

# SECTION 03-01B Engine, 3.0L/3.2L SHO

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## VEHICLE APPLICATION

Taurus with 3.0L/3.2L SHO engine.

## DESCRIPTION

The 3.0L/3.2L SHO is a high performance V-6 engine with DOHC (double overhead camshafts), four valves per cylinder, and sequential multiport fuel injection (SFI). The engine has aluminum cylinder heads, 24 valves, shim set bucket tappets and a cast-iron, 60 degree V-block.

**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.

The left and right bank intake camshafts are driven by a timing belt. Then, the intake camshafts drive the exhaust camshafts on the rear of the engine through timing chains.

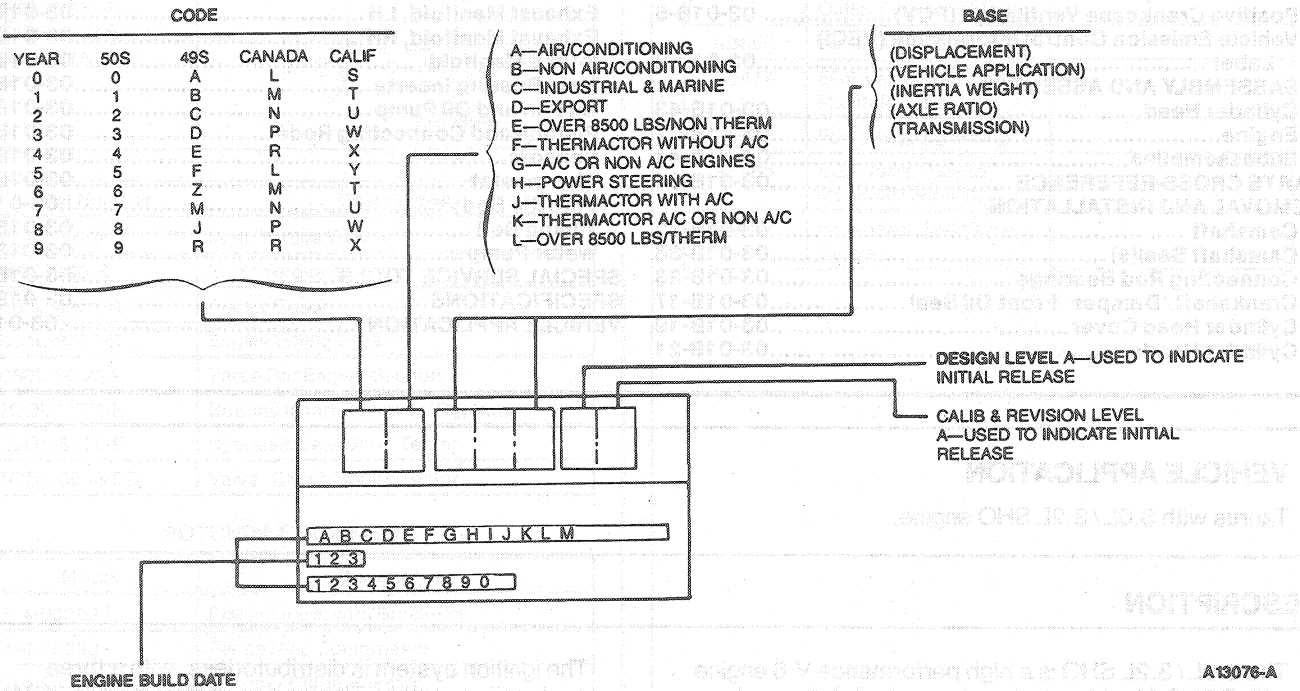
The ignition system is distributorless, with a three pack coil assembly. The ignition control module (ICM) 12A297 is mounted on the upper intake connector tube. The high-energy ignition system is required for fast-burn combustion. The spark plugs are 14mm with a 0.044 inch gap and are centrally located in the combustion chambers.

A unique air intake system utilizes a secondary intake port along with a primary intake port. The secondary port is opened and closed by a vacuum-operated intake air control valve, thus improving low and mid-range torque and fuel efficiency.

**DESCRIPTION (Continued)**

**Engine Code Information Label**

The engine code calibration number label is located on the engine right hand camshaft cover, adjacent to the throttle body (9E926). The label contains, among other information, the engine calibration number, engine build date, the engine plant code and an engine code.



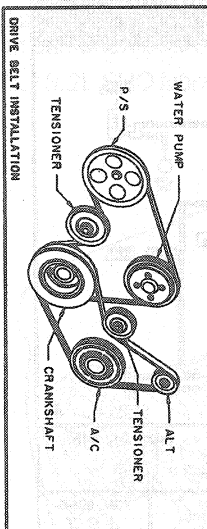
**Vehicle Emission Control Information (VECI) Label**

The VECI label is located on the upper radiator shield area. 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.

DESCRIPTION (Continued)

49 States

3.0L SHO



FORD MOTOR COMPANY

VEHICLE EMISSION CONTROL INFORMATION

THIS VEHICLE IS EQUIPPED WITH EEC IV, EFI AND DIS SYSTEMS. IDLE SPEEDS, IDLE MIXTURES AND IGNITION TIMING ARE NOT ADJUSTABLE. SEE SHOP MANUAL FOR ADDITIONAL INFORMATION.

CHECK TIMING WITH THE TRANSMISSION IN NEUTRAL, PARKING BRAKE SET AND THE WHEELS BLOCKED. ENGINE MUST BE AT NORMAL OPERATING TEMPERATURE.

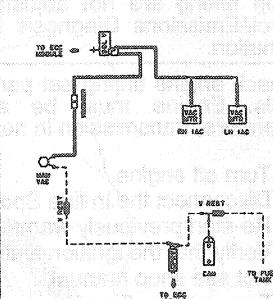
- 1) TURN OFF ENGINE.
- 2) DISCONNECT SMALL IN-LINE SPOUT CONNECTOR ( ) LOCATED ABOVE THE POWER STEERING PUMP.
- 3) RE-START PREVIOUSLY WARMED-UP ENGINE.
- 4) IGNITION TIMING IS 10° BTDC. IF NOT SEE SHOP MANUAL.
- 5) TURN OFF ENGINE AND RESTORE ELECTRICAL CONNECTION.

THIS ENGINE IS EQUIPPED WITH AUTOMATIC IDLE SPEED CONTROL. IDLE RPM IS NOT ADJUSTABLE. IF NOT WITHIN SPECIFIED RPM RANGE, SEE SHOP MANUAL:

MANUAL TRANS. IN NEUTRAL: 800 RPM

THIS VEHICLE CONFORMS TO U.S. EPA REGULATIONS APPLICABLE TO 1991 MODEL YEAR NEW MOTOR VEHICLES.

VACUUM HOSE ROUTING



USE SAE 5W-30 OIL API SERVICE SG - ENERGY CONSERVING II.

SPARK PLUG: AGSP-32PP 3.0L SHO W/F3.0L/3.2L/3.0L - TRC/MS28/5MP GAP 1.042-046

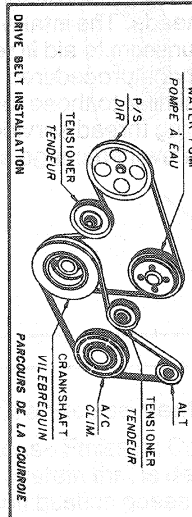
CATALYST

FIAC-3C483-G F F

A14863-B

Canada

CANADA



VEHICLE EMISSION CONTROL INFORMATION FORD MOTOR COMPANY

CONTRÔLE DES ÉMISSIONS DU VÉHICULE

THIS VEHICLE IS EQUIPPED WITH EEC IV, EFI AND DIS SYSTEMS. IDLE SPEEDS, IDLE MIXTURES AND IGNITION TIMING ARE NOT ADJUSTABLE. SEE SHOP MANUAL FOR ADDITIONAL INFORMATION.

CHECK TIMING WITH THE TRANSMISSION IN NEUTRAL, PARKING BRAKE SET AND THE WHEELS BLOCKED. ENGINE MUST BE AT NORMAL OPERATING TEMPERATURE.

- 1) ARRÊTER LE MOTEUR.
- 2) DÉBRANCHER LE PETIT CONNECTEUR ( ) INTERCALÉ DANS LE CIRCUIT DE DÉCLENCHEMENT DE L'ÉTINCELLE, AU-DESSUS DE LA POMPE D'ASSISTANCE DE DIRECTION.
- 3) REDÉMARRER LE MOTEUR PRÉALABLEMENT RÉCHAUFFÉ.
- 4) L'ALLUMAGE DOIT ÊTRE CALÉ À 10° AVANT PMH. SINON, VOIR LE MANUEL DE RÉPARATION.
- 5) ARRÊTER LE MOTEUR ET REBRANCHER LE CONNECTEUR.

THIS ENGINE IS EQUIPPED WITH AUTOMATIC IDLE SPEED CONTROL. IDLE RPM IS NOT ADJUSTABLE. IF NOT WITHIN SPECIFIED RPM RANGE, SEE SHOP MANUAL:

MANUAL TRANS. IN NEUTRAL: 800 RPM

CE VÉHICULE EST MUNI DES SYSTÈMES EEC IV, EFI ET DIS. LES RÉGIMES DE RALENTI, LES MÉLANGES DE RALENTI ET L'ALLUMAGE NE SONT PAS RÉGLABLES. POUR PLUS DE DÉTAILS, CONSULTER LE MANUEL DE RÉPARATION.

POUR VÉRIFIER LE CALAGE DE L'ALLUMAGE, PLACER LE LEVIER DE VITESSE AU POINT MORT, SERRER LE FREIN DE STATIONNEMENT ET BLOQUER LES ROUES. LE MOTEUR DOIT ÊTRE NORMALEMENT CHAUD.

- 1) ARRÊTER LE MOTEUR.
- 2) DÉBRANCHER LE PETIT CONNECTEUR ( ) INTERCALÉ DANS LE CIRCUIT DE DÉCLENCHEMENT DE L'ÉTINCELLE, AU-DESSUS DE LA POMPE D'ASSISTANCE DE DIRECTION.
- 3) REDÉMARRER LE MOTEUR PRÉALABLEMENT RÉCHAUFFÉ.
- 4) L'ALLUMAGE DOIT ÊTRE CALÉ À 10° AVANT PMH. SINON, VOIR LE MANUEL DE RÉPARATION.
- 5) ARRÊTER LE MOTEUR ET REBRANCHER LE CONNECTEUR.

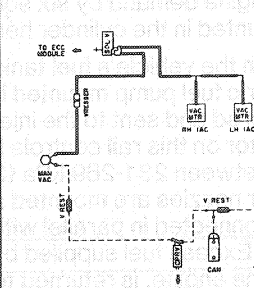
CE MOTEUR EST À COMMANDE DE RALENTI AUTOMATIQUE. LE RÉGIME DE RALENTI N'EST PAS RÉGLABLE. S'IL N'EST PAS CONFORME, CONSULTER LE MANUEL DE RÉPARATION:

B.V.M. AU POINT MORT: 800 TR/MIN

• EEC IV = COMMANDE ÉLECTRONIQUE DU MOTEUR, VERSION IV  
 • EFI = INJECTION ÉLECTRONIQUE MULTIPONT  
 • DIS = ALLUMAGE SANS DISTRIBUTEUR

VACUUM HOSE ROUTING

SCHEMA DE DÉPRESSION



USE SAE 5W-30 OIL API SERVICE SG - ENERGY CONSERVING II. NULLE PRÉCONSEILÉE SAE 5W-30, CLASSE API « SG » - « ÉCONOMIE D'ÉNERGIE II »

SPARK PLUG / BOUGIES: AGSP-32PP 3.0L GAP / ÉLECTRODES: 042-046


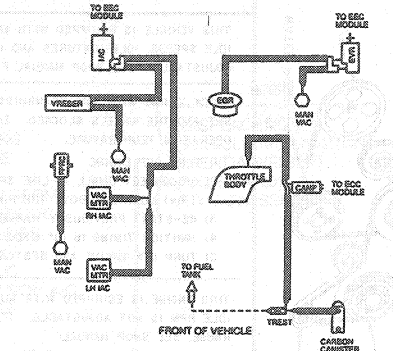
CATALYST/CATALYSEUR

FIAC-9C483-G F G

A14864-A

DESCRIPTION (Continued)

49 States

		<p><b>VEHICLE EMISSION CONTROL INFORMATION</b></p>	
<p>This vehicle is equipped with electronic engine control systems. Engine idle speed, idle mixture, and ignition timing are not adjustable. See Powertrain Control/Emissions Diagnosis Manual for additional information.</p>		<p><b>VACUUM HOSE ROUTING</b></p> 	
<p>To check engine timing set parking brake and block wheels. Engine must be at normal operating temperature, transmission in neutral, and accessories off.</p> <ol style="list-style-type: none"> <li>(1) Turn off engine.</li> <li>(2) Disconnect the in-line Spout Connector ( =□□ ).</li> <li>(3) Re-start previously warmed-up engine.</li> <li>(4) Verify that the ignition timing is 10° BTDC. If not see shop manual.</li> <li>(5) Turn engine off and restore electrical connection.</li> </ol>		<p>Spark Plug: AGSP-32PP 3.2L-HM PFM3.2V5FDF3-TWC/HO2S/SFI</p>	
<p>Use SAE 5W-30 Oil API Service SG - Energy Conserving II.</p>		<p>Gap: .042-.046</p>	
<p>This vehicle conforms to U.S. EPA regulations applicable to 1993 model year new motor vehicles.</p>		<p><b>Catalyst</b></p> <p>F3AE-8C485-J C Y</p>	

A14865-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 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 regulator on this rail controls the fuel delivery pressure between 231-269 kPa (33.5-39 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.

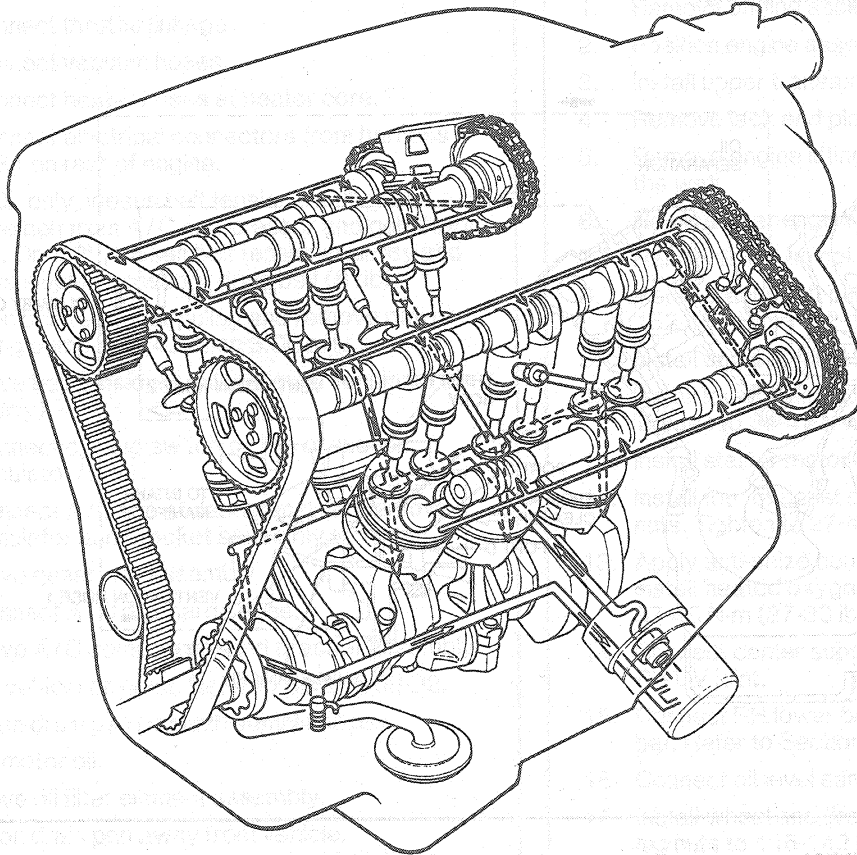
These fuel induction systems are mounted on an aluminum intake manifold (9424) which in turn is bolted to aluminum alloy cylinder heads. The intake manifolds and heads are cast from aluminum to aid in removing weight from the engine. Service procedures related to these components remain similar to those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

## DESCRIPTION (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, bucket tappets and camshaft bearings.

NOTE: 3.0L/3.2L SHO lubrication systems are alike.



A12693-A

**Positive Crankcase Ventilation (PCV)**

The Crankcase Emission Control System is a closed ventilation system that is designed to prevent case fumes or combustion gases from escaping through the engine oil filler cap to the atmosphere.

The crankcase control system controls these fumes or vapors (blowby) by directing them back into the intake manifold where they are consumed in the normal combustion process.

The crankcase ventilating air source is the throttle body. The fresh air passes through the engine air cleaner (9600) and then through the ventilation hose (2) connecting the throttle body to the LH cylinder head cover. Then, ventilating air moves down through the oil return passage into the lower crankcase.

The air and crankcase gas mixture flow from the crankcase through the oil separator and ventilation hose (1) to the throttle body and intake manifold.

There are three outlet ports for the air and crankcase mixture, and one port for fresh air in the throttle body. Under the following various throttle positions, the air and crankcase gas mixture flows differently through these outlet ports.

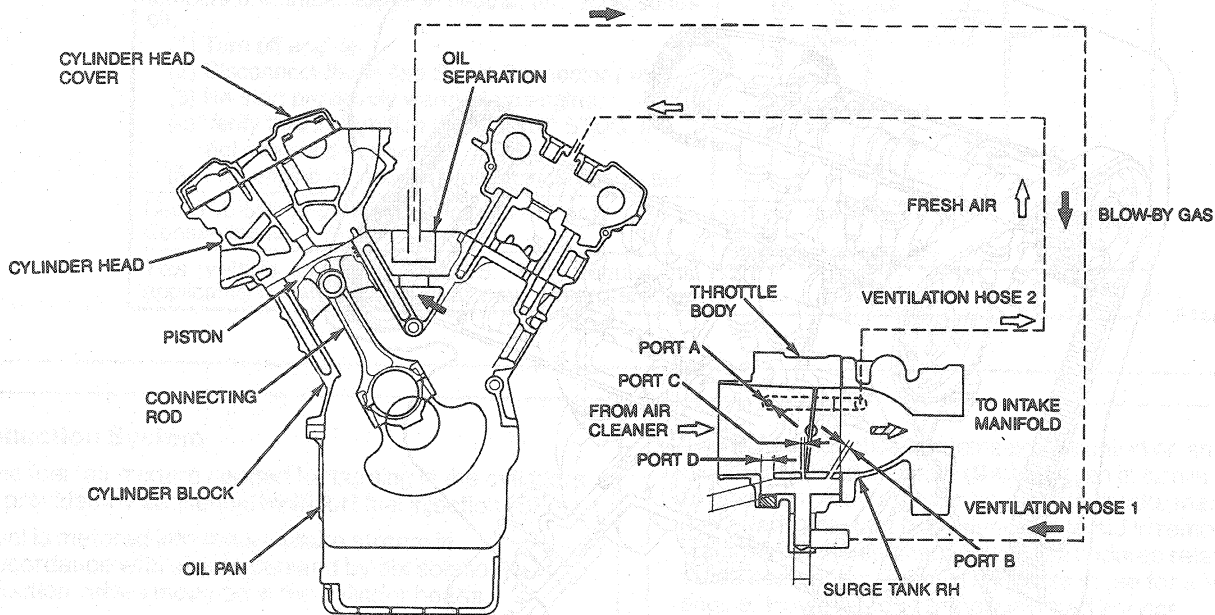
1. Fresh air normally flows through port "A" to the cylinder head.
2. At closed throttle position, the air and crankcase gas mixture flows through port "B" into the intake manifold.
3. At partial open throttle position, the air and crankcase gas mixture flows through ports "B" and "C" into the intake manifold with the air and crankcase gas mixture.

At the same time, fresh air flows through port "D" to ports "B" and "C" and goes into the intake manifold with the air and crankcase gas mixture.

## DESCRIPTION (Continued)

4. At wide open throttle position, the air and crankcase gas mixture flows through ports "B", "C" and "D" into the intake manifold.

At this time, when crankcase gas is excessive, the crankcase gas also flows through port "A" into the intake manifold from the LH cylinder head. The ventilation process goes on continuously while the engine is running.



A12690-B

## REMOVAL AND INSTALLATION

## Engine

## Tools Required:

- Engine Lifting Bracket D89L-6001-A
- Rotunda Hi-Lift Jack 014-00210
- Rotunda Three Bar Engine Support Kit 014-00750

## Removal

1. Drain engine cooling system. Refer to Section 03-03.
2. Disconnect battery cables.
3. Remove battery. Refer to Section 14-01.
4. Remove battery tray assembly.
5. Disconnect wiring connector retaining under hood lamp, if so equipped.
6. Mark position of hood hinges and remove hood.
7. Remove oil level indicator.
8. Disconnect generator and voltage regulator wiring assembly.

9. Remove radiator upper sight shield.
10. Discharge A/C system. Refer to Section 12-00.
11. Remove radiator coolant recovery reservoir assembly.
12. Remove constant control relay module (CCRM).
13. Remove air cleaner hose assembly.
14. Remove upper radiator hose.
15. Remove electric fan and shroud assembly. Refer to Section 03-03.
16. Remove lower radiator hose.
17. Remove radiator assembly. Refer to Section 03-03.
18. Relieve fuel system pressure.
19. Disconnect fuel inlet hose.
20. Disconnect fuel return hose.
21. Remove barometric pressure (BARO) sensor 12A680.

**REMOVAL AND INSTALLATION (Continued)**

22. Remove engine vibration damper and bracket assembly from RH side of engine.
23. Remove engine to damper bracket.
24. Remove retaining bolt from power steering reservoir and place reservoir out of the way.
25. Disconnect hose to power steering cooler at pump.
26. Disconnect throttle linkage.
27. Disconnect vacuum hoses.
28. Disconnect heater hoses at heater core.
29. Disconnect electrical connectors from harness 12A581 on rear of engine.
30. On 3.0L only, loosen belt tensioner pulley and remove belt from A/C compressor and generator (6 rib). On 3.2L, loosen belt tensioner pulley and remove single accessory drive belt (6 rib).
31. Loosen belt tensioner pulley and remove power steering pump belt (4 rib) on 3.0L only.
32. Remove belt tensioner pulley (lower tensioner on 3.0L only).
33. Disconnect cycling switch on top of suction accumulator/drier.
34. Disconnect A/C line at dash panel and remove accumulator and bracket assembly.
35. Remove generator assembly.
36. Disconnect A/C discharge hose.
37. Remove A/C compressor and bracket assembly.
38. Raise vehicle on hoist. Refer to Section 00-02.
39. Position drain pan beneath vehicle oil pan.
40. Drain motor oil.
41. Remove oil filter element assembly.
42. Position drain pan away from vehicle.
43. Remove wheel and tire assemblies.
44. Disconnect oil level sensor switch.
45. Disconnect RH lower ball joint, tie rod end, and stabilizer bar. Refer to Section 04-01.
46. Disconnect center support bearing bracket, and RH CV joint from transaxle.
47. Disconnect heated oxygen sensor (HO2S)(9F472).
48. Disconnect four exhaust catalyst-to-engine retaining bolts.
49. Remove starter motor assembly.
50. Remove lower transaxle to engine retaining bolts.
51. Remove engine mount to subframe retaining nuts.
52. Remove crankshaft pulley assembly.
53. Lower vehicle.
54. Remove upper transaxle to engine retaining bolts.
55. Install Engine Lifting Bracket D89L-6001-A or equivalent.
56. Position Rotunda Hi-Lift Jack 014-00210 or equivalent under transaxle.

57. Position Rotunda Adjustable Three Bar Engine Support Kit 014-00750 or equivalent.

58. Raise transaxle assembly slightly.
59. Remove engine assembly from vehicle.
60. Place engine on work stand.

**Installation**

1. Remove engine assembly from work stand.
2. Position engine assembly in vehicle.
3. Install upper transaxle to engine retaining bolts.
4. Remove jack and place out of the way.
5. Remove engine lifting equipment and place out of the way.
6. Remove rear engine lifting eye.
7. Raise vehicle on hoist. Refer to Section 00-02.
8. Install crankshaft pulley assembly. Tighten to 152-172 N·m (112-127 lb-ft).
9. Install engine mount to subframe nuts.
10. Install lower transaxle to engine retaining bolts. Tighten to 34-47 N·m (25-35 lb-ft).
11. Install starter motor assembly.
12. Install four exhaust catalyst to engine retaining nuts. Tighten to 27-47 N·m (20-35 lb-ft).
13. Apply anti-seize compound to the threads, then install heated oxygen sensor (HO2S). Tighten to 37-45 N·m (27-33 lb-ft).
14. Connect center support bearing bracket. Install RH CV joint.
15. Connect RH lower ball joint, tie rod and stabilizer bar. Refer to Section 04-01.
16. Connect oil level sensor.
17. Install wheel and tire assemblies. Tighten wheel lug nuts to 115-142 N·m (85-105 lb-ft).
18. Install oil filter. Ensure oil drain plug is installed, tighten to 20-33 N·m (15-24 lb-ft).
19. Lower vehicle.
20. Install A/C compressor and bracket assembly. Tighten to 36-55 N·m (27-41 lb-ft).
21. Connect A/C discharge hose.
22. Install generator assembly. Tighten to 48-72 N·m (36-53 lb-ft).
23. Install accumulator and bracket assembly.
24. Connect cycling switch to top of accumulator.
25. Install belt tensioner (lower tensioner on 3.0L only).
26. Install power steering belt (4 rib) and tighten belt tensioner pulley on 3.0L only.
27. On 3.0L, install belt on A/C compressor and generator (6 rib). Tighten tensioner pulley. On 3.2L, install single accessory drive belt and release tensioner.
28. Connect electrical connectors from harness 12A581 on rear of engine.

## REMOVAL AND INSTALLATION (Continued)

29. Connect heater hoses at heater core.
30. Connect vacuum hoses.
31. Connect throttle linkage.
32. Connect hose from power steering cooler at pump.
33. Install power steering reservoir.
34. Install damper bracket to engine.
35. Install engine vibration damper and bracket assembly to RH side of engine.
36. Install barometric pressure (BARO) sensor.
37. Connect fuel return hose.
38. Connect fuel inlet hose.
39. Install radiator assembly. Refer to Section 03-03.
40. Install lower radiator hose.
41. Install electric fan and shroud assembly. Refer to Section 03-03.
42. Install upper radiator hose.
43. Install air cleaner hose.
44. Install constant control relay module (CCRM).
45. Install radiator coolant recovery reservoir.
46. Install radiator upper sight shield.
47. Connect generator and voltage regulator wiring.
48. Install oil level indicator tube.
49. Install hood.
50. Connect underhood lamp wiring, if so equipped.
51. Install battery tray.
52. Install battery.
53. Connect battery ground cable.
54. Fill crankcase with correct viscosity and amount of engine oil.
55. Refill coolant.
56. Drain, evacuate, pressure test and recharge A/C system. Refer to Section 12-00.
57. Start engine and check for leaks.

