ENGINE MECHANICAL

Engine Overhaul Tips

Most engine overhaul procedures are fairly standard. In addition to specific parts replacement procedures and specifications for your individual engine, this section is also a guide to acceptable rebuilding procedures. Examples of standard rebuilding practice are shown and should be used along with specific details concerning your particular engine.

Competent and accurate machine shop services will ensure maximum performance, reliability and engine life.

In most instances, it is more profitable for the do-it-yourself mechanic to remove, clean and inspect the component, buy the necessary parts and deliver these to a shop for actual machine work.

On the other hand, much of the rebuilding work (crankshaft, block, bearings, piston rods, and other components) is well within the scope of the do-it-yourself mechanic's tools and abilities. You will have to decide for yourself the depth of involvement you desire in an engine repair or rebuild.

TOOLS

The tools required for an engine overhaul or parts replacement will depend on the depth of your involvement. With few exceptions, they will be the tools found in a mechanic's basic tool kit (see Section 1 of this manual). More in-depth work will require some or all of the following:

- **a dial indicator (reading in thousandths) mounted on a universal base**
- **micrometers and telescoping gauges**
- **jaw and screw-type pullers**
- **scraper**
- **valve spring compressor**
- **ring groove cleaner**
- **piston ring expander and compressor**
- **ridge reamer**
- **cylinder hone or glaze breaker**
- **Plastigage®**
- **engine stand**

The use of most of these tools is covered in this section. Many can be rented for a one-time use from a local parts jobber or tool supply house specializing in automotive work.

Occasionally, the use of special tools is called for. See the information on Special Tools and the Safety Notice in the front of this book before substituting another tool.

INSPECTION TECHNIQUES

Procedures and specifications are given in this section for inspecting, cleaning and assessing the wear limits of most major components. Other procedures such as Magnaflux® and Zyglo® can be used to locate material flaws and stress cracks. Magnaflux® is a magnetic process applicable only to ferrous materials. The Zyglo® process coats the material with a fluorescent dye penetrant and can be used on any material. Checking for suspected surface cracks can be more readily made using spot check dye. The dye is sprayed onto the suspected area, wiped off and the area sprayed with a developer. Cracks will show up brightly.

OVERHAUL TIPS

Aluminum has become extremely popular for use in engines, due to its low weight. Observe the following precautions when handling aluminum parts:

- **Never hot tank aluminum part (the caustic hot tank solution will eat the aluminum).**
- **Remove all aluminum parts (identification tag, etc.) from engine parts prior to the tanking.**
- **Always coat threads lightly with engine oil or anti-seize compounds before installation, to prevent seizure.**
- **Never overtorque bolts or spark plugs, especially in aluminum threads.**

When assembling the engine, any parts that will be exposed to frictional contact must be prelubed to provide lubrication at initial start-up. Any product specifically formulated for this purpose can be used, but engine oil is not recommended as a prelube in most cases.

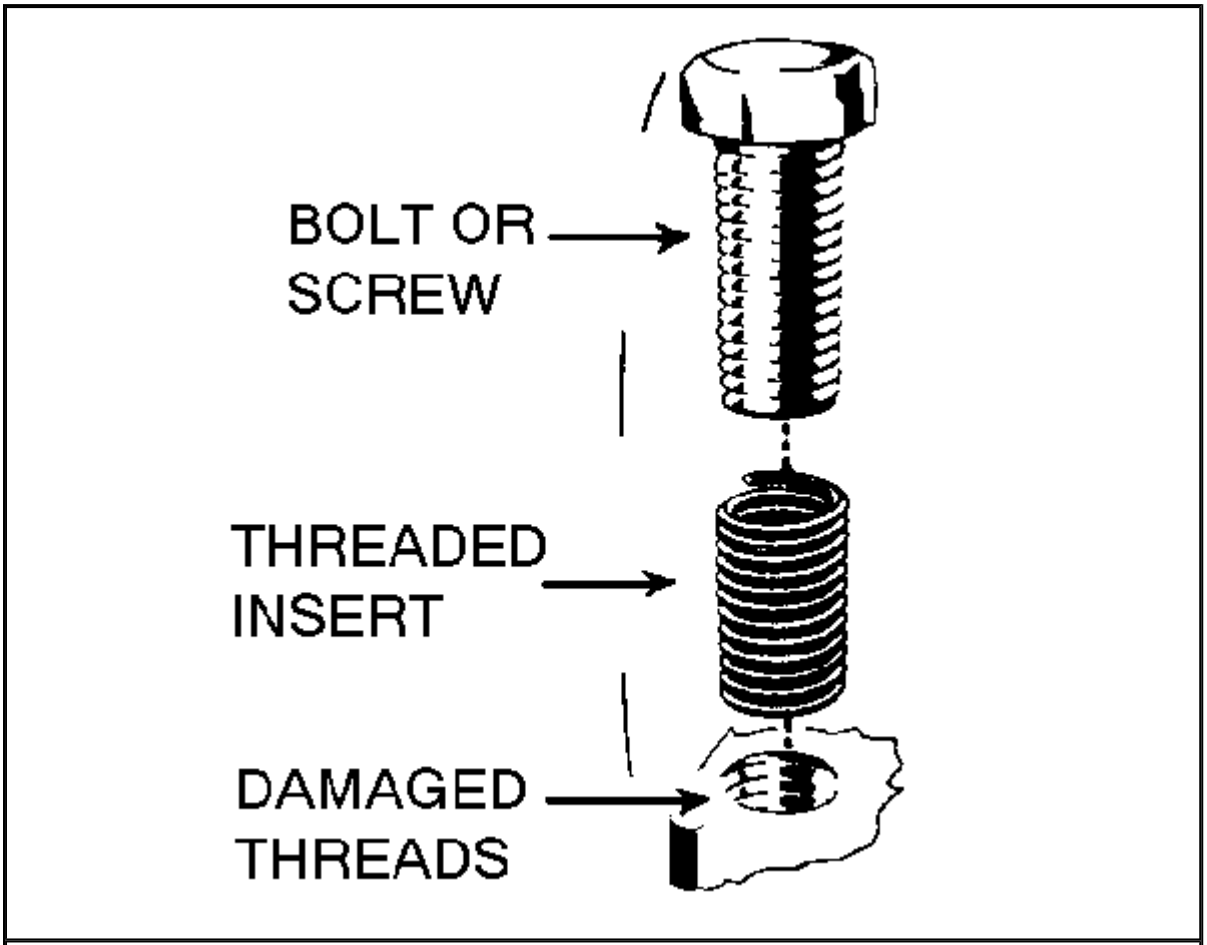
When semi-permanent (locked, but removable) installation of bolts or nuts is desired, threads should be cleaned and coated with Loctite® or other similar, commercial non-hardening sealant.

REPAIRING DAMAGED THREADS

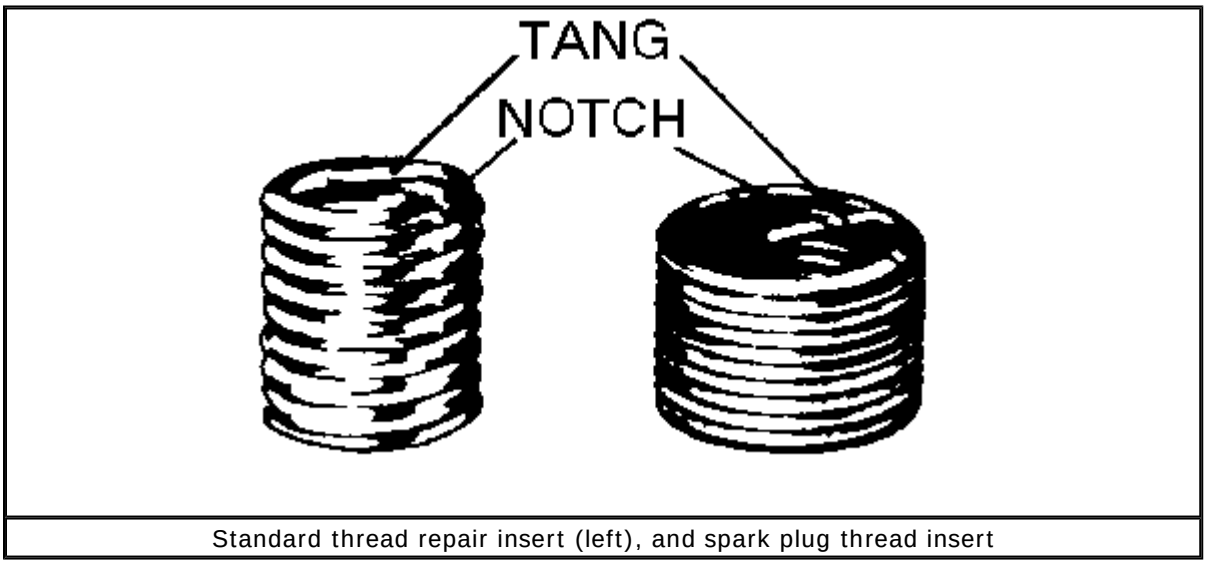
Several methods of repairing damaged threads are available. Heli-Coil® (shown here), Keenserts® and Microdot® are among the most widely used. All involve basically the same principle-drilling out stripped threads, tapping the hole and installing a prewound insert-making welding, plugging and oversize fasteners unnecessary.

Two types of thread repair inserts are usually supplied: a standard type for most Inch Coarse, Inch Fine, Metric Coarse and Metric Fine thread sizes, and a spark plug type to fit most spark plug port sizes. Consult the individual manufacturer's catalog to determine exact applications. Typical thread repair kits will contain a selection of prewound threaded inserts, a tap (corresponding to the outside diameter threads of the insert) and an installation tool. Spark plug inserts usually differ because they require a tap equipped with pilot threads and a combined reamer/tap section. Most manufacturers also supply blister-packed thread repair inserts separately, in addition to a master kit containing a variety of taps and inserts plus installation tools.

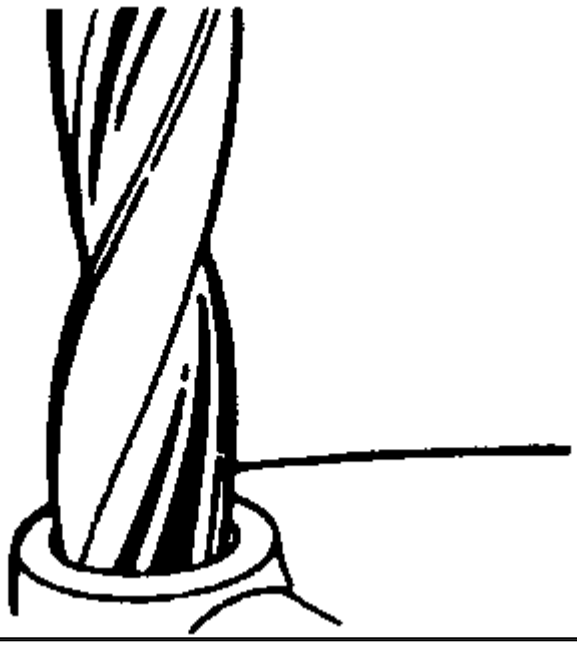
Before effecting a repair to a threaded hole, remove any snapped, broken or damaged bolts or studs. Penetrating oil can be used to free frozen threads. The offending item can be removed with locking pliers or with a screw or stud extractor. After the hole is clear, the thread can be repaired, as shown in the series of accompanying illustrations and in the kit manufacturer's instructions.



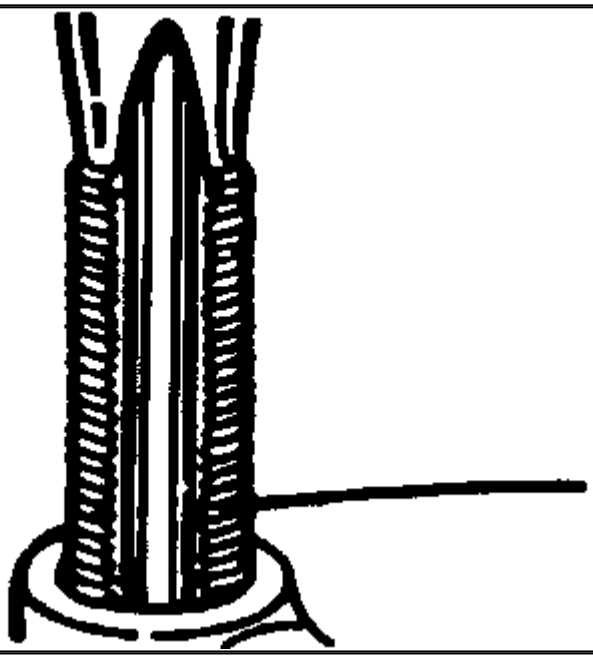
Damaged bolt hole threads can be replaced with thread repair inserts



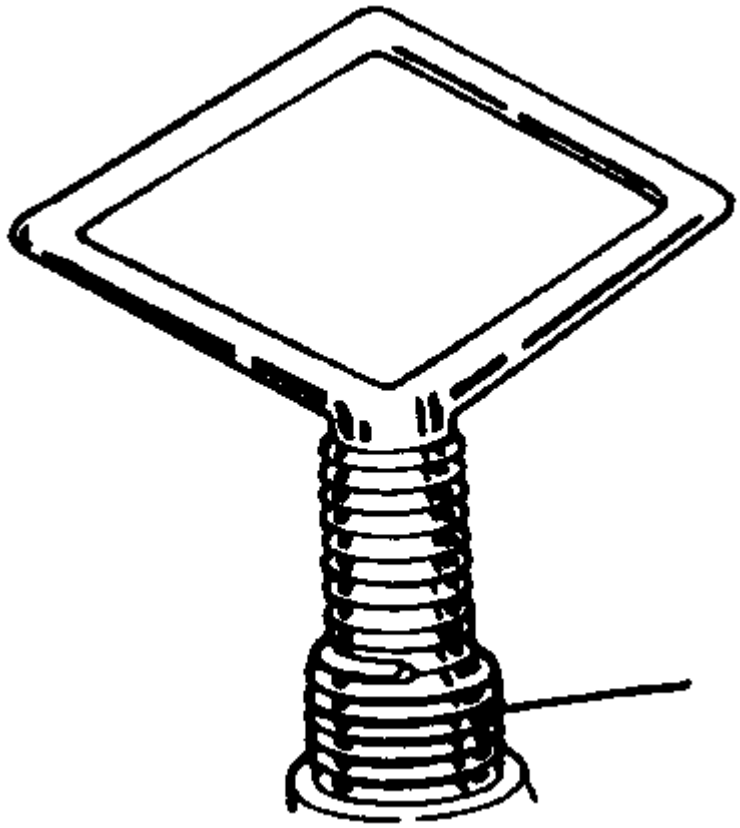
Standard thread repair insert (left), and spark plug thread insert



Drill out the damaged threads with the specified drill. Be sure to drill completely through the hole or to the bottom of a blind hole



Using the kit, tap the hole in order to receive the thread insert. Keep the tap well oiled and back it out frequently to avoid clogging the threads



Screw the threaded insert onto the installer tool until the tang engages the slot. Thread the insert into the hole until it is $^{1}/_{4}$-$^{1}/_{2}$ turn below the top surface, then remove the tool and break off the tang using a punch

Engine

REMOVAL & INSTALLATION

CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container. Coolant should be reused unless it is contaminated or several years old.

The EPA warns that prolonged contact with used engine oil may cause a number of skin disorders, including cancer! You should make every effort to minimize your exposure to used engine oil. Protective gloves should be worn when changing the oil. Wash your hands and any other exposed skin areas as soon as possible after exposure to used engine oil. Soap and water, or waterless hand cleaner should be used.

WARNING

The manufacturer requires the discharge and recovery of the air conditioning system for these procedures. DO NOT attempt this without the proper equipment! Depending on your vehicle application,

the air conditioning system may utilize R-12 or R-134a refrigerant. These two refrigerants should NOT be mixed, and depending on your local laws, attempting to service your A/C system could be illegal!

2.5L Engine

1. **Properly relieve the fuel system pressure. For fuel system relief procedures, please refer to *Section 1* or *Section 5* of this manual.**
2. **If equipped with an automatic transaxle, remove the transaxle timing window cover and rotate the engine until the flywheel timing marker is aligned with the timing pointer.**
3. **If equipped with an automatic transaxle, place a reference mark on the crankshaft pulley at the 12 o'clock position (TDC) then rotate the crankshaft pulley mark to the 6 o'clock position (BTDC).**
4. **Disconnect the negative battery cable.**
5. **Matchmark the hood hinges for installation reference, then remove the hood.**
6. **Remove the air cleaner assembly, then position a drain pan under the radiator and drain the cooling system. Close the drain valve.**
7. **Disconnect the upper radiator hose at the engine.**
8. **Identify, tag and disconnect all electrical wiring and vacuum hoses as required.**
9. **Disconnect the crankcase ventilation hose at the valve cover and the intake manifold.**
10. **Disconnect the fuel lines at the fuel rail, then disconnect the heater hoses at the water outlet connector and the water pump.**
11. **Disconnect the engine ground wire.**
12. **Disconnect the accelerator and throttle valve control cables at the throttle body.**
13. **If equipped, properly discharge the air conditioning system and remove the suction and discharge lines from the compressor.**
14. **On manual transaxle equipped vehicles, remove the engine damper brace.**
15. **Remove the driver belt and water pump pulley.**
16. **Remove the air cleaner-to-canister hose.**
17. **Raise and safely support the vehicle.**
18. **Drain the engine oil, then remove the oil filter.**
19. **Disconnect the starter cable, then remove the starter motor. For details regarding starter motor removal, please refer to the procedure earlier in this section.**
20. **On automatic transaxle equipped vehicles, remove the converter nuts and align the previously made reference mark as close to the 6 o'clock (BTDC) position as possible with the converter stud visible.**

The flywheel timing marker must be in the 6 o'clock (BTDC) position for proper engine removal and installation.

21. **Disconnect the engine damper at the subframe bracket.**
22. **Remove the engine insulator nuts.**
23. **Disconnect the exhaust pipe from the manifold.**

24. **Disconnect the canister and halfshaft brackets from the engine.**
25. **Remove the lower engine-to-transaxle retaining bolts.**
26. **Disconnect the lower radiator hose.**
27. **Carefully lower the vehicle, then position a floor jack under the transaxle.**
28. **Disconnect the power steering lines from the power steering pump.**
29. **Install engine lifting eyes tool D81L-6001-D or equivalent and engine support tool T79P-6000-A or equivalent.**
30. **Connect suitable lifting equipment to support the engine, then remove the upper engine-to-transaxle retaining bolts.**
31. **Remove the engine from the vehicle and support on a suitable holding fixture, then remove the lifting equipment.**

To install:

32. **Install engine lifting eyes tool D81L-6001-D and engine support tool T79P-6000-A or equivalent, then attach the lifting equipment.**

Make sure the timing marker is in the 6 o'clock (BDC) position.

33. **Remove the engine from the stand and position it in the vehicle. Remove the lifting equipment.**
34. **Using a floor jack to aid in alignment, install the upper engine-to-transaxle bolts and tighten them to 26-34 ft. lbs. (35-46 Nm).**
35. **Connect the power steering lines to the pump.**
36. **Raise and safely support the vehicle.**
37. **Connect the lower radiator hose to the tube.**
38. **Install the lower engine-to-transaxle attaching bolts and tighten to 26-34 ft. lbs. (35-46 Nm).**
39. **Connect the halfshaft and canister brackets to the engine.**
40. **Connect the exhaust pipe to the manifold.**
41. **Install the engine insulator nuts and tighten them to 40-55 ft. lbs. (54-75 Nm).**
42. **Position the marks on the crankshaft pulley as close to 6 o'clock position (BTDC) as possible, and install the converter nuts. Tighten the nuts to 20-33 ft. lbs. (27-45 Nm).**
43. **Install the starter, then connect the starter cable. For details, please refer to the procedure earlier in this section.**
44. **Install the oil filter and make sure the oil drain plug is tight.**
45. **Connect the engine damper-to-subframe bracket.**
46. **Carefully lower the vehicle.**
47. **Install the air cleaner-to-canister hose, and the water pump pulley and drive belt.**
48. **If equipped with A/C, connect the pressure and suction lines to the air conditioning compressor.**
49. **Connect the accelerator cable and throttle valve control cable at the throttle body.**
50. **Connect the ground wire at the engine, then connect the heater hoses at the water outlet connector and the water pump.**

51. **Connect the fuel lines to the fuel rail.**
52. **Connect the crankcase ventilation hose at the valve cover and the intake manifold.**
53. **Connect the engine control sensor wiring assembly and vacuum lines.**
54. **Connect the upper radiator hose at the engine, then install the air cleaner assembly.**
55. **Connect the negative battery cable.**
56. **Rotate the engine until the flywheel timing marker is aligned with the timing pointer.**
57. **Install the timing window cover.**
58. **Engage the electrical connector at the inertia switch.**
59. **Fill the cooling system with the proper amount and type of coolant. Fill the crankcase with the proper engine oil to the required level.**
60. **Align and install the hood, using the marks made during removal.**
61. **Charge the air conditioning system, if equipped.**
62. **Check all fluid levels, the start the vehicle and check for leaks.**

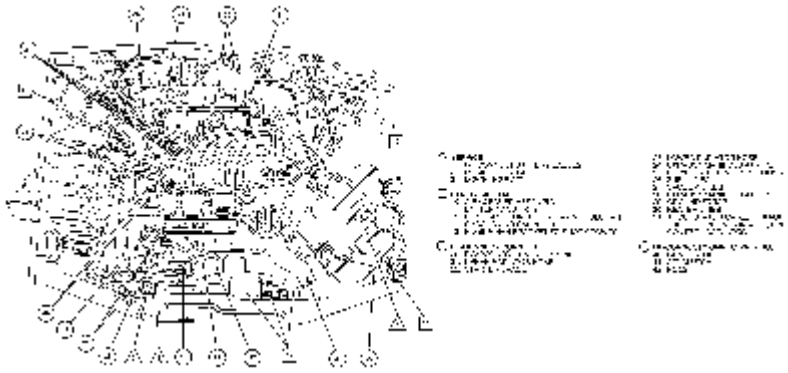
3.0L Engine

EXCEPT SHO ENGINES

1. **Disconnect the battery cables, then properly drain the cooling system.**
2. **Matchmark the hood hinges for installation reference, then remove the hood.**
3. **Evacuate the air conditioning system safely and properly.**
4. **Relieve the fuel system pressure. For details regarding this procedure, please refer to *Section 1* or *Section 5* of this manual.**
5. **Remove the air cleaner assembly, then remove the battery and the battery tray.**
6. **Remove the integrated relay controller, cooling fan and radiator with fan shroud. Remove the engine bounce damper bracket on the shock tower.**
7. **Remove the evaporative emission line, upper radiator hose, starter brace and lower radiator hose.**
8. **Remove the exhaust pipes from both exhaust manifolds. Disconnect and plug the power steering pump lines.**
9. **Disconnect the fuel lines, then remove and tag all necessary vacuum lines.**
10. **Disconnect the ground strap, heater lines, accelerator cable linkage, throttle valve linkage and speed control cable.**
11. **For gasoline engines, tag and disengage the following wiring connectors; alternator, A/C clutch, heated oxygen sensor, ignition coil, radio frequency suppressor, cooling fan voltage resistor, engine coolant temperature sensor, ignition control module, injector wiring harness, ISC motor wire, throttle position sensor, oil pressure sending switch, ground wire, block heater (if equipped), knock sensor, EGR sensor and oil level sensor.**
12. **For Flexible Fuel (FF) engines, tag and disengage the following wiring connectors: alternator, A/C clutch, heated oxygen sensor, engine control sensor, injector wiring harness, IAT sensor, IAC sensor, throttle position sensor, oil pressure sending switch, engine ground wire, block heater (if equipped), low oil level sensor, and the water temperature indicator sender unit.**

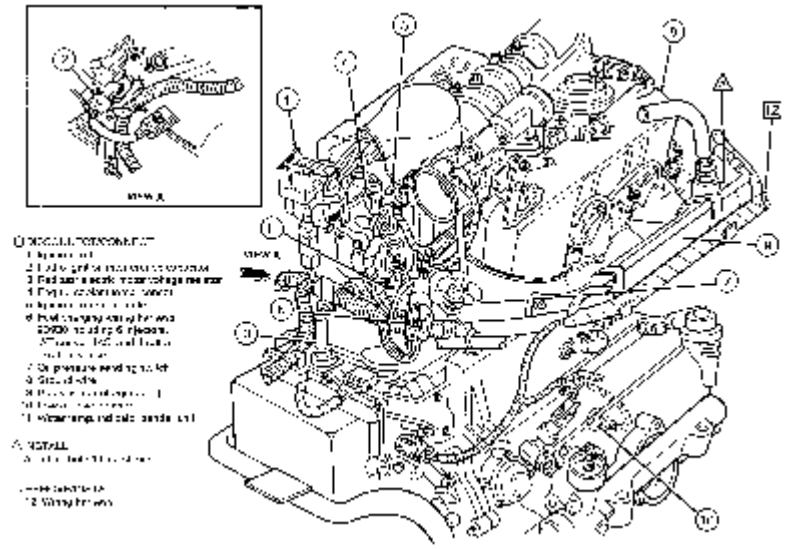
13. **Raise the vehicle and support it safely. Remove the engine mount bolts and engine mounts. Remove the transaxle to engine mounting bolts and transaxle brace assembly.**

14. **Lower the vehicle. Install a suitable engine lifting plate onto the engine and use a suitable engine hoist to remove the engine from the vehicle. Remove the main wiring harness from the engine.**



Engine removal/component disconnect points-3.0L gasoline engine

Click to enlarge



Engine removal/component disconnect points (continued)-3.0L gasoline engine

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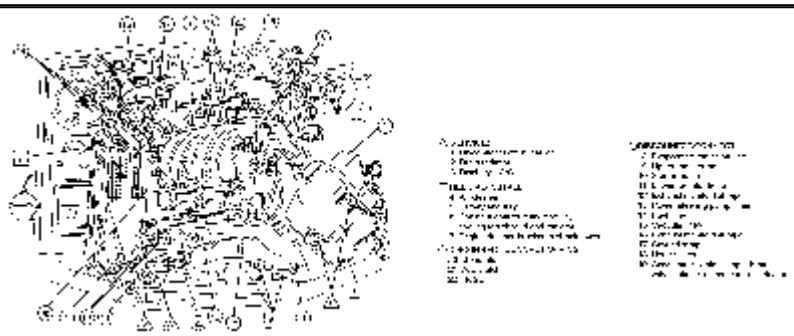
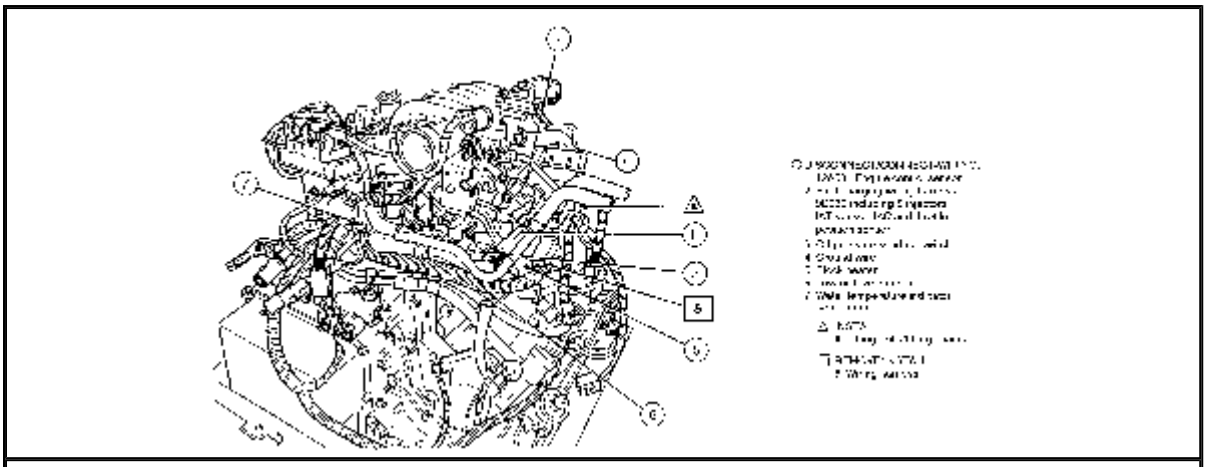


Engine removal/component disconnect points-3.0L Flexible Fuel (FF) engine

Click to enlarge



Engine removal/component disconnect points (continued)-3.0L Flexible Fuel (FF) engine

Click to enlarge

To install:

15. **Install the main wiring harness on the engine. Position the engine in the vehicle and remove the engine lifting plate.**
16. **Raise the vehicle and support it safely. Install the engine mounts and bolts, and tighten to 40-55 ft. lbs. (54-75 Nm). Install the transaxle brace assembly and tighten the bolts to 40-55 ft. lbs. (54-75 Nm).**
17. **Attach all wiring connectors according to their labels.**
18. **Connect the ground strap, heater lines, accelerator cable linkage, throttle valve linkage and speed control cables.**
19. **Connect the power steering pump lines.**
20. **Fasten the exhaust pipes to the exhaust manifolds.**
21. **Connect the fuel lines and vacuum lines.**
22. **Install the evaporative emission line, upper radiator hose, starter brace and lower radiator hose.**
23. **Install the integrated relay controller, cooling fan and radiator with fan shroud. Install the engine bounce damper bracket on the shock tower.**
24. **Install the battery tray and the battery, then install the air cleaner assembly.**
25. **Charge the air conditioning system, using the correct equipment and precautions.**
26. **Fill the cooling system with the proper type and quantity of coolant. Fill the crankcase with the correct type of motor oil to the required level.**
27. **Install the hood according to the alignment marks made during removal.**
28. **Connect the negative battery cable, then start the engine and check for leaks.**

3.0L and 3.2L SHO Engines

1. **Properly drain the engine cooling system.**
2. **Disconnect the battery cables, then remove the battery and battery tray.**
3. **Properly relieve the fuel system pressure. For details, please refer to the procedure in *Section 1* or *Section 5* of this manual.**
4. **If equipped, disengage the wiring connector retaining the underhood light, then**

mark the position of the hood hinges and remove the hood.

5. Remove the oil level dipstick.
6. Disengage the alternator and voltage regulator wiring assembly.
7. Remove the radiator upper sight shield.
8. Properly discharge the air conditioning system, using suitable equipment.
9. Remove the radiator coolant recovery reservoir assembly.
10. Remove the computer control module, air cleaner outlet tube assembly, upper radiator hose, electric fan and shroud assembly.
11. Remove the lower radiator hose, then remove the radiator.
12. Disconnect the fuel supply hose and the fuel return hose from the fuel injection supply manifold.
13. Remove the Barometric Absolute Pressure (BAP) sensor.
14. Remove the engine vibration damper and bracket assembly from the right side of the engine.
15. Remove the engine mounting damper bracket.
16. Remove the retaining bolt from the power steering reservoir and place the reservoir aside. Disconnect and plug the hose to the power steering oil cooler at the power steering pump.
17. Disconnect the throttle linkage, then tag and disconnect the vacuum hoses.
18. Disconnect the heater hoses at the heater core.
19. Disengage the electrical connectors from the engine control sensor wiring on the rear of the engine.
20. On the 3.0L SHO engine only, loosen the accessory drive belt tensioner pulley, then remove the belt from the A/C compressor and the alternator.
21. On the 3.2L SHO engine only, loosen the accessory drive belt tensioner. Remove the single accessory drive belt, then remove the tensioner pulley.
22. On the 3.0L SHO only, loosen the accessory drive belt lower tensioner pulley, then remove the power steering pump belt, and the lower tensioner pulley.
23. Disconnect the A/C cycling switch on top of the suction accumulator/drier.
24. Disconnect the evaporator-to-compressor suction line at the dash panel, then remove the suction accumulator/drier and the A/C accumulator bracket.
25. Remove the alternator assembly. For details, please refer to the procedure located earlier in this section.
26. Disconnect the A/C manifold and tube, then remove the A/C compressor and bracket assembly.
27. Raise and safely support the vehicle.
28. Place a drain pan under the vehicle's oil pan, then drain the motor oil and remove the filter element. Move the drain pan away from the vehicle.
29. Remove the wheel and tire assemblies. Disengage the oil level sensor switch.
30. Disconnect the right-side lower ball joint, tie rod end and front stabilizer bar.
31. Remove the front axle bearing bracket from the cylinder block, then remove the right-side halfshaft from the transaxle.
32. Disconnect the heated oxygen sensor assembly.

33. **Disconnect the 4 dual converter/Y pipe-to-exhaust manifold retaining bolts.**
34. **Remove the starter motor assembly. For details, please refer to the procedure located earlier in this section.**
35. **Remove the lower transaxle-to-engine retaining bolts.**
36. **Remove the front engine mount-to-front subframe retaining nuts.**
37. **Remove the crankshaft vibration damper and pulley assembly.**
38. **Carefully lower the vehicle, then remove the upper transaxle-to-engine retaining bolts.**
39. **Install engine lifting bracket D89L-6001-A or equivalent, according to manufacturer's instructions.**
40. **Position Rotunda Hi-Lift Jack 014-00210, or an equivalent floor jack under the transaxle.**
41. **Position Rotunda Three Bar Engine Support 014-00750 or equivalent, then raise the transaxle assembly slightly and remove the engine assembly from the vehicle.**

To install:

42. **Position the engine assembly in the vehicle.**
43. **Install the upper transaxle-to-engine bolts, then remove the floor jack and engine lifting equipment.**
44. **Raise and safely support the vehicle.**
45. **Install the crankshaft damper and pulley assembly. Tighten the retaining bolt to 112-127 ft. lbs. (152-172 Nm).**
46. **Install the front engine mount-to-front subframe nuts.**
47. **Install the lower transaxle-to-engine retaining bolts. Tighten the bolts to 25-35 ft. lbs. (34-47 Nm).**
48. **Install the starter motor assembly. For details, please refer to the procedure located earlier in this section.**
49. **Install the 4 dual converter Y pipe-to-exhaust manifold retaining nuts, then tighten them to 20-35 ft. lbs. (27-47 Nm).**
50. **Apply anti-seize compound to the threads, then install the heated oxygen sensor. Tighten the sensor to 27-33 ft. lbs. (37-45 Nm).**
51. **Install the right-side halfshaft to the transaxle, then connect the front axle bearing bracket the cylinder block. Tighten the retaining bolts to 30-47 ft. lbs. (40-64 Nm).**
52. **Connect the right-side lower ball joint, tie rod end and the front stabilizer bar.**
53. **Connect the low oil level sensor, then install the wheel and tire assemblies. Tighten the wheel lug nuts to 85-105 ft. lbs. (115-142 Nm).**
54. **Install the oil filter, then install the oil drain plug and tighten to 15-24 ft. lbs. (20-33 Nm).**
55. **Carefully lower the vehicle.**
56. **Install the A/C compressor and mounting bracket assembly, then tighten to 27-41 ft. lbs. (36-55 Nm). Connect the A/C manifold and tube.**
57. **Install the alternator assembly and tighten the retaining bolts to 36-53 ft. lbs. (49-72 Nm).**
58. **Install the suction accumulator/drier and the A/C accumulator bracket assembly,**

then connect the cycling switch to the top of the accumulator.

59. For the 3.2L SHO, install the accessory drive belt tensioner pulley. For the 3.0L SHO, install the lower belt tensioner.
60. For the 3.0L SHO, install the power steering accessory belt (4-rib belt), then tighten the accessory drive belt tensioner pulley.
61. On the 3.0L SHO, install the accessory drive belt on the A/C compressor, and the alternator pulley, then tighten the tensioner pulley. On the 3.2L SHO, install the single accessory drive belt, then release the accessory drive belt tensioner.
62. Engage the electrical connectors from the engine control sensor wiring on the rear of the engine.
63. Connect the heater hoses at the heater core. Attach the vacuum hoses and the throttle linkage.
64. Connect the power steering pressure hose from the power steering oil cooler at the power steering pump, then install the power steering reservoir.
65. Install the damper bracket to the engine, then install the engine vibration damper and bracket assembly to the right side of the engine.
66. Install the Barometric Absolute Pressure (BAP) sensor.
67. Connect the fuel return and supply hoses.
68. Install the radiator assembly, then connect the lower radiator hose.
69. Install the electric cooling fan and shroud assembly, upper radiator hose, air cleaner outlet tube, computer control module relay, radiator coolant recovery reservoir and the radiator upper sight shield.
70. Engage the alternator and voltage regulator wiring.
71. Install the oil level dipstick.
72. Install the hood according to the marks made during removal, then connect the underhood light wiring, if equipped.
73. Install the battery tray and the battery.
74. Connect the positive, then the negative battery cables.
75. Fill the cooling system with the proper type and quantity of coolant. Fill the crankcase with the proper type of motor oil to the required level.
76. Evacuate, pressure test and recharge the air conditioning system.
77. Start the engine, then check for leaks.

3.8L Engine

1. Drain the cooling system, then disconnect the negative battery cable.
2. Properly relieve the fuel system pressure. For details, please refer to the procedure located in *Section 1* or *Section 5* of this manual.
3. Disengage the underhood light wiring connector. Matchmark the position of the hood hinges, then remove the hood.
4. Remove the oil level indicator tube.
5. Disconnect the alternator-to-voltage regulator wiring assembly.
6. Remove the radiator upper sight shield.
7. If equipped, remove the Powertrain Control Module (PCM) relay and the bracket retaining bolts, then position the PCM relay and bracket out of the way.

8. **Remove the air cleaner assembly.**
9. **Disconnect the cooling fan motor and the front center radiator primary crash sensor wire connectors.**
10. **Remove the cooling fan motor/fan blade and fan shroud assembly.**
11. **Remove the upper radiator hose.**
12. **Disconnect and plug the transaxle oil cooler inlet and outlet tubes to prevent dirt and grease from entering the tubes. Disconnect the heater hoses.**
13. **Disconnect the power steering pressure hose assembly.**
14. **Disconnect the engine control sensor wiring from the A/C clutch field coil. Discharge the A/C system using the proper equipment, then disconnect the compressor-to-condenser discharge line.**
15. **Remove the radiator coolant recovery reservoir assembly. Remove the wiring shield from the throttle body.**
16. **Remove the accelerator cable mounting bracket.**
17. **Disconnect the fuel supply and return lines.**
18. **Disconnect the power steering pump pressure hose from the bracket.**
19. **Disconnect the fuel charging wiring from the engine control sensor wiring assembly.**
20. **Identify, tag and disconnect all necessary vacuum hoses.**
21. **Disconnect the ground wire assembly. Remove the air cleaner outlet tube.**
22. **Disconnect one end of the throttle control valve cable. Detach the bulkhead electrical connector and transaxle pressure switches.**
23. **Remove the transaxle support assembly retaining bolts, then remove the transaxle support assembly from the vehicle.**
24. **Raise and safely support the vehicle. Remove the wheel and tire assemblies.**
25. **Position a drain pan under the car's oil pan, then drain the engine oil and remove the filter. Move the drain pan out of the way.**
26. **Disconnect the heated oxygen sensor.**
27. **Loosen and remove the drive belt. Remove the crankshaft pulley and drive belt tensioner assemblies.**
28. **Remove the starter motor. For details, please refer to the procedure located earlier in this section.**
29. **Remove the dual converter Y-pipe retaining bolts, then remove the Y-pipe.**
30. **Remove the left and right front engine support insulator-to-front subframe retaining nuts.**
31. **If equipped, remove the engine rear cover, then remove the converter-to-flywheel nuts.**
32. **Disconnect the engine control sensor wiring from the low oil level sensor. Remove the crankshaft pulley and damper assembly.**
33. **Disconnect the lower radiator hose.**
34. **Remove the engine-to-transaxle bolts and partially lower the vehicle. Remove the front wheel and tire assemblies.**
35. **Unfasten the water pump pulley retaining bolt, then remove the water pump pulley.**

36. **Remove the distributor cap and position aside, then pull out the distributor rotor.**
37. **Remove the radiator.**
38. **Unfasten the exhaust manifold bolt lock retaining bolts. Remove the thermactor air pump retaining bolts and the thermactor air pump.**
39. **Disconnect the engine control sensor wiring from the oil pressure sensor.**
40. **Install Engine Lifting Eyes D81L-6001-D, or equivalent, then position and install suitable engine lifting equipment.**
41. **Position a suitable jack under the transaxle and raise the transaxle slightly.**
42. **Carefully remove the engine from the vehicle.**

To install:

Lightly oil all bolt and stud threads before installation, except those specifying special sealant.

43. **Position the engine assembly in the vehicle.**
44. **Install the engine-to-transaxle bolts, then remove the jack from under the transaxle and remove the engine lifting equipment. Remove the engine lifting eyes. Place all lifting equipment aside and out of the way.**
45. **Tighten the engine-to-transaxle bolts to 41-50 ft. lbs. (55-68 Nm).**
46. **Engage the engine control sensor wiring to the oil pressure sensor.**
47. **Install the air conditioning compressor and tighten the retaining bolts to 30-45 ft. lbs. (41-61 Nm). Connect the compressor-to-condenser discharge line.**
48. **Connect the A/C clutch field coil to the engine control sensor wiring.**
49. **Fasten the heater hoses and the fuel supply and return hoses, then connect the vacuum hoses.**
50. **Connect the engine control module wiring assembly.**
51. **Attach the transaxle oil cooler inlet and outlet tubes.**
52. **Install the radiator assembly.**
53. **Partially raise and safely support the vehicle.**
54. **Install the converter-to-flywheel nuts/bolts and tighten to 20-34 ft. lbs. (27-46 Nm).**
55. **Install the left and right front engine supports, then install the engine rear plate.**
56. **Install the starter motor. For details, please refer to the procedure located earlier in this section.**
57. **Connect the lower radiator hose.**
58. **Install the drive belt tensioner assembly and the crankshaft pulley and vibration damper assembly. Tighten the crankshaft pulley retaining bolts to 20-28 ft. lbs. (27-38 Nm).**
59. **Install the dual converter Y-pipe, then connect the engine control sensor wiring to the heated exhaust gas oxygen sensor.**
60. **Install the oil filter, then connect the engine control sensor wiring to the low oil level sensor.**
61. **Carefully lower the vehicle.**
62. **Position the thermactor air supply pump and install the retaining bolts.**

63. Connect the vacuum pump and install the exhaust air supply pump pulley assembly.
64. Install the wiring shield.
65. Install the distributor cap and rotor.
66. Install the radiator coolant recovery reservoir assembly, upper radiator hose and water pump pulley.
67. Connect the alternator-to-voltage regulator wiring assembly, then fasten the fuel charging wiring to the engine control sensor wiring.
68. Connect the wiring assembly ground.
69. Install the accelerator cable mounting bracket.
70. Connect the power steering pressure hose assembly and the power steering return hose.
71. Install the cooling fan motor/fan blade and the fan shroud assembly.
72. Connect the cooling fan motor and the front center radiator primary crash sensor wire connectors.
73. Install the Powertrain Control Module (PCM) relay and bracket. Make sure to tighten the retainers securely.
74. Install the drive belts.
75. Position and install the engine and transaxle support assembly.
76. Install the radiator upper sight shield.
77. Partially raise and safely support the vehicle. Install the wheel and tire assemblies, then tighten the lug nuts to 85-105 ft. lbs. (115-142 Nm).
78. Carefully lower the vehicle.
79. Install the hood, using the aligning marks made during removal, and connect the negative battery cable.
80. Fill the cooling system with the proper type and quantity of coolant. Fill the crankcase with the proper type and viscosity of motor oil to the required level.
81. Evacuate, pressure test and recharge the A/C system, using the proper equipment.
82. Start the engine and check for leaks.

Engine Mounts

REMOVAL & INSTALLATION

2.5L and 3.0L Engines

RIGHT REAR ENGINE INSULATOR (NO. 3)

1. Disconnect the negative battery cable. Remove the lower damper nut from the right side of the engine on manual transaxle equipped vehicles. Raise and support the vehicle safely.
2. Place a suitable jack and a block of wood beneath the engine block.
3. Remove the nut attaching the right front and rear insulators to the frame.
4. Raise the engine with the jack until enough of a load is taken off of the insulator.
5. Remove the insulator retaining bolts, then remove the insulator from the engine

support bracket.

6. Installation is the reverse of the removal procedure. Tighten the insulator-to-engine support bracket to 40-55 ft. lbs. (54-75 Nm). Tighten the nut attaching the right, front and rear insulators to the frame to 55-75 ft. lbs. (75-102 Nm).

LEFT ENGINE INSULATOR AND SUPPORT ASSEMBLY-AUTOMATIC TRANSAXLE

1. Disconnect the negative battery cable. Raise and support the vehicle safely. Remove the wheel and tire assembly.
2. Place a suitable jack and a block of wood under the transaxle and support the transaxle.
3. Remove the nuts attaching the insulator to the support assembly. Remove the through-bolts attaching the insulator to the frame.
4. Raise the transaxle with the jack enough to relieve the weight on the insulator.
5. Remove the bolts attaching the support assembly to the transaxle. Remove the insulator and/or transaxle support assembly.
6. Installation is the reverse of the removal procedure. Tighten the support assembly retaining bolts to 40-55 ft. lbs. (54-75 Nm). Tighten the insulator-to-frame bolts to 60-86 ft. lbs. (81-116 Nm). Tighten the insulator-to-support assembly nuts to 55-75 ft. lbs. (74-102 Nm).

LEFT ENGINE INSULATOR AND SUPPORT ASSEMBLY-MANUAL TRANSAXLE

1. Disconnect the negative battery cable. Raise and support the vehicle safely. Remove the tire and wheel assembly.
2. Place a jack and a block of wood under the transaxle and support the transaxle.
3. Remove the bolts attaching the insulator to the frame.
4. Raise the transaxle with the jack enough to relieve the weight on the insulator.
5. Remove the bolts attaching the insulator to the transaxle. Remove the insulator.
6. Installation is the reverse of the removal procedure. Tighten the insulator-to-transaxle bolts to 60-86 ft. lbs. (81-116 Nm). Tighten the insulator-to-frame bolts to 60-86 ft. lbs. (81-116 Nm).

RIGHT FRONT ENGINE INSULATOR (NO. 2)

1. Disconnect the negative battery cable. Remove the lower damper nut or bolt from the right side of the engine. Raise and support the vehicle safely.
2. Place a jack and a block of wood under the engine block.
3. Remove the nuts attaching the right front and rear insulators to the frame.
4. Raise the engine with the jack until enough of a load is taken off of the insulator.
5. Remove the bolt(s) and the insulator from the engine bracket.
6. Installation is the reverse of the removal procedure. Tighten the insulator-to-engine bracket bolt(s) to 40-55 ft. lbs. (54-75 Nm) on the 2.5L engine, or 71-95 ft. lbs. (96-129 Nm) on the 3.0L engine. Tighten the nut attaching the right front and right rear insulators to the frame to 55-75 ft. lbs. (75-102 Nm).

3.0L and 3.2L SHO Engines

RIGHT FRONT (NO. 2) AND RIGHT REAR (NO. 3)

1. Remove the lower damper bolt from the right side of the engine.
2. Raise the vehicle and support it safely.
3. Place a jack and a wood block in a suitable place under the engine.
4. Remove the roll damper-to-engine retaining nuts and remove the roll damper.
5. Raise the engine enough to unload the insulator.
6. Remove the 2 through-bolts and remove the insulators from the engine bracket.
7. Installation is the reverse of the removal procedure. Tighten the insulator-to-engine bracket bolts to 40-55 ft. lbs. (54-75 Nm). Tighten the insulator-to-frame nuts to 50-70 ft. lbs. (68-95 Nm). Tighten the roll damper retaining nuts to 40-55 ft. lbs. (54-75 Nm). Tighten the engine damper-to-engine bolt to 40-55 ft. lbs. (54-75 Nm).

LEFT ENGINE INSULATOR AND SUPPORT ASSEMBLY

1. Remove the bolt retaining the roll damper to the lower damper bracket and place the damper shaft aside.
2. Remove the back-up light switch and the energy management bracket.
3. Raise the vehicle and support it with jackstands under the vehicle body, allowing the subframe to hang.
4. Remove the left tire and wheel assembly.
5. Place a jack and wood block under the transaxle.
6. Remove the nuts retaining the lower damper bracket to the engine mount and the bolts retaining the insulator to the transaxle and subframe.
7. Raise the transaxle with the jack enough to unload the insulator.
8. Remove the insulator and lower damper bracket.
9. Installation is the reverse of the removal procedure. Tighten the damper bracket-to-insulator nuts to 40-55 ft. lbs. (54-75 Nm) and the insulator-to-transaxle bolts to 70-95 ft. lbs. (95-139 Nm). Tighten the insulator-to-frame bolts to 60-85 ft. lbs. (81-115 Nm) and the damper to damper bracket bolt to 40-55 ft. lbs. (54-75 Nm).

3.8L Engine

RIGHT FRONT ENGINE INSULATOR

1. Disconnect the negative battery cable. Remove the air conditioning compressor-to-engine mounting bracket mounting bolts and position the compressor to the side. Do not discharge the air conditioning system.
2. Raise the vehicle and support safely.
3. Remove the nut attaching the engine mount to the air conditioning compressor bracket.
4. Temporarily attach the air conditioning compressor to the mounting bracket with the 2 lower bolts.
5. Position a jack and wood block in a convenient location under the engine block.
6. Remove the upper and lower nuts attaching the right front and left rear insulators to the frame.
7. Raise the engine with the jack enough to relieve the load on the insulator.
8. Remove the insulator assembly. Remove the heat shield from the insulator.

9. Installation is the reverse of the removal procedure. Tighten the upper insulator stud retaining nut to 40-55 ft. lbs. (54-75 Nm) and the lower retaining nut to 50-70 ft. lbs. (68-95 Nm).

RIGHT REAR ENGINE INSULATOR (NO. 3)

1. Disconnect the negative battery cable and raise, then support the vehicle safely.
2. Remove the nuts retaining the right front and right rear engine mounts to the frame.
3. Lower the vehicle.
4. Using suitable engine lifting equipment, raise the engine approximately 1 in. (25mm).
5. Loosen the retaining nut on the right rear (No. 3) mount and heat shield assembly.
6. Raise and support the vehicle safely.
7. Remove the insulator retaining nut and the insulator and heat shield assembly.
8. Installation is the reverse of the removal procedure. Tighten the top retaining nut on the insulator to 40-55 ft. lbs. (54-75 Nm). Tighten the retaining nuts on the right front and right rear engine mounts to 55-75 ft. lbs. (75-102 Nm).

LEFT ENGINE MOUNT AND SUPPORT ASSEMBLY

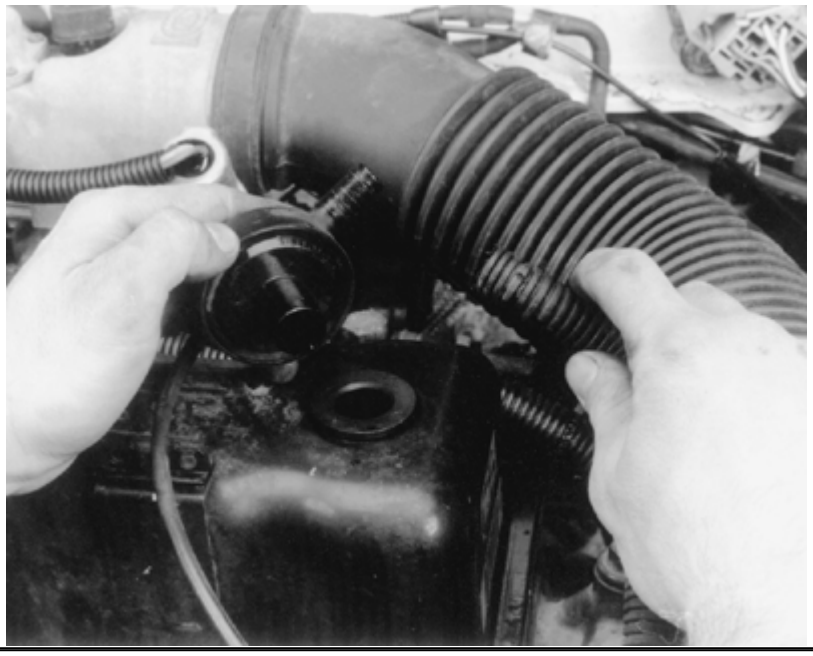
1. Raise the vehicle and support it safely.
2. Remove the tire and wheel assembly.
3. Place a jack and wood block under the transaxle and support the transaxle.
4. Remove the 2 bolts retaining the vertical restrictor assembly.
5. Remove the nut retaining the transaxle mount to the support assembly.
6. Remove the 2 through-bolts retaining the transaxle mount to the frame.
7. Raise the transaxle with the jack enough to unload the mount.
8. Remove the bolts retaining the support assembly to the transaxle and remove the mount and/or transaxle support assembly.
9. Installation is the reverse of the removal procedure. Tighten the support assembly-to-transaxle bolts to 35 ft. lbs. (48 Nm) and the mount-to-frame bolts to 60-86 ft. lbs. (81-116 Nm). Tighten the transaxle mount-to-support nut to 55-75 ft. lbs. (75-102 Nm) and the 2 bolts retaining the vertical restrictor assembly to 40-55 ft. lbs. (54-75 Nm).

Rocker Arm (Valve) Cover

REMOVAL & INSTALLATION

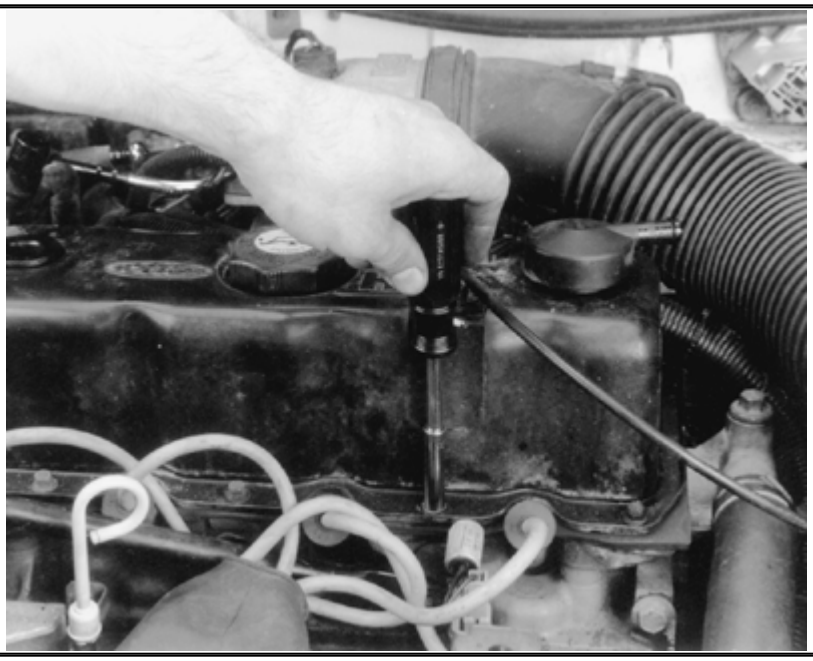
2.5L Engine

1. Disconnect the negative battery cable.
2. If necessary, remove the oil fill cap and rocker arm filter, and set aside.
3. Disconnect the PCV hose and set it aside.

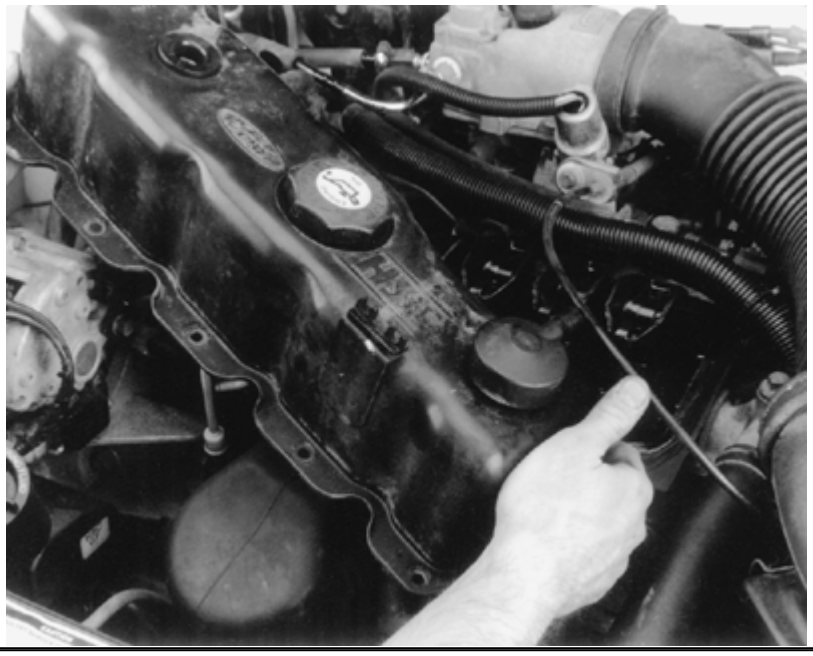


Disconnect the PCV hose, then set it aside-early model 2.5L shown

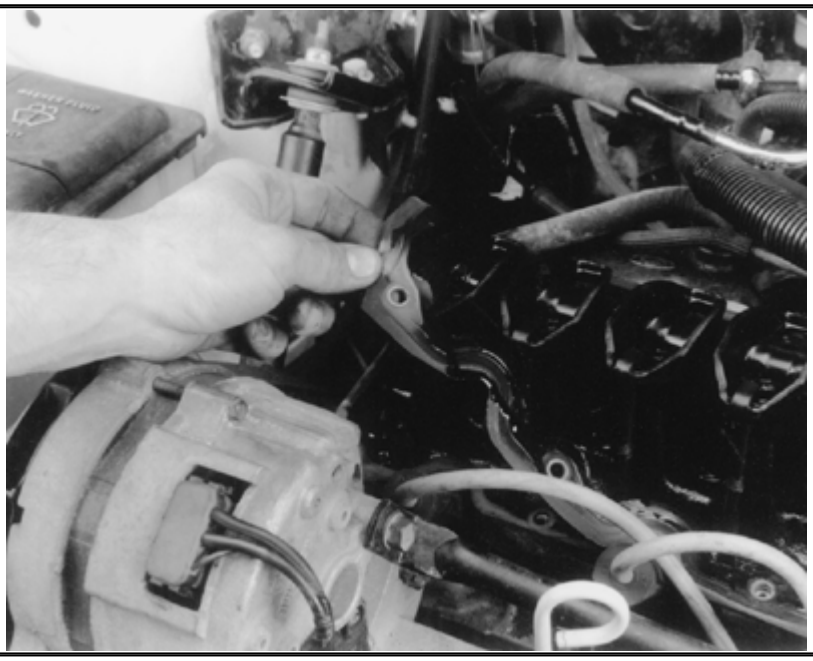
4. **Disconnect the throttle linkage cable from the top of the rocker arm cover. If equipped, disconnect the speed control cable from the top of the rocker arm cover.**
5. **Remove the rocker arm cover bolts. Remove the rocker cover and gasket assembly from the engine.**



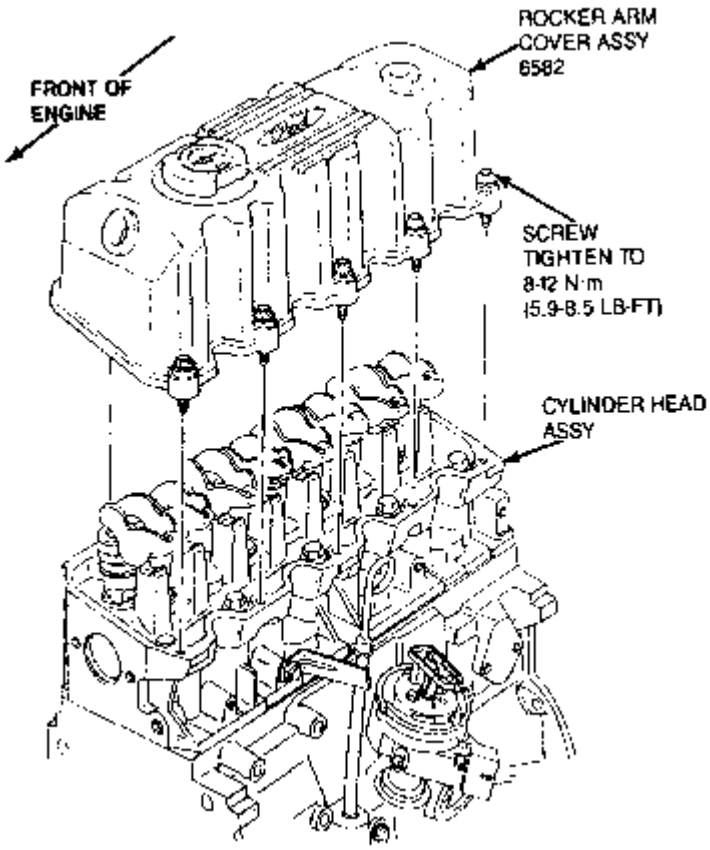
Remove the rocker arm cover retaining bolts-early model 2.5L shown



Remove the rocker arm cover from the engine-early model 2.5L shown



Inspect the rocker arm cover gasket for damage-early model 2.5L shown



Rocker arm cover assembly-2.5L engine shown

Click to enlarge

To install:

6. **Clean the cylinder head and rocker arm cover mating surfaces.**

When using RTV sealant, install the rocker arm cover within five minutes to prevent the sealant from "skinning'' over.

7. **If the gasket is damaged by a cut and/or nick of about $^{1}/_{8}$ in. (3mm) (two cuts or nicks at the most), fill in the damaged area with RTV sealant E8AZ-19562-A or equivalent. If the gasket is damaged more than that, the entire rocker arm cover must be replaced.**
8. **If damaged, replace the rubber isolator(s), washer, or bolt and rubber isolator assembly.**

If reusing the old rocker arm cover bolts, always put a drop of adhesive threadlock (ESE-M2G260-AA) or equivalent on the threads of the bolt, prior to installation. Only new bolts are pre-applied with adhesive. Failure to do so may result in an oil leak.

9. **Install the rocker arm cover assembly, then tighten the retaining bolts to 6-9 ft. lbs. (8-12 Nm).**
10. **If equipped, connect the speed control cable and the throttle linkage cable to the top of the rocker arm cover.**
11. **Connect the PCV hose into the rocker arm cover, then install the rocker arm filter**

and the oil fill cap, if removed.

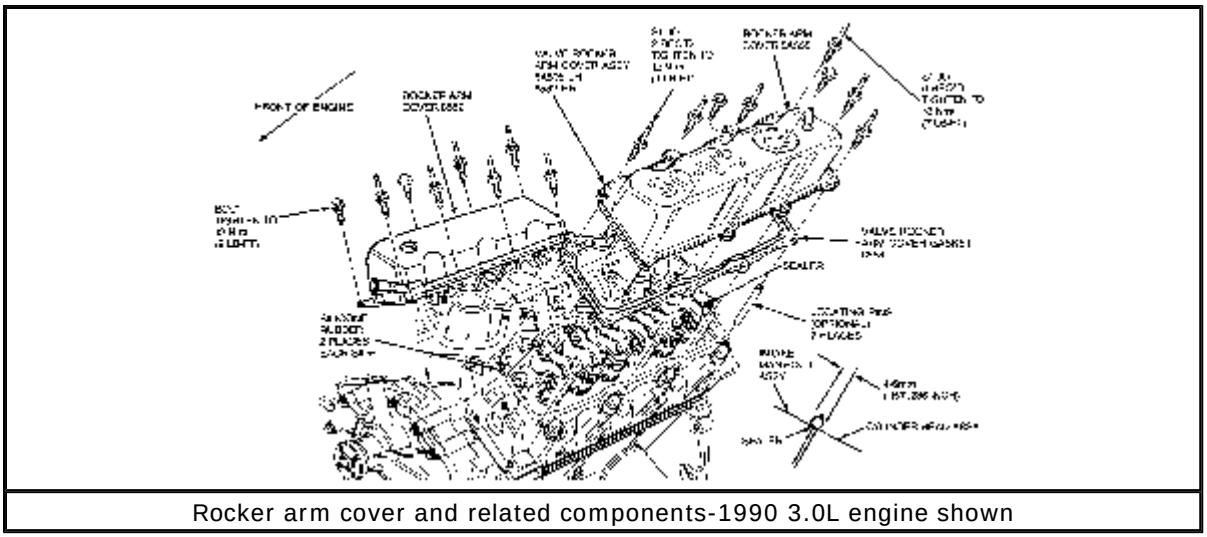
RTV must be cured completely before coming in contact with engine oil. Wait about one hour before starting the engine to allow the RTV to cure.

12. Connect the negative battery cable, then start the engine and run it at a fast idle. Check for any oil leaks.

3.0L Engine

1986-90 VEHICLES

1. Disconnect the negative battery cable.
2. Tag and disconnect the spark plug wires.
3. Remove the ignition wire/separator assembly from the rocker arm cover retaining studs, then move it out of the way.
4. If the left rocker arm cover is being removed: remove the oil fill cap, disconnect the air cleaner closure system hose and remove the fuel injector harness stand-offs from the inboard rocker arm cover, then move the harness out of the way.
5. If the right rocker arm cover is being removed: remove the PCV valve and, if equipped, loosen the lower EGR tube retaining nut and rotate the tube aside. Remove the throttle body and move the fuel injection harness aside.
6. Remove the rocker arm cover attaching screws and the cover(s) and gasket(s) from the vehicle.



Rocker arm cover and related components-1990 3.0L engine shown

Click to enlarge

To install:

7. Lightly oil all bolt and stud threads before installation. Using cleaning solvent, clean the cylinder head and rocker arm cover sealing surfaces to remove all silicone sealer and/or dirt.
8. Apply a bead of Silicone Rubber D6AZ-19562-BA, or equivalent, at the cylinder head-to-intake manifold rail step (two places per rail) as shown in accompanying figure, then position a new gasket into place using the gasket retaining features.
9. Position the cover onto the cylinder head, then install the retaining bolts and studs. Tighten the retainers to 9 ft. lbs. (12 Nm).

10. If the left rocker arm cover is being installed: install the oil fill cap, connect the air cleaner closure system hose to the nipple, and install the fuel injector harness stand-offs to the appropriate inboard rocker arm cover studs.
11. If the right rocker arm cover is being installed: install the throttle body (refer to *Section 5* for details), then install the PCV valve and connect the hoses. If equipped, connect the EGR tube to the EGR valve. Tighten the retaining nuts to (37 ft. lbs. (50 Nm).
12. Connect the ignition wires to the spark plugs, as tagged during removal. Install the ignition wire separator stand-offs to the appropriate rocker arm cover studs.
13. Connect the negative battery cable, then start the engine and check for oil and/or vacuum leaks.

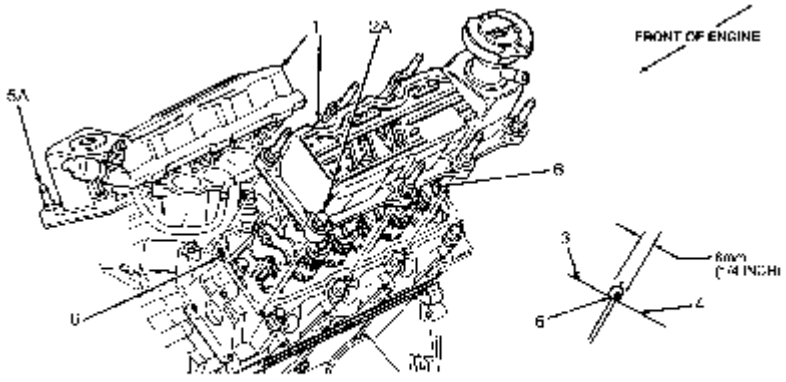
1991-95 VEHICLES

The rocker arm / valve covers on these vehicles have built-in gaskets which should last the life of the vehicle.

1. Disconnect the negative battery cable.
2. Tag and disconnect the ignition wires from the spark plugs.
3. Remove the ignition wire(s) and bracket from the rocker arm/valve cover retaining studs, then move it out of the way.
4. If the left valve cover is being removed: disconnect the crankcase ventilation tube, remove the oil filler cap, and remove the the fuel charging wiring harness stand-offs from the inboard valve cover studs, then move the harness out of the way.
5. If the right valve cover is being removed, first remove the throttle body (refer to *Section 5* for this procedure). Loosen the lower EGR valve-to-exhaust manifold tube retaining nut and rotate the EGR valve-to-exhaust manifold tube out of the way. Remove the PCV valve, then remove the fuel charging wiring stand-offs from the inboard valve cover studs and move the fuel charging wiring out of the way.
6. Loosen the valve cover retaining bolts and studs, then carefully slide a sharp, thin-bladed object between the cylinder head and the valve cover gasket where the intake manifold mates to the cylinder head. Be careful to cut only the sealer and not the valve cover gasket itself.
7. Remove the valve cover, making sure that the silicone sealer does not pull the integral valve cover gasket from the cover.

If removing the gasket, make sure to note the bolt and stud locations before removing the valve cover gasket, as the fasteners are secured by the valve cover gasket.

8. If necessary, remove the built-in (or integral) valve cover gasket by pulling it from the valve cover gasket channel.



Rocker arm/valve cover assembly-1991-95 3.0L engines (except SHO)

Click to enlarge

To install:

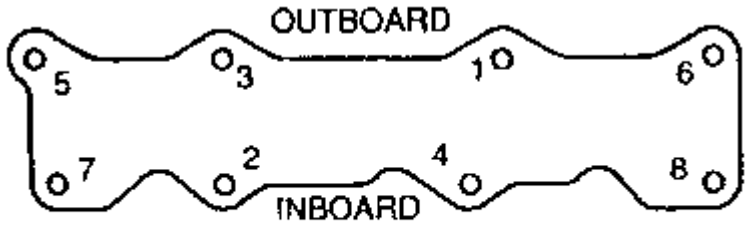
9. **Lightly oil all bolt and stud bolt threads before installation. Clean the gasket with a soft, clean cloth to remove any dirt, then using a suitable solvent, clean off any remaining silicone sealant.**

Check the valve cover gasket for correct installation. A new valve cover gasket will lay flat to the valve cover in both the channel and fastener areas. If the gasket is installed wrong, oil leakage will occur.

10. **If installing a new gasket, align the fastener holes, then lay the new gasket onto the channel.**
11. **Install the valve cover gasket to each fastener by securing the fastener head with a nut driver or socket. Seat the fastener against the valve cover and, at the same time, roll the gasket around the fastener collar. If it's installed correctly, all of the fasteners will be secured by the valve cover gasket and will not fall out.**
12. **Before applying sealer, clean all sealing surfaces with Metal Surface Cleaner F4AZ-19A536-RA or equivalent, to remove any residues that may interfere with the sealer's ability to adhere.**
13. **Apply a bead of Silicone Gasket and Sealant F1AZ-19562-A or equivalent, at the cylinder head-to-intake manifold step (two places per side) as shown in the accompanying figure.**

When installing the valve cover, use a "straight down'' approach, to avoid smearing or smudging the sealant, which will cause leaks.

14. **Position the valve cover on the cylinder head and hand-tighten the retaining bolts and stud bolts, then tighten in sequence (see accompanying figure) to 8-10 ft. lbs. (10-14 Nm).**



TIGHTENING SEQUENCE — VALVE COVER

Rocker arm/valve cover tightening sequence-1991-95 3.0L vehicles (except SHO)

15. **If the left cover is being installed: install the oil filler cap, fasten the crankcase ventilation tube to the connector, and install the fuel charging wiring stand-offs to the appropriate inboard valve cover stud bolts.**
16. **If the right cover is being installed: install the fuel charging wiring stand-offs to the appropriate inboard valve cover stud bolts, install the throttle body (see Section 5 of this manual for details), install the PCV valve, then connect the crankcase ventilation tube, and connect the EGR valve-to-exhaust manifold tube-to-EGR valve. Tighten both retaining nuts to 26-48 ft. lbs. (35-65 Nm).**
17. **Install the ignition wire(s) and bracket to the rocker arm/valve cover retaining studs, then connect the ignition wires to the spark plugs as tagged during removal.**
18. **Connect the negative battery cable.**

3.0L and 3.2L SHO Engines

1. **Disconnect the negative battery cable.**
2. **Properly relieve the fuel system pressure. For details, please refer to the procedure in *Section 1* or *Section 5* of this manual.**
3. **Tag and disengage all vacuum lines and electrical connectors from the intake manifold.**
4. **Remove the upper intake manifold assembly. For details, please refer to the procedure later in this section.**
5. **Tag and disconnect the spark plug wires.**
6. **If the left cover is being removed, remove the oil fill cap and the ignition coil plastic cover.**
7. **If the right cover is being removed, disconnect the fuel lines.**
8. **Remove the rocker arm/valve cover retaining bolts, then remove the cover.**

To install:

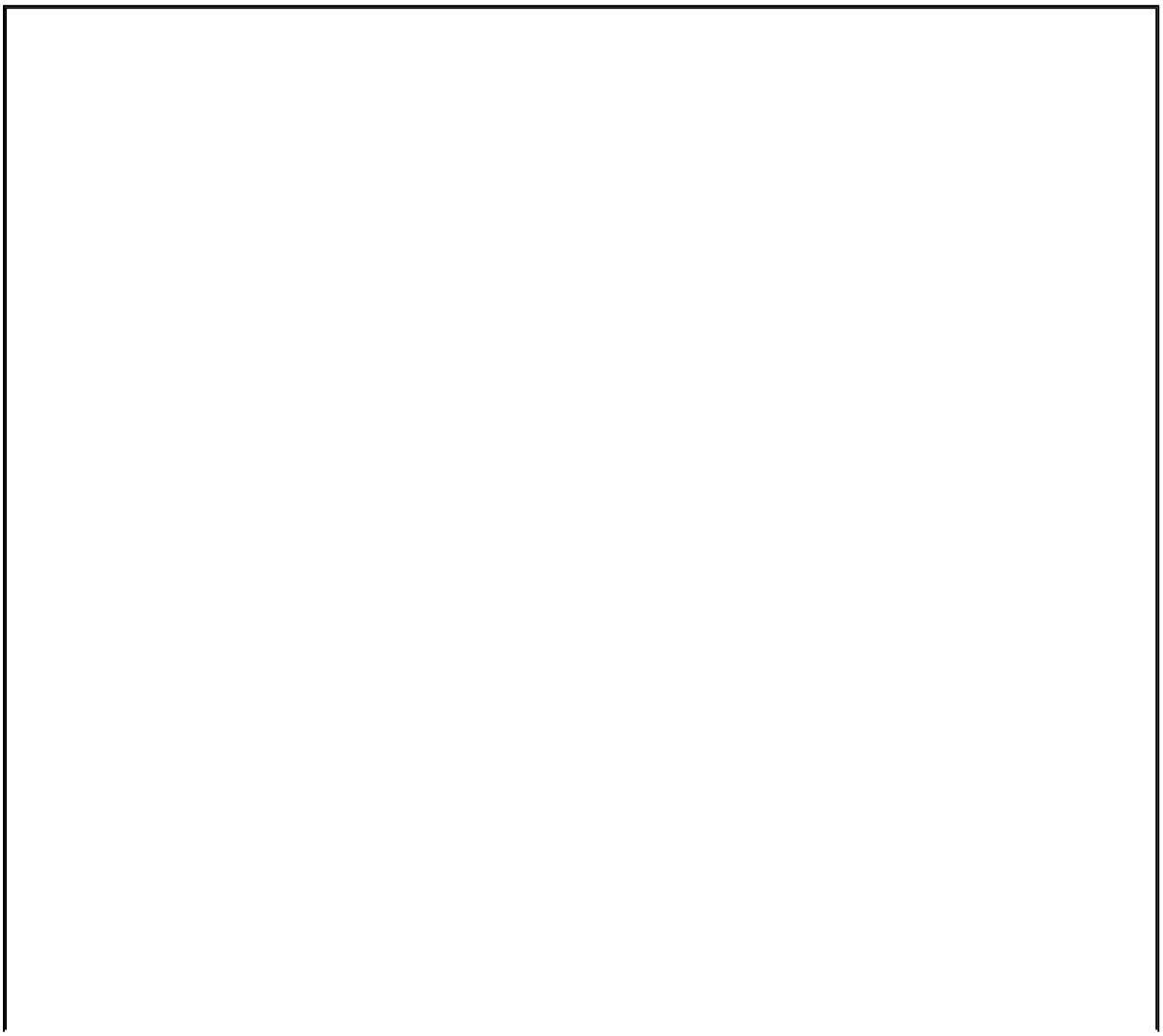
Lightly oil all bolt and stud threads before installation. Clean the cylinder head and valve cover sealing surfaces, using solvent, to remove all dirt.

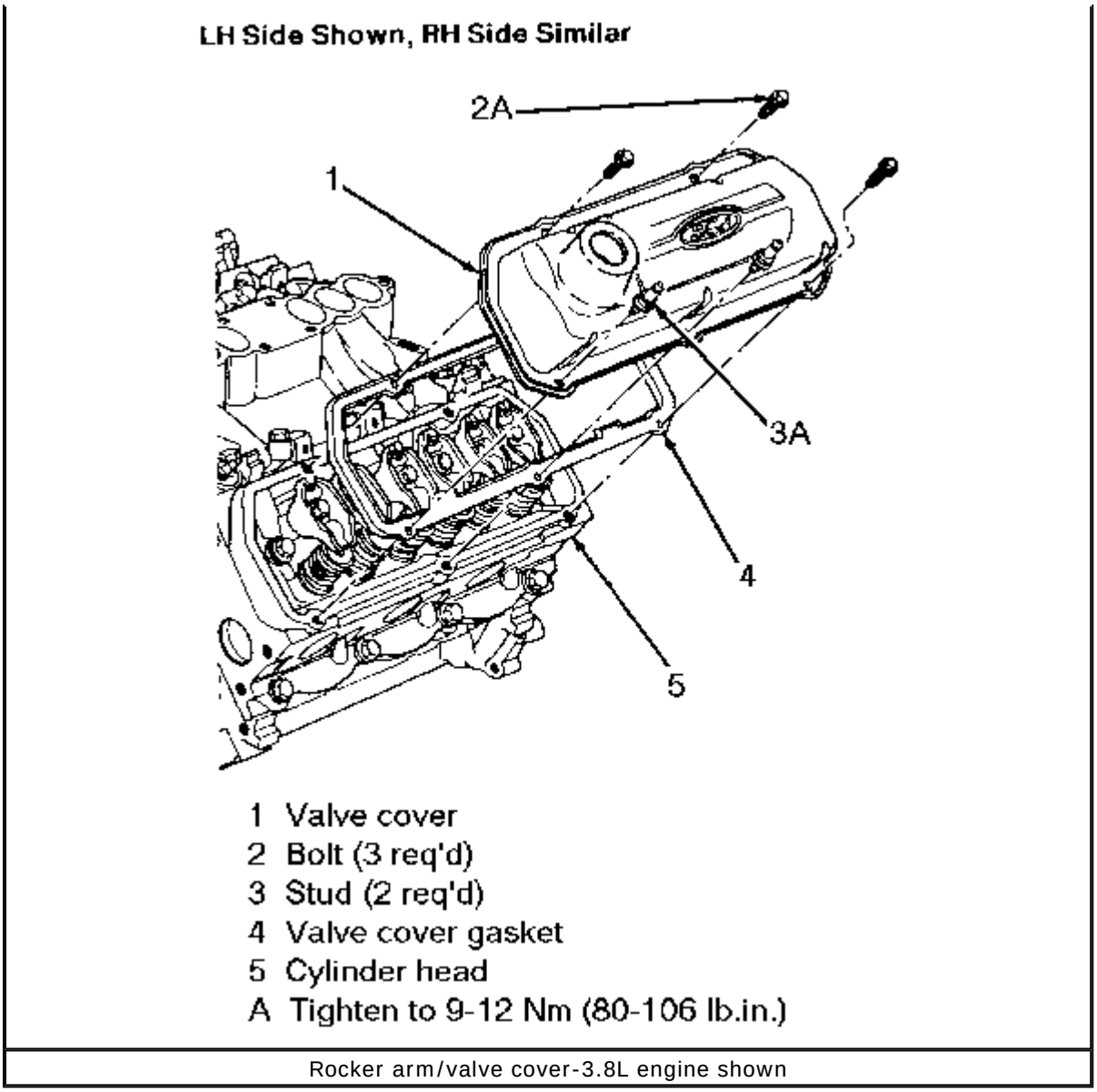
9. **Inspect the gasket and the three spark plug holes for damage and replace, if necessary. Position the valve cover on the cylinder head and install the retaining bolts. Tighten the bolts to 7-12 ft. lbs. (9.5-16 Nm).**
10. **If the left valve cover is being installed, install the ignition coil plastic cover and the oil filler cap.**

11. If the right valve cover is being installed, connect the fuel lines.
12. Connect the spark plug wires as tagged during removal.
13. Install the upper intake manifold. For details, please refer to the procedure located later in this section.
14. Engage all vacuum lines and electrical connectors, as tagged during removal, to the intake manifold.
15. Connect the negative battery cable, then start the engine and check for fuel, coolant, and/or oil leaks.

