Chapter 2 Part C:
2.4, 2.8 and 2.9 litre V6 engines

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Degrees of difficulty

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

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/in²)
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
## 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**

- **Identification**
  
  Nylon, selective sizes

- **Type**
  
  White

- **Red**
  
  Blue

- **Green**
  
  Black

### Torque wrench settings

<table>
<thead>
<tr>
<th>Component</th>
<th>Nm</th>
<th>lbf ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main bearing cap bolts</td>
<td>90 to 104</td>
<td>66 to 77</td>
</tr>
<tr>
<td>Big-end cap nuts</td>
<td>26 to 33</td>
<td>19 to 24</td>
</tr>
<tr>
<td>Crankshaft pulley/damper central bolt</td>
<td>115 to 130</td>
<td>85 to 96</td>
</tr>
<tr>
<td>Camshaft gear bolt</td>
<td>42 to 50</td>
<td>31 to 37</td>
</tr>
<tr>
<td>Camshaft thrust plate bolts</td>
<td>17 to 21</td>
<td>13 to 16</td>
</tr>
<tr>
<td>Timing cover to cylinder block</td>
<td>17 to 21</td>
<td>13 to 16</td>
</tr>
</tbody>
</table>
## Torque wrench settings (continued)

<table>
<thead>
<tr>
<th>Component</th>
<th>Nm</th>
<th>lbf ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing cover to intermediate plate</td>
<td>13 to 17</td>
<td>10 to 13</td>
</tr>
<tr>
<td>Intermediate plate to cylinder block</td>
<td>17 to 21</td>
<td>13 to 16</td>
</tr>
<tr>
<td>Oil pump to cylinder block</td>
<td>14 to 17</td>
<td>10 to 13</td>
</tr>
<tr>
<td>Oil pump cover bolts</td>
<td>9 to 13</td>
<td>7 to 10</td>
</tr>
<tr>
<td>Rocker shaft securing bolts</td>
<td>62 to 70</td>
<td>46 to 52</td>
</tr>
<tr>
<td>Sump bolts:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 1</td>
<td>4 to 7</td>
<td>3 to 5</td>
</tr>
<tr>
<td>Stage 2</td>
<td>7 to 10</td>
<td>5 to 7</td>
</tr>
<tr>
<td>Sump drain plug</td>
<td>21 to 28</td>
<td>16 to 21</td>
</tr>
<tr>
<td>Oil pressure switch</td>
<td>12 to 15</td>
<td>9 to 11</td>
</tr>
<tr>
<td>Oil cooler threaded sleeve</td>
<td>20 to 40</td>
<td>15 to 30</td>
</tr>
<tr>
<td>Cylinder head hexagon bolts:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 1</td>
<td>40 to 45</td>
<td>30 to 33</td>
</tr>
<tr>
<td>Stage 2</td>
<td>55 to 70</td>
<td>41 to 52</td>
</tr>
<tr>
<td>Stage 3 (after 10 to 20 minutes)</td>
<td>95 to 115</td>
<td>70 to 85</td>
</tr>
<tr>
<td>Stage 4 (after warm-up)</td>
<td>95 to 115</td>
<td>70 to 85</td>
</tr>
<tr>
<td>Cylinder head - Torx bolts:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 1</td>
<td>35 to 40</td>
<td>26 to 30</td>
</tr>
<tr>
<td>Stage 2</td>
<td>70 to 75</td>
<td>52 to 55</td>
</tr>
<tr>
<td>Stage 3 (after 5 minutes)</td>
<td>Tighten further 90°</td>
<td>Tighten further 90°</td>
</tr>
<tr>
<td>Rocker cover bolts</td>
<td>6 to 8</td>
<td>4 to 6</td>
</tr>
<tr>
<td>Fuel pump blanking plate</td>
<td>16 to 18</td>
<td>12 to 13</td>
</tr>
<tr>
<td>Flywheel bolts</td>
<td>64 to 70</td>
<td>47 to 52</td>
</tr>
<tr>
<td>Bellhousing-to-engine bolts</td>
<td>27 to 30</td>
<td>20 to 22</td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer's code</td>
<td>ARC</td>
</tr>
<tr>
<td>Bore - mm (in)</td>
<td>84.0 (3.307)</td>
</tr>
<tr>
<td>Stroke - mm (in)</td>
<td>72.0 (2.865)</td>
</tr>
<tr>
<td>Cubic capacity - cc (cu in)</td>
<td>2394 (146.1)</td>
</tr>
<tr>
<td>Compression ratio</td>
<td>9.5:1</td>
</tr>
<tr>
<td>Maximum power (DIN, kW @ rpm)</td>
<td>96 @ 5800</td>
</tr>
<tr>
<td>Maximum torque (DIN, Nm @ rpm)</td>
<td>193 @ 3000</td>
</tr>
</tbody>
</table>

