

## REMOVAL & INSTALLATION

**CAUTION:** When battery is disconnected, vehicle computer and memory systems may lose memory data. Driveability problems may exist until computer systems have completed a relearn cycle. See **COMPUTER RELEARN PROCEDURES** article in **GENERAL INFORMATION** before disconnecting battery.

**NOTE:** For reassembly reference, label all electrical connectors, vacuum hoses and fuel lines before removal. Also place mating marks on engine hood before removal.

### FUEL PRESSURE RELEASE

#### Standard Method

To relieve fuel pressure, disconnect negative battery cable. Remove fuel cap to release fuel tank pressure. Remove relief valve cap from fuel rail. Connect fuel pressure gauge to fuel rail and release fuel into a suitable container.

#### Alternate Method

Disconnect wiring from inertia switch and crank engine for 20 seconds.

### COOLING SYSTEM BLEEDING

1. Fill cooling system with 50/50 mixture of coolant and water. Pause several minutes for circulation. Fill radiator to filler neck seat. Install radiator cap fully, then back off to first stop.

**WARNING:** When engine is operating, **DO NOT** remove radiator cap under any condition. Failure to follow instruction could cause personal injury, or damage to cooling system or engine. Always wrap towel around radiator cap to avoid injury from hot coolant.

2. Place heater controls to maximum heat. Start engine and operate at 2000 RPM for approximately 3-4 minutes. Turn engine off. Using protective rag, carefully remove radiator cap. Add coolant to filler neck seat. Install radiator cap fully, then back off to first stop.
3. Start engine and allow to operate at 2000 RPM until upper radiator hose is warm. Check heater output. Turn engine off. Using protective rag, carefully remove radiator cap. Add coolant to filler neck seat if necessary.
4. Tightly install radiator cap. Remove small cap on coolant recovery reservoir (large cap is for windshield washer reservoir). Add 50/50 mixture of coolant and water to between fill level marks of reservoir. Install reservoir cap.

### ENGINE

#### Removal

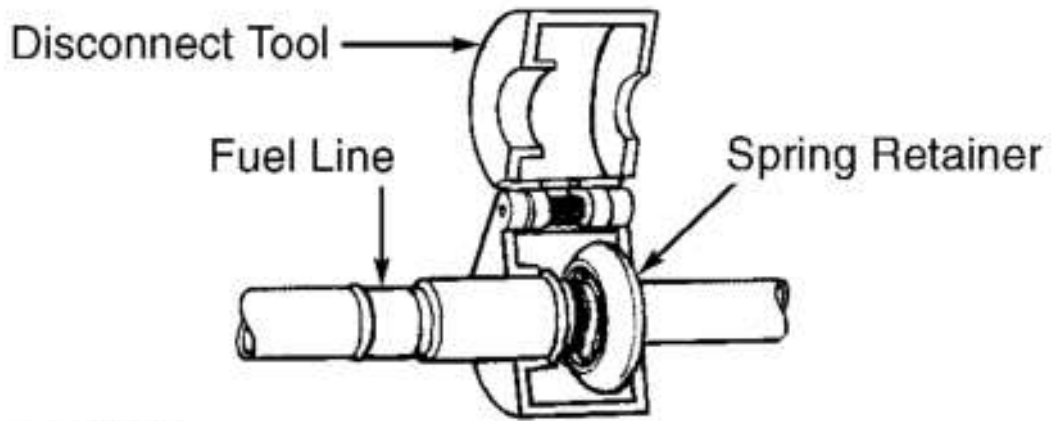
1. Relieve fuel pressure. See **FUEL PRESSURE RELEASE** . Using Disconnect Tool (T81P 19623-G1) for 3/8" line or (T81P 19623-G2) for 1/2" line, disconnect fuel feed line. See **Fig. 1** . Disconnect

negative battery cable. Drain cooling system.

2. Disconnect air cleaner outlet tube at throttle body. Mark location of hood hinges, and remove hood. Remove accelerator control splash shield. Disconnect fan shroud, and position over fan blades. Remove fan and clutch assembly retaining screws. Remove fan and clutch assembly. Remove fan shroud.
3. Remove accessory drive belt(s). Remove water pump pulley. Remove upper radiator supports. Disconnect radiator overflow tube. Disconnect radiator hoses at engine. On vehicles equipped with A/T, disconnect transmission cooler lines. On all models, remove radiator with hoses attached.
4. Disconnect fuel charging wiring and MAF sensor. Disconnect generator power lead. Disconnect heater hoses from engine, and position aside. Disconnect accelerator cable from throttle body lever. Disconnect speed control cable (if equipped).
5. Disconnect water hose leading into water pump. Remove water pump inlet tube and bolts. Remove generator and bolts. Remove mounting generator bracket and bolts.
6. Disconnect PCM connector. Remove ground wire at stud by PCM. Disconnect brake booster vacuum hose and EVR tube at upper intake manifold. Disconnect EVR vacuum supply hose. Disconnect main firewall electrical connector. Remove differential pressure feedback EGR sensor.
7. On vehicles equipped with A/C, disconnect A/C cycling switch and discharge A/C system using approved refrigerant recovery/recycling equipment. Disconnect A/C hoses at accumulator and condenser using appropriate quick-disconnect tool, and plug openings.
8. On all models, disconnect power steering pump hoses and power steering cut-out switch. Disconnect any remaining electrical or vacuum connections from engine. Raise and support vehicle. Disconnect starter wiring connectors. Remove starter.
9. On A/T equipped vehicles, disconnect 2 transmission wiring connectors. Remove nut retaining starter harness and bracket for transmission cooler lines. Access and remove 4 torque converter nuts through starter hole. Disconnect heated oxygen sensor connector and remove connector from bellhousing.
10. On M/T equipped vehicles, disconnect transmission wiring connector and heated oxygen sensor connector. Remove nut from bracket retaining starter harness.
11. On all models, disconnect catalytic converter from exhaust manifold. Remove 2 engine-to-transmission bolts at left rear and right rear engine support bracket. Remove 4 lower engine-to-transmission bolts and spacers (if equipped). Lower vehicle. Support transmission with appropriate jack.
12. Attach engine hoist to lifting eyes and support engine. Remove 2 top engine-to-transmission bolts. Remove 2 bottom engine-to-transmission bolts and spacers (if equipped). Remove engine mount nuts. With help from an assistant, lift engine from vehicle.