3.8L Engine

1. Disconnect the negative battery cable.
2. Tag and disconnect the ignition wires from the spark plugs.
3. Remove the ignition wire separators from the valve cover retaining bolt studs.
4. For 1993-95 vehicles, remove the upper intake manifold. For details, please refer to the procedure located later in this section.
5. If the left cover is being removed, remove the oil fill cap.
6. If the right cover is being removed, position the air cleaner assembly aside and remove the PCV valve.
7. Remove the rocker arm/valve cover mounting bolts, then remove the cover.





Rocker arm/valve cover-3.8L engine shown

Click to enlarge

To install:

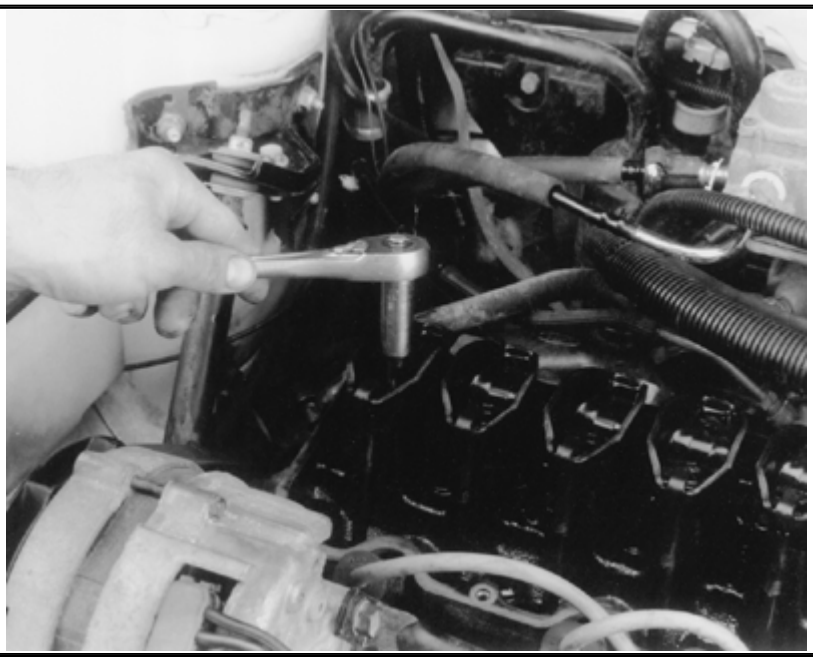
8. **Lightly oil all bolt and stud bolt threads, then, using solvent, clean the cylinder head and valve cover sealing surface to remove all gasket material and dirt.**
9. **Position a new rocker arm/valve cover gasket on the cylinder head, then install the retaining bolts. Make sure to note the position of the ignition wire separator stud bolts, then tighten the retaining bolts to 80-106 inch lbs. (9-12 Nm).**
10. **If removed, install the upper intake manifold. For details, please refer to the procedure located later in this section.**
11. **If the left cover is being installed, install the oil filler cap.**
12. **If the right cover is being installed, install the PCV valve, then the air cleaner.**
13. **Install the ignition wire separators, then connect the ignition wires to the spark plugs as tagged during removal.**
14. **Connect the negative battery cable, then start the engine and check for oil leaks.**

Rocker Arms

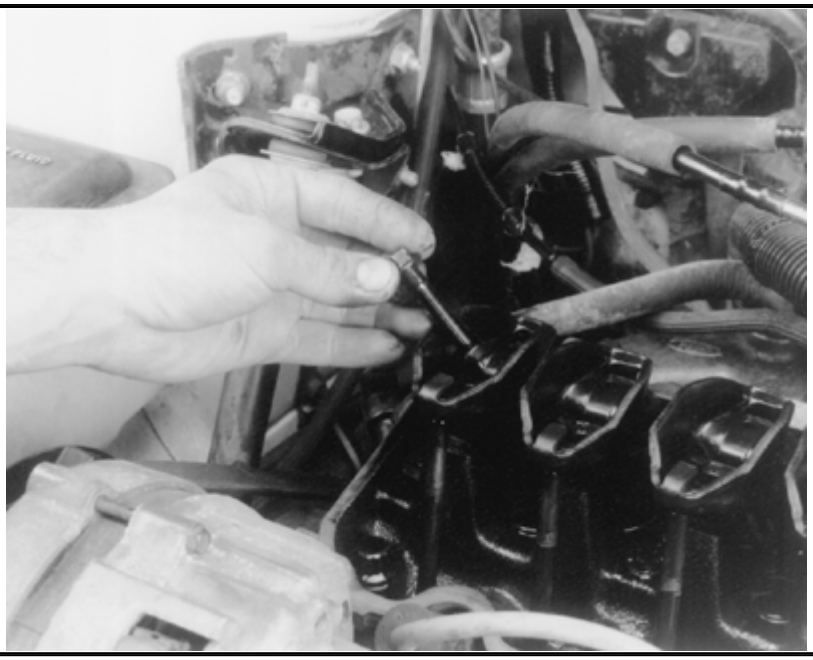
REMOVAL & INSTALLATION

2.5L Engine

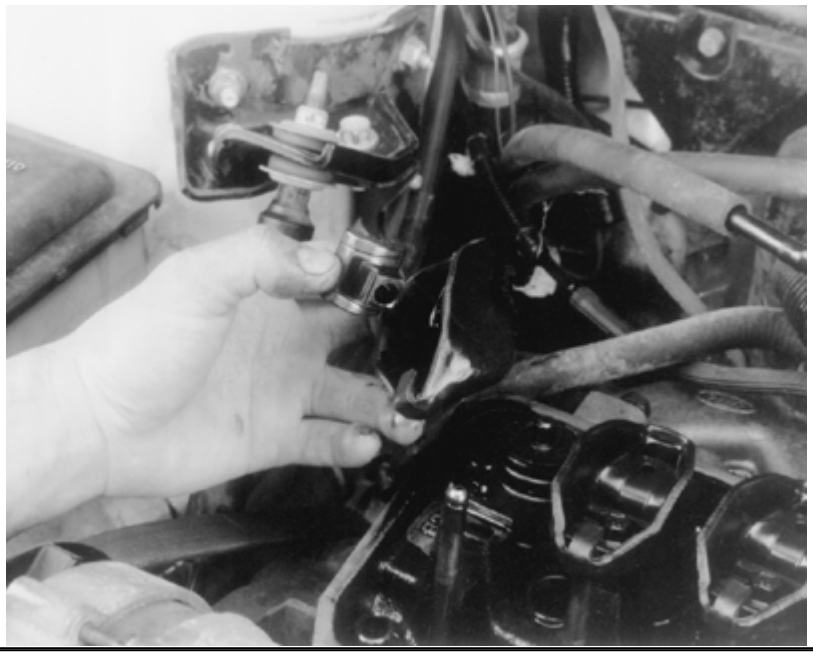
1. **Disconnect the negative battery cable.**
2. **Remove the rocker arm cover. For details, please refer to the procedure located earlier in this section.**
3. **Remove the rocker arm bolts, fulcrums, rocker arms and fulcrum washers. Keep all parts in order so they can be reinstalled to their original position.**



Loosen the rocker arm retaining bolts-early 2.5L engine shown



Remove the rocker arm bolts-early 2.5L engine shown



When removing the rocker arm and fulcrum, make sure to keep all parts in order so they can be installed in their original position

To install:

4. **Clean the cylinder head and rocker arm cover mating surfaces.**
5. **Coat the valve tips, rocker arm and fulcrum contact areas with Lubricate® or equivalent.**
6. **For each valve, rotate the engine until the lifter is on the base circle of the cam (valve closed).**
7. **Install the rocker arm and components, then tighten the rocker arm bolts in 2 steps, first to 6-8 ft. lbs. (8-11 Nm) and second to 20-26 ft. lbs. (27-35 Nm). Be sure the lifter is on the base circle of the cam for each rocker arm as it is installed. For the final tightening, the camshaft may be in any position. Check the valve lash.**
8. **Install a new rocker arm cover gasket, using suitable sealer, unless the cover is equipped with a molded-in gasket, in which case no sealer should be used.**
9. **Install the rocker arm cover and tighten the bolts to 6-8 ft. lbs. (8-11 Nm), then install/connect the components to the rocker arm cover. For details, please refer to the rocker arm cover procedure located earlier in this section.**
10. **Connect the negative battery cable.**

3.0L Engine-Except SHO

1. **Disconnect the negative battery cable. Tag and disconnect the ignition wires from the spark plugs.**
2. **Remove the rocker arm/valve covers from the cylinder head. For details, please refer to the procedure located earlier in this section.**
3. **Remove the rocker arm bolts, fulcrums, rocker arms and fulcrum washers. Keep all parts in order so they can be reinstalled to their original position.**

To install:

4. **Lightly oil all the bolt and stud threads before installation. Coat the valve tips, rocker arm and fulcrum contact areas with Engine Assembly Lubricant D9AZ-**

19579-D, or equivalent.

Rocker arm seats must be fully seated in the cylinder head, and the pushrod(s) must be fully seated in the rocker arm valve lifter sockets before final tightening.

5. Install the rocker arms into position with the pushrods, then snug the retaining bolt. Rotate the crankshaft to position the camshaft lobes straight down and away from the rocker arm.
6. Tighten the retaining bolts which secure the rocker arm seats into the cylinder head to 5-11 ft. lbs. (7-15 Nm), then final-tighten the retaining bolts to 19-28 ft. lbs. (26-38 Nm). Be sure the lifter is on the base circle of the cam for each rocker arm as it is installed.
7. Install the rocker arm/valve covers. For details, please refer to the procedure located earlier in this section.
8. Attach the ignition wires to the spark plugs as tagged during removal, then connect the negative battery cable.

3.8L Engine

1. Disconnect the negative battery cable.
2. Remove the rocker arm/valve cover(s). For details, please refer to the procedure located earlier in this section.
3. Remove the rocker arm bolt, fulcrum and rocker arm. Keep all parts in order so they can be reinstalled in their original positions.

To install:

4. Lubricated all rocker arms with Engine Assembly Lubricant D9AZ-19579-D or equivalent.

Rocker arm seats must be fully seated in the cylinder head, and pushrods must be seated in the rocker arm sockets before final tightening, or engine damage may occur.

5. For each valve, rotate the crankshaft until the valve lifter rests on the heel (base circle) of the camshaft lobe. Position the rocker arm(s) over the push rods, then install the rocker arm seats. Tighten the rocker arm seat retaining bolts to 44 inch lbs. (5 Nm).
6. Final-tighten the rocker arm retaining bolt(s) to 19-25 ft. lbs. (25-35 Nm). For final tightening, the camshaft may be in any position.
7. Clean the rocker arm cover and cylinder head mating surfaces of old gasket material and dirt.
8. Install the rocker arm/valve cover(s). For details, please refer to the procedure located earlier in this section.
9. Connect the negative battery cable.

Thermostat

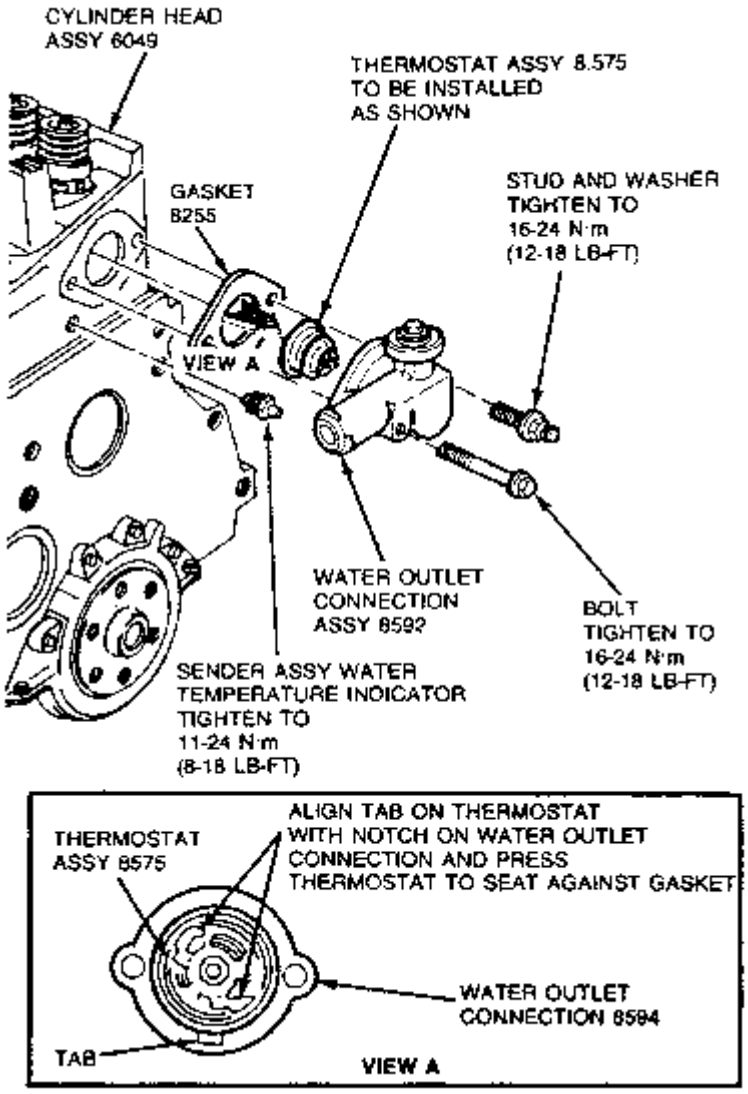
REMOVAL & INSTALLATION

CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted byethylene glycol antifreeze, and are quite likely to drink any that is left inan uncovered container or in puddles on the ground. This will prove fatal insufficient quantity. Always drain the coolant into a sealable container.Coolant should be reused unless it is contaminated or several years old.

2.5L Engine

1. **Disconnect the negative battery cable.**



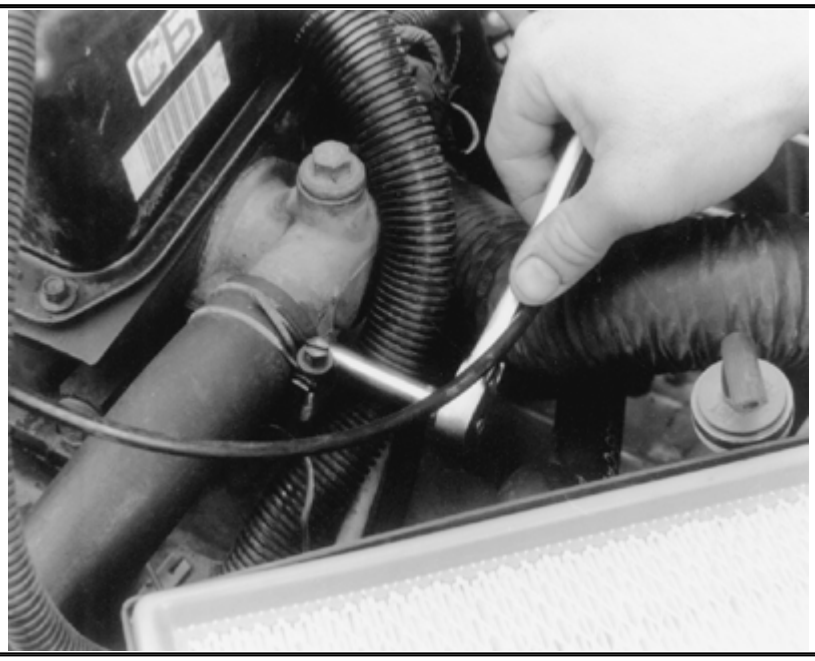
Thermostat and related components-2.5L engine

Click to enlarge

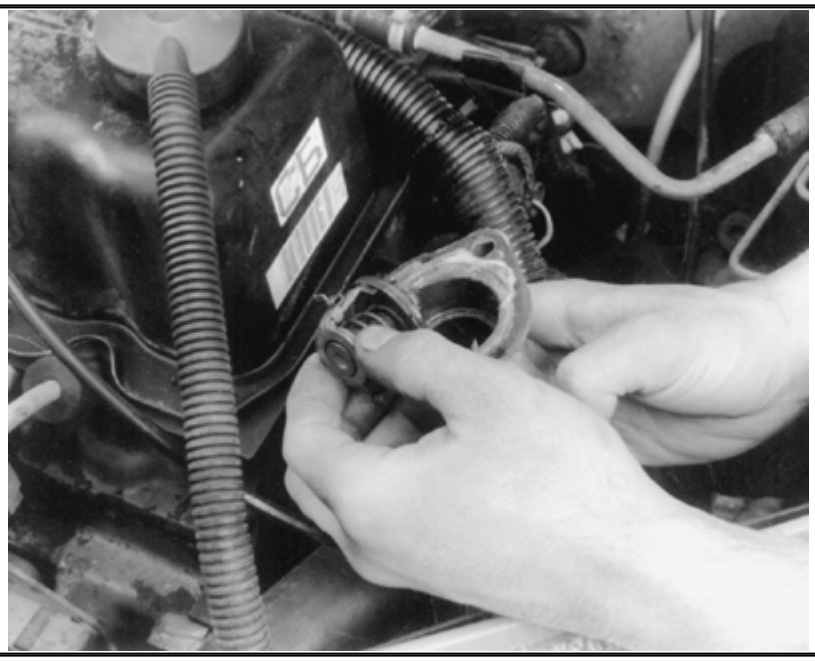
2. **Position a suitable drain pan below the radiator. Carefully remove the radiator cap, then attach a 0.4 in. (9.5mm) hose to the drain tube (to prevent a mess) and open the draincock. Drain the radiator to a corresponding level below the water outlet connection, then close the draincock.**

3. **Remove the vent plug from the water outlet connection.**
4. **Loosen the top hose clamp at the radiator, then remove the water outlet connection retaining bolts and lift the outlet clear of the engine. Remove the thermostat by pulling it out of the water outlet connection.**

Do NOT pry the housing off.



Remove the water outlet connection retaining bolts



Remove the thermostat by pulling it out of the water outlet connection

To install:

5. **Make sure the water outlet connection and cylinder head mating surfaces are clean and free from gasket material. Make sure the water outlet connection pocket and air vent passage are clean and free from rust. Clean the vent plug and gasket.**
6. **Place the thermostat in position, fully inserted to compress the gasket and pressed into the water outlet connection to secure. Install the water outlet**

connection to the cylinder head using a new gasket. Tighten the bolts to 12-18 ft. lbs. (16-24 Nm). Position the top hose to the radiator and tighten the clamps.

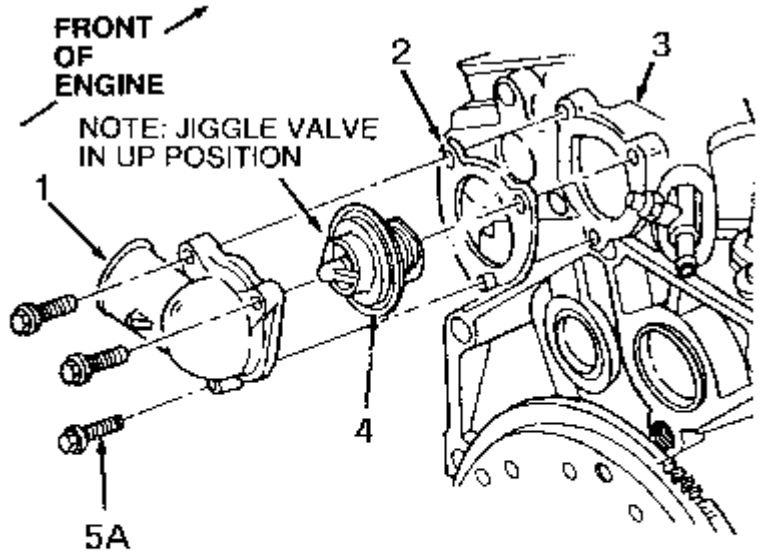
Use a new gasket when installing the water outlet connection

7. **Refill the cooling system.**
8. **Connect the negative battery cable. Start the engine and check for leaks.**
9. **Check the coolant level and add as required.**

3.0L Engine-Except SHO

1. **Disconnect the negative battery cable.**
2. **Place a suitable drain pan under the radiator.**
3. **Carefully remove the radiator cap and open the draincock, then drain the cooling system.**
4. **Remove the upper radiator hose from the water outlet connection/thermostat housing.**
5. **Remove the three retaining bolts from the water outlet connection/thermostat housing.**
6. **Remove the housing and the thermostat as an assembly.**
7. **Remove the thermostat from the housing/water outlet connection, then discard the water outlet hose gasket and carefully clean the mating surfaces with a gasket scraper.**

Be careful when scraping the gasket surfaces becausealuminum gouges easily, forming leaks paths.



1 Water outlet connection
2 Water hose connection gasket
3 Lower intake manifold
4 Water thermostat
5 Bolt (3 req'd)
A Tighten to 10-14 Nm (8-10 lb.ft.)

Thermostat and related components-3.0L engine (except SHO)

Click to enlarge

To install:

8. **Make sure all sealing surfaces are free of old gasket material.**
9. **Insert the thermostat into the water outlet connection/housing and rotate clockwise to lock it in. Note the location of the jiggle valve in relation to the water outlet connection.**
10. **Position a new gasket onto the water outlet connection/housing using the bolts as a holding device.**
11. **Install the thermostat assembly, then tighten the retaining bolts to 8-10 ft. lbs. (10-14 Nm).**

Make sure that the hose clamps are beyond the center ofthe clamping surface of the connection. Any used hose clamps must be replaced withnew clamps to ensure proper sealing at the connection.

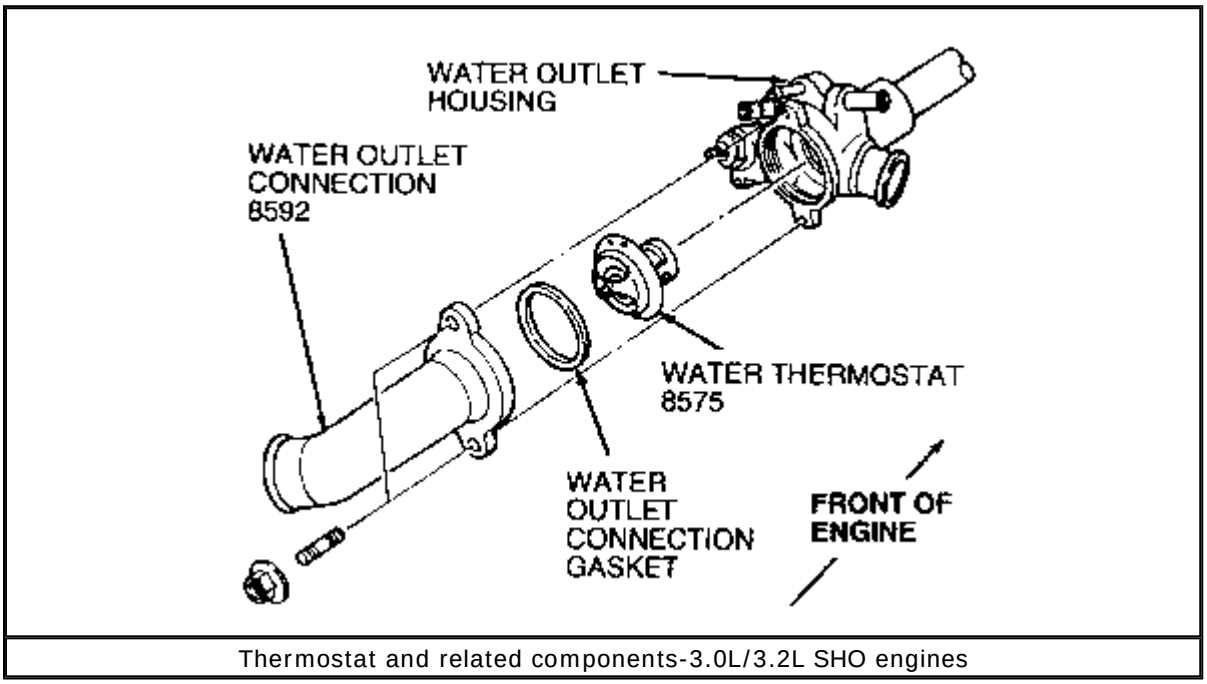
11. **Install the upper radiator hose and position the clamps between the alignment marks on both ends of the hose, then slide the hose on the connections. Tighten the screw clamps to 20-30 inch lbs. (2.2-3.4 Nm).**
12. **Fill and bleed the cooling system. Connect the negative battery cable, start the engine and check for coolant leaks. Check the coolant level and add as required.**

3.0L and 3.2L SHO Engines

1. **Disconnect the negative battery cable.**
2. **Place a suitable drain pan below the radiator. Remove the radiator cap and open**

the draincock. Partially drain the cooling system, then close the draincock.

3. Remove the air cleaner outlet tube.
4. Disconnect the upper radiator hose from the water outlet connection.
5. Remove the two retaining nuts, then remove the water outlet connection.
6. Remove the thermostat and the water hose connection gasket from the water outlet connection.



Thermostat and related components-3.0L/3.2L SHO engines

Click to enlarge

To install:

Align the jiggle valve of the thermostat with the upper bolt on the wateroutlet connection.

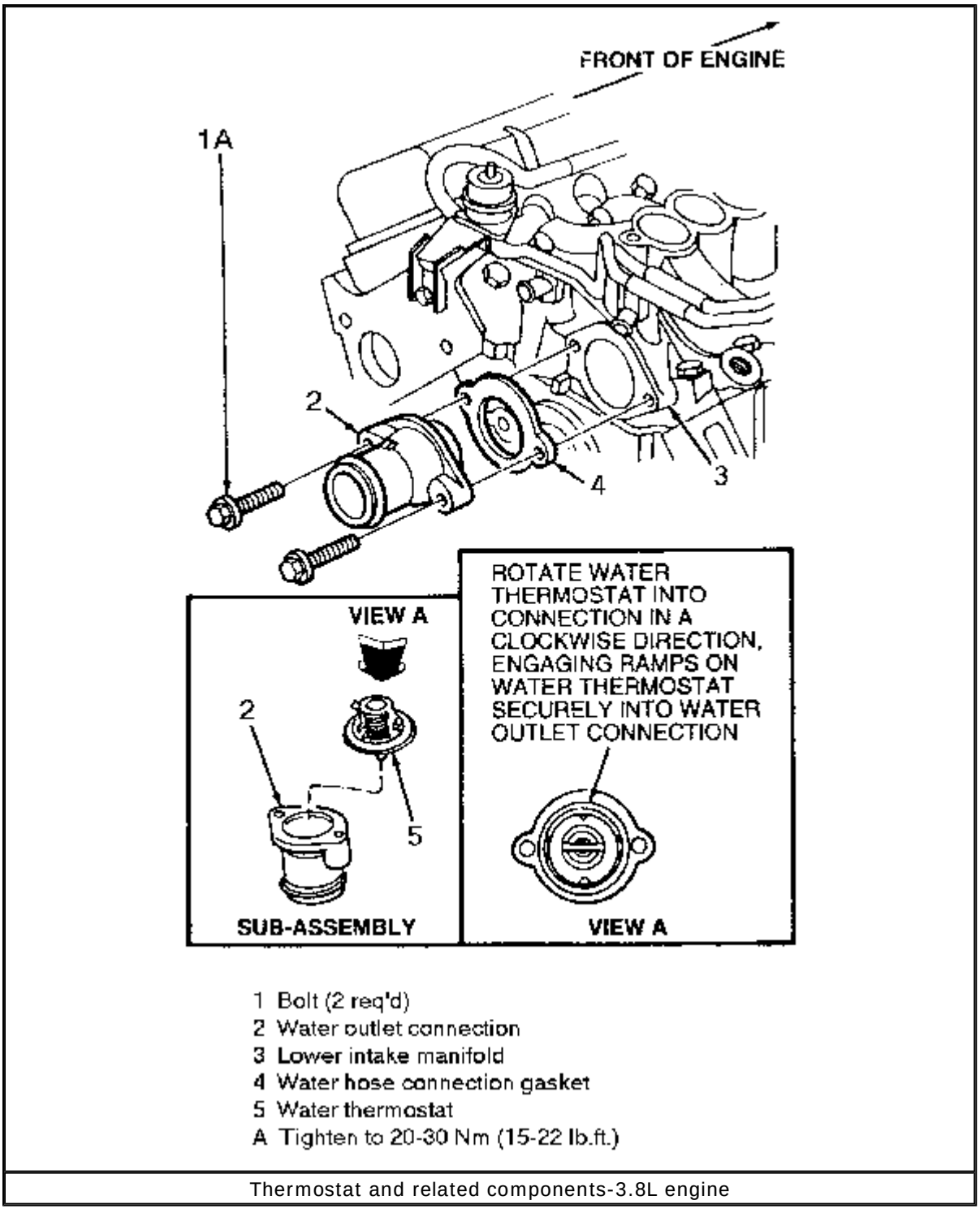
7. Install the water hose connection gasket around the outer rim of the thermostat, then install the thermostat into the water outlet connection.
8. Position the water outlet connection, then install and tighten the two retaining nuts to 5-8 ft. lbs. (7-11 Nm).
9. Install the air cleaner outlet tube.
10. Refill the cooling system.
11. Connect the negative battery cable. Start the engine and check for leaks.
12. Check the coolant level and add as necessary.

3.8L Engine

1. Disconnect the negative battery cable.
2. Place a suitable drain pan below the radiator.
3. Carefully remove the radiator cap, then connect a $^{3}/_{8}$ in. (9.5mm) hose to the drain tube, then open the draincock. Drain the radiator to a level below the water outlet connection, then close the draincock.

4. **Loosen the upper radiator hose clamp at the radiator, then remove the water outlet connection retaining bolts and lift the water outlet clear of the engine. Remove the thermostat by rotating it counterclockwise in the water outlet connection until the thermostat becomes free to remove.**

Do not pry the water outlet connection off.



Thermostat and related components-3.8L engine

Click to enlarge

To install:

5. **Make sure the water outlet connection pocket and all mating surfaces are clean.**

6. **Fully insert the thermostat and rotate it clockwise in the water outlet connection to secure.**
7. **Position the water outlet connection to the intake manifold with a new gasket and secure the retaining bolts. Tighten the bolts to 15-22 ft. lbs. (20-30 Nm).**

Make sure the hose clamps are beyond the bead and placedin the center of the clamping surface of the connection. Any used hose clampsmust be replaced with a new clamp to ensure proper sealing at the connection.

8. **Position the upper radiator hose to the radiator. Position the clamps between the alignment marks on both ends of the upper radiator hose, then slide the hose on the connections. Tighten the screw clamps to 20-30 inch lbs. (2.2-3.4 Nm).**
9. **Refill the cooling system.**
10. **Connect the negative battery cable. Start the engine and check for leaks.**
11. **Check the coolant level and add as required.**

Cooling System Bleeding

CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container. Coolant should be reused unless it is contaminated or several years old.

When the entire cooling system is drained, the following procedure should be used to ensure a complete fill.

1. **Install the block drain plug, if removed, and close the draincock. With the engine off, add antifreeze to the radiator to a level of 50 percent of the total cooling system capacity. Then add water until it reaches the radiator filler neck seat.**

On 2.5L engines, remove the vent plug on the water connection outlet. The vent plug must be removed before the radiator is filled or the engine may not fill completely. Do not turn the plastic cap under the vent plug or the gasket may be damaged. Do not try to add coolant through the vent plug hole. Install the vent plug after filling the radiator and before starting the engine.

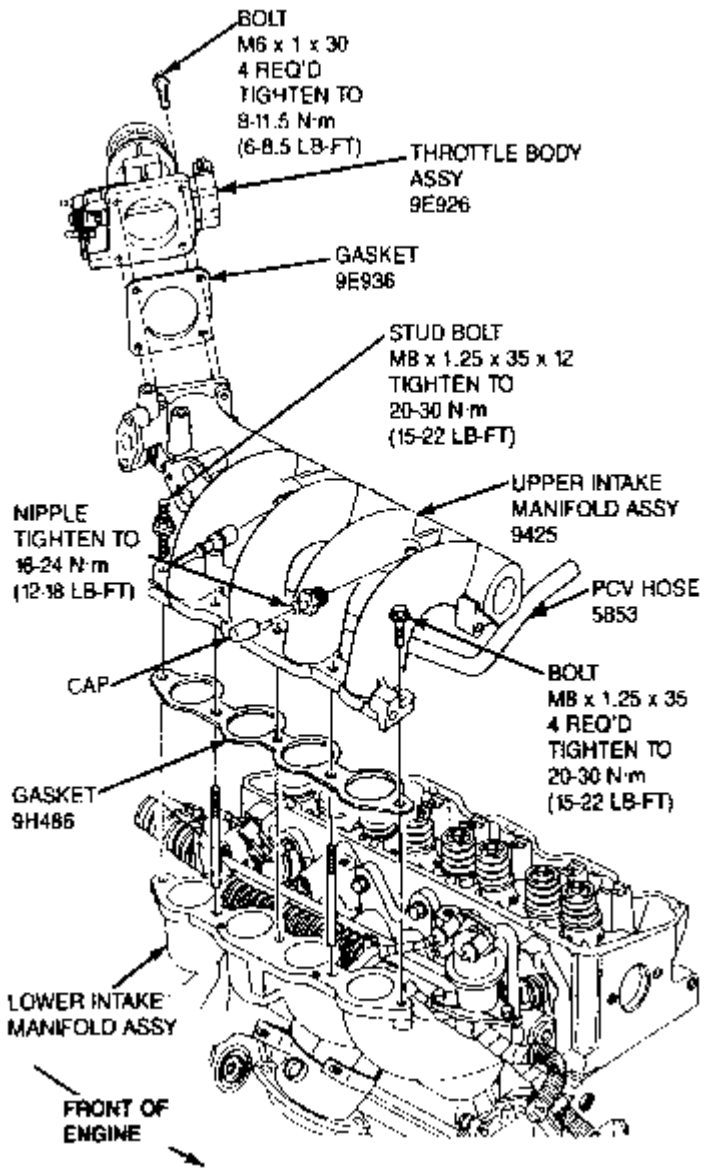
2. **Install the radiator cap to the first notch to keep spillage to a minimum.**
3. **Start the engine and let it idle until the upper radiator hose is warm. This indicates that the thermostat is open and coolant is flowing through the entire system.**
4. **Carefully remove the radiator cap and top off the radiator with water. Install the cap on the radiator securely.**
5. **Fill the coolant recovery reservoir to the FULL COLD mark with antifreeze, then add water to the FULL HOT mark. This will ensure that a proper mixture is in the coolant recovery bottle.**
6. **Check for leaks at the draincock, block plug and at the vent plug on 2.5L engine.**

Intake Manifold

REMOVAL & INSTALLATION

2.5L Engine

1. **Open and secure the hood.**

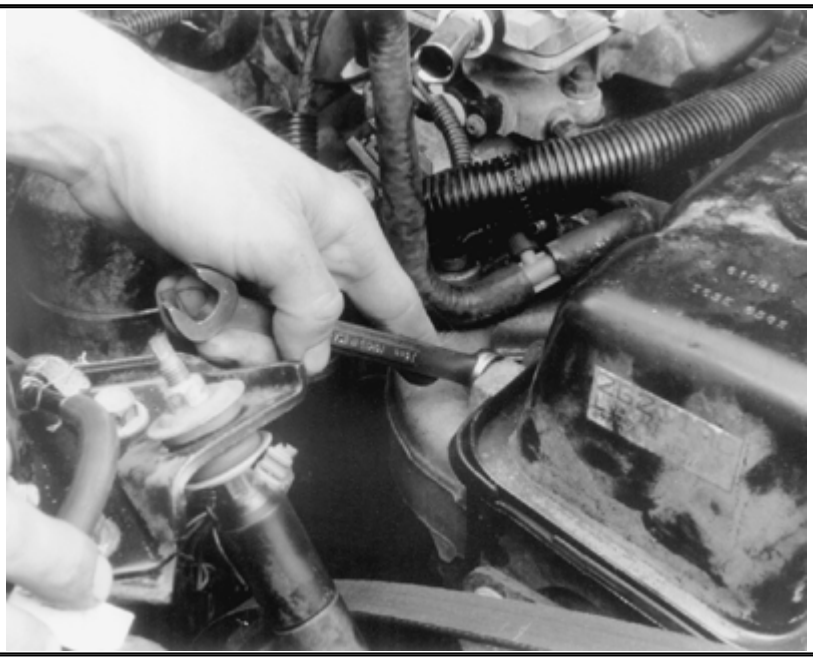


Common intake manifold assembly-late model 2.5L engine shown

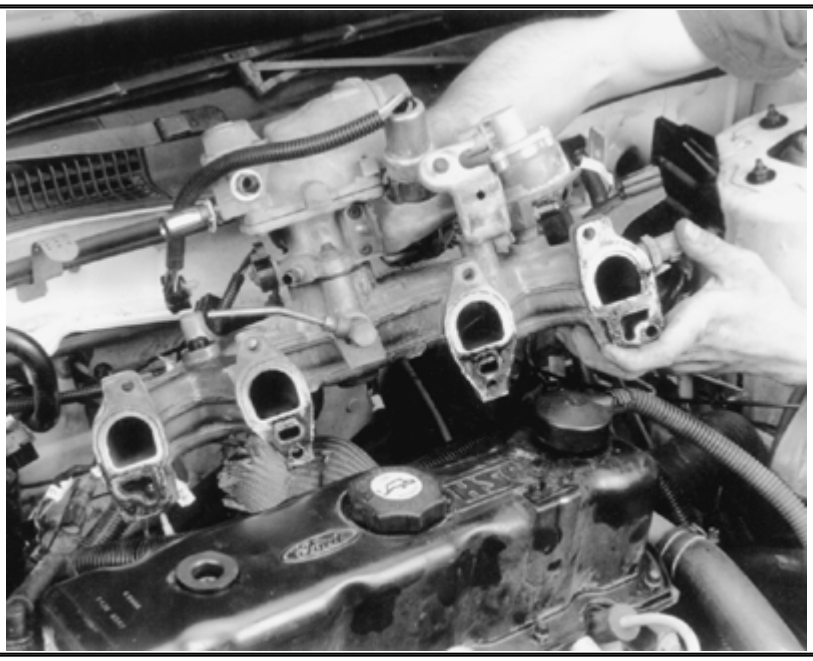
Click to enlarge

2. **Properly relieve the fuel system pressure, then disconnect the negative battery cable.**
3. **Drain the cooling system.**
4. **Remove accelerator cable and, if equipped, the cruise control cable.**
5. **Remove the air cleaner assembly and the heat stove tube at the heat shield.**

6. **Tag and disengage any required vacuum lines and electrical connections.**
7. **As required on vehicles before 1990, disconnect the thermactor check valve hose at the tube assembly and remove the bracket-to-EGR valve attaching nuts.**
8. **Disconnect the fuel supply and return lines.**
9. **As required on vehicles before 1990, disconnect the water inlet tube at the intake manifold. On 1991 vehicles, remove the exhaust manifold heat shroud assembly.**
10. **Disconnect the EGR tube at the EGR valve.**
11. **Unfasten the intake manifold retaining bolts and remove the intake manifold. Remove the gasket and clean the gasket contact surfaces.**



Remove the intake manifold retaining bolts



After removing the intake manifold, remove the gasket and clean the gasket mating surfaces

To install:

12. **Install the intake manifold using a new gasket, then secure using the retaining bolts. Tighten the retaining bolts to 15-22 ft. lbs. (20-30 Nm) in the proper sequence.**
13. **As required on vehicles before 1990, connect the water inlet tube at the intake manifold, connect the thermactor check valve hose at the tube assembly and install the bracket-to-EGR valve attaching nuts.**
14. **Connect the EGR tube to the EGR valve.**
15. **Connect the fuel supply and return lines.**
16. **Fasten any applicable vacuum lines and electrical connectors, as tagged during removal.**
17. **On 1991 vehicles, install the heat shroud.**
18. **Install the air cleaner assembly and the heat stove tube.**
19. **Install accelerator cable and cruise control cable, if equipped.**
20. **Connect the negative battery cable and fill the cooling system to the proper level with a 50/50 mixture of coolant and water.**
21. **Start the engine and check for leaks.**

3.0L Engine-Except SHO

VEHICLES THROUGH 1991

1. **Disconnect the negative battery cable and drain the engine cooling system.**
2. **Properly relieve the fuel system pressure at the fuel supply manifold schrader valve.**

> **CAUTION**
>
> When relieving the fuel system pressure, cover the Schrader valve with a clean rag to prevent fuel from spraying into your eyes!

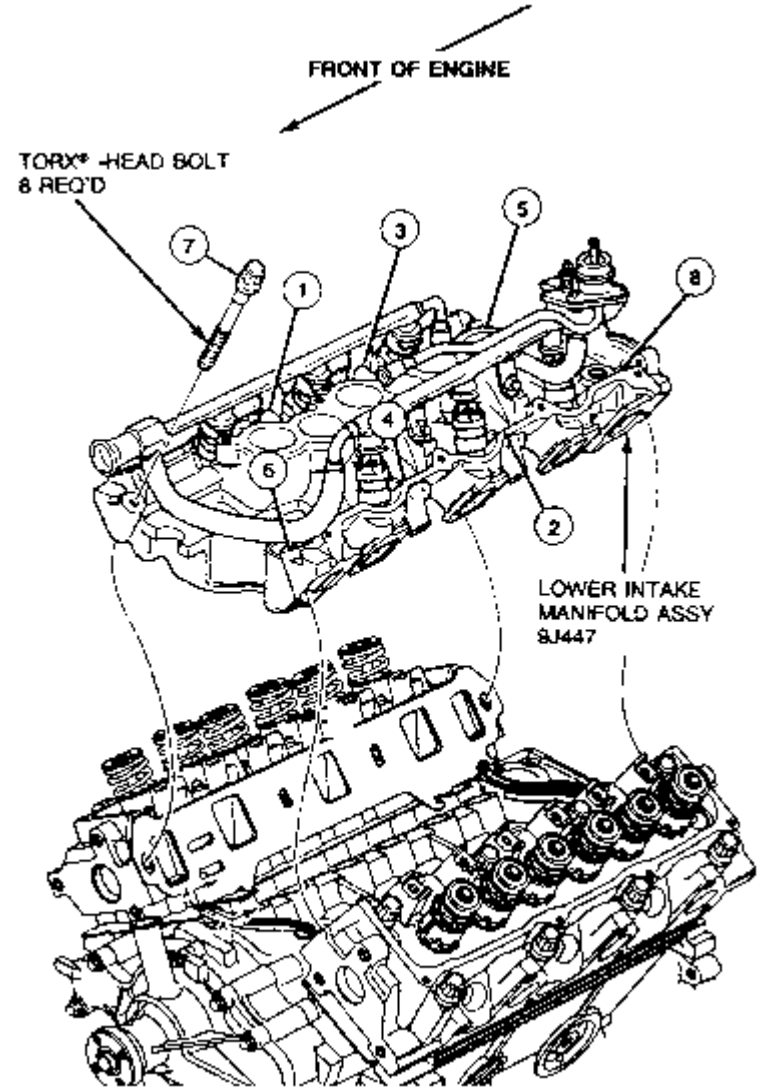
3. **Loosen the hose clamp attaching the air cleaner outlet flex hose to the throttle body, then remove the flex hose.**
4. **Identify, tag and disengage and all vacuum connections to the throttle body.**
5. **Loosen the lower EGR tube nut, then rotate the tube away from the valve. Disconnect the throttle cable and TV cable from the throttle linkage.**
6. **Disengage the air charge temperature sensor, throttle position sensor, air-by-pass valve, and pressure feedback EGR electrical connectors.**
7. **Disconnect the throttle body retaining bolts, then remove the throttle body. For details regarding throttle body removal, please refer to the procedure in *Section 5* of this manual.**
8. **Remove the fuel lines safety clips, then disconnect the fuel lines from the fuel supply manifold. Cover the ends of the fuel lines to prevent dirt and/or debris from entering the lines. Remove the fuel injector wiring harness stand-offs from the inboard rocker arm cover retaining studs and each injector from the engine.**

Fuel injectors and the fuel supply manifold may be removed with the intake manifold as an assembly.

9. **Remove the ignition coil and bracket and set aside, out of the way.**

10. **Tag and disconnect the spark plug wires, then remove the rocker arm covers. For details regarding rocker arm cover removal, please refer to the procedure located earlier in this section.**
11. **Disconnect the upper radiator hose and heater hoses.**
12. **If equipped, remove the distributor cap rubber boot, then mark the position of the distributor housing to the engine block and remove the cap and note the rotor position.**
13. **Disengage the distributor electrical connector, then remove the distributor assembly.**
14. **Disconnect the engine coolant temperature sensor and temperature sending unit connector.**
15. **Loosen the intake valve retaining nut from the No. 3 cylinder and rotate the rocker arm from the retainer, then remove the pushrod.**
16. **Using a Torx® head socket, remove the intake manifold attaching bolts, then place a suitable prybar between the intake manifold (near the thermostat) and the transmission. Use the prybar to carefully loosen the intake manifold from the sealing surfaces.**
17. **Lift the intake manifold away from the engine. Place clean rags in the lifter valley to catch any dirt or gasket materials. Remove the manifold side gaskets and seals and discard. Scrape the sealing surfaces to remove any trace of gasket material and rubber sealant.**

Be careful when scraping aluminum surfaces to prevent gouging which will cause leaking. To remove the old silicone rubber, use a suitable cleaning solvent.



Lower intake manifold assembly-3.0L engine (except SHO)

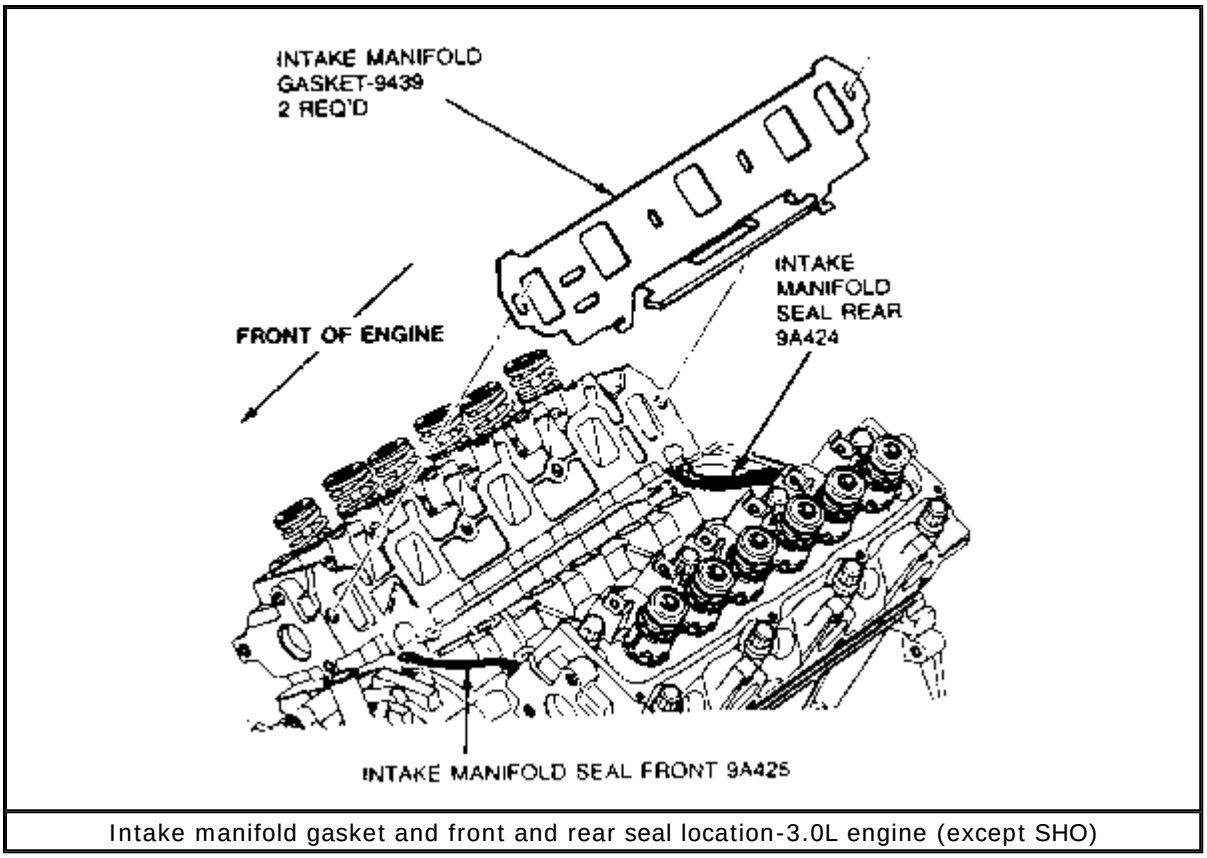
Click to enlarge

To install:

Lightly oil all the attaching bolts and stud threads before installation. When using a silicone rubber sealer, assembly must occur within 15 minutes after the sealer has been applied. After this time, the sealer may start to set-up and its sealing quality may be reduced. In high temperature/humidity conditions, the sealant will start to set up in approximately 5 minutes.

18. **The intake manifold, cylinder head and cylinder block mating surfaces should be clean and free of old silicone rubber sealer. Use a suitable solvent to clean these surfaces.**
19. **Apply a Silicone Rubber Sealer D6AZ-19562-AA, or equivalent, to the intersection of the cylinder block end rails and cylinder heads.**
20. **Install the front and rear intake manifold end seals in place and secure. Install the intake manifold gaskets.**

The gaskets are marked for correct installation.



Intake manifold gasket and front and rear seal location-3.0L engine (except SHO)

Click to enlarge

21. **Carefully lower the intake manifold into position on the cylinder block and cylinder heads to prevent smearing the silicone sealer and causing gasket voids.**
22. **Using a Torx® head socket, install the retaining bolts and tighten the bolts, in sequence, to 11 ft. lbs. (15 Nm), then retorque to 21 ft. lbs. (28 Nm).**
23. **Install the fuel supply manifold and injectors. Apply lubricant to the injector holes in the intake manifold and fuel supply manifold prior to injector installation. Install the fuel supply manifold retaining bolts and tighten to 7 ft. lbs. (10 Nm).**
24. **Install the thermostat housing and a new gasket, if removed. Tighten the retaining bolts to 9 ft. lbs. (12 Nm).**
25. **Install the No. 3 cylinder intake valve pushrod. Apply Lubricant ESE-M2C39 or equivalent to the pushrod and valve stem prior to installation. Position the lifter on the base circle of the camshaft and tighten the rocker arm bolt in 2 steps, first to 8 ft. lbs. (11 Nm) and then to 24 ft. lbs. (32 Nm).**
26. **Install the rocker arm covers. For information regarding rocker arm installation, please refer to the procedure located earlier in this section.**
27. **Install the fuel injector harness. Install the stand-offs to the inboard rocker arm retaining studs, then attach the connectors to the fuel injectors.**
28. **Install the throttle body using a new gaskets. For details, please refer to throttle body installation in *Section 5* of this manual.**
29. **Connect the PCV hose to the PCV valve.**
30. **If equipped, install the EGR tube and nut, using a new gasket. Tighten the nut on both ends to 37 ft. lbs. (50 Nm). Install the EGR cover using a new gasket. Tighten the bolts to 18 ft. lbs. (25 Nm).**
31. **Engage any electrical connectors or vacuum lines as tagged during removal.**

32. **Connect the fuel lines, then install the fuel line safety clips.**
33. **Install the distributor assembly, aligning the marks that were made during the removal procedure, then engage the electrical connector. Install the distributor cap rubber boot, if equipped.**
34. **Install the spark plug wire harness to the plugs, using the retaining features attaching onto the rocker cover stud bolts.**
35. **Install the coil and bracket to the left hand front cylinder head. Tighten the retaining bolts to 35 ft. lbs. (48 Nm).**
36. **Engage the engine coolant temperature (ECT) sensor and the temperature sending unit electrical connectors.**
37. **Install the upper radiator and heater hose, making sure the clamp is fastened securely.**
38. **Install the air cleaner outlet flex tube to the throttle body, then tighten the clamp to 30 inch lbs. (4 Nm).**
39. **Fill and bleed the cooling system, then drain and replace the engine oil.**
40. **Reconnect the negative battery cable, start the engine and check for coolant, fuel, vacuum and oil leaks.**
41. **Check and if necessary, adjust the engine idle speed, transaxle throttle linkage and speed control.**

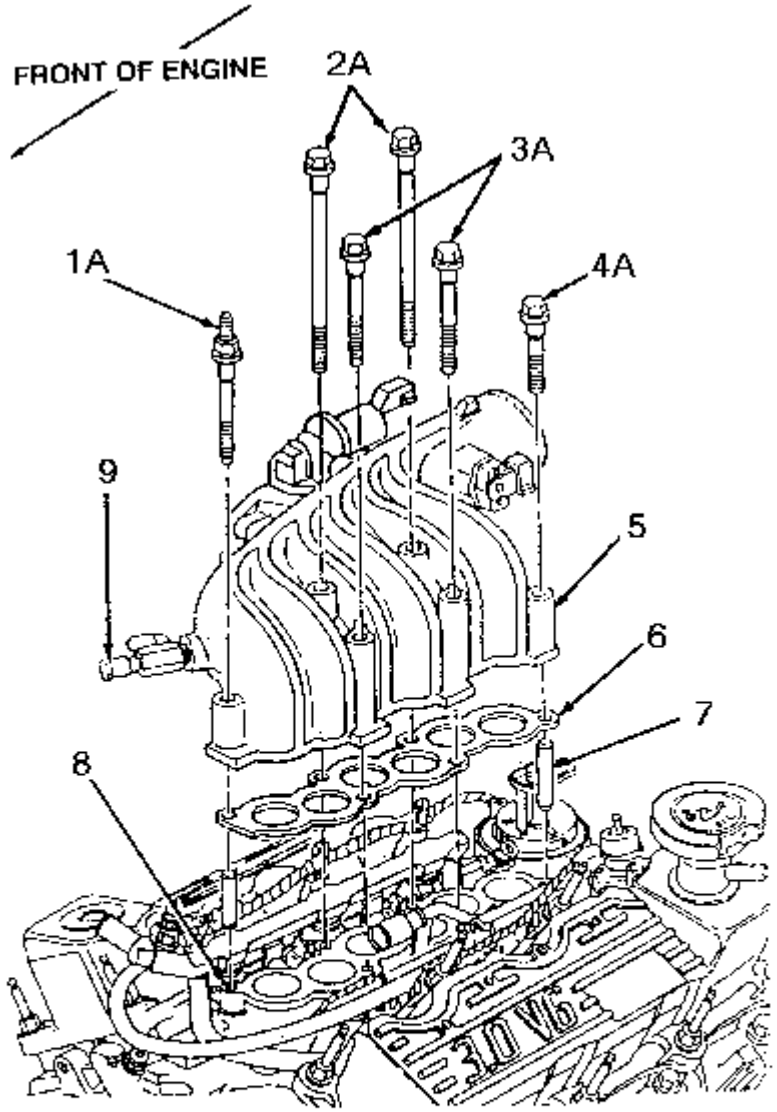
1992-95 VEHICLES

1. **Disconnect the negative battery cable, then properly drain the cooling system.**
2. **Remove the idle air control valve snow shield.**
3. **Remove the PCV tube from the rocker arm/valve cover and the air cleaner outlet tube.**
4. **Remove the aspirator hose from the air cleaner outlet tube. Remove the air cleaner from the throttle body and the air cleaner outlet tube.**

Before relieving the fuel pressure, cover the Schrader valve with a clean rag to prevent fuel from spraying into your eyes.

5. **Carefully relieve the fuel system pressure at the fuel pressure relief Schrader valve. For details regarding this procedure, please refer to *Section 1* of this manual.**
6. **Remove the fuel line clips, then disconnect the fuel lines.**
7. **Tag and disconnect vacuum lines from the throttle body.**
8. **For unleaded fuel vehicles only, disengage the intake air temperature and distributor electrical connector. For flexible fuel (FF) vehicles only, disengage the CSI and camshaft position sensor electrical connectors.**
9. **Disengage the throttle position sensor, the idle air control sensor, engine coolant temperature sensor, and the pressure feedback, or differential pressure feedback EGR sensor electrical connectors.**
10. **Disconnect the upper radiator hose from the thermostat housing. After loosening the retaining clamp, use a twisting motion on the hose to loosen it from the thermostat housing.**
11. **Remove the brace spanning from the alternator bracket to the throttle body stud.**
12. **Disconnect the throttle body retaining bolts, then remove the throttle body. For**

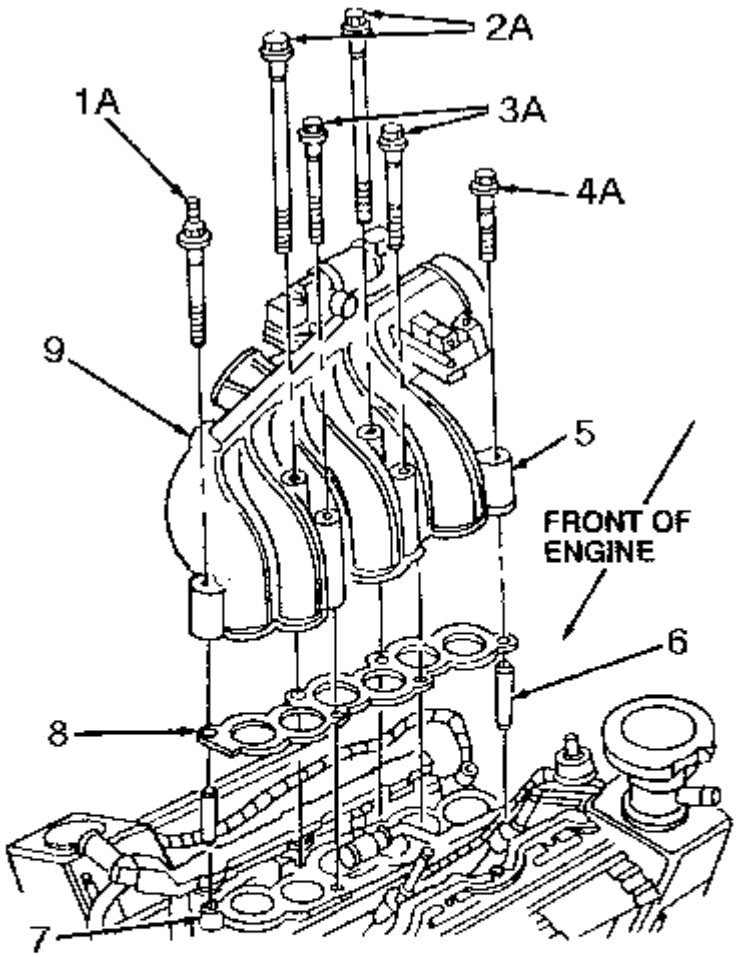
throttle body removal, please refer to the procedure in *Section 5* of this manual.



1A Stud bolt
2A Bolt (2 req'd)
3A Bolt (2 req'd)
4A Bolt
5 Throttle body
6 Intake manifold upper gasket
7 Guide pin
8 Intake manifold
9 Intake manifold vacuum
A Tighten to 20-30 Nm (15-22 lb.ft.)

Throttle body (upper intake manifold) removal-1994 3.0L unleaded gasoline engine shown

Click to enlarge



1A Stud bolt
2A Bolt (2 req'd)
3A Bolt (2 req'd)
4A Bolt
5 Throttle body
6 Guide pin (2 req'd)
7 Intake manifold
8 Intake manifold upper gasket
9 Intake manifold vacuum outlet fitting and cap
A Tighten to 20-30 Nm (15-22 lb.ft.)

Throttle body (upper intake manifold removal-1994 3.0L flexible fuel (FF) engine shown

Click to enlarge

13. **Loosen the EGR retaining nut, them remove it from the EGR valve-to-exhaust manifold tube from the exhaust manifold.**

14. **Disconnect the fuel injector harness retaining stand-offs from the inboard rocker arm cover studs. Carefully disengage the electrical connections to each injector, then remove the fuel charging wiring from the engine.**

The intake manifold assembly may be removed with the fuel supply manifold and injectors in place.

15. **Disconnect the heater hoses.**

16. **Tag and remove the spark plug wires using a twisting motion on the plug rubber boot. Do NOT pull on the wire itself. Remove the harness retaining stand-offs from the rocker arm cover studs.**

Do NOT remove or disturb the camshaft position sensor during the disassembly process. On the 3.0L Flexible Fuel (FF) engine, the camshaft position sensor is NOT adjustable, and it requires a special tool to correctly index the camshaft position.

17. **On unleaded gasoline engines only, mark the distributor housing to engine block and note the rotor position. Remove the distributor retaining bolt and washer, then remove the distributor.**

18. **Remove the ignition coil from the rear of the left hand cylinder head.**

19. **Remove the rocker arm/valve covers. For details regarding rocker arm cover removal, please refer to the procedure located earlier in this section.**

20. **Loosen the cylinder No. 3 intake valve rocker arm retaining nut, then rotate the arm off the push rod and away from the top of the valve stem. Remove the push rod.**

21. **Using a Torx® head socket, remove the intake manifold retaining bolts. Before trying to take the intake manifold out of the engine, carefully wedge a suitable prybar between the intake manifold and the engine block and pry upward on the tool using the area between the thermostat and the transaxle as a leverage point to break the seal. Remove the intake manifold from the engine.**

To install:

22. **Lightly oil all retaining bolt and stud bolt threads before installation.**

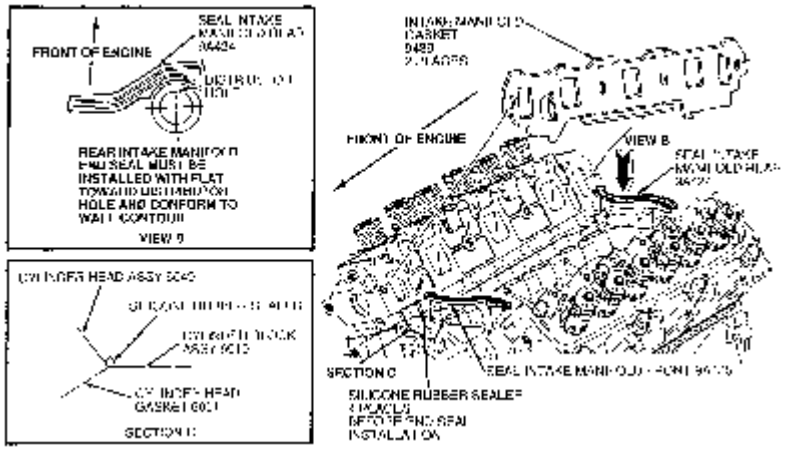
Be careful when scraping aluminum gasket surfaces because aluminum gouges easily, and if scratched, may cause gasket leaks.

23. **Clean the mating surfaces of the intake manifold and cylinder head. Lay a clean cloth in the lifter valley to catch any gasket material. After scraping, carefully lift the cloth from the valley preventing any particles from entering the oil drain holes or cylinder head. Use a suitable solvent to remove old rubber sealant.**

24. **If installing a new intake manifold, transfer the engine coolant temperature (ECT) sensor, thermostat, gasket and housing, heater hose elbow and coolant temperature sending unit to the new manifold.**

25. **If removed, install the fuel supply manifold. Apply engine oil (10W30) or equivalent oil lightly to the fuel injector rubber O-rings before installation. Install the injectors into the fuel supply manifold. Carefully align the manifold assembly to the intake manifold and the injector holes. Push one side into place, one at a time until the manifold "clicks" into place. Install the fuel supply manifold retaining bolts and tighten them to 71-106 inch lbs. (8-12 Nm).**

26. **Apply a $^{1}/_{4}$ in. (5-6mm) drop of Silicone Rubber D6AZ-19562-AA or BA or equivalent, to the intersection of the cylinder block and the cylinder head assembly at the four corners shown.**



Intake manifold gasket and seal location-3.0L engine

Click to enlarge

27. **Position the intake gaskets onto the cylinder heads. Align the intake gasket locking tabs to the provisions on the cylinder head gaskets.**
28. **Install the front and rear intake manifold seals and secure with the retainers.**
29. **Carefully lower the intake manifold into position, aligning the manifold bolts holes to those in the cylinder head. Use care to prevent disturbing the rubber sealer which can cause sealing voids. Install bolts No. 1, 2, 3 and 4 and hand tighten. Tighten, in numerical sequence, to 15-22 ft. lbs. (20-30 Nm), then again in sequence to 19-24 ft. lbs. (26-32 Nm).**
30. **On unleaded gasoline engines only, coat the distributor gear teeth with Engine Assembly Lubricant D9AZ-19579-D or equivalent. Install the distributor, and align to premarked location on the cylinder block and rotor position. Install the retaining bolt and washer and hand tighten.**
31. **Apply engine oil (10W30) or equivalent, to the cylinder No. 3 intake valve push rod and rocker arm. Install the push rod. Move the rocker arm into position with the push rod, then snug the retaining bolt. Rotate the crankshaft to position the crankshaft lobe straight down and away from the valve lifter. Tighten the retaining bolt to 5-11 ft. lbs. (7-15 Nm) to seat the rocker arm fulcrum into the cylinder head. Final tighten the bolt to 19-28 ft. lbs. (26-38 Nm) in any position.**

The fulcrum must be seated into the cylinder head and the push rod must be fully seated in the rocker arm and lifter sockets before final tightening.

32. **Install the rocker arm cover. For details, please see the rocker arm cover procedure located earlier in this section.**
33. **Install the fuel charging wiring to each injector. Secure the wiring with the stand-offs to the inboard rocker arm cover studs.**
34. **Install the ignition coil to the rear of the left hand cylinder head, then tighten the retaining bolts to 29-41 ft. lbs. (40-55 Nm).**
35. **For unleaded gasoline engines only, install the distributor cap and ignition wires. Install the wire harness stand-offs to the rocker arm cover studs, then connect the ignition wires to the spark plugs and the ignition coil.**
36. **Using a new gasket, install the throttle body assembly.**
37. **Install the EGR valve-to-exhaust manifold tube from the exhaust manifold-to-EGR valve. Tighten the retaining nuts to 26-48 ft. lbs. (35-65 Nm).**

38. Connect the fuel lines, then install the fuel lines safety clips.
39. Install the upper radiator hose and heater hoses. Make sure to tighten the retaining clamps securely.
40. Connect the vacuum lines as tagged during removal.
41. For unleaded fuel engines only, engage the electrical connectors to the intake air temperature, and the distributor. For flexible fuel engines only, engage the electrical connectors to the CSI and camshaft position sensor.
42. Engage the electrical connectors to the idle air control, throttle position, engine coolant temperature, pressure feedback or differential pressure feedback EGR sensors, the ignition coil and temperature sending unit.
43. Fill and bleed the cooling system with specified coolant and proper mixture.

Because engine coolant is corrosive to all engine bearing material, replacing the oil after the removal of a coolant carrying component prevents damage.

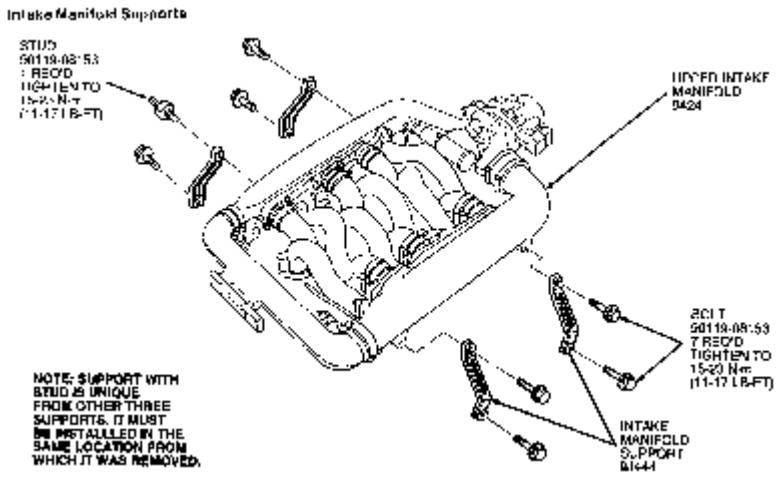
44. Fill the crankcase with the correct viscosity and amount of engine oil.
45. Install the air cleaner outlet tube to the throttle body and air cleaner. Tighten the retaining clamps to 24-48 inch lbs. (2.7-5.4 Nm).
46. Install the PCV tube to the rocker arm cover and the air cleaner outlet tube.
47. Connect the negative battery cable, then start the engine and check for coolant, oil, fuel, and/or vacuum leaks.

Flexible Fuel (FF) base initial engine timing is NOT adjustable.

48. Verify, and if necessary, correct the base initial engine timing to 10° BTDC (before top dead center), then tighten the distributor retaining bolt to 18 ft. lbs. (24 Nm).
49. Install the idle air control valve snowshield.

3.0L and 3.2L SHO Engines

1. Disconnect the negative battery cable.
2. Partially drain the cooling system to allow removal of the intake manifold.
3. Tag and disengage the electrical connectors and vacuum lines from the intake manifold.
4. Remove the air cleaner outlet tube.
5. Disconnect the coolant hoses, throttle position sensor wiring and cables from the throttle body.
6. Remove the four bolts retaining the upper intake manifold supports.
7. Loosen the four lower bolts, then remove the intake manifold supports.
8. Remove the bolts retaining the intake manifold to the cylinder heads.
9. Remove the intake manifold and the intake manifold upper gaskets.



Intake manifold and bracket assembly-3.0L and 3.2L SHO engines

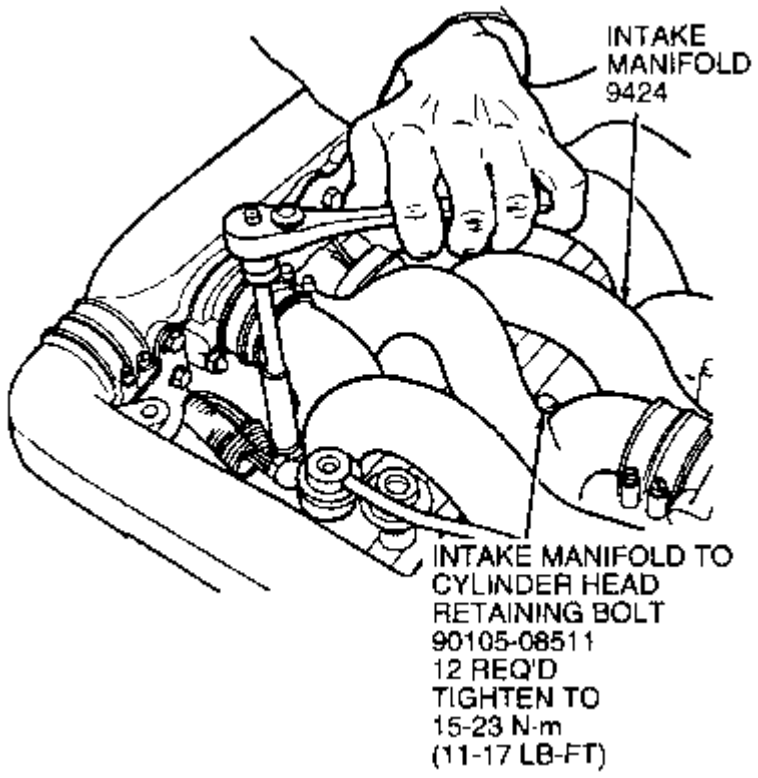
Click to enlarge

To install:

10. **Lightly oil all of the retaining bolts and stud threads before installation.**

If not damaged, the intake manifold upper gasket is reusable.

11. **Position the intake manifold upper gasket on the cylinder head, then position the intake manifold on the cylinder heads.**
12. **Install the retaining bolts, then tighten the bolts to 11-17 ft. lbs. (15-23 Nm).**



For the SHO engines, tighten the intake manifold retaining bolts to 11-17 ft. lbs. (15-23 Nm).

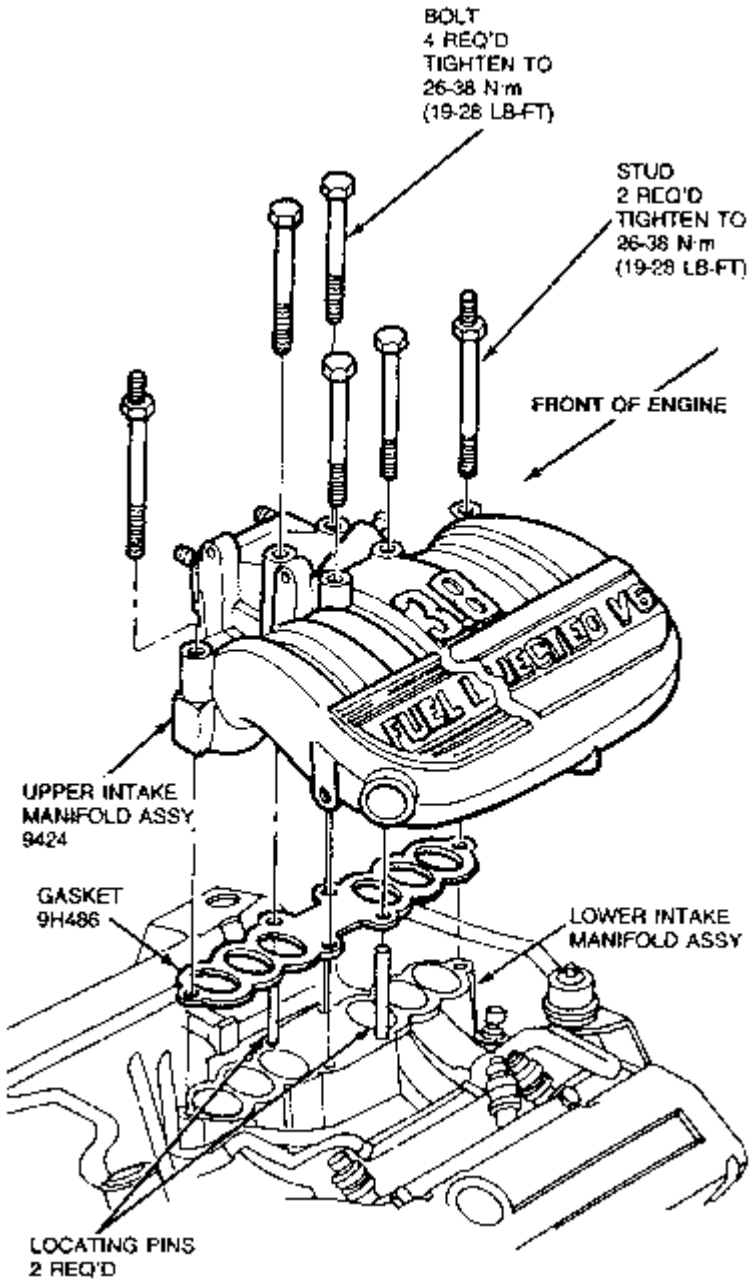
Click to enlarge

13. **Install the intake manifold supports, then tighten the retaining bolts to 11-17 ft. lbs. (15-23 Nm).**
14. **Connect the coolant hoses, throttle position sensor wiring and cables to the throttle body.**
15. **Engage all electrical connectors and vacuum lines to the intake manifold.**
16. **Install the air cleaner outlet tube.**
17. **Fill the cooling system with the proper type and quantity of coolant.**
18. **Connect the negative battery, then start the engine and check for coolant leaks. Check that there is a proper level of coolant, and add coolant if necessary.**

3.8L Engine

VEHICLES THROUGH 1993

1. **Disconnect the negative battery cable, then properly drain the cooling system.**
2. **Remove the air cleaner assembly including the air intake duct and heat tube.**
3. **Disconnect the accelerator cable at the throttle body assembly. If equipped, disconnect speed control cable**
4. **Disconnect the transaxle linkage at the upper intake manifold.**
5. **Remove the attaching bolts from the accelerator cable mounting bracket, then position the cables aside.**
6. **Disconnect the Secondary Air Injection (AIR)/thermactor air supply hose at the check valve.**
7. **Disconnect the flexible fuel lines from steel lines over the rocker arm cover.**
8. **Disconnect the fuel lines at the injector fuel rail assembly.**
9. **Disconnect the radiator hose at the thermostat housing connection.**
10. **Disconnect the coolant bypass hose at the intake manifold connection.**
11. **Disconnect the heater tube at the intake manifold. Remove the heater tube support bracket attaching nut. Remove the heater hose at rear of heater tube. Loosen hose clamp at heater elbow, then remove the heater tube with the hose attached. Remove the heater tube with fuel lines attached and set the assembly aside.**
12. **Tag and disconnect the vacuum lines at the fuel rail assembly and the intake manifold.**
13. **Tag and disengage all necessary electrical connectors.**
14. **If equipped with A/C, remove the air compressor support bracket.**
15. **Disconnect the PCV lines. One is located on the upper intake manifold. The second is located at the left rocker cover and the lower intake stud.**
16. **Remove the throttle body assembly and remove the EGR valve assembly from the upper intake manifold. For details regarding throttle body removal, please refer to *Section 5* of this manual.**
17. **Remove the attaching nut, then remove the wiring retainer bracket located at the left front of the intake manifold and set aside with the spark plug wires.**
18. **Remove the upper intake manifold attaching bolts/studs. Remove the upper intake manifold and gasket.**



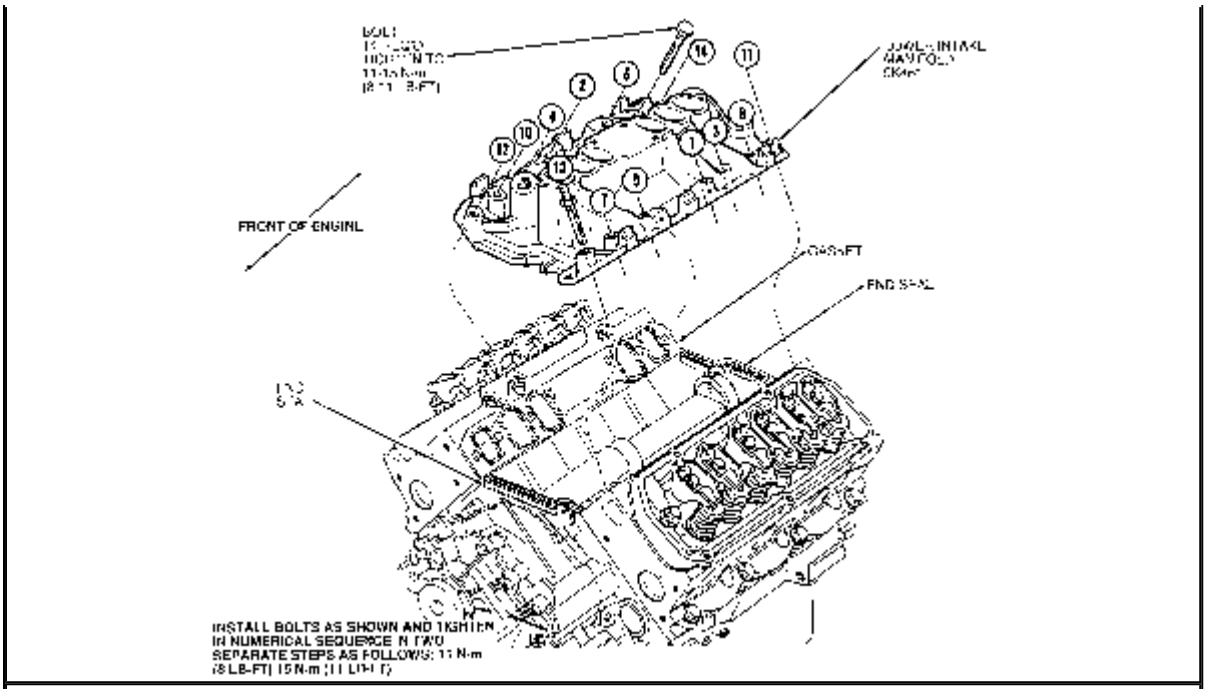
Upper intake manifold assembly-3.8L engine

Click to enlarge

19. **Remove the injectors and fuel injection supply manifold assembly.**
20. **Remove the heater water outlet hose.**

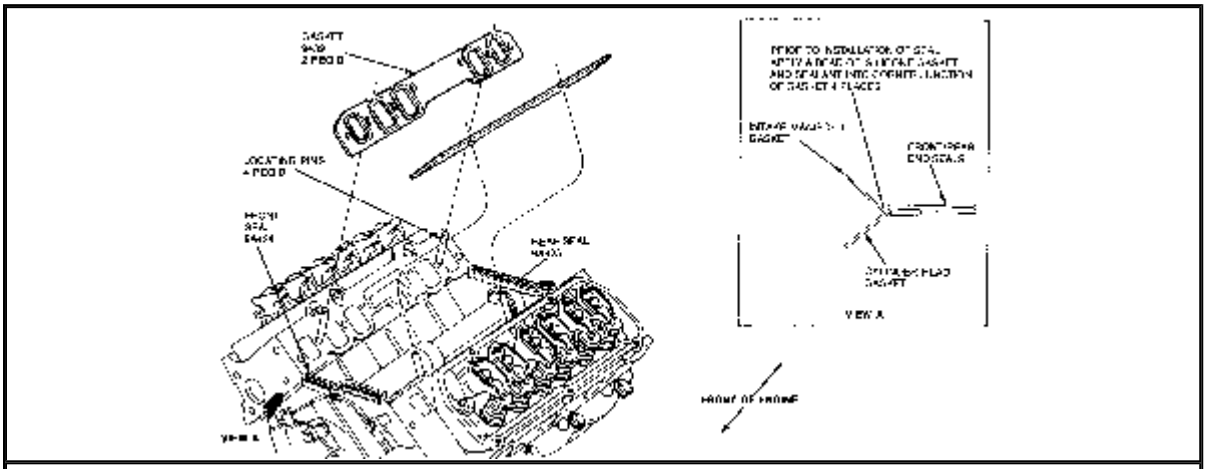
When removing the intake manifold retainers keep them in order so they can be installed in their original positions.

