

# Chapter 2 Part A:

## HCS engine in-car repair procedures

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### Degrees of difficulty

<b>Easy</b> , suitable for novice with little experience 	<b>Fairly easy</b> , suitable for beginner with some experience 	<b>Fairly difficult</b> , suitable for competent DIY mechanic 	<b>Difficult</b> , suitable for experienced DIY mechanic 	<b>Very difficult</b> , suitable for expert DIY or professional 
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2A

### Specifications

#### General

Engine type . . . . .	Four-cylinder, in-line overhead valve
Engine code:	
1.0 litre carburettor models . . . . .	TLB
1.1 litre carburettor models . . . . .	GUE or GUD
1.1 litre CFI fuel injection models . . . . .	G6A
1.3 litre carburettor models . . . . .	JBC
1.3 litre CFI fuel injection models . . . . .	J6B
Capacity:	
1.0 litre models . . . . .	999 cc
1.1 litre models . . . . .	1118 cc
1.3 litre models . . . . .	1297 cc
Bore:	
1.0 and 1.1 litre models . . . . .	68.68 mm
1.3 litre models . . . . .	73.96 mm
Stroke:	
1.0 litre models . . . . .	67.40 mm
1.1 and 1.3 litre models . . . . .	75.48 mm
Compression ratio:	
Carburettor models . . . . .	9.5:1
CFI fuel injection models . . . . .	8.8:1
Firing order . . . . .	1-2-4-3 (No 1 cylinder at timing chain end)
Direction of crankshaft rotation . . . . .	Clockwise (seen from right-hand side of vehicle)

#### Valves

Valve clearance (cold):	
Inlet . . . . .	0.20 mm
Exhaust . . . . .	0.30 mm

**Lubrication**

Engine oil type/specification . . . . .	See "Lubricants, fluids and tyre pressures"
Engine oil capacity . . . . .	See "Lubricants, fluids and tyre pressures"
Oil pressure:	
At idle speed . . . . .	0.60 bars
At 2000 rpm . . . . .	1.50 bars
Oil pump clearances:	
Outer rotor-to-body . . . . .	0.14 to 0.26 mm
Inner rotor-to-outer rotor . . . . .	0.051 to 0.127 mm
Rotor endfloat . . . . .	0.025 to 0.06 mm

**Torque wrench settings**

	Nm	lbf ft
Camshaft thrust plate bolts . . . . .	5	4
Camshaft sprocket bolt . . . . .	18	13
Crankshaft pulley bolt . . . . .	115	85
Rocker shaft pedestal bolts . . . . .	43	32
Flywheel bolts . . . . .	67	49
Sump:		
Stage 1 . . . . .	7	5
Stage 2 . . . . .	9	7
Stage 3 (with engine warm) . . . . .	9	7
Oil pressure switch . . . . .	14	10
Cylinder head bolts (may be re-used once only):		
Stage 1 . . . . .	30	22
Stage 2 . . . . .	Angle-tighten a further 90°	
Stage 3 . . . . .	Angle-tighten a further 90°	
Timing chain tensioner . . . . .	8	6
Timing chain cover . . . . .	9	7
Crankshaft rear oil seal housing . . . . .	18	13
Rocker cover bolts . . . . .	5	4
Oil pump . . . . .	18	13
Oil pump cover . . . . .	9	7
Engine mountings:		
Engine mounting (right-hand):		
Bolt to body (in wheel arch) . . . . .	41 to 58	30 to 43
Nut to body (by suspension strut) . . . . .	41 to 58	30 to 43
Bracket to cylinder block . . . . .	54 to 72	40 to 53
Rubber insulator to bracket . . . . .	71 to 95	52 to 70
Transmission mounting fasteners . . . . .	Refer to Chapter 7A or 7B	

**Note:** Refer to Part D of this Chapter for remaining torque wrench settings.

**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, and includes only the Specifications relevant to those procedures. Similar information concerning the 1.4 and 1.6 litre CVH and PTE engines, and the 1.6 and 1.8 litre Zetec engines, will be found in Parts B and C of this Chapter respectively. 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/transmission removal and refitting, and engine overhaul, can be found in Part D of this Chapter, which also includes the Specifications relevant to those procedures.

**Engine description**

The engine is an overhead valve, water-cooled, four cylinder in-line design, designated HCS (High Compression Swirl). The engine is mounted transversely at the front of the vehicle together with the transmission to form a combined power unit.

The crankshaft is supported in three or five shell-type main bearings. The connecting rod big-end bearings are also split shell-type, and are attached to the pistons by interference-fit gudgeon pins. Each piston is fitted with two compression rings and one oil control ring.

The camshaft, which runs on bearings within the cylinder block, is chain-driven from the crankshaft, and operates the valves via pushrods and rocker arms. The valves are each closed by a single valve spring, and operate in guides integral in the cylinder head.

The oil pump is mounted externally on the crankcase, incorporates a full-flow oil filter, and is driven by a skew gear on the camshaft. On carburettor versions, the fuel pump is also driven from the camshaft, via an eccentric lobe.

**Repair operations possible with the engine in the car**

The following work can be carried out with the engine in the car:

- a) Compression pressure - testing.
- b) Cylinder head rocker cover - removal and refitting.
- c) Valve clearances - adjustment.
- d) Rocker shaft assembly - removal, inspection and refitting.
- e) Cylinder head - removal and refitting
- f) Cylinder head and pistons - decarbonising.
- g) Crankshaft pulley - removal and refitting.
- h) Crankshaft oil seals - renewal.
- i) Timing chain, sprockets and tensioner - removal, inspection and refitting.
- j) Oil filter renewal.
- k) Oil pump - removal and refitting.
- l) Sump - removal and refitting.
- m) Flywheel - removal, inspection and refitting.
- n) Engine/transmission mountings - inspection and renewal.

**Note:** It is possible to remove the pistons and

connecting rods (after removing the cylinder head and sump) without removing the engine. However, this is not recommended. Work of this nature is more easily and thoroughly completed with the engine on the bench, as described in Chapter 2D.

## 2 Compression test - description and interpretation



1 When engine performance is down, or if misfiring occurs which cannot be attributed to the ignition or fuel systems, a compression test can provide diagnostic clues as to the engine's condition. If the test is performed regularly, it can give warning of trouble before any other symptoms become apparent.

