

SECTION 6A2A

3.4 LITER V6 ENGINE ON-VEHICLE SERVICE

RPO L32 – VIN S

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J-B under "On-Vehicle Service" and the SIR Components and Wiring Location view in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with "live" or "hot at all times" exposed electrical terminals, disconnect the battery negative cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "OFF" or "LOCK" position.

NOTICE: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

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ON-VEHICLE SERVICE

FUEL SYSTEM PRESSURE RELIEF

CAUTION:

- To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing fuel system components.

- After relieving system pressure, a small amount of fuel may be released when servicing fuel lines or connections. In order to reduce the chance of personal injury, cover fuel pipe fittings with a shop towel before disconnecting, to catch any fuel that may leak out. Place the towel in an approved container when disconnect is completed.

Tool Required:

J 34730-1 Fuel Pressure Gage

1. Disconnect battery negative cable assembly terminal to avoid possible fuel discharge if an additional attempt is made to start the engine.
2. Loosen fuel filler cap to relieve tank vapor pressure.
3. Connect J 34730-1 to fuel pressure connection. Wrap a shop towel around fitting while connecting J 34730-1 to avoid spilling.
4. Install bleed hose into an approved container and open valve to bleed system pressure. Fuel connections are now safe for servicing.
5. Drain any fuel remaining in J 34730-1 into an approved container.

SERPENTINE DRIVE BELT AND TENSIONER ASSEMBLY

Figures 1 and 2

NOTICE: Routine inspection of the belt may reveal cracks in the belt ribs. These cracks will not impair belt performance and therefore should not be considered a problem requiring belt replacement. However, the belt should be replaced if belt slip occurs or if sections of the belt ribs are missing.

A single serpentine drive belt is used to drive all engine accessories. All belt driven accessories are rigidly mounted with belt tension maintained by a spring loaded tensioner assembly.

The indicator on the movable portion of the tensioner assembly must be within the limits of the marks of the stationary portion of the tensioner assembly. Any reading outside of these limits indicates either a defective belt or tensioner assembly.

Drive Belt



Inspect

- Belt length scale on drive belt tensioner assembly for proper installed length. If belt length scale does not indicate proper installed length, install a new drive belt.



Remove or Disconnect

CAUTION: See "Caution" on page 6A2A-1 of this section.

1. Battery negative cable assembly.
2. Lift drive belt tensioner assembly (145) downward (clockwise) off drive belt using a socket and handle on tensioner pulley bolt/screw.
3. Drive belt (148).



Clean

- Accessory drive belt surfaces.



Install or Connect

1. Drive belt (148) over tensioner pulley by pushing down on drive belt tensioner assembly (145).

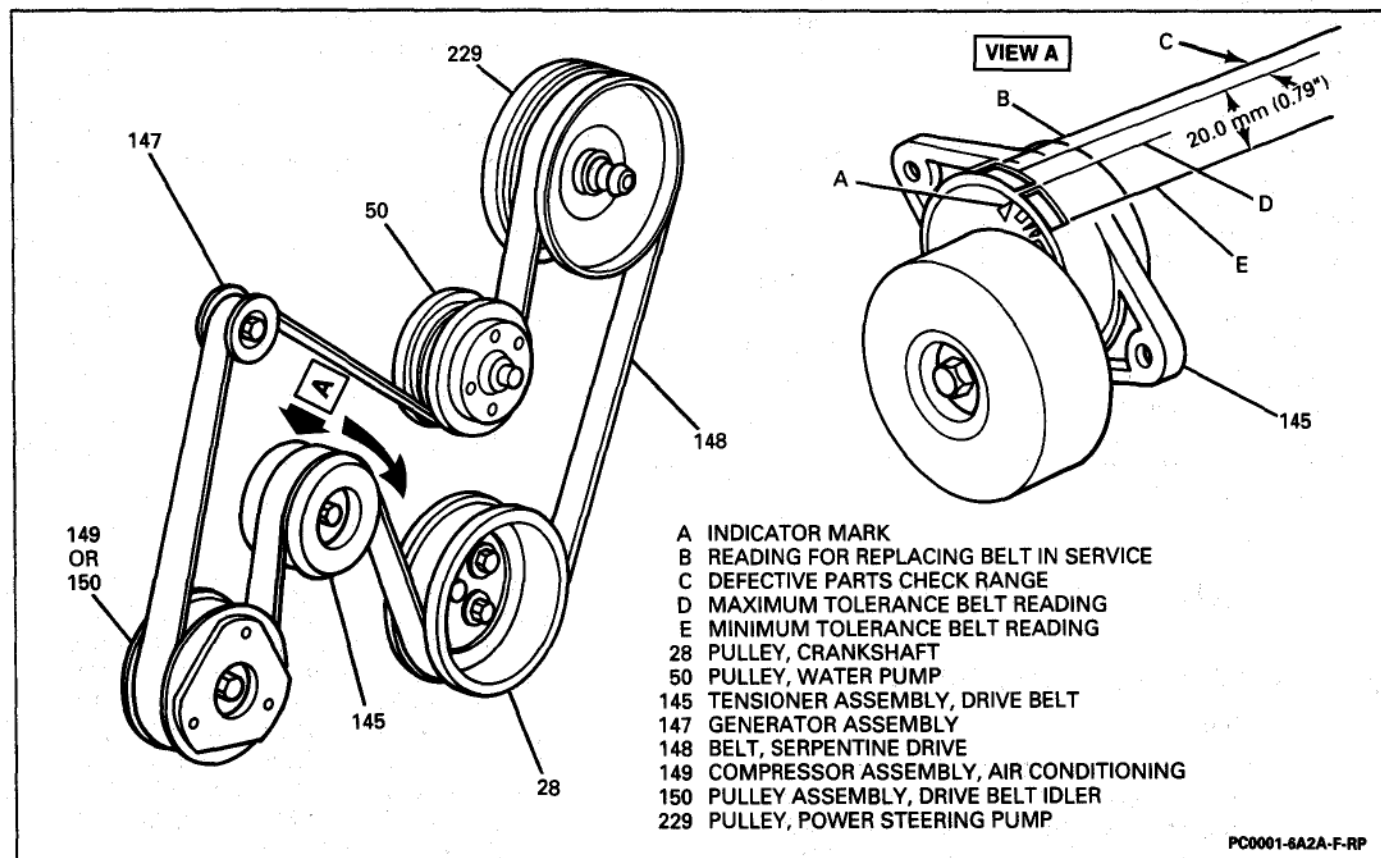


Figure 1 - Serpentine Drive Belt

- Be sure drive belt (148) is aligned into proper grooves of accessory drive pulleys.

2. Battery negative cable assembly.

Drive Belt Tensioner Assembly

↔ Remove or Disconnect

1. Drive belt (148) by lifting drive belt tensioner assembly (145) downward (clockwise) off drive belt using a socket and handle on tensioner pulley bolt/screw.
2. Drive belt tensioner bolts/screws (152).
3. Drive belt tensioner assembly (145).

↔ Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Drive belt tensioner assembly (145).
2. Drive belt tensioner bolts/screws (152).

⌚ Tighten

- Drive belt tensioner bolts/screws (152) to 33 N•m (24 lb. ft.).
3. Drive belt (148) over tensioner pulley by pushing down on drive belt tensioner assembly (145).
 - Be sure drive belt (148) is aligned into proper grooves of accessory drive pulleys.

Drive Belt Idler Pulley

The drive belt idler pulley assembly is used in place of the A/C compressor when the vehicle is not equipped with air conditioning.

↔ Remove or Disconnect

1. Drive belt (148) by lifting drive belt tensioner assembly (145) downward (clockwise) off drive belt using a socket and handle on tensioner pulley bolt/screw.
2. Idler pulley bolts/screws (151).
3. Drive belt idler pulley assembly (150).

↔ Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Drive belt idler pulley assembly (150).
2. Idler pulley bolts/screws (151).

⌚ Tighten

- Idler pulley bolts/screws (151) to 50 N•m (37 lb. ft.).
3. Drive belt (148) over tensioner pulley by pushing down on drive belt tensioner assembly (145).
 - Be sure belt is aligned into proper grooves of accessory drive pulleys.

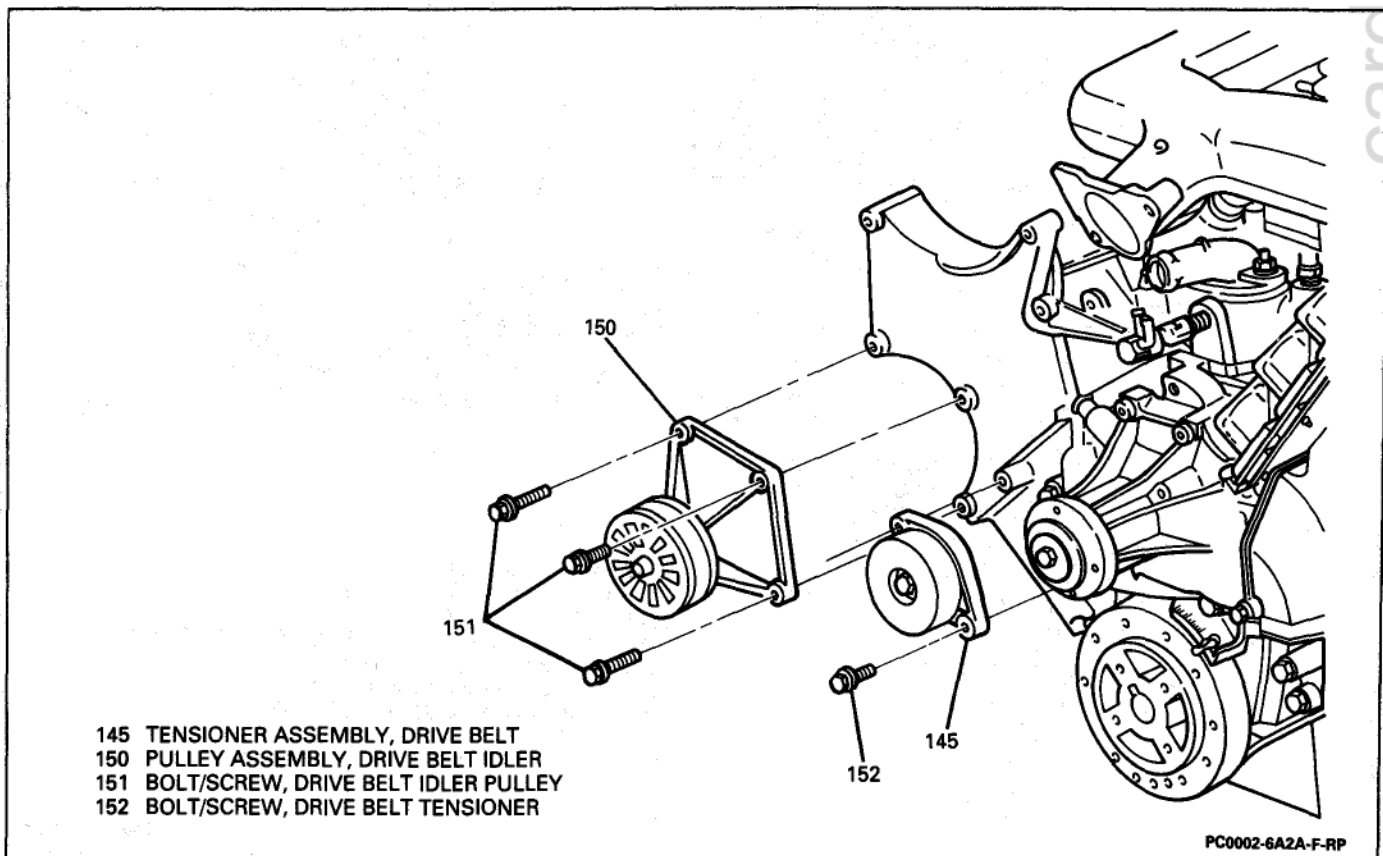


Figure 2 – Drive Belt Tensioner Assembly and Idler Pulley

ENGINE MOUNT ASSEMBLIES AND BRACKETS

Figure 3

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, crankshaft pulley, or any sheet metal. Due to small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pickup unit.

Inspect

- Engine mounts for damage to rubber portions of mount.
 - Rubber surface covered with heat check cracks.
 - Rubber cushion separated from plate of mount.
 - Rubber cushion split through center.

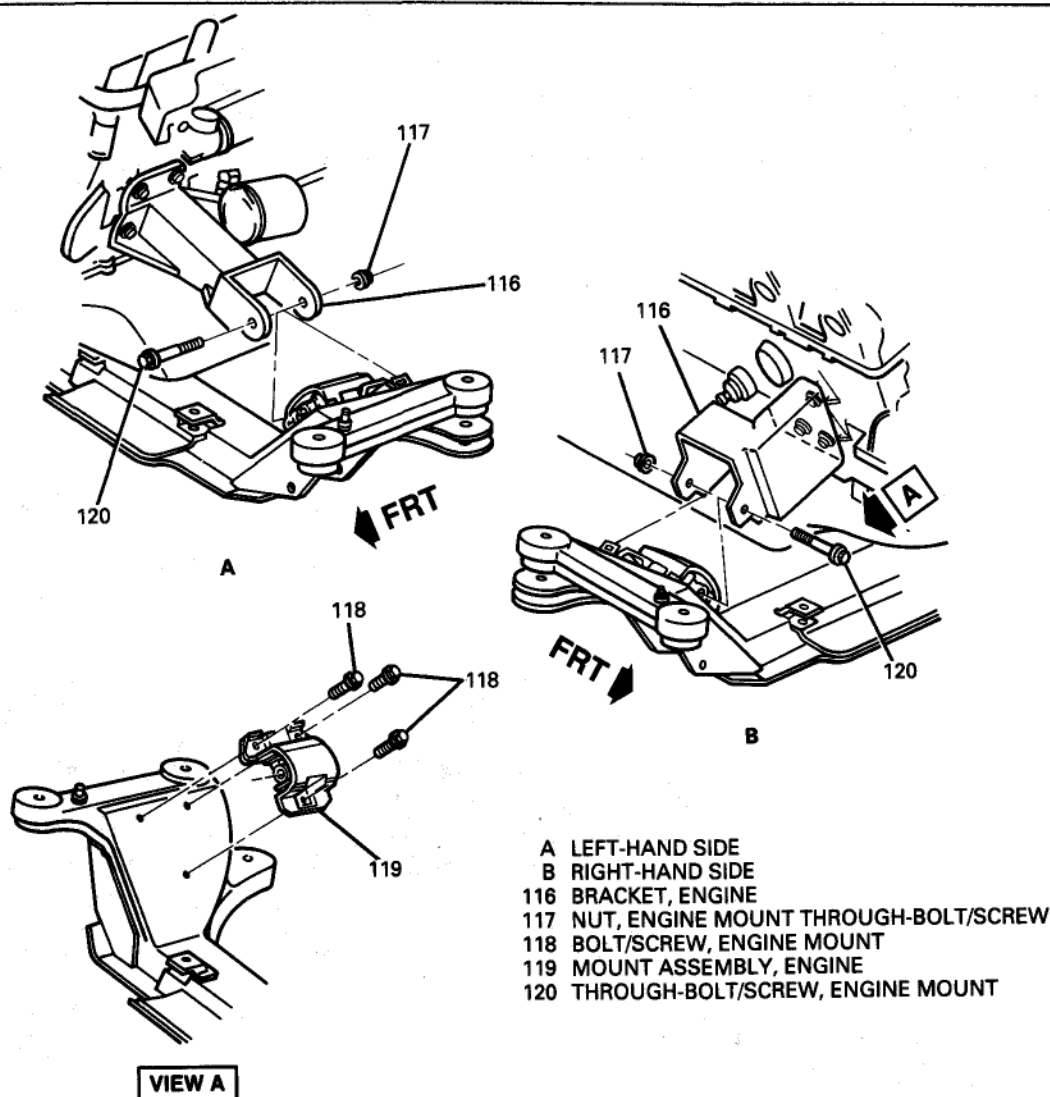
Remove or Disconnect

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Exhaust crossover pipe. Refer to SECTION 6F.
3. Engine mount through-bolts/screws (120) and nuts (117).
4. Raise engine with a jacking fixture.
5. Engine mount bolts/screws (118) and mount assemblies (119).
6. Engine bracket bolts/screws and brackets (116).

Install or Connect

NOTICE: See “Notice” on page 6A2A-1 of this section.

1. Engine brackets (116) and bolts/screws.
2. Engine mount assemblies (119) and bolts/screws (118).



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Figure 3 – Engine Mount Assemblies and Brackets

 Tighten

- Engine mount bolts/screws (118) and bracket bolts/screws to 58 N•m (43 lb. ft.).
3. Lower engine.
 4. Engine mount through-bolts/screws (120) and nuts (117).

 Tighten

- Engine mount through-bolt/screw nuts (117) to 80 N•m (59 lb. ft.).
 - or-
 - Engine mount through-bolts/screws (120) to 95 N•m (70 lb. ft.).
5. Exhaust crossover pipe. Refer to SECTION 6F.
 6. Lower vehicle.

OIL LEVEL INDICATOR AND TUBE ASSEMBLIES **Remove or Disconnect**

1. Nut securing tube bracket to left cylinder head stud bolt/screw.
2. Level indicator and tube assemblies from engine block.

 Install or Connect

NOTICE: See “Notice” on page 6A2A-1 of this section.

1. Clean tube assembly and apply sealant, GM P/N 12345493 or equivalent, around tube 12.7 mm (0.50 inch) below bead.
2. Tube assembly into engine block and rotate into position.
3. Nut securing tube bracket.

 Tighten

- Oil level indicator tube nut to 21 N•m (15 lb. ft.).
4. Level indicator.

UPPER INTAKE MANIFOLD ASSEMBLY**Figures 4 and 5** **Remove or Disconnect**

CAUTION: See “Caution” on page 6A2A-1 of this section.

1. Battery negative cable assembly.
2. Drain coolant. Refer to SECTION 6B.
3. Throttle body air duct.
4. Fuel rail injector wiring harness connectors.
5. Wiring harness retaining nut and lay harness aside.

6. Accelerator cable bracket bolts/screws, bracket and cables from throttle body assembly.
7. Relieve fuel system pressure. Refer to “Fuel System Pressure Relief” in this section.
8. Fuel pipe connectors.
9. Fuel pipe bracket bolts/screws.
10. Fuel pipe hold down plate bolt/screw (167).
11. Fuel pipe assembly and reposition.
12. Coolant hoses from throttle body assembly.
13. Fuel rail stud (169).
14. Fuel pressure regulator vacuum hose.
15. Wiring harness electrical connectors from the following:
 - Idle air control
 - Throttle position sensor
 - Manifold absolute pressure sensor
 - Evaporative emissions canister purge solenoid valve
16. Blow dirt out of injector bores with compressed air.
17. Fuel rail assembly (166).
18. Vacuum harness assembly.
19. Exhaust gas recirculation (EGR) flexible pipe bolts/screws and reposition EGR flexible pipe assembly and gasket at upper intake manifold assembly (155).
20. Upper intake manifold bolts/screws (156).
21. Upper intake manifold assembly (155) and gasket (154).

 Clean

- Upper intake manifold bolts/screws (156).
- Upper intake manifold sealing surfaces.

 Install or Connect

NOTICE: See “Notice” on page 6A2A-1 of this section.

1. Upper intake manifold gasket (154) and manifold assembly (155).
2. Upper intake manifold bolts/screws (156).

 Tighten

- Upper intake manifold bolts/screws (156) to 25 N•m (18 lb. ft.).
3. EGR flexible pipe gasket, pipe assembly and bolts/screws at upper intake manifold assembly (155).
 - A. Apply teflon sealant GM P/N 1052080 to threads of bolts/screws.
 - B. Gasket must be installed with text “tube side” facing the tube.