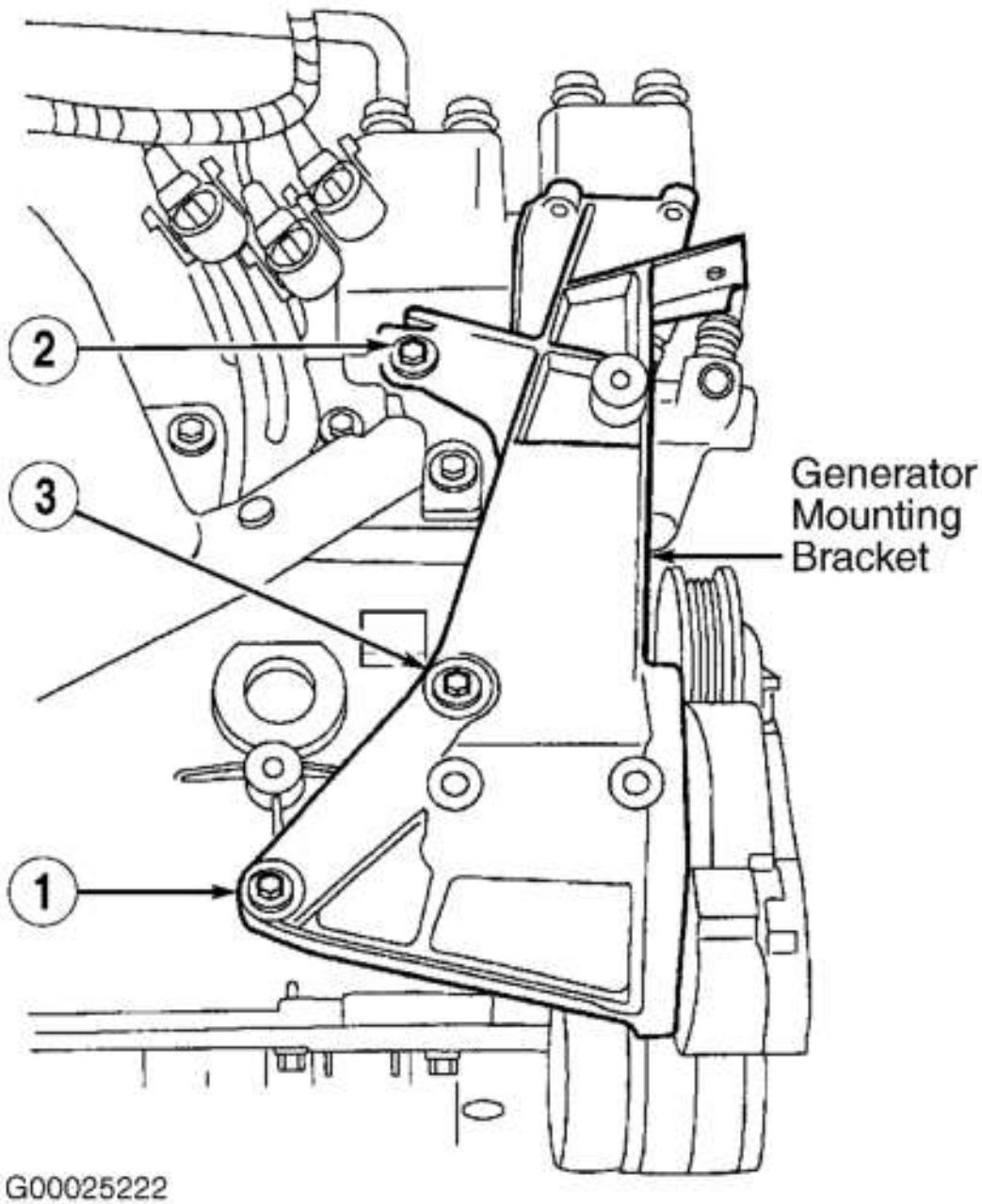
## Installation

Install generator bracket in 4 stages, first hand start bolt No. 1. Install and tighten bolts No. 2 and 3 to specification. Tighten bolt No. 1 to specification. See **Fig. 2** . To complete installation, reverse removal procedure. Tighten bolts to specification. See **TORQUE SPECIFICATIONS** . Fill or top off all engine fluids. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** . Recharge A/C system.



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**Fig. 1: Disconnecting Fuel Feed Line**  
Courtesy of FORD MOTOR CO.



**Fig. 2: Generator Mounting Bracket Tightening Sequence**  
Courtesy of FORD MOTOR CO.

## INTAKE MANIFOLD

### Removal (Upper)

1. Disconnect negative battery cable. Disconnect air intake temperature sensor. Remove air cleaner and duct assembly. Drain coolant. Relieve fuel pressure. See **FUEL PRESSURE RELEASE** .
2. Mark and disconnect electrical wiring, vacuum lines and vacuum fittings from upper and lower intake

manifolds. Remove engine oil dipstick bracket retaining bolt. Remove throttle linkage shield. Disconnect accelerator cable. Remove accelerator cable bracket, and position bracket and cable aside.

3. Disconnect crankcase vent hose from valve cover. Disconnect heater hoses. Loosen EGR tube at exhaust manifold. Disconnect EGR tube from EGR valve. Remove EGR valve. Remove 7 bolts and upper intake manifold from lower intake manifold.

