and the right way round, and the nuts and washers (see illustration).

12 Tighten the bearing cap nuts half a turn at a time in progressive sequence so the camshafts are pulled down evenly. Finally tighten them to the specified torque (see illustration).

13 Fit new oil seals as described in Section 9.

14 Refit the sprockets to their respective camshafts. Fit the sprocket bolts and tighten them to the specified torque, holding the camshafts with a spanner on the flats to prevent rotation (see illustration).

15 Using a strap wrench on the sprocket or a spanner on the sprocket bolt, carefully move each camshaft a little way to verify that it is free to turn. If the cylinder head is installed on the engine, be careful that piston-to-valve contact does not occur. If a camshaft will not turn, it may be that the bearing caps have been fitted the wrong way round.

16 Refit the distributor and the camshaft cover.



10.7 Distributor housing bearing cap has two extra nuts



10.12 Tightening a camshaft bearing cap nut

17 Fit a new camshaft toothed belt as described in Section 7.

18 If new camshafts have been fitted, it is suggested that the running-in schedule specified in Chapter 2B, Section 9, paragraph 14, be observed.

11 Cylinder head - removal and refitting

Note: The procedure described here is the removal of the cylinder head leaving the inlet manifold and fuel injection equipment in place. If preferred, the manifold can be removed with the head after making the appropriate disconnections.

Removal

1 Remove the camshaft toothed belt as described in Section 7.



11.7 Disconnecting the small breather hoses from the camshaft cover



10.11 Fitting a camshaft bearing cap



10.14 Tightening a camshaft sprocket bolt

2 Disconnect the multi-plug from the air mass meter. Undo the four or five Allen screws, release the idle speed adjuster hose and remove the volume chamber and air mass meter together.

3 Drain the cooling system by disconnecting the radiator bottom hose (see Chapter 1).

4 Disconnect the accelerator cable.

5 Remove the nine nuts which secure the inlet manifold. They have deformed threads so they are stiff. A socket with a universal joint or 'wobble drive' will be needed to reach some of the nuts.

6 Cut the cable-tie which secures the injector wiring harness to the cylinder head.

7 Disconnect the two small breather hoses from the camshaft cover (see illustration).

8 Unbolt the support bracket from the base of the inlet manifold (see illustration). Slide the manifold off the cylinder head studs. Be careful not to strain the fuel hoses or the wiring.



11.8 Unbolting the inlet manifold support bracket (seen from below)



11.11 Disconnecting the heater hose from the cylinder head



11.15 Disconnecting the large breather hose



11.16 Removing a camshaft cover screw

- 9 Remove the exhaust manifold (Chapter 4B).
- 10 Remove the radiator top hose.
- 11 Disconnect the heater hose from below the distributor (*see illustration*).
- 12 Remove the spark plug lead cover secured by two Allen screws. Disconnect the HT leads from the plugs and move them aside.
- 13 Remove the distributor (Chapter 5C).
- 14 Remove the thermostat housing (Chapter 3).
- 15 Disconnect the large breather hose from the camshaft cover (*see illustration*). Unbolt the hose bracket from the cylinder head.
- 16 Remove the 20 Allen screws which secure the camshaft cover (*see illustration*). Remove the cover.
- 17 Remove the camshaft sprockets (Section 10).
- 18 Remove the two Torx screws which

secure the top of the belt backplate to the cylinder head. Also remove the rubber bush and unscrew the belt cover mounting stud (*see illustrations*).

19 Using a size E12 Torx socket, slacken the cylinder head bolts a quarter-turn each in the sequence shown. In the same sequence slacken the bolts a further half-turn, then undo them completely and remove them (*see illustrations*). Recover the washers. New bolts must be used when refitting.

20 Lift off the cylinder head, pulling the inlet manifold back towards the bulkhead slightly if necessary (*see illustration*). Be careful not to bend the belt backplate. Put the head down on two blocks of wood so that it does not rest on the protruding valves.

21 Recover the gasket from the cylinder block and clean the mating surface, being

careful not to get any debris into the cylinder bores. Cover the open bores, or stuff oily rags into them, to protect them if the head is going to be off for more than a few hours.

