

Chapter 2 Part C:

2.4, 2.8 and 2.9 litre V6 engines

Contents

Ancillary components - refitting	40	Flywheel/driveplate and adapter plate - refitting	35
Ancillary components - removal	7	Flywheel/driveplate and adapter plate - removal	11
Camshaft and bearings - examination and renovation	22	Flywheel ring gear - examination and renovation	28
Camshaft and intermediate plate - refitting	32	General information	1
Camshaft and intermediate plate - removal	14	Initial start-up after overhaul or major repair	42
Compression test - description and interpretation	43	Major operations possible with the engine in the vehicle	2
Crankcase ventilation system - general information	29	Major operations requiring engine removal	3
Crankshaft and bearings - examination	26	Methods of engine removal	4
Crankshaft and main bearings - refitting	31	Oil pump - dismantling, examination and reassembly	27
Crankshaft and main bearings - removal	15	Oil pump - refitting	34
Crankshaft front oil seal - renewal	17	Oil pump - removal	12
Crankshaft rear oil seal - renewal	18	Pistons and connecting rods - examination and renovation	25
Cylinder bores - examination and renovation	24	Pistons and connecting rods - refitting	33
Cylinder heads - overhaul	23	Pistons and connecting rods - removal	13
Cylinder heads - refitting	38	Rocker shaft - dismantling, examination and reassembly	20
Cylinder heads - removal	8	Sump - refitting	37
Engine - refitting	41	Sump - removal	9
Engine - removal	5	Tappets and pushrods - examination	21
Engine dismantling - general	6	Timing cover and drive - refitting	36
Engine mountings - renewal	16	Timing cover and drive - removal	10
Engine reassembly - general information	30	Valve clearances - checking and adjustment	39
Examination and renovation - general information	19		

2C

Degrees of difficulty

Easy , suitable for novice with little experience 	Fairly easy , suitable for beginner with some experience 	Fairly difficult , suitable for competent DIY mechanic 	Difficult , suitable for experienced DIY mechanic 	Very difficult , suitable for expert DIY or professional 
---	--	--	---	--

Specifications

2.8 litre engine

General

Manufacturer's code	PRE
Bore - mm (in)	93.0 (3.66)
Stroke - mm (in)	68.5 (2.70)
Cubic capacity - cc (cu in)	2792 (170)
Compression ratio	9.2:1
Compression pressure at cranking speed	11.5 to 12.5 bar (167 to 181 lbf/in ²)
Maximum power (DIN, kW @ rpm)	110 @ 5800
Maximum torque (DIN, Nm @ rpm)	216 @ 3000

Lubrication system

Oil type	See "Lubricants and fluids"
Oil capacity (drain and refill, including filter)	4.25 litres (7.5 pints) approx
Oil pressure (SAE 10W/30 oil at 80°C/176°F):	
At 750 rpm	1.0 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

2C•2 V6 engines

Oil pump

Type	Bi-rotor
Drive	From camshaft
Operating clearances:	
Outer rotor-to-housing	0.15 to 0.30 mm
Inner-to-outer rotor	0.05 to 0.20 mm
Rotor endfloat	0.03 to 0.10 mm

Cylinder block

Cast identification mark	E
Bore diameter:	
Standard grade 1	93.010 to 93.020 mm
Standard grade 2	93.020 to 93.030 mm
Standard grade 3	93.030 to 93.040 mm
Standard grade 4	93.040 to 93.050 mm
Oversize grade A	93.520 to 93.530 mm
Oversize grade B	93.530 to 93.540 mm
Oversize grade C	93.540 to 93.550 mm
Standard service grade	93.040 to 93.050 mm
Oversize 0.5	93.540 to 93.550 mm
Oversize 1.0	94.040 to 94.050 mm
Main bearing parent bore:	
Standard	60.620 to 60.640 mm
Oversize	61.000 to 61.020 mm
Camshaft bearing bore (without bushes):	
Front	47.025 to 47.060 mm
Front centre	46.645 to 46.680 mm
Rear centre	46.265 to 46.300 mm
Rear	45.885 to 45.920 mm

Crankshaft

Number of main bearings	4
Main bearing journal diameter (standard)	56.980 to 57.000 mm
Main bearing running clearance	0.008 to 0.062 mm
No 3 (thrust) bearing shoulder width (standard)	26.390 to 26.440 mm
No 3 (thrust) flanged bearing shell width (standard)	26.240 to 26.290 mm
Crankshaft endfloat	0.08 to 0.20 mm
Big-end bearing journal diameter (standard)	53.980 to 54.000 mm
Big-end bearing running clearance	0.006 to 0.064 mm

Pistons

Diameter:	
Standard grade 1	92.972 to 92.982 mm
Standard grade 2	92.982 to 92.992 mm
Standard grade 3	92.992 to 93.002 mm
Standard grade 4	93.002 to 93.012 mm
Service standard	93.000 to 93.020 mm
Oversize 0.5	93.500 to 93.520 mm)
Oversize 1.0	94.000 to 94.020 mm
Clearance in bore	0.020 to 0.050 mm
Piston ring end gaps:	
Top and centre	0.38 to 0.58 mm
Bottom	0.40 to 1.40 mm

Gudgeon pins

Diameter:	
Red	23.994 to 23.997 mm
Blue	23.997 to 24.000 mm
Clearance in piston	0.008 to 0.014 mm
Interference in connecting rod	0.018 to 0.042 mm

Connecting rods

Big-end parent bore diameter	56.820 to 56.840 mm
Small-end bush internal diameter	23.958 to 23.976 mm

Cylinder heads

Cast identification mark	EN
Valve seat angle	44° 30' to 45° 00'
Valve seat width	1.61 to 2.33 mm
Valve guide bore:	
Standard	8.063 to 8.088 mm
Oversizes	+0.2, 0.4, 0.6 and 0.8 mm

Camshaft

Drive	Gear	
Gear backlash	0.17 to 0.27 mm	
Valve timing:		
Inlet opens	26° 30' BTDC	
Inlet closes	69° 30' ABDC	
Exhaust opens	75° 30' BBDC	
Exhaust closes	22° 30' ATDC	
Cam lift:		
Inlet	6.7 mm	
Exhaust	6.6 mm	
Cam length:		
Inlet	35.995 to 36.165 mm	
Exhaust	35.895 to 36.065 mm	
Thrust plate thickness:		
Red	3.960 to 3.985 mm	
Blue	3.986 to 4.011 mm	
Spacer thickness:		
Red	4.075 to 4.100 mm	
Blue	4.101 to 4.125 mm	
Camshaft endfloat	0.02 to 0.10 mm	
Bearing journal diameter:		
Front	43.903 to 43.923 mm	
Front centre	43.522 to 43.542 mm	
Rear centre	43.141 to 43.161 mm	
Rear	42.760 to 42.780 mm	
Bearing bush internal diameter:		
Front	43.948 to 43.968 mm	
Front centre	43.567 to 43.587 mm	
Rear centre	43.186 to 43.206 mm	
Rear	42.805 to 42.825 mm	

Valve clearances (cold)

Inlet	0.35 mm (0.014 in)
Exhaust	0.40 mm (0.016 in)

Inlet valves

Head diameter	41.85 to 42.24 mm
Length	105.25 to 106.95 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
Valve stem oil seal type	Rubber, one size

Exhaust valves

Head diameter	35.83 to 36.21 mm
Length	105.20 to 106.20 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 stem oil seal:	
Type	Nylon, selective sizes
Identification:	
Standard size	White
+ 0.2	Red
+ 0.4	Blue
+ 0.6	Green
+ 0.8	Black

Torque wrench settings

	Nm	lbf ft
Main bearing cap bolts	90 to 104	66 to 77
Big-end cap nuts	26 to 33	19 to 24
Crankshaft pulley/damper central bolt	115 to 130	85 to 96
Camshaft gear bolt	42 to 50	31 to 37
Camshaft thrust plate bolts	17 to 21	13 to 16
Timing cover to cylinder block	17 to 21	13 to 16

2C•4 V6 engines

Torque wrench settings (continued)

	Nm	lbf ft
Timing cover to intermediate plate	13 to 17	10 to 13
Intermediate plate to cylinder block	17 to 21	13 to 16
Oil pump to cylinder block	14 to 17	10 to 13
Oil pump cover bolts	9 to 13	7 to 10
Rocker shaft securing bolts	62 to 70	46 to 52
Sump bolts:		
Stage 1	4 to 7	3 to 5
Stage 2	7 to 10	5 to 7
Sump drain plug	21 to 28	16 to 21
Oil pressure switch	12 to 15	9 to 11
Oil cooler threaded sleeve	20 to 40	15 to 30
Cylinder head hexagon bolts:		
Stage 1	40 to 45	30 to 33
Stage 2	55 to 70	41 to 52
Stage 3 (after 10 to 20 minutes)	95 to 115	70 to 85
Stage 4 (after warm-up)	95 to 115	70 to 85
Cylinder head - Torx bolts:		
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	6 to 8	4 to 6
Fuel pump blanking plate	16 to 18	12 to 13
Flywheel bolts	64 to 70	47 to 52
Bellhousing-to-engine bolts	27 to 30	20 to 22

2.4 litre engine

Note: Unless otherwise stated, the specifications and torque wrench settings for the 2.4 litre engine are as given for the 2.8 litre engine.