### **Installation**

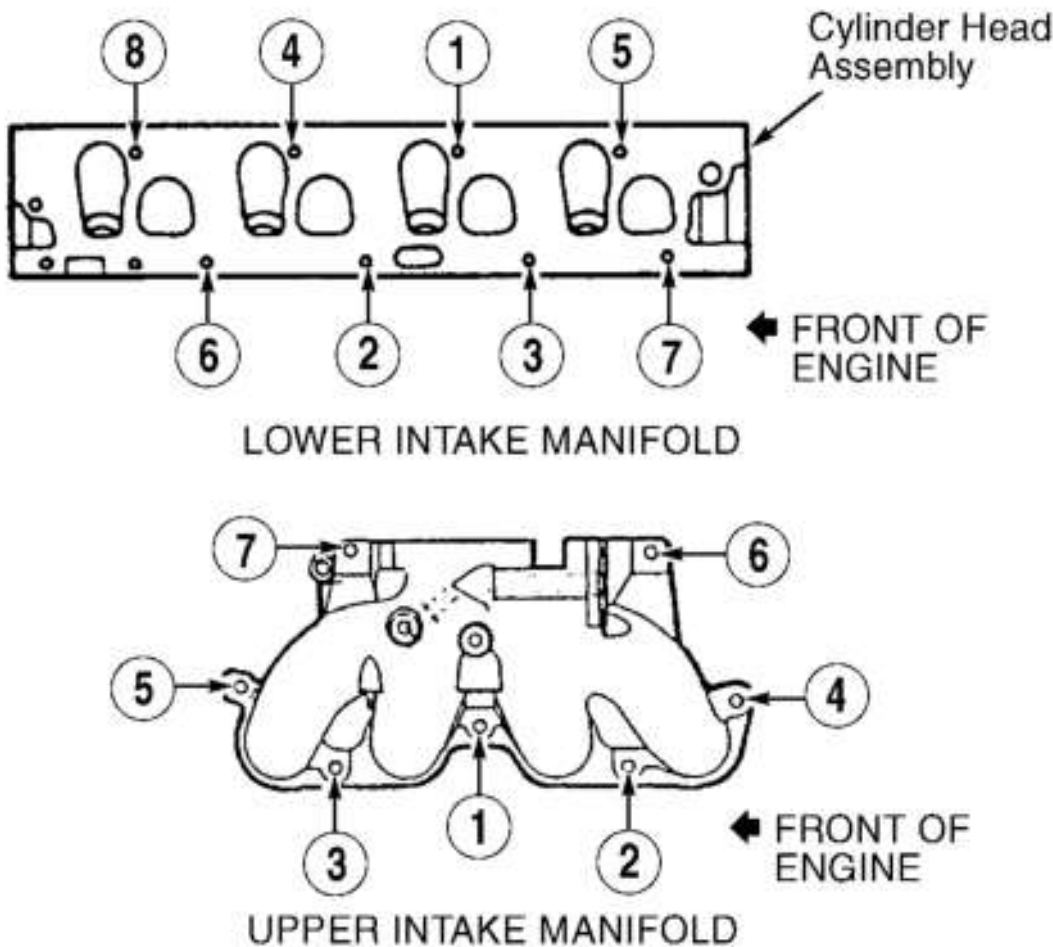
1. Clean gasket mating surfaces. Clean and oil bolt threads. Install NEW gasket. Position upper intake manifold and install bolts finger tight.
2. Tighten bolts, in sequence, to specification in 2 steps. See **Fig. 3** . See **TORQUE SPECIFICATIONS** . To complete installation, reverse removal procedure. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** .

### **Removal (Lower)**

1. Remove upper intake manifold. See **REMOVAL (UPPER)** . Remove drive belt(s). Remove engine oil dipstick tube.
2. On models with A/C, remove A/C compressor bolts, and wire compressor aside. Remove A/C compressor bracket bolts and bracket.
3. On all models, disconnect dash panel ground cable from intake manifold stud. Disconnect injector connectors and all other wiring from lower intake manifold.
4. Disconnect spring lock coupling for fuel feed line using Disconnect Tool (D87L 9280-A) for 3/8" line or (D87L 9280-B) for 1/2" line. See **Fig. 1** . Remove engine lifting eye. Remove 4 bottom lower intake manifold bolts. Remove 4 top lower intake manifold bolts. Remove intake manifold and gasket.

### **Installation**

1. Clean gasket mating surfaces. Clean and oil bolt threads. Install NEW gasket. Position lower intake manifold to cylinder head, and install bolts finger tight.
2. Tighten bolts, in sequence, to specification in 2 steps. See **Fig. 3** . See **TORQUE SPECIFICATIONS** . To complete installation, reverse removal procedure. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** .



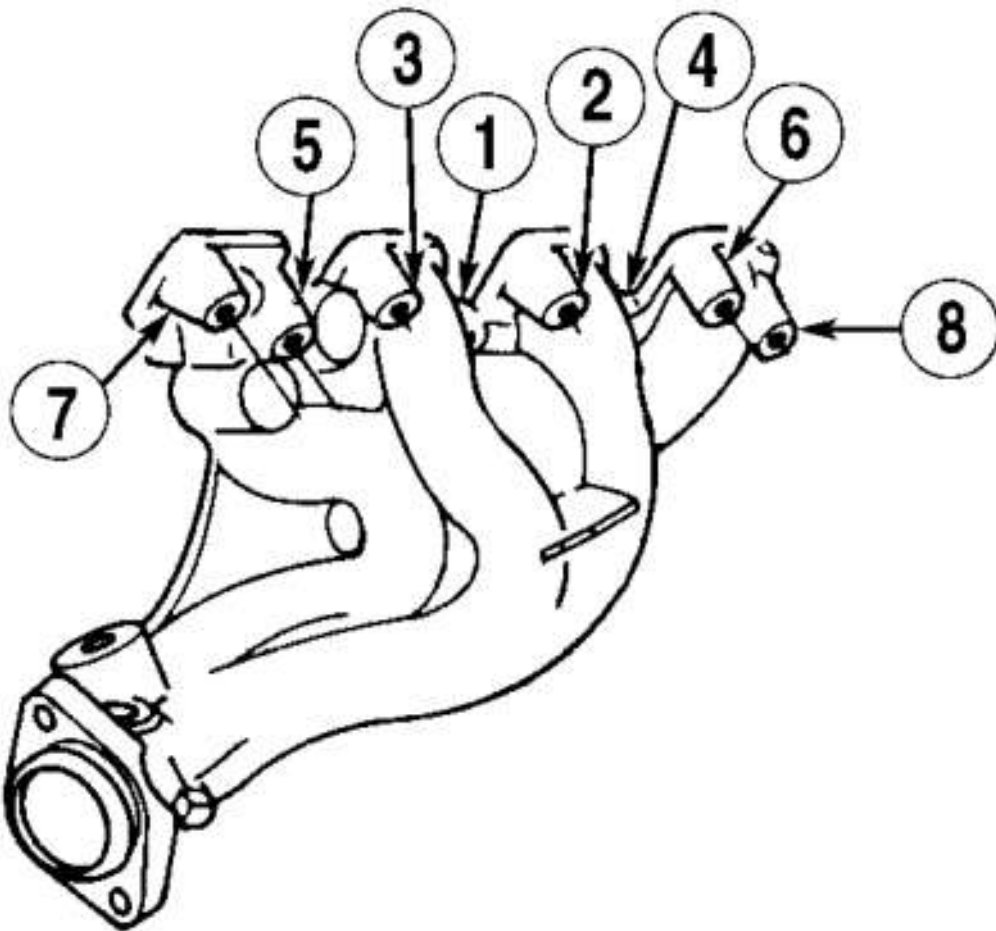
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**Fig. 3: Intake Manifold Bolt Tightening Sequence**  
 Courtesy of FORD MOTOR CO.