Refitting

22 Commence refitting by placing a new head gasket onto the block, making sure that it fits over the locating dowels and that it is the right way up (*see illustration*). It is marked 'OBEN/TOP'.

23 Lower the head onto the block and fit it onto the dowels. Fit the washers to the new bolts, fit the bolts and tighten them finger tight.

24 Following the sequence shown, tighten the bolts through the first four stages given in the Specifications (*see illustrations*).



11.18a Remove the rubber bush . . .



11.18b . . . and the belt cover mounting stud

| | | | | | |
|-----------------------|---------|---|----|---|---|
| TIMING GEAR END | 1 | 5 | 9 | 8 | 4 |
| | 2 | 6 | 10 | 7 | 3 |
| | 1/20747 | | | | |

11.19a Cylinder head bolt slackening sequence



11.19b Removing a cylinder head bolt and washer



11.20 Lifting off the cylinder head



11.22 New head gasket in position

| | | | | | |
|-----------------------|---------|---|---|---|---|
| TIMING GEAR END | 10 | 6 | 2 | 3 | 7 |
| | 9 | 5 | 1 | 4 | 8 |
| | H.20748 | | | | |

11.24a Cylinder head bolt tightening sequence

25 The remainder of refitting is a reversal of the removal procedure, noting the following points:

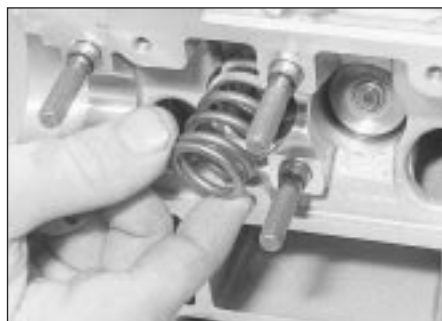
- Use new gaskets on the thermostat housing, the manifolds and the camshaft cover (see illustration).



12.4 Removing a tappet. Note the oil ring (arrowed)



12.5 Detail of valve spring compressor head and tube



12.6c ... the valve spring ...



11.24b Angle tightening a cylinder head bolt

- Use a new camshaft toothed belt and tension it as described in Section 7.
- Tighten all fastenings to the specified torque.
- Run the engine until the cooling fan cuts in. If the hydraulic tappets have been disturbed, they may be noisy for a few minutes until they settle down. Switch the engine off, remove the camshaft cover again and tighten the cylinder head bolts through the final specified stage.

12 Cylinder head - overhaul

- Remove the manifold gaskets
- Remove the camshafts, slackening the bearing cap nuts progressively until the valve spring pressure is released.
- Remove the spark plugs.



12.6a Remove the valve ...



11.25 Fitting a new gasket to the camshaft cover

4 Using a sucker or a magnet, remove the hydraulic tappet buckets from their bores (see illustration). If they are to be re-used, keep them in order so that they can be refitted to their original locations. To stop the oil draining out of them, store them in a bath of clean engine oil with the oil ring lowermost.

5 Prepare a box with 16 compartments to receive the valve components. Using a valve spring compressor and a piece of tube with two slots cut in it, compress a valve spring (see illustration). Extract the collets from the top of the valve stem using a pencil magnet or a magnetic screwdriver.

6 Carefully release the compressor and remove the valve, the spring upper seat and the spring. Pull off the valve stem oil seal with longnosed pliers and recover the valve spring seat. Place all the components in the appropriate compartment in the box (see illustrations).



12.6b ... the spring upper seat ...



12.6d ... the valve stem oil seal (arrowed) ...



12.6e ... and the valve spring seat



12.12a Fit a valve stem oil seal into a socket or tube . . .



12.12b . . . and press it home



12.13 Fitting a valve collet

7 Repeat the operations on the other 15 valves.

8 Clean the combustion chambers and the gasket mating faces with a wooden or plastic scraper. Finish up with a rag or toothbrush and a solvent such as a proprietary carburettor cleaner.

9 Inspect the valves, springs and seats as described in Chapter 2A, Section 9, paragraphs 7 to 11. Note however that the exhaust valves on these engines are filled with sodium to improve heat transfer. Sodium is a highly reactive metal which will ignite or explode spontaneously on contact with air or water. Valves containing sodium must not be disposed of in ordinary scrap.

