SECTION 03-01C Engine, 3.8L

VEHICLE APPLICATION

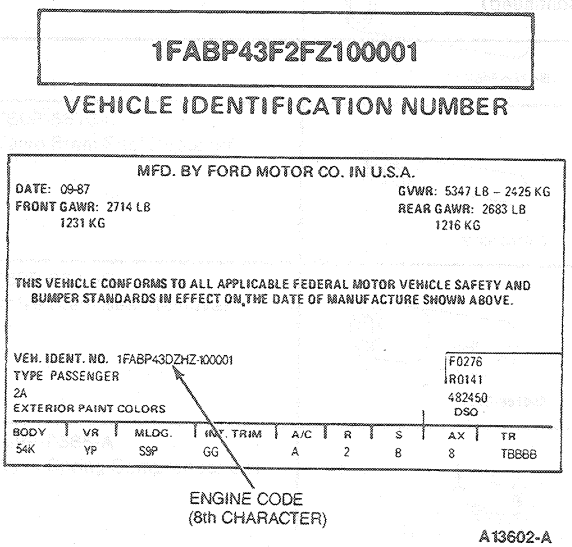
Taurus / Sable.

DESCRIPTION AND OPERATION

Engine Code Information Label

The engine code information label is located on the rocker arm cover. The label contains, among other information, the engine calibration number, engine build date, the engine plant code and an engine code.

The 3.8L engine has a V-block construction with overhead valves. The engine is available with automatic transaxle only and operates on unleaded fuel. The V-6, 3.8L engine is lightweight, compact and is similar to a V-8 engine in construction and components. The similarities and differences between the V-6 and V-8 will be noted in the following descriptions.



DESCRIPTION AND OPERATION (Continued)

Engine Identification

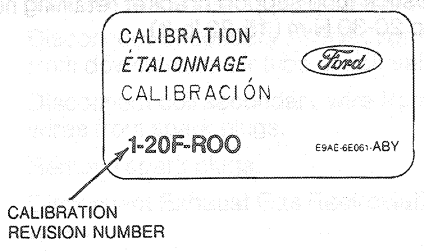
For quick engine identification, refer to the Safety Certification Decal. The decal is mounted on the LH front door lock face panel. Find the engine code (letter or number) on the decal, then refer to the engine identification chart to determine the engine type and size. An engine identification label is also attached to the engine. The symbol code on the identification tag identifies each engine for determining parts usage; for instance, engine cubic inch displacement and model year.

Code	Engines	Cyl.	Fuel Metering
U	3.0L (186 CID)	6	MFI
3	3.8L (231 CID)	6	MFI

Emission Calibration Label

NOTE: It is imperative that the engine codes and the calibration number be used when ordering parts or making inquiries about the engine.

The emission calibration number label is located on the LH side door or door post pillar. It identifies the engine calibration number, the engine code number and revision level. These numbers are used to determine if parts are unique to specific engines.



A11644-B

Induction System

The fuel / air mixture needed for burning in the cylinders is provided by Sequential Multiport Fuel Injection (SFI).

Fuel is metered into the air intake stream in accordance with engine demand by six solenoid injection valves mounted in the cylinder heads.

Fuel is supplied from the vehicle's fuel tank (9002) by a high-pressure electric fuel pump mounted in the fuel tank. The fuel is filtered and sent to the injector fuel rail assembly. A fuel pressure regulator (9C968) on this rail controls the fuel delivery pressure at a constant 269 kPa (39 psi). The six injector nozzles are mounted above the intake valves and connected in parallel with the fuel pressure regulator. Excess fuel supplied by the pump, but not needed by the engine, is returned to the vehicle fuel tank by a fuel return line.

These fuel induction systems are mounted on an aluminum intake manifold (9424) which in turn is bolted to aluminum alloy cylinder heads. The manifolds and heads are cast from aluminum to aid in removing weight from the engine. Service procedures related to these components remain similar to those for a V-8 engine. However, a spark plug thread service procedure is provided in the event damage should occur to these threads.

Crankshaft, Camshaft and Balance Shaft

The crankshaft is supported on the bottom of the cylinder block by four steel backed, over-plated copper-lead main bearings. The No. 3 bearing insert limits crankshaft end play and absorbs thrust loads applied to the crankshaft ends. To provide smooth engine operation, the piston crankpins are positioned to provide a power impulse every 120 degrees of crankshaft rotation. This spacing, along with the necessary changes to camshaft lobe and distributor timing, provides smoothness of operation and quietness comparable to a V-8 engine. Two sprockets and a timing chain connect the crankshaft with the camshaft and provide a 2:1 drive ratio.

The camshaft is installed in the block and is supported on four babbit-lined bearing inserts. Thrust loads and end play, however, are limited by a thrust plate installed at the front of the camshaft. Immediately behind the thrust plate are the balance shaft drive gear, the camshaft sprocket, and the distributor drive gear.

The purpose of the balance shaft is to reduce vibration produced by the engine. The balance shaft is gear-driven by the camshaft. The balance shaft is located in the tappet valley of the block and is supported by a babbit bearing at each end.

During operation the balance shaft rotates at engine speed in the opposite direction of crankshaft rotation, producing a force which cancels the rotating couple of the crankshaft.

Valve Train

The configuration of the valve train is identical to that used in V-8 engines. A hydraulic roller tappet, providing automatic lash adjustment, rides on a camshaft lobe and transfers its up-and-down motion to the rocker arm through a push rod. The rocker arms are pedestal-mounted and pivot on fulcrums bolted to the cylinder head. The valves are arranged alternately intake / exhaust.

DESCRIPTION AND OPERATION (Continued)

Lubrication System

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the crankshaft and connecting rod bearings, hydraulic tappets and camshaft bearings. From the tappets, a controlled volume of oil is supplied to the rocker arms through the hollow push rods. All other moving parts are lubricated by gravity flow or splash. The rotary gear-type pump, which develops the oil pressure, is attached to the front cover assembly. The pump driven gear is rotated by the distributor shaft through an intermediate shaft. A full flow oil filter is externally mounted on the front cover and normally all engine oil passes through the filter element. However, if the element should become restricted, a spring-loaded bypass valve will open, allowing an uninterrupted flow of oil to the engine's moving parts.

Drive Belt, Serpentine

Accessories mounted on the front of the engine are belt-driven by the crankshaft. A serpentine drive belt is routed over each accessory pulley and is driven by a pulley bolted to the crankshaft damper. The belt is held tight against the drive pulleys by an idler pulley attached to a tensioner mounted on the RH side of the engine. For service procedures, including tensioning, refer to Section 03-05.

IN-VEHICLE SERVICE

Exhaust Manifold, LH

Removal

1. Remove oil level dipstick tube support bracket.
2. Disconnect wires from spark plugs.
3. Raise vehicle on hoist. Refer to Section 00-02.
4. Remove manifold-to-exhaust pipe retaining nuts.
5. Lower vehicle.
6. Remove exhaust manifold retaining bolts and exhaust manifold (9431).

Installation

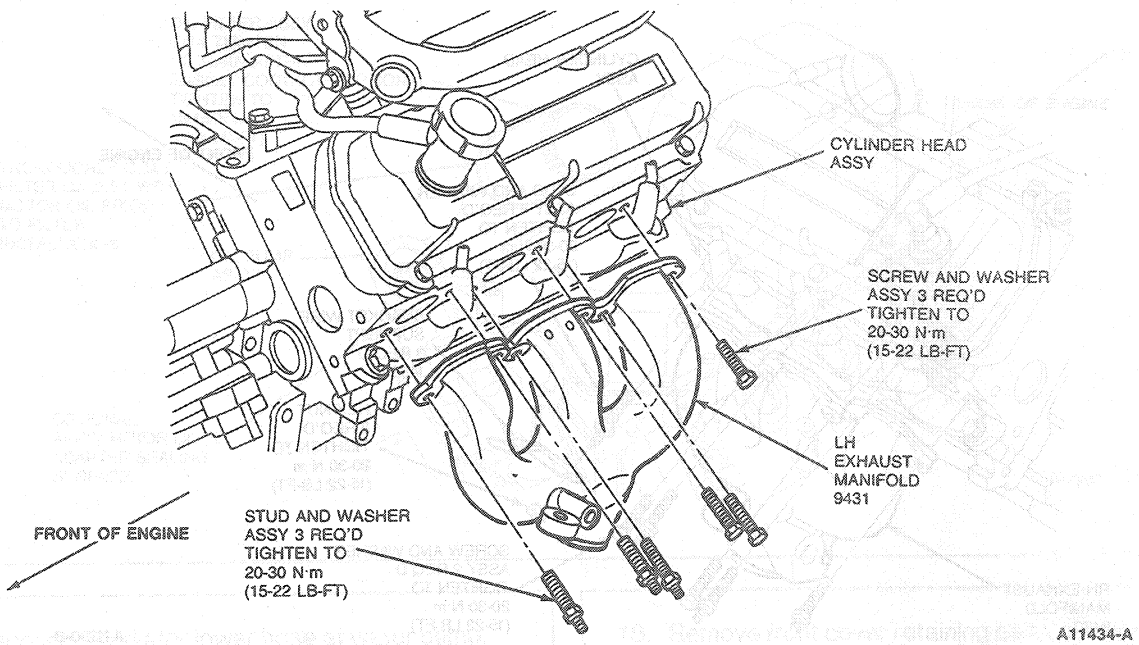
NOTE: Lightly oil all bolt and stud bolt threads before installation except those specifying special sealant.

1. Clean mating surfaces on the exhaust manifold cylinder head and exhaust pipe.
2. Position exhaust manifold on the cylinder head. Install pilot bolt (lower front bolt hole on No. 5 cylinder).

   NOTE: A slight warpage in the exhaust manifold may cause a misalignment between the bolt holes in the head and the manifold. Elongate the holes in the exhaust manifold as necessary to correct the misalignment. Do not elongate the pilot hole (lower front bolt on No. 5 cylinder).
3. Install remaining manifold retaining bolts. Tighten to 20-30 N·m (15-22 lb-ft).
4. Raise vehicle.
5. Connect exhaust pipe to exhaust manifold. Tighten retaining nuts to 21-32 N·m (16-24 lb-ft).
6. Lower vehicle.
7. Connect spark plug wires.
8. Install dipstick tube support bracket retaining nut. Tighten to 20-30 N·m (15-22 lb-ft).

IN-VEHICLE SERVICE (Continued)

9. Start engine and check for exhaust leaks.



Exhaust Manifold, RH

Removal

1. Remove air cleaner assembly and heat tube.
2. Disconnect Secondary Air Injection (AIR) hose from downstream air tube check valve.
3. Disconnect coil secondary wire from coil and wires from spark plugs.
4. Remove spark plugs.
5. Disconnect Exhaust Gas Recirculation (EGR) tube.
6. Raise vehicle on hoist. Refer to Section 00-02.
7. Remove transaxle dipstick tube.
8. Remove manifold-to-exhaust pipe retaining nuts.
9. Lower vehicle.
10. Remove exhaust manifold retaining bolts. Remove exhaust manifold (9430) assembly.

Installation

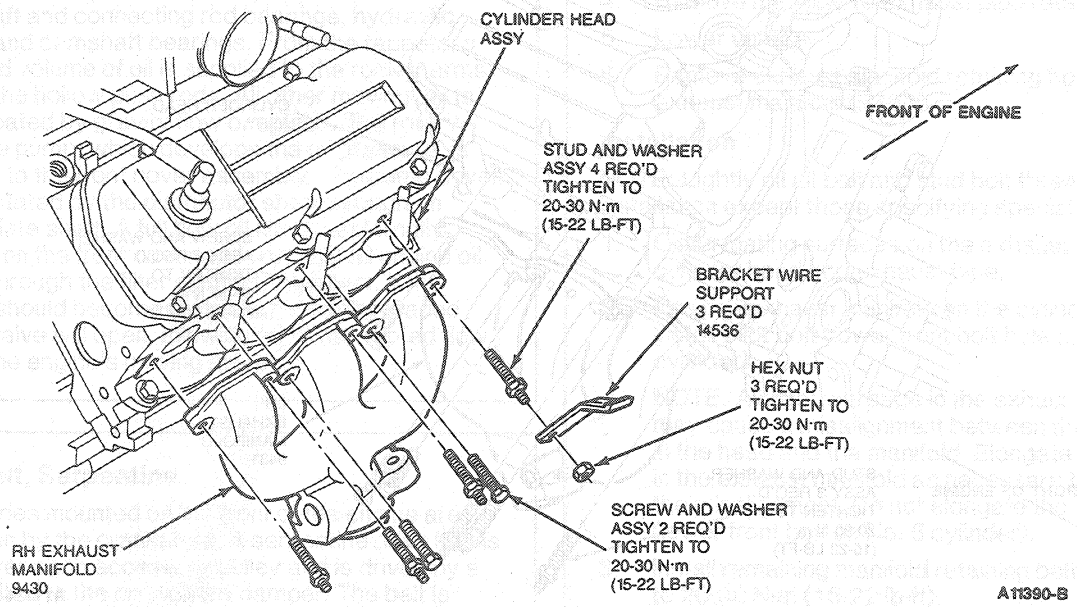
NOTE: Lightly oil all bolt and stud bolt threads before installation except those specifying special sealant.

1. Clean mating surfaces on exhaust manifold, cylinder head and exhaust pipe.
2. Position exhaust manifold on cylinder head. Start two retaining bolts.

   NOTE: A slight warpage in the exhaust manifold may cause a misalignment between the bolt holes in the head and exhaust manifold. Elongate the holes in the exhaust manifold as necessary to correct the misalignment. Do not elongate the pilot hole (lower rear bolt hole on No. 2 cylinder).
3. Install remaining manifold retaining bolts. Tighten all to 20-30 N·m (15-22 lb-ft).
4. Raise vehicle.
5. Connect exhaust pipe to exhaust manifold. Tighten retaining nuts to 21-32 N·m (16-24 lb-ft).
6. Install transaxle dipstick tube.
7. Lower vehicle.
8. Install spark plugs.
9. Connect wires to spark plugs.
10. Connect coil secondary wire to coil.
11. Connect EGR tube.
12. Connect Secondary Air Injection (AIR) hose to downstream air tube and clamp securely.
13. Install air cleaner assembly and heat tube.

IN-VEHICLE SERVICE (Continued)

14. Start engine and check for exhaust leaks. Check transaxle fluid level. Refer to Group 07.



Front Cover Assembly and Timing Chain

If the front cover is being removed to check timing chain deflection, refer to Adjustments for procedure.

Tools Required:

- Crankshaft Damper Remover T58P-6316-D
- Damper / Front Cover Seal Installer T82L-6316-A
- Vibration Damper Remover Adapter T82L-6316-B

Removal

1. Drain cooling system.
2. Disconnect battery ground cable.
3. Remove air cleaner assembly and air intake duct.
4. Loosen accessory drive belt idler. Remove drive belt and water pump pulley.
5. Remove power steering pump mounting bracket retaining bolts.

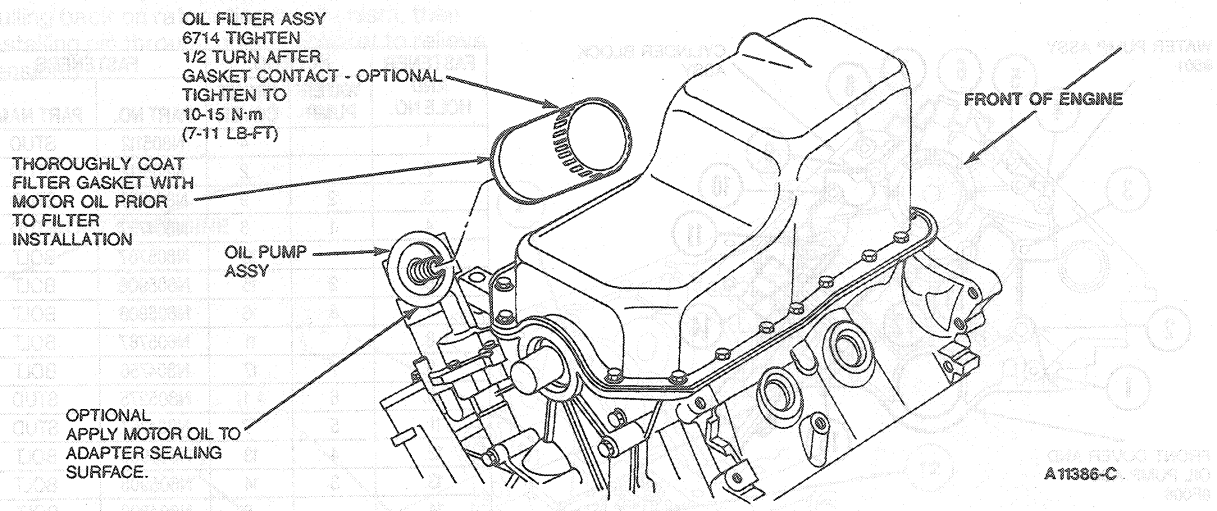
   Leaving hoses connected, place pump / bracket assembly aside in a position to prevent fluid from leaking out.
6. If equipped with air conditioning, remove compressor front support bracket. Leave compressor in place.
7. Disconnect coolant bypass hose at water pump.
8. Disconnect heater hose at water pump.
9. Disconnect radiator upper hose at thermostat housing.
10. Disconnect coil wire from distributor cap and remove cap with secondary wires attached.
11. Remove distributor hold-down clamp and lift distributor out of the front cover.
12. Raise vehicle on hoist. Refer to Section 00-02.

    NOTE: If the crankshaft pulley and vibration damper have to be separated, mark the damper and pulley so that they may be reassembled in the same relative position. This is important as the damper and pulley are initially balanced as a unit.
13. Remove crankshaft damper and pulley using Crankshaft Damper Remover T58P-6316-D and Vibration Damper Remover Adapter T82L-6316-B.

    NOTE: If the crankshaft damper is being replaced, check if the original damper has balance pins installed. If so, new balance pins (6A328 or equivalent) must be installed on the new damper in the same position as the original damper. The crankshaft pulley (new or original) must also be installed in the same relative position as originally installed.

IN-VEHICLE SERVICE (Continued)

14. Remove oil filter.



15. Disconnect radiator lower hose at water pump.

    CAUTION: The front cover cannot be removed without lowering the oil pan.

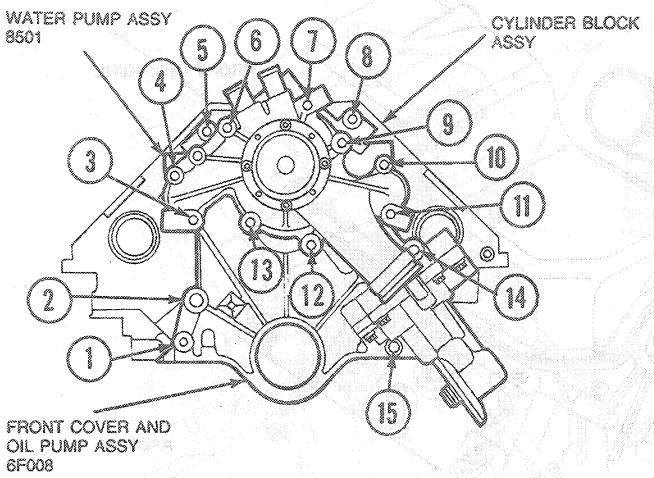
16. Remove oil pan. Refer to Oil Pan, Removal.
17. Lower vehicle.

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

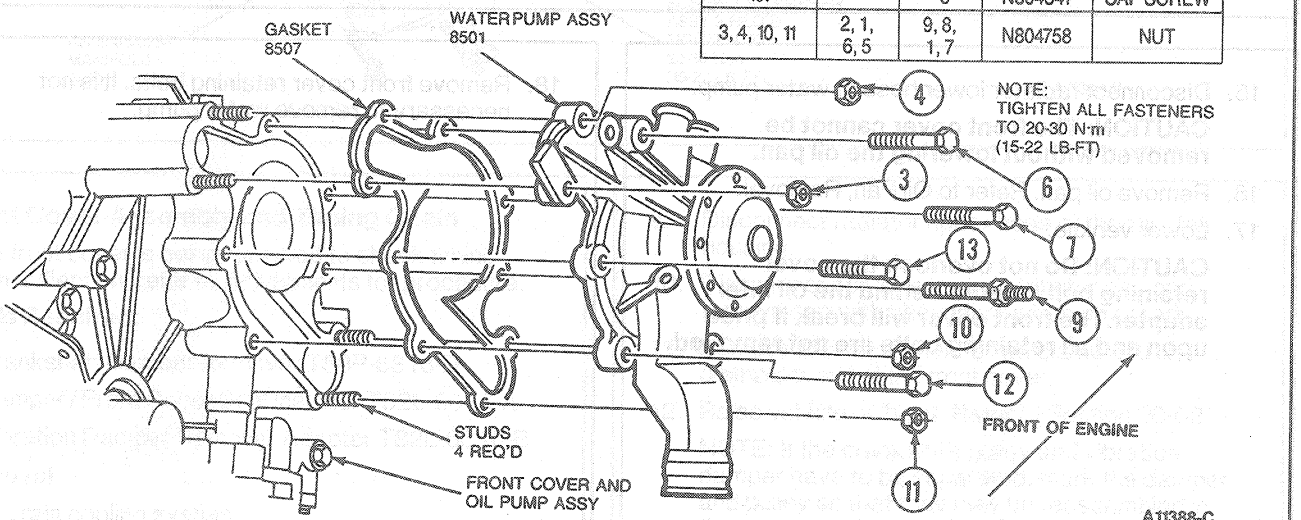
18. Remove front cover retaining bolts. It is not necessary to remove water pump.

IN-VEHICLE SERVICE (Continued)

19. Remove front cover and water pump as an assembly.

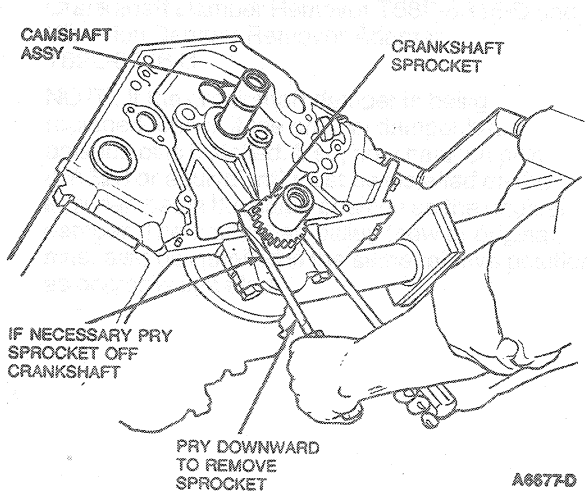


FASTENER AND HOLE NO.	HOLE NO.		FASTENERS	
	WATER PUMP	FRONT COVER	PART NO.	PART NAME
1.		4	N805112	STUD
2.		2	N805112	STUD
3.	2	9	N804757	STUD
4.	1	8	N804757	STUD
5.		10	N605787	BOLT
6.	9	15	N605908	BOLT
7.	8	16	N605908	BOLT
8.		11	N605787	BOLT
9.	7	17	N804756	BOLT
10.	6	1	N805275	STUD
11.	5	7	N804757	STUD
12.	4	13	N605908	BOLT
13.	3	14	N605908	BOLT
14.		6	N804839	BOLT
15.		5	N804841	CAP SCREW
3, 4, 10, 11	2, 1, 6, 5	9, 8, 1, 7	N804758	NUT



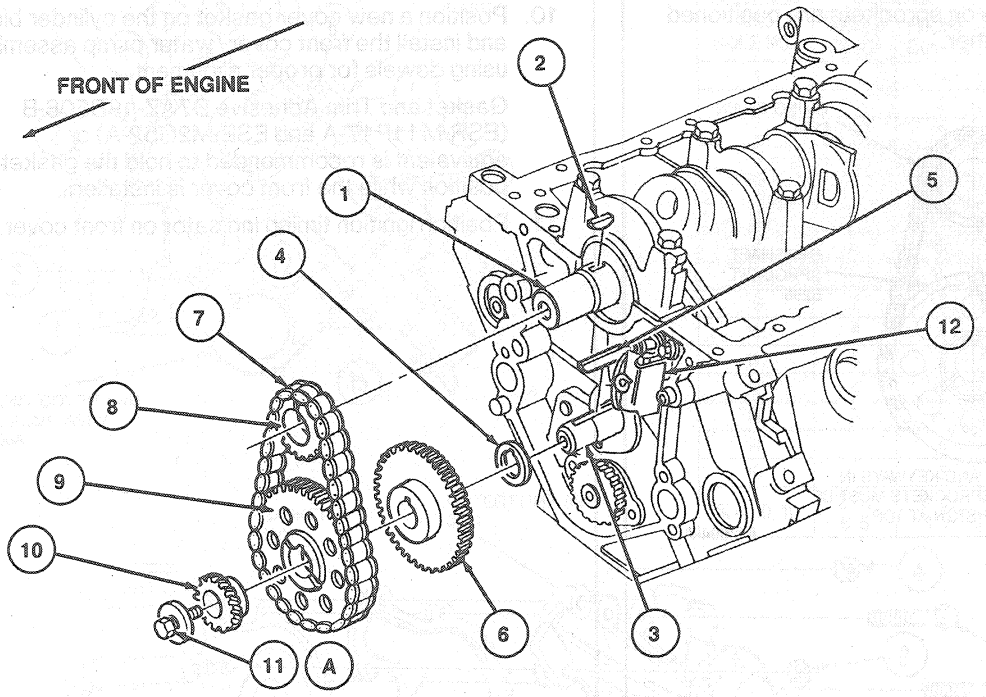
20. Remove cover gasket and discard.
21. Remove camshaft bolt and washer from end of the camshaft.
22. Remove distributor drive gear.

    NOTE: If crankshaft sprocket is difficult to remove, pry sprocket off shaft using a pair of large screwdrivers positioned on both sides of the sprocket.
23. Remove camshaft sprocket, crankshaft sprocket and timing chain.



IN-VEHICLE SERVICE (Continued)

24. Remove chain tensioner assembly (three bolts) from front of cylinder block. (This requires first pulling back on ratcheting mechanism, then installing pin through hole in bracket to relieve tension.)



Item	Part Number	Description
1	6303	Crankshaft
2	6B316	Key Crankshaft
3	6250	Camshaft
4	6265	Spacer
5	6L268	Key Camshaft
6	6A303	Balance Shaft Drive Gear

(Continued)

Item	Part Number	Description
7	6268	Timing Chain
8	6306	Crankshaft Sprocket
9	6256	Camshaft Sprocket
10	6255	Distributor Drive Gear
11A	—	Bolt and Washer Assy
12	6K254	Tensioner and Snubber
A		Tighten to 40-50 N·m (29.5-37 Lb-Ft)

NOTE: The front cover contains the oil pump and water pump. If a new front cover is to be installed, remove the water pump and oil pump from the old front cover. Refer to Front Cover, Assembly.

Installation

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

1. Clean all gasket surfaces on the front cover, cylinder block and fuel pump.

   If reusing the front cover, replace crankshaft front oil seal.

2. If a new front cover is to be installed:
   - Install oil pump.
   - Clean water pump gasket surface. Position a new water pump gasket on the front cover and install water pump. Install pump retaining bolts. Tighten to 20-30 N·m (15-22 lb-ft).
3. Rotate crankshaft as necessary to position piston No. 1 at TDC and crankshaft keyway at the 12 o'clock position.
4. Install tensioner assembly using three mounting bolts and tighten bolts to 8-14 N·m (70-124 lb-in). Ensure ratcheting mechanism is in retracted position with pin sticking out drum hole in bracket assembly.

