2004 ENGINE

Engine Mechanical - 2.0L (L34 GMDAT) - Epica

REPAIR INSTRUCTIONS

INTAKE MANIFOLD REPLACEMENT

Removal Procedure

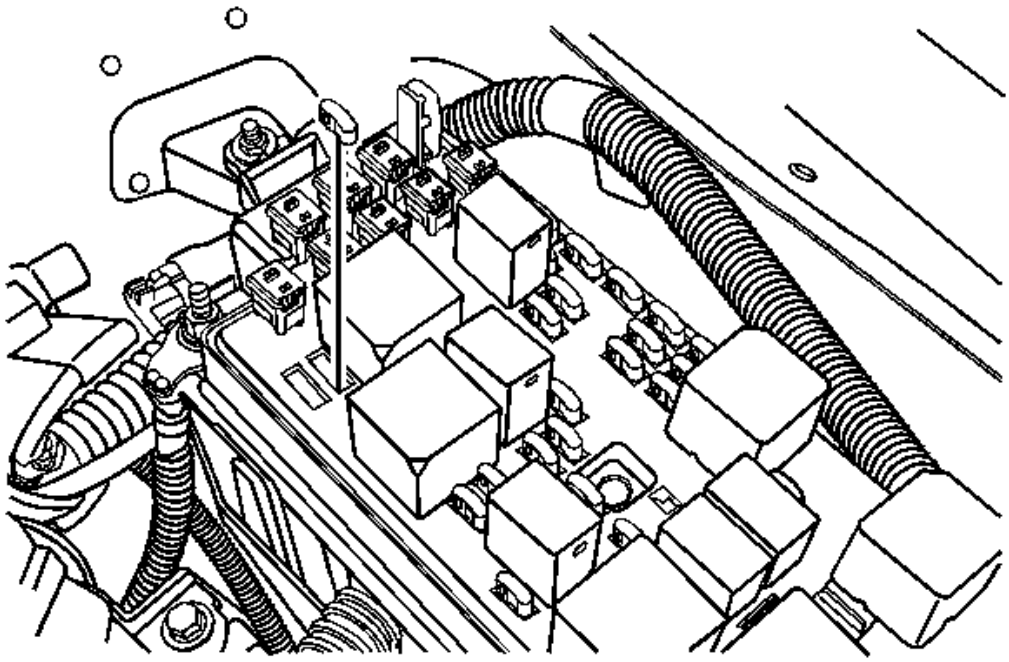

Fig. 1: Identifying Fuel Pump Fuse
Courtesy of GENERAL MOTORS CORP.

1. Remove the fuel pump fuse.
2. Start the engine. After it stalls, crank the engine for 10 seconds to rid the fuel system of fuel pressure.

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

3. Disconnect the negative battery cable.

4. Disconnect the canister purge solenoid from the intake manifold and loosen the bracket bolt.
5. Drain the engine coolant. Refer to **Draining and Filling Cooling System (2.0L)** in Engine Cooling.

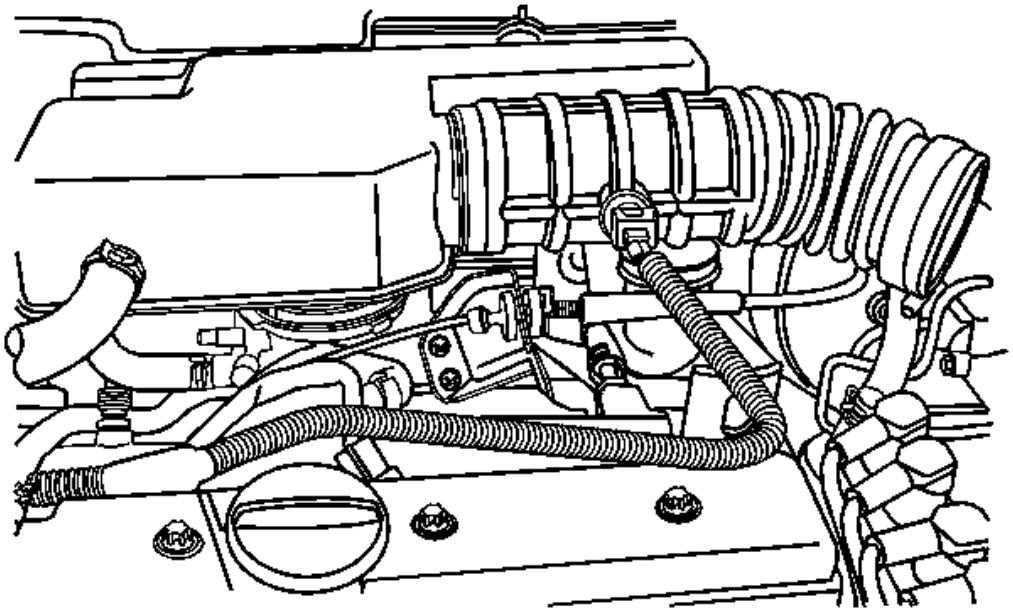

Fig. 2: View Of Manifold Air Temperature Sensor And Throttle Body Intake Tube
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the manifold air temperature sensor connector.
7. Disconnect the air intake tube from the throttle body.

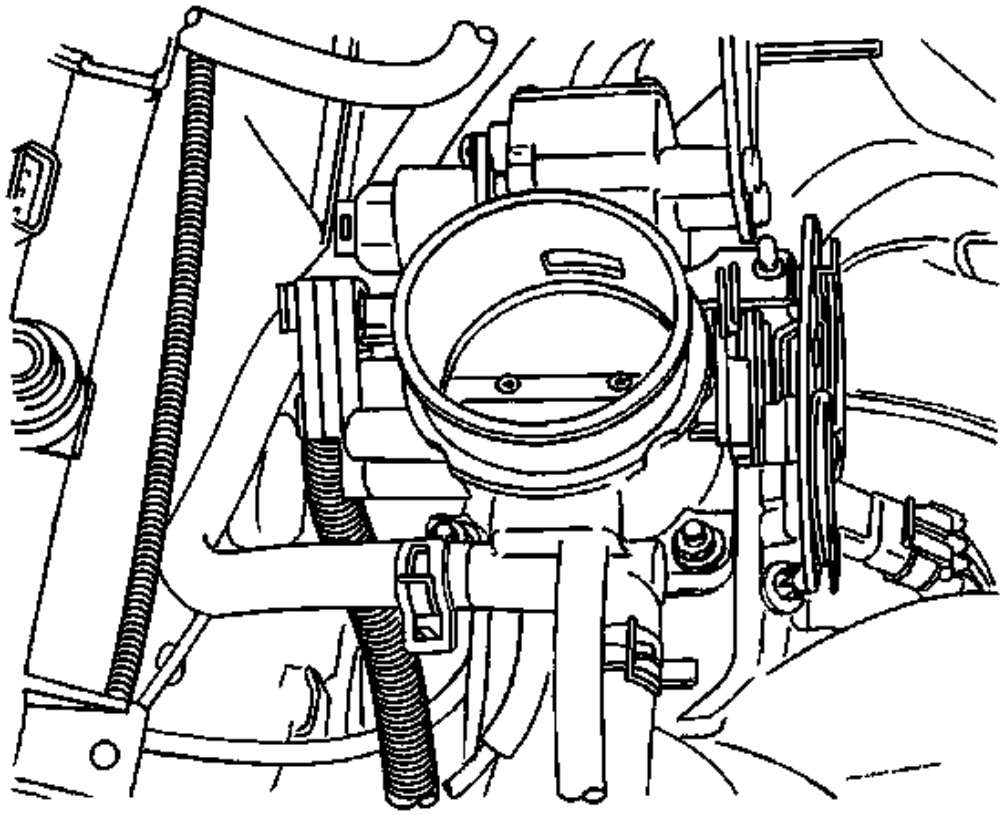

Fig. 3: View Of Throttle Body And Connectors
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the idle air control (IAC) valve connector.
9. Disconnect the throttle position (TP) sensor connector.
10. Disconnect the manifold absolute pressure (MAP) sensor connector.
11. Disconnect the coolant hose at the throttle body.

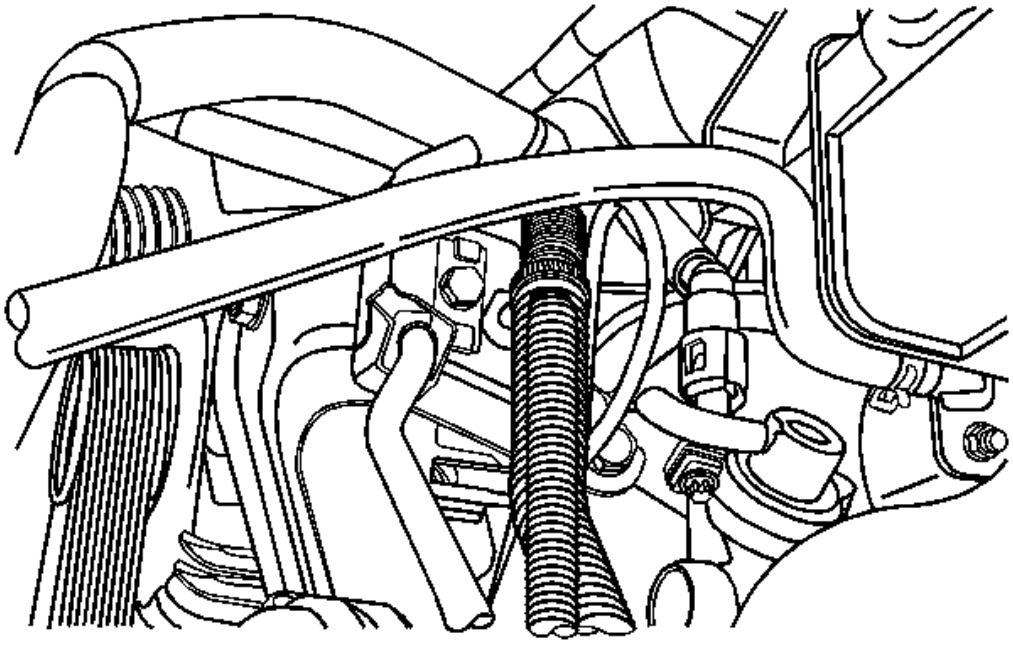

Fig. 4: View Of Vacuum Hoses
Courtesy of GENERAL MOTORS CORP.

12. Disconnect all of the necessary vacuum hoses, including the vacuum hose at the fuel pressure regulator and the brake booster vacuum hose at the intake manifold.
13. Disconnect the throttle cable from the throttle body and the intake manifold.
14. Remove the throttle cable bracket bolts from the intake manifold.
15. Remove the throttle cable bracket.
16. Remove the alternator-to-intake manifold strap bracket bolts and the strap.
17. Remove the power steering hose clamp bolt, and position the hose clear of the repair area.

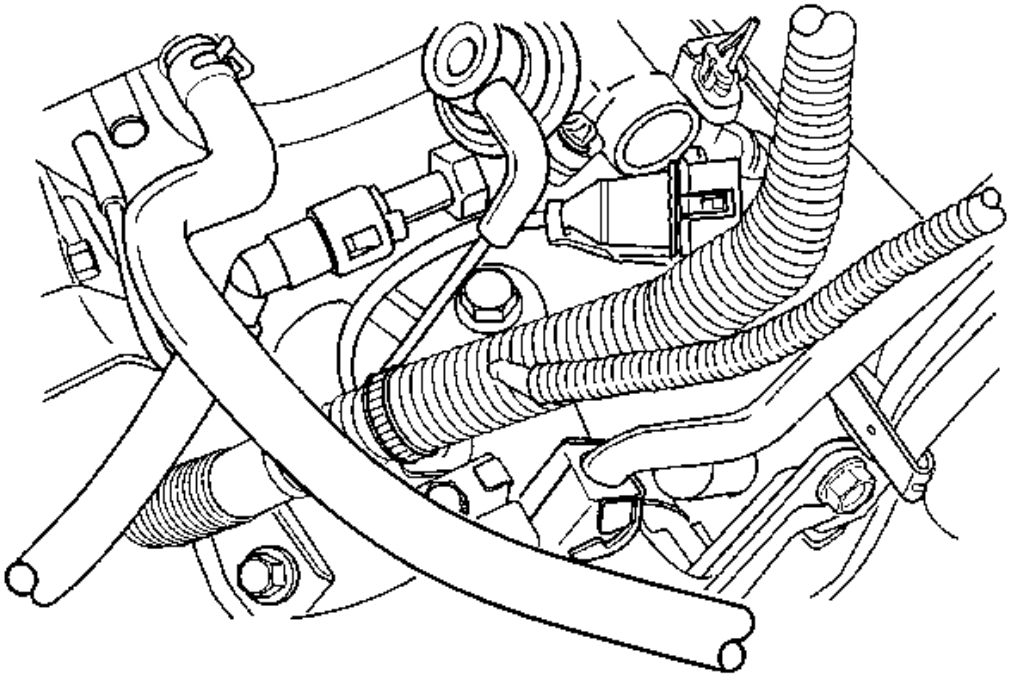

Fig. 5: View Of Surge Tank Coolant Hose
Courtesy of GENERAL MOTORS CORP.

18. Remove the fuel rail and the injector cover. Refer to **Fuel Rail Assembly Replacement** in Engine Controls-2.0 L.
19. Remove the alternator-to-intake manifold support bracket bolts.
20. Remove the alternator-to-intake manifold support bracket.
21. Remove the intake manifold support bracket bolt at the engine block and the intake manifold.
22. Remove the intake manifold support bracket.

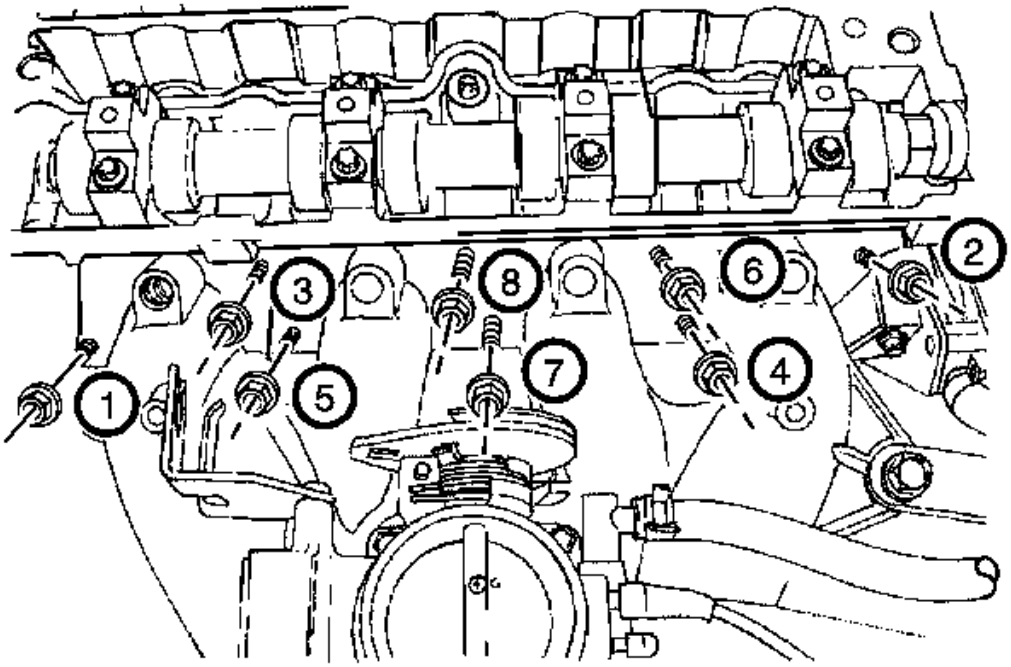

Fig. 6: View Of Intake Manifold Retaining Nut Removal Sequence
Courtesy of GENERAL MOTORS CORP.

23. Remove the intake manifold retaining bolts and the nuts in the sequence shown.
24. Remove the intake manifold.
25. Remove the intake manifold gasket.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

26. Clean the sealing surfaces of the intake manifold and the cylinder head.

Installation Procedure

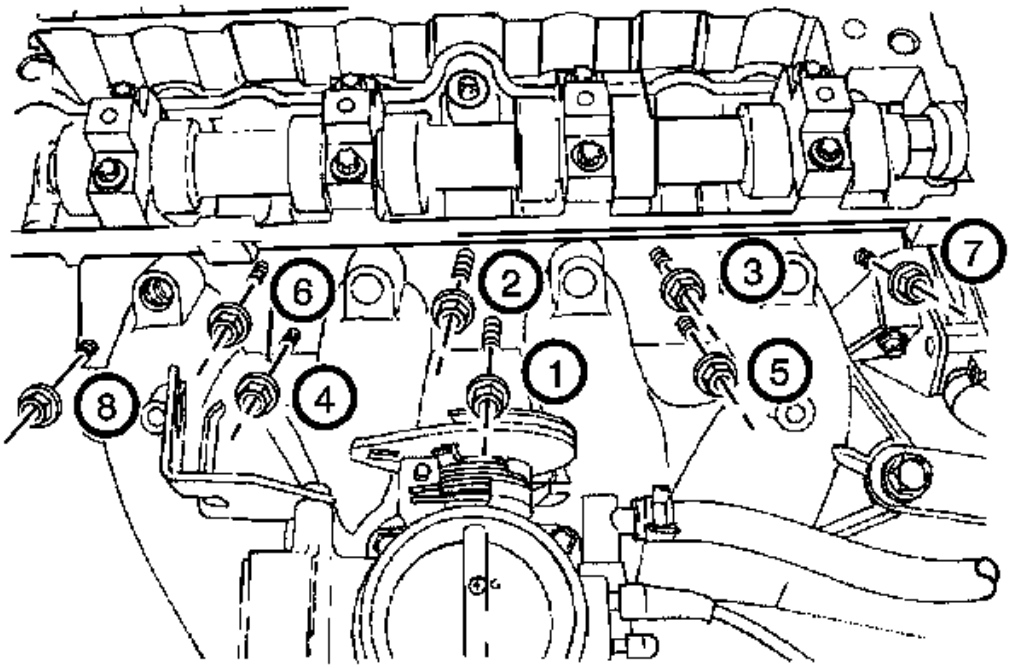

Fig. 7: View Of Intake Manifold Retaining Nut Installation Sequence
Courtesy of GENERAL MOTORS CORP.

1. Install the intake manifold gasket.
2. Install the intake manifold.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the intake manifold retaining bolts and the nuts in the sequence shown.

   Tighten: Tighten the intake manifold retaining bolts and the nuts to **22 N.m (16 lb ft)** .

4. Install the alternator-to-intake manifold strap bracket and bolts.

   Tighten: Tighten the alternator-to-intake manifold strap bracket bolts to **20 N.m (15 lb ft)** .

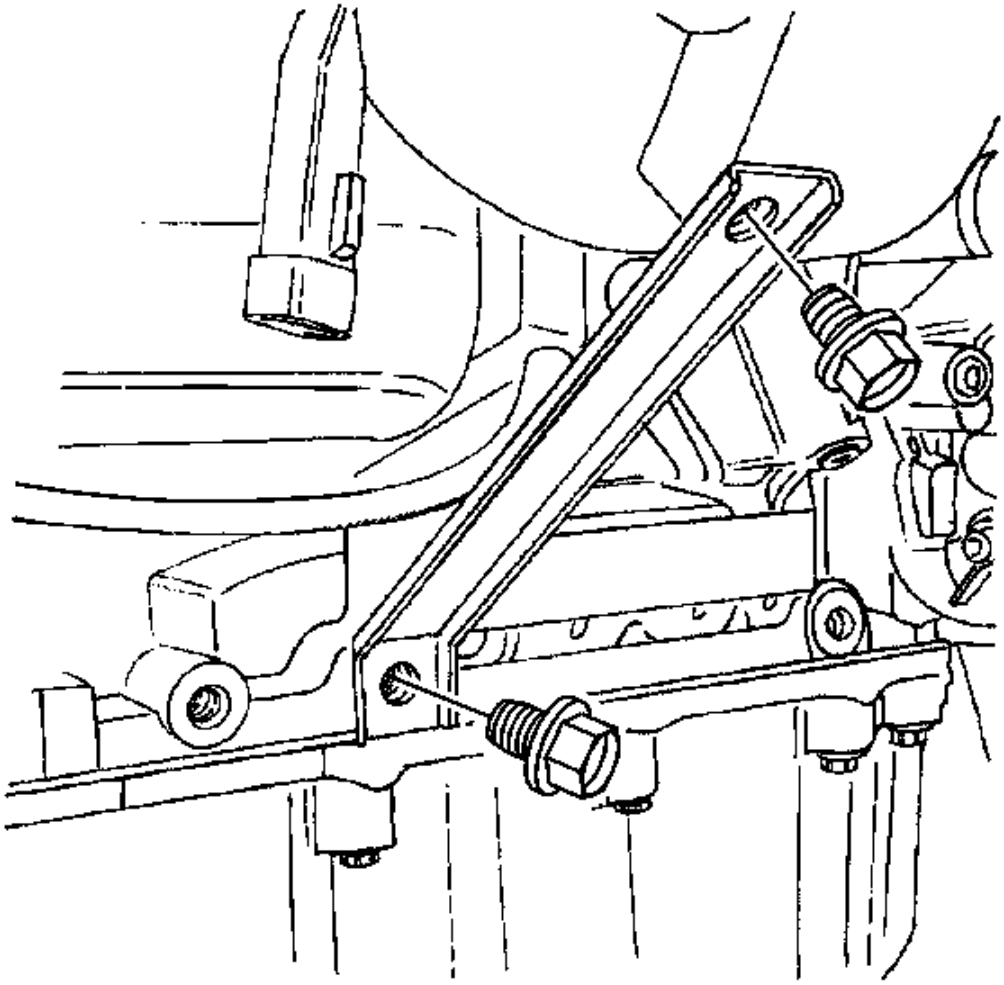

Fig. 8: View Of Intake Manifold Support Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the intake manifold support bracket.
6. Install the intake manifold support bracket upper bolts to the intake manifold.

   Tighten: Tighten the intake manifold support bracket upper bolts to **25 N.m (18 lb ft)** .

7. Install the intake manifold support bracket lower bolt to the engine block.

   Tighten: Tighten the intake manifold support bracket lower bolt to the engine block to **25 N.m (18 lb ft)** .

8. Install the alternator-to-intake manifold support bracket bolts.

   Tighten: Tighten the alternator-to-intake manifold support bracket and bolts to **35 N.m (26 lb ft)** .

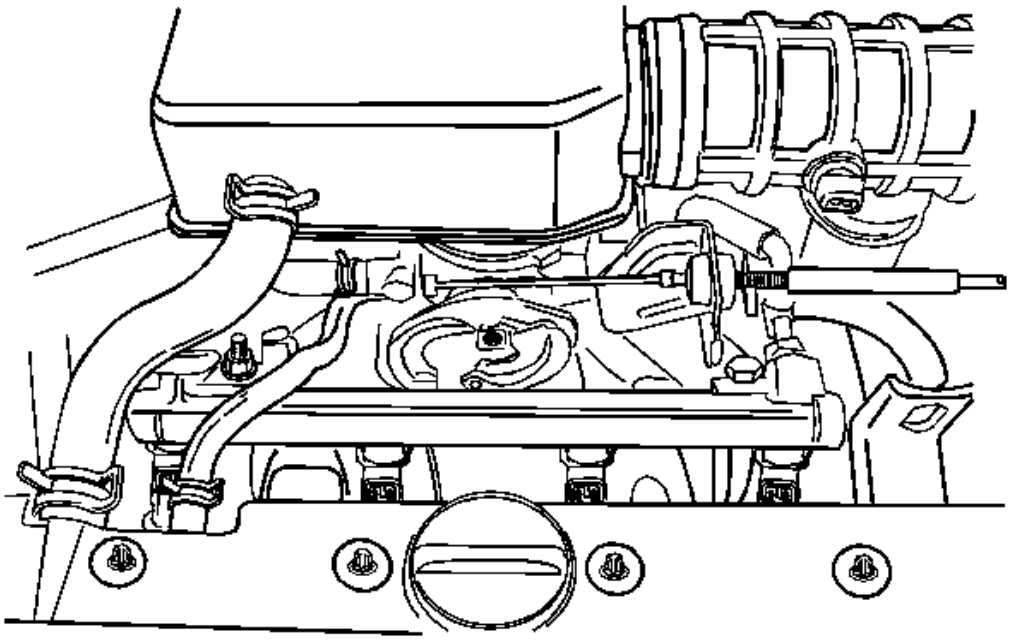

Fig. 9: View Of Fuel Rail, Throttle Cable, Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

9. Install the fuel rail and the injector cover. Refer to **Fuel Rail Assembly Replacement** in Engine Controls-2.0 L.
10. Install the throttle cable bracket.
11. Install the throttle cable bracket bolts.

    Tighten: Tighten the throttle cable bracket bolts to **8 N.m (71 lb in)** .

12. Connect the throttle cable to the intake manifold and the throttle body.
13. Connect all of the necessary vacuum lines that were previously disconnected.

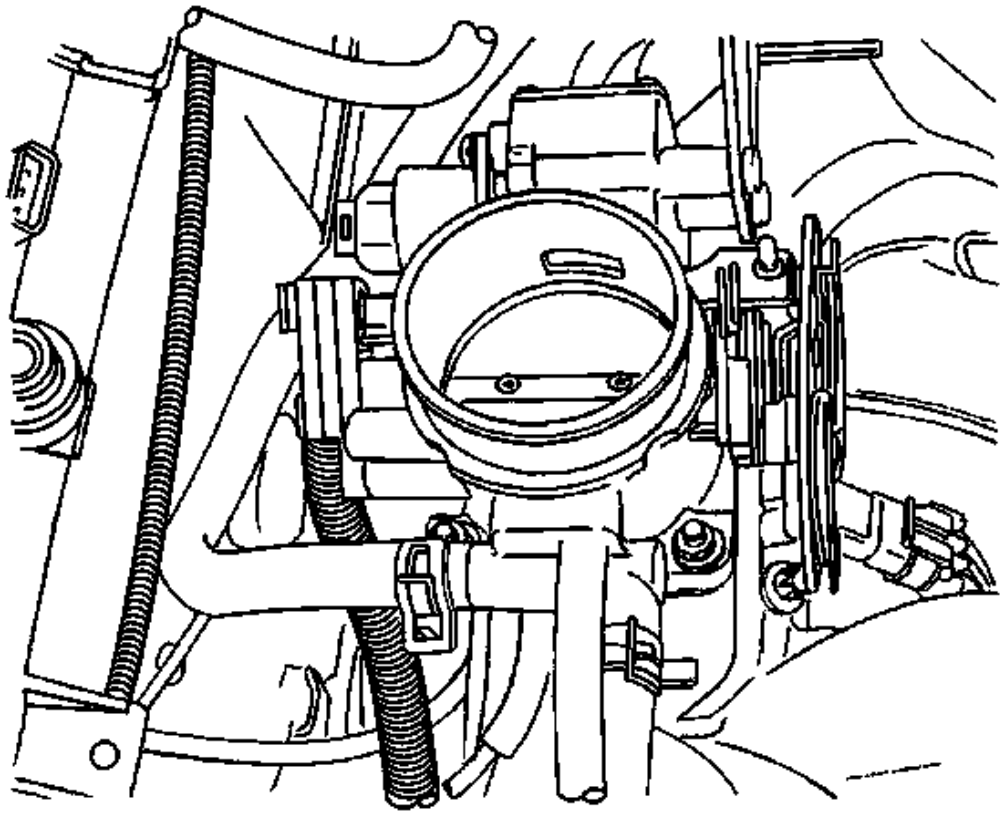

Fig. 10: View Of Throttle Body And Connectors
Courtesy of GENERAL MOTORS CORP.

14. Connect the MAP sensor connector.
15. Connect the coolant hoses to the throttle body.
16. Connect the IAC connector.
17. Connect the TP sensor connector.
18. Position the power steering hose in place and install the clamp bolt.

Tighten: Tighten the power steering hose clamp bolt to **8 N.m (71 lb in)** .

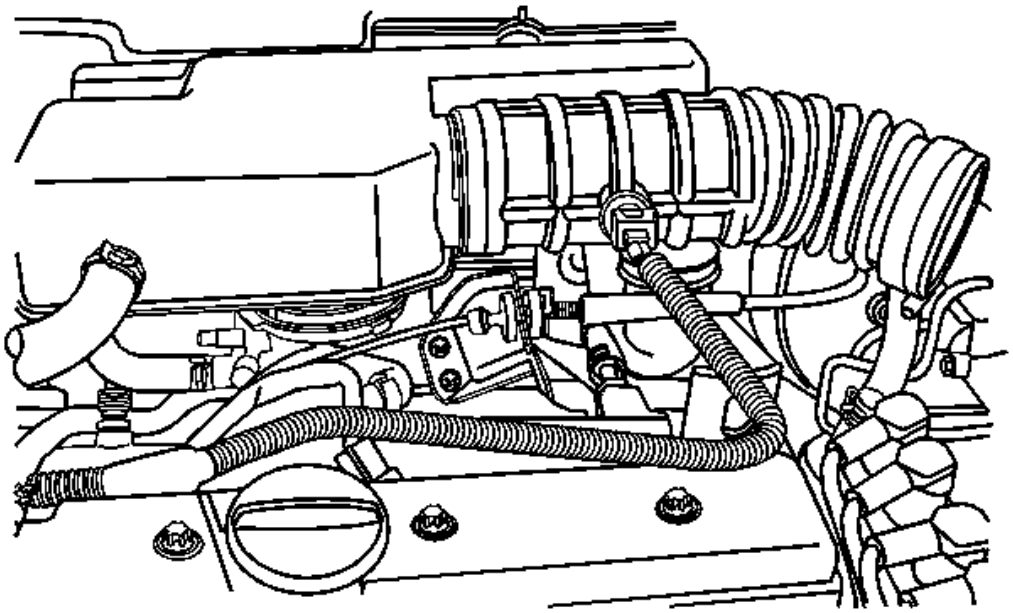

Fig. 11: View Of Manifold Air Temperature Sensor And Throttle Body Intake Tube
Courtesy of GENERAL MOTORS CORP.

19. Connect the air intake tube to the throttle body.
20. Connect the manifold air temperature sensor connector.
21. Connect the canister purge solenoid at the intake manifold and tighten the bracket bolt.

    Tighten: Tighten the canister purge solenoid bracket bolt to **5 N.m (44 lb in)** .

22. Install the fuel pump fuse.
23. Connect the negative battery cable.
24. Refill the engine cooling system. Refer to **Draining and Filling Cooling System (2.0L)** in Engine Cooling.

TIMING BELT REPLACEMENT

Removal Procedure

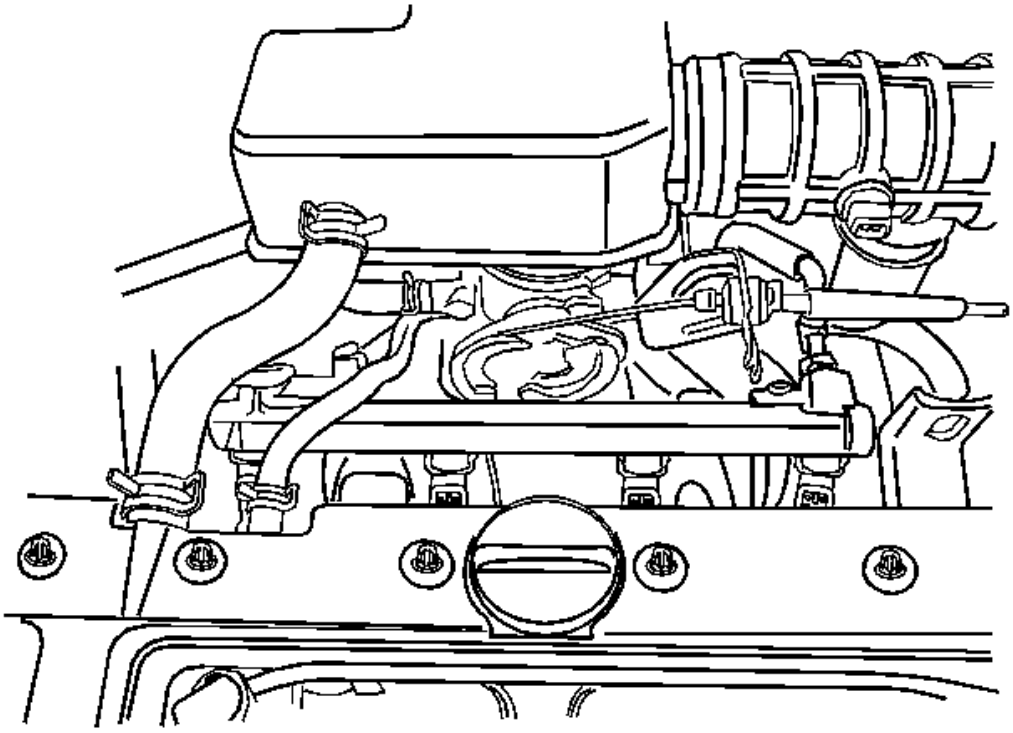

Fig. 12: View Of Valve Cover Breather Tube
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Disconnect the air intake tube from the throttle body.
3. Remove the resonator retaining bolts and the resonator from the throttle body.
4. Disconnect the breather tube from the valve cover.

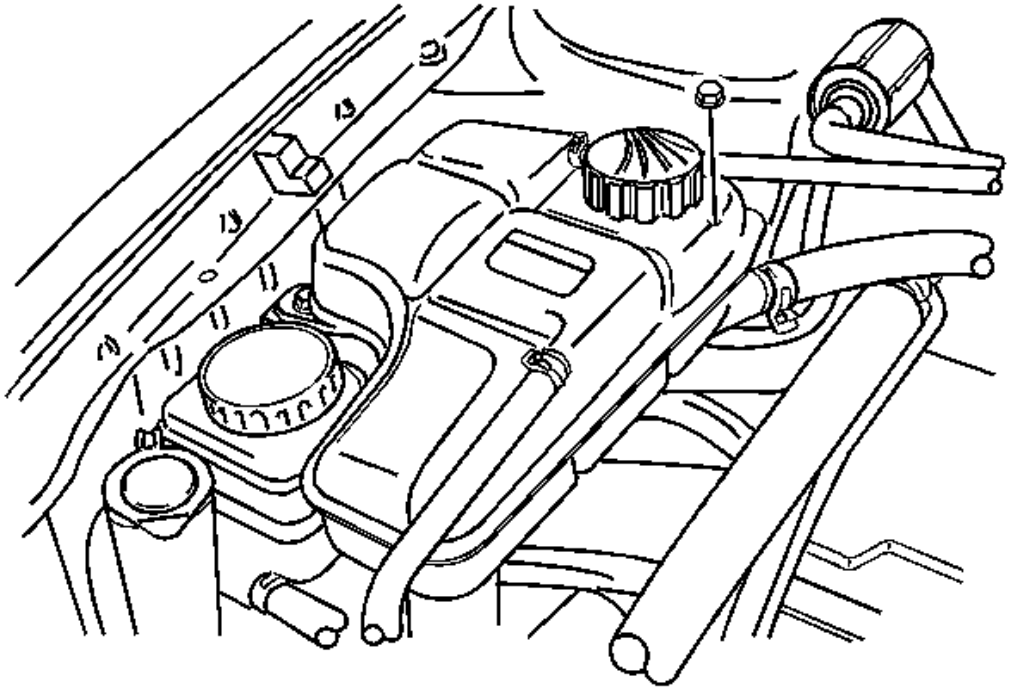

Fig. 13: View Of Surge Tank And Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the right front wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
6. Remove the right front wheel well splash shield. Refer to **Splash Shield Replacement - Wheelhouse** in Body Front End.

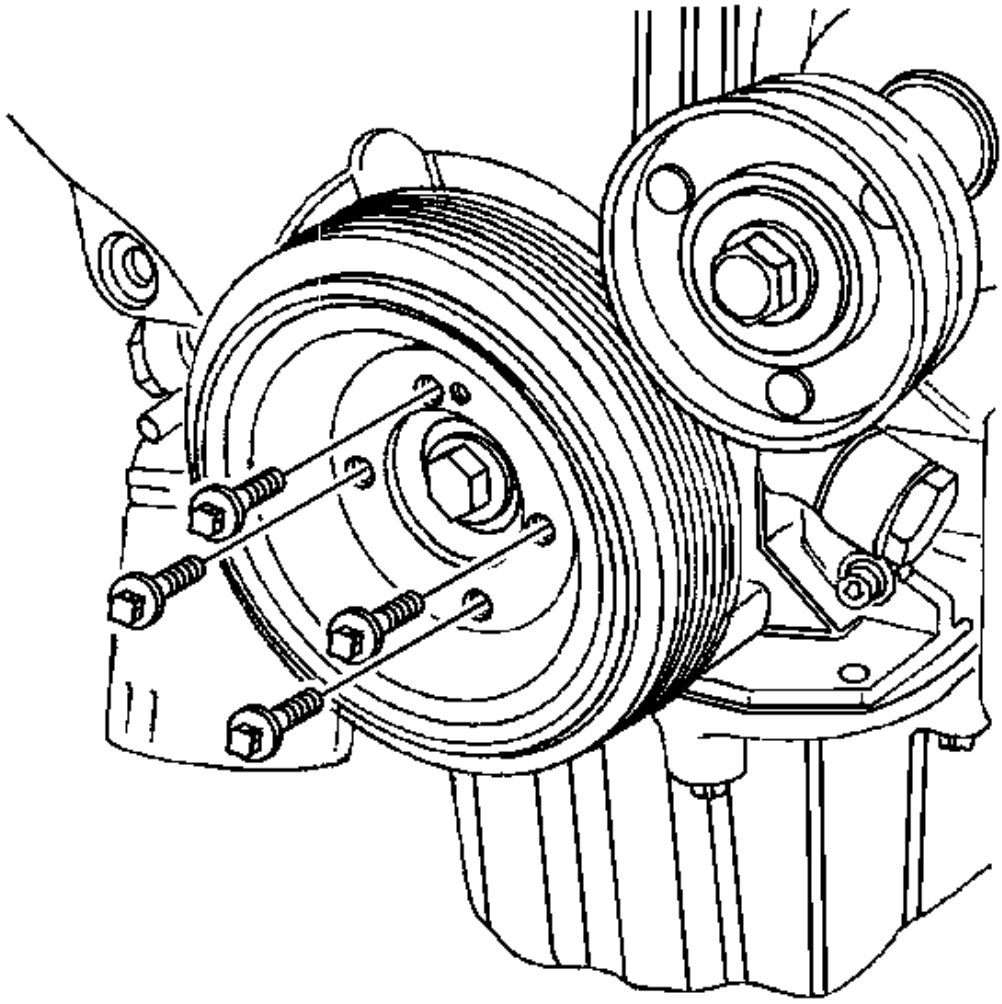

Fig. 14: View Of Crankshaft Pulley And Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Belt Dressing Notice in Cautions and Notices.

7. Remove the power steering pump drive belt. Refer to **Power Steering Pump Drive Belt Replacement (2.0L)** in Power Steering System.
8. Remove the crankshaft pulley bolts.
9. Remove the crankshaft pulley.
10. Remove the right engine mount bracket. Refer to **Engine Mount Replacement (Right Side)** or **Engine Mount Replacement (Forward)**.

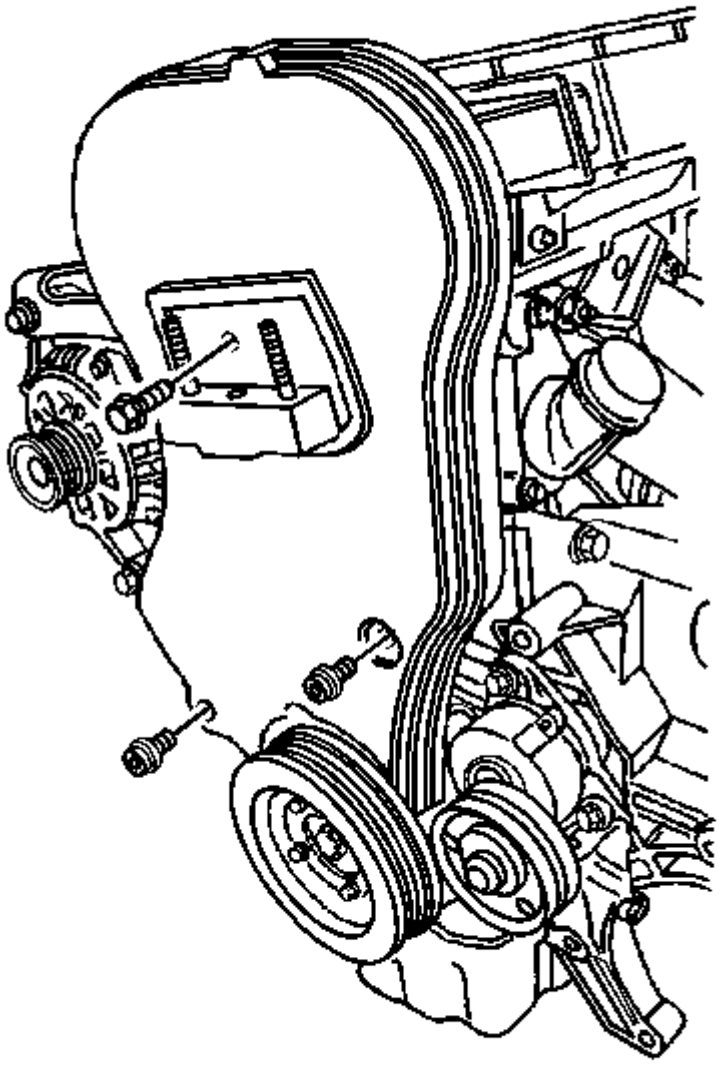

Fig. 15: View Of Front Timing Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

11. Remove the power steering hose clamp bolt, and position the hose clear of the repair area.
12. Remove the front timing cover bolts.
13. Remove the front timing belt cover.

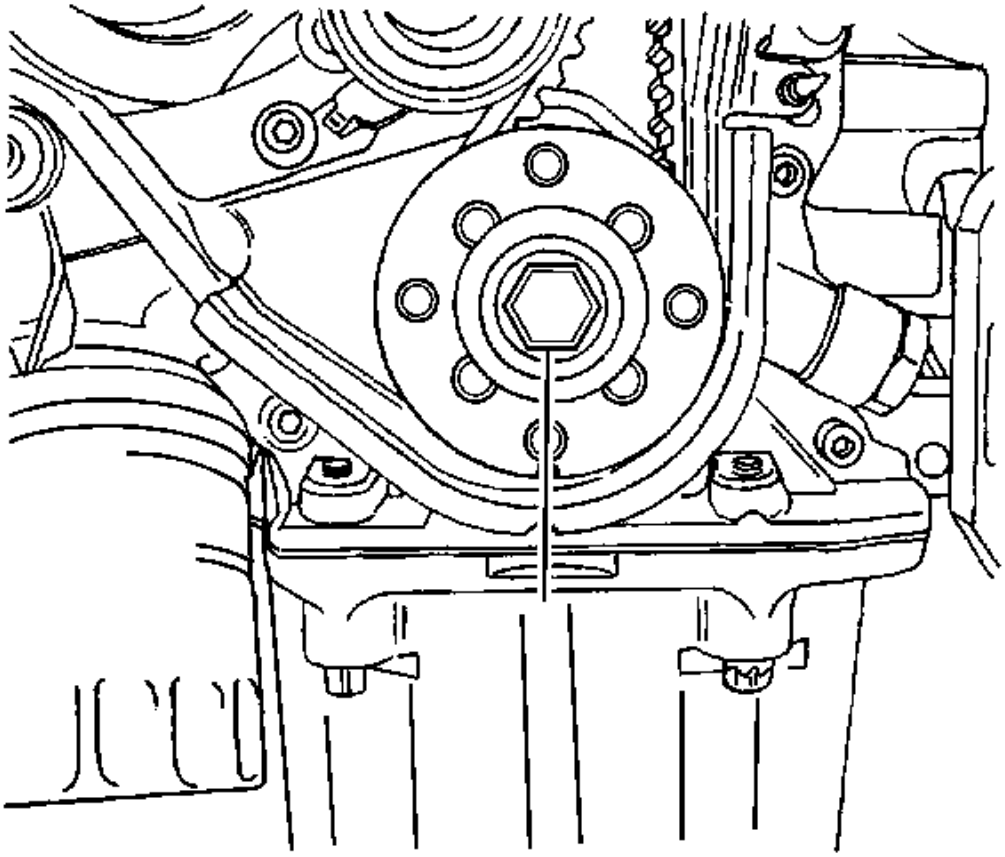

Fig. 16: Identifying Crankshaft Gear Bolt
Courtesy of GENERAL MOTORS CORP.

14. Using the crankshaft gear bolt, rotate the crankshaft clockwise until the timing mark on the crankshaft gear is aligned with the notch at the bottom of the rear timing belt cover.

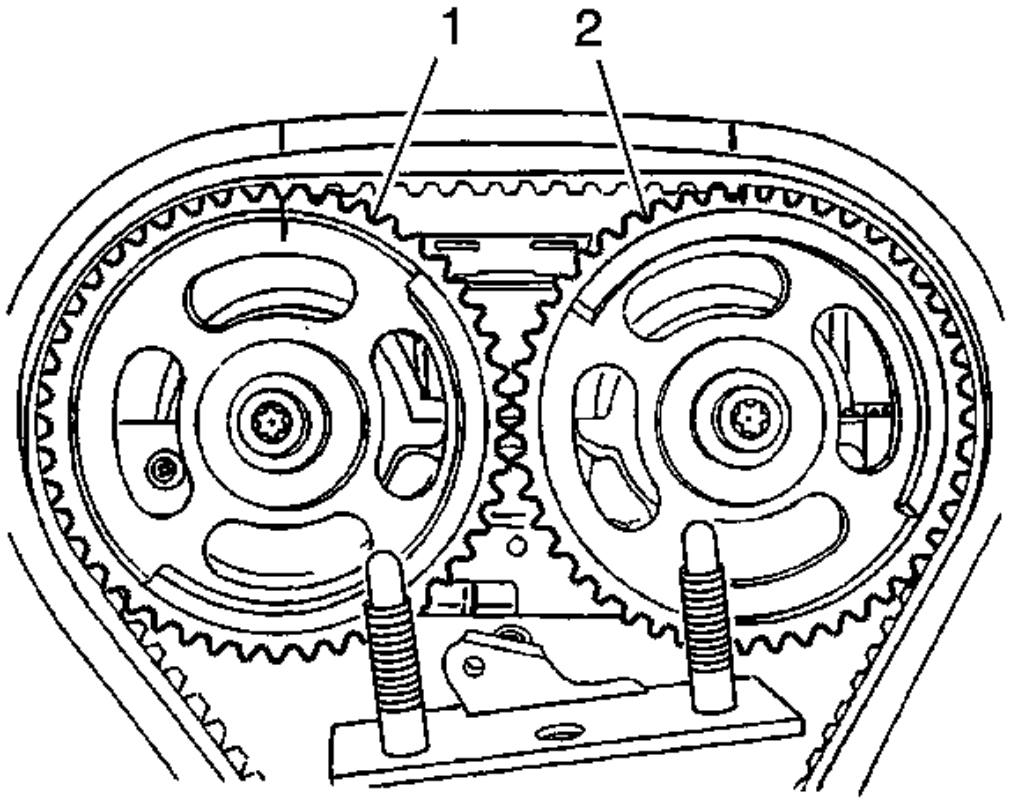

Fig. 17: View Of Intake And Exhaust Gears
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The camshaft gears must align with the notch on the valve cover or damage to the engine could result.

IMPORTANT: Use the intake gear mark for the intake camshaft gear and the exhaust gear (1) mark for the exhaust camshaft gear (2) since both gears are interchangeable.

15. Align the camshaft gears with the notch on the valve cover.

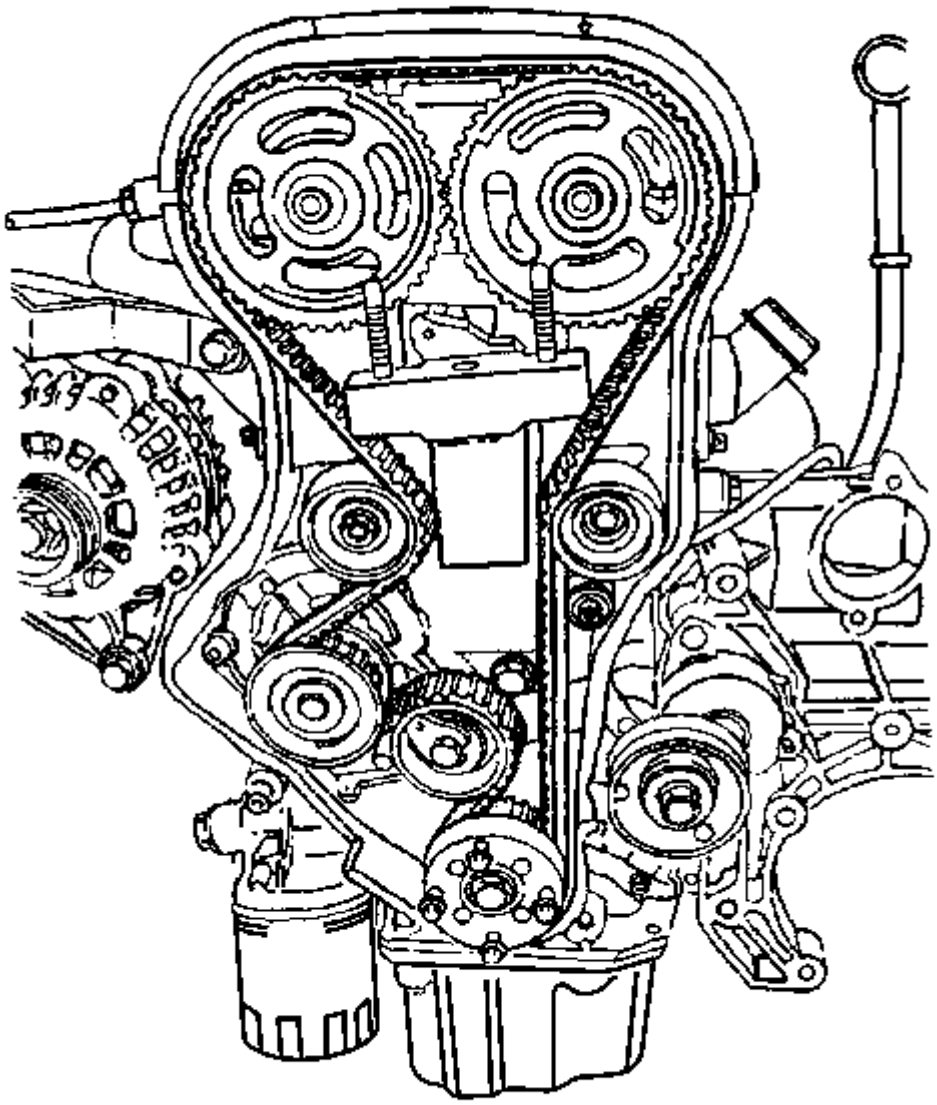

Fig. 18: View Of Timing Belt And Components
Courtesy of GENERAL MOTORS CORP.

16. Loosen the automatic tensioner bolt. Turn the hex key tab to relieve the belt tension.
17. Remove the timing belt.

Installation Procedure

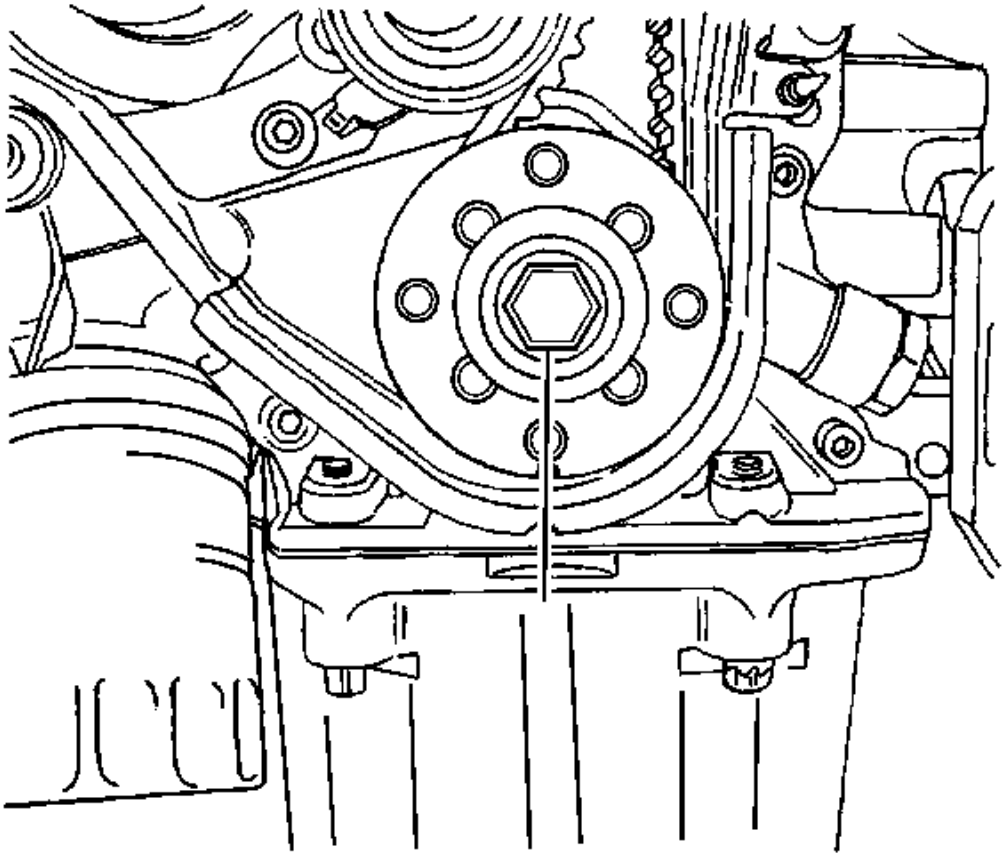

Fig. 19: Identifying Crankshaft Gear Bolt
Courtesy of GENERAL MOTORS CORP.

1. Align the timing mark on the crankshaft gear with the notch on the bottom of the rear timing belt cover.

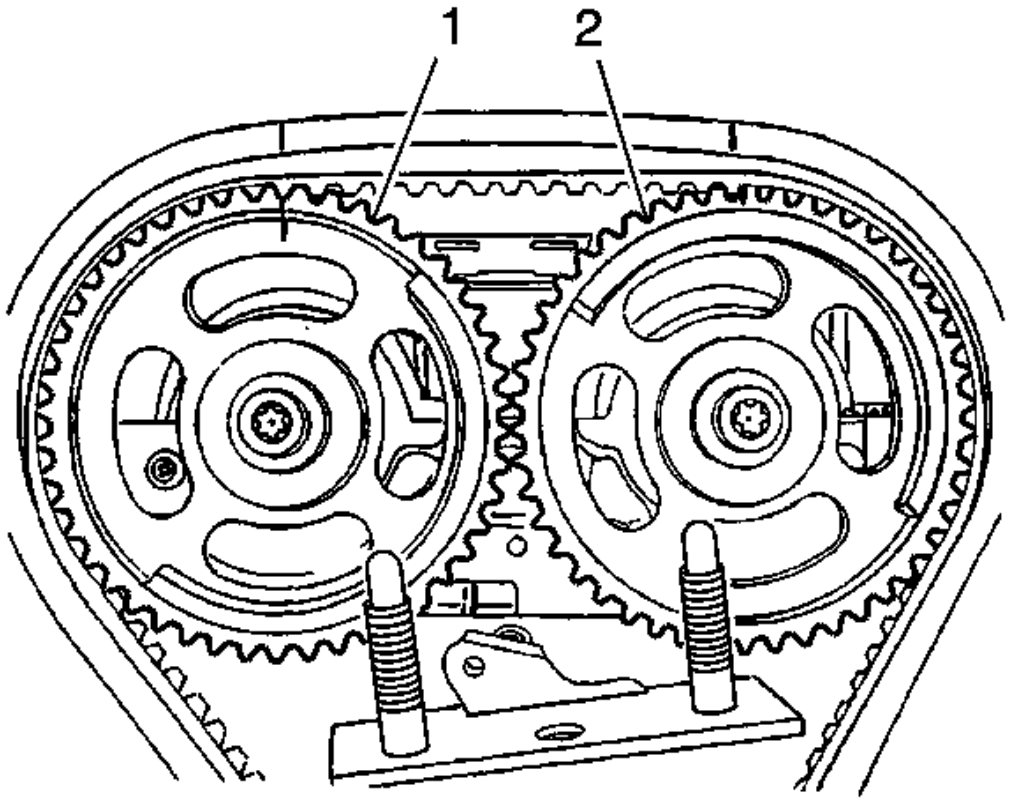

Fig. 20: View Of Intake And Exhaust Gears
Courtesy of GENERAL MOTORS CORP.

2. Align the timing marks on the camshaft gears, using the intake gear mark for the intake gear (1) and the exhaust gear mark for the exhaust gear (2).

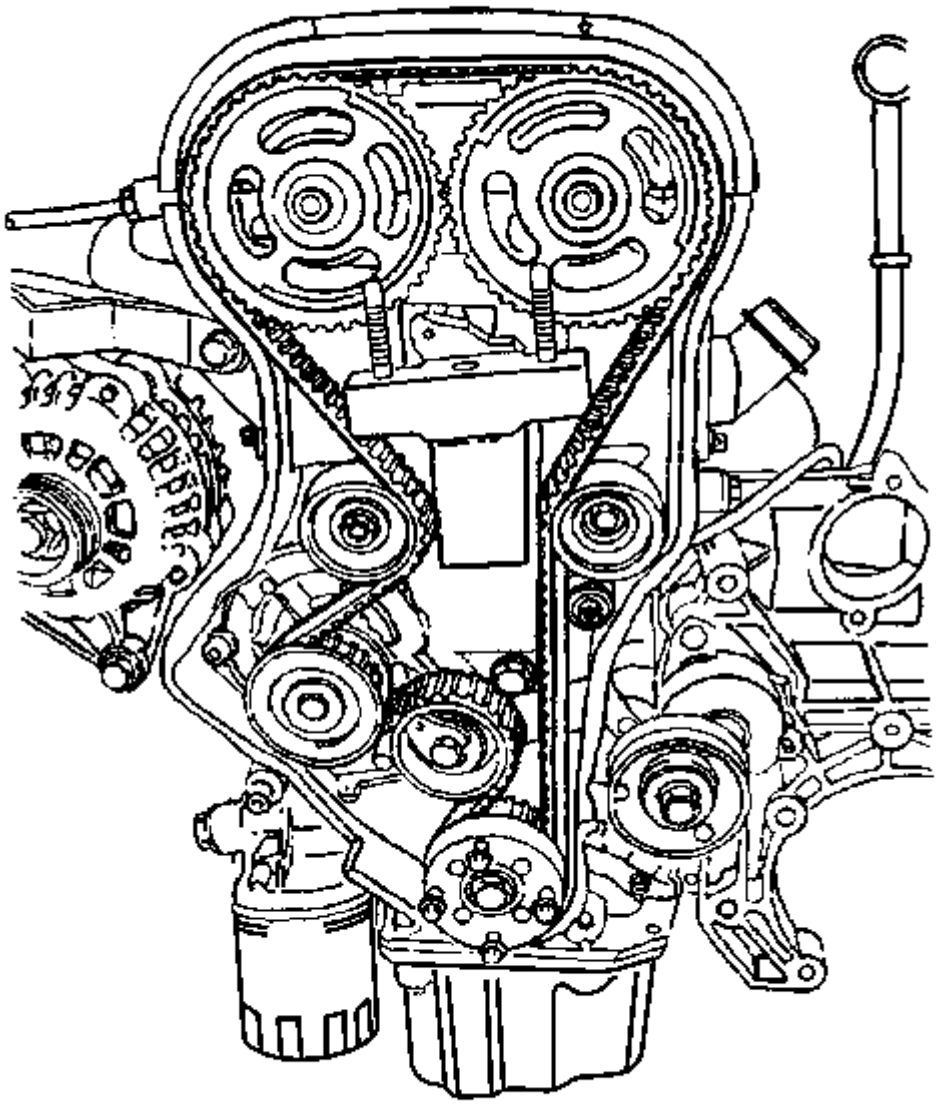

Fig. 21: View Of Timing Belt And Components
Courtesy of GENERAL MOTORS CORP.

3. Install the timing belt.

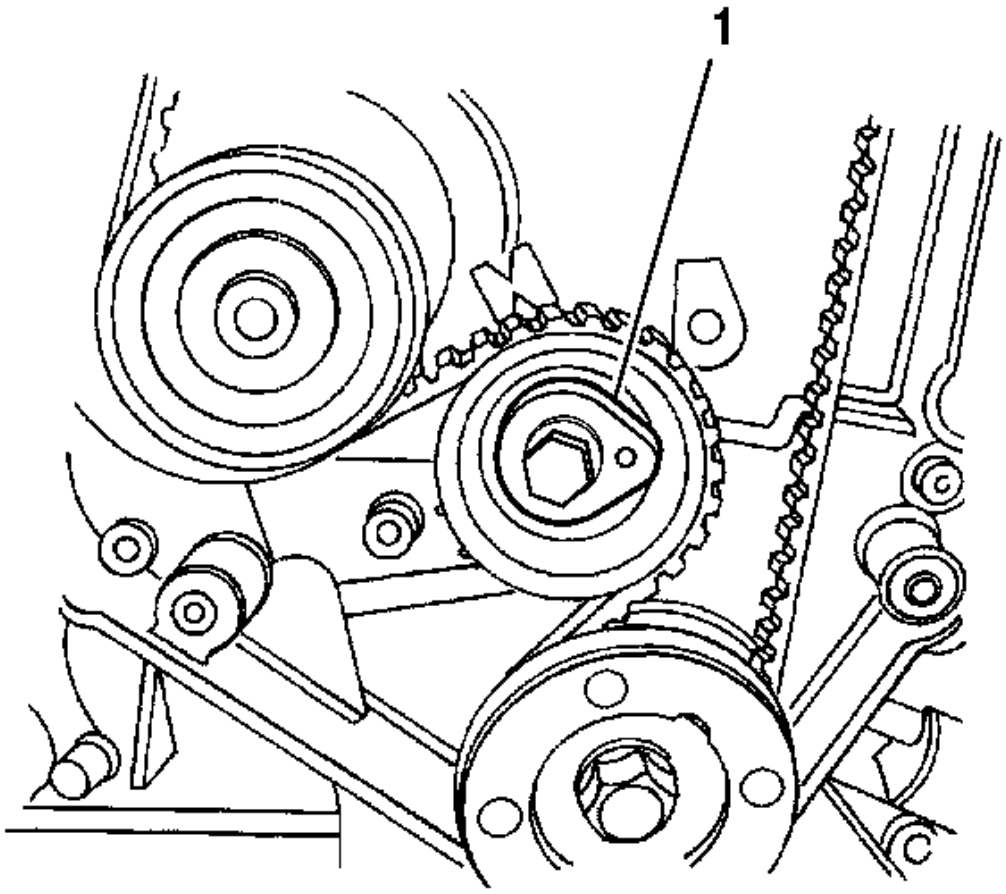

Fig. 22: View Of Automatic Tensioner And Hex-Key Tab
Courtesy of GENERAL MOTORS CORP.

4. Turn the hex-key tab in a counterclockwise direction to tension the belt. Turn until the pointer aligns with the notch.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Install the automatic tensioner bolt.

   Tighten: Tighten the automatic tensioner bolt to **25 N.m (18 lb ft)** .

6. Rotate the crankshaft 2 full turns clockwise using the crankshaft gear bolt.
7. Inspect the automatic tensioner pointer.

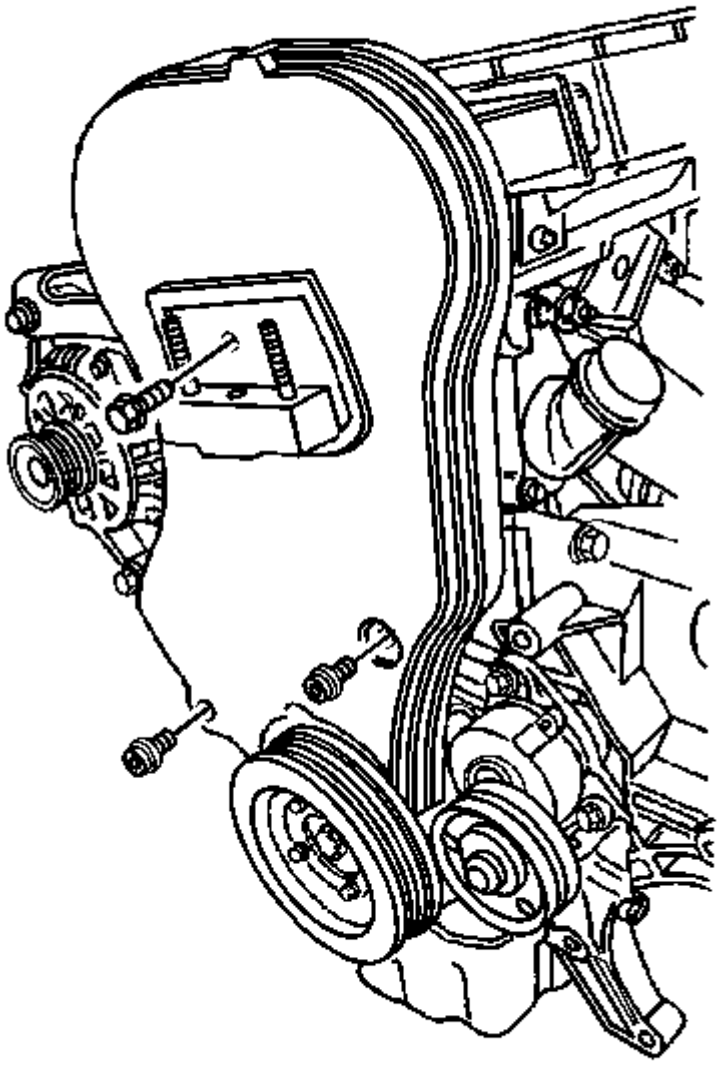

Fig. 23: View Of Front Timing Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

8. Install the front timing belt cover.
9. Install the front timing belt cover bolts.

   Tighten: Tighten the front timing belt cover bolts to **6 N.m (53 lb in)** .

10. Install the right engine mount bracket. Refer to **Engine Mount Replacement (Right Side)** or **Engine**

Mount Replacement (Forward).

11. Position the power steering hose in place and install the clamp bolt.

    Tighten: Tighten the power steering hose clamp bolt to **8 N.m (71 lb in)** .

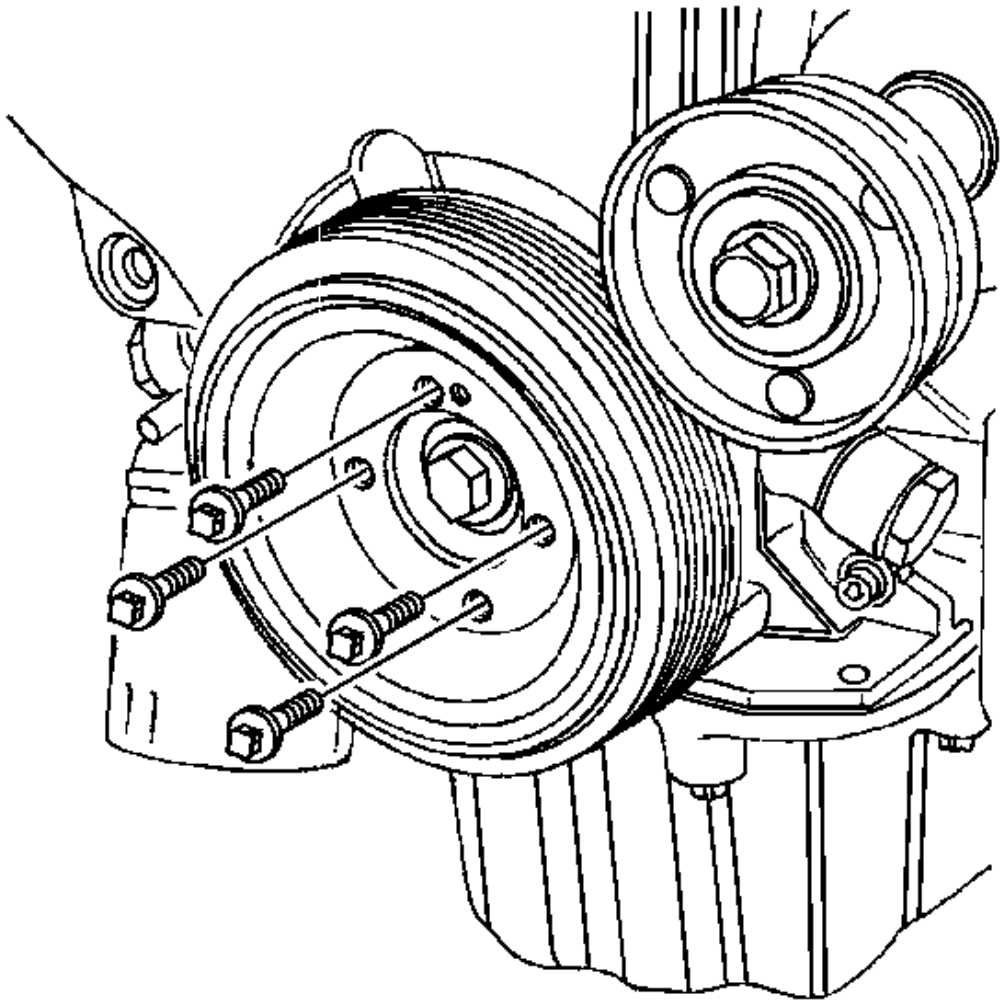

Fig. 24: View Of Crankshaft Pulley And Bolts
Courtesy of GENERAL MOTORS CORP.

12. Install the crankshaft pulley.
13. Install the crankshaft pulley bolts

Tighten: Tighten the crankshaft pulley bolts to **20 N.m (15 lb ft)** .

NOTE: Refer to Belt Dressing Notice in Cautions and Notices.

14. Install the power steering pump drive belt. Refer to **Power Steering Pump Drive Belt Replacement (2.0L)** in Power Steering System.
15. Install the right front wheel well splash shield. Refer to **Splash Shield Replacement - Wheelhouse** in Body Front End.
16. Install the right front wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

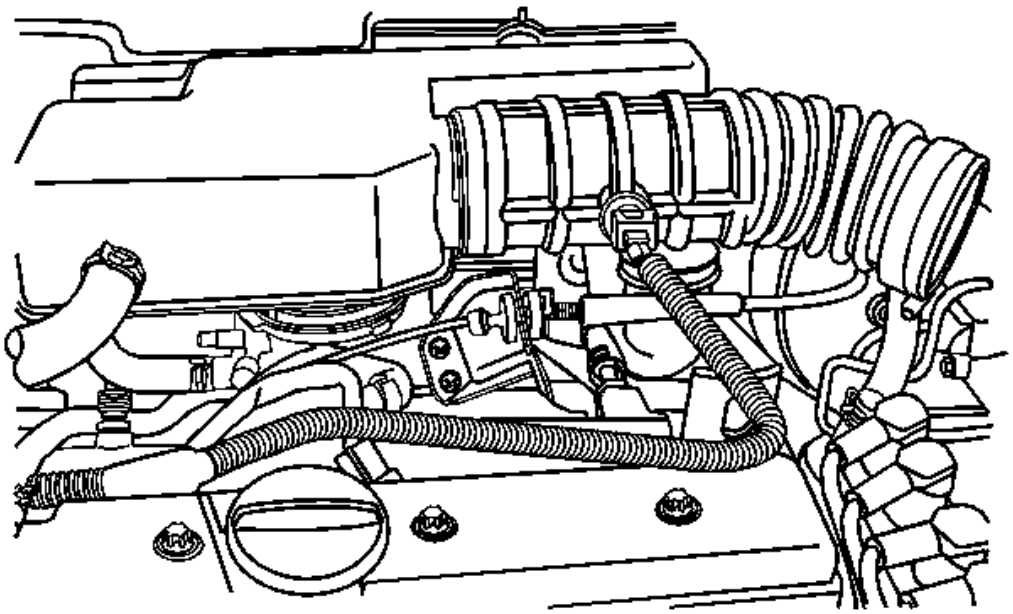

Fig. 25: View Of Manifold Air Temperature Sensor And Throttle Body Intake Tube
Courtesy of GENERAL MOTORS CORP.

17. Install the air filter housing.
18. Install the air filter housing bolts.

Tighten: Tighten the air filter housing bolts to **6 N.m (53 lb in)** .

19. Install the resonator and the retaining bolts.

Tighten: Tighten the resonator retaining bolts to **3 N.m (27 lb in)** .

20. Connect the air intake tube to the throttle body.
21. Connect the breather tube to the valve cover.
22. Connect the negative battery cable.

TIMING BELT INSPECTION

Adjustment Procedure

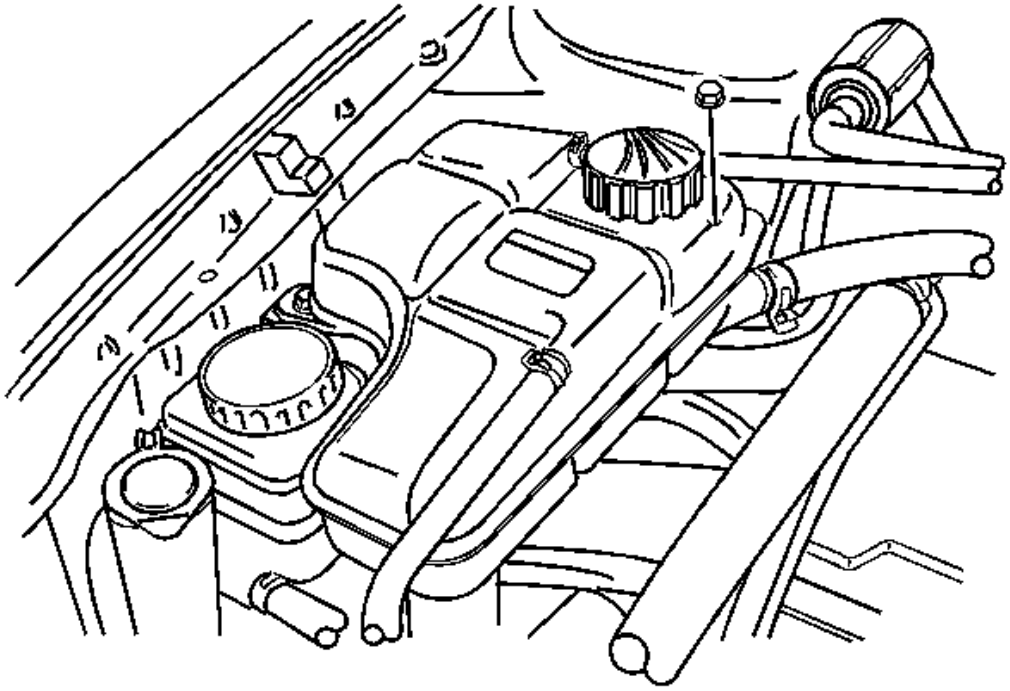

Fig. 26: View Of Surge Tank And Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Remove the spark plug cover.
3. Remove the surge tank mounting bolts.
4. Remove the surge tank.

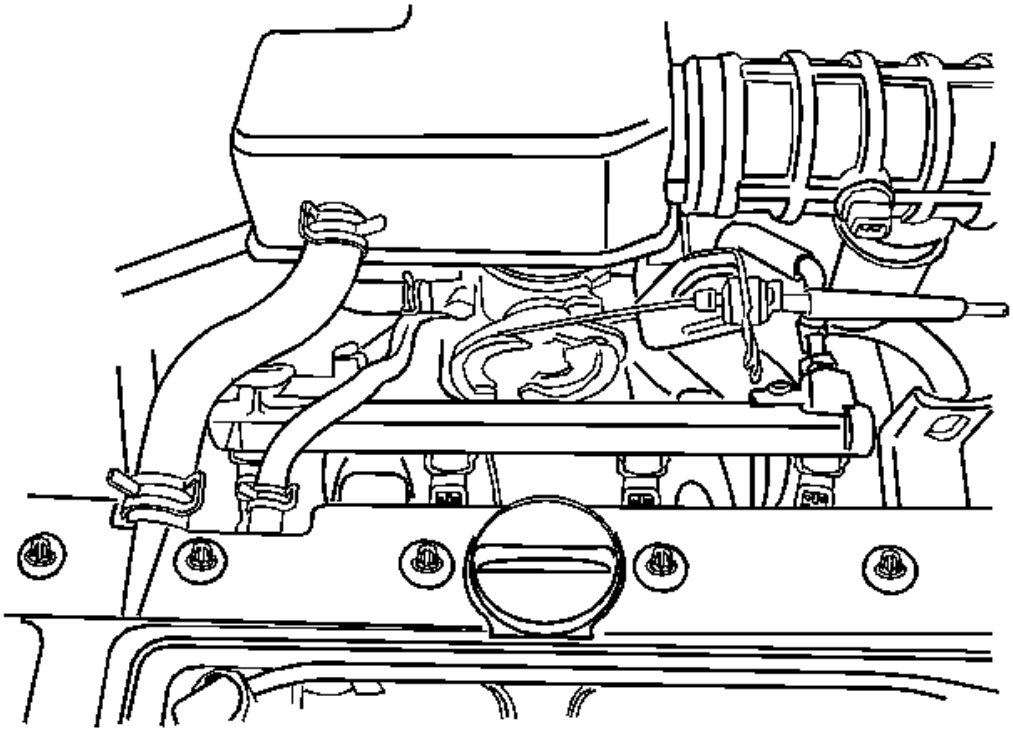

Fig. 27: View Of Valve Cover Breather Tube
Courtesy of GENERAL MOTORS CORP.

5. Remove the air intake tube from the throttle body.
6. Remove the breather tube from the valve cover.
7. Remove the right front wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
8. Remove the right front wheel well splash shield. Refer to **Splash Shield Replacement - Wheelhouse** in Body Front End.

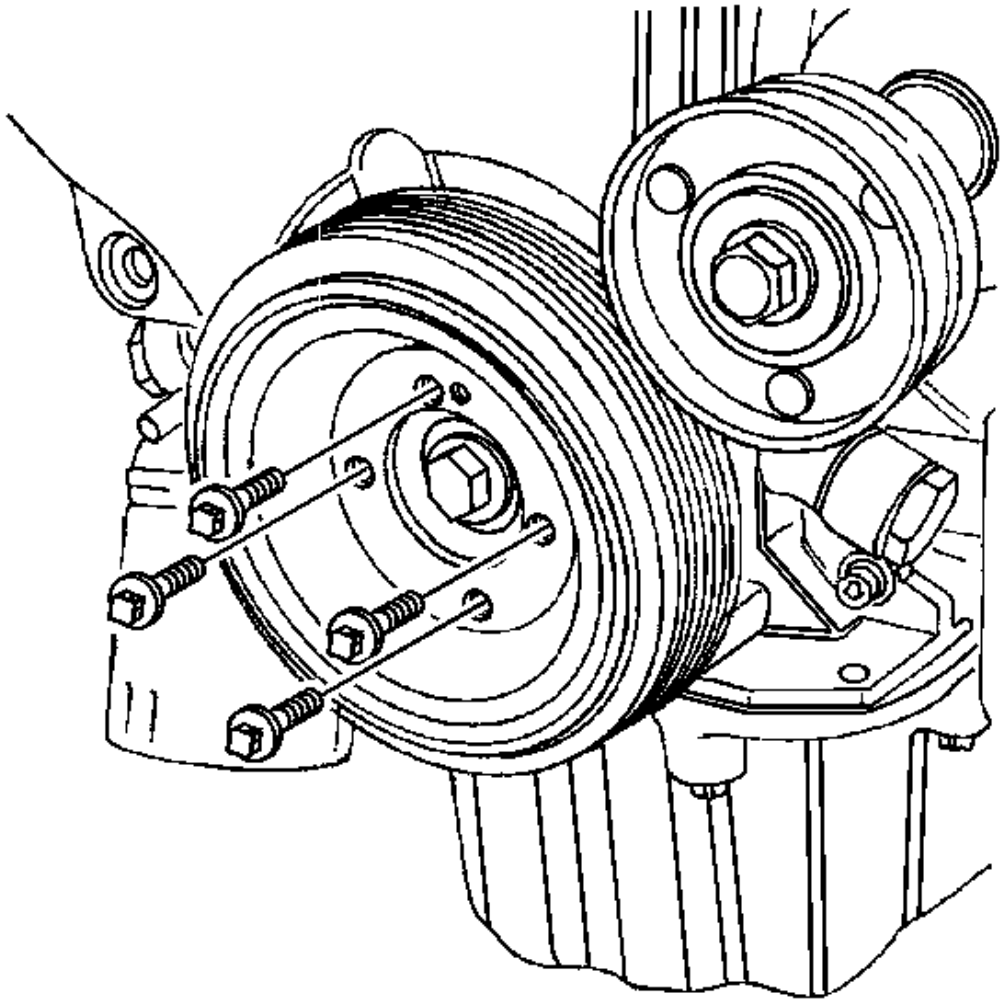

Fig. 28: View Of Crankshaft Pulley And Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Belt Dressing Notice in Cautions and Notices.

9. Remove the power steering pump drive belt. Refer to **Power Steering Pump Drive Belt Replacement (2.0L)** in Power Steering System.
10. Remove the crankshaft pulley bolts.
11. Remove the crankshaft pulley.
12. Remove the right engine mount bracket. Refer to **Engine Mount Replacement (Right Side)** or **Engine Mount Replacement (Forward)**.

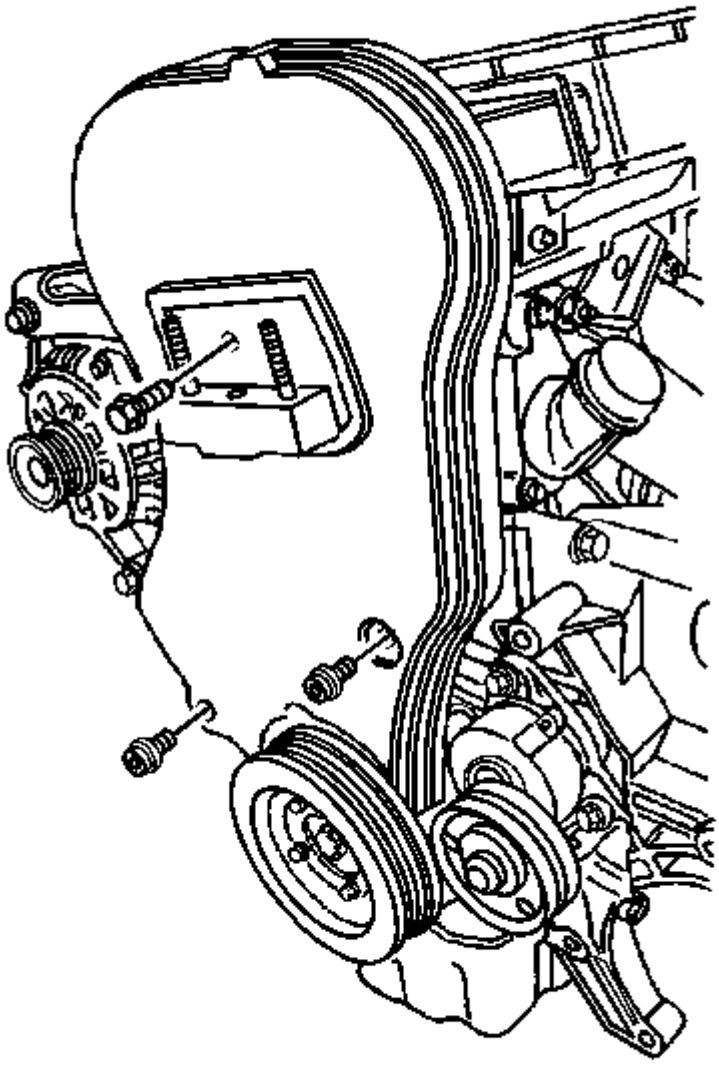

Fig. 29: View Of Front Timing Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

13. Remove the front timing belt cover bolts.
14. Remove the front timing belt cover.

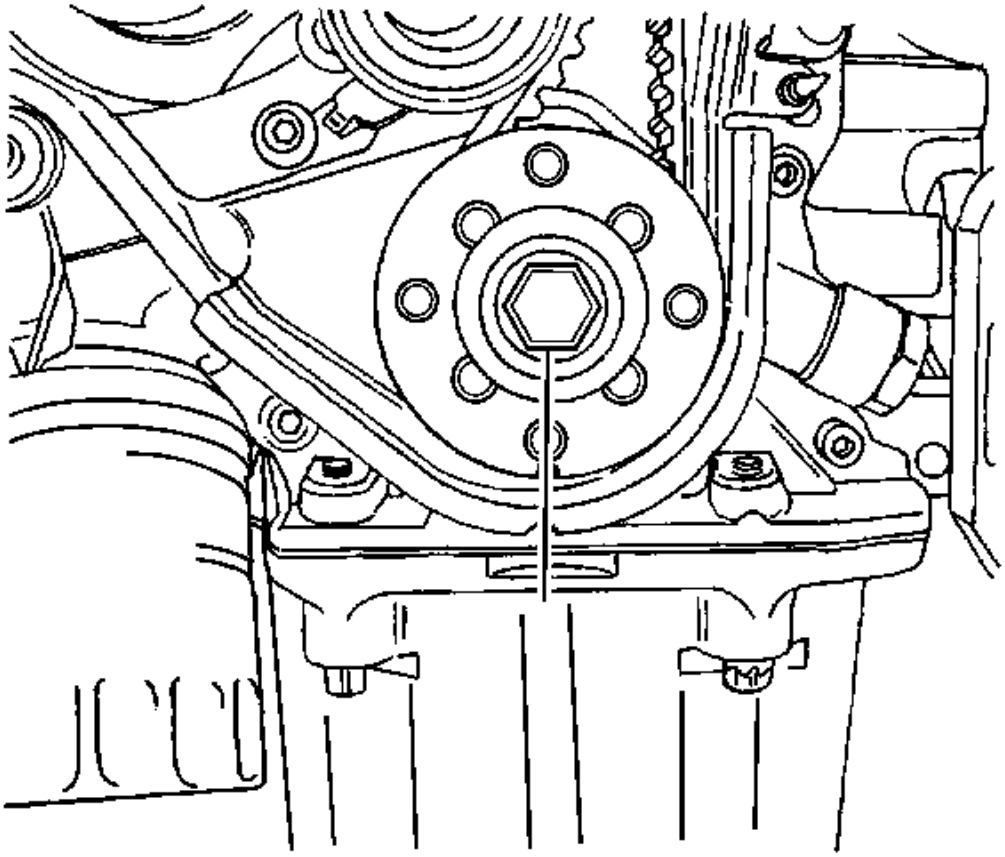

Fig. 30: Identifying Crankshaft Gear Bolt
Courtesy of GENERAL MOTORS CORP.

15. Rotate the crankshaft at least 1 full turn clockwise using the crankshaft gear bolt.
16. Align the mark on the crankshaft gear with the notch at the bottom of the rear timing belt cover.