21. **Remove the lower intake manifold attaching bolts/studs, then remove the lower intake manifold. Remove the manifold side gaskets and end seals. Discard and replace with new gaskets and end seals.**



Lower intake manifold assembly-3.8L engine

Click to enlarge



Lower intake manifold gasket and seal locations-3.8L engine

Click to enlarge

The manifold is sealed at each end with RTV-type sealer. To break the seal, it may be necessary to pry on the front of the manifold with a small or medium pry bar. If it is necessary to pry on the manifold, use care to prevent damage to the machined surfaces.

To install:

22. **Lightly oil all attaching bolt and stud threads before installation.**

When using silicone rubber sealer, assembly must occur within 15 minutes after sealer application. After this time, the sealer may start to set-up and its sealing effectiveness may be reduced. The lower intake manifold, cylinder head and cylinder block mating surfaces should be clean and free of oil gasketing material. Use a suitable solvent to clean these surfaces.

23. **Apply a dab of Gasket and Trim Adhesive D7AZ-19B508-B, or equivalent adhesive, to each cylinder head mating surface. Press the new intake manifold gaskets into place, using locating pins as necessary to aid in assembly alignment.**

24. **Apply a $^{1}/_{8}$ in. (3-4mm) bead of silicone sealer at each corner where the cylinder head joins the cylinder block.**

25. **Install the front and rear intake manifold end seals.**

26. **Carefully lower the intake manifold into position on cylinder block and cylinder heads. Use locating pins as necessary to guide the manifold.**

27. **Install the retaining bolts and stud bolts in their original locations.**

28. **For vehicles through 1991, torque the retaining bolts in numerical sequence to the following specifications in 3 steps:**
    1. **Step 1: 8 ft. lbs. (11 Nm)**
    2. **Step 2: 15 ft. lbs. (20 Nm)**
    3. **Step 3: 24 ft. lbs. (32 Nm)**

29. **For 1992-93 vehicles torque the retaining bolts in numerical sequence to the following specifications in 2 steps:**
    1. **Step 1: 8 ft. lbs. (11 Nm)**
    2. **Step 2: 15 ft. lbs. (20 Nm)**

30. **Connect the rear PCV line to upper intake tube, then install the front PCV tube so the mounting bracket sits over the lower intake stud.**

31. **Install the injectors and fuel rail assembly. Tighten the screws to 6-8 ft. lbs. (8-11 Nm).**

32. **Position the upper intake gasket and manifold on top of the lower intake. Use locating pins to secure position of gasket between manifolds.**

33. **Install bolts and studs in their original locations. Tighten the 4 center bolts, then tighten the end bolts. Repeat Steps 28 or 29 depending on vehicle year application.**

34. **Install the EGR valve assembly on the manifold. Tighten the attaching bolt to 15-22 ft. lbs. (20-30 Nm).**

35. **Install the throttle body. Cross-tighten the retaining nuts to 15-22 ft. lbs. (20-30 Nm).**

36. **Connect the rear PCV line at PCV valve and upper intake manifold connections. If equipped with A/C, install the compressor support bracket. Tighten the retaining fasteners to 15-22 ft. lbs. (20-30 Nm).**

37. **Engage all electrical connectors and vacuum hoses.**

38. **Connect the heater tube hose to the heater elbow. Position the heater tube support bracket and tighten attaching nut to 15-22 ft. lbs. (20-30 Nm). Tighten the hose clamp at the heater elbow securely.**

39. **Connect the heater hose to the rear of the heater tube, then tighten the hose clamp.**

40. **Connect the coolant bypass and upper radiator hoses and tighten the hose clamps securely.**

41. **Connect the fuel line(s) at injector fuel rail assembly, then connect the flexible fuel lines to the steel lines.**

42. **Position the accelerator cable mounting bracket, then install and tighten the retaining bolts to 15-22 ft. lbs. (20-30 Nm).**

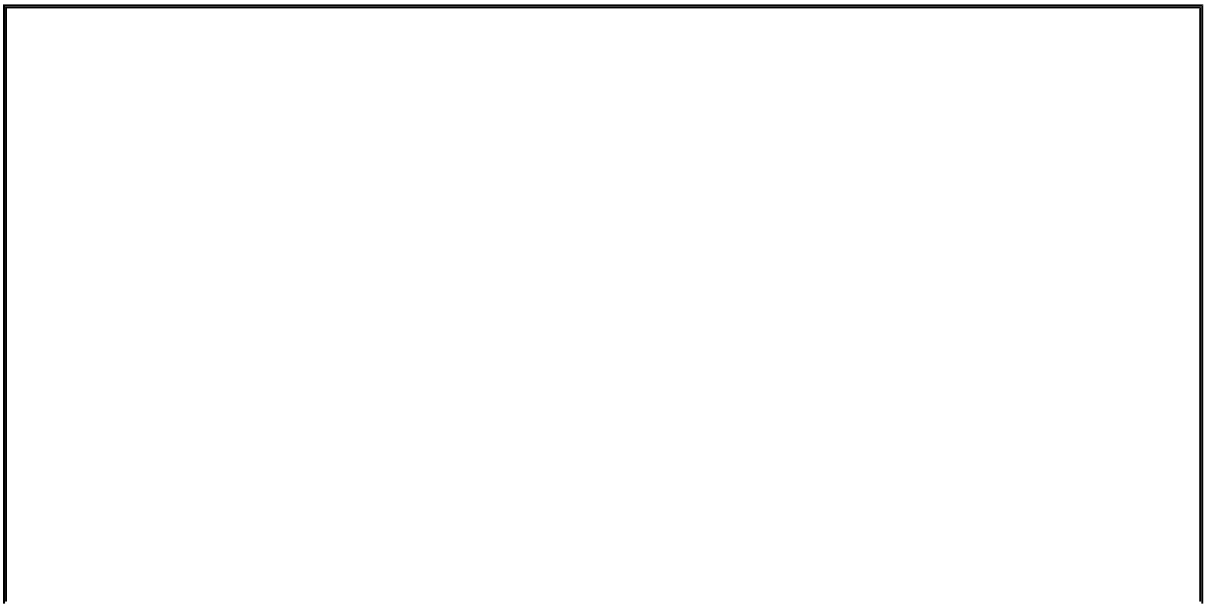
43. **Connect the speed control cable, if equipped. Connect the transaxle linkage at the**

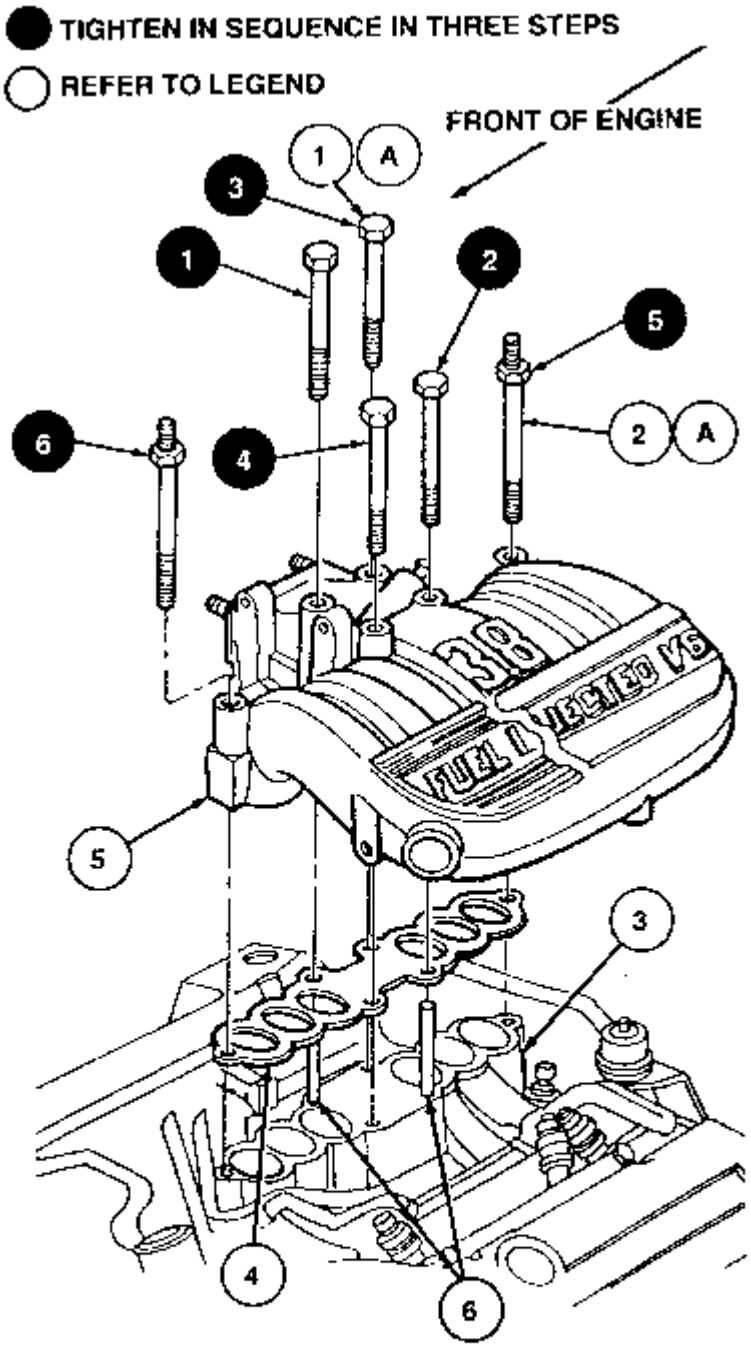
upper intake manifold.

44. Fill the cooling system to the proper level with the specified coolant.
45. Connect the negative battery cable, then start the engine and check for coolant or fuel leaks.
46. Check and, if necessary, adjust engine idle speed, transaxle throttle linkage and speed control.
47. Install the air cleaner assembly and air intake duct.

1994-95 VEHICLES

1. Disconnect the negative battery cable, then properly drain the engine cooling system.
2. Remove the air cleaner outlet tube.
3. Disconnect the accelerator cable at the throttle body. If equipped, disconnect the cruise control actuator.
4. Remove the retaining bolts from the accelerator cable bracket, then position the cables aside.
5. Tag and disconnect the vacuum lines from the fuel pressure regulator and the intake manifold.
6. Disengage any necessary electrical connectors.
7. Remove the drive belt. For details regarding this procedure, please refer to *Section 1* of this manual.
8. Disconnect the crankcase ventilation hoses located on the upper intake manifold.
9. Remove the alternator mounting brace.
10. If necessary, disconnect the throttle body retaining bolts, then remove the throttle body.
11. If necessary remove the EGR valve from the upper intake manifold.
12. Remove the retaining nut, then remove the wiring retainer bracket located at the left hand front of the intake manifold, then set it aside with the ignition wires.
13. Remove the upper intake manifold upper gasket retaining bolts and stud bolt, then remove the intake manifold from the engine.





1 Bolt (4 req'd)
2 Stud (2 req'd)
3 Lower intake manifold
4 Intake manifold upper gasket
5 Upper intake manifold
6 Guide pin (2 req'd)
A Tighten in sequence in three steps:
10 Nm (8 lb.ft.)
20 Nm (15 lb.ft.)
32 Nm (24 lb.ft.)

Upper intake manifold assembly-1995 3.8L engine shown

Click to enlarge

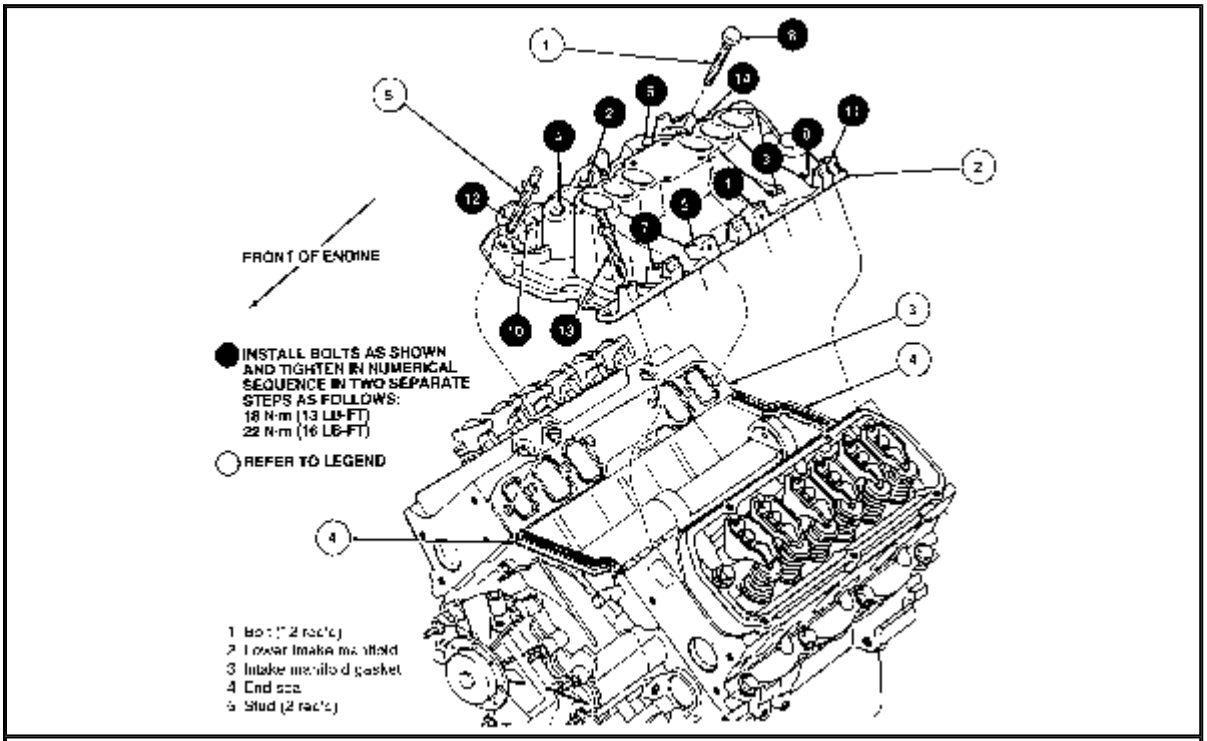
14. Disconnect the upper radiator hose from the water hose connection.

15. **Disconnect the heater water hose from the lower intake manifold, then disconnect the heater water outlet tube from the lower intake manifold.**

16. **Remove the fuel injectors and the fuel injection supply manifold.**

The lower intake manifold is secured at each corner with sealer. To break the seal you may have to carefully pry the front of the manifold with a suitable prybar. Be careful not to damage the machined surfaces.

17. **Remove the lower intake manifold retaining bolts. then remove the lower intake manifold. Remove the manifold gasket, and end seals and discard them.**



Lower intake manifold and gasket and seal location-1995 3.8L engine shown

Click to enlarge

To install:

When installing the upper and/or lower intake manifold(s), ALWAYS use a new gasket.

18. **Lightly oil all retaining bolt and stud bolt threads before installation.**

When using silicone rubber sealer, assembly must occur within 15 minutes of sealer application. After 15 minutes, the sealer may start to set-up, and lose its sealing effectiveness.

19. **Use a suitable solvent to clean the gasket mating surfaces. The mating surfaces of the lower intake manifold, cylinder head and cylinder block should be clean and free of old gasketing material.**

20. **Before applying sealer, clean the sealing surfaces of the cylinder heads and the lower intake manifold with Metal Surface Cleaner F4AZ-19A536-RA or equivalent, to remove all residues that may affect the sealer's ability to adhere.**

21. **Apply a dab of Gasket and Trim Adhesive D7AZ-19B508 or equivalent, to each**

cylinder head mating surface. Press the new gaskets into place, using locating pins as necessary to aid in alignment.

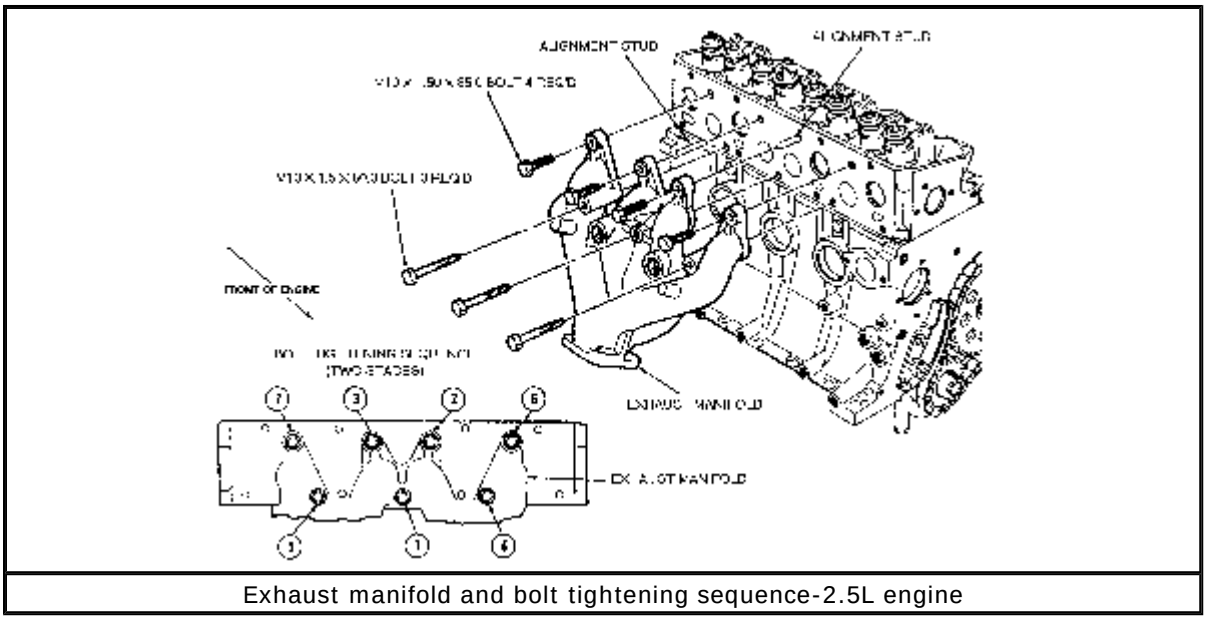
22. Apply a $^{1}/_{8}$ in. (3-4mm) bead of Silicone Rubber D6AZ-19562-BA or equivalent, at each corner where the cylinder head joins the cylinder block.
23. Install the front and rear intake manifold end seals.
24. Carefully install the intake manifold into position on the cylinder block and cylinder heads. Use locating pins, as necessary, to guide the intake manifold.
25. Install the retaining bolts in their original locations. Tighten the bolts in numerical sequence to the following specifications in two steps:
    1. Step 1: 13 ft. lbs. (18 Nm)
    2. Step 2: 16 ft. lbs. (22 Nm)
26. Install the fuel injectors and the fuel injection supply manifold. Tighten the retaining bolts to 6-8 ft. lbs. (8-11 Nm).
27. Connect the heater water outlet tube to the lower intake manifold. Make sure to fasten the hose clamp securely.
28. Connect the heater water hose to the lower intake manifold, making sure to fasten the hose clamp securely.
29. Connect the upper radiator hose to the water hose connection and tighten clamp securely.
30. Apply a light coat of Pipe Sealant with Teflon® or equivalent to the upper intake manifold retaining bolts and stud bolts.
31. Install the upper manifold retaining bolts and stud bolts in there original location, then tighten in numerical sequence in three steps:
    1. Step 1: 8 ft. lbs. (10 Nm)
    2. Step 2: 15 ft. lbs. (20 Nm)
    3. Step 3: 24 ft. lbs. (32 Nm)
32. If removed, install the EGR valve on the intake manifold, then tighten the retaining nuts to 15-22 ft. lbs. (20-30 Nm).
33. If removed, install the throttle body using the retaining nuts. Torque the nuts in a cross-tightening sequence to 15-22 ft. lbs. (20-30 Nm).
34. Connect the rear crankcase ventilation hoses at the PCV valve and the upper intake manifold.
35. Install the alternator mounting brace, then install the drive belt. For drive belt installation procedures, please refer to *Section 1* of this manual.
36. Engage the necessary electrical connectors and vacuum hoses.
37. Position the accelerator cable bracket, then install and tighten the retaining bolts to 15-22 ft. lbs. (20-30 Nm).
38. If equipped, connect the cruise control actuator to the throttle body, then connect the accelerator cable to the throttle body.
39. Install the air cleaner and air cleaner outlet tube, then fill the cooling system with the proper type and quantity of coolant.
40. Connect the negative battery cable, then start the engine and check for oil, coolant or fuel leaks.

Exhaust Manifold

REMOVAL & INSTALLATION

2.5L Engine

1. **Disconnect the negative battery cable.**
2. **Drain the cooling system.**
3. **Remove the accelerator cable and, if equipped, the cruise control cable.**
4. **Remove air cleaner assembly and heat stove tube at the heat shield.**
5. **Identify, tag and disengage all necessary vacuum lines and electrical connections.**
6. **Disconnect the exhaust pipe-to-exhaust manifold retaining nuts.**
7. **Remove exhaust manifold heat shroud. Disengage the oxygen sensor wire at the connector.**
8. **Disconnect the fuel supply and return lines.**
9. **As required on vehicles before 1990, disconnect the thermactor check valve hose at tube assembly, remove bracket-to-EGR valve attaching nuts and disconnect water inlet tube at intake manifold.**
10. **Disconnect EGR tube from the EGR valve.**
11. **Remove the intake manifold. For details regarding intake manifold removal, please refer to the procedure located earlier in this section.**
12. **Remove the exhaust manifold retaining nuts, then remove the exhaust manifold from the vehicle.**



Exhaust manifold and bolt tightening sequence-2.5L engine

Click to enlarge

To install:

13. **Position the exhaust manifold to the cylinder head using guide bolts in holes 2 and 3.**
14. **Install the remaining attaching bolts.**
15. **Tighten the attaching bolts until snug, then remove guide bolts and install**

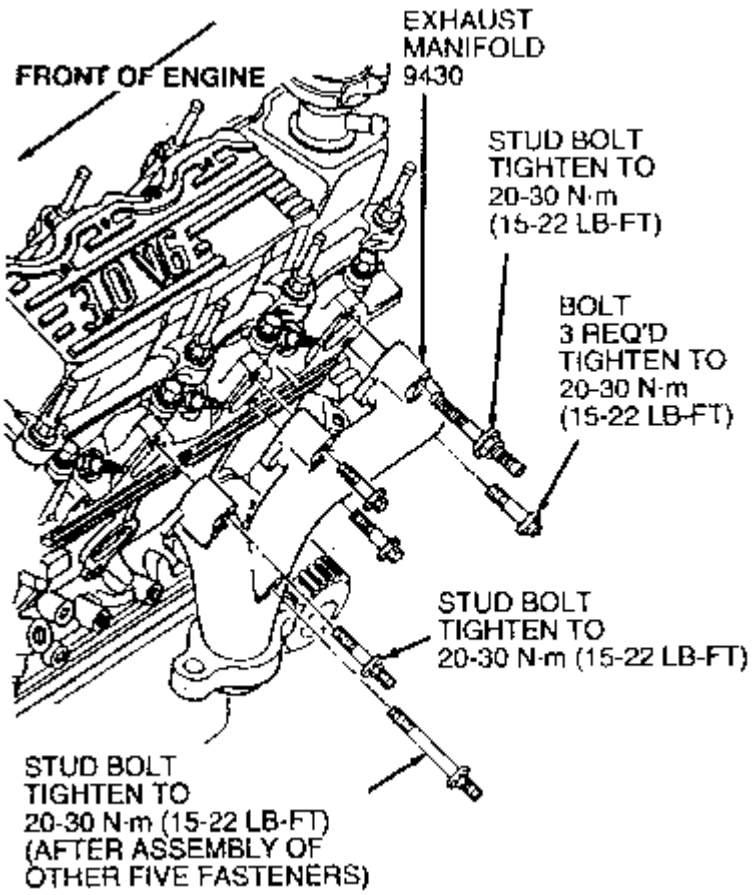
attaching bolts in holes 2 and 3.

16. Tighten all of the exhaust manifold retaining bolts, in sequence, to 5-7 ft. lbs. (7-10 Nm), then retorque, in sequence, to 20-30 ft. lbs. (27-41 Nm).
17. Install the intake manifold gasket and bolts. Tighten the intake manifold retaining bolts to 15-23 ft. lbs. (20-30 Nm).
18. As required on vehicles before 1990, connect the water inlet tube at intake manifold, connect thermactor check valve hose at tube assembly and install bracket to EGR valve attaching nuts.
19. Connect the oxygen sensor wire.
20. Connect the EGR tube to EGR valve.
21. Install exhaust manifold studs.
22. Connect exhaust pipe to the exhaust manifold.
23. Engage the vacuum lines and electrical connectors as tagged during removal.
24. Install the air cleaner assembly and heat stove tube.
25. Install accelerator cable and cruise control cable, if equipped.
26. Connect the negative battery cable, then fill the cooling system to the proper level.
27. Start engine and check for leaks, then check the coolant level, and add if necessary.

3.0L Engine

LEFT SIDE

1. Disconnect the negative battery cable. Remove the oil level indicator support bracket.
2. Remove the engine control sensor wiring from the oil level indicator tube bracket, then remove the oil dipstick and the oil level indicator tube.
3. On 1986-89 vehicles, remove the power steering pump pressure and return hoses.
4. Raise and safely support the vehicle.
5. Remove the exhaust manifold-to-dual converter Y-pipe retaining nuts.
6. Lower the vehicle. Remove the exhaust manifold attaching bolts, then remove the exhaust manifold.



Left side exhaust manifold mounting-3.0L engine (except SHO)

Click to enlarge

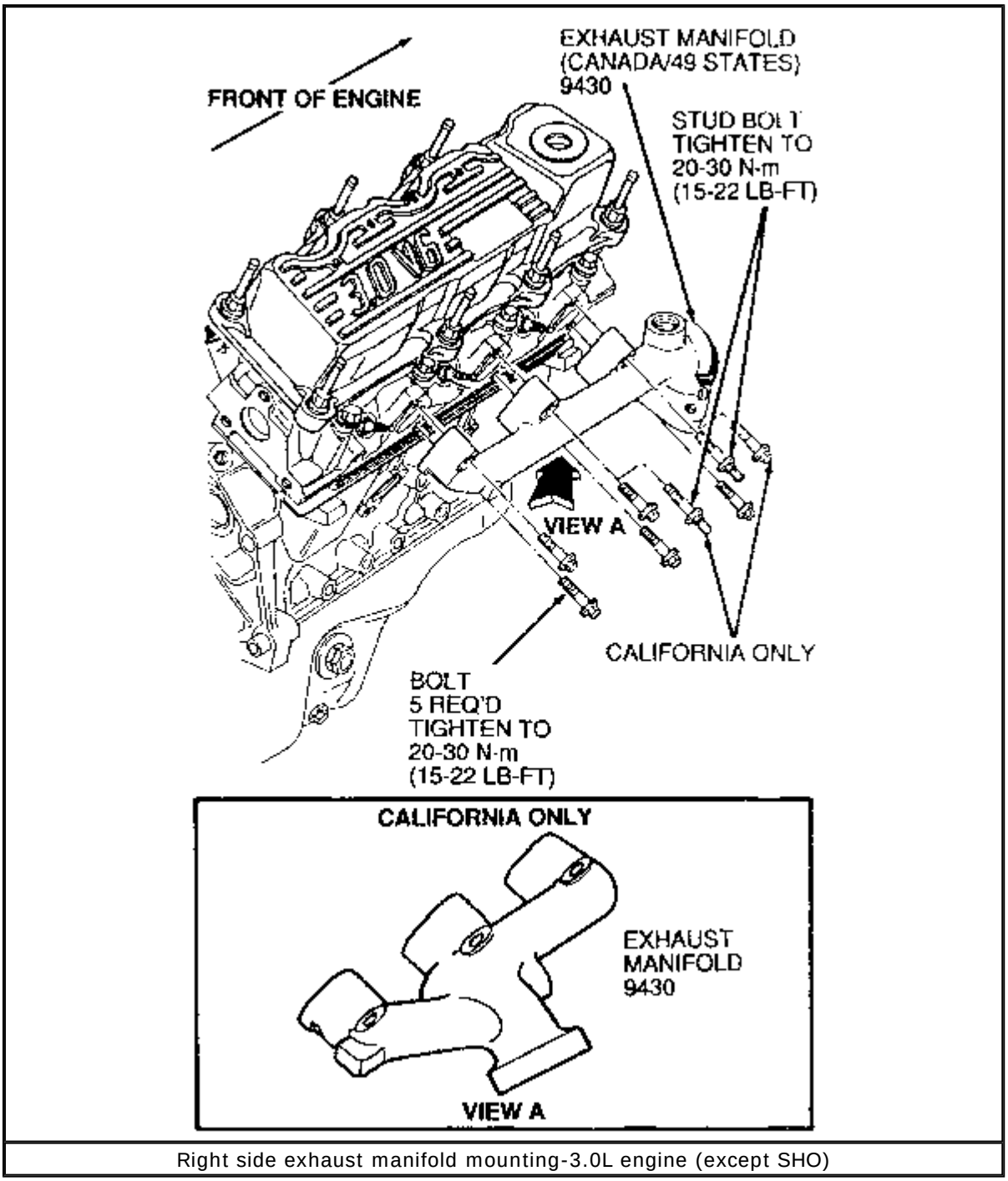
To install:

7. **Clean all exhaust manifold, cylinder head and Y-pipe mating surfaces, then lightly oil all bolt and stud threads.**
8. **Position the exhaust manifold on the cylinder head, then install the retaining bolts. Tighten the retaining bolts to 15-22 ft. lbs. (20-30 Nm).**
9. **Raise and safely support the vehicle, then connect the dual converter Y-pipe to the exhaust manifold. Tighten the retaining nuts to 25-34 ft. lbs. (34-47 Nm).**
10. **Install the oil level indicator tube bracket, then position the electrical harness. Tighten the retaining nut to 11-15 ft. lbs. (15-20 Nm).**
11. **If removed, connect the power steering pump pressure and return hoses.**
12. **Connect the negative battery cable, then start the engine and check for leaks.**

RIGHT SIDE

1. **Disconnect the negative battery cable. Remove the heater hose support bracket.**
2. **Disconnect and plug the heater hoses.**
3. **Disconnect the pressure feedback (PFE) or differential pressure feedback (DPFE) hose(s) from the EGR valve-to-exhaust manifold tube.**
4. **Remove the EGR valve-to-exhaust manifold tube from the exhaust manifold. Use a backup wrench on the EGR valve tube-to-manifold connector.**

5. **If equipped, remove the water bypass tube.**
6. **Raise and safely support the vehicle. Remove the exhaust manifold-to-dual converter Y-pipe retaining nuts, then remove the pipe from the manifold.**
7. **Lower the vehicle. Remove the exhaust manifold retaining bolts, then remove the exhaust manifold from the vehicle.**



Right side exhaust manifold mounting-3.0L engine (except SHO)

Click to enlarge

To install:

8. **Clean all exhaust manifold, cylinder head and Y-pipe mating surfaces, then lightly oil all bolt and stud threads.**
9. **If replacing the exhaust manifold, remove the EGR valve-to-exhaust manifold tube**

and install it on the new manifold.

10. Position the exhaust manifold on the cylinder head, then install the retaining bolts. Tighten the retaining bolts to 15-22 ft. lbs. (20-30 Nm).
11. Raise and safely support the vehicle.
12. Connect the dual converter Y-pipe to the exhaust manifold. Tighten the retaining nuts to 25-34 ft. lbs. (34-47Nm).
13. If removed, install the water bypass tube, then tighten the retaining nut to 15-22 ft. lbs. (20-30 Nm).
14. Connect the EGR valve-to-exhaust manifold tube to the exhaust manifold, then tighten to 26-48 ft. lbs. (35-65 Nm).
15. Connect the PFE or DPFE hose(s), then connect the negative battery cable.
16. Start the engine and check for exhaust and/or coolant leaks.

3.0L SHO Engine

Always use new gaskets when installing the exhaust manifolds.

LEFT SIDE

1. Disconnect the negative battery cable.
2. Remove the oil level indicator tube support bracket.
3. Remove the power steering pressure and return hoses.
4. Remove the exhaust manifold-to-dual converter Y-pipe retaining nuts.
5. Remove the heat shield retaining bolts.
6. Remove the exhaust manifold retaining nuts, then remove the exhaust manifold.

To install:

7. Clean all exhaust manifold, cylinder head and Y-pipe mating surfaces, then lightly oil all bolt and stud threads.
8. Position the exhaust manifold on the cylinder head, using a new gasket, then install the retaining nuts. Tighten the retaining nuts 26-38 ft. lbs. (35-52 Nm).
9. Install the heat shield retaining bolts, then tighten the bolts to 11-17 ft. lbs. (15-23 Nm).
10. Connect the dual converter Y-pipe to the exhaust manifold. Tighten the retaining nuts to 15-24 ft. lbs. (20-32 Nm).
11. Connect the power steering pressure and return hoses.
12. Install the oil level indicator tube support bracket.
13. Connect the negative battery cable.

RIGHT SIDE

1. Disconnect the negative battery cable.
2. Remove the right hand cylinder head. For details regarding cylinder head removal, please see the procedure located later in this Section.
3. Remove the heat shield retaining bolts.

4. **Remove the exhaust manifold retaining nuts, then remove the exhaust manifold.**

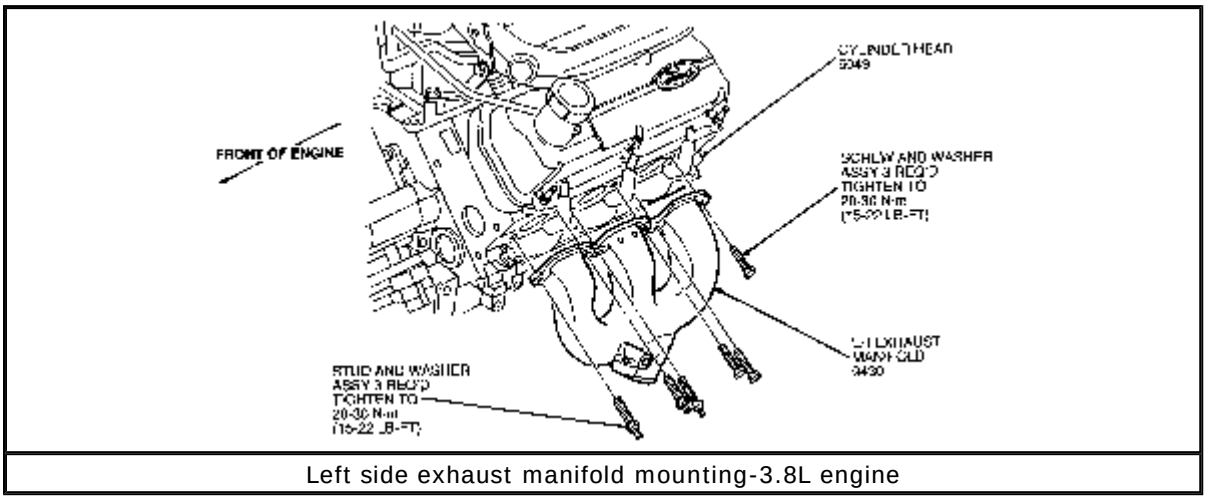
To install:

5. **Clean all of the cylinder head, exhaust manifold and Y-pipe mating surfaces, then lightly oil all bolt and stud threads.**
6. **Position the exhaust manifold on the cylinder head, a new gasket, then install the retaining nuts. Tighten the nuts to 15-24 ft. lbs. (20-32 Nm).**
7. **Install the heat shield retaining bolts. Tighten to 11-17 ft. lbs. (15-23 Nm).**
8. **Install the right hand cylinder head. For details regarding cylinder head installation, please refer to the procedure located later in this section.**
9. **Connect the negative battery cable, then start the engine and check for exhaust and/or coolant leaks.**

3.8L Engine

LEFT SIDE

1. **Disconnect the negative battery cable.**
2. **Remove the oil level dipstick tube support bracket.**
3. **Tag and disconnect the spark plug wires.**
4. **Raise and safely support the vehicle.**
5. **Remove the exhaust manifold-to-exhaust pipe attaching nuts.**
6. **Lower the vehicle.**
7. **Remove the exhaust manifold retaining bolts, then remove the exhaust manifold from the vehicle.**



Left side exhaust manifold mounting-3.8L engine

Click to enlarge

To install:

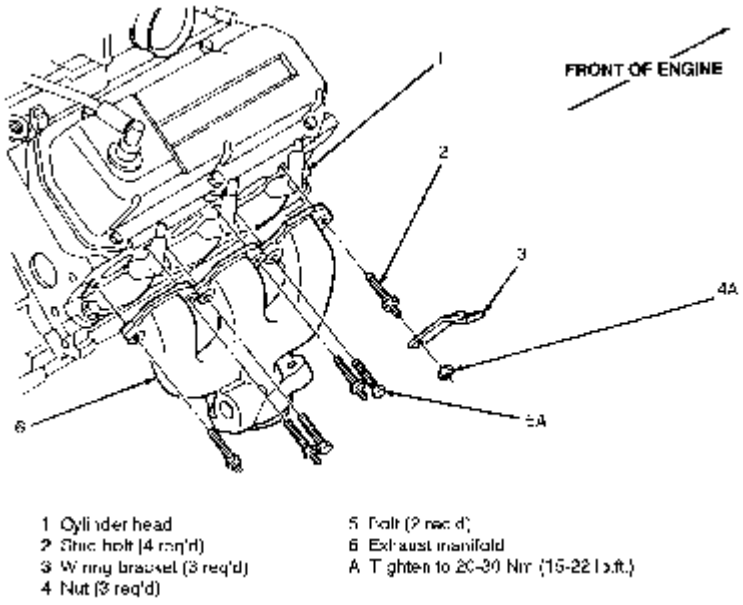
8. **Lightly oil all bolt and stud threads before installation. Clean the exhaust manifold, cylinder head and Y-pipe mating surfaces.**
9. **Position the exhaust manifold on the cylinder head. Install the lower front bolt hole on the No. 5 cylinder as a pilot bolt.**

A slight warpage in the exhaust manifold may cause a misalignment betweenthe bolt holes in the head and the manifold. Elongate the holes in the exhaustmanifold as necessary to correct the misalignment, if apparent. Do NOT elongatethe pilot hole, the lower front bolt on No. 5 cylinder.

10. **Install the remaining exhaust manifold retaining bolts, then tighten the bolts 15-22 ft. lbs. (20-30 Nm).**
11. **Raise and safely support the vehicle.**
12. **Connect the dual converter Y-pipe to the exhaust manifold. Tighten the attaching nuts to 16-24 ft. lbs. (21-32 Nm).**
13. **Carefully lower the vehicle.**
14. **Connect the spark plug wires as tagged during removal.**
15. **Install the oil level dipstick tube support bracket attaching nut. Tighten to 15-22 ft. lbs. (20-30 Nm).**
16. **Connect the negative battery cable, then start the engine and check for exhaust leaks.**

RIGHT SIDE

1. **Disconnect the negative battery cable.**
2. **Remove the air cleaner and the air cleaner outlet tube assembly.**
3. **If equipped, disconnect the thermactor hose or the Secondary Air Injection (AIR) hose from the downstream air tube check valve.**
4. **Tag and disconnect the ignition wire from the ignition coil, then tag and disconnect the wires from the spark plugs. Remove the spark plugs.**
5. **Disconnect the EGR valve-to-exhaust manifold tube of the exhaust manifold.**
6. **Raise and safely support the vehicle.**
7. **Remove the transaxle dipstick tube.**
8. **For vehicles through 1990, remove the thermactor air tube by cutting the tube clamp at the underbody catalyst fitting with a suitable cutting tool.**
9. **Remove the exhaust manifold-to-exhaust pipe attaching nuts.**
10. **Carefully lower the vehicle.**
11. **Remove the exhaust manifold retaining bolts, them remove the exhaust manifold from the vehicle.**



Right side exhaust manifold mounting-3.8L engine

Click to enlarge

To install:

12. **Lightly oil all bolt and stud threads before installation. Clean the exhaust manifold, cylinder head and Y-pipe mating surfaces.**
13. **Position the inner half of the heat shroud, if equipped, and exhaust manifold on cylinder head. Start two retaining bolts to align the manifold with the cylinder head. Install the remaining retaining bolts and tighten to 15-22 ft. lbs. (20-30 Nm).**

A slight warpage in the exhaust manifold may cause a misalignment betweenthe bolt holes in the cylinder head and exhaust manifold. Elongate the holes inthe exhaust manifold as necessary to to correct the misalignment. Do notelongate the pilot hole (the lower rear bolt hole on the No. 2 cylinder).

14. **Raise and safely support the vehicle.**
15. **Connect the dual converter Y-pipe to the exhaust manifold. Tighten the retaining nuts to 16-24 ft. lbs. (22-33 Nm).**
16. **For vehicles through 1990, position the thermactor hose to the downstream air tube and clamp tube to the underbody catalyst fitting.**
17. **Install the transaxle dipstick tube, then carefully lower the vehicle.**
18. **If equipped, install the outer heat shroud, then tighten the retaining screws to 50-70 inch lbs. (6-8 Nm).**
19. **Install the spark plugs. Connect the ignition wires to their respective spark plugs, then connect the ignition wire to the coil.**
20. **Connect the EGR valve-to-exhaust manifold tube.**
21. **Connect the thermactor hose or the Secondary Air Injection (AIR) hose to the downstream air tube and secure with the retaining clamp.**
22. **Install the air cleaner and the air cleaner outlet tube assembly.**
23. **Connect the negative battery cable, then start the engine and check for exhaust leaks. Check the transaxle fluid.**

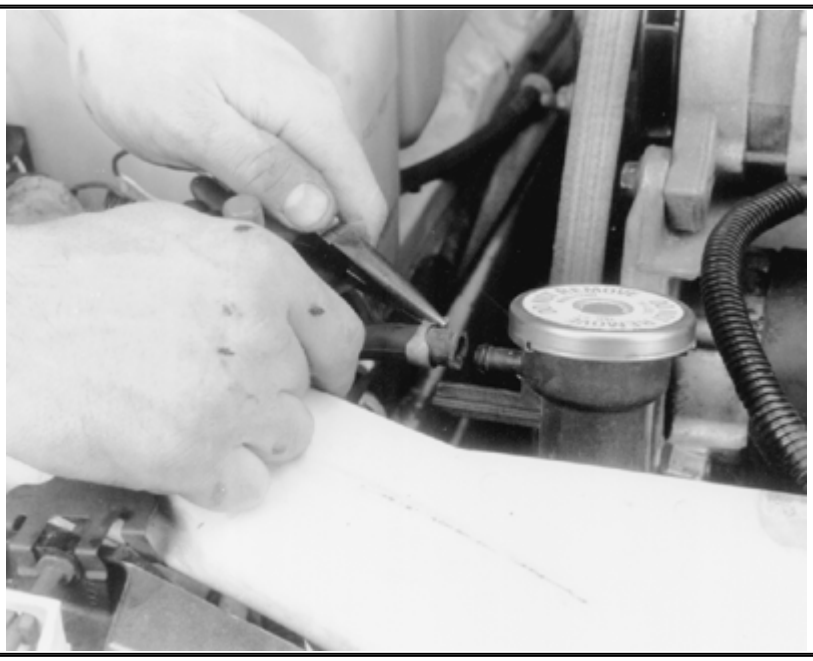
Radiator

REMOVAL & INSTALLATION

CAUTION

When draining the coolant, keep in mind that cats and dogs are attracted by ethylene glycol antifreeze, and are quite likely to drink any that is left in an uncovered container or in puddles on the ground. This will prove fatal in sufficient quantity. Always drain the coolant into a sealable container. Coolant should be reused unless it is contaminated or several years old.

1. **Disconnect the negative battery cable.**
2. **Drain the cooling system by removing the radiator cap and opening the draincock located at the lower rear corner of the radiator inlet tank.**
3. **Remove the rubber overflow tube from the coolant recovery bottle and detach it from the radiator. On the Taurus SHO, disconnect the tube from the radiator and remove the recovery bottle.**
4. **Remove 2 upper shroud retaining screws and lift the shroud out of the lower retaining clip(s).**
5. **Disconnect the electric cooling fan motor wires and remove the fan and shroud assembly.**
6. **Loosen the upper and lower hose clamps at the radiator and remove the hoses from the radiator tank connectors.**



Removing the coolant hoses-Early model 2.5L engine shown

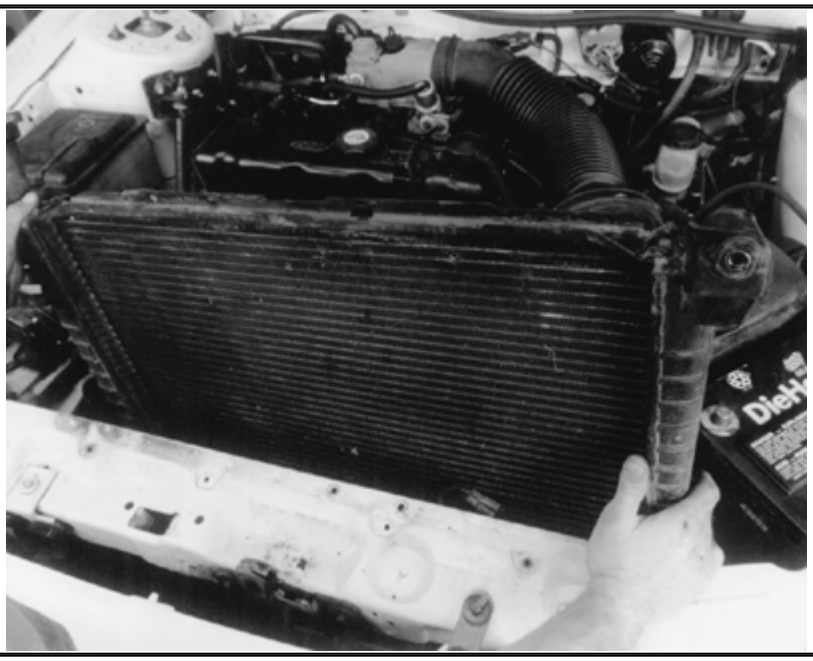
7. **If equipped with an automatic transaxle, disconnect the transmission oil cooling lines from the transmission oil cooler radiator fittings using disconnect tool T82L-9500-AH or equivalent.**
8. **For vehicles through 1992, if equipped with 3.0L or SHO engines, remove the two**

radiator upper retaining screws. For vehicles through 1992, if equipped with the 3.8L engine, remove 2 hex nuts from the right radiator support bracket and 2 screws from the left radiator support bracket and remove the brackets.

9. **For 1993-94 3.0L engines, remove the two radiator upper retaining screws. For 1993-94 3.8L and SHO engines, remove the two hex nuts from the right hand radiator support bracket, then remove the two retaining nuts from the left hand radiator support bracket, then remove both brackets.**

Remove the radiator retaining bolts/screws

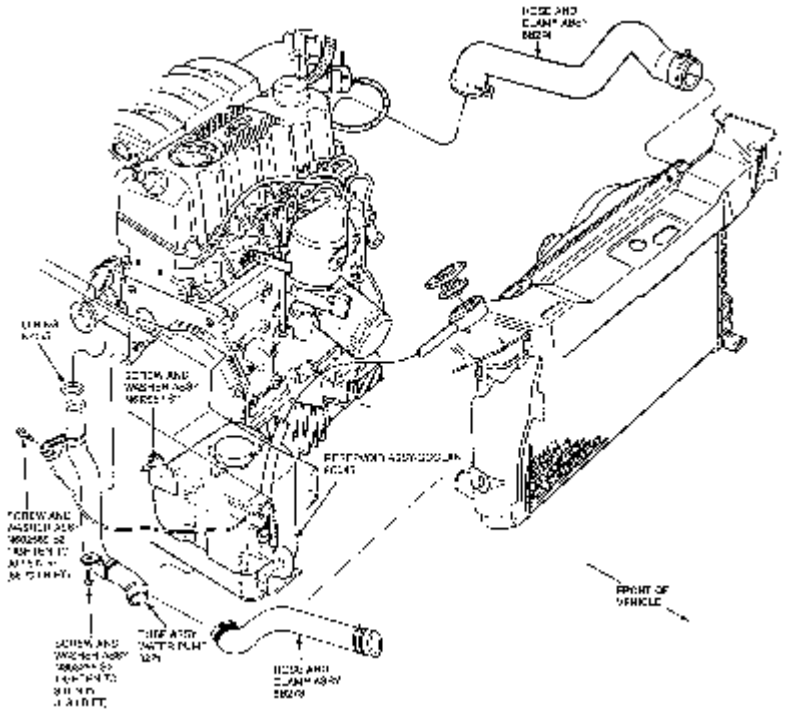
10. **For all 1995 vehicles, remove the two hex nuts from the right hand side radiator support bracket, then remove the bracket. Remove the two screws from the left hand side radiator support bracket, then remove the bracket.**
11. **Tilt the radiator rearward approximately 1 in. (25mm) and lift it directly upward, clear of the radiator support.**



Lift the radiator upward, then remove it from the engine

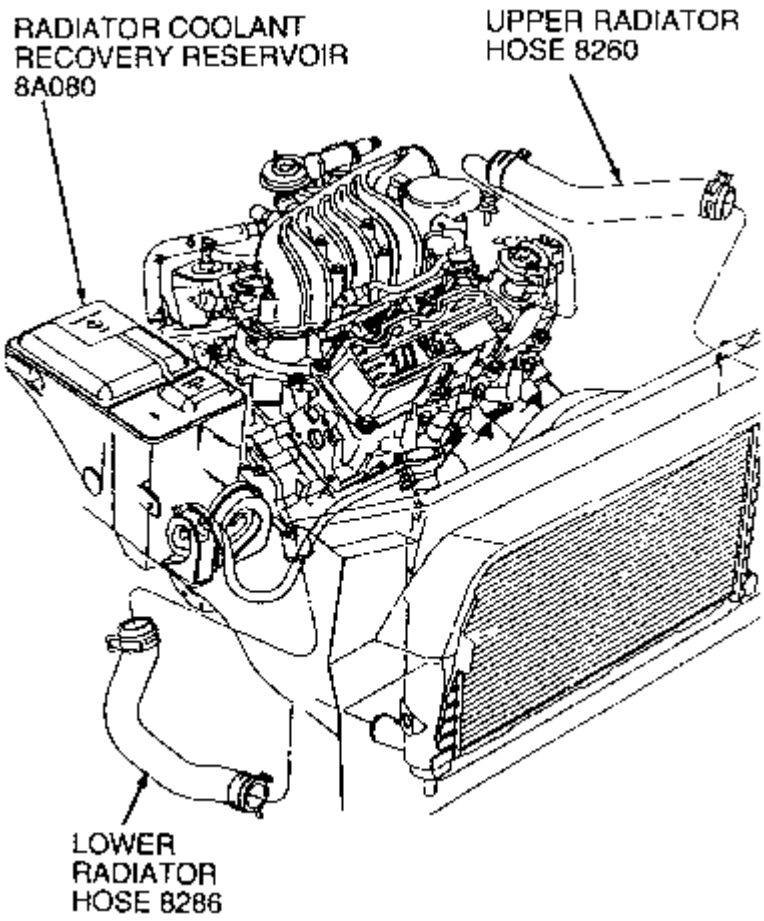
12. **If the lower or upper radiator hose it to be replaced, loosen the clamp at the engine end and, using a twisting motion, slip the hose off the connections.**

13. **Remove the radiator lower support rubber pads, if pad replacement is necessary.**



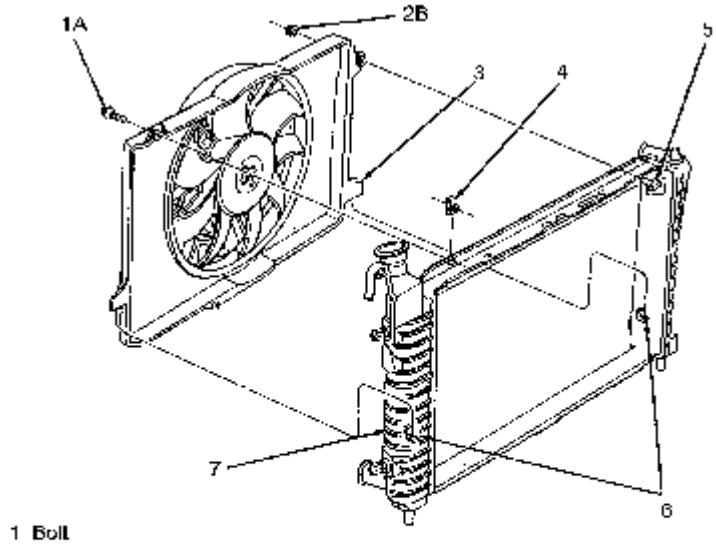
Radiator and related components-2.5L engine

Click to enlarge



Radiator and related components-3.0L engine (except SHO)

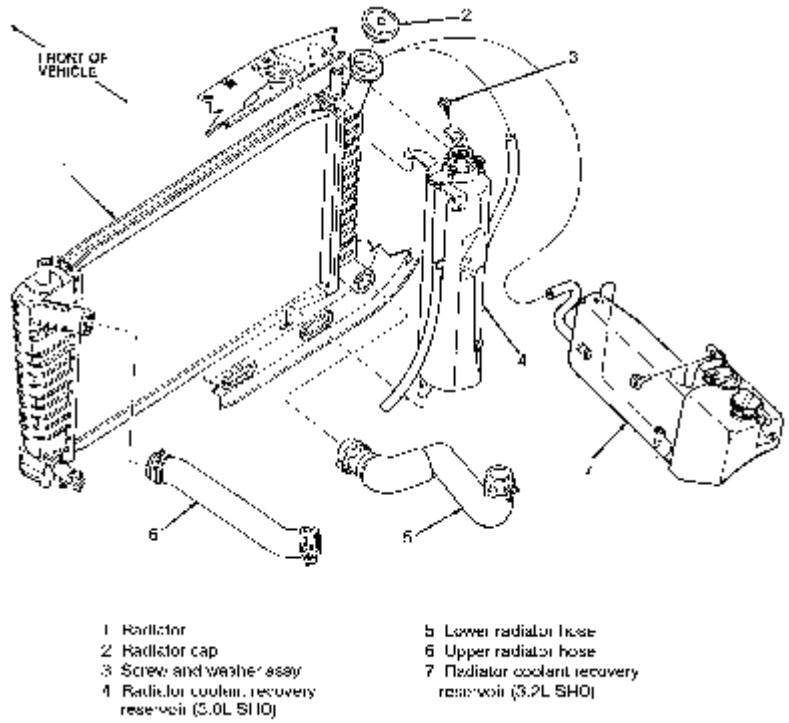
Click to enlarge



1 Bolt
2 Nut
3 Fan shroud
4 U nut
5 Bolt
6 Fan shroud mounting tab
7 Radiator
A Tighten to 2.6 3.7 Nm (23 33 lb.in.)
B Tighten to 8-12 Nm (71-106 lb.in.)

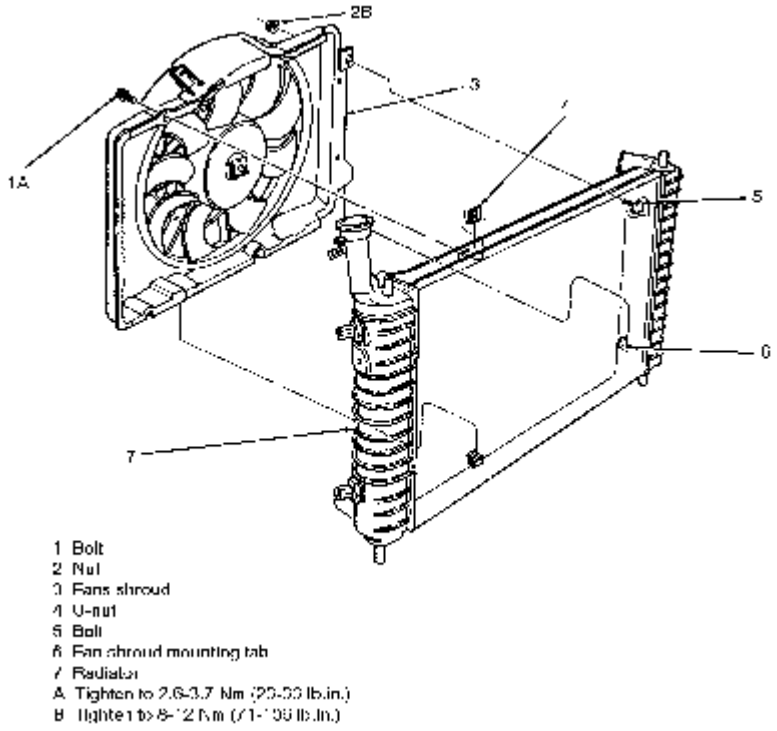
Radiator and fan retainer locations-3.0L engine (except SHO)

Click to enlarge



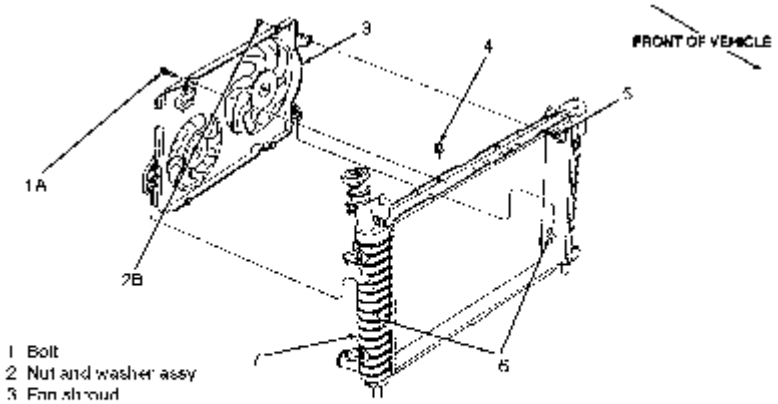
Radiator and related components-3.0L and 3.2L SHO

Click to enlarge



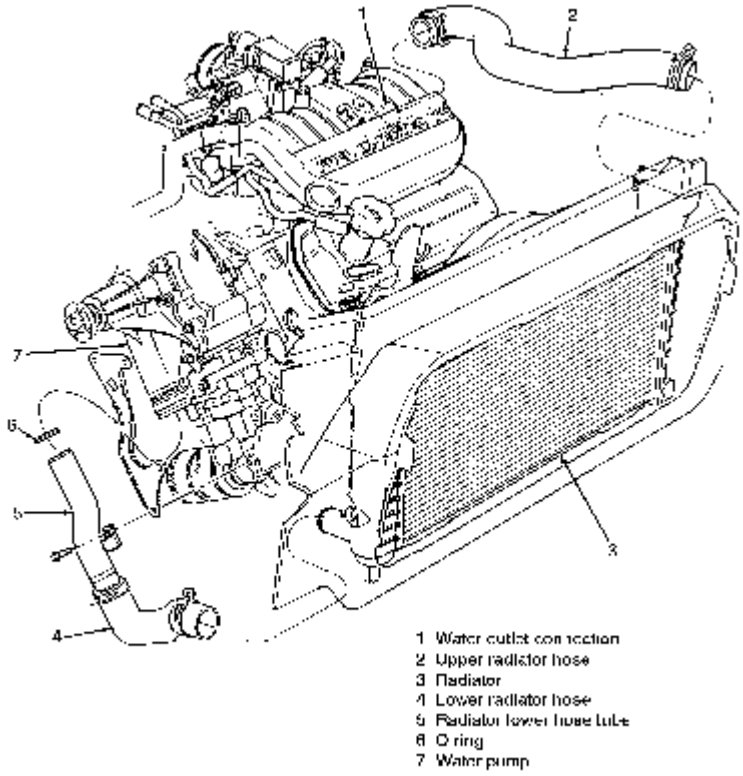
Radiator and fan retainer locations-3.0L SHO engine

Click to enlarge



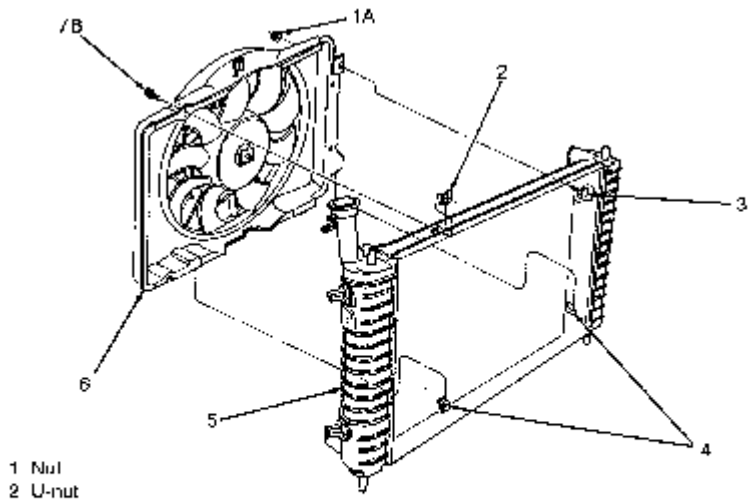
Radiator and fan retainer locations-3.2L SHO engine

Click to enlarge



Radiator and related components-3.8L engine

Click to enlarge



1 Nut
2 U-nut
3 Bolt
4 Fan shroud mounting tab
5 Radiator
6 Fan shroud
7 Bolt
A Tighten to 8-12 Nm (71-106 lb.in.)
B Tighten to 2.6-3.7 Nm (23-33 lb.in.)

Radiator and fan retainer locations-3.8L engine

Click to enlarge

To install:

14. **Position the radiator lower support rubber pads to the lower support, if removed.**

Make sure the hose clamps are beyond the bead and placed in the center of the clamping surface of the connection. Any used clamps must be replaced with a new clamp to ensure proper sealing at the connection.

15. **If the lower or upper hose has been replaced, position the hose on the engine with the index arrow in-line with the mark on the fitting at the engine. Tighten the screw clamps to 20-30 inch lbs. (2.5-3.4 Nm). On 3.8L engines through 1992, install the constant tension hose hose clamp between the alignment marks on the hose.**
16. **Position the radiator into the engine compartment, and to the radiator support. Insert the moulded pins at the bottom of each tank through slotted holes in the lower support rubber pads.**
17. **Inspect the radiator nylon tank upper mounting bushings for damage. Replace if damaged.**
18. **On 3.8L engines through 1992, inspect the outer tank metallic pin bracket, and the left and right hand support brackets. Replace if necessary.**
19. **On 3.8L engines through 1992, if the outlet tank pin bracket must be replaced, remove the two retaining bolts. Position the bracket on the outlet tank, then install the two retaining bolts and tighten to 6.6-9.6 ft. lbs. (9-13 Nm).**
20. **For all engines through 1992 and 1993-94 3.0L engines, make sure that the plastic pads on the bottom of the radiator tanks are resting on the rubber pads. Install the two upper retaining bolts to attach the radiator to the radiator support. For all engines except the 3.8L, tighten the bolts to 46-60 inch lbs. (5-7 Nm). On the 3.8L engine through 1992, tighten the bolts to 13-20 ft. lbs. (17-27 Nm).**
21. **For vehicles through 1992, equipped with the 3.8L engine, position the right hand support bracket onto the radiator and over the two studs on the radiator support.**

22. On the 3.8L engine through 1992, position the left hand support bracket over the radiator and the radiator support. Align the holes in the bracket with the corresponding holes in the radiator support and secure with the two retaining screws. Tighten the screws to 9-17 ft. lbs. (12-24 Nm).
23. On the 1993-94 3.8L and SHO engines and all 1995 engines, position the left and right hand support bracket over the radiator and radiator support. Align the holes in the bracket with the corresponding holes in the radiator support and secure with the two retaining screws. Tighten the screws to 9-17 ft. lbs. (12-24 Nm).
24. If applicable, secure the right hand support bracket to the radiator support with two hex nuts, then tighten the nuts to 8.7-17.7 ft. lbs. (11.8-24 Nm).

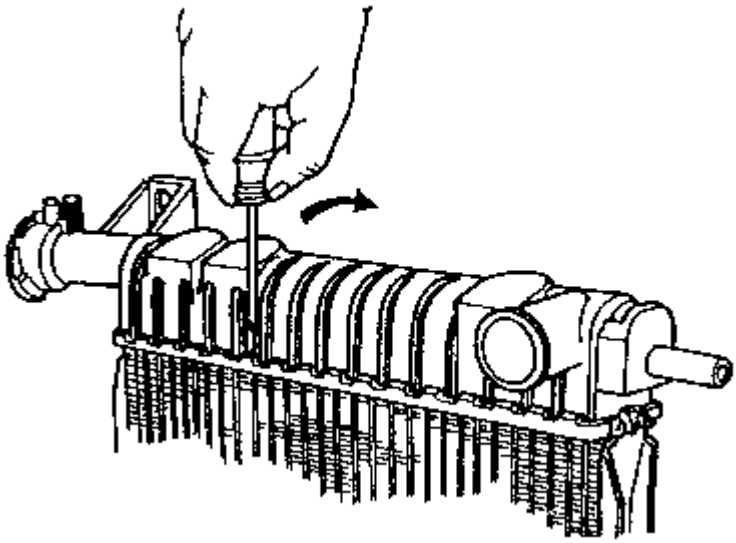
Make sure that the hose clamps are beyond the bead and placed in the center of the clamping surface of the connection. Any used clamps must be replaced with new clamps to ensure proper sealing.

25. Install the radiator upper and lower hoses to the radiator. Position the hose on the radiator connector so that the index arrow on the hose is in line with the mark on the connector. Position the clamps between the alignment marks on both ends of the hose, then slide the hose on the connections. Tighten the clamps to 20-30 inch lbs. (2.3-3.4 Nm). On 3.8L and 3.0L SHO engines through 1992, install the constant tension hose clamp between the alignment marks on the hoses.
26. On vehicles equipped with automatic transaxles, connect the oil cooler lines using Pipe Sealant with Teflon® D8AZ-19554-A or equivalent oil resistant sealer.
27. Install the fan and shroud assembly by connecting the motor wiring and positioning it on the lower retainer clips. Attach the top of the shroud to the radiator with the two screw and washer assemblies, and nuts. Tighten to 35 inch lbs. (4 Nm).
28. Attach the rubber overflow tube to the radiator filler neck overflow nipple and the coolant recovery bottle. On the SHO, install the coolant recovery bottle, then connect the overflow hose.
29. Connect the negative battery cable.
30. Install a 50/50 mixture of clean water and fresh antifreeze, then run the engine for 15 minutes. Check the coolant level and bring it to within $1^1/_2$ in. (38mm) of the radiator filler neck.

Engine Oil Cooler

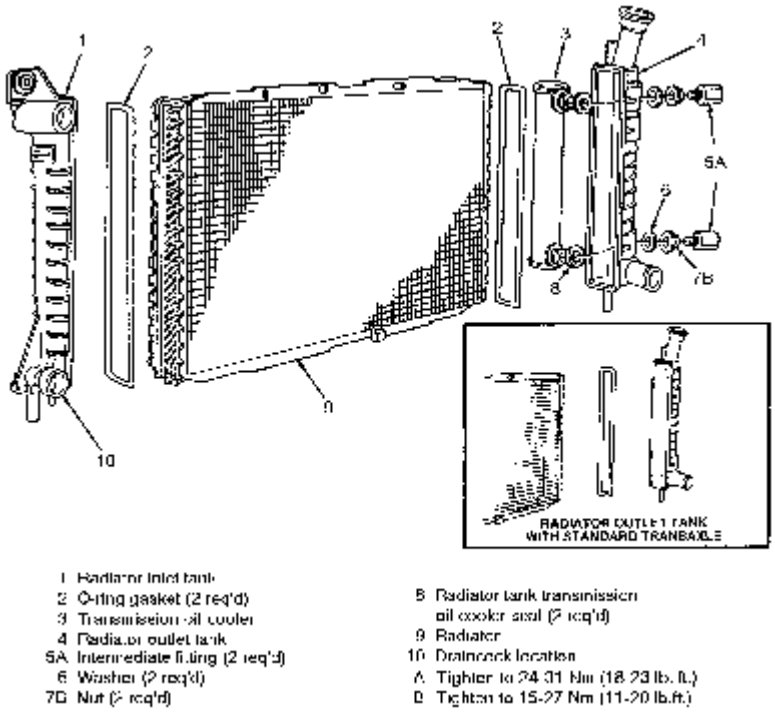
REMOVAL & INSTALLATION

1. Disconnect the negative battery cable.
2. Remove the radiator outlet tank from the radiator. To remove the radiator outlet tank:
    1. Remove the radiator from the vehicle as outlined earlier in this section.
    2. Using Borroughs Tool BT-8260, or an equivalent prybar, insert the end of the tool between the header tab and the radiator tank and gently bend the tab away from the radiator tank. Repeat the procedure for each tab. Do NOT open the tabs more than is necessary to for tank removal.
    3. Lift the radiator outlet tank from the radiator, then remove and discard the O-ring.