10 Check the head gasket mating face for distortion using a straightedge and feeler blades. Check crosswise, lengthwise and diagonally. Warp limits are given in the Specifications.

11 Inspect the camshafts and their bearing surfaces and caps as described in Section 24.

12 Commence reassembly by fitting a valve spring seat to its location. Fit a new valve stem oil seal to the top of the valve guide, using a deep socket or a piece of tube (see illustrations).

13 Oil the valve stem and insert the valve into its guide, passing it gently through the stem oil seal to avoid damage. Fit the valve spring and upper seat. Compress the spring and fit the collets using a magnetic screwdriver this is a fiddly business. A dab of grease on each collet will keep them in position on the valve stem (see illustration).

14 Carefully release the valve spring

compressor. Apply a solid tube or piece of wood (eg a hammer handle) to the top of the valve and tap smartly with a hammer to settle the components.

15 Repeat the operations on the other valves.

16 Refit the tappets, with the oil ring lowermost, oiling them generously (see illustrations). If new camshafts are to be fitted, apply some of the assembly lubricant supplied with new camshafts to the top surfaces of the tappets.

17 Fit the camshafts and their oil seals as described in Section 10.

18 The distributor and spark plugs may be refitted now, or if preferred left until after the head has been refitted.

13 Sump and oil baffle plate - removal and refitting

Removal

1 Raise and support the front of the vehicle (see "Jacking and Vehicle Support"). Disconnect the battery earth (negative) lead.

2 Drain the engine oil.

3 Remove the exhaust manifold (Chapter 4).

4 Disconnect the multi-plug from the engine oil level sensor.

5 Remove the flywheel cover plate.

6 Remove the sump retaining bolts. Remove the sump, tapping it with a hide or plastic mallet if necessary to break the joint.

7 Remove the oil pick-up pipe and its bracket, followed by the baffle plate.

8 Remove the old gaskets and clean the mating surfaces.

Refitting

9 Commence refitting by applying sealant to the oil pump housing joint and the rear main bearing cap joint.

10 Apply sealant to a new gasket and fit the gasket to the block. Make sure that the locating dowels are in position.

11 Fit the baffle plate to the block. Refit the oil pick-up pipe and bracket, using a new O-ring between the pipe and the pump and applying sealant to the bolt threads.

12 Fit another new gasket, this time without sealant, between the baffle plate and the sump. Fit the sump, apply sealant to the bolt threads and insert and tighten the bolts.

13 The remainder of refitting is the reverse of the removal procedure. Remember to refit and tighten the drain plug and to refill the engine with oil on completion.

14 Oil pump - removal and refitting

Removal

1 Remove the camshaft toothed belt as described in Section 7.

2 Disconnect the oil cooler lines from the filter housing and move them aside. Be prepared for oil spillage.

3 Remove the camshaft cover and both camshaft sprockets (see Section 10).

4 Remove the belt tensioner and idler rollers.

5 Remove the crankshaft sprocket central bolt, using an E20 Torx socket. The bolt is very tight prevent the crankshaft turning by engaging a gear, chocking the wheels and applying the handbrake, or remove the flywheel cover plate and have an assistant jam the ring gear teeth.

6 Remove the crankshaft sprocket, using a puller if necessary. Note how the tang on the sprocket engages with the keyway in the crankshaft. Recover the spacer from behind the sprocket. Remove the timing belt backplate.

7 Remove the sump, oil pick-up pipe and baffle plate as described in Section 13.

8 Unbolt the oil pump from the block and remove it. Clean the pump and block mating faces.



12.16a Oiling a tappet . . .



12.16b . . . and fitting it to its bore

Refitting

9 Commence refitting by smearing a new gasket with grease and placing it on the pump. Grease the lips of the oil seal and refit the pump, being careful not to damage the oil seal as it passes over the crankshaft.

10 Insert the pump securing bolts. Position the bottom of the pump flush with the sump mating face of the block and tighten the bolts to the specified torque.

11 Thinly coat the outer face of the spacer with sealant to GM spec 15 04 200/8 983 368 (see Chapter 2B, Section 20, paragraph 17). Push the spacer onto the crankshaft.