General

Manufacturer's code	ARC
Bore - mm (in)	84.0 (3.307)
Stroke - mm (in)	72.0 (2.865)
Cubic capacity - cc (cu in)	2394 (146.1)
Compression ratio	9.5:1
Maximum power (DIN, kW @ rpm)	96 @ 5800
Maximum torque (DIN, Nm @ rpm)	193 @ 3000

Cylinder block

Identification mark	D
Bore diameter:	
Standard grade 1	84.000 to 84.010 mm
Standard grade 2	84.010 to 84.020 mm
Standard grade 3	84.020 to 84.030 mm
Standard grade 4	84.030 to 84.040 mm
Oversize grade A	84.510 to 84.520 mm
Oversize grade B	84.520 to 84.530 mm
Oversize grade C	84.530 to 84.540 mm
Standard service grade	84.030 to 84.040 mm
Oversize 0.5	84.530 to 84.540 mm
Oversize 1.0	85.030 to 85.040 mm

Pistons

Diameter:	
Standard grade 1	83.962 to 83.972 mm
Standard grade 2	83.972 to 83.982 mm
Standard grade 3	83.982 to 83.992 mm
Standard grade 4	83.992 to 84.002 mm
Standard service grade	83.978 to 84.002 mm
Oversize 0.5	84.478 to 84.502 mm
Oversize 1.0	84.978 to 85.002 mm
Clearance in bore	0.028 to 0.048 mm
Piston ring end gap:	
Top and centre	0.30 to 0.50 mm
Bottom (oil control)	0.40 to 1.40 mm

Cylinder head

Identification mark	H
---------------------	---

Crankshaft

Thrustwasher thickness:	
Standard	2.28 to 2.33 mm
Oversize	2.48 to 2.53 mm
Crankshaft endfloat	0.08 to 0.32 mm
Permitted undersize for main and big-end bearing journals	0.254 mm

Camshaft

Camshaft drive	Chain
Cam lift (inlet and exhaust)	6.72 mm
Cam lobe height (inlet and exhaust)	36.08 to 36.25 mm
Camshaft endfloat	0.065 to 0.165 mm
Thrust plate thickness	4.02 to 4.05 mm

Valves

Valve timing:	
Inlet opens	24°BTDC
Inlet closes	64°ABDC
Exhaust opens	66°BBDC
Exhaust closes	22°ATDC
Head diameter:	
Inlet valve	39.67 to 40.06 mm
Exhaust valve	33.83 to 34.21 mm
Length:	
Inlet valve	106.2 to 106.9 mm
Exhaust valve	106.1 to 107.1 mm
Valve spring free length	55.12 mm

Torque wrench settings

	Nm	lbf ft
Camshaft sprocket bolt	60 to 68	44 to 50
Camshaft thrust plate	9 to 13	7 to 10
Timing chain guide to block bolts	10 to 12	7 to 9
Timing chain tensioner to block	9 to 11	7 to 8
Oil inlet pipe to oil pump bolts	9 to 13	7 to 10
Oil pump to block bolts	17 to 21	13 to 15
Sump drain plug	21 to 28	15 to 21
Crankshaft pulley to vibration damper bolts	27 to 33	20 to 24
Crankshaft vibration damper bolt:		
Stage 1	40 to 50	30 to 37
Stage 2	Tighten further 80° to 90°	Tighten further 80° to 90°

2.9 litre engine

Note: Unless otherwise stated, the specifications and torque wrench settings for the 2.9 litre engine are as given for the 2.8 litre engine.

General

Manufacturer's code:	
Models without catalytic converter	BRC
Models equipped with type N manual gearbox or automatic transmission and a catalytic converter	BRD
Models equipped with MT75 manual gearbox and catalytic converter	BRE
Stroke - mm (in)	72.0 (2.835)
Cubic capacity - cc (cu in)	2936 (179.2)
Compression ratio:	
BRC engine	9.5:1
BRD and BRE engine	9.0:1
Maximum power (DIN, kW @ rpm):	
BRC engine	110 @ 5700
BRD and BRE engines	107 @ 5500
Maximum torque (DIN, Nm @ rpm):	
BRC engine	233 @ 3000
BRD engine	222 @ 3000
BRE engine	226 @ 3000

Cylinder block

Identification mark	F
---------------------	---

Pistons

Clearance in bore	0.028 to 0.048 mm
Piston ring end gaps:	
Top and centre	0.30 to 0.50 mm

Cylinder head

Identification mark:

BRC engine	F
BRD and BRE engines	K

Crankshaft

Crankshaft endfloat	0.08 to 0.24 mm
Permitted undersize for main and big-end bearing journals	0.254 mm

Camshaft

Cam lift (inlet and exhaust):	
BRC engine	6.72 mm
BRD and BRE engine	6.54 mm
Cam lobe height (inlet and exhaust):	
BRC engine	36.08 to 36.25 mm
BRD and BRE engine	36.22 to 36.41 mm
Camshaft endfloat	0.065 to 0.165 mm
Thrust plate thickness	4.02 to 4.05 mm

Valves

Valve timing:	
BRC engine	As 2.4 litre V6
BRD and BRE engines:	
Inlet opens	30°BTDC
Inlet closes	66°ABDC
Exhaust opens	76°BBDC
Exhaust closes	20°ATDC
Length:	
BRC engine:	
Inlet	106.2 to 106.9 mm
Exhaust	106.8 to 107.8 mm
BRD and BRE engine:	
Inlet	104.7 to 105.4 mm
Exhaust	104.6 to 105.6 mm
Valve spring free length:	
BRC engine	55.12 mm
BRD and BRE engines	53.00 mm

1 General information

The V6 engine fitted to the Granada is only available in fuel-injected form. Mechanically, the design of the engine is well-established, and it is improved by the latest fuel, ignition and engine management systems (see illustration).

The combined crankcase and cylinder block is made of cast iron, and houses the pistons, crankshaft and camshaft. The sump is attached to the bottom of the crankcase and the cylinder heads to the top.

The cylinder heads are of the crossflow design, the inlet manifold being located between them and the exhaust manifolds being on the outboard sides. The overhead valves are operated by tappets, pushrods and rockers from the centrally located camshaft. Camshaft drive is by gears (2.8 litre) or chain (2.4 & 2.9 litre).

The crankshaft runs in four main bearings. Endfloat is controlled by thrust flanges on the No 3 bearing shells. The connecting rods are selected so that all are in the same weight class.

Aluminium alloy pistons are used. The gudgeon pins are an interference fit in their connecting rods.

The lubrication system is of the usual wet sump, pressure fed type, with a full-flow disposable canister oil filter. The oil pump is driven by a shaft which engages in the bottom of the distributor drivegear.

2 Major operations possible with the engine in the vehicle

The following operations can be carried out without removing the engine, although some work will be easier and quicker with the engine removed.

- Removal and refitting of the cylinder heads
- Removal and refitting of the sump and oil pump
- Removal and refitting of the timing gears
- Removal and refitting of the pistons, connecting rods and big-end bearings
- Renewal of the engine mountings
- Removal and refitting of the flywheel
- Renewal of the crankshaft front and rear oil seals
- Removal and refitting of the camshaft (after removal of the cylinder heads, tappets and timing gears)

3 Major operations requiring engine removal

The engine must be removed for the following operations:

- Renewal of the crankshaft main bearings
- Removal and refitting of the crankshaft

4 Methods of engine removal

The engine is removed from above, without the transmission. Removal with the transmission is not recommended because of the weight and unwieldiness of the combined units.

5 Engine - removal

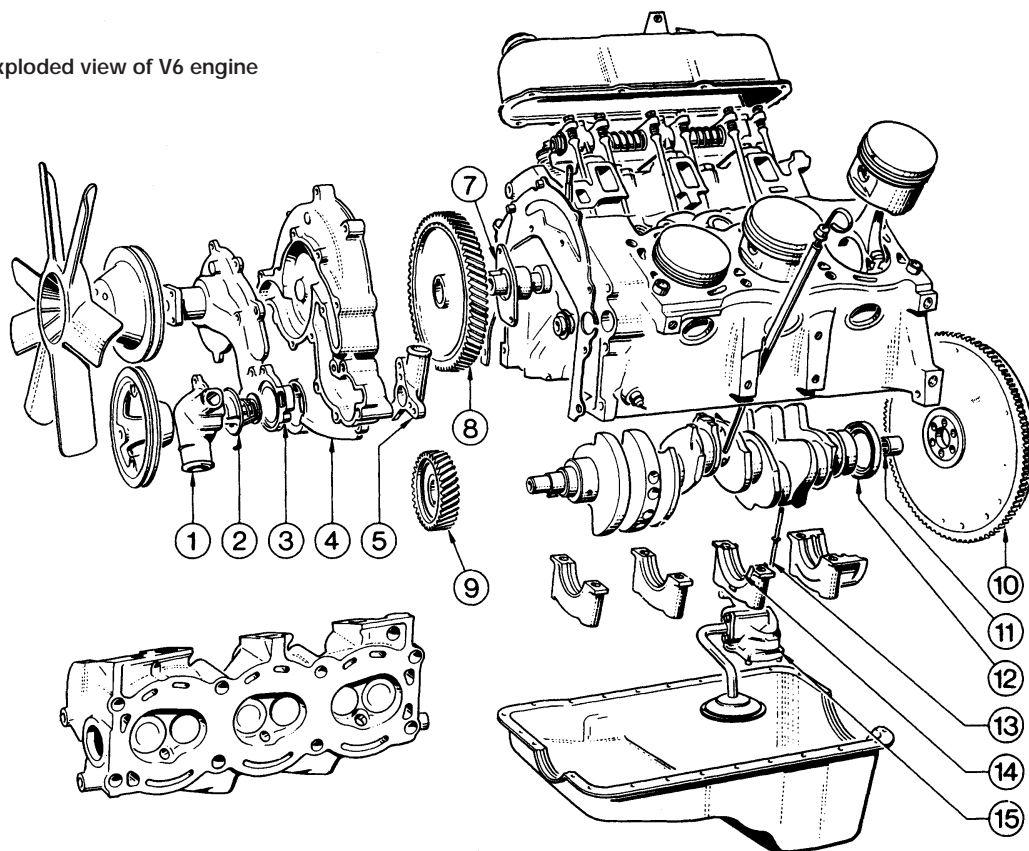
2.8 litre engine

- Disconnect the battery negative lead.
- Remove the bonnet.
- Remove the throttle valve cover, which is retained by three screws.
- Remove the air cleaner cover, valve airflow



1.1 Exploded view of V6 engine

- 1 Water inlet connection
- 2 Thermostat
- 3 Water pump
- 4 Timing cover
- 5 By-pass hose flange
- 7 Camshaft thrust plate
- 8 Camshaft gear
- 9 Crankshaft gear
- 10 Flywheel
- 11 Crankshaft pilot bearing
- 12 Oil seal
- 13 Oil pump drive shaft
- 14 Main bearing
- 15 Oil pump



meters and air inlet trunking. Also remove the oil filler cap, which is connected to the trunking by a crankcase ventilation hose.

