

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 and other major assemblies before removal.

FUEL PRESSURE RELEASE & FUEL LINE CONNECTIONS

WARNING: Fuel system is under pressure. Release pressure before servicing fuel system components.

1. Remove fuel cap to release fuel tank pressure. Remove relief valve cap. Relief valve (service port) is located on fuel supply manifold. Using Fuel Pressure Gauge (T80L-9974-B), release fuel pressure from relief valve (Schrader valve).
2. If fuel pressure gauge is not available, disconnect electrical connector to Inertia Fuel Shutoff (IFS) switch. IFS switch is located behind passenger-side kick panel. Crank engine for 15 seconds to reduce system pressure.
3. To disconnect fuel lines, remove retaining clip from fuel line coupling. Use Spring Lock Coupling Remover (D87L-9280-A) for 3/8" line and (D87L-9280-B) for 1/2" line. Install spring lock coupling remover on fuel line coupling so it enters cage opening. See **Fig. 1**.
4. Push spring lock coupling remover into cage opening to release female fitting from garter spring. Pull couplings apart. Remove spring lock coupling remover.
5. When installing fuel lines, install NEW "O" rings on fuel lines. Use only specified fuel-resistant "O" rings (Brown). Before installing, lightly coat "O" rings with clean engine oil. Clean fittings, and replace garter spring (if necessary).
6. Install female fitting to male fitting and push until garter spring snaps over flared end of female fitting. Ensure lines are locked together and garter spring is over flared end of female fitting. Install retaining clip. Ensure horseshoe portion of clip is over coupling. **DO NOT** install retaining clip over rubber fuel line.

NOTE: Install Black retaining clip on fuel supply line and Gray clip on fuel return line.

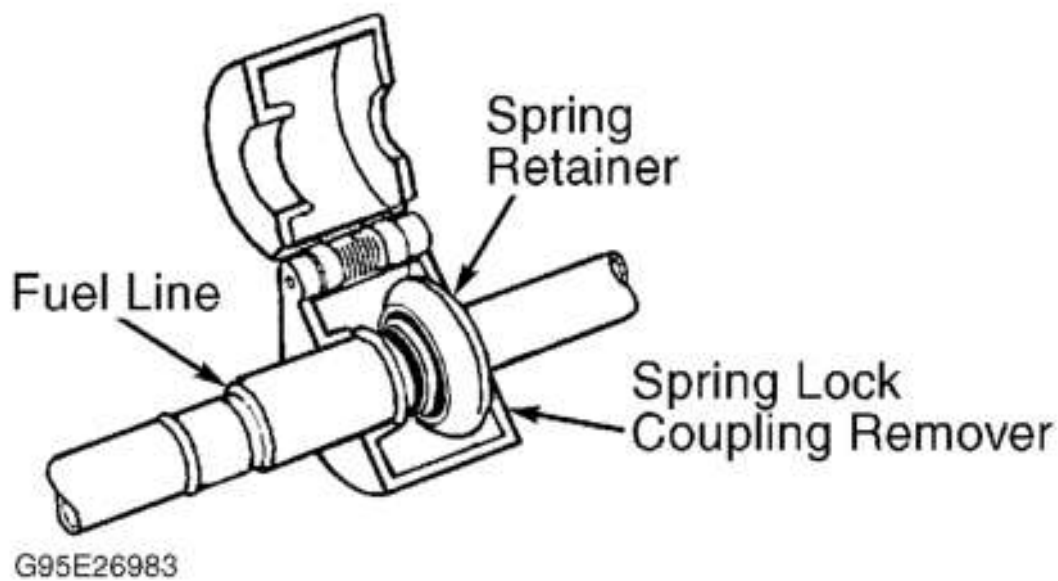


Fig. 1: Disconnecting Fuel Lines
 Courtesy of FORD MOTOR CO.

ENGINE

Removal (Pickup)

1. Disconnect negative and positive battery cable. Mark hinges and remove hood. Drain cooling system. Discharge A/C system using approved refrigerant recovery/recycling equipment. Release fuel pressure and disconnect fuel lines. See **FUEL PRESSURE RELEASE & FUEL LINE CONNECTIONS**.
2. Remove upper front air deflector. Remove air cleaner outlet tube. Remove radiator. Remove fan blade and fan shroud. Disconnect throttle body control cables. Disconnect throttle control cable bracket, and position aside.
3. Disconnect necessary vacuum and water lines. Disconnect necessary harness connectors and ground cables. Unbolt power steering reservoir, and position aside. Disconnect A/C manifold line at compressor, and position aside. Remove power steering pump retaining bolts, and position pump aside.

WARNING: Air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. Air suspension switch is located behind right kick panel. Failure to do so can result in inflation or deflation of air springs, which could cause vehicle to shift during servicing.

4. Remove upper intake manifold. See **INTAKE MANIFOLD**. Remove fuel injector supply manifold and injectors. Raise and support vehicle. Disconnect exhaust pipes from exhaust manifold. Remove starter.
5. Remove transmission. For A/T, see REMOVAL & INSTALLATION - A/T article in TRANSMISSION SERVICING. For M/T, see appropriate article in CLUTCHES.

6. Remove right and left engine mount through-bolt. Lower vehicle. Install engine lifting equipment. Remove transmission-to-engine retaining bolts. Remove engine.

Installation (Pickup)

1. To install, reverse removal procedure. Tighten all bolts to specification. See **TORQUE SPECIFICATIONS**.
2. When installing fuel lines, fit NEW fuel resistant "O" rings (Brown) on fuel lines. Lightly coat "O" rings with clean engine oil before installing. Clean fittings, and replace garter spring (if necessary).
3. Adjust all control cables and fluid levels. Refill cooling system. Evacuate and recharge A/C system.

Removal (Van)

1. Disconnect negative and positive battery cable(s). Discharge A/C system using approved refrigerant recovery/recycling equipment. Release fuel pressure and disconnect fuel lines. See **FUEL PRESSURE RELEASE & FUEL LINE CONNECTIONS**. Remove air cleaner assembly and throttle body inlet tube.
2. Remove engine cover. Remove radiator air deflector. Remove radiator, fan shroud and cooling fan. Remove radiator inner grille. Remove radiator grille reinforcement panel. Remove stone deflector.
3. Remove headlight and side marker assemblies. Remove power steering cooler and auxiliary transmission cooler. Remove power steering cooler mounting brackets. Remove A/C condenser, and plug openings. Disconnect hood latch cable, and remove hood latch assembly.
4. Disconnect positive battery cable from power distribution box, and position aside. Remove power steering reservoir retaining bolts, and position aside. Remove upper and lower core support. Remove oil dipstick tube. Remove upper and lower intake manifolds. See **INTAKE MANIFOLD**.
5. Disconnect necessary harness and ground connections. Remove accessory drive belt. Disconnect low-pressure hose at power steering pump. Unbolt power steering pump, and position aside. Remove lower radiator hose. Disconnect A/C manifold at compressor, plug openings, and position aside. Disconnect A/C high-pressure hose at evaporator, and plug openings.
6. Raise and support vehicle. Drain engine oil. Remove starter. Remove torque converter nuts. Remove oil pan-to-transmission bolts. Disconnect exhaust pipes at exhaust manifolds. Disconnect shift cable bracket. Remove engine mount nuts.
7. Lower vehicle. Support transmission. Remove transmission dipstick tube. Install engine lifting equipment. Remove transmission-to-engine retaining bolts. Remove engine.

Installation (Van)

1. To install, reverse removal procedure. Replace torque converter nuts with NEW ones. Tighten all bolts to specification. See **TORQUE SPECIFICATIONS**.
2. When installing fuel lines, fit NEW fuel resistant "O" rings (Brown) on fuel lines. Lightly coat "O" rings with clean engine oil before installing. Clean fittings, and replace garter spring (if necessary).
3. Adjust all control cables and fluid levels. Refill cooling system. Evacuate and recharge A/C system.

