

Chapter 2 Part A:

1.8 & 2.0 litre SOHC engines

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Degrees of difficulty

<p>Easy, suitable for novice with little experience</p> 	<p>Fairly easy, suitable for beginner with some experience</p> 	<p>Fairly difficult, suitable for competent DIY mechanic</p> 	<p>Difficult, suitable for experienced DIY mechanic</p> 	<p>Very difficult, suitable for expert DIY or professional</p> 
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Specifications

General

	1.8 HC E	2.0 HC	2.0 HC EFi
Manufacturer's code	REC	NEL	NRA
Bore - mm (in)	86.20 (3.39)	90.82 (3.58)	90.82 (3.58)
Stroke - mm (in)	76.95 (3.03)	76.95 (3.03)	76.95 (3.03)
Cubic capacity - cc (cu in)	1796 (109.6)	1993 (121.6)	1993 (121.6)
Compression ratio	9.5:1	9.2:1	9.2:1
Compression pressure at cranking speed (all models)	11 to 13 bar (160 to 189 lbf/in ²)		
Maximum power (DIN, kW @ rpm)	66 @ 5400	77 @ 5200	85 @ 5500
Maximum torque (DIN, Nm @ rpm)	140 @ 3500	157 @ 4000	160 @ 4000

Lubrication system

Oil type	See "Lubricants and fluids"
Oil capacity (drain and refill, including filter)	3.75 litres (6.6 pints) approx
Oil pressure (SAE 10W/30 oil at 80°C/176°F):	
At 750 rpm	2.1 bar
At 2000 rpm	2.5 bar
Oil pressure relief valve opening pressure	4.0 to 4.7 bar
Oil pressure warning light switch setting	0.3 to 0.5 bar

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Oil pump

Type	Bi-rotor
Drive	From auxiliary shaft
Operating clearances:	
Outer rotor-to-housing	0.15 to 0.30 mm
Inner-to-outer rotor	0.05 to 0.20 mm
Rotor endfloat	0.04 to 0.10 mm

Cylinder block

	1.8 (REC)	2.0 (NEL and NRA)
Cast identification mark	18S	20S
Bore diameter:		
Standard grade 1	86.180 to 86.190 mm	90.800 to 90.810 mm
Standard grade 2	86.190 to 86.200 mm	90.810 to 90.820 mm
Standard grade 3	86.200 to 86.210 mm	90.820 to 90.830 mm
Standard grade 4	86.210 to 86.220 mm	90.830 to 90.840 mm
Oversize grade 5	86.690 to 86.700 mm	91.310 to 91.320 mm
Oversize grade B	86.700 to 86.710 mm	91.320 to 91.330 mm
Oversize grade C	86.710 to 86.720 mm	91.330 to 91.340 mm
Standard service grade	Not stated	90.830 to 90.840 mm
Oversize 0.5	Not stated	91.330 to 91.340 mm
Oversize 1.0	Not stated	91.830 to 91.840 mm

Crankshaft

Number of main bearings	5
Main bearing journal diameter:	
Standard	56.970 to 56.990 mm
Undersize 0.25	56.720 to 56.740 mm
Undersize 0.50	56.470 to 56.490 mm
Undersize 0.75	56.220 to 56.240 mm
Undersize 1.00	55.970 to 55.990 mm
Main bearing running clearance	0.010 to 0.064 mm
Big-end bearing journal diameter:	
Standard	51.980 to 52.000 mm
Undersize 0.25	51.730 to 51.750 mm
Undersize 0.50	51.480 to 51.500 mm
Undersize 0.75	51.230 to 51.250 mm
Undersize 1.00	50.980 to 51.000 mm
Big-end bearing running clearance	0.006 to 0.060 mm
Thrustwasher thickness:	
Standard	2.30 to 2.35 mm
Oversize	2.50 to 2.55 mm
Crankshaft endfloat	0.08 to 0.28 mm

Connecting rods

Big-end parent bore diameter	55.000 to 55.020 mm
Small-end bush internal diameter	23.964 to 23.976 mm

Pistons

	1.8 (REC)	2.0 (NEL and NRA)
Diameter:		
Standard grade 1	86.145 to 86.155 mm	90.765 to 90.775 mm
Standard grade 2	86.155 to 86.165 mm	90.775 to 90.785 mm
Standard grade 3	86.165 to 86.175 mm	90.785 to 90.795 mm
Standard grade 4	86.175 to 86.185 mm	90.795 to 90.805 mm
Service standard	86.170 to 86.195 mm	90.790 to 90.815 mm
Oversize 0.5	86.670 to 86.695 mm	91.290 to 91.315 mm
Oversize 1.0	87.170 to 87.195 mm	91.790 to 91.815 mm
Clearance in bore	0.015 to 0.050 mm	0.015 to 0.050 mm
Piston ring end gaps:		
Top and centre	0.3 to 0.5 mm	0.4 to 0.6 mm
Bottom	0.4 to 1.4 mm	0.4 to 1.4 mm

Gudgeon pins

Length	68.0 to 68.8 mm
Diameter:	
Red	23.994 to 23.997 mm
Blue	23.997 to 24.000 mm
Yellow	24.000 to 24.003 mm
Clearance in piston	0.008 to 0.014 mm
Interference in connecting rod	0.018 to 0.039 mm

Cylinder head

Identification mark:	
1.8 (REC)	85
2.0 (NEL and NRA)	0
Valve seat angle	44° 30' to 45° 00'
Valve seat width	1.5 to 2.0 mm
Valve guide bore:	
Standard	8.063 to 8.088 mm
Oversize 0.2	8.263 to 8.288 mm
Oversize 0.4	8.463 to 8.488 mm
Camshaft bearing parent bores:	
Front	45.072 to 45.102 mm
Centre	47.692 to 47.722 mm
Rear	48.072 to 48.102 mm

Auxiliary shaft

Endfloat	0.050 to 0.204 mm
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Camshaft

Drive	Toothed belt
Thrust plate thickness	3.98 to 4.01 mm
Endfloat	0.104 to 0.204 mm
Cam lift	6.3323 mm
Cam length	36.26 to 36.60 mm
Valve timing:	
Inlet opens	24° BTDC
Inlet closes	64° ABDC
Exhaust opens	70° BBDC
Exhaust closes	18° ATDC
Bearing journal diameter:	
Front	41.987 to 42.013 mm
Centre	44.607 to 44.633 mm
Rear	44.987 to 45.013 mm
Bearing bush internal diameter:	
Front	42.035 to 42.055 mm
Centre	44.655 to 44.675 mm
Rear	45.035 to 45.055 mm

Valve clearances (cold)

Inlet	0.20 ± 0.03 mm (0.008 ± 0.001 in)
Exhaust	0.25 ± 0.03 mm (0.010 ± 0.001 in)

Inlet valves

Length:	
1.8 (REC)	111.75 to 112.75 mm
2.0 (NEL and NRA)	110.65 to 111.65 mm
Head diameter	41.80 to 42.20 mm
Stem diameter:	
Standard	8.025 to 8.043 mm
Oversizes	+0.2, 0.4, 0.6 and 0.8 mm
Stem-to-guide clearance	0.020 to 0.063 mm

Exhaust valves

Length:	
1.8 (REC)	111.15 to 112.15 mm
2.0 (NEL)	110.05 to 111.05 mm
2.0 (NRA)	110.75 to 111.75 mm
Head diameter:	
1.8 (REL)	34.00 to 34.40 mm
2.0 (NEL and NRA)	35.80 to 36.20 mm
Stem diameter:	
Standard	7.999 to 8.017 mm
Oversizes	+0.2, 0.4, 0.6 and 0.8 mm
Stem-to-guide clearance	0.046 to 0.089 mm

Valve springs

Free length	47.0 mm
Inside diameter	23.45 to 23.95 mm
Wire diameter	3.87 to 3.93 mm
Number of turns	4.7

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Torque wrench settings

	Nm	lbf ft
Main bearing cap bolts	88 to 102	65 to 75
Big-end bearing cap nuts	40 to 47	30 to 35
Crankshaft pulley bolt:		
1.8 (REC) and 2.0 (NEL)	110 to 115	81 to 85
2.0 (NRA)	115 to 130	85 to 96
Camshaft sprocket bolt	45 to 50	33 to 37
Auxiliary shaft sprocket bolt	45 to 50	33 to 37
Flywheel bolts	64 to 70	47 to 52
Oil pump-to-cylinder block bolts	17 to 21	13 to 16
Oil pump cover bolts	9 to 13	7 to 10
Sump bolts (see text):		
Stage 1	1 to 2	0.7 to 1.5
Stage 2	6 to 8	4 to 6
Stage 3 (after 20 minutes running)	8 to 10	6 to 7
Sump drain plug	21 to 28	16 to 21
Oil pressure switch	12 to 15	9 to 11
Valve adjustment ball-pins	50 to 55	37 to 41
Cylinder head bolts (see text):		
Stage 1	35 to 40	26 to 30
Stage 2	70 to 75	52 to 55
Stage 3 (after 5 minutes)	Tighten further 90°	Tighten further 90°
Rocker cover bolts (see text):		
Bolts 1 to 6 - Stage 1	6 to 8	4 to 6
Bolts 7 and 8 - Stage 2	2 to 3	1.5 to 2
Bolts 9 and 10 - Stage 3	6 to 8	4 to 6
Bolts 7 and 8 - Stage 4	6 to 8	4 to 6
Front cover bolts	13 to 17	10 to 13
Timing belt tensioner bolts	20 to 25	15 to 18
Oil pump pick-up pipe:		
To pump	11 to 14	8 to 10
To block	17 to 21	13 to 16
Engine mounting to crossmember	41 to 51	30 to 38

1 General information

The engine is of four-cylinder, in-line, single overhead camshaft type (see illustration). It is mounted longitudinally at the front of the car. Three versions are available: 1.8 litre carburettor, 2.0 litre carburettor and 2.0 litre fuel-injection.