## Engine Damper, RH

## Removal

**CAUTION:** Do not clamp damper tube or piston rod.

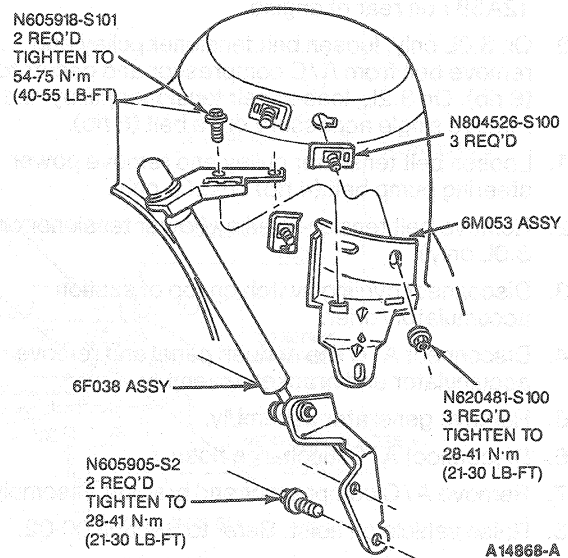
**NOTE:** Whenever self-locking fasteners are removed, replace with new self-locking fasteners.

1. Remove nuts retaining lower end of damper to engine bracket.

2. Remove bolts retaining upper damper bracket to shock tower bracket.
3. Remove engine damper.

## Installation

1. Position engine damper lower sleeve to line up with engine bracket notch. Secure with a new nut. Tighten to 28-41 N·m (21-30 lb-ft).
2. Position engine damper with upper bracket to shock tower bracket. Secure with new bolts. Tighten to 54-75 N·m (40-55 lb-ft).



A14868-A

## Engine Damper, LH

## Removal

**CAUTION:** Do not clamp damper tube or piston rod.

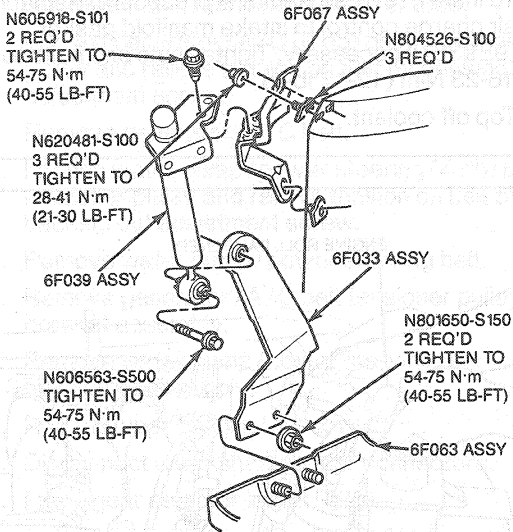
**NOTE:** Whenever self-locking fasteners are removed, replace with new self-locking fasteners.

1. Remove speed control servo and bracket assembly. Refer to Section 10-03.
2. Remove bolt and flag nut retaining lower end of damper to No. 1A engine mount retaining bracket.
3. Remove bolts retaining upper damper bracket to side rail bracket.



REMOVAL AND INSTALLATION (Continued)

4. Remove engine damper.



A14869-A

Installation

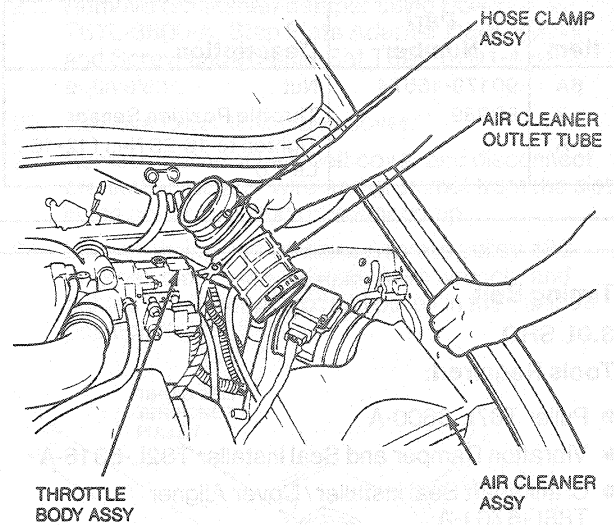
1. Insert lower end of damper into engine mount retaining bracket being careful to align groove in damper sleeve with notch in bracket.
2. Insert bolt through bracket and damper and hand start new flag nut. Tighten bolt to 28-41 N·m (21-30 lb-ft).  
NOTE: Bolt must be inserted with head toward engine.
3. Pull damper into position against the shock tower mounting bracket.
4. Install speed control servo and bracket assembly. Refer to Section 10-03.

Throttle Body

**CAUTION:** The 3.2L SHO throttle body contains a special coating. DO NOT attempt to clean.

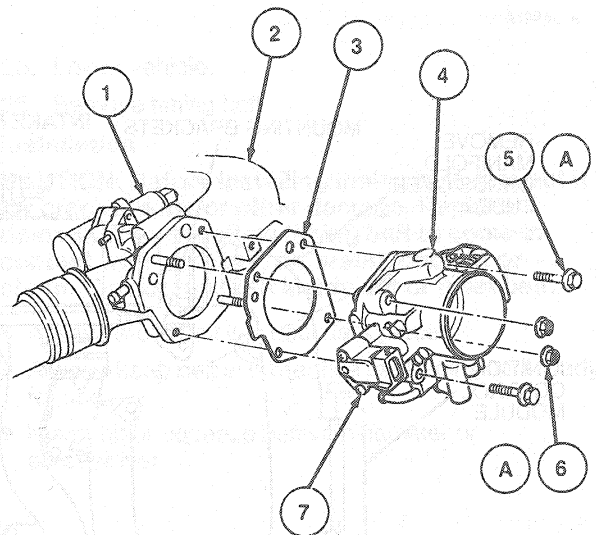
Removal and Installation

1. Loosen hose clamp retaining flex hose to throttle body. Remove air cleaner flex hose.
2. Remove throttle linkage snowshield.



A12858-A

3. Relieve cooling system pressure. Refer to Section 03-03. Loosen and disconnect all vacuum and coolant connections to throttle body.
4. Disconnect throttle linkage. Refer to Section 10-02.
5. Disconnect throttle position sensor (9B989).



A12859-C

Item	Part Number	Description
1	9F715	Idle Air Control Valve
2	9424	Intake Manifold
3	9E936	Air Charge Control to Intake Manifold Gasket
4	9E926	Throttle Body
5A	90105-08536	Bolt

(Continued)

## REMOVAL AND INSTALLATION (Continued)

Item	Part Number	Description
6A	90179-15574	Nut
7	9B989	Throttle Position Sensor
A		Tighten to 16-23 N·m (12-16 Lb-Ft)

- Remove two throttle body retaining bolts and nuts.
- To install, reverse Removal procedure. Replace air charge control to intake manifold gasket (9E936) if necessary. Tighten nuts and bolts to 16-23 N·m (12-17 lb-ft).
- Top off coolant.

## Timing Belt

## 3.0L SHO

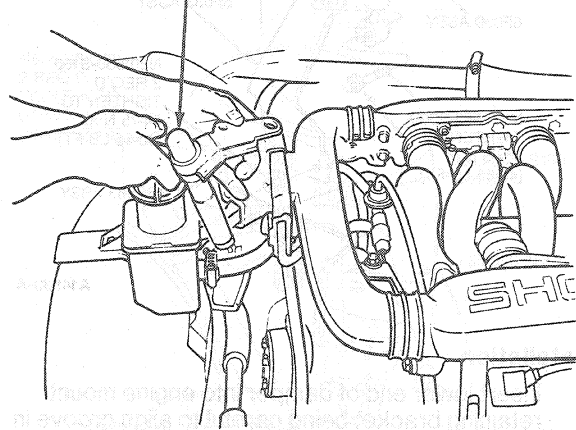
## Tools Required:

- Puller T67L-3600-A
- Vibration Damper and Seal Installer T82L-6316-A
- Crankshaft Seal Installer / Cover Aligner T88L-6701-A
- Screw and Washer Set T89P-6701-A
- Step Plate Adapter D80L-630-3
- Rotunda Offset Belt Tension Gauge 021-0028A

## Removal

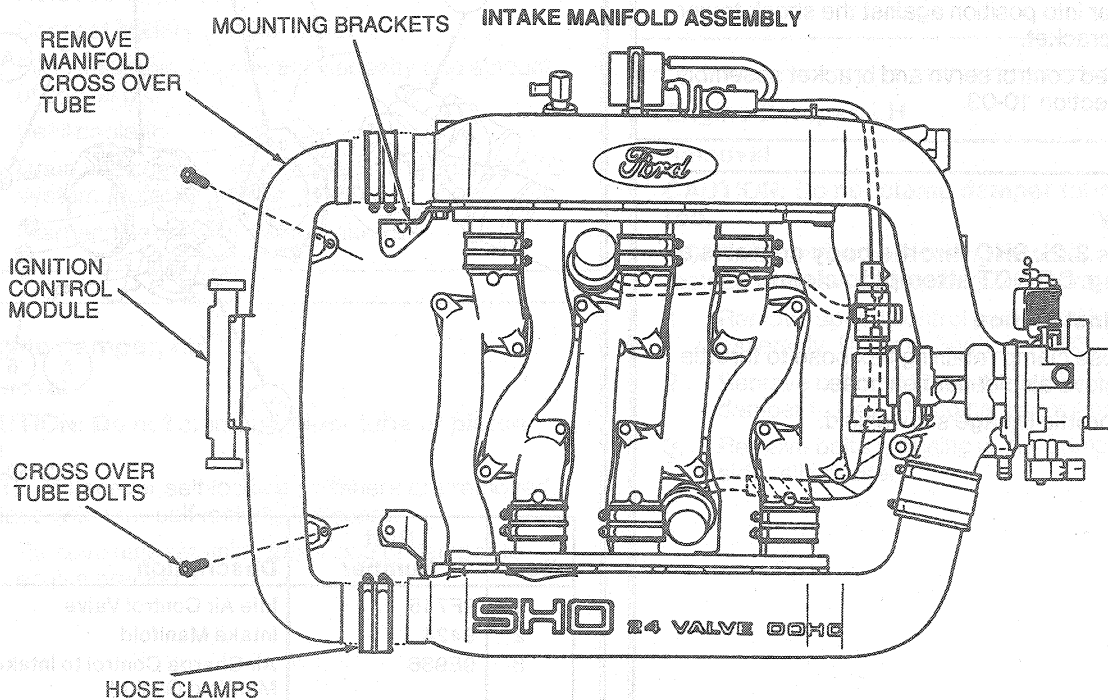
- Disconnect battery cables.
- Remove battery.
- Remove RH engine roll damper as outlined.

ENGINE ROLL DAMPENER



A12904-A

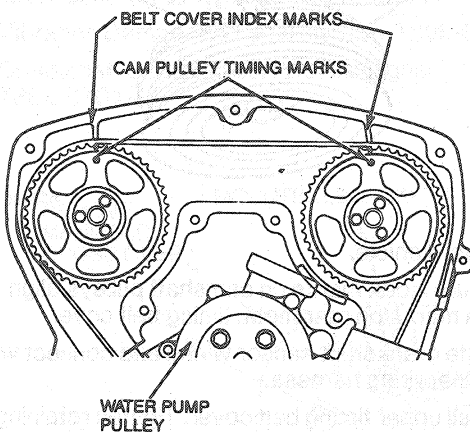
- Disconnect wiring to ignition control module (ICM).
- Remove intake manifold crossover tube bolts.



A12903-C

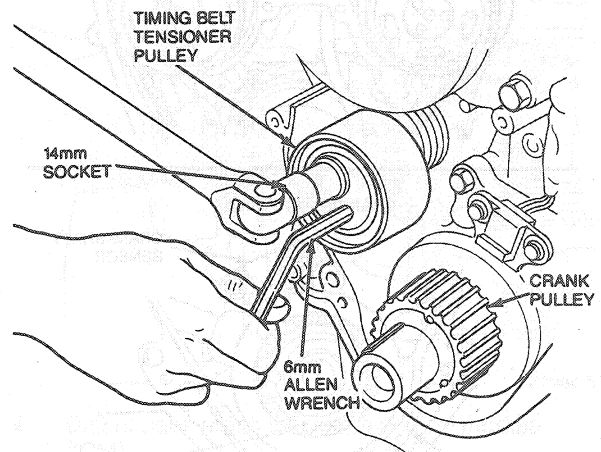
## REMOVAL AND INSTALLATION (Continued)

6. Loosen intake manifold crossover tube hose clamps.
7. Remove intake manifold crossover tube.
8. Loosen generator / A / C (6 rib) belt tensioner pulley and relieve tension on belt by backing out adjustment screw.
9. Remove generator / A / C belt.
10. Loosen water pump / power steering (4 rib) belt tensioner pulley and relieve tension on belt by backing out adjustment screw.
11. Remove water pump / power steering belt.
12. Remove generator / A / C belt tensioner pulley and bracket assembly.
13. Remove water pump / power steering belt tensioner pulley only.
14. Remove upper timing belt cover.
15. Disconnect crankshaft sensor connectors.
16. Place gear selector in NEUTRAL.
17. Set engine to TDC on No. 1 cylinder. Ensure that "white" mark on crankshaft damper aligns with 0 degree index mark on lower timing belt cover and that marks on intake camshaft pulleys align with index marks on metal timing belt cover.



18. Raise vehicle on a hoist. Refer to Section 00-02.
19. Remove RH front wheel and tire assembly.
20. Loosen fender splash shield and place out of the way.

21. Remove crankshaft damper using Puller T67L-3600-A, Step Plate Adapter D80L-630-3 and Screw and Washer Set T89P-6701-A or equivalent.
22. Remove lower timing belt cover.
23. Remove center timing belt cover and disconnect crankshaft sensor wire and grommet from the slot in the cover and stud on water pump.
24. Loosen timing belt tensioner, rotate pulley 180 degrees clockwise using an Allen wrench, and tighten tensioner nut to hold pulley in the "unload position."



25. Lower vehicle.
26. Remove timing belt.

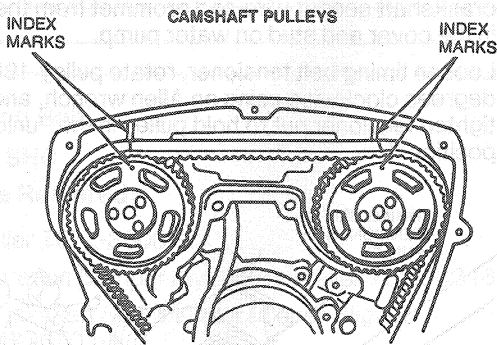
## Installation

**CAUTION:** Before installing timing belt, inspect it for cracks, wear or other damage. Replace if damaged. Do not allow timing belt to come in contact with gasoline, oil, water, coolant or steam. Do not turn belt inside out or twist belt.

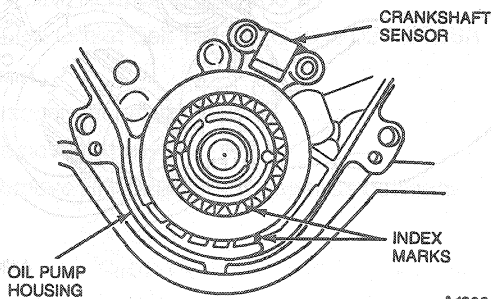
- Always store belt in a cool dark place.
- Always keep belt in protective packaging until ready for use.
- Never hit or squeeze belt with hammer or screwdriver.

## REMOVAL AND INSTALLATION (Continued)

1. Ensure engine is at TDC on No. 1 cylinder. Check that camshaft pulley marks line up with index marks on upper steel belt cover and that crankshaft pulley aligns with index mark on oil pump housing.



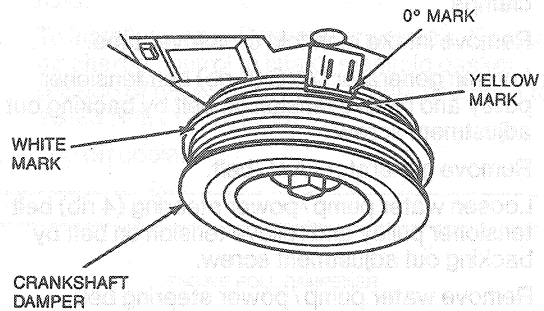
CRANKSHAFT PULLEY



A13084-A

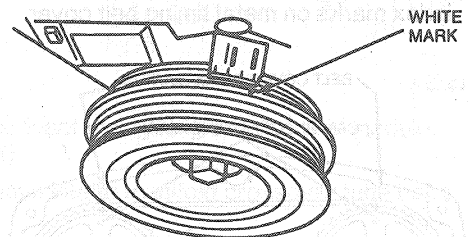
**NOTE:** The timing belt has three yellow lines. Each line aligns with the index marks shown.

2. Install timing belt on crankshaft pulley and route to camshaft pulleys. Lettering on belt "KOA" should be readable from rear of engine (top of lettering to front of engine). Also ensure that the yellow lines are aligned with the index marks on the pulleys.
3. Release tensioner locknut and leave nut loose.
4. Raise vehicle on hoist. Refer to Section 00-02.
5. Install center timing belt cover. Ensure crankshaft sensor wiring and grommet are installed and routed properly. Tighten retaining bolts to 7-11 N·m (62-97 lb-in).
6. Install lower timing belt cover. Tighten retaining bolts to 7-11 N·m (62-97 lb-in).
7. Install crankshaft damper using Crankshaft Seal Installer / Cover Aligner T88T-6701-A with forcing screw from Vibration Damper and Seal Installer T82L-6316-A or equivalent.
8. Rotate crankshaft two revolutions in the clockwise direction until the yellow mark on damper aligns with 0 degree mark on lower timing belt cover.



A13085-A

9. Remove plastic door in the lower timing belt cover. Tighten belt tensioner lock nut to 33-51 N·m (24-38 lb-ft) and install plastic door.
10. Rotate crankshaft 60 degrees more in the clockwise direction until the white mark on the damper aligns with 0 degree index mark on lower timing belt cover.



A13086-A

11. Lower vehicle.
12. Ensure index marks on camshaft pulleys align with marks on rear metal timing belt cover.
13. Route crankshaft sensor wiring and connect with engine wiring harness.
14. Install upper timing belt cover. Tighten retaining bolts to 7-11 N·m (62-97 lb-in).
15. Install water pump pulley. Tighten retaining nut to 16-23 N·m (12-17 lb-ft).
16. Install generator / A / C tensioner pulley and bracket assembly. Tighten bolts to 15-23 N·m (11-17 lb-ft).
17. Install water pump / power steering (4 rib) belt. Using Rotunda Offset Belt Tension Gauge 021-0028A or equivalent, set tension. Tighten idler pulley retaining nut to 34-50 N·m (25-36 lb-ft).
  - New belt: 690-880 N (154-198 lb)
  - Used belt: 500-700 N (112-157 lb)

## REMOVAL AND INSTALLATION (Continued)

18. Install generator / A / C (6 rib) belt. Using Rotunda Offset Belt Tension Gauge 021-0028A or equivalent, set tension. Tighten idler pulley nut to 34-50 N·m (25-36 lb-ft).

- New belt: 980-1180 N (220-265 lb)
- Used belt: 660-850 N (148-192 lb)

19. Install intake manifold cross over tube. Tighten bolts to 15-23 N·m (11-17 lb-ft).

20. Install engine roll damper.

21. Install battery.

22. Connect battery cables.

23. Raise vehicle.

24. Install splash shield.

25. Install RH front tire and wheel assembly. Tighten wheel lug nuts to 115-142 N·m (85-105 lb-ft).

26. Lower vehicle.

## 3.2L SHO

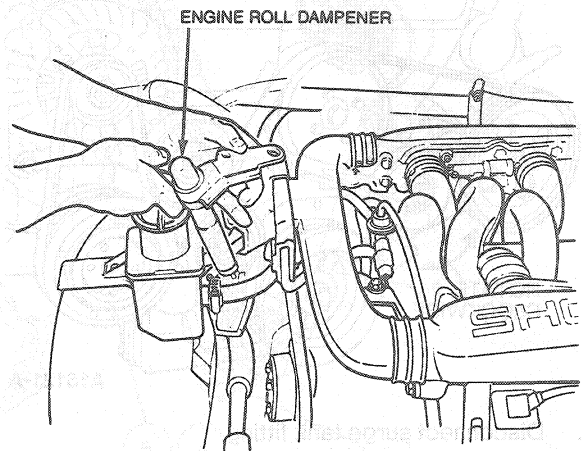
## Tools Required:

- Puller T67L-3600-A
- Strap Wrench D85L-6000-A
- Step Plate Adapter D80L-630-3
- Inch Pound Torque Wrench D81L-600-A
- Vibration Damper and Seal Installer T82L-6316-A
- Crankshaft Seal Installer / Cover Aligner T88L-6701-A

- Screw and Washer Set T89P-6701-A
- Torque Wrench Attachment T93P-6254-A
- Timing Belt Tensioner Tool T93P-6254-B

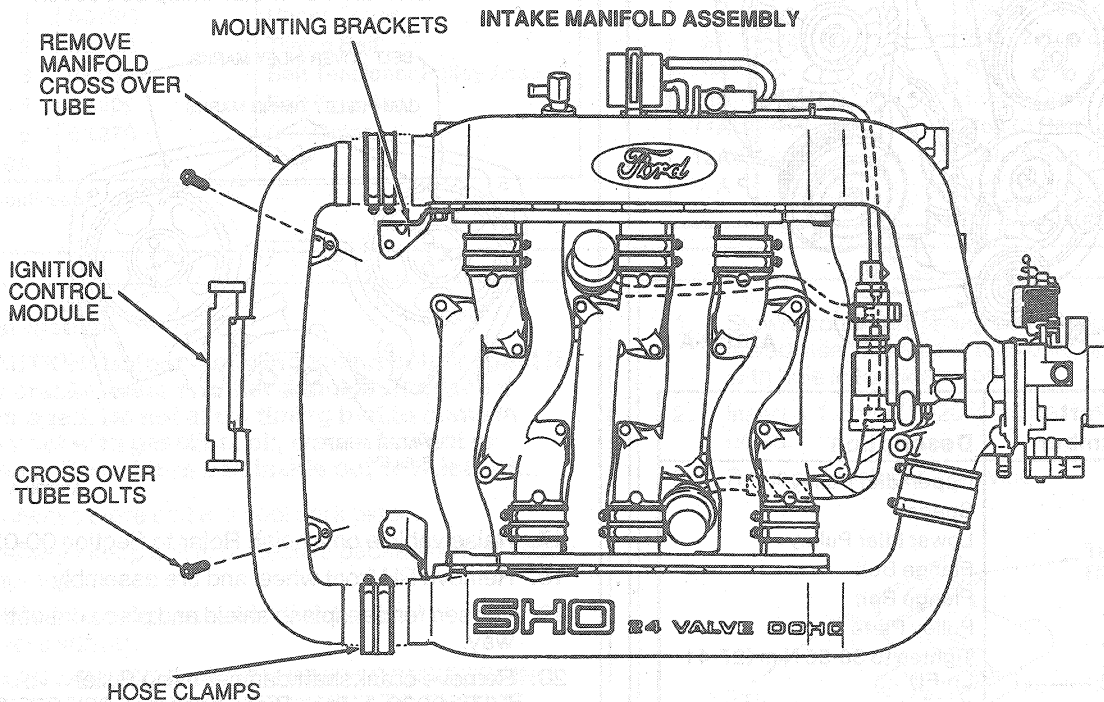
## Removal

1. Disconnect battery cables.
2. Remove battery.
3. Remove RH engine roll damper as outlined.



A12904-A

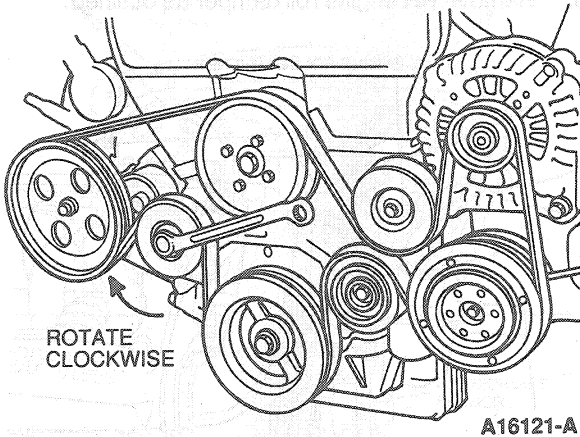
4. Disconnect wiring to ignition control module (ICM).
5. Remove intake manifold crossover tube bolts.



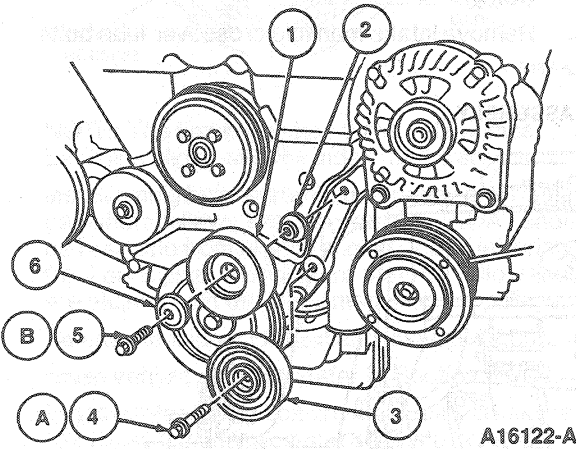
A12903-C

**REMOVAL AND INSTALLATION (Continued)**

6. Loosen intake manifold crossover tube hose clamps.
7. Remove intake manifold crossover tube.
8. Rotate accessory drive belt tensioner clockwise to relieve tension and remove single accessory drive belt.