 Tighten

- EGR flexible pipe bolts/screws to 26 N•m (19 lb. ft.).
4. Vacuum harness assembly.

- 155 MANIFOLD ASSEMBLY, UPPER INTAKE
- 166 RAIL ASSEMBLY, FUEL INJECTOR FUEL
- 167 BOLT/SCREW, FUEL PIPE HOLD DOWN PLATE
- 169 STUD, FUEL INJECTOR FUEL RAIL

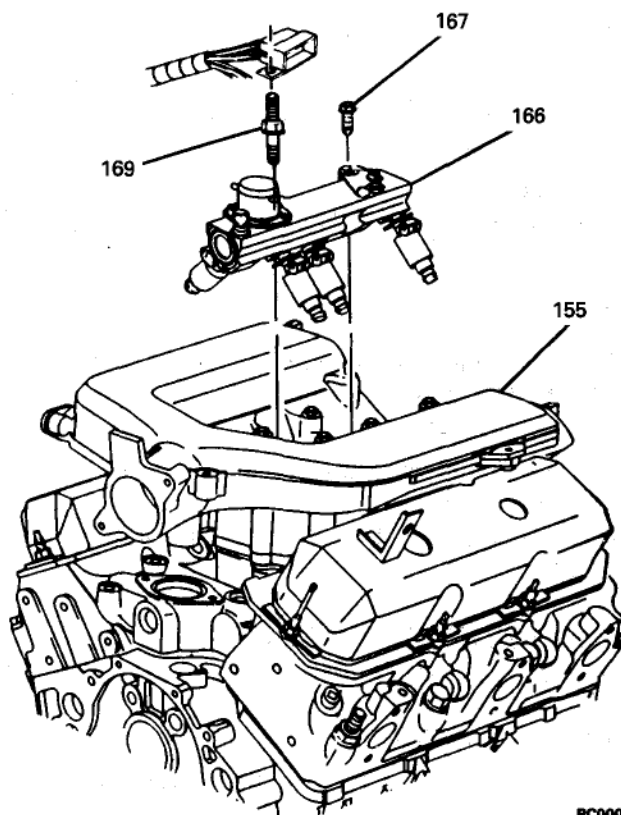


Figure 4 – Fuel Rail Assembly

- 142 MANIFOLD ASSEMBLY, LOWER INTAKE
- 154 GASKET, UPPER INTAKE MANIFOLD
- 155 MANIFOLD ASSEMBLY, UPPER INTAKE
- 156 BOLT/SCREW, UPPER INTAKE MANIFOLD

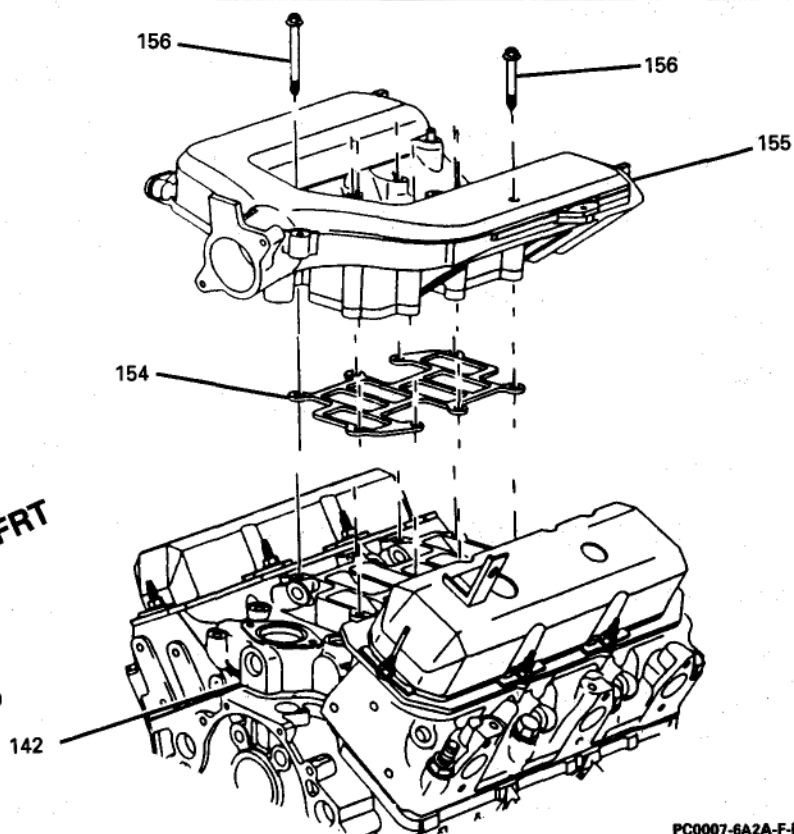


Figure 5 – Upper Intake Manifold Assembly

**Important**

- Do not press on the regulator cover or piedmont valve when installing fuel rail assembly.

5. Fuel rail assembly (166).

- Lightly lubricate fuel injector O-rings using clean engine oil.
- Install injectors of fuel rail assembly (166) into bores of manifold.
- Carefully press on fuel rail assembly (166) with palms of both hands until injectors are fully seated.

6. Fuel rail stud (169).

**Tighten**

- Fuel rail stud (169) to 25 N•m (18 lb. ft.).

7. Wiring harness electrical connectors to the following:

- Idle air control
- Throttle position sensor
- Manifold absolute pressure sensor
- Evaporative emissions canister purge solenoid valve

8. Fuel pressure regulator vacuum hose.

9. Fuel rail wiring harness retaining nut.

10. Fuel pipe assembly to fuel rail assembly (166).

- Slide fuel line hold down plate over fuel pipe assembly.

11. Fuel pipe hold down plate bolt/screw (167).

- Apply teflon sealant GM P/N 1052080 to threads of bolt/screw (167).

**Tighten**

- Fuel pipe hold down plate bolt/screw (167) to 25 N•m (18 lb. ft.)

12. Fuel pipe bracket bolts/screws.

13. Accelerator cable bracket, bolts/screws and cables.

**Tighten**

- Accelerator cable bracket bolts/screws to 10 N•m (90 lb. in.).
- Fuel pipe bracket-to-front brace bolt/screw to 8 N•m (71 lb. in.)
- Fuel pipe bracket-to-intake manifold assembly bolt/screw to 10 N•m (89 lb. ft.).

14. Fuel pipe connectors.

15. Fuel rail injector wiring harness connectors.

16. Coolant hoses to throttle body assembly.

17. Throttle body air duct.

18. Battery negative cable assembly.

19. Refill with coolant. Refer to SECTION 6B.

VALVE ROCKER ARM COVER ASSEMBLIES*Figure 6***Right Side****Remove or Disconnect**

- Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this Section.
- EGR valve adapter bolt/screw, stud, and adapter with EGR valve assembly from exhaust manifold assembly.
- Crankcase vent pipe.
- Spark plug wiring harness assembly from clips.
- Nuts (192) and reinforcements (193).
- Valve rocker arm cover assembly (194) and gasket (195).

**Clean**

- Rocker cover assembly and cylinder head gasket surfaces.

**Install or Connect**

NOTICE: See "Notice" on page 6A2A-1 of this section.

- Valve rocker arm cover gasket (195) and cover assembly (194).
- Reinforcements (193) and nuts (192).

**Tighten**

- Nuts (192) to 10 N•m (89 lb. in.).
- Spark plug wiring harness assembly to clips.
 - Crankcase vent pipe.
 - EGR valve adapter, bolt/screw and stud with EGR valve assembly to exhaust manifold assembly.

**Tighten**

- EGR valve adapter bolt/screw and stud to 31 N•m (23 lb. ft.).
- Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.

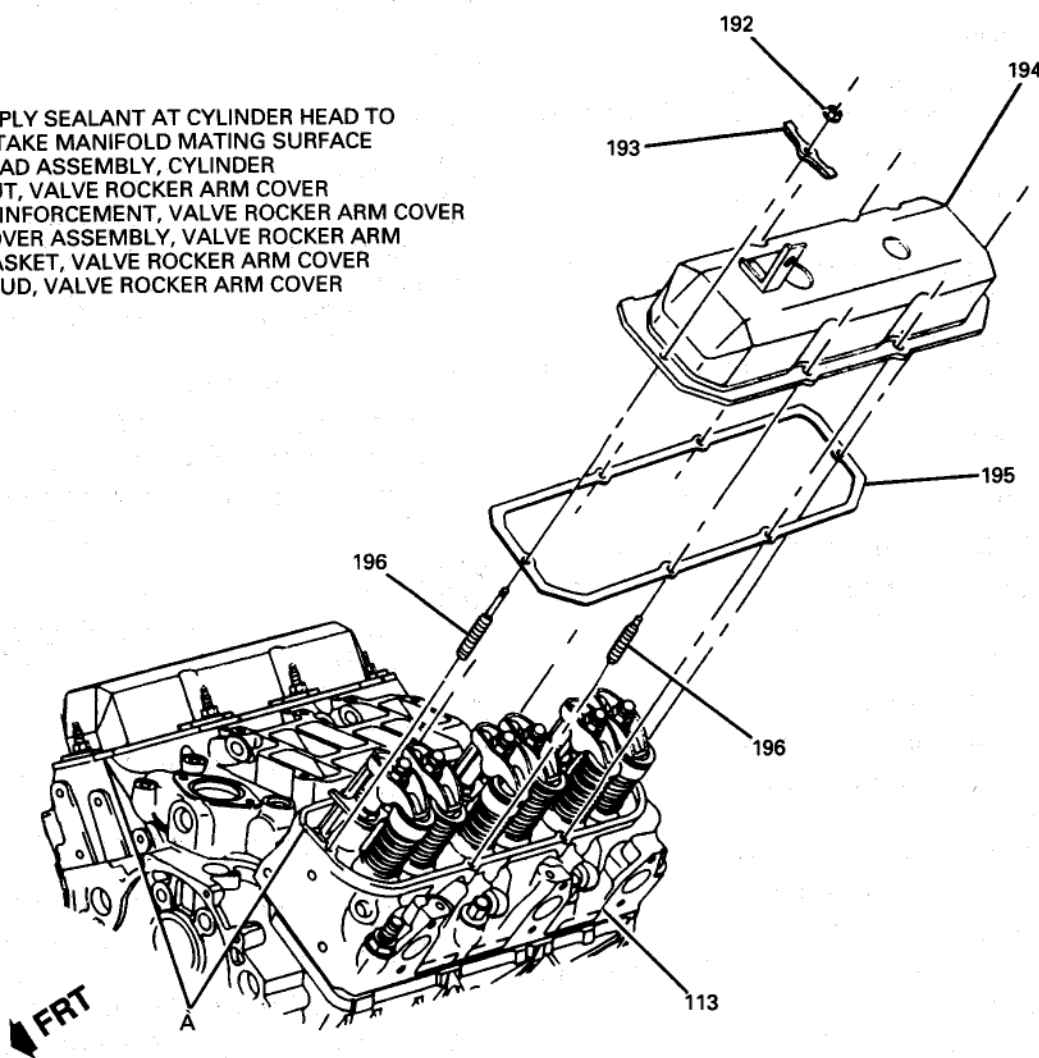
Left Side**Remove or Disconnect**

- Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
- PCV valve and hose assembly.
- Spark plug wire harness assembly from clips.
- Nuts (192) and reinforcements (193).
- Valve rocker arm cover assembly (194) and gasket (195).

**Install or Connect**

NOTICE: See "Notice" on page 6A2A-1 of this section.

- A APPLY SEALANT AT CYLINDER HEAD TO INTAKE MANIFOLD MATING SURFACE
- 113 HEAD ASSEMBLY, CYLINDER
- 192 NUT, VALVE ROCKER ARM COVER
- 193 REINFORCEMENT, VALVE ROCKER ARM COVER
- 194 COVER ASSEMBLY, VALVE ROCKER ARM
- 195 GASKET, VALVE ROCKER ARM COVER
- 196 STUD, VALVE ROCKER ARM COVER



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Figure 6 - Valve Rocker Arm Cover Assemblies

1. Valve rocker arm cover gasket (195) and cover assembly (194).
2. Reinforcements (193) and nuts (192).

**Tighten**

- Nuts (192) to 10 N•m (89 lb. in.).
3. Spark plug wire harness assembly to clips.
 4. PCV valve and hose assembly.
 5. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.

VALVE ROCKER ARMS AND PUSHROD ASSEMBLIES

Figure 7

**Remove or Disconnect**

1. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.

2. Valve rocker arm nuts (124) and balls (123).
3. Valve rocker arms (122) and pushrod assemblies (93).

- Place valve rocker arms (122), balls (123) and pushrod assemblies (93) in a rack so they can be reinstalled in same locations from which they were removed.

**Important**

- Refer to SECTION 6A2B for inspection of the rocker arms, studs and pushrod assemblies.

**Install or Connect**

NOTICE: See "Notice" on page 6A2A-1 of this section.

**Important**

- When installing valve rocker arms (122), balls (123) and pushrod assemblies (93), coat their

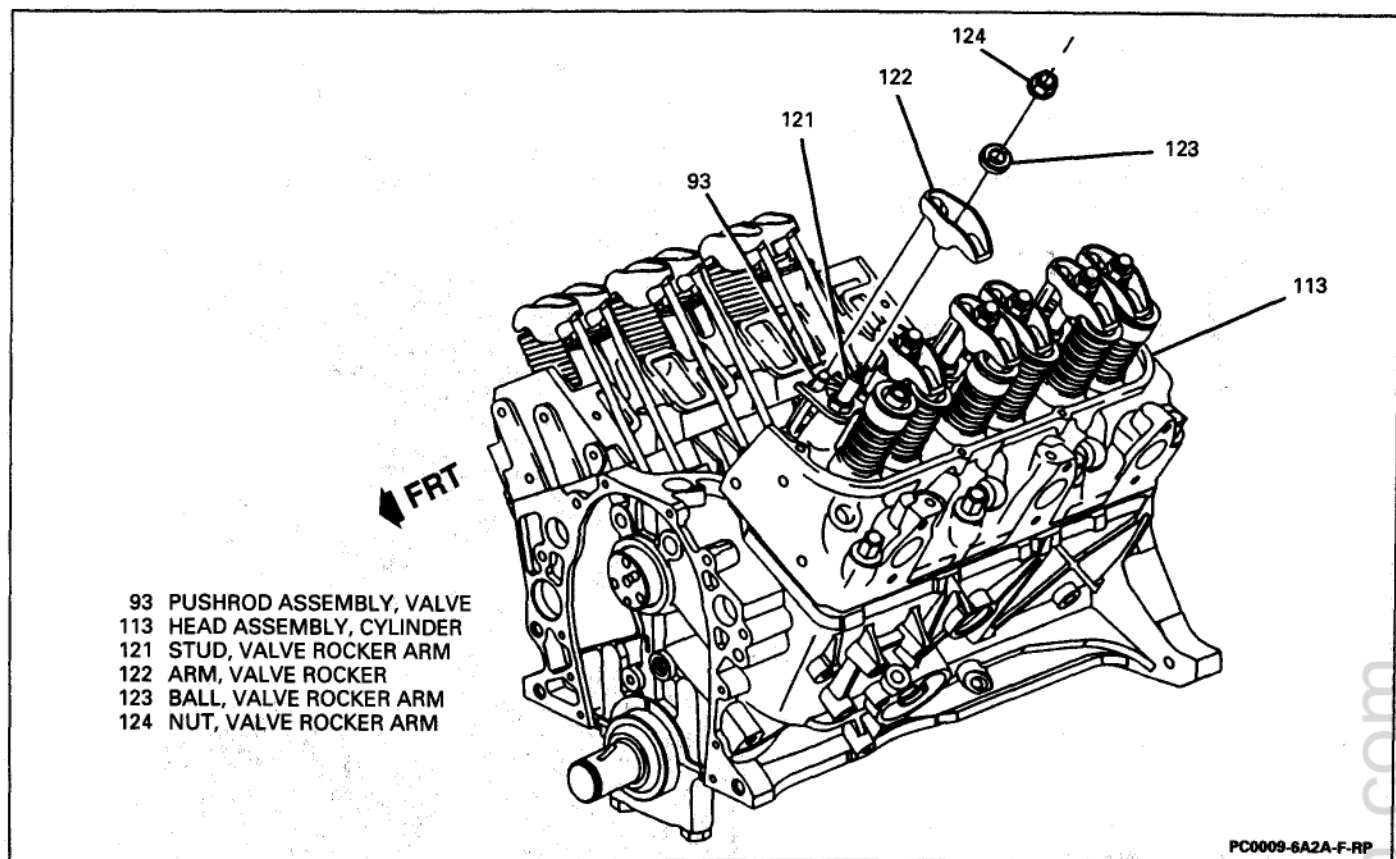


Figure 7 - Valve Rocker Arms and Pushrod Assemblies

bearing surfaces with prelube, GM P/N 1052365 or equivalent. Install these components in the locations from which they were removed.

1. Pushrod assemblies (93). Make sure pushrod assemblies (93) seat in lifter sockets.
2. Valve rocker arms (122).
3. Valve rocker arm balls (123) and nuts (124).



Adjust

- A. Turn crankshaft assembly until arrow on crankshaft hub and balancer assembly are in 12 o'clock position and number 1 cylinder is in firing position (top dead center).
 - Watch number 1 cylinder valves as arrow approaches 12 o'clock position. If a valve moves as the arrow moves to position, the engine is in number 6 cylinder firing position. Crankshaft assembly must then be turned one more time to reach number 1 cylinder firing position.
- B. With engine in number 1 cylinder firing position, the following valves can be adjusted:
 - Exhaust 1, 2, 3
 - Intake 1, 5, 6
- C. Back off rocker arm nut (124) until lash is felt in pushrod assembly (93). Then tighten rocker arm nut (124) until all lash is removed. Zero lash can be felt by moving pushrod assembly

(93) up and down using thumb and forefinger until there is no more movement.

- D. When all free play has been removed, tighten rocker arm nut (124) one additional turn.
- E. Turn crankshaft assembly one revolution until hub arrow is again at 12 o'clock position. This is number 6 cylinder firing position. The following valves can now be adjusted:
 - Exhaust 4, 5, 6
 - Intake 2, 3, 4
4. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.

LOWER INTAKE MANIFOLD ASSEMBLY

Figure 8



Remove or Disconnect

1. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
2. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
3. Upper radiator hose from lower intake manifold assembly (142).
4. Heater hose from lower intake manifold assembly (142).
5. Wiring harness ground leads.
6. Manifold bolts/screws (144) and nuts (143).