12 The remainder of refitting is the reverse of the removal procedure. Remember to fit a new camshaft toothed belt.

15 Oil pump - overhaul

Refer to Chapter 2B, Section 14.

16 Oil cooler thermostatic valve - removal and refitting

Removal

1 The thermostatic valve is mounted in the oil cooler adapter, just above the oil filter.

2 Place a drain tray under the filter housing. Remove the circlip from the end of the valve (see illustration).

3 Recover the plug, spring and thermostatic element. There will be some oil spillage.

4 Clean and examine the components: renew any which are obviously worn or damaged.

Refitting

5 Refitting is the reverse of the removal procedure. Check the engine oil level and top-up if necessary.

17 Crankshaft front oil seal - renewal

1 Remove the crankshaft sprocket as described in the procedure for oil pump removal. There is no need to remove the camshaft sprockets or belt backplate. Recover the spacer from behind the sprocket.

2 Drill or punch a small hole in the face of the oil seal. Screw in a self tapping screw and use this to lever out the seal. Clean the seal seat.

3 Grease the lips of a new oil seal. Fit the seal, lips inwards, and seat it using a piece of tube, some washers and the crankshaft sprocket bolt.

4 Thinly coat the outer face of the spacer with sealant to GM spec 15 04 200/8 983 368 (see Chapter 2B, Section 20, paragraph 17). Push the spacer onto the crankshaft.

5 The remainder of refitting is the reverse of the removal procedure. Remember to fit a new camshaft toothed belt.



16.2 Circlip securing oil cooler thermostatic valve

18 Pistons and connecting rods - removal and refitting

Refer to Chapter 2A, Section 15, but note that the pistons and rods may be separated if wished, as described in Section 19.

19 Pistons and connecting rods - dismantling and reassembly

1 With the pistons and connecting rods removed they may be separated if necessary as follows.

2 Note the relative orientation of rod and piston. When fitted, the arrow on the piston crown points to the camshaft sprocket end of the engine, and the bosses on the connecting rod face towards the flywheel.

3 Remove one of the circlips which secure the gudgeon pin. Push the gudgeon pin out of the piston and connecting rod using a wooden or brass rod. No great force should be necessary.

4 When refitting, fit the connecting rod into the piston and make sure they are the right way round. Oil the gudgeon pin and push it home, then secure it with the circlip.

20 Flywheel - removal and refitting

Removal

1 Remove the clutch assembly as described in Chapter 6.

2 Mark the position of the flywheel relative to the crankshaft. Jam the ring gear teeth and slacken the flywheel retaining bolts (see Chapter 2A, Section 16).

3 Remove the bolts and lift off the flywheel. Do not drop it, it is heavy. Obtain new bolts for reassembly.

Refitting

4 Refitting is the reverse of the removal procedure. Tighten the bolts to the specified torque.

21 Crankshaft rear oil seal - renewal

Remove the flywheel as described in Section 20.

Renew the oil seal as described in Chapter 2A, Section 19.

22 Engine/transmission mountings - removal and refitting

Refer to Chapter 2A, Section 17.

23 Crankshaft and main bearings - removal and refitting

Refer to Chapter 2B, Section 20.

24 Engine components - examination and renovation

1 The cylinder head and oil pump have been considered earlier in this Chapter. For other components refer to Chapter 2A, Section 21, and note the following additional information.

Camshafts

2 With the camshafts removed, examine the bearing surfaces and lobes for wear, pitting and scuffing. Measure the bearing journals with a micrometer. Dimensions are given in the Specifications.

3 Wear or damage to a camshaft means that it must be renewed. If there is corresponding wear in the bearing seats and caps, a complete new cylinder head will be required. The bearing caps are line bored in position on the head and cannot be renewed separately.

4 With the camshafts fitted to the head, check their endfloat using a dial gauge or feeler blades. Endfloat outside the limits specified means that the camshaft(s) and/or cylinder head must be renewed.

Camshaft toothed belt

5 As mentioned earlier, the belt must be renewed every time that it is removed, even if it appears to be in good condition.