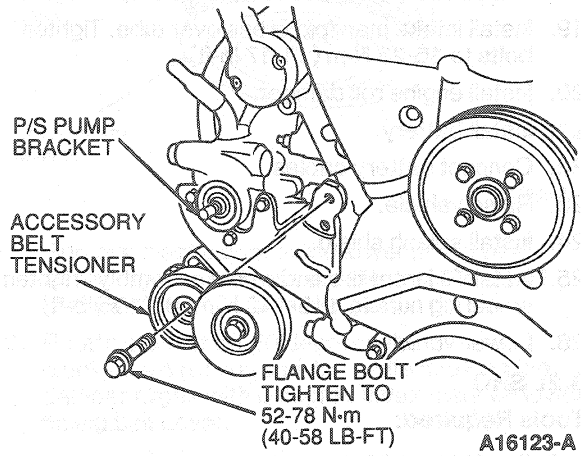


9. Disconnect surge tank fitting.
10. Remove bolts retaining upper and lower idler pulleys to engine and remove pulleys.

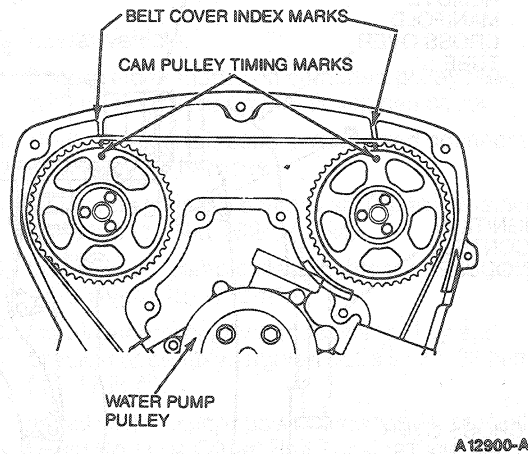


Item	Part Number	Description
1	8679	Upper Idler Pulley
2	8A613	Spacer
3	8679	Lower Idler Pulley
4A	—	Flange Bolt
5B	—	Flange Bolt
6	—	Pulley Plate
A		Tighten to 36-55 N·m (27-41 Lb-Ft)
B		Tighten to 35-51 N·m (26-38 Lb-Ft)

11. Using strap wrench D85L-6000-A or equivalent, to hold power steering pump pulley, remove nut, washer and remove power steering pulley.
12. Remove retaining bolt from belt tensioner and remove tensioner.



13. Remove upper and center timing belt covers.
14. Disconnect crankshaft position (CKP) sensor (12A127) connectors.
15. Place transmission selector lever in NEUTRAL.
16. Set engine to TDC on No. 1 cylinder. Ensure that "white" mark on crankshaft damper aligns with 0 degrees index mark on lower timing belt cover and that marks on intake camshaft pulleys align with index marks on metal timing belt cover.

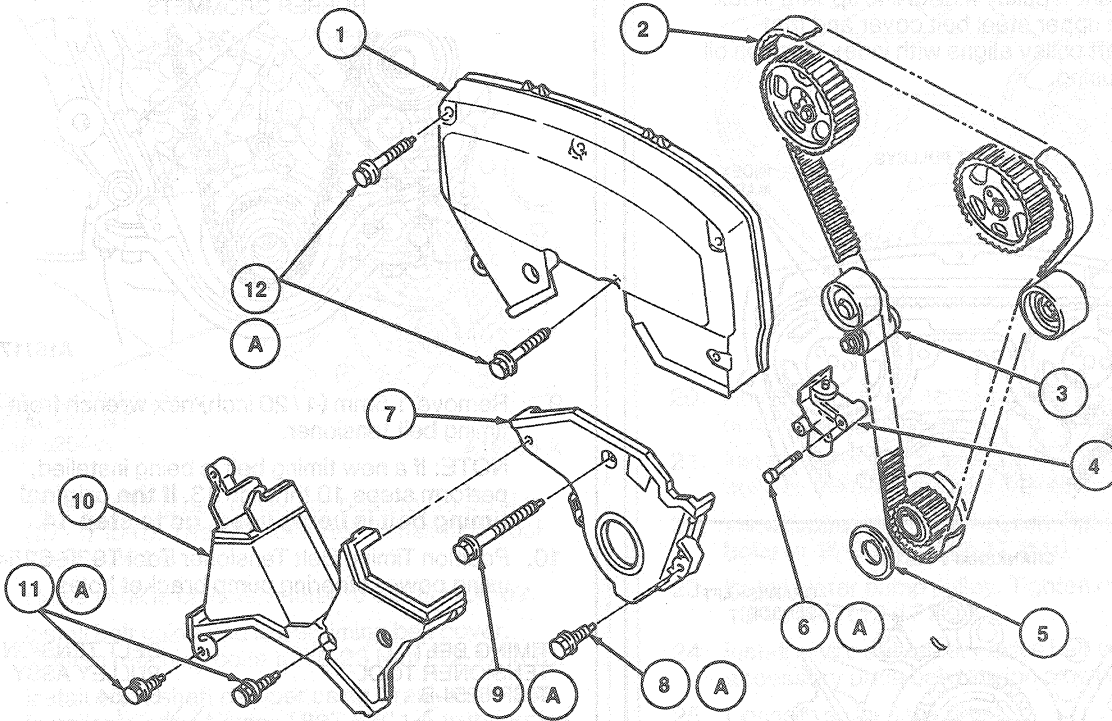


17. Raise vehicle on a hoist. Refer to Section 00-02.
18. Remove RH front wheel and tire assembly.
19. Loosen fender splash shield and place out of the way.
20. Remove crankshaft damper using Puller T67L-3600-A, Step Plate Adapter D80L-630-3 and Screw and Washer Set T89P-6701-A.
21. Remove lower timing belt cover and belt guide.
22. Remove upper timing belt tensioner bolt.

REMOVAL AND INSTALLATION (Continued)

23. Slowly loosen lower timing belt tension bolt and remove tensioner.

24. Lower vehicle.  
25. Remove timing belt.



A16107-A

Item	Part Number	Description
1	6019G	Upper Cover
2	6268B	Timing Belt
3	6K254	Belt Tensioner Pulley Assy
4	6B209	Belt Tensioner
5	6K279	Belt Guide
6A	—	Bolt

Item	Part Number	Description
7	—	Center Cover
8A	—	Bolt (2 Req'd)
9A	—	Bolt
10	6019H	Lower Cover
11A	—	Bolt (3 Req'd)
12A	—	Bolt (8 Req'd)
A	—	Tighten to 16-23 N·m (12-17 Lb·Ft)

(Continued)

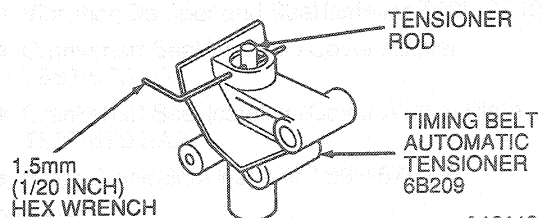
Installation

**CAUTION:** Before installing timing belt, inspect if for cracks, wear or other damage. Replace if damaged. Do not allow timing belt to come in contact with gasoline, oil, water, coolant or steam. Do not turn belt inside out or twist belt.

- Always store belt in a cool dark place.
- Always keep belt in protective packaging until ready for use.
- Never hit or squeeze belt with hammer or screwdriver.

**WARNING:** USE CAUTION WHEN COMPRESSING TIMING BELT TENSIONER IN VISE TO ENSURE THAT TENSIONER DOES NOT SLIP FROM VISE.

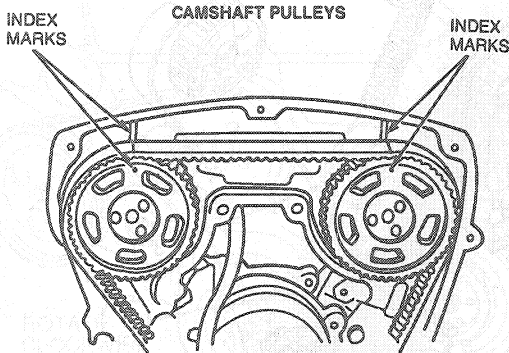
1. Slowly compress timing belt tensioner in a soft jawed vise until hole in tensioner housing aligns with hole in tensioner rod.
2. Insert a 1.5mm (1/20 inch) hex wrench through holes.
3. Release tensioner from vise.



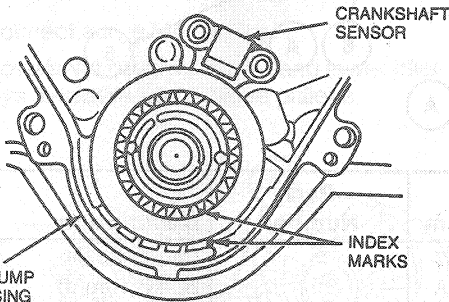
A16110-A

### REMOVAL AND INSTALLATION (Continued)

4. If a new timing belt is being installed, loosen timing belt idler bolt.
5. Ensure engine is at TDC on No. 1 cylinder. Check that camshaft pulley marks line up with index marks on upper steel belt cover and that crankshaft pulley aligns with index mark on oil pump housing.



CAMSHAFT PULLEYS



CRANKSHAFT PULLEY

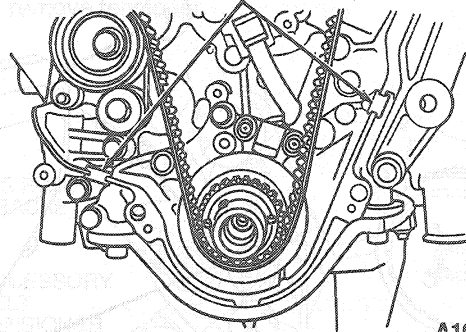
A13084-A

**NOTE:** The timing belt has three yellow lines. Each line aligns with the index marks shown.

6. Install timing belt on crankshaft pulley and route to camshaft pulleys. Lettering on belt "KOB" should be readable from rear of engine (top of lettering to front of engine). Also ensure that the yellow lines are aligned with the index marks on the pulley.
- CAUTION:** Do not install timing belt tensioner with rod extended.
7. Install timing belt tensioner on cylinder block while pushing timing belt idler toward belt. Tighten tensioner bolts to 16-23 N-m (12-17 lb-ft).

8. Install grommets between timing belt tensioner and oil pump.

RUBBER GROMMETS



A16117-A

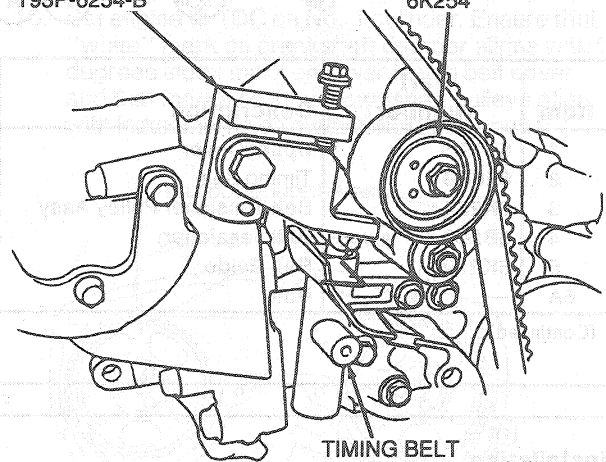
9. Remove 1.5mm (1/20 inch) hex wrench from timing belt tensioner.

**NOTE:** If a new timing belt is being installed, perform steps 10 through 13. If the original timing belt is being used, go to step 14.

10. Position Timing Belt Tensioner Tool T93P-6254-B using power steering pump bracket holes.

TIMING BELT TENSIONER TOOL T93P-6254-B

BELT TENSIONER PULLEY ASSY 6K254



TIMING BELT AUTOMATIC TENSIONER 6B209

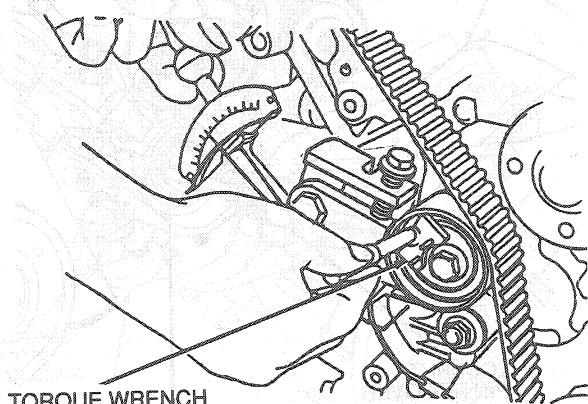
A16355-A

11. Hand-tighten timing belt idler bolt.



## REMOVAL AND INSTALLATION (Continued)

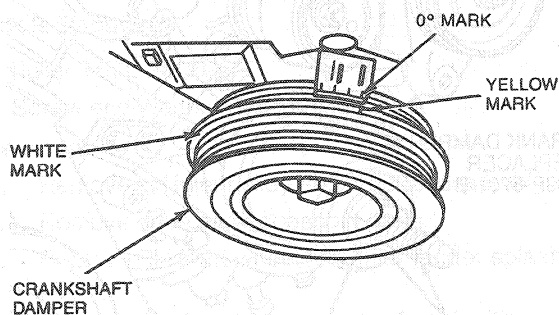
12. Using Inch Pound Torque Wrench D81L-600-A or equivalent, rotate Torque Wrench Attachment T93P-6254-A clockwise to 0.5 N·m (4.3 lb-in).



TORQUE WRENCH  
ATTACHMENT  
T93P-6254-A

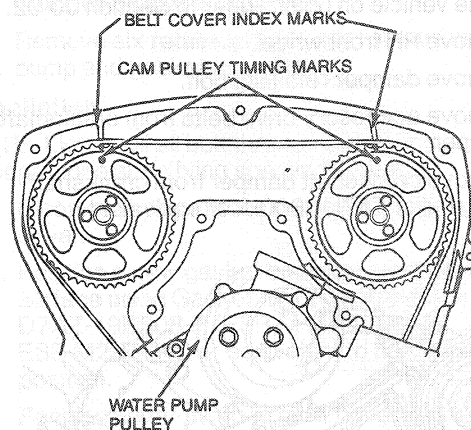
A16356-A

13. Tighten timing belt tensioner bolts to 36-50 N·m (27-37 lb-ft). Then remove Belt Tensioning Tool T93P-6254-B.
14. Raise vehicle on hoist. Refer to Section 00-02.
15. Install belt guide and lower timing belt cover. Tighten retaining bolts to 16-23 N·m (12-17 lb-ft).
16. Install crankshaft damper using Crankshaft Seal Installer / Cover Aligner T88T-6701-A with forcing screw from Vibration Damper and Seal Installer T82L-6316-A.
17. Rotate crankshaft two revolutions in the clockwise direction until the yellow mark on damper aligns with 0 degree mark on lower timing belt cover.



A13085-A

18. Lower vehicle.
19. Ensure index marks on camshaft pulleys align with marks on rear metal timing belt cover.



A12900-A

20. Route crankshaft sensor wiring and connect with engine wiring harness.
21. Install center timing belt cover. Tighten retaining bolts to 16-23 N·m (12-17 lb-ft).
22. Install upper timing belt cover. Tighten retaining bolts to 16-23 N·m (12-17 lb-ft).
23. Install water pump pulley. Tighten retaining nut to 16-23 N·m (12-17 lb-ft).
24. Install single accessory drive belt while rotating accessory drive belt tension clockwise.
25. Connect surge tank fitting.
26. Install intake manifold cross over tube. Tighten bolts to 15-23 N·m (11-17 lb-ft).
27. Install engine roll damper.
28. Connect wiring to ignition control module (ICM).
29. Install battery.
30. Connect battery cables.
31. Raise vehicle.
32. Install splash shield.
33. Install RH front tire and wheel assembly. Tighten wheel lug nuts to 115-142 N·m (85-105 lb-ft).
34. Lower vehicle.

## Crankshaft/Damper/Front Oil Seal

## Tools Required:

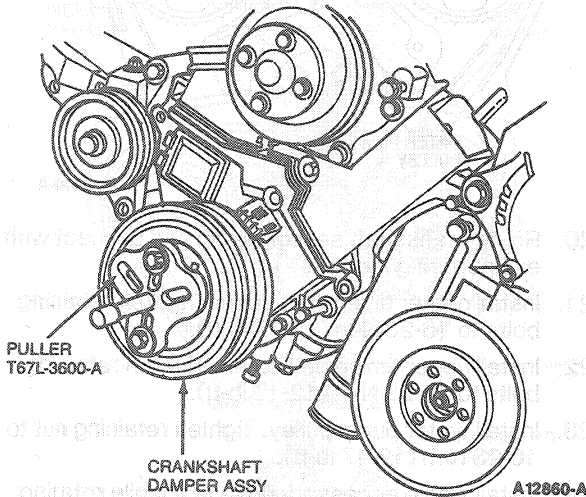
- Puller T67L-3600-A
- Locknut Pin Remover T78P-3504-N
- Vibration Damper and Seal Installer T82L-6316-A
- Crankshaft Seal Installer / Cover Aligner T88T-6701-A
- Crankshaft Seal Installer / Cover Aligner Plate T88T-6701-A2
- Front Crank Seal Installer T89P-6701-B

## Removal

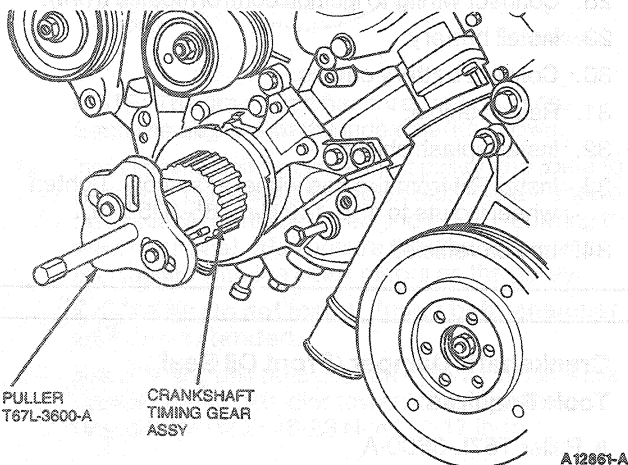
1. Loosen accessory drive belts.

## REMOVAL AND INSTALLATION (Continued)

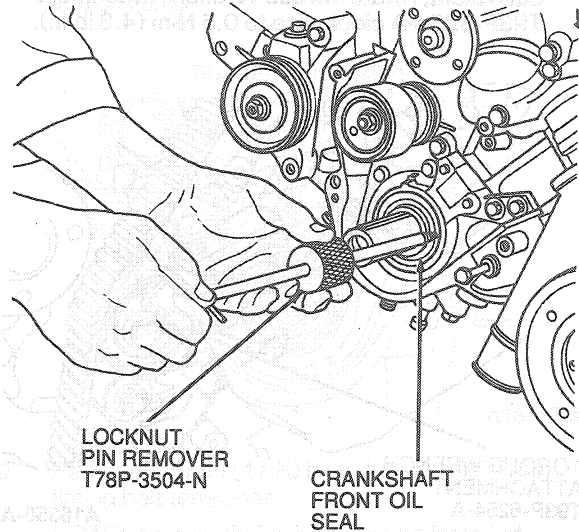
2. Raise vehicle on hoist. Refer to Section 00-02.
3. Remove RH front wheel.
4. Remove damper retaining bolt.
5. Remove accessory drive belts from crankshaft damper.
6. Remove crankshaft damper from crankshaft using Puller T67L-3600-A or equivalent.



7. Remove timing belt as outlined.
  8. Remove crankshaft timing gear using Puller T67L-3600-A.
- NOTE: Be careful not to damage the crankshaft sensor or shutter.

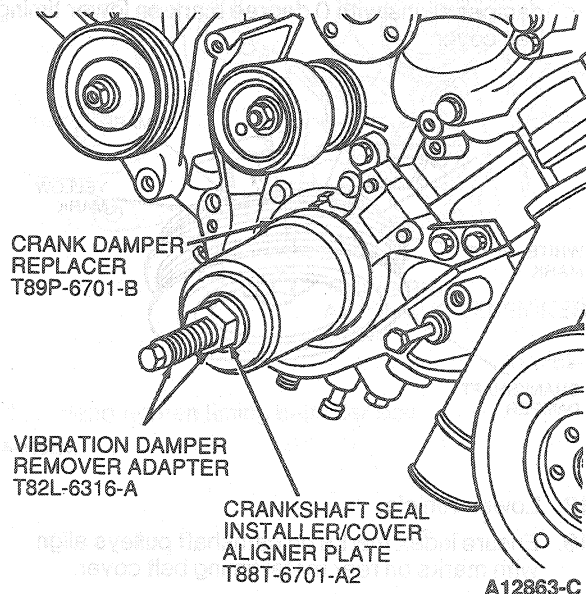


9. Remove crankshaft front oil seal using Locknut Pin Remover T78P-3504-N.



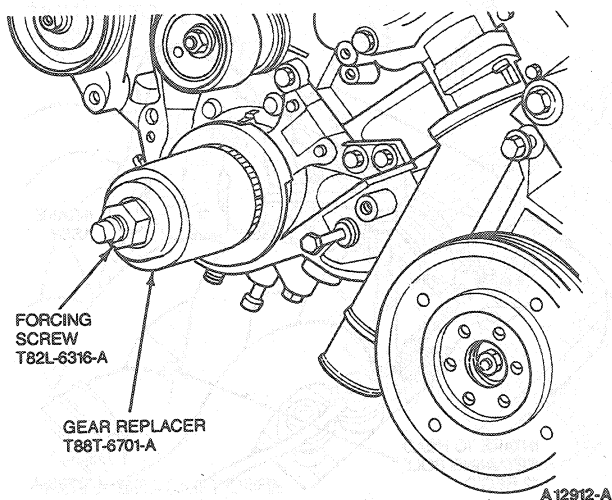
## Installation

1. Inspect front cover and shaft seal surface of the crankshaft damper for damage, nicks, burrs or other roughness which may cause the new seal to fail. Service or replace components as necessary.
2. Using Vibration Damper and Seal Installer T82L-6316-A, Crankshaft Seal Installer / Cover Aligner Plate T88T-6701-A2 and Front Crank Seal Installer T89P-6701-B install new front oil seal.



**REMOVAL AND INSTALLATION (Continued)**

3. Install Crankshaft Seal Installer / Cover Aligner T88T-6701-A with forcing screw from T82L-6316-A to press seal the rest of the way onto crankshaft.



4. Install crankshaft damper using Front Crank Seal Installer T89P-6701-B or equivalent. Install crankshaft damper retaining bolt. Tighten to 152-172 N·m (112-127 lb-ft).
5. Position accessory drive belts over crankshaft damper.
6. Check drive belts for proper routing and engagement in the pulleys. Adjust drive belts to specification. Refer to Section 03-05.
7. Start engine and check for oil leaks.

**Water Pump****Tools Required:**

- Puller T67L-3600-A
- Screw and Washer Set T89P-6701-A

**Removal**

1. Remove LH idler pulley and bracket assembly.
2. Remove drive and accessory belts.
3. Remove RH front wheel and inner fender splash panel.
4. Disconnect electrical connector from ignition control module.
5. Loosen four hose clamps and remove two bolts from intake connector tube and remove tube.
6. Remove upper timing belt cover.
7. Remove crankshaft damper using Puller T67L-3600-A or equivalent. Remove lower timing belt cover.
8. Disconnect crankshaft sensor wire assembly and position out of the way.
9. Remove center timing belt cover.

10. Remove pulley from RH idler.
11. Remove six retaining bolts and remove water pump and gasket assembly.

**Installation**

**NOTE:** Lightly oil all 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 using Gasket and Trim Adhesive D7AZ-19B508-B (ESR-M11P17-A and ESE-M2G52-A) or equivalent to hold the gasket in position.
3. Position water pump to front cover and install retaining bolts. Tighten bolts to 16-23 N·m (12-16 lb-ft).
4. Install pulley on RH idler.
5. Install center timing belt cover.
6. Connect crankshaft sensor wire assembly.
7. Install lower timing belt cover. Install crankshaft damper using Screw and Washer Set T89P-6701-A or equivalent. Install damper retaining bolt and tighten to 152-172 N·m (113-126 lb-ft).
8. Install upper timing belt cover.
9. Install intake connector tube. Tighten bolts to 15-23 N·m (11-16 lb-ft). Secure four hose clamps.
10. Connect ignition control module connector.
11. Install RH front inner splash panel and wheel. Tighten wheel lug nuts to 115-142 N·m (85-105 lb-ft).
12. Position accessory drive belts over pump pulley and adjust drive belts. Refer to Section 03-05.
13. Fill and bleed cooling system.
14. Start engine and check for coolant leaks.

**Cylinder Head Cover****Removal**

1. Disconnect battery ground cable.
2. Release pressure from fuel system.
3. Disconnect all vacuum lines and electrical connectors from intake manifold assembly.
4. Remove upper intake manifold as outlined.
5. Disconnect spark plug wires.
6. If LH cylinder head cover is being removed perform the following:
  - Remove oil fill cap.
  - Remove coil pack plastic cover.
7. If RH cylinder head cover is being removed, disconnect fuel lines.

## REMOVAL AND INSTALLATION (Continued)

- Remove cylinder head cover retaining bolts and remove cover.

### Installation

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

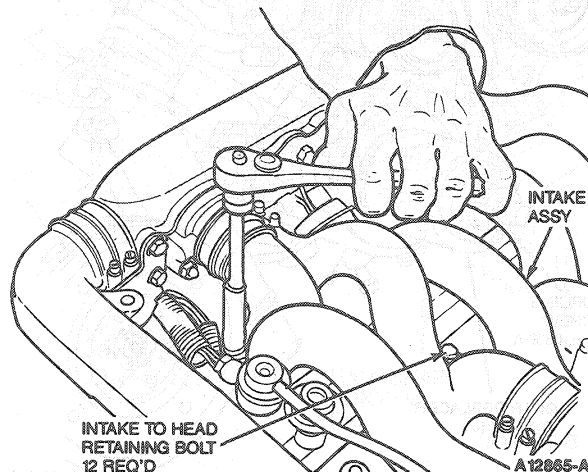
- Install new gasket and three spark plug hole gaskets on cover. Position cover on the cylinder head and install retaining bolts. Tighten retaining bolts to 9.8-16 N·m (7-12 lb-ft).
- If LH cylinder head cover is being installed, perform the following:
  - Install coil pack plastic cover.
  - Install oil fill cap.
- If RH cylinder head cover is being installed, connect fuel lines.
- Connect spark plug wires.
- Install upper intake manifold as outlined.
- Connect all vacuum lines and electrical connectors to intake manifold assembly.
- Connect battery ground cable.
- Start engine and check for fuel, coolant and oil leaks.

### Intake Manifold

#### Removal

- Partially drain engine cooling system.
- Disconnect battery ground cable.
- Disconnect electrical connectors and vacuum lines from intake assembly.
- Remove air cleaner tube.
- Disconnect coolant lines and cables from throttle body.
- Remove four bolts retaining upper intake brackets.

- Loosen four lower bolts and remove brackets.
- Remove 12 bolts retaining intake manifold to cylinder heads.
- Remove intake manifold assembly and gaskets.