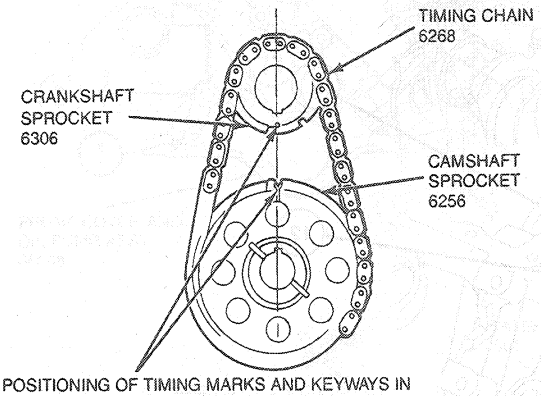
IN-VEHICLE SERVICE (Continued)

5. Lubricate timing chain with XO-10W30-QSP (ESE-M2C153-E) or equivalent engine oil.

   Install camshaft sprocket, crankshaft sprocket and timing chain.

6. Remove pin from tensioner assembly to load tensioner arm against chain.

   Ensure timing marks on sprockets are positioned across from each other.



POSITIONING OF TIMING MARKS AND KEYWAYS IN CAMSHAFT AND CRANKSHAFT SPROCKETS MUST BE IN LINE AS SHOWN WITH NO. 1 PISTON AT TOP DEAD CENTER FIRING.

A12694-A

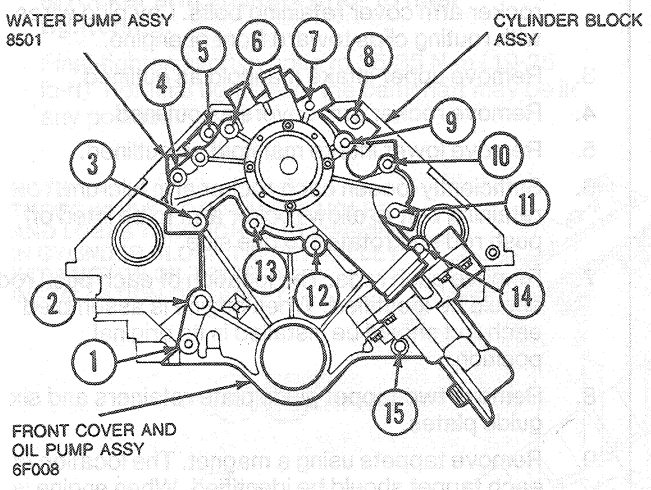
7. Install distributor drive gear.
8. Install bolt and washer assembly at end of camshaft and tighten to 40-50 N·m (30-37 lb-ft).
9. Lubricate crankshaft front oil seal with clean engine oil XO-10W30-QSP (ESE-M2C153-E) or equivalent.
10. Position a new cover gasket on the cylinder block and install the front cover / water pump assembly using dowels for proper alignment.

    Gasket and Trim Adhesive D7AZ-19B508-B (ESR-M11P17-A and ESE-M2G52-A) or equivalent is recommended to hold the gasket in position while the front cover is installed.

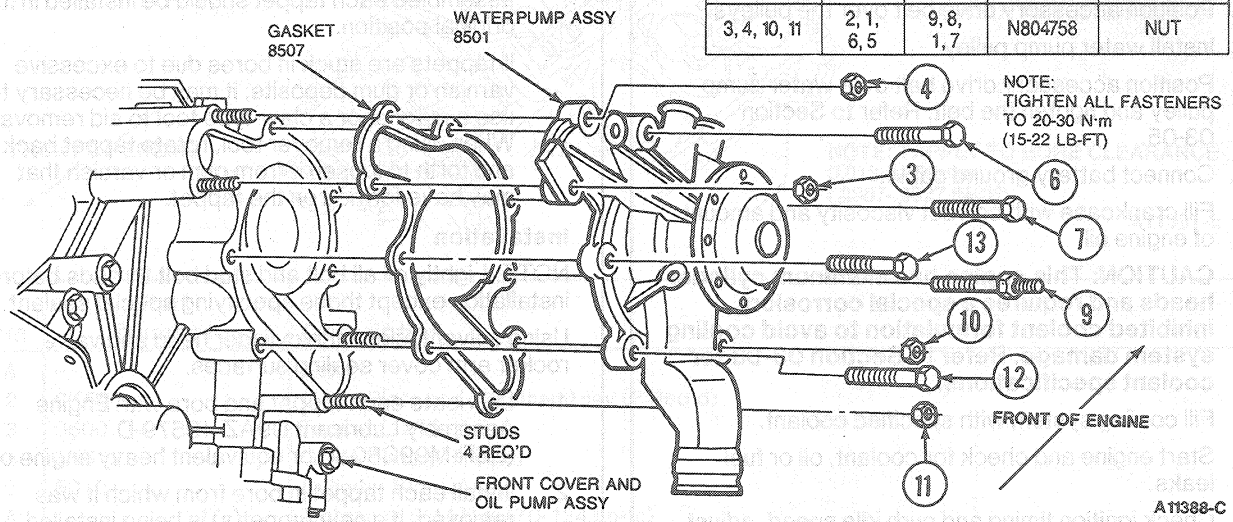
11. Position ignition timing indicator on front cover.

IN-VEHICLE SERVICE (Continued)

12. Install the front cover retaining bolts. Tighten to 20-30 N·m (15-22 lb-ft). Install the capscrew (Part No. N804841) nearest the oil filter flange last, and tighten last. Apply Loctite® or equivalent to bolt prior to installation.



FASTENER AND HOLE NO.	HOLE NO.		FASTENERS	
	WATER PUMP	FRONT COVER	PART NO.	PART NAME
1.		4	N805112	STUD
2.		2	N805112	STUD
3.	2	9	N804757	STUD
4.	1	8	N804757	STUD
5.		10	N605787	BOLT
6.	9	15	N605908	BOLT
7.	8	16	N605908	BOLT
8.		11	N605787	BOLT
9.	7	17	N804756	BOLT
10.	6	1	N805275	STUD
11.	5	7	N804757	STUD
12.	4	13	N605908	BOLT
13.	3	14	N605908	BOLT
14.		6	N804839	BOLT
15.		5	N804841	CAP SCREW
3, 4, 10, 11	2, 1, 6, 5	9, 8, 1, 7	N804758	NUT



13. Raise vehicle.
14. Install oil pan. Refer to illustration under Removal, Step 10.
15. Connect radiator lower hose. Tighten clamp securely.
16. Install oil filter. Refer to illustration following Removal, Step 14.
17. Coat crankshaft damper sealing surface with clean engine oil XO-10W30-QSP (ESE-M2C153-E) or equivalent.

    NOTE: 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.
18. Apply a small amount of Silicone Gasket and Sealant F1AZ-19562-A (WSE-M4G320-A2) or equivalent to crankshaft keyway.
19. Position crankshaft pulley key in the crankshaft keyway.
20. Install the damper using Damper / Front Cover Seal Installer T82L-6316-A.

IN-VEHICLE SERVICE (Continued)

21. Install damper washer and retaining bolt. Tighten bolt to 140-180 N·m (103-132 lb-ft).
22. Install crankshaft pulley. Tighten retaining bolts to 26-38 N·m (19-28 lb-ft).
23. Lower vehicle.
24. Connect coolant bypass hose. Tighten clamp securely.
25. Install distributor with rotor pointing at No. 1 distributor cap tower. Refer to Section 03-04C.
26. Install distributor cap and coil wire.
27. Connect radiator upper hose at thermostat housing. Tighten clamp securely.
28. Connect heater hose. Tighten clamp securely.
29. If equipped with air conditioning, install compressor and mounting brackets. Tighten retaining bolts to specification. Refer to Group 12 in the applicable Section for torque specifications.
30. Install power steering pump and mounting brackets. Tighten retaining bolts to specification. Refer to Group 11 in the applicable Section for torque specifications.
31. Position accessory drive belt over the pulleys.
32. Install water pump pulley.
33. Position accessory drive belt over water pump pulley and tighten the belt. Refer to Section 03-05.
34. Connect battery ground cable.
35. Fill crankcase with correct viscosity and amount of engine oil.

    CAUTION: This engine has aluminum cylinder heads and requires a special corrosion inhibited coolant formulation to avoid cooling system damage. Refer to Section 03-03 for coolant specifications.
36. Fill cooling system with specified coolant.
37. Start engine and check for coolant, oil or fuel leaks.
38. Check ignition timing and curb idle speed, adjust as required. Refer to Powertrain Control / Emissions Diagnosis Manual[1]. Tighten distributor hold-down bolt to 27-40 N·m (20-29 lb-ft).
39. Install air cleaner assembly and air intake duct.

Tappet (Roller)

NOTE: Before replacing a tappet for noisy operation, ensure the noise is not caused by improper valve-to-rocker arm clearance or by worn rocker arms or push rods.

Tools Required:

- Spark Plug Wire Remover T74P-6666-A

Removal

1. Disconnect secondary ignition wires at the spark plugs. To avoid damaging plug wires use Spark Plug Wire Remover T74P-6666-A.
2. Remove plug wire routing clips from studs on the rocker arm cover retaining bolts. Lay plug wires with routing clips toward front of engine.
3. Remove upper intake manifold as outlined.
4. Remove rocker arm covers as outlined.
5. Remove lower intake manifold as outlined.
6. Sufficiently loosen each rocker arm fulcrum retaining bolt to allow rocker arm to be lifted off push rod and rotated to one side.
7. Remove push rods. The location of each push rod should be identified. When engine is assembled each rod should be installed in its original position.
8. Remove two tappet guide plate retainers and six guide plates.
9. Remove tappets using a magnet. The location of each tappet should be identified. When engine is assembled each tappet should be installed in its original position.

   If tappets are stuck in bores due to excessive varnish or gum deposits, it may be necessary to use a magnet or a claw-type tool to aid removal. When using a remover tool, rotate tappet back and forth to loosen it from gum or varnish that may have formed on the tappet.

Installation

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

Using solvent, clean the cylinder head and valve rocker arm cover sealing surfaces.

1. Lubricate each tappet and bore with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil.
2. Install each tappet in bore from which it was removed. If a new tappet(s) is being installed, check new tappet for a free fit in bore.
3. Align flats on sides of tappets and install six guide plates between adjacent tappets (make sure the word "up" and / or button is showing). Install two guide plate retainers and tighten four bolts to 8-14 N·m (6-10 lb-ft).
4. Dip each push rod end in Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil. Install push rods in their original position.
5. For each valve, rotate crankshaft until tappet rests onto heel (base circle) of camshaft lobe. Position rocker arms over push rods. Install fulcrums. Tighten fulcrum retaining bolt to 5 N·m (44 lb-in).

1 Can be purchased as a separate item.

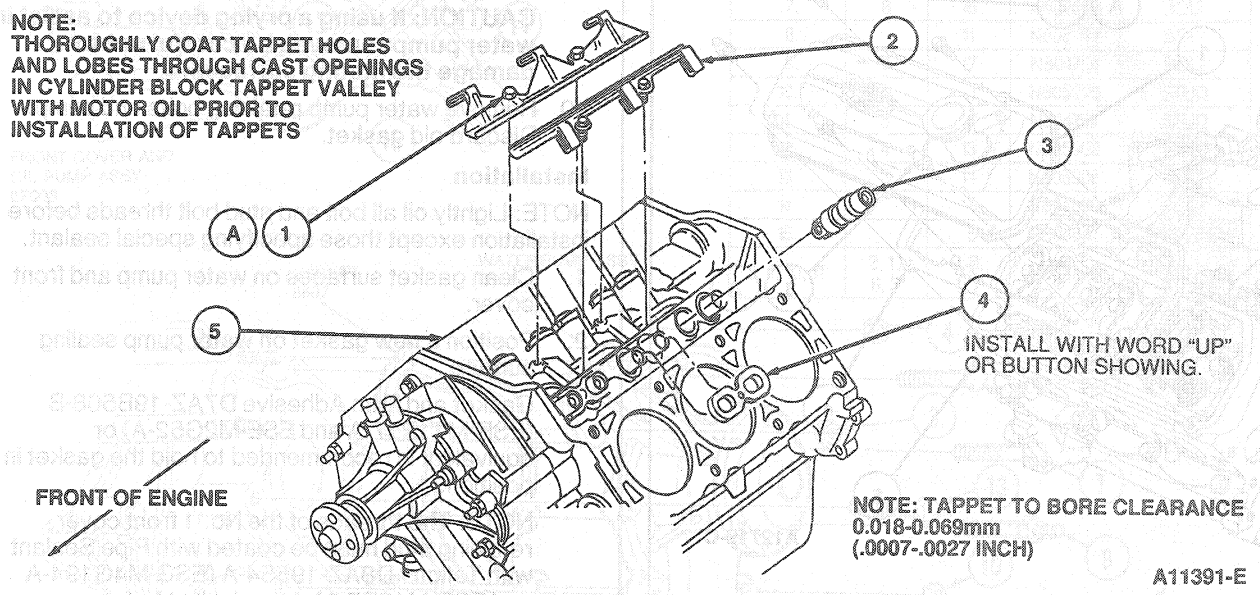
IN-VEHICLE SERVICE (Continued)

6. Lubricate all rocker arm assemblies with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil.

   CAUTION: Fulcrums must be fully seated in cylinder head and push rods must be seated in rocker arm sockets prior to final tightening.

   Final-tighten fulcrum bolts to 25-35 N·m (19-25 lb-ft). For final tightening, the camshaft may be in any position.

7. Install lower intake manifold as outlined.
8. Install valve rocker arm covers as outlined.
9. Install upper intake manifold as outlined.
10. Install plug wire routing clips and connect wires to the spark plugs.
11. Start engine and check for oil or coolant leaks.



Item	Part Number	Description
1A	—	Bolt
2	6K564	Guide Plate and Retainer Assy (2 Req'd)
3	6500	Tappet (12 Req'd)
4	6K512	Guide Plate (6 Req'd)
5	6010	Cylinder Block Assy
A		Tighten to 8-14 N·m (70-124 Lb-in)

Rocker Arm Cover

Removal

1. Disconnect secondary wires from spark plugs.
2. Remove spark plug wire routing clips from rocker arm cover retaining bolt studs.
3. Remove upper intake manifold as outlined.
4. If LH rocker arm cover is being removed, remove oil fill cap.
5. If RH rocker arm cover is being removed, proceed with the following steps:
   a. Position air cleaner assembly aside.
   b. Remove Positive Crankcase Ventilation (PCV) valve.
6. Remove valve rocker arm retaining bolts.

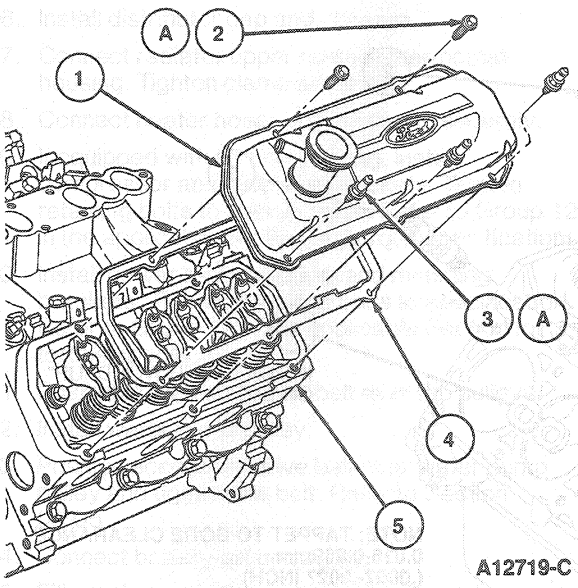
Installation

NOTE: Lightly oil all bolt and stud bolt threads before installation. Using solvent, clean cylinder head and valve rocker cover sealing surfaces to remove all gasket material and dirt.

1. Position a new gasket onto cylinder head.
2. Position cover on the cylinder head and install retaining bolts. Note location of spark plug wire routing clip stud bolts. Tighten retaining bolts to 9-12 N·m (80-106 lb-in).
3. Install upper intake manifold as outlined.
4. If LH rocker arm cover is being installed, install oil filler cap.

IN-VEHICLE SERVICE (Continued)

5. If RH rocker arm cover is being installed perform the following:
   - Install PCV valve
   - Install air cleaner assembly
6. Install spark plug wire routing clips.
7. Connect secondary wires to spark plugs.
8. Start engine and check for oil leaks.



Item	Part Number	Description
1	6A505 LH 6582 RH	Rocker Arm Cover Assy
2A	—	Bolt (2 Req'd)
3A	—	Stud (3 Req'd) M6 x 1 x 55.1
4	6584	Gasket
5	6049	Cylinder Head Assy
A		Tighten to 9-12 N·m (80-106 Lb-In)

Water Pump

Tools Required:

- Engine Support Bar D88L-6000-A

Removal

1. Drain cooling system.
2. Raise and support engine using Engine Support Bar D88L-6000-A or equivalent.
3. Remove lower nut on both RH engine mounts.
4. Raise engine.
5. Loosen accessory drive belt idler. Remove drive belt and water pump pulley.
6. Remove power steering pump mounting bracket retaining bolts.

   Leaving hoses connected, place pump / bracket assembly aside in a position to prevent fluid from leaking out.
7. If equipped with air conditioning, remove the compressor front support bracket. Leave compressor in place.
8. Disconnect coolant bypass hose at water pump.
9. Disconnect heater hose at water pump.

   CAUTION: If using a prying device to assist in water pump removal, be careful not to damage the mating surfaces.
10. Remove water pump retaining bolts and pump. Discard old gasket.

Installation

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

1. Clean gasket surfaces on water pump and front cover.
2. Position a new gasket on water pump sealing surface.

   Gasket and Trim Adhesive D7AZ-19B508-B (ESR-M11P17-A and ESE-M2G52-A) or equivalent is recommended to hold the gasket in position.

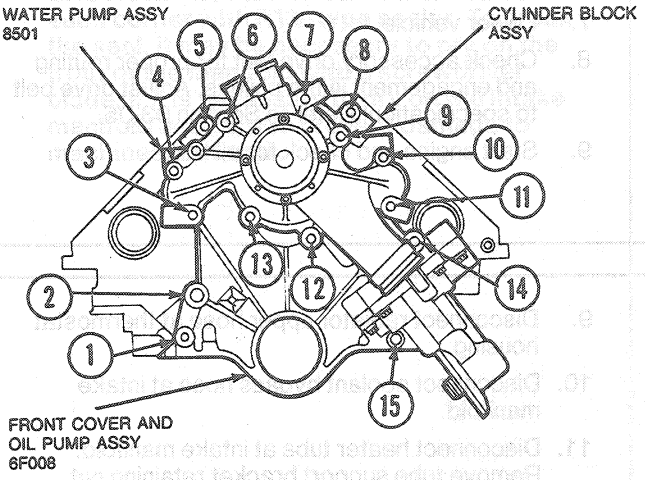
   NOTE: The threads of the No. 1 front cover retaining stud must be coated with Pipe Sealant with Teflon® D8AZ-19554-A (ESG-M4G194-A and ESR-M18P7-A) or equivalent before installing.
3. Position water pump on the front cover. Install retaining bolts.

   Tighten retaining bolts to 20-30 N·m (15-22 lb-ft).
4. Connect cooling bypass hose, heater hose and radiator lower hose to water pump. Tighten clamps securely.
5. If equipped with air conditioning, install compressor front support bracket. Tighten retaining bolts to 41-61 N·m (30-44 lb-ft).
6. Position power steering pump and mounting brackets. Install the retaining bolts. Tighten to 40-62 N·m (30-45 lb-ft).
7. Position accessory drive belt over pump pulley and adjust drive belt tension. Refer to Section 03-05.

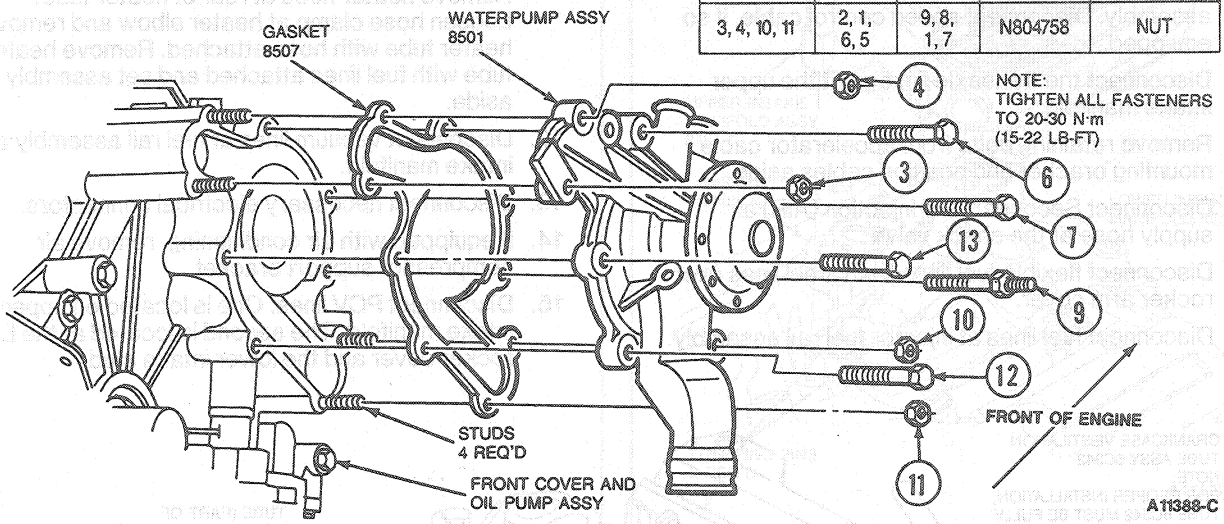
   CAUTION: This engine has aluminum cylinder heads and requires a special corrosion inhibiting coolant to avoid cooling system damage. Refer to Section 03-03 for the coolant specifications.
8. Fill cooling system with specified coolant.

IN-VEHICLE SERVICE (Continued)

9. Start engine and check for coolant leaks.



FASTENER AND HOLE NO.	HOLE NO.		FASTENERS	
	WATER PUMP	FRONT COVER	PART NO.	PART NAME
1.		4	N805112	STUD
2.		2	N805112	STUD
3.	2	9	N804757	STUD
4.	1	8	N804757	STUD
5.		10	N605787	BOLT
6.	9	15	N605908	BOLT
7.	8	16	N605908	BOLT
8.		11	N605787	BOLT
9.	7	17	N804756	BOLT
10.	6	1	N805275	STUD
11.	5	7	N804757	STUD
12.	4	13	N605908	BOLT
13.	3	14	N605908	BOLT
14.		6	N804839	BOLT
15.		5	N804841	CAP SCREW
3, 4, 10, 11	2, 1, 6, 5	9, 8, 1, 7	N804758	NUT



Crankshaft Front Oil Seal

Tools Required:

- Crankshaft Damper Remover T58P-6316-D
- Front Cover Seal Installer T70P-6B070-A
- Damper / Front Cover Seal Installer T82L-6316-A
- Vibration Damper Remover Adapter T82L-6316-B

Removal

1. Loosen accessory drive belt idler.
2. Raise vehicle on hoist. Refer to Section 00-02.
3. Disengage accessory drive belt and remove crankshaft pulley.
4. Remove crankshaft damper using Crankshaft Damper Remover T58P-6316-D and Vibration Damper Remover Adapter T82L-6316-B.

   CAUTION: Use care to prevent damage to front cover and crankshaft.
5. Remove seal from the front cover using a screwdriver.

Installation

1. Inspect 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.
2. Lubricate the seal lip with clean engine oil and install the seal using Damper / Front Cover Seal Installer T82L-6316-A and Front Cover Seal Installer T70P-6B070-A.

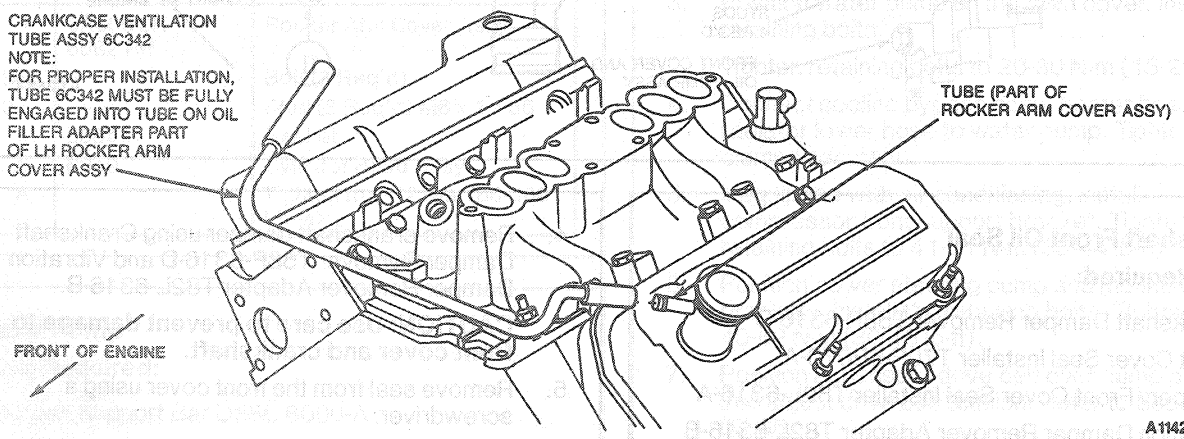
IN-VEHICLE SERVICE (Continued)

3. Lubricate seal surface on the damper with clean engine oil XO-10W30-QSP (ESE-M2C153-E) or equivalent.
   Install damper using Damper / Front Cover Seal Installer T82L-6316-A.
4. Install damper retaining bolt. Tighten to 140-180 N·m (103-132 lb-ft).
5. Position crankshaft pulley and install retaining bolts. Tighten bolts to 26-38 N·m (19-28 lb-ft).
6. Position accessory drive belt over crankshaft pulley.
7. Lower vehicle.
8. Check accessory drive belt for proper routing and engagement in the pulleys. Adjust drive belt to specification. Refer to Section 03-05.
9. Start engine and check for oil leaks.

Upper and Lower Intake Manifolds

Removal

1. Drain engine cooling system.
2. Remove air cleaner assembly including air intake duct and heat tube.
3. Disconnect accelerator cable at throttle body assembly. Disconnect speed control cable, if so equipped.
4. Disconnect the transaxle linkage at the upper intake manifold.
5. Remove retaining bolts from accelerator cable mounting bracket and position cables aside.
6. Disconnect Secondary Air Injection (AIR) air supply hose at the check valve.
7. Disconnect flexible fuel lines from steel lines over rocker arm cover.
8. Disconnect fuel lines at injector fuel rail assembly.
9. Disconnect radiator upper hose at thermostat housing.
10. Disconnect coolant bypass hose at intake manifold.
11. Disconnect heater tube at intake manifold. Remove tube support bracket retaining nut. Remove heater hose at rear of heater tube. Loosen hose clamp at heater elbow and remove heater tube with hose attached. Remove heater tube with fuel lines attached and set assembly aside.
12. Disconnect vacuum lines at fuel rail assembly and intake manifold.
13. Disconnect necessary electrical connectors.
14. If equipped with air conditioning, remove air compressor support bracket.
15. Disconnect PCV lines. One is located on upper intake manifold. The second is located at the LH rocker cover and the lower intake stud.



