

2006 ENGINE

Engine Mechanical - 2.8L (LP1) - CTS (1 Of 5)

DRIVE BELT REPLACEMENT - GENERATOR AND WATER PUMP

REMOVAL PROCEDURE

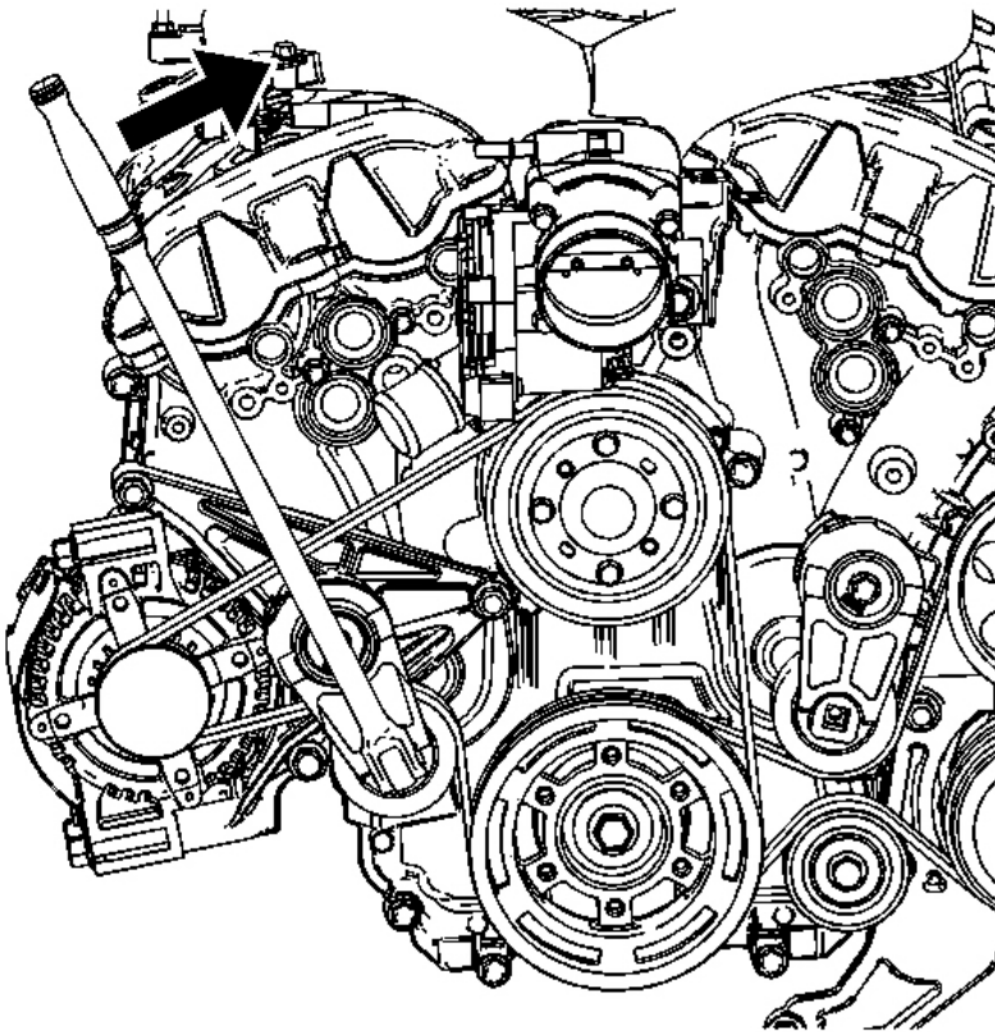


Fig. 1: Rotating Drive Belt Tensioner To Release Drive Belt Tension
Courtesy of GENERAL MOTORS CORP.

1. Using a 1/2 drive breaker bar or ratchet, rotate the drive belt tensioner clockwise in order to release tension on the drive belt.
2. Remove the drive belt from the generator pulley.
3. Slowly release the drive belt tensioner.
4. Remove the drive belt from the water pump pulley and crankshaft balancer.

INSTALLATION PROCEDURE

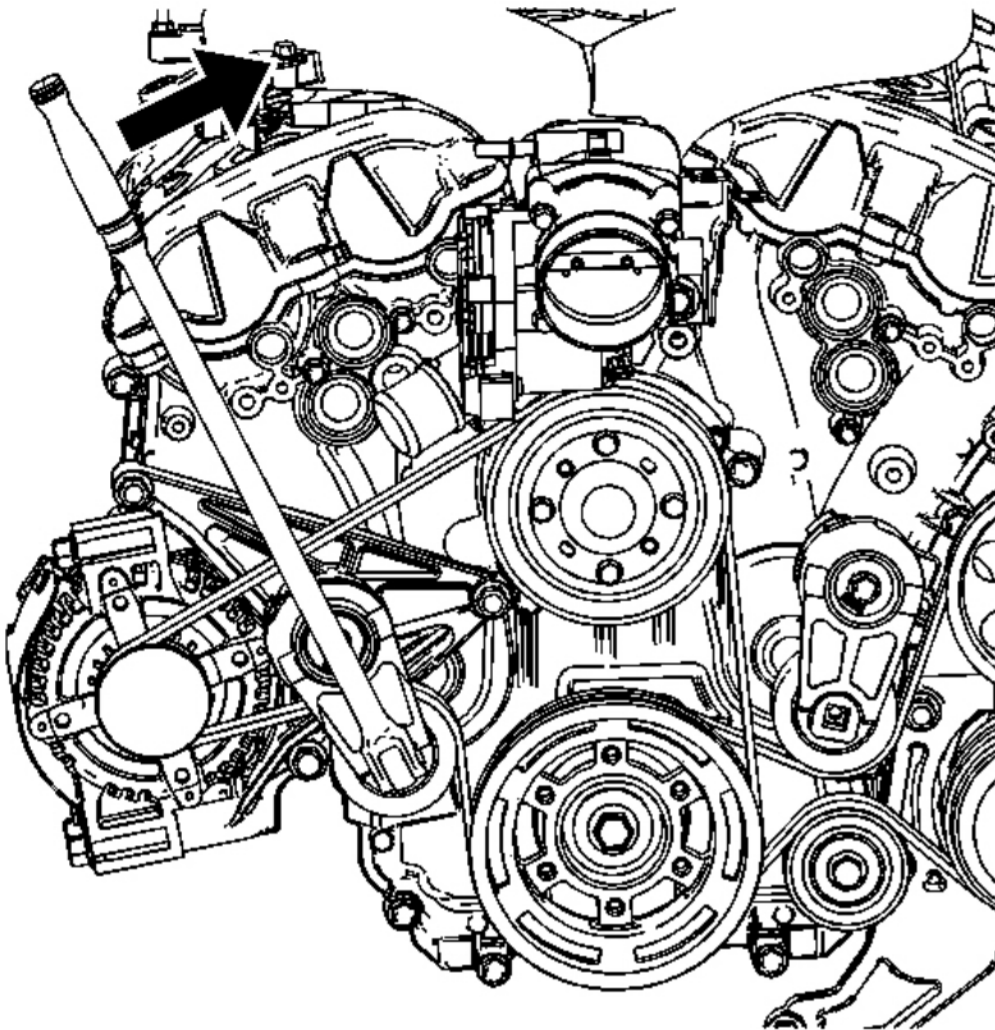


Fig. 2: Rotating Drive Belt Tensioner To Release Drive Belt Tension
Courtesy of GENERAL MOTORS CORP.

1. Install the drive belt onto the crankshaft balancer and water pump pulley.
2. Using a 1/2 drive breaker bar or ratchet, rotate the drive belt tensioner clockwise.
3. Install the drive belt to the generator.
4. Slowly release the drive belt tensioner.

IMPORTANT: Ensure the drive belt is properly aligned and seated into the grooves of the accessory drive pulleys.

DRIVE BELT REPLACEMENT - POWER STEERING AND AIR CONDITIONING

REMOVAL PROCEDURE

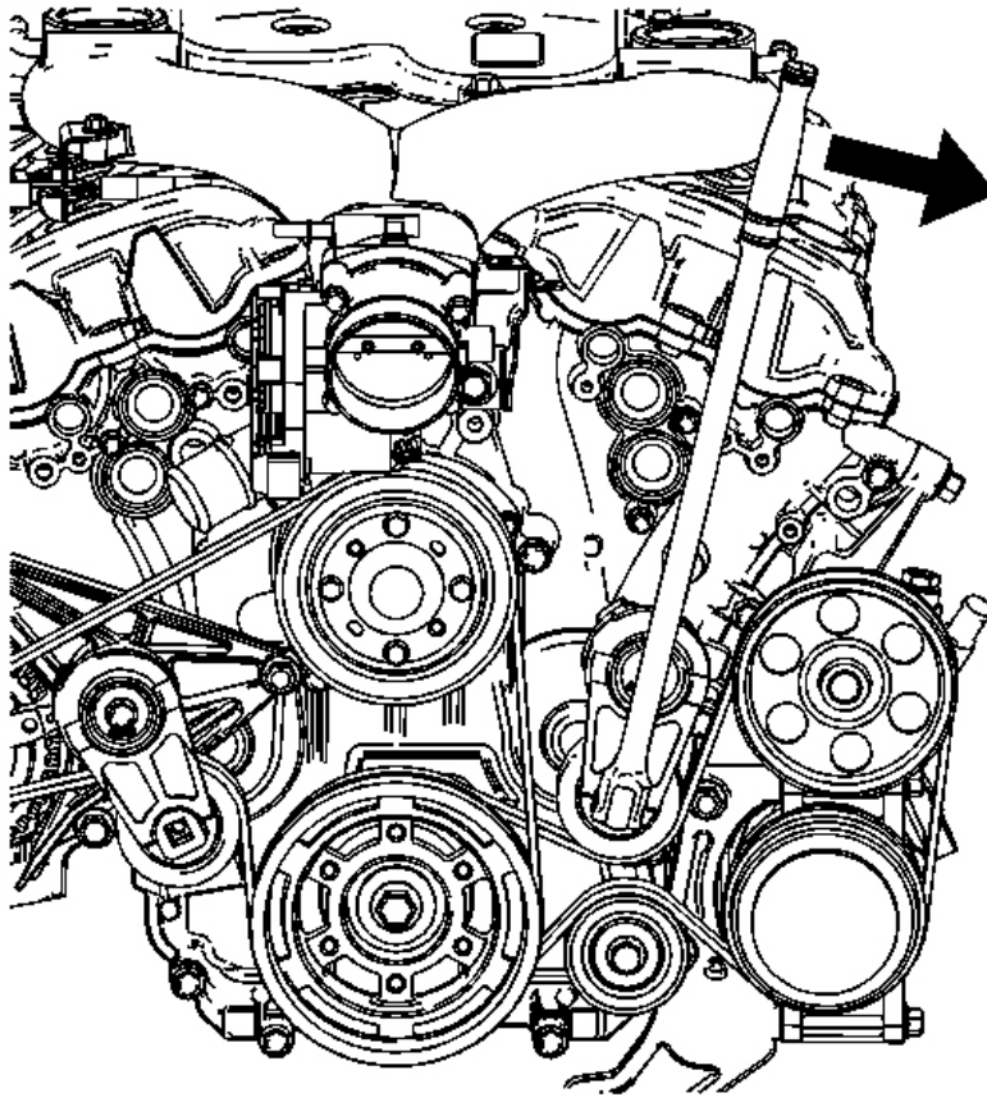


Fig. 3: Rotating Drive Belt Tensioner To Release Drive Belt Tension (Power Steering and Air Conditioning)

Courtesy of GENERAL MOTORS CORP.

1. Remove the generator and water pump drive belt. Refer to **Drive Belt Replacement - Generator and Water Pump**.
2. Using a 1/2 drive breaker bar or ratchet, rotate the drive belt tensioner clockwise in order to release tension on the drive belt.

3. Remove the drive belt from the power steering pump pulley.
4. Slowly release the drive belt tensioner.
5. Remove the drive belt from the air conditioning (A/C) compressor pulley, idler pulley, and crankshaft balancer.

INSTALLATION PROCEDURE

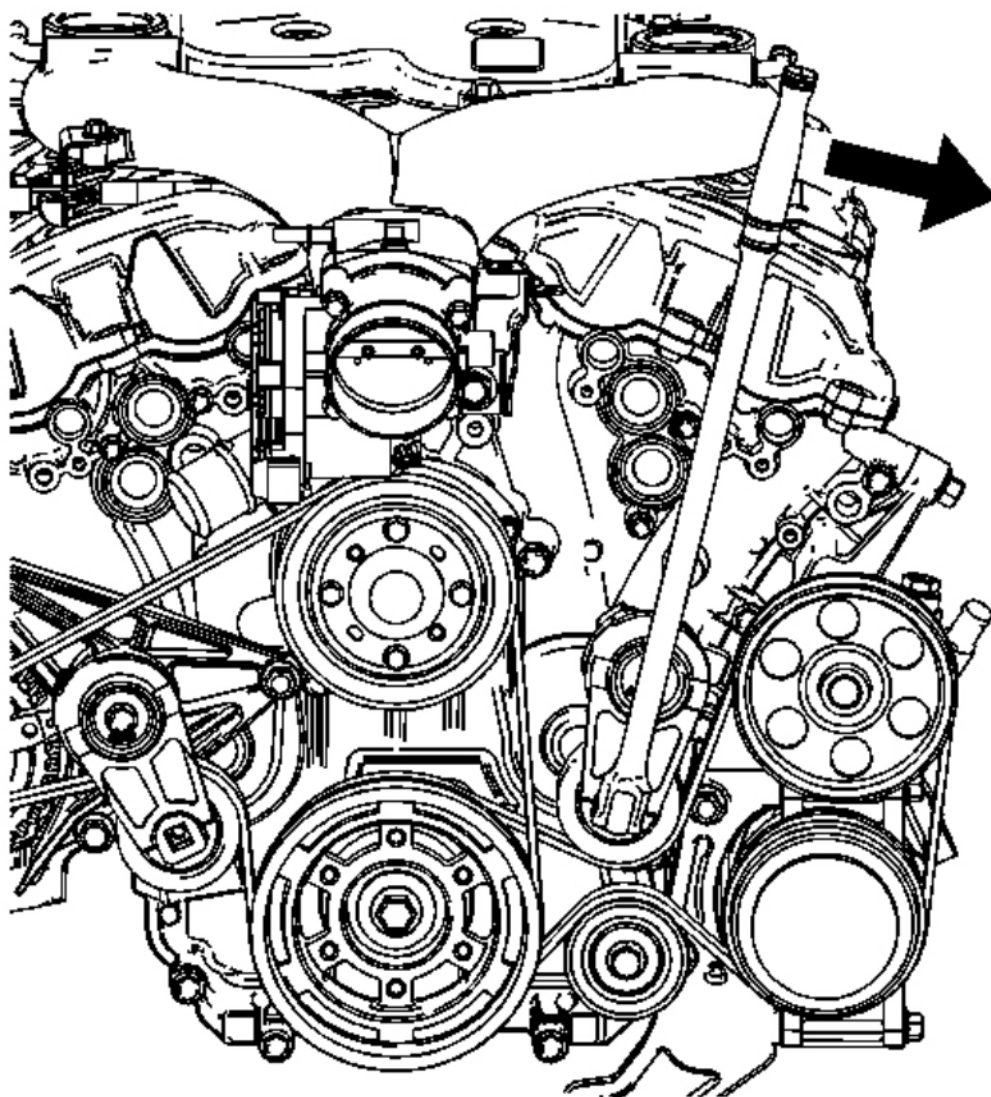


Fig. 4: Rotating Drive Belt Tensioner To Release Drive Belt Tension (Power Steering and Air

Conditioning)

Courtesy of GENERAL MOTORS CORP.

1. Install the drive belt around the crankshaft balancer, idler pulley, and A/C compressor pulley.
2. Using a 1/2 drive breaker bar or ratchet, rotate the drive belt tensioner clockwise.
3. Install the drive belt to the power steering pump pulley.
4. Slowly release the drive belt tensioner.

IMPORTANT: Ensure the drive belt is properly aligned and seated into the grooves of the accessory drive pulleys.

5. Install the generator and water pump drive belt. Refer to **Drive Belt Replacement - Generator and Water Pump.**

DRIVE BELT TENSIONER REPLACEMENT - GENERATOR AND WATER PUMP

REMOVAL PROCEDURE

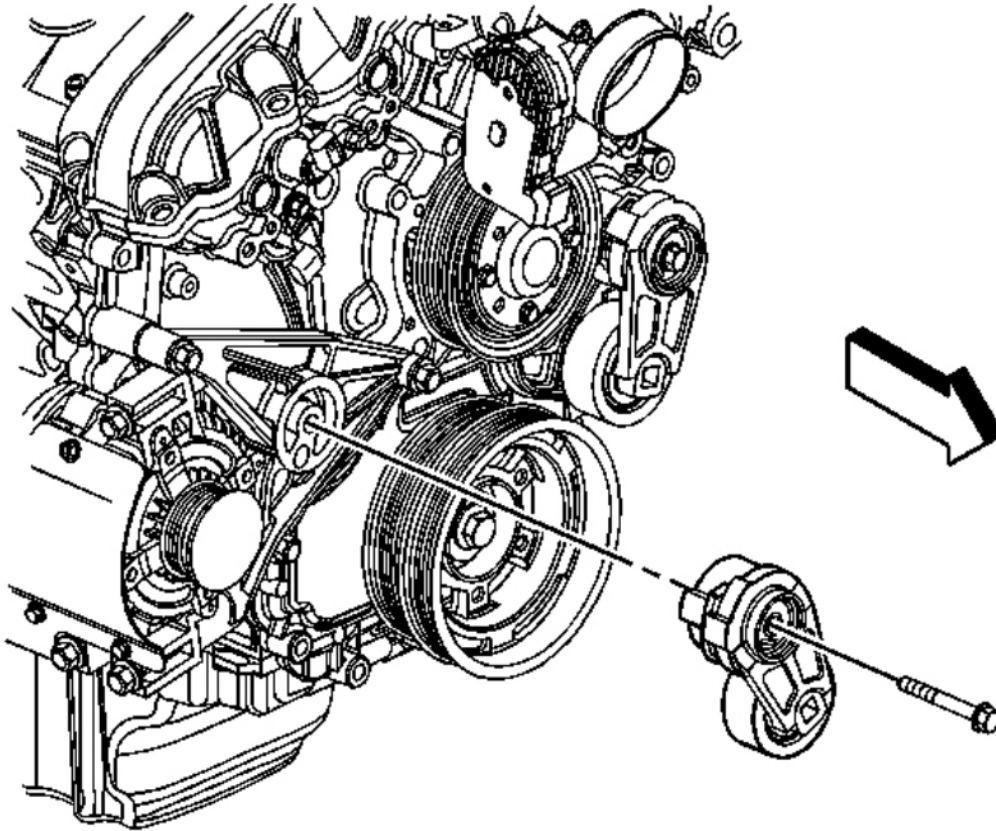


Fig. 5: View Of Generator & Water Pump Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator and water pump drive belt. Refer to **Drive Belt Replacement - Generator and Water Pump.**
2. Loosen the drive belt tensioner bolt.
3. Remove the drive belt tensioner and bolt from the engine.

INSTALLATION PROCEDURE

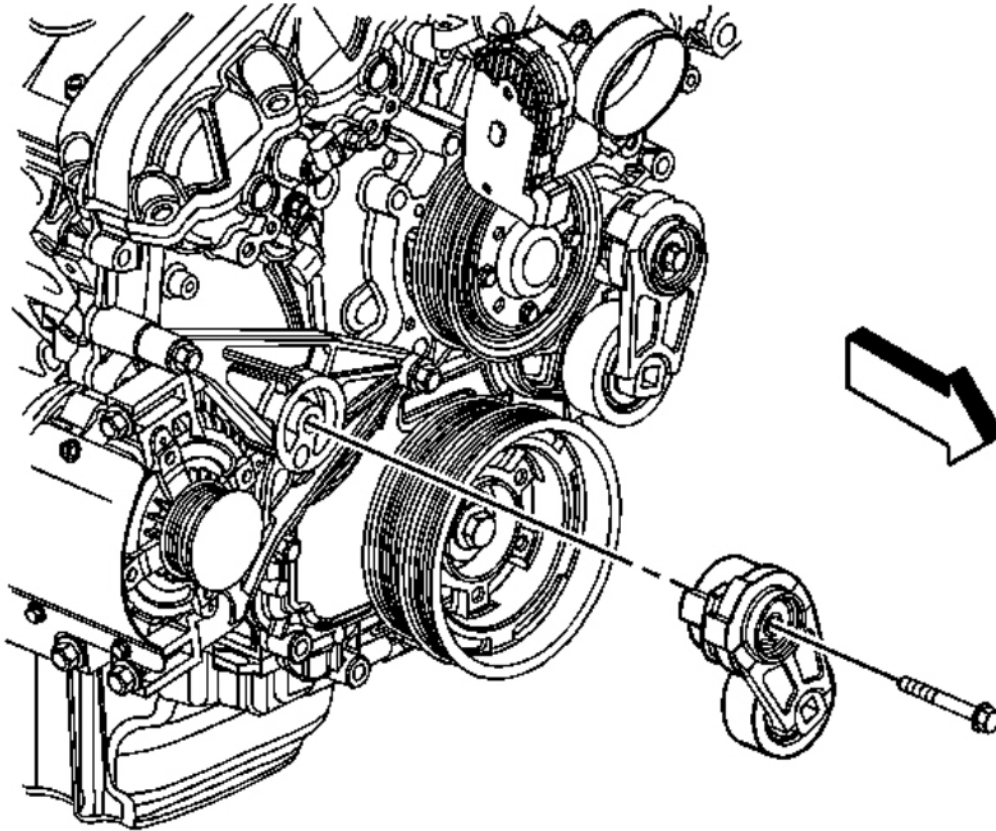


Fig. 6: View Of Generator & Water Pump Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Position the drive belt tensioner and bolt to the engine as an assembly.
2. Ensure that the alignment pin on the rear of the tensioner assembly is aligned with the locating hole on the engine.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the drive belt tensioner bolt.

Tighten: Tighten the bolt to 50 N.m (37 lb ft).

4. Install the generator and water pump drive belt. Refer to Drive Belt Replacement - Generator and Water Pump.

DRIVE BELT TENSIONER REPLACEMENT - POWER STEERING AND AIR CONDITIONING

REMOVAL PROCEDURE

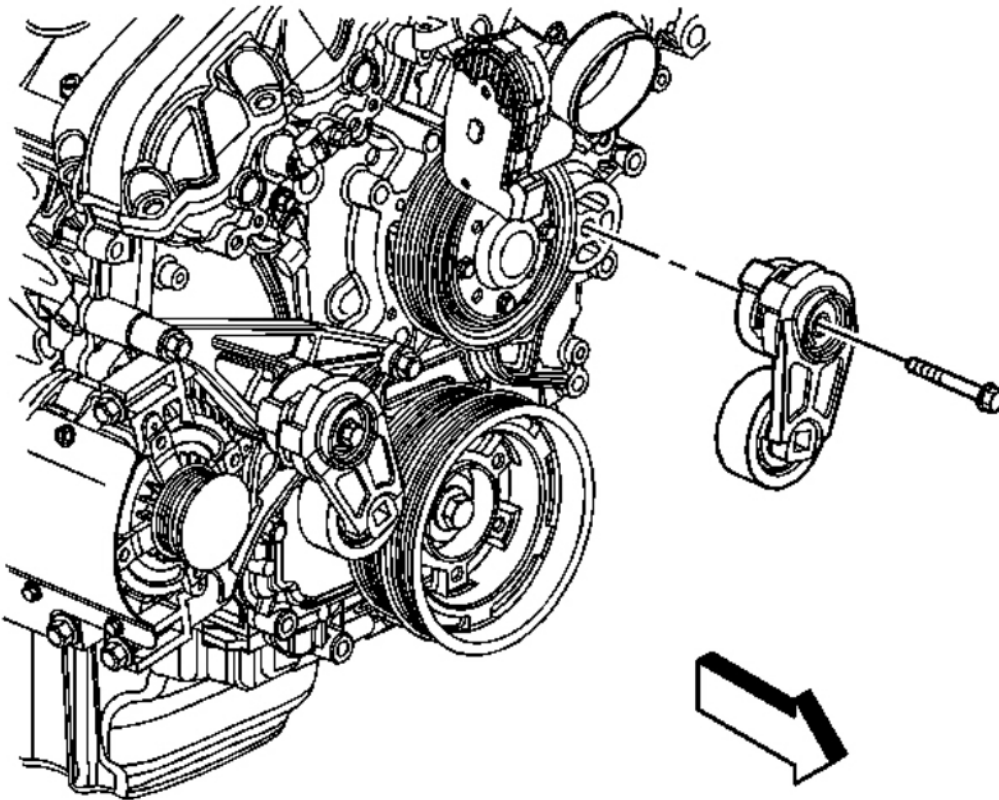


Fig. 7: View Of Power Steering & A/C Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Remove the power steering and air conditioning drive belt. Refer to **Drive Belt Replacement - Power Steering and Air Conditioning**.
2. Loosen the drive belt tensioner bolt.
3. Remove the drive belt tensioner and bolt from the engine.

INSTALLATION PROCEDURE

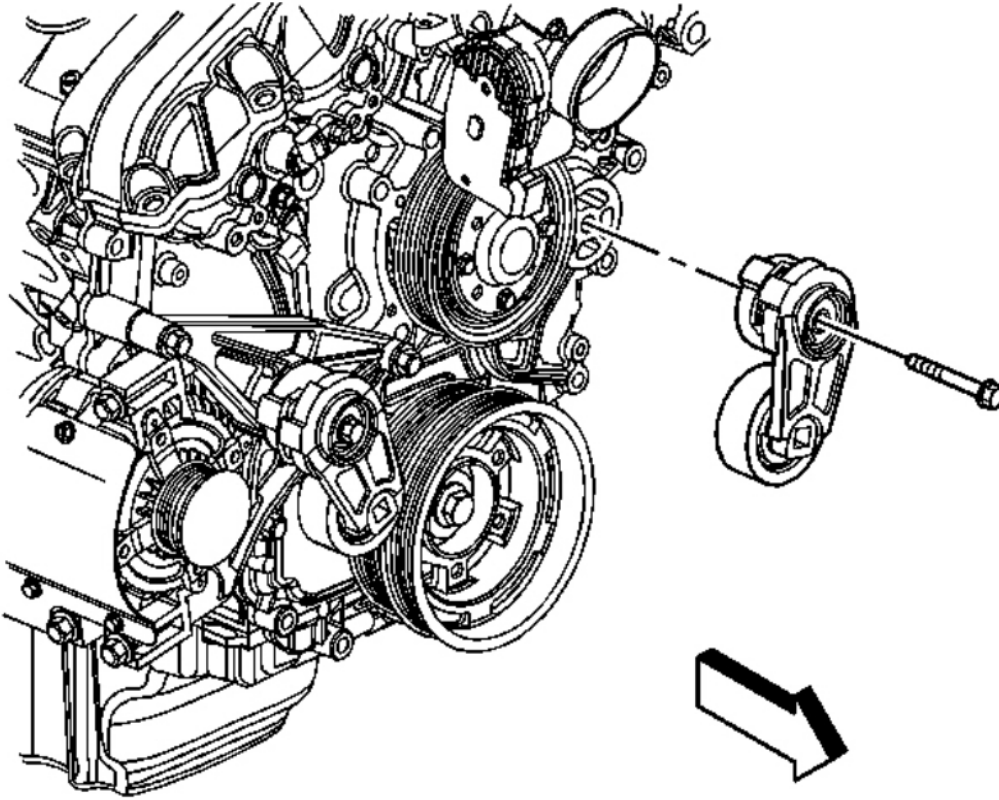


Fig. 8: View Of Power Steering & A/C Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Position the drive belt tensioner and bolt to the engine as an assembly.
2. Ensure that the alignment pin on the rear of the tensioner assembly is aligned with the locating hole on the engine.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the drive belt tensioner bolt.

Tighten: Tighten the bolt to 50 N.m (37 lb ft).

4. Install the power steering and air conditioning drive belt. Refer to Drive Belt Replacement - Power Steering and Air Conditioning.

Tools Required

- EN 46114 Engine Lift Brackets. See Special Tools .
- J 28467-B Universal Engine Support Fixture. See Special Tools .
- J 28467-501 Engine Support Fixture Adapters. See Special Tools .

INSTALLATION PROCEDURE

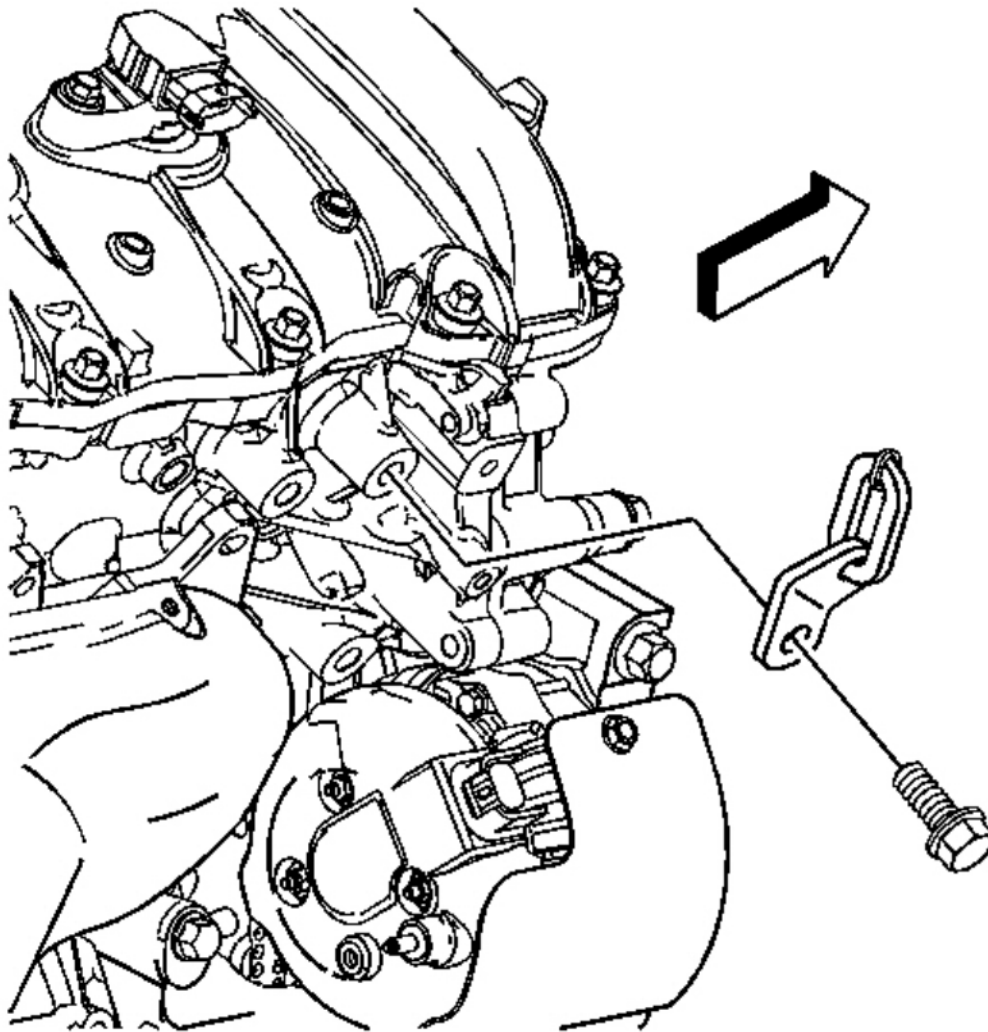


Fig. 9: View Of Engine Lift Bracket - Front Of Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to **Fastener Notice** in Cautions and Notices.

1. Use a M10 X 1.5 X 40 bolt (GM P/N 11519182 or equivalent) in order to install an engine lift hook bracket (OTC #7100, **J 36857** or equivalent) to the front of the right (Bank 1) cylinder head in the location shown. See **Special Tools** .

Tighten: Tighten the lift hook bracket bolt to 65 N.m (48 lb ft).

2. Remove the electrical connector bolt and the electrical connector from the rear of the left cylinder head.

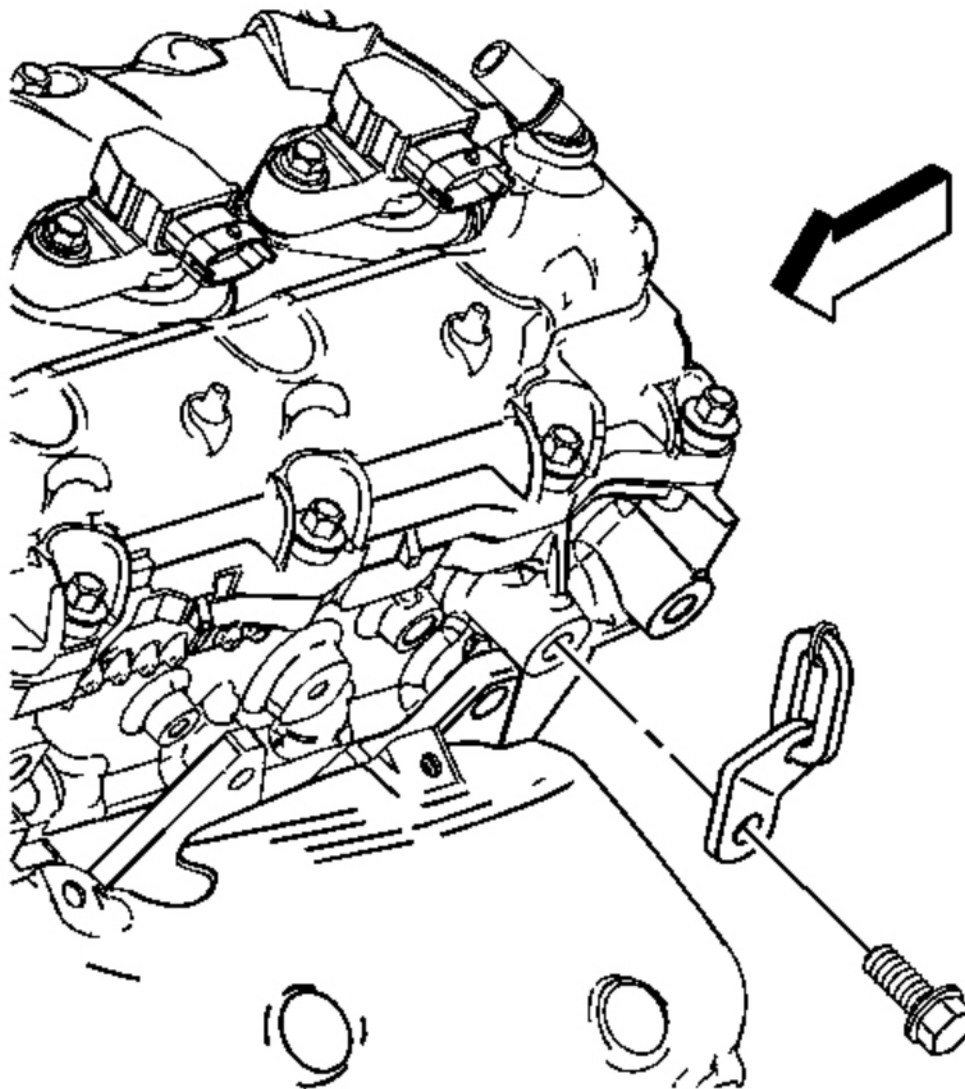


Fig. 10: View Of Engine Lift Bracket - Rear Of Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

3. Use a M10 X 1.5 X 40 bolt (GM P/N 11519182 or equivalent) in order to install an engine lift hook bracket (OTC #7100, **J 36857** or equivalent) to the rear of the left (Bank 2) cylinder head in the location shown. See **Special Tools** .

Tighten: Tighten the lift hook bracket bolt to 65 N.m (48 lb ft).

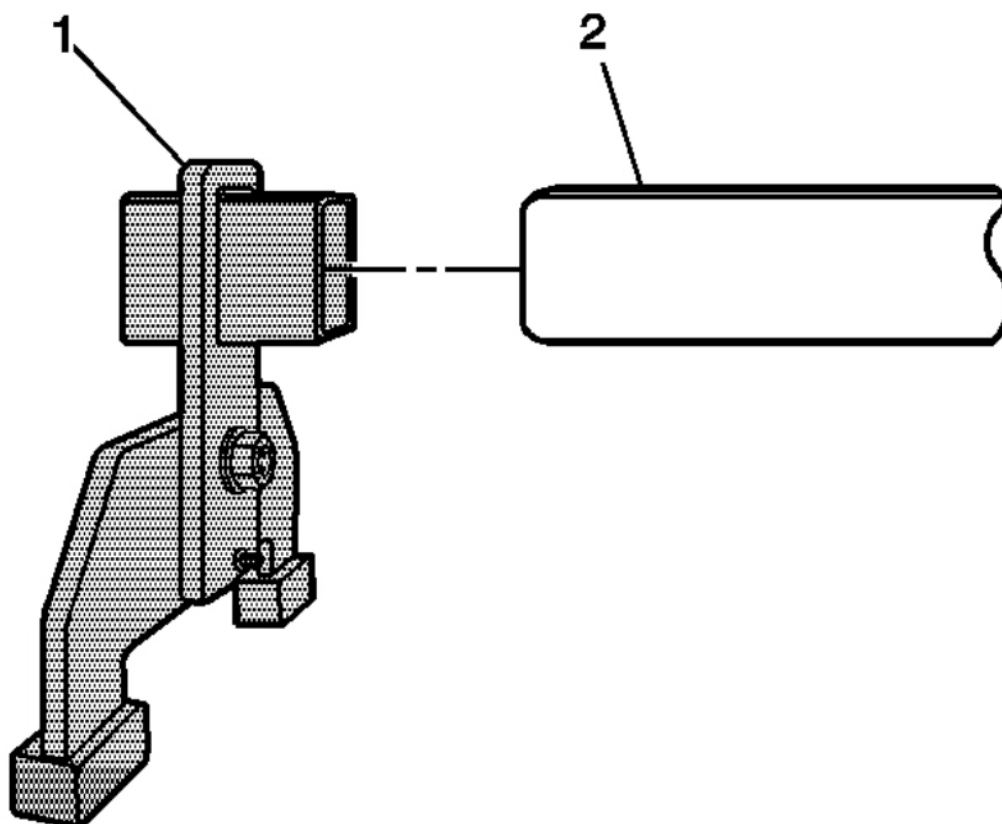


Fig. 11: Identifying J 28467-B & J 28467-3
Courtesy of GENERAL MOTORS CORP.

4. Loosely install the **J 28467-501** (1) to the ends of the strut tower tube **J 28467-3** (2). See **Special Tools** .

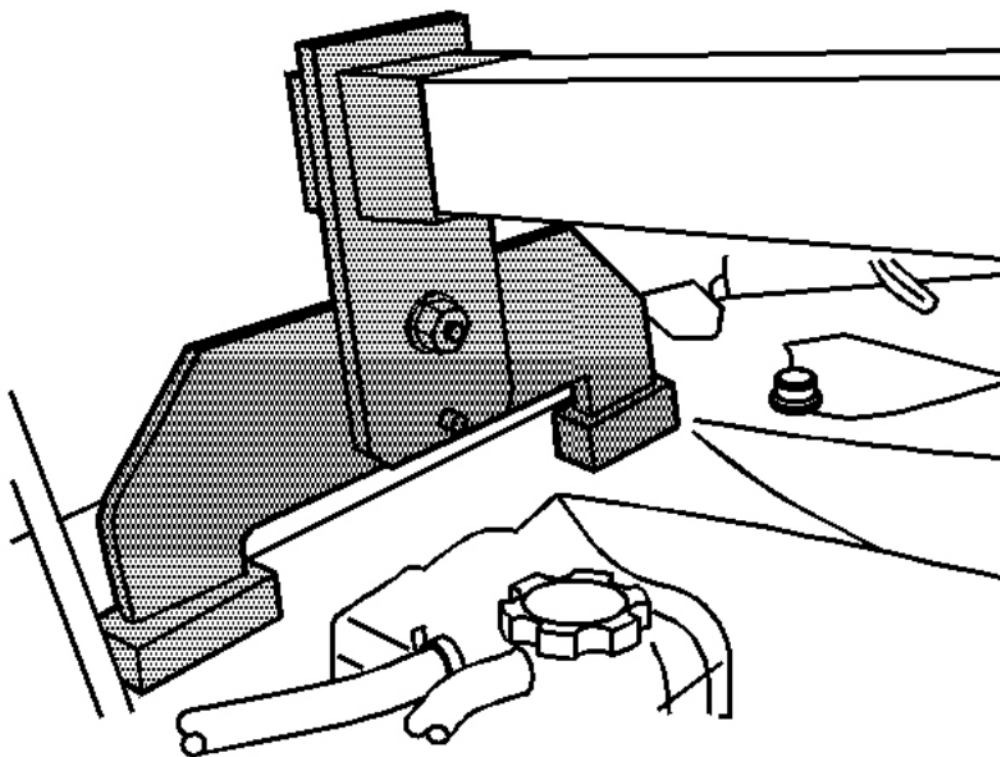


Fig. 12: View Of J 28467-501

Courtesy of GENERAL MOTORS CORP.

5. Place the strut tower tube J 28467-3 and the **J 28467-501** on top of both the left and right fender lips, over the engine rear lift bracket. See **Special Tools** .

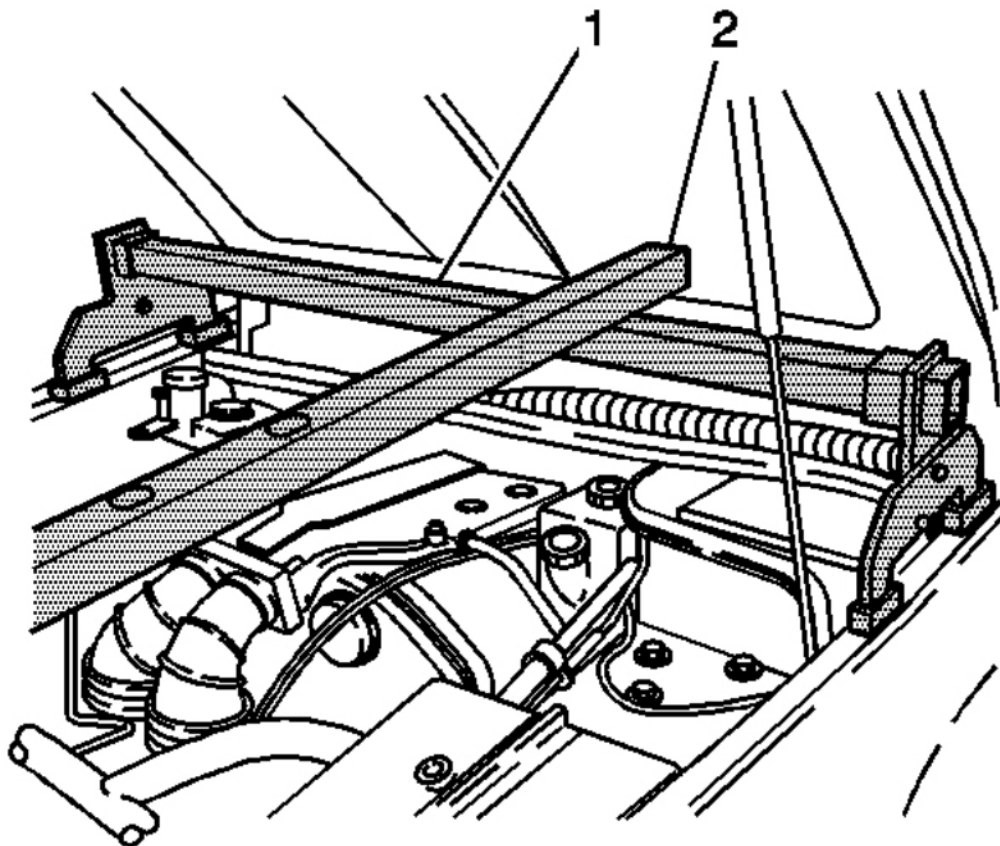


Fig. 13: Identifying J 28467-2A & J 28467-3
Courtesy of GENERAL MOTORS CORP.

6. Install the radiator shelf tube J 28467-2A (2) on top of the strut tower tube J 28467-3 (1) above the engine front (right bank) lift hook bracket.

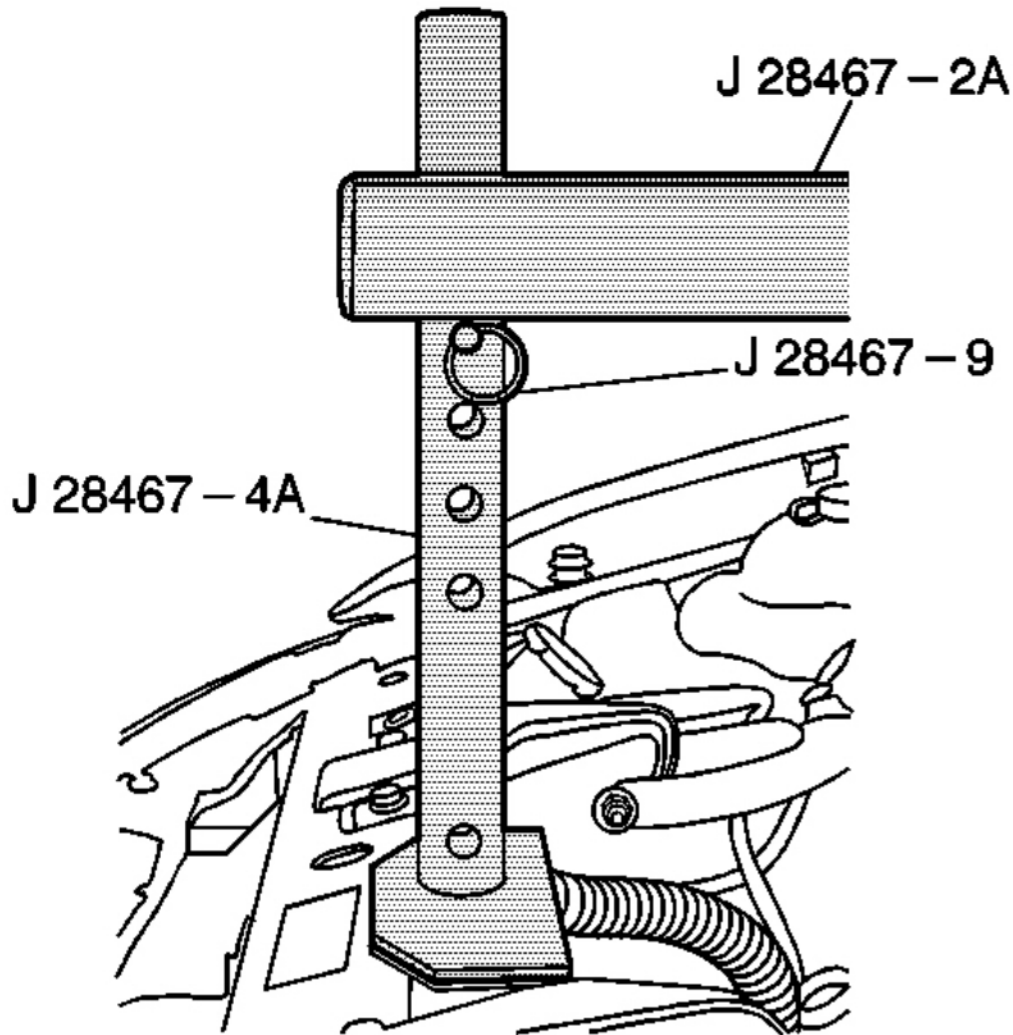


Fig. 14: Positioning Front Engine Support Assembly
 Courtesy of GENERAL MOTORS CORP.

7. Install the round tube of the front support assembly J 28467-4A through the large hole in the radiator shelf tube J 28467-2A.
8. Remove the upper tie bar cover.
9. Locate the J 28467-4A front support assembly to the upper tie bar.
10. Install the J 28467-9 7/16 in x 2.0 in quick-release pin through the top hole in the J 28467-4A front support assembly.

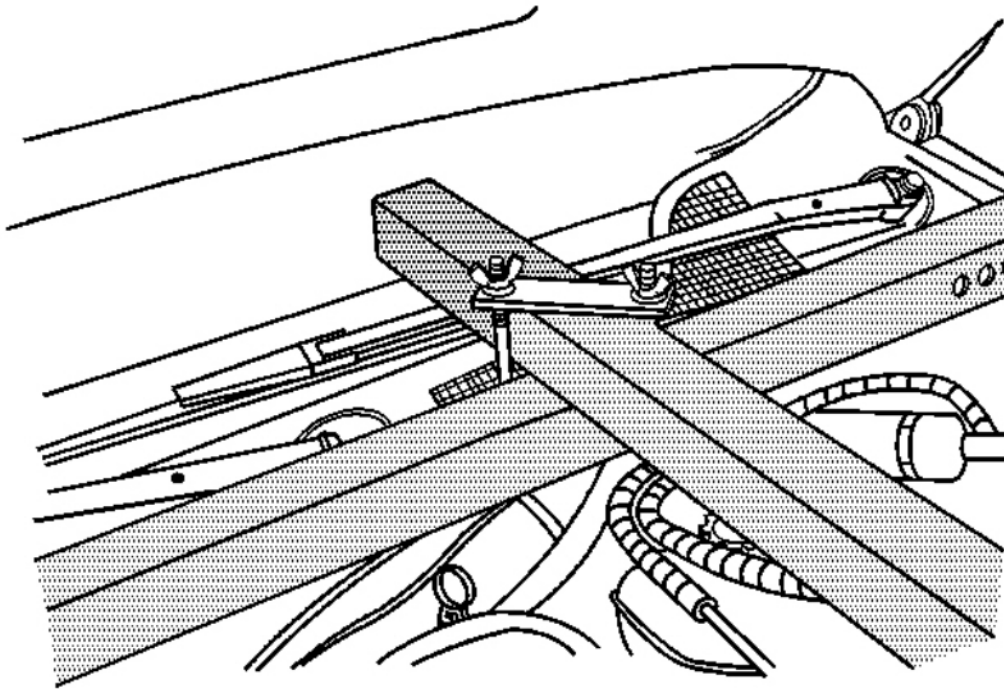


Fig. 15: Using Cross Bracket Assembly
Courtesy of GENERAL MOTORS CORP.

11. Install the J 28467-1A cross bracket assembly.
12. Hand tighten the J 28467-1A cross bracket wing nuts.

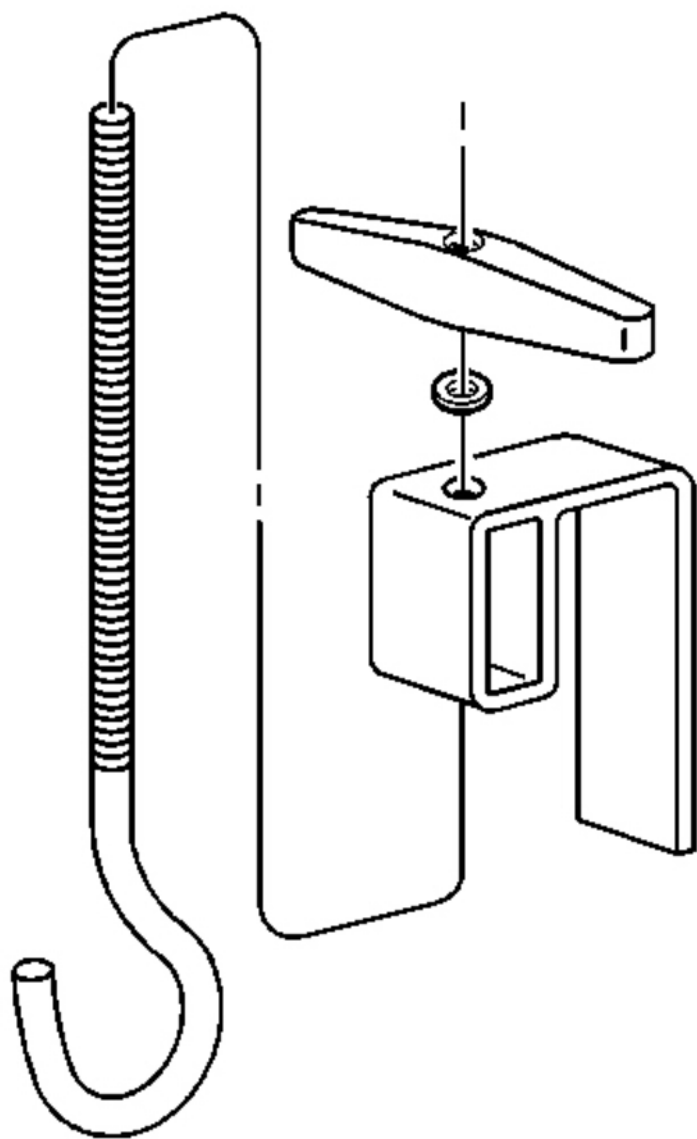


Fig. 16: View Of Lift Hook Assembly
Courtesy of GENERAL MOTORS CORP.

13. Install the J 28467-7A bolt hook through the J 28467-6A bracket.
14. Install the J 28467-34 lift hook wing nut and washer to the J 28467-7A lift hook.
15. Repeat the previous 2 steps in order to assemble 2 lift hooks and brackets.

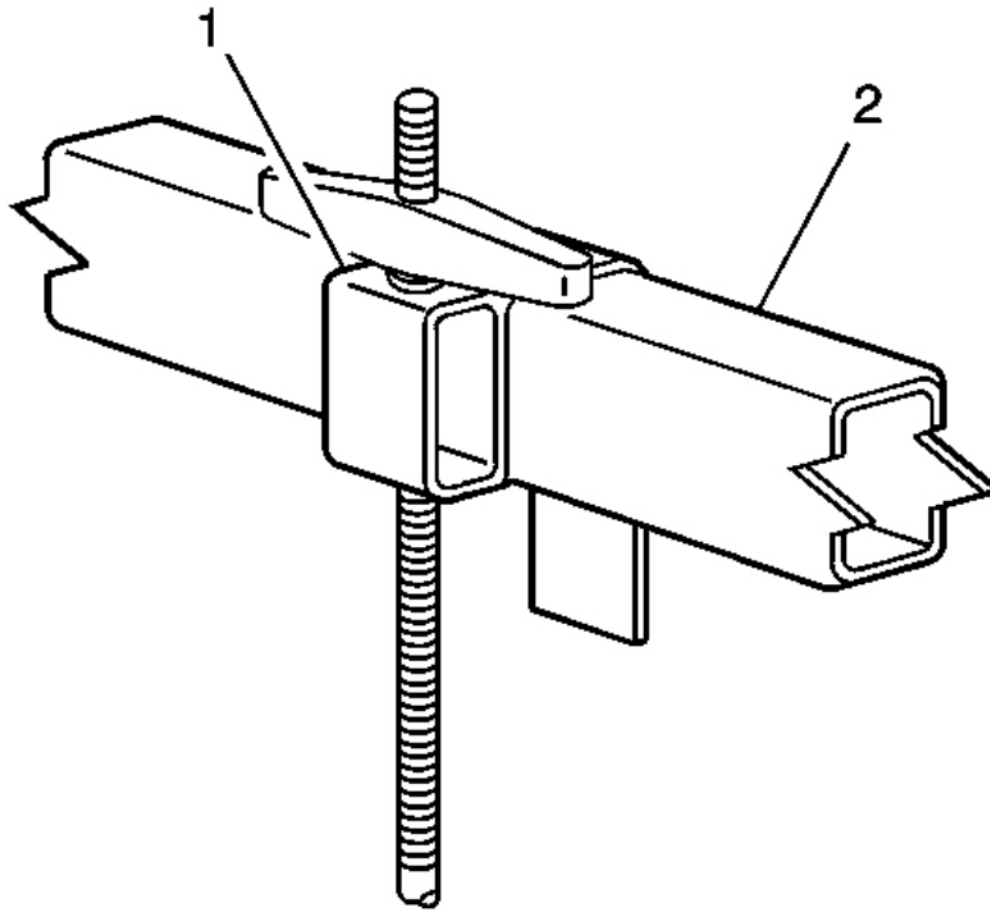


Fig. 17: View Of Lift Hook & Bracket Assembly At Longitudinal Mounted Cross Bar
Courtesy of GENERAL MOTORS CORP.

16. Install one of the lift hook and bracket assemblies (1) to the J 28467-3 strut tower tube (2) above the **EN 46114** engine rear lift bracket. See **Special Tools** .
17. Install the lift hook J 28467-7A through the **EN 46114** engine rear lift bracket. See **Special Tools** . Ensure the hook does not damage adjacent components.
18. Install the other lift hook and bracket assembly (1) to the J 28467-2A radiator shelf tube (2) above the engine front lift bracket.
19. Install the lift hook J 28467-7A through the **EN 46114** engine front lift bracket. See **Special Tools** . Ensure the hook does not damage adjacent components.
20. Hand tighten the lift hook wing nuts J 28467-34 in order to remove all slack from the engine support fixture assembly.

REMOVAL PROCEDURE

1. Remove the **J 28467-B** . See **Special Tools** .
2. Remove the **J 28467-501** . See **Special Tools** .
3. Install the wiring harness electrical connector bracket to the rear of the left (Bank 2) cylinder head.

ENGINE MOUNT INSPECTION

IMPORTANT: Before replacing any engine mount due to suspected fluid loss, verify that the source of the fluid is actually the engine mount, not the engine or other accessories.

1. Install the engine support fixture. Refer to **Engine Support Fixture**. Raising the engine, will remove the weight from the engine mount and create a slight tension in the rubber mount.
2. Observe the engine mount while raising the engine. Replace the engine mount if the mount exhibits any of the following conditions:
 - The hard rubber surface is covered with heat check cracks.
 - The rubber is separated from the metal plate of the engine mount.
 - The rubber is split through the center of the engine mount.
 - The GLYCOL™ fluid is leaking from the engine mount.
3. If there is movement between the metal plate of the engine mount and its attaching points, lower the engine on the engine mount. Tighten the bolts or nuts attaching the engine mount to the frame or engine mount bracket. Refer to **Engine Mount Replacement - Left** or **Engine Mount Replacement - Right**.

ENGINE MOUNT REPLACEMENT - LEFT

REMOVAL PROCEDURE

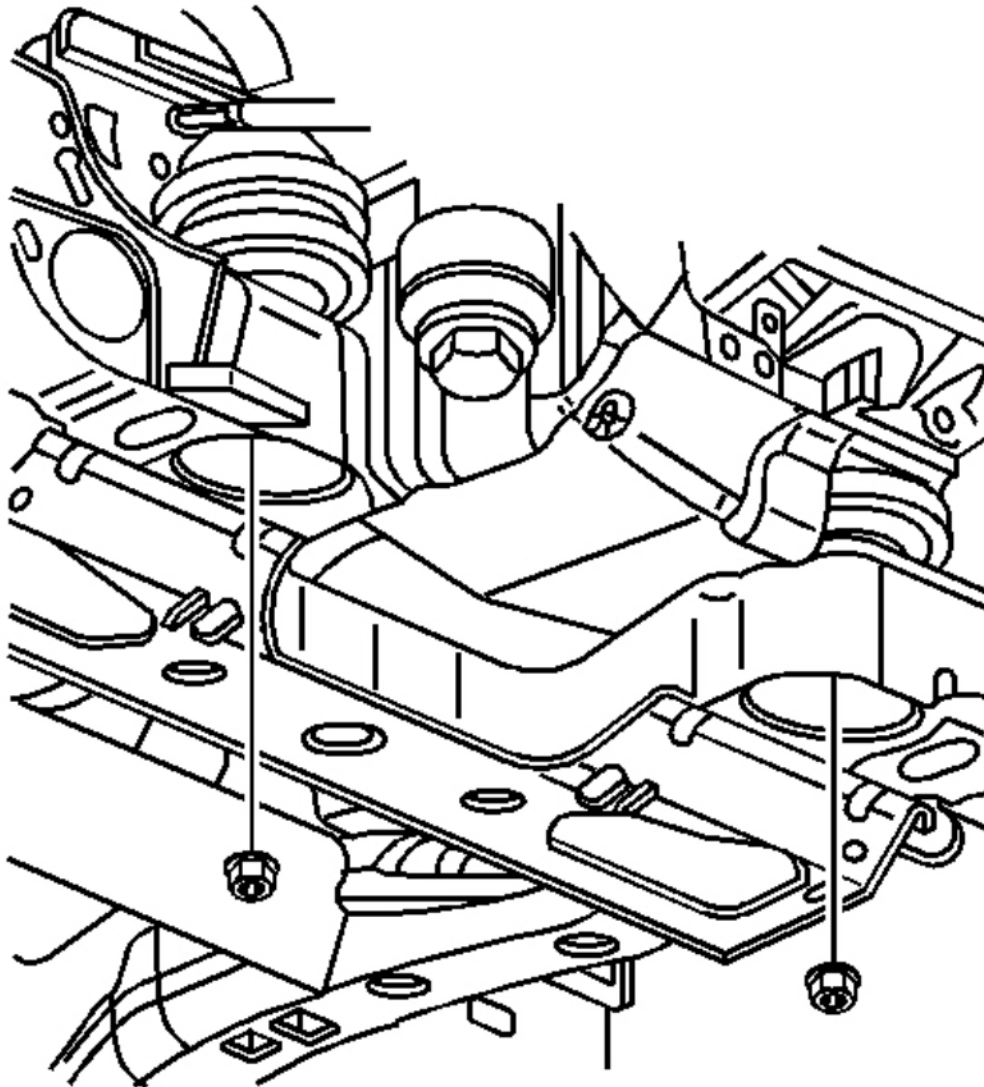


Fig. 18: Identifying Frame Mounting Nuts
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Install a screw jack with a block of wood under the oil pan for support.
3. Remove the lower engine mount retaining nut.
4. Raise the engine using the screw jack until the weight is removed from the mount.

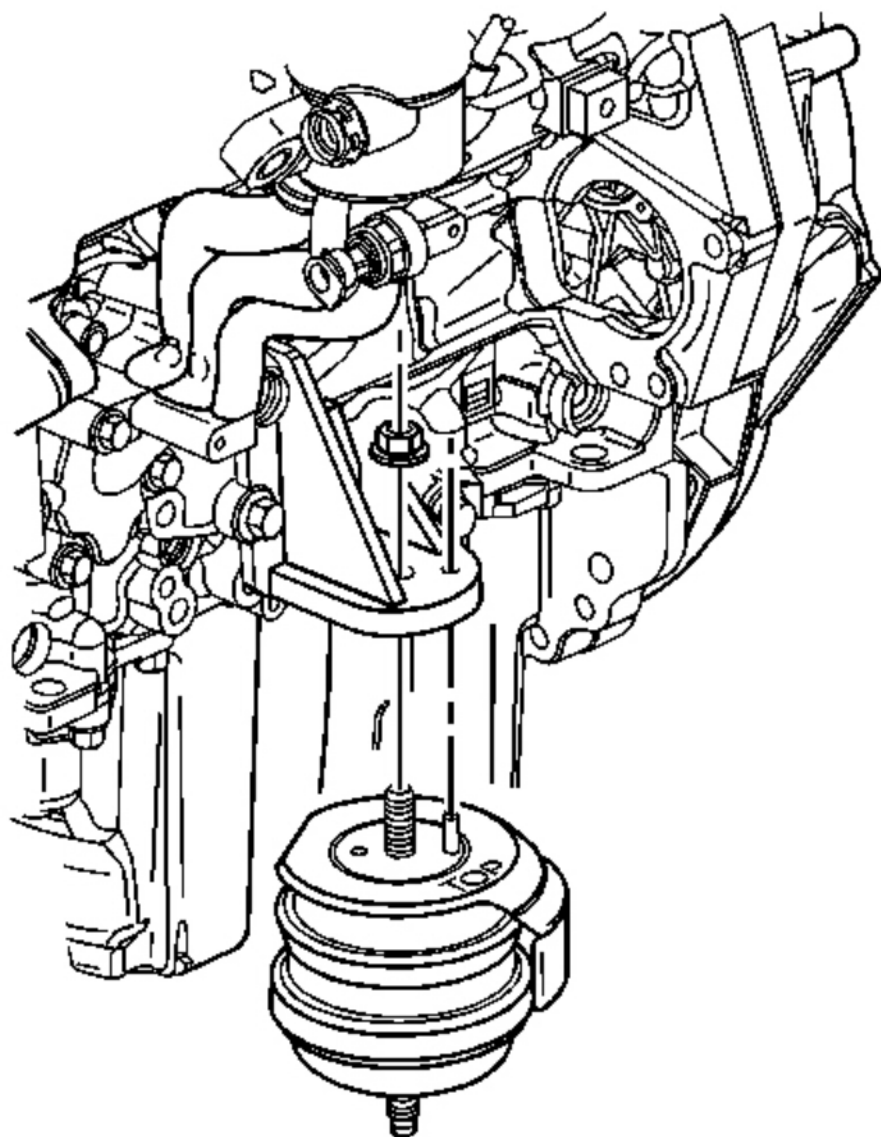


Fig. 19: View Of Left Engine Mount

Courtesy of GENERAL MOTORS CORP.

5. Remove the upper engine mount retaining nut.
6. Remove the engine mount from the vehicle.

INSTALLATION PROCEDURE

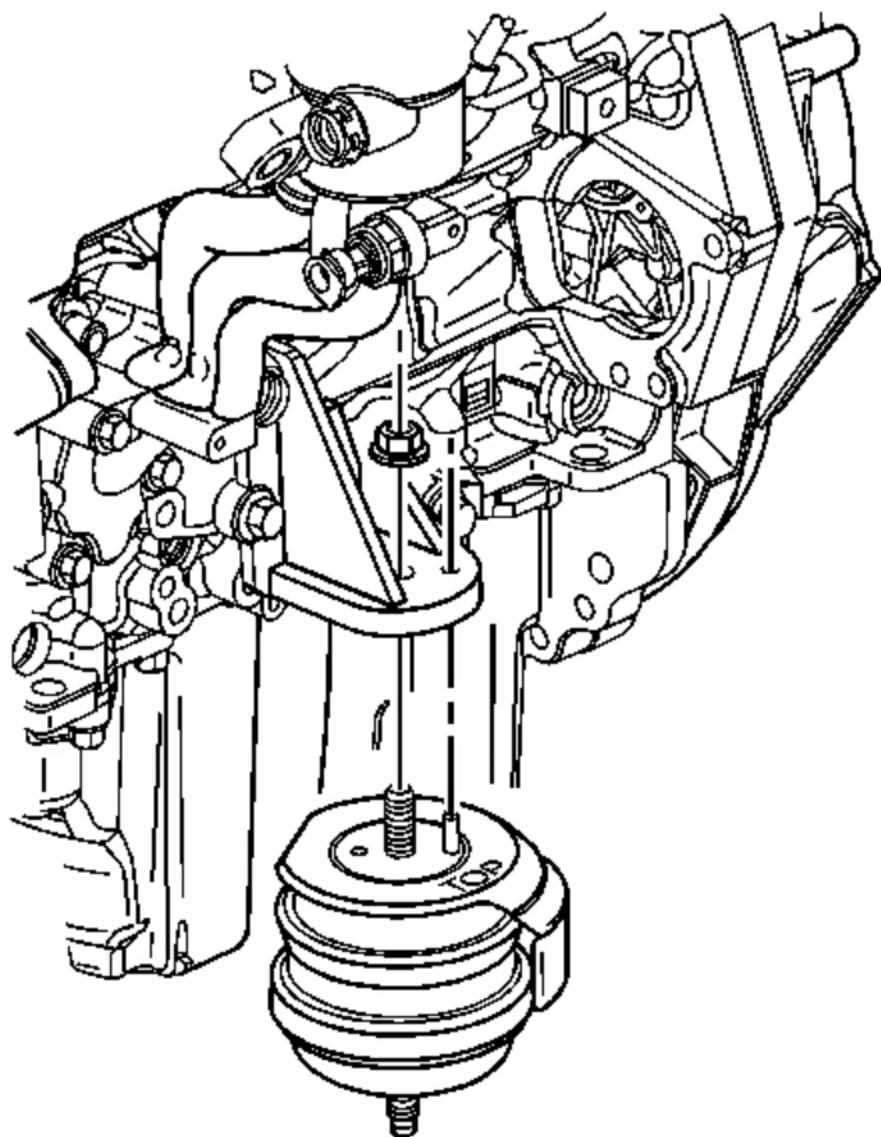


Fig. 20: View Of Left Engine Mount

Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount to the vehicle.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the upper engine mount retaining nut.

Tighten: Tighten the nut to 80 N.m (59 lb ft).

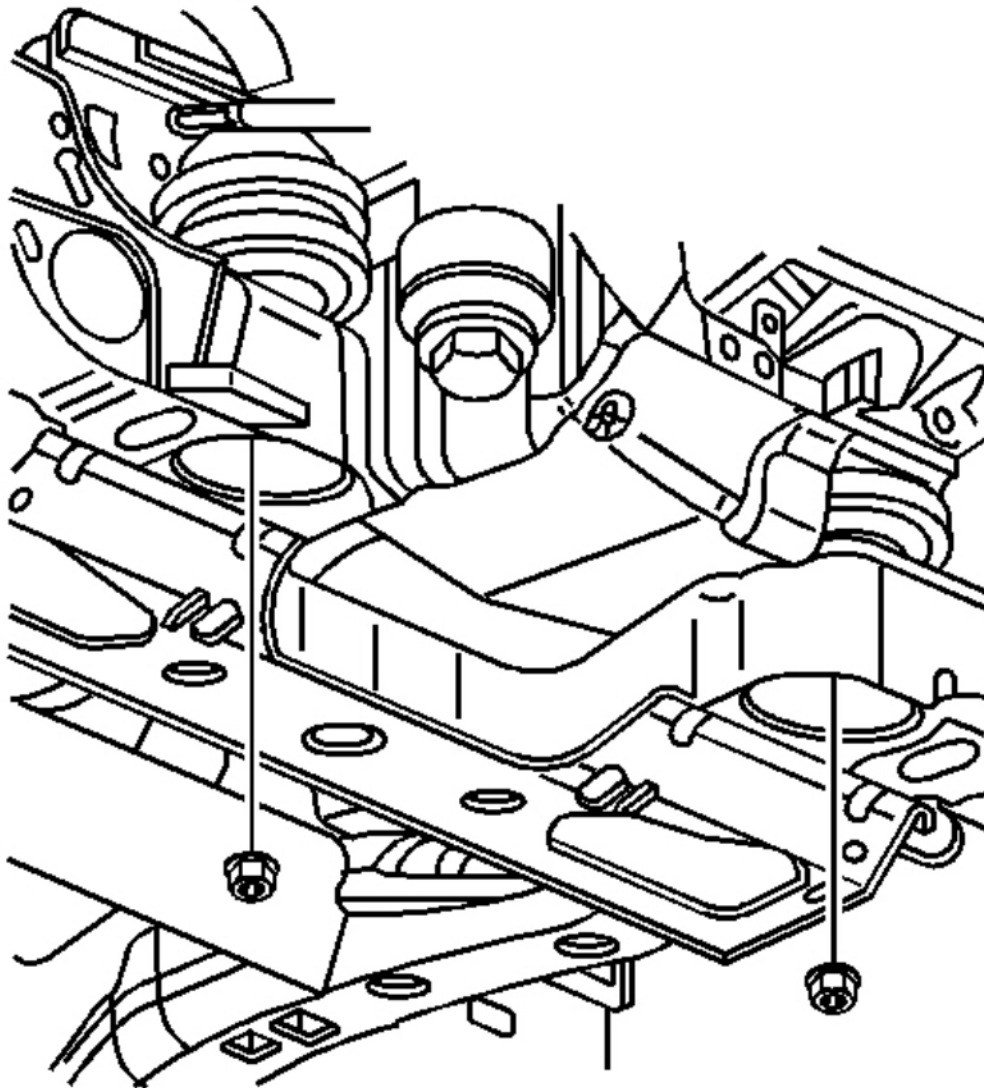


Fig. 21: Identifying Frame Mounting Nuts
Courtesy of GENERAL MOTORS CORP.

3. Lower the engine using the screw jack until the weight is resting on the mount.

4. Install the engine mount lower retaining nut.

Tighten: Tighten the nut to 80 N.m (59 lb ft).

5. Remove the screw jack and block of wood from under the oil pan.
6. Lower the vehicle.

ENGINE MOUNT REPLACEMENT - RIGHT

REMOVAL PROCEDURE

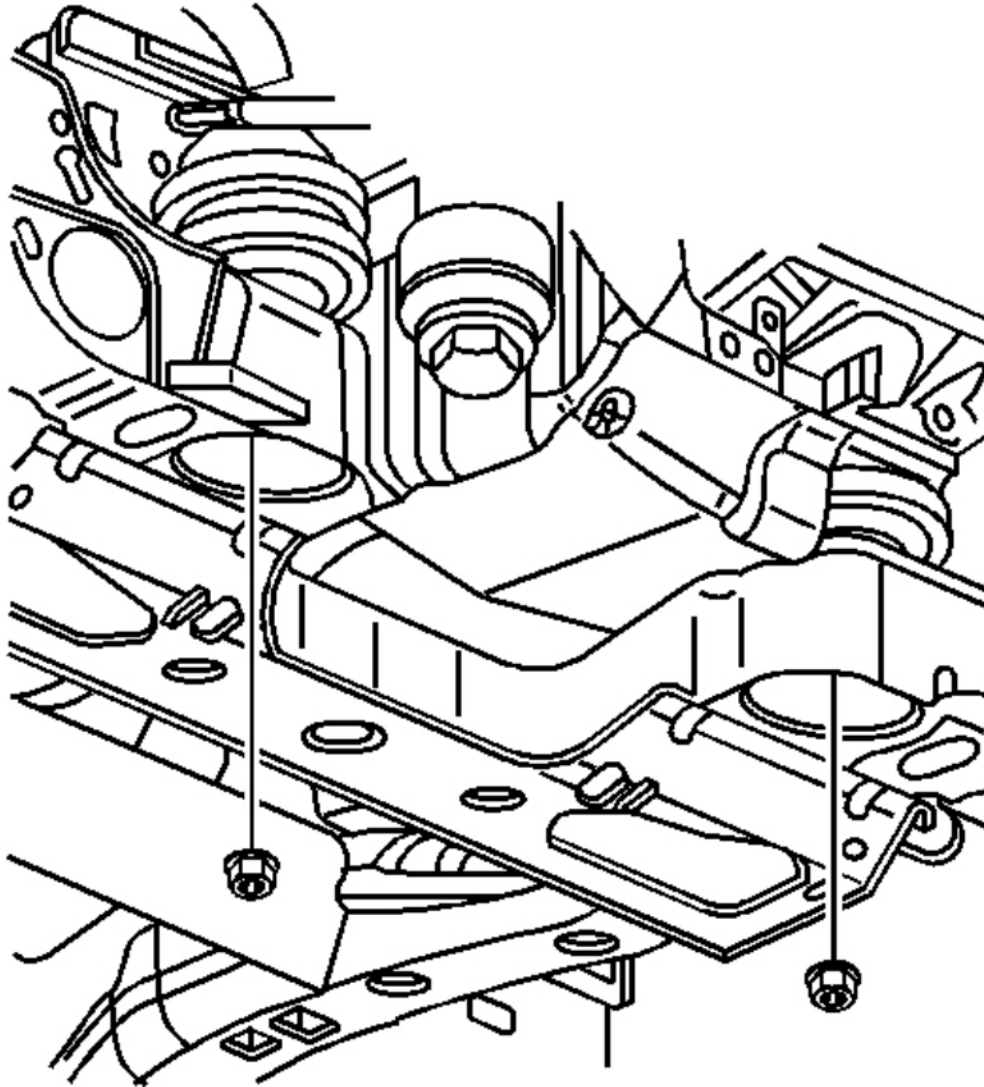


Fig. 22: Identifying Frame Mounting Nuts
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Install a screw jack with a block of wood under the oil pan for support.
3. Remove the lower engine mount retaining nut.
4. Raise the engine using the screw jack until the weight is removed from the mount.

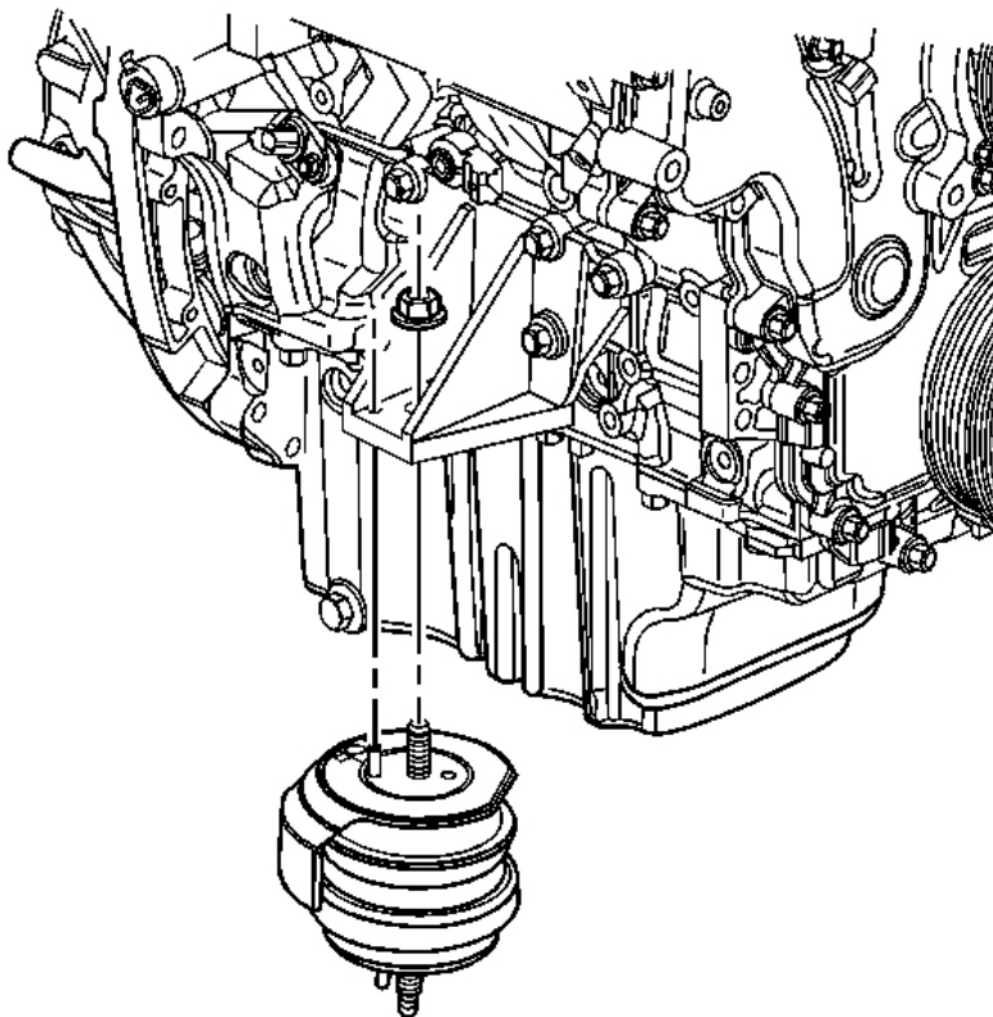


Fig. 23: View Of Right Engine Mount
Courtesy of GENERAL MOTORS CORP.