### Installation

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

**NOTE:** The intake gasket is reusable.

- Position gasket on cylinder head.
- Position intake manifold on the cylinder heads.
- Install 12 retaining bolts. Tighten bolts to 15-23 N·m (11-17 lb-ft).
- Install intake manifold brackets. Tighten retaining bolts to 15-23 N·m (11-17 lb-ft).
- Connect coolant lines and cables to throttle body.
- Connect all electrical connectors and vacuum lines to intake manifold.
- Install air cleaner tube.
- Fill cooling system.
- Connect battery ground cable.

## REMOVAL AND INSTALLATION (Continued)

## 10. Start engine and check for coolant leaks.

STUD  
1 REQ'D  
TIGHTEN TO  
16-23 N·m  
(12-17 LB-FT)

UPPER INTAKE  
MANIFOLD AND  
THROTTLE BODY  
ASSY

BOLT 7 REQ'D  
TIGHTEN TO  
16-23 N·m  
(12-17 LB-FT)

BRACKET

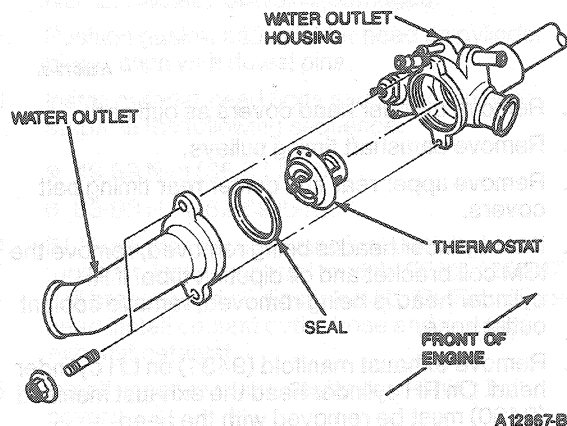
NOTE: BRACKET WITH  
STUD IS UNIQUE  
FROM OTHER THREE  
BRACKETS. IT MUST  
BE INSTALLED IN THE  
SAME LOCATION FROM  
WHICH IT WAS REMOVED.

V7352-C

### Thermostat

#### Removal

1. Disconnect battery ground cable.
2. Partially drain engine cooling system.
3. Remove air cleaner tube.
4. Disconnect hose from water outlet tube.
5. Remove two retaining nuts and remove water outlet tube.
6. Remove thermostat and seal from water outlet housing.



### Installation

NOTE: Align jiggle valve of thermostat with upper bolt on water outlet housing.

1. Install seal around the outer rim of the thermostat, and install thermostat into water outlet housing.
2. Install water outlet tube.
3. Install two retaining nuts. Tighten nuts to 7-11 N·m (62-97 lb-in).
4. Install air cleaner tube.
5. Fill engine cooling system.
6. Connect battery ground cable.
7. Start engine and check for coolant leaks.

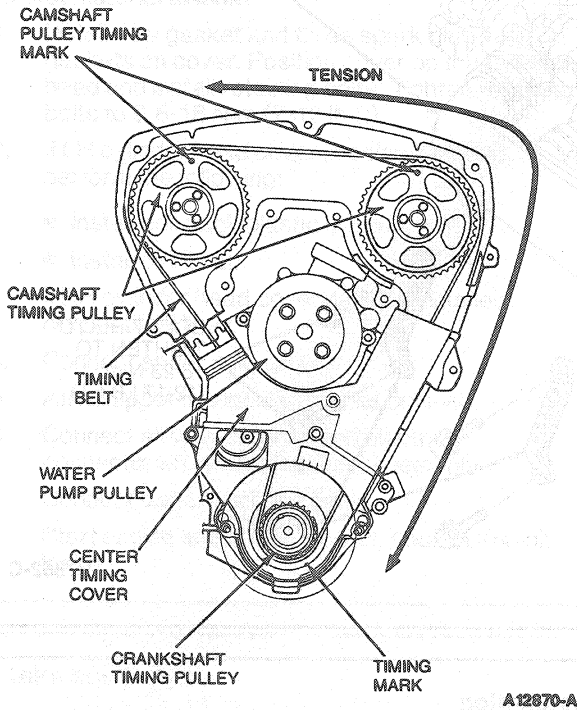
### Cylinder Heads

#### Removal

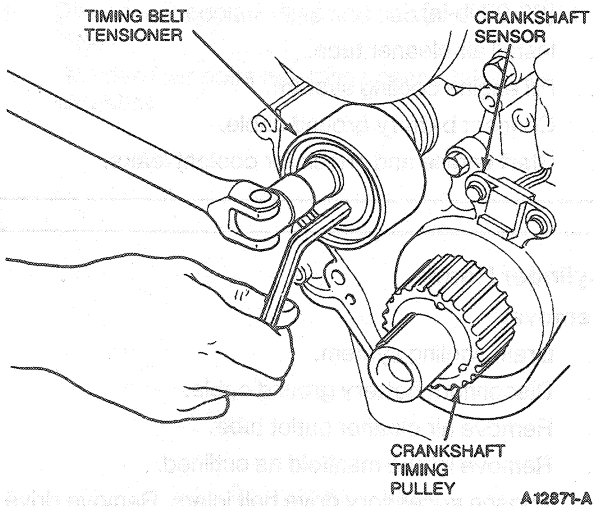
1. Drain cooling system.
2. Disconnect battery ground cable.
3. Remove air cleaner outlet tube.
4. Remove intake manifold as outlined.
5. Loosen accessory drive belt idlers. Remove drive belts.
6. Remove upper timing belt cover.
7. Remove LH idler pulley and bracket assembly.

## REMOVAL AND INSTALLATION (Continued)

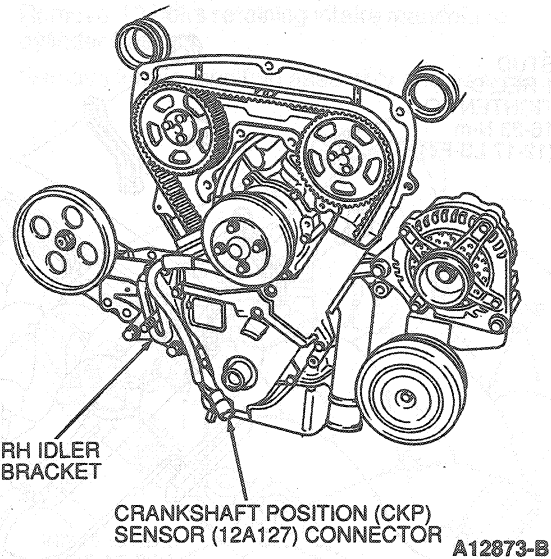
8. Raise vehicle on a hoist. Refer to Section 00-02.
9. Remove RH wheel and inner fender splash shield.
10. Remove crankshaft damper pulley.
11. Remove lower timing belt cover.
12. Align timing marks as shown.



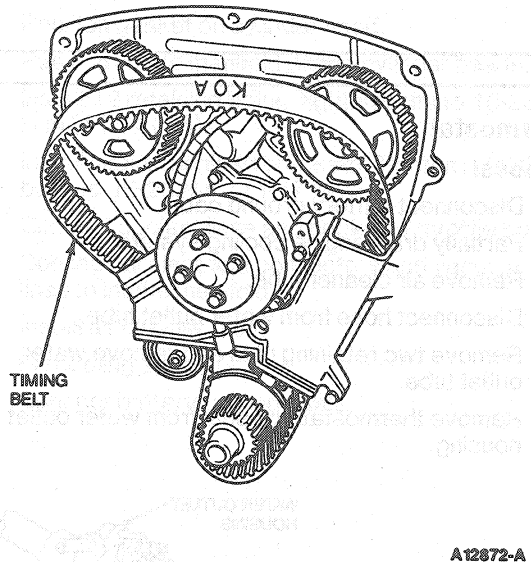
13. Release tension on timing belt by loosening tensioner nut and rotating tensioner with a hex head wrench. When tension is released, tighten nut. This will hold tensioner in place. Lower vehicle until wheels touch and keep supported on hoist.



14. Disconnect crankshaft position (CKP) sensor 12A127 wiring assembly.



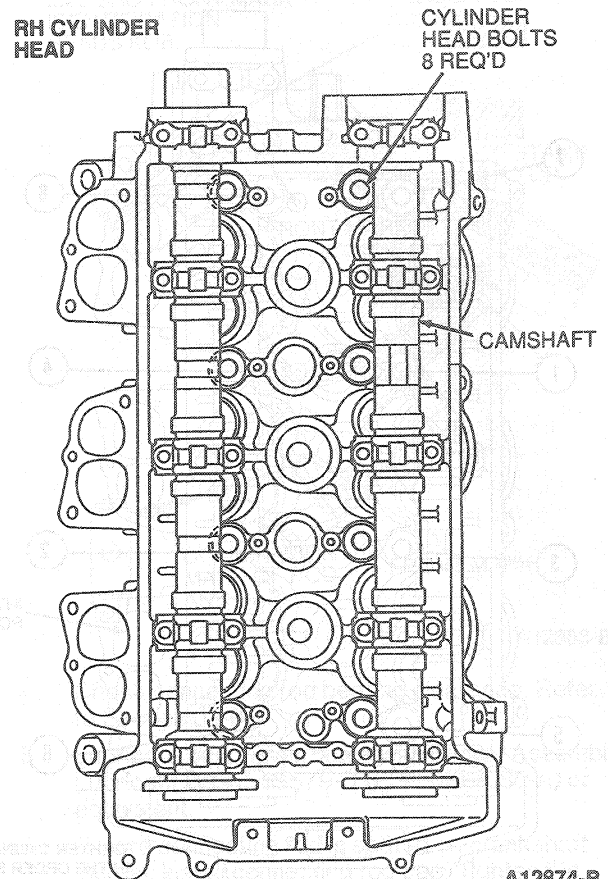
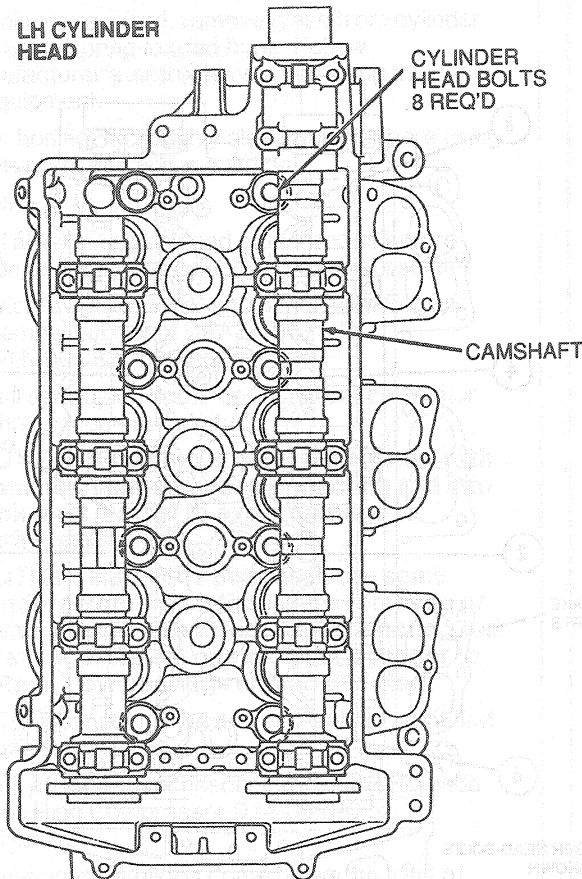
15. Remove center cover assembly.
16. Remove timing belt. Note location of "KOA" (or "KOB" on 3.2L SHO) on timing belt. The belt must be installed in the same direction.



17. Remove cylinder head covers as outlined.
18. Remove camshaft timing pulleys.
19. Remove upper rear and center rear timing belt covers.
20. If LH cylinder head is being removed, remove the ICM coil bracket and oil dipstick tube. If RH cylinder head is being removed, remove coolant outlet hose.
21. Remove exhaust manifold (9431) on LH cylinder head. On RH cylinder head the exhaust manifold (9430) must be removed with the head.
22. Remove eight cylinder head to block retaining bolts.

## REMOVAL AND INSTALLATION (Continued)

23. Remove cylinder head assembly.



A12874-B

**Installation**

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

1. Remove any foreign materials or oil from top of cylinder block and lower surface of cylinder head.

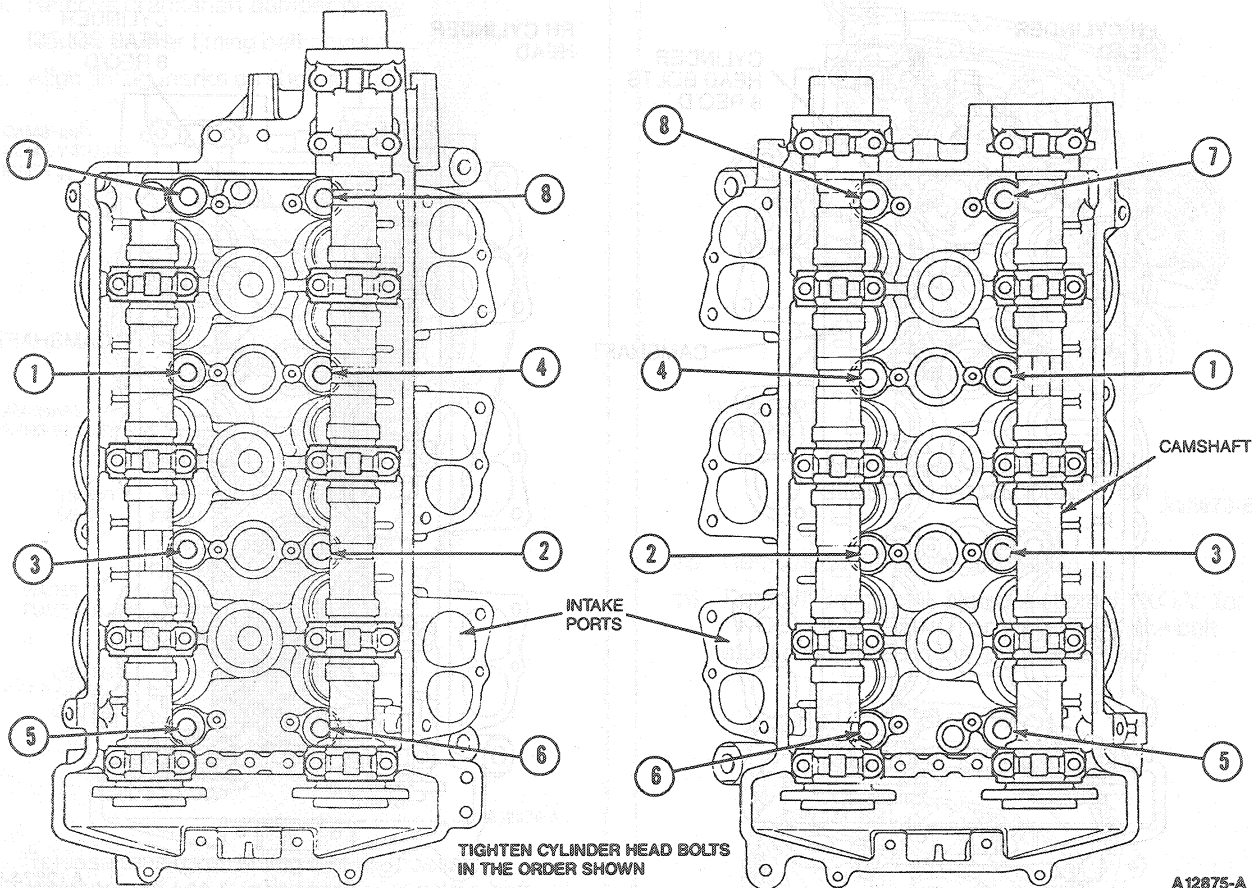
**NOTE:** Replace dowels if damaged.

2. Position gasket and cylinder head on cylinder block, align with dowel pins.
3. Install cylinder head bolts and tighten in two steps, in the following sequence:
  - 49-69 N·m (36-51 lb-ft).
  - 83-93 N·m (62-69 lb-ft).
4. If LH cylinder head is being installed, exhaust manifold, ignition control module (ICM) 12A297 coil bracket and oil dipstick tube. On RH cylinder head install coolant outlet hose and connect exhaust catalyst.
5. Install upper rear and center rear timing belt covers.
6. Install camshaft timing pulleys in the timed positions.

7. Install cylinder head covers as outlined.
8. Install timing belt and adjust as outlined.
9. Install center timing belt cover.
10. Connect crankshaft position (CKP) 12A127 sensor wiring assembly.
11. Install lower timing belt cover.
12. Raise vehicle on a hoist. Refer to Section 00-02.
13. Install inner fender splash shield and RH wheel and tire assembly. Tighten wheel lug nuts to 115-142 N·m (85-105 lb-ft).
14. Install LH idler pulley and bracket.
15. Install upper timing belt cover.
16. Install accessory drive belts. Refer to Section 03-05.
17. Install intake manifold as outlined.
18. Install air cleaner outlet tube.
19. Connect battery ground cable.
20. Fill engine cooling system.

## REMOVAL AND INSTALLATION (Continued)

21. Start engine and check for coolant, fuel or oil leaks.



## Pistons and Connecting Rods

## Tools Required:

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

## Removal

1. Drain engine cooling system.
2. Remove intake manifold as outlined.
3. Remove spark plugs, plug wires and ignition coil bracket.
4. Remove exhaust manifolds manifolds.
5. Remove cylinder heads as outlined.
6. Remove oil pan and oil baffle.
7. Remove oil pump assembly as outlined.
8. Before removing piston, inspect the 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 the piston to be removed is at the bottom of cylinder bore.

- b. Place a clean shop cloth over the piston head to collect cuttings.
- c. Remove ridge using Rotunda Cylinder Ridge Reamer 014-00292 or equivalent. Never cut into the ring travel area more than 0.794mm (1/32 inch) when removing the ridge.

9. Turn crankshaft until the piston to be removed is at the high 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.
10. Remove connecting rod cap retaining nuts and cap.
11. Install spark plug boots over connecting rod cap studs and push piston out through top of the cylinder bore. Use care to prevent damage to bearing surfaces.
12. Install connecting rod cap and hold in position with cap retaining nuts.
13. If piston is to be disassembled, refer to Piston Disassembly.



## REMOVAL AND INSTALLATION (Continued)

14. Inspect cylinder bore. If new piston rings are to be installed on the piston, a visible cross-hatch pattern should be obvious on 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.

**Installation**

Lightly oil all retaining bolt and stud 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.
2. Install spark plug boots or equivalent protection on the connecting rod studs.

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

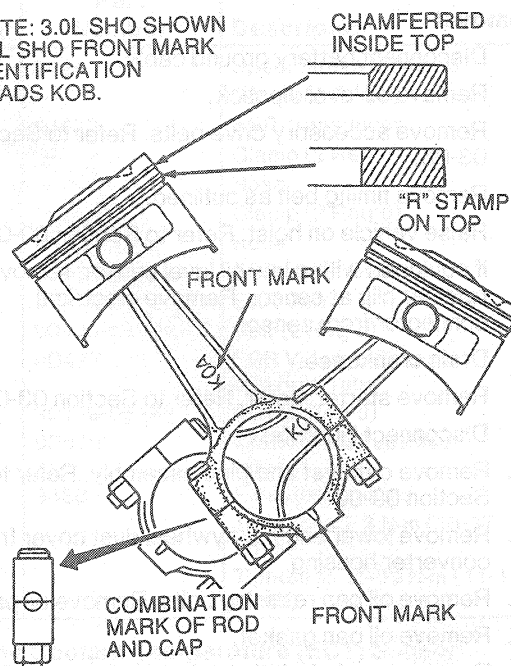
**CAUTION:** Install the pistons in the same cylinders from which they were removed or to which they were fitted. If a connecting rod is transposed from one block or cylinder to another, new bearings should be fitted.

**NOTE:** Connecting rod and cap are not identified to cylinder position.

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

Ensure notch in piston dome faces the front of engine and machine locating boss is facing RH side of engine.

**NOTE:** 3.0L SHO SHOWN  
3.2L SHO FRONT MARK  
IDENTIFICATION  
READS KOB.



A12883-B

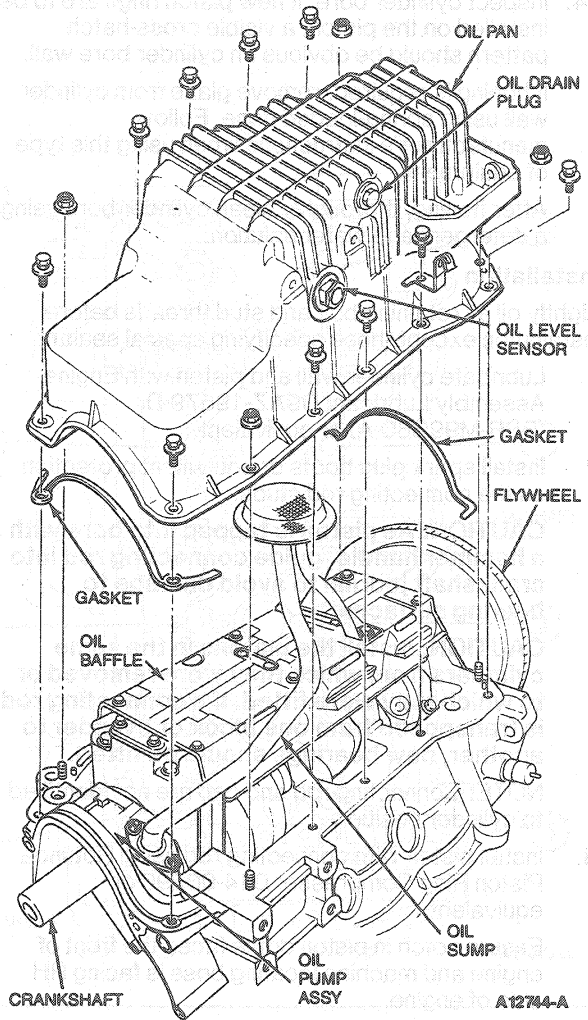
4. Check connecting rod bearing clearance. Refer to Section 03-00.
5. Lubricate bearing surfaces with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent.
6. Ensure connecting rod is seated on crankshaft journal. Install connecting rod cap. Tighten the retaining nuts in two steps: 30-35 N·m (22-26 lb-ft) 45-50 N·m (33-37 lb-ft).
7. If necessary, check connecting rod side clearance. Refer to Specifications.
8. Install oil pump as outlined.
9. Install upper oil baffle. Tighten bolts to 15-23 N·m (11-17 lb-ft).
10. Install oil pan.
11. Install exhaust manifolds.
12. Install cylinder heads as outlined.
13. Install intake manifold.
14. Install cylinder head cover as outlined.
15. Install coil bracket, plug wires and spark plugs.
16. Fill crankcase with correct viscosity and amount of engine oil.
17. Fill cooling system with specified coolant.
18. Start engine and check for oil, exhaust and coolant leaks.
19. Check, and if necessary, adjust transaxle throttle linkage and speed control.

## REMOVAL AND INSTALLATION (Continued)

### Oil Pan and Oil Pump

#### Removal

1. Disconnect battery ground cable.
2. Remove oil level dipstick.
3. Remove accessory drive belts. Refer to Section 03-05.
4. Remove timing belt as outlined.
5. Raise vehicle on hoist. Refer to Section 00-02.
6. If equipped with a low oil level sensor, remove retainer clip at sensor. Remove electrical connector from sensor.
7. Drain crankcase.
8. Remove starter motor. Refer to Section 03-06.
9. Disconnect HO2S's.
10. Remove catalyst and pipe assembly. Refer to Section 09-00.
11. Remove lower engine/flywheel dust cover from converter housing.
12. Remove oil pan retaining bolts. Remove oil pan.
13. Remove oil pan gasket.
14. Remove crankshaft timing belt pulley as outlined.
15. Remove sump to oil pump retaining bolts.
16. Remove oil pump to block retaining bolts and remove pump.



#### Installation

1. Clean gasket surfaces on the cylinder block and oil pan.
2. Align oil pump on crankshaft and install oil pump retaining bolts. Tighten bolts to 15-23 N-m (11-17 lb-ft).
3. Install oil sump to oil pump retaining bolts. Tighten bolts to 7-11 N-m (62-97 lb-in).
4. Install crankshaft timing belt pulley as outlined.  
 NOTE: When using silicone rubber sealer, assembly should occur within 15 minutes after sealer application. After this time, the sealer may start to set-up, and its sealing effectiveness may be reduced.
5. Locate oil pan gasket to oil pan with bend against pan surface and secure with Gasket and Trim Adhesive D7AZ-19B508-B (ESR-M11P17-A and ESE-M2G52-A) or equivalent.
6. Position oil pan.
7. Install oil pan. Tighten retaining bolts to 15-23 N-m (11-17 lb-ft).

## REMOVAL AND INSTALLATION (Continued)

8. Install lower engine / flywheel dust cover to the converter housing.
9. Install catalyst and pipe assembly. Connect HO<sub>2</sub>S's.
10. Install starter motor. Refer to Section 03-06.
11. Install low oil level sensor connector to the sensor and install retainer clip.
12. Lower vehicle.
13. Install accessory drive belts. Refer to Section 03-05.
14. Replace oil level dipstick.
15. Connect battery ground cable.
16. Fill crankcase with the correct viscosity and amount of engine oil.
17. Start engine and check for engine oil and exhaust leaks.

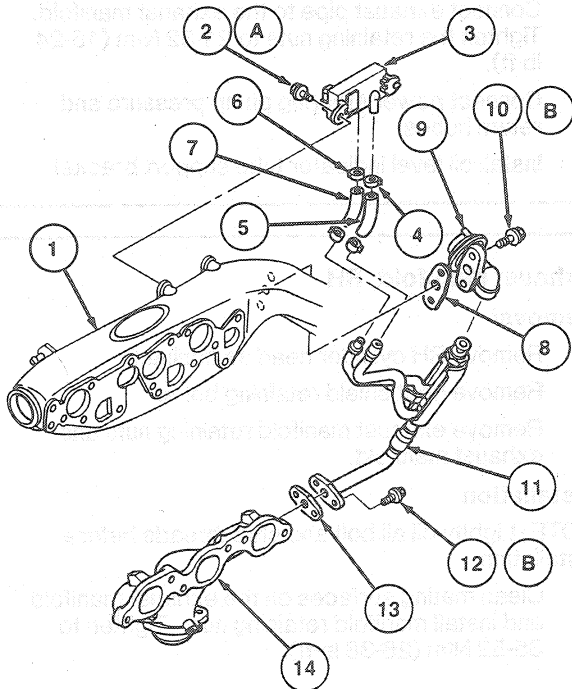
## Sensors

## Removal

Unless otherwise noted, all sensors are removed by disconnecting wiring connector and unscrewing sensor. Refer to Section 18-01 for electrical connector disengagement.