## EXHAUST MANIFOLD

### Removal & Installation

1. Disconnect negative battery cable. Disconnect air intake temperature sensor. Remove air cleaner and duct assembly. Disconnect EGR transducer hoses from EGR transducer. Loosen EGR tube at EGR valve. Remove EGR tube from exhaust manifold. Disconnect catalytic converter from exhaust manifold. Remove rear engine lifting eye from exhaust manifold studs.
2. Remove 2 studs and 6 bolts attaching exhaust manifold to engine. Remove exhaust manifold and gasket. To install, position exhaust manifold on cylinder head using NEW gasket. Tighten bolts, in sequence, to specification in 2 steps. See [Fig. 4](#) . See [TORQUE SPECIFICATIONS](#) . To complete installation, reverse removal procedure.



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**Fig. 4: Exhaust Manifold Tightening Sequence**  
 Courtesy of FORD MOTOR CO.

## VALVE COVER

### Removal

1. Disconnect negative battery cable. Disconnect air intake temperature sensor. Remove air cleaner outlet tube. Remove accelerator control splash shield. Remove accelerator cable. Disconnect crankcase vent from valve cover. Disconnect wiring from IAC valve and TP sensor.
2. Disconnect intake side spark plug wires from front coil, and position aside. Disconnect exhaust side spark plug wire retainer from valve cover studs. Remove 4 throttle body bolts and throttle body. Disconnect remaining electrical connectors and vacuum lines. Remove valve cover bolts and valve cover.

### Installation

Install valve cover onto engine using NEW valve cover gasket. To complete installation, reverse removal procedure. Tighten bolts to specifications. See **TORQUE SPECIFICATIONS** .

## CYLINDER HEAD

### Removal

1. Disconnect negative battery cable. Relieve fuel pressure. See **FUEL PRESSURE RELEASE** . Drain cooling system. Disconnect air intake sensor and mass airflow sensor. Remove air cleaner assembly and air outlet tube. Remove upper and lower intake manifold. See **INTAKE MANIFOLD** .
2. Disconnect TWC from exhaust manifold. Remove EGR tube. Label and remove spark plug wires. Remove spark plugs and oil dipstick tube. Label and disconnect vacuum hoses. Remove valve cover. See **VALVE COVER** . Loosen water pump pulley bolts. Remove drive belt(s). Remove fan and clutch assembly. Remove water pump pulley.
3. On models with A/C, discharge A/C system using approved refrigerant recovery/recycling equipment. Disconnect A/C wiring connector. Disconnect A/C hoses and plug openings. Remove A/C compressor. Remove A/C compressor bracket with power steering pump attached, and position aside.
4. On all models, disconnect generator wiring connectors. Disconnect upper and lower radiator hoses from engine. Disconnect 2 heater hoses from water pump inlet tube. Remove water pump inlet tube. Remove generator bolts and generator. Remove generator bracket retaining bolts and bracket.
5. Disconnect electrical connectors from ignition coils. Remove ignition coil bracket with ignition coils attached. Remove outer timing belt cover and timing belt. See **TIMING BELT** . Remove rear engine lifting eye. Remove 2 studs and 6 bolts attaching exhaust manifold. Remove exhaust manifold. Remove cylinder head retaining bolts. Lift cylinder head off engine.

### Inspection

Inspect cylinder head for warpage. Resurface if warpage exceeds specification. See **CYLINDER HEAD SPECIFICATIONS** table under ENGINE SPECIFICATIONS. If warpage exceeds specification, DO NOT machine more than .010" (.25 mm) from original cylinder head thickness. Clean and tap cylinder head bolt holes in cylinder block.

**CAUTION: Before installing cylinder head, ensure crankshaft is at TDC. Position camshaft so valves for No. 1 cylinder are closed. Failure to properly position camshaft and crankshaft may result in valves contacting pistons during installation.**

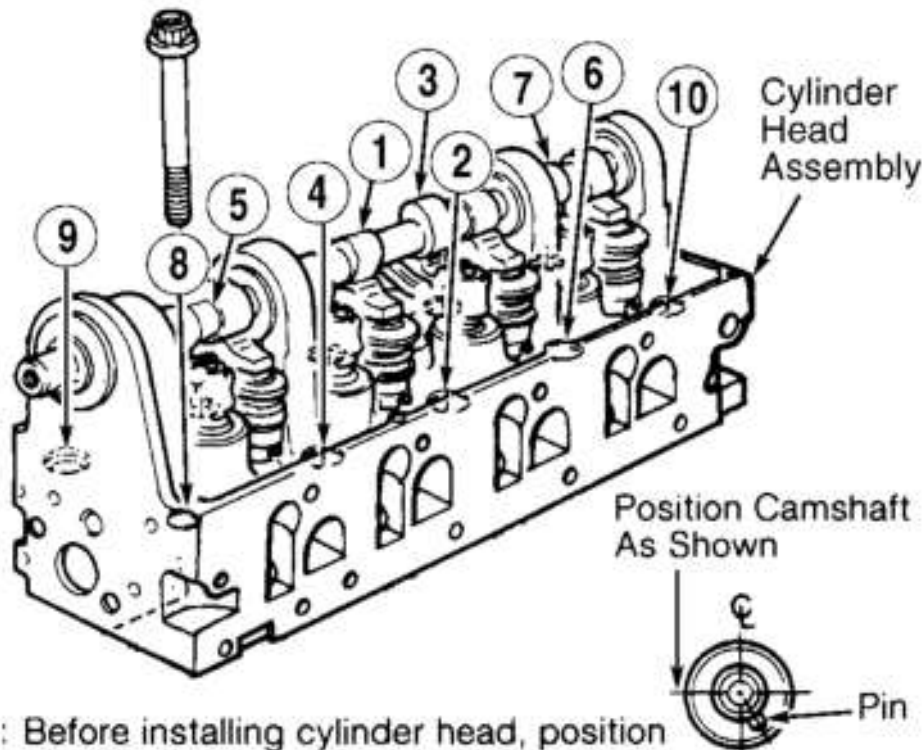
### Installation

Clean all gasket mating surfaces and replace all gaskets. Install cylinder head using NEW gasket. Install NEW head bolts. Tighten bolts in sequence to specification in 3 steps. See **Fig. 5** . See **TORQUE SPECIFICATIONS** . To complete installation, reverse removal procedure. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** . Recharge A/C system.

**CAUTION: If valves/seats were serviced, ensure valve clearance is within specification. See VALVE CLEARANCE CHECK under ADJUSTMENTS.**



FRONT OF ENGINE



Caution: Before installing cylinder head, position camshaft as shown to protect protruding valves.

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**Fig. 5: Cylinder Head Bolt Tightening Sequence**  
Courtesy of FORD MOTOR CO.