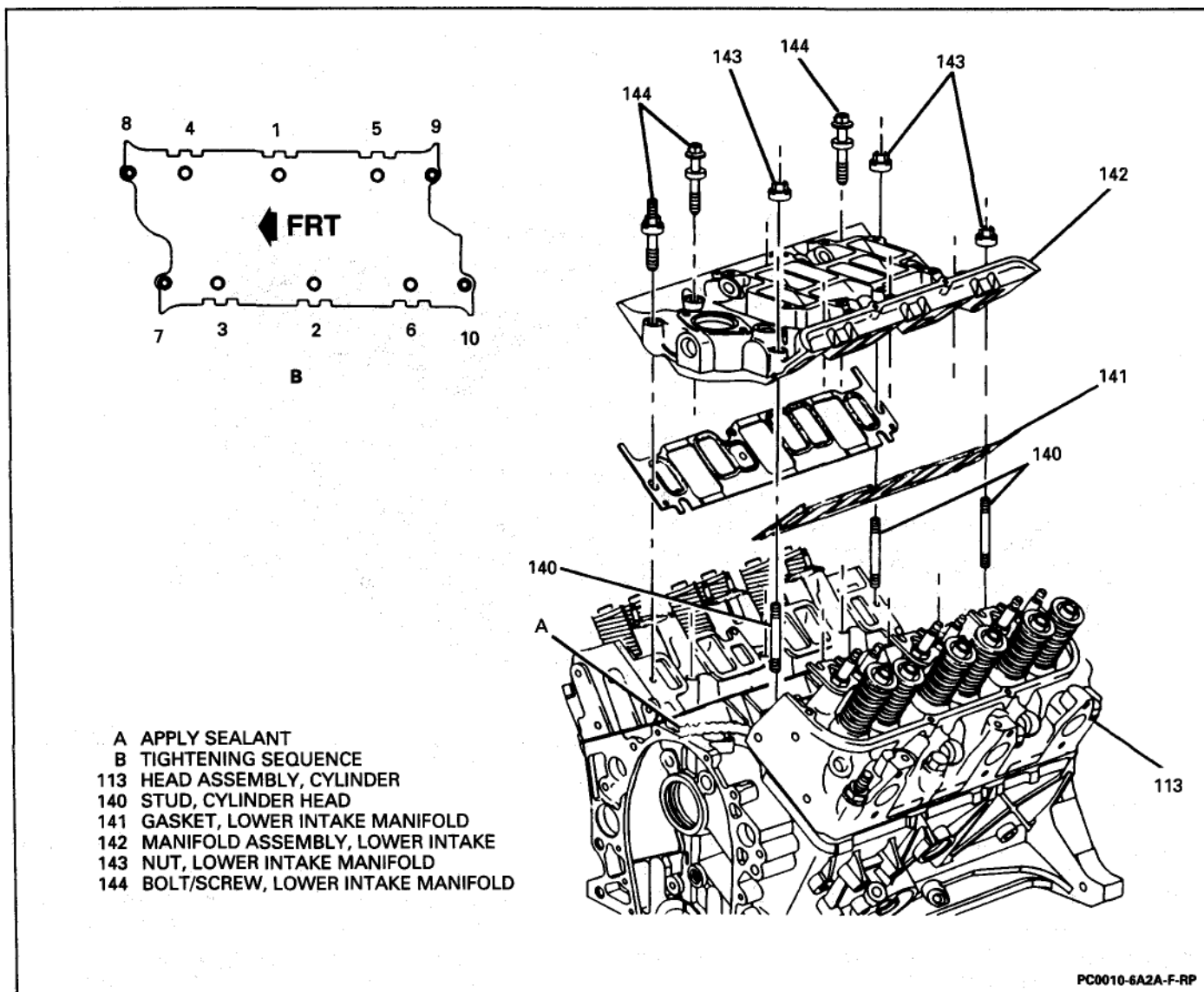


Figure 8 - Lower Intake Manifold Assembly

- Lower intake manifold assembly (142) and gaskets (141).

Install or Connect

- Gaskets (141).
- Apply sealant GM P/N 12345739 at engine block to manifold mating surface. Bead should be 2.0-3.0 mm (0.08-0.12 inch) wide and 3.0-5.0 mm (0.12-0.20 inch) thick.
- Lower intake manifold assembly (142).
- Manifold bolts/screws (144) and nuts (143).

Tighten

- Manifold bolts/screws (144) and nuts (143) to 30 N•m (22 lb. ft.).
- Wiring harness ground leads.
 - Heater hose.
 - Upper radiator hose.

- Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.

- Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.

VALVE LIFTER ASSEMBLIES

Figures 9 and 10

No service parts are available for valve lifter assemblies. They are replaced as a unit when worn and when a new camshaft assembly is installed.

Valve lifters should be kept in order so they may be installed in their original position. Some engines will have both standard and 0.25 mm (.010 inch) oversize (O.S.) valve lifters.

Where oversize lifters are used, the cylinder case will be marked with a daub of white paint and/or "0.25 mm O.S." stamped on the lifter boss.

If the lifters are removed, they must be installed in their original location. If replacement is necessary, use lifters with a narrow flat ground along the lower 3/4 of

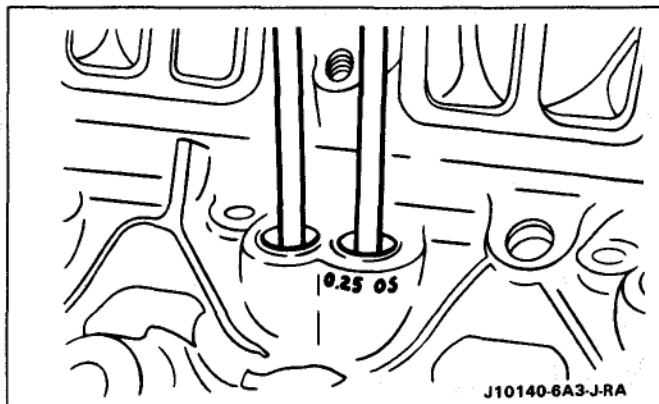


Figure 9 – Oversize Lifter Marking

lifter. These flats provide additional oil to the cam lobe and lifter surfaces.

Remove or Disconnect

1. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
2. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
3. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.
4. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
5. Valve lifter assembly (94).

Important

- Refer to SECTION 6A2B for cleaning and inspection of the valve lifter assemblies.

Install or Connect

1. Coat lifters with prelube, GM P/N 1052365 or equivalent.
2. Valve lifter assembly (94).
3. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
4. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.
5. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
6. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.

EXHAUST MANIFOLD ASSEMBLIES

Figures 11 and 12

Left Side

Remove or Disconnect

CAUTION: See "Caution" on page 6A2A-1 of this section.

1. Battery negative cable assembly.

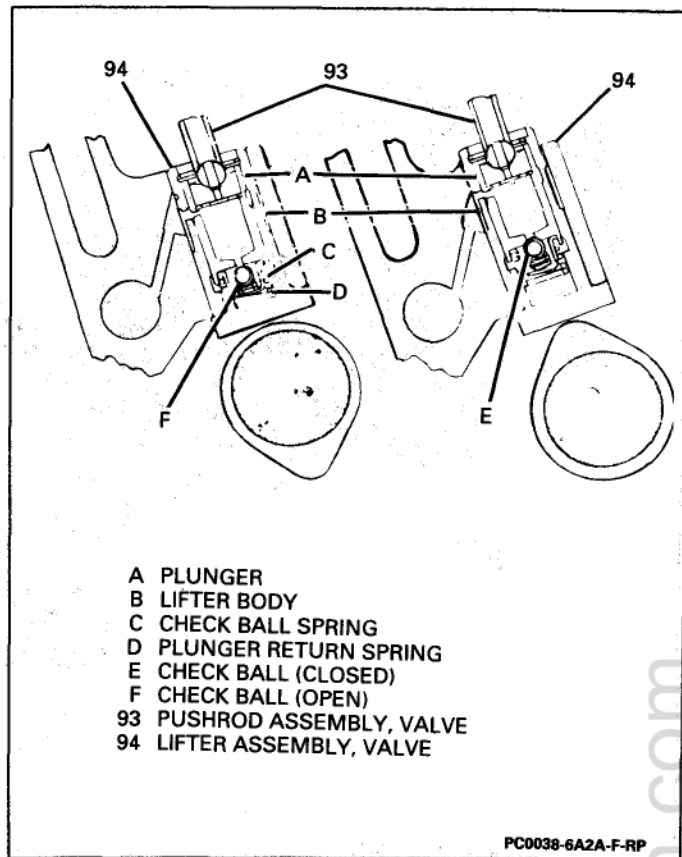


Figure 10 – Valve Lifter Assembly Operation

2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Exhaust crossover pipe. Refer to SECTION 6F.
4. Lower vehicle.
5. Oxygen sensor electrical connector.
6. Secondary air injection check valve pipe bracket nut and reposition pipe (manual transmission only).
7. Exhaust manifold bolts/screws (102).
8. Exhaust manifold assembly (105) and heat shields (103 and 104).
9. Exhaust manifold gasket (106).

Clean

- Exhaust manifold and cylinder head sealing surfaces.

Install or Connect

1. Exhaust manifold gasket (106).
2. Exhaust manifold assembly (105) and heat shields (103 and 104).
3. Exhaust manifold bolts/screws (102).

Tighten

- Exhaust manifold bolts/screws (102) to 25 N•m (18 lb. ft.).
4. Oxygen sensor electrical connector.
 5. Secondary air injection check valve pipe bracket nut (manual transmission only).

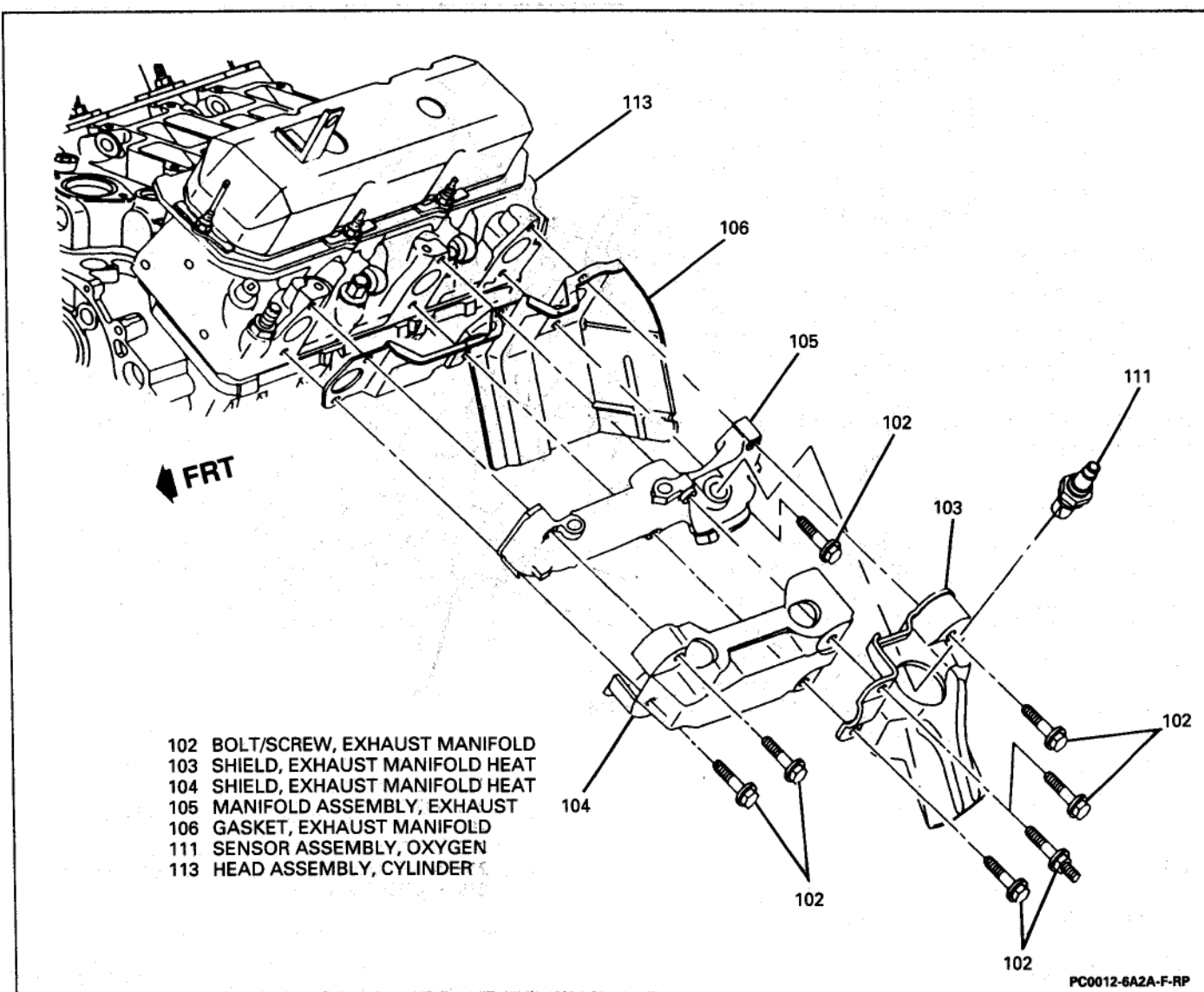


Figure 11 - Left Exhaust Manifold Assembly

**Tighten**

- Secondary air injection check valve pipe bracket nut to 25 N•m (18 lb. ft.).
- 6. Raise and suitably support vehicle. Refer to SECTION 0A.
- 7. Exhaust crossover pipe. Refer to SECTION 6F.
- 8. Lower vehicle.
- 9. Battery negative cable assembly.

Right Side**Remove or Disconnect**

CAUTION: See "Caution" on page 6A2A-1 of this section.

1. Battery negative cable assembly.
2. Raise and suitably support vehicle. Refer to SECTION 0A.
3. Exhaust crossover pipe. Refer to SECTION 6F.
4. Transmission filler tube. Refer to SECTION 7A.

5. A/C compressor rear bracket bolts/screws. Refer to SECTION 1B.
6. Rear two exhaust manifold bolts/screws (202).
7. Lower vehicle.
8. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
9. Oxygen sensor electrical connector.
10. Generator. Refer to SECTION 6D3.
11. A/C compressor from bracket and reposition. Refer to SECTION 1B.
12. Generator rear "Y" brace. Refer to SECTION 6D3.
13. EGR valve, adapter, and flexible pipe. Refer to SECTION 6E3.
14. Secondary air injection pipe assembly from exhaust manifold assembly (215) (manual transmission only). Refer to SECTION 6E3.
15. Exhaust manifold front and middle bolts/screws (202).
16. Exhaust manifold assembly (215), heat shields (203 and 205) and gasket (216).

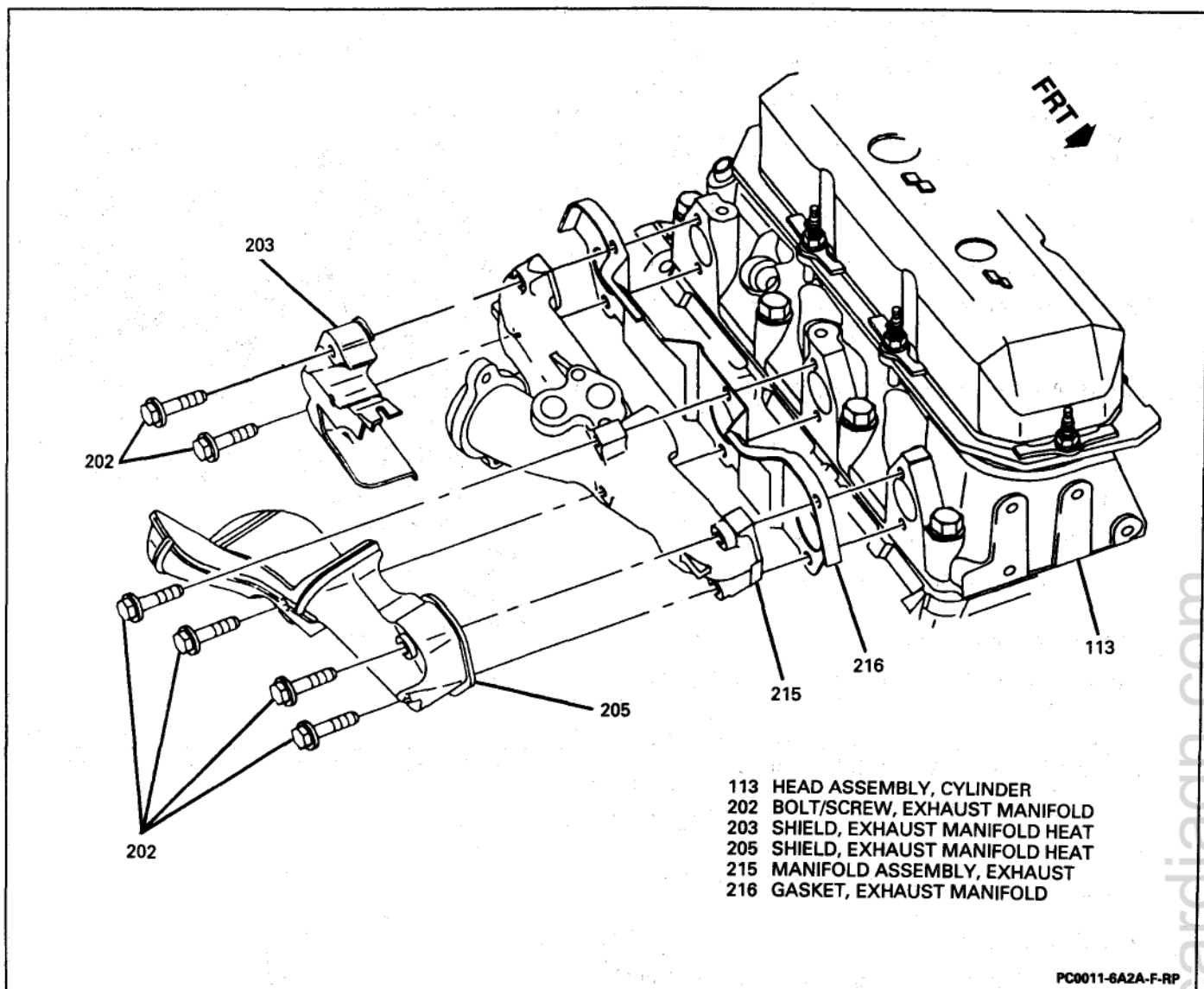


Figure 12 - Right Exhaust Manifold Assembly

**Clean**

- Exhaust manifold and cylinder head sealing surfaces.

**Install or Connect**

NOTICE: See "Notice" on page 6A2A-1 of this section.

- Exhaust manifold gasket (216).
- Exhaust manifold assembly (215) and heat shields (203 and 205).
- Exhaust manifold front and middle bolts/screws (202).

**Tighten**

- Exhaust manifold bolts/screws (202) to 25 N•m (18 lb. ft.).

- EGR valve adapter and flexible pipe. Refer to SECTION 6E3.
- Generator rear "Y" brace. Refer to SECTION 6D3.
- Generator. Refer to SECTION 6D3.
- A/C compressor. Refer to SECTION 1B.
- Oxygen sensor electrical connector.
- Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
- Raise and suitably support vehicle. Refer to SECTION 0A.
- Transmission filler tube. Refer to SECTION 7A.
- A/C compressor rear bracket bolts/screws. Refer to SECTION 1B.

13. Exhaust crossover pipe. Refer to SECTION 6F.

14. Exhaust manifold rear bolts/screws (202).

Tighten

- Exhaust manifold rear bolts/screws (202) to 25 N•m (18 lb. ft.).

15. Lower vehicle.

16. Battery negative cable assembly.

17. Refill transmission. Refer to SECTION 7A.

CRANKSHAFT BALANCER ASSEMBLY

Figures 13 and 14

Tools Required:

J 24420-B Torsional Damper Remover

J 29113 Torsional Damper Installer

Remove or Disconnect

- Raise and suitably support vehicle. Refer to SECTION 0A.
- Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
- Crankshaft balancer bolt/screw and washer.
- Crankshaft pulley bolts/screws and pulley.
- Crankshaft balancer assembly (27) using J 24420-B.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

- Crankshaft balancer assembly (27) using J 29113.
- Remove J 29113.
- Crankshaft pulley and bolts/screws.
- Crankshaft balancer washer and bolt/screw.

Important

- If balancer assembly is replaced, new balance weights of the same size must be installed on the new balancer assembly in the same hole locations as the old balancer assembly.

Tighten

- Crankshaft balancer bolt/screw to 78 N•m (58 lb. ft.).
 - Crankshaft pulley bolts/screws to 50 N•m (37 lb. ft.).
- Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
 - Lower vehicle.