5. Remove the upper engine mount retaining nut.
6. Remove the engine mount from the vehicle.

INSTALLATION PROCEDURE

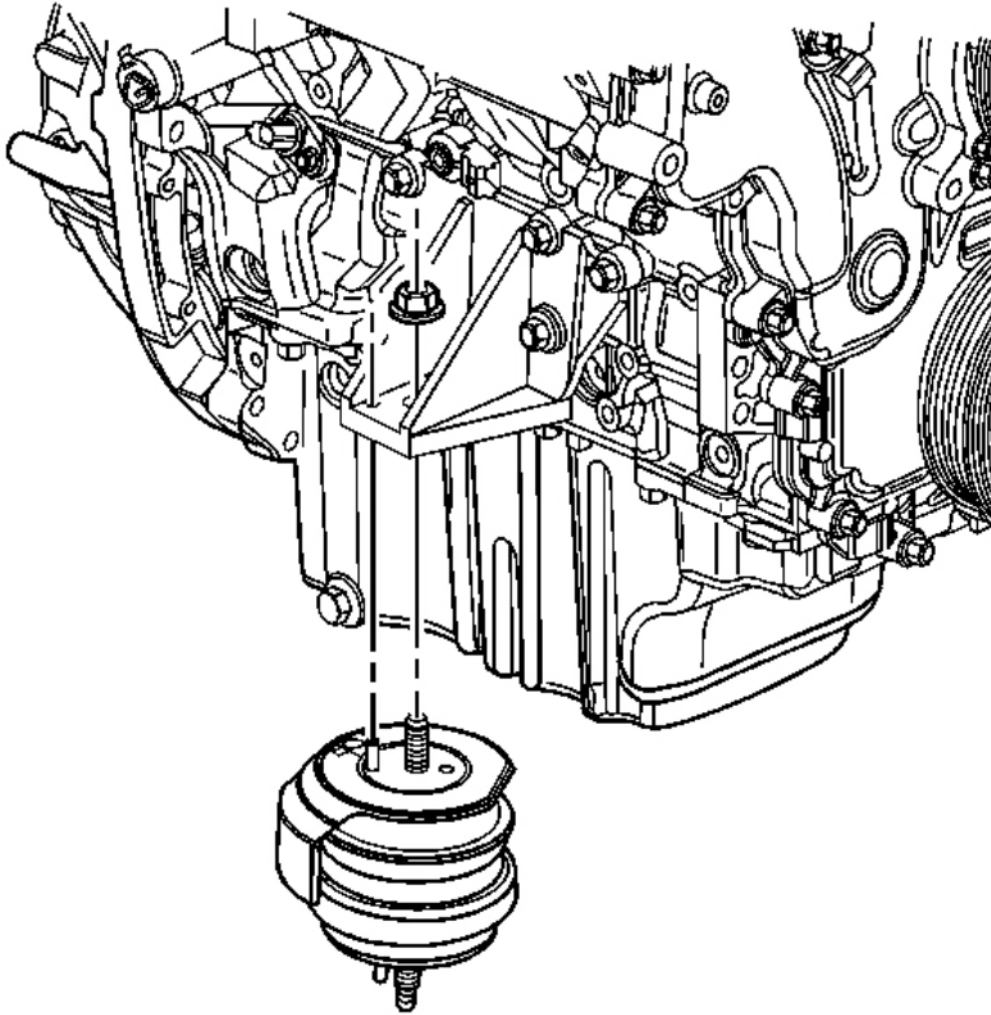


Fig. 24: View Of Right Engine Mount
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount to the vehicle.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the upper engine mount retaining nut.

Tighten: Tighten the nut to 80 N.m (59 lb ft).

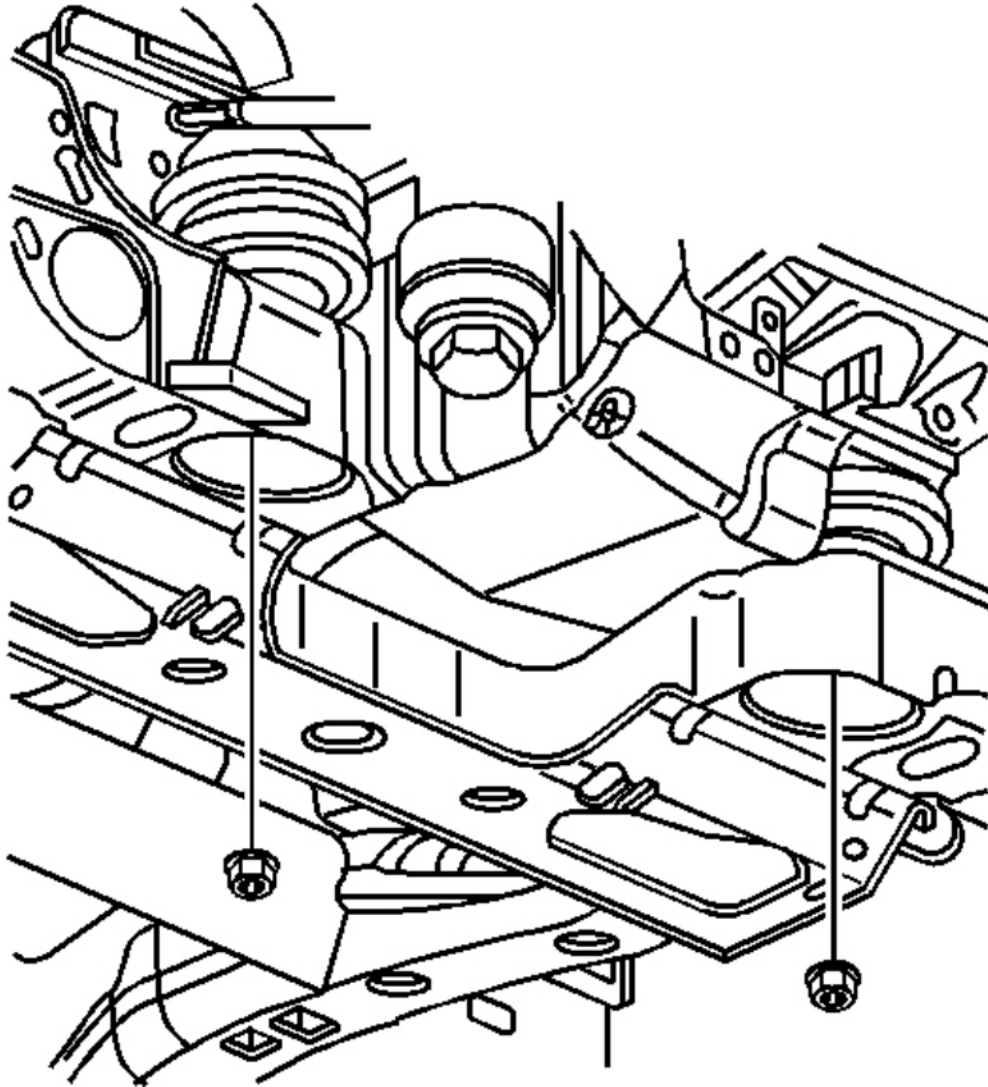


Fig. 25: Identifying Frame Mounting Nuts

Courtesy of GENERAL MOTORS CORP.

3. Lower the engine using the jack screw until the weight is resting on the mount.
4. Install the engine mount retaining nut.

Tighten: Tighten the nut to 80 N.m (59 lb ft).

5. Remove the screw jack and block of wood from under the oil pan.
6. Lower the vehicle.

ENGINE MOUNT BRACKET REPLACEMENT - LEFT

REMOVAL PROCEDURE

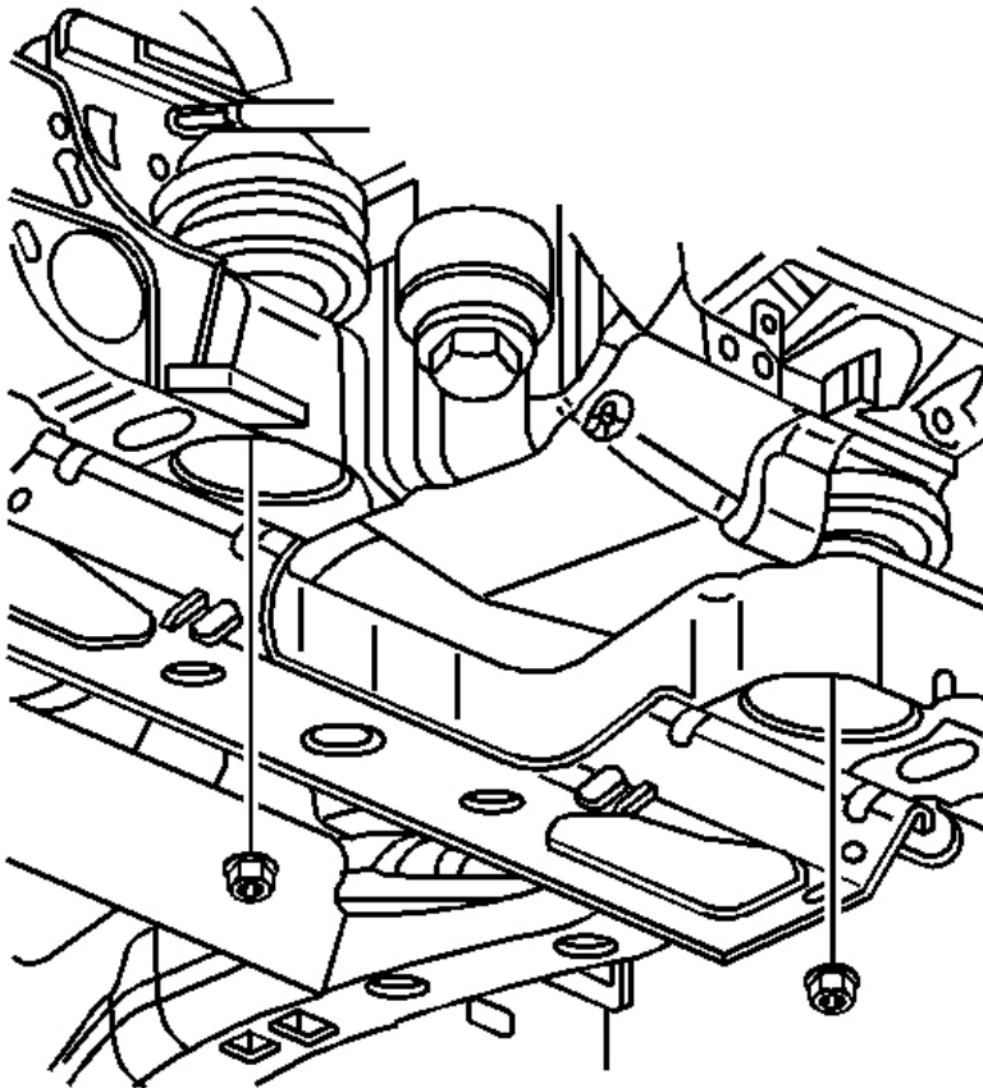


Fig. 26: Identifying Frame Mounting Nuts

Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Install a screw jack with a block of wood under the oil pan for support.
3. Remove the lower engine mount retaining nut.
4. Raise the engine using the screw jack until the weight is removed from the mount.

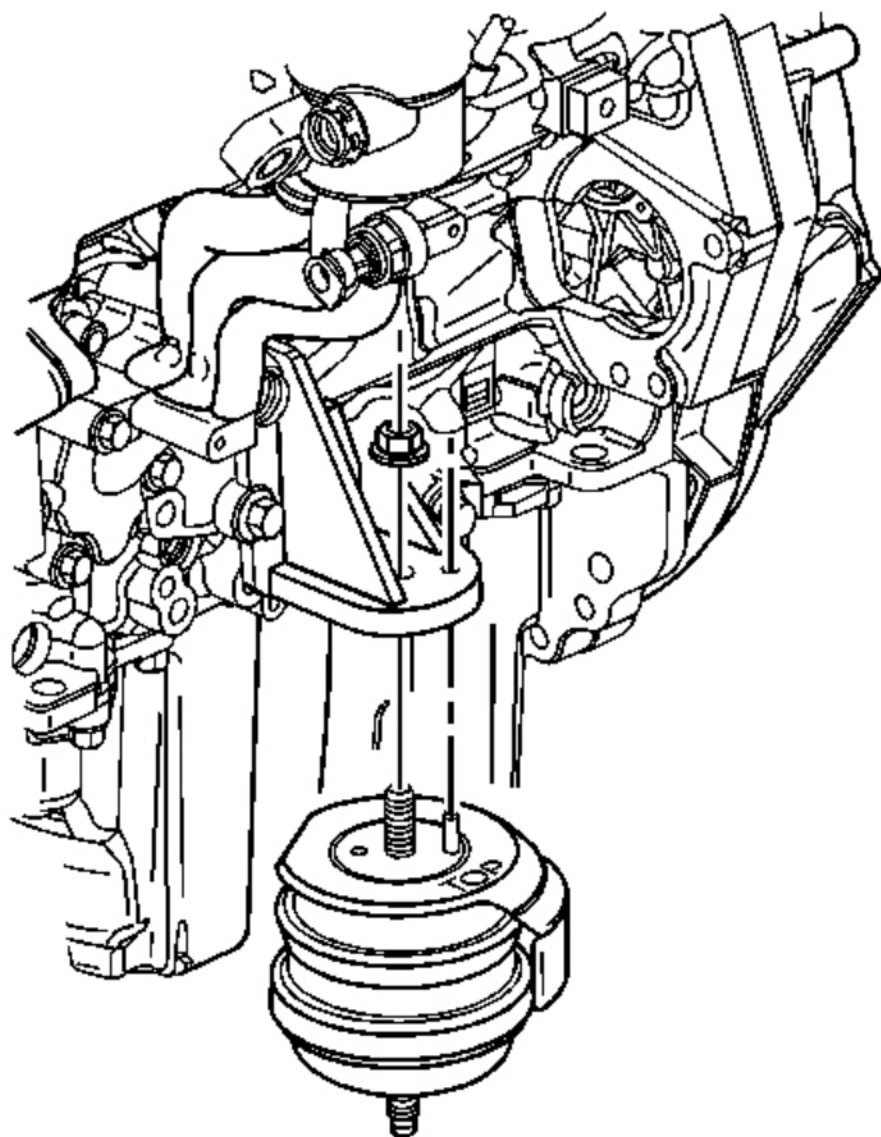


Fig. 27: View Of Left Engine Mount

Courtesy of GENERAL MOTORS CORP.

5. Remove the upper engine mount retaining nut.
6. Remove the engine mount from the vehicle.

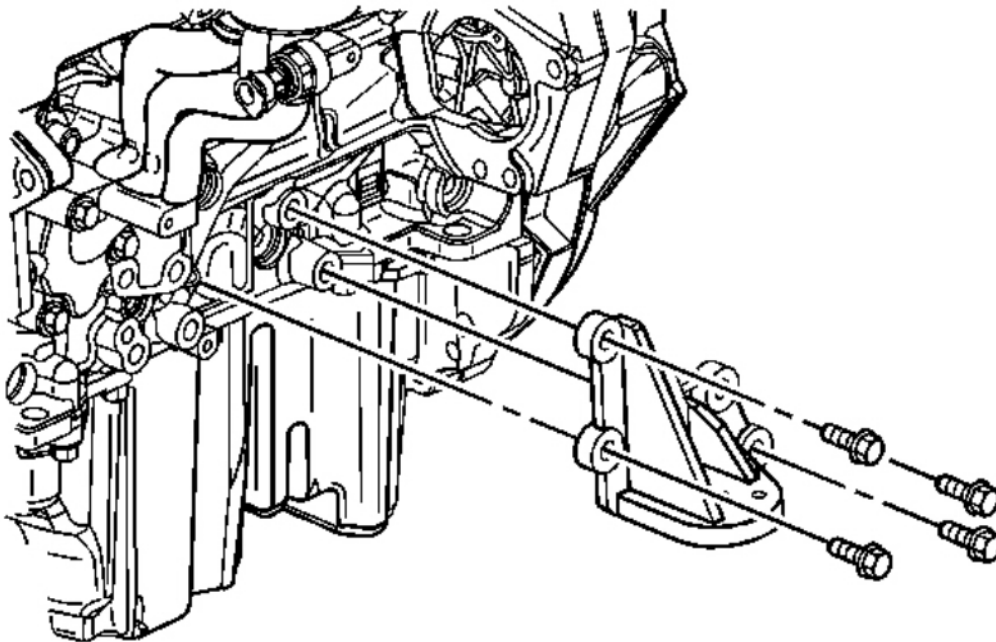


Fig. 28: View Of Left Engine Mount Bracket

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure not to distort or bend the engine mount heat shield.

7. Remove the left engine mount bracket retaining bolts.
8. Remove the left engine mount bracket.

INSTALLATION PROCEDURE

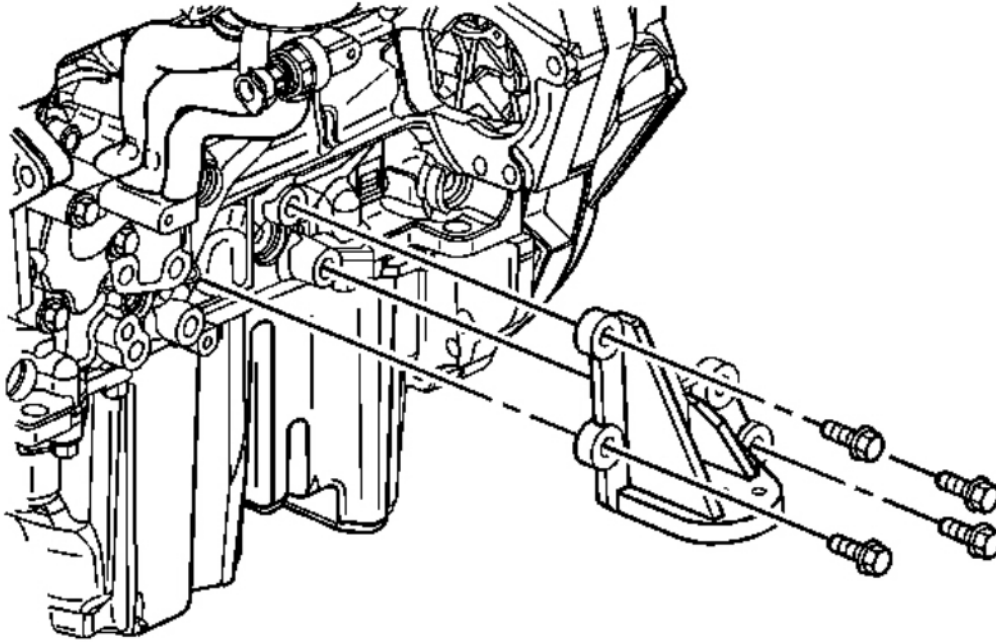


Fig. 29: View Of Left Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

1. Install the left engine mount bracket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the left engine mount bracket retaining bolts.

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

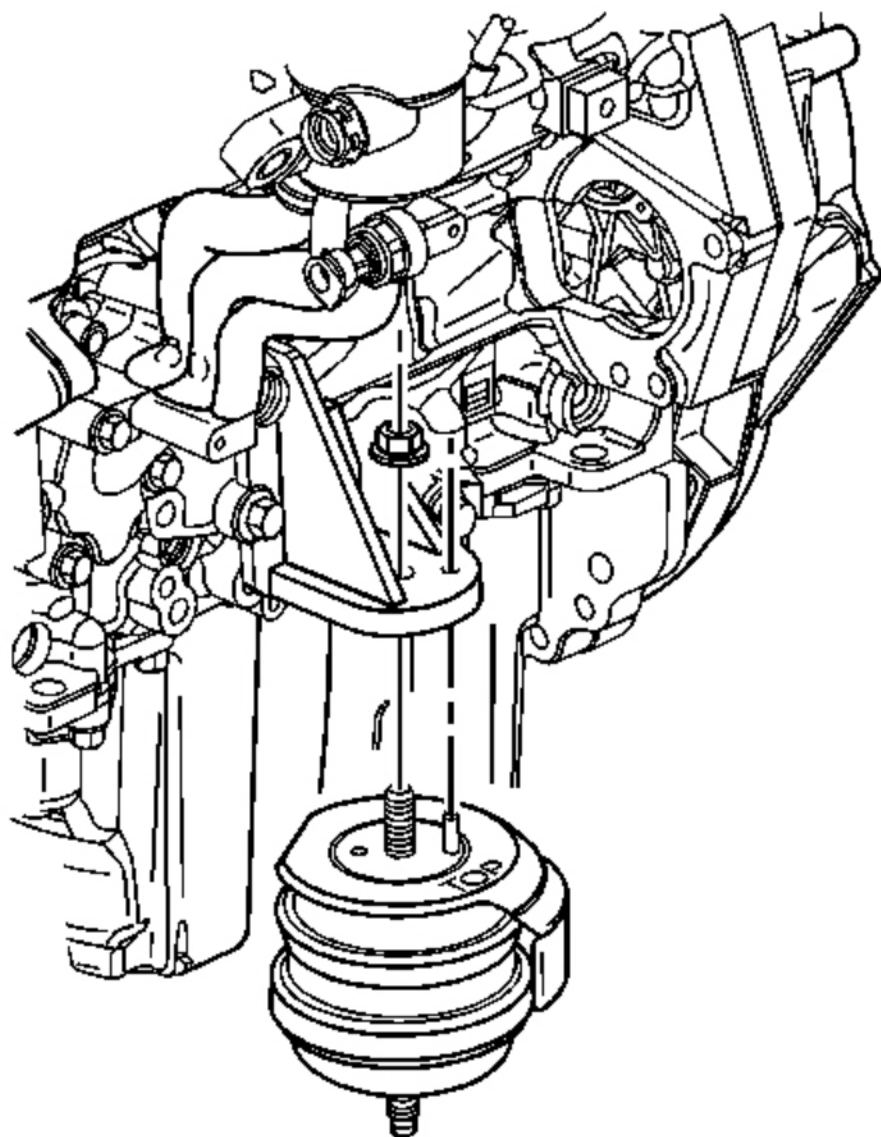


Fig. 30: View Of Left Engine Mount
Courtesy of GENERAL MOTORS CORP.

3. Install the engine mount to the vehicle.
4. Install the upper engine mount retaining nut.

Tighten: Tighten the nut to 80 N.m (59 lb ft).

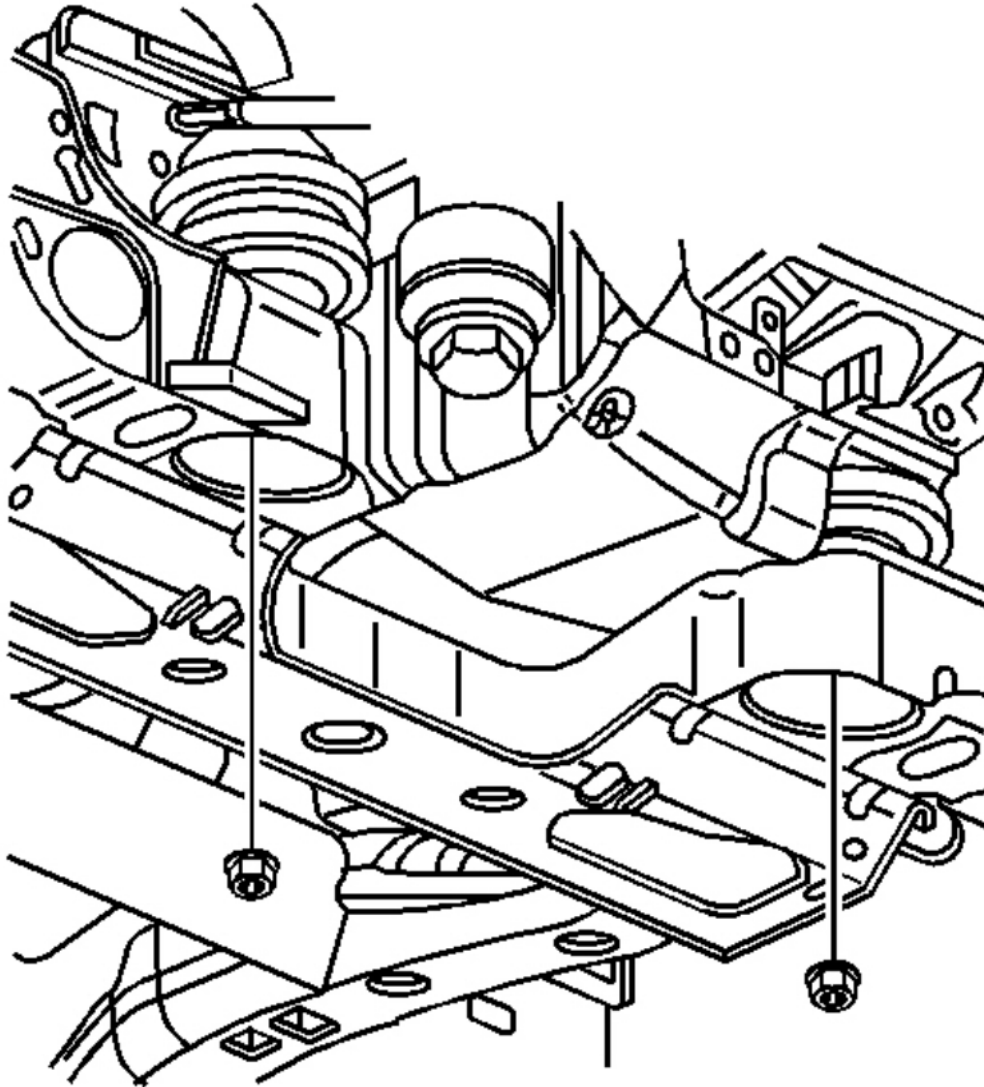


Fig. 31: Identifying Frame Mounting Nuts
Courtesy of GENERAL MOTORS CORP.

5. Lower the engine using the screw jack until the weight is resting on the mount.
6. Install the engine mount lower retaining nut.

Tighten: Tighten the nut to 80 N.m (59 lb ft).

7. Remove the screw jack and block of wood from under the oil pan.
8. Lower the vehicle.

ENGINE MOUNT BRACKET REPLACEMENT - RIGHT

REMOVAL PROCEDURE

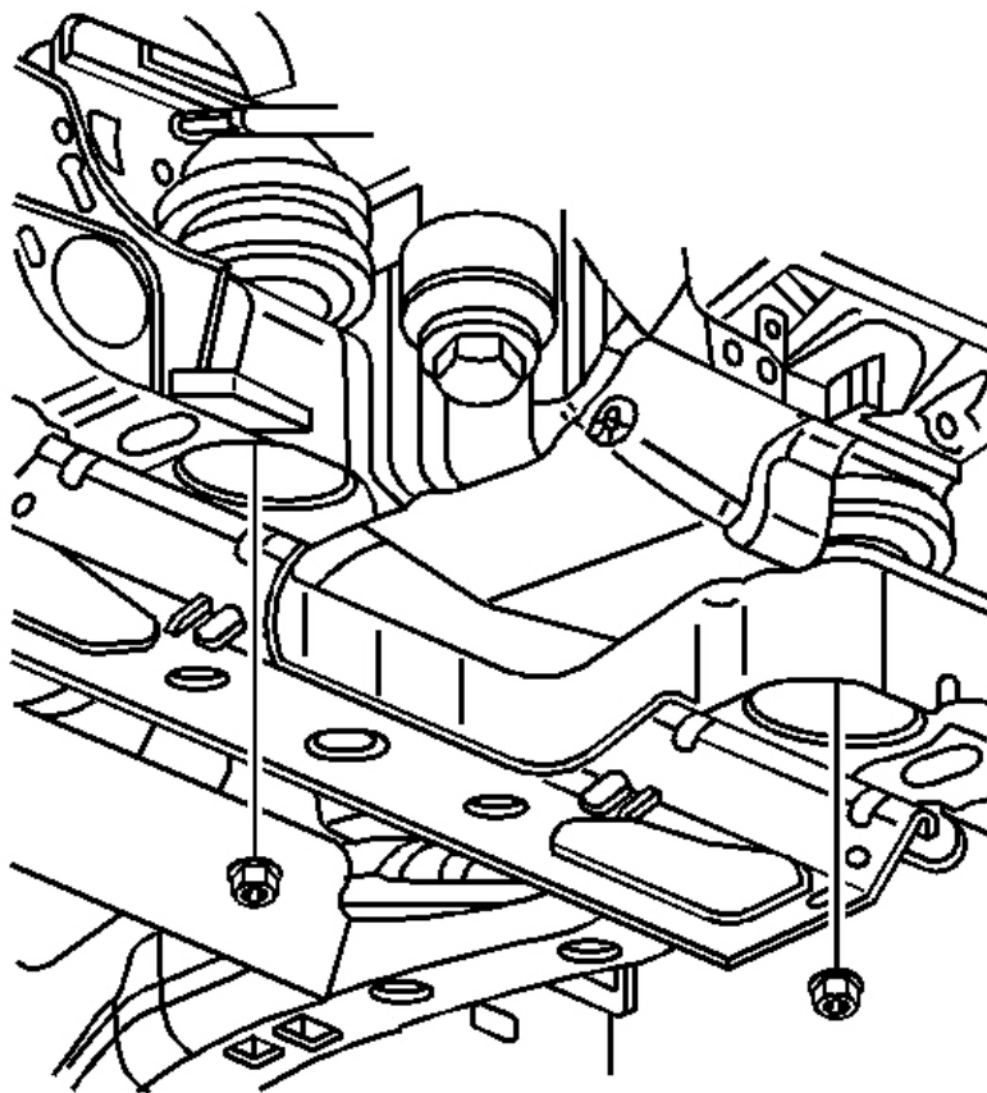


Fig. 32: Identifying Frame Mounting Nuts

Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Install a screw jack with a block of wood under the oil pan for support.
3. Remove the lower engine mount retaining nut.
4. Raise the engine using the screw jack until the weight is removed from the mount.

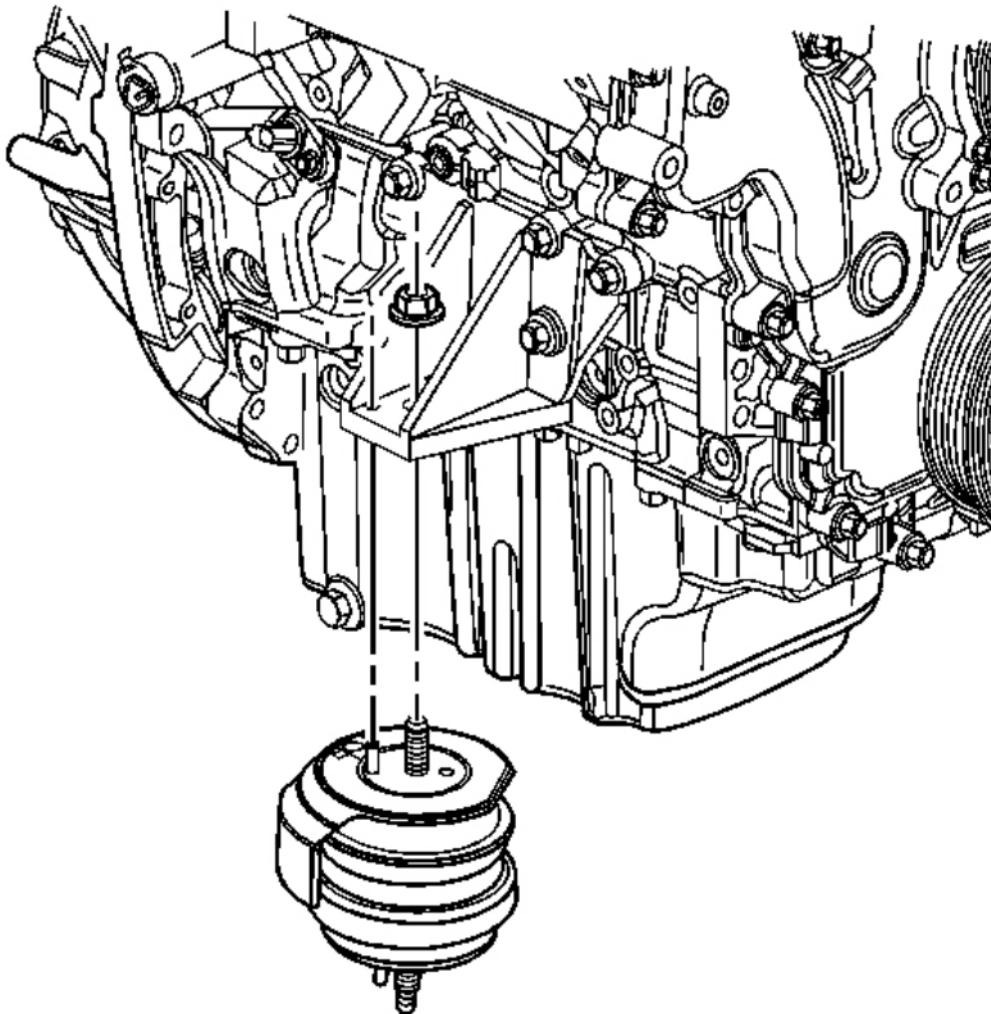


Fig. 33: View Of Right Engine Mount
Courtesy of GENERAL MOTORS CORP.

5. Remove the upper engine mount retaining nut.
6. Remove the engine mount from the vehicle.
7. Remove the starter. Refer to **Starter Motor Replacement (LP1, LY7)** in Engine Electrical.

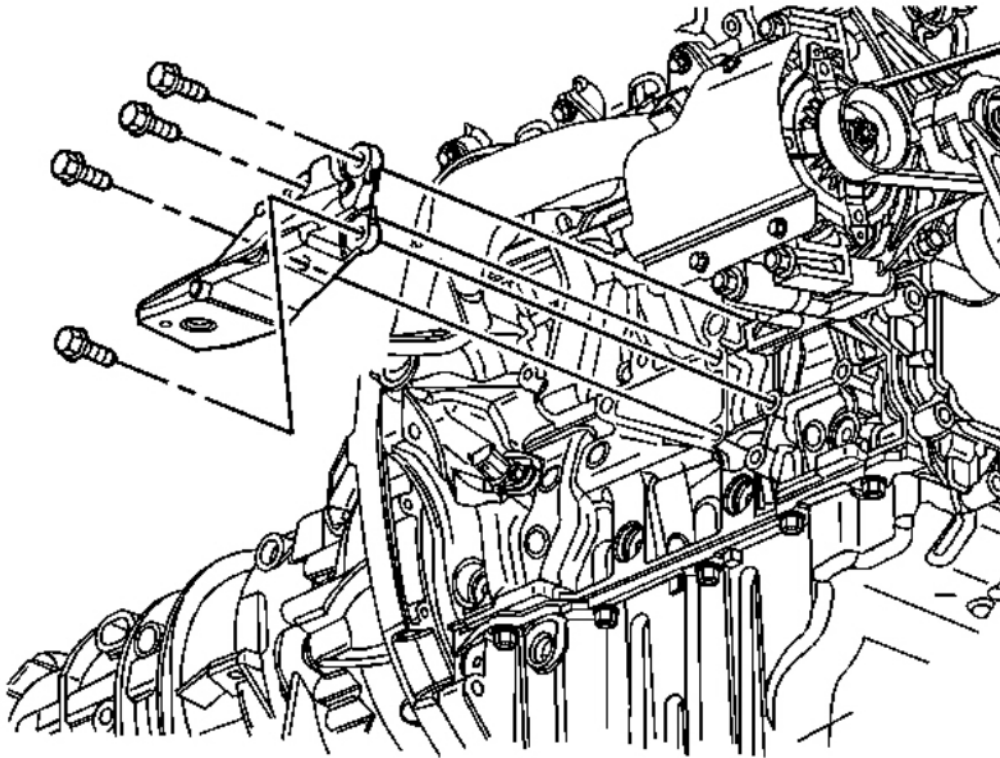


Fig. 34: View Of Right Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure not to distort or bend the engine mount heat shield.

8. Remove the right engine mount bracket mounting bolts.
9. Remove the engine mount bracket from the vehicle.

INSTALLATION PROCEDURE

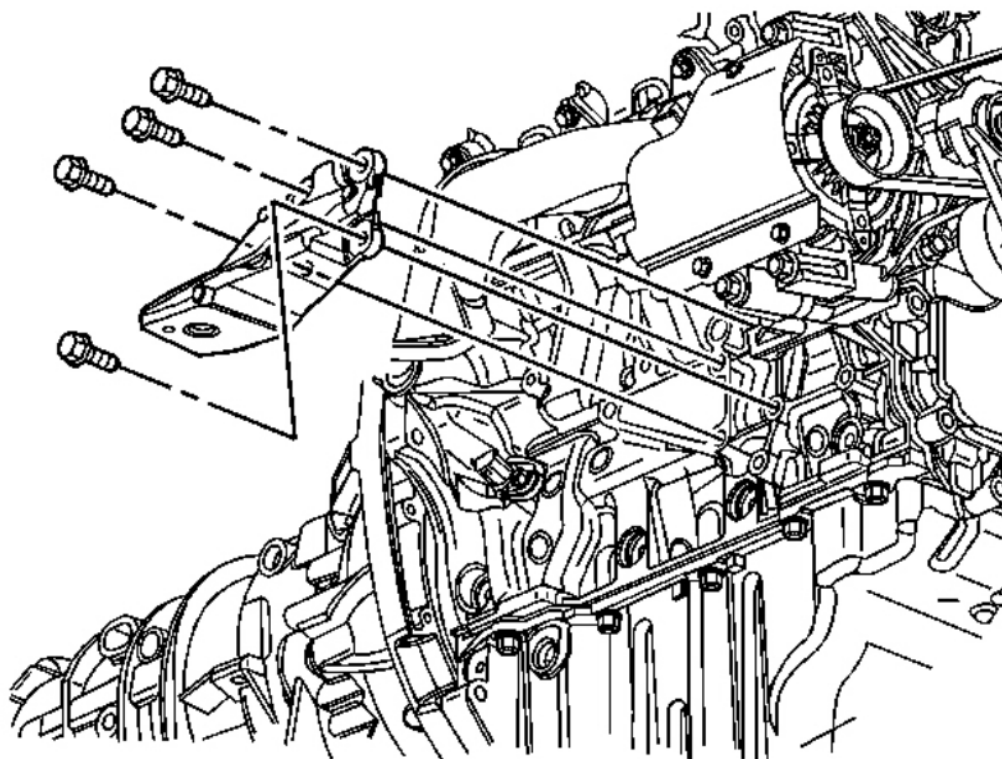


Fig. 35: View Of Right Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount bracket to the vehicle.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Tighten the M 10 engine mount bracket mounting bolts.

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

3. Tighten the M 8 engine mount bracket mounting bolt.

Tighten: Tighten the bolt to 38 N.m (28 lb ft).

4. Install the starter. Refer to Starter Motor Replacement (LP1, LY7) in Engine Electrical.

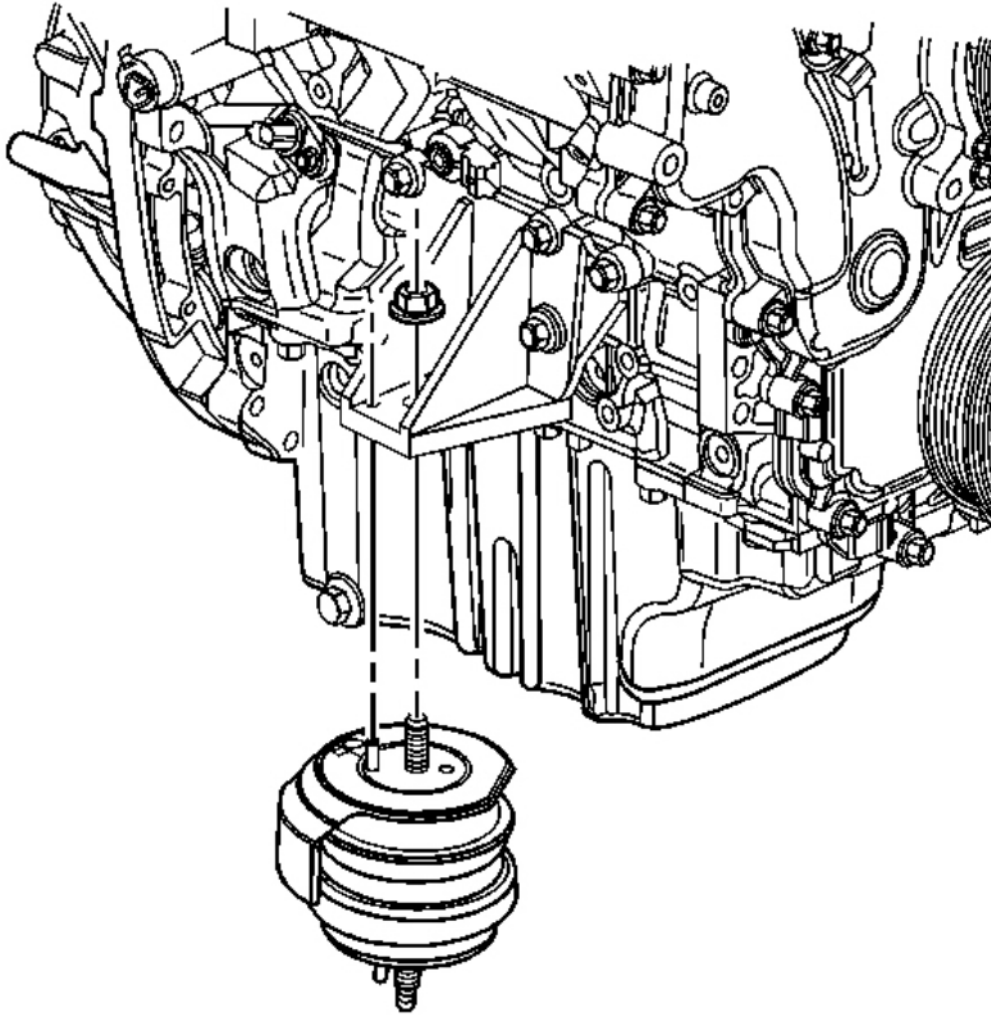


Fig. 36: View Of Right Engine Mount
Courtesy of GENERAL MOTORS CORP.

5. Install the engine mount to the vehicle.

NOTE: Refer to Fastener Notice in Cautions and Notices.

6. Install the upper engine mount retaining nut.

Tighten: Tighten the nut to 80 N.m (59 lb ft).

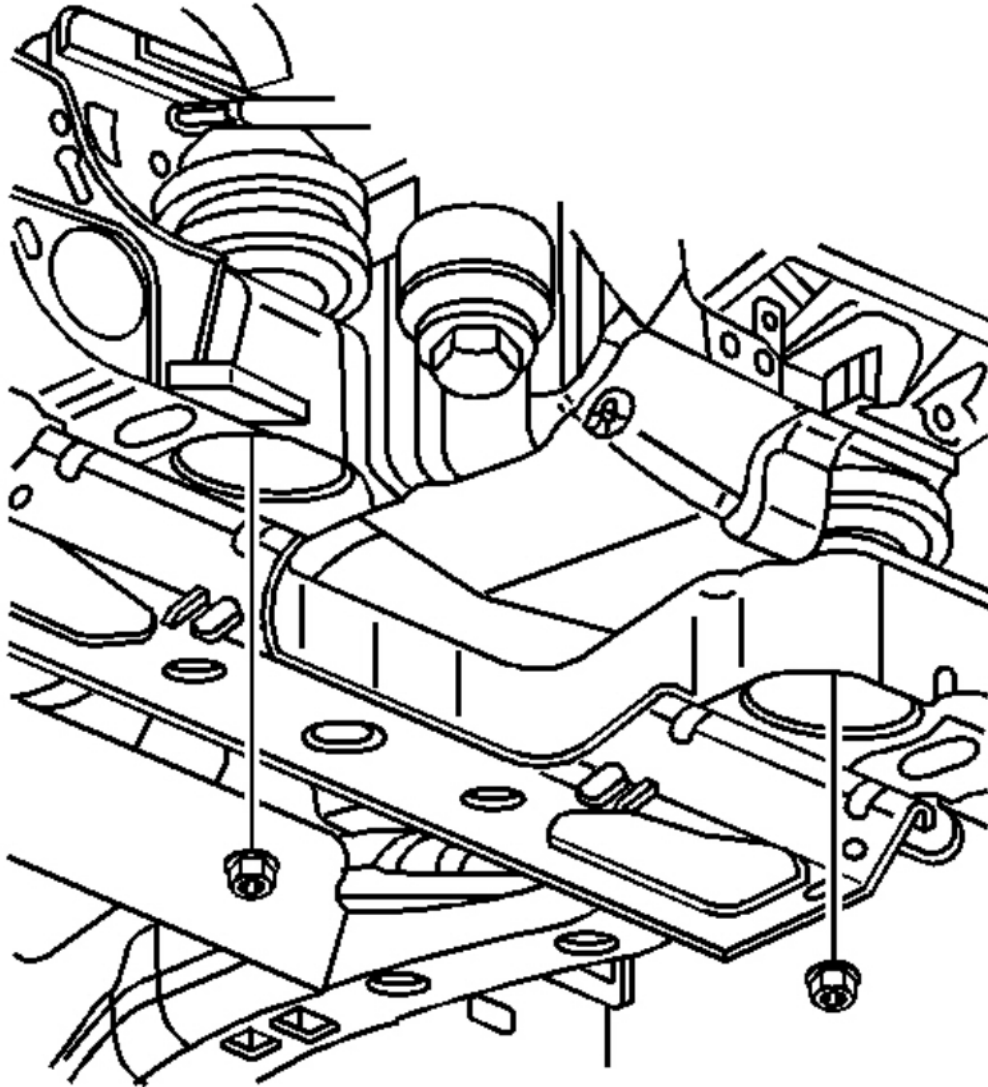


Fig. 37: Identifying Frame Mounting Nuts
Courtesy of GENERAL MOTORS CORP.

7. Lower the engine using the jack screw until the weight is resting on the mount.
8. Install the engine mount retaining nut.

Tighten: Tighten the nut to 80 N.m (59 lb ft).

9. Remove the screw jack and block of wood from under the oil pan.
10. Lower the vehicle.

FUEL INJECTOR SIGHT SHIELD REPLACEMENT

REMOVAL PROCEDURE

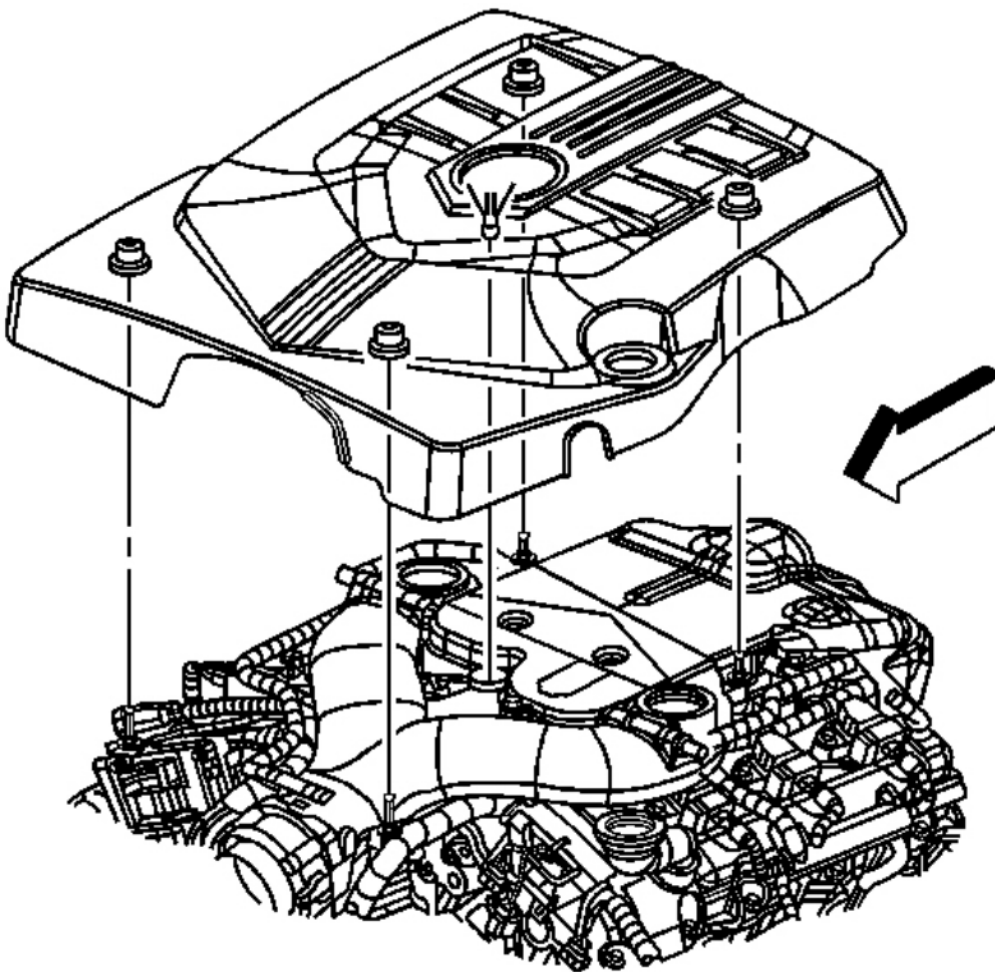


Fig. 38: View Of Engine Cover/Sight Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the cross car brace, if necessary. Refer to **Brace Replacement - Cross Vehicle** in Body Front End.

2. Remove the oil fill cap.
3. Disengage the cover/shield from the ball studs by pulling up firmly on the rear and front of the engine cover.
4. Remove the engine cover/sight shield.

INSTALLATION PROCEDURE

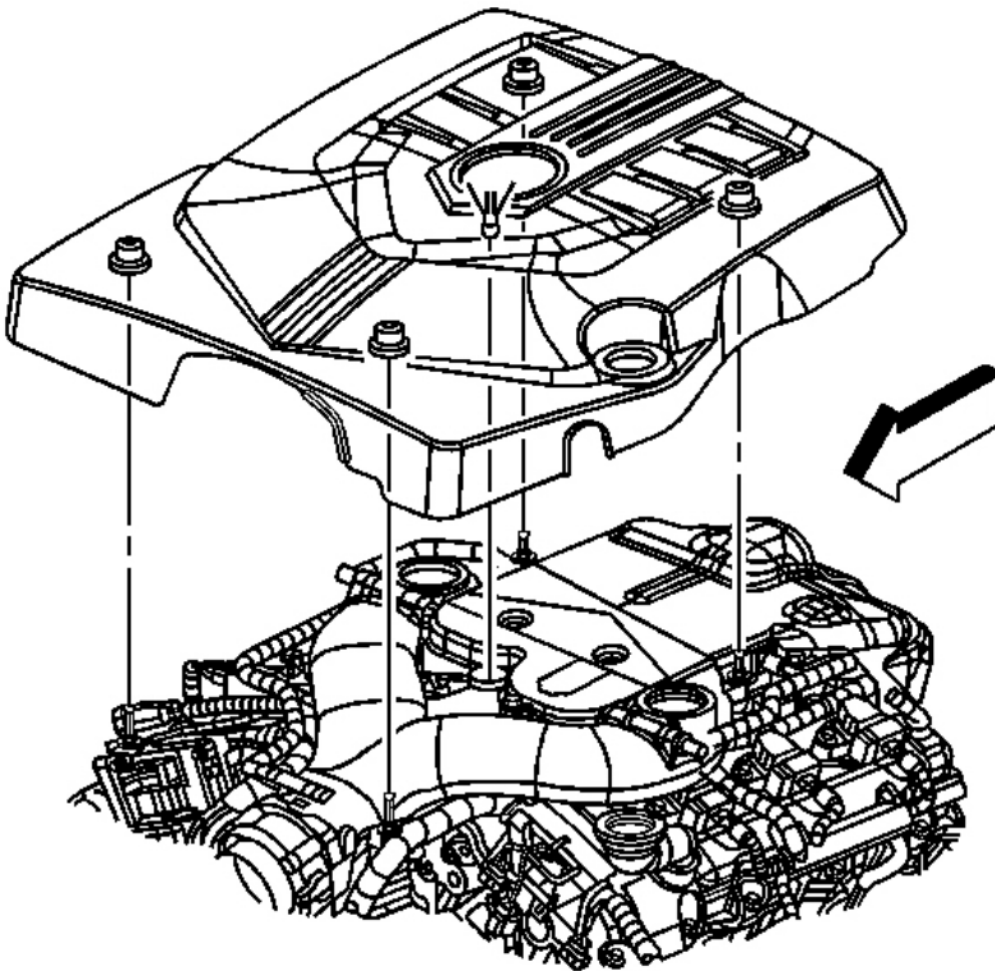


Fig. 39: View Of Engine Cover/Sight Shield
Courtesy of GENERAL MOTORS CORP.

1. Position the engine cover/sight shield over the intake manifold so the grommets are aligned with the ball studs.

2. Press the engine cover/sight shield down firmly near the ball studs in order to install the engine cover/sight shield.
3. Install the oil fill cap.
4. Install the cross car brace, if necessary. Refer to **Brace Replacement - Cross Vehicle** in Body Front End.

UPPER INTAKE MANIFOLD COVER REPLACEMENT - REAR

REMOVAL PROCEDURE

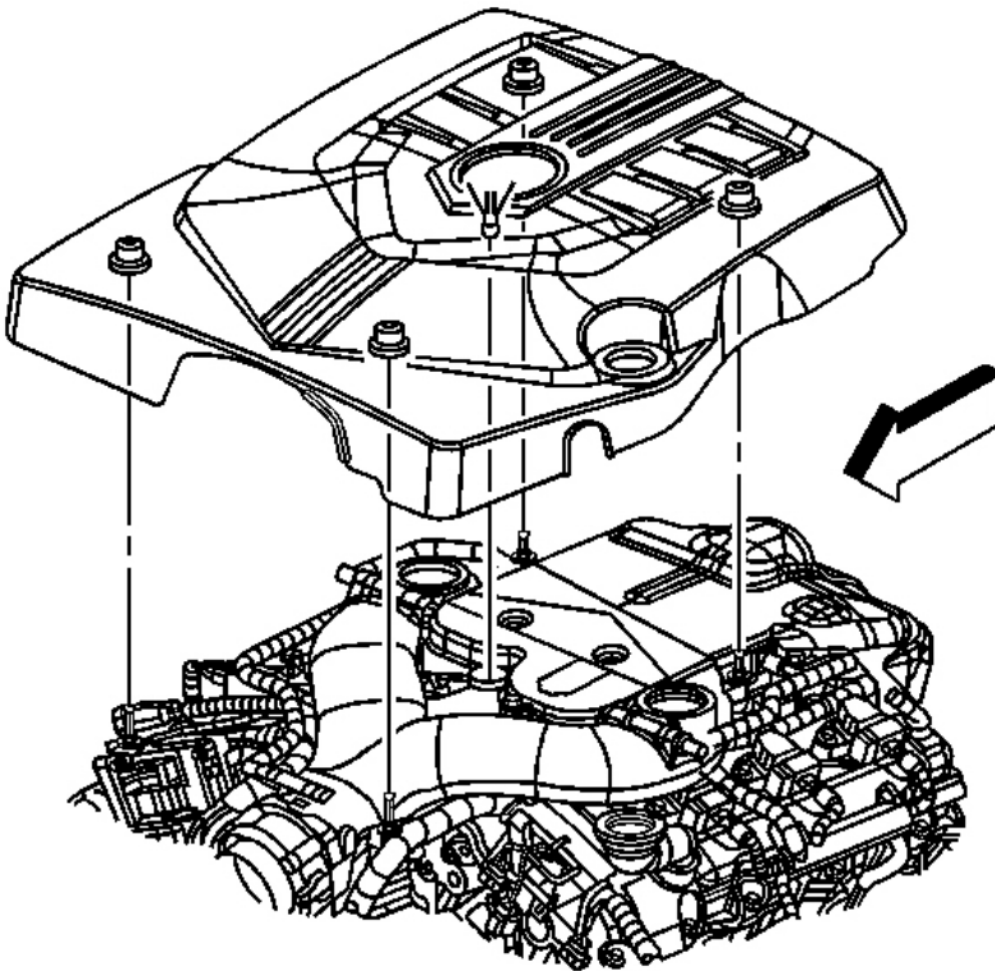


Fig. 40: View Of Engine Cover/Sight Shield
Courtesy of GENERAL MOTORS CORP.

1. Remove the cross car brace, if necessary. Refer to **Brace Replacement - Cross Vehicle** in Body Front End.
2. Remove the oil fill cap.
3. Disengage the cover/shield from the ball studs by pulling up firmly on the rear and front of the engine cover.
4. Remove the engine cover/sight shield.

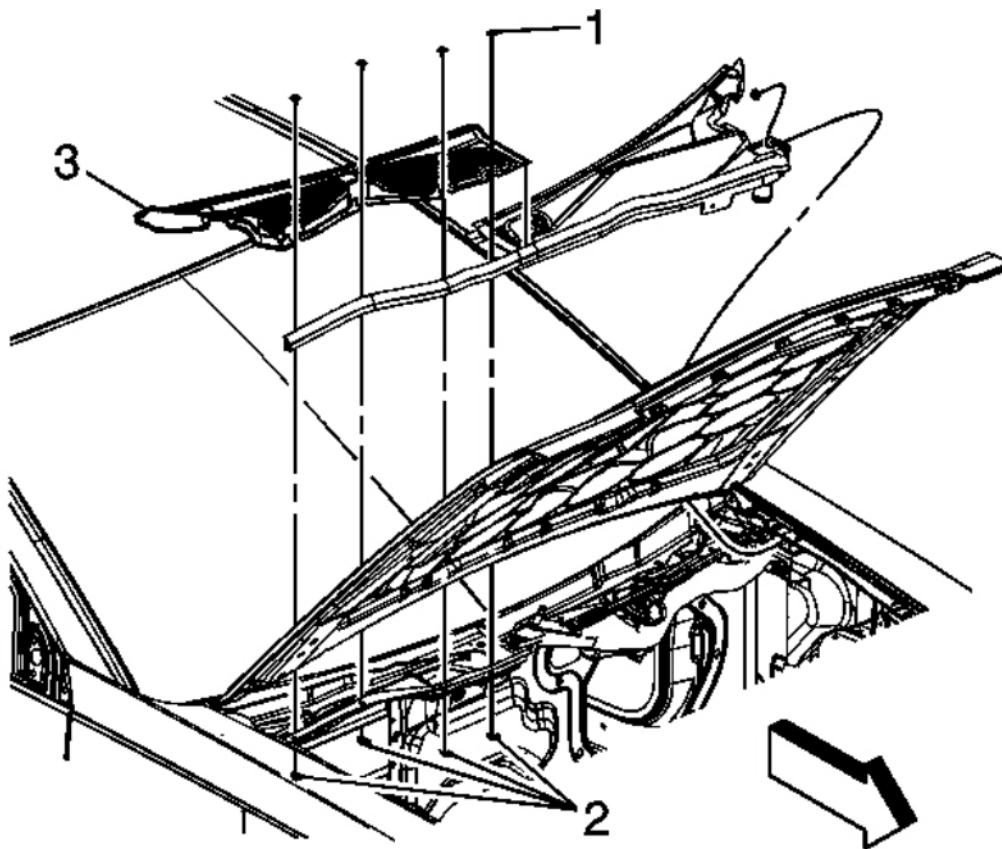


Fig. 41: View Of Hood Seal & Passenger Side Air Inlet Screen Panel
 Courtesy of GENERAL MOTORS CORP.

5. Remove the hood seal from the passenger side air inlet screen panel.
6. Remove the air inlet screen panel bolts (1).
7. Remove the passenger side air inlet screen panel (3).

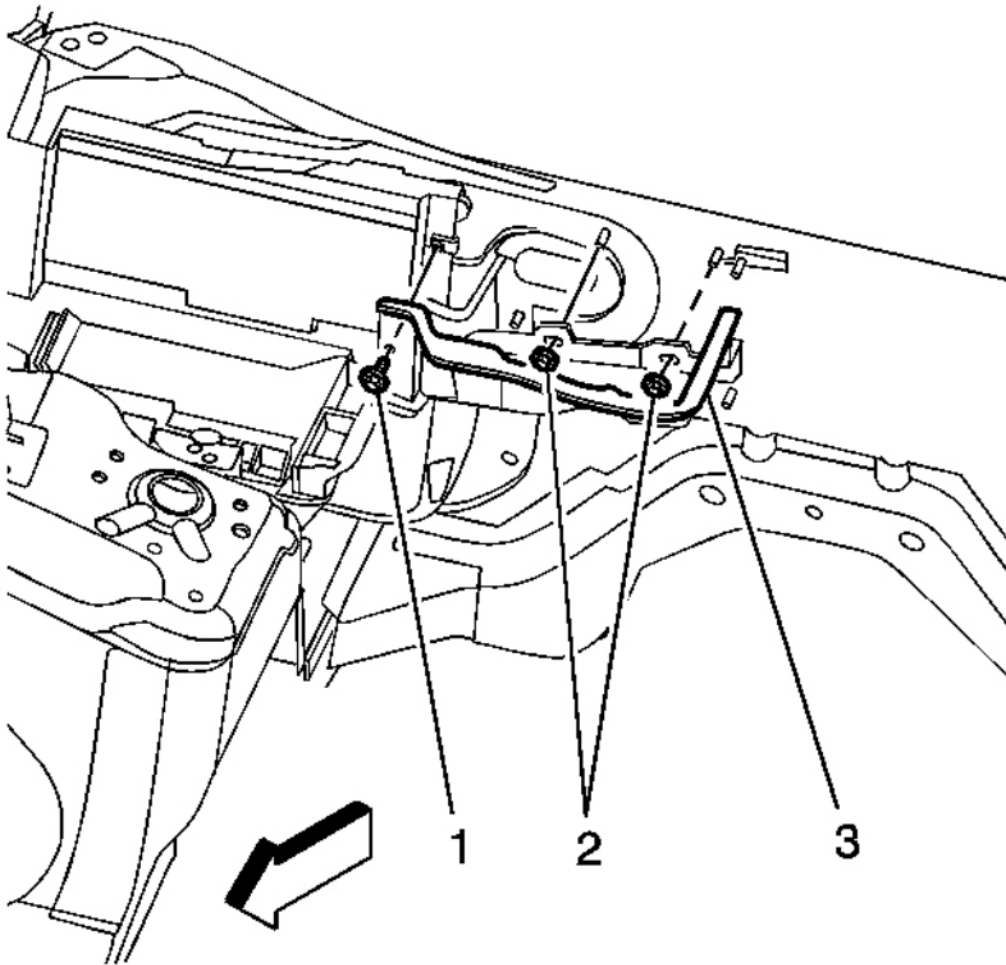


Fig. 42: Locating Air Inlet Housing Panel
Courtesy of GENERAL MOTORS CORP.

8. Remove the air inlet housing panel bolt (3) and nuts (2).
9. Remove the air inlet housing panel (1).

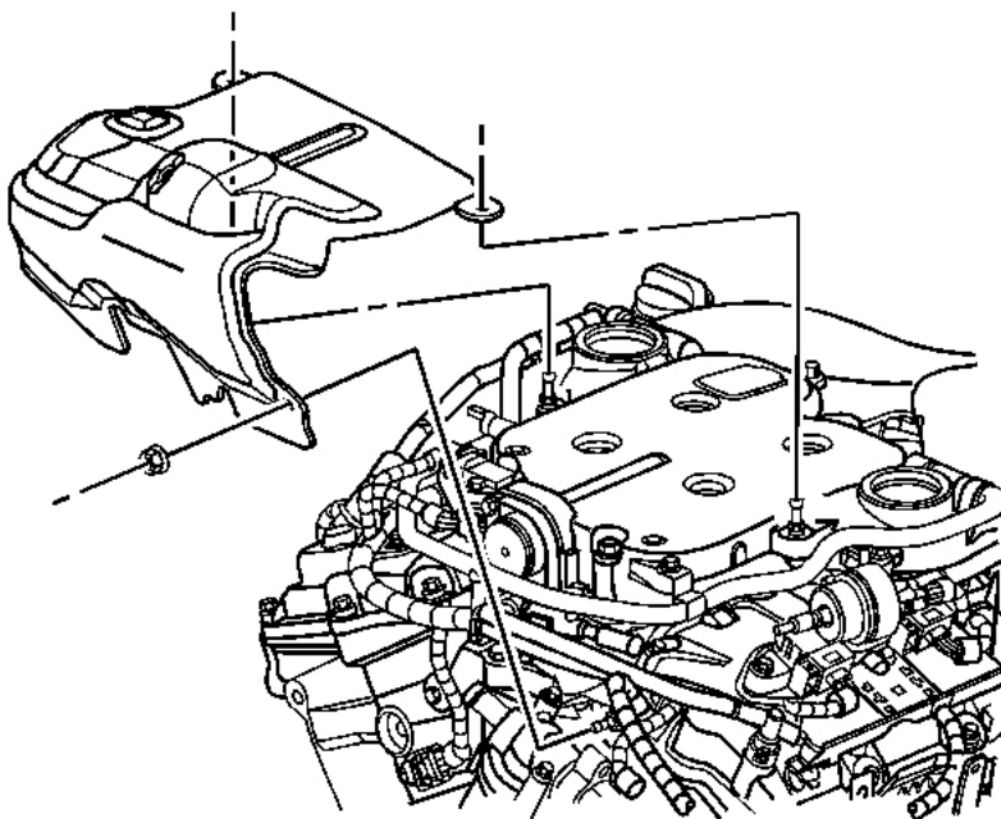


Fig. 43: View Of Rear Upper Intake Manifold Cover
Courtesy of GENERAL MOTORS CORP.

10. Remove the nut from the rear stud.
11. Remove the cover from the upper studs.

INSTALLATION PROCEDURE

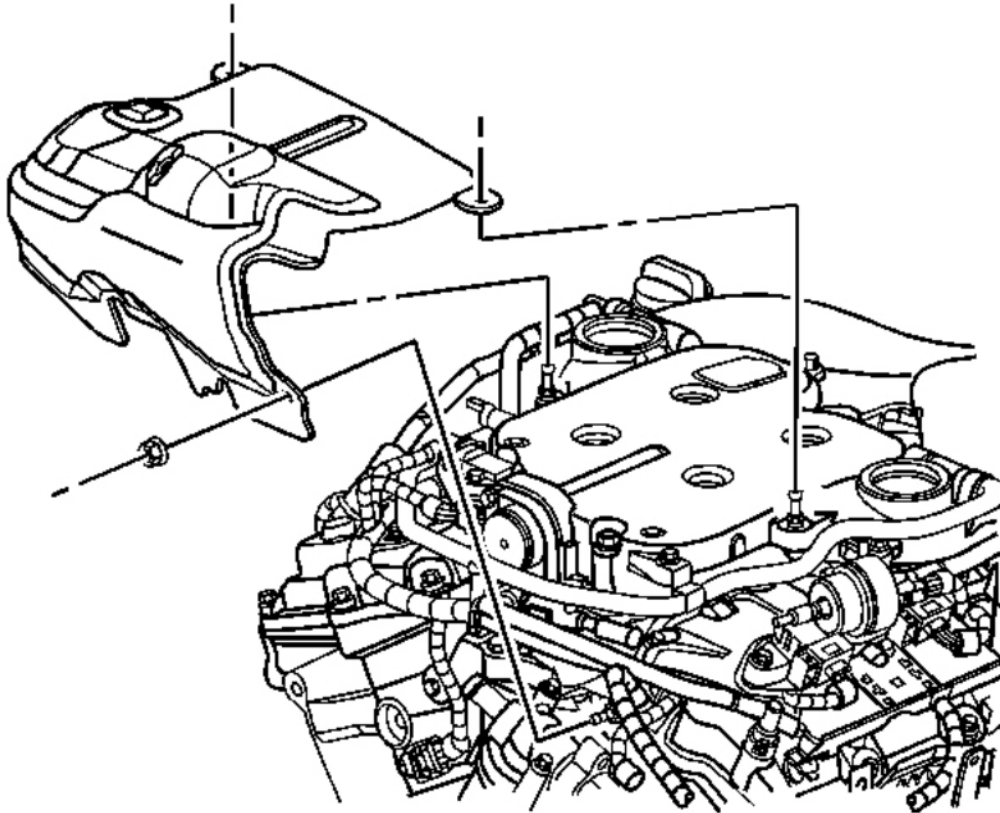


Fig. 44: Locating Upper Rear Intake Manifold Cover
Courtesy of GENERAL MOTORS CORP.

1. Install the cover to the upper studs.
2. Install the cover to the rear stud.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the cover nut.

Tighten: Tighten the nut to 23 N.m (17 lb ft).

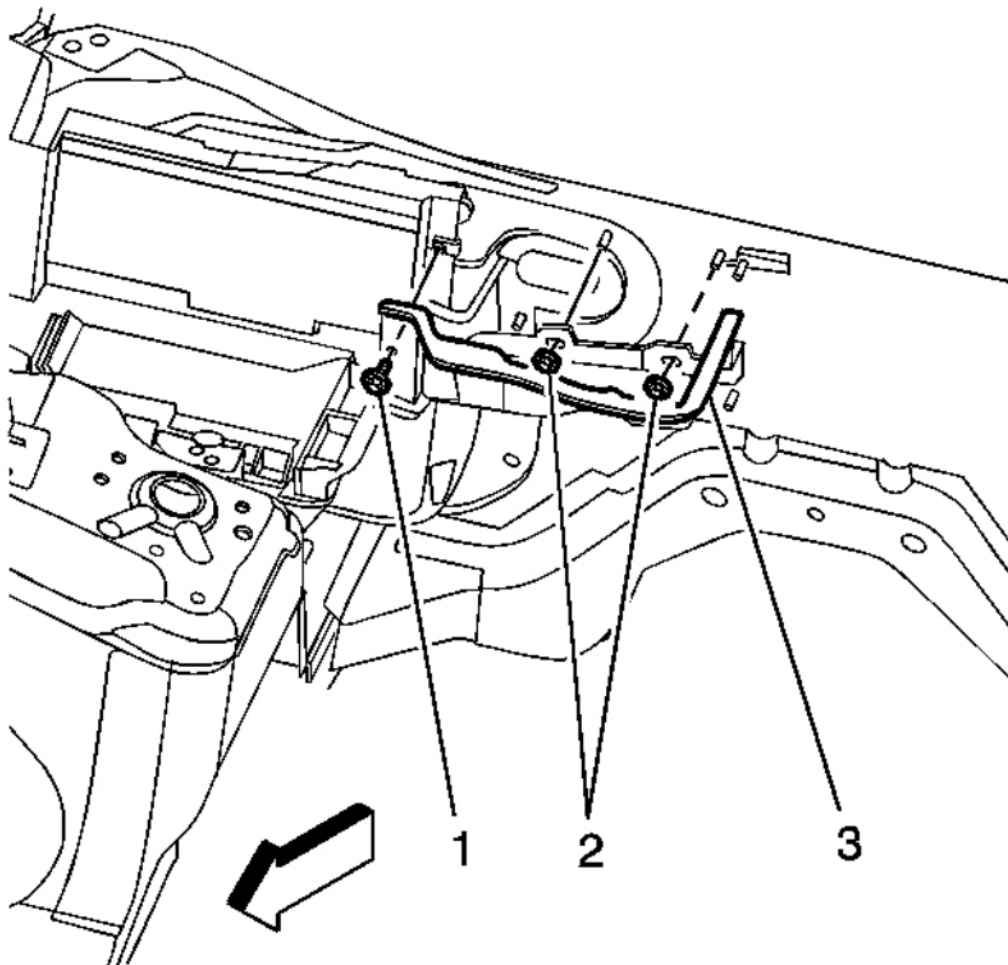


Fig. 45: View Of Air Inlet Housing Panel
 Courtesy of GENERAL MOTORS CORP.

4. Position the slots in the air inlet housing panel (1) over the studs in the front of dash.
5. Instal the air inlet housing panel bolt (3) and nuts (2).

Tighten: Tighten the bolt/nuts to 10 N.m (89 lb in).

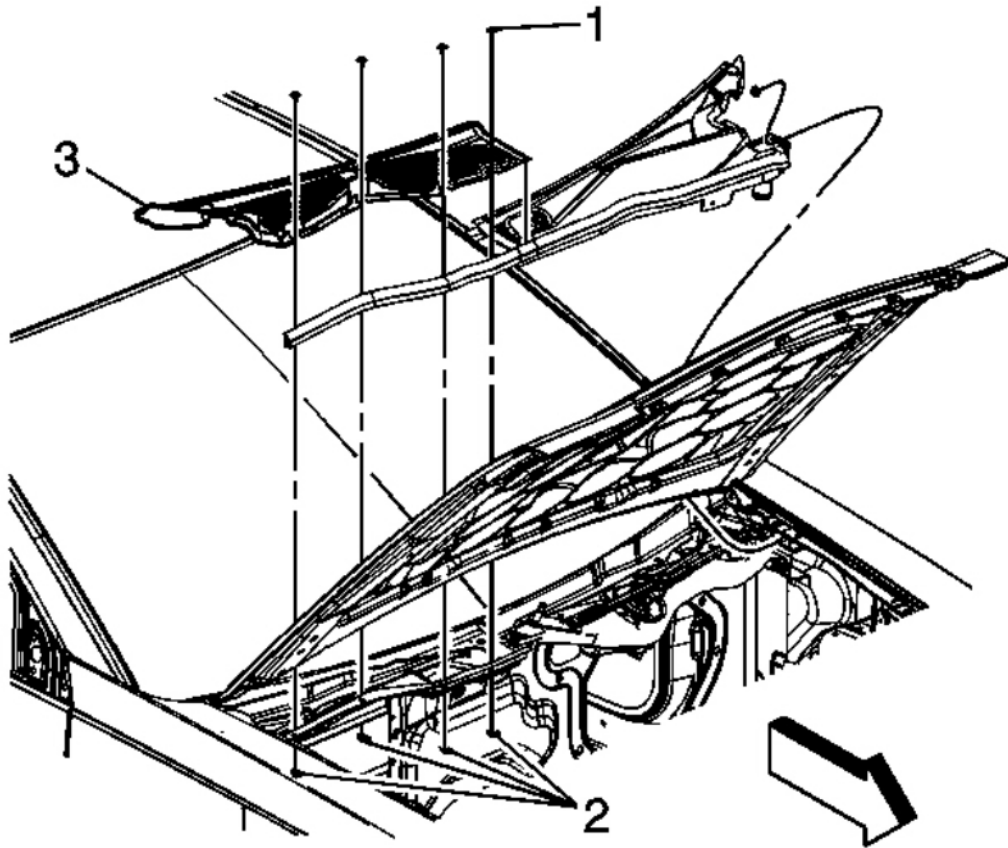


Fig. 46: View Of Hood Seal & Passenger Side Air Inlet Screen Panel
Courtesy of GENERAL MOTORS CORP.

6. Push the passenger side air inlet screen panel (3) towards the rear of the vehicle until the clips engage the windshield.
7. Align the center seam of the passenger side panel to the driver side panel.
8. Install the cowl vent screen bolts (1).

Tighten: Tighten the bolts to 10 N.m (89 lb in).

9. Install the hood seal to the panel.

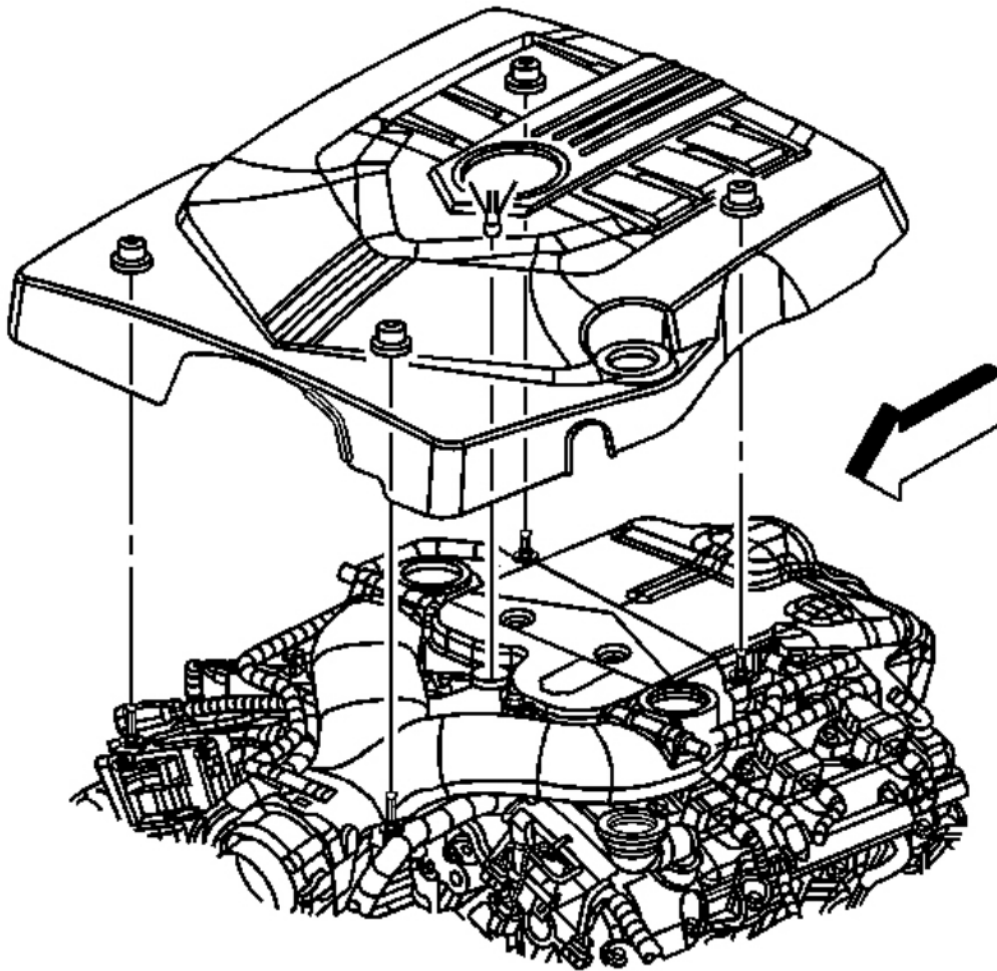


Fig. 47: View Of Engine Cover/Sight Shield
Courtesy of GENERAL MOTORS CORP.

10. Position the engine cover/sight shield over the intake manifold so the grommets are aligned with the ball studs.
11. Press the engine cover/sight shield down firmly near the ball studs in order to install the engine cover/sight shield.
12. Install the oil fill cap.
13. Install the cross car brace, if necessary. Refer to **Brace Replacement - Cross Vehicle** in Body Front End.

CRANKCASE VENTILATION HOSES/PIPES REPLACEMENT

REMOVAL PROCEDURE

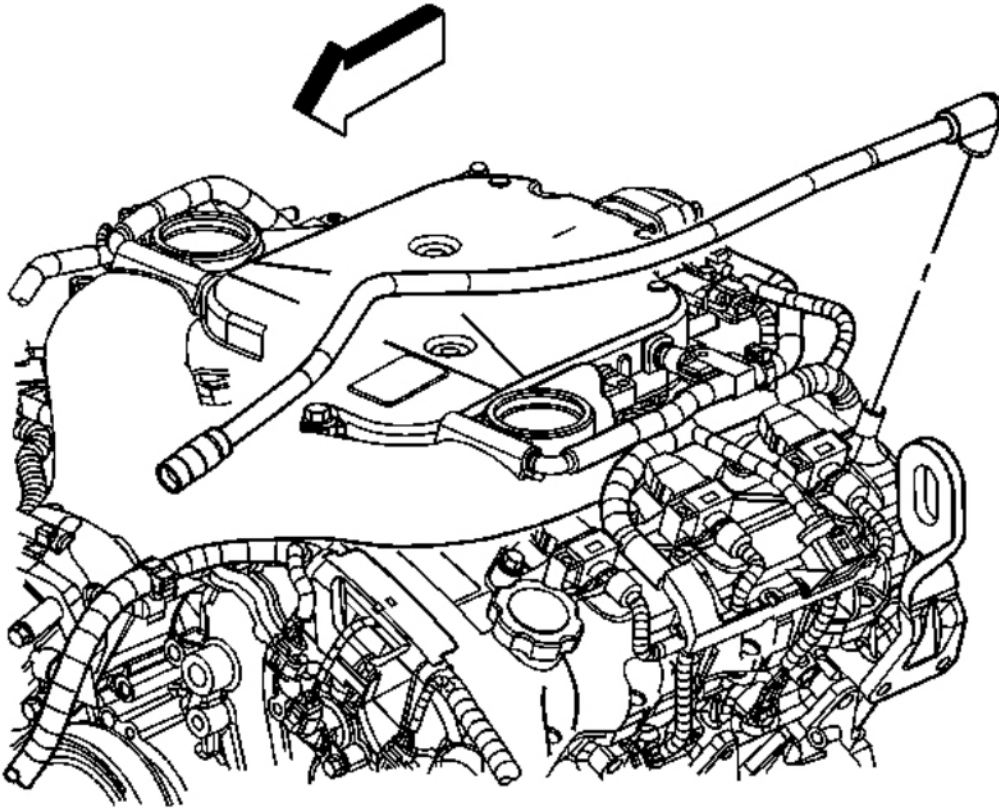


Fig. 48: View Of PCV Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.
2. Disconnect the positive crankcase valve (PCV) fresh air tube from the left camshaft cover.
3. Remove the PCV fresh air tube from the air inlet.