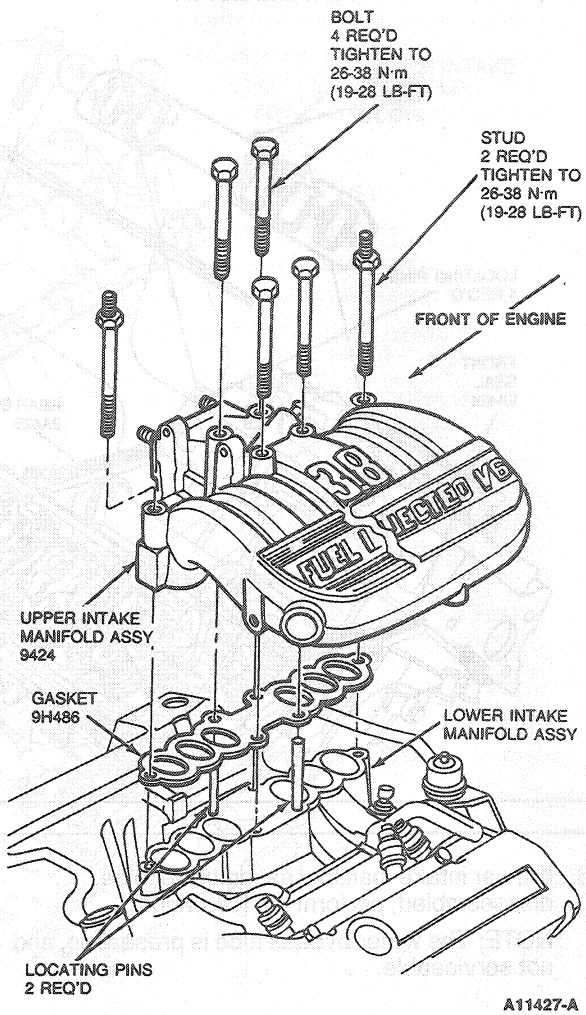
16. Remove throttle body assembly.
17. Remove the EGR valve assembly from the upper manifold.
18. Remove the retaining nut and remove wiring retainer bracket located at the LH front of the intake manifold and set aside with spark plug wires.
19. Remove intake manifold upper gasket (9H486)retaining bolts / studs.
20. Remove intake manifold upper gasket.
21. Remove injectors and fuel injection supply manifold (9F792) assembly.
22. Remove heater water outlet hose.

IN-VEHICLE SERVICE (Continued)

23. Remove lower intake manifoldretaining bolts.

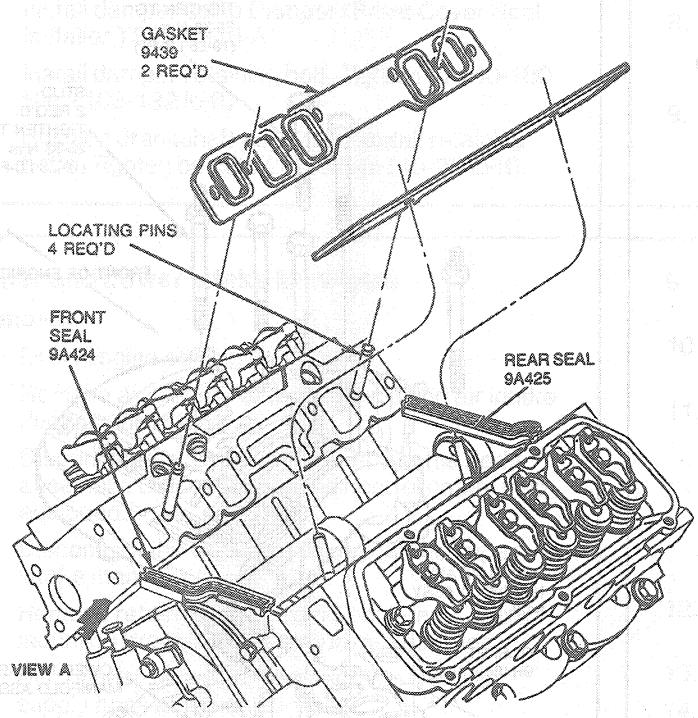
CAUTION: The intake manifold is sealed at each corner with RTV-type sealer. To break the seal, it may be necessary to pry on the front of the manifold with a screwdriver blade. If it is necessary to pry on the intake manifold use care to prevent damage to machined surfaces.

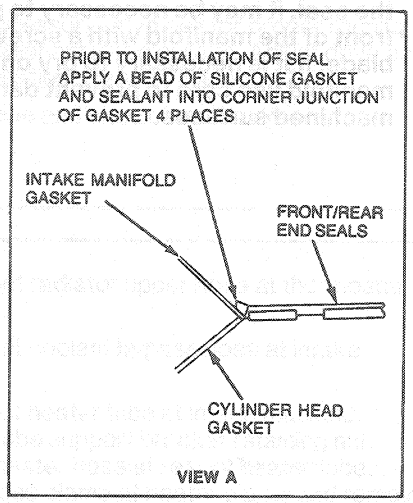
24. Remove lower intake manifold.

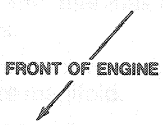


IN-VEHICLE SERVICE (Continued)

25. Remove intake manifold to cylinder head gasket (9439) and end seals, and discard.





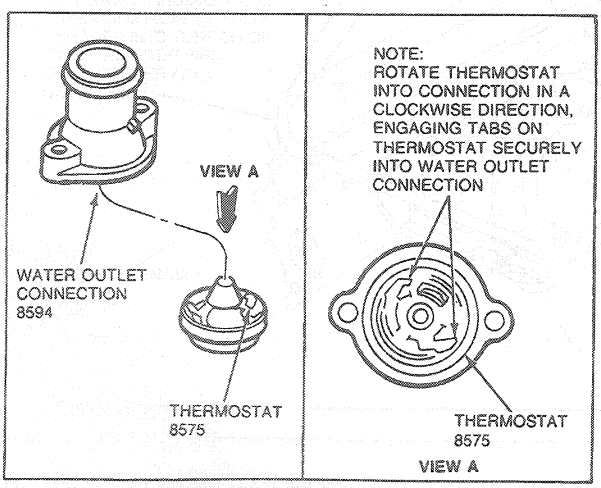


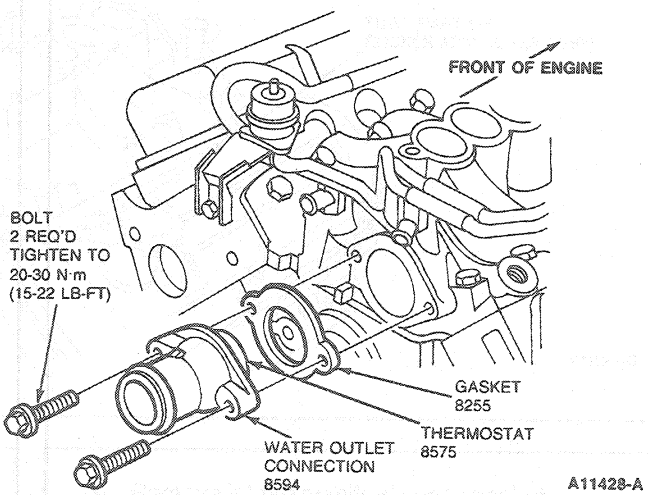
A11400-D

26. If lower intake manifold assembly is to be disassembled, perform the following:

NOTE: The water bypass tube is pressed-in, and not serviceable.

a. Remove thermostat housing and thermostat.





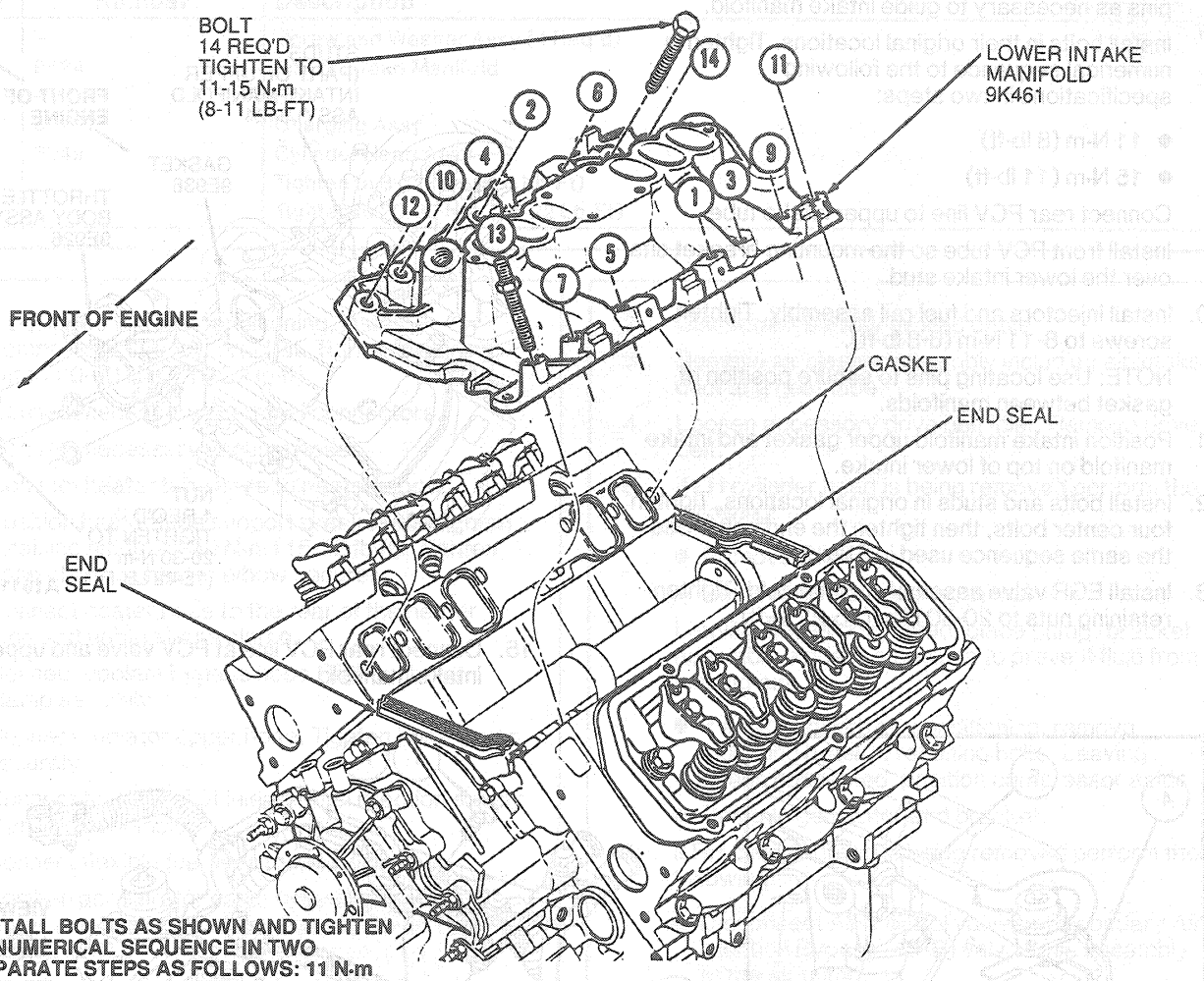
A11428-A

b. Remove water temperature sending unit.

c. Remove heater elbow.

IN-VEHICLE SERVICE (Continued)

d. Remove all vacuum and electrical fittings.



Installation

NOTE: Lightly oil all retaining bolt and stud bolt threads before installation.

NOTE: 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.

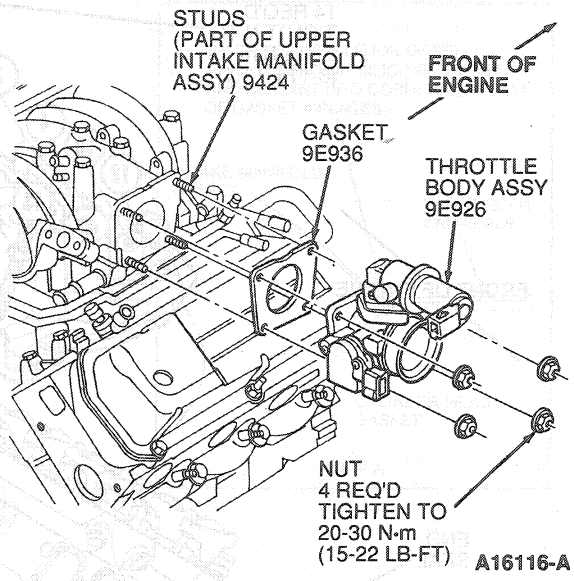
1. The lower intake manifold, cylinder head, and cylinder block mating surfaces should be clean and free of old gasketing material. Use a suitable solvent to clean these surfaces.
2. If intake manifold was disassembled:
   - Apply a coat of Pipe Sealant with Teflon® D8AZ-19554-A (ESG-M4G194-A and ESR-M18P7-A) or equivalent to the threads of the temperature sending unit, all vacuum fittings, heater elbows, electrical fittings, if equipped. Refer to Specifications.
   - Install thermostat (note direction) and gasket. Install thermostat housing. Tighten retaining bolts to 20-30 N·m (15-22 lb-ft).

   NOTE: Using solvent, clean sealing surfaces of cylinder heads and intake manifold before applying Silicone Sealer.
3. Apply a dab of Gasket and Trim Adhesive D7AZ-19B508-B (ESR-11P17-A and ESE-M2G52-A) or equivalent to each cylinder head mating surface. Press new intake manifold to cylinder head gaskets into place, using locating pins as necessary to aid in assembly.
4. Apply a 3-4mm (1/8 inch) bead of Silicone Rubber D6AZ-19562-BA (ESB-M4G92-A and ESE-M4G195-A) or equivalent at each corner where the cylinder head joins the cylinder block.
5. Install front and rear intake manifold end seals.

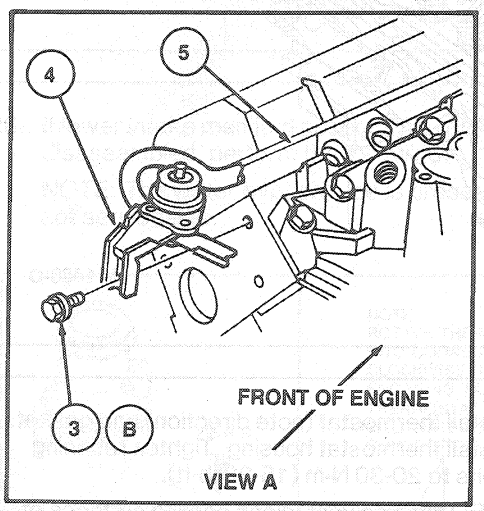
IN-VEHICLE SERVICE (Continued)

6. Carefully lower intake manifold into position on cylinder block and cylinder heads. Use locating pins as necessary to guide intake manifold.
7. Install bolts in their original locations. Tighten in numerical sequence to the following specifications in two steps:
   - 11 N·m (8 lb-ft)
   - 15 N·m (11 lb-ft)
8. Connect rear PCV line to upper intake tube.
9. Install front PCV tube so the mounting bracket sits over the lower intake stud.
10. Install injectors and fuel rail assembly. Tighten screws to 8-11 N·m (6-8 lb-ft).

    NOTE: Use locating pins to secure position of gasket between manifolds.
11. Position intake manifold upper gasket and intake manifold on top of lower intake.
12. Install bolts and studs in original locations. Tighten four center bolts, then tighten the end bolts. Use the same sequence used in Step 7.
13. Install EGR valve assembly on manifold. Tighten retaining nuts to 20-30 N·m (15-22 lb-ft).
14. Install throttle body. Cross-tighten retaining nuts to 20-30 N·m (15-22 lb-ft).



15. Connect rear PCV line at PCV valve and upper intake manifold.



IN-VEHICLE SERVICE (Continued)

Item	Part Number	Description
1A	—	Screw and Washer Assy (4 Req'd)
2	9424	Lower Intake Manifold
3B	—	Bolt
4	9F797	Charging Assy
5	6049	Cylinder Head Assy
A		Tighten to 8-11 N·m (6-8 Lb-Ft)
B		Tighten to 20-30 N·m (15-22 Lb-Ft)

16. If equipped with air conditioning, install compressor support bracket. Tighten retaining nut to 20-30 N·m (15-22 lb-ft).
17. Connect necessary electrical connectors.
18. Connect necessary vacuum hoses.
19. Connect heater tube hose to heater elbow.
20. Position heater tube support bracket and tighten retaining nut to 20-30 N·m (15-22 lb-ft). Tighten hose clamp at heater elbow securely.
21. Connect heater hose to the rear of the heater tube and tighten hose clamp.
22. Connect coolant bypass hose. Tighten hose clamp securely.
23. Connect radiator upper hose. Tighten hose clamp securely.
24. Connect fuel line(s) at injector fuel injection supply manifold assembly.
25. Connect flexible fuel lines to steel lines.
26. Position accelerator cable mounting bracket. Install and tighten retaining bolts to 20-30 N·m (15-22 lb-ft).
27. Connect speed control cable, if so equipped.
28. Connect transaxle linkage at upper intake manifold.

    CAUTION: This engine has aluminum cylinder heads and requires a special corrosion inhibiting coolant to avoid cooling system damage. Refer to Section 03-03 for the coolant specifications.
29. Fill cooling system with specified coolant.
30. Start engine and check for coolant or fuel leaks.
31. Check and, if necessary, adjust engine idle speed. Refer to Powertrain Control / Emissions Diagnosis Manual[2]. Adjust transaxle throttle linkage and speed control. Refer to Section 10-02.
32. Install air cleaner assembly and air intake duct.

Cylinder Heads

Removal

1. Drain cooling system.
2. Disconnect battery ground cable.
3. Remove air cleaner assembly including air intake duct and heat tube.
4. Loosen accessory drive belt idler. Remove drive belt.
5. If LH cylinder head is being removed perform the following:
   - Remove oil fill cap.
   - Remove power steering pump.

   Leaving hoses connected, place pump / bracket assembly aside in a position to prevent fluid from leaking out.
   - If equipped with air conditioning, remove mounting bracket retaining bolts. Leaving hoses connected, position compressor aside.
   - Remove generator and bracket.
6. If RH cylinder head is being removed perform the following:
   - Disconnect AIR control valve or Secondary Air Injection Bypass (AIRB) valve hose assembly at the air pump.
   - Disconnect AIR tube support bracket from the rear of cylinder head.
   - Remove accessory drive idler.
   - Remove AIR pump pulley. Remove AIR pump.
   - Remove PCV valve.
7. Remove upper intake manifold.
8. Remove valve rocker arm cover retaining screws.
9. Remove injector fuel rail assembly.
10. Remove lower intake manifold.
11. Remove exhaust manifold and exhaust manifold.
12. Loosen rocker arm fulcrum retaining bolts enough to allow rocker arm to be lifted off the push rod and rotate to one side.
13. Remove push rods. Identify position of each rod. Rods should be installed in their original position during assembly.
14. Remove cylinder head retaining bolts and discard.

2 Can be purchased as a separate item.

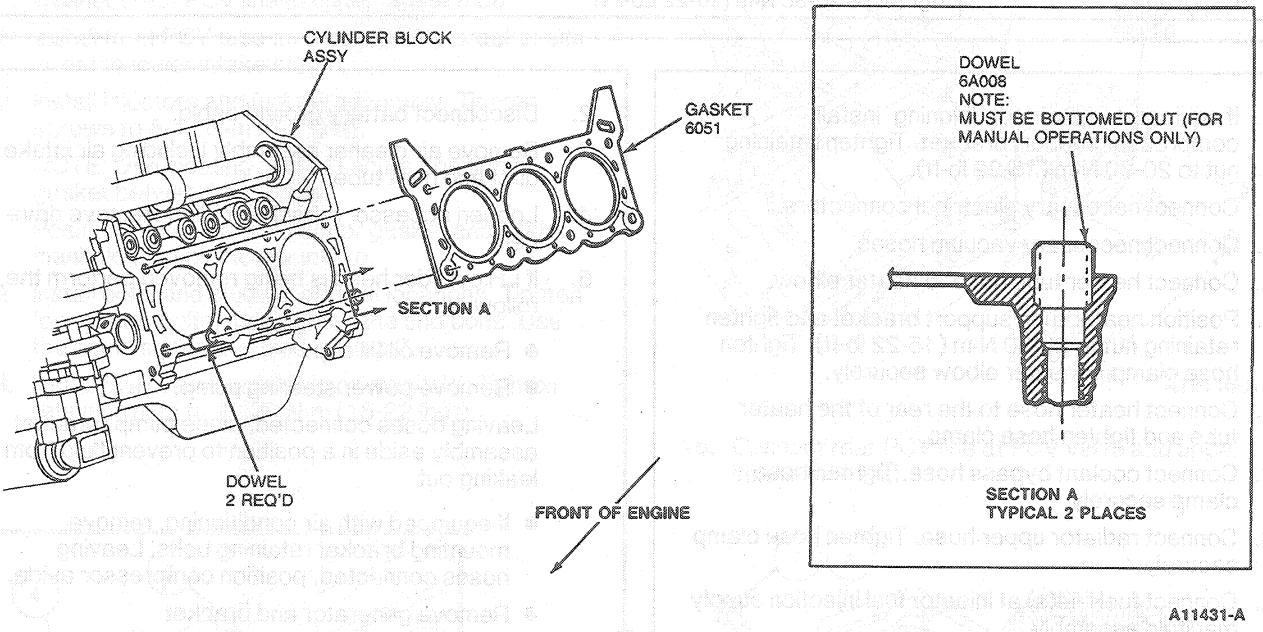
IN-VEHICLE SERVICE (Continued)

15. Remove cylinder head(s).
16. Remove and discard old cylinder head gasket(s).
17. If disassembling cylinder head(s), refer to Cylinder Head, Disassembly.

Installation

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

1. Clean cylinder head, intake manifold, valve rocker arm cover and cylinder head gasket surfaces. If cylinder head was removed for a cylinder head gasket replacement, check flatness of cylinder head and block gasket surfaces. Refer to Section 03-00 for procedure.
2. Position new head gasket(s) onto cylinder block using dowels for alignment.



3. Position cylinder head(s) onto block.

   CAUTION: Always use new cylinder head bolts to ensure a leak-tight assembly. Torque retention with used bolts can vary, which may result in coolant or compression leakage at the cylinder head mating surface area.

4. Install cylinder head bolts (eight each side).
5. Tighten cylinder head retaining bolts in sequence as follows:
   a. 50 N·m (37 lb-ft)
   b. 60 N·m (45 lb-ft)
   c. 70 N·m (52 lb-ft)
   d. 80 N·m (59 lb-ft)

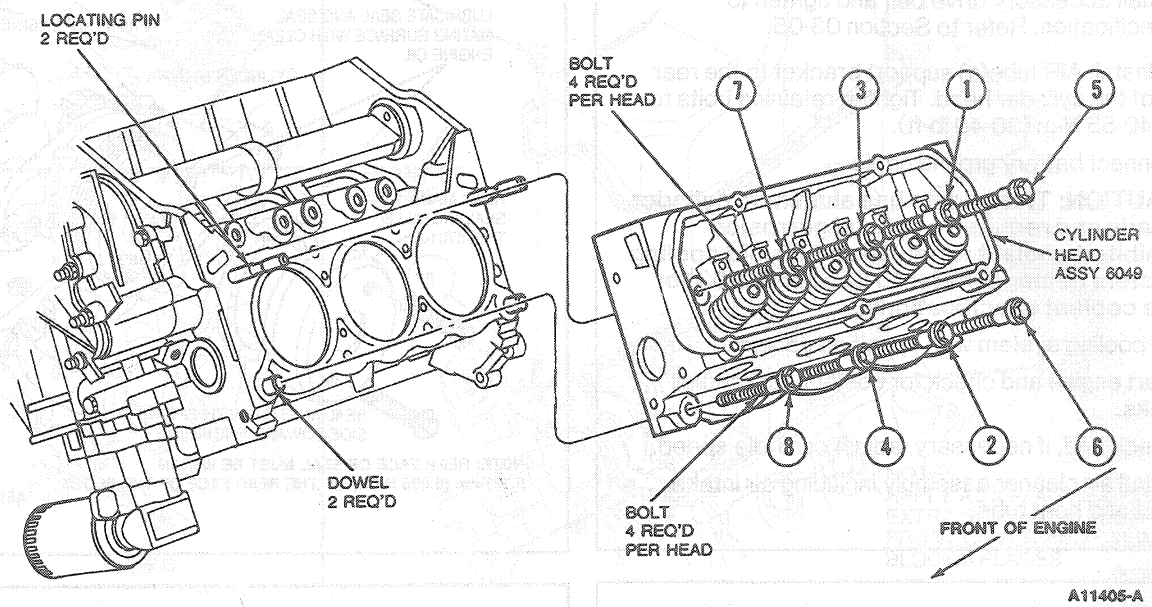
   CAUTION: Do not loosen all of the bolts at the same time, only work on one bolt at a time.

   In sequence, retighten bolts one at a time in the following manner:

   e. Long bolts: Loosen bolt and back out two or three revolutions. Retighten long bolt to 15-25 N·m (11-18 lb-ft). Then tighten bolt an additional 85-95 degrees and go to the next bolt in sequence.

IN-VEHICLE SERVICE (Continued)

f. Short bolts: Loosen bolt and back out two or three revolutions. Retighten to 10-20 N·m (7-15 lb-ft), then rotate an additional 85-95 degrees. Go to next bolt in sequence.



NOTE: When cylinder head retaining bolts have been tightened using the above procedure, it is not necessary to retighten bolts after extended engine operation. However, bolts can be checked for tightness if desired.

6. Dip each push rod end in Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil.

   Install push rods in their original position.

7. For each valve, rotate crankshaft until tappet rests on the heel (base circle) of the camshaft lobe, before tightening fulcrum retaining bolts. Position rocker arms over push rods, install fulcrums. Tighten fulcrum bolts to 5 N·m (44 lb-in) maximum.

8. Lubricate all rocker arm assemblies with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil.

   NOTE: If original valve train components are being installed, a valve clearance check is not required. If a component has been replaced, perform a valve clearance check. Refer to Section 03-00.

   Final-tighten the fulcrum bolts to 25-35 N·m (19-25 lb-ft). For final tightening, camshaft may be in any position.

9. Install exhaust manifold and exhaust manifold.

10. Install lower intake manifold.

11. Install injector fuel rail assembly. Tighten retaining bolts to 8-11 N·m (6-8 lb-ft).

12. Position cover and new gasket on cylinder head and install retaining bolts. Note location of spark plug wire routing clip stud bolts. Tighten bolts to 9-12 N·m (80-106 lb-in).

13. Install upper intake manifold.

14. Install spark plugs, if removed.

15. Connect secondary wires to the spark plugs.

16. If LH cylinder head is being installed, perform the following:

    - Install oil fill cap.
    - If equipped with air conditioning, install compressor mounting and support brackets. Refer to Section 12-03 for torque specifications.
    - Install power steering pump mounting and support brackets. Tighten all bolts to 40-62 N·m (30-45 lb-ft).
    - Install generator / support bracket.

17. If RH cylinder head is being installed, perform the following:

    - Install PCV valve.
    - Install generator bracket. Tighten retaining nuts to 40-55 N·m (30-40 lb-ft).
    - Install Secondary Air Injection (AIR) pump and pump pulley. Refer to Specifications.

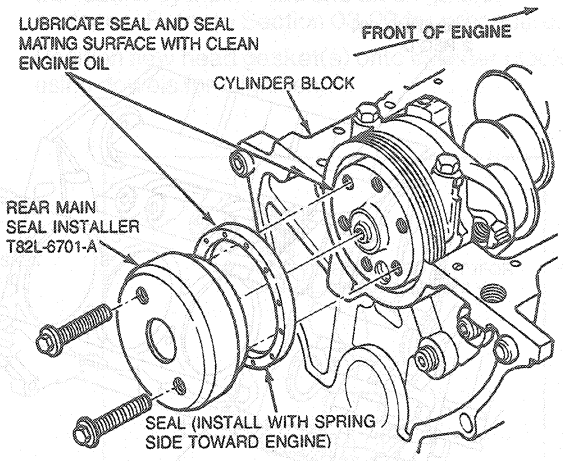
IN-VEHICLE SERVICE (Continued)

- Install accessory drive idler.
- Install AIR control valve or Secondary Air Injection Bypass (AIRB) valve hose. Tighten clamps securely to the air pump assembly.

18. Install accessory drive belt and tighten to specification. Refer to Section 03-05.
    - Install AIR tube(s) support bracket to the rear of the cylinder head. Tighten retaining bolts to 40-55 N·m (30-40 lb-ft).
19. Connect battery ground cable.