2 The engine must be fully warmed-up to normal operating temperature, the oil level must be correct and the battery must be fully charged. The aid of an assistant will also be required.

3 On fuel injection engines, refer to Chapter 12 and remove the fuel pump fuse from the fusebox. Now start the engine and allow it to run until it stalls.

4 Disable the ignition system by disconnecting the multi-plug from the DIS or E-DIS ignition coil. Remove all the spark plugs with reference to Chapter 1 if necessary.

5 Fit a compression tester to the No 1 cylinder spark plug hole - the type of tester which screws into the plug thread is to be preferred.

6 Arrange for an assistant to hold the accelerator pedal fully depressed to the floor, while at the same time cranking the engine over for several seconds on the starter motor. Observe the compression gauge reading. The compression will build up fairly quickly in a healthy engine. Low compression on the first stroke, followed by gradually-increasing pressure on successive strokes, indicates worn piston rings. A low compression on the first stroke which does not rise on successive strokes, indicates leaking valves or a blown head gasket (a cracked cylinder head could also be the cause). Deposits on the underside of the valve heads can also cause low compression. Record the highest gauge reading obtained, then repeat the procedure for the remaining cylinders.

7 Due to the variety of testers available, and the fluctuation in starter motor speed when cranking the engine, different readings are often obtained when carrying out the compression test. For this reason, actual compression pressure figures are not quoted by Ford. However, the most important factor is that the compression pressures are uniform in all cylinders, and that is what this test is mainly concerned with.

8 Add some engine oil (about three squirts from a plunger type oil can) to each cylinder through the spark plug holes, and then repeat the test.

9 If the compression increases after the oil is added, it is indicative that the piston rings are definitely worn. If the compression does not increase significantly, the leakage is occurring at the valves or the head gasket. Leakage past the valves may be caused by burned valve seats and/or faces, or warped, cracked or bent valves.

10 If two adjacent cylinders have equally low compressions, it is most likely that the head gasket has blown between them. The appearance of coolant in the combustion chambers or on the engine oil dipstick would verify this condition.

11 If one cylinder is about 20 percent lower than the other, and the engine has a slightly rough idle, a worn lobe on the camshaft could be the cause.

12 On completion of the checks, refit the spark plugs and reconnect the HT leads and the ignition coil plug. Refit the fuel pump fuse to the fusebox.

## 3 Top Dead Centre (TDC) for No 1 piston - locating



1 Top dead centre (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 at the end of the compression stroke for No 1 piston is used. On the HCS engine, No 1 cylinder is at the crankshaft pulley/timing chain end of the engine. Proceed as follows.

2 Ensure that the ignition is switched off. Disconnect the HT leads from the spark plugs, then unscrew and remove the plugs as described in Chapter 1.

3 Turn the engine over by hand (using a spanner on the crankshaft pulley) to the point where the timing mark on the crankshaft pulley aligns with the TDC (0) mark or TDC reference pointer on the timing cover (see illustration). As the pulley mark nears the timing mark, the No 1 piston is simultaneously approaching the top of its cylinder. To ensure that it is on its compression stroke, place a finger over the No 1 cylinder plug hole, and

feel to ensure that air pressure exits from the cylinder as the piston reaches the top of its stroke.

4 A further check to ensure that the piston is on its compression stroke can be made by first removing the air cleaner (refer to the relevant Part of Chapter 4), then unbolting and removing the rocker cover, so that the movement of the valves and rockers can be observed.

5 With the TDC timing marks on the crankshaft pulley and timing cover in alignment, rock the crankshaft back and forth a few degrees each side of this position, and observe the action of the valves and rockers for No 1 cylinder. When No 1 piston is at the TDC firing position, the inlet and exhaust valve of No 1 cylinder will be fully closed, but the corresponding valves of No 4 cylinder will be seen to rock open and closed.

6 If the inlet and exhaust valves of No 1 cylinder are seen to rock whilst those of No 4 cylinder are shut, the crankshaft will need to be turned one full rotation to bring No 1 piston up to the top of its cylinder on the compression stroke.

7 Once No 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 (in its normal direction of rotation), 180° at a time, and following the firing order (see Specifications).

## 4 Cylinder head rocker cover - removal and refitting



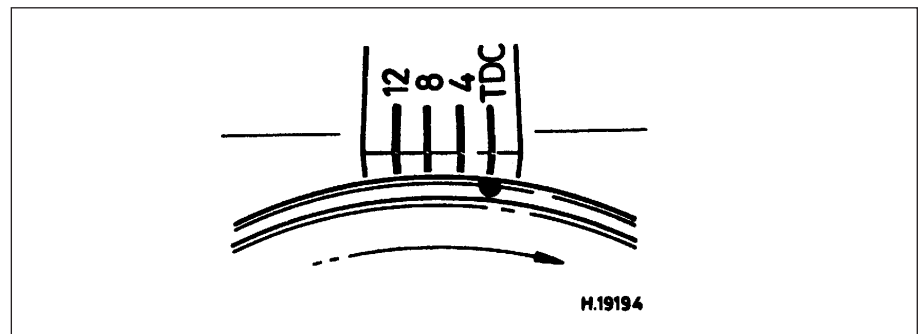
### Removal

1 Where necessary for access, remove the air cleaner as described in the relevant Part of Chapter 4.

2 Detach the HT leads from the spark plugs. Pull on the connector of each lead (not the lead itself), and note the order of fitting.

3 Remove the engine oil filler cap and breather hose (where fitted).

4 Unscrew the four retaining bolts, and lift the rocker cover clear of the cylinder head. Remove the gasket.



3.3 Timing mark on the crankshaft pulley aligned with the TDC (0) mark on the timing cover



4.6a Engage tags of rocker cover gasket into the cut-outs in the cover



4.6b Refitting the rocker cover



5.6 Adjusting the valve clearances

**Refitting**

5 Thoroughly clean the rocker cover, and scrape away any traces of old gasket remaining on the cover and cylinder head mating surfaces.

6 Fit a new gasket to the rocker cover, then refit the rocker cover (see illustrations). Tighten the cover retaining bolts to the specified torque wrench setting, in a diagonal sequence.