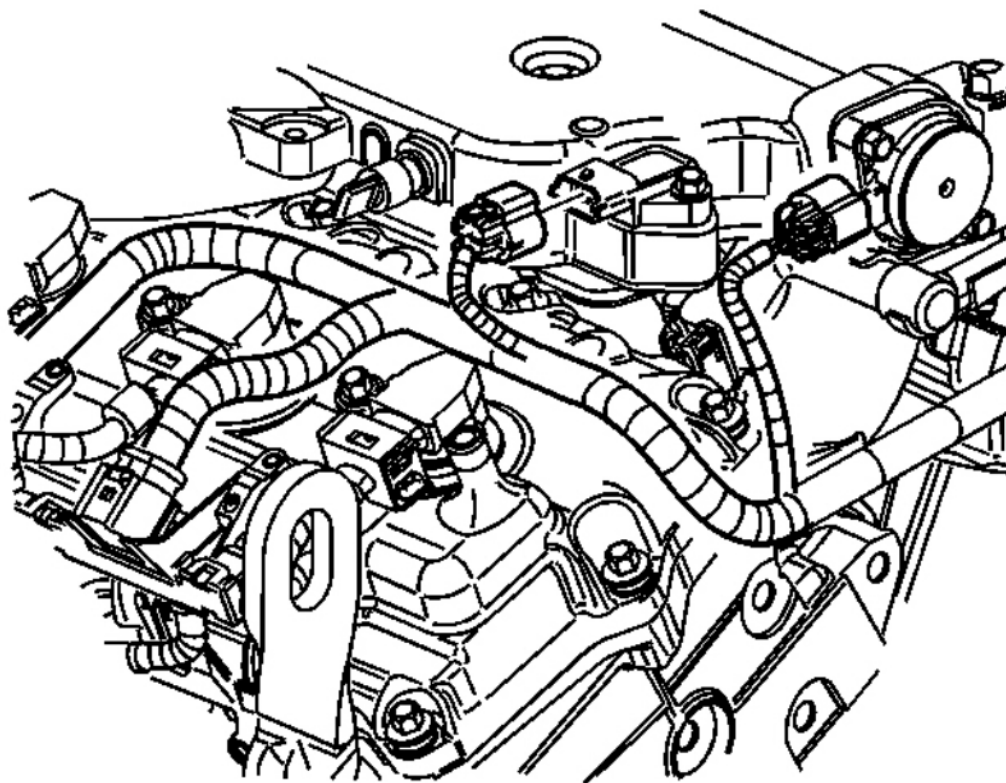


Fig. 49: Identifying Barometric Pressure Sensor And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the barometric pressure (BARO) sensor electrical connector.

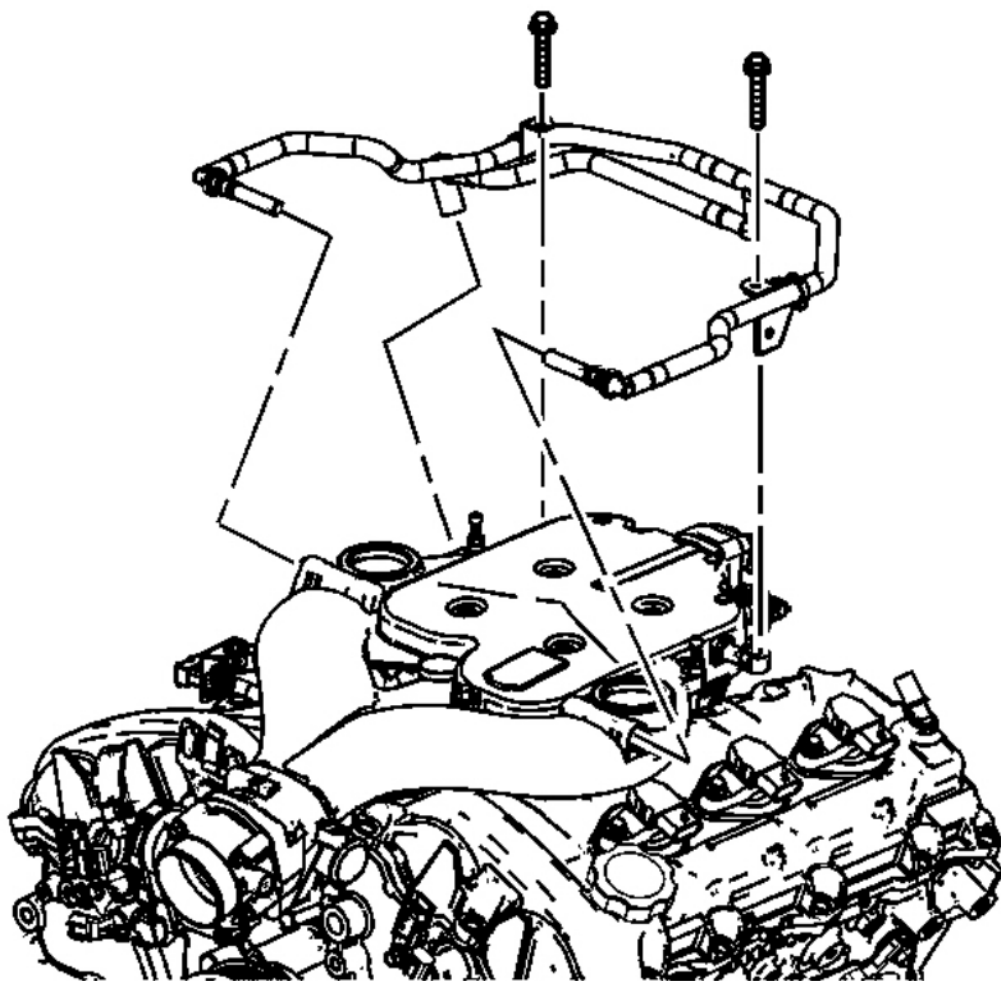


Fig. 50: View Of PCV Dirty Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Remove the PCV tube bracket bolts.
6. Remove the PCV dirty air tube from the right camshaft cover.
7. Remove the PCV dirty air tube from the intake manifold.

INSTALLATION PROCEDURE

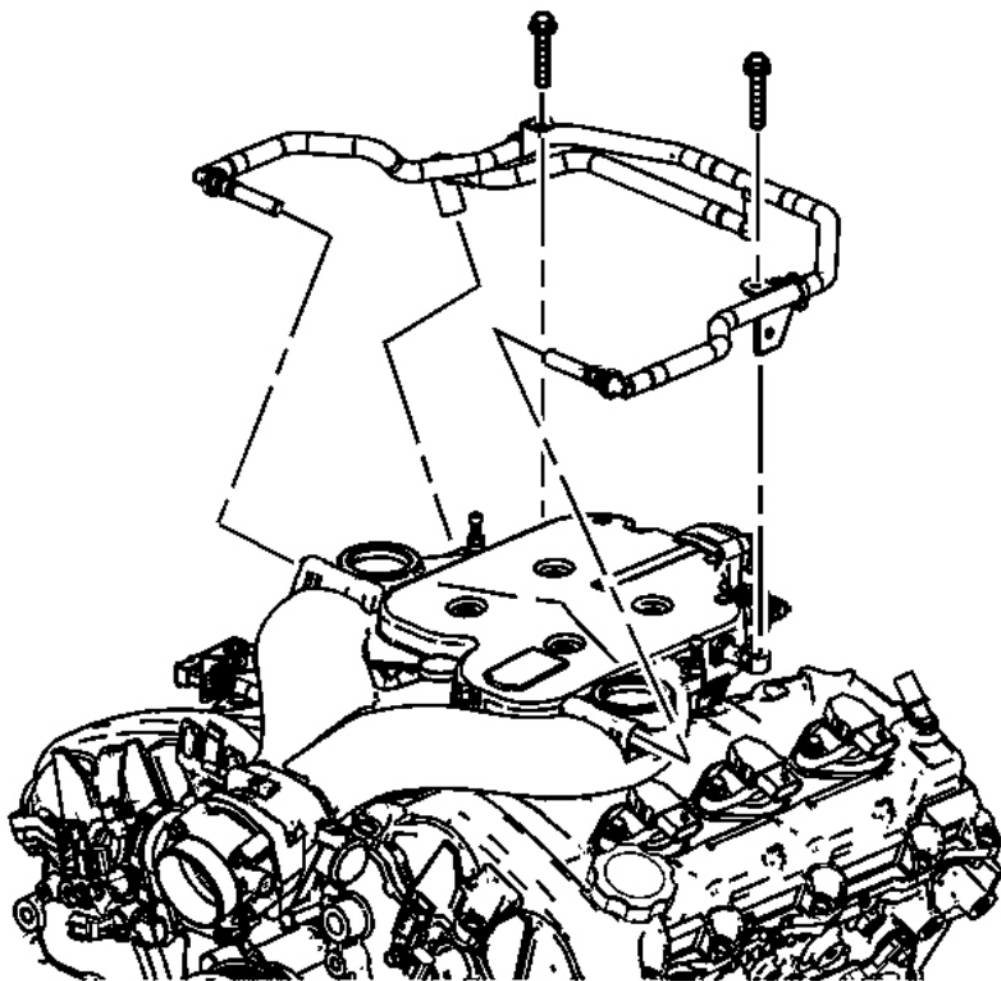


Fig. 51: View Of PCV Dirty Air Tube
Courtesy of GENERAL MOTORS CORP.

1. Install the PCV dirty air tube to the intake manifold.
2. Install the PCV dirty air tube to the right camshaft cover.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the PCV tube bracket bolts.

Tighten: Tighten the bolts to 10 N.m (89 lb in).

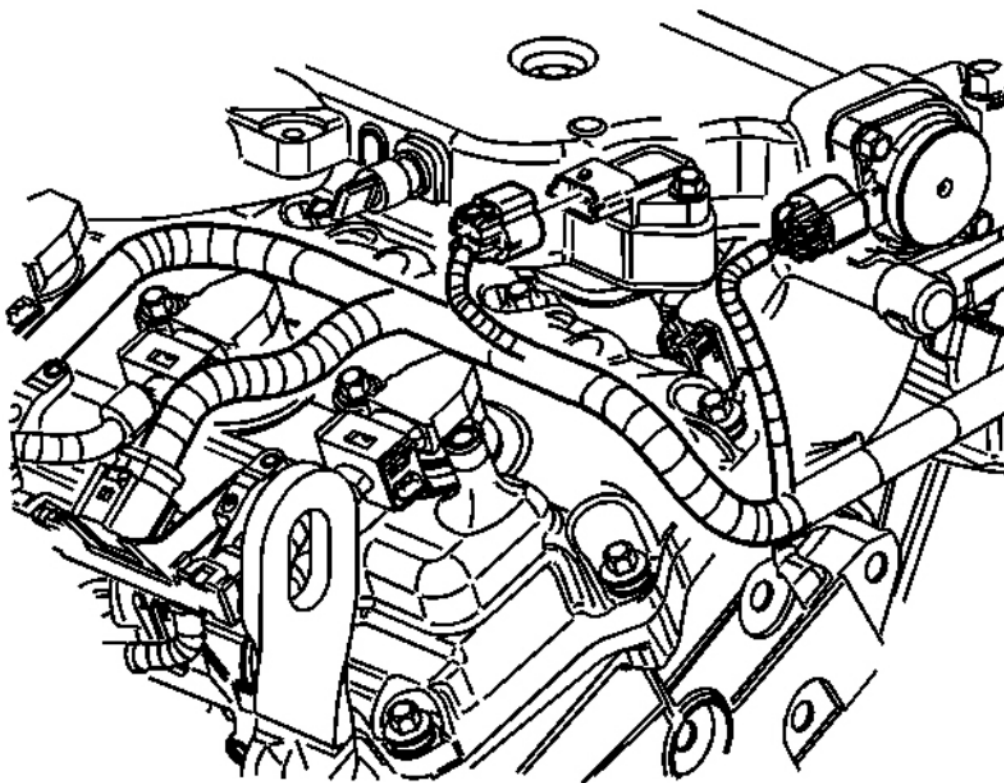


Fig. 52: Identifying Barometric Pressure Sensor And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Connect the BARO sensor electrical connector.

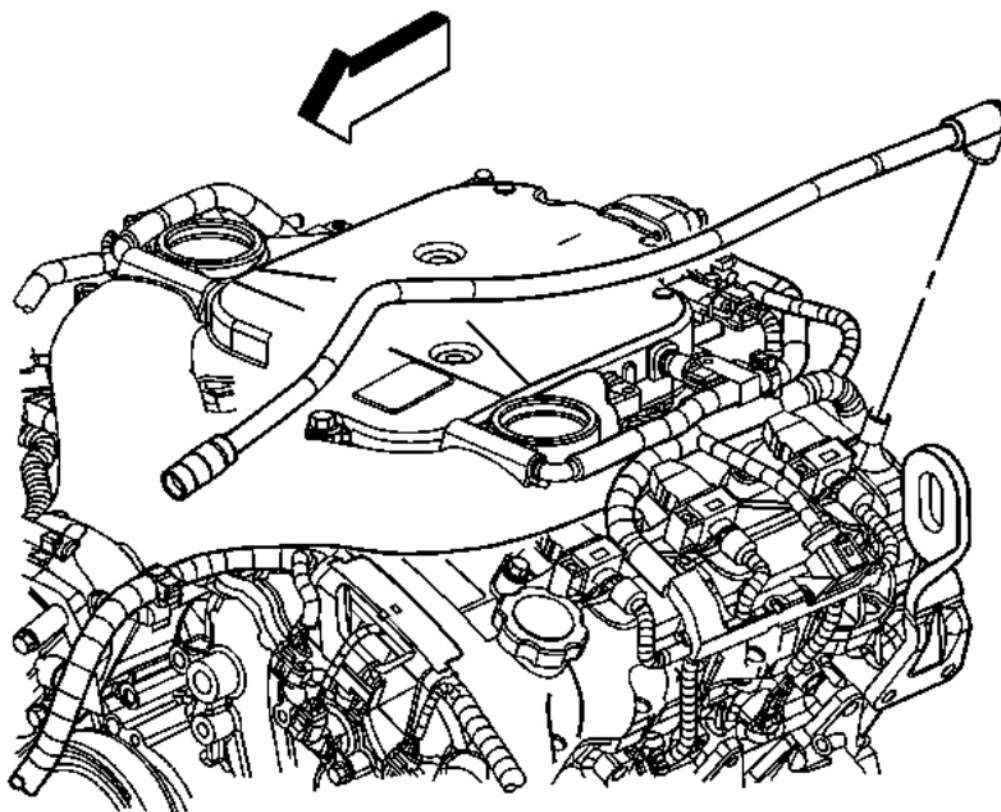


Fig. 53: View Of PCV Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Install the PCV fresh air tube to the air inlet.
6. Install the PCV fresh air tube to the left camshaft cover.
7. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.

INTAKE MANIFOLD REPLACEMENT - UPPER

REMOVAL PROCEDURE

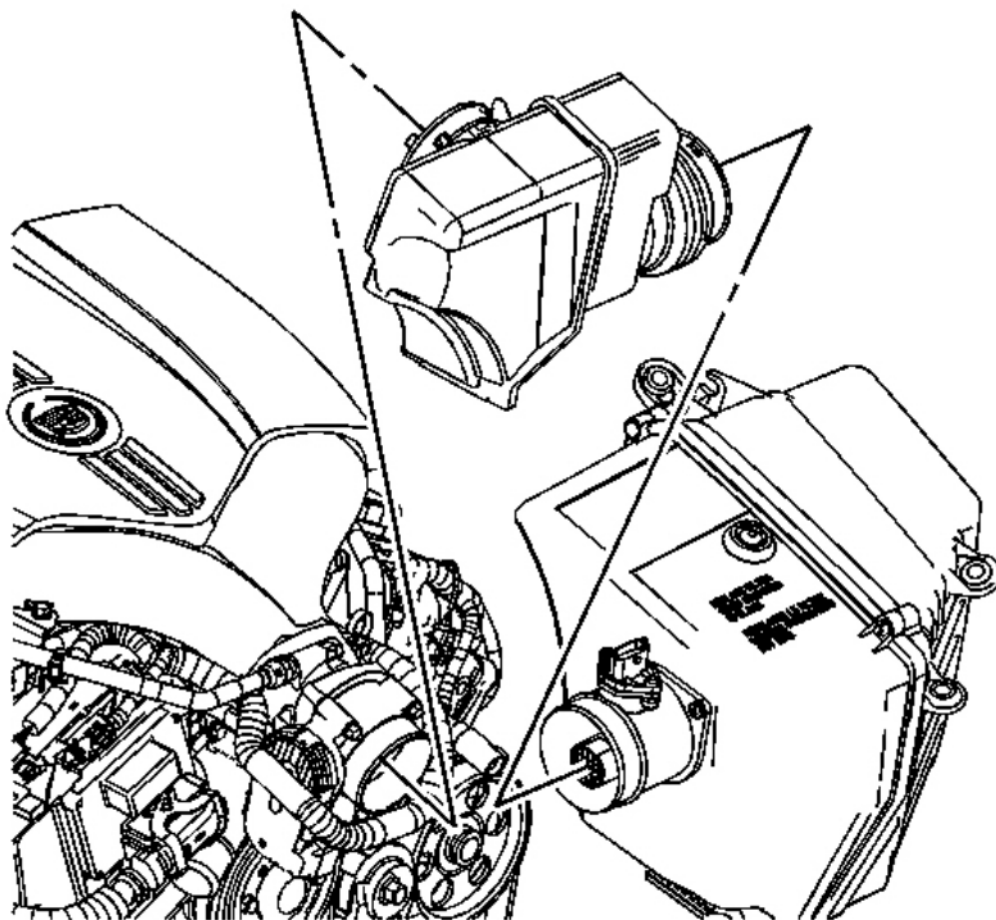


Fig. 54: View Of Air Inlet Duct

Courtesy of GENERAL MOTORS CORP.

1. Turn the ignition OFF.
2. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.
3. Remove the air inlet duct. Refer to **Air Cleaner Intake Duct Replacement** in Engine Controls - 2.8L.
4. Disconnect the brake booster vacuum hose from the intake manifold.

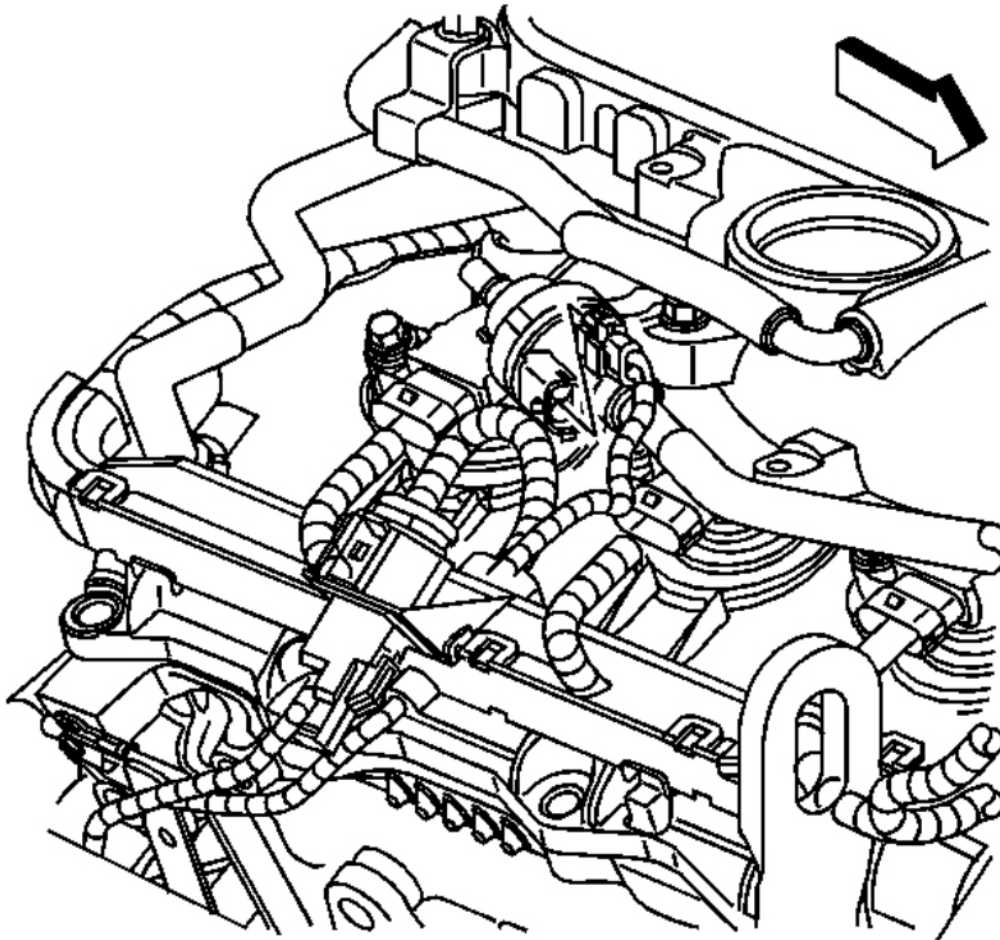


Fig. 55: View Of Purge Solenoid Valve And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the purge solenoid valve electrical connector.

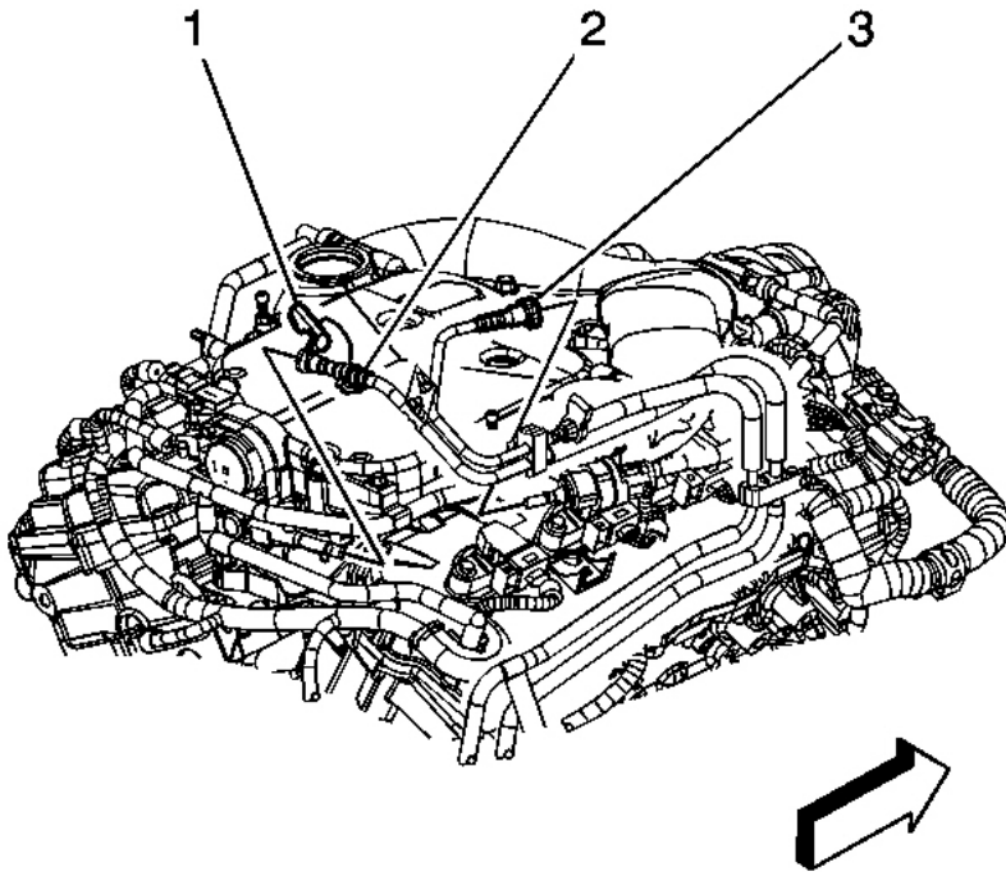


Fig. 56: Top Of Engine View

Courtesy of GENERAL MOTORS CORP.

6. Disconnect the purge line (3) from the purge solenoid valve.

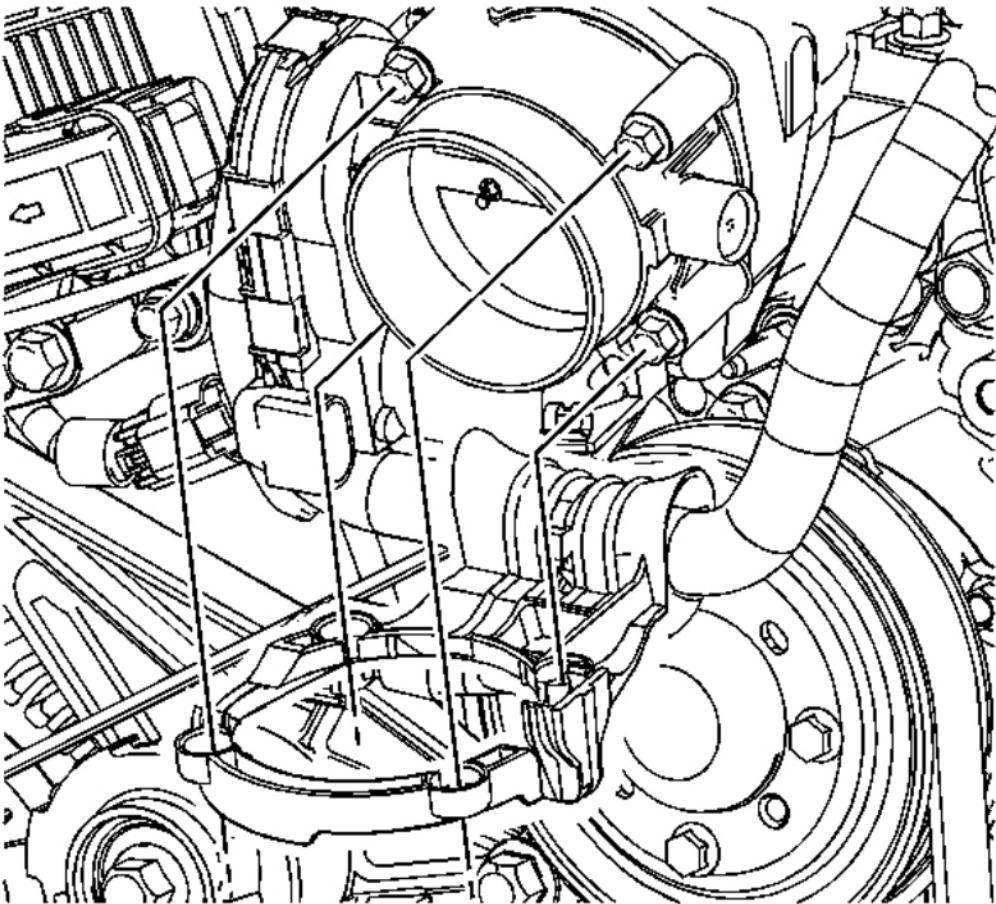


Fig. 57: View Of Wiring Harness Conduit
Courtesy of GENERAL MOTORS CORP.

7. Remove the wiring harness retainer.

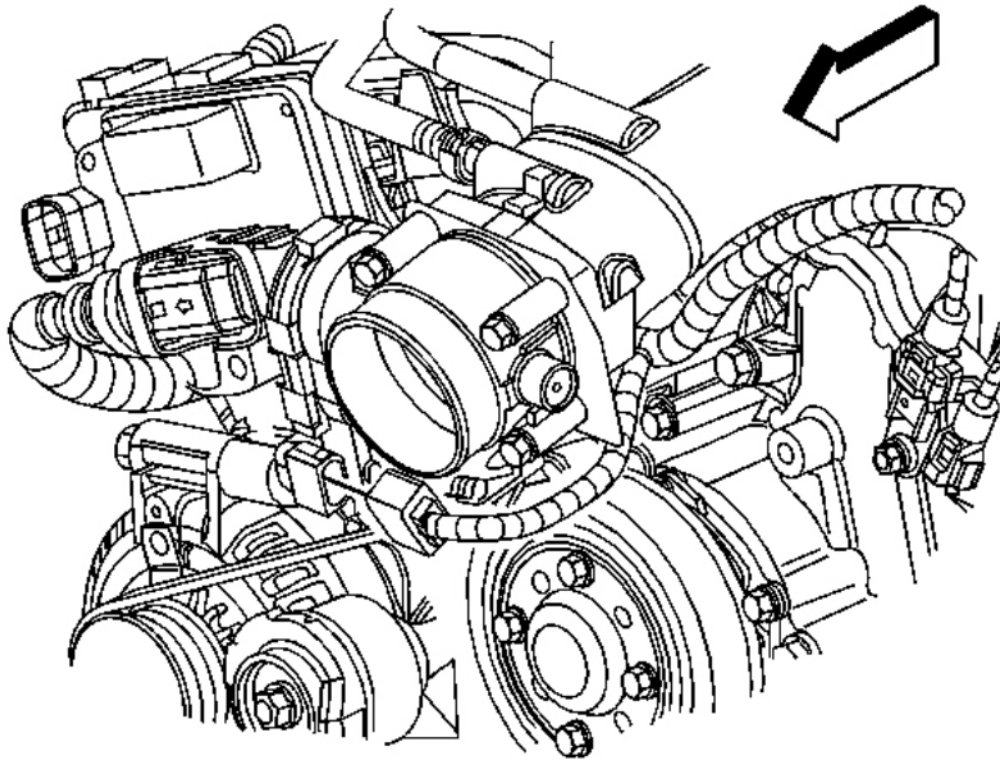


Fig. 58: View Of Throttle Body Electrical Connector
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the throttle body electrical connector.

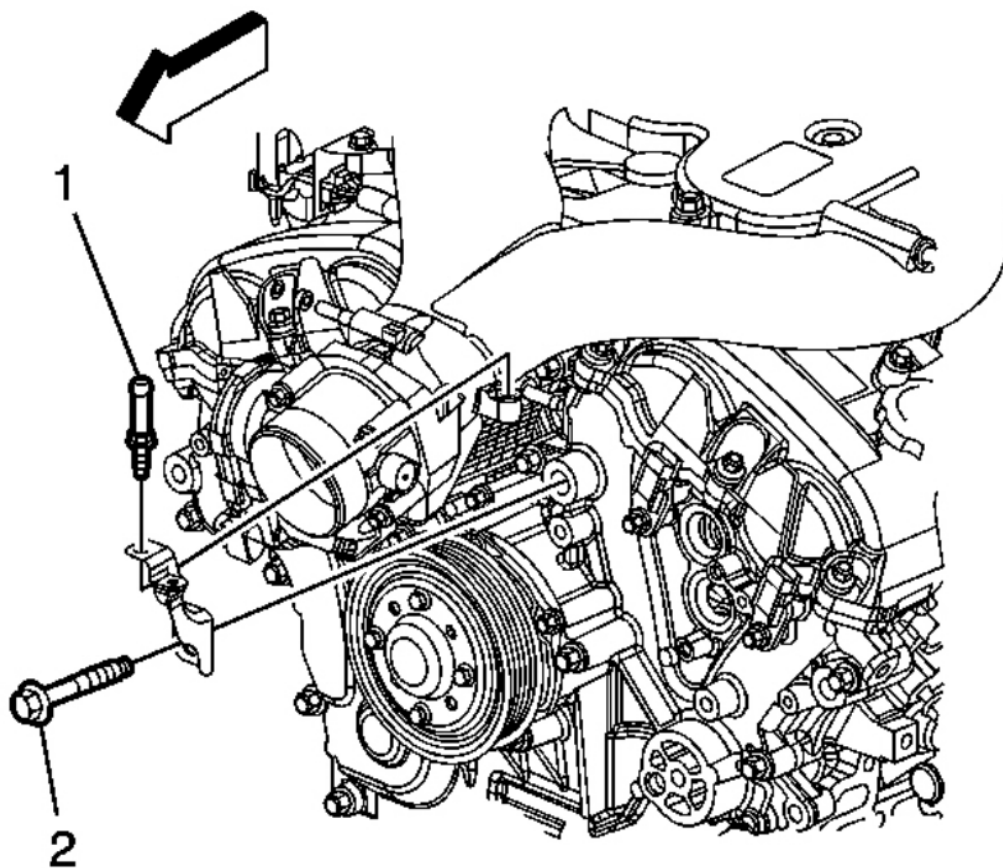


Fig. 59: Identifying Upper Intake Manifold Brace Stud, Bolt & Brace
Courtesy of GENERAL MOTORS CORP.

9. Remove the harness clip from the brace/bracket.
10. Remove the upper intake manifold brace stud (1), bolt (2), and brace.
11. Disconnect the positive crankcase valve (PCV) hose from the right bank camshaft cover.

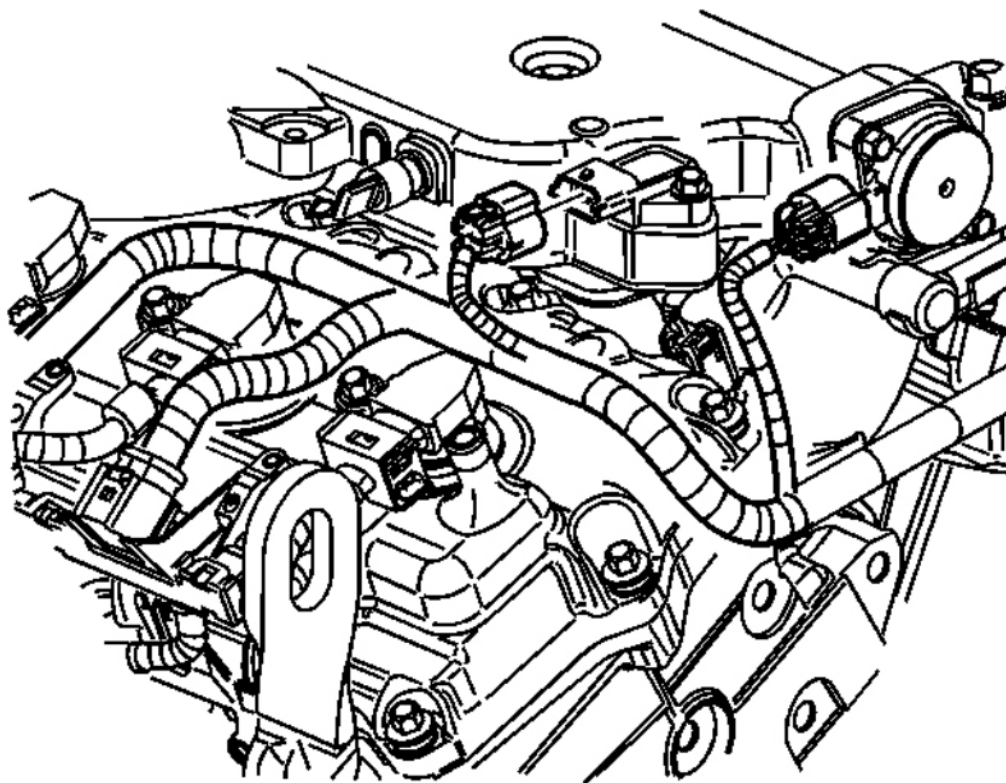


Fig. 60: Identifying Barometric Pressure Sensor And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

12. Disconnect the barometric pressure sensor electrical connector.

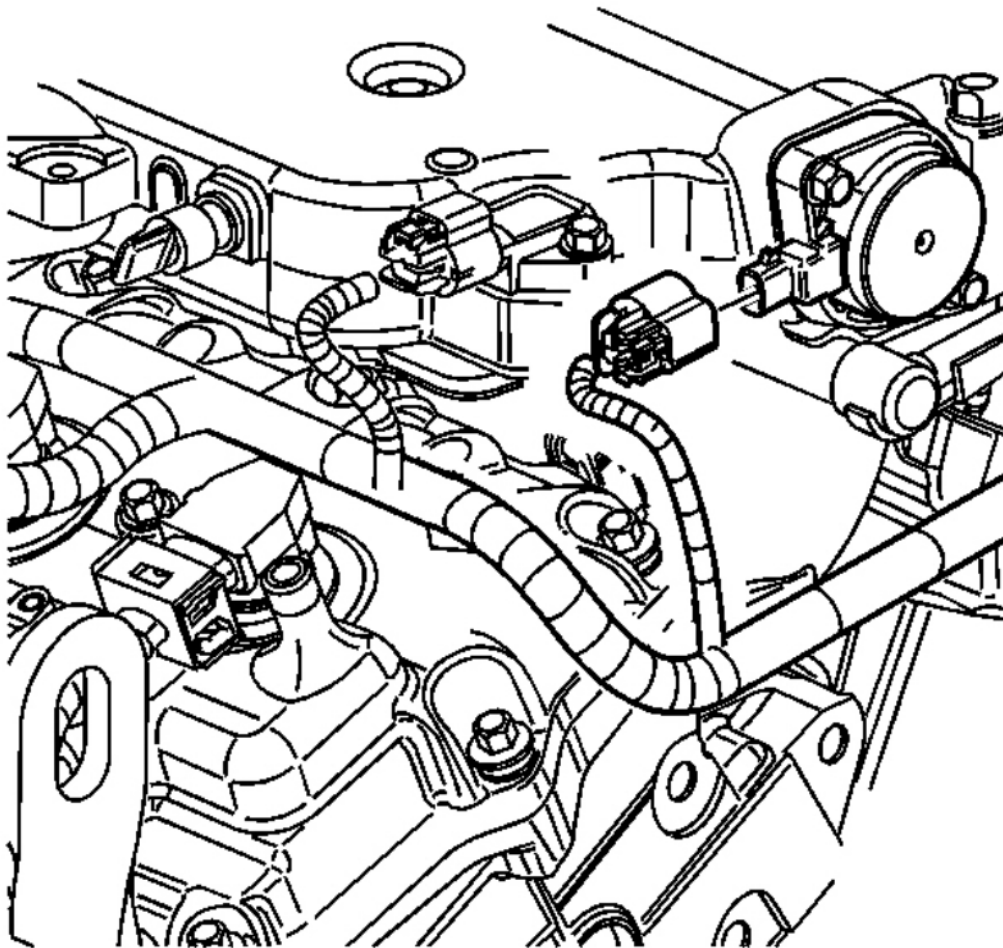


Fig. 61: View Of Communicator And Intake Manifold Runner Control Solenoid Electrical Connectors

Courtesy of GENERAL MOTORS CORP.

13. Disconnect the intake manifold runner control solenoid electrical connector.

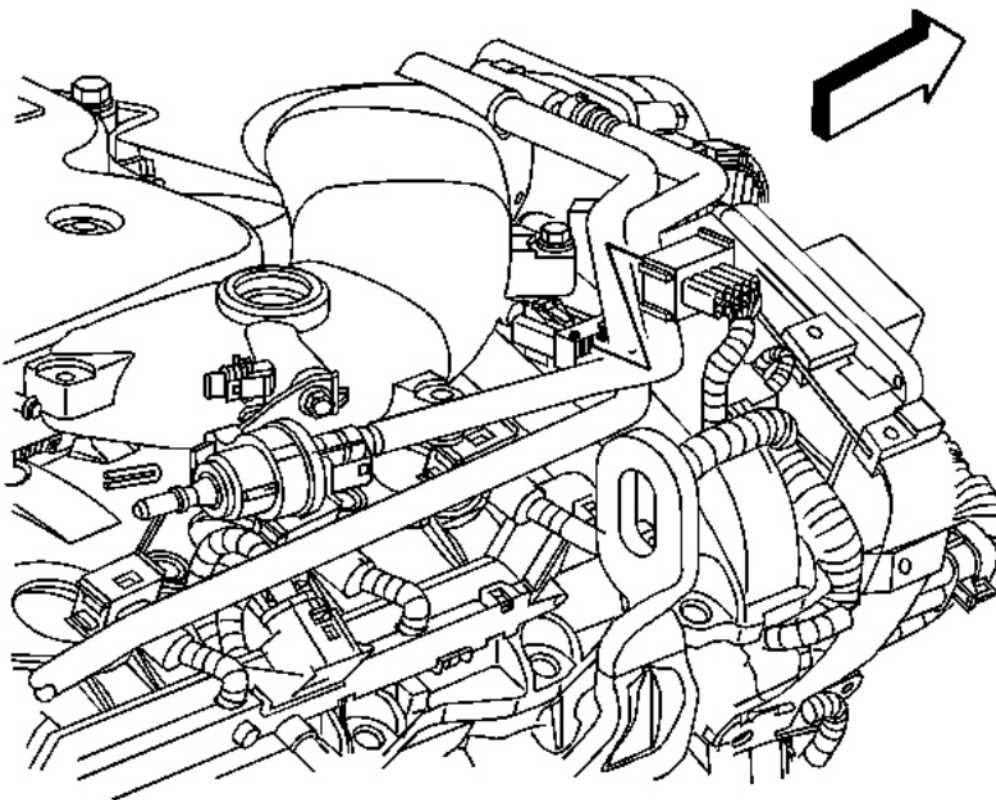


Fig. 62: View Of Fuel Injector Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

14. Disconnect the left bank ignition coil harness electrical connector.
15. Remove the PCV line from the clip on the harness bracket.

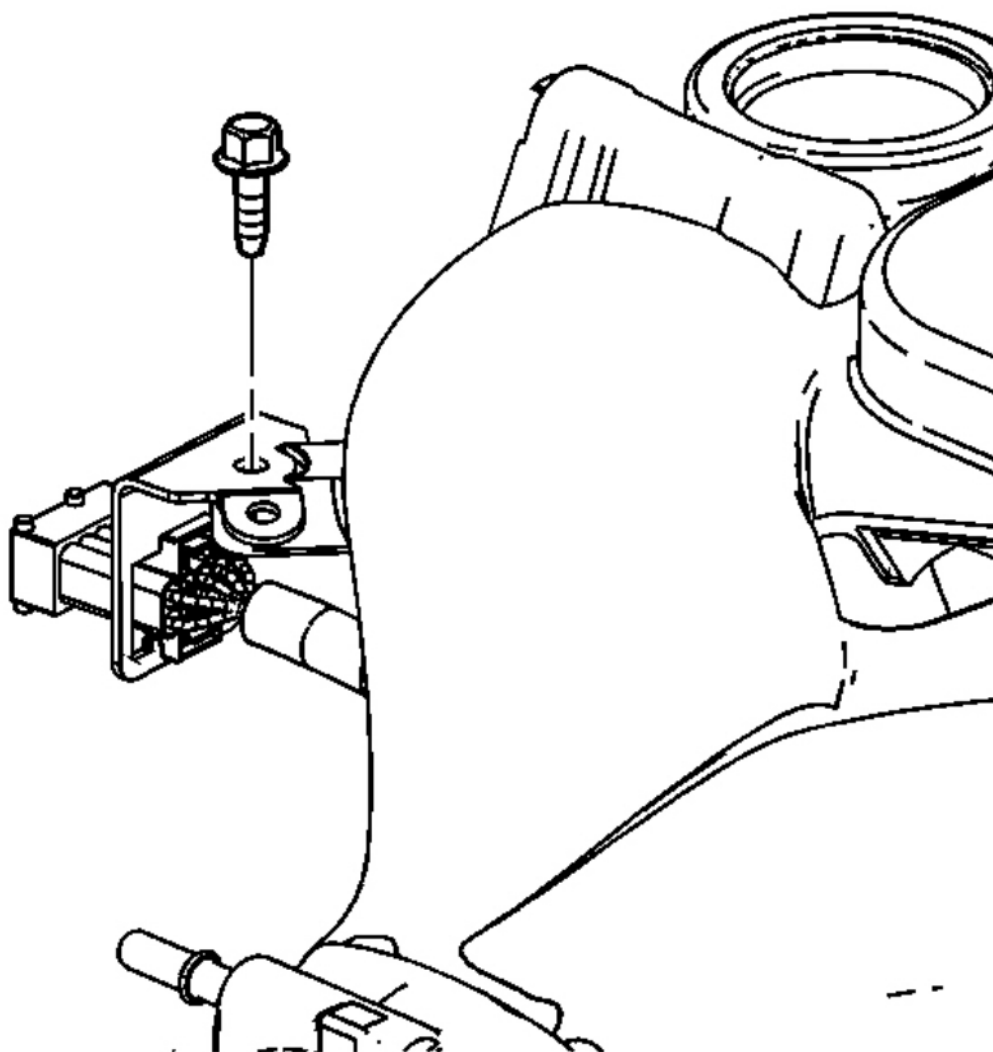


Fig. 63: View Of Injector Harness Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

16. Remove the left bank ignition coil wiring harness from the bracket.
17. Remove the injector harness bracket bolt and bracket.

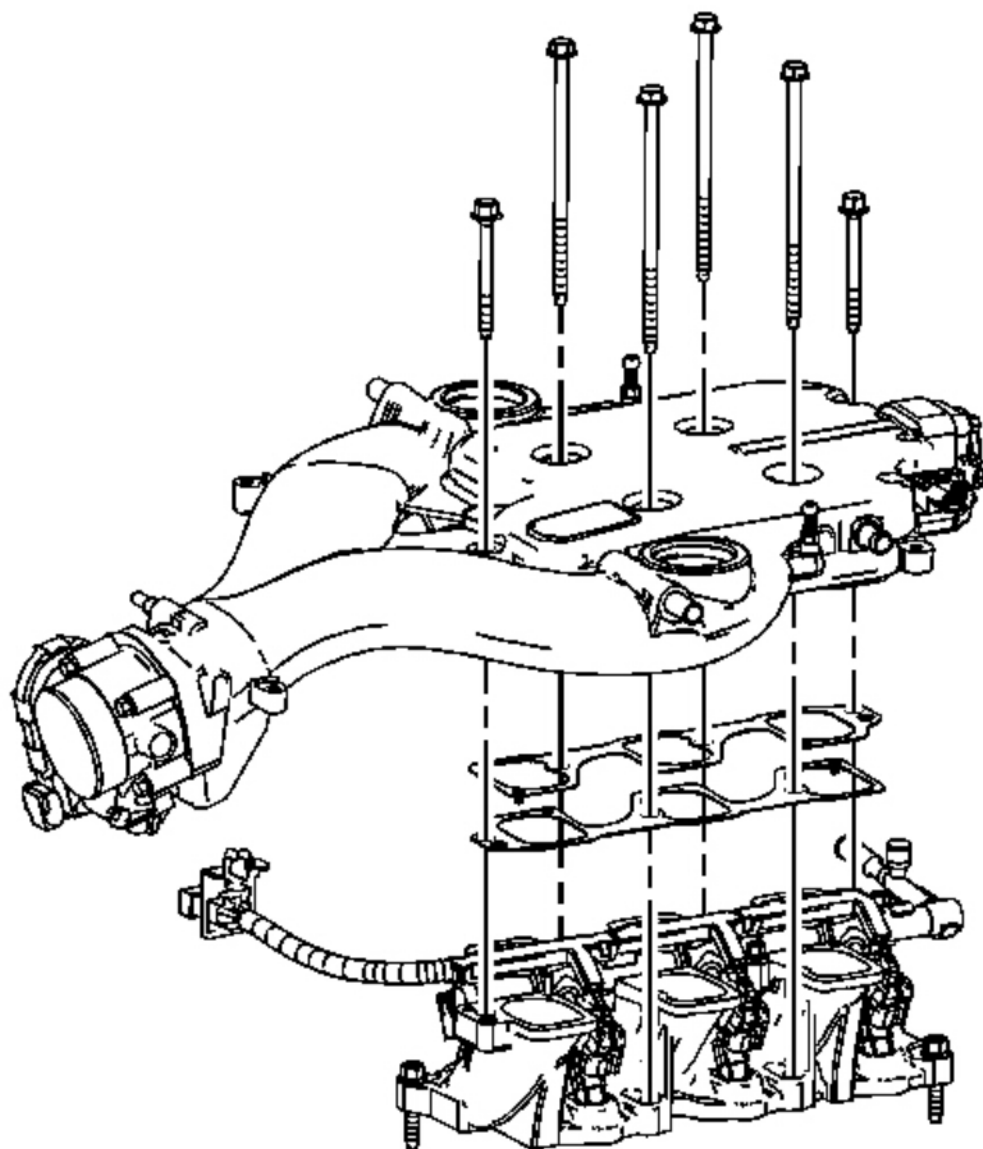


Fig. 64: View Of Upper Intake Manifold
Courtesy of GENERAL MOTORS CORP.

18. Remove the upper intake manifold bolts. Some deflection of the cowl panel may be necessary to extract the right rear bolt.
19. Remove the upper intake manifold with the throttle body.

2006 Cadillac CTS

2006 ENGINE Engine Mechanical - 2.8L (LP1) - CTS (1 Of 5)

20. If the upper intake manifold is being replaced, disassemble the intake manifold. Refer to **Intake Manifold Disassemble** .
21. Clean and inspect the intake manifold. Refer to **Intake Manifold Cleaning and Inspection** .

INSTALLATION PROCEDURE

1. If the upper intake manifold is being replaced, assemble the intake manifold. Refer to **Intake Manifold Assemble** .

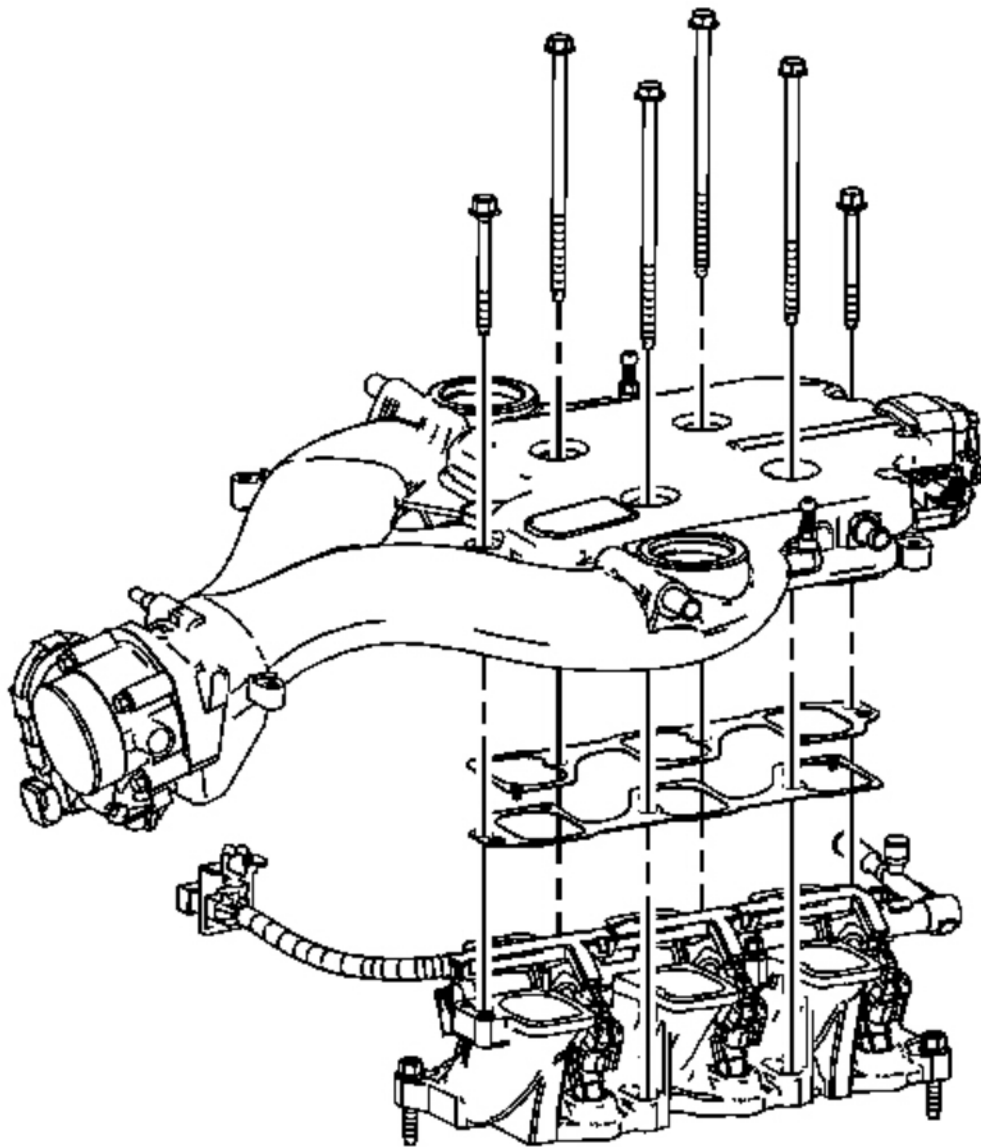


Fig. 65: View Of Upper Intake Manifold
Courtesy of GENERAL MOTORS CORP.

2. Install a NEW upper intake manifold gasket.
3. Install the upper intake manifold.

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT: Tighten the intake manifold bolts in a circular pattern starting at the center (long bolts) and moving outward.

4. Install the upper intake manifold bolts.

Tighten: Tighten the bolts to 23 N.m (17 lb ft).

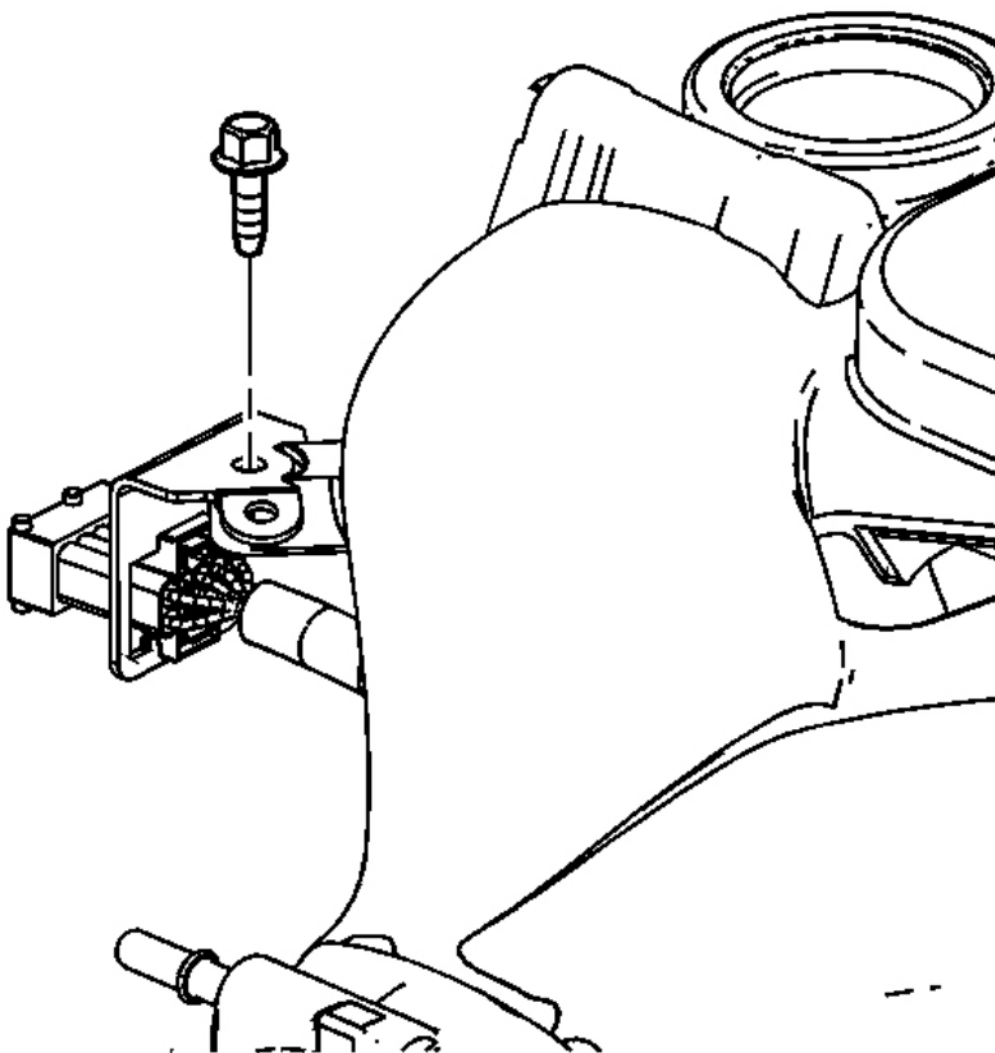


Fig. 66: View Of Injector Harness Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

5. Install the injector harness bracket and bolt.

Tighten: Tighten the bolt to 10 N.m (89 lb in).

6. Install the left bank ignition coil wiring harness to the bracket.

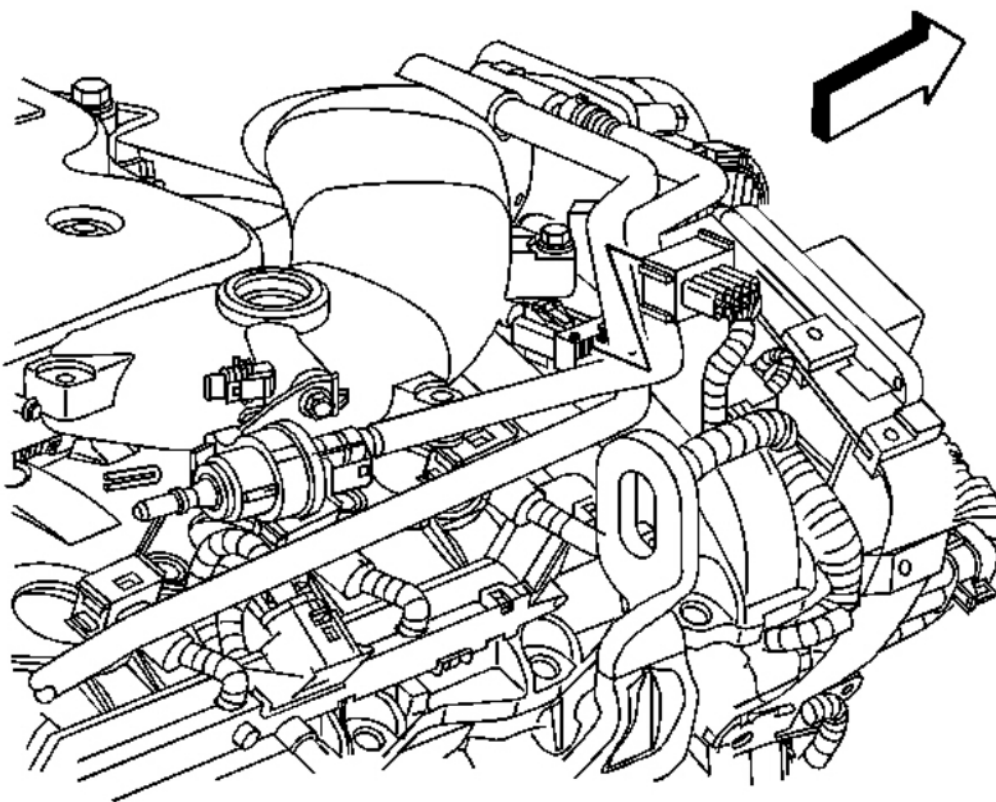


Fig. 67: View Of Fuel Injector Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

7. Install the PCV line to the clip on the harness bracket.
8. Connect the left bank ignition coil harness electrical connector.

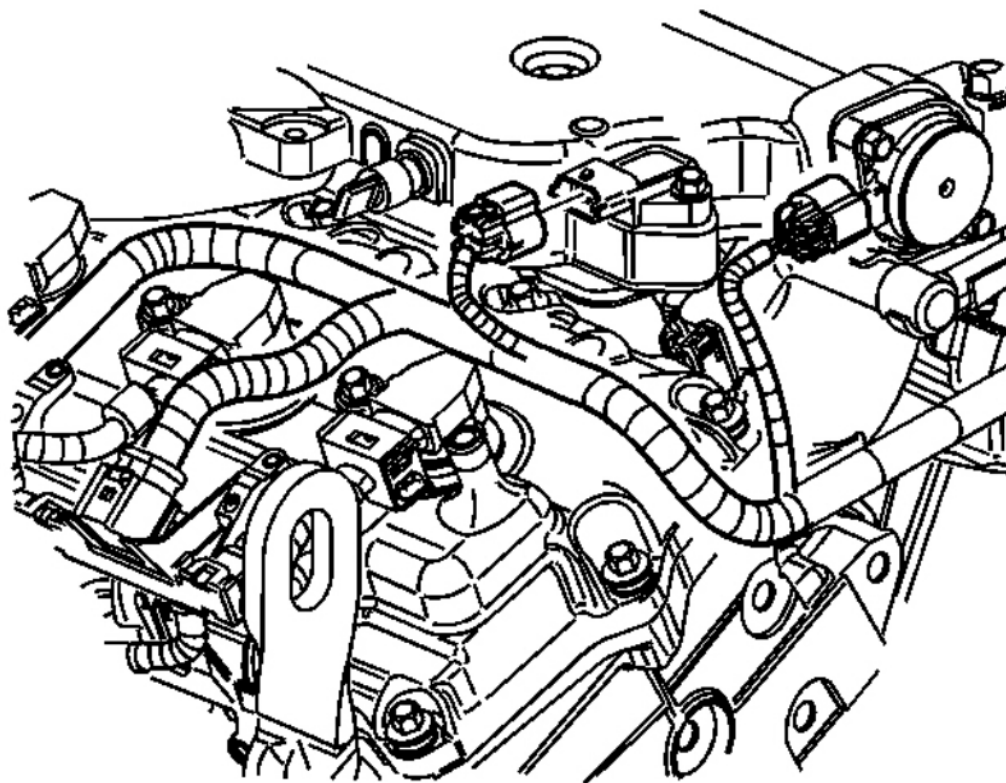


Fig. 68: Identifying Barometric Pressure Sensor And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

9. Connect the BARO sensor electrical connector.

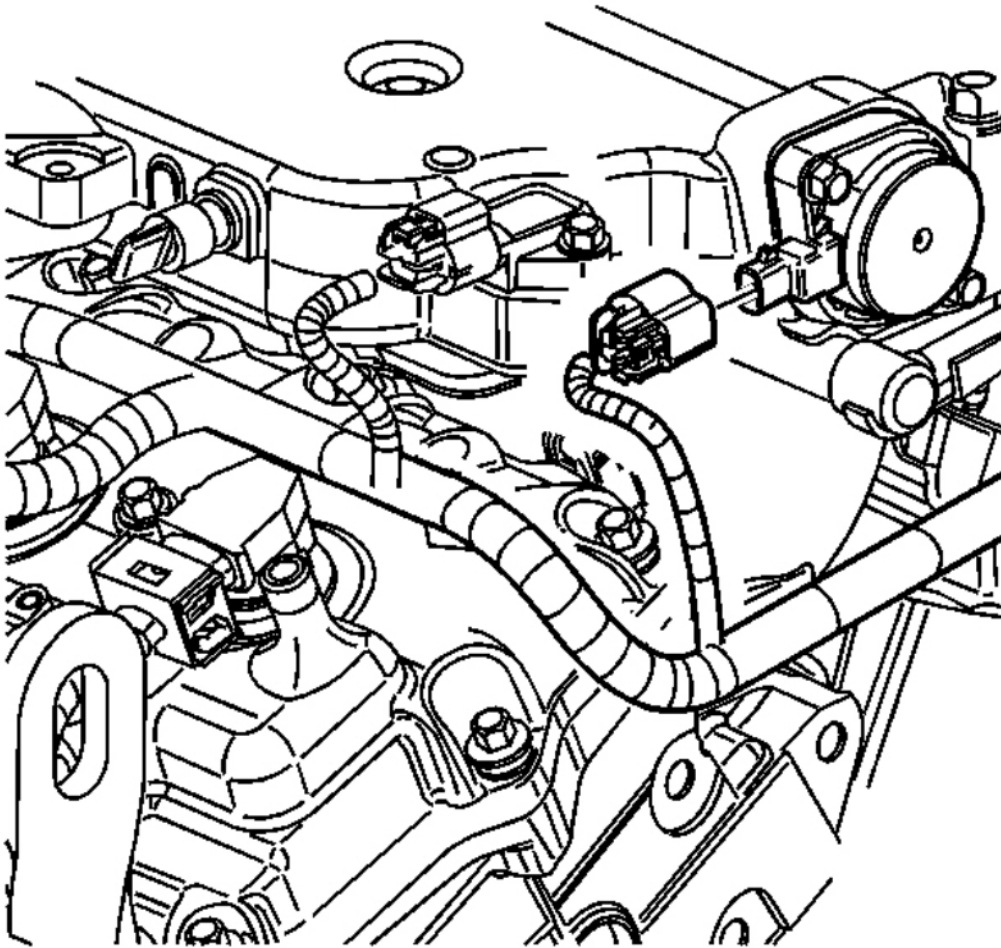


Fig. 69: View Of Communicator And Intake Manifold Runner Control Solenoid Electrical Connectors

Courtesy of GENERAL MOTORS CORP.

10. Connect the intake manifold runner control solenoid electrical connector.
11. Connect the PCV hose to the right bank camshaft cover.

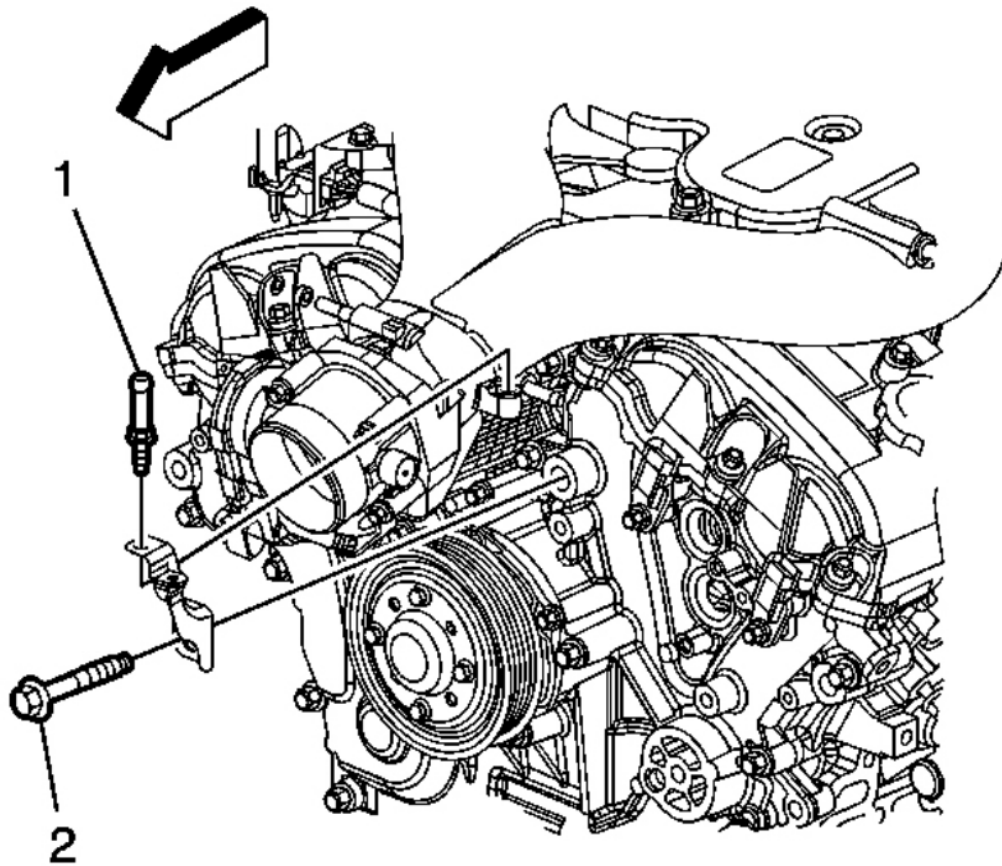


Fig. 70: Identifying Upper Intake Manifold Brace Stud, Bolt & Brace
Courtesy of GENERAL MOTORS CORP.

12. Install the upper intake manifold brace, bolt (2), and stud (1).

Tighten: Tighten the bolts.

1. Tighten the bolt (2) to 65 N.m (48 lb ft).
2. Tighten the stud (1) to 10 N.m (89 lb in).

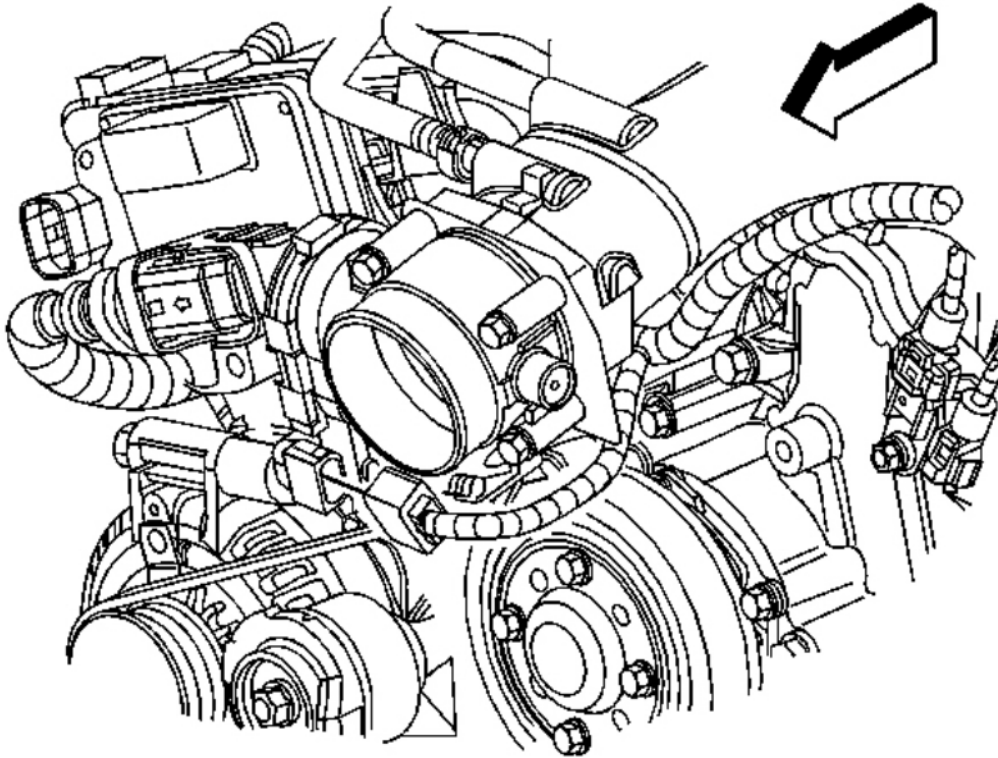


Fig. 71: View Of Throttle Body Electrical Connector
Courtesy of GENERAL MOTORS CORP.

NOTE: Ensure proper engagement of the wiring harness connector. The wiring harness connector must be installed straight onto the component connector and firmly seated. Visually inspect the connector to ensure that the connector latches are engaged and locked. Any damage to the connector or wiring must be repaired. Failure to follow this procedure can lead to an intermittent electrical connection, driveability concerns, and/or wiring harness or wiring harness connector damage or failure.

13. Connect the throttle body electrical connector.

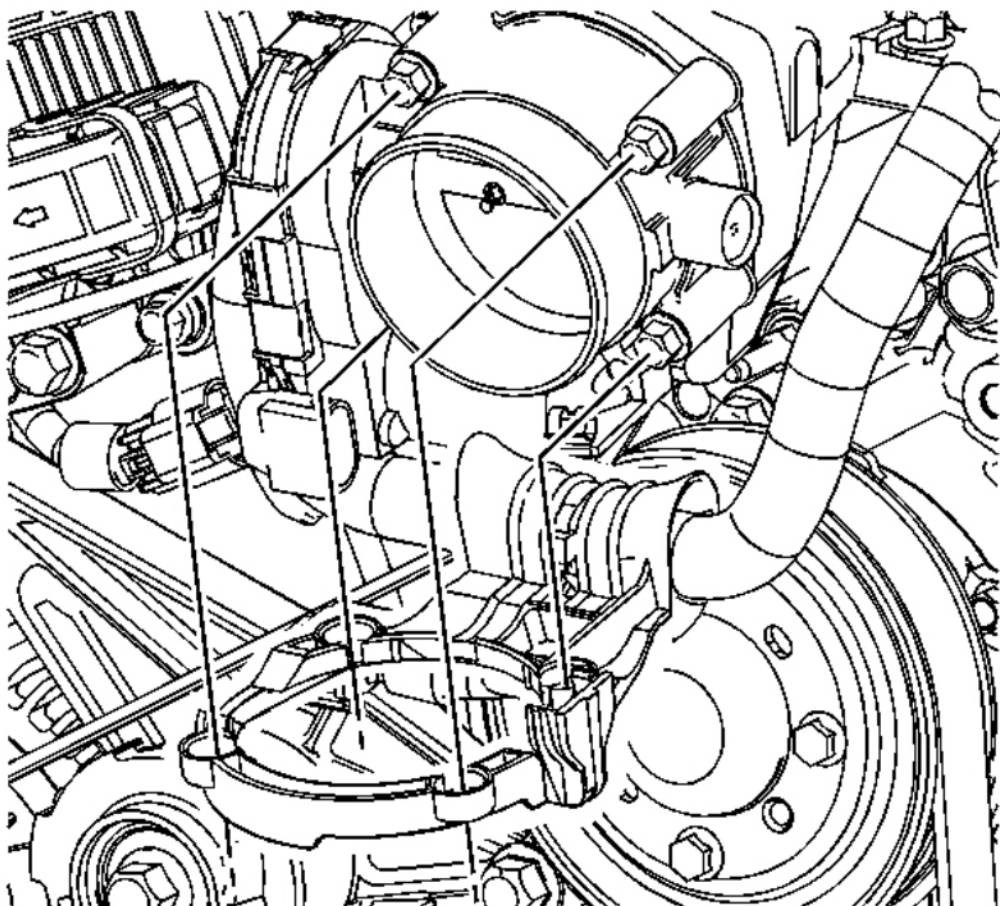


Fig. 72: View Of Wiring Harness Conduit
Courtesy of GENERAL MOTORS CORP.

14. Install the wiring harness retainer.

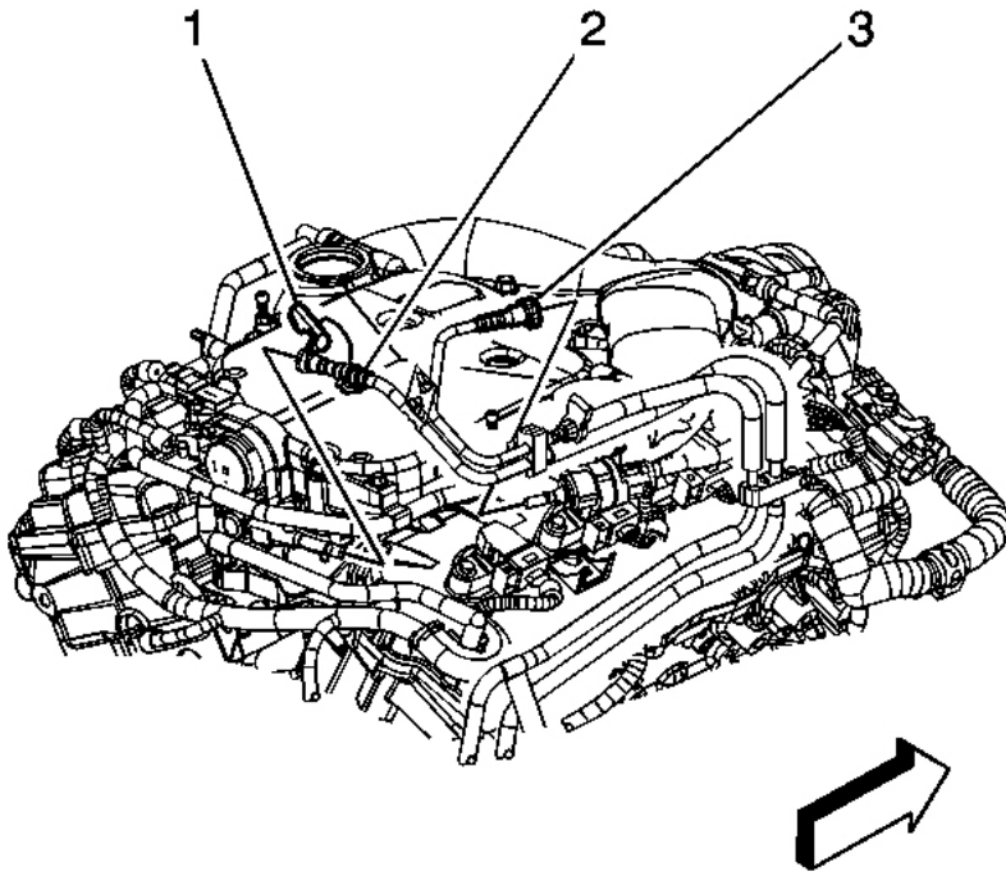


Fig. 73: Top Of Engine View

Courtesy of GENERAL MOTORS CORP.

15. Connect the purge line (3) to the purge solenoid valve.

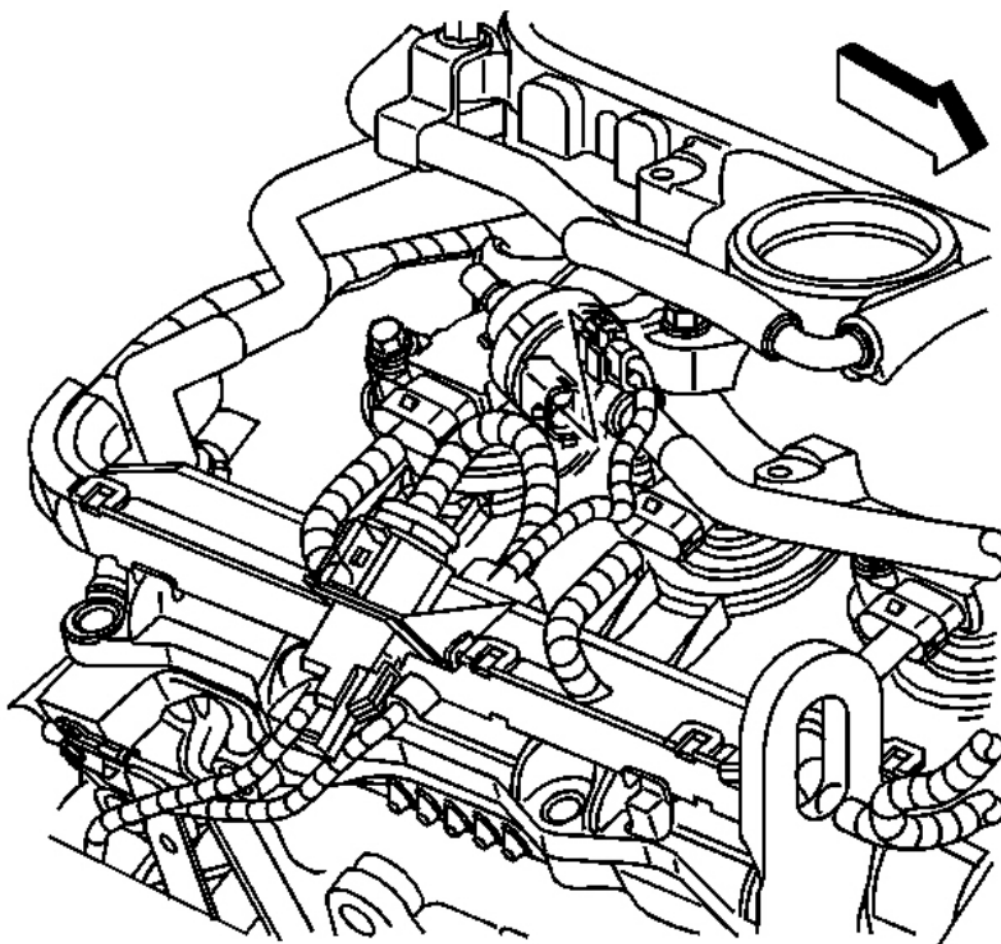


Fig. 74: View Of Purge Solenoid Valve And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

16. Connect the purge solenoid valve electrical connector.
17. Connect the brake booster vacuum hose to the intake manifold.