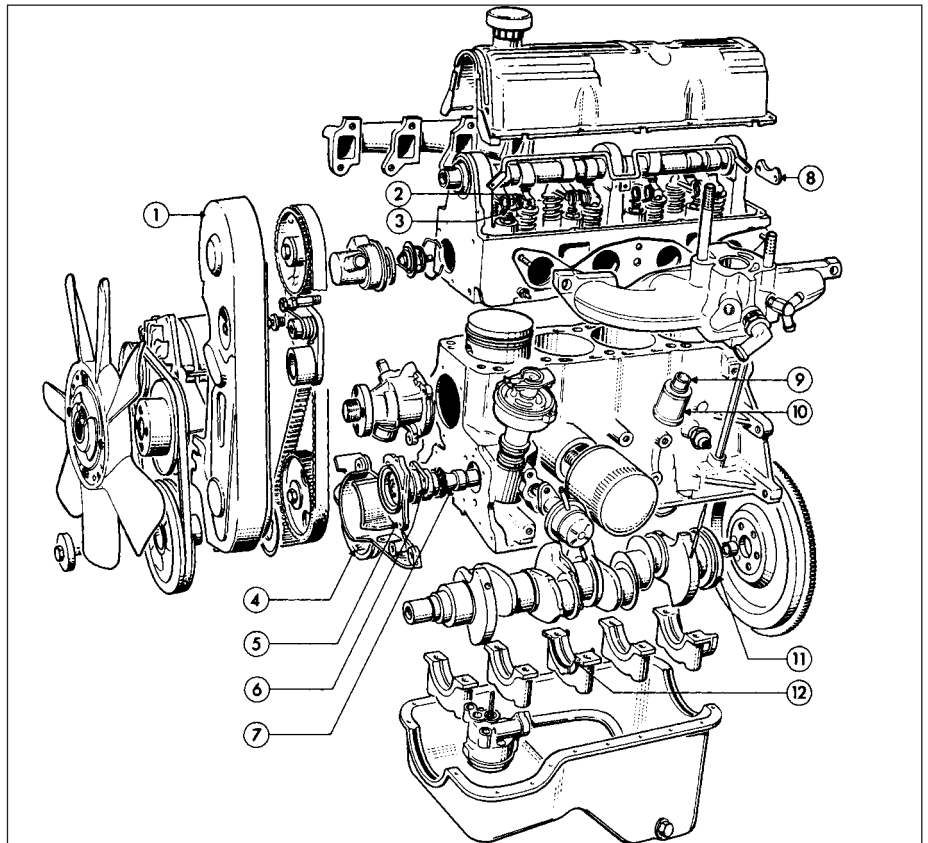
The crankshaft incorporates five main bearings. Thrustwashers are fitted to the centre main bearing in order to control crankshaft endfloat.

The camshaft is driven by a toothed belt and operates the slightly angled valve via cam followers which pivot on ball-pins.

The auxiliary shaft, which is also driven by the toothed belt, drives the distributor, oil pump and on some models the fuel pump.

1.1 Exploded view of the SOHC engine

- 1 Timing cover
- 2 Cam follower
- 3 Retaining spring clip
- 4 Crankshaft front oil seal housing
- 5 Auxiliary shaft front cover
- 6 Thrust plate
- 7 Auxiliary shaft
- 8 Thrust plate
- 9 Vent valve
- 10 Oil separator
- 11 Crankshaft rear oil seal
- 12 Thrust washer



The cylinder head is of crossflow design with the inlet manifold mounted on the left-hand side and the exhaust manifold mounted on the right-hand side.

Lubrication is by means of a bi-rotor pump which draws oil through a strainer located inside the sump, and forces it through a full-flow filter into the engine oil galleries where it is distributed to the crankshaft, camshaft and auxiliary shaft. The big-end bearings are supplied with oil via internal drillings in the crankshaft. The undersides of the pistons are supplied with oil from drillings in the big-ends. The distributor shaft is intermittently supplied with oil from the drilled auxiliary shaft. The camshaft and cam followers are supplied with oil via a drilled spray tube from the centre camshaft bearing.

A semi-closed crankcase ventilation system is employed whereby piston blow-by gases are drawn into the inlet manifold via an oil separator and on carburettor models a control valve.

2 Major operations possible with the engine in the vehicle

The following operations can be carried out without removing the engine, although the work may be easier and quicker with the engine removed:

- a) Removal and refitting of the cylinder head
- b) Removal and refitting of the camshaft (after removing the cylinder head)
- c) Removal and refitting of the timing belt and sprockets
- d) Removal and refitting of the sump and oil pump
- e) Removal and refitting of the pistons, connecting rods and big-end bearings
- f) Renewal of the engine mountings
- g) Renewal of the crankshaft oil seals
- h) Removal and refitting of the auxiliary shaft
- j) Removal and refitting of the flywheel

3 Major operations requiring engine removal

The engine must be removed from the vehicle for the following operations:

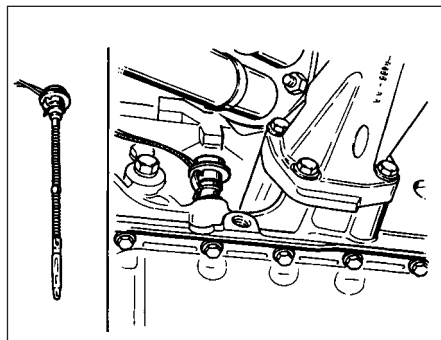
- a) Renewal of the crankshaft main bearings
- b) Removal and refitting of the crankshaft

4 Methods of engine removal

The engine may be lifted out either on its own or together with the gearbox. Unless work is also necessary on the gearbox it is recommended that the engine is removed on its own. Where automatic transmission is fitted, the engine should be removed on its own owing to the additional weight. If the engine and gearbox are removed together, they will have to be tilted at a very steep angle; make sure that the range of the lifting tackle is adequate.

5 Engine - removal leaving gearbox/transmission in vehicle

- 1 Disconnect the battery negative lead.
- 2 Remove the bonnet.
- 3 On carburettor models, remove the air cleaner. On fuel-injection models, remove the air cleaner cover, vane airflow meter and air inlet trunking.
- 4 If a splash guard is fitted, remove it.
- 5 Release the securing clips and bolts and remove the upper half of the fan shroud. On carburettor models remove the lower half of the shroud too.
- 6 Drain the cooling system.
- 7 Disconnect the radiator top and bottom hoses from the thermostat housing and water pump. Disconnect the top hose spur from the expansion tank and unclip it.
- 8 Disconnect the heater hoses from the water pump and from the inlet manifold or automatic choke housing. Unclip the hoses.
- 9 On models with power steering, remove the steering pump.
- 10 Disconnect the vacuum pipe(s) from the inlet manifold, labelling them if there is any possibility of confusion.
- 11 Disconnect the following wiring, as applicable:
 - a) Alternator
 - b) Temperature gauge sender
 - c) Engine management temperature sensor
 - d) Distributor
 - e) Oil pressure switch
 - f) Automatic choke and thermo-switch
 - g) Carburettor stepper motor
 - h) Fuel-injection system sub-harness
 - j) Inlet manifold heater
- 12 Disconnect the HT lead from the coil.
- 13 If an oil level sensor is fitted, remove it (see illustration).
- 14 Unbolt the throttle cable bracket, disconnect the inner cable and move the cable and bracket aside. Also disconnect the downshift cable on automatic transmission models.
- 15 On carburettor models, disconnect the fuel lines from the fuel pump (mechanised type) and from the carburettor. **Be prepared for fuel spillage.**
- 16 On fuel-injection models, disconnect the fuel supply union from the injector rail, and the fuel return pipe from the fuel pressure



5.13 Oil level sensor

regulator. **Be prepared for fuel spillage, and for some spray if the supply side is still under pressure.**

- 17 Unbolt the exhaust downpipe from the manifold.
- 18 On models with air conditioning, unbolt the compressor and move it aside without straining the flexible hoses.
- 19 Remove the starter motor.
- 20 Although not specified by the manufacturers, the author advises that either the radiator or the cooling fan be removed, to reduce the risk of damage.
- 21 Attach the lifting tackle to the two lifting eyes on the engine, so that when suspended the engine will be roughly horizontal. Take the weight of the engine.
- 22 Remove the single nut on each side which secures each engine bearer to its mounting.
- 23 Working under the vehicle, remove the bracing strap which connects the engine and transmission. Unbolt the adapter plate from the bottom of the transmission bellhousing.
- 24 On automatic transmission models, unbolt the torque converter from the driveplate.
- 25 Remove the engine-to-bellhousing bolts. Note the location of the battery earth strap.
- 26 Support the transmission, preferably with a trolley jack.
- 27 Check that nothing has been overlooked, then raise the engine and draw it forwards clear of the transmission input shaft. Do not allow the weight of the engine to hang on the shaft, and do not lift the transmission by it.
- 28 On automatic transmission models, make sure that the torque converter stays engaged with the oil pump in the transmission as the engine is withdrawn.
- 29 Lift the engine out of the engine bay and take it to the bench.

6 Engine - removal with manual gearbox

- 1 Engine removal with automatic transmission is not recommended.
- 2 Proceed as in the previous Section, paragraphs 1 to 18.
- 3 Disconnect the wiring from the starter motor, and release the battery earth cable from its bellhousing bolt.
- 4 Remove the radiator.
- 5 Remove the propeller shaft.
- 6 Disconnect and unclip the reversing light switch and speedometer sender unit wiring.
- 7 Disconnect the clutch cable.
- 8 Unbolt the anti-roll bar mounting brackets and lower the anti-roll bar as far as possible.
- 9 From inside the vehicle remove the gear lever.
- 10 Drain the engine oil.
- 11 Unhook the exhaust system from its mounting on the gearbox crossmember. Either support the system or remove it completely.
- 12 Support the gearbox, preferably with a trolley jack, then unbolt and remove the gearbox crossmember. Note the earth strap (if fitted) under one of the crossmember bolts.
- 13 Attach lifting tackle to the two lifting eyes on the engine so that when suspended it will be at an angle of approximately 45°.

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- 14 Take the weight of the engine and remove the two engine bearer-to-mounting nuts.
- 15 Lift the engine/transmission, at the same time lowering the trolley jack. Draw the unit forwards and lift it out of the engine bay.
- 16 Temporarily refit the anti-roll bar if the vehicle is to be moved.

7 Engine - separation from manual gearbox



- 1 With the engine and gearbox on the bench, remove the starter motor.
- 2 Remove the bolt from the engine adapter plate.
- 3 Remove the bracing strap and the remaining engine-to-bellhousing bolts.
- 4 With the aid of an assistant draw the gearbox off the engine. Do not allow the weight of the gearbox to hang on the input shaft.

8 Engine dismantling - general information

- 1 It is best to mount the engine on a dismantling stand, but if this is not available, stand the engine on a strong bench at a comfortable working height. Failing this, it will have to be stripped down on the floor.
- 2 Cleanliness is most important, and if the engine is dirty, it should be cleaned with paraffin while keeping it in an upright position.
- 3 Avoid working with the engine on a concrete floor, as grit can be a real source of trouble.
- 4 As parts are removed, clean them in paraffin. However, do not immerse parts with internal oilways in paraffin as it is difficult to remove, usually requiring a high pressure hose.



