Chapter 2 Part A
Four-cylinder engines

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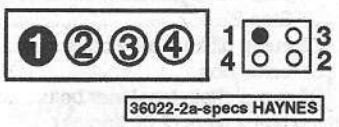
Specifications

General

2.0L engine	
Engine type	Four-cylinder, in-line, DOHC
Displacement	121 cubic inches (1989 cc)
Engine VIN code	B
Bore	3.34 inches (84.8 mm)
Stroke	3.46 inches (88.0 mm)
Compression ratio	9.6:1
Compression	See Chapter 2C
Firing order	1-3-4-2
Oil pressure	See Chapter 2C
2.3L engine	
Engine type	Four cylinder, in line DOHC
Displacement	2.3 L 140 cubic inches (2261 cc)
Engine VIN code	Z
Bore	3.44 inches (87.5 mm)
Stroke	3.70 (94.0 mm)
Compression ratio	9.7: 1
Compression	See Chapter 2C
Firing order	1-3-4-2
Oil pressure	See Chapter 2C



Cylinder/coil terminal locations - four-cylinder engine

Camshafts

2.0L engine	
Lobe height	
Intake	0.350 inch (8.9 mm)
Exhaust	0.343 inch (8.7 mm)
Bearing journal diameter	1.022 to 1.023 inches (25.96 to 25.98 mm)
Endplay	0.003 to 0.009 inch (0.080 to 0.220 mm)
2.3L engine	
Lobe height	
Intake	0.324 inch (8.35 mm)
Exhaust	0.307 inch (7.8 mm)
Bearing journal diameter	0 982 inch (24.97 mm)
Endplay	0.003 to 0.009 inches (0.9 to 0.24 mm)

Valve clearances (cold)

2.0L engine	
Intake	0.004 to 0.007 inch (0.11 to 0.18 mm)
Exhaust	0.011 to 0.013 inch (0.27 to 0.34 mm)
2.3L engine	
Intake	0.008 to 0.011 inches (0.22 to 0.28 mm)
Exhaust	0.11 to 0.13 inches (0.27 to 0.33 mm)

Warpage limits

Cylinder head gasket surfaces (head and block)	0.002 inch (0.05 mm)
Intake and exhaust manifolds	0.008 inch (0.20 mm)

Torque specifications

	Ft-lbs (unless otherwise indicated)	**Nm**
Camshaft bearing cap bolts		
2.0L engine		
Step 1	89 in-lbs	10
Step 2	168 in-lbs	19
2.3L engine		
Step 1	62 in-lbs	7
Step 2	144 in-lbs	16
Camshaft sprocket bolts	50	68
Crankshaft pulley bolt	85	115
Cylinder head bolts - 2.0L engine **(in sequence - see illustration 13.35a)**		
Step 1	15	20
Step 2	30	40
Step 3	Tighten an additional 90-degrees	
Cylinder head bolts - 2.3L engine **(in sequence - see illustration 13.35b)**		
Step 1	44 in-lbs	5
Step 2	132 in-lbs	15
Step 3	33	44
Step 4	Tighten an additional 90-degrees	
Step 5	Tighten an additional 90-degrees	
Valve cover bolts	80 in-lbs	9
Exhaust manifold nuts and bolts (2.0L engine)	144 in-lbs	16
Exhaust Manifold/Catalytic converter (2.3L engine)	35	47
Flywheel bolts	83	112
Intake manifold nuts and bolts	156 in-lbs	18
Lower crankcase-to-engine block **(in sequence - see illustration 15.23)**	22	30
Oil pick-up pipe bolts	89 in-lbs	10
Oil pump-to-cylinder block bolts (2.0L engine)		
Step 1	53 in-lbs	6
Step 2	Tighten an additional 45-degrees	
Oil pan-to-lower crankcase (2.0L engine)		
Step 1	53 in-lbs	6
Step 2	105 in-lbs	12
Oil pan-to-bellhousing bolts (2.3L engine)	35	48
Oil pan-to-timing chain cover bolts (2.3L engine)	89 in-lbs	10
Oil pan-to-engine block bolts (2.3L engine)	18	25
Oil pump (2.3L engine)		
Oil pump mounting bolts		
Step 1	89 in-lbs	10
Step 2	15	20
Oil pump pick-up tube bolts	89	10
Sprocket bolt	18	25
Oil pump chain tensioner bolt	89 in-lbs	10
Timing belt covers (2.0L engine)		
Upper cover bolts	71 in-lbs	8
Middle cover bolts	37	50
Lower cover bolts	71 in-lbs	8
Timing belt guide pulley bolt (2.0L engine)	18	25
Timing chain guide bolts (2.3L engine)	89 in-lbs	10
Timing belt tensioner pulley bolt (2.0L engine)	18	25
Timing chain tensioner bolts (2.3L engine)	89 in-lbs	10
Timing chain cover bolts (2.3L engine)		
8 mm bolts	89 in-lbs	10
13 mm bolts	35	48

1 General information

How to use this Chapter

This Part of Chapter 2 is devoted to repair procedures possible while the engine is still installed in the vehicle. Since these procedures are based on the assumption that the engine is installed in the vehicle, if the engine has been removed from the vehicle and mounted on a stand, some of the preliminary dismantling steps outlined will not apply.

Information concerning engine/transaxle removal and replacement and engine overhaul, can be found in Part C of this Chapter.

Engine description

These engines are sixteen-valve, double overhead camshaft (DOHC), four-cylinder, in-line type, mounted transversely at the front of the vehicle, with the transmission on its left-hand end. The 2.0L engine is equipped with plastic timing belt covers, a fiberglass-reinforced plastic intake manifold, a cast-iron cylinder block/crankcase and aluminum cylinder head. The 2.0L engine also includes a cast aluminum alloy lower crankcase that is bolted to the underside of the engine block, with a pressed-steel oil pan bolted under that. This arrangement offers greater rigidity than the normal oil pan arrangement, and helps to reduce engine vibration.

The 2.3L engine incorporates an aluminum cylinder head and an aluminum cylinder block.

The two camshafts are driven by a timing belt (2.0L engine), or timing chain (2.3L engines), each operating eight valves via conventional cam followers. Each camshaft rotates in five bearings that are line-bored directly in the cylinder head and the (bolted-on) bearing caps. This means that the bearing caps are not available separately from the cylinder head, and must not be interchanged with caps from another engine.

In addition to the features of the 2.0L Zetec engine, the 2.3L engine incorporates an all aluminum timing chain cover, engine block and oil pan. The bottom end of the engine is non-serviceable; this includes the pistons, connecting rods, crankshaft and engine block. Any failure of any one of these components will require replacement of the entire engine block/crankcase as an assembly.

When working on this engine, note that Torx-type (both male and female heads) and hexagon socket (Allen head) fasteners are widely used. A good selection of sockets, with the necessary adapters, will be required, so that these can be unscrewed without damage and, on reassembly, tightened to the torque wrench settings specified.

Lubrication system

Lubrication is by means of an eccentric-rotor trochoidal pump, which is mounted on the crankshaft right-hand end, and draws oil through a strainer located in the oil pan. The pump forces oil through an externally-mounted full-flow cartridge-type filter. From the filter, the oil is pumped into a main gallery in the cylinder block/crankcase, from where it is distributed to the crankshaft (main bearings) and cylinder head.

The connecting rod bearings are supplied with oil via internal drillings in the crankshaft. Each piston crown is cooled by a spray of oil directed at its underside by a jet. These jets are fed by passages off the crankshaft oil supply galleries, with spring-loaded valves to ensure that the jets open only when there is sufficient pressure to guarantee a good oil supply to the rest of the engine components. Where the jets are not installed, separate blanking plugs are provided so that the passages are sealed, but can be cleaned at overhaul.

The cylinder head is provided with two oil galleries, one on the intake side and one on the exhaust, to ensure constant oil supply to the camshaft bearings and cam followers. A retaining valve (inserted into the cylinder head's top surface, in the middle, on the intake side) prevents these galleries from being drained when the engine is switched off. The valve incorporates a ventilation hole in its upper end, to allow air bubbles to escape from the system when the engine is restarted.

While the crankshaft and camshaft bearings receive a pressurized supply, the camshaft lobes and valves are lubricated by splash, as are all other engine components.

2 Repair operations possible with the engine in the vehicle

Many major repair operations can be accomplished without removing the engine from the vehicle.

Clean the engine compartment and the exterior of the engine with some type of degreaser before any work is done. It will make the job easier and help keep dirt out of the internal areas of the engine.

Depending on the components involved, it may be helpful to remove the hood to improve access to the engine as repairs are performed (refer to Chapter 11 if necessary). Cover the fenders to prevent damage to the paint. Special pads are available, but an old bedspread or blanket will also work.

If vacuum, exhaust, oil or coolant leaks develop, indicating a need for gasket or seal replacement, the repairs can generally be made with the engine in the vehicle. The intake and exhaust manifold gaskets, oil pan gasket, camshaft and crankshaft oil seals and cylinder head gasket are all accessible with the engine in place.

Exterior engine components, such as the intake and exhaust manifolds, the oil pan, the oil pump, the water pump, the starter motor, the alternator and the fuel system components can be removed for repair with the engine in place.

Since the camshaft(s) and cylinder head can be removed without pulling the engine, valve component servicing can also be accomplished with the engine in the vehicle. Replacement of the timing belt or chain and sprockets is also possible with the engine in the vehicle.

In extreme cases caused by a lack of necessary equipment, repair or replacement of piston rings, pistons, connecting rods and rod bearings is possible with the engine in the vehicle. However, this practice is not recommended because of the cleaning and preparation work that must be done to the components involved.

3 Top Dead Center (TDC) for Number 1 piston - locating

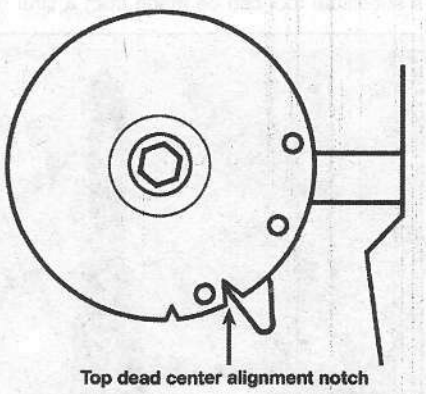
Refer to illustrations 3.4, 3.5a, 3.5b, 3.6, 3.7a, 3.7b and 3.7c

1 Top dead center (TDC) is the highest point of the cylinder that each piston reaches as the crankshaft turns. Each piston reaches its TDC position at the end of its compression stroke, and then again at the end of its exhaust stroke. For the purpose of engine timing, TDC on the compression stroke for the Number 1 piston is used. The Number 1 cylinder is at the timing belt end of the engine. Proceed as follows.

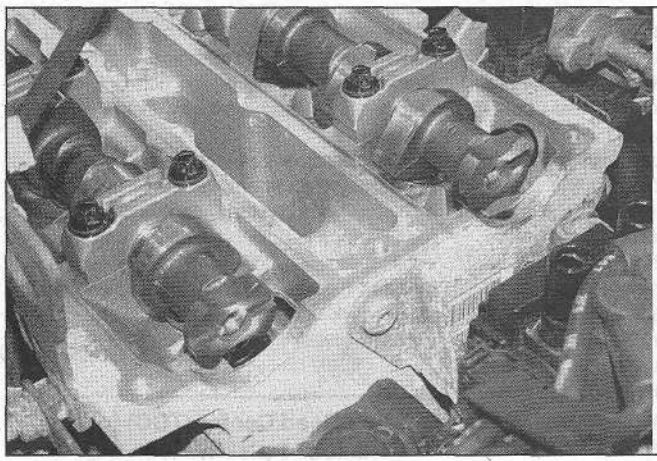
2 Disconnect the cable from the battery negative terminal (see Chapter 5).

3 Remove all the spark plugs as described in Chapter 1, then remove the valve cover as described in Section 4.

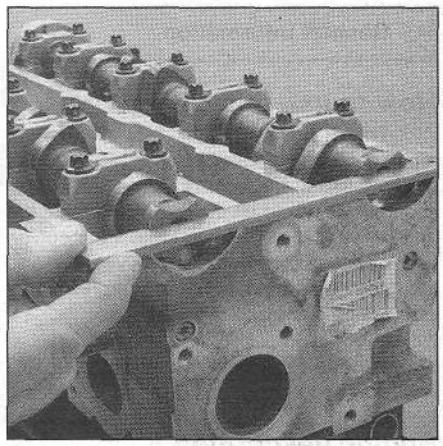
4 Loosen the right front wheel lug nuts, raise the front of the vehicle and support it securely on jackstands, then remove the wheel. Remove the fender splash shield. Using a wrench or socket on the crankshaft pulley bolt, rotate the crankshaft clockwise until the intake valves for the Number 1 cylinder have opened and just closed again. **Note:** *Double-check the TDC notch on the crank-shaft with the alignment mark on the lower crankcase (above oil pan)* **(see illustration).**



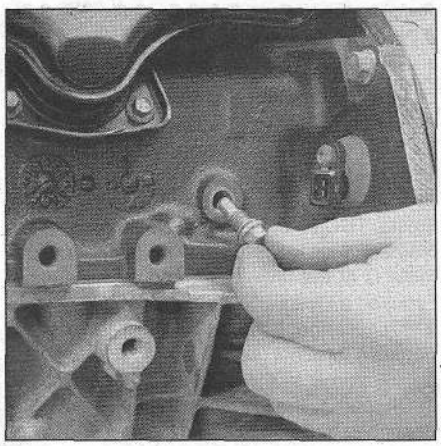
3.4 Align the Top Dead Center (TDC) notch with the casting on the lower crankcase



3.5a Turn the engine so that the camshaft end slots are aligned . . .



3.5b . . . then insert the metal strip into the slots to locate and set the shafts to TDC



3.6 Remove the timing hole blanking plug - catalytic converter removed for clarity

5 The camshafts each have a machined slot at the transaxle end of the engine. Both slots will be completely horizontal, and at the same height as the cylinder head machined surface, when the engine is at TDC on the Number 1 cylinder. Ford service tool 303-465 is used to check this position, and to positively locate the camshafts in position. Fortunately, a substitute tool can be made from a strip of metal 5 mm thick. While the strip's thickness is critical, its length and width are not, but should be approximately 180 to 230 mm long by 20 to 30 mm wide **(see illustrations)**.

6 A TDC timing hole is provided on the front of the cylinder block to permit the crankshaft to be located more accurately at TDC. The blanking plug is located behind the catalytic converter, and access is not easy - also, take care against burning if the engine is still warm **(see illustration)**.

7 Unscrew the timing pin blanking plug and screw in the timing pin (Ford service tool 303-574). This tool is obtainable from Ford dealers or a tool supplier. An alternative pin can be made from an M10 diameter bolt, cut down so that the length from the underside of the bolt head to the tip is exactly 63.4 mm **(see illustrations)**. It may be necessary to slightly turn the crankshaft either way (remove the tool from the camshafts first) to be able to fully insert the timing pin.

8 Turn the engine forwards slowly until the crankshaft comes into contact with the timing pin - in this position, the engine is set to TDC on the Number 1 cylinder.

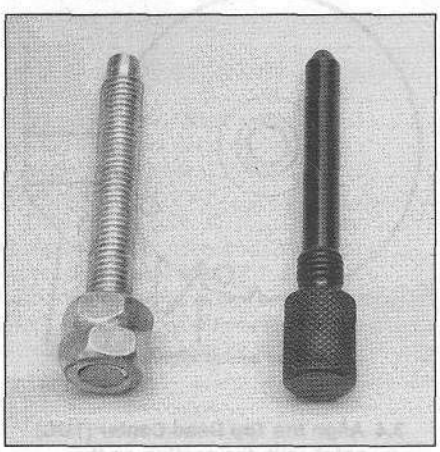
9 Before rotating the crankshaft again, make sure that the timing pin is removed. When operations are complete, do not forget to install the blanking plug.

10 If the timing pin is not available, insert a length of wooden dowel (about 150 mm/ 6 in long) or similar into the Number 1 spark plug hole until it rests on the piston crown. Turn the engine back from its TDC position, then forward (taking care not to allow the dowel to be trapped in the cylinder) until the dowel stops rising - the piston is now at the top of its compression stroke and the dowel can be removed.

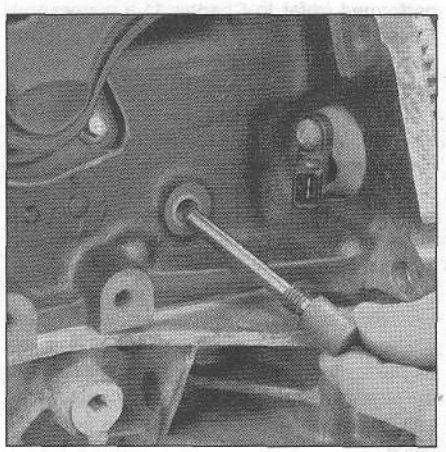
11 There is a 'dead' area around TDC (as the piston stops rising, pauses and then begins to descend) which makes it difficult to find the exact location of TDC by this method; if accuracy is required, either carefully establish the exact mid-point of the dead area (perhaps by using a dial gauge and probe), or refer to Step 5.

12 Once the Number 1 cylinder has been positioned at TDC on the compression stroke, TDC for any of the other cylinders can then be located by rotating the crankshaft clockwise 180° at a time and following the firing order (see this Chapter's Specifications).

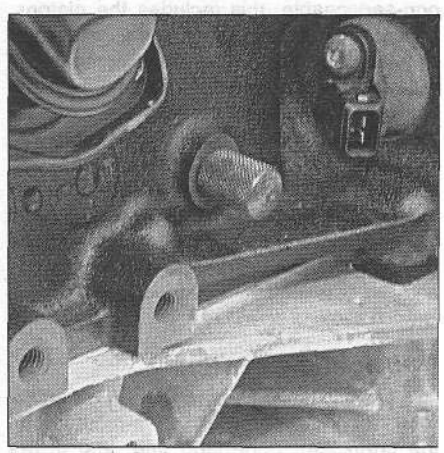
13 Reconnect the battery. After you're done, the Powertrain Control Module (PCM) must relearn its idle and fuel trim strategy for optimum driveability and performance (see Chapter 5, Section 1).