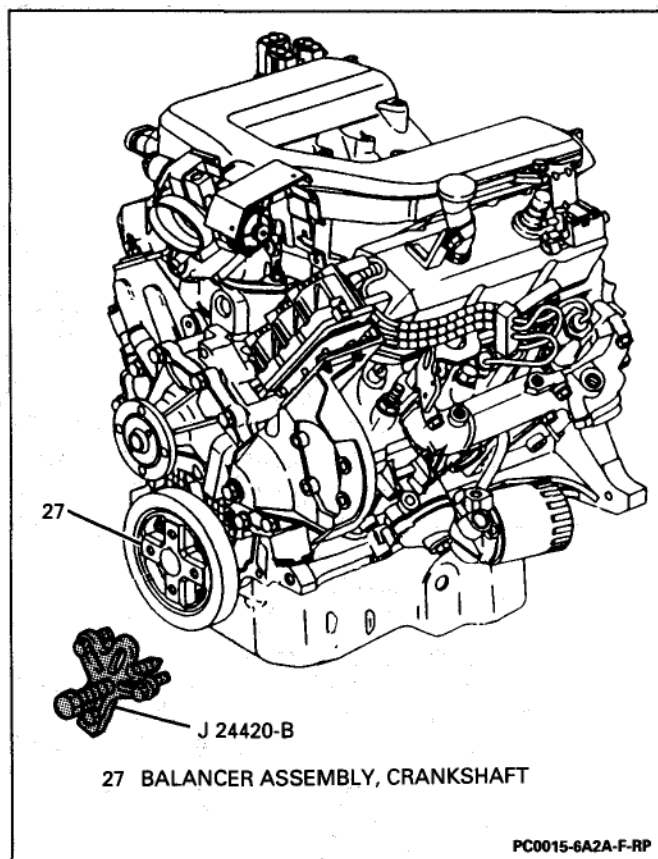


Figure 13 – Removing Crankshaft Balancer Assembly

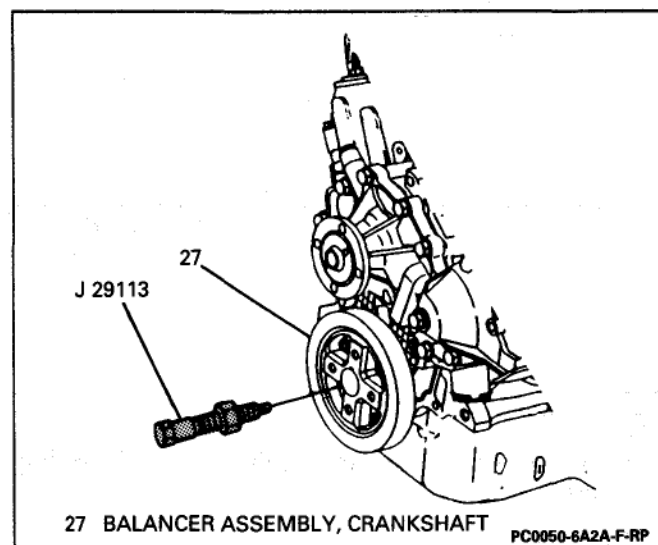


Figure 14 – Installing Crankshaft Balancer Assembly

ENGINE FRONT COVER ASSEMBLY

Figure 15

Remove or Disconnect

- Throttle body air duct.
- Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
- Water pump assembly. Refer to SECTION 6B.

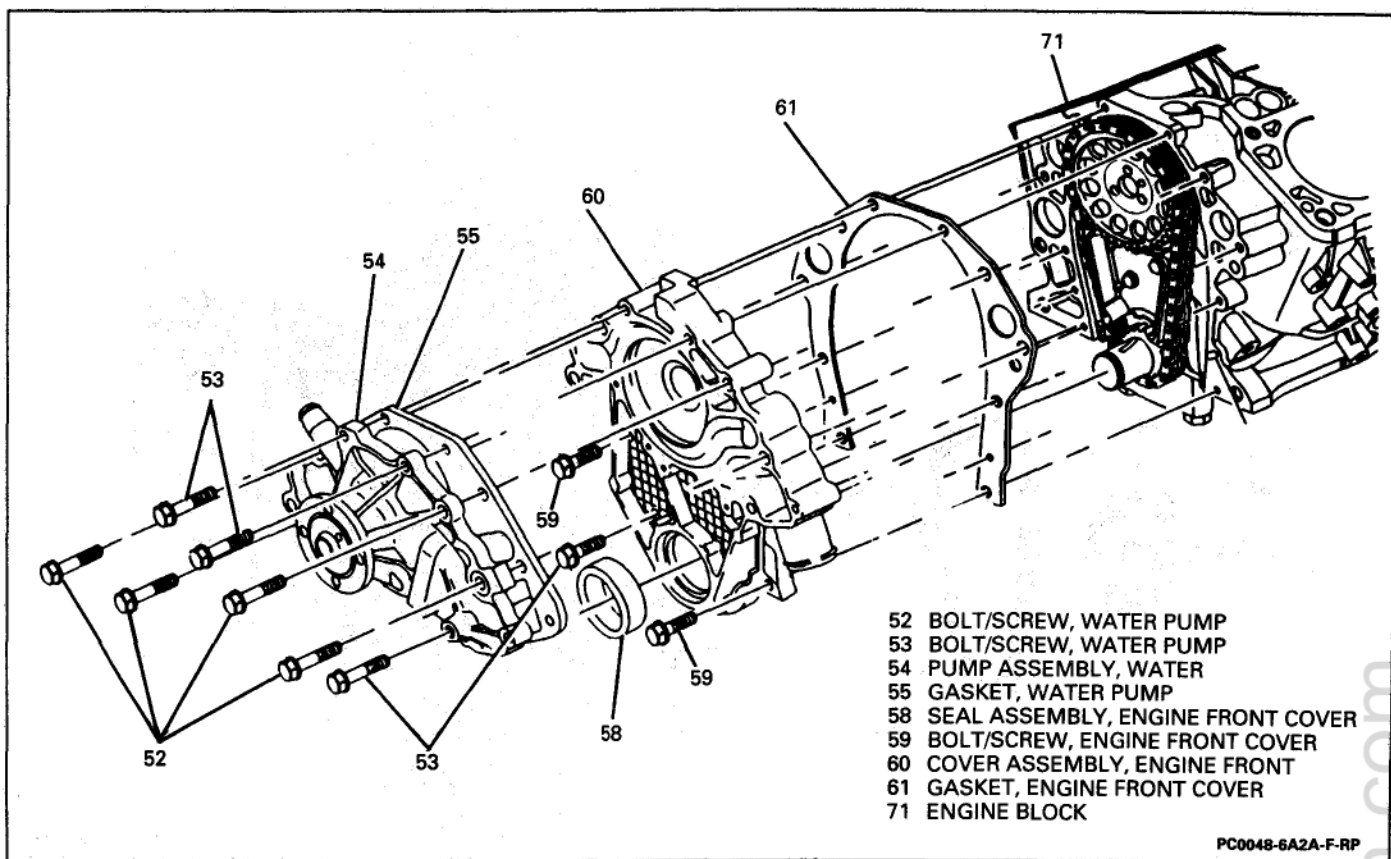


Figure 15 – Engine Front Cover Assembly

4. Crankshaft balancer assembly. Refer to “Crankshaft Balancer Assembly” in this section.
5. Power steering pump and bracket. Refer to SECTION 3B1.
6. Oil pan assembly. Refer to “Oil Pan Assembly” in this section.
7. Lower radiator hose from the front cover assembly.
8. Crankshaft sensor.
9. Engine front cover bolts/screws (59).
10. Engine front cover assembly (60) and gasket (61).

**Clean**

- Engine front cover and engine block gasket surfaces.

**Inspect**

- Engine front cover assembly (60) for damage to the seals or gasket surface. Refer to SECTION 6A2B to replace front cover seals if necessary.

**Install or Connect**

NOTICE: See “Notice” on page 6A2A-1 of this section.

1. Gasket (61) and engine front cover assembly (60).
 - Coat both sides of lower tabs of gasket (61) with sealer, GM P/N 1052080.
2. Engine front cover bolts/screws (59).

**Tighten**

- Engine front cover bolts/screws (59) to 21 N•m (15 lb. ft.).
3. Oil pan assembly. Refer to “Oil Pan Assembly” in this section.
 4. Crankshaft sensor.
 5. Lower radiator hose.
 6. Crankshaft balancer assembly. Refer to “Crankshaft Balancer Assembly” in this section.
 7. Lower vehicle.
 8. Water pump assembly. Refer to SECTION 6B.
 9. Power steering pump and bracket. Refer to SECTION 3B1.
 10. Serpentine drive belt. Refer to “Serpentine Drive Belt and Tensioner Assembly” in this section.
 11. Throttle body air duct.

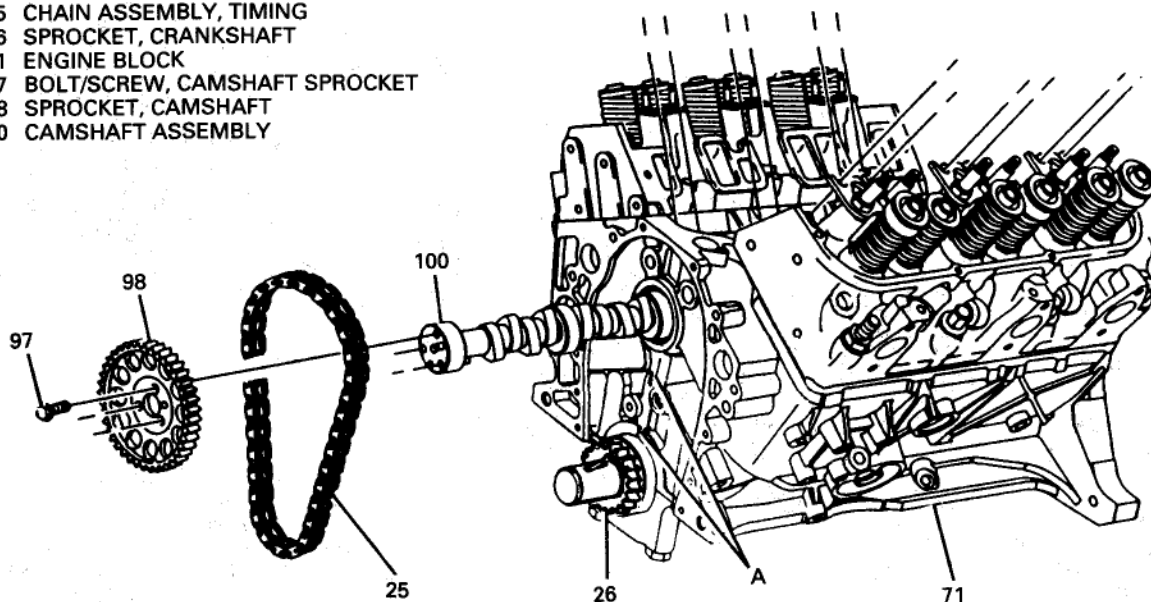
TIMING CHAIN ASSEMBLY, AND CRANKSHAFT AND CAMSHAFT SPROCKETS

Figures 16 through 19

Tools Required:

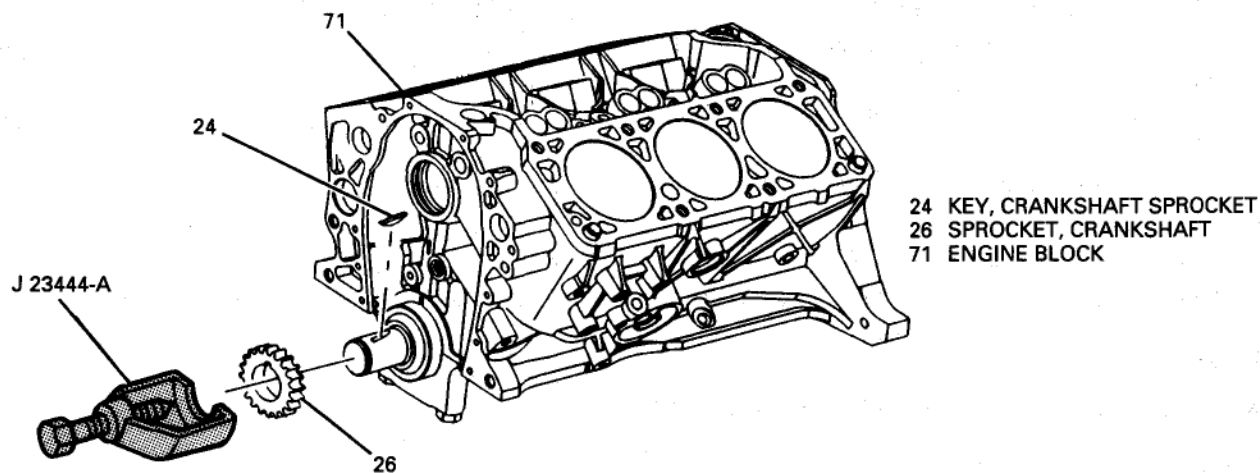
- J 23444-A Crankshaft Sprocket Remover
- J 38612 Crankshaft Sprocket Installer

- A ALIGNMENT MARKS
 25 CHAIN ASSEMBLY, TIMING
 26 SPROCKET, CRANKSHAFT
 71 ENGINE BLOCK
 97 BOLT/SCREW, CAMSHAFT SPROCKET
 98 SPROCKET, CAMSHAFT
 100 CAMSHAFT ASSEMBLY



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Figure 16 – Camshaft Assembly, Sprockets and Timing Chain Assembly



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Figure 17 – Removing Crankshaft Sprocket

Remove or Disconnect

1. Engine front cover assembly. Refer to "Engine Front Cover Assembly" in this section.
2. Rotate crankshaft assembly (22) until timing marks punched on crankshaft sprocket (26) and camshaft sprocket (98) are aligned to marks on engine block (71) or timing chain dampener. See Figure 16. This is the number 4 piston at top dead center.
3. Camshaft sprocket bolts/screws (97).
4. Camshaft sprocket (98) and timing chain assembly (25).
5. Crankshaft sprocket (26) using J 23444-A.
6. Timing chain dampener bolts/screws (62) and dampener (63).

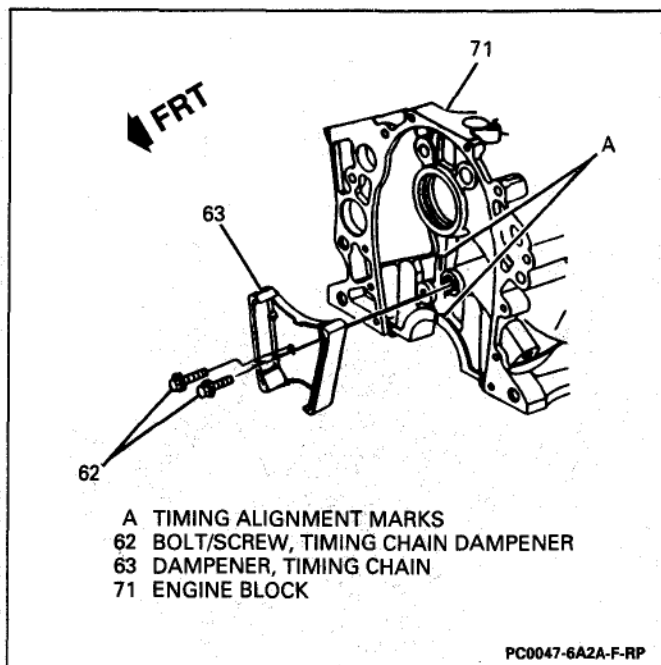


Figure 18 - Timing Chain Dampener

7. Key (24), if necessary.

Inspect

- Refer to SECTION 6A2B for component inspection.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

- Key (24), if previously removed.
- Crankshaft sprocket (26) using J 38612.
- Camshaft sprocket (98) and timing chain assembly (25).
 - Make sure timing marks on camshaft and crankshaft sprockets are aligned with marks cast into engine block.
 - Coat crankshaft and camshaft sprockets with engine oil.
- Camshaft sprocket bolts/screws (97).

Tighten

- Camshaft sprocket bolts/screws (97) to 24 N•m (18 lb. ft.).
5. Timing chain dampener (63) and bolts/screws (62).

Tighten

- Bolts/screws (62) to 21 N•m (15 lb. ft.).
6. Engine front cover assembly. Refer to "Engine Front Cover Assembly" in this section.

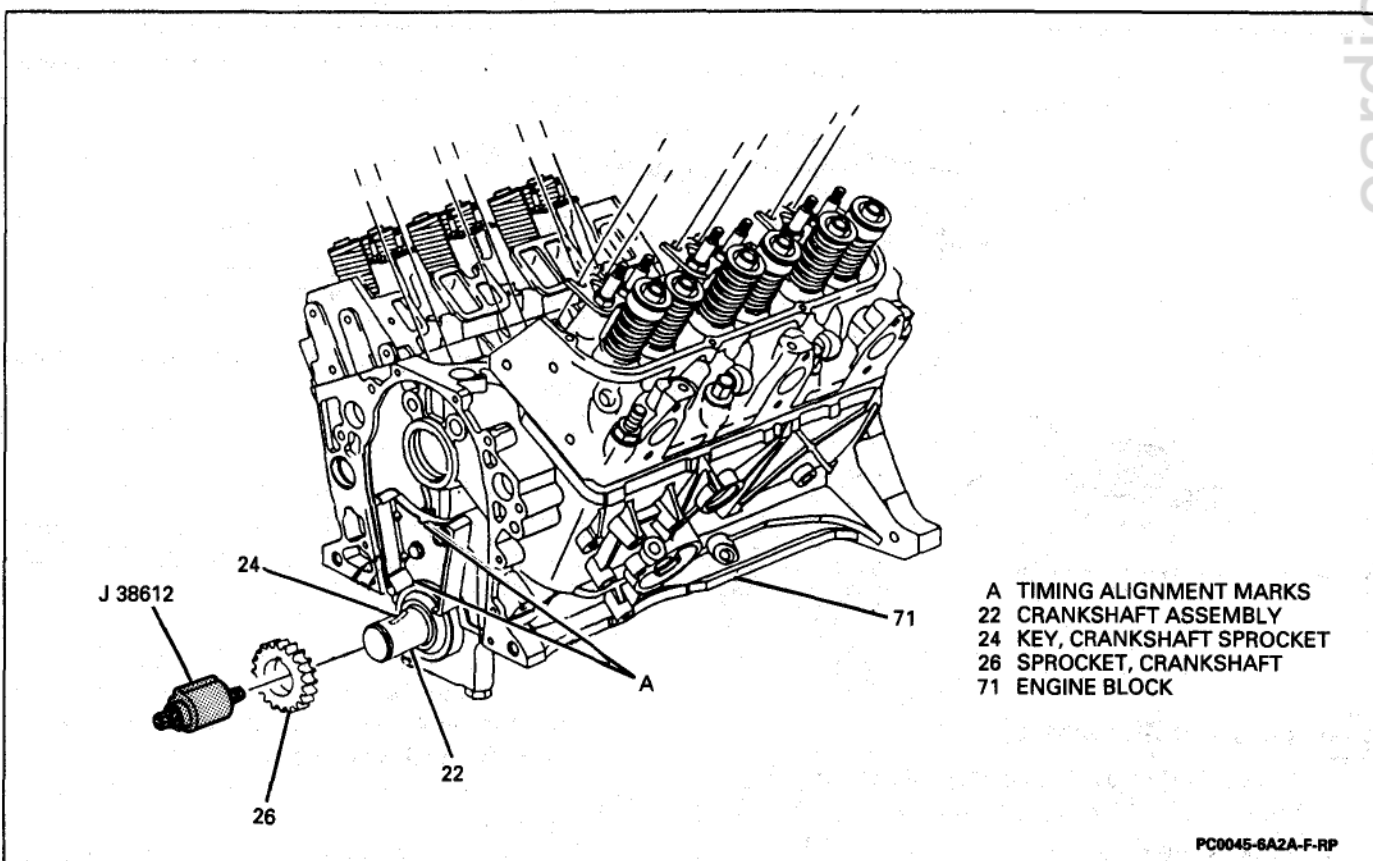


Figure 19 - Installing Crankshaft Sprocket

CAMSHAFT ASSEMBLY

Figures 20, 21 and 22

Measuring Camshaft Lobe Lift

Tool Required:

J 8520 Cam Lobe Lift Indicator

Measuring lobe lift procedure is similar to that used for checking valve timing. If improper valve operation is indicated, measure lift of each pushrod in consecutive order and record readings.