## CAMSHAFT, FRONT CRANKSHAFT & OIL PUMP SHAFT OIL SEALS

### Removal

1. Ensure crankshaft is set at TDC and camshaft sprocket timing mark is aligned with inner cover pointer. See **Fig. 6** . Remove timing belt. See **TIMING BELT** .
2. If replacing front crankshaft seal, remove crankshaft sprocket. If replacing camshaft and/or oil pump shaft seal(s), use Camshaft/Oil Pump Shaft Sprocket Holder (T74P 6256-B) to remove camshaft and/or oil pump shaft sprocket. Using Seal Remover (T74P 6700-B), remove crankshaft, camshaft and/or oil pump shaft oil seals.

### Installation

Install seal(s) using Seal Installer (T74P 6850-A). To complete installation, reverse removal procedure. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** .

## CHECKING VALVE TIMING

**CAUTION:** Always rotate engine in direction of normal rotation (clockwise as

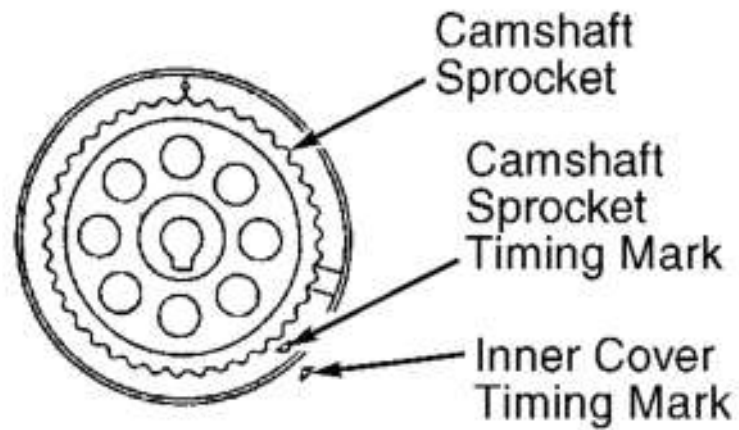
**viewed from front of engine). Reverse rotation may cause timing belt to jump, possibly causing engine damage.**

1. Remove 2 access plugs from engine timing belt cover. Rotate crankshaft clockwise and position No. 1 cylinder on TDC of compression stroke. Align crankshaft damper TDC mark with TC mark on timing belt cover.
2. Looking through plug hole of outer timing belt cover, ensure camshaft sprocket timing mark is aligned with inner timing cover pointer. See **Fig. 6** . Ensure diamond timing mark on oil pump sprocket is aligned with timing mark on inner timing belt cover. If all timing marks are not aligned, timing belt must be removed, sprockets properly positioned and timing belt reinstalled or replaced.

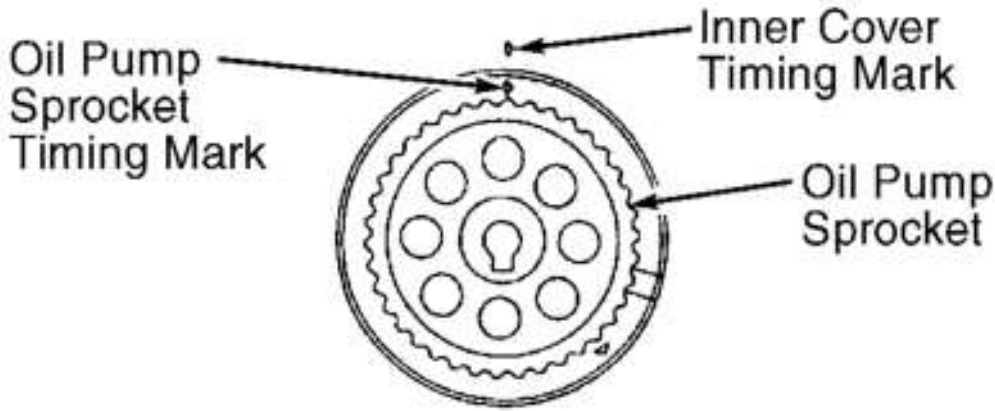
## **TIMING BELT**

### **Removal**

1. Remove spark plugs. Ensure crankshaft is set at TDC and camshaft sprocket timing mark and oil pump sprocket timing mark are aligned with inner cover timing marks. See **Fig. 6** . Disconnect fan shroud and position over fan blades. Remove fan and clutch assembly retaining screws. Remove fan and clutch assembly. Remove fan shroud. Remove accessory drive belt(s). Remove water pump pulley.
2. On models with A/C, discharge A/C system using approved refrigerant recovery/recycling equipment. Remove A/C compressor hoses and plug openings. Remove A/C compressor. Remove A/C compressor mounting bracket with power steering pump attached, and position aside.
3. On all models, remove outer timing belt cover retaining bolt. Release 7 outer cover interlocking tabs. Remove outer timing belt cover. Holding timing belt tensioner with Camshaft Belt Tension Adjuster (T74P 6254-A), loosen adjusting bolt and slowly release tension. See **Fig. 7** . Pry tensioner away from timing belt, and tighten bolt to hold tensioner in place. Remove timing belt.