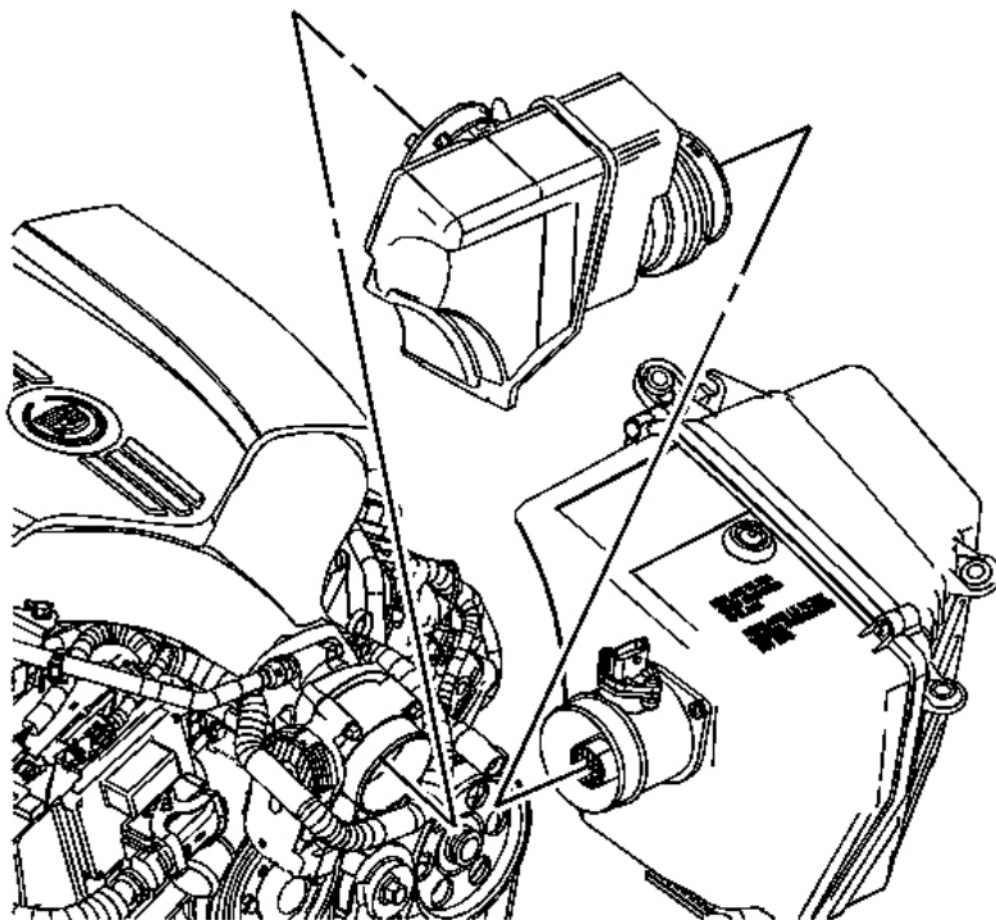


Fig. 75: View Of Air Inlet Duct

Courtesy of GENERAL MOTORS CORP.

18. Install the air inlet duct. Refer to **Air Cleaner Intake Duct Replacement** in Engine Controls - 2.8L.
19. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.

INTAKE MANIFOLD REPLACEMENT - LOWER

REMOVAL PROCEDURE

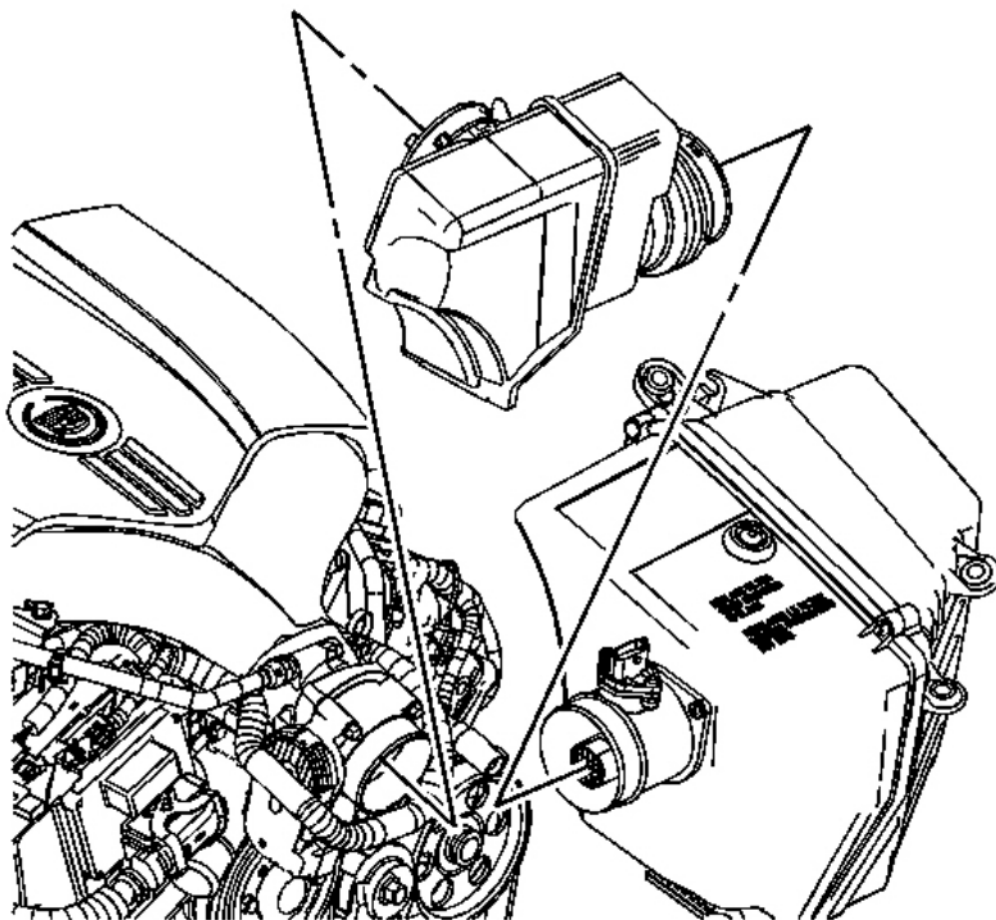


Fig. 76: View Of Air Inlet Duct

Courtesy of GENERAL MOTORS CORP.

1. Turn the ignition OFF.
2. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.
3. Remove the air inlet duct. Refer to **Air Cleaner Intake Duct Replacement** in Engine Controls - 2.8L.
4. Disconnect the brake booster hose from the intake manifold.

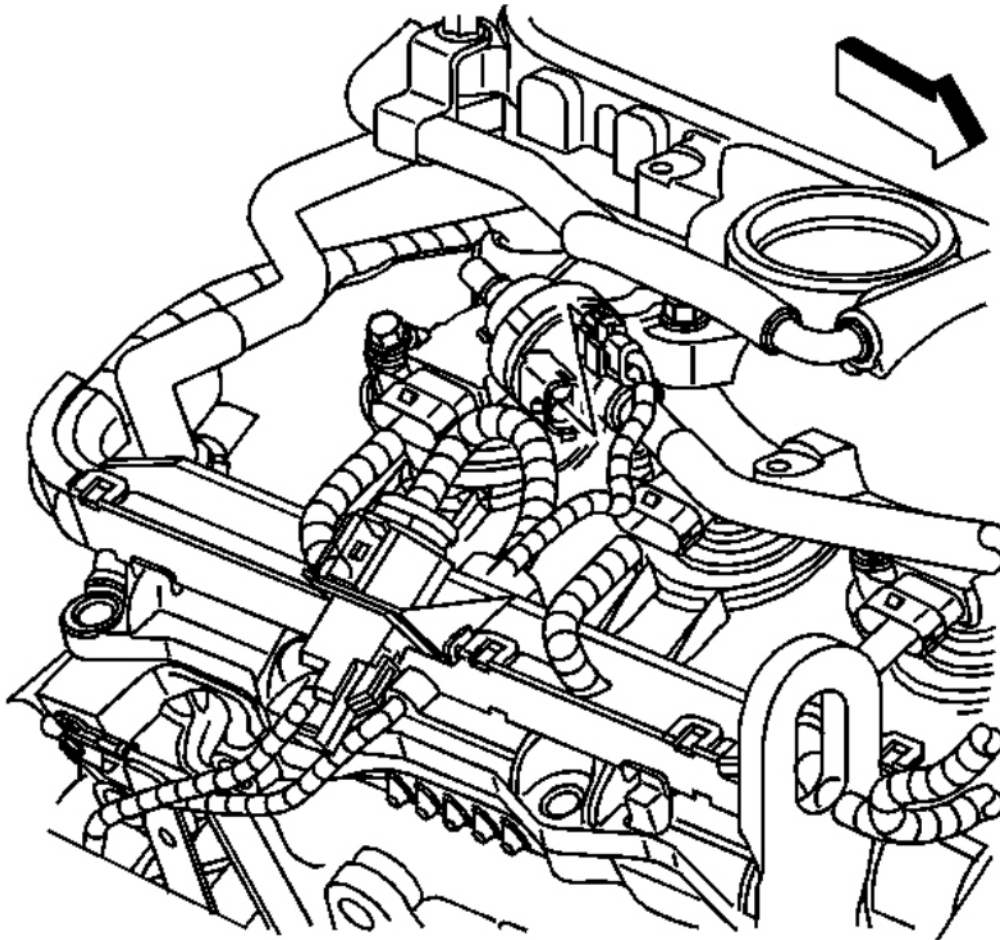


Fig. 77: View Of Purge Solenoid Valve And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the purge solenoid valve electrical connector.

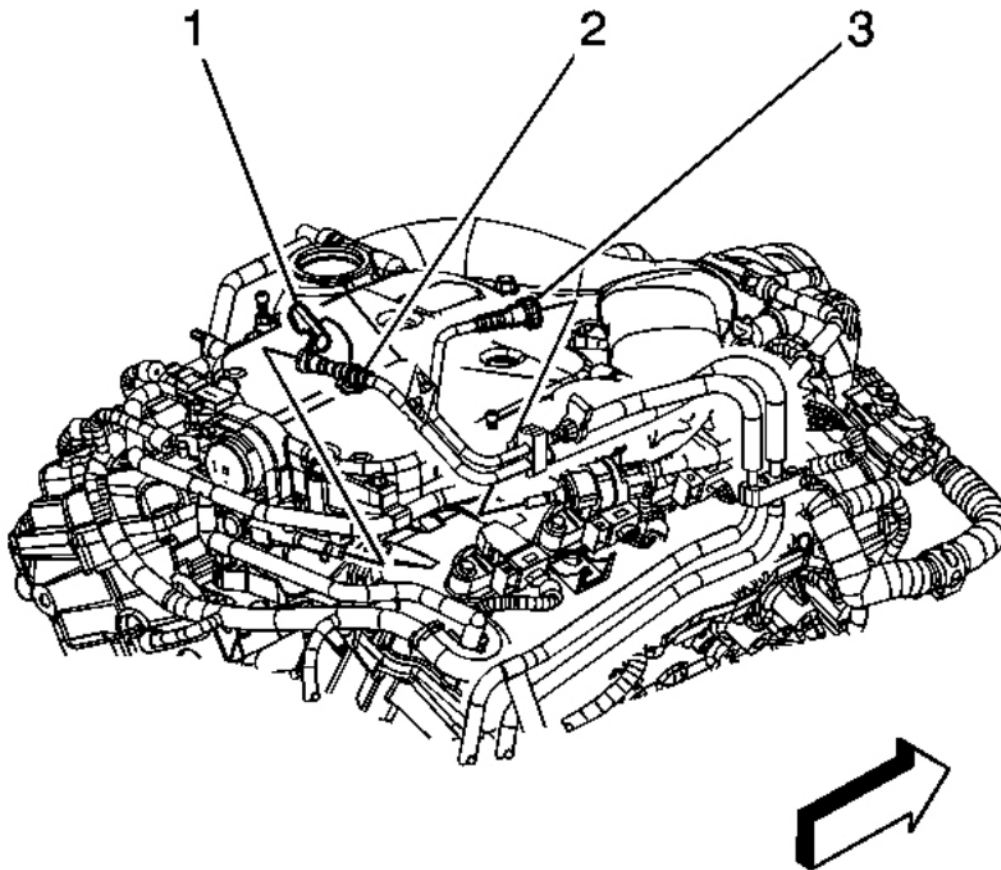


Fig. 78: Top Of Engine View

Courtesy of GENERAL MOTORS CORP.

6. Disconnect the purge line (3) from the purge solenoid valve.

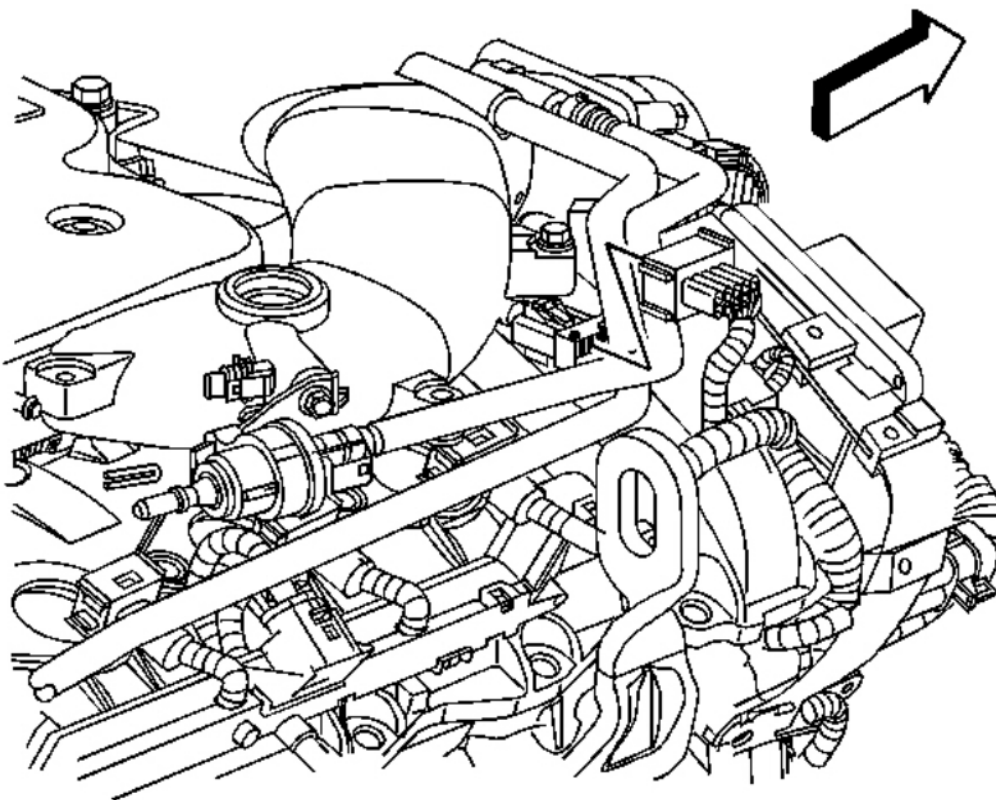


Fig. 79: View Of Fuel Injector Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the fuel injector harness electrical connector.

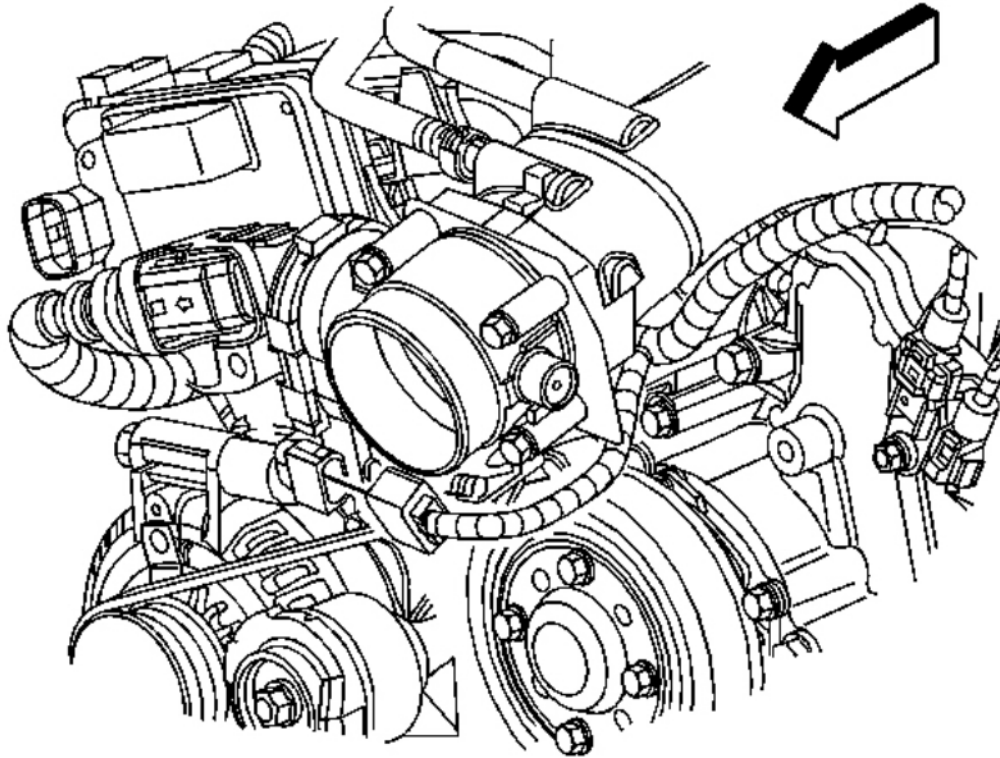


Fig. 80: View Of Throttle Body Electrical Connector
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the throttle body electrical connector.

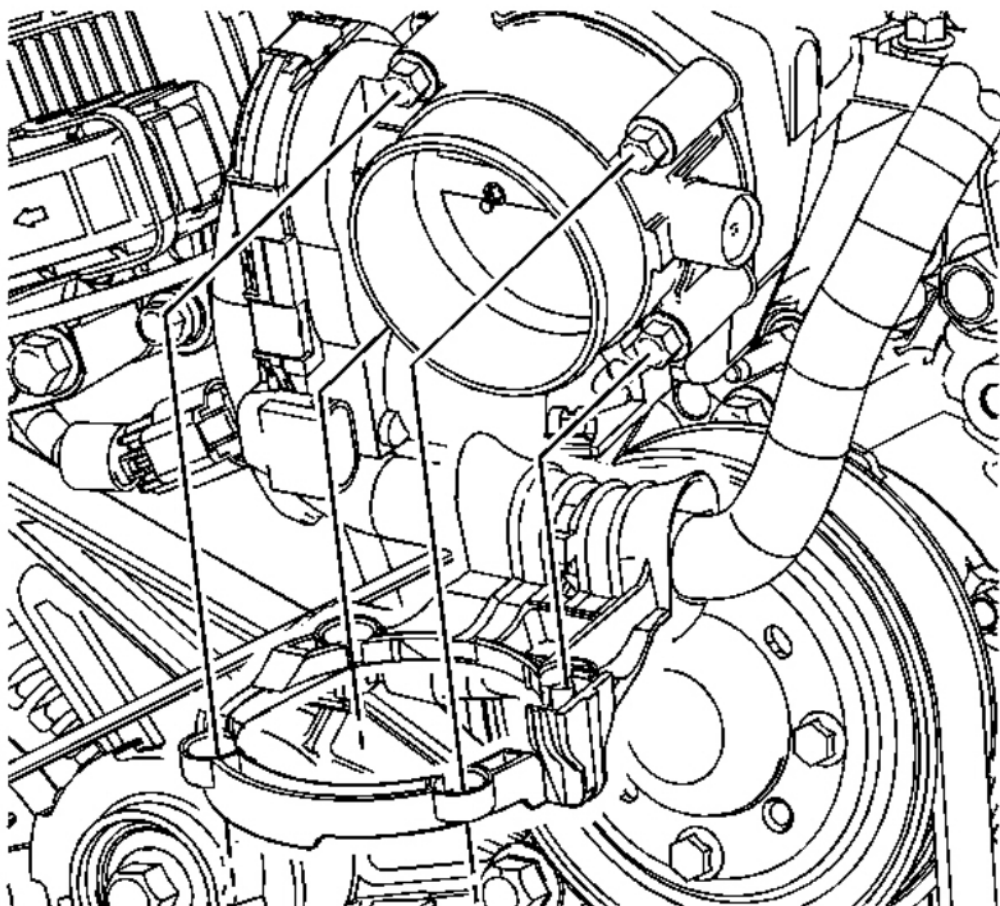


Fig. 81: View Of Wiring Harness Conduit
Courtesy of GENERAL MOTORS CORP.

9. Remove the wiring harness retainer.

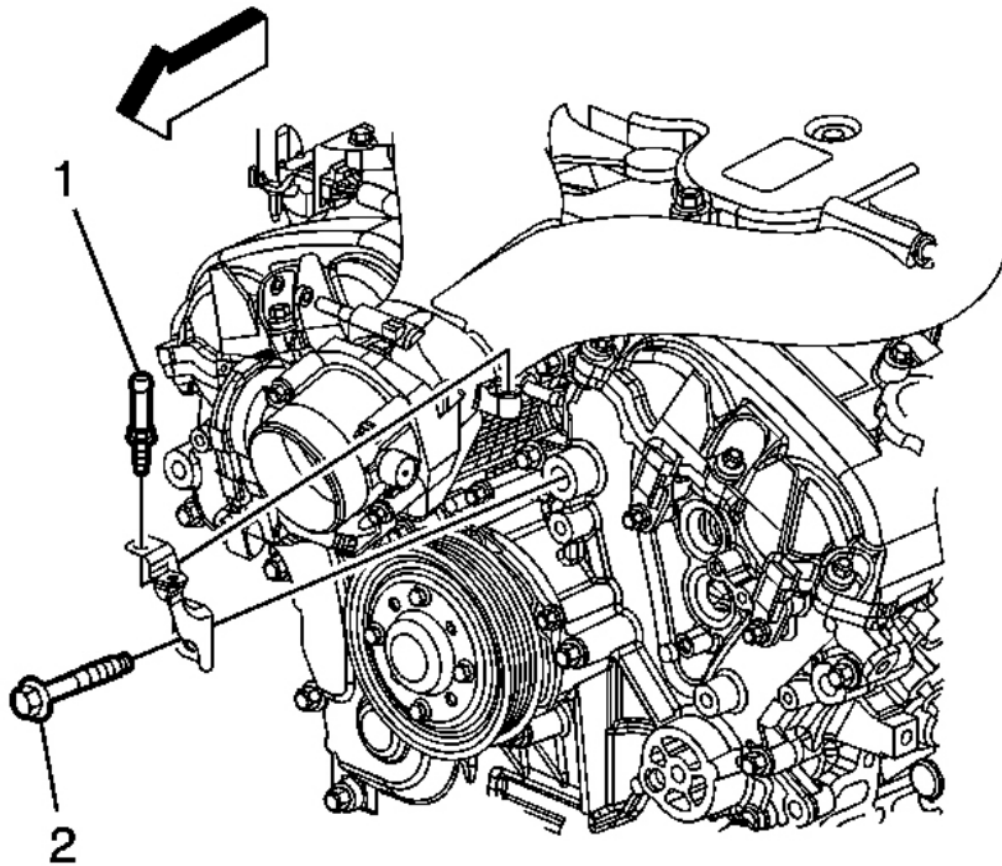


Fig. 82: Identifying Upper Intake Manifold Brace Stud, Bolt & Brace
Courtesy of GENERAL MOTORS CORP.

10. Remove the upper intake manifold brace bolt (2) and stud (1), reposition the brace with the wiring harness.
11. Remove the wiring harness retainer from the right side of the throttle body.
12. Disconnect the positive crankcase valve (PCV) hose from the right bank camshaft cover.

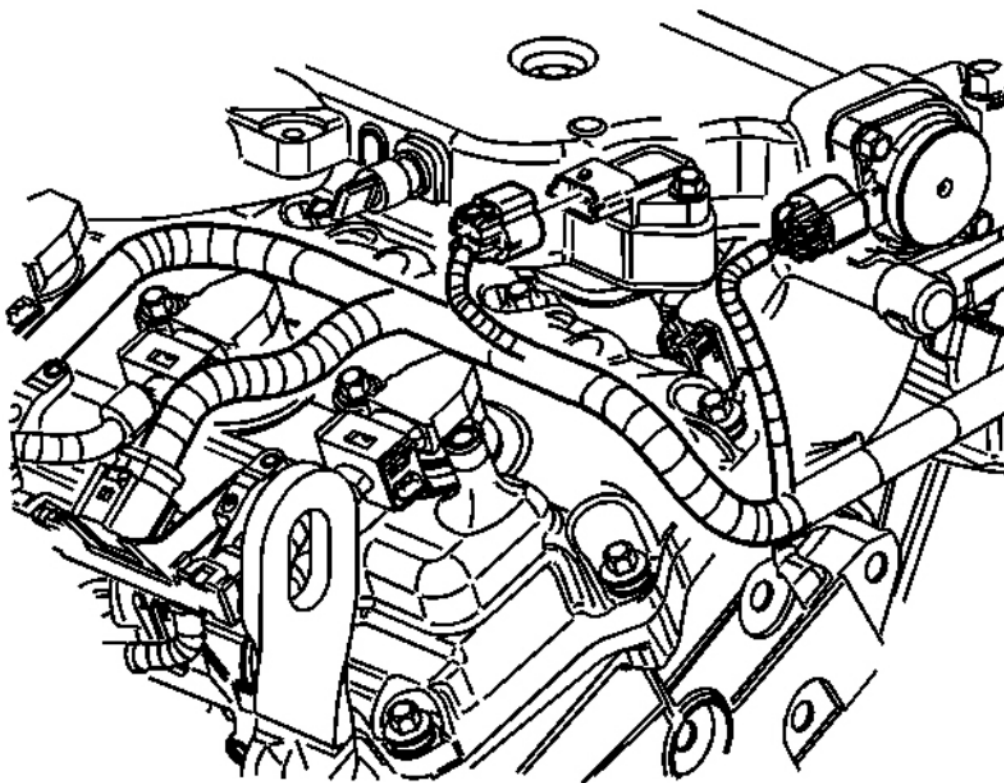


Fig. 83: Identifying Barometric Pressure Sensor And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

13. Disconnect the barometric pressure (BARO) sensor electrical connector.

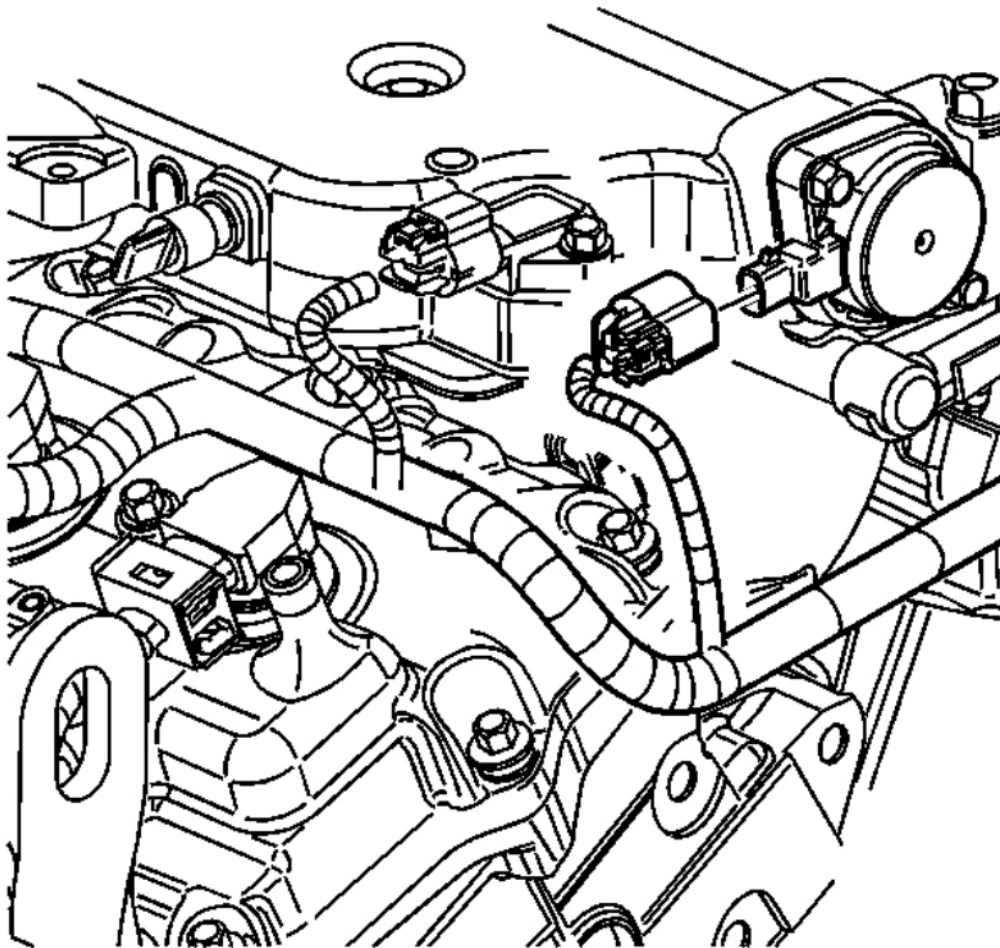


Fig. 84: View Of Communicator And Intake Manifold Runner Control Solenoid Electrical Connectors

Courtesy of GENERAL MOTORS CORP.

14. Disconnect the intake manifold runner control solenoid electrical connector.
15. Remove the left bank ignition coil wiring harness from the bracket.

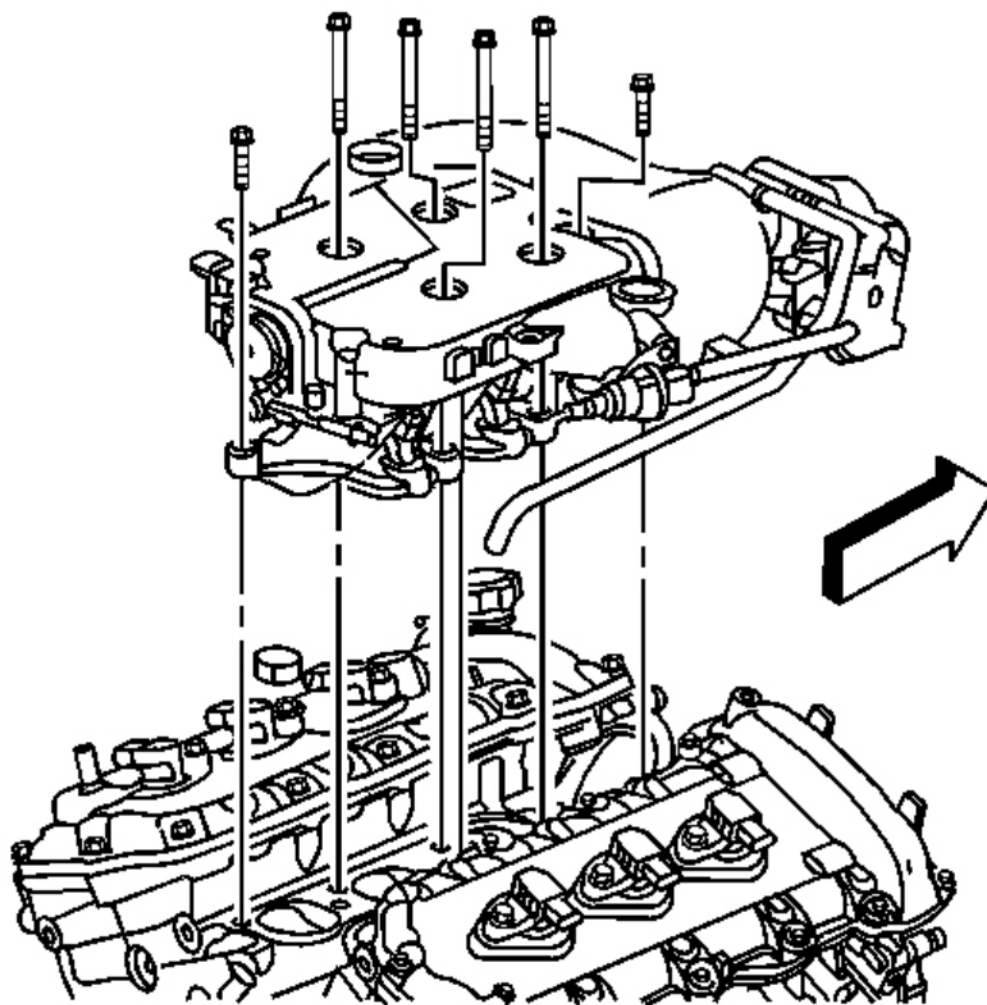


Fig. 85: View Of Lower Intake Manifold
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not remove the upper to lower intake manifold bolts.

IMPORTANT: DO NOT kink or damage the fuel pipe.

16. Remove the intake manifold bolts.
17. Reposition the intake manifold to gain access to the fuel pipe connector.

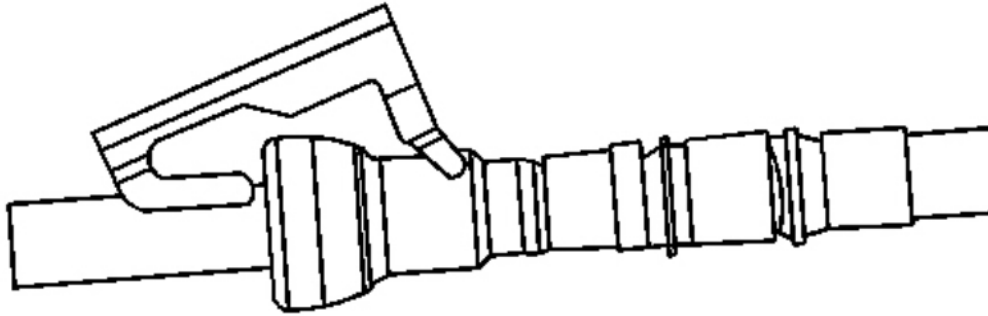


Fig. 86: View Of Quick-Connect Fitting Retainer
Courtesy of GENERAL MOTORS CORP.

18. Remove the fuel feed pipe retainer.
19. Disconnect the fuel feed pipe from the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** in Engine Controls - 2.8L.
20. Disassemble the intake manifold as necessary. Refer to **Intake Manifold Disassemble** .
21. Clean and inspect the intake manifold and the sealing surfaces. Refer to **Intake Manifold Cleaning and Inspection** .

INSTALLATION PROCEDURE

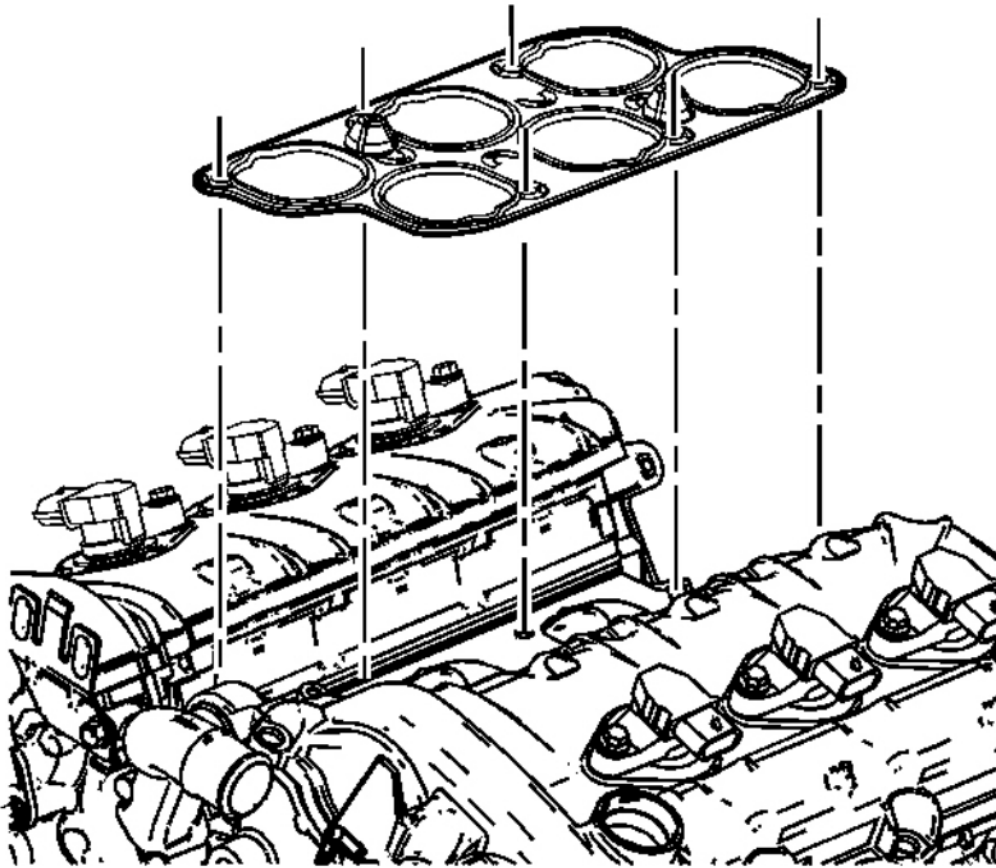


Fig. 87: View Of Lower Intake Manifold Gasket
Courtesy of GENERAL MOTORS CORP.

1. Assemble the intake manifold as necessary. Refer to **Intake Manifold Assemble** .

IMPORTANT: Inspect and replace the lower intake manifold gasket only if the gasket is worn or damaged.

2. Install the lower intake manifold gasket.

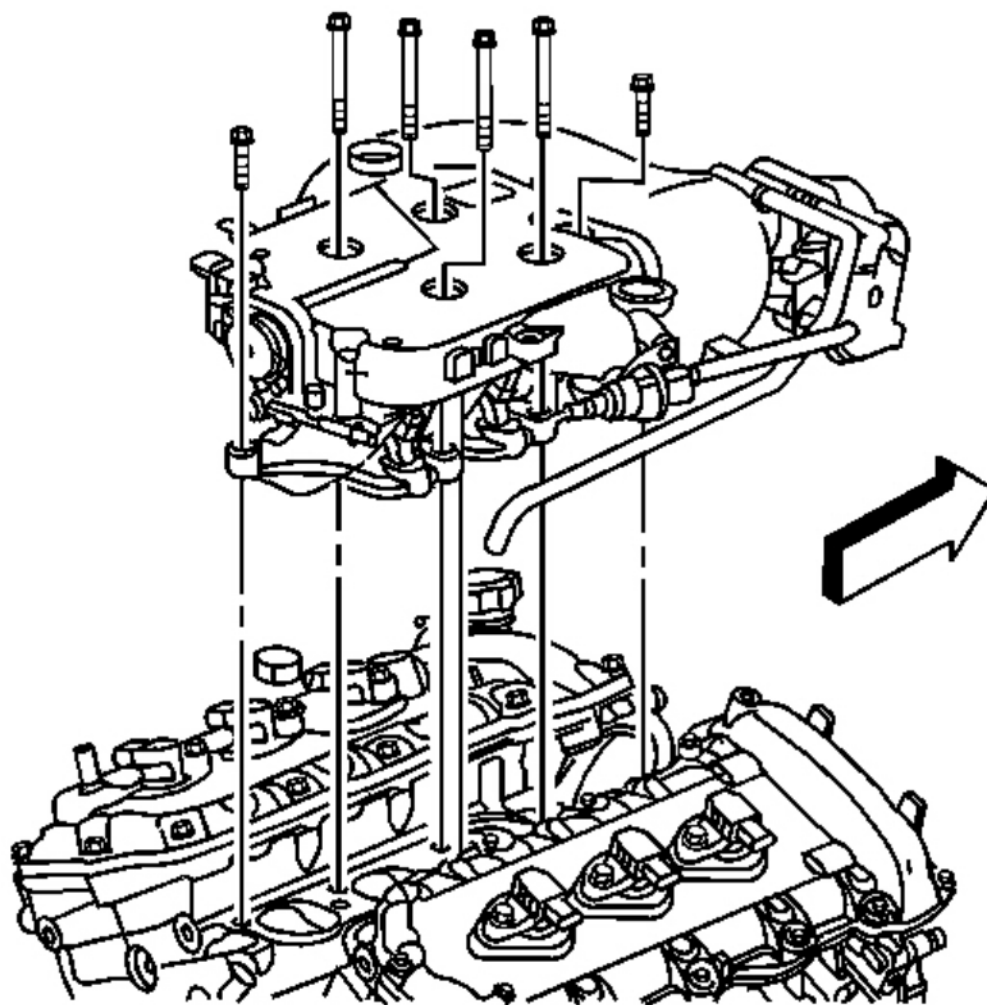


Fig. 88: View Of Lower Intake Manifold
Courtesy of GENERAL MOTORS CORP.

3. Install the intake manifold. Refer to **Intake Manifold Installation** .

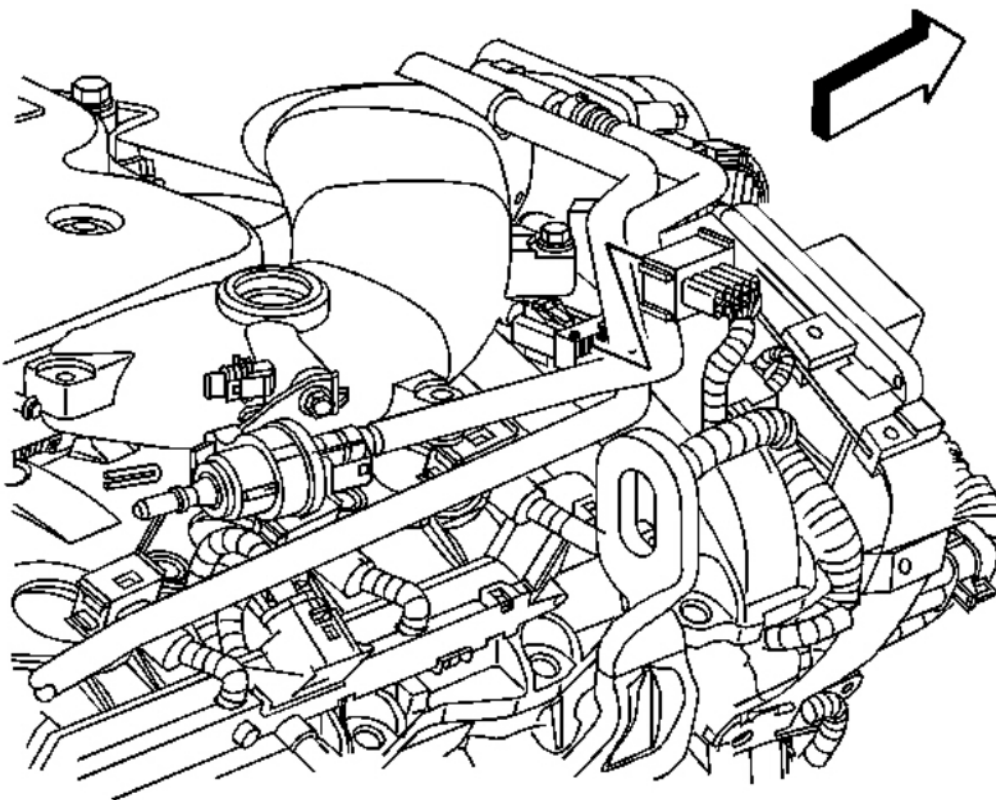


Fig. 89: View Of Fuel Injector Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Connect the fuel injector harness electrical connector.

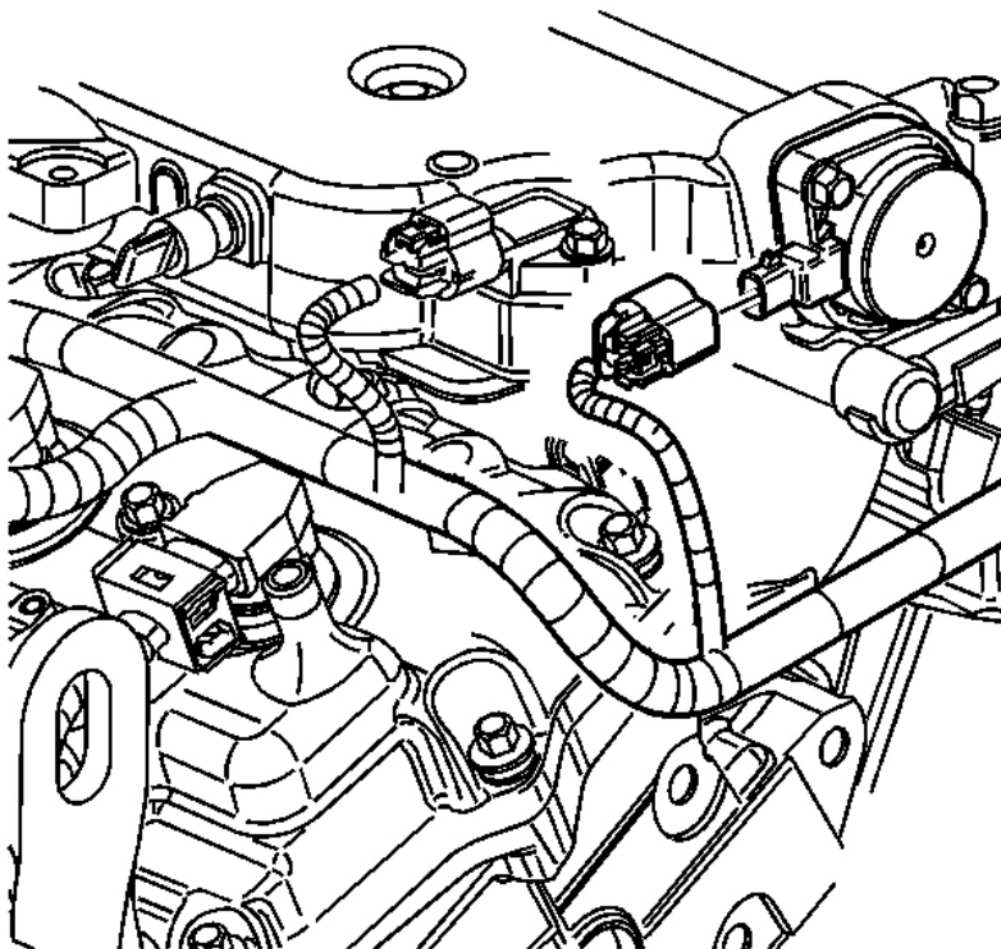


Fig. 90: View Of Communicator And Intake Manifold Runner Control Solenoid Electrical Connectors

Courtesy of GENERAL MOTORS CORP.

5. Connect the intake manifold runner control solenoid electrical connector.

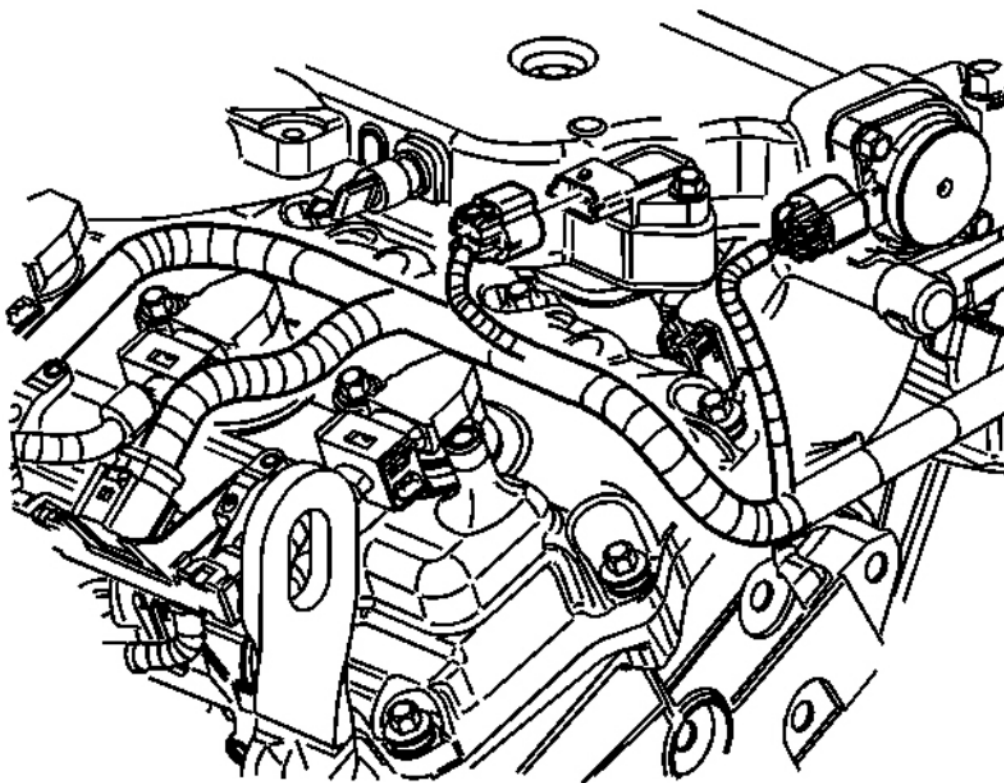


Fig. 91: Identifying Barometric Pressure Sensor And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Connect the BARO sensor electrical connector.
7. Connect the PCV hose to the right bank camshaft cover.

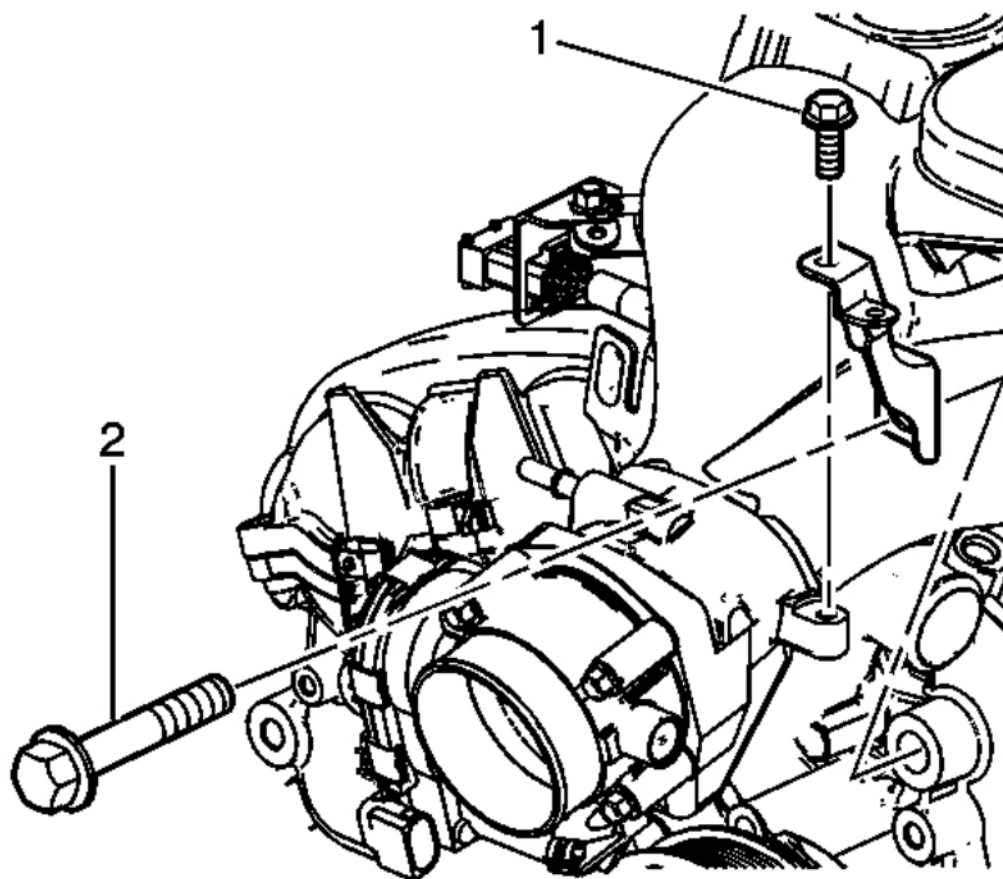


Fig. 92: View Of Intake Manifold Brace & Bolts
Courtesy of GENERAL MOTORS CORP.

8. Install the upper intake manifold brace, bolt (2), and stud (1).

Tighten: Tighten the bolt/stud.

1. Tighten the bolt (2) to 65 N.m (48 lb ft).
2. Tighten the stud (1) to 10 N.m (89 lb in).

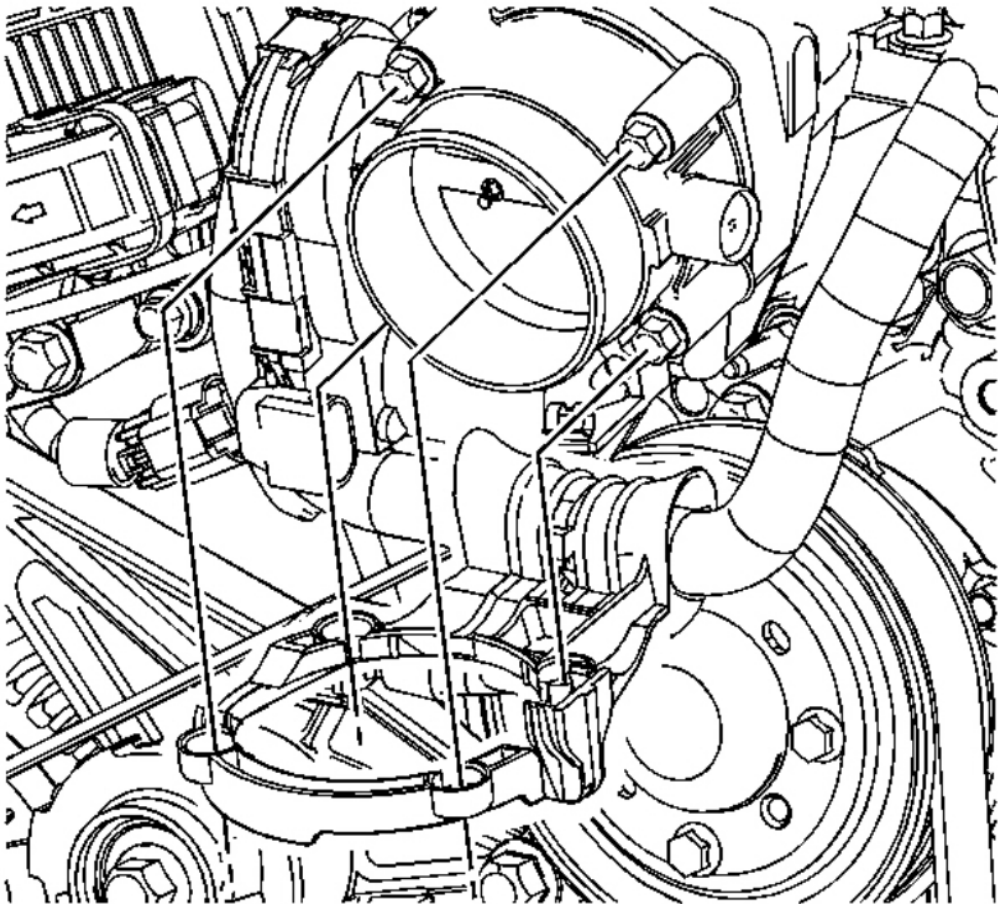


Fig. 93: View Of Wiring Harness Conduit
Courtesy of GENERAL MOTORS CORP.

9. Install the wiring harness retainer.

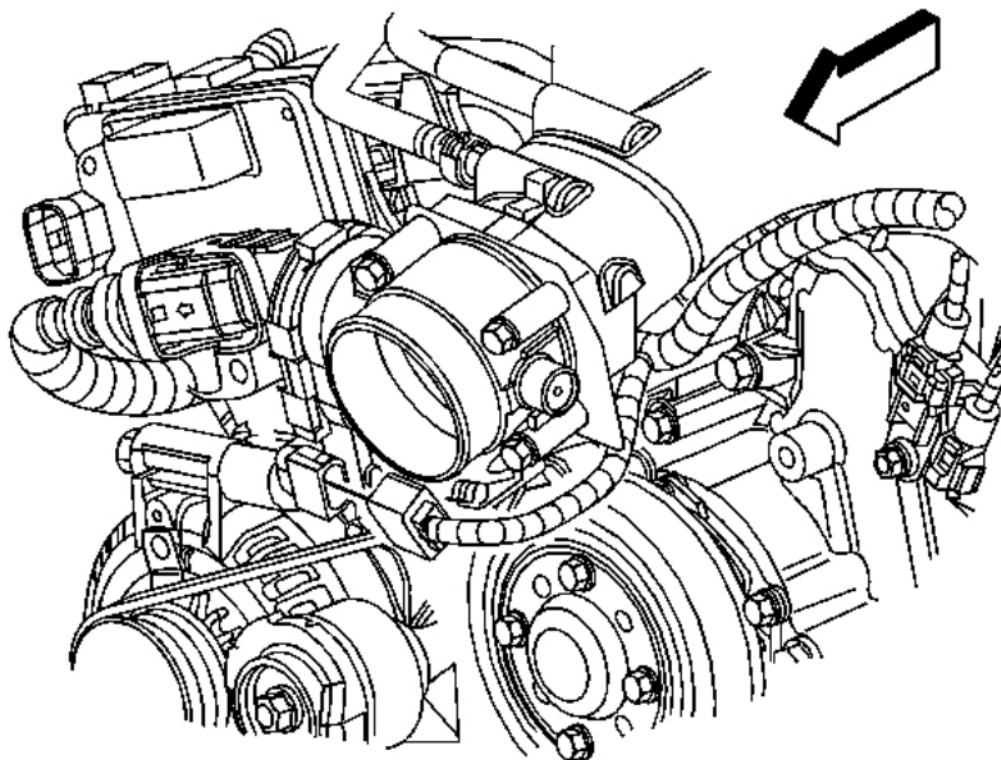


Fig. 94: View Of Throttle Body Electrical Connector
Courtesy of GENERAL MOTORS CORP.

NOTE: Ensure proper engagement of the wiring harness connector. The wiring harness connector must be installed straight onto the component connector and firmly seated. Visually inspect the connector to ensure that the connector latches are engaged and locked. Any damage to the connector or wiring must be repaired. Failure to follow this procedure can lead to an intermittent electrical connection, driveability concerns, and/or wiring harness or wiring harness connector damage or failure.

10. Connect the throttle body electrical connector.

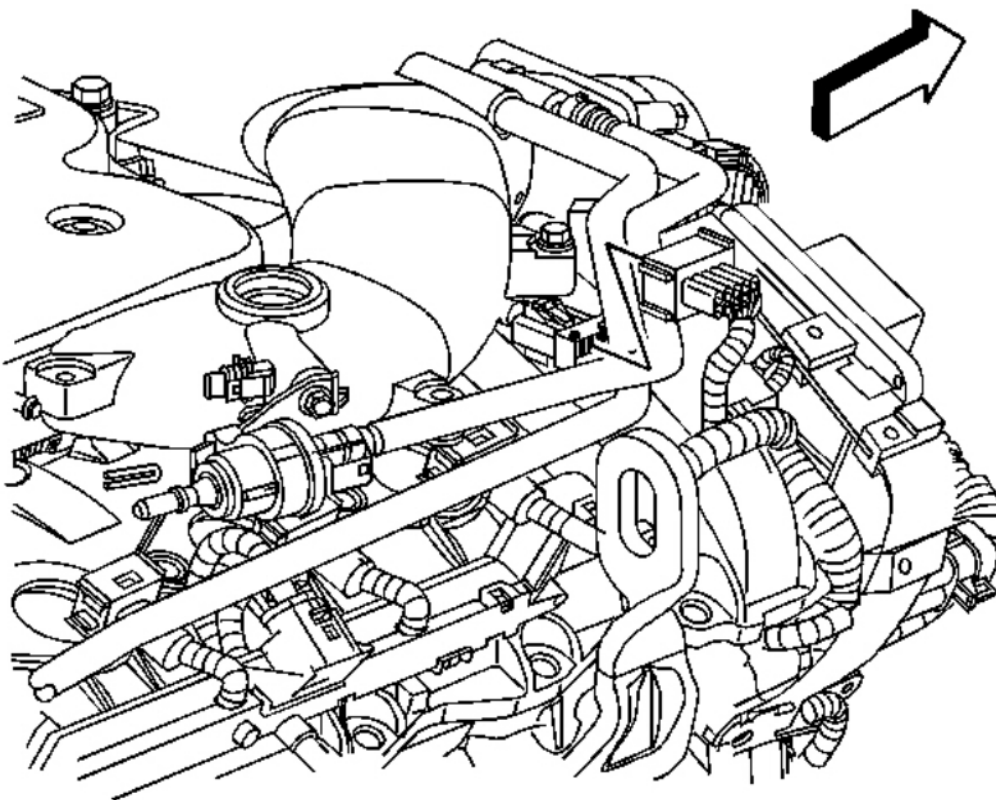


Fig. 95: View Of Fuel Injector Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

11. Connect the fuel injector harness electrical connector.

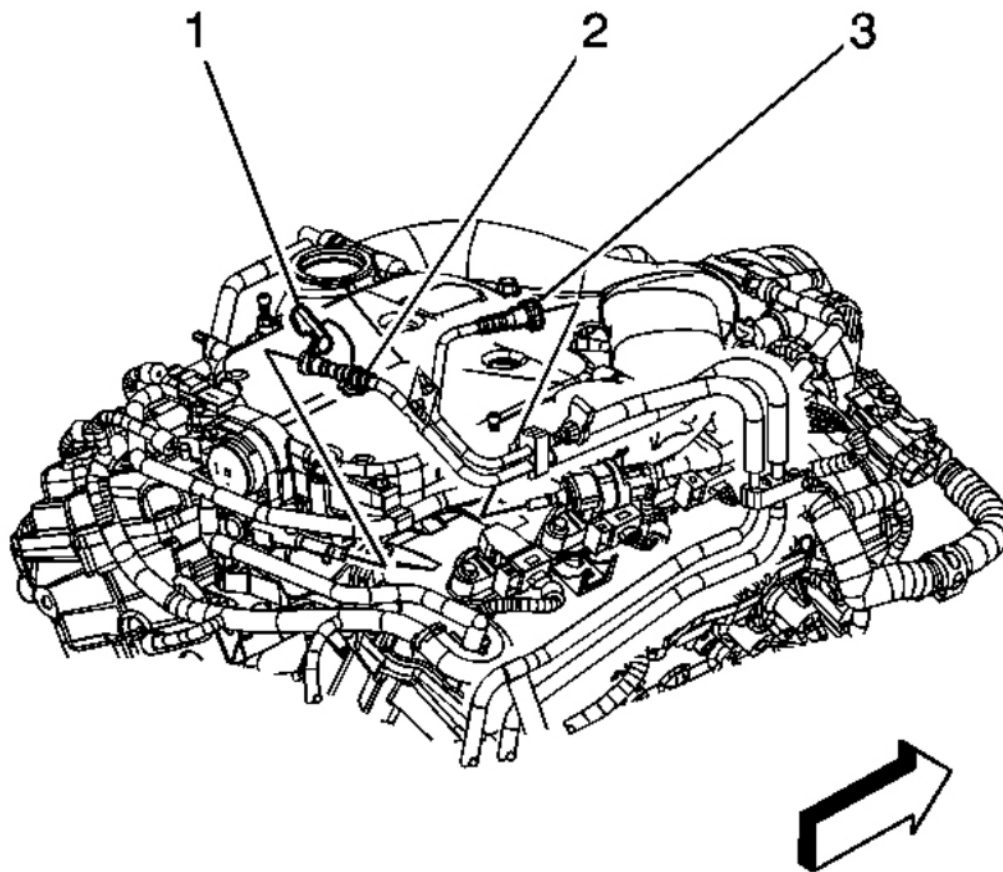


Fig. 96: Top Of Engine View

Courtesy of GENERAL MOTORS CORP.

12. Connect the fuel feed pipe (1) to the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** in Engine Controls - 2.8L.
13. Connect the purge line (3) to the purge solenoid valve.

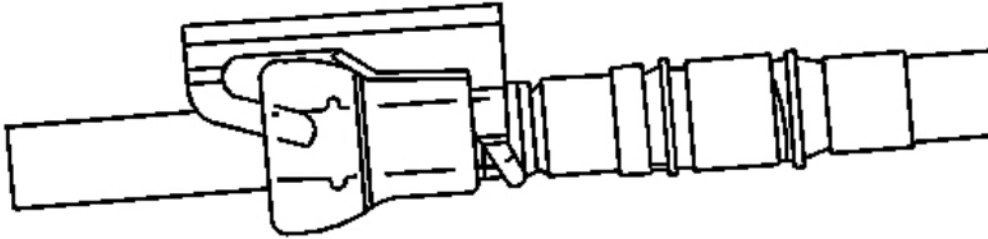


Fig. 97: View Of Fuel Pipe Retainer
Courtesy of GENERAL MOTORS CORP.

14. Install the fuel pipe retainer.

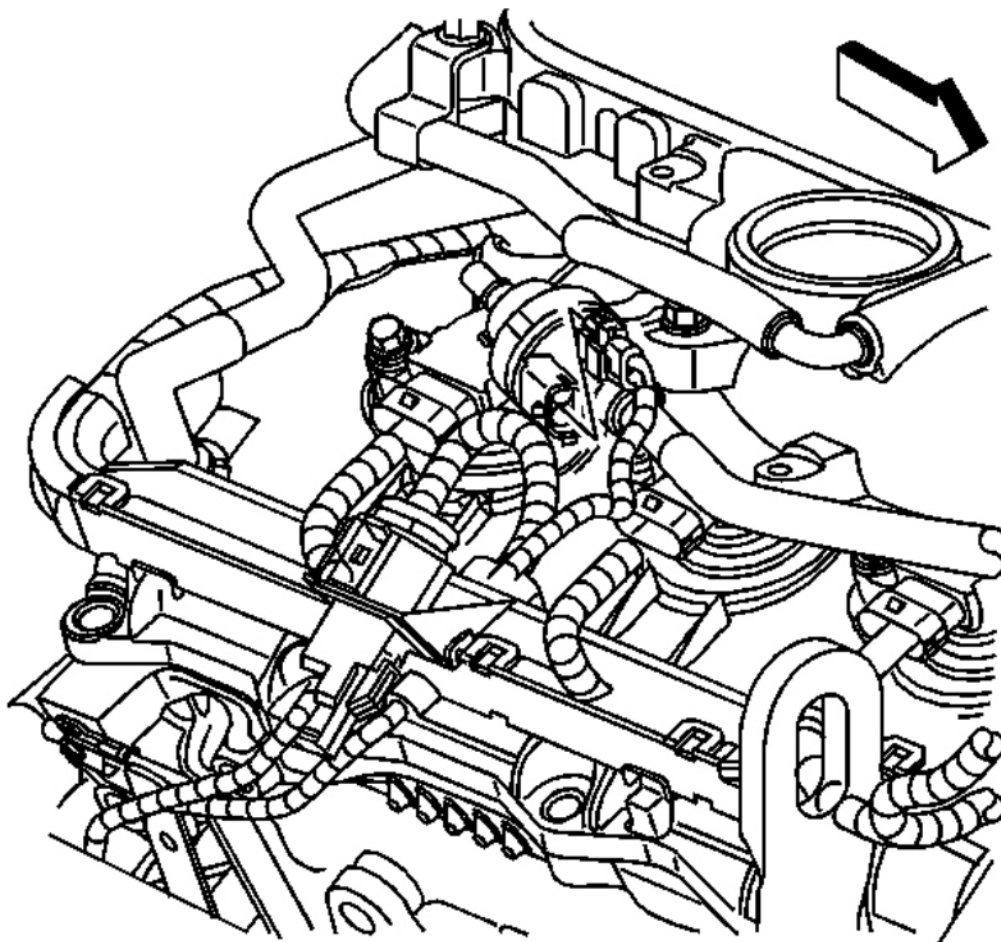


Fig. 98: View Of Purge Solenoid Valve And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

15. Connect the purge solenoid valve electrical connector.
16. Install the brake booster hose and check valve to the brake booster.

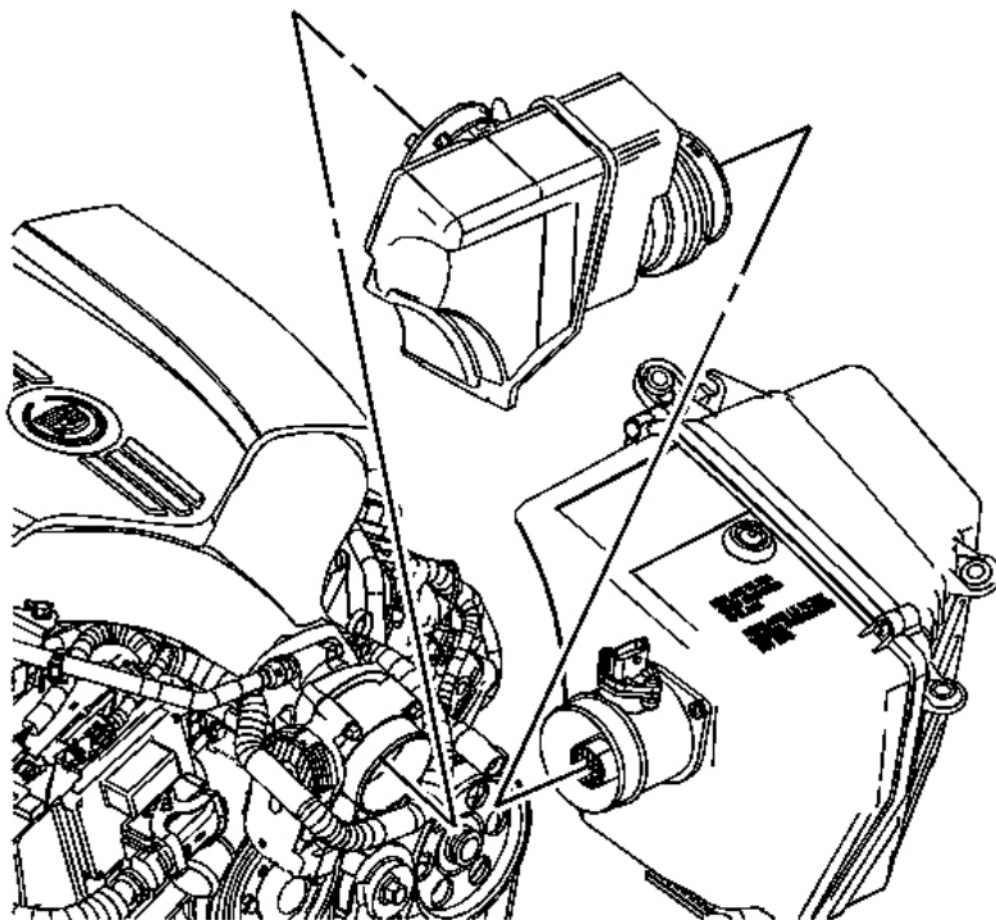


Fig. 99: View Of Air Inlet Duct

Courtesy of GENERAL MOTORS CORP.

17. Install the air inlet duct. Refer to **Air Cleaner Intake Duct Replacement** in Engine Controls - 2.8L.
18. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.

OIL LEVEL INDICATOR AND TUBE REPLACEMENT

REMOVAL PROCEDURE

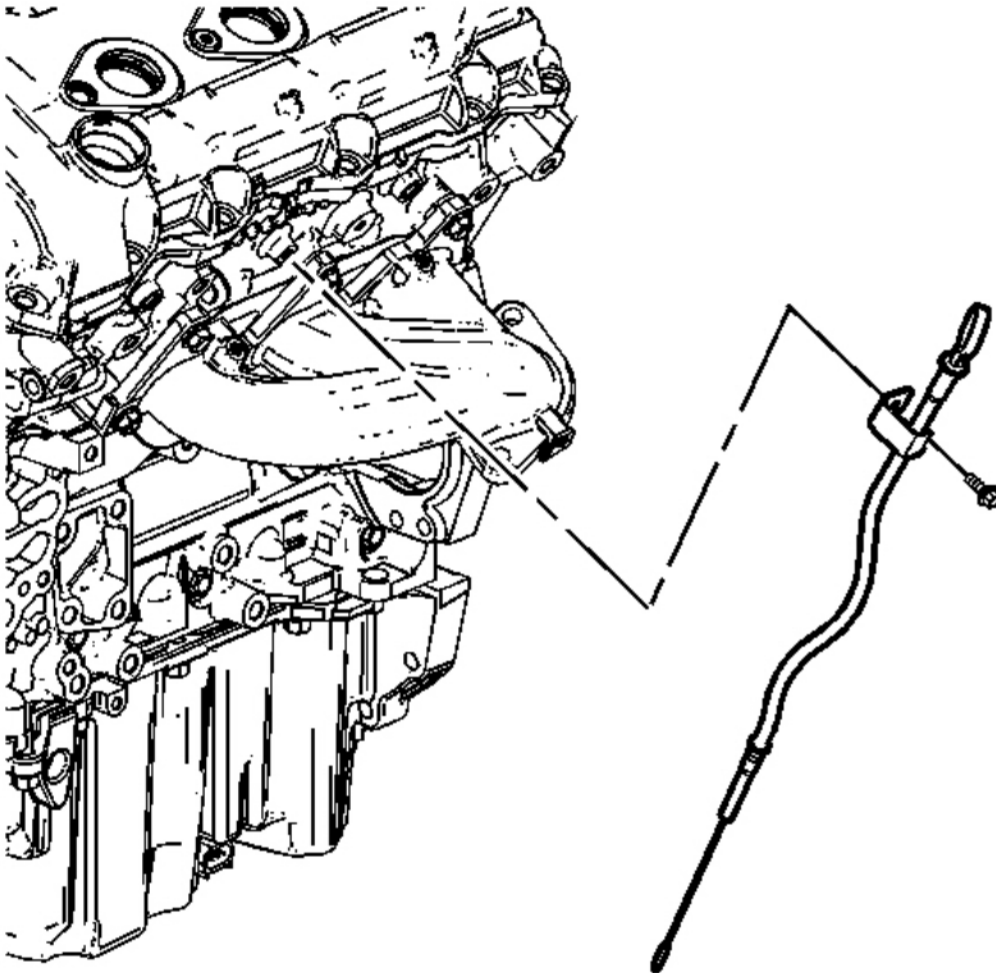


Fig. 100: View Of Oil Level Indicator Tube
Courtesy of GENERAL MOTORS CORP.

1. Turn the ignition OFF.
2. Remove the oil level indicator from the oil level indicator tube.
3. Remove the oil level indicator tube bolt.
4. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
5. Remove the knock sensor. Refer to **Knock Sensor (KS) Replacement - Bank 2** in Engine Controls - 2.8L.
6. Remove the heat shield clip from the oil level indicator tube.
7. Lower the vehicle.

IMPORTANT: Note the location and orientation of the secondary (small square) heat shield.

8. Remove the oil level indicator tube up through the exhaust manifold.
9. If you are replacing only the oil level indicator tube seal, remove and discard the old seal.

INSTALLATION PROCEDURE

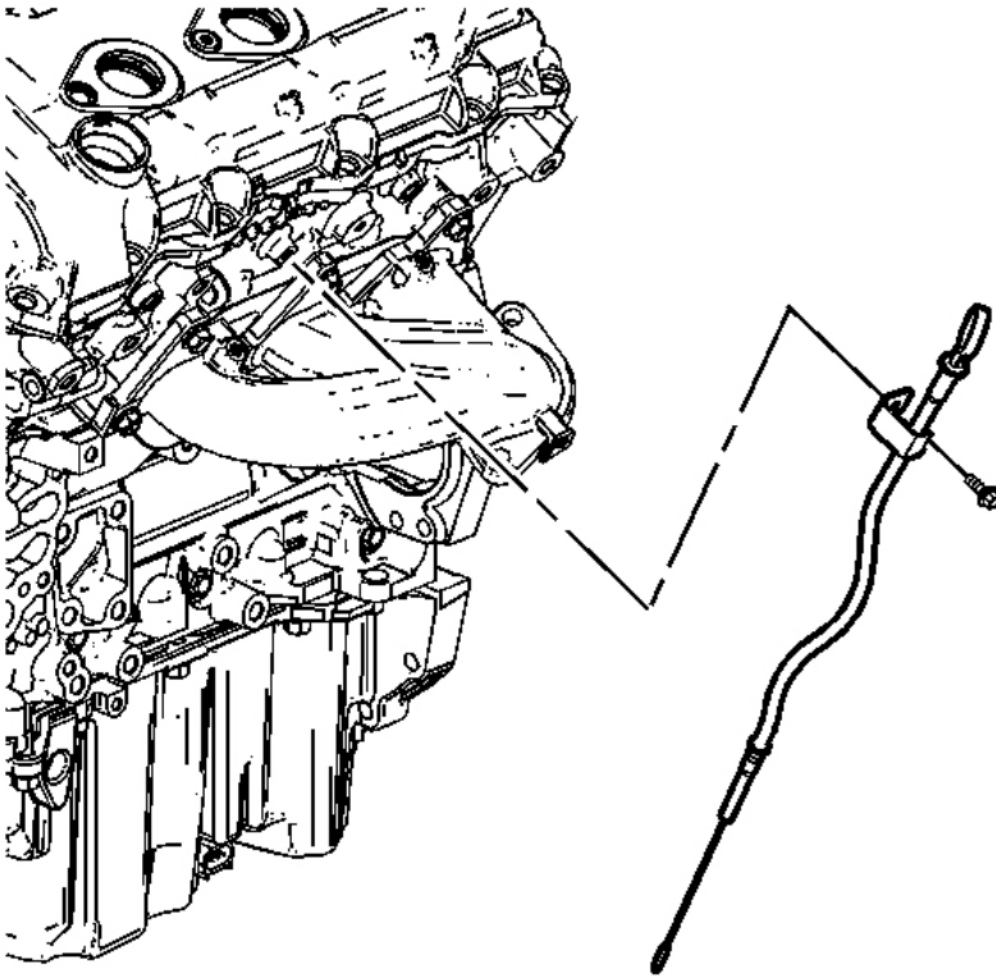


Fig. 101: View Of Oil Level Indicator Tube
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the secondary (small square) heat shield is properly installed

to the oil level indicator tube as noted during removal.

1. Install the oil level indicator and tube. Refer to **Oil Level Indicator and Tube Installation** .
2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Install the knock sensor. Refer to **Knock Sensor (KS) Replacement - Bank 2** in Engine Controls - 2.8L.
4. Install the heat shield clip to the oil level indicator tube as noted during removal.
5. Lower the vehicle.