7 Reconnect the HT leads, and refit the air cleaner as described in Chapter 4.

5 Adjust the valve clearances following the sequence given in the following table. Turn the crankshaft pulley 180° (half a turn) after adjusting each pair of valve clearances.

**HAYNES HINT** *Turning the engine will be easier if the spark plugs are removed first - see Chapter 1.*

<b>Valves "rocking"</b>	<b>Valves to adjust</b>
7 and 8	1 (exhaust), 2 (inlet)
5 and 6	3 (exhaust), 4 (inlet)
1 and 2	8 (exhaust), 7 (inlet)
3 and 4	6 (exhaust), 5 (inlet)

6 The clearances for the inlet and exhaust valves differ (refer to the Specifications). Use a feeler gauge of the appropriate thickness to check each clearance between the end of the valve stem and the rocker arm (see illustration). The gauge should be a firm sliding fit between the valve and rocker arm. Where adjustment is necessary, turn the adjuster bolt as required with a ring spanner to set the clearance to that specified. The adjuster bolts are of stiff-thread type, and require no locking nut.

7 On completion, refit the rocker cover as described in Section 4.

**HAYNES HINT**

*If the pushrods are to be removed, keep them in the correct order of fitting by labelling them 1 to 8, starting from the thermostat end of the cylinder head, or locate them in a card.*

**5 Valve clearances - checking and adjustment**

**Note:** The valve clearances must be checked and adjusted only when the engine is cold.

1 The importance of having the valve clearances correctly adjusted cannot be overstressed, as they vitally affect the performance of the engine. If the clearances are too big, the engine will be noisy (characteristic rattling or tapping noises) and engine efficiency will be reduced, as the valves open too late and close too early. A more serious problem arises if the clearances are too small, however. If this is the case, the valves may not close fully when the engine is hot, resulting in serious damage to the engine (eg. burnt valve seats and/or cylinder head warping/cracking). The clearances are checked and adjusted as follows.

2 Set the engine to TDC for No 1 piston, as described in Section 3.

3 Remove the rocker cover as described in Section 4.

4 Starting from the thermostat end of the cylinder head, the valves are numbered as follows:

Valve No	Cylinder No
1 - Exhaust	1
2 - Inlet	1
3 - Exhaust	2
4 - Inlet	2
5 - Inlet	3
6 - Exhaust	3
7 - Inlet	4
8 - Exhaust	4

**6 Cylinder head rocker gear - removal, inspection and refitting**

**Removal**

1 Remove the rocker cover as described in Section 4.

2 Unscrew the four retaining bolts, and lift the rocker gear assembly from the cylinder head. As the assembly is withdrawn, ensure that the pushrods remain seated in their positions in the engine.

**Inspection**

3 To dismantle the rocker shaft assembly, extract the split pin from one end of the shaft, then withdraw the spring and plain washers from the shaft.

4 Slide off the rocker arms, the support pedestals and coil springs from the shaft, but

take care to keep them in their original order of fitting (see illustration).

5 Clean the respective components, and inspect them for signs of excessive wear or damage. Check that the oil lubrication holes in the shaft are clear.

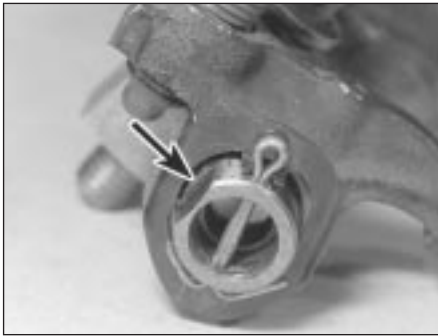
6 Check the rocker shaft and arm pads which bear on the valve stem end faces for wear and scoring, and check each rocker arm on the shaft for excessive wear. Renew any components as necessary.

**Refitting**

7 Apply clean engine oil to the rocker shaft prior to reassembling.



6.4 Rocker shaft partially dismantled for inspection



**6.8 Flat on the rocker shaft (arrowed) to same side as rocker arm adjusting screws**

**8** Reassemble in the reverse order of dismantling. Make sure that the “flat” on the rear end of the rocker shaft is to the same side as the rocker arm adjusting screws (closest to the thermostat end of the cylinder head when fitted) (see illustration). This is essential for the correct lubrication of the cylinder head components.

**9** Refit the rocker shaft assembly. As it is fitted, ensure that the rocker adjuster screws engage with their corresponding pushrods.

**10** Refit the rocker shaft retaining bolts, hand-tighten them and then tighten them to the specified torque wrench setting. As they are tightened, some of the rocker arms will apply pressure to the ends of the valve stems, and some of the rocker pedestals will not initially be in contact with the cylinder head - these should pull down as the bolts are tightened to their specified torque. If for any reason they do not, avoid the temptation to overtighten in order to pull them into position; loosen off the bolts, and check the cause of the problem. It may be that the rocker adjuster screws require loosening off in order to allow the assembly to be tightened down as required.

**11** Adjust the valve clearances as described in Section 5.

## 7 Cylinder head - removal and refitting



### Removal

**Note:** The following procedure describes removal and refitting of the cylinder head complete with inlet and exhaust manifolds. If wished, the manifolds may be removed first, as described in the relevant Part of Chapter 4, and the cylinder head then removed on its own.

**1** On fuel injection engines, depressurise the fuel system as described in Chapter 4, Part B.

**2** Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).

**3** Refer to Chapter 4A or 4B as applicable and remove the air cleaner.

**4** Refer to Section 4 and remove the rocker cover.

**5** Refer to Chapter 1 and drain the cooling system.

**6** Disconnect the hoses from the thermostat housing.

**7** Disconnect the heater (coolant) hoses from the inlet manifold and CFI unit, where applicable.



**Whenever you disconnect any vacuum lines, coolant or emissions hoses, wiring connectors and fuel lines, always label them clearly, so that they can be correctly reassembled. Masking tape and/or a touch-up paint applicator work well for marking items. Take instant photos, or sketch the locations of components and brackets.**

**8** Disconnect the accelerator and choke cables as applicable (see Chapter 4A or 4B).

**9** Disconnect the vacuum and breather hoses from the carburettor/CFI unit, and inlet manifold as applicable.

**10** Disconnect the fuel feed and return lines at the carburettor, or at the quick-release couplings, then unclip the fuel hoses from the inlet manifold; use rag to soak up any spilt fuel.