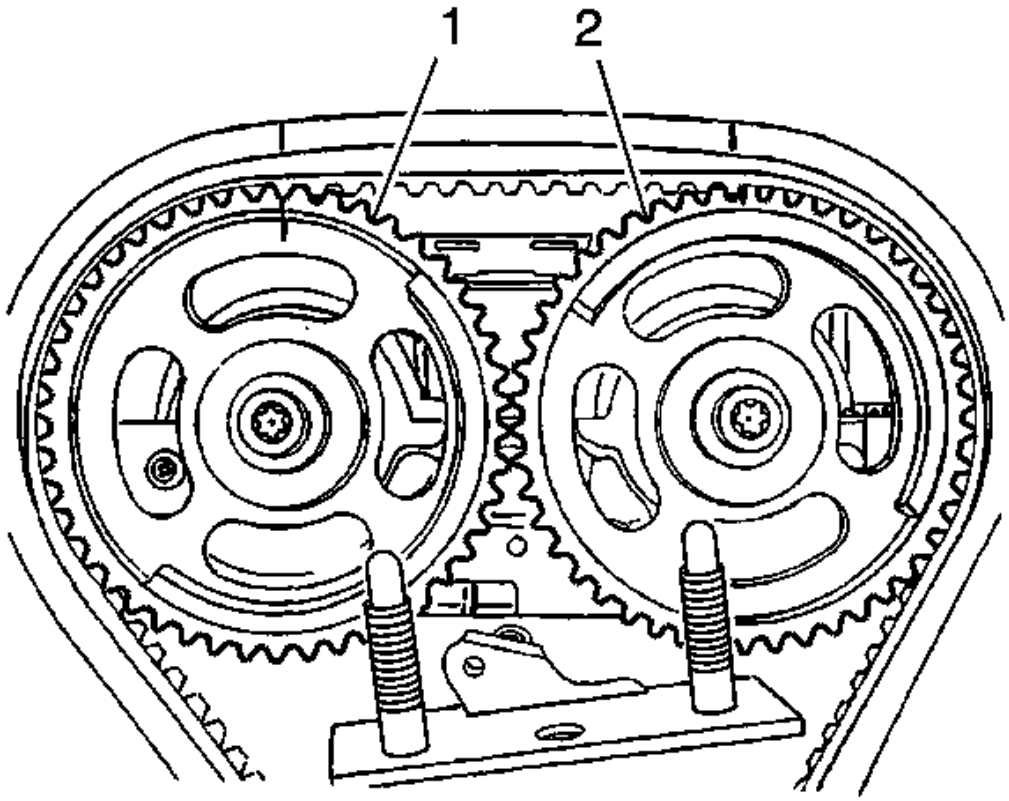

Fig. 31: View Of Intake And Exhaust Gears
Courtesy of GENERAL MOTORS CORP.

17. Align the camshaft gear timing marks. Use the exhaust gear mark for the exhaust gear (2) and the intake gear mark for the intake gear (1), since the gears are interchangeable.

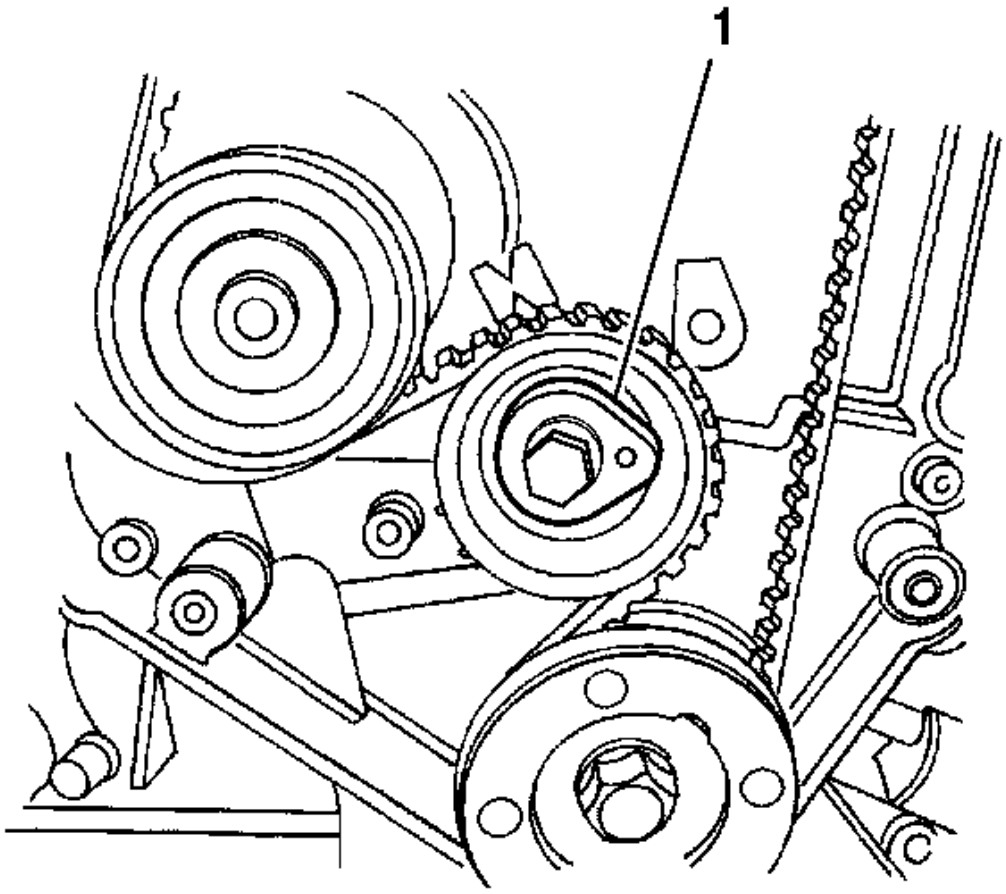

Fig. 32: View Of Automatic Tensioner And Hex-Key Tab
Courtesy of GENERAL MOTORS CORP.

18. Loosen the automatic tensioner bolt. To tighten the belt tension, turn the hex-key tab counterclockwise.
19. Rotate the automatic tensioner hex-key tab clockwise until the adjust arm pointer of the timing belt automatic tensioner is aligned with the notch in the timing belt automatic tensioner bracket.

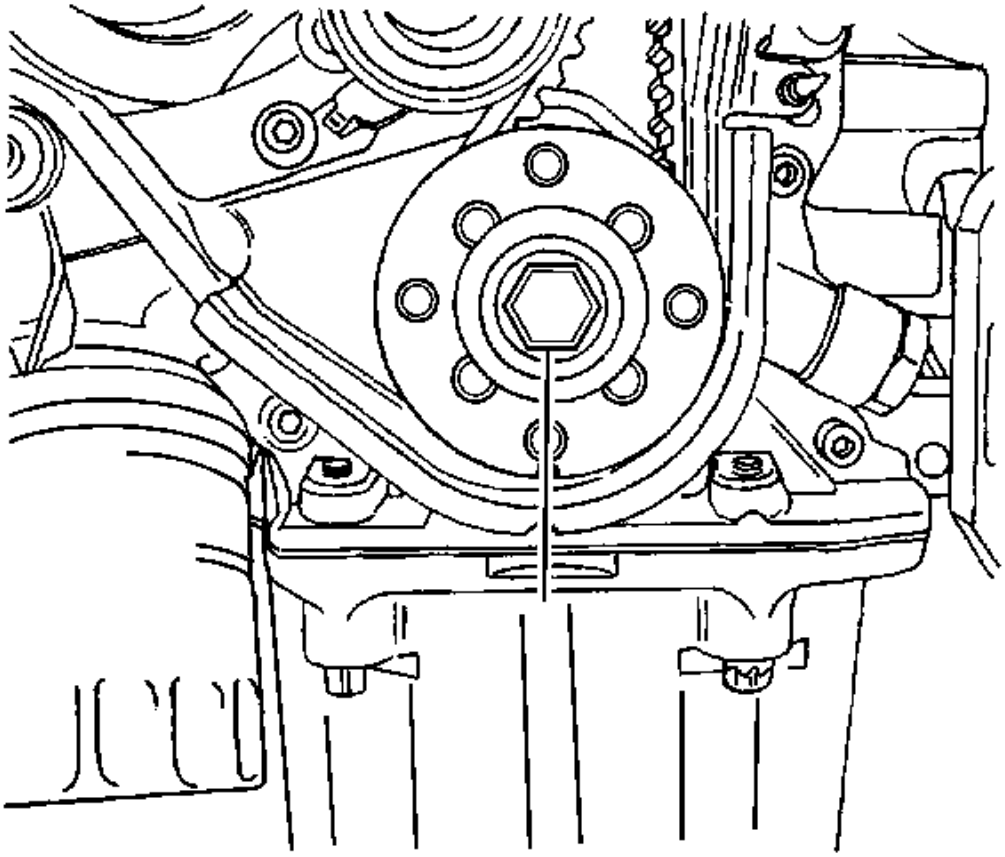

Fig. 33: Identifying Crankshaft Gear Bolt
Courtesy of GENERAL MOTORS CORP.

20. Tighten the automatic tensioner bolt.
21. Rotate the crankshaft 2 full turns clockwise using the crankshaft gear bolt.
22. Inspect the automatic tensioner pointer.

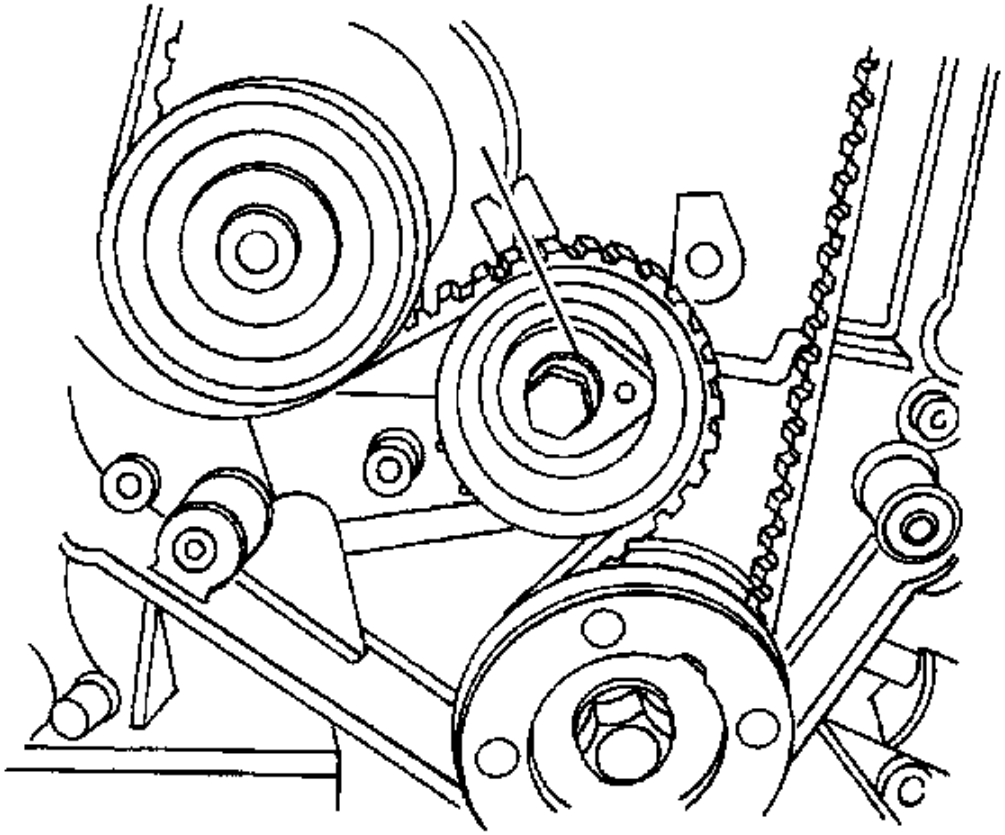

Fig. 34: Identifying Tensioner Notch Alignment
Courtesy of GENERAL MOTORS CORP.

23. When the adjust arm pointer of the timing belt automatic tensioner is aligned with the notch on the timing belt automatic tensioner bracket, the belt is tensioned correctly.

    Tighten: Tighten the automatic tensioner bolt to **25 N.m (18 lb ft)** .

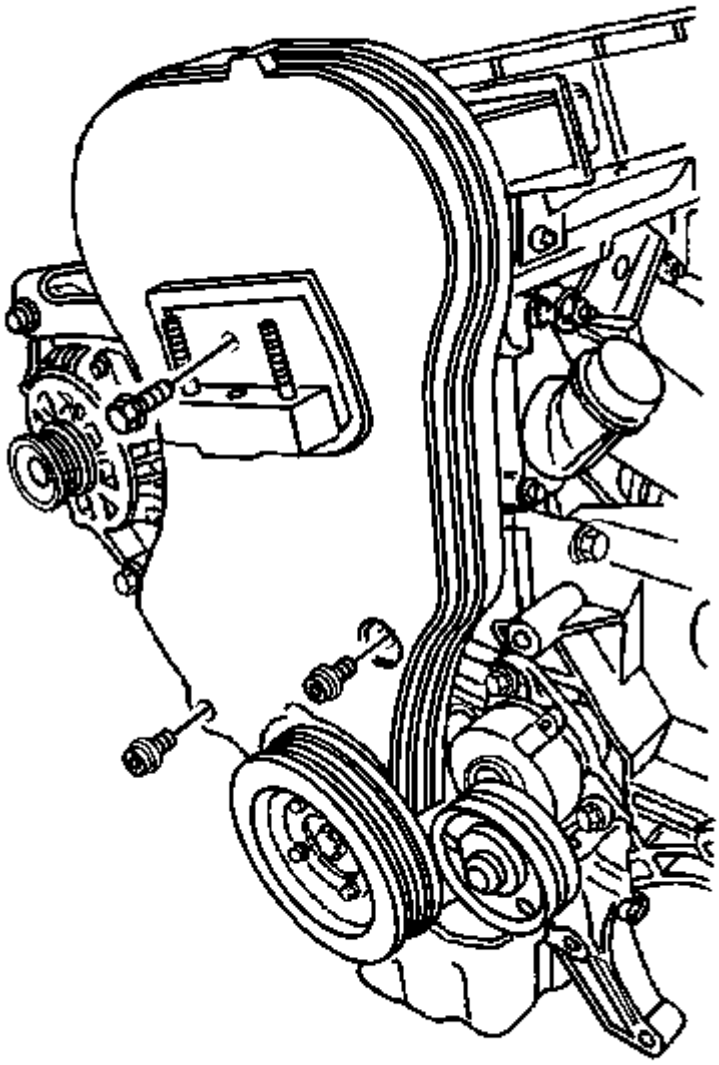

Fig. 35: View Of Front Timing Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

24. Install the front timing belt cover.
25. Install the front timing belt cover bolts.

Tighten: Tighten the front timing belt cover bolts to **6 N.m (53 lb in)** .

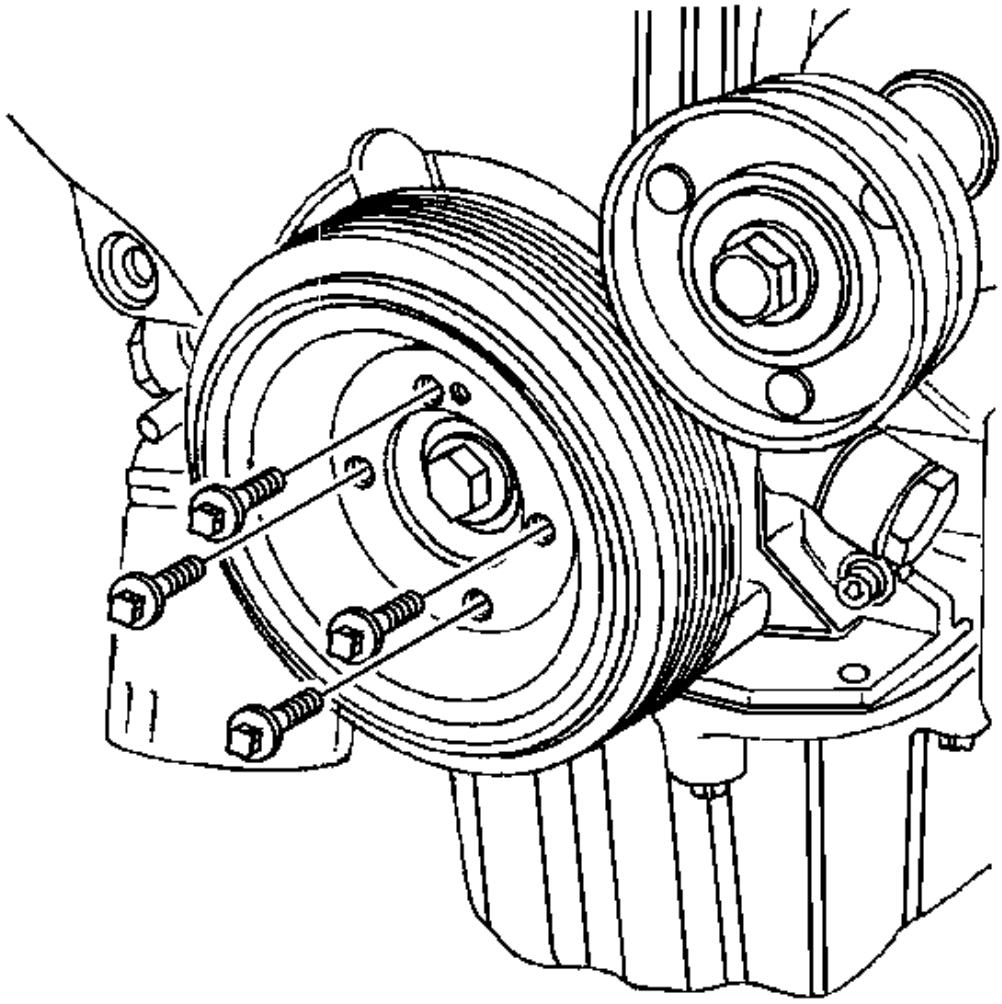

Fig. 36: View Of Crankshaft Pulley And Bolts
Courtesy of GENERAL MOTORS CORP.

26. Install the crankshaft pulley.
27. Install the crankshaft pulley bolts.

    Tighten: Tighten the crankshaft pulley bolts to **20 N.m (15 lb ft)** .

28. Install the right engine mount bracket. Refer to **Engine Mount Replacement (Right Side)** or **Engine Mount Replacement (Forward)**.

NOTE: Refer to Belt Dressing Notice in Cautions and Notices.

29. Install the power steering pump. Refer to **Power Steering Pump Drive Belt Replacement (2.0L)** in Power Steering System.

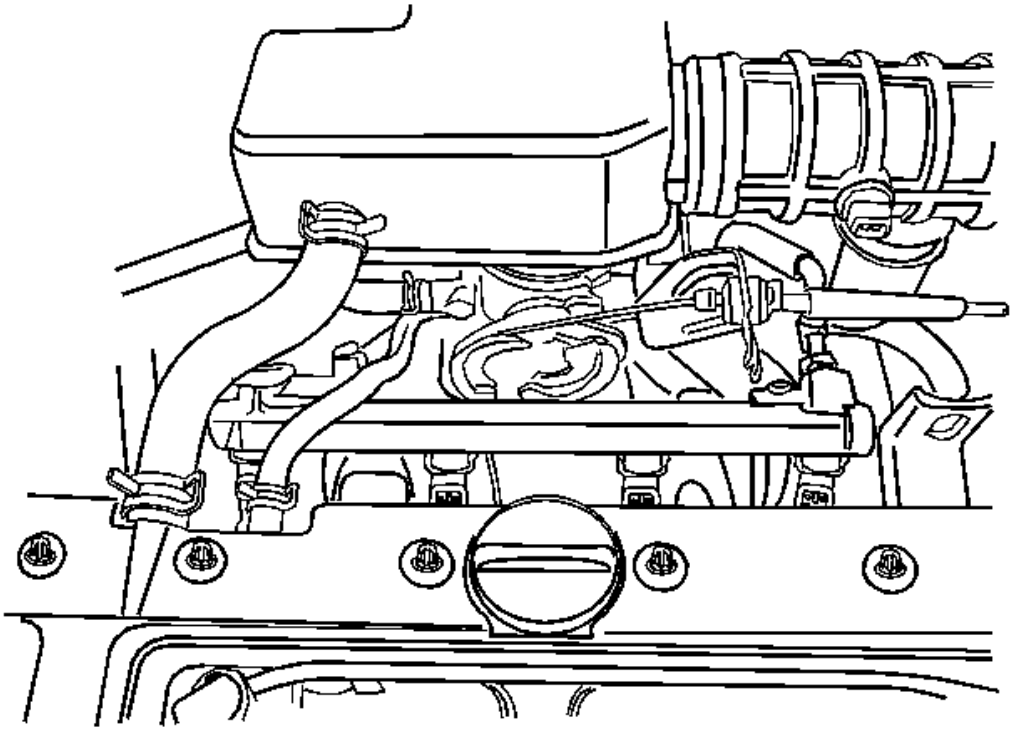

Fig. 37: View Of Valve Cover Breather Tube
Courtesy of GENERAL MOTORS CORP.

30. Install the right front wheel well and splash shield. Refer to **Splash Shield Replacement - Wheelhouse** in Body Front End.
31. Install the right front wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
32. Connect the air intake tube to the throttle body.
33. Connect the breather tube to the valve cover.
34. Connect the negative battery cable.

TIMING BELT COVER REPLACEMENT

Tools Required

- **J 45059** Angle Meter. See **Special Tools** .
- **KM-470-B** Angular Torque Gage. See **Special Tools** .

Removal Procedure

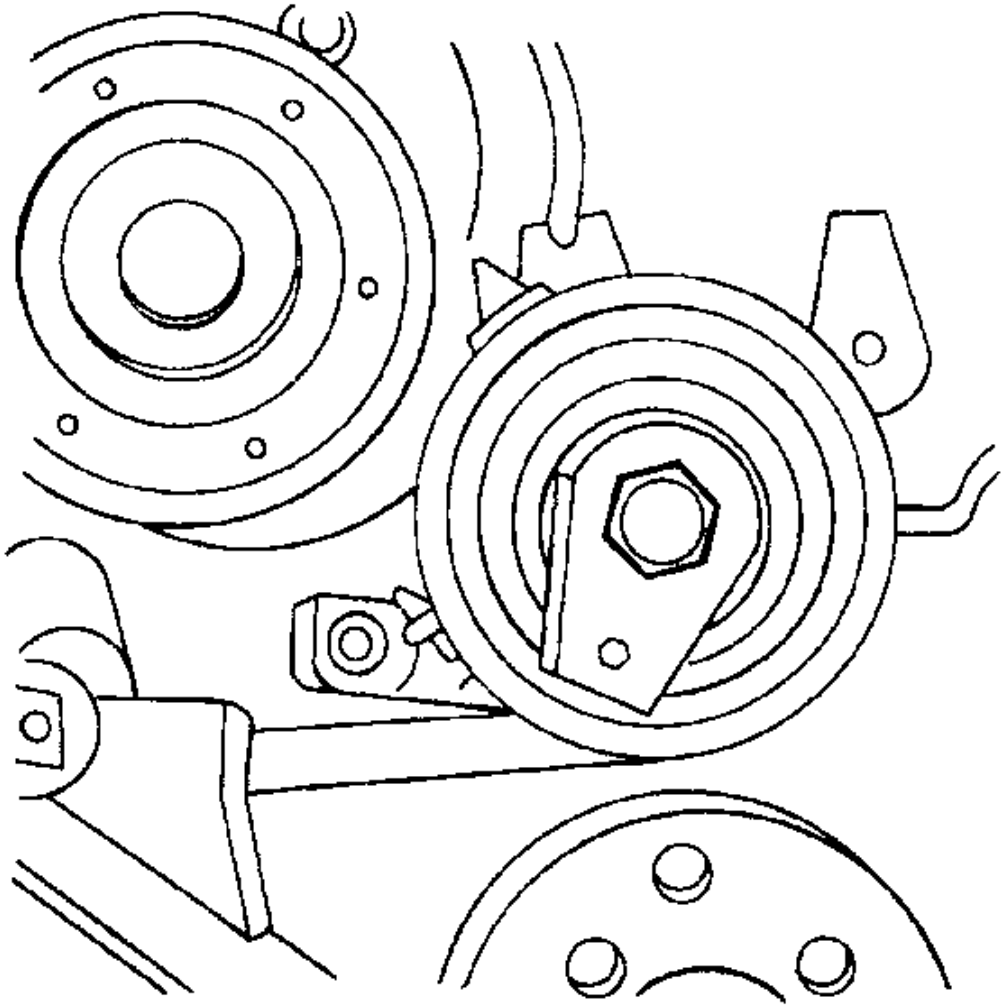

Fig. 38: View Of Timing Belt Automatic Tensioner And Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Remove the timing belt. Refer to **Timing Belt Replacement**.
3. Remove the camshaft gears. Refer to **Camshaft Gear Replacement**.
4. Remove the timing belt automatic tensioner bolt.
5. Remove the timing belt automatic tensioner.

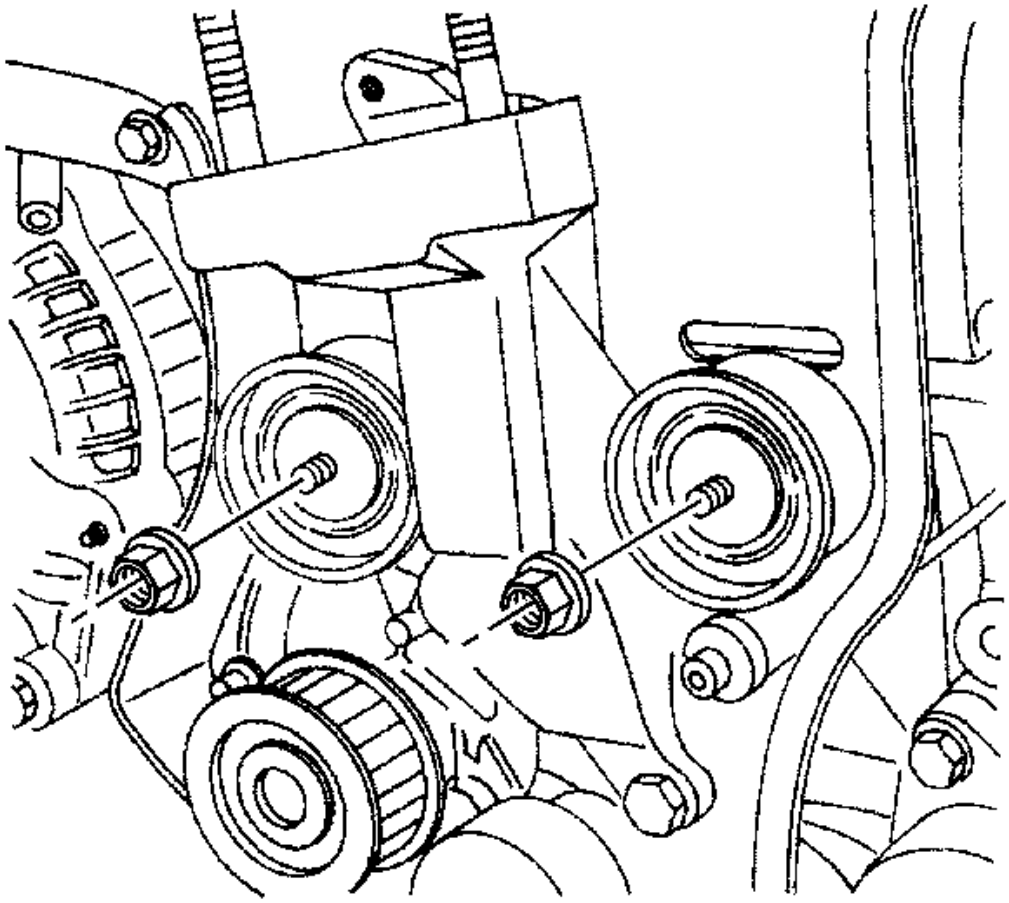

Fig. 39: View Of Timing Belt Idler Pulleys And Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the timing belt idler pulley nuts.
7. Remove the timing belt idler pulleys.
8. Remove the engine mount retaining bolts.
9. Remove the engine mount.

10. Remove the crankshaft timing belt drive gear bolt.
11. Remove the crankshaft gear.

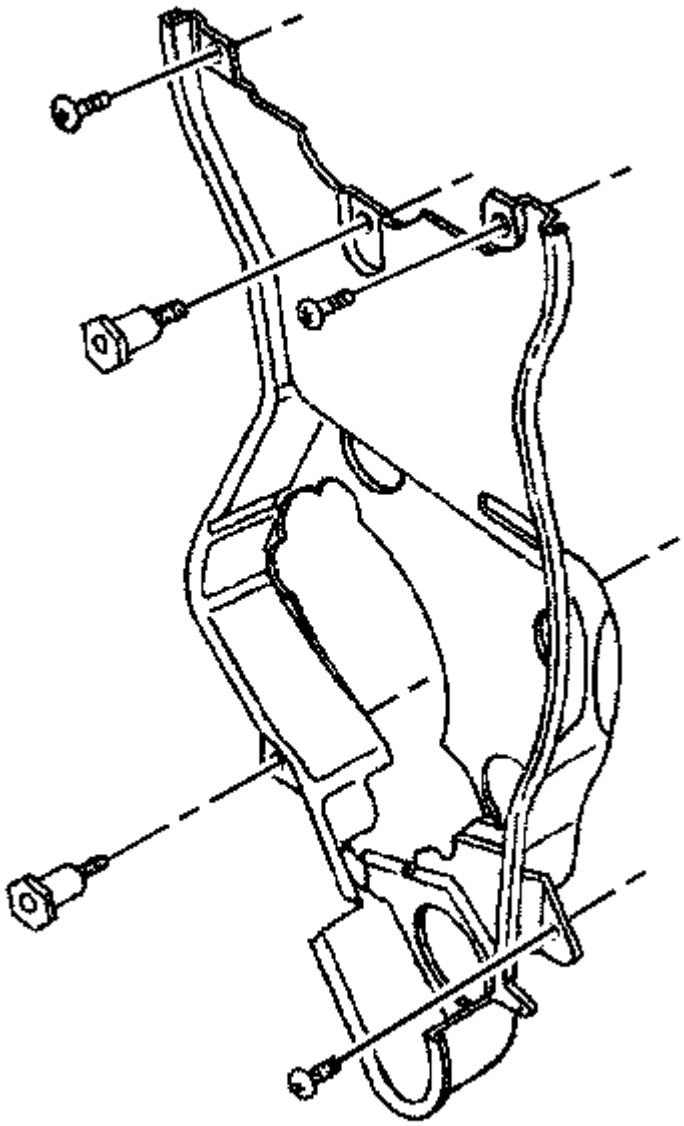

Fig. 40: View Of Rear Timing Belt Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

12. Remove the rear timing belt cover bolts.

13. Remove the rear timing belt cover.

Installation Procedure

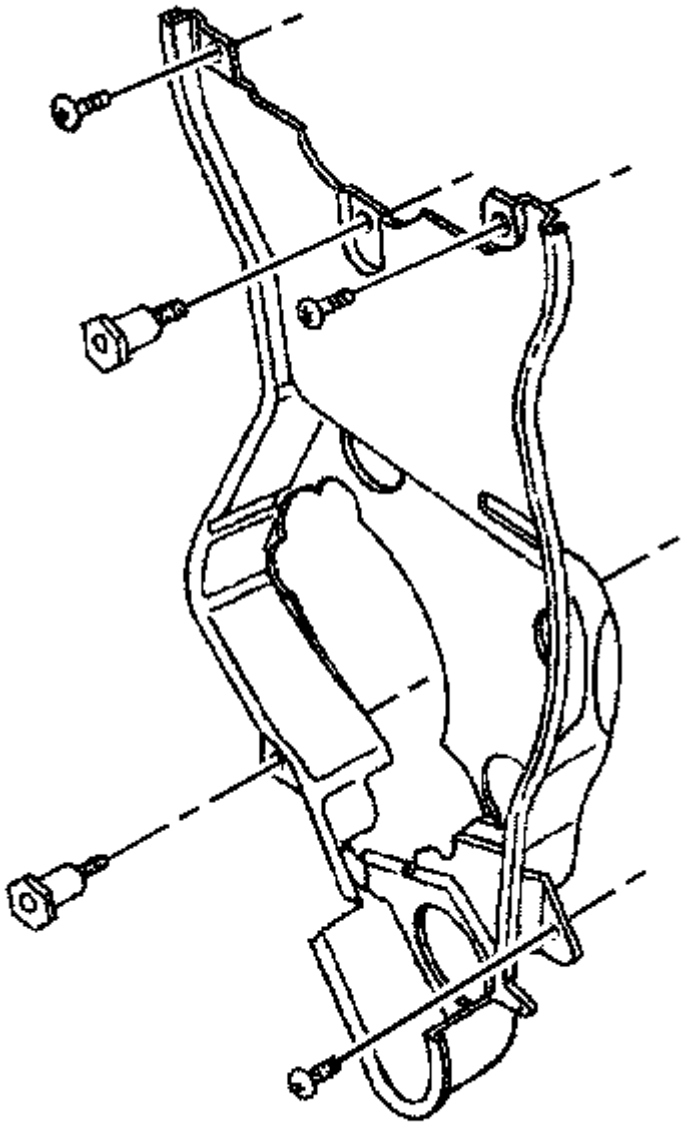

Fig. 41: View Of Rear Timing Belt Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the rear timing belt cover.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the rear timing belt cover bolts.

   Tighten: Tighten the rear timing belt cover bolts to **6 N.m (53 lb in)** .

3. Install the engine mount and the retaining bolts.

   Tighten: Tighten the engine mount retaining bolts to **60 N.m (44 lb ft)** .

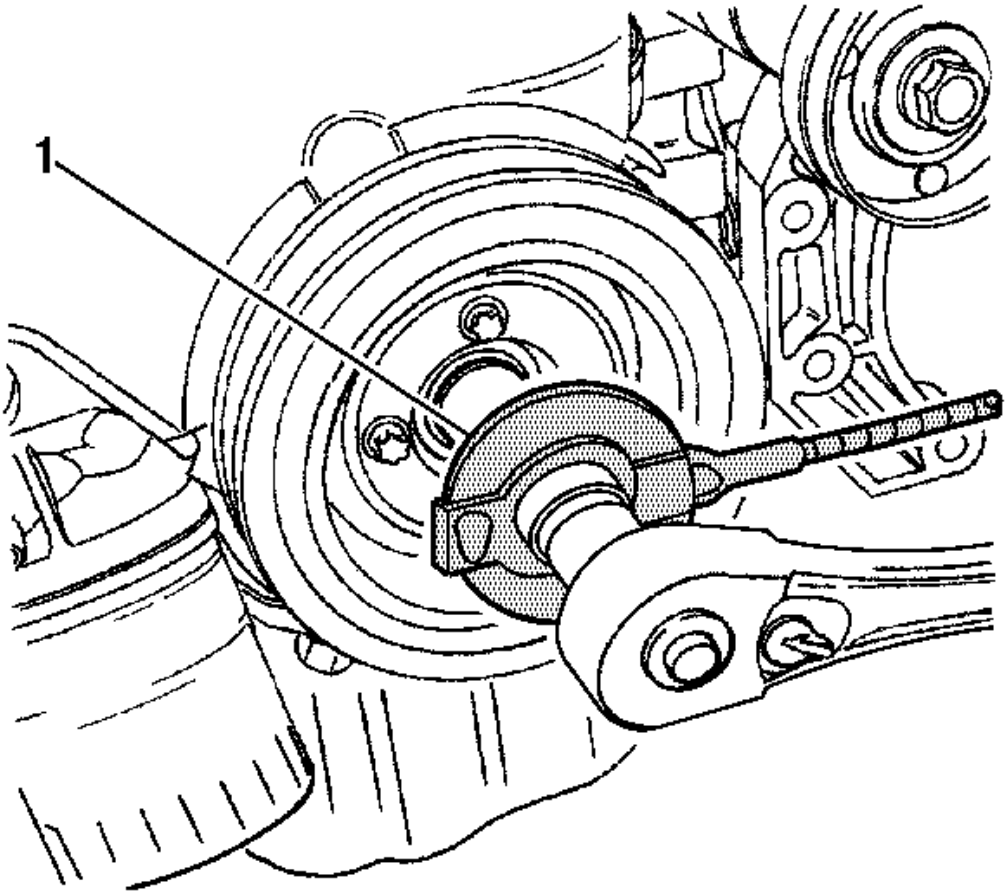

Fig. 42: View Of Drive Gear Bolt Torque Tool KM-470-B
Courtesy of GENERAL MOTORS CORP.

4. Install the timing belt idler pulleys.
5. Install the timing belt idler pulley nuts.

Tighten: Tighten the timing belt idler pulley nuts to **25 N.m (18 lb ft)** .

6. Install the crankshaft timing belt drive gear and bolt.

   Tighten: Tighten the crankshaft timing belt drive gear bolt to **135 N.m (100 lb ft)** plus 30 degrees to 10 degrees using the **J 45059** or the **KM-470-B** (1). See **Special Tools** .

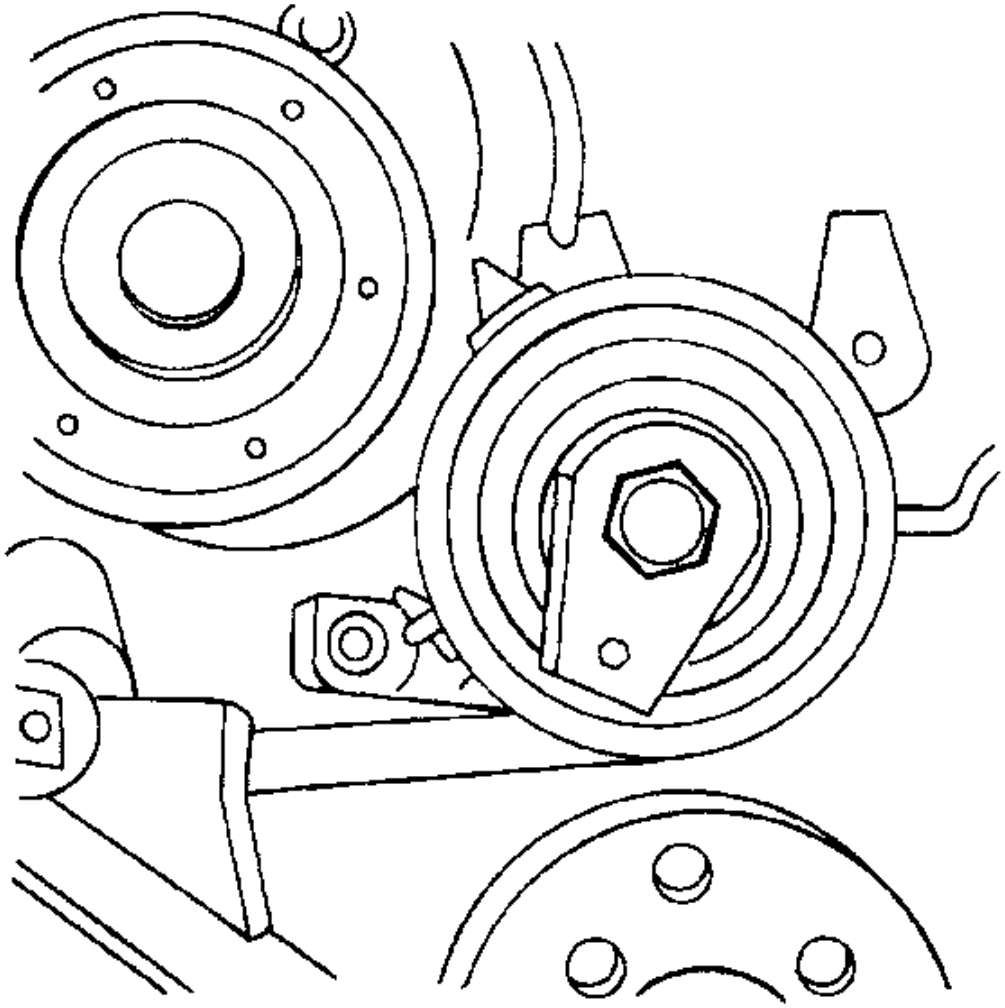

Fig. 43: View Of Timing Belt Automatic Tensioner And Bolt
Courtesy of GENERAL MOTORS CORP.

7. Install the timing belt automatic tensioner and bolt.

Tighten: Tighten the timing belt automatic tensioner bolt to **25 N.m (18 lb ft)** .

8. Install the camshaft gears. Refer to **Camshaft Gear Replacement**.
9. Install the timing belt and timing belt cover. Refer to **Timing Belt Replacement**.
10. Connect the negative battery cable.

VALVE ROCKER ARM COVER REPLACEMENT

Removal Procedure

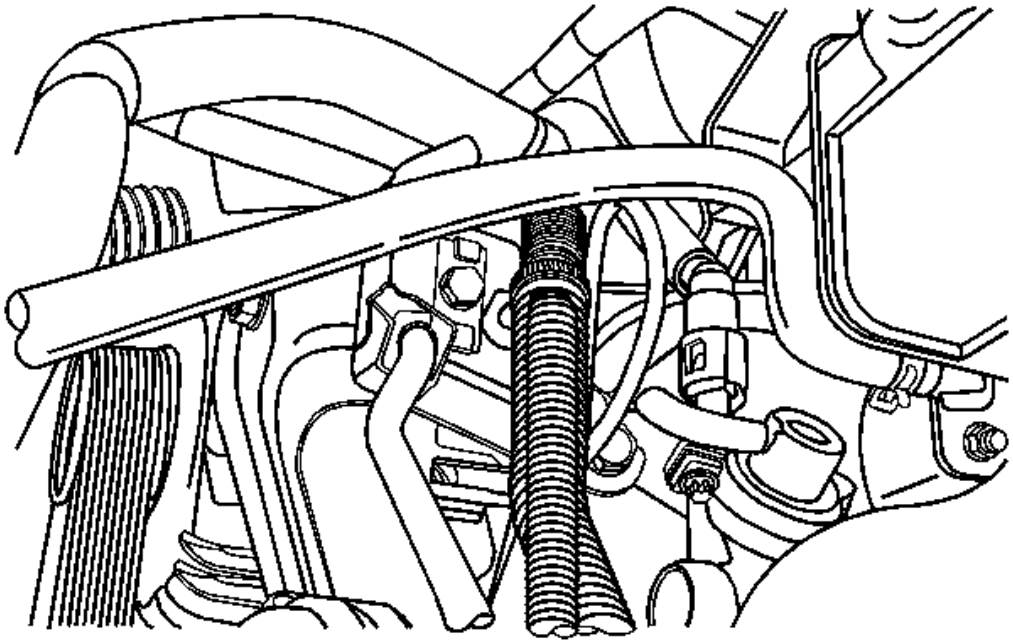

Fig. 44: View Of Vacuum Hoses
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Disconnect the breather tube from the valve cover.
3. Disconnect the crankshaft ventilation tube from the valve cover.
4. Disconnect the vacuum line from the valve cover.

5. Remove the spark plug cover bolts.
6. Remove the spark plug cover.
7. Disconnect the ignition wires from the spark plugs.
8. Remove the power steering hose clamp bolt and the position power steering hose clamp clear of the repair area.

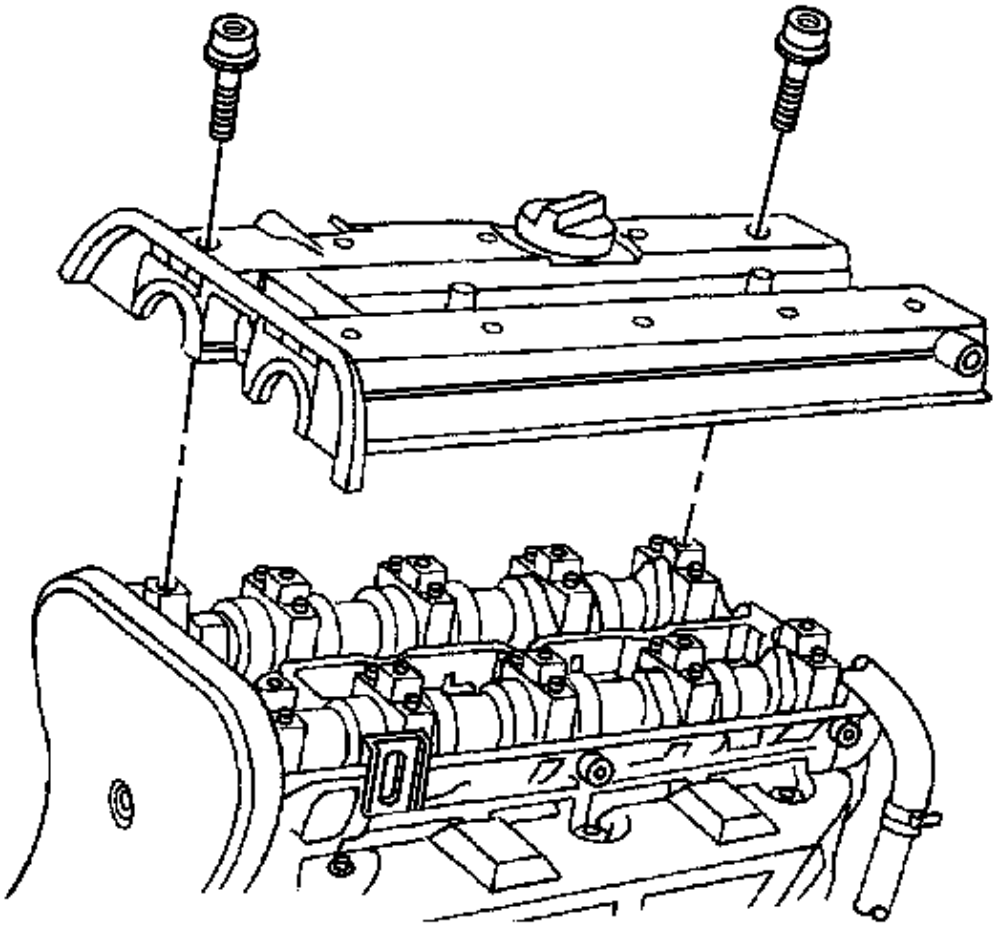

Fig. 45: View Of Valve Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

9. Disconnect the camshaft position (CMP) sensor connector.
10. Remove the valve cover bolts.
11. Remove the valve cover washers.

12. Remove the valve cover.

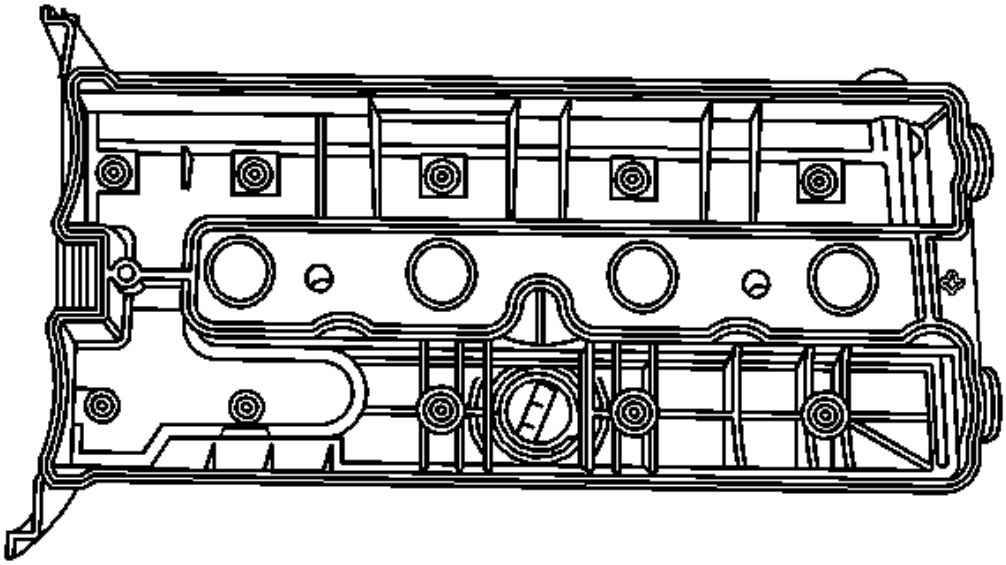

Fig. 46: View Of Valve Cover And Gasket
Courtesy of GENERAL MOTORS CORP.

13. Remove the valve cover gasket from the valve cover.

Installation Procedure

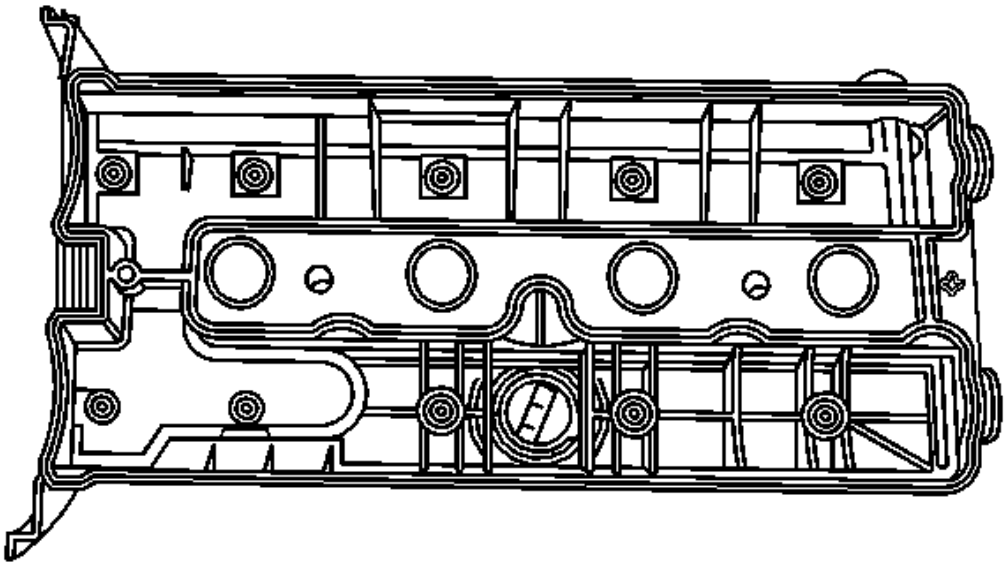

Fig. 47: View Of Valve Cover And Gasket
Courtesy of GENERAL MOTORS CORP.

1. Apply a small amount of gasket sealant to the corners of the front camshaft caps and the top of the rear valve cover-to-cylinder head seal.
2. Install the new valve cover gasket to the valve cover.

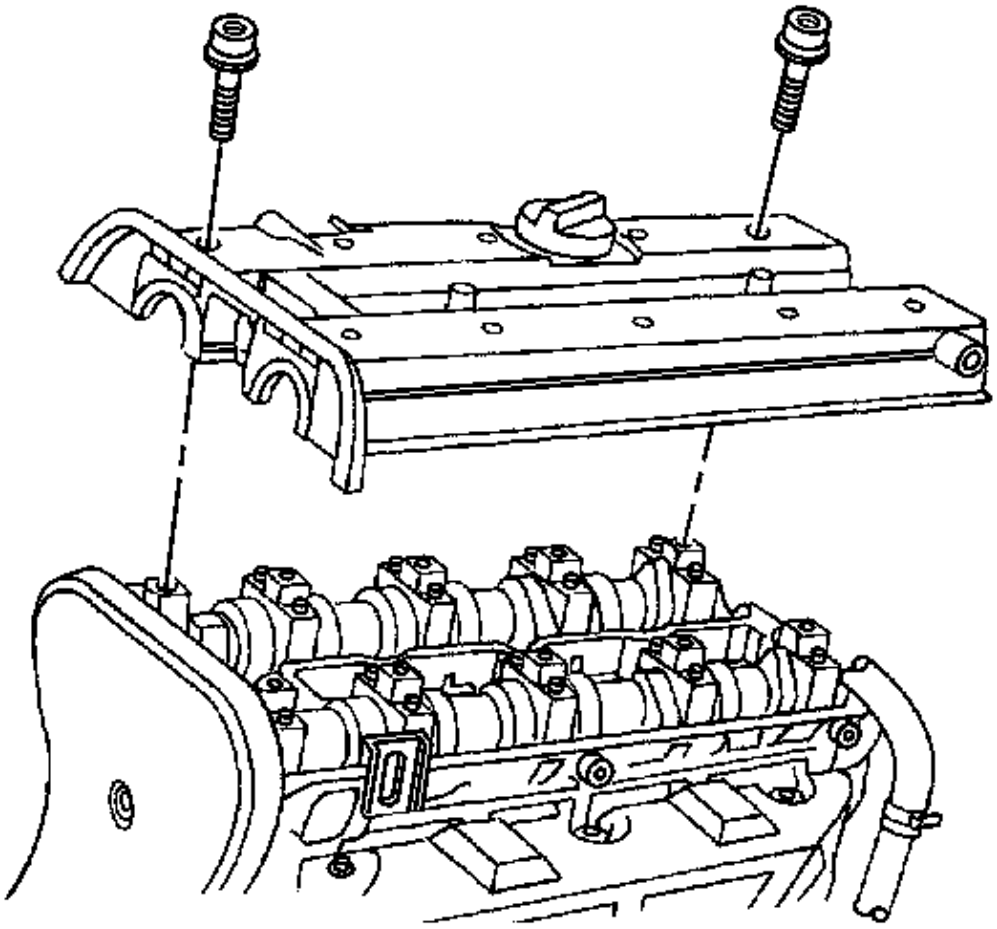

Fig. 48: View Of Valve Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the valve cover.
4. Install the valve cover washers.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Install the valve cover bolts.

Tighten: Tighten the valve cover bolts to **8 N.m (71 lb in)** .

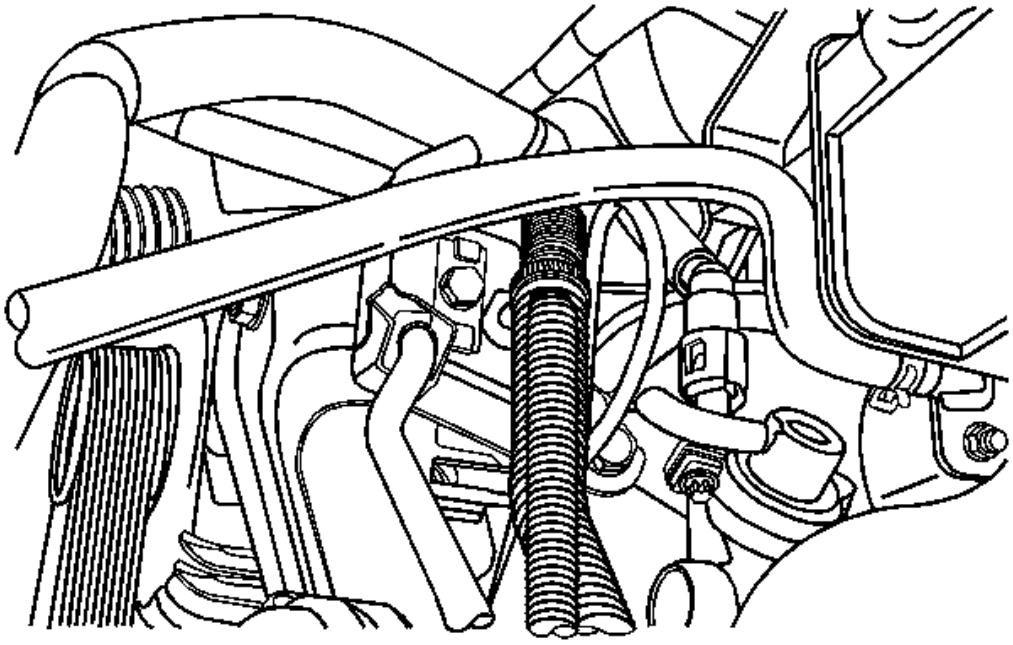

Fig. 49: View Of Vacuum Hoses
Courtesy of GENERAL MOTORS CORP.

6. Connect the ignition wires to the spark plugs.
7. Install the spark plug cover.
8. Install the spark plug cover bolts.

   Tighten: Tighten the spark plug cover bolts to **3 N.m (27 lb in)** .

9. Connect the vacuum line to the valve cover.
10. Connect the crankshaft ventilation tube to the valve cover.
11. Connect the breather tube to the valve cover.
12. Connect the CMP sensor connector.
13. Position the power steering pressure hose in place and install the bolt.

    Tighten: Tighten the power steering hose clamp bolt to **8 N.m (71 lb in)** .

14. Connect the negative battery cable.

CYLINDER HEAD REPLACEMENT

Tools Required

- **J 28467-B** (DW-117) Universal Engine Support Fixture. See **Special Tools** .
- **J 45059** Angle Meter. See **Special Tools** .
- **KM-470-B** Angular Torque Gage. See **Special Tools** .

Removal Procedure

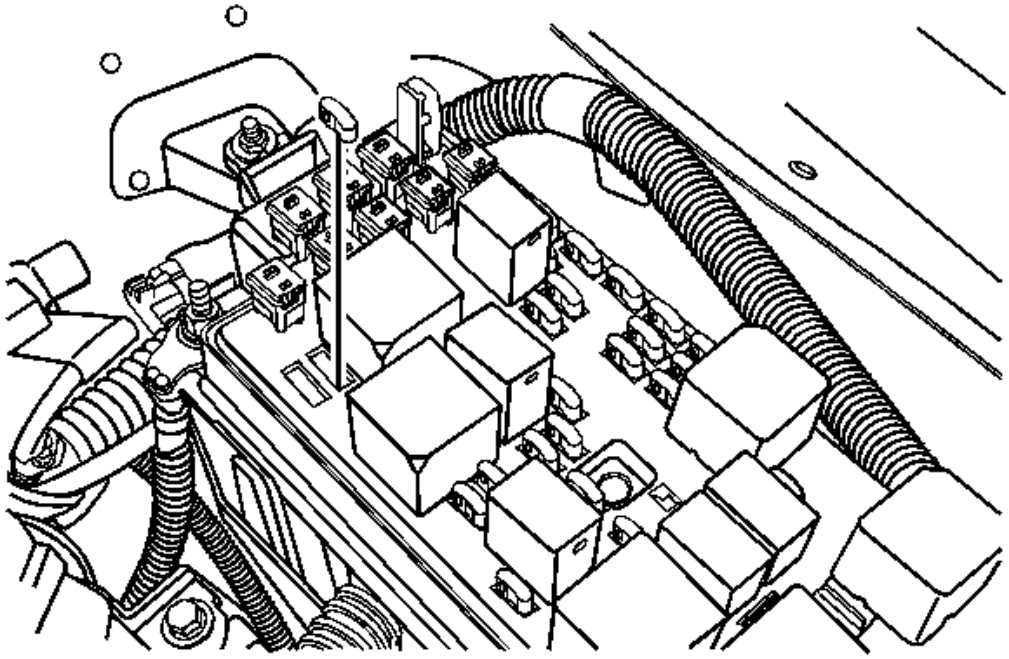

Fig. 50: Identifying Fuel Pump Fuse
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Compressed Valve Spring Caution in Cautions and Notices.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

1. Remove the fuel pump fuse.
2. Start the engine and wait for it to stall.
3. Crank the engine for 10 seconds to rid the fuel system of fuel pressure.

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

4. Disconnect the negative battery cable.
5. Disconnect the engine control module (ECM) ground terminal.
6. Drain the engine coolant. Refer to **Draining and Filling Cooling System (2.0L)** in Engine Cooling.

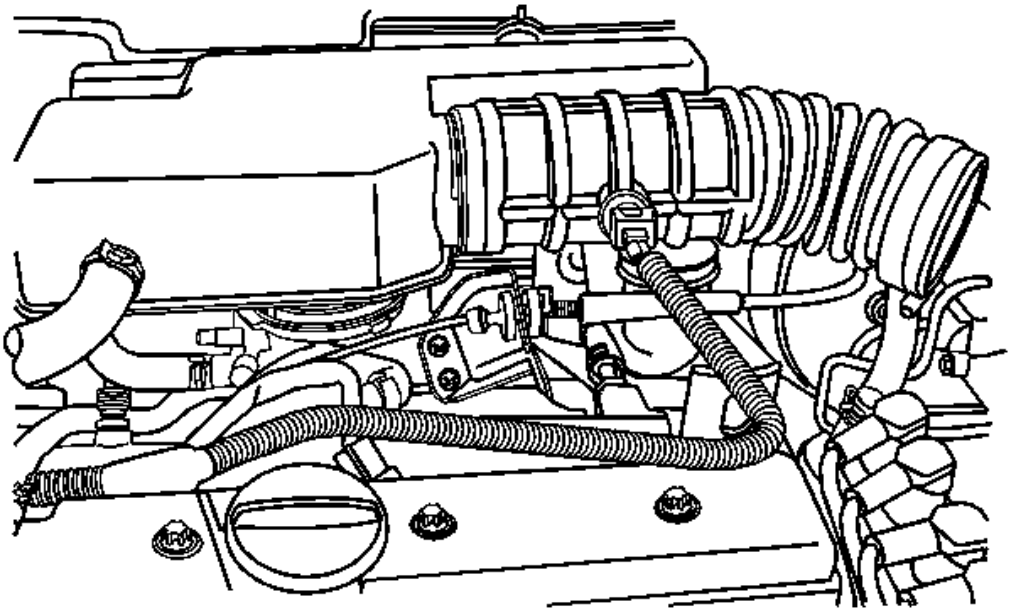

Fig. 51: View Of Manifold Air Temperature Sensor And Throttle Body Intake Tube
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the intake air temperature (IAT) sensor and connector.
8. Disconnect the breather tube from the valve cover.
9. Disconnect the crankshaft ventilation tube from the valve cover.
10. Disconnect the vacuum line from the valve cover.
11. Remove the resonator retaining bolts and the resonator.
12. Remove the air intake tube.
13. Remove the canister purge solenoid bracket bolt and reposition the canister purge solenoid clear of the repair area.

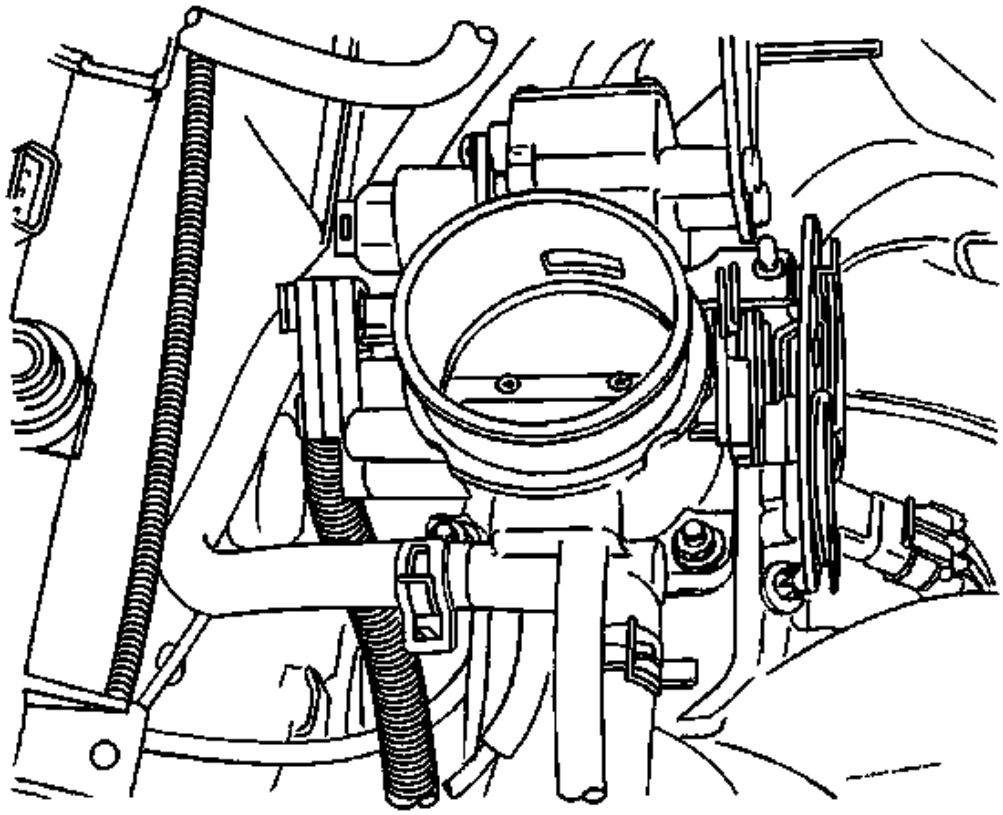

Fig. 52: View Of Throttle Body And Connectors
Courtesy of GENERAL MOTORS CORP.

14. Disconnect the ignition coil connector.
15. Disconnect the oxygen sensor connector if equipped.
16. Disconnect the idle air control (IAC) valve connector.
17. Disconnect the throttle position (TP) sensor connector.
18. Disconnect the engine coolant temperature (ECT) sensor connector.
19. Disconnect the coolant temperature sensor (CTS) connector.
20. Disconnect the camshaft position (CMP) sensor connector.

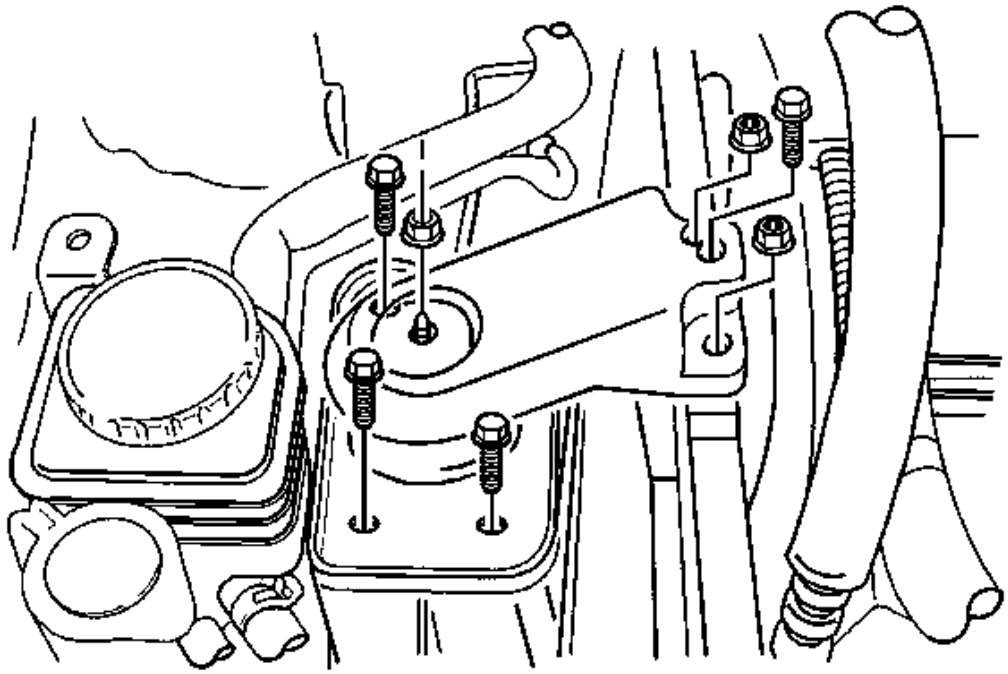

Fig. 53: View Of Surge Tank, Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

21. Remove the bolts with the surge tank. Refer to **Surge Tank Replacement (2.0L)** in Engine Cooling.
22. Remove the right front wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
23. Remove the right front wheel well splash shield. Refer to **Splash Shield Replacement - Wheelhouse** in Body Front End.
24. Install the **J 28467-B** . See **Special Tools** .
25. Remove the right engine mount bracket and the retaining bolt and nuts.

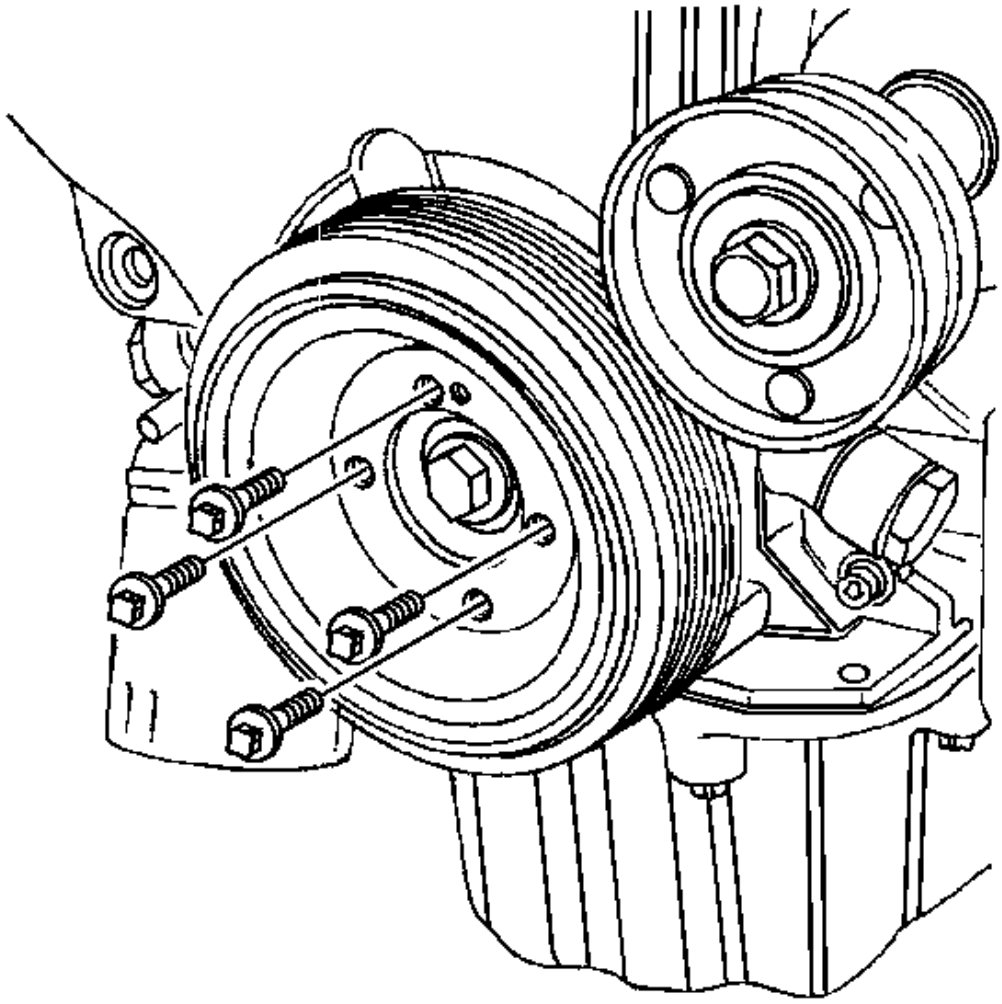

Fig. 54: View Of Crankshaft Pulley And Bolts
Courtesy of GENERAL MOTORS CORP.

26. Disconnect the upper radiator hose at the thermostat housing.

CAUTION: Refer to Belt Dressing Notice in Cautions and Notices.

27. Remove the power steering pump drive belt. Refer to **Power Steering Pump Drive Belt Replacement (2.0L)** in Power Steering System.
28. Remove the crankshaft pulley bolts.

29. Remove the crankshaft pulley.

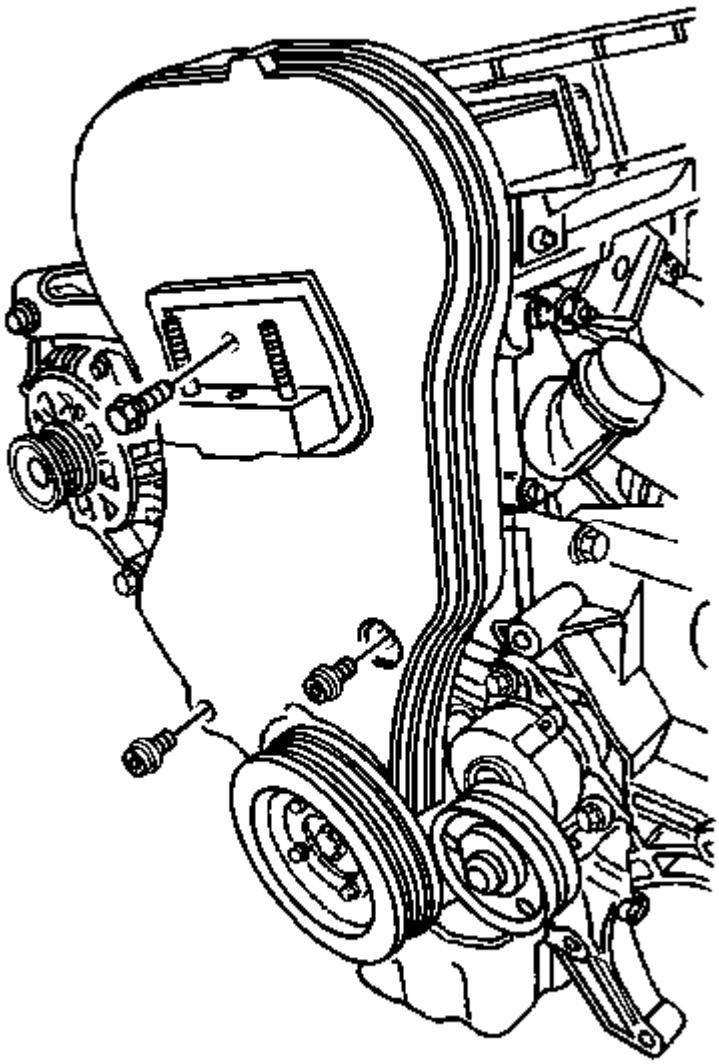

Fig. 55: View Of Front Timing Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

30. Remove the front timing belt cover bolts.
31. Remove the front timing belt cover.

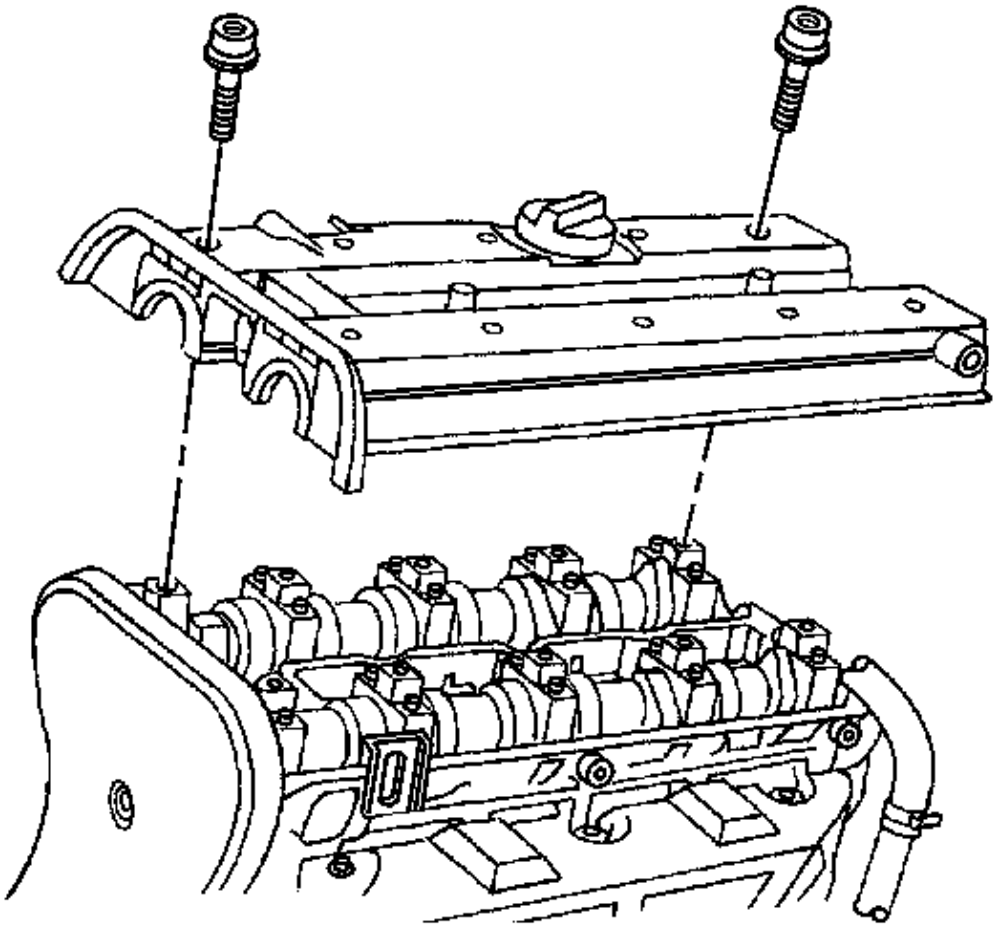

Fig. 56: View Of Valve Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

32. Remove the timing belt. Refer to **Timing Belt Replacement**.
33. Remove the spark plug cover bolts.
34. Remove the spark plug cover.
35. Disconnect the ignition wires from the spark plugs.
36. Remove the valve cover bolts.
37. Remove the valve cover washers.
38. Remove the valve cover and the valve cover gasket.

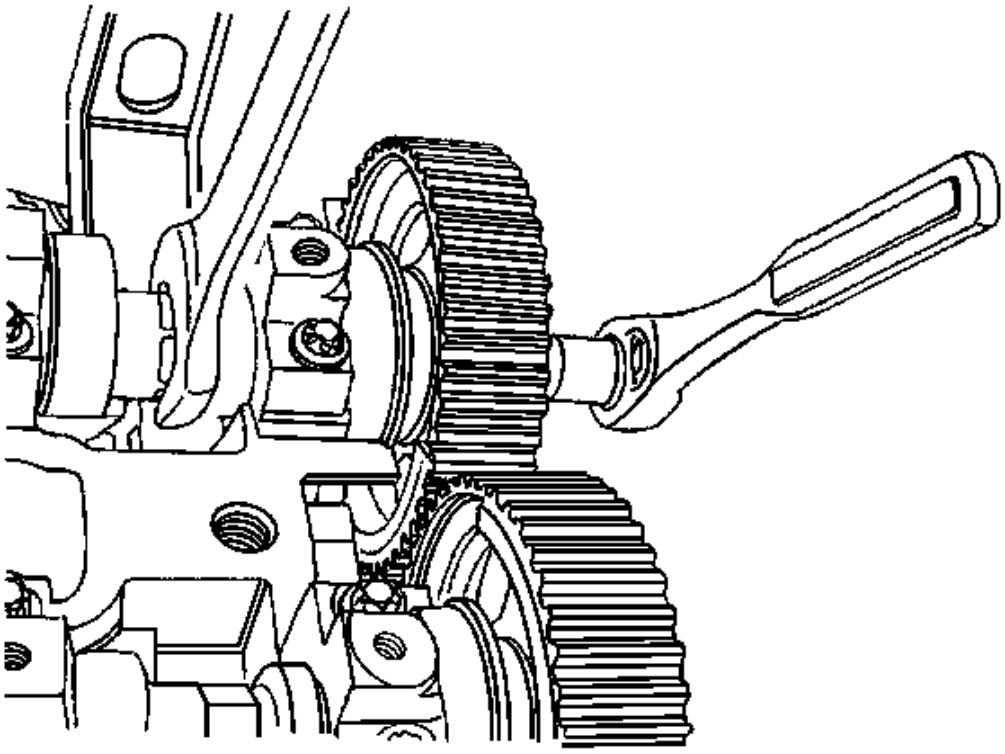

Fig. 57: Removing/Installing Intake Camshaft Gear Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Use extreme care when installing the camshaft not to nick, scratch, or damage the camshaft lobes or bearing surfaces.

39. While holding the intake camshaft firmly in place, remove the intake camshaft gear bolt.
40. Remove the intake camshaft gear.
41. While holding the exhaust camshaft firmly in place, remove the exhaust camshaft gear bolt.
42. Remove the exhaust camshaft gear.

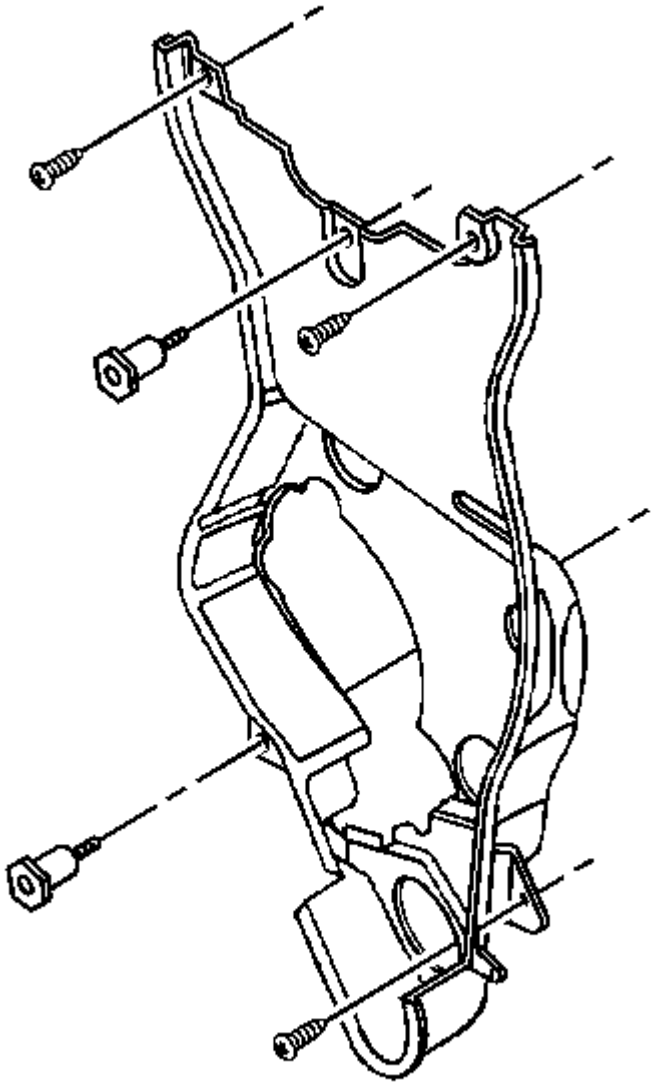

Fig. 58: View Of Rear Timing Belt Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

43. Remove the rear timing belt cover bolts.

NOTE: Refer to Fastener Notice in Cautions and Notices.

44. Install the right engine mount bracket, the retaining bolt, and the nuts.

Tighten: Tighten the right engine mount bracket retaining bolt and nuts to **60 N.m (44 lb ft)** .

45. Remove **J 28467-B** . See **Special Tools** .

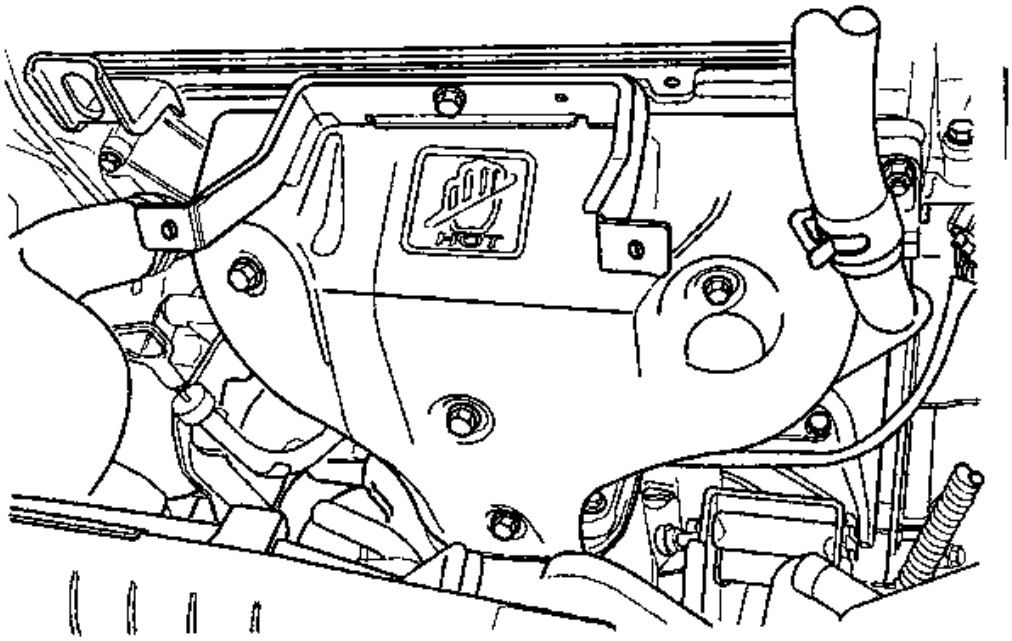

Fig. 59: View Of Exhaust Manifold Heat Shield
Courtesy of GENERAL MOTORS CORP.

46. Remove the exhaust manifold heat shield nuts and the heat shield.

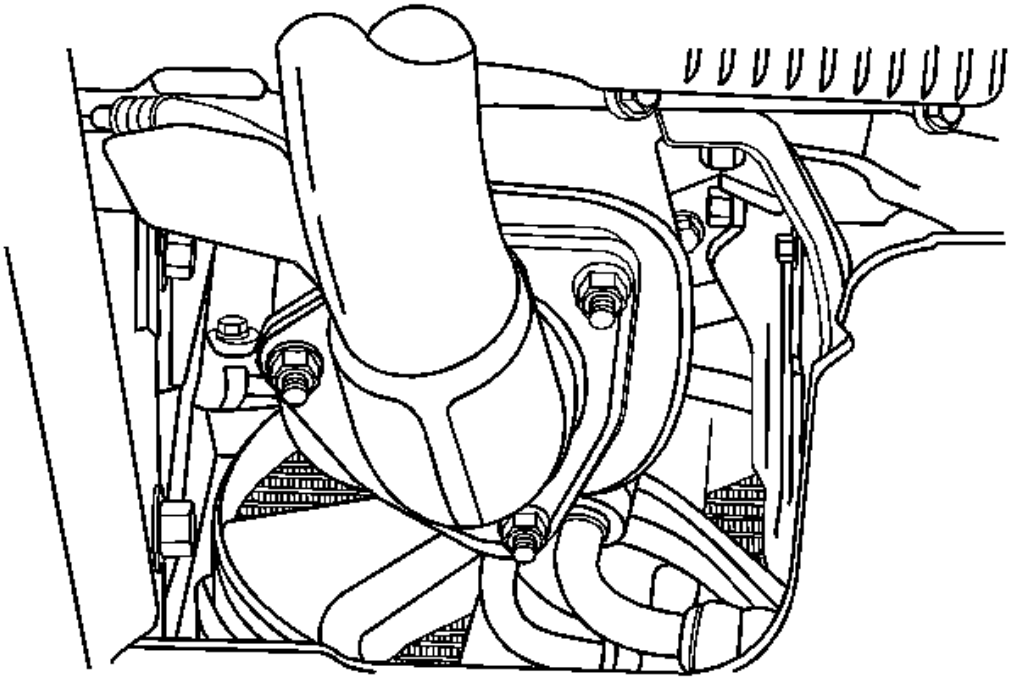

Fig. 60: View Of Flex Pipe And Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

47. Remove the exhaust flex pipe retaining nuts from the exhaust manifold studs.

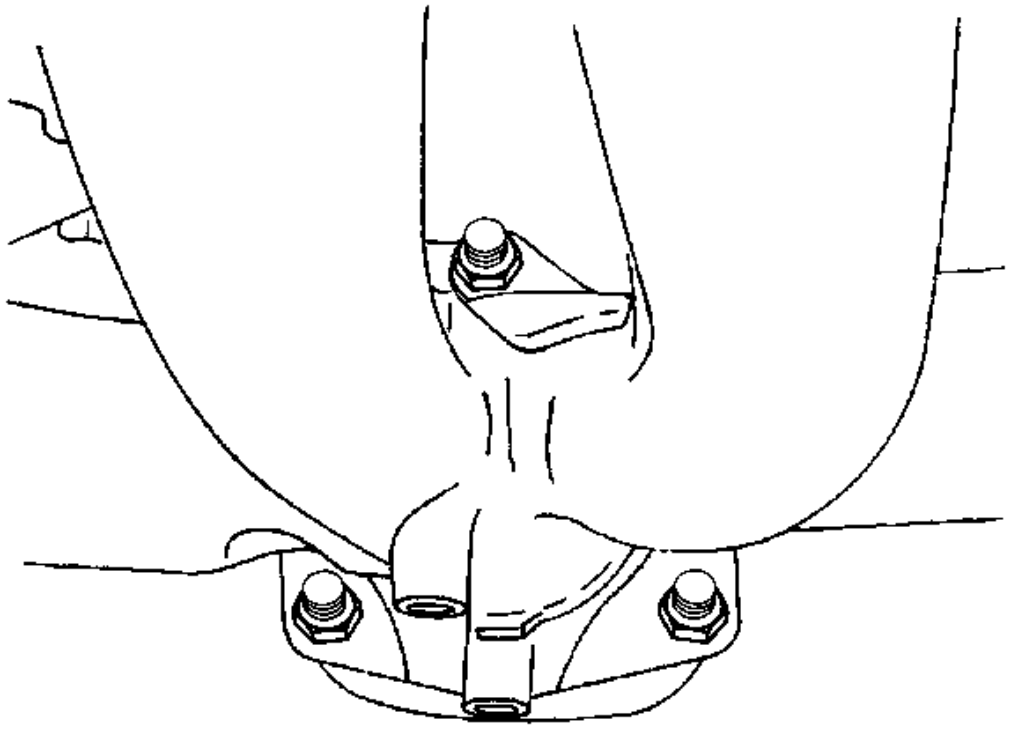

Fig. 61: Locating Auxiliary Catalytic Converter Upper Flange Nuts
Courtesy of GENERAL MOTORS CORP.