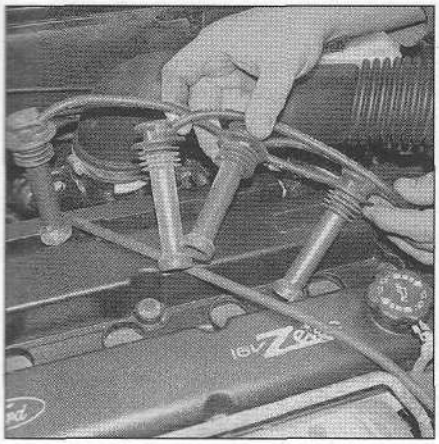
3.7a Home-made (left) and factory (right) timing pins



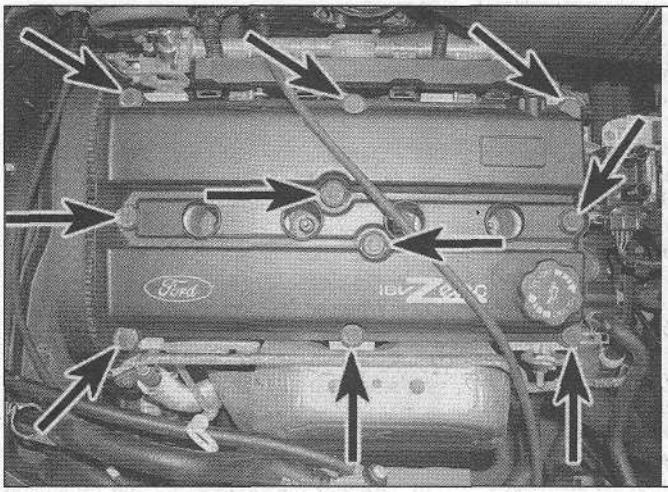
3.7b Insert the timing pin in the hole . . .



3.7c . . . and screw it fully into position



4.3 Twist the spark plug wire boots, then remove the plug wires from the spark plugs



4.8a Remove the retaining bolts and . . .

4 Valve cover - removal and installation

Refer to illustrations 4.3, 4.8a and 4.8b

Removal

1 Disconnect the battery cable from the negative battery terminal (see Chapter 5).
2 Remove the air intake duct from the air filter housing (see Chapter 4).
3 Remove the spark plug wires from the spark plugs **(see illustration)**. On the 2.3L engine, remove the ignition coil assemblies from the spark plugs.
4 Disconnect the accelerator cable and the cruise control actuator cable from the throttle valve (see Chapter 4).
5 Disconnect the catalytic converter monitor connector and the heated oxygen sensor connector (see Chapter 6). Remove the connectors from the bracket.
6 Remove the wiring harness support nuts from the studs on the valve cover and position the wiring harness off to the side.
7 Remove the ignition coil (see Chapter 5) and the ignition coil bracket from the valve cover (2001 to 2004 only).
8 Working progressively, unscrew the valve cover retaining bolts, noting the (captive) spacer sleeve and rubber seal, then withdraw the cover **(see illustrations)**.
9 Discard the cover gasket. This must be replaced whenever it is disturbed. Check that the sealing faces are undamaged and that the rubber seal at each bolt hole is serviceable. Replace any worn or damaged seals.

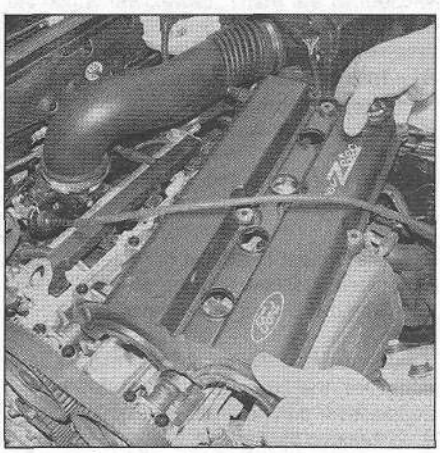
Installation

10 On installation, clean the cover and cylinder head gasket faces carefully, then install a new gasket onto the valve cover, ensuring that it is located correctly by the rubber seals and spacer sleeves.
11 Install the cover to the cylinder head, ensuring as the cover is tightened that the gasket remains seated.
12 Working in a diagonal sequence from the center outwards, first tighten the cover bolts by hand only. Once all the bolts are hand-tight, go around once more in sequence, and tighten the bolts to the torque listed in this Chapter Specifications.
13 On 2004 and earlier four-cylinder models, install the spark plug wires, clipping them into place so that they are correctly routed; each is numbered and can also be identified by the numbering on its respective coil terminal. On other models, install the ignition coils.
14 Reconnect the battery. After you're done, the Powertrain Control Module (PCM) must relearn its idle and fuel trim strategy for optimum driveability and performance (see Chapter 5, Section 1).
15 On completion, run the engine and check for signs of oil leakage.

5 Valve clearances - checking and adjustment

2.0L engine

Note: *Note that while checking the valve clearances is an easy operation, changing the shims requires the use of a Ford special tool - owners may prefer to have this work carried out by a Ford dealer.*

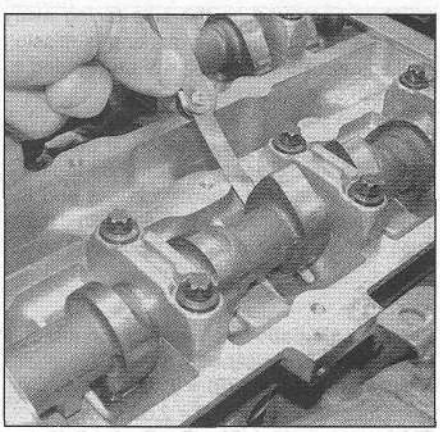


4.8b . . . lift off the valve cover from the cylinder head

Checking

Refer to illustration 5.3

1 Remove the valve cover as described in Section 4.
2 Set the number 1 cylinder to TDC on the compression stroke as described in Section 3. The intake and exhaust cam lobes of the number 1 cylinder will be pointing upwards (though not vertical) and the valve clearances can be checked.
3 Working on each valve in turn, measure the clearance between the base of the cam lobe and the shim using feeler gauges **(see illustration)**. Record the thickness of the blade required to give a firm sliding fit on all four valves of the Number 1 cylinder.
4 Now turn the crankshaft clockwise through 180 degrees so that the valves of cylinder Number 3 are pointing upwards. Measure and record the valve clearances for cylinder number 3. The clearances for cylinders 4 and 2 can be measured after turning the crankshaft through 180° each time. Any measured valve clearances that do not fall in the specified range (see Specifications) must be adjusted.



5.3 Check the valve clearances with a feeler gauge of the specified thickness

Adjustment

Note: *Use of the Ford special tool is highly recommended, as the design of the camshafts and cylinder head and the lack of space mean that it would not be possible to use a screwdriver or similar tool to depress the cam follower without serious risk of damage to the cylinder head. The only alternative is to measure the clearances very carefully several times each, record the clearances measured, and take the average as determining the true value. Access can then be gained to the shims by removing the camshafts* (see Section 12) *so that all relevant shims can be changed without the need for special tools. This approach requires very careful, methodical work if the camshafts are not to be removed and replaced several times.*

5 If adjustment is required, the shim thicknesses must be changed by depressing the cam follower and removing the old shim, then fitting a new one.

6 Before changing a shim, the piston for the relevant cylinder needs to be lowered from its TDC position by turning the crankshaft approximately 90 degrees clockwise. If this is not done, the piston will be too close to the valve to allow the cam follower to be depressed, and there is a risk of the valve being bent.

7 Ford technicians use service tool 303-350, which is bolted onto the cylinder head above each camshaft in turn using two of the camshaft bearing cap bolt locations - a spacer 8 x 12 mm (or equivalent thickness of 8 mm washers) may be required to allow the tool to be bolted onto the head. Locate the operating end of the tool onto the cam follower and operate the handle to depress the cam follower.

8 Take great care not to scratch or otherwise damage the cam follower and its housing. Remove the shim with a small screwdriver or magnetic probe, taking care not to scratch or damage the cam follower, then slowly release the pressure applied to the tool. Do not rotate the camshaft while a shim is removed - the risk of damage to the cam lobe and/or cam follower is too great.

9 Record the thickness of the shim (in mm) which is engraved on the side facing away from the camshaft. If the marking is missing or illegible, a micrometer will be needed to establish shim thickness.

10 If the valve clearance was too small, a thinner shim must be installed. If the clearance was too large, a thicker shim must be installed. When the shim thickness and the valve clearance are known, the required thickness of the new shim can be calculated as follows:

Sample calculation - clearance too small
Desired clearance (A) = 0.15 mm
Measured clearance (B) = 0.09 mm
Shim thickness found (C) = 2.55 mm
Thickness required (D) = C + B - A = 2.49 mm

Sample calculation - clearance too large
Desired clearance (A) = 0.30 mm
Measured clearance (B) = 0.36 mm
Shim thickness found (C) = 2.19 mm
Thickness required (D) = C + B - A = 2.25 mm

11 Depress the cam follower again, and press the correct shim into the recess in the cam follower with the thickness marking facing downwards. Ensure that the shim is properly located in the cam follower, and apply a smear of clean oil to it.

12 When all the clearances of the first cylinder's valves have been set, rotate the crankshaft through two full turns clockwise to settle the shims. Return the cylinder to TDC on the compression stroke and recheck the valve clearances. Repeat the procedure from Step 10 onwards if any are still incorrect.

13 Repeat the process for the remaining cylinders, turning the crankshaft to bring each in turn first to the TDC position and then 90 degrees after TDC, as described above.

14 It will be helpful for future adjustment if a record is kept of the thickness of the shims fitted at each position. The shims required can be purchased in advance once the clearances and the existing shim thicknesses are known. It is permissible to interchange shims between cam followers to achieve the correct clearances, but it is not advisable to turn the camshaft with any shims removed, since there is a risk that the cam lobe will jam in the empty cam follower.

15 When all the clearances are correct, remove the tool, then install the valve cover as described in Section 4.

2.3L engine

16 On these engines the valve clearances are checked the same way as on the 2.0L engine, but instead of removable shims to set the proper clearance, cam followers with heads of differing thicknesses are available to set the desired clearance. The same formula used to calculate shim thickness is used to calculate desired follower head thickness (see Step 10). To change the cam followers, the camshafts have to be removed (see Section 12).

6 Intake manifold - removal and installation

Removal

1 Relieve the fuel system pressure (see Chapter 4)

2 Disconnect the cable from the negative battery terminal (see Chapter 5).

3 Remove the air intake hose (see Chapter 4).

4 Disconnect the accelerator cable and, if equipped, the cruise control cable from the throttle lever arm (see Chapter 4).

5 Remove the fuel rail, fuel pressure regulator and fuel injectors as a single assembly (see Chapter 4).

6 Remove the breather hose and the PCV valve from the intake manifold (see Chapter 6).

7 Remove the ignition wires and disconnect the ignition coil harness connector (see Chapter 5).

8 Disconnect the vacuum lines from the intake manifold and label them for correct reassembly.

9 Disconnect the PCM harness connector (see Chapter 6).

10 Disconnect the cylinder head temperature (CHT) sensor connector (see Chapter 6). Detach the harness from the clip and separate the harness from the intake manifold.

11 Remove the alternator (see Chapter 5).

12 Remove the EGR valve (see Chapter 6).

13 If you're planning to *replace* or *service* the intake manifold, remove the throttle body (see Chapter 4). **Note:** *If you're simply removing the intake manifold plenum to remove or service the cylinder head, it's not necessary to remove the throttle body from the intake manifold plenum.*

14 Remove the intake manifold support bracket.

15 Remove the intake manifold fasteners and washers and then remove the intake manifold and the manifold gasket.

Inspection

16 Using a straightedge and feeler gauge, check the intake manifold mating surface for warpage. Check the intake manifold surface on the cylinder head also. If the warpage on either surface exceeds the limit listed in this Chapter's Specifications, the intake manifold and/or the cylinder head must be resurfaced at an automotive machine shop or, if the warpage is too excessive for resurfacing, replaced.

Installation

17 Using a new manifold gasket, install the intake manifold. Tighten the bolts and nuts in several stages, working from the center out, to the torque listed in this Chapter's Specifications.

18 Installation is otherwise the reverse of removal.

19 Reconnect the battery. After you're done, the Powertrain Control Module (PCM) must relearn its idle and fuel trim strategy for optimum driveability and performance (see Chapter 5, Section 1).

7 Exhaust manifold - removal and installation

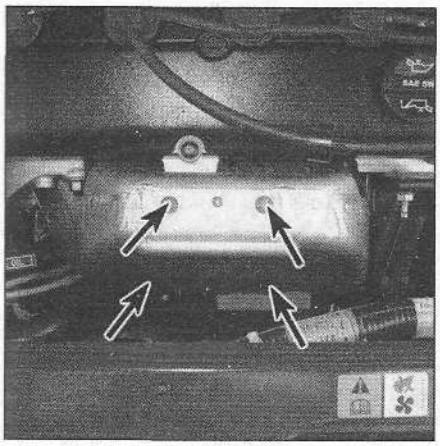
Warning: *Allow the engine to cool completely before beginning this procedure.*

Removal

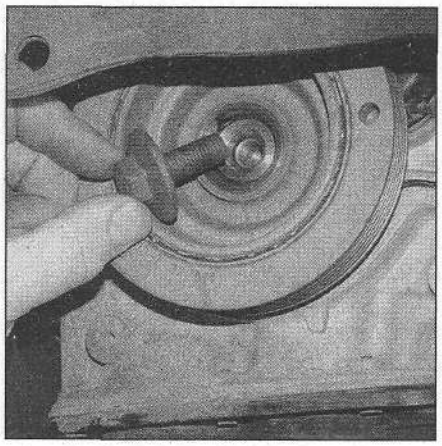
Refer to illustration 7.5

1 Raise the vehicle and place it securely on jackstands.

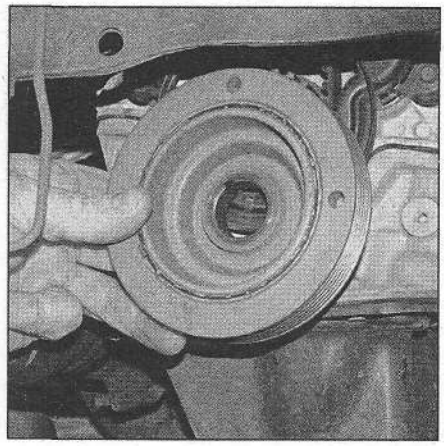
2 Remove the exhaust pipe and the catalytic converter (see Chapter 4). Remove and discard the old flange gasket.



7.5 Remove the heat shield mounting bolts



8.4a Unscrew and remove the pulley bolt . . .



8.4b . . . and remove the crankshaft pulley

3 Remove the dipstick tube bracket bolt and lift the assembly from the engine compartment.

4 Unplug the electrical connector for the oxygen sensor and then remove the oxygen sensor from the exhaust manifold (see Chapter 6).

5 Remove the exhaust manifold heat shield **(see illustration)**.

6 Remove the exhaust manifold mounting bolts and then remove the exhaust manifold and the old manifold gasket.

Inspection

7 Inspect the exhaust manifold for cracks and any other obvious damage. If the manifold is cracked or damaged in any way, replace it.

8 Using a wire brush, clean up the threads of the exhaust manifold bolts and then inspect the threads for damage. Replace any bolts that have thread damage.

9 Using a scraper, remove all traces of gasket material from the mating surfaces and inspect them for wear and cracks. **Caution:** *When removing gasket material from any surface, especially aluminum, be very careful not to scratch or gouge the gasket surface. Any damage to the surface may leak after reassembly. Gasket removal solvents are available from auto parts stores and may prove helpful.*

10 Using a straightedge and feeler gauge, inspect the exhaust manifold mating surface for warpage. Check the exhaust manifold surface on the cylinder head also. If the warpage on any surface exceeds the limits listed in this Chapter's Specifications, the exhaust manifold and/or cylinder head must be replaced or resurfaced at an automotive machine shop.

Installation

11 Coat the threads of the exhaust manifold bolts and studs with an anti-seize compound. Install a new gasket, install the manifold and install the fasteners. Tighten the bolts and nuts in several stages, working from the center out, to the torque listed in this Chapter's Specifications.

12 The remainder of installation is the reverse of removal. When you're done, be sure to run the engine and check for exhaust leaks.

8 Crankshaft pulley - removal and installation

2.0L engine

Removal

Refer to illustrations 8.4a and 8.4b

1 Remove the drivebelt (see Chapter 1).

2 If the pulley is being removed as part of another procedure such as timing belt replacement, it will be easier to set the engine to TDC now (see Section 3) before removing the crankshaft pulley bolt. **Note:** *NEVER use the timing pin as a means of locking the crankshaft - it is not strong enough for this, and will shear off. Always ensure that the timing pin is removed before the crankshaft pulley bolt (or similar fasteners) is slackened or tightened.*

3 The crankshaft must now be held or locked to prevent its rotation while the pulley bolt is unscrewed. There are two recommended procedures. One method is to use a chain wrench around the crankshaft pulley with a piece of rubber or old drivebelt material under the chain to prevent any damage to the pulley. Another method to prevent crankshaft rotation is to lock the flywheel by removing the starter (see Chapter 5) and wedging a screwdriver in the flywheel/driveplate ring gear teeth.

4 Unscrew the pulley bolt and remove the pulley **(see illustrations)**.

Installation

5 Installation is the reverse of the removal procedure. Ensure that the pulley's keyway is aligned with the crankshaft's locating key. Tighten the pulley bolt to the torque setting listed in this Chapter's Specifications. Lock the crankshaft using the same method as for loosening.

2.3L engine

Removal

Refer to illustration 8.10

Caution: *Once the crankshaft pulley is loosened, the crankshaft (timing) sprocket will be loosened as well. The engine is considered out-of-time at this point. The installation procedure in this Section must be followed exactly to re-time the engine properly. Severe engine damage may occur otherwise.*

6 Remove the cooling fan and shroud (see Chapter 3).

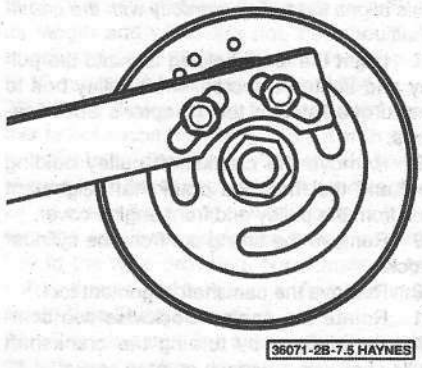
7 Remove the auxiliary drivebelt (see Chapter 1).

8 Remove the valve cover (see Section 4)

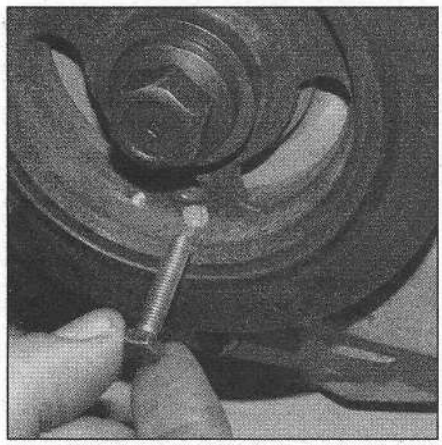
9 Set the engine to TDC (see Section 3).