Clean oilways with nylon pipe cleaners.

- 5 It is advisable to have suitable containers to hold small items according to their use, as this will help when reassembling the engine and also prevent possible losses.
- 6 Always obtain complete sets of gaskets when the engine is being dismantled, but retain the old gaskets with a view of using them as a pattern to make a replacement if a new one is not available.



9.1b Removing an engine bearer arm



8.10 This valve spring compressor is used by hooking it under the camshaft

- 7 When possible, refit nuts, bolts and washers in their location after being removed, as this helps protect the threads and will also be helpful when reassembling the engine.
- 8 Retain unserviceable components in order to compare them with the new parts supplied.
- 9 A Torx key, size T55, will be needed for dealing with the cylinder head bolts. A 12-spline key (to fit bolt size M8) will be needed for the oil pump bolts. Other Torx and 12-spline bolts may be encountered: sets of the keys required to deal with them are available from most motor accessory shops and tool factors.
- 10 Another tool which is useful, though by no means essential, is a valve spring compressor of the type which hooks under the camshaft (see illustration). As a Ford tool this bears the number 21-005-A; proprietary versions may also be available.

9 Ancillary components - removal

Before dismantling the engine into its main components, the following ancillary components can be removed. The actual items removed, and the sequence of removal, will depend on the work to be done:

- Inlet manifold and associated items*
- Exhaust manifold*
- Fuel pump (mechanical type) and pushrod*
- Alternator*
- Distributor, HT leads and spark plugs*
- Fan, water pump and thermostat*
- Oil pressure switch (see illustration)*
- Temperature gauge sender*



9.1c Removing the alternator bracket



9.1a Engine oil pressure switch (arrowed)

- Oil filter and dipstick*
- Engine bearer arms (see illustration)*
- Crankcase ventilation components*
- Clutch*
- Alternator mounting bracket (see illustration)*

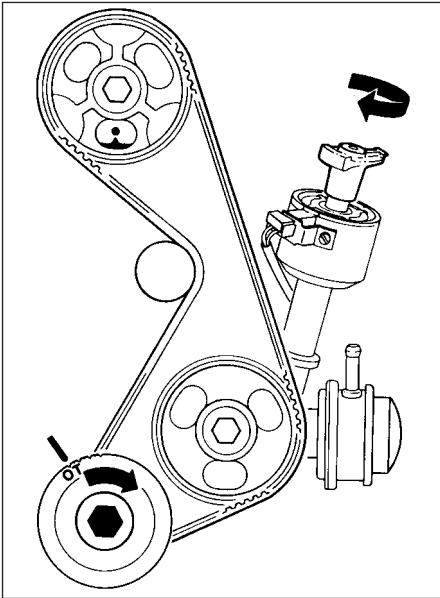
10 Cylinder head - removal



- 1 If the engine is still in the vehicle, carry out the following preliminary operations:
 - a) *Disconnect the battery negative lead*
 - b) *Drain the cooling system*
 - c) *Remove the inlet and exhaust manifolds*
 - d) *Disconnect the radiator top hose from the thermostat housing, and the spur from the expansion tank*
 - e) *Disconnect the wiring from the temperature gauge sender*
 - f) *Remove the distributor cap, HT leads and spark plugs*
- 2 Unscrew the bolts and withdraw the timing cover (see illustration). Note the location of the cover in the special bolt.
- 3 Using a socket on the crankshaft pulley bolt, turn the engine clockwise until the TDC (top dead centre) notch on the pulley is aligned with the pointer on the crankshaft front oil seal housing, and the pointer on the camshaft sprocket is aligned with the indentation on the cylinder head (see illustrations). Note the position of the distributor rotor arm, and mark its contact end in relation to the rim of the distributor body.
- 4 Slacken the timing belt tensioner bolts. Pivot



10.2 Removing the timing cover



10.3a Alignment of crankshaft and camshaft timing marks, and distributor rotor position, for No 1 firing

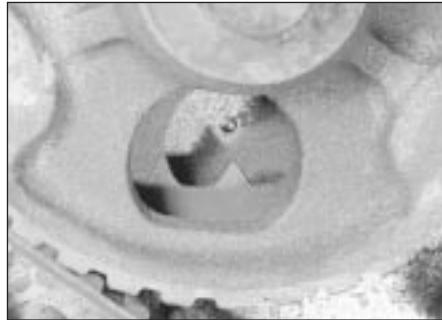
the tensioner to release the load on the belt and slip the belt off the camshaft sprocket. Do not kink the belt, or get oil or grease on it.

5 Remove the ten bolts which secure the rocker cover, noting the location of the different shapes of reinforcing plates. Remove the cover and gasket.

6 Using a Torx key, slacken the cylinder head bolts half a turn at a time in the reverse of the tightening sequence.



11.3 Removing the camshaft sprocket backplate



10.3b Camshaft sprocket pointer aligned with the indentation on the cylinder head

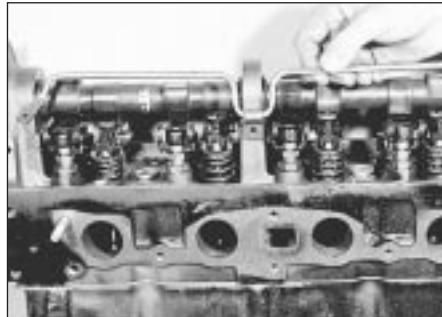
7 With the bolts removed, lift the cylinder head from the block. If it is stuck, tap it with a wooden or plastic mallet to free it. **Do not** lever between the head and block, or the mating surfaces may be damaged. **Do not** crank the engine to free the head, as the pistons may contact the valves.

8 Place the cylinder head on a couple of wooden blocks so that the protruding valves are not damaged.

11 Camshaft - removal

1 Remove the cylinder head as described in the previous Section.

2 Hold the camshaft with a spanner on the lug behind the sixth cam. Unscrew and remove the camshaft sprocket bolt (see illustration).



11.4 Removing the camshaft oil supply tube

3 Remove the camshaft sprocket using a puller if necessary. Remove the backplate (see illustration).

4 Unscrew the bolts and remove the camshaft oil supply tube (see illustration).

5 Note how the cam follower retaining spring clips are fitted, then unhook them from the cam followers.

6 If the special tool 21-005-A is available, compress the valve springs in turn and remove the cam followers, keeping them identified for location. Alternatively loosen the locknuts and back off the ball-pins until the cam followers can be removed (see illustration).

7 Unscrew the bolts and remove the camshaft thrust plate (see illustration).

8 Carefully withdraw the camshaft from the rear of the cylinder head, taking care not to damage the bearings (see illustration).

9 Prise the oil seal from the front bearing (see illustration).



11.2 Removing the camshaft sprocket bolt and sprocket



11.6 Removing the cam followers



11.7 Removing the camshaft thrust plate



11.8 Removing the camshaft



11.9 Prise out the camshaft bearing oil seal

12 Cylinder head - dismantling



1 Remove the camshaft as described in the previous Section. (If tool 21-005-A is available, leave the camshaft in place until the valves have been removed).

2 Using a valve spring compressor, compress each valve spring in turn until the split collets can be removed. Release the compressor and remove the cap and spring, keeping them identified for location (see illustrations).



12.2a Compressing a valve spring



12.2b Removing a valve spring and cap

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If the caps are difficult to remove do not continue to tighten the compressor, but gently tap the top of the tool with a hammer. Always ensure that the compressor is held firmly over the cap.

3 Remove each valve from the cylinder head, but identify them for location (see illustration).

4 Prise the valve stem oil seals from the tops of the valve guides (see illustration).

5 If necessary unscrew the cam follower ballpins from the cylinder head, keeping them identified for location.

6 If necessary unscrew the bolts and remove the timing belt tensioner.

7 Remove the thermostat and housing.

8 Remove the temperature gauge sender unit.

9 Remove the manifold studs if wished by locking two nuts onto each stud in turn and unscrewing it.



12.3 Removing a valve



12.4 Removing a valve stem oil seal

13 Timing belt and sprockets - removal



1 If the engine is still in the vehicle, carry out the following preliminary operations:

a) Disconnect the battery negative lead

b) Remove the radiator and disconnect the hose from the thermostat housing

c) Remove the accessory drivebelt(s)

2 Unscrew the bolts and withdraw the timing cover. Note the location of the cover in the special bolt.

3 Using a socket on the crankshaft pulley bolt, turn the engine clockwise until the TDC (top dead centre) notch on the pulley is aligned

with the pointer on the crankshaft front oil seal housing, and the pointer on the camshaft sprocket is aligned with the indentation on the cylinder head. Note the position of the distributor rotor arm. Mark the contact end of the rotor in relation to the rim of the distributor body.

4 Slacken the timing belt tensioner retaining bolts then pivot the tensioner pulley away from the belt, to obtain maximum drivebelt free play (see illustration). Hold the tensioner pulley in this position and securely retighten the retaining bolts.

5 Mark the running direction of the belt if it is to be re-used, then slip it off the camshaft sprocket.

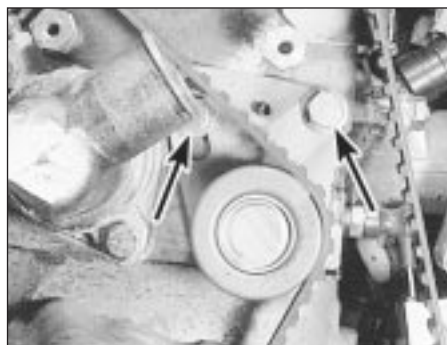
6 Slacken the crankshaft pulley bolt. Prevent the crankshaft from turning by engaging 5th

gear (manual gearbox), or by removing the starter motor and jamming the ring gear teeth. Alternatively, if the pulley has peripheral bolt holes, screw in a couple of bolts and use a lever between them to jam it. Do not allow the crankshaft to turn very far, or piston/valve contact may occur.

7 Remove the bolt and washer and withdraw the pulley. If the pulley will not come off easily, refit the bolt part way and use a puller (see illustration). A puller will almost certainly be required on fuel-injection models.

8 Remove the guide washer from in front of the crankshaft sprocket, then remove the timing belt (see illustration). Do not kink it or get oil on it if it is to be re-used.

9 Remove the crankshaft sprocket using a puller if necessary (see illustration).



13.4 Timing belt tensioner bolts (arrowed)



13.7 Using a puller to remove the crankshaft pulley



13.8 Remove the guide washer from in front of the crankshaft sprocket



13.9 Removing the crankshaft sprocket

10 Unscrew the auxiliary shaft sprocket bolt while holding the sprocket stationary with a screwdriver inserted through one of the holes.