    CAUTION: This engine has aluminum cylinder heads and requires a special corrosion inhibited coolant formulation to avoid cooling system damage. Refer to Section 03-03 for the coolant specifications.
20. Fill cooling system with specified coolant.
21. Start engine and check for coolant, fuel and oil leaks.
22. Check and, if necessary, adjust curb idle speed.
23. Install air cleaner assembly including air intake duct and heat tube.

2. Alternate bolt tightening, to seat the seal properly. (Two bolts are supplied with Tool T82L-6701-A. Engine flywheel bolts may be used if necessary.)



NOTE: REAR FACE OF SEAL MUST BE WITHIN 0.127mm (0.005 INCH) OF THE REAR FACE OF THE BLOCK

Crankshaft Rear Main Oil Seal

A one-piece crankshaft rear main oil seal is used on this engine.

Tools Required:

- Jet Plug Remover T77L-9533-B
- Rear Main Seal Installer T82L-6701-A

Removal

CAUTION: Avoid scratching or damaging oil seal surface.

1. Using a sharp awl, punch one hole into the seal metal surface between lip and block.
2. Screw in the threaded end of Jet Plug Remover T77L-9533-B. Use the Jet Plug Remover to remove seal.

Installation

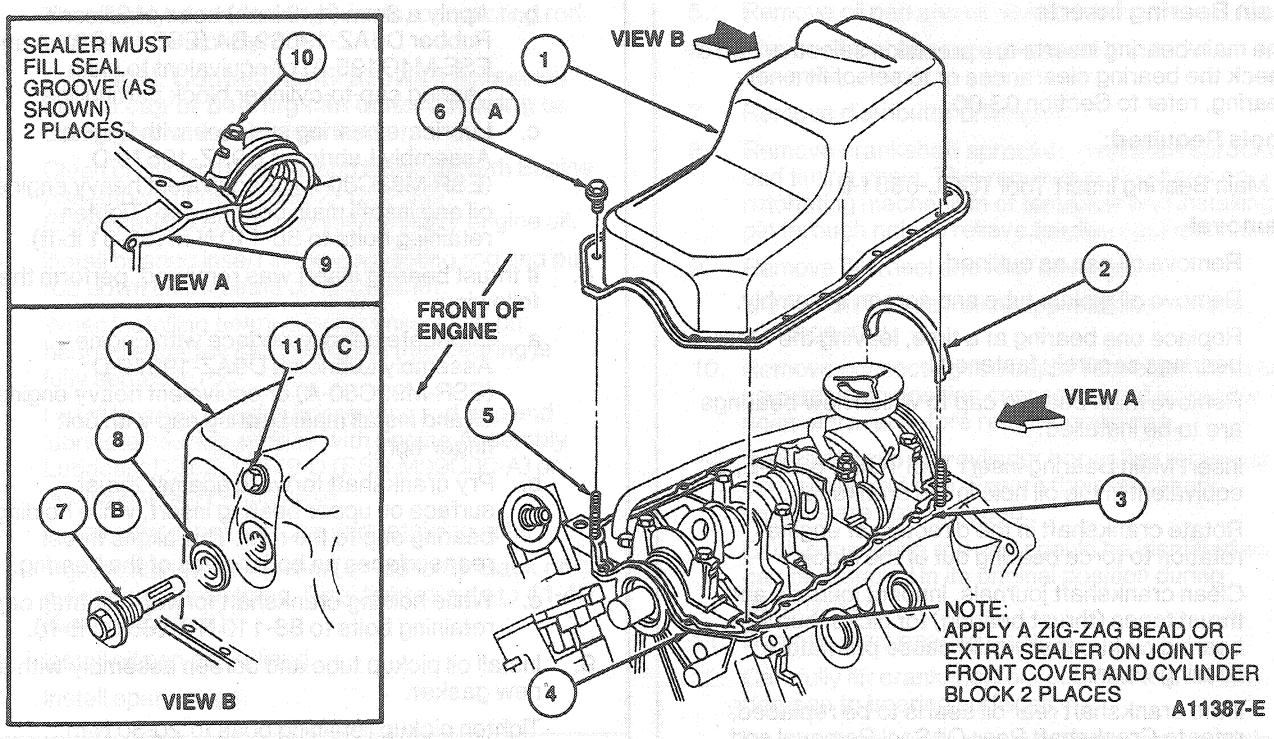
1. Position seal on Rear Main Seal Installer T82L-6701-A. Position tool and seal to rear of engine.

Oil Pan

Removal

1. Disconnect battery ground cable.
2. Raise vehicle on a hoist. Refer to Section 00-02.
3. Drain oil pan.
4. Remove oil filter element.
5. Position drain pan out of the way.
6. Remove catalytic converter assembly.
7. Remove starter motor.
8. Remove torque converter housing cover.
9. Remove bolts retaining oil pan assembly.
10. Remove oil pan assembly.

IN-VEHICLE SERVICE (Continued)



Item	Part Number	Description
1	6675	Oil Pan Assy
2	6723	Rear Seal
3	—	Silicone Rubber Sealer
4	—	Front Cover Assy
5	—	Guide Pin (2 Req'd)
6A	—	Screw and Washer Assy Hex Head
7B	6C644	Low Oil Level Sensor Assy

(Continued)

Item	Part Number	Description
8	6C626	Gasket
9	6010	Cylinder Block Assy
10	—	Rear Cap
11C	—	Oil Pan Drain Plug
A		Tighten to 9-12 N·m (80-106 Lb-In)
B		Tighten to 25-34 N·m (18-25 Lb-Ft)
C		Tighten to 20-34 N·m (15-25 Lb-Ft)

Installation

NOTE: 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.

1. Clean gasket surfaces on cylinder block and oil pan.
2. Trial fit oil pan to cylinder block. Ensure enough clearance has been provided to allow oil pan to be installed without sealant being scraped off when pan is positioned under engine.
3. Apply Silicone Gasket and Sealant F1AZ-19562-A (WSE-M4G320-A2) or equivalent to oil pan.
4. Install oil pan assembly. Tighten retaining screws to 9-12 N·m (80-106 lb-in).
5. Install oil filter element assembly.
6. Install torque converter housing cover.
7. Install starter motor. Refer to Section 03-06A.
8. Install catalytic converter assembly. Refer to Section 09-00.
9. Lower vehicle.
10. Fill crankcase with the correct viscosity and amount of engine oil.
11. Connect battery ground cable.
12. Start engine and check for leaks.

IN-VEHICLE SERVICE (Continued)

Main Bearing Inserts

The main bearing inserts are precision selective fit. To check the bearing clearances or to select fit a new bearing, refer to Section 03-00.

Tools Required:

- Main Bearing Insert Tool TOOL-6331-E

Removal

1. Remove oil pan as outlined.
2. Remove oil pickup tube and screen assembly.
3. Replace one bearing at a time, leaving the other bearings securely fastened.

   Remove main bearing cap to which new bearings are to be installed.
4. Insert Main Bearing Insert Tool TOOL-6331-E, or equivalent in the oil hole in the crankshaft.
5. Rotate crankshaft in the direction of engine rotation to force bearing out of the block.
6. Clean crankshaft journals. Inspect journals and thrust faces (thrust bearing) for nicks, burrs or bearing pickup that would cause premature bearing wear.
7. If the crankshaft rear oil seal is to be replaced, refer to Crankshaft Rear Oil Seal Removal and Installation.

Installation

NOTE: Lightly oil all bolt and stud bolt threads before installation.

1. Lubricate with XO-10W30-QSP (ESE-M2C153-E) or equivalent engine oil and position the upper bearing insert on crankshaft journal with plain end started into the side of cylinder block with locking tang slot. Line up bearing tang with slot in block.
2. Install Main Bearing Insert Tool TOOL-6331-E or equivalent in crankshaft journal oil hole.
3. With bearing and tool in position, rotate crankshaft so that the tool catches the edge of the bearing, pushes into position and sets in cylinder block. Remove tool.
4. Install bearing insert in main cap.
5. If bearing insert clearance is to be checked, refer to Section 03-00.
6. If No. 1 or No. 2 bearing was removed, lubricate bearing surface with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil and install main cap.

   Tighten retaining bolts to 88-110 N·m (65-81 lb-ft).
7. If rear main bearing insert was removed, perform the following:
   a. Remove all traces of sealant from main bearing cap to cylinder block parting line.

      NOTE: The bearing cap must be installed within 15 minutes after the silicone sealer application. After this time, the sealer may start to set-up and its sealing effectiveness may be reduced.
   b. Apply a 3mm (1/8 inch) bead of Silicone Rubber D6AZ-19562-BA (ESB-M4G92-A and ESE-M4G195-A) or equivalent to main bearing cap-to-cylinder block parting line.
   c. Lubricate bearing surfaces with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil and install main bearing cap. Tighten retaining bolts to 88-110 N·m (65-81 lb-ft).
8. If thrust bearing insert was removed, perform the following:
   a. Lubricate bearing surface with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil and install main bearing cap with bolt finger-tight.
   b. Pry crankshaft forward against thrust surface on upper bearing insert, while holding bearing cap to the rear. This aligns thrust rear surfaces on both halves of the bearing.
   c. While holding crankshaft forward, tighten cap retaining bolts to 88-110 N·m (65-81 lb-ft).
9. Install oil pickup tube and screen assembly with a new gasket.

   Tighten pickup retaining bolts to 20-30 N·m (15-22 lb-ft).

   Tighten tube support bracket retaining nut to 40-55 N·m (30-40 lb-ft).
10. Install oil pan as outlined.

Connecting Rod Bearings

The connecting rod bearings are a selective fit to provide the necessary clearance. Refer to Section 03-00 to measure clearance and select the proper bearing insert.

Removal

1. Remove spark plugs.
2. Remove oil pan as outlined.

   NOTE: On Taurus Police applications, remove windage tray.
3. Turn crankshaft until connecting rod from which the bearings are to be removed is at the lowest point of travel.
4. Remove connecting rod cap and bearing lower insert.

   CAUTION: Tape or place old spark plug boots over rod bolts to avoid damage to journal during service.
5. Remove upper bearing insert. Push piston up into cylinder bore slightly to provide clearance for removal.

Installation

NOTE: Lightly oil all bolt and stud bolt threads before installation.

IN-VEHICLE SERVICE (Continued)

1. Thoroughly clean bearing inserts, connecting rod cap and connecting rod.

   CAUTION: Contaminants allowed to remain on the cap or bearing can distort bearing or damage crankshaft journals.
2. Clean crankshaft journal and lubricate with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil.
3. Install bearing insert in the connecting rod and pull rod down until it seats on crankshaft.

   When installing bearing insert ensure tab on bearing engages slot in rod and that bearing is fully seated in rod.
4. Install bearing insert in connecting rod cap and lubricate bearing surface with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil.
5. Install connecting rod cap and retaining nuts.

   Tighten nuts to 41-49 N·m (31-36 lb-ft). Back off nuts two to three turns. Final tighten nuts to 41-49 N·m (31-36 lb-ft).
6. Install oil pan as outlined.
7. Install spark plugs.

Crankshaft

Removal

1. Remove engine from vehicle as outlined.
2. Mount engine in a suitable workstand. If necessary, drain crankcase and cylinder block cooling jackets.
3. Disconnect secondary wire from the spark plugs.

   Remove distributor cap and wires as an assembly.
4. Remove spark plugs.
5. Remove oil pan and oil pickup tube.
6. Remove front cover and water pump as an assembly.
7. Remove distributor drive gear.
8. Remove crankshaft sprocket, camshaft sprocket and timing chain. This requires pulling back on ratcheting mechanism of tensioner and installing pin through hole to relieve tension against chain.
9. Remove flywheel and rear cover plate.

   NOTE: On Taurus Police applications remove windage tray.
10. Remove connecting rod caps. Turn crankshaft as necessary to position connecting rod in the low point of travel before removing rod cap.

    Push piston up into cylinder bore after removing connecting rod cap. Ensure the crankshaft journals are not damaged.

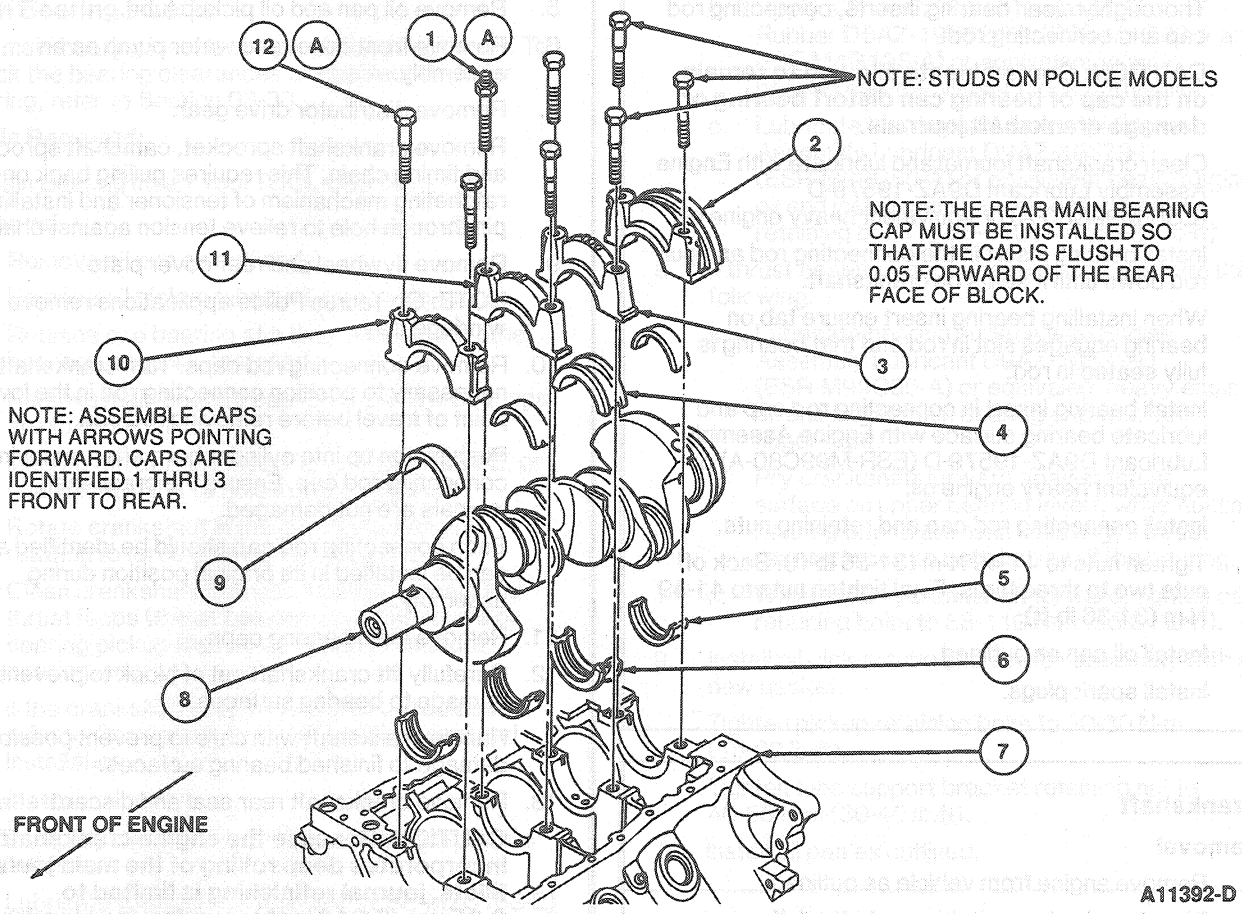
    Each connecting rod cap should be identified so it can be installed in its original position during assembly.
11. Remove main bearing caps.
12. Carefully lift crankshaft out of block to prevent damage to bearing surfaces.

    Handle crankshaft with care to prevent possible damage to finished bearing surfaces.
13. Remove crankshaft rear seal and discard.

    CAUTION: Because the engine crankshaft incorporates deep rolling of the main journal fillets, journal refinishing is limited to 0.25mm (0.010 inch)—undersize standard journal dimensions. Further main journal refinishing may result in fatigue failure of the crankshaft.

    Refer to Section 03-00 for crankshaft cleaning, inspection and refinishing.

IN-VEHICLE SERVICE (Continued)



Item	Part Number	Description
1A	—	Stud
2	6325	Rear Cap
3	6327	Rear Intermediate Cap
4	6A339	Thrust Bearing-Lower
5	6333	Main Bearing-Upper (3 Req'd)
6	6337	Thrust Bearing-Upper

(Continued)

Item	Part Number	Description
7	6010	Cylinder Block Assy
8	6303	Crankshaft Assy
9	6A338	Main Bearing-Lower (3 Req'd)
10	6329	Front Cap
11	6334	Front Intermediate Cap
12A	—	Bolt (7 Req'd)
A		Tighten to 88-110 N·m (65-81 Lb-Ft)

Installation

NOTE: Lightly oil all bolts and stud bolt threads before installation.

CAUTION: Contaminants under a bearing will cause distortion. Contaminants on a bearing surface will cause damage to the crankshaft journals.

1. Ensure all crankshaft bearing surfaces and bearing inserts are clean.
2. If crankshaft main bearing journals have been refinished to a definite undersize, remove main bearing inserts from cylinder block and main bearing caps.

   Loosen lower intake manifold attachments prior to installing bearings or measuring bearing clearance.

   Install new bearings. Ensure tabs on insert assembly engage slots in the cap and block.
3. Ensure seal groove in cylinder block is clean.
4. Carefully lower crankshaft into position in cylinder block. Be careful not to damage thrust bearing.

IN-VEHICLE SERVICE (Continued)

5. Ensure seal groove in rear main cap is clean.

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

6. Apply a 3mm (1/8 inch) bead of Silicone Rubber D6AZ-19562-AA (ESB-M4G92-A and ESE-M4G195-A) or equivalent to rear main bearing cap-to-cylinder block parting line.
7. Lubricate bearing surfaces with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil. Install main bearing caps and retaining bolts.
8. Tighten main bearing cap retaining bolts as follows:

   NOTE: Do not jam the screwdriver into position. Carefully tap on the screwdriver until it holds crankshaft toward front of engine.

   a. Wedge a screwdriver between cylinder block web and crankshaft cheek in front of the No. 3 main bearing.

      NOTE: No. 2 main bearing retaining stud should be tightened to 90-110 N·m (67-81 lb-ft).

   b. Tighten main bearing cap retaining bolts to 88-110 N·m (65-81 lb-ft).
   c. Remove screwdriver.
9. Check crankshaft end play as outlined.
10. Install crankshaft rear oil seal as outlined.
11. If crankshaft connecting rod journals have been refinished to a definite undersize, remove bearing inserts from connecting rods and rod caps.

    Install new bearings. Ensure tabs on insert securely engage the slots in cap and rod.

12. Rotate crankshaft as necessary to bring each crankshaft throw to lowest point of travel. Pull piston downward until connecting rod seats on crank throw and install rod caps.
13. Check connecting rod clearance. Refer to Section 03-00.

    As each clearance check is completed, lubricate bearing surfaces with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil before installing connecting rod cap.

    Tighten retaining nuts to 41-49 N·m (31-36 lb-ft), back off nuts two to three turns. Final tighten the nuts to 41-49 N·m (31-36 lb-ft).
14. Install timing chain and front cover / water pump assembly as outlined.
15. Install distributor drive gear.
16. Install oil pan as outlined.
17. Install rear cover plate and flywheel as outlined.
18. Install spark plugs.
19. Install distributor cap. Connect secondary wires to spark plugs.
20. Tighten lower intake manifold bolts to specification if loosened to service main bearings.
21. Install engine in the vehicle as outlined.

Camshaft

Removal

1. Remove engine from vehicle as outlined.
2. Remove intake manifold as outlined.
3. Remove tappets, guide plates and guide plate retainers as outlined.
4. Remove front cover and timing chain as outlined.
5. Remove oil pan as outlined.
6. Remove thrust plate.
7. Remove camshaft through the front of the engine, being careful not to damage bearing surfaces.

Installation

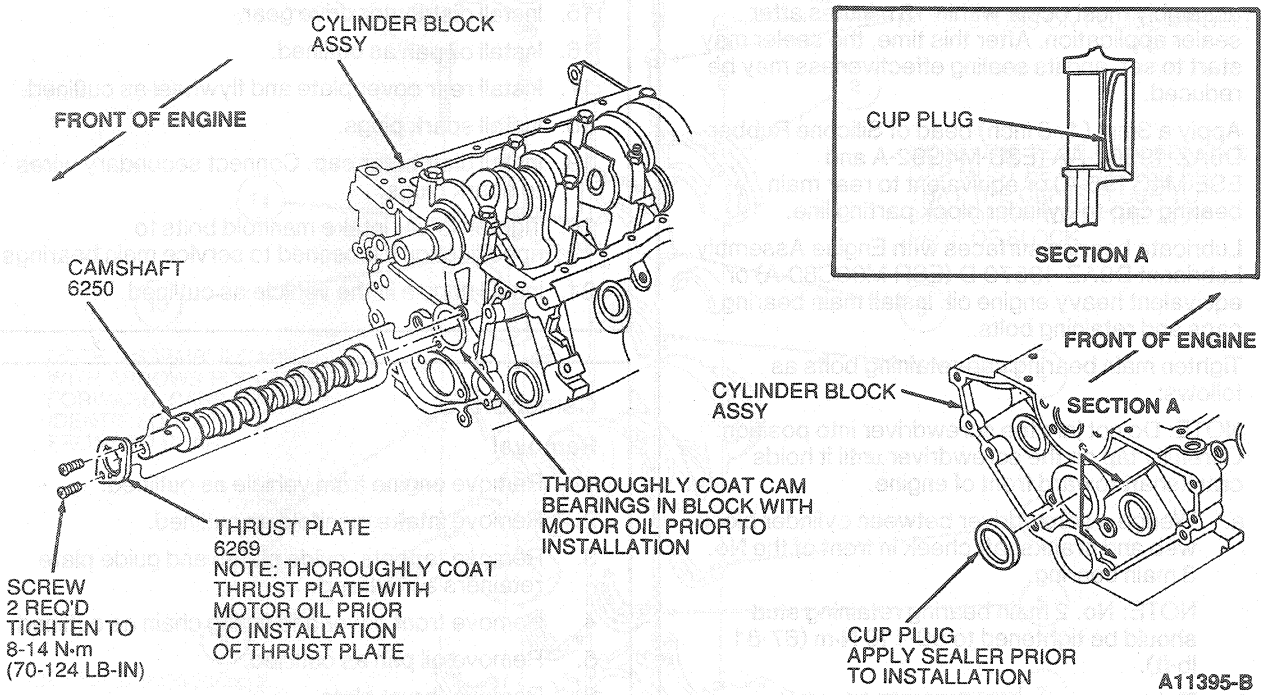
NOTE: Lightly oil all retaining bolts and stud bolt threads before installation except those specifying special sealant.

Inspect bore plug for damage or leakage. Replace or reseal as necessary (engine removed).

1. Lubricate the cam lobes and bearing surfaces with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent.
2. Install camshaft being careful not to damage bearing surfaces while sliding into position.
3. Install thrust plate. Tighten bolts to 8-14 N·m (70-124 lb-in).
4. Check end play of crankshaft as outlined.
5. Install front cover and timing chain as outlined.
6. Install oil pan as outlined.
7. Install tappets, guide plates and guide plate retainers as outlined.
8. Install intake manifolds as outlined.

IN-VEHICLE SERVICE (Continued)

9. Install engine in vehicle as outlined.



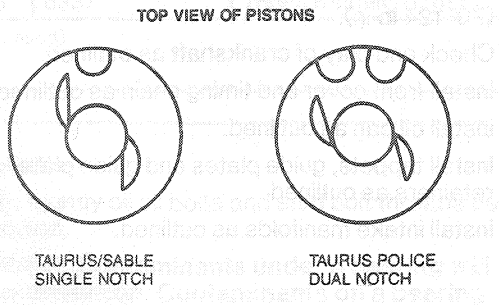
Pistons and Connecting Rods

Tools Required:

- Rotunda Piston Ring Compressor 014-00290
- Rotunda Cylinder Ridge Reamer 014-00292

Removal

CAUTION: Taurus Police vehicles use high silicon alloy pistons. They must be replaced with the same. These pistons are identified by two notches in the top of the piston.



1. Drain engine cooling system.
2. Remove intake manifolds as outlined.
3. Remove cylinder heads as outlined.
4. Remove oil pan as outlined.
5. Remove oil pickup tube and screen assembly.

   NOTE: If additional clearance is needed, remove windage tray for Police application.
6. Before removing piston, inspect top of each cylinder bore. If a ridge has formed at the top of the cylinder it must be removed before piston removal. Remove ridge as follows:
   a. Turn crankshaft until piston to be removed is at bottom of cylinder bore.
   b. Place a clean shop cloth over piston head to collect cuttings.
   c. Remove ridge using Rotunda Cylinder Ridge Reamer 014-00292 or equivalent. Never cut into ring travel area more than 0.8mm (1/32 inch) when removing ridge.
7. Turn crankshaft until piston to be removed is at the low point of its travel.

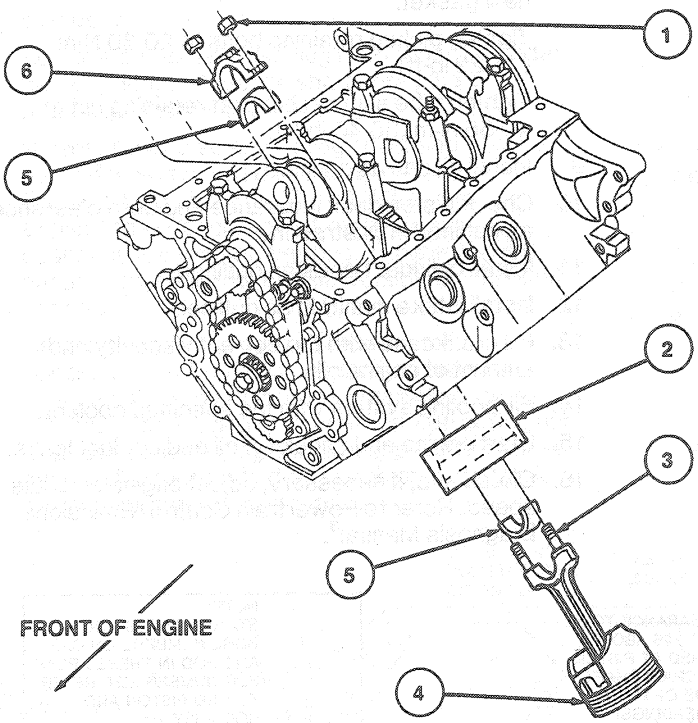
   If more than one piston is being removed, identify the pistons and connecting rod caps. Each component should be installed in its original position during assembly.
8. Remove connecting rod cap retaining nuts and cap.
9. Install spark plug boots or suitable protection over connecting rod cap studs and push piston out through the top of the cylinder bore. Use care to prevent damage to bearing surfaces.
10. Install connecting rod cap and hold in position with cap retaining nuts.

IN-VEHICLE SERVICE (Continued)

11. If piston is to be disassembled, refer to Piston, Disassembly.
12. Inspect cylinder bore. If new piston rings are to be installed on the piston a visible cross-hatch pattern should be obvious on the cylinder bore wall.

    If honing is required, remove glaze from cylinder wall using spring-loaded hone. Follow manufacturer's instructions when using this type of equipment.

After honing, thoroughly clean cylinder bore using a detergent and water solution.



TIGHTENING PROCEDURE:

1. RE-USED NUTS, FOR RE-ASSEMBLY, MUST BE WASHED CLEAN PRIOR TO ASSEMBLY. OIL NUTS OF CONNECTING ROD STUD AND CAP SEAT.
2. HAND START NUT OR USE AUTOMATIC NUT INSTALLATION AND RUN-DOWN.
3. TIGHTEN NUT TO SEAT CAP AND NUT TO 41-49 N•m (31-36 LB-FT).
4. BACK OFF NUT A MINIMUM OF TWO REVOLUTIONS.
5. FINAL TIGHTEN NUT TO 41-49 N•m (31-36 LB-FT).