OIL FILTER ADAPTER REPLACEMENT

REMOVAL PROCEDURE

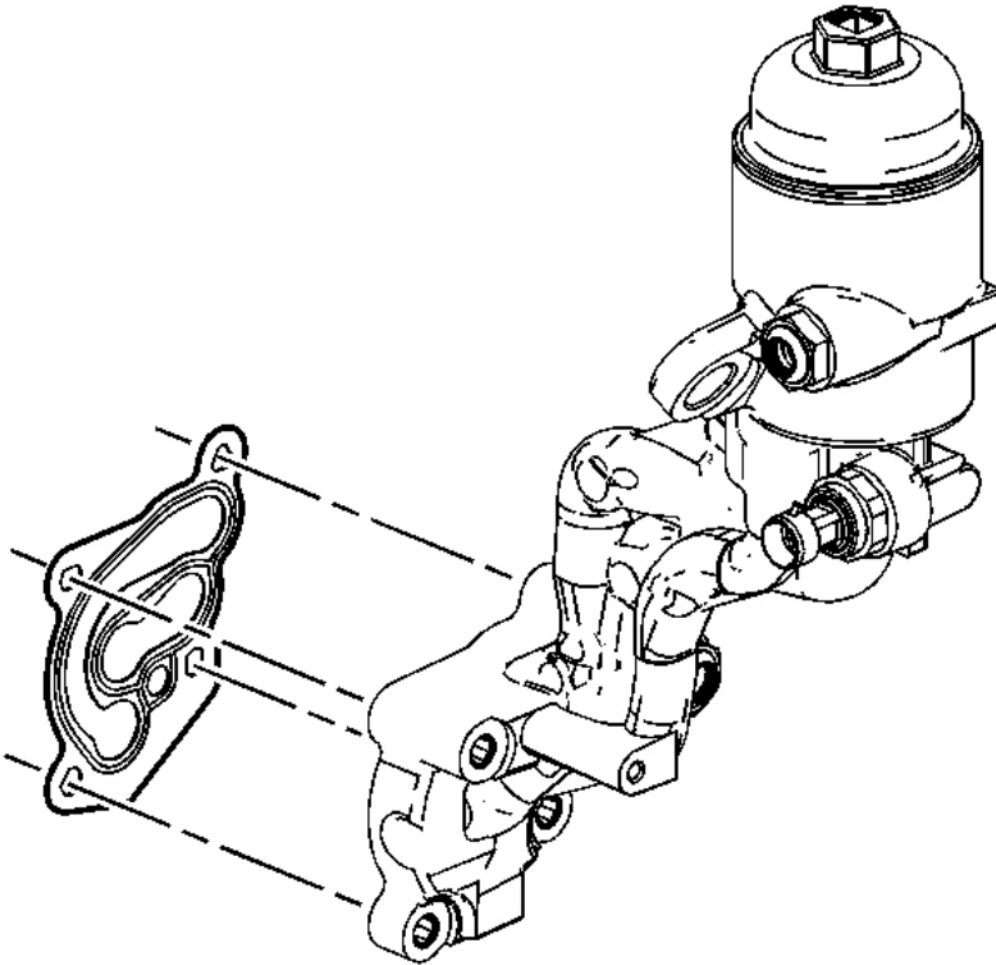


Fig. 102: View Of Oil Filter Adapter & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil filter. Refer to **Engine Oil and Oil Filter Replacement** .
2. Remove the A/C compressor and power steering drive belt. Refer to **Drive Belt Replacement - Power Steering and Air Conditioning**.

IMPORTANT: Do not disconnect the A/C pipes from the A/C compressor.

3. Remove the A/C compressor bolts and reposition the A/C compressor in order to gain access to the oil filter adapter fasteners.
4. Disconnect the oil pressure sensor electrical connector.

5. Remove the oil filter adapter. Refer to **Oil Filter Adapter Removal** .

INSTALLATION PROCEDURE

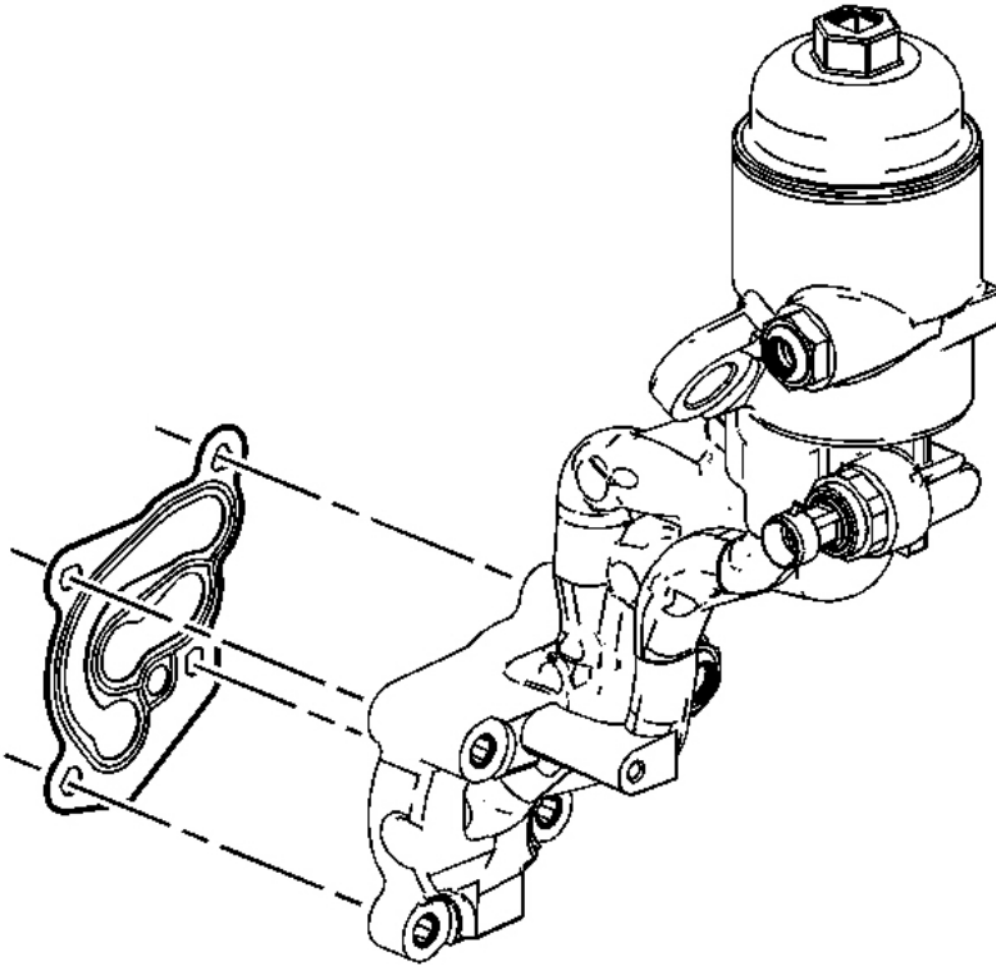


Fig. 103: View Of Oil Filter Adapter & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the oil filter adapter. Refer to **Oil Filter Adapter Installation** .
2. Connect the oil pressure sensor electrical connector.
3. Install the A/C compressor with the A/C pipes to the engine. Refer to **Compressor Replacement (LHD, LY7)** or **Compressor Replacement (2.8L (LP1))** in Heating, Ventilation and Air Conditioning.
4. Install the A/C compressor and power steering drive belt. Refer to **Drive Belt Replacement - Power**

Steering and Air Conditioning.

5. Install the oil filter. Refer to **Engine Oil and Oil Filter Replacement** .

CRANKSHAFT BALANCER REPLACEMENT

Tools Required

- **J 24420-C** Harmonic Balancer Puller. See **Special Tools** .
- **J 41998-B** Crankshaft Balancer Installer. See **Special Tools** .

REMOVAL PROCEDURE

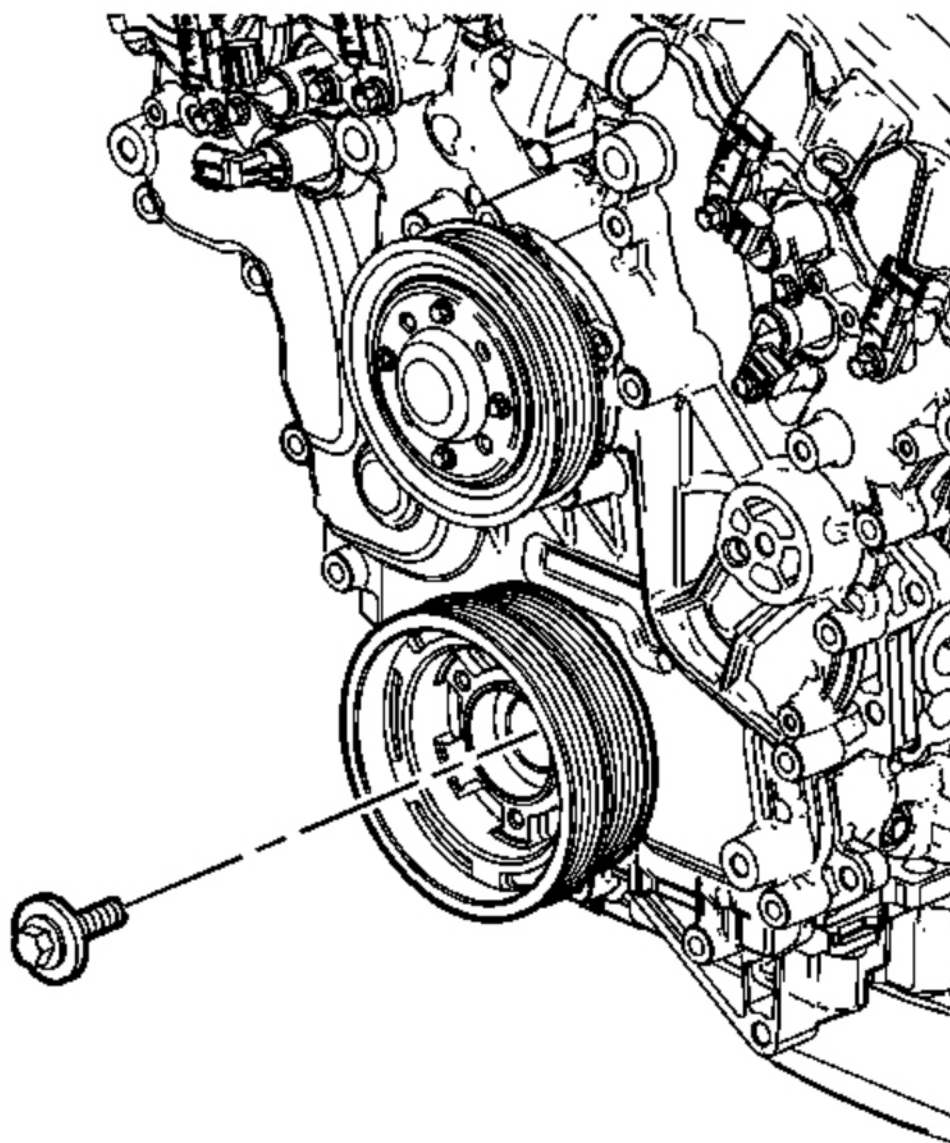


Fig. 104: View Of Crankshaft Balancer & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator and water pump drive belt. Refer to **Drive Belt Replacement - Power Steering and Air Conditioning**.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

3. Remove the front air deflector. Refer to [Air Deflector Replacement - Front](#) in Body Front End.
4. Use the **J 24420-C** in order to remove the crankshaft balancer. See [Special Tools](#) . Refer to [Crankshaft Balancer Removal](#) .

INSTALLATION PROCEDURE

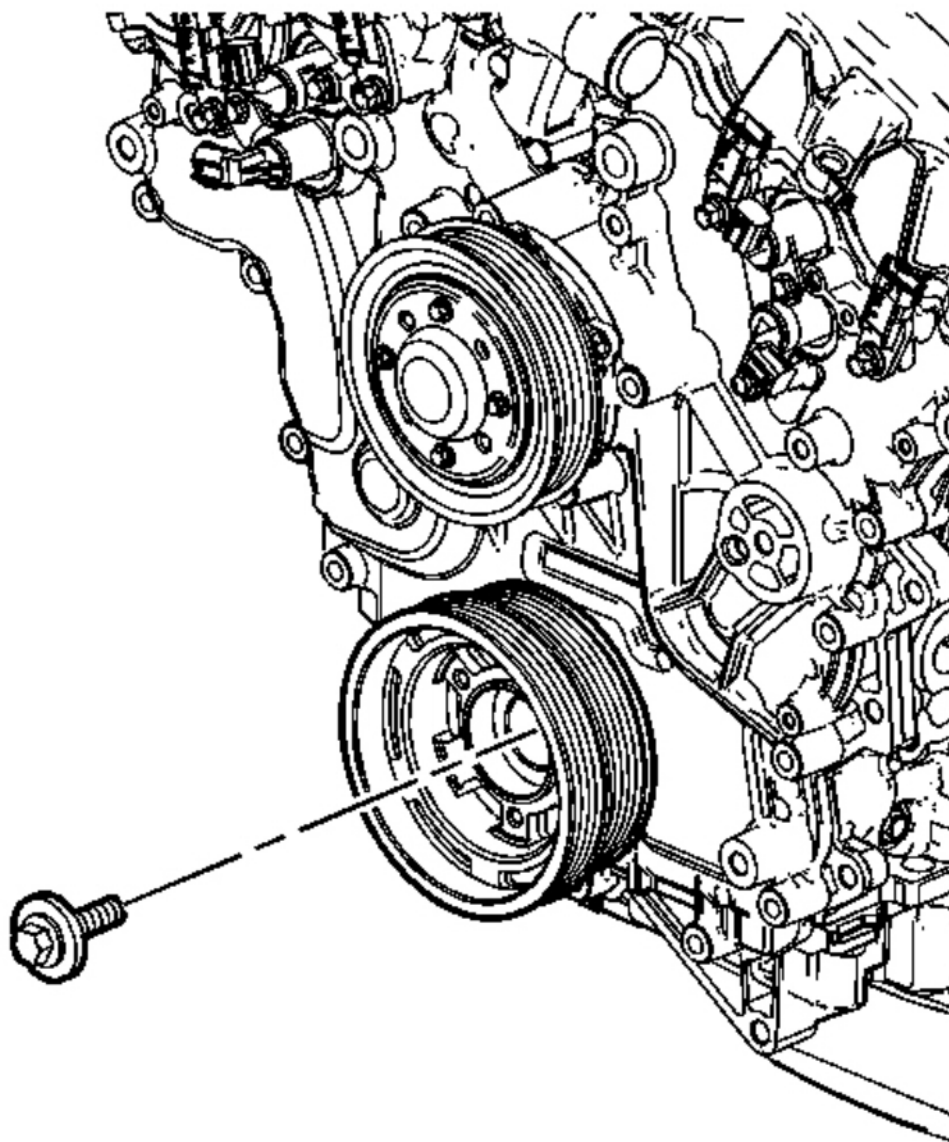


Fig. 105: View Of Crankshaft Balancer & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the crankshaft balancer. Refer to **Crankshaft Balancer Installation** .
2. Install the front air deflector. Refer to **Air Deflector Replacement - Front** in Body Front End.
3. Install the A/C compressor and power steering pump drive belt. Refer to **Drive Belt Replacement - Power Steering and Air Conditioning**.

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

TOOLS REQUIRED

J 29184 Oil Seal Installer. See **Special Tools** .

REMOVAL PROCEDURE

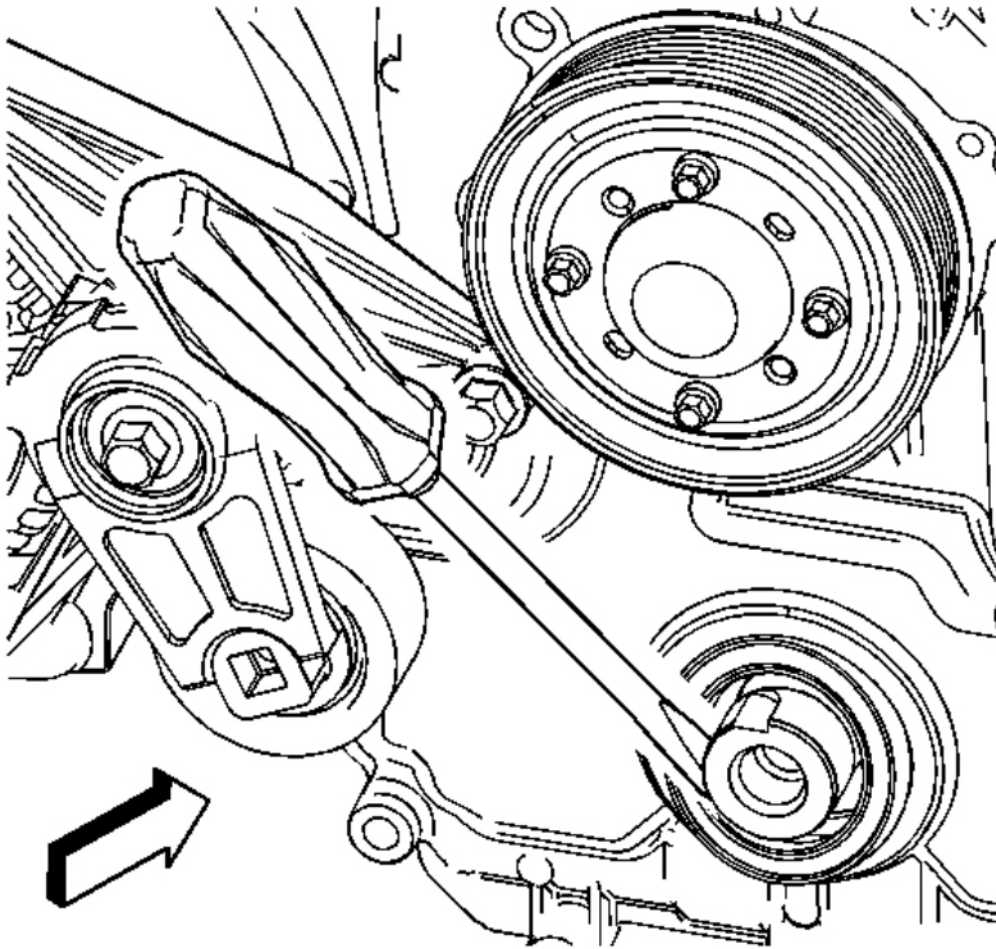


Fig. 106: Identifying Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the A/C compressor and power steering pump drive belt. Refer to **Drive Belt Replacement - Power Steering and Air Conditioning**.
2. Remove the generator and water pump drive belt. Refer to **Drive Belt Replacement - Generator and Water Pump**.
3. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Removal**.
4. Use a flat-bladed tool in order to remove the crankshaft oil seal.

INSTALLATION PROCEDURE

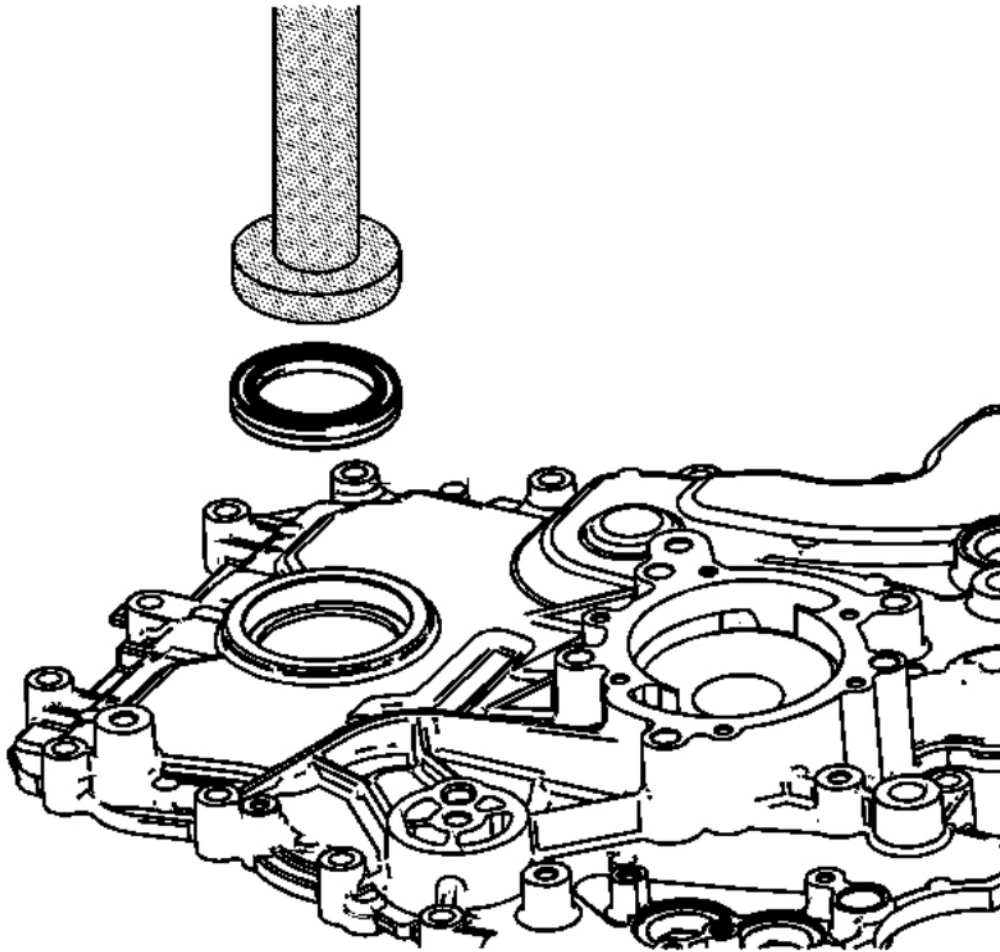


Fig. 107: Installing Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not lubricate the crankshaft front oil seal or the crankshaft balancer sealing surfaces.

1. Use the **J 29184** or equivalent to install the crankshaft front oil seal. See **Special Tools** .
2. Install the crankshaft balancer. Refer to **Crankshaft Balancer Installation** .
3. Install the generator and water pump drive belt. Refer to **Drive Belt Replacement - Generator and Water Pump**.
4. Install the A/C compressor and power steering pump drive belt. Refer to **Drive Belt Replacement - Power Steering and Air Conditioning**.

CAMSHAFT COVER REPLACEMENT - LEFT

REMOVAL PROCEDURE

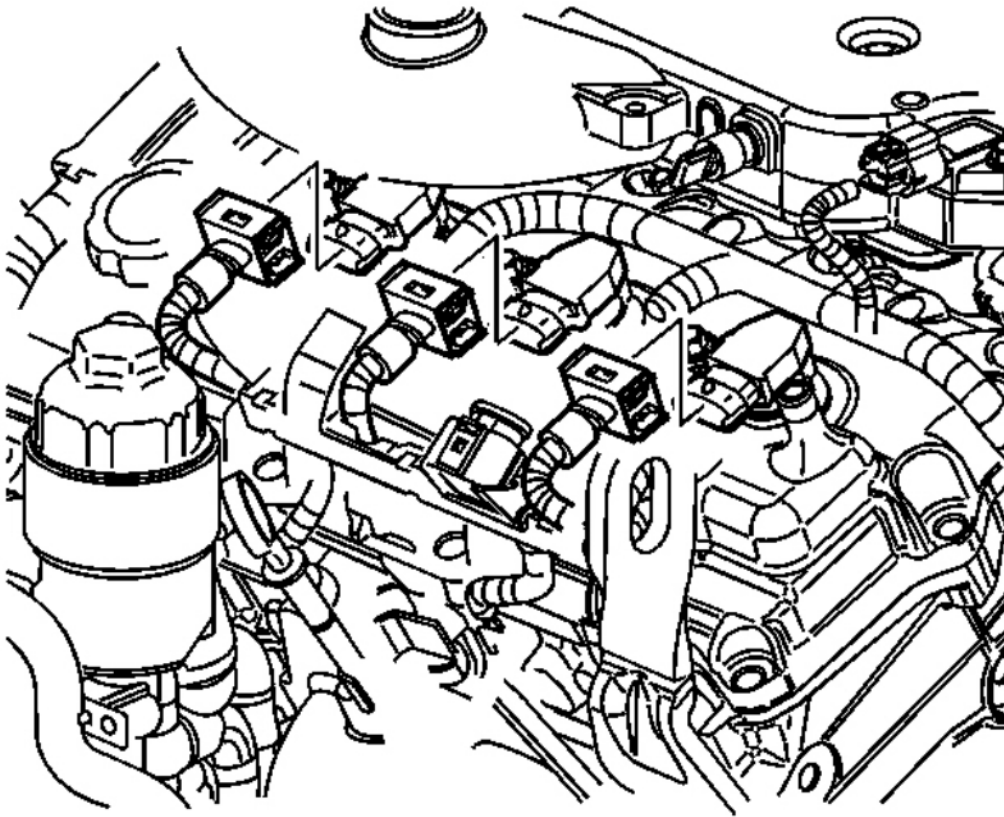


Fig. 108: View Of Left Ignition Coils Wiring Harness Connectors
Courtesy of GENERAL MOTORS CORP.

1. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.
2. Remove the upper intake manifold with the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
3. Disconnect the ignition coil electrical connectors.

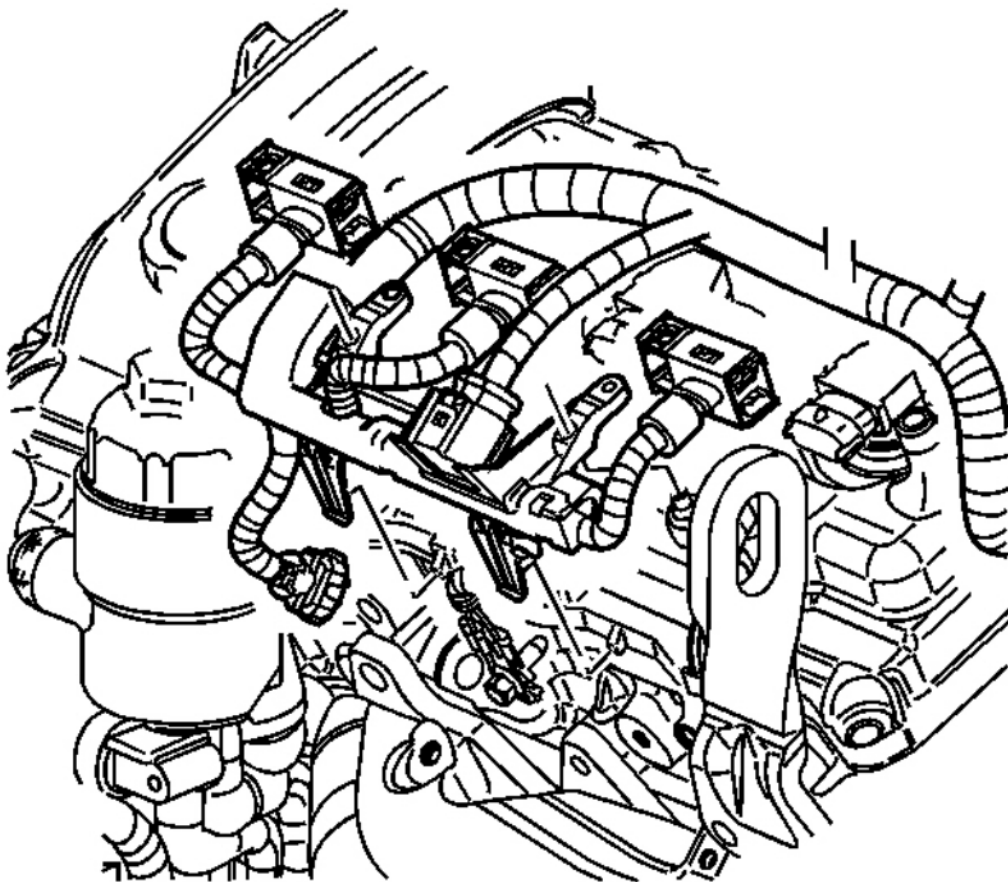


Fig. 109: View Of Left Camshaft Cover Wiring Harness Connectors
Courtesy of GENERAL MOTORS CORP.

4. Remove the wiring harness from the side of the camshaft cover by sliding the conduit down and outboard.
5. Remove the wiring conduit retainers from the camshaft cover by rotating the wiring harness conduit retainers counterclockwise.

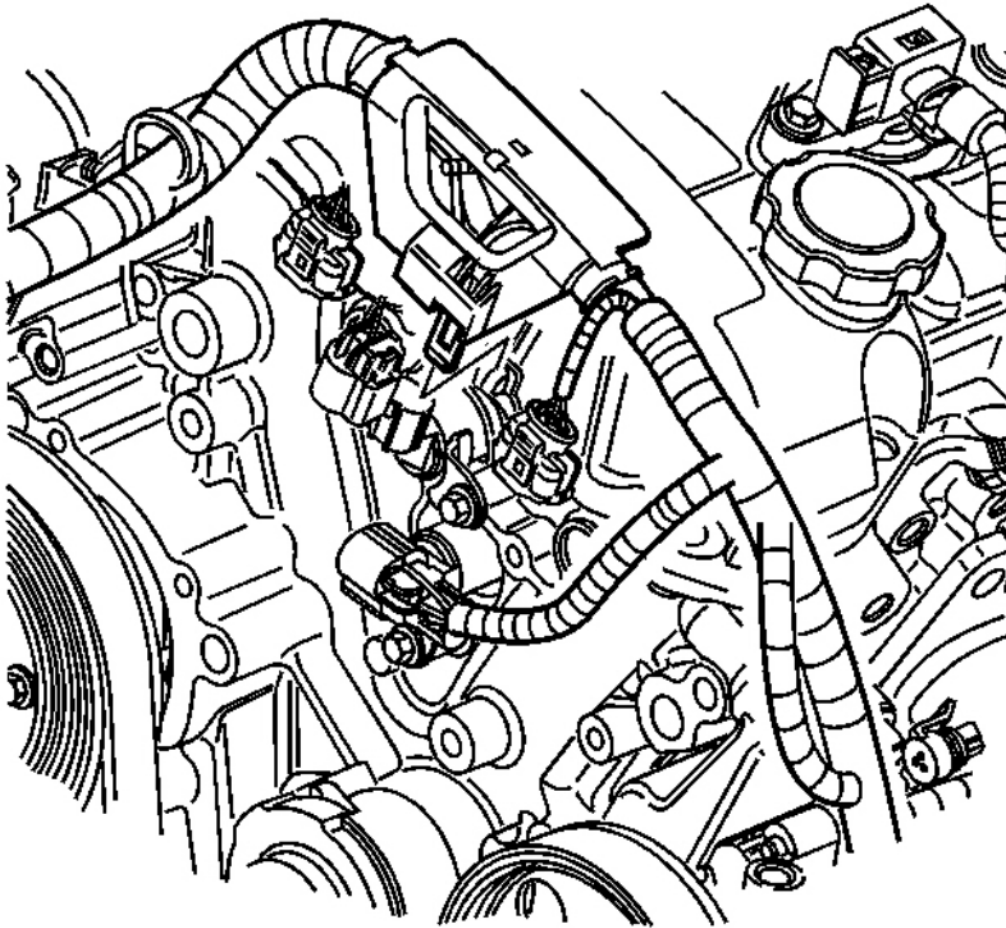


Fig. 110: View Of Left Camshaft Cover Wiring Harness Connector - Front
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: It is not necessary to disconnect the engine front cover electrical connectors.

6. Remove the wiring harness from the front of the camshaft cover.
7. Reposition and secure the wiring harnesses away from the camshaft cover in order to provide clearance.

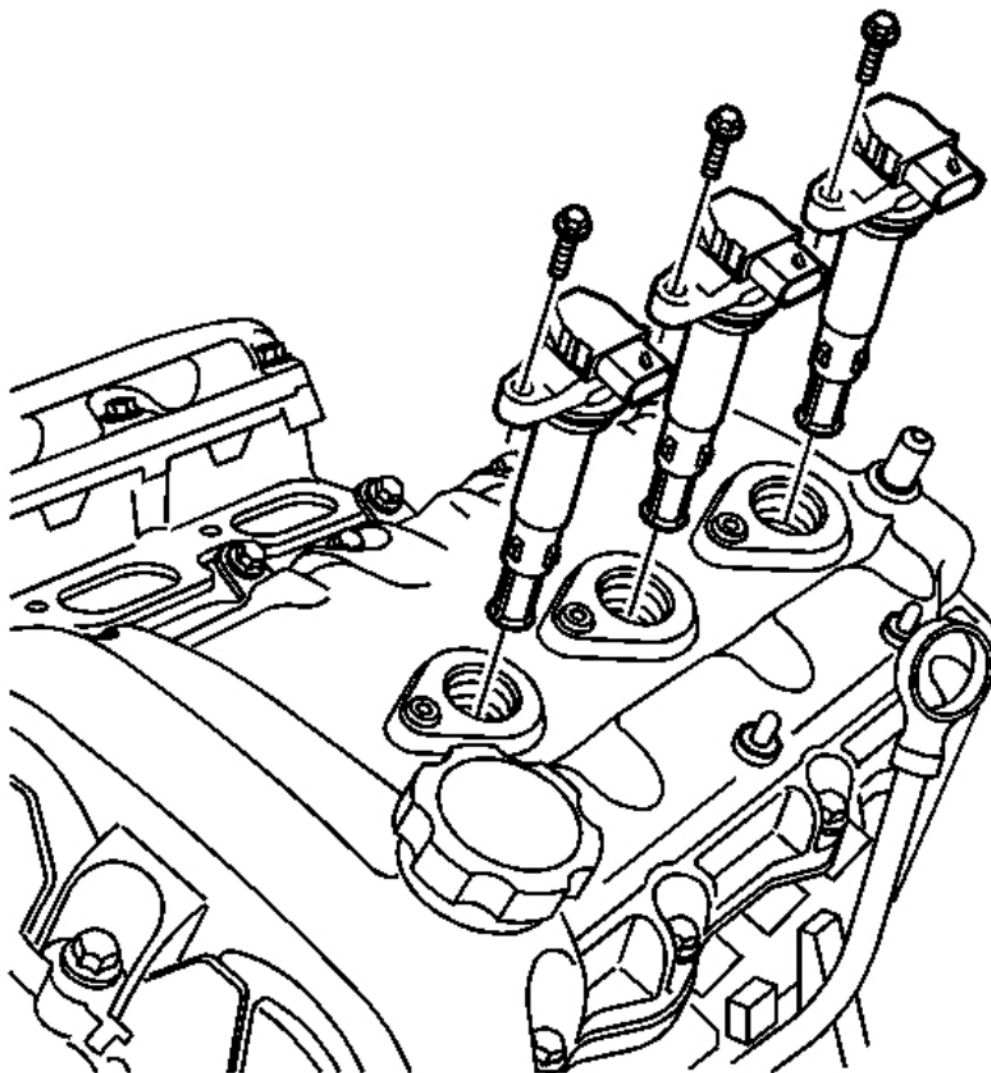


Fig. 111: Identifying Left Cylinder Head Ignition Coils
Courtesy of GENERAL MOTORS CORP.

8. Remove the ignition coils.

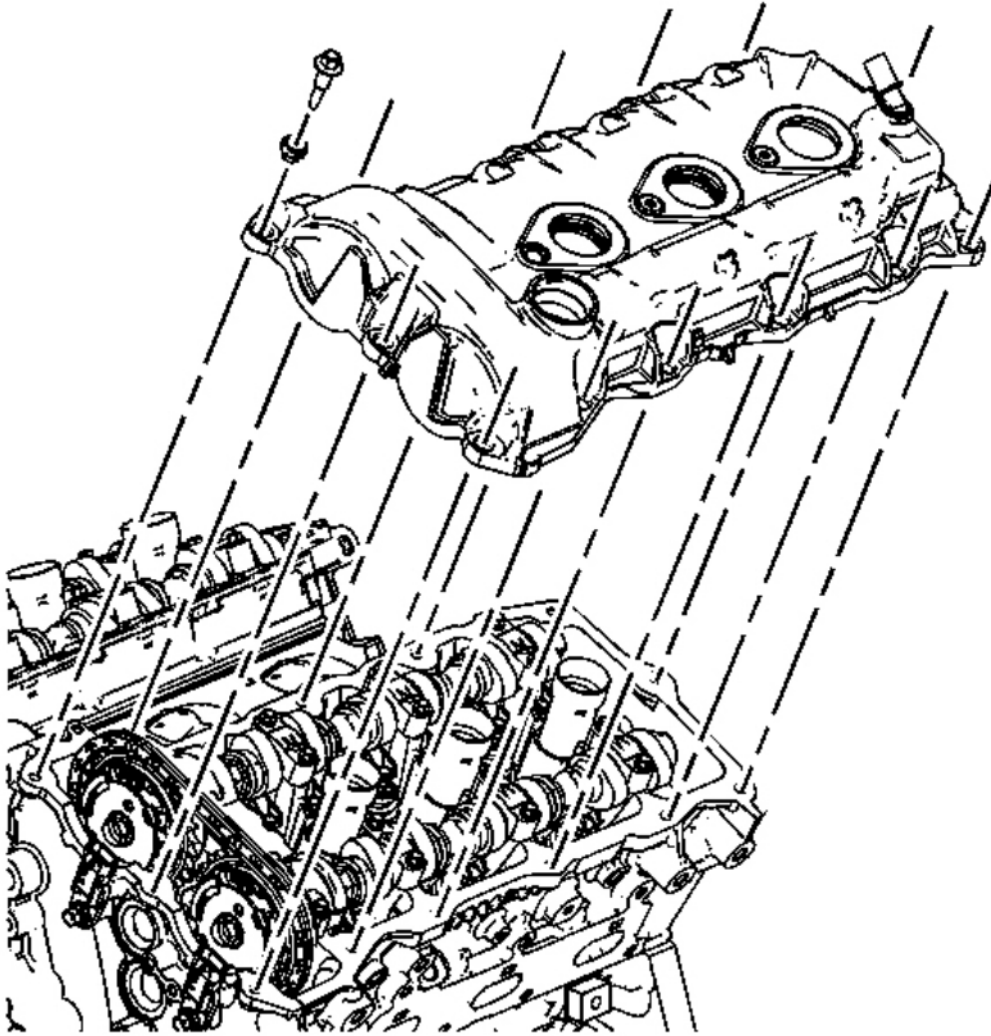


Fig. 112: Removing & Installing Left Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

9. Remove the camshaft cover.
10. Remove and discard the camshaft cover seal and grommets.

INSTALLATION PROCEDURE

1. Install a NEW camshaft cover seal and NEW grommets.

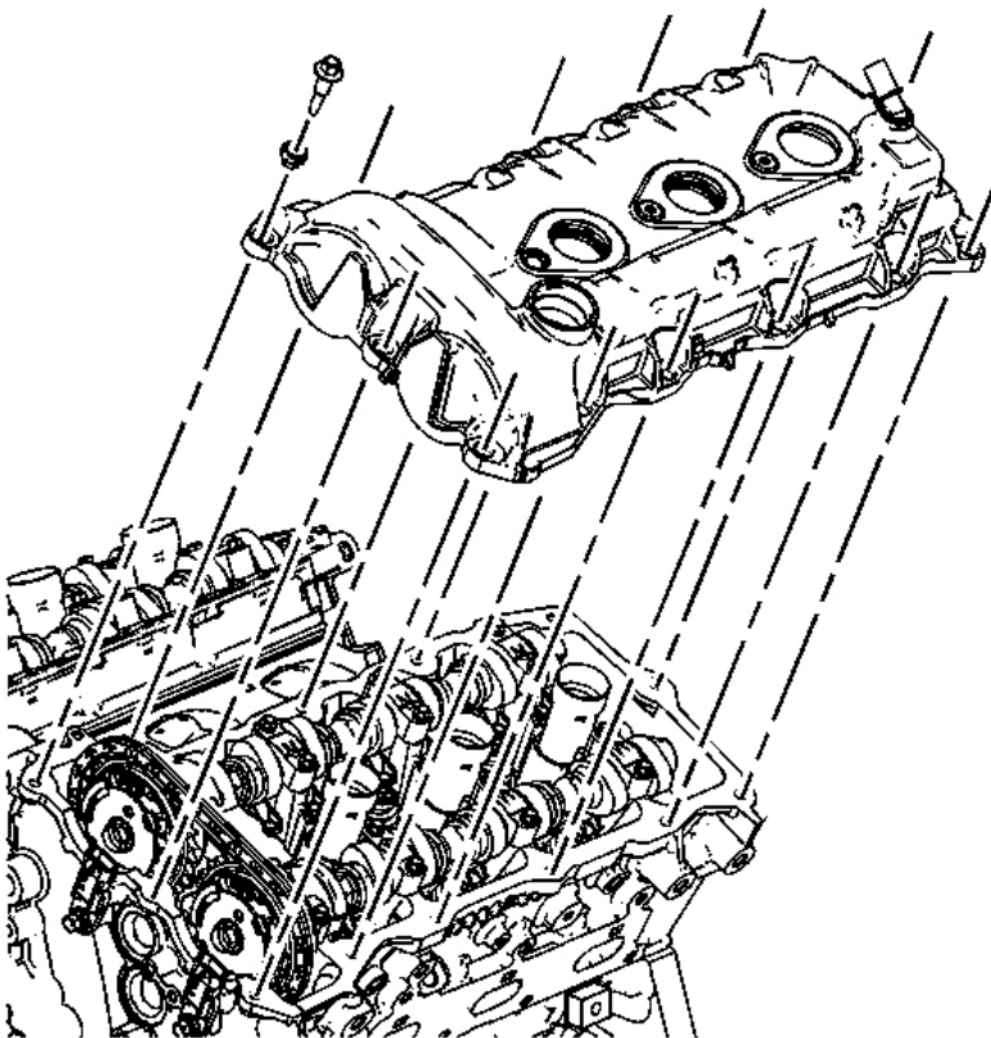


Fig. 113: Removing & Installing Left Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

2. Install the camshaft cover. Refer to **Camshaft Cover Installation - Left** .

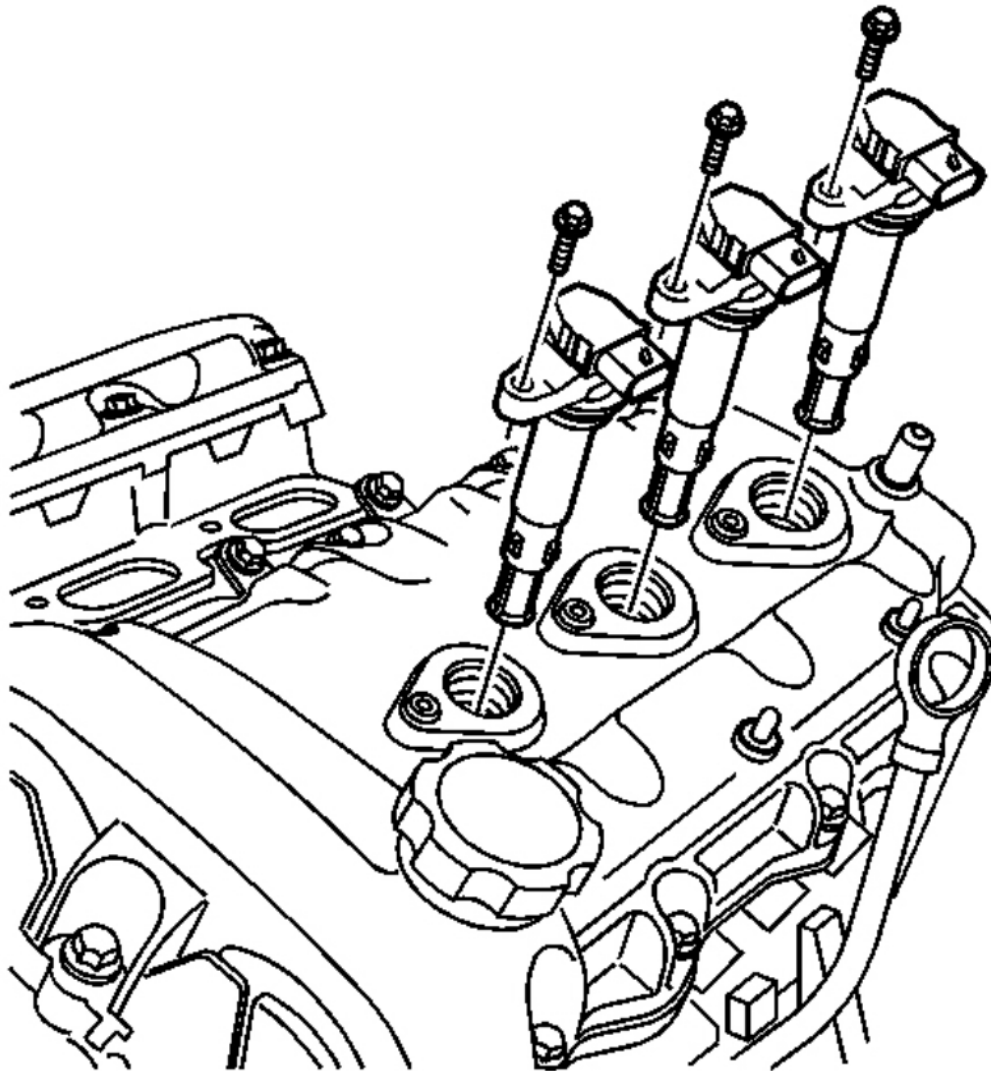


Fig. 114: Identifying Left Cylinder Head Ignition Coils
Courtesy of GENERAL MOTORS CORP.

3. Install the ignition coils.

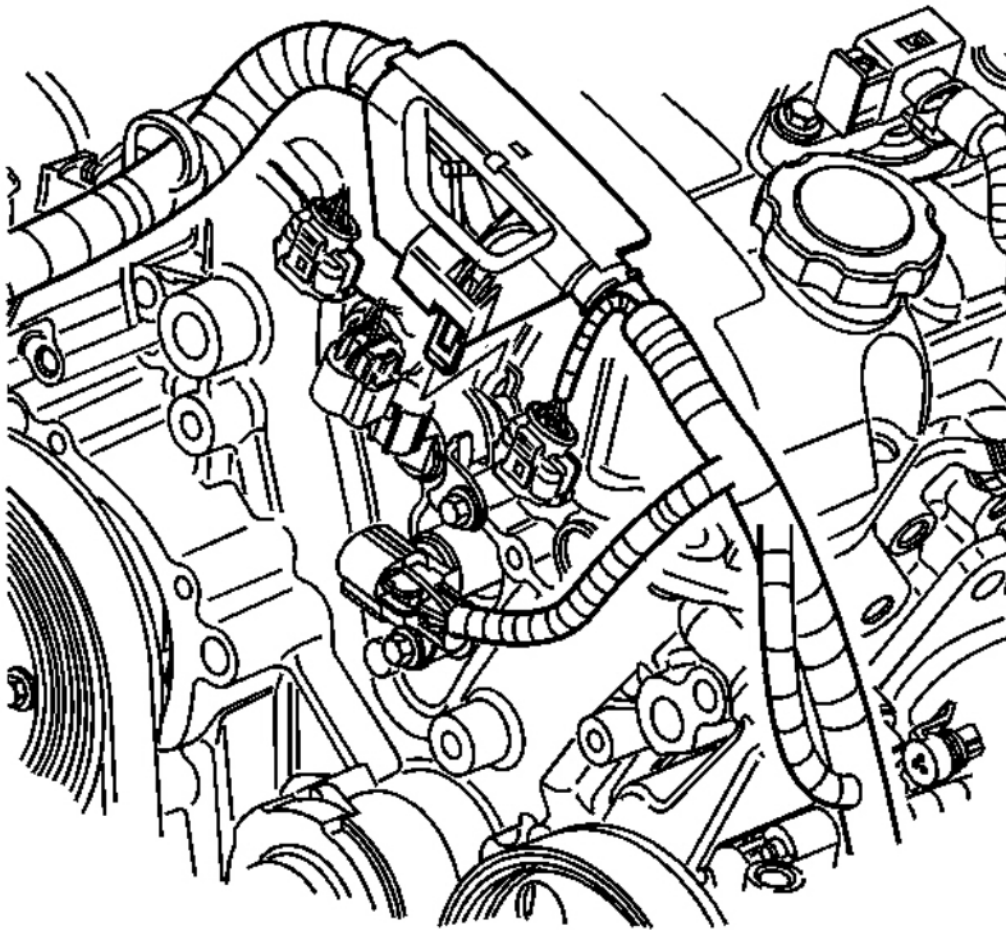


Fig. 115: View Of Left Camshaft Cover Wiring Harness Connector - Front
Courtesy of GENERAL MOTORS CORP.

4. Install the wiring harness to the front of the camshaft cover.
5. Install the wiring harness conduit retainers to the wiring harness conduit.

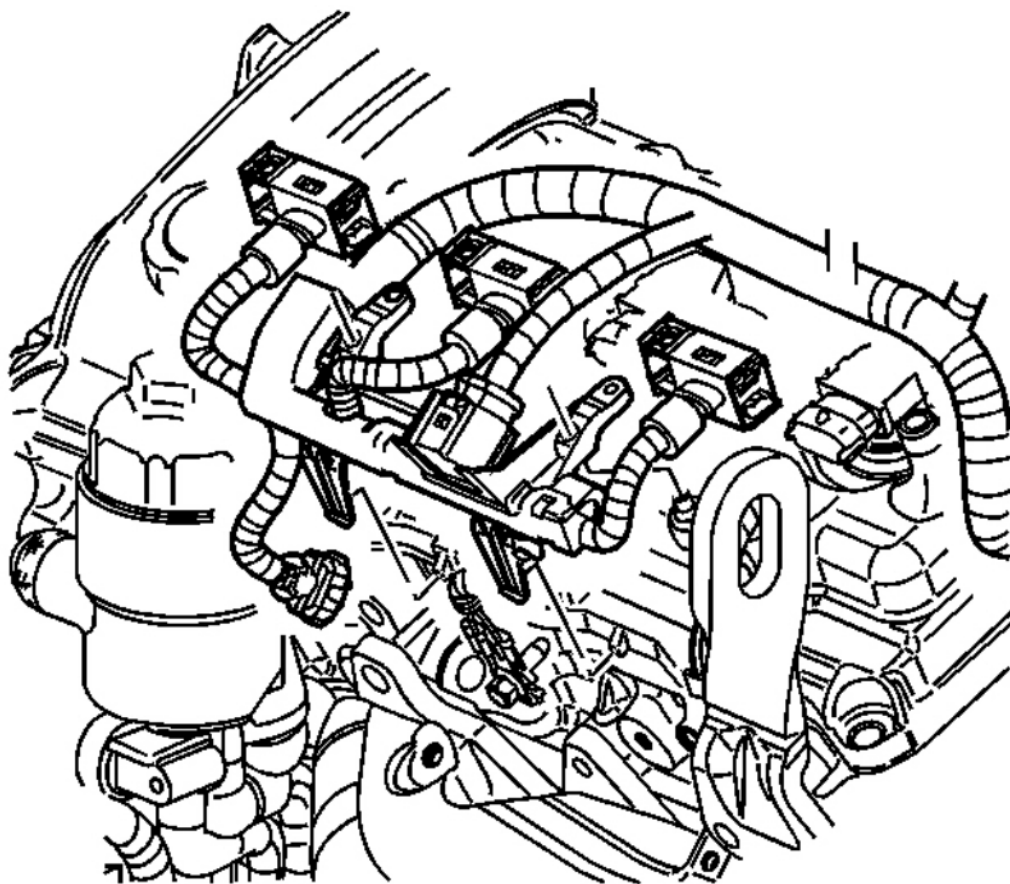


Fig. 116: View Of Left Camshaft Cover Wiring Harness Connectors
Courtesy of GENERAL MOTORS CORP.

6. Install the wiring harness to the side of the camshaft cover.

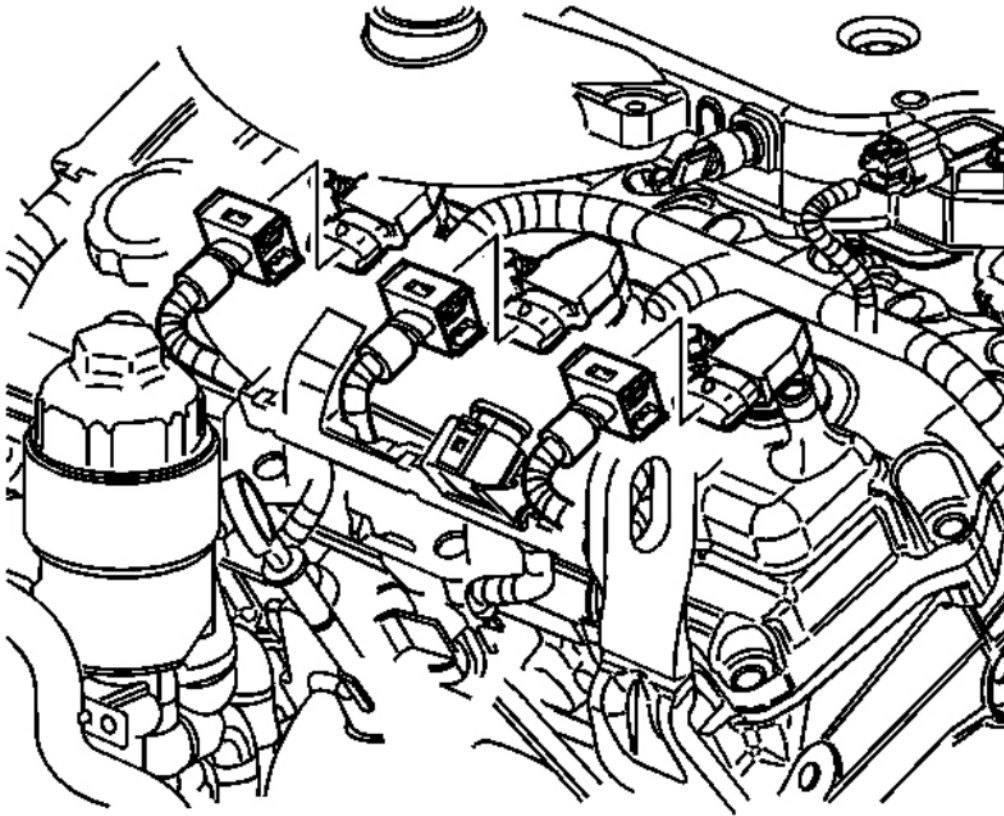


Fig. 117: View Of Left Ignition Coils Wiring Harness Connectors
Courtesy of GENERAL MOTORS CORP.

7. Connect the ignition coil electrical connectors.
8. Install the upper intake manifold with the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
9. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.

CAMSHAFT COVER REPLACEMENT - RIGHT

REMOVAL PROCEDURE

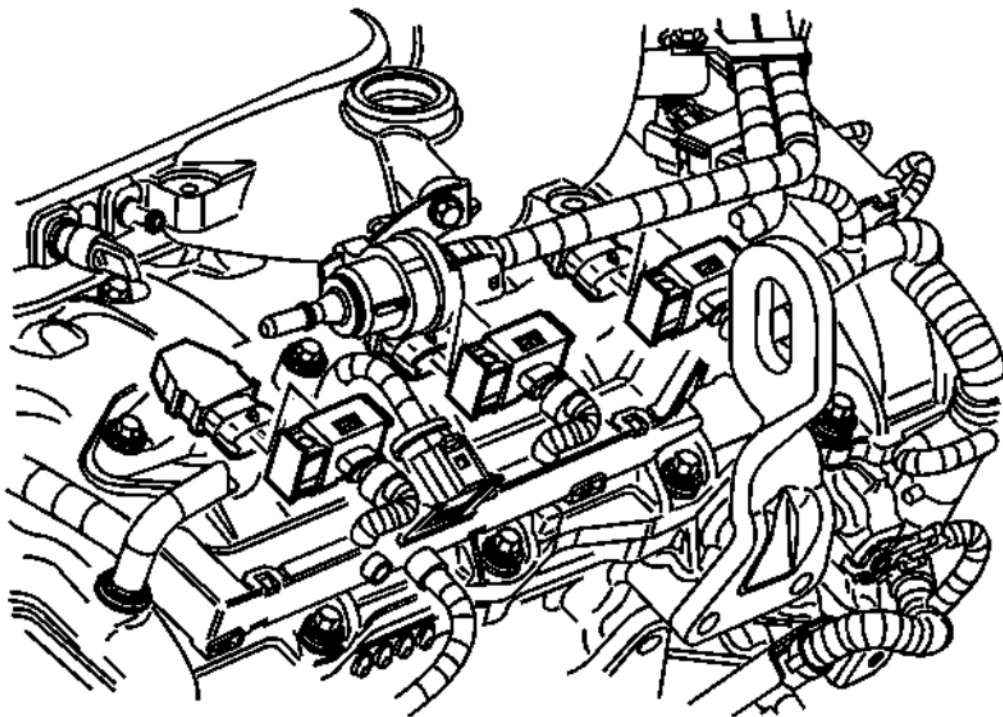


Fig. 118: View Of Right Ignition Coils Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

1. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.
2. Remove the upper intake manifold with the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
3. Disconnect the ignition coil electrical connectors.

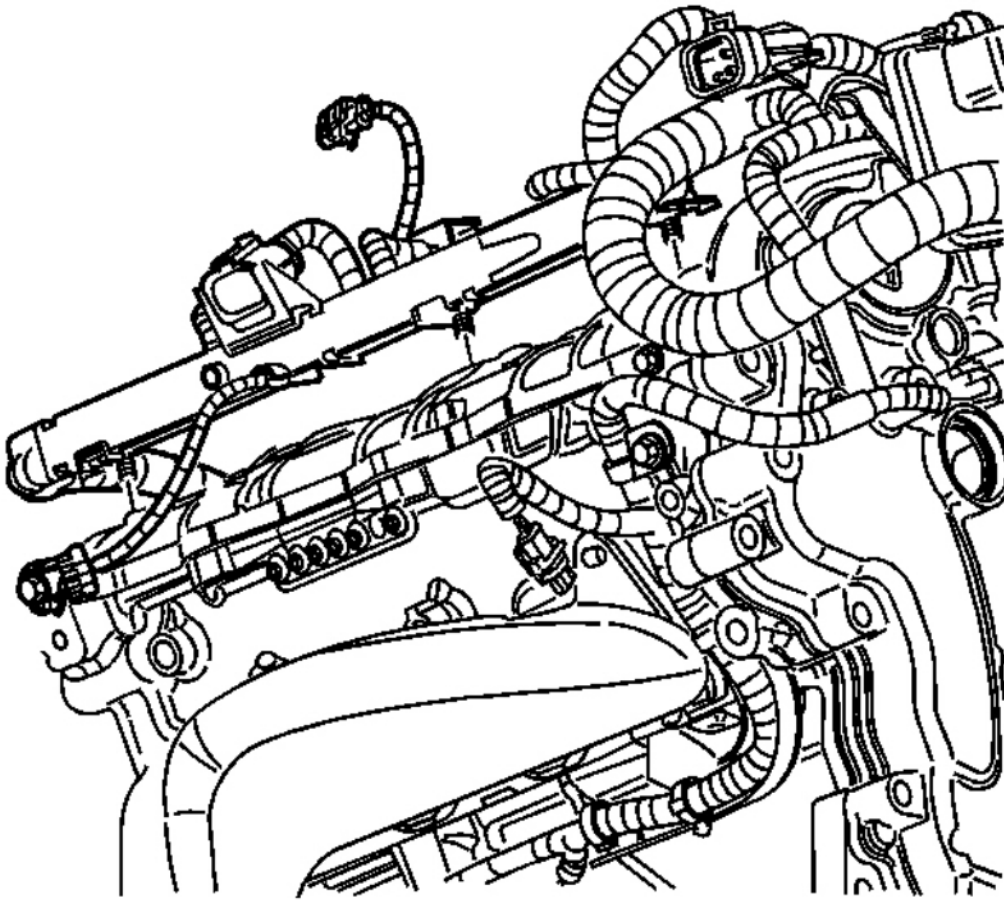


Fig. 119: View Of Right Camshaft Cover Wiring Harness Connector - Top
Courtesy of GENERAL MOTORS CORP.

4. Remove the wiring harness from the side of the camshaft cover by sliding the conduit down and outboard.
5. Remove the wiring conduit retainers from the camshaft cover by rotating the wiring harness conduit retainers counterclockwise.

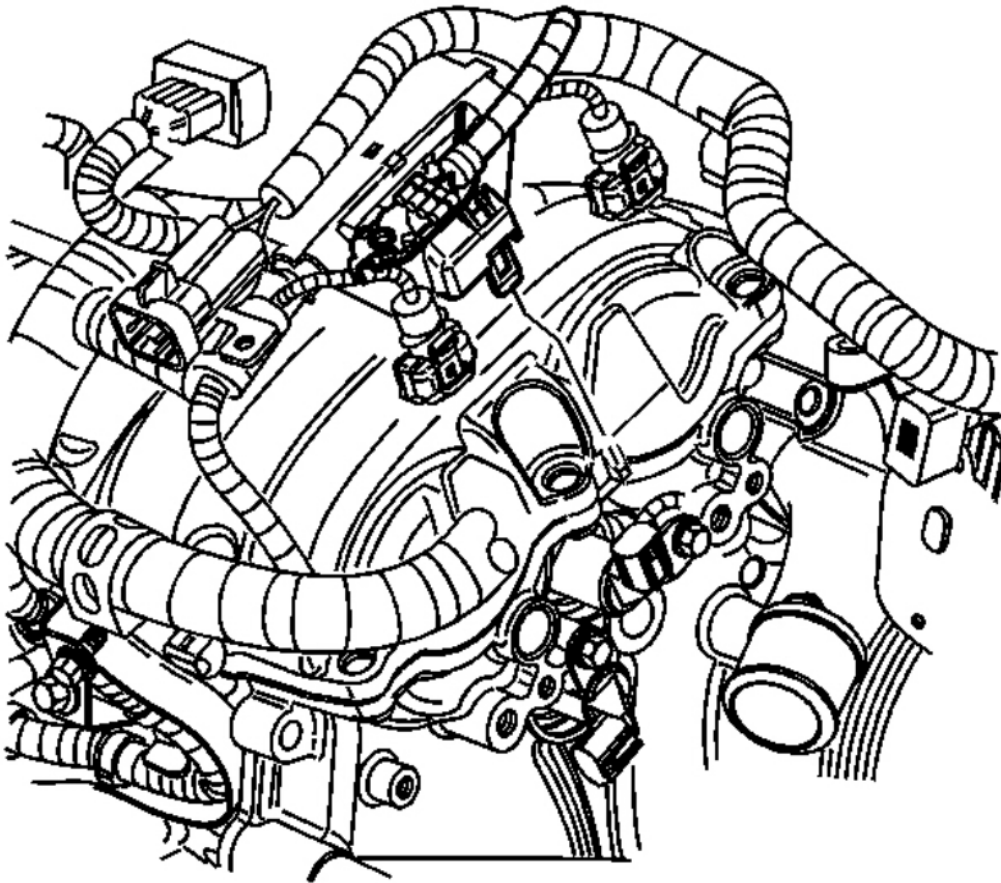


Fig. 120: View Of Right Camshaft Cover Wiring Harness Connector - Front
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: It is not necessary to disconnect the engine front cover electrical connectors.

6. Remove the wiring harness from the front of the camshaft cover.
7. Reposition and secure the wiring harnesses away from the camshaft cover in order to provide clearance.

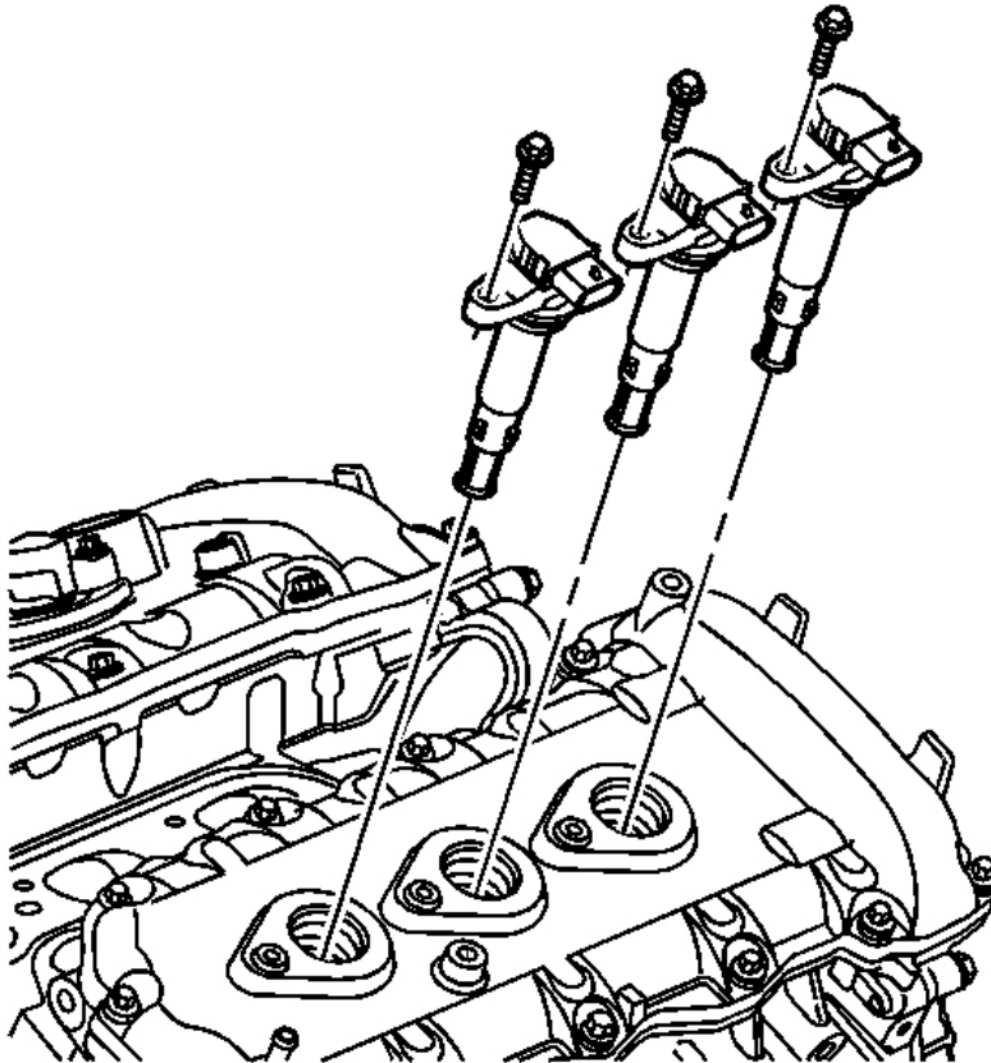


Fig. 121: Ignition Coil View

Courtesy of GENERAL MOTORS CORP.

8. Remove the ignition coils.

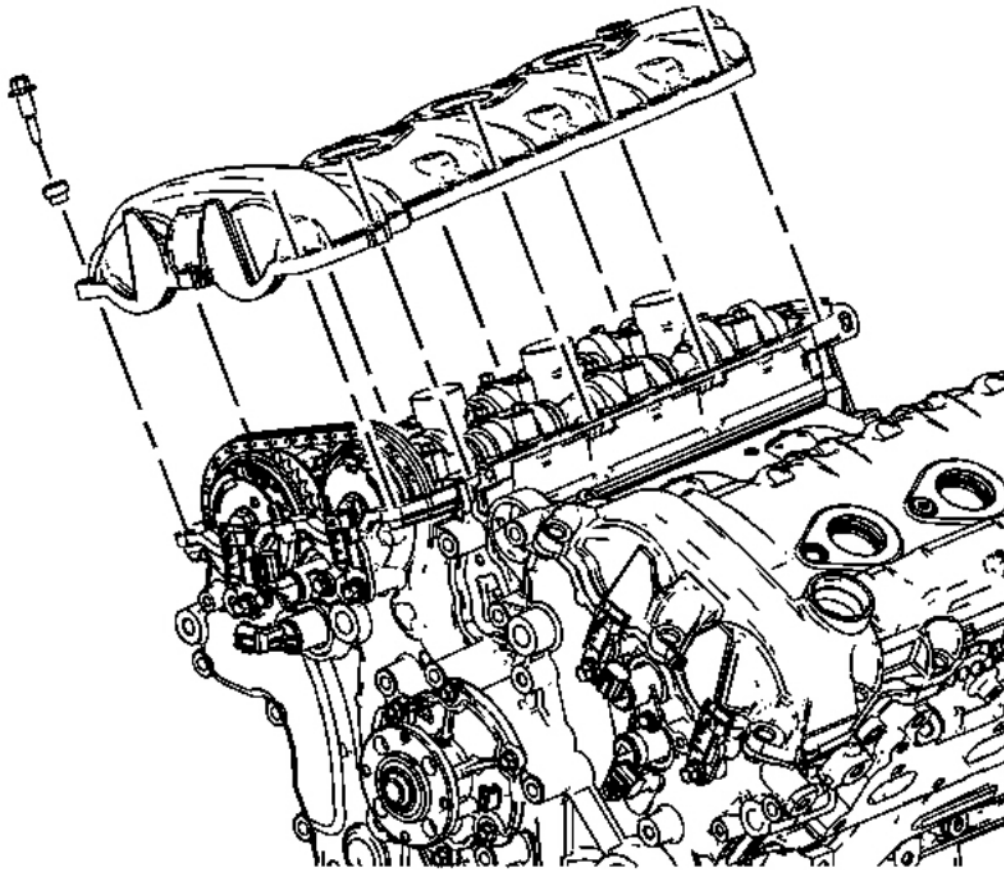


Fig. 122: Removing & Installing Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

9. Remove the camshaft cover.
10. Remove and discard the camshaft cover seal and grommets.

INSTALLATION PROCEDURE

1. Install a NEW camshaft cover seal and NEW grommets.

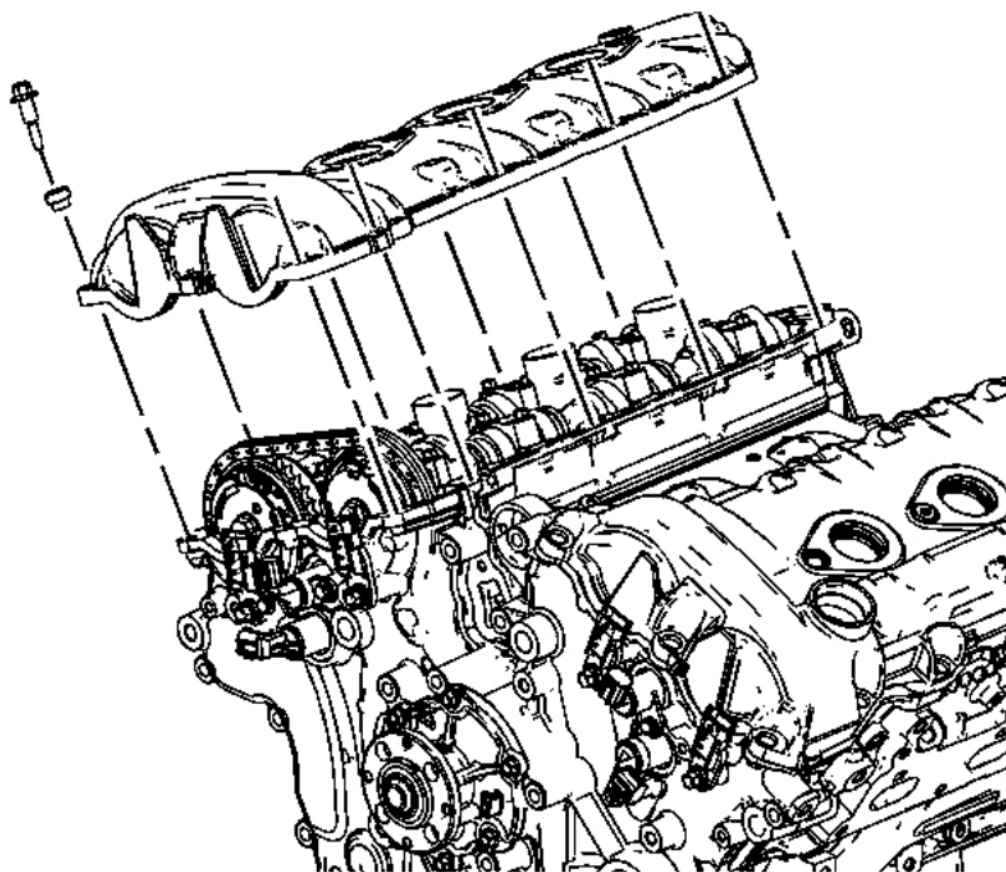


Fig. 123: Removing & Installing Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

2. Install the camshaft cover. Refer to **Camshaft Cover Installation - Right** .

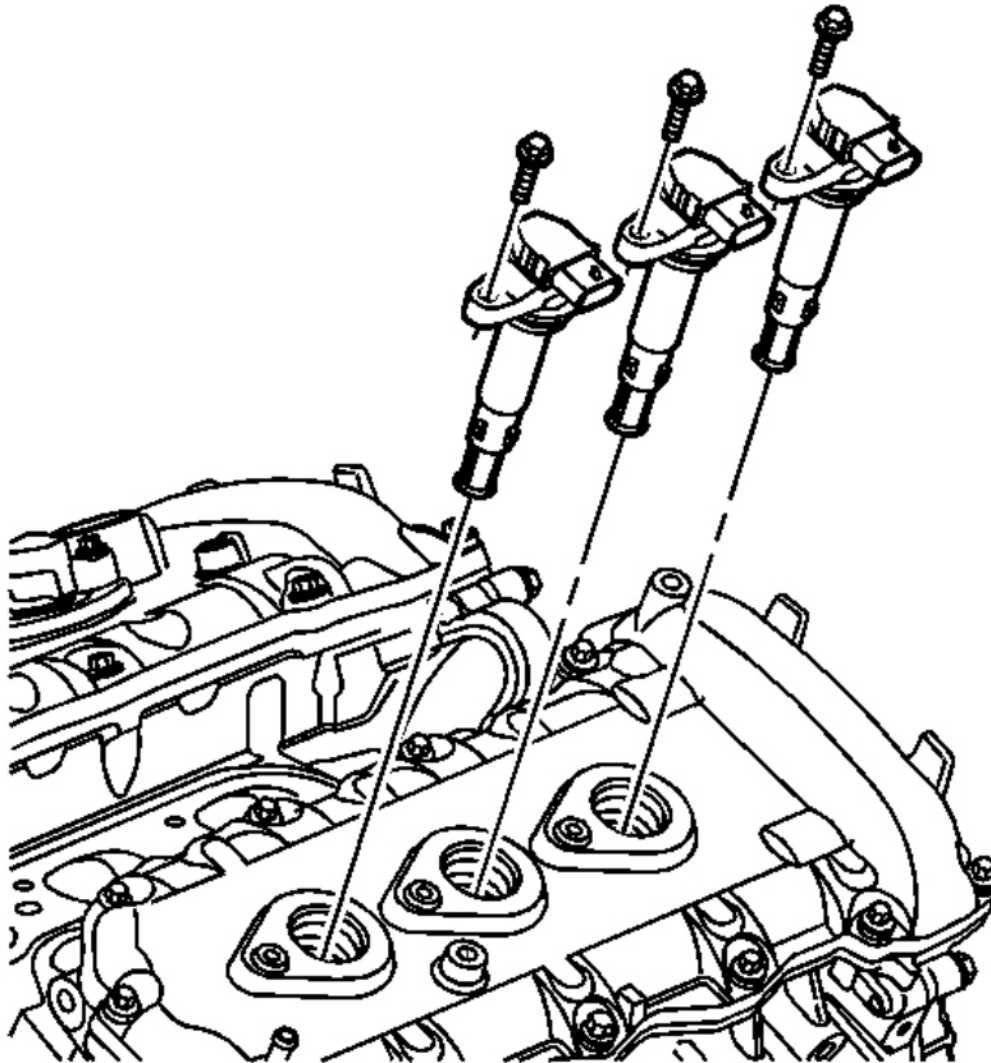


Fig. 124: Ignition Coil View

Courtesy of GENERAL MOTORS CORP.

3. Install the ignition coils.

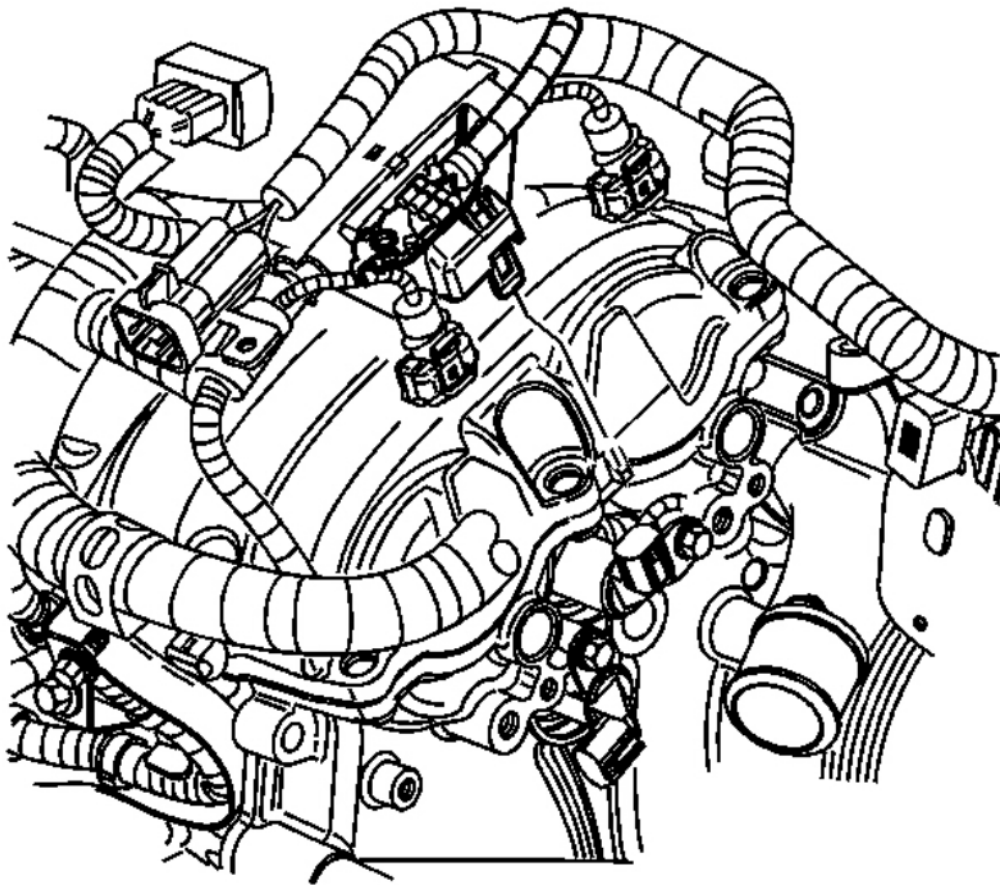


Fig. 125: View Of Right Camshaft Cover Wiring Harness Connector - Front
Courtesy of GENERAL MOTORS CORP.

4. Install the wiring harness to the front of the camshaft cover.
5. Install the wiring harness conduit retainers to the wiring harness conduit.