INTAKE MANIFOLD

Removal

1. Disconnect negative battery cable. Remove air cleaner outlet tube. Disconnect spark plugs wires and harness connectors at ignition coil. Disconnect control cables from throttle body. Remove throttle

body control cable bracket, and position aside.

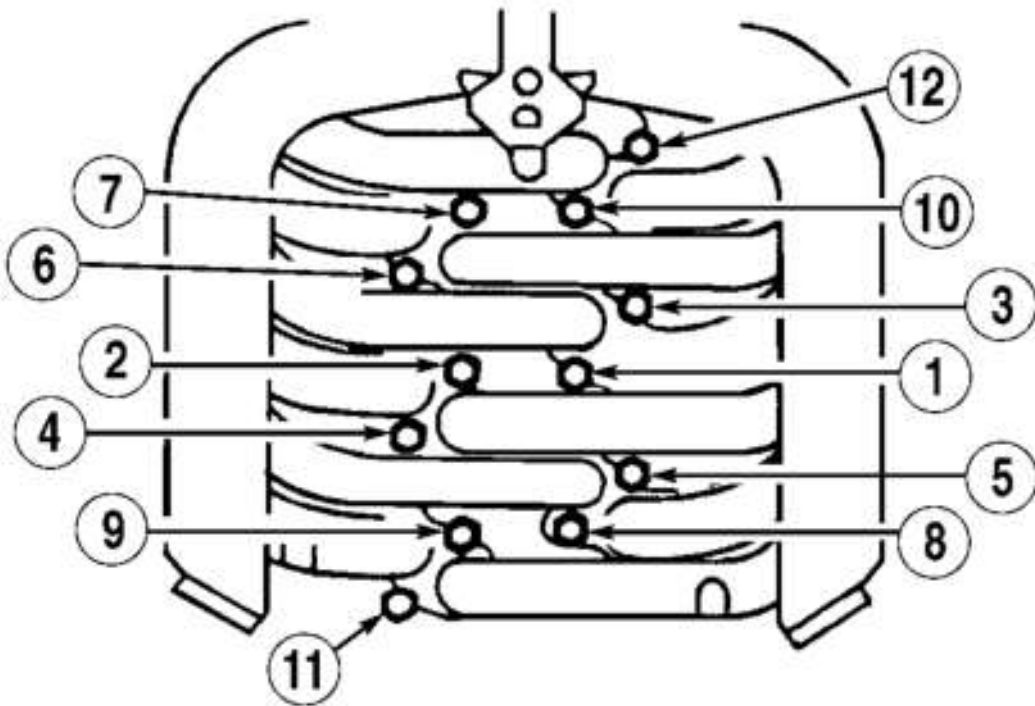
2. Disconnect necessary vacuum and water lines. Disconnect necessary harness connectors and ground cables. Remove engine vacuum regulator from intake manifold. Remove upper intake manifold retaining bolts. Remove upper intake manifold and gasket.
3. Disconnect fuel injector harness connectors. Disconnect EGR manifold from EGR valve. Disconnect IMRC electrical connector. Release fuel pressure and disconnect fuel lines. See **FUEL PRESSURE RELEASE & FUEL LINE CONNECTIONS**.
4. On 2001 models, mark position for installation, remove intake manifold spacer assembly retaining bolts in reverse order. See **Fig. 4**. Remove intake manifold spacer assembly.
5. On all models, mark position for installation, remove lower intake manifold retaining bolts in reverse order. See **Fig. 5**. Remove lower intake manifold and gaskets.

Installation

1. To install, reverse removal procedure. Use NEW gaskets and "O" rings. Lubricate fuel injector "O" rings with Light Grade Oil (ESE-M2C39-F) before installing.
2. Ensure alignment tabs on intake manifold gaskets align with holes in cylinder head. Tighten intake manifold bolts to specification in sequence. See **Fig. 2**, **Fig. 3**, **Fig. 4** and **Fig. 5**. See **TORQUE SPECIFICATIONS** table.

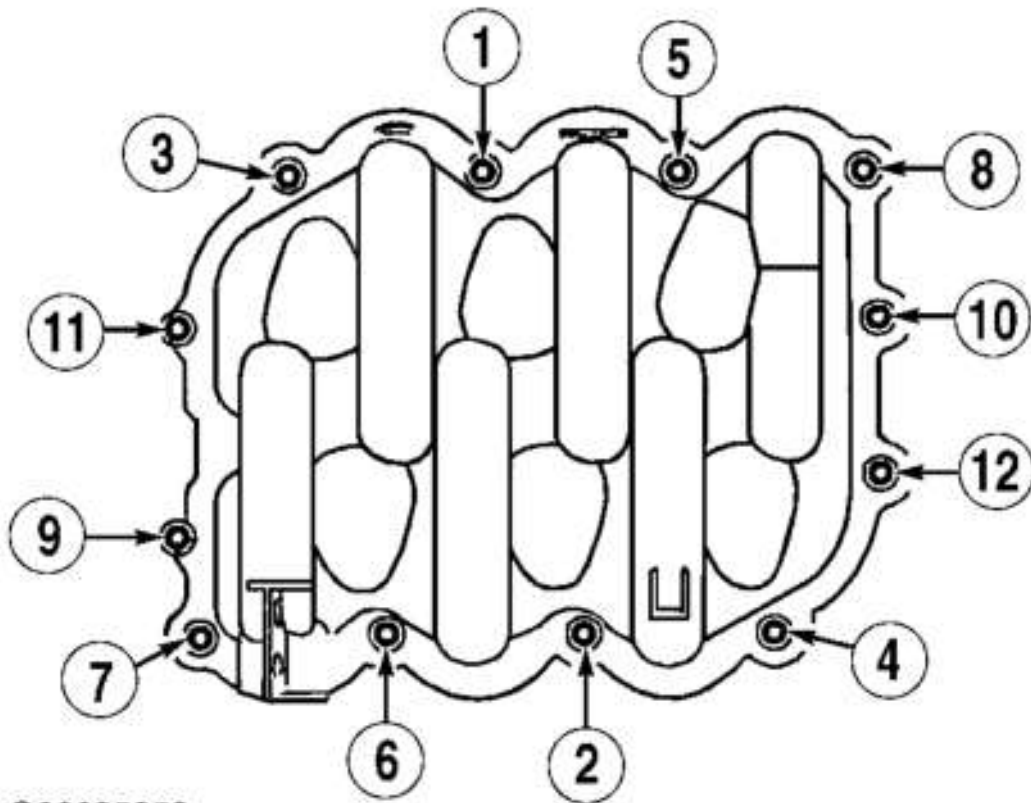
CAUTION: Intake manifold bolts must be retightened to specification after engine has reached normal operating temperature.

3. When installing fuel lines, fit NEW fuel resistant "O" rings (Brown) on fuel lines. Lightly coat "O" rings with clean engine oil before installing. Clean fittings, and replace garter spring (if necessary).
4. To install remaining components, reverse removal procedure. Adjust all control cables and fluid levels. Refill cooling system. When installing spark plug wires, ensure wires are in correct position on coils. See SERVICE & ADJUSTMENT SPECIFICATIONS article in ENGINE PERFORMANCE.



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Fig. 2: Upper Intake Manifold Bolt Tightening Sequence (Pickup & Van - 2000)
 Courtesy of FORD MOTOR CO.



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Fig. 3: Upper Intake Manifold Bolt Tightening Sequence (Pickup & Van - 2001)
 Courtesy of FORD MOTOR CO.