Using a prybar to gently bend the tabs away from the radiator tank

3. **Remove the retaining nuts and washers from the oil cooler inlet and outlet connections, then lift the oil cooler from the radiator outlet tank.**
4. **Remove the radiator tank gasket from the oil cooler inlet and outlet connections, if the cooler is to be reused.**



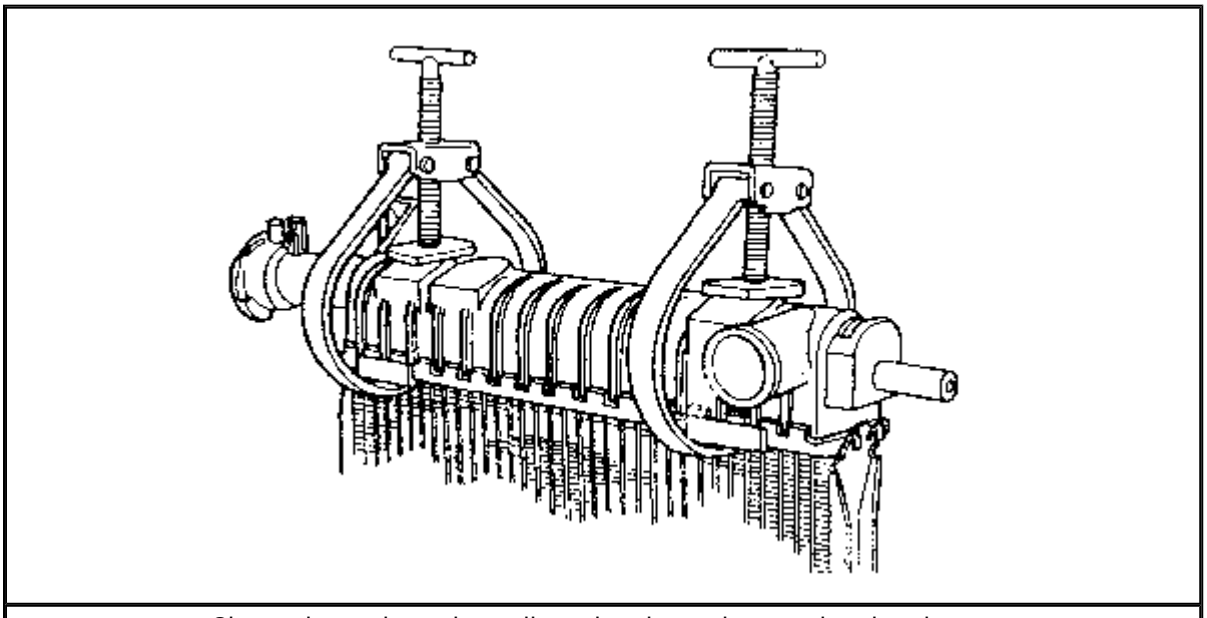
Exploded view of a common engine oil cooler and related components

Click to enlarge

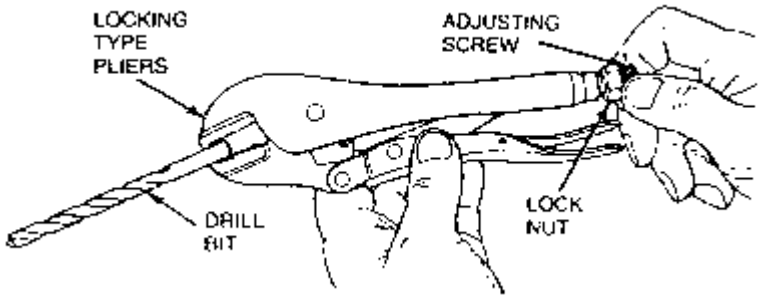
To install:

5. **Position the transmission oil cooler to the radiator outlet tank, then insert the inlet and outlet oil tube connectors through the holes in the radiator outlet tank.**
6. **Install the flat washer and nut on each oil cooler connection to the retain the oil cooler in the radiator outlet tank.**

7. **Tighten the oil cooler retaining nuts to 12-14 ft. lbs. (15-19 Nm). Tighten the intermediate fitting to 18-23 ft. lbs. (24-31 Nm).**
8. **Install the radiator outlet tank on the radiator core header. To install the outlet tank:**
    1. **Inspect the seal surface of the radiator core header to ensure it is clean and undamaged. Check to be sure that the new O-ring to be installed, is not twisted.**
    2. **Dip the new O-ring in coolant, then place it in the header groove.**
    3. **Position the tank to the header, being careful not to scratch the radiator tank sealing surfaces with the tabs.**
    4. **Clamp the radiator tank into position on the header using two header clamps, as shown in the accompanying figure, then tighten the clamps to compress the O-ring gasket.**
    5. **If locking-type pliers will be used to squeeze the header tabs against the radiator tank, install a hex nut on the pliers adjusting screw. With the jaws of the pliers closed and locked, turn the adjusting screw to position the jaws against the shank of a $^{27}/_{64}$ in. (10.9mm) drill bit. Tighten the hex nut on the adjusting screw against the handle to lock the adjustment in place.**
    6. **Using a special crimping tool or locking-type pliers, squeeze header tabs down against the lip of the radiator tank base, while rotating the pliers toward the radiator tank.**
    7. **Remove the header clamps from the radiator and squeeze the tab(s) down that were behind the clamps.**
    8. **Install the radiator as outlined earlier in this section.**

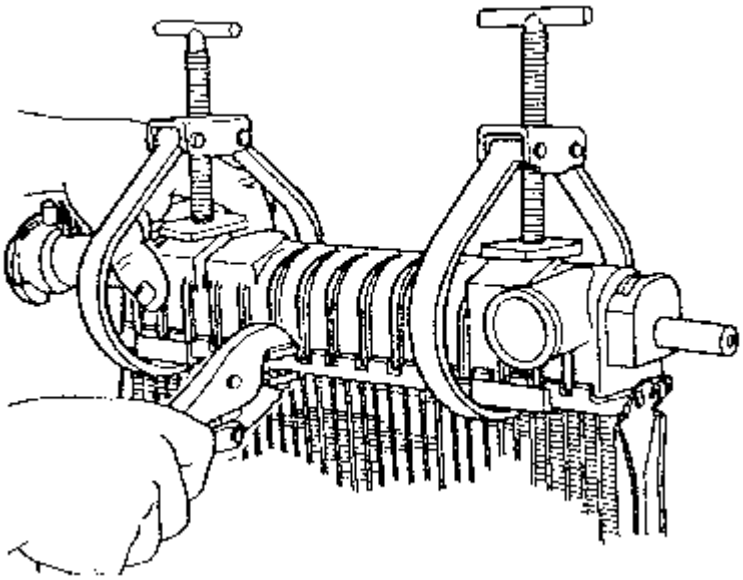


Clamp the tank on the radiator header, using two header clamps

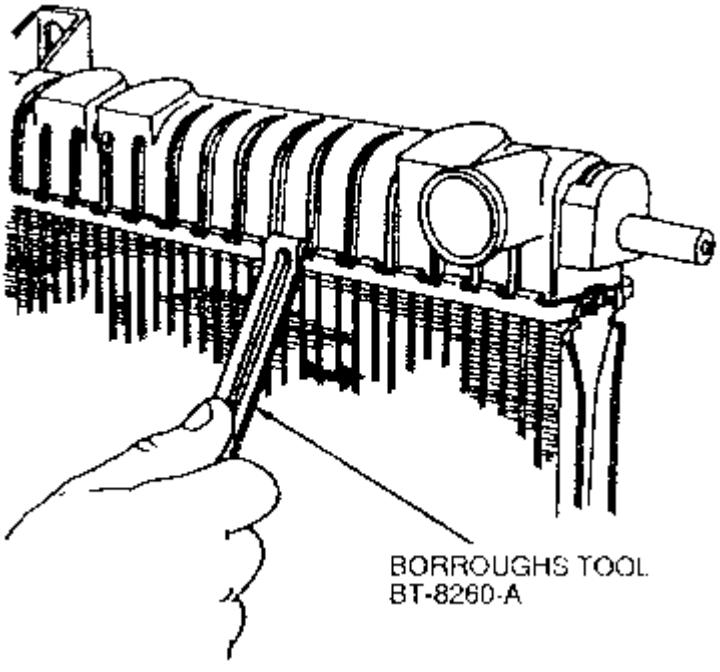


Adjusting the height of the crimp. NOTE: It is important that the height of the crimp be $^{27}/_{64}$ in. (10.9mm) (maximum) when measured from the bottom of the header to the top of the tab

Click to enlarge



Crimping the tabs using locking-type pliers



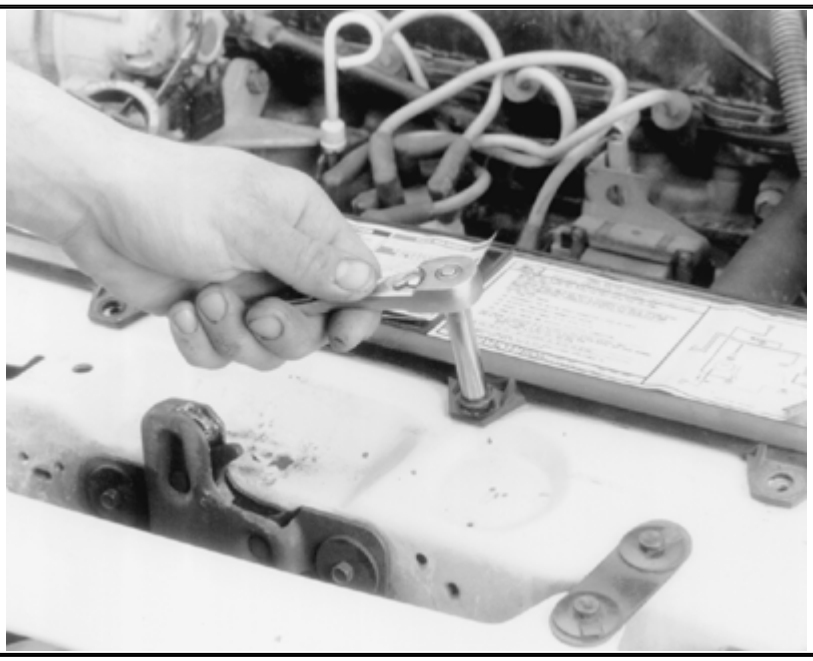
Crimping the tabs using a special crimping tool

9. **Connect the negative battery cable, then start the engine and check for leaks.**

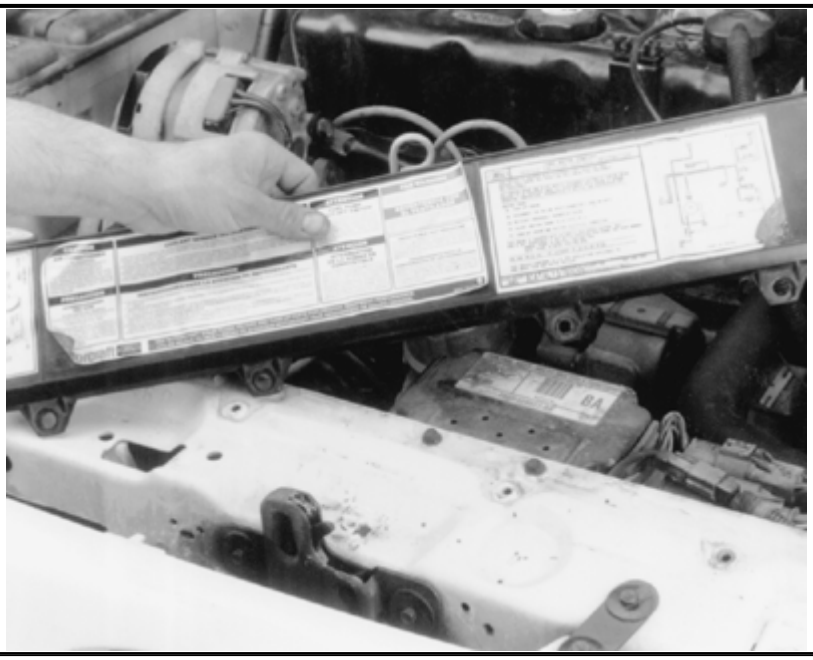
Engine Fan

REMOVAL & INSTALLATION

1. **Disconnect the negative battery cable.**
2. **Remove the radiator upper sight shield.**

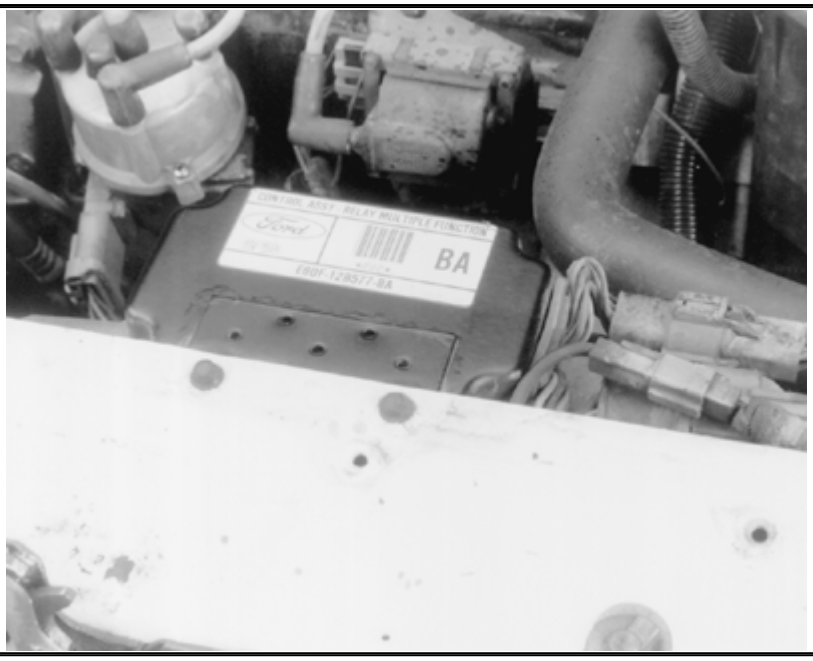


Disconnect the radiator upper sight shield retaining bolts

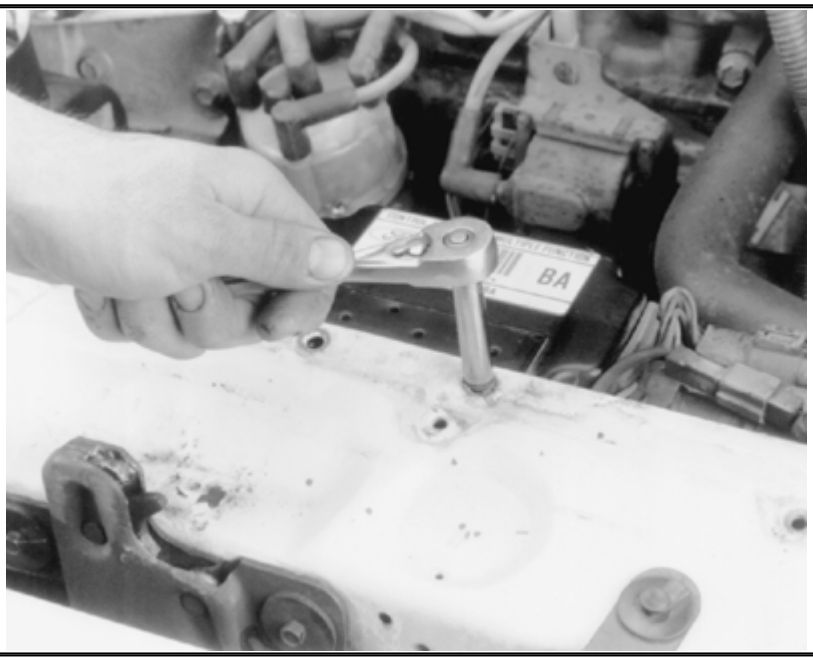


Remove the radiator upper sight shield

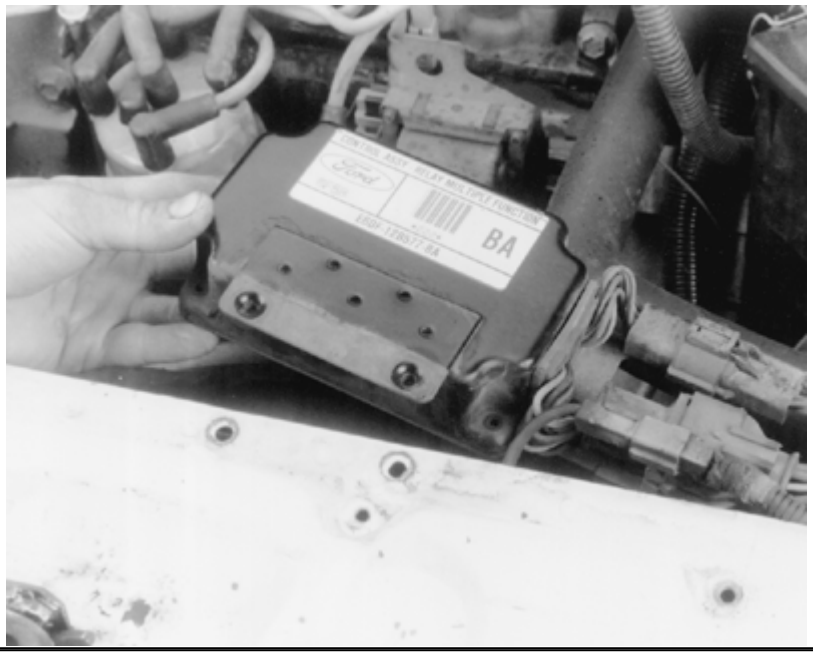
3. **Disengage the electrical connector, then remove the integrated relay control/constant control relay module assembly located on the radiator support.**



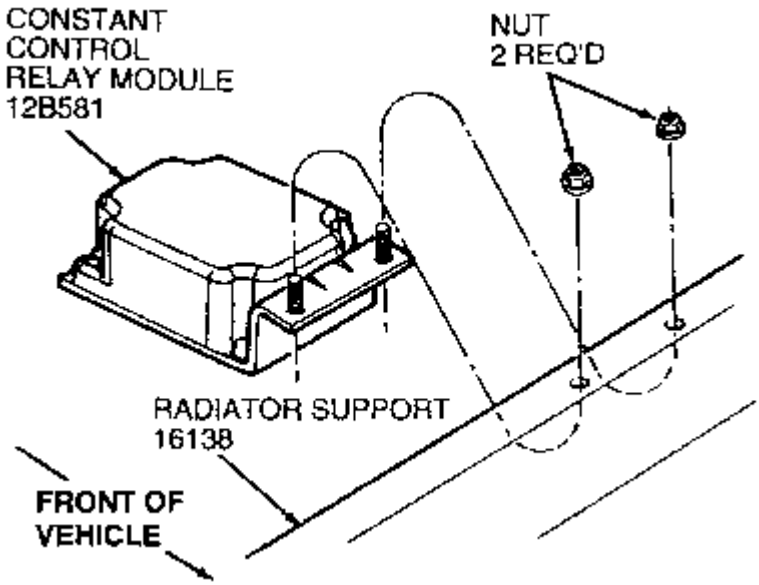
Location of the relay module-Early model 2.5L engine



Disconnect the relay retaining bolts

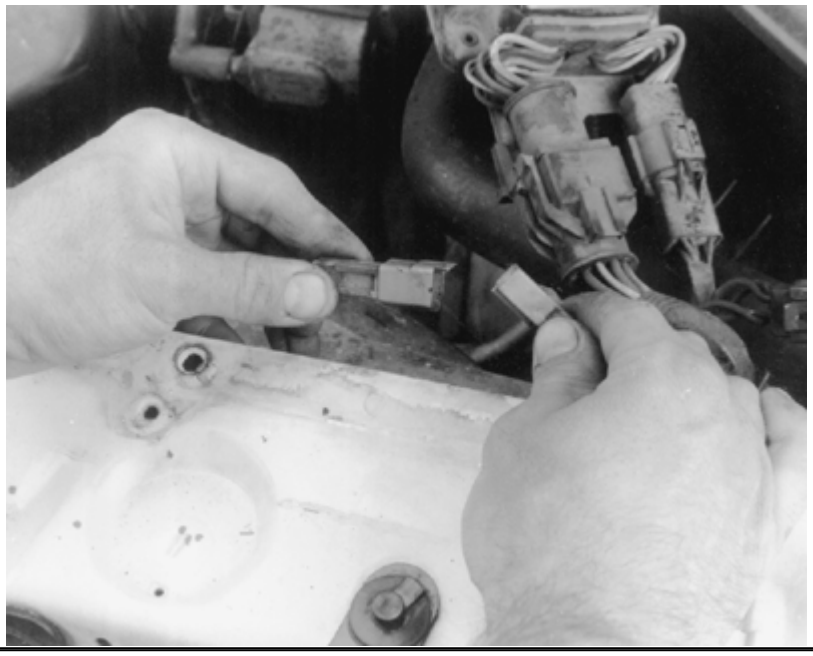


Remove the relay from the radiator support



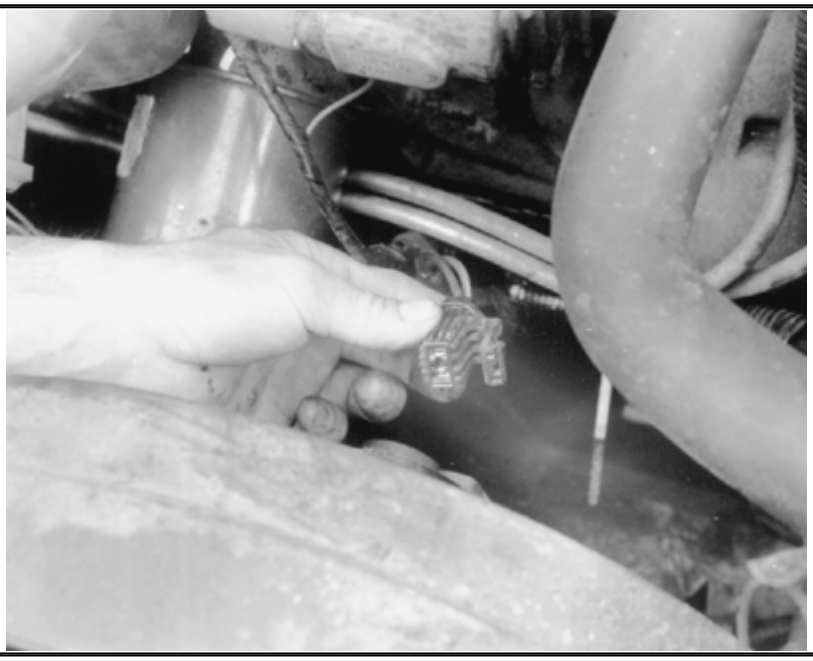
Constant control relay module location-3.0L engine (except SHO)

Click to enlarge



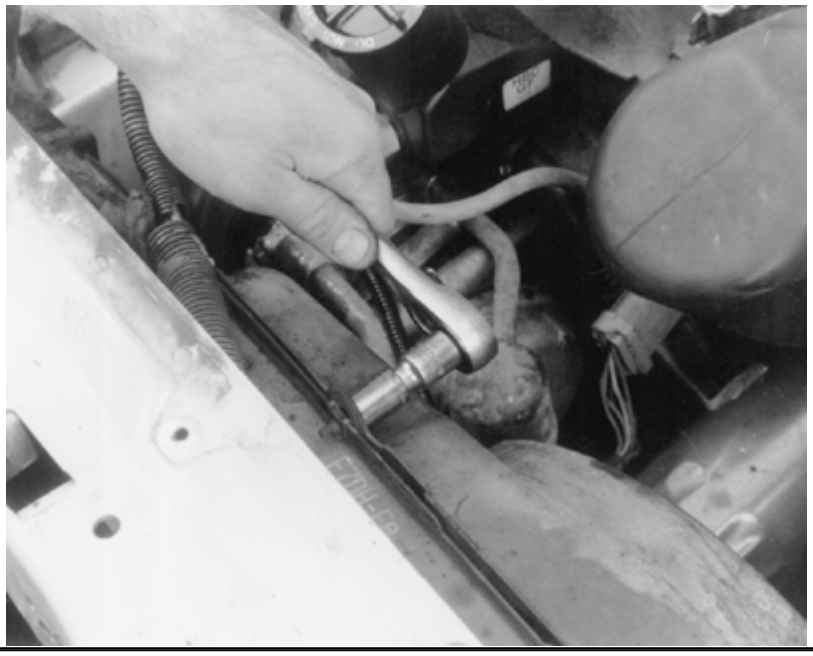
Disengage the relay module electrical connector

4. **Disconnect the fan electrical connector.**

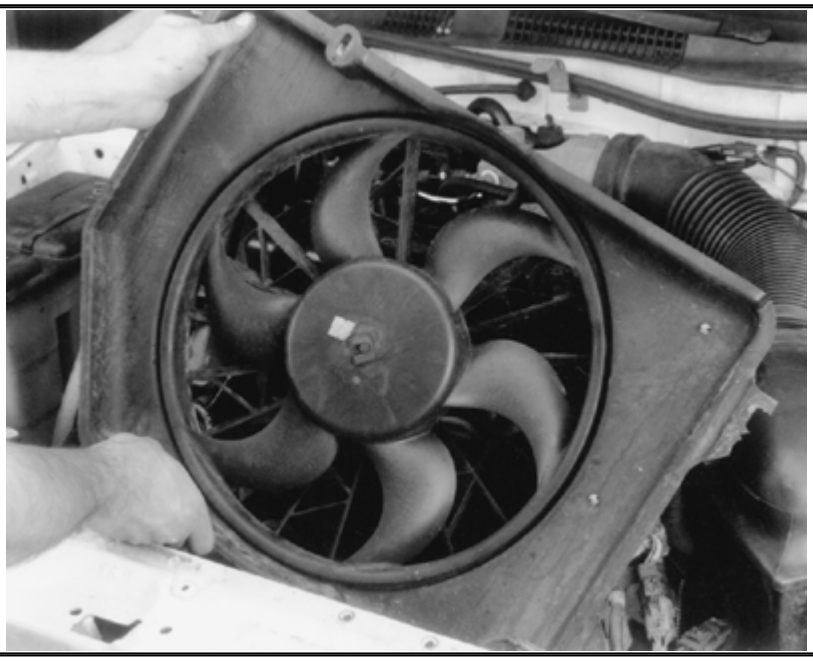


Disengage the fan electrical connector

5. **If necessary, remove the air bag crash sensor.**
6. **Unbolt the fan/shroud assembly from the radiator and remove.**

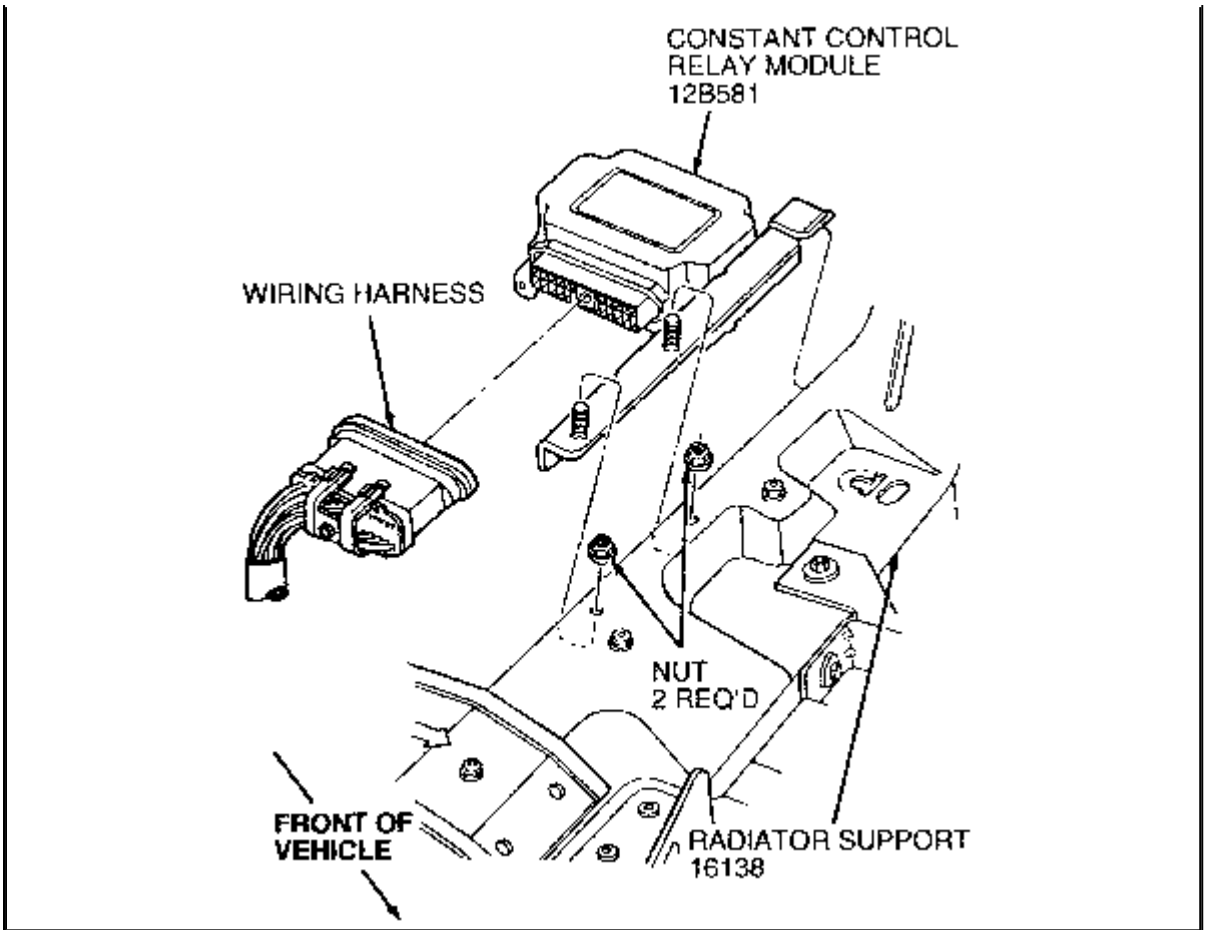


Unbolt the fan assembly from the radiator



Remove the fan from the engine

7. **Remove the retainer and the fan from the motor shaft and unbolt the fan motor from the shroud.**
8. **Installation is the reverse of the removal procedures. Tighten the fan shroud retaining bolt to 23-33 inch lbs. (2.6-3.7 Nm). Tighten the fan shroud retaining nut to 71-106 inch lbs. (8-12 Nm).**



Constant control relay module location-3.0L SHO, 3.2L SHO and 3.8L engines

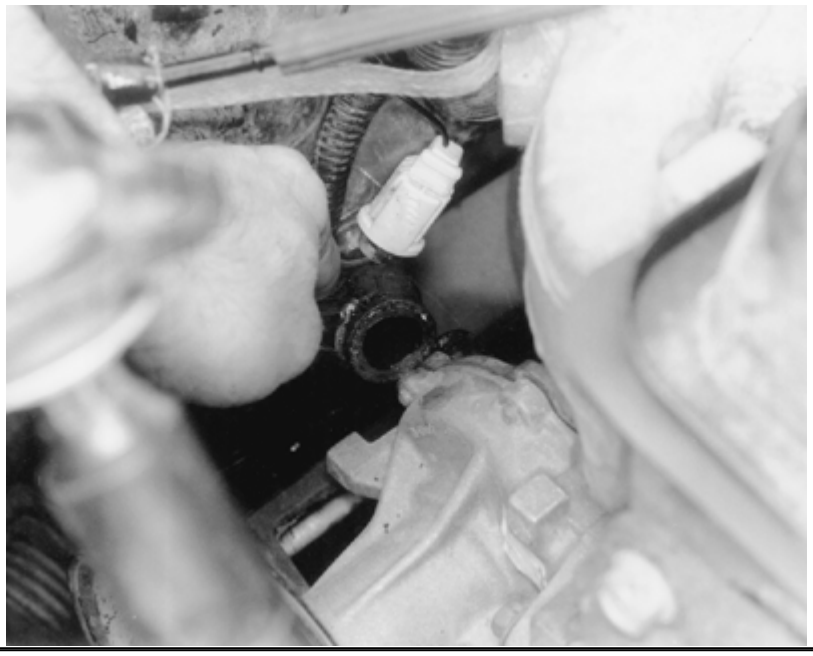
Click to enlarge

Water Pump

REMOVAL & INSTALLATION

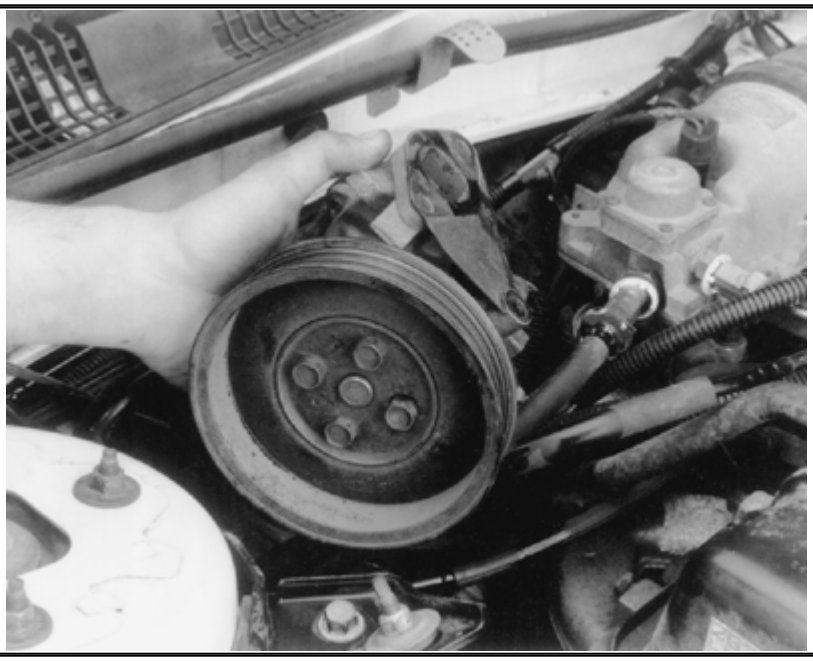
2.5L Engine

1. **Disconnect the negative battery cable.**
2. **Carefully remove the radiator cap, then position a drain pan under the bottom radiator hose.**
3. **Raise and safely support the vehicle. Remove the lower radiator hose from the radiator and drain the coolant into the drain pan.**
4. **Remove the water pump inlet tube.**

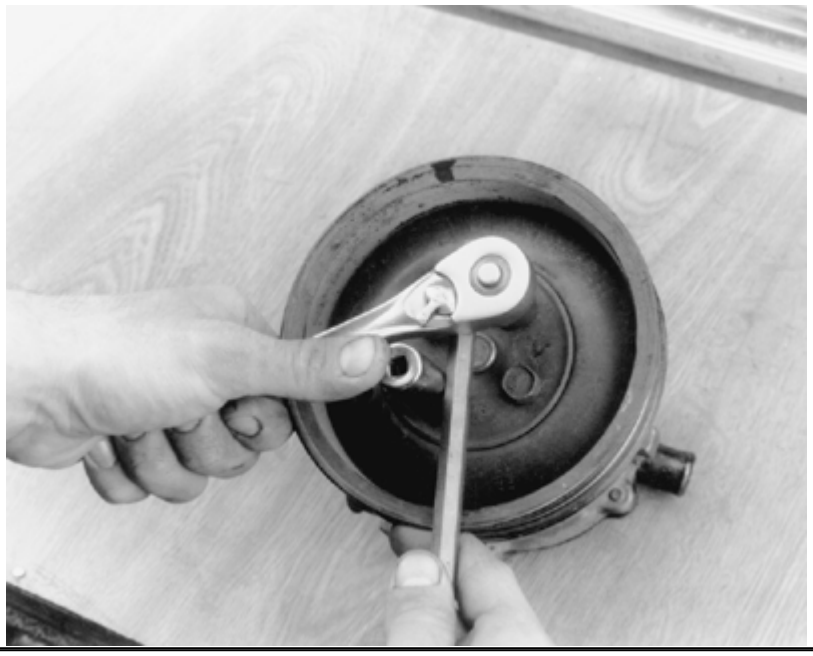


Remove the water pump inlet tube

5. **Loosen the belt tensioner by inserting a $^{1}/_{2}$ in. flex handle in the square hole of the tensioner, then rotate the tensioner counterclockwise and remove the belt from the pulleys.**
6. **Disconnect the heater hose from the water pump.**
7. **Remove the water pump retaining bolts, then remove the water pump assembly from the engine.**



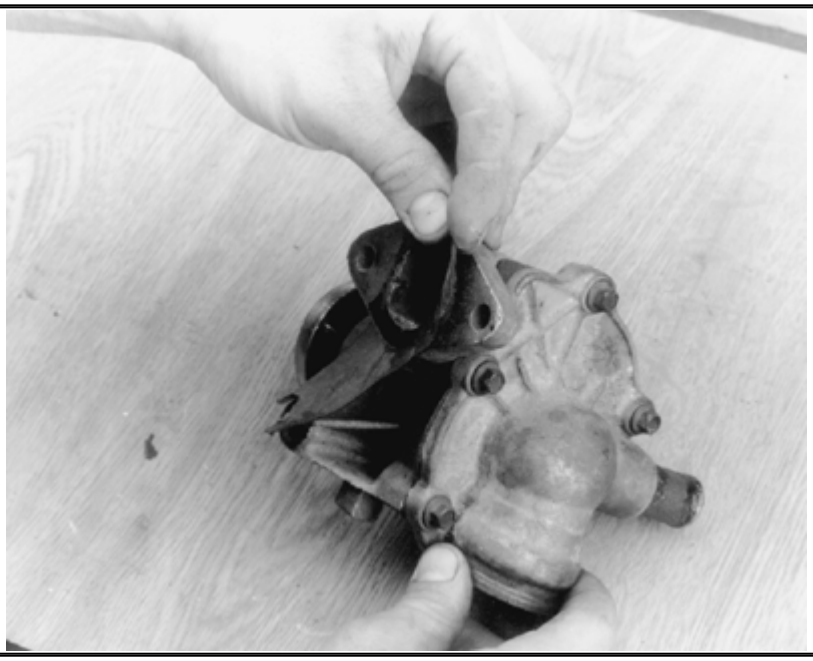
After removing the retaining bolts, remove the water pump assembly from the engine



If necessary, removing the water pump-to-pulley retaining bolts, then remove the pulley

To install:

8. **Using a gasket scraper, clean the water pump and cylinder block so that they are free of old gasket material.**
9. **Apply Perfect Seal Sealing Compound B5A-19554-A or equivalent to the new water pump gasket, then place the water pump assembly and new gasket to the cylinder block.**



Remove all old gasket material from the water pump, then use a new gasket during installation

10. **Install the three water pump retaining bolts. Tighten the bolts to 15-22 ft. lbs. (20-30 Nm).**
11. **Connect the heater hose to the water pump.**
12. **Install the water pump belt on the pulley, then adjust the tension. For details,**

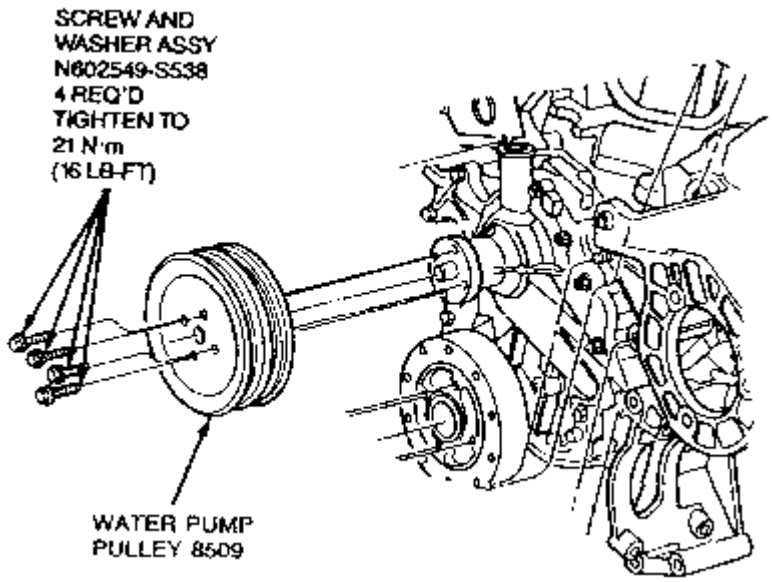
please refer to *Section 1* of this manual.

13. Use a new O-ring for the water pump inlet, then install the water pump inlet. Tighten the retaining bolts to 7 ft. lbs. (10 Nm).
14. Close the radiator draincock. Install the drive belt on the water pump pulley, then adjust the tension. See *Section 1* for details.
15. Connect the negative battery cable. Refill the cooling system to the specified level, then run the engine until it reaches normal operating temperatures. Check for leaks, then check the coolant level and add as necessary.

3.0L Engine-Except SHO

1986-89 VEHICLES

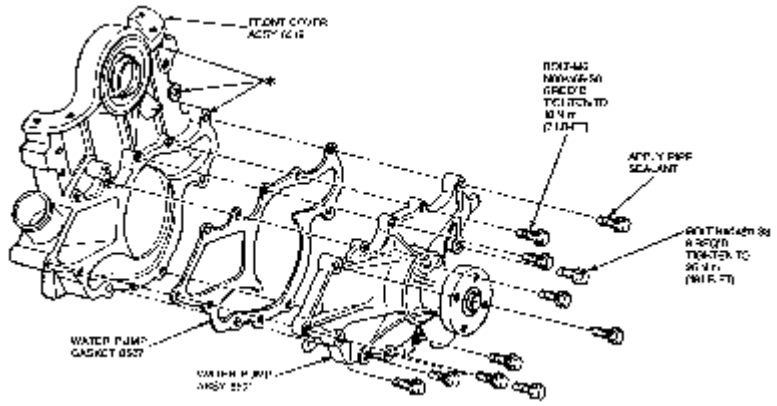
1. Disconnect the negative battery cable, then place a drain pan under the radiator draincock and properly drain the engine cooling system.
2. Loosen the accessory belt idle, then remove the drive belts.
3. Remove the two nuts and bolt retaining the idler bracket to the engine, then remove the bracket.
4. Disconnect the heater hose at the water pump.
5. Remove the four pulley-to-pump hub bolts. The pulley will remain loose on the hub because there is not enough clearance between the inner fender and the water pump, restricting removal from the vehicle.



Remove the four pulley retainers

Click to enlarge

6. Remove the eleven water pump-to-engine retaining bolts, then lift the water pump and pulley from the vehicle.



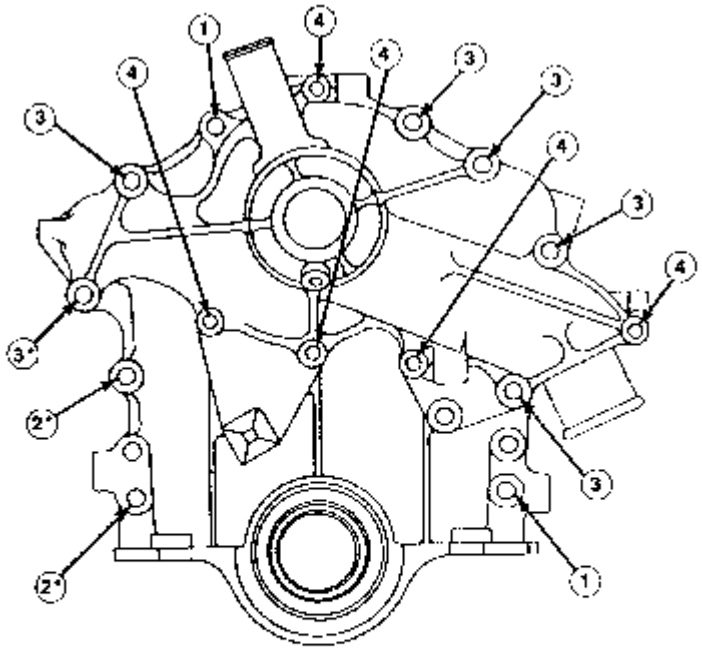
Location of the water pump-to-engine retaining bolts

Click to enlarge

To install:

Lightly oil all bolt and stud threads before installation except thosespecifying special sealant.

7. **Clean the water pump and engine front cover gasket mating surfaces.**
8. **Position a new gasket on the water pump sealing surface using Gasket and Trim Adhesive D7AZ-19B508-AA or equivalent.**
9. **With the pulley positioned on the water pump hub, position the water pump on the front cover, then install the retaining bolts. Tighten the retaining bolts, as specified on the accompanying figures.**



NUMBER	PART NUMBER	SIZE	QTY	N-m	LB-FT
1	N605909-S8	M8 x 1.25 x 42.0	2	25	19
2	N804113-S8	M8 x 1.25 x 43.5 (LARGE HEX)	2	25	19
3	N804811-S8	M8 x 1.25 x 70.0	6	25	19
4	N804168-S8	M6 x 1.0 x 25.0	5	10	7

*APPLY PIPE SEALANT D6AZ-19554-A TO THE THREADS OF THESE BOLTS.

Location and size of the water pump mounting bolts and torque specifications-1986-89 3.0L engine (except SHO)

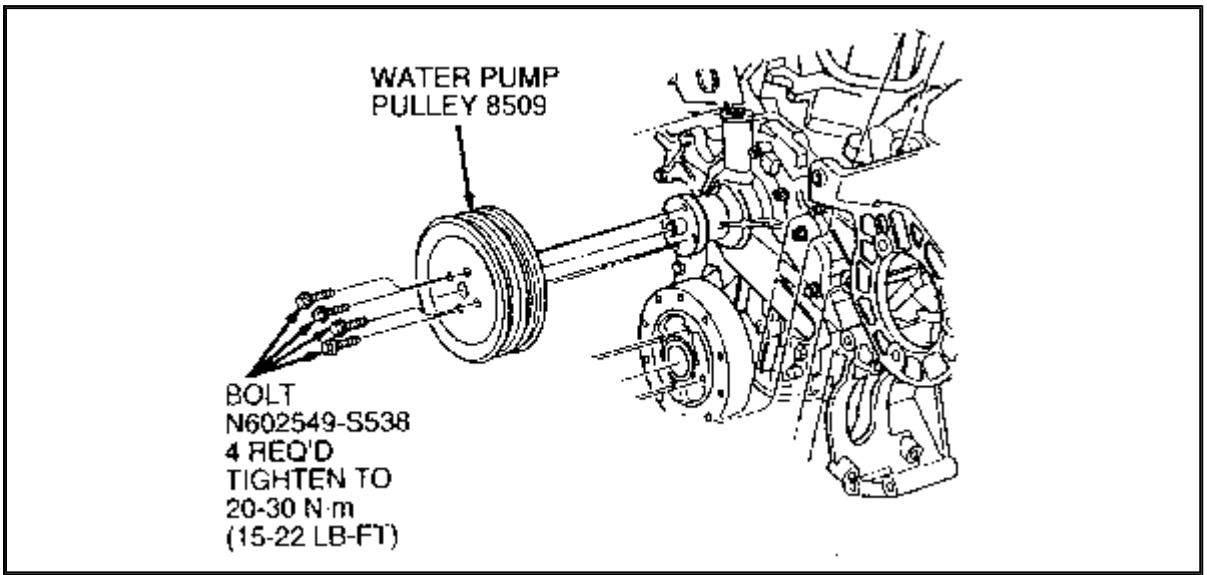
Click to enlarge

Two different lengths of retaining bolts are used. Refer to theaccompanying figure for specifications.

10. **Install the pulley-to-pump hob bolts. Tighten the bolts to 16 ft. lbs. (22 Nm).**
11. **Connect the coolant bypass/heater hose to the water pump.**
12. **Install the idle bracket to the engine front cover.**
13. **Position the accessory drive belt over the pump pulley, then adjust the drive belt tension, if equipped with a manual tensioner. For details regarding belt tensioning, please refer to the procedure located in *Section 1* of this manual.**
14. **Connect the negative battery cable, then fill the cooling system to the proper level with the correct mixture of coolant and water. Start the engine and let it run until it reaches normal operating temperatures, then check for leaks and check the coolant level.**

1990-95 VEHICLES

1. **Disconnect the negative battery cable, then place a drain pan under the radiator drain cock.**
2. **Carefully remove the radiator cap, then open the drain cock on the radiator and drain the cooling system.**
3. **Loosen the four water pump pulley retaining bolts while the accessory drive belts are still tight.**

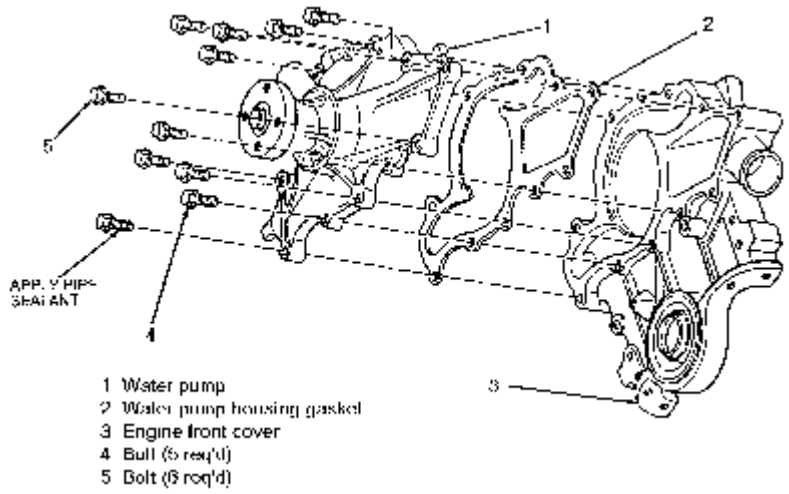


Location of the four water pump pulley retaining bolts-Late model 3.0L (except SHO)

Click to enlarge

4. **Loosen the alternator belt adjuster jack screw to provide enough clearance for the removal of the alternator belt.**
5. **Using a $^{1}/_{2}$ in. breaker bar, rotate the automatic tensioner down and to the left.**
6. **Remove the power steering/air conditioner belt.**

7. **Remove the two nuts and bolt retaining the drive belt automatic tensioner to the engine, then remove the tensioner.**
8. **Disconnect and remove the lower radiator and heater hose from the water pump.**
9. **Remove the eleven water pump-to-engine retaining bolts, then lift the water pump and pulley up and out of the vehicle.**



Water pump mounting-Late model 3.0L engine

Click to enlarge

9. **Remove the water pump pulley retaining bolts, them remove the pulley from the water pump.**

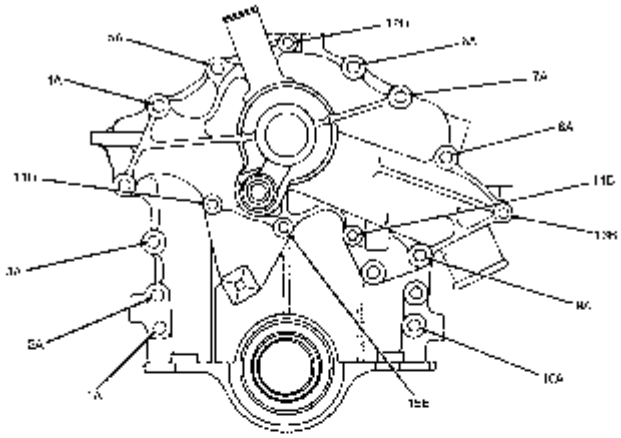
To install:

Be careful not to gouge the aluminum surfaces when scraping the oldgasket material from the mating surfaces of the water pump and front cover.

10. **Clean the gasket surfaces on the water pump and front cover. Lightly oil all bolt and stud threads except those requiring special sealant.**
11. **Position a new water pump housing gasket on the water pump sealing surface using Gasket and Trim Adhesive D7AZ-19B508-B or equivalent, to hold the gasket in place.**

Apply Pipe Sealant with Teflon® D8AZ-19554-A orequivalent to bolt No. 3 (see fig.) before installation.

12. **With the water pump pulley and retaining bolts loosely installed on the water pump, align the water pump-to-engine front cover, then install the retaining bolts.**
13. **Tighten the bolts to the following specifications:**
    1. **Numbers 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 to 15-22 ft. lbs. (20-30 Nm).**
    2. **Numbers 11, 12, 13, 14 and 15 to 71-106 inch lbs (8-12 Nm).**



Fastener and Hole Number	Fastener Part Number	Fastener Size	Fastener Application
1A	[illegible]	[illegible]	Engine Front Cover To Cylinder Block
2A	[illegible]	[illegible]	Engine Front Cover To Cylinder Block
3A	[illegible]	[illegible]	Water Pump And Engine Front Cover To Cylinder Block
4A	[illegible]	[illegible]	Water Pump And Engine Front Cover To Cylinder Block
5A	[illegible]	[illegible]	Engine Front Cover To Cylinder Block
6A	[illegible]	[illegible]	Water Pump And Engine Front Cover To Cylinder Block
7A	[illegible]	[illegible]	Water Pump And Engine Front Cover To Cylinder Block

Fastener and Hole Number	Fastener Part Number	Fastener Size	Fastener Application
9A	[illegible]	[illegible]	Water Pump And Engine Front Cover To Cylinder Block
10A	[illegible]	[illegible]	Engine Front Cover To Cylinder Block
11B	[illegible]	[illegible]	Water Pump To Engine Front Cover
12B	[illegible]	[illegible]	Water Pump To Engine Front Cover
13B	[illegible]	[illegible]	Water Pump To Engine Front Cover
14B	[illegible]	[illegible]	Water Pump To Engine Front Cover
15B	[illegible]	[illegible]	Water Pump To Engine Front Cover

A Tighten to 20-26 Nm (15-22 Lb Ft)
B Tighten to [illegible]

Water pump retaining fastener locations, size and torque specification

Click to enlarge

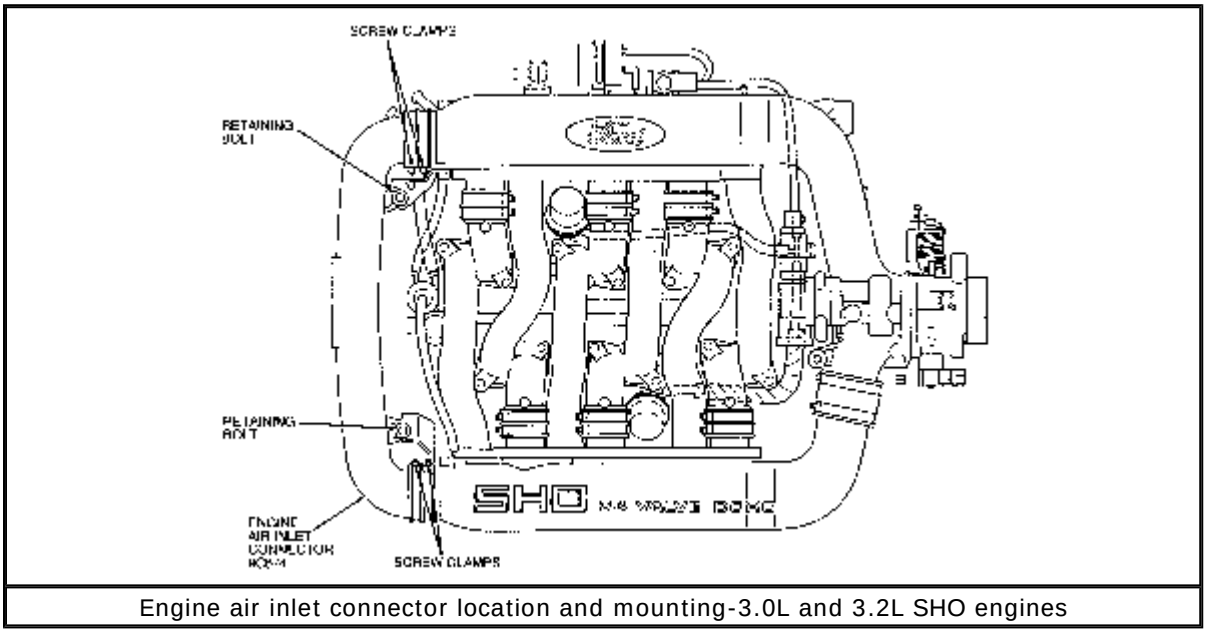
14. **Hand-tighten the water pump pulley retaining bolts.**
15. **Install the automatic belt tensioner assembly. Tighten the two retaining nuts and bolt to 35 ft. lbs. (47 Nm).**
16. **Install the alternator and power steering belts. Final tighten the water pump pulley retaining bolts to 15-22 ft. lbs. (22-30 Nm).**
17. **Position the hose clamps between the alignment marks on both ends of the hose, then slide the hose on the connection. Tighten the hose clamps to 20-30 inch lbs. (2.2-3.4 Nm).**
18. **Fill and bleed the cooling system with the appropriate quantity and coolant type.**
19. **Connect the negative battery cable. Start the engine and check for leaks.**

3.0L and 3.2L SHO Engines

1. **Disconnect the battery cables, then, if necessary for access, remove the battery and the battery tray. For details, please refer to the battery and battery tray removal procedures located earlier in this section.**
2. **Properly drain the cooling system.**
3. **Remove the accessory drive belts. For details regarding this procedure, please**

refer to *Section 1* of this manual.

4. For the 3.0L SHO, remove the left-hand side drive belt tensioner pulley and bracket. For the 3.2L SHO remove the left-hand side drive belt pulleys.
5. Disengage the electrical connector from the ignition control module and the ground strap.
6. Loosen the four screw clamps on the upper intake/engine inlet connector tube, then remove the retaining bolts and remove the connector tube.



Engine air inlet connector location and mounting-3.0L and 3.2L SHO engines

Click to enlarge

7. Remove the upper outer timing belt cover.
8. Raise and safely support the vehicle. Remove the right wheel and tire assembly.
9. Remove the splash guard/shield.
10. Using steering wheel puller T67L-3600-A, remove the crankshaft vibration damper and pulley.
11. Disconnect the crankshaft position (CKP) sensor wiring harness, then move it out of the way.
12. Disconnect the bolts from the center outer timing belt cover, then remove the cover.
13. On the 3.0L SHO, remove the right-hand side drive belt tensioner idler pulley and bracket. On the 3.2L SHO, remove the drive belt tensioner.
14. Remove the water pump attaching bolts, then remove the water pump and housing gasket.

To install:

Lightly oil all bolt threads before installation.

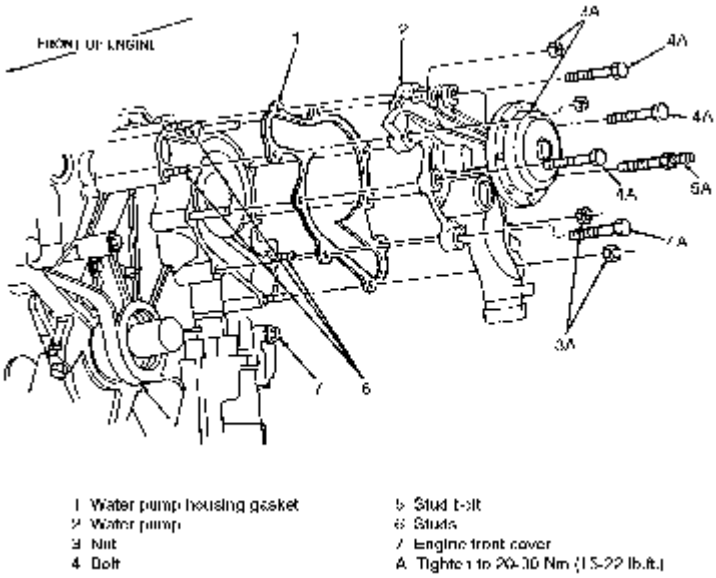
15. Clean the old gasket material from the water pump and cylinder block mating surfaces.
16. Position a new water pump housing gasket on the water pump sealing surface using Gasket and Trim Adhesive D7AZ-19B508-B or equivalent, to hold the gasket

in position.

17. Install the water pump and retaining bolts to the cylinder block, then tighten the bolts to 12-17 ft. lbs. (16-23 Nm).
18. On the 3.0L SHO, install the right-hand drive belt tensioner idler pulley and bracket. On the 3.2L SHO install the drive belt tensioner.
19. Install the center outer timing cover.
20. Connect the crankshaft position (CKP) sensor wire harness.
21. Install the lower outer timing belt cover.
22. Using Screw and Washer Set T89P-6701-A and Step Plate D80L-630-3 or equivalent, install the crankshaft vibration damper and pulley. Install the retaining bolt, then tighten to 112-127 ft. lbs. (152-172 Nm).
23. Install the splash guard/shield.
24. Install the tire and wheel assembly. Tighten the lug nuts to 85-105 ft. lbs. (115-142 Nm).
25. Carefully lower the vehicle.
26. Install the upper outer timing belt cover.
27. On the 3.0L SHO, install the left-hand side drive belt tensioner idler pulley and bracket. On the 3.2L SHO, install the left-hand side drive belt idler pulleys.
28. Install the engine upper intake/air inlet connector tube.
29. Install the two retaining bolts on the upper intake/air inlet connector tube. Tighten the bolts to 11-17 ft. lbs. (15-23 Nm), then tighten the four screw clamps.
30. Engage the ignition control module electrical connector.
31. Install the accessory drive belts. For details please refer to the belt installation procedure in *Section 1* of this manual.
32. Connect the negative battery cable, then fill the cooling system to the correct level with a 50/50 mixture of approved coolant and water. Start the engine and check for leaks. Add more coolant if necessary.

3.8L Engine

1. Disconnect the negative battery cable. Drain the cooling system.
2. Loosen the drive belt tensioner, then remove the drive belts.
3. Remove the two nuts and bolt retaining the drive belt tensioner to the engine.
4. Disconnect the heater hose at the water pump.
5. Remove the four water pump pulley bolts. The pulley will remain loose on the hub because there is insufficient room between the inner fender and the water pump, restricting removal from the vehicle.
6. Remove the water pump-to-engine retaining bolts, then lift the water pump and pulley assembly out of the vehicle.



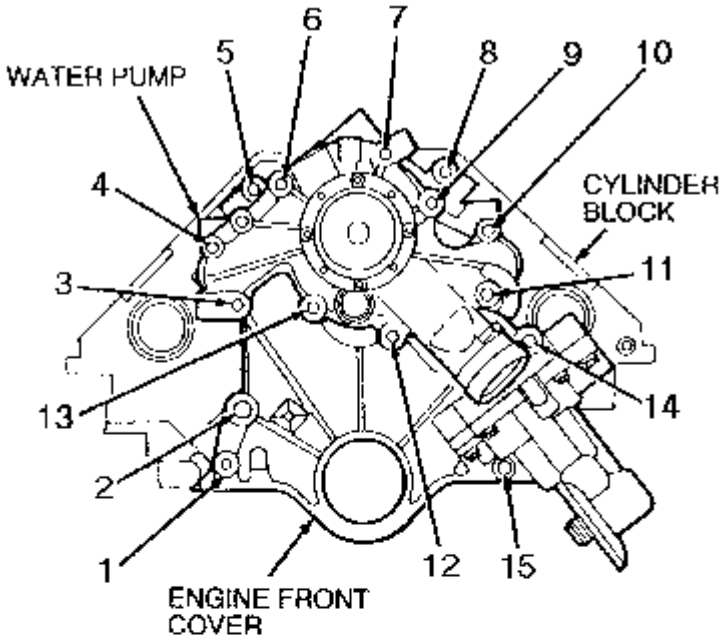
Water pump and gasket mounting-3.8L engine

Click to enlarge

To install:

7. **Lightly oil all bolt and stud threads before installation except those that require sealant. Thoroughly clean the water pump and front cover gasket contact surfaces.**
8. **Position the new water pump gasket on the pump sealing surface using Gasket and Trim Adhesive D7AZ-19B508-B or equivalent.**
9. **With the water pump pulley positioned on the water pump hub, position the water pump on the engine front cover, then install the retaining bolts. Tighten the retaining bolts to 15-22 ft. lbs. (20-30 Nm).**

There are two different length of bolts used to retainthe water pump. Install the bolts as shown in the accompanying figure or damageto the engine may occur.



Reference Number	Part Number	Size	Part Name
1	N805112	M8 x 1.25 x 98.0	Stud
2	N805112	M8 x 1.25 x 98.0	Stud
3	N805757	M8 x 1.25 x 131.0	Stud
4	N805757	M8 x 1.25 x 131.0	Stud
5	N605787	M8 x 1.25 x 25.0	Bolt
6	N605908	M8 x 1.25 x 35.0	Bolt
7	N605908	M8 x 1.25 x 35.0	Bolt
8	N605787	M8 x 1.25 x 25.0	Bolt
9	N804756	M8 x 1.25 x 61.5	Stud Bolt
10	N805275	M8 x 1.25 x 141.0	Stud
11	N804757	M8 x 1.25 x 131.0	Stud
12	N605908	M8 x 1.25 x 35.0	Bolt
13	N605908	M8 x 1.25 x 35.0	Bolt
14	N804839	M8 x 1.25 x 105.0	Bolt
15	N804841	M8 x 1.25 x 20.0	Cap Screw

3.8L engine water pump retaining bolt locations. Since two bolt lengths are used, install the bolts as shown to prevent possible damage to the engine

Click to enlarge

10. **Install the water pump pulley bolts, then tighten the bolts to 16 ft. lbs. (21 Nm).**
11. **Connect the heater water hose to the water pump.**
12. **Install the drive belt tensioner to the engine front cover, then install the drive belt.**
13. **Connect the negative battery cable, then fill the cooling system with a 50/50 mixture of approved coolant and water. Start and run the engine until in reaches**

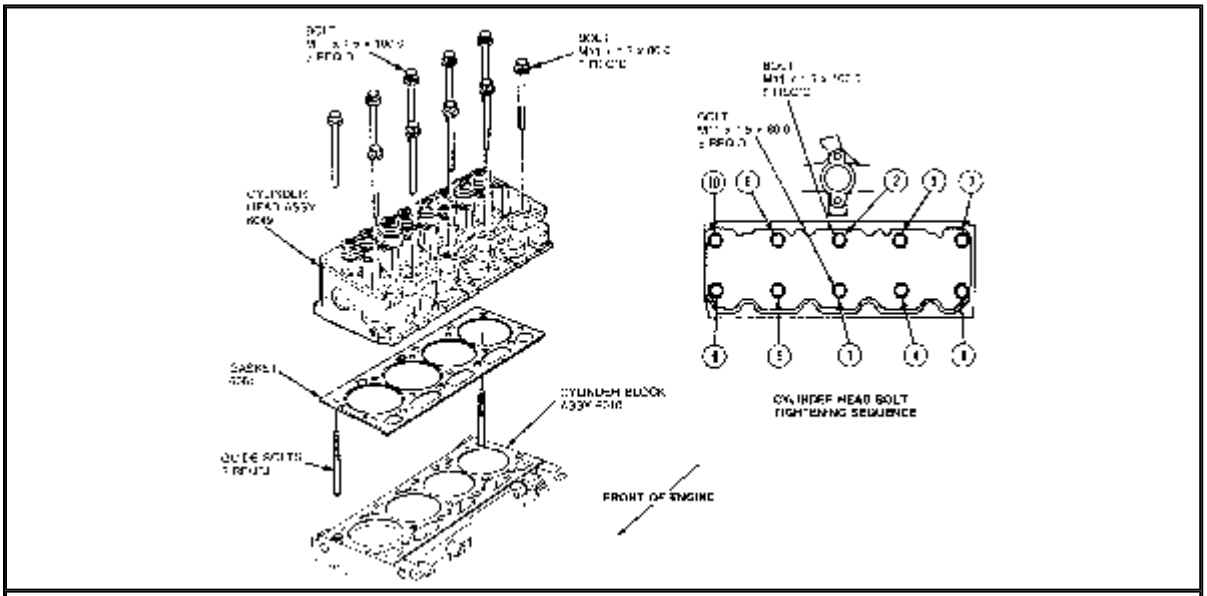
normal operating temperatures, then check for leaks and check the coolant level.

Cylinder Head

REMOVAL & INSTALLATION

2.5L Engine

1. Disconnect the negative battery cable. Drain the cooling system.

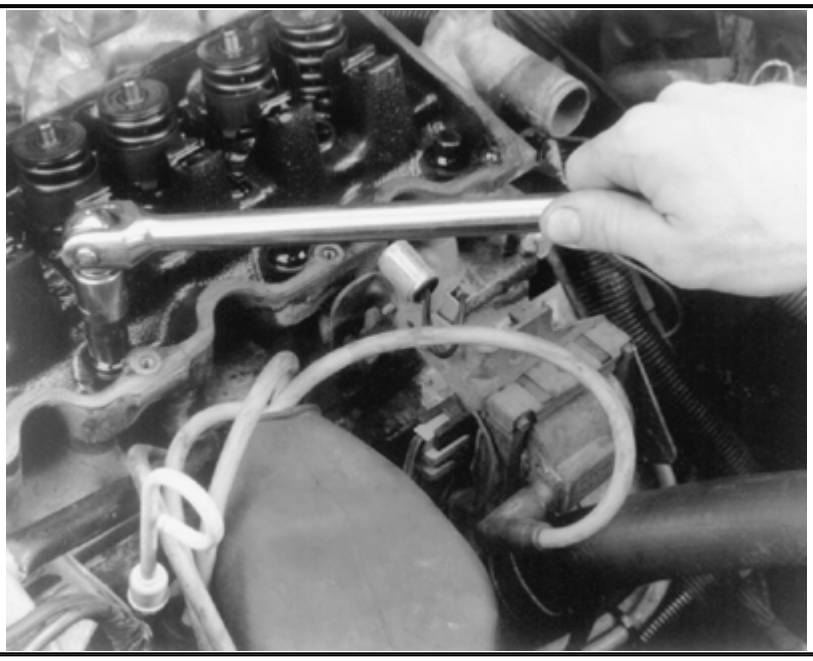


Cylinder head assembly and head bolt tightening sequence-2.5L engine

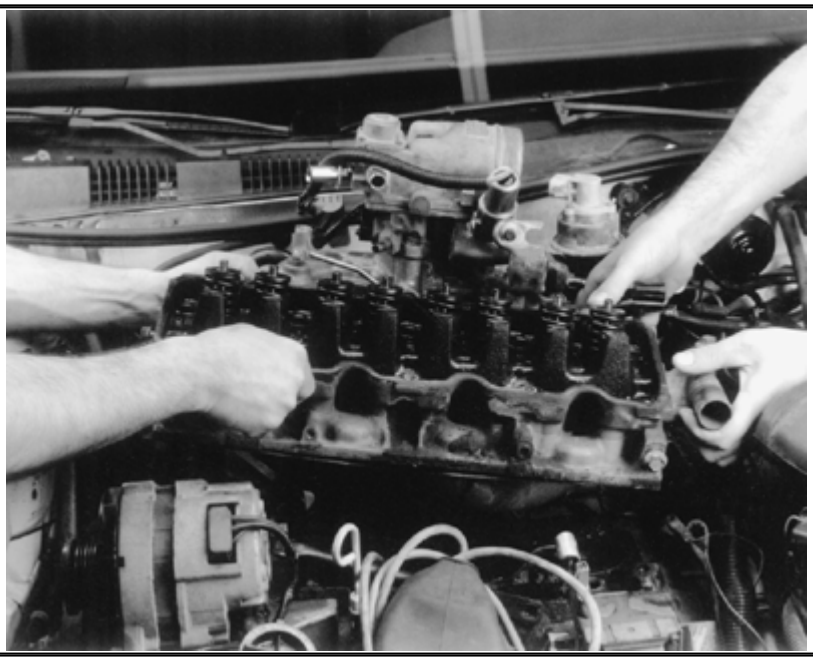
Click to enlarge

2. Remove the air cleaner assembly. Properly relieve the fuel system pressure.
3. As required on vehicles before 1990, disconnect the heater hose at the fitting located under the intake manifold. On 1991 vehicles, disconnect the heater hose at the heater inlet tube and disconnect the adapter hose at the water outlet connector.
4. Disconnect the upper radiator hose at the cylinder head, then disengage the electric cooling fan switch at the plastic connector.
5. Disconnect the distributor cap and spark plug wires, then remove as an assembly.
6. If necessary, tag and disconnect the spark plugs.
7. Disconnect the EGR tube at the EGR valve.
8. Disconnect and tag the required vacuum hoses. Remove the accessory drive belts.
9. Disconnect the choke cap wire.
10. Remove rocker arm cover retaining bolts, then remove the cover.
11. Remove the rocker arm fulcrum bolts, the fulcrums, rocker arms and pushrods. Identify the location of each so they may be reinstalled in their original positions.
12. Disconnect the fuel supply and return lines at the rubber connections. Disconnect the accelerator cable and speed control cable, if equipped.
13. Raise and safely support the vehicle. Disconnect the exhaust system at the exhaust pipe, and hose at the tube. Lower the vehicle.

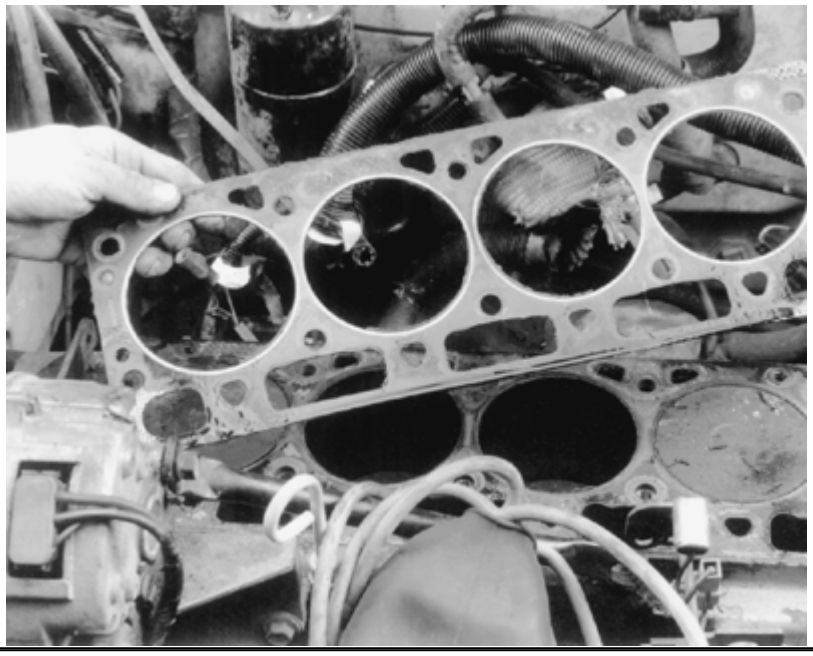
14. Remove the cylinder head bolts. Remove the cylinder head and gasket with the exhaust and intake manifolds attached.



Removing the cylinder head bolts-2.5L engine



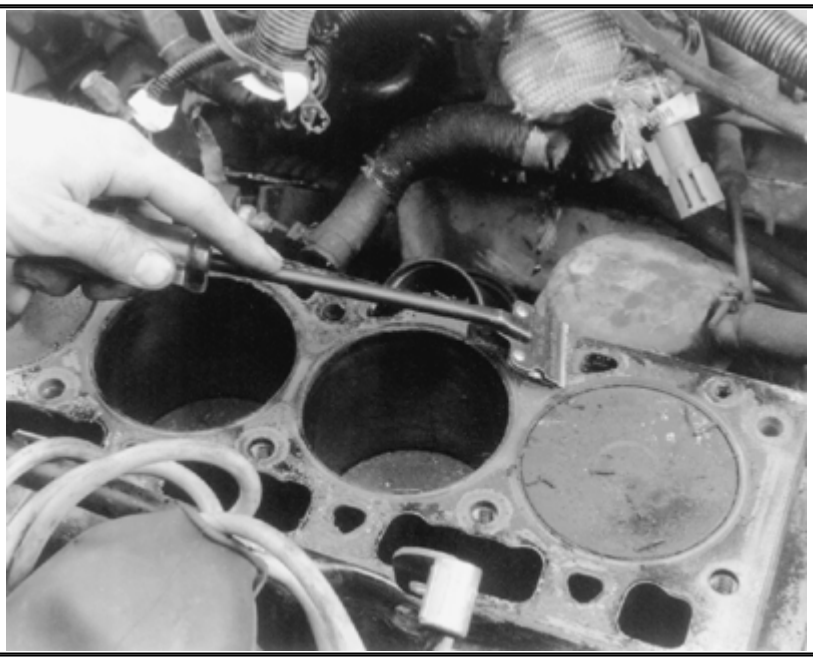
An assistant is handy when removing the cylinder head from the engine



Remove the cylinder head gasket and replace with a new one when installing the head

To install:

15. **Clean all gasket material from the mating surface of the cylinder head and block. Position the cylinder head gasket on the cylinder block, using a suitable sealer to retain the gasket.**



Clean the engine block mating surface with a gasket scraper to get rid of all of the old gasket material

16. **Before installing the cylinder head, thread 2 Cylinder Head Alignment Studs T84P-6065-A through the head bolt holes in the gasket and into the block at opposite corners of the block.**

17. **Install the cylinder head and cylinder head bolts. Start and run down several head bolts and remove the 2 guide bolts. Replace them with the remaining head bolts. Tighten the bolts in sequence in 2 steps, first to 52-59 ft. lbs. (70-80 Nm) and then to 70-76 ft. lbs. (95-103 Nm).**

Torque the head bolts in sequence and to the correct specification

18. **Raise and safely support the vehicle. Connect the exhaust system at the exhaust pipe and hose to metal tube. Lower the vehicle.**
19. **Install the thermactor pump drive belt, if equipped.**
20. **Connect the accelerator cable and speed control cable, if equipped.**
21. **Connect the fuel supply and return lines. Connect the choke cap wire, if equipped.**
22. **Install the pushrods, rocker arms, fulcrums and fulcrum bolts in their original positions. Install the rocker arm cover.**
23. **Connect the EGR tube at the EGR valve. Install the distributor cap and spark plug wires as an assembly. If removed , install the spark plugs, as tagged during removal.**
24. **Install all accessory drive belts.**
25. **Connect the required vacuum hoses. Install the air cleaner assembly. Engage the electric cooling fan switch at the connector.**
26. **Connect the upper radiator hose and the heater hose. Fill the cooling system. Connect the negative battery cable.**
27. **Start the engine and check for leaks. After the engine has reached normal operating temperature, check and if necessary add coolant.**

3.0L Engine-Except SHO

1. **For 1992-95 vehicles, rotate the crankshaft to 0° TDC on the compression stroke.**
2. **Disconnect the negative battery cable. Properly relieve the fuel system pressure, then drain the cooling system.**
3. **Remove the air cleaner outlet flex hose-to-throttle body.**
4. **Loosen the accessory drive belt idler pulley, remove the drive belt.**
5. **If the left cylinder head is being removed, perform the following:**
    1. **Disconnect the alternator electrical connectors.**
    2. **Rotate the tensioner clockwise and remove the accessory drive belt.**

3. **Remove the automatic belt tensioner assembly.**
4. **Remove the alternator.**
5. **Remove the power steering mounting bracket retaining bolts. Leave the hoses connected and place the pump aside in a position to prevent fluid from leaking out.**
6. **Remove the engine oil dipstick tube from the exhaust manifold.**

6. **If the right head is being removed, perform the following:**

1. **Remove the alternator belt tensioner bracket.**
2. **Remove the heater supply tube retaining brackets from the exhaust manifold.**
3. **Remove the vehicle speed sensor cable retaining bolt and the EGR vacuum regulator sensor and bracket.**

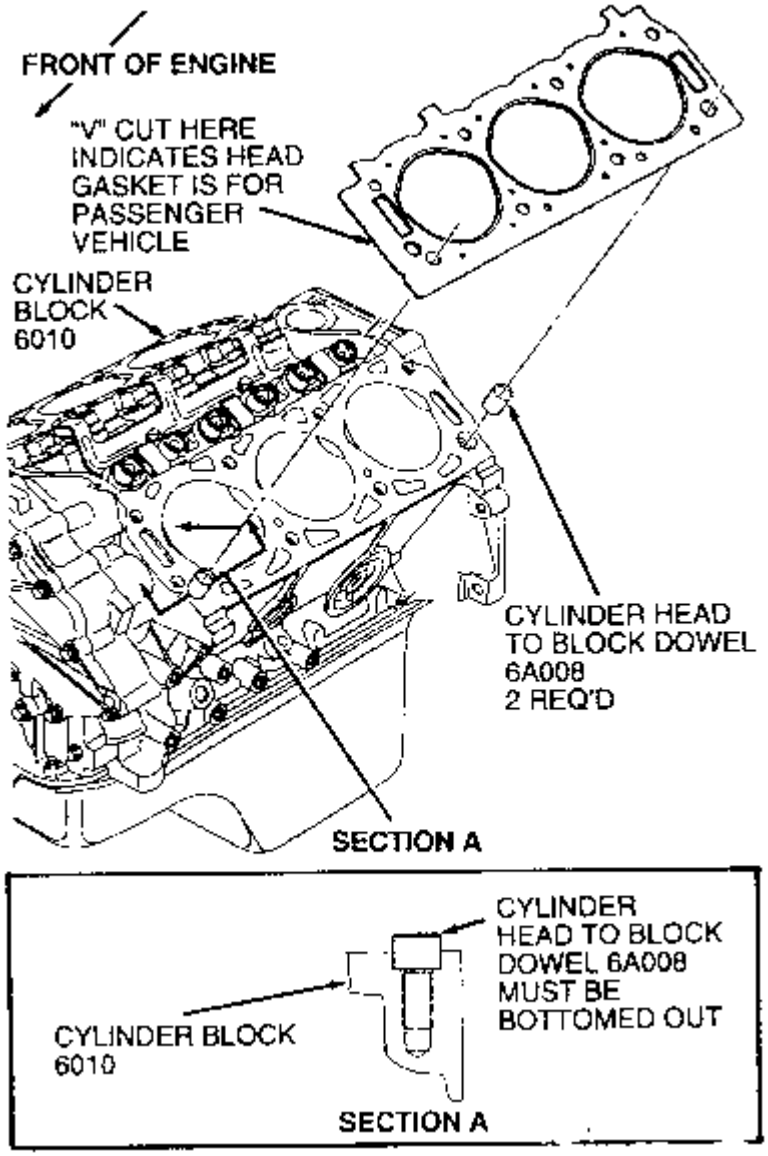
6. **Remove the exhaust manifolds from both heads. Remove the PCV and the rocker arm covers. Loosen the rocker arm fulcrum attaching bolts enough to allow the rocker arm to be lifted off the pushrod and rotated to one side.**
7. **Remove the pushrods. Be sure to identify and label the position of each pushrod. The rods should be installed in their original position during reassembly.**
8. **Remove the intake manifold. For details, please refer to the procedure located earlier in this section.**
9. **Remove the cylinder head attaching bolts and remove the cylinder heads from the engine. Remove and discard the old cylinder head gaskets.**

To install:

11. **Lightly oil all bolt and stud bolt threads before installation. Clean the cylinder head, intake manifold, rocker arm cover and cylinder head gasket contact surfaces. If the cylinder head was removed for a cylinder head gasket replacement, check the flatness of the cylinder head and block gasket surfaces.**

If the flat surface of the cylinder head is warped, donot plane or grind off more than 0.010 in. (0.25mm). If the head is machinedpast its resurface limit, the head will have to be replaced with a new one.

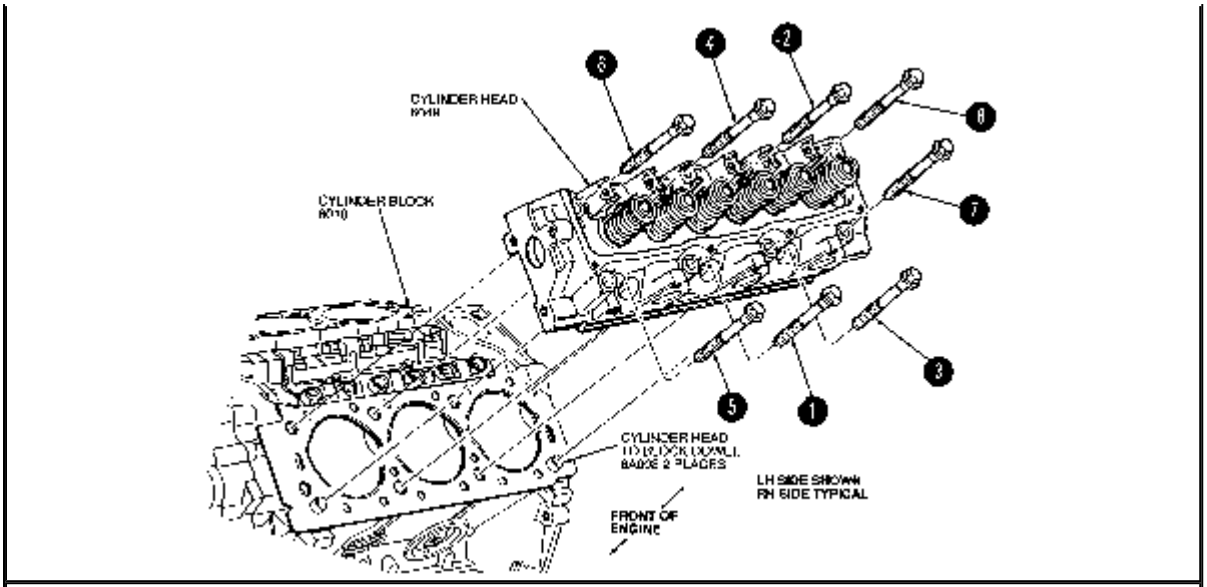
12. **Position new head gaskets on the cylinder block, noting the UP position on the gasket face, using the dowels in the engine block for alignment. If the dowels are damaged, they must be replaced.**



Installing a new cylinder head gasket, using the dowels in the block for alignment. If the dowels are damaged, they must be replaced

Click to enlarge

13. **Position the cylinder head on the cylinder block. Tighten the cylinder head attaching bolts in 2 steps following the proper torque sequence. The first step is 37 ft. lbs. (50 Nm) and the second step is 68 ft. lbs. (92 Nm).**



Cylinder head bolt torque sequence-3.0L engine (except SHO)

Click to enlarge

When cylinder head attaching bolts have been tightened using the aboveprocedure, it is not necessary to retighten the bolts after extended engineoperation. The bolts can be rechecked for tightness if desired.

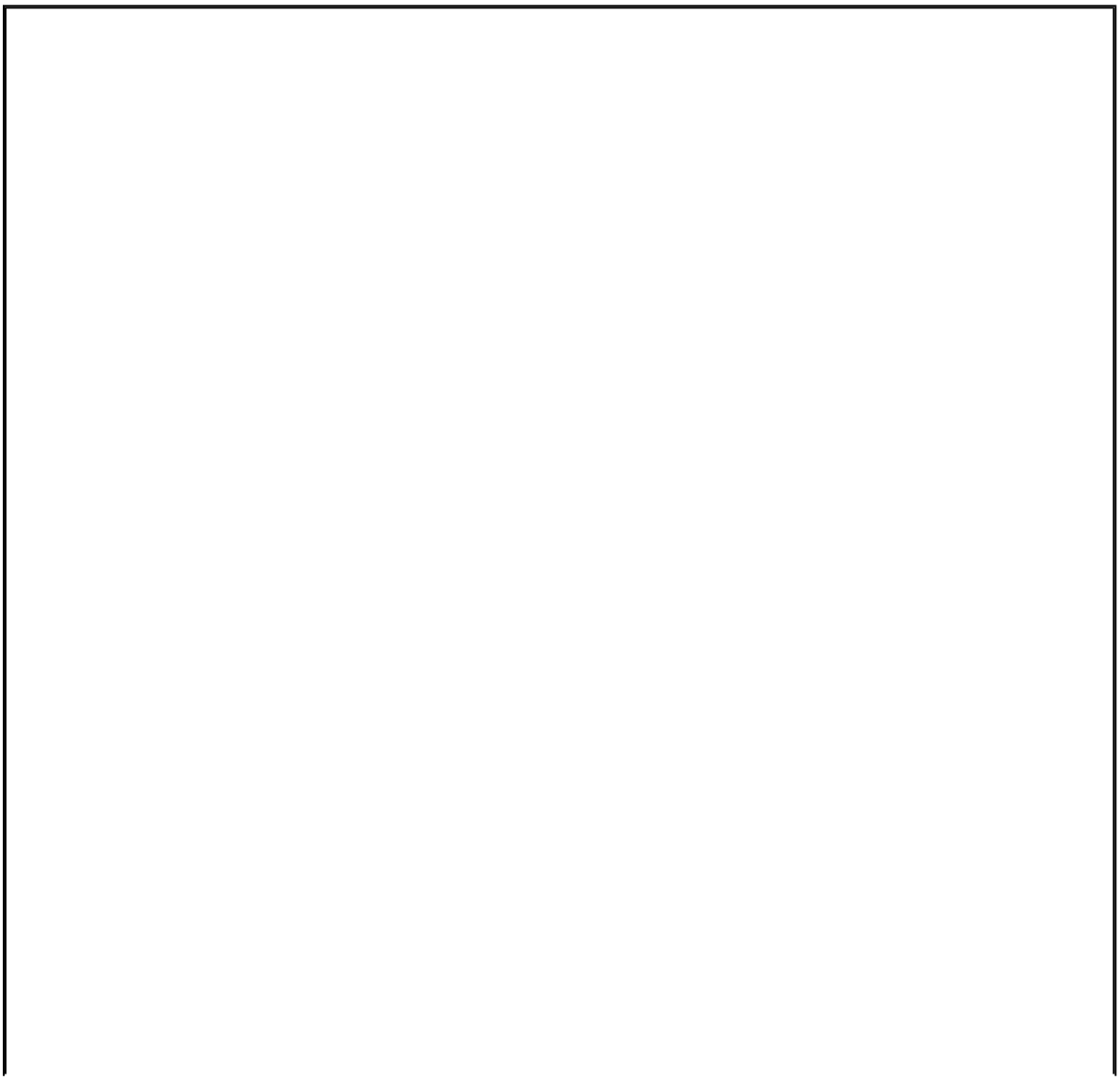
14. **Install the intake manifold. For details, please refer to the procedure located earlier in this section.**
15. **Engage the coolant temperature sending unit connectors.**
16. **Dip each pushrod end in oil conditioner or heavy engine oil. Install the pushrods in their original position.**
17. **Before installation, coat the valve tips, rocker arm and fulcrum contact areas with Lubricate® or equivalent. Lightly oil all the bolt and stud threads before installation.**
18. **Rotate the engine until the lifter is on the base circle of the cam (valve closed).**
19. **Install the rocker arm and components and torque the rocker arm fulcrum bolts to 24 ft. lbs. (32 Nm). Be sure the lifter is on the base circle of the cam for each rocker arm as it is installed.**

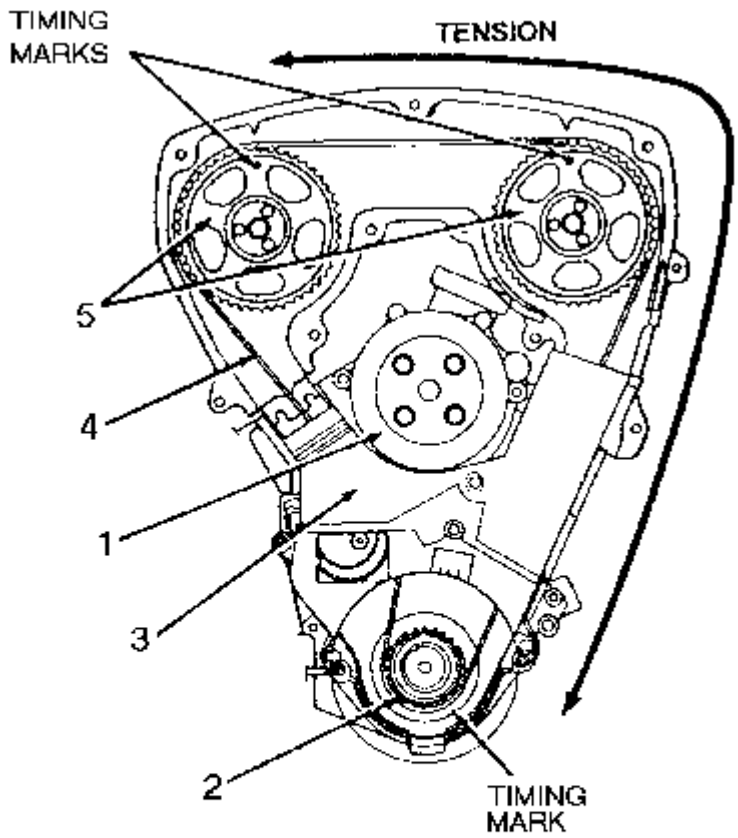
The fulcrums must be fully seated in the cylinder headand the pushrods must be seated in the rocker arm sockets prior to the finaltightening.