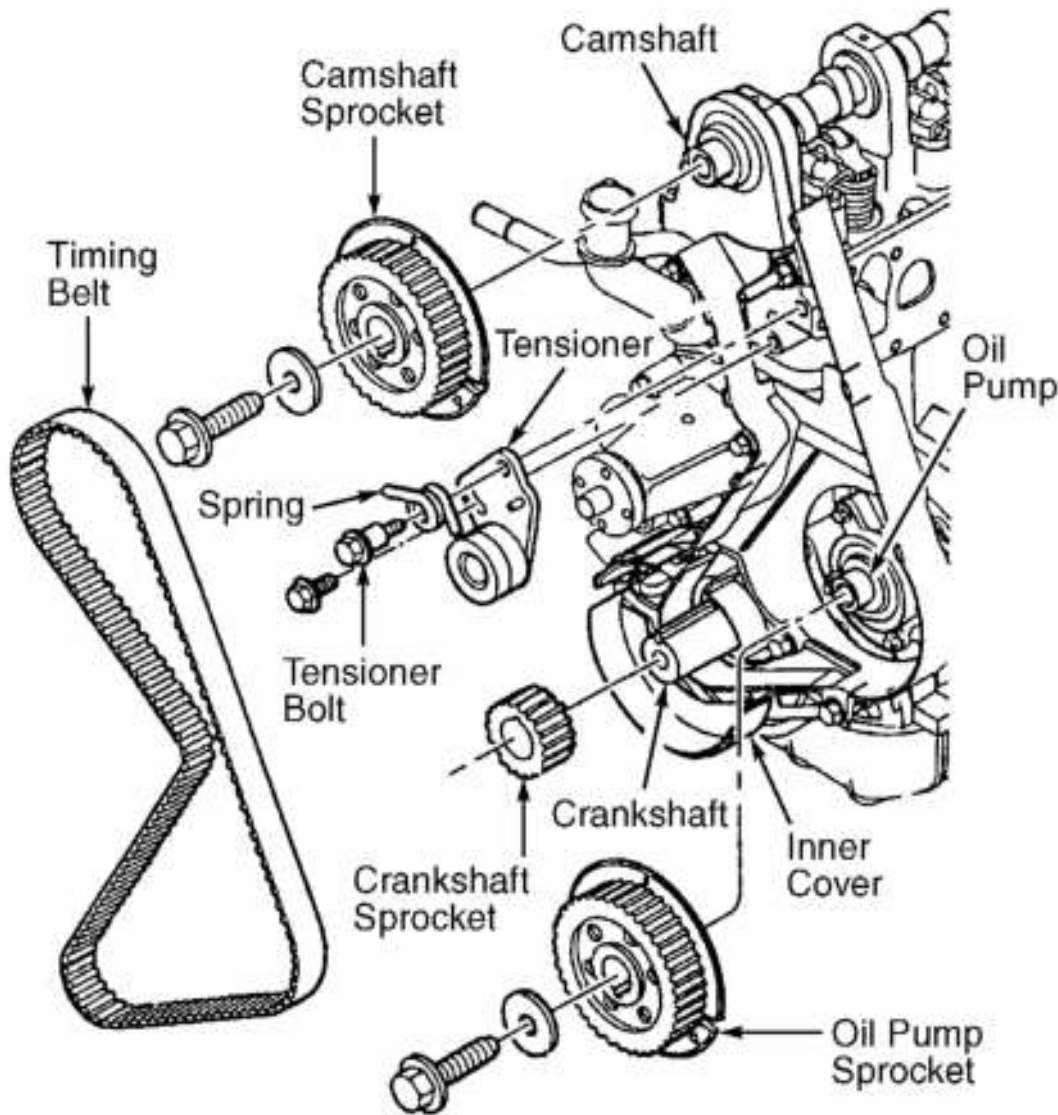
CAMSHAFT SPROCKET



OIL PUMP SPROCKET

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**Fig. 6: Aligning Camshaft & Oil Pump Timing Marks**  
 Courtesy of FORD MOTOR CO.



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**Fig. 7: Exploded View Of Timing Belt & Components**

Courtesy of FORD MOTOR CO.

**NOTE:** If crankshaft position sensor was removed, see procedures in CRANKSHAFT POSITION SENSOR for installation procedure.

**CAUTION:** Always rotate engine in direction of normal rotation (clockwise as viewed from front of engine). Reverse rotation may cause timing belt to jump, possibly causing engine damage.

#### Installation

1. Ensure crankshaft is set at TDC and camshaft sprocket timing mark and oil pump sprocket timing mark are aligned with inner cover timing marks. Install crankshaft sprocket (if removed) with recessed

area toward crankshaft.

2. Install timing belt. Loosen tensioner bolt. Allow tensioner to adjust itself against timing belt. DO NOT tighten belt tensioner. Slowly rotate crankshaft clockwise 2 complete turns so No. 1 cylinder is at TDC of compression stroke.
3. Recheck timing alignment marks. Tighten tensioner bolts. See **TORQUE SPECIFICATIONS** . To complete installation, reverse removal procedure. Recharge A/C system. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** .

## **CRANKSHAFT POSITION SENSOR**

### **Removal**

1. Disconnect negative battery cable. Drain cooling system and remove lower radiator hose. Rotate drive belt tensioner and remove drive belt. Disconnect generator wiring connector, and remove generator.
2. Remove heater hose from water pump inlet tube. Remove water pump inlet tube. Disconnect crankshaft position sensor connector, and remove crankshaft position sensor retaining screw. Carefully pry crankshaft position sensor from engine front cover.

### **Installation**

Position crankshaft position sensor in engine cover, and tighten retaining screw to specification. Reconnect crankshaft position sensor connector. To complete installation, reverse removal procedure. Install NEW "O" ring on water pump inlet tube. Tighten remaining bolts to specification. See **TORQUE SPECIFICATIONS** .

## **CAMSHAFT POSITION SENSOR**

### **Removal**

Disconnect negative battery cable. Raise and support vehicle. Disconnect camshaft position sensor connector. Remove camshaft position sensor bolts and camshaft position sensor.

### **Installation**

To install, reverse removal procedure. Tighten bolts to specification. See **TORQUE SPECIFICATIONS** .

## **VALVE LASH ADJUSTER**

### **Removal**

Remove valve cover. See **VALVE COVER** . Rotate camshaft so base circle of cam is facing lash adjuster to be removed. Using Valve Spring Compressor (T95T 6565-A), collapse valve spring, and slide out cam follower over lash adjuster. Remove lash adjuster.

### **Inspection**

Replace lash adjusters as complete assemblies only. Test adjusters with Leak-Down Tester (6500-E). Lash adjusters cannot be checked with engine oil in them. Use hydraulic tester fluid. Fluid can be obtained from tester manufacturer. Time required for plunger to leak down 1/8" (3.2 mm) with 50-lb. load is 2-8 seconds.

### **Installation**

Lubricate points of cam follower with Multipurpose Grease (D0AZ 19584-AA) or equivalent. To install, reverse removal procedure. Tighten bolts to specification. See **TORQUE SPECIFICATIONS** .

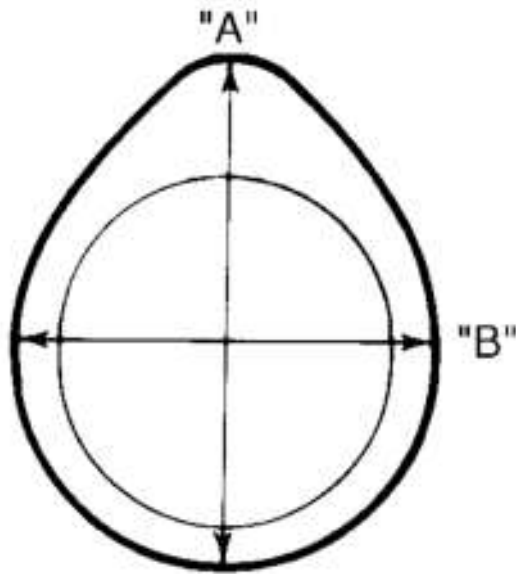
## **CAMSHAFT**

### **Removal**

1. Remove timing belt. See **TIMING BELT** . Remove air cleaner assembly. Remove accelerator cable splash shield. Label and disconnect spark plug wires and vacuum hoses. Remove valve cover. See **VALVE COVER** .
2. Rotate camshaft until heel of camshaft is resting on rocker arm. Using Valve Spring Compressor (T95T 6565-A), compress valve springs, and remove all camshaft followers. Using Camshaft Sprocket Holding/Removing Tool (T74P 6256-B), remove camshaft sprocket. Using Front Cover Seal Remover (T74P 6700-B), remove camshaft seal.
3. Remove camshaft retainer plate bolts and retainer plate. Remove engine support insulator nuts. Place a block of wood between engine block and jack. Raise engine as high as it will go. Place block of wood between engine mount and chassis brackets. Carefully remove camshaft to avoid damaging journals and lobes.