48. Remove the auxiliary catalytic converter upper flange nuts.
49. Disconnect the vacuum hoses, as needed.

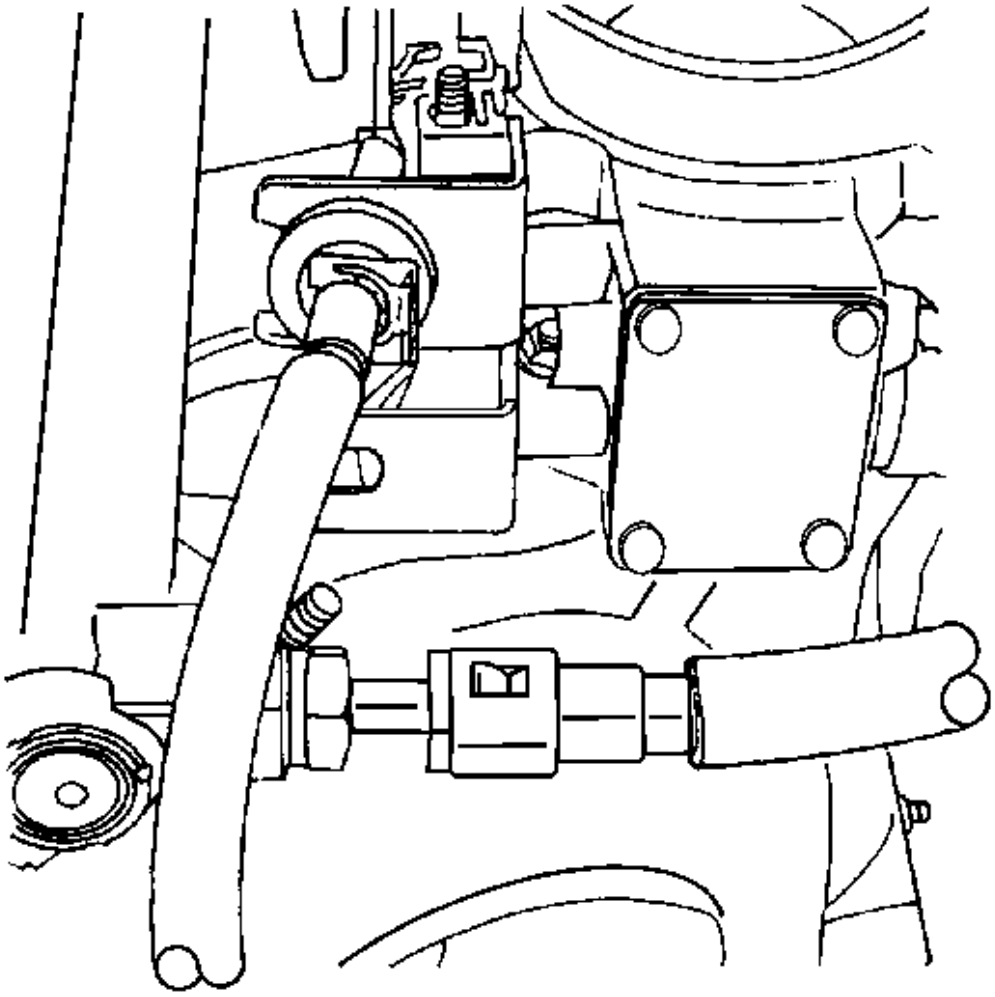

Fig. 62: View Of Fuel Return Line And Fuel Feed Line
Courtesy of GENERAL MOTORS CORP.

50. Disconnect the fuel return line at the fuel pressure regulator.
51. Disconnect the fuel feed line at the fuel rail.
52. Disconnect the coolant hose at the rear cylinder head and ignition coil exhaust gas recirculation (EGR) bracket.
53. Disconnect the surge tank coolant hose at the throttle body.
54. Remove the fuel rail assembly. Refer to **Fuel Rail Assembly Replacement** in Engine Controls - 2.0L.

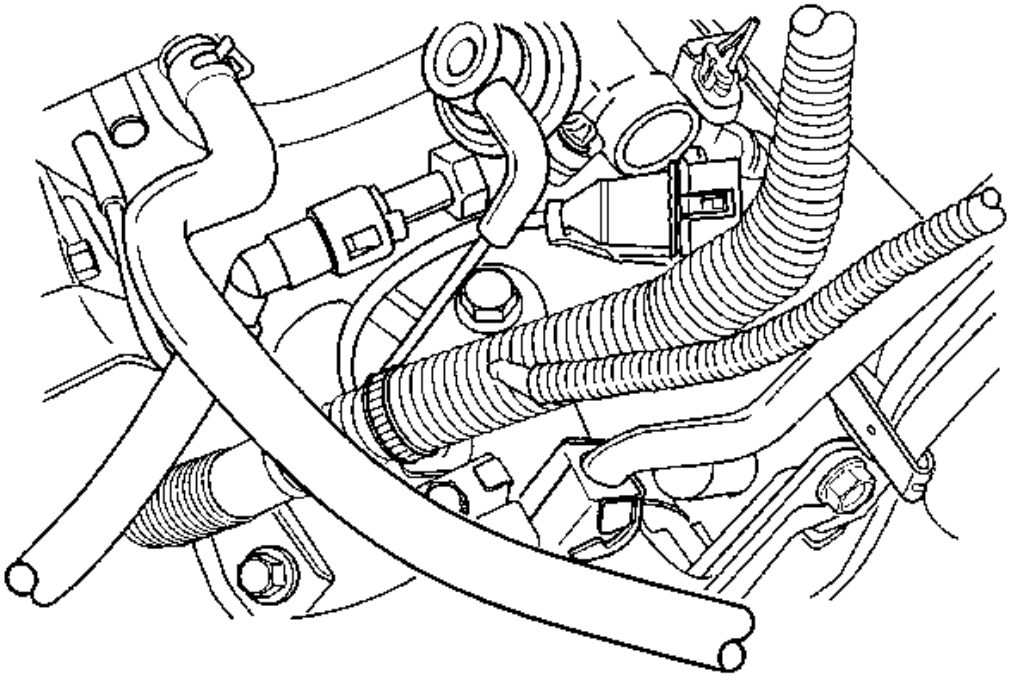

Fig. 63: View Of Surge Tank Coolant Hose
Courtesy of GENERAL MOTORS CORP.

55. Remove the alternator-to-intake manifold support bracket bolts at the cylinder head coolant bypass and the intake manifold.
56. Remove the alternator support bracket.
57. Remove the intake manifold-to-alternator strap bracket bolt and loosen the bolt on the alternator.
58. Move the strap clear of the intake manifold.
59. Remove the canister purge solenoid bracket bolt and move the bracket clear, if equipped.

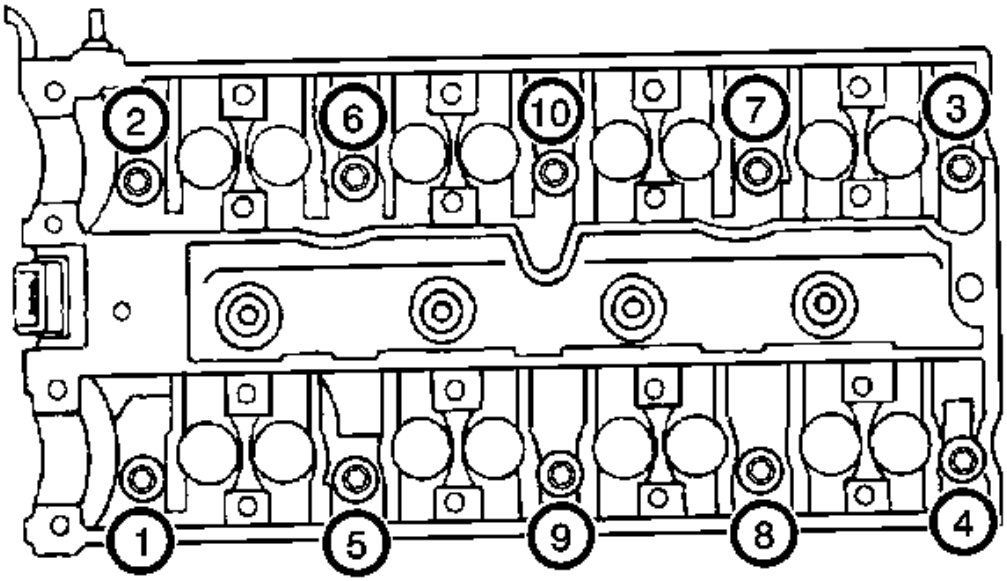

Fig. 64: View Of Cylinder Head Bolt Removal Sequence
Courtesy of GENERAL MOTORS CORP.

60. Disconnect the throttle cable at the throttle body and the intake manifold.
61. Loosen all of the cylinder head bolts gradually and in the sequence shown.
62. Remove the cylinder head bolts.
63. Remove the cylinder head with the intake manifold and the exhaust manifold attached.

IMPORTANT: Prevent any engine oil or coolant from entering the cylinders when removing the cylinder head.

64. Remove the cylinder head gasket.
65. Clean the gasket surfaces of the cylinder head and the engine block. Refer to **Cylinder Head Cleaning and Inspection**.

Installation Procedure

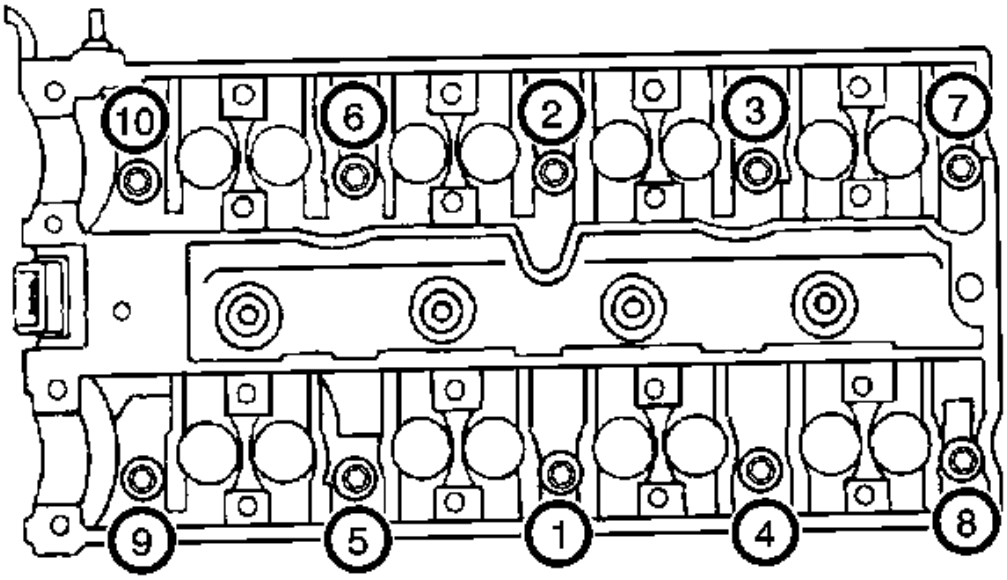

Fig. 65: View Of Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Compressed Valve Spring Caution in Cautions and Notices.

1. Install the cylinder head gasket.
2. Install the cylinder head with the intake manifold and the exhaust manifold attached.
3. Install the cylinder head bolts.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Tighten the cylinder head bolts gradually and in the sequence shown.

   Tighten: Tighten the cylinder head bolts to **25 N.m (18 lb ft)** and turn the bolts another 3 turns of 90 degrees using **J 45059** or the **KM-470-B** . See **Special Tools** .

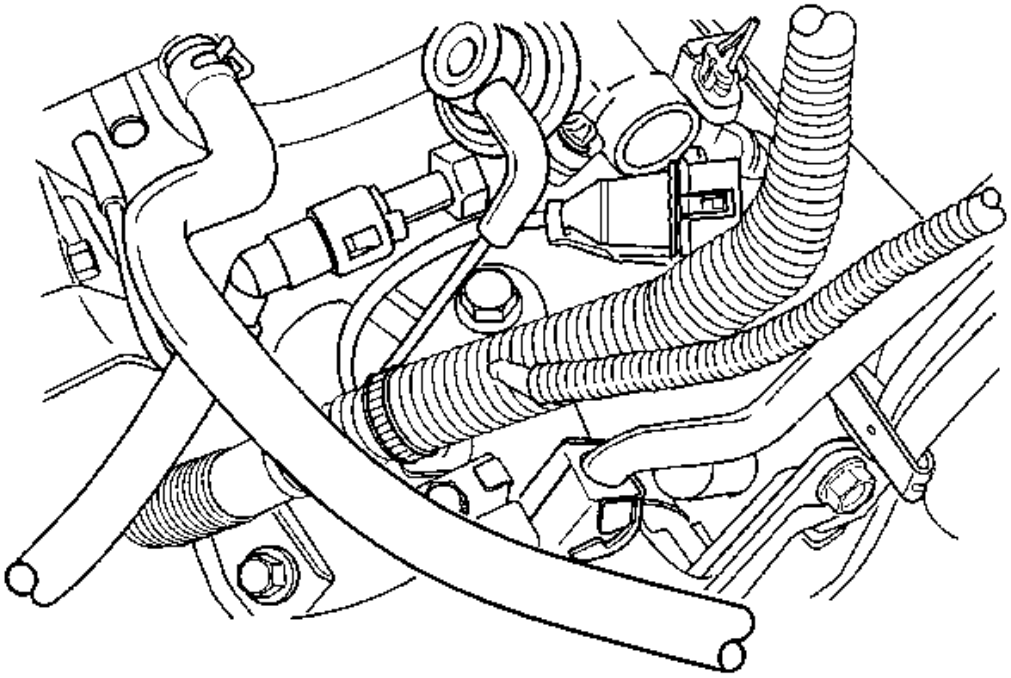

Fig. 66: View Of Surge Tank Coolant Hose
Courtesy of GENERAL MOTORS CORP.

5. Connect the throttle cable at the throttle body and the intake manifold.
6. Install the alternator-to-intake manifold support bracket.
7. Install the alternator-to-manifold support bracket bolts.

   Tighten: Tighten the alternator-to-intake manifold support bracket bolts at the intake manifold to **35 N.m (26 lb ft)** .

8. Install the intake manifold support bracket bolts to the alternator.

   Tighten: Tighten the alternator-to-intake manifold support bracket bolts at the alternator to **20 N.m (15 lb ft)** .

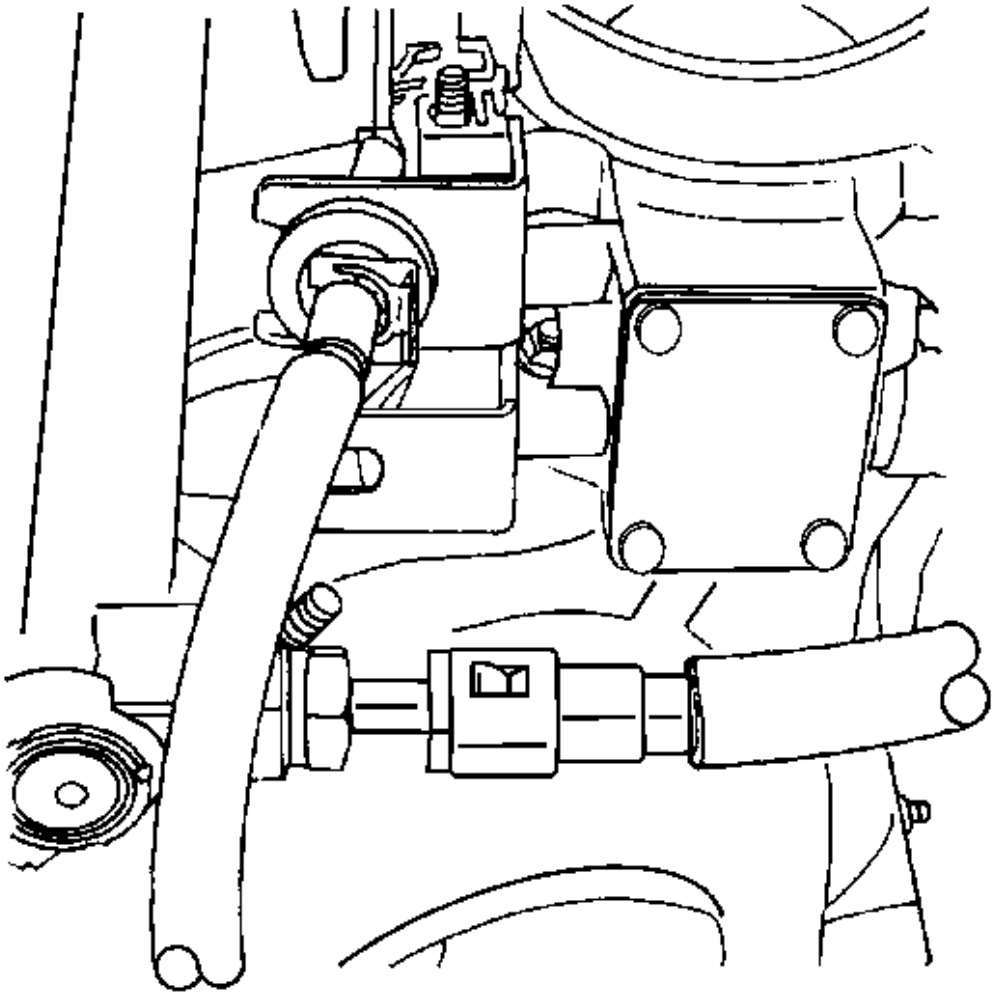

Fig. 67: View Of Fuel Return Line And Fuel Feed Line
Courtesy of GENERAL MOTORS CORP.

9. Connect the surge tank coolant hose at the throttle body.
10. Connect the coolant hose to the rear cylinder head and ignition coil EGR bracket.
11. Connect the fuel feed line at the fuel rail.
12. Connect the fuel return line at the fuel rail.
13. Connect all of the necessary vacuum hoses.
14. Install the fuel rail assembly. Refer to **Fuel Rail Assembly Replacement** in Engine Controls - 2.0L.

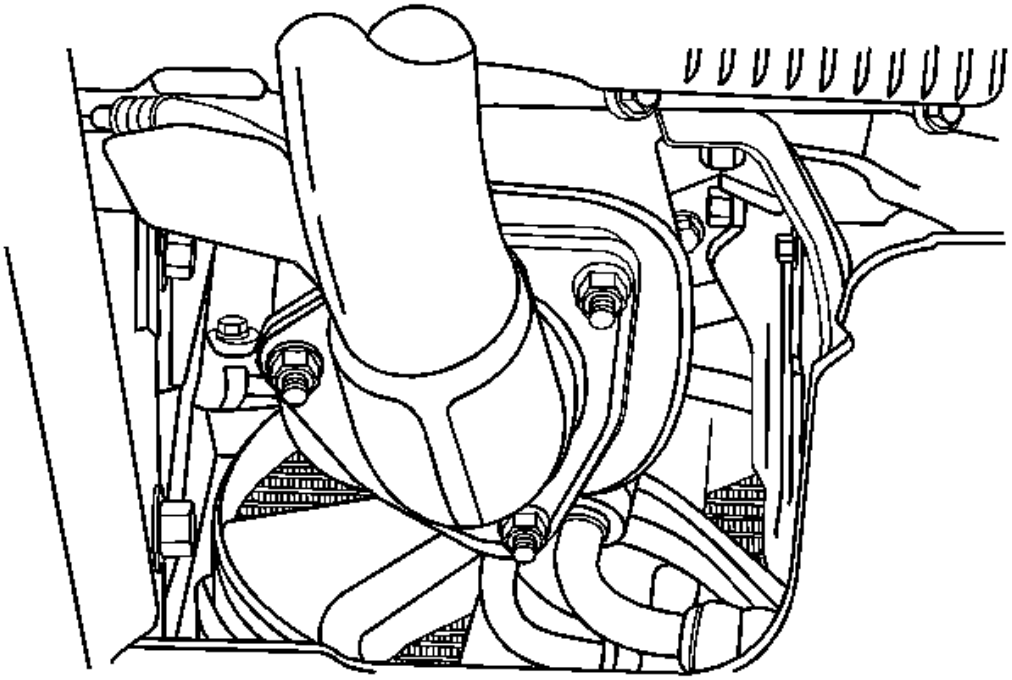

Fig. 68: View Of Flex Pipe And Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

15. Install the exhaust flex pipe retaining nuts to the exhaust manifold studs.

    Tighten: Tighten the exhaust flex pipe retaining nuts to **22 N.m (16 lb ft)** .

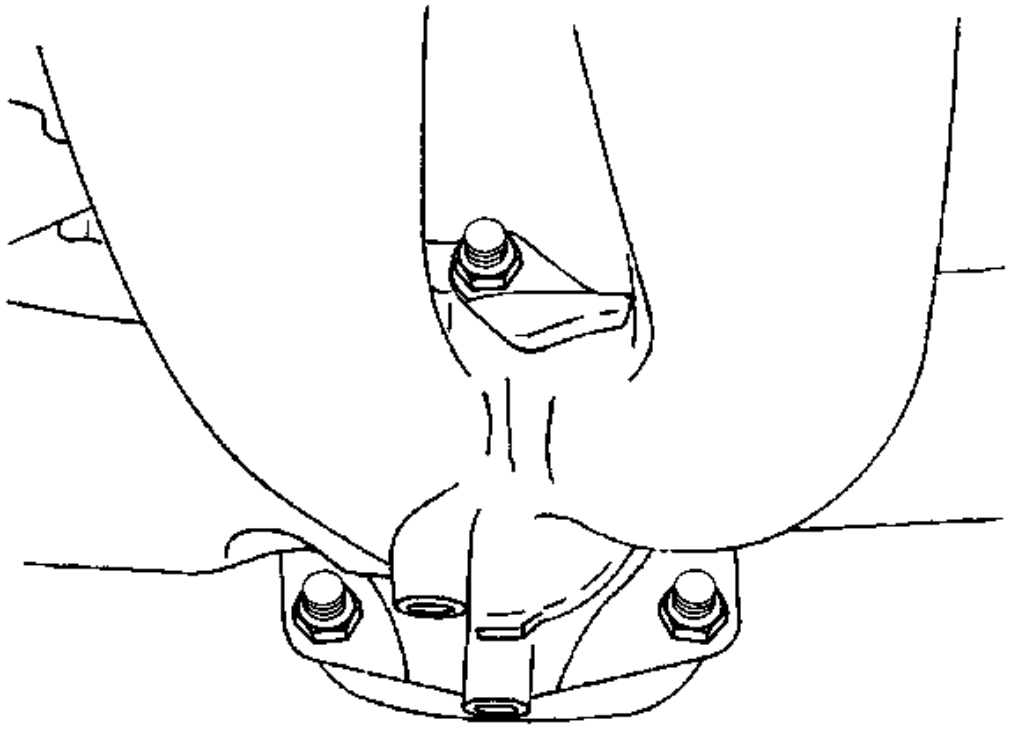

Fig. 69: Locating Auxiliary Catalytic Converter Upper Flange Nuts
Courtesy of GENERAL MOTORS CORP.

16. Install the auxiliary catalytic converter nuts.

    Tighten: Tighten the auxiliary catalytic convert-to-exhaust manifold nuts to **40 N.m (30 lb ft)** .

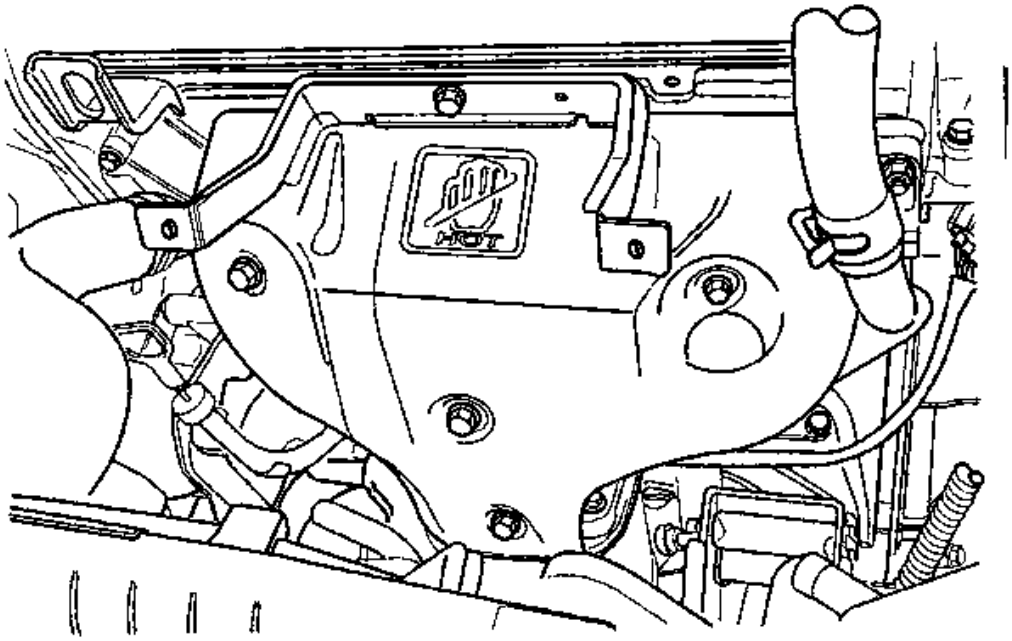

Fig. 70: View Of Exhaust Manifold Heat Shield
Courtesy of GENERAL MOTORS CORP.

17. Install the exhaust manifold heat shield bolts.

    Tighten: Tighten the exhaust manifold heat shield bolts to **8 N.m (71 lb in)** .

18. Install the **J 28467-B** . See **Special Tools** .
19. Remove the right engine mount bracket, the retaining bolt, and the nuts.

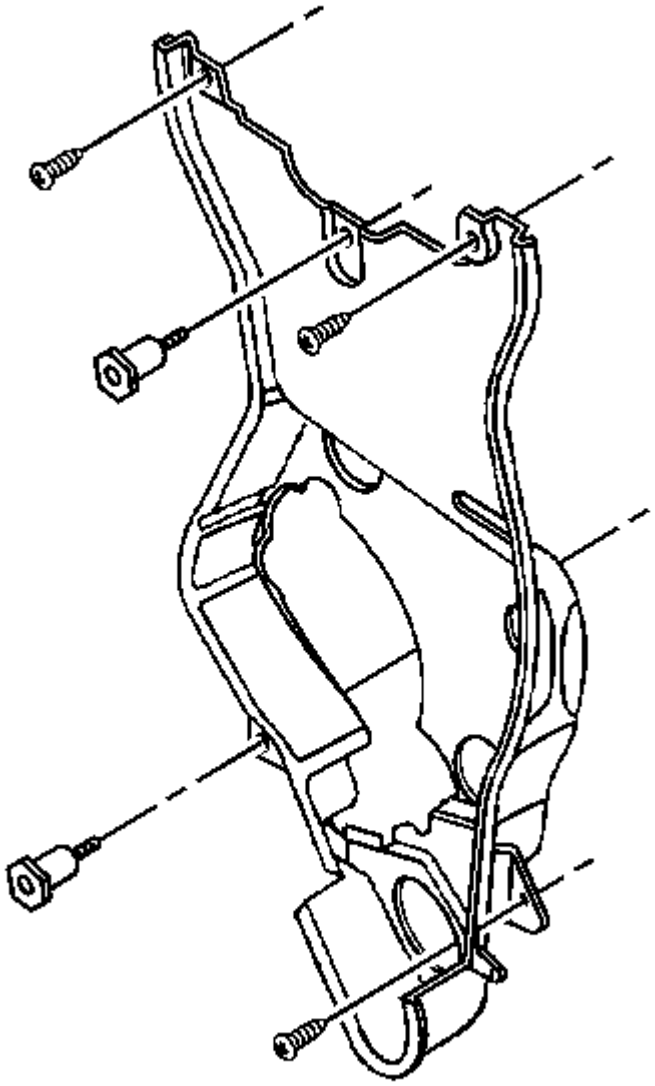

Fig. 71: View Of Rear Timing Belt Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

20. Install the rear timing belt cover bolts.

    Tighten: Tighten the rear timing belt cover bolts to **7 N.m (62 lb in)** .

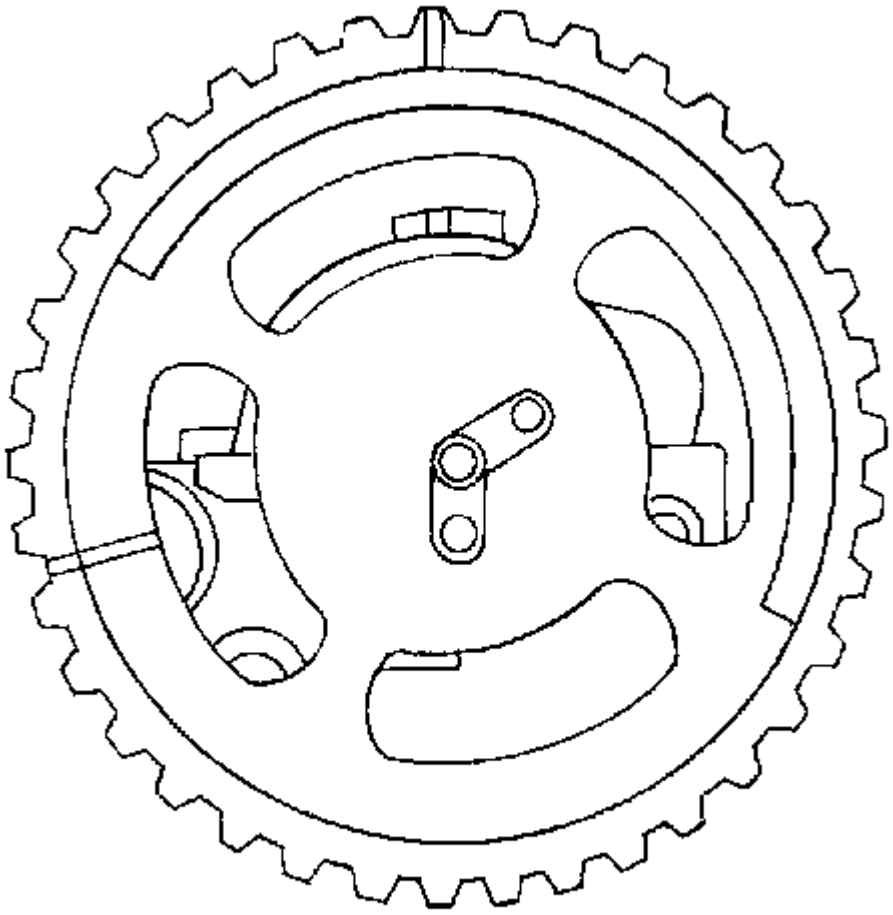

Fig. 72: View Of Camshaft Gear And Timing Mark
Courtesy of GENERAL MOTORS CORP.

21. Install the camshaft gears with the timing marks at the front.
22. Insert the guide pin of the intake camshaft into the IN bore.
23. Insert the guide pin of the exhaust camshaft into the EX bore.

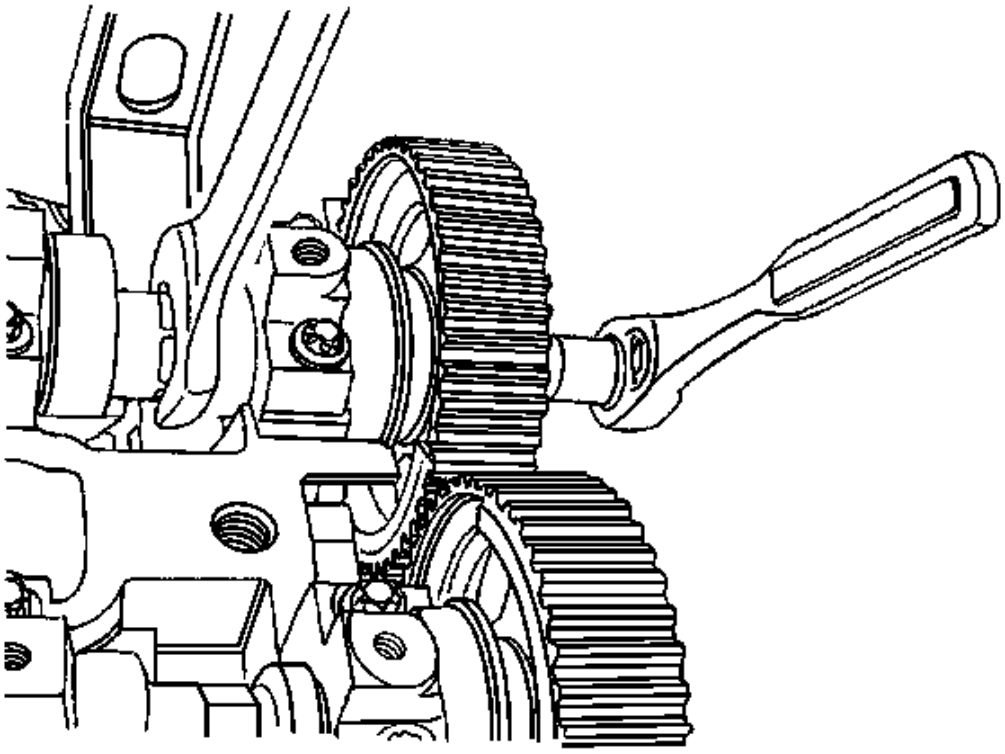

Fig. 73: Removing/Installing Intake Camshaft Gear Bolt
Courtesy of GENERAL MOTORS CORP.

24. Install the camshaft gears by counterholding on the hex of the camshaft with an open-ended wrench.
25. Install the intake camshaft gear with a new bolt to the camshaft.

    Tighten: Tighten the intake camshaft gear bolt to **50 N.m (37 lb ft)** , turn the bolt another 60 degrees and 15 degrees using the **J 45059** or the **KM-470-B** . See **Special Tools** .

26. While holding the exhaust camshaft firmly in place, install the exhaust camshaft gear bolt.

    Tighten: Tighten the exhaust camshaft gear bolt to **50 N.m (37 lb ft)** , turn the bolt another 60 degrees and 15 degrees using the **J 45059** or the **KM-470-B** . See **Special Tools** .

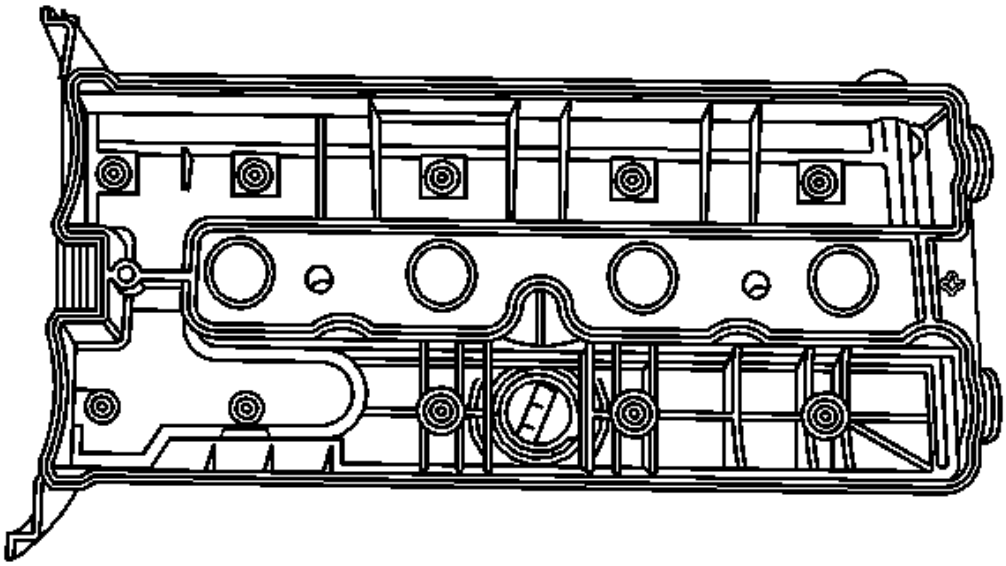

Fig. 74: View Of Valve Cover And Gasket
Courtesy of GENERAL MOTORS CORP.

27. Apply a small amount of gasket sealant to the corners of the front camshaft caps and to the top of the rear valve cover-to-cylinder head seal.
28. Install the valve cover and the valve cover gasket.
29. Install the valve cover washers.
30. Install the valve cover bolts.

Tighten: Tighten the valve cover bolts to **8 N.m (71 lb in)** .

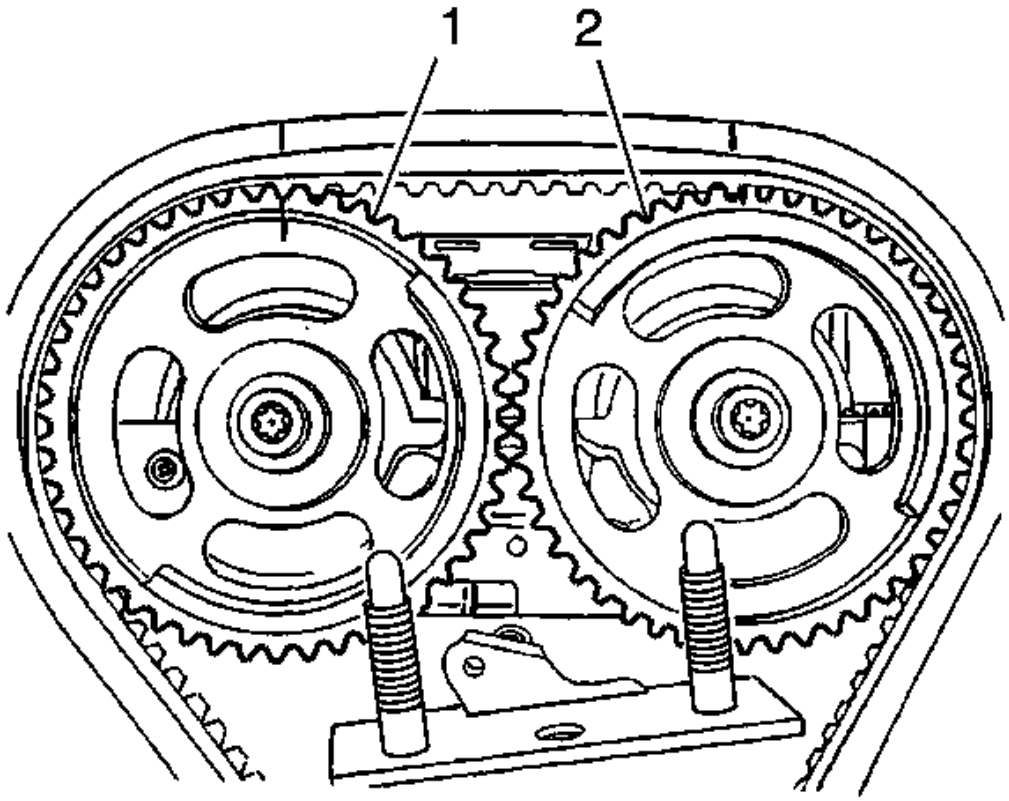

Fig. 75: View Of Intake And Exhaust Gears
Courtesy of GENERAL MOTORS CORP.

31. Connect the ignition wires to the spark plugs.
32. Install the spark plug cover.
33. Install the spark plug cover bolts.

    Tighten: Tighten the spark plug cover bolts to **3 N.m (27 lb in)** .

34. Align the timing marks on the camshaft gears to the notches on the valve cover, using the intake gear (1) mark for the intake gear and the exhaust gear mark for the exhaust gear (2).

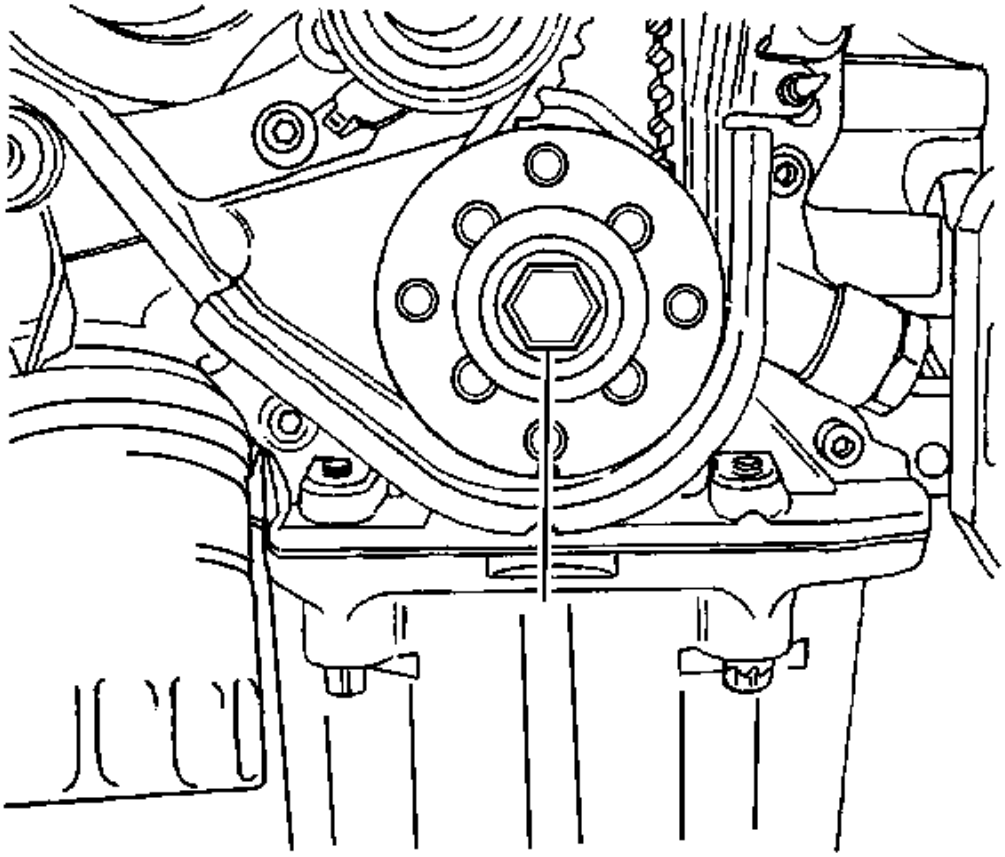

Fig. 76: Identifying Crankshaft Gear Bolt
Courtesy of GENERAL MOTORS CORP.

35. Align the mark on the crankshaft gear with the notch at the bottom of the rear timing belt cover.

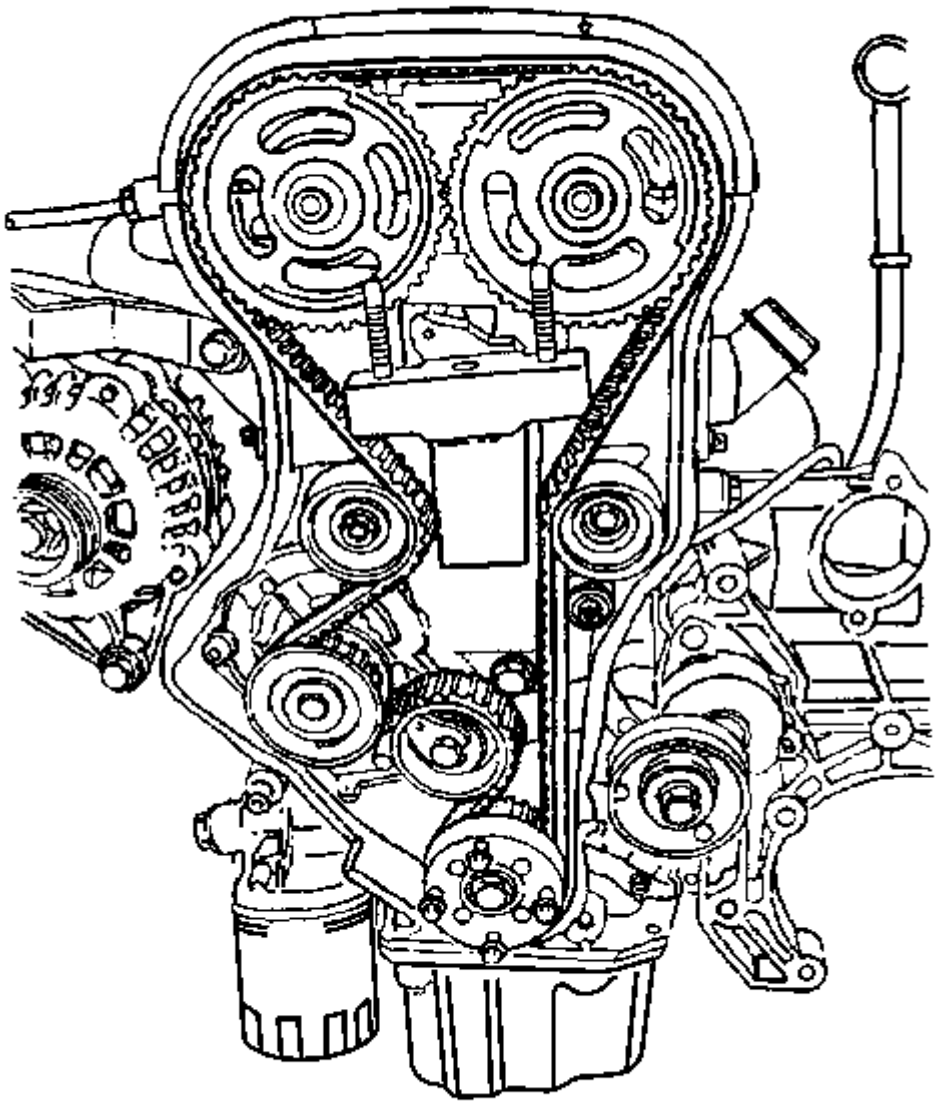

Fig. 77: View Of Timing Belt And Components
Courtesy of GENERAL MOTORS CORP.

36. Install the timing belt. Refer to **Timing Belt Replacement**.
37. Check and adjust the timing belt tension. Refer to **Timing Belt Inspection**.

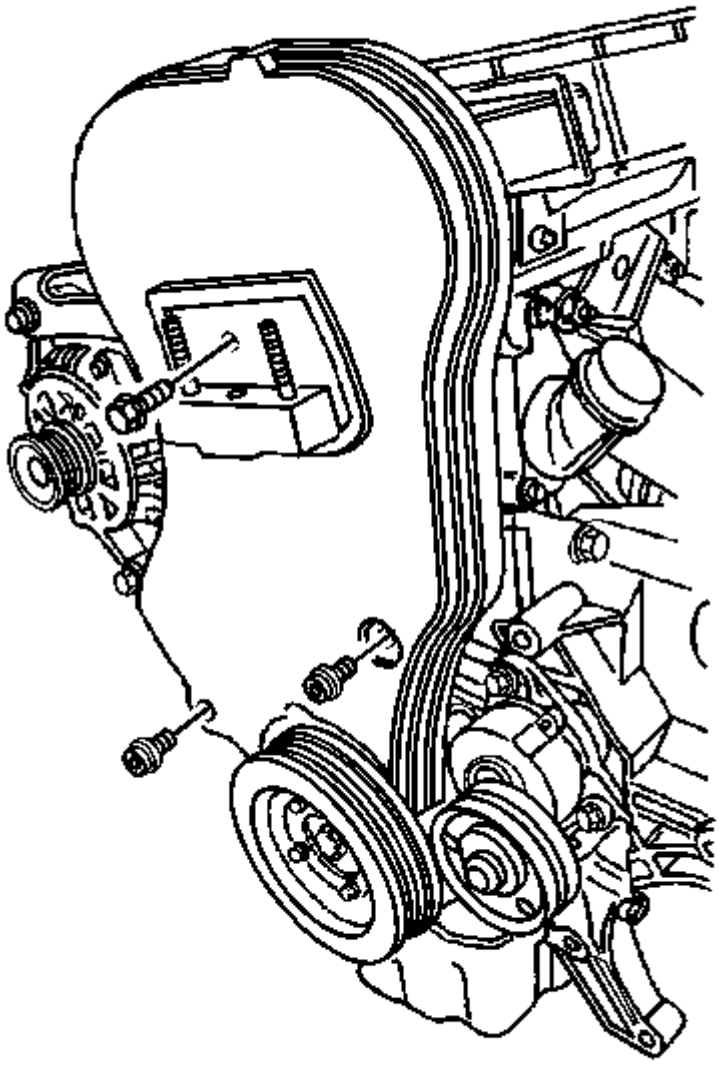

Fig. 78: View Of Front Timing Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

38. Install the front timing belt cover.
39. Install the front timing belt cover bolts.

    Tighten: Tighten the upper and lower front timing belt cover bolts to **6 N.m (53 lb in)** .

40. Install the crankshaft pulley.

41. Install the crankshaft pulley bolts.

    Tighten: Tighten the crankshaft pulley bolts to **20 N.m (15 lb ft)** .

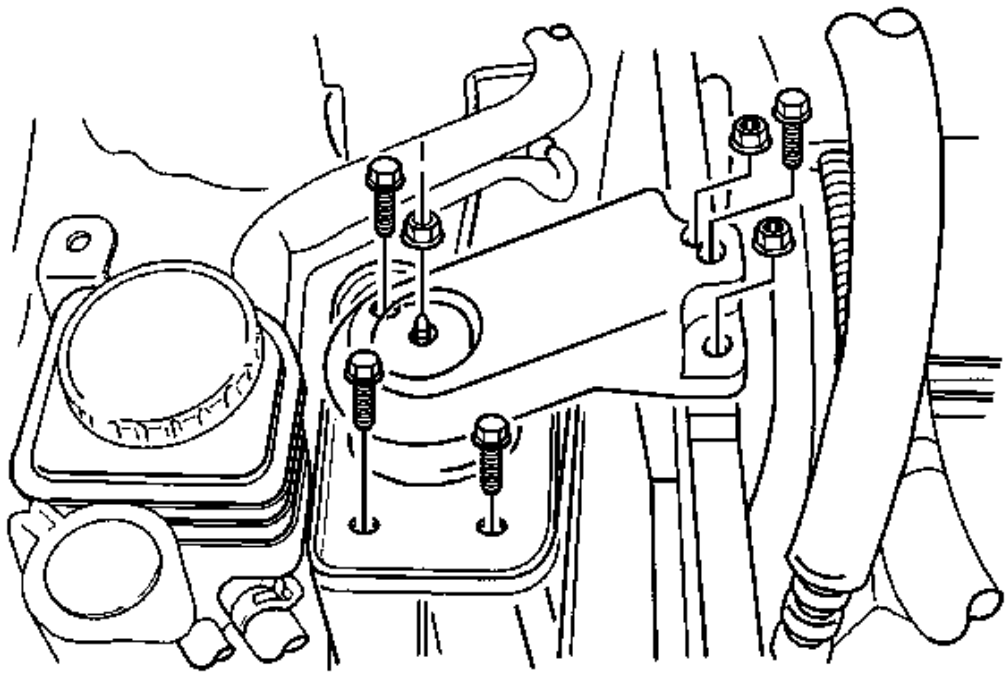

Fig. 79: View Of Surge Tank, Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

42. Install the right engine mount bracket, the retaining bolts, and the nut.

    Tighten: Tighten the right engine mount bracket retaining bolt and nuts to **60 N.m (44 lb ft)** .

43. Remove the **J 28467-B** . See **Special Tools** .

NOTE: Refer to Belt Dressing Notice in Cautions and Notices.

44. Install the power steering pump. Refer to **Power Steering Pump Drive Belt Replacement (2.0L)** in Power Steering System.
45. Connect the upper radiator hose to the thermostat housing.
46. Install the front wheel well splash shield. Refer to **Splash Shield Replacement - Wheelhouse** in Body Front End.

47. Install the right front wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.

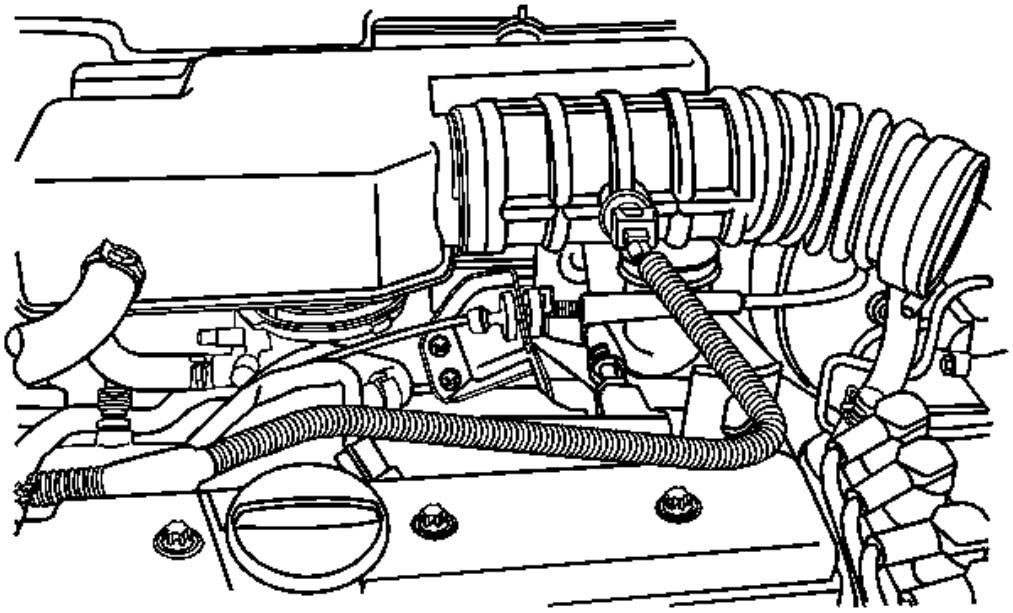

Fig. 80: View Of Manifold Air Temperature Sensor And Throttle Body Intake Tube
Courtesy of GENERAL MOTORS CORP.

48. Install the surge tank. Refer to **Surge Tank Replacement (2.0L)** in Engine Cooling.
49. Connect the air intake tube to the throttle body.
50. Connect the vacuum line to the valve cover.
51. Connect the crankshaft ventilation tube from the valve cover.
52. Connect the breather tube to the valve cover.
53. Connect the manifold air temperature sensor connector.
54. Install the resonator retaining bolts.

Tighten: Tighten the resonator retaining bolts to **3 N.m (27 lb in)** .

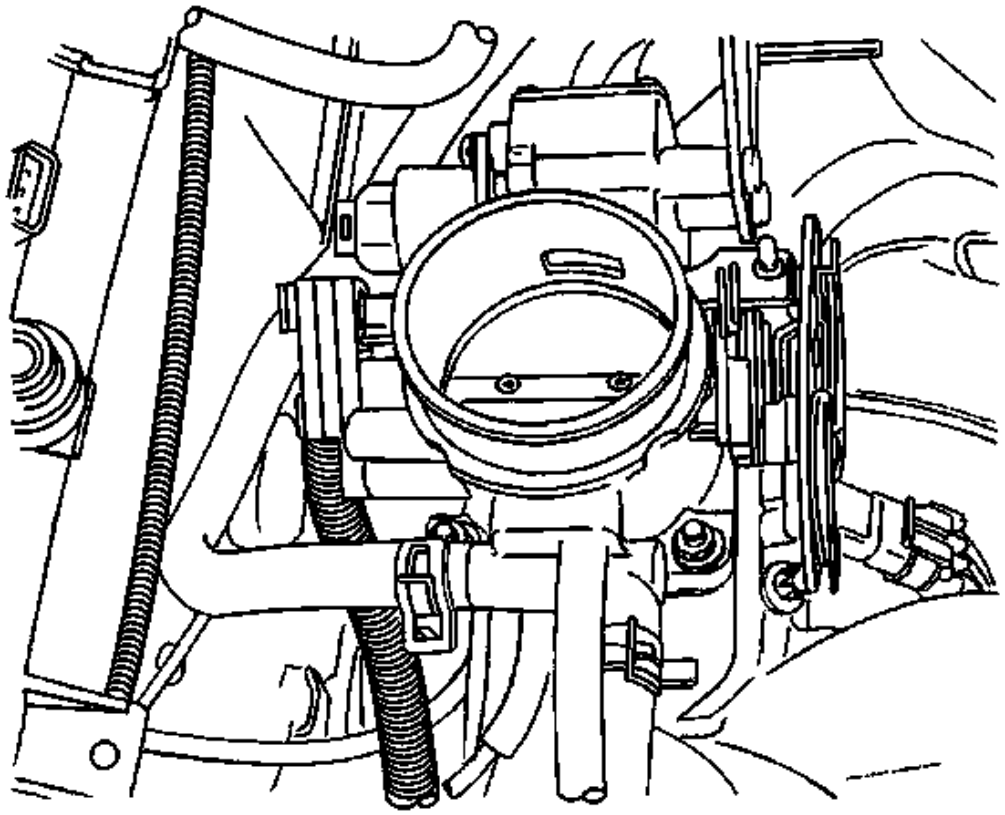

Fig. 81: View Of Throttle Body And Connectors
Courtesy of GENERAL MOTORS CORP.

55. Connect the CMP sensor connector.
56. Connect the CTS connector.
57. Connect the ECT sensor connector.
58. Connect the IAC valve connector.
59. Connect the TP sensor connector.
60. Install the canister purge solenoid bracket bolt.

Tighten: Tighten the canister purge solenoid bracket bolt to **5 N.m (44 lb in)** .

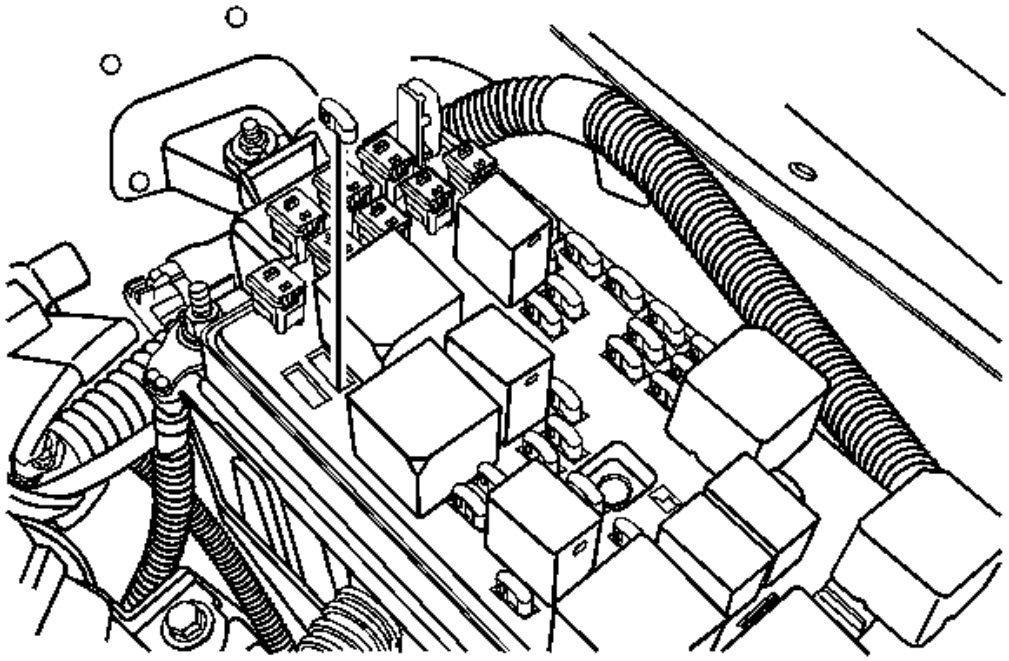

Fig. 82: Identifying Fuel Pump Fuse
Courtesy of GENERAL MOTORS CORP.

61. Connect the ignition coil connector.
62. Connect the oxygen sensor connector, if equipped.
63. Connect the ECM ground terminal.
64. Install the fuel pump fuse.
65. Connect the negative battery ground cable.
66. Refill the engine cooling system. Refer to **Draining and Filling Cooling System (2.0L)** in Engine Cooling.

OIL PAN REPLACEMENT

Removal Procedure

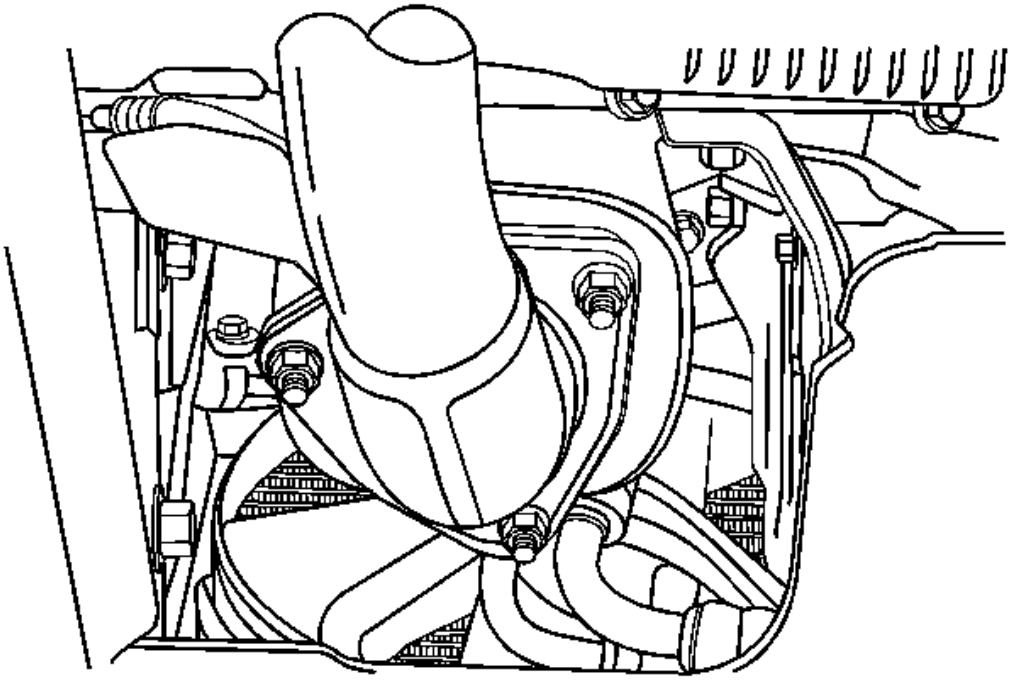

Fig. 83: View Of Flex Pipe And Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Remove the exhaust pipe retaining nuts from the catalytic converter.
3. Remove the front exhaust pipe.

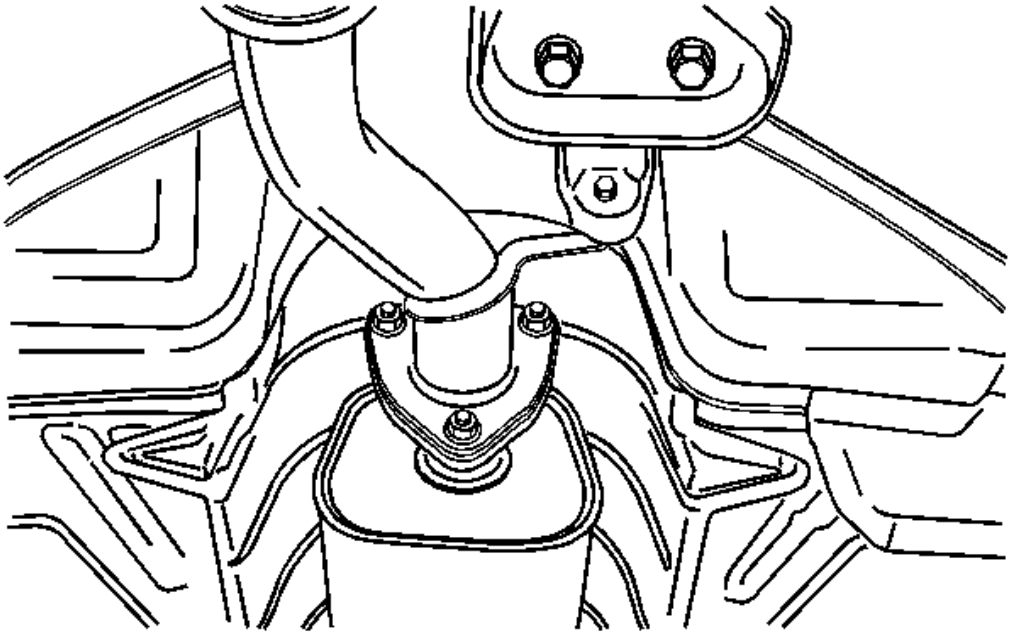

Fig. 84: View Of Front Exhaust Pipe, 3rd Muffler And Nuts
Courtesy of GENERAL MOTORS CORP.

4. Remove the nuts that secure the front exhaust pipe-to-3rd muffler.
5. Remove the rubber hangers that attach the connecting pipe to the vehicle.

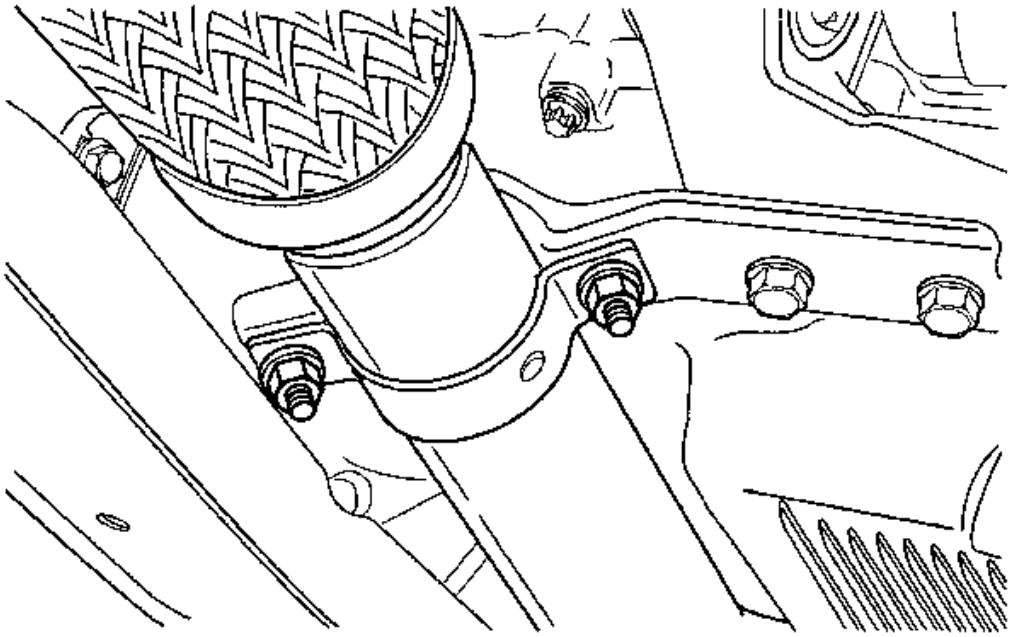

Fig. 85: View Of Connecting Pipe, Mounting Bracket And Nuts
Courtesy of GENERAL MOTORS CORP.

6. Remove the connecting pipe mounting bracket nuts and the bracket.
7. Remove the connecting pipe.

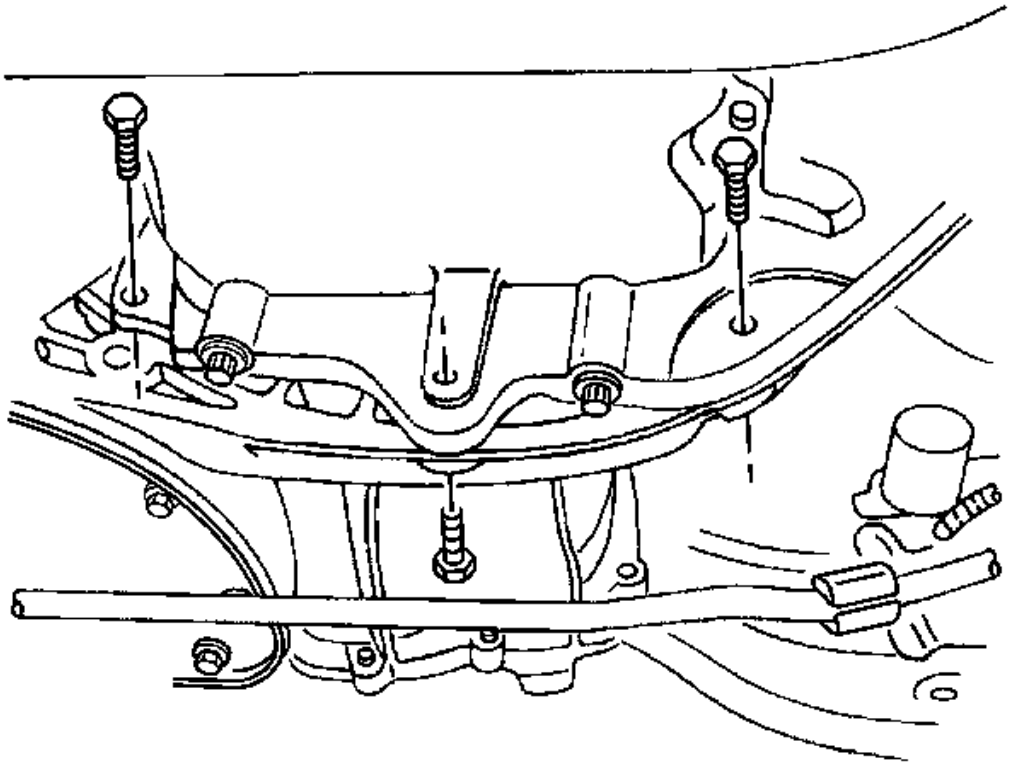

Fig. 86: View Of Oil Pan Flange-To-Transaxle Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

8. Drain the engine oil from the engine crankcase.
9. Remove the oil pan flange-to-transaxle retaining bolts.

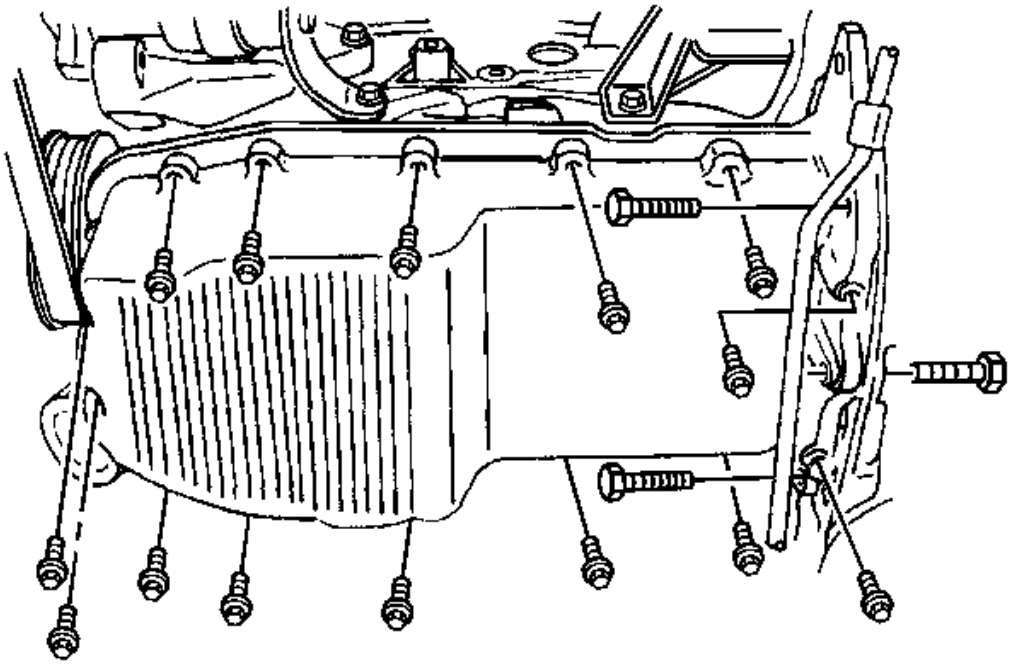

Fig. 87: View Of Oil Pan And Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

10. Remove the oil pan retaining bolts.
11. Remove the oil pan from the engine block.
12. Remove the oil pan gasket from the oil pan.
13. Clean the oil pan. Refer to **Oil Pan Cleaning and Inspection**.

Installation Procedure

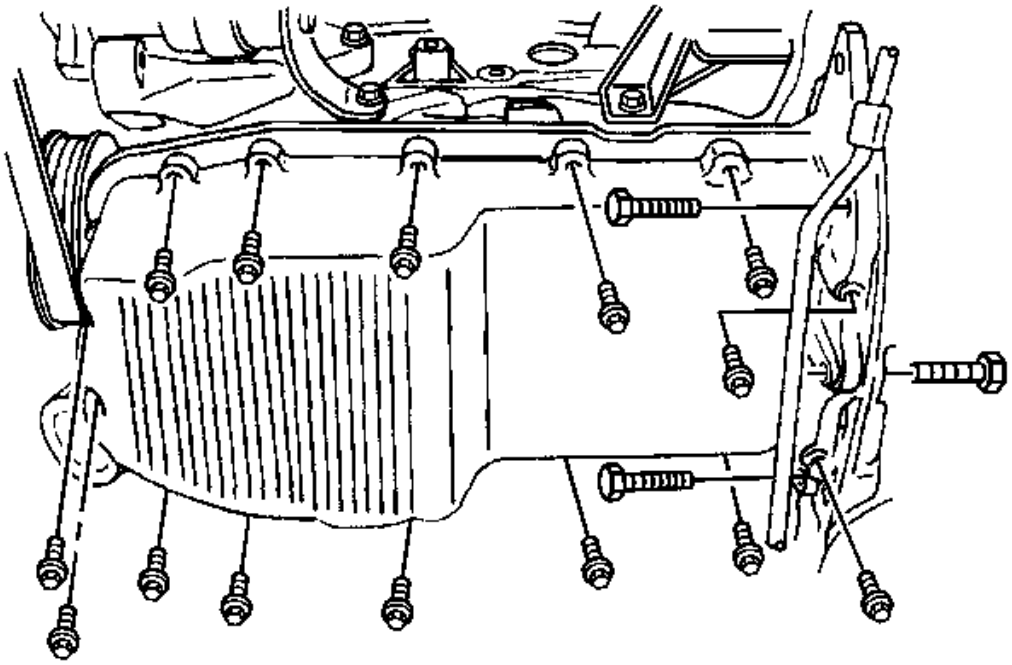

Fig. 88: View Of Oil Pan And Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

1. Coat the new oil pan gasket with sealant.
2. Install the oil pan gasket to the oil pan.
3. Install the oil pan to the engine block.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the oil pan retaining bolts.

Tighten: Tighten the oil pan retaining bolts to **20 N.m (15 lb ft)** .

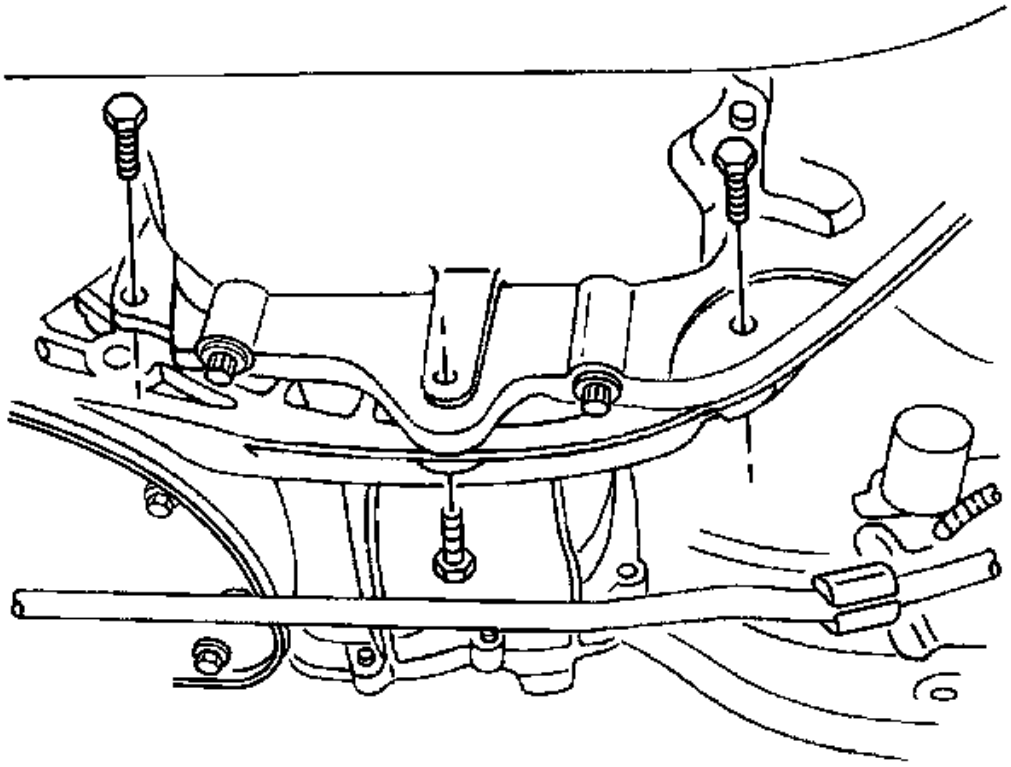

Fig. 89: View Of Oil Pan Flange-To-Transaxle Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the oil pan flange-to-transaxle retaining bolts.

   Tighten: Tighten the oil pan flange-to-transaxle retaining bolts to **40 N.m (30 lb ft)** .

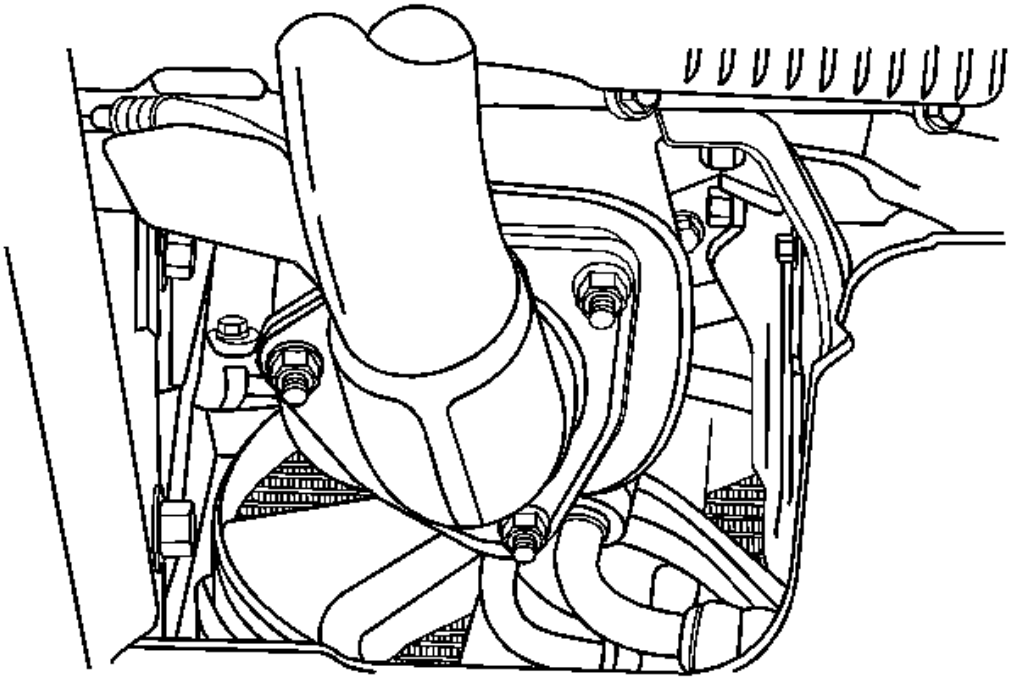

Fig. 90: View Of Flex Pipe And Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

6. Install the front exhaust pipe.
7. Install the front exhaust pipe retaining nuts to the catalytic converter.

Tighten: Tighten the front exhaust pipe retaining nuts to the catalytic converter to **30 N.m (22 lb ft)** .

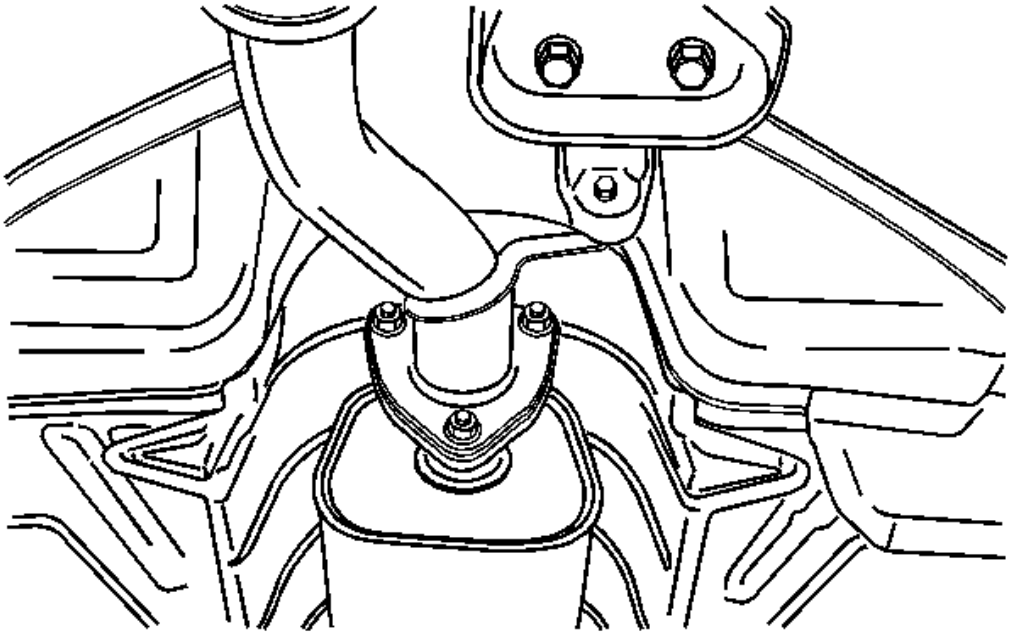

Fig. 91: View Of Front Exhaust Pipe, 3rd Muffler And Nuts
Courtesy of GENERAL MOTORS CORP.

8. Insert the 3rd muffler bolts into the front exhaust pipe flange.
9. Install the rubber hangers that attach the connecting pipe to the vehicle.
10. Install the nuts to secure the front exhaust pipe-to-3rd muffler.

Tighten: Tighten the front exhaust pipe-to-3rd muffler nuts to **30 N.m (22 lb ft)** .

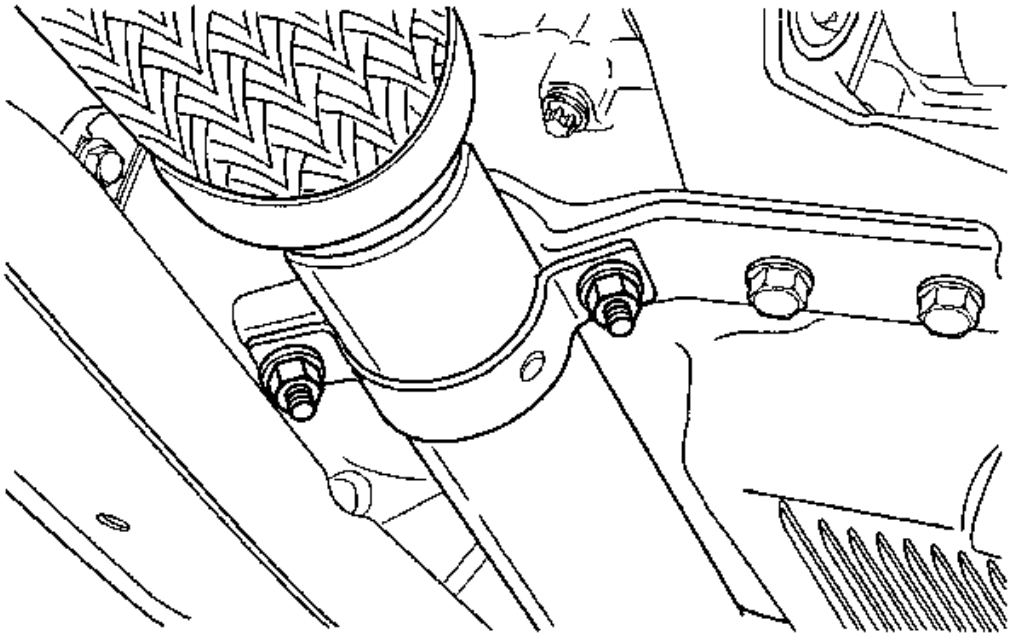

Fig. 92: View Of Connecting Pipe, Mounting Bracket And Nuts
Courtesy of GENERAL MOTORS CORP.

11. Install the connecting pipe mounting bracket and nuts.

    Tighten: Tighten the connecting pipe mounting bracket nuts to **30 N.m (22 lb ft)** .

12. Connect the rear heated oxygen sensor connector.
13. Connect the negative battery cable.
14. Refill the engine crankcase with engine oil.

OIL PAN CLEANING AND INSPECTION

Cleaning Procedure

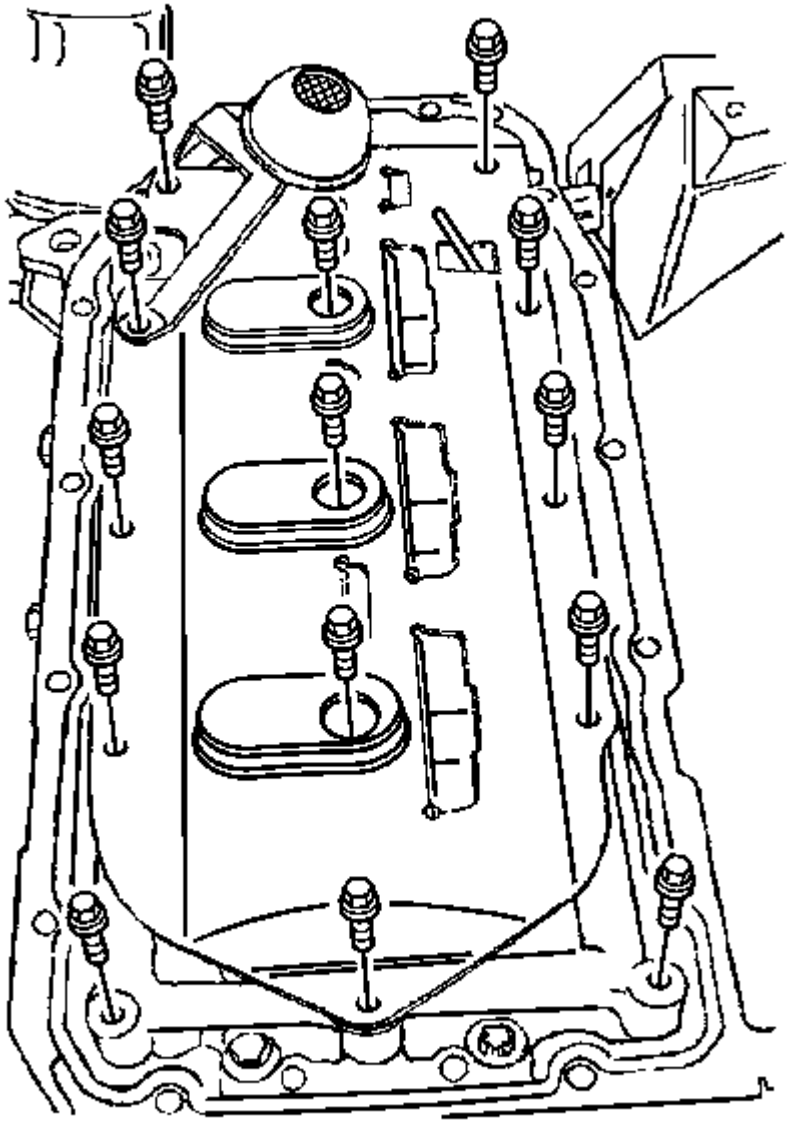

Fig. 93: View Of Oil Pan Attaching Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

1. Clean the oil pan sealing surface.

2. Clean the engine block sealing surface.
3. Clean the oil pan retaining bolts.
4. Clean the oil pan attaching bolt holes in the engine block.
5. Clean the oil pan splash shield.