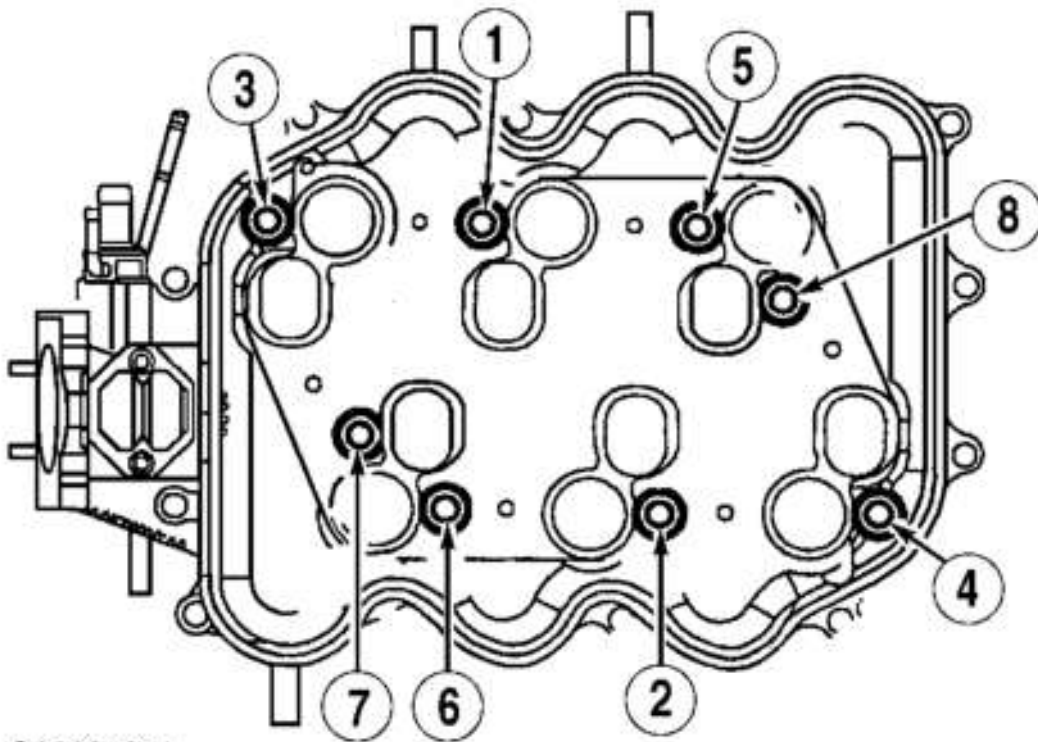


Fig. 4: Intake Manifold Spacer Assembly Bolt Tightening Sequence (Pickup & Van - 2001)
Courtesy of FORD MOTOR CO.

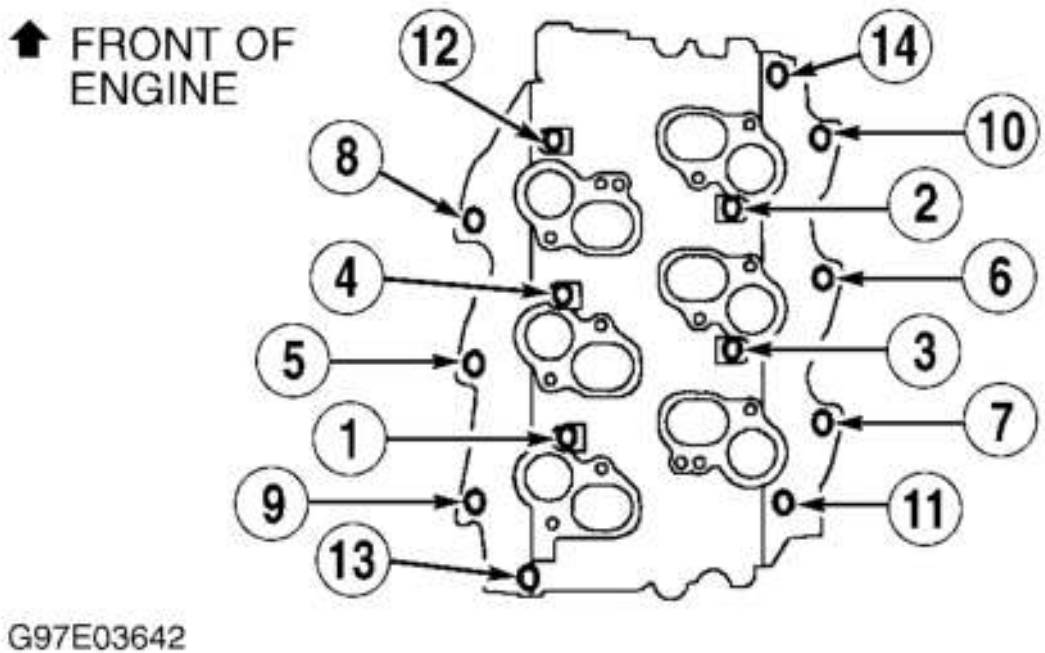


Fig. 5: Lower Intake Manifold Bolt Tightening Sequence
 Courtesy of FORD MOTOR CO.

EXHAUST MANIFOLD

Removal

On left manifold, remove oil dipstick tube. On right manifold, remove EGR manifold tube. On both sides, disconnect oxygen sensor. Disconnect exhaust pipe from exhaust manifold. Remove exhaust manifold retaining bolts in reverse order. See **Fig. 6**. Remove exhaust manifold and gasket.

Installation

To install, reverse removal procedure. Tighten exhaust manifold nuts to specification in sequence. See **Fig. 6**. See **TORQUE SPECIFICATIONS**.

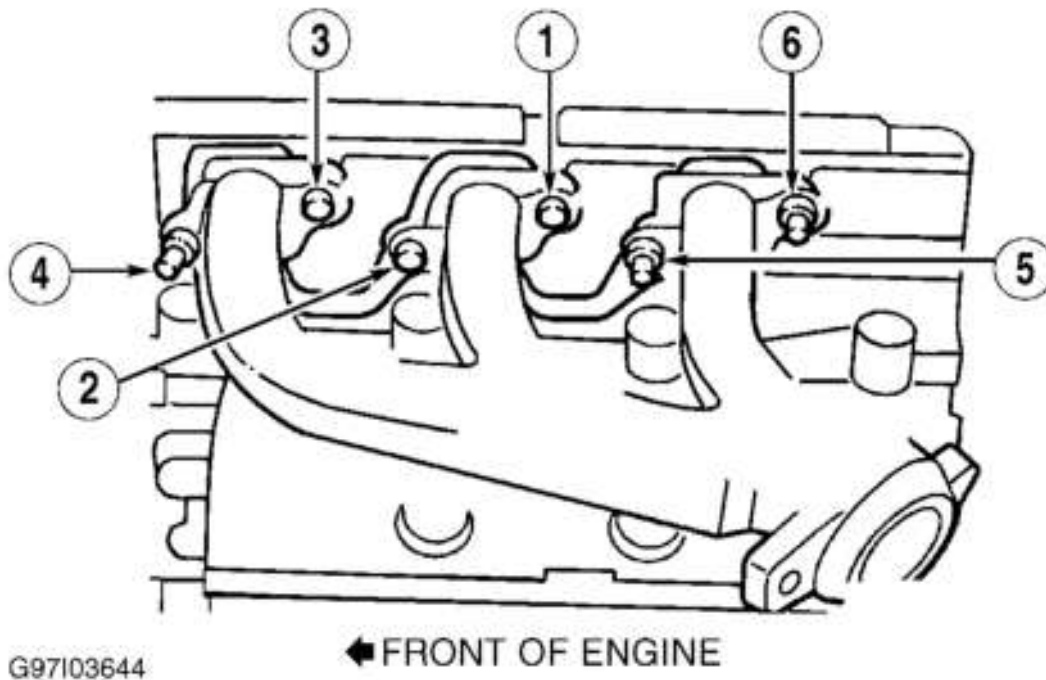


Fig. 6: Exhaust Manifold Bolt Tightening Sequence
 Courtesy of FORD MOTOR CO.

CYLINDER HEAD

Removal

1. Disconnect negative battery cable. Remove upper and lower intake manifolds. See **INTAKE MANIFOLD**. Remove valve cover. Remove exhaust manifold. See **EXHAUST MANIFOLD**. Remove accessory drive belt.
2. If removing left cylinder head, unbolt power steering reservoir and position aside. Remove A/C compressor, with hoses attached, and position aside. Remove power steering bracket, with pump and hoses attached, and position aside.
3. If removing right cylinder head, remove generator. Remove accessory drive belt idler pulley. Remove generator bracket.