**11** Disconnect the HT leads from the spark plugs and the support bracket. Unscrew and remove the spark plugs.

**12** Disconnect the electrical leads from the temperature gauge sender, radiator cooling fan, the engine coolant temperature sender, and the anti-run-on (anti-dieselling) valve at the carburettor.

**13** Disconnect the remaining wiring multi-plugs from the engine sensors at the inlet manifold and from the oxygen sensor (where fitted) in the exhaust manifold or downpipe.

**14** On vehicles equipped with a pulse-air system, remove the pulse-air piping and filter assembly as described in Chapter 4E.

**15** Chock the rear wheels then jack up the front of the car and support it on axle stands (see “Jacking and Vehicle Support”).

**16** Undo the retaining nuts and bolts, and disconnect the exhaust downpipe from the manifold. Remove the flange gasket. (Note that both the gasket and the joint self-locking nuts must be renewed.) To prevent the exhaust system from being strained, tie the downpipe up using strong wire or a length of cord to support it. Lower the vehicle.

**17** Undo the four retaining bolts and lift clear the rocker gear assembly from the cylinder head.

**18** Lift out the pushrods. Keep them in order of fitting by labelling them 1 to 8, starting from the thermostat end of the cylinder head. Alternatively, push them through a piece of card in their fitted sequence.

**19** Progressively unscrew and loosen off the cylinder head retaining bolts in the reverse sequence to that shown for tightening (see illustration 7.27a). When they are all

loosened off, remove the bolts, then lift the cylinder head clear and remove the gasket. If it is stuck, tap it upwards using a hammer and block of wood. Do not try to turn it, as it is located by dowels; make no attempt whatsoever to prise it free using a screwdriver inserted between the block and head faces. The gasket must always be renewed; it should be noted that the cylinder head retaining bolts may be re-used, but only once. They should be marked accordingly with a punch or paint mark. If there is any doubt as to how many times the bolts have been used, they must be renewed.

**20** To dismantle/overhaul the cylinder head, refer to Part D of this Chapter. It is normal for the cylinder head to be decarbonised and the valves to be reground whenever the head is removed.

### Preparation for refitting

**21** The mating faces of the cylinder head and cylinder block must be perfectly clean before refitting the head. Use a hard plastic or wood scraper to remove all traces of gasket and carbon; also clean the piston crowns. Take particular care during the cleaning operations, as aluminium 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. Using adhesive tape and paper, seal the water, oil and bolt holes in the cylinder block.



**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.**

**22** 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, but if excessive, machining may be the only alternative to renewal.

**23** If warpage of the cylinder head gasket surface is suspected, use a straight-edge to check it for distortion. Refer to Part D of this Chapter if necessary.

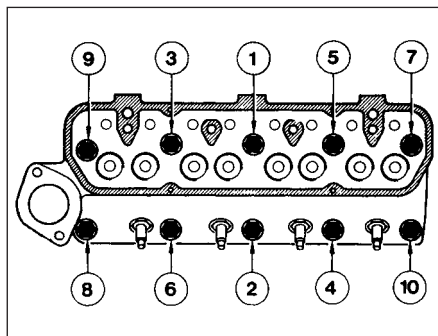
**24** Clean the threads of the cylinder head bolts or fit new ones (as applicable) and clean out the bolt holes in the block. Screwing a bolt into an oil-filled hole can (in extreme cases) cause the block to fracture, due to the hydraulic pressure.

### Refitting

**25** Check that the new cylinder head gasket is the same type as the original, and that the “TOP” (or “OBEN”) marking is facing upwards. Locate the new cylinder head



7.25 Cylinder head gasket top-face marking ("OBEN")



7.27a Cylinder head bolt tightening sequence



7.27b Tightening the cylinder head bolts (Stage 1)



7.27c Cylinder head bolt tightening (Stages 2 and 3) using an angle gauge

gasket onto the top face of the cylinder block and over the dowels. Ensure that it is correctly aligned with the coolant passages and oilways (see illustration).

26 Lower the cylinder head carefully into position, then insert the retaining bolts and hand-tighten them.

27 Tightening of the cylinder head bolts must be done in three stages, and in the correct sequence (see illustration). First tighten all of the bolts in the sequence shown to the Stage 1 torque setting (see illustration). When all of the bolts are tightened to the Stage 1 setting, further tighten each bolt (in sequence) through the Stage 2 specified angle of rotation. When the second stage tightening is completed on all of the bolts, further tighten them to the Stage 3 angle setting (in sequence) to complete. Where possible, use an angular torque setting gauge attachment tool for accurate tightening of stages two and three (see illustration).

28 Lubricate the pushrods with clean engine oil, and then insert them into their original locations in the engine.

29 Refit the rocker shaft assembly. As it is fitted, ensure that the rocker adjuster screws engage with their corresponding pushrods.

30 Refit the rocker shaft retaining bolts, hand-tighten them and then tighten them to the specified torque wrench setting. As they are tightened, some of the rocker arms will apply pressure to the ends of the valve stems, and some of the rocker pedestals will not initially be in contact with the cylinder

head - these should pull down as the bolts are tightened. If for any reason they do not, avoid the temptation to overtighten in order to pull them into position; loosen off the bolts, and check the cause of the problem. It may be that the rocker adjuster screws require loosening off in order to allow the assembly to be tightened down as required.

31 Adjust the valve clearances as described in Section 5.

32 Refit the rocker cover as described in Section 4.

33 The remainder of the refitting procedure is a reversal of the removal process. Tighten all fastenings to their specified torque setting (where given). Refer to the appropriate Parts of Chapter 4 for details on reconnecting the fuel and exhaust system components. Ensure that all coolant, fuel, vacuum and electrical connections are securely made.

34 On completion, refill the cooling system and top-up the engine oil (see Chapter 1 and "Weekly Checks"). When the engine is restarted, check for any sign of fuel, oil and/or coolant leakages from the various cylinder head joints.

## 8 Crankshaft pulley - removal and refitting

### Removal

1 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).

2 Chock the rear wheels then jack up the front of the car and support it on axle stands (see "Jacking and Vehicle Support"). Remove the right-hand front roadwheel.