OIL PUMP REPLACEMENT

Removal Procedure

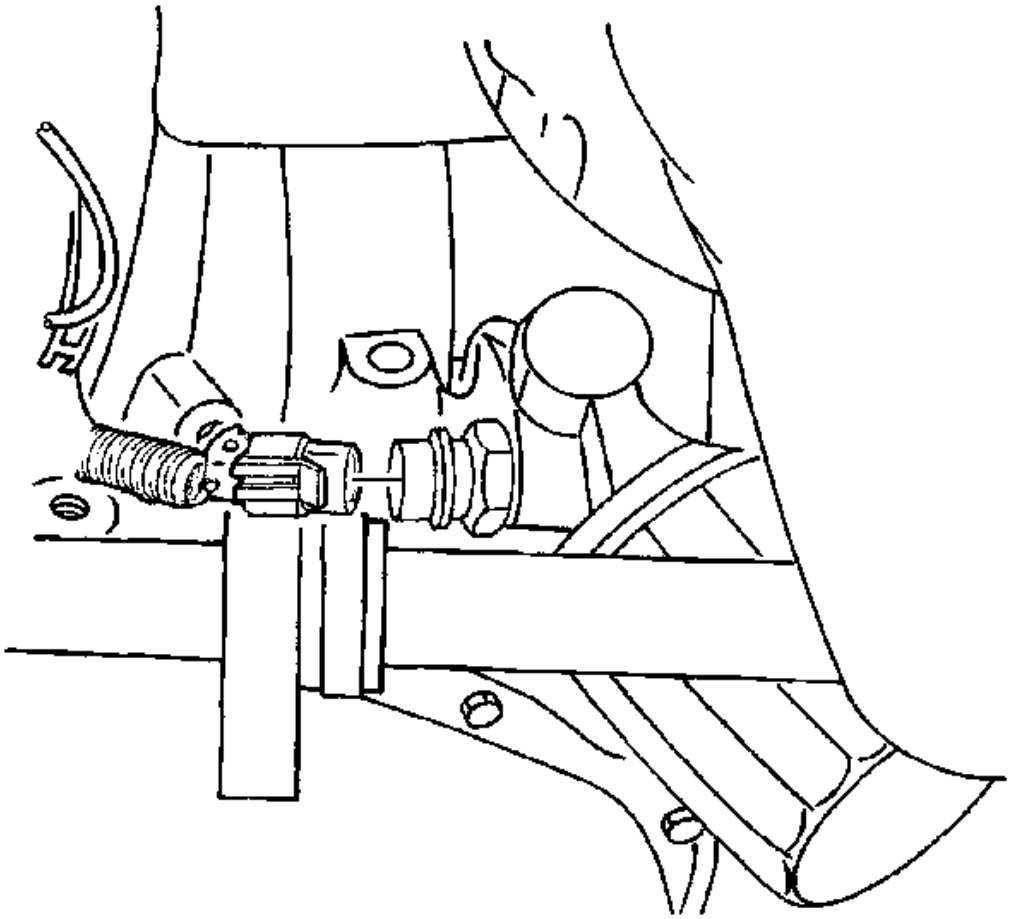

Fig. 94: Identifying Oil Pressure Gage Sensor
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Remove the timing belt. Refer to **Timing Belt Replacement**.
3. Remove the rear timing belt cover. Refer to **Timing Belt Cover Replacement**.
4. Disconnect the oil pressure switch connector.

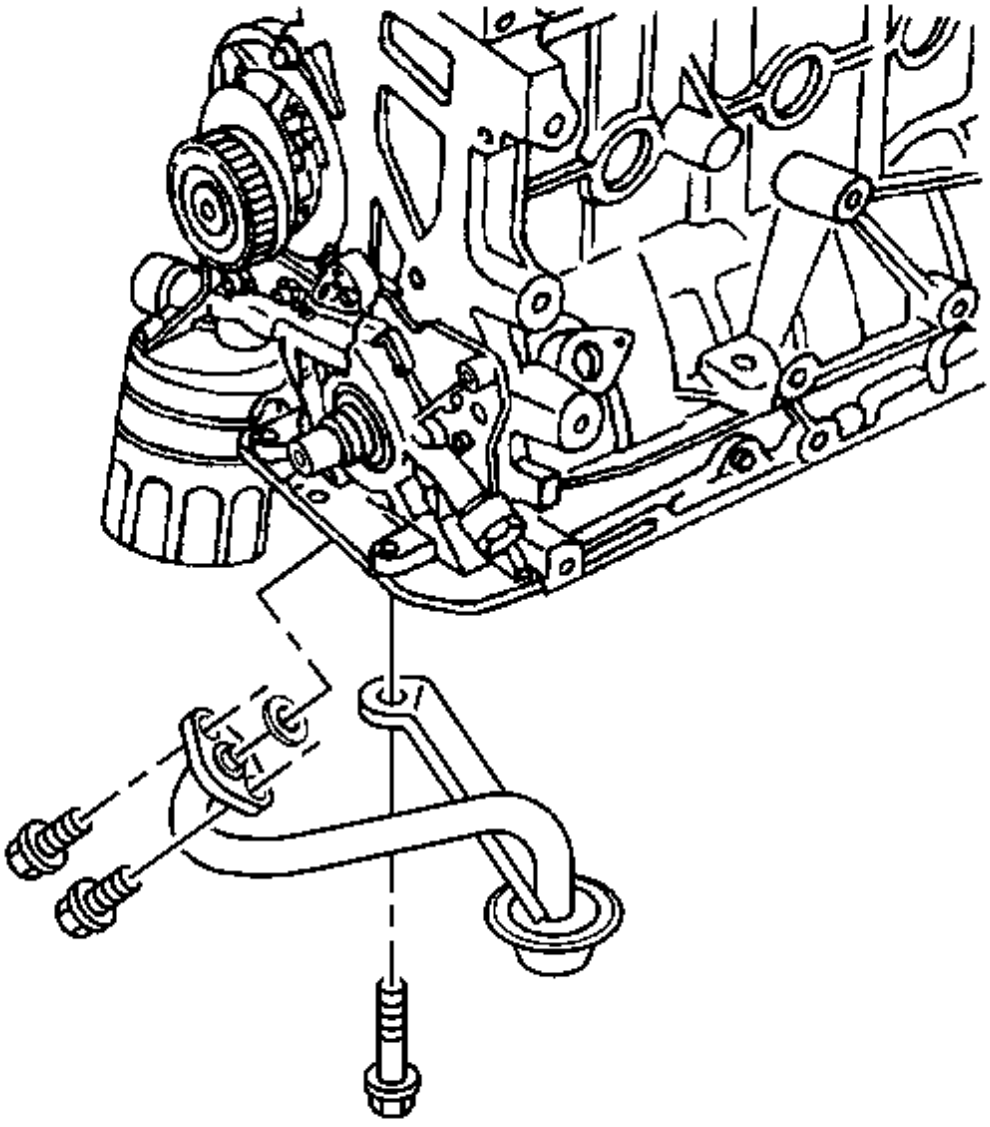

Fig. 95: View Of Oil Pump Pickup Tube, Support Bracket And Bolts

Courtesy of GENERAL MOTORS CORP.

5. Remove the oil pan. Refer to **Oil Pan Replacement**.
6. Remove the oil pump pickup tube and support the bracket bolts.
7. Remove the oil pump pickup tube.

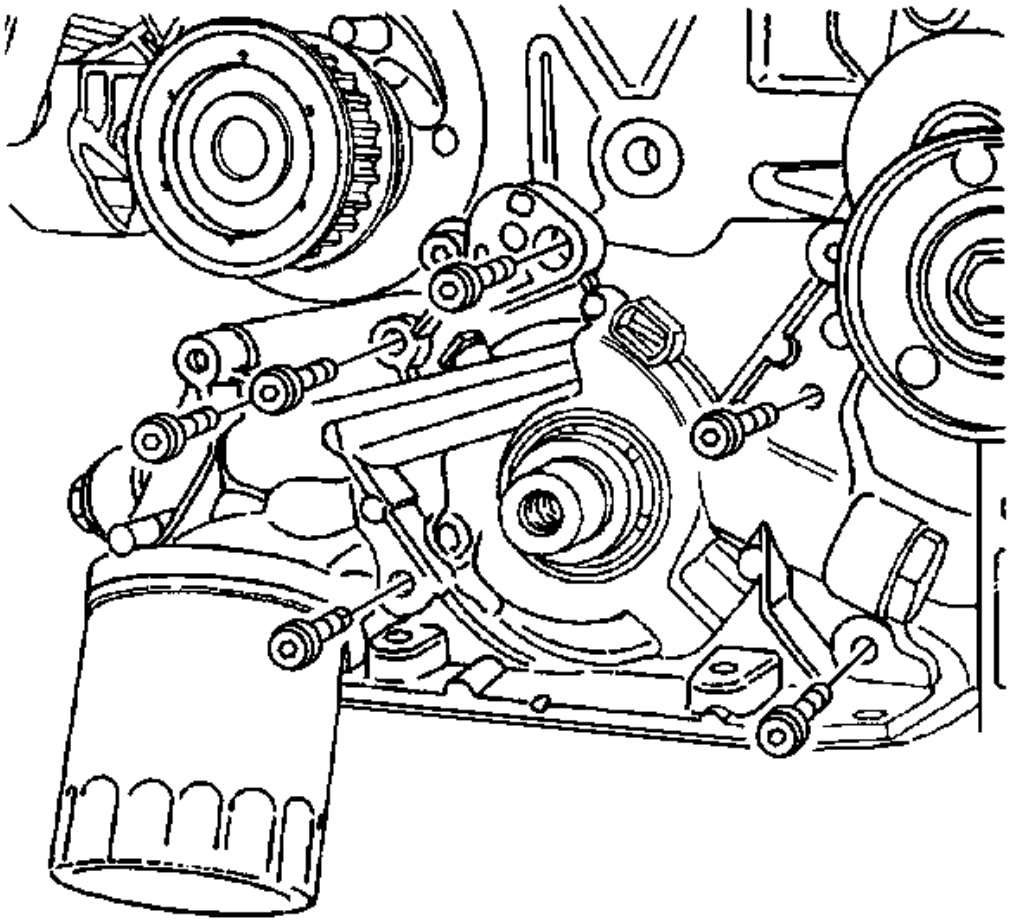

Fig. 96: View Of Oil Pump And Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

8. Remove the oil pump retaining bolts.

9. Carefully separate the oil pump and the gasket from the engine block and the oil pan.
10. Remove the oil pump.

Installation Procedure

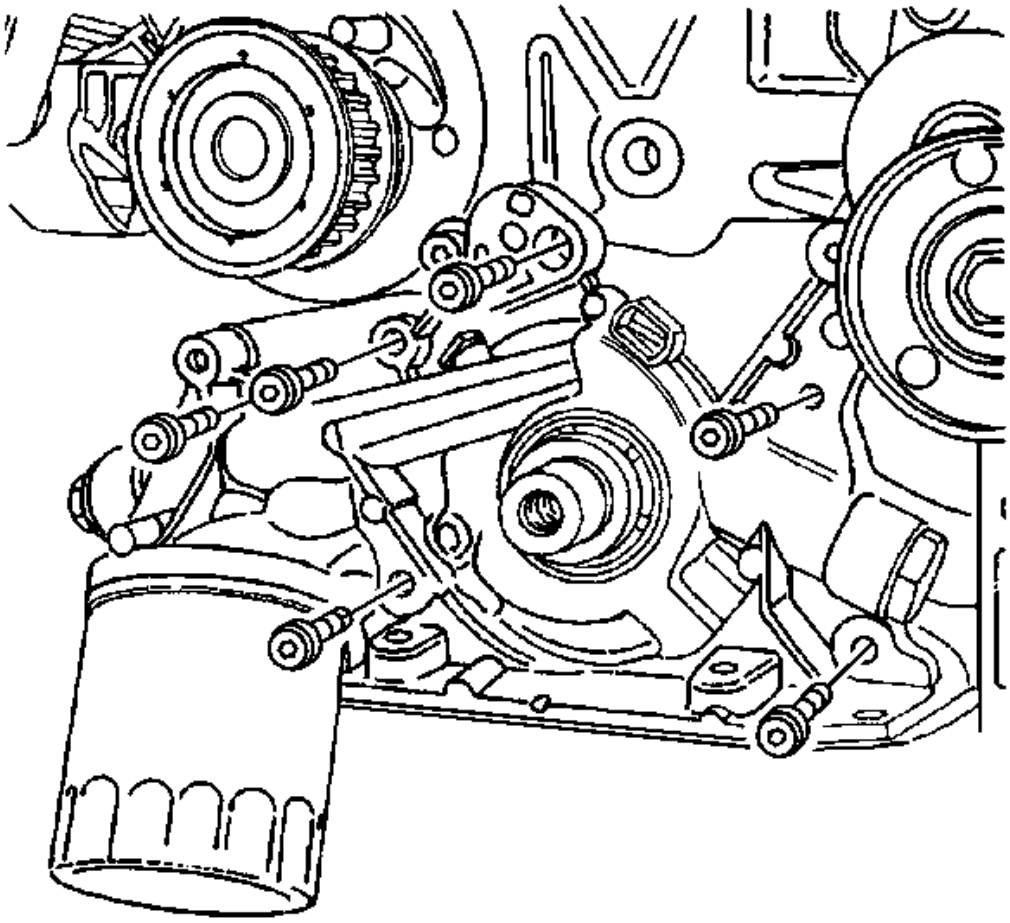

Fig. 97: View Of Oil Pump And Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

1. Apply LOCTITE® 242 to the oil pump bolts and RTV sealant to the new oil pump gasket.
2. Install the gasket to the oil pump and install the oil pump to the engine block with the bolts.

Tighten: Tighten the oil pump retaining bolts to **10 N.m (89 lb in)** .

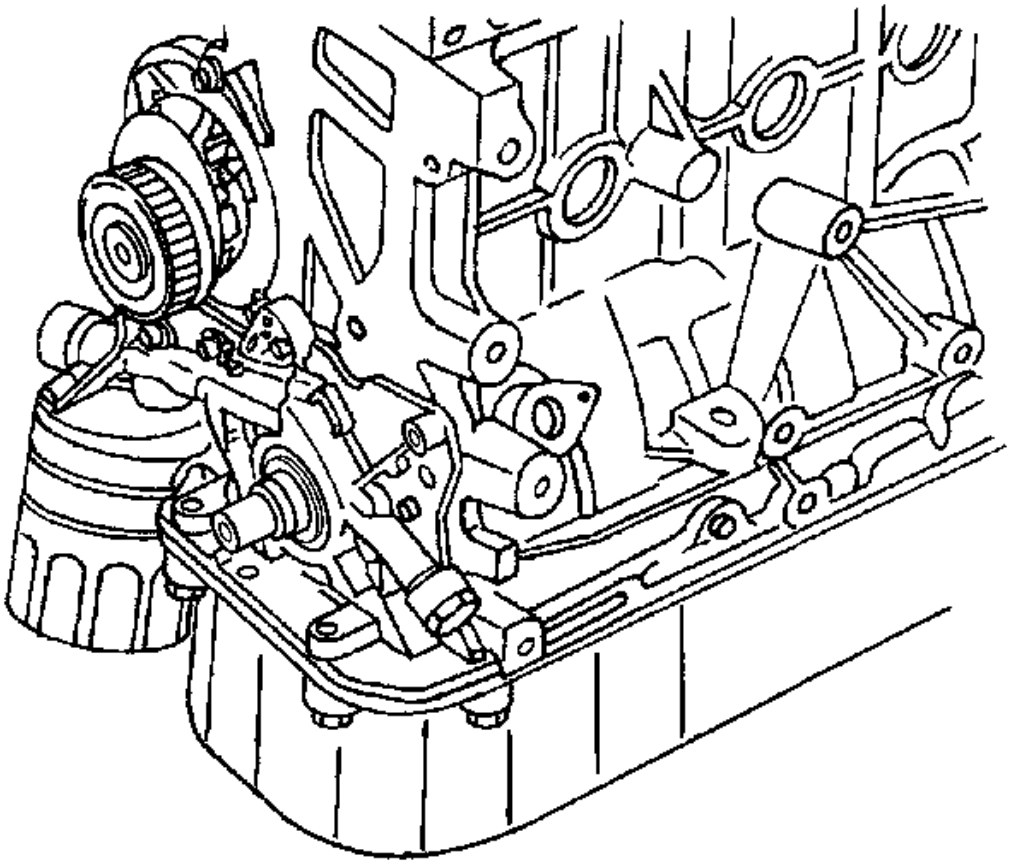

Fig. 98: View Of Oil Pump At Crankshaft
Courtesy of GENERAL MOTORS CORP.

3. Install a new oil pump-to-cranshaft seal. Coat the lip of the seal with a thin coat of grease.

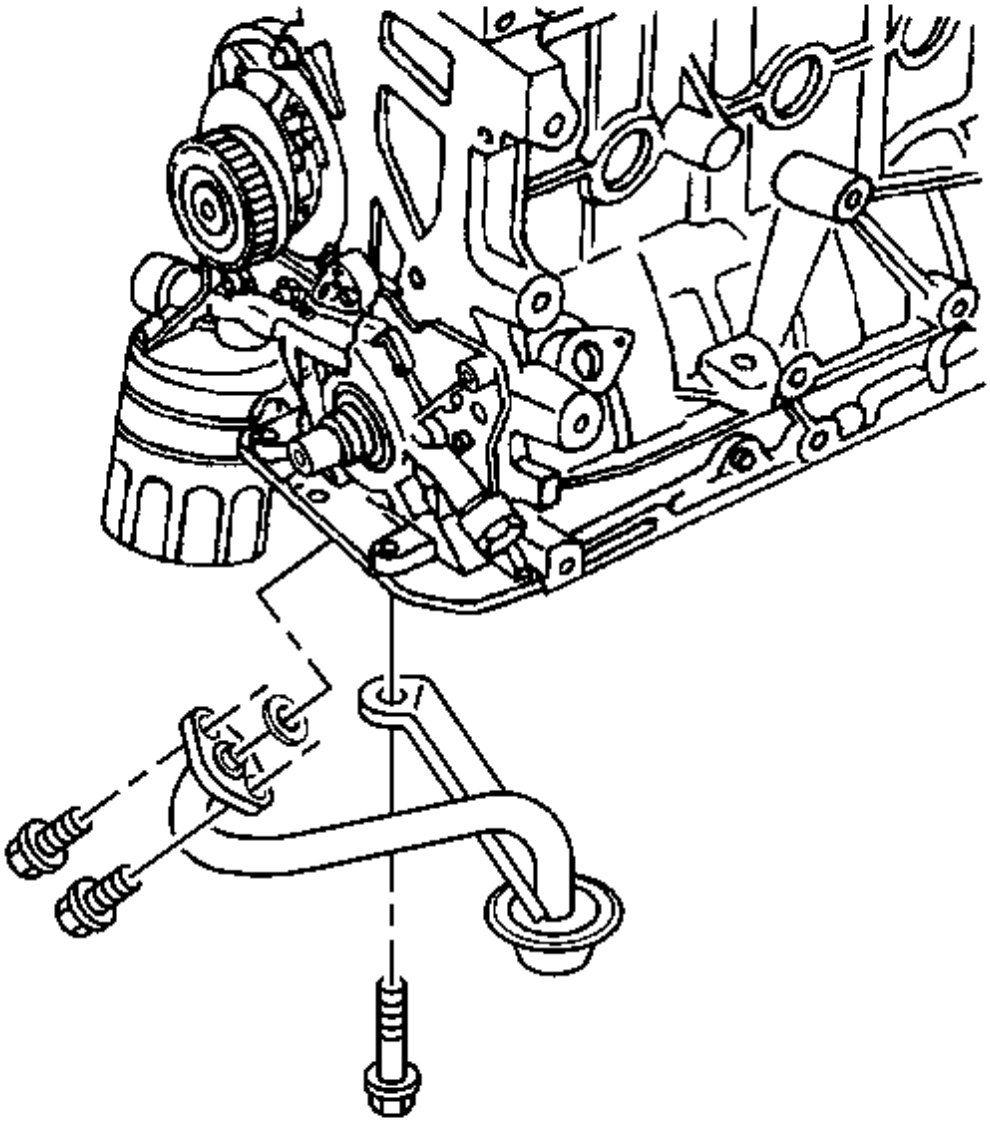

Fig. 99: View Of Oil Pump Pickup Tube, Support Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

4. Coat the threads of the oil pump pickup tube and the support bracket bolts with LOCTITE® 242.
5. Install the oil pump tube and the bolts.

Tighten:

- Tighten the oil pump pickup tube bolts to **8 N.m (71 lb in)** .

- Tighten the oil pump pickup tube support bracket bolt to **10 N.m (89 lb in)** .

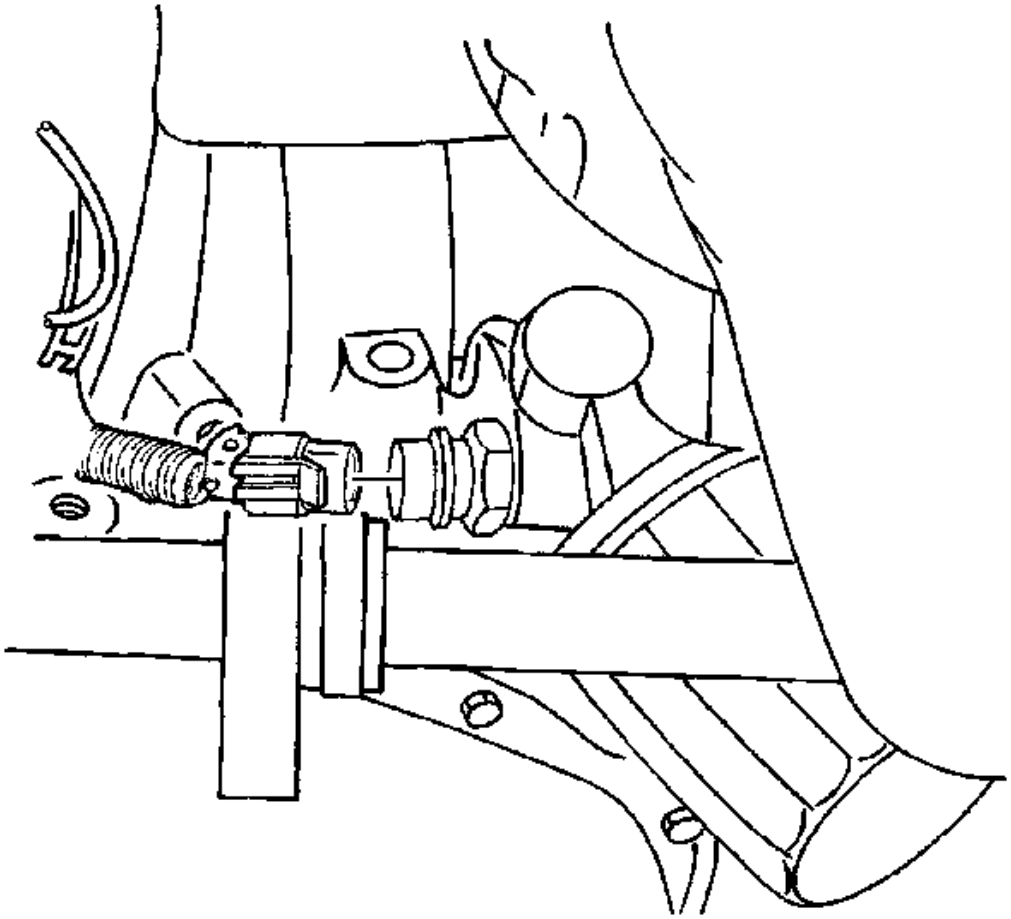

Fig. 100: Identifying Oil Pressure Gage Sensor
Courtesy of GENERAL MOTORS CORP.

6. Install the oil pan. Refer to **Oil Pan Replacement**.
7. Connect the oil pressure switch connector.
8. Install the rear timing belt cover. Refer to **Timing Belt Cover Replacement**.
9. Install the timing belt. Refer to **Timing Belt Replacement**.
10. Connect the negative battery cable.

OIL PUMP CLEANING AND INSPECTION

Cleaning Procedure

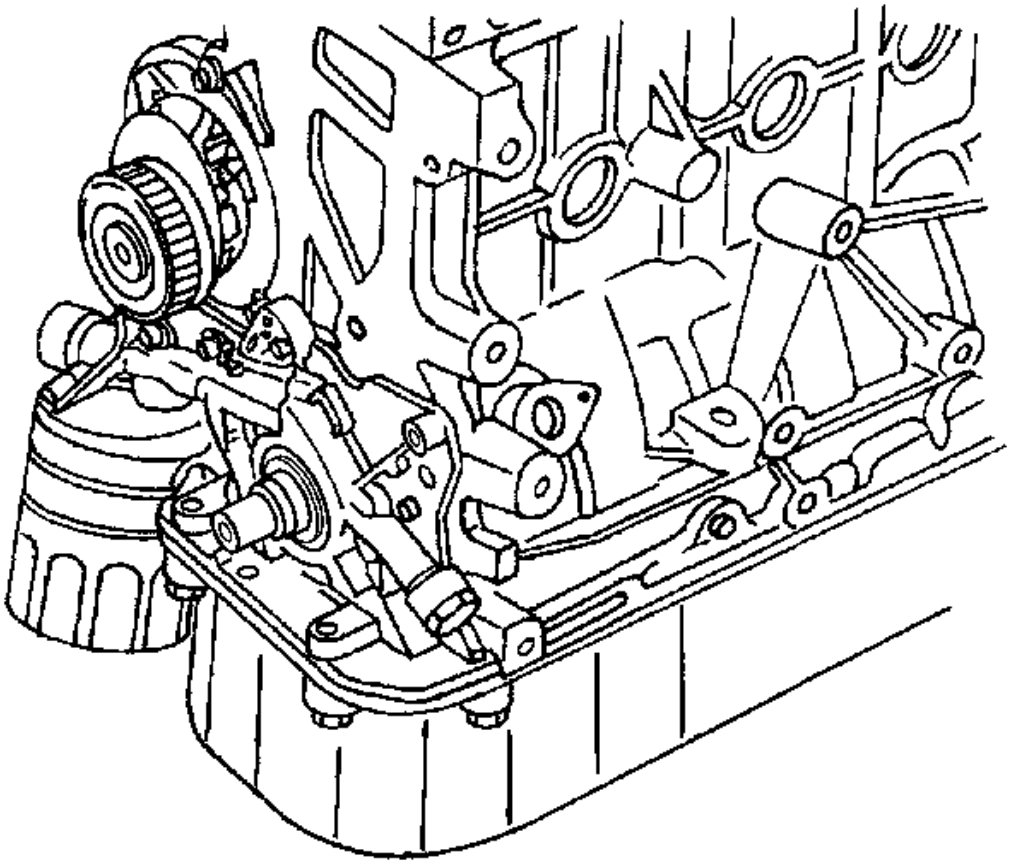

Fig. 101: View Of Oil Pump At Crankshaft
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

1. Clean the oil pump and the engine block gasket mating surfaces areas.
2. Remove the safety relief valve bolt.
3. Remove the safety relief valve and the spring.
4. Remove the oil pump-to-crankshaft seal.

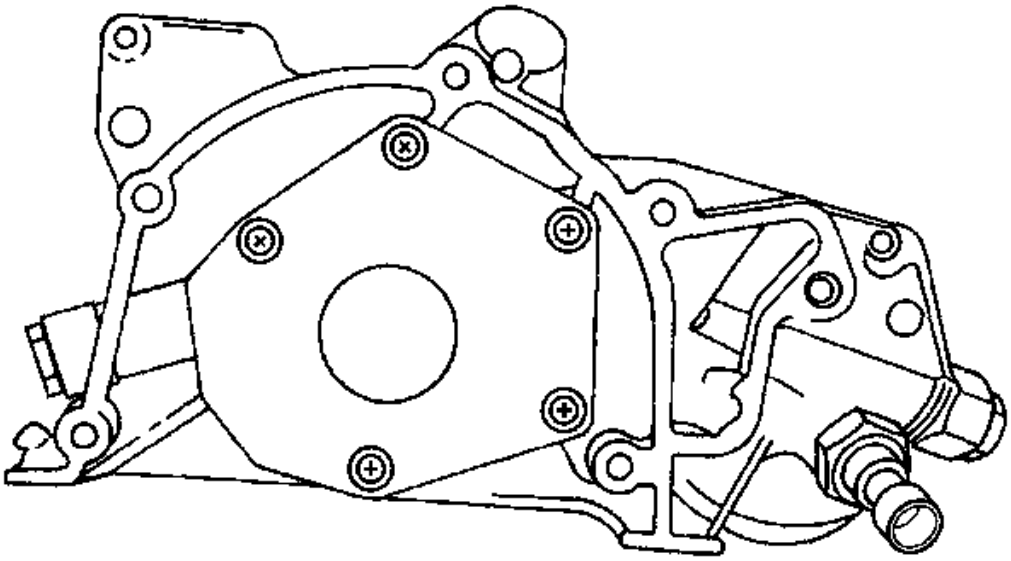

Fig. 102: Rear View Of Oil Pump
Courtesy of GENERAL MOTORS CORP.

5. Remove the oil pump rear cover bolts.
6. Remove the rear cover.
7. Clean the oil pump housing and all of the parts.

Inspection Procedure

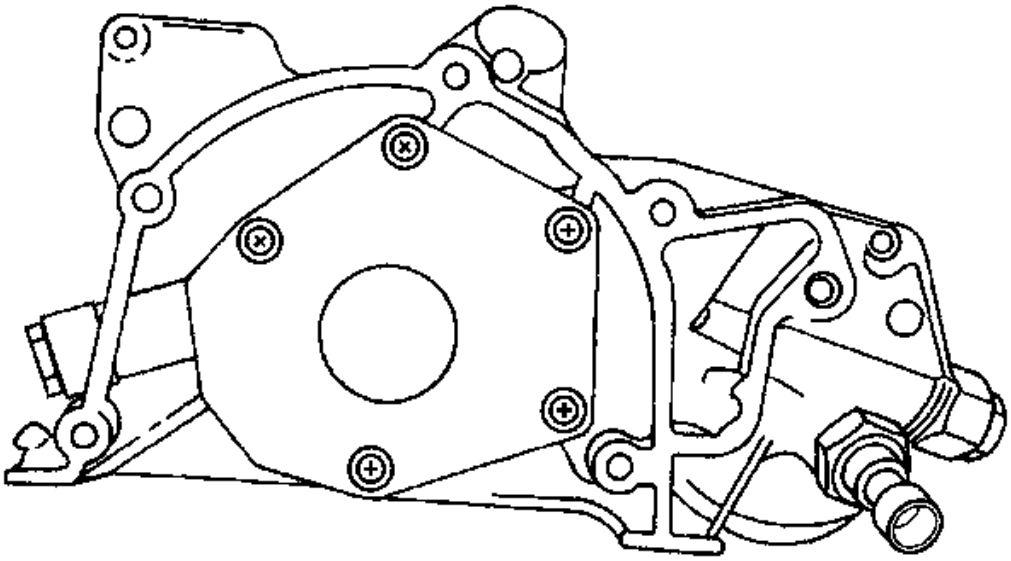

Fig. 103: Rear View Of Oil Pump
Courtesy of GENERAL MOTORS CORP.

1. Inspect all parts for signs of wear. Refer to **Engine Mechanical Specifications** .
2. Coat all oil pump parts with clean engine oil and install.

NOTE: Pack the oil pump gear cavity with petroleum jelly to ensure an oil pump prime, or engine damage could result.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Apply LOCTITE® 242 to the rear cover bolts and install the cover and the bolts.

   Tighten: Tighten the rear cover bolts to **6 N.m (53 lb in)** .

4. Install the safety relief valve, the spring, the washer, and the bolt.

   Tighten: Tighten the safety relief valve bolt to **30 N.m (22 lb ft)** .

ENGINE MOUNT REPLACEMENT (RIGHT SIDE)

Tools Required

J 28467-B Universal Engine Support Fixture. See **Special Tools** .

Removal Procedure

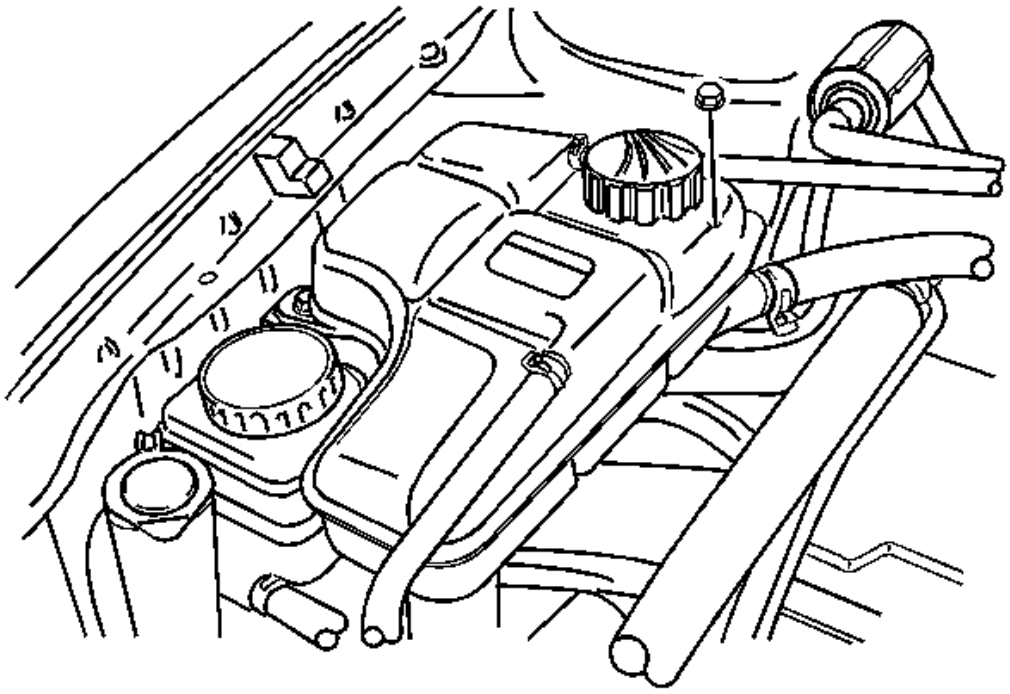

Fig. 104: View Of Surge Tank And Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Engine Mounting Notice in Cautions and Notices.

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.

NOTE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal, or crankshaft balancer. Jacking against the oil pan may cause it to crack or break.

2. Support the engine assembly using the **J 28467-B** . See **Special Tools** .
3. Remove the right front wheel well splash shield. Refer to **Splash Shield Replacement - Wheelhouse** in Body Front End.

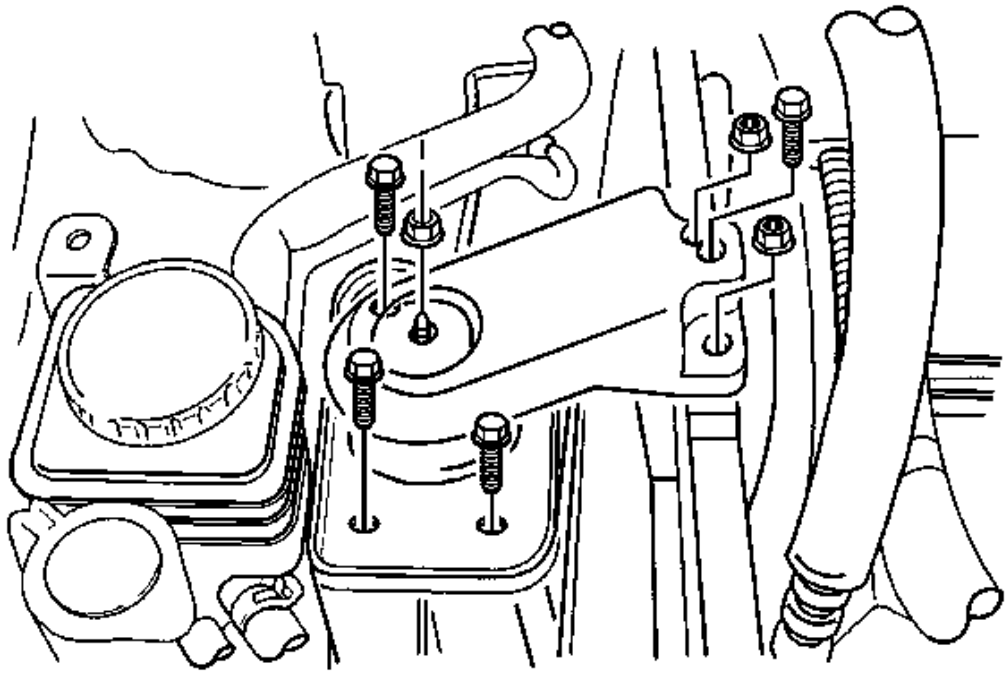

Fig. 105: View Of Surge Tank, Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine mount bracket retaining bolts.
5. Remove the engine mount bracket.
6. Remove the power steering pump drive belt. Refer to **Power Steering Pump Drive Belt Replacement (2.0L)** in Power Steering System.

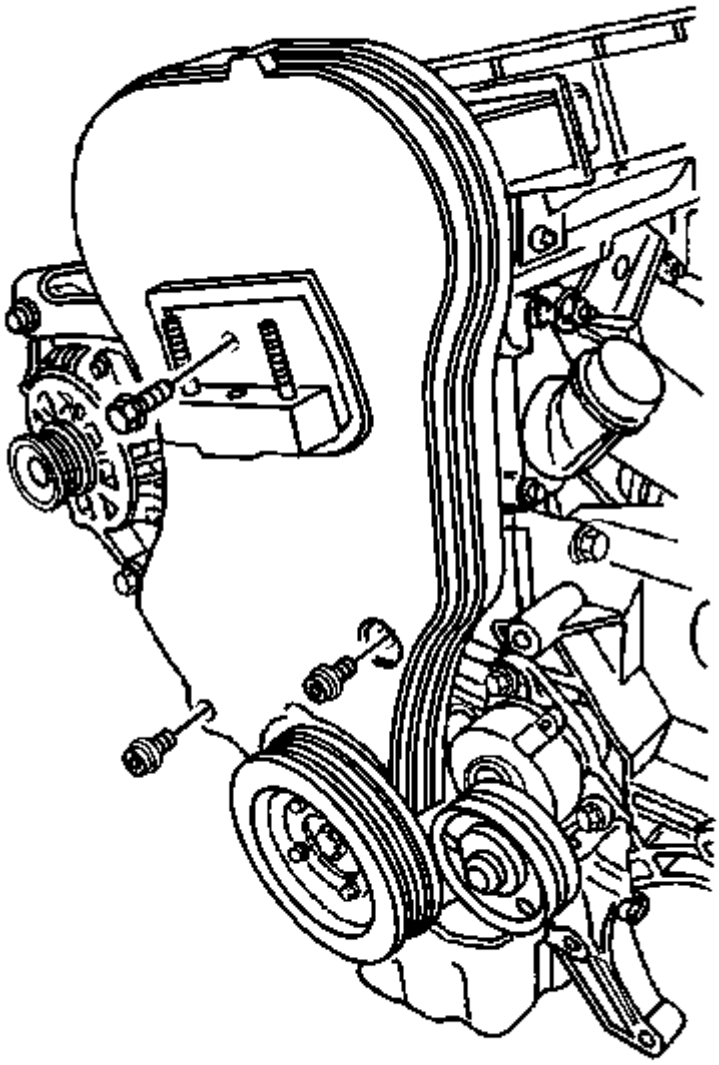

Fig. 106: View Of Front Timing Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the front timing belt cover bolts and the front timing belt cover.
8. Align the crankshaft pulley timing mark with the pointer, and the camshaft gears with the timing marks on the rear cover, by turning the crankshaft gear bolt.
9. Loosen the timing belt automatic tension bolt.
10. Turn the hex-key tab to relieve belt tension.
11. Remove the timing belt idler pulley nuts.

12. Remove the timing belt idler pulley.
13. Remove the engine mount retaining bolts.
14. Remove the engine mount.

Installation Procedure

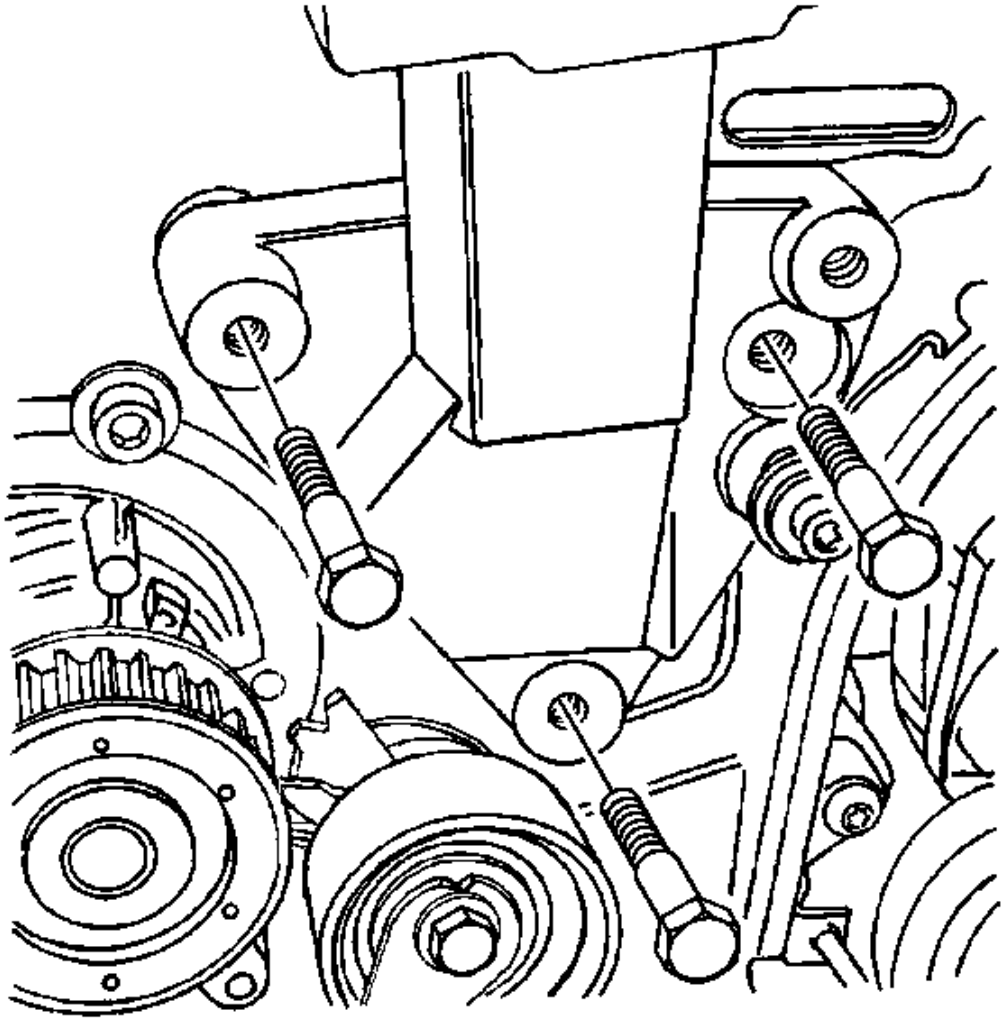

Fig. 107: View Of Engine Mount And Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the engine mount retaining bolts.

   Tighten: Tighten the engine mount retaining bolts to **60 N.m (44 lb ft)** .

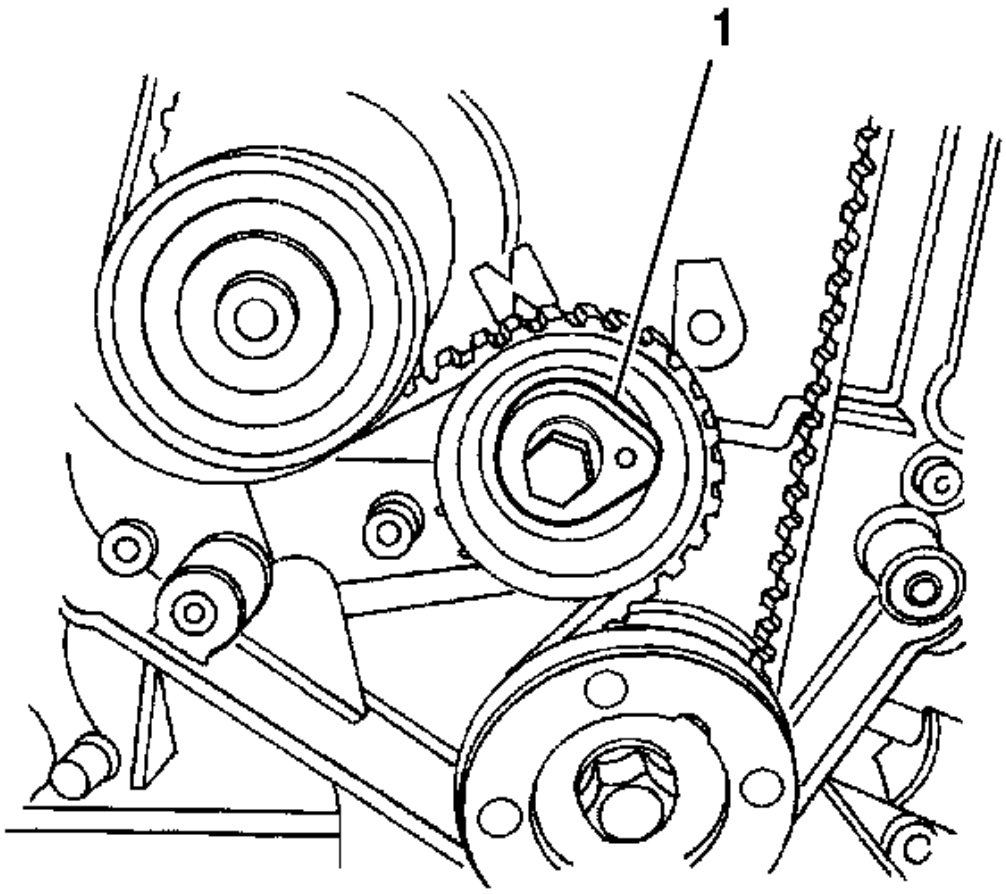

Fig. 108: View Of Automatic Tensioner And Hex-Key Tab
Courtesy of GENERAL MOTORS CORP.

3. Install the timing belt idler pulleys.
4. Install the timing belt idler pulley nuts.

   Tighten: Tighten the timing belt idler pulley nuts to **25 N.m (44 lb ft)** .

5. Tension the timing belt by turning the timing belt automatic tensioner hex-key tab counterclockwise until

the pointer is aligned to the indicator.

Tighten: Tighten the timing belt automatic tensioner bolt to **25 N.m (18 lb ft)** .

6. Install the front timing belt cover.
7. Install the front timing belt cover bolts.

Tighten: Tighten the front timing belt cover bolts to **6 N.m (53 lb in)** .

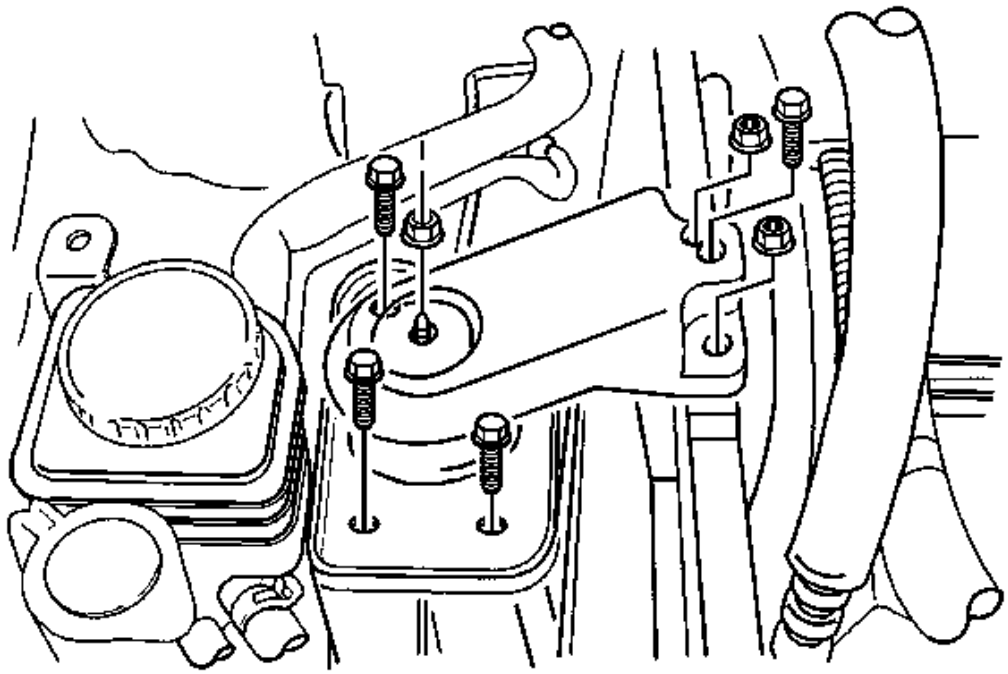

Fig. 109: View Of Surge Tank, Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

8. Install the engine mount bracket and retaining bolts.

Tighten: Tighten the engine mount bracket retaining bolts to **60 N.m (44 lb ft)** .

9. Remove the **J 28467-B** . See **Special Tools** .
10. Install the power steering pump drive belt. Refer to **Power Steering Pump Drive Belt Replacement (2.0L)** in Power Steering System.
11. Install the right front wheel well splash shield. Refer to **Splash Shield Replacement - Wheelhouse** in Body Front End.

12. Install the air filter housing assembly with the bolts.

    Tighten: Tighten the air filter housing assembly bolts to **6 N.m (53 lb in)** .

13. Connect the negative battery cable.

ENGINE MOUNT REPLACEMENT (FORWARD)

Removal Procedure

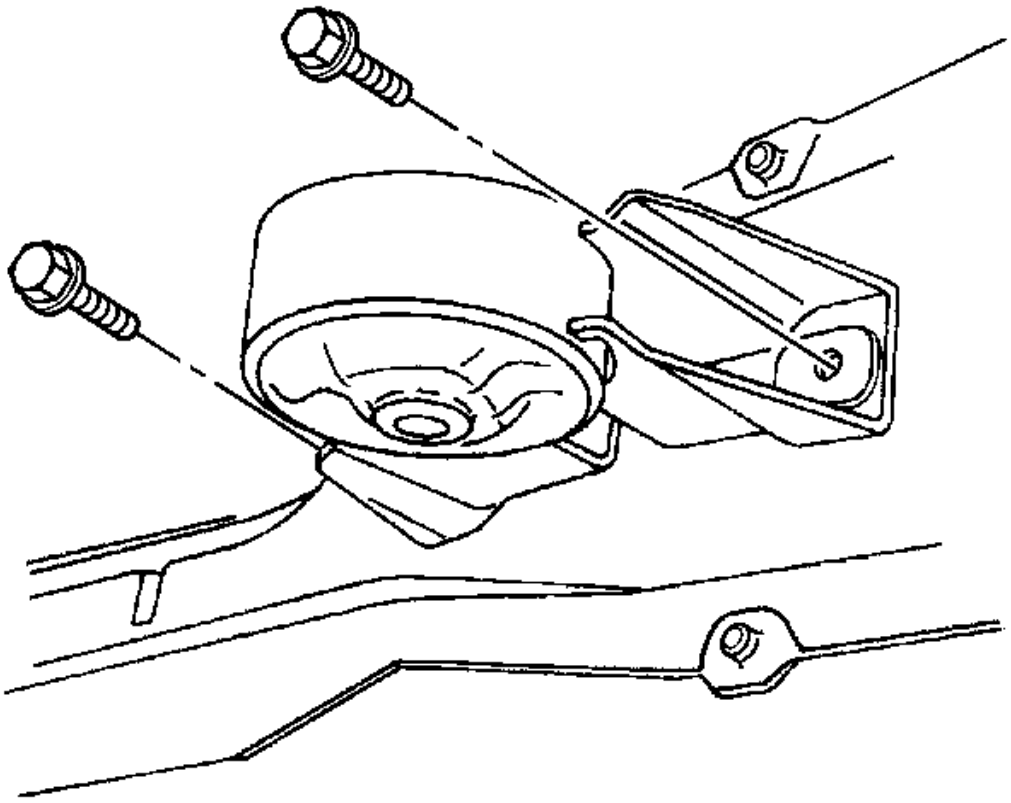

Fig. 110: View Of Engine Mount At Center Member
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Engine Mounting Notice in Cautions and Notices.**

NOTE: **Refer to Battery Disconnect Caution in Cautions and Notices.**

1. Disconnect the negative battery cable.
2. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Remove the front engine crossmember. Refer to **Crossmember Replacement - Front Engine** in Frame and Underbody.
4. Remove the bolts securing the engine mount to the center member.
5. Remove the engine mount.

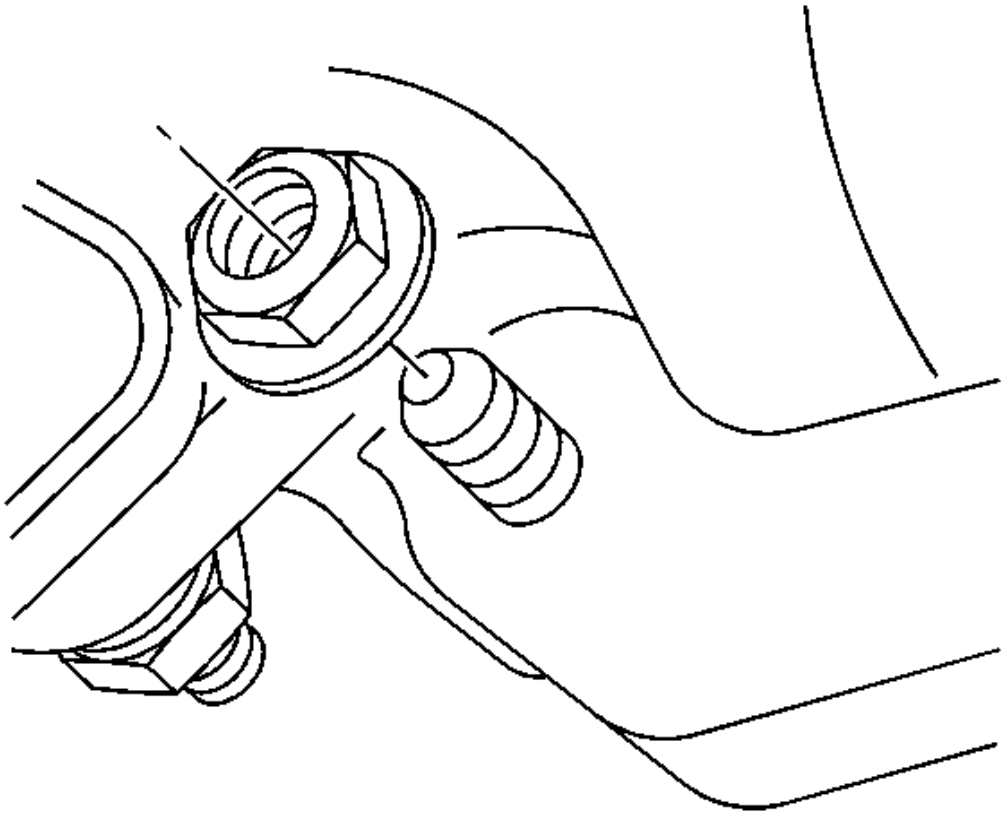

Fig. 111: View Of Engine Mount Bracket-To-Engine Block Nuts
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine mount bracket-to-engine block nuts.

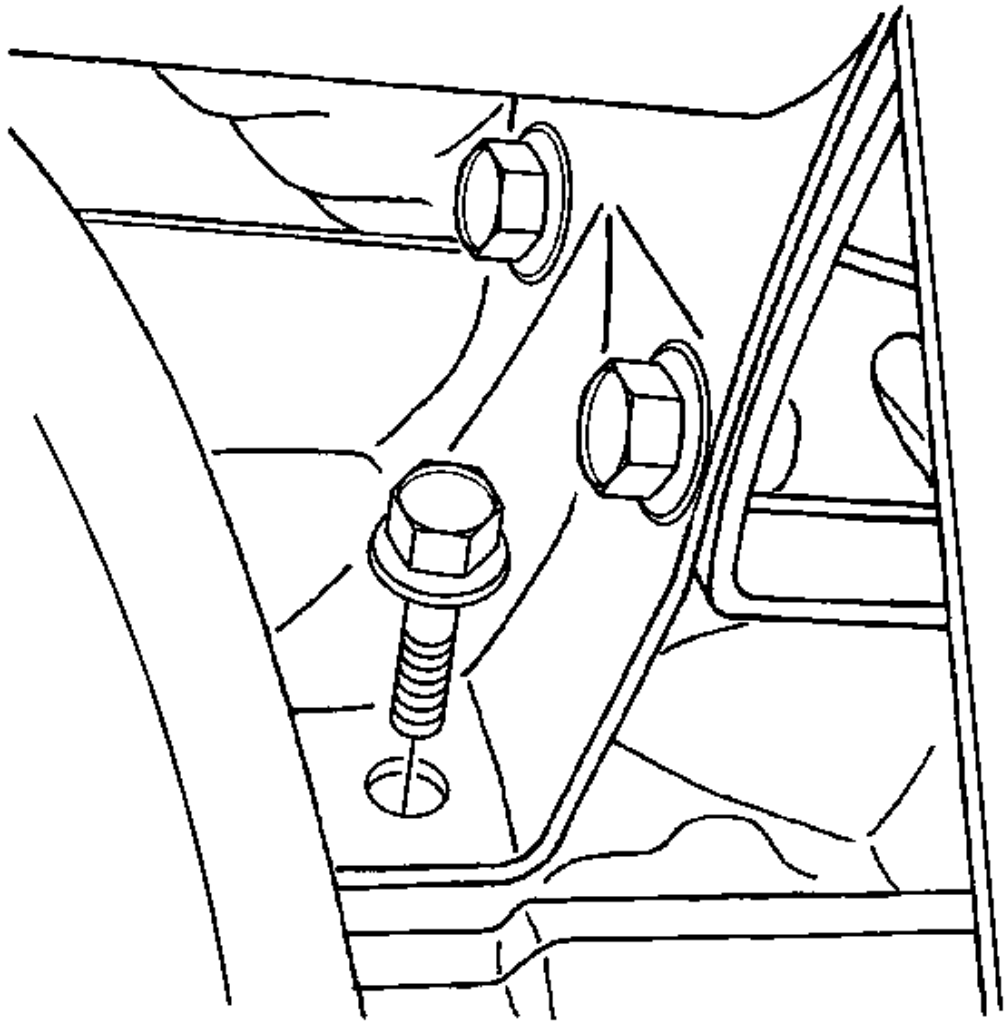

Fig. 112: View Of Engine Mount Bracket-To-Engine Block Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the engine mount bracket-to-engine block bolts.
8. Remove the engine mount bracket.

Installation Procedure

NOTE: Refer to Fastener Notice in Cautions and Notices.

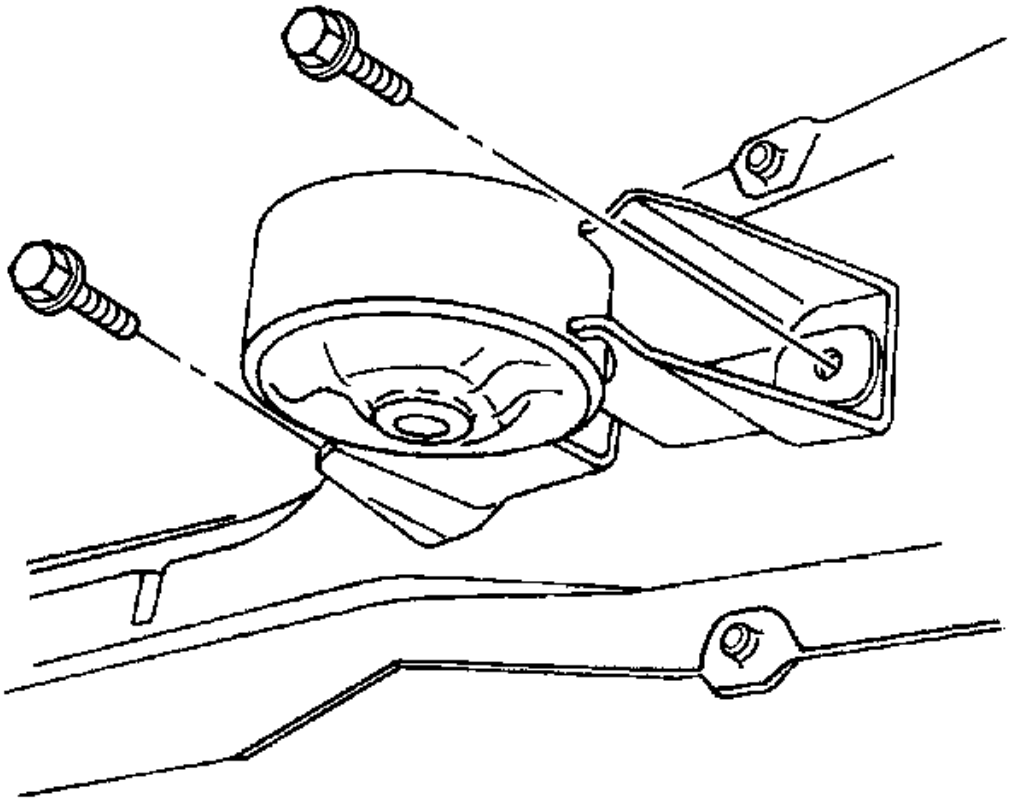

Fig. 113: View Of Engine Mount At Center Member
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount and bolts to the front engine crossmember.

   Tighten: Tighten the engine mount bolts to **60 N.m (44 lb ft)** .

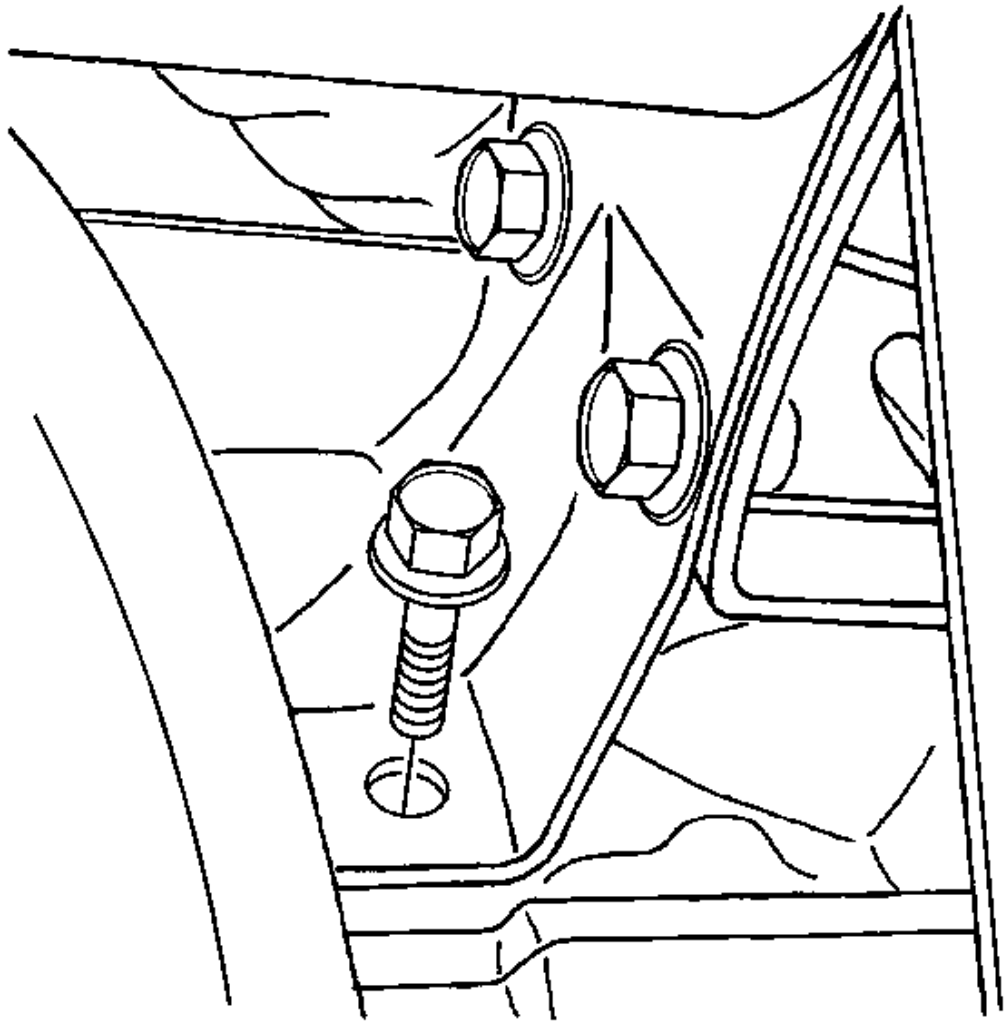

Fig. 114: View Of Engine Mount Bracket-To-Engine Block Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the engine mount bracket-to-engine block bolts.

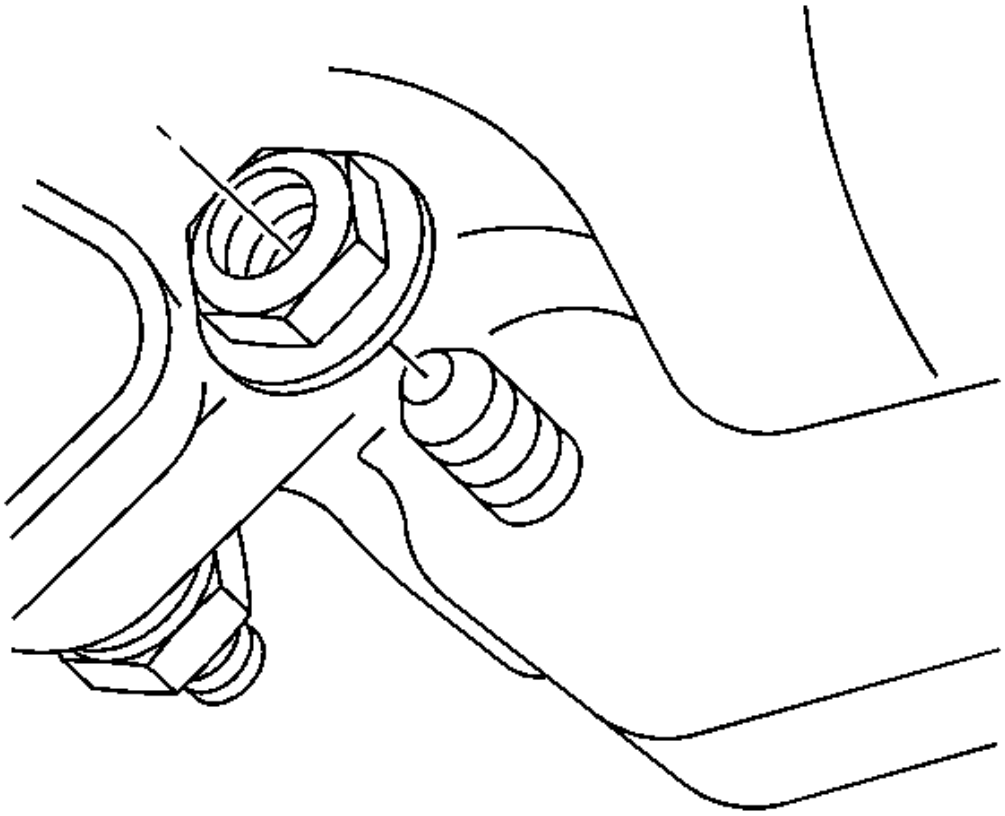

Fig. 115: View Of Engine Mount Bracket-To-Engine Block Nuts
Courtesy of GENERAL MOTORS CORP.

3. Install the engine mount bracket-to-engine block nuts.

   Tighten: Tighten the engine mount bracket-to-engine block bolts and nuts to **80 N.m (59 lb ft)** .

4. Install the front engine crossmember. Refer to **Crossmember Replacement - Front Engine** in Frame and Underbody.
5. Lower the vehicle.
6. Connect the negative battery cable.

ENGINE REPLACEMENT

Removal Procedure

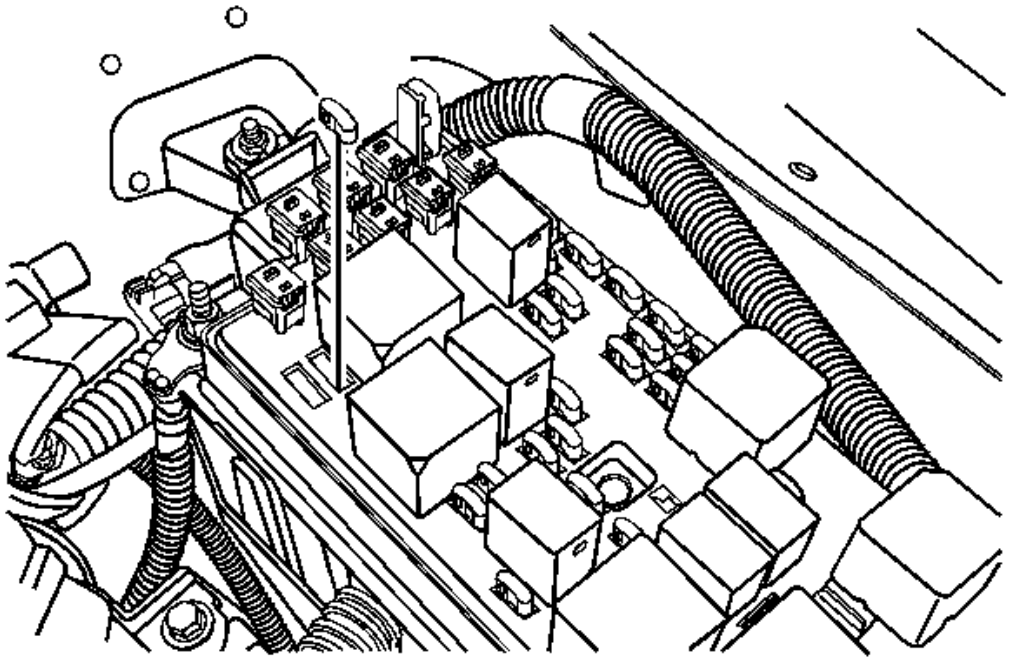

Fig. 116: Identifying Fuel Pump Fuse
Courtesy of GENERAL MOTORS CORP.

NOTE: If the engine is damaged internally and a new engine assembly is installed in the vehicle, ensure that all foreign material is flushed out of the cooling system. You must also flush out the oil cooler system. Failure to rid the oil cooler system of debris can result in engine damage.

1. Remove the fuel pump fuse.
2. Start the engine and wait until it stalls.
3. Crank the engine for 10 seconds to rid the fuel system of fuel pressure.
4. Remove the hood. Refer to **Hood Replacement** in Body Front End.
5. Drain the engine oil.

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

6. Disconnect the negative battery cable.

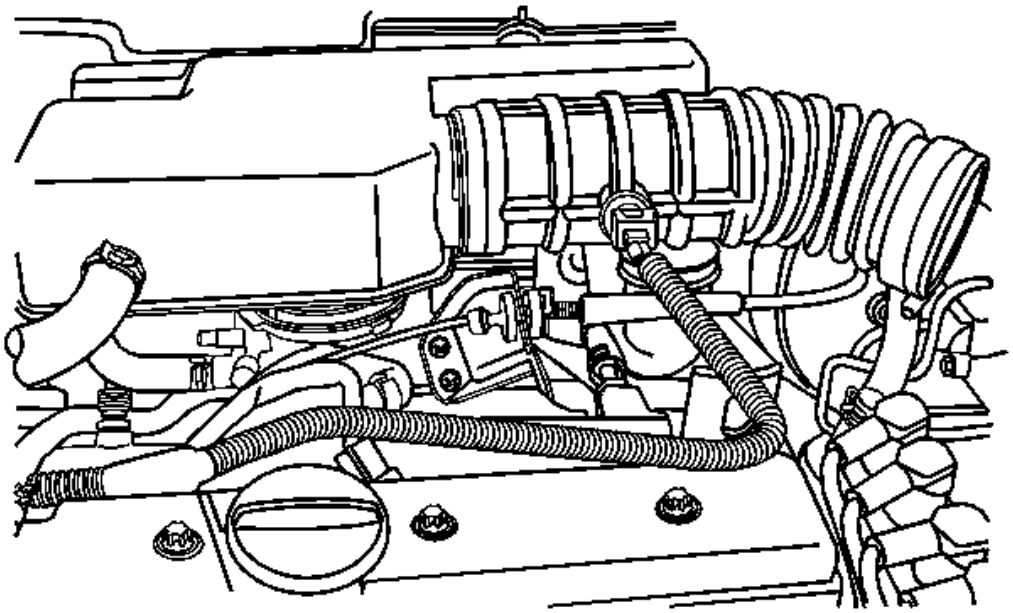

Fig. 117: View Of Manifold Air Temperature Sensor And Throttle Body Intake Tube
Courtesy of GENERAL MOTORS CORP.

7. Discharge the air conditioning (A/C) system, if equipped. Refer to **Refrigerant Recovery and Recharging** in Heating, Ventilation and Air Conditioning.
8. Disconnect the manifold air temperature sensor connector.
9. Remove the air intake tube.
10. Disconnect the breather tubes from the valve cover.
11. Remove the right front wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
12. Remove the right front wheel well splash shield. Refer to **Splash Shield Replacement - Wheelhouse** in Body Front End.
13. Remove the power steering pump drive belt. Refer to **Power Steering Pump Drive Belt Replacement (2.0L)** in Power Steering System.

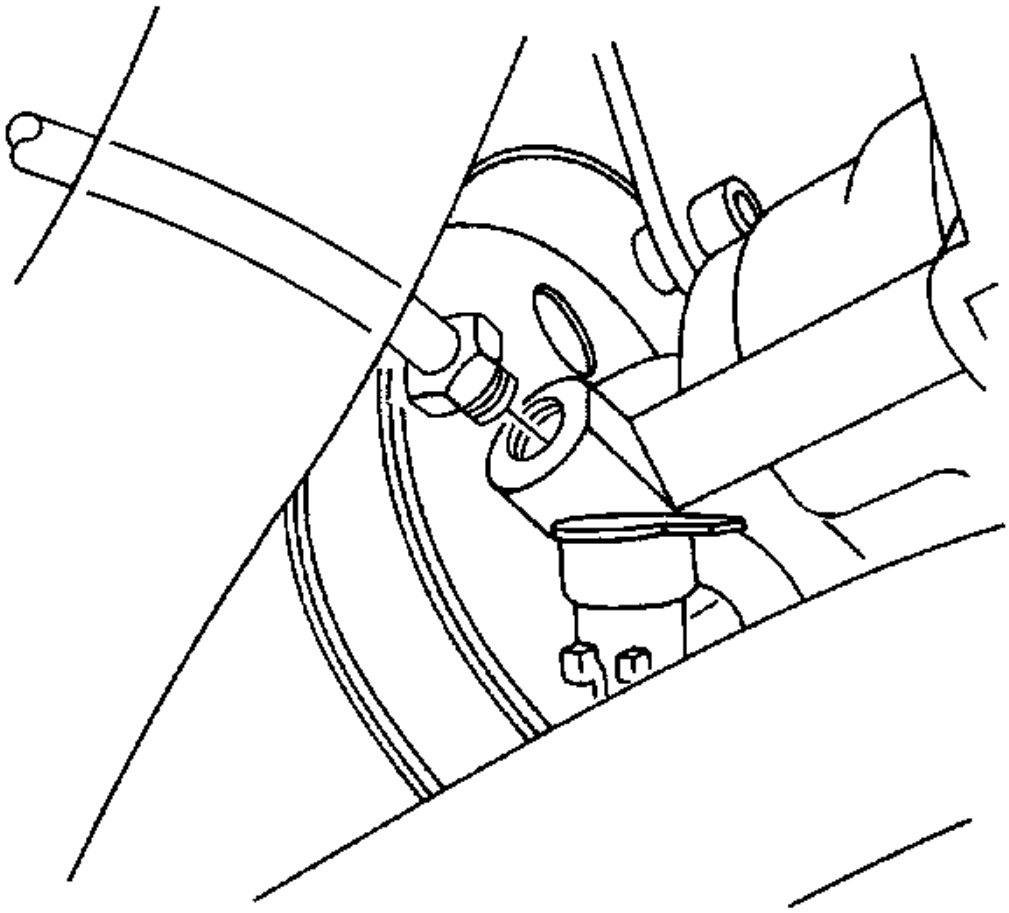

Fig. 118: View Of Power Steering Pressure Hose
Courtesy of GENERAL MOTORS CORP.

14. Drain the engine coolant. Refer to **Draining and Filling Cooling System (2.0L)** in Engine Cooling.
15. Remove the cooling system radiator and the engine cooling fans. Refer to **Radiator Replacement (2.0L)** in Engine Cooling.
16. Disconnect the upper radiator hose from the thermostat housing.
17. Disconnect the power steering return hose from the power steering pump. Collect the oil in a suitable container.
18. Disconnect the power steering pressure hose from the power steering pump. Collect the oil in a suitable container.
19. Disconnect the electrical connector at the ignition coil and the engine control module (ECM) ground terminal.

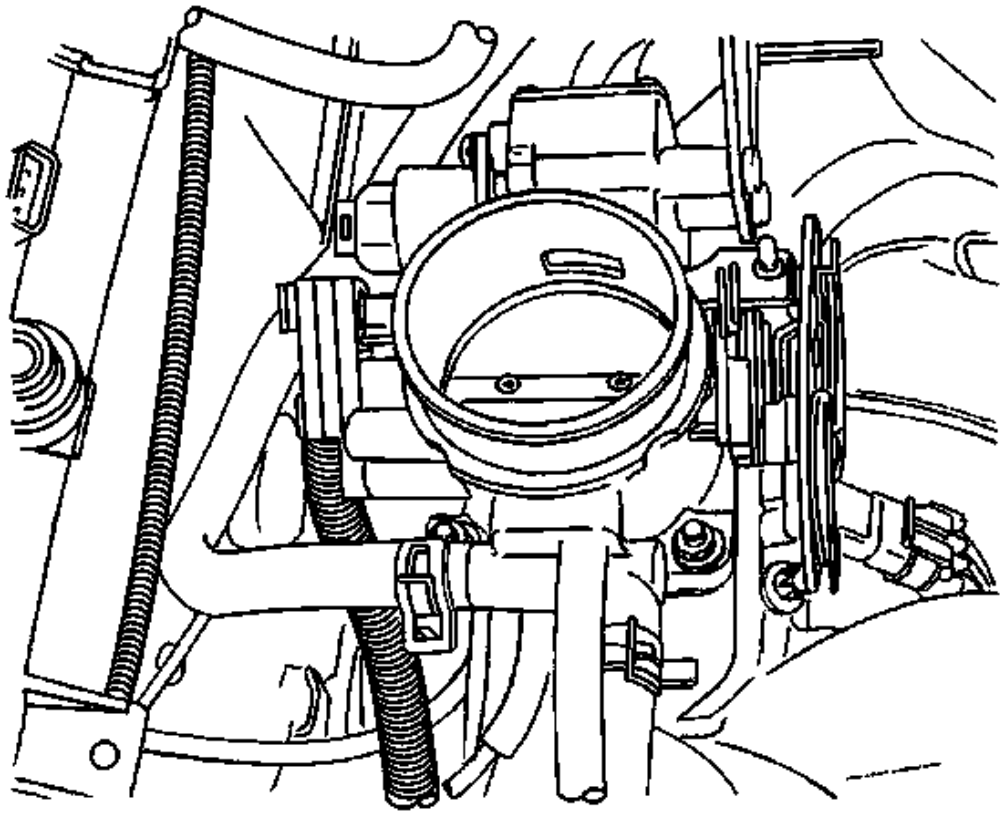

Fig. 119: View Of Throttle Body And Connectors
Courtesy of GENERAL MOTORS CORP.

20. Disconnect the oxygen sensor connector, if equipped.
21. Disconnect the idle air control (IAC) valve connector and the manifold absolute pressure (MAP) sensor connector.
22. Disconnect the throttle position (TP) sensor connector.
23. Disconnect the engine coolant temperature (ECT) sensor connector.
24. Disconnect the coolant temperature sensor (CTS) connector.
25. Disconnect the alternator voltage regulator connector and the power lead.
26. Disconnect the camshaft position (CMP) sensor connector.

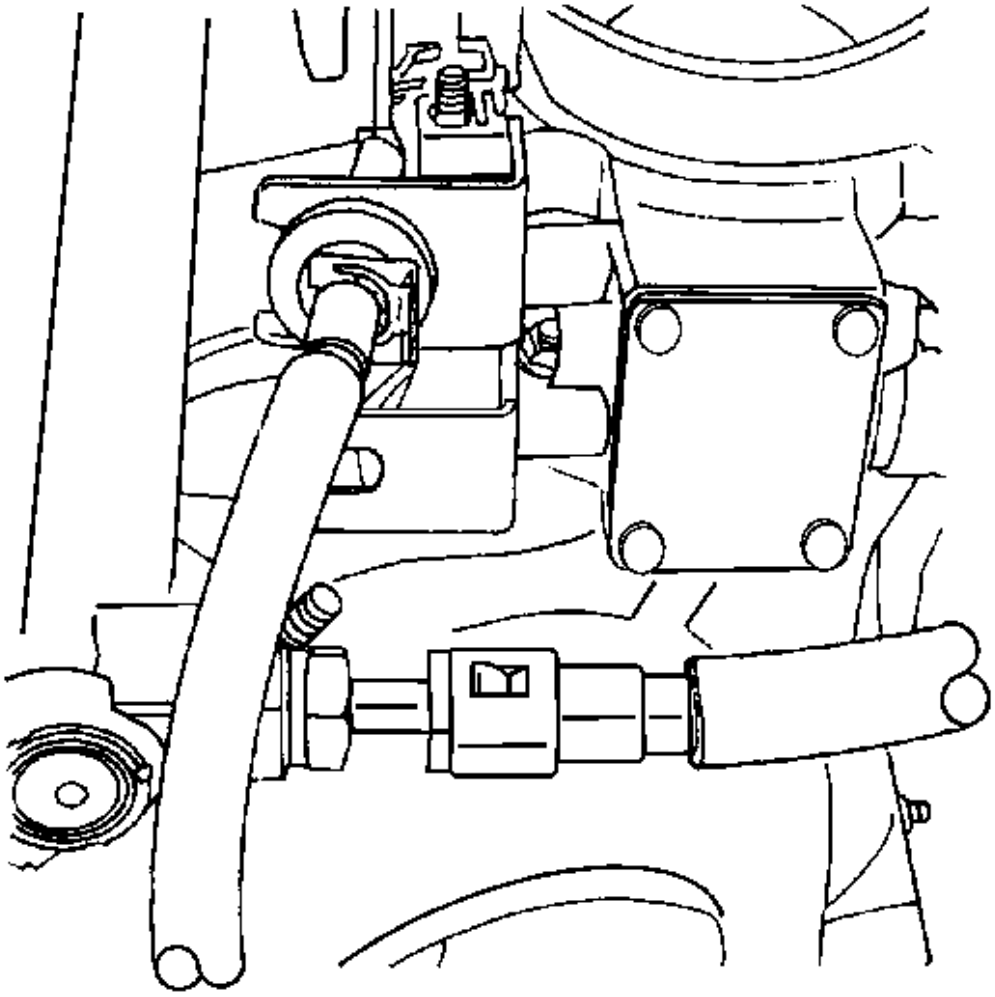

Fig. 120: View Of Fuel Return Line And Fuel Feed Line
Courtesy of GENERAL MOTORS CORP.

27. Disconnect all of the vacuum lines including the brake booster vacuum hose.
28. Disconnect the fuel return line at the fuel pressure regulator.
29. Disconnect the fuel feed line at the fuel rail.
30. Remove the fuel rail and the injector channel cover. Refer to **Fuel Rail Assembly Replacement** in Engine Controls - 2.0L.

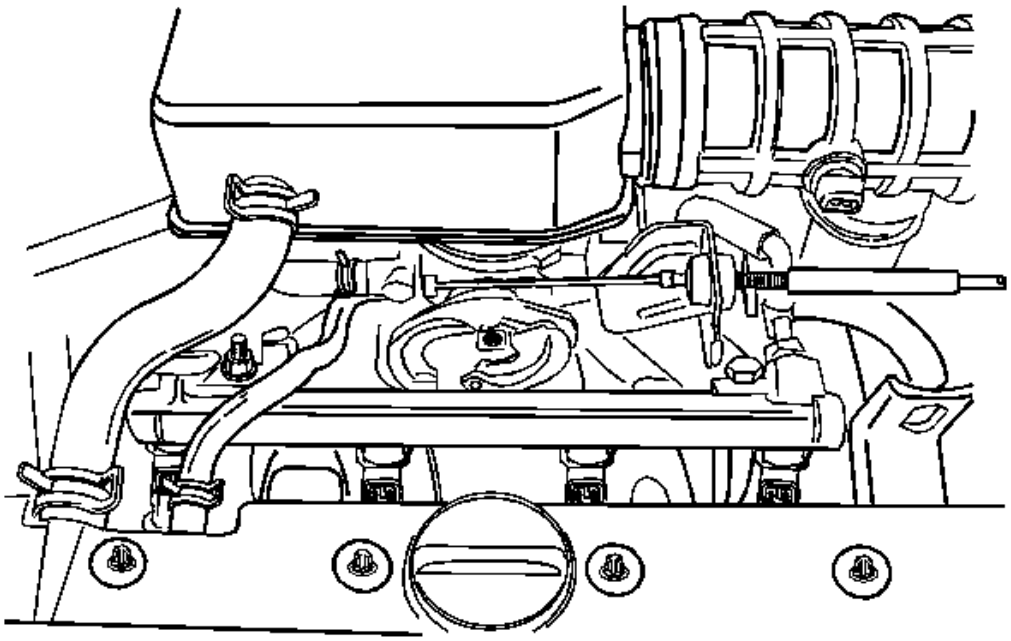

Fig. 121: View Of Fuel Rail, Throttle Cable, Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

31. Disconnect the throttle cable from the throttle body and the intake manifold bracket.
32. Disconnect the coolant hose at the throttle body.
33. Disconnect the heater outlet hose at the coolant pipe.
34. Disconnect the coolant bypass hose from the cylinder head.
35. Disconnect the surge tank coolant hose from the coolant pipe.
36. Disconnect the lower radiator hose from the coolant pipe.
37. Disconnect the starter solenoid S terminal wire and the power lead.
38. Remove the A/C compressor. Refer to **Compressor Replacement** in Heating, Ventilation and Air Conditioning.