20. **Install the exhaust manifold(s). For details, please refer to the procedure located earlier in this section.**
21. **Install the oil dipstick tube.**
22. **Install the remaining components by reversing the removal procedure.**
23. **Fill the cooling system with the proper type and quantity of approved coolant.**
24. **Connect the negative battery cable, then start the engine and check for leaks.**
25. **Check and if necessary, adjust the transaxle throttle linkage and speed control. Install the air cleaner outlet tube duct.**

3.0L and 3.2L SHO Engines

1. **Disconnect the negative battery cable.**
2. **Drain the cooling system, then properly relieve the fuel system pressure.**
3. **Remove the air cleaner outlet tube.**
4. **Remove the intake manifold. For detail, please refer to the procedure located earlier in this section.**
5. **Loosen the accessory drive belt tensioners, then remove the drive belts.**
6. **Remove the upper outer timing belt cover.**
7. **For the 3.0L SHO, Remove the left-hand side drive belt tensioner idler pulley and bracket assembly. For the 3.2L SHO engine, remove the left-hand drive belt idler pulleys.**
8. **Raise and safely support the vehicle.**
9. **Remove the right wheel and tire assembly, then remove the front fender splash shield.**
10. **Remove the crankshaft vibration damper and pulley.**
11. **Remove the lower timing belt cover.**
12. **Align both camshaft pulley timing marks with the index marks on the upper steel belt cover.**



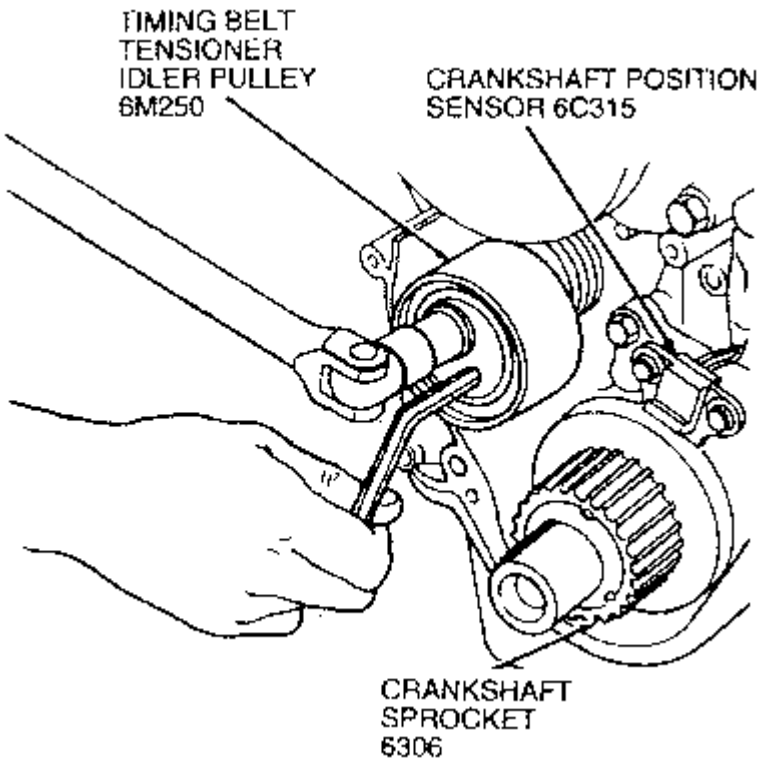


1 Water pump pulley
2 Crankshaft sprocket
3 Center outer timing belt cover
4 Timing belt
5 Camshaft sprocket

Timing alignment marks-3.0L and 3.2L SHO engines

Click to enlarge

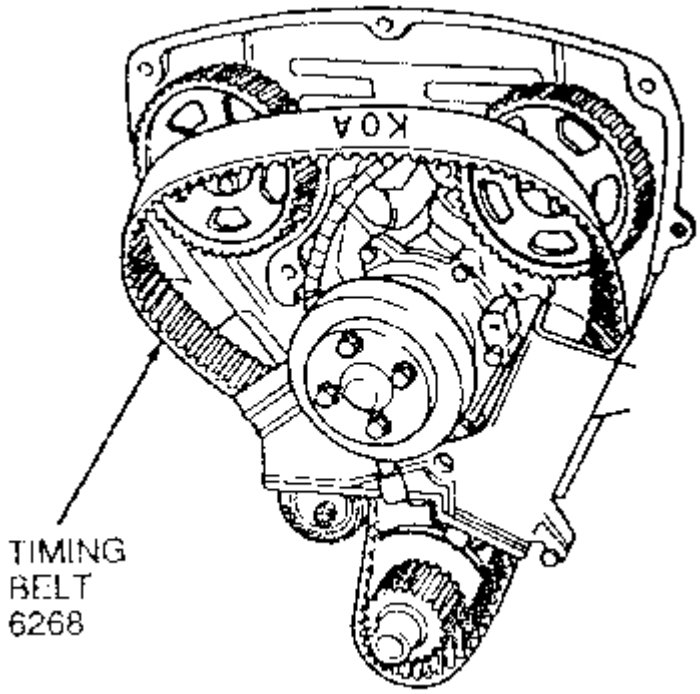
13. **Release the tension on the belt by loosening the tensioner nut and rotating the tensioner with a hex head wrench. When tension is released, tighten the nut. This will hold the tensioner in place. Lower the vehicle until the wheels touch but keep the vehicle supported.**



Use a hex head wrench to loosen the tensioner nut

Click to enlarge

14. **Disconnect the crankshaft position (CKP) sensor wiring assembly.**
15. **Remove the center cover assembly.**
16. **Remove the timing belt, noting the location of the letters KOA on the belt. The belt must be installed in the same direction.**



When removing the timing belt, note the location of the letters KOA on the belt. The belt

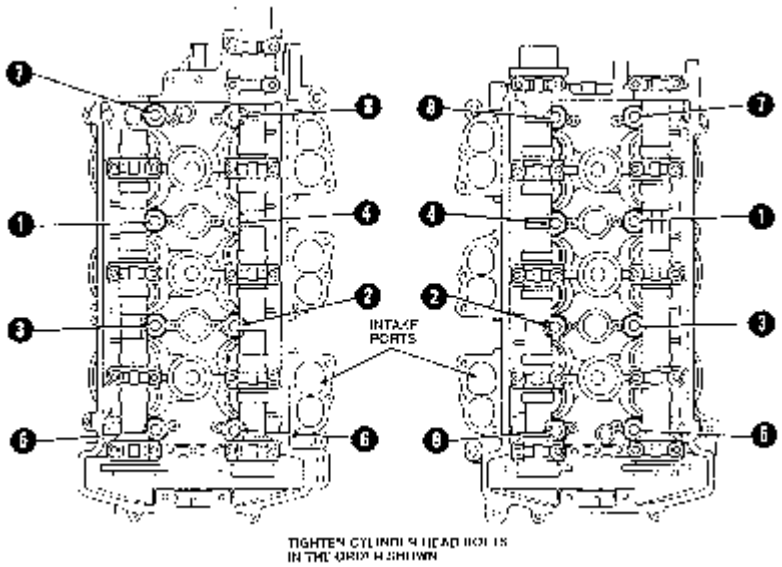
MUST be installed in the same direction

17. **Remove the rocker arm/valve covers covers. For details, please refer to the procedure located earlier in this section.**
18. **Remove the camshaft sprockets.**
19. **Remove the upper and the center inner timing belt covers.**
20. **If the left-hand cylinder head is being removed, remove the ignition control module, ignition coil bracket and the oil level dipstick tube.**
21. **If the right cylinder head is being removed, remove the coolant outlet/water bypass hose.**
22. **Remove the exhaust manifold on the left cylinder head. On the right cylinder head, the exhaust manifold must be removed with the head as an assembly.**
23. **Remove the cylinder head-to-block retaining bolts and washers, then remove the cylinder head from the engine.**

To install:

Lightly oil all bolt and stud bolt threads before installation exceptthose specifying special sealant.

24. **Remove any foreign material or oil from the top of the cylinder block and/or the lower surfaces of the cylinder head and clean the cylinder head and engine block mating surfaces of all old gasket material.**
25. **Position the cylinder head and gasket on the engine block and align with the cylinder head-to-block dowels.**
26. **Install the cylinder head bolts and tighten, in sequence, in 2 steps, the first to 36-51 ft. lbs. (49-69 Nm) and finally to 62-69 ft. lbs. (83-93 Nm).**



Cylinder head bolt tightening sequence-3.0L and 3.2L SHO

Click to enlarge

27. **When installing the left cylinder head, install the exhaust manifold, ignition control module, ignition coil bracket and the oil dipstick tube.**
28. **When installing the right cylinder head, install the coolant outlet/water bypass**

hose and connect the dual converter Y-pipe.

29. Install the upper and center inner timing belt covers.
30. Install the camshaft pulleys in the timed position.
31. Install the rocker arm/valve covers head covers. For details, please refer to the procedure located earlier in this section.
32. Install and adjust the timing belt.
33. Install the center timing belt cover.
34. Connect the crankshaft position (CKP) sensor wiring harness assembly.
35. Install the lower outer timing belt cover.
36. Raise and safely support the vehicle.
37. Install the front fender splash shield, then install the right wheel and tire assembly. Tighten the lug nuts to 85-105 ft. lbs. (115-142 Nm).
38. For the 3.0L SHO, install the left-hand idler pulley and bracket assembly. For the 3.2L SHO install the drive belt tensioner.
39. Install the upper outer timing belt cover.
40. Install the drive belts. For details, please refer to the belt installation procedure located in *Section 1* of this manual.
41. Install the intake manifold. For details, please refer to the procedure located earlier in this section.
42. Install the air cleaner outlet tube.
43. Connect the negative battery cable.
44. Fill the engine cooling system with the proper type and quantity of coolant.
45. Start the engine and check for coolant, fuel or oil leaks.

3.8L Engine

1. Drain the cooling system, then disconnect the negative battery cable.
2. Properly relieve the fuel system pressure.
3. Remove the air cleaner assembly including air intake duct and heat tube.
4. Loosen the accessory drive belt idler, then remove the drive belt.
5. If the left cylinder head is being removed, perform the following:
    1. Remove the oil filler cap.
    2. Remove the power steering pump. Leave the hoses connected and place the pump/bracket assembly aside in a position to prevent the fluid from leaking out.
    3. If equipped with air conditioning, remove mounting bracket attaching bolts. Leaving the hoses connected, position the compressor aside.
    4. Remove the alternator and bracket.
6. If the right cylinder head is being removed, perform the following:
    1. Disconnect the thermactor air control valve or bypass valve hose assembly at the air pump.

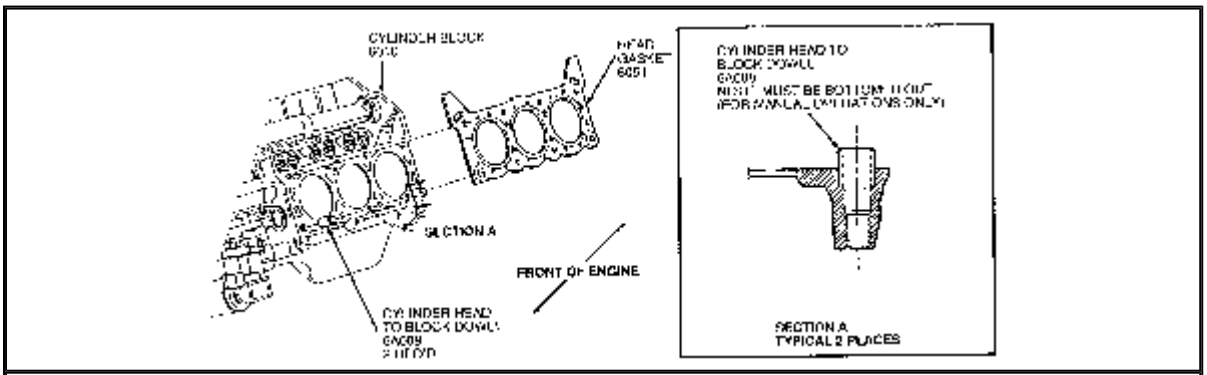
2. **If equipped, disconnect the thermactor tube support bracket from the rear of cylinder head.**
3. **Remove accessory drive idler.**
4. **Remove the thermactor pump pulley and thermactor pump.**
5. **Remove the PCV valve.**
6. **Remove the upper intake manifold. For details, please refer to the procedure located earlier in this section.**
7. **Remove the valve/rocker arm cover retaining bolts, then remove the covers.**
8. **Remove the injector fuel rail assembly.**
9. **Remove the lower intake manifold and the exhaust manifold(s). For details, please refer to the procedure located earlier in this section.**
10. **Loosen the rocker arm fulcrum attaching bolts enough to allow rocker arm to be lifted off the pushrod and rotate to one side. Remove the pushrods. Identify and label the position of each pushrod. Pushrods should be installed in their original position during assembly.**

You must use new cylinder head retaining bolts andgaskets when replacing or reinstalling the cylinder head!

12. **Remove the cylinder head attaching bolts and discard. Do NOT reuse the old bolts.**
13. **Remove the cylinder head(s). Remove and discard old cylinder head gasket(s).**

To install:

14. **Lightly oil all bolt threads before installation.**
15. **Clean cylinder head, intake manifold, valve rocker arm cover and cylinder head gasket contact surfaces. If cylinder head was removed for a cylinder head gasket replacement, check flatness of cylinder head and block gasket surfaces.**
16. **Position the new head gasket(s) onto cylinder block using dowels for alignment. Position cylinder head(s) onto block.**



When replacing or reinstalling the head, ALWAYS use new gasket(s) and bolts to avoid possible coolant and/or compression leaks which could result in engine damage

Click to enlarge

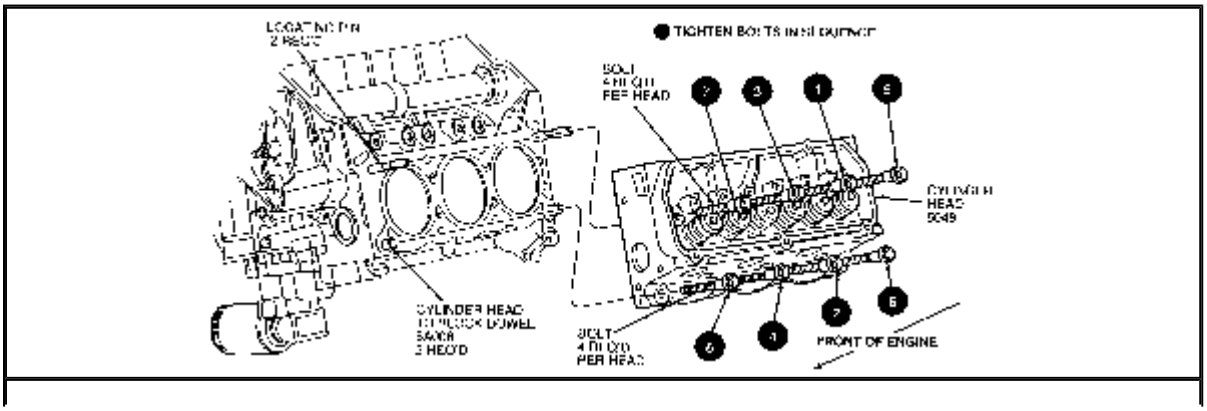
17. **Apply a thin coating of pipe sealant with Teflon® to the threads of the short cylinder head bolts, nearest to the exhaust manifold. Do not apply sealant to the long bolts. Install the cylinder head bolts.**

Always use new cylinder head bolts to ensure a leak-tightassembly. Torque retention with used bolts can vary, which may result incoolant or compression leakage at the cylinder head mating surface area.

18. **For vehicles through 1994, tighten the cylinder head attaching bolts, in sequence, to the following specifications:**
    - **Step 1: 37 ft. lbs. (50 Nm)**
    - **Step 2: 45 ft. lbs. (60 Nm)**
    - **Step 3: 52 ft. lbs. (70 Nm)**
    - **Step 4: 59 ft. lbs. (80 Nm)**
19. **For 1995 vehicles, tighten the cylinder head attaching bolts, in sequence, to the following specifications:**
    - **Step 1: 15 ft. lbs. (20 Nm)**
    - **Step 2: 29 ft. lbs. (40 Nm)**
    - **Step 3: 37 ft. lbs. (50 Nm)**
20. **For vehicles through 1992, retighten the cylinder head bolts, in sequence, one at a time in the following manner:**
    1. **Long cylinder head bolts: Loosen the bolts and back them out 2-3 turns. Retighten to 11-18 ft. lbs. (15-25 Nm). Then tighten the bolt an additional 85-105° and go to the next bolt in sequence.**
    2. **Short cylinder head bolts: Loosen the bolts and back them out 2-3 turns. Retighten to 11-18 ft. lbs. (15-25 Nm). Then tighten the bolt an additional 65-85°.**

18. **For 1993-95 vehicles, retighten the cylinder head bolts, in sequence, one at a time in the following manner:**
    1. **Long cylinder head bolts: Loosen the bolts and back them out 2-3 turns. Retighten to 11-18 ft. lbs. (15-25 Nm). Then tighten the bolt an additional 85-95° and go to the next bolt in sequence.**
    2. **Short cylinder head bolts: Loosen the bolt and back them out 2-3 turns. Retighten to 7-15 ft. lbs. (10-20 Nm). Then tighten the bolt an additional 85-95°.**

When cylinder head attaching bolts have been tightenedusing the above procedures, it is not necessary to retighten bolts afterextended engine operation. However, bolts can be checked for tightness ifdesired.



Cylinder head bolt tightening sequence-3.8L engine

Click to enlarge

22. Dip each pushrod end in oil conditioner or heavy engine oil, then install the pushrods in their original position.
23. For each valve, rotate crankshaft until the tappet rests on the heel (base circle) of the camshaft lobe. Torque the fulcrum attaching bolts to 44 inch lbs. (5 Nm) maximum.
24. Lubricate all rocker arm assemblies with oil conditioner or heavy engine oil.
25. Tighten the fulcrum bolts a second time to 19-25 ft. lbs. (26-34 Nm). For final tightening, camshaft may be in any position.

If original valve train components are being installed, avalve clearance check is not required. If a component has been replaced, perform a valve clearance check.

26. Install the exhaust manifold(s) and the lower intake manifold. For details, please see these procedures located earlier in this section.
27. Install the injector fuel rail assembly. Tighten the retaining bolts to 71-97 inch lbs. (8-11 Nm).
28. Position the rocker arm/valve cover(s) and new gasket on cylinder head and install attaching bolts. Note location of spark plug wire routing clip stud bolts. Tighten attaching bolts to 80-106 inch lbs. (9-12 Nm).
29. Install the upper intake manifold, then connect the ignition wires to the spark plugs.
30. If the left cylinder head is being installed, perform the following: install oil fill cap, compressor mounting and support brackets, power steering pump mounting and support brackets and the alternator/support bracket.
31. If the right cylinder head is being installed, perform the following: install the PCV valve, alternator bracket, thermactor pump and pump pulley, accessory drive idler, thermactor air control valve or air bypass valve hose.
32. Install the accessory drive belt. Attach the thermactor tube(s) support bracket to the rear of the cylinder head. Tighten the attaching bolts to 30-40 ft. lbs. (40-55 Nm).
33. Install the air cleaner assembly, including the air intake duct and heat tube.
34. Connect the negative battery cable and fill the cooling system.
35. Start the engine and check for leaks.

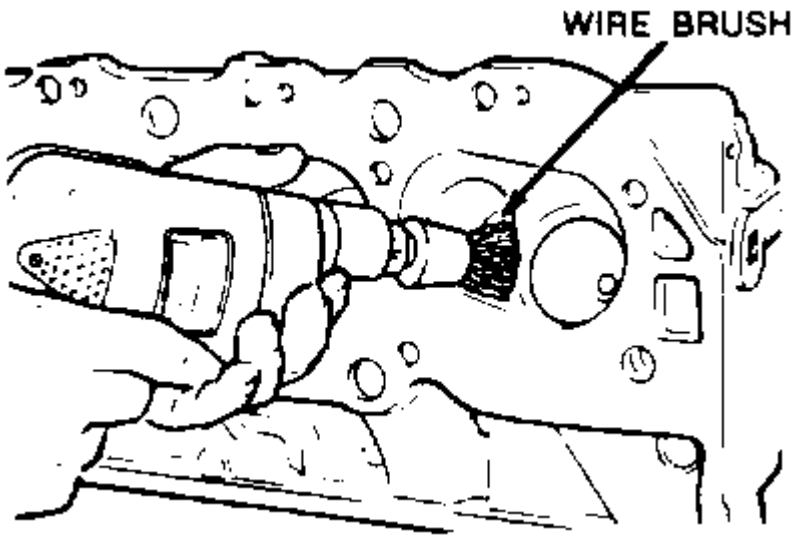
CLEANING & INSPECTION

1. With the valves installed to protect the valve seats, remove carbon deposits from the combustion chambers and valve heads with a drill-mounted wire brush. Be careful not to damage the cylinder head gasket surface. If the head is to be disassembled, proceed to Step 3. If the head is not to be disassembled, proceed to Step 2.
2. Remove all dirt, oil and old gasket material from the cylinder head with solvent. Clean the bolt holes and the oil passage. Be careful not to get solvent on the valve seals as the solvent may damage them. If available, dry the cylinder head with compressed air. Check the head for cracks or other damage, and check the gasket surface for burrs, nicks and flatness. If you are in doubt about the head's

serviceability, consult a reputable automotive machine shop.

3. **Remove the valves, springs and retainers, then clean the valve guide bores with a valve guide cleaning tool. Remove all dirt, oil and old gasket material from the cylinder head with solvent. Clean the bolt holes and the oil passage.**
4. **Remove all deposits from the valves with a wire brush or buffing wheel. Inspect the valves as described later in this section.**
5. **Check the head for cracks using a dye penetrant in the valve seat area and ports, head surface and top. Check the gasket surface for burrs, nicks and flatness. If you are in doubt about the head's serviceability, consult a reputable automotive machine shop.**

If the cylinder head was removed due to an overheatingcondition and a crack is suspected, do not assume that the head is not crackedbecause a crack is not visually found. A crack can be so small that it cannotbe seen by eye, but can pass coolant when the engine is at operatingtemperature. Consult an automotive machine shop that has pressure testingequipment to make sure the head is not cracked.

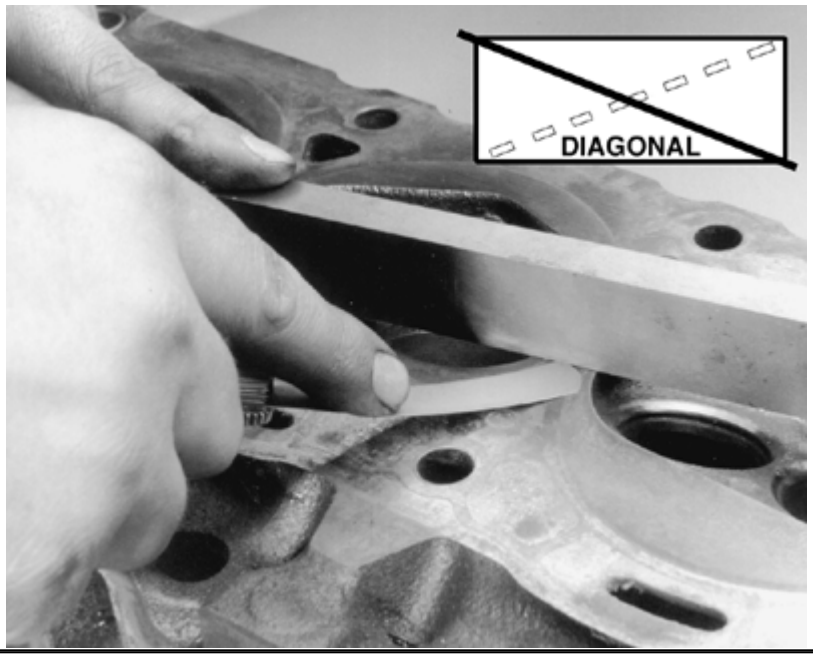


Clean the combustion chamber using a drill-mounted wire brush

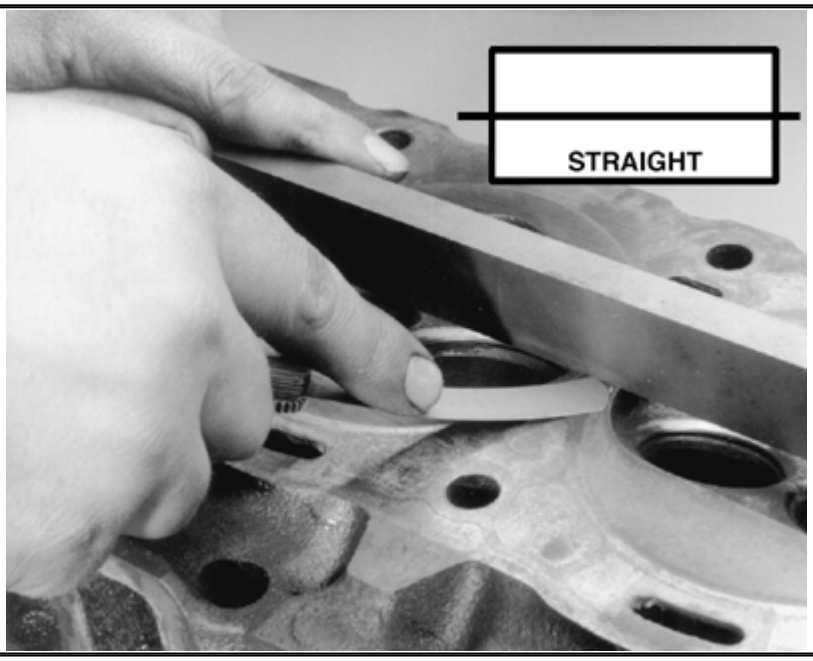
RESURFACING

Whenever the cylinder head is removed, check the flatness of the cylinder head gasket surface as follows:

1. **Make sure all dirt and old gasket material has been cleaned from the cylinder head. Any foreign material left on the head gasket surface can cause a false measurement.**



Checking the cylinder head for flatness diagonally across the head surface



Checking the cylinder head for flatness straight across the head surface

2. **Place a straightedge straight across and diagonally across the gasket surface of the cylinder head (in the positions shown in the figures). Using feeler gauges, determine the clearance at the center of the straightedge.**
3. **If warpage exceeds the 0.006 in. (0.15mm) then the cylinder head should likely be resurfaced or replaced. Contact a reputable machine shop for machining service and recommendations.**

When resurfacing the cylinder head(s), the intakemanifold mounting position is altered and must be corrected by machining aproportionate amount from the intake manifold flange.

Valves

REMOVAL & INSTALLATION

1. **Remove the cylinder head(s) and place on a clean surface.**
2. **Block the head on its side, or install a pair of head-holding brackets made especially for valve removal.**
3. **Use a socket slightly larger than the valve stem and keepers, place the socket over the valve stem and gently hit the socket with a plastic hammer to break loose any varnish buildup.**
4. **Remove the valve keepers, retainer, spring shield and valve spring using a valve spring compressor (the locking C-clamp type is the easiest kind to use).**
5. **Put the parts in a separate container numbered for the cylinder being worked on. Do not mix them with other parts removed.**
6. **Remove and discard the valve stem oil seal, a new seal will be used at assembly time.**
7. **Remove the valve from the cylinder head and place, in order, through numbered holes punched in a stiff piece of cardboard or wooden valve holding stick.**

The exhaust valve stems, on some engines, are equipped with small metal caps. Take care not to lose the caps. Make sure to reinstall them at assembly time. Replace any caps that are worn.

8. **Use an electric drill and rotary wire brush to clean the intake and exhaust valve ports, combustion chamber and valve seats. In some cases, the carbon will need to be chipped away. Use a blunt pointed drift for carbon chipping, be careful around the valve seat areas.**
9. **Use a wire valve guide cleaning brush and safe solvent to clean the valve guides.**
10. **Clean the valves with a revolving wire brush. Heavy carbon deposits may be removed with the blunt drift.**

When using a wire brush to clean carbon from the valve ports, valves, etc., be sure that the deposits are actually removed, rather than burnished.

11. **Wash and clean all valve spring, keepers, retaining caps etc., in safe solvent.**
12. **Clean the head with a brush and some safe solvent and wipe dry.**
13. **Check the head for cracks. Cracks in the cylinder head usually start around an exhaust valve seat because it is the hottest part of the combustion chamber. If a crack is suspected but cannot be detected visually have the area checked with dye penetrant or other method by a machine shop.**
14. **After all cylinder head parts are reasonably clean, check the valve stem-to-guide clearance. If a dial indicator is not on hand, a visual inspection can give you a fairly good idea if the guide, valve stem or both are worn.**
15. **Insert the valve into the guide until slightly away from the valve seat. Wiggle the valve sideways. A small amount of wobble is normal, excessive wobble means a worn guide or valve stem. If a dial indicator is on hand, mount the indicator so that the stem of the valve is at 90° to the valve stem, as close to the valve guide as possible. Move the valve off the seat, and measure the valve guide-to-stem clearance by rocking the stem back and forth to actuate the dial indicator. Measure the valve stem using a micrometer and compare to specifications to determine whether stem or guide wear is causing excessive clearance.**
16. **The valve guide, if worn, must be repaired before the valve seats can be resurfaced. Ford supplies valves with oversize stems to fit valve guides that are reamed to oversize for repair. The machine shop will be able to handle the guide**

reaming for you. In some cases, if the guide is not too badly worn, knurling may be all that is required.

17. **Reface, or have the valves and valve seats refaced. The valve seats should be a true 45° angle for the 2.5L and 3.0L engines, and 44.5° angle for the 3.8L engine. Remove only enough material to clean up any pits or grooves. Be sure the valve seat is not too wide or narrow. Use a 60° grinding wheel to remove material from the bottom of the seat for raising and a 30° grinding wheel to remove material from the top of the seat to narrow.**
18. **After the valves are refaced by machine, hand lap them to the valve seat. Clean the grinding compound off and check the position of face-to-seat contact. Contact should be close to the center of the valve face. If contact is close to the top edge of the valve, narrow the seat; if too close to the bottom edge, raise the seat.**
19. **Valves should be refaced to a true angle of 44° for the 2.5L and 3.0L engines, and 45.8° for the 3.8L engine. Remove only enough metal to clean up the valve face or to correct run-out. If the edge of the valve head, after machining, is 0.8mm or less replace the valve. The tip of the valve stem should also be dressed on the valve grinding machine, however, do not remove more than 0.010 in. (0.25mm).**
20. **After all valve and valve seats have been machined, check the remaining valve train parts (springs, retainers, keepers, etc.) for wear. Check the valve springs for straightness and tension.**
21. **Reassemble the head in the reverse order of disassembly using new valve guide seals and lubricating the valve stems. Check the valve spring installed height, shim or replace as necessary.**

Valve Stem Seals

REPLACEMENT

Most engines are equipped with a positive valve stem seal using a Teflon® insert. Teflon® seals are available for other engines but usually require valve guide machining, consult your automotive machine shop for advice on having positive valve stem oil seals installed.

When installing valve stem oil seals, ensure that a small amount of oil is able to pass the seal to lubricate the valve stems and guide walls; otherwise, excessive wear will occur.

Head Off Vehicle

1. **Remove the cylinder head from the vehicle. Position the assembly in a cylinder head holding fixture.**
2. **Using the proper valve stem seal removal tool, remove the valve keepers from the valve stem. Remove and discard the old valve stem seal.**
3. **As required, remove the valve from the cylinder head. Be sure to keep the valves in the proper order for reassembly.**
4. **Continue this process for the remaining valves.**
5. **Installation is the reverse of the removal procedure.**

Head On Vehicle

1. **Disconnect the negative battery cable. Remove the valve cover.**
2. **Remove the spark plug from the cylinder that you are working on.**

3. **Position the engine so that both the intake and exhaust valves are closed.**
4. **Screw the proper tool into the spark plug hole. Attach an air line to the tool and pressurize the cylinder with low pressure compressed air, just enough to hold the valves in the closed position.**

Failure to properly compress air into the cylinder will result in the valve falling into the cylinder bore which will necessitate disassembling the engine to retrieve them.

5. **Using the proper valve stem seal removal tool, remove the valve keepers from the valve stem. Remove and discard the old valve seal.**
6. **Installation is the reverse of the removal procedure.**

Valve Seats

If a valve seat is damaged or burnt and cannot be serviced by refacing, it may be possible to have the seat machined and an insert installed. Consult the automotive machine shop for their advice.

The aluminum heads on some engines are equipped with inserts.

Valve Guides

Worn valve guides can, in most cases, be reamed to accept a valve with an oversized stem. Valve guides that are not excessively worn or distorted may, in some cases, be knurled rather than reamed. However, if the valve stem is worn reaming for an oversized valve stem is the answer since a new valve would be required.

Knurling is a process in which metal is displaced and raised, thereby reducing clearance. Knurling also produces excellent oil control. The possibility of knurling instead of reaming the valve guides should be discussed with a machinist.

Valve Lifters

REMOVAL & INSTALLATION

2.5L Engine

1. **Disconnect the negative battery cable. Remove the cylinder head.**
2. **Using a magnet, remove the lifters. Identify, tag and place the lifters in a rack so they can be installed in the original positions.**
3. **If the lifters are stuck in their bores by excessive varnish or gum, it may be necessary to use a hydraulic lifter puller tool to remove the lifters. Rotate the lifters back and forth to loosen any gum and varnish which may have formed. Keep the assemblies intact until the are to be cleaned.**
4. **Install the lifters through the pushrod openings with a magnet.**
5. **Install the cylinder head and related parts.**

3.0L Engine-Except SHO

1. **Disconnect the negative battery cable.**

2. **Drain the cooling system and relieve the fuel system pressure.**
3. **Disconnect the fuel lines from the fuel supply manifold and remove the throttle body.**
4. **Disconnect the spark plug wires from the spark plugs. Remove the ignition wire/separator assembly from the rocker cover retaining studs.**
5. **Mark the position of the distributor housing and rotor and remove the distributor.**
6. **Remove the rocker arm covers. Loosen the No. 3 intake valve rocker arm retaining bolt to allow the rocker arm to be rotated to 1 side.**
7. **Remove the intake manifold assembly.**
8. **Loosen the rocker arm fulcrum retaining bolt enough to allow the rocker arm to be lifted off the pushrod and rotated to 1 side.**
9. **Remove the pushrod(s). If more than 1 is removed, identify each pushrods location. The pushrods should be installed in their original position during reassembly.**
10. **On 1992 engines equipped with roller lifters, loosen the two roller lifter guide plate retaining bolts. Remove the guide plate retainer assembly from the lifter valley. Remove the lifter guide plate from the lifter by lifting straight up. To remove, grasp the lifter and pull it in line with the bore.**
11. **Remove the lifter(s) using a magnet, as required.**

If the lifter(s) are stuck in the bore(s) due to excessive varnish or gum deposits, it may be necessary to use a claw-type tool to aid removal. Rotate the lifter back and forth to loosen it from the gum or varnish that may have formed on the lifter.

To install:

12. **Clean all gasket mating surfaces. Place a rag in the lifter valley to catch any stray gasket material.**
13. **Lubricate each lifter and bore with heavy engine oil. Install the lifter in the bore, checking for free fit.**
14. **If equipped with roller lifters align the lifter flat to the lifter guide plate. Install the plate with the word UP and or button visible. Install the guide retainer assembly over the guide plates. Tighten the bolts to 810 ft. lbs.**
15. **Install the intake manifold and new gaskets. Dip each pushrod end in oil conditioner and install in it's original position.**
16. **For each valve, rotate the crankshaft until the lifter rests on the base circle of the camshaft lobe. Position the rocker arms over the pushrod and valve. Tighten the retaining bolt to 8 ft. lbs. (11 Nm) to initially seat the fulcrum into the cylinder head and onto the pushrod. Final tighten the bolt to 24 ft. lbs. (32 Nm).**
17. **Install the rocker arm covers and the distributor.**
18. **Install the throttle body and connect the fuel lines to the fuel supply manifold. Install the safety clips.**
19. **Install the coolant hoses. Fill and bleed the cooling system. Drain and change the crankcase oil.**
20. **Connect the air cleaner hoses to the throttle body and rocker cover.**
21. **Connect the negative battery cable, start the engine and check for leaks. Check the ignition timing.**

3.8L Engine

1. Disconnect the negative battery cable. Disconnect the secondary ignition wires at the spark plugs.
2. Remove the plug wire routing clips from mounting studs on the rocker arm cover attaching bolts. Lay plug wires with routing clips toward the front of engine.
3. Remove the upper intake manifold, rocker arm covers and lower intake manifold.
4. Sufficiently loosen each rocker arm fulcrum attaching bolt to allow the rocker arm to be lifted off the pushrod and rotated to one side.
5. Remove the pushrods. The location of each pushrod should be identified and labeled. When engine is assembled, each rod should be installed in its original position.
6. If equipped with roller lifters, remove the 2 tappet guide plate retainers and 6 guide plates.
7. Remove the lifters using a magnet. The location of each lifters should be identified and labeled. When engine is assembled, each lifter should be installed in its original position.

If lifters are stuck in bores due to excessive varnish or gum deposits, it may be necessary to use a hydraulic lifter puller tool to aid removal. When using a remover tool, rotate lifter back and forth to loosen it from gum or varnish that may have formed on the lifter.

To install:

8. Lightly oil all bolt and stud threads before installation. Using solvent, clean the cylinder head and valve rocker arm cover sealing surfaces.
9. Lubricate each lifter and bore with oil conditioner or heavy engine oil.
10. Install each lifter in bore from which it was removed. If a new tappet(s) is being installed, check new lifter for a free fit in bore.
11. If equipped with roller lifters, align the flats on the sides of the lifters and install the 6 guide plates between the adjacent lifters. Make sure the word "up" and/or button is showing. Install the 3 guide plate retainers and tighten the 4 bolts to 6-10 ft. lbs. (8-14 Nm).
12. Dip each pushrod end in oil conditioner or heavy engine oil. Install pushrods in their original positions.
13. For each valve, rotate crankshaft until lifter rests onto heel (base circle) of camshaft lobe. Position rocker arms over pushrods and install the fulcrums. Initially tighten the fulcrum attaching bolts to 44 inch lbs. (5 Nm) maximum.
14. Lubricate all rocker arm assemblies with suitable heavy engine oil.
15. Finally tighten the fulcrum bolts to 19-25 ft. lbs. (26-34 Nm). For the final tightening, the camshaft may be in any position.

Fulcrums must be fully seated in the cylinder head and pushrods must be seated in rocker arm sockets prior to the final tightening.

16. Complete the installation of the lower intake manifold, valve rocker arm covers and the upper intake manifold by reversing the removal procedure.
17. Install the plug wire routing clips and connect wires to the spark plugs.

18. **Start the engine and check for oil or coolant leaks.**

Oil Pan

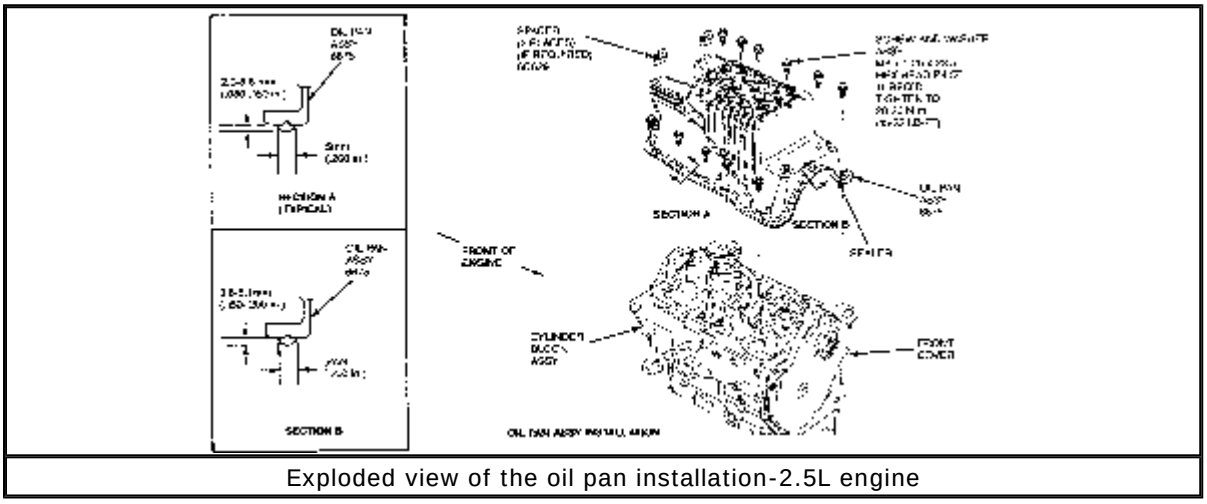
REMOVAL & INSTALLATION

CAUTION

The EPA warns that prolonged contact with used engine oil may cause a number of skin disorders, including cancer! You should make every effort to minimize your exposure to used engine oil. Protective gloves should be worn when changing the oil. Wash your hands and any other exposed skin areas as soon as possible after exposure to used engine oil. Soap and water, or waterless hand cleaner should be used.

2.5L Engine

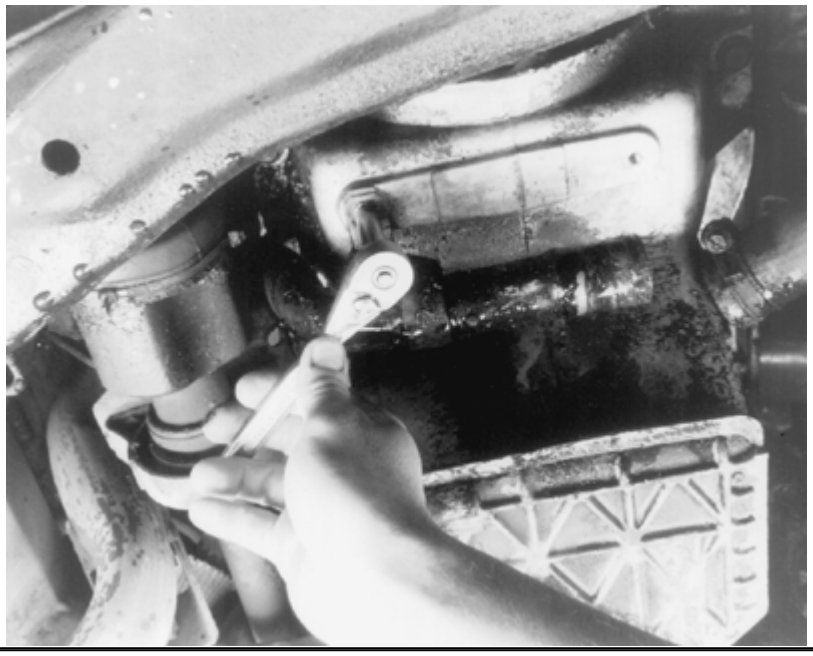
1. **Disconnect the negative battery cable. Raise and safely support the vehicle.**



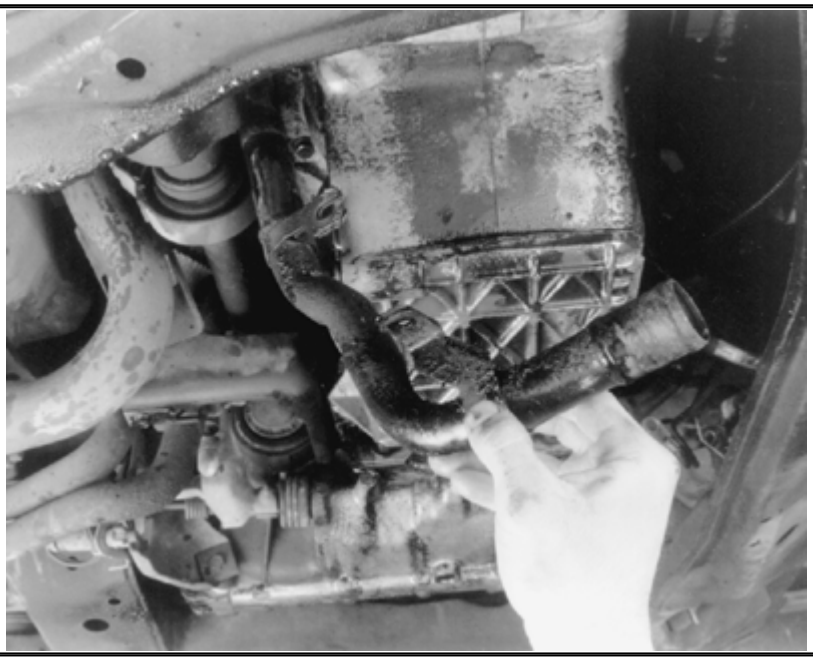
Exploded view of the oil pan installation-2.5L engine

Click to enlarge

2. **Drain the crankcase, then drain the cooling system by removing the lower radiator hose.**
3. **On vehicles equipped with a manual transaxle, remove the roll restrictor.**
4. **Disconnect the starter cable, then remove the starter.**
5. **Disconnect the exhaust pipe from oil pan.**
6. **Remove the engine coolant tube located at the lower radiator hose, at the water pump and at the tabs on the oil pan. Position air conditioner line off to the side.**



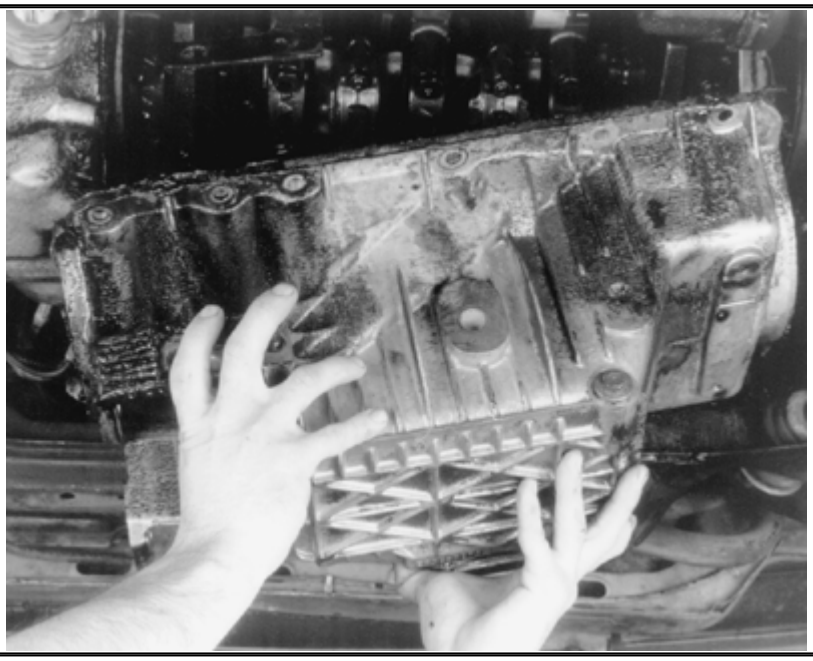
Remove the coolant tube-to-oil pan retainers, then...



... remove the coolant tube from the pan

7. Disconnect the retaining bolts, then remove the oil pan.

Remove the oil pan retaining bolts



Carefully lower the oil pan from the engine

To install:

8. **Clean both mating surfaces of oil pan and cylinder block, making certain all traces of RTV sealant are removed.**

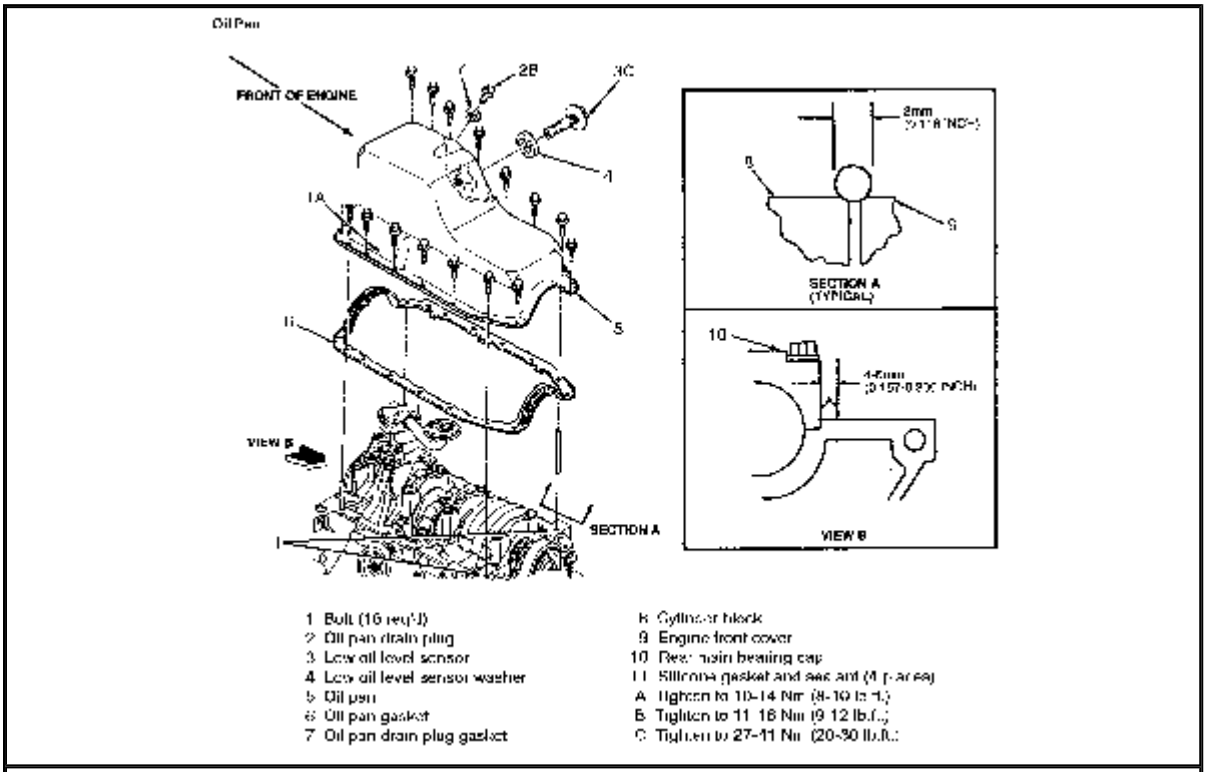
Clean all traces of gasket/sealer from the oil pan

9. **Remove and clean oil pump pick-up tube and screen assembly. After cleaning, install tube and screen assembly.**
10. **Fill the oil pan groove with RTV sealer; the bead should be approximately $^{1}/_{8}$ in. (3mm) above the surface of the pan rail. Immediately (within 5 minutes) install the oil pan.**
11. **Install and tighten the 2 oil pan-to-transaxle bolts to 30-39 ft. lbs. (41-53 Nm) to align the pan with the transaxle then back off $^{1}/_{2}$ turn.**
12. **Tighten the pan flange bolts to 6-8 ft. lbs. (8-11 Nm).**
13. **Tighten the 2 oil pan-to-transaxle bolts to 30-39 ft. lbs. (41-53 Nm).**
14. **Install the exhaust pipe bracket to the oil pan.**
15. **Install the engine coolant tube and the air conditioning line.**
16. **Install the starter, then connect the starter cable.**
17. **Carefully lower the vehicle, then fill the crankcase and cooling system to the proper level.**
18. **Start the engine and inspect for leaks.**

3.0L Engine-Except SHO

1. **Disconnect the negative battery cable and remove the oil level dipstick.**
2. **Raise and safely support the vehicle. If equipped with a low level sensor, remove the retainer clip at the sensor. Disengage the electrical connector from the sensor.**
3. **Drain the crankcase.**
4. **Remove the starter motor. For details, please refer to the procedure located earlier in this section.**
5. **Disengage the electrical connector from the oxygen sensor.**
6. **Remove the dual converter Y-pipe.**
7. **Remove the lower engine/flywheel dust cover from the torque converter housing.**

8. **Remove the oil pan attaching bolts, then slowly remove the oil pan, making sure the internal pan baffle does not snag the oil pump screen cover and tube. Remove the oil pan gasket.**



Exploded view of the oil pan-3.0L engine (except SHO)

Click to enlarge

To install:

9. **Clean the gasket surfaces on the cylinder block and oil pan. Clean the sealing surface with Metal Surface Cleaner F4AZ-19A536-RA or equivalent. Apply a $^{1}/_{4}$ in. (6mm) bead of silicone sealer to the junction of the rear main bearing cap and cylinder block junction of the front cover assembly and cylinder block.**

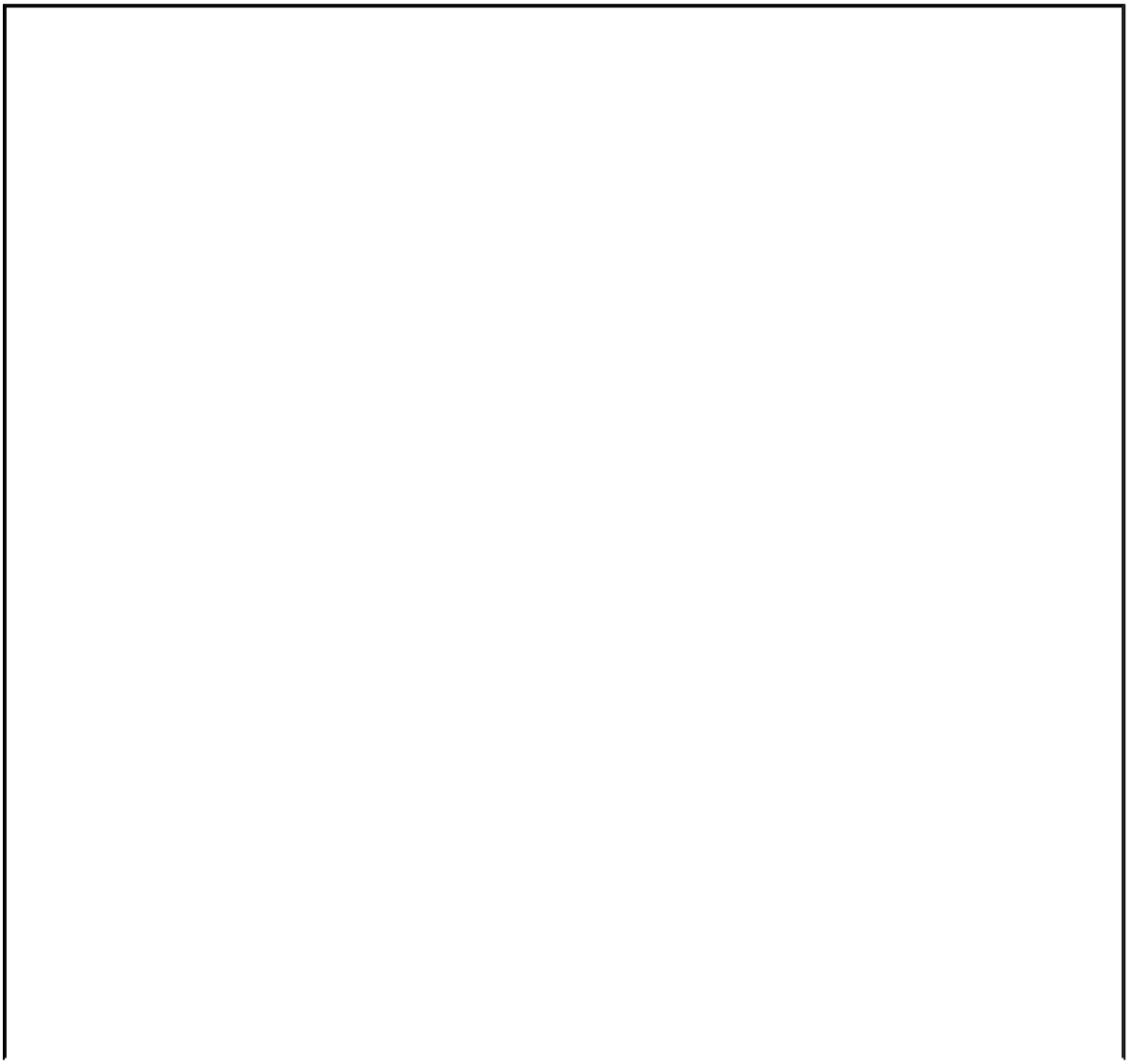
When using a silicone sealer, the assembly process should occur within 15 minutes after the sealer has been applied. After this time, the sealer may start to set-up and its sealing effectiveness may be affected.

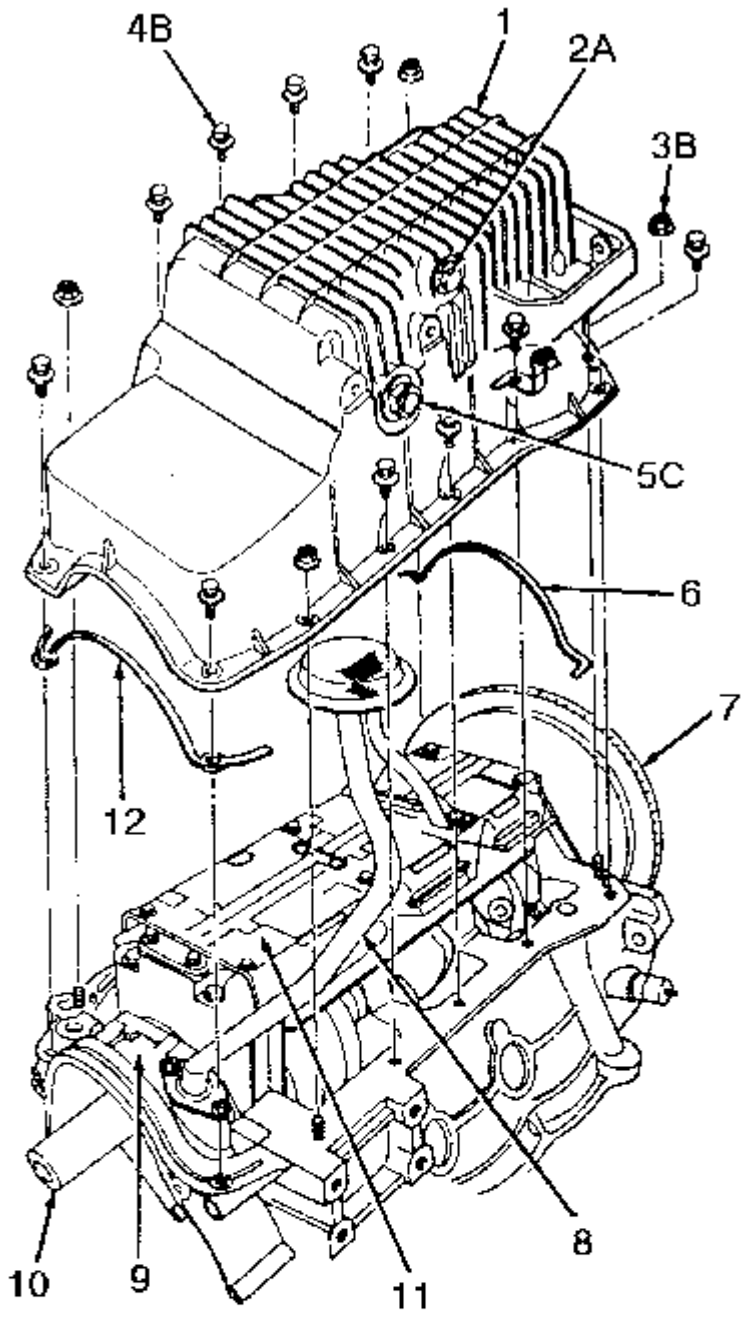
10. **Position the oil pan gasket to the oil pan with sealing bends against the oil pan surface and secure with Gasket and Trim Adhesive D7AZ-19B508-B.**
11. **Position the oil pan on the engine block and install the oil pan attaching bolts. Torque the bolts to 8 ft. lbs. (10 Nm), then back off the all of the bolts and retighten them.**
12. **Install the lower engine/flywheel dust cover to the torque converter housing. Install the Y-pipe assembly.**
13. **Engage the oxygen sensor connector.**
14. **Install the starter motor. For installation details, please refer to the starter motor procedure located earlier in this section.**
15. **Fasten the low oil level sensor connector to the sensor and install the retainer clip. Lower the vehicle and replace the oil level dipstick.**
16. **Connect the negative battery cable. Fill the crankcase with the correct viscosity**

and amount of engine oil, then start the engine and check for oil and exhaust leaks.

3.0L and 3.2L SHO Engines

1. **Disconnect the negative battery cable.**
2. **Remove the oil level dipstick.**
3. **Raise and safely support the vehicle.**
4. **If equipped with a low oil level sensor, remove the retainer clip, then disengage the electrical connector from the sensor.**
5. **Drain the engine oil.**
6. **Remove the starter motor. For details, please refer to the procedure located earlier in this section.**
7. **Disconnect the heated oxygen sensors.**
8. **Remove the dual converter Y-pipe assembly.**
9. **Remove the lower flywheel dust cover from the converter housing.**
10. **Remove the oil pan attaching bolts, then carefully remove the oil pan.**
11. **Remove the front oil pan seal and the oil pan rear seal.**





1 Oil pan
2 Oil pan drain plug
3 Nut (4 req'd)
4 Bolt (10 req'd)
5 Low oil level sensor
6 Oil pan rear seal
7 Flywheel
8 Oil pump screen cover and tube
9 Oil pump
10 Crankshaft
11 Oil pan baffle

Exploded view of the oil pan assembly-3.0L and 3.2L engine

Click to enlarge

To install:

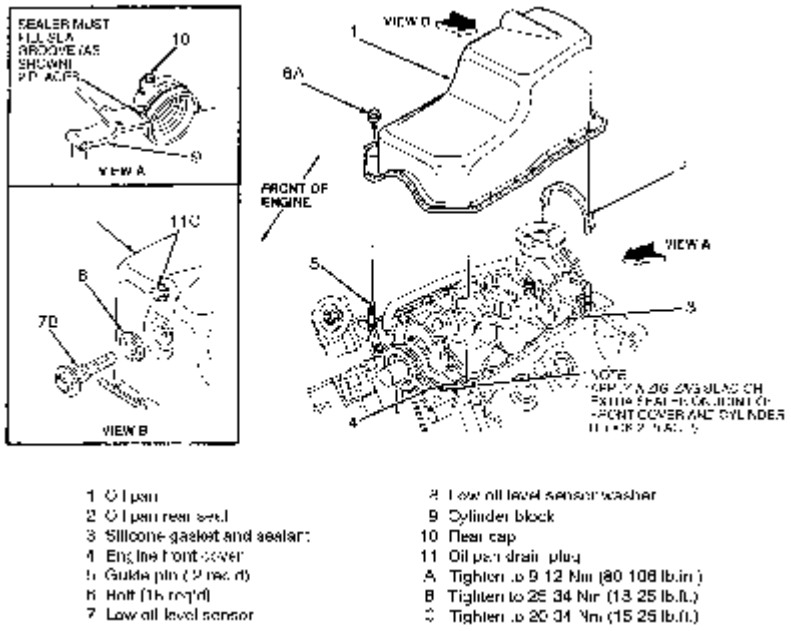
12. **Clean the gasket surfaces of the cylinder block and the oil pan.**

When using silicone sealer, assembly should occur within 15 minutes of application or the sealer may start to seal up losing its effectiveness.

13. **Clean the oil pan sealing surfaces, then apply a 0.2 in. (5mm) continuous bead of silicone sealer to the oil pan sealing surfaces.**
14. **Install a new front and rear oil pan seal, then position the oil pan and tighten the retaining bolts, in sequence, to 11-17 ft. lbs. (15-23 Nm).**
15. **Install the lower flywheel dust cover to the converter housing.**
16. **Install the Y-pipe assembly, then connect the heated oxygen sensors.**
17. **Install the starter. For details, please refer to the procedure located earlier in this section.**
18. **Engage the low oil level sensor connector to the sensor. Install the retainer clip.**
19. **Carefully lower the vehicle.**
20. **Replace the oil level dipstick and connect the negative battery cable.**
21. **Fill the crankcase with the proper type and quantity of oil. Start the vehicle and check for leaks.**

3.8L Engine

1. **Disconnect the negative battery cable.**
2. **Raise and safely support the vehicle.**
3. **Drain the oil pan, then remove the oil filter. Position the drain pan out of the way.**
4. **Remove the dual converter Y-pipe assembly.**
5. **Remove the starter motor. For details, please refer to the procedure located earlier in this section.**
6. **Remove the engine rear plate/converter housing cover.**
7. **Remove the retaining bolts and remove the oil pan.**



Exploded view of the oil pan assembly-3.8L engine

Click to enlarge

To install:

8. **Clean the gasket surfaces on cylinder block and the oil pan.**
9. **Trial fit oil pan to cylinder block. Ensure that enough clearance has been provided to allow the oil pan to be installed without sealant being scraped off when pan is positioned under the engine.**
10. **Apply a bead of silicone sealer to the oil pan flange. Also apply a bead of sealer to the front cover/cylinder block joint and fill the grooves on both sides of the rear main seal cap.**

When using silicone rubber sealer, assembly must occur within 15 minutes after sealer application. After this time, the sealer may start to harden and its sealing effectiveness may be reduced.

11. **Install the oil pan and secure to the block with the attaching screws. Tighten the screws to 7-9 ft. lbs. (9-12 Nm).**
12. **Install a new oil filter.**
13. **Install the engine rear plate/converter housing cover.**
14. **Install the starter motor. For details, please refer to the procedure located earlier in this section.**
15. **Install the Y-pipe converter assembly, then carefully lower the vehicle.**
16. **Fill the crankcase with the correct viscosity and amount of oil, then connect the negative battery cable.**
17. **Start the engine and check for leaks.**

Oil Pump

REMOVAL & INSTALLATION

2.5L Engine

1. Disconnect the negative battery cable, then remove the oil pan.
2. Disconnect the oil pump attaching bolts, then remove the oil pump and intermediate driveshaft.

To install:

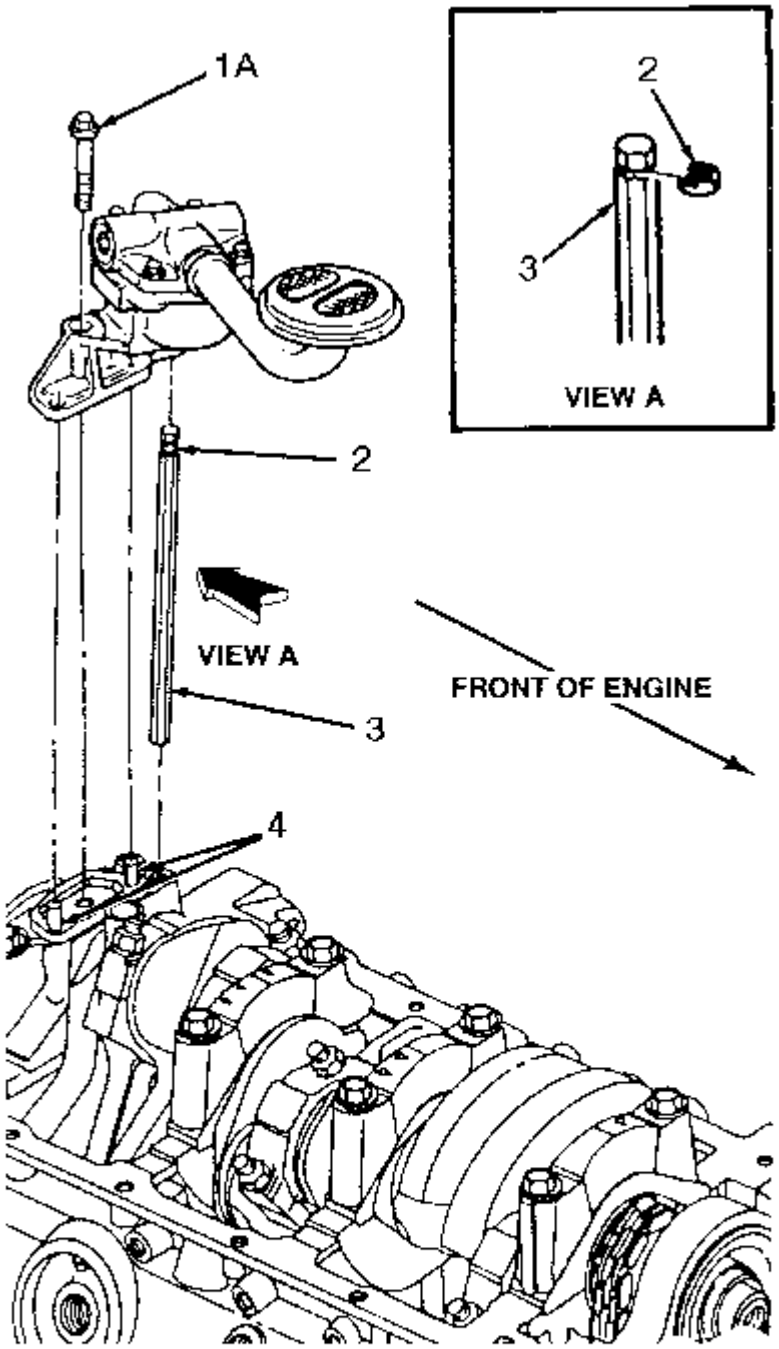
3. Prime the oil pump by filling the inlet port with engine oil. Rotate the pump shaft until oil flows from the outlet port.
4. If the screen and cover assembly have been removed, replace the gasket. Clean and reinstall the screen and cover assembly, then tighten attaching bolts.
5. Position the intermediate driveshaft into the distributor socket.
6. Insert intermediate driveshaft into oil pump. Install pump and shaft as an assembly.

Do NOT attempt to force the pump into position if it will not seat. Theshaft hex may be misaligned with the distributor shaft. To align, remove theoil pump and rotate the intermediate driveshaft into a new position.

7. Tighten the oil pump attaching bolts to 15-22 ft. lbs. (20-30 Nm).
8. Install the oil pan.
9. Fill the crankcase with the correct viscosity and amount of oil, then connect the negative battery cable. Start engine and check for leaks.

3.0L Engine-Except SHO

1. Disconnect the negative battery cable.
2. Remove the oil pan.
3. Remove the oil pump attaching bolts. Lift the oil pump from the engine. If replacing the pump, withdraw the oil pump intermediate shaft.



1 Bolt
2 Oil pump intermediate shaft retaining ring
3 Oil pump intermediate shaft
4 Dowel
A Tighten to 40-55 Nm (30-40 lb.ft.)

Exploded view of the oil pump and related components-3.0L engine (except SHO)

Click to enlarge

To install:

4. Prime the oil pump by filling either the inlet or the outlet port with engine oil. Rotate the pump shaft to distribute the oil within the oil pump body cavity.
5. Insert the oil pump intermediate shaft assembly into the hex drive hole in the oil pump assembly until the retainer "clicks" into place. Place the oil pump in the proper position with a new gasket and install the retaining bolt.
6. Torque the oil pump retaining bolt to 35 ft. lbs. (48 Nm).
7. Install the oil pan.
8. Fill the crankcase. Connect the negative battery cable, then start engine and check for leaks.

3.0L and 3.2L SHO Engines

1. Disconnect the negative battery cable.
2. Remove the oil pan.
3. Remove the accessory drive belt.
4. Remove the timing belt. For details, please refer to the procedure located later in this section.
5. Remove the oil pump-to-cylinder block retaining bolts, them remove the oil pump.

To install:

6. Align the oil pump on the crankshaft and install the oil pump retaining bolts. Tighten the bolts to 11-17 ft. lbs. (15-23 Nm).
7. Install the timing belt.
8. Install the oil pan.
9. Fill the crankcase with the proper type and quantity of oil.
10. Start the engine and check for leaks.

3.8L Engine

The oil pump, oil pressure relief valve and drive intermediate shaft arecontained in the front cover assembly.

1. Disconnect the negative battery cable.
2. If necessary for access, remove the oil filter.
3. Remove the oil pump and filter body-to-engine front cover retaining bolts, them remove the oil pump and filter body from the engine front cover.
4. Inspect the oil pump body seal, oil pump and filter body, and engine front cover for distortion. Replace damaged components as necessary.

To install:

5. Position the oil pump and filter body on the engine front cover, then install the retaining bolts.
6. Tighten the four large engine front cover retaining bolts to 17-23 ft. lbs. (23-32 Nm), then tighten the remaining retaining bolts to 6-8 ft. lbs. (8-11 Nm).
7. If removed, install the oil filter, then connect the negative battery cable.

INSPECTION AND OVERHAUL

2.5L and 3.0L Engines

1. Remove the oil pump from the vehicle.
2. Inspect the inside of the pump housing for damage or excessive wear.
3. Check the mating surface for wear. Minor scuff marks are normal but if the cover, gears or housing are excessively worn, scored or grooved, replace the pump.
4. Inspect the rotor for nicks, burrs, or score marks. Remove minor imperfections with an oil stone.
5. Measure the inner-to-outer rotor tip clearance. The clearance must not exceed 0.012 in. (0.30mm) with a feeler gauge inserted $^{1}/_{2}$ in. (13mm) minimum with the rotors removed from the pump housing.
6. With the rotor assembly installed in the housing, place a straight edge across the rotor assembly and housing. Measure the clearance (rotor end-play) between the the inner and outer rotors. The clearance is 0.005 in. (0.13mm) maximum.
7. Check the relief valve spring tension. If the spring is worn or damaged, replace the pump. Check the relief valve piston for freedom of movement in the bore.

3.0L SHO Engine

1. Remove the oil pump from the vehicle.
2. Inspect the inside of the pump housing for damage or excessive wear.
3. Check the mating surface for wear. Minor scuff marks are normal but if the cover, gears or housing are excessively worn, scored or grooved, replace the pump.
4. Check the inner rotor tip-to-outer rotor tip clearance using a feeler gauge. The clearance must not exceed 0.0024-0.0071 in. (0.06-0.18mm) with the feeler gauge inserted $^{1}/_{2}$ in. (13mm) minimum and the rotors removed from the pump housing.
5. With the rotor assembly installed in the pump housing, place a straight-edge over the rotor assembly and the housing. Measure the clearance (rotor end-play) between the straight-edge and the rotor and outer race. The clearance should be 0.0012-0.0035 in. (0.03-0.09mm).
6. Check the relief valve spring tension. If the spring is worn or damaged, replace the pump. Check the relief valve piston for freedom of movement in the bore.

3.8L Engine

PUMP GEAR END CLEARANCE

1. Inspect the pump cover mating surface on the front cover and pump body. Visually inspect the O-ring for any cuts and/or nicks and replace, if necessary. Remove any burrs or nicks.
2. Measure the thickness of the gear using a micrometer. The gear should measure 1.19-1.20 in. (30.226-30.480mm) thick.
3. If the gear is less than the specified minimum thickness, replace the gear. If the gear thickness is within specification, it may be necessary to replace the pump body. If the gear thickness is within the specified limits, proceed to Step 4.
4. Measure the depth of the gear pocket in the oil pump body. The depth should be 1.200-1.202 in. (30.48-30.53mm) thick.

5. If the depth is more than 1.202 in. (30.53mm), replace the oil pump body.

PUMP GEAR SIDE CLEARANCE

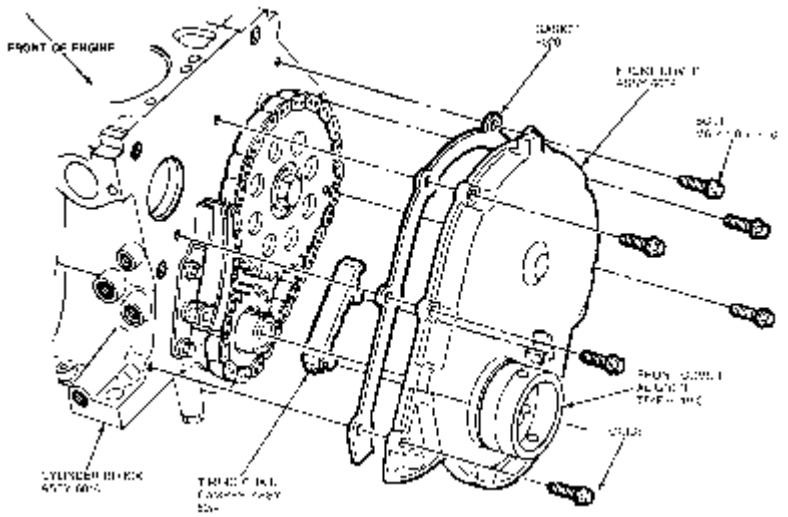
1. Measure the side clearance by inserting a feeler gauge between the gear tooth and the side wall of the gear pocket.
2. The clearance should be a maximum of 0.005 in. (0.13mm) and the gears should be free to turn. If the clearance is greater than 0.005 in. (0.13mm), proceed to Step 3.
3. Measure the diameter of the gear using a micrometer. The gear should be 1.505-1.509 in. (38.227-38.329mm) wide.
4. If the gear is less than 1.505 in. (38.227mm) in diameter, replace the gear and measure the clearance as in Step 1. If the diameter of the gear is within the specified limits, go to Step 5.
5. Measure the diameter of the gear pocket in the front cover. The diameter should be 1.504-1.507 in. (38.20-38.28mm). If the diameter is less than 1.504 in. (38.20mm), replace the front cover and measure the clearance as in Step 1.

Timing Chain Cover

REMOVAL & INSTALLATION

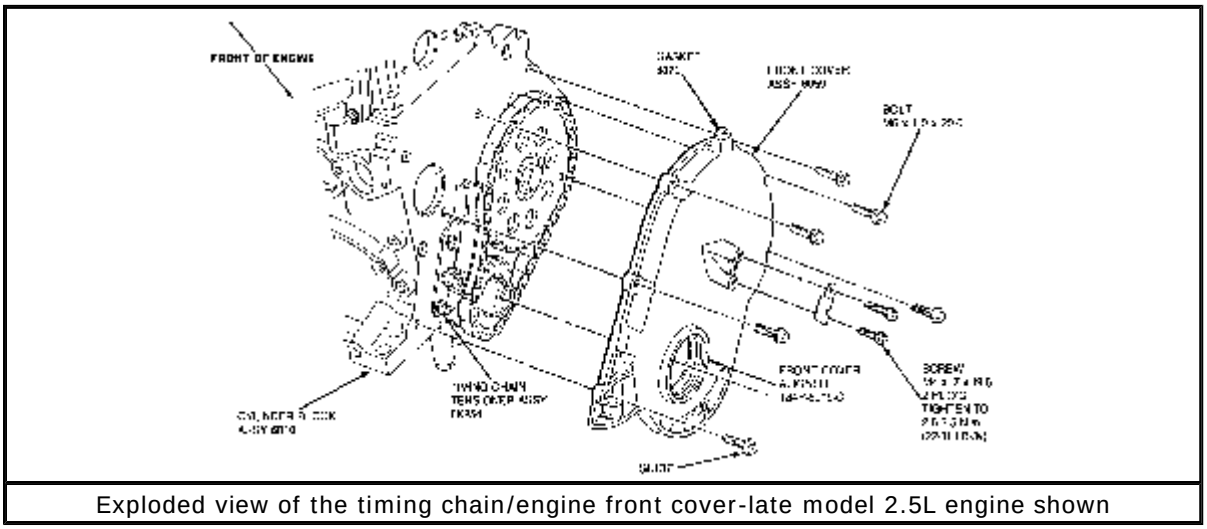
2.5L Engine

1. Disconnect the negative battery cable.
2. Remove the engine and transaxle assembly from the vehicle and position in a suitable holding fixture. Remove the dipstick.
3. If equipped, remove the accessory drive pulley. Remove the crankshaft pulley attaching bolt and washer, then remove the pulley.
4. Using Front Seal Remover T74P-6700-A or equivalent, remove the timing/front cover oil seal.
5. Remove the front cover attaching bolts from front cover. Pry the top of the front cover away from the block.
6. Clean all dirt and old gasket material from all mating surfaces.
7. Remove the oil pan.