## Differential Pressure Feedback EGR (DPFE) 3.2L SHO Only

Located in the rear of the intake manifold. When installing, tighten to 15-23 N·m (11-17 lb-ft). Sensor is retained by two screws to intake manifold. When installing, tighten to 2-3 N·m (18-27 lb-in).



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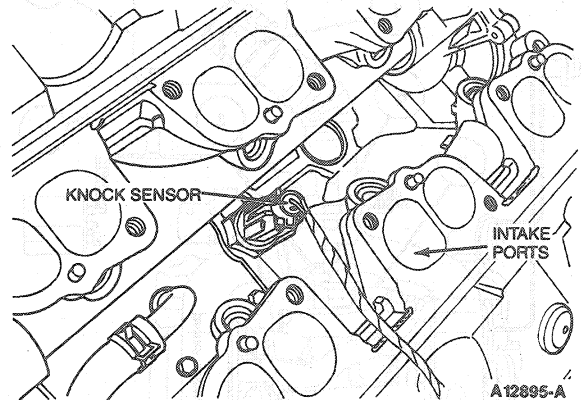
Item	Part Number	Description
1	9424	Upper Intake Manifold
2A	—	Screw (2 Req'd)
3	9J433	EGR Transducer
4	—	Clamp (2 Req'd)
5	—	Hose
6	—	Clamp (2 Req'd)
7	—	Hose
8	9D476	EGR Valve Gasket
9	9D475	EGR Valve
10A	90119-08151	Bolt (2 Req'd)
11	9D477	EGR Valve to Exhaust Manifold Tube
12A	90119-08146	Bolt (2 Req'd)
13	9F470	EGR Cooler Tube Inlet Gasket
14	9430	Exhaust Manifold
A		Tighten to 2-3 N·m (18-27 Lb-In)
B		Tighten to 15-23 N·m (11-17 Lb-Ft)

## Engine Coolant Temperature (ECT) Sensor 12A648

Located at the rear of the intake manifold to the rear of the throttle body. When installing, tighten to 16-24 N·m (12-17 lb-ft).

## Knock Sensor (KS) 12A699

Located under the intake manifold and fuel rails. When installing, tighten to 29-39 N·m (21-29 lb-ft).



## Oil Level Sensor

Located in the oil pan. When installing, tighten to 21-33 N·m (15-24 lb-ft).

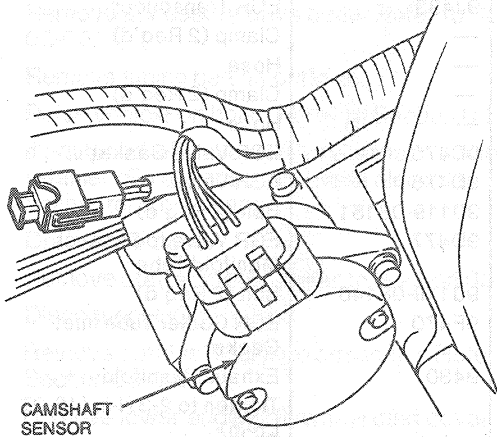
## Oil Pressure Sending Switch

Located in the right rear face of cylinder block. When installing, tighten to 16-24 N·m (12-18 lb-ft).

## REMOVAL AND INSTALLATION (Continued)

### Camshaft Sensor

Located on the RH side of vehicle on end of camshaft No. 1. When installing, tighten to 7-11 N-m (62-97 lb-in).



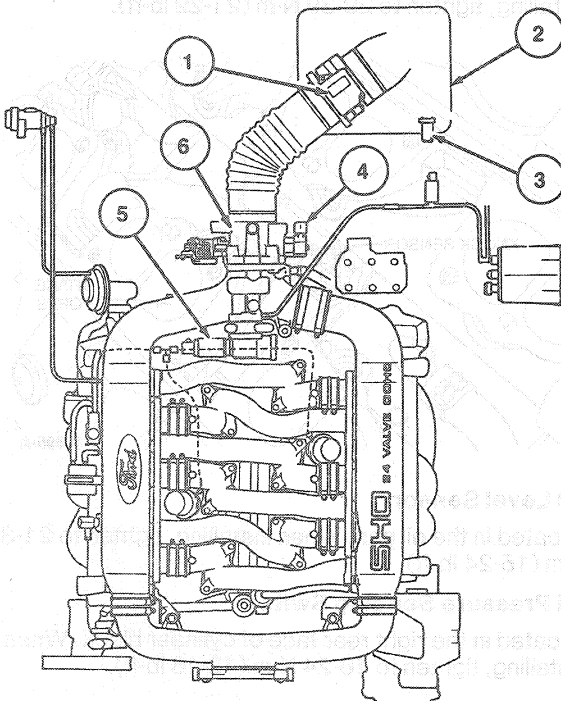
A12897-A

### Crankshaft Position Sensor (CKP) 12A127

Located on the front of the engine block just above the crankshaft. When installing, tighten to 1.5-2.5 N-m (13-22 lb-in).

### Throttle Position (TP) Sensor

Located on the throttle body. When installing, tighten to 2-3 N-m (18-27 lb-in).



A12905-B

Item	Part Number	Description
1	12B579	MAF Sensor
2	9600	Engine Air Cleaner
3	12A697	Intake Air Temperature (IAT) Sensor
4	9B989	Throttle Position Sensor
5	9F715	Idle Air Control Valve
6	9E926	Throttle Body

### Exhaust Manifold, LH

#### Removal

1. Remove oil level indicator tube support bracket.
2. Remove power steering pump pressure and return hoses.
3. Remove manifold to exhaust pipe retaining nuts.
4. Remove heat shield retaining bolts.
5. Remove exhaust manifold retaining nuts and exhaust manifold.

#### Installation

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

1. Clean mating surfaces on the exhaust manifold, cylinder head and exhaust pipe.
2. Position exhaust manifold on the cylinder head and install manifold retaining nuts. Tighten to 35-52 N-m (26-38 lb-ft).
3. Install heat shield retaining bolts. Tighten to 15-23 N-m (11-17 lb-ft).
4. Connect exhaust pipe to the exhaust manifold. Tighten the retaining nuts to 21-32 N-m (15-24 lb-ft).
5. Connect power steering pump pressure and return hoses.
6. Install oil level indicator tube support bracket.

### Exhaust Manifold, RH

#### Removal

1. Remove RH cylinder head as outlined.
2. Remove heat shield retaining bolts.
3. Remove exhaust manifold retaining nuts and exhaust manifold.

#### Installation

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

1. Clean mating surfaces on the exhaust manifold and install manifold retaining nuts. Tighten to 35-52 N-m (26-38 lb-ft).

## REMOVAL AND INSTALLATION (Continued)

2. Position exhaust manifold on the cylinder head and install manifold retaining nuts. Tighten to 35-52 N·m (26-38 lb-ft).
3. Install heat shield retaining bolts. Tighten to 15-23 N·m (11-17 lb-ft).
4. Install RH cylinder head as outlined.
5. Start engine and check for exhaust and coolant leaks.

### 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 Specifications.

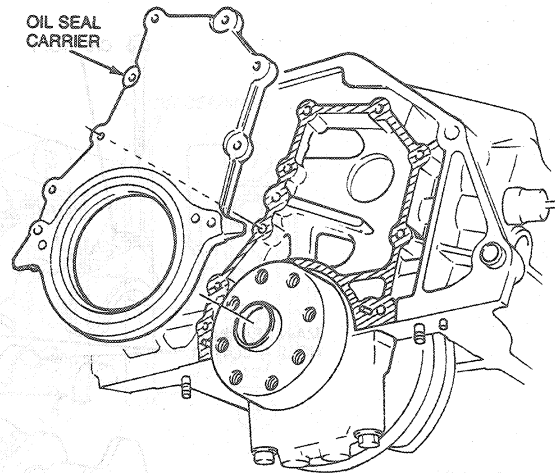
#### Tools Required:

- Flywheel Holding Tool T74P-6375-A
- Locknut Pin Remover T78P-3504-N
- Rear Crankshaft Seal Replacer T81P-6701-A
- Clutch Aligner T81P-7550-A
- Rear Crankshaft Seal Replacer T88C-6701-BH
- Rear Seal Replacer Screw Set T89P-6701-C
- Rotunda Dial Indicator with Bracketry 014-00282

#### Removal

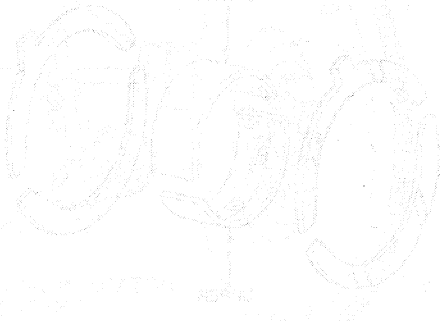
1. Disconnect battery ground cable.
2. Raise vehicle on hoist. Refer to Section 00-02.
3. Remove subframe. Refer to Section 02-01.
4. Remove transaxle. Refer to Section 07-03.
5. Remove clutch cover, disc and flywheel.

6. Remove oil pan as outlined.
7. Remove oil baffle plate and oil pick-up tube.
8. Remove oil seal carrier.



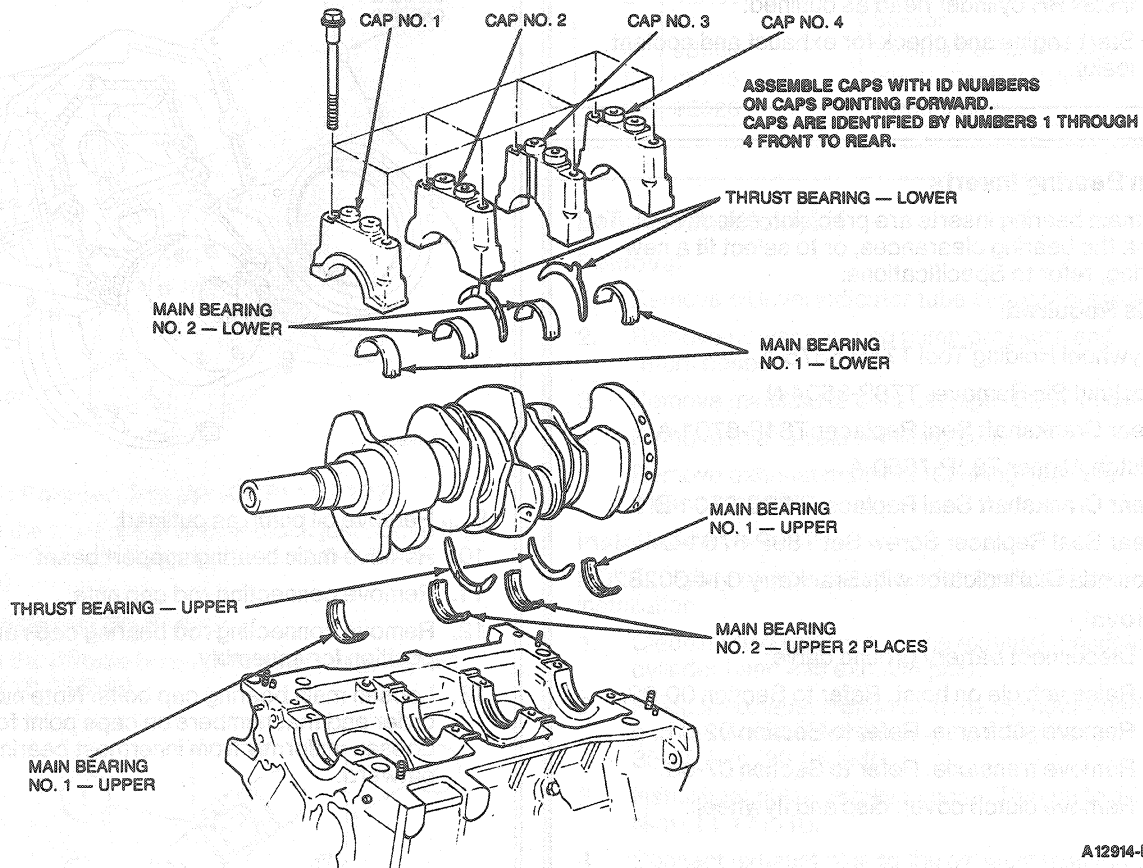
A12913-A

9. Remove oil pump as outlined.
10. Remove main bearing support beam.
11. Remove connecting rod cap nuts.
12. Remove connecting rod bearing caps and note position for assembly.
13. Loosen main bearing cap bolts. Note numerical order and that numbers on caps point forward. Loosen uniformly from innermost bearing outward.



## REMOVAL AND INSTALLATION (Continued)

14. Remove all but one bearing cap. With an assistant, support crankshaft and remove remaining bearing cap. Lower crankshaft from engine.

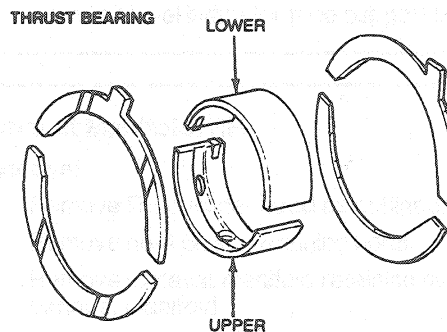


## Installation

1. Inspect bearing journals and bearing faces for any damage prior to assembly.
2. Press bearing upper halves into block. Ensure they seat completely.
3. Lubricate bearing surfaces with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent. Install bearings into lower main caps.
4. With an assistant, position crankshaft in block and loosely install No. 1 and 4 bearings in caps. Note numbers point forward.

**CAUTION: Oil groove on thrust bearing must face crankshaft.**

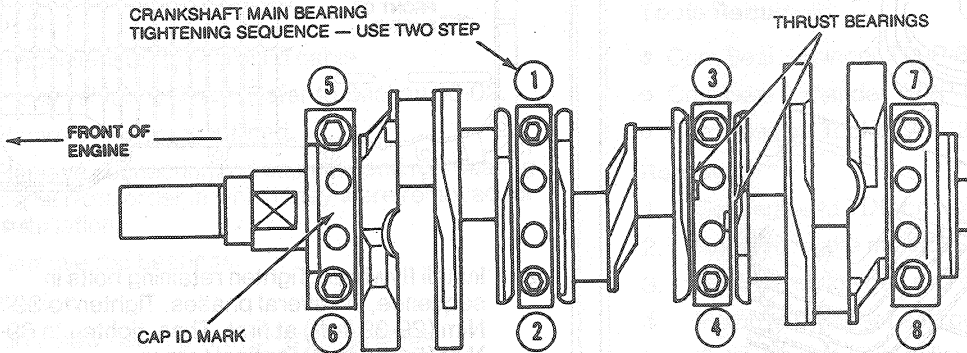
5. Install upper thrust bearings on the front and rear of the No. 3 journal by moving crankshaft back and forth.



6. Install lower thrust bearings with No. 3 main cap.
7. Install No. 2 main cap.

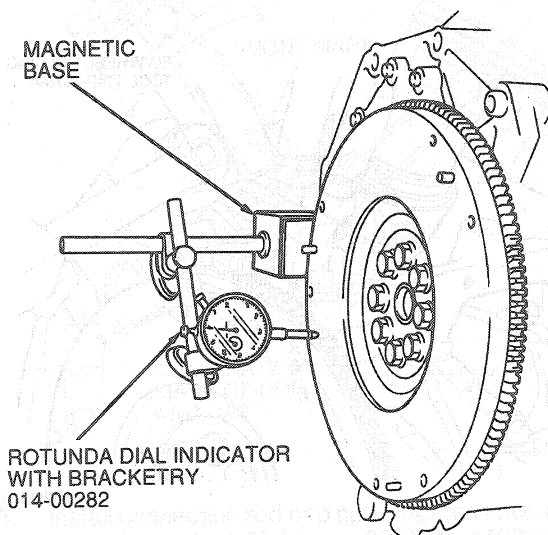
## REMOVAL AND INSTALLATION (Continued)

8. Apply a coat of Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent to bearing cap bolts and tighten in sequence shown. Use two-step method. Tighten to 46-69 N·m (34-51 lb-ft), then, tighten to 78-88 N·m (58-65 lb-ft).



A12920-A

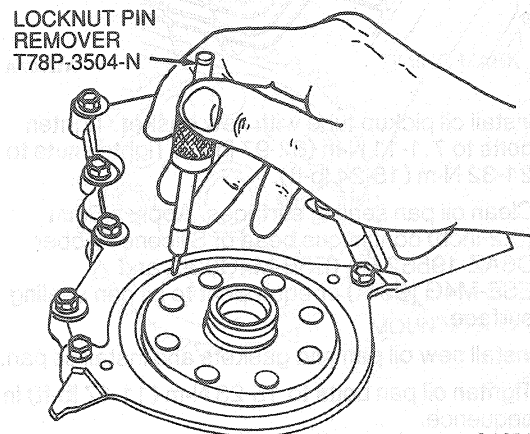
9. Ensure that the crank turns freely. Use caution so as not to contact or jam connecting rods against engine block.
10. With Rotunda Dial Indicator with Bracketry 014-00282 or equivalent, check crankshaft end play: 0.021-0.221 mm (0.0008-0.0087 inch). If out of specification, determine if caused by excessive wear on crankshaft, block or both and replace as necessary.



MEASURING CRANKSHAFT ENDPLAY A12916-D

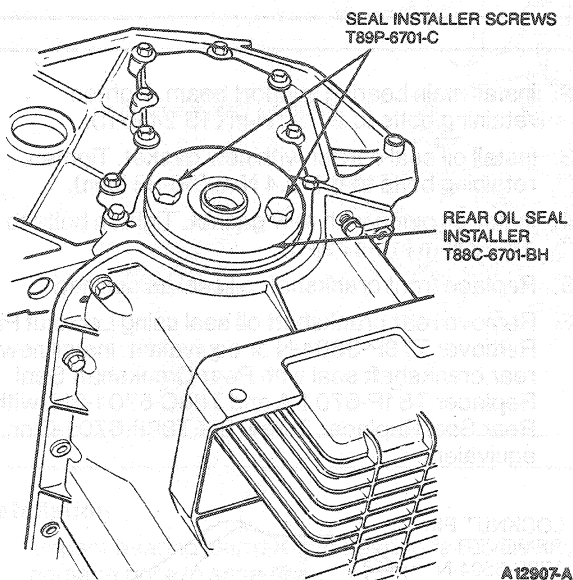
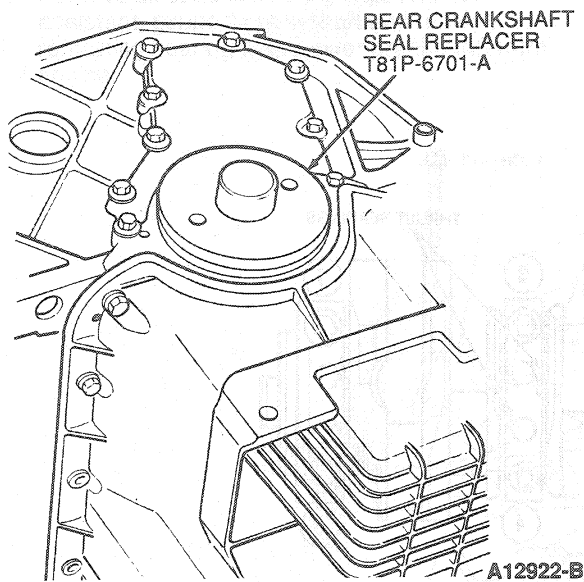
11. Install connecting rods and caps to crankshaft. Tighten retaining bolts using two step method. Tighten to 30-35 N·m (22-26 lb-ft), then to 45-50 N·m (33-37 lb-ft).

12. Install main bearing support beam. Tighten retaining bolts to 21-32 N·m (15-24 lb-ft).
13. Install oil seal carrier with new gasket. Tighten retaining bolts to 6.3-9.4 N·m (56-83 lb-in).
14. Install oil pump with new gasket. Tighten bolts to 15-23 N·m (11-17 lb-ft).
15. Replace front crankshaft oil seal as outlined.
16. Remove rear crankshaft oil seal using Locknut Pin Remover T78P-3504-N or equivalent. Install new rear crankshaft seal with Rear Crankshaft Seal Replacer T81P-6701-A and T88C-6701-BH, with Rear Seal Replacer Screw Set T89P-6701-C or equivalent.

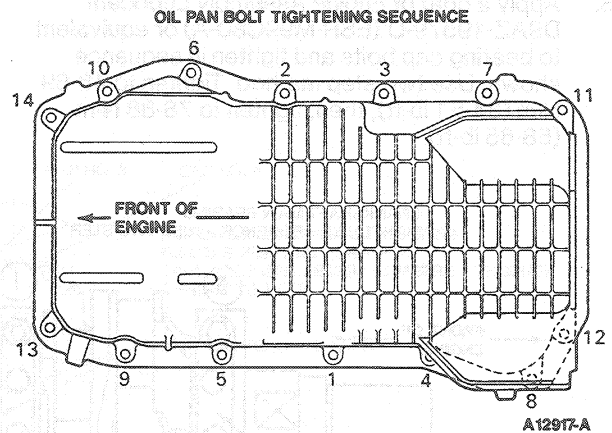


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## REMOVAL AND INSTALLATION (Continued)

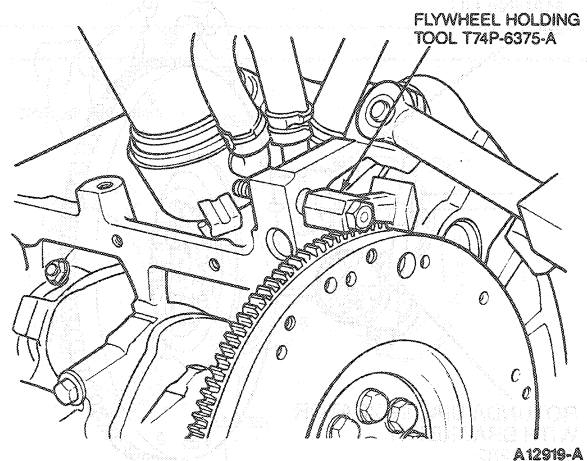
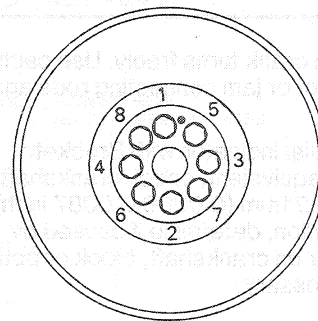


17. Install oil pickup tube with new gasket. Tighten bolts to 7.1-11 N·m (62-97 lb-in). Tighten nuts to 21-32 N·m (15-24 lb-ft).
18. Clean oil pan sealing surfaces. Apply a 5mm (0.2-inch) continuous bead of Silicone Rubber D6AZ-19562-BA (ESB-M4G92-A and ESE-M4G 195-A) or equivalent to oil pan sealing surface.
19. Install new oil pan end gaskets and install oil pan.
20. Tighten oil pan bolts to 15-23 N·m (11-17 lb-ft) in sequence.



21. Install flywheel. Tighten retaining bolts in sequence, in several phases. Tighten to 39-50 N·m (29-39 lb-ft) at first. Then, tighten to 69-78 N·m (51-58 lb-ft) for final torque.

Use Flywheel Holding Tool T74P-6375-A or equivalent to hold flywheel.



22. Align clutch disc with Clutch Aligner T81P-7550-A or equivalent and install pressure plate and cover assembly. Tighten retaining bolts to 16-33 N·m (12-24 lb-ft).
23. Install transaxle. Refer to Section 07-03.
24. Install subframe. Refer to Section 02-01.



## REMOVAL AND INSTALLATION (Continued)

25. Lower vehicle.
26. Fill engine with correct viscosity and amount of engine oil. Connect battery ground cable.

5. Lower vehicle.
6. Fill engine with correct viscosity and amount of engine oil. Connect battery ground cable.

### Connecting Rod Bearings

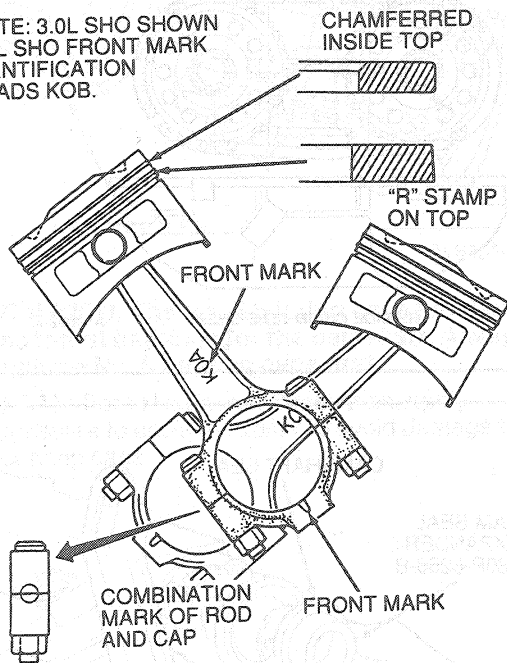
#### Removal

1. Disconnect battery ground cable.
2. Raise vehicle on hoist. Refer to Section 00-02.
3. Remove oil pan as outlined.
4. Remove connecting rod cap nuts and rod bearing caps. Note order in which they were removed for installation.
5. Remove rod bearings.

#### Installation

1. Coat new bearing with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent, and install shell halves in connecting rod and bearing caps.
2. Install bearing caps to connecting rod. Ensure combination marks are correct. Install caps in order they were removed.

NOTE: 3.0L SHO SHOWN  
3.2L SHO FRONT MARK  
IDENTIFICATION  
READS KOB.



3. Install connecting rod cap nuts. Tighten nuts using two step method. Tighten to 30-35 N·m (22-26 lb-ft), then to 45-50 N·m (33-37 lb-ft).
4. Install oil pan as outlined.

### Camshaft

#### Tools Required:

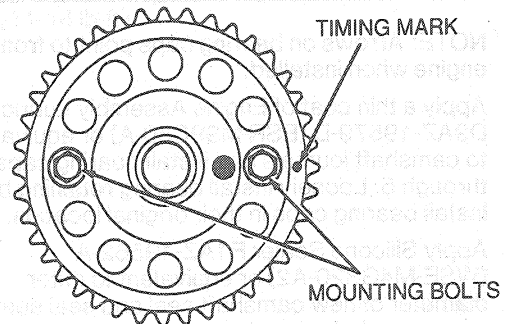
- Cam Seal Replacer T89P-6256-A
- Cam Seal Expander T89P-6256-B
- Cam Position Tool T89P-6256-C

#### Removal

1. Set engine to TDC on No. 1 cylinder.
  2. Remove intake manifold assembly as outlined.
  3. Remove timing belt and cover as outlined.
  4. Remove cylinder head cover(s).
  5. Remove camshaft pulley(s). Note location of dowel pin(s).
  6. Remove upper rear timing belt cover.
- CAUTION: If camshaft bearing caps are not uniformly loosened, camshaft damage may result.**
7. Uniformly loosen camshaft bearing caps.
  8. Remove bearing caps. Note position for installation.
  9. Remove camshaft chain tensioner mounting bolts.
  10. Remove camshafts together with chain and tensioner.
  11. Discard camshaft oil seal.
  12. Remove chain sprocket from camshaft.