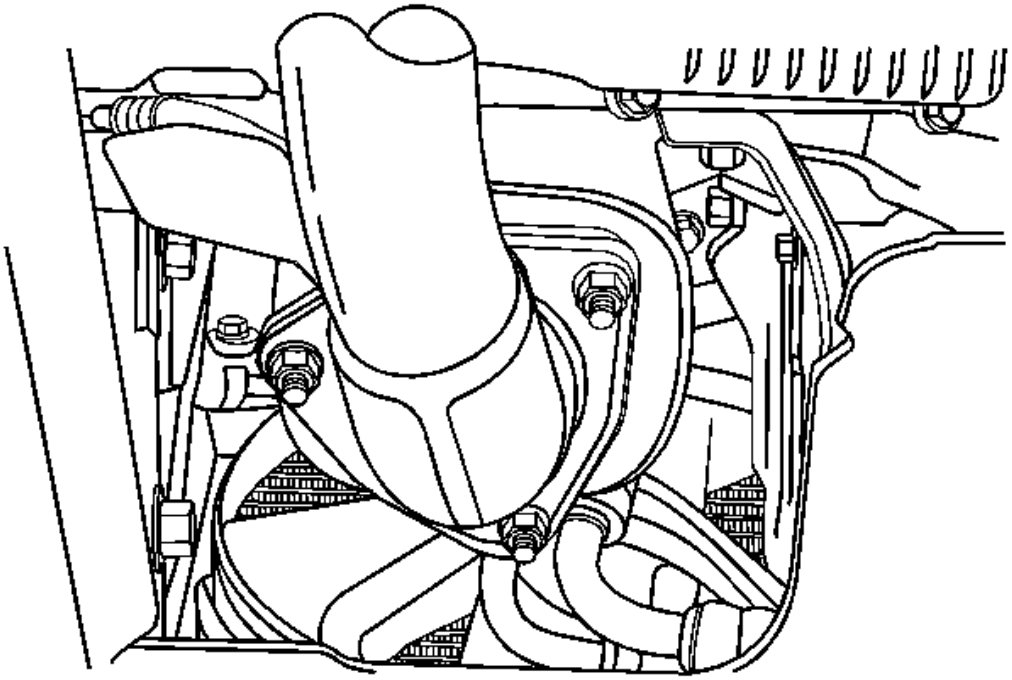

Fig. 122: View Of Flex Pipe And Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

39. Remove the front exhaust pipe retaining nuts from the catalytic converter.
40. Remove the exhaust flex pipe.

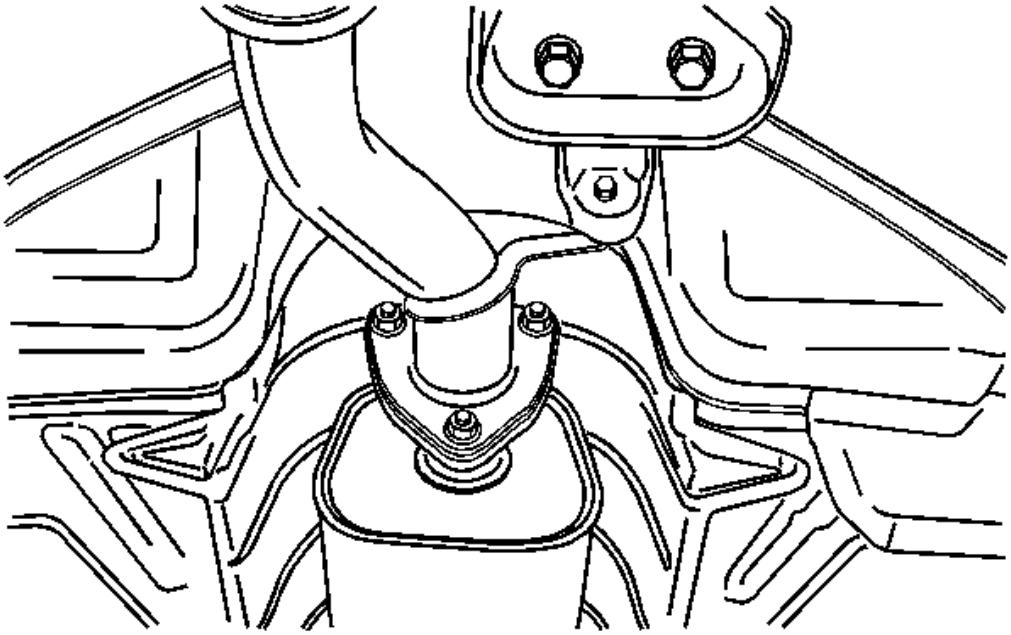

Fig. 123: View Of Front Exhaust Pipe, 3rd Muffler And Nuts
Courtesy of GENERAL MOTORS CORP.

41. Remove the nuts that secure the front exhaust pipe to the third muffler.
42. Remove the rubber hangers that attach the connecting pipe to the vehicle.

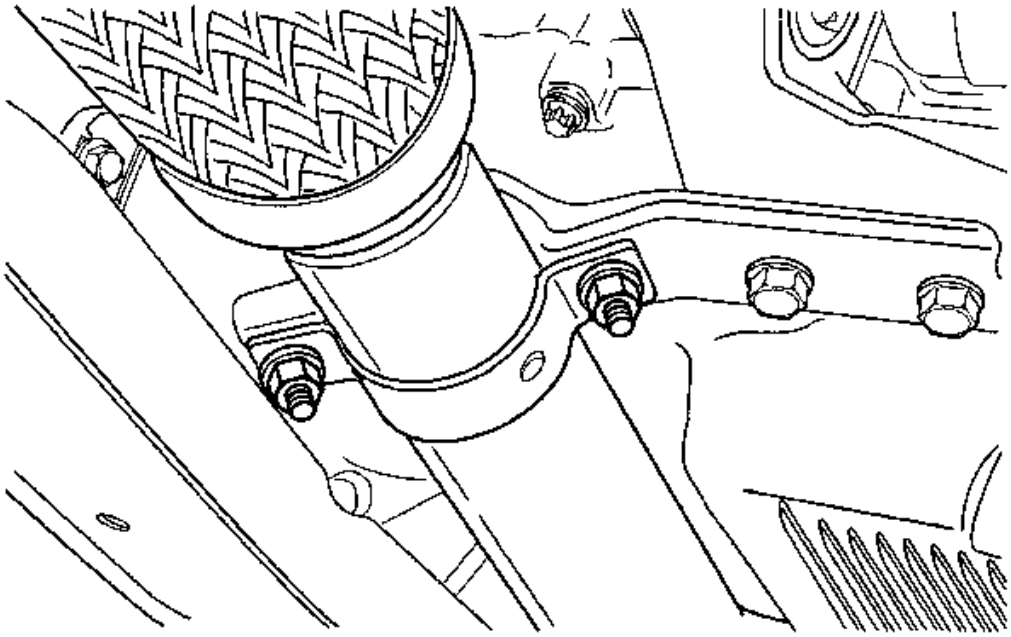

Fig. 124: View Of Connecting Pipe, Mounting Bracket And Nuts
Courtesy of GENERAL MOTORS CORP.

43. Remove the connecting pipe mounting bracket nuts and the bracket.
44. Remove the connecting pipe.

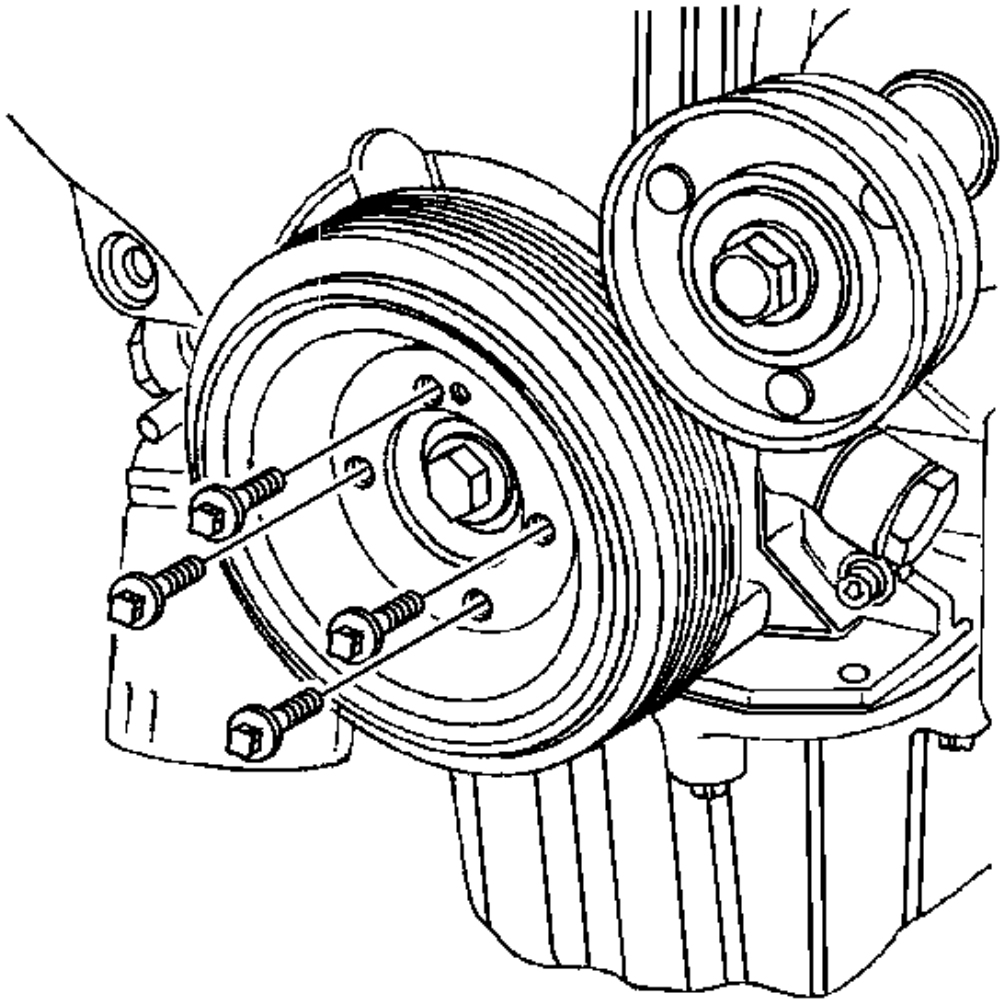

Fig. 125: View Of Crankshaft Pulley And Bolts
Courtesy of GENERAL MOTORS CORP.

45. Remove the crankshaft pulley bolts.
46. Remove the crankshaft pulley.
47. Disconnect the vacuum lines at the charcoal canister purge (CCP) and the exhaust gas recirculation (EGR) solenoid.
48. Disconnect the electrical connector at the CCP and the EGR solenoid.
49. Disconnect the electrical connector at the oil pressure switch.
50. Disconnect the crankshaft position and the knock sensor connectors.
51. Support the transmission with a floor jack.

52. Remove the front engine crossmember. Refer to **Crossmember Replacement - Front Engine** in Frame and Underbody.
53. Install the engine lifting device.

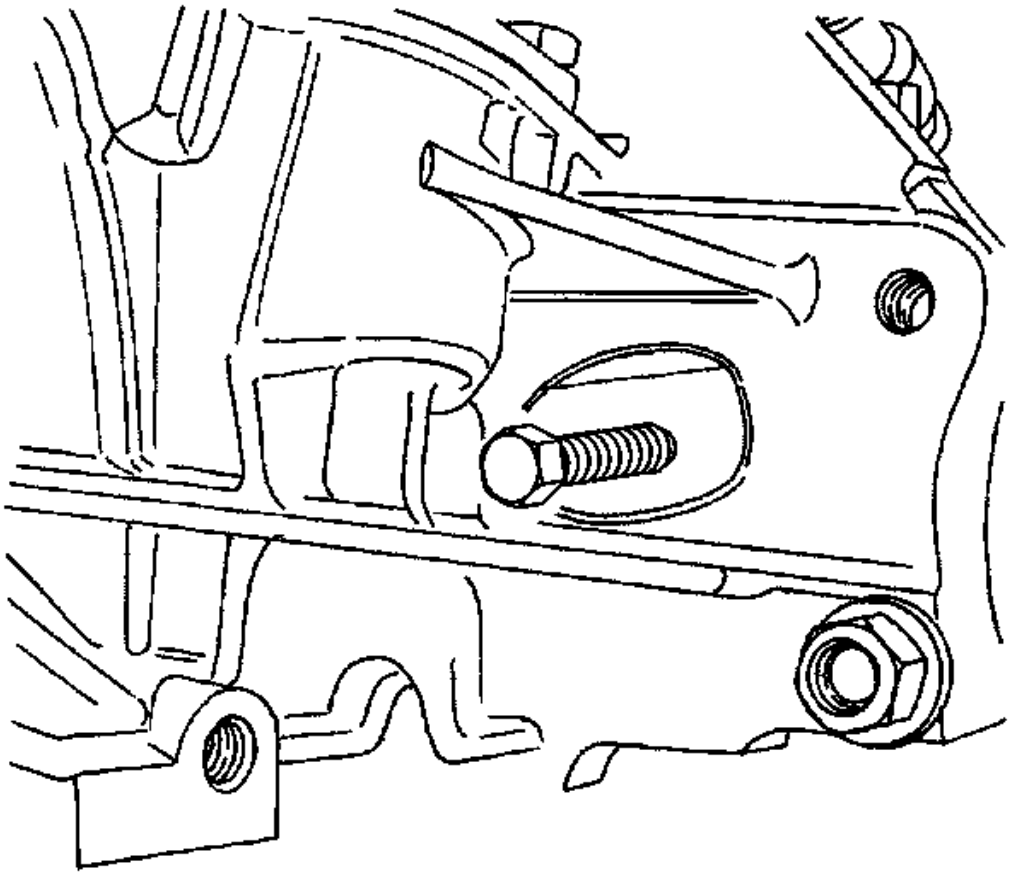

Fig. 126: View Of Transaxle Torque Converter Bolt
Courtesy of GENERAL MOTORS CORP.

54. Remove the transaxle torque converter bolts, if automatic transaxle equipped.
55. Remove the transaxle bell housing bolts and the oil pan flange bolts.
56. Remove the rear engine/transaxle mount bracket. Refer to **Transmission Disassemble** in Manual Transmission - D20 or **Transmission Replacement (2.0L DOHC)** in Automatic Transmission - ZF 4HP 16.
57. Remove the resonator bolts and the resonator.
58. Remove the surge tank and the bolts.

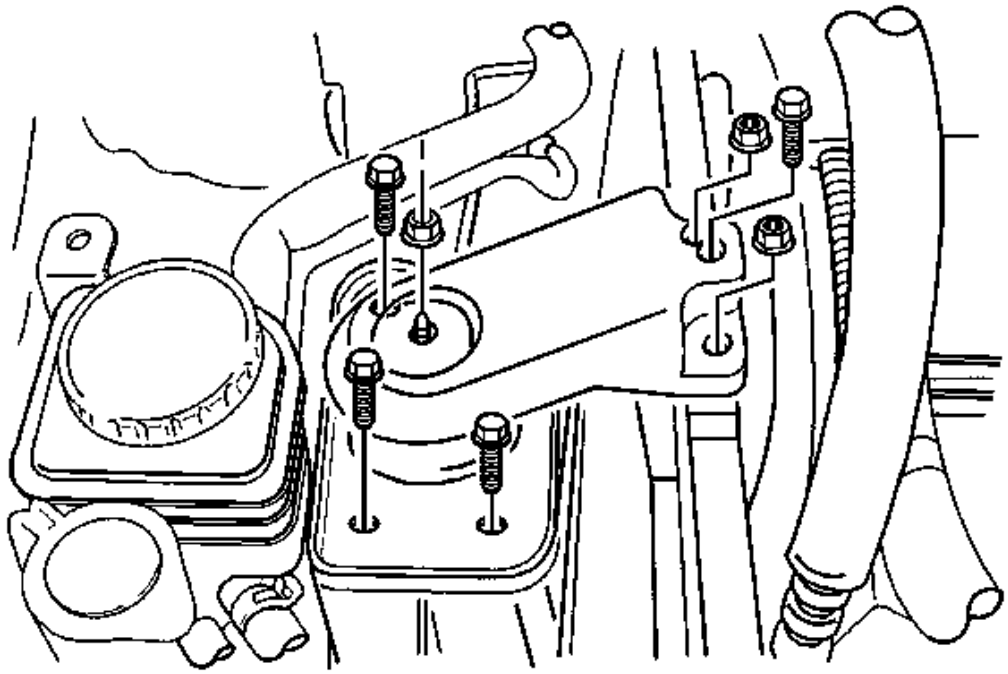

Fig. 127: View Of Surge Tank, Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

59. Disconnect the right engine mount bracket from the engine mount and the engine by removing the retaining bolts.

NOTE: Refer to Engine Lifting Notice in Cautions and Notices.

60. Separate the engine block from the transaxle. Remove the engine.

Installation Procedure

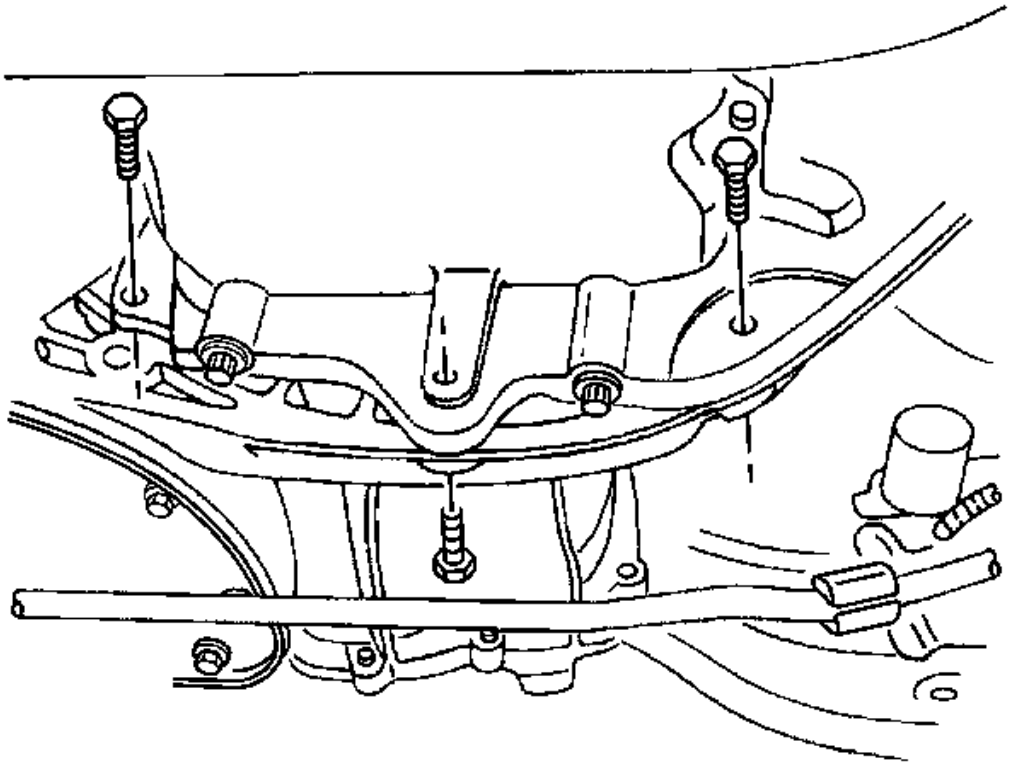

Fig. 128: View Of Oil Pan Flange-To-Transaxle Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine into the engine compartment.
2. Align the engine alignment pins to the transaxle.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the transaxle bell housing bolts.

   Tighten: Tighten the transaxle bell housing bolts to **75 N.m (55 lb ft)** .

4. Install the oil pan flange-to-transaxle retaining bolts.

   Tighten: Tighten the oil pan flange-to-transaxle bolts to **40 N.m (30 lb ft)** .

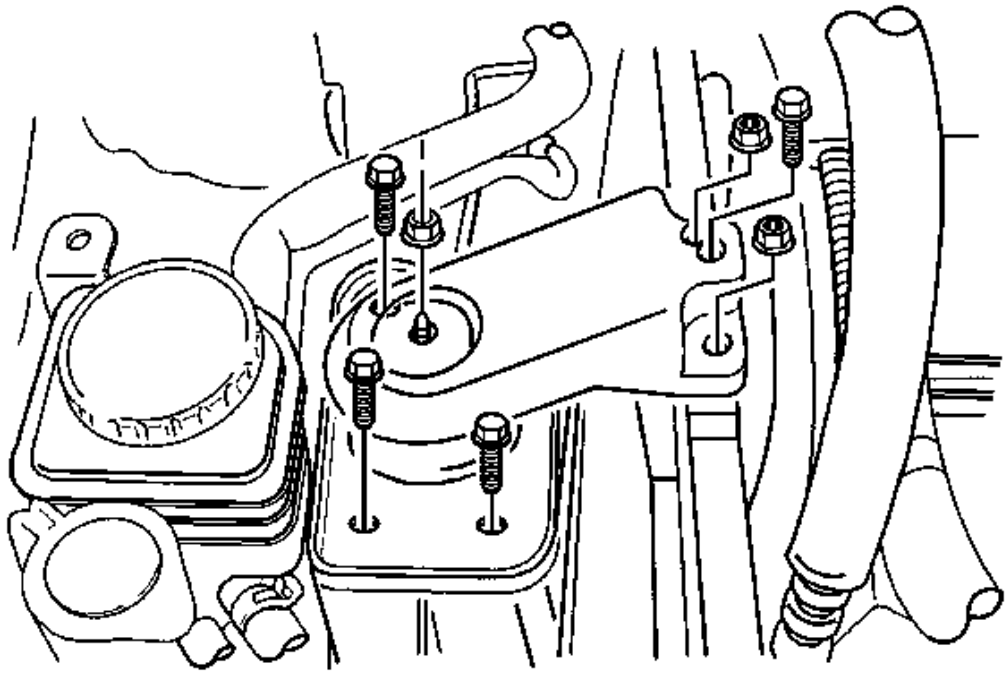

Fig. 129: View Of Surge Tank, Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the right engine mount bracket to the engine block mount and the frame mount.
6. Install the right engine mount bracket retaining bolts and the nuts.

   Tighten: Tighten the right engine mount bracket retaining bolts and the nut to **60 N.m (44 lb ft)** .

7. Install the rear engine/transaxle mount bracket. Refer to **Transmission Disassemble** in Manual Transmission - D20 or **Transmission Replacement (2.0L DOHC)** in Automatic Transmission - ZF 4HP 16.
8. Install the front engine crossmember. Refer to **Crossmember Replacement - Front Engine** in Frame and Underbody.

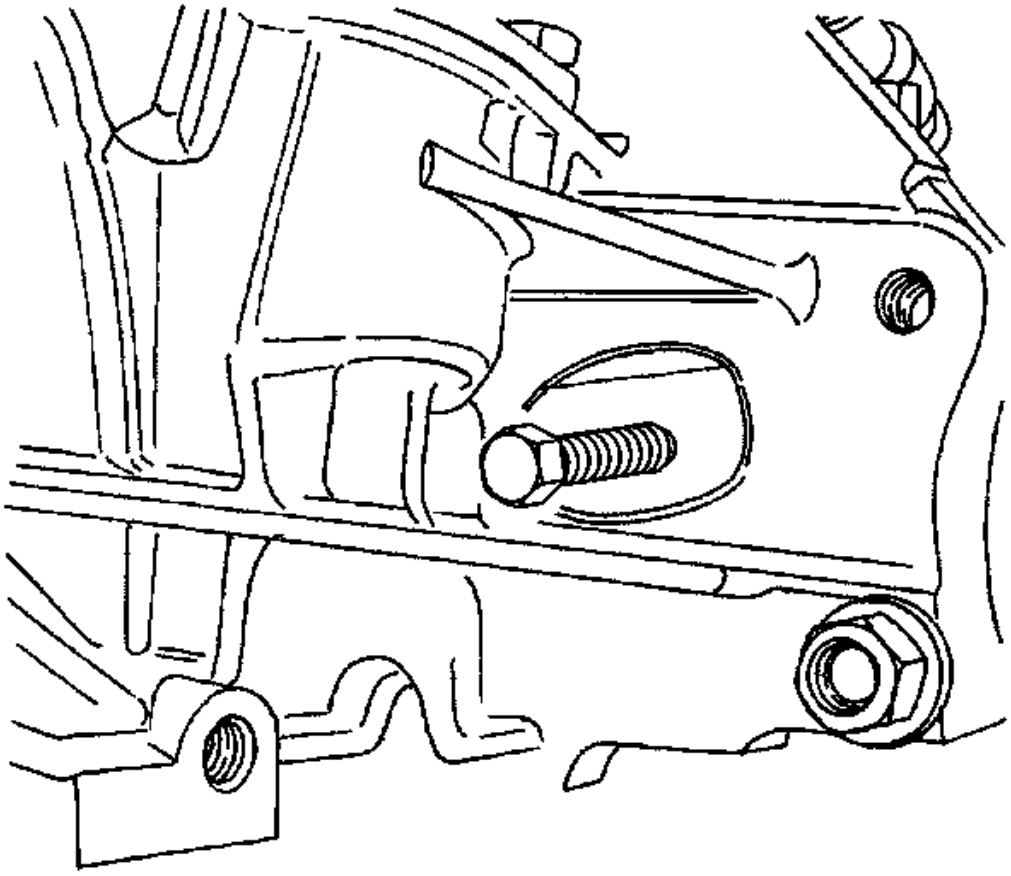

Fig. 130: View Of Transaxle Torque Converter Bolt
Courtesy of GENERAL MOTORS CORP.

9. Remove the floor jack used for support of the transaxle.
10. Remove the engine lifting device.
11. Install the transaxle torque converter bolts, if automatic transaxle equipped.

Tighten: Tighten the transaxle torque converter bolts to **45 N.m (33 lb ft)** .

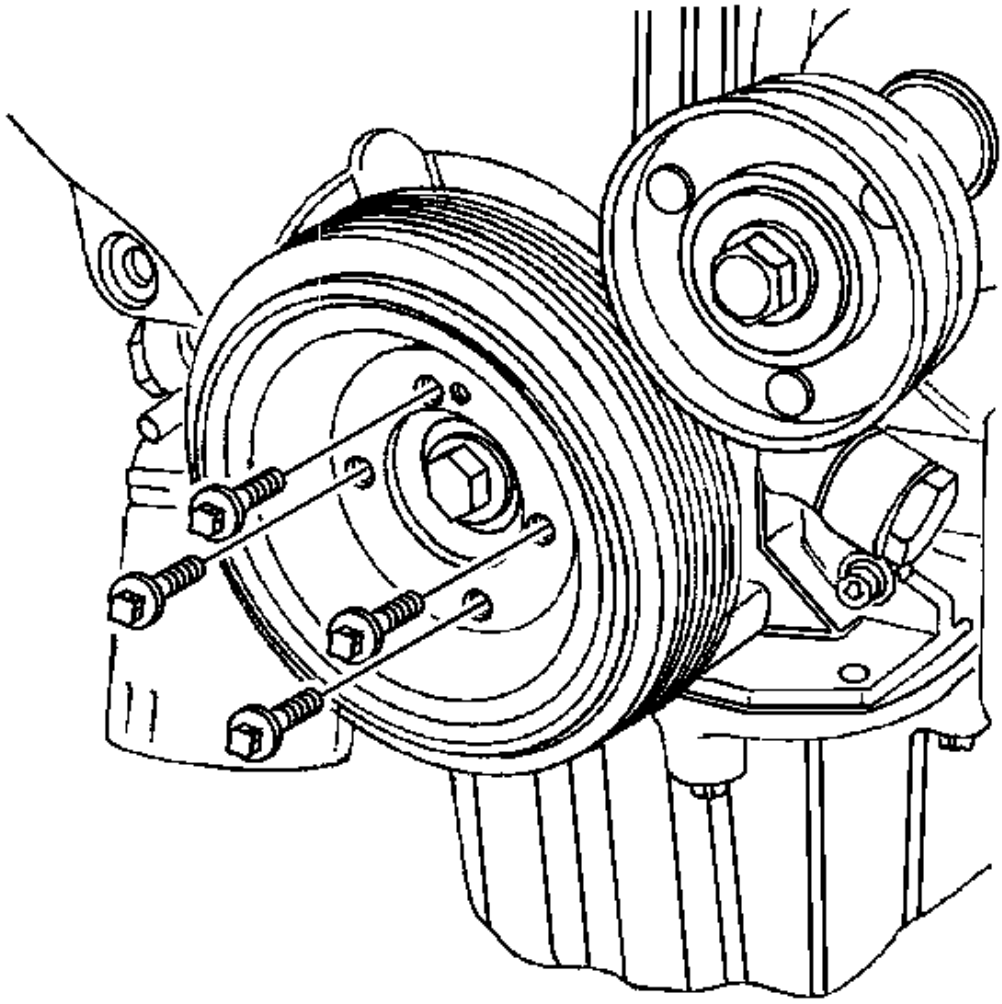

Fig. 131: View Of Crankshaft Pulley And Bolts
Courtesy of GENERAL MOTORS CORP.

12. Connect the vacuum lines at the charcoal canister purge solenoid.
13. Connect the electrical connectors to the charcoal canister purge solenoid.
14. Connect the oil pressure switch connector.
15. Install the crankshaft pulley.
16. Install the crankshaft pulley bolts.

Tighten: Tighten the crankshaft pulley bolts to **20 N.m (15 lb ft)** using a torque wrench.

17. Connect the crankshaft position and knock sensor connectors.

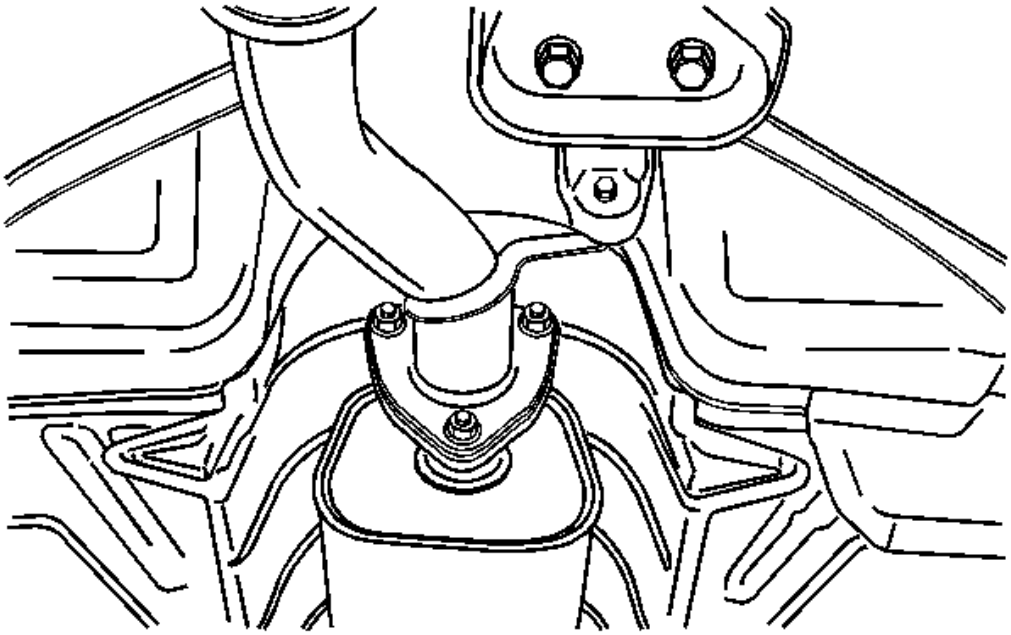

Fig. 132: View Of Front Exhaust Pipe, 3rd Muffler And Nuts
Courtesy of GENERAL MOTORS CORP.

18. Install the 3rd muffler bolts into the front exhaust pipe flange.
19. Install the rubber hangers that attach the connecting pipe to the vehicle.
20. Install the nuts to secure the front exhaust pipe-to-3rd muffler.

Tighten: Tighten the front exhaust pipe-to-3rd muffler nuts to **30 N.m (22 lb ft)** .

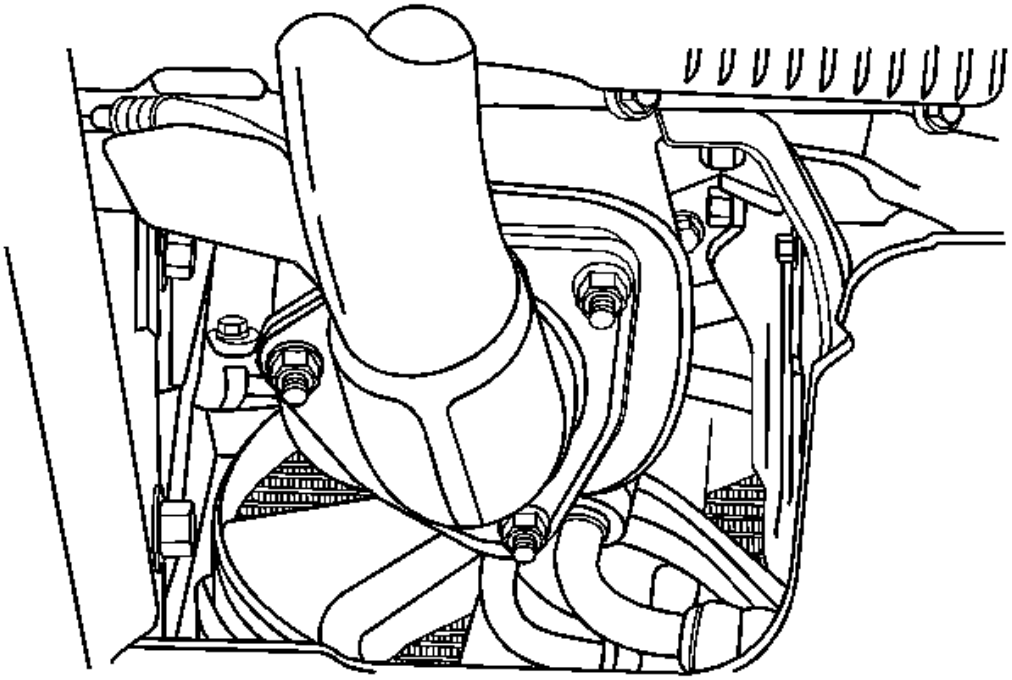

Fig. 133: View Of Flex Pipe And Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

21. Install the catalytic converter lower flange bolts.

    Tighten: Tighten the catalytic converter-to-connecting pipe nuts to **40 N.m (30 lb ft)** .

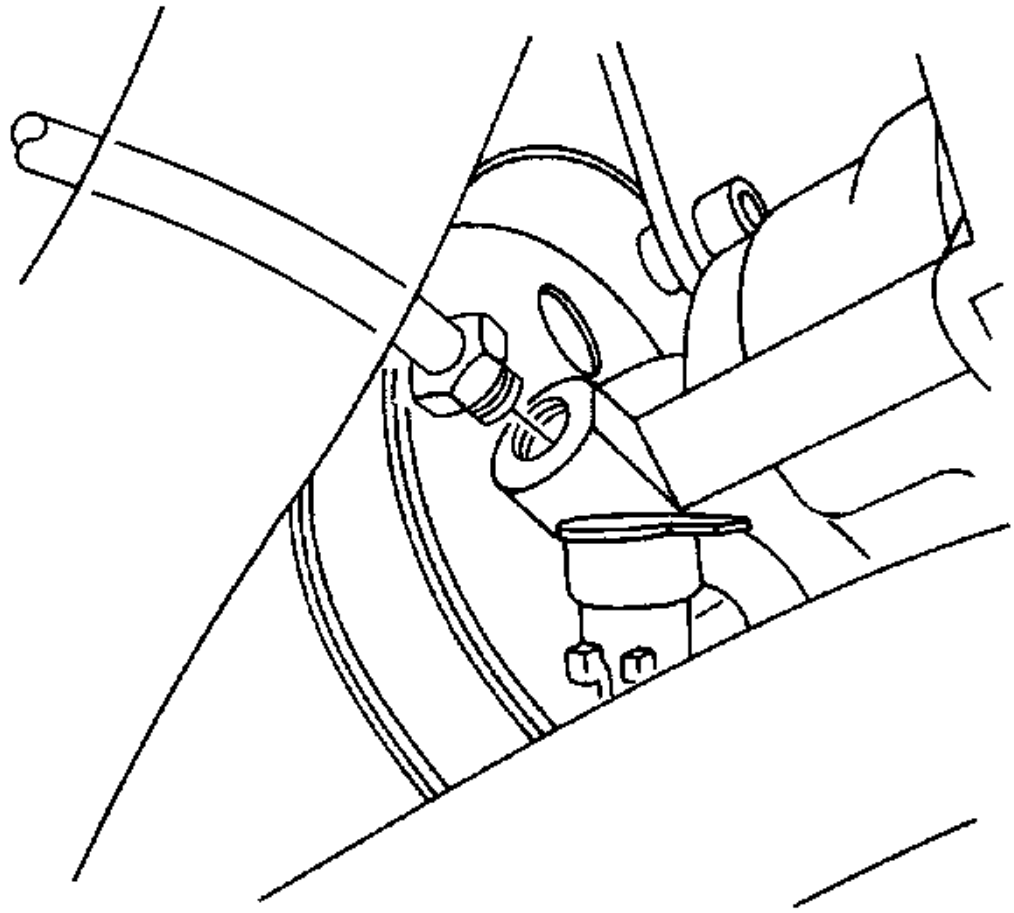

Fig. 134: View Of Power Steering Pressure Hose
Courtesy of GENERAL MOTORS CORP.

22. Install the exhaust flex pipe retaining nuts to the catalytic converter or the 3rd muffler.

    Tighten: Tighten the exhaust flex pipe retaining nuts to the catalytic converter or the 3rd muffler to **30 N.m (22 lb ft)** .

23. Connect the power steering pressure hose.
24. Connect the power steering return hose.
25. Install the A/C compressor, if equipped. Refer to **Compressor Replacement** in Heating, Ventilation, and Air Conditioning.

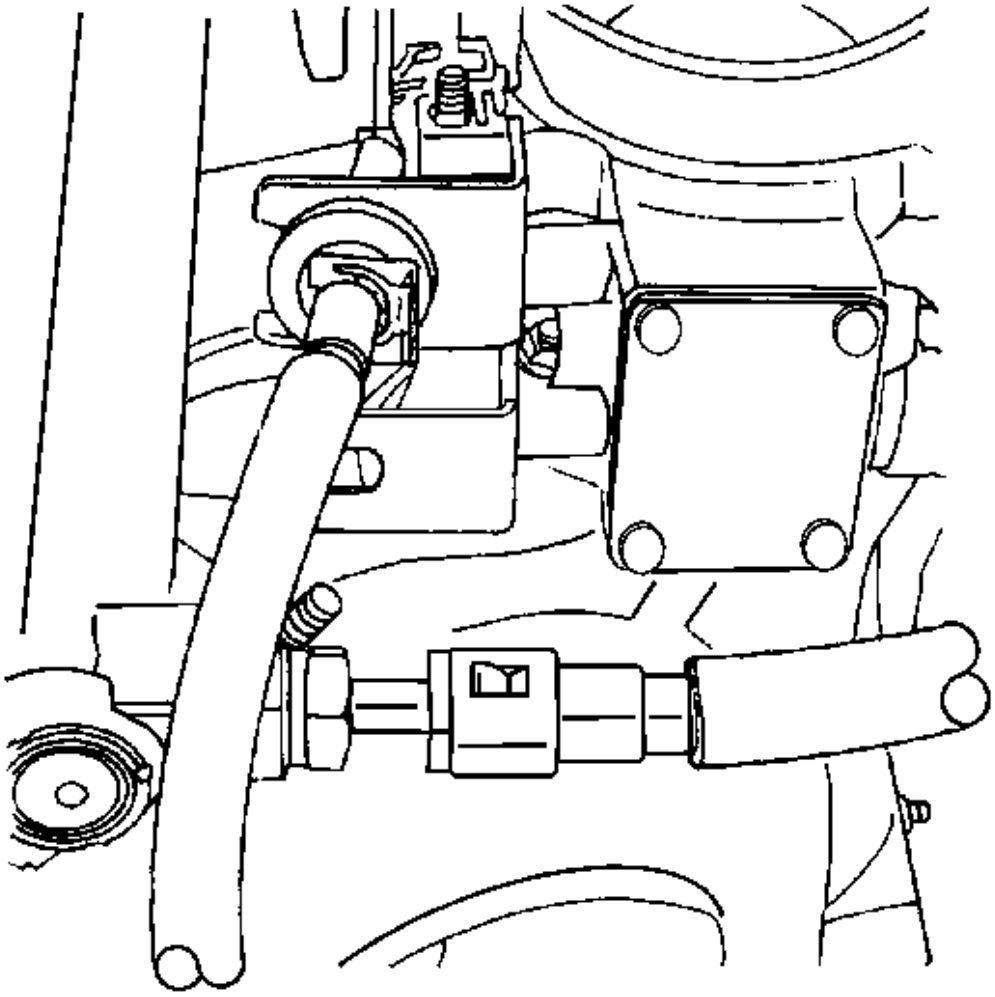

Fig. 135: View Of Fuel Return Line And Fuel Feed Line
Courtesy of GENERAL MOTORS CORP.

26. Install the power steering drive belt. Refer to **Power Steering Pump Drive Belt Replacement (2.0L)** in Power Steering System.
27. Install the right front wheel well splash shield. Refer to **Splash Shield Replacement - Wheelhouse** in Body Front End.
28. Install the right front wheel. Refer to **Tire and Wheel Removal and Installation** in Tires and Wheels.
29. Connect the fuel feed line to the fuel rail.
30. Connect the fuel return line to the fuel pressure regulator.
31. Install the fuel rail and the injector channel cover as an assembly. Refer to **Fuel Rail Assembly**

Replacement in Engine Controls - 2.0L.

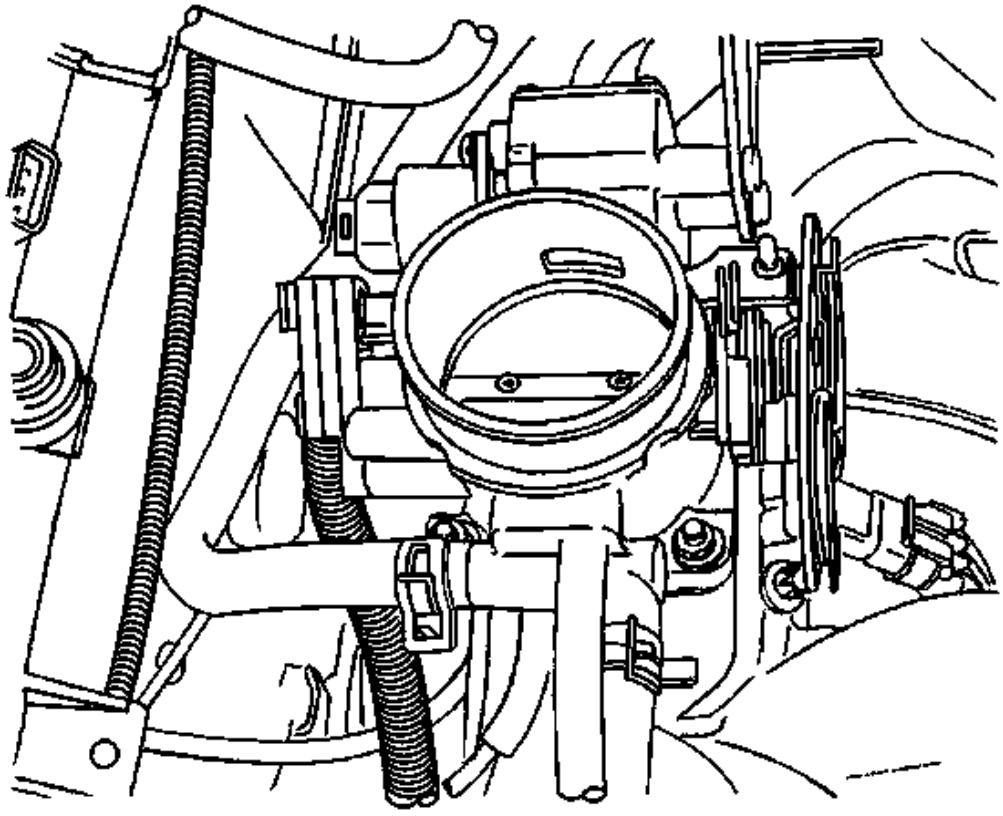

Fig. 136: View Of Throttle Body And Connectors
Courtesy of GENERAL MOTORS CORP.

32. Connect all the previously disconnected vacuum lines, including the brake booster vacuum hose.
33. Connect the oxygen sensor connector, if equipped.
34. Connect the starter solenoid S terminal wire and the power lead.
35. Connect the alternator voltage regulator connector.
36. Connect the CTS connector.
37. Connect the ECT sensor connector.
38. Connect the TP sensor connector.
39. Connect the IAC valve connector.
40. Connect the MAP sensor connector.
41. Connect the CMP sensor connector.

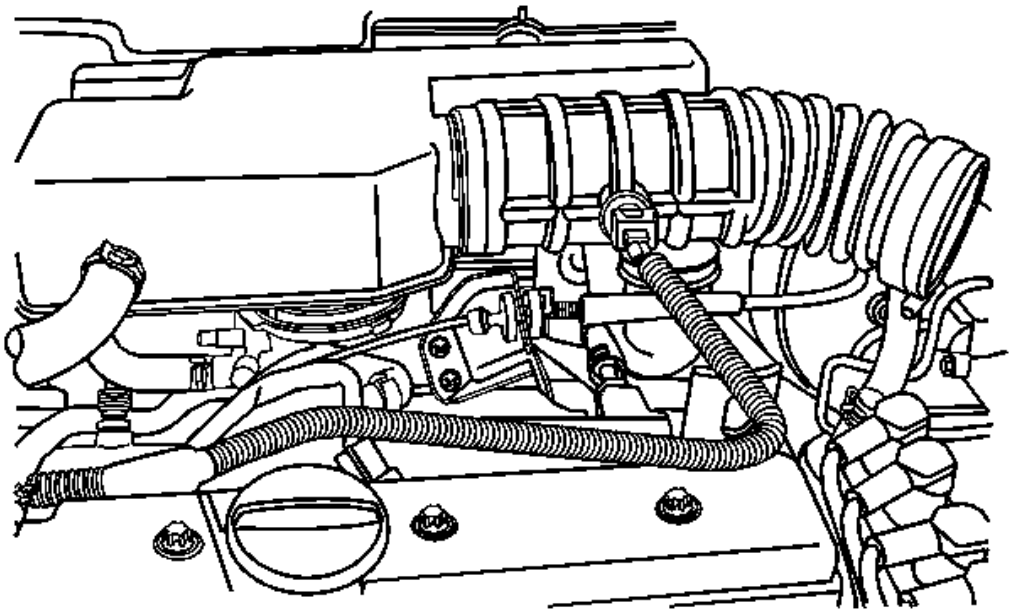

Fig. 137: View Of Manifold Air Temperature Sensor And Throttle Body Intake Tube
Courtesy of GENERAL MOTORS CORP.

42. Connect the electrical connector at the ignition coil and the ECM ground terminal.
43. Install the air intake tube.
44. Install the air filter housing and the bolts.

    Tighten: Tighten the air filter housing bolts to **6 N.m (53 lb in)** .

45. Connect the breather tubes to the valve cover.
46. Connect the manifold air temperature sensor connector.
47. Install the cooling system and the engine cooling fans. Refer to **Radiator Replacement (2.0L)** in Engine Cooling.
48. Install the resonator and the retaining bolts.

    Tighten: Tighten the resonator retaining bolts to **3 N.m (27 lb in)** .

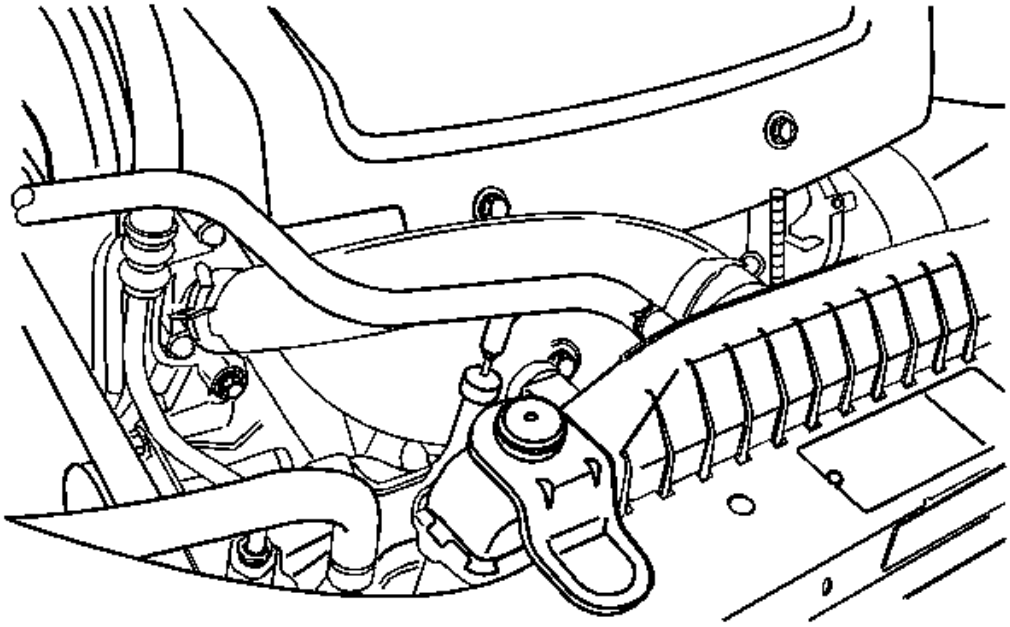

Fig. 138: Identifying Radiator And Coolant Hoses
Courtesy of GENERAL MOTORS CORP.

49. Connect the lower radiator hose to the coolant pipe.
50. Connect the upper radiator hose to the thermostat housing.
51. Connect the heater inlet hose to the cylinder head.
52. Connect the heater outlet hose to the coolant pipe.
53. Connect the coolant surge tank hose to the coolant pipe.
54. Connect the coolant hose to the throttle body.

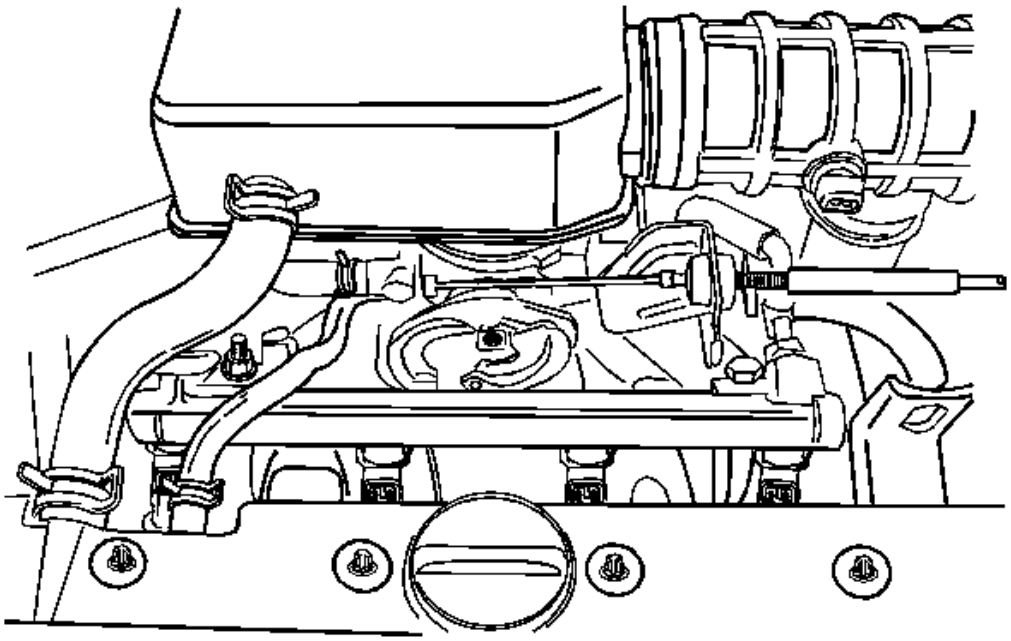

Fig. 139: View Of Fuel Rail, Throttle Cable, Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

55. Connect the throttle cable to the throttle body and the intake manifold bracket.
56. Install the fuel pump fuse.
57. Connect the negative battery cable.
58. Refill the engine crankcase with engine oil.
59. Refill the engine coolant system. Refer to **Draining and Filling Cooling System (2.0L)** in Engine Cooling.
60. Fill and bleed the power steering system. Refer to **Bleeding the Power Steering System** in Power Steering System.
61. Refill the A/C refrigerant system, if equipped. Refer to **Refrigerant Recovery and Recharging** in Heating, Ventilation and Air Conditioning.
62. Install the hood. Refer to **Hood Replacement** in Body Front End.

EXHAUST MANIFOLD REMOVAL

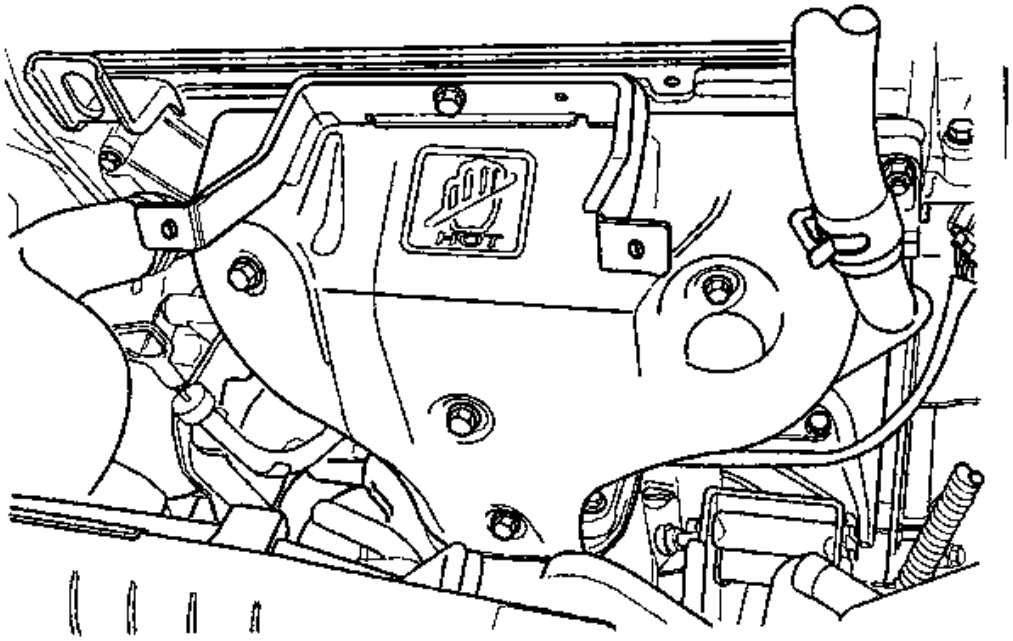

Fig. 140: View Of Exhaust Manifold Heat Shield
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Disconnect the oxygen sensor connector, if equipped.
3. Remove the exhaust manifold heat shield bolts.
4. Remove the exhaust manifold heat shield.

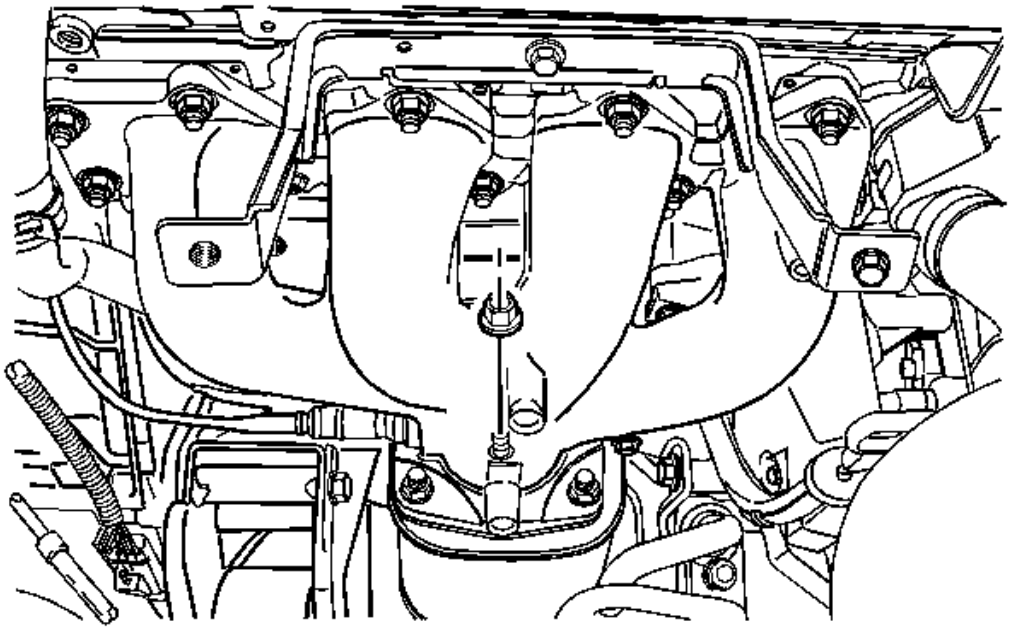

Fig. 141: View Of Auxiliary Catalytic Converter Upper Flange Nuts
Courtesy of GENERAL MOTORS CORP.

5. Remove the auxiliary catalytic converter upper flange nuts.

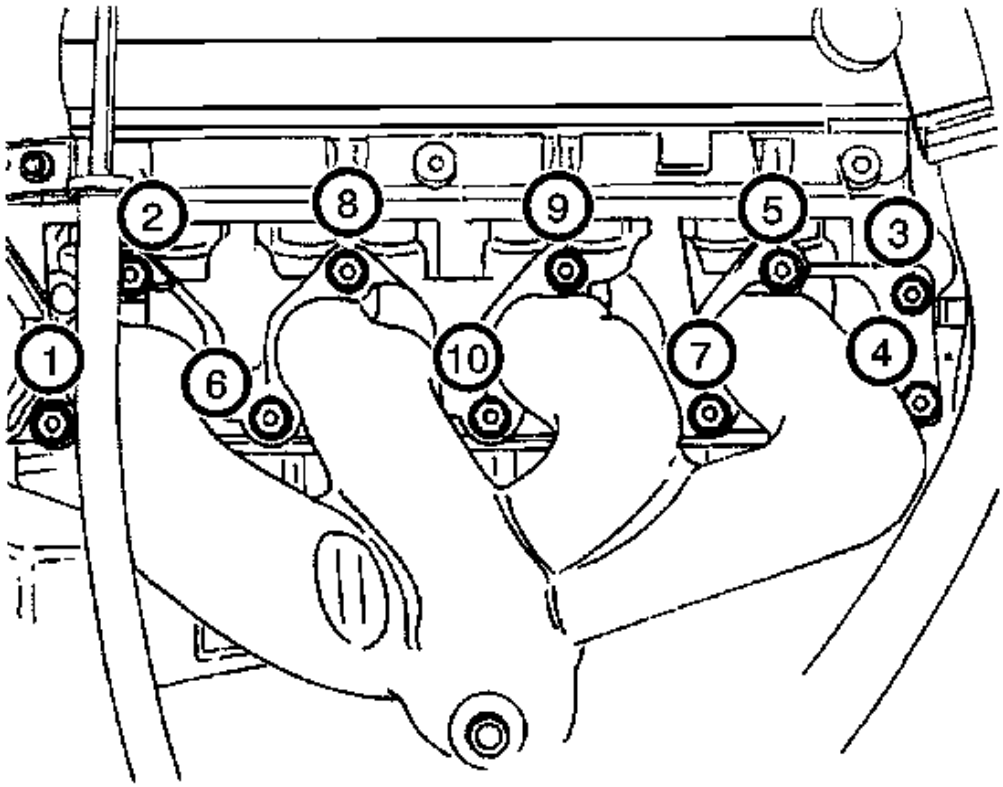

Fig. 142: View Of Exhaust Manifold Retaining Nut Removal Sequence
Courtesy of GENERAL MOTORS CORP.

6. Remove the exhaust manifold retaining nuts in the sequence shown.
7. Remove the exhaust manifold.
8. Remove the exhaust manifold gasket.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

9. Clean the sealing surfaces of the exhaust manifold and the cylinder head.

CRANKSHAFT AND BEARINGS CLEANING AND INSPECTION

Tools Required

- **J 45059** Angle Meter. See **Special Tools** .

- **KM-470-B** Angular Torque Gage. See **Special Tools** .

Inspection Procedure

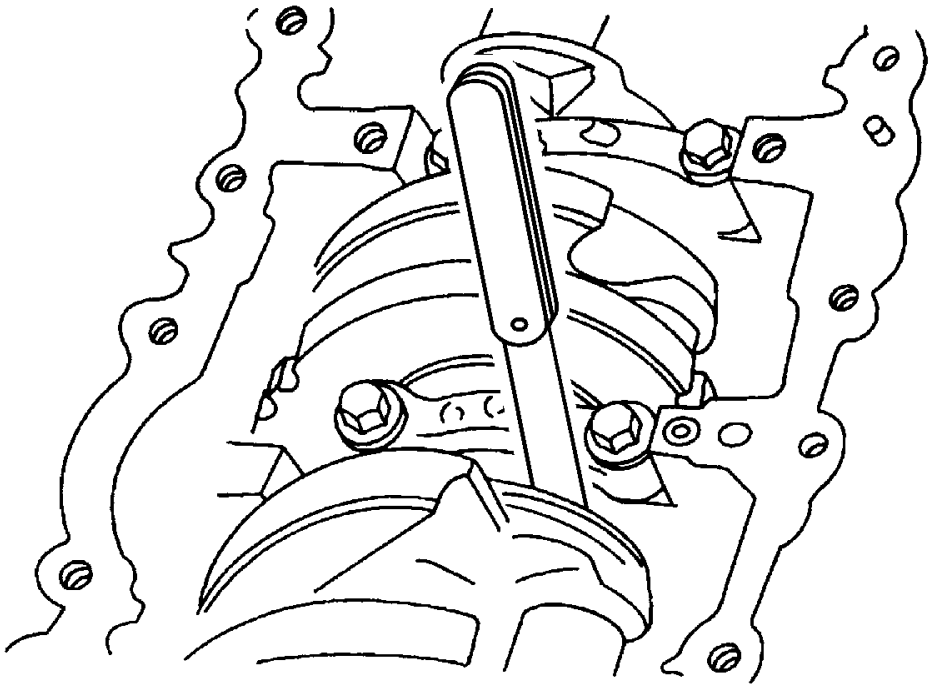

Fig. 143: Inspecting Crankshaft End Play
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

1. Coat the crankshaft bearings with engine oil.
2. Install the upper crankshaft bearings into the engine block crankshaft journals.
3. Install the lower crankshaft bearings into the crankshaft bearing caps.
4. Install the crankshaft.
5. Inspect the crankshaft end play with the crankshaft bearings installed.
6. Check the permissible crankshaft end play. Refer to **Engine Mechanical Specifications** .

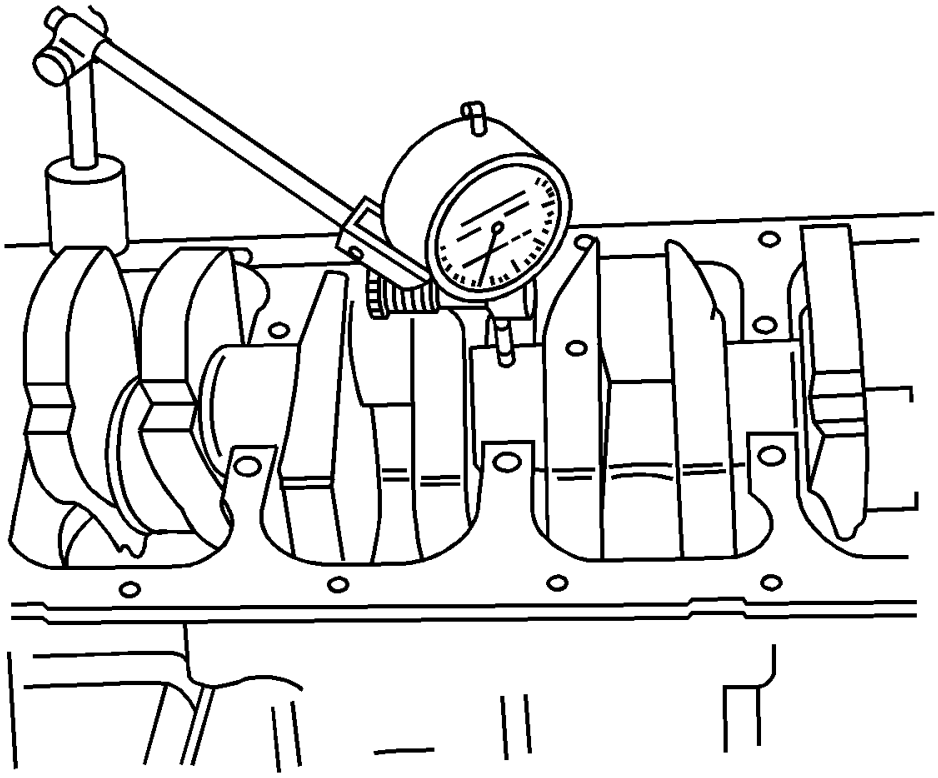

Fig. 144: Checking Crankshaft Journal For Out-Of-Round Runout
Courtesy of GENERAL MOTORS CORP.

7. With the crankshaft mounted on the front and the rear crankshaft bearings, check the middle crankshaft journal for permissible out-of-round, runout. Refer to **Engine Mechanical Specifications** .

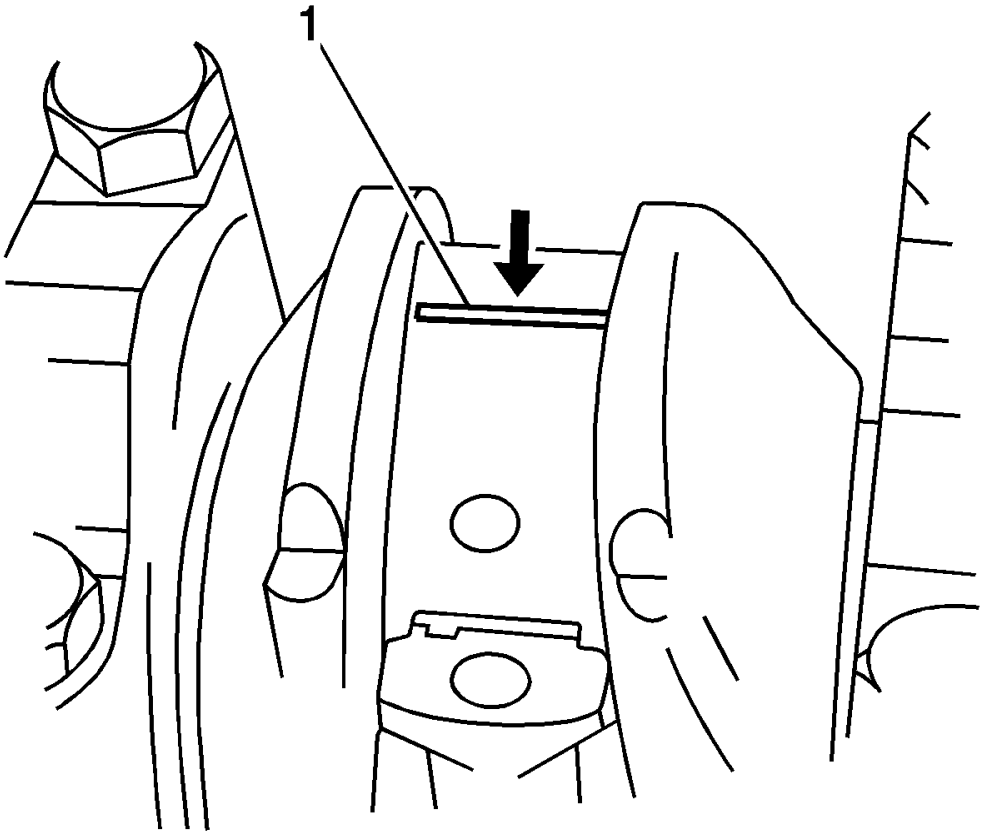

Fig. 145: View Of Plastigage On Journal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Grease the crankshaft journals and lubricate the crankshaft bearings slightly so that the plastic gaging thread does not tear when the crankshaft bearing caps are removed.

8. Measure all of the crankshaft bearing clearances using a commercially available plastic gaging, ductile plastic threads.
9. Cut the plastic gaging threads (1) to the length of the bearing width. Lay them axially between the crankshaft journals and the crankshaft bearings.

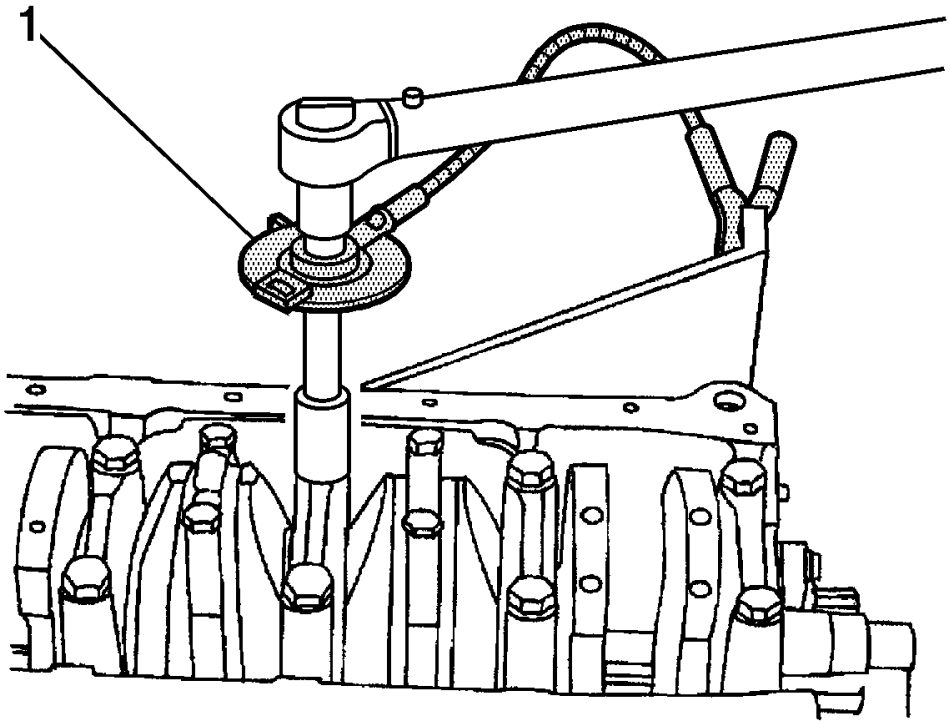

Fig. 146: Using J 45059 To Tighten Bearing Caps
Courtesy of GENERAL MOTORS CORP.

10. Install the crankshaft bearing caps.

NOTE: Refer to Fastener Notice in Cautions and Notices.

11. Install the crankshaft bearing cap bolts.

Tighten: Tighten the crankshaft bearing cap bolts to **50 N.m (37 lb ft)** using the **J 45059** or the **KM-470-B** (1) to tighten the crankshaft bearing cap bolts plus 45 degrees, plus 15 degrees. See **Special Tools** .

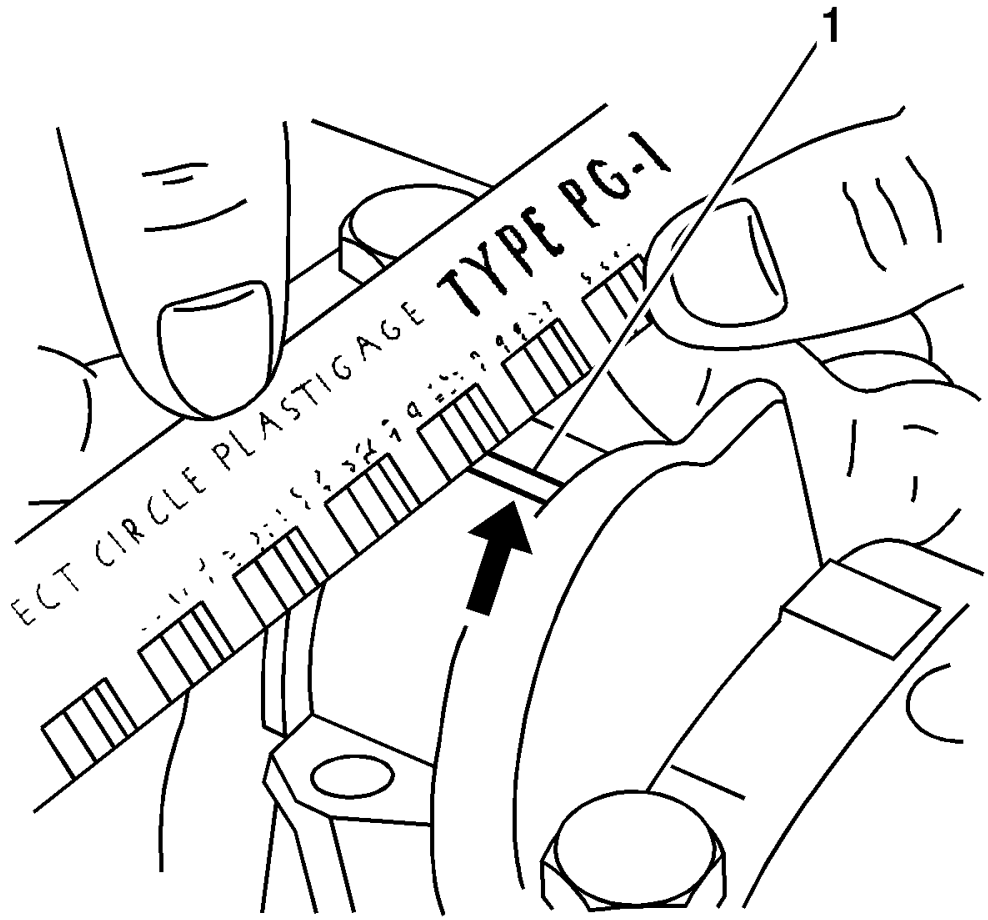

Fig. 147: Measuring Plastigage
Courtesy of GENERAL MOTORS CORP.

12. Remove the crankshaft bearing caps.
13. Measure the width of the flattened plastic thread (1) of the plastic gaging using the scale printed on the plastic gaging package. Plastic gaging is available for different tolerance ranges.
14. Inspect the bearing clearances for permissible tolerance ranges. Refer to **Engine Mechanical Specifications** .

PISTON, CONNECTING ROD, AND BEARING REPLACEMENT

Tools Required

- **J 24086-B** Piston Pin Remover/Installer Set. See **Special Tools** .
- **J 45059** Angle Meter. See **Special Tools** .
- **J 8037** Ring Compressor or equivalent. See **Special Tools** .
- **J 8087** Cylinder Bore Gage or equivalent. See **Special Tools** .
- **KM-470-B** Angular Torque Gage. See **Special Tools** .

Removal Procedure

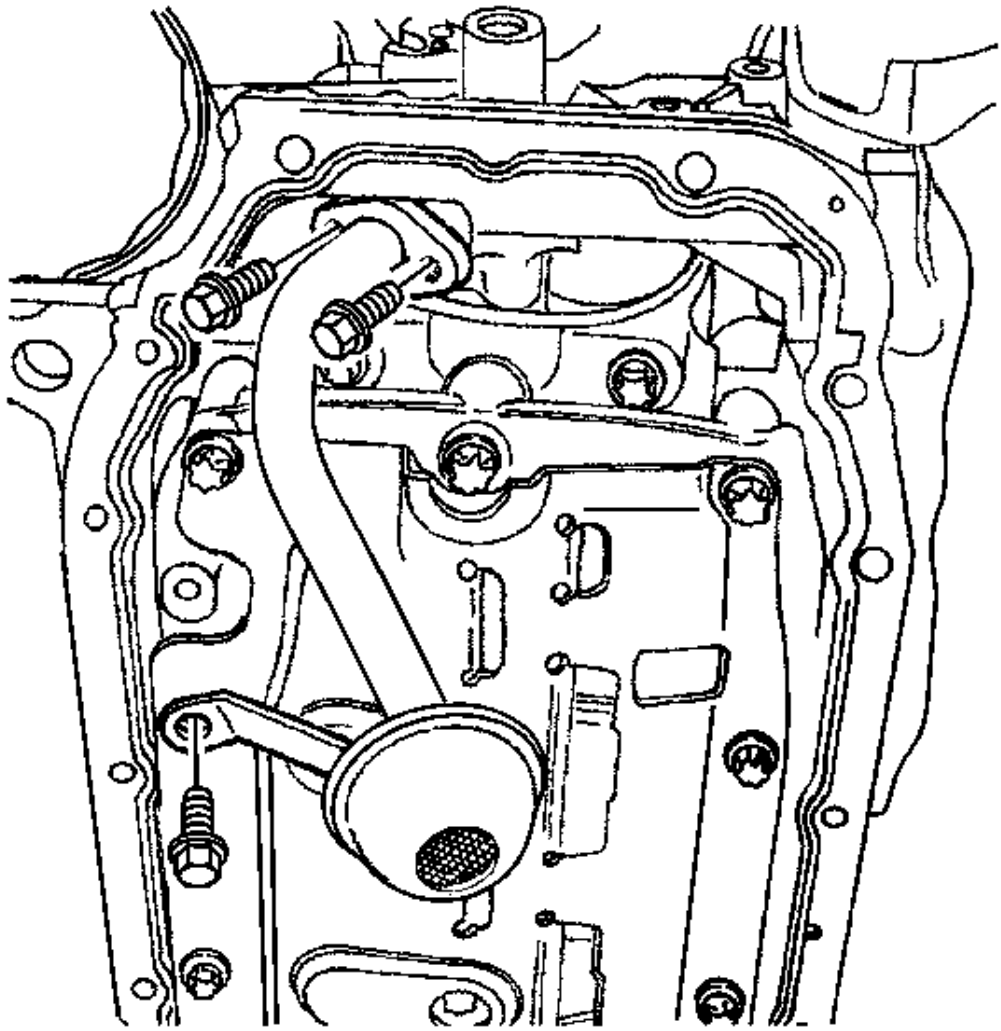

Fig. 148: View Of Oil Pump Pickup Tube And Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

1. Remove the cylinder head with the intake manifold and the exhaust manifold attached. Refer to **Cylinder Head Replacement**.

2. Remove the oil pan. Refer to **Oil Pan Replacement**.
3. Remove the oil pump/pickup tube bolts.
4. Remove the oil pump/pickup tube.
5. Remove the engine block lower support and the splash shield bolts.
6. Remove the engine block lower support and the splash shield.

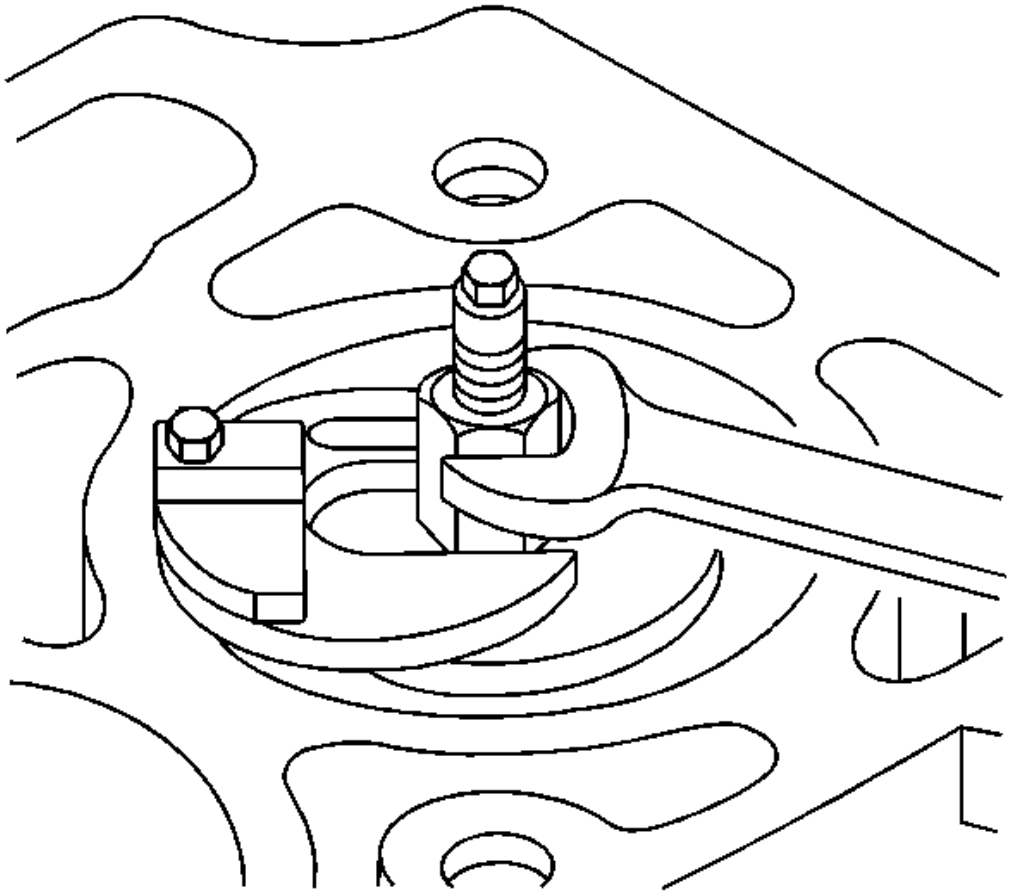

Fig. 149: View Of Connecting Rod Cap Bolt
Courtesy of GENERAL MOTORS CORP.

7. Move the piston to the bottom of the piston stroke.
8. Mark the connecting rod cap for position.
9. Remove the connecting rod cap bolts.
10. Remove the connecting rod cap and the lower connecting rod bearing.

11. Remove the upper piston connecting rod bearing.
12. Ridge ream the cylinder wall.

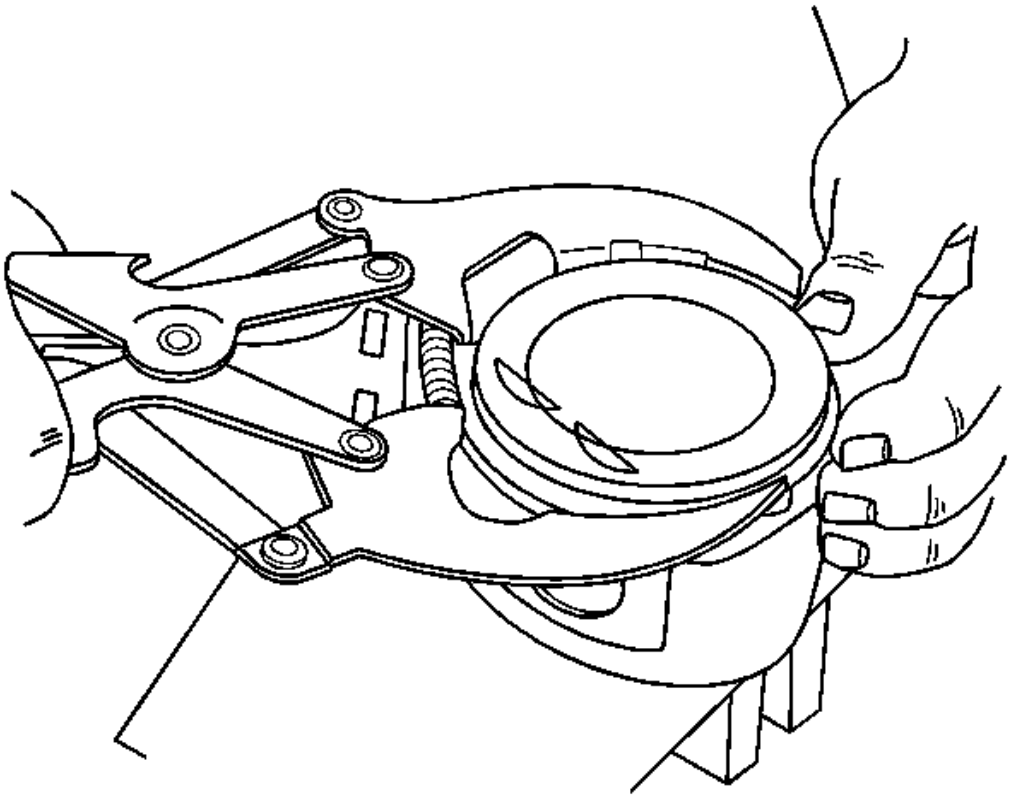

Fig. 150: View Of Piston Ring Expander
Courtesy of GENERAL MOTORS CORP.

CAUTION: Handle the piston carefully. Worn piston rings are sharp and may cause bodily injury.

13. Remove the piston.
14. Use a piston ring expander tool to expand the piston rings.
15. Remove the piston rings.

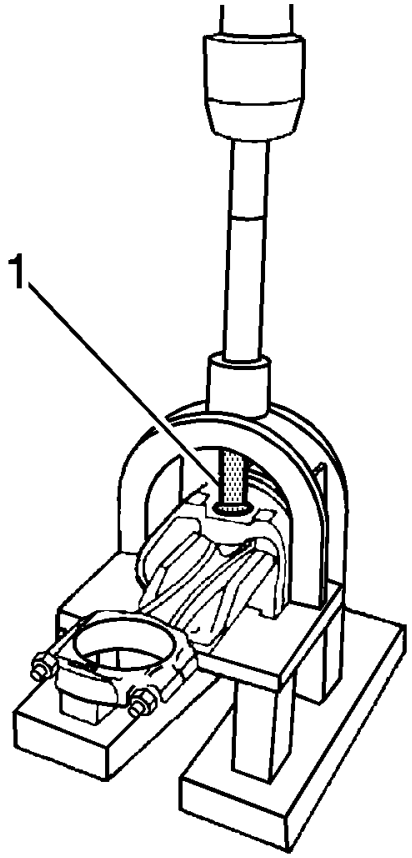

Fig. 151: View Of Piston Pin And Installation/Removal Tool J 24086-B
Courtesy of GENERAL MOTORS CORP.

16. Remove the piston pin from the piston and connecting rod assembly using the **J 24086-B** (1). See **Special Tools** .
17. Separate the piston from the connecting rod.

Inspection Procedure

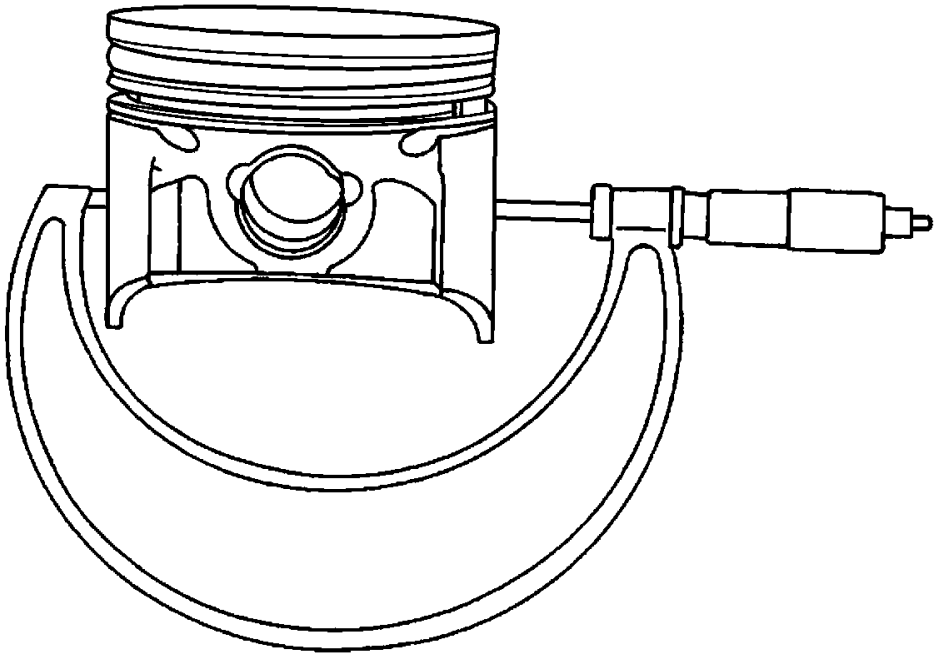

Fig. 152: Inspecting Connecting Rod
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

1. Inspect the connecting rod for bending or twisting. If the connecting rod is bent or twisted, replace the connecting rod.
2. Inspect the connecting rod bearings.
3. Inspect the connecting rod lower end for wear.
4. Inspect the connecting rod upper end for scoring.
5. Inspect the crankshaft rod bearing journal for wear. Refer to **Engine Mechanical Specifications** .
6. Inspect the piston for scoring, cracks, and wear.
7. Inspect the piston for taper using a micrometer.