Exploded view of the timing chain/engine front cover-early model 2.5L engine shown

Click to enlarge



Exploded view of the timing chain/engine front cover-late model 2.5L engine shown

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To install:

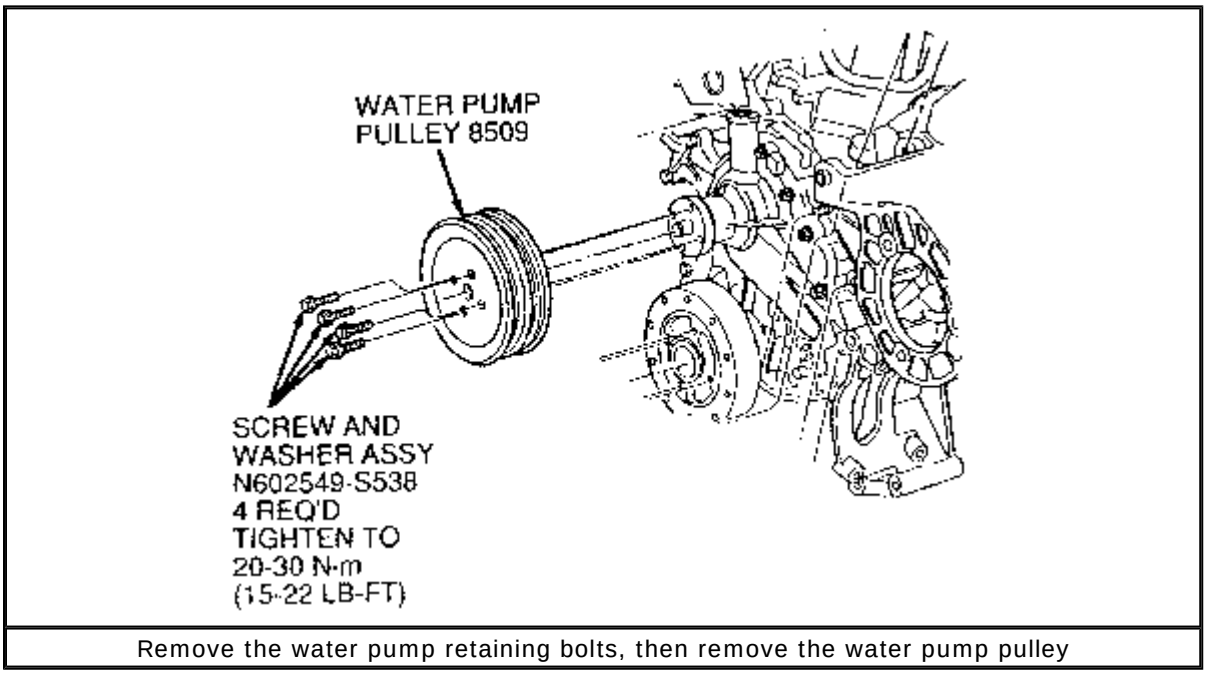
8. **Clean and inspect all parts before installation. Make sure that the cylinder block and front cover are free of old gasket material and/or dirt.**
9. **Apply oil resistant sealer to a new front cover gasket, then position the gasket into front cover.**
10. **With the front oil seal removed, position the front cover on the engine.**
11. **Position front cover alignment tool T84P-6019-C or equivalent, onto the end of the crankshaft, ensuring the crank key is aligned with the keyway in the tool. Bolt the front cover to the engine and tighten the bolts to 6-8 ft. lbs. (8-11 Nm). Remove the front cover alignment tool.**
12. **Install a new front cover oil seal using Pinion Oil Seal Installer T83T-4676-A, or equivalent suitable seal installer. Lubricate the hub of the crankshaft pulley with polyethylene grease to prevent damage to the seal during installation and initial engine start.**
13. **Install the crankshaft pulley.**
14. **Install the oil pan.**
15. **If equipped, install the accessory drive pulley.**
16. **Install crankshaft pulley attaching bolt and washer. Tighten to 140-170 ft. lbs. (190-230 Nm).**
17. **Install the engine and transaxle assembly in the vehicle. Connect the negative battery cable.**

3.0L Engine-Except SHO

1. **Disconnect the negative battery cable. Properly drain the engine cooling system.**
2. **Loosen the four water pump pulley bolts while the water pump drive belt is in place.**
3. **Loosen the alternator belt-adjuster jackscrew to provide enough slack in the alternator drive belt for removal.**
4. **Using a $^{1}/_{2}$ in. drive breaker bar, rotate the automatic belt tensioner down and to**

the left or right (depending upon application) to remove the water pump drive belt.

5. Remove the lower radiator hose and the heater hose from the water pump.
6. Remove the crankshaft pulley and damper:
    1. If necessary, raise and safely support the vehicle, then remove the right-hand front wheel and tire assembly.
    2. Remove the four crankshaft pulley-to-damper retaining bolts, then remove the crankshaft pulley.
    3. Remove the crankshaft damper retaining bolt and washer.
    4. Remove the damper using Crankshaft Damper Remover T58P-6316-D and Vibration Damper Remover Adapter T82L-6316-B.
    5. Remove the timing cover/crankshaft front seal from the engine front cover using Jet Plug Remover T77L-9533-B.
7. Disengage the engine control sensor wiring from the crankshaft position (CKP) sensor and locating stud bolt (Flexible Fuel (FF) only).
8. Drain and remove the oil pan.
9. Remove the water pump pulley retaining bolts and water pump pulley.



Remove the water pump retaining bolts, then remove the water pump pulley

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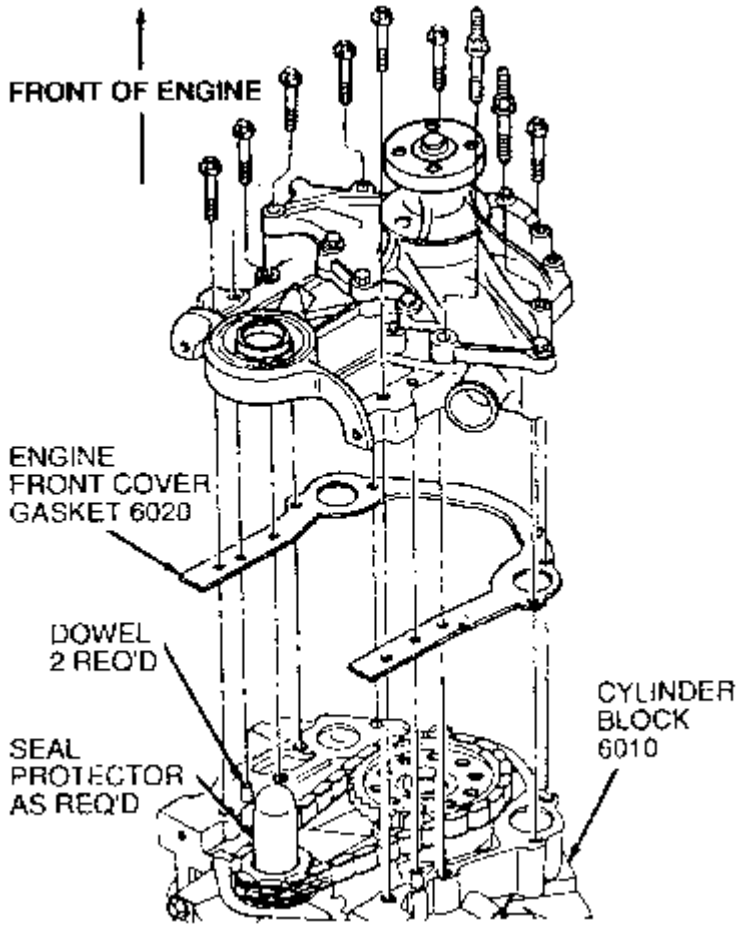
10. Remove the retaining bolts from the timing cover to the block, then remove the timing cover.

The timing cover and water pump may be removed as an assembly by not removing bolts 11-15.



After removing the retaining bolts, remove the front cover from the engine

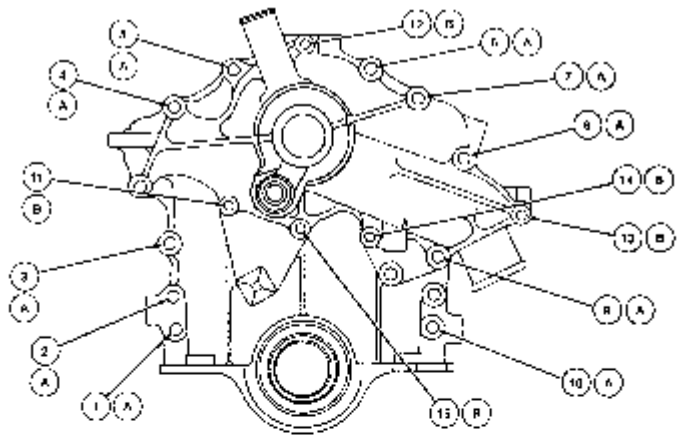
Click to enlarge

To install:

11. **Lightly oil all bolt and stud threads except those specifying special sealant.**

Be careful when scraping the old gasket material from the timing/front cover because aluminum gouges easily, and if scratched, leakage may occur.

12. **Clean all old gasket material and sealer from the timing cover, oil pan and cylinder block.**
13. **Inspect the timing cover seal for wear or damage, and replace if necessary.**
14. **Align a new timing cover gasket over the cylinder block dowels.**
15. **Install the timing cover/water pump assembly onto the cylinder block with the water pump pulley loosely attached to the water pump hub.**
16. **Apply pipe sealant to bolt numbers 1, 2 and 3 and hand start them along with the rest of the cover retaining bolts. Tighten bolts 1-10 to 15-22 ft. lbs. (20-30 Nm) and 11-15 to 71-106 inch lbs. (8-12 Nm).**



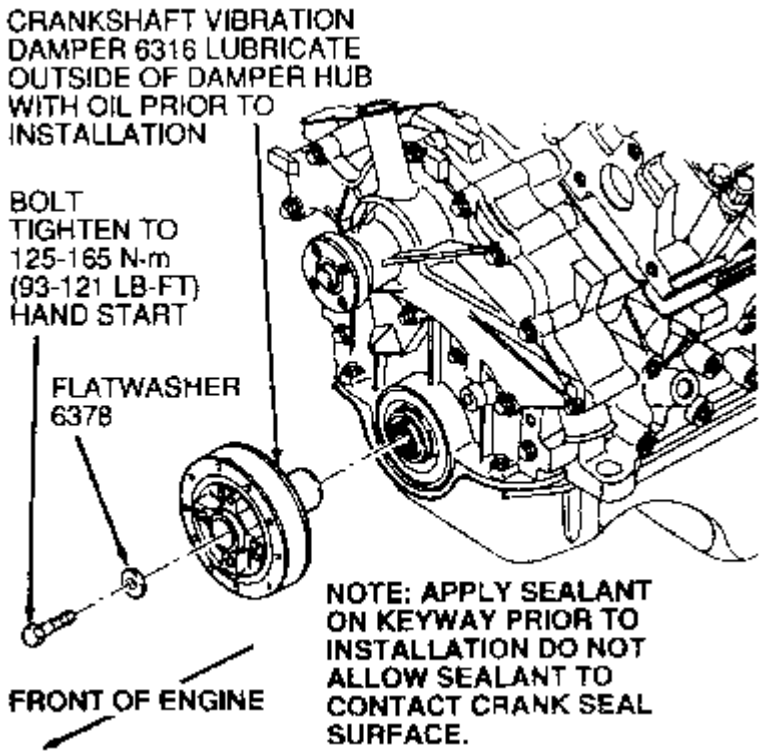
FASTENER AND HOLE NO.	FASTENERS			TORQUE SPECIFICATIONS	
	PART NO.	SIZE	FASTENER APPLICATION	Nm	LB-FT
1A	[illegible]	M8 x 1.25 x 45.5	[illegible]	[illegible]	[illegible]
2A	[illegible]	M8 x 1.25 x 40.5	[illegible]	[illegible]	[illegible]
3A	[illegible]	M8 x 1.25 x 70	W/P AT CYLINDER BLOCK	20-30	15-22
4A	[illegible]	M8 x 1.25 x 60	W/P & F CYLINDER BLOCK	[illegible]	[illegible]
5A	[illegible]	M8 x 1.25 x 42	[illegible]	[illegible]	[illegible]
7A	[illegible]	M8 x 1.25 x 70	W/P AT CYLINDER BLOCK	20-30	15-22
7A	[illegible]	M8 x 1.25 x 60	W/P & F CYLINDER BLOCK	[illegible]	[illegible]
8A	[illegible]	M8 x 1.25 x 70	W/P AT CYLINDER BLOCK	20-30	15-22
8A	[illegible]	M8 x 1.25 x 60	W/P & F CYLINDER BLOCK	[illegible]	[illegible]
9A	[illegible]	M8 x 1.25 x 19	CYLINDER BLOCK	20-30	15-22
10A	[illegible]	M8 x 1.25 x 90	W/P TO F/C	[illegible]	[illegible]
11A	[illegible]	M8 x 1.25 x 25	W/P TO F/C	[illegible]	[illegible]
12A	[illegible]	M8 x 1.25 x 80	W/P TO F/C	[illegible]	[illegible]
14A	[illegible]	M8 x 1.25 x 80	W/P TO F/C	[illegible]	[illegible]
15A	[illegible]	M8 x 1.25 x 70	W/P TO F/C	[illegible]	[illegible]

W/P—Water Pump
F/C—Engine Front Cover

Cover mounting bolt location and torque specifications

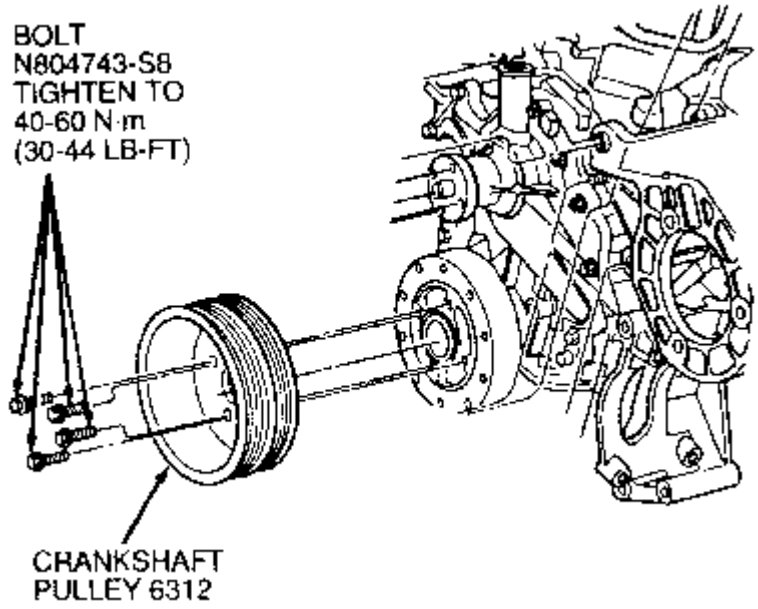
Click to enlarge

17. **Install the oil pan and tighten the retaining bolts to 9 ft. lbs. (12 Nm).**
18. **Hand tighten the water pump pulley retaining bolts.**
19. **Install the crankshaft damper and pulley:**
    1. **Lubricate the oil seal with clean oil, then install the seal suing Vibration Damper and Seal Replacer T82L-6316-A and Front Cover Replacer T70P.**
    2. **Coat the crankshaft damper sealing surface with clean engine oil. Apply Silicone Rubber D6AZ-19562-AA or BA to the keyway of the damper before installation. Install the damper using Vibration Damper and Seal Replacer T82L-6316-A.**
    3. **Install the damper retaining bolt and washer. Tighten to 93-121 ft. lbs. (125-165 Nm).**
    4. **Install the crankshaft pulley, then install the four retaining bolts. Tighten the bolts to 30-44 ft. lbs. (40-60 Nm).**
    5. **If removed, install the right-hand wheel and tire assembly, then carefully lower the vehicle.**



Location of the crankshaft vibration damper-3.0L engine (except SHO)

Click to enlarge



Location of the crankshaft pulley-3.0L engine (except SHO)

Click to enlarge

20. **Install the automatic belt tensioner. Tighten the two retaining nuts and bolt to 35 ft. lbs. (48 Nm).**
21. **Install the water pump and accessory drive belts. Torque the water pump pulley retaining bolts to 15-22 ft. lbs. (20-30 Nm).**
22. **Install the lower radiator hose and the heater hose and tighten the clamps.**

23. Fill the crankcase with the correct amount and type of engine oil. Connect the negative battery cable. Fill and bleed the cooling system.
24. Start the engine and check for coolant and oil leaks.

3.8L Engine

1. Disconnect the negative battery cable. Properly drain the cooling system and the engine oil.
2. Remove the air cleaner assembly and air intake duct.
3. If necessary, remove the fan shroud attaching screws and bolts, then remove the fan/clutch assembly and shroud.
4. Loosen the accessory drive belt idler. Remove the drive belt and water pump pulley.
5. Remove the power steering pump mounting bracket attaching bolts. Leaving the hoses connected, place the pump/bracket assembly in a position that will prevent the loss of power steering fluid.
6. If equipped with air conditioning, remove the compressor front support bracket. Leave the compressor in place.
7. Disconnect coolant bypass and heater hoses at the water pump. Disconnect the radiator upper hose at the thermostat housing.
8. Disconnect the coil wire from the distributor cap, then remove the cap with the secondary wires still attached. Remove the distributor retaining clamp and lift distributor out of the front cover.
9. Raise and safely support the vehicle.
10. Remove the crankshaft damper and pulley.

If the crankshaft pulley and vibration damper have to be separated, mark the damper and pulley so they may be reassembled in the same relative position. This is important as the damper and pulley are initially balanced as a unit. If the crankshaft damper is being replaced, check if the original damper has balance pins installed. If so, new balance pins (E0SZ-6A328-A or equivalent) must be installed on the new damper in the same position as the original damper. The crankshaft pulley must also be installed in the original installation position.

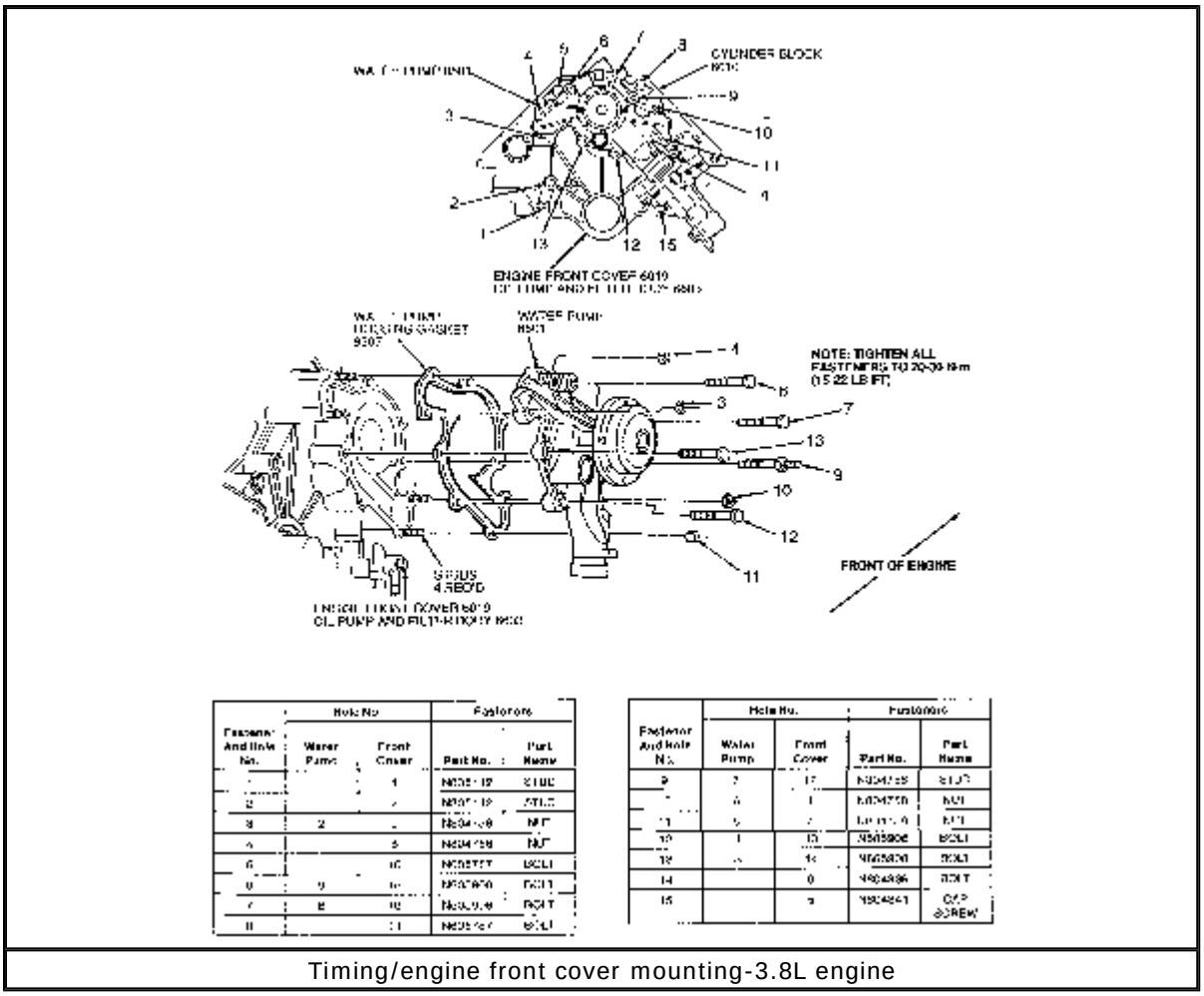
11. Remove the oil filter, the disconnect the radiator lower hose at the water pump.
12. Remove the oil pan. For details, please refer to the procedure located earlier in this section.
13. Lower the vehicle.
14. Remove the front cover attaching bolts.

Do not overlook the cover attaching bolt located behind the oil filter adapter. The front cover will break if pried upon and all of the attaching bolts are not removed.

15. Remove the ignition timing indicator.
16. Remove the front cover and water pump as an assembly. Remove the cover gasket and discard.

The front cover houses the oil pump. If a new front cover is to be

installed, remove the water pump and oil pump from the old front cover.



Timing/engine front cover mounting-3.8L engine

Click to enlarge

To install:

17. **Lightly oil all bolt and stud threads before installation. Clean all gasket surfaces on the front cover, cylinder block and fuel pump. If reusing the front cover, replace crankshaft front oil seal.**
18. **If a new front cover is to be installed, complete the following:**
    1. **Install the oil pump gears.**
    2. **Clean the water pump gasket surface. Position a new water pump gasket on the front cover and install the water pump. Install the pump attaching bolts and tighten to 15-22 ft. lbs. (20-30 Nm).**
19. **Install the distributor drive gear.**
20. **Lubricate the crankshaft front oil seal with clean engine oil.**
21. **Position a new cover gasket on the cylinder block and install the front cover/water pump assembly using dowels for proper alignment. A suitable contact adhesive is recommended to hold the gasket in position while the front cover is installed.**
22. **Position and install the ignition timing indicator.**
23. **Install the front cover attaching bolts. Apply Loctite® or equivalent, to the threads of the bolt installed below the oil filter housing prior to installation. This bolt is to be installed and tightened last. Tighten all bolts to 15-22 ft. lbs. (20-30 Nm).**

24. Raise the vehicle and support safely.
25. Install the oil pan. Connect the radiator lower hose. Install a new oil filter.
26. Coat the crankshaft damper sealing surface with clean engine oil.
27. Position the crankshaft pulley key in the crankshaft keyway.
28. Install the damper with damper washer and attaching bolt. Tighten the bolt to 103-132 ft. lbs. (140-179 Nm).
29. Install the crankshaft pulley and tighten the attaching bolts 19-28 ft. lbs. (26-38 Nm).
30. Lower the vehicle.
31. Connect the coolant bypass hose.
32. Install the distributor with rotor pointing at No. 1 distributor cap tower. Install the distributor cap and coil wire.
33. Connect the radiator upper hose at thermostat housing.
34. Connect the heater hose.
35. If equipped with air conditioning, install compressor and mounting brackets.
36. Install the power steering pump and mounting brackets.
37. Position the accessory drive belt over the pulleys.
38. Install the water pump pulley. Position the accessory drive belt over water pump pulley and tighten the belt.
39. Connect the negative battery cable. Fill the crankcase and cooling system to the proper level.
40. Install the air cleaner assembly and air intake duct.
41. Start the engine and check for leaks.
42. Check the ignition timing and adjust as required.

Timing Belt Cover

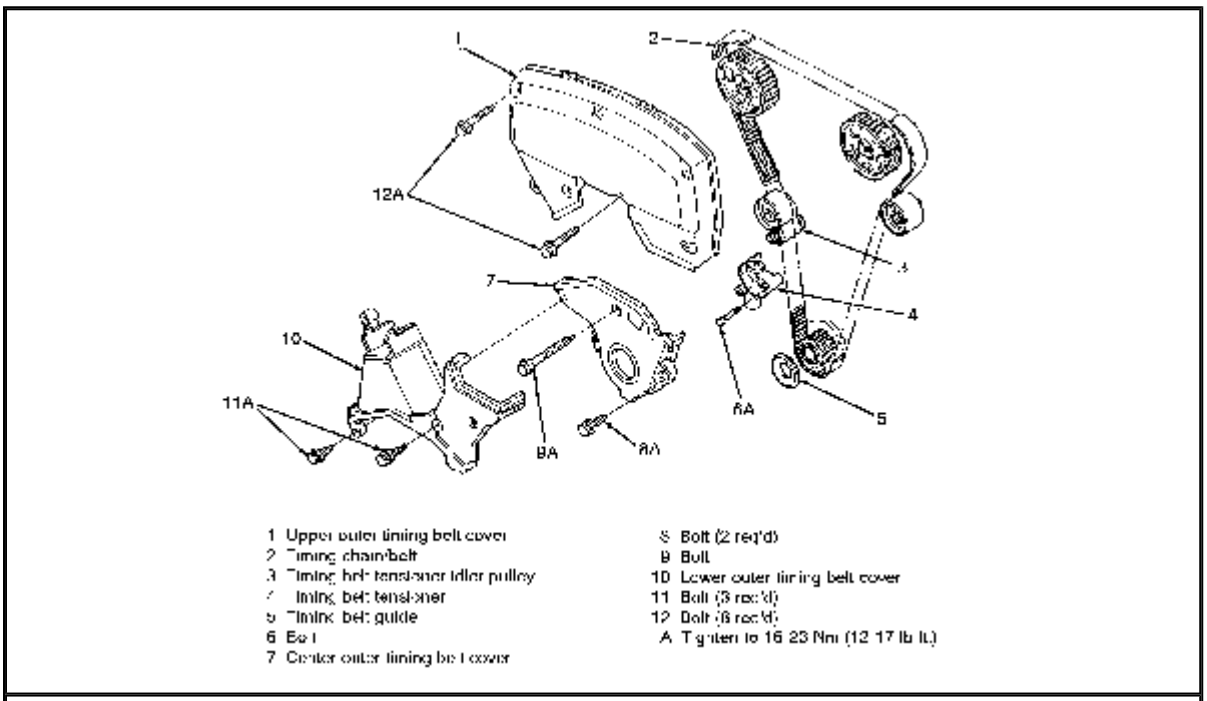
REMOVAL & INSTALLATION

3.0L SHO Engine

The timing belt/front cover on the 3.0L SHO engine is made up of 3 separate sections.

1. Disconnect the battery cables and remove the battery. Remove the right engine roll damper.
2. Disconnect the wiring to the ignition module. Remove the engine air inlet/intake manifold crossover tube bolts, loosen the crossover tube clamps, then remove the crossover tube.
3. Loosen the alternator/air conditioner belt tensioner pulley and relieve the tension on the belt by backing out the adjustment screw. Remove the belt.
4. Loosen the water pump/power steering belt tensioner pulley and relieve the tension on the belt by backing out the adjustment screw. Remove the belt.
5. Remove the alternator/air conditioner belt tensioner pulley and bracket assembly. Remove the water pump/power steering belt tensioner pulley only.

6. **Remove the upper timing belt cover.**
7. **Disconnect the crankshaft sensor connectors.**
8. **Raise and safely support the vehicle. Remove the right front wheel and tire assembly.**
9. **Loosen the fender splash shield and move aside. Remove the crankshaft vibration damper and pulley using Steering Wheel Puller T67L-3600-A, Step Plate Adapter D80L-630-3 or equivalent and Screw and Washer Set T89P-6701-A.**
10. **Remove the center and lower timing belt covers.**
11. **Installation is the reverse of the removal procedure. Tighten the timing belt cover retaining bolts to 60-90 inch lbs. (7-10 Nm) and the crankshaft damper bolt to 113-126 ft. lbs. (153-171 Nm).**



Exploded view of the timing belt cover components-3.0L and 3.2L SHO engines

Click to enlarge

3.2L SHO Engine

The front cover on the 3.2L SHO engine is made up of 3 separate sections.

1. **Disconnect the battery cables, then remove the battery from the engine.**
2. **Remove the right-hand engine roll damper.**
3. **Disconnect the wiring to the ignition control module. Remove the engine air inlet connector/intake manifold crossover tube bolts, loosen the crossover tube clamps, then remove the crossover tube.**
4. **Rotate the accessory drive belt tensioner clockwise to relieve the tension, then remove the belt.**
5. **Disconnect the surge tank fittings.**
6. **Remove the bolts retaining the upper and lower idler pulleys to the engine, then remove the pulleys.**

7. Using strap wrench D85L-6000-A, or equivalent, to hold the power steering pump pulley, remove the nut, washer, then remove the power steering pulley.
8. Remove the retaining bolt from the belt tensioner, then remove the tensioner.
9. Remove the upper and center timing belt covers.
10. Disengage the crankshaft position (CKP) sensor electrical connectors.
11. Raise and safely support the vehicle, then remove the right front wheel and tire assembly.
12. Loosen the fender splash shield and move it aside. Remove the crankshaft vibration damper and pulley using Puller T67L-3600-A, Step Plate Adapter D80L-630-3 and Screw Washer Set T89P-6701-A.
13. Remove the lower timing belt cover.
14. Installation is the reverse of the removal procedure. Tighten the timing belt cover retaining bolts to 12-17 ft. lbs. (16-23 Nm) and the crankshaft damper bolt to 112-127 ft. lbs. (152-172 Nm).

Timing Chain Cover Oil Seal

REPLACEMENT

2.5L Engine

The removal and installation of the front cover oil seal on these engines can only be accomplished with the engine removed from the vehicle.

1. Remove the engine from the vehicle and position in a suitable holding fixture.
2. Remove the bolt and washer at the crankshaft pulley, then remove the crankshaft pulley.
3. Using Differential Side Bearing Puller T77F-4220-B1, remove the front cover oil seal.

To install:

4. Coat a new seal with Long Life Lubricant C1AZ-19590-BA, or equivalent grease. Using Pinion Oil Seal Installer T83T-4676-A or equivalent, install the seal into the cover. Make sure the seal is fully seated. Check the seal after installation to be sure the spring is properly positioned in the seal.
5. Install the crankshaft pulley, attaching bolt and washer. Tighten the crankshaft pulley bolt to 140-170 ft. lbs. (190-230 Nm).

3.0L Engine-Except SHO

1. Disconnect the negative battery cable and remove the accessory drive belt(s).
2. Raise and safely support the vehicle. Remove the right front wheel and tire assembly.
3. Remove the pulley-to-damper attaching bolts, then remove the crankshaft pulley.
4. Remove the crankshaft damper retaining bolt and washer. Remove the damper from the crankshaft using Crankshaft Damper Remover T58P-6316-D and Vibration Damper Remover Adapter T82L-6316-B or equivalent damper removal tool.
5. Remove the front seal from the timing cover using Jet Plug Remover T77L-9533-B or equivalent tool and be careful not to damage the front cover and crankshaft.

To install:

Before installation, inspect the front cover and shaft seal surface of the crankshaft damper for damage, nicks, burrs or other roughness which may cause the new seal to fail. Service or replace components as necessary.

6. Lubricate the seal lip with clean engine oil and install the seal using Vibration Damper and Seal Replacer T82L-6316-A and Front Cover Seal Replacer T70P-6B070-A or equivalent seal installer tools.
7. Coat the crankshaft damper sealing surface with clean engine oil. Apply RTV to the keyway of the damper prior to installation. Install the damper using a damper seal installer tool. Install the damper retaining bolt and washer. Tighten to 93-121 ft. lbs. (125-165 Nm).
8. Position the crankshaft pulley and install the attaching bolts. Tighten the attaching bolts to 30-44 ft. lbs. (40-60 Nm).
9. Install the right front wheel and tire assembly, then carefully lower the vehicle.
10. Position the drive belt over the crankshaft pulley. Check the drive belt for proper routing and engagement in the pulleys.
11. Reconnect the negative battery cable and start the engine and check for oil leaks.

3.8L Engine

1. Disconnect the negative battery cable.
2. Loosen the accessory drive belt idler.
3. Raise the vehicle and support safely.
4. Disengage the accessory drive belt and remove crankshaft pulley.
5. Remove the crankshaft/vibration damper using Crankshaft Damper Remover T58P-6316-D and Vibration Damper Remover Adapter T82L-6316-B or equivalent suitable removal tools.
6. Remove the seal from the front cover with a suitable prying tool. Use care to prevent damage to front cover and crankshaft.

To install:

Inspect the front cover and crankshaft damper for damage, nicks, burrs or other roughness which may cause the seal to fail. Service or replace components as necessary.

7. Lubricate the seal lip with clean engine oil and install the seal using Damper/Front Cover Seal Replacer T82L-6316-A and Front Cover Seal Replacer T70P-6B070-A or equivalent suitable seal installers.
8. Lubricate the seal surface on the damper with clean engine oil. Install damper and pulley assembly. Install the damper attaching bolt and tighten to 103-132 ft. lbs. (140-179 Nm).
9. Position the crankshaft pulley and install the retaining bolts. Tighten to 19-28 ft. lbs. (26-38 Nm).
10. Position accessory drive belt over crankshaft pulley.
11. Lower the vehicle.

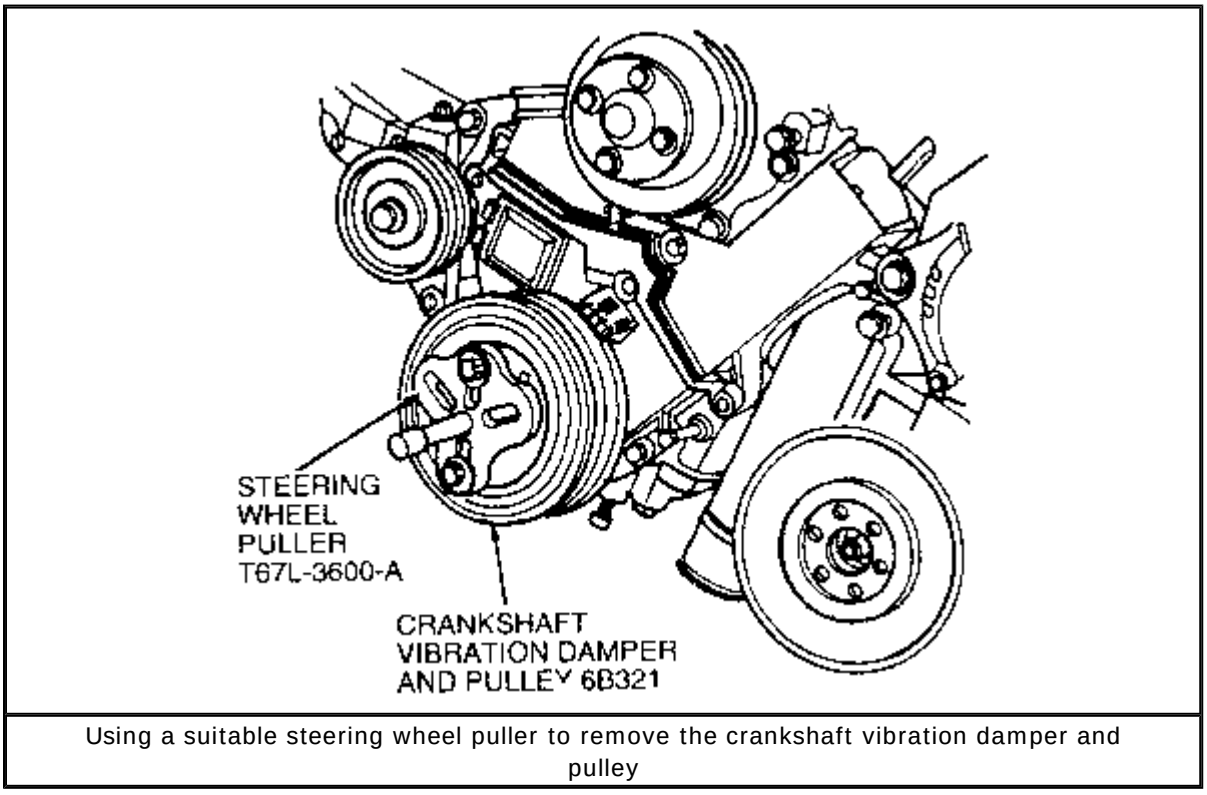
12. **Check accessory drive belt for proper routing and engagement in the pulleys. Adjust the drive belt tension.**
13. **Connect the negative battery cable. Start the engine and check for leaks.**

Timing Belt Cover Oil Seal

REMOVAL & INSTALLATION

3.0L and 3.2L SHO Engines

1. **Loosen the accessory drive belts.**
2. **Raise and safely support the vehicle, then remove the right front wheel and tire assembly.**
3. **Remove the crankshaft vibration damper and pulley attaching bolt, then remove the accessory drive belts from the crankshaft vibration damper and pulley.**
4. **Using Steering Wheel Puller T67L-3600-A or equivalent puller, remove the crankshaft vibration damper and pulley from the crankshaft.**



Using a suitable steering wheel puller to remove the crankshaft vibration damper and pulley

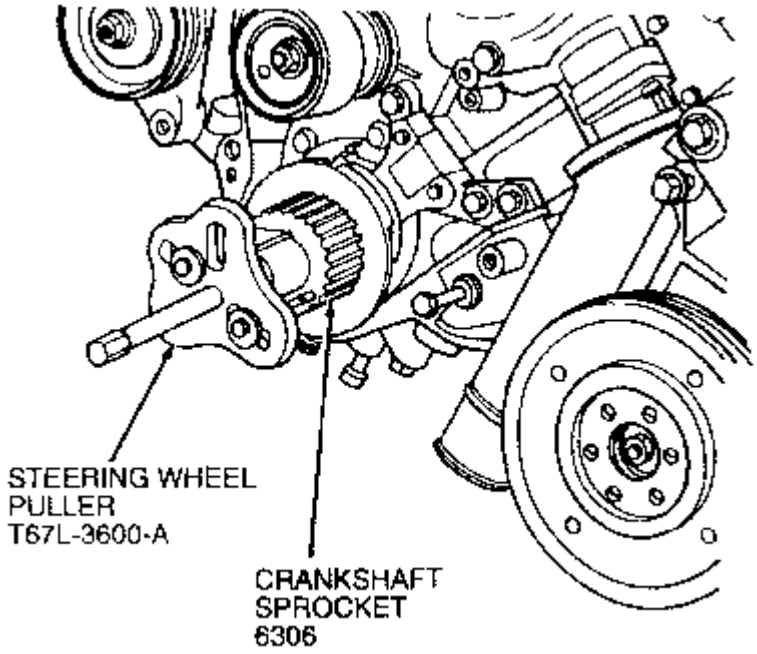
Click to enlarge

5. **Remove the timing belt. For details, please refer to the procedure located later in this section.**

Be careful not to damage the crankshaft position (CKP) sensor or pulse wheel.

6. **Remove the crankshaft timing gear/sprocket using Steering Wheel Puller T67L-3600-A or suitable puller.**

Be careful not to damage the crankshaft sensor or shutter.



Using a suitable steering wheel puller to remove the crankshaft sprocket

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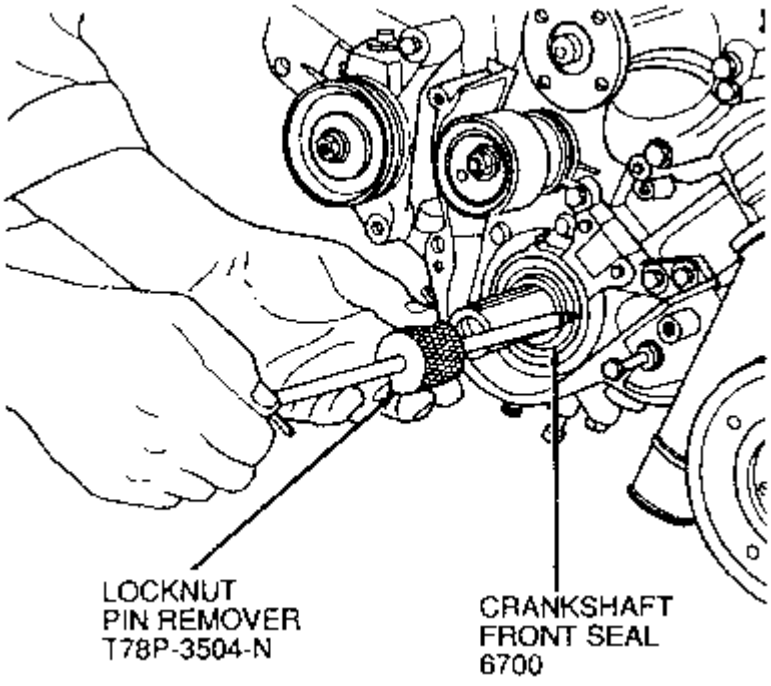
7. **Remove the crankshaft front oil seal using Locknut Pin Remover T87P-3504-N, or equivalent.**



To remove the front oil seal, use a suitable locknut pin remover

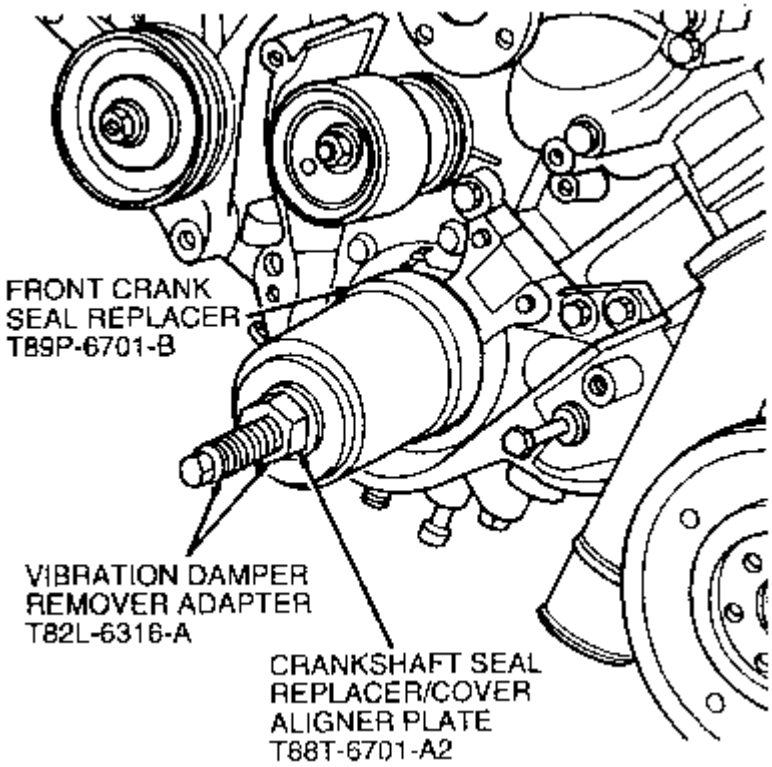
Click to enlarge

To install:

8. **Inspect the front cover and shaft seal surface of the crankshaft damper for damage, nicks, burrs or other roughness which may cause the new seal to fail.**

Repair or replace as necessary.

9. Using Vibration Damper Remover Adapter T82L-6316-A, Crankshaft Seal Replacer/Cover Aligner Plate T88T-6701-A2 and Front Crank Replacer T89P-6701-B, install a new crankshaft front oil seal. Install Crankshaft Seal Replacer/Cover Aligner T88T-6701-A with forcing screw from Vibration Damper Remover Adapter T82L-6316-A to press the crankshaft front seal the rest of the way into the oil.



Installing the timing belt cover oil seal-3.0L and 3.2L SHO engines

Click to enlarge

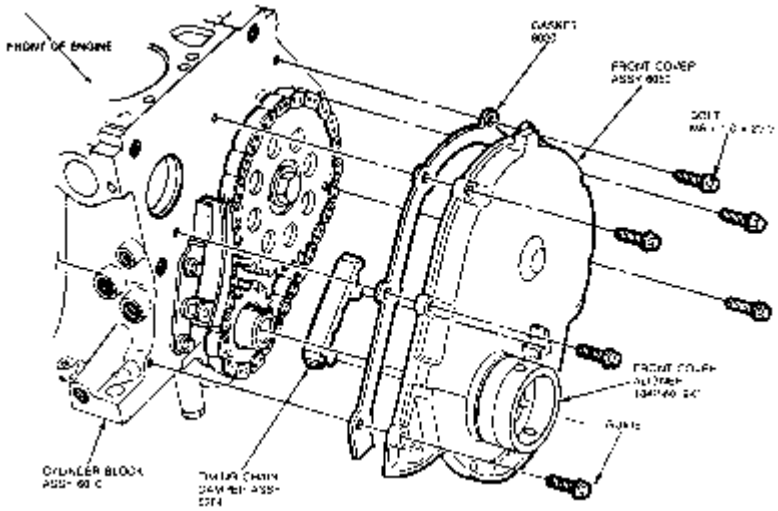
10. Install the crankshaft timing gear/sprocket onto the crankshaft.
11. Install the timing belt. For details, please refer to the procedure located later in this section.
12. Install the crankshaft vibration damper and pulley using Front Crank Seal Installer T89P-6701-B. Tighten the damper attaching bolt to 112-127 ft. lbs. (152-172 Nm).
13. Position the drive belts over the crankshaft vibration damper and pulley.
14. Install the front right side wheel and tire assembly. Tighten the lug nuts to 85-105 ft. lbs. (152-172 Nm).
15. Carefully lower the vehicle, the install the drive belts. Check the belts for proper routing and engagement in the pulleys and adjust belt tension to specification.
16. Connect the negative battery cable, then start the engine and check for oil leaks.

Timing Chain

REMOVAL & INSTALLATION

2.5L Engine

1. **Remove the engine and transaxle from the vehicle as an assembly and position in a suitable holding fixture. Remove the dipstick.**
2. **Remove accessory drive pulley, if equipped, Remove the crankshaft pulley attaching bolt and washer and remove pulley.**
3. **Remove front cover attaching bolts from front cover. Pry the top of the front cover away from the block.**
4. **Clean any gasket material from the surfaces.**
5. **Check timing chain and sprockets for excessive wear. If the timing chain and sprockets are worn, replace with new.**
6. **Check timing chain tensioner blade for wear depth. If the wear depth exceeds specification, replace tensioner.**
7. **Turn engine over until the timing marks are aligned. Remove camshaft sprocket attaching bolt and washer. Slide both sprockets and timing chain forward and remove as an assembly.**
8. **If equipped, check timing chain vibration damper for excessive wear. Replace if necessary; the damper is located inside the front cover.**



Timing chain-2.5L engine with a timing chain damper

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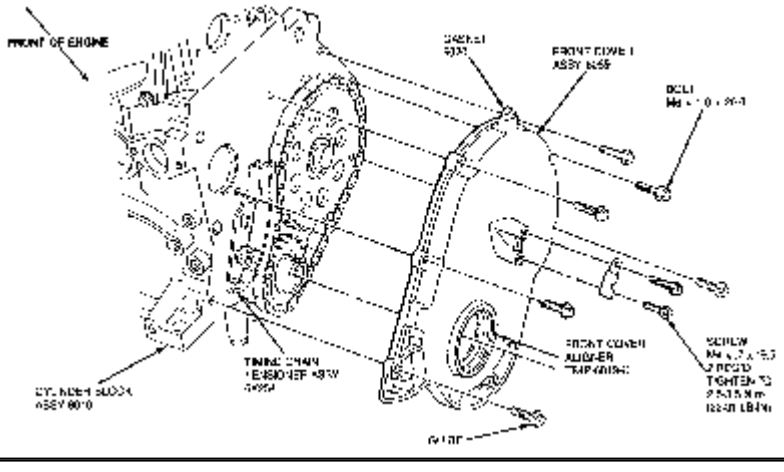
9. **Remove the oil pan. For details, please refer to the procedure regarding this procedure.**



Timing chain-1991 2.5L engine shown

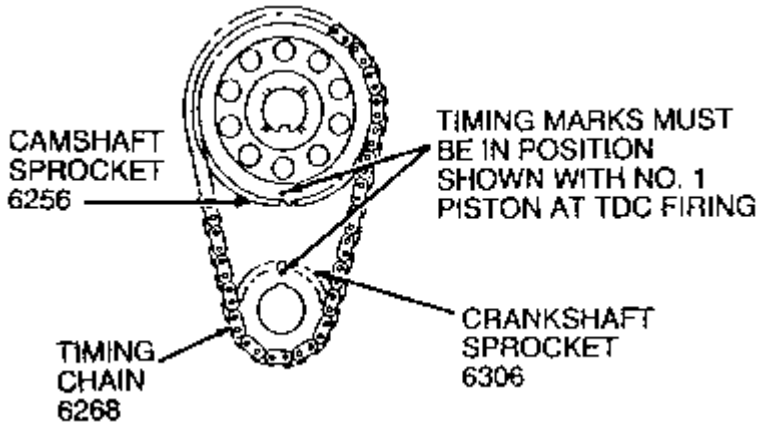
Click to enlarge

To install:

10. **Clean and inspect all parts before installation. Clean the oil pan, cylinder block and front cover of gasket material and dirt.**
11. **Slide both sprockets and timing chain onto the camshaft and crankshaft with timing marks aligned.**
12. **Install camshaft bolt and washer and tighten to 41-56 ft. lbs. (56-76 Nm).**
13. **Oil timing chain, sprockets and tensioner after installation with clean engine oil.**
14. **Apply oil resistant sealer to a new front cover gasket and position gasket into front cover.**
15. **Remove the front cover oil seal and position the front cover on the engine.**
16. **Position front cover alignment tool T84P-6019-C or equivalent, onto the end of the crankshaft, ensuring the crank key is aligned with the keyway in the tool. Bolt the front cover to the engine and tighten the bolts to 6-8 ft. lbs. (8-11 Nm).**
17. **Remove the front cover alignment tool.**
18. **Install a new front cover oil seal using a suitable seal installer. Lubricate the hub of the crankshaft pulley with polyethylene grease to prevent damage to the seal during installation and initial engine start. Install crankshaft pulley.**
19. **Install the oil pan.**
20. **Install the accessory drive pulley, if equipped.**
21. **Install crankshaft pulley attaching bolt and washer. Tighten to 140-170 ft. lbs. (190-230 Nm).**
22. **Remove engine from work stand and install in vehicle.**

3.0L Engine Except SHO

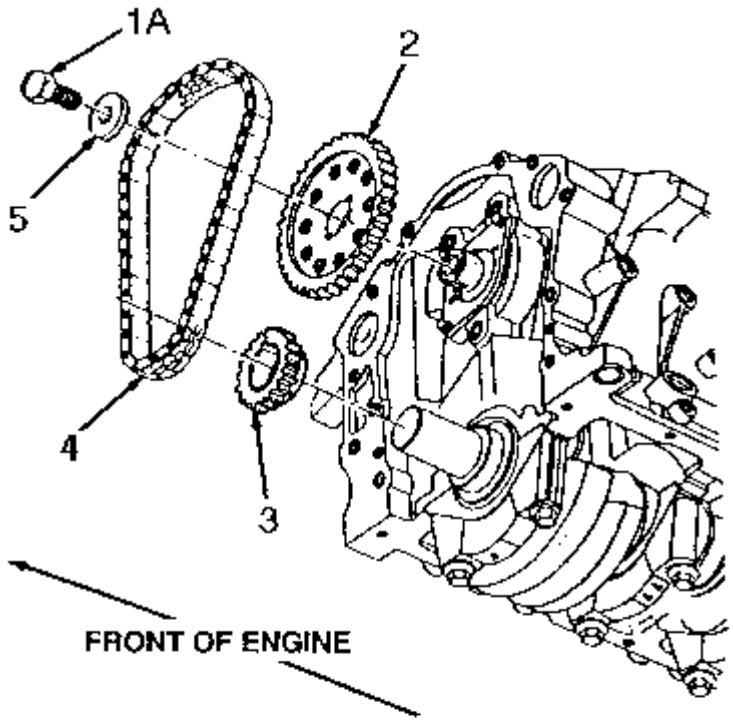
1. **Disconnect the negative battery cable. Drain the cooling system and crankcase. Remove the crankshaft pulley and front cover assemblies.**
2. **Rotate the crankshaft until the No. 1 piston is at the TDC on its compression stroke and the timing marks are aligned.**



Rotate the crankshaft until the No. 1 piston is at the TDC of its compression stroke and the timing marks are aligned

Click to enlarge

3. **Remove the camshaft sprocket attaching bolt and washer. Slide both sprockets and timing chain forward and remove as an assembly.**
4. **Check the timing chain and sprockets for excessive wear. Replace if necessary.**



1 Bolt
2 Camshaft sprocket
3 Crankshaft sprocket
4 Timing chain
5 Washer
A Tighten to 50-70 Nm (37-51 lb.ft.)

Exploded view of the timing chain and related components

Click to enlarge

To install:

Before installation, clean and inspect all parts. Clean the gasketmaterial and dirt from the oil pan, cylinder block and front cover.

5. **Slide both sprockets and timing chain onto the camshaft and crankshaft with the timing marks aligned. Install the camshaft bolt and washer and torque to 37-51 ft. lbs. (50-70 Nm). Apply clean engine oil to the timing chain and sprockets after installation.**

The camshaft bolt has a drilled oil passage in it fortiming chain lubrication. If the bolt is damaged, do NOT replace it with astandard bolt.

6. **Install the timing cover and the crankshaft pulley and damper. Tighten the**

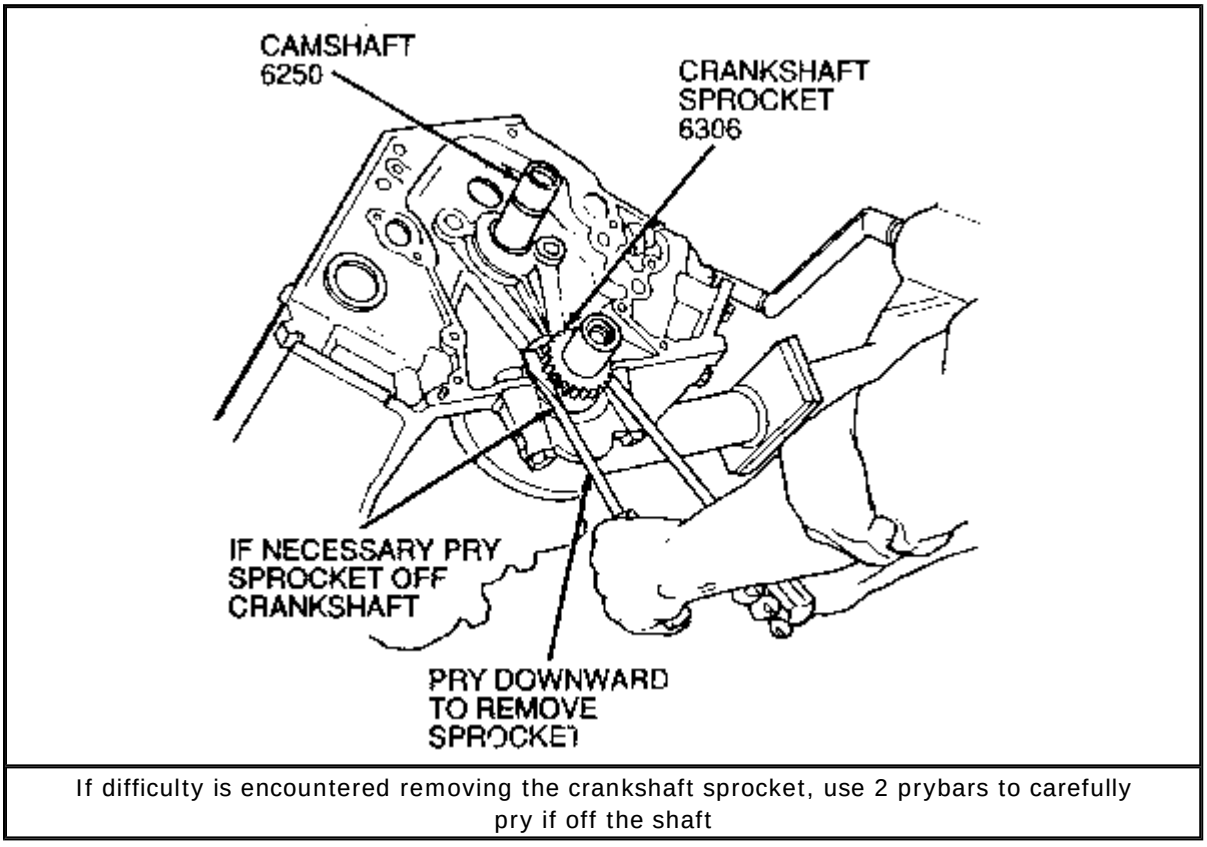
crankshaft damper bolt to 93-121 ft. lbs. (126-164 Nm) and the pulley bolts to 30-44 ft. lbs. (41-60 Nm).

7. Fill the crankcase with the proper type and quantity of oil. Fill and bleed the engine cooling system.
8. Connect the negative battery cable, then start the engine and check for coolant, oil and exhaust leaks.

3.8L Engine

1. Disconnect the negative battery cable. Drain the cooling system and crankcase.
2. Remove the timing chain/engine front cover and water pump as an assembly. For details, please refer to the timing chain cover procedure located earlier in this section.
3. Remove the camshaft sprocket bolt and washer from end of the camshaft.
4. Remove the distributor drive gear.
5. Remove the camshaft sprocket, crankshaft sprocket and timing chain.

If the crankshaft sprocket is difficult to remove,carefully pry to sprocket off of the shaft using a pair of large prybarspositioned on both sides of the crankshaft sprocket.



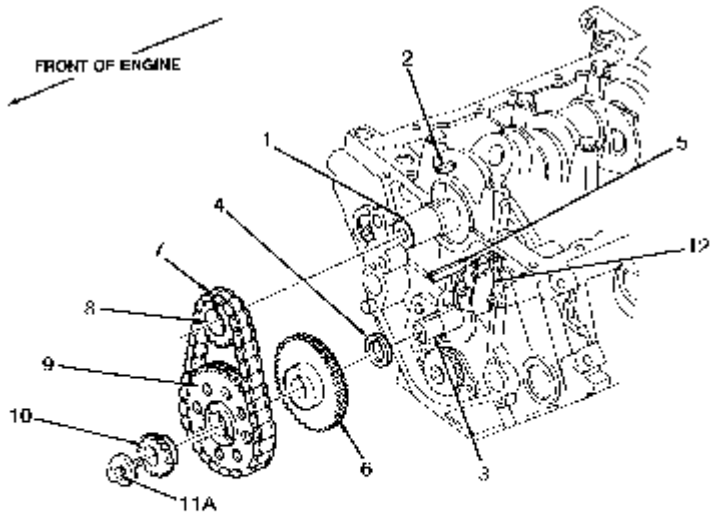
If difficulty is encountered removing the crankshaft sprocket, use 2 prybars to carefully pry if off the shaft

Click to enlarge

6. Remove the chain tensioner assembly from the front of the cylinder block. This is accomplished by pulling back on the ratcheting mechanism and installing a pin through the hole in the bracket to relieve tension.

The front cover houses the oil pump. If a new front coveris to be

installed, remove the water pump and oil pump from the old frontcover.



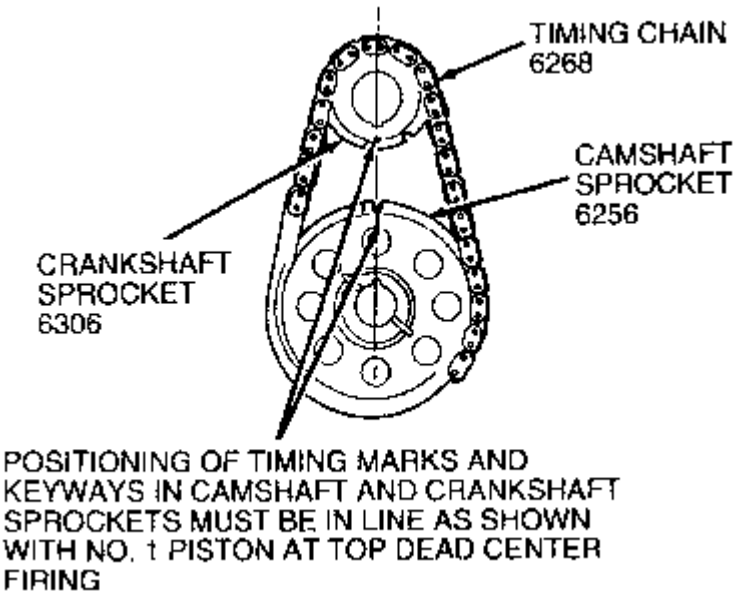
1 Crankshaft
2 Crankshaft key
3 Camshaft
4 Camshaft sprocket
5 Camshaft sprocket key
6 Engine balance shaft drive gear
7 Timing chain
8 Crankshaft sprocket
9 Camshaft sprocket
10 Distributor drive gear
11 Camshaft sprocket bolt
12 Timing chain vibration damper
A Tighten to 40-50 Nm (30-37 lb.ft.)

Timing chain and related components-3.8L engine

Click to enlarge

To install:

7. **Lightly oil all bolt and stud threads before installation. Clean all gasket surfaces on the front cover, cylinder block and fuel pump. If reusing the front cover, replace crankshaft front oil seal.**
8. **If a new front cover is to be installed, complete the following:**
    1. **Install the oil pump gears.**
    2. **Clean the water pump gasket surface. Position a new water pump gasket on the front cover and install water pump. Install the pump attaching bolts and tighten to 15-22 ft. lbs. (20-30 Nm).**
9. **Rotate the crankshaft as necessary to position piston No. 1 at TDC and the crankshaft keyway at the 12 o' clock position.**
10. **Install the tensioner assembly. Make sure the ratcheting mechanism is in the retracted position with the pin pointing outward from the hole in the bracket assembly. Tighten the retaining bolts to 6-10 ft. lbs. (8-14 Nm).**
11. **Lubricate timing chain with clean engine oil. Install the camshaft sprocket, crankshaft sprocket and timing chain.**
12. **Remove the pin from the tensioner/vibration damper assembly to load the timing chain vibration damper arm against the timing chain. Make certain the timing marks are positioned across from each other.**



Position of the timing marks when the No. 1 piston is at TDC

Click to enlarge

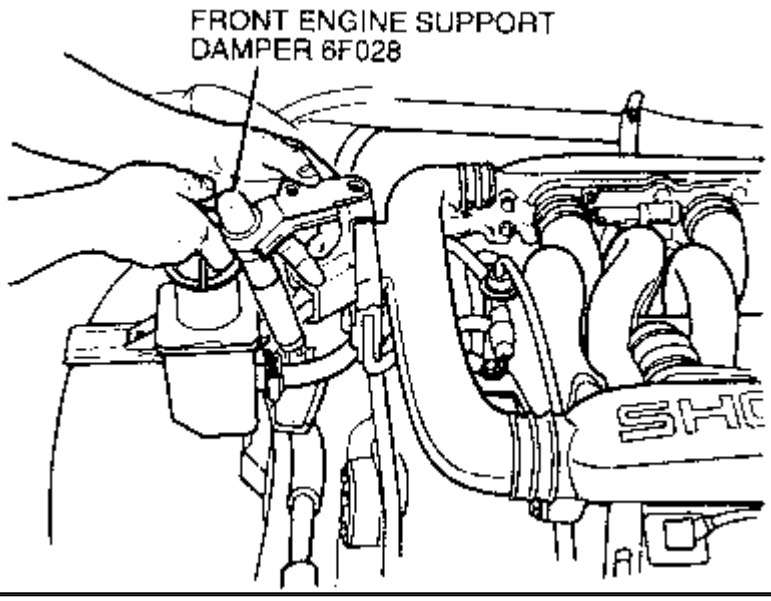
13. **Install the distributor drive gear.**
14. **Install the camshaft sprocket washer and bolt at the end of the camshaft, then tighten to 30-37 ft. lbs. (41-50 Nm).**
15. **Install the timing chain/engine front cover, using a new gasket. For details regarding this procedure, please refer to timing chain cover removal and installation earlier in this section.**
16. **Connect battery ground cable. Start the engine and check for leaks.**

Timing Belt and Tensioner

REMOVAL & INSTALLATION

3.0L SHO Engine

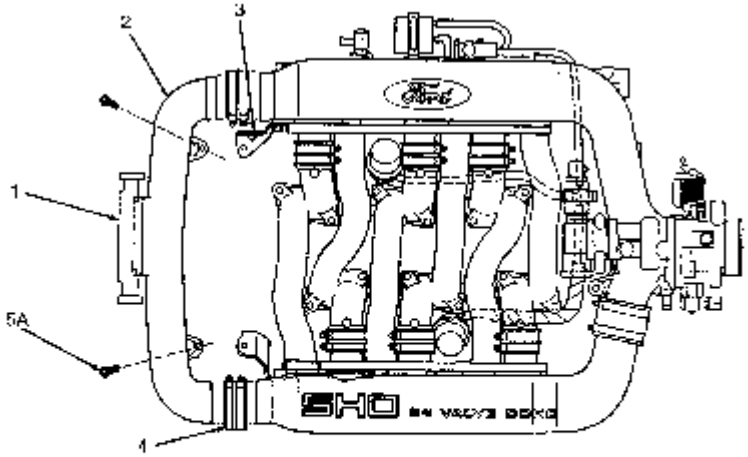
1. **Disconnect the battery cables.**
2. **Remove the battery.**
3. **Remove the right engine roll damper/front engine support damper.**



Location of the front engine support damper-3.0L SHO engine

Click to enlarge

4. **Disconnect the wiring to the ignition control module.**
5. **Remove the engine air inlet/intake manifold crossover tube bolts. Loosen the intake manifold tube hose clamps. Remove the engine air inlet/intake manifold crossover tube.**



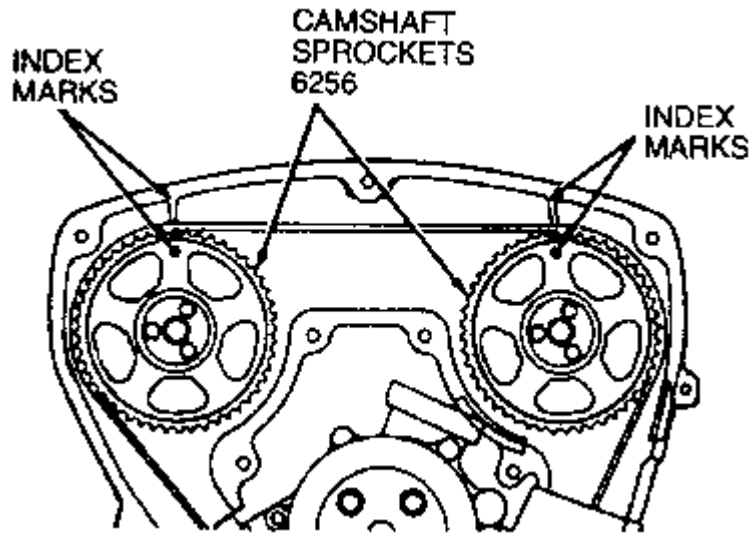
Engine inlet air connector mounting-3.0L SHO engine

Click to enlarge

6. **Loosen the alternator/air conditioning belt tensioner pulley and relieve the tension on the belt by backing out the adjustment screw. Remove the alternator/air conditioning belt.**
7. **Loosen the water pump/power steering belt tensioner pulley and relieve the**

tension on the belt by backing out the adjustment screw. Remove the water pump/power steering belt.

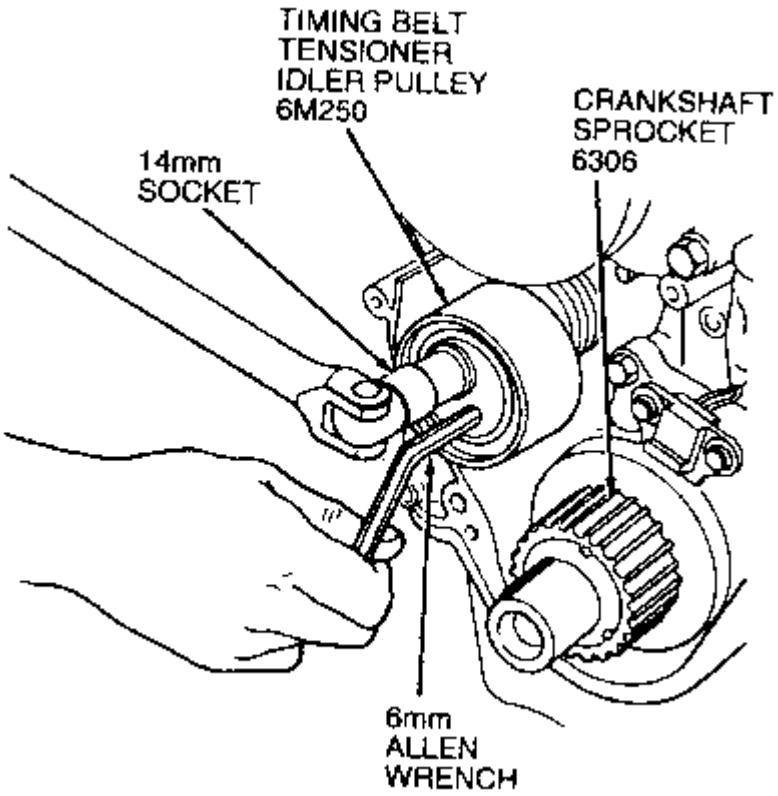
8. Remove the alternator/air conditioning belt tensioner pulley and bracket assembly.
9. Remove the water pump/power steering belt tensioner pulley only.
10. Remove the upper timing belt cover.
11. Disengage the crankshaft position (CKP) sensor connectors.
12. Place the gear selector in N (neutral).
13. Set the engine to the TDC on No. 1 cylinder position. Make sure the white mark on the crankshaft damper aligns with the 0 degree index mark on the lower timing belt cover and that the marks on the intake camshaft pulleys align with the index marks on the metal timing belt cover.



Alignment of marks with the engine set to TDC on the No. 1 cylinder position.

Click to enlarge

14. Raise and safely support the vehicle.
15. Remove the right front wheel and tire assembly.
16. Loosen the fender splash shield and place it aside.
17. Using a suitable puller, remove the crankshaft damper.
18. Remove the lower timing belt cover.
19. Remove the center timing belt cover and disconnect the crankshaft sensor wire and grommet from the slot in the cover and the stud on the water pump.
20. Loosen the timing belt tensioner, rotate the pulley 180° ($^1/_2$ turn)clockwise and tighten the tensioner nut to hold the pulley in the unload position.



Loosening the timing belt tensioner-3.0L SHO engine

Click to enlarge

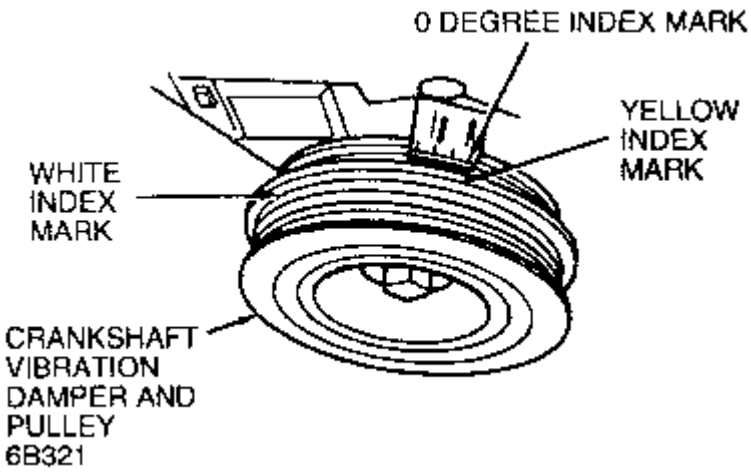
21. Carefully lower the vehicle, then remove the timing belt.

To install:

Before installing the timing belt, inspect it for cracks, wear or otherdamage and replace, if necessary. Do NOT allow the timing belt to come intocontact with gasoline, oil, water, coolant or steam. Do not twist or turn thebelt inside out.

22. Make sure the engine is at TDC on the No. 1 cylinder. Check that the camshaft pulley marks line up with the index marks on the upper steel belt cover and that the crankshaft pulley aligns with the index mark on the oil pump housing. The timing belt has 3 yellow lines. Each line aligns with the index marks.
23. Install the timing belt over the crankshaft and camshaft pulleys. The lettering on the belt KOA should be readable from the rear of the engine; top of the lettering to the front of the engine. Make sure the yellow lines are aligned with the index marks on the pulleys.
24. Release the tensioner locknut and leave the nut loose.
25. Raise the vehicle and support safely.
26. Install the center timing belt cover. Make sure the crankshaft sensor wiring and grommet are installed and routed properly. Tighten the mounting bolts to 62-97 inch lbs. (7-11 Nm).
27. Install the lower timing belt cover. Tighten the bolts to 62-97 inch lbs. (7-11 Nm).
28. Using a suitable tool, install the crankshaft damper. Tighten the damper attaching bolt to 113-126 ft. lbs. (153-171 Nm).

29. **Rotate the crankshaft 2 revolutions in the clockwise direction until the yellow mark on the damper aligns with the 0° mark on the lower timing belt cover.**

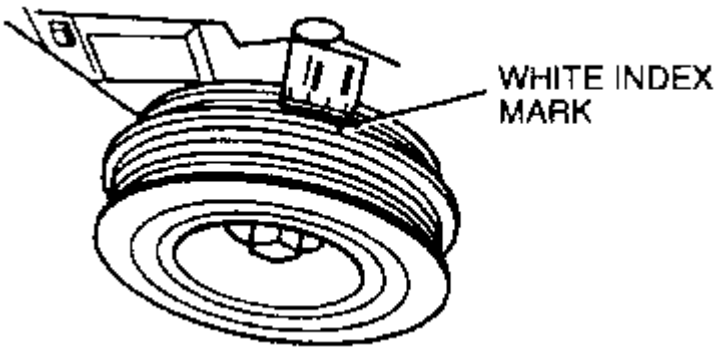


Rotate the crankshaft 2 revolutions (clockwise) until the yellow mark on the vibration damper aligns with the 0° mark on the lower timing belt cover

Click to enlarge

30. **Remove the plastic door in the lower timing belt cover. Tighten the tensioner locknut to 24-38 ft. lbs. (33-51 Nm) and install the plastic door.**

31. **Rotate the crankshaft 60° ($^1/_6$ turn) more in the clockwise direction until the white mark on the crankshaft vibration damper aligns with the 0° mark on the lower timing belt cover.**



Rotate the crankshaft 60° more (clockwise) until the white mark on the crankshaft vibration damper aligns with the 0° mark on the lower timing belt cover

32. **Lower the vehicle.**

33. **Make sure the index marks on the camshaft pulleys align with the marks on the rear metal timing belt cover.**

34. **Route the crankshaft sensor wiring and connect with the engine wiring harness.**

35. **Install the upper timing belt cover. Tighten the bolts to 62-97 inch lbs. (7-11 Nm).**

36. **Install the water pump/power steering tensioner pulley. Tighten the nut to 11-17 ft. lbs. (15-23 Nm).**

37. **Install the alternator/air conditioning tensioner pulley and bracket assembly. Tighten the bolts to 11-17 ft. lbs. (15-23 Nm).**

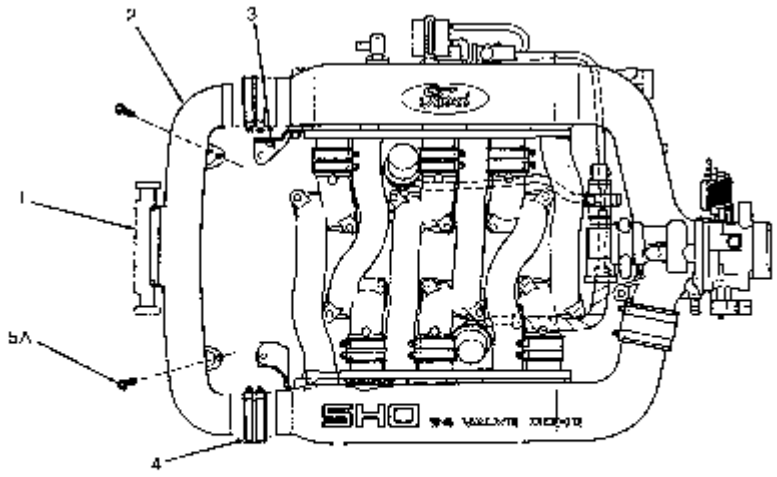
38. **Install the water pump/power steering and alternator/air conditioning belts and set**

the tension. Tighten the idler pulley nut to 25-36 ft. lbs. (34-49 Nm).

39. Install the engine air inlet connector/intake manifold crossover tube. Tighten the bolts to 11-17 ft. lbs. (15-23 Nm).
40. Install the engine roll damper/engine front support damper.
41. Install the battery, then connect the battery cables.
42. Raise the vehicle and support safely.
43. Install the front fender splash shield.
44. Install the right front wheel and tire assembly. Tighten the lug nuts to 85-105 ft. lbs. (115-142 Nm).
45. Lower the vehicle.

3.2L SHO Engine

1. Disconnect the battery cables, then remove the battery.
2. Remove the right-hand engine roll damper/engine support damper.
3. Disengage the wiring to the ignition control module.
4. Remove the engine air inlet/intake manifold crossover tube bolts. Loosen the tube hose clamps, then remove the tube.

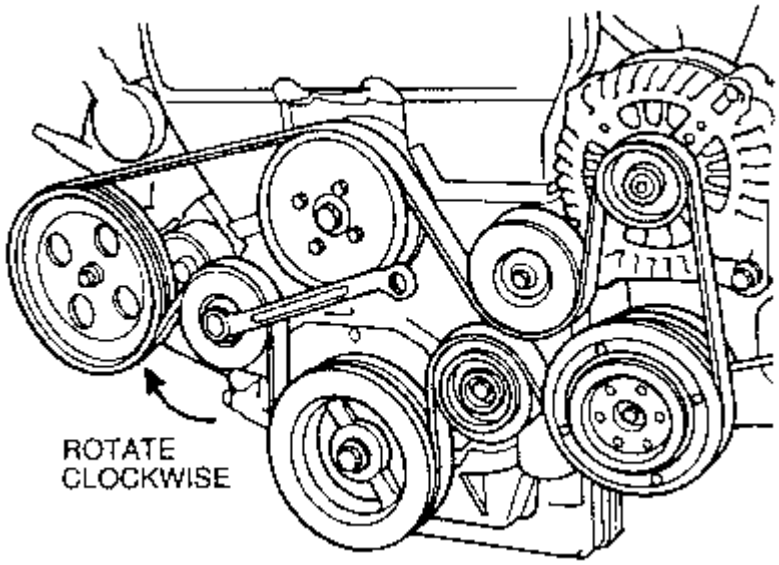


1 Ignition control module
2 Engine air inlet connector
3 Intake manifold support (2 req'd)
4 Hose clamp (4 req'd)
5 Bolts (2 req'd)
A Tighten to 15 23 Nm (11 17 lb.ft.)

Location of the engine air inlet/intake manifold crossover tube

Click to enlarge

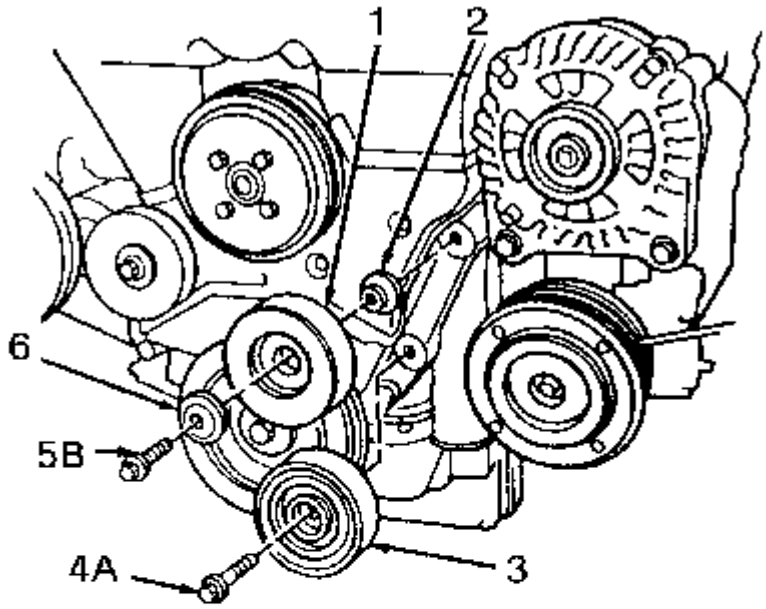
5. Rotate the accessory drive belt tensioner clockwise to relieve tension, then remove the belt.



Rotate the drive belt tensioner clockwise to relieve tension, then remove the belt

Click to enlarge

6. **Disconnect the surge tank fitting.**
7. **Remove the bolts retaining the upper and lower idler pulleys to the engine, then remove the pulleys.**

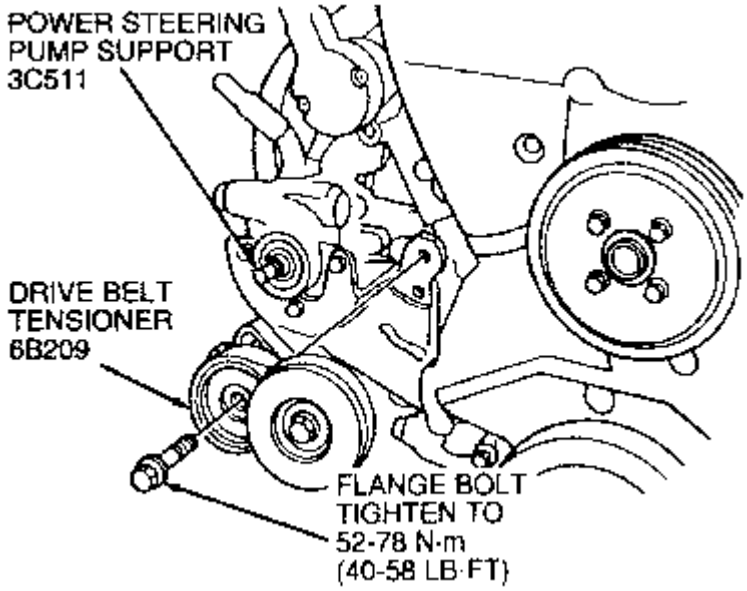


1 Upper drive belt idler pulley
2 Spacer
3 Lower drive belt idler pulley
4 Flange bolt
5 Flange bolt
6 Spacer
A Tighten to 36-55 Nm (27-41 lb.ft.)
B Tighten to 35-51 Nm (26-38 lb.ft.)