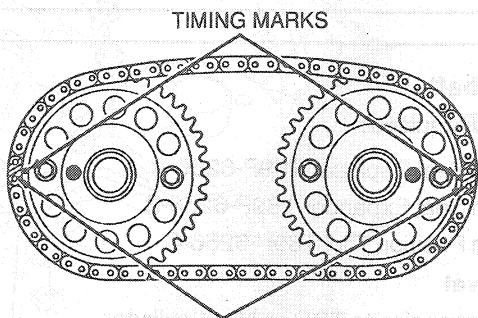
#### Installation

1. Align timing marks on chain sprocket(s) with camshaft and install sprocket(s). Tighten retaining bolts to 14-18 N·m (10-13 lb-ft).

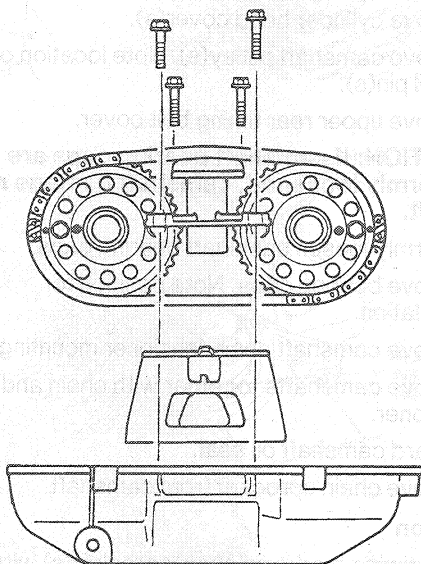


## REMOVAL AND INSTALLATION (Continued)

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

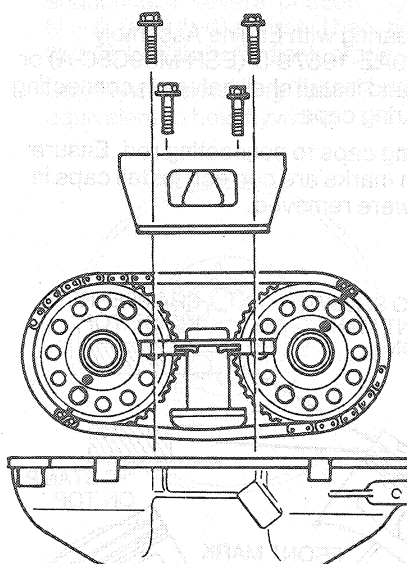


WHITE PAINTED CHAIN LINKS **A12890-B**



LH SIDE CHAIN TENSIONER

- CAUTION: LH and RH chain tensioners are not interchangeable.**
3. Rotate camshafts approximately 60 degrees counterclockwise. Set chain tensioner between sprockets and position camshafts on cylinder head.



RH SIDE CHAIN TENSIONER

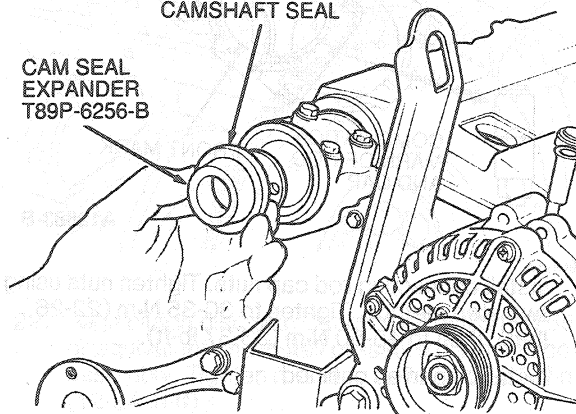
**A12892-A**

**NOTE:** Arrows on bearing caps point to front of engine when installed.

4. Apply a thin coat of Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent to camshaft journals and install bearing caps 2 through 5. Loosely install bearing retaining bolts. Install bearing caps in their original location.
5. Apply Silicone Sealer F1AZ-19562-A (WSE-M4G320-A2) or equivalent to outer diameter of new camshaft seal and seal seating area on cylinder head.
6. Install camshaft seal with Cam Seal Expander T89P-6256-B and Cam Seal Replacer T89P-6256-A.

## CAMSHAFT SEAL

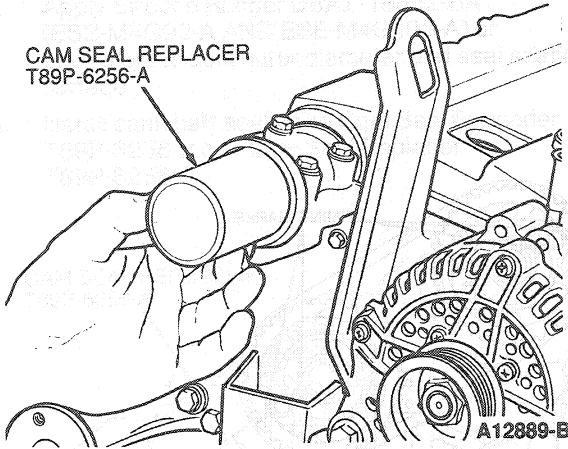
CAM SEAL  
EXPANDER  
T89P-6256-B



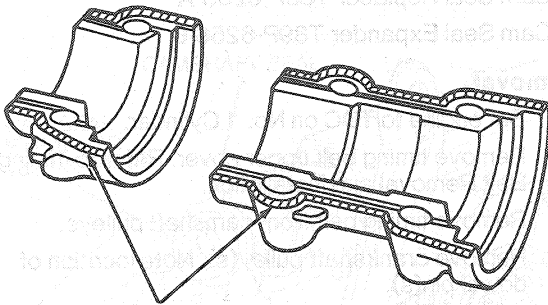
**A12888-B**

REMOVAL AND INSTALLATION (Continued)

CAM SEAL REPLACER  
T89P-6256-A



- Apply a 2.5mm (0.10 inch) bead of Silicone Sealer F1AZ-19568-A (WSE-M4G320-A2) or equivalent to No. 1 bearing cap and install bearing cap while holding cam seal in place with Cam Seal Replacer T89P-6256-A. Loosely install bolts.



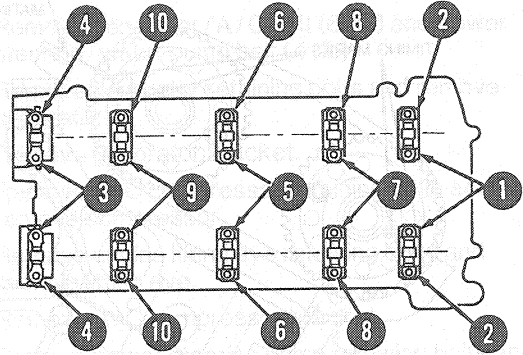
APPLY SEALER

A16151-A

**CAUTION:** The No. 5 bearing caps function as thrust bearings for the camshaft. Always tighten No. 5 bearing caps first.

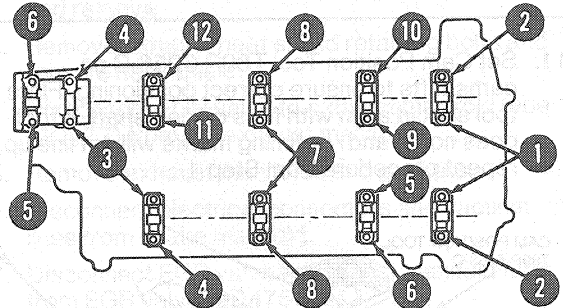
**NOTE:** For LH camshaft installation, apply pressure to chain tensioner to avoid damage to bearing caps.

- Tighten bearing caps in sequence using two step method. Tighten to 8-12 N·m (71-106 lb-in) then tighten to 16-22 N·m (12-16 lb-ft).



CAMSHAFT BEARING TIGHTENING  
SEQUENCE RH CYLINDER HEAD

FRONT OF  
ENGINE



CAMSHAFT BEARING TIGHTENING  
SEQUENCE LH CYLINDER HEAD

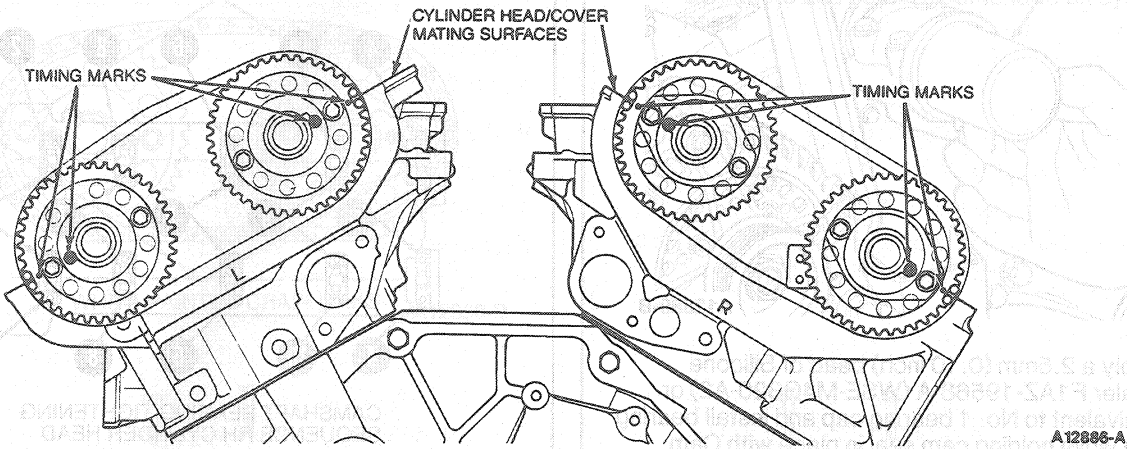
A12887-B

**CAUTION:** LH and RH chain tensioners are different. Be sure to install chain tensioners on the proper side.

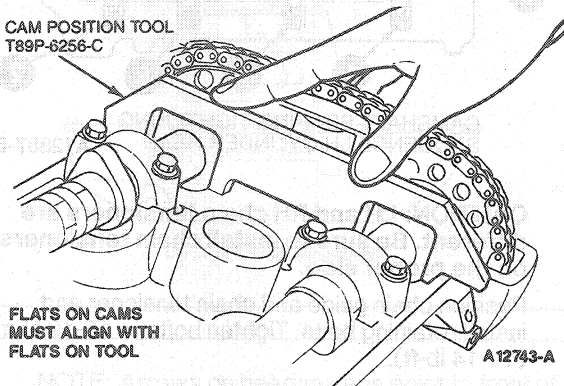
- Position chain guide and chain tensioner and install retaining bolts. Tighten bolts to 15-19 N·m (11-14 lb-ft).

## REMOVAL AND INSTALLATION (Continued)

10. Rotate camshafts 60 degrees clockwise and check for proper alignment of timing marks. Marks on camshaft sprockets should align with cylinder head cover mating surface as shown.



11. Set Cam Position Tool T89P-6256-C on camshafts to ensure correct positioning. Flats on tool should align with flats on camshaft. If tool does not fit and/or timing marks will not line up, repeat procedure from Step 1.



12. Install timing belt rear cover. Tighten bolts to 8.8 N·m (78 lb-in).
13. Install camshaft pulley(s). Tighten bolts to 21-25 N·m (15-18 lb-ft). Ensure proper installation of dowel pin(s).
14. Install timing belt and cover as outlined.
15. Install cylinder head cover(s). Tighten bolts to 9.8-16 N·m (7-12 lb-ft).
16. Install intake manifold assembly as outlined.

**Camshaft Seal(s)****Tools Required:**

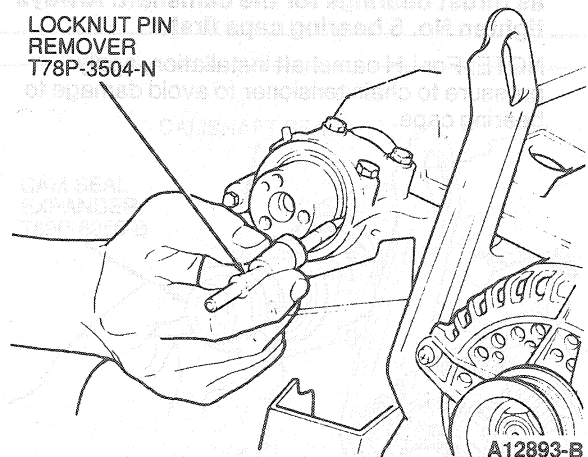
- Locknut Pin Remover T78P-3504-N

- Cam Seal Replacer T89P-6256-A
- Cam Seal Expander T89P-6256-B

**Removal**

1. Set engine to TDC on No. 1 Cylinder.
2. Remove timing belt upper cover. Refer to Timing Belt Removal and Installation.
3. Remove timing belt from camshaft pulleys.
4. Remove crankshaft pulley(s). Note location of dowel pin(s).
5. Remove camshaft seal with Locknut Pin Remover T78P-3504-N.

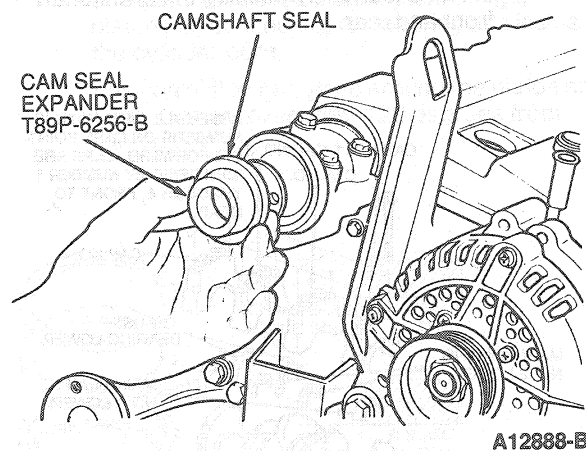
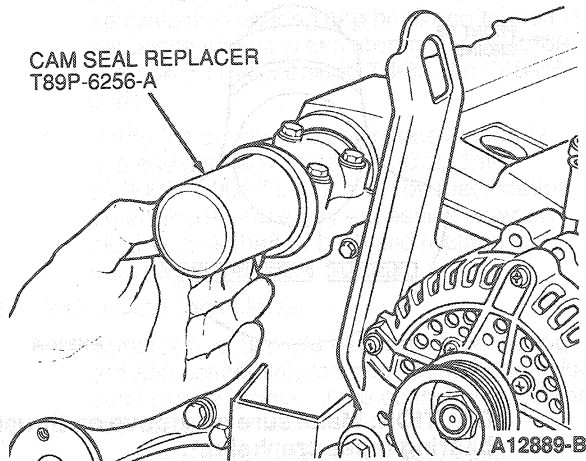
**LOCKNUT PIN  
REMOVER  
T78P-3504-N**

**Installation**

1. Clean and inspect seal surface area.

## REMOVAL AND INSTALLATION (Continued)

2. Apply Silicone Rubber D6AZ-19562-BA (ESB-M4G92-A AND ESE-M4G195-A) or equivalent to seal outer diameter and seal seating surface.
3. Install camshaft seal using Cam Seal Expander T89P-6256-B and Cam Seal Replacer T89P-6256-A.



4. Install camshaft pulley(s). Tighten retaining bolts to 21-25 N·m (15-18 lb-ft). Ensure proper installation of dowel pin(s).
5. Install timing belt and belt cover. Refer to timing belt Removal and Installation as outlined in this section.

## DISASSEMBLY AND ASSEMBLY

## Engine

NOTE: Reference to the EGR system is for 3.2L SHO engines only.

## Tools Required:

- Puller T67L-3600-A
- Rotunda Piston Ring Compressor 014-00290

## Disassembly

1. Remove flywheel and rear cover plate.
2. Loosen idler pulley nuts.
3. Turn belt adjusting screws counterclockwise to loosen belts.
4. Remove generator / A / C belt (6 rib) and power steering / water pump belt (4 rib).
5. Remove generator retaining bolts and remove generator.
6. Remove generator bracket.
7. Remove A / C compressor retaining bolts and remove compressor.
8. Remove engine lifting eye retaining bolts and remove lifting eye.
9. Remove A / C compressor bracket.
10. Remove power steering pump retaining bolts and remove power steering pump.
11. Remove power steering pump bracket.
12. Remove retaining bolts from idler pulley brackets and remove.
13. Remove exhaust heat shield retaining bolts and remove heat shield.
14. Disconnect EGR valve to exhaust manifold tube (9D477) from RH exhaust manifold.
15. Remove exhaust manifolds and gaskets.
16. Disconnect electrical connectors and vacuum lines from intake manifold.
17. Disconnect EGR valve to exhaust manifold tube from EGR valve (9D475).
18. Remove intake manifold bracket bolts and remove brackets.
19. Remove 12 bolts retaining intake manifold to cylinder head.
20. Remove intake manifold assembly.
21. Remove upper timing belt cover retaining bolts and remove upper timing belt cover.
22. Remove spark plug connectors and ignition lead.
23. Remove spark plugs.
24. Remove crankshaft damper pulley using Puller T67L-3600-A.
25. Remove lower timing belt cover retaining bolts and remove lower timing belt cover.
26. Remove center timing belt cover retaining bolts and remove center timing belt cover.
27. Loosen timing belt tensioner nut. Using an Allen wrench, rotate tensioner so that tension is released from timing belt, and tighten nut.
28. Remove timing belt.
29. Remove camshaft timing belt pulleys.
30. Remove upper rear timing belt cover retaining bolts and remove cover.
31. Remove center rear timing belt cover retaining bolts and remove cover.

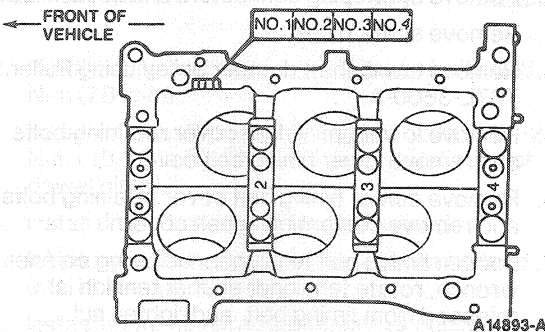
**DISASSEMBLY AND ASSEMBLY (Continued)**

32. Remove fuel rail retaining bolts and remove fuel rail.
33. Disconnect wiring harness to fuel injectors.
34. Remove six injector insulators from cylinder heads.
35. Remove ignition coil pack retaining screws and remove coil pack.
36. Remove ignition coil pack bracket.
37. Remove water pump retaining bolts and remove water pump.
38. Remove water bypass pipe.
39. Remove water outlet assembly.
40. Remove cylinder head covers and gaskets.
41. Remove oil indicator tube.
42. Disconnect cooler hose from LH head.
43. Remove cylinder head retaining bolts and remove cylinder heads.
44. Disconnect engine oil level sensor.
45. Remove engine oil pan.
46. Remove oil screen assembly.
47. Remove main bearing support beam.
48. Remove oil pump retaining bolts and remove oil pump.
49. Remove oil baffle.
50. Remove connecting rod caps and pistons.
51. Remove crankshaft bearing caps and remove crankshaft.

**Assembly**

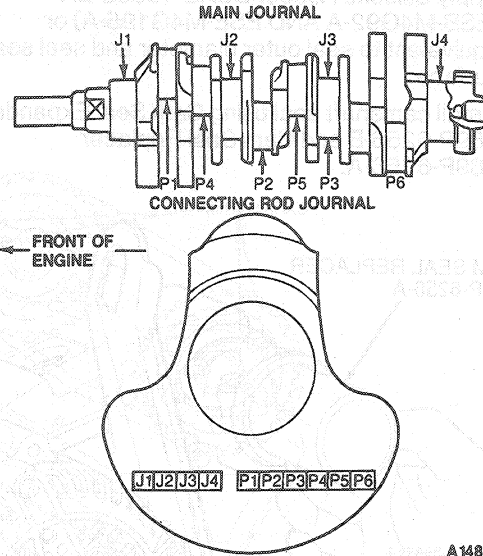
**NOTE:** Check for defects and scratches on main bearing inner face before assembly. Thoroughly clean bearing housings and back face of main bearings. Check all component specifications before installation.

1. Install crankshaft as follows:
  - a. Install upper main bearings on cylinder block.



A14893-A

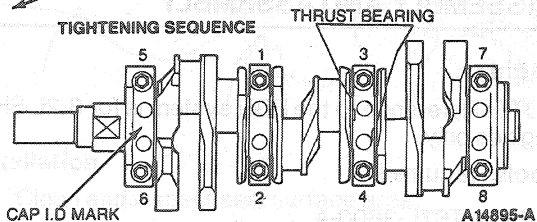
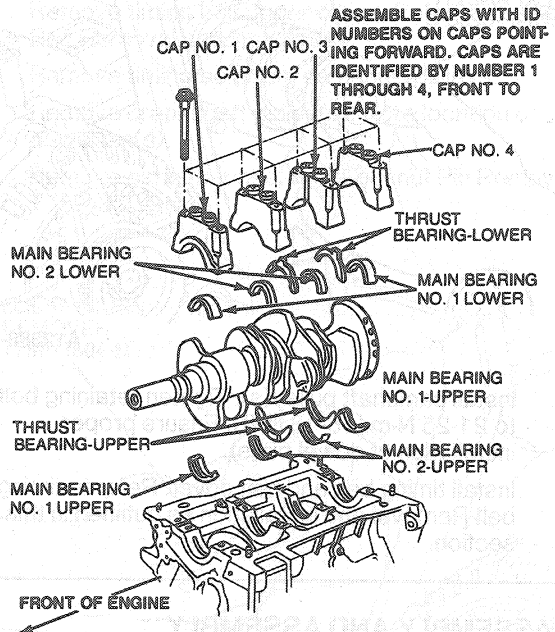
- b. Apply a coat of Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent onto bearings.
- c. Carefully lay crankshaft on bearings.



A14894-A

**CAUTION:** Make sure oil groove on thrust bearing faces crankshaft.

- d. Install upper thrust bearings on front and rear of No. 3 journal by pushing the crankshaft front and rear.

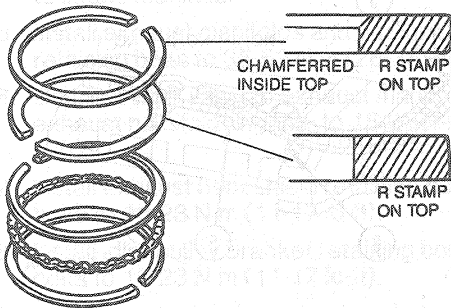


A14895-A

## DISASSEMBLY AND ASSEMBLY (Continued)

NOTE: Install bearing cap 3 with lower thrust bearings and check position front and rear.

- e. Lubricate journals of crankshaft with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent and install bearing caps 1 through 4.
  - f. Apply a coat of Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent to bearing cap bolts and tighten in sequence shown in two steps, first to 46-69 N·m (34-51 lb-ft), then to 78-88 N·m (58-65 lb-ft).
  - g. Verify the crankshaft can rotate smoothly and end play is within 0.021-0.221mm (0.0008-0.0087 inch). If out of specification, determine if caused by excessive wear on block, crankshaft or both and replace as necessary.
2. Install piston as follows:
- a. Install connecting rod bearing to connecting rod and connecting rod cap so the bearing lug can fit in the groove of the connecting rod and rod cap.
  - b. Apply a light coat of Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent on the piston, piston rings, piston pin, connecting rod bearing and inside the cylinder bore.
  - c. Position piston ring gaps around the piston so gaps are approximately 120 degrees from each other.

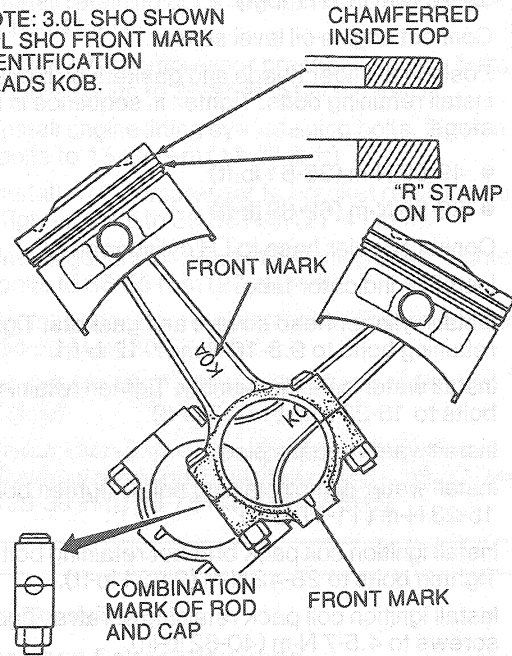


A14888-A

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

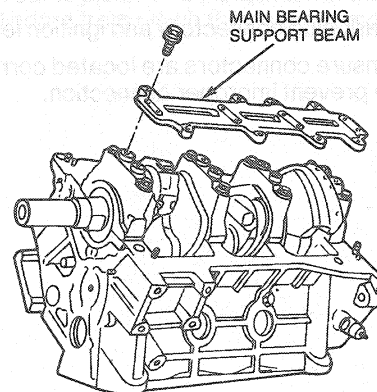
- d. Install pistons using Rotunda Piston Ring Compressor 014-00290 or equivalent. Ensure the marks on the piston and connecting rod face towards the front of the engine.

NOTE: 3.0L SHO SHOWN  
3.2L SHO FRONT MARK  
IDENTIFICATION  
READS KOB.



A12883-B

- e. Lubricate connecting rod bolts and nuts flange with Premium Long-Life Grease XG-1-C (ESA-M1C75-B) or equivalent. Install connecting rod caps and retaining nuts. Tighten nuts in two steps, 30-35 N·m (22-26 lb-ft), 45-50 N·m (33-37 lb-ft).
3. Install oil baffle retaining bolts. Tighten bolts to 15-23 N·m (11-17 lb-ft).
  4. Position oil pump and install retaining bolts. Tighten bolts to 15-23 N·m (11-17 lb-ft).
  5. Install main bearing support beam retaining bolts. Tighten to 21-32 N·m (15-24 lb-ft).