5 Release the securing clips and bolts and remove the upper half of the fan shroud.

6 Drain the cooling system and remove the radiator.

7 Disconnect the heater hoses from the heater matrix and from the coolant outlet. Unclip the hoses.

8 Remove the fan and viscous clutch (where fitted).

9 Disconnect the following wiring:

- a) Alternator
- b) Temperature gauge sender
- c) Engine management temperature sensor
- d) Oil pressure switch
- e) Idle speed control valve
- f) Throttle position sensor
- g) Injector nut-harness
- h) Distributor multi-plug
- i) Distributor-to-coil HT lead

10 Disconnect the throttle cable. When applicable, also disconnect the downshaft cable or switch.

11 Depressurise the fuel system and disconnect the fuel supply and return lines (see Chapter 4).

12 Remove the steering pump and air conditioning compressor drivebelts (as applicable). Unbolt the steering pump and compressor, move them aside within the limits

of their flexible hoses and support them by wiring them to adjacent components.

13 Remove the distributor cap and rotor.

14 Remove the starter motor.

15 Drain the engine oil. Unscrew the oil filter with a strap or chain wrench and remove it; be prepared for oil spillage.

16 On manual gearbox models, disconnect the clutch cable from the release lever.

17 Unbolt the exhaust pipes from the manifolds.

18 On automatic transmission models, unbolt the torque converter from the driveplate.

19 Attach lifting tackle to the engine. If no lifting eyes are fitted, pass ropes or chains round the exhaust manifolds.

20 Take the weight of the engine, then remove the single nut on each side which holds engine bearer to its mountings.

21 From under the vehicle unbolt the engine adapter plate from the bellhousing.

22 Remove the engine-to-bellhousing bolts. Also disconnect or unclip the battery negative lead, the starter motor lead and the heat shield.

23 Support the transmission, preferably with a trolley jack.

24 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.

HAYNES *It may be necessary to rock the engine a little to release it from the gearbox.*

HINT

25 With automatic transmission, make sure that the torque converter stays engaged with the oil pump in the transmission as the engine is withdrawn.

26 Lift the engine out of the engine bay and take it to the bench.

2.4 & 2.9 litre engines

27 The removal operations for these engines are essentially as described for the 2.8 litre version. Note the following points.

Coolant hoses

28 Remove the hoses which run between the thermostat housing and the water pump, and the cooling system expansion tank.

29 Remove the heater hoses which run between the thermostat housing or coolant distribution pipe and oil cooler (where fitted).

Vacuum hoses

30 Disconnect the hose from the fuel pressure regulator.

31 Disconnect the hose from the plenum chamber.

32 Disconnect the hose from the throttle valve.

33 Disconnect the hose from the T-piece connector.

Other items

- 34 Disconnect the throttle cable from the operating lever and bracket.
- 35 Disconnect the right-hand exhaust downpipe from the manifold then remove the starter motor, the oil filter, and disconnect the left-hand exhaust downpipe, in that order.

6 Engine dismantling - general

Refer to Part A, Section 8, paragraphs 1 to 8 of this Chapter.

Cylinder head bolts on the V6 engine may be conventional (hexagon-headed) or Torx type. The appropriate Torx key will be needed to deal with the latter.

7 Ancillary components - removal

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

- Distributor and bracket*
- Spark plugs*
- Inlet manifold and associated items*
- Exhaust manifolds*
- Clutch*
- Alternator and bracket*
- Oil pressure switch (see illustration)*



8.14a Front airflow sensor wiring plug



8.14b Throttle position sensor wiring plug
Vacuum nozzles arrowed



7.1 The oil pressure switch is on the left-hand side of the block

- Temperature gauge sender*
- Engine bearer arms*
- Dipstick*

If an oil cooler is fitted between the oil filter and the block, remove it by disconnecting the coolant hoses and unscrewing the central sleeve. The cooler and seal can now be removed. If the threaded bush is removed from the block (it may come out with the sleeve) it must be renewed.

8 Cylinder heads - removal

The procedure is described for the engine in the vehicle. With the engine removed, the preliminary steps can be ignored.

2.8 litre engine

- 1 Disconnect the battery negative lead.
- 2 Remove the inlet manifold and associated components.
- 3 Unbolt the power steering pump, remove the drivebelts and move the pump aside. Support it by wiring it to adjacent components.
- 4 Remove the alternator and its bracket.
- 5 Remove the three bolts which secure each rocker shaft. Remove the shafts and pushrods, keeping them in order so that they can be refitted in the same locations.
- 6 Unbolt the exhaust pipes from the manifolds.
- 7 Remove the spark plugs.



8.15 Oil filler breather hose (arrowed)



8.13 Disconnecting the air hoses from the throttle valve housing

8 Slacken the cylinder head bolts half a turn at a time, following the reverse sequence to that used when tightening (see illustration 38.5). Remove the bolts.

9 Remove the cylinder heads. If they are stuck, try to rock them free, or tap them with a soft-faced hammer. **Do not** hit them directly with a metal hammer, and **do not** lever in between the joint faces.

10 Recover the head gaskets.

2.4 & 2.9 litre engines

- 11 Disconnect the battery and drain the cooling system.
- 12 Disconnect the radiator top hose and the heater hose from the thermostat housing.
- 13 Disconnect the air hoses from the throttle valve housing (see illustration).
- 14 Detach the two wiring plugs from the airflow sensors (see illustrations).
- 15 Pull the breather hose from the oil filler cap (see illustration).
- 16 Unclip the air cleaner cover and remove it together with the airflow sensors and air hoses.
- 17 Disconnect the hoses from the coolant expansion tank.
- 18 Disconnect the wiring from the following components:
 - a) *Alternator (right-hand cylinder head removal only).*
 - b) *Coolant temperature sensors (see illustration).*
 - c) *Idle speed control valve (see illustration).*
 - d) *Throttle valve potentiometer.*
 - e) *The fuel-injector wiring loom.*



8.18a Coolant temperature sensor location



8.18b Disconnecting the idle speed control valve wiring plug

19 Disconnect the wiring connectors from the ignition distributor and the fuel temperature sensor (see illustrations).

20 Release the pressure in the fuel distributor pipe by depressing the pin in the vent valve. Cover the valve with a rag during this operation to prevent fuel being sprayed out (see illustration).

21 Disconnect the fuel lines (see illustration).

22 Disconnect the vacuum hoses from the following components:

a) Fuel pressure regulator.

b) Throttle valve assembly.

c) T-piece connector (see illustration).

23 Disconnect the rocker cover breather hose (see illustration).

24 Unbolt the plenum chamber and place it to one side with the throttle cable attached.



8.19a Disconnecting the distributor wiring plug

25 Disconnect the HT leads from the spark plugs and the ignition coil noting their correct fitted locations. Undo the two retaining screws then remove the distributor cap and HT leads as an assembly.

26 Using a 19 mm socket on the crankshaft damper centre bolt, set No 1 piston to its firing point (12° BTDC) and remove the distributor.

27 If the right-hand cylinder head is to be removed, remove the drivebelts, unbolt the alternator and power steering pump and tie them to one side of the engine compartment.

28 Unbolt and remove the rocker cover(s).

29 Unbolt and remove the rocker shaft(s) (see illustration).

30 Withdraw the pushrods and keep them in their originally fitted sequence.

31 Disconnect the inlet manifold to timing



8.19b Disconnecting the fuel temperature sensor wiring plug

cover coolant hose from the manifold.

32 Unbolt and remove the inlet manifold complete with fuel rail and injectors. Discard the gasket.

33 Disconnect the exhaust downpipe(s) from the manifold(s).

34 Disconnect the earth straps from the rear of the left-hand cylinder head and release the cable retaining clamp.

35 Unscrew and remove the spark plugs.

36 Unscrew the cylinder head bolts using the reverse of the tightening sequence (see illustration 38.5). Obtain new bolts for refitting. Remove the cylinder head(s) and discard the gasket(s).

9 Sump - removal

Proceed as described in Part A, Section 16 of this Chapter but note that there are 24 bolts retaining the sump, not 23.

10 Timing cover and drive - removal

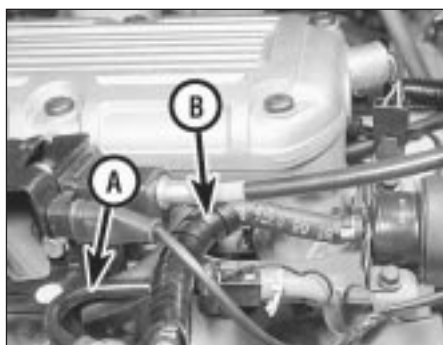
The procedure is described for the engine in the vehicle. With the engine removed, the preliminary steps can be ignored.