3 Remove the auxiliary drivebelt as described in Chapter 1.

4 Loosen off the crankshaft pulley retaining bolt. To prevent the crankshaft from turning, unbolt and remove the clutch housing cover plate. Lock the starter ring gear on the flywheel using a large screwdriver or similar tool inserted through the cover plate aperture. Alternatively, remove the starter motor (Chapter 5A) and lock the ring gear through the starter motor aperture.

5 Fully unscrew the crankshaft pulley bolt, and withdraw the pulley from the front end of the crankshaft. If it does not pull off by hand, lever it free using a pair of suitable levers positioned diagonally opposite each other behind the pulley.

6 If required, the crankshaft front oil seal can be renewed at this stage, as described in Section 14.

### Refitting

7 Refitting is a reversal of the removal procedure ensuring that the pulley retaining bolt is tightened to the specified torque setting.

8 Refit the auxiliary drivebelt as described in Chapter 1, and lower the vehicle to complete.

## 9 Timing chain cover - removal and refitting

### Removal

1 Remove the sump as described in Section 11.

2 Remove the crankshaft pulley as described in the previous Section.

3 A combined timing cover and water pump gasket is fitted during production; if this is still in position, it will be necessary to drain the cooling system and remove the water pump as described in Chapter 3. If the water pump and/or the timing cover have been removed at any time, the single gasket used originally will have been replaced by an individual gasket for each component, in which case the water pump can remain in position.

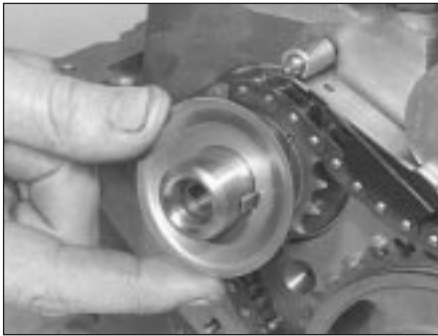
4 Unscrew the retaining bolts, and carefully prise free the timing chain cover.

5 Clean the mating faces of the timing chain cover, and the engine.

6 If necessary, renew the crankshaft front oil seal in the timing cover prior to refitting the cover (see Section 14).

### Refitting

7 Lightly lubricate the front end of the crankshaft and the radial lip of the timing chain cover oil seal (already installed in the



10.2 Oil slinger removal from crankshaft

cover). Using a new gasket, fit the timing chain cover, centring it with the aid of the crankshaft pulley - lubricate the seal contact surfaces beforehand. Refit and tighten the retaining bolts but, where applicable, leave out the timing cover bolt which also secures the water pump at this stage.

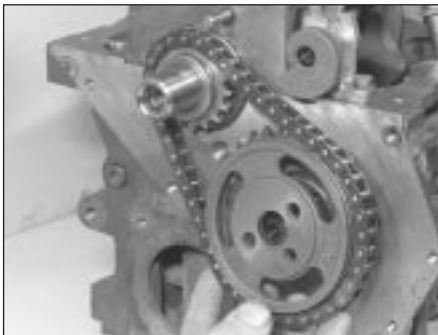
- 8 Where applicable, refit the water pump as described in Chapter 3.
- 9 Refit the crankshaft pulley as described in the previous Section.
- 10 Refit the sump as described in Section 11.

**10 Timing chain, sprockets and tensioner - removal, inspection and refitting**



**Removal**

- 1 Remove the timing chain cover as described in the previous Section.
- 2 Remove the oil slinger from the front face of the crankshaft, noting its orientation (see illustration).
- 3 Retract the chain tensioner cam back against its spring pressure, then slide the chain tensioner arm from its pivot pin on the front main bearing cap (see illustration).
- 4 Unbolt and remove the chain tensioner.
- 5 Bend back the lockplate tabs from the camshaft sprocket bolts, then unscrew and remove the bolts.
- 6 Withdraw the sprocket complete with the timing chain.



10.12a Fit the timing chain to the crankshaft and camshaft sprockets . . .



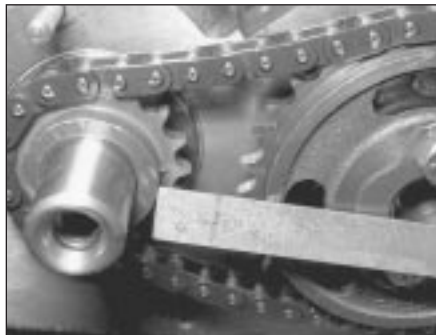
10.3 Chain tensioner arm removal from the pivot pin. Note tensioner retaining bolts (arrowed)

**Inspection**

- 7 Examine the teeth on the timing sprockets for any signs of excessive wear or damage.
- 8 The timing chain should always be renewed during a major engine overhaul. Slack links and pins are indicative of a worn chain. Unless the chain is known to be relatively new, it should be renewed.
- 9 Examine the rubber cushion on the tensioner spring leaf. If grooved or deteriorated, it must be renewed.

**Refitting**

- 10 Commence reassembly by bolting the timing chain tensioner into position. Check that the face of the tensioner cam is parallel with the face of the cylinder block, ideally using a dial gauge. The maximum permissible error between the two measuring points is 0.2 mm. Release and turn the timing chain tensioner as required to achieve this (if necessary). Refer to the Specifications for the correct tightening torque.
- 11 Turn the crankshaft so that the timing mark on its sprocket is directly in line with the centre of the camshaft sprocket mounting flange.
- 12 Engage the camshaft sprocket with the timing chain, then engage the chain around the teeth of the crankshaft sprocket. Push the camshaft sprocket onto its mounting flange, and check that the sprocket retaining bolt holes are in alignment (see illustration). Also



10.12b . . . and check that the timing marks on the sprockets are in alignment

check that the timing marks of both sprockets face each other. If required, turn the camshaft/sprocket as required to achieve this. It may also be necessary to remove the camshaft from the chain in order to reposition it in the required location in the chain to align the timing marks. This is a "trial and error" procedure, which must be continued until the exact alignment of the bolt holes and the timing marks is made (see illustration).