11 Remove the auxiliary shaft sprocket using a puller if necessary (see illustration).

12 Unscrew the camshaft sprocket bolt while holding the sprocket stationary with a screwdriver engaged in one of the grooves. Alternatively remove the rocker cover and use a spanner on the camshaft lug.

13 Remove the camshaft sprocket using a puller if necessary, then remove the backplate. Note that the oil seal can be removed using a special removal tool or by using self-tapping screws and a pair of grips.

14 Auxiliary shaft - removal

1 Remove the timing belt and the auxiliary shaft sprocket (only) (Section 13).

2 Remove the distributor.

3 Remove the fuel pump and pushrod (not applicable to models with an electric pump).

4 Unscrew the bolts and remove the auxiliary shaft front cover (see illustration).

5 Unscrew the cross-head screws, using an impact screwdriver if necessary, remove the thrust plate and withdraw the auxiliary shaft from the block (see illustrations).

6 Cut the front cover gasket along the top of the crankshaft front oil seal housing and scrape off the gasket.

15 Flywheel/driveplate and adapter plate - removal

1 If the engine is still in the vehicle, remove the clutch or automatic transmission.

2 Prevent the flywheel or driveplate rotating by jamming the ring gear teeth, or by bolting a strap to it.

3 Remove the securing bolts and withdraw the flywheel or driveplate. Do not drop it, it is heavy.

4 The engine adapter plate (backplate) may now be withdrawn from the dowels if required (see illustration).



13.11 Removing the auxiliary shaft sprocket

16 Sump - removal

1 If the engine is out of the vehicle, start at paragraph 11. If possible, remove the sump without inverting the engine, so that any sludge in the bottom of the sump stays there.

2 Disconnect the battery negative lead.

3 Raise and support the front of the vehicle.

4 Remove the splash guard, if fitted, and drain the engine oil.

5 Remove the starter motor.

6 Remove the two nuts which secure the engine bearers to the engine mountings.

7 Release the steering shaft universal joint strap bolt to allow for subsequent movement.

8 Free the brake hydraulic pipes from the clips on the front crossmember.



14.4 Removing the auxiliary shaft front cover

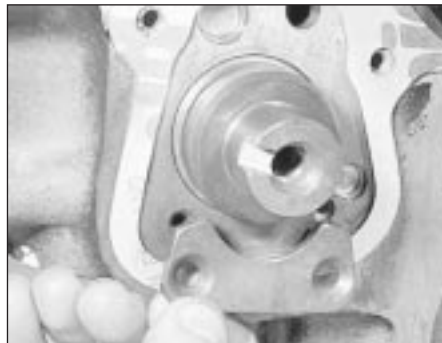
9 Support the engine, either with conventional lifting tackle or with a bar positioned across the engine bay and resting on two wooden blocks drilled to fit securely on the suspension turrets. Make sure the support arrangements are satisfactory, as you will be working underneath the suspended engine.

10 Take the weight of the engine. Place a jack under the front crossmember, remove the crossmember mounting bolts and carefully lower the jack. Only lower the crossmember far enough to permit removal of the sump.

11 Remove the 23 bolts retaining the sump.

12 Remove the sump from the cylinder block (see illustration). If it is stuck, hit it with a soft-faced mallet, or prise it sideways (not between the mating faces) with a large screwdriver or bar.

13 Recover the gaskets and sealing strips.



14.5a Removing the auxiliary shaft thrust plate



14.5b Removing the auxiliary shaft



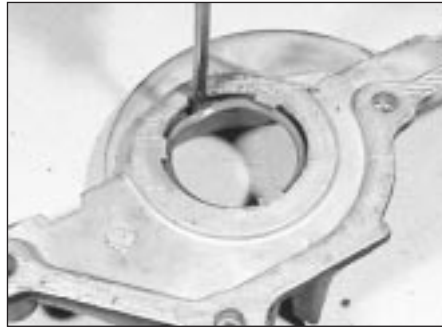
15.4 Removing the engine adaptor plate (backplate)



16.12 Removing the sump



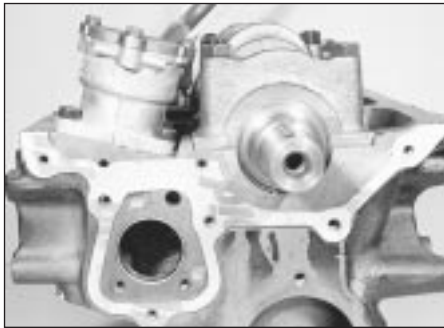
17.3a Removing the crankshaft front oil seal housing



17.3b Driving the oil seal out of the housing



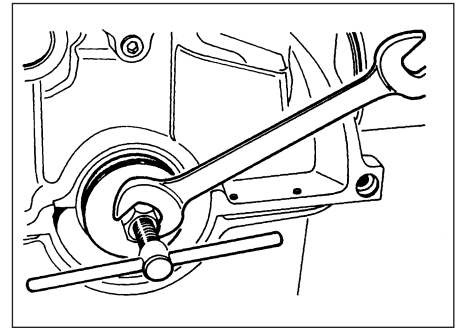
17.4 Using a socket and a hammer to seat the new seal



17.5a Oil seal housing and auxiliary shaft cover gasket in position



17.5b Checking the alignment of the front oil seal housing



18.2 Using an oil seal removal tool to extract the crankshaft rear oil seal

17 Crankshaft front oil seal - renewal



1 Remove the timing belt and the crankshaft sprocket (only).

2 If an oil seal removal tool is available, the oil seal can be removed at this stage. It may also be possible to remove the oil seal by drilling the outer face and using self-tapping screws and a pair of grips.

3 If the oil seal cannot be removed as described in paragraph 2, remove the sump. Also remove the auxiliary shaft sprocket. Unbolt the oil seal housing and auxiliary shaft front cover and remove the gasket. The oil seal can then be driven out from the inside (see illustrations).

4 Clean the oil seal seating, then drive in a new seal using metal tubing or a suitable socket (see illustration). Make sure that the

sealing lip faces into the engine, and lightly oil the lip.

5 If applicable fit the oil seal housing and auxiliary shaft front cover to the block together with a new gasket and tighten the bolts. Make sure that the bottom face of the housing is aligned with the bottom face of the block (see illustrations). Fit the sump.

6 Refit the timing belt and sprockets.

18 Crankshaft rear oil seal - renewal



1 Remove the flywheel or driveplate and the engine adapter plate (backplate).

2 Using a special removal tool extract the oil seal (see illustration). However it may be possible to remove the oil seal by drilling the outer face and using self-tapping screws and a pair of grips.

3 Clean the oil seal seating, then drive in a new seal using a suitable metal tube. Make sure that the sealing lip faces into the engine, and lightly oil the lip.

4 Refit the adapter plate and the flywheel/driveplate.

19 Oil pump - removal



1 Remove the sump.

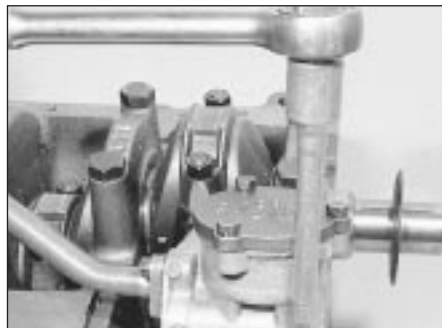
2 Unscrew the bolt securing the pick-up tube and strainer to the block (see illustration).

3 Using a special splined key, unscrew the bolts and withdraw the oil pump and strainer (see illustration).

4 Withdraw the hexagon shaped driveshaft which engages the bottom of the distributor, noting which way round it is fitted (see illustration).



19.2 Unbolting the oil pump pick-up strainer from the block



19.3 Removing the splined bolts which secure the oil pump



19.4 Removing the oil pump driveshaft



21.2 Big-end cap and connecting rod identification numbers



21.4 Piston, connecting rod, cap and bearing shells



22.5 Main bearing cap identification marks
The arrow points to the front of the engine

20 Oil filter - renewal

See Chapter 1, Section 8.

21 Pistons and connecting rods - removal

- 1 Remove the sump and cylinder head.
- 2 Check the big-end caps for identification marks and if necessary use a centre-punch to identify the caps and connecting rods (see illustration).
- 3 Turn the crankshaft so that No 1 crankpin is at its lowest point, then unscrew the nuts and tap off the cap. Keep the bearing shells in the cap and connecting rod.

- 4 Using the handle of a hammer, push the piston and connecting rod up the bore and withdraw from the top of the cylinder block. Loosely refit the cap to the connecting rod (see illustration).
- 5 Repeat the procedure in paragraphs 3 and 4 on the No 4 piston and connecting rod, then turn the crankshaft through half a turn and repeat the procedure on Nos 2 and 3 pistons and connecting rods.

22 Crankshaft and main bearings - removal

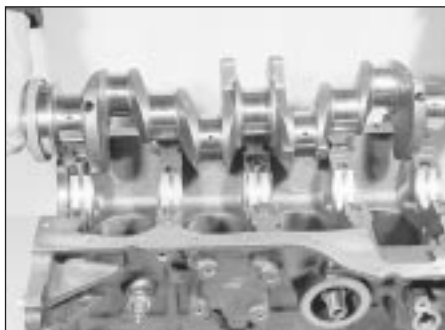
- 1 With the engine removed from the vehicle, remove the pistons and connecting rods as described in the previous Section. (In fact it is not necessary to push the pistons out of the bores if no work is to be done on them.)



22.6 Checking crankshaft endfloat



22.7 Removing the rear main bearing cap



22.8a Removing the crankshaft



22.8b Removing a thrustwasher from the centre main bearing

- 2 Remove the timing belt and crankshaft sprocket, and the flywheel or driveplate. Also remove the auxiliary shaft sprocket.
- 3 Unbolt the crankshaft front oil seal housing and auxiliary shaft front cover and remove the gasket.
- 4 Remove the oil pump and strainer.
- 5 Check the main bearing caps for identification marks and if necessary use a centre-punch to identify them (see illustration).
- 6 Before removing the crankshaft check that the endfloat is within the specified limits by inserting a feeler blade between the centre crankshaft web and the thrustwashers (see illustration). This will indicate whether new thrustwashers are required or not.
- 7 Unscrew the bolts and tap off the main bearing caps complete with bearing shells (see illustration). If the thrustwashers are to be re-used identify them for location.
- 8 Lift the crankshaft from the crankcase and remove the rear oil seal. Remove the remaining thrustwashers (see illustrations).
- 9 Extract the bearing shells keeping them identified for location (see illustration).