2.8 litre engine

- 1 Disconnect the battery negative lead.
- 2 Drain the engine oil.
- 3 Drain the coolant and remove the radiator.



8.20 Fuel rail vent (depressurising) valve and cap



8.21 Fuel feed (A) and return (B) hoses



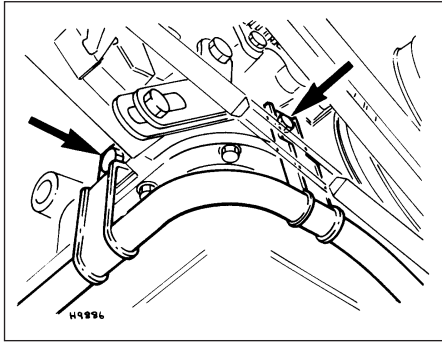
8.22 Vacuum hose T-piece connector



8.23 Rocker cover breather hose (arrowed)



8.29 Removing rocker shaft and pedestal



10.9 Heater connecting pipe clip bolts (arrowed)

- 4 Remove the auxiliary drivebelts.
- 5 Remove the fan and viscous clutch if fitted.
- 6 Jam the crankshaft, either by engaging 5th gear and applying the handbrake, or by removing the starter motor and having an assistant jam a screwdriver in the starter ring gear teeth. Unbolt the crankshaft pulley. When the pulley is secured to a vibration damper, also remove the damper central bolt.
- 7 Remove the pulley or damper, using a puller if necessary.
- 8 Disconnect the coolant hoses from the front of the engine, including the water pump bypass hose.
- 9 Disconnect the heater connecting pipe from the timing cover and unbolt the two clips which secure the pipe to the cover of the cylinder block (see illustration).
- 10 If not already done, remove the starter motor.



10.22b Removing radiator upper shroud



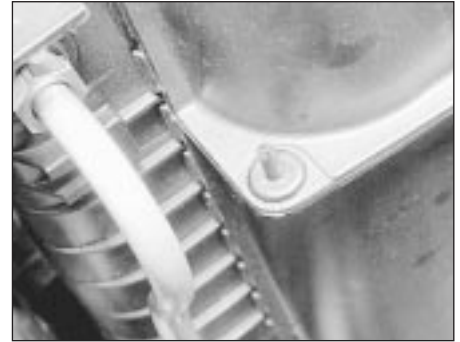
10.13 Camshaft and crankshaft gear marks in alignment (engine inverted)

Disregard the other mark on the crankshaft gear

- 11 Remove the sump.
- 12 Remove the nine securing bolts and remove the timing cover complete with water pump and thermostat.
- 13 Turn the crankshaft to bring the marks on the timing gears into alignment as shown (see illustration). Note that there are two marks on the crankshaft gear - do not get them confused.
- 14 Remove the bolt which secures the camshaft gear. It should now be possible to remove the camshaft gear by hand.
- 15 Draw off the crankshaft gear using a puller. Recover the Woodruff keys if they are loose.
- 16 Clean the old gasket off the timing cover and the cylinder block. Remove the oil seal from the timing cover.



10.22c Manoeuvre the radiator out from under the vehicle



10.22a Radiator upper shroud plastic clip and centre pin

2.4 & 2.9 litre engines

- 17 Using the crankshaft damper centre bolt, turn the engine until No 1 piston is at its firing point (12° BTDC). This can be verified by removing the distributor cap and checking that the rotor arm is aligned with the No 1 HT lead contact.
- 18 Disconnect the battery negative terminal.
- 19 Unclip the air cleaner cover and remove it complete with air flow sensors and air hoses. Remove the oil filler cap.
- 20 Drain the cooling system, disconnect the radiator upper hose from the thermostat housing.
- 21 Disconnect the hose which runs between the water pump and the expansion tank.
- 22 Remove the radiator upper shroud, then the radiator (see illustrations).
- 23 Remove the fan from the water pump hub noting that it has a left-hand thread.
- 24 Disconnect the coolant hoses from the timing cover/water pump hose stubs.
- 25 Remove the alternator and power steering pump drivebelts (as applicable)
- 26 Unscrew the four bolts and remove the crankshaft pulley.
- 27 Lock the crankshaft by jamming the starter ring gear teeth, and unscrew the vibration damper centre bolt. Withdraw the damper from the front of the crankshaft. A puller will be required for this, preferably one which has two screws for the tapped holes provided (see illustrations).
- 28 Using an engine support bar or hoist, take the weight of the engine then unscrew the nuts



10.27a Unscrewing the vibration damper centre bolt



10.27b Using a puller to withdraw the vibration damper



10.28a Using an engine support bar to support the engine



10.28b Engine mounting top nut



10.30 Coolant distribution pipe bracket



10.32 Steering shaft coupling pinch bolt

from the top of the engine mounting brackets (see illustrations).

29 Drain the engine oil, retaining it for further use only if it is not contaminated or due for renewal.

30 Unbolt the coolant distribution pipe bracket from the timing cover (see illustration).

31 Disconnect the leads and remove the starter motor.

32 Ensure that the front roadwheels and the steering wheels are in the straight-ahead position, then remove the pinch-bolt from the steering shaft coupling and slide the coupling down the shaft (see illustration).

33 Unscrew the sump retaining nuts and bolts. The rear bolts can only be unscrewed using a box spanner or thin-walled socket.

34 Release the brake hydraulic lines from their support brackets by pulling out their retaining clips.

35 Unscrew the two bolts from each of the crossmember side brackets. Lower the crossmember just enough to be able to remove the sump. In practice, as the car is standing on its roadwheels, the car body should be raised by placing two axle stands under the front jacking points (see illustration).

36 Extract the nine bolts and remove the timing cover complete with water pump (see illustration). Removal of the radiator grille will provide better access to the cover bolts.

37 Check that the crankshaft and camshaft sprocket timing marks are aligned at the nearest point to each other (see illustration).

If not, turn the crankshaft as necessary.

38 Unbolt and remove the timing chain tensioner. Take care not to allow the spring-loaded tensioner plunger to eject (see illustration).

39 Lock the camshaft sprocket by passing a rod through one of the holes and unscrew the sprocket retaining bolt (see illustration).

40 Remove the camshaft sprocket then release the chain from the crankshaft sprocket and remove the camshaft sprocket and chain from the engine.

41 If required, the crankshaft sprocket, Woodruff key and chain guide can now be also removed.

42 Clean away all old pieces of gasket from the cylinder block and timing cover flanges.

43 Remove and discard the sump gasket. The gasket rear tabs may break off, so pick

them out of the recesses in the rear main bearing cap using a sharp, pointed knife.

11 Flywheel/driveplate and adapter plate - removal

Refer to Part A, Section 15 of this Chapter.

12 Oil pump - removal

2.8 litre engine

1 Remove the sump.

2 Remove the two securing bolts and remove the oil pump complete with pick-up and strainer.



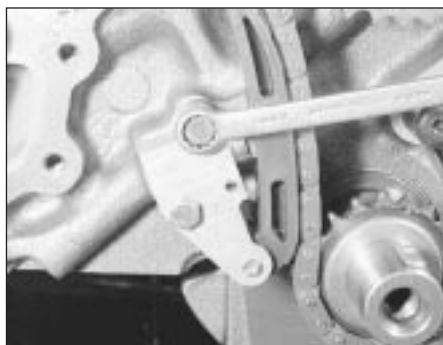
10.35 Unscrewing crossmember side bracket mounting bolts



10.36 Removing a timing cover retaining bolt



10.37 Timing sprocket alignment marks (arrowed)



10.38 Timing chain tensioner assembly



10.39 Slackening camshaft sprocket retaining bolt



12.6 Removing the oil pump and driveshaft

- 3 Recover the oil pump driveshaft, noting which way round it is fitted.
- 4 Recover the oil pump-to-block gasket.

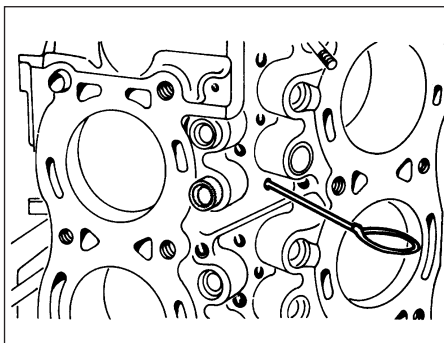
2.4 & 2.9 litre engines

- 5 Remove the sump.
- 6 Unbolt the oil pump/inlet pipe assembly and remove it then extract the driveshaft, which is splined into the distributor shaft (see illustration).

13 Pistons and connecting rods - removal

- 1 Remove the cylinder heads, the sump and the oil pump.
- 2 Check that the big-end bearing caps and connecting rods have identification marks. This is to ensure that the correct caps are fitted to the correct connecting rods and at reassembly are fitted in their correct cylinder bores. Note that the pistons have an arrow (or notch) marked on the crown to indicate the forward facing side.
- 3 Remove the big-end nuts and place to one side in the order in which they are removed.
- 4 Pull off the big-end caps, taking care to keep them in the right order and the correct way round. Also ensure that the shell bearings are kept with their respective connecting rods unless they are being renewed.

HAYNES
HINT *If the big-end caps are difficult to remove they can be tapped lightly with a soft faced hammer.*



14.2 Using a piece of wire to remove the tappets

5 To remove the shell bearings, press the bearing on the side opposite the groove in both the connecting rod and the cap, and the bearing will slide out.

6 Withdraw the pistons and connecting rods upwards out of the cylinder bores.

14 Camshaft and intermediate plate - removal

- 1 Remove the cylinder heads and pushrods.
- 2 Remove the tappets from their bores, using a pencil magnet or by inserting a piece of bent brass wire through the lubrication holes (see illustration).
- 3 Remove the timing cover and the camshaft gear.
- 4 Remove the two bolts which secure the camshaft thrust plate. Withdraw the camshaft, thrust plate and spacer ring.
- 5 The intermediate plate may now be removed after removing the retaining bolts. Note the oil seals on the timing cover locating dowels, which must also be removed.