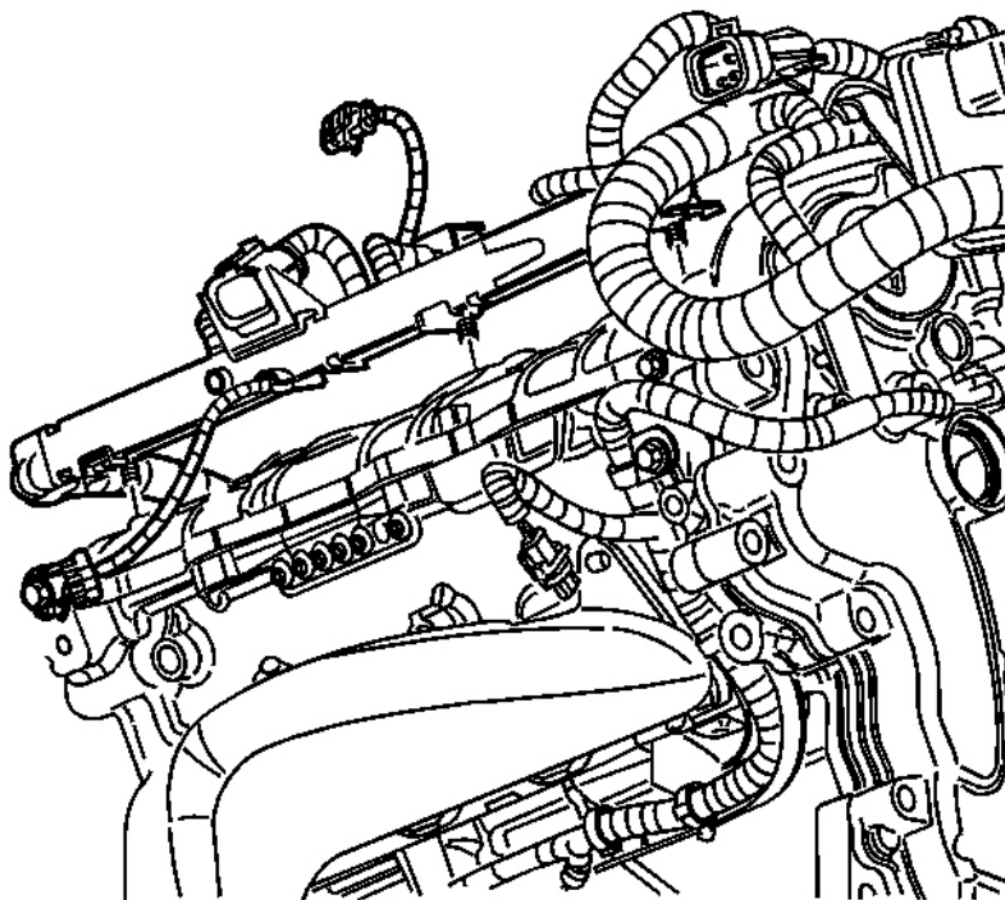


Fig. 126: View Of Right Camshaft Cover Wiring Harness Connector - Top
Courtesy of GENERAL MOTORS CORP.

6. Install the wiring harness to the side of the camshaft cover.

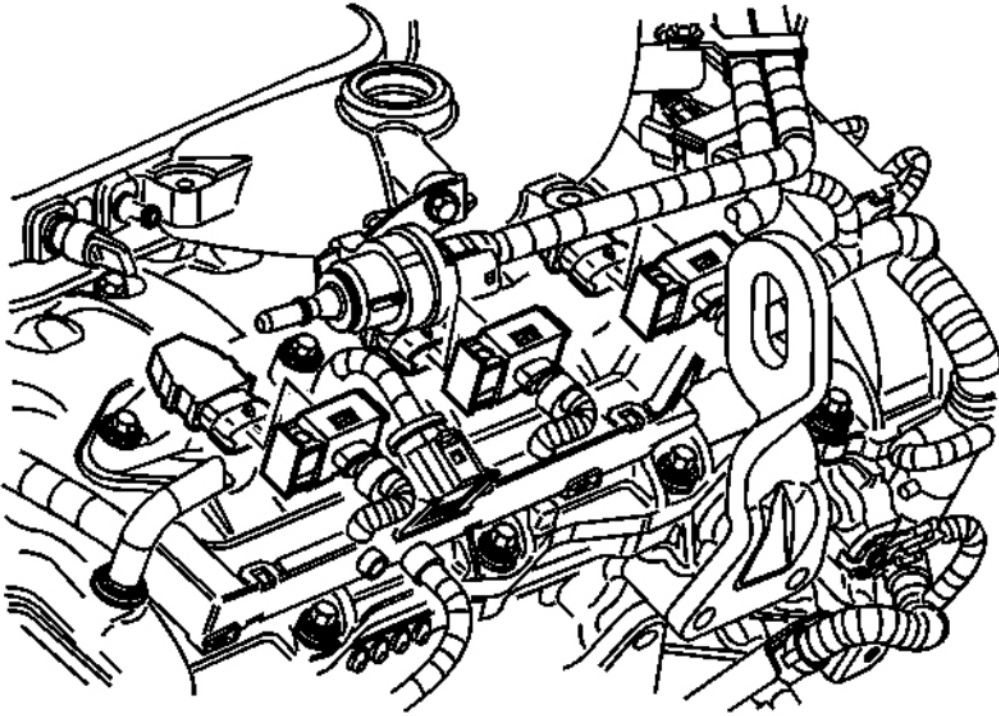


Fig. 127: View Of Right Ignition Coils Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

7. Connect the ignition coil electrical connectors.
8. Install the upper intake manifold with the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
9. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.

ENGINE FRONT COVER REPLACEMENT

TOOLS REQUIRED

EN 46109 Engine Front Cover Installation Guide Pins. See **Special Tools** .

REMOVAL PROCEDURE

1. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement**.
2. Remove the upper intake manifold with the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.

3. Remove the camshaft covers. Refer to **Camshaft Cover Replacement - Left** and **Camshaft Cover Replacement - Right**.
4. Drain the engine coolant. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)** in Engine Cooling.
5. Disconnect the purge vent hose from the water outlet.
6. Remove the water outlet with the radiator hose and reposition aside. Refer to **Water Outlet Housing Replacement (LP1, LY7)** in Engine Cooling.
7. Remove the accessory drive belts. Refer to **Drive Belt Replacement - Generator and Water Pump** and **Drive Belt Replacement - Power Steering and Air Conditioning**.
8. Remove the A/C compressor and power steering belt tensioner. Refer to **Drive Belt Tensioner Replacement - Power Steering and Air Conditioning**.
9. Remove the generator bracket with the generator and the belt tensioner. Refer to **Generator Bracket Replacement (LP1, LY7)** in Engine Electrical.

IMPORTANT: Do not disconnect the power steering pipes or drain the power steering fluid.

10. Remove the power steering fluid reservoir and reposition the power steering fluid reservoir in order to provide access.
11. Remove the power steering pump pulley. Refer to **Power Steering Pump Removal** .

IMPORTANT: Do not disconnect the power steering pipes/hoses.

12. Remove the power steering pump upper front bolt and loosen the remaining two bolts. Refer to **Power Steering Pump Removal** .
13. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Removal** .
14. Remove the oil control valves. Refer to **Camshaft Position (CMP) Actuator Replacement - Bank 2 (Left) Intake** and **Camshaft Position (CMP) Actuator Replacement - Bank 2 (Left) Exhaust**.

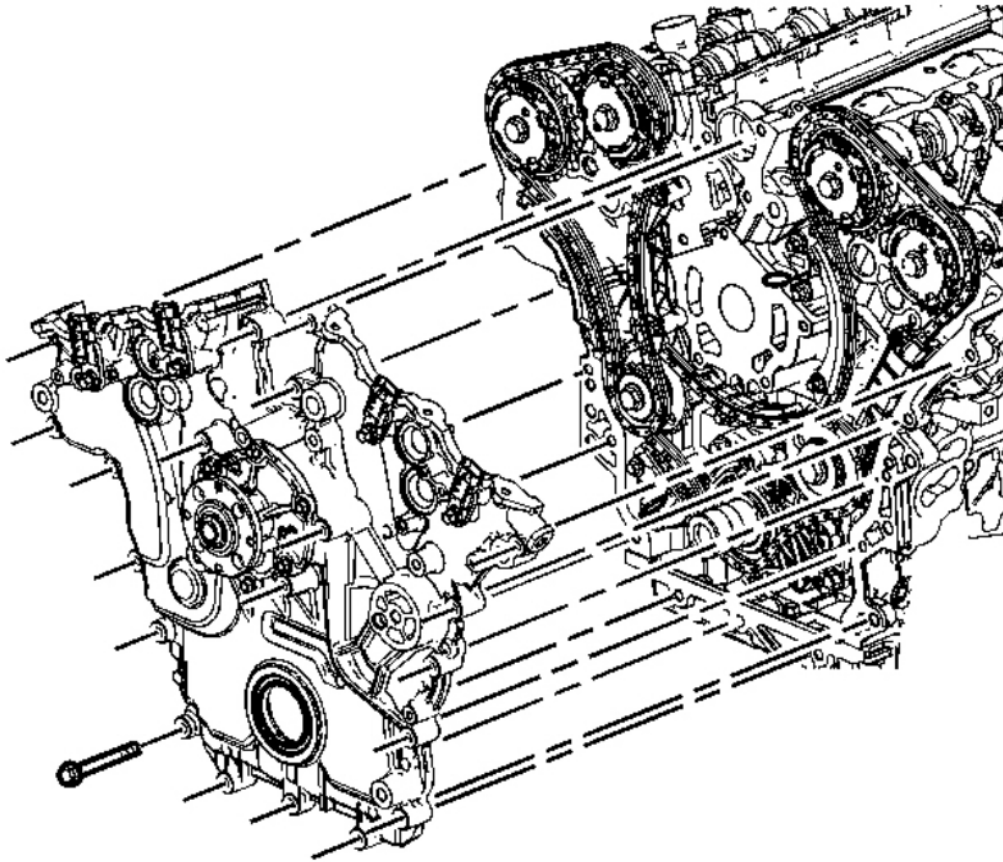


Fig. 128: Engine Front Cover

Courtesy of GENERAL MOTORS CORP.

15. Remove the engine front cover with the water pump. Refer to **Engine Front Cover Removal**.
16. Disassemble the engine front cover as necessary. Refer to **Engine Front Cover Disassemble**.

IMPORTANT: Do NOT use sharp and/or metal gasket scrapers in order to clean the sealing surfaces. Insert a piece of cardboard between the oil pan front and the oil pump in order to prevent any contaminants from falling into the oil pan.

17. Carefully clean the engine front cover sealing surfaces. Refer to **Engine Front Cover Cleaning and Inspection**.
18. Use compressed air in order to remove any engine coolant from the engine cooling passages and from the top of the oil pan scraper (windage tray).

INSTALLATION PROCEDURE

1. Assemble the engine front cover as necessary. Refer to Engine Front Cover Assemble .

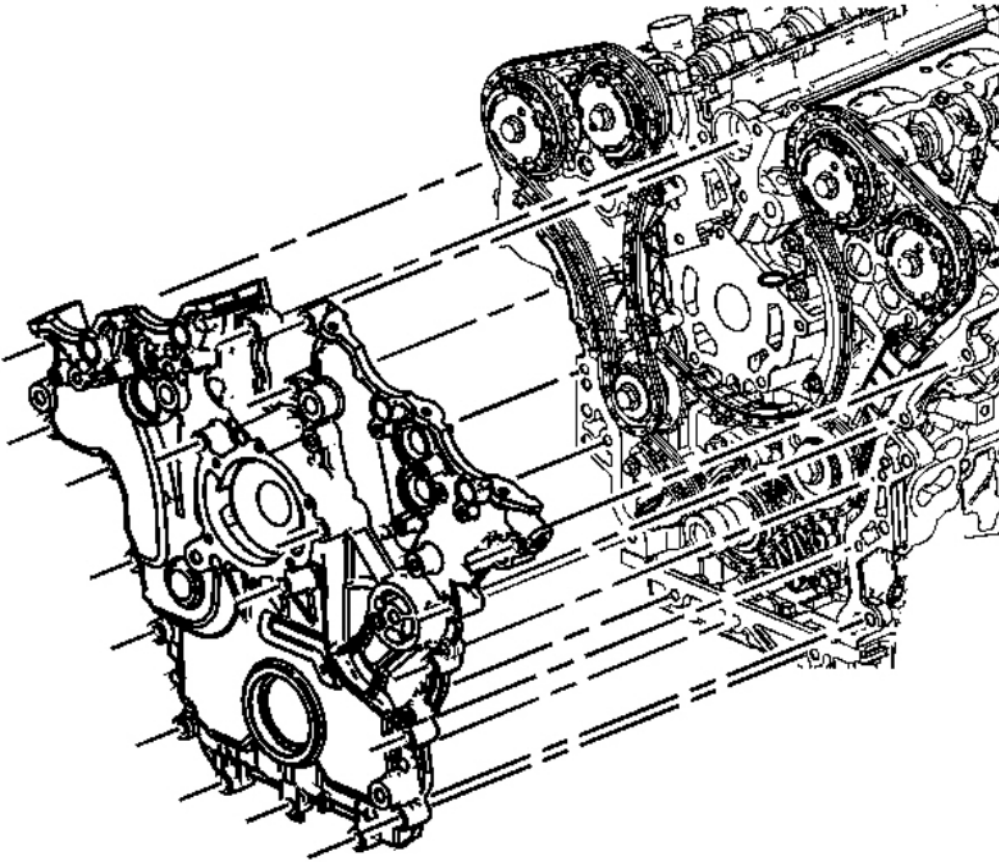


Fig. 129: View Of Engine Front Cover
Courtesy of GENERAL MOTORS CORP.

2. Use the **EN 46109** in order to install the engine front cover. See Special Tools . Refer to Engine Front Cover Installation .
3. Install the oil control valves. Refer to Camshaft Position (CMP) Actuator Replacement - Bank 2 (Left) Exhaust and Camshaft Position (CMP) Actuator Replacement - Bank 2 (Left) Intake.
4. Install the crankshaft balancer. Refer to Crankshaft Balancer Installation .
5. Install the power steering pump. Refer to Power Steering Pump Installation .
6. Install the power steering pump pulley. Refer to Power Steering Pump Installation .
7. Install the power steering fluid reservoir. Refer to Remote Power Steering Fluid Reservoir

Replacement (LP1, LY7) .

8. Install the generator bracket with the generator and the belt tensioner. Refer to **Generator Bracket Replacement (LP1, LY7)** in Engine Electrical.
9. Install the A/C compressor and power steering belt tensioner. Refer to **Drive Belt Tensioner Replacement - Power Steering and Air Conditioning.**
10. Install the accessory drive belts. Refer to **Drive Belt Replacement - Power Steering and Air Conditioning** and **Drive Belt Replacement - Generator and Water Pump.**
11. Install the water outlet. Refer to **Water Outlet Housing Replacement (LP1, LY7)** in Engine Cooling.
12. Install the purge vent hose to the water outlet.
13. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)** in Engine Cooling.
14. Install the camshaft covers. Refer to **Camshaft Cover Replacement - Left** and **Camshaft Cover Replacement - Right.**
15. Install the upper intake manifold with the lower intake manifold. Refer to **Intake Manifold Replacement - Lower.**
16. Install the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement.**
17. Fill the cooling system. Refer to **Draining and Filling Cooling System (LP1, LY7 Static Fill)** or **Draining and Filling Cooling System (LS2 Static Fill)** or **Draining and Filling Cooling System (GE 47716)** in Engine Cooling.
18. Change the engine oil. Refer to **Engine Oil and Oil Filter Replacement .**

SECONDARY CAMSHAFT DRIVE CHAIN REPLACEMENT - LEFT**REMOVAL PROCEDURE**

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
2. Remove the engine front cover. Refer to **Engine Front Cover Replacement.**
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Removal - Right .**
4. Remove the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Right .**
5. Remove the right bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Removal - Right .**
6. Remove the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Drive Chain Removal - Right .**
7. Remove the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Drive Chain Tensioner Removal .**
8. Remove the primary upper camshaft drive chain guide. Refer to **Primary Camshaft Drive Chain Guide Removal - Upper .**
9. Remove the primary camshaft drive chain. Refer to **Primary Camshaft Drive Chain Removal .**

2006 Cadillac CTS

2006 ENGINE Engine Mechanical - 2.8L (LP1) - CTS (1 Of 5)

10. Remove the right bank camshaft intermediate drive chain idler. Refer to **Camshaft Intermediate Drive Chain Idler Removal - Right** .
11. Remove the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Removal - Left** .
12. Remove the left bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Left** .
13. Remove the left bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Removal - Left** .
14. Remove the left bank camshaft intermediate drive chain idler. Refer to **Camshaft Intermediate Drive Chain Idler Removal - Left** .

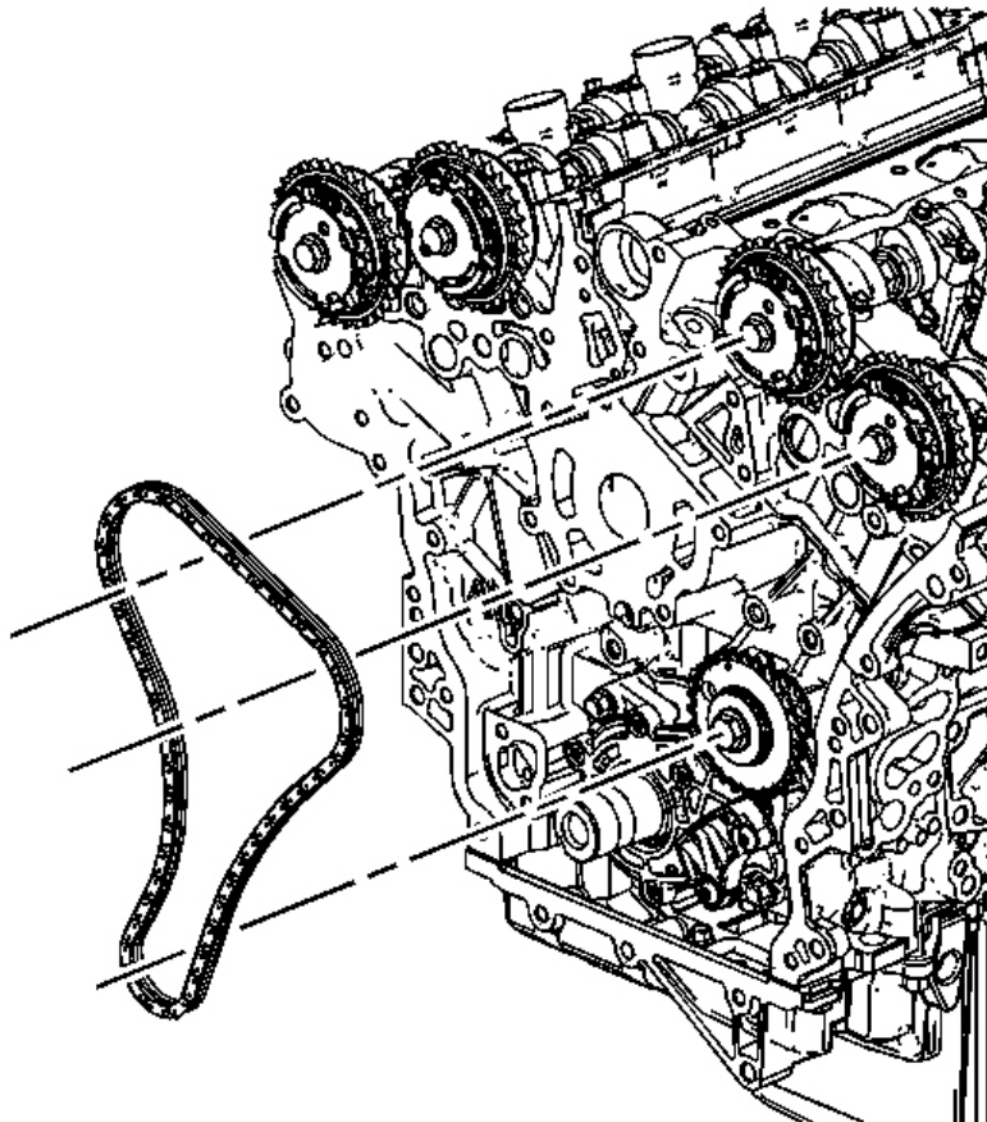


Fig. 130: View Of Left Bank Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

15. Remove the left bank secondary camshaft drive chain. Refer to **Secondary Camshaft Drive Chain Removal - Left**.
16. Clean and inspect all of the camshaft timing drive components. Refer to **Camshaft Timing Drive Components Cleaning and Inspection**. Replace components as necessary.

INSTALLATION PROCEDURE

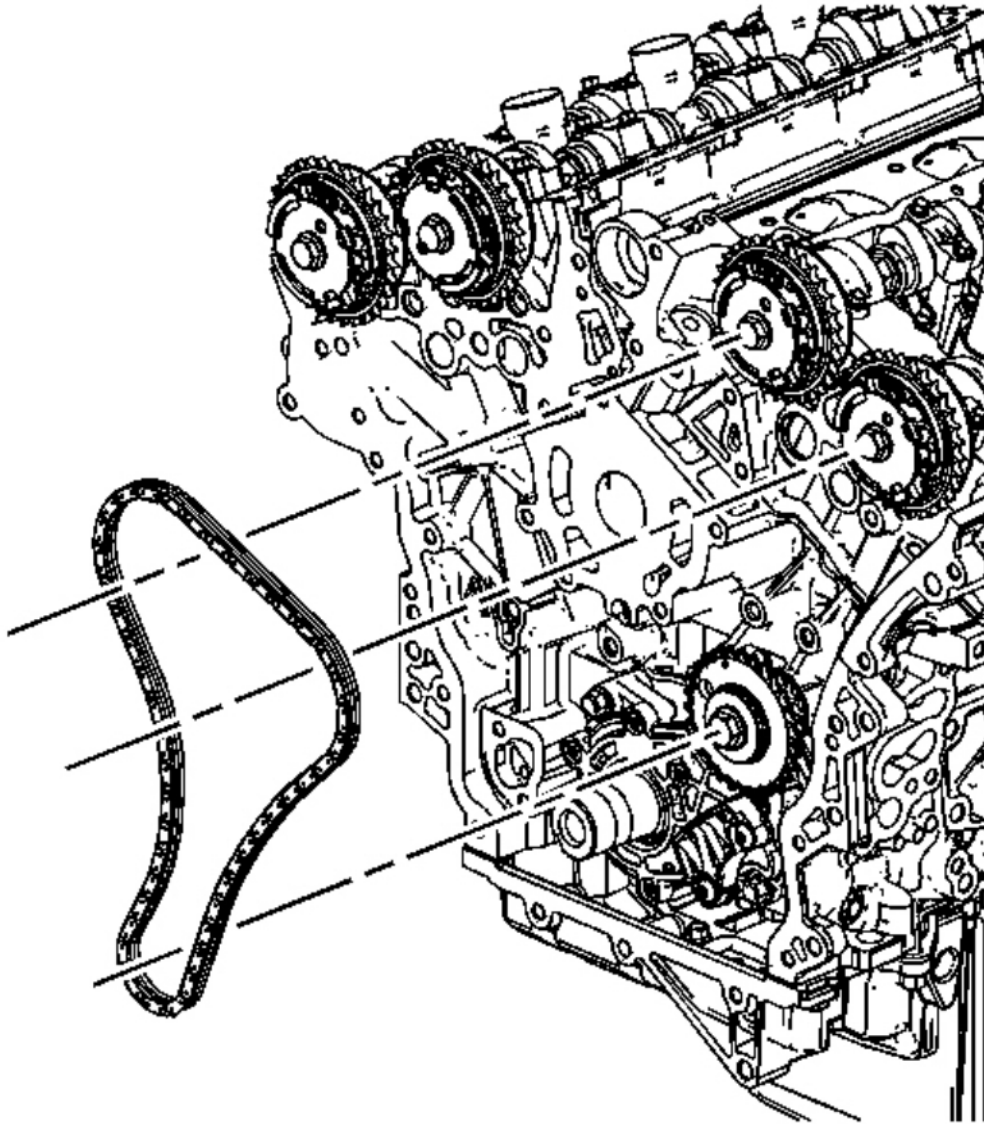


Fig. 131: View Of Left Bank Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

1. Install the left bank secondary camshaft drive chain. Refer to **Secondary Camshaft Drive Chain Installation - Left**.
2. Install the left bank camshaft intermediate drive chain idler. Refer to **Camshaft Intermediate Drive**

Chain Idler Installation - Left .

3. Install the left bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Installation - Left .**
4. Install the left bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Left .**
5. Install the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Installation - Left .**
6. Install the right bank camshaft intermediate drive chain idler. Refer to **Camshaft Intermediate Drive Chain Idler Installation - Right .**
7. Install the primary camshaft drive chain. Refer to **Primary Camshaft Drive Chain Installation .**
8. Install the primary upper camshaft drive chain guide. Refer to **Primary Camshaft Drive Chain Guide Installation - Upper .**
9. Install the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Drive Chain Tensioner Installation .**
10. Install the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Drive Chain Installation - Right .**
11. Install the right bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Installation - Right .**
12. Install the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Right .**
13. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Installation - Right .**
14. Install the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
15. Install the engine front cover. Refer to **Engine Front Cover Replacement.**

SECONDARY CAMSHAFT DRIVE CHAIN REPLACEMENT - RIGHT**REMOVAL PROCEDURE**

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
2. Remove the engine front cover. Refer to **Engine Front Cover Replacement.**
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Removal - Right .**
4. Remove the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Right .**
5. Remove the right bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Removal - Right .**

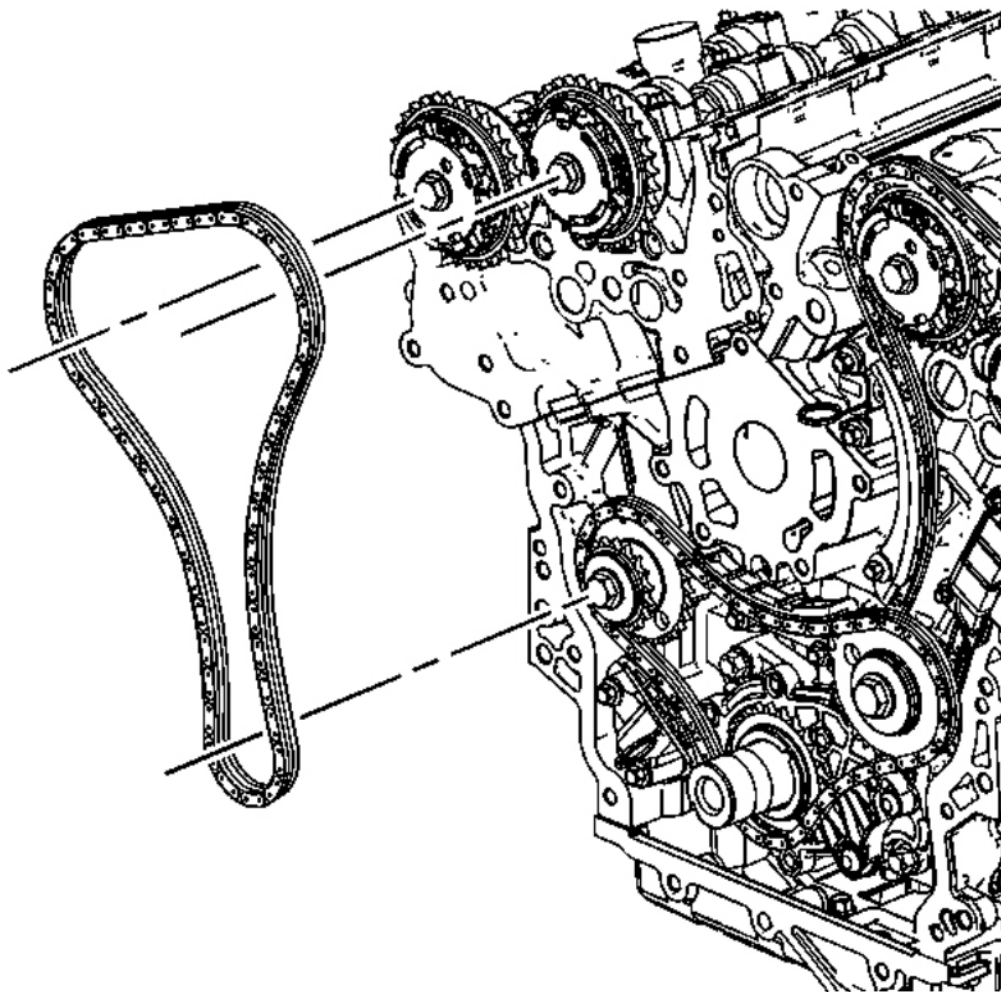


Fig. 132: View Of Right Bank Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

6. Remove the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Drive Chain Removal - Right** .

INSTALLATION PROCEDURE

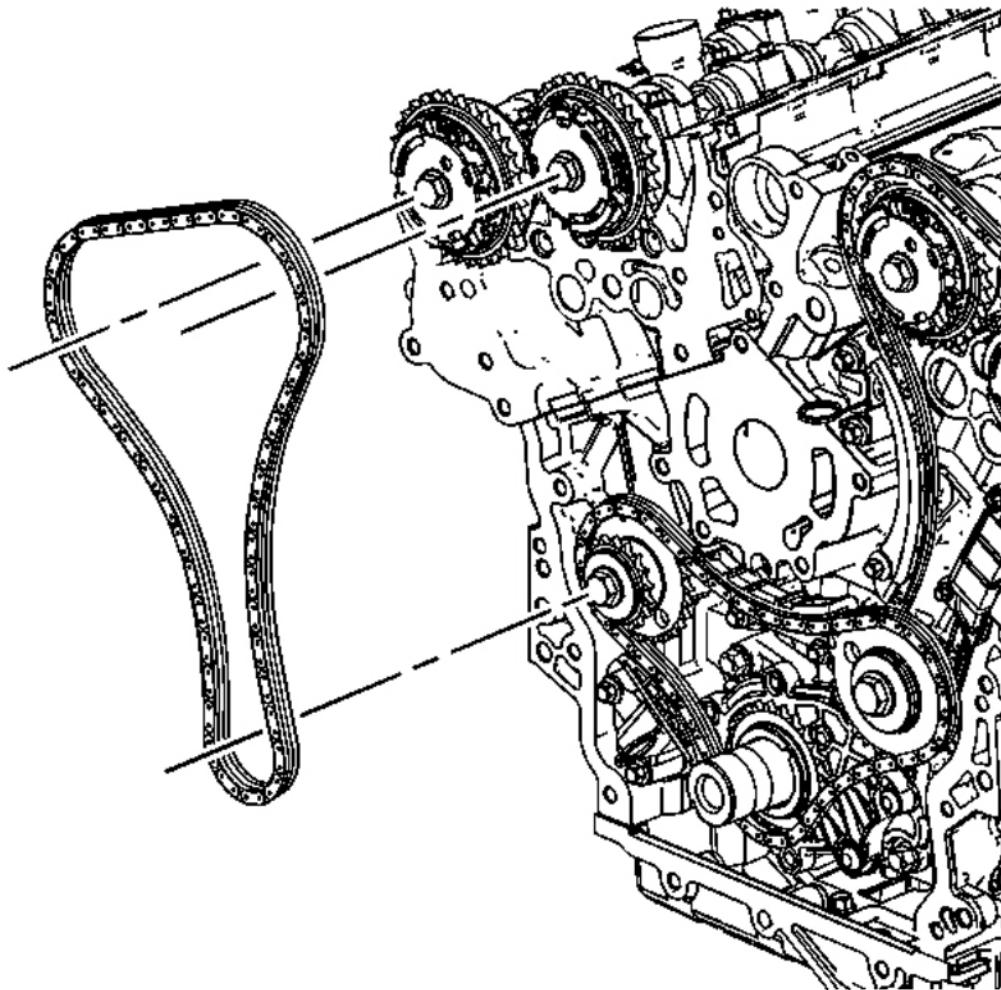


Fig. 133: View Of Right Bank Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

1. Install the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Drive Chain Installation - Right** .
2. Install the right bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Installation - Right** .
3. Install the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Right** .
4. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Installation - Right** .

5. Install the spark plugs. Refer to [Spark Plug Replacement](#) in Engine Controls - 2.8L.
6. Install the engine front cover. Refer to [Engine Front Cover Replacement](#).

SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REPLACEMENT - LEFT

REMOVAL PROCEDURE

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to [Spark Plug Replacement](#) in Engine Controls - 2.8L.
2. Remove the engine front cover. Refer to [Engine Front Cover Replacement](#).

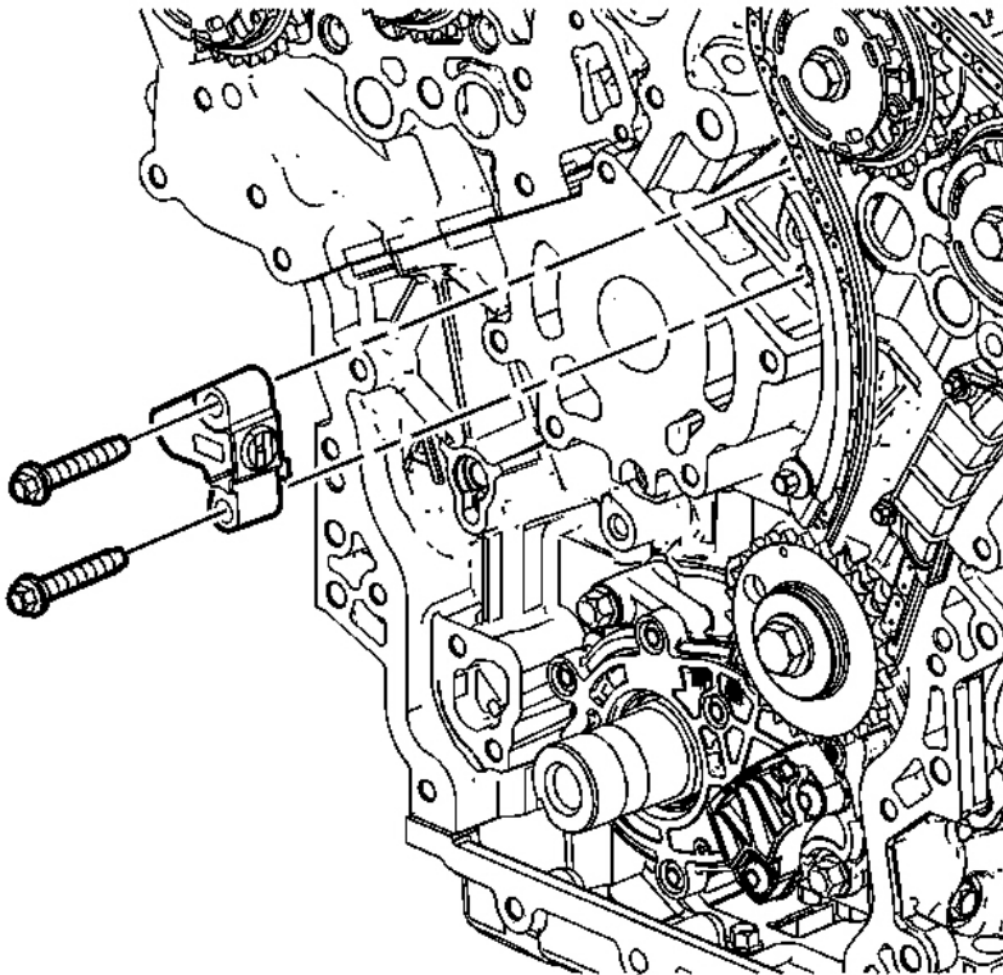


Fig. 134: Location Of Left Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

3. Remove the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Removal - Left**.

INSTALLATION PROCEDURE

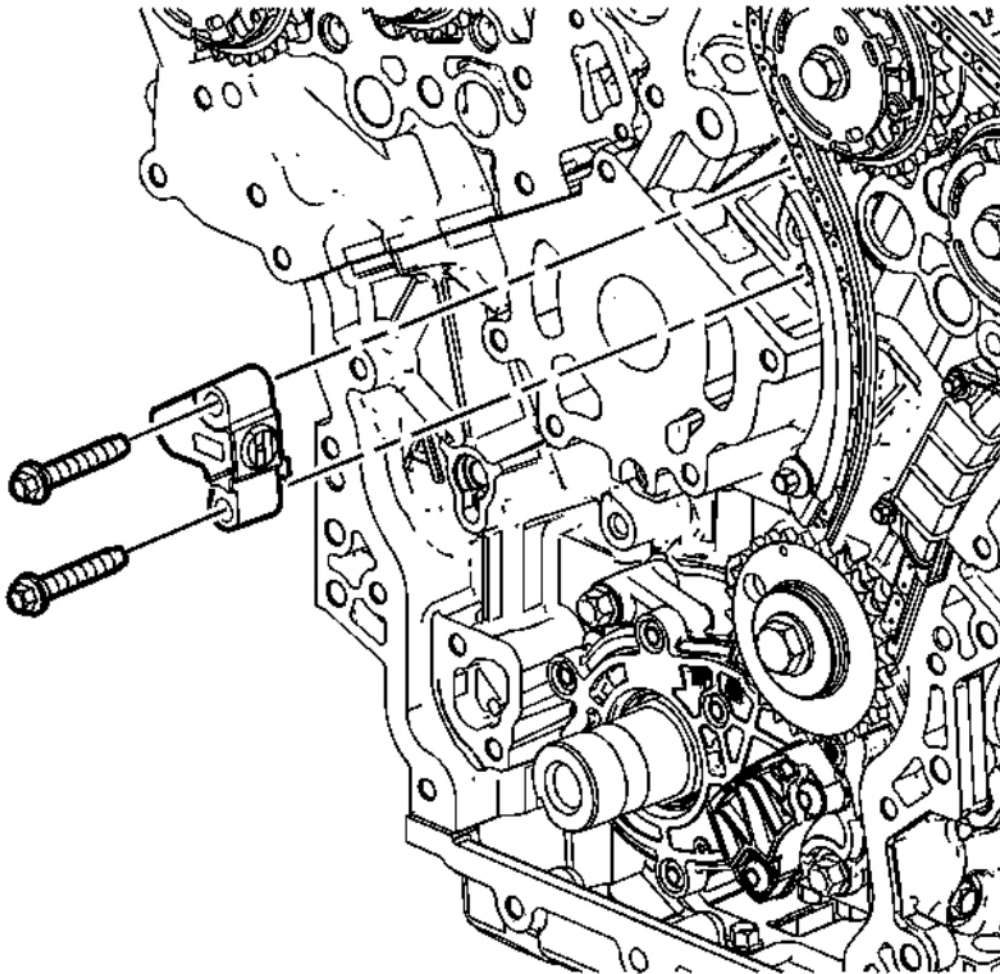


Fig. 135: Location Of Left Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Install the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Installation - Left**.

2. Install the spark plugs. Refer to [Spark Plug Replacement](#) in Engine Controls - 2.8L.
3. Install the engine front cover. Refer to [Engine Front Cover Replacement](#).

SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER REPLACEMENT - RIGHT

REMOVAL PROCEDURE

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to [Spark Plug Replacement](#) in Engine Controls - 2.8L.
2. Remove the engine front cover. Refer to [Engine Front Cover Replacement](#).

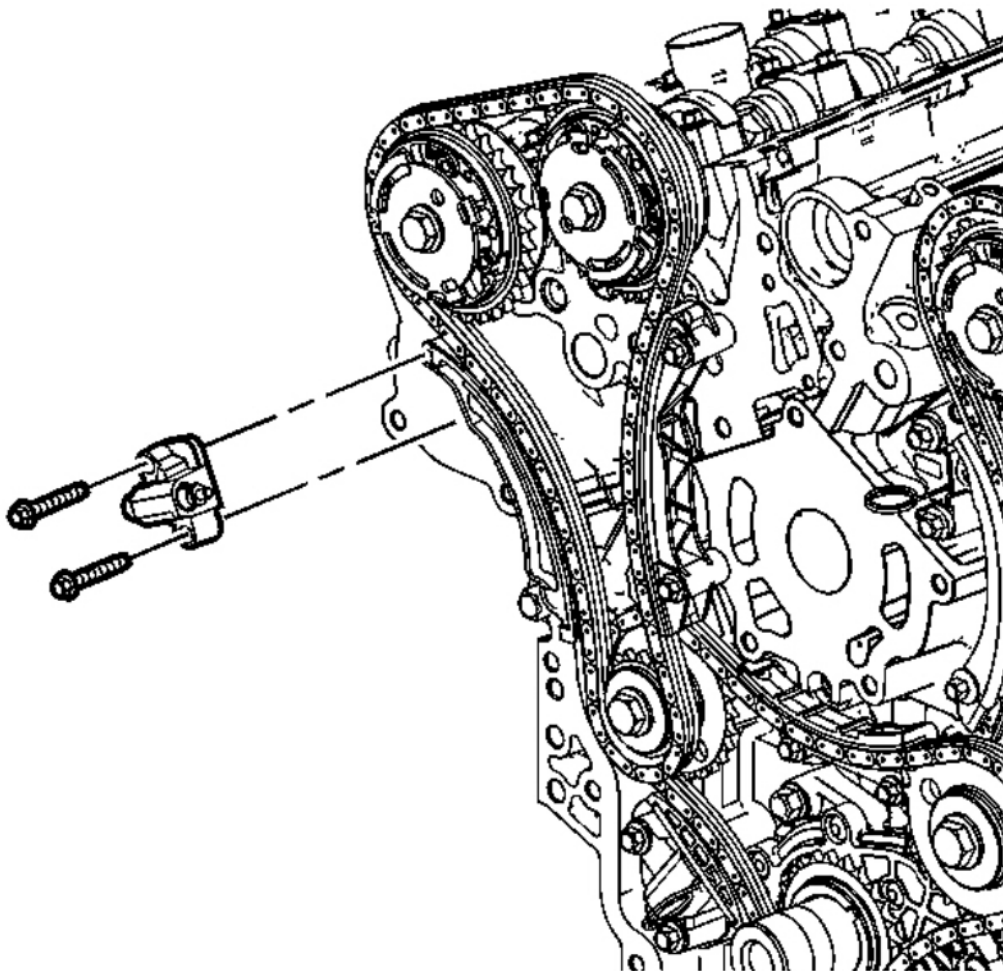


Fig. 136: View Of Right Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Removal - Right**.

INSTALLATION PROCEDURE

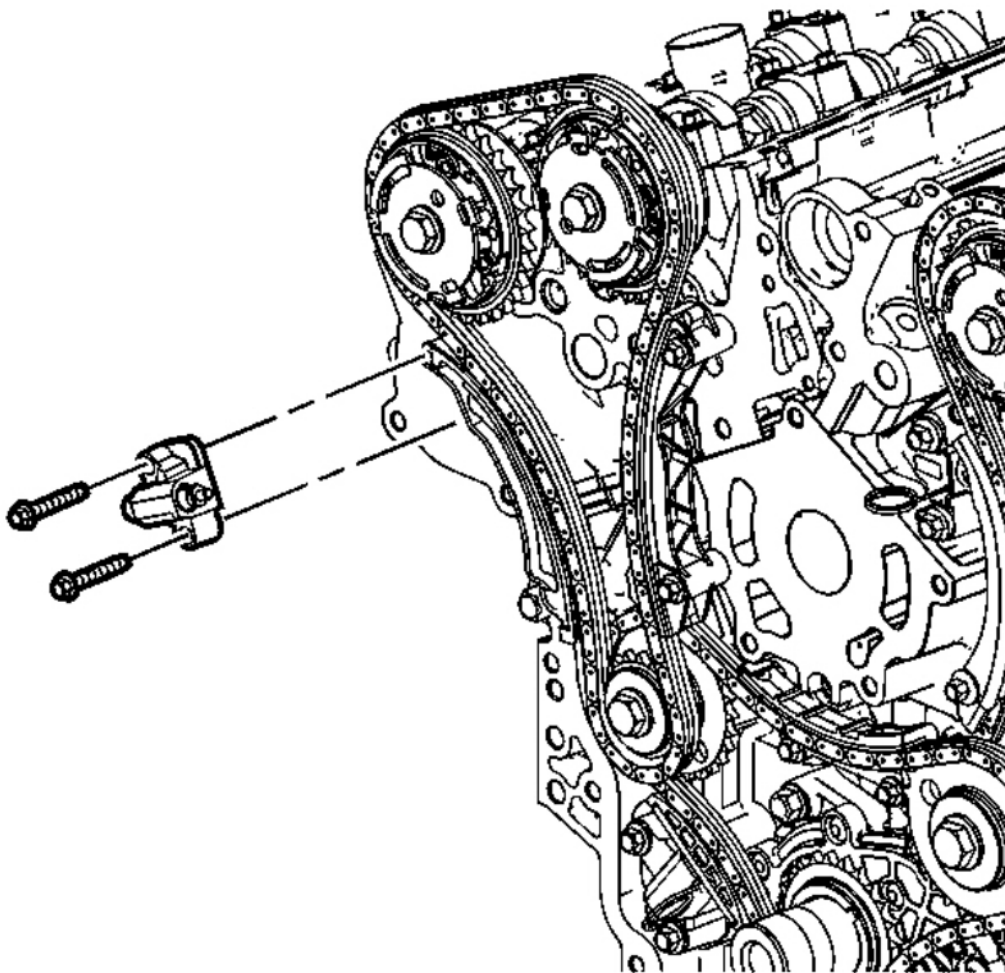


Fig. 137: View Of Right Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Installation - Right**.

2. Install the spark plugs. Refer to [Spark Plug Replacement](#) in Engine Controls - 2.8L.
3. Install the engine front cover. Refer to [Engine Front Cover Replacement](#).

SECONDARY CAMSHAFT DRIVE CHAIN SHOE REPLACEMENT - LEFT

REMOVAL PROCEDURE

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to [Spark Plug Replacement](#) in Engine Controls - 2.8L.
2. Remove the engine front cover. Refer to [Engine Front Cover Replacement](#).

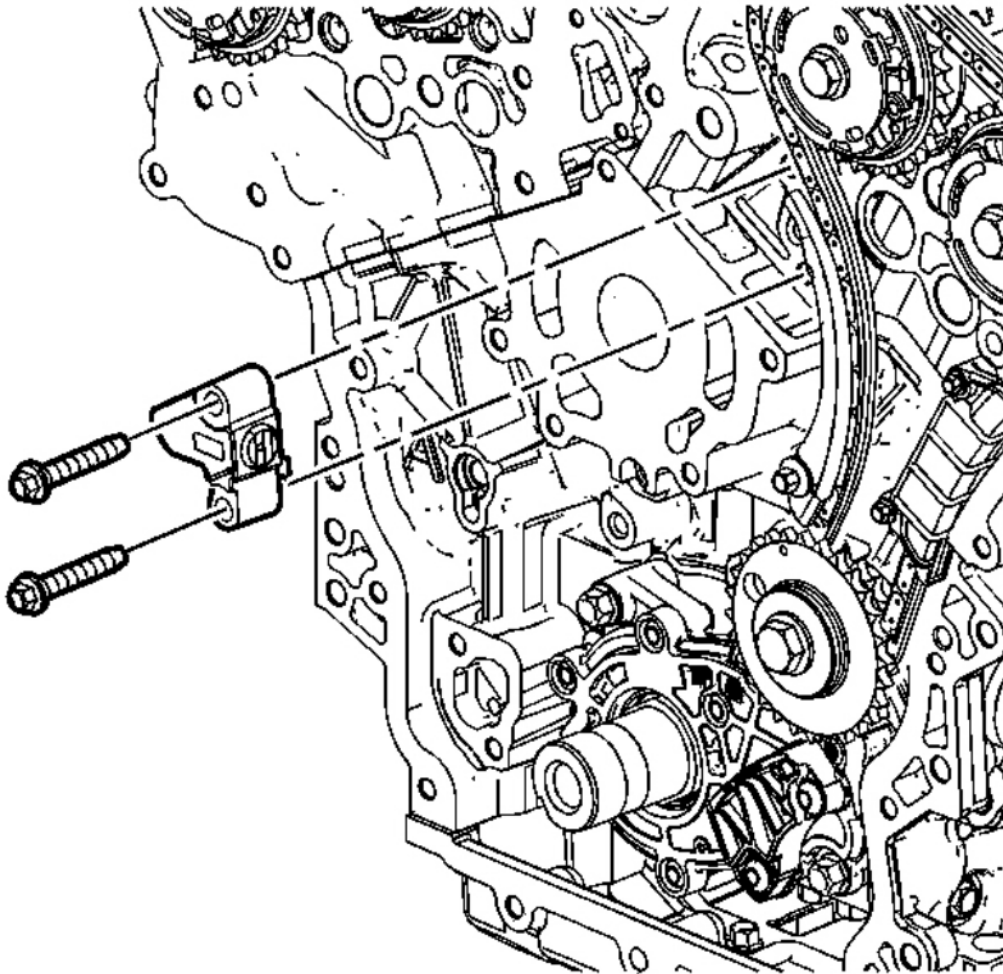


Fig. 138: Location Of Left Bank Secondary Camshaft Drive Chain Tensioner

Courtesy of GENERAL MOTORS CORP.

3. Remove the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Removal - Left**.

INSTALLATION PROCEDURE

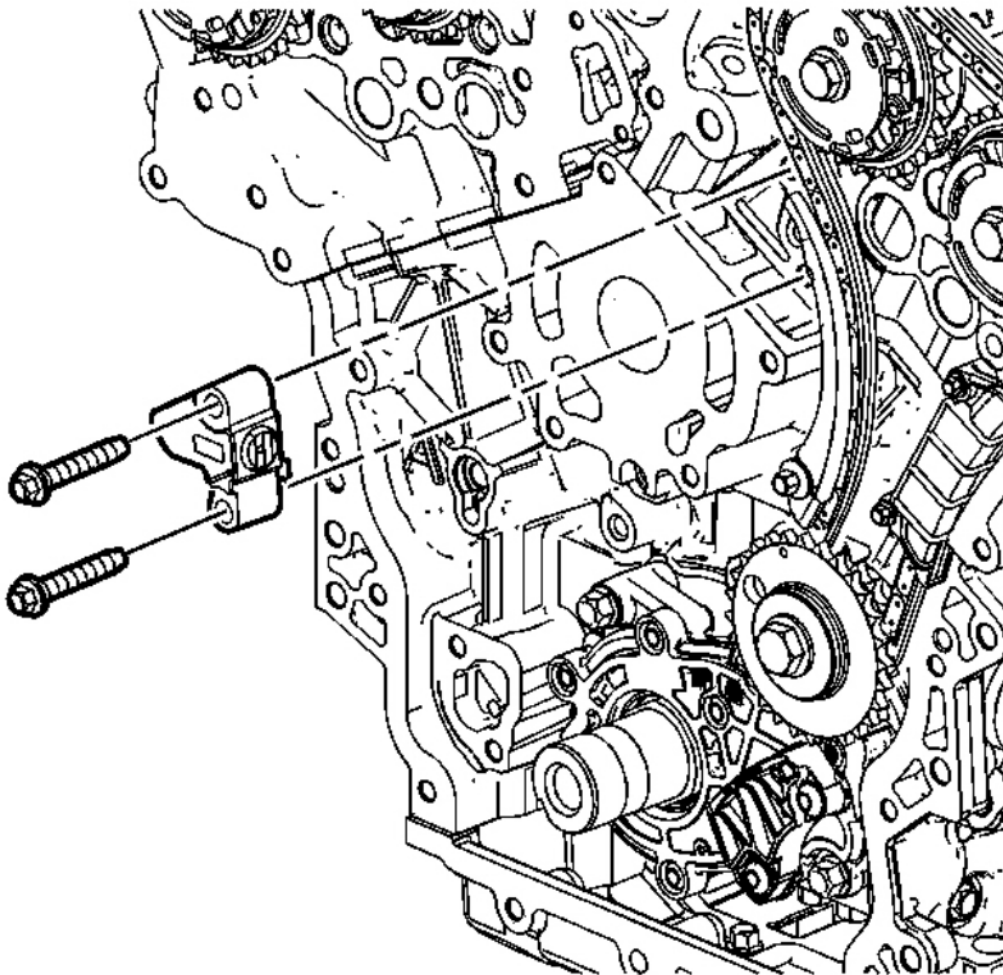


Fig. 139: Location Of Left Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Install the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Installation - Left**.
2. Install the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.

3. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

SECONDARY CAMSHAFT DRIVE CHAIN SHOE REPLACEMENT - RIGHT

REMOVAL PROCEDURE

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.

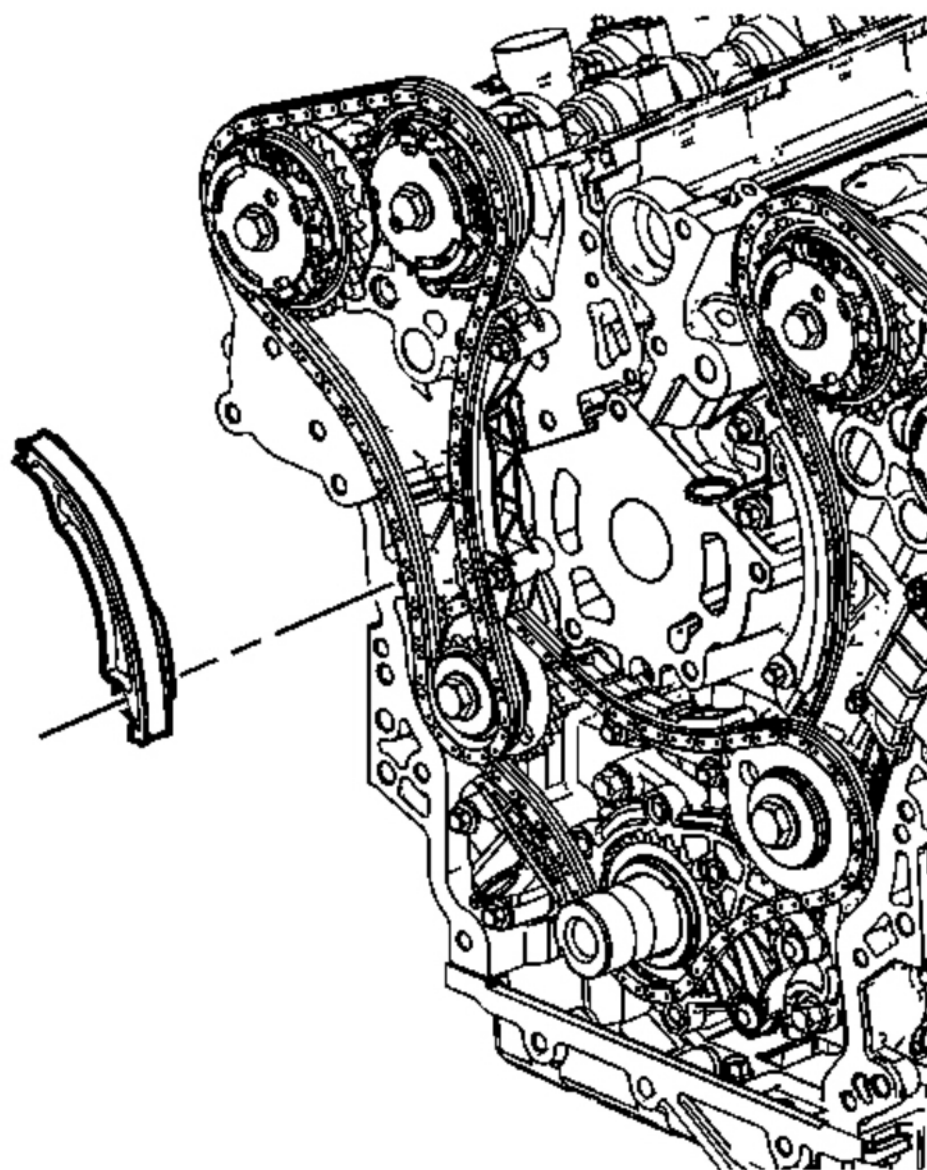


Fig. 140: View Of Right Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

2. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Removal - Right**.

4. Remove the right bank secondary camshaft drive chain shoe. Refer to Secondary Camshaft Drive Chain Shoe Removal - Right.

INSTALLATION PROCEDURE

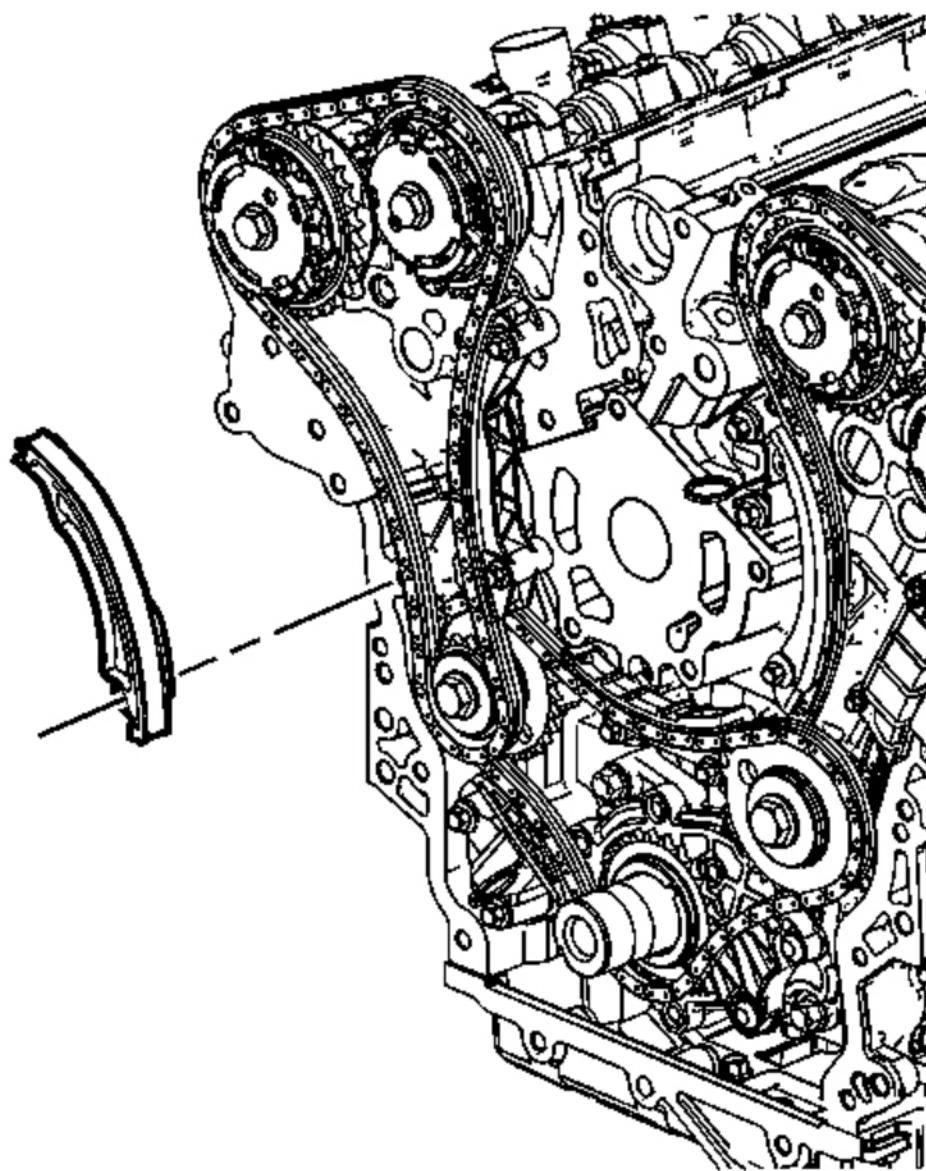


Fig. 141: View Of Right Secondary Camshaft Drive Chain Shoe

Courtesy of GENERAL MOTORS CORP.

1. Install the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Right** .
2. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Installation - Right** .
3. Install the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
4. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REPLACEMENT - LEFT

REMOVAL PROCEDURE

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
2. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
3. Remove the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Removal - Left** .

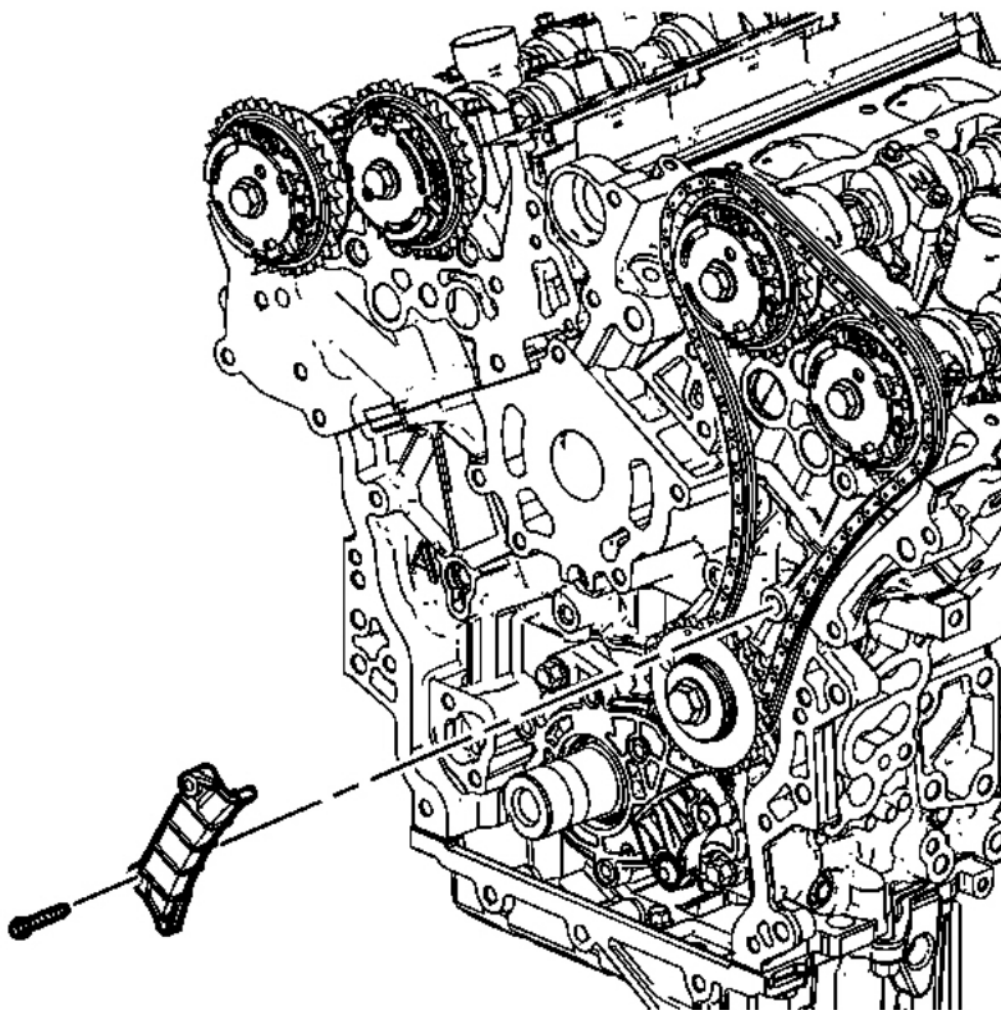


Fig. 142: View Of Left Bank Secondary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

4. Remove the left bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Removal - Left**.

INSTALLATION PROCEDURE

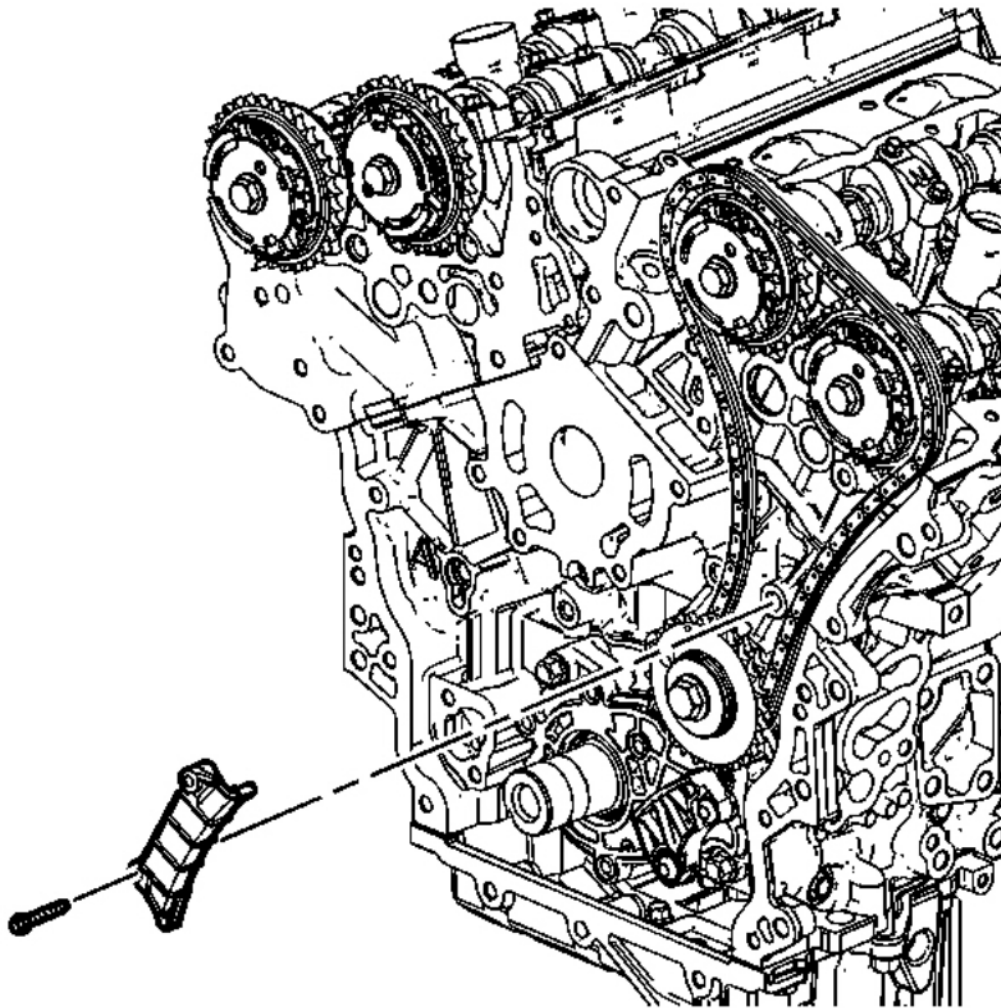


Fig. 143: View Of Left Bank Secondary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

1. Install the left bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Installation - Left**.
2. Install the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Installation - Left**.
3. Install the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
4. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

SECONDARY CAMSHAFT DRIVE CHAIN GUIDE REPLACEMENT - RIGHT

REMOVAL PROCEDURE

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
2. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Removal - Right**.

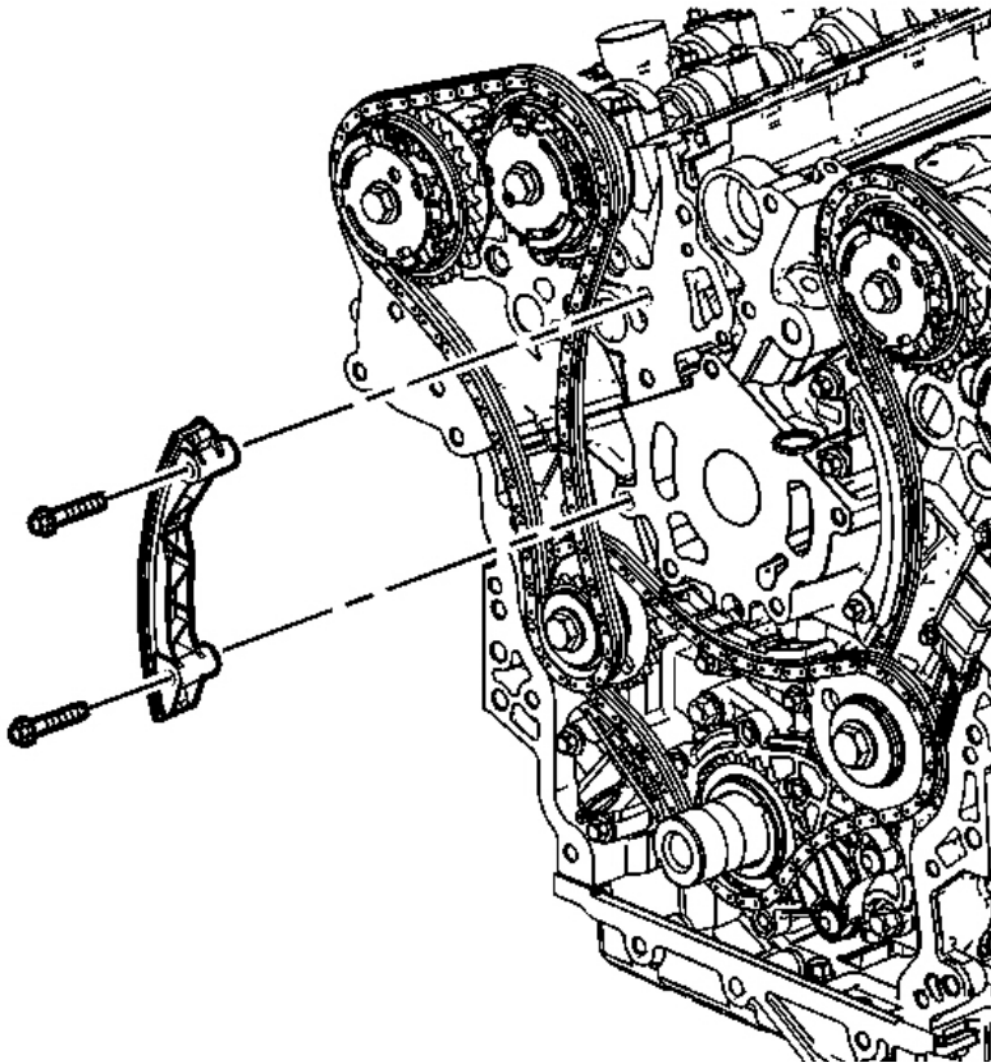


Fig. 144: View Of Right Secondary Camshaft Drive Chain Guide & Bolts

Courtesy of GENERAL MOTORS CORP.

4. Remove the right bank secondary camshaft drive chain guide. Refer to Secondary Camshaft Drive Chain Guide Removal - Right .

INSTALLATION PROCEDURE

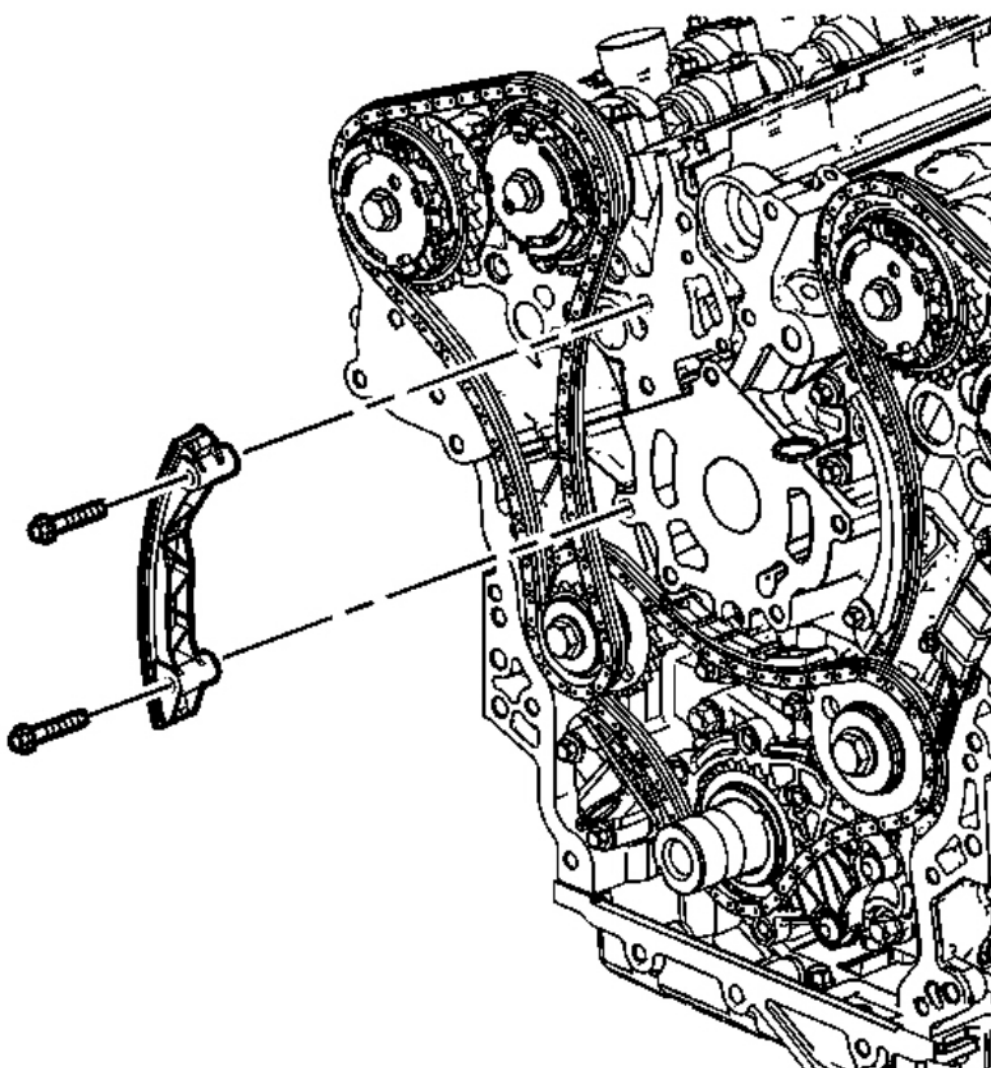


Fig. 145: View Of Right Secondary Camshaft Drive Chain Guide & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the right bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Installation - Right** .
2. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Installation - Right** .
3. Install the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
4. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

PRIMARY CAMSHAFT DRIVE CHAIN AND SPROCKETS REPLACEMENT

REMOVAL PROCEDURE

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
2. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Removal - Right** .
4. Remove the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Right** .
5. Remove the right bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Removal - Right** .
6. Remove the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Drive Chain Removal - Right** .
7. Remove the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Drive Chain Tensioner Removal** .
8. Remove the primary camshaft drive chain upper guide. **Primary Camshaft Drive Chain Guide Removal - Upper** .

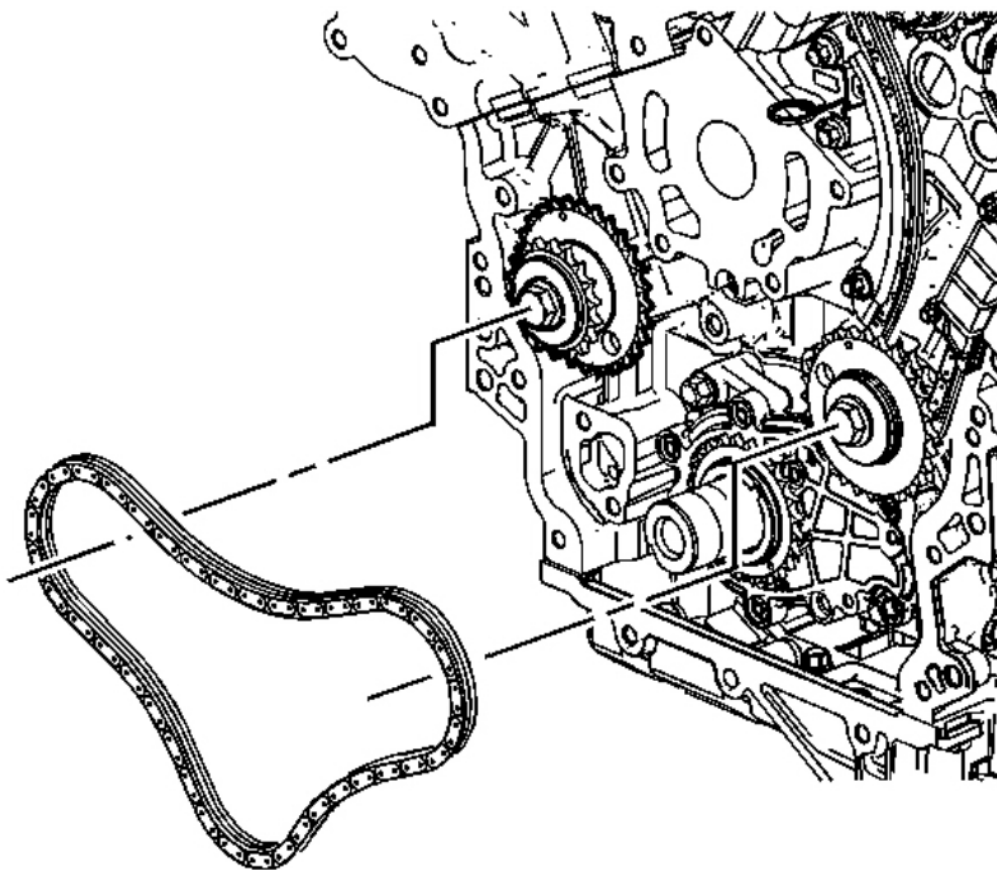


Fig. 146: View Of Primary Camshaft Timing Chain
Courtesy of GENERAL MOTORS CORP.

9. Remove the primary camshaft timing chain. Refer to **Primary Camshaft Drive Chain Removal** .

INSTALLATION PROCEDURE

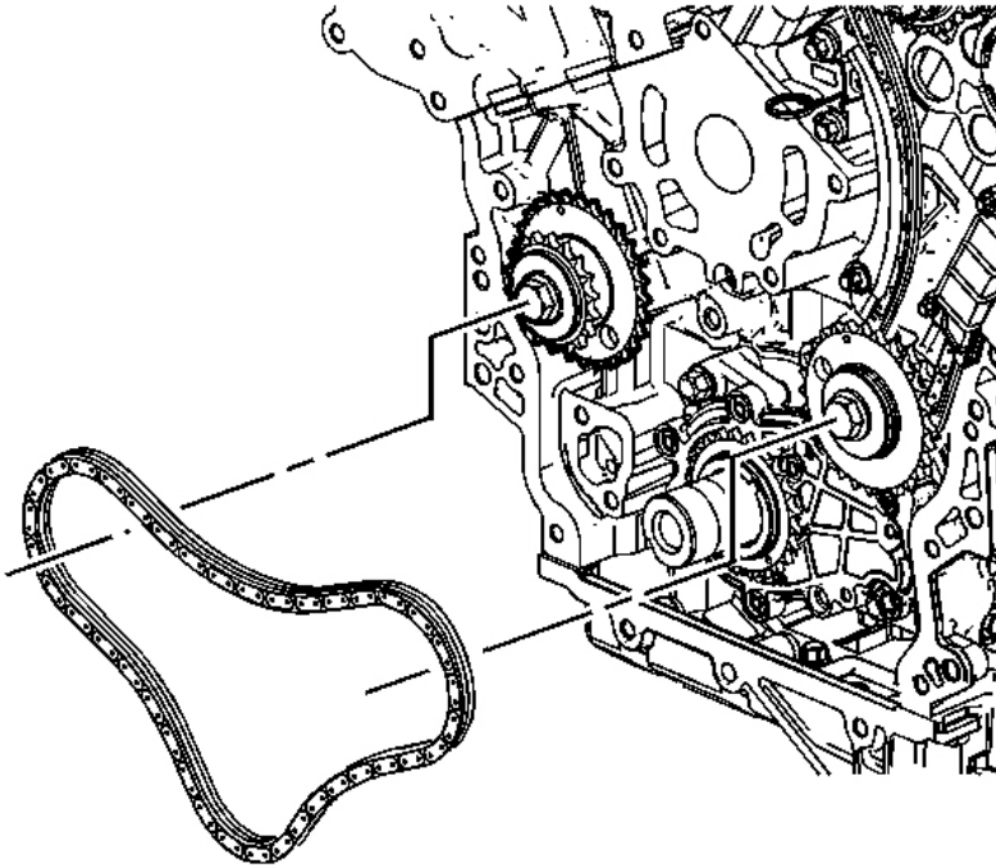


Fig. 147: View Of Primary Camshaft Timing Chain
Courtesy of GENERAL MOTORS CORP.