10 The crankshaft must be held to prevent its rotation while the pulley bolt is unscrewed. A special tool to hold the crankshaft pulley is needed for this **(see illustration)**, and is available at most auto supply stores or equipment rental locations. A suitable equivalent can be fabricated from a length of strap steel. **Caution:** *Use of a pry bar or similar tool can damage the crankshaft pulley.*

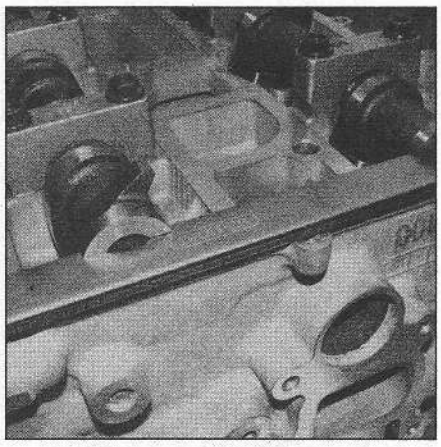
11 Insert the service tool into the spaces in the front face of the pulley to hold it in place



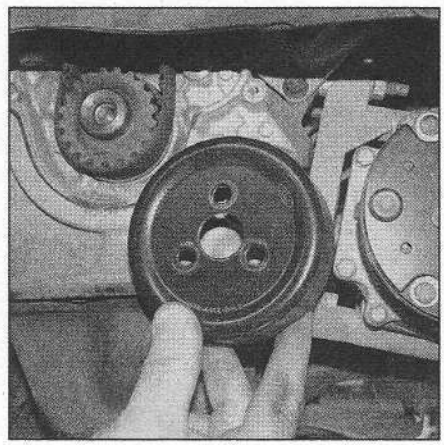
8.10 The crankshaft pulley holding tool installed



8.16 Installing the M6 bolt to verify TDC



8.25 The camshaft alignment tool installed



9.12 Unbolt and remove the water pump pulley

while turning the crankshaft pulley bolt with a large wrench or socket/breaker-bar combination. **Caution:** *Failure to hold the crankshaft pulley securely while removing the pulley bolt could result in engine damage. Moreover, NEVER rely on the timing pin or the camshaft service tool as a means of locking the crankshaft - they are designed for calibration only. Engine damage could occur by not using these tools for their intended purpose.*

12 Unscrew the pulley bolt and remove the holding tool.

13 Remove the pulley and label or mark which side is installed towards the engine.

Installation

Refer to illustrations 8.16 and 8.25

14 Lightly coat the crankshaft front seal with clean engine oil, then install the crankshaft pulley. **Note:** *If the seal shows signs of leakage, you may want to replace it before installing the crankshaft pulley (see Section 16).*

15 Install a new crankshaft pulley bolt and hand tighten only. Attempt to closely align the hole in the pulley with the threaded hole in the timing chain cover.

16 Install a crankshaft pulley alignment bolt (M6 x 18 mm) through the pulley and into the front engine cover. Rotate the pulley as necessary to do this **(see illustration)**. **Note:** *This aligns the pulley correctly with the crankshaft.*

17 Insert the large holding tool into the pulley and tighten the crankshaft pulley bolt to the torque listed in this Chapter's Specifications.

18 Remove the crankshaft pulley holding tool and the threaded crankshaft alignment bolt from the pulley and front engine cover.

19 Remove the timing pin from the cylinder block.

20 Remove the camshaft alignment tool.

21 Rotate the engine clockwise two complete revolutions by turning the crankshaft pulley bolt with a wrench or large socket.

22 Rotate the engine again to achieve TDC (see Section 3). **Note:** *Rotate the engine in the clockwise direction only.*

23 Install the timing pin into the cylinder block.

24 Install the crankshaft pulley alignment bolt (M6 x 18 mm). If it cannot be installed, the crankshaft pulley must be removed and aligned so that it can. Repeat Steps 14 through 23 until crankshaft pulley alignment is correct.

25 With the crankshaft pulley alignment bolt (M6 x 18 mm) installed, install the camshaft alignment tool and check the position of the camshafts **(see illustration)**. If the tool cannot be installed, the engine timing must be corrected by repeating Steps 14 through 24.

26 The correct engine timing is achieved when the camshaft alignment tool, timing pin and the crankshaft pulley alignment bolt tool can be placed simultaneously.

27 Once correct engine timing is achieved, remove all the alignment tools and bolts and install the timing pin plug.

28 The remainder of installation is the reverse of removal.

9 Timing belt - removal, inspection and installation (2.0L engine)

Removal

Refer to illustrations 9.12, 9.14a, 9.14b, 9.17, 9.19a, 9.19b, 9.20, 9.21, 9.24a, 9.24b and 9.25

1 Disconnect the battery cable from the negative battery terminal (see Chapter 5).

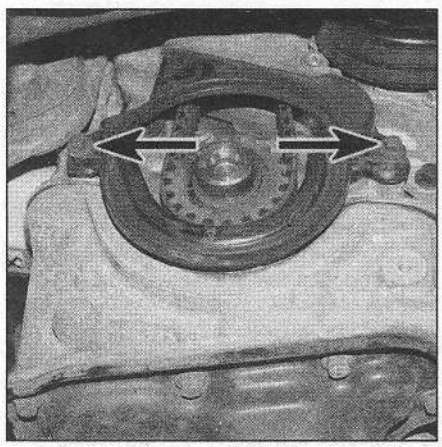
2 Remove the air intake duct from the air filter housing (see Chapter 4).

3 Remove the spark plugs (see Chapter 5).

4 Disconnect the accelerator cable and the cruise control actuator cable from the throttle valve (see Chapter 4).

5 Disconnect the catalytic converter monitor connector and the heated oxygen sensor connector (see Chapter 6). Remove the connectors from the bracket.

6 Remove the wiring harness support nuts



9.14a Unscrew the bolts . . .

from the studs on the valve cover and position the wiring harness off to the side.

7 Remove the valve cover (see Section 4).

8 Drain the coolant (see Chapter 1). Remove the coolant pipe mounting bolts and position the coolant pipe off to the side.

9 Loosen the right front wheel lug nuts. Raise the vehicle and secure it on jackstands.

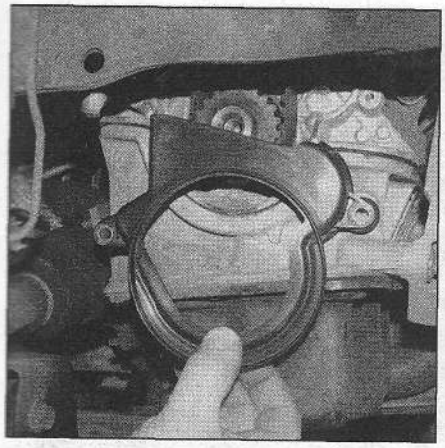
10 Remove the front wheel and front fender splash shield on the timing belt side of the engine compartment.

11 Position the engine at TDC for number 1 (see Section 3). **Note:** *NEVER use the timing pin as a means of locking the crankshaft - it is not strong enough for this, and will shear off. Always ensure that the timing pin is removed before the crankshaft pulley bolt (or similar fasteners) is slackened or tightened. Follow the recommended procedure in Section 8 for locking the flywheel.*

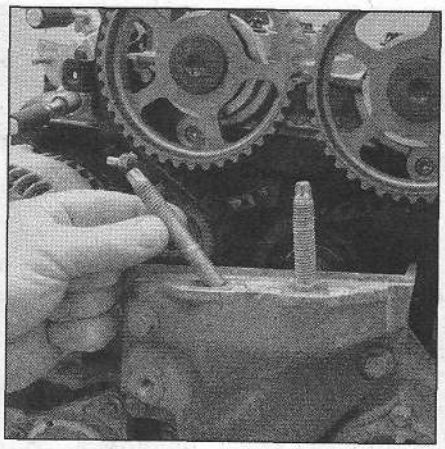
12 Remove the three water pump pulley bolts (see Chapter 3). Separate the water pump pulley from the timing belt cover **(see illustration)**.

13 Remove the crankshaft pulley (see Section 8).

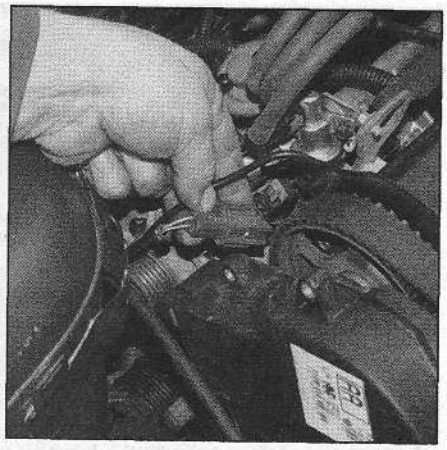
14 Remove the bolts from the lower timing belt cover **(see illustrations)**.



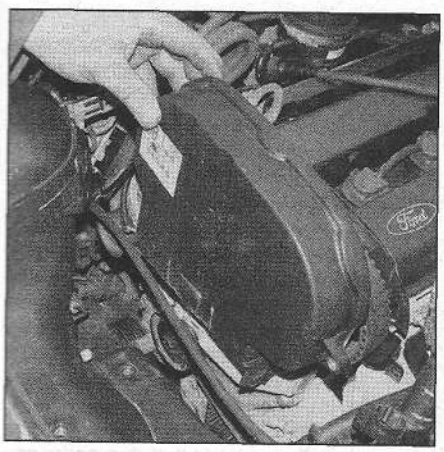
9.14b . . . and remove the timing belt lower cover



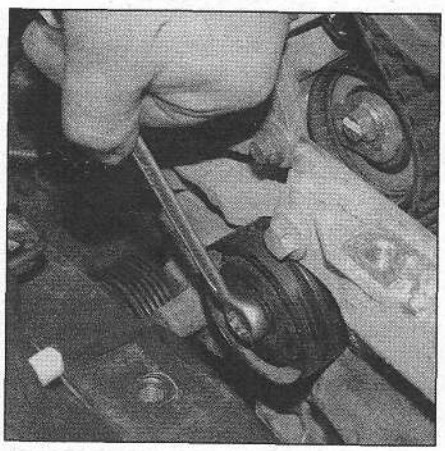
9.17 Unscrew and remove the engine mount studs



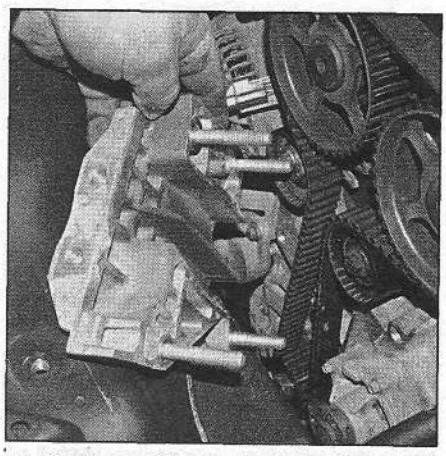
9.19a Disconnect the harness connector next to the upper timing belt cover



9.19b Remove the bolts and lift off the upper timing belt cover



9.20 Remove the bolt for the idler pulley



9.21 Remove the engine mount bracket

15 Connect a hoist or an engine support fixture to the engine (see Chapter 2C). Alternatively, a floor jack and block of wood can be positioned under the oil pan to support the engine.

16 Remove the upper engine mount next to the timing belt cover (see Section 18).

17 Remove the studs from the engine mount bracket **(see illustration)**.

18 Remove the knock sensor electrical connector from the upper timing belt cover (see Chapter 6).

19 Remove the upper timing belt cover **(see illustrations)**.

20 Remove the accessory drivebelt idler pulley bolt and pulley from the timing belt cover **(see illustration)**.

21 Remove the engine mount bracket **(see illustration)**.

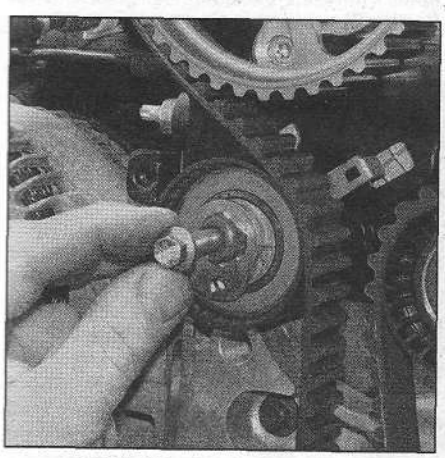
22 Before removing the timing belt, note that Ford service tool 303-376 will be needed (see Section 3), to set the camshafts to their TDC position. Fortunately, a substitute tool can be made from a strip of metal 5 mm thick (while the strip's thickness is critical, its length and width are not, but should be approximately 180 to 230 mm long by 20 to 30 mm wide) **(see illustration 3.5b)**.

23 If the timing belt is to be re-used (and this is not recommended), mark it with paint to indicate its direction of rotation, clockwise, viewed from the timing belt end of the engine.

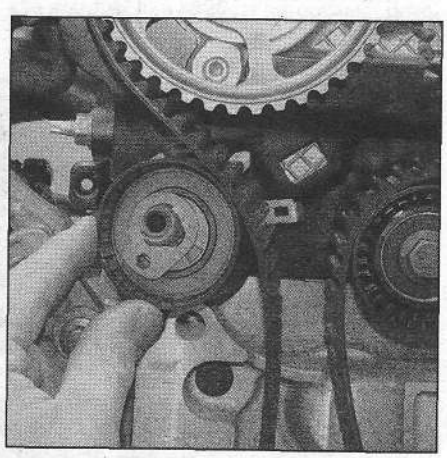
24 Loosen the timing belt tensioner bolt and turn the tensioner clockwise, using an Allen key in the hole provided. Now unscrew the bolt and unhook the tensioner from the inner shield **(see illustrations)**.

25 Ensuring that the sprockets are turned as little as possible, slide the timing belt off the sprockets and pulleys, and remove it **(see illustration)**.

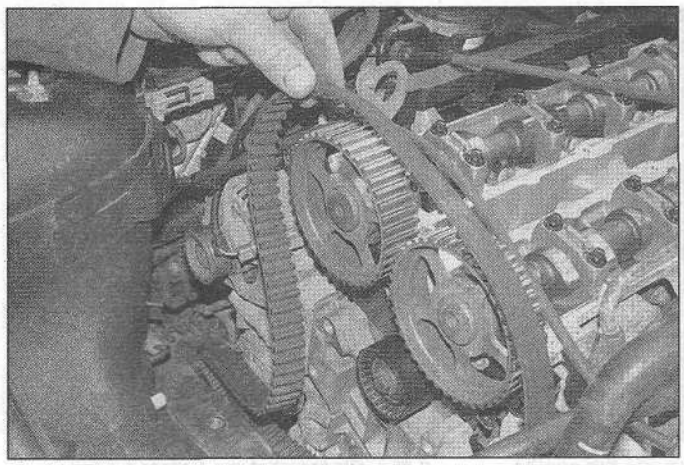
26 If the timing belt is not being installed



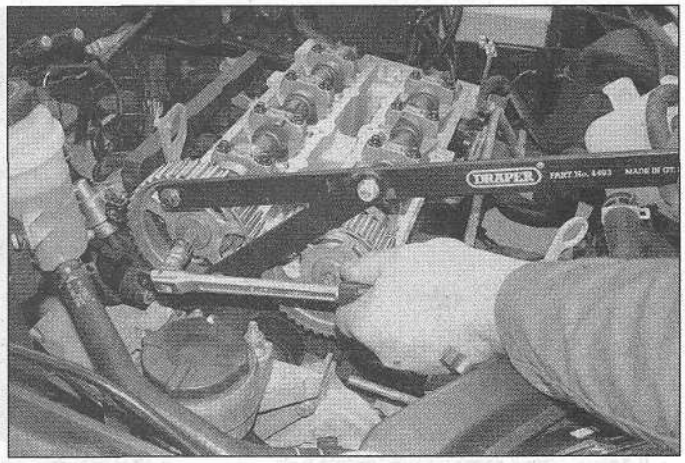
9.24a Unscrew the bolt . . .



9.24b . . . then unhook and remove the timing belt tensioner



9.25 When removing the timing belt, ensure the sprockets do not turn



9.32 Use a sprocket holding tool while loosening the camshaft sprocket bolts

right now or if the belt is being removed as part of another procedure, such as cylinder head removal, temporarily install the engine right-hand mount and tighten the bolts securely.

Inspection

27 If the old belt is likely to be reinstalled, check it carefully for any signs of uneven wear, splitting, cracks especially at the roots of the belt teeth.

28 Even if a new belt is to be installed, check the old one for signs of oil or coolant. If evident, trace the source of the leak and rectify it, then clean the engine timing belt area and related components to remove all traces of oil or coolant. Do not simply install a new belt in this instance, or its service life will be greatly reduced, increasing the risk of engine damage if it fails in service.

29 Always replace the belt if there is the slightest doubt about its condition. As a precaution against engine damage, the belt must be replaced as a matter of course at the intervals given in Chapter 1; if the car's history is unknown, the belt should be replaced irrespective of its apparent condition whenever the engine is overhauled.

30 Similarly check the belt tensioner, replacing it if there is any doubt about its condition. Check also the sprockets and pulleys for signs of wear or damage (and particularly cracking), and ensure that the tensioner and guide pulleys rotate smoothly on their bearings; replace any worn or damaged components. **Note:** *It is considered good practice by many professional mechanics to replace tensioner and guide pulley assemblies as a matter of course, whenever the timing belt is replaced.*

Installation

Refer to illustrations 9.32, 9.38a and 9.38b

31 Without turning the crankshaft more than a few degrees, check that the engine is still set to TDC on the Number 1 cylinder (see Section 3).

32 The TDC position of the camshafts must now be set, and for this, the camshaft sprocket bolts must be loosened. A holding tool will be required to prevent the camshaft sprockets from rotating while their bolts are slackened and retightened; either obtain Ford service tool 303-465, or fabricate a substitute as follows. Find two lengths of steel strip, one approximately two feet long and the other about eight inches long, and three bolts with nuts and washers; one nut and bolt forming the pivot of a forked tool, with the remaining nuts and bolts at the tips of the 'forks', to engage with the sprocket spokes **(see illustration)**. **Note:** *Do not use the camshaft TDC alignment tool (whether genuine Ford or not) to prevent rotation while the camshaft sprocket bolts are loosened or tightened; the risk of damage to the camshaft concerned and to the cylinder head is far too great. Use only a holding tool applied directly to the sprockets, as described.*

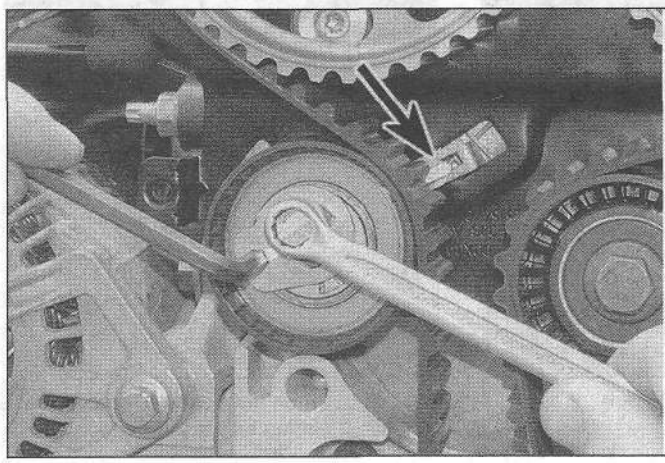
33 Loosen the camshaft sprocket bolts, ensuring that the camshafts are turned as little as possible as this is done. The bolts should be loose enough that the sprockets are free to turn on the shafts. It is essential that the bolts are left loose until the timing belt has been installed and tensioned, otherwise the valve timing will not be accurate.