15 Crankshaft and main bearings - removal

- 1 The engine must be removed from the vehicle for this task.
- 2 Remove the flywheel/driveplate, timing cover and crankshaft gear, and the pistons and connecting rods, as described in the preceding Sections. (If no work is to be done on the pistons, they need not actually be pushed out of their bores.)
- 3 Make sure that the main bearing caps carry identification marks, then remove the bolts and lift off the caps. Tap the caps with a soft-faced mallet if necessary to free them.

HAYNES
HINT *Keep the bearing shells with their caps if they are to be re-used.*

4 Note that the rear main bearing cap also retains the crankshaft rear oil seal, and that the shells for No 3 main bearing have thrust flanges to control crankshaft endfloat.

5 Lift out the crankshaft. Do not drop it, it is heavy.

6 Recover the upper half main bearing shells from their seats in the crankcase, again keeping them in order if they are to be re-used.

7 Remove the old oil seal from the rear of the crankshaft.

16 Engine mountings - renewal

Refer to Part A, Section 23 of this Chapter.

17 Crankshaft front oil seal - renewal

- 1 Disconnect the battery negative lead.
- 2 Remove the crankshaft pulley (and damper, when fitted).
- 3 Extract the old oil seal by levering it out with a hooked tool.
- 4 Clean out the seal seat in the timing cover. Lubricate the new seal and fit it, lips inwards. Seat the seal with a piece of tube or a large socket. (If available, Ford tool 21-063 and a non-damper type pulley may be used to seat the seal.)
- 5 Lubricate the sealing surface of the pulley or damper and refit it.
- 6 The remainder of refitting is a reversal of the removal procedure. Check the engine oil level on completion.

18 Crankshaft rear oil seal - renewal

Refer to Part A, Section 18 of this Chapter.

19 Examination and renovation - general information

Refer to Part A, Section 25 of this Chapter. New cylinder head bolts are not required if they are of the hexagon head type. Torx type bolts must be renewed. The two types of cylinder head bolt must not be mixed on the same engine.

20 Rocker shaft - dismantling, examination and reassembly

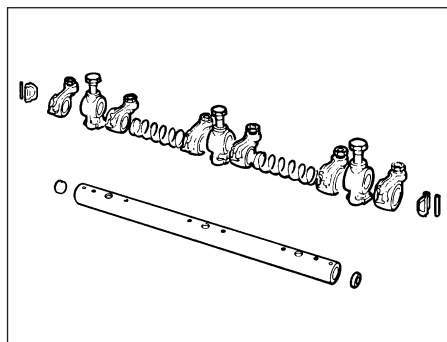
1 Tap out the roll pin from one end of the rocker shaft and remove the spring washer (see illustration).

2 Slide the rocker arms, rocker supports and springs off the rocker shaft. Keep them in the correct order so that they can be reassembled in the same position (see illustration).

HAYNES
HINT *If a rocker support sticks it can be removed by tapping it with a soft-faced hammer.*



20.1 Rocker shaft roll pin (arrowed)



20.2 Rocker shaft and associated components

3 Examine the rocker shaft and rocker arms for wear. If the rocker arm surface that contacts the valve stem is considerably worn, renew the rocker arm. If it is worn slightly step-shaped it may be cleaned up with a fine oil stone.

4 Oil the parts and reassemble them on their shafts in the original order. With both rocker shafts fitted the oil holes must face downwards to the cylinder heads. This position is indicated by a notch on one end face of the rocker shaft (see illustration).

21 Tappets and pushrods - examination

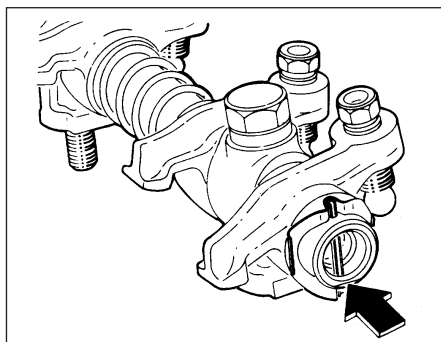
Inspect the tappets for scuffing, surface wear or other damage. Renew them if necessary. It is good practice to renew the tappets if a new camshaft is being fitted.



23.2a Compressing a valve spring to expose the collets



23.2b Removing the spring retainer and spring



20.4 Notch (arrowed) shows position of oil holes

Check the pushrods for bending by rolling them on a flat surface. Straighten or renew as necessary. Also check the pushrod ends for wear or damage.

22 Camshaft and bearings - examination and renovation

1 If there is excessive wear in the camshaft bearings they will have to be renewed. As the fitting of new bearings requires special tools this should be left to your local Ford dealer.

2 The camshaft may show signs of wear on the bearing journals or cam lobes. The main decision to take is what degree of wear necessitates renewing the camshaft, which is expensive. Scoring or damage to the bearing journals cannot be removed by regrinding; renewal of the camshaft is the only solution.

3 The cam lobes may show signs of ridging or pitting on the high points. If ridging is slight then it may be possible to remove it with a fine oil stone or emery cloth. The cam lobes, however, are surface hardened and once the hard skin is penetrated wear will be very rapid.

4 Excessive endfloat of the camshaft may be remedied by fitting a thicker spacer and/or thrust plate - see Specifications.

5 Excessive backlash in the camshaft drive gears (timing gears), which will have been noticed before dismantling by virtue of the characteristic growling noise, can only be remedied by renewing the gears.



23.2c Removing an inlet valve

23 Cylinder heads - overhaul

1 Clean the dirt and oil off the cylinder heads. Remove the carbon deposits from the combustion chambers and valve heads with a scraper or rotary wire brush.

2 Remove the valves by compressing the valve springs with a suitable valve spring compressor and lifting out the collets. Release the valve spring compressor and remove the valve spring retainer, spring and valve (see illustrations). **Note:** When removing and refitting the valve spring take care not to damage the valve stem when pressing down the valve spring retainer to remove or refit the collets. If the stem gets damaged the sealing will be ineffective and result in excessive oil consumption and wear of the valve guides.

HAYNES HINT Mark each valve so that they can be fitted in the same location.

3 Remove the valve stem oil seals from the valve guides and discard them.

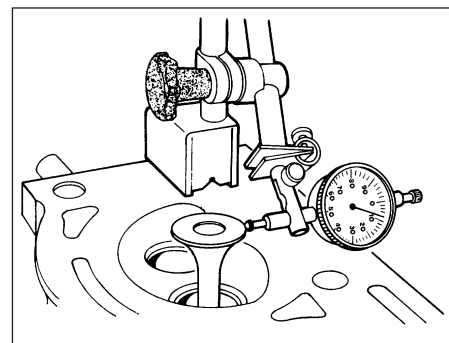
4 With the valves removed clean out the carbon from the ports.

5 Examine the heads of the valves and the valve seats for pitting and burning. If the pitting on valve and seat is slight it can be removed by grinding the valves and seats together with coarse, and then fine, valve grinding paste.

6 Severe pitting or burning of the valves probably means that they must be renewed. Badly burnt valve seats can be recut, or inserts can be fitted, by a Ford dealer or other specialist.

7 Check the valve guides for wear by inserting the valve into its guide until the valve stem is flush with the end of the guide, then checking the play at the valve head (see illustration). Movement in excess of 0.6 mm (0.024 in) means that the clearance between guide and stem is excessive.

8 Valve guide wear is dealt with by reaming the guides to a known oversize and fitting new valves with oversize stems. Again, this is a dealer or specialist task.



23.7 Checking valve guide wear using a valve and a dial test indicator

9 Inspect the valve springs, if possible comparing their free length with new springs. Renew the springs anyway if they have been in use for 20 000 miles (32 000 km) or more.

10 Use a straight-edge and feeler blades to check that the cylinder head mating faces are not distorted. If they are, have the heads resurfaced by an engineering works.

11 Commence reassembly by oiling a valve stem and inserting the valve into its guide. Cover the collet grooves with adhesive tape and press the new valve stem oil seal down the stem, using a suitable tube to press the seals home. Note that the inlet valve seals are rubber and the exhaust seals nylon. On the 2.8 litre engine, oversize exhaust valve seals must be used when valves with oversize stems are fitted. Remove the adhesive tape.

12 Fit the valve spring and spring retainer. Compress the spring and fit the collets, using a dab of grease to hold them in position. Carefully release the compressor.

13 Tap the valve stem smartly with a mallet to seat the components.

14 Repeat the process on the remaining valves.

24 Cylinder bores - examination and renovation

Refer to Part A, Section 28 of this Chapter. The main bearing caps should be fitted, and their bolts tightened to the specified torque, when making bore measurements.

25 Pistons and connecting rods - examination and renovation

Refer to Part A, Section 29 of this Chapter.

26 Crankshaft and bearings - examination

1 Refer to Part A, Section 27 of this Chapter for the examination procedure. Note that regrinding of this crankshaft is not permitted, so if significant journal wear is present, a new crankshaft (and new bearing shells) must be fitted.

2 As with the SOHC engine, oversize main bearing parent bores may be encountered. These are marked with paint stripes on the bearing caps, corresponding paint marks on the bearing shells and identification codes on the backs of the bearing shells.

3 On the 2.4 litre engine, separate thrustwashers are used to control crankshaft endfloat. On the 2.9 litre engine, No 3 main bearing shells have integral thrust flanges.

27 Oil pump - dismantling, examination and reassembly

2.8 litre engine

1 If oil pump wear is suspected, check the cost and availability of new parts and the cost of a new pump. Examine the pump and then decide whether renewal or repair is the best course of action (see illustration).