1. Remove valve rocker arm. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
2. Position J 8520 with ball socket adapter on pushrod. Make sure pushrod is in lifter socket.
3. Rotate crankshaft slowly in direction of rotation until lifter is on heel of camshaft lobe. At this point, pushrod is in its lowest position.
4. Set dial indicator on zero, then rotate crankshaft slowly until pushrod is in fully raised position (Figure 20).
5. Compare total lift recorded from dial indicator with specifications.
6. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
7. Install and adjust rocker arms. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.

Remove or Disconnect

1. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
2. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
3. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.
4. Bolt/screw (91), clamp (92) and oil pump drive assembly (90).

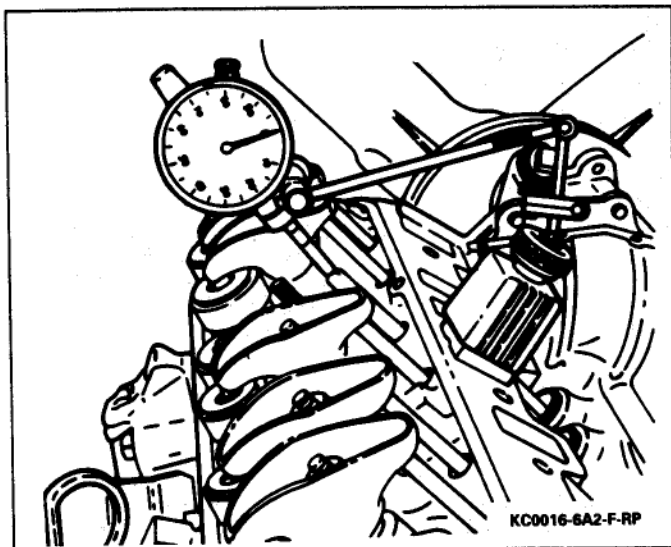


Figure 20 – Measuring Camshaft Lobe Lift

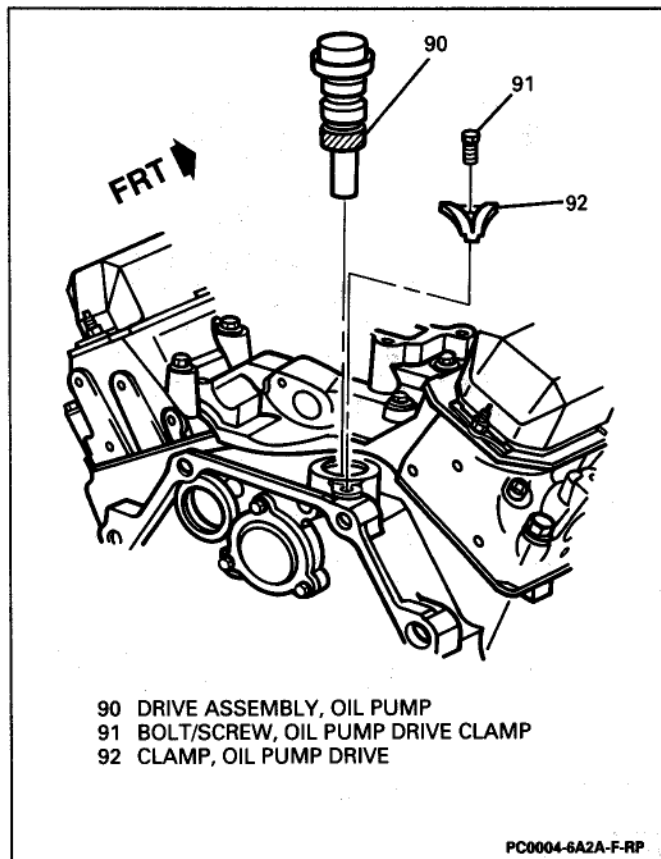


Figure 21 – Oil Pump Drive Assembly

5. Engine front cover assembly. Refer to "Engine Front Cover Assembly" in this section.
 6. Camshaft sprocket. Refer to "Timing Chain Assembly, and Crankshaft and Camshaft Sprockets" in this section.
 7. Valve lifter assemblies. Refer to "Valve Lifter Assemblies" in this section.
 8. Discharge air conditioning system. Refer to SECTION 1B.
 9. Air conditioning compressor and condenser hose from condenser.
 10. Air conditioning receiver and dehydrator hose from condenser.
 11. Radiator assembly with air conditioning condenser. Refer to SECTION 6B.
 12. Air conditioning condenser support assembly.
- NOTICE:** All camshaft journals are the same diameter so care must be used in removing the camshaft to avoid damage to the bearings.
13. Camshaft assembly (100).
 - A. Install three 5/16-18 x 4-inch bolts/screws in camshaft bolt/screw holes.
 - B. Carefully rotate and pull camshaft assembly (100) out of bearings.

Important

- Refer to "Cleaning, Inspection and Repair" in SECTION 6A2B for inspection and measurement procedures for camshaft assembly.

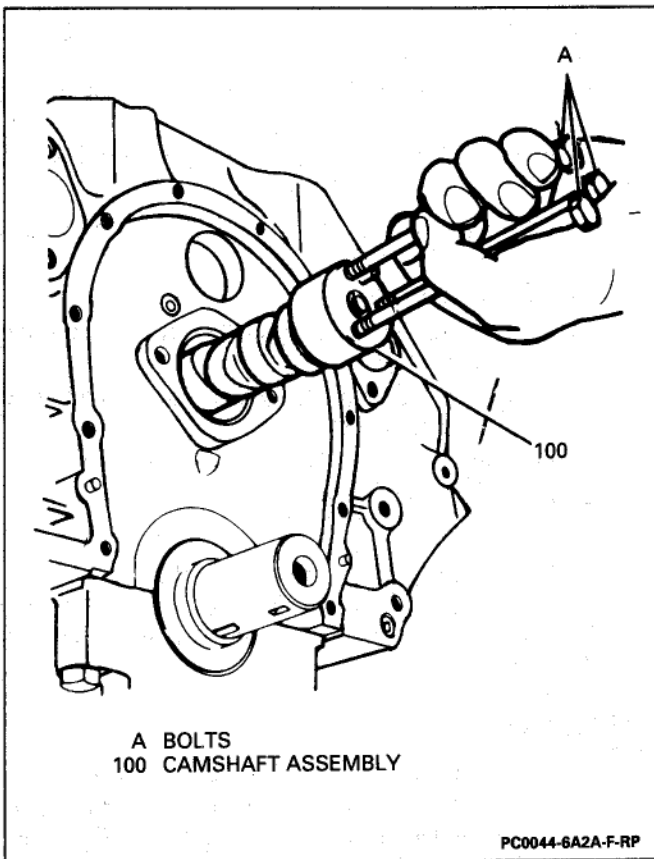


Figure 22 – Removing and Installing Camshaft Assembly

**Inspect**

- Camshaft bearings for scratches, pits, or loose fit in their bores. Replace camshaft bearings, if necessary. Refer to SECTION 6A2B.

**Install or Connect**

NOTICE: See “Notice” on page 6A2A of this section.

1. When installing a new camshaft assembly (100), coat camshaft lobes with “Molykote” or its equivalent.
2. When installing a new camshaft assembly (100), replace all valve lifter assemblies to ensure durability of camshaft lobes and lifter rollers.
3. Lubricate all camshaft journals with engine oil.
4. Camshaft assembly (100).
5. Air conditioning condenser support assembly.
6. Radiator assembly with air conditioning condenser. Refer to SECTION 6B.
7. Air conditioning receiver and dehydrator hose to condenser.
8. Air conditioning compressor and condenser hose to condenser.
9. Charge air conditioning system. Refer to SECTION 1B.
10. Valve lifter assemblies. Refer to “Valve Lifter Assemblies” in this section.

11. Camshaft sprocket. Refer to “Timing Chain Assembly, Crankshaft and Camshaft Sprockets” in this section.
12. Engine front cover assembly. Refer to “Engine Front Cover Assembly” in this section.
13. Oil pump drive assembly (90), clamp (92) and bolt/screw (91).
 - Lubricate oil pump drive gear with prelube, GM P/N 1052365 or equivalent.
 - Lubricate assembly with engine oil for ease of installation.

**Tighten**

- Oil pump drive clamp bolt/screw (91) to 34 N•m (25 lb. ft.).
14. Lower intake manifold assembly. Refer to “Lower Intake Manifold Assembly” in this section.
 15. Valve rocker arms and pushrod assemblies. Refer to “Valve Rocker Arms and Pushrod Assemblies” in this section.
 16. Upper intake manifold assembly. Refer to “Upper Intake Manifold Assembly” in this section.

VALVE SPRINGS AND STEM SEALS**Figures 23 and 24****Tools Required:**

- J 23590 Spark Plug Port Adapter
- J 5892-C Valve Spring Compressor (Head-On)
- J 23738-A Valve Stem Seal Tester

**Remove or Disconnect**

1. Valve rocker arms and pushrod assemblies at cylinder to be serviced. Refer to “Valve Rocker Arms and Pushrod Assemblies” in this section.
2. Spark plug at cylinder to be serviced.
3. Install J 23590 to spark plug hole and apply compressed air to hold valve (125 or 132) in place.

NOTICE: When using the valve spring compressor, be careful not to scratch or gouge the valve stem.
4. Compress valve spring (128 or 135) using J 5892-C (Figure 23).
5. Valve stem key (131 or 139).
6. Valve spring cap (130 or 138), and oil shield (137) on exhaust valves.
7. Valve spring (128 or 135) and dampener (127 or 134).
8. Intake valve stem oil seal (126).
9. Valve stem O-ring seal (129 or 136).

**Install or Connect**

NOTICE: See “Notice” on page 6A2A-1 of this section.

1. Intake valve stem oil seal (126) and seat seal against cylinder head, or valve spring shim, if equipped.
2. Valve stem O-ring seal (129 or 136).

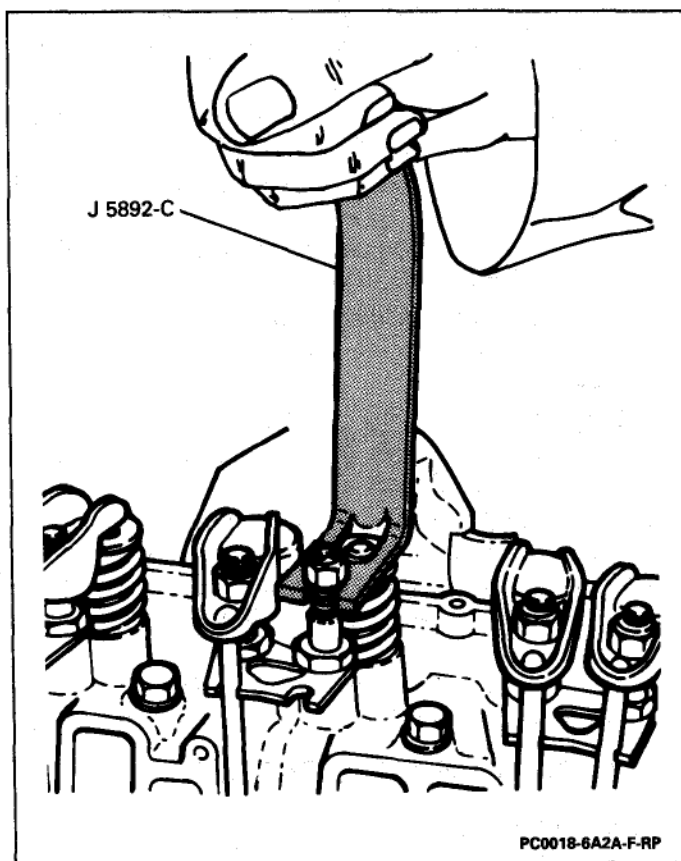


Figure 23 - Compressing Valve Spring

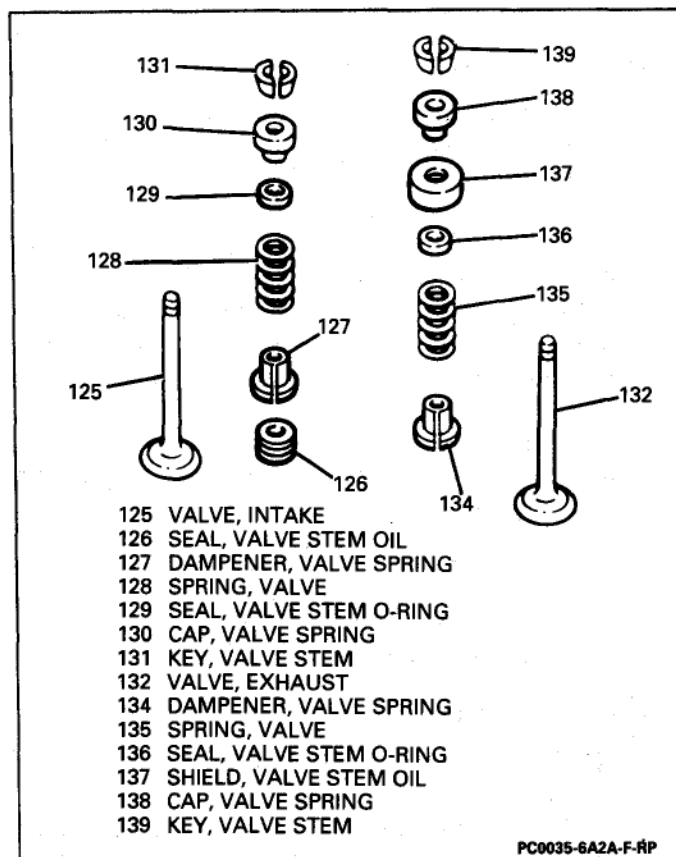


Figure 24 - Valve Assemblies

3. Valve spring dampener (127 or 134) and spring (128 or 135).
4. Valve spring oil shield (137) on exhaust valve and valve cap (130 or 138).
5. Compress valve spring (128 or 135) using J 5892-C.
6. Valve stem key (131 or 139).
 - A. Use grease to hold key in place while disconnecting J 5892-C.
 - B. Remove J 23590.
 - C. Make sure key seats properly in upper groove of valve stem.
 - D. Tap end of stem with a plastic-faced hammer to seat key, if necessary.
7. Spark plug.

**Tighten**

- Spark plug to 15 N•m (11 lb. ft.).
8. Valve rocker arms and pushrod assemblies. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.

**Inspect**

- Valve stem O-ring seal (129 or 136) for leaks.
 - Place J 23738-A in position over end of valve stem and against valve spring cap (130 or 138). Operate J 23738-A and make sure no air leaks past valve stem O-ring seals (129 or 136).

**Measure**

- Valve spring installed height.
 - Use a narrow, thin scale and measure from bottom of valve spring (128 or 135) on dampener lip to bottom inside of oil shield (137) for exhaust valve (132) and to top of valve spring cap (130) for intake valve (125). If measurement exceeds specified height, install valve spring seat shims as necessary. Do not shim so height is less than specified.

CYLINDER HEAD ASSEMBLY AND GASKET

Figure 25

Tool Required:

J 36660 Torque Angle Meter

Left Cylinder Head Assembly**Remove or Disconnect**

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Drain coolant. Refer to SECTION 6B.
3. Lower vehicle.
4. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
5. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
6. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.

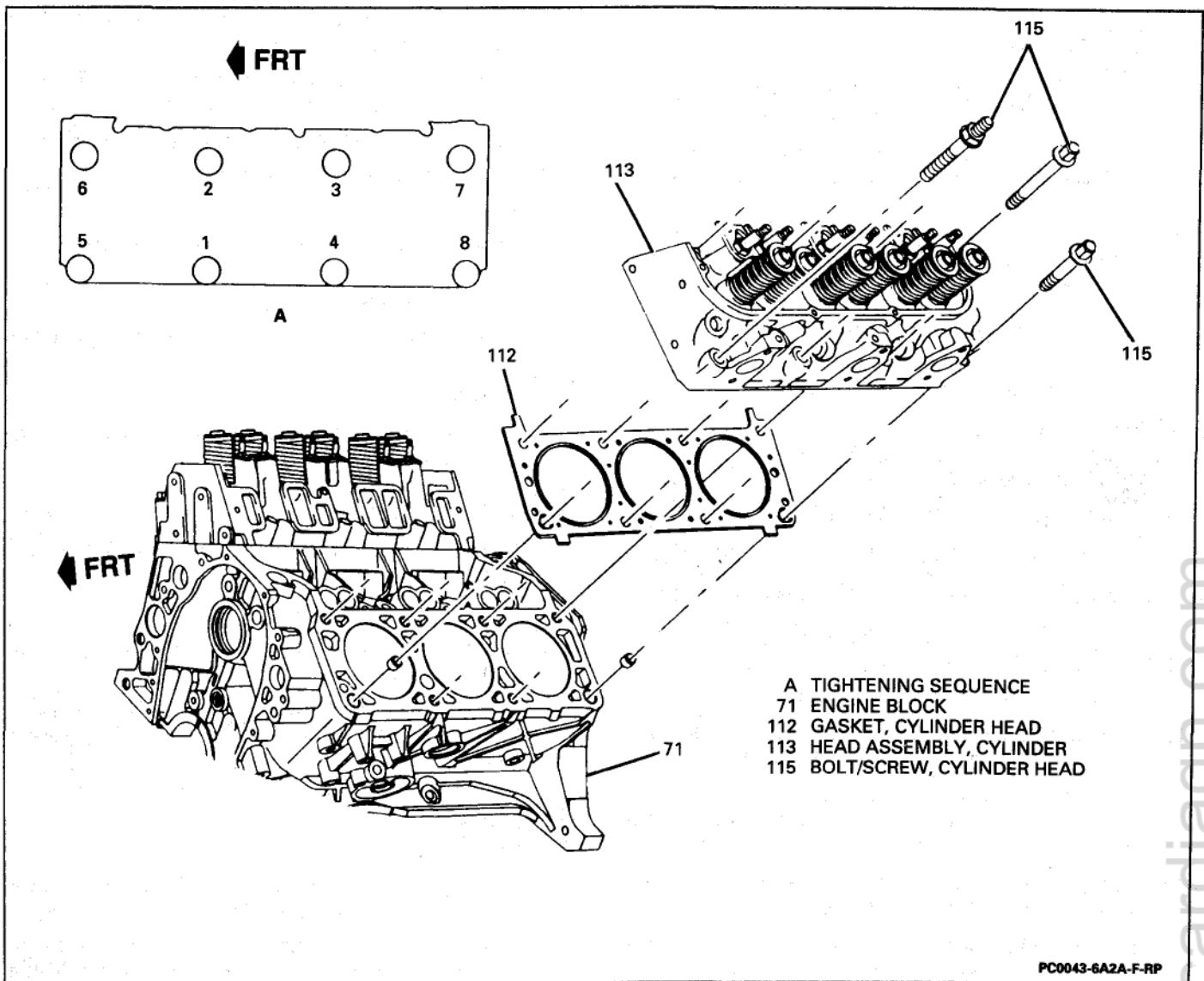


Figure 25 – Cylinder Head Assembly

7. Left exhaust manifold assembly. Refer to "Exhaust Manifold Assemblies" in this section.
8. Oil level indicator and tube assemblies. Refer to "Oil Level Indicator and Tube Assemblies" in this section.
9. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
10. Coolant temperature sensor connector.
11. Spark plug wires from spark plugs.
12. Spark plugs.
13. Engine lift bracket.
14. Wiring harness clip from rear of cylinder head assembly (113).
15. Secondary air injection pipe bracket bolt/screw.
16. Power steering pump assembly and brackets and lay aside. Refer to SECTION 3B1.
17. Loosen rocker arms until pushrod assemblies can be removed.