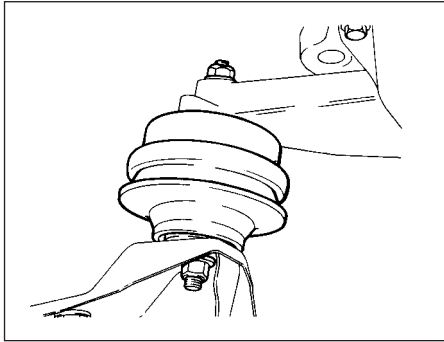
23 Engine mountings - renewal

- 1 Unscrew the two nuts which secure the engine bearers to the tops of the mountings. Recover the washers (see illustration).
- 2 Raise and support the front of the vehicle. Remove the two nuts which secure the



22.9 Removing the centre main bearing shell

2A



23.1 An engine mounting

mountings to the front crossmember. Recover the washers.

3 Raise the engine with a hoist or a suitable protected jack until the mountings are free, then remove them.

4 Fit the new mountings and lower the engine onto them.

5 Fit the nuts and washers and tighten the nuts.

6 Lower the vehicle.

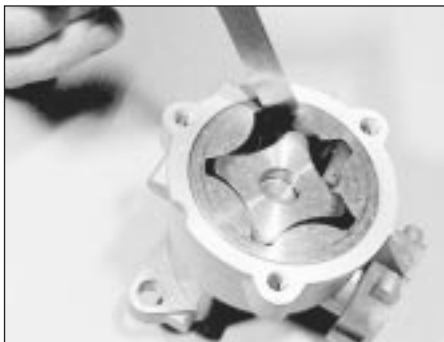
24 Crankcase ventilation system - general information

Carburettor models

The crankcase ventilation system consists of the special oil filter cap (containing a steel wool filter) and an oil separator and vent valve on the left-hand side of the engine. This is connected by hose to the inlet manifold. The system operates according to the vacuum in the inlet manifold. Air is drawn through the filler cap, through the crankcase, and then together with piston blow-by gasses through the oil separator and vent valve to the inlet manifold. The blow-by gasses are then drawn into the engine together with the fuel/air mixture. Refer to Chapter 1 for maintenance of the system.

Fuel-injection models

This system is closed, consisting of an oil



26.2b Checking the inner-to-outer rotor clearance



26.1 Removing the oil pump cover

separator on the left-hand side of the engine and a hose connecting it to the inlet air trunking. Because the trunking is not subject to manifold vacuum, no vent valve is needed.

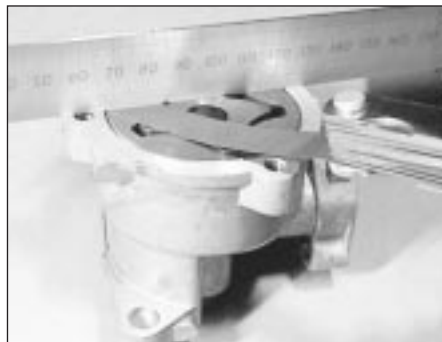
25 Examination and renovation - general information

1 With the engine completely stripped, clean all the components and examine them for wear. Each part should be checked, and where necessary renewed or renovated as described in the following Sections. Renew main and big end shell bearings as a matter of course, unless you know that they have had little wear and are in perfect condition.

2 If in doubt as to whether to renew a component which is still just serviceable, consider the time and effort which will be incurred should it fail at an early date. Obviously the age and expected life of the vehicle must influence the standards applied.

3 Gaskets, oil seals and O-rings must all be renewed as a matter of routine. Flywheel and cylinder head bolts must be renewed because of the high stresses to which they are subjected.

4 Take the opportunity to renew the engine core plugs while they are easily accessible. Knock out the old plugs with a hammer and chisel or punch. Clean the plug seats, smear the new plugs with sealant and tap them squarely into position.



26.2c Checking the oil pump rotor endfloat



26.2a Checking the outer rotor-to-housing clearance

26 Oil pump - examination and renovation

1 Unscrew the bolts and remove the oil pump cover (see illustration).

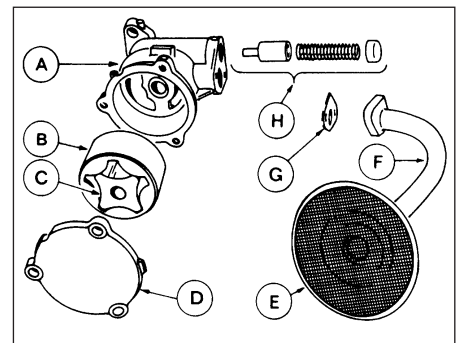
2 Using feeler blades check that the rotor clearances are within the limits given in Specifications (see illustrations). If not, unbolt the pick-up tube and strainer and obtain a new unit (see illustration). Fit the pick-up tube and strainer to the new pump using a new gasket, and tighten the bolts.

3 If the oil pump is serviceable refit the cover and tighten the bolts.

27 Crankshaft and bearings - examination and renovation

1 Examine the bearing surfaces of the crankshaft for scratches or scoring and, using a micrometer, check each journal and crankpin for ovality. Where this is found to be in excess of 0.0254 mm (0.001 in) the crankshaft will have to be reground and undersize bearings fitted.

2 Crankshaft regrinding should be carried out by a suitable engineering works, who will normally supply the matching undersize main and big-end shell bearings.



26.2d Exploded view of the oil pump

A Body

B Outer rotor

C Inner rotor

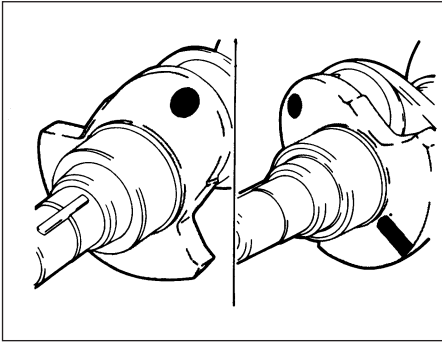
D Cover

E Strainer

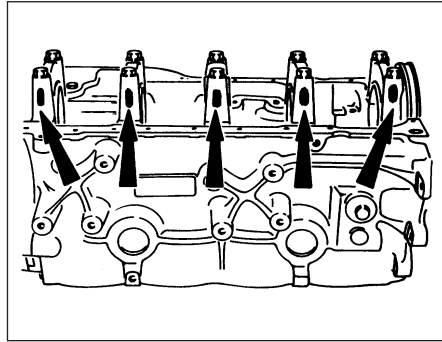
F Pick-up tube

G Gasket

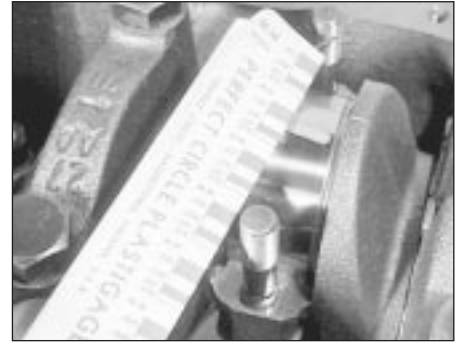
H Relief valve



27.3a Undersize crankshaft bearings are indicated by a spot and/or line on the front counterweight



27.3b Main bearing cap marks (arrowed) denote oversize parent bore



27.5 Checking the width of the Plastigage filament against the scale on the packet

3 Note that undersize bearings may already have been fitted, either in production or by a previous repairer. Check the markings on the backs of the old bearing shells, and if in doubt take them along when buying new ones (see illustrations). Production undersizes are also indicated by paint marks as follows:

White line on main bearing cap - parent bore 0.40 mm oversize

Green line on crankshaft front counterweight - main bearing journals 0.25 mm undersize

Green spot on counterweight - big-end bearing journals 0.25 mm undersize

4 If the crankshaft endfloat is more than the maximum specified amount, new thrustwashers should be fitted to the centre main bearings. These are usually supplied together with the main and big-end bearings on a reground crankshaft.

5 An accurate method of determining bearing wear is by the use of Plastigage. The crankshaft is located in the main bearings (and big-end bearings if necessary) and the Plastigage filament located across the journal which must be dry. The cap is then fitted and the bolts/nuts tightened to the specified torque. On removal of the cap the width of the filaments is checked against a scale which shows the bearing running clearance. This clearance is then compared with that given in the Specifications (see illustration).

6 If the spigot bearing in the rear of the crankshaft requires renewal extract it with a suitable puller. Alternatively fill it with heavy

grease and use a close fitting metal dowel driven into the centre of the bearing. Drive the new bearing into the crankshaft with a soft metal drift.

28 Cylinder block and bores - examination and renovation

1 The cylinder bores must be examined for taper, ovality, scoring and scratches. Start by examining the top of the bores; if these are worn, a slight ridge will be found which marks the top of the piston ring travel. If the wear is excessive, the engine will have had a high oil consumption rate accompanied by blue smoke from the exhaust.

2 If available, use an inside dial gauge to measure the bore diameter just below the ridge and compare it with the diameter at the bottom of the bore, which is not subject to wear. If the difference is more than 0.152 mm (0.006 in), the cylinders will normally require reboring with new oversize pistons fitted.

3 Proprietary oil control rings can be obtained for fitting to the existing pistons if it is felt that the degree of wear does not justify a rebore. However, any improvement brought about by such rings may be short-lived.

4 If new pistons or piston rings are to be fitted to old bores, deglaze the bores with abrasive paper or a "glaze buster" tool. The object is to produce a light cross-hatch pattern to assist the new rings to bed in.

5 If there is a ridge at the top of the bore and new piston rings are being fitted, either the top piston ring must be stepped ("ridge dodger" pattern) or the ridge must be removed with a ridge reamer. If the ridge is left, the piston ring may hit it and break.

6 Thoroughly examine the crankcase and cylinder block for cracks and damage and use a piece of wire to probe all oilways and waterways to ensure that they are unobstructed.

29 Pistons and connecting rods - examination and renovation

1 Examine the pistons for ovality, scoring and scratches. Check the connecting rods for wear and damage. The connecting rods carry a letter indicating their weight class; all the rods fitted to one engine must be of the same class (see illustration).

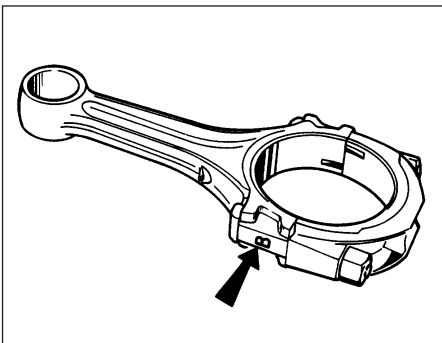
2 The gudgeon pins are an interference fit in the connecting rods, and if new pistons are to be fitted to the existing connecting rods the work should be carried out by a Ford garage who will have the necessary tooling. Note that the oil splash hole on the connecting rod must be located on the right-hand side of the piston (the arrow on the piston crown faces forwards) (see illustration).