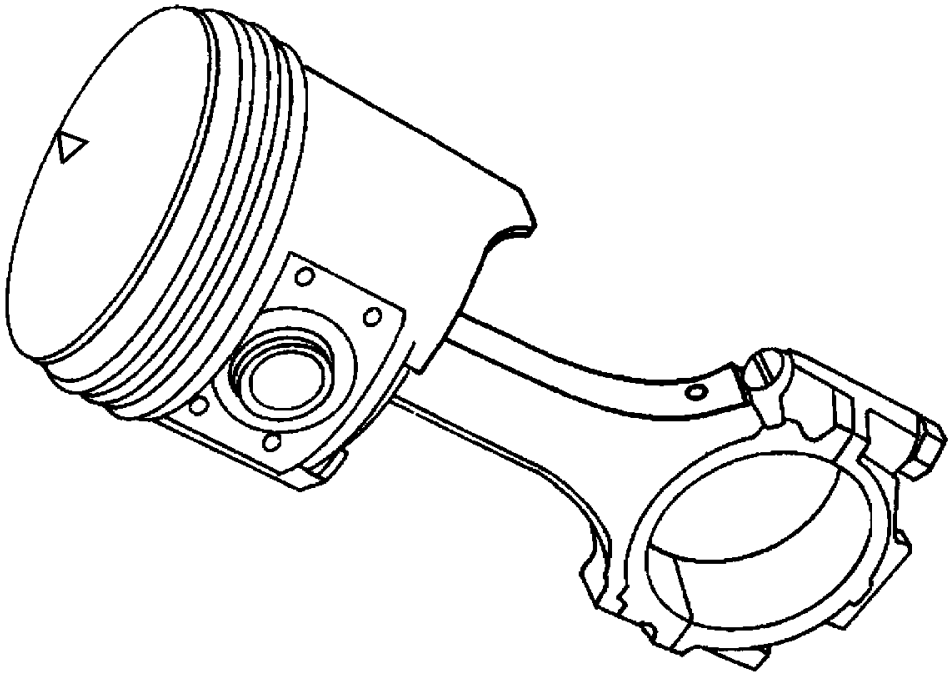

Fig. 153: Inspecting Piston And Connecting Rod Fit
Courtesy of GENERAL MOTORS CORP.

8. Inspect the piston for fit to the connecting rod.

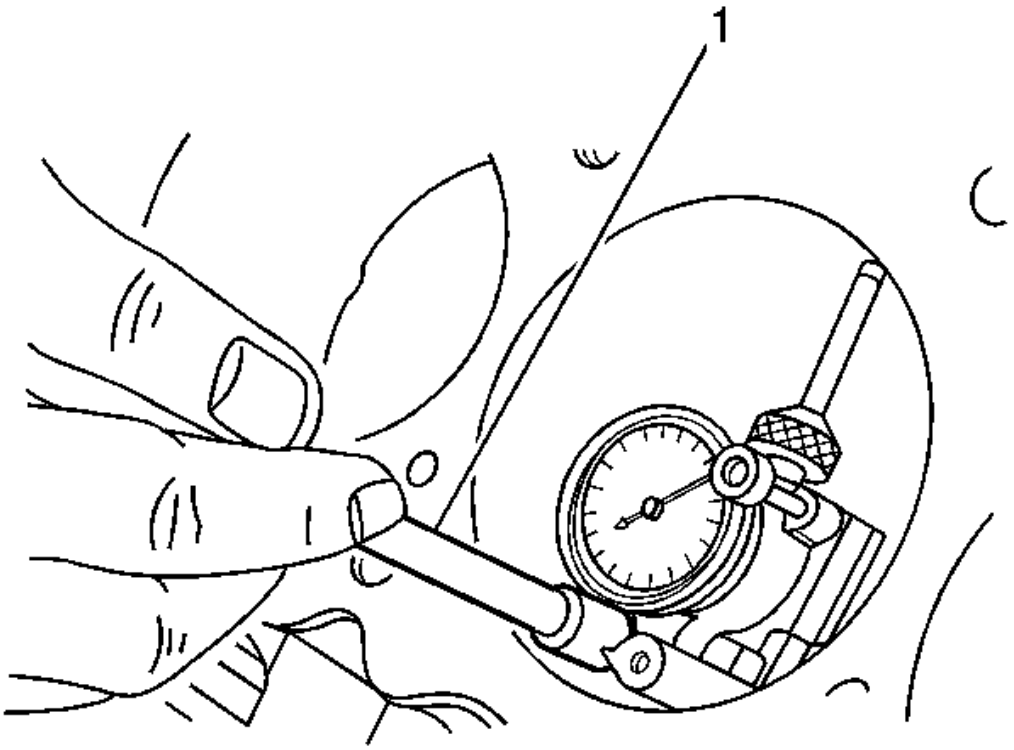

Fig. 154: View Of J 8087 In Cylinder Bore
Courtesy of GENERAL MOTORS CORP.

9. Inspect the engine block deck surface for flatness using a straight edge and a feeler gage. Refer to **Engine Mechanical Specifications** .
10. Inspect the bearing bore for concentricity and alignment using the **J 8087** (1). See **Special Tools** . Refer to **Engine Mechanical Specifications** .
11. If the bearing bore is beyond specifications, replace the engine block.
12. Inspect the engine block cylinder bore for wear, runout, ridging and taper using the **J 8087** . See **Special Tools** . Refer to **Engine Mechanical Specifications** .
13. Inspect the engine block cylinder bore for glazing.
14. Lightly hone the cylinder bore as necessary.

Installation Procedure

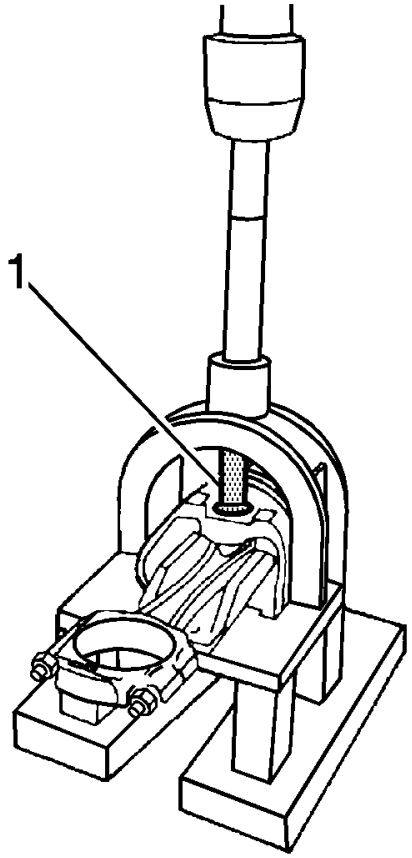

Fig. 155: View Of Piston Pin And Installation/Removal Tool J 24086-B
Courtesy of GENERAL MOTORS CORP.

CAUTION: Avoid contact with moving parts and hot surfaces while working around a running engine in order to prevent physical injury.

IMPORTANT: For ease of installation of the piston pin, the connecting rod should be heated to 280°C (536°F). Heat the upper connecting rod only. Use commercial thermocolor material to determine the correct temperature. When the thermocolor material changes from black to green, the temperature is correct for installation.

1. Align the notch on the piston and the connecting rod so that the proper sides will be facing the front of the engine.
2. Install the piston pin guide through the piston and the connecting rod.
3. Coat the piston pin with clean oil.
4. Install the piston pin into the opposite side of the piston.

5. Install the piston pin into the piston and the connecting rod assembly using the **J 24086-B** (1). See **Special Tools** .

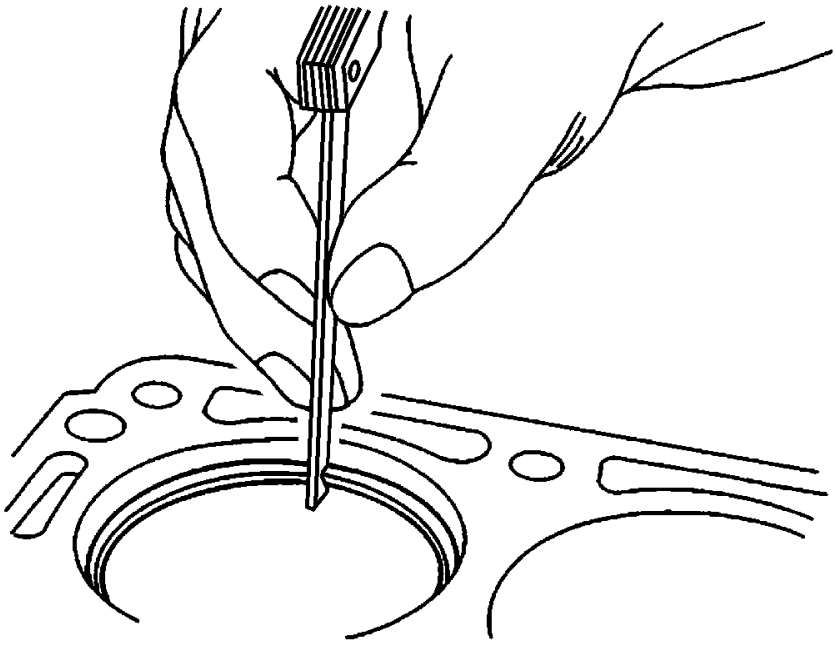

Fig. 156: Measuring Piston Ring Gap Using Feeler Gage
Courtesy of GENERAL MOTORS CORP.

6. Select the set of new piston rings.
7. Measure the piston ring gap using a feeler gage. Refer to **Engine Mechanical Specifications** .
8. Increase the piston ring gap by carefully filing off excess material if the piston ring gap is below specifications.

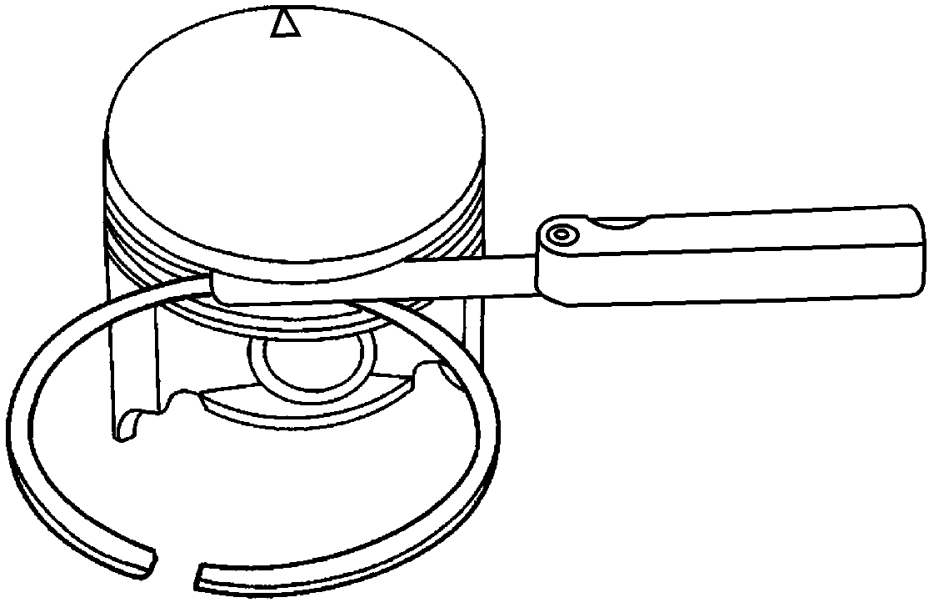

Fig. 157: Measuring Piston Ring Side Clearance
Courtesy of GENERAL MOTORS CORP.

9. Measure the piston ring side clearance using a feeler gage. Refer to **Engine Mechanical Specifications** .
10. If the piston ring is too thick, try another piston ring.
11. If no piston ring can be found that fits to specifications, the piston ring may be ground to size with emery paper placed on a sheet of glass.

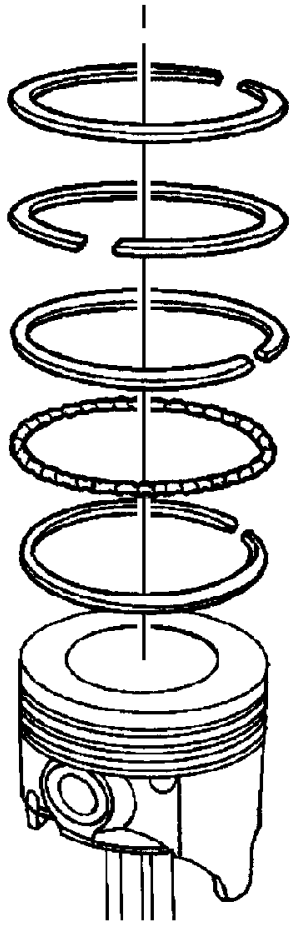

Fig. 158: View Of Piston Oil Rings, 2nd Compression Ring And Top Compression Ring
Courtesy of GENERAL MOTORS CORP.

12. Install a piston oil ring, the expander, then the second piston oil ring to the bottom ring groove of the piston.
13. Install the second compression ring to the middle ring groove of the piston.
14. Install the top compression ring to the top ring groove of the piston.

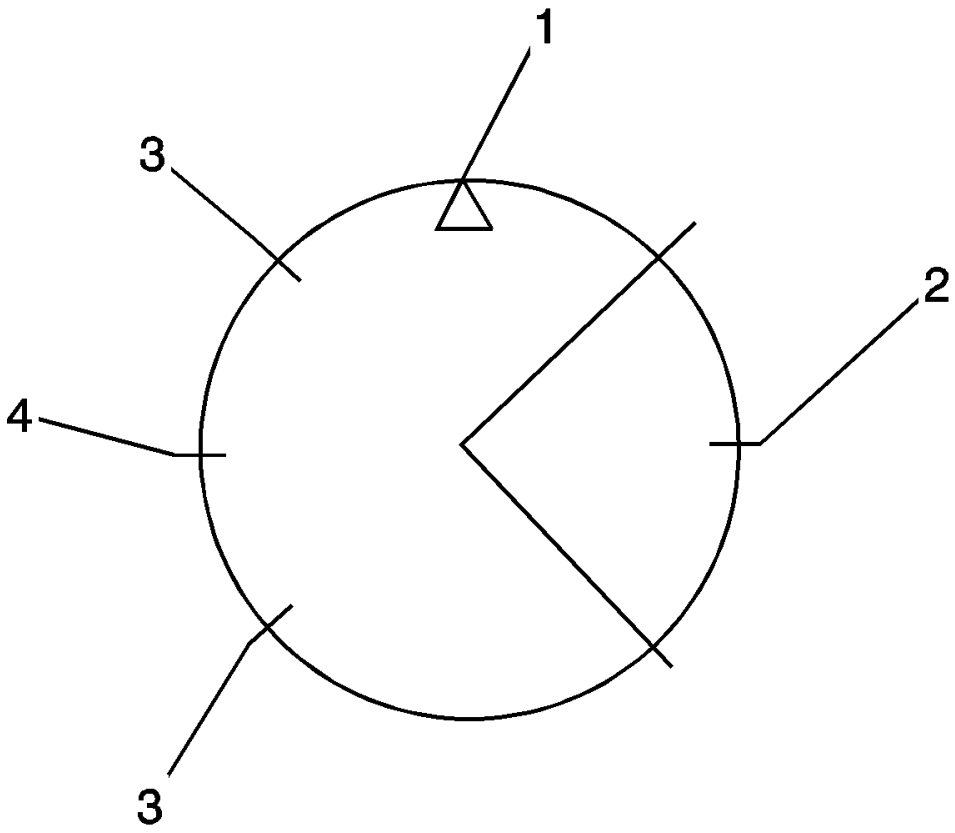

Fig. 159: View Of Piston Oil Rings, Rail Gaps, And 2nd Compression Ring
Courtesy of GENERAL MOTORS CORP.

NOTE: Use a piston ring expander to install the piston rings. The rings may be damaged if expanded more than necessary.

15. Install the piston rings.
16. Stagger the piston oil rings (2), the oil ring rail gaps (4), the second compression ring (5), and the top compression ring in relation to the notch (1) on the top of the piston.

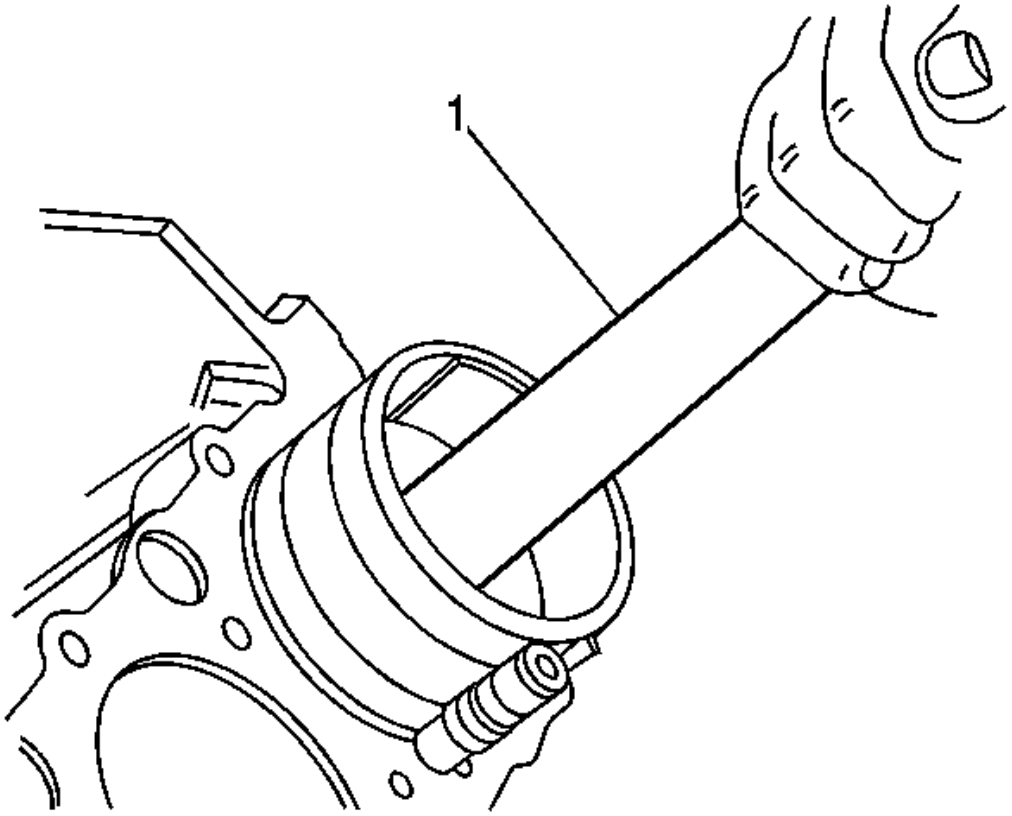

Fig. 160: View Of J 8037 And Wood Handle
Courtesy of GENERAL MOTORS CORP.

17. Lubricate the cylinder wall and the piston rings with clean engine oil.
18. Install the piston using the **J 8037** (1) and a wood handle. See **Special Tools** . Guide the lower connecting rod end to prevent damaging the crankshaft journal.
19. Install the connecting rod cap and bearings. Refer to **Crankshaft and Bearings Cleaning and Inspection**.

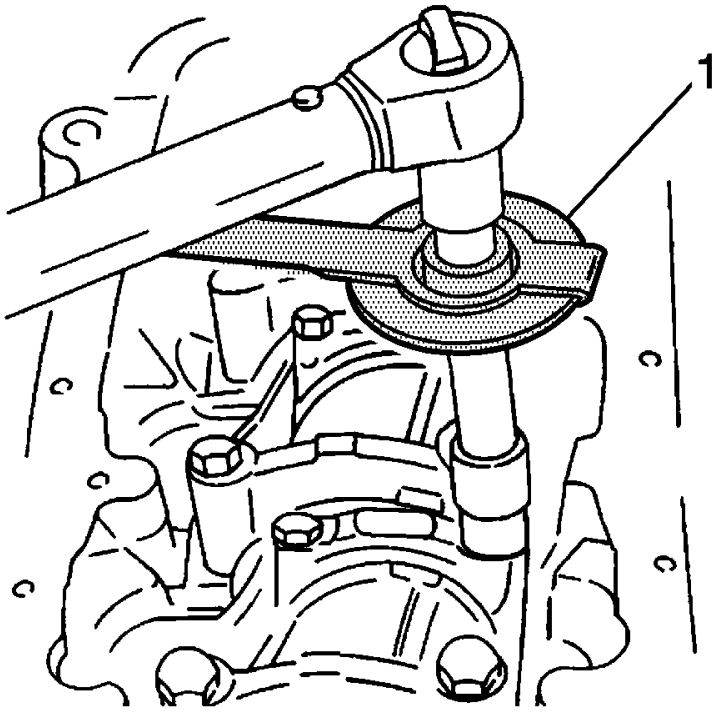

Fig. 161: Using J 45059 Or KM-470-B To Torque Rod Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

20. Install the connecting rod cap bearing bolts.

    Tighten: Tighten the connecting rod cap bearing bolts to **35 N.m (26 lb ft)** . Using the **J 45059** or the **KM-470-B** (1), tighten the bolts 1 turn of 45 degrees plus 15 degrees. See **Special Tools** .

21. Install the engine block lower support bracket/splash shield bolts.

    Tighten: Tighten the engine block lower support bracket/splash shield bolts to **35 N.m (26 lb ft)** .

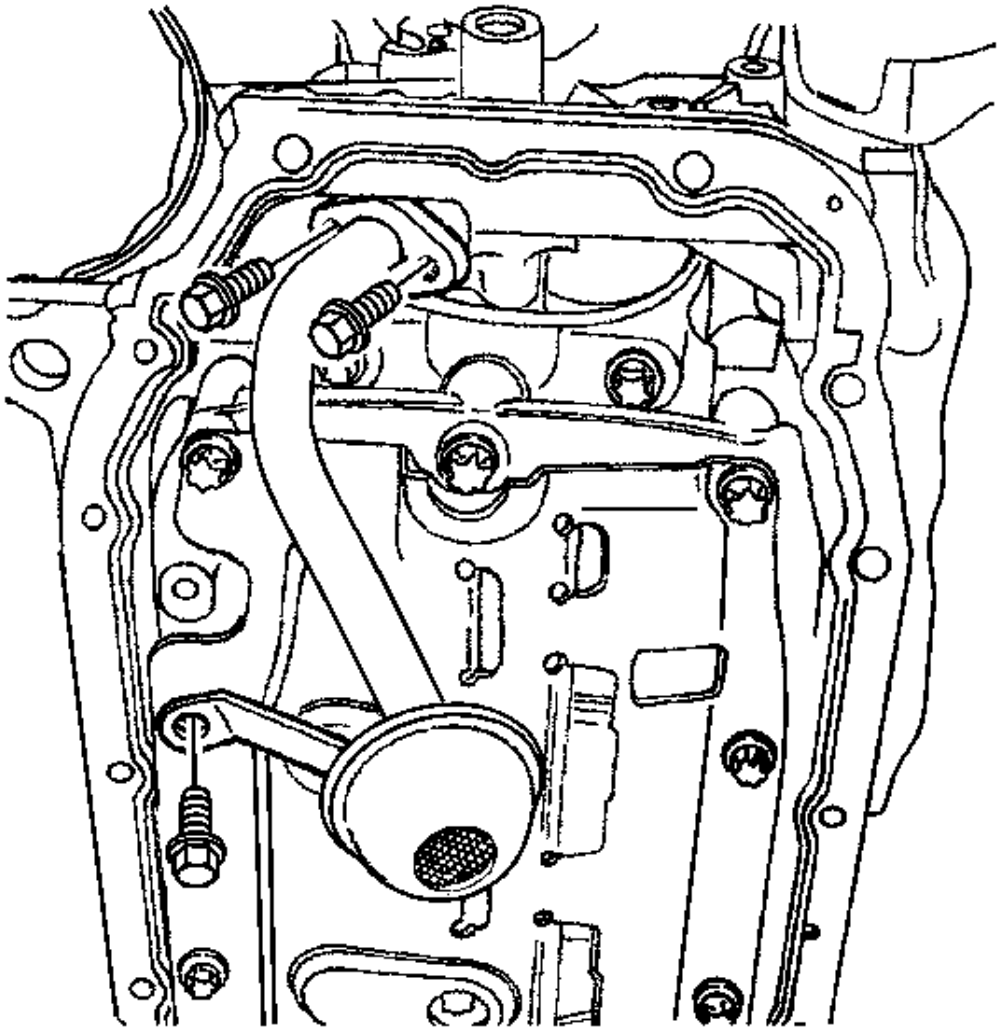

Fig. 162: View Of Oil Pump Pickup Tube And Bolts
Courtesy of GENERAL MOTORS CORP.

22. Install the oil pump/pickup tube.
23. Install the oil pump/pickup tube bolts.

    Tighten: Tighten the oil pump/pickup tube bolts to **8 N.m (71 lb in)** .

24. Install the oil pan. Refer to **Oil Pan Replacement**.
25. Install the cylinder head with the intake manifold and exhaust manifold attached. Refer to **Cylinder Head Replacement**.

PISTON, CONNECTING ROD, AND BEARINGS CLEANING AND INSPECTION

Tools Required

- **J 45059** Angle Meter. See **Special Tools** .
- **KM-470-B** Angular Torque Gage. See **Special Tools** .

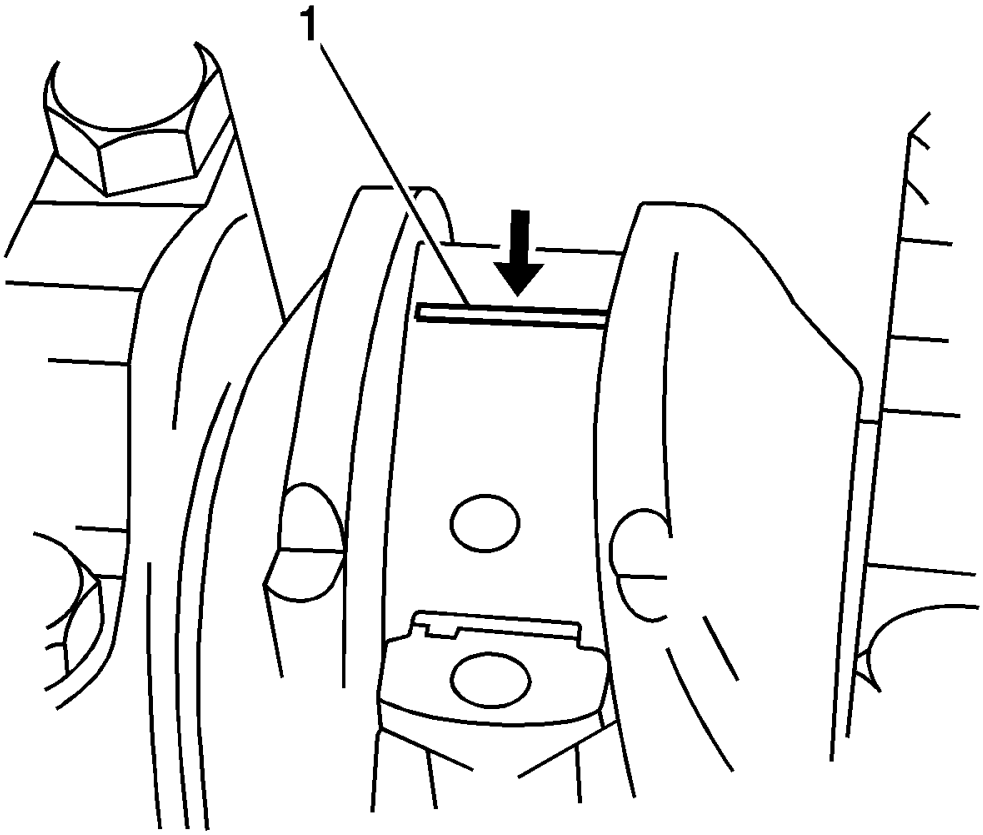

Fig. 163: View Of Plastigage On Journal
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

1. Coat the connecting rod bearings with engine oil.
2. Install the upper connecting rod bearings into the connecting rod journals.
3. Install the lower connecting rod bearings into the connecting rod bearing caps.

IMPORTANT: Grease the connecting rod journals and lubricate the connecting rod bearings slightly so that the plastic gaging thread does not tear when the connecting rod bearing caps are removed.

4. Measure all of the connecting rod bearing clearances using a commercially available plastic gaging, ductile plastic threads.
5. Cut the plastic gaging threads (1) to the length of the bearing width. Lay them axially between the connecting rod journals and the connecting rod bearings.

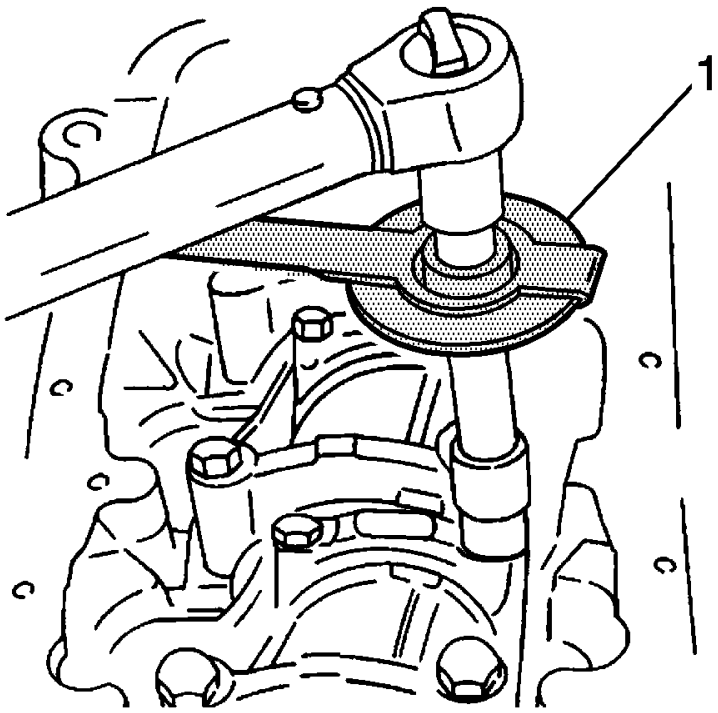

Fig. 164: Using J 45059 Or KM-470-B To Torque Rod Bolts
Courtesy of GENERAL MOTORS CORP.

6. Install the connecting rod bearing caps.
7. Install the connecting rod bearing cap bolts.

Tighten: Tighten the connecting rod bearing cap bolts to **35 N.m (26 lb ft)** . Using the **J 45059** or the **KM-470-B** (1), tighten the connecting rod bearing cap bolts plus 45 degrees plus 15 degrees. See **Special Tools** .

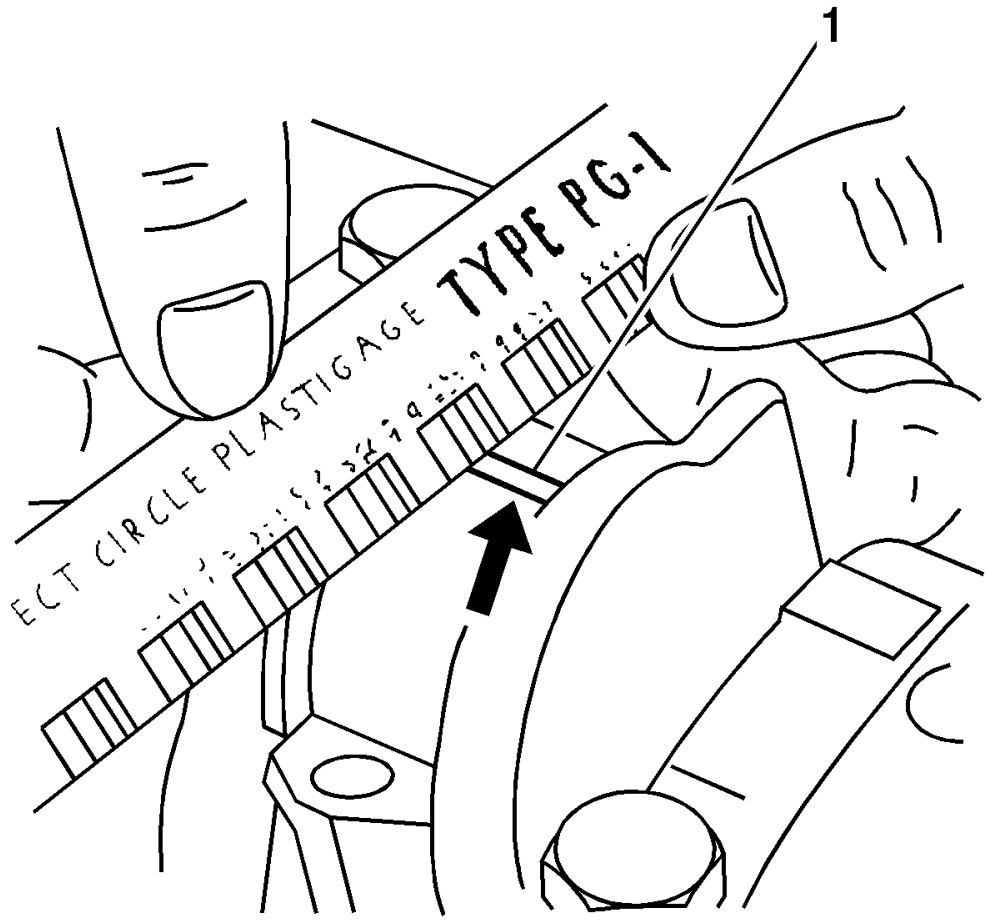

Fig. 165: Measuring Plastigage
Courtesy of GENERAL MOTORS CORP.

8. Remove the connecting rod bearing caps.
9. Measure the width of the flattened plastic thread (1) of the plastic gaging using the scale printed on the plastic gaging package. Plastic gaging is available for different tolerance ranges.
10. Inspect the bearing clearance for permissible tolerance ranges. Refer to **Engine Mechanical Specifications** .

CAMSHAFT GEAR REPLACEMENT

Tools Required

- **J 45059** Angle Meter. See **Special Tools** .
- **KM-470-B** Angular Torque Gage. See **Special Tools** .

Removal Procedure

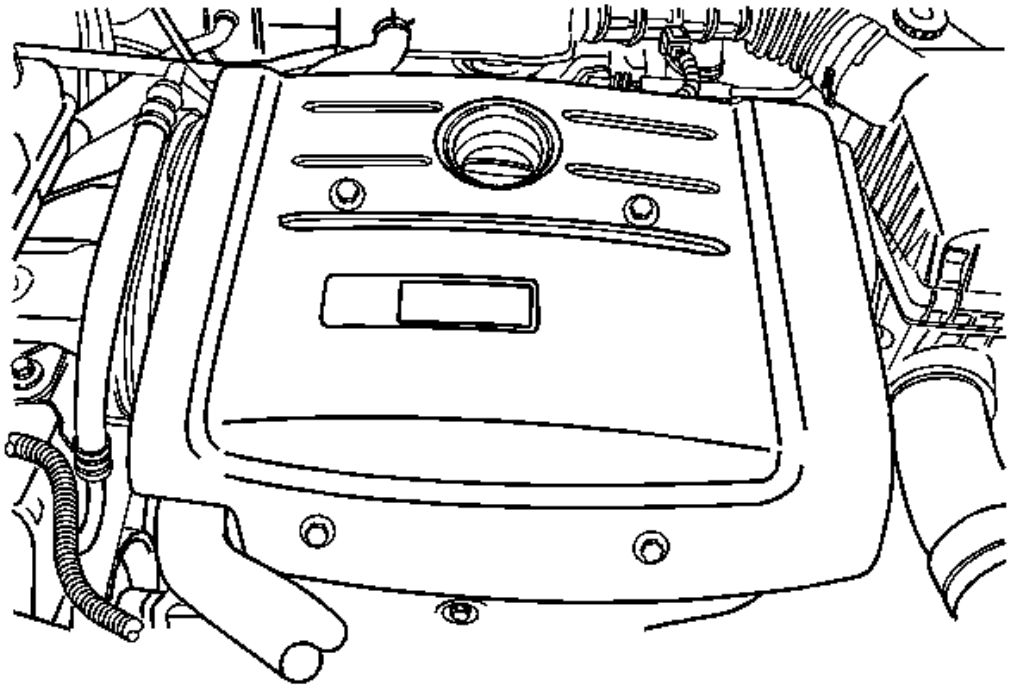

Fig. 166: View Of Spark Plug Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Remove the timing belt. Refer to **Timing Belt Replacement**.
3. Remove the spark plug cover bolts.
4. Remove the spark plug cover.
5. Disconnect the ignition wires from the spark plugs.
6. Disconnect the crankcase breather tubes from the valve cover.

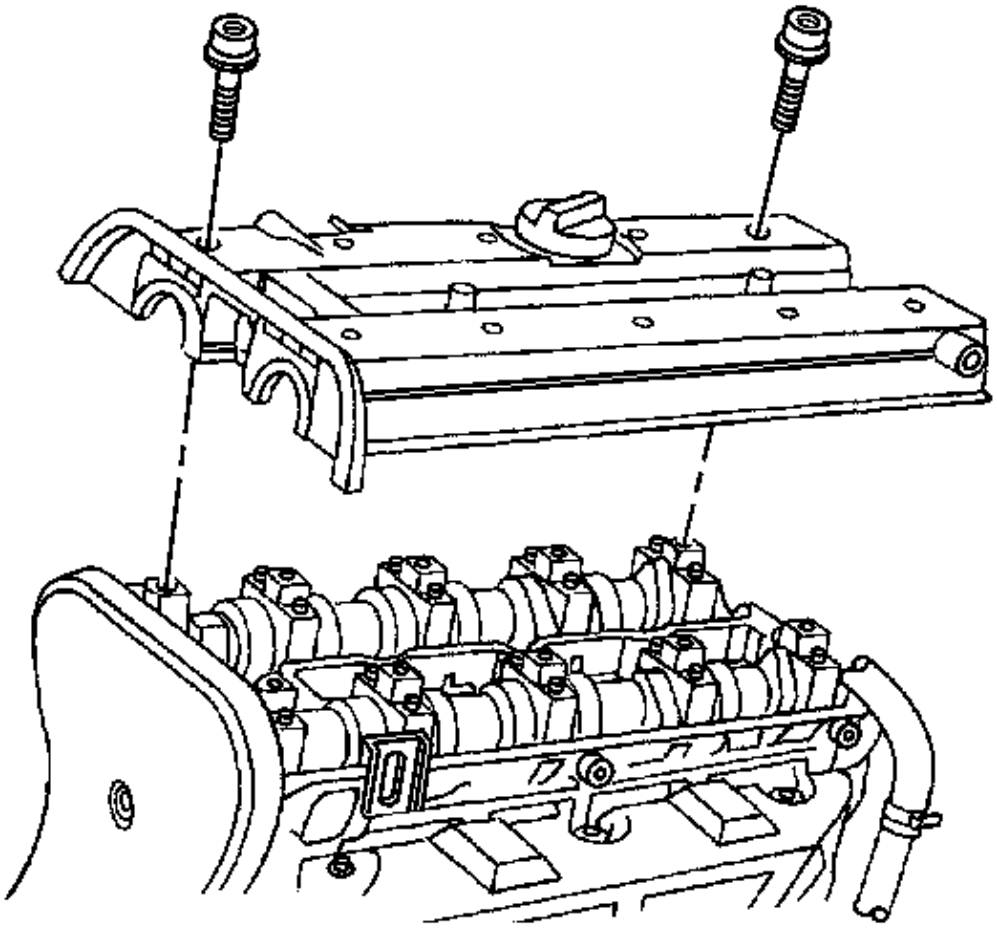

Fig. 167: View Of Valve Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the valve cover bolts.
8. Remove the valve cover washers.
9. Remove the valve cover and the valve cover gasket.

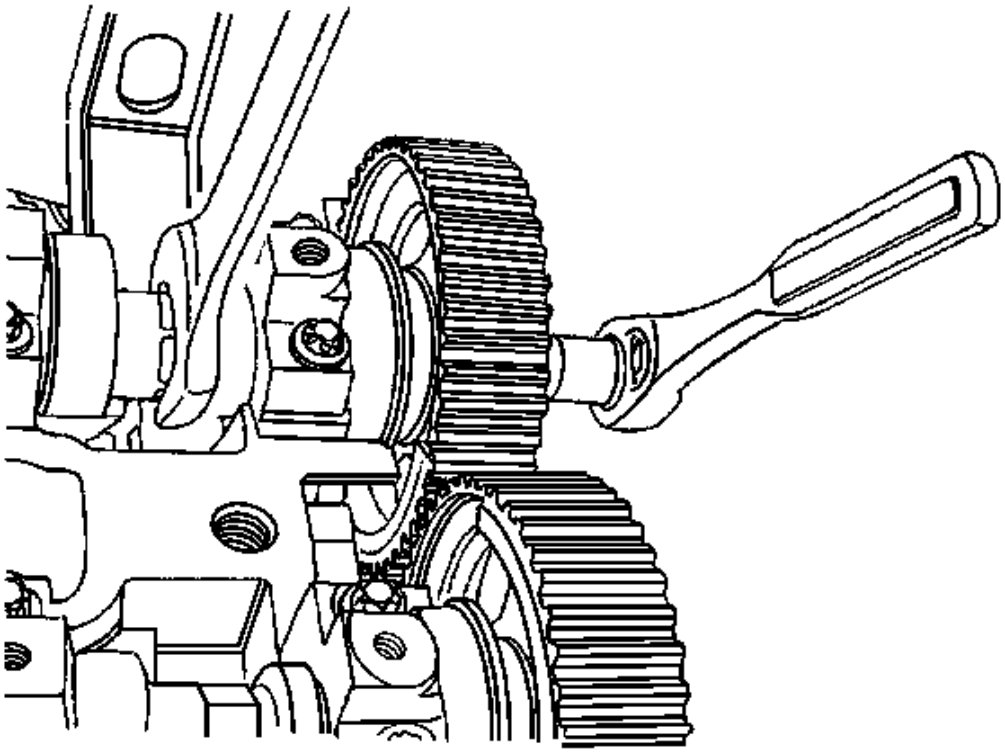

Fig. 168: Removing/Installing Intake Camshaft Gear Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Use extreme care when installing the camshaft not to nick, scratch, or damage the camshaft lobes or bearing surfaces.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

10. While holding the intake camshaft firmly in place, remove the intake camshaft gear bolt.
11. Remove the intake camshaft gear.
12. While holding the exhaust camshaft firmly in place, remove the exhaust camshaft gear bolt.
13. Remove the exhaust camshaft gear.

Installation Procedure

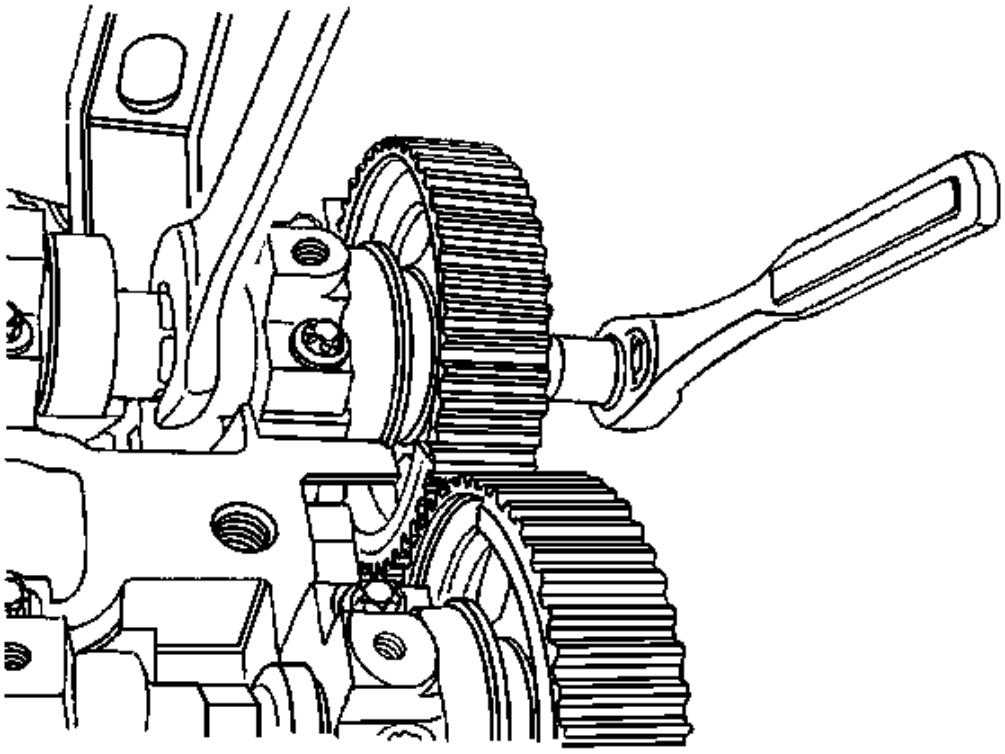

Fig. 169: Removing/Installing Intake Camshaft Gear Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Use extreme care when installing the camshaft not to nick, scratch, or damage the camshaft lobes or bearing surfaces.

1. Install the intake camshaft gear.

NOTE: All camshaft journals are the same diameter, so care must be used in removing or installing the camshaft to avoid damage to the camshaft bearings.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. While holding the intake camshaft firmly in place, install the intake camshaft gear bolt.

Tighten: Tighten the intake camshaft gear bolt to **50 N.m (37 lb ft)** . Turn another 60 degrees plus 15 degrees using the **J 45059** or the **KM-470-B** . See **Special Tools** .

3. Install the exhaust camshaft gear.
4. While holding the exhaust camshaft firmly in place, install the exhaust camshaft gear bolt.

   Tighten: Tighten the exhaust camshaft gear bolt to **50 N.m (37 lb ft)** . Turn another 60 degrees plus 15 degrees using the **J 45059** or the **KM-470-B** . See **Special Tools** .

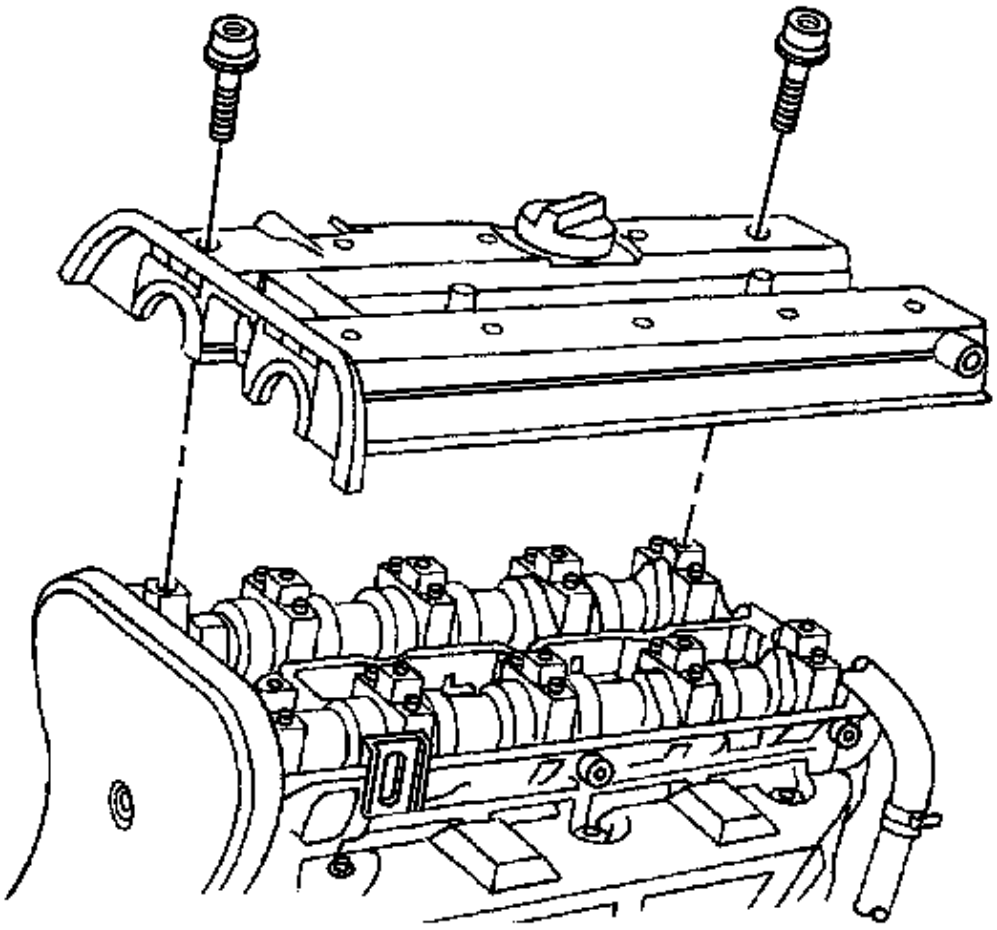

Fig. 170: View Of Valve Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

5. Apply a small amount of gasket sealant to the corners of the front camshaft caps and to the top of the rear valve cover-to-cylinder head seal.
6. Install the valve cover and the valve cover gasket.
7. Install the valve cover washers.

8. Install the valve cover bolts.

   Tighten: Tighten the valve cover bolts to **8 N.m (71 lb in)** .

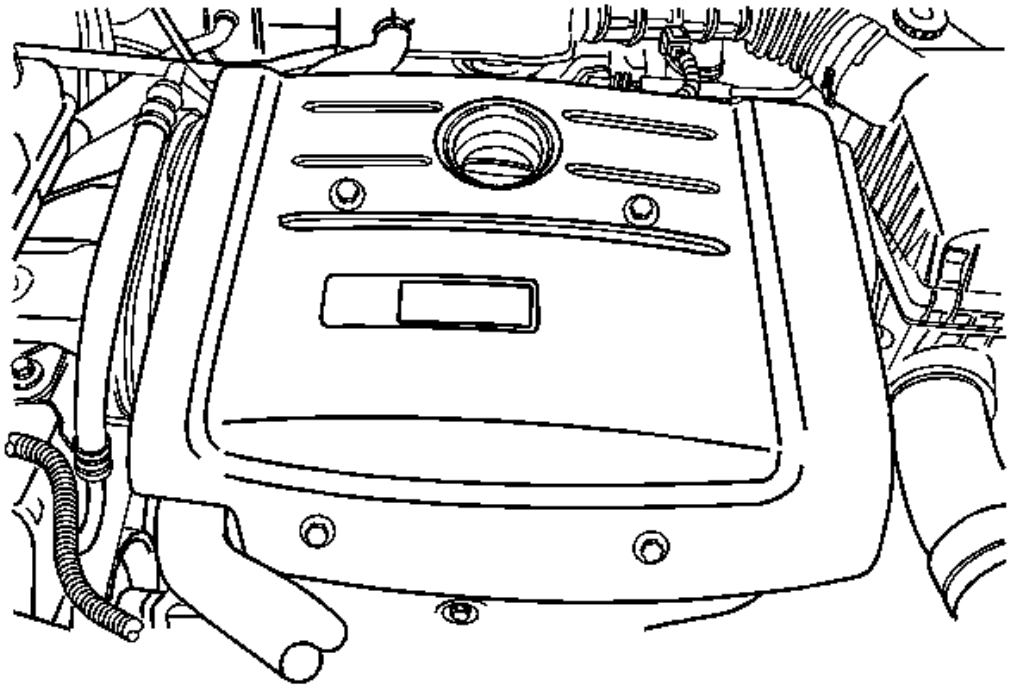

Fig. 171: View Of Spark Plug Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

9. Connect the crankcase breather tubes to the valve cover.
10. Connect the ignition wires to the spark plugs.
11. Install the spark plug cover.
12. Install the spark plug cover bolts.

    Tighten: Tighten the spark plug cover bolts to **3 N.m (27 lb in)** .

13. Install the timing belt. Refer to **Timing Belt Replacement**.
14. Connect the negative battery cable.

CAMSHAFT REPLACEMENT

Tools Required

- **J 45059** Angle Meter. See **Special Tools** .
- **KM-470-B** Angular Torque Gage. See **Special Tools** .

Removal Procedure

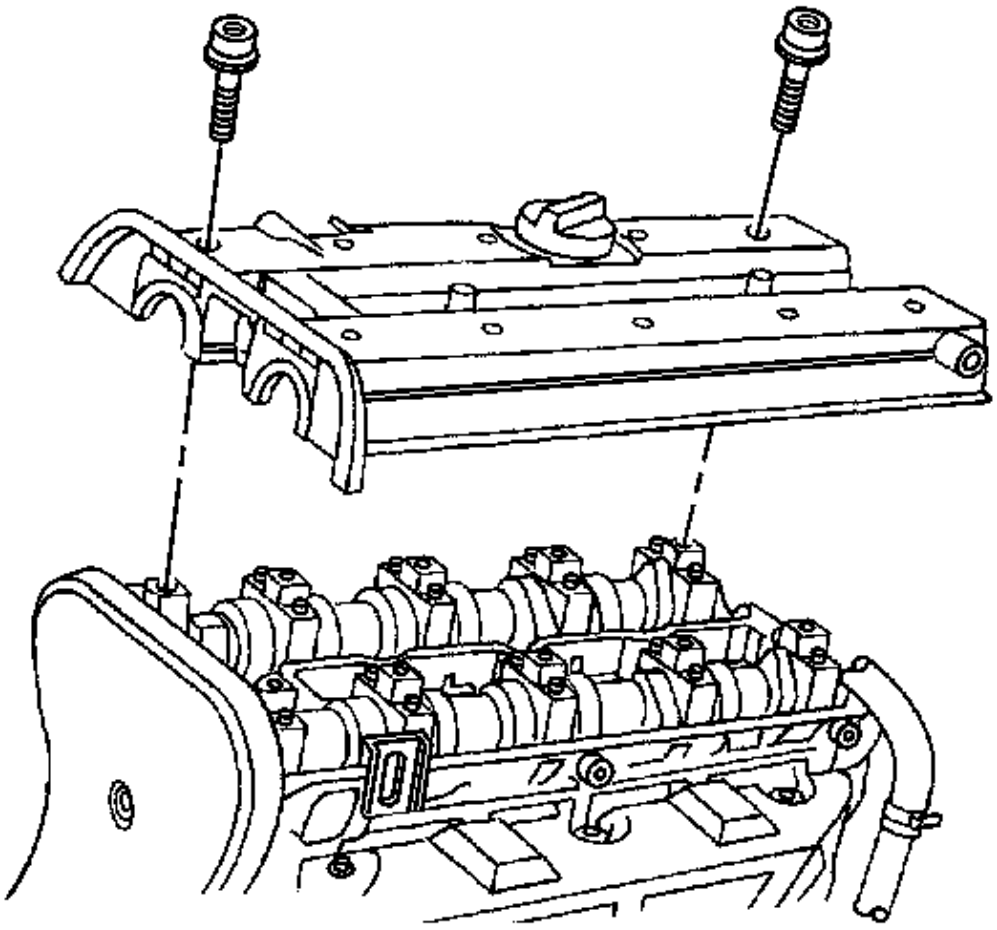

Fig. 172: View Of Valve Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the timing belt. Refer to **Timing Belt Replacement**.
2. Disconnect the breather tube at the valve cover.
3. Disconnect the crankcase ventilation tube at the valve cover.
4. Disconnect the vacuum line at the valve cover.

5. Remove the spark plug cover bolts.
6. Remove the spark plug cover.
7. Disconnect the ignition wires from the spark plugs.
8. Disconnect the camshaft position (CMP) sensor connector.
9. Remove the valve cover bolts.
10. Remove the valve cover washers.
11. Remove the valve cover and the valve cover gasket.

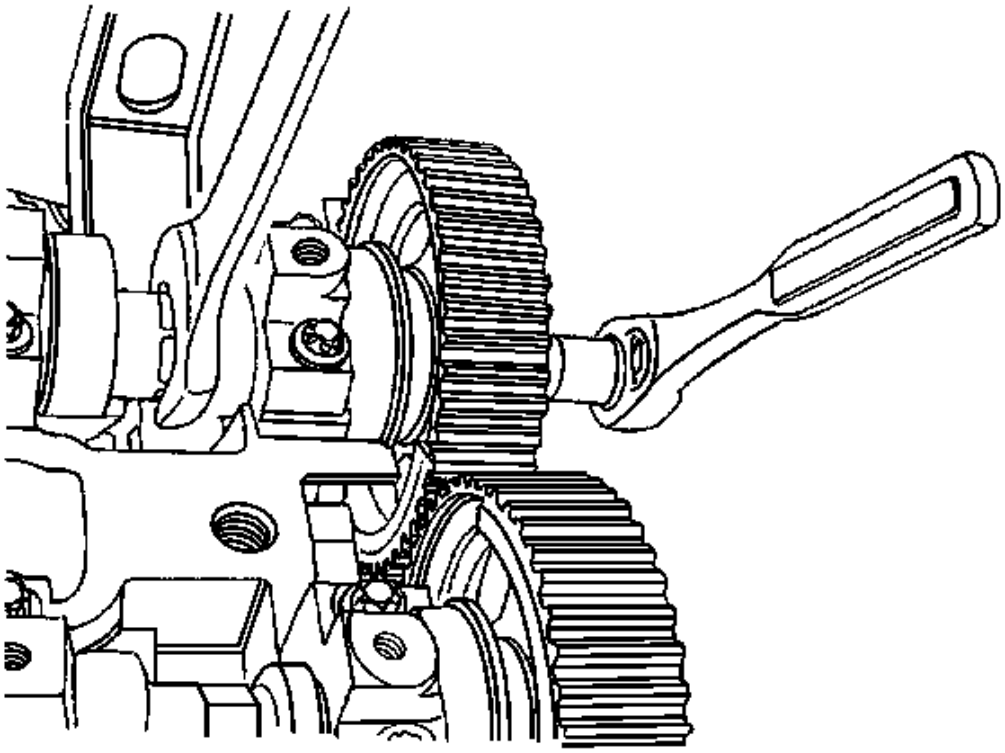

Fig. 173: Removing/Installing Intake Camshaft Gear Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Use extreme care when installing the camshaft not to nick, scratch, or damage the camshaft lobes or bearing surfaces.

12. While holding the intake camshaft firmly in place, remove the intake camshaft gear bolt.
13. Remove the intake camshaft gear.

14. While holding the exhaust camshaft firmly in place, remove the exhaust camshaft gear bolt.
15. Remove the exhaust camshaft gear.

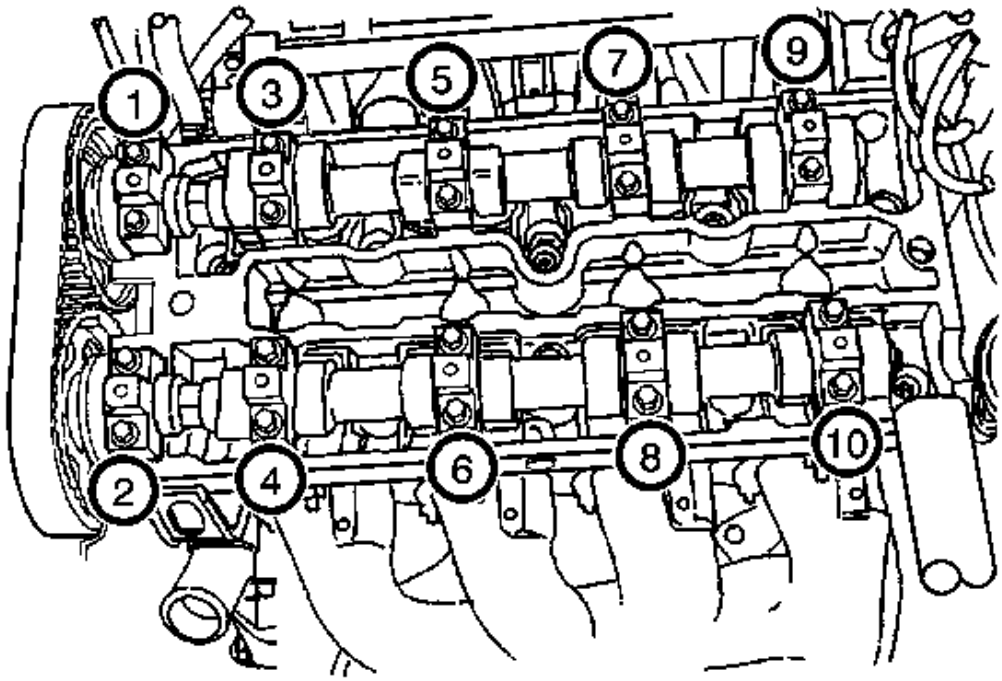

Fig. 174: View Of Camshaft Bearing Caps And Bolts
Courtesy of GENERAL MOTORS CORP.

16. Loosen the camshaft bearing cap bolts in stages of one-half to one turn.
17. Remove the camshaft bearing cap bolts from the cylinder head.
18. Remove the camshafts.
19. Remove the seal ring from the camshafts.

IMPORTANT: The camshaft must detach evenly from the bearing seals in the front guide bearing.

20. Check the camshaft and bearing seats for wear and replace them if necessary.

Installation Procedure

NOTE: Use extreme care when installing the camshaft not to nick, scratch, or

damage the camshaft lobes or bearing surfaces.

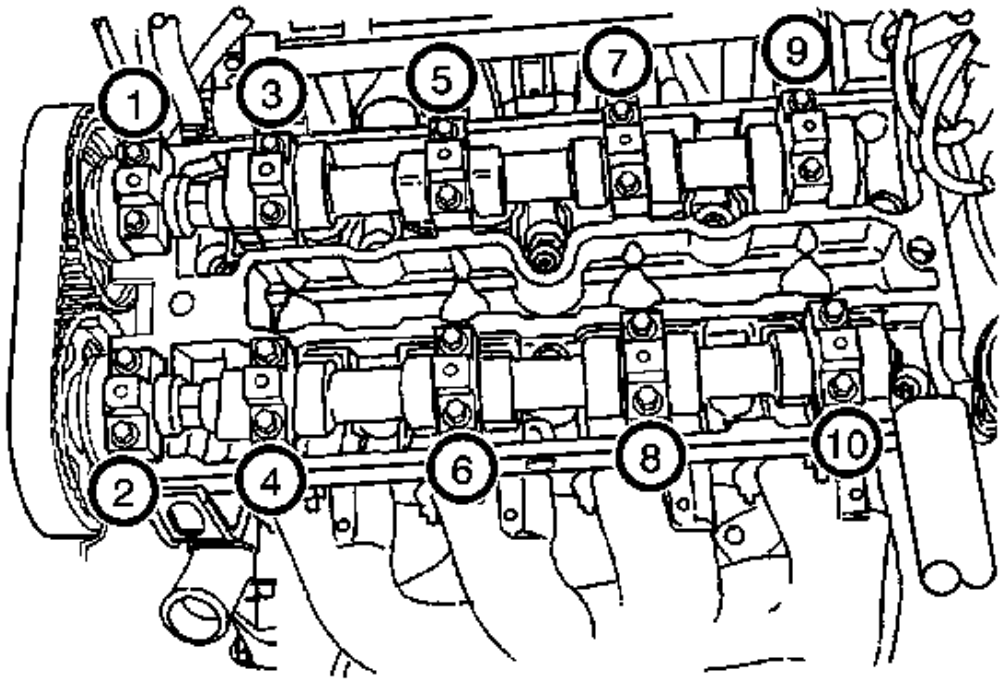

Fig. 175: View Of Camshaft Bearing Caps And Bolts
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the camshaft journals and the camshaft caps with engine oil.
2. Install the intake camshaft.
3. Install the intake camshaft caps in their original positions.
4. Install the intake camshaft cap bolts.
5. Install the exhaust camshaft.
6. Install the exhaust camshaft caps in their original positions.
7. Install the exhaust camshaft cap bolts.

NOTE: Refer to Fastener Notice in Cautions and Notices.

8. Tighten the camshaft cap bolts gradually and in the sequence shown for each camshaft cap.

Tighten: Tighten the camshaft bearing cap bolts to **8 N.m (71 lb in)** .

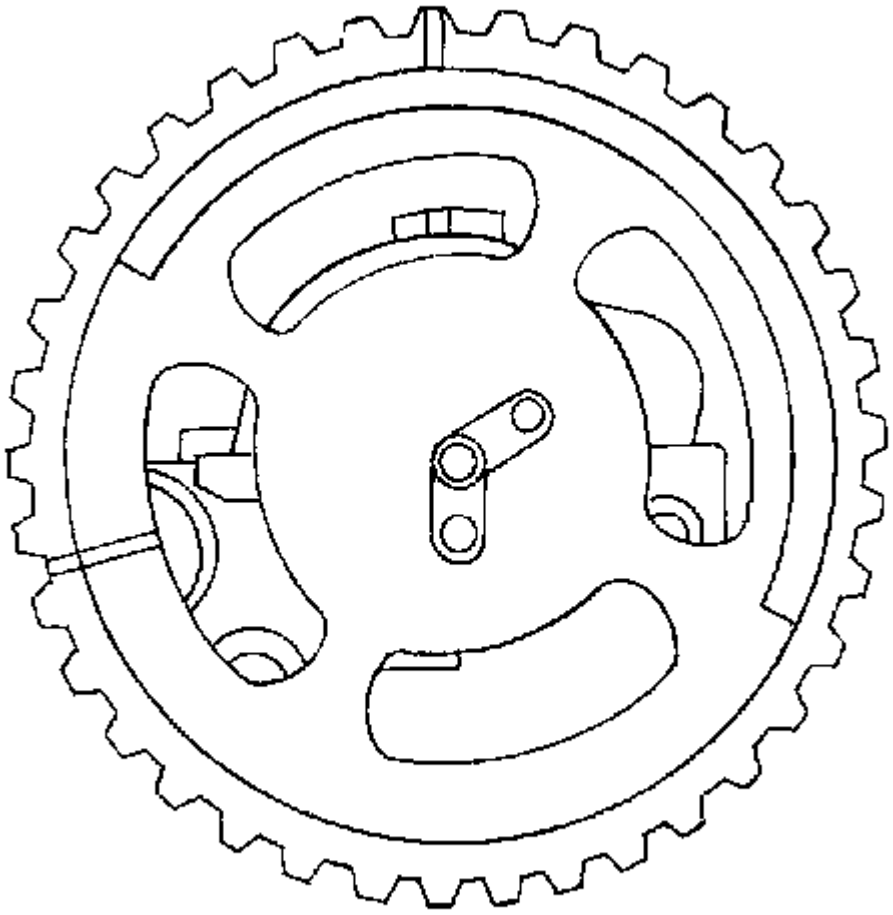

Fig. 176: View Of Camshaft Gear And Timing Mark
Courtesy of GENERAL MOTORS CORP.

9. Measure the intake camshaft end play and the exhaust camshaft end play. Refer to **Engine Mechanical Specifications** .
10. Install the intake camshaft gear.
11. While holding the intake camshaft firmly in place, install the intake camshaft gear bolt.

Tighten: Tighten the intake camshaft gear bolt to **50 N.m (37 lb ft)** . Turn the bolt another 60 degrees and 15 degrees using the **J 45059** or the **KM-470-B** . See **Special Tools** .

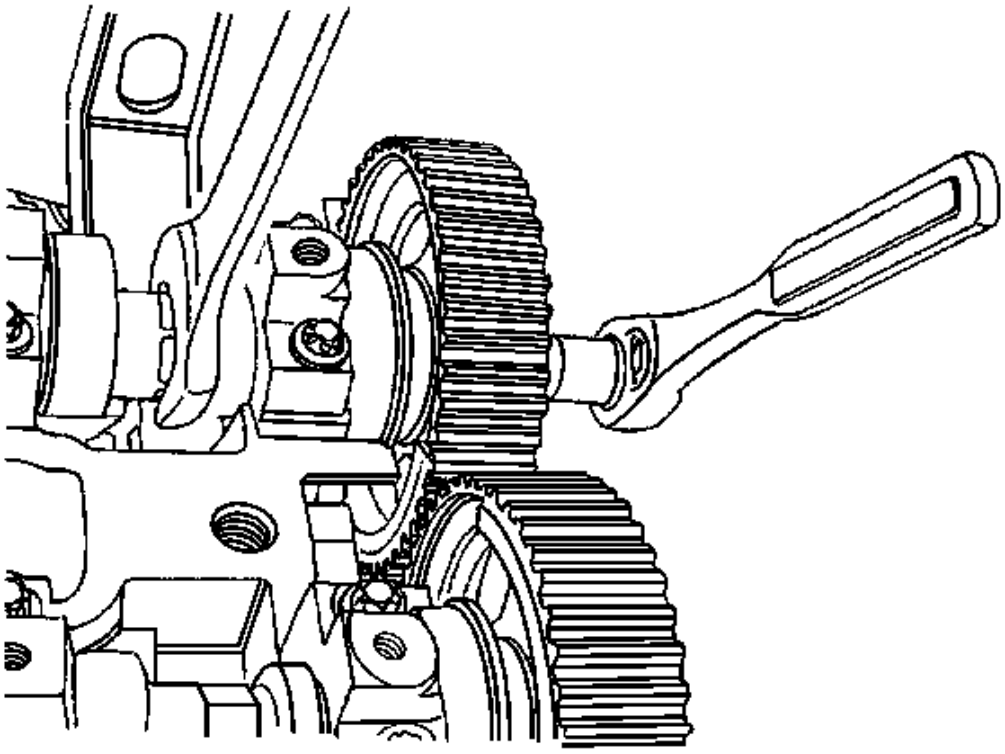

Fig. 177: Removing/Installing Intake Camshaft Gear Bolt
Courtesy of GENERAL MOTORS CORP.

12. Install the exhaust camshaft gear.

NOTE: **All camshaft journals are the same diameter, so care must be used in removing or installing the camshaft to avoid damage to the camshaft bearings.**

13. While holding the exhaust camshaft firmly in place, install the exhaust camshaft gear bolt.

Tighten: Tighten the exhaust camshaft gear bolt to **50 N.m (37 lb ft)** , turn the bolt another 60 degrees and 15 degrees using the **J 45059** or the **KM-470-B** . See **Special Tools** .

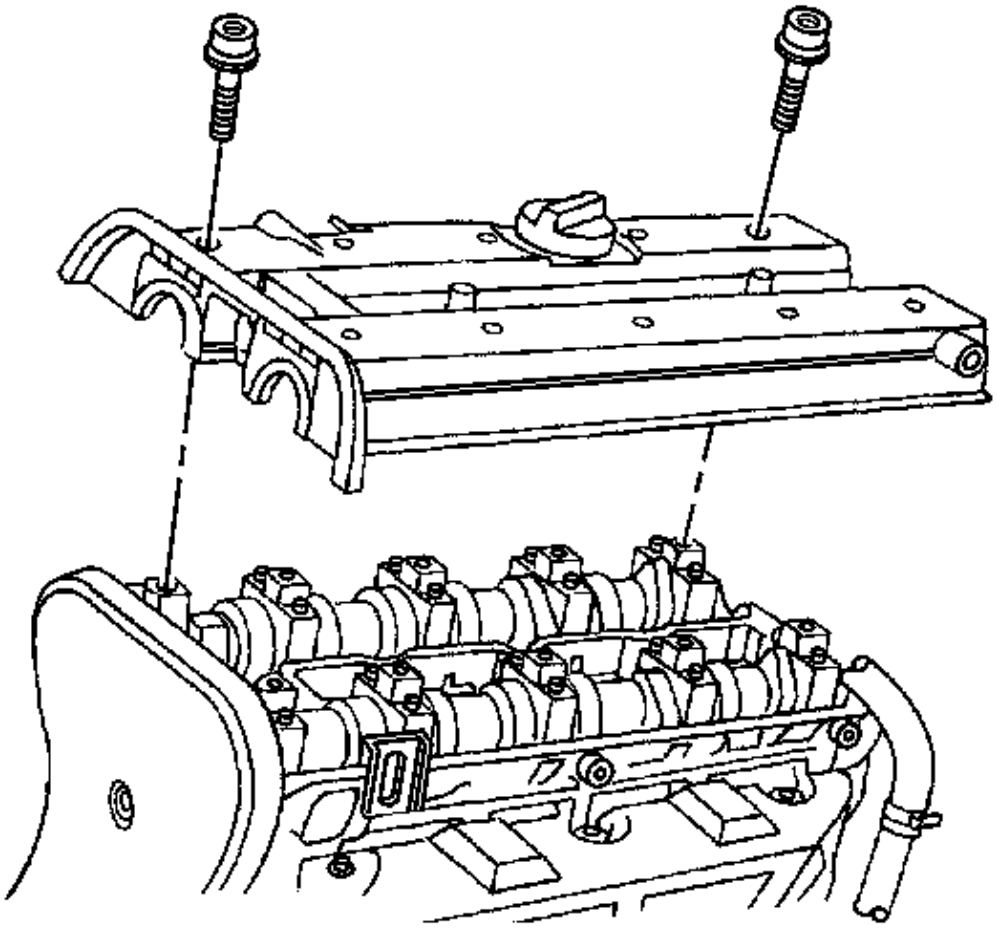

Fig. 178: View Of Valve Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

14. Install the valve cover and the valve cover gasket.
15. Install the valve cover washers.
16. Install the valve cover bolts.

Tighten: Tighten the valve cover bolts to **8 N.m (71 lb in)** .

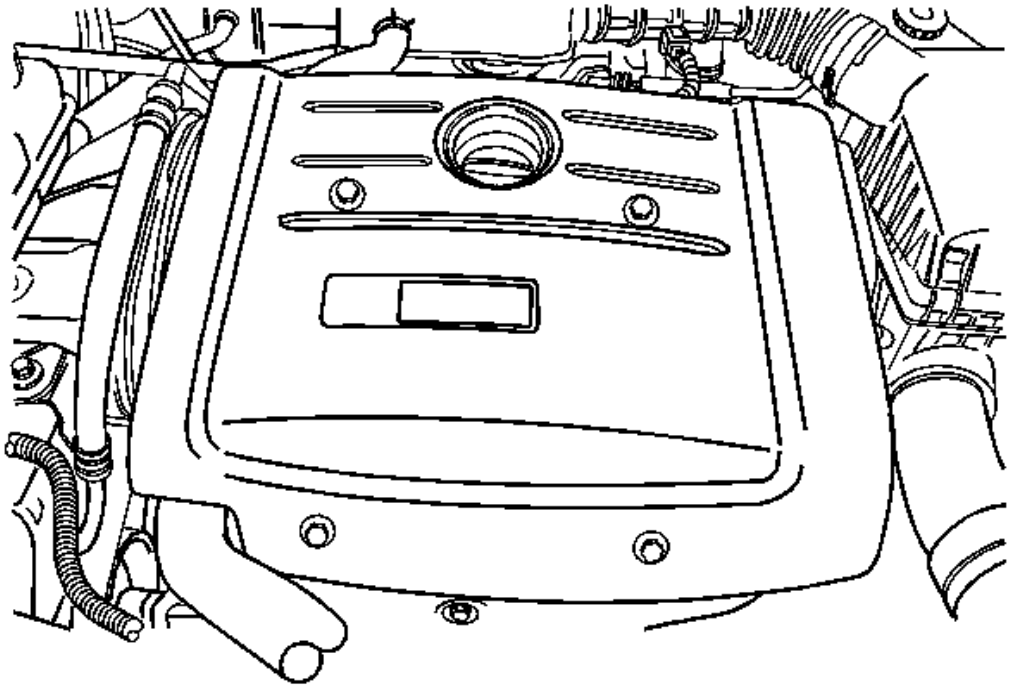

Fig. 179: View Of Spark Plug Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

17. Connect the ignition wires to the spark plugs.
18. Connect the CMP sensor connector.
19. Install the spark plug cover.
20. Install the spark plug cover bolts.

    Tighten: Tighten the spark plug cover bolts to **3 N.m (27 lb in)** .

21. Connect the vacuum line to the valve cover.
22. Connect the crankcase velitation tube to the valve cover.
23. Connect the breather tube to the valve cover.
24. Install the timing belt. Refer to **Timing Belt Replacement**.

VALVE ROCKER ARM AND SHAFT CLEANING AND INSPECTION

Inspection Procedure

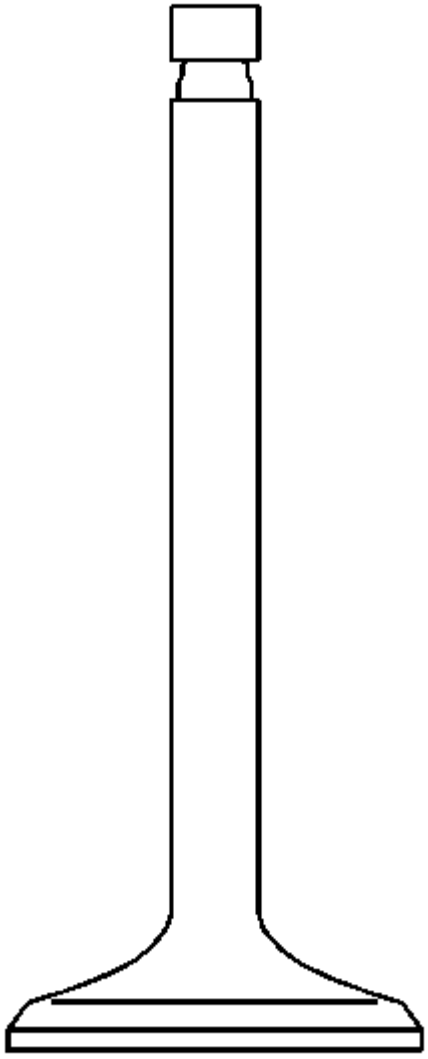

Fig. 180: View Of Valve
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

1. Inspect the valve stem tip for wear.
2. Inspect the valve retainer grooves and the oil seal grooves for chips and wear.
3. Inspect the valves for burns or cracks.

4. Inspect the valve stem for burrs and scratches.
5. Inspect the valve stem. The valve stem must be straight.
6. Inspect the valve face for grooving. If the groove is so deep that refacing the valve would result in a sharp edge, replace the valve.
7. Inspect the valve spring. If the valve spring ends are not parallel, replace the valve spring.
8. Inspect the valve spring seating surface of the valve rotators for wear or gouges. Replace as required.

Cleaning Procedure

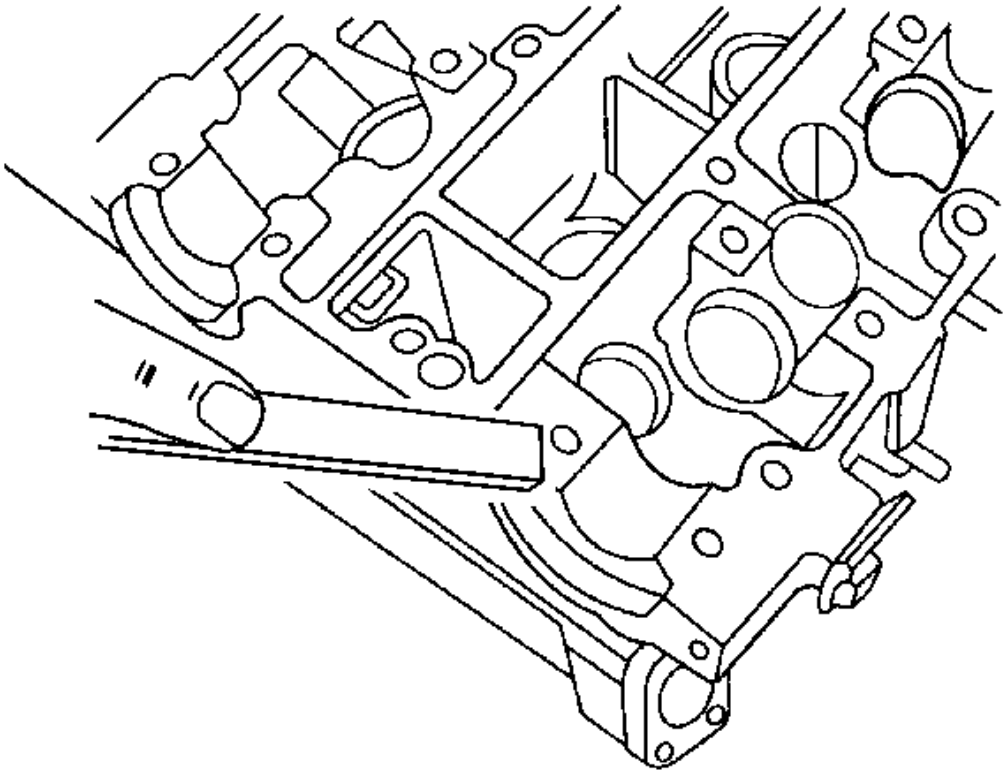

Fig. 181: Cleaning Cylinder Head
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

1. Clean the cylinder head.

2. Clean the valve guides.
3. Clean all of the threaded holes.
4. Clean the valves of carbon, oil, and varnish.

VALVE GUIDE REAMING/VALVE AND SEAT GRINDING

Tools Required

- **KM-340-1-C** Cutter Set. See **Special Tools** .
- **KM-571-B** Gage or equivalent. See **Special Tools** .
- **KM-805** Valve Guide Reamer. See **Special Tools** .

Valve Grind - In

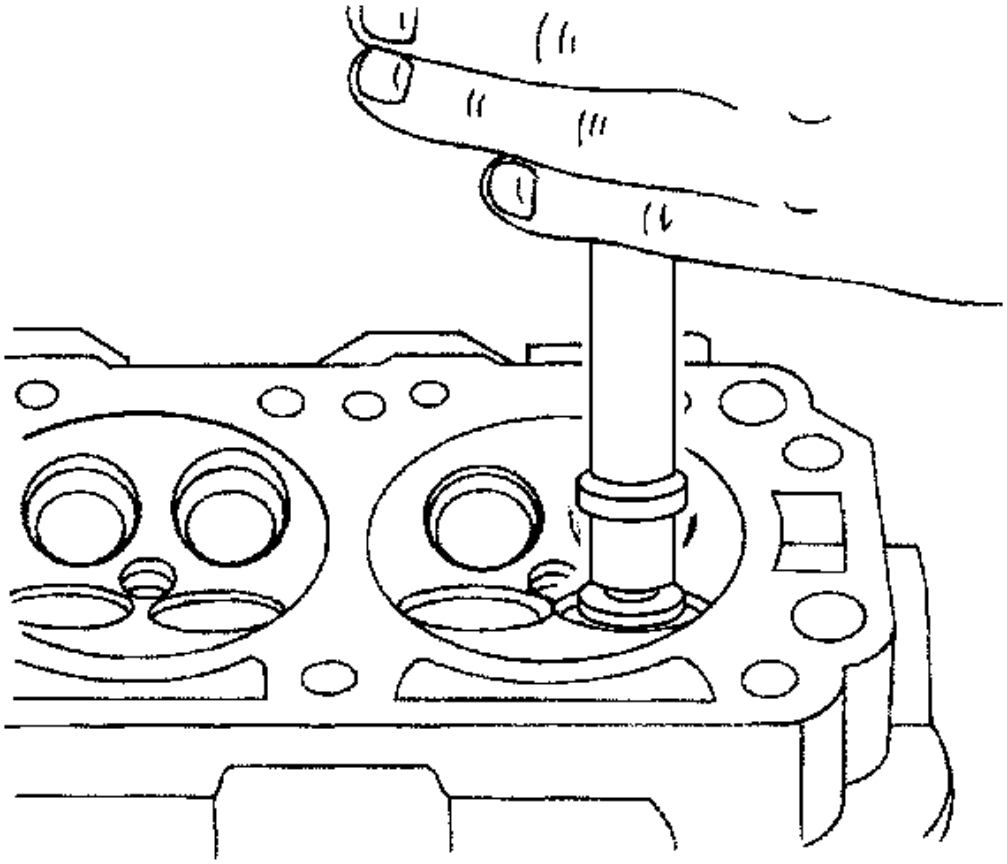

Fig. 182: View Of Valve Grinding Tool

Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

1. Lubricate the valve seat using a fine-grained paste.
2. Lift the valve rhythmically from the seat with a commercially-available valve grinding tool in order to distribute the paste.

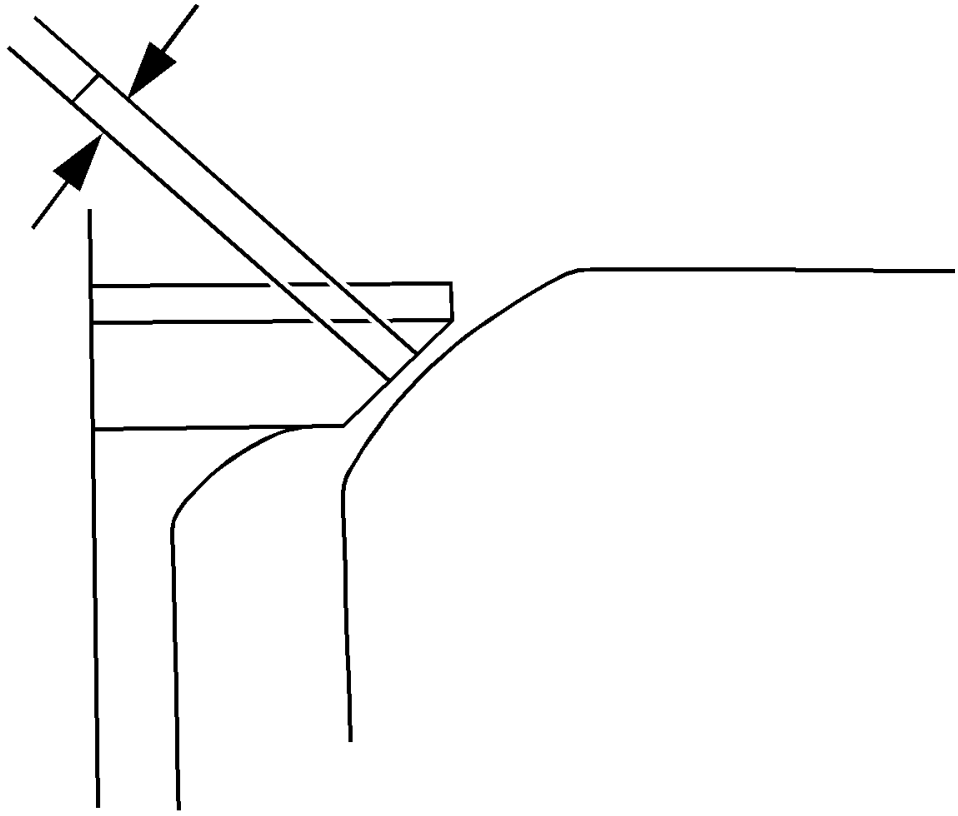

Fig. 183: Cleaning Valves, Valve Guides, And Cylinder Head
Courtesy of GENERAL MOTORS CORP.

3. Inspect the contact pattern on the valve head and in the cylinder head.
4. Clean the valves, the valve guides, and the cylinder head.