34 The tool described in Step 22 is now required. Rest the tool on the cylinder head mating surface, and slide it into the slots in the opposite end (transaxle side) of both camshafts. The tool should slip snugly into both slots while resting on the cylinder head mating surface. If one camshaft is only slightly out of alignment, rotate the camshaft gently and carefully until the tool will fit. Once the camshafts are set at TDC, the positions of the sprockets are less important - they can move independently of the camshafts, to allow the timing belt to be accurately aligned with the teeth on the sprockets.

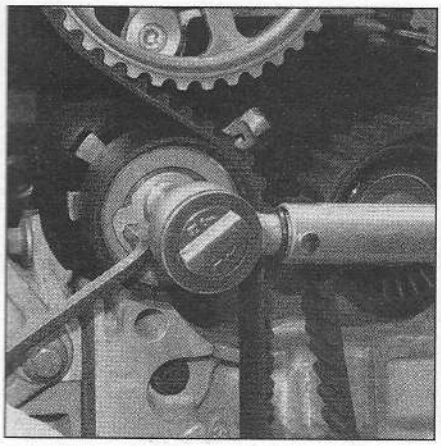
35 When installing the belt, note that the tensioner must not be installed until after the belt is fully positioned around the sprockets and pulley(s).

36 Install the timing belt; if the original is being reinstalled, ensure that the marks and notes made on removal are followed, so that the belt is installed to run in the same direction. Starting at the crankshaft sprocket, work counterclockwise around the guide pulley(s) and camshaft sprockets. Ensure that the belt teeth engage correctly with those on the sprockets. **Note:** *The crankshaft gear does not have alignment marks to verify TDC position. Instead it will be necessary to install the crankshaft pulley and check the alignment mark with the relief mark on the case* (see Section 3).

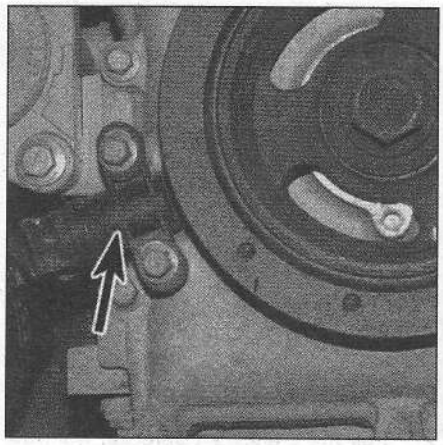
37 Any slack in the belt should be kept on



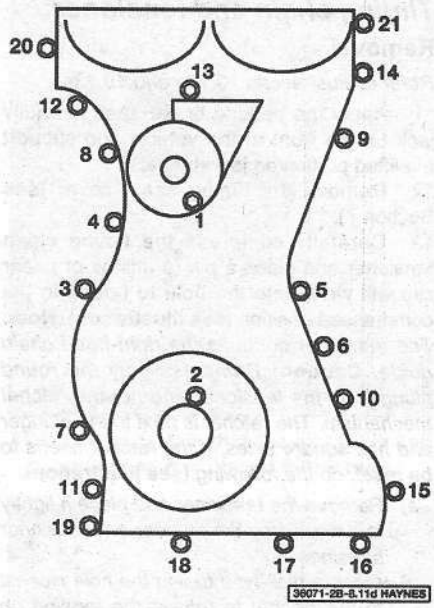
9.38a Use an Allen key to set the tensioner pointer in the center of the square window. . .



9.38b . . . then hold it while the tensioner bolt is tightened to the specified torque



10.3 The crankshaft position (CKP) sensor is located adjacent to the crankshaft pulley



10.10 Timing chain cover bolt tightening sequence

the tensioner side - the 'front' run must be kept tensioned, without altering the position of the crankshaft or the camshafts. If necessary, the camshaft sprockets can be turned slightly in relation to the camshafts (which remain fixed by the aligning tool).

38 When the timing belt is correctly installed on the sprockets and guide pulley(s), the belt tensioner can be installed. Hook the tensioner into the timing belt inner shield, and insert the bolt loosely. Using the Allen key, turn the tensioner counterclockwise until the arrow (Type A) **(see illustrations)** or fork (Type B) is aligned with the mark or square hole on the bracket, then tighten the tensioner bolt to its specified torque. **Note 1:** *There are two types of indicators on the tensioner. Type A uses an arrow that aligns with the dot in the square box. Type B uses a fork that aligns with a mark directly in the middle of the two prongs on the fork.* **Note 2:** *The timing belt tensioner automatically adjusts the tension by internal spring forces - checking the tension once set, for instance, by depressing or twisting the timing belt, will not give a meaningful result.*

39 Tighten both camshaft sprocket bolts to the torque listed in this Chapter's Specifications, holding the sprockets stationary using the tool described in Step 32.

40 Remove the camshaft aligning tool and the timing pin (see Section 3). Temporarily install the crankshaft pulley, and rotate the crankshaft through two full turns clockwise to settle and tension the timing belt, returning it to TDC. Check that the timing pin can be fully installed, then install the camshaft aligning tool; it should slip into place. If the checks are not correct, go back to Step 31 and perform the timing procedures again.

41 If one camshaft is slightly out of line, attach the forked holding tool to its sprocket (see Step 32), adjust its position as required, and check that any slack created in the belt has been taken up by the tensioner. Rotate the crankshaft two turns clockwise and install the camshaft aligning tool to check that it now fits as it should. If all is well, proceed to Step 43.

42 If either camshaft is significantly out of line, use the holding tool described in Step 32 above to prevent its sprocket from rotating while its retaining bolt is loosened - the camshaft can then be rotated carefully until the camshaft aligning tool will slip into place. Take care not to disturb the relationship of the sprocket to the timing belt. Without disturbing the sprocket's new position on the camshaft, tighten the sprocket bolt to the torque listed in this Chapter's Specifications. Remove the camshaft aligning tool and timing pin, and rotate the crankshaft two more turns clockwise, and install the tool to check that it now fits as it should.

43 The remainder of the reassembly procedure is the reverse of removal, noting the following points:

a) Make sure that the timing pin and camshaft aligning tool are removed.
b) When replacing the engine right-hand mount, remember to install the timing belt upper cover.
c) Tighten all fasteners to the specified torque settings.

44 After you reconnect the battery, the Powertrain Control Module (PCM) must relearn its idle and fuel trim strategy for optimum driveability and performance (see Chapter 5, Section 1).

10 Timing chain cover and timing chain and tensioner - removal and installation

Timing chain cover

Removal

Refer to illustration 10.3

1 Disconnect the negative battery cable (see Chapter 5).

2 Remove the crankshaft pulley (see Section 8).

3 Disconnect the crankshaft position (CKP) sensor electrical connector **(see illustration)**. Move the wiring harness away from the engine cover by removing the harness retainers.

4 Remove the (CKP) sensor (see Chapter 6). **Note:** *Unfortunately with this engine, anytime this sensor is removed, a new sensor must be installed. The new sensor is packaged with a special sensor alignment tool that is critical for installation.*

5 Remove the drivebelt and the tensioner (see Chapter 1).

6 Remove the water pump pulley (see Chapter 3).

7 Disconnect the electrical connector to the power steering pressure switch. The switch is located on a high-pressure hose within the power steering system.

8 Remove the single bolt on the lower left corner of the power steering pump and move the pump aside.

9 Remove the bolts and the engine cover.

Installation

Refer to illustration 10.10

10 Installation is the reverse of removal noting the following:

a) Clean the mating surfaces of all material. **Note:** *Be careful not to gouge or use any abrasives on the mating surfaces.*
b) Install the engine cover within four minutes of applying a 2.5 mm bead of RTV sealant.
c) Tighten all bolts to the specified torque settings (using a three-stage sequence - see Specifications) and also using the sequence pattern provided **(see illustration)**.
d) Be sure to re-time the engine as described in Section 8 and also use a new crankshaft position sensor which includes the necessary alignment tool.

Timing chain and tensioner

Removal

Refer to illustrations 10.13a and 10.13b

11 Apply the parking brake, then carefully jack up the front of the vehicle and support the lifted portion on jackstands.

12 Remove the timing chain cover (see Section 7).

13 Carefully compress the timing chain tensioner and place a pin (a drill bit or paper clip will work) into the hole to hold it in the compressed position **(see illustration)**. **Note:** *The tensioner contacts the right-hand chain guide.* **Caution:** *Compress only the round plunger on the tensioner and not the ratchet mechanism. The ratchet is next to the plunger and has square sides. If the ratchet needs to be reset, do the following* **(see illustration)**:

a) *Remove the tensioner and place it lightly in a vise using the plunger and tensioner housing.*
b) *Place a pick-type tool in the hole closest to the ratchet to relieve the tension on the ratchet mechanism.*
c) *While holding the pick tool in place, move the ratchet back into the tensioner, then install a pin into the other hole to keep the plunger and ratchet compressed.*
d) *Remove the tensioner from the vise.*

14 Remove the two tensioner mounting bolts and then the tensioner itself.

15 Remove the loose timing chain guide (right). Remove the timing chain.

16 The left chain guide and camshaft sprockets can now be removed if necessary (see Section 10).

Installation

Refer to illustration 10.22

17 Remove the camshaft alignment tool (if installed).

18 Loosen both camshaft sprocket bolts but don't remove them. Use a wrench on the hexagonal area of the camshaft to hold it while turning the camshaft sprocket bolt. **Note:** *The hexagonal portion of the camshaft is located just after the second lobe from the front.* **Caution:** *Damage to the valves or pistons may occur if the camshafts are rotated during this procedure.*

19 Install the left chain guide (if removed).

20 Install the timing chain.

21 Install the right chain guide.

22 Install the timing chain tensioner and tighten the fasteners to the torque listed in this Chapter's Specifications. Then remove the pin to release the tensioner to engage the chain guide **(see illustration)**.

23 Install the camshaft alignment tool.

24 Tighten the camshaft sprocket bolts to the torque listed in this Chapter's Specifications while holding the camshafts in place with a wrench. **Caution:** *Do not rely on the camshaft alignment tool to hold the camshafts while tightening the camshaft sprocket bolts. Tool and engine damage may occur.*

25 The timing chain cover can now be installed (see Section 8).

11 Engine front oil seals - replacement

Crankshaft front oil seal

2.0L engine

Refer to illustrations 11.2, 11.3 and 11.7

Caution: *Do not rotate the camshaft(s) or crankshaft when the timing belt is removed or damage to the engine may occur.*

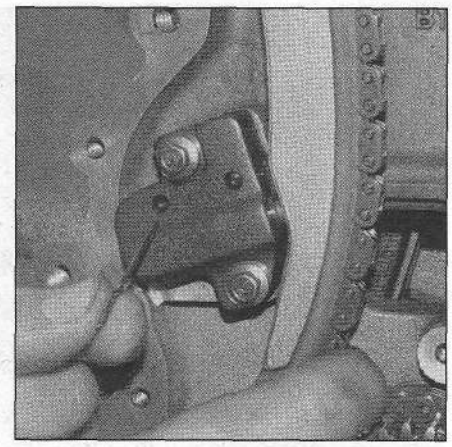
1 Remove the timing belt (see Section 9).

2 Pull the crankshaft sprocket from the crankshaft **(see illustration)**. Remove the Woodruff key.

3 Remove the timing belt guide washer from the crankshaft **(see illustration)**.

4 Wrap the tip of a small screwdriver with tape. Working from below the right inner fender, use the screwdriver to pry the seal out of its bore. Take care to prevent damaging the oil pump assembly, the crankshaft and the seal bore.

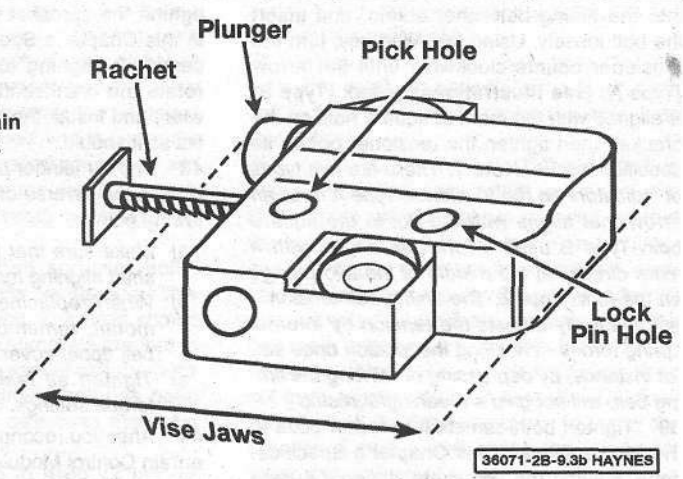
5 Thoroughly clean and inspect the seal bore and sealing surface on the crankshaft.



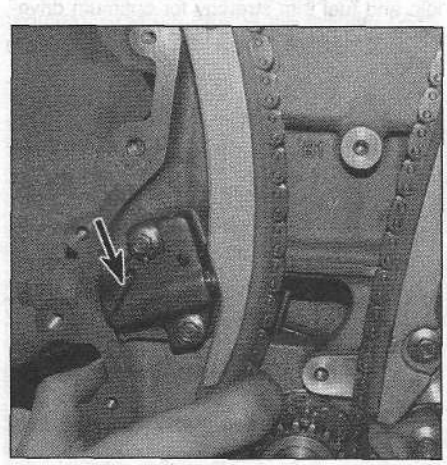
10.13a Compressing the timing chain tensioner and placing the lock pin

Minor imperfections can be removed with emery cloth. If there is a groove worn in the crankshaft sealing surface from contact with the seal, installing a new seal will probably not stop the leak.

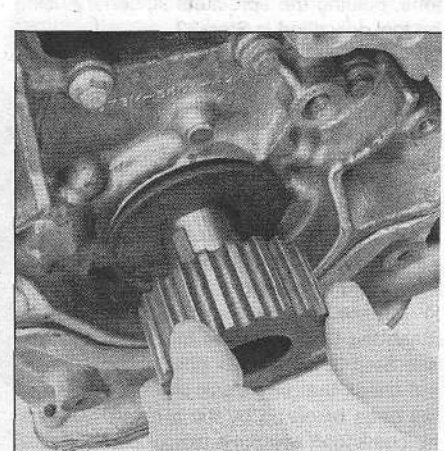
6 Lubricate the new seal with engine oil and drive the seal into place with a hammer and an appropriate size socket.



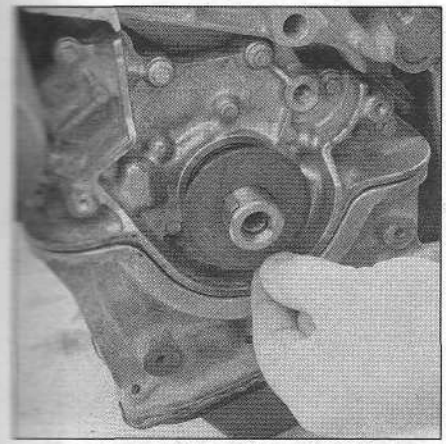
10.13b Timing chain tensioner details



10.22 Compressing the tensioner to release the lock pin

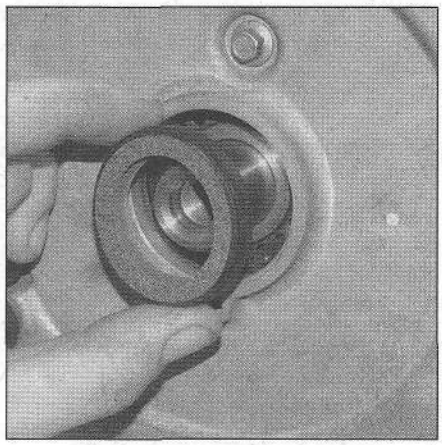


11.2 Remove the crankshaft sprocket from the crankshaft



11.3 Remove the timing belt guide washer

11.7 Make sure the FRONT mark on the crankshaft sprocket is facing out



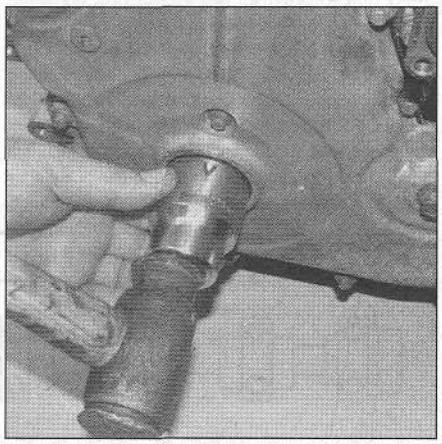
11.14 Make certain that the oil seal is kept square as it is placed in the bore

7 The remaining steps are the reverse of removal. **Note:** *Position the crankshaft sprocket with the word FRONT facing out* **(see illustration)**.
8 Reinstall the timing belt and covers (see Section 9).
9 Run the engine and check for oil leaks.

2.3L engine

Refer to illustrations 11.14 and 11.15

10 Remove the crankshaft pulley (see Section 8).
11 Use a screwdriver or hook tool to carefully pry out the seal. **Note:** *Be careful not to damage the timing chain cover bore where the seal is seated or the nose and sealing surface of the crankshaft.*
12 Another procedure for removing the seal is to drill a small hole on each side of the seal and place a self-tapping screw in each hole. Use these screws as a means of pulling the seal out without having to pry on it.
13 Wipe the sealing surfaces in the engine cover and on the crankshaft. Clean and coat them with clean engine oil.
14 Start installing the new seal by pressing it into the timing chain cover **(see illustration)**.
15 Once started, use a seal driver or a suitable socket of the correct size to carefully drive the seal squarely into place **(see illustration)**.
16 The seal should be flush with the engine cover and remain square when installed.
17 Coat the lip of the seal (where it contacts the crankshaft) with clean engine oil.
18 Install the crankshaft pulley (see Section 8).