27.1 Exploded view of the oil pump

- 1 Body
- 2 Bolt
- 3 Bolts
- 4 Lockwasher
- 5 Driveshaft
- 6 Toothed washer
- 7 Rotor set
- 8 Pressure relief valve plunger
- 9 Pressure relief valve spring
- 10 Pressure relief valve plug
- 11 Cover
- 12 Pick-up pipe and strainer

2 Remove the pick-up pipe and strainer.

3 Note the position of the oil pump cover relative to the body, then remove the bolts and spring washers. Lift off the cover.

4 Mark the rotor faces so that they can be refitted the same way round, then remove them from the body.

5 Remove the pressure relief valve plug by piercing it with a punch and levering it out. Withdraw the spring and plunger.

6 Thoroughly clean all parts in petrol or paraffin and wipe dry using a non-fluffy rag. The necessary clearances may now be checked using a machined straight-edge (a good steel rule) and a set of feeler blades. The critical clearances are between the lobes of the centre rotor and convex faces of the outer rotor; between the rotor and pump body; and between both rotors and the end cover plate (endfloat). The clearances are given in the Specifications.

7 Endfloat may be measured by refitting the rotors, placing the straight-edge across the bottom of the pump and measuring the clearance between the two rotors and the straight-edge.

8 New rotors are only available as a pair. If the rotor-to-body clearance is excessive, a complete new pump should be fitted.

9 Commence reassembly by lubricating the relief valve plunger. Fit the plunger and spring.

10 Fit a new relief valve plug, flat side outwards and seat it with a drift, until it is flush with the pick-up pipe mating face.

11 Lubricate the rotors and fit them, observing the marks made when dismantling if applicable.

12 Fit the cover and secure it with the bolts and spring washers. Tighten the bolts to the specified torque.

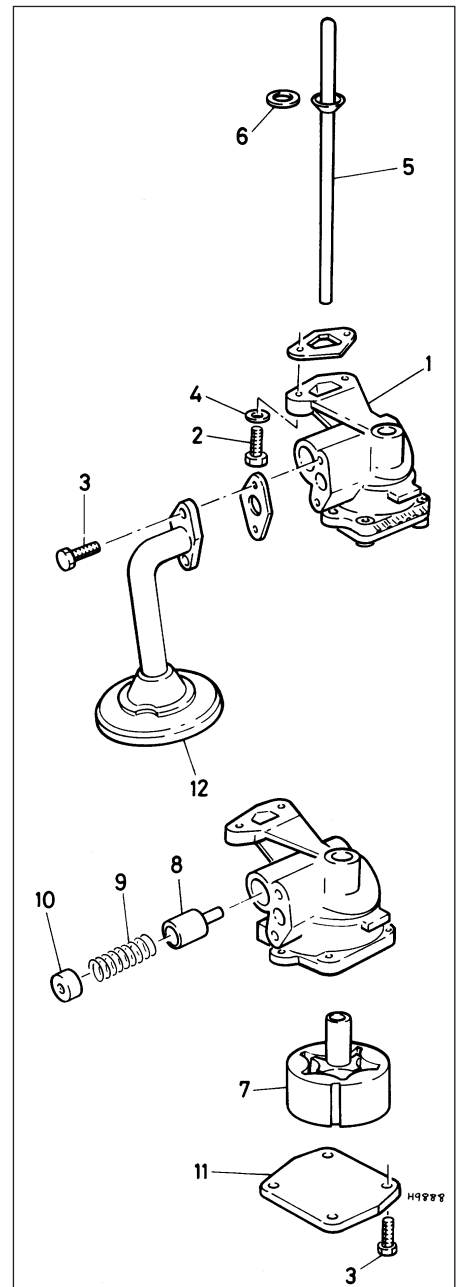
13 Fit the pick-up pipe and strainer, using a new gasket.

14 Temporarily insert the driveshaft into the pump and make sure that the rotors turn freely.

15 A new or overhauled pump must be primed before fitting.

2.4 & 2.9 litre engines

16 Oil pump overhaul is essentially as described for the 2.8 litre engine, noting the differences in design of the components (see illustrations).



27.16a Removing the pick-up from the oil pump



27.16b Removing the oil pump cover



31.1 Rear main bearing shell in the crankcase



31.6 Placing the crankshaft in position

28 Flywheel ring gear - examination and renovation



Refer to Part A, Section 33 of this Chapter.

29 Crankcase ventilation system - general information

The crankcase ventilation system is very simple. One hose joins the rear air inlet trunking to the oil filler cap, and another hose joins the left-hand rocker cover to the plenum chamber. Filtered (and metered) air passes through the oil filler cap into the engine, and is extracted, along with any other fumes, via the second hose. Refer to Chapter 1 for maintenance of the system.

30 Engine reassembly - general information

Refer to Part A, Section 35 of this Chapter but disregard the reference to new cylinder head bolts when these are of the conventional (hexagon-headed) type. Only Torx type bolts need to be renewed.

31 Crankshaft and main bearings - refitting



1 Wipe the bearing shell locations in the crankcase with a clean rag and fit the main

bearing upper half shells in position (see illustration).

2 Clean the main bearing shell locations and fit the half shells in the caps.

HAYNES *If the old bearings are being refitted (although this is false economy unless they are practically new) make sure they are fitted in their original positions.*

3 Fit the flanged shells to No 3 bearing.

4 Lubricate the shells and the main bearing journals with engine oil.

5 Lubricate a new rear oil seal and fit it to the end of the crankshaft, lips facing inwards.

6 Carefully place the crankshaft in position (see illustration).

7 Make sure that the surfaces are clean, then apply a film of sealant (Ford No A-70SX-19554-BA, or equivalent) to the mating faces of the crankcase and the rear main bearing cap.

8 Fit the bearing caps, with the arrows on the caps pointing to the front of the engine (see illustration).

9 Insert the main bearing cap bolts. The bolts for bearing caps No 2 and 3 have rounded heads, and are 14 mm (0.55 in) longer than those for caps 1 and 4.

10 Tighten the main bearing cap bolts progressively to the specified torque.

11 Make sure that the crankshaft is free to rotate. Some stiffness is to be expected with

new components, but there should be no tight spots or binding.

12 Press the crankshaft rear oil seal firmly against the rear main bearing.

13 Check the crankshaft endfloat, levering the crankshaft back and forth and inserting feeler blades between the crankshaft and No 3 main bearing (see illustration). Excessive endfloat can only be due to wear of the crankshaft or bearing shell flanges.

14 Coat the rear main bearing cap sealing wedges with sealant and press into position with a blunt screwdriver (see illustration). The rounded end of each wedge carries a red paint mark, which must face the bearing cap.

32 Camshaft and intermediate plate - refitting



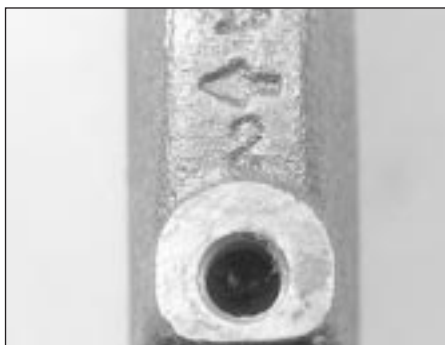
1 Slide the spacer ring onto the camshaft, chamfered side first. Refit the Woodruff key if it was removed.

2 Lubricate the camshaft bearings, the camshaft and thrust plate.

3 Carefully insert the camshaft from the front and fit the thrust plate and self-locking securing bolts. Tighten the bolts to the specified torque (see illustrations).

4 Fit the timing cover dowels and O-ring seals onto the crankcase. The chamfered end of the dowels must face outwards towards the timing cover (see illustration).

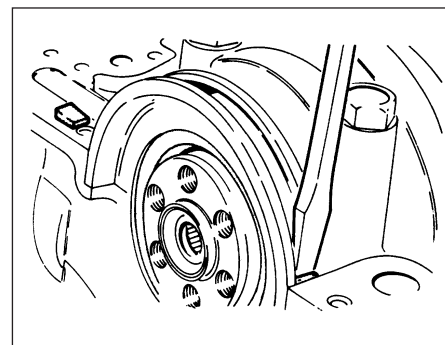
5 Ensure that the mating faces of the crankcase and front intermediate plate are



31.8 Main bearing cap markings - arrow points to front of engine



31.13 Checking crankshaft endfloat



31.14 Fitting the rear main bearing cap sealing wedges



32.3a Fitting the camshaft into the cylinder block



32.3b Fitting the camshaft thrust plate



32.4 Timing cover dowel and seal

clean and then apply sealing compound to both faces. Position the gasket on the crankcase and then fit the intermediate plate (see illustration).

6 Fit the two centre bolts finger-tight, then fit another two bolts temporarily for locating purposes. Tighten the centre securing bolts, then remove the temporarily fitted locating bolts.

7 If the engine is in the vehicle, reverse the steps taken to gain access to the camshaft.

33 Pistons and connecting rods - refitting



1 Wipe clean the bearing seats in the connecting rod and cap, and clean the backs of the bearing shells. Fit the shells to each rod



33.1 Piston, connecting rod and shells ready for assembly

and cap with the locating torques engaged in the corresponding cut-outs (see illustration).

2 If the old bearings are nearly new and are being refitted, then ensure that they are refitted in their correct locations on the correct rods.