NOTE:
PRIOR TO INSTALLATION OF PISTON ROD ASSY AND CAP, APPLY OIL TO ALL CRANKSHAFT PIN JOURNALS AND COAT ALL CYLINDER BORE SURFACES AND/OR PISTONS.

INSTALL PISTON AND CONNECTING ROD ASSY'S IN THE FOLLOWING ORDER.

1. **PISTON AND ROD ASSY NO. 1 AND NO. 5**
2. **PISTON AND ROD ASSY NO. 2 AND NO. 6**
3. **PISTON AND ROD ASSY NO. 3 AND NO. 4**

A11397-D

Item	Part Number	Description
1	—	Nut (12 Req'd)
2	014-00290	Piston Ring Compressor
3	6214	Bolt (12 Req'd)
4	6100	Piston and Rod Assy (6 Req'd)
5	6211	Rod Bearing (6 Req'd)
6	6210	Rod Cap (6 Req'd)

Installation

NOTE: Lightly oil all retaining bolt and stud bolt threads before installation except those specifying special sealant.

1. Lubricate cylinder wall and piston with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil.

IN-VEHICLE SERVICE (Continued)

2. Install spark plug boots or suitable protection on connecting rod studs.

   NOTE: Install pistons in the same cylinders from which they were removed or to which they were fitted. The connecting rod and bearing caps are numbered from 1 to 3 in the RH bank and from 4 to 6 in the LH bank, beginning at the front of the engine. Numbers on connecting rod and bearing cap must be on the same side when installed in cylinder bore. If a connecting rod is transposed from one block or cylinder to another, new bearings should be fitted and connecting rod should be numbered to correspond with new cylinder number.

3. Install piston using Rotunda Piston Ring Compressor 014-00290 or equivalent.

   CAUTION: As piston is tapped into bore with a hammer handle, guide connecting rod onto crankshaft journal to avoid damage to bearing surfaces.

   Ensure notch in piston dome and button on connecting rod faces front of engine and that connecting rod oil squirt hole is facing RH side of engine.

4. Check connecting rod bearing clearance. Refer to Section 03-00.

5. Lubricate bearing surfaces with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent.

6. Ensure connecting rod is seated on crankshaft journal. Install connecting rod cap.

   Tighten retaining nuts to 41-49 N·m (31-36 lb-ft). Back-off nuts two or three turns. Final tighten to 41-49 N·m (31-36 lb-ft).

7. If necessary, check connecting rod side clearance as outlined.

   NOTE: Install windage tray for Police application if removed.

8. Install oil pickup tube and screen assembly with a new gasket.

   Tighten pickup retaining bolts to 20-30 N·m (15-22 lb-ft).

   Tighten tube support bracket retaining nut to 40-55 N·m (30-40 lb-ft).

9. Install oil pan as outlined.

10. Check piston deck clearance and bore clearance as outlined in illustration.

11. Install cylinder heads as outlined.

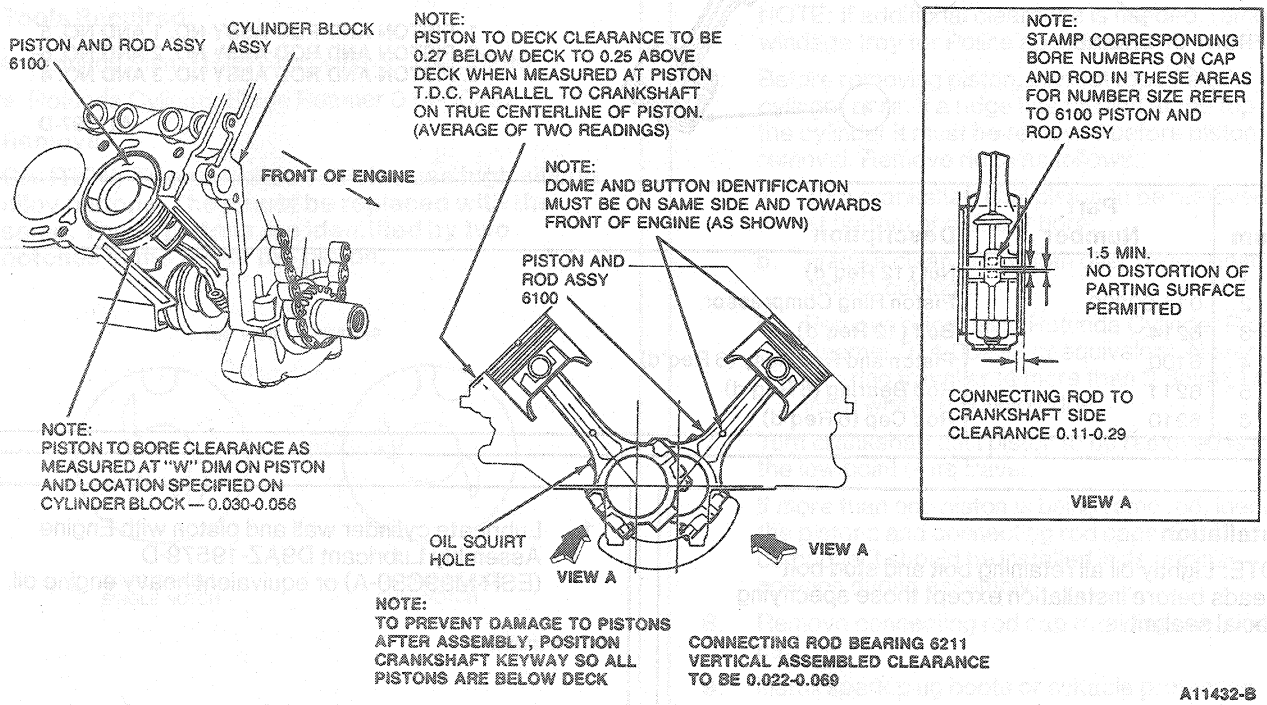
12. Install intake manifold as outlined.

13. Fill crankcase with the correct viscosity and amount of engine oil.

14. Fill cooling system with the specified coolant.

15. Start engine and check for oil and coolant leaks.

16. Check and, if necessary, adjust engine curb idle speed. Refer to Powertrain Control / Emissions Diagnosis Manual[3].



3 Can be purchased as a separate item.

IN-VEHICLE SERVICE (Continued)

Camshaft and Balance Shaft Bearings

Tools Required:

- Camshaft Bearing Set T65L-6250-A

Removal

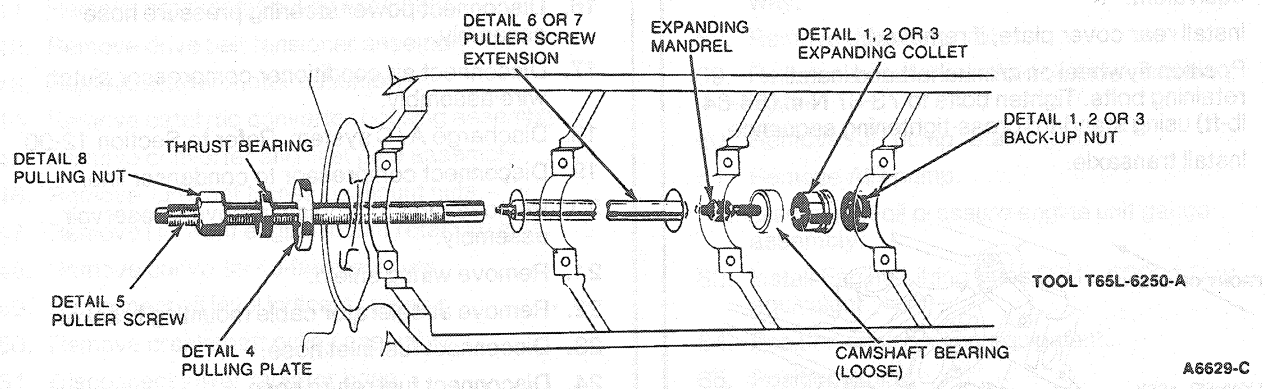
1. Remove engine from vehicle as outlined.
2. Remove flywheel and rear cover plate.
3. Remove camshaft as outlined, (and balance shaft if replacing balance shaft bearings).
4. Remove crankshaft and push piston to top of cylinder bore.
5. Remove camshaft bore plug from rear of cylinder block. (Remove balance shaft bore plug if replacing balance shaft bearings.)
6. Select proper size expanding collet and backup nut and assemble on expanding mandrel from Camshaft Bearing Set T65L-6250-A. With expanding collet collapsed, install collet assembly in camshaft bearing. Tighten backup nut on expanding mandrel until collet fits camshaft bearing.
7. Assemble puller screw and extension if necessary, and install on expanding mandrel. Wrap a cloth around threads of puller screw to protect front bearing or journal. Tighten pulling nut against thrust bearing and pulling plate to remove camshaft bearing. Hold a wrench on end of puller screw to prevent it from turning.
8. Repeat this procedure for each bearing. To remove front bearing, install puller screw from rear of cylinder block.

Installation

Camshaft bearings are available prefinished to size for standard journal diameters. The bearings are not interchangeable from one bore to another.

CAUTION: Failure to use correct expanding collet can cause severe bearing damage. Ensure front bearing is installed specified distance below front face of cylinder block.

1. Position new bearings at bearing bores with oil holes aligned with holes in block. Press them in place using Camshaft Bearing Set T65L-6250-A. Center pulling plate and puller screw to avoid damage to bearing.
2. Install camshaft bore plug as outlined.
3. Install crankshaft as outlined.
4. Install camshaft as outlined.
5. Install rear cover plate and flywheel as outlined.
6. Install engine in vehicle as outlined.



Balance Shaft and Camshaft Rear Bearing Bore Plug

Tools Required:

- Impact Slide Hammer T50T-100-A
- Impact Slide Hammer T50T-100-B

Removal

1. Remove transaxle. Refer to applicable Section in Group 07.
2. Remove flywheel as outlined.
3. Remove engine rear cover plate.
4. Using a sharp chisel or punch and hammer, cut a hole in center of plug.
5. Remove plug using Impact Slide Hammer T59L-100-B or T50T-100-A. The plug can also be pried from bore using a large punch. Use care to prevent damage to plug bore.

Installation

NOTE: Prior to installing a core plug, the plug bore should be inspected for any damage that would interfere with proper sealing of the plug. If the bore is damaged it will be necessary to true the surface by boring for the next specified oversize plug. Oversize (OS) plugs are identified by the OS stamped in the flat located on cup side of plug.

IN-VEHICLE SERVICE (Continued)

Apply a light coating of Perfect-Seal Sealing Compound B5A-19554-A (ESR-M18P2-A and ESE-M4G115-A) or equivalent to sealing edge of plug before installation.

1. Install bore plug using a suitable driver.
2. Install engine rear cover plate.
3. Install flywheel as outlined.
4. Install transaxle. Refer to applicable Section in Group 07.

Flywheel

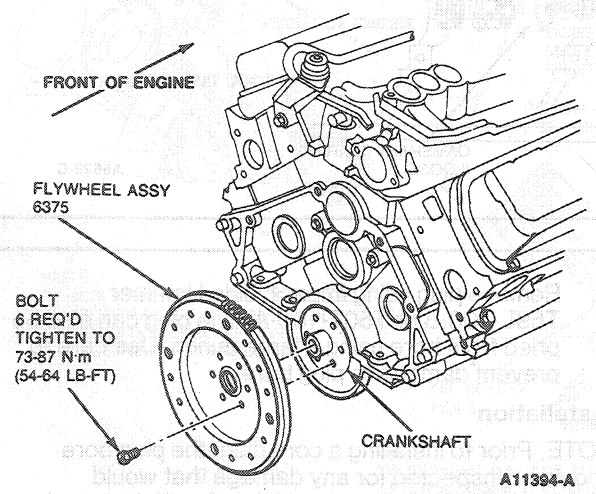
Removal

1. Remove transaxle.
2. Remove flywheel retaining bolts and flywheel.
3. The rear cover plate can be removed, if necessary.

Installation

NOTE: If flywheel is to be replaced, check if original flywheel has balance pins or rivets installed. If so, new balance rivets E2DZ-6A32-A or equivalent, must be installed on new flywheel in same position as on original flywheel.

1. Coat threads of flywheel retaining bolts with Pipe Sealant with Teflon® D8AZ-19554-A (ESG-M4G194-A and ESR-M18P7-A) or equivalent.
2. Install rear cover plate, if removed.
3. Position flywheel on crankshaft and install retaining bolts. Tighten bolts to 73-87 N·m (54-64 lb-ft) using standard cross-tightening sequence.
4. Install transaxle.



REMOVAL AND INSTALLATION

Engine Assembly

Tools Required:

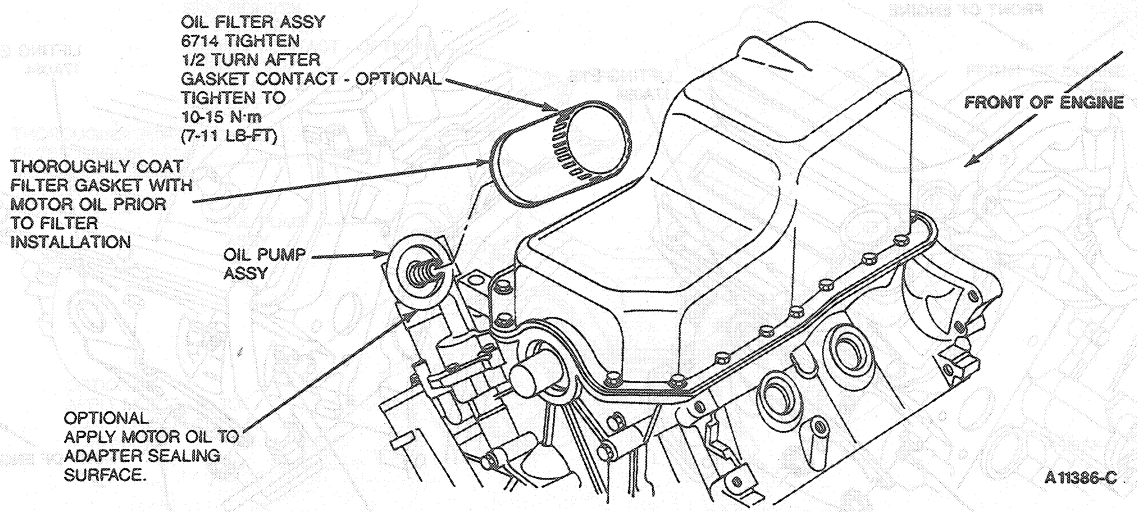
- Engine Lifting Eyes D81L-6001-D

Removal

1. Drain engine cooling system.
2. Disconnect battery ground cable.
3. Disconnect wiring connector retaining underhood lamp.
4. Mark position of hood hinges and remove hood.
5. Remove oil level indicator tube.
6. Disconnect generator to voltage regulator wiring assembly.
7. Remove radiator upper sight shield.
8. Remove engine cooling fan motor relay retaining bolts.
9. Position cooling fan motor relay out of the way.
10. Remove air cleaner assembly.
11. Disconnect radiator electric fan and motor assembly.
12. Remove fan shroud.
13. Remove upper radiator hose.
14. Disconnect transaxle oil cooler inlet and outlet tubes.
15. Disconnect heater hoses.
16. Disconnect power steering pressure hose assembly.
17. Disconnect air conditioner compressor clutch wire assembly.
18. Discharge A/C system. Refer to Section 12-00.
19. Disconnect compressor to condenser line.
20. Remove radiator coolant recovery reservoir assembly.
21. Remove wiring shield.
22. Remove accelerator cable mounting bracket.
23. Disconnect fuel inlet hose.
24. Disconnect fuel return hose.
25. Disconnect power steering pump pressure and return tube bracket.
26. Disconnect powertrain control module (PCM) wiring assembly.
27. Disconnect vacuum hoses.
28. Disconnect ground wire assembly.
29. Remove duct assembly.
30. Disconnect one end of throttle control valve cable.
31. Disconnect bulkhead electrical connector and transaxle pressure switches.
32. Remove bolts retaining transaxle support assembly.
33. Remove transaxle and support assembly from vehicle.

REMOVAL AND INSTALLATION (Continued)

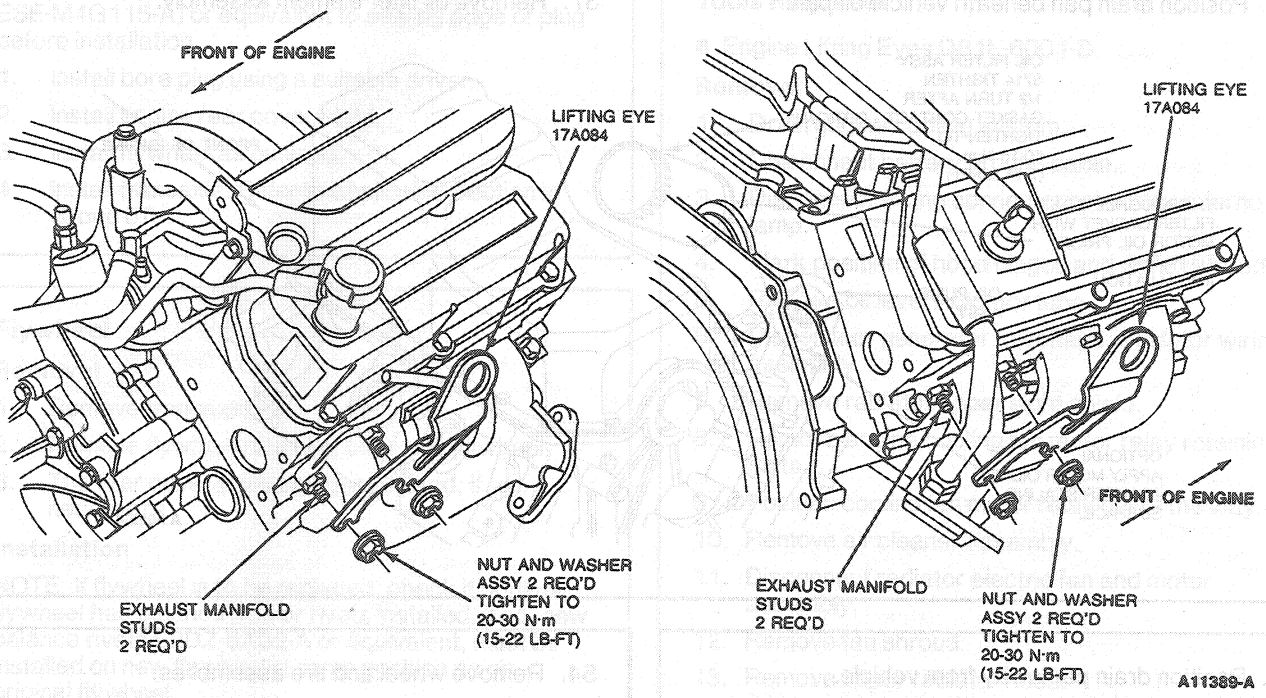
34. Raise vehicle on hoist. Refer to Section 00-02.
35. Position drain pan beneath vehicle oil pan.
36. Drain engine oil.
37. Remove oil filter element assembly.



38. Position drain pan away from vehicle.
39. Disconnect heated oxygen sensor (H02S)(9F472).
40. Loosen and remove drive belt assembly.
41. Remove crankshaft pulley assembly.
42. Remove drive belt tensioner assembly.
43. Remove starter motor assembly.
44. Remove catalytic converter housing assembly.
45. Remove converter and inlet pipe assembly.
46. Remove LH front transaxle mount nuts.
47. Remove RH front engine mount retaining nuts.
48. Remove converter-to-flywheel nuts.
49. Disconnect oil level indicator sensor.
50. Remove crankshaft pulley assembly.
51. Disconnect lower radiator hose.
52. Remove engine-to-transaxle bolts.
53. Partially lower engine.
54. Remove wheel and tire assemblies.
55. Remove water pump pulley retaining bolts.
56. Remove water pump pulley.
57. Remove distributor cap and position out of the way.
58. Remove distributor rotor.
59. Remove exhaust manifold bolt lock retaining bolts.
60. Remove AIR pump retaining bolts.
61. Remove AIR pump.
62. Disconnect oil pressure engine unit gauge assembly.
63. Install Engine Lifting Eyes D81L-60001-D or equivalent.
64. Position engine lifting equipment.
65. Position jacks.
66. Raise transaxle assembly slightly.

REMOVAL AND INSTALLATION (Continued)

67. Remove engine assembly from vehicle.



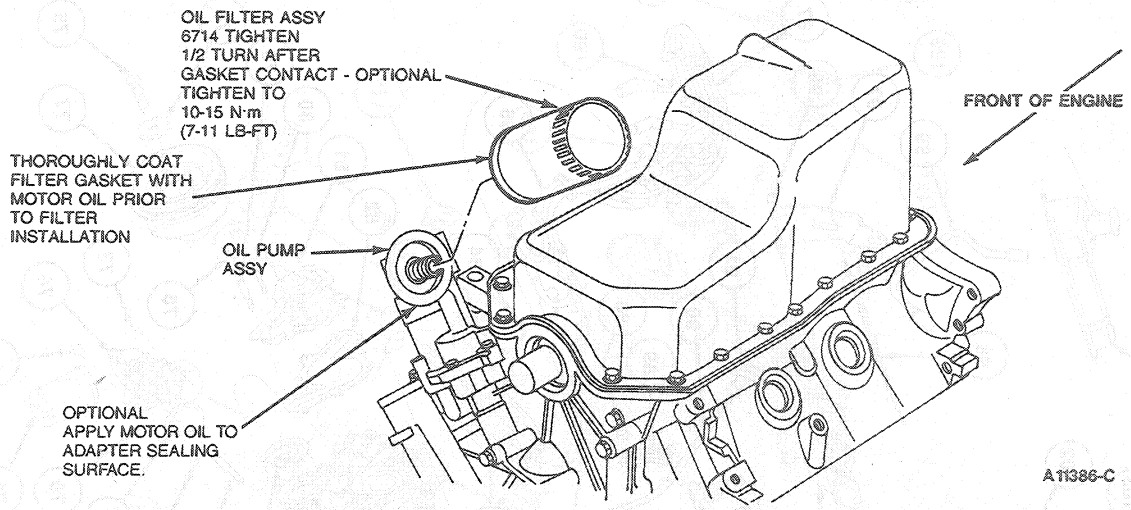
Installation

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

1. Position engine assembly in vehicle.
2. Install engine-to-transaxle bolts.
3. Remove jacks and place them out of the way.
4. Remove engine lifting equipment and place out of the way.
5. Remove engine lifting eyes.
6. Tighten engine-to-transaxle bolts to 55-68 N·m (40-50 lb-ft).
7. Connect oil pressure engine unit gauge assembly.
8. Place A/C compressor in proper position and tighten retaining bolts to 41-61 N·m (30-45 lb-ft).
9. Connect compressor to condenser discharge line.
10. Connect air conditioner compressor clutch wire assembly.
11. Connect water heater hoses.
12. Connect fuel tube hose.
13. Connect fuel return line hose.
14. Connect vacuum hose.
15. Connect transaxle oil cooler inlet and outlet tubes.
16. Install radiator assembly.
17. Partially raise vehicle.
18. Install converter-to-flywheel bolts. Tighten to 27-46 N·m (20-34 lb-ft).
19. Install LH and RH transaxle and engine mount retaining nuts.
20. Install converter housing cover.
21. Install starter motor. Refer to Section 03-06A.
22. Connect lower radiator hose.
23. Install drive belt tensioner assembly.
24. Install crankshaft pulley assembly. Tighten retaining bolts to 26-38 N·m (19-28 lb-ft).
25. Install converter assembly.
26. Connect HO2S.

REMOVAL AND INSTALLATION (Continued)

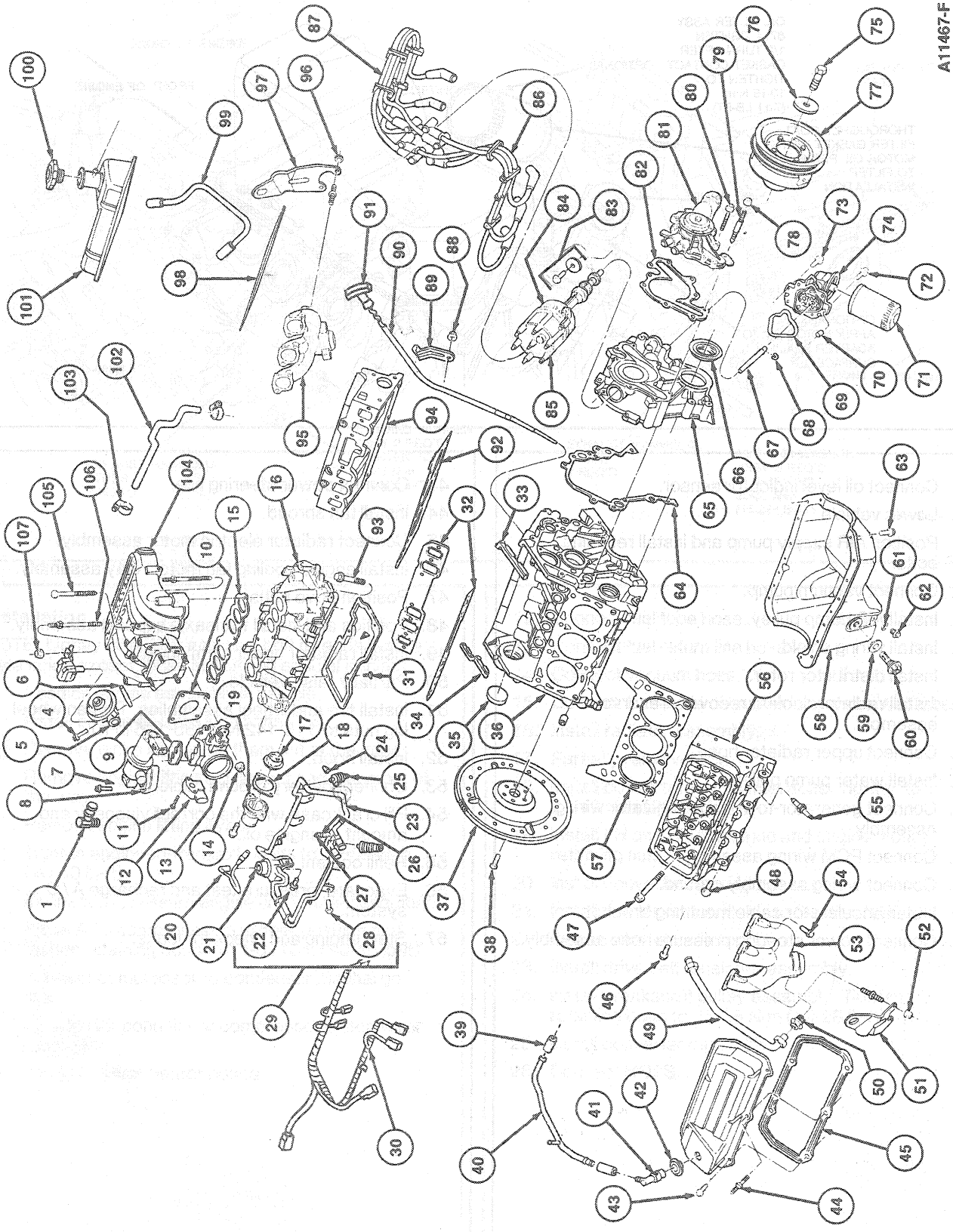
27. Install oil filter.