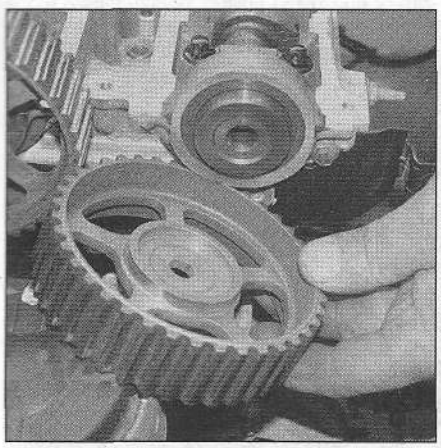


11.15 A socket of the correct size can be used to install the new seal

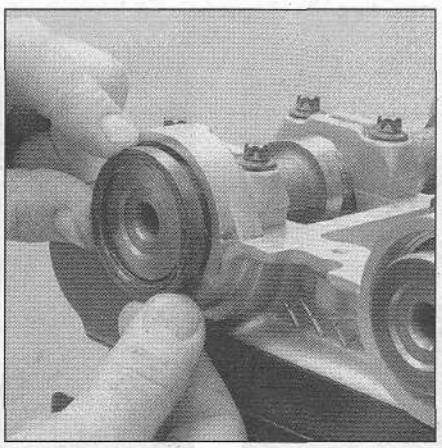
Camshaft oil seals

Refer to illustrations 11.21, 11.24a and 11.24b

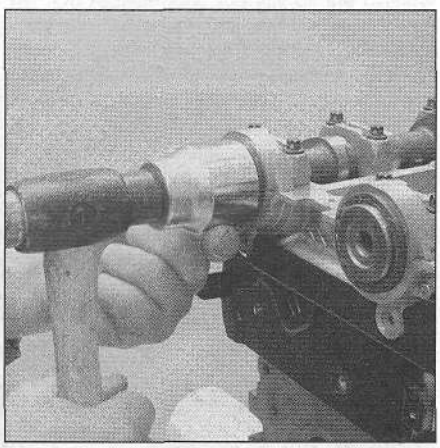
Caution: *Do not rotate the camshaft(s) or crankshaft when the timing belt is removed or damage to the engine may occur.*
19 Position the engine at TDC for number 1 piston (see Section 3).
20 Remove the timing belt (see Section 9).
21 Remove the camshaft sprocket bolts **(see illustration 9.32)**. Then, remove the sprockets from the camshafts **(see illustration)**.
22 Note how far the seal is seated in the bore, then carefully pry it out with a small screwdriver. Don't scratch the bore or damage the camshaft in the process. If the camshaft is damaged, the new seal will end up leaking.
23 Clean the bore and coat the outer edge of the new seal with engine oil or multi-purpose grease. Also lubricate the seal lip.
24 Using a socket with an outside diameter slightly smaller than the outside diameter of the seal, carefully drive the new seal into place with a hammer **(see illustrations)**. Make sure it's installed squarely and driven in to the same depth as the original.
25 Set the camshafts to their TDC posi-



11.21 Remove the camshaft sprocket from the camshaft



11.24a Install the seal with the lip toward the journal



11.24b Tap the seal into the housing using a large socket

tions by inserting the tool shown in **illustration 3.5b** into the slots in the ends of the camshafts.

26 Install the camshaft sprockets. Tighten the bolts to the torque listed in this Chapter's Specifications, using the tool shown in **illustration 9.32** to prevent the camshafts from turning.

27 Reinstall the timing belt (see Section 9).

28 Run the engine and check for oil leaks at the camshaft seal.

12 Camshafts and cam followers - removal, inspection and installation

Removal

Refer to illustrations 12.3, 12.4a, 12.4b, 12.5a and 12.5b

1 Remove the timing belt as described in Section 9.

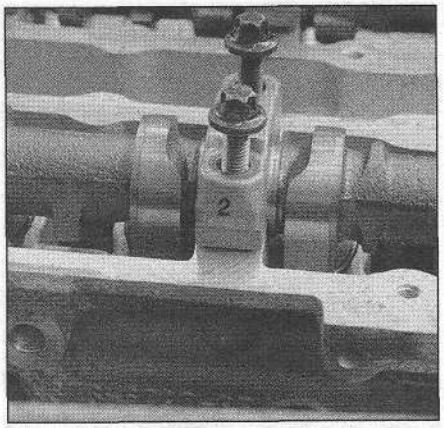
2 Remove the camshaft sprockets as described in Section 11. While both sprockets are the same and could be interchanged, it is good working practice to mark them so that each sprocket is reinstalled to its original location.

3 All the camshaft bearing caps have a single-digit identifying number etched on them. The exhaust camshaft's bearing caps are numbered in sequence from 0 (right-hand cap) to 4 (left-hand cap); the intake's are numbered from 5 (right-hand cap) to 9 (left-hand cap). Each cap is to be fitted so that its numbered side faces outwards, to the front (exhaust) or to the rear (intake) **(see illustration)**. If no marks are present, or they are hard to see, make your own - the bearing caps must be reinstalled in their original positions.

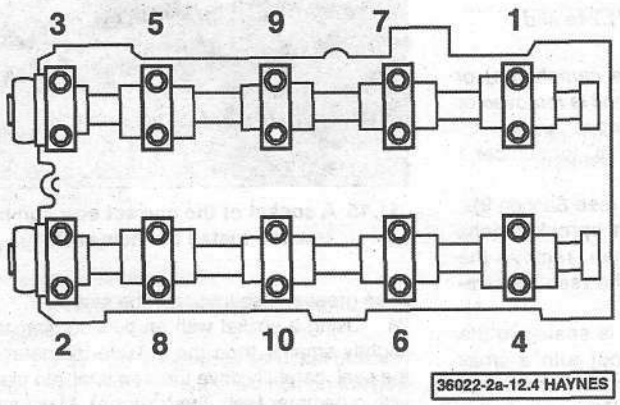
4 Working in the sequence shown, loosen the camshaft bearing cap bolts progressively by half a turn at a time **(see illustrations)**. Work only as described, to release gradually and evenly the pressure of the valve springs on the caps.

5 Withdraw the caps, noting their markings and the presence of the locating dowels, then remove the camshafts and withdraw their oil seals **(see illustrations)**. The intake camshaft can be identified by the reference lobe for the camshaft position sensor; therefore, there is no need to mark the camshafts.

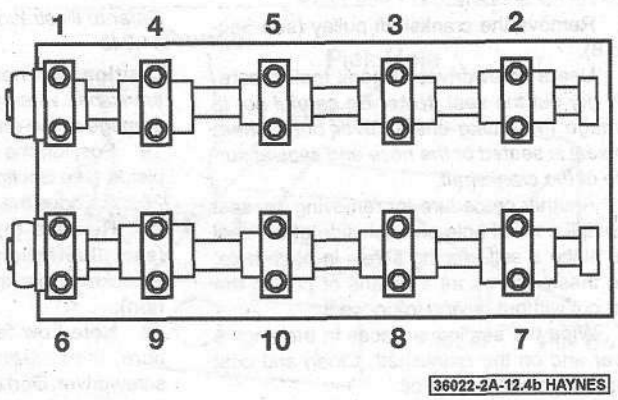
6 Obtain sixteen small, clean containers, and number them 1 to 16. Using a rubber suction tool (such as a valve-lapping tool), withdraw each cam follower in turn and place them in the containers. Do not interchange the cam followers, or the rate of wear will be greatly increased. Make sure the shims remain with their corresponding cam followers, to ensure correct installation.



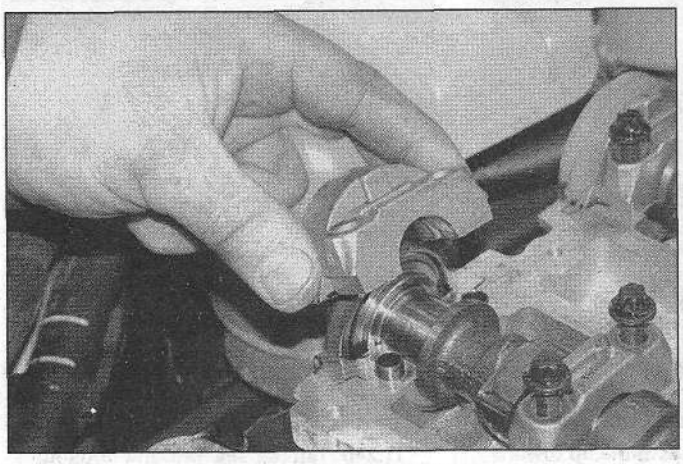
12.3 Location of the camshaft bearing designations



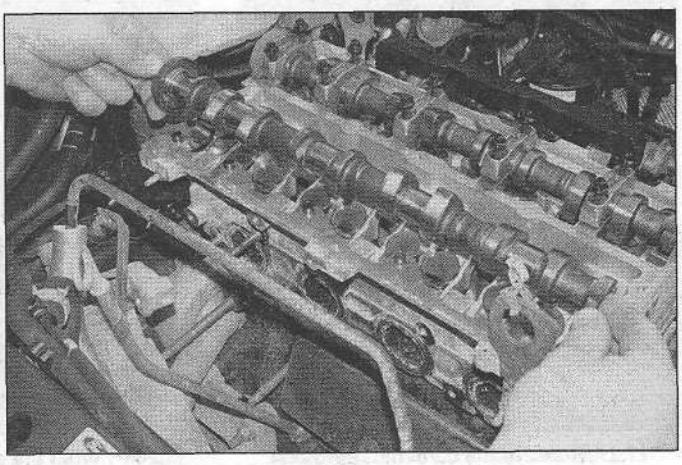
12.4a Camshaft bearing cap loosening sequence (2.0L engine) - loosen each pair of bolts on the designated bearing cap in sequence



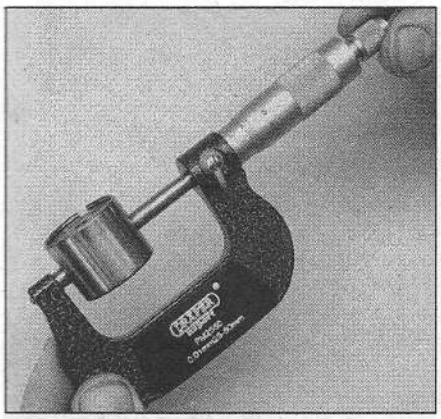
12.4b Camshaft bearing cap loosening sequence (2.3L engine) - loosen each pair of bolts on the designated bearing cap in sequence



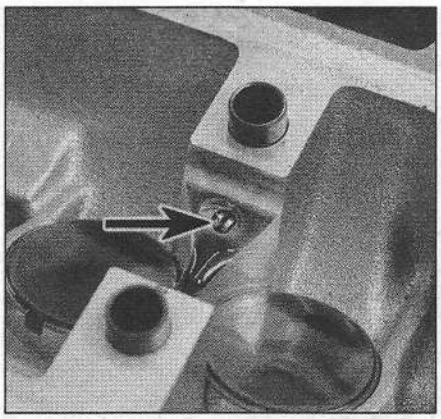
12.5a Remove the bearing caps . . .



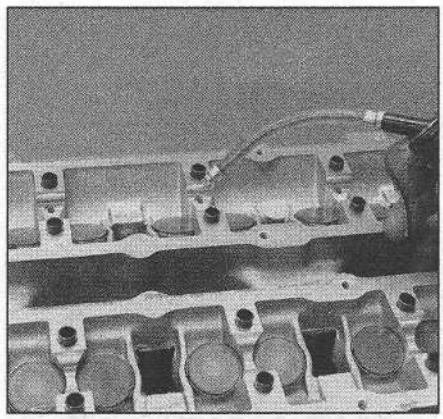
12.5b . . . then lift out the camshafts



12.8 Measure the cam follower outside diameter at several points



12.11 Check that the camshaft bearing oilways are not blocked with debris



12.20a Lubricate the camshaft bearing surfaces . . .

Inspection

Refer to illustrations 12.8 and 12.11

7 With the camshafts and cam followers removed, check each for signs of obvious wear (scoring, pitting, etc) and for roundness and replace if necessary.

8 Measure the outside diameter of each cam follower - take measurements at the top and bottom of each cam follower, then a second set at right-angles to the first; if any measurement is significantly different from the others, the cam follower is tapered or oval (as applicable) and must be replaced **(see illustration)**. If the necessary equipment is available, measure the inside diameter of the corresponding cylinder head bore. No manufacturer's specifications were available at time of writing; if the cam followers or the cylinder head bores are excessively worn, new cam followers and/or a new cylinder head may be required.

9 If the engine's valve components have sounded noisy, it may be just that the valve clearances need adjusting. Although this is part of the routine maintenance schedule in Chapter 1, the extended checking interval and the need for dismantling or special tools may result in the task being overlooked.

10 Visually examine the camshaft lobes for score marks, pitting, galling (wear due to rubbing) and evidence of overheating (blue, discolored areas). Look for flaking away of the hardened surface layer of each lobe. If any such signs are evident, replace the component concerned.

11 Examine the camshaft bearing journals and the cylinder head bearing surfaces for signs of obvious wear or pitting. If any such signs are evident, consult an automotive machine shop for advice. Also check that the bearing oilways in the cylinder head are clear **(see illustration)**.

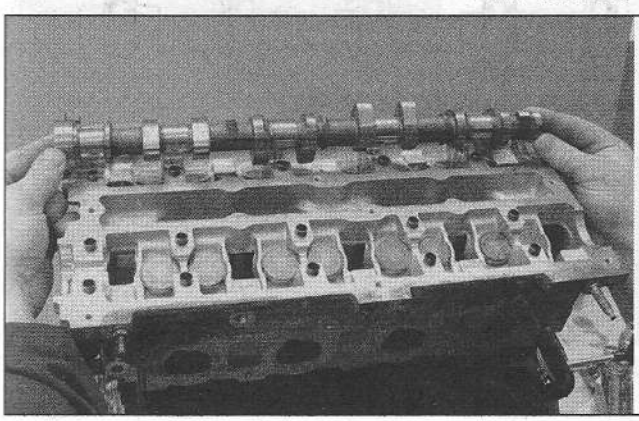
12 Using a micrometer, measure the diameter of each journal at several points. If the diameter of any one journal is less than the specified value, replace the camshaft.

13 To check the bearing journal running clearance, remove the cam followers, use a suitable solvent and a clean lint-free rag to carefully clean all bearing surfaces, then install the camshafts and bearing caps with a strand of Plastigage across each journal. Tighten the bearing cap bolts in the given sequence (see *Installation*) to the specified torque setting (do not rotate the camshafts), then remove the bearing caps and use the scale provided to measure the width of the compressed strands. Scrape off the Plastigage with your fingernail or the edge of a credit card - don't scratch or nick the journals or bearing caps.

14 If the running clearance of any bearing is found to be worn to beyond the specified service limits, install a new camshaft and repeat the check; if the clearance is still excessive, the cylinder head must be replaced.

15 To check camshaft endplay, remove the cam followers, clean the bearing surfaces carefully and install the camshafts and bearing caps. Tighten the bearing cap bolts to the specified torque wrench setting, then measure the endplay using a dial indicator mounted on the cylinder head so that its tip bears on the camshaft right-hand end.

16 Tap the camshaft fully towards the gauge, zero the gauge, then tap the camshaft fully away from the gauge and note the gauge reading. If the endplay measured is found to be at or beyond the specified service limit, install a new camshaft and repeat the check; if the clearance is still excessive, the cylinder head must be replaced.



12.20b . . . then install the camshafts . . .

Installation

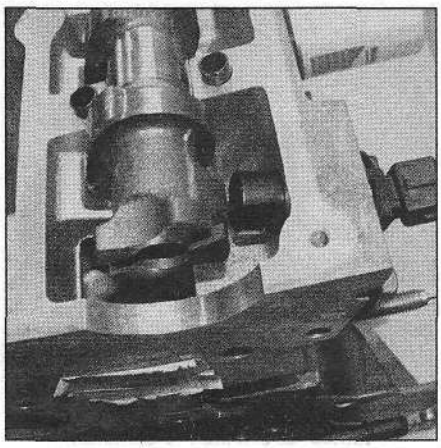
Refer to illustrations 12.20a, 12.20b, 12.20c, 12.21, 12.22a, 12.22b, 12.23a, 12.23b, 12.29a and 12.29b

17 As a precaution against the valves hitting the pistons when the camshafts are replaced, remove the timing pin and turn the engine approximately 90-degrees (1/4-turn) back from the TDC position - this will move all the pistons an equal distance down the bores. This is only a precaution - if the engine is known to be at TDC on the Number 1 cylinder, and the camshafts are replaced as described below, valve-to-piston contact should not occur.

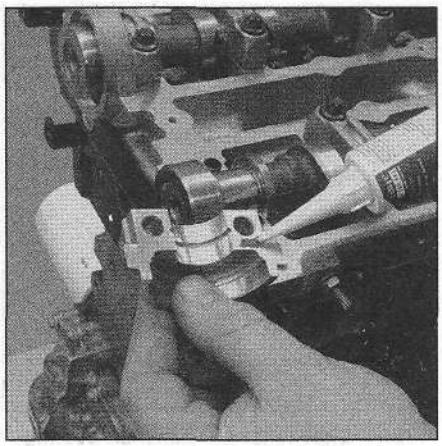
18 On reassembly, liberally oil the cylinder head cam follower bores and the cam followers. Carefully install the cam followers to the cylinder head, ensuring that each cam follower is replaced to its original bore, and is the correct way up. Some care will be required to guide the cam followers squarely into their bores. Make sure that the shims are installed in their previously-noted positions.

19 It is highly recommended that new camshaft oil seals are installed. The new seals are installed after the caps are tightened - see Section 11.

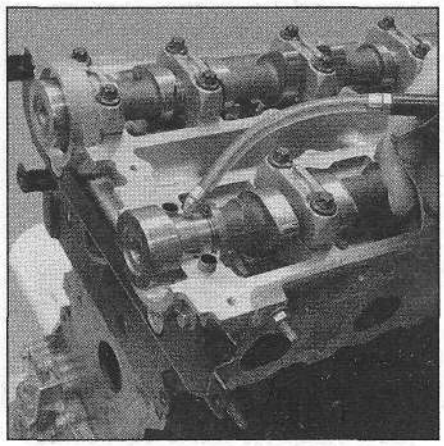
20 Liberally oil the camshaft bearings (not the caps) and lobes. Ensuring that each camshaft is in its original location, install the camshafts, locating each so that the slot in its left-hand end is approximately parallel to, and just above, the cylinder head mating surface **(see illustrations)**. Check that, as each camshaft



12.20c . . . ensuring that the slot at the transmission end is approximately horizontal



12.21 Apply sealant to each of the bearing caps at the timing belt end



12.22a Apply a little oil to the camshaft surface . . .

is laid in position, the metal strip TDC setting tool will fit into the slot.