- 13 Insert and tighten the camshaft sprocket retaining bolts to the specified torque wrench setting. Bend up the tabs of the new lockplate to secure (see illustration).
- 14 Retract the timing chain tensioner cam, and then slide the tensioner arm onto its pivot pin. Release the cam so that it bears on the arm.
- 15 Refit the oil slinger to the front of the crankshaft sprocket so that its convex side faces the sprocket.
- 16 Refit the timing chain cover as described in the previous Section.

**11 Sump - removal and refitting**

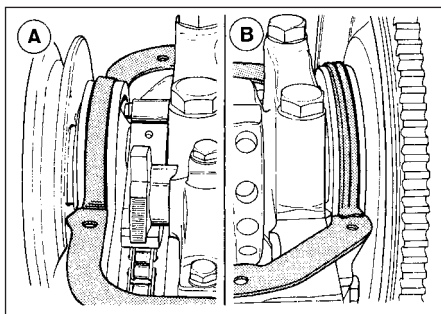


**Removal**

- 1 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).
- 2 Refer Chapter 1 and drain the engine oil. Refit the sump drain plug.
- 3 Undo the retaining nuts and detach the exhaust downpipe from the manifold flange. Note that the flange gasket should be renewed on reassembly. Allowing sufficient clearance for sump removal, tie the exhaust downpipe up with a suitable length of wire or cord to prevent the system straining the insulators. On catalytic converter-equipped vehicles, avoid straining the oxygen sensor wiring; if necessary, disconnect the sensor's multi-plug.
- 4 Remove the starter motor (see Chapter 5A).
- 5 Undo the two retaining bolts and remove the clutch housing cover plate and, where fitted, the auxiliary drivebelt lower cover from inside the right-hand wheel arch.



10.13 Bend locktabs against the camshaft retaining bolt heads to secure



**11.8a Sump gasket fitting details at the timing chain cover end (A) and the flywheel end (B)**

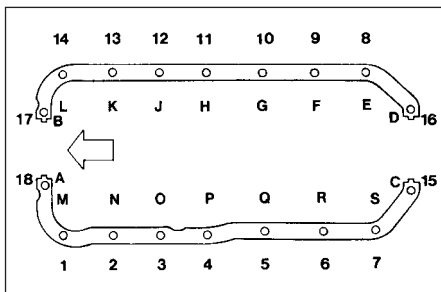
6 Undo the eighteen bolts securing the sump to the base of the engine crankcase, then prise free and lower the sump. If the sump is stuck tight to the engine, cut around the flange gasket with a sharp knife, then lightly tap and prise it free. Keep the sump upright as it is lowered, to prevent spillage of any remaining oil in it. Also be prepared for oil drips from the crankcase when the sump is removed.

7 Remove any dirt and old gasket from the contact faces of the sump and crankcase, and wash the sump out thoroughly before refitting. Check that the mating faces of the sump are not distorted. Check that the oil pick-up strainer is clear, cleaning it if necessary.

**Refitting**

8 Clean the gasket location faces. Apply a dab of sealing compound to the mating faces where the ends of each cork half-gasket are to be fitted (see illustration). Stick the new cork gaskets into position on the block face, using clean thick grease to retain them, then locate the new rubber gaskets into their slots in the timing chain cover and rear oil seal carrier. The lugs of the cork gasket halves fit under the cut-outs in the rubber gaskets (see illustration).

9 Before offering up the sump, check that the gap between the sump and the oil baffle is between 2.0 and 3.8 mm (see illustration).



**11.10 Sump bolt tightening sequence - arrow indicates crankshaft pulley end of engine**

See Specifications for torque wrench settings  
 Stage 1 - Tighten in alphabetical order  
 Stage 2 - Tighten in numerical order  
 Stage 3 - Tighten in alphabetical order



**11.8b Lugs of cork gasket halves to fit under the cut-outs in the rubber gaskets**

Do not use a dented or damaged sump, as the indicated dimension is important for correct engine lubrication.

10 Fit the sump into position, and fit the retaining bolts. Initially tighten them all finger-tight, then further tighten them in the sequence shown through Stages 1 and 2, to the torque wrench settings specified (see illustration). Note that different tightening sequences are specified for the tightening stages. Final (Stage 3) tightening is carried out after the engine has been started and warmed up.

11 Refit the lower plate to the front face of the clutch housing and refit the auxiliary drivebelt lower cover.

12 Refit the starter motor.

13 Check that the downpipe and manifold mating faces are clean, then locate a new gasket and reconnect the exhaust downpipe to the manifold. Where applicable, use new self-locking nuts, and tighten securely.

14 Check that the sump drain plug is fitted and tightened to the specified torque, then lower the vehicle to the ground.

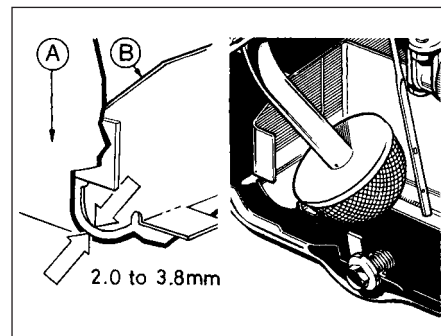
15 Refill the engine with oil as described in Chapter 1.

16 Reconnect the battery, then start the engine and run it up to its normal operating temperature. Check that no oil leaks are evident around the sump joint.

17 After the engine has warmed up for approximately 15 minutes, switch it off. Tighten the sump bolts to the Stage 3 torque wrench setting given in the Specifications, in the sequence shown in illustration 11.10.



**12.4 Unscrewing the oil pump retaining bolts**



**11.9 Sump (A) and oil baffle (B) clearance details**

**12 Oil pump - removal and refitting**



**Removal**

1 The oil pump is externally-mounted, on the rear-facing side of the crankcase.

2 Chock the rear wheels then jack up the front of the car and support it on axle stands (see "Jacking and Vehicle Support").

3 Unscrew and remove the oil filter cartridge. It should unscrew by hand, but will probably be tight. Use a strap wrench to loosen it off, if required. Catch any oil spillage in a suitable container.

4 Undo the three retaining bolts and withdraw the oil pump from the engine (see illustration).

5 Clean all traces of the old gasket from the mating surfaces of the pump and engine.

**Refitting**

6 If the original oil pump has been dismantled and reassembled and is to be re-used, or if a new pump is to be fitted, it must first be primed with engine oil prior to fitting. To do this, turn its driveshaft and simultaneously inject clean engine oil into it.