CAUTION: Mark location of rocker arms and push rod if they are to be reused. Ensure they are installed in their original location.

4. If removing either cylinder head, remove rocker arms and push rods. Remove and discard cylinder head retaining bolts in reverse sequence. See **Fig. 7**. Remove cylinder head and gasket.

Inspection

Check cylinder head for warpage, cracks and damage. Maximum warpage information is not available from manufacturer.

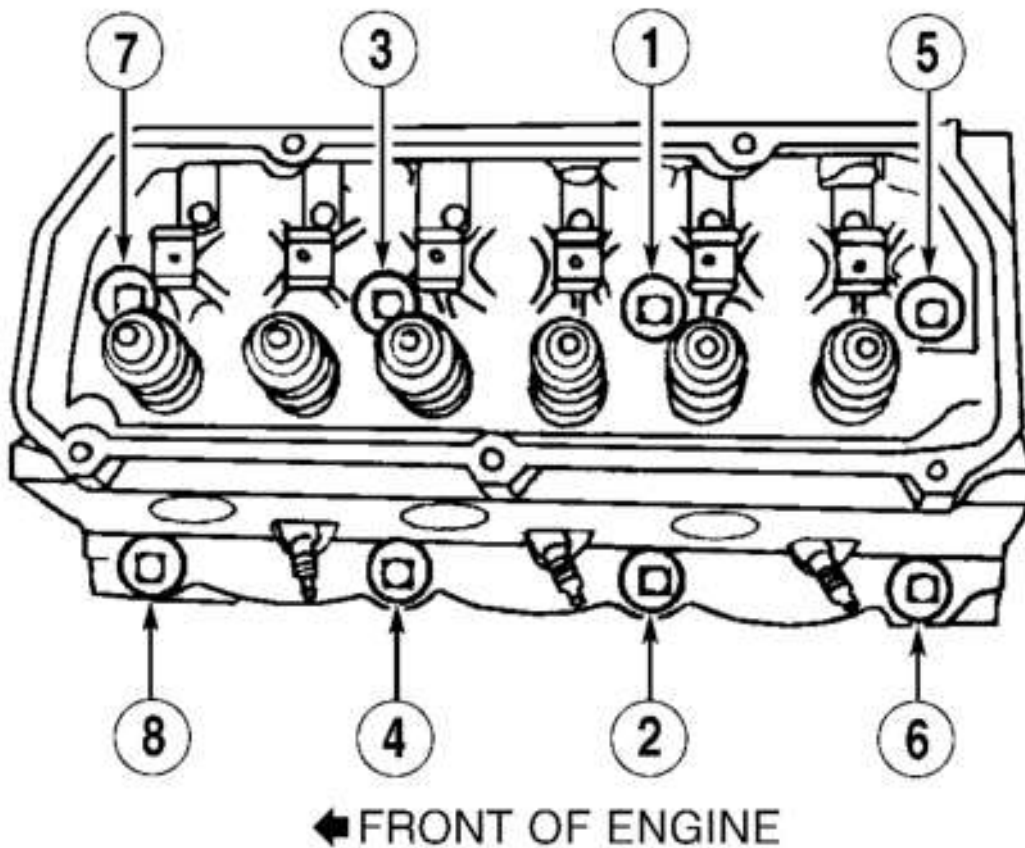
CAUTION: DO NOT reuse cylinder head bolts.

Installation

1. Install NEW cylinder head gaskets on block with small hole at front of engine. Always use NEW cylinder head bolts. Lubricate cylinder head bolts with engine oil prior to installation.
2. Install cylinder head and tighten bolts to 14 ft. lbs. (19 N.m), in sequence. See **Fig. 7**. Repeat sequence again, tightening bolts to 29 ft. lbs. (39 N.m). Repeat sequence again, tightening bolts to 36 ft. lbs (49 N.m).

CAUTION: DO NOT loosen all cylinder head bolts at one time. Loosen and tighten each cylinder head bolt before proceeding to next.

3. Working in order and on one bolt at a time, loosen bolt 3 revolutions and tighten to specification. See **TORQUE SPECIFICATIONS**. To complete cylinder head installation, reverse removal procedure.



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Fig. 7: Cylinder Head Bolt Tightening Sequence
Courtesy of FORD MOTOR CO.

FRONT COVER OIL SEAL

Removal

1. Disconnect negative battery cable. Remove accessory drive belt. Remove cooling fan and fan shroud. Raise and support vehicle. Mark pulley and damper position. Remove crankshaft pulley. Remove damper bolt.
2. Install Crankshaft Damper Remover (T58P-6316-D) and Crankshaft Damper Remover Adapter (T82L-6316-B). Remove damper. Using Seal Remover (T92C-6700-CH), remove oil seal from front cover.

Installation

To install, reverse removal procedure. Lubricate oil seal bore and seal lip with engine oil before installing. Apply silicone sealant to keyway of crankshaft damper before installing. Install seal. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**.

FRONT COVER

WARNING: Air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. Air suspension switch is located behind right kick panel. Failure to do so can result in accidental deflation or inflation of air springs, which may cause vehicle to shift during servicing.

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.

Removal (Pickup 2000)

1. Disconnect the battery ground cable, remove air cleaner assembly.
2. Raise vehicle, drain coolant from radiator, drain the engine oil.
3. Lower vehicle, remove upper radiator hose. Remove the fan shroud and the lower radiator hose.
4. Disconnect Cam Position (CMP) sensor harness connector.
5. Raise vehicle, disconnect Crankshaft (CKP) sensor harness connector. Position wiring harness aside.
6. Remove power steering support bracket bolts. Remove the A/C compressor mounting bracket nuts and position the A/C compressor aside.
7. Remove crankshaft pulley and damper. See **FRONT COVER OIL SEAL**.
8. Remove front oil pan bolts that intersect with the front cover.
9. Lower vehicle, remove the supply tube heater hoses. Detach wiring harness from the outlet tube and position aside.
10. Remove the heater water outlet tube (remove bolt), pull out tube.
11. Remove Cam Position Synchronizer. See **CAMSHAFT SYNCHRONIZER**.
12. Remove front cover crankshaft oil seal. See **FRONT COVER OIL SEAL**.

CAUTION: Failure to remove Cap Screw which may be over looked, may damage the cover if not removed.

13. Remove engine front cover stud bolts and cover bolt, remove CAP SCREW. See Fig. 8.
14. Slide the front cover off the dowels, remove the gasket and discard.

Removal (Pickup 2001)

1. Disconnect the battery ground cable, remove air cleaner assembly.
2. Raise vehicle, drain coolant from radiator, drain the engine oil.
3. Lower vehicle, remove upper radiator hose. Remove the fan shroud and the lower radiator hose.
4. Disconnect Cam Position (CMP) sensor harness connector.
5. Raise vehicle, disconnect Crankshaft (CKP) sensor harness connector. Position wiring harness aside.
6. Remove power steering support bracket bolts. Remove power steering support bracket nuts and remove the bracket.
7. Remove crankshaft pulley and damper. See FRONT COVER OIL SEAL.
8. Remove front oil pan bolts that intersect with the front cover.
9. Lower vehicle, remove the supply tube heater hoses. Detach wiring harness from the outlet tube and position aside.
10. Remove the heater water outlet tube (remove bolt), pull out tube.
11. Remove Cam Position Synchronizer. See CAMSHAFT SYNCHRONIZER.
12. Remove fasteners and remove the water pump.
13. Remove front cover crankshaft oil seal. See FRONT COVER OIL SEAL.

CAUTION: Failure to remove Cap Screw which may be over looked, may damage the cover if not removed.

14. Remove engine front cover stud bolts and cover bolt, remove CAP SCREW. See Fig. 8.
15. Slide the front cover off the dowels, remove the gasket and discard.

Installation (Pickup 2000)

CAUTION: Failure to prevent foreign material from entering the engine block or front engine cover. Will result in engine damage. To prevent damage to engine components, seal coolant and oil passages. Prevent foreign material from entering the oil pan.

CAUTION: DO NOT use a surface conditioning pad or any other type of fibrous abrasive disc to clean gasket surfaces. failure to follow these directions will result in engine damage.