21 Ensure that the locating dowels are pressed firmly into their recesses and check that all mating surfaces are completely clean, unmarked and free from oil. Apply a thin film of suitable sealant (Ford recommends a sealant to specification WSK-M2G348-A5) to the mating surfaces of each camshaft's right-hand bearing cap **(see illustration)**.

22 Apply a little oil to the camshaft as shown, then install each of the camshaft bearing caps to its previously-noted position, so that its numbered side faces outwards, to the front (exhaust) or to the rear (intake) **(see illustrations)**.

23 Ensuring that each cap is kept square to the cylinder head as it is tightened down and working in the sequence shown, tighten the camshaft bearing cap bolts slowly and by one turn at a time, until each cap touches the cylinder head **(see illustrations)**.

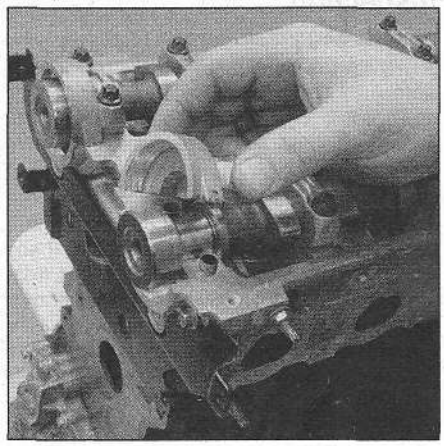
24 Next, using the same sequence, tightening the bolts to the Step 1 torque listed in this Chapter's Specifications.

25 With all the bolts tightened to the Step 1 torque, tighten them to the Stage 2 torque listed in this Chapter's Specifications.

26 Wipe off all surplus sealant, so that none is left to find its way into any oilways. Follow the sealant manufacturer's instructions as to the time needed for curing; usually, at least an hour must be allowed between application of the sealant and starting the engine (including turning the engine for further reassembly work).

27 Once the caps are fully tightened, it makes sense to check the valve clearances before proceeding - assuming that the Ford tool described in Section 5 is not available, the camshafts have to be removed to allow any of the shims to be changed. Turning the camshafts with the timing belt removed carries a risk of the valves hitting the pistons, so (if not already done) remove the timing pin and turn the crankshaft 90° counterclockwise first. Set the camshafts to TDC on the Number 1 cylinder using the setting tool (see Section 3) to establish a starting point, then proceed as described in Section 5 **(see illustration 3.5b)**. When all the clearances have been checked, bring the crankshaft back to TDC, and install the timing pin.

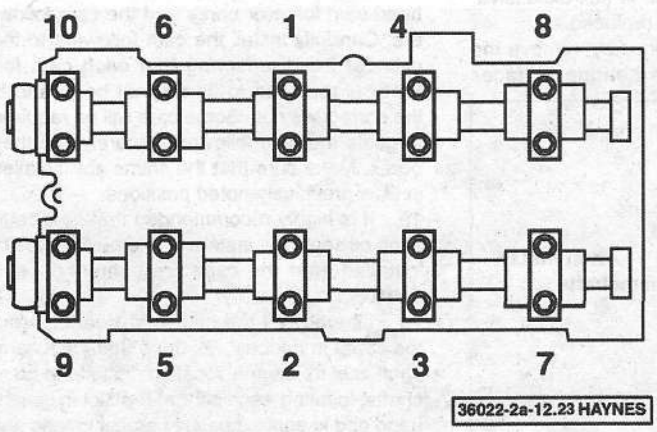
28 Install new camshaft oil seals as described in Section 11.



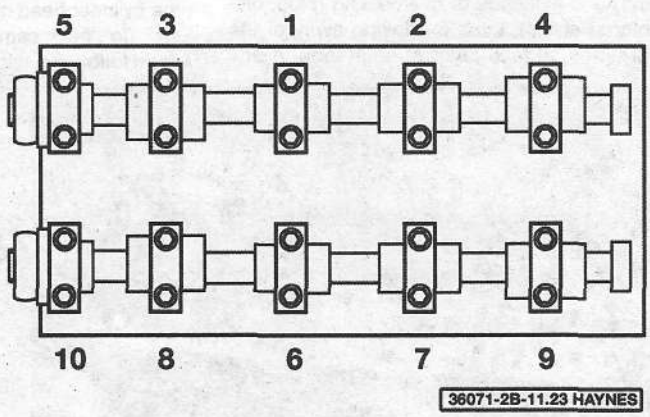
12.22b . . . then install the camshaft bearing caps

29 Using the marks and notes made on dismantling to ensure that each is replaced to its original camshaft, install the sprockets to the camshafts, tightening the retaining bolts loosely **(see illustrations)**.

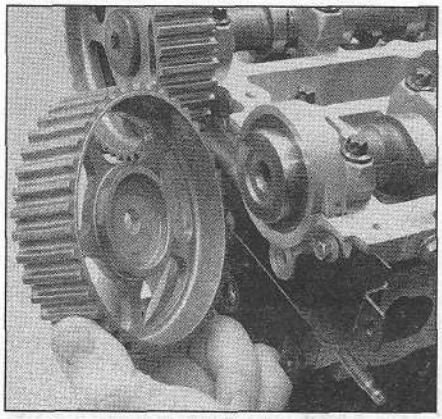
30 The remainder of the reassembly procedure, including replacement of the timing belt and setting the valve timing, is as described



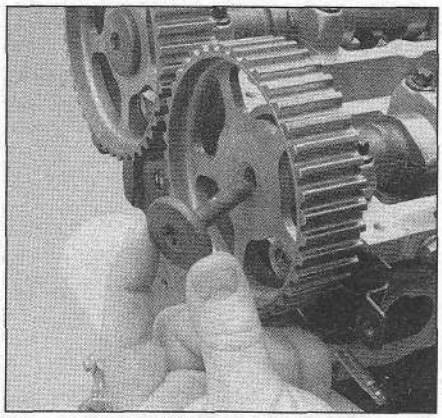
12.23a Camshaft bearing cap tightening sequence (2.0L engine)



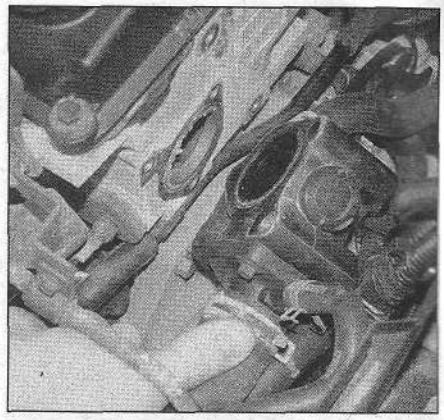
12.23b Camshaft bearing cap tightening sequence (2.3L engine)



12.29a Install the camshaft sprockets . . .



12.29b . . . and secure with the retaining bolts, tightened only loosely at this stage



13.12 Remove the thermostat housing from the cylinder head

in Section 9. On completion (if not already done), check and adjust the valve clearances as described in Section 5.

31 After you reconnect the battery, the Powertrain Control Module (PCM) must relearn its idle and fuel trim strategy for optimum driveability and performance (see Chapter 5, Section 1).

13 Cylinder head - removal and installation

Warning: *Wait until the engine is completely cool before beginning this procedure.*

Removal

Refer to illustrations 13.12, 13.14, 13.16, 13.18, 13.19 and 13.20

1 Relieve the fuel pressure (see Chapter 4).

2 Disconnect the battery cable from the negative battery terminal (see Chapter 5).

3 Remove the intake duct from the air filter housing (see Chapter 4).

4 Disconnect the accelerator cable (see Chapter 4) and cruise control cable, if equipped.

5 Drain the cooling system (see Chapter 1).

6 Remove the timing belt (see Section 9) or timing chain (see Section 10).

7 Remove the camshafts (see Section 12).

8 Temporarily install the valve cover, to protect the top of the engine until the cylinder head bolts are removed.

9 Disconnect the camshaft position sensor (see Chapter 6).

10 Remove the fuel rail and injectors as a complete assembly (see Chapter 4).

11 Remove the alternator and its mounting bracket (see Chapter 5).

12 Remove the thermostat housing from the cylinder head **(see illustration)**.

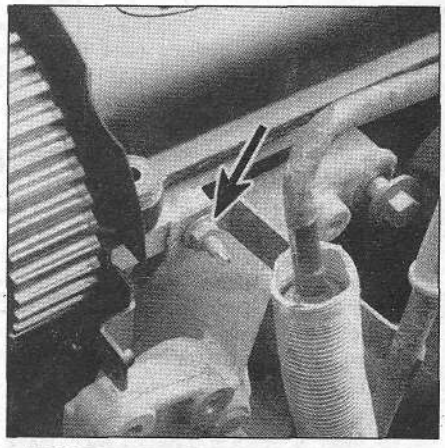
13 Remove the intake manifold (see Section 6).

14 Remove the nut and detach the dipstick tube from the cylinder head **(see illustration)**.

15 Remove the exhaust manifold (see Section 7).

16 Remove the bolt from the power steering hose support bracket **(see illustration)** and position the hose off to the side.

17 If an engine support fixture or hoist is being used to hold the engine up (for timing belt removal), reinstall the engine mount

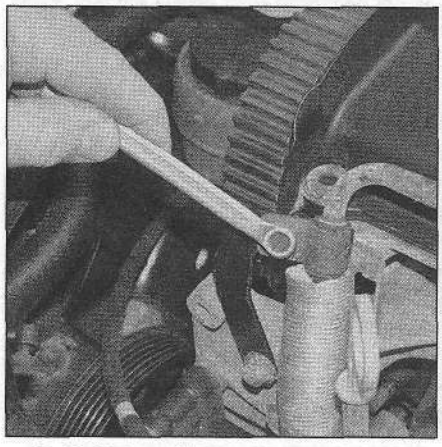


13.14 Remove the nut that secures the dipstick tube

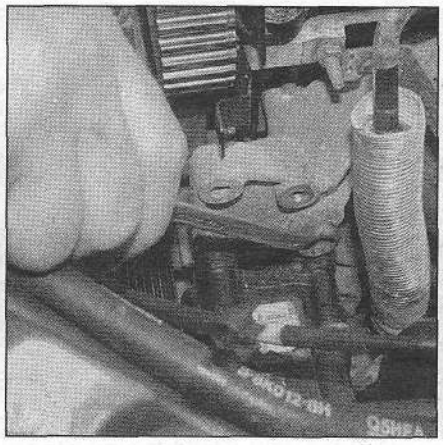
bracket and engine mount, then remove the hoist or support fixture. If a floor jack and block of wood is being used to support the engine, it can remain in place.

18 Remove the power steering pump mounting bracket **(see illustration)**.

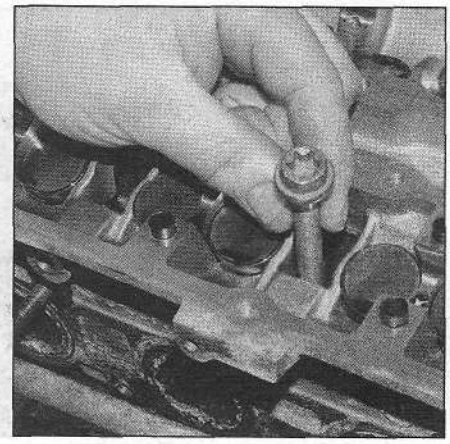
19 Loosen the ten cylinder head bolts progressively and by half a turn at a time **(see illustration)**, working in the reverse order



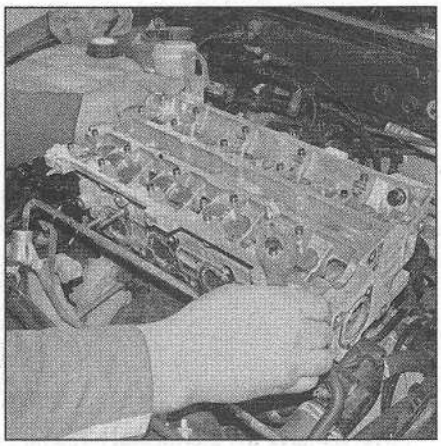
13.16 Unbolt this power steering fluid pipe bracket



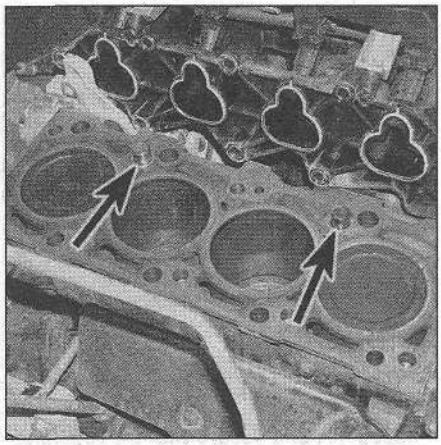
13.18 Unbolt the power steering pump bracket



13.19 Remove the cylinder head bolts - note the head bolt uses a Torx socket



13.20 Lift off the cylinder head



13.27 Location of the cylinder head locating dowels

of the tightening sequence **(see illustrations 13.35a and 13.35b)**. **Caution:** *The head bolts are torque-to-yield bolts that must be replaced with new ones on installation.*

20 Lift the cylinder head from the engine compartment **(see illustration)**.

21 If the head is stuck, be careful how you choose to free it. Remember that the cylinder head is made of aluminum alloy, which is easily damaged. Striking the head with tools carries the risk of damage, and the head is located on two dowels, so its movement will be limited. Do not, under any circumstances, pry the head between the mating surfaces, as this will certainly damage the sealing surfaces for the gasket, leading to leaks. Try rocking the head free, to break the seal, taking care not to damage any of the surrounding components.

22 Once the head has been removed, recover the gasket from the two dowels, and discard it.

Inspection

23 The mating faces of the cylinder head and cylinder block must be perfectly clean before replacing the head. Use a hard plastic or wood scraper to remove all traces of gasket and carbon.

24 Take particular care during the cleaning operations, as aluminum alloy is easily damaged. Also, make sure that the carbon is not allowed to enter the oil and water passages - this is particularly important for the lubrication system, as carbon could block the oil supply to the engine's components.

25 To prevent carbon entering the gap between the pistons and bores, smear a little grease in the gap. After cleaning each piston, use a small brush to remove all traces of grease and carbon from the gap, then wipe away the remainder with a clean rag.

26 Check the mating surfaces of the cylinder block and the cylinder head for nicks, deep scratches and other damage. If slight, they may be removed carefully with a file. Also check the cylinder head gasket surface and the cylinder block gasket surface with a precision straight-edge and feeler gauges. If either surface exceeds the warpage limit listed in this Chapter's Specifications, the manufacturer states that the component out of specification must be replaced. If the gasket mating surface of your cylinder head or block is out of specification or is severely nicked or scratched, you may want to consult with an automotive machine shop for advice.

Installation

Refer to illustrations 13.27, 13.30a, 13.30b, 13.34, 13.35a, 13.35b and 13.47

27 Wipe clean the mating surfaces of the cylinder head and cylinder block. Check that the two locating dowels are in position in the cylinder block **(see illustration)**.

28 The cylinder head bolt holes must be free from oil or water. This is most important, because a hydraulic lock in a cylinder head bolt hole can cause a fracture of the block casting when the bolt is tightened.

29 The new head gasket is selected according to a number cast on the front face of the cylinder block, in front of the Number 1 cylinder. Consult a Ford dealer or your parts supplier for details.

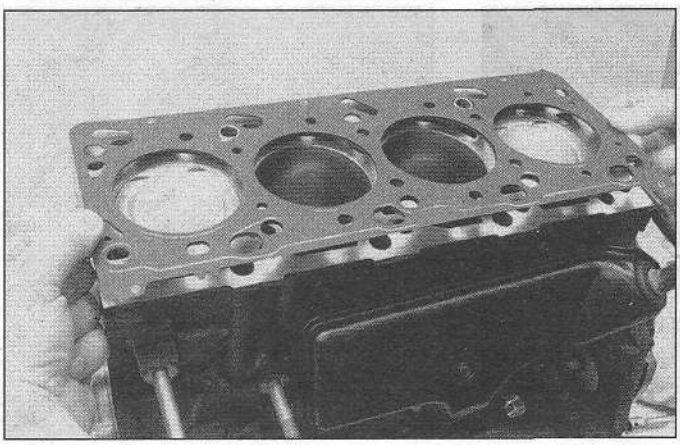
30 Position a new gasket over the dowels on the cylinder block surface, so that the TOP mark is uppermost; where applicable, the teeth must protrude towards the front of the vehicle **(see illustrations)**.

31 Temporarily install the crankshaft pulley and rotate the crankshaft counterclockwise so that the Number 1 cylinder's piston is lowered to approximately 20 mm before TDC, thus avoiding any risk of valve/piston contact and damage during reassembly.

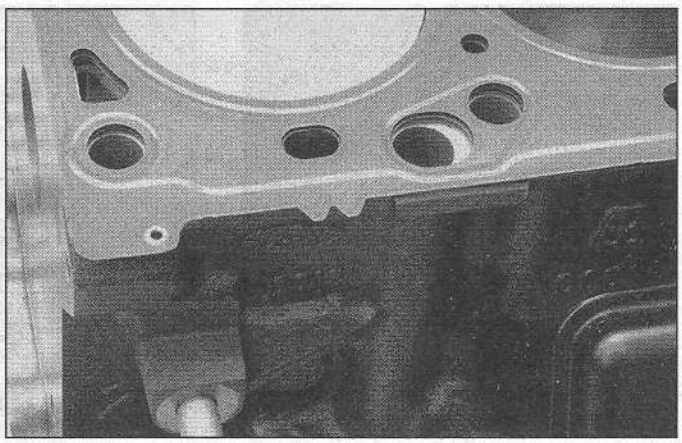
32 As the cylinder head is such a heavy and awkward assembly to install, it is helpful to make up a pair of guide studs from two 10 mm (thread size) studs approximately 90 mm long, with a screwdriver slot cut in one end - you can use two of the old cylinder head bolts with their heads cut off. Screw these guide studs, screwdriver slot upwards to permit removal, into the bolt holes at diagonally-opposite corners of the cylinder block surface; ensure that approximately 70 mm of stud protrudes above the gasket.

33 Install the cylinder head, sliding it down the guide studs (if used) and locating it on the dowels. Unscrew the guide studs (if used) when the head is in place.

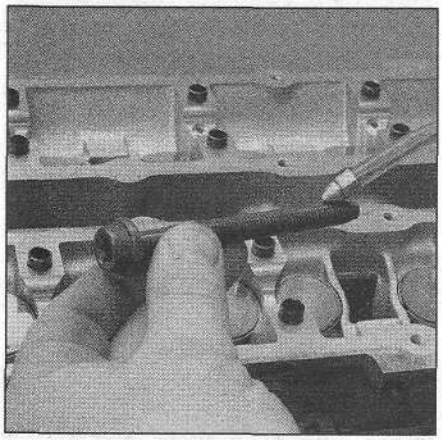
34 Coat the threads with a light oil - do not apply more than a light film of oil **(see illustration)**. Install the cylinder head bolts carefully, and screw them in by hand only until finger-tight.