18. Cylinder head bolts/screws (115).

19. Cylinder head assembly (113) and gasket (112).



Important

- Refer to SECTION 6A2B for cylinder head assembly cleaning, inspection and repair.



Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. New cylinder head gasket (112).
2. Cylinder head assembly (113) over locator pins and gasket (112).
3. Coat threads of cylinder head bolts/screws (115) with sealing compound, GM P/N 1052080 or equivalent.
4. Cylinder head bolts/screws (115) finger tight.

**Tighten**

- Cylinder head bolts/screws (115) in sequence to 55 N•m (41 lb. ft.) (Figure 25).
 - Turn cylinder head bolts/screws (115) in sequence an additional 90 degrees using J 36660
5. Pushrod assemblies and rocker arms. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
 6. Power steering pump assembly and brackets. Refer to SECTION 3B1.
 7. Secondary air injection pipe bracket bolt/screw.
 8. Spark plugs.

**Tighten**

- Spark plugs to 15 N•m (11 lb. ft.).
9. Spark plug wire harness assembly to spark plugs.
 10. Wiring harness clip to rear of cylinder head assembly (113).
 11. Engine lift bracket.
 12. Coolant temperature sensor connector.
 13. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
 14. Oil level indicator and tube assemblies. Refer to "Oil Level Indicator and Tube Assemblies" in this section.
 15. Left exhaust manifold assembly. Refer to "Exhaust Manifold Assemblies" in this section.
 16. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.
 17. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
 18. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
 19. Refill with coolant. Refer to SECTION 6B.

Right Cylinder Head Assembly**Remove or Disconnect**

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Drain coolant. Refer to SECTION 6B.
3. Lower vehicle.
4. Serpentine drive belt tensioner assembly. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
5. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
6. Valve rocker arm cover assemblies. Refer to "Valve Rocker Arm Cover Assemblies" in this section.

7. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.
8. Right exhaust manifold assembly. Refer to "Exhaust Manifold Assemblies" in this section.
9. Generator and brackets. Refer to SECTION 6D3.
10. Spark plug wires from spark plugs.
11. Spark plugs.
12. Loosen rocker arms until pushrod assemblies can be removed.
13. Cylinder head bolts/screws (115).
14. Cylinder head assembly (113) and gasket (112).

**Important**

- Refer to SECTION 6A2B for cylinder head assembly cleaning, inspection and repair.

**Install or Connect**

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. New cylinder head gasket (112).
2. Cylinder head assembly (113) over locator pins and gasket (112).
3. Coat threads of cylinder head bolts/screws (115) with sealing compound, GM P/N 1052080 or equivalent.
4. Cylinder head bolts/screws (115) finger tight.

**Tighten**

- Cylinder head bolts/screws (115) in sequence to 55 N•m (41 lb. ft.) (Figure 25).
 - Turn cylinder head bolts/screws (115) in sequence an additional 90 degrees using J 36660
5. Pushrod assemblies and rocker arms. Refer to "Valve Rocker Arms and Pushrod Assemblies" in this section.
 6. Spark plugs.

**Tighten**

- Spark plugs to 15 N•m (11 lb. ft.).
7. Spark plug wires to spark plugs.
 8. Generator and brackets. Refer to SECTION 6D3.
 9. Right exhaust manifold assembly. Refer to "Exhaust Manifold Assemblies" in this section.
 10. Lower intake manifold assembly. Refer to "Lower Intake Manifold Assembly" in this section.
 11. Valve rocker arm covers. Refer to "Valve Rocker Arm Cover Assemblies" in this section.
 12. Upper intake manifold assembly. Refer to "Upper Intake Manifold Assembly" in this section.
 13. Serpentine drive belt tensioner assembly. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.

14. Refill with coolant. Refer to SECTION 6B.

OIL PAN ASSEMBLY

Figure 26

Remove or Disconnect

CAUTION: See "Caution" on page 6A2A-1 of this section.

1. Battery negative cable assembly.
2. Air intake duct.
3. Raise and suitably support vehicle. Refer to SECTION 0A.
4. Drain engine oil.
5. Wiring harness clips from left side of oil pan assembly (1).
6. Oil level sensor connector.
7. Oil level sensor assembly.
8. Exhaust crossover pipes from exhaust manifold assemblies. Refer to SECTION 6F.
9. Exhaust pipe hanger bolt/screw and reposition pipe. Refer to SECTION 6F.
10. Transmission fluid cooler lines from clip at oil pan assembly (automatic transmission).
11. Starter motor assembly. Refer to SECTION 6D2.
12. Converter cover bolts/screws and cover (automatic transmission). Refer to SECTION 7A.
13. Engine mount through-bolts/screws.
14. Raise engine with jacking fixture.
15. Oil pan bolts/screws (12), studs (13), nuts (11) and reinforcements (10).
16. Oil pan assembly (1) and gasket (2).
 - Rotate crankshaft assembly to reposition counterweights if necessary.

Important

- If adequate clearance is not available, to remove the oil pan assembly from the engine, follow these steps:
 - A. With engine raised from its mounts, place jackstands at either end of engine frame assembly for additional support.
 - B. Loosen engine frame assembly mounting bolts/screws NO MORE THAN SIX COMPLETE REVOLUTIONS.

Clean

1. Oil pan and engine block gasket surfaces.
2. Apply a small amount of sealer, GM P/N 12345739 or equivalent, where oil pan gasket tabs seat on rear crankshaft bearing cap groove.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Oil pan gasket (2) and oil pan assembly (1).
2. Oil pan nuts (11), reinforcements (10), bolts/screws (12) and studs (13).

Tighten

- Front corner oil pan nuts (11) to 33 N•m (24 lb. ft.).
 - Rear corner oil pan bolts/screws to 25 N•m (18 lb. ft.).
 - Oil pan side rail bolts/screws (12) to 10 N•m (89 lb. in.).
 - Oil pan studs (13) to 6 N•m (53 lb. in.).
3. Lower engine.
 4. Engine mount through-bolts/screws.
 5. Oil level sensor assembly.

Tighten

- Engine mount through-bolts/screws to 95 N•m (70 lb. ft.).
 - Engine oil level sensor assembly to 22 N•m (16 lb. ft.).
6. Converter cover and bolts/screws (automatic transmission). Refer to SECTION 7A.
 7. Starter motor assembly. Refer to SECTION 6D2.
 8. Transmission fluid cooler lines to clip at oil pan assembly (automatic transmission).
 9. Exhaust pipe hanger bolt/screw.
 10. Exhaust crossover pipes to exhaust manifold assemblies. Refer to SECTION 6F.
 11. Oil level sensor connector.
 12. Wiring harness clips to oil pan assembly (1).
 13. Lower vehicle.
 14. Air intake duct.
 15. Refill engine with oil.
 16. Battery negative cable assembly.

OIL PUMP ASSEMBLY

Figure 27

Remove or Disconnect

1. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
2. Bolt/screw (16) attaching oil pump assembly (17) to rear crankshaft bearing cap.
3. Oil pump assembly (17) and driveshaft (18).

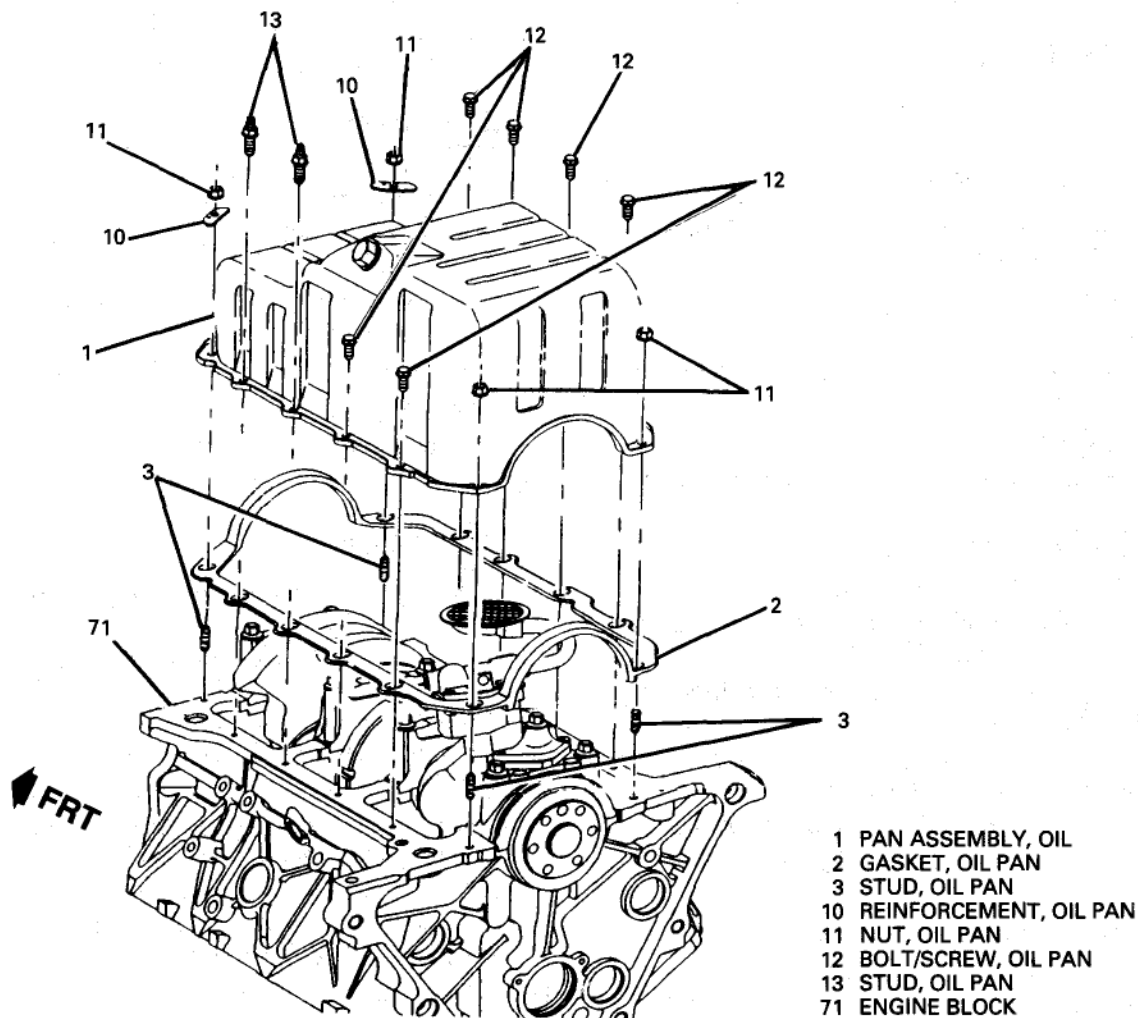
Important

- Refer to SECTION 6A2B for oil pump assembly cleaning, inspection and repair.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Oil pump assembly (17) and driveshaft (18).



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Figure 26 - Oil Pan Assembly

- Align slot on end of intermediate shaft (18) with drive tang on oil pump drive assembly.

2. Bolt/screw (16) attaching oil pump assembly (17) to rear crankshaft bearing cap.

**Tighten**

- Bolt/screw (16) to 41 N•m (30 lb. ft.).

3. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.

CONNECTING ROD BEARINGS**Figures 28, 29 and 30**

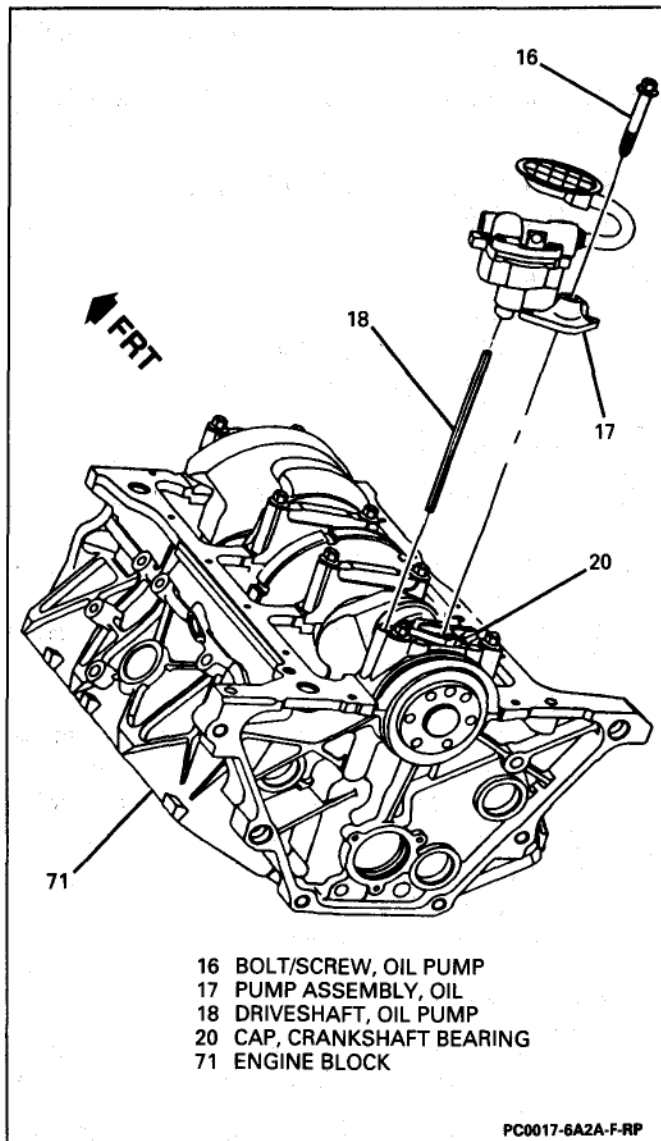
Connecting rod bearings are the precision insert type and do not use shims for adjustment. Do not file connecting rods or rod caps. If clearances are found to be excessive, a new bearing will be required. Service bearings are available in standard size and 0.013 and 0.026 mm under-size for use with new and used standard size crankshafts.

**Remove or Disconnect**

1. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
2. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.

**Important**

- Place matchmarks or numbers on connecting rod assemblies (83) and connecting rod caps (81). Connecting rod caps (81) must be assembled to their original connecting rod assemblies (83).
3. Connecting rod nuts (80).
 4. Connecting rod cap (81) and bearings (82).
 - Keep bearings (82) with their original connecting rod assembly (83) and cap (81) for reassembly.
 - Wipe oil from bearings (82) and crankpins.



- 16 BOLT/SCREW, OIL PUMP
17 PUMP ASSEMBLY, OIL
18 DRIVESHAFT, OIL PUMP
20 CAP, CRANKSHAFT BEARING
71 ENGINE BLOCK

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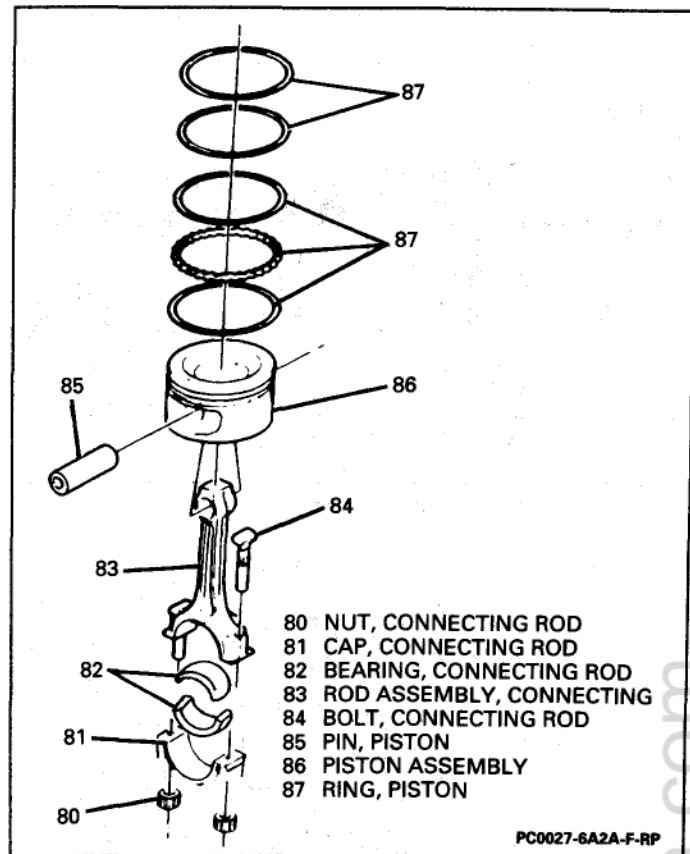
Figure 27 - Oil Pump Assembly

Inspect

- Bearings (82) for excessive wear or damage.

Measure

1. Crankpin for out-of-round and taper with a micrometer. Refer measurements to "Specifications" in this section.
 - If not within specifications, replace or recondition crankshaft assembly.
 - If installing new bearings (82), determine new bearing size from the maximum crankpin diameter.
2. Bearing clearances, using gaging plastic.
 - A. Place piece of gaging plastic the full width of bearing (82), (parallel to crankshaft assembly) onto the crankpin.
 - Gaging plastic should be positioned in middle of bearing (82). Bearing (82) is



- 80 NUT, CONNECTING ROD
81 CAP, CONNECTING ROD
82 BEARING, CONNECTING ROD
83 ROD ASSEMBLY, CONNECTING
84 BOLT, CONNECTING ROD
85 PIN, PISTON
86 PISTON ASSEMBLY
87 RING, PISTON

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Figure 28 - Piston and Connecting Rod Assembly

thickest in center and bearing clearance must be measured at this location.

- B. Install connecting rod cap (81) with bearing (82) onto connecting rod assembly (83).
- C. Install connecting rod nuts (80).

Tighten

- Connecting rod nuts (80), evenly, to 50 N•m (37 lb. ft.).

NOTICE: Do not turn the crankshaft assembly with the gaging plastic installed or the accuracy of the measurement will be affected.

- D. Remove connecting rod nuts (80) and cap (81). Gaging plastic will be found adhering to either connecting rod cap (81) or crankshaft journal and is measured without removing it.
- E. Measure gaging plastic at its widest, using scale provided with gaging plastic. Refer measurements to "Specifications" in this section.
 - If clearance is greater than specified, select an undersize bearing (82) and re-measure clearance.
 - If clearance cannot be brought to specifications, regrind crankpin. If crankpin is already at maximum undersize, replace crankshaft assembly (22).
- F. Remove all gaging plastic material after measuring.