3 The pistons, complete with connecting rods, are fitted to their bores from the top of the block.

4 Locate the piston ring gaps in the following manner:

Top: 150° from one side of the oil control ring helical expander gap

Centre: 150° from the opposite side of the oil control ring helical expander gap

Bottom: oil control ring helical expander, opposite the marked piston front side

Oil control ring, intermediate rings, 25 mm (1 in) each side of the helical expander gap

5 Lubricate the piston and rings well with engine oil.

6 Fit a universal ring compressor and prepare to insert the first piston into the bore. Make sure it is the correct piston-connecting rod assembly for that particular bore, that the connecting rod is the correct way round and that the front of the piston (marked with an arrow or a notch) is to the front of the engine (see illustrations).

7 Again lubricate the piston and the piston skirt, and insert the connecting rod and piston assembly into the cylinder bore up to the bottom of the piston ring compressor.

8 Gently but firmly tap the piston through the piston ring compressor and into the cylinder



32.5 Intermediate plate in position

bore, using the shaft of a hammer (see illustration).

9 Generously lubricate the crankpin journals with engine oil and turn the crankshaft so that the crankpin is in the most advantageous position for the connecting rods to be drawn onto it.

10 Lubricate the bearing shell in the connecting rod cap. Fit the cap to the rod.

11 Lubricate the threads and contact faces of the big-end cap nuts. Fit the nuts and tighten them to the specified torque.

12 Check the crankshaft for freedom of rotation.

13 Repeat the operations for the other five pistons.

14 Refit the oil pump, the sump and the cylinder heads.



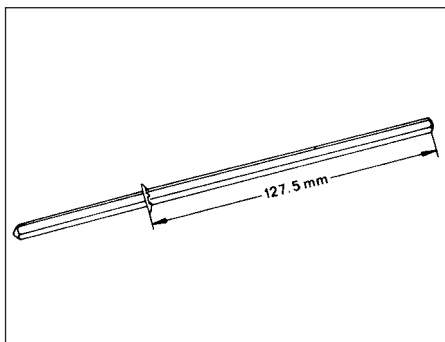
33.6a Piston with ring compressor fitted



33.6b Connecting rod and cap carry cylinder numbers



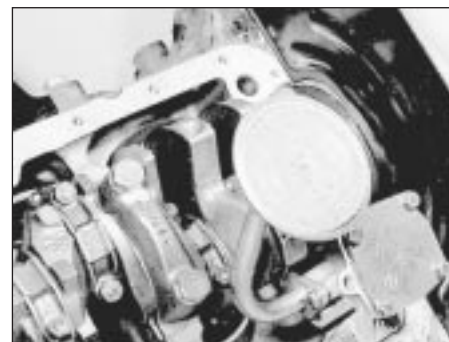
33.8 Tapping a piston into the bore



34.2 Oil pump driveshaft washer location



34.4 Fitting the oil pump driveshaft



34.5 Oil pump in position

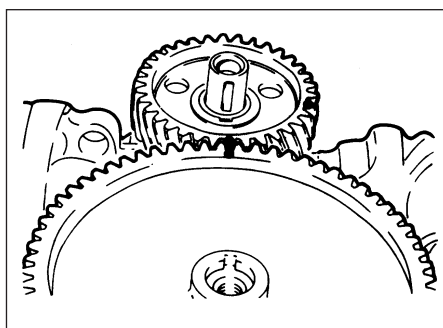
34 Oil pump - refitting



- 1 Make sure that the oil pump and crankcase mating faces are clean.
- 2 Check that the washer on the oil pump driveshaft is located correctly (see illustration).
- 3 If a new or overhauled pump is being fitted, prime it by injecting oil into it and turning it by hand.
- 4 Insert the oil pump driveshaft into the block with the pointed end towards the distributor (see illustration).
- 5 Fit the assembled oil pump, using a new gasket. Insert the pump-to-block bolts and tighten them to the specified torque (see illustration).
- 6 Refit the sump.



36.1 Timing cover oil seal



36.4 Crankshaft and camshaft gears correctly aligned



36.7a Timing cover gasket in position



36.7b Fitting the timing cover



36.5 Camshaft gear washer and bolt



36.9 Fitting the crankshaft pulley

35 Flywheel/driveplate and adapter plate - refitting



Refer to Part A, Section 40 of this Chapter.

36 Timing cover and drive - refitting



2.8 litre engines

- 1 Lubricate a new oil seal and fit it to the timing cover (see illustration).
- 2 If the Woodruff keys were removed from the camshaft and crankshaft, refit them.
- 3 Refit the crankshaft gear, if removed, using a length of tube to drive it home.
- 4 Position the camshaft and crankshaft so that their keyways are facing each other (see

illustration). Slide the camshaft gear onto the camshaft, rotating the shafts slightly if necessary so that the marks on the two gears are aligned. Remember that there are two marks on the crankshaft gear.

5 Fit the camshaft gear retaining bolt and washer (see illustration). Tighten the bolt to the specified torque.

6 Apply sealant to the mating faces of the timing cover and the intermediate plate.

7 Position a new gasket on the intermediate plate and fit the timing cover to the cylinder block (see illustrations).

8 Fit the timing cover bolts, but do not tighten them yet.

9 Oil the sealing face of the crankshaft pulley or damper. Fit the pulley/damper and the central bolt and washer, applying sealant to the inboard face of the washer (see illustration). Draw the pulley/damper into



36.15 Crankshaft and camshaft key and slot alignment

place by tightening the bolt; this will centralise the timing cover.

10 Tighten the timing cover bolts evenly to the specified torque.

11 Jam the crankshaft and tighten the pulley/damper central bolt to the specified torque.

12 Refit the sump.

13 If the water pump was removed from the timing cover, refit it using a new gasket.

14 If the engine is still in the vehicle, reverse the steps taken to gain access.

2.4 & 2.9 litre engines

15 If the crankshaft sprocket was removed, check that the key slots in the end of the crankshaft and camshaft are in alignment at the closest point to each other (see illustration).



36.18 Fitting timing chain and sprockets

16 Fit the crankshaft sprocket and chain guide.

17 Engage the chain around the teeth of the crankshaft sprocket.

18 Engage the camshaft sprocket in the upper loop of the chain in such a way so that the camshaft sprocket will slip onto the key slot when the timing mark is aligned with that on the crankshaft sprocket (see illustration). Some trial and error may be involved in achieving this.

19 Lock the camshaft sprocket and tighten the retaining bolt to the specified torque.

20 Retract the chain tensioner. To do this, insert the plunger (bevelled side entering), then release the pawl with a small screwdriver pushed into the hole in the tensioner body (see illustration).



36.20 Releasing timing chain tensioner pawl

21 Compress the plunger/slipper and retain it in the retracted position using a cable-tie or similar. New chain tensioners are supplied complete with a retainer (see illustration).

22 Bolt the tensioner in position, at the same time removing the plunger retainer. Tighten the bolts to the specified torque.

23 Locate a new gasket on the front face of the engine.

24 Renew the timing cover oil seal and apply grease to the lips.

25 Fit the timing cover, centre it and align it with the sump mounting flange.

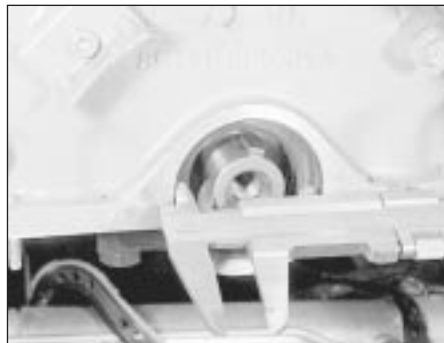
26 Although a special tool (21-137) is available for centring the cover, a piece of plastic pipe, or a socket of suitable thickness, will serve as an adequate substitute. Alternatively measure the space between the crankshaft nose and the timing cover damper recess at several different points and adjust the position of the cover until all the measurements are equal. A strip of metal 14.0 mm wide will serve as a gauge if calipers are not available (see illustrations).

27 Tighten the timing cover bolts (see illustration) and fit the Woodruff key (where removed) for the vibration damper.

28 Apply jointing compound to the front and rear sump flange areas on the timing cover/cylinder block and rear main bearing cap. Make sure that the bearing surfaces are perfectly clean. Checking that the rear tabs of the gasket enter the recesses in the main bearing cap, locate a new sump gasket on the crankcase (see illustration).



36.21 Timing chain tensioner retracted using a cable-tie



36.26a Measuring the crankshaft to timing cover gap



36.26b Using a socket to check the crankshaft to timing cover gap



36.27 Timing cover retaining bolts (arrowed)



36.28 Sump gasket at rear main bearing cap



36.39a Alternator drivebelt tensioner strap bolt

29 Fit the sump and the retaining nuts and bolts. Tighten them progressively in two stages.

30 Oil the lip of the timing cover oil seal and the contact surface of the crankshaft damper.

31 Fit the damper to the crankshaft, being careful not to dislodge the Woodruff key. Draw the damper into position using the retaining bolt and washer.

32 Remove the bolt and apply sealant to the faces of the washer. Refit the bolt and washer then jam the starter gear ring teeth and tighten the bolt to the specified torque.

33 Refit the crankshaft pulley and tighten the retaining bolts to the specified torque.

34 Refit the crossmember side brackets and brake pipes.

35 Reconnect the engine mountings and remove the engine hoist or axle stands (see "Jacking").



36.39b Power steering pump drivebelt tensioner bolt

36 Connect the steering shaft coupling with the steering wheel and front roadwheels in the straight-ahead position. Fit the pinch-bolt and tighten it to the specified torque.

37 Fit the starter motor and connect the leads.

38 Bolt the coolant distributor pipe to the timing cover.

39 Refit the alternator and power steering pump drivebelts and tension them (see illustrations).

40 Fit the fan and radiator, connect all coolant hoses, and fit the radiator upper shroud.

41 Fit the air cleaner cover with attachments.

42 Fill the engine with oil and coolant and connect the battery.



37.3 Slide the sump gasket tab into the seal cut-out

then to the Stage 2 torque starting at point B.

