

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: Discharge A/C system using approved refrigerant recovery/recycling equipment.

FUEL PRESSURE RELEASE

To release 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

Remove fuel cap to relieve tank pressure. 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, NEVER remove radiator cap under any conditions. Failure to follow instruction could damage cooling system or engine, and cause personal injury. Always wrap protective material around radiator cap to avoid injury from hot coolant.

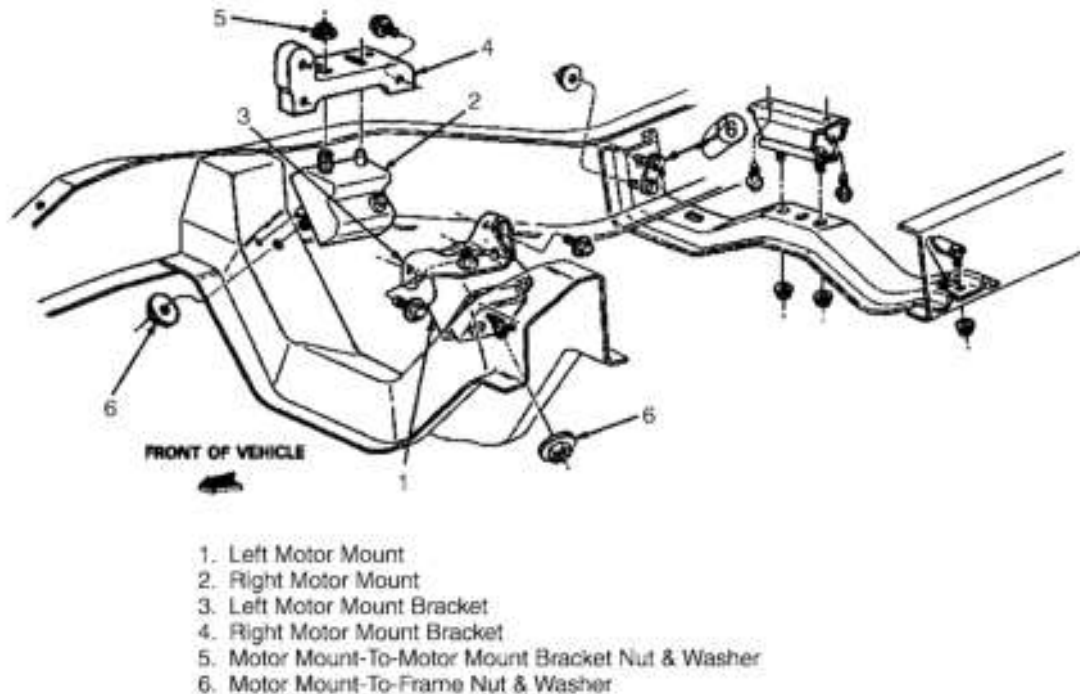
2. Place heater controls to maximum heat. Start engine and operate at 2000 RPM for approximately 3-4 minutes. Turn engine off. Use a protective rag, and carefully remove radiator cap. Add coolant to filler neck seat.
3. Install radiator cap fully, then back off to first stop. Start engine and allow to operate at 2000 RPM until upper radiator hose is warm. Check heater output. Turn engine off. Use protective rag, and carefully remove radiator cap. Add coolant to filler neck seat if necessary.
4. Tightly install radiator cap. Remove small cap (large cap is for windshield washer reservoir) on coolant recovery reservoir. Add 1.1 qt. (1L) of 50/50 mixture of coolant and water to reservoir. Install reservoir cap.

MOTOR MOUNTS

NOTE: For some applications , it may be necessary to remove the motor mount brackets to gain access to the lower stud nuts of the motor mount.

Removal & installation

1. Remove the rubber overflow tube from the radiator coolant recovery reservoir and detach it from the fan (if necessary). Remove the fan shroud attaching screws and lift the fan shroud back and drape it onto the fan blade.
2. Support the engine using a wood block and a jack placed under the oil pan. Remove the nut and washer assemblies attaching motor mounts to motor mount brackets.
3. Lift the engine sufficiently to disengage motor mounts from motor mount brackets. Remove bolt attaching fuel pump shield to left motor mount bracket, if required. Remove motor mount nuts securing motor mount to frame. Remove motor mounts. To install, reverse removal procedure. Tighten bolts and nuts to specification. See **TORQUE SPECIFICATIONS**.



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Fig. 1: Identifying Motor Mount Components
Courtesy of FORD MOTOR CO.

ENGINE

Removal

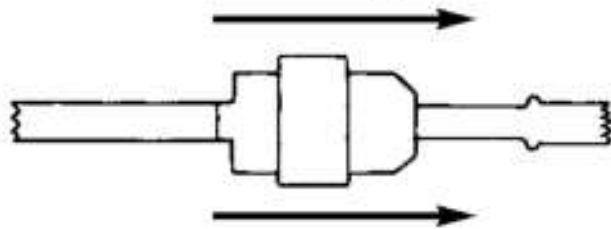
1. Disconnect negative battery cable. Remove air cleaner tube and assembly. Drain engine oil. Disconnect and remove power steering and transmission coolers.
2. Drain cooling system. Remove upper and lower radiator hoses. Disconnect radiator fan shroud and position over fan. Remove radiator. Remove accessory drive belt(s). Remove center hood latch support.
3. Remove A/C compressor (if equipped). Remove hood. Remove alternator. Disconnect exhaust system from exhaust manifolds. Disconnect and remove starter.
4. On A/T models, remove converter-to-flexplate bolts. Remove bolt securing transmission oil cooler bracket. Remove engine mount-to-frame bolts. Remove converter housing-to-engine bolts, except 2 upper bolts. Remove left motor mount from engine. Remove 2 upper converter housing bolts.