1. Install the primary camshaft timing chain. Refer to **Primary Camshaft Drive Chain Installation** .
2. Install the primary upper camshaft drive chain guide. Refer to **Primary Camshaft Drive Chain Guide Installation - Upper** .
3. Install the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Drive Chain Tensioner Installation** .
4. Install the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Drive Chain Installation - Right** .
5. Install the right bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Installation - Right** .
6. Install the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Right** .

7. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Installation - Right** .
8. Install the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
9. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER SPROCKET REPLACEMENT - LEFT

REMOVAL PROCEDURE

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.

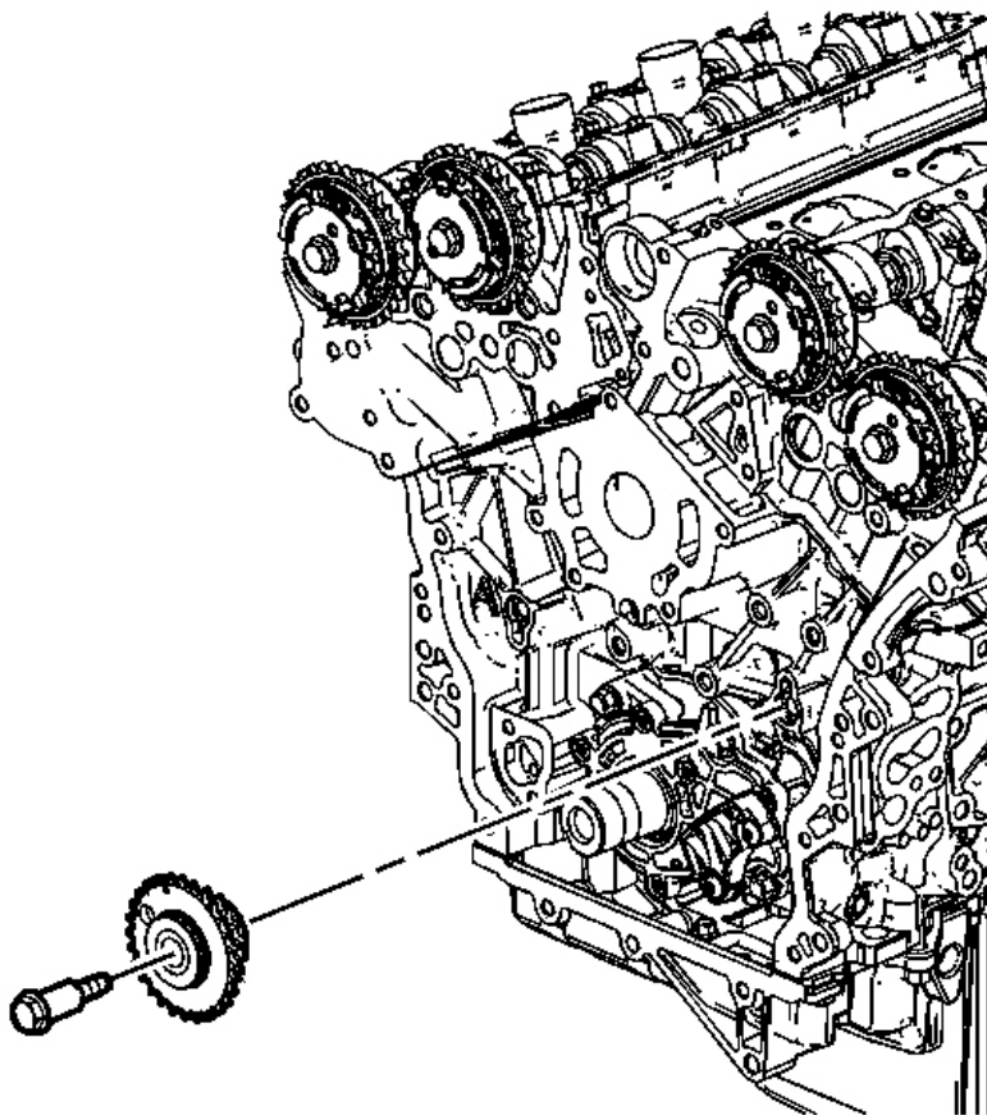


Fig. 148: View Of Left Camshaft Intermediate Drive Chain Idler
Courtesy of GENERAL MOTORS CORP.

2. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
3. Remove the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Removal - Right**.
4. Remove the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Right**.

5. Remove the right bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Removal - Right**.
6. Remove the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Drive Chain Removal - Right**.
7. Remove the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Drive Chain Tensioner Removal**.
8. Remove the primary upper camshaft drive chain guide. Refer to **Primary Camshaft Drive Chain Guide Removal - Upper**.
9. Remove the primary camshaft drive chain. Refer to **Primary Camshaft Drive Chain Removal**.
10. Remove the right bank camshaft intermediate drive chain idler. Refer to **Camshaft Intermediate Drive Chain Idler Removal - Right**.

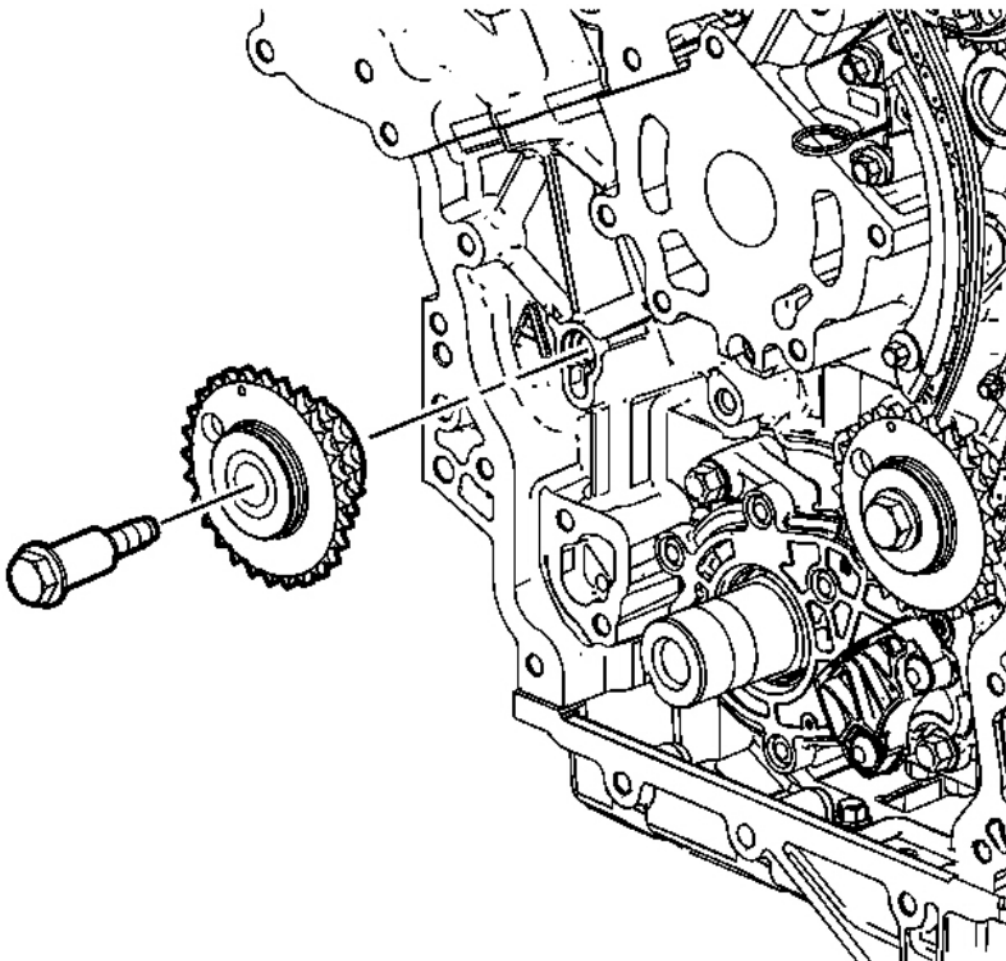


Fig. 149: View Of Right And Left Camshaft Intermediate Drive Chain Idlers
Courtesy of GENERAL MOTORS CORP.

11. If you are servicing the left bank camshaft intermediate drive chain idler, perform the following steps:
 1. Remove the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Removal - Left**.
 2. Remove the left bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Removal - Left**.
 3. Remove the left bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Removal - Left**.
 4. Remove the left bank secondary camshaft drive chain. Refer to **Secondary Camshaft Drive Chain Removal - Left**.
 5. Remove the left bank camshaft intermediate drive chain idler. Refer to **Camshaft Intermediate Drive Chain Idler Removal - Left**.

INSTALLATION PROCEDURE

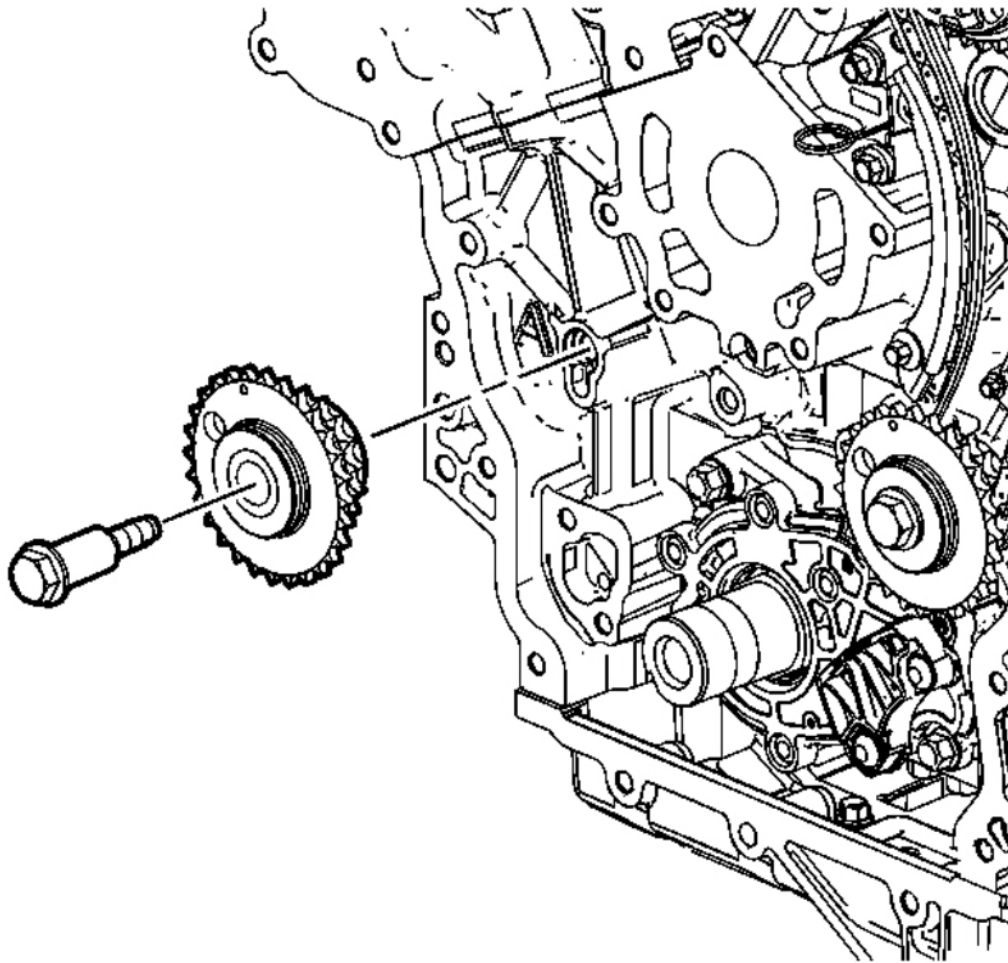


Fig. 150: View Of Right And Left Camshaft Intermediate Drive Chain Idlers
Courtesy of GENERAL MOTORS CORP.

1. If you are servicing the left bank idler sprocket, perform the following steps:
 - Install the left bank camshaft intermediate drive chain idler. Refer to **Camshaft Intermediate Drive Chain Idler Installation - Left** .
 - Install the left bank secondary camshaft drive chain. Refer to **Secondary Camshaft Drive Chain Installation - Left** .
 - Install the left bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Installation - Left** .
 - Install the left bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Left** .

- Install the left bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Installation - Left**.

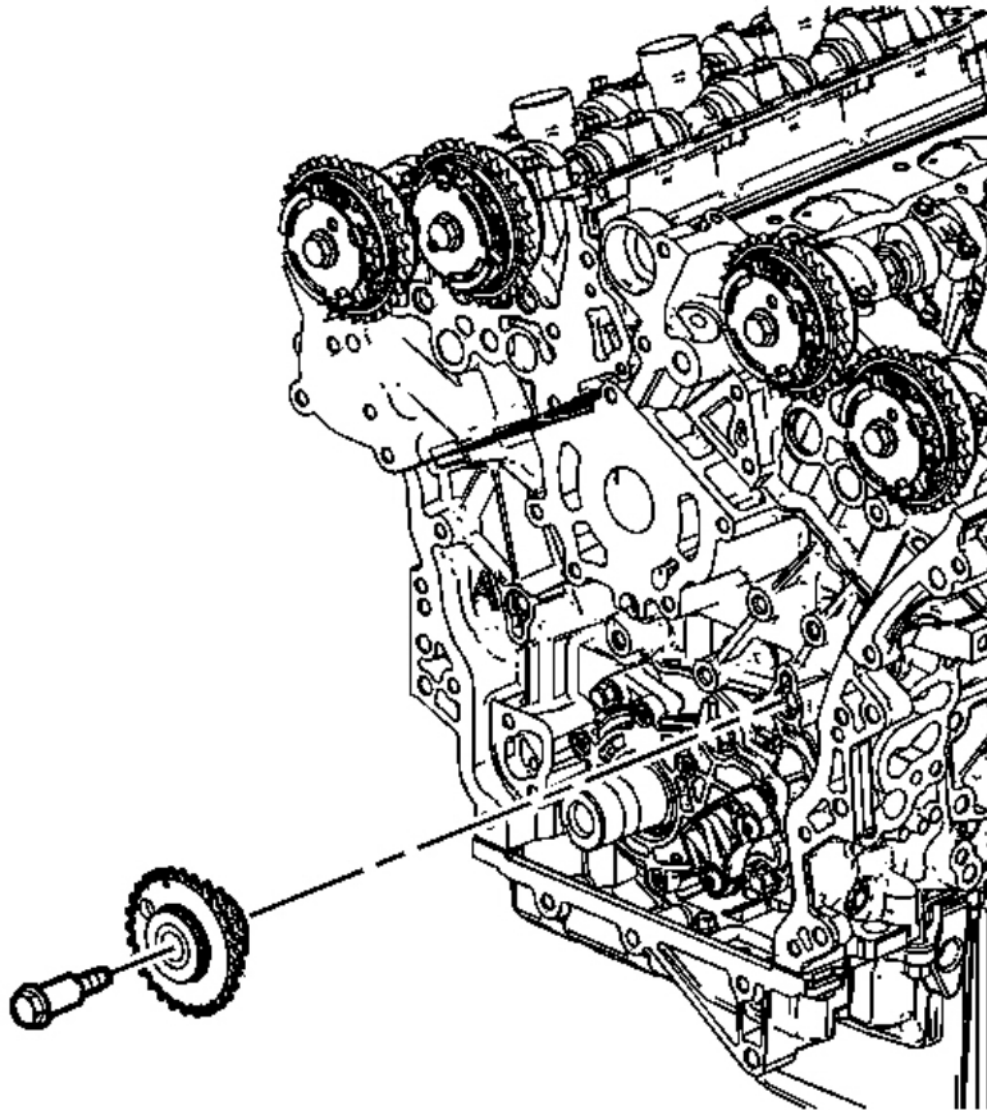


Fig. 151: View Of Left Camshaft Intermediate Drive Chain Idler
Courtesy of GENERAL MOTORS CORP.

2. Install the right bank camshaft intermediate drive chain idler. Refer to **Camshaft Intermediate Drive Chain Idler Installation - Right**.

3. Install the primary camshaft drive chain. Refer to **Primary Camshaft Drive Chain Installation** .
4. Install the primary upper camshaft drive chain guide. Refer to **Primary Camshaft Drive Chain Guide Installation - Upper** .
5. Install the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Drive Chain Tensioner Installation** .
6. Install the right bank secondary camshaft drive chain. Refer to **Secondary Camshaft Drive Chain Installation - Right** .
7. Install the right bank secondary camshaft drive chain guide. Refer to **Secondary Camshaft Drive Chain Guide Installation - Right** .
8. Install the right bank secondary camshaft drive chain shoe. Refer to **Secondary Camshaft Drive Chain Shoe Installation - Right** .
9. Install the right bank secondary camshaft drive chain tensioner. Refer to **Secondary Camshaft Drive Chain Tensioner Installation - Right** .
10. Install the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
11. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

PRIMARY CAMSHAFT DRIVE CHAIN TENSIONER REPLACEMENT

REMOVAL PROCEDURE

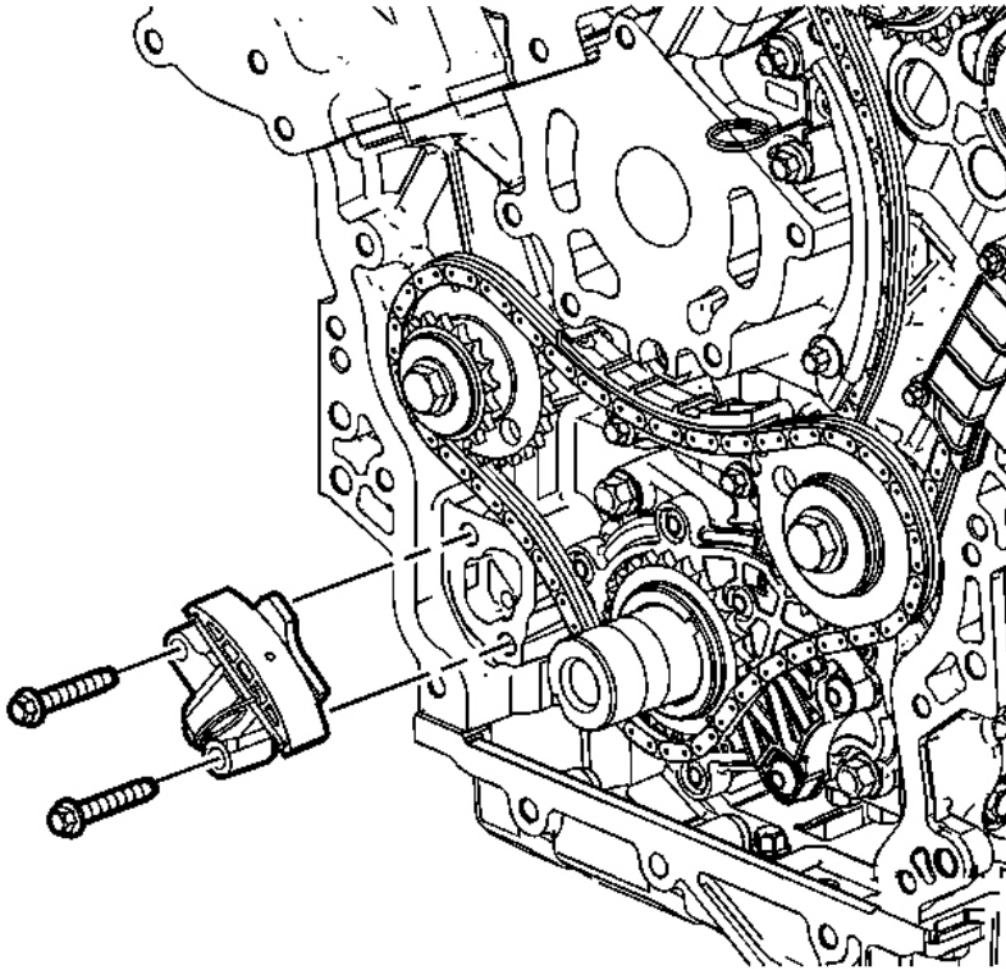


Fig. 152: View Of Primary Camshaft Drive Chain Tensioners
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
2. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.

IMPORTANT: If the entire camshaft timing system is not in Stage 2 (**Camshaft Timing Drive Chain Alignment Diagram (W/Primary Inverted Tooth (IT) Chain)**), mark the timing chain and sprockets in order to ensure proper reassembly.

3. Remove the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Drive Chain**

Tensioner Removal .

INSTALLATION PROCEDURE

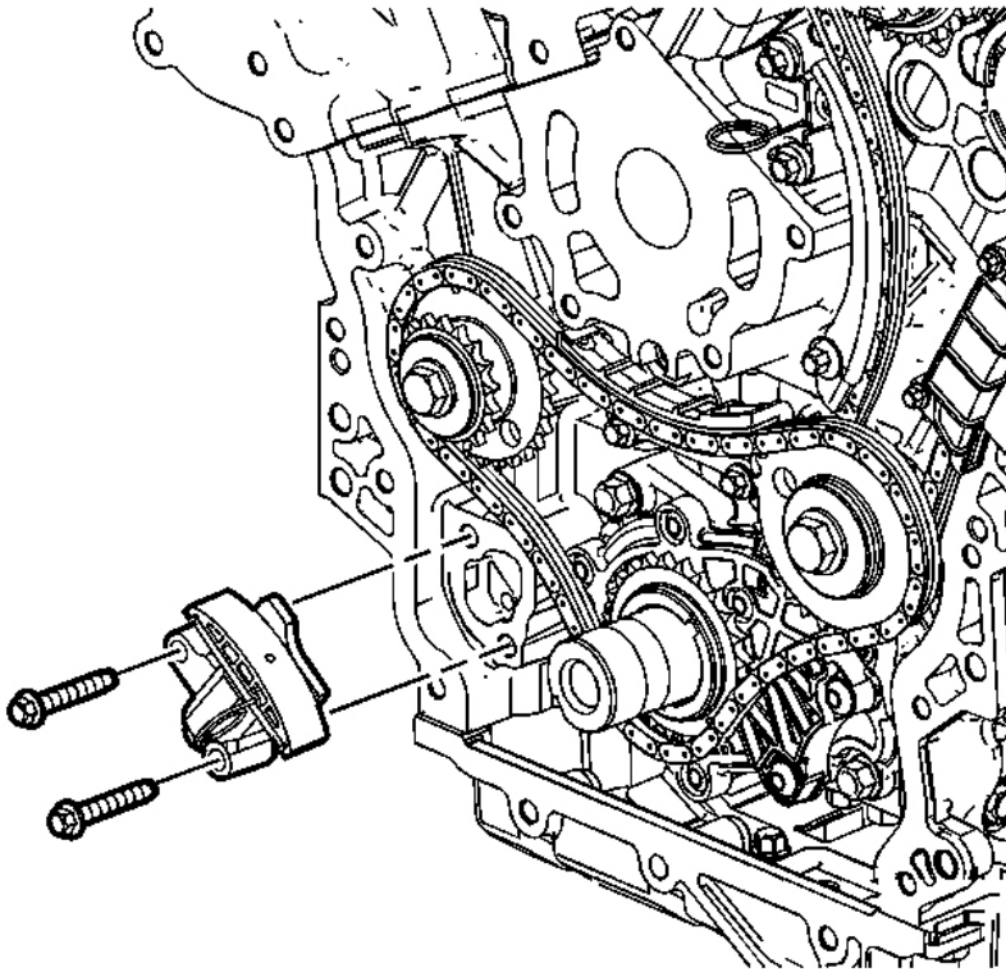


Fig. 153: View Of Primary Camshaft Drive Chain Tensioners
Courtesy of GENERAL MOTORS CORP.

1. Install the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Drive Chain Tensioner Installation** .
2. Install the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
3. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

PRIMARY CAMSHAFT DRIVE CHAIN GUIDE REPLACEMENT - LOWER

The primary camshaft drive chain guide is not serviceable separately. If the guide is worn or damaged, the guide must be replaced with the oil pump.

PRIMARY CAMSHAFT DRIVE CHAIN GUIDE REPLACEMENT - UPPER

REMOVAL PROCEDURE

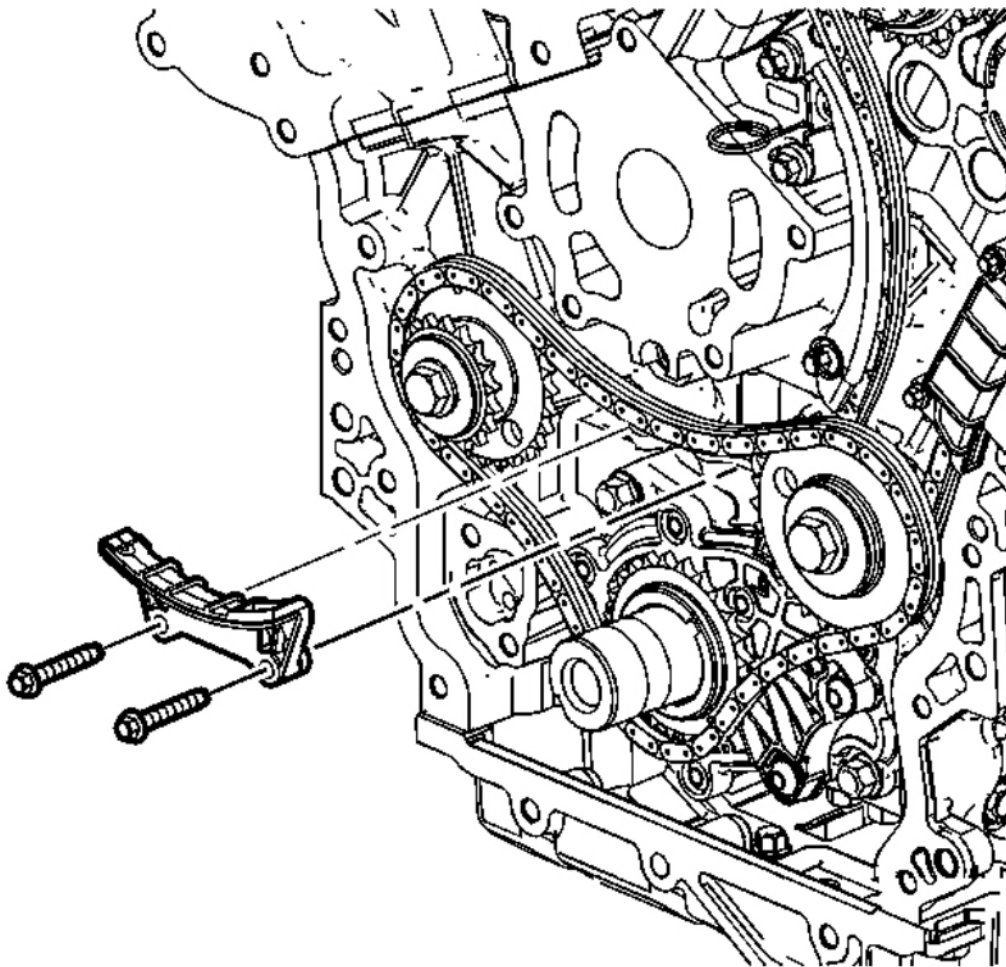


Fig. 154: View Of Upper Primary Camshaft Drive Chain Guides
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plugs in order to ease crankshaft/engine rotation. Refer to **Spark Plug Replacement** in

Engine Controls - 2.8L.

2. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
3. Remove the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Drive Chain Tensioner Removal**.
4. Remove the primary upper camshaft drive chain guide. Refer to **Primary Camshaft Drive Chain Guide Removal - Upper**.

INSTALLATION PROCEDURE

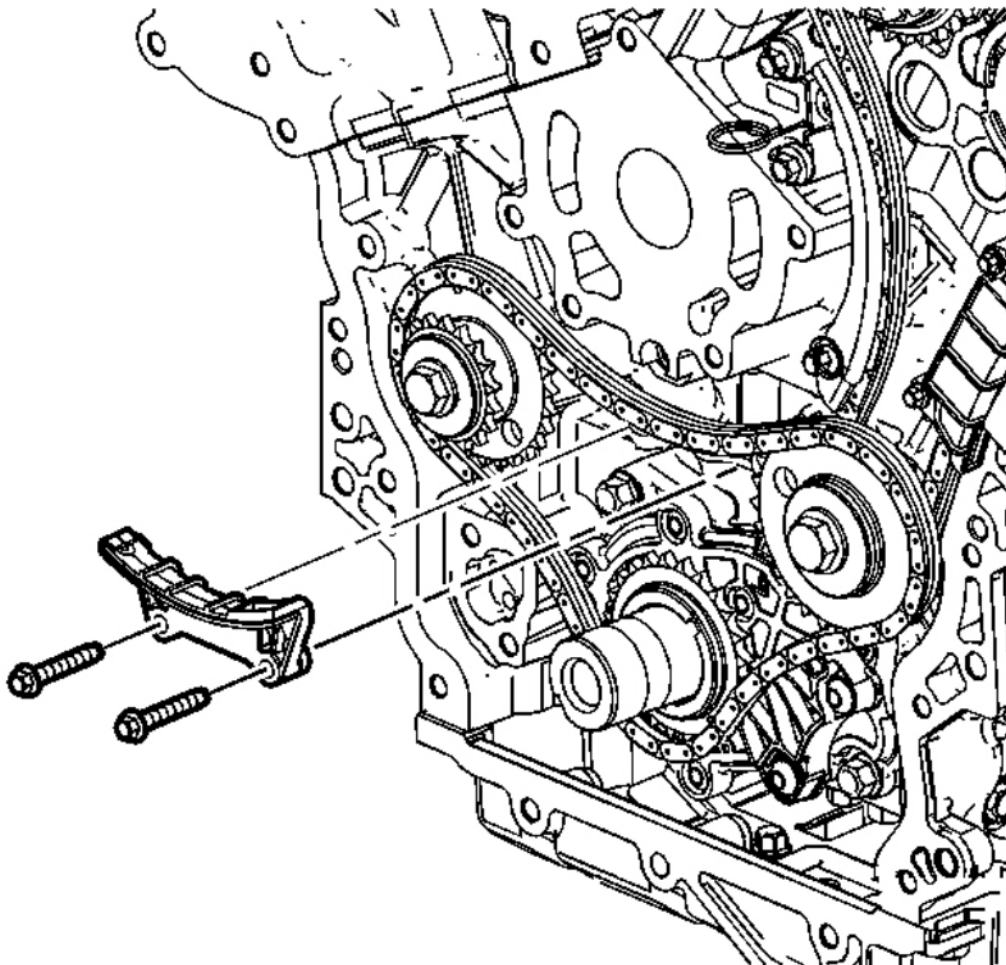


Fig. 155: View Of Upper Primary Camshaft Drive Chain Guides
Courtesy of GENERAL MOTORS CORP.

1. Install the primary upper camshaft drive chain guide. Refer to **Primary Camshaft Drive Chain Guide Installation - Upper** .
2. Install the primary camshaft drive chain tensioner. Refer to **Primary Camshaft Drive Chain Tensioner Installation** .
3. Install the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
4. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

CAMSHAFT POSITION (CMP) ACTUATOR REPLACEMENT - BANK 2 (LEFT) EXHAUST

REMOVAL PROCEDURE

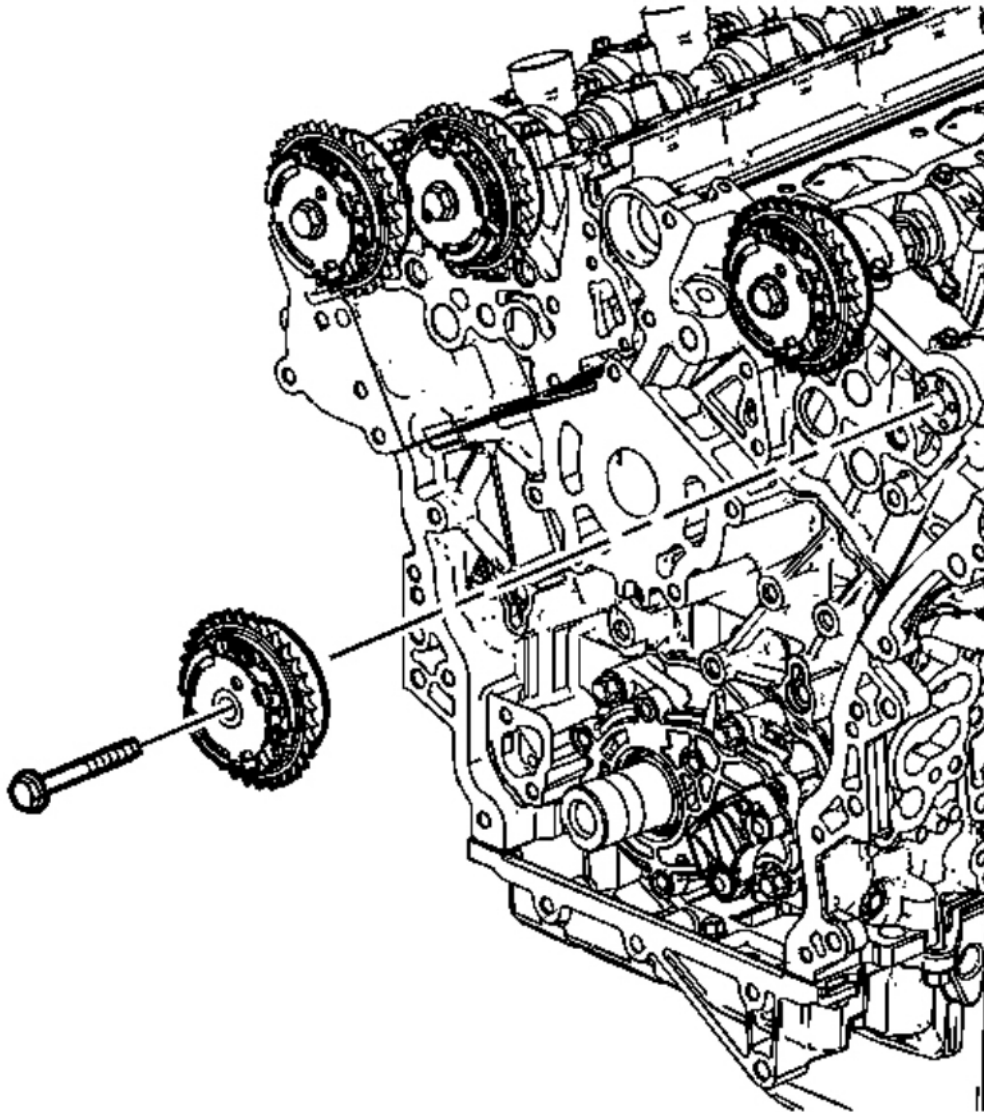


Fig. 156: View Of Camshaft Position (CMP) Actuator - Bank 2 Exhaust
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

1. Remove the camshaft. Refer to Camshaft Replacement - Left.
2. Remove the camshaft position actuator from the timing chain.

INSTALLATION PROCEDURE

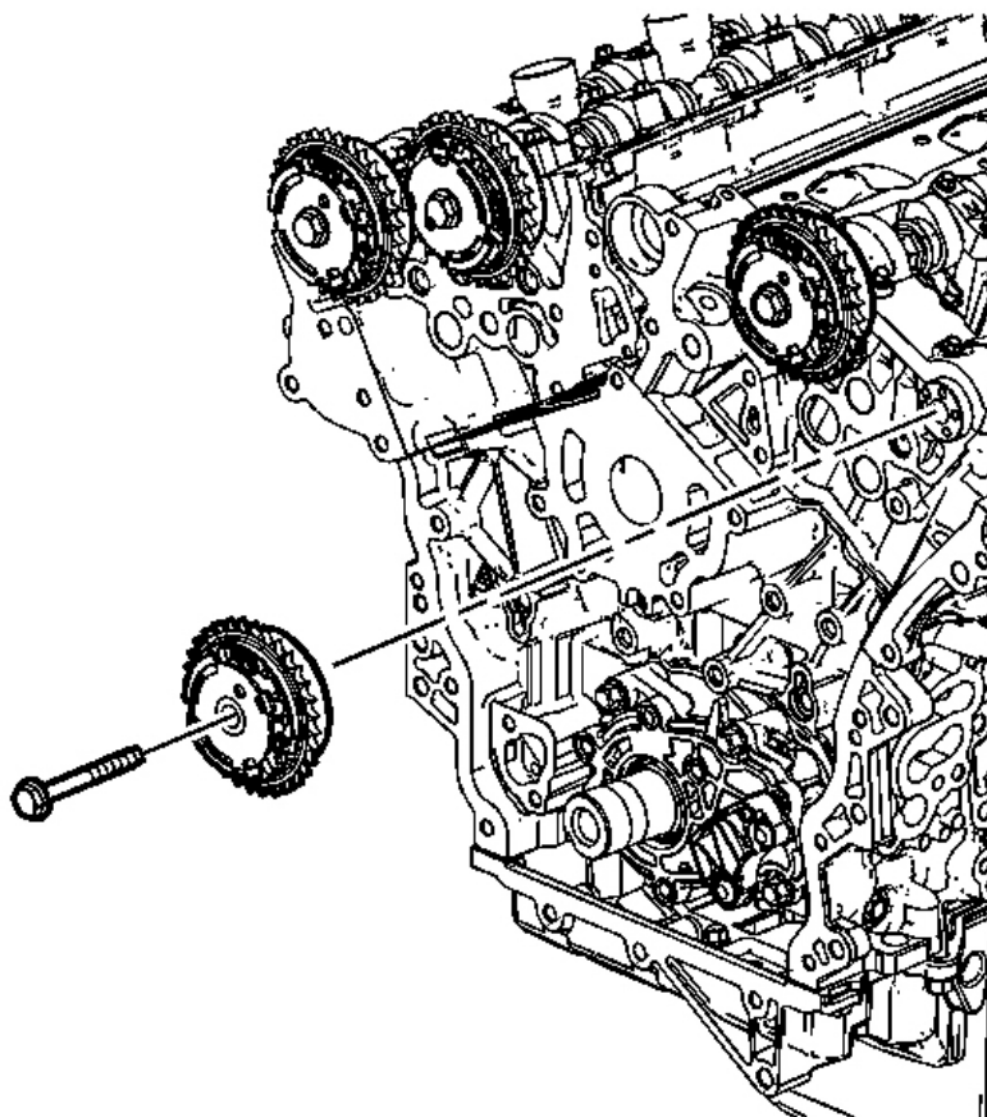


Fig. 157: View Of Camshaft Position (CMP) Actuator - Bank 2 Exhaust
Courtesy of GENERAL MOTORS CORP.

1. Install the camshaft position actuator to the timing chain.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions

and Notices.

2. Install the applicable camshaft. Refer to Camshaft Replacement - Left.

CAMSHAFT POSITION (CMP) ACTUATOR REPLACEMENT - BANK 1 (RIGHT) EXHAUST

REMOVAL PROCEDURE

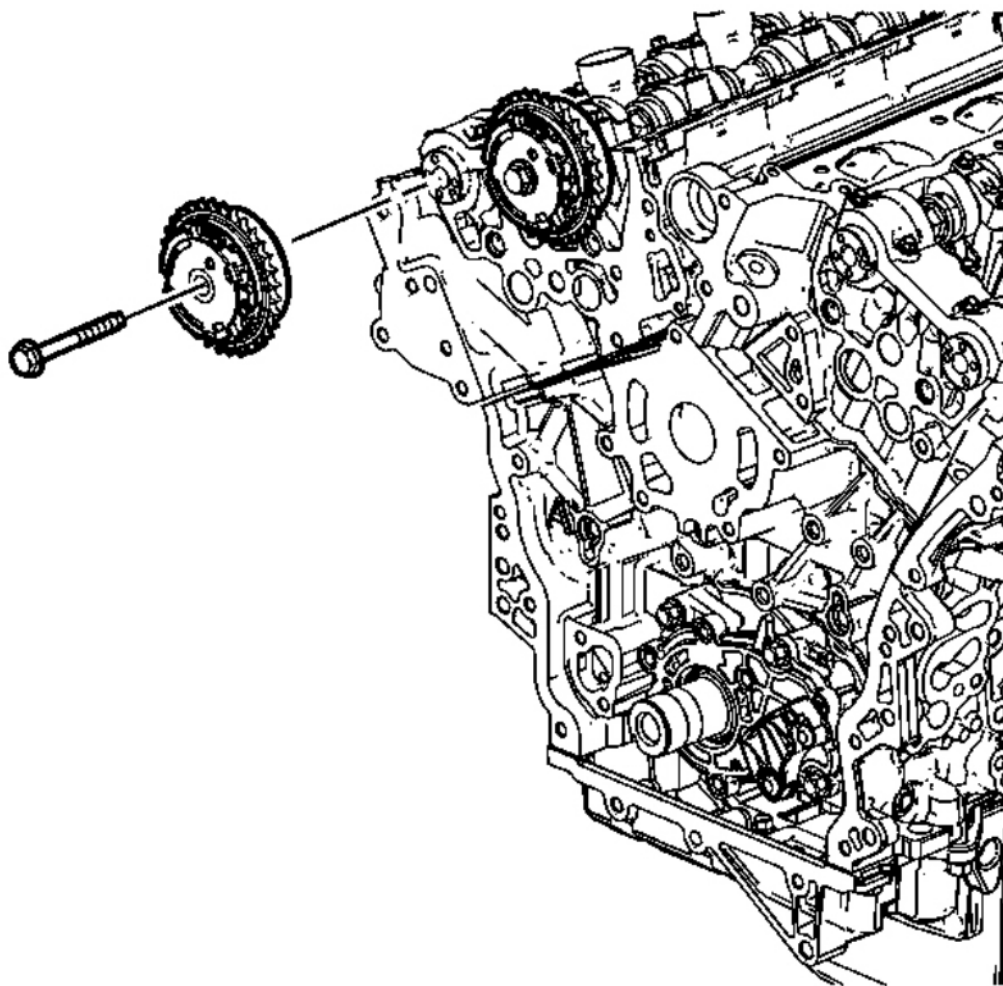


Fig. 158: View Of Right Exhaust Camshaft Position Actuator
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

1. Remove the camshaft. Refer to Camshaft Replacement - Right.
2. Remove the camshaft position actuator from the timing chain.

INSTALLATION PROCEDURE

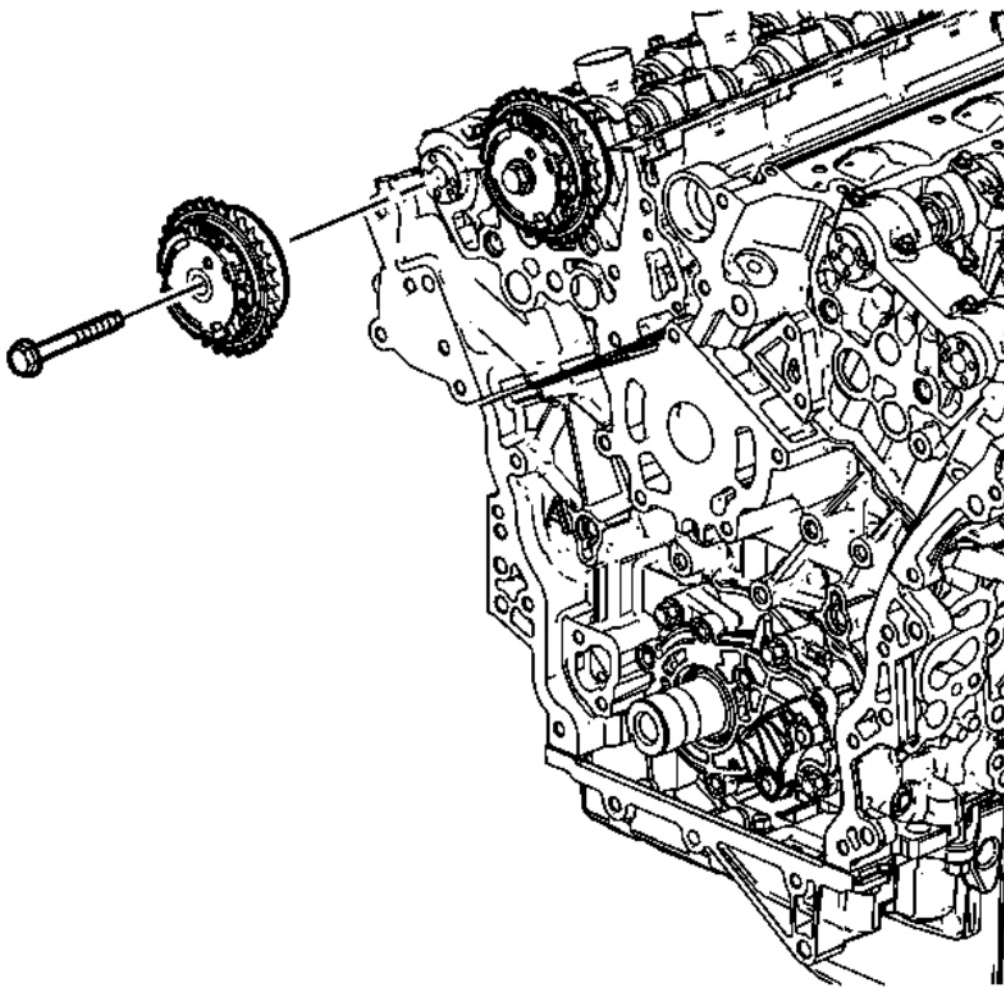


Fig. 159: View Of Right Exhaust Camshaft Position Actuator
Courtesy of GENERAL MOTORS CORP.

1. Install the camshaft position actuator to the timing chain.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

2. Install the camshaft. Refer to Camshaft Replacement - Right.

CAMSHAFT POSITION (CMP) ACTUATOR REPLACEMENT - BANK 2 (LEFT) INTAKE

REMOVAL PROCEDURE

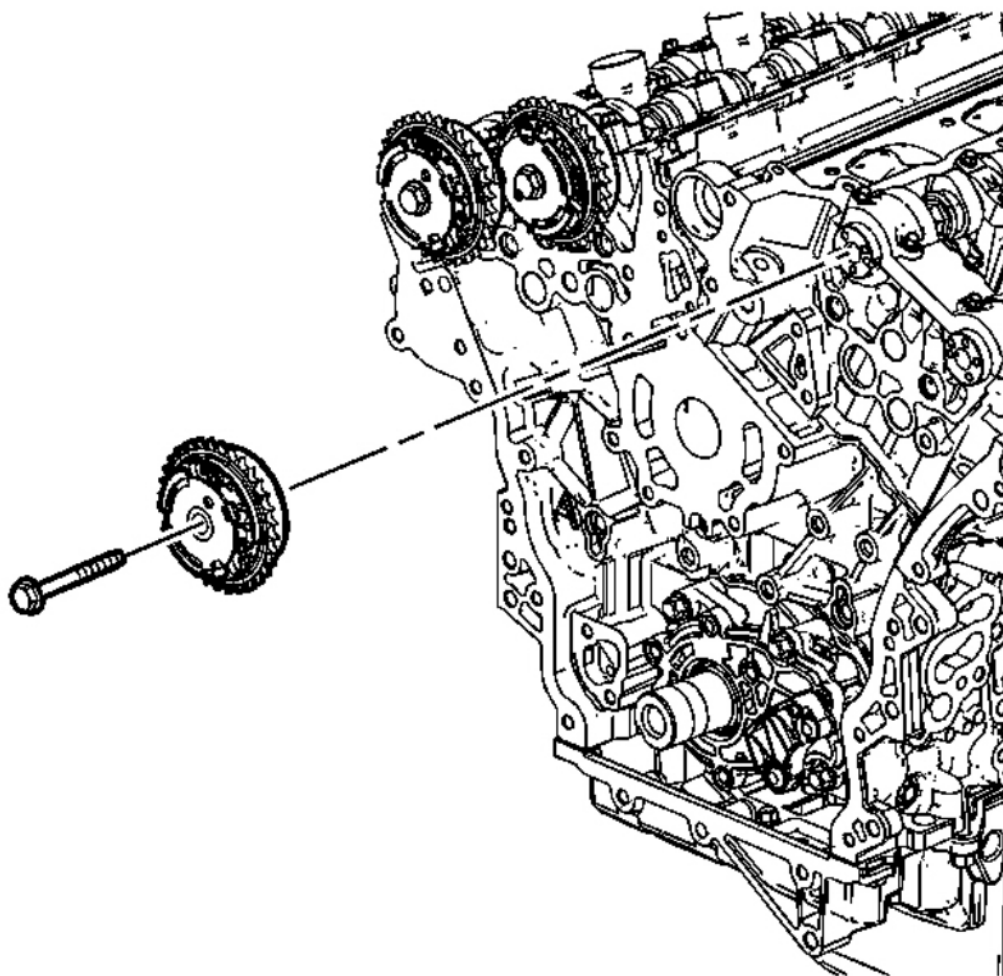


Fig. 160: Removing/Installing Camshaft Position (CMP) Actuator
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

1. Remove the camshaft. Refer to Camshaft Replacement - Left.
2. Remove the camshaft position actuator from the timing chain.

INSTALLATION PROCEDURE

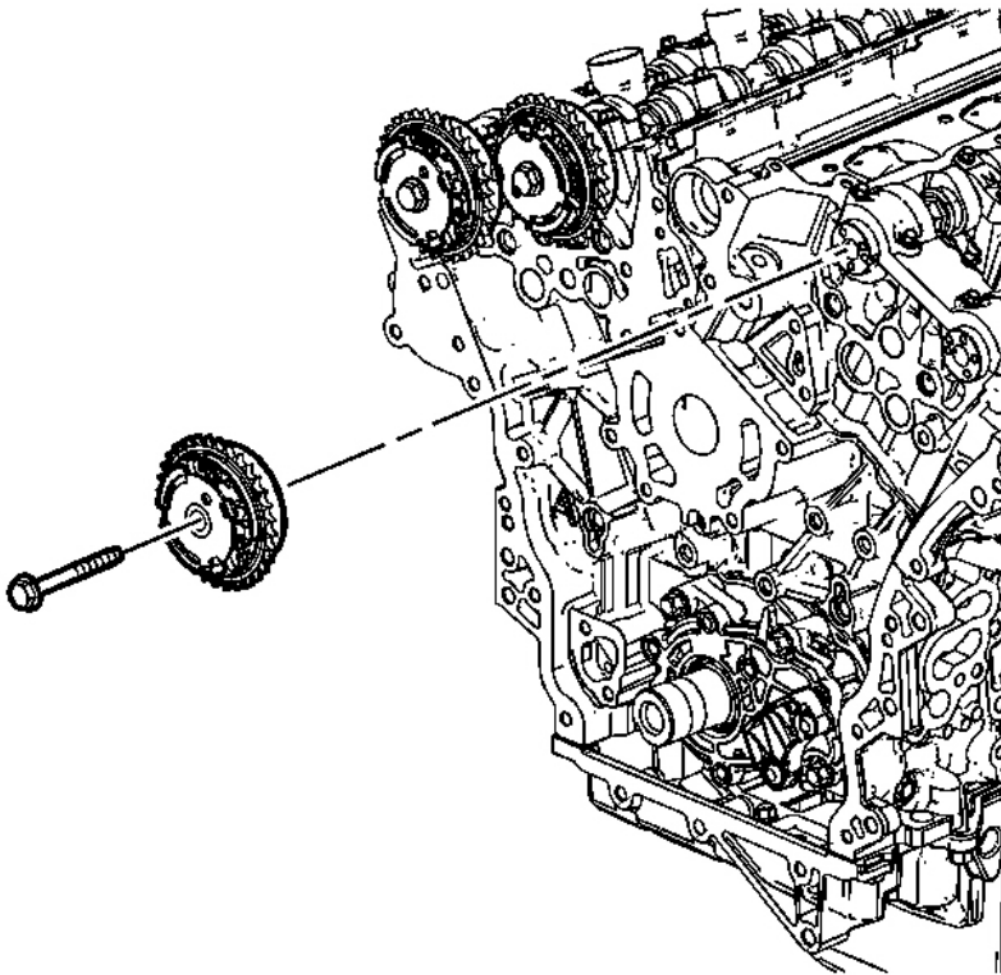


Fig. 161: Removing/Installing Camshaft Position (CMP) Actuator
Courtesy of GENERAL MOTORS CORP.

1. Install the camshaft position actuator to the timing chain.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

2. Install the camshaft. Refer to Camshaft Replacement - Left.

CAMSHAFT POSITION (CMP) ACTUATOR REPLACEMENT - BANK 1 (RIGHT) INTAKE

REMOVAL PROCEDURE

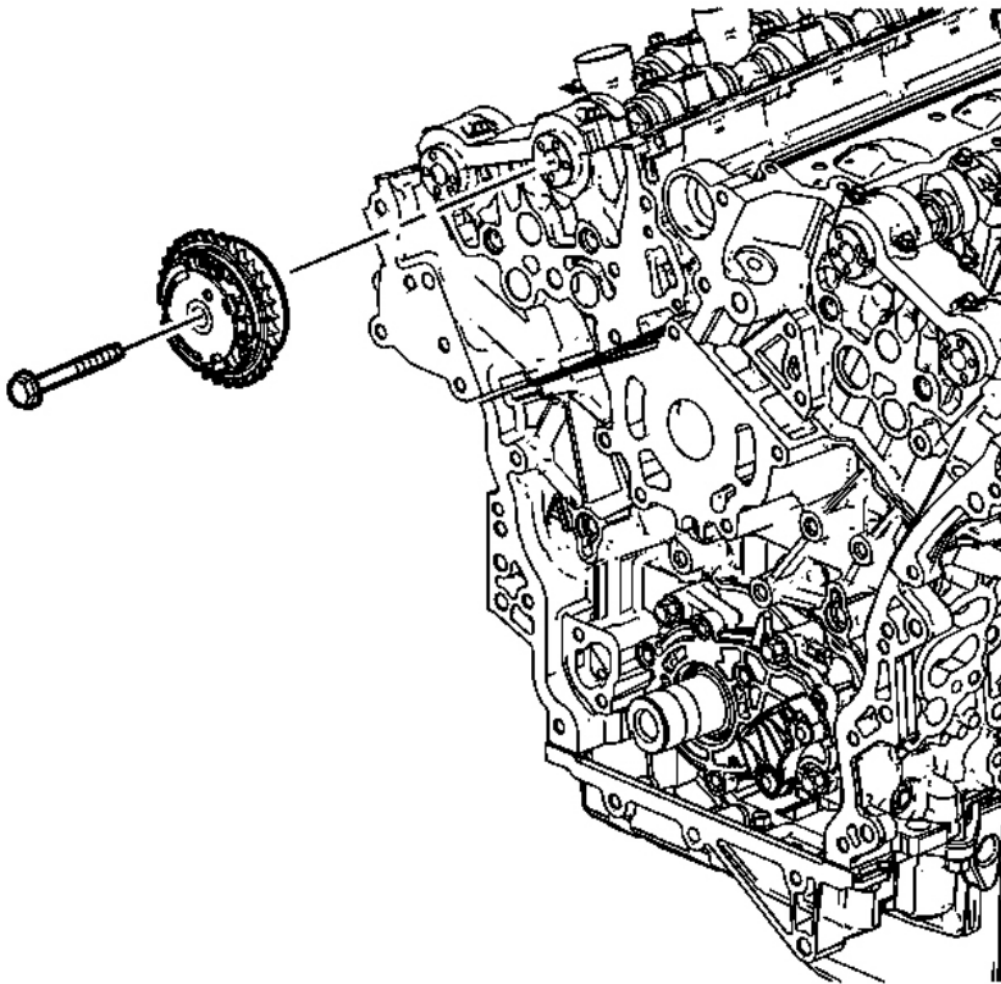


Fig. 162: View Of Camshaft Position (CMP) Actuator - Bank1 Intake
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

1. Remove the camshaft. Refer to Camshaft Replacement - Right.
2. Remove the camshaft position actuator from the timing chain.

INSTALLATION PROCEDURE

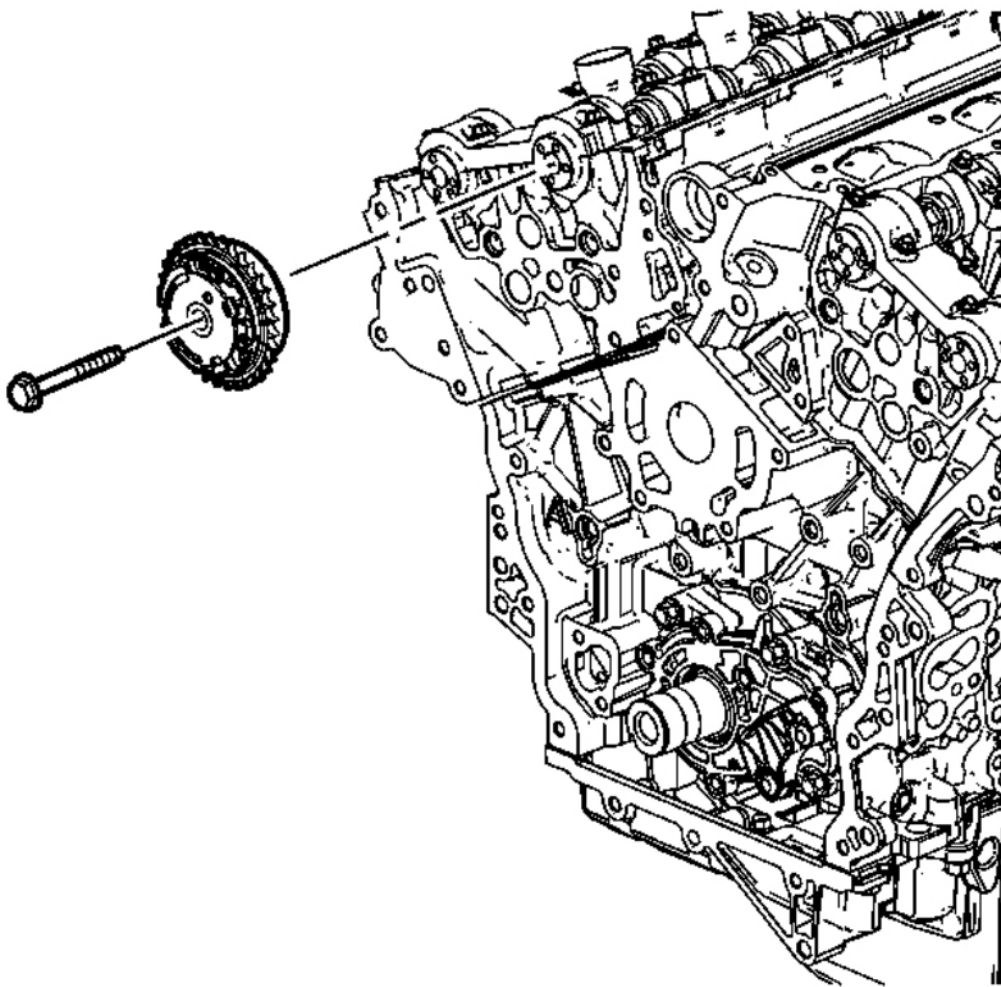


Fig. 163: View Of Camshaft Position (CMP) Actuator - Bank1 Intake
Courtesy of GENERAL MOTORS CORP.

1. Install the camshaft position actuator to the timing chain.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

2. Install the camshaft. Refer to Camshaft Replacement - Right.

SETTING CAMSHAFT TIMING

IMPORTANT: Setting the camshaft timing is necessary whenever the camshaft drive system has been disturbed such that the relationship between any chain and sprocket has been lost. Even when only one sprocket is involved, multiple crankshaft rotations will not produce conditions where correct timing can be confirmed.

If necessary, follow the left bank secondary camshaft drive chain replacement procedures to reset the camshaft timing. Refer to Secondary Camshaft Drive Chain Replacement - Left.

CAMSHAFT REPLACEMENT - LEFT

Tools Required

- EN 46108 Timing Chain Retention Tool. See Special Tools .
- EN 46111 Crankshaft Rotation Socket. See Special Tools .

REMOVAL PROCEDURE

1. Remove the upper intake manifold with the lower intake manifold. Refer to Intake Manifold Replacement - Lower.
2. Remove the left bank camshaft cover. Refer to Camshaft Cover Replacement - Left.
3. Remove the camshaft position (CMP) sensors. Refer to Camshaft Position (CMP) Sensor Replacement - Bank 2 (Left) Exhaust and Camshaft Position (CMP) Sensor Replacement - Bank 2 (Left) Intake in Engine Controls - 2.8L.
4. Remove the CMP actuator solenoid. Refer to Camshaft Position (CMP) Actuator Solenoid Replacement - Bank 2 (Left) Intake in Engine Controls - 2.8L.
5. Remove the crankshaft balancer. Refer to Crankshaft Balancer Removal .

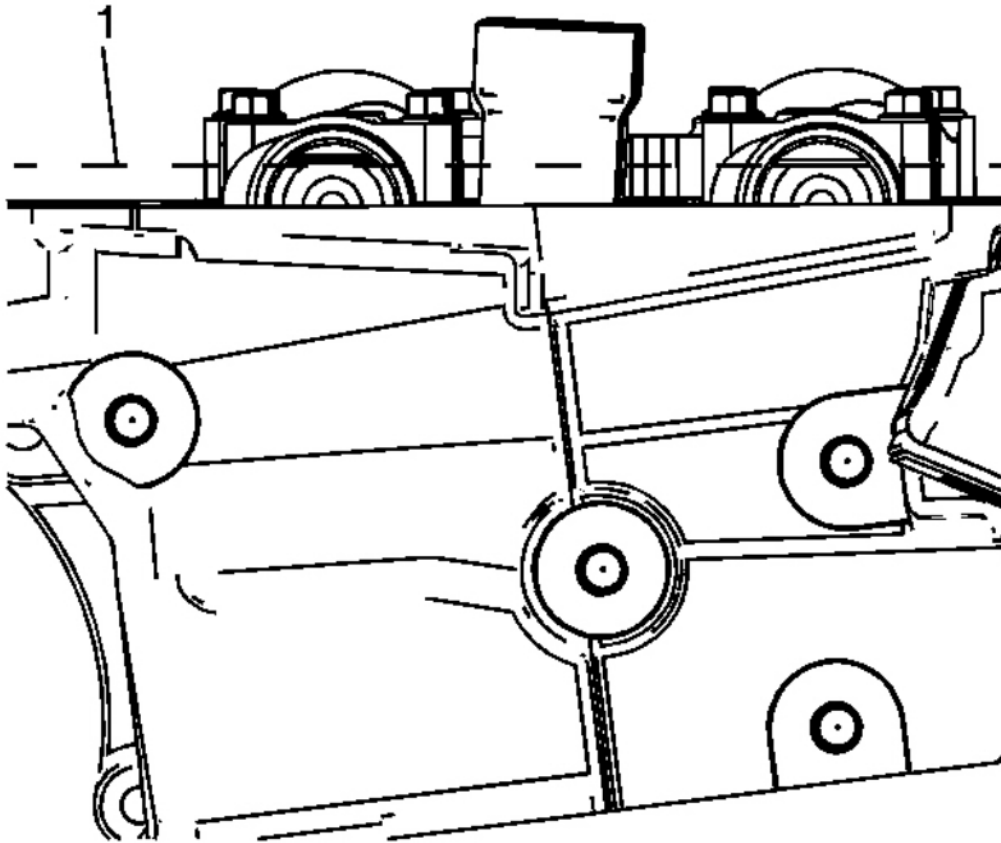


Fig. 164: Camshaft Flats Parallel With Camshaft Cover Rail
Courtesy of GENERAL MOTORS CORP.

6. Rotate the crankshaft with the **EN 46111** until the camshafts are in a neutral (low tension) position. See **Special Tools** . The camshaft flats will be parallel with the camshaft cover rail (1).

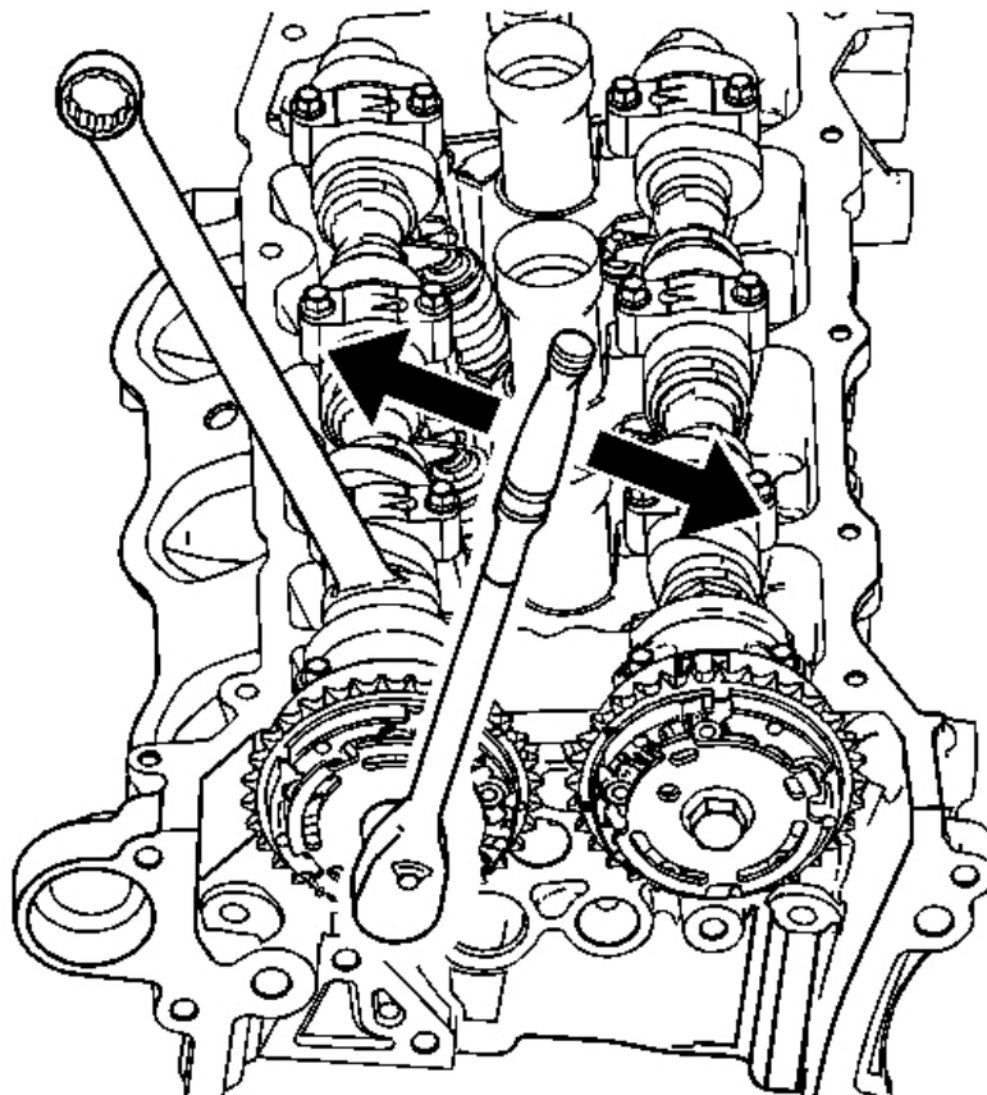


Fig. 165: Preventing Camshaft/Engine Rotation Using Open-End Wrench
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

IMPORTANT: Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

IMPORTANT: DO NOT remove the camshaft position actuator bolt at this time.

7. Loosen the camshaft position actuator bolt.

IMPORTANT: Ensure that the tips of the EN 46108 are fully engaged into the timing chain (3 and 4). See Special Tools .

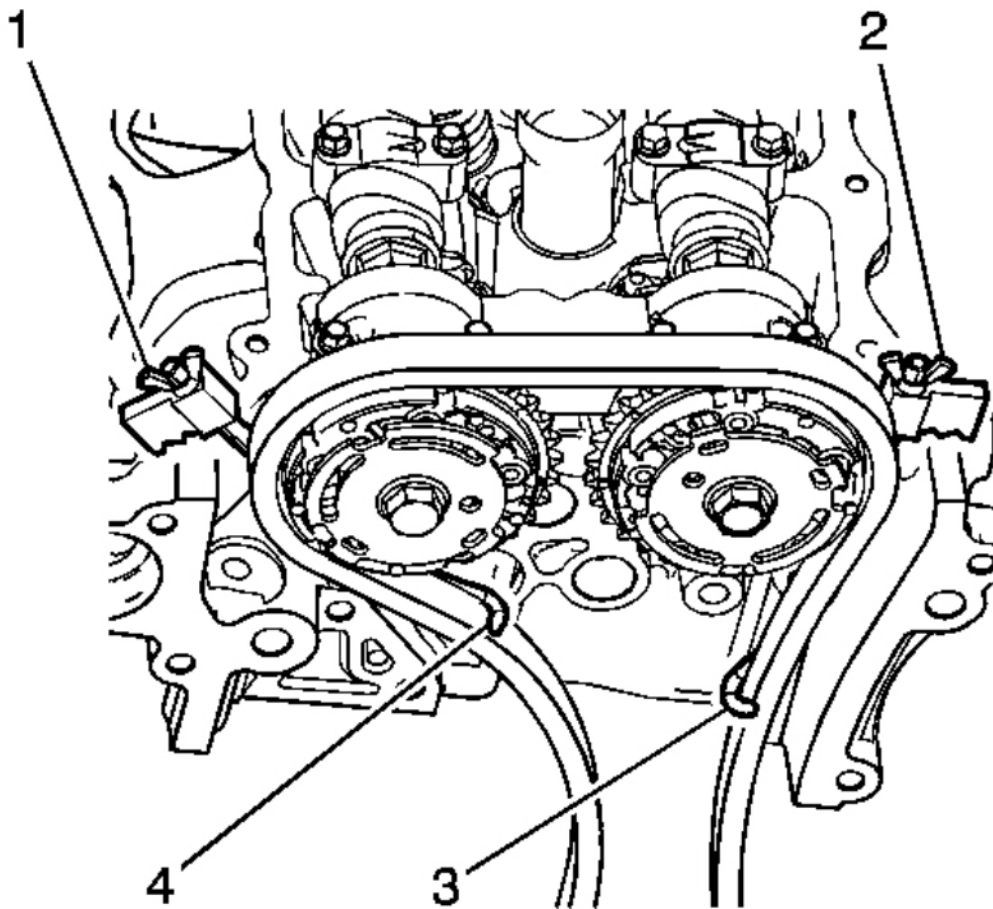


Fig. 166: Identifying EN 46108

Courtesy of GENERAL MOTORS CORP.

8. Install the EN 46108 (1 and 2) in order to retain the timing chain. See Special Tools .

Firmly tighten the EN 46108 nuts. See Special Tools .

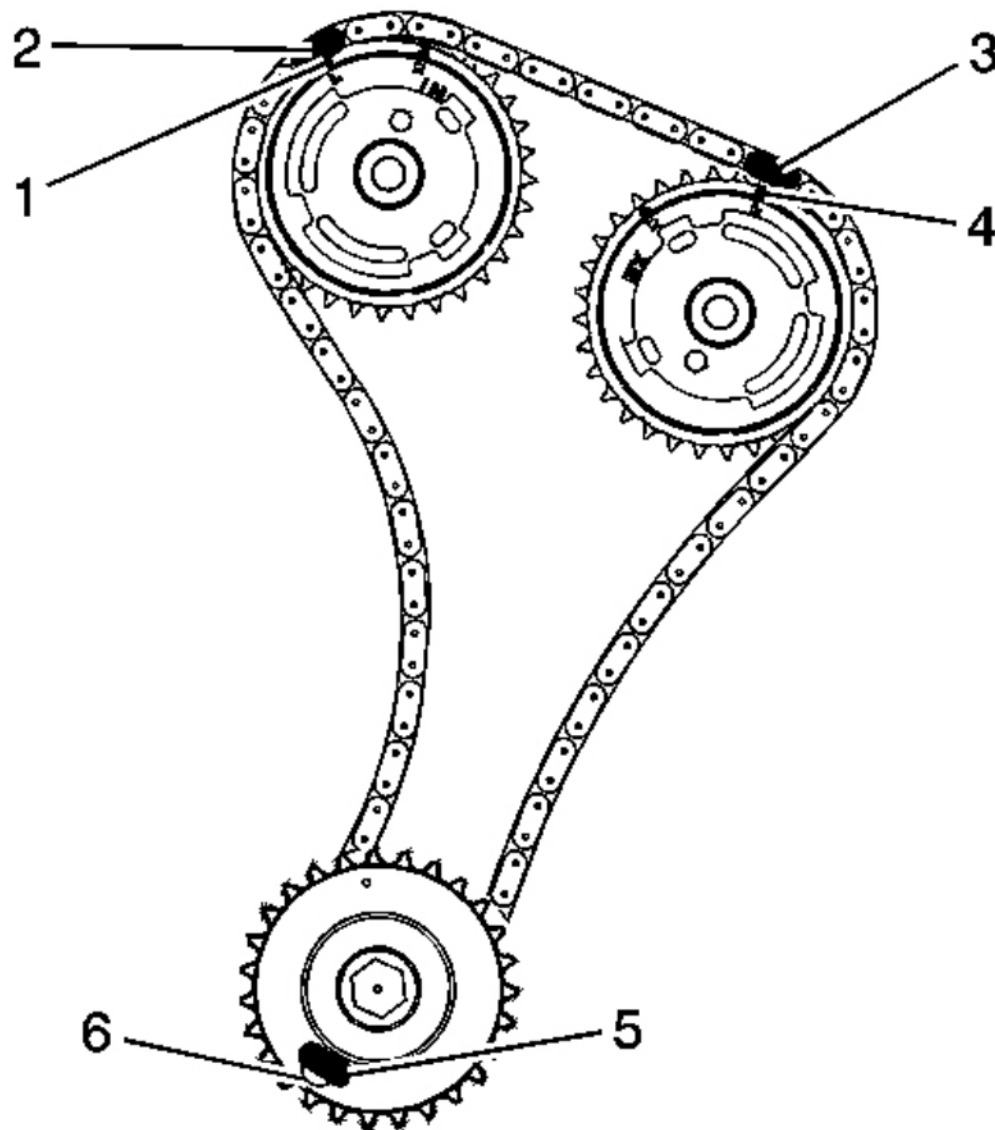


Fig. 167: Locating Left Secondary Camshaft Drive Chain Timing Marks
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the camshaft timing chain and the camshaft position actuators are marked for proper assembly.

9. Mark the timing chain and the respective locations on the camshaft position actuators (1-4).

10. Remove the camshaft position actuator bolt.
11. Remove the camshaft(s). Refer to **Camshaft Removal - Left**.

INSTALLATION PROCEDURE

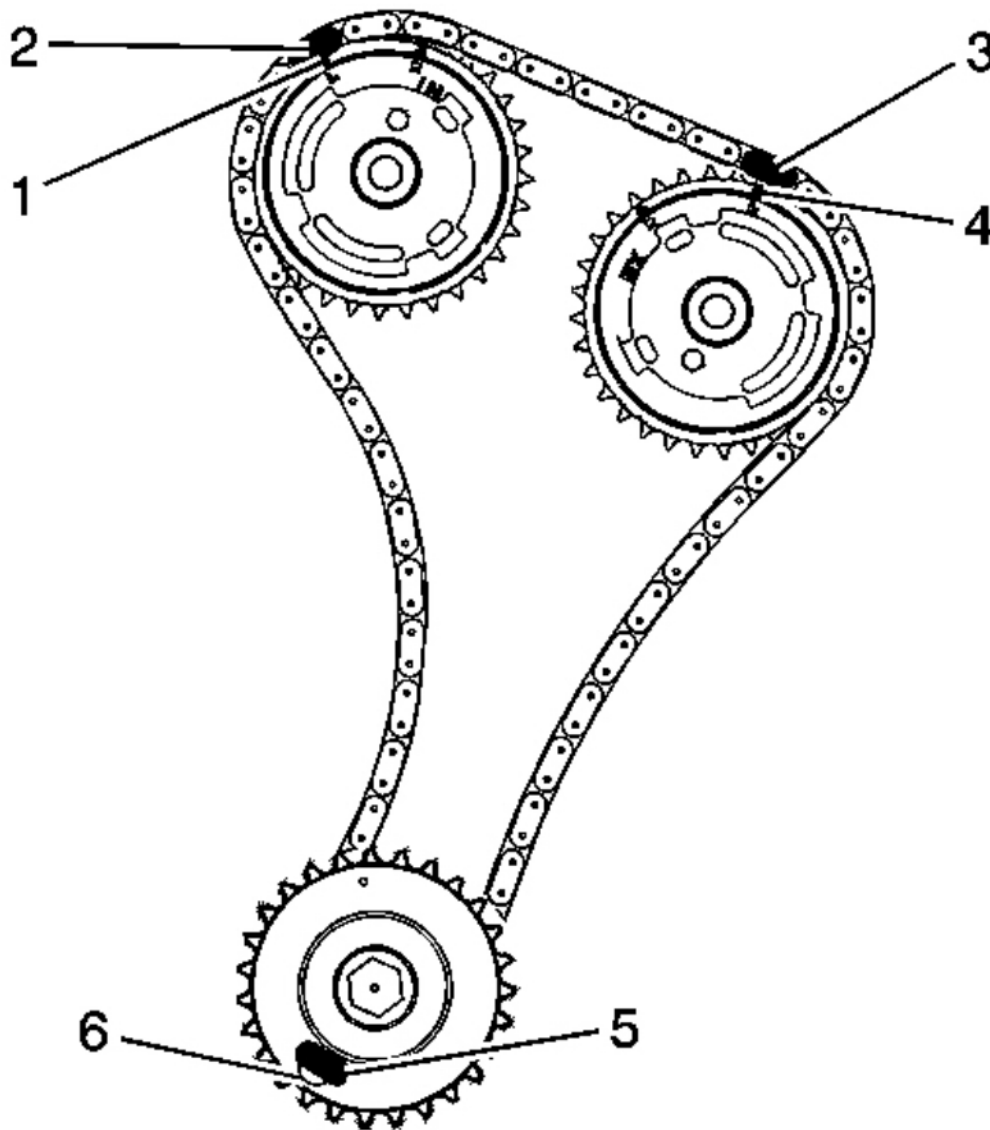


Fig. 168: Locating Left Secondary Camshaft Drive Chain Timing Marks
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the marks on the camshaft position actuator and the timing chain (1-4) are aligned.

IMPORTANT: DO NOT tighten the camshaft position actuator bolt at this time.

1. Locate the camshafts to the cylinder head and assemble the camshaft actuators to the camshafts.
2. Install the camshafts and the camshaft bearing caps. Refer to **Camshaft Installation - Left** .
3. Remove the **EN 46108** . See **Special Tools** .