Piston/bore grade marks

6 The number or code denoting the piston and bore grade (see Specifications) is stamped on the block near the engine number.

25 Engine - removal and refitting

Removal

1 The engine is removed with the transmission by lowering the two out of the engine bay. They can then be separated on the bench.

- 2 Disconnect both leads from the battery.
- 3 Depressurise the fuel system (Chapter 4B).
- 4 Remove the bonnet.
- 5 Remove the air cleaner (Chapter 4B).
- 6 Disconnect the idle adjuster hose from the pre-volume chamber. Remove the screws from the pre-volume chamber, disconnect the multi-plug from the air mass meter and remove the pre-volume chamber and air mass meter together.
- 7 Drain the cooling system (Chapter 1).
- 8 Disconnect all coolant and heater hoses from the engine.
- 9 Disconnect the brake servo vacuum hose at the servo.
- 10 Disconnect the accelerator cable.
- 11 Disconnect the fuel supply and return pipes from the fuel injector rail. Be prepared for fuel spillage. Release the pipes from any clips or ties and move them out of the way.
- 12 Remove the exhaust manifold securing nuts and heat shield.
- 13 Disconnect the engine wiring harness multi-plug next to the expansion tank.
- 14 Disconnect the multi-plugs from the fuel injectors and the throttle valve switch. Also unbolt the earth straps from the fuel rail.
- 15 Disconnect the HT distributor-to-ignition coil lead and the LT multi-plug from the distributor.
- 16 Disconnect the wiring harness multi-plug at the left-hand suspension turret.
- 17 In the area of the right-hand suspension turret, disconnect the multi-plugs for the inductive pulse sensor and (if applicable) the vent valve and the oxygen sensor.
- 18 Disconnect the wiring from the two temperature sensors on the thermostat housing.
- 19 On the rear of the engine disconnect the multi-plugs from the knock sensor, the idle speed adjuster and the oil temperature switch.
- 20 Disconnect the oil level sensor and the reversing light switch.

- 21 Unbolt the earth strap from the transmission.
- 22 Disconnect the speedometer cable, or disconnect the speedometer sender multi-plug, as applicable (**see illustration**).
- 23 Engage second gear, then disconnect the gearchange remote control by undoing the pinch-bolt.
- 24 Disconnect the clutch cable.
- 25 Slacken the front wheel bolts, raise and securely support the front of the car and remove the front wheels (see "*Jacking and Vehicle Support*").
- 26 On models with power steering, remove the pump drivebelt. Unbolt the pump and move it aside without disconnecting its hoses. Support it so that the hoses are not strained.
- 27 Disconnect the oil cooler lines from the filter housing. Be prepared for oil spillage.
- 28 Remove the exhaust manifold (Chapter 4B).
- 29 Separate the control arm balljoints from the steering knuckles (see Chapter 10).
- 30 Separate the driveshafts from the final drive housing (see Chapter 8). Be prepared for oil spillage. Plug the holes and tie the driveshafts up out of the way.
- 31 Attach the lifting tackle to the engine/transmission and take the weight. Check that no cables, hoses etc are still attached or are otherwise in the way.
- 32 Unbolt the engine/transmission mountings in the following order:
 - a) LH front.
 - b) Rear.
 - c) RH front.
- 33 Carefully lower the assembly through the engine bay to the ground. If necessary lift the vehicle off the engine to enable it to be withdrawn.

Refitting

- 34 When refitting, apply thread-locking compound to the engine/ transmission mounting bolts. Tighten them finger tight at



25.22 Speedometer sender (used with digital instrument panel)

first, then to the specified torque in the following order:

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

- 35 The remainder of refitting is the reverse of the removal procedure.

26 Engine - initial start-up after overhaul

- 1 Refer to Chapter 1, Section 24, but disregard the instructions to check the idle speed and valve clearances.
- 2 If new camshafts have been fitted, it is suggested that the running-in schedule specified in Chapter 2B, Section 9, paragraph 14, be observed.
- 3 Run the engine until the cooling fan cuts in. If the hydraulic tappets have been disturbed, they may be noisy for a few minutes until they settle down.
- 4 Switch the engine off, remove the camshaft cover and tighten the cylinder head bolts through the final specified stage.