5. On M/T models, disconnect electrical connectors at transmission and transfer case. Release fuel pressure. See **FUEL PRESSURE RELEASE**. Using Fuel Line Coupling Key (T90P-9550-A), disconnect fuel supply and return lines at fuel supply manifold. See **Fig. 2**. Disconnect throttle linkage and bracket. Remove heater hoses.
6. Mark and disconnect all engine vacuum hoses. Disconnect throttle position switch connector. Remove throttle body from upper intake manifold. Disconnect engine wiring harness main connectors. Install engine lifting brackets on right front and left rear of engine. Remove engine.

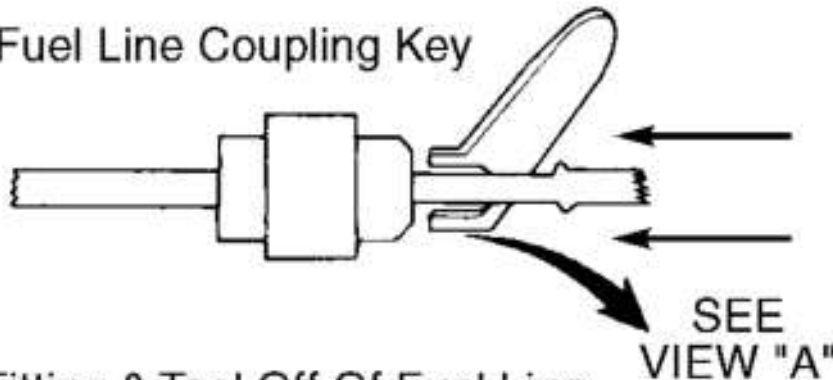
Installation

To install, reverse removal procedure. Evacuate and recharge A/C system (if equipped). Check and top off all fluid levels. Fill and bleed air from cooling system. See **COOLING SYSTEM BLEEDING**.

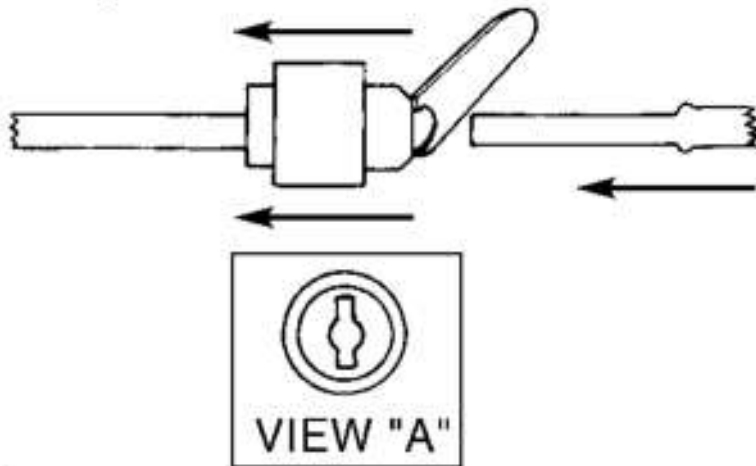
1. To Disconnect Push Fitting Toward Fuel Line



2. Insert Fuel Line Coupling Key



3. Slide Fitting & Tool Off Of Fuel Line



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Fig. 2: Disconnecting Fuel Lines
Courtesy of FORD MOTOR CO.

INTAKE MANIFOLDS

Removal (Upper)

1. Remove negative battery cable. Remove air cleaner intake duct from throttle body. Remove snow/ice shield to expose throttle linkage. Remove throttle cable and bracket from throttle body.
2. Disconnect all vacuum hoses. Disconnect all electrical connectors. Relieve fuel pressure. See **FUEL PRESSURE RELEASE**. Using Fuel Line Coupling Key (T90P-9550-A), disconnect fuel supply and

return lines at fuel supply manifold. See **Fig. 2**. Remove ignition coil. Remove upper intake manifold bolts. Remove upper intake manifold and throttle body as an assembly.

Installation

Clean and inspect mounting surfaces. Position NEW gasket on mounting studs. Install upper intake manifold and tighten bolts to specifications. See **TORQUE SPECIFICATIONS**. To complete installation, reverse removal procedure.

Removal (Lower)

With upper intake manifold removed, remove valve covers. See **VALVE COVERS**. Remove manifold attaching bolts. Remove lower intake manifold assembly and gasket.

Installation

Clean gasket mating surfaces. Install intake manifold gaskets. Apply silicone sealer at 4 corners of cylinder block sealing surface. Install lower intake manifold within 15 minutes of silicone sealer application. Tighten bolts in sequence to specification. See **Fig. 3**. See **TORQUE SPECIFICATIONS**.