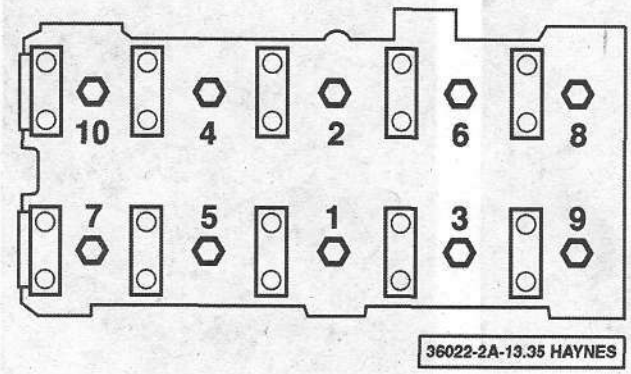
13.30a Position the head gasket over the dowels



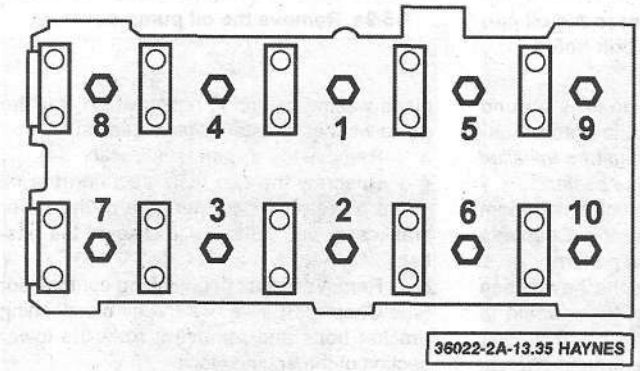
13.30b The head gasket teeth must be positioned at the front of the block



13.34 Apply a light coat of oil to the cylinder head bolt threads



13.35a Cylinder head bolt tightening sequence (2.0L engine)



12.35b Cylinder head bolt tightening sequence (2.3L engine)

35 Working progressively and in the sequence shown, first tighten all the bolts to the specified Step 1 torque setting listed in this Chapter's Specifications **(see illustrations)**.

2.0L engine

36 With all the bolts tightened to Step 1, tighten them in sequence to the Step 2 torque setting.

37 Step 3 involves tightening the bolts through an angle, rather than to a torque. Each bolt in sequence must be rotated through the specified angle - special angle gauges are available from tool outlets **(see illustration)**, but a 90° angle is equivalent to a quarter-turn, and this is easily judged by assessing the start and end positions of the socket handle or torque wrench.

38 Once all the bolts have been tightened to Step 3, no subsequent tightening is necessary.

2.3L engine

39 On these engines there are five tightening stages, the final two using the angle torque method **(see illustration 13.37)**.

40 Before proceeding with replacement, turn the crankshaft forwards to TDC, and check that the setting tools described in Section 3 can be inserted. Do not turn the engine more than necessary while the timing belt is removed, or the valves may hit the pistons - for instance, if the engine is accidentally turned past the TDC position, turn it back slightly and try again - do not rotate the crankshaft a full turn.

41 Replacement of the other components removed is a reversal of removal, noting the following points:

a) Install the catalytic converter with reference to Chapter 4 if necessary, using new gaskets.

b) Install the camshafts as described in Section 12, and the timing belt or timing chain as described in Section 9 or 10.

c) Tighten all fasteners to the specified torque, where given, and use new gaskets.

d) Ensure that all hoses and wiring are correctly routed, and that hose clips and wiring connectors are securely installed.

e) Refill the cooling system as described in Chapter 1.

f) Check all disturbed joints for signs of oil or coolant leakage once the engine has been restarted and warmed-up to normal operating temperature.

42 After you reconnect the battery, the Powertrain Control Module (PCM) must relearn its idle and fuel trim strategy for optimum driveability and performance (see Chapter 5, Section 1).

14 Oil pan - removal and installation

Removal

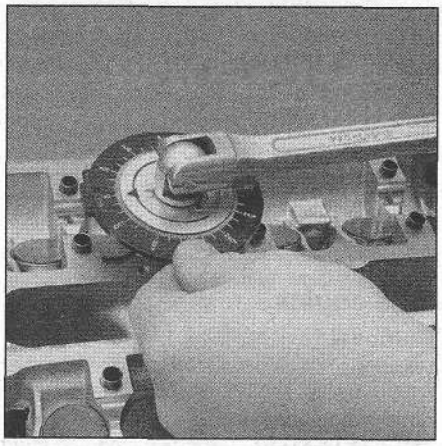
1 Raise the vehicle and support it on jackstands (see *Jacking and Towing*).

2 Drain the engine oil (see Chapter 1), then clean and install the engine oil drain plug, tightening it to the torque listed in the Chapter 1 Specifications. Remove and discard the oil filter, so that it can be replaced with the oil.

3 Remove the catalytic converter from the exhaust system (see Chapter 6).

4 Progressively unscrew the oil pan retaining bolts. Use a rubber mallet to loosen the oil pan seal, then lower the oil pan, turning it as necessary to clear the exhaust system.

5 Unfortunately, the use of sealant can make removal of the oil pan more difficult. Be careful when prying between the mating surfaces, otherwise they will be damaged, resulting in leaks when finished. With care, a putty knife can be used to cut through the sealant.



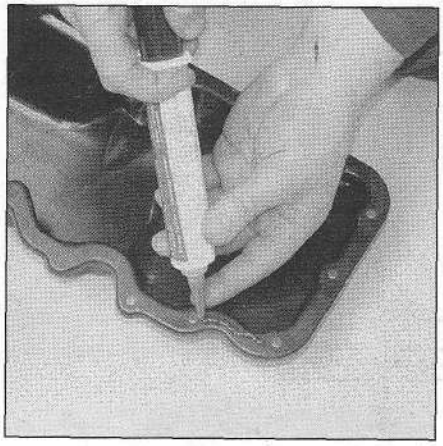
13.37 You can use a torque angle gauge, or you can carefully note the starting and stopping points of the wrench handle

Installation

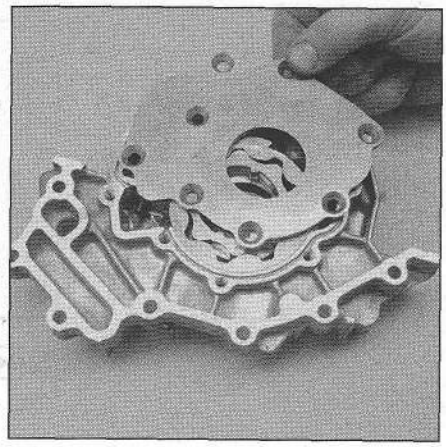
Refer to illustration 14.7

6 Thoroughly clean and degrease the mating surfaces of the lower engine block/crankcase and oil pan, removing all traces of sealant, then use a clean rag to wipe out the oil pan.

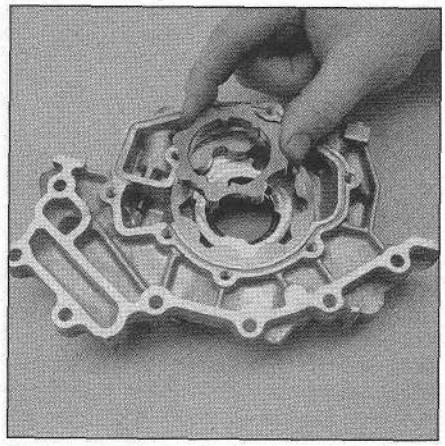
7 Apply a 1/8-inch wide bead of sealant to the oil pan flange so that the bead is approximately 3/16-inch from the outside edge of



14.7 Apply a bead of sealant to the oil pan flange, inboard of the bolt holes



15.9a Remove the oil pump cover . . .



15.9b . . . and withdraw the rotors, noting which way they are facing

the flange. Make sure the bead is around the inside edge of the bolt holes **(see illustration)**. **Note:** *The oil pan must be installed within 7 minutes of applying the sealant.*

8 Install the oil pan bolts, tightening them to the Step 1 torque listed in this Chapter's Specifications, in a criss-cross pattern.

9 When all the oil pan bolts have been tightened to Step 1, tighten them again in sequence to the Step 2 setting.

10 Lower the vehicle to the ground. Wait at least 1 hour for the sealant to cure, or whatever time is indicated by the sealant manufacturer, before refilling the engine with oil. Trim off the excess sealant with a sharp knife. Install a new oil filter with reference to Chapter 1.

15 Oil pump - removal, inspection and installation

2.0L engine

Removal

Warning: *The air conditioning system is under high pressure. DO NOT loosen any fittings or remove any components until after the system has been discharged. Air conditioning refrigerant must be properly discharged into an EPA-approved container at a dealership service department or an automotive air conditioning repair facility. Always wear eye protection when disconnecting air conditioning system fittings.*

Note: *While this task is theoretically possible when the engine is in place in the vehicle, in practice, it requires so much preliminary dismantling and is so difficult to carry out due to the restricted access, that owners are advised to remove the engine from the vehicle first* (see Chapter 2C). *Note, however, that the oil pump pressure relief valve can be removed with the engine in place* (see Step 11).

1 Have the air conditioning system discharged (see the **Warning** above).

2 Remove the timing belt (see Section 9), then withdraw the crankshaft sprocket and the guide washer behind it, noting which way the guide washer is installed (see Section 10).

3 Remove the oil pan (see Section 14).

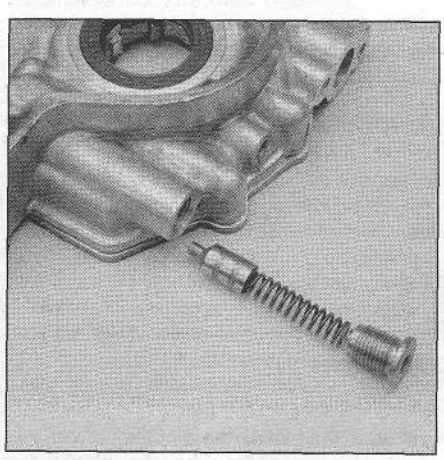
4 Unscrew the two bolts securing the oil pump pick-up tube to the base of the lower crankcase, and withdraw it. Discard the gasket.

5 Remove the air conditioning compressor (see Chapter 3). Remove the air conditioning bracket bolts and remove it from the lower section of the engine block.

6 Remove the timing belt tensioner (see Section 9).

7 Progressively unscrew and remove the bolts securing the lower crankcase to the base of the engine block and the transaxle. Remove the lower crankcase, and recover any spacer washers, noting where they are installed, as these must be used on replacement. Remove the gasket, and remove any traces of sealant at the joint with the oil pump.

8 Unbolt the pump from the engine block. Withdraw and discard the gasket, then remove the crankshaft right-hand oil seal. Thoroughly clean and degrease all components, particularly the mating surfaces of the pump, the oil pan and the engine block.



15.12 Oil pump pressure relief valve components (seen with oil pump removed)

Inspection

Refer to illustrations 15.9a, 15.9b, 15.12, 15.13, 15.14a and 15.14b

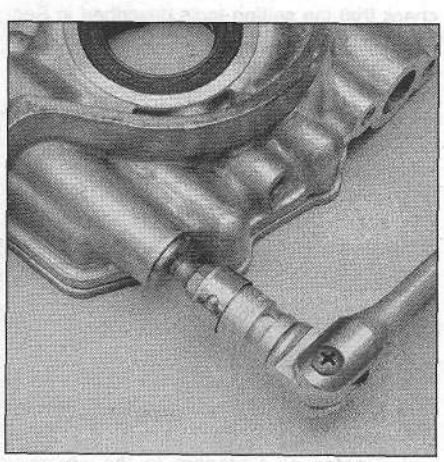
9 Unscrew the Torx screws and remove the pump cover plate; noting any identification marks on the rotors, withdraw the rotors **(see illustrations)**.

10 Inspect the rotors for obvious signs of wear or damage, and replace if necessary. If either rotor, the pump body, or its cover plate are scored or damaged, the complete oil pump assembly must be replaced.

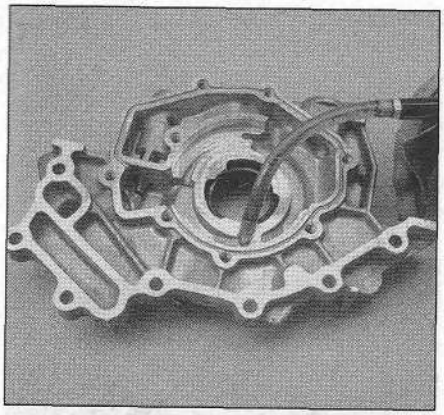
11 The oil pressure relief valve can be disassembled, if required, without disturbing the pump. With the vehicle parked on firm level ground, apply the parking brake securely and raise its front end, supporting it securely on jackstands. Remove the front right-hand wheel and fender splash shield to provide access to the oil pressure relief valve.

12 Unscrew the threaded plug and recover the valve spring and plunger **(see illustration)**.

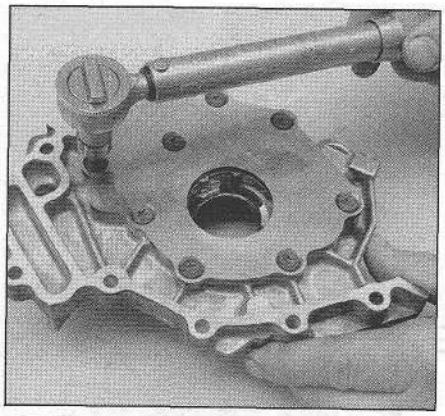
13 Reassembly is the reverse of the disassembly procedure; ensure the spring and valve are reinstalled the correct way and tighten the threaded plug securely **(see illustration)**.



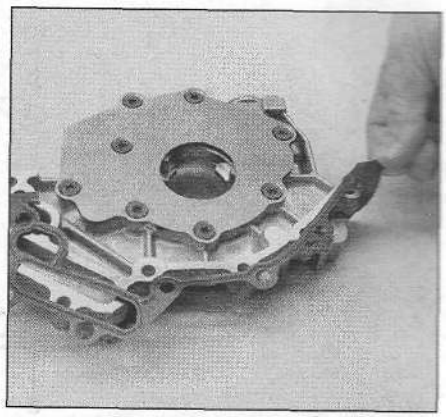
15.13 Tighten the relief valve cover plug securely



15.14a Oil the housing and rotors as they are installed



15.14b Tighten the oil pump cover bolts securely



15.16a Place the new gasket into position . . .

14 When reassembling the oil pump, oil the housing and components as they are installed; tighten the oil pump cover bolts securely **(see illustrations)**.

Installation

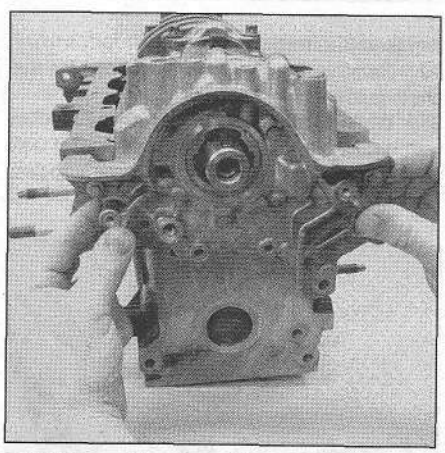
Refer to illustrations 15.16a, 15.16b, 15.17, 15.21a, 15.21b, 15.22, 15.23, 15.24a, 15.24b and 15.24c

15 The oil pump must be primed on installation, by pouring clean engine oil into it and rotating its inner rotor a few turns.

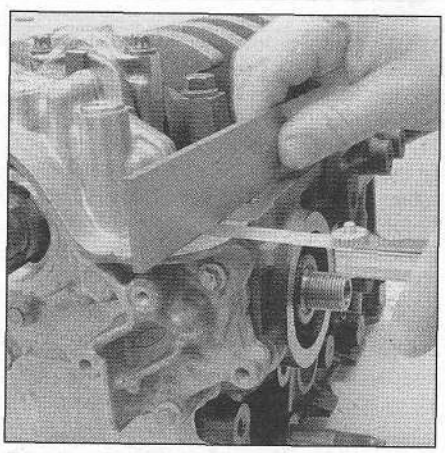
16 Rotate the pump's inner rotor to align with the flats on the crankshaft, then install the pump (and new gasket) and insert the bolts, tightening them lightly at first **(see illustrations)**.

17 Using a suitable straight-edge and feeler gauges, check that the pump is both centered exactly around the crankshaft and aligned squarely so that its (oil pan) mating surface is exactly the same amount between 0.012 and 0.031-inch (0.30 to 0.80 mm) below that of the cylinder block/crankcase on each side of the crankshaft **(see illustration)**. Being careful not to disturb the gasket, move the pump into the correct position and tighten its bolts to the torque listed in this Chapter's Specifications.

18 Check that the pump is correctly located;



15.16b . . . then install the oil pump and the bolts, tightening them finger tight only at this stage



15.17 Check the alignment of the oil pump with the crankcase

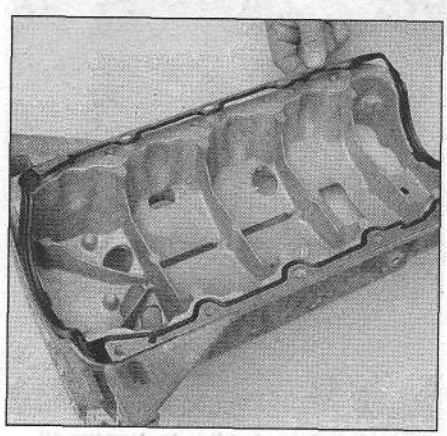
if necessary, unbolt it again and repeat the full procedure to ensure that the pump is correctly aligned.

19 Install a new oil pump housing seal (see *Section 10*).

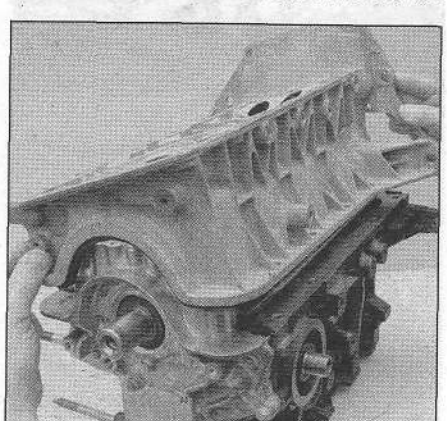
20 Apply a little RTV sealant to the joints between the oil pump and cylinder block. **Note:** *Once this sealant has been applied, the lower crankcase must be installed and the bolts fully tightened within 7 minutes.*

21 Install the new gasket in place, then raise the lower crankcase into position and loosely secure with the bolts **(see illustrations)**.