3 If new rings are to be fitted to the existing pistons, expand the old rings over the top of the pistons. The use of two or three old feeler blades will be helpful in preventing the rings dropping into empty grooves. Note that the oil control ring is in three sections.

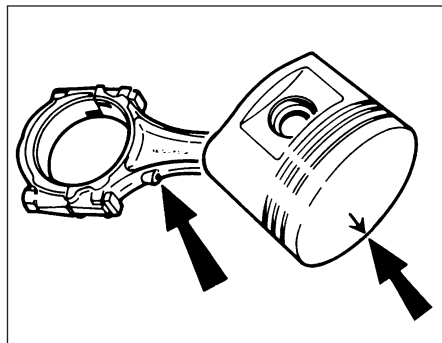
4 Before fitting the new rings to the pistons, insert them into the cylinder bore and use a feeler blade to check that the end gaps are within the specified limits (see illustrations).

5 Clean out the piston ring grooves using a piece of old piston ring as a scraper. Be careful not to scratch the aluminium surface of the pistons. Protect your fingers - piston ring edges are sharp. Also probe the groove oil return holes.

6 Fit the oil control ring sections with the spreader ends abutted opposite the front of the piston. The side ring gaps should be 25 mm



29.1 Weight class mark (arrowed) on connecting rod



29.2 Relationship of piston crown arrow and connecting rod oil splash hole (arrowed)



29.4a Checking a piston ring gap at the top of the cylinder

(1.0 in) either side of the spreader gap. Fit the tapered lower compression ring with the TOP mark towards the top of the piston and the gap 150° from the spreader gap, then fit the upper compression ring with the gap 150° on the other side of the spreader gap. Note that the compression rings are coated with a molybdenum skin which must not be damaged. 7 Note that the compression rings are made of cast iron, and will snap if expanded too far.

30 Camshaft and cam followers - examination and renovation

Examine the surface of the camshaft journals and lobes and the cam followers for wear. If excessive, considerable noise would have been noticed from the top of the engine and a new camshaft and followers must be fitted.

Check the camshaft bearings for wear and if necessary have them renewed by a Ford garage.

Check the camshaft lubrication tube for obstructions and make sure that the jet holes are clear. Obstruction of the holes can be due to sludge build-up which occurs when regular oil changes have been neglected.

31 Auxiliary shaft - examination and renovation

Examine the auxiliary shaft for wear and damage and renew it if necessary.

If the auxiliary shaft endfloat is outside the limits given in the Specifications fit a new thrust plate. If this does not bring the endfloat within limits, renew the shaft.

32 Timing belt - examination and renovation

Whenever the timing belt is removed it is worthwhile renewing it, especially if it has covered a high mileage. This is more important on the 2.0 litre engine where stripped teeth on the timing belt can cause the pistons to foul the valves.



29.4b Checking a ring gap at the bottom of the cylinder

33 Flywheel ring gear - examination and renovation

If the ring gear is badly worn or has missing teeth, it should be renewed. The old ring can be removed from the flywheel by cutting a notch between two teeth with a hacksaw and then splitting it with a cold chisel. Wear eye protection when doing this.

To fit a new ring gear requires heating the ring to 204°C (400°F). This can be done by polishing four equal sections of the gear, laying it on a suitable heat resistant surface (such as fire bricks) and heating it evenly with a blow lamp or torch until the polished areas turn a light yellow tinge. Do not overheat or the hard wearing properties will be lost. The gear has a chamfered inner edge which should go against the shoulder when put on the flywheel. When hot enough place the gear in position quickly, tapping it home if necessary and let it cool naturally, without quenching.

34 Cylinder head - decarbonising, valve grinding and renovation

1 This operation will normally only be required at comparatively high mileages. However, if persistent pinking occurs and performance has deteriorated even though the engine adjustments are correct, decarbonising and valve grinding may be required.

2 With the cylinder head removed, use a scraper to remove the carbon from the combustion chambers and ports. Remove all traces of gasket from the cylinder head surface, then wash it thoroughly with paraffin.

3 Use a straight-edge and feeler blade to check that the cylinder head surface is not distorted. If it is, it must be resurfaced by a suitably equipped engineering works.

4 If the engine is still in the car, clean the piston crowns and cylinder bore upper edges, but make sure that no carbon drops between the pistons and bores. To do this, locate two of the pistons at the top of their bores and seal off the remaining bores with paper and masking tape. Press a little grease between the two pistons and their bores to collect any carbon dust; this can be wiped away when the piston is lowered.



To prevent carbon build-up, polish the piston crown with metal polish, but remove all traces of the polish after.

5 Examine the heads of the valves for pitting and burning, especially the exhaust valve heads. Renew any valve which is badly burnt. Examine the valve seats at the same time. If the pitting is very slight, it can be removed by grinding the valve heads and seats together with coarse, then fine, grinding paste.

6 Where excessive pitting has occurred, the valve seats must be recut or renewed by a suitably equipped engineering works.

7 Valve grinding is carried out as follows. Place the cylinder head upside down on a bench on blocks of wood.

8 Smear a trace of coarse carborundum paste on the seat face and press a suction grinding tool onto the valve head. With a semi-rotary action, grind the valve head to its seat, lifting the valve occasionally to redistribute the grinding paste. When a dull matt even surface is produced on both the valve seat and the valve, wipe off the paste and repeat the process with fine carborundum paste as before. A light spring placed under the valve head will greatly ease this operation. When a smooth unbroken ring of light grey matt finish is produced on both the valve and seat, the grinding operation is complete.

9 Scrape away all carbon from the valve head and stem, and clean away all traces of grinding compound. Clean the valves and seats with a paraffin soaked rag, then wipe with a clean rag.

10 If the guides are worn they will need reboring for oversize valves or for fitting guide inserts. The valve seats will also need recutting to ensure that they are concentric with the stems. This work should be given to your Ford dealer or local engineering works.

11 If the valve springs have been in use for 20 000 miles (32 000 km) or more, renew them. Always renew the valve stem oil seals when the valves are removed.

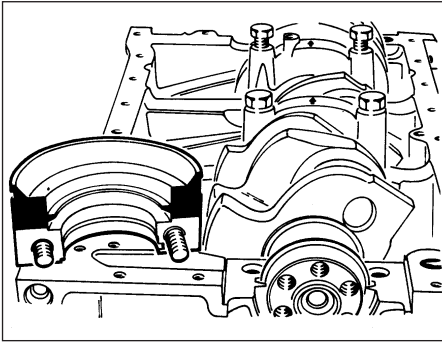
35 Engine reassembly - general information

1 To ensure maximum life with minimum trouble from a rebuilt engine, not only must everything be correctly assembled, but it must also be spotlessly clean. All oilways must be clear, and locking washers and spring washers must be fitted where indicated. Oil all bearings and other working surfaces thoroughly with engine oil during assembly.

2 Before assembly begins, renew any bolts or studs with damaged threads.

3 Gather together a torque wrench, oil can, clean rag, and a set of engine gaskets and oil seals, together with a new oil filter.

4 If they have been removed, new cylinder head bolts and flywheel bolts will also be required.



36.12 Apply sealant to the rear main bearing cap areas shown darkened



36.14 Fitting a thrust washer to the centre main bearing cap



36.19 Fitting a sealing wedge to the rear main bearing cap

36 Crankshaft and main bearings - refitting



- 1 Wipe the bearing shell locations in the crankcase with a soft, non-fluffy rag.
- 2 Wipe the crankshaft journals with a soft, non-fluffy rag.
- 3 Fit the five upper half main bearing shells to their locations in the crankcase. If the old shells are being re-used, make sure they are refitted to their old locations.
- 4 Identify each main bearing cap and place in order. The number is cast onto the cap and on intermediate caps an arrow is also marked which should point towards front of engine.
- 5 Wipe the cap bearing shell location with a soft non-fluffy rag.
- 6 Fit the bearing half shell onto each main bearing cap.
- 7 Apply a little grease to each side of the centre main bearing so as to retain the thrustwasher.
- 8 Fit the upper halves of the thrustwashers into their grooves either side of the main bearing. The slots must face outwards.
- 9 Lubricate the crankshaft journals and the upper and lower main bearing shells with engine oil and locate the rear oil seal (with lip lubricated) on the rear of the crankshaft.
- 10 Carefully lower the crankshaft into the crankcase.
- 11 Lubricate the crankshaft main bearing journals again and then fit No 1 bearing cap. Fit the two securing bolts but do not tighten yet.

12 Make sure that the mating faces are clean, then apply sealant (Loctite 518 or equivalent) to the areas on the rear main bearing cap (see illustration).

13 Fit the rear main bearing cap. Fit the two securing bolts, but as before do not tighten yet.

14 Apply a little grease to either side of the centre main bearing cap so as to retain the thrustwashers. Fit the thrustwashers with the tag located in the groove and the slots facing outwards (see illustration).

15 Fit the centre main bearing cap and the two securing bolts, then refit the intermediate main bearing caps. Make sure that the arrows point towards the front of the engine.

16 Lightly tighten all main cap securing bolts and then fully tighten in a progressive manner to the specified torque wrench setting.

17 Check that the crankshaft rotates freely. Some stiffness is to be expected with new components, but there must be no tight spots or binding.

18 Check that the crankshaft endfloat is within the specified limits by inserting a feeler blade between the centre crankshaft web and the thrustwashers.

19 Make sure that the rear oil seal is fully located onto its seating. Coat the rear main bearing cap wedges with sealing compound, then press them into position with the rounded red face towards the cap (see illustration).

20 Refit the oil pump and strainer.

21 Refit the crankshaft front oil seal housing, and auxiliary shaft front cover, if applicable, together with a new gasket and tighten the bolts.

Make sure that the bottom face of the housing is aligned with the bottom face of the block.

22 Refit the flywheel or driveplate and the pistons and connecting rods.

23 Refit the timing belt and sprockets.

37 Pistons and connecting rods - refitting



1 Clean the backs of the bearing shells and the recesses in the connecting rods and big-end caps.

2 Press the bearing shells into the connecting rods and caps in their correct positions and oil them liberally. Note that the lugs must be adjacent to each other (see illustration).