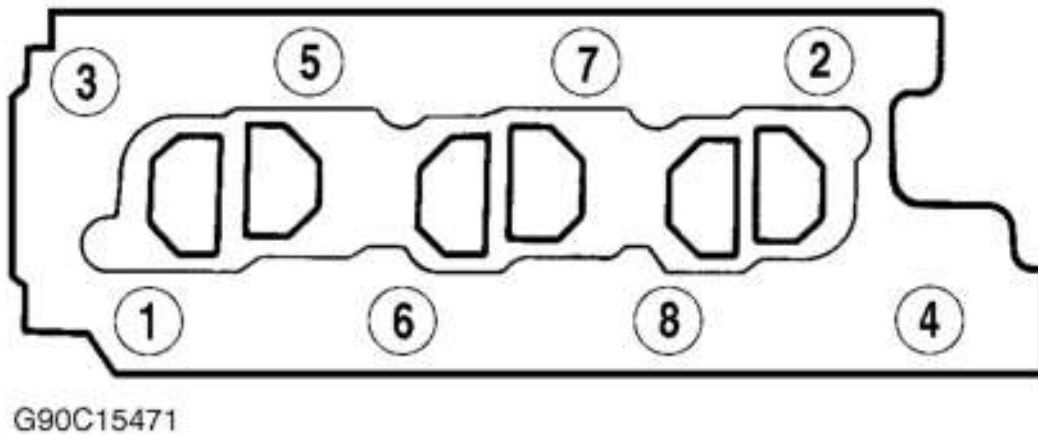


Fig. 3: Lower Intake Manifold Tightening Sequence
Courtesy of FORD MOTOR CO.

EXHAUST MANIFOLDS

Removal

1. On left exhaust manifold, remove oil dipstick tube support bracket. It may be necessary to remove power steering pressure and return hose. If removing right exhaust manifold, disconnect heater hoses.
2. On both exhaust manifolds, remove exhaust pipe-to-manifold attaching bolts. Remove exhaust manifold-to-cylinder head bolts. Remove exhaust manifolds.

Installation

Clean all mating surfaces. Lightly oil all bolt/stud threads before installation. Install exhaust manifold on cylinder head and tighten to specification. See **TORQUE SPECIFICATIONS**. To complete installation, reverse removal procedure. Fill and bleed cooling system if necessary. See **COOLING SYSTEM BLEEDING**.

VALVE COVERS

Removal

1. Disconnect negative battery cable. Remove intake air tube. On right valve cover, remove ignition coil and alternator. Remove spark plug wires. Remove engine harness clips from valve cover. Remove valve cover bolts and valve cover.
2. If removing left valve cover, remove upper intake manifold. Disconnect necessary vacuum hoses. Remove wiring harness from valve cover. Remove spark plug wires.
3. Remove PCV hose and breather. Keeping in removal order, remove valve cover attaching bolts and load distribution washers. Remove valve covers.

CAUTION: Failure to use NEW valve cover gaskets and valve cover load distribution washers will result in oil leaks.

Installation

Clean all gasket surfaces. Position NEW gasket in place. Install valve cover. Install valve cover load distribution washers in their original location. Install valve cover screws and tighten to specification. See **TORQUE SPECIFICATIONS**. To complete installation, reverse removal procedure.

CYLINDER HEAD

Removal

1. Disconnect negative battery cable. Drain cooling system. Release fuel pressure. See **FUEL PRESSURE RELEASE**. Remove upper and lower intake manifolds. See **INTAKE MANIFOLDS**. Remove exhaust manifold. See **EXHAUST MANIFOLDS**.
2. Remove valve covers. See **VALVE COVERS**. Remove spark plugs. Remove accessory drive belt. If removing left cylinder head, remove A/C compressor (if equipped). Remove power steering pump and bracket, and position aside.
3. If removing right cylinder head, remove alternator and bracket. On all cylinder heads, remove rocker arm shaft bolts evenly by loosening bolts 2 turns at a time. Remove rocker arm shaft assembly.

CAUTION: If rocker arm shafts are not loosened gradually, shafts may become bent or damaged.

4. Mark push rod location for installation reference, and remove push rods. Remove and discard cylinder head bolts. Remove cylinder head(s) and gaskets.

Inspection

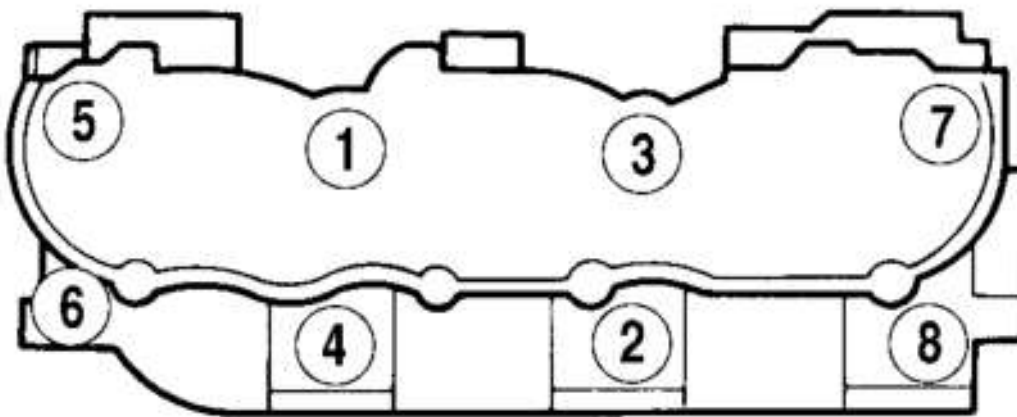
Check dowels in cylinder block and replace if necessary. Check cylinder head warpage. Resurface cylinder head if warpage exceeds specification. See **CYLINDER HEAD** table under ENGINE SPECIFICATIONS.

DO NOT machine more than .010" (.25 mm) from original cylinder head surface.

CAUTION: Always use NEW cylinder head bolts when installing cylinder heads.