1. Clean off surfaces of the block, front engine cover and exposed oil pan flange.

NOTE: If sealant (F6AZ-19562-A) is exposed for longer than 7 minutes, wipe off sealant and re-apply.

2. Install front engine cover gasket, apply sealant (F6AZ-19562-A) to base of gasket where oil pan and block come together. Apply a bead of sealant in center of oil pan flange and around bolt holes. Apply a thin layer of sealant to front cover gasket mating surface (DO NOT over apply the sealant).

NOTE: There are 13 fasteners securing the front engine cover. The CAP SCREW will be identified as fastener No. 12. DO NOT tighten the CAP SCREW (No. 12) in the first tightening sequence.

3. Tighten fasteners in 3 stages, as follows:

- Starting with bolt at about the 6 o'clock position (identified as bolt No. 1), tighten fasteners 1-11 and 13 in sequence to 16 Ft. lbs. (22 N.m). See Fig. 8.

NOTE: Apply a small amount of loctite® to threads of cap screw (do not over apply compound).

- Tighten CAP SCREW (No. 12) to 89 INCH. lbs. (10 N.m).
 - Tighten all fasteners (except Cap Screw No. 12) an additional 90 degrees, in sequence.
4. Install Cam Position Synchronizer. See CAMSHAFT SYNCHRONIZER.
 5. Install the heater water outlet tube, tighten to 71-97 INCH. lbs. (8-11 N.m).
 6. Attach the wiring to the outlet tube, install both supply tube heater hoses.
 7. Raise vehicle, install oil pan bolts, tighten to 80-106 INCH. lbs. (9-12 N.m).
 8. Connect Crankshaft Position (CKP) sensor, install the CKP sensor shield (if removed).
 9. Install NEW front cover crankshaft oil seal. See FRONT COVER OIL SEAL.
 10. Install crankshaft pulley and damper. See FRONT COVER OIL SEAL and TORQUE SPECIFICATIONS.
 11. Lower vehicle.
 12. Install A/C compressor mounting bracket nuts, tighten to 30-40 Ft. lbs. (40-45 N.m).
 13. Install power steering support bracket bolts, tighten to 30-40 Ft. lbs. (40-45 N.m).
 14. Install accessory drive belt.
 15. Install the lower radiator hose, the fan shroud and upper radiator hose.
 16. Refill coolant system, refill the engine oil. Ensure oil drain plug has been tightened.
 17. Reconnect the battery ground cable, install air cleaner assembly.
 18. Start vehicle and check for leaks.

Installation (Pickup 2001)

CAUTION: Failure to prevent foreign material from entering the engine block or front engine cover. Will result in engine damage. To prevent damage to engine components, seal coolant and oil passages. Prevent foreign material from entering the oil pan.

CAUTION: DO NOT use a surface conditioning pad or any other type of fibrous abrasive disc to clean gasket surfaces. failure to follow these directions will result in engine damage.

1. Clean off surfaces of the block, front engine cover and exposed oil pan flange.

NOTE: If sealant (F6AZ-19562-A) is exposed for longer than 7 minutes, wipe off sealant and re-apply.

2. Install front engine cover gasket, apply sealant (F6AZ-19562-A) to base of gasket where oil pan and block come together. Apply a bead of sealant in center of oil pan flange and around bolt holes. Apply a thin layer of sealant to front cover gasket mating surface (DO NOT over apply the sealant).

NOTE: There are 13 fasteners securing the front engine cover. The CAP SCREW will be identified as fastener No. 12. DO NOT tighten the CAP SCREW (No. 12) in the first tightening sequence.

3. Tighten fasteners in 3 stages, as follows:

- Install studs and tighten to 62 INCH. lbs. (7 N.m).
- Starting with bolt at about the 6 o'clock position (identified as bolt No. 1), tighten fasteners 1-11 and 13 in sequence to 21 Ft. lbs. (28 N.m). See Fig. 8.

NOTE: Apply a small amount of loctite® to threads of cap screw (do not over apply compound).

- Tighten CAP SCREW (No. 12) to 89 INCH. lbs. (10 N.m).
 - Tighten all fasteners (except Cap Screw No. 12) an additional 90 degrees, in sequence.
4. Install Cam Position Synchronizer. See CAMSHAFT SYNCHRONIZER
 5. Install the heater water outlet tube, tighten to 89 INCH. lbs. (10 N.m).
 6. Attach the wiring to the outlet tube, install both supply tube heater hoses.
 7. Raise vehicle, install oil pan bolts, tighten to 89 INCH. lbs. (10 N.m).
 8. Connect Crankshaft Position (CKP) sensor, install the CKP sensor shield (if removed).
 9. Install NEW front cover crankshaft oil seal. See FRONT COVER OIL SEAL.
 10. Install crankshaft pulley and damper. See FRONT COVER OIL SEAL and TORQUE SPECIFICATIONS.
 11. Lower vehicle.
 12. Install power steering support bracket nuts, tighten to 18 Ft. lbs. (25 N.m).
 13. Install power steering support bracket bolts, tighten to 35 Ft. lbs. (48 N.m).
 14. Connect Crankshaft Position (CKP) sensor, install the CKP sensor shield (if removed).
 15. Install accessory drive belt.
 16. Install the lower radiator hose, the fan shroud and upper radiator hose.
 17. Refill coolant system, refill the engine oil. Ensure oil drain plug has been tightened.
 18. Reconnect the battery ground cable, install air cleaner assembly.
 19. Start vehicle and check for leaks.

Removal (Van)

1. Disconnect negative battery cable.
2. Drain coolant, remove water pump. See WATER PUMP.

3. Raise and support vehicle. Remove crankshaft damper and pulley. See **FRONT COVER OIL SEAL**.
4. Disconnect Crankshaft Position (CKP) sensor harness connector.
5. Remove front oil pan bolts that intersect with the front cover.
6. Remove Cam Position Synchronizer. See **CAMSHAFT SYNCHRONIZER**.
7. Remove accessory drive belt idler pulley, remove the belt tensioner.
8. Remove the 4 water pump mounting studs and discard.
9. Remove front cover crankshaft oil seal. See **FRONT COVER OIL SEAL**.

CAUTION: Failure to remove Cap Screw which may be over looked, may damage the cover if not removed.

10. Remove engine front cover stud bolts and cover bolt, remove CAP SCREW. See **Fig. 8**.
11. Slide the front cover off the dowels, remove the gasket and discard.

Installation (Van)

CAUTION: Failure to prevent foreign material from entering the engine block or front engine cover. Will result in engine damage. To prevent damage to engine components, seal coolant and oil passages. Prevent foreign material from entering the oil pan.

CAUTION: DO NOT use a surface conditioning pad or any other type of fibrous abrasive disc to clean gasket surfaces. failure to follow these directions will result in engine damage.

1. Clean off surfaces of the block, front engine cover and exposed oil pan flange.

NOTE: If sealant (F6AZ-19562-A) is exposed for longer than 7 minutes, wipe off sealant and re-apply.