7 Locate a new gasket into position on the pump mounting flange, then insert the pump, engaging the drivegear as it is fitted (see illustration). Fit the retaining bolts, and tighten to the specified torque wrench setting.



**12.7 Refitting the oil pump. Note the new gasket**

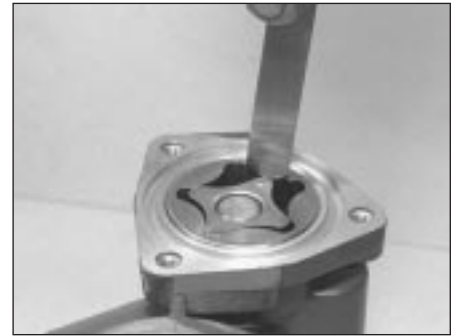




13.1 Extract the O-ring from the groove in the oil pump



13.4a Checking the outer body-to-rotor clearance



13.4b Checking the inner rotor-to-outer rotor clearance

8 Fit a new oil filter into position on the oil pump body, as described in Chapter 1.

9 Lower the vehicle to the ground, and top-up the engine oil as described in "Weekly Checks".

### 13 Oil pump - dismantling, inspection and reassembly



#### Dismantling

1 To inspect the oil pump components for excessive wear, undo the retaining bolts and remove the cover plate from the pump body. Remove the O-ring seal from the cover face (see illustration).

2 Wipe the exterior of the pump housing clean housing.

#### Inspection

3 Noting their orientation, extract and clean the rotors and the inner body of the pump housing. Inspect them for signs of severe scoring or excessive wear, which if evident will necessitate renewal of the complete pump.

4 Using feeler gauges, check the clearances between the pump body and the outer rotor, the inner-to-outer rotor clearance, and the amount of rotor endfloat (see illustrations).



13.4c Checking the rotor endfloat

5 Check the drivegear for signs of excessive wear or damage.

6 If the clearances measured are outside the specified maximum clearances and/or the drivegear is in poor condition, the complete pump unit must be renewed.

#### Reassembly

7 Refit the rotors into the pump (in their original orientation), lubricate the rotors and the new O-ring seal with clean engine oil, and refit the cover. Tighten the retaining bolts to the specified torque wrench setting.

### 14 Crankshaft oil seals - renewal



#### Front oil seal

1 Remove the crankshaft pulley as described in Section 8.

2 Using a suitable claw tool, extract the oil seal from the timing chain cover, but take care not to damage the seal housing. As it is removed, note the fitted orientation of the seal in the cover.

3 Clean the oil seal housing in the timing chain cover. Lubricate the sealing lips of the new seal and the crankshaft stub with clean engine oil.

4 Locate the new seal into position so that it

is squarely located on the crankshaft stub and in the housing, and is correctly orientated. Drift it into position using a large socket, another suitable tool, or the old seal, until the new seal is flush with the edge of the timing chain cover.

5 Lightly lubricate the rubbing surface of the crankshaft pulley, then refit the pulley as described in Section 8.

#### Rear oil seal

6 Remove the flywheel as described in Section 16.

7 Using a suitable claw tool, lever the seal from the rear seal housing (taking care not to damage the housing). As it is removed, note the fitted orientation of the seal.

8 Clean the seal housing, the crankshaft rear flange face and the flywheel mating surface.

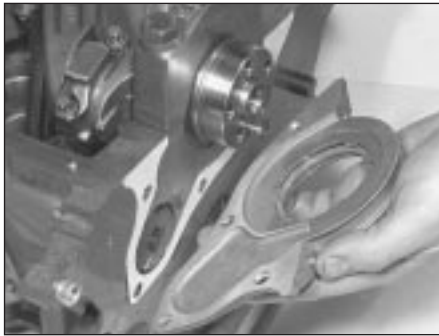
9 One of two possible methods may be used to insert the new oil seal, depending on the tools available.

10 If Ford service tool No 21-011 is available, lubricate the crankshaft flange and the oil seal inner lip with clean engine oil. Position the seal onto the service tool (ensuring correct orientation), then press the seal into its housing.

11 If the service tool is not available, remove the engine sump (Section 11), then unscrew the Torx-head bolts retaining the rear seal housing in position, and remove the seal housing from the rear face of the cylinder block. New gaskets will be required for both the seal housing and the sump when refitting. Clean the seal housing seat and the mating surfaces of the sump and the crankcase. To fit the seal squarely into its housing without damaging either component, place a flat block of wood across the seal, then carefully tap the seal into position in the housing (see illustration). Do not allow the seal to tilt as it is being fitted. Lubricate the crankshaft flange and the oil seal inner lip with clean engine oil, then with a new gasket located on the seal housing/crankcase face, fit the housing into position. Take care not damage the seal lips as it is pressed over the crankshaft rear flange



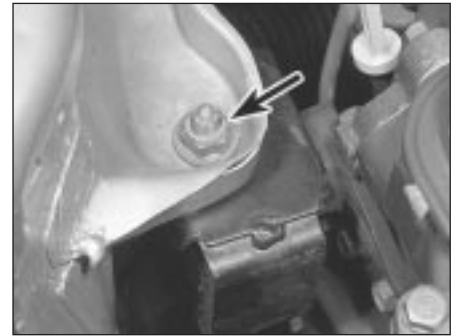
14.11a Positioning the crankshaft rear oil seal in its housing



14.11b Fitting the rear oil seal housing with a new gasket in position on the rear face of the cylinder block



15.8 Unscrew and remove the engine mounting side bolt (arrowed) from under the wheel arch



15.9 Unscrew and remove the mounting retaining nut and washer from the suspension strut cup retaining plate

(see illustration). Centralise the seal on the shaft, then insert and tighten the housing retaining bolts to the specified torque setting. Refit the sump with reference to Section 11.  
**12** Check that the crankshaft rear flange and the flywheel mating faces are clean, then refit the flywheel as described in Section 16.