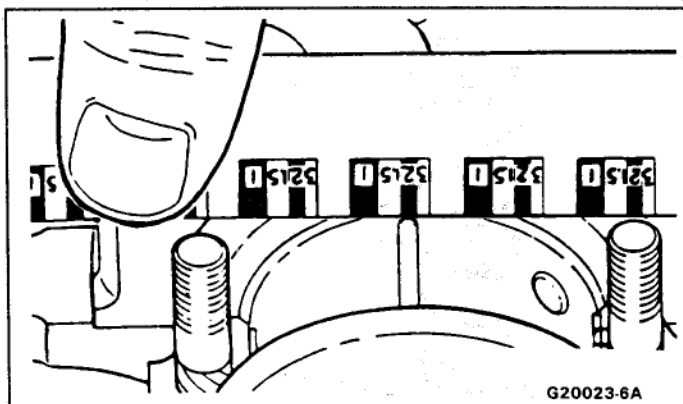


Figure 29 - Measuring Bearing Clearance

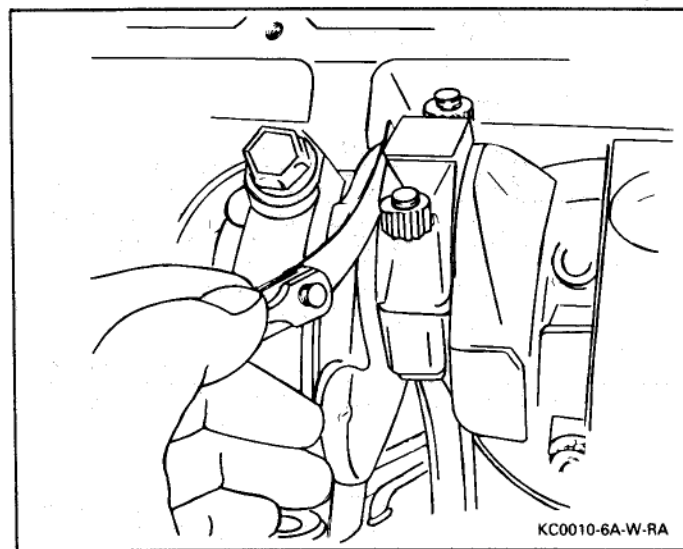


Figure 30 - Measuring Connecting Rod Side Clearance

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Coat inside surface of bearings (82) with engine oil.
2. Connecting rod cap (81) and bearings (82).
3. Connecting rod nuts (80).

Tighten

- Connecting rod nuts (80), evenly, to 50 N•m (37 lb. ft.).

Measure

- Connecting rod side clearance.
 - A. When all connecting rod bearings (82) have been installed, tap each connecting rod assembly (83) lightly parallel to crankpin to make sure they have clearance.
 - B. Measure side clearance between connecting rod caps (81) using a feeler gage, or dial indicator.
 - C. Rod side clearance should be 0.18 to 0.44 mm (0.007 to 0.017 inch).

4. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.
5. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.

PISTON AND CONNECTING ROD ASSEMBLIES

Figures 28 and 31

Tools Required:

- J 5239 Connecting Rod Bolt Guide Set
- J 8037 Piston Ring Compressor

Remove or Disconnect

1. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
2. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.
3. Cylinder head assembly. Refer to "Cylinder Head Assembly and Gasket" in this section.
4. Ring ridge.
 - A. Turn crankshaft assembly (22) until piston assembly (86) is at bottom of its stroke.
 - B. Place a cloth on top of piston assembly (86).
 - C. Use a ridge reamer to remove ring ridge.
 - D. Turn crankshaft assembly (22) so piston assembly (86) is at top of its stroke.
 - E. Remove cloth and cutting debris.

Important

- Place matchmarks or numbers on connecting rod assemblies (83) and connecting rod caps (81). Connecting rod caps (81) must be assembled to their original connecting rod assemblies (83).
5. Connecting rod nuts (80) and cap (81).
 6. Connecting rod assembly (83) and piston assembly (86) out of top of engine block using J 5239.

Important

- Refer to SECTION 6A2B for cleaning, inspection and repair of piston and connecting rod assembly.

Clean

1. Cylinder bores with hot water and detergent or with a light honing.
2. Swab bores with engine oil and a clean, dry cloth.

Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Coat piston assembly (86), piston rings, cylinder bore, and bearing surfaces with engine oil.
2. Piston assembly (86) into its original bore using J 5239 and J 8037 and lightly tapping top of piston assembly (86) with a wooden hammer handle.

- A. When installing piston assembly (86) and connecting rod assembly (83), stamped arrow on piston assembly (86) must point to front of engine while flange on connecting rod assembly (83) must face toward front of piston on left hand assembly and face toward rear of piston on right hand assembly.
- B. Hold J 8037 firmly against engine block until all piston rings have entered cylinder bore.
3. Connecting rod caps (81) onto their original connecting rod assemblies (83).
 - Align matchmarks or numbers which were placed on connecting rod assembly (83) and connecting rod cap (81) during removal.
4. Connecting rod nuts (80).

**Tighten**

- Connecting rod nuts (80), evenly, to 50 N•m (37 lb. ft.).

**Inspect**

- Connecting rod assembly (83) for binding by prying back and forth with a suitable tool. If necessary, loosen and retighten connecting rod cap (81).

**Measure**

- Connecting rod side clearance. Refer to "Specifications" in this section.

5. Cylinder head assembly. Refer to "Cylinder Head Assembly and Gasket" in this section.
6. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.
7. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.

CRANKSHAFT BEARINGS**Figures 31 and 32****Tools Required:**

J 8080 Main Bearing Shell Remover and Installer

J 36660 Torque Angle Meter

Crankshaft bearings are of the precision insert type. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are available in both standard size and undersize. Replace both bearing shells as a set.

**Remove or Disconnect**

1. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
2. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.
3. Spark plugs.
4. Cap (20) and lower crankshaft bearing (23) requiring replacement.

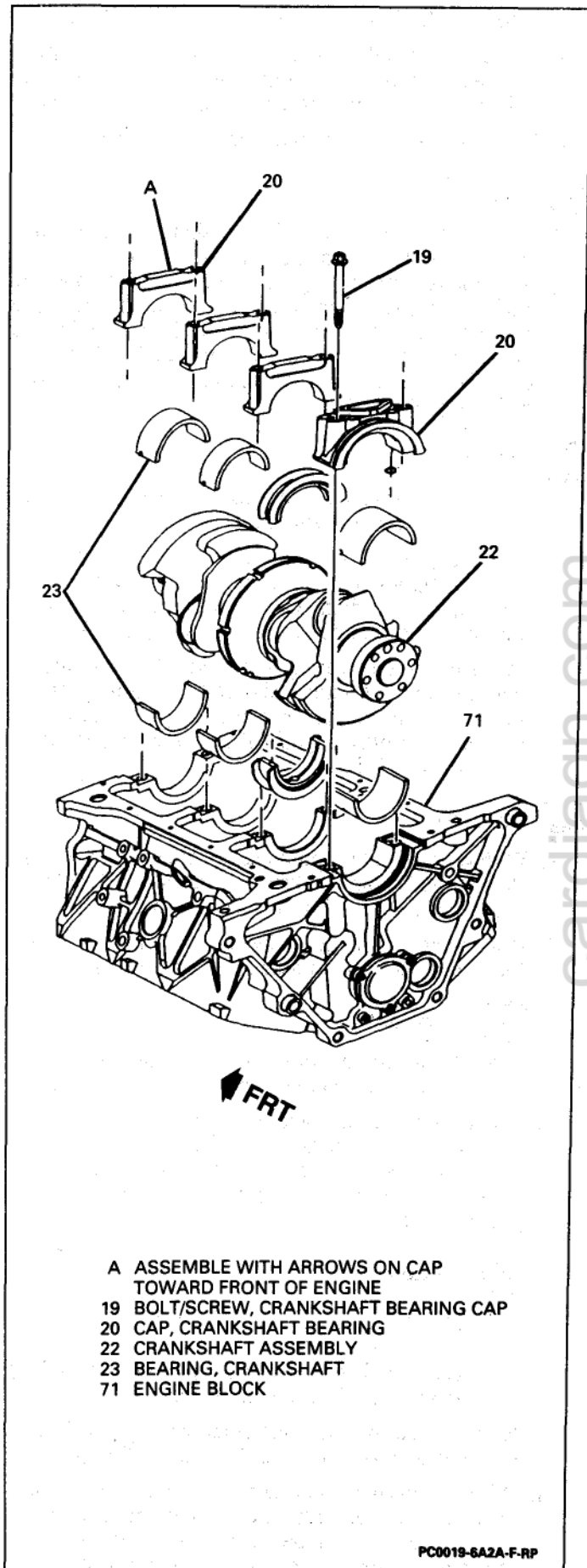


Figure 31 – Crankshaft Assembly

5. Insert J 8080 into oil hole in crankshaft journal.
6. Rotate crankshaft assembly (22) allowing J 8080 to push against insert's straight (unnotched) side. This will roll upper crankshaft bearing (23) out of block.
7. Remove J 8080 from crankshaft assembly (22).



Inspect

- In general, lower half of crankshaft bearing insert (except number 1 bearing) shows a greater wear and most distress from fatigue. If upon inspection lower half is suitable for use, it can be assumed that upper half is also satisfactory. If lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing other half.



Important

- To obtain most accurate results when checking crankshaft bearing clearances, use gaging plastic.
- When engine is in vehicle, crankshaft assembly must be supported upward to remove any clearance from upper bearing. Total clearance can then be measured between lower bearing and journal.
- To assure proper seating of crankshaft assembly, all bearing cap bolts/screws should be at their specified torque. In addition, prior to checking fit of bearings, surface of crankshaft journal and bearing should be wiped clean of oil.



Measure

1. With oil pan and oil pump assemblies removed, and starting with rear crankshaft bearing, remove bearing cap and wipe oil from journal and bearing cap.
2. Place a piece of gaging plastic full width of bearing (parallel to crankshaft assembly) on journal.



Important

- Do not rotate crankshaft assembly while gaging plastic is between bearing and journal.
3. Install bearing cap and evenly tighten retaining bolts/screws to specifications. Bearing cap must be tightened to specification in order to assure proper reading. Variations in torque affect compression of gaging plastic.



Tighten

- Crankshaft bearing cap bolts/screws (19) to 50 N•m (37 lb. ft.).
 - Turn crankshaft bearing cap bolts/screws (19) an additional 77 degrees using J 36660.
4. Remove bearing caps. Flattened gaging plastic will be found adhering to either bearing shell or journal.
 5. Without removing gaging plastic, measure its compressed width (at widest point) with graduations on gaging plastic envelope. Normally crankshaft bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-

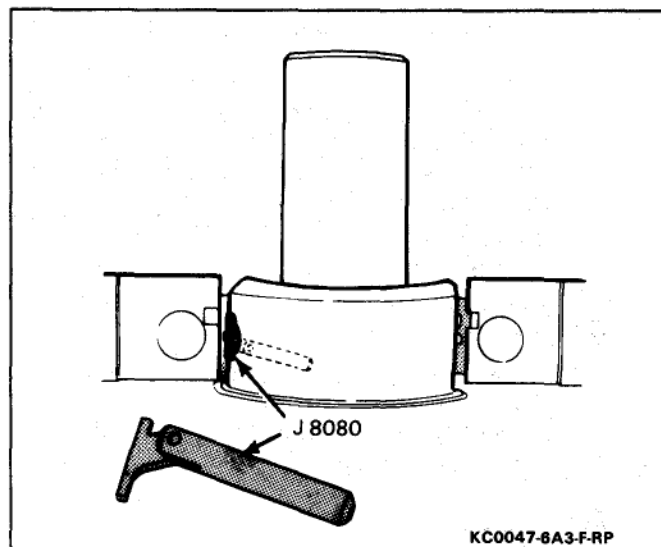


Figure 32 - Removing Crankshaft Bearing

round journal 0.005 mm (0.0002 inch maximum), be sure to fit to maximum diameter of journal. If bearing is fitted to minimum diameter, and journal is out-of-round 0.005 mm (0.0002 inch) or more, interference between bearing and journal will result in rapid bearing failure. If flattened gaging plastic tapers toward middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of bearing or journal. Be sure to measure journal with a micrometer if flattened gaging plastic indicates this difference.

6. If bearing clearance is within specifications, bearing insert is satisfactory. If clearance is not within specifications, replace insert. Always replace both upper and lower inserts as a unit. When bearing cap is installed and clearance is less than 0.032 mm (0.0012 inch), inspect for burrs or nicks.
7. An undersize bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal for use with next undersize bearing. After selecting new bearing, recheck clearance.
8. Proceed to next bearing. When checking number 1 crankshaft bearing, remove serpentine drive belt so as to prevent tapered reading with gaging plastic. After all bearings have been checked, rotate crankshaft assembly to see that there is no excessive drag.



Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Crankshaft bearings (23) into engine block (71) and crankshaft bearing caps (20).
 - A. Coat crankshaft bearings (23) with oil.
 - B. Insert plain (unnotched) end between crankshaft assembly and indented or notched side of block. Rotate bearing into place using J 8080 as previously described, and remove J 8080 from oil hole in crankshaft journal.
2. Crankshaft bearing caps (20) with assembled crankshaft bearings (23) with arrows pointing toward front of engine.

3. Crankshaft bearing cap bolts/screws (19).

- With crankshaft assembly (22), crankshaft bearings (23) and crankshaft bearing caps (20) installed and bolts/screws (19) started, thrust crankshaft assembly (22) rearward to set and align bearing caps (20). Then force crankshaft assembly forward to align crankshaft thrust bearing.

 Tighten

- Crankshaft bearing cap bolts/screws (19) to 50 N•m (37 lb. ft.).
- Turn crankshaft bearing cap bolts/screws (19) evenly an additional 77 degrees using J 36660.

 Measure

- Crankshaft end play, using a dial indicator or feeler gage. Refer to "Specifications" in this section.
 - If using a feeler gage, measure between front of number three crankshaft bearing cap (20) and crankshaft thrust surface.
- 4. Oil pump assembly. Refer to "Oil Pump Assembly" in this section.
- 5. Oil pan assembly. Refer to "Oil Pan Assembly" in this section.
- 6. Spark plugs.

FLYWHEEL ASSEMBLY*Figure 33***Flywheel Assembly Replacement** **Remove or Disconnect**

1. Transmission assembly. Refer to SECTION 7A for an automatic transmission or SECTION 7B for a manual transmission and SECTION 7C for the clutch.
2. Flywheel bolts/screws (36), retainer (34) and flywheel assembly (33).

 Install or Connect

NOTICE: See "Notice" on page 6A2A-1 of this section.

1. Flywheel assembly (33), retainer (34) and flywheel bolts/screws (36).

 Tighten

- Flywheel bolts/screws (36) to 83 N•m (61 lb. ft.).
2. Transmission assembly. Refer to SECTION 7A for an automatic transmission or SECTION 7B for a manual transmission and SECTION 7C for the clutch.

Flywheel Assembly Balancing*Figure 33* **Inspect**

- Flywheel assembly (33) for missing or loose converter-to-flywheel bolts/screws. Tighten or replace as necessary.
- Converter for damage or missing balance weights. If converter is damaged or balance weights are missing, replace converter.
- If flywheel assembly (33) is replaced, new balance weights of same size must be installed on new flywheel assembly in same hole locations as old flywheel assembly.

CRANKSHAFT REAR OIL SEAL ASSEMBLY

Tool Required:

J 34686 Rear Main Bearing Oil Seal Installer

Figures 34 and 35 **Remove or Disconnect**

1. Flywheel assembly. Refer to "Flywheel Assembly Replacement" under "Flywheel Assembly" in this section.
 - Care should be taken not to nick crankshaft sealing surface when removing seal.
2. Crankshaft rear oil seal assembly.
 - Insert a screwdriver or similar tool through dust lip at an angle as shown in Figure 34. Pry seal out by moving handle of tool towards end of crankshaft. Repeat as necessary around seal.

 Install or Connect

1. Coat new seal assembly entirely with engine oil.
2. Seal assembly onto J 34686.
3. J 34686 onto rear of crankshaft assembly. Tighten screws snugly to ensure seal assembly will be installed squarely over crankshaft assembly.
4. Crankshaft rear oil seal assembly to crankshaft assembly.
5. Tighten wing nut on J 34686 until it bottoms.
6. Remove J 34686 from crankshaft assembly.
7. Flywheel assembly. Refer to "Flywheel Assembly Replacement" in this section.

ENGINE ASSEMBLY **Remove or Disconnect**

CAUTION: See "Caution" on page 6A2A-1 of this section.

1. Battery negative cable assembly.
2. Battery positive cable assembly.
3. Raise and suitably support vehicle. Refer to SECTION OA.
4. Front wheels and tires. Refer to SECTION 3E.