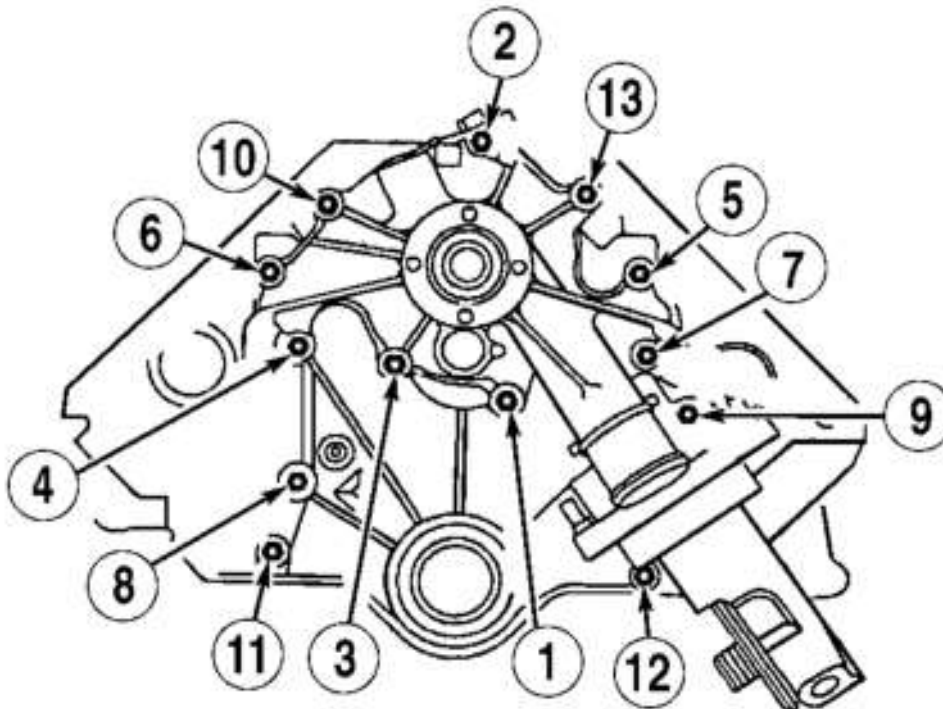
2. Install front engine cover gasket, apply sealant (F6AZ-19562-A) to base of gasket where oil pan and block come together. Apply a bead of sealant in center of oil pan flange and around bolt holes. Apply a thin layer of sealant to front cover gasket mating surface (DO NOT over apply the sealant).
3. Install water pump mounting studs (new studs are coated with locking compound). Install studs with compound threaded into block. Tighten studs to 62 INCH. lbs. (7 N.m).

NOTE: There are 13 fasteners securing the front engine cover. The CAP SCREW will be identified as fastener No. 12. DO NOT tighten the CAP SCREW (No. 12) in the first tightening sequence.

4. Tighten fasteners in 3 stages, as follows:
 - Starting with bolt at about the 6 o'clock position (identified as bolt No. 1), tighten fasteners 1-11 and 13 in sequence to 16 Ft. lbs. (22 N.m). See **Fig. 8**.

NOTE: Apply a small amount of loctite® to threads of cap screw (do not over apply compound).

- Tighten CAP SCREW (No. 12) to 89 INCH. lbs. (10 N.m).
 - Tighten all fasteners (except Cap Screw No. 12) an additional 90 degrees, in sequence.
5. Install accessory drive belt idler pulley, tighten to 35-47 Ft. lbs. (48-64 N.m).
 6. Install belt tensioner, tighten to 35-47 Ft. lbs. (48-64 N.m).
 7. Raise vehicle, install oil pan bolts, tighten to 80-106 INCH. lbs. (9-12 N.m).
 8. Drain engine oil, reinstall drain plug.
 9. Install NEW front cover crankshaft oil seal. See **FRONT COVER OIL SEAL**.
 10. Install crankshaft pulley and damper. See **FRONT COVER OIL SEAL** and **TORQUE SPECIFICATIONS**.
 11. Connect Crankshaft Position (CKP) sensor, install the CKP sensor shield.
 12. Lower vehicle. Install Cam Position Synchronizer. See **CAMSHAFT SYNCHRONIZER**.
 13. Install water pump. See **WATER PUMP**.
 14. Install accessory drive belt.
 15. Install the lower radiator hose, the fan shroud and upper radiator hose.
 16. Refill coolant system, refill the engine oil. Ensure oil drain plug has been tightened.
 17. Reconnect the battery ground cable.
 18. Start vehicle and check for leaks. **TORQUE SPECIFICATIONS**



NOTE: See text for Torque Spec - Cap Screw #12.

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Fig. 8: Front Cover Tightening Sequence

Courtesy of FORD MOTOR CO.

TIMING CHAINS

CAUTION: DO NOT rotate engine with timing chain removed. Damage to valve/piston may result.

Removal

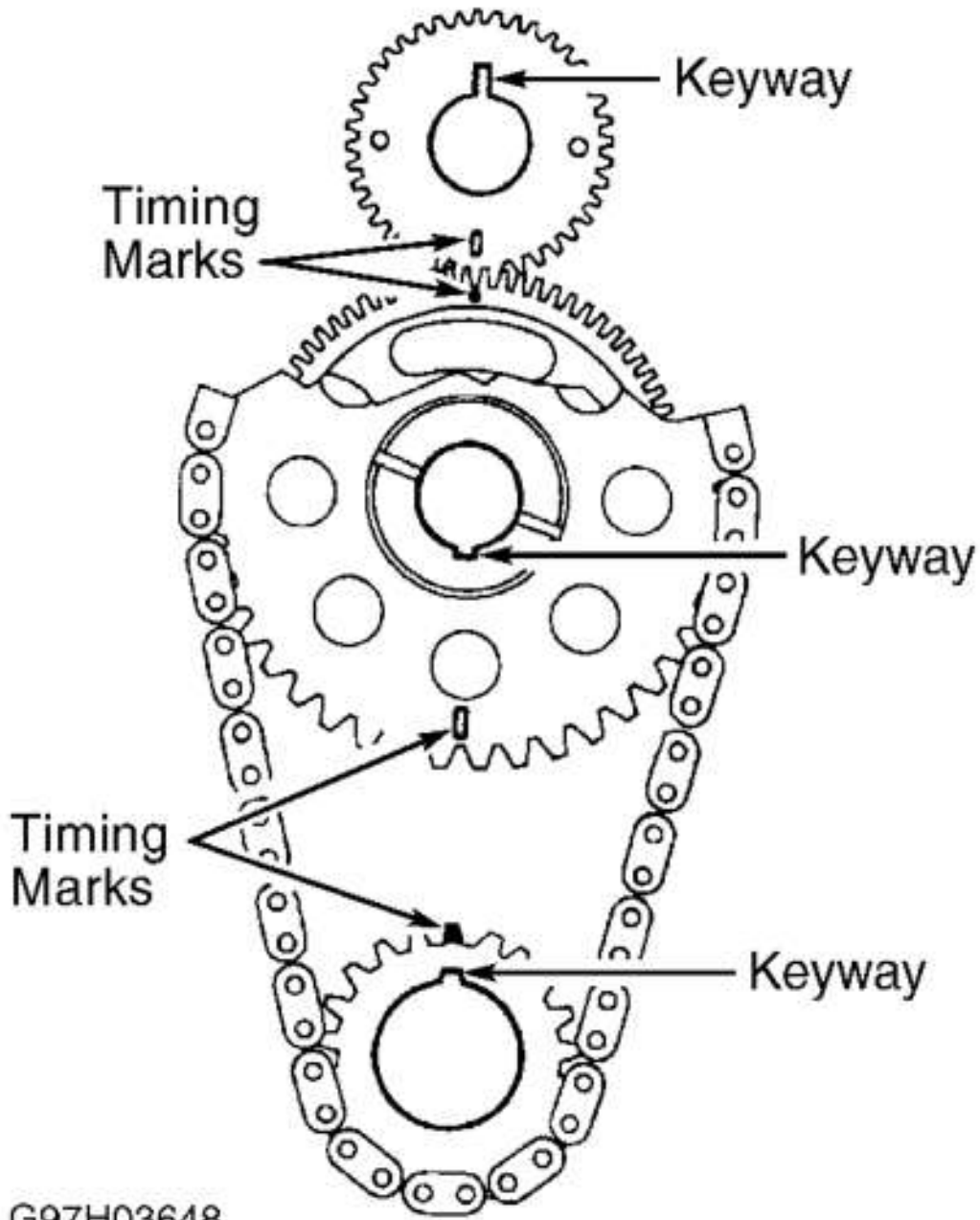
Remove front cover. See **FRONT COVER**. Remove camshaft synchronizer. See **CAMSHAFT SYNCHRONIZER**. Rotate crankshaft until timing marks and keyways align. See **Fig. 9**. Compress and install retaining pin to timing chain tensioner. See **Fig. 10**. Remove timing chain and gears as an assembly. Remove timing chain tensioner.