Location of the upper and lower idler pulleys

Click to enlarge

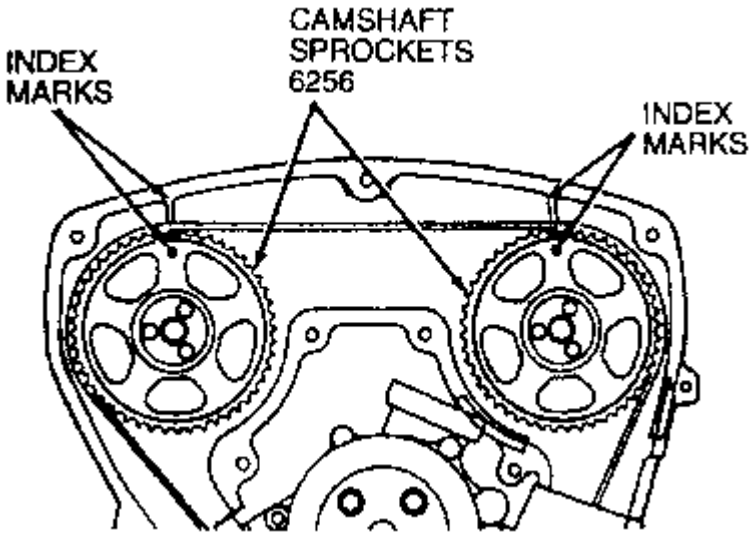
8. **Using Strap Wrench D85L-6000-A or equivalent, to hold the power steering pump pulley, remove the nut and the washer, then remove the power steering pulley.**
9. **Remove the retaining bolt from the belt tensioner, then remove the tensioner.**



Remove the retaining bolt from the belt tensioner, then remove the tensioner

Click to enlarge

10. **Remove the upper and center timing belt covers.**
11. **Disengage the crankshaft position (CKP) sensor electrical connectors.**
12. **Place the transaxle selector in N (neutral).**
13. **Rotate the crankshaft until the No. 1 cylinder piston is at TDC of the compression stroke. Make sure the white mark on the crankshaft damper aligns with the 0° index mark on the lower timing belt cover and the marks on the intake camshaft sprockets align with the index marks on the metal timing belt cover.**



Location of alignment marks on the camshaft sprockets

Click to enlarge

14. **Raise and safely support the vehicle, then remove the right front wheel and tire assembly.**
15. **Loosen the fender splash shield and place it aside.**

16. **Using a suitable puller, remove the crankshaft vibration damper.**
17. **Remove the lower timing belt cover and belt guide.**
18. **Remove the upper timing belt tensioner bolt.**
19. **Slowly loosen the lower timing belt tension bolt, then remove the tensioner.**
20. **Carefully lower the vehicle, then remove the timing belt.**

To install:

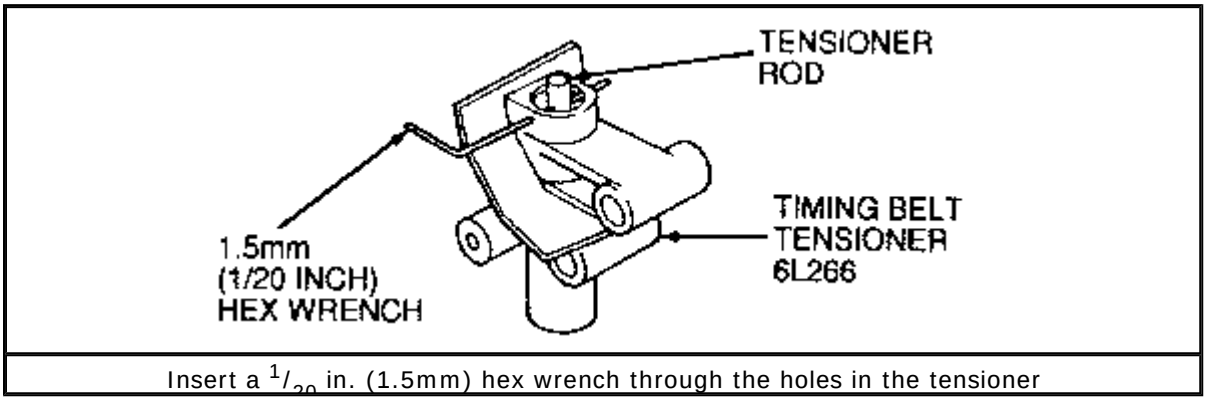
Before installing the timing belt, inspect it for cracks, wear or otherdamage and replace, if necessary. Do NOT allow the timing belt to come intocontact with gasoline, oil, water, coolant or steam. Do not twist or turn thebelt inside out.

21. **Slowly compress the timing belt tensioner in a soft jawed vise until the hole in the tensioner housing aligns with the hole in the tensioner rod.**

CAUTION

Be careful when compressing the timing belt tensioner in the vise to ensurethat the tensioner does not slip from the vise.

22. **Insert a $^{1}/_{20}$ in. (1.27mm) hex wrench through the holes.**

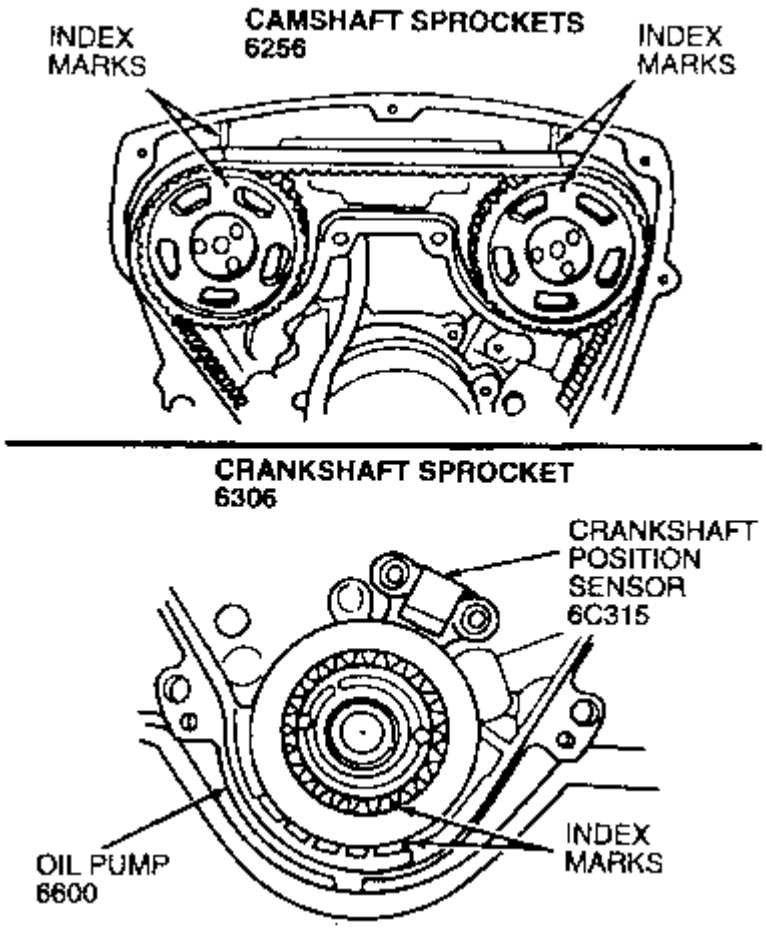


Insert a $^{1}/_{20}$ in. (1.5mm) hex wrench through the holes in the tensioner

Click to enlarge

23. **Release the timing belt tensioner from the vise.**
24. **If a new belt is being installed, loosen the timing belt idler bolt.**
25. **Make sure the engine is at TDC on the No. 1 cylinder. Check that the camshaft sprocket marks line up with the index marks on the upper steel belt cover, and that the crankshaft sprocket aligns with the index mark on the oil pump housing.**

The timing belt has 3 yellow lines. Each line aligns withthe index marks.



Index marks on the camshaft sprockets and oil pump

Click to enlarge

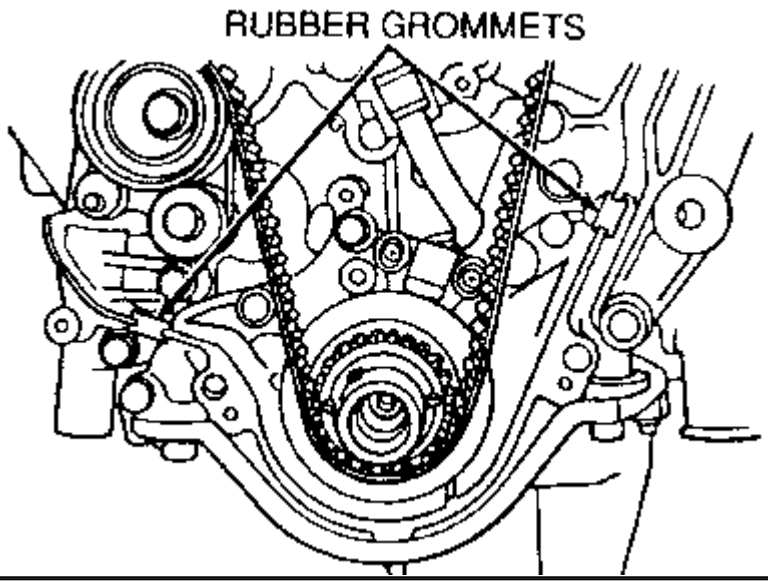
26. **Install the timing belt over the crankshaft and camshaft sprockets. The lettering on the belt KOB should be readable from the rear of the engine; top of the lettering to the front of the engine. Make sure the yellow lines are aligned with the index marks on the sprockets.**

WARNING

Do NOT install the timing belt tensioner with the rod extended.

27. **Install the timing belt tensioner on the cylinder block while pushing the timing belt idler toward the belt. Tighten the tensioner bolts to 12-17 ft. lbs. (16-23 Nm).**

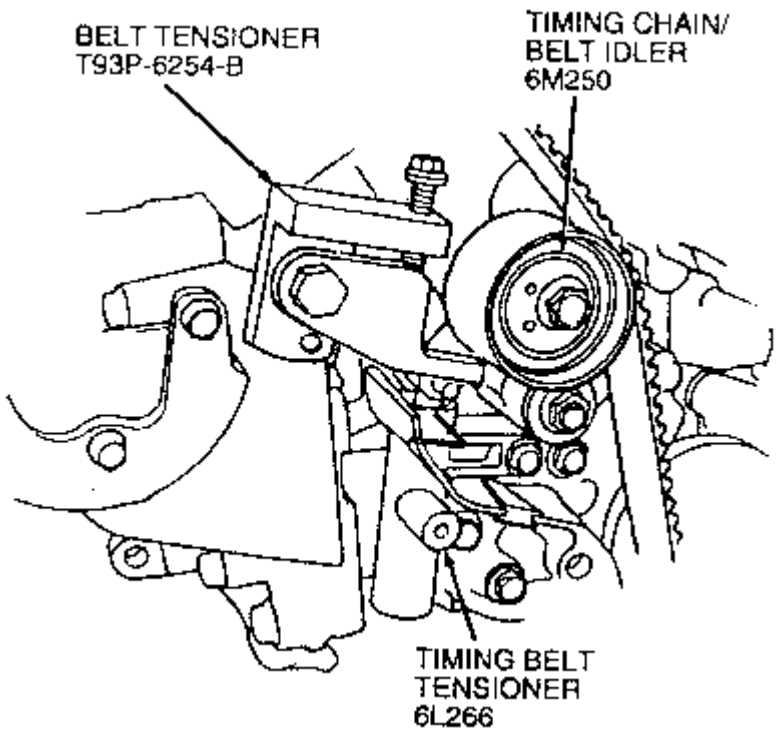
28. **Install the grommets between the timing belt tensioner and the oil pump.**



Location of the rubber grommets

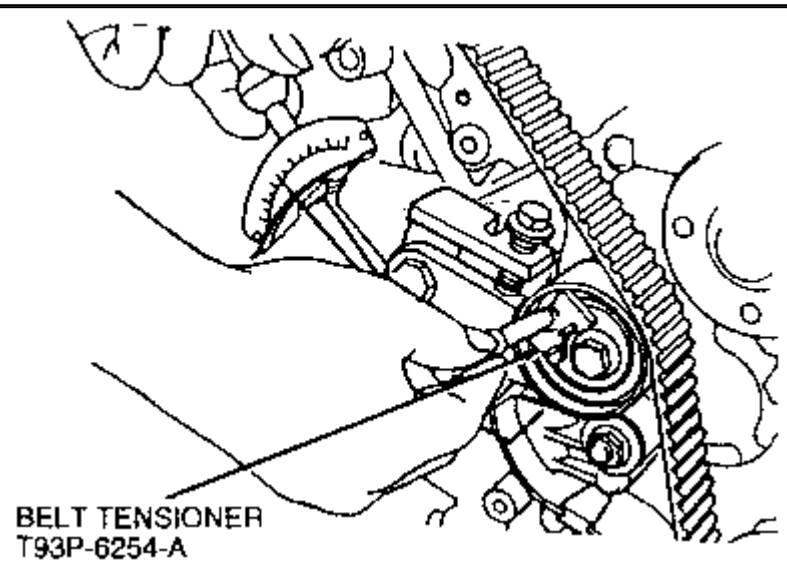
Click to enlarge

29. **Remove the $^{1}/_{20}$ in. (1.27mm) hex wrench from the timing belt tensioner.**
30. **If a new belt is being installed, perform the following steps:**
    1. **Position the timing belt tensioner tool T93P-6254-A or equivalent, using the power steering pump bracket holes.**
    2. **Hand tighten the timing belt idler bolt.**
    3. **Using a inch lbs. torque wrench with belt tensioner attachment T93P-6254-A, rotate clockwise to 4.3 inch lbs. (0.5 Nm).**
    4. **Tighten the timing belt tensioner bolts to 27-37 ft. lbs. (36-50 Nm), then remove the timing belt tensioning tool.**



Position the timing belt tensioner tool, using the power steering pump bracket holes

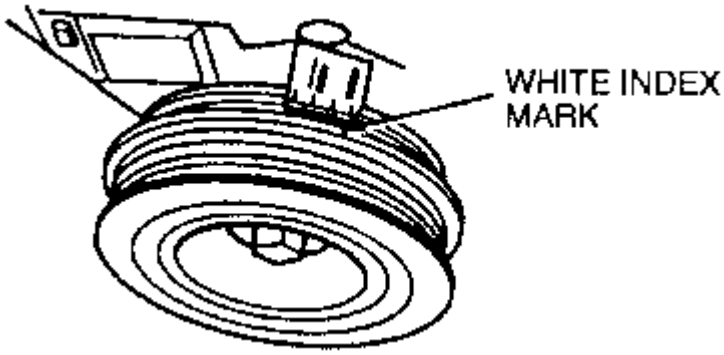
Click to enlarge



Using an inch lbs. torque wrench with a belt tensioner attachment, rotate clockwise to 4.3 inch lbs. (0.5 Nm)

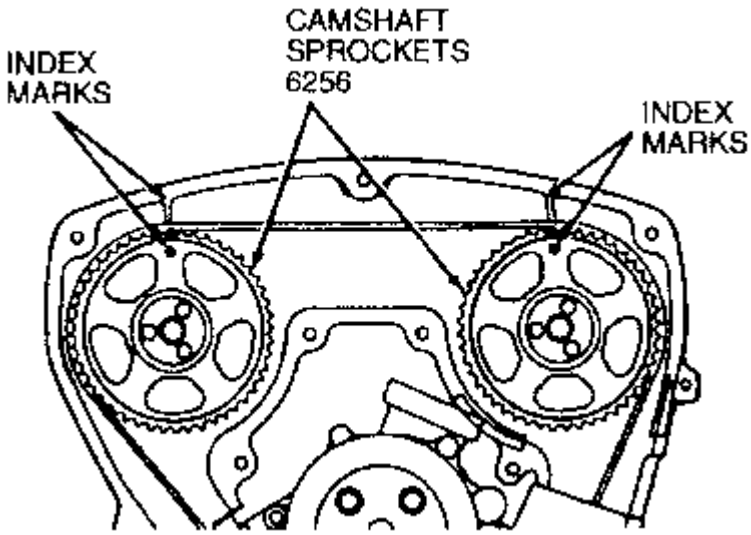
Click to enlarge

31. **Raise and safely support the vehicle.**
32. **Install the belt guide and lower timing belt cover. Tighten the retaining bolts to 12-17 ft. lbs. (16-23 Nm).**
33. **Using a suitable tool, install the crankshaft vibration damper. Tighten the damper attaching bolt to 113-126 ft. lbs. (152-172 Nm).**
34. **Rotate the crankshaft 2 revolutions in the clockwise direction until the white mark on the vibration damper aligns with the 0° marks on the lower timing belt cover.**



Rotate the crankshaft 2 revolutions (clockwise) until the white mark on the vibration damper aligns with the 0° mark on the lower timing belt cover

35. **Carefully lower the vehicle.**
36. **Make sure the index marks on the camshaft sprockets align with the marks on the rear metal timing belt cover.**



Make sure the index marks on the camshaft sprockets align with the marks on the rear metal timing belt cover

Click to enlarge

37. **Route the crankshaft position sensor wiring, then connect it with the wiring harness.**
38. **Install the center and upper timing belt covers. Tighten the bolts to 12-17 ft. lbs. (16-23 Nm).**
39. **Install the water pump pulley. Tighten the nut to 12-17 ft. lbs. (16-23 Nm).**
40. **Install the single accessory drive belt while rotating the accessory drive belt tensioner clockwise.**
41. **Install the surge tank fitting.**
42. **Install the engine air inlet connector/intake manifold crossover tube. Tighten the bolts to 11-17 ft. lbs. (15-23 Nm).**
43. **Install the engine roll damper/support damper.**
44. **Install the battery, then connect the wiring to the ignition control module, and connect the battery cable.**

45. Raise and safely support the vehicle.
46. Install the fender splash shield, then install the right front wheel and tire assembly. Carefully lower the vehicle, then tighten the lug nuts to 85-105 ft. lbs. (115-142 Nm).

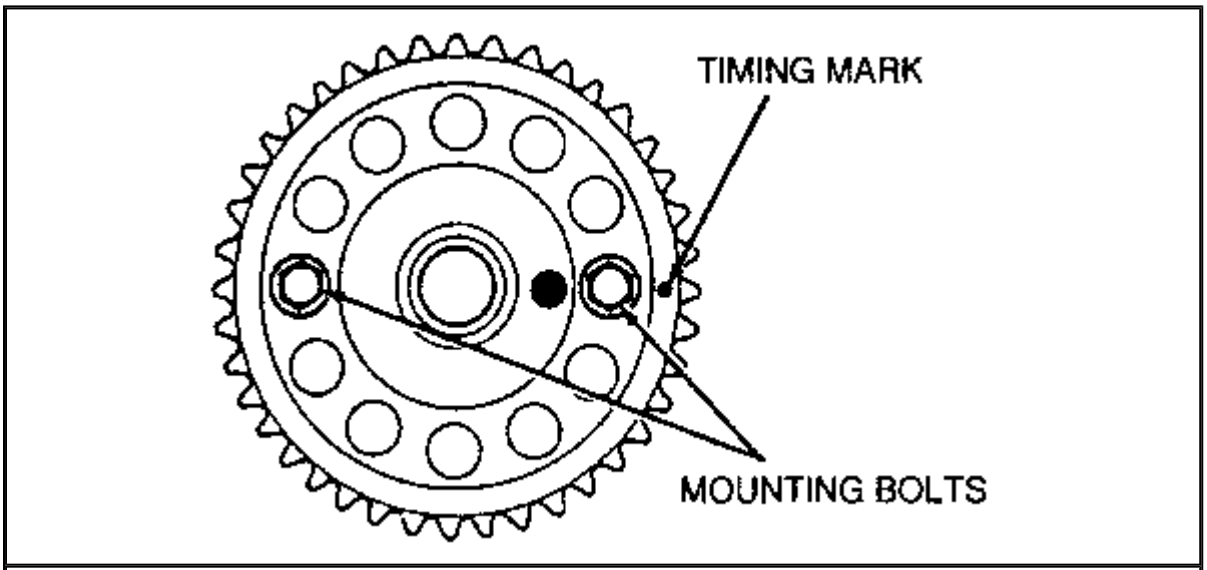
Timing Sprockets

REMOVAL & INSTALLATION

3.0L and 3.2L SHO Engines

CAMSHAFT SPROCKETS

1. Disconnect the negative battery cable.
2. Position the engine to TDC at the No. 1 cylinder.
3. Remove the intake manifold. For details, please refer to the procedure located earlier in this section.
4. Remove the timing belt. For details, please refer to the procedure located earlier in this section.
5. Remove the valve covers.
6. Remove the camshaft sprocket retaining bolts and camshaft sprockets, noting the position of the dowel pins.



Location of the camshaft sprocket retaining bolts and timing mark-SHO engines

To install:

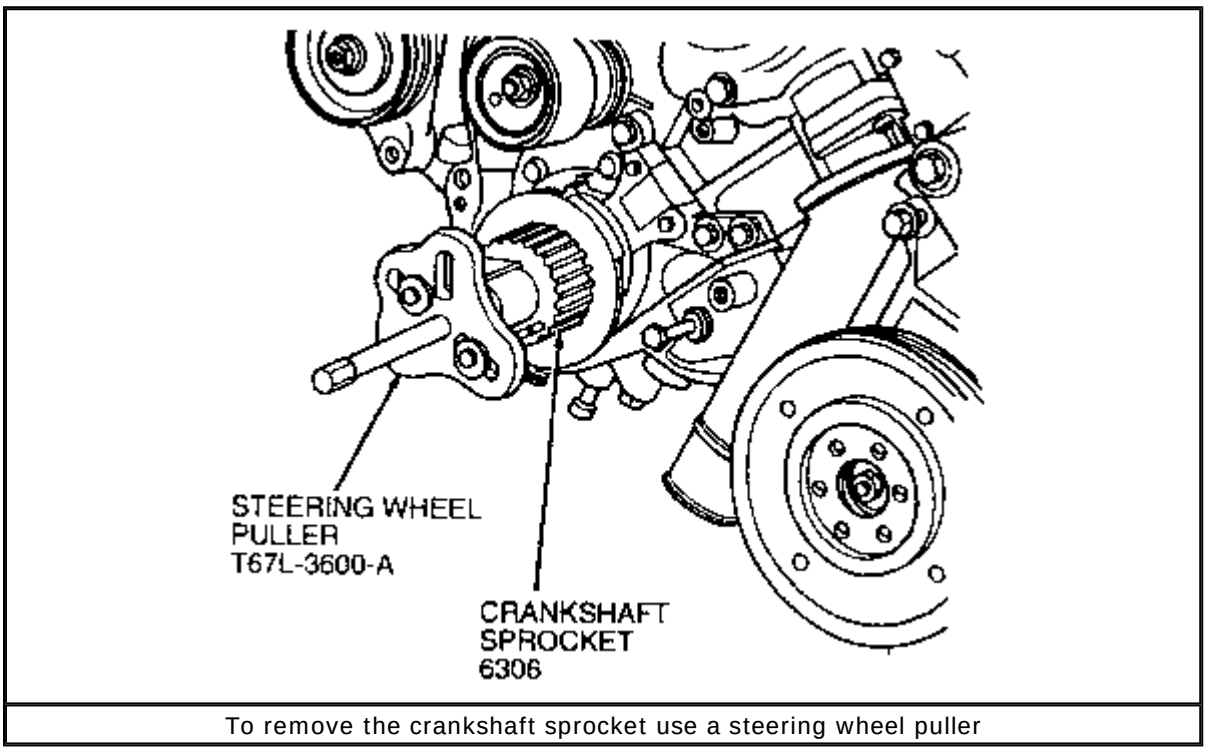
7. Align the timing marks on the camshaft sprockets with the camshafts, then install the sprockets. Tighten the retaining bolts to 10-13 ft. lbs (14-18 Nm).
8. Install the valve covers.
9. Install the timing belt and the intake manifold. For details, please refer to the appropriate procedures located earlier in this section.
10. Connect the negative battery cable.

CRANKSHAFT SPROCKETS

1. Disconnect the negative battery cable.
2. Remove the timing belt. For details, please refer to the procedure located earlier in this section.

Be careful not to damage the crankshaft position (CKP) sensor or the pulse wheel.

3. Remove the crankshaft sprocket using Steering Wheel Puller T67L-3600-A or equivalent.



To remove the crankshaft sprocket use a steering wheel puller

Click to enlarge

To install:

4. Install the crankshaft sprocket onto the crankshaft.
5. Install the timing belt. Please refer to the timing belt procedure, located earlier in this section, for details.
6. Connect the negative battery.

Camshaft

REMOVAL & INSTALLATION

2.5L Engine

1. Drain the cooling system and the crankcase. Relieve the fuel system pressure.
2. Remove the engine from the vehicle and position in a suitable holding fixture. Remove the engine oil dipstick.
3. Remove necessary drive belts and pulleys.
4. Remove cylinder head. For details, please refer to the cylinder head procedure

located earlier in this section.

5. **Using a magnet, remove the hydraulic lifters and label them so they can be installed in their original positions. If the tappets are stuck in the bores by excessive varnish, etc., use a suitable claw-type puller to remove the tappets.**
6. **Loosen and remove the drive belt, fan and pulley.**
7. **Using Differential Side Bearing Puller T77F-4220-B1 or equivalent, remove the crankshaft pulley.**
8. **Remove the oil pan.**
9. **Remove the cylinder front cover and gasket.**
10. **Check the camshaft end-play as follows:**
    1. **Push the camshaft toward the rear of the engine and install a dial indicator tool, so the indicator point is on the camshaft sprocket attaching screw.**
    2. **Zero the dial indicator. Position a small prybar or equivalent, between the camshaft sprocket or gear and block.**
    3. **Pull the camshaft forward and release it. Compare the dial indicator reading with the camshaft end-play specification of 0.009 in. (0.23mm).**
    4. **If the camshaft end-play is over the amount specified, replace the thrust plate.**
11. **Remove the timing chain, sprockets and timing chain tensioner.**
12. **Remove camshaft thrust plate. Carefully remove the camshaft by pulling it toward the front of the engine. Use caution to avoid damaging bearings, journals and lobes.**

To install:

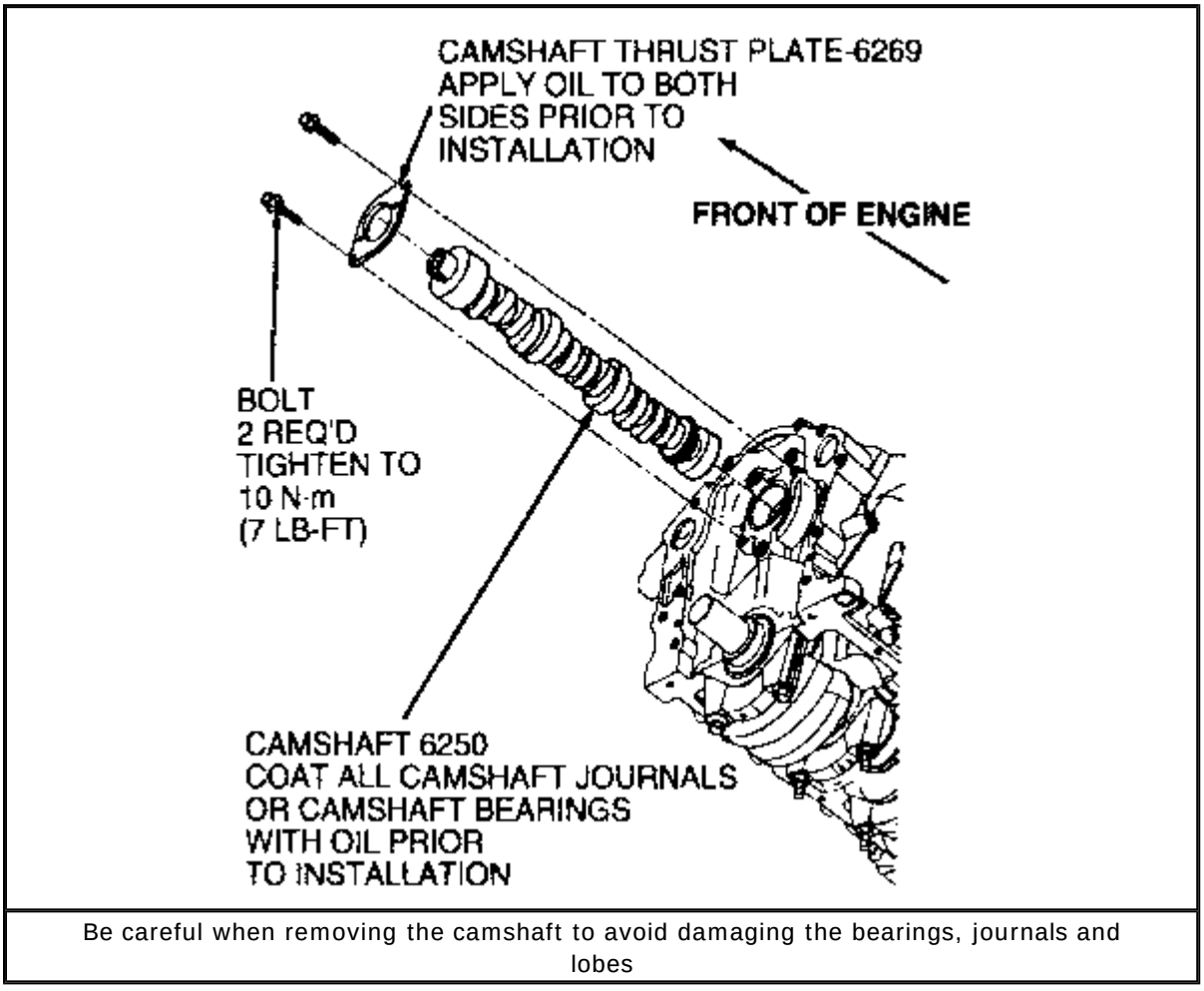
13. **Clean and inspect all parts before installation.**
14. **Lubricate camshaft lobes and journals with heavy engine oil. Carefully slide the camshaft through the bearings in the cylinder block.**
15. **Install the thrust plate. Tighten attaching bolts to 6-9 ft. lbs. (8-12 Nm).**
16. **Install the timing chain, sprockets and timing chain tensioner.**
17. **Install the cylinder front cover and crankshaft pulley.**
18. **Clean the oil pump inlet tube screen, oil pan and cylinder block gasket surfaces. Prime oil pump by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet tube. Install oil pump, oil pump inlet tube screen and oil pan.**
19. **Install the accessory drive belts and pulleys.**
20. **Lubricate the lifters and lifter bores with heavy engine oil. Install tappets into their original bores.**
21. **Install cylinder head.**
22. **Install the engine assembly.**
23. **Position No. 1 piston at TDC after the compression stroke. Position distributor in the block with the rotor at the No. 1 firing position. Install distributor retaining clamp.**

24. **Connect engine temperature sending unit wire. Connect coil primary wire. Install distributor cap. Connect spark plug wires and the coil high tension lead.**
25. **Fill the cooling system and crankcase to the proper levels. Connect the negative battery cable.**
26. **Start the engine. Check and adjust ignition timing, if necessary and check for coolant, oil, fuel and/or vacuum leaks.**

3.0L Engine-Except SHO

1. **Drain the cooling system and crankcase. Relieve the fuel system pressure.**
2. **Remove the engine from the vehicle and position in a suitable holding fixture.**
3. **Remove the accessory drive components from the front of the engine to allow for camshaft removal.**
4. **Remove the throttle body and the fuel injector harness. For details, please refer to the procedures located in *Section 5* of this manual.**
5. **On unleaded gasoline engines only, matchmark and remove the distributor assembly. For details, please refer to the procedure located earlier in this section.**
6. **Remove the ignition coil from the rear of the left-hand cylinder head.**
7. **Tag and disconnect the spark plug wires, then remove the rocker arm covers.**
8. **Loosen the cylinder No. 3 intake valve rocker arm seat retaining bolt and rotate the rocker arm off of the pushrod and away from the top of the valve stem, then remove the pushrod.**
9. **Remove the alternator, brackets, drive belt tensioner and drive belt.**
10. **Remove the intake manifold.**
11. **Loosen the rocker arm fulcrum nuts and position the rocker arms to the side for easy access to the pushrods. Remove the pushrods and label so they may be installed in their original positions.**
12. **Using a suitable magnet or lifter removal tool, remove the hydraulic lifters/tappets and keep them in order so they can be installed in their original positions. If the lifters/tappets are stuck in the bores by excessive varnish use a hydraulic lifter puller to remove the lifters/tappets.**
13. **Remove the crankshaft pulley and damper using a suitable removal tool.**
14. **Remove the oil pan assembly.**
15. **Remove the front cover assembly. Align the timing marks on the camshaft and crankshaft gears. Check the camshaft end-play as follows:**
    1. **Push the camshaft toward the rear of the engine and install a dial indicator tool, so the indicator point is on the camshaft sprocket attaching screw.**
    2. **Zero the dial indicator. Position a small prybar or equivalent, between the camshaft sprocket or gear and block.**
    3. **Pull the camshaft forward and release it. Compare the dial indicator reading with the camshaft end-play service limit specification of 0.005 in. (0.13mm).**
    4. **If the camshaft end-play is over the amount specified, replace the thrust plate.**
16. **Remove the timing chain and sprockets.**

17. **Remove the camshaft thrust plate. Carefully remove the camshaft by pulling it toward the front of the engine. Remove it slowly to avoid damaging the bearings, journals and lobes.**



Be careful when removing the camshaft to avoid damaging the bearings, journals and lobes

Click to enlarge

To install:

18. **Clean and inspect all parts before installation.**
19. **Lubricate camshaft lobes and journals with heavy engine oil. Carefully insert the camshaft through the bearings in the cylinder block.**
20. **Lubricate the engine thrust plate with Engine Assembly Lubricant D9AZ-19579-D, then install the thrust plate. Tighten the retaining bolts to 7 ft. lbs. (10 Nm).**
21. **Install the timing chain and sprockets. Check the camshaft sprocket bolt for blockage of drilled oil passages prior to installation and clean, if necessary.**
22. **Install the front timing cover and crankshaft damper and pulley.**
23. **Lubricate the lifters/tappets and lifter bores with a heavy engine oil. Install the lifters/tappets into their original bores.**
24. **Install the intake manifold assembly.**
25. **For unleaded gasoline engines only, coat the distributor drive gear teeth with Engine Assembly Lubricant D9AZ-19579-D or equivalent, then install the distributor, aligning with the marks made during removal and hand tighten the retaining bolt.**

26. Lubricate the pushrods and rocker arms with heavy engine oil. Install the pushrods and rocker arms into their original positions. Rotate the crankshaft to set each lifter on its base circle, then tighten the rocker arm bolt. Tighten the rocker arm bolts to 19-28 ft. lbs. (26-38 Nm).
27. Install the oil pan.
28. Install the rocker arm/valve covers.
29. Install the alternator, brackets, drive belt tensioner and the drive belt.
30. Install the fuel injector harness and the throttle body
31. Install the distributor cap, then connect the ignition wires to the spark plugs as tagged during removal.
32. Install the engine assembly into the vehicle. For details, please refer to the procedure located in this section.
33. Connect the negative battery cable. Start the engine and check for leaks. Check and adjust the ignition timing (unleaded gasoline engines only), then tighten the distributor mounting bolt to 15-22 ft. lbs. (20-30 Nm).

3.0L SHO Engine

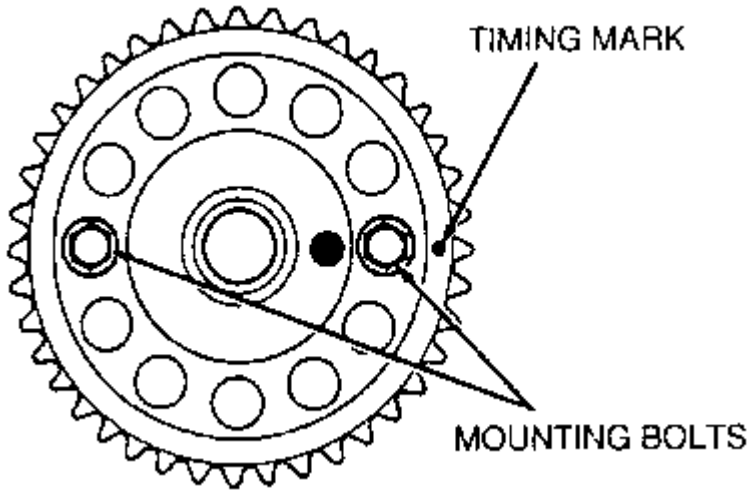
1. Disconnect the negative battery cable. Properly relieve the fuel system pressure.
2. Set the engine on TDC on No. 1 cylinder.
3. Remove the intake manifold assembly.
4. Remove the timing cover and belt.
5. Remove the cylinder head covers.
6. Remove the camshaft pulleys, noting the location of the dowel pins.
7. Remove the upper rear timing belt cover.
8. Uniformly loosen the camshaft bearing caps.

If the camshaft bearing caps are not uniformly loosened, camshaft damage may result.

9. Remove the bearing caps and note their positions for installation.
10. Remove the camshaft chain tensioner mounting bolts.
11. Remove the camshafts together with the chain and tensioner.
12. Remove and discard the camshaft oil seal.
13. Remove the chain sprocket from the camshaft.

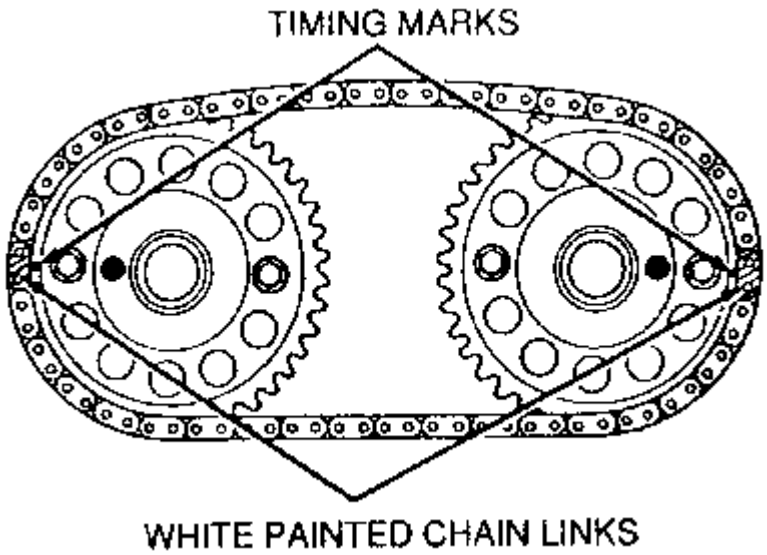
To install:

14. Align the timing marks on the chain sprockets with the camshaft and install the sprockets. Tighten the bolts to 10-13 ft. lbs. (14-18 Nm).



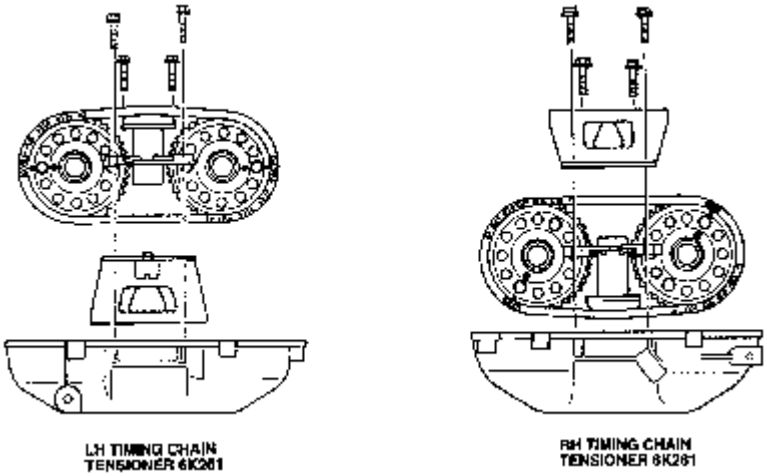
Camshaft sprocket mounting bolt locations-SHO engines

15. Install the chain over the camshaft sprockets. Align the white painted link with the timing mark on the sprocket.



Align the white painted links with the timing mark on the camshaft sprockets

16. Rotate the camshafts 60° ($^1/_6$ turn) counterclockwise. Set the chain tensioner between the sprockets and install the camshafts on the cylinder head. The left and right chain tensioners are not interchangeable.



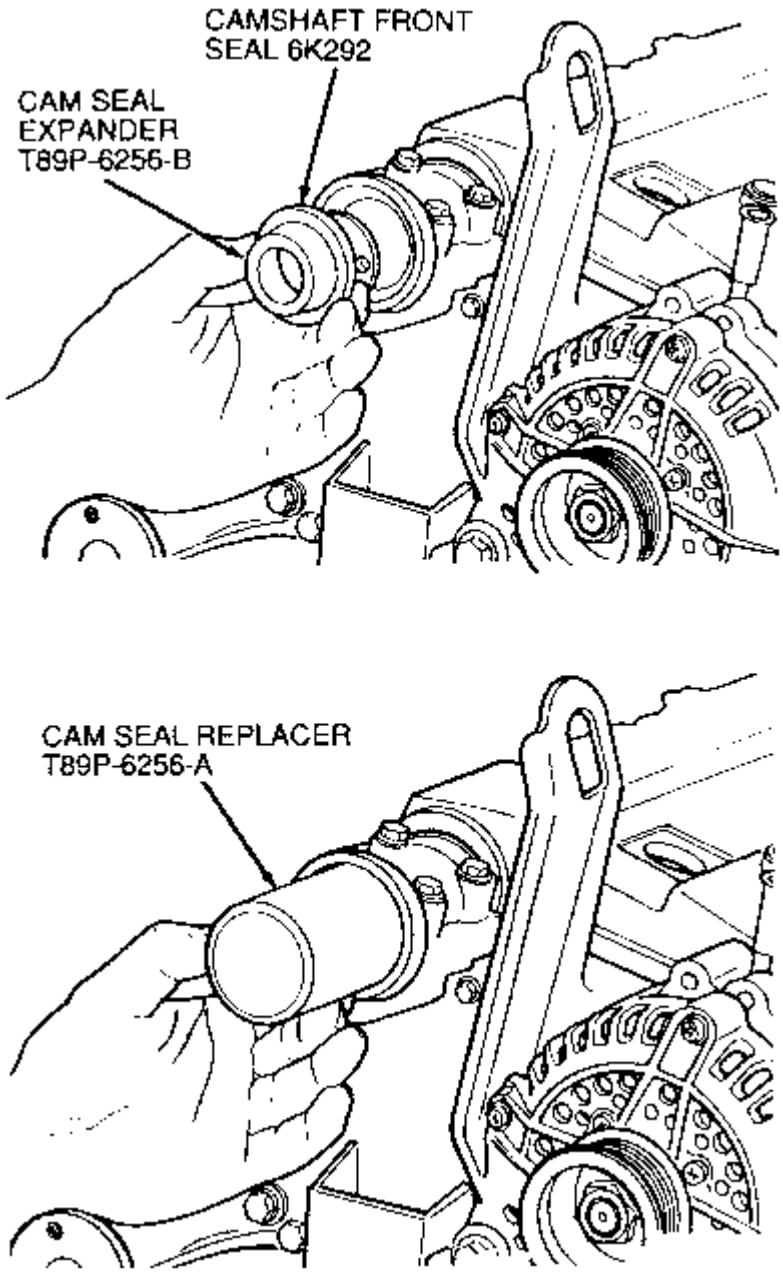
Timing chain tensioner mounting-SHO engines

Click to enlarge

17. **Apply a thin coat of engine oil to the camshaft journals and install bearing caps No. 2 through No. 5 and loosely install the bolts.**

The arrows on the bearing caps point to the front of the engine when installed.

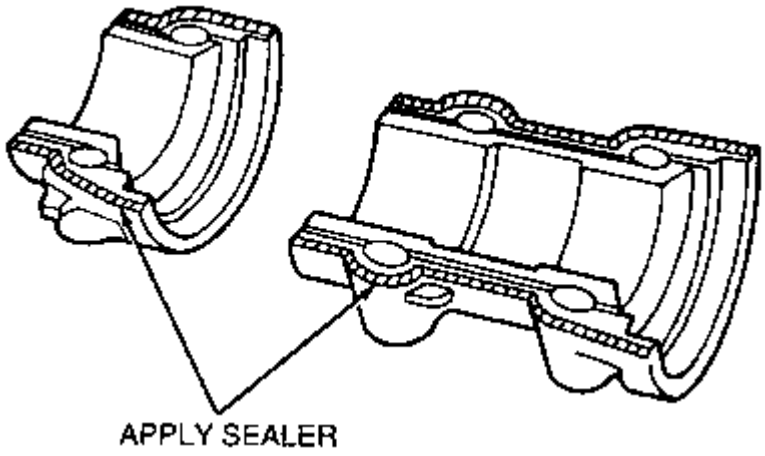
18. **Apply silicone sealer to outer diameter of the new camshaft seal and the seal seating area on the cylinder head. Install the camshaft seal using Cam Seal Expander T89P-6256-B, and Cam Seal Replacer T89P-6256-A.**



Installing the camshaft seal using the specified tools

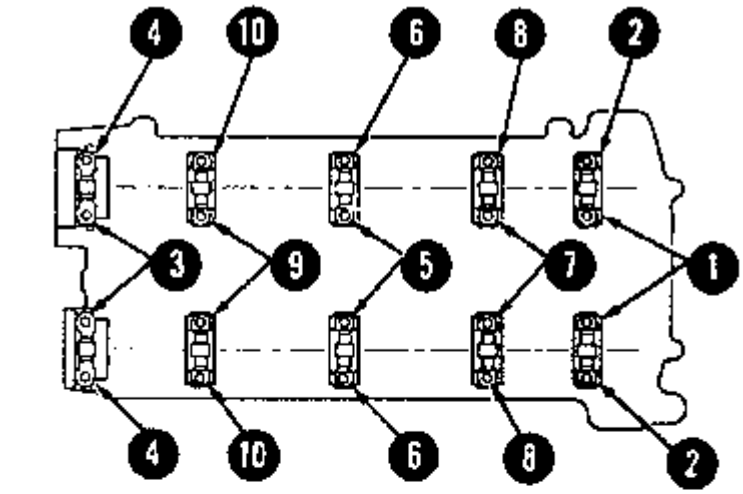
Click to enlarge

19. **Apply silicone sealer to the No. 1 bearing cap, then install the bearing cap while holding the camshaft front seal in place with the Cam Seal Replacer. Loosely install the bolts.**

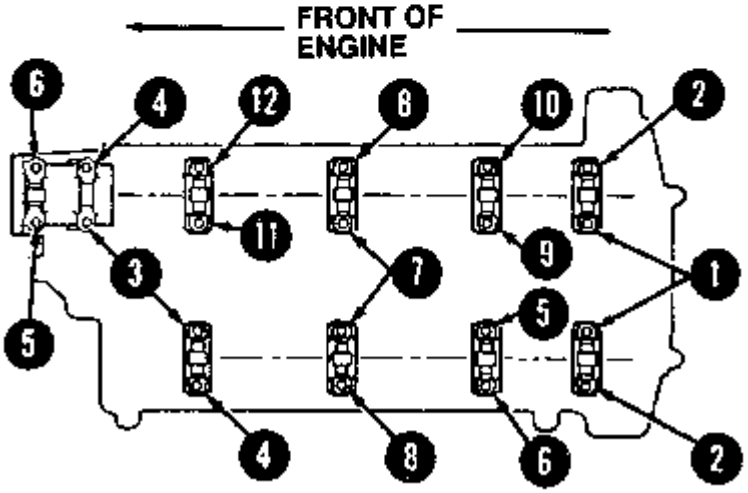


Apply sealer to the No. 1 cylinder head camshaft journal cap

20. Tighten the bearing caps in sequence using a 2 step method. Tighten to 6-9 ft. lbs. (8-12 Nm), then tighten to 12-16 ft. lbs. (16-22 Nm). For left camshaft installation, apply pressure to the chain tensioner to avoid damage to the bearing caps.



CAMSHAFT JOURNAL CAP TIGHTENING
SEQUENCE RH CYLINDER HEAD 6049

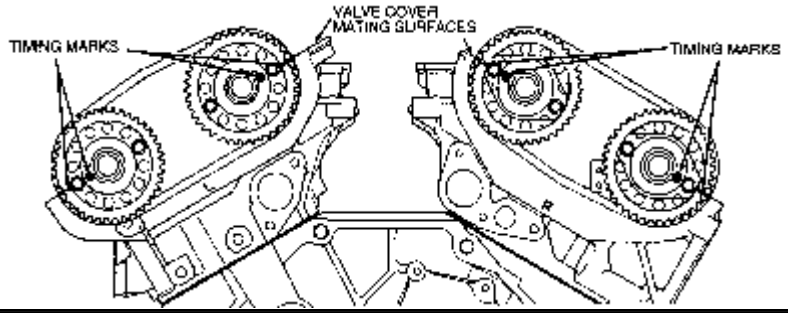


CAMSHAFT JOURNAL CAP TIGHTENING
SEQUENCE LH CYLINDER HEAD 6049

Camshaft journal cap tightening sequence

Click to enlarge

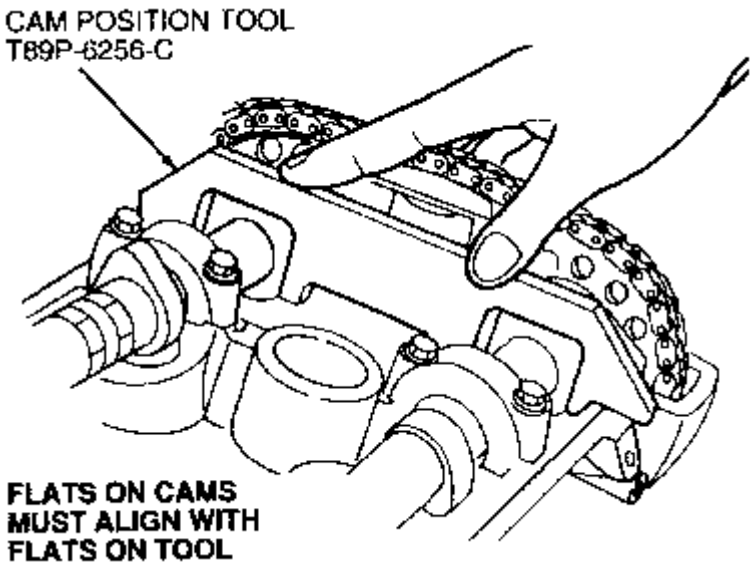
21. **Install the chain tensioner and tighten the bolts to 11-14 ft. lbs. (15-19 Nm). Rotate the camshafts 60° ($^1/_6$ turn) clockwise and check for proper alignment of the timing marks. Marks on the camshaft sprockets should align with the cylinder head cover mating surface.**



Marks on the camshaft sprockets should align with the valve/head cover mating surface

Click to enlarge

22. **Install the camshaft positioning tool T89P-6256-C or equivalent, on the camshafts to check for correct positioning. The flats on the tool should align with the flats on the camshaft. If the tool does not fit and/or timing marks will not line up, repeat the procedure from Step 14.**



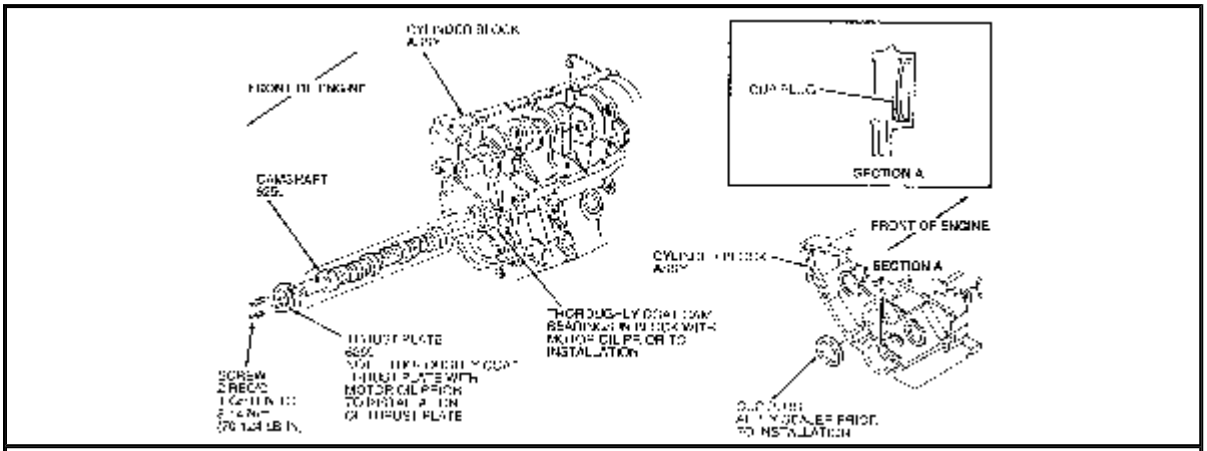
Set a Cam Position Tool or equivalent on the camshafts to ensure correct positioning

Click to enlarge

23. **Install the timing belt rear cover and tighten the bolts to 70 inch lbs. (7.8 Nm).**
24. **Install the camshaft pulleys and tighten the bolts to 15-18 ft. lbs. (20-24 Nm).**
25. **Install the timing belt and cover.**
26. **Install the cylinder head covers and tighten the bolts to 7-12 ft. lbs. (10-16 Nm).**
27. **Install the intake manifold assembly.**
28. **Connect the negative battery cable.**

3.8L Engine

1. **Disconnect the negative battery cable.**
2. **Properly relieve the fuel system pressure.**
3. **Drain the cooling system and crankcase.**
4. **Remove the engine from the vehicle and position in a suitable holding fixture.**
5. **Remove the intake manifold.**
6. **Remove the rocker arm covers, rocker arms, pushrods and lifters.**
7. **Remove the oil pan.**
8. **Remove the front cover and timing chain.**
9. **Remove the thrust plate. Remove the camshaft through the front of the engine, being careful not to damage bearing surfaces.**



Remove the camshaft through the front of the engine, but be careful not to damage the bearing surfaces

Click to enlarge

To install:

10. **Lightly oil all attaching bolts and stud threads before installation. Lubricate the cam lobes, thrust plate and bearing surfaces with a suitable heavy engine oil.**
11. **Install the camshaft being careful not to damage bearing surfaces while sliding into position. Install the thrust plate and tighten the bolts to 6-10 ft. lbs. (8-14 Nm).**
12. **Install the front cover and timing chain.**
13. **Install the oil pan.**
14. **Install the lifters.**
15. **Install the upper and lower intake manifolds.**
16. **Install the engine assembly.**
17. **Fill the cooling system and crankcase to the proper level and connect the negative battery cable.**
18. **Start the engine. Check and adjust the ignition timing and engine idle speed as necessary. Check for leaks.**

INSPECTION

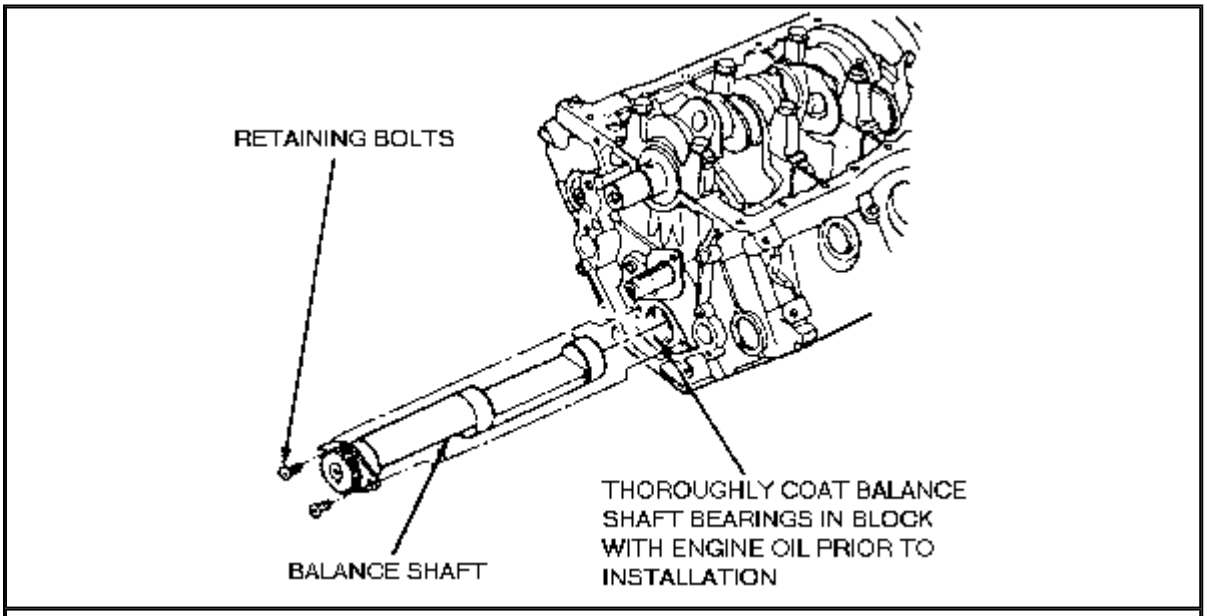
1. **Remove the camshaft from the engine.**
2. **Check each lobe for excessive wear, flatness, pitting or other physical damage. Replace the camshaft as required.**
3. **Using a micrometer measure the lobes, if not within specification, replace the camshaft.**
4. **If replacing the camshaft be sure to check and replace the valve lifters.**

Balance Shaft

REMOVAL & INSTALLATION

3.8L Engine

1. **Remove the engine from the vehicle.**
2. **Remove the intake manifolds.**
3. **Remove the oil pan.**
4. **Remove the front cover and timing chain and camshaft sprocket.**
5. **Remove the balance shaft drive gear and spacer.**
6. **Remove the balance shaft gear, thrust plate and shaft assembly.**



Balance shaft assembly and related components-3.8L engine

Click to enlarge

To install:

7. **Thoroughly coat the balance shaft bearings in the block with engine oil.**
8. **Install the balance shaft gear.**
9. **Install the balance shaft, thrust plate and gear, then tighten the retaining bolts to 6-10 ft. lbs. (8-14 Nm).**

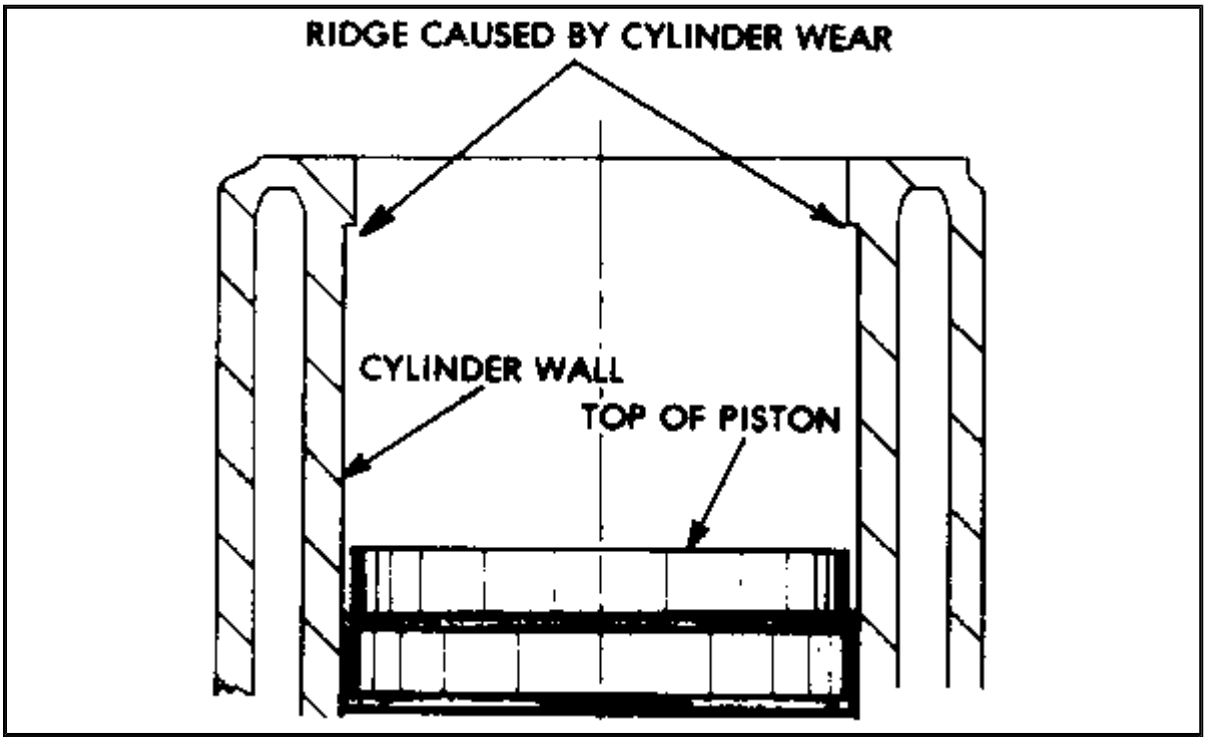
10. **Install the timing chain and camshaft sprocket.**
11. **Install the oil pan.**
12. **Install the timing cover.**
13. **Install the intake manifolds.**
14. **Install the engine in the vehicle.**

Pistons and Connecting Rods

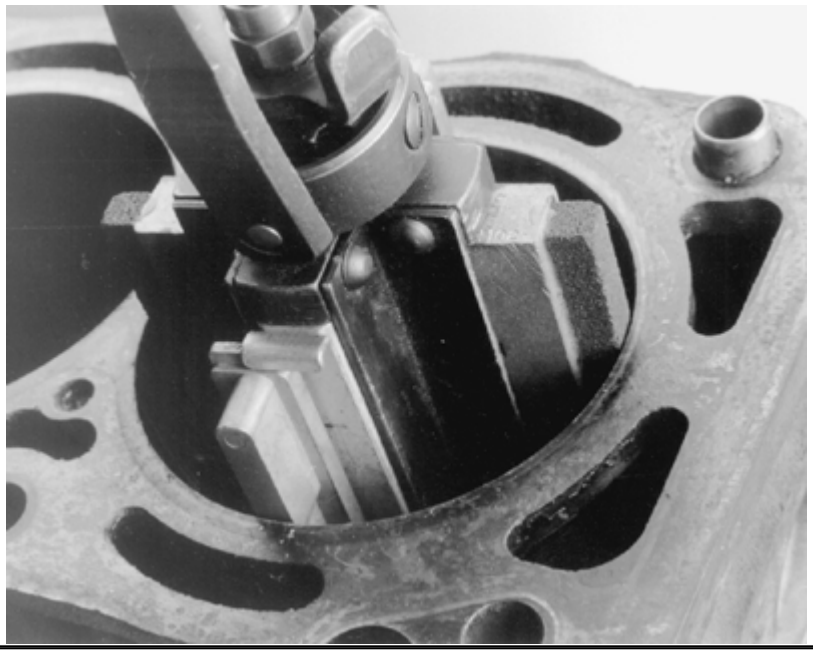
REMOVAL

Although in some cases the pistons and connecting rods may be removed with the engine still in the vehicle, it is rarely worth the aggravation, especially when you are not working with a lift. On vehicles where this is possible (cylinder head and oil pan removal are both possible with the engine installed and there is sufficient working clearance) take EXTREME care to assure no dirt or contamination is allowed into the cylinders during assembly and installation.

Before removing the pistons, the top of the cylinder bore must be examined for a ridge. A ridge at the top of the bore is the result of normal cylinder wear, caused by the piston rings only traveling so far up the bore in the course of the piston stroke. If the ridge can be felt by hand; it must be removed before the pistons are removed.



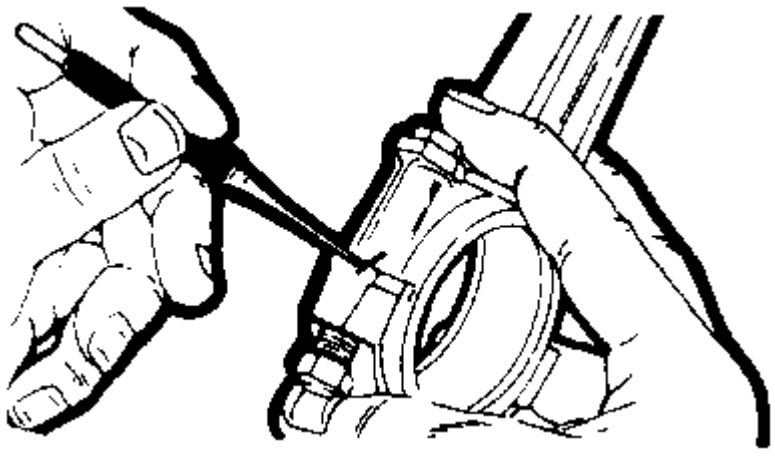
If present, the cylinder ridge must be removed before the pistons are removed from the block



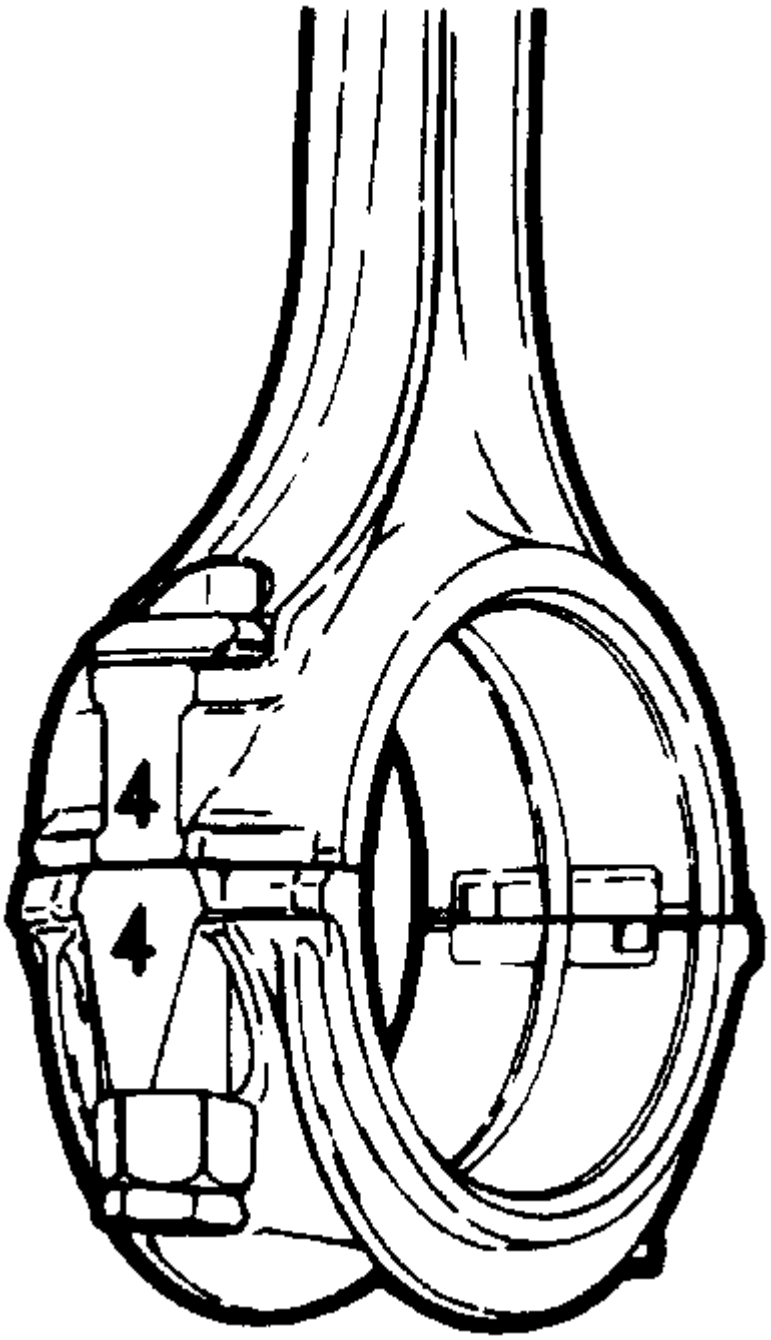
Removing the ridge from the cylinder bore using a ridge cutter

A ridge reamer is necessary for this operation. Place the piston at the bottom of its stroke, and cover it with a rag. Cut the ridge away with the ridge reamer, using extreme care to avoid cutting too deeply. Remove the rag, and remove the cuttings that remain on the piston with a magnet and a rag soaked in clean oil. Make sure the piston top and cylinder bore are absolutely clean before moving the piston. For more details, refer to the ridge removal and honing procedures later in this section.

1. **Remove cylinder head or heads.**
2. **Remove the oil pan.**
3. **If necessary, remove the oil pump assembly.**



Match connecting rods to their caps using a scribe mark



Match the connecting rods to their cylinders using a number stamp

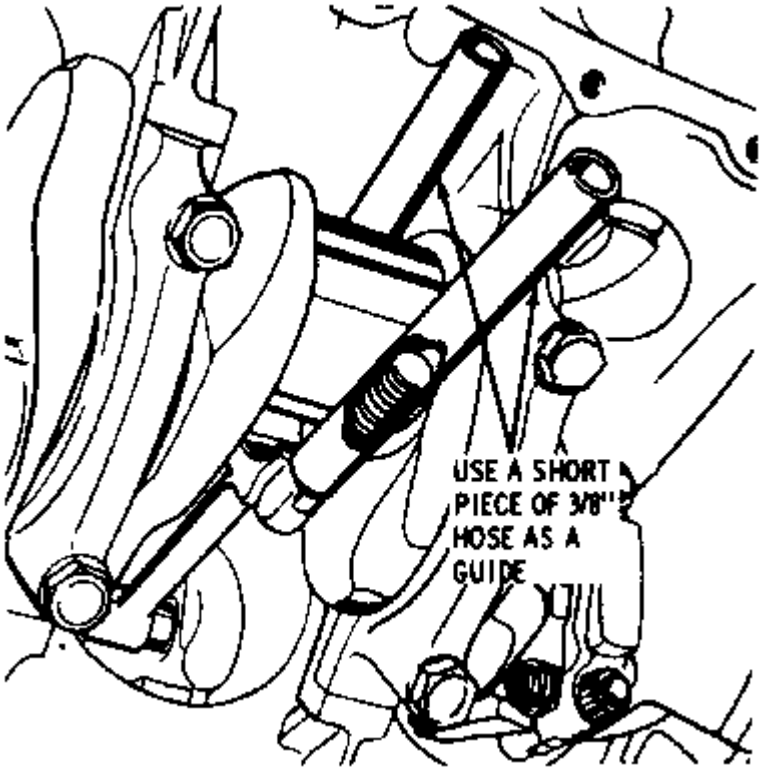
4. **Matchmark the connecting rod cap to the connecting rod with a scribe; each cap must be reinstalled on its proper rod in the proper direction. Remove the connecting rod bearing cap and the rod bearing. Number the top of each piston with silver paint or a felt-tip pen for reference during assembly.**

5. **Cut lengths of $^{3}/_{8}$ in. (10mm) diameter hose to use as rod bolt guides. Install the hose over the threads of the rod bolts, to prevent the bolt threads from damaging the crankshaft journals and cylinder walls when the piston is removed.**

6. **Squirt some clean engine oil onto the cylinder wall from above, until the wall is coated. Carefully push the piston and rod assembly up and out of the cylinder by tapping on the bottom of the connecting rod with a wooden hammer handle.**

7. **Place the rod bearing and cap back on the connecting rod, and install the nut temporarily. Using a number stamp or punch, stamp the cylinder number on the side of the connecting rod and cap; this will help keep the proper piston and rod**

assembly on the proper cylinder.



Cut lengths of rubber hose for connecting rod bolt guides

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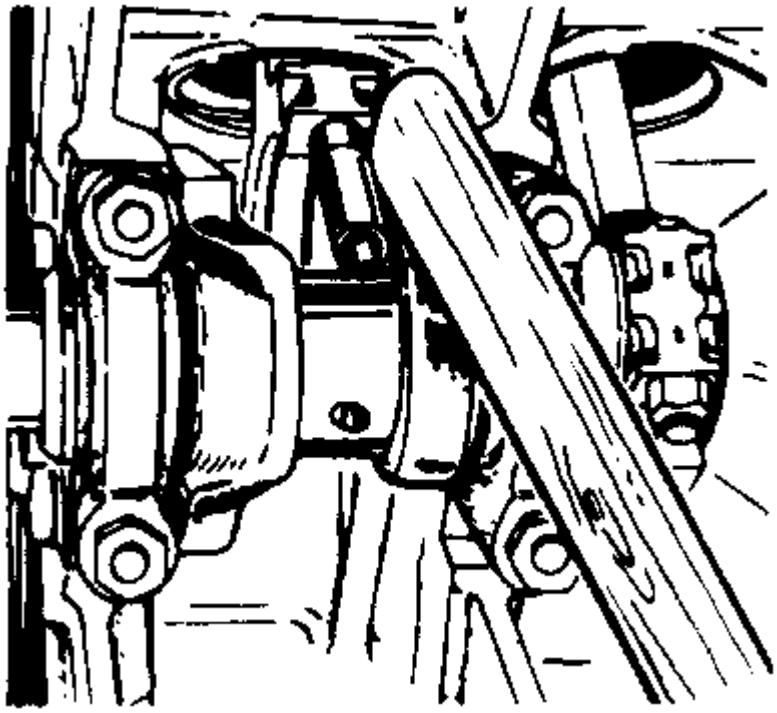


Carefully tap the piston and rod assembly out using a wooden hammer handle

8. **Remove remaining pistons in similar manner.**
9. **Clean and inspect the engine block, the crankshaft, the pistons and the connecting rods.**

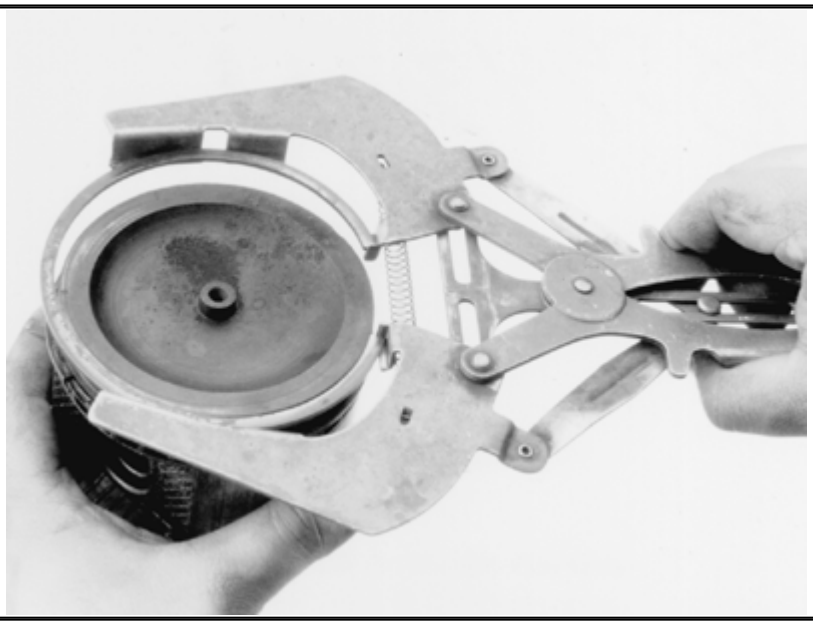
CLEANING AND INSPECTION

Pistons

A piston ring expander is necessary for removing piston rings without damaging them; any other method (screwdriver blades, pliers, etc.) usually results in the ring being bent, scratched or distorted, or the piston itself being damaged. When the rings are removed, clean the piston grooves using an appropriate ring groove cleaning tool, using care not to cut too deeply. Thoroughly clean all carbon and varnish from the piston with solvent.

WARNING

Do NOT use a wire brush or caustic solvent (acids, etc.) on pistons. Inspectthe pistons for scuffing, scoring, cracks, pitting, or excessive ring groovewear. If these are evident, the piston must be replaced.



Use a ring expander tool to remove the piston rings

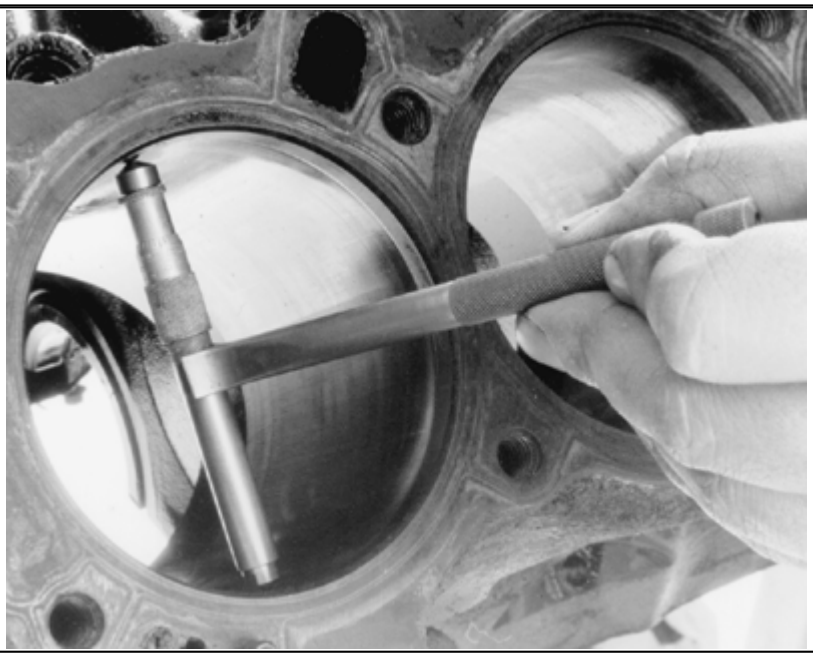
Clean the piston grooves using a ring groove cleaner

Clean the varnish from the piston skirts and pins with a cleaning solvent. DO NOT WIRE BRUSH ANY PART OF THE PISTON. Clean the ring grooves with a groove cleaner and make sure that the oil ring holes and slots are clean.

Inspect the piston for cracked ring lands, scuffed or damaged skirts, eroded areas at the top of the piston. Replace the pistons that are damaged or show signs of excessive wear.

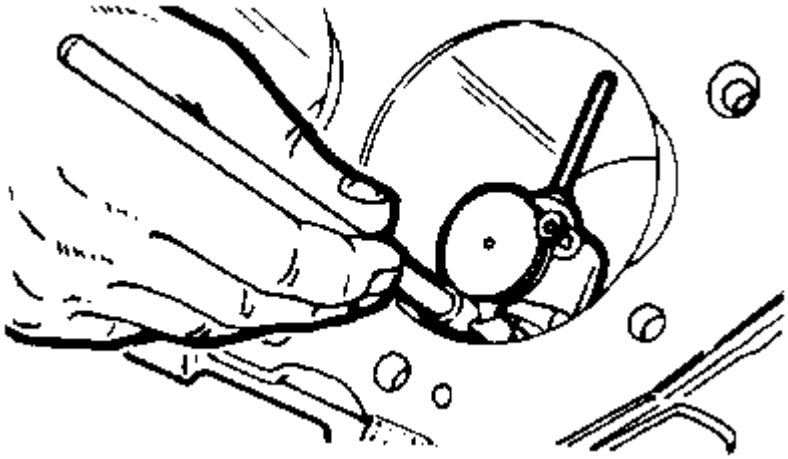
Inspect the grooves for nicks of burrs that might cause the rings to hang up.

Measure the piston in relation to cylinder diameter. Refer to the cylinder bore cleaning and inspection procedures later in this section.

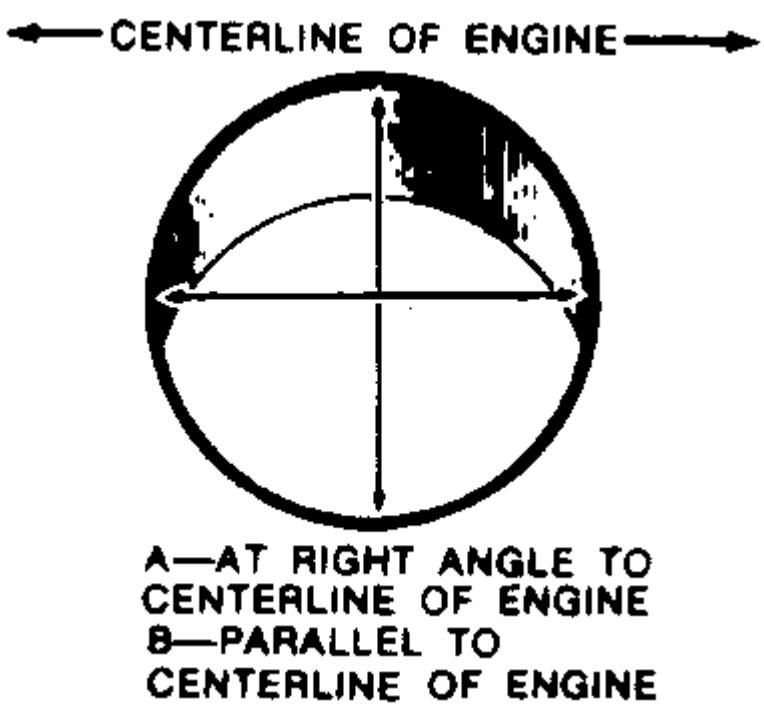


A telescoping gauge may be used to measure the cylinder bore diameter

Measure the piston's outer diameter using a micrometer



The cylinder bore may also be measured using a dial gauge



Cylinder bore measuring points

Connecting Rods

Wash the connecting rods in cleaning solvent and dry with compressed air. Check for twisted or bent rods and inspect for nicks or cracks. Replace connecting rods that are damaged.