A14887-A

6. Install oil screen retaining bolts. Tighten bolts to 7-11 N·m (62-97 lb-in).

**DISASSEMBLY AND ASSEMBLY (Continued)**

7. Install engine oil pan retaining bolts. Tighten to 15-23 N·m (11-17 lb-ft).
8. Connect engine oil level sensor.
9. Position cylinder heads and gaskets on block and install retaining bolts. Tighten in sequence in two steps:
  - 49-69 N·m (36-51 lb-ft)
  - 83-93 N·m (62-69 lb-ft)
10. Connect cooler hose to LH cylinder head.
11. Install oil indicator tube.
12. Install cylinder head covers and gaskets. Tighten retaining bolts to 9.8-16 N·m (7-12 lb-ft).
13. Install water outlet assembly. Tighten retaining bolts to 15-23 N·m (11-17 lb-ft).
14. Install water bypass pipe.
15. Install water pump retaining bolts. Tighten bolts to 15-23 N·m (11-17 lb-ft).
16. Install ignition coil pack bracket retaining bolts. Tighten bolts to 28-42 N·m (21-31 lb-ft).
17. Install ignition coil pack retaining screws. Tighten screws to 4.5-7 N·m (40-62 lb-in).
18. Install six injector insulators in cylinder heads.
19. Install fuel rail assembly retaining bolts. Tighten bolts to 15-23 N·m (11-17 lb-ft).
20. Connect wiring harness at fuel injectors.
21. Install center rear timing belt cover.
22. Install upper rear timing belt cover.
23. Install camshaft timing belt pulley retaining bolts. Tighten bolts to 21-25 N·m (15-18 lb-ft).
24. Install timing belt as outlined.
25. Install center timing belt cover.
26. Install lower timing belt cover.
27. Install crankshaft damper pulley.
28. Install spark plugs. Tighten to 22-27 N·m (16-20 lb-ft).
29. Install spark plug connectors and ignition lead.

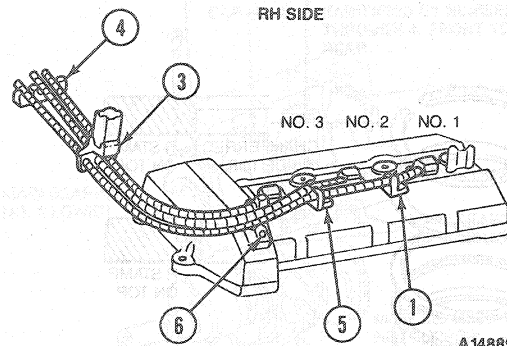
**NOTE:** Ensure connectors are located correctly in clips to prevent improper connection.

**DISASSEMBLY AND ASSEMBLY (Continued)**

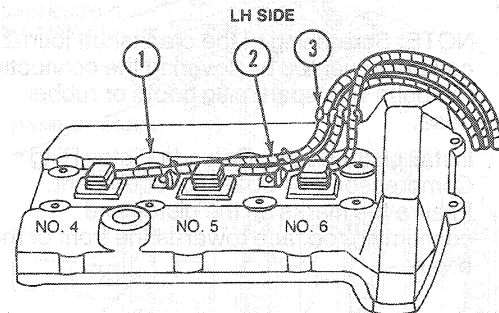
	SHAPE	PART NUMBER/ PART NAME	LOCATION OF INSTALLATION
①		CLAMP, WIRE 1	CYLINDER HEAD COVER
②		CLAMP, WIRE 2	CYLINDER HEAD COVER LH
③		CLAMP, WIRE 3	CYLINDER HEAD COVER RH SURGE TANK RH
④		CLAMP, WIRE 4	
⑤		CLAMP, WIRE 5	CYLINDER HEAD COVER RH
⑥		CLAMP, WIRE 6	CYLINDER HEAD COVER RH

A14891-A

- a. Install clamp to cylinder head and wires one through six.
- b. Connect plug wires onto spark plug.



A14889-A

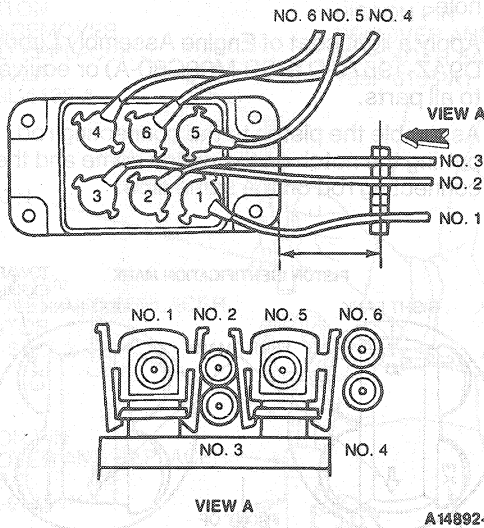


A14890-A



DISASSEMBLY AND ASSEMBLY (Continued)

c. Adjust wire routing.



30. Install upper timing belt cover.
31. Position intake manifold and new gaskets on cylinder heads and install retaining bolts. Tighten bolts to 15-23 N·m (11-17 lb-ft).
32. Install intake manifold bracket bolts. Tighten bolts to 15-23 N·m (11-17 lb-ft).
33. Connect EGR valve to exhaust manifold tube to EGR valve. Tighten to 25-34 N·m (18-25 lb-ft).
34. Connect electrical connectors and vacuum lines to intake manifold.
35. Install exhaust manifolds and gaskets. Tighten retaining bolts to 35-52 N·m (26-38 lb-ft).
36. Connect EGR valve to exhaust manifold tube to exhaust manifold. Tighten to 15-23 N·m (11-17 lb-ft).
37. Install exhaust heat shield retaining bolts. Tighten bolts to 15-23 N·m (11-17 lb-ft).
38. Install idler pulley bracket retaining bolts. Tighten bolts to 15-23 N·m (11-17 lb-ft).
39. Install power steering pump bracket retaining bolts. Tighten bolts to 36-55 N·m (27-41 lb-ft).

Cylinder Head

Tools Required:

- Inport Side Hammer T53L-100-B
- Pry Bar and Drive T27C-6586-A
- Valve Guide Remover/Replacer T89P-6510-A
- Valve Guide Replacer T89P-6510-B
- Valve Stem Seal Replacer T89P-6510-C

40. Position power steering pump on bracket and install retaining bolts. Tighten bolts to 20-32 N·m (15-24 lb-ft).
41. Install A/C compressor bracket retaining bolts. Tighten bolts to 36-55 N·m (27-41 lb-ft).
42. Install engine lifting eye retaining bolts. Tighten bolts to 15-23 N·m (11-17 lb-ft).
43. Install A/C compressor to bracket retaining bolts. Tighten bolts to 36-55 N·m (27-41 lb-ft).
44. Install generator bracket retaining bolts. Tighten bolts to 36-55 N·m (27-41 lb-ft).
45. Install generator retaining bolts. Tighten bolts to 34-50 N·m (25-37 lb-ft).
46. Install accessory drive belts. Refer to Section 03-05.
47. Install rear cover plate and flywheel. Tighten flywheel retaining bolts in two steps: 39-50 N·m (29-39 lb-ft) 69-78 N·m (51-58 lb-ft).

Subassemblies

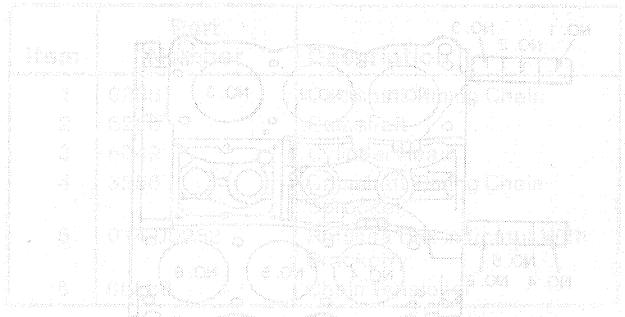
Pistons and Connecting Rods

Tools Required:

- Piston Pin Remover/Replacer Base T68P-6135-A 1
- Piston Pin Remover/Replacer Sleeve T71P-6135-P1
- Feeler Gauge D81L-4201-A
- Piston Pin Remover and Replacer Driver and Locator D89L-6135-A

Disassembly

1. Remove bearing inserts from connecting rod and cap.
2. Remove piston rings using a suitable piston ring expander.
3. Mark connecting rod cap to ensure assembly with the same piston and installation in the same cylinders from which they were removed.

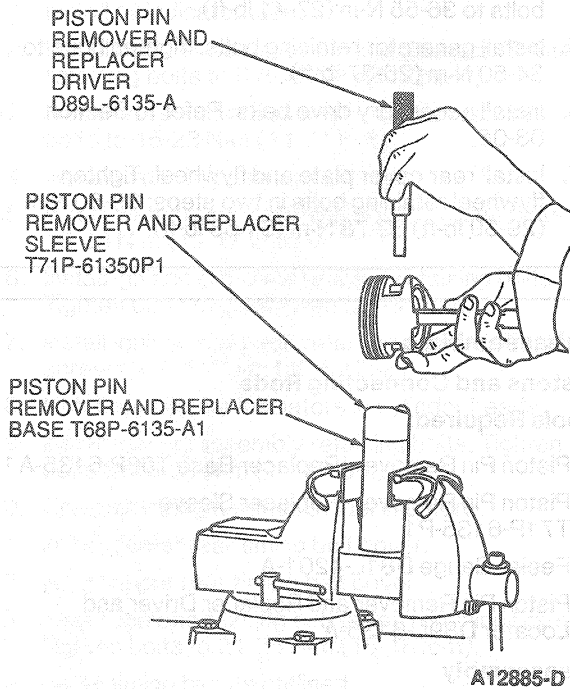


• If the clearance is greater than maximum, replace camshaft and/or cylinder head.

**DISASSEMBLY AND ASSEMBLY (Continued)**

- Using an arbor press Piston Pin Remover / Replacer Base T68P-6135-A1, Piston Pin Remover / Replacer Sleeve T71P-6135-P1 and Piston Pin Remover and Replacer D89L-6135-A or equivalent drive the piston pin from the piston and connecting rod.

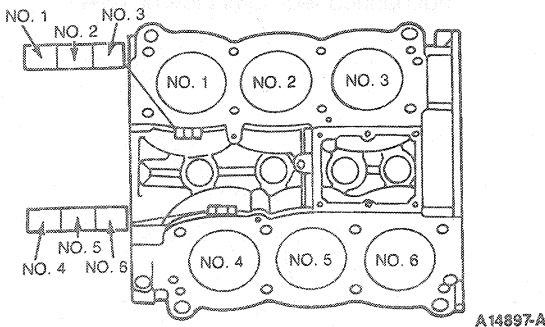
NOTE: Cylinder number is stamped on top of the piston. Matching letters are stamped in the side of corresponding rod and cap.



**Assembly**

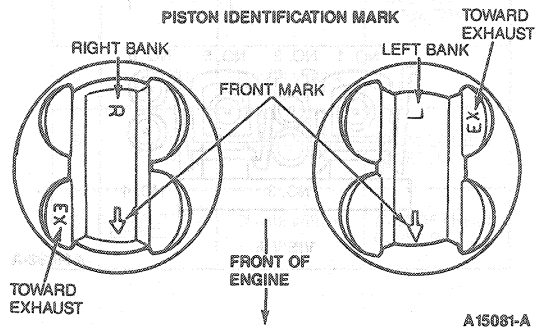
Measure cylinder bore 47mm (1.85 inch) from top face of cylinder block.

Check the new piston diameter which is stamped on the block, and cylinder bore before assembling the piston pin to the connecting rod.



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

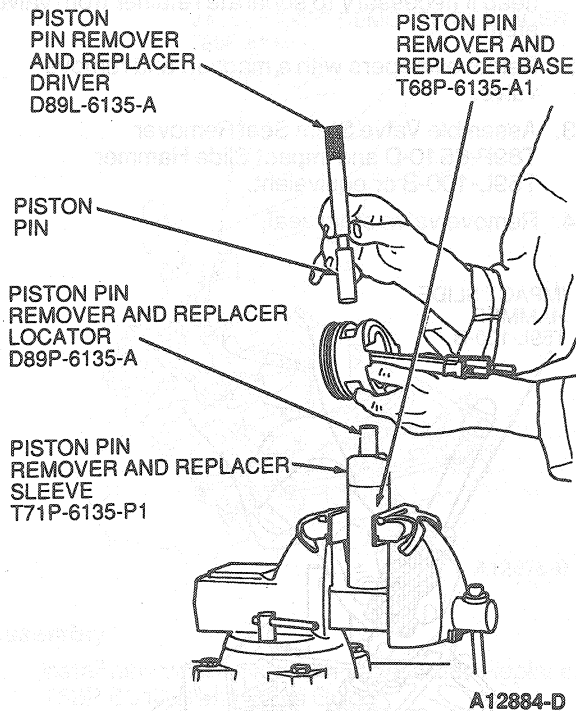
- Install snap ring onto groove on end of piston pin hole.
- Apply a light coat of Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent to all parts.
- Assemble the piston to the connecting rod, putting the notch on the piston dome and the connecting rod on the same side.



- Start the piston pin in the piston and connecting rod. (This may require a very light tap with a mallet). Using a hammer, Piston Pin Remover / Replacer Base T68P-6135-A1, Piston Pin Remover / Replacer Sleeve T71P-6135-P1 and Piston Pin Remover / Replacer Driver and Locator D89L-6135-A or equivalents, heat the piston top 70-80°C (158-176°F) then press the piston pin into the piston through the connecting rod until centered.

## DISASSEMBLY AND ASSEMBLY (Continued)

5. Install the other snap ring in groove of piston pin hole.



6. Install piston rings and check the end gap of all piston rings. Gap must be within specification. Follow the instructions contained on the piston ring package when installing the piston rings.
7. Check the ring side clearance of the compression rings with Feeler Gauge D81L-4201-A or equivalent, by inserting it between the ring and its lower land. The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. If the lower lands have high steps, the pistons should be replaced.
8. Ensure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

**Cylinder Head****Tools Required:**

- Impact Slide Hammer T59L-100-B
- Pivot Bar and Stand T87C-6565-A
- Valve Guide Remover/Replacer T89P-6510-A
- Valve Guide Replacer T89P-6510-B
- Valve Stem Seal Replacer T89P-6510-C

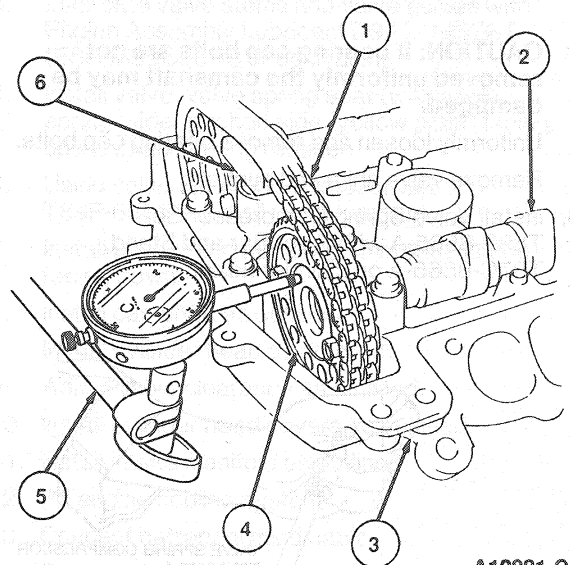
- Valve Stem Seal Remover T89P-6510-D
- Valve Spring Compressor Set T89P-6565-A
- Rotunda Dial Indicator with Bracketry 014-00262

**Disassembly**

1. Disconnect battery ground cable.
2. Drain coolant.
3. Remove intake manifold as outlined.
4. Remove cylinder head covers as outlined.
5. Remove cylinder heads as outlined.
6. Place cylinder head on holding fixture.

**NOTE:** Inspect camshaft end play before disassembly. If out of specification, determine if caused by excessive wear on crankshaft, block or both and replace as necessary. Using Rotunda Dial Indicator with Bracketry 014-00282 or equivalent, measure end play while moving camshaft back and forth.

Maximum play is 0.30mm (0.0118 inch).

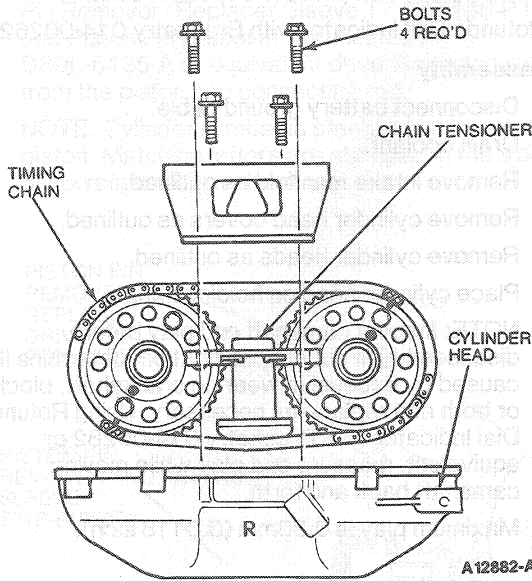


Item	Part Number	Description
1	6268	Camshaft Timing Chain
2	6250	Camshaft
3	6049	Cylinder Head
4	6256	Camshaft Timing Chain Sprocket
5	014-00282	Rotunda Dial Indicator With Bracketry
6	6L266	Chain Tensioner

If end play is greater than maximum, replace camshaft and/or cylinder head.

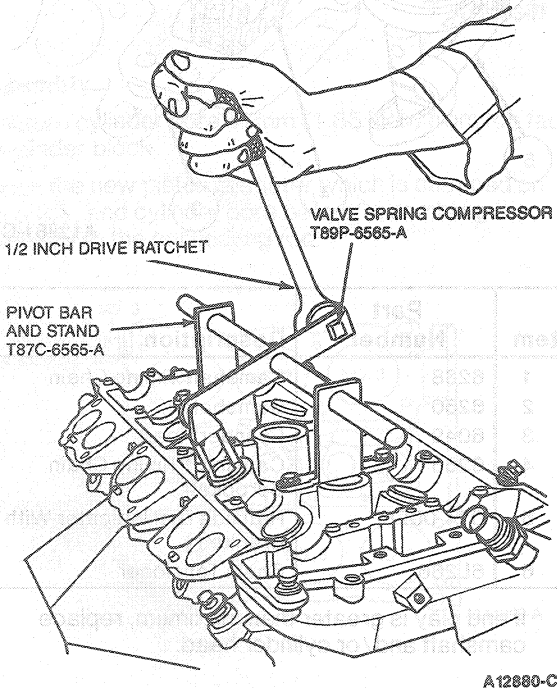
**DISASSEMBLY AND ASSEMBLY (Continued)**

- Remove chain tensioner retaining bolts.

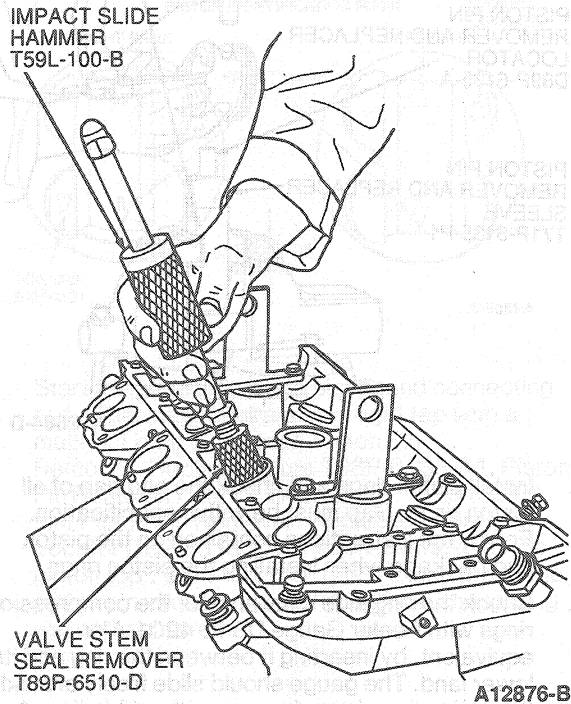


**CAUTION:** If bearing cap bolts are not removed uniformly the camshaft may be damaged.

- Uniformly loosen and remove bearing cap bolts.
- Remove valve shim and bucket.
- Install Valve Spring Compressor Set T89P-6565-A with Pivot Bar and Stand, T87C-6565-A on cylinder head.



- Align spring compressor squarely over valve retainer. Attach a 1/2-inch drive ratchet and apply pressure to valve retainer. Support valve in head if necessary to separate retainer from valve stem.
- Remove keepers with a magnet, and remove valve.
- Assemble Valve Stem Seal Remover T89P-6510-D and Impact Slide Hammer T59L-100-B or equivalent.
- Remove valve stem seal.

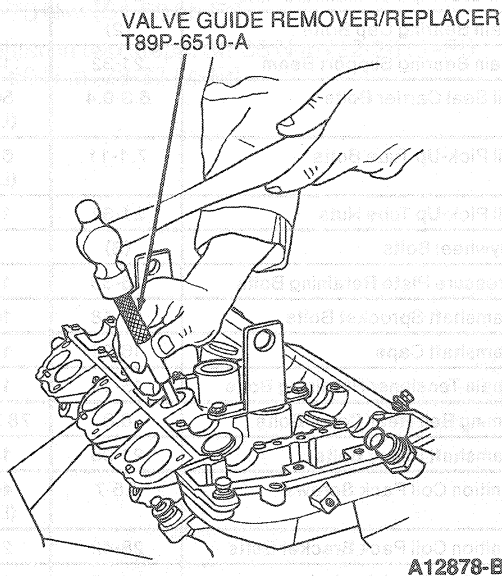


Ensure the bearing insert and the bearing bore in the connecting rod and cap are clear. Foreign material under the insert will distort the bearing and cause a failure. Install the bearing insert in the connecting rod and cap with the tangs fitting in the slots provided.

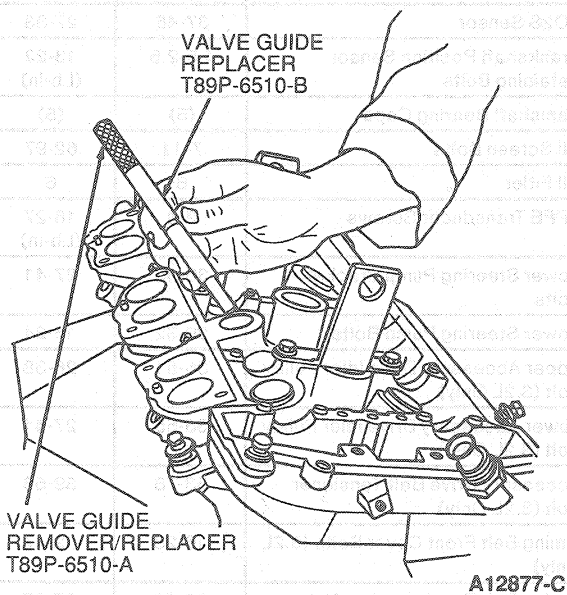
- Cylinder Head
- Tools Required:
- Impact Slide Hammer T59L-100-B
  - Pivot Bar and Stand T87C-6565-A
  - Valve Guide Remover/Replacer T89P-6510-A
  - Valve Guide Replacer T89P-6510-B
  - Valve Stem Seal Replacer T89P-6510-C

## DISASSEMBLY AND ASSEMBLY (Continued)

15. Drive out valve guide with Valve Guide Remover / Replacer T89P-6510-A.

**Assembly**

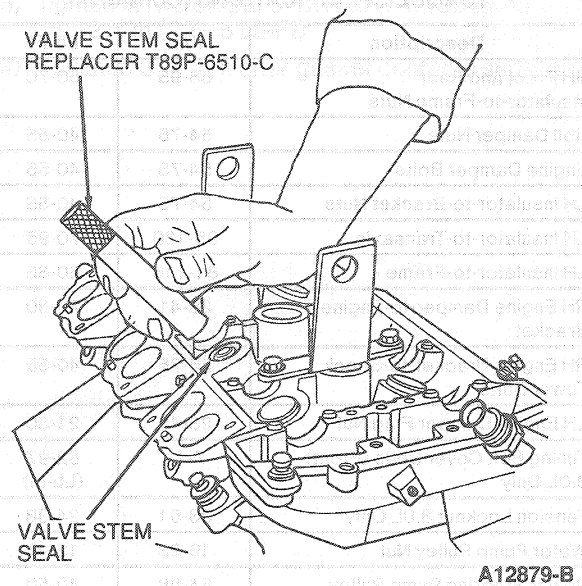
1. Install new valve guide with Valve Guide Replacer T89P-6510-B and Valve Guide Remover / Replacer T89P-6510-A. Drive guide until fully seated.



2. Install new valve stem seal with Valve Stem Seal Replacer T89P-6510-C. Press in by hand until fully seated.

**NOTE:** Intake valve seals are brown. Exhaust valve seals are black.

VALVE STEM SEAL  
REPLACER T89P-6510-C



3. Lubricate valve stems and valve guides with Engine Assembly Lubricant D9AZ-19579-D (ESR-M99C80-A) or equivalent.
4. Install valve, valve spring seat (with valve spring-wider pitched side (yellow paint) facing upward) and spring retainer.
5. Using valve Spring Compressor Set T89P-6565-A install valve keepers.
6. Install bucket and adjusting shim with number facing down.
7. Install camshaft as outlined.
8. Install cylinder head as outlined.
9. Adjust valve clearance as outlined.
10. Install cylinder head covers as outlined.
11. Install intake manifold as outlined.
12. Fill engine cooling system.
13. Connect battery ground cable.
14. Start engine and check for coolant, oil and fuel leaks.