### **Inspection**

1. Clean all components and gasket mating surfaces. Check lobe lift and camshaft-to-bearing clearance. To check camshaft lobe lift, measure distances "A" and "B" of each camshaft lobe. See **Fig. 8** .
2. Distance "A" minus distance "B" equals camshaft lobe lift. Check lift of each lobe and note all readings. If readings are not within specification, replace camshaft and all rocker arms. See **CAMSHAFT SPECIFICATIONS** table under ENGINE SPECIFICATIONS.



Camshaft Lobe Lift = Dimension "A" - Dimension "B"

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### **Fig. 8: Measuring Camshaft Lobe Lift**

Courtesy of FORD MOTOR CO.

#### **Installation**

Coat entire camshaft with clean engine oil. Carefully slide camshaft into cylinder head. Lower engine and tighten engine support insulator nuts. To complete installation, reverse removal procedure. Install NEW camshaft oil seal using Front Seal Installer (T74P 6150-A). Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING**.

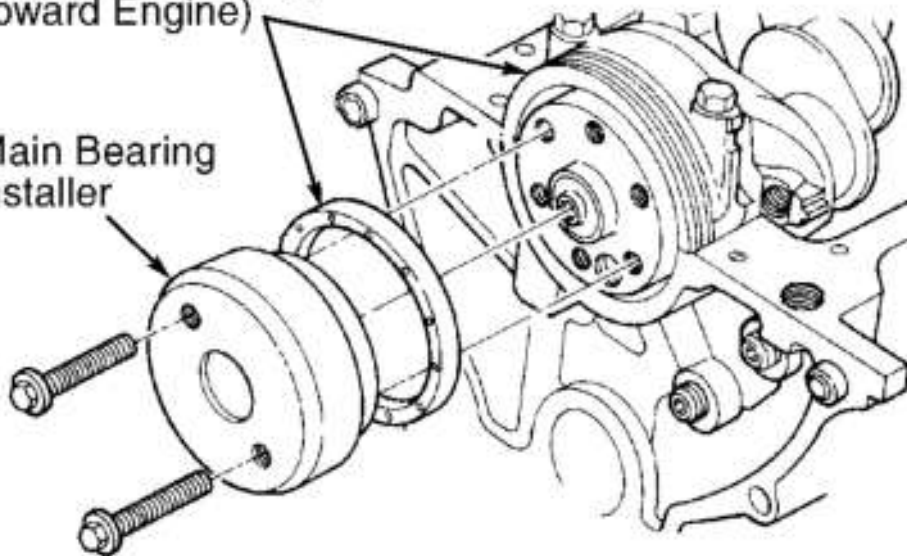
#### **CRANKSHAFT REAR OIL SEAL**

##### **Removal & Installation**

Remove transmission. For A/T, see TRANSMISSION REMOVAL & INSTALLATION article in TRANSMISSION SERVICING. For M/T, see appropriate article in CLUTCHES. Remove flywheel/flexplate. Clean rear oil seal and surrounding area of cylinder block prior to seal removal. Screw in Jet Plug Remover (T77L 9533-B) and remove seal. DO NOT damage crankshaft sealing surface. Coat NEW seal surfaces with engine oil. Using Rear Main Bearing Seal Installer (T82L 6701-A), install seal. See **Fig. 9**. Tighten bolts evenly to pull seal straight in until firmly seated. To complete installation, reverse removal procedure.

Rear Main Bearing Oil Seal (Install With Spring Side Toward Engine)

Rear Main Bearing Seal Installer



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**Fig. 9: Installing Crankshaft Rear Oil Seal**  
Courtesy of FORD MOTOR CO.

## **WATER PUMP**

### **Removal**

Drain cooling system. Loosen water pump pulley bolts. Disconnect fan shroud and position over fan blades. Remove fan and clutch assembly. Remove fan shroud. Rotate drive belt tensioner and remove drive belt(s). Remove water pump inlet tube bolts and water pump inlet tube. Remove water pump retaining bolts, and remove water pump from engine.

### **Installation**

Ensure gasket surfaces are clean. Apply Teflon sealant to water pump bolts before installation. Tighten water pump retaining bolts in a crisscross sequence to specification. See **TORQUE SPECIFICATIONS** . To complete installation, reverse removal procedure. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** .

## **OIL PAN**

### **Removal & Installation**

1. Remove engine assembly. See **ENGINE** . Mount engine on engine stand. Remove oil pan retaining bolts and remove pan. To install, use a NEW oil pan gasket. Apply sealant at specified areas. See **Fig. 10** . Install oil pan so transmission mounting face of oil pan is even with engine block rear face.