Cylinder Bores

The piston should also be checked in relation to the cylinder diameter. Using a telescoping gauge and micrometer, or a dial gauge, measure the cylinder bore diameter perpendicular (90 degrees) to the piston pin, about 1-$2^{1}/_{2}$ in. (25-64mm) below the cylinder block deck (surface where the block mates with the heads). Then, with the micrometer, measure the piston perpendicular to its wrist pin on the skirt. The difference between the two measurements is the piston clearance.

If the clearance is within specifications or slightly below (after the cylinders have been bored or honed), finish honing is all that is necessary, If the clearance is excessive, try to obtain a slightly larger piston to bring the clearance within specifications. If this is not possible obtain, the first oversize piston and hone the cylinder or (if necessary) bore the cylinder to size. Generally, if the cylinder bore is tapered more than 0.005 in. (0.127mm) or is out-of-round more than 0.003 in. (0.0762mm), it is advisable to rebore for the smallest possible oversize piston and rings. After measuring, mark the pistons with a felt-tip pen for reference and for assembly.

Boring of the cylinder block should be performed by a reputable machineshop with the proper equipment. In some cases, clean-up honing can be done withthe cylinder block in the vehicle, but most excessive honing and all cylinderboring MUST BE done with the block stripped and removed from the vehicle.

RIDGE REMOVAL & HONING

1. **Before the piston is removed from the cylinder, check for a ridge at the top of the cylinder bore. This ridge occurs because the piston ring does not travel all the way to the top of the bore, thereby leaving an unworn portion of the bore surface.**
2. **Clean away any carbon buildup at the top of the cylinder with sand paper, in order to see the extent of the ridge more clearly. If the ridge is slight, it will be safe to remove the pistons without damaging the rings or piston ring lands. If the ridge is severe, and easily catches your fingernail, it will have to be removed using a ridge reamer.**

A severe ridge is an indication of excessive bore wear.Before removing the piston, check the cylinder bore diameter with a bore gauge,as explained in the cleaning and inspection procedure. Compare your measurementwith engine specification. If the bore is excessively worn, the cylinder willhave to bored oversize and the piston and rings replaced.

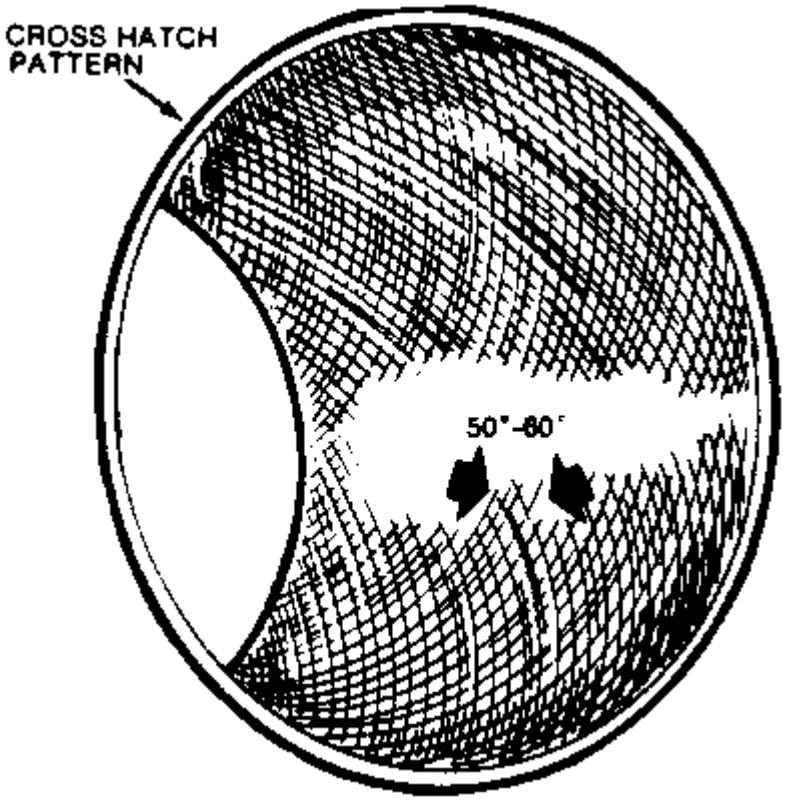
3. **Install the ridge removal tool in the top of the cylinder bore. Carefully follow the manufacturers instructions for operation. Only remove the amount of material necessary to remove the ridge. Place the piston at the bottom of its stroke, and cover it with a rag. Cut the ridge away with the ridge reamer, using extreme care to avoid cutting too deeply. Remove the rag, and remove the cuttings that remain on the piston with a magnet and a rag soaked in clean oil. Make sure the piston top and cylinder bore are absolutely clean before moving the piston.**

WARNING

Be very careful if you are unfamiliar with operating a ridge reamer. It isvery easy to remove more cylinder bore material than you want, possiblyrequiring a cylinder overbore and piston replacement that may not have beennecessary.

4. **After the piston and connecting rod assembly have been removed, check the clearances as explained earlier in this section under the cleaning and inspection procedure, to determine whether boring and honing or just light honing are required. If boring is necessary, consult an automotive machine shop. If light honing is all that is necessary, proceed with the next step.**
5. **Honing is best done with the crankshaft removed, to prevent damage to the crankshaft and to make the post-honing cleaning easier, as the honing process will scatter metal particles. However, if you do not want to remove the crankshaft, position the connecting rod journal for the cylinder being honed as far away from the bottom of the cylinder bore as possible, and wrap a shop cloth around the journal.**

Removing cylinder glazing using a flexible hone



Cylinder bore cross-hatch pattern

6. **Honing can be done either with a flexible glaze breaker type hone or with a rigid hone that has honing stones and guide shoes. The flexible hone removes the least amount of metal, and is especially recommended if your piston-to-cylinder bore clearance is on the loose side. The flexible hone is useful to provide a finish on which the new piston rings will seat. A rigid hone will remove more material than the flexible hone and requires more operator skill.**
7. **Regardless of which type of hone you use, carefully follow the manufacturers instructions for operation.**
8. **The hone should be moved up and down the bore at sufficient speed to obtain a**

uniform finish. A rigid hone will provide a definite cross-hatch finish; operate the rigid hone at a speed to obtain a 45-65 degree included angle in the cross-hatch. The finish marks should be clean but not sharp, free from embedded particles and torn or folded metal.

9. Periodically during the honing procedure, thoroughly clean the cylinder bore and check the piston-to-bore clearance with the piston for that cylinder.
10. After honing is completed, thoroughly wash the cylinder bores and the rest of the engine with hot water and detergent. Scrub the bores well with a stiff bristle brush and rinse thoroughly with hot water. Thorough cleaning is essential, for if any abrasive material is left in the cylinder bore, it will rapidly wear the new rings and the cylinder bore. If any abrasive material is left in the rest of the engine, it will be picked up by the oil and carried throughout the engine, damaging bearings and other parts.
11. After the bores are cleaned, wipe them down with a clean cloth coated with light engine oil, to keep them from rusting.

A properly cross-hatched cylinder bore

To install:

12. Lubricate each piston, rod bearing, and cylinder wall with heavy weight engine oil.
13. Take the bearing nuts and cap off connecting rod. Install rubber hoses over the connecting rod bolts to protect the block and crankshaft journal.
14. Install a ring compressor over the piston, position piston with the mark toward front of engine and carefully install.
15. Position the connecting rod with bearing insert over the crank journal. Install the rod cap with bearing in proper position. Secure with rod nuts and torque to the proper specifications. Install all of the rod and piston assemblies.

PISTON RING REPLACEMENT

1. Take the new piston rings and compress them, one at a time into the cylinder that they will be used in. Press the ring about 25mm below the top of the cylinder block using an inverted piston.
2. Use a feeler gauge and measure the distance between the ends of the ring. This is

called measuring the ring end gap. Compare the reading to the one called for in the specifications table. If the measurement is too small, when the engine heats up the ring ends will butt together and cause damage. File the ends of the ring with a fine file to obtain necessary clearance.

If inadequate ring end gap is utilized, ring breakagewill result.

3. Inspect the ring grooves on the piston for excessive wear or taper. If necessary, have the grooves recut for use with a standard ring and spacer. The machine shop can handle the job for you.
4. Check the ring grooves by rolling the new piston ring around the groove to check for burrs or carbon deposits. If any are found, remove with a fine file. Hold the ring in the groove and measure side clearance with a feeler gauge. If the clearance is excessive, spacer(s) will have to be added.

Always add spacers above the piston ring.

5. Install the ring on the piston, lower oil ring first. Use a ring installing tool (piston ring expander) on the compression rings. Consult the instruction sheet that comes with the rings to be sure they are installed with the correct side up. A mark on the ring usually faces upward.
6. When installing oil rings, first, install the expanding ring in the groove. Hold the ends of the ring butted together (they must not overlap) and install the bottom rail (scraper) with the end about 25mm away from the butted end of the control ring. Install the top rail about 25mm away from the butted end of the control but on the opposite side from the lower rail. Be careful not to scrap the piston when installing oil control rings.
7. Install the two compression rings. The lower ring first.
8. Consult the illustration for ring positioning, arrange the rings as shown, install a ring compressor and insert the piston and rod assembly into the engine.

PISTON PIN REPLACEMENT

1. Matchmark the piston head and the connecting rod for reassembly.
2. Position the piston assembly in a piston pin removal tool.
3. Following the tool manufacturers instructions, press the piston pin from the piston.
4. Check the piston pin bore for damage, replace defective components as required. Check the piston pin for damage, replace as required.
5. Installation is the reverse of the removal procedure.

ROD BEARING REPLACEMENT

1. Remove the engine from the vehicle. Position the engine assembly in a suitable holding fixture.
2. Remove the oil pan. Remove the oil pump, as required.
3. Rotate the crankshaft so that you can remove the rod bearing cap. Matchmark the rod bearing cap so that it can be reinstalled properly.
4. Remove the rod bearing cap.
5. Remove the upper half of the bearing from its mounting.
6. Carefully remove the lower half of the bearing from its mounting. It may be

necessary to push the piston down in the cylinder bore to to this.

7. Installation is the reverse of the removal procedure.

Freeze Plugs

For the vehicles covered by this manual, one of two types of freeze plugs may be used: a cup-type plug or an expansion-type plug. They are removed in the same way, however two different kinds of tools are used to install them.

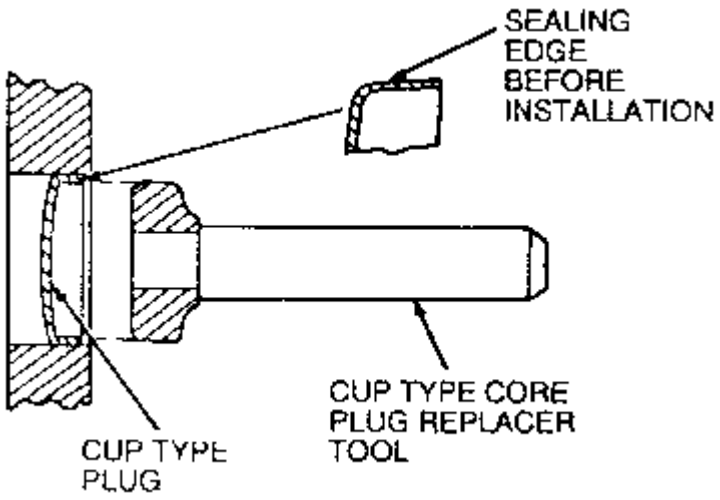
REMOVAL & INSTALLATION

1. Disconnect the negative battery cable. Drain the cooling system.
2. Remove the necessary components to gain access to the freeze plug.
3. As required, raise and support the vehicle safely.
4. Drill a $^{1}/_{2}$ in. (12.7mm) hole in the center of the plug, then remove the plug using a Universal Impact Slide Hammer T59L-100-B or equivalent. Inspect the plug bore for damage that might interfere with the proper sealing of the plug. If the bore is damaged, you will have to bore the surface to accommodate the next specified oversize plug.

Oversize plugs are identified by the "OS'' stamped in the flat on the cup side of the plug.

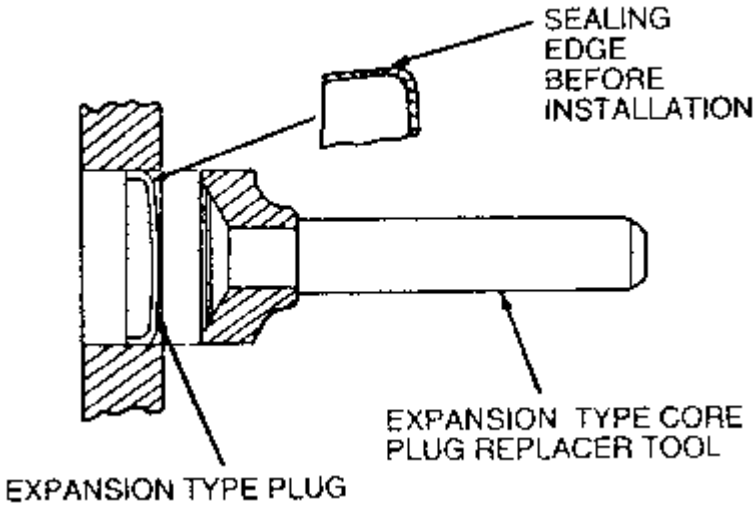
To install:

5. Lightly coat the plug and/or bore with an oil resistant Stud and Bearing Mount E0AZ-19554-BA or Threadlock 262 E2FZ-19554-B or equivalent.
6. Cup type core plugs are installed with the flanged edge outward. The maximum diameter of this plug is located at the outer edge of the flange. The flange on cup type plugs flares outward with the largest diameter at the outer sealing edge.
7. Expansion type core plugs are installed with the flanged edge inward. The maximum diameter of this plug is located at the base of the flange with the flange flaring inward.
8. For the cup-type plug, it is important to push or drive the plug into the machined bore by using the proper tool. Never drive the plug using a tool that contacts the crowned part of the plug. Damage to the plug and/or plug bore may result. When installed, the trailing (maximum) diameter must be below the the chamfered edge of the bore to effectively seal the plugged bore.



Use the proper tool when installing a cup-type plug

9. **For the expansion-type plug, it is important to pull the plug into the machined bore by using a properly designed tool. Never drive the plug into the bore using a tool that contacts the flange. Leakage and/or plug blowout will result. the flanged (trailing) edge must be below the chamfered edge of the bore to effectively seal the plugged bore.**



Use the proper installation tool when installing an expansion-type plug

10. **Install all the removed components. Lower the vehicle, as required.**
11. **Fill the cooling system and check for leaks.**

Block Heater

REMOVAL & INSTALLATION

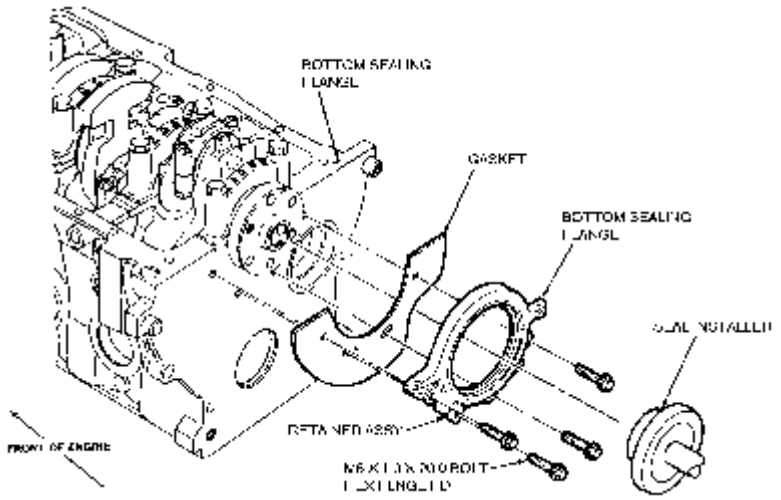
1. **Disconnect the negative battery cable. Drain the cooling system.**
2. **Remove the necessary components to gain access to the engine block heater.**
3. **As required, raise and support the vehicle safely.**
4. **Carefully remove the engine block heater from its mounting on the engine block.**
5. **Installation is the reverse of the removal procedure.**

Rear Main Seal

REMOVAL & INSTALLATION

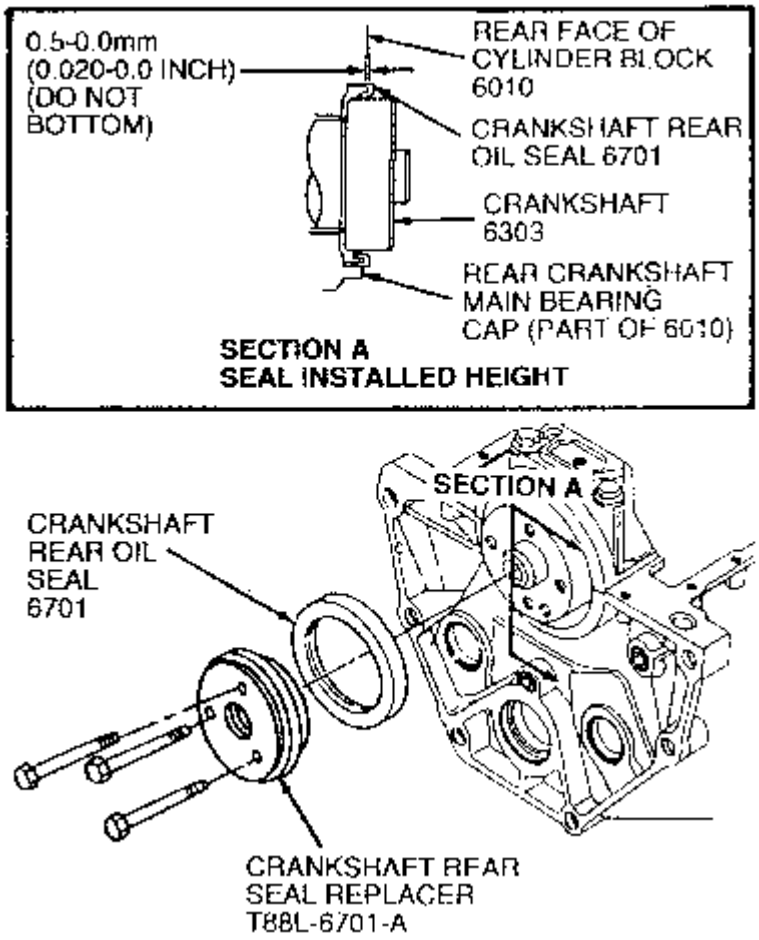
1. **Disconnect the negative battery cable.**
2. **Raise and safely support the vehicle.**
3. **Remove the transaxle. For details, please refer to the procedure located in *Section 7* of this manual.**
4. **Remove the flywheel and the rear cover plate, if necessary.**
5. **Using a sharp awl, punch one hole into the crankshaft rear oil seal metal surface between the seal lip and the cylinder block.**
6. **On all engines except the SHO engines, screw in the threaded end of Jet Plug Remover T77L-9533-B or equivalent, then use the tool to remove the seal.**
7. **For the SHO engines, Locknut Pin Remover T78P-3504-N into the crankshaft rear oil seal, then remove the seal from the retainer.**

Use caution to avoid damaging the oil seal surface.



Rear main bearing installation-2.5L engine

Click to enlarge



Rear main bearing installation-3.0L engine (except SHO)

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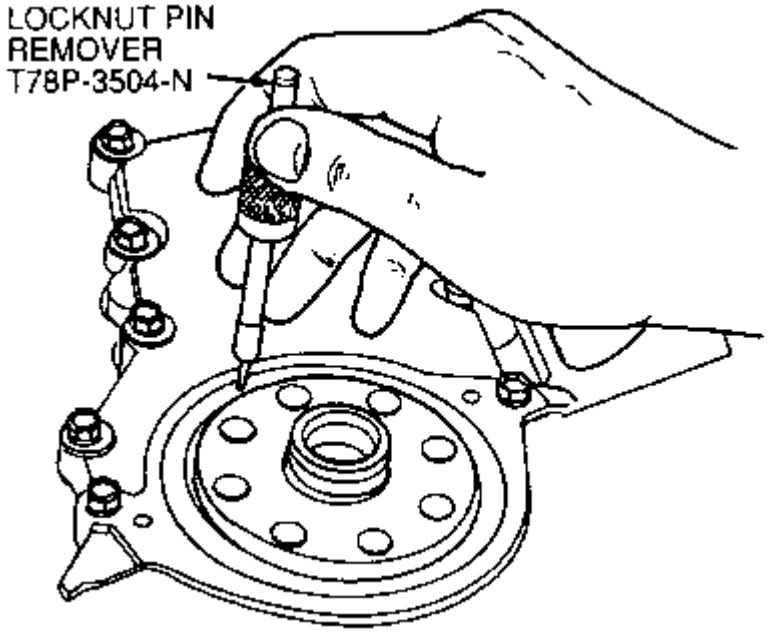
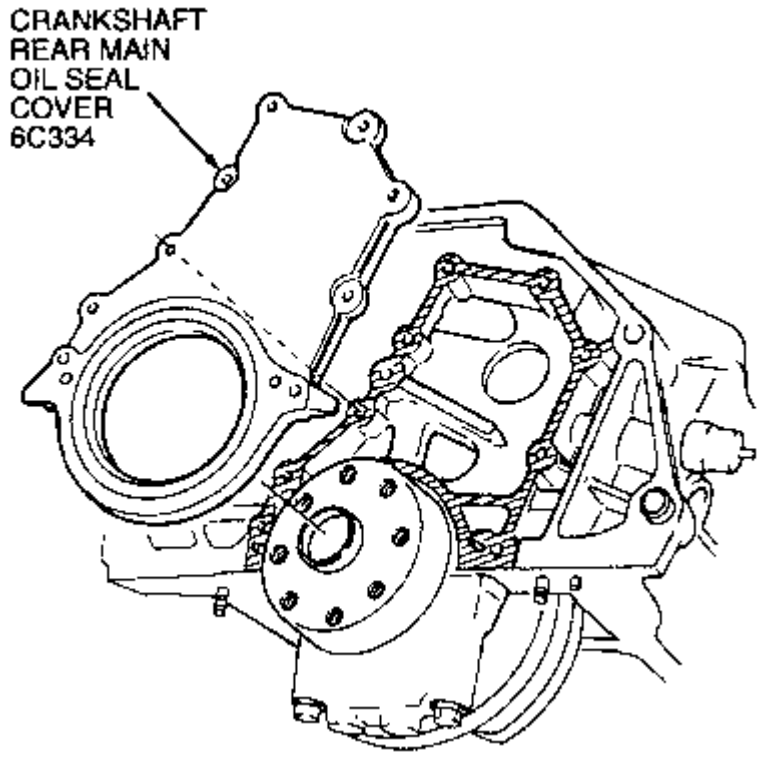
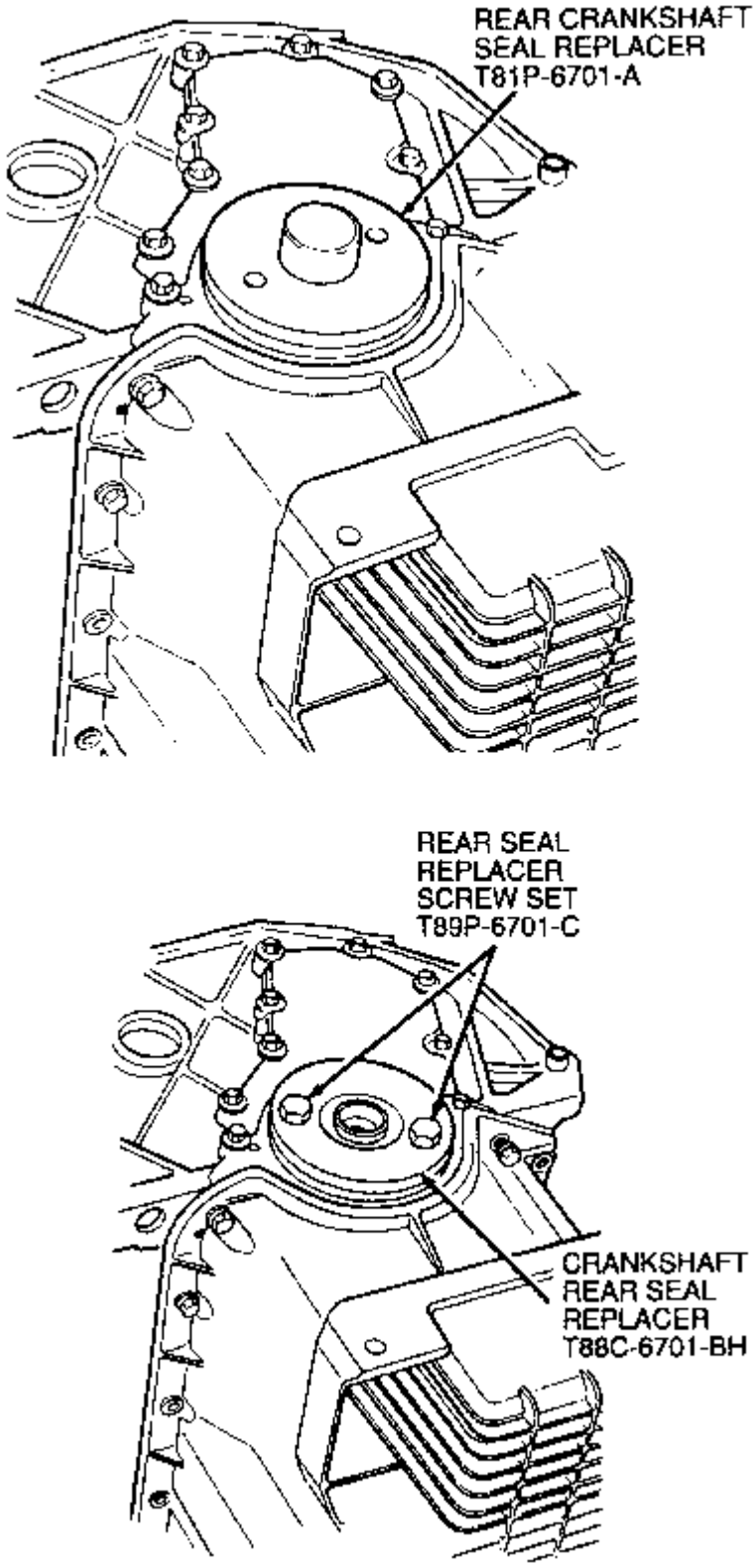


Removing the rear main oil seal using the specified tool-3.0L and 3.2L SHO engines

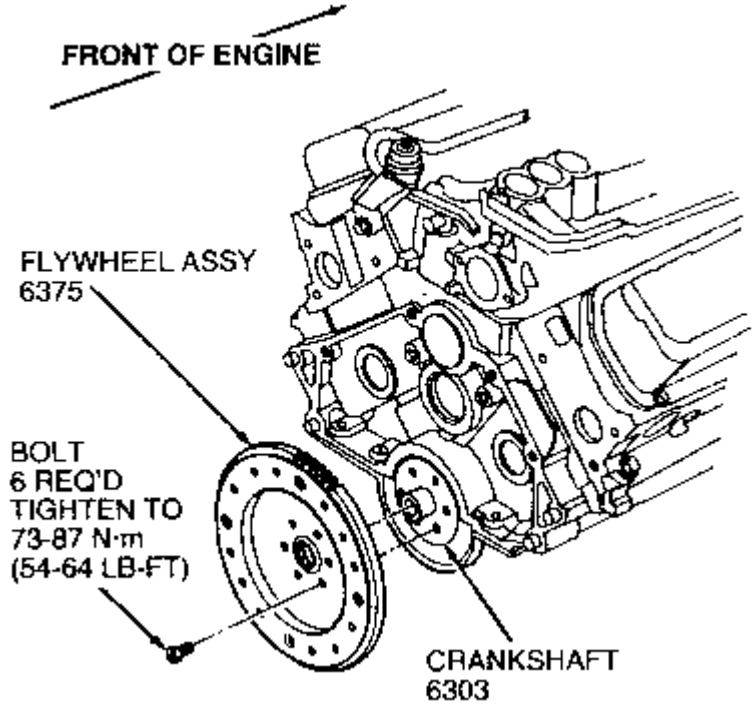


Crankshaft rear main oil seal cover-3.0L and 3.2L SHO engines



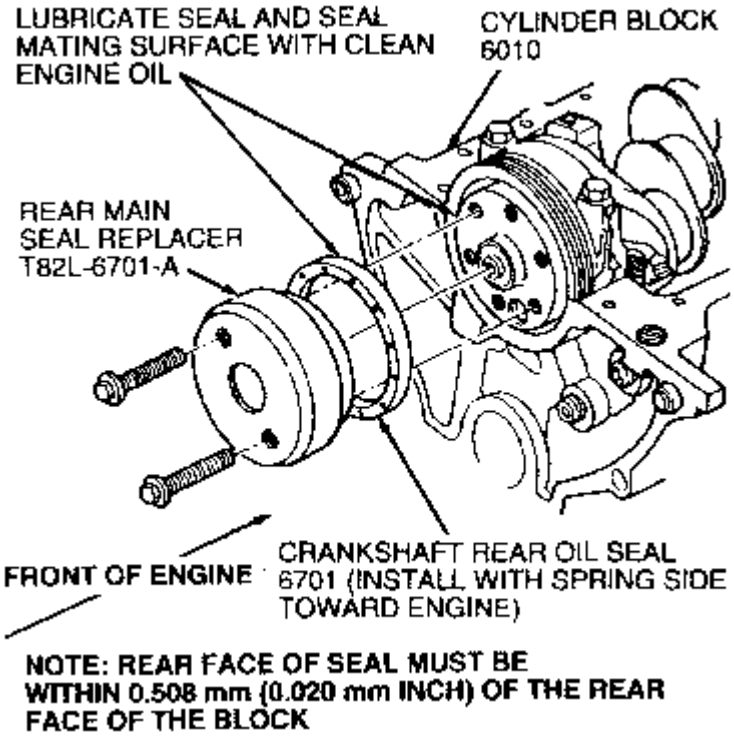
Installing the rear main oil seal on the SHO engines using the required tools

Click to enlarge



For the 3.8L engine, you have to remove the flywheel to access the rear main oil seal

Click to enlarge



Exploded view of installing the rear main oil seal-3.8L engine

Click to enlarge

To install:

8. **Inspect the crankshaft seal area for any damage which may cause the seal to leak. If damage is evident, service or replace the crankshaft as necessary.**

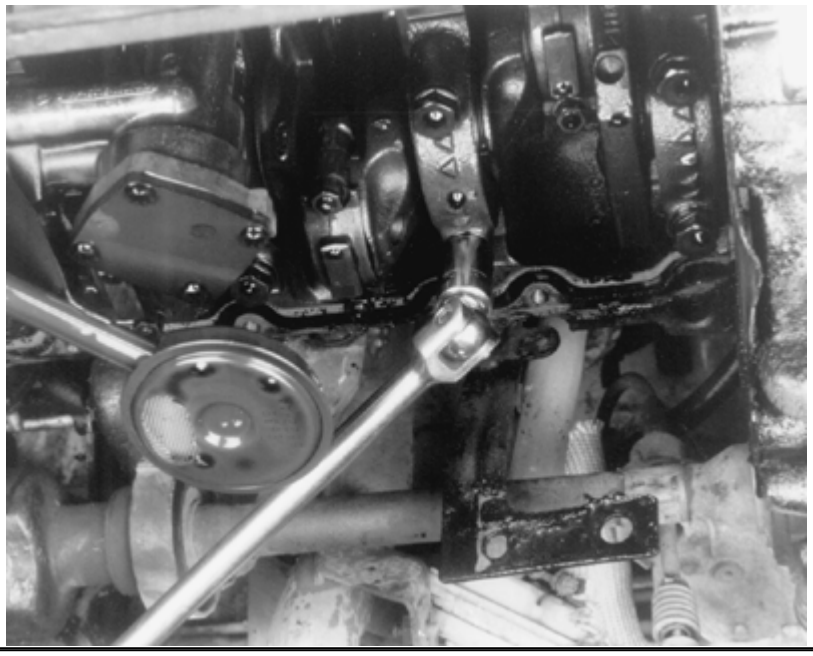
9. Coat the crankshaft seal area and the lip with engine oil.
10. Using a Rear Crankshaft Seal Replacer T81P-6701-A seal installer tool, install the seal. Tighten the bolts of the seal installer tool evenly so the seal is straight and seats without misalignment.
11. Install the flywheel. Tighten attaching bolts to 54-64 ft. lbs. (73-87 Nm) on all except the SHO engines. On the SHO engines, tighten the bolts to 51-58 ft. lbs. (69-79 Nm).
12. Install rear cover plate, if necessary.
13. Install the transaxle and connect the negative battery cable.

Crankshaft and Main Bearings

REMOVAL & INSTALLATION

2.5L Engine

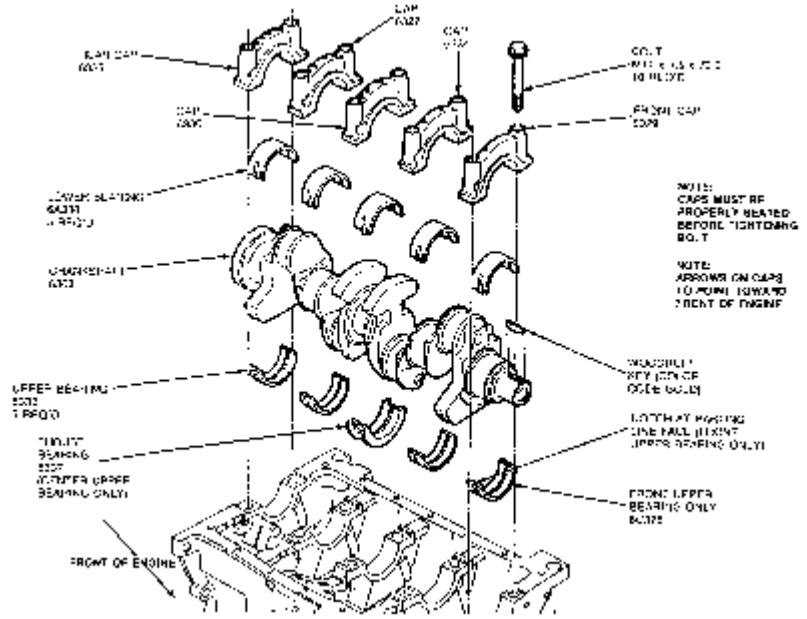
1. Disconnect the negative battery cable, then drain the engine oil.
2. Remove the engine from the vehicle, then place it on a work stand, then remove the oil level dipstick.
3. Remove the accessory drive pulley, if so equipped. Remove the crankshaft pulley attaching bolts and washer.
4. Remove the cylinder front cover and the air conditioning idler pulley assembly, if so equipped. Remove cover assembly.
5. Check the timing chain deflection. Remove the timing chain and sprockets.
6. Invert the engine on the work stand. Remove the flywheel and the rear seal cover. Remove the oil pan and gasket. Remove the oil pump inlet and the oil pump assembly.
7. Ensure all bearing caps (main and connecting rod) are marked so they can be installed in their original positions. Turn the crankshaft until the connecting rod from which the cap is being removed is up. Remove the connecting rod cap. Install a rubber hose onto the connecting rod bolts to prevent journal damage. Push the connecting rod and piston assembly up in the cylinder, then install the cap and nuts in their original positions. Repeat the procedure for the remaining connecting rod assemblies.
8. Remove the main bearing caps.



Remove the main bearing caps by removing the retaining bolts

9. **Carefully lift crankshaft out of the block so the upper thrust bearing surfaces are not damaged. Reinstall the main bearing caps on the block.**

Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.



Exploded view of the crankshaft and the related components-2.5L engine

Click to enlarge

To install:

If the bearings are to be reused they should be identified to ensure that they are installed in their original position.

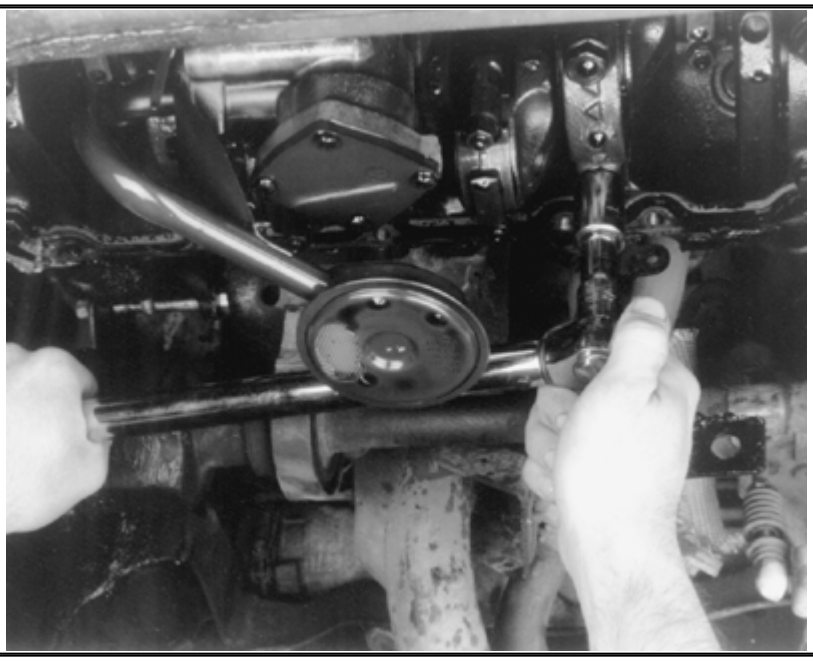
10. **Remove the main bearing inserts from the block and bearing caps.**

11. **Remove the connecting rod bearing inserts from the connecting rods and caps.**
12. **Install a new rear oil seal in the rear seal cover.**
13. **Apply a thin coat of Ford Polyethylene Grease D0AZ-19584-A (ESR-M1C159-A or ESB-M1C93-A) or equivalent, to the rear crankshaft surface. Do not apply sealer to the area forward of oil sealer groove. Inspect all the machined surfaces on the crankshaft for nicks, scratches or scores which could cause premature bearing wear.**
14. **If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings, usually 0.25mm, 0.50mm, 0.80mm undersize. Ensure the bearing inserts and bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.**
15. **Place the upper main bearing inserts in position in the bores with the tang fitted in the slot provided.**

Lubricate the bearing surfaces with Oil Conditioner part No. D9AZ-19579-CF or equivalent. Conditioner is needed for lubrication at initial start up.

16. **Install the lower main bearing inserts in the bearing caps.**
17. **Carefully lower the crankshaft into place.**
18. **Check the clearance of each main bearing. Select fit the bearings for proper clearance.**
19. **After the bearings have been fitted, apply a light coat of oil conditioner to journals and bearings. Install all the bearing caps and torque to proper specifications. Tighten the main bearing cap bolts to 52-66 ft. lbs. (70-90 Nm) and the connecting rod cap nuts to 21-26 ft. lbs. (28-35 Nm).**

The main bearing caps must be installed in their original positions.



Torque the main bearing cap bolts to specification

20. **Align the upper thrust bearing.**
21. **Check the crankshaft end play, using a dial indicator mounted on the front of the engine.**

22. If the end play exceeds specification, replace the upper thrust bearing. If the end play is less than the specification, inspect the thrust bearing faces for damage, dirt or improper alignment. Install the thrust bearing and align the faces. Check the end play.
23. Install the new bearing inserts in the connecting rods and caps. Install rubber hoses on the rod bolts to prevent crankshaft journal damage. Check the clearance of each bearing using a piece of Plastigage®.
24. If the bearing clearances are to specification, apply a light coat of Oil Conditioner part No. D9AZ-19579-CF to the journals and bearings.
25. Turn the crankshaft throw to the bottom of the stroke. Push the piston all the way down until the rod bearings seat on the crankshaft journal.
26. Install the connecting rod cap and nuts. Torque the nuts to specifications
27. After the piston and connecting rod assemblies have been installed, check all the connecting-rod-crankshaft journal clearances using a piece of Plastigage®.
28. Turn the engine on the work stand so the front end is up. Install the timing chain, sprockets, timing chain tensioner, front cover, oil seal and the crankshaft pulley.
29. Clean the oil pan, oil pump and the oil pump screen assembly.
30. Prime the oil pump by filling the inlet opening with oil and rotating the pump shaft until oil emerges from the outlet opening. Install the oil pump. Install the oil pan.
31. Position the flywheel on the crankshaft. Apply Pipe Sealant with Teflon® D8AZ-19554-A (ESG-M4G194-A and ESR-M18P7-A) or equivalent oil resistant sealer to the flywheel attaching bolts using a cross tightening sequence. Torque the bolts to 54-64 ft. lbs. (73-87 Nm).

On the flywheel, if equipped with manual transmission, locate clutch disc and install pressure plate.

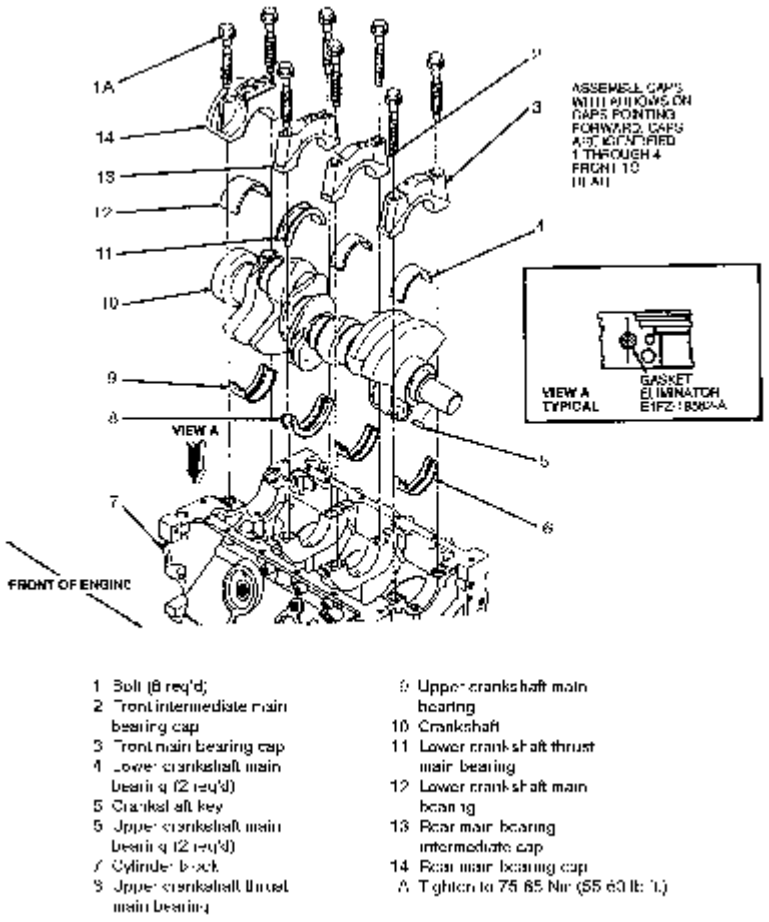
32. Turn the engine on the work stand so the engine is in the normal upright position. Install the oil level dipstick. Install the accessory drive pulley, if so equipped. Install and adjust the drive belt and the accessory belts to specification.
33. Remove the engine from work stand. Install the engine in the vehicle. Fill the crankcase with the correct amount and type of oil, then connect the negative battery cable.

3.0L Engine-Except SHO

1. With the engine removed from the vehicle and placed on a workstand, loosen the idler pulley and the alternator belt adjusting bolt.
2. Remove the oil pan and gasket.
3. Remove the front cover assembly.
4. Check the timing chain deflection. Remove the timing chain and sprockets.
5. Invert the engine on the workstand. For vehicles through 1993, remove the flywheel. For 1994-95 vehicles remove the pushrod. Remove the oil pump inlet and the oil pump assembly.
6. Ensure all bearing caps (main and connecting rod) are marked so that they can be installed in their original positions. Turn the crankshaft until the connecting rod from which the cap is being removed is up. Remove the connecting rod cap. Push the connecting rod and piston assembly up in the cylinder. Repeat the procedure for the remaining connecting rod assemblies.
7. Remove the main bearing caps.

Handle the crankshaft with care to avoid possible damage to the finished surfaces or the engine.

8. **Carefully lift the crankshaft out of the block so that the upper thrust bearing surfaces are not damaged.**



Exploded view of the crankshaft, main bearing caps, and bearings-3.0L engine (except SHO)

Click to enlarge

To install:

If the bearings are to be reused they should be identified to ensure that they are installed in their original positions.

9. **Remove the main bearing inserts from the block and bearing caps.**
10. **Remove the connecting rod bearing inserts from the connecting rods and caps.**
11. **Inspect all the machined surfaces on the crankshaft for nicks, scratches, scores, etc., which could cause premature bearing wear.**
12. **If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings.**

Ensure that the bearing inserts and the bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.

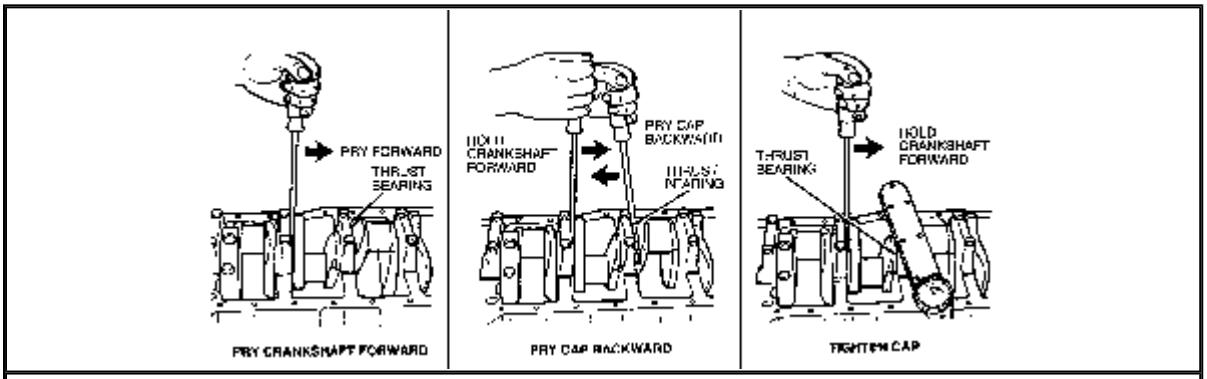
13. **Place the upper main bearing inserts into position in the bores with the tang fitted**

in the slot provided.

14. Install the lower main bearing inserts in the bearing caps.
15. Carefully lower the crankshaft into place.
16. Check the clearance of each main bearing. Select fit the bearings for proper clearance.
17. After the bearings have been fitted, apply a light coat of Oil Conditioner part No. D9AZ-19578-CO or heavy engine oil, SAE 50 weight, to the journals bearings and rear seal surface. Install all the bearing caps. Apply RTV to the gap between the rear main bearing and the block. Take care to keep RTV from the parting surfaces between the block and the cap.

Ensure the main bearing caps are installed in their original positions and orientation.

18. Lubricate the journal with oil conditioner or heavy engine oil 50 SAE weight. Install the thrust bearing cap with the bolts finger-tight. Pry the crankshaft forward against the thrust surface of the upper half of the crankshaft thrust main bearing. Hold the crankshaft cap to the rear. This will align the thrust surfaces of both halves of the bearing to be positioned properly. Retain the forward pressure on the crankshaft. Tighten the cap bolts to 55-63 ft. lbs. (75-85 Nm).



Crankshaft bearing alignment-3.0L engine (except SHO)

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19. Check the crankshaft end play with a dial indicator mounted on the front of the engine.
20. If the end play exceeds specification, replace the upper and lower thrust bearings. If the end play is less than specification, inspect the thrust bearing faces for damage, dirt or improper alignment. Install the thrust bearing and align the faces. Recheck the end play.
21. Install the new bearing inserts in the connecting rods and caps. Check the clearance of each bearing by using a piece of Plastigage®.
22. If the bearing clearances are to specification, apply a light coat of Oil Conditioner part No. D9AZ-19579-C or heavy engine oil, SAE 50 weight, to the journals and bearings.
23. Turn the crankshaft throw to the bottom of the stroke. Push the piston all the way down until the rod bearings seat on the crankshaft journal.
24. Install the connecting rod cap.
25. After the piston and connecting rod assemblies have been installed, check all the connecting rod crankshaft journal clearances using a piece of Plastigage®.

26. Turn the engine on the work stand so that the front end is up. Install the timing chain, sprockets, front cover, new oil seal and crankshaft pulley. Turn the engine on the work stand so that the rear end is up. Install the rear oil seal.
27. Clean the oil pan, oil pump and the oil pump screen assembly.
28. Prime the oil pump by filling the inlet opening with oil and rotating the pump shaft until the oil emerges from the outlet opening. Install the oil pump, baffle and oil pan.
29. Position the flywheel on the crankshaft. Tighten to 54-64 ft. lbs. (73-87 Nm).
30. Turn the engine on work stand so that the engine is in the normal upright position. Install the accessory drive pulley. Install and adjust the accessory drive belts to specification.
31. Install the torque converter, as required.
32. Remove the engine from the work stand. Install the engine in the vehicle.

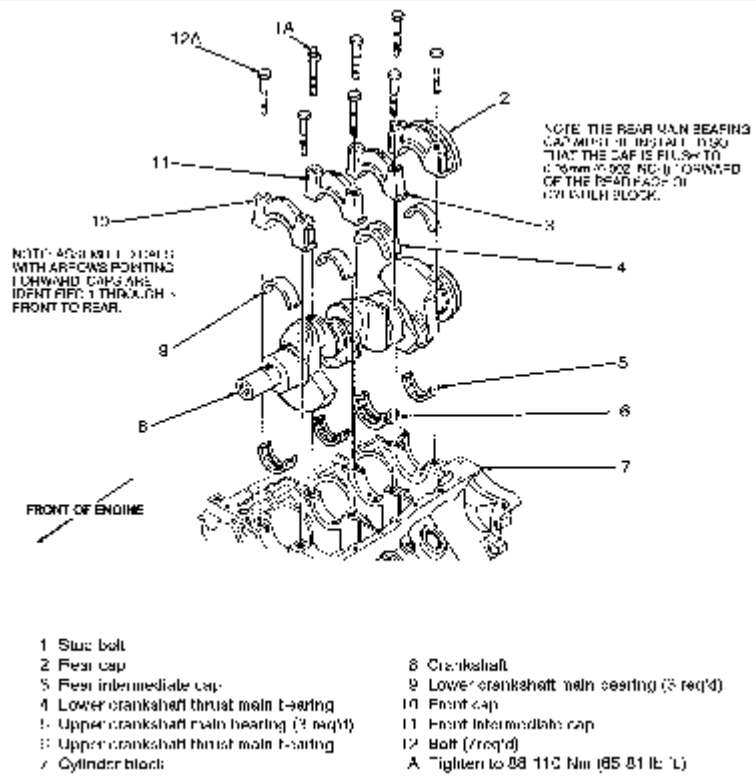
3.8L Engine

If the bearings are to be reused, they should be identified to ensure that they are installed in their original positions.

1. Disconnect the negative battery cable, then drain the engine oil. Remove the engine from the vehicle and mount it on a suitable work stand.
2. Tag and disconnect the ignition wires from the spark plugs, then remove the distributor cap and ignition wires as an assembly. Remove the spark plugs.
3. On Taurus Police vehicles, remove the oil pan baffle.
4. Remove the oil pan and oil pickup tube.
5. Remove the front cover and water pump as an assembly.
6. Remove the distributor drive gear,.
7. Remove the camshaft and crankshaft sprockets and the timing chain.To do this: pull back on the ratcheting mechanism of the timing chain vibration damper, then install the pin through the hole to relieve the tension against the chain.
8. Remove the flywheel and the engine rear cover.
9. Remove the connecting rod bearing nuts and caps. Identify each bearing cap to insure that they are installed in their original positions. Push the pistons up into the cylinder and put pieces of rubber hose on the connecting rod bolts so the crankshaft journals do not get damaged.
10. Inspect all the machined surfaces on the crankshaft for nicks, scratches, scores, etc., which could cause premature bearing wear.

Because the engine crankshaft incorporates deep rolling of the main journal fillets, journal refinishing is limited to 0.25mm undersize. Further refinishing may result in fatigue failure of the crankshaft. Ensure the bearing inserts and the bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.

11. Remove the main bearing caps and identify each bearing cap to insure that they are installed in their original positions.
12. Carefully lift the crankshaft out of the block to prevent damage to bearing surfaces. Remove rear oil seal and discard. Before installation, lightly oil all bolt and stud threads.



Exploded view of the crankshaft, main bearing caps and bearings-3.8L engine

Click to enlarge

To install:

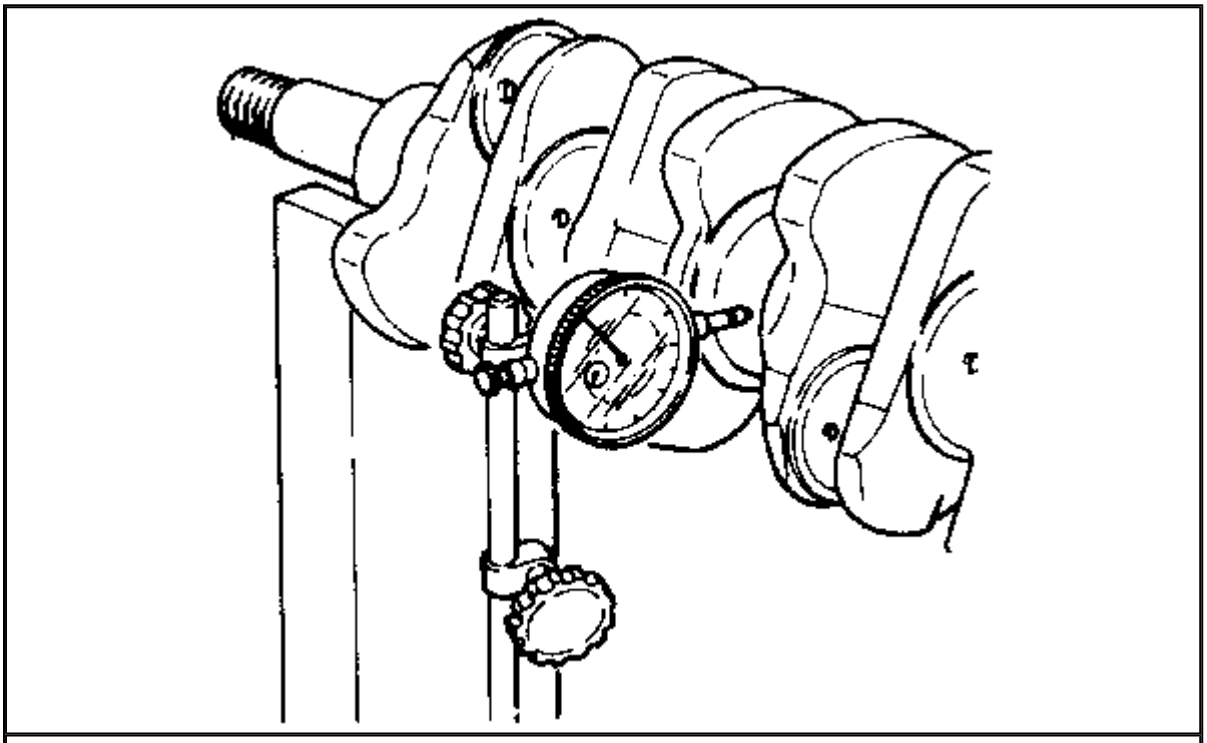
13. **Make sure all crankshaft bearing journals and bearing caps are clean. Contaminants under a bearing will cause distortion. Contaminants on the bearing surface will cause damage to the bearing journals.**
14. **If the crankshaft journals have been refinished to a definite undersize, make sure the proper undersize is being used.**
15. **Install the used main bearings to their original positions. If using new ones, install the tabs on the bearings into the slots in the cap and the block.**
16. **Carefully lower crankshaft into position in the cylinder block. Be careful not to damage the thrust bearing surfaces.**
17. **Apply a 3mm bead of Silicone Sealer part No. D6AZ-19562-A or equivalent to the rear main bearing cap-to-cylinder block parting line.**
18. **Lubricate the bearing surfaces and journals with Oil Conditioner part No. D9AZ-19579-CF or equivalent heavy engine oil 50 SAE weight.**
19. **Install the main bearing caps in the proper direction. Tighten the retaining bolts as follows:**
    1. **Do NOT jam the pry bar into position. Carefully tap on the pry bar until it holds the crankshaft toward the front of the engine. Wedge a pry bar between the cylinder block web and crankshaft cheek in front of the No. 3 crankshaft main bearing.**
    2. **Tighten the main bearing cap retaining bolts to 65-81 ft. lbs. (88-110 Nm), then remove the prybar.**
20. **Check crankshaft end-play. If the end play exceeds specification, replace the upper and lower thrust bearings. If the end play is less than specification, inspect**

the thrust bearing faces for damage, dirt or improper alignment. Install the thrust bearing and align the faces. Recheck the end play.

21. Install a new crankshaft rear oil seal.
22. Install the used connecting rod bearings to their original positions. If using new ones, install the tabs on the bearings into the slots in the cap and the rod.
23. Rotate the crankshaft as necessary to bring each throw to the lowest point of travel. Pull the piston downward until the connecting rod seats on the crank throw. Install the connecting rod caps and torque in three steps:
    1. Tighten retaining nuts to 31-36 ft. lbs. (42-49 Nm).
    2. Loosen the nuts 2-3 turns.
    3. Final tighten the nuts to 31-36 ft. lbs. (42-49 Nm).
24. Install the timing chain assembly, distributor gear, oil pan baffle, oil pan, rear cover and flywheel, and spark plugs.
25. Install the distributor cap, then connect the ignition wires as tagged during removal.
26. Install the engine in the vehicle. Connect the negative battery cable, then fill the crankcase with the correct amount and type of engine oil.

CLEANING & INSPECTION

1. Clean the crankshaft with solvent and a brush. Clean the oil passages with a suitable brush, then blow them out with compressed air.
2. Inspect the crankshaft for obvious damage or wear. Check the main and connecting rod journals for cracks, scratches, grooves or scores. Inspect the crankshaft oil seal surface for nicks, sharp edges or burrs that could damage the oil seal or cause premature seal wear.

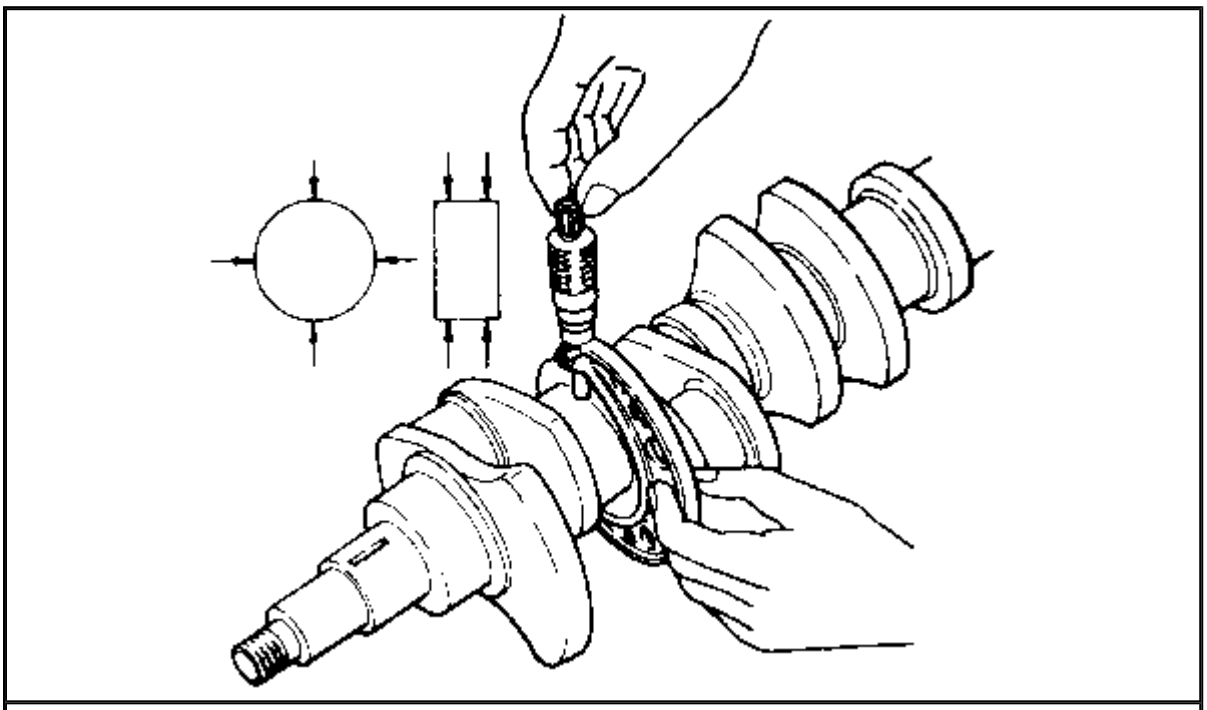


Checking the crankshaft for excessive run-out

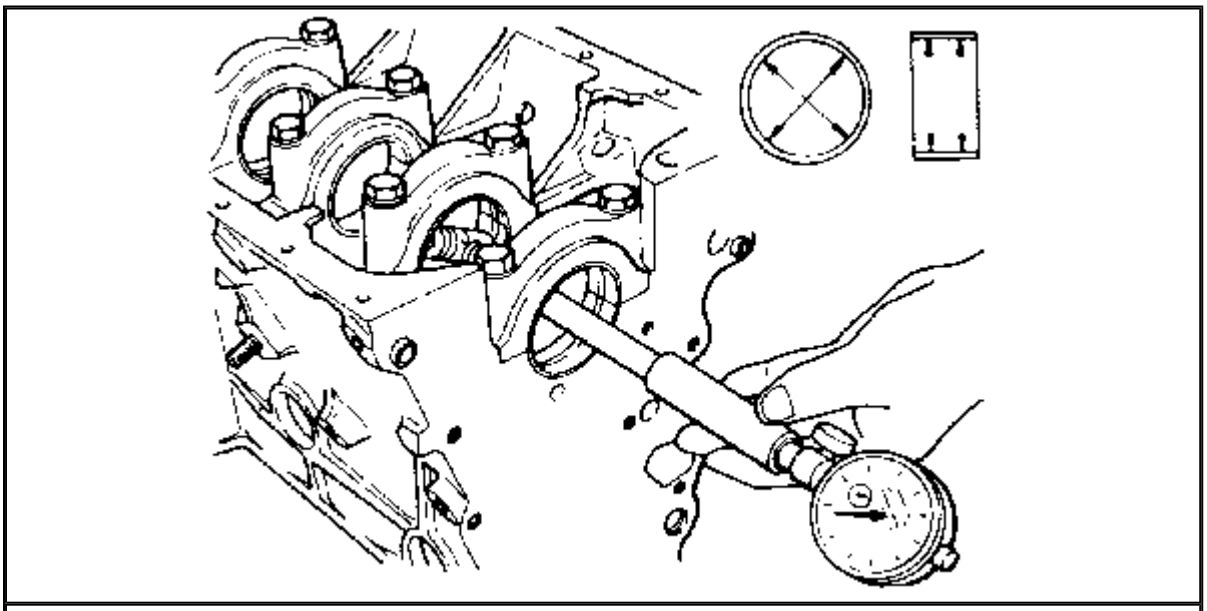
3. If the crankshaft passes a visual inspection, check journal run-out using a dial indicator. Support the crankshaft in V-blocks as shown in the figure and check the

run-out as shown. Compare to specifications.

4. Measure the main and connecting rod journals for wear, out-of-roundness or taper, using a micrometer. Measure in at least 4 places around each journal and compare your findings with the journal diameter specifications.
5. If the crankshaft fails any inspection for wear or damage, it must be reground or replaced.



Checking the main bearing journal using a micrometer



Checking main bearing bore diameter with the bearings installed

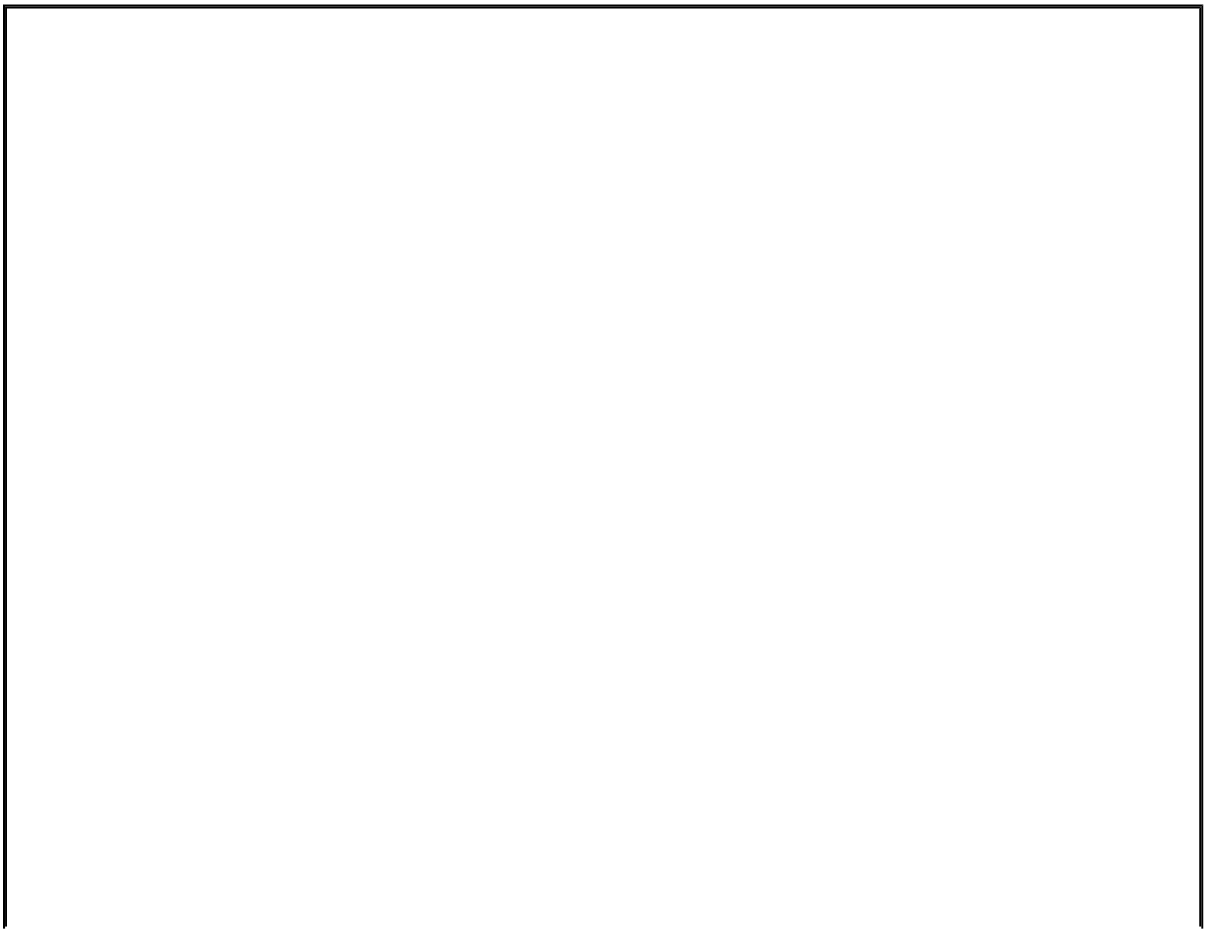
BEARING REPLACEMENT

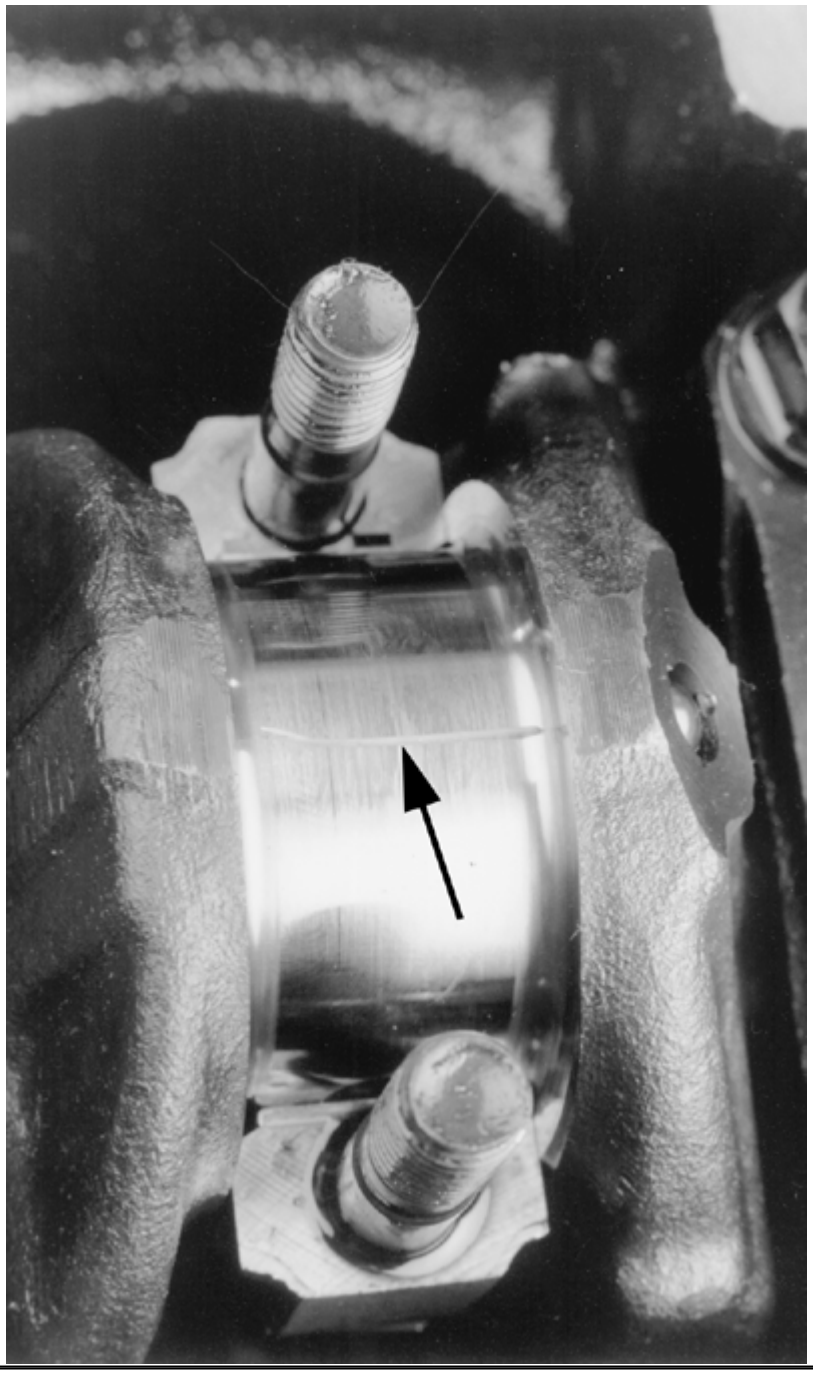
The following procedure requires the use of Plastigage® or a micrometer set consisting of inside and outside micrometers, and a dial indicator.

1. Inspect the bearings for scoring, chipping or other wear.

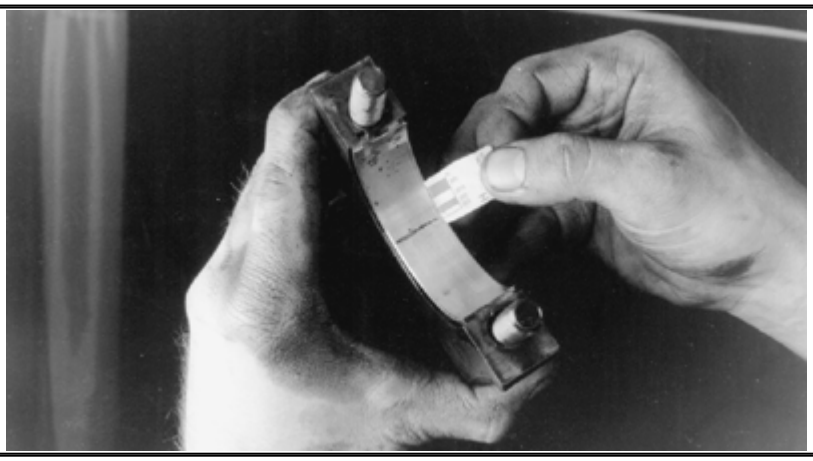
2. **Inspect the crankshaft journals as detailed in the Cleaning and Inspection procedure.**
3. **If the crankshaft journals appear usable, clean them and the bearing shells until they are completely free of oil. Blow any oil from the oil hole in the crankshaft.**
4. **To check the crankshaft/rod bearing clearances using a micrometer, perform the following procedures:**
    1. **Set the crankshaft on V-blocks. Using a dial indicator set on the center bearing journal, check the crankshaft run-out. Repair or replace the crankshaft if out of specification.**
    2. **Using an outside micrometer, measure the crankshaft bearing journals for diameter and out-of-round conditions; if necessary, regrind the bearing journals.**
    3. **Install the bearings and caps, then torque the nuts/bolts to specifications. Using an inside micrometer, check the bearing bores in the engine block. If out of specification, regrind the bearing bores to the next largest oversize.**
    4. **The difference between the two readings is the bearing clearance. If out of specification, inspect for the cause and repair as necessary.**
5. **To inspect the main bearing surfaces, using the Plastigage® method, perform the following procedures:**

NOTE: The journal surfaces and bearing shells must be completely free of oil to get an accurate reading with Plastigage®.





Apply a strip of gauging material to the bearing, then install and tighten the cap



As with the connecting rod bearings, remove the cap and compare the gauging material to the provided scale

1. Place a strip of Plastigage® or equivalent gauging material, lengthwise along the bottom center of the lower bearing shell, then install the cap with the shell and torque the connecting rod nuts or main cap bolts to specification. When the Plastigage® material is installed on the bearing surfaces, DO NOT rotate the crankshaft.
2. Remove the bearing cap with the shell. The flattened Plastigage® will either be sticking to the bearing shell or the crankshaft journal.
3. Using the printed scale on the Plastigage® package, measure the flattened material at its widest point. The number on the scale that most closely corresponds to the width of the Plastigage® indicates the bearing clearance in thousandths of an inch or hundredths of a millimeter.
4. Compare your findings with the bearing clearance specification. If the bearing clearance is excessive, the bearing must be replaced or the crankshaft must be ground and the bearing replaced. NOTE: Bearing shell sets over standard size are available to correct excessive bearing clearance.
5. After clearance measurement is completed, be sure to remove the Plastigage® from the crankshaft and/or bearing shell.
6. For final bearing shell installation, make sure the connecting rod and rod cap and/or cylinder block and main cap bearing saddles are clean and free of nicks or burrs. Install the bearing shells in the bearing saddles, making sure the shell tangs are seated in the notches.

NOTE: Be careful when handling any plain bearings. Your hands and the working area should be clean. Dirt is easily embedded in the bearing surface and the bearings are easily scratched or damaged.

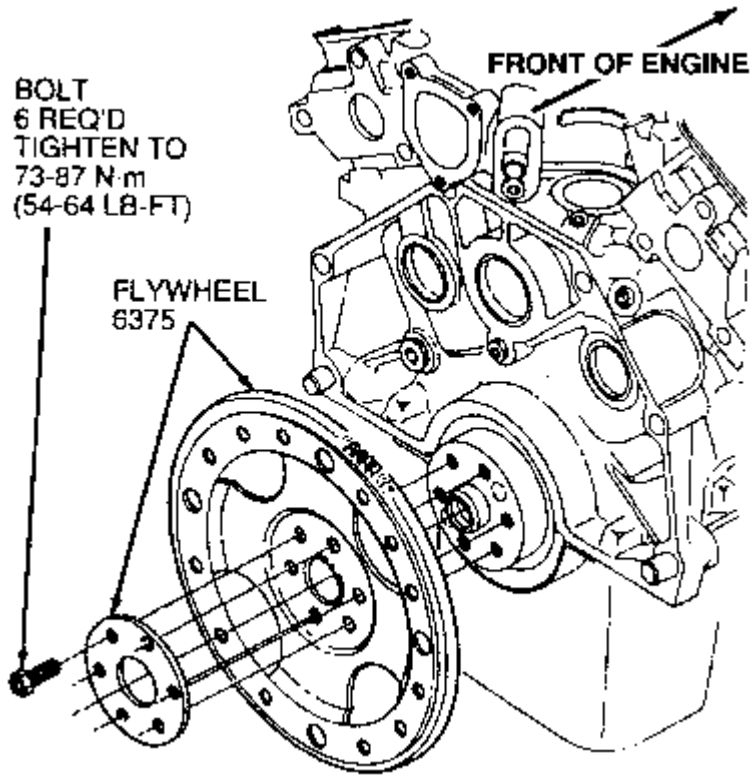
CRANKSHAFT END-PLAY/CONNECTING ROD SIDE PLAY

6. Place a prybar between a main bearing cap and crankshaft casting taking care not to damage any journals. Pry backward and forward, measure the distance between the thrust bearing and crankshaft with a feeler gauge.
7. Compare reading with specifications, 0.10-0.20mm. If too great a clearance is determined, a main bearing with a larger thrust surface or crank machining may be required. Check with an automotive machine shop for their advice.
8. Connecting rod clearance between the rod and crankthrow casting can be checked with a feeler gauge. Pry the rod carefully on one side as far as possible and measure the distance on the other side of the rod. Check the crankshaft and connecting rod specification table.

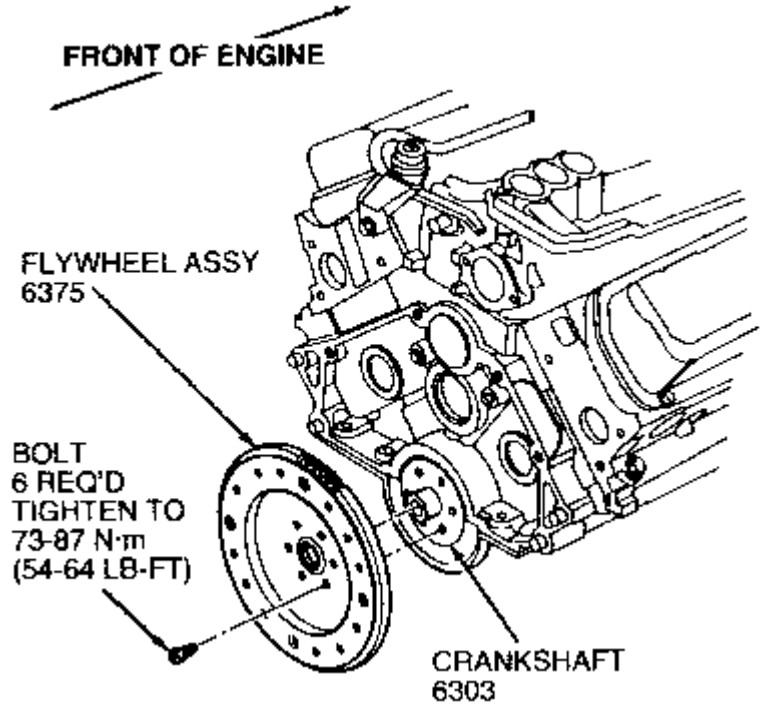
Flywheel/Flexplate

REMOVAL & INSTALLATION

1. For all vehicles except 1991-95 3.0L engines, remove the transaxle from the vehicle.
2. For the 1991-95 3.0L engine, remove the engine from the vehicle.
3. Remove the flywheel/flexplate attaching bolts and the flywheel.
4. The rear cover plate can be removed (manual transmission only).



Flywheel mounting-3.0L engine (except SHO)



Flywheel mounting-3.8L engine

To install:

All major rotating components including the flexplate / flywheel are individually balance to zero. Engine assembly balancing is not required. Balance weights should not be installed on new flywheels.

5. **Install the rear cover plate, if removed.**

6. **Position the flywheel on the crankshaft and install the attaching bolts. For all engines except the SHO, tighten the attaching bolts to 54-64 ft. lbs. (73-87 Nm), using the standard cross-tightening sequence. For the SHO engines, tighten the bolts in two steps:**
    1. **Step 1: 29-39 ft. lbs. (39-53 Nm)**
    2. **Step 2: 51-58 ft. lbs. (69-79 Nm)**
7. **If removed, install the transaxle.**