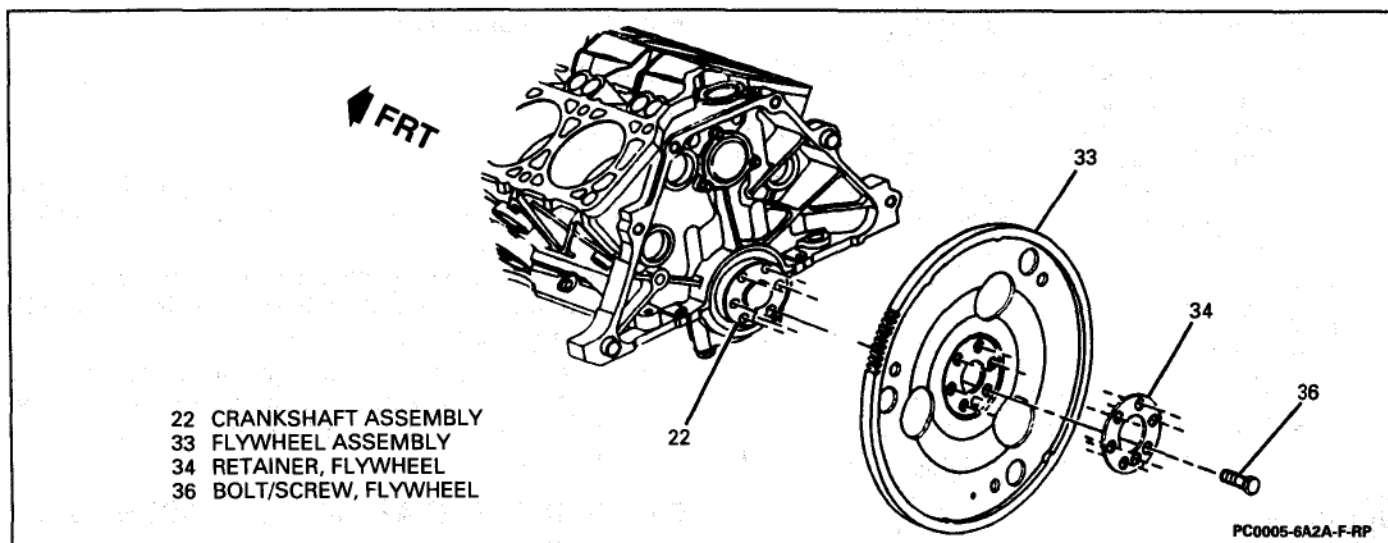


Figure 33 - Flywheel Assembly

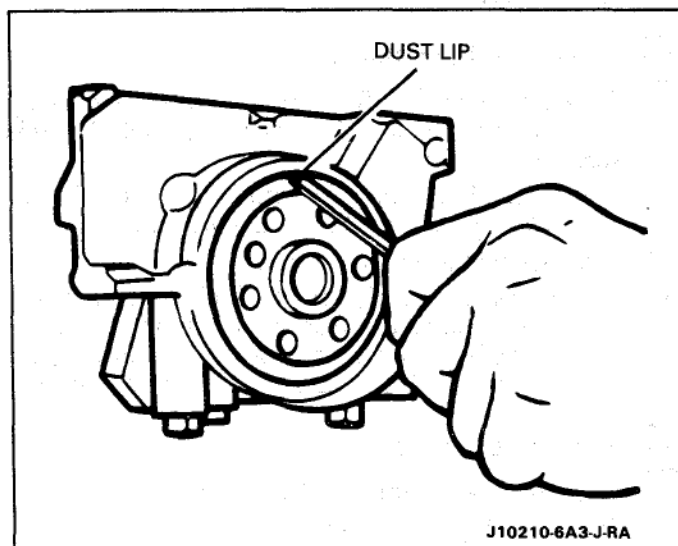


Figure 34 - Removing Crankshaft Rear Oil Seal Assembly

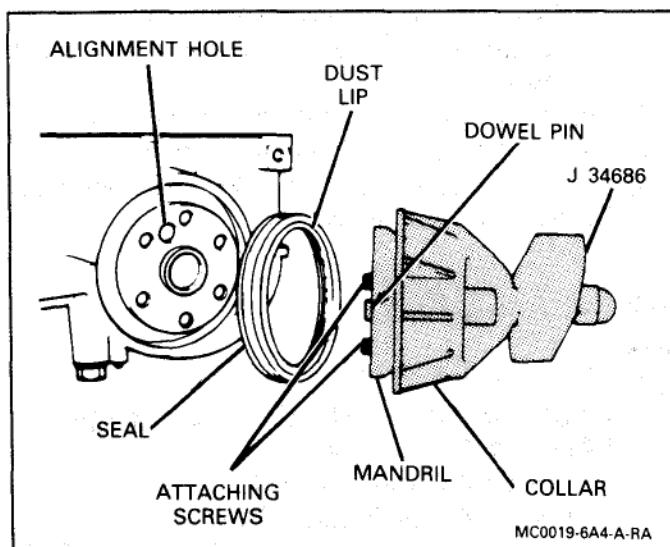


Figure 35 - Installing Crankshaft Rear Oil Seal Assembly

5. Drain coolant. Refer to SECTION 6B.
6. Drain engine oil.
7. Exhaust crossover pipe assembly from intermediate pipe. Refer to SECTION 6F.
8. Converter bolts/screws (automatic transmission). Refer to SECTION 7A.
9. Front fascia lower deflectors. Refer to SECTION 10-5.
10. Stabilizer bar bolts/screws. Refer to SECTION 3C.
11. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in this section.
12. Transmission fluid cooler lines from radiator assembly (automatic transmission). Refer to SECTION 6B.
13. Lower radiator hose from radiator assembly. Refer to SECTION 6B.
14. Heater hoses from pipes at engine assembly. Refer to SECTION 1B1.
15. Electrical ground straps from right side of engine block.
16. Shift linkage from transmission assembly. Refer to SECTION 7A or SECTION 7B.
17. Propeller shaft assembly after matchmarking. Refer to SECTION 4A.
18. Torque arm from transmission assembly. Refer to SECTION 3D.
19. Intermediate steering shaft from rack and pinion assembly. Refer to SECTION 3F4.
20. Electrical ground straps from left side of frame rail.
21. Lower vehicle.
22. Air intake duct.
23. Fuel pipe assembly. Refer to "Upper Intake Manifold Assembly" in this section.
24. Cruise and accelerator control cables from throttle body assembly. Refer to SECTION 6E3.
25. Upper radiator hose from intake manifold assembly. Refer to SECTION 6B.

26. Lower radiator hose from front cover assembly. Refer to SECTION 6B.
27. Brake booster vacuum hose.
28. “Y” brace from right exhaust manifold assembly. Refer to SECTION 6D3.
29. Generator and air conditioning compressor bracket and reposition. Refer to SECTION 6D3.
30. Brace lines from antilock brake system (ABS) brake combination valve. Refer to SECTION 5.
31. Brake lines and clips from ABS hydraulic modulator assembly. Refer to SECTION 5.
32. Right-hand body hinge pillar trim panel assembly. Refer to SECTION 10-5.
33. Three engine wiring harness connectors (blue, black and white connectors) and evaporator temperature sensor connector.
34. Forward lamp wiring harness connectors.
35. Powertrain control module (PCM) and harness.
 - Place PCM and harness on top of engine.
36. Engine wire harness through front of dash.
 - Place harness on top of engine.
37. Positive lead at generator.
38. Positive lead at junction block.
39. Negative lead at mounting stud (located next to the junction block).
40. Lower shock attachment bolts/screws and nuts from lower control arm.
41. Upper control arm ball stud assembly from steering knuckle assembly. Refer to SECTION 3C.
42. Raise and suitably support vehicle. Refer to SECTION OA.
43. Position lift table under engine and engine frame assembly. Use Kent-Moore tool number 204-BX-75G or equivalent.
44. Engine frame and transmission support bolts/screws. Refer to SECTION 10-3.
45. Raise vehicle from engine, transmission and engine frame assemblies.
46. Secure strut assemblies to engine frame.
47. Transmission assembly. Refer to SECTION 7A or SECTION 7B.
48. Clutch housing and clutch assembly (manual transmission). Refer to SECTION 7C.
49. Power steering lines from power steering pump assembly. Refer to SECTION 3B.
50. Engine mount through-bolts/screws.
51. Engine assembly from engine frame.



Install or Connect

NOTICE: See “Notice” on page 6A2A-1 of this section.

1. Engine assembly to engine frame.
2. Engine mount through-bolts/screws.



Tighten

- Engine mount through-bolts/screws to 95 N•m (70 lb. ft.).
3. Power steering lines to power steering pump. Refer to SECTION 3B.
 4. Clutch housing and clutch assembly. Refer to SECTION 7C.
 5. Transmission assembly. Refer to SECTION 7A or SECTION 7B.
 6. Position engine lift table and install engine, transmission and engine frame assemblies by lowering vehicle to crossmember assembly.
 7. Engine frame and transmission support bolts/screws. Refer to SECTION 10-3.
 8. Engine lift table.
 9. Lower vehicle.
 10. Upper control arm ball stud assembly to steering knuckle assembly. Refer to SECTION 3C.
 11. Lower shock attachment bolts/screws and nuts to lower control arm.
 12. Negative lead at mounting stud (located next to junction block).
 13. Positive lead at generator.
 14. Engine wire harness through front of dash.



Important

- When reinstalling engine wiring harness back through front of dash, the rubber grommet **MUST BE INSTALLED PROPERLY** to ensure correct sealing. If grommet is torn or damaged for any reason, it must be replaced.
15. ECM and harness.
 16. Forward lamp wiring harness connectors.
 17. Wiring harness connectors.
 18. Right-hand body hinge pillar trim panel assembly. Refer to SECTION 10-5.
 19. Brake lines and clips to ABS hydraulic modulator assembly. Refer to SECTION 5.
 20. Brake lines to ABS brake combination valve. Refer to SECTION 5.
 21. Generator and air conditioning compressor bracket and reposition. Refer to SECTION 6D3.
 22. “Y” brace to right exhaust manifold assembly. Refer to SECTION 6D3.
 23. Brake booster vacuum hose.
 24. Lower radiator hose to front cover assembly. Refer to SECTION 6B.
 25. Upper radiator hose to intake manifold assembly. Refer to SECTION 6B.
 26. Cruise and accelerator control cables to throttle body assembly. Refer to SECTION 6E3.
 27. Fuel pipe assembly. Refer to “Upper Intake Manifold Assembly” in this section.
 28. Raise and suitably support vehicle. Refer to SECTION OA.

29. Electrical ground straps to left side of frame rail.
30. Intermediate steering shaft to rack and pinion assembly. Refer to SECTION 3F4.
31. Torque arm to transmission assembly. Refer to SECTION 3D.
32. Propeller shaft assembly. Refer to SECTION 4A.
33. Shift linkage to transmission assembly. Refer to SECTION 7A or SECTION 7B.
34. Electrical ground straps to right side of engine block.
35. Heater hoses to pipes at engine assembly. Refer to SECTION 1B1.
36. Lower radiator hose to radiator assembly. Refer to SECTION 6B.
37. Transmission fluid cooler lines to radiator assembly (automatic transmission). Refer to SECTION 6B.
38. Serpentine drive belt. Refer to "Serpentine Drive Belt and Tensioner Assembly" in the section.
39. Stabilizer bar bolts/screws. Refer to SECTION 3C.
40. Front fascia lower deflectors. Refer to SECTION 10-5.
41. Converter bolts/screws (automatic transmission). Refer to SECTION 7A.
42. Exhaust crossover pipe assembly from intermediate pipe. Refer to SECTION 6F.
43. Lower vehicle.
44. Refill with engine oil. Refer to SECTION OA.
45. Refill with engine coolant. Refer to SECTION 6B.
46. Front wheels and tires. Refer to SECTION 3E.
47. Battery positive cable assembly.
48. Battery negative cable assembly.
49. Bleed brake system. Refer to SECTION 5E1.
50. Bleed power steering system. Refer to SECTION 3B.

51. Air intake duct.

52. Align wheels. Refer to SECTION 3A.

THREAD REPAIR

Figure 36

Damaged threads may be reconditioned by drilling out, re-threading and installing a suitable thread insert. General purpose thread repair kits are available commercially.

CAUTION: Wear safety glasses to avoid eye damage.

1. Determine size, pitch and depth of damaged thread. If necessary, adjust stop collars on cutting tool and tap to required depth.

Important

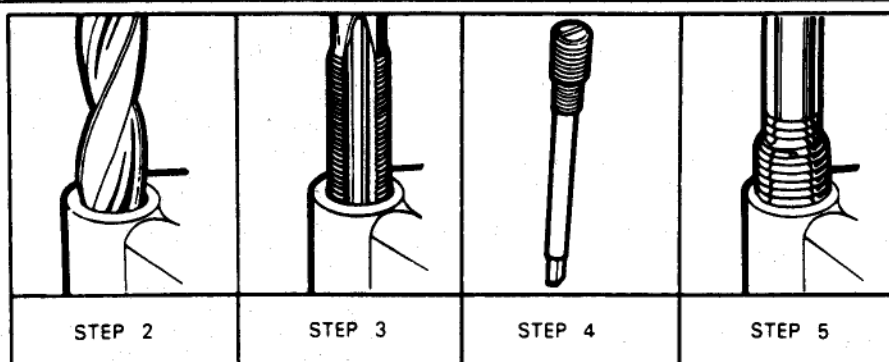
- Refer to kit manufacturer's instructions regarding size of drill and tap to be used.
2. Drill out damaged thread. Clean out chips.
 3. Tap hole.
 - A. Lubricate tap with light engine oil.
 - B. Clean thread.

Important

- Avoid build-up of chips. Back out tap every few turns and remove chips.
4. Thread the thread insert onto mandrel of installer. Engage tang of insert onto end on mandrel.
 5. Lubricate insert with light engine oil (except when installing in aluminum) and install.

Important

- When correctly installed, insert should be flush to one turn below surface.
6. If tang of insert does not break off when backing out installer, break tang off with a drift pin.



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Figure 36 - Repairing Threaded Holes

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Accelerator Control Cable Bracket Bolt/Screw	10 N•m (90 lb. in.)
Camshaft Sprocket Bolt/Screw	24 N•m (18 lb. ft.)
Connecting Rod Nut	50 N•m (37 lb. ft.)
Crankshaft Balancer Bolt/Screw	78 N•m (58 lb. ft.)
Crankshaft Bearing Cap Bolt/Screw (plus 77 degrees)	50 N•m (37 lb. ft.)
Crankshaft Pulley Bolt/Screw	50 N•m (37 lb. ft.)
Cylinder Head Bolt/Screw (plus 90 degrees)	55 N•m (41 lb. ft.)
Drive Belt Idler Pulley Bolt/Screw	50 N•m (37 lb. ft.)
Drive Belt Tensioner Bolt/Screw	33 N•m (24 lb. ft.)
EGR Flexible Pipe Bolt/Screw	26 N•m (19 lb. ft.)
EGR Valve Adapter Tube Bolt/Screw	31 N•m (23 lb. ft.)
Engine Bracket Bolt/Screw	58 N•m (43 lb. ft.)
Engine Front Cover Bolt/Screw	21 N•m (15 lb. ft.)
Engine Mount Through-Bolt/Screw	95 N•m (70 lb. ft.)
Engine Mount Through-Bolt/Screw Nut	80 N•m (59 lb. ft.)
Engine Mount-to-Frame Bolt/Screw	58 N•m (43 lb. ft.)
Engine Oil Level Sensor Assembly	22 N•m (16 lb. ft.)
Exhaust Manifold Bolt/Screw	25 N•m (18 lb. ft.)
Flywheel Bolt/Screw	83 N•m (61 lb. ft.)
Fuel Injector Fuel Rail Stud	25 N•m (18 lb. ft.)
Fuel Pipe Bracket-to-Front Brace Bolt/Screw	8 N•m (71 lb. in.)
Fuel Pipe Bracket-to-Intake Manifold Bolt/Screw	10 N•m (89 lb. in.)
Fuel Pipe Hold Down Plate Bolt/Screw	25 N•m (18 lb. ft.)
Lower Intake Manifold Bolt/Screw	30 N•m (22 lb. ft.)
Oil Level Indicator Tube Nut	21 N•m (15 lb. ft.)
Oil Pan	
Front Corner Bolt/Screw and Nut	33 N•m (24 lb. ft.)
Rear Corner Bolt/Screw	25 N•m (18 lb. ft.)
Side Rail Bolt/Screw	10 N•m (89 lb. in.)
Stud	6 N•m (53 lb. in.)
Oil Pan Drain Plug	25 N•m (18 lb. ft.)
Oil Pump Drive Clamp Bolt/Screw	34 N•m (25 lb. ft.)
Oil Pump-to-Crankshaft Bearing Cap Bolt/Screw	41 N•m (30 lb. ft.)
Secondary Air Injection Check Valve Pipe Bracket Bolt/Screw	25 N•m (18 lb. ft.)
Secondary Air Injection Pipe Fitting	25 N•m (18 lb. ft.)
Timing Chain Dampener Bolt/Screw	21 N•m (15 lb. ft.)
Upper Intake Manifold Bolt/Screw	25 N•m (18 lb. ft.)
Valve Rocker Arm Cover Nut	10 N•m (89 lb. in.)

ENGINE ASSEMBLY SPECIFICATIONS (3.4L L32)

General

Type	V6
Displacement	3.4L (204 CID)
Bore	92 mm (3.622")
Stroke	84 mm (3.312")
Compression Ratio	9.0:1
Firing Order	1-2-3-4-5-6
Oil Pressure (Minimum at operating temperature)	103 kPa (15 psig) at 1,100 engine rpm
Oil Filter Torque	16 N•m (12 lb. ft.)

Cylinder Bore

Diameter	92.020-92.038 mm (3.6228-3.6235")
Out-of-Round	0.007 mm (0.0003") MAX.

Piston Assembly

Diameter	91.977-91.992 mm (3.6211-3.6217")
Piston Bore Clearance	0.028-0.061 mm (0.0011-0.0024")

Piston Rings**Piston Compression Ring****Groove Clearance**

Top	0.05-0.09 mm (0.002-0.0035")
2nd	0.05-0.09 mm (0.002-0.0035")

Gap

Top	0.18-0.41 mm (0.007-0.016")
2nd	0.48-0.74 mm (0.019-0.029")

Piston Oil Ring

Groove Clearance-MAX	0.20 mm (0.008")
Gap	0.25-0.76 mm (0.010-0.030")

Piston Pin

Diameter	22.9915-22.9964 mm (0.9052-0.9054")
Clearance in Piston Assembly	0.0116-0.0218 mm (0.0005-0.0009")
Fit In Connecting Rod Assembly	0.0165-0.0464 mm (0.00065-0.0018") Interference

Crankshaft Assembly**Main Journal**

Diameter-All	67.239-67.257 mm (2.6473-2.6483")
Taper-Max	0.005 mm (0.0002") MAX.
Out-of-Round	0.005 mm (0.0002") MAX.
Crankshaft Bearing Clearance	0.032-0.077 mm (0.0012-0.0030")
Crankshaft Thrust Bearing Clearance	0.032-0.077 mm (0.0012-0.0030")
Crankshaft Assembly End Play	0.06-0.21 mm (0.0024-0.0083")

Connecting Rod Assembly**Connecting Rod Journal**

Diameter	50.768-50.784 mm (1.9987-1.9994")
Taper-Max	0.005 mm (0.0002")
Out-of-Round-Max	0.005 mm (0.0002")
Rod Bearing Clearance	0.028-0.082 mm (0.0011-0.0032")
Rod Side Clearance	0.18-0.44 mm (0.007-0.017")

Camshaft Assembly

Journal Diameter	47.44-47.52 mm (1.868-1.871")
Bearing Inside Diameter	47.523-47.549 mm (1.871-1.872")
Journal Clearance	0.026-0.101 mm (0.001-0.004")
Lobe Lift	
Intake	6.67 mm (0.2626")
Exhaust	6.94 mm (0.2732")

Valve System

Lifter Assembly	Hydraulic
Rocker Arm Ratio	1.50:1
Valve Lash	1 ± 1/2 turn down from zero lash
Face Angle	45°
Seat Angle	46°
Seat Runout	0.025 mm (0.001") MAX.
Seat Width	
Intake	1.55-1.85 mm (0.061-0.073")
Exhaust	1.70-2.00 mm (0.067-0.079")
Stem Clearance	
Intake	0.0356 mm-0.0686 mm (0.0014-0.0027")
Exhaust	0.0381 mm-0.0737 mm (0.0015-0.0029")
Valve Spring	
Free Length	48.5 mm (1.91")
Pressure	
Closed	356 N at 40.9 mm (80 lb. at 1.61")
Open	841 N at 30.5 mm (190 lb. at 1.20")
Installed Height	40.9 mm (1.61")
Approximate # of Coils	4

Oil Pump

Gear Lash	0.094-0.195 mm (0.0037-0.0077")
Gear Pocket	
Depth	30.53-30.61 mm (1.202-1.205")
Diameter	38.202-38.252 mm (1.504-1.506")
Gear	
Length	30.45-30.48 mm (1.199-1.200")
Diameter	38.05-38.10 mm (1.498-1.500")
Side Clearance	0.08-0.10 mm (0.003-0.004")
End Clearance	0.05-0.152 mm (0.002-0.006")
Valve-to-Bore Clearance	0.038-0.089 mm (0.0015-0.0035")

SPECIAL TOOLS



1. J 23444-A



8. J 8520



2. J 29113



9. J 23590



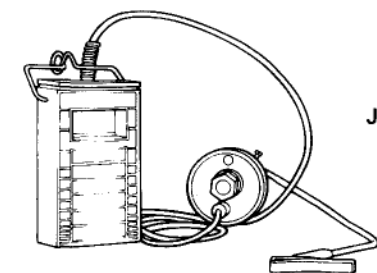
3. J 8037



10. J 23738-A



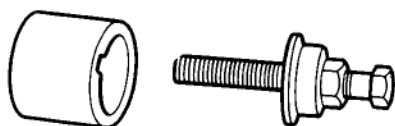
4. J 24420-B



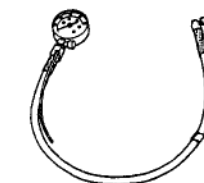
11. J 36660



5. J 34686



6. J 38612



12. J 34730-1



7. J 5892-C



13. J 8080

1. CRANKSHAFT SPROCKET REMOVER
2. TORSIONAL DAMPER INSTALLER
3. PISTON RING COMPRESSOR
4. TORSIONAL DAMPER REMOVER
5. REAR MAIN BEARING OIL SEAL INSTALLER
6. CRANKSHAFT SPROCKET INSTALLER
7. VALVE SPRING COMPRESSOR
8. CAM LOBE LIFT INDICATOR
9. SPARK PLUG PORT ADAPTER
10. VALVE STEM SEAL TESTER
11. TORQUE ANGLE METER
12. FUEL PRESSURE GAGE
13. MAIN BEARING SHELL REMOVER & INSTALLER
14. CONNECTING ROD BOLT GUIDE SET



14. J 5239