Installation

1. Ensure all bolt holes in cylinder block are clean. Install gaskets and cylinder heads. Install NEW cylinder head bolts. Tighten cylinder head bolts in sequence to specification in Step 1. Refer to **Fig. 4**. See **TORQUE SPECIFICATIONS**.
2. Install lower intake manifold. See **INTAKE MANIFOLD**. Tighten lower intake manifold bolts to Step 1. See **TORQUE SPECIFICATIONS**. Tighten cylinder head bolts to Step 2. Tighten lower intake manifold bolts to Step 2. See **TORQUE SPECIFICATIONS**.
3. Tighten cylinder head bolts to Step 3. Tighten lower intake manifold bolts to Steps 3 and 4. See **TORQUE SPECIFICATIONS**.
4. Coat push rods with Oil Conditioner (D9AZ-19579-CA) and install in original position. Install rocker arm shaft assembly to cylinder head. Guide rocker arms onto push rods.
5. Tighten rocker arm bolts evenly to specification. To complete installation, reverse removal installation. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING**.



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Fig. 4: Cylinder Head Bolt Tightening Sequence

Courtesy of FORD MOTOR CO.

CRANKSHAFT FRONT OIL SEAL

Removal & Installation

1. Remove accessory drive belts. Remove crankshaft damper retaining bolt. Using Crankshaft Damper Remover (T74P-6316-A), remove crankshaft damper. Carefully pry seal from timing chain cover; **DO NOT** damage timing chain cover or crankshaft.

2. To install, lubricate NEW seal lip with engine oil. Using Timing Chain Cover Aligner (T74P-6019-A) and Crankshaft Front Seal Installer (T90T-6701-A), install front crankshaft seal. Apply silicone sealer to crankshaft keyway.
3. Coat crankshaft damper sealing surface with engine oil. Install crankshaft damper. Tighten to specification. See **TORQUE SPECIFICATIONS**. Install accessory drive belts.

TIMING CHAIN COVER

Removal

1. Remove oil pan. See **OIL PAN**. Drain cooling system. Remove upper and lower radiator hoses. Remove radiator. Remove coolant hoses from water pump. Remove A/C compressor and power steering bracket (if equipped).
2. Remove alternator and drive belt(s). Using Fan Clutch Pulley Holder (T84T-6312-C) and Fan Clutch Nut Wrench (T84T-6312-D), remove fan and clutch assembly. See **Fig. 9**.

CAUTION: Fan clutch nut has left-hand threads. Remove nut by turning clockwise as viewed from front of engine.

3. If equipped with A/C, remove alternator and bracket. Remove water pump pulley. Remove water pump attaching bolts, and remove pump. Remove gasket. Using Crankshaft Damper Remover (T74P-6316-A), remove crankshaft damper.
4. Remove crankshaft position sensor. Remove timing chain cover bolts (note bolt location for installation reference). Remove cover and gasket.

Installation

1. Clean timing chain cover mating surfaces. Apply sealing compound to gasket surfaces. Place NEW timing chain cover gasket into position. Replace crankshaft seal. Position timing chain cover on engine. Insert bolts in their original location.
2. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**. Apply silicone sealer to crankshaft keyway. To complete installation, reverse removal procedure. Install oil pan. See **OIL PAN**. Fill or top off all fluids. Fill and bleed air from cooling system. See **COOLING SYSTEM BLEEDING**.

TIMING CHAIN & SPROCKETS

Removal

1. Position No. 1 piston at TDC of compression stroke. Remove timing chain cover. See **TIMING CHAIN COVER**. Remove oil pan. Refer to **OIL PAN**.
2. Ensure all timing marks are aligned. See **Fig. 5**. Check camshaft end play. If end play is not within specification, replace camshaft thrust plate. See **CAMSHAFT** table under ENGINE SPECIFICATIONS.
3. Remove camshaft sprocket retaining bolt and crankshaft sprocket Woodruff key. Remove tensioner and guide rail; replace worn parts as necessary. Remove crankshaft, camshaft sprockets and timing chain as an assembly.
4. If crankshaft sprocket is difficult to remove, carefully pry off with a pair of screwdrivers positioned evenly on sprocket.