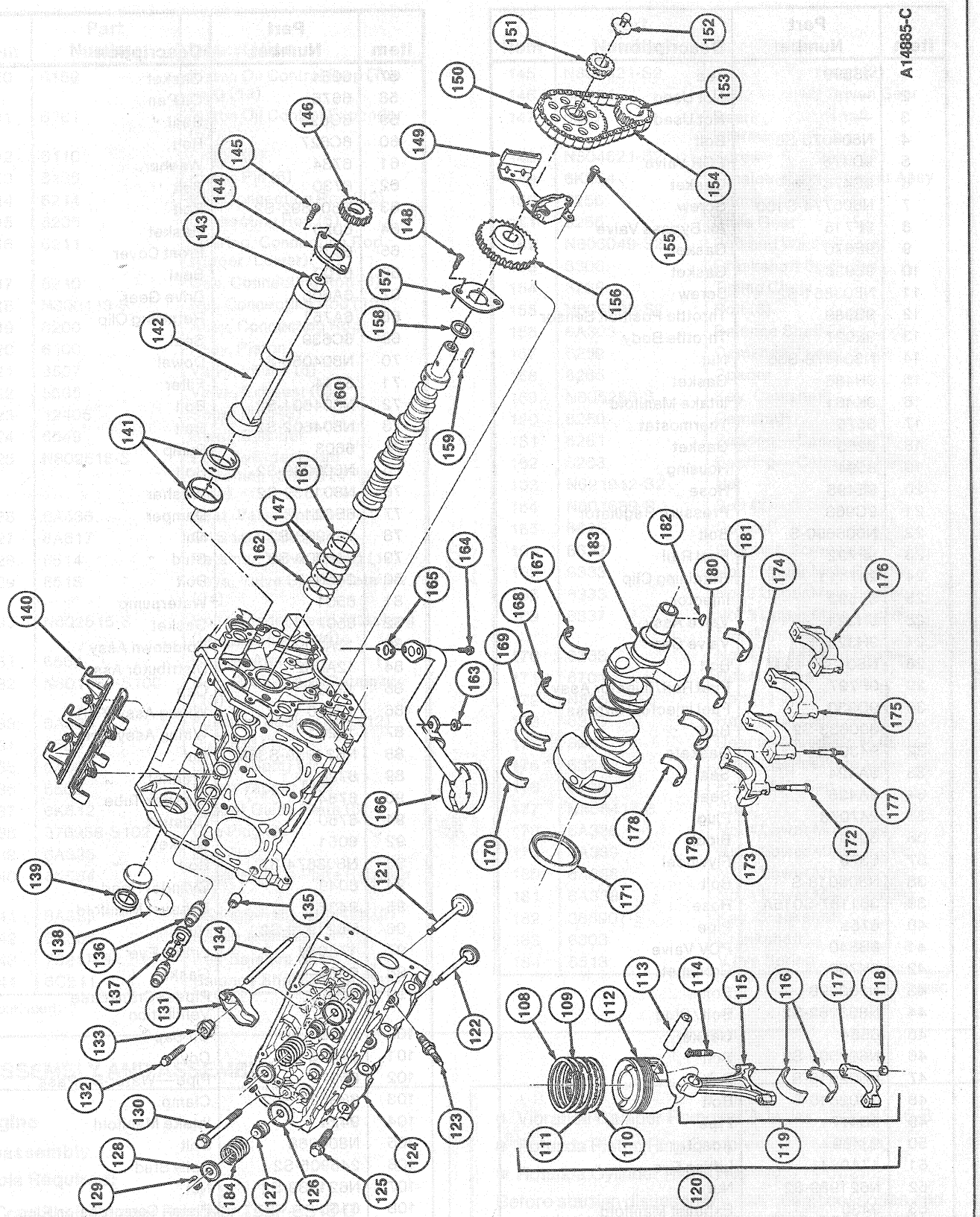
28. Connect oil level indicator sensor.
29. Lower vehicle.
30. Position AIR supply pump and install retaining bolts.
31. Connect vacuum pump.
32. Install AIR pump pulley.
33. Install wiring shield.
34. Install distributor rotor.
35. Install radiator coolant recovery reservoir assembly.
36. Connect upper radiator hose.
37. Install water pump pulley.
38. Connect generator-to-voltage regulator wiring assembly.
39. Connect PCM wiring assembly.
40. Connect wiring assembly ground.
41. Install accelerator cable mounting bracket.
42. Connect power steering pressure hose assembly.
43. Connect power steering line.
44. Install fan shroud.
45. Connect radiator electric motor assembly.
46. Install engine cooling fan motor relay assembly.
47. Position drive belts.
48. Position and install transaxle support assembly.
49. Install radiator upper sight shield.
50. Partially raise vehicle.
51. Install tire and wheel assemblies. Tighten wheel lug nuts to 115-142 N·m (85-105 lb-ft).
52. Install hood.
53. Connect battery ground cable.
54. Fill crankcase with the correct viscosity and amount of engine oil.
55. Refill coolant.
56. Evacuate, pressure test and recharge A/C system.
57. Start engine and check for leaks.

REMOVAL AND INSTALLATION (Continued)

Disassembled View



REMOVAL AND INSTALLATION (Continued)



REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
1	18599	Tee
2	—	Not Used
3	—	Not Used
4	N804073-S8	Bolt
5	9D475	EGR Valve
6	9S476	Gasket
7	N605774-S100	Screw
8	9F715	Air Bypass Valve
9	9F670	Gasket
10	9E936	Gasket
11	N803851-S2	Screw
12	9B989	Throttle Position Sensor
13	9E927	Throttle Body
14	N804178-S36	Nut
15	9H486	Gasket
16	9K461	Intake Manifold
17	8575	Thermostat
18	8255	Gasket
19	8594	Housing
20	9E498	Hose
21	9C968	Pressure Regulator
22	N606690-S	Bolt
23	9F792	Fuel Rail
24	247111	Retaining Clip
25	9F593	Injector
26	9H321	Valve Assy
27	9H323	Valve Cap
28	N804394-S8M	Bolt
29	9F797	Fuel Rail / Injector Assy
30	9D930	Fuel Injector Harness
31	390633-S2	Bolt
32	9439	Gaskets
33	9A424	Seal
34	9A425	Seal
35	247073	Plug
36	6010	Block
37	6375	Flywheel
38	N805018-S	Bolt
39	381187-S015A	Hose
40	6758	Pipe
41	6B840	PCV Valve
42	6K786	Grommet
43	N803298	Bolt
44	N803262-S2	Bolt / Stud
45	6584	Gasket
46	N602569-S2	Bolt
47	N802516-S	Bolt
48	N802516-S	Bolt
49	9D477	Pipe
50	9J469	Adapter
51	17A084	Lifting Eye
52	N621939-S2	Nut
53	9430	Exhaust Manifold
54	N8D1647-S	Bolt
55	12405	Spark Plug
56	6049	Cylinder Head

(Continued)

Item	Part Number	Description
57	6051	Gasket
58	6675	Oil Pan
59	6C626	Seal
60	6C627	Bolt
61	6734	Washer
62	6730	Bolt
63	N605892-S2	Bolt
64	6020	Gasket
65	6019	Front Cover
66	6700	Seal
67	6A605	Drive Gear
68	6A751	Retaining Clip
69	6C639	Seal
70	N804055-S	Dowel
71	6714	Filter
72	N804601-S2	Bolt
73	N804602-S2	Bolt
74	6603	Pump
75	N800069-S2	Bolt
76	N801539-S2	Washer
77	6B321	Damper
78	245908-S2	Nut
79	245906-S2	Stud
80	246097	Bolt
81	8501	Waterpump
82	6507	Gasket
83	12A309	Holddown Assy
84	12A332	Distributor Assy
85	12106	Cap
86	12280	Wiring Assy (RH)
87	12281	Wiring Assy (LH)
88	N621939-S36M	Nut
89	6786	Bracket
90	6784	Dipstick Tube
91	6750	Dipstick
92	6051	Gasket
93	N803674-S2	Bolt
94	6049	Cylinder Head
95	9431	Exhaust Manifold
96	N621939-S2	Nut
97	17A084	Lifting Eye
98	6584	Gasket
99	6C342	Pipe—Crankcase Ventilation
100	6766	Oil Cap
101	6A505	Cover
102	8597	Pipe—Water-By-Pass
103	383522-S02	Clamp
104	9424	Intake Manifold
105	N804268	Bolt
106	245905-S2	Bolt / Stud
107	N621939-S2	Nut
108	6150	Piston Compression Ring (Top) (6)
109	6152	Piston Compression Ring (Bottom) (6)

(Continued)

REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
110	6159	Piston Oil Control Ring (Top Rail) (12)
111	6161	Piston Oil Control Expander (6)
112	6110	Piston (6)
113	6135	Piston Pin (6)
114	6214	Bolt Connecting Rod (12)
115	6205	Connecting Rod (6)
116	6211	Bearing, Connecting Rod (Upper / Lower)(12)
117	6210	Cap, Connecting Rod (6)
118	N800113-S	Nut, Connecting Rod (12)
119	6200	Assy, Connecting Rod
120	6100	Assy, Piston
121	6507	Valve, Intake (6)
122	6505	Valve, Exhaust (6)
123	12405	Spark Plug (6)
124	6049	Head, Cylinder
125	N802516-S	Bolt, Cylinder Head Attaching (Short) (4 Per Side)
126	6A536	Seat, Valve Spring
127	6A517	Oil Seal Valve (6)
128	6514	Retainer, Valve Spring (12)
129	6518	Keys, Valve Spring Retainer (24)
130	N802515-S	Bolt Cylinder Head Attaching (Long) (4 Per Side)
131	6564	Rocker Arm (12)
132	N801365-S100	Bolt, Rocker Arm Retaining (12)
133	6A528	Fulcrum, Rocker Arm (12)
134	6565	Pushrod (12)
135	6A008	Dowel (Split) (4)
136	6500	Roller Tappet (12)
137	6K512	Tappet Guide Plate (6)
138	376958-S102	Cup Plug (2)
139	6A335	Cup Plug
140	6K564	Tappet Guide Plate Retainer (2)
141	6A333	Bearing-Balance Shaft (2)
142	6A306	Balance Shaft
143	73217-S	Key-Balance Shaft
144	6C341	Balance Shaft Thrust Plate
145	N804621-S2	Screw—Flat Head (2)
146	6A304	Balance Shaft Driven Gear
147	6267	Bearing—Camshaft Intermediate (2)
148	N804621-S2	Screw—Flat Head (2)
149	6K254	Tensioner and Snubber Assy
150	6256	Camshaft Sprocket
151	6255	Drive Gear
152	N806049-S2	Bolt and Washer Assy
153	6306	Crankshaft Sprocket
154	6268	Timing Chain
155	N605890-S2	Bolt (3)
156	6A303	Balance Shaft Drive Gear
157	6269	Camshaft Thrust Plate
158	6265	Spacer
159	N805256-S	Key, Camshaft
160	6250	Camshaft
161	6261	Bearing—Camshaft Front
162	6263	Bearing—Camshaft Rear
163	N621942-S2	Nut
164	N801689-S	Bolt (2)
165	6625	Gasket
166	6622	Oil Pump Screen and Cover
167	6333	No. 1 Upper Main Bearing
168	6333	No. 2 Upper Main Bearing
169	6337	No. 3 Upper Main Thrust Bearing
170	6333	No. 4 Upper Main Bearing
171	6701	Rear Oil Seal
172	N805416-S	Bolt (7)
173	6325	Rear Main Cap
174	6237	Rear Intermediate Main Cap
175	6334	Front Intermediate Main Cap
176	6329	Front Main Cap
177	N805417-S	Stud
178	6A338	No. 4 Lower Main Bearing
179	6A339	No. 3 Lower Main Bearing
180	6A338	No. 2 Lower Main Bearing
181	6A338	No. 1 Lower Main Bearing
182	388907-S	Key, Crankshaft
183	6303	Crankshaft
184	6513	Valve Spring

TA14885C

(Continued)

DISASSEMBLY AND ASSEMBLY

Engine

Disassembly

Tools Required:

- Crankshaft Damper Remover T58P-6316-D
- Front Cover Seal Installer T70P-6B070-A
- Spark Plug Wire Remover T74P-6666-A
- Damper / Front Cover Seal Installer T82L-6316-A
- Vibration Damper Remover Adapter T82L-6316-B
- Rotunda Piston Ring Compressor 014-00290
- Rotunda Cylinder Ridge Reamer 014-00292

Before starting disassembly, remove accessories and any emission control equipment which is not directly attached to engine.

1. Remove flywheel and rear cover plate.

DISASSEMBLY AND ASSEMBLY (Continued)

2. Remove exhaust manifold and exhaust manifold.

   When exhaust manifold is removed, note location of dipstick tube support bracket.
3. Remove following positive crankcase ventilation system components:
   a. Front and rear PCV tubes.
   b. PCV valve.
   c. PCV valve grommet.
4. Disconnect engine coolant bypass hose at water pump and intake manifold. Remove hose.
5. Disconnect secondary wires from spark plugs.

   Remove distributor cap (with secondary wires) and rotor.

   When removing a wire from a spark plug, use Spark Plug Wire Remover T74P-6666-A. Grasp and twist boot back and forth on plug insulator to free boot. Use tool to pull boot from plug. Do not pull on wire directly or it may become separated from connector inside boot.
6. Remove following components:
   a. Throttle body (9E926) assembly and gasket.
   b. EGR valve assembly.
7. Remove intake manifold upper gasket.
8. Remove injector fuel rail assembly.
9. Remove crankshaft pulley and vibration damper. Use Crankshaft Damper Remover T58P-6316-D and Vibration Damper Remover Adapter T82L-6316-B to remove vibration damper.
10. Remove distributor hold-down clamp and distributor.
11. Remove rocker arm covers.

    CAUTION: Use care to prevent damage to machined surfaces.

    NOTE: Before attempting to remove lower intake manifold, break seal between intake manifold and cylinder block. Wedge a large screwdriver between intake manifold and block. Pry downward on screwdriver using lug on water pump as a leverage point.
12. Remove lower intake manifold and intake manifold to cylinder head gaskets. Discard intake manifold to cylinder head gaskets and seals.
13. Remove spark plugs.
14. Remove rocker arms and push rods.

    The location of each rocker arm, push rod and fulcrum should be noted. When engine is assembled each component should be installed in its original position.
15. Remove cylinder heads. Discard cylinder head retaining bolts. Remove and discard cylinder head gaskets.
16. Remove valve tappets and guide plate and retainer assemblies.

    The location of each tappet should be identified. When engine is assembled each tappet should be installed in its original position.

    If tappets are stuck in bores due to excessive varnish or gum deposits, it may be necessary to use a magnet or a claw-type tool to aid removal. When using a remover tool, rotate tappet back and forth to loosen it from any gum or varnish that may have formed on tappet.
17. Remove oil filter.
18. Remove oil pan and clean off RTV gasket.

    NOTE: On Taurus Police applications remove windage tray.
19. Remove oil pickup tube and filter assembly. Discard pickup tube gasket.

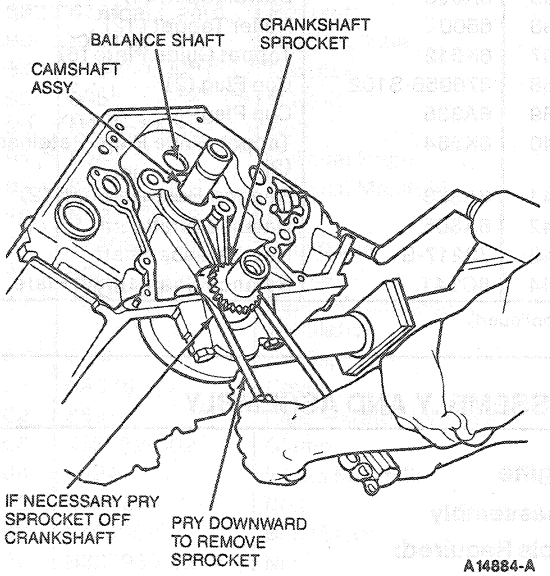
    NOTE: If necessary, water pump can be removed from front cover. Discard pump gasket after removal.
20. Remove water pump and front cover as an assembly. Remove and discard cover gasket.

    After removing cover, remove bolt and washer from end of camshaft.
21. Remove distributor drive gear.

    CAUTION: Use care to prevent damage to finished areas on crankshaft and sprocket.

    NOTE: If crankshaft sprocket is difficult to remove, it can be pried off using two large screwdrivers.

    Remove camshaft sprocket, crankshaft sprocket, timing chain and tensioner assembly.

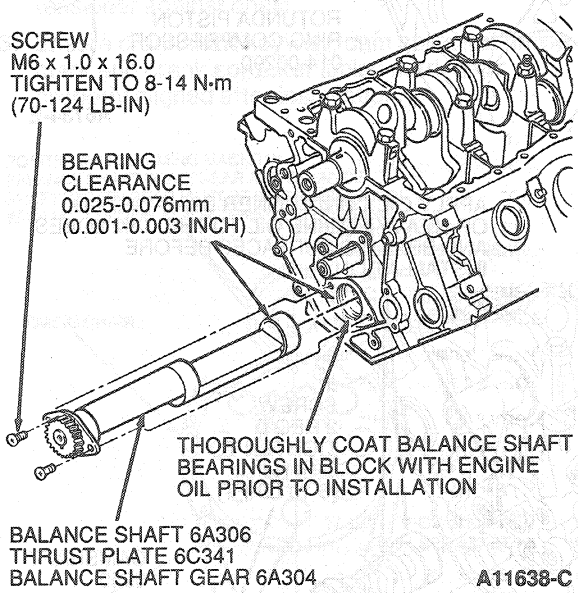


22. Remove balance shaft drive gear and spacer.
23. Remove camshaft thrust plate.

DISASSEMBLY AND ASSEMBLY (Continued)

24. Remove camshaft. Use care to prevent damage to camshaft bearing surfaces.
25. If necessary, remove camshaft plug from back of engine.
26. Remove screws securing balance shaft thrust plate.

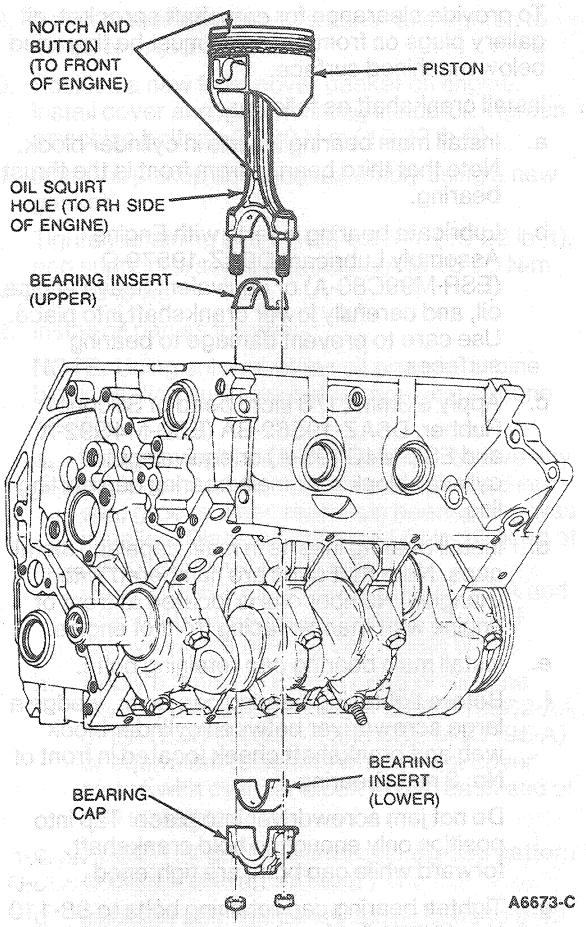
    CAUTION: Use care to prevent damage to bearing surface.
27. Remove balance shaft gear, thrust plate and shaft assembly.



CAUTION: Never cut into ring travel area in excess of 0.794mm (0.0325 inch).

NOTE: Before removing pistons, inspect top of cylinder bores. If necessary, remove ridge and/or carbon deposits from each cylinder using Rotunda Cylinder Ridge Reamer 014-00292 or equivalent. Before ridge or deposits are removed, turn crankshaft until piston is at bottom of its stroke. Cover piston with a clean shop towel to collect cuttings. After cutting operation, turn crankshaft until piston is at top of its stroke and remove shop towel with cuttings.

28. Remove connecting rod caps and pistons.



The location of each piston, crank bearing and rod cap should be noted. When engine is assembled each component should be installed in its original position.

29. Remove main bearing caps and crankshaft.

    The location of main bearings should be identified. When engine is assembled each bearing should be installed in its original position.
30. For cleaning purposes, oil gallery and cooling jacket plugs can be removed.

Assembly

NOTE: During engine assembly, a RTV-type sealer will be applied to many components before installation. When the sealant is applied, the component should be installed within 15 minutes. After this time the sealant begins to set-up and its sealing effectiveness can be reduced.

NOTE: Lightly oil all retaining bolt and stud bolt threads before installation except those specifying special sealant.

1. If removed, install oil gallery and cooling jacket plugs. Tighten plugs to specification.

   Before installation, coat plug threads with Pipe Sealant with Teflon® D8AZ-19554-A (ESG-M4G194-A and ESR-M18P7-A) or equivalent.

DISASSEMBLY AND ASSEMBLY (Continued)

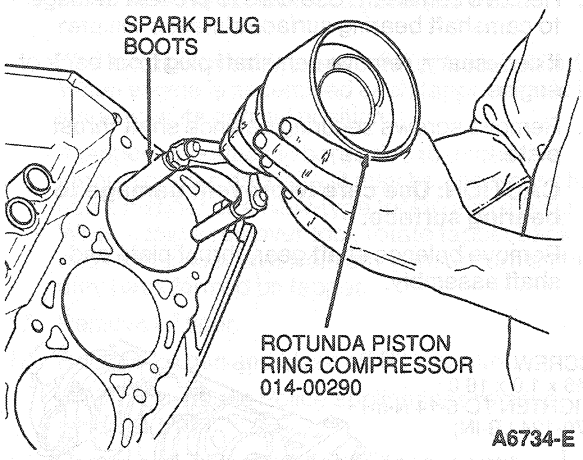
To provide clearance for camshaft sprocket, oil gallery plugs on front of engine must be threaded below machined surface.

2. Install crankshaft as follows:
   a. Install main bearing inserts in cylinder block. Note that third bearing from front is the thrust bearing.
   b. Lubricate bearing inserts with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil, and carefully lower crankshaft into place. Use care to prevent damage to bearing surfaces.
   c. Apply a 3mm (1/8 inch) bead of Silicone Rubber, D6AZ-19562-BA (ESB-M4G92-A and ESE-M4G195-A) or equivalent to cylinder block rear main bearing cap parting line.
   d. Install bearing inserts in main caps and install caps. Note that caps are numbered with triangles. Number one is located at front of engine with triangle facing front of engine.
   e. Install main bearing cap retaining bolts.
   f. Before tightening bearing cap bolts, wedge a large screwdriver between cylinder block web and crankshaft cheek located in front of No. 3 main bearing.

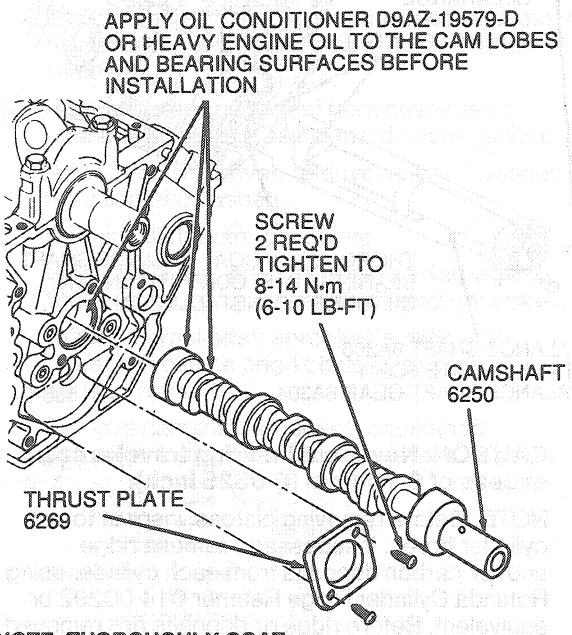
      Do not jam screwdriver into place. Tap into position only enough to hold crankshaft forward while cap bolts are tightened.
   g. Tighten bearing cap retaining bolts to 88-110 N·m (65-81 lb-ft) and remove screwdriver.
3. Check crankshaft end play as outlined.
4. Install pistons as follows:
   a. Install bearing inserts in connecting rods and connecting rod caps.
   b. Install pistons using Rotunda Piston Ring Compressor 014-00290 or equivalent. The notch in piston dome and button on connecting rod have to face front of engine. Oil squirt hole in rod faces RH side of engine.

      Lubricate piston and cylinder walls with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil before installation.

      NOTE: Scratching of crankshaft journal can be prevented by covering connecting rod bolts with spark plug boots or flexible hose.



A6734-E



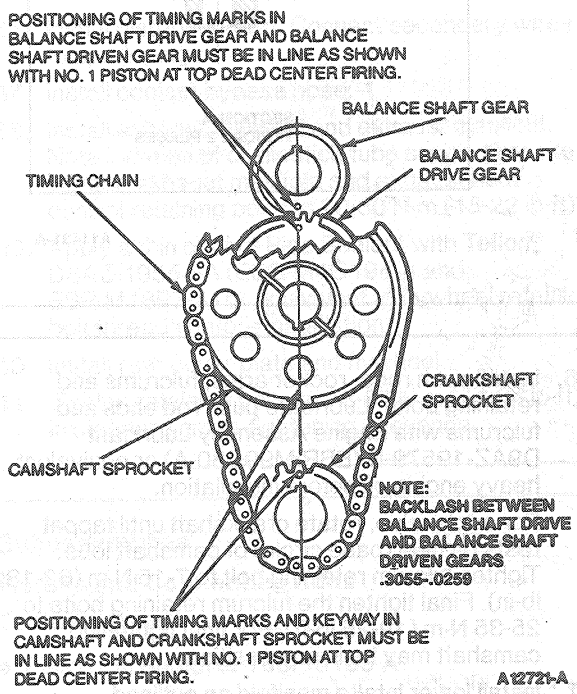
NOTE: THOROUGHLY COAT THRUST PLATE WITH ENGINE OIL PRIOR TO INSTALLATION OF THRUST PLATE

A6738-H

   c. Install connecting rod caps and retaining nuts. Tighten nuts to 41-49 N·m (31-36 lb-ft).
5. Check connecting rod side clearance as outlined.
6. Coat sealing edge of plug with Perfect-Seal Sealing Compound B5A-19554-A (ESR-M18P2-A and ESE-M4G115-A) or equivalent before installation.
7. Install bore plug using a suitable driver.
8. Coat camshaft lobes with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent. Lubricate camshaft bearings with heavy oil SF.
9. Install camshaft as outlined.
10. Install camshaft thrust plate.
11. Install balance shaft gear.

DISASSEMBLY AND ASSEMBLY (Continued)

12. Install balance shaft, thrust plate and gear, and tighten retaining bolts to 8-14 N·m (70-124 lb-in). Align balance shaft timing marks as shown.
13. Lubricate timing chain with clean engine oil XO-10W30-QSP (ESE-M2C153-E) or equivalent.
14. Rotate crankshaft, as necessary, to position crank sprocket keyway in 12 o'clock position. Install balance shaft drive gear spacer. Install timing chain tensioner (retracted position).
15. Install camshaft sprocket, crankshaft sprocket and timing chain. Pull pin on tensioner to release tensioner against chain.
16. Ensure crankshaft keyway, cam sprocket timing mark and crank sprocket timing mark are properly aligned after installation.



17. Install distributor drive gear.
18. If water pump was removed from front cover during engine disassembly, position a new pump gasket on front cover and install water pump.

    Tighten pump retaining bolts to 20-30 N·m (15-22 lb-ft).
19. Install camshaft bolt and washer and tighten to 40-50 N·m (30-37 lb-ft).
20. Position a new front cover gasket on engine. Install cover and ignition timing indicator. Tighten attaching bolts to 20-30 N·m (15-22 lb-ft).
21. Install oil pickup and tube assembly using a new gasket.