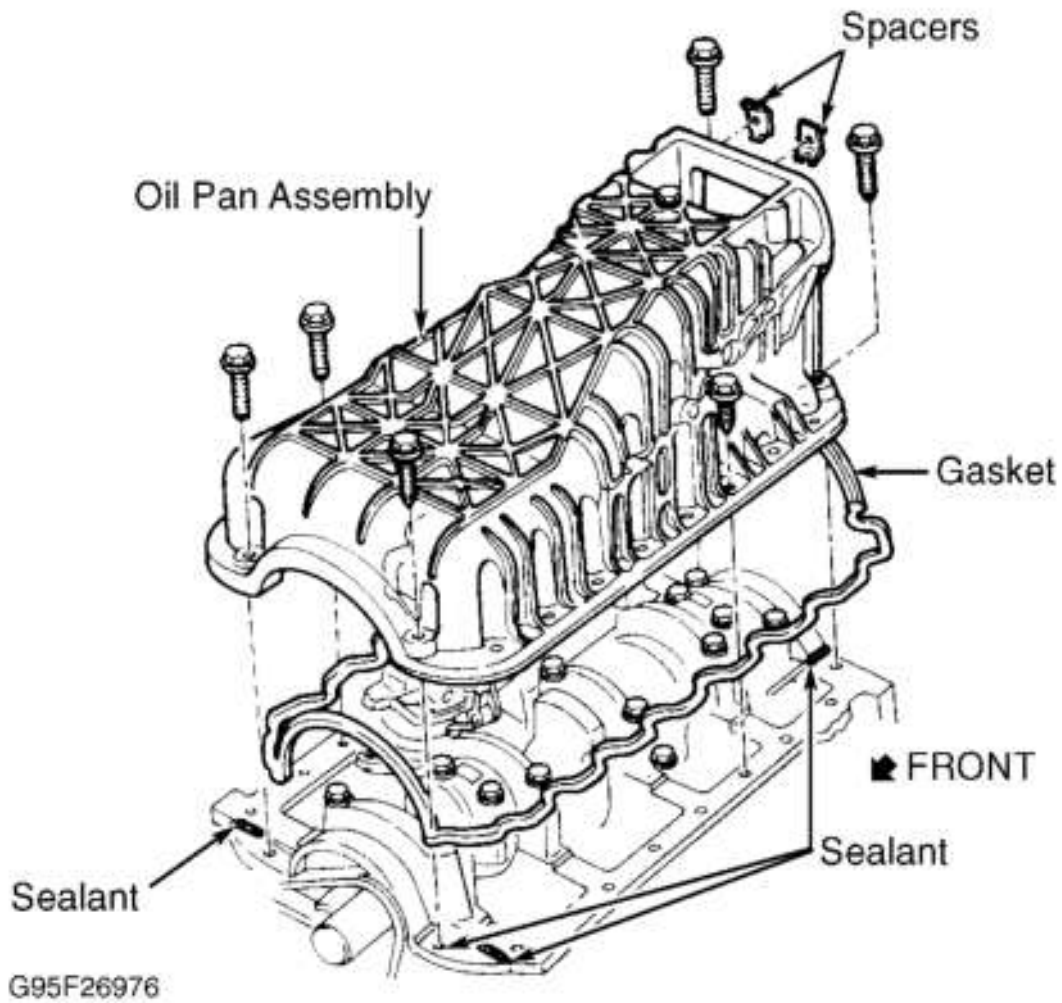
**NOTE:** On transmission bolts to engine and oil pan, ensure rear face of oil pan and rear face of engine block are on same plane, or shims will be required between oil pan and transmission.

2. Tighten oil pan retaining bolts. Place a straightedge across engine block and oil pan-to-transmission bolt mounting pads. Use a feeler gauge to measure gap between mounting pad and straightedge. Repeat procedure on opposite mounting pad.
3. If necessary, select spacers and install to mounting pads on oil pan before bolting engine and transmission together. See **SPACER SELECTION** table. Install and tighten oil pan bolt in sequence to specification. See **Fig. 11** . To complete installation, reverse removal procedure. Tighten bolts to specification. See **TORQUE SPECIFICATIONS** .

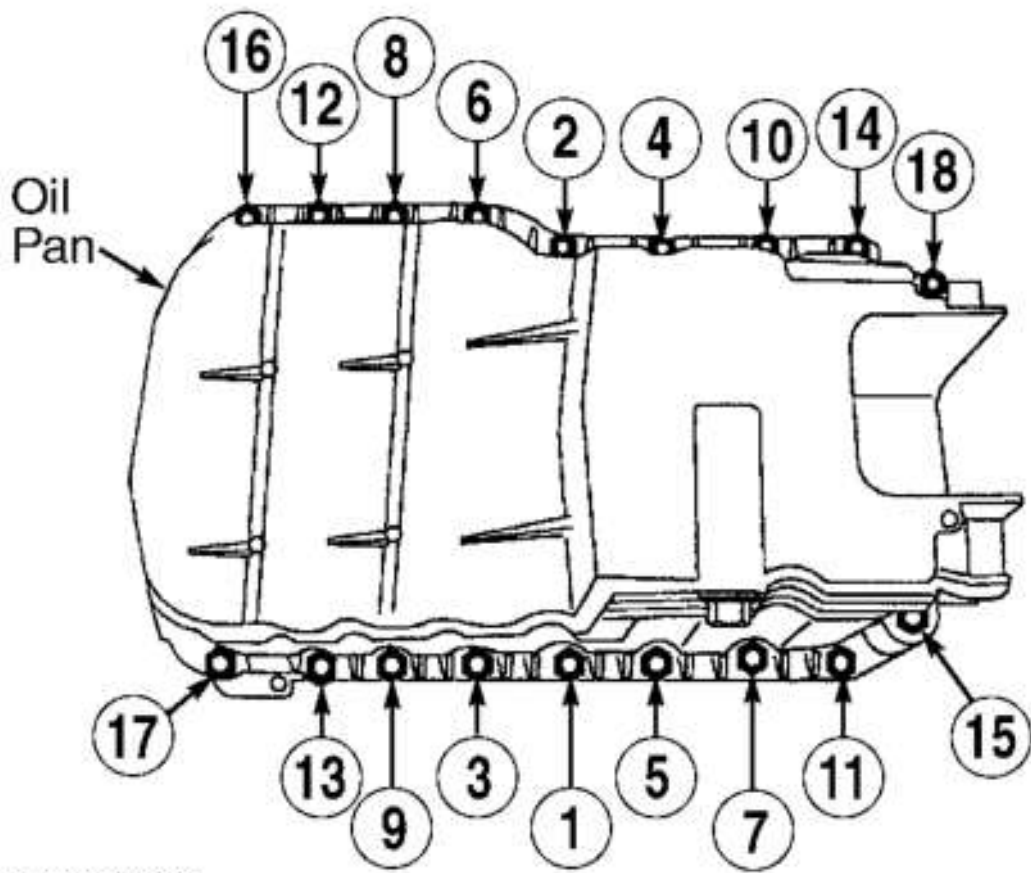
#### **SPACER SELECTION**

<b>Gap - In. (mm)</b>	<b>Spacer Color</b>	<b>Spacer - In. (mm)</b>
.0-.010 (0-.25)	None Needed	None Needed
.011-.020 (.27-.51)	Yellow	.010 (.25)
.021-.030 (.52-.76)	Blue	.020 (.51)
.031-.040 (.78-1.0)	Pink	.030 (.76)

**CAUTION:** Failure to measure gap and install spacer can result in insufficient or excessive space between oil pan and transmission. This can cause oil pan damage or oil leaks.



**Fig. 10: Exploded View Of Oil Pan Assembly**  
Courtesy of FORD MOTOR CO.



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**Fig. 11: Oil Pan Tightening Sequence**  
 Courtesy of FORD MOTOR CO.