#### Cylinder block

<table>
<thead>
<tr>
<th>Identification mark</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bore diameter:</td>
<td></td>
</tr>
<tr>
<td>Standard grade 1</td>
<td>84.000 to 84.010 mm</td>
</tr>
<tr>
<td>Standard grade 2</td>
<td>84.010 to 84.020 mm</td>
</tr>
<tr>
<td>Standard grade 3</td>
<td>84.020 to 84.030 mm</td>
</tr>
<tr>
<td>Standard grade 4</td>
<td>84.030 to 84.040 mm</td>
</tr>
<tr>
<td>Oversize grade A</td>
<td>84.510 to 84.520 mm</td>
</tr>
<tr>
<td>Oversize grade B</td>
<td>84.520 to 84.530 mm</td>
</tr>
<tr>
<td>Oversize grade C</td>
<td>84.530 to 84.540 mm</td>
</tr>
<tr>
<td>Standard service grade</td>
<td>84.030 to 84.040 mm</td>
</tr>
<tr>
<td>Oversize 0.5</td>
<td>84.530 to 84.540 mm</td>
</tr>
<tr>
<td>Oversize 1.0</td>
<td>85.030 to 85.040 mm</td>
</tr>
</tbody>
</table>

#### Pistons

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

#### Cylinder head

| Identification mark               | H                         |

---

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

**Thrustwasher thickness:**
- Standard .................................................. 2.28 to 2.33 mm
- Oversize .................................................. 2.48 to 2.53 mm

**Crankshaft endfloat ........................................**
- 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

**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**

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

**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: Inlet opens 30° BTDC, Exhaust closes 20° ATDC
- BRD and BRE engine: Inlet closes 66° ABDC, Exhaust opens 76° BBDC

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.

a) Removal and refitting of the cylinder heads
b) Removal and refitting of the sump and oil pump
c) Removal and refitting of the timing gears
d) Removal and refitting of the pistons, connecting rods and big-end bearings
e) Renewal of the engine mountings
f) Removal and refitting of the flywheel

3 Major operations requiring engine removal
The engine must be removed for the following operations:

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

c) Removal and refitting of the camshaft

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
1. Disconnect the battery negative lead.
2. Remove the bonnet.
3. Remove the throttle valve cover, which is retained by three screws.
4. Remove the air cleaner cover, valve airflow...
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 downshift 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.

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 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.

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.

8.14a Front airflow sensor wiring plug
8.14b Throttle position sensor wiring plug
8.15 Oil filler breather hose (arrowed)
8.18a Coolant temperature sensor location
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.

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, unbol 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 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.
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 unbolting 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.

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.
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).

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.
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.

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.

**12.6 Removing the oil pump and driveshaft**

3. Recover the oil pump drive shaft, 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:** 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.

**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.

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 oil 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.
20.2 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).

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 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.

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.
9 Inspect the valve springs, it 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 seal 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, 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 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).

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).
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.

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.

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.
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-705X-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.

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...
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 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 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.
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.

2.8 litre engines

1. Lubricate a new oil seal and fit it to the timing cover (see illustration).
2. Fit the Woodruff keys if removed from the camshaft and crankshaft.
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).
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 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 position.
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).

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).

21 Compress the plunger/sliper 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).
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 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.

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.
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.

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).

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.
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-998-9000-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.

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 retightened 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.

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.