## 15 Engine/transmission mountings - inspection and renewal



### Inspection

- 1** The engine/transmission mountings seldom require attention, but broken or deteriorated mountings should be renewed immediately, or the added strain placed on the driveline components may cause damage or wear.
- 2** During the check, the engine/transmission must be raised slightly, to remove its weight from the mountings.
- 3** Chock the rear wheels then jack up the front of the car and support it on axle stands (see *"Jacking and Vehicle Support"*). Position a jack under the sump, with a large block of wood between the jack head and the sump, then carefully raise the engine/transmission just enough to take the weight off the mountings.
- 4** Check the mountings to see if the rubber is cracked, hardened or separated from the



15.10 Undo the three bolts securing the mounting assembly to the cylinder block and withdraw the mounting

metal components. Sometimes, the rubber will split right down the centre.

- 5** Check for relative movement between each mounting's brackets and the engine/transmission or body (use a large screwdriver or lever to attempt to move the mountings). If movement is noted, lower the engine and check-tighten the mounting fasteners.

### Renewal

- 6** The engine mountings can be removed if the weight of the engine/transmission is supported by one of the following alternative methods.
- 7** Either support the weight of the assembly from underneath using a jack and a suitable piece of wood between the jack saddle and the sump or transmission (to prevent damage), or from above by attaching a hoist to the engine. A third method is to use a suitable support bar with end pieces which will engage in the water channel each side of the bonnet lid aperture. Using an adjustable

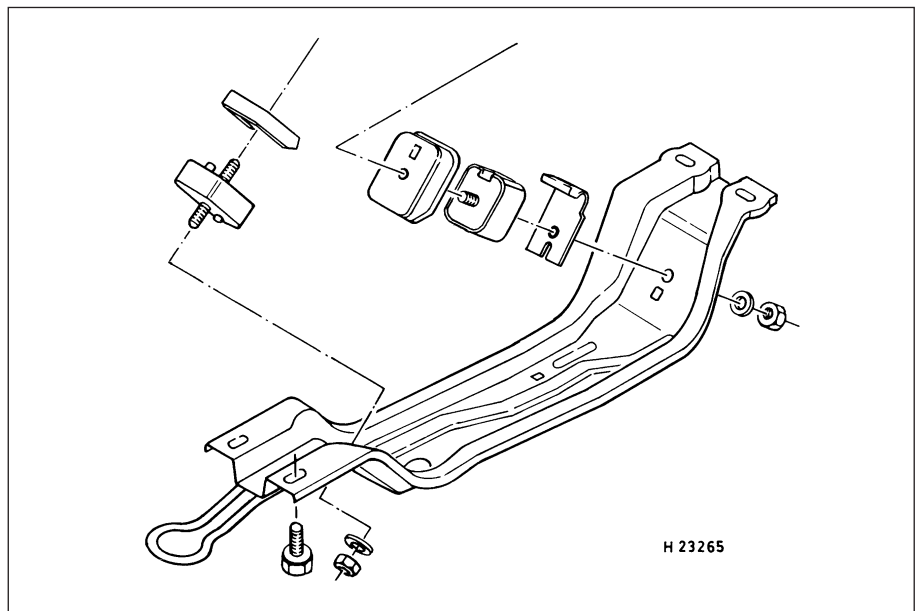
hook and chain connected to the engine, the weight of the engine and transmission can then be taken from the mountings.

### Engine right-hand mounting

- 8** Unscrew and remove the mounting side bolt from under the right-hand wheel arch (see illustration).
- 9** Unscrew and remove the mounting retaining nut and washer from the suspension strut cup retaining plate (see illustration).
- 10** Undo the three bolts securing the mounting unit to the cylinder block. The mounting unit and bracket can then be lowered from the engine (see illustration).
- 11** Unbolt and remove the mounting from its support bracket.

### Transmission bearer and mountings

- 12** Unscrew and remove the two nuts securing the mountings (front and rear) to the transmission bearer (see illustration).
- 13** Support the transmission bearer, then undo and remove the four retaining bolts from the floorpan, two at the front and two at the



15.12 Exploded view of the transmission bearer mountings

rear, and lower the transmission bearer from the vehicle. Note plate fitment, as applicable, for reassembly.

**14** Unscrew the single nut securing each mounting and its retainer to the transmission support bracket, and remove. The transmission support brackets are fixed externally to the transmission casing and do not need to be removed for this operation.

#### All mountings

**15** Refitting of all mountings is a reversal of removal. Make sure that the original sequence of assembly of washers and plates is maintained.

**16** Do not fully tighten any mounting bolts until they are all located. As the mounting bolts and nuts are tightened, check that the mounting rubbers do not twist.

### 16 Flywheel - removal, inspection and refitting



#### Refitting

**1** Remove the transmission as described in Chapter 7A, then remove the clutch as described in Chapter 6.

**2** Unscrew the six retaining bolts, and remove the flywheel from the rear end flange of the crankshaft - take care not to drop the flywheel, as it is heavy. A tool similar to that shown in illustration 16.5 can be fitted to prevent the flywheel/crankshaft from rotating as the bolts are removed. If on removal, the retaining bolts are found to be in poor condition (stretched threads, etc) they must be renewed.

#### Inspection

**3** Inspect the starter ring gear on the flywheel for any broken or excessively-worn teeth. If evident, the ring gear must be renewed; this is a task best entrusted to a Ford dealer or a competent garage. Alternatively, obtain a complete new flywheel.

**4** The clutch friction surface on the flywheel must be carefully inspected for grooving or hairline cracks (caused by overheating). If these conditions are evident, it may be possible to have the flywheel surface-ground to renovate it, providing that the balance is not upset. Regrinding is a task for an automotive engineer. If surface-grinding is not possible, the flywheel must be renewed.

#### Refitting

**5** Check that the mating faces of the flywheel



#### 16.5 Tightening the flywheel retaining bolts to the specified torque

*Note the "peg" tool (arrowed) locking the ring gear teeth to prevent the flywheel/crankshaft from rotating*

and the crankshaft are clean before refitting. Lubricate the threads of the retaining bolts with engine oil before they are screwed into position. Locate the flywheel onto the crankshaft, and insert the bolts. Hand-tighten them initially, then tighten them in a progressive sequence to the specified torque wrench setting (**see illustration**).

**6** Refit the clutch as described in Chapter 6 and the transmission as described in Chapter 7A.

**Notes**