Valve Grind

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

IMPORTANT: The valve may be reground only 2 times. Do not grind the valve stem end.

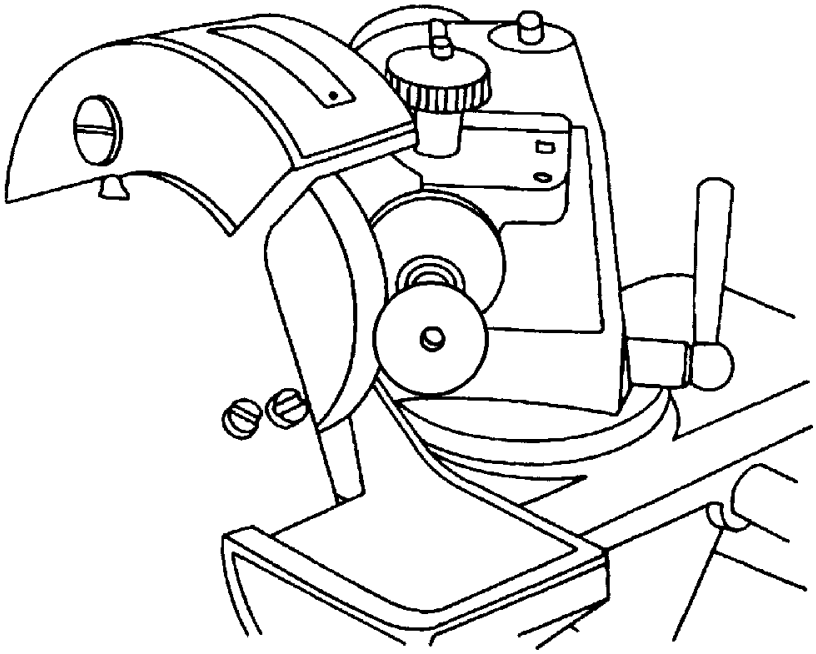

Fig. 184: View Of Valve And Refacing Tool
Courtesy of GENERAL MOTORS CORP.

1. Ensure that there are no crater line burns on the valve cone.
2. Ensure that the angle at the valve face is 45 degrees.
3. Inspect the assembly height of the intake valves and the exhaust valves.

Valve Guide - Ream

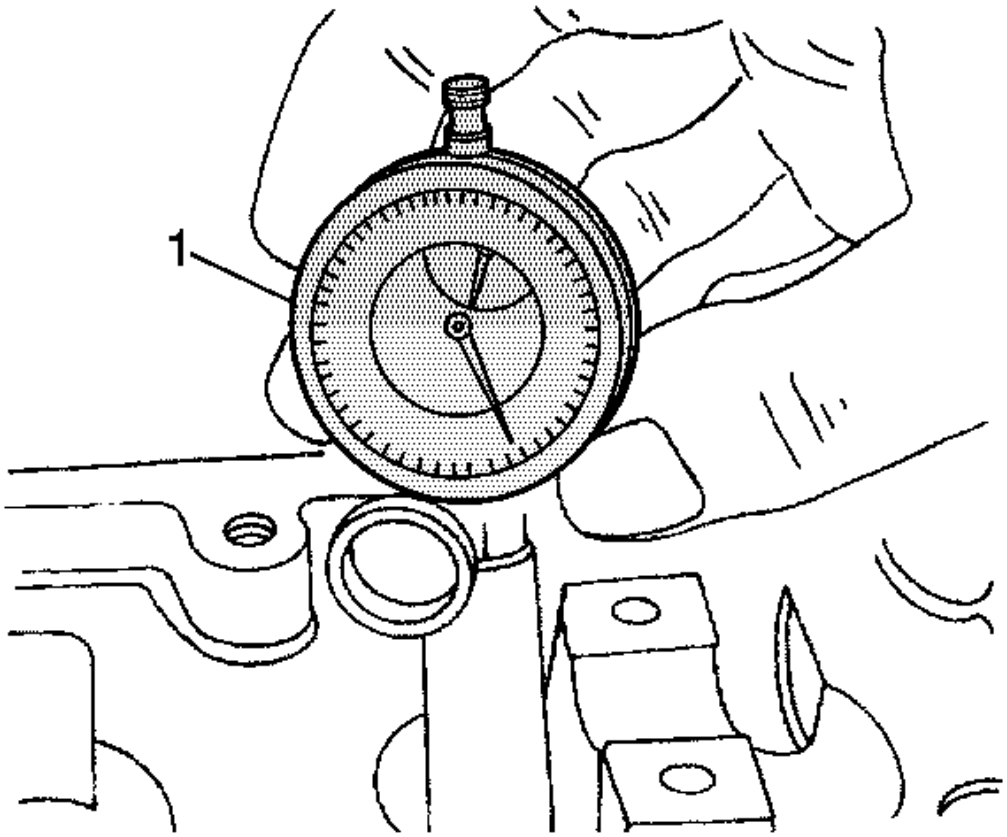

Fig. 185: View Of KM-571-B
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

1. Measures the diameter of the valve guide using the **KM-571-B** (1) and a commercially available inside micrometer. See **Special Tools** .

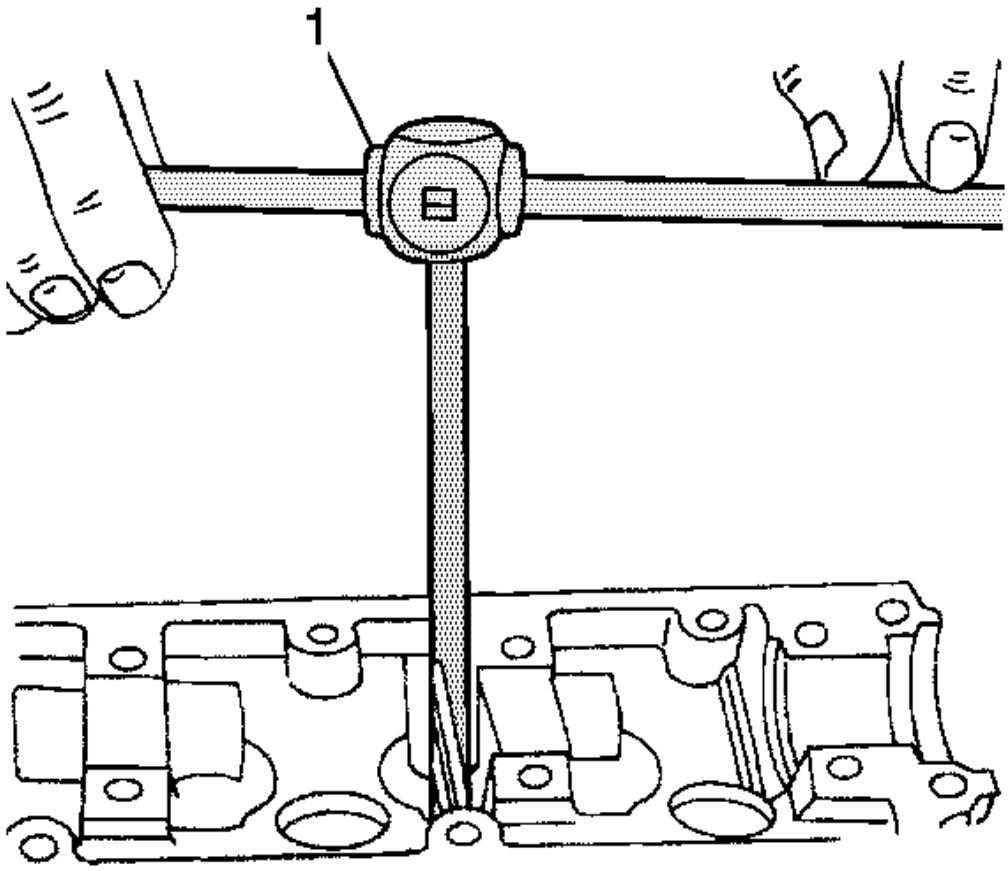

Fig. 186: View Of KM-805
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Valve oversizes may already have been fitted in production.

2. An oversize service code is on the valve guide and the valve stem end. Refer to the **Engine Mechanical Specifications** for correct size, reamer, production code, and service code for each service.
3. Ream the valve guide with the **KM-805** (1) from the upper side of the cylinder head to the next oversize. See **Special Tools** .
4. After reaming, cross out the code and emboss the valve guide with the new code.

Valve Seat - Cut

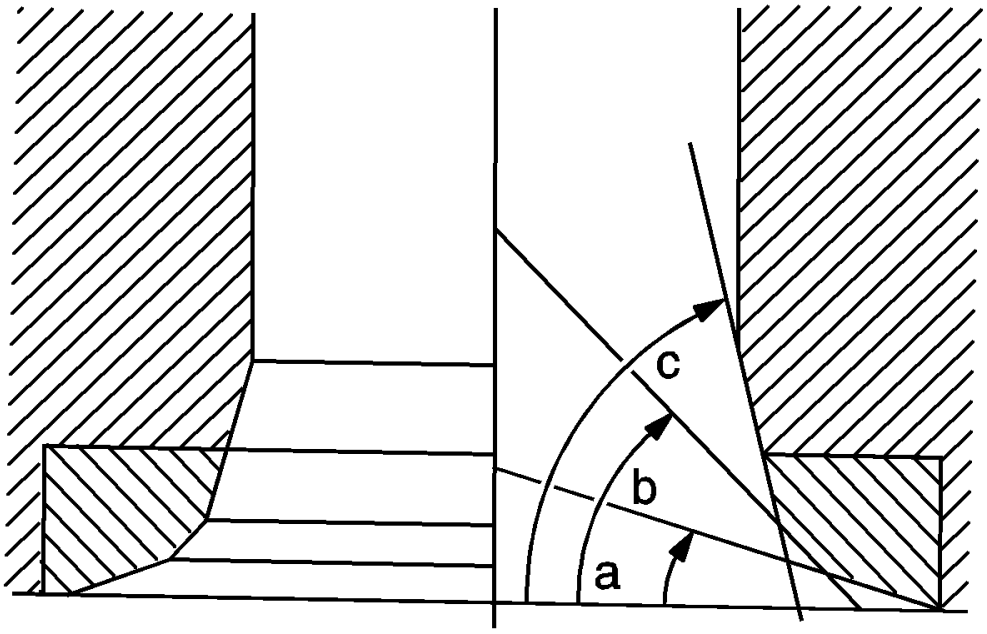

Fig. 187: Identifying Valve Seat Angle, Upper Correction Angle, And Lower Correction Angle
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

1. Place the cylinder head on wooden blocks.
2. Cut the intake and the exhaust valve seats using the KM-340-7 (part of kit KM 340-0) as follows.

   Specifications:
   - Cut the valve seat to a 45 degree surface (b) with the KM-340-13 (part of kit KM 340-0).
   - Cut the upper correction angle to a 30 degree surface (a) with the KM-340-13 (part of kit KM 340-0).
   - Cut lower correction angle to a 60 degree surface (c) with the KM-340-26 (part of kit KM 340-0).

3. Clean the chippings from the cylinder head.
4. Inspect the dimension for the valve seat width.

Specifications:

- The intake valve seat width is 1.2-1.4 mm (0.47-0055 in).
- The exhaust valve seat width is 1.4-1.8 mm (0.055-0.070 in).

5. Inspect the assembly height of the intake valves and the exhaust valves. If the specified dimension is exceeded, install new valves. Inspect the assembly height of the intake valves and the exhaust valves again. If the valve assembly height is still too large despite replacing the valves, replace the cylinder head.

CYLINDER HEAD DISASSEMBLE

Tools Required

- **J 8062** (KM-348) Valve Spring Compressor - Head Off. See **Special Tools** .
- **KM-653-A** Adapter. See **Special Tools** .

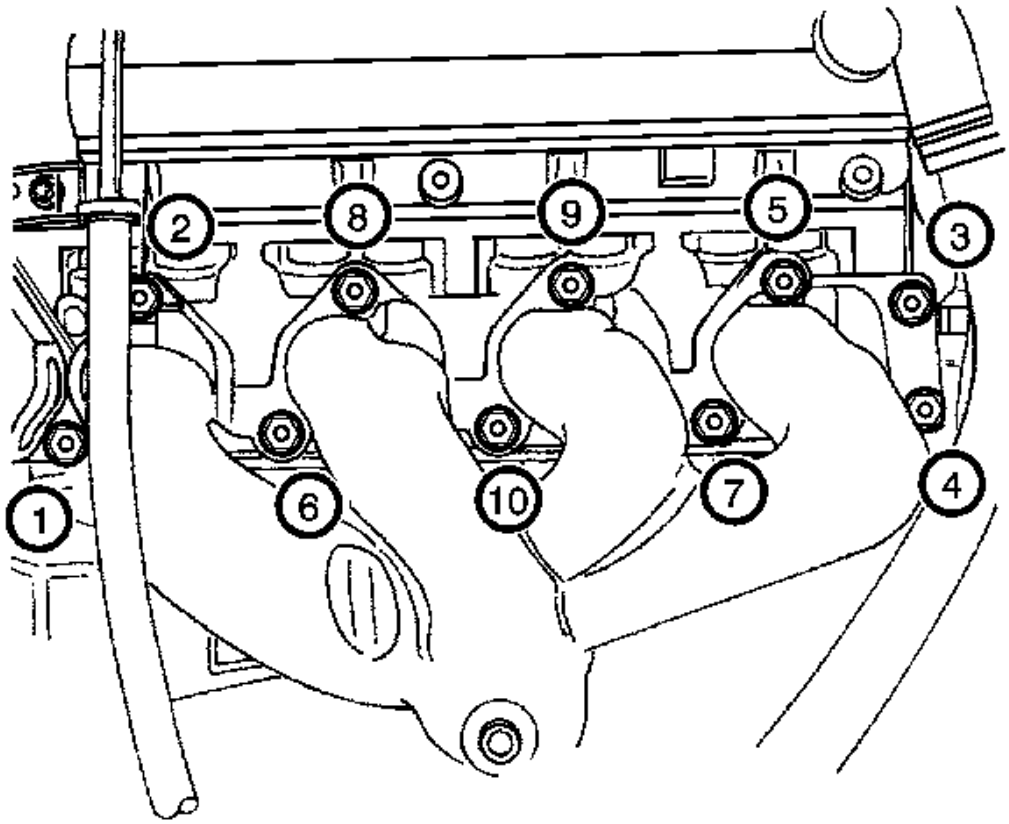

Fig. 188: View Of Exhaust Manifold Retaining Nut Removal Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Compressed Valve Spring Caution in Cautions and Notices.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

1. Remove the cylinder head with the intake manifold and the exhaust manifold attached. Refer to **Cylinder Head Replacement**.
2. Remove the coolant temperature sensor.
3. Remove the exhaust manifold heat shield bolts.
4. Remove the exhaust manifold heat shield.
5. Remove the exhaust manifold retaining nuts in the sequence shown.
6. Remove the exhaust manifold.
7. Remove the exhaust manifold gasket.
8. Remove the exhaust manifold studs.

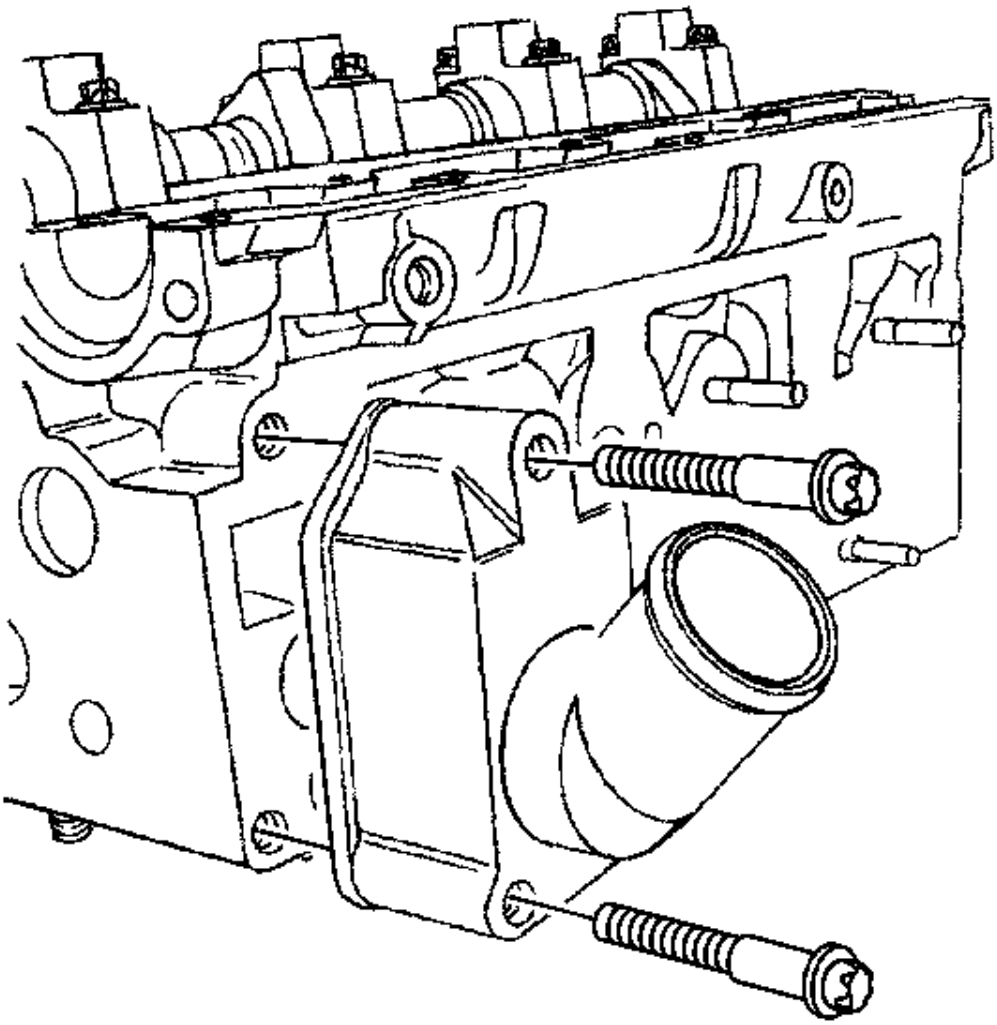

Fig. 189: View Of Thermostat Housing And Bolts
Courtesy of GENERAL MOTORS CORP.

9. Remove the thermostat housing mounting bolts.
10. Remove the thermostat housing assembly.
11. Remove the fuel rail assembly. Refer to **Fuel Rail Assembly Replacement** in Engine Controls - 2.0L.
12. Remove the coolant bypass housing mounting bolts and the housing.

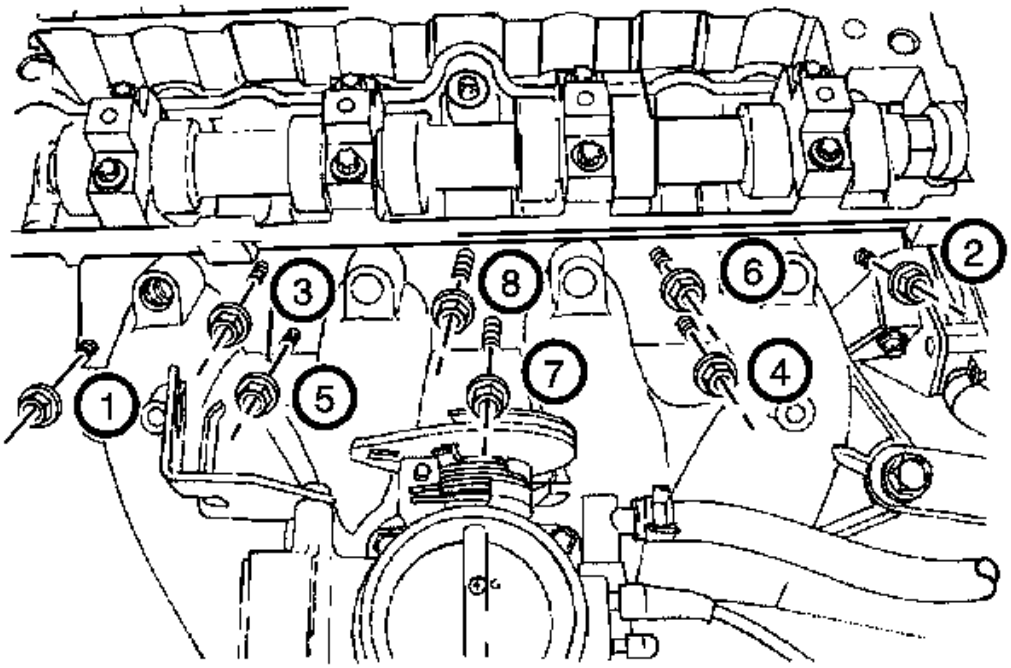

Fig. 190: View Of Intake Manifold Retaining Nut Removal Sequence
Courtesy of GENERAL MOTORS CORP.

13. Remove the intake manifold retaining nuts and the retaining bolts in the sequence shown.
14. Remove the intake manifold.
15. Remove the intake manifold gasket.

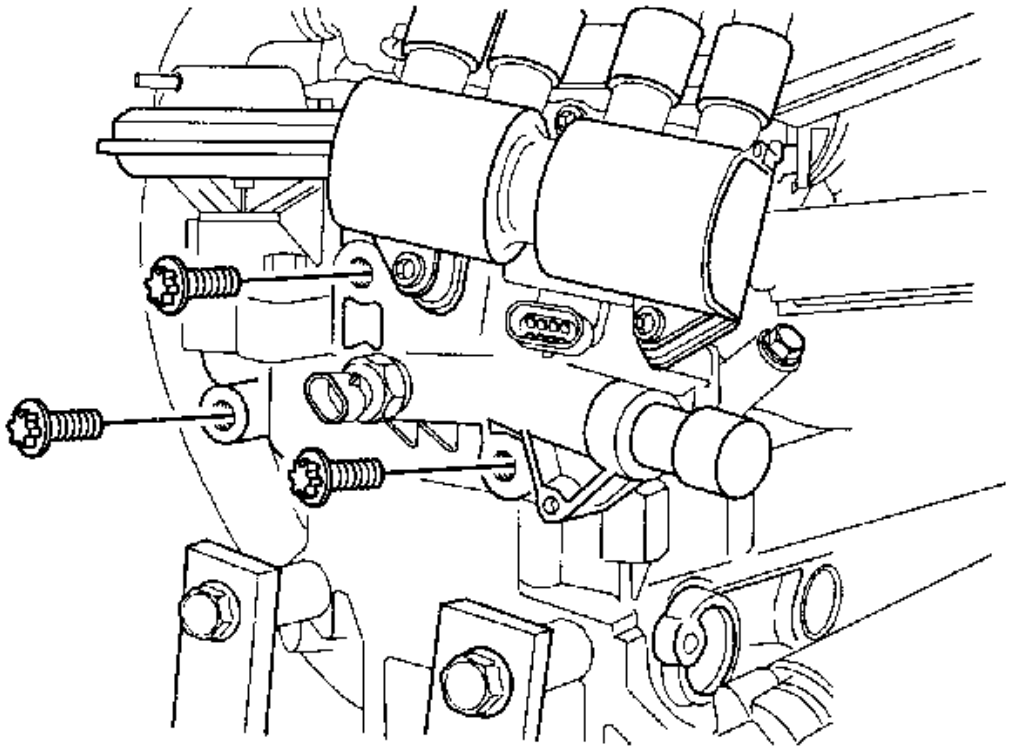

Fig. 191: View Of Ignition Coil, EGR Mounting Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

16. Remove the ignition coil and exhaust gas recirculation (EGR) mounting bracket and ignition wires.
17. Remove the ignition coil and EGR mounting bracket and the ignition wires.
18. Remove the intake manifold studs.
19. Remove the spark plugs.

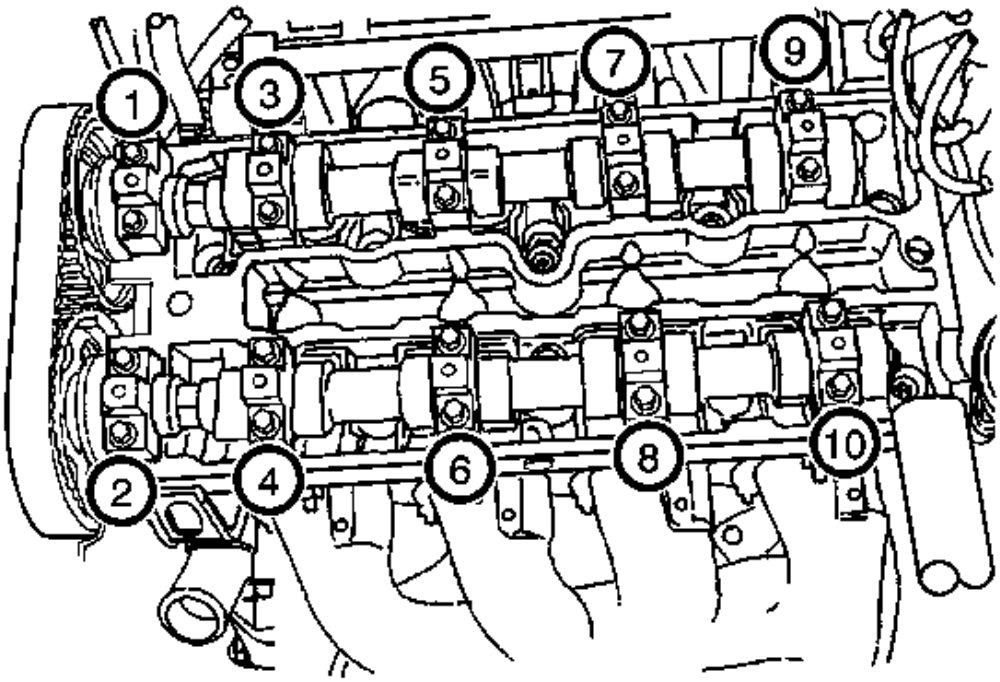

Fig. 192: View Of Camshaft Bearing Caps And Bolts
Courtesy of GENERAL MOTORS CORP.

20. Remove the camshaft bearing cap bolts gradually and in the sequence shown for each camshaft cap.

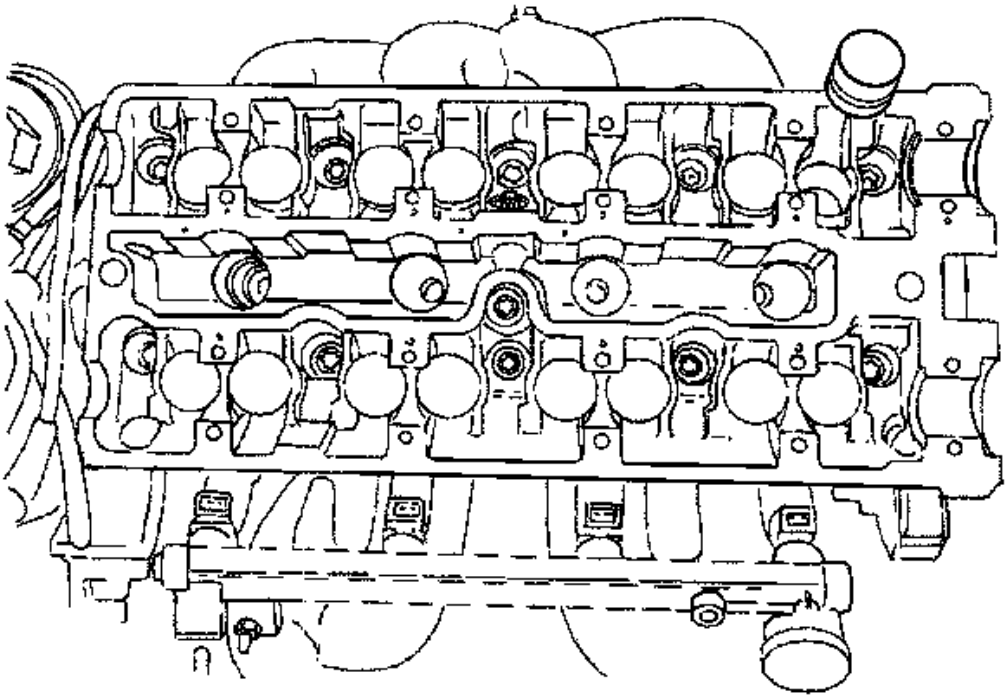

Fig. 193: View Of Valve Lash Adjusters
Courtesy of GENERAL MOTORS CORP.

21. Remove the intake camshaft caps. Maintain the correct positions for installation.
22. Remove the intake camshaft.
23. Remove the intake valve lash adjusters.
24. Remove the exhaust camshaft caps. Maintain the correct positions for installation.
25. Remove the exhaust camshaft.
26. Remove the exhaust valve lash adjusters.

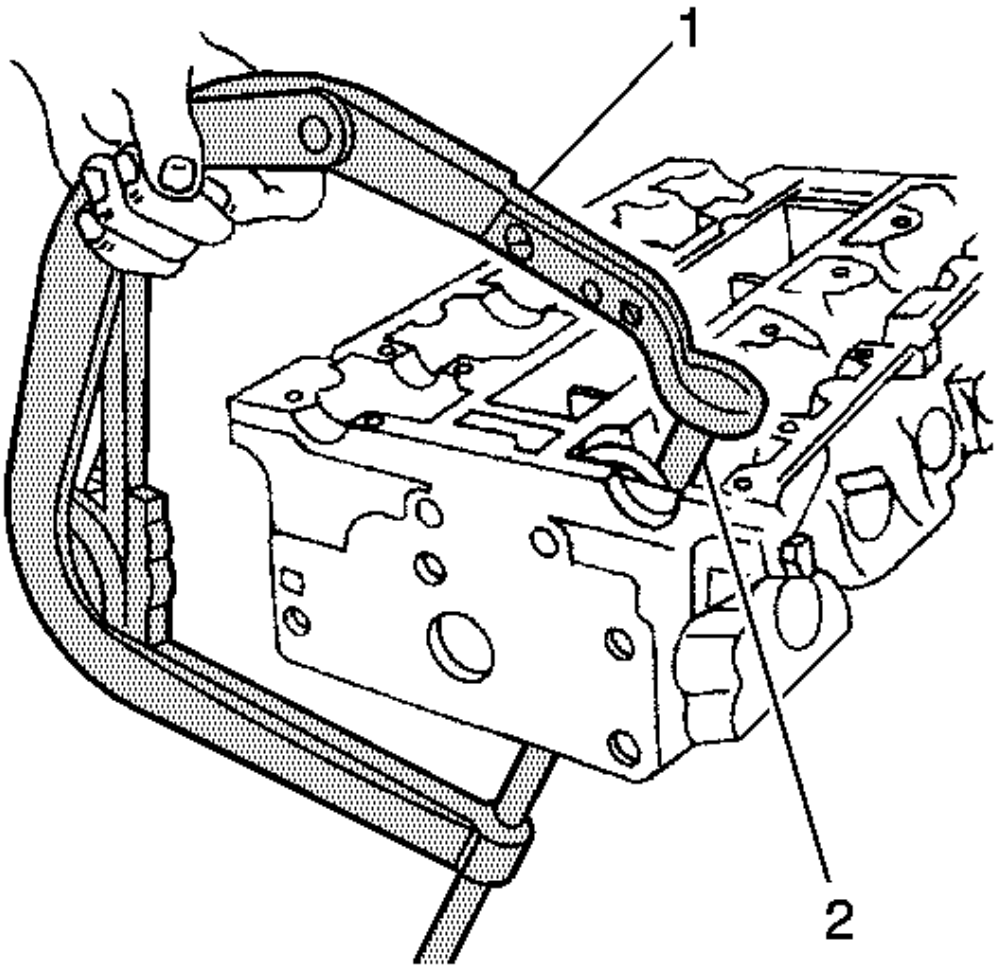

Fig. 194: Compressing Valve Springs
Courtesy of GENERAL MOTORS CORP.

27. Compress the valve springs with the **J 8062** (1) and the **KM-653-A** (2). See **Special Tools** .
28. Remove the valve retainers.
29. Remove the **J 8062** (1) and **KM-653-A** (2). See **Special Tools** .
30. Remove the valve spring caps.
31. Remove the valve springs. Maintain the original position of the valve springs for installation.

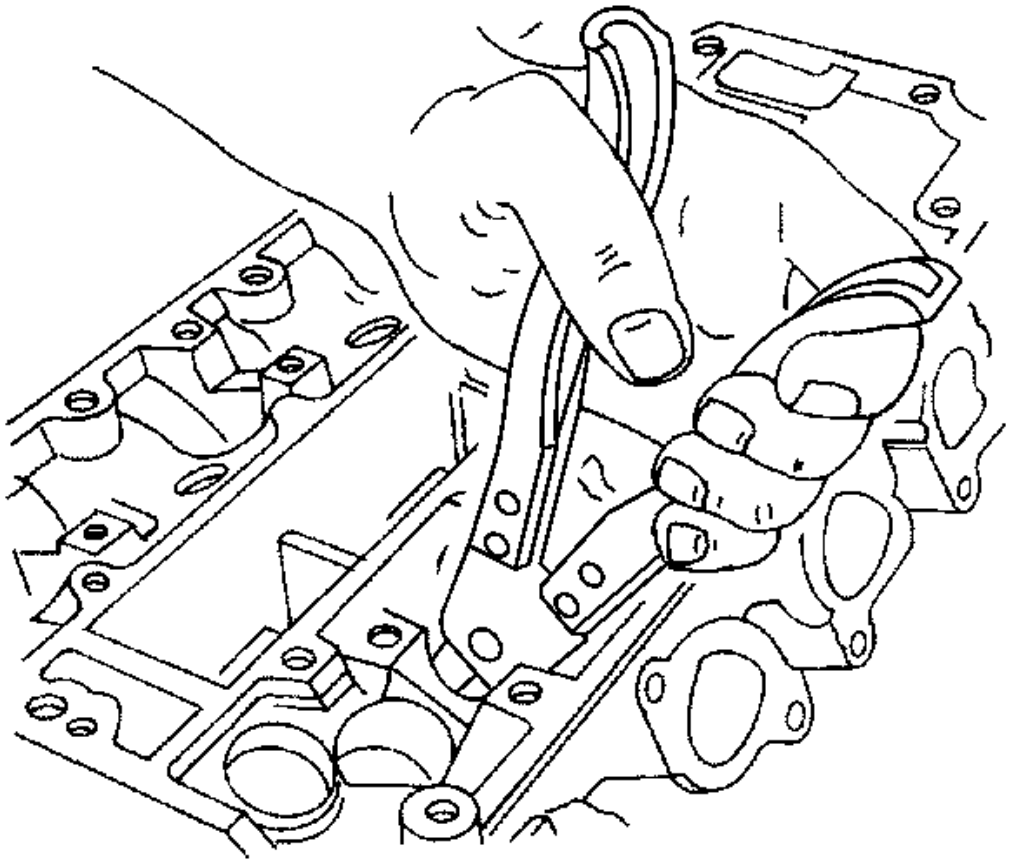

Fig. 195: Removing Valve Stem Seals
Courtesy of GENERAL MOTORS CORP.

32. Remove the valves. Maintain the original position of the valves for installation.
33. Remove the valve stem seals.

CYLINDER HEAD CLEANING AND INSPECTION

Cleaning Procedure

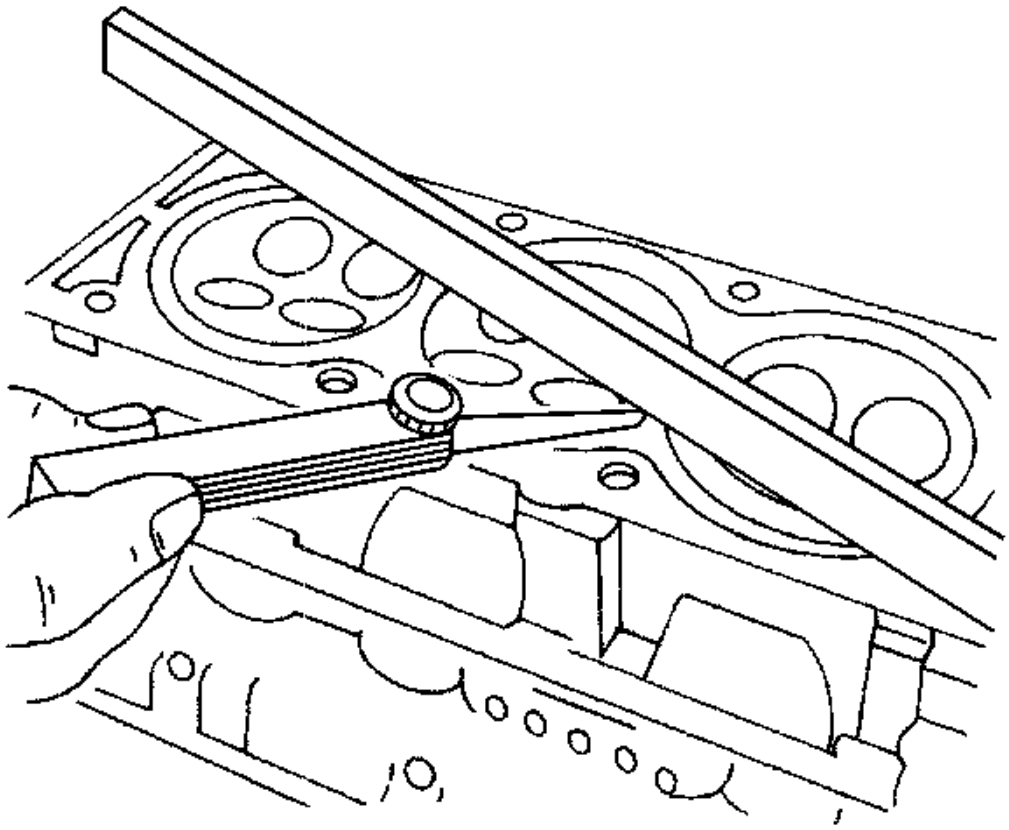

Fig. 196: Inspecting Cylinder Head
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

1. Clean the sealing surfaces.
2. Clean the cylinder head bolts.

Inspection Procedure

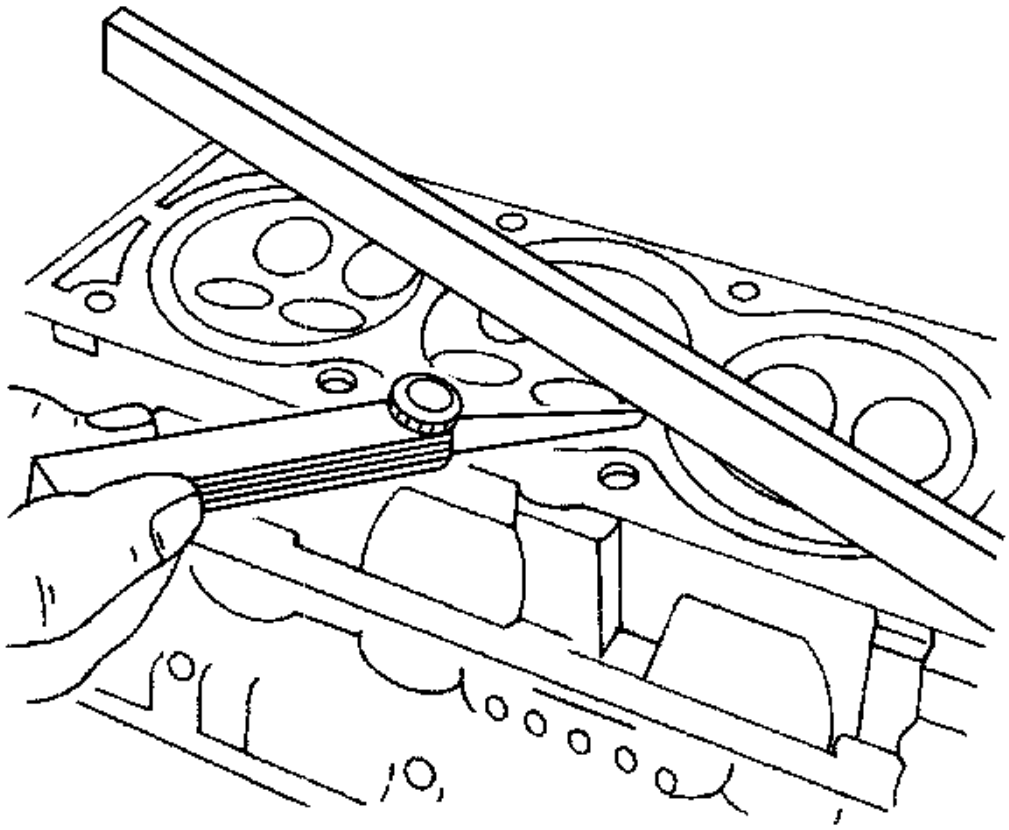

Fig. 197: Inspecting Cylinder Head
Courtesy of GENERAL MOTORS CORP.

1. Make sure the gasket surfaces of the cylinder head and the engine block are free of nicks and heavy scratches.
2. Inspect the cylinder head gasket and the mating surfaces for leaks, corrosion, and blow-by.
3. Inspect the cylinder head for cracks.
4. Inspect the length and the width of the cylinder head using a feeler gage and a straight edge.
5. Check the sealing surfaces for deformation and warpage. The cylinder head sealing surfaces must be flat within 0.025 mm (0.001 in) maximum.

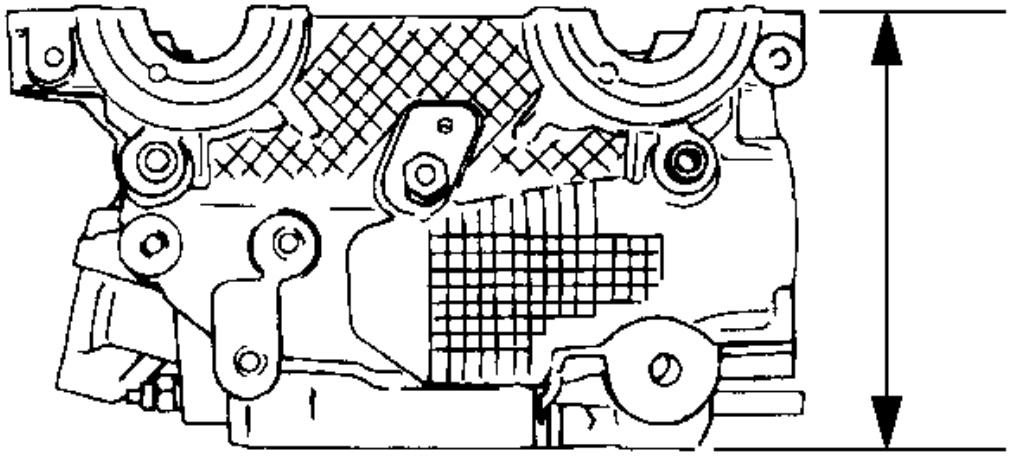

Fig. 198: Cylinder Head Height Measurement
Courtesy of GENERAL MOTORS CORP.

6. Measure the height of the cylinder head from sealing surface to sealing surface. The cylinder head height should be 133.975-134.025 mm (5.274-5.276 in). If the cylinder head height is less than 133.9 mm (5.271 in), replace the cylinder.
7. Inspect all threaded holes for damage.
8. Inspect the valve seats for excessive wear and burned spots.

CYLINDER HEAD ASSEMBLE

Tools Required

- **J 8062** Valve Spring Compressor - Head OFF. See **Special Tools** .
- **KM-653-A** Adapter. See **Special Tools** .

Assembly Procedure

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

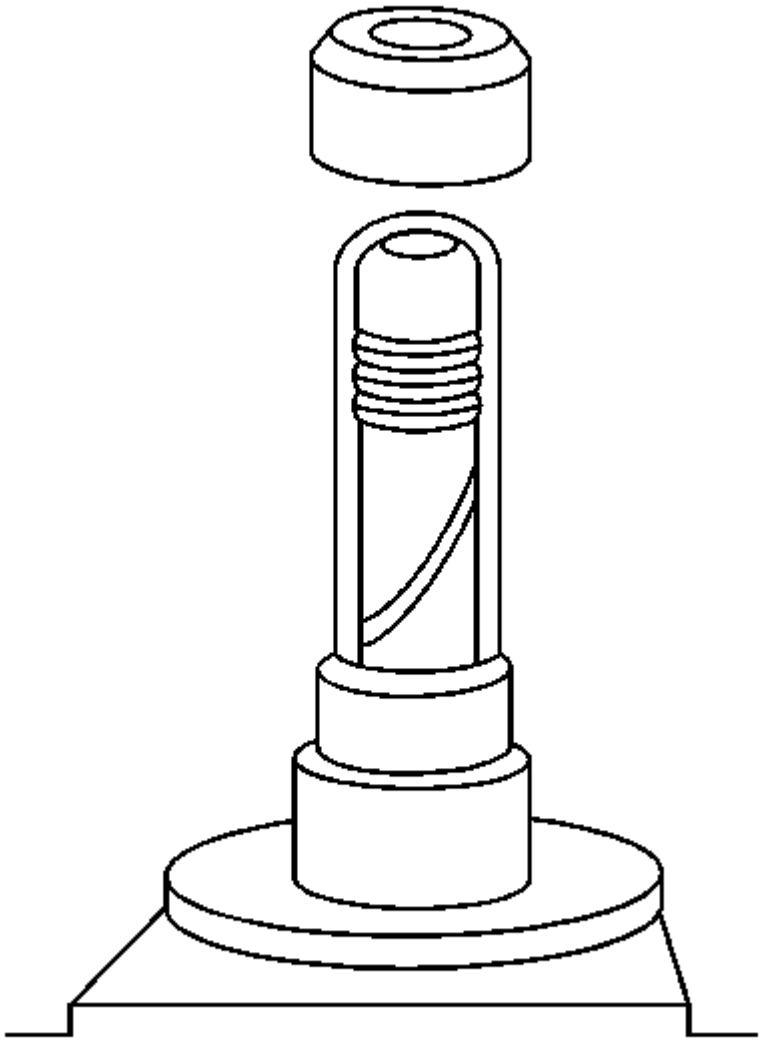

Fig. 199: View Of Oil Coated Valve Stem And Seat
Courtesy of GENERAL MOTORS CORP.

1. Coat the valve stems with engine oil.
2. Insert the valves in the cylinder head in their original positions.
3. Insert the valve spring seats.

CAUTION: Refer to Compressed Valve Spring Caution in Cautions and Notices.

4. Push the accompanying assembly sleeve onto the valve stem.
5. Insert the new valve stem seat.
6. Carefully drive the valve stem seal onto the stop with light taps.
7. Install the valve springs in their original positions.
8. Install the valve springs caps.

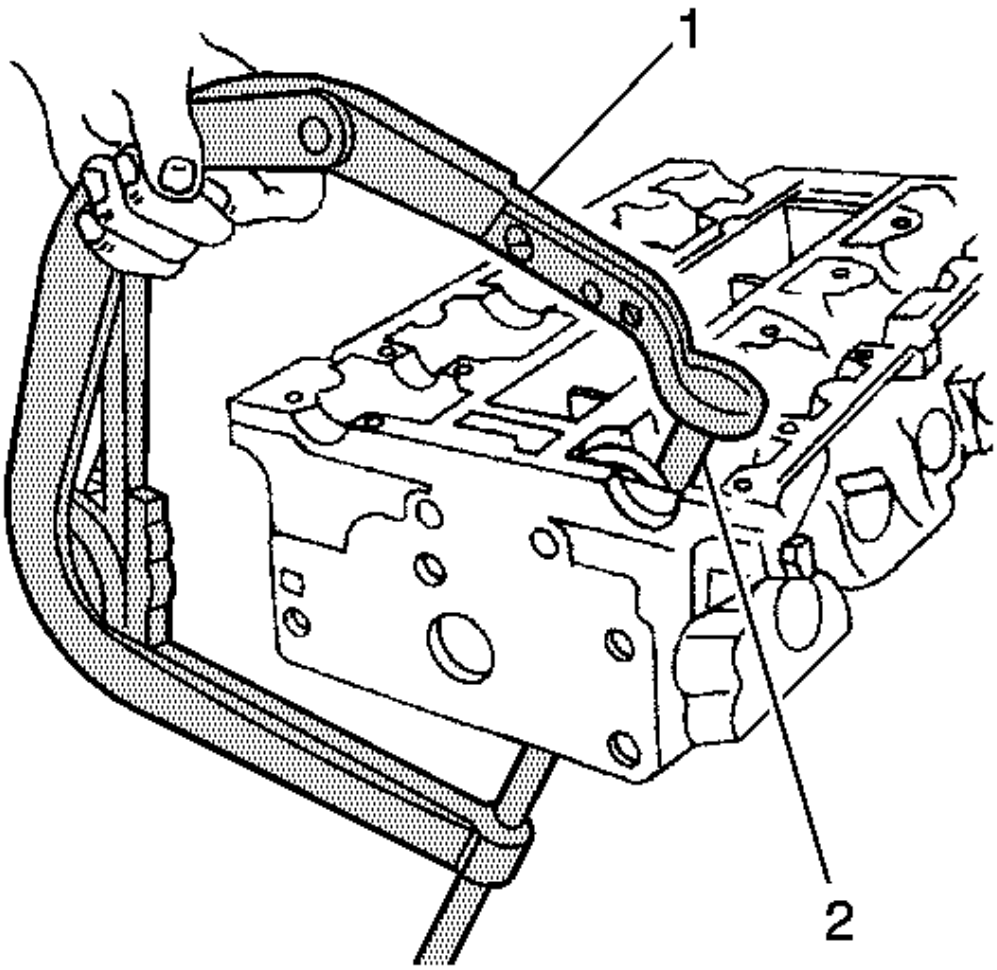

Fig. 200: Compressing Valve Springs
Courtesy of GENERAL MOTORS CORP.

9. Compress the valve springs with the **J 8062** (1) and **KM-653-A** (2). See **Special Tools** .
10. Install the valve retainers.

11. Remove the **J 8062** (1) and **KM-653-A** (2). See **Special Tools** .

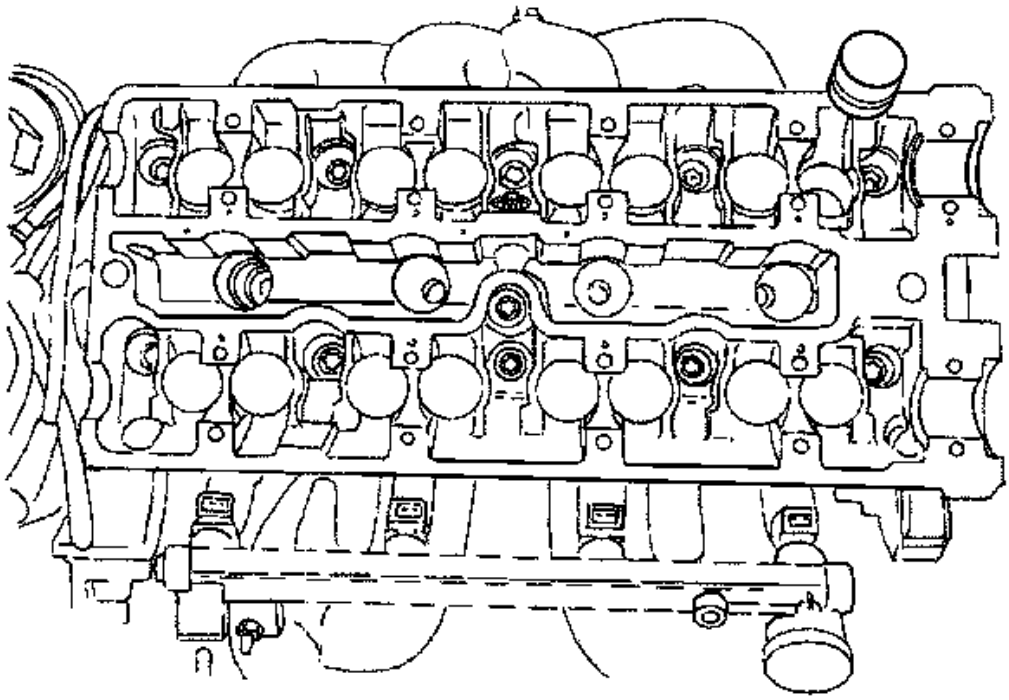

Fig. 201: View Of Valve Lash Adjusters
Courtesy of GENERAL MOTORS CORP.

12. Lubricate the valve lash adjusters with engine oil.
13. Install the valve lash adjusters.

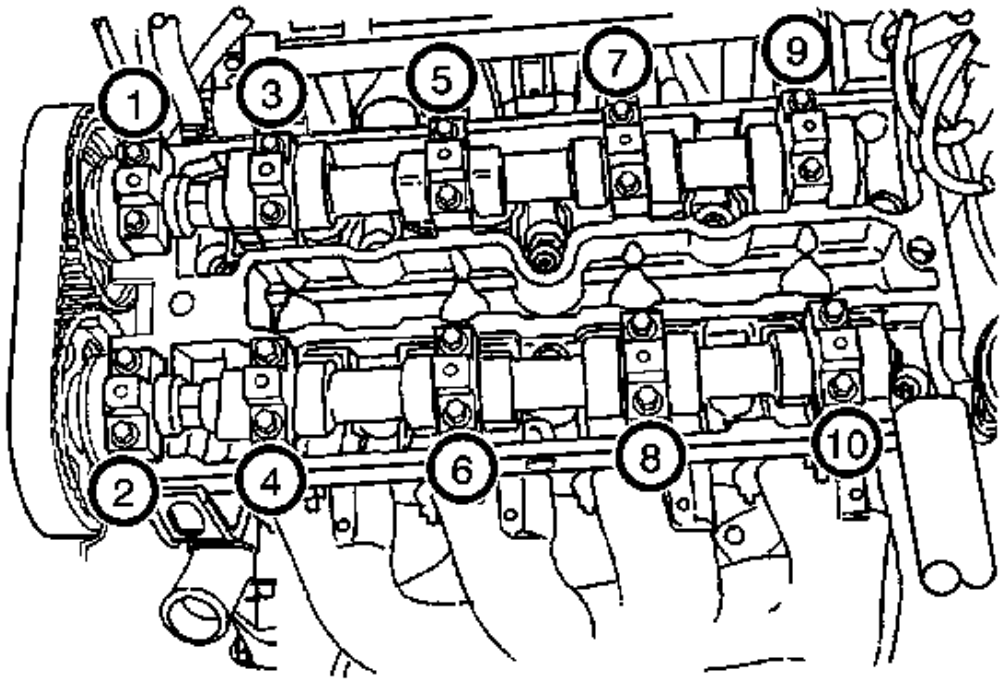

Fig. 202: View Of Camshaft Bearing Caps And Bolts
Courtesy of GENERAL MOTORS CORP.

14. Install the intake camshaft.
15. Install the intake camshaft bearing caps in their original positions.
16. Install the exhaust camshaft.
17. Install the exhaust camshaft bearing caps in their original positions.
18. Install the camshaft bearing cap bolts.

NOTE: Refer to Fastener Notice in Cautions and Notices.

19. Tighten the camshaft bearing cap bolts gradually and in the sequence shown for each camshaft cap.

    Tighten: Tighten the camshaft bearing cap bolts to **8 N.m (71 lb in)** .

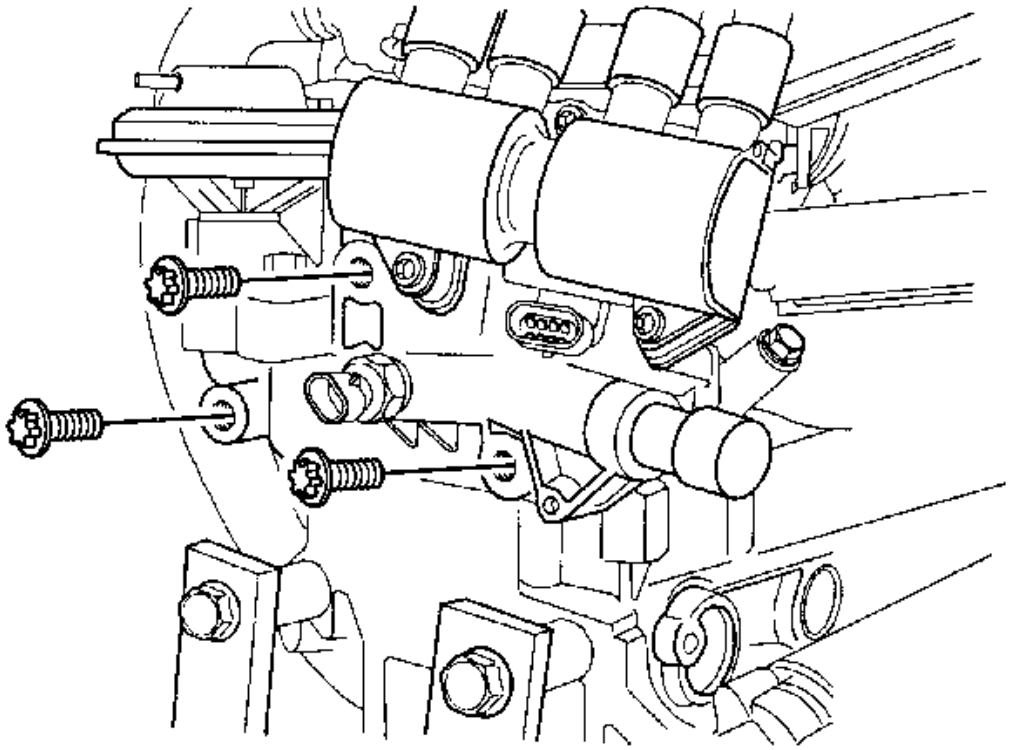

Fig. 203: View Of Ignition Coil, EGR Mounting Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

20. Install the spark plugs.

    Tighten: Tighten the spark plugs to **20 N.m (15 lb ft)** .

21. Install the ignition coil and exhaust gas recirculation (EGR) mounting bracket and bolt.

    Tighten: Tighten the ignition coil and EGR mounting bracket bolts to **25 N.m (18 lb ft)** .

22. Install the ignition coil and EGR.

    Tighten: Tighten the ignition coil and EGR to **10 N.m (89 lb ft)** .

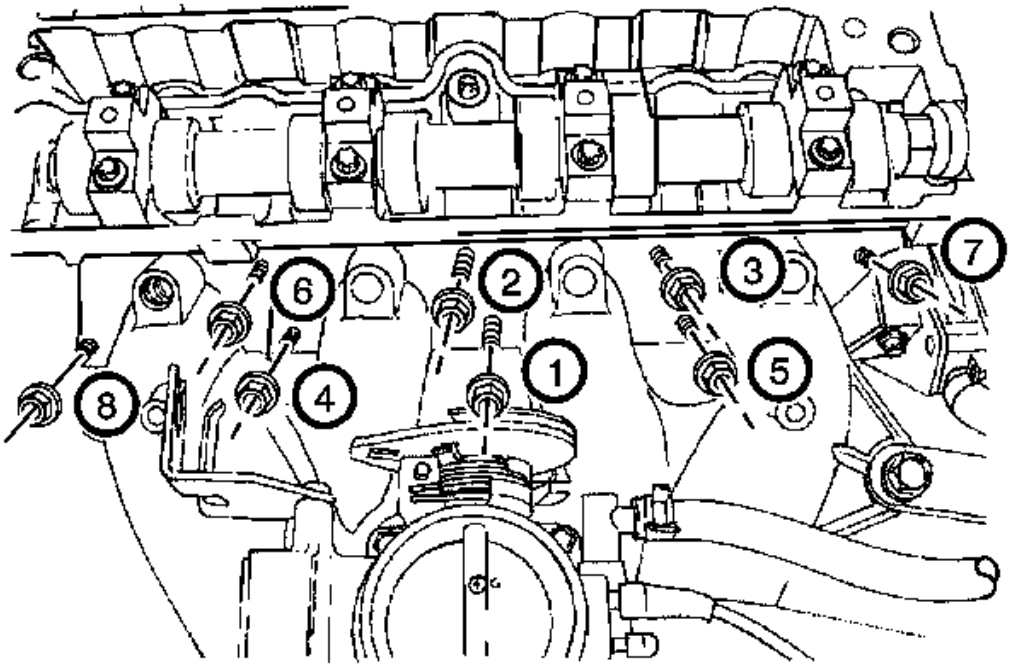

Fig. 204: View Of Intake Manifold Retaining Nut Installation Sequence
Courtesy of GENERAL MOTORS CORP.

23. Install the intake manifold studs.
24. Install the intake manifold gasket.
25. Install the intake manifold.
26. Install the intake manifold retaining nuts and retaining bolts in the sequence shown.

Tighten: Tighten the intake manifold retaining nuts and retaining bolts to **22 N.m (16 lb ft)** .

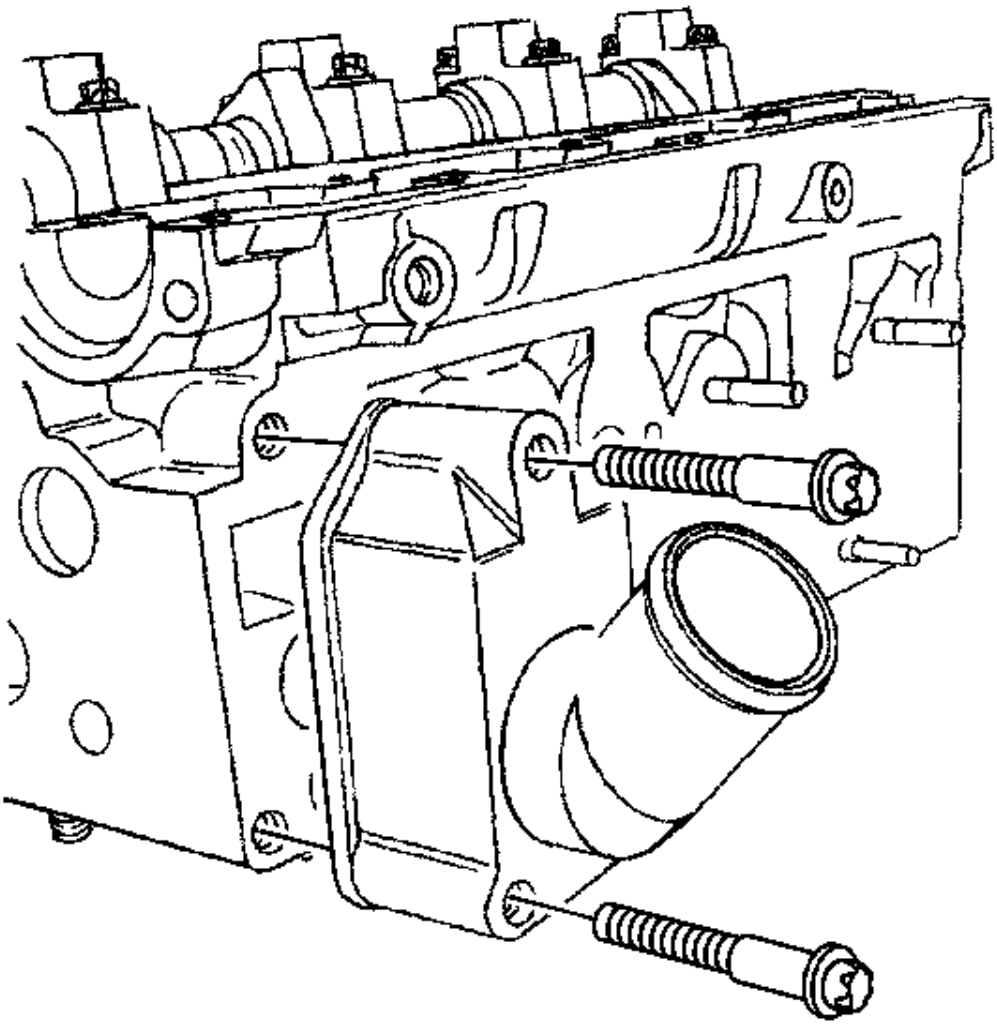

Fig. 205: View Of Thermostat Housing And Bolts
Courtesy of GENERAL MOTORS CORP.

27. Install the fuel rail assembly. Refer to **Fuel Rail Assembly Replacement** in Engine Controls - 2.0L.
28. Install the thermostat housing assembly.
29. Install the thermostat housing mounting bolts.

    Tighten: Tighten the thermostat housing mounting bolts to **15 N.m (11 lb ft)** .

30. Install the coolant bypass housing bolts.

Tighten: Tighten the coolant bypass housing bolts to **15 N.m (11 lb ft)** .

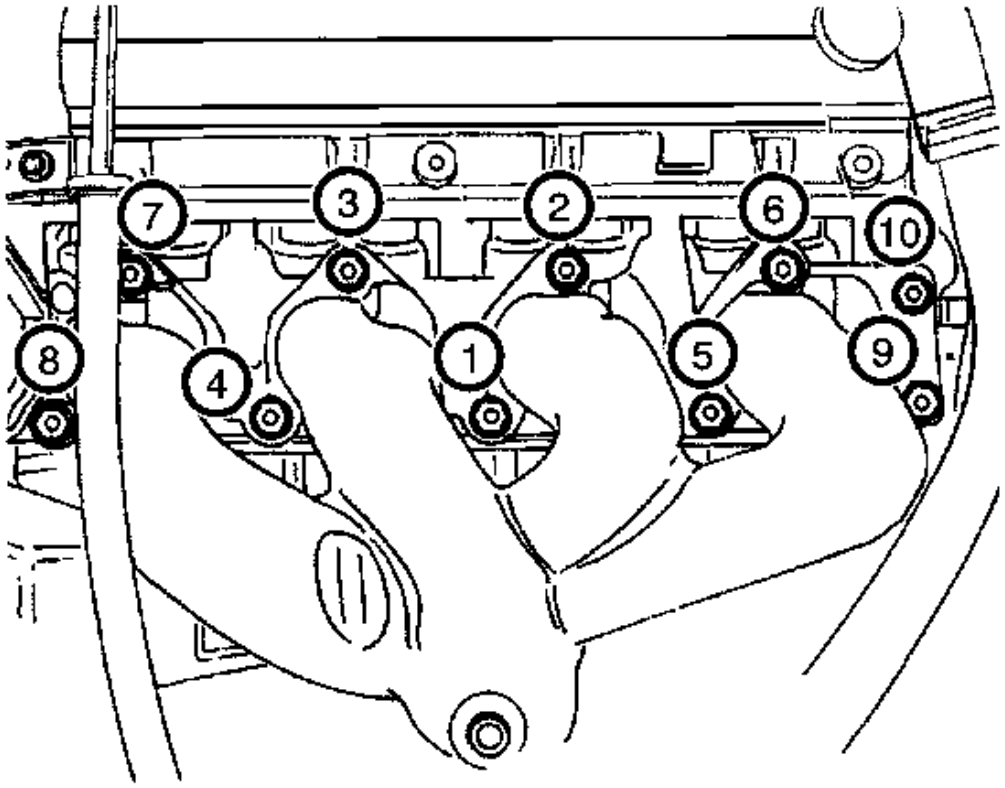

Fig. 206: View Of Exhaust Manifold Retaining Nut Installation Sequence
Courtesy of GENERAL MOTORS CORP.

31. Install the exhaust manifold studs.
32. Install the exhaust manifold gasket.
33. Install the exhaust manifold.
34. Install the exhaust manifold retaining nuts in the sequence shown.

    Tighten: Tighten the exhaust manifold retaining nuts to **22 N.m (16 lb ft)** .

35. Install the exhaust manifold heat shield.
36. Install the exhaust manifold heat shield bolts.

    Tighten: Tighten the exhaust manifold heat shield bolts to **8 N.m (71 lb in)** .

37. Install the cylinder head with the intake manifold and the exhaust manifold attached. Refer to **Cylinder Head Replacement**.

CRANKSHAFT REPLACEMENT

Tools Required

- **OTC 1726** (KM-412) Engine Overhaul Stand or equivalent. See **Special Tools** .
- **J 45059** Angle Meter. See **Special Tools** .
- **KM-470-B** Angular Torque Gage. See **Special Tools** .
- **J 36972** or **KM-635** Crankshaft Rear Oil Seal Installer. See **Special Tools** .

Disassembly Procedure

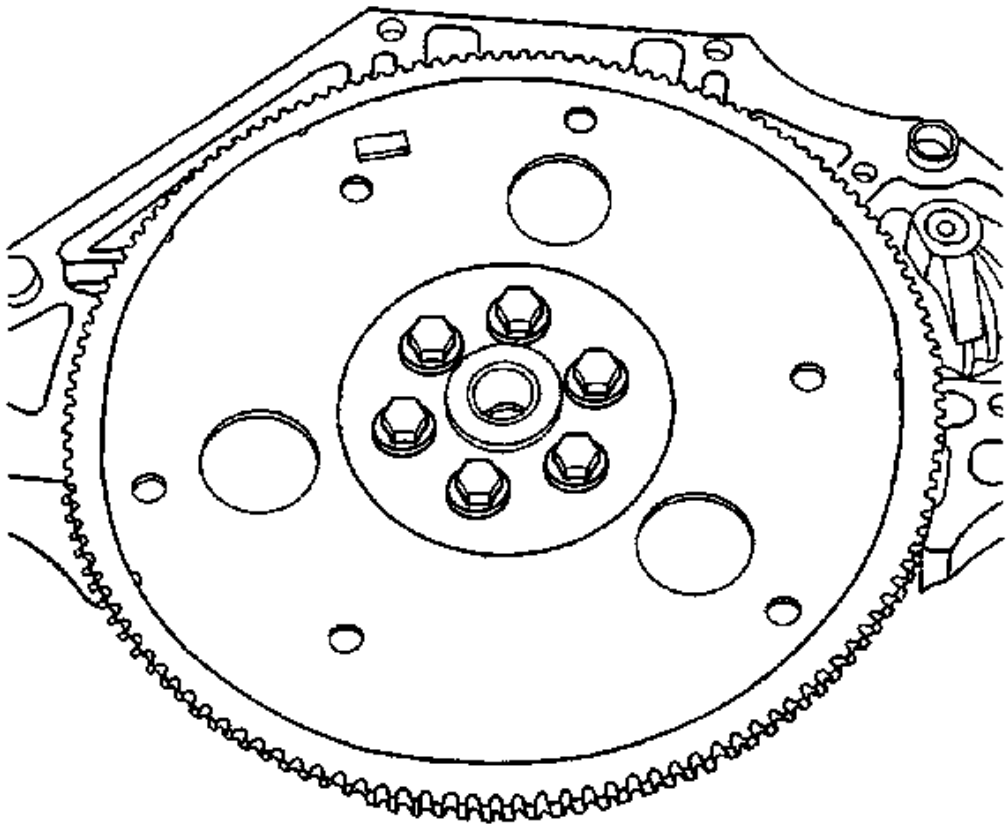

Fig. 207: View Of Flexplate And Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

NOTE: Use extreme care when installing the camshaft not to nick, scratch, or damage the camshaft lobes or bearing surfaces.

1. Remove the engine. Refer to **Engine Replacement**.
2. Remove the flywheel or the flexible plate bolts.
3. Remove the flywheel or the flexible plate.

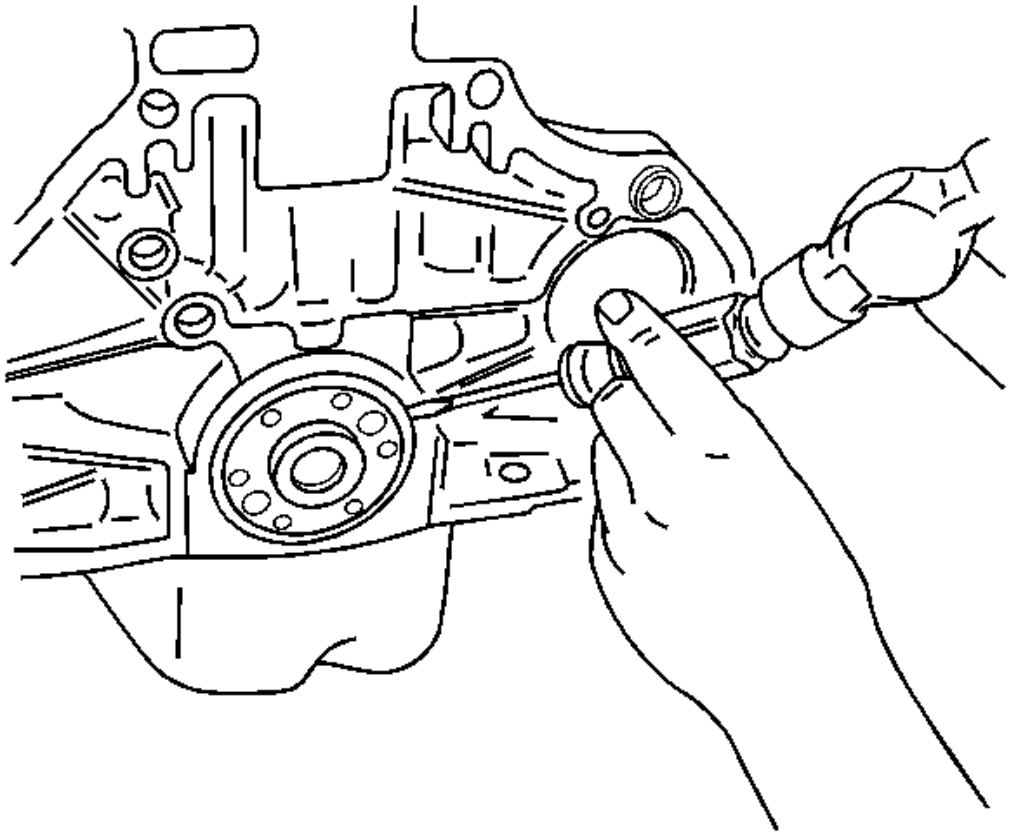

Fig. 208: Removing Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

4. Remove the crankshaft rear oil seal.
5. Mount the engine assembly on the **OTC 1726** . See **Special Tools** .

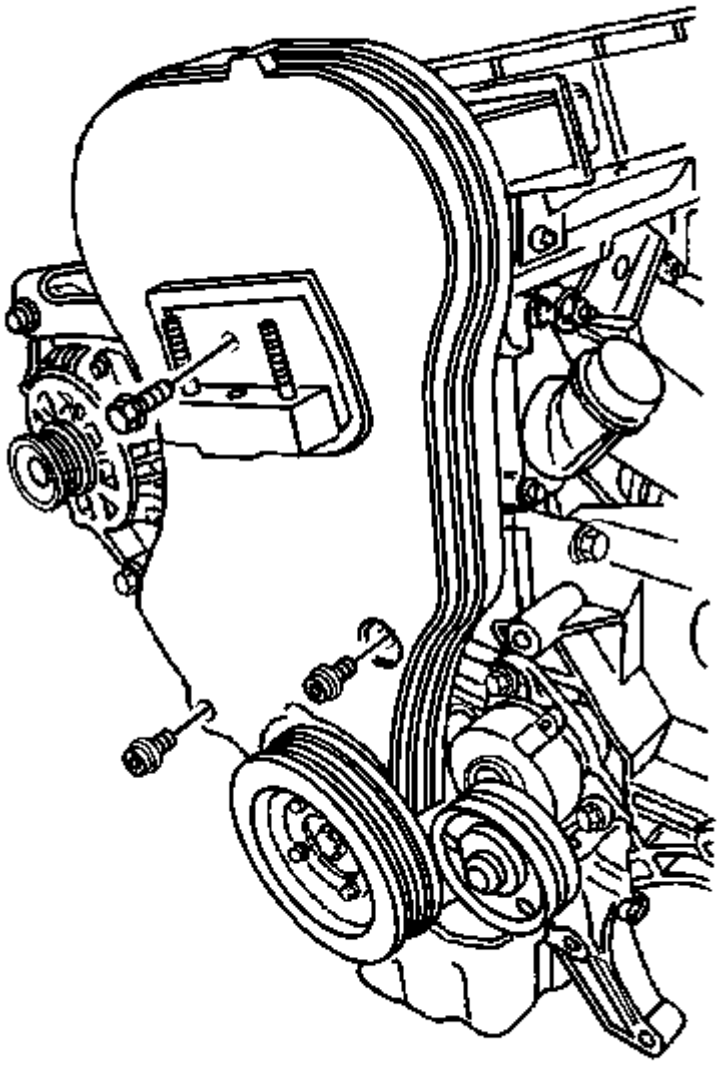

Fig. 209: View Of Front Timing Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the front timing belt cover bolts.
7. Remove the front timing belt cover.
8. Remove the crankshaft pulley bolts.
9. Remove the crankshaft pulley.

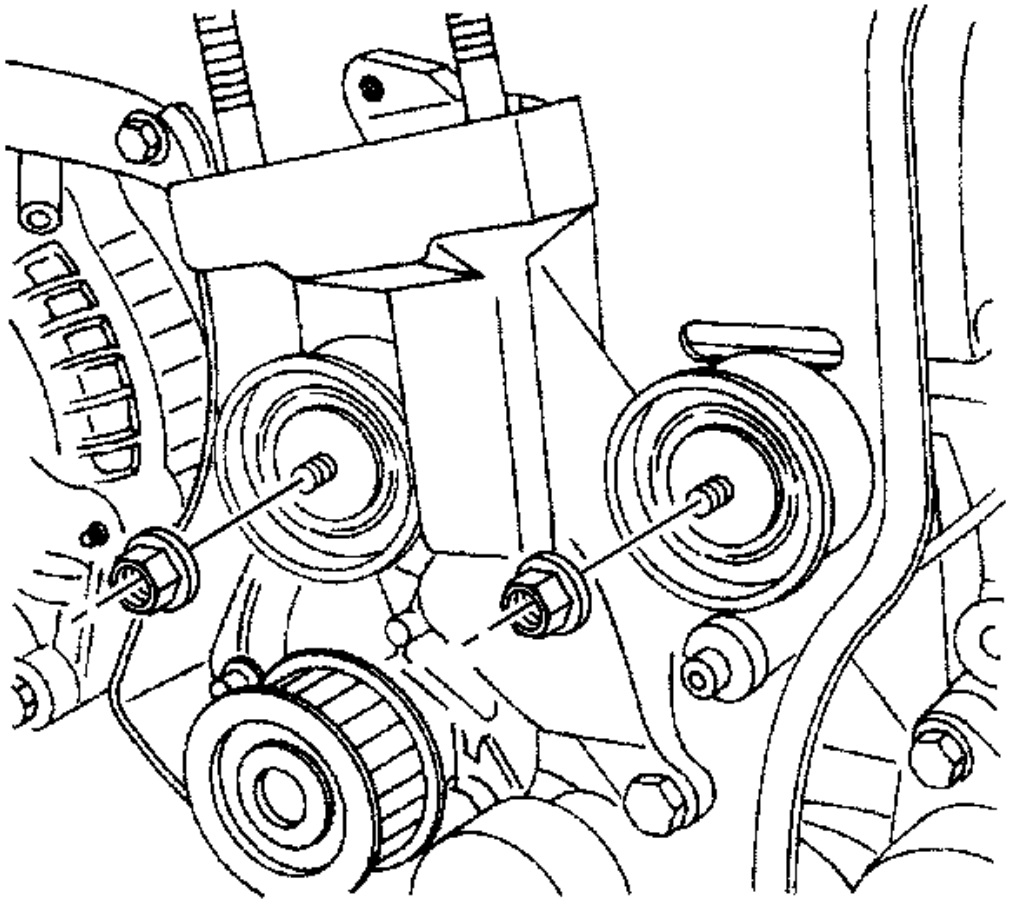

Fig. 210: View Of Timing Belt Idler Pulleys And Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

10. Loosen the timing belt automatic tensioner bolt.
11. Rotate the timing belt automatic tensioner hex-key clockwise to release the tension.
12. Remove the timing belt idler pulley nuts.
13. Remove the timing belt idler pulleys.
14. Remove the timing belt.
15. Remove the engine mount retaining bolt.
16. Remove the engine mount.

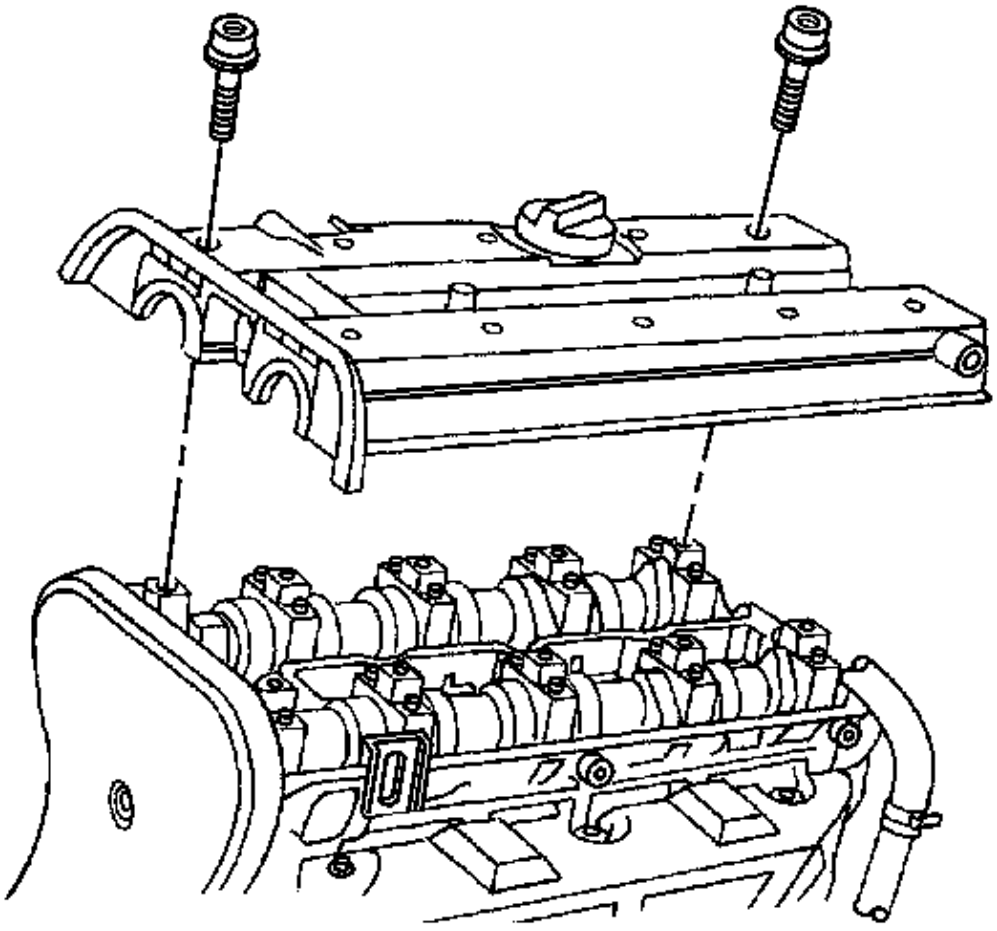

Fig. 211: View Of Valve Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

17. Disconnect the crankcase breather tubes from the valve cover.
18. Remove the spark plug cover bolts.
19. Remove the spark plug cover.
20. Disconnect the ignition wires from the spark plugs.
21. Remove the valve cover bolts.
22. Remove the valve cover washers.
23. Remove the valve cover and the valve cover gasket.

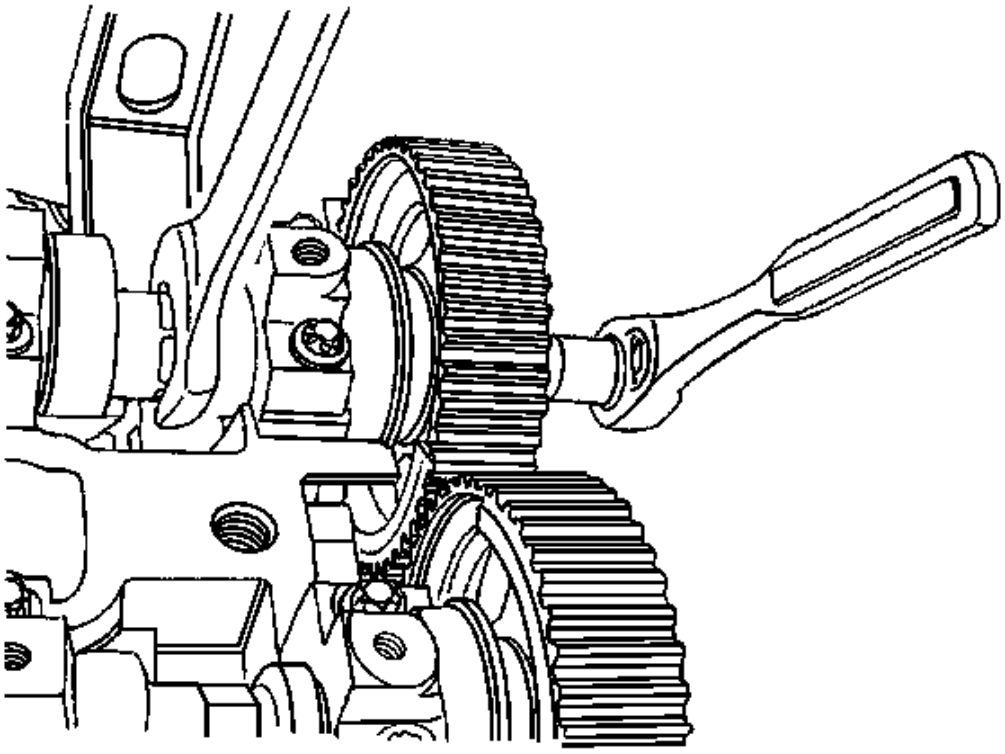

Fig. 212: Removing/Installing Intake Camshaft Gear Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Use extreme care when installing the camshaft not to nick, scratch, or damage the camshaft lobes or bearing surfaces.

24. While holding the intake camshaft firmly in place, remove the intake camshaft bolt.
25. Remove the intake camshaft gear.
26. While holding the exhaust camshaft firmly in place, remove the exhaust camshaft bolt.
27. Remove the exhaust camshaft gear.

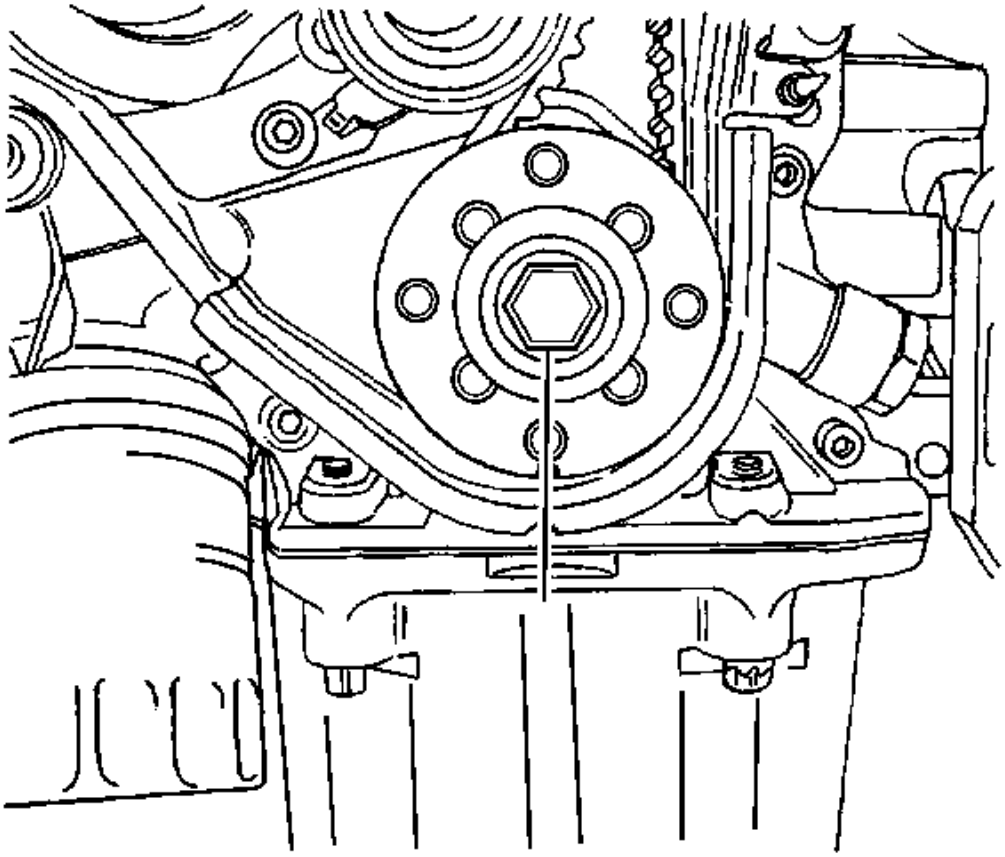

Fig. 213: Identifying Crankshaft Gear Bolt
Courtesy of GENERAL MOTORS CORP.