3 Lubricate the cylinder bores with engine oil.

4 Fit a ring compressor to No 1 piston, then insert the piston and connecting rod into No 1 cylinder. With No 1 crankpin at its lowest point, drive the piston carefully into the cylinder with the wooden handle of a hammer, and at the same time guide the connecting rod onto the crankpin. Make sure that the arrow on the piston crown is facing the front of the engine (see illustrations).

5 Oil the crankpin, then fit the big-end bearing cap in its previously noted position. Oil the big-end bearing cap nuts, fit the nuts and tighten them to the specified torque.

6 Check that the crankshaft turns freely.

7 Repeat the procedure given in paragraphs 4 to 6 inclusive on the remaining pistons.

8 Refit the cylinder head and sump.



37.2 Big-end bearing shell lugs (arrowed) are adjacent



37.4a Fitting a piston ring compressor



37.4b Piston crown markings
Arrow points to front of engine

38 Oil pump - refitting



- 1 Insert the oil pump driveshaft into the block in its previously noted position.
- 2 Prime the pump by injecting oil into it and turning it by hand (see illustration).
- 3 Fit the pump, insert the bolts and tighten them to the specified torque with the splined key.
- 4 Insert the pick-up tube securing bolt and tighten it.
- 5 Where applicable refit the crankshaft front oil seal housing together with a new gasket and tighten the bolts. Make sure that the bottom face of the housing is aligned with the bottom face of the block.
- 6 Refit the sump.



38.2 Priming the oil pump

- 3 Locate the sump on the gaskets and insert the bolts loosely.
- 4 Tighten the bolts to the specified torques in the two stages given in the Specifications (see illustration). Tighten to the first stage in circular sequence starting at point A, then tighten to the second stage starting at point B. Tighten to the third stage after the engine has been running for twenty minutes.
- 5 If the engine is in the vehicle, reverse the steps taken to gain access to the sump.

39 Sump - refitting



- 1 Apply sealing compound to the corners of the front and rear rubber sealing strap locations, then press the strips into the grooves of the rear main bearing cap and crankshaft front oil seal housing (see illustrations)
- 2 Apply a little sealing compound to the bottom face of the cylinder block, then fit the sump gaskets in position and locate the end tabs beneath the rubber sealing strips (see illustration).



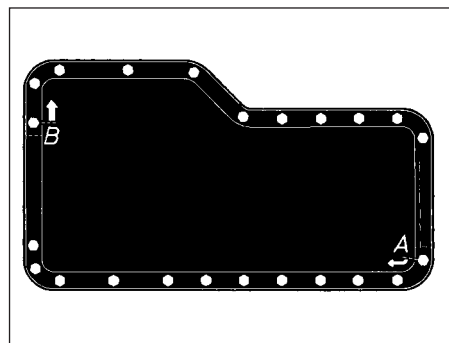
39.1a Applying sealing compound to a rubber strip location



39.1b Fitting the rubber strip into its groove



39.2 Locate the gasket tabs beneath the sealing strips



39.4 Sump bolt tightening sequence
For A and B see text



40.4a Method of holding the flywheel when tightening the bolts



40.4b Tightening a flywheel bolt

40 Flywheel/driveplate and adapter plate - refitting



- 1 If it was removed, refit the adapter plate (backplate) over the dowels on the rear of the block.

41 Auxiliary shaft - refitting



- 1 Oil the auxiliary shaft journals, then insert the shaft into the cylinder block.
- 2 Locate the thrust plate in the shaft groove, then insert the crosshead screws and tighten them with an impact screwdriver.
- 3 Support the front cover on blocks of wood and drive out the old oil seal. Drive in the new seal using a metal tube or socket (see illustrations). Make sure that the sealing lip faces toward the engine. Smear a little oil on the lip.
- 4 If applicable cut the unwanted top half of a new gasket and locate it on the cylinder block, then fit the front cover and tighten the bolts.
- 5 Refit the fuel pump and operating rod (when applicable).
- 6 Refit the distributor.
- 7 Refit the auxiliary shaft sprocket and timing belt.



41.3a Driving out the auxiliary shaft cover oil seal



41.3b Fitting a new oil seal in the auxiliary shaft cover



42.3 Cam follower ball-pins and spring clips fitted

42 Cylinder head - reassembly



- 1 Refit the thermostat and housing.
- 2 Refit the timing belt tensioner if it was removed, but do not tighten the bolts yet.
- 3 If applicable, screw the cam follower ball-pins in their correct locations (see illustration).
- 4 Oil the valve stems and insert the valves in their correct guides.
- 5 Wrap some adhesive tape over the collet groove of each valve, then oil the oil seals and slide them over the valve onto the guides. Use a suitable metal tube if necessary to press them onto the guides. Remove the adhesive tape.
- 6 Working on each valve in turn, fit the valve spring and cap, then compress the spring with the compressor and insert the split collets. Release the compressor and remove it. Tap the end of the valve stem with a non-metallic mallet to settle the collets. If tool 21-005-A is being used, first locate the camshaft in its bearings.



A dab of grease on the collets will keep them in position on the valve stem

- 7 Refit the camshaft.



43.1 Fitting the camshaft front bearing oil seal

43 Camshaft - refitting



- 1 Drive the new oil seal into the camshaft front bearing location on the cylinder head using a suitable metal tube or socket (see illustration). Smear the lip with engine oil.
- 2 Lubricate the bearings with hypoid SAE 80/90 oil, then carefully insert the camshaft.
- 3 Locate the thrust plate in the camshaft groove, then insert and tighten the bolts.
- 4 Using feeler blades check that the endfloat is as given in the Specifications.
- 5 Lubricate the ball-pins with hypoid SAE 80/90 oil, then fit the cam followers in their correct locations and retain with the spring clips. It will be necessary to rotate the camshaft during this operation.
- 6 Fit the oil supply tube and tighten the bolts.
- 7 Fit the camshaft sprocket backplate and sprocket. Insert and tighten the bolt while holding the camshaft stationary with a spanner on the lug (see illustration).
- 8 Refit the cylinder head.

44 Cylinder head - refitting



- 1 Adjust the valve clearances. This work is easier to carry out on the bench rather than in the car.
- 2 Turn the engine so that No 1 piston is approximately 2 cm (0.8 in) before top dead



43.7 Fitting the camshaft sprocket backplate



44.3 Fitting a new cylinder head gasket

centre. This precaution will prevent any damage to open valves.

3 Make sure that the faces of the cylinder block and cylinder head are perfectly clean, then locate the new gasket on the block making sure that all the internal holes are aligned (see illustration). Do not use jointing compound.

4 Turn the camshaft so that the TDC pointer is aligned with the indentation on the front of the cylinder head.

5 Lower the cylinder head onto the gasket. The help of an assistant will ensure that the gasket is not dislodged. Alternatively, make a couple of guide studs by sawing the heads off two old cylinder head bolts; remove the studs when the head is in position.

6 Lightly oil the heads and threads of the new head bolts and insert them into their holes.

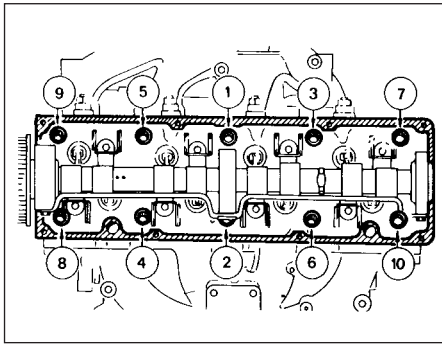
7 Using the Torx key, tighten the bolts progressively to the Stage 1 specified torque in the indicated sequence (see illustration).

8 In the same sequence tighten the bolts to the Stage 2 specified torque.

9 Wait five minutes, then tighten the bolts through the angle specified for Stage 3, still following the same sequence. (If the engine is on the bench, it may be preferable to leave this final stage until after refitting the engine, when the problem of holding it still will not arise.)

10 Refit the rocker cover, using a new gasket. Make sure that the dovetail sections of the gasket engage correctly (see illustration).

11 Fit the rocker cover bolts and reinforcing plates. Tighten the bolts as follows, referring to



44.7 Cylinder head bolt tightening sequence

the Specifications and to illustration 44.11:

- Stage 1 - Bolts 1 to 6
- Stage 2 - Bolts 7 and 8
- Stage 3 - Bolts 9 and 10
- Stage 4 - Bolts 7 and 8 (again)

12 No further tightening of the cylinder head bolts is required.

13 Refit and tension the timing belt as described in the next Section.

45 Timing belt and sprockets - refitting

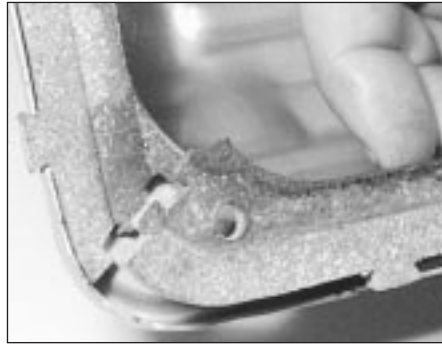
1 Fit the camshaft sprocket backplate and sprocket. Insert the bolt, hold the camshaft or sprocket and tighten the bolt to the specified torque.



45.4 Fitting the timing belt over the crankshaft sprocket



45.5a Refitting the crankshaft pulley



44.10 Dovetail section of rocker cover gasket

2 Fit the auxiliary shaft sprocket with the ribs towards the engine. Fit the sprocket bolt and tighten it to the specified torque, counterholding the sprocket with a bar through one of the holes.

3 Fit the crankshaft sprocket, chamfered side inwards.

4 Fit the timing belt over the camshaft sprocket, but do not engage it with the other sprockets yet. Be careful not to kink the belt. If the old belt is being refitted, observe the previously noted running direction (see illustration).

5 Refit the guide washer and the crankshaft pulley. Fit the bolt and washer and tighten just enough to seat the pulley, being careful not to turn the crankshaft (see illustrations).

6 Make sure that the TDC pointer on the camshaft sprocket backplate is still aligned with the indentation on the cylinder head.

7 Turn the crankshaft by the shortest route to align the TDC notch in the pulley with the pointer on the oil seal housing.

8 If the distributor is fitted, turn the auxiliary shaft sprocket so that the rotor arm points to the No 1 HT segment position.

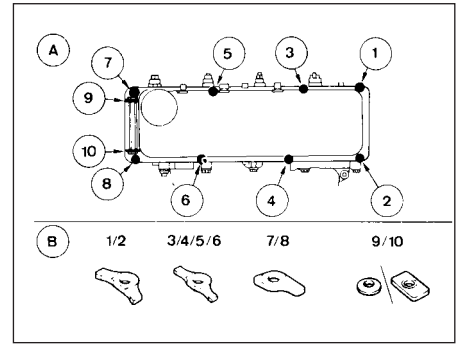
9 Fit the timing belt over the sprockets and round the tensioner. Move the tensioner to tension the belt roughly and nip up the tensioner bolts.