**SPECIFICATIONS****TORQUE SPECIFICATIONS**

Description	N-m	Lb-Ft
Crankshaft Pulley Bolt	152-172	112-127
Transaxle-to-Engine Bolts	34-47	25-35
Catalyst-to-Engine Bolts	27-47	20-35
Oil Drain Plug	20-33	15-24
A/C Compressor and Bracket Bolts	36-55	27-41
Generator Bracket Retaining Bolts	48-72	36-53
Insulator-to-Engine Bracket	54-75	40-55

(Continued)

## SPECIFICATIONS (Continued)

## TORQUE SPECIFICATIONS (Cont'd)

Description	N-m	Lb-Ft
RH Front and Rear Insulator-to-Frame Nuts	68-95	50-70
Roll Damper Nuts	54-75	40-55
Engine Damper Bolts	54-75	40-55
LH Insulator-to-Bracket Nuts	54-75	40-55
LH Insulator-to-Transaxle	95-130	70-95
LH Insulator-to-Frame	81-116	60-85
RH Engine Damper-to-Engine Bracket	28-41	21-30
RH Engine Bracket-to-Shock Tower Bolts	54-75	40-55
LH Engine Damper Flag Nut	28-41	21-30
Timing Belt Cover Bolts (Front) 3.0L Only	7-11	62-97 (Lb-In)
Tension Locknut 3.0L Only	33-51	24-38
Water Pump Pulley Nut	16-23	12-17
Power Steering Pump Pulley	54-68	40-50
Wheel Lug Nuts	115-142	85-105
Throttle Body Bolts and Nuts	16-23	12-17
Idler Pulley Nut	34-50	25-36
Generator A/C Pulley and Bracket Bolts	15-23	11-17
Intake Manifold Crossover Tube Nuts	15-23	11-17
Water Pump Retaining Bolts	16-23	12-17
Cylinder Head Cover Bolts	9.8-16	7-12
Intake Manifold Retaining Bolts	15-23	11-17
Intake Manifold Bracket Bolts	15-23	11-17
Thermostat Housing Retaining Nuts	7-11	62-97 (Lb-In)
Cylinder Head Bolts	(1)	(1)
Upper Oil Battle Bolts	15-23	11-17
Connecting Rod Nuts	(4)	(4)
Oil Pump Retaining Bolts	15-23	11-17
Oil Sump-to-Oil Pump Bolts	7-11	62-97 (Lb-In)
Oil Pan Retaining Bolts	15-23	11-17
EGR Valve Retaining Bolts	15-23	11-17
Engine Coolant Temperature Sensor	16-24	12-17
Knock Sensor	29-39	21-29
Oil Level Sensor	21-33	15-24
Oil Pressure Sending Switch	16-24	12-18
Camshaft Sensor	7-11	62-97 (Lb-In)
Crankshaft Position Sensor	1.5-2.5	13-22 (Lb-In)
Throttle Position Sensor	2-3	18-27 (Lb-In)
Exhaust Manifold-to-Cylinder Head	35-52	26-38
Heat Shield Retaining Bolts	15-23	11-17

(Continued)

## TORQUE SPECIFICATIONS (Cont'd)

Description	N-m	Lb-Ft
Exhaust Pipe-to-Manifold Nuts	21-32	15-24
Main Bearing Cap Bolts	(2)	(2)
Main Bearing Support Beam	21-32	15-24
Oil Seal Carrier Bolts	6.3-9.4	56-83 (Lb-In)
Oil Pick-Up Tube Bolts	7.1-11	62-97 (Lb-In)
Oil Pick-Up Tube Nuts	21-32	15-24
Flywheel Bolts	(3)	(3)
Pressure Plate Retaining Bolts	16-33	12-24
Camshaft Sprocket Bolts	14-18	10-13
Camshaft Caps	16-22	12-16
Chain Tensioner Retaining Bolts	15-19	11-14
Timing Belt Rear Cover Bolts	8.8	78 (Lb-In)
Camshaft Pulley Bolts	21-25	15-18
Ignition Coil Pack Screws	4.5-7	40-62 (Lb-In)
Ignition Coil Pack Bracket Bolts	28-42	21-31
Fuel Rail Retaining Bolts	15-23	11-17
Spark Plugs	22-27	16-20
Engine Lifting Eye Bolts	15-23	11-17
Generator Retaining Bolts (3.0L Only)	34-50	25-37
EGR Tube to EGR Valve	25-34	18-25
EGR Tube to Exhaust Manifold	15-23	11-17
HO2S Sensor	37-45	27-33
Crankshaft Position Sensor Retaining Bolts	1.5-2.5	13-22 (Lb-In)
Camshaft Bearing Caps	(5)	(5)
Oil Screen Bolts	7-11	62-97
Oil Filler	6	6
DPFE Transducer Screws	2-3	18-27 (Lb-In)
Power Steering Pump Bracket Bolts	36-55	27-41
Power Steering Pump Bolts	20-32	15-24
Upper Accessory Drive Idler Pulley Bolt (3.2L Only)	35-51	26-38
Lower Accessory Drive Idler Pulley Bolt (3.2L Only)	36-55	27-41
Accessory Drive Belt Tensioner Bolt (3.2L Only)	53-78	39-58
Timing Belt Front Cover Bolts (3.2L Only)	16-23	12-17
Timing Belt Tensioner Arm Nut (3.2L Only)	36-50	27-37
Timing Belt Tensioner Bolts (3.2L Only)	16-23	12-17
Generator Retaining Bolts (3.2L Only)	36-55	27-41

(1) Tighten in two steps: 49-69 N-m (36-51 Lb-Ft)  
83-93 N-m (62-69 Lb-Ft)

**SPECIFICATIONS (Continued)**

SPECIFICATIONS (Continued)

- (2) Tighten in two steps: 46-69 N·m (34-51 Lb-Ft)  
78-88 N·m (58-65 Lb-Ft)**
- (3) Tighten in two steps: 39-50 N·m (29-39 Lb-Ft)  
69-78 N·m (51-58 Lb-Ft)**
- (4) Tighten in two steps: 30-35 N·m (22-26 Lb-Ft)  
45-50 N·m (33-37 Lb-Ft)**

- (5) Tighten in two steps: 8-12 N·m (71-106 Lb-In)  
16-22 N·m (12-16 Lb-Ft)**
- (6) Advance 3/4 turn after gasket contacts surface.**

<p>COIL SPRING</p> <p>Coil (Lb) 29-33</p> <p>Coil (STD) 30-35</p> <p>Coil (STD) 30-35</p> <p>Coil (Lb) 29-33</p>	<p>CRANK SHAFT</p> <p>Journal (Lb) 29-33</p> <p>Journal (STD) 30-35</p> <p>Journal (STD) 30-35</p> <p>Journal (Lb) 29-33</p>	<p>CONNECTING ROD</p> <p>Pin (Lb) 29-33</p> <p>Pin (STD) 30-35</p> <p>Pin (STD) 30-35</p> <p>Pin (Lb) 29-33</p>	<p>PISTON RING</p> <p>Ring (Lb) 29-33</p> <p>Ring (STD) 30-35</p> <p>Ring (STD) 30-35</p> <p>Ring (Lb) 29-33</p>	<p>CRANK BEARING</p> <p>Journal (Lb) 29-33</p> <p>Journal (STD) 30-35</p> <p>Journal (STD) 30-35</p> <p>Journal (Lb) 29-33</p>	<p>CONNECTING ROD BEARING</p> <p>Journal (Lb) 29-33</p> <p>Journal (STD) 30-35</p> <p>Journal (STD) 30-35</p> <p>Journal (Lb) 29-33</p>	<p>VALVE SHIM TO GUIDE</p> <p>Shim (Lb) 29-33</p> <p>Shim (STD) 30-35</p> <p>Shim (STD) 30-35</p> <p>Shim (Lb) 29-33</p>	<p>VALVE SHIM TO GUIDE</p> <p>Shim (Lb) 29-33</p> <p>Shim (STD) 30-35</p> <p>Shim (STD) 30-35</p> <p>Shim (Lb) 29-33</p>	<p>VALVE SHIM TO GUIDE</p> <p>Shim (Lb) 29-33</p> <p>Shim (STD) 30-35</p> <p>Shim (STD) 30-35</p> <p>Shim (Lb) 29-33</p>	<p>VALVE SHIM TO GUIDE</p> <p>Shim (Lb) 29-33</p> <p>Shim (STD) 30-35</p> <p>Shim (STD) 30-35</p> <p>Shim (Lb) 29-33</p>	<p>VALVE SHIM TO GUIDE</p> <p>Shim (Lb) 29-33</p> <p>Shim (STD) 30-35</p> <p>Shim (STD) 30-35</p> <p>Shim (Lb) 29-33</p>	<p>VALVE SHIM TO GUIDE</p> <p>Shim (Lb) 29-33</p> <p>Shim (STD) 30-35</p> <p>Shim (STD) 30-35</p> <p>Shim (Lb) 29-33</p>	<p>VALVE SHIM TO GUIDE</p> <p>Shim (Lb) 29-33</p> <p>Shim (STD) 30-35</p> <p>Shim (STD) 30-35</p> <p>Shim (Lb) 29-33</p>	<p>VALVE SHIM TO GUIDE</p> <p>Shim (Lb) 29-33</p> <p>Shim (STD) 30-35</p> <p>Shim (STD) 30-35</p> <p>Shim (Lb) 29-33</p>
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SPECIFICATIONS (Continued)

(Continued) SPECIFICATIONS

GENERAL SPECIFICATIONS	
DISPLACEMENT	3.0L/3.2L
NUMBER OF CYLINDERS	6
BORE AND STROKE	
Bore 3.0L	89.00mm (3.5039 in)
Bore 3.2L	92.0mm (3.6220 in)
Stroke 3.0L/3.2L	80.00mm (3.1496 in)
FIRING ORDER	1-4-2-5-3-6
OIL PRESSURE (Hot, Idling)	Min. 12.8 PSI
DRIVE BELT TENSION	SEE CHART

CYLINDER HEAD AND VALVE TRAIN	
COMBUSTION CHAMBER VOLUME 3.0L	47.0-48.0 cc
COMBUSTION CHAMBER VOLUME 3.2L	46.7-48.3 cc
VALVE GUIDE BORE DIAMETER	
Intake and Exhaust	6.000-6.018 mm (0.2362-0.2369 in.)
VALVE SEATS	
Width — Intake	1.0-1.4mm (0.039-0.055 in.)
— Exhaust	1.0-1.4mm (0.039-0.055 in.)
Angle	45°
Width Limit	1.5mm (0.06 in.)
GASKET SURFACE FLATNESS	0.2mm (0.008 in.)
VALVE STEM TO GUIDE CLEARANCE	
Intake	0.025-0.058mm (0.0010-0.0023 in.)
Exhaust	0.030-0.063mm (0.0012-0.0025 in.)
VALVE HEAD DIAMETER (GAGE)	
Intake	35mm (1.38 in.)
Exhaust	30mm (1.18 in.)
MARGIN THICKNESS LIMIT	0.5mm (0.02 in.)
VALVE FACE ANGLE	45.5°
VALVE STEM DIAMETER (STD.)	
Intake	5.960-5.975mm (0.2346-0.2352 in.)
Exhaust	5.955-5.970mm (0.2344-0.2350 in.)
VALVE SPRINGS	
Compression Pressure (Kg [Lb] @ Spec. Length)	
Maximum Load	537.4 N (120.8 lbs.) @ 30.2mm (1.19 in.)
Set Load	188.3 N (42.3 lbs.) @ 38.7mm (1.52 in.)
Free Length (Approximate)	44.82mm (1.76 in.)
Service Limit	10% Force Loss @ Specified Height
VALVE LIFTER	
Diameter (Std.)	31.970-31.994mm (1.2587-1.2596 in.)
Clearance to Bore	0.024-0.036mm (0.0009-0.0014 in.)
Service Limit	0.07mm (0.003 in.)
VALVE CLEARANCE	
Intake	0.15-0.25mm (0.006-0.010 in.)
Exhaust	0.25-0.35mm (0.010-0.014 in.)
CAMSHAFT BORE INSIDE DIAMETER	
All	31.000-31.025mm (1.2205-1.2215 in.)

CAMSHAFT 3.0L	
LOBE LIFT	
Intake	8.5mm (0.335 in.)
Exhaust	8.0mm (0.315 in.)
LOBE HEIGHT	
Intake	41.81-41.91mm (1.6461-1.650 in.)
Limit	41.80mm (1.6457 in.)
Exhaust	41.31-41.41mm (1.6264-1.6303 in.)
Limit	41.30mm (1.6260 in.)
END PLAY	
Service Limit	0.30mm (0.012 in.)
JOURNAL TO BEARING CLEARANCE	
All	0.025-0.066mm (0.0010-0.0026 in.)
JOURNAL DIAMETER	
All	30.959-30.975mm (1.2189-1.2195 in.)

CAMSHAFT 3.2L	
LOBE LIFT	
Intake	8.0mm (0.315 in.)
Exhaust	8.0mm (0.315 in.)
LOBE HEIGHT	
Intake	41.31-41.41 (1.6264-1.6303)
Limit	41.30 (1.6260 in.)
Exhaust	41.31-41.41mm (1.6264-1.6303 in.)
Limit	41.30mm (1.6260 in.)

ENDPLAY	
Service Limit	0.30mm (0.012 in.)
JOURNAL TO BEARING CLEARANCE	
All	0.025-0.066mm (0.0010-0.0026 in.)
JOURNAL DIAMETER	
All	30.959-30.975mm (1.2189-1.2195 in.)

CYLINDER BLOCK	
HEAD GASKET SURFACE FLATNESS	
All	0.05mm (0.002 in.)
CYLINDER BORE	
Diameter 3.0L	89.000-89.030mm (3.5039-3.5051 in.)
3.2L	92.000-92.030mm (3.6220-3.6232 in.)
Surface Finish (RMS) micrometers	
Out-of-Round Limit	0.01mm (0.0004 in.)
Out-of-Round Service Limit	0.02mm (0.0008 in.)
Taper Service Limit	0.02mm (0.0008 in.)
MAIN BEARING BORE DIAMETER	
All	68.000mm (2.677 in.)

CRANKSHAFT AND FLYWHEEL	
MAIN BEARING JOURNAL	
Diameter	63.976-64.000mm (2.5187-2.5197 in.)
Out-of-Round Limit	0.02mm (0.0008 in.)
Taper Limit	0.02mm (0.0008 in.) TOTAL
Journal Runout Limit	0.06mm (0.0024 in.)
THRUST BEARING	
Thickness	2.227-2.277mm (0.0877-0.0896 in.)
CONNECTING ROD JOURNAL	
Diameter	51.976-52.000mm (2.0463-2.0472 in.)
Out-of-Round Limit	0.02mm (0.0008 in.) MAX
Taper Limit	0.02mm (0.0008 in.) TOTAL

FLYWHEEL RING GEAR LATERAL RUNOUT (T.I.R.)	
CRANKSHAFT END PLAY	0.021-0.221mm (0.0008-0.0087 in.)
CONNECTING ROD BEARINGS	
Clearance to Crankshaft	
Desired	0.024-0.056mm (0.0009-0.0022 in.)
Allowable	0.08mm (0.0031 in.)
Bearing Wall Thickness (Std.)	1.484-1.496mm (0.0584-0.0589 in.)
MAIN BEARINGS	
Clearance to Crankshaft	
Desired	0.028-0.056mm (0.0011-0.0022 in.)
Allowable	0.08mm (0.0031 in.)
Bearing Wall Thickness (Std.)	1.981-1.998mm (0.0780-0.0787 in.)

CONNECTING ROD, PISTON AND RINGS	
CONNECTING ROD	
Piston Pin Bore Diameter 3.0L	21.005-21.017mm (0.8270-0.8274 in.)
3.2L	22.005-22.017 (0.8663-0.8668)
Crankshaft Bearing Bore Diameter	55.000-55.016mm (2.1653-2.1660 in.)
Length (Center-to-Center)	146.75-146.85mm (5.778-5.781 in.)
ALIGNMENT (BORE-TO-BORE MAX. DIFF)	
Twist	0.15 per 100mm (0.0015 per in.)
Bend	0.05 per 100 mm (0.0005 per in.)
SIDE CLEARANCE (ASSEMBLED TO CRANK)	
Standard	0.16-0.312mm (0.0063-0.0123 in.)
Service Limit	0.35mm MAX. (0.0138 in. MAX.)

PISTON 3.0L	
Diameter	
Coded (STD.)	88.960-88.990mm (3.5023-3.5035 in.)
Coded (O/S: 0.25)	①

① Specification not available at time of publication.



**SPECIFICATIONS (Continued)**

SPECIAL SERVICE TOOLS

**PISTON 3.0L Continued**

Coded (O/S:050)	TBDmm (TBD in.)
PISTON-TO-BORE CLEARANCE	0.030-0.050mm (0.0012-0.0020 in.)
Service Limit	0.080mm MAX.
<b>RING GROOVE WIDTH</b>	
Compression (Top)	1.21-1.23mm (0.0476-0.0484 in.)
Compression (Bottom)	1.505-1.525mm (0.0593-0.0600 in.)
Oil	2.81-2.83mm (0.1106-0.1114 in.)
<b>PISTON PIN</b>	
Length	61.9-62.0mm (2.437-2.441 in.)
Diameter	20.997-21.009mm (0.8267-0.8271 in.)
PISTON TO PISTON CLEARANCE	- 0.005 + 0.001mm (- 0.00020 + 0.0004 in.)
PISTON TO ROD CLEARANCE	0.005-0.011mm (0.00020-0.00043 in.)
PISTON PIN INSTALLING TEMPERATURE	70-80°C (158-176°F)
<b>PISTON RINGS</b>	
Ring Width	
Compression (Top)	1.17-1.19mm (0.0461-0.0469 in.)
Compression (Bottom)	1.47-1.49mm (0.0579-0.0587 in.)
Ring Gap	
Compression (Top) (In Gauge)	0.30-0.45mm (0.012-0.018 in.)
Compression (Bottom) (In Gauge)	0.30-0.45mm (0.012-0.018 in.)
Oil Ring (Steel Rail) (In Gauge)	0.20-0.50mm (0.008-0.020 in.)
Side Clearance	
1st Ring	0.02-0.06mm (0.0008-0.0024 in.)
2nd Ring	0.015-0.055mm (0.0006-0.0022 in.)
Oil Ring	0.06-0.15mm (0.0024-0.0059 in.)

**PISTON 3.2L**

Diameter	
Coded (STD)	91.960-91.990mm (3.6205-3.6217 in.)
Coded (O/S: 0.25)	TBDmm (TBD in.)
Coded (O/S: 0.50)	TBDmm (TBD in.)
PISTON-TO-BORE CLEARANCE	0.030-0.050mm (0.0012-0.0020 in.)
Service Limit	0.080mm MAX.
<b>RING GROOVE WIDTH</b>	
Compression (Top)	1.23-1.25mm (0.0484-0.0492 in.)
Compression (Bottom)	1.51-1.53mm (0.0594-0.0602 in.)
Oil	2.81-2.83mm (0.1106-0.1114 in.)
<b>PISTON PIN</b>	
Length	61.9-62.0mm (2.437-2.441 in.)
Diameter	21.997-22.009 (0.8660-0.8665 in.)
PISTON TO PISTON CLEARANCE	0.005 + 0.001mm (- 0.00020 + 0.0004 in.)
PISTON TO ROD CLEARANCE	0.005-0.011mm (- 0.00020 + 0.0004 in.)

**PISTON 3.2L Continued**

PISTON TO ROD CLEARANCE	0.005-0.011mm (0.00020-0.00043 in.)
PISTON PIN INSTALLING TEMPERATURE	70-80°C (158-176°F)
<b>PISTON RINGS</b>	
Ring Width	
Compression (Top)	1.17-1.19mm (0.0461-0.0469 in.)
Compression (Bottom)	1.47-1.49mm (0.0579-0.0587 in.)
Ring Gap	
Compression (Top) (In Gauge)	0.30-0.45mm (0.012-0.018 in.)
Compression (Bottom) (In Gauge)	0.45-0.60mm (0.018-0.024 in.)
Oil Ring (Steel Rail) (In Gauge)	0.20-0.50mm (0.008-0.020 in.)
Side Clearance	
1st Ring	0.04-0.08mm (0.0016-0.0031 in.)
2nd Ring	0.02-0.06mm (0.0008-0.0024 in.)
Oil Ring	0.06-0.15mm (0.0024-0.0059 in.)

**LUBRICATION SYSTEM**

<b>OIL PUMP</b>	
Relief Valve Spring Tension (Force @ Length)	6.05 N/mm (34.5 lb./in.)
Relief Valve to Bore Clearance	0.052-0.088mm (0.0020-0.0035 in.)
<b>Outer and Inner Rotor</b>	
Tip Clearance	0.06-0.018mm (0.0024-0.0071 in.)
Rotor to Housing Side Clearance	0.03-0.09mm (0.0012-0.0035 in.)
<b>Outer Rotor to Housing</b>	
Radial Clearance	0.10-0.175mm (0.0039-0.0069 in.)
<b>Inner Rotor Shaft to Housing Clearance</b>	0.03-0.095mm (0.0012-0.0037 in.)

**OIL CAPACITY**

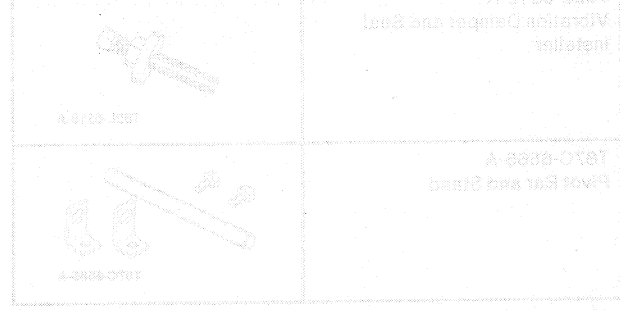
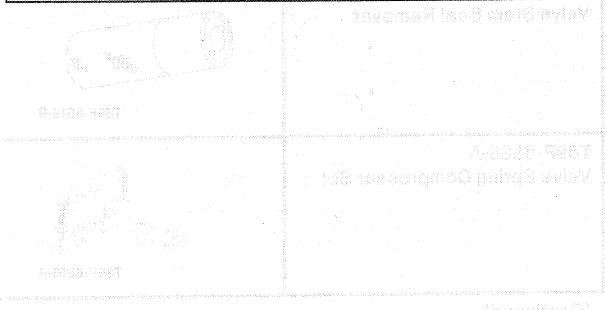
Passenger Car: 5.0 qt. with filter change.

**BELT TENSION ALLOWABLE LIMITS — 3.0L SHO ONLY**

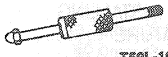
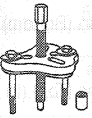
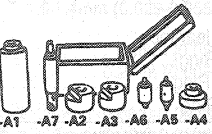
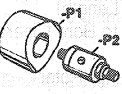
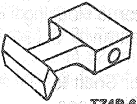
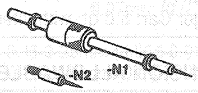

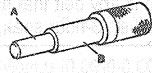
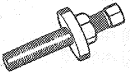
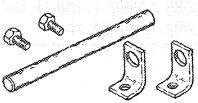
	Specifications		Allowable Minimum
	New Belt (1) Installation Tension	Used Belt (2) Reset Tension	Cold Belt (2) (3) Audit Check
6 Rib	100-120 kg (220-265 lbs.)	67-87 kg (148-192 lbs.)	N.A.
4 Rib	70-90 kg (154-198 lbs.)	51-71 kg (112-157 lbs.)	

- (1) New belt installed and tensioned/engine not rotated.
- (2) Used belt is any belt that has rotated on an engine.
- (3) Cold belt (i.e., 3-hour soak; 0 warm-up).

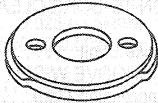
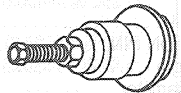
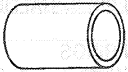


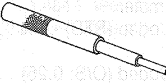
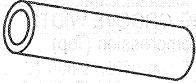

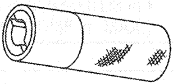
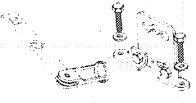
CA12924-B



## SPECIAL SERVICE TOOLS

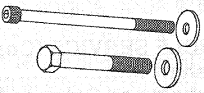
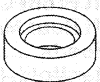
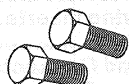
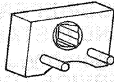
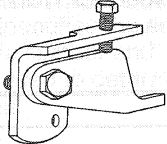
Tool Number/ Description	Illustration
T59L-100-B Impact Slide Hammer	 T59L-100-B
T67L-3600-A Puller	 T67L-3600-A
T68P-6135-A1 Piston Pin Remover / Replacer	 -A1 -A7 -A2 -A3 -A6 -A5 -A4 T68P-6135-A
T71P-6135-P1 Piston Pin Remover / Replacer Sleeve	 -P1 -P2 T71P-6135-P
T74P-6375-A Flywheel Holding Tool	 T74P-6375-A
T78P-3504-N Locknut Pin Remover	 -N2 -N1 T78P-3504-N
T81P-6701-A Rear Crankshaft Seal Replacer	 T81P-6701-A
T81P-7550-A Clutch Aligner	 T81P-7550-A
T82L-6316-A Vibration Damper and Seal Installer	 T82L-6316-A
T87C-6565-A Pivot Bar and Stand	 T87C-6565-A

(Continued)

Tool Number/ Description	Illustration
T88C-6701-BH Rear Crankshaft Seal Replacer	 T88C-6701-BH
T88T-6701-A Crankshaft Seal Installer / Cover Aligner Tool Set— Consists of: T88T-6701-A2 Crankshaft Seal Installer / Cover Aligner Plate	 T88T-6701-A
T89P-6256-A Cam Seal Replacer	 T89P-6256-A
T89P-6256-B Cam Seal Expander	 T89P-6256-B
T89P-6256-C Cam Position Tool	 T89P-6256-C
T89P-6510-A Valve Guide Remover / Replacer	 T89P-6510-A
T89P-6510-B Valve Guide Replacer	 T89P-6510-B
T89P-6510-C Valve Stem Seal Replacer	 T89P-6510-C
T89P-6510-D Valve Stem Seal Remover	 T89P-6510-D
T89P-6565-A Valve Spring Compressor Set	 T89P-6565-A

(Continued)

**SPECIAL SERVICE TOOLS (Continued)**

Tool Number/ Description	Illustration
T89P-6701-A Screw and Washer Set	 T89P-6701-A
T89P-6701-B Front Crank Seal Installer	 T89P-6701-B
T89P-6701-C Rear Seal Replacer Screw Set	 T89P-6701-C
T93P-6254-A Torque Wrench Attachment	 T93P-6254-A
T93P-6254-B Timing Belt Tensioner Tool	 T93P-6254-B

Tool Number	Description
D81L-600-A	Inch Pound Torque Wrench
D81L-4201-A	Feeler Gauge
D85L-6000-A	Strap Wrench

(Continued)

Tool Number	Description
D89L-6001-A	Engine Lifting Bracket
D89L-6135-A	Piston Pin Remover / Replacer Driver and Locator
T80L-630-3	Step Plate Adapter

**ROTUNDA EQUIPMENT**

Model	Description
014-00210	Hi-Lift Jack
014-00282	Dial Indicator With Bracketry
014-00290	Piston Ring Compressor
014-00292	Cylinder Ridge Reamer
014-00750	3 Bar Engine Support Kit
021-0028A	Offset Belt Tension Gauge

**PARTS CROSS-REFERENCE**

Base Part #	Part Name	Old Part Name
9424	Intake Manifold	
9430	Exhaust Manifold	
9431	Exhaust Manifold	
9600	Engine Air Cleaner	
9B989	Throttle Position Sensor	Throttle Potentiometer
9D475	EGR Valve	
9D477	EGR Valve to Exhaust Manifold Tube	
9E926	Throttle Body	
9E936	Air Charge Control to Intake Manifold Gasket	
9F472	Heated Oxygen Sensor	Exhaust Gas Oxygen Sensor