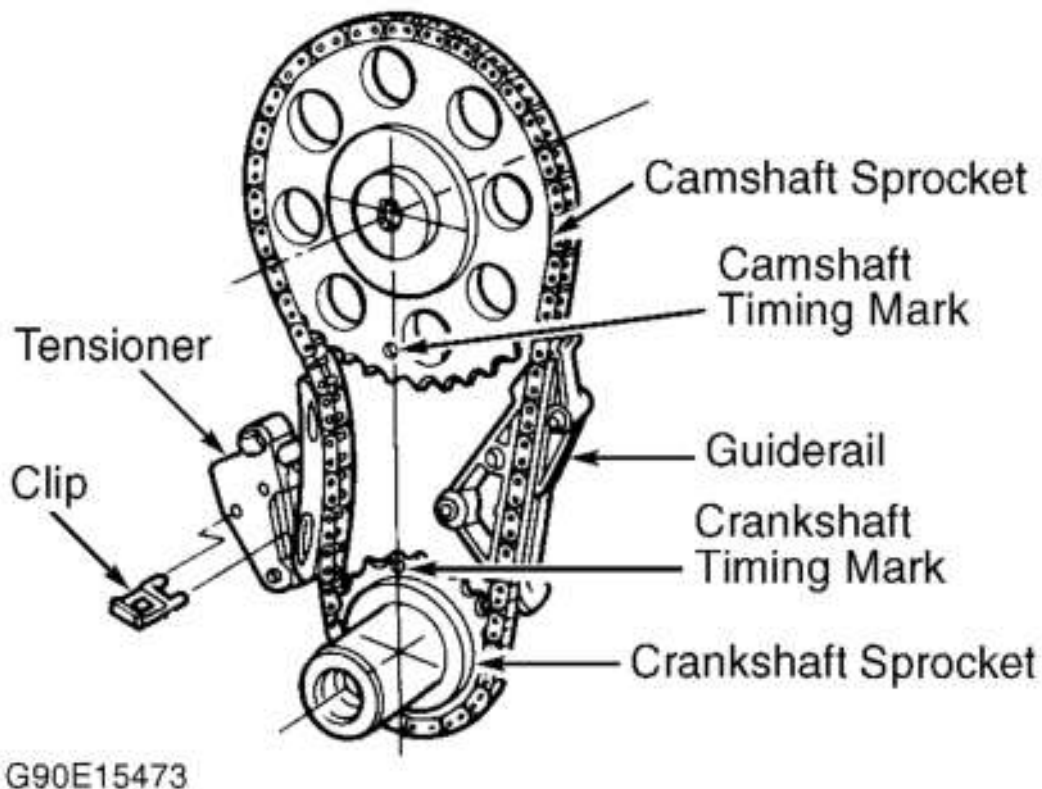


Fig. 5: Identifying Timing Chain & Components
 Courtesy of FORD MOTOR CO.

Installation

1. Install guide rail to cylinder block, with pin inserted into oil hole of block. Install 2 tensioner retaining bolts. Ensure timing marks are aligned. See **Fig. 5**. If camshaft thrust plate was removed, install thrust plate so that it covers main oil gallery. See **Fig. 6**.
2. Install crankshaft, camshaft sprocket and timing chain as an assembly. Install tensioner with clip in place to lock tensioner in retracted position. See **Fig. 5**. Install camshaft sprocket bolt and tighten to specification. See **TORQUE SPECIFICATIONS**.
3. Remove clip from tensioner. Rotate crankshaft 2 revolutions clockwise, and recheck timing marks. To complete installation, reverse removal procedure. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING**.

CAUTION: Ensure tensioner side of timing chain is held inward, and guide side is straight and tight. Ensure clip is removed from tensioner before installing timing chain cover.

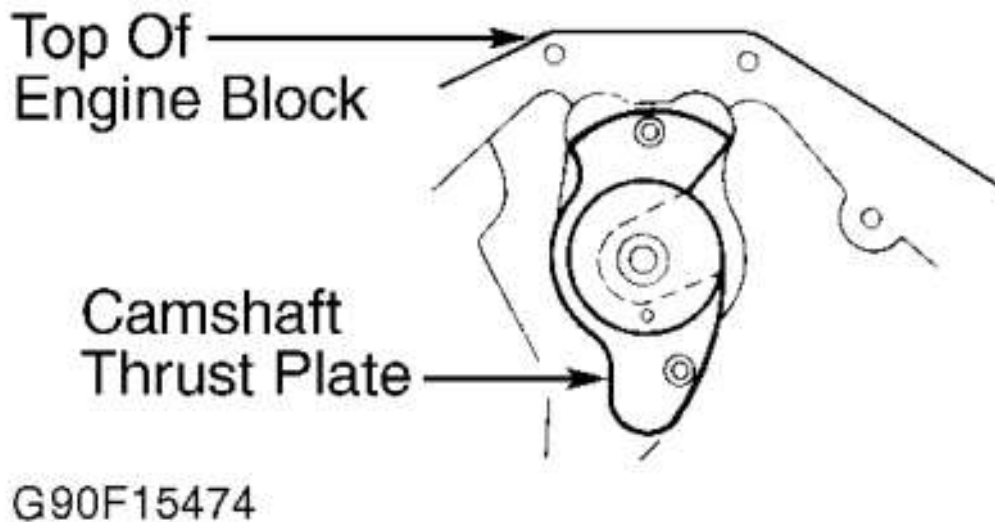


Fig. 6: Installing Camshaft Thrust Plate
 Courtesy of FORD MOTOR CO.

VALVE LIFTERS

Removal

Remove cylinder head. See CYLINDER HEAD. Note original location of lifter during removal for installation reference.

CAUTION: If rocker arm shafts are not loosened gradually, shafts may be bent or damaged.

Inspection

Inspect lifter for damage. Ensure roller rotates smoothly. Measure lifter O.D. and cylinder block lifter bore I.D. Replace components if oil clearance is not within specification. See VALVE LIFTERS table under ENGINE SPECIFICATIONS.

Installation

1. Lubricate lifter and cylinder block bore with Oil Conditioner (D9AZ-19579-CA) or heavy engine oil. Install lifter in original location, with alignment tab in locating groove of bore. See Fig. 7. Ensure lifters slide freely in bore.
2. To install cylinder head, reverse removal procedure. See CYLINDER HEAD. Tighten retaining bolts/nuts to specification. See the TORQUE SPECIFICATIONS table. To install remaining components, reverse removal procedure.