10 Turn the crankshaft through two full turns clockwise, then 60° anti-clockwise (so it is now at 60° BTDC)

11 The belt tension should now ideally be checked by applying Ford tension gauge 21-113



45.5b Crankshaft pulley bolt and washer



44.11 Rocker cover bolts (A) and reinforcing plates (B)

For tightening sequence see text

to the longest run. Desired gauge readings are:

Used belt - 4 to 5

New belt - 10 to 11

12 If the tension gauge is not available, a rough guide is that belt tension is correct when the belt can be twisted 90° in the middle of the longest run with the fingers (see illustration).

13 If adjustment of belt tension is necessary, turn the crankshaft clockwise to bring No 1 cylinder to TDC (see illustration) then slacken the tensioner bolts and move the tensioner to increase or decrease belt tension. Tighten the tensioner bolts.

14 Turn the crankshaft 90° clockwise past TDC, then anti-clockwise back to the 60° BTDC position. Check the belt tension again.

15 Repeat the above procedure until the belt tension is correct.

16 Tighten the tensioner bolts and the crankshaft pulley bolt to the specified torques (see illustration).

17 Refit the belt cover and tighten its bolts.

18 If the engine is in the vehicle, reverse the preliminary steps given in Section 13.

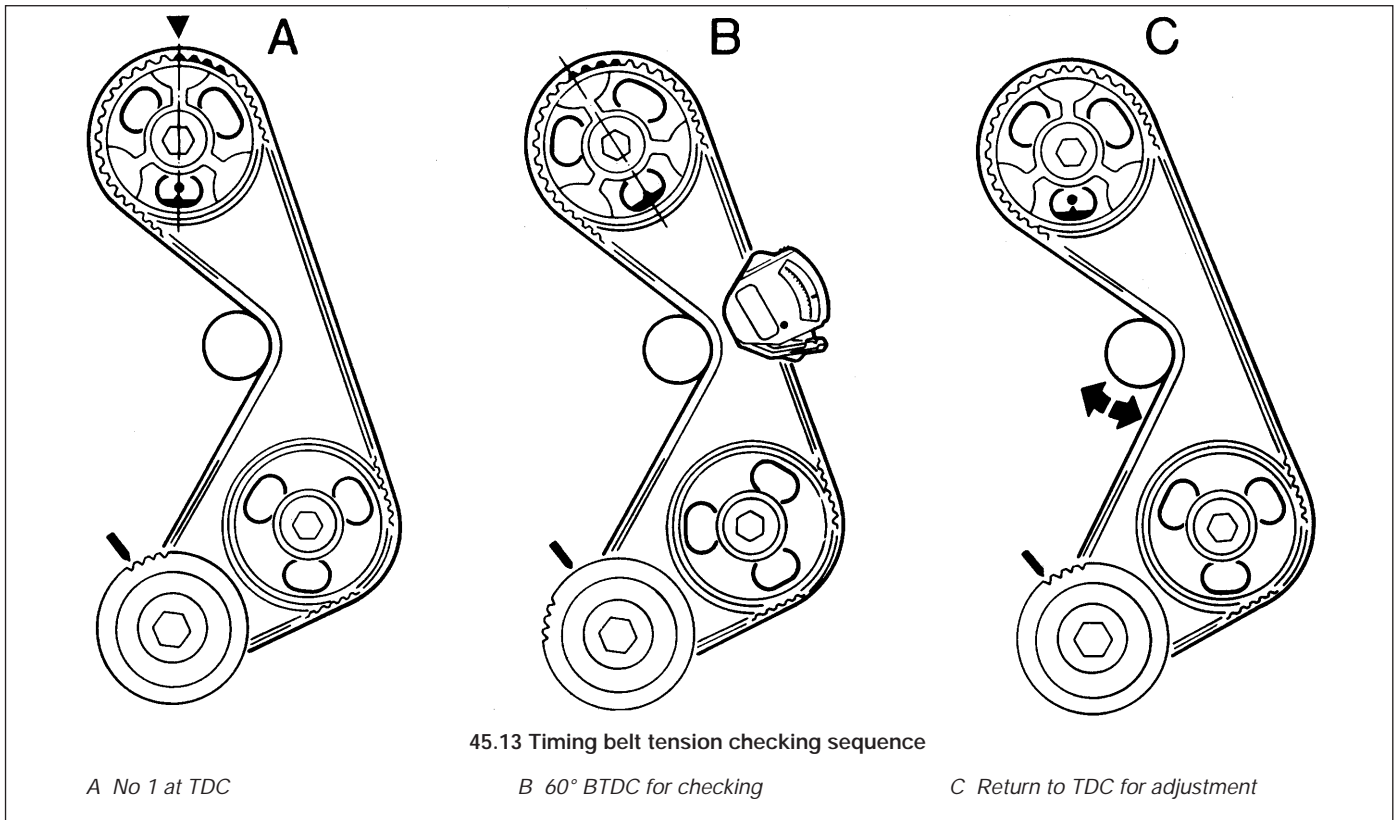
19 Check the ignition timing when the engine is next run.

46 Ancillary components - refitting

Refer to Section 9 and refit the components listed. Delicate items such as the alternator and distributor may be left until after the engine has been refitted, if preferred.



45.12 Twisting the timing belt to assess its tension



2A



45.16 Holding the crankshaft pulley with two bolts and a lever while tightening the central bolt

If the crankcase ventilation oil separator was removed, apply a liquid locking agent to its tube before pressing it into the cylinder block.

47 Engine and gearbox - reconnection

- 1 Make sure that the clutch is centred.
- 2 Apply a smear of grease or anti-seize compound to the gearbox input shaft splines.
- 3 With the aid of an assistant, offer the gearbox to the engine. If the input shaft is reluctant to enter the clutch, rock the gearbox slightly or turn the crankshaft back and forth. Support the gearbox until it is engaged with the dowels on the engine - do not leave it hanging on the input shaft.

- 4 Refit the engine-to-bellhousing bolts, the bracing strap and the starter motor.

48 Engine - refitting with manual gearbox

- 1 Sling the engine/gearbox unit so that it hangs at an angle of approximately 45°.
- 2 Lower the unit into the engine bay, at the same time moving it towards the rear of the vehicle. Have an assistant watch as the unit is lowered to check that no pipes, wires etc are fouled or trapped.
- 3 Raise the gearbox as the engine is lowered until the unit takes up its correct position. Secure the engine bearers to the mountings and refit the gearbox crossmember.
- 4 The remainder of refitting is a reversal of the removal procedure. Refer to Section 6. Also refer to Section 49, paragraph 9.
- 5 Before starting the engine, refer to Section 51.

49 Engine - refitting without gearbox/transmission

- 1 On manual gearbox models, check that the clutch is centred correctly. Apply a smear of grease or anti-seize compound to the gearbox input shaft.
- 2 On automatic transmission models, check that the torque converter is fully engaged with the transmission oil pump.
- 3 Sling the engine so that it is roughly horizontal.

Lift it and position it over the engine bay.

- 4 Lower the engine into place. Have an assistant watch as the unit is lowered to check that no pipes, wires etc are fouled or trapped.
- 5 Guide the engine onto the transmission, raising or lowering the transmission slightly if necessary. Do not place any weight on the transmission input shaft. With manual gearbox models, rock the engine gently from side to side to encourage the input shaft to enter the clutch.
- 6 When the engine and transmission are fully engaged, refit the engine-to-bellhousing bolts. Do not overlook the earth strap.
- 7 Lower the engine so that the engine bearers engage with the mountings. Fit the mounting nuts and remove the lifting tackle.
- 8 On automatic transmission models, bolt the torque converter to the driveplate.
- 9 The remainder of refitting is a reversal of the removal procedure. Note the following additional points:
 - a) Refill the engine with oil
 - b) Check the transmission oil level if necessary
 - c) Adjust the tension of the accessory drivebelts
 - d) Adjust the throttle cable
 - e) Adjust the downshift cable when applicable
 - f) Refill the cooling system
- 10 Before starting the engine, see Section 51

50 Valve clearances - checking and adjustment



See Chapter 1, Section 23.

51 Initial start-up after overhaul or major repair



- 1 Make a final check to ensure that everything has been reconnected to the engine and that no rags or tools have been left in the engine bay.
- 2 Check that oil and coolant levels are correct.
- 3 Start the engine. This may take a little longer than usual as fuel is pumped up to the engine.
- 4 Check that the oil pressure light goes out when the engine starts.
- 5 Run the engine at a fast tickover and check for leaks of oil, fuel and coolant. Also check power steering and transmission fluid cooler unions, when applicable. Some smoke and odd smells may be experienced as assembly lubricant burns off the exhaust manifold and other components.

- 6 Bring the engine to operating temperature. Check the ignition timing then adjust the idle speed (if applicable) and mixture.
- 7 Stop the engine and allow it to cool, then re-check the oil and coolant levels.
- 8 If new bearings, pistons etc have been fitted, the engine should be run in at reduced speeds and loads for the first 500 miles (800 km) or so. It is beneficial to change the engine oil and filter after this mileage.

52 Compression test - description and interpretation



- 1 When engine performance is down, or if misfiring occurs which cannot be attributed to the ignition or fuel system, a compression test can provide diagnostic clues. If the test is performed regularly it can give warning of trouble before any other symptoms become apparent.
- 2 The engine must be at operating temperature, the battery must be fully charged and the spark plugs must be removed. The services of an assistant will also be required.
- 3 Disable the ignition system by dismantling

the coil LT feed. Fit the compression tester to No 1 spark plug hole. (The type of tester which screws into the spark plug hole is to be preferred.)

- 4 Have the assistant hold the throttle wide open and crank the engine on the starter. Record the highest reading obtained on the compression tester.
- 5 Repeat the test on the remaining cylinders, recording the pressure developed in each.
- 6 Desired pressures are given in the Specifications. If the pressure in any cylinder is low, introduce a teaspoonful of clean engine oil into the spark plug hole and repeat the test.
- 7 If the addition of oil temporarily improves the compression pressure, this indicates that bore or piston wear was responsible for the pressure loss. No improvement suggests that leaking or burnt valves, or a blown head gasket, may be to blame.
- 8 A low reading from two adjacent cylinders is almost certainly due to the head gasket between them having blown.
- 9 On completion of the test, refit the spark plugs and reconnect the coil LT feed.