    Tighten retaining bolts to 20-30 N·m (15-22 lb-ft), and support bracket retaining nut to 40-55 N·m (30-40 lb-ft).
22. Install oil pan as follows:

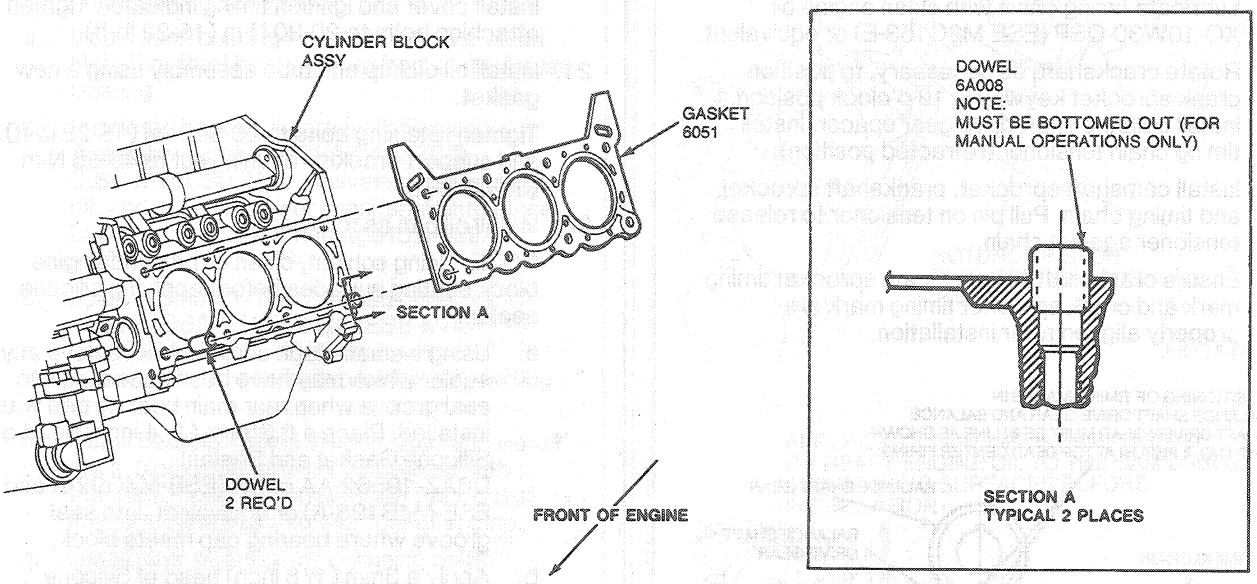
    NOTE: Using solvent, clean oil pan and engine block seating surfaces before applying silicone sealer.

    a. Using a small-blade screwdriver remove any sealer which may have been squeezed into seal groove when rear main bearing cap was installed. Place a 6.35mm (1/4 inch) bead of Silicone Gasket and Sealant D6AZ-19562-AA or BA (ESB-M4G92-A and ESE-M4B195-A) or equivalent, into seal groove where bearing cap meets block.
    b. Apply a 3mm (1/8 inch) bead of Silicone Gasket and Sealant Sealer D6AZ-19562-AA or BA (ESB-M4G92-A and ESE-M4G195-A) or equivalent to seams where front cover mates with cylinder block and to each end of pan end seal.
    c. Apply RTV gasket material in zig-zag pattern to oil pan sealing surface.
    d. Install oil pan. Tighten retaining bolts to 9-12 N·m (80-106 lb-in).
23. Lubricate oil filter gasket with clean engine oil and install.

    Thread filter onto adapter until gasket contacts cylinder block and then advance filter an additional one-half turn.
24. Lubricate tappets with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent, and install. Install guide plates and retainers.

DISASSEMBLY AND ASSEMBLY (Continued)

25. Install new cylinder head gaskets using dowels to align gasket.



CAUTION: Always use new cylinder head bolts to ensure a leak-tight assembly. Torque retention with used bolts can vary, which may result in coolant or compression leakage at the cylinder head mating surface area.

Tighten cylinder head retaining bolts in sequence.

a. 50 N·m (37 lb-ft)
b. 60 N·m (45 lb-ft)
c. 70 N·m (52 lb-ft)
d. 80 N·m (59 lb-ft)

In sequence, retighten bolts one at a time in the following manner:

e. Long bolts: Loosen bolt and back out two or three revolutions. Retighten long bolt to 15-25 N·m (11-18 lb-ft). Then tighten an additional 85-105 degrees and go to the next bolt in sequence.
f. Short bolts: Same as long bolt tightening procedure **EXCEPT** once torque of 15-25 N·m (11-18 lb-ft) is reached, bolt should only be tightened an additional 65-85 degrees.

26. Install push rods, rocker arms, fulcrums and retaining bolts. Lubricate push rod ends and fulcrums with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent heavy engine oil before installation.

    For each valve, rotate crankshaft until tappet rests on heel (base circle) of camshaft lobe. Tighten fulcrum retaining bolt to 7-15 N·m (62-132 lb-in). Final tighten the fulcrum retaining bolts to 25-35 N·m (19-25 lb-ft). For final tightening, camshaft may be in any position.
27. Install lower intake manifold as outlined.
28. Install spark plugs. Tighten to 7-15 N·m (62-132 lb-in).
29. Install rocker arm covers as follows:

    NOTE: Using solvent, clean valve cover and cylinder head sealing surfaces to remove all gasket material and dirt.

    a. Install a new gasket onto cylinder head.
    b. Install valve cover and retaining bolts. Note location of stud / bolts.
    c. Tighten retaining bolts to 9-12 N·m (80-106 lb-in).
30. Install distributor and hold-down clamp. Tighten hold down bolt to 27-40 N·m (20-29 lb-ft).

DISASSEMBLY AND ASSEMBLY (Continued)

31. Install crankshaft damper using Damper / Front Cover Seal Installer T82L-6316-A and Front Cover Seal Installer T70P-6B070-A. Tighten retaining bolts to 140-180 N·m (103-132 lb-ft).

    Install crankshaft pulley. Tighten retaining bolts to 26-38 N·m (19-28 lb-ft).
32. Install injector and fuel rail assembly and tighten bolts for fuel rail bracket to 8-11 N·m (6-8 lb-ft).
33. Install PCV tubes and valve assembly.
34. Install intake manifold and tighten bolts and studs in two steps:
    a. 11 N·m (8 lb-ft)
    b. 15 N·m (11 lb-ft)
35. Install EGR valve assembly. Tighten bolts to 20-30 N·m (15-22 lb-ft).
36. Install distributor cap. Connect secondary wires to spark plugs.
37. Install coolant bypass hose.
38. Install exhaust manifold and exhaust manifold. Note location of oil dipstick tube support bracket. Tighten exhaust manifold and exhaust heat control retaining bolts to 20-30 N·m (15-22 lb-ft).
39. Apply a thin coat of Pipe Sealant with Teflon® D8AZ-19554-A (ESG-M4G194-A and ESR-M18P7-A) or equivalent to flywheel retaining bolt threads before installation.
40. Install rear cover plate and flywheel.
41. Tighten retaining bolts to 73-87 N·m (54-64 lb-ft) in standard cross-tightening sequence.

Subassemblies

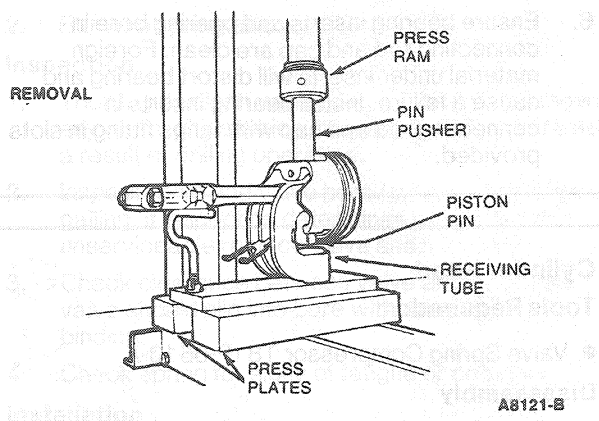
Pistons and Connecting Rods

Tools Required:

- Piston Pin Remover T68P-6135-A
- Feeler Gauge D81L-4201-A

Disassembly

1. Remove bearing inserts from connecting rod and cap.
2. Remove piston rings using a suitable piston ring expander.
3. Mark pistons to ensure assembly with same rod and installation in same cylinders from which they were removed.
4. Using an Arbor Press and Piston Pin Remover and Replacer T68P-6135-A press piston pin from piston and connecting rod.



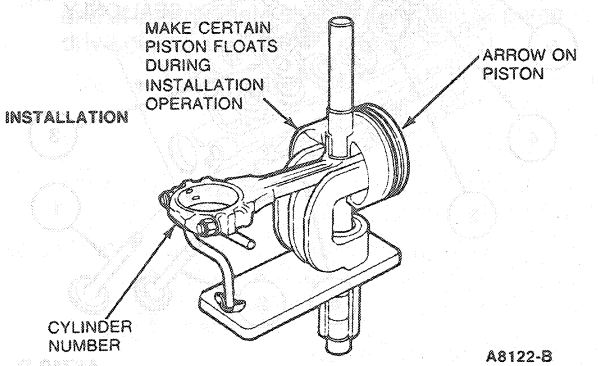
Assembly

Check the fit of a new piston in the cylinder bore before assembling piston and piston pin to connecting rod.

The piston pin bore of a connecting rod and diameter of piston pin must be within specification.

1. Apply light coat of XO-10W30-QSP (ESE-M2C153-E) or equivalent engine oil to all parts.
2. Assemble piston to connecting rod using notch in piston dome and connecting rod oil squirt hole for assembly reference.

   On V-6 engines with one rod per pin, both sides of rod have larger chamfers.
3. Start piston pin in piston and connecting rod (this may require a very light tap with a mallet). Using an Arbor Press and Piston Pin Remover and Replacer T68P-6135-A, press piston pin through piston until the pin is centered.



4. Check end gap of all piston rings. It must be within specification. Follow instructions contained on piston ring package and install piston rings.
5. Check ring side clearance of compression rings with Feeler Gauge D81L-4201-A or equivalent, by inserting it between ring and its lower land. The gauge should slide freely around entire ring circumference without binding. Any wear that occurs will form a step at inner portion of lower land. If lower lands have high steps, piston should be replaced.

DISASSEMBLY AND ASSEMBLY (Continued)

6. Ensure bearing inserts and bearing bore in connecting rod and cap are clean. Foreign material under inserts will distort bearing and cause a failure. Install bearing inserts in connecting rod and cap with tangs fitting in slots provided.

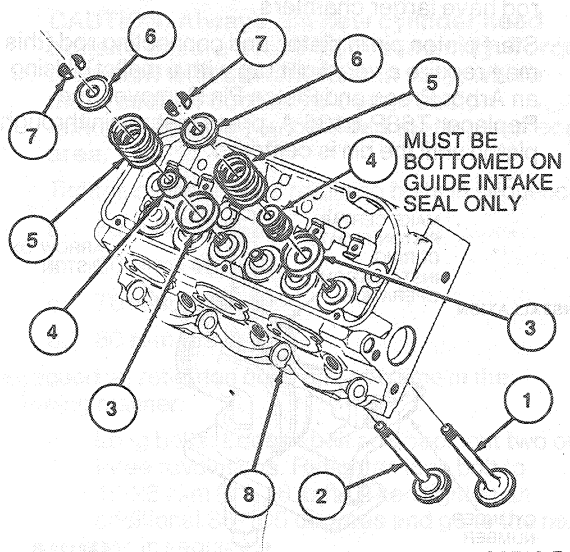
Cylinder Head

Tools Required:

- Valve Spring Compressor T81P-6513-A

Disassembly

1. Remove rocker arm fulcrum retaining bolts, fulcrums and rocker arms.
2. Remove exhaust manifold, if required and spark plugs.
3. Clean carbon out of cylinder head combustion chambers before removing valves.
4. Compress valve springs using Valve Spring Compressor T81P-6513-A. Remove spring retainer locks and release spring.
5. Remove spring retainer, spring, spring seat, stem seal and valve. Discard valve stem seals. Identify all valve parts as to which cylinder they were removed from and whether intake or exhaust.



A6719-D

Item	Part Number	Description
1	6507	Intake Valve
2	6505	Exhaust Valve
3	6A536	Valve Spring Seat
4	6A517	Valve Stem Seal
5	6513	Valve Spring
6	6514	Valve Spring Retainer
7	6518	Valve Spring Retainer Keys
8	6049	Cylinder Head

(Continued)

6. Clean, inspect and service cylinder head as required, or prepare to transfer all usable parts to a new cylinder head.

Assembly

All valves, valve stems and valve guides are to be lubricated with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent. The valve tips are to have Multi-Purpose Grease D0AZ-19584-AA (ESR-M1C159-A and ESB-M1C93-A) or equivalent applied before installation.

NOTE: Exhaust valve stem seals have a white stripe to identify them.

1. Install each valve in port from which it was removed or to which it was fitted.

   CAUTION: Due to different leakage rates between intake and exhaust valve stems, seals must not be interchanged.
2. Install exhaust valve stem seal. Make sure seal is bottomed on guide.
3. Install intake valve stem seal. Seal must be bottomed on guide.
4. Install spring seat.
5. Install valve spring over valve and then install spring retainer. Compress spring and install retainer locks.

   CAUTION: Do not install the spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing valve springs and overloading camshaft lobes which could lead to spring breakage and/or worn camshaft lobes.
6. Measure assembled height of valve spring from top of spring seat to underside of spring retainer with dividers. Check dividers against a scale. If assembled height is greater than specification, install necessary 0.79mm (0.030 inch) thick spacer(s) between cylinder head spring pad and valve spring seat, to bring assembled height to recommended specification.
7. Position rocker arms and fulcrums on cylinder head and install fulcrum retaining bolts. **Do not tighten bolts.** The bolts must be loose enough to allow rocker arm to be rotated to side.
8. Install exhaust manifold if removed, and spark plugs.

Front Cover Assembly

The front cover assembly contains three components related to the lubrication system. These components are:

DISASSEMBLY AND ASSEMBLY (Continued)

- Oil pump
- Oil pressure relief valve
- Pump drive intermediate shaft

Oil Pump

Disassembly

1. If necessary, remove oil filter.
2. Remove oil pump cover retaining bolts and remove cover.
3. Lift pump gears off pocket in front cover.
4. Remove cover seal and discard.

Pump Cover Flatness

1. Remove all traces of seal material from pump cover.
2. Place a straightedge across mounting surface of pump cover and measure for wear or warpage using a feeler gauge.
3. If surface is out of flat by more than 0.04mm (0.0016 inch) replace cover.

Assembly

1. If necessary, remove pump gears from cover.
2. Lightly pack gear pocket with petroleum jelly or coat all gear surfaces with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent. **Do not use chassis lubricants.**

   CAUTION: Failure to properly coat the oil pump gears may result in failure of the pump to prime when engine is started.
3. Install gears in cover pocket. Ensure petroleum jelly fills all voids between gears and pocket.
4. Position cover seal and install pump cover.
5. Tighten pump cover retaining bolts to 25-30 N·m (18-22 lb-ft).

Pressure Relief Valve

Removal

1. After drilling a hole through valve plug, remove plug with a slide hammer or by prying.
2. Remove spring and valve from bore.

Inspection

1. Thoroughly clean valve bore and valve to remove any metal chips which may have entered bore as a result of drilling operation.
2. Inspect valve and valve bore for wear, scoring or galling. If inspection determines part(s) to be unserviceable replace valve and / or cover.
3. Check clearance between valve and bore. The valve should slip into bore without side play or binding.
4. Check spring for signs of fatigue or collapse.

Installation

1. Lubricate relief valve with XO-10W30-QSP (ESE-M2C153-E) or equivalent engine oil and install in bore. The end with smaller diameter goes in first.
2. Position spring in bore.
3. Install a new plug. The plug can be tapped into bore using a plastic tipped hammer. Ensure plug is 0-0.25mm (0-0.010 inch) below machined surface.

Intermediate Shaft

Removal

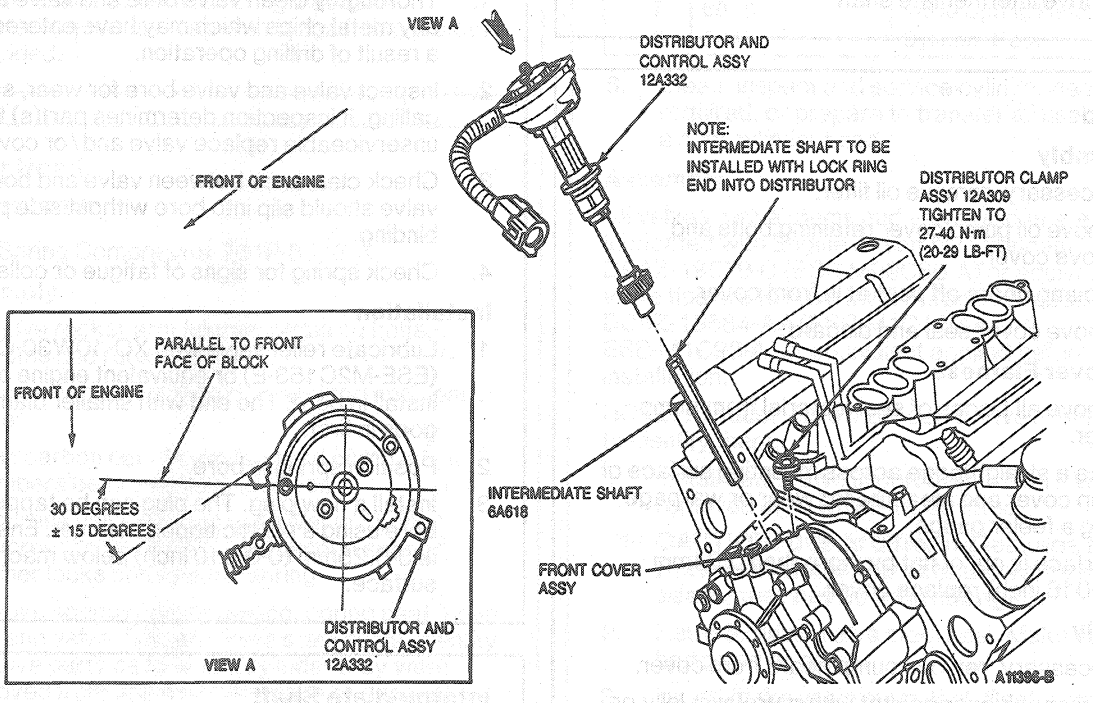
1. Remove distributor assembly.
2. Separate intermediate shaft from distribution.

Installation

1. Push lock ring end of shaft into distributor shaft.
2. Install distributor / shaft assembly, ensuring that end of intermediate shaft is seated in oil pump drive gear.

DISASSEMBLY AND ASSEMBLY (Continued)

3. Install distributor clamp assembly and tighten to 27-40 N·m (20-29 lb-ft).



Spark Plug Thread Service

Tools Required:

- Rotunda Tapersert Installation Kit 107-00901

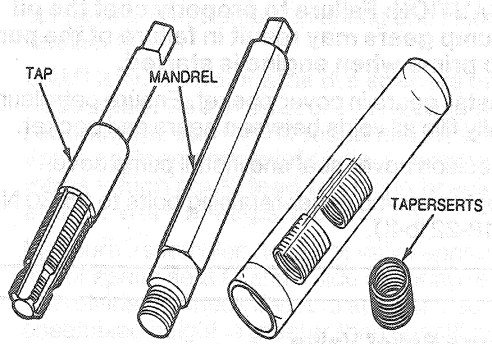
Damaged spark plug threads in the cylinder head can be serviced using Rotunda Tapersert Installation Kit 107-00901 or equivalent.

NOTE: The use of power or air driven tools is not approved for the installation of taperserts.

The procedure involves cutting new threads in the spark plug hole. After rethreading operation, a tapered sleeve will be installed in the head. The sleeve is threaded on the inside and outside. The outside threads into the cylinder head while the inside provides new threads for the spark plug.

This service is permanent and will have no effect on cylinder head or spark plug life.

CAUTION: The cylinder head must be removed from engine before installing a tapersert. The service procedure includes a thread cutting process which produces metal chips. Performing this procedure while the cylinder head is on the engine will cause metal chips to fall into the cylinder. Once in the cylinder, these chips can damage the cylinder wall when the engine is started.



ROTUNDA TAPERSERT INSTALLATION KIT 107-00901
A6651-D

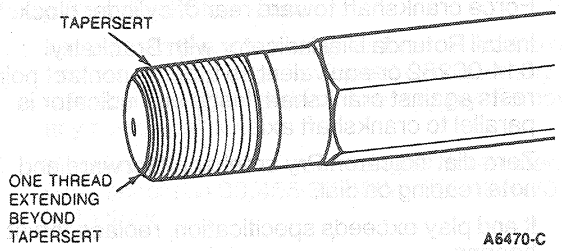
1. Thoroughly clean spark plug counter bore, seat and threads of all dirt or other foreign material.
2. Start tap into spark plug hole being careful to keep it properly aligned.

   As tap begins cutting new threads, apply aluminum cutting oil to tap.

   Continue cutting threads and applying oil until stop ring bottoms against spark plug seat.
3. Remove tap. Remove all metal chips using compressed air.

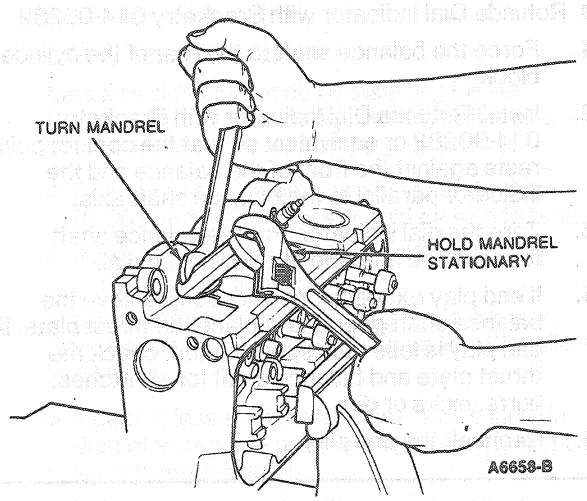
DISASSEMBLY AND ASSEMBLY (Continued)

4. Coat threads of mandrel with cutting oil. Thread tapersert onto mandrel until one thread of mandrel extends beyond tapersert.



5. Thread tapersert into tapped spark plug hole using a torque wrench. Continue tightening mandrel until torque wrench indicates 61 N·m (45 lb-ft).
6. To loosen mandrel for removal, hold mandrel stationary and turn mandrel body approximately one-half turn. Remove mandrel.

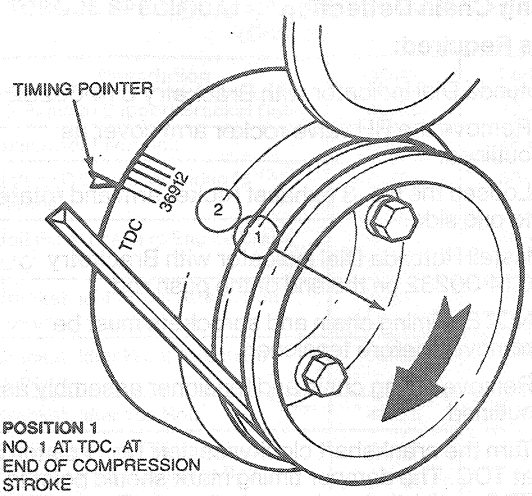
   NOTE: A properly installed tapersert will be flush to one millimeter below spark plug gasket seat.



ADJUSTMENTS

Hydraulic Valve Clearance

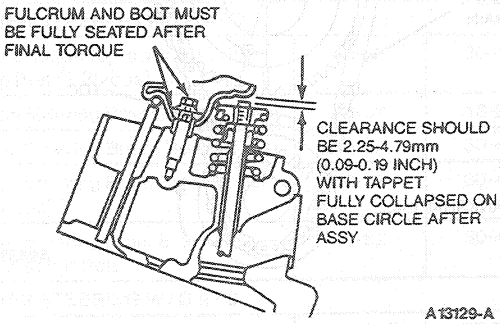
1. With No. 1 piston on TDC at the end of compression stroke (Position 1 in the illustration) check the following valves.



CYL. NO.	CRANKSHAFT POSITION	
	1	2
	SET GAP OF VALVES NOTED	
1	INT — EXH	NONE
2	EXH	INT
3	INT	EXH
4	EXH	INT
5	NONE	INT — EXH
6	INT	EXH

A13128-A

2. When compressing valve spring to remove push rods, ensure piston in individual cylinder is below TDC to avoid contact between valve and piston. To replace a push rod, it will be necessary to loosen the valve rocker arm shaft assembly and rotate rocker arm to the side. Upon replacement of a valve push rod, valve rocker arm assembly or hydraulic valve tappet, the engine should not be cranked or rotated until tappets have an opportunity to leak down to their normal operating position. The leakdown rate can be accelerated by using a tappet bleed-down wrench on valve rocker arm and applying pressure in a direction to collapse lifter.



ADJUSTMENTS (Continued)

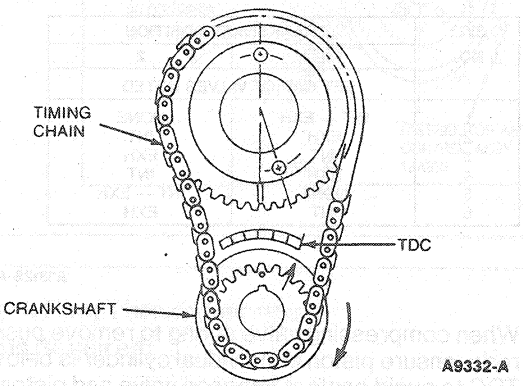
Timing Chain Deflection

Tools Required:

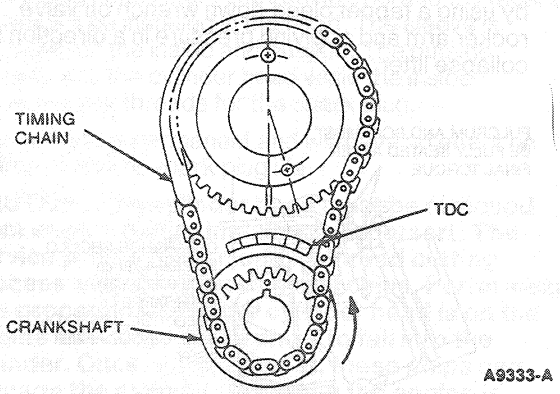
- Rotunda Dial Indicator with Bracketry 014-00282

1. Remove the RH valve rocker arm cover as outlined.
2. Loosen the No. 3 exhaust rocker arm and rotate to one side.
3. Install Rotunda Dial Indicator with Bracketry 014-00282 on the end of the push rod.

   NOTE: Timing chain and sprockets must be removed before tensioner.
4. Remove timing chain and tensioner assembly as outlined.
5. Turn the crankshaft clockwise until No. 1 piston is at TDC. The damper timing mark should point to TDC on the timing degree indicator. This will also take up the slack on the RH side of the chain.



6. Zero the dial indicator.
7. Slowly turn the crankshaft counterclockwise until the slightest movement is seen on the dial indicator. Stop, and observe the damper timing mark for the number of degrees of travel from TDC.



8. If the reading on the timing degree indicator exceeds 6 degrees, replace the timing chain and sprockets.

Crankshaft End Play Check

Tools Required:

- Rotunda Dial Indicator with Bracketry 014-00282

1. Force crankshaft toward rear of cylinder block.
2. Install Rotunda Dial Indicator with Bracketry 014-00282 or equivalent so that the contact point rests against crankshaft flange and indicator is parallel to crankshaft axis.
3. Zero dial indicator. Pry crankshaft forward and note reading on dial.
4. If end play exceeds specification, replace thrust bearing.

   If end play is less than specification, inspect thrust bearing surfaces for scratches, burrs, nicks or dirt.
5. Recheck end play.