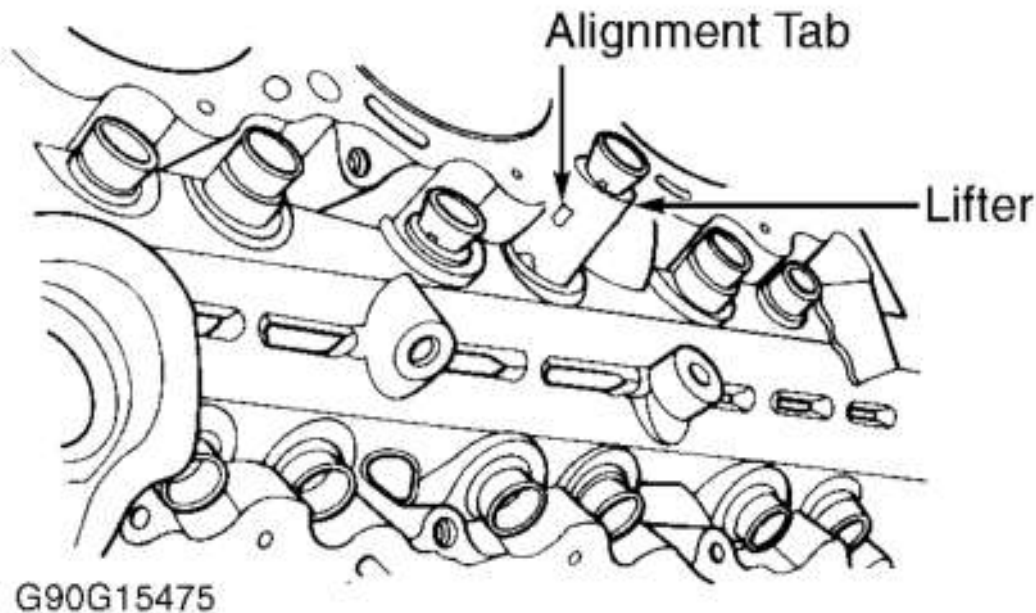


Fig. 7: Installing Hydraulic Lifters
Courtesy of FORD MOTOR CO.

CAMSHAFT

Removal

1. Disconnect negative battery cable. Remove timing chain cover. See **TIMING CHAIN COVER**. Remove upper and lower intake manifolds. See **INTAKE MANIFOLDS**. Remove bolt, hold-down clamp and oil pump drive assembly from rear of engine. See **Fig. 8**.
2. Remove valve covers. See **VALVE COVERS**. Remove valve lifters. See **VALVE LIFTERS**. Remove timing chain and camshaft sprocket. See **TIMING CHAIN & SPROCKETS**. Remove thrust plate attaching bolts, and remove thrust plate. Slowly remove camshaft from block; **DO NOT** damage camshaft bearings.

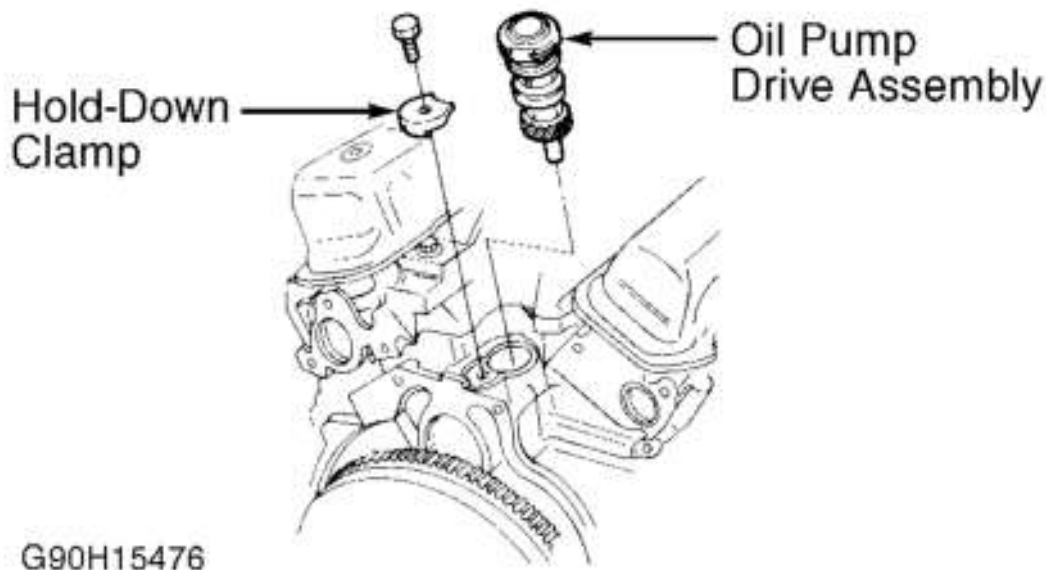


Fig. 8: Removing Oil Pump Drive Assembly
 Courtesy of FORD MOTOR CO.

Inspection

Inspect components for damage. Check camshaft journal diameter, lobe lift and oil clearance. Replace components if damaged or not within specification. See **CAMSHAFT** table under ENGINE SPECIFICATIONS.

Installation

1. Lubricate camshaft lobes and bearing surfaces with Oil Conditioner (D9AZ-19579-CA). Install camshaft carefully to prevent damaging bearings and journal surfaces. Install thrust plate so it covers main oil gallery. See **Fig. 6**.
2. Ensure camshaft end play is within specification. See **CAMSHAFT** table under ENGINE SPECIFICATIONS. To complete installation, reverse removal procedure. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING**.

CRANKSHAFT REAR OIL SEAL

Removal & Installation

1. Rear main bearing oil seal is a one-piece seal. Remove transmission. On M/T models, remove clutch assembly. Remove flywheel/flexplate. Punch hole in metal portion of seal with an awl. Remove seal using a slide hammer.
2. To install, lubricate seal and mating surfaces with engine oil. Install seal on crankshaft, with spring side toward crankshaft. Using Crankshaft Rear Oil Seal Replacer (T72C-6165-R), install seal into position until seal is firmly seated. To install remaining components, reverse removal procedure.

WATER PUMP

Removal

1. Remove negative battery cable. Drain cooling system. Disconnect lower radiator hose and heater return hose from water pump. Using Fan Clutch Pulley Holder (T84T-6312-C) and Fan Clutch Nut Wrench (T84T-6312-D), remove radiator fan and clutch assembly. See **Fig. 9**.