6 Fit the sump drain plug, using a new washer, and tighten it to the specified torque.

7 If the engine is in the vehicle, reverse the steps taken to gain access.

2.4 & 2.9 litre engines

8 Refer to paragraphs 28 to 29, Section 36.

38 Cylinder heads - refitting



2C

2.8 litre engine

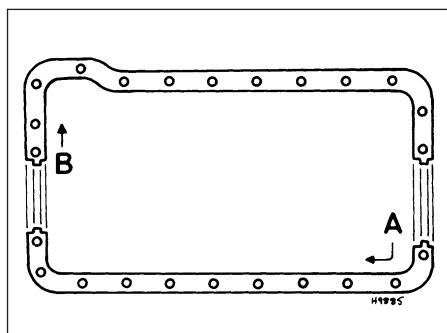
1 Lubricate the valve tappets with clean engine oil and insert them in the cylinder block. Ensure that they are fitted in their original locations (see illustration).

2 Ensure that the mating faces of the cylinder block and the cylinder heads are clean.

3 Position the new cylinder head gaskets over the guide bushes on the cylinder block. Check that they are correctly located. The right and left-hand gaskets are different. The gaskets are marked FRONT TOP (see illustration).

4 Carefully lower the cylinder heads onto the cylinder block. Oil the threads and contact faces of the cylinder head bolts and insert them into their holes.

5 Tighten the cylinder head bolts, in the correct order (see illustration), to the Stage 1 specified torque. Repeat in the same order for Stages 2 and 3. Final tightening, when required, is done after warm-up.



37.5 Sump bolt tightening sequence
For A and B see text

37 Sump - refitting



2.8 litre engine

1 Clean the mating faces of the crankcase and sump. Ensure that the grooves in the seal carriers are clean.

2 Fit the rubber seals in the grooves.

3 Apply sealing compound on the crankcase and slide the tabs of the gasket under the cut-outs in the rubber seals (see illustration).

4 Ensure that the gasket hole lines up with the holes in the gasket crankcase and fit the sump. Take care not to dislodge the gasket.

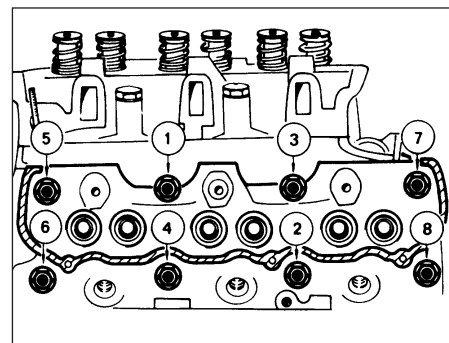
5 Fit the 24 securing bolts. Tighten them in the sequence shown to the Stage 1 specified torque starting at point A (see illustration),



38.1 Fitting a tappet in the block



38.3 Cylinder head gasket markings



38.5 Cylinder head bolt tightening sequence



38.7a Fitting the pushrods and oil splash shields

6 Lubricate the pushrods with engine oil and insert them in the cylinder block.

7 Place the oil splash shields in position on the cylinder heads and fit the rocker shaft assemblies. Guide the rocker arm adjusting screws into the pushrod sockets (see illustrations).

8 Tighten the rocker shaft securing bolts progressively to the specified torque.

9 Refit the inlet manifold, using a new gasket. Do not refit the rocker covers yet.

10 Adjust the valve clearances (Section 39).

11 Refit the spark plugs.

12 Refit the rocker covers, using new gaskets. The adhesive side of the gaskets should face the rocker cover.

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



38.7b Fitting an assembled rocker shaft

2.4 & 2.9 litre engines

14 Refitting the cylinder heads to these engines is essentially a reversal of the removal procedure but also refer to information given for the 2.8 litre engine whilst noting the following points.

15 Always use new Torx type cylinder head bolts. Oil them and allow them to drain. When fitted the word OBEN should be visible on the new gaskets.

16 Tighten the bolts in the specified sequence (as for the 2.8 litre engine) to the correct torque. The final stage in the tightening procedure is by the angular method. Use a disc similar to the one shown or make a paint mark at the same point on each bolt head to ensure that each bolt is turned through exactly the same number of degrees (see illustration).



38.16 Tightening a cylinder head bolt using an angular tightening disc

17 As a result of the bolt tightening torque used and the elasticity of the bolts, no further tightening is required after the initial running-in period.

18 Apply jointing compound to the areas where the inlet manifold and cylinder heads meet and locate a new gasket in position. Make sure that it is the correct way around. Tighten the inlet manifold bolts to the specified torque and in the sequence shown (see illustrations).

19 Check that No 1 piston is still at the firing point (12° BTDC) and fit the distributor.

20 Adjust the valve clearances.

21 Fit new rocker cover gaskets, peeling off the self-adhesive shield before sticking the gaskets to the covers. Note the aluminium spacers in the gaskets to prevent overtightening (see illustration).

22 Use a new gasket at the plenum chamber and tighten the fixing bolts to the specified torque (see illustration).

23 Refit the alternator and power steering pump (where removed) and tension the drivebelts.

24 Reconnect the fuel lines and secure them in position with new clips. Reconnect all coolant and vacuum hoses and electrical connectors. Refill the engine with coolant and reconnect the battery.

25 Switch on the ignition and bleed the fuel system by operating the vent valve on the fuel rail.

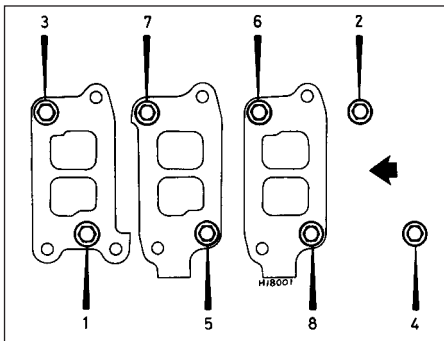
26 Run the engine up to normal operating temperature and then check the ignition timing.



38.18a Inlet manifold gasket correctly located



38.18b Fitting inlet manifold complete with fuel rail and injectors



38.18c Inlet manifold tightening sequence
Arrow indicates the front of the engine



38.21 Peeling off rocker cover gasket protective shield



38.22 Lowering the plenum chamber into position

27 The inlet manifold bolts should be retightened to the specified torque in the correct sequence. This will mean disconnecting the air hoses from the throttle valve housing, the vacuum hose from the left-hand rocker cover, and the wiring connector from the idle speed control valve and throttle valve potentiometer. Remove the plenum chamber, place it to one side, then release the fuel rail bolts but **do not** disconnect the fuel pipes. It may also be necessary to remove the distributor again to gain access to one of the bolts.

39 Valve clearances - checking and adjustment

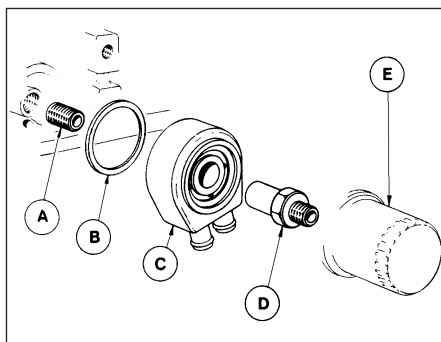
See Chapter 1, Section 23.

40 Ancillary components - refitting

- 1 Refer to Section 7 and refit the items listed.
- 2 If the oil cooler and its threaded bush were removed, refit them as follows (see illustration).
- 3 Screw the new bush into the cylinder block. Apply Omnifit Activator "Rapid" (to Ford specification SSM-99B-9000-AA) to the exposed threads of the bush and to the inside of the threaded sleeve.
- 4 Apply one drop of Omnifit Sealant "300 Rapid" (to Ford specification SSM-4G-9003-AA) to the leading threads of the bush. **Do not** use more than one drop, otherwise sealant may get into the lubrication circuit.
- 5 Fit the cooler, using a new gasket, and secure with the threaded bush. Make sure that the coolant pipes are positioned at the correct angle (see illustration), then tighten the threaded sleeve to the specified torque.
- 6 Fit a new oil filter element, oiling its sealing ring prior to installation. Tighten the filter approximately three-quarters of a turn beyond the point where the seal contacts the cooler face. Do not use any tool to tighten the filter.

41 Engine - refitting

Refer to Part A, Section 49, paragraphs 1 to 9 of this Chapter. Before starting the engine, refer to the following Section.



40.2 Oil cooler components

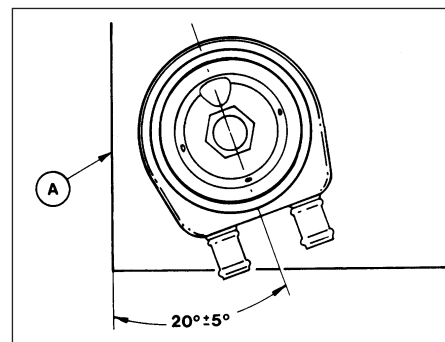
- A Threaded bush D Sleeve
B Seal E Oil filter
C Cooler

42 Initial start-up after overhaul or major repair

- 1 Refer to Part A, Section 51 of this Chapter.
- 2 When conventional (hexagon-headed) cylinder head bolts are fitted, they must be re-tightened after the engine has warmed up. Proceed as follows.
- 3 Stop the engine and remove the rocker covers.
- 4 Working in the sequence used for tightening, slacken one cylinder head bolt a quarter turn, then re-tighten it to the Stage 4 specified torque. Repeat in sequence for all the cylinder head bolts.
- 5 Tighten the inlet manifold bolts.
- 6 Check the valve clearances.
- 7 Refit the rocker covers and other disturbed components.

43 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.



40.5 Oil cooler installation angle
A Rear face of cylinder block

- 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.