Inspection

Inspect components for damage. Inspect friction surfaces on tensioner arms and chain guides for wear. Replace components if necessary. If tensioner arms or guides are worn or damaged, remove and clean oil pan. Also, replace oil pump screen cover and tube.

Installation

To install, reverse removal procedure. Ensure all timing marks are properly aligned. See **Fig. 9**. Tighten all nuts and bolts to specification. See **TORQUE SPECIFICATIONS**.



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Fig. 9: Identifying Timing Marks
Courtesy of FORD MOTOR CO.

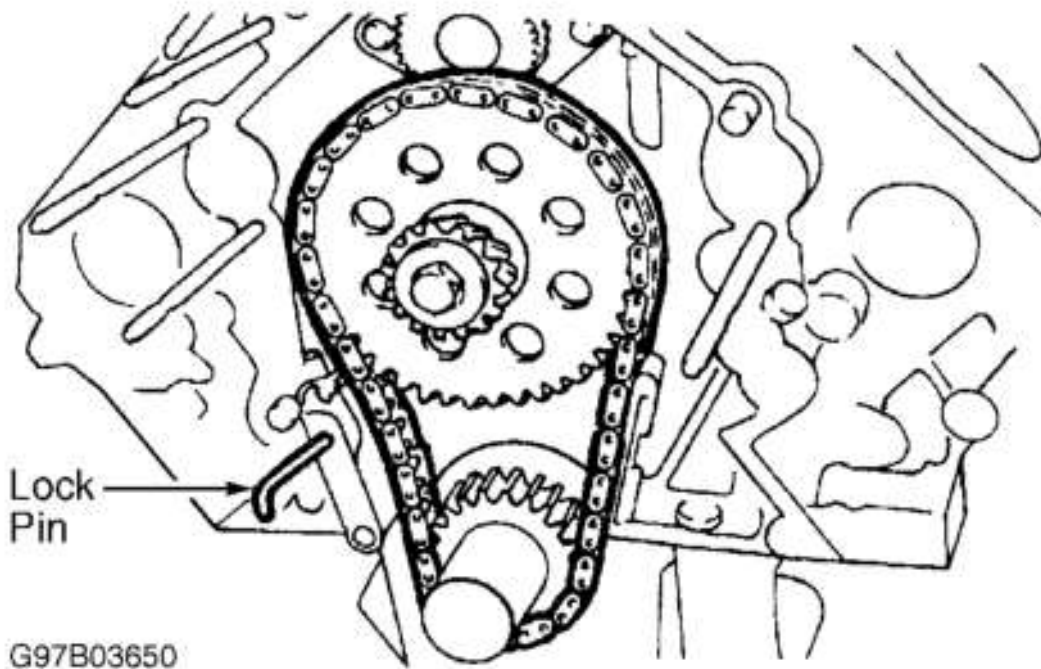


Fig. 10: Installing Timing Chain Tensioner Lock Pin
 Courtesy of FORD MOTOR CO.

LIFTER

Removal

Remove upper and lower intake manifolds. See **INTAKE MANIFOLD**. Remove valve covers. Mark position of rockers push rods and lifters for installation reference. Remove rockers and push rods. Remove lifter retainer plates. Remove lifters.

Inspection

Inspect components for damage. Measure lash adjuster O.D. and oil clearance. Replace components if damaged or measurements are not within specification. See **CAMSHAFT** table under ENGINE SPECIFICATIONS.

Installation

To install, reverse removal procedure. Coat components with engine oil before installing. Tighten all nuts and bolts to specifications. See **TORQUE SPECIFICATIONS**.

CAMSHAFT

Removal

Remove lifters. See **LIFTER**. Remove timing chains. See **TIMING CHAINS**. Remove balance shaft drive gear from camshaft. Remove camshaft thrust plate. Remove camshaft.

Inspection

Measure camshaft bore I.D., journal O.D., oil clearance and lobe lift. Replace camshaft if measurements are not within specification. See **CAMSHAFT** table under ENGINE SPECIFICATIONS.

Installation

Coat camshaft bearings, journals and lobes with Engine Assembly Lubrication (D9AZ-19579-D). Install camshaft. To complete installation, reverse removal procedures. Tighten all nuts and bolts to specification. See **TORQUE SPECIFICATIONS**.

CAMSHAFT SYNCHRONIZER

CAUTION: DO NOT rotate crankshaft or camshaft during removal and installation procedure or fuel system timing will be out of time. Possible engine damage may occur.

Removal

1. Disconnect negative battery cable(s). Position crankshaft so piston No. 1 is at TDC of compression stroke. Partially drain cooling system. Remove air cleaner assembly. Disconnect EGR vacuum hose from EGR valve. Remove EGR valve and adapter. Disconnect heater outlet tube, and position aside.
2. Disconnect camshaft position sensor harness connector. Mark orientation of camshaft position sensor electrical connector. Remove camshaft position sensor. Remove camshaft synchronizer retaining bolt. Remove camshaft synchronizer.

NOTE: Oil pump driveshaft might come out with camshaft synchronizer. If so, retrieve oil pump driveshaft before proceeding.

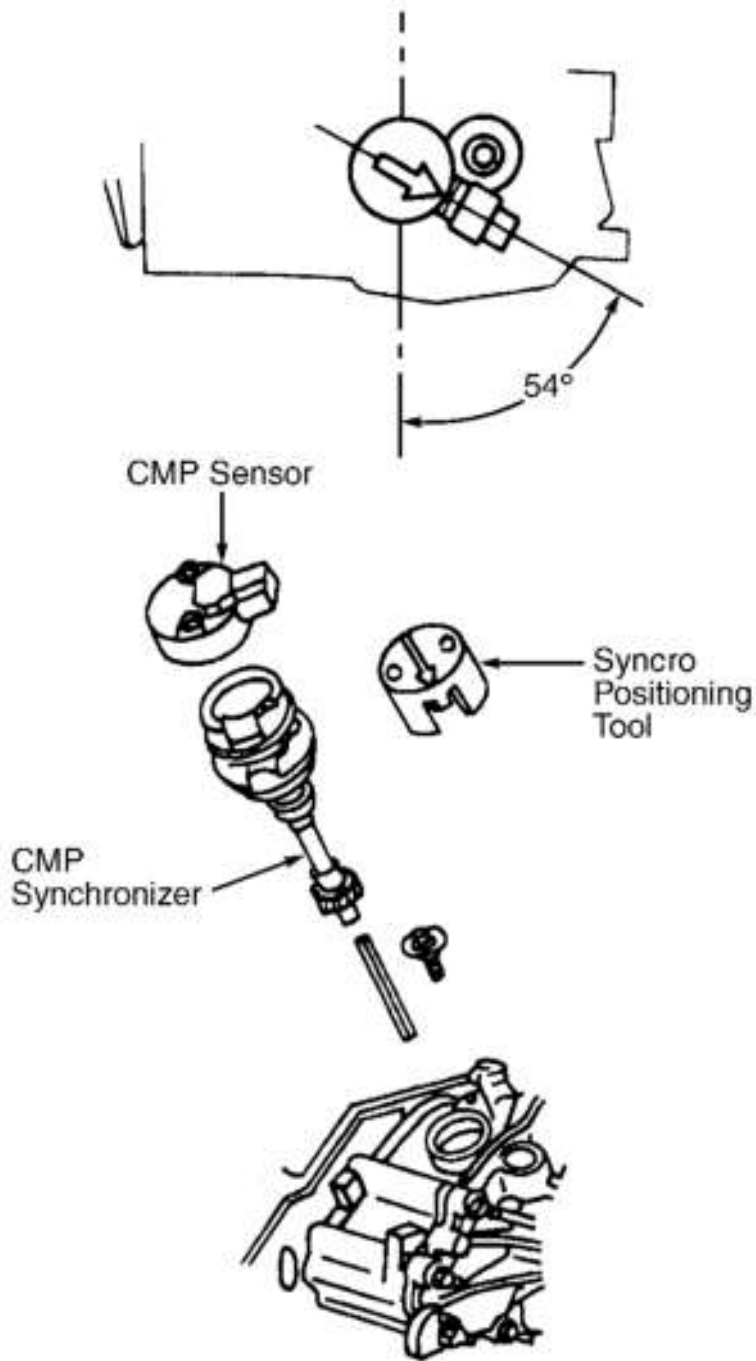
CAUTION: Synchro Positioner (T96T-12200-A) must be used during installation of synchronizer assembly. Failure to do so will result in fuel system to be out of time, and possible engine damage may occur.