CAUTION: Fan clutch nut has left-hand threads. Remove nut by turning it clockwise as viewed from front of engine.

2. Remove alternator drive belt. If equipped with A/C, remove alternator and bracket. Remove water pump pulley. Remove water pump bolts, and remove pump. Remove gasket.

Installation

Clean all gasket surfaces. Apply sealer to both sides of NEW gasket, and position gasket on water pump. Install water pump. To complete installation, reverse removal procedure. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING**.

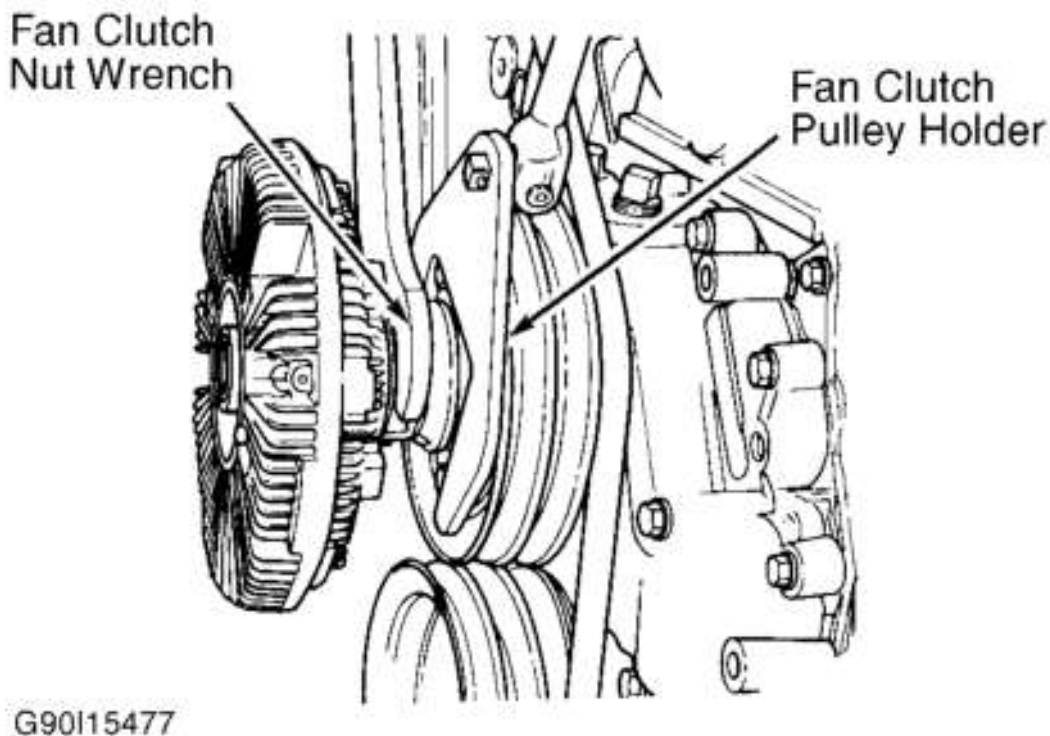


Fig. 9: Removing Fan Clutch
Courtesy of FORD MOTOR CO.

OIL PAN

Removal

Remove engine. See **ENGINE**. Mount engine on engine stand with oil pan facing up. Remove oil pan, gasket and rear main bearing cap wedge seal. Clean gasket mating surfaces.

Installation

1. Install NEW crankshaft rear main bearing cap wedge seal. Wedge seal should fit snugly into sides of rear main bearing cap. Position NEW oil pan gasket into groove in oil pan. Position oil pan on engine.
2. Install oil pan retaining bolts/nuts and tighten to specification. See **TORQUE SPECIFICATIONS**. Position a straightedge along rear of engine block so it extends over one of the oil pan spacer mounting pads. See **Fig. 11**.
3. Using a feeler gauge, measure gap between mounting pad and straightedge. Repeat procedure for other mounting pad. Determine spacer thickness from measured clearance. See **SPACER SELECTION** table. To complete installation, reverse removal procedure. Fill or top off all fluids. Start engine and check for leaks.

CAUTION: Oil pan spacers must be installed before bolting engine to transmission.