Balance Shaft End Play Check

Tools Required:

- Rotunda Dial Indicator with Bracketry 014-00282

1. Force the balance shaft to the rear of the cylinder block.
2. Install Rotunda Dial Indicator with Bracketry 014-00282 or equivalent so that the contact point rests against the front of the balance and the indicator parallel to the balance shaft axis.
3. Zero the dial indicator. Pry the balance shaft forward and note the reading on the dial.
4. If end play exceeds specification, remove the balance shaft gear and replace the thrust plate. If end play is less than specification, check the thrust plate and balance shaft for scratches, burrs, nicks or dirt.
5. Recheck the end play.

Connecting Rod Side Clearance Check

Tools Required:

- Rotunda Dial Indicator with Bracketry 014-00282

1. Install Rotunda Dial Indicator with Bracketry 014-00282 or equivalent so that the contact point rests against the connecting rod cap.
2. Pull cap toward front of engine and zero the dial indicator.
3. Push cap toward rear of engine and observe amount of side clearance on dial indicator.
4. If side clearance exceeds specification, replace connecting rod and cap.

   If side clearance is less than specification, remove rod and cap and inspect for scratches, burrs, nicks or dirt between crankshaft and connecting rod.

ADJUSTMENTS (Continued)

Oil Pump Inspection

Tools Required:

- Feeler Gauge D81L-4201-A

Pump Gear End Clearance

1. Inspect pump cover mating surface on front cover and pump body. Visually inspect O-ring for any cuts and/or nicks, replace if necessary. Remove any burrs or nicks.
2. Measure thickness of gear using a micrometer. Gear should be 30.455-30.480mm (1.19-1.20 inch) thick.
   - If gear is less than 30.455mm (1.19 inch) thick, replace gear.
   - If gear thickness is within specification, it may be necessary to replace the pump body.
   - If thickness of gear is within specified limits, proceed to Step 3.
3. Measure depth of the gear pocket in oil pump body. Depth should be 30.49-30.54mm (1.200-1.202 inch).
   - If depth is more than 30.54mm (1.202 inch) replace oil pump body.

Pump Gear Side Clearance

1. Measure side clearance by inserting Feeler Gauge D81L-4201-A or equivalent, between a gear tooth and side wall of the gear pocket.
   - Clearance should be a maximum of 0.13mm (0.005 inch), and gears should be free to turn.
   - If clearance is greater than 0.13mm (0.005 inch) proceed to Step 2.
2. Measure diameter of gear using a micrometer. Gear should be 38.252-38.332mm (1.505-1.509 inch) wide.
   - If gear is less than 38.252mm (1.505 inch) in diameter, replace gear and measure clearance as outlined in Step 1.
   - If diameter of gear is within specified limits go to Step 3.
3. Measure diameter of gear pocket in the front cover. The diameter should be 38.22-38.30mm (1.504-1.507 inch).
   - If diameter is less than 38.22mm (1.504 inch) replace front cover and measure clearance as specified in Step

SPECIFICATIONS

TORQUE SPECIFICATIONS ENGINE ACCESSORIES

Description	N·m	Lb-Ft
A/C Lower Mounting Bracket to Engine Nuts	41-61	30-44
Air Pump Pivot Bolt	54-75	40-55

(Continued)

TORQUE SPECIFICATIONS ENGINE ACCESSORIES (Cont'd)

Description	N·m	Lb-Ft
Air Pump to Support Bracket Bolt	40-55	30-40
Generator Pivot Bolt	61-75	45-57
Bolt A/C Comp. Mounting (5 Places)	41-61	30-45
Bolt Front Brace to Engine Brace A/C	41-61	30-45
Bracket, Idler Front Attach Bolt Lower	40-55	30-40
Bracket, Idler Front Attach Bolt Upper	70-95	52-70
Bracket, Idler Top Bolt	40-55	30-40
Engine Bracket Reinforcement Brace to Engine Bracket Bolt (Damper)	47-67	35-50
Engine Bracket Reinforcement Brace to Engine Bracket Nut (Damper)	80-107	60-80
Front A/C Comp. Plate Nut to Engine Stud (2 Places)	41-61	30-45
Front A/C Comp. Plate to Lower A/C Mounting Bracket Bolt	41-61	30-45
Front Brace, A/C to Engine Stud Nut	20-30	15-22
Insulator to A/C Bracket Bolt	54-75	40-55
Insulators to Frame RH Front, RH Rear Nut	68-95	50-70
Transaxle Support Assembly Bolt	48	35
Transaxle Insulator to Frame Bolt	54-75	40-55
Vertical Restrictor Assembly	54-75	40-55
Transaxle Mount to Insulator Nut	74-102	55-75
Insulator LH Rear Top Nut	54-75	40-55
Generator Bracket	40-55	30-40
Transmission to Engine Bolt	55-68	40-50
Torque Converter to Flywheel Bolt	27-46	20-34
Idler Bracket to Generator Top Attaching Flange Bolt	33-46	24-34
Idler Pulley Adv. Bolts (2 Places)	40-55	30-40
Nut Brace to Engine, A/C	20-30	15-22
Support A/C Comp. Mounting Bolt to Bracket Assembly (2 Places)	41-61	30-45
POWER STEERING WITH A/C		
Front Bracket to Power Steering Pump Bolt (3 Places)	40-62	30-45
Power Steering Brace Bolt (Lower)	24-32	18-24
Power Steering Brace Bolt (Upper)	40-62	30-45
Power Steering Front Bracket Nut (2 Places)	40-62	30-45
Power Steering Front Bracket to A/C Bracket Bolt	40-62	30-45
POWER STEERING W/O A/C		
Power Steering Brace Bolt (2 Places)	40-62	30-45

(Continued)

SPECIFICATIONS (Continued)

TORQUE SPECIFICATIONS ENGINE ACCESSORIES (Cont'd)

Description	N·m	Lb-Ft
Power Steering Front Bracket Bolt (2 Places)	40-62	30-45
Power Steering Front Bracket Bolt (3 Places)	40-62	30-45

TORQUE SPECIFICATIONS*

Thread Size	Torque Cast Iron & Aluminum
(1/4-18) Pipe	24 N·m (18 Lb-Ft)
(3/8-18) Pipe	38 N·m (28 Lb-Ft)

(Continued)

TORQUE SPECIFICATIONS* (Cont'd)

Thread Size	Torque Cast Iron & Aluminum
M6	14 N·m (10 Lb-Ft)
M8	28 N·m (21 Lb-Ft)
M10	53 N·m (39 Lb-Ft)
M12	96 N·m (71 Lb-Ft)
M14	158 N·m (117 Lb-Ft)

* Unless Otherwise Noted Values for Parts as Supplied

TA8375C

SPECIFICATIONS (Continued)

GENERAL SPECIFICATION	
DISPLACEMENT	3.8L
NUMBER OF CYLINDERS	6
BORE AND STROKE	
Bore	96.8mm (3.81 in.)
Stroke	86.0mm (3.39 in.)
FIRING ORDER	1-4-2-5-3-6
OIL PRESSURE (HOT 2500 RPM)	40-60 PSI
DRIVE BELT TENSION	Self-Tensioning

CYLINDER HEAD AND VALVE TRAIN	
COMBUSTION CHAMBER VOLUME (cc)	61.48-64.48
VALVE GUIDE BORE DIAMETER	
Intake & Exhaust	8.745-8.720mm (0.3443-0.3433 in.)
VALVE SEATS	
Width — Intake & Exhaust	1.5-2.0mm (.06-.08 in.)
Angle	44.5°
Runout (T.I.R.)	0.076mm (0.003 in.)
BORE DIAMETER (INSERT COUNTERBORE DIAMETER)	
Intake	47.097mm (1.8542 in.) MAX. 47.072mm (1.8532 in.) MIN.
Exhaust	39.739mm (1.5645 in.) MAX.
GASKET SURFACE FLATNESS	0.018mm (0.007 in.)
VALVE STEM TO GUIDE CLEARANCE	
Intake	0.026-0.071mm (0.001-0.0028 in.)
Exhaust	0.038-0.083mm (0.0015-0.0033 in.)
VALVE HEAD DIAMETER	
Intake	45.3mm (1.78 in.)
Exhaust	37.1mm (1.46 in.)
VALVE FACE RUNOUT LIMIT	0.05mm (0.002 in.)
VALVE FACE ANGLE	45.8°
VALVE STEM DIAMETER (STD.)	
Intake	8.694-8.674mm (0.3423-0.3415 in.)
Exhaust	8.682-8.662mm (0.3418-0.3410 in.)
Oversize	
Intake	9.075-9.055mm (0.3573-0.3565 in.)
Exhaust	9.063-9.043mm (0.3568-0.3560 in.)
Oversize	
Intake	9.456-9.436mm (0.3723-0.3715 in.)
Exhaust	9.444-9.424mm (0.3718-0.3710 in.)
VALVE SPRINGS	
Compression Pressure (N [Lb] @ Spec. Length)	
Valve Open	
(Without Damper)	979N (220 lbs.) @ 30.0mm (1.18 in.)
Valve Closed	
(Without Damper)	378N (85 lbs.) @ 41.9mm (1.65 in.)
Free Length (Approximate)	
Assembled Height	50.0mm (1.97 in.)
Service Limit	10% Force Loss @ Specified Height
ROCKER ARM	
Ratio	1.73
VALVE TAPPET, HYDRAULIC	
Diameter (Std.)	22.200-22.212mm (0.8740-0.8745 in.)
Clearance to Bore	0.018-0.068mm (0.0007-0.0027 in.)
Service Limit	0.127mm (0.005 in.)
Hydraulic Leakdown Rate	(a)
Collapsed Tappet Gap (Nominal)	
Intake	2.25-4.79mm (0.089-0.189 in.)
Exhaust	2.25-4.79mm (0.089-0.189 in.)
DISTRIBUTOR SHAFT BEARING BORE DIAMETER	
Tappet Bore Diameter	22.268-22.230mm (0.8767-0.8752 in.)
CAMSHAFT BORE INSIDE DIAMETER	
No. 1	55.689-55.664mm (2.192-2.191 in.)
No. 2	55.308-55.283mm (2.177-2.176 in.)
BALANCE SHAFT BORE	
Inside Diameter	55.689-55.664 (2.192-2.191 in.)
End Plug	0.16-0.075 (0.003-0.006 in.)

CYLINDER HEAD AND VALVE TRAIN (Continued)	
BALANCE SHAFT	
End Play	0.075-0.21mm (0.003-0.008 in.)
Journal Diameter	52.108-52.082mm (2.0515-2.0505 in.)
Runout	0.025mm (0.001 in.)
CAMSHAFT BORE INSIDE DIAMETER	
No. 3	55.308-55.283mm (2.177-2.176 in.)
No. 4	55.684-55.664mm (2.192-2.191 in.)

CAMSHAFT	
LOBE LIFT	
INTAKE	6.22 (0.245 in.)
EXHAUST	6.57 (0.259 in.)
Allowable Lobe Lift Loss	0.127mm (0.005 in.)
THEORETICAL VALVE LIFT @ ZERO LASH	
Intake	10.67mm (0.424 in.)
Exhaust	11.37mm (0.448 in.)
ENDPLAY	
Service Limit	0.025-0.150mm (0.001-0.006 in.)
JOURNAL TO BEARING	
CLEARANCE	0.025-0.076mm (0.001-0.003 in.)
JOURNAL DIAMETER	
All	52.108-52.082mm (2.0515-2.0505 in.)
CAM BEARING I.D.	52.158-52.133mm (2.0535-2.0525 in.)
Runout Limit	0.05mm (0.002 in.) Runout of #2 or #3 relative to #1 and #4
Out-of-Round Limit	0.025mm (0.001 in.)

CAMSHAFT DRIVE	
Assembled Gear Face Runout	
Crankshaft	0.10mm (0.004 in.)
Camshaft	0.25mm (0.010 in.)
Timing Chain Deflection	12.7mm (0.5 in.)

CYLINDER BLOCK	
HEAD GASKET SURFACE	
FLATNESS	0.08mm (0.003 in.) in 152.0mm (6.00 in.)
HEAD GASKET SURFACE FINISH (RMS)	2.0 @ 0.8 5.5 @ 2.5
CYLINDER BORE	
Diameter	96.80mm (3.81 in.)
Surface Finish (RMS)	0.45-0.96
Out-of-Round Limit	0.025mm (0.001 in.)
Out-of-Round Service Limit	0.050mm (0.002 in.)
Taper Service Limit	0.050mm (0.002 in.)
MAIN BEARING BORE DIAMETER	68.905mm (2.713 in.) 68.885mm (2.712 in.)

CRANKSHAFT AND FLYWHEEL	
MAIN BEARING JOURNAL	
DIAMETER	63.983-64.003mm (2.5190-2.5198 in.)
Out-of-Round Limit	0.008mm (0.0003 in.) MAX. in 45°, 0.015mm (0.0006 in.) TOTAL
Taper Limit	0.008mm (0.0003 in.) per 25mm (1 in.)
Journal Runout Limit	0.05mm (0.002 in.) (2), 0.05mm (0.002 in.) (3)
Surface Finish (RMS)	0.3 micrometers (11.8 micro in.)
THRUST BEARING JOURNAL	
Length	29.725-29.775mm (1.703-1.703-1.1722 in.)
CONNECTING ROD JOURNAL	
Diameter	58.682-58.702mm (2.3103-2.3111 in.)
Out-of-Round Limit	0.008mm (0.0003 in.) MAX in 45°, 0.015mm (0.0006 in.) TOTAL
Taper Limit	0.008mm per 25mm (0.0003 in. per in.)
Surface Limit (RMS)	0.3 micrometers (11.8 micro in.)
MAIN BEARING THRUST FACE	
Surface Finish (RMS) 0.9 micrometers (0.354 micro in.) FRONT; 0.6 micrometers (0.236 micro in.) REAR;	
Runout Limit	0.025mm (0.001 in.)

CA12722-C

SPECIFICATIONS (Continued)

CRANKSHAFT AND FLYWHEEL (Continued)	
FLYWHEEL RING GEAR LATERAL RUNOUT (T.I.R.)	
Automatic Transmission	1.778mm (0.07 in.)
CRANKSHAFT END PLAY	0.10-0.20mm (0.004-0.008 in.)
CONNECTING ROD BEARINGS	
Clearance to Crankshaft	
Desired	0.025-0.035mm (0.001-0.0014 in.)
Allowable	0.022-0.069 (0.00086-0.0027 in.)
Bearing Wall Thickness (Std.)	1.453-1.466mm (0.0572-0.0577 in.)
MAIN BEARINGS	
Clearance to Crankshaft	
Desired	0.025-0.035mm (0.001-0.0014 in.)
Allowable	0.013-0.058mm (0.0005-0.0023 in.)
Bearing Wall Thickness (Std.)	2.431-2.443mm (0.0957-0.957-0.962 in.)

CONNECTING ROD, PISTON AND RINGS	
CONNECTING ROD	
Piston Pin Bore Diameter	23.105-23.145mm (0.9096-0.9112 in.)
Crankshaft Bearing Bore Diameter	61.635-61.655mm (2.4266-2.4274 in.)
Out-of-Round Limit — Piston Pin Bore	0.008mm (0.0003 in.) greater to 0.025mm (0.001 in.) (1)
Taper Limit Piston Bore	0.033 per 25mm (0.013 per in.)
Length (Center-to-Center)	150.165-150.240mm (5.912-5.915 in.)
ALIGNMENT (BORE-TO-BORE MAX. DIFF.)	
Twist	0.075 per 25mm (0.003 per in.)
Bend	0.04 per 25mm (0.0016 per in.)
SIDE CLEARANCE (ASSEMBLED TO CRANK)	
Standard	0.11-0.29mm (0.0047-0.0114 in.)
Service Limit	0.36mm MAX. (0.014 in. MAX.)

PISTON	
Diameter	
Coded Red	96.761-96.777mm (3.8095-3.8101 in.)
Coded Blue	96.791-96.807mm (3.8107-3.8113 in.)
Coded Yellow	96.821-96.837mm (3.8119-3.8125 in.)
PISTON-TO-BORE CLEARANCE	0.036-0.081mm (0.0014-0.0032 in.)
SERVICE PISTON SELECTION	I.D. Code of Service
Piston Bore Diameter	Piston Required
96.799-96.830mm (3.8110-3.8122 in.)	RED
96.830-96.860mm (3.8122-3.8134 in.)	BLUE
96.860-96.891mm (3.8134-3.8146 in.)	YELLOW
When replacing pistons, measure the cylinder bore as outlined in General Engine Service Section 21-01. Install the service piston matched to the piston bore diameter above.	
PIN BORE DIAMETER	23.170-23.185mm (0.9122-0.9128 in.)
RING GROOVE WIDTH	
Compression (Top)	1.550-1.530mm (0.0610-0.0602 in.)
Compression (Bottom)	1.550-1.530mm (0.0610-0.0602 in.)
Oil	4.030-4.055mm (0.1587-0.1596 in.)
PISTON PIN	
Length	76.5-77.2mm (3.012-3.039 in.)
Diameter	23.162-23.175mm (0.9119-0.9124 in.)
PIN TO PISTON CLEARANCE	0.005-0.012mm (0.0002-0.0005 in.)
PIN TO ROD CLEARANCE	Press Fit 8 Kilonewtons (1800 lbs.)
PISTON RINGS	
Ring Width	
Compression (Top)	1.463-1.490mm (0.0576-0.0587 in.)
Compression (Bottom)	1.463-1.490mm (0.0576-0.0587 in.)
Oil Ring	Side Seal — Snug Fit
Service Limit	Side Clearance 0.15mm MAX. (0.0006 in. MAX.)

PISTON (Continued)	
Ring Gap	
Compression (Top) (In Gage)	0.29-0.55mm (0.011-0.012 in.)
Compression (Bottom) (In Gage)	0.25-0.50mm (0.01-0.02 in.)
Oil Ring (Steel Rail) (In Gage)	0.38-1.40 (0.015-0.0583 in.)
Side Clearance	
1st Ring	0.040-0.087mm (0.0016-0.0034 in.)
2nd Ring	0.040-0.095mm (0.0016-0.0034 in.)

(a) 20-200 seconds to leakdown 3.18 (0.125 in.) with 225 Newtons (50 pounds) load and tappet filled with leak-down fluid.
(1) Smaller than pin bore measured along center to center axis.
(2) Runout of journals II and III to journals I and IV.
(3) Runout of adjacent journals to each other.
* Engine packages equipped with Tripminder: Return line must be closed when checking pressure.
** Passenger Car: 4 qt. + ½ qt. with filter change.

LUBRICATION SYSTEM	
OIL PUMP	
Relief Valve Spring Tension	
(Force @ Length)	76.2-67.6 NT (17.1-15.2 lbs.) @ 30.5mm (1.20 in.)
Relief Valve to Bore Clearance	0.073-0.043mm (0.0029-0.0017 in.)
Oil Pump Gear Backlash	0.02-0.03mm (0.008-0.012 in.)
Oil Pump Gear Radial Clearance (Idler and Drive)	0.125-0.050mm (0.0055-0.002 in.)
Oil Pump Gear End Height (Extends Beyond Housing)	0.140-0.050mm (0.0055-0.0005 in.)
Idler Shaft to Idler Gear Clearance	0.044-0.010mm (0.0017-0.0005 in.)
Driver Shaft to Housing Clearance	0.076-0.038mm (0.0030-0.0015 in.)
OIL CAPACITY**	

CA6634-M

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	N·m	Lb-Ft
Accelerator Cable Mounting Bracket—Bolt	20-30	15-22
Upper Intake Manifold	26-38	19-28
Balance Shaft Thrust Plate—Bolt	8-14	6-10
Oil Pan Drain Plug	20-34	15-25
Camshaft Sprocket to Camshaft—Bolt	40-50	30-37
Low Level Oil Sensor	25-34	18-25
Camshaft Thrust Plate—Bolt	8-14	70-124 (Lb-In)
Connecting Rod—Nut	41-49	31-36
Main Bearing Cap—Bolt	88-110	65-81
Coolant Temp. Switch	11-16	8-12
MTC Sensor	8-13	6-9.5
Crankshaft Damper to Crankshaft—Bolt	140-180	103-132
Oil Filter Adapter to Front Cover—Bolt	25-30	18-22
Crankshaft Pulley to Damper—Bolt	26-38	103-132
Oil Filter to Oil Filter Adapter		(2)
Cylinder-Head Bolt	—	(1)
Oil Inlet Tube to Cylinder Block—Bolt	20-30	15-22
Distributor Cap	2.0-2.6	18-23 (Lb-In)
Oil Inlet Tube to Main Bearing Cap—Nut	40-55	30-40
Distributor Hold-Down Bolt	27-40	20-29
Oil Pan to Cylinder Block —Bolt	9-12	80-106 (Lb-In)
Distributor Rotor	2.8-3.9	25-35 (Lb-In)
PVS Valve	8-13	6-9.5
ECT Sensor	8-13	6-9.5
PVS Valve	8-13	6-9.5
EGR Valve to Intake Manifold—Nut	20-30	15-22
Rocker Arm Cover to Cylinder Head—Bolts / Studs	9-12	80-106 (Lb-In)
Exhaust Manifold—Bolt / Stud	20-30	15-22
Rocker Arm Function to Cylinder Head—Bolt	—	(4)
Fan Clutch Assembly—Bolt	16-24	12-18
Spark Knock Sensor	20-26.5	15-19
Flywheel to Crankshaft—Bolt	73-87	54-64
Spark Plug to Cylinder Head	7-15	62-132 (Lb-In)
Front Cover to Cylinder Block—Bolt	20-30	15-22
Thermostat Housing to Intake Manifold—Bolt	20-30	15-22
Fuel Pump to Front Cover—Bolt	20-30	15-22

(Continued)

TORQUE SPECIFICATIONS (Cont'd)

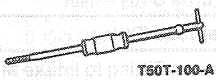
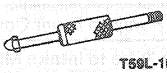
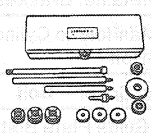
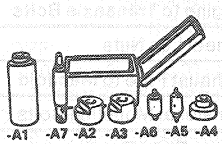
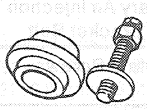
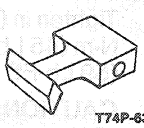
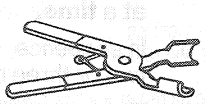
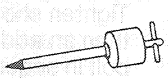
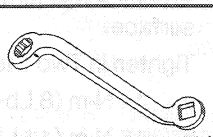
Description	N·m	Lb-Ft
Throttle Body—Nut	20-30	15-22
Fuel Tube Fitting	20-24	15-32.5
Vacuum Fitting to Intake Manifold	17-25	13-19
Fuel Tube Fitting—Inlet	16-20	12-15
Vacuum Tree to Intake Manifold	8-13	6.-9.5
Fuel Tube Fitting—Return	12-16	9-12
Vacuum Tree to Intake Manifold—Studs / Bolts	10-15	7-11
Heater Elbow	8.5-13.5	6.5-10
Water Pump to Front Cover—Bolt	20-30	15-22
Heater Tube to Intake Manifold Stud—Bolt	10-15	7-11
Wiring Retainer Bracket—Nut	10-15	8-11
Intake Manifold to Cylinder Head—Bolt	—	(3)
Oil Pump Cover—Bolt	25-30	18-22
Tappet Guide Plate Bolt	8-14	6-10
Engine Lifting Eye Nuts	20-30	15-22
Engine to Transaxle Bolts	55-68	41-50
Wheel Lug Nuts	115-142	85-105
Exhaust Pipe to Manifold	21-32	16-24
Tensional Mounting Bolts	8-14	6-10
Guide Plate Retainers	8-14	6-10
Fuel Rail	8-11	6-8
Secondary Air Injection Tube Support Bracket Bolt	40-55	30-40
Thrust Plate Screws	8-14	70-124 (Lb-In)

1.
   a. Tighten in (4) Steps: 50 N·m (37 Lb-Ft), 60 N·m (45 Lb-Ft), 70 N·m (52 Lb-Ft), 80 N·m (59 Lb-Ft)

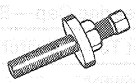
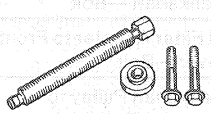
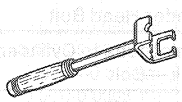
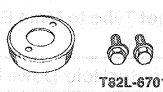
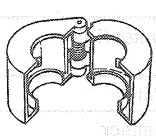
      CAUTION: Do not loosen all of the bolts at the same time, only work on one bolt at a time.

   b. In sequence, one at a time loosen each bolt two or three revolutions.
   c. Tighten long bolts to 15-25 N·m (11-18 Lb-ft) then an additional 85-95 degrees. Tighten short bolts to 10-20 N·m (7-15 Lb-Ft) then an additional 85-95 degrees. Go to next bolt in sequence.
2. Advance half turn after gasket contacts sealing surface.
3. Tighten in Two Steps:
   a. 11 N·m (8 Lb-Ft)
   b. 15 N·m (11 Lb-Ft)
4. Tighten in Two Steps:
   a. 5 N·m maximum (44 Lb-In)
   b. 25-35 N·m (19-25 Lb-Ft)

SPECIAL SERVICE TOOLS

Tool Number / Description	Illustration
T50T-100-A Impact Slide Hammer	 T50T-100-A
T58P-6316-D Crankshaft Damper Remover	 T58P-6316-D
T59L-100-B Impact Slide Hammer	 T59L-100-B
T65L-6250-A Camshaft Bearing Set	 T65L-6250-A
T68P-6135-A Piston Pin Remover and Replacer	 -A1 -A7 -A2 -A3 -A6 -A5 -A4 T68P-6135-A
T70P-6B070-A Front Cover Seal Installer	 T70P-6B070-A
T74P-6375-A Flywheel Locking Tool	 T74P-6375-A
T74P-6666-A Spark Plug Wire Remover	 T74P-6666-A
T77L-9533-B Jet Plug Remover	 T77L-9533-B
T81P-6254-A Belt Tension Adaptor	 T81P-6254-A

(Continued)

Tool Number / Description	Illustration
T81P-6513-A Valve Spring Compressor	 T81P-6513-A
T81P-9425-A Intake Manifold Torque Adapter	 T81P-9425-A
T82L-6316-A Damper / Front Cover Seal Installer	 T82L-6316-A
T82L-6316-B Vibration Damper Remover Adapter	 T82L-6316-B
T82L-6500-A Tappet Collapser	 T82L-6500-A
T82L-6701-A Rear Main Seal Installer	 T82L-6701-A
T83P-19623-C Spring Lock Coupling Tool	 T83P-19623-C

Tool Number	Description
D81L-600-A	Lb-In Torque Wrench
D81L-600-B	Lb-Ft Torque Wrench
D81L-4201-A	Feeler Gauge
D88L-6000-A	Engine Support Bar
D81L-6001-D	Engine Lifting Eyes
TOOL-6331-E	Main Bearing Insert Tool
TOOL-6500-E	Hydraulic Leakdown Tester
TOOL-6513-DD	Valve / Clutch Spring Tester

SPECIAL SERVICE TOOLS (Continued)

ROTUNDA EQUIPMENT

Model	Description
014-00282	Dial Indicator with Bracketry
014-00290	Piston Ring Compressor
014-00292	Cylinder Ridge Reamer
107-00901	Tapersert Installation Kit

PARTS CROSS-REFERENCE

Base Part #	Part Name	Old Part Name
9002	Fuel Tank	
9424	Intake Manifold	
9430	Exhaust Manifold	
9431	Exhaust Manifold	
9439	Intake Manifold to Cylinder Head Gasket	
9C968	Fuel Pressure Regulator	
9E926	Throttle Body	
9F472	Heated Oxygen Sensor	Exhaust Gas Oxygen Sensor
9F792	Fuel Injection Supply Manifold	
9H486	Intake Manifold Upper Gasket	

(Continued)