Installation

1. Ensure crankshaft is still at TDC No. 1 compression stroke. Install synchro positioning tool on camshaft synchronizer by rotating tool until it engages notch in camshaft synchronizer housing.

NOTE: During installation, arrow on synchro positioning tool will rotate clockwise as gears engage.

2. Install camshaft synchronizer so arrow on synchro positioning tool is 54 degrees from centerline of engine. See **Fig. 11**. Install camshaft synchronizer retaining bolt.
3. Remove synchro positioning tool. Install camshaft position sensor. To complete installation, reverse removal procedure. Tighten nuts and bolts to specification. See **TORQUE SPECIFICATIONS**.



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Fig. 11: Aligning Camshaft Synchronizer
Courtesy of FORD MOTOR CO.

BALANCE SHAFT

Removal

Remove timing chain. See **TIMING CHAINS**. Remove balance shaft drive gear from camshaft. Remove balance shaft thrust plate retaining bolts. Remove balance shaft.

Installation

To install, reverse removal procedure. Tighten nuts and bolts to specification. See **TORQUE SPECIFICATIONS**. Ensure all timing mark are aligned. See **Fig. 9**.

CRANKSHAFT REAR OIL SEAL

Removal

Remove transmission. For A/T, see REMOVAL & INSTALLATION - A/T article in TRANSMISSION SERVICING. For M/T, see appropriate article in CLUTCHES. Remove flywheel. Using Rear Crankshaft Slinger Remover (T95P-6701-EH) and Slide Hammer (T50T-100-A), remove oil seal.

Installation

Clean and inspect all mating surface. Using Rear Seal Replacer (T82L-6701-A), install oil seal. To complete installation, reverse removal procedure. Tighten nuts and bolts to specification. See **TORQUE SPECIFICATIONS**.

THERMOSTAT

Removal

Partially drain cooling system. Remove upper radiator hose. Remove water outlet bolts. Remove water outlet connection. Remove water thermostat and paper gasket assembly.

Installation

NOTE: Water thermostat is indexed and must be installed correctly.

Install thermostat. Install water outlet adapter and bolts. Connect upper radiator hose. Fill cooling system.

WATER PUMP

Removal & Installation

Drain cooling system. Remove cooling fan and shroud. Remove radiator. Remove accessory drive belt. Remove water pump pulley. Disconnect lower radiator hose from water pump. Disconnect water by-pass tube and engine harness clamp from water pump. Remove A/C support bracket from water pump. Remove water pump retaining bolts. Remove water pump and gasket. To install, reverse removal procedure. Tighten all nut and bolts to specifications. See **TORQUE SPECIFICATIONS**.

OIL PAN

WARNING: The electrical power to air suspension system must be shut off prior to hoisting, jacking or towing an air suspension vehicle. Air suspension switch is located behind right kick panel area. Failure to do so can result in accidental deflation or inflation of air springs, which may cause vehicle to shift during these operations.

Removal (4x2 Pickup)

The oil pan on a 4x2 vehicle cannot be removed in-vehicle. Remove engine. See **ENGINE**. Remove the oil level indicator tube bolt and remove tube, if necessary. Discard "O" ring. Remove oil filter, if necessary. Remove oil pan bolts and remove oil pan.

Removal (4WD Pickup)

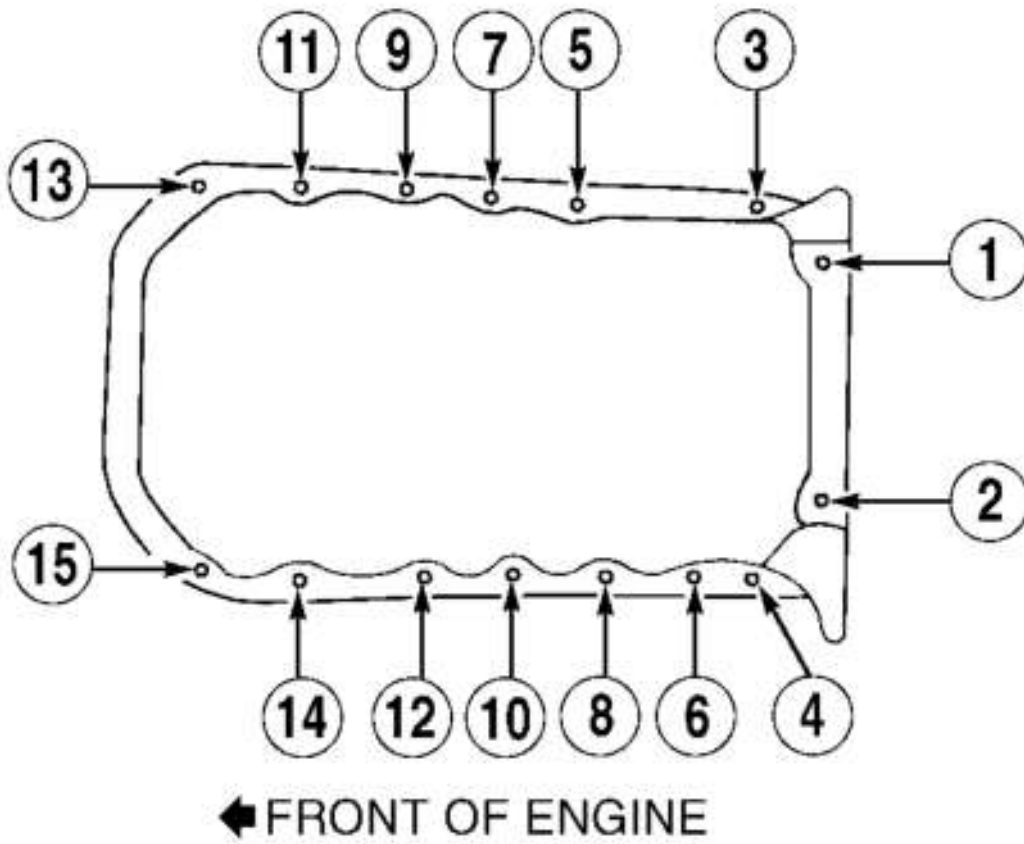
1. With transmission in Neutral, raise and support vehicle. Mark front drive shaft and differential flange for installation reference. Disconnect front drive shaft from differential and support drive shaft. Disconnect front halfshafts from differential, and support aside.
2. Disconnect vacuum lines from front axle tube. Using Hi-Lift Jack (014-00210) support front differential. Remove front differential support. Remove front differential bolts. Lower front differential, and position aside. Remove oil pan retaining bolts in reverse sequence. See **Fig. 12**. Remove oil pan and gasket.

Removal (Van)

1. Disconnect negative battery cable(s). Drain cooling system. Remove engine cover. Remove air cleaner and outlet tube assembly. Remove cooling fan and fan shroud. Remove oil indicator tube. Remove upper intake manifold. See **INTAKE MANIFOLD**. Raise and support vehicle.
2. Drain engine oil. Loosen transmission mount-to-rear crossmember nuts. Disconnect exhaust pipe at exhaust manifolds. Remove motor mount-to-subframe nuts. Remove flywheel inspection plate. Raise engine about 13" and position blocks between motor mounts and subframe. Remove oil pan retaining bolts. Remove oil pan and gasket.

Installation

To install, reverse removal procedure. Apply silicone sealant on front cover and seal retainer-to-cylinder block areas before installing gasket and oil pan. Tighten all bolts to specification. See **TORQUE SPECIFICATIONS**.



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Fig. 12: Oil Pan Bolt Tightening Sequence
 Courtesy of FORD MOTOR CO.