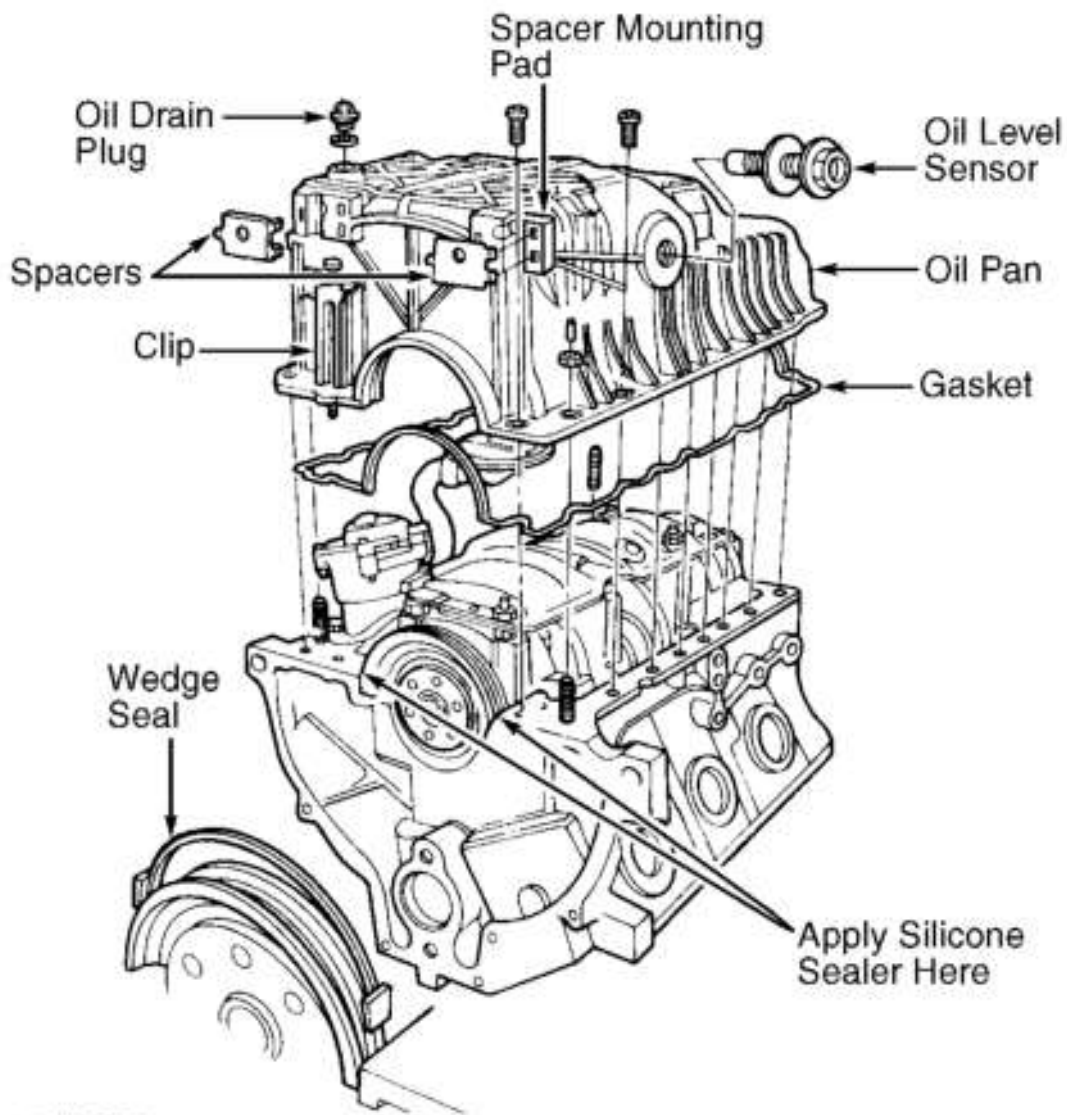


Fig. 10: Exploded View Of Oil Pan Assembly
 Courtesy of FORD MOTOR CO.

SPACER SELECTION

Clearance: In. (mm)	Shim Thickness: In. (mm)	Shim Color Code
0.011-.020 (.28-.51)	.010 (.25)	Yellow
0.021-.029 (.53-.74)	.020 (.51)	Blue
0.030-.039 (.76-.99)	.030 (.76)	Pink

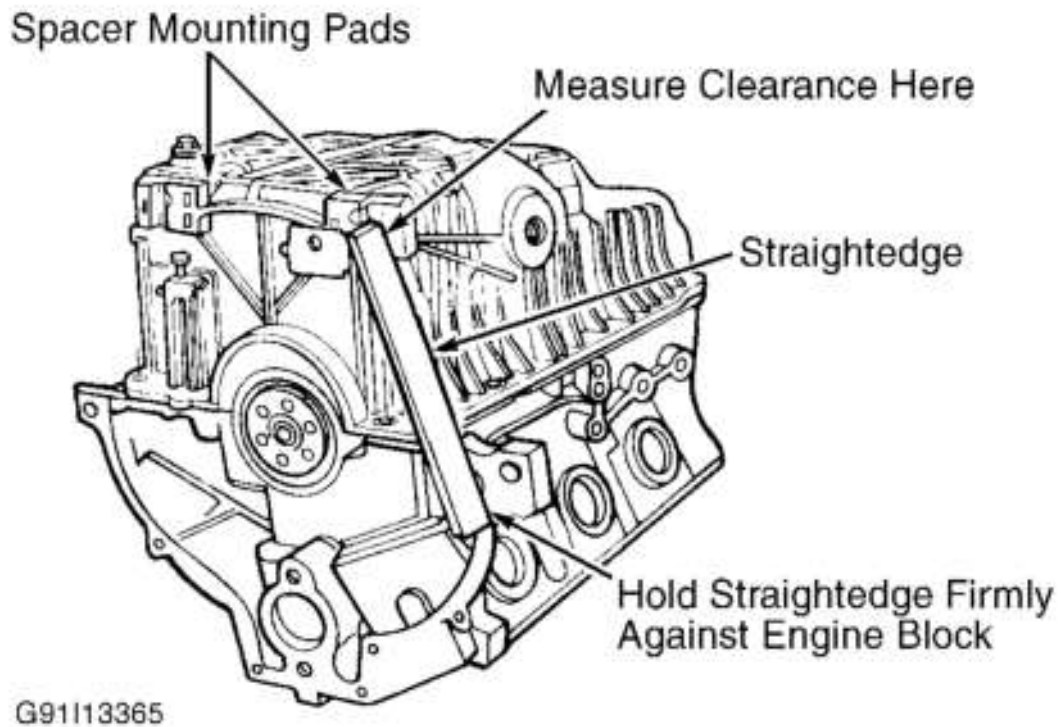


Fig. 11: Measuring Oil Pan Spacer Clearance
Courtesy of FORD MOTOR CO.