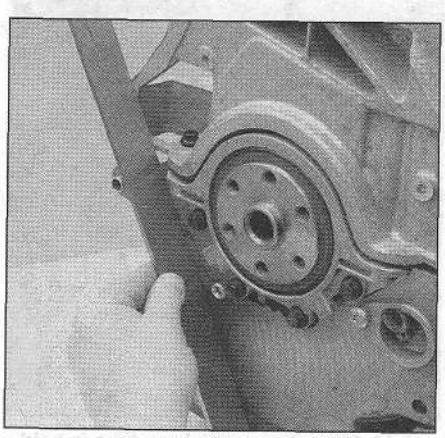
22 The lower crankcase must now be aligned with the cylinder block before the bolts are tightened. Using a straight-edge and feeler gauges, check the alignment of the end faces **(see illustration)**.



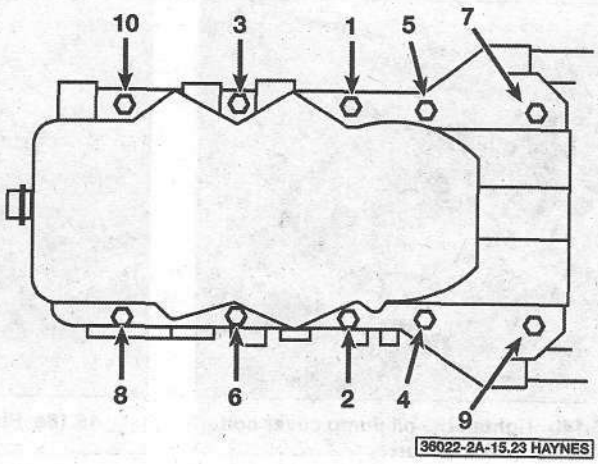
15.21a Install the new gasket . . .



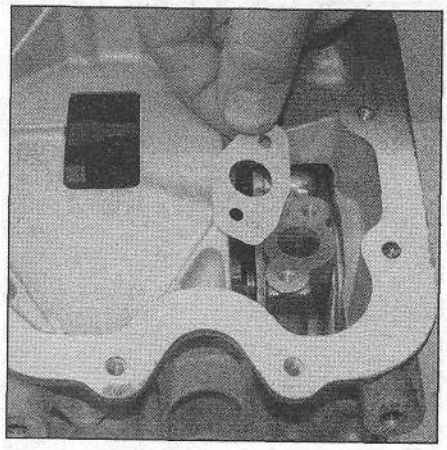
15.21b . . . then install the lower crankcase



15.22 Check the alignment of the lower crankcase and engine block



15.23 Lower crankcase bolt tightening sequence (2.0L engine)



15.24a Using a new gasket . . .

23 Tighten the lower crankcase bolts, in sequence, to the specified torque, ensuring that the alignment with the cylinder block is not lost **(see illustration)**.

24 Using grease to stick the gasket in place on the pump, install the pickup/strainer pipe, tightening the retaining bolts to the specified torque **(see illustrations)**.

25 The remainder of reassembly is the reverse of the removal procedure; refer to the relevant text for details where required.

2.3L engine

Refer to illustrations 15.28, 15.29 15.31 and 15.33

Note: *Removing the oil pump on this engine requires engine removal. Refer to Chapter 2C for the engine removal procedure. Also, the oil pump is serviced as a complete unit without any sub-assembly or internal inspection.*

26 With the engine removed, remove the timing chain (see Section 9).

27 Remove the oil pan.

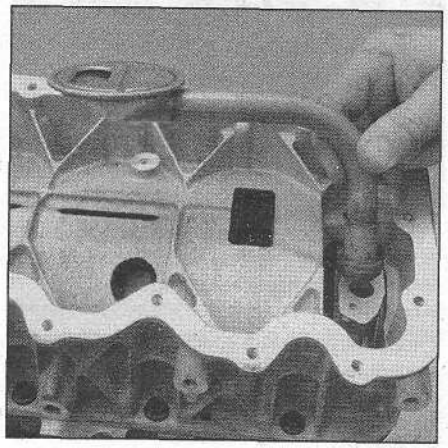
28 Remove the oil pick-up mounting bolts and then remove the pick-up tube **(see illustration)**.

29 Remove the chain tensioner mounting bolt and the tensioner, noting the spring location **(see illustration)**.

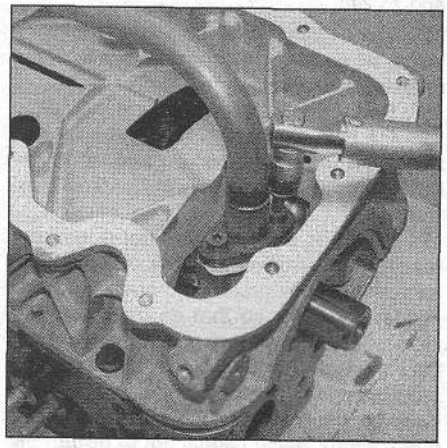
30 Remove the two mounting bolts for the chain guide and remove the guide.

31 While holding the oil pump drive sprocket with a suitable tool, remove the sprocket bolt from the oil pump, then remove the sprocket **(see illustration)**.

32 Slide the oil pump drive sprocket (and timing chain sprocket) and chain from the end of the crankshaft (if necessary). **Caution:** *The special washers on each side of the sprocket must be placed back in their original positions or engine timing will not be maintained after assembly. This may result in engine damage*

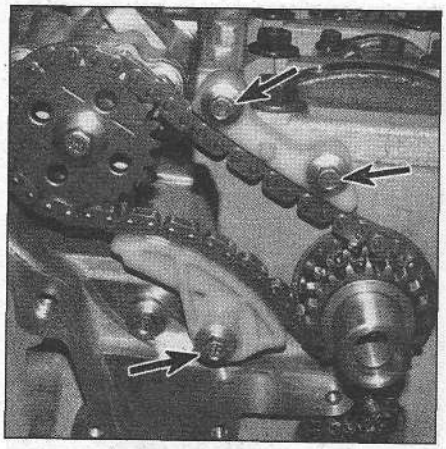


15.24b . . . install the oil pump pickup/strainer pipe . . .

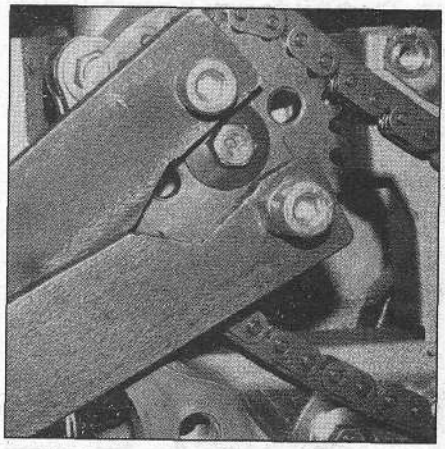


15.24c . . . and tighten the bolts to the specified torque

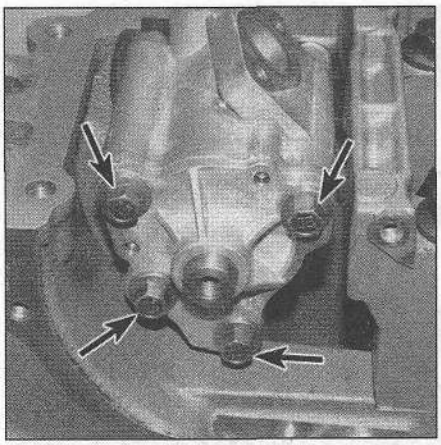
15.28 The oil pump pick-up tube is held by two mounting bolts



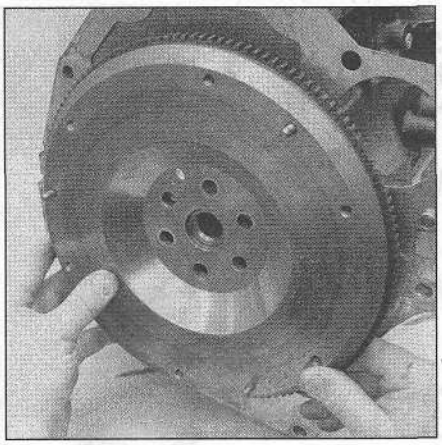
15.29 The tensioner is secured by one mounting bolt while the guide is held by two



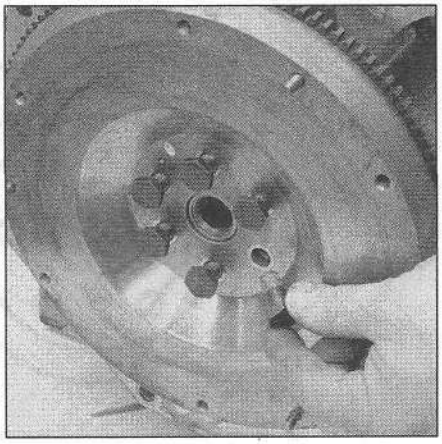
15.31 Using a holding tool on the oil pump drive sprocket to remove the retaining bolt



15.33 Remove the four mounting bolts for the oil pump



16.10a Place the flywheel into position . . .



16.10b . . . and secure with the new bolts

or failure.

33 Remove the oil pump mounting bolts, then remove the pump **(see illustration)**.

34 Installation is the reverse of removal noting the following points:

a) *Replace all gaskets with new ones.*
b) *Tighten the oil pump mounting bolts to the torque listed in this Chapter's Specifications in a criss-cross pattern.*
c) *After installing the engine, refill the crankcase with oil and the cooling system with the proper type and mixture of antifreeze (see Chapter 1).*
d) *Be certain to check for any oil warning lights in the instrument panel after the vehicle has been started and idling.*

16 Flywheel - removal, inspection and installation

Removal

1 Remove the transaxle as described in Chapter 7A. Now is a good time to check components such as oil seals and replace them if necessary.

2 Remove the clutch as described in Chapter 8. Now is a good time to check or replace the clutch components and release bearing.

3 Use a center-punch or paint to make alignment marks on the flywheel and crankshaft to make replacement easier - the bolt holes are slightly offset, and will only line up one way, but making a mark eliminates the guesswork (and the flywheel is heavy).

4 Hold the flywheel stationary using one of the following methods:

a) *If an assistant is available, insert one of the transaxle mounting bolts into the cylinder block, and have the assistant engage a wide-bladed screwdriver with the starter ring gear teeth while the bolts are loosened.*
b) *Alternatively, a piece of angle-iron can be engaged with the ring gear, and located against the transaxle mounting bolt.*

5 Loosen and remove each bolt in turn and ensure that new replacements are obtained for reassembly. These bolts are subjected to severe stresses and so must be replaced, regardless of their apparent condition, whenever they are disturbed.

6 Remove the flywheel, remembering that it is very heavy - do not drop it.

Inspection

7 Clean the flywheel to remove grease and oil. Inspect the surface for cracks, rivet grooves, burned areas and score marks. Light scoring can be removed with emery cloth. Check for cracked and broken ring gear teeth. Lay the flywheel on a flat surface and use a straight-edge to check for warpage.

8 Clean and inspect the mating surfaces of the flywheel and the crankshaft. If the oil seal is leaking, replace it (see Section 17) before replacing the flywheel. If the engine has covered a high mileage, it may be worth installing a new seal as a matter of course, given the amount of work needed to access it.

9 While the flywheel is removed, carefully clean its inboard face, particularly the recesses that serve as the reference points for the crankshaft speed/position sensor. Clean the sensor's tip and check that the sensor is securely fastened.

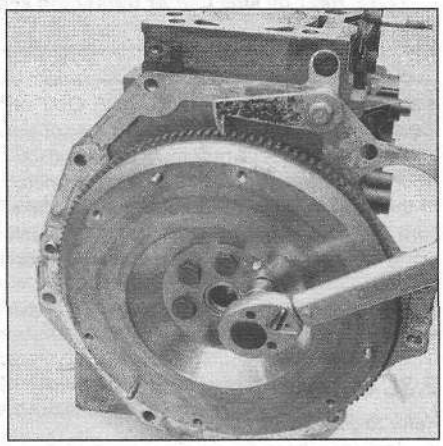
Installation

Refer to illustrations 16.10a, 16.10b and 16.11

10 On installation, ensure that the engine/transaxle adapter plate is in place (where necessary), then install the flywheel on the crankshaft so that all bolt holes align - it will fit only one way - check this using the marks made on removal. Install the new bolts, tightening them by hand **(see illustrations)**.

11 Lock the flywheel by the method used on dismantling. Working in a diagonal sequence to tighten them evenly and increasing to the final amount in two or three stages, tighten the new bolts to the torque listed in this Chapter's Specifications **(see illustration)**.

12 The remainder of reassembly is the reverse of the removal procedure



16.11 Tighten the flywheel bolts to the specified torque

17 Rear main oil seal - replacement

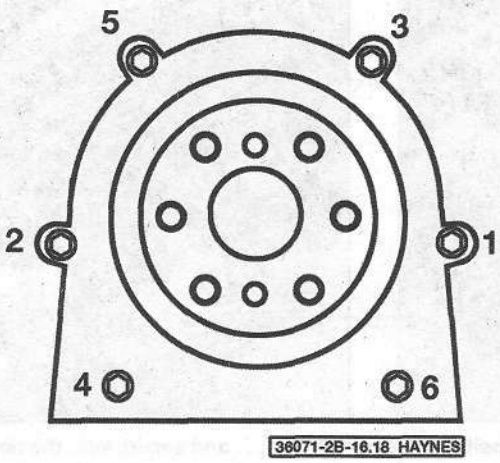
1 The one-piece rear main oil seal is pressed into rear main oil seal carrier mounted. Remove the transaxle (see Chapter 7), the clutch components (see Chapter 8) and the flywheel (see Section 16). **Note:** *The rear main oil seal carrier is not to be removed with the engine in the vehicle. Observe that the oil seal is installed flush with the seal carrier and the lip of the oil pan.*

2.0L engine

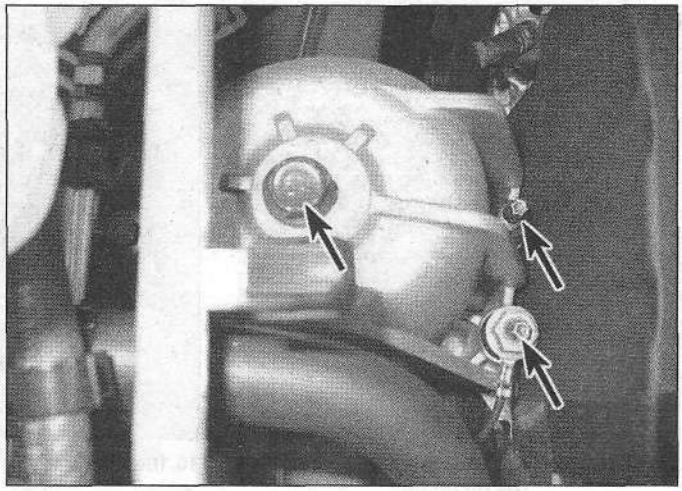
2 Pry out the old seal with a flat-blade screwdriver. **Caution:** *To prevent an oil leak after the new seal is installed, be very careful not to scratch or otherwise damage the crankshaft sealing surface or the bore in the engine block.*

3 Clean the crankshaft and seal bore in the block thoroughly and de-grease these areas by wiping them with a rag soaked in lacquer thinner or acetone. Lubricate the lip of the new seal and the outer diameter of the crankshaft with engine oil. Make sure the edges of the new oil seal are not rolled over.

4 Position the new seal onto the crankshaft. **Note:** *When installing the new seal,*



17.13 Rear oil seal carrier tightening sequence (2.3L engine)



18.9 Remove the bolts and lift the engine mount upper bracket off the engine mount

if so marked, the words THIS SIDE OUT on the seal must face out, toward the rear of the engine. Use a special rear main oil seal installation tool or a socket with the exact diameter of the seal to drive the seal in place. Make sure the seal is not off-set; it must be flush along the entire circumference of the seal carrier.

5 The remainder of installation is the reverse of removal.

2.3L engine

Refer to illustration 17.13

6 Remove the oil pan (see Section 13).

7 Unbolt the oil seal and carrier.

8 Clean the mating surface for the oil seal carrier on the cylinder block and the crankshaft. Carefully remove and polish any burrs or raised edges on the crankshaft that may have caused the seal to fail.

9 Lightly coat the inside lip of the new seal with clean engine oil. Then, use a thin (but durable) two-inch wide plastic strip (or a two-liter plastic beverage bottle cut to size) around the inside circumference of the seal to act as a liner for installation.

10 With the plastic seal liner in place, carefully move the new oil seal and carrier into position by sliding it onto the contact surface of the crankshaft.

11 Install the oil seal carrier bolts and finger tighten them while holding the carrier in place.

12 Carefully remove the plastic liner or bottle so that the new seal contacts the crankshaft mating surface correctly.

13 Tighten the oil seal carrier to the torque listed in this Chapter's Specifications using the proper sequence **(see illustration)**.

14 The seal is now fully installed. Be sure to check for signs of oil leakage when the engine is operable.

18 Engine mounts - check and replacement

1 Engine mounts seldom require attention, but broken or deteriorated mounts should be replaced immediately or the added strain placed on the driveline components may cause damage or wear.

Check

2 During the check, the engine must be raised slightly to remove the weight from the mounts.

3 Raise the vehicle and support it securely on jackstands, then position a jack under the engine oil pan. Place a large wood block between the jack head and the oil pan to prevent oil pan damage, then carefully raise the engine just enough to take the weight off the mounts. **Warning:** *DO NOT place any part of your body under the engine when it's supported only by a jack!*

4 Check the mounts to see if the rubber is cracked, hardened or separated from the metal backing. Sometimes the rubber will split right down the center.

5 Check for relative movement between the mount plates and the engine or frame. Use a large screwdriver or pry bar to attempt to move the mounts. If movement is noted, lower the engine and tighten the mount fasteners.

6 Rubber preservative may be applied to the mounts to slow deterioration.

Replacement

Refer to illustration 18.9

Note: *Refer to Chapter 7 for information on the transaxle mounts.*

7 Disconnect the battery cable from the battery negative terminal (see Chapter 5), then raise the vehicle and support it securely on jackstands (if not already done).

8 Place a floor jack under the engine with a wood block between the jack head and oil pan and raise the engine slightly to relieve the weight from the mounts.

9 Remove the fasteners and detach the mount from the frame and engine **(see illustration)**. **Caution:** *Do not disconnect more than one mount at a time, except during engine removal.*

10 Installation is the reverse of removal. Use thread locking compound on the mount bolts and be sure to tighten them securely.

11 After you reconnect the battery, the Powertrain Control Module (PCM) must relearn its idle and fuel trim strategy for optimum driveability and performance (see Chapter 5, Section 1).