28. Remove the crankshaft timing belt gear.

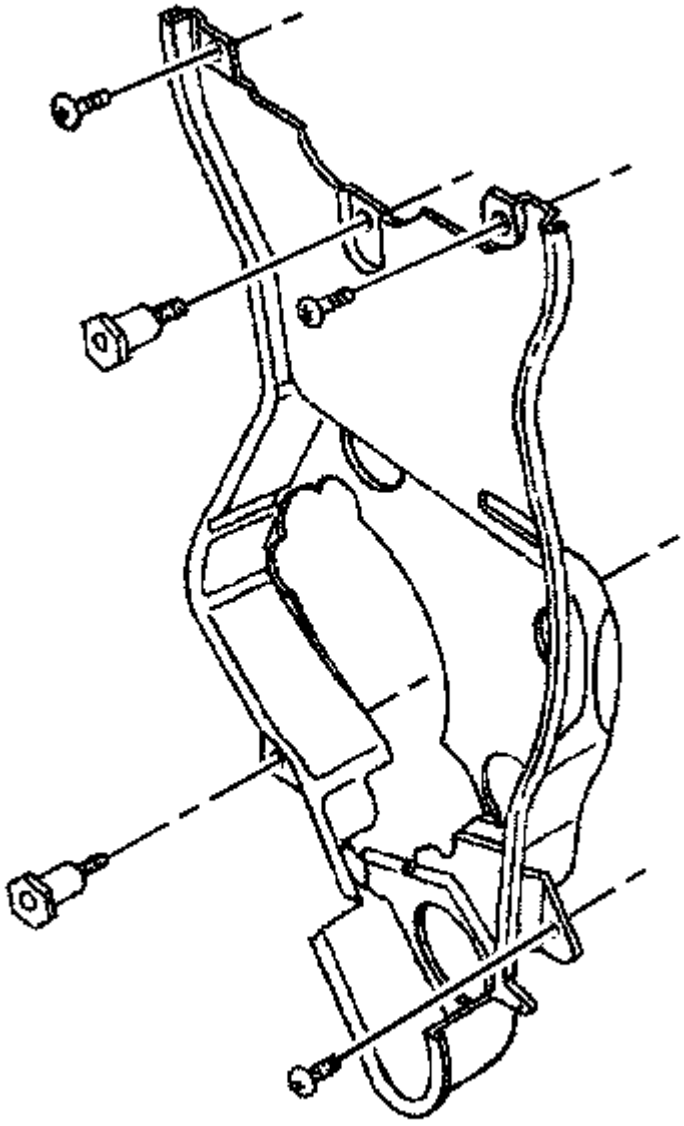

Fig. 214: View Of Rear Timing Belt Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

29. Remove the rear timing belt cover bolts and cover.

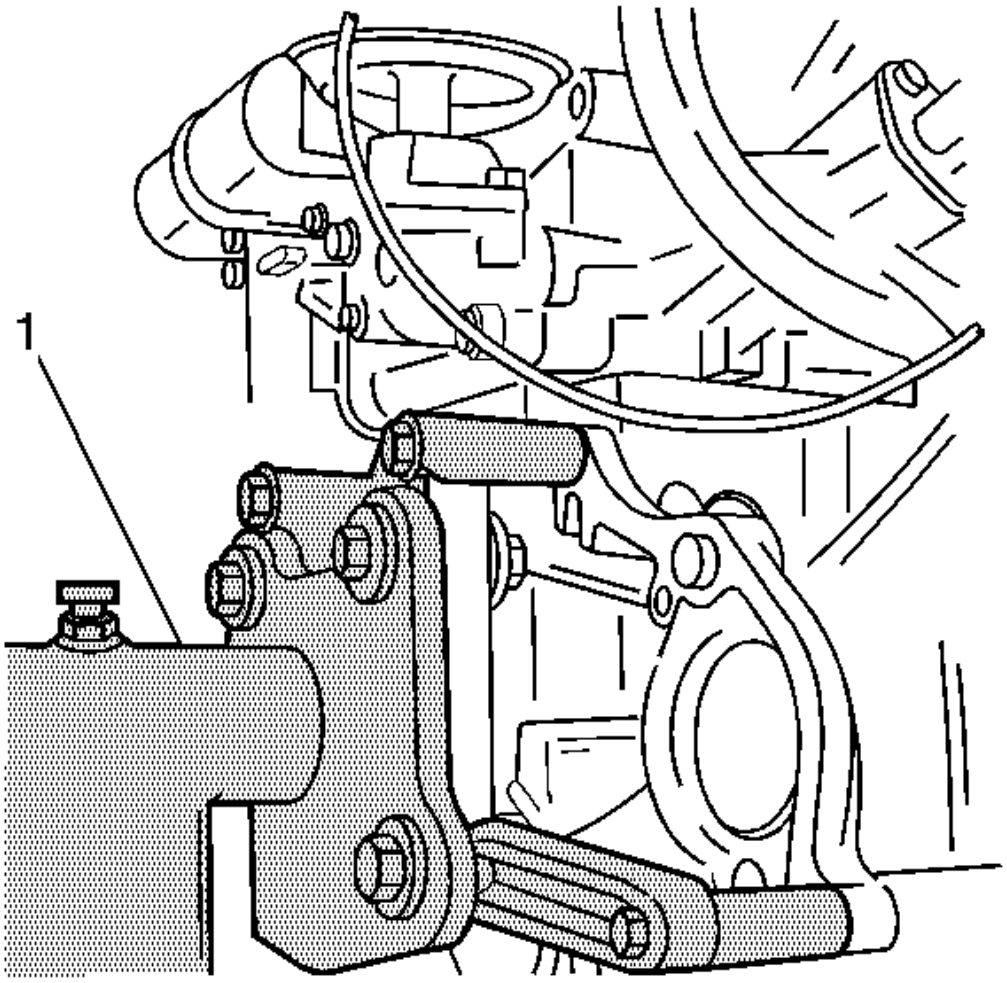

Fig. 215: View Of OTC 1726 And Engine
Courtesy of GENERAL MOTORS CORP.

30. Rotate the engine on the **OTC 1726** (1). See **Special Tools** .

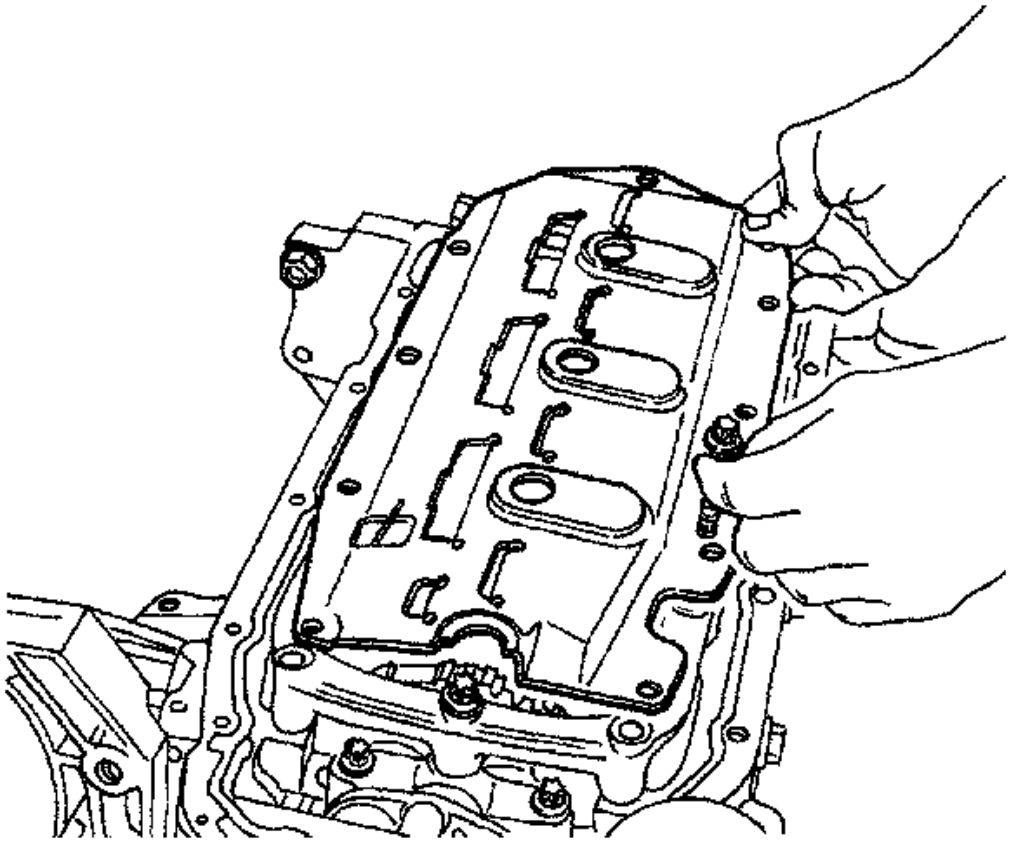

Fig. 216: View Of Oil Pan Retaining Bolt
Courtesy of GENERAL MOTORS CORP.

31. Remove the oil pan retaining bolts.
32. Remove the oil pan.
33. Remove the oil pump/pickup tube bolts.
34. Remove the oil pump/pickup tube.
35. Remove the lower block support bracket/splash shield bolts.
36. Remove the splash shield.
37. Remove the lower block support bracket bolts.
38. Remove the lower block support bracket.

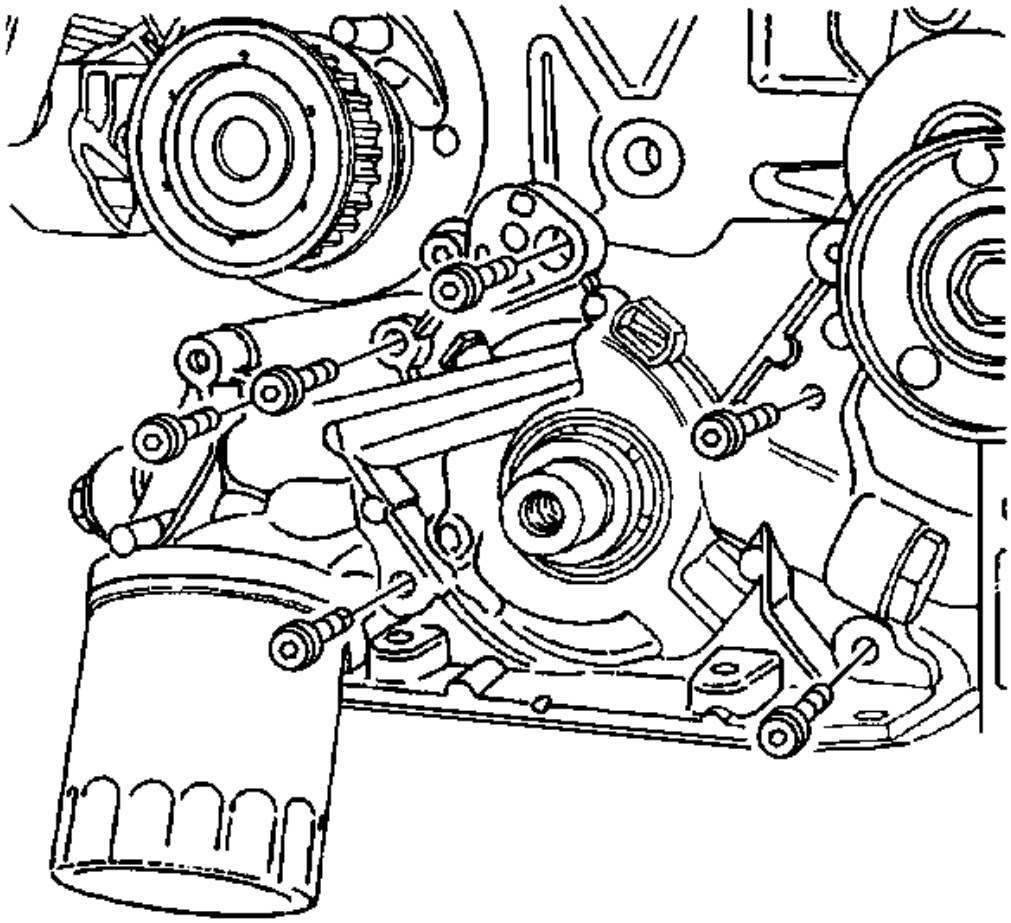

Fig. 217: View Of Oil Pump And Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

39. Remove the oil pump retaining bolts.
40. Remove the oil pump.

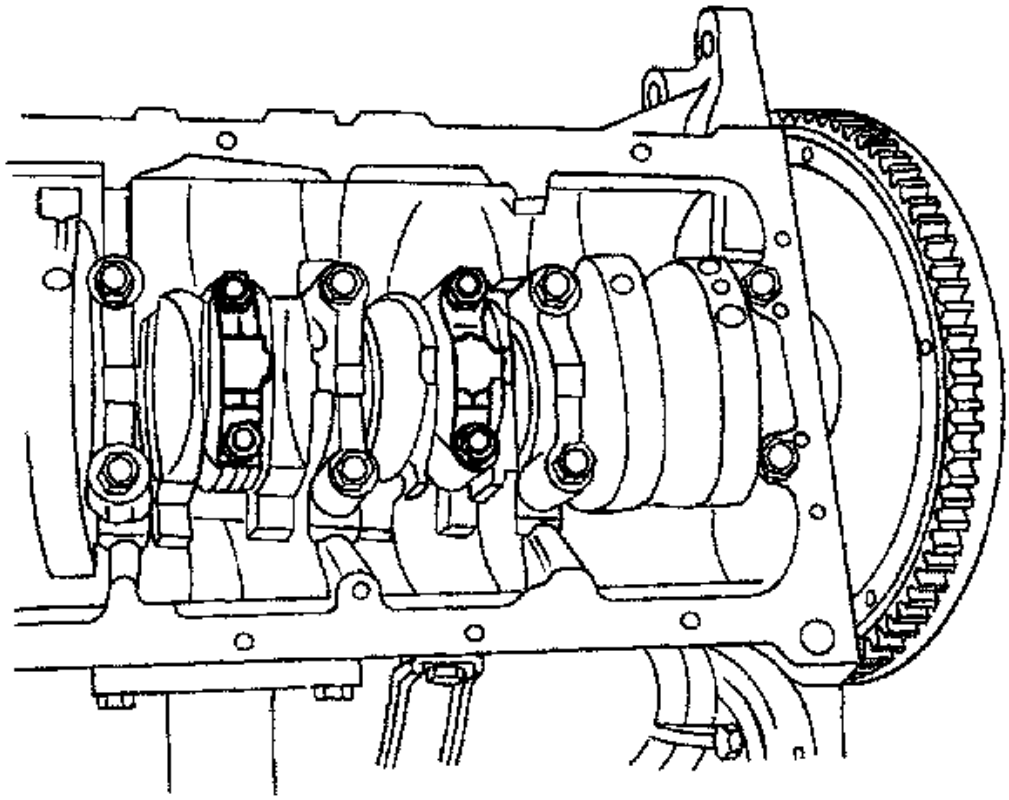

Fig. 218: View Of Connecting Rods And Bearing Caps
Courtesy of GENERAL MOTORS CORP.

41. Mark the order of the connecting rod bearing caps.
42. Remove the connecting rod bearing cap bolts for all of the pistons.
43. Remove the connecting rod bearing caps and the lower connecting rod bearings.

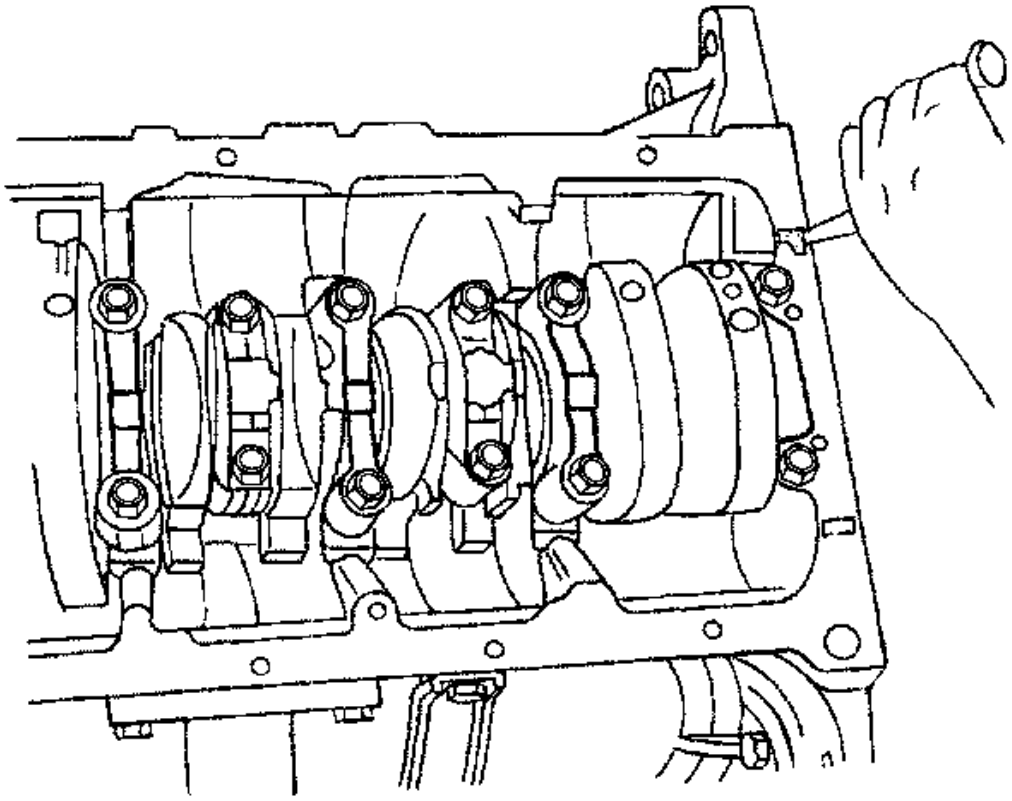

Fig. 219: Cleaning Gasket Remnants From Mating Surface
Courtesy of GENERAL MOTORS CORP.

44. Mark the order of the crankshaft bearing caps.
45. Remove the crankshaft bearing cap bolts.
46. Remove the crankshaft bearing caps and the lower crankshaft bearings.
47. Remove the crankshaft.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

48. Clean any necessary parts.

Assembly Procedure

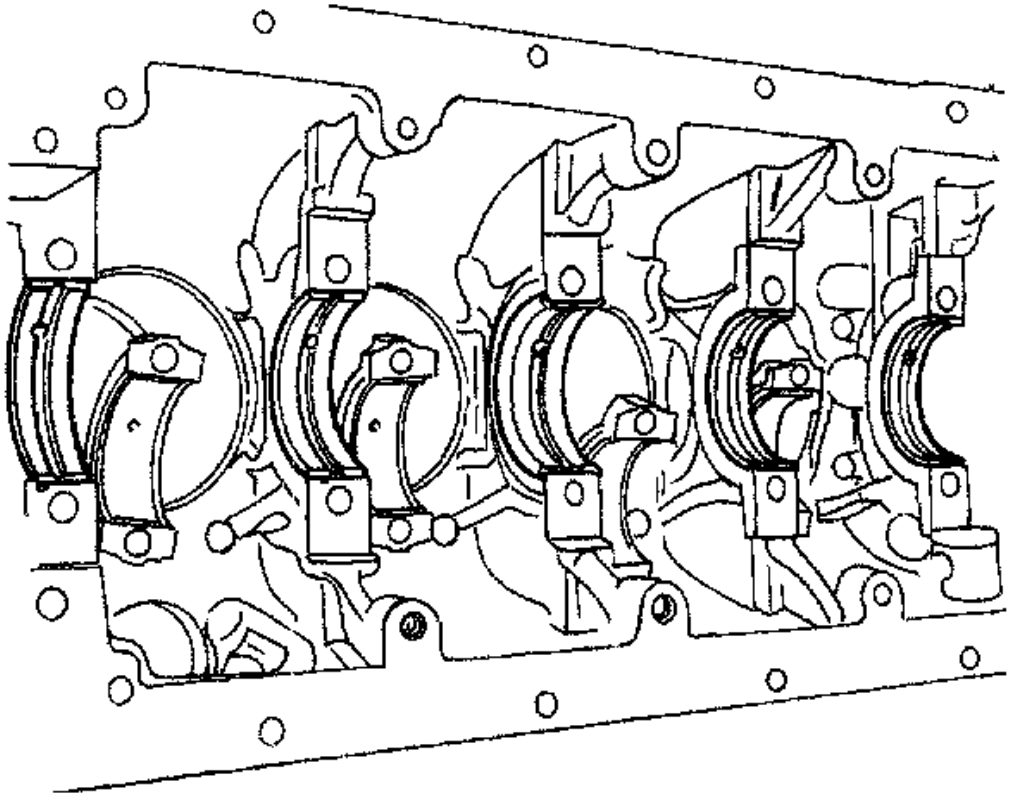

Fig. 220: View Of Crankshaft Bearings
Courtesy of GENERAL MOTORS CORP.

1. Coat the crankshaft bearings with engine oil.
2. If replacing the crankshaft, transfer the pulse pickup sensor disc to the new crankshaft.

Tighten: Tighten the pulse pickup sensor disc to **13 N.m (115 lb in)** .

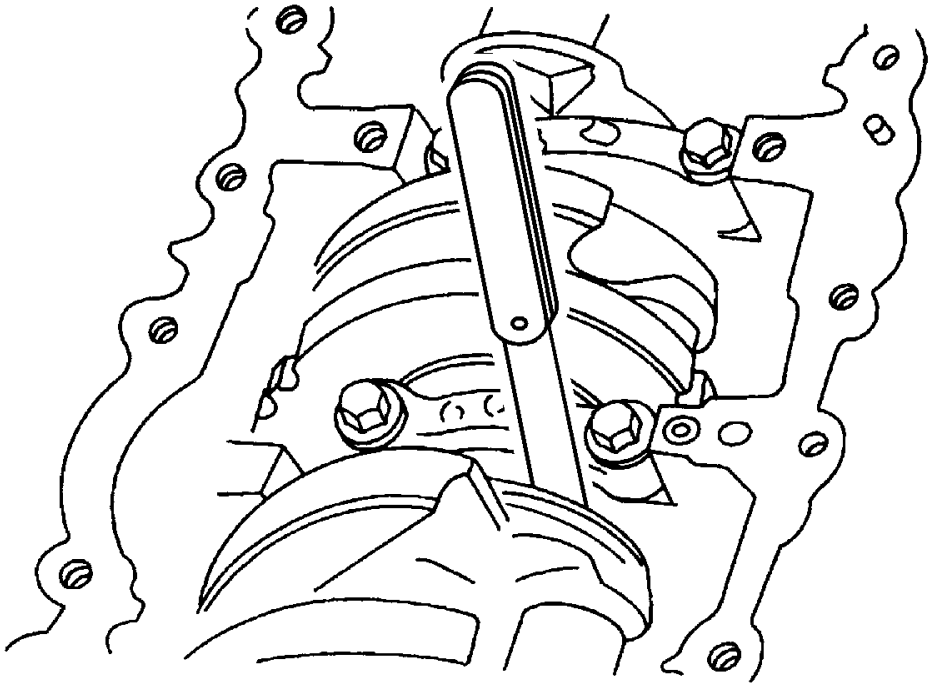

Fig. 221: Inspecting Crankshaft End Play
Courtesy of GENERAL MOTORS CORP.

3. Install the crankshaft.
4. Install the lower crankshaft bearings in the bearing caps.
5. Inspect the crankshaft end play with the crankshaft bearings installed.
6. Check for permissible crankshaft end play. Refer to **Engine Mechanical Specifications** .

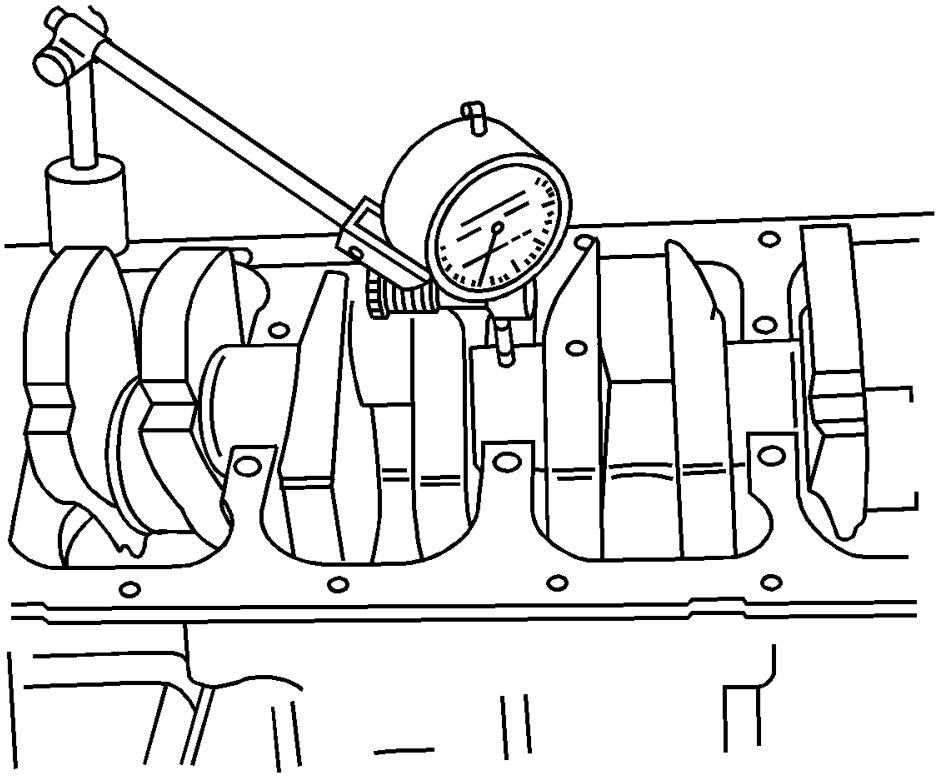

Fig. 222: Checking Crankshaft Journal For Out-Of-Round Runout
Courtesy of GENERAL MOTORS CORP.

7. With the crankshaft mounted on the front and rear crankshaft bearings, check the middle crankshaft journal for permissible out-of-round, runout. Refer to **Engine Mechanical Specifications** .

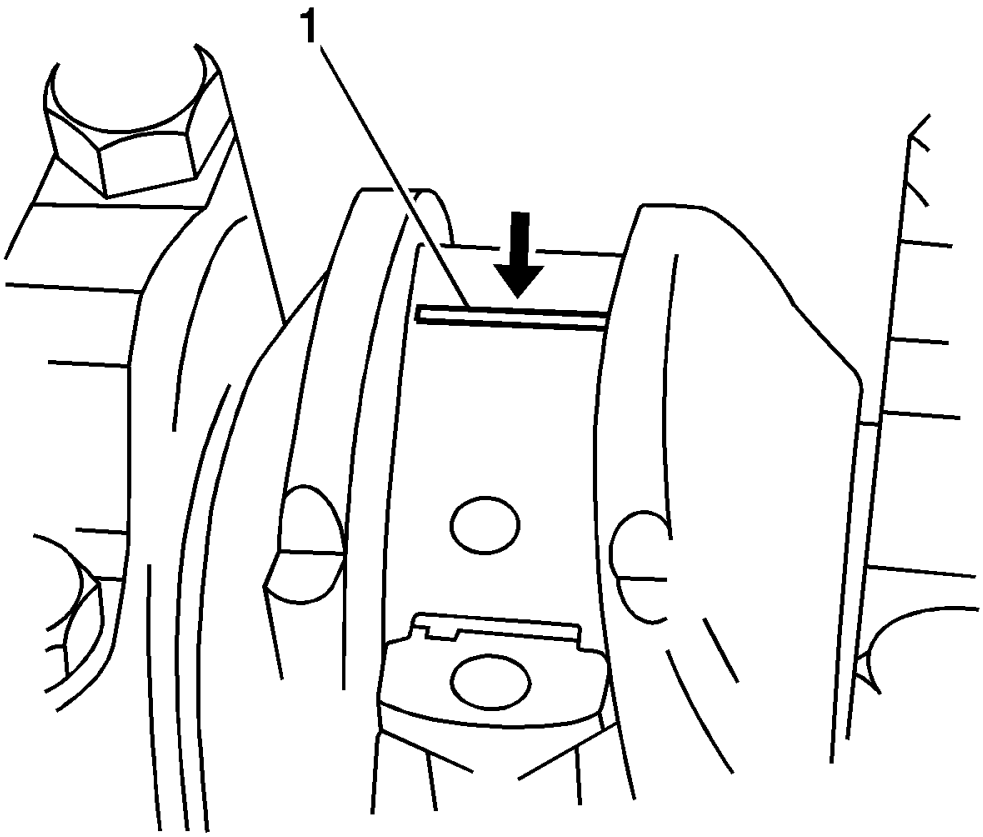

Fig. 223: View Of Plastigage On Journal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Grease the crankshaft journals and lubricate the crankshaft bearings slightly so that the plastic gaging thread does not tear when the crankshaft bearing caps are removed.

8. Measure all of the crankshaft bearing clearances using a commercially available plastic gaging, ductile plastic threads.
9. Cut the plastic gaging threads (1) to the length of the bearing width. Lay them axially between the crankshaft journals and the crankshaft bearings.

NOTE: Refer to Fastener Notice in Cautions and Notices.

10. Install the crankshaft bearing caps and the bolts.

Tighten: Tighten the crankshaft bearing cap bolts to **50 N.m (37 lb ft)** . Using the **J 45059** or the **KM-470-B** (1), tighten the bolt an additional turn of 45 degrees plus 15 degrees. See **Special Tools** .

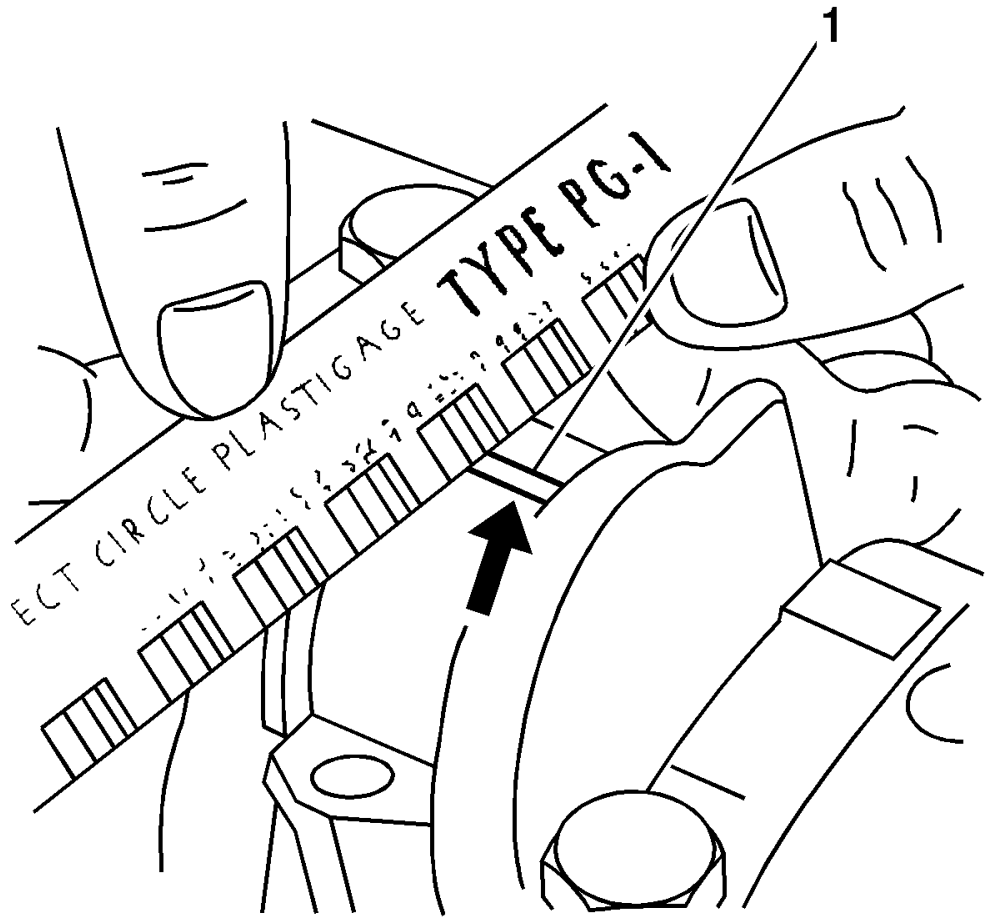

Fig. 224: Measuring Plastigage
Courtesy of GENERAL MOTORS CORP.

11. Remove the crankshaft bearing cap bolts and the caps.
12. Measure the width of the flattened plastic thread (1) of the plastic gaging using the scale printed on the plastic gaging package. Plastic gaging is available for different tolerance ranges.
13. Inspect the bearing clearance for permissible tolerance ranges. Refer to **Engine Mechanical Specifications** .

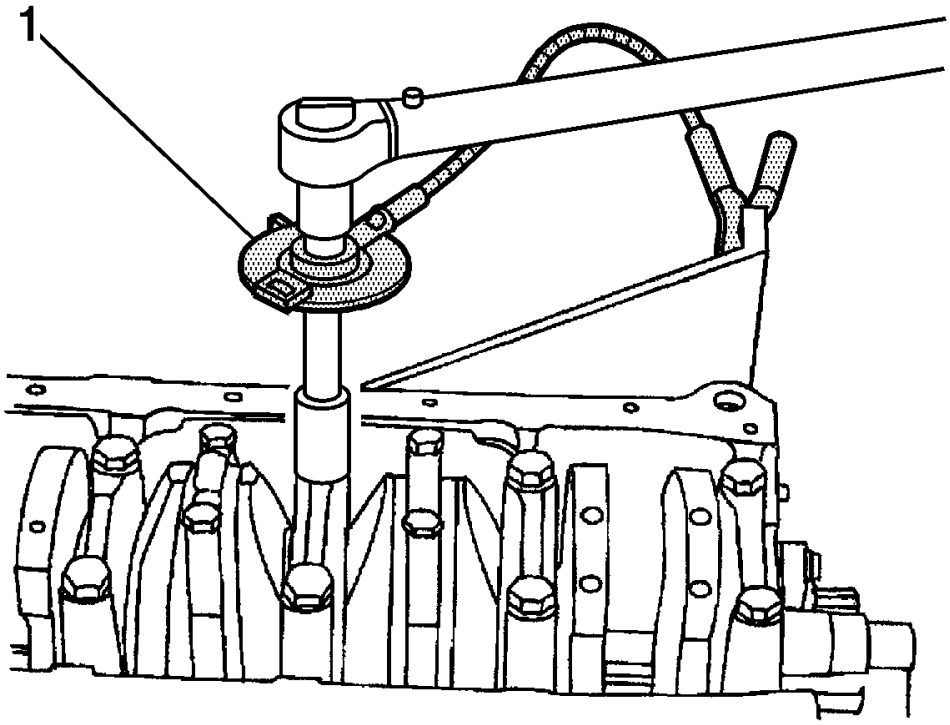

Fig. 225: Using J 45059 To Tighten Bearing Caps
Courtesy of GENERAL MOTORS CORP.

14. Apply a bead of adhesive sealing compound to the grooves of the crankshaft bearing caps.
15. Install the crankshaft bearing caps to the engine block.
16. Tighten the crankshaft bearing caps using new bolts.

Tighten: Tighten the crankshaft bearing cap bolts to **50 N.m (37 lb ft)** using a torque wrench. Using the **J 45059** or the **KM-470-B** (1), tighten the bolts an additional turn of 45 degrees, plus another turn of 15 degrees. See **Special Tools** .

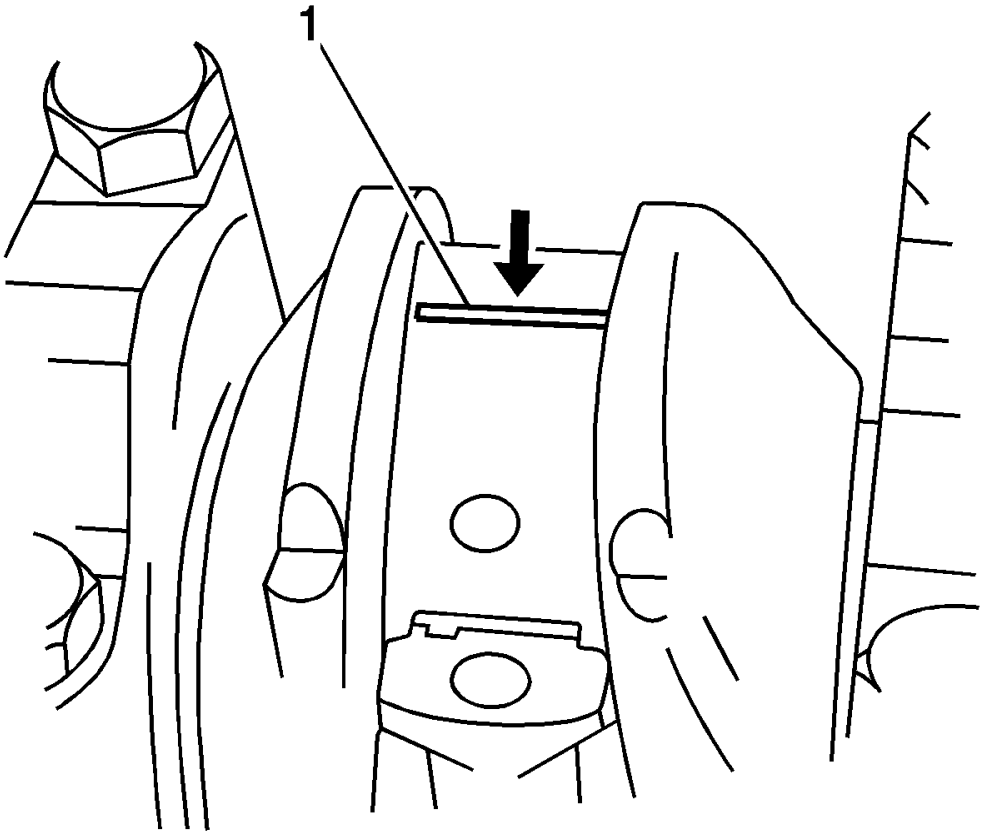

Fig. 226: View Of Plastigage On Journal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Grease the connecting rod journals and lubricate the connecting rod bearings slightly so that the plastic gaging thread does not tear when the connecting rod bearing caps are removed.

17. Measure all of the connecting rod bearing clearances using a commercially available plastic gaging, ductile plastic threads.
18. Cut the plastic gaging threads (1) to the length of the connecting rod bearing width. Lay them axially between the connecting rod journals and the connecting rod bearings.
19. Install the connecting rod bearing caps.

    Tighten: Tighten the connecting rod bearing cap bolts to **35 N.m (26 lb ft)** using a torque wrench. Use the **J 45059** or the **KM-470-B** to tighten the connecting rod bearing cap bolts to plus 45 degrees plus 15 degrees. See **Special Tools** .

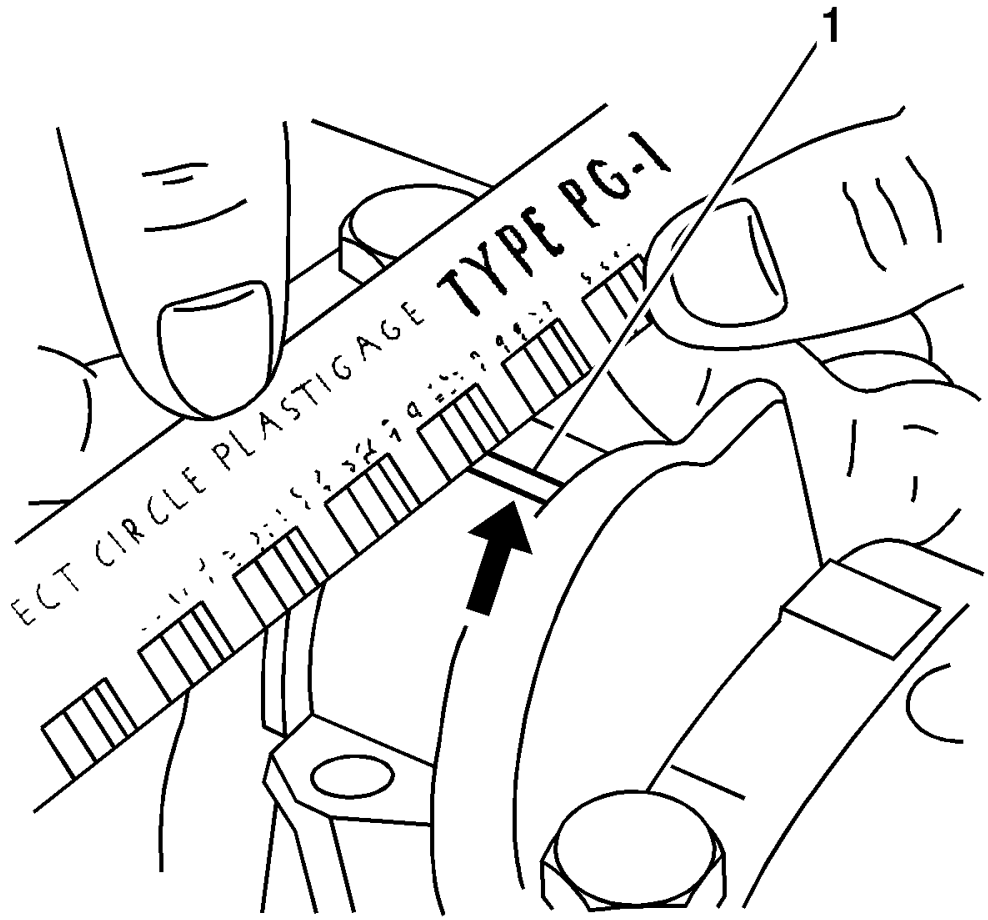

Fig. 227: Measuring Plastigage
Courtesy of GENERAL MOTORS CORP.

20. Remove the connecting rod bearing caps.
21. Measure the width of the flattened plastic thread (1) of the plastic gaging using the scale printed on the plastic gaging package. Plastic gaging is available for different tolerance ranges.
22. Inspect the bearing clearance for permissible tolerance ranges. Refer to **Engine Mechanical Specifications** .

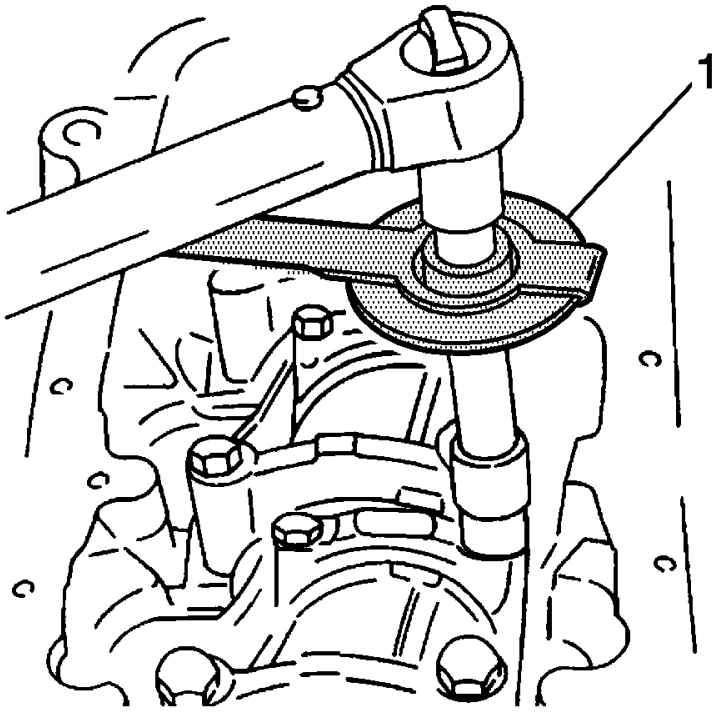

Fig. 228: Using J 45059 Or KM-470-B To Torque Rod Bolts
Courtesy of GENERAL MOTORS CORP.

23. Install the connecting rod bearing caps to the connecting rods.
24. Tighten the connecting rod bearing caps using new bolts.

Tighten: Tighten the connecting rod bearing cap bolts to **35 N.m (26 lb ft)** using a torque wrench. Use the **J 45059** or the **KM-470-B** (1) to tighten the connecting rod cap bolts plus 45 degrees plus 15 degrees. See **Special Tools** .

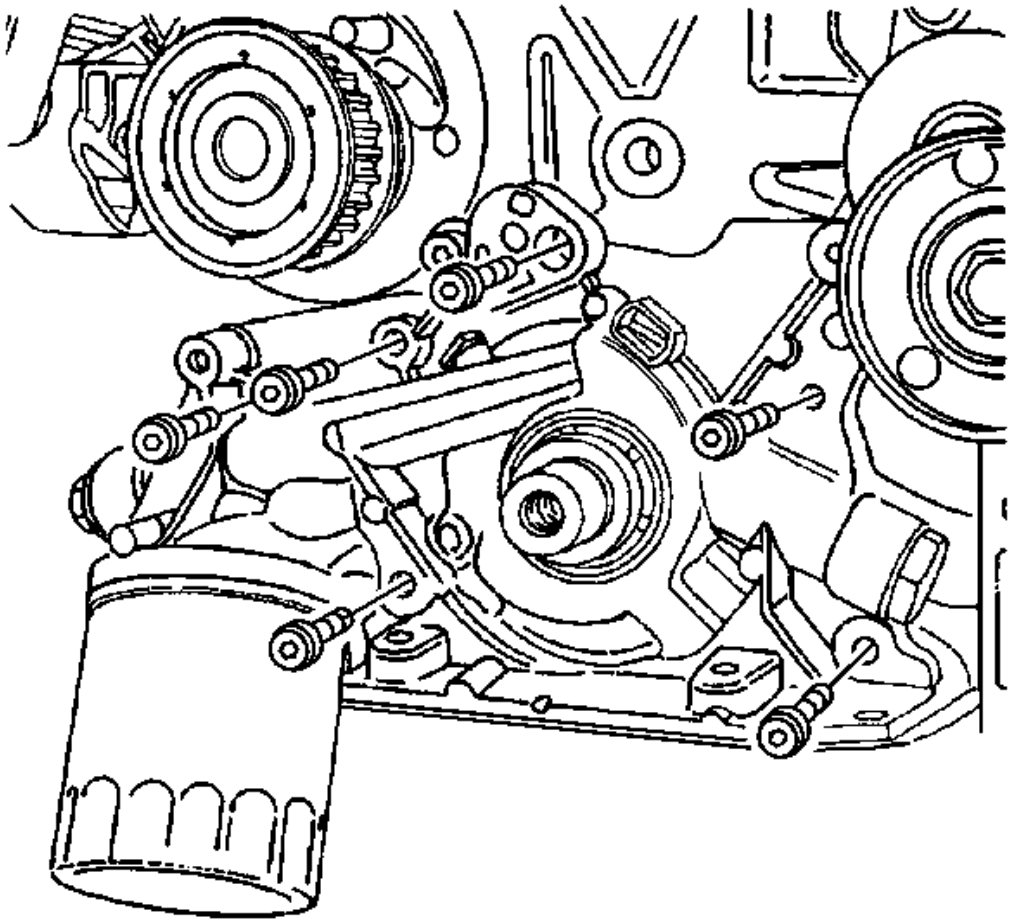

Fig. 229: View Of Oil Pump And Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

25. Install the oil pump.
26. Install the oil pump retaining bolts.

Tighten: Tighten the oil pump retaining bolts to **10 N.m (89 lb in)** .

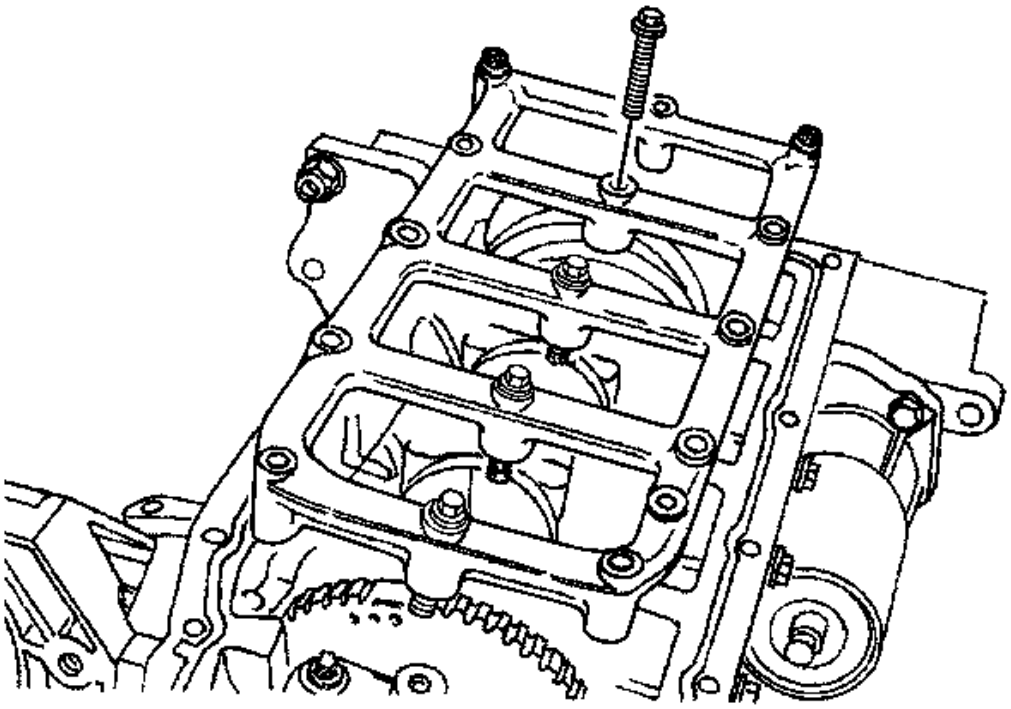

Fig. 230: View Of Engine Block Lower Support Bracket And Bolts
Courtesy of GENERAL MOTORS CORP.

27. Install engine block lower support bracket and the bolts.

    Tighten: Tighten the engine block lower support bracket bolts to **35 N.m (26 lb in)** .

28. Install the lower block support bracket splash shield and the bolts.

    Tighten: Tighten the lower block support bracket splash shield bolts to **35 N.m (26 lb ft)** .

29. Install the oil pump/pickup tube.
30. Install the oil pump/pickup tube bolts.

    Tighten: Tighten the oil pump/pickup tube bolts to **8 N.m (71 lb in)** .

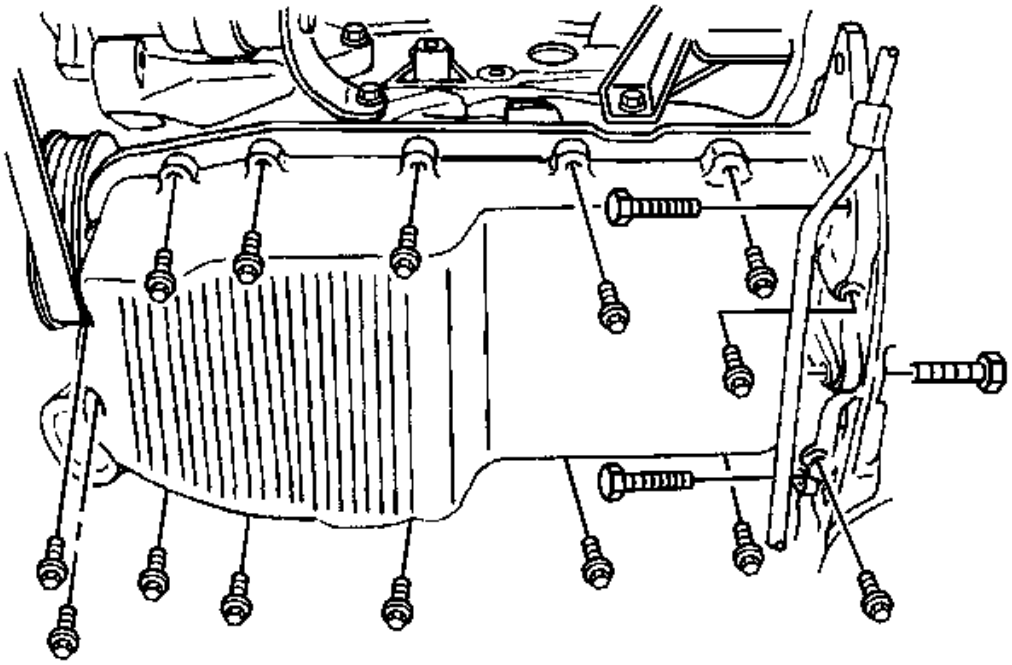

Fig. 231: View Of Oil Pan And Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

31. Coat the new oil pan gasket with the sealant.
32. Install the oil pan gasket to the oil pan.
33. Install the oil pan.
34. Install the oil pan retaining bolts.

Tighten: Tighten the oil pan retaining bolts to **20 N.m (15 lb ft)** .

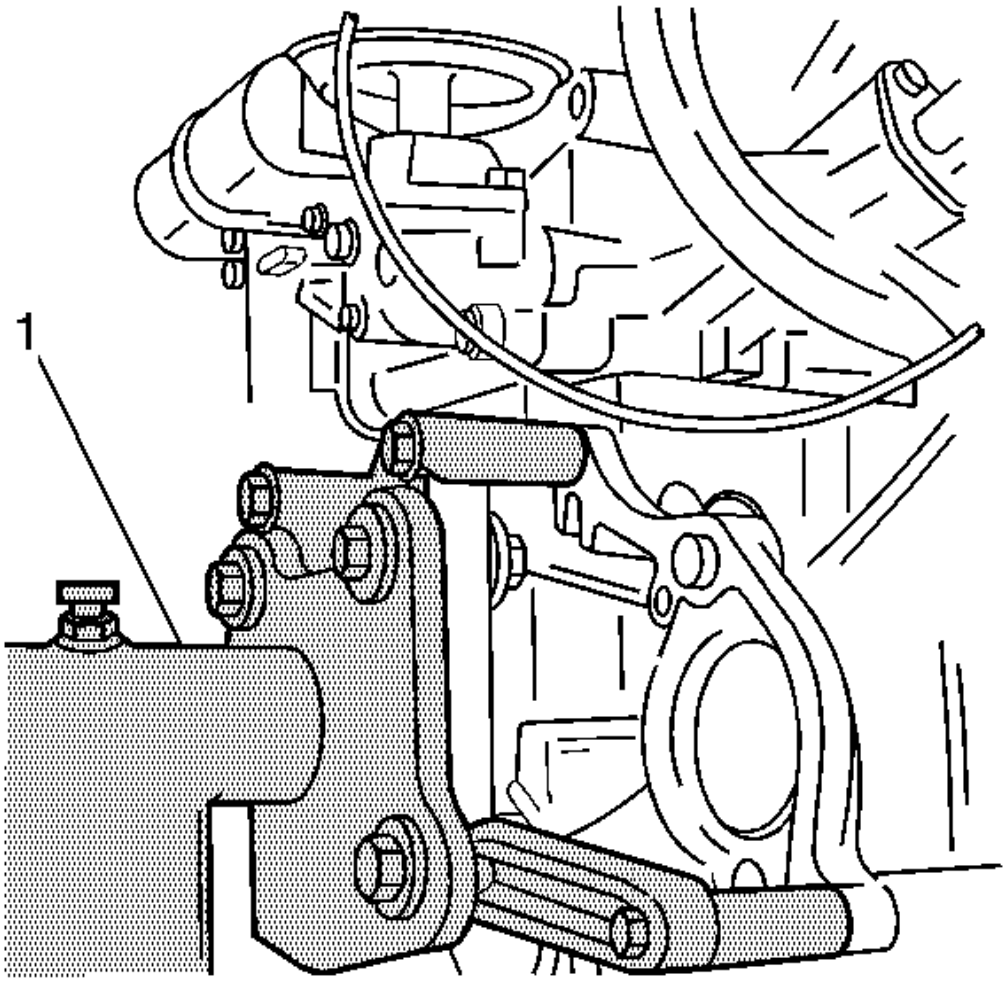

Fig. 232: View Of OTC 1726 And Engine
Courtesy of GENERAL MOTORS CORP.

35. Rotate the engine on the **OTC 1726** (1). See **Special Tools** .

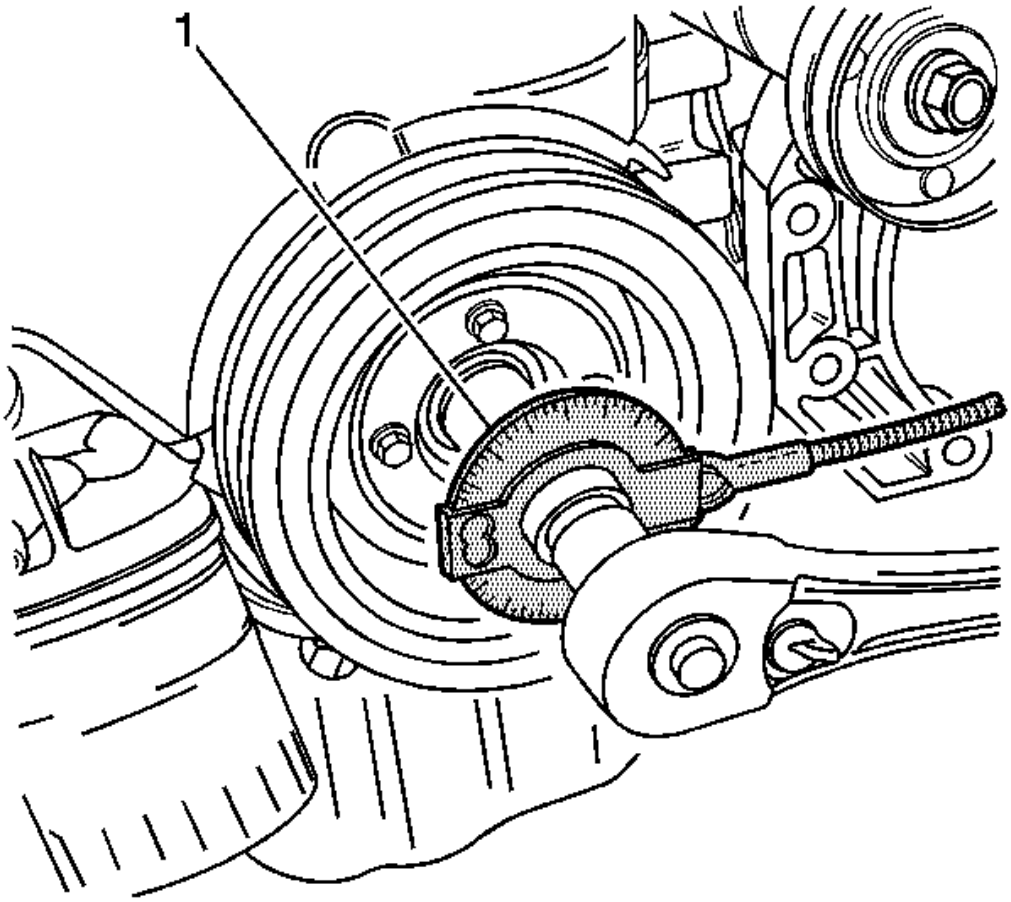

Fig. 233: View Of Torque Wrench And Special Tool On Drive Gear Bolt
Courtesy of GENERAL MOTORS CORP.

36. Install the rear timing belt cover.
37. Install the rear timing belt cover bolts.

    Tighten: Tighten the rear timing belt cover bolts to **6 N.m (53 lb in)** .

38. Install the crankshaft timing belt drive gear and the bolt.

    Tighten: Tighten the crankshaft timing belt drive gear bolt to **135 N.m (100 lb ft)** plus 30 to 10 degrees using the **J 45059** or the **KM-470-B** (1). See **Special Tools** .

39. Install the engine mount and the retaining bolts.

Tighten: Tighten the engine mount retaining bolts to **60 N.m (44 lb ft)** .

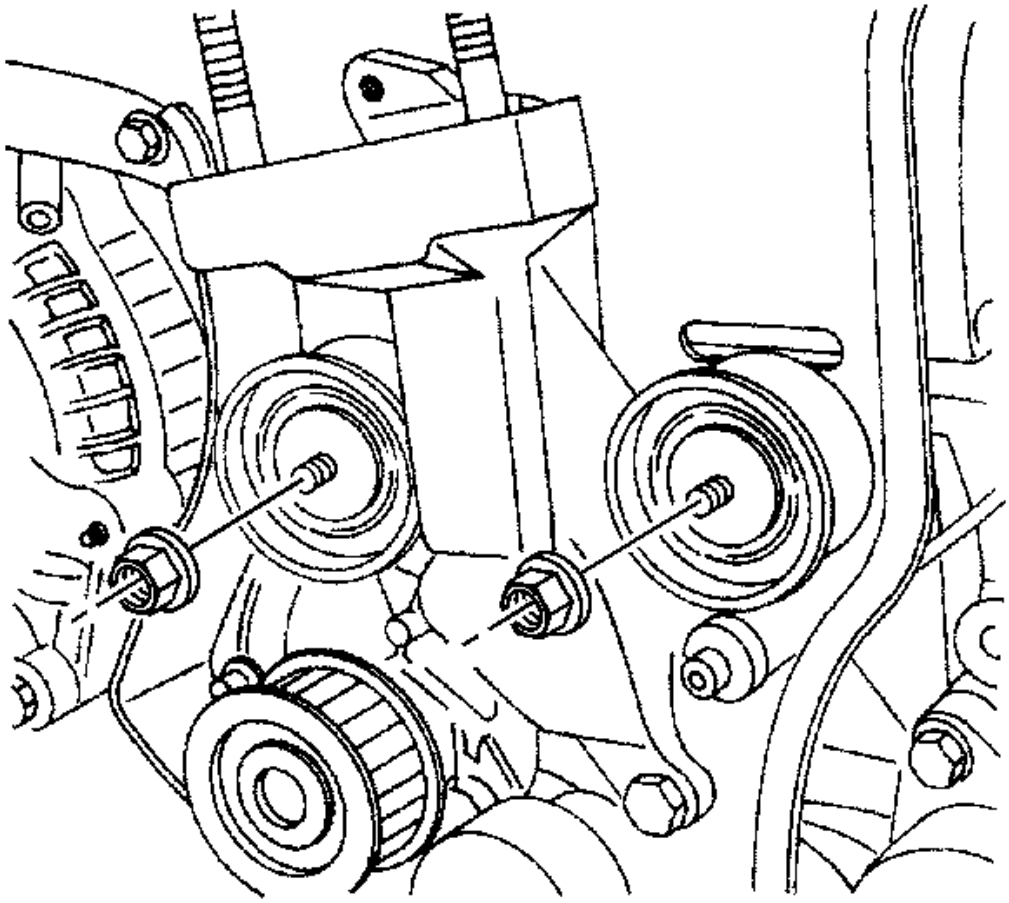

Fig. 234: View Of Timing Belt Idler Pulleys And Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

40. Install the timing belt automatic tensioner.
41. Install the timing belt automatic tensioner bolts.

Tighten: Tighten the timing belt automatic tensioner bolts to **25 N.m (18 lb ft)** .

42. Install the timing belt idler pulley.
43. Install the timing belt idler pulley nuts.

Tighten: Tighten the timing belt idler pulley nuts to **25 N.m (18 lb ft)** .

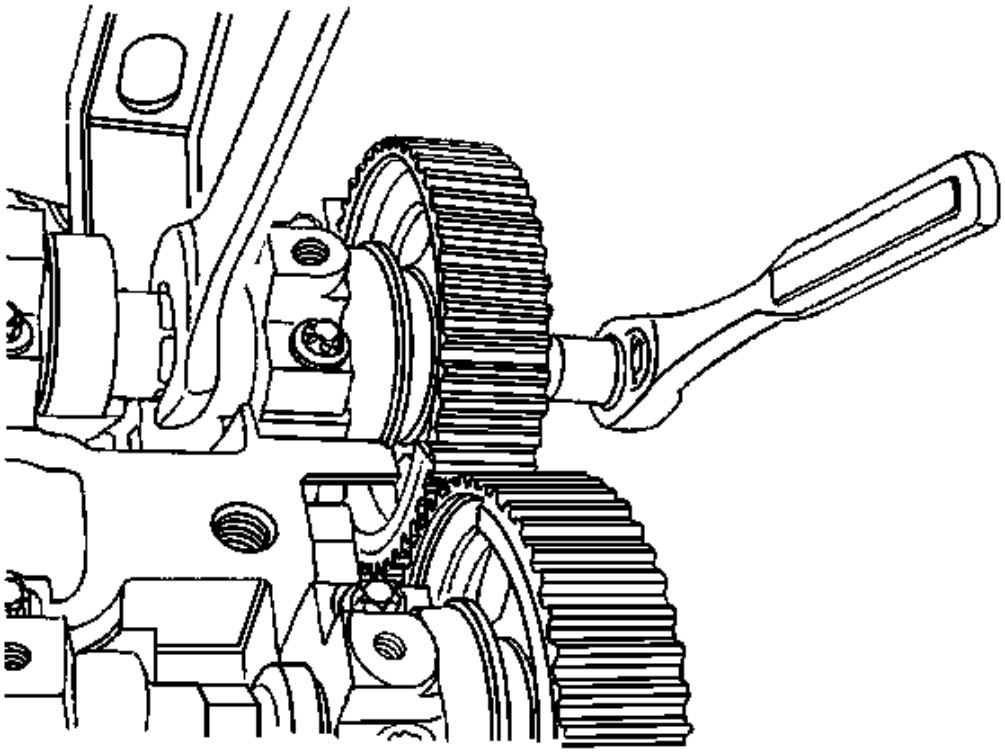

Fig. 235: Removing/Installing Intake Camshaft Gear Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Use extreme care when installing the camshaft not to nick, scratch, or damage the camshaft lobes or bearing surfaces.

44. Install the intake camshaft gear.
45. Install the intake camshaft gear bolt while holding the intake camshaft firmly in place.

    Tighten: Tighten the intake camshaft gear bolt to **50 N.m (37 lb ft)** plus 60 degrees and 15 degrees.

46. Install the exhaust camshaft gear.
47. Install the exhaust camshaft gear bolt while holding the exhaust camshaft firmly in place.

    Tighten: Tighten the exhaust camshaft gear bolt to **50 N.m (37 lb ft)** plus 60 degrees and 15 degrees.

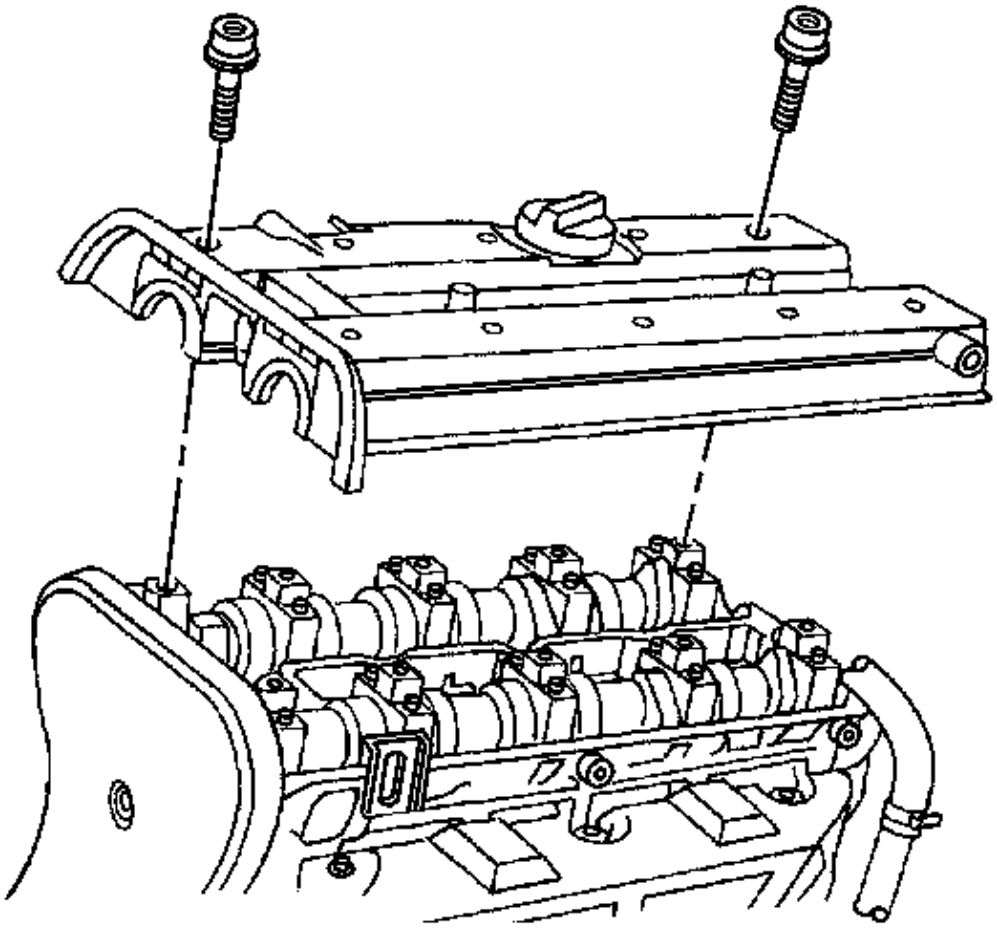

Fig. 236: View Of Valve Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

48. Install the timing belt. Refer to **Timing Belt Replacement**.
49. Adjust the timing belt tension. Refer to **Timing Belt Inspection**.
50. Apply a small amount of gasket sealant to the corners of the front camshaft caps and to the top of the rear valve cover to the cylinder head seal.
51. Install the valve cover and the valve cover gasket.
52. Install the valve cover washers.
53. Install the valve cover bolts.

Tighten: Tighten the valve cover bolts to **8 N.m (71 lb in)** .

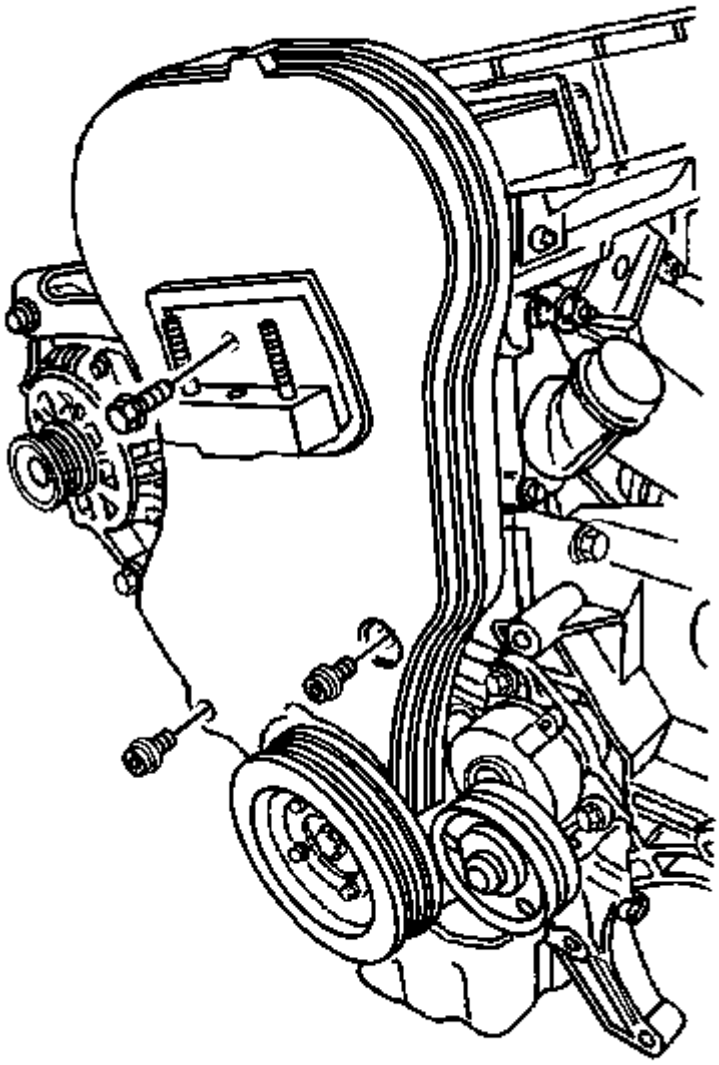

Fig. 237: View Of Front Timing Cover And Bolts
Courtesy of GENERAL MOTORS CORP.

54. Connect the ignition wires to the spark plugs.
55. Install the spark plug cover.
56. Install the spark plug cover bolts.

Tighten: Tighten the spark plug cover bolts to **3 N.m (27 lb in)** .

57. Connect the crankcase breather tube to the valve cover.
58. Install the front timing belt cover.
59. Install the front timing belt cover bolts.

    Tighten: Tighten the front timing belt cover bolts to **6 N.m (53 lb in)** .

60. Install the engine lifting device.
61. Remove the engine from the **OTC 1726** . See **Special Tools** .

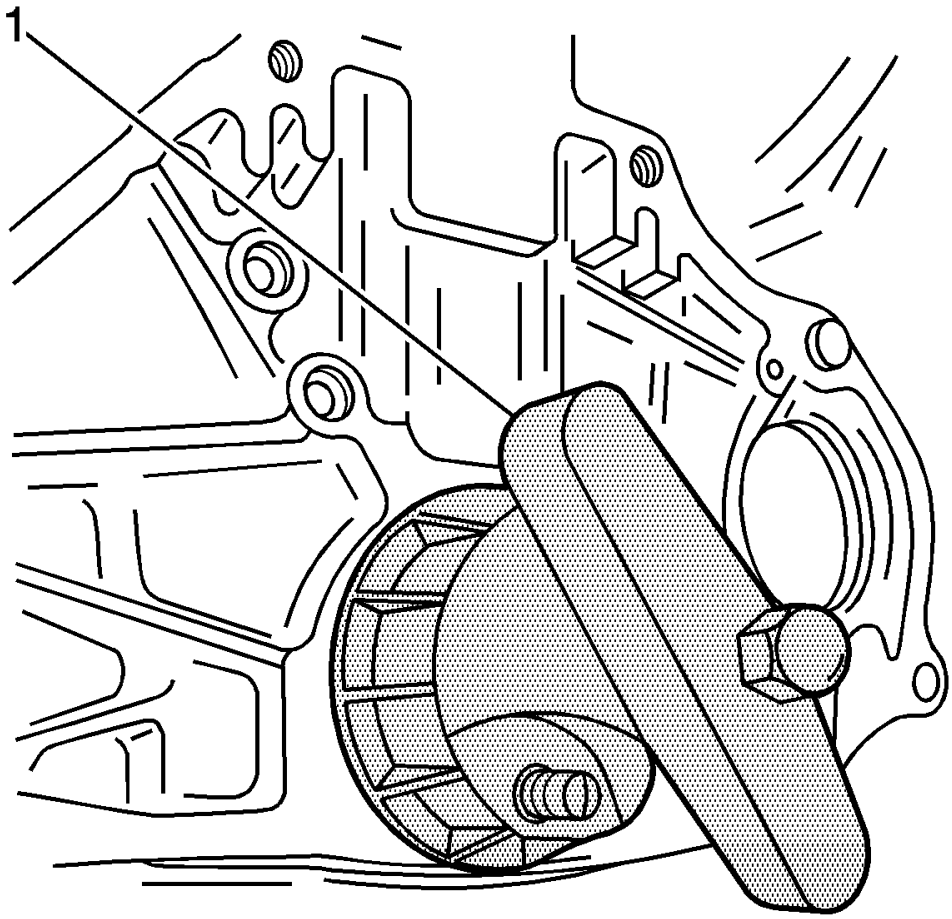

Fig. 238: Installing New Crankshaft Rear Oil Seal Using J36972
Courtesy of GENERAL MOTORS CORP.

62. Install a new crankshaft rear oil seal using the **J 36972** (1) or **KM-635** . See **Special Tools** .

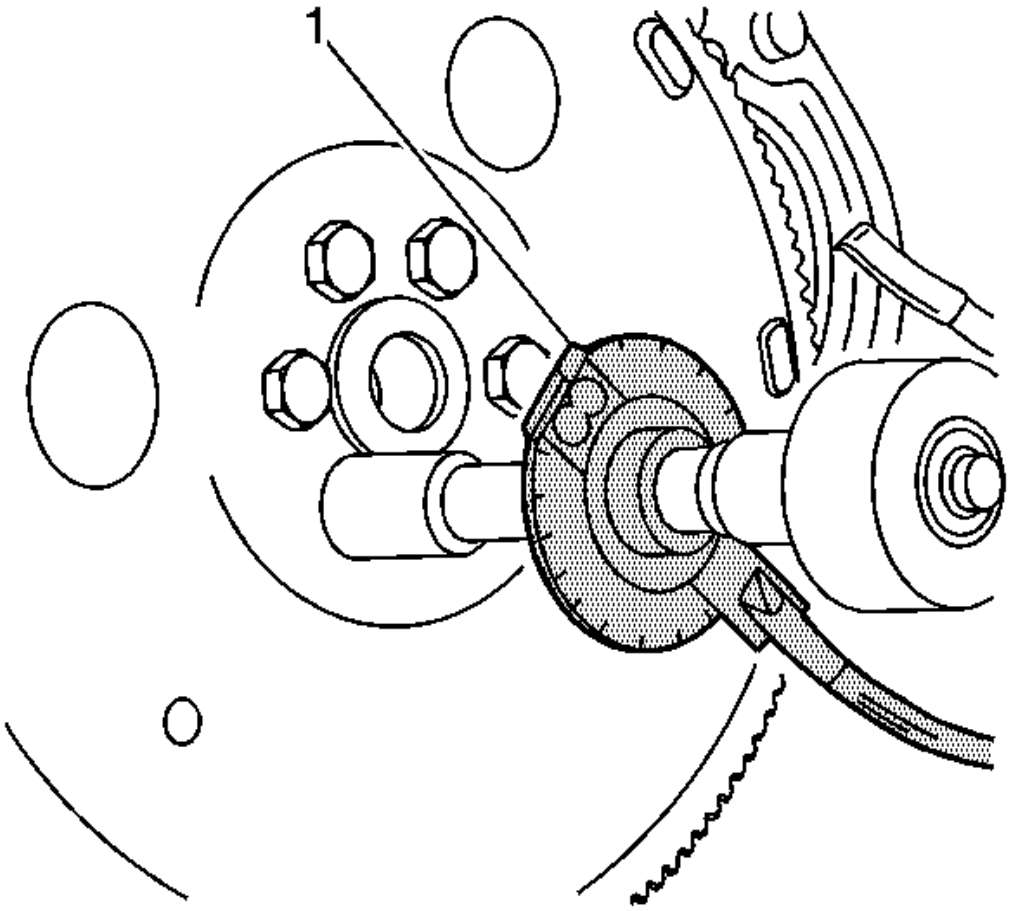

Fig. 239: View Of Torque Wrench Special Tool And Flexplate
Courtesy of GENERAL MOTORS CORP.

63. Install the flywheel or flexible plate.
64. Install the flywheel or the flexible plate bolts.

    Tighten: Tighten the flywheel bolt to **65 N.m (48 lb ft)** . Use the **J 45059** or the **KM-470-B** (1) to tighten the flywheel bolts another 30 degrees plus 15 degrees. See **Special Tools** . For the automatic transaxle, tighten the flexible plate bolts to **60 N.m (44 lb ft)** .

65. Install the engine. Refer to **Engine Replacement**.

EXHAUST MANIFOLD INSTALLATION

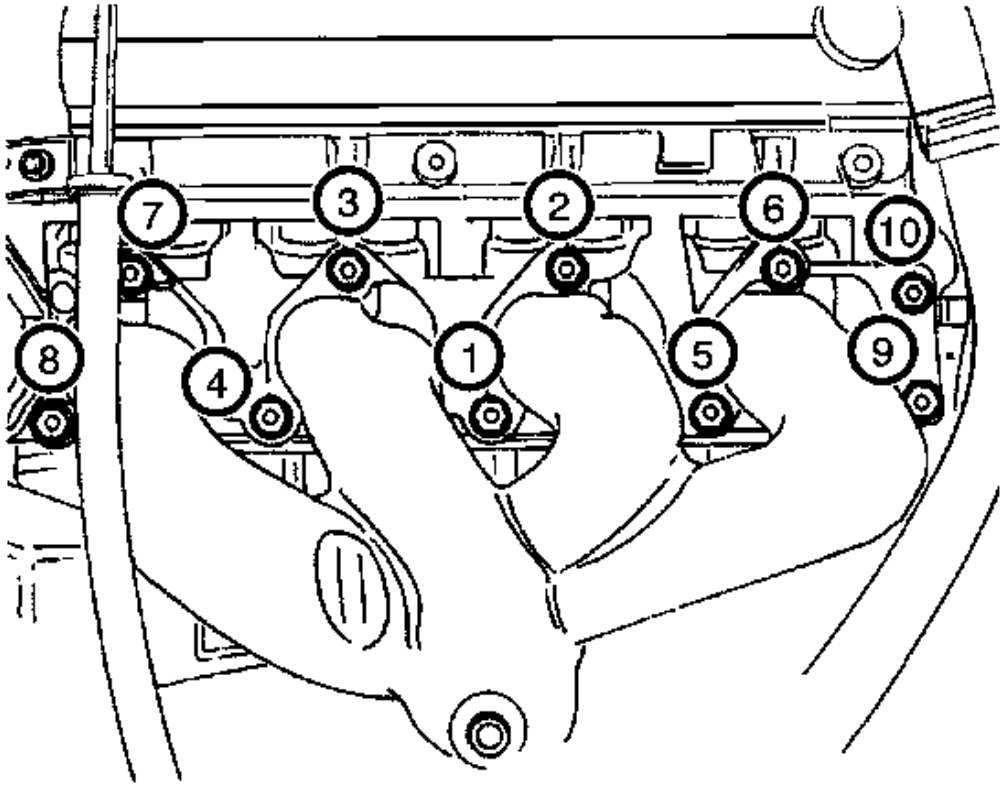

Fig. 240: View Of Exhaust Manifold Retaining Nut Installation Sequence
Courtesy of GENERAL MOTORS CORP.

1. Install the exhaust manifold gasket.
2. Install the exhaust manifold.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the exhaust manifold retaining nuts and tighten in the sequence shown.

Tighten: Tighten the exhaust manifold retaining nuts **22 N.m (16 lb ft)** .

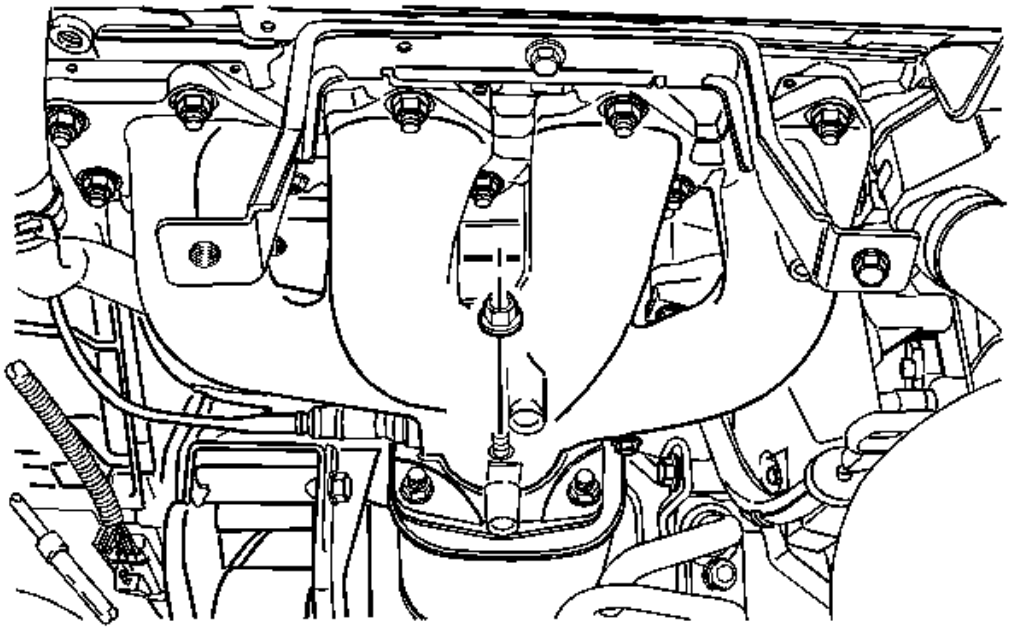

Fig. 241: View Of Auxiliary Catalytic Converter Upper Flange Nuts
Courtesy of GENERAL MOTORS CORP.

4. Install the auxiliary catalytic converter upper flange nuts.

   Tighten: Tighten the auxiliary catalytic converter-to-exhaust manifold nuts to **40 N.m (30 lb ft)** .

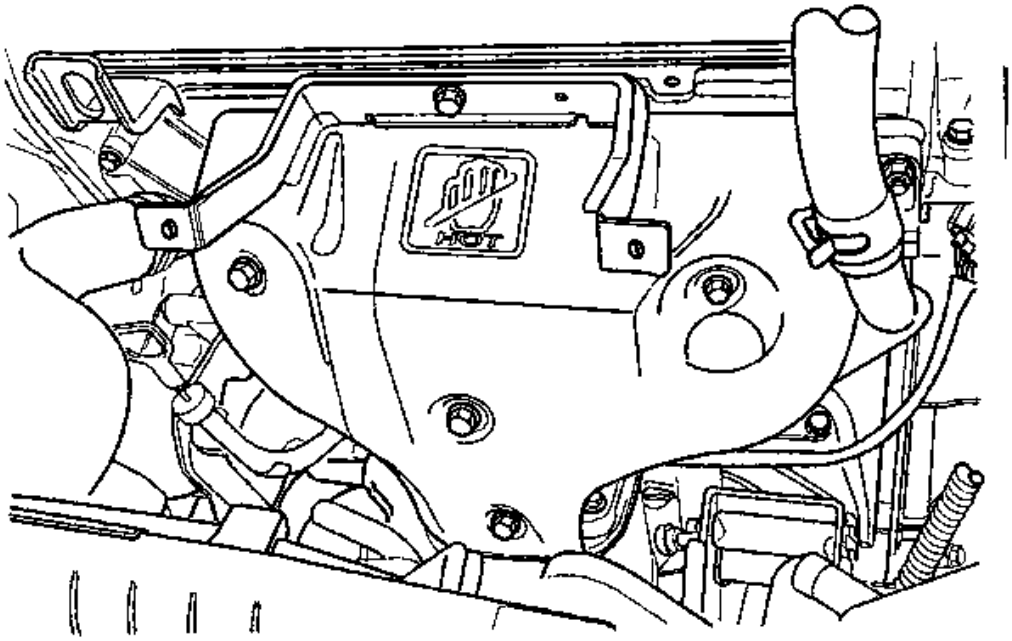

Fig. 242: View Of Exhaust Manifold Heat Shield
Courtesy of GENERAL MOTORS CORP.

5. Install the exhaust manifold heat shield.
6. Install the exhaust manifold heat shield bolts.

   Tighten: Tighten the exhaust manifold heat shield bolts to **8 N.m (71 lb in)** .

7. Connect the oxygen sensor connector, if equipped.
8. Connect the negative battery.