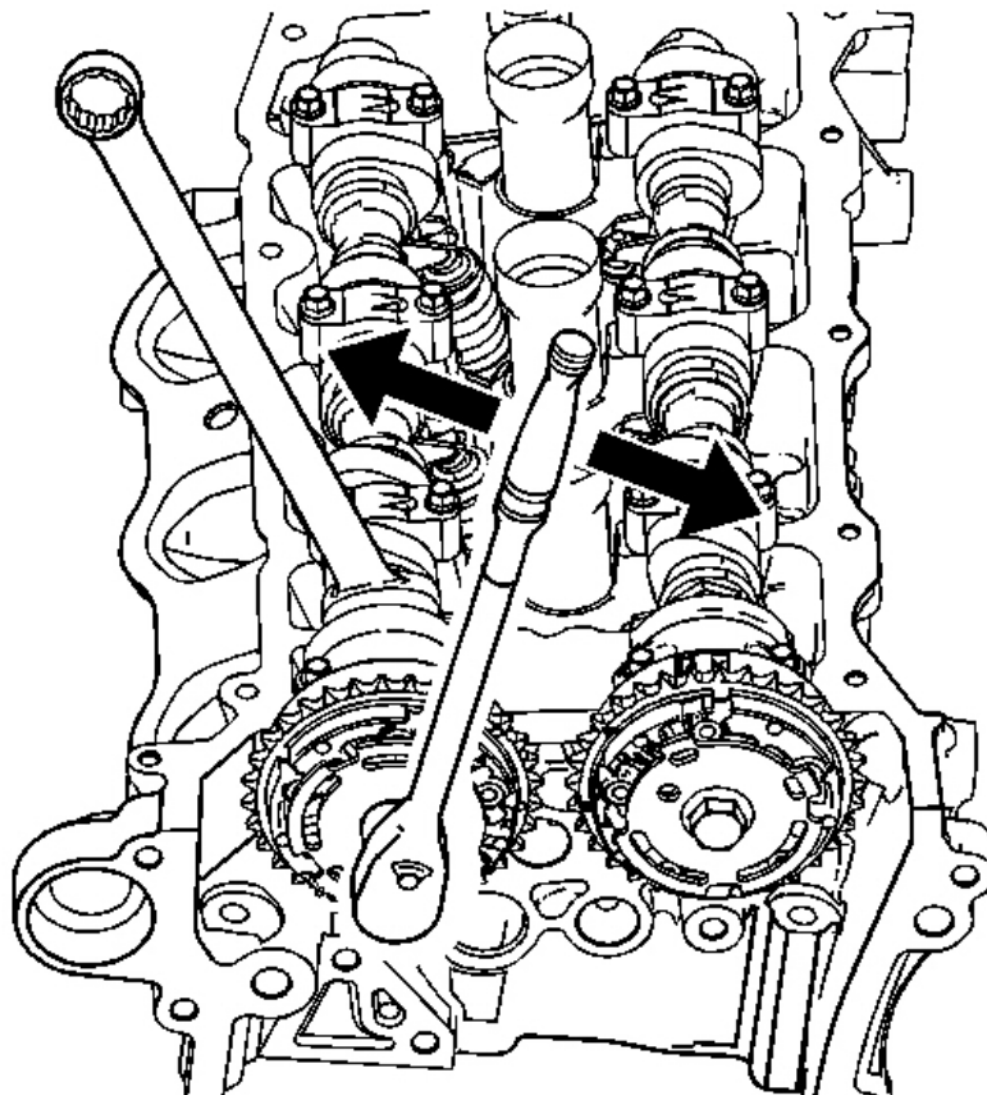


Fig. 169: Preventing Camshaft/Engine Rotation Using Open-End Wrench
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

IMPORTANT: Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

4. Install and tighten the camshaft position actuators. Refer to **Camshaft Position (CMP) Actuator Installation - Left Intake** and **Camshaft Position (CMP) Actuator Installation - Left Exhaust** .
5. Install the intake camshaft position actuator solenoid. Refer to **Camshaft Position (CMP) Actuator Solenoid Replacement - Bank 2 (Left) Intake** in Engine Controls - 2.8L.
6. Install the CMP sensors. Refer to **Camshaft Position (CMP) Sensor Replacement - Bank 2 (Left) Exhaust** and **Camshaft Position (CMP) Sensor Replacement - Bank 2 (Left) Intake** in Engine Controls - 2.8L.
7. Install the crankshaft balancer. Refer to **Crankshaft Balancer Installation** .
8. Install the camshaft cover. Refer to **Camshaft Cover Replacement - Left**.
9. Install the upper intake manifold with the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.

CAMSHAFT REPLACEMENT - RIGHT

TOOLS REQUIRED

- **EN 46108** Timing Chain Retention Tool. See **Special Tools** .
- **EN 46111** Crankshaft Rotation Socket. See **Special Tools** .

REMOVAL PROCEDURE

1. Remove the upper intake manifold with the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.
2. Remove the camshaft cover. Refer to **Camshaft Cover Replacement - Right**.
3. Remove the camshaft position (CMP) sensors. Refer to **Camshaft Position (CMP) Sensor Replacement - Bank 1 (Right) Exhaust** and **Camshaft Position (CMP) Sensor Replacement - Bank 1 (Right) Intake** in Engine Controls - 2.8L.
4. Remove the intake camshaft position actuator solenoid. Refer to **Camshaft Position (CMP) Actuator Solenoid Replacement - Bank 1 (Right) Intake** in Engine Controls - 2.8L.
5. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Removal** .

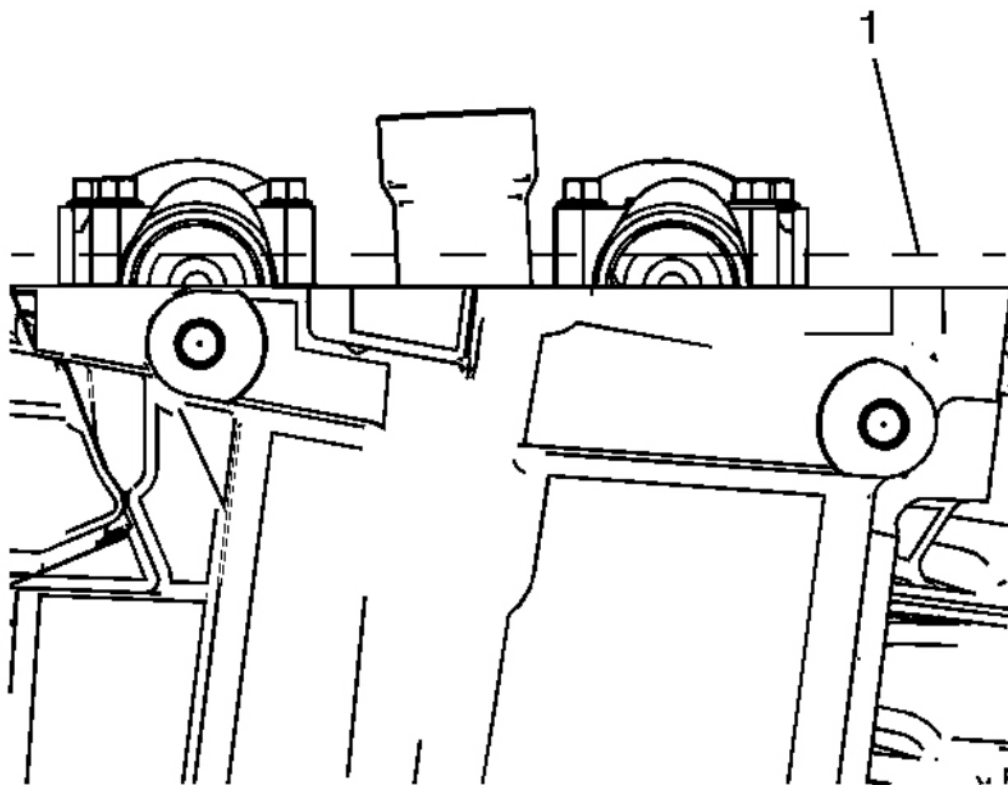


Fig. 170: Identifying Camshaft Neutral (Low Tension) Position
Courtesy of GENERAL MOTORS CORP.

6. Rotate the crankshaft with the **EN 46111** until the camshafts are in a neutral (low tension) position. See **Special Tools** . The camshaft flats will be parallel with the camshaft cover rail (1).

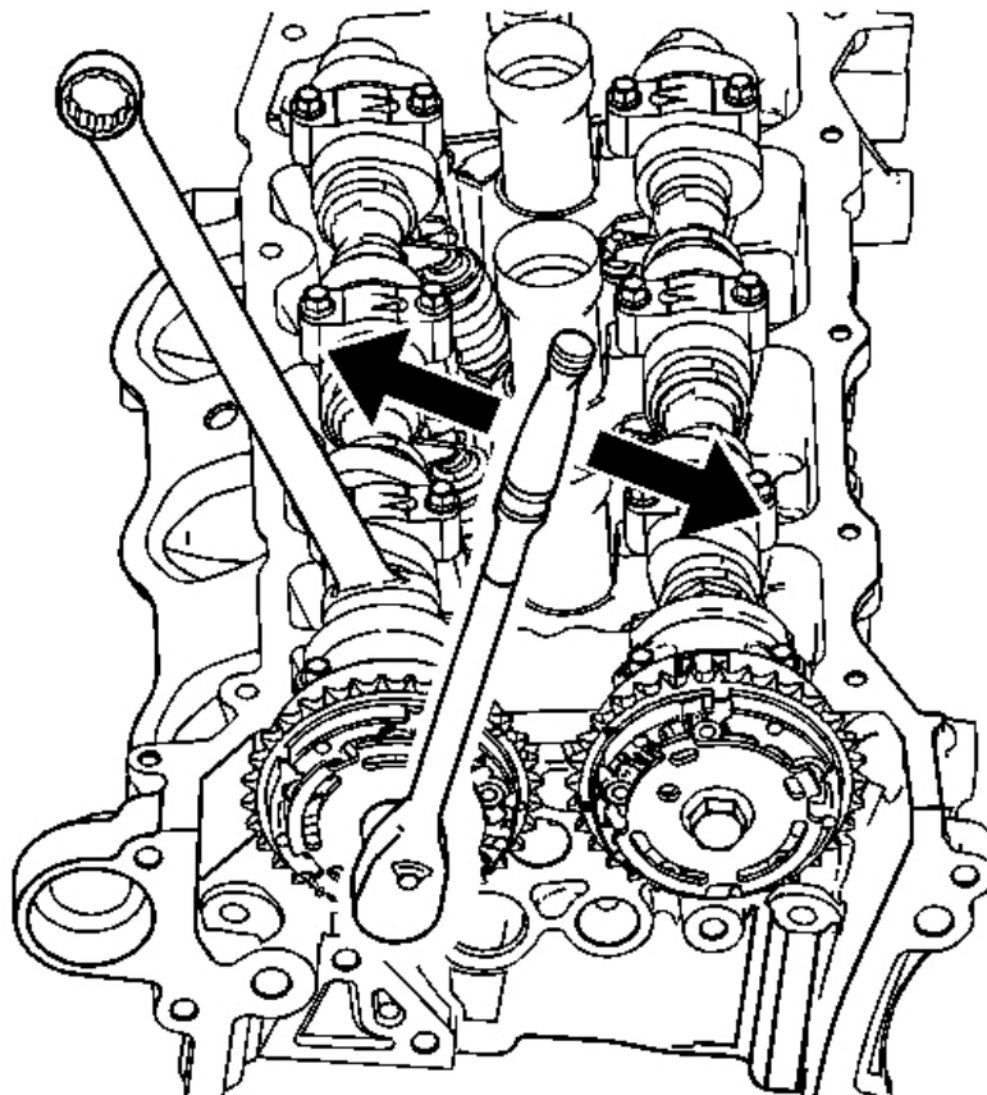


Fig. 171: Preventing Camshaft/Engine Rotation Using Open-End Wrench
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

IMPORTANT: Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

IMPORTANT: DO NOT remove the camshaft position actuator bolt at this time.

7. Loosen the camshaft position actuator bolt.

IMPORTANT: Ensure that the tips of the EN 46108 are fully engaged into the timing chain (3 and 4). See Special Tools .

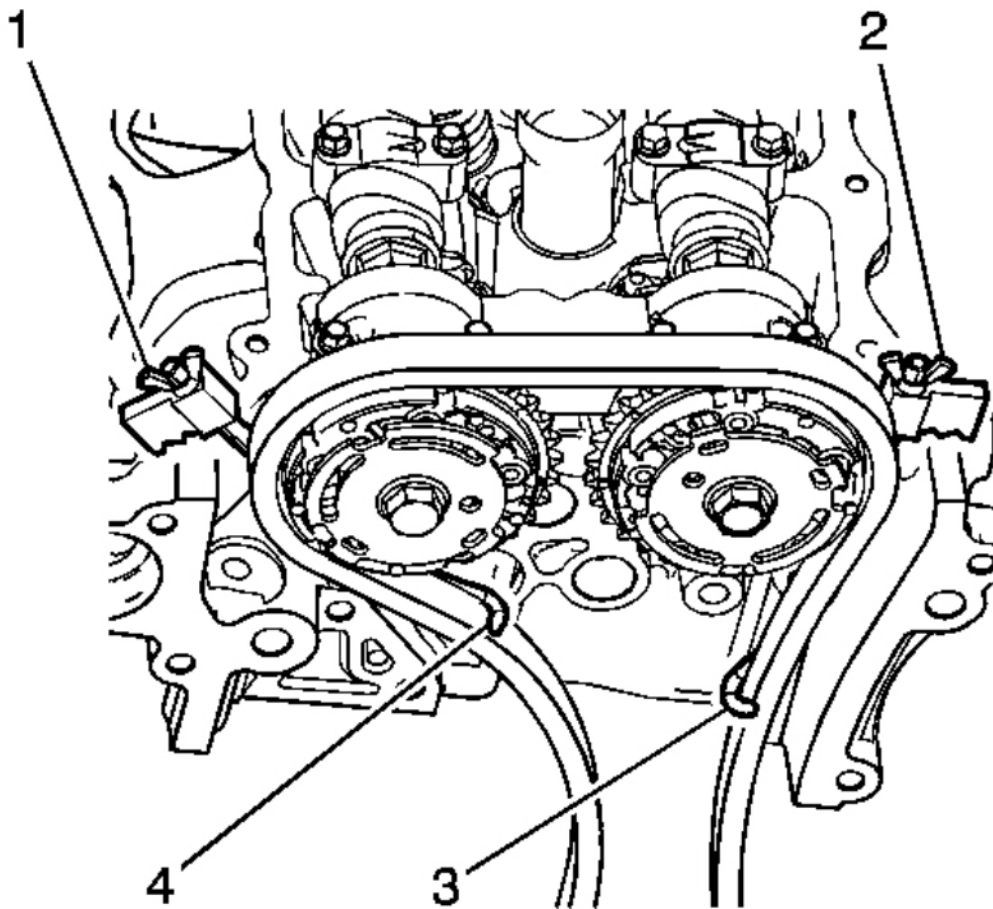


Fig. 172: Identifying EN 46108

Courtesy of GENERAL MOTORS CORP.

8. Install the EN 46108 (1 and 2) in order to retain the timing chain. See Special Tools .

Firmly tighten the EN 46108 nuts. See Special Tools .

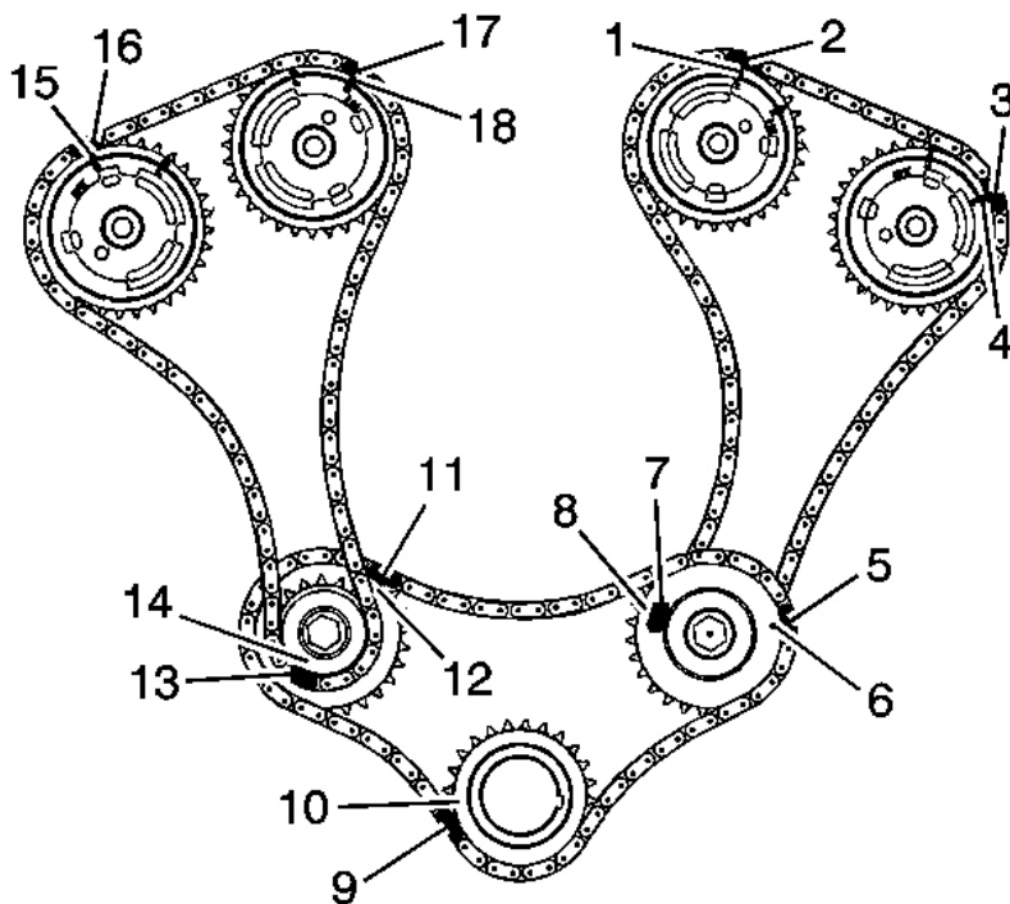


Fig. 173: Identifying Timing Chain Marks And Their Respective Locations On Gears, Sprockets And Actuators

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the camshaft timing chain and the camshaft position actuators are marked for proper assembly.

9. Mark the timing chain and the respective locations on camshaft position actuators (15-18).
10. Remove the camshaft position actuator bolt.
11. Remove the camshaft bearing caps and the camshaft. Refer to **Camshaft Removal - Right**.

INSTALLATION PROCEDURE

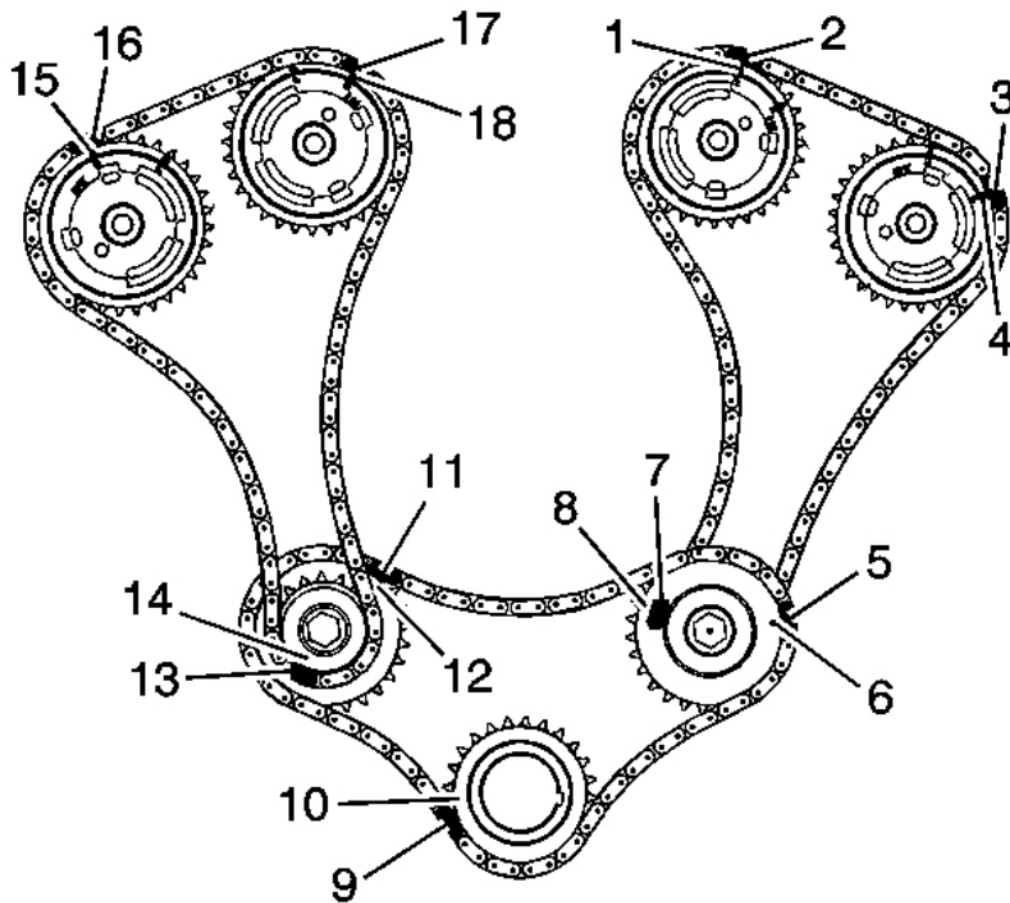


Fig. 174: Identifying Timing Chain Marks And Their Respective Locations On Gears, Sprockets And Actuators

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the marks on the camshaft position actuators and the timing chain (15-18) are aligned.

IMPORTANT: DO NOT tighten the camshaft position actuator bolt at this time.

1. Locate the camshafts to the cylinder head and assemble the camshaft actuators to the camshafts.
2. Install the camshafts and the camshaft bearing caps. Refer to **Camshaft Installation - Right** .
3. Remove the **EN 46108** . See **Special Tools** .
4. Install the crankshaft balancer. Refer to **Crankshaft Balancer Installation** .

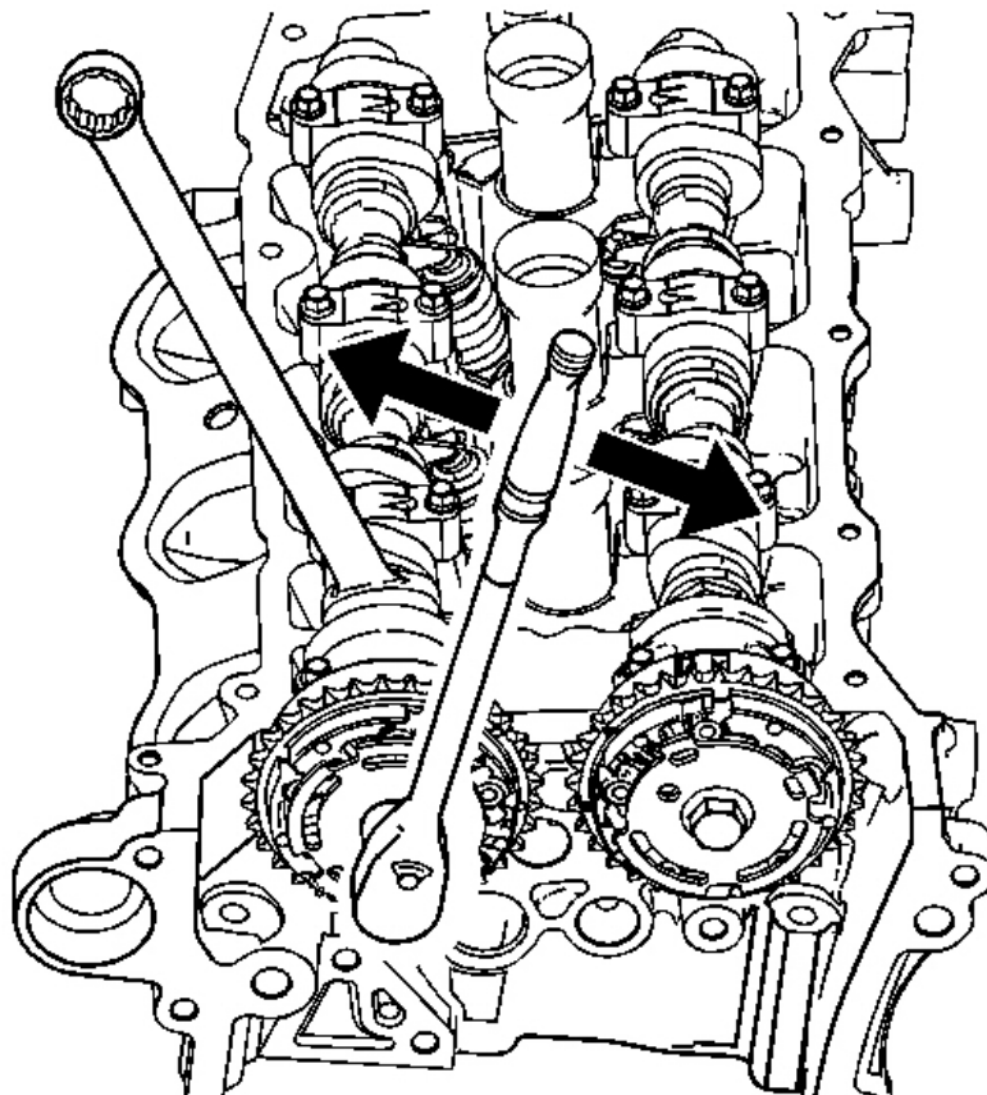


Fig. 175: Preventing Camshaft/Engine Rotation Using Open-End Wrench
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

IMPORTANT: Use an open-end wrench at the camshaft hex to prevent camshaft/engine rotation.

2006 Cadillac CTS

2006 ENGINE Engine Mechanical - 2.8L (LP1) - CTS (1 Of 5)

5. Install and tighten the camshaft position actuators. Refer to **Camshaft Position (CMP) Actuator Installation - Right Intake** and **Camshaft Position (CMP) Actuator Installation - Right Exhaust**.
6. Install the intake camshaft position actuator solenoid. Refer to **Camshaft Position (CMP) Actuator Solenoid Replacement - Bank 1 (Right) Intake** in Engine Controls - 2.8L.
7. Install the CMP sensors. Refer to **Camshaft Position (CMP) Sensor Replacement - Bank 1 (Right) Exhaust** and **Camshaft Position (CMP) Sensor Replacement - Bank 1 (Right) Intake** in Engine Controls - 2.8L.
8. Install the camshaft cover. Refer to **Camshaft Cover Replacement - Right**.
9. Install the upper intake manifold with the lower intake manifold. Refer to **Intake Manifold Replacement - Lower**.

VALVE ROCKER ARM REPLACEMENT - LEFT

REMOVAL PROCEDURE

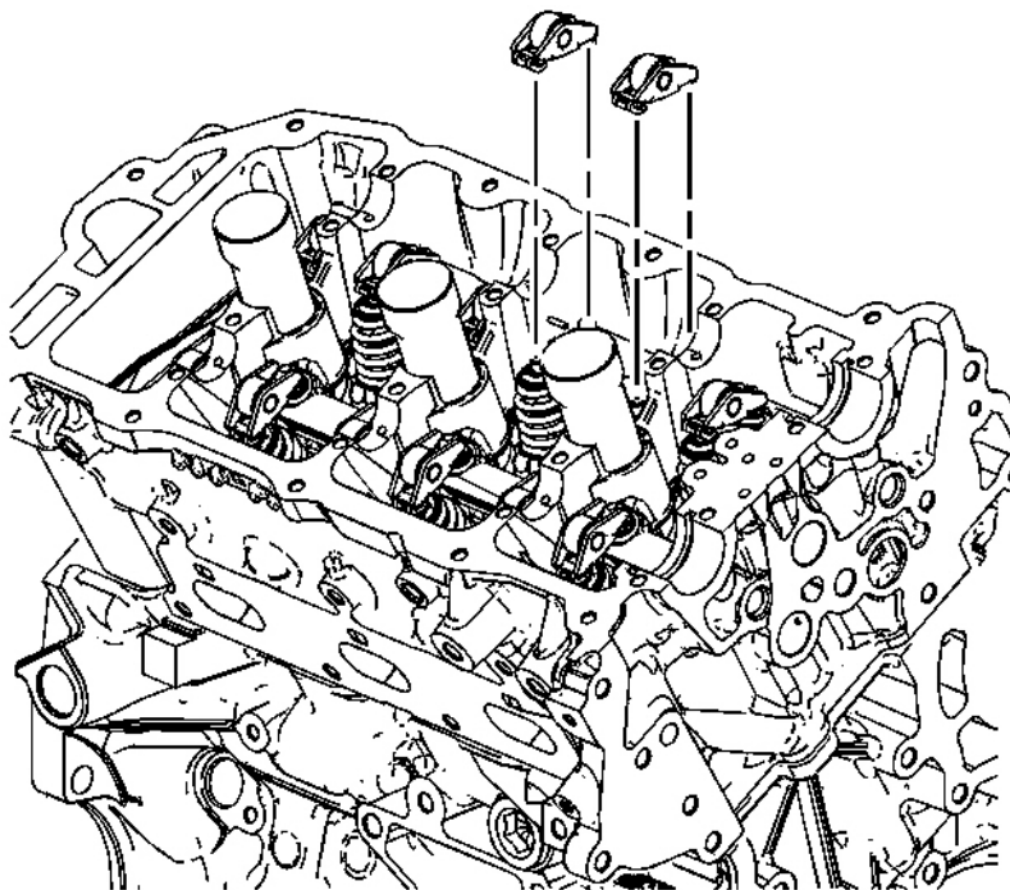


Fig. 176: Identifying Valve Rocker Arms
Courtesy of GENERAL MOTORS CORP.

1. Remove the applicable camshafts. Refer to **Camshaft Replacement - Left**.
2. Remove the rocker arms. Refer to **Valve Rocker Arm Removal - Left**.
3. Clean and inspect the camshafts and the rocker arms. Repair or replace as necessary. Refer to **Camshaft Cleaning and Inspection** and **Valve Rocker Arms Cleaning and Inspection**.

INSTALLATION PROCEDURE

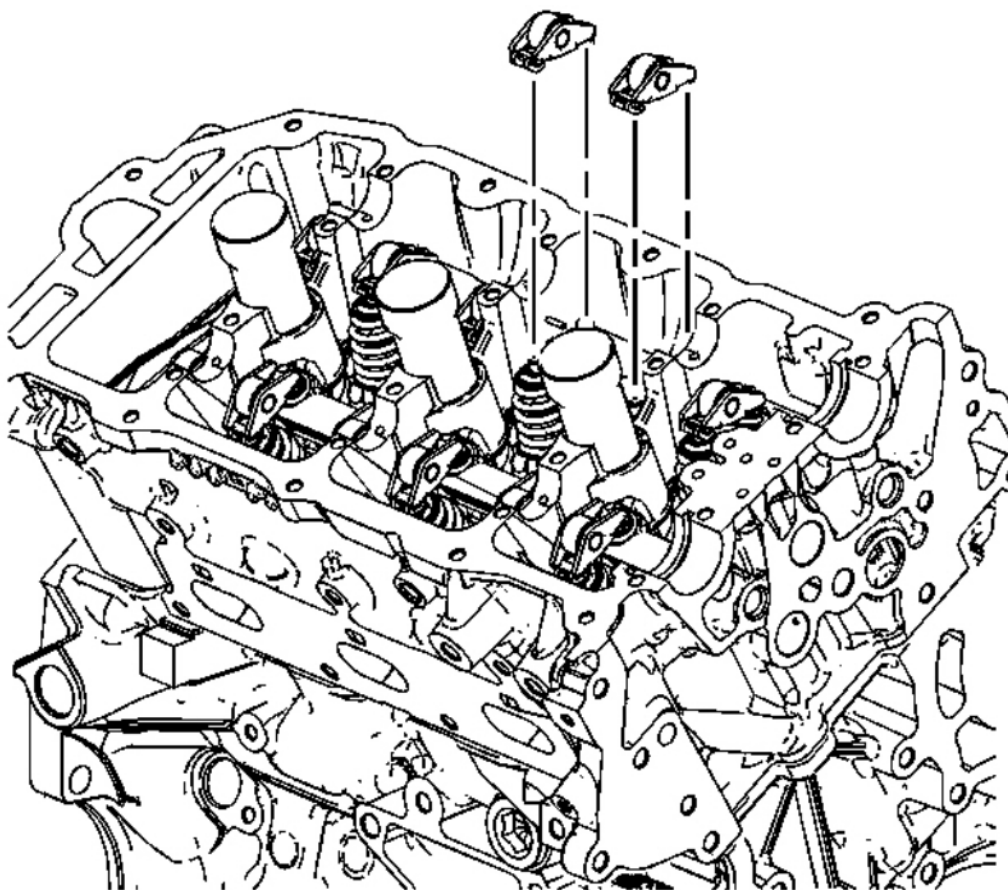


Fig. 177: Identifying Valve Rocker Arms
Courtesy of GENERAL MOTORS CORP.

1. Install the rocker arms. Refer to **Valve Rocker Arm Installation - Left**.
2. Install the applicable camshafts. Refer to **Camshaft Installation - Left**.

VALVE ROCKER ARM REPLACEMENT - RIGHT

REMOVAL PROCEDURE

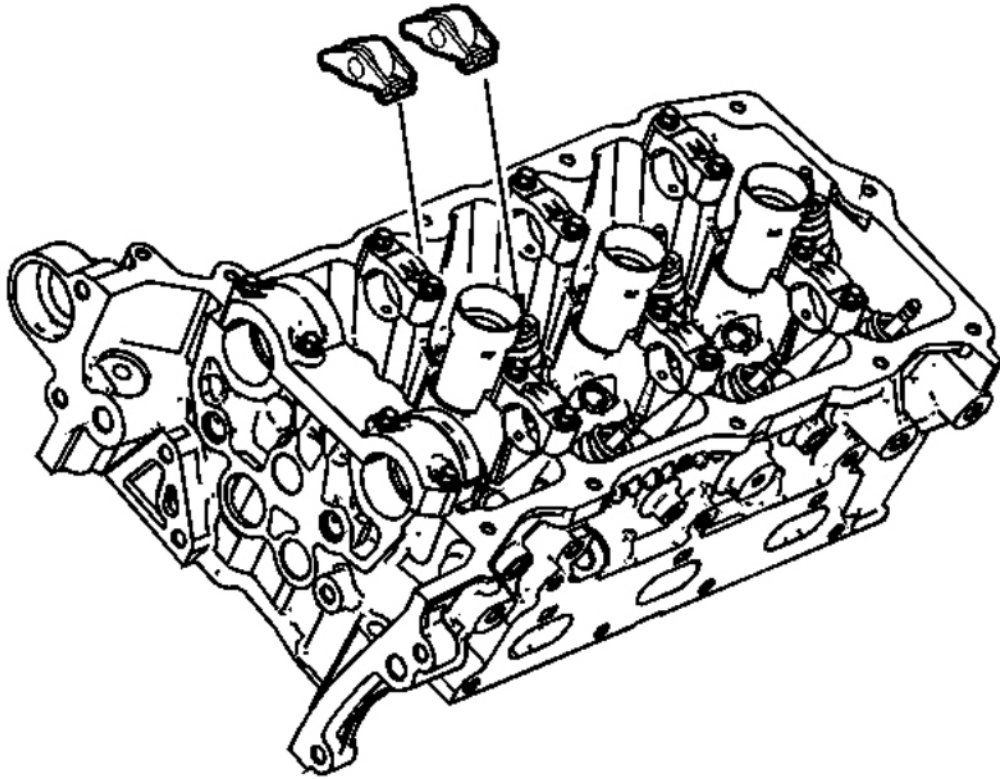


Fig. 178: View Of Valve Rocker Arm
Courtesy of GENERAL MOTORS CORP.

1. Remove the applicable camshafts. Refer to **Camshaft Replacement - Right**.
2. Remove the rocker arms. Refer to **Valve Rocker Arm Removal - Right**.
3. Clean and inspect the camshafts and the rocker arms. Repair or replace as necessary. Refer to **Camshaft Cleaning and Inspection** and **Valve Rocker Arms Cleaning and Inspection**.

INSTALLATION PROCEDURE

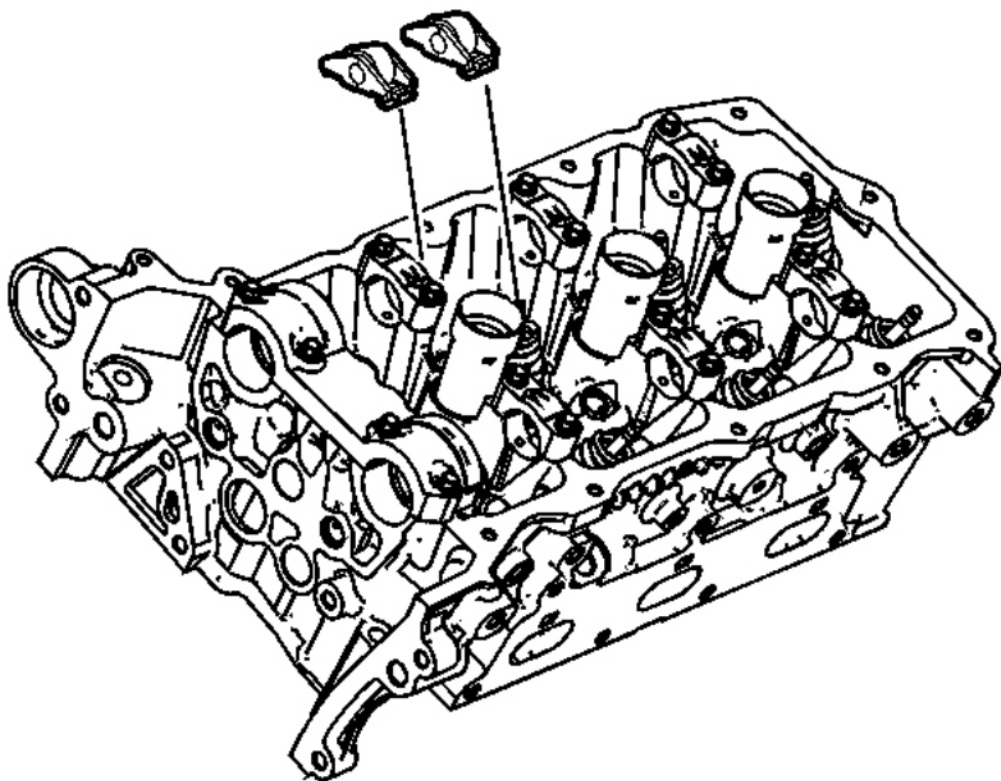


Fig. 179: View Of Valve Rocker Arm
Courtesy of GENERAL MOTORS CORP.

1. Install the rocker arms. Refer to **Valve Rocker Arm Installation - Right** .
2. Install the applicable camshafts. Refer to **Camshaft Replacement - Right**.

VALVE LIFTER REPLACEMENT - LEFT

REMOVAL PROCEDURE

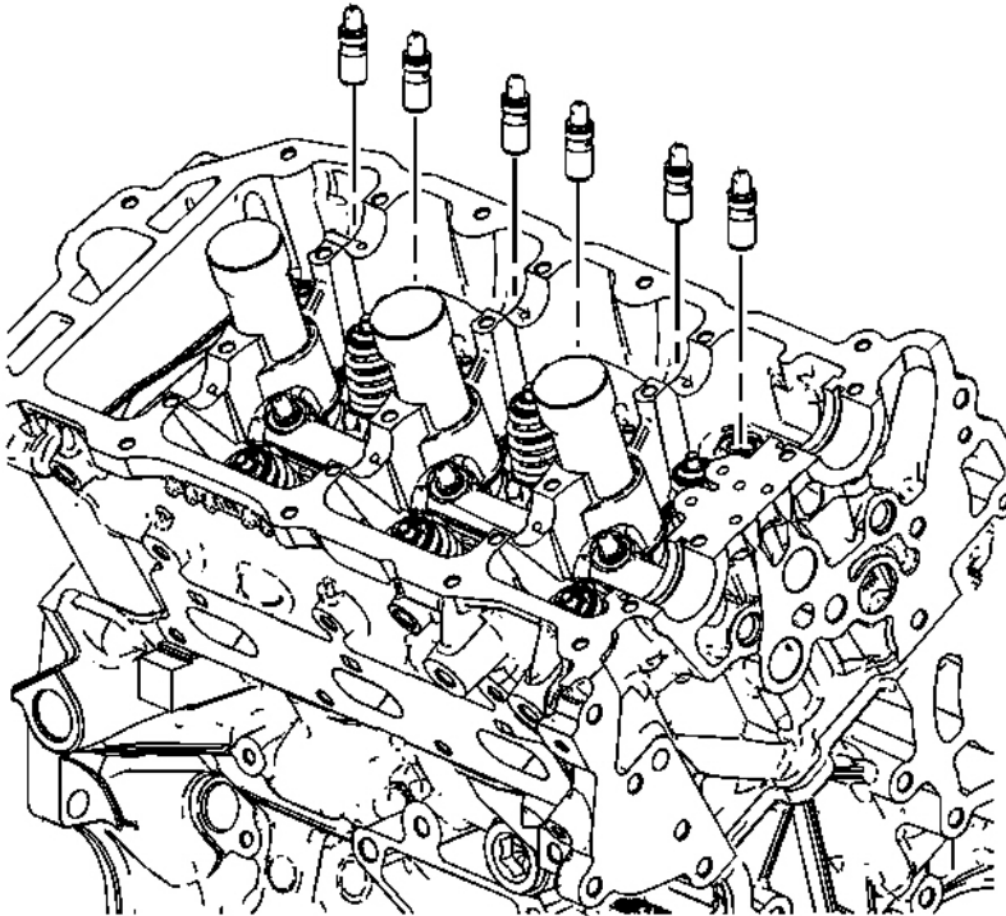


Fig. 180: Identifying Stationary Hydraulic Lash Adjuster (SHLA)
Courtesy of GENERAL MOTORS CORP.

1. Remove the applicable camshafts. Refer to Camshaft Replacement - Left.
2. Remove the rocker arms. Refer to Valve Rocker Arm Removal - Left.
3. Remove the lifters. Refer to Valve Lifter Removal - Left.
4. Clean and inspect the camshafts, rocker arms and lifters. Repair or replace as necessary. Refer to Camshaft Cleaning and Inspection, Valve Rocker Arms Cleaning and Inspection and Valve Lifters Cleaning and Inspection.

INSTALLATION PROCEDURE

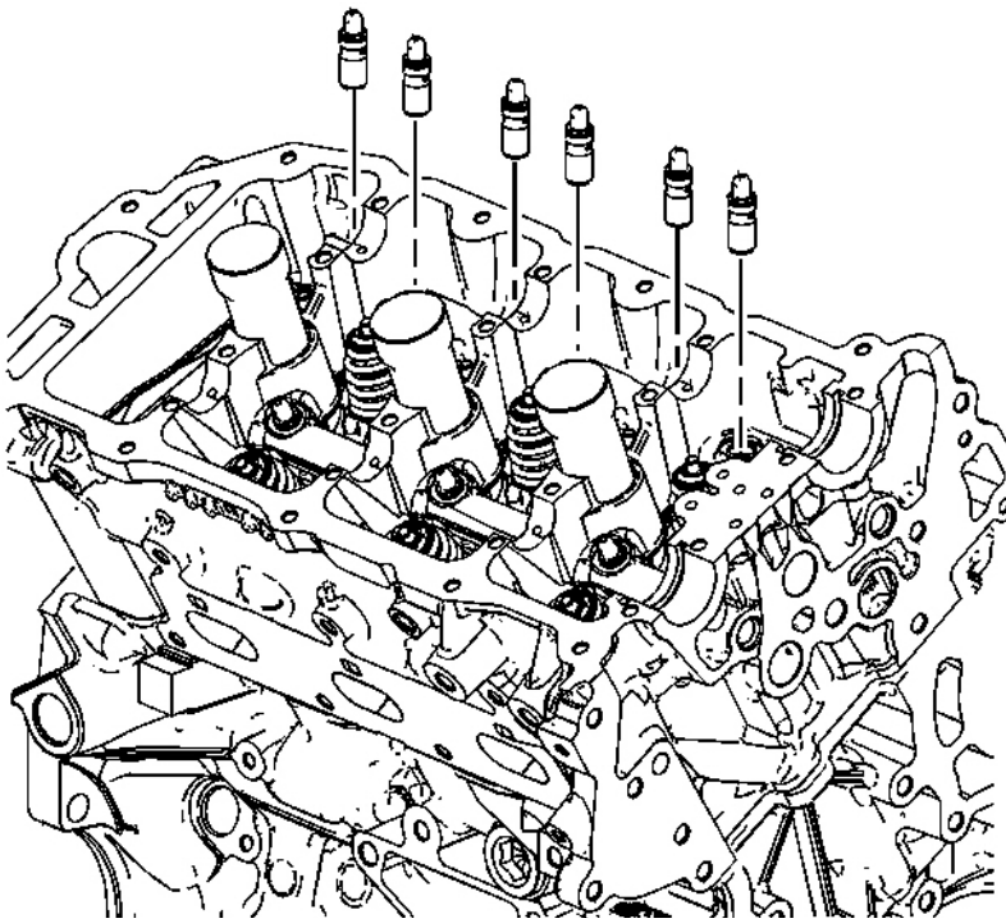


Fig. 181: Identifying Stationary Hydraulic Lash Adjuster (SHLA)
Courtesy of GENERAL MOTORS CORP.

1. Install the lifters. Refer to Valve Lifter Installation - Left.
2. Install the rocker arms. Refer to Valve Rocker Arm Installation - Left.
3. Install the applicable camshafts. Refer to Camshaft Replacement - Left.

VALVE LIFTER REPLACEMENT - RIGHT

REMOVAL PROCEDURE

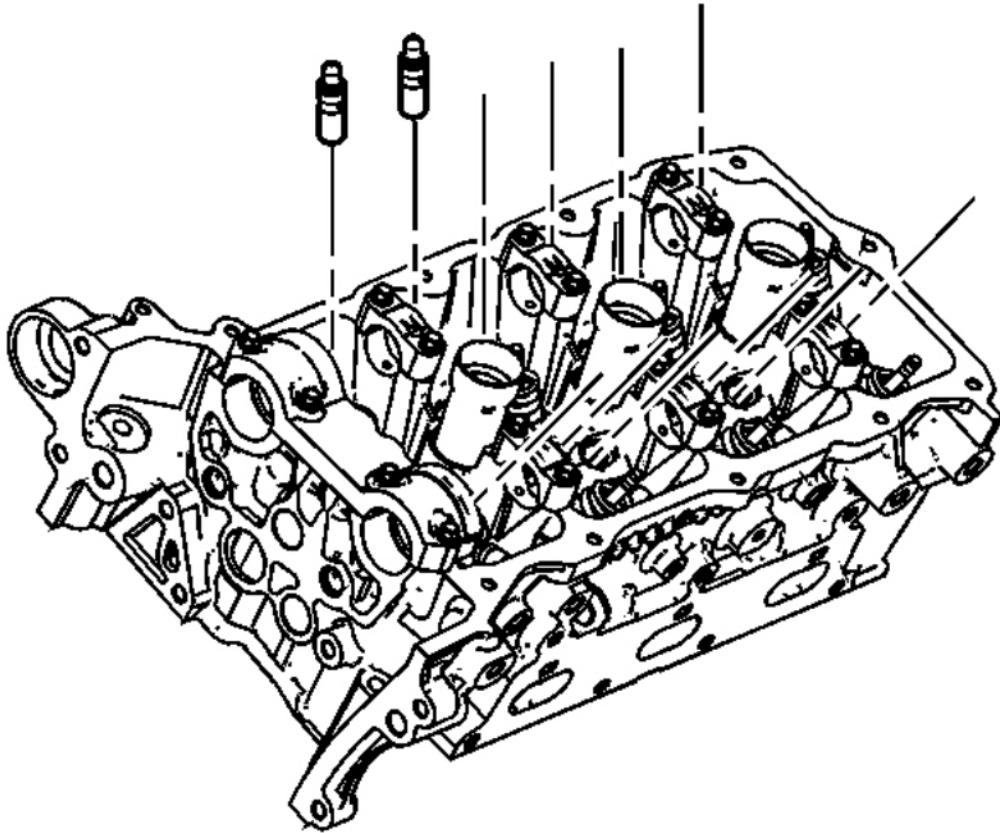


Fig. 182: View Of SHLAs

Courtesy of GENERAL MOTORS CORP.

1. Remove the applicable camshafts. Refer to [Camshaft Replacement - Right](#).
2. Remove the rocker arms. Refer to [Valve Rocker Arm Removal - Right](#).
3. Remove the lifters. Refer to [Valve Lifter Removal - Right](#).
4. Clean and inspect the camshafts, rocker arms and lifters. Repair or replace as necessary. Refer to [Camshaft Cleaning and Inspection](#), [Valve Rocker Arms Cleaning and Inspection](#) and [Valve Lifters Cleaning and Inspection](#).

INSTALLATION PROCEDURE

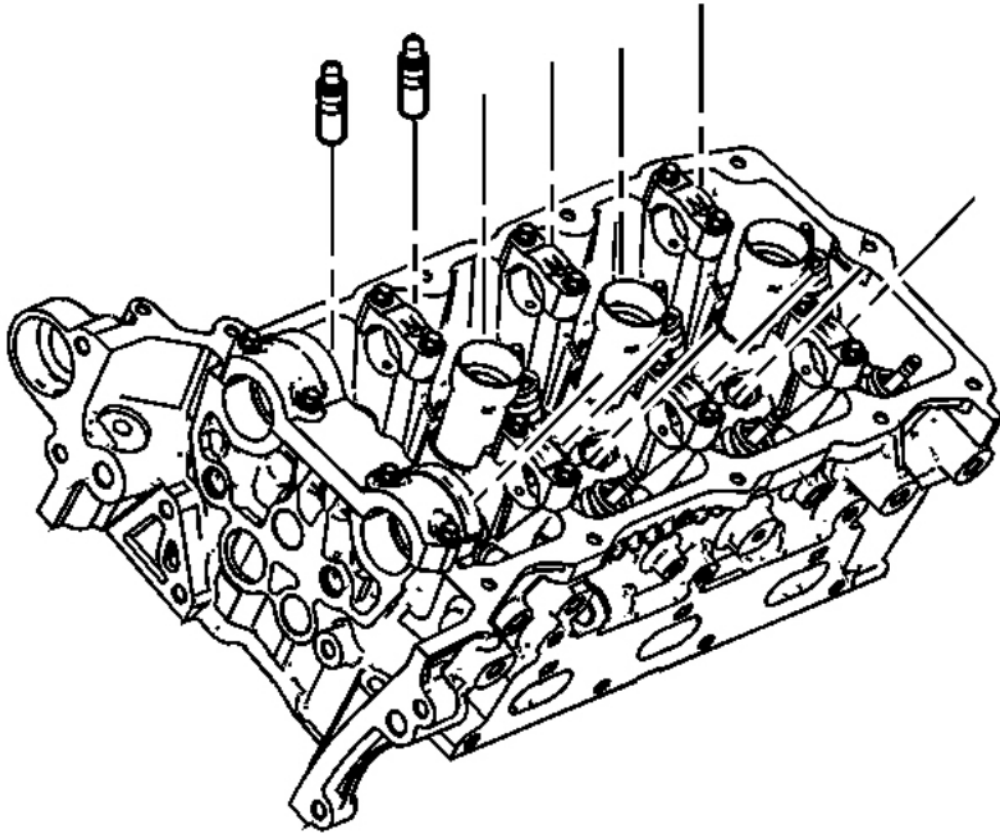


Fig. 183: View Of SHLAs

Courtesy of GENERAL MOTORS CORP.

1. Install the lifters. Refer to [Valve Lifter Installation - Right](#) .
2. Install the rocker arms. Refer to [Valve Rocker Arm Installation - Right](#) .
3. Install the applicable camshafts. Refer to [Camshaft Replacement - Right](#).

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT - LEFT

Tools Required

- J 39313 Spark Plug Port Adapter. See [Special Tools](#) .
- EN 46106 Flywheel Holding Tool. See [Special Tools](#) .
- EN 46108 Timing Chain Retention Tool. See [Special Tools](#) .
- EN 46110 On-Vehicle Valve Spring Compressor. See [Special Tools](#) .

- EN 46116 Valve Stem Seal Remover/Installer. See Special Tools .

REMOVAL PROCEDURE

1. Remove the starter motor. Refer to Starter Motor Replacement (LP1, LY7) in Engine Electrical.

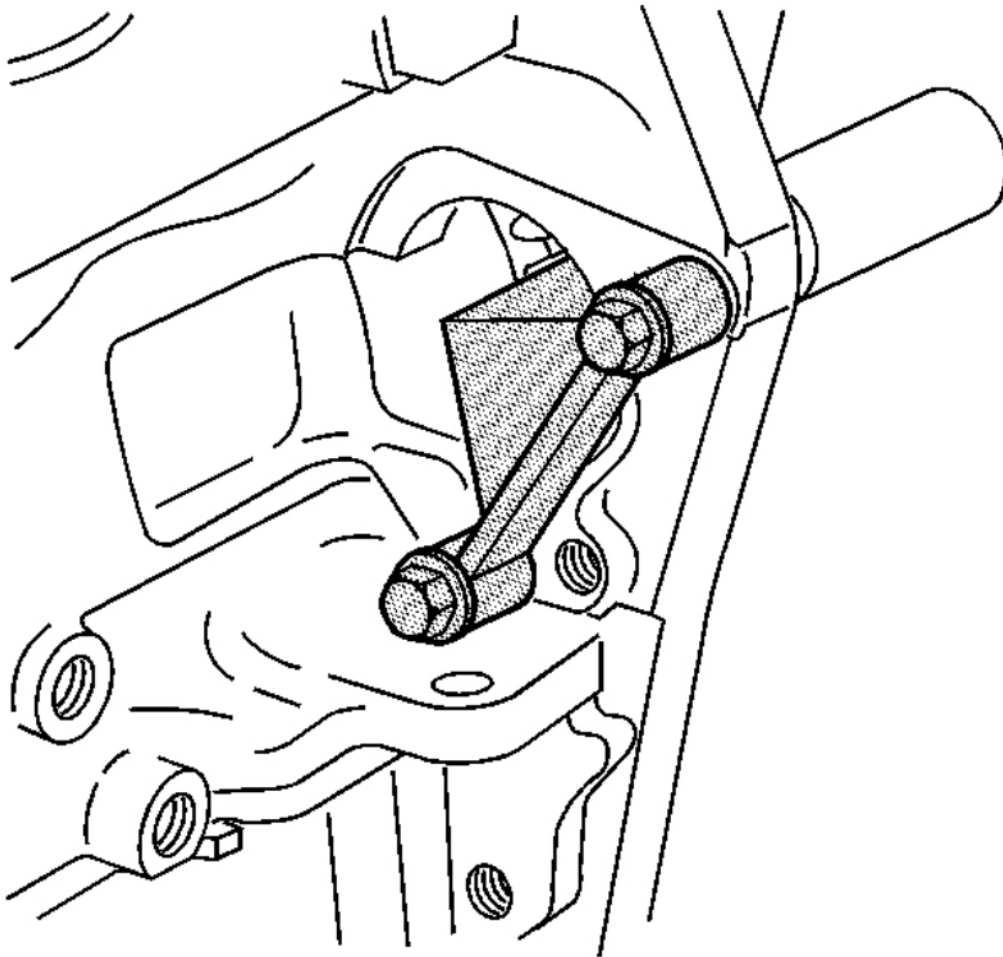


Fig. 184: View Of Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If the EN 46106 is not installed, the crankshaft may rotate. See Special Tools . If the crankshaft rotates, disassembly and reassembly of the entire camshaft timing system may be required.

2. Install the **EN 46106** in order to prevent crankshaft rotation. See **Special Tools** .
3. Remove the camshafts and rocker arms. Refer to **Camshaft Replacement - Left**.
4. Remove the spark plug from the applicable cylinder. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
5. Install the **J 39313** to the applicable cylinder. See **Special Tools** .
6. Connect the **J 39313** to a compressed air source. See **Special Tools** .

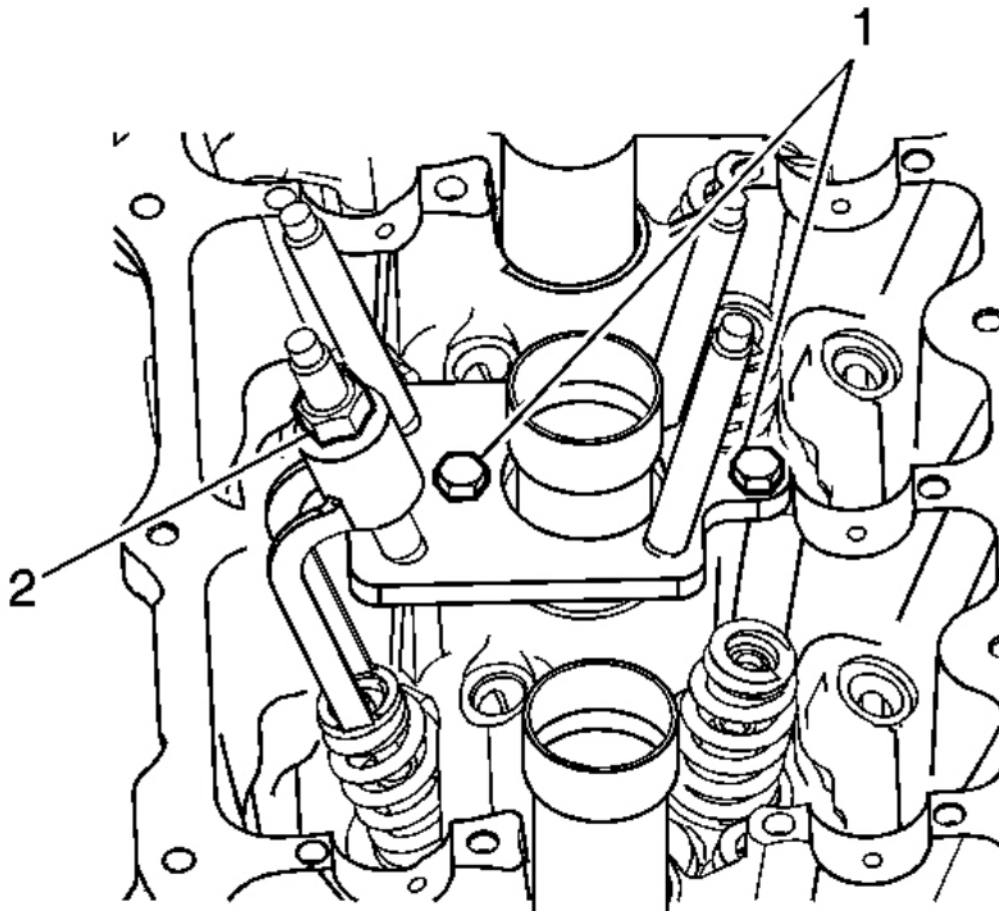


Fig. 185: View Of Installed Valve Spring Compressor Tool
Courtesy of GENERAL MOTORS CORP.

7. Install the **EN 46110** above the applicable cylinder as shown. See **Special Tools** .
8. Tighten the **EN 46110** valve spring compressor nut (2). See **Special Tools** .

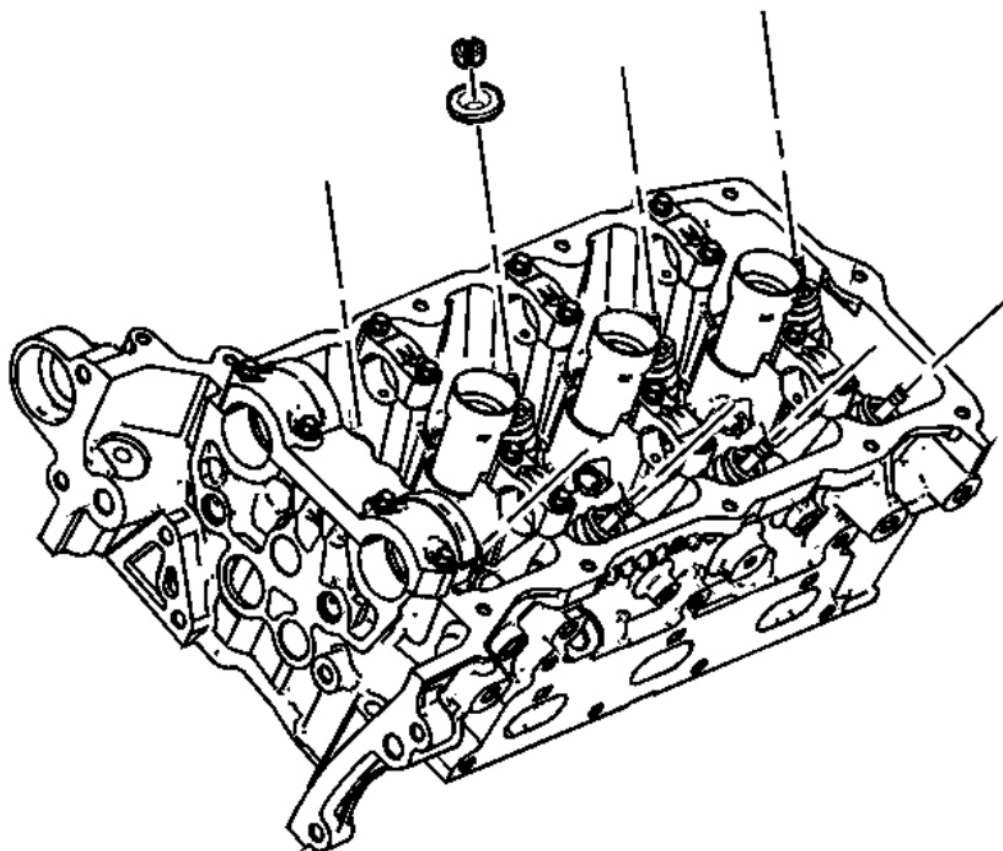


Fig. 186: View Of Valve Spring Keepers
Courtesy of GENERAL MOTORS CORP.

9. Remove the valve keepers.
10. Loosen the **EN 46110** valve spring compressor nut. See **Special Tools** .
11. Remove the valve spring retainer.

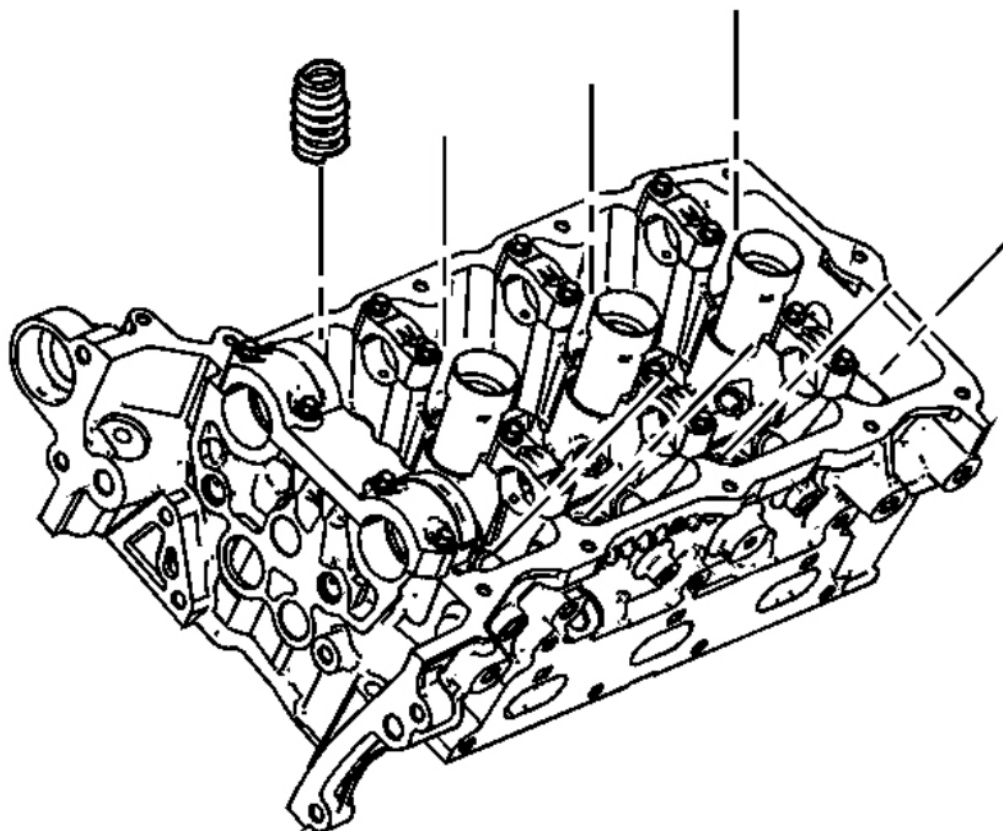


Fig. 187: View Of Valve Spring
Courtesy of GENERAL MOTORS CORP.

12. Remove the valve spring.

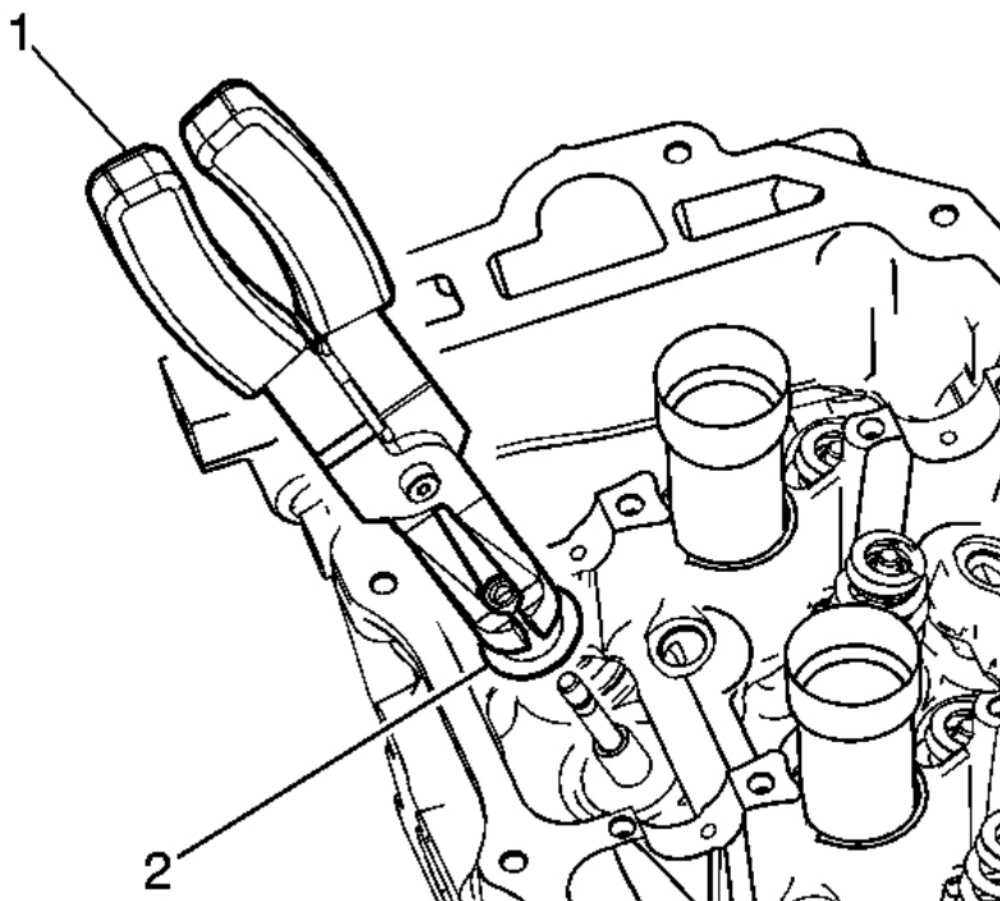


Fig. 188: Removing/Installing Valve Stem Seal
Courtesy of GENERAL MOTORS CORP.

13. Use the **EN 46116** (1) in order to remove the valve stem seal (2). See **Special Tools** .

INSTALLATION PROCEDURE

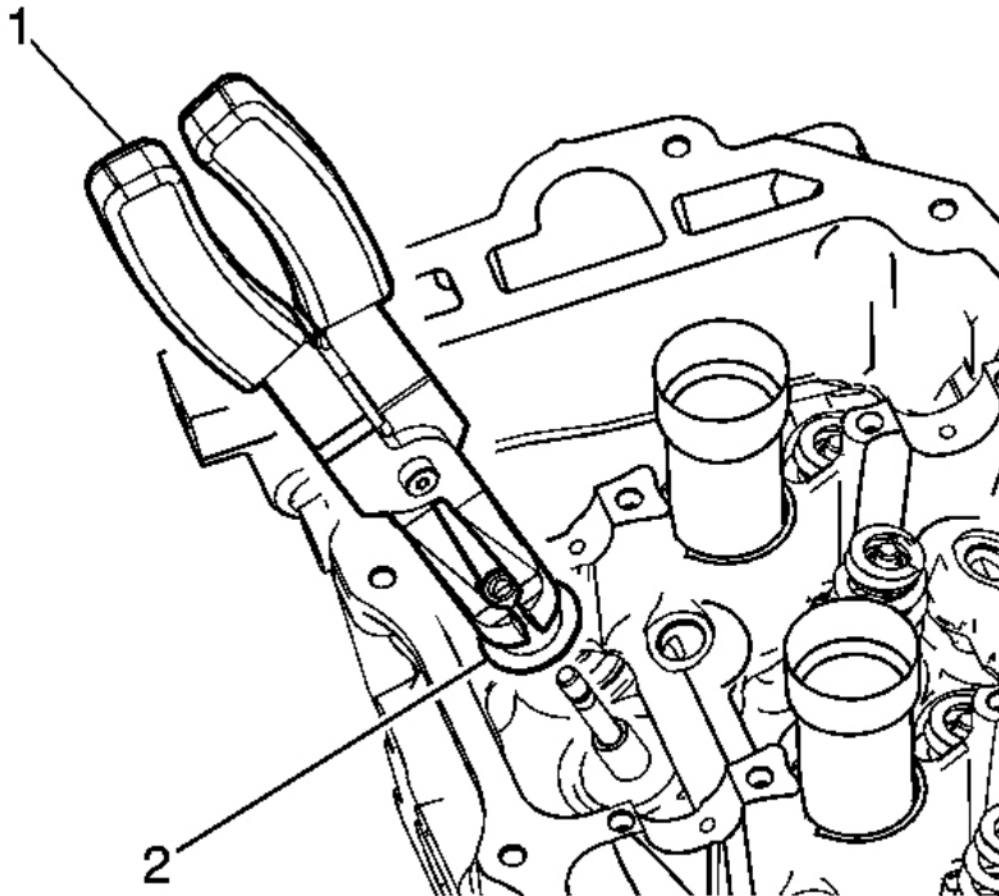


Fig. 189: Removing/Installing Valve Stem Seal
Courtesy of GENERAL MOTORS CORP.

1. Use the **EN 46116** (1) in order to install the valve stem seal (2). See **Special Tools** .

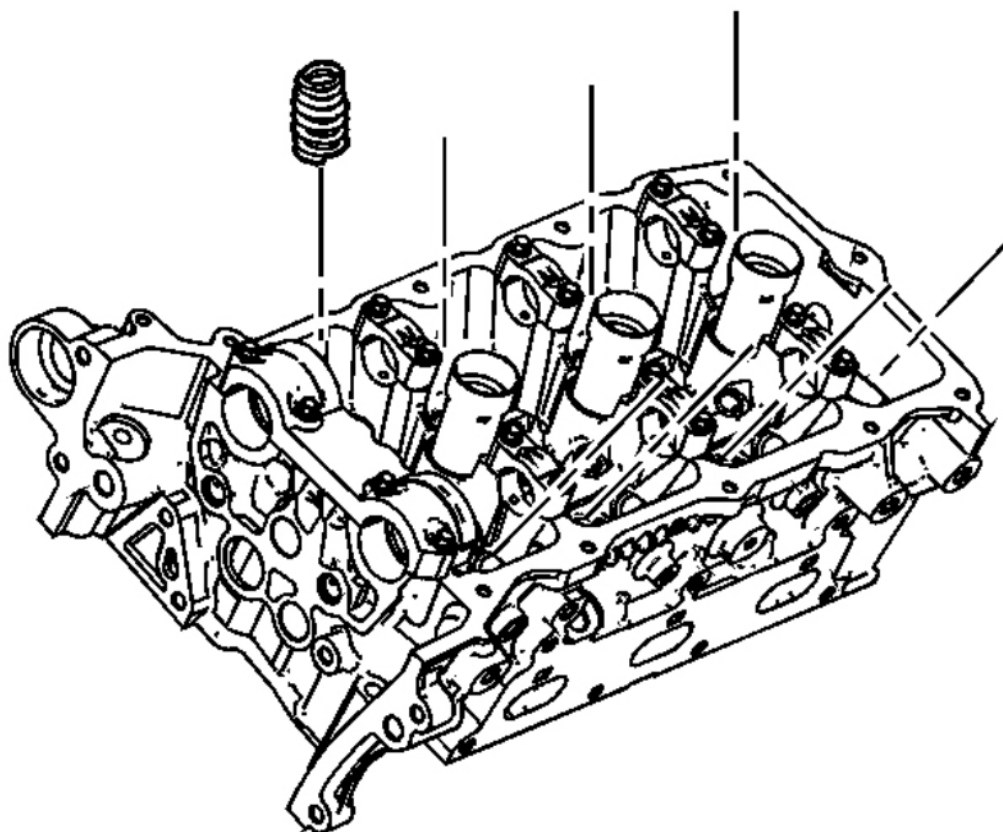


Fig. 190: View Of Valve Spring

Courtesy of GENERAL MOTORS CORP.

2. Install the valve spring.
3. Install the valve spring retainer.

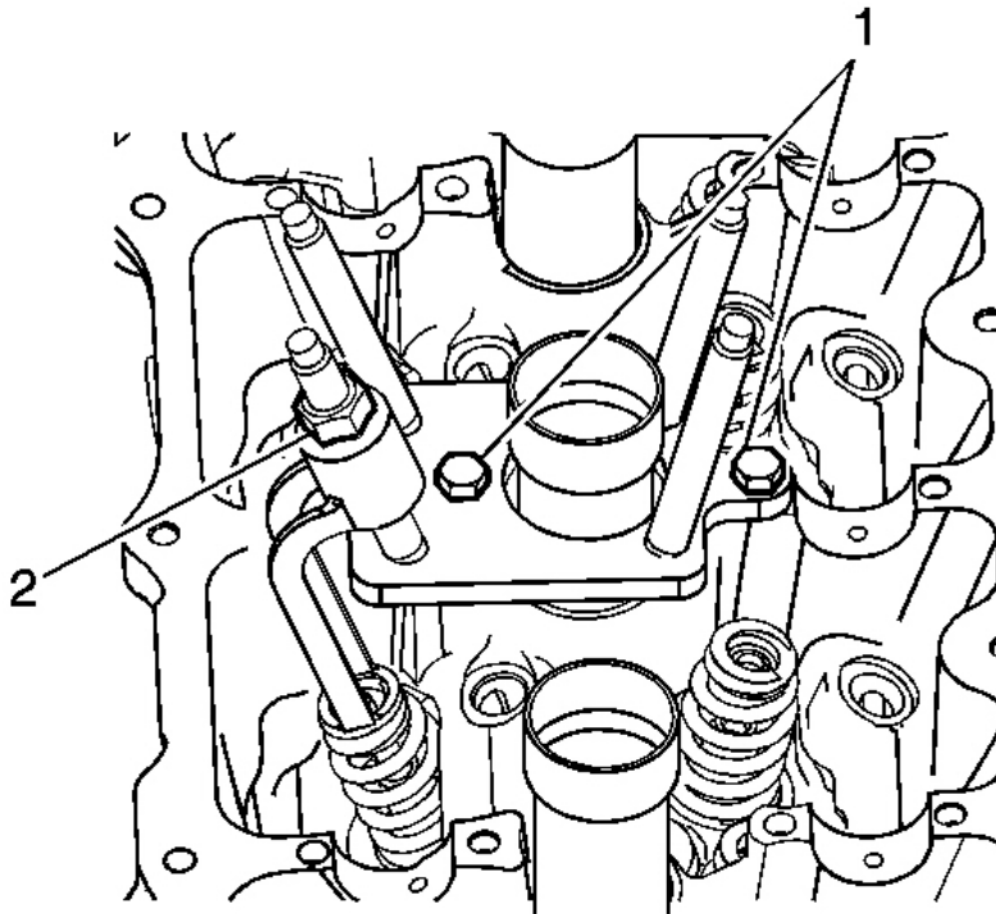


Fig. 191: View Of Installed Valve Spring Compressor Tool
Courtesy of GENERAL MOTORS CORP.

4. Install the **EN 46110** above the applicable valve spring as shown. See **Special Tools** .
Tighten the **EN 46110** valve spring compressor nut (2). See **Special Tools** .

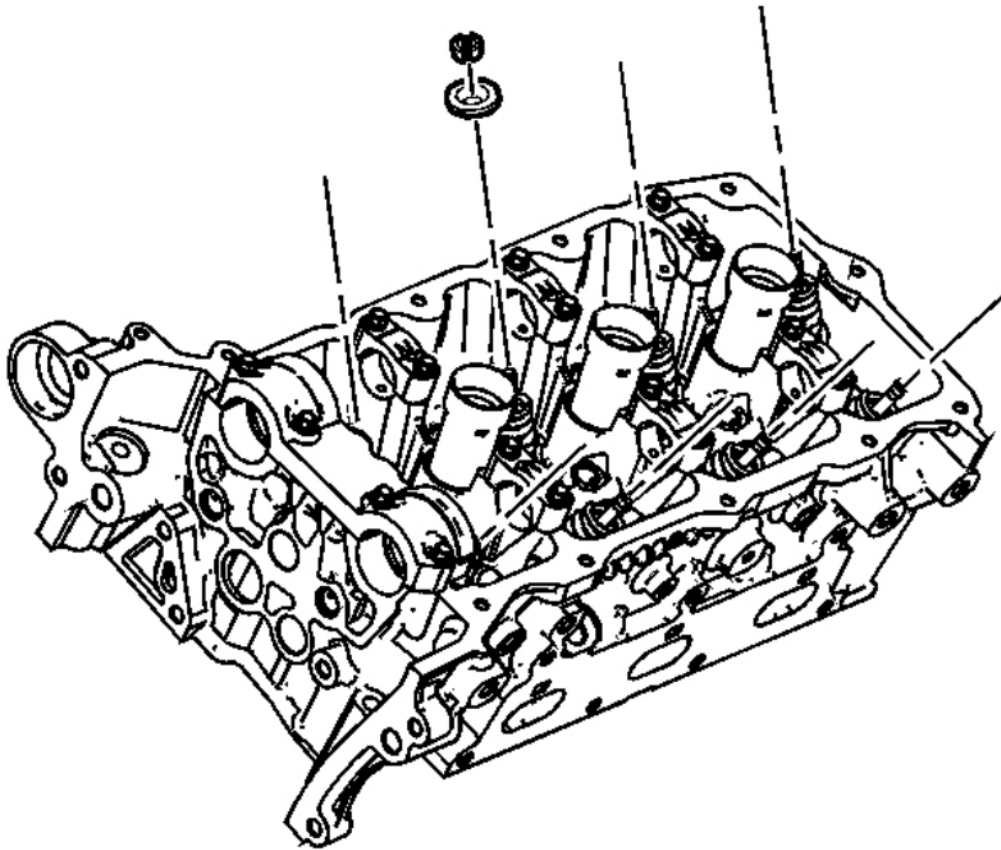


Fig. 192: View Of Valve Spring Keepers
Courtesy of GENERAL MOTORS CORP.

5. Install the valve spring keepers.
6. Remove the **EN 46110** . See **Special Tools** .
7. Disconnect the **J 39313** from the compressed air source. See **Special Tools** .
8. Remove the **J 39313** . See **Special Tools** .
9. Install the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
10. Install the rocker arms and camshafts. Refer to **Camshaft Replacement - Left**.
11. Remove the **EN 46106** in order to prevent crankshaft rotation. See **Special Tools** .
12. Install the starter motor. Refer to **Starter Motor Replacement (LP1, LY7)** in Engine Electrical.

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT - RIGHT

Tools Required

- **J 39313** Spark Plug Port Adapter. See **Special Tools** .
- **EN 46106** Flywheel Holding Tool. See **Special Tools** .
- **EN 46108** Timing Chain Retention Tool. See **Special Tools** .
- **EN 46110** On-Vehicle Valve Spring Compressor. See **Special Tools** .
- **EN 46116** Valve Stem Seal Remover/Installer. See **Special Tools** .

REMOVAL PROCEDURE

1. Remove the starter motor. Refer to **Starter Motor Replacement (LP1, LY7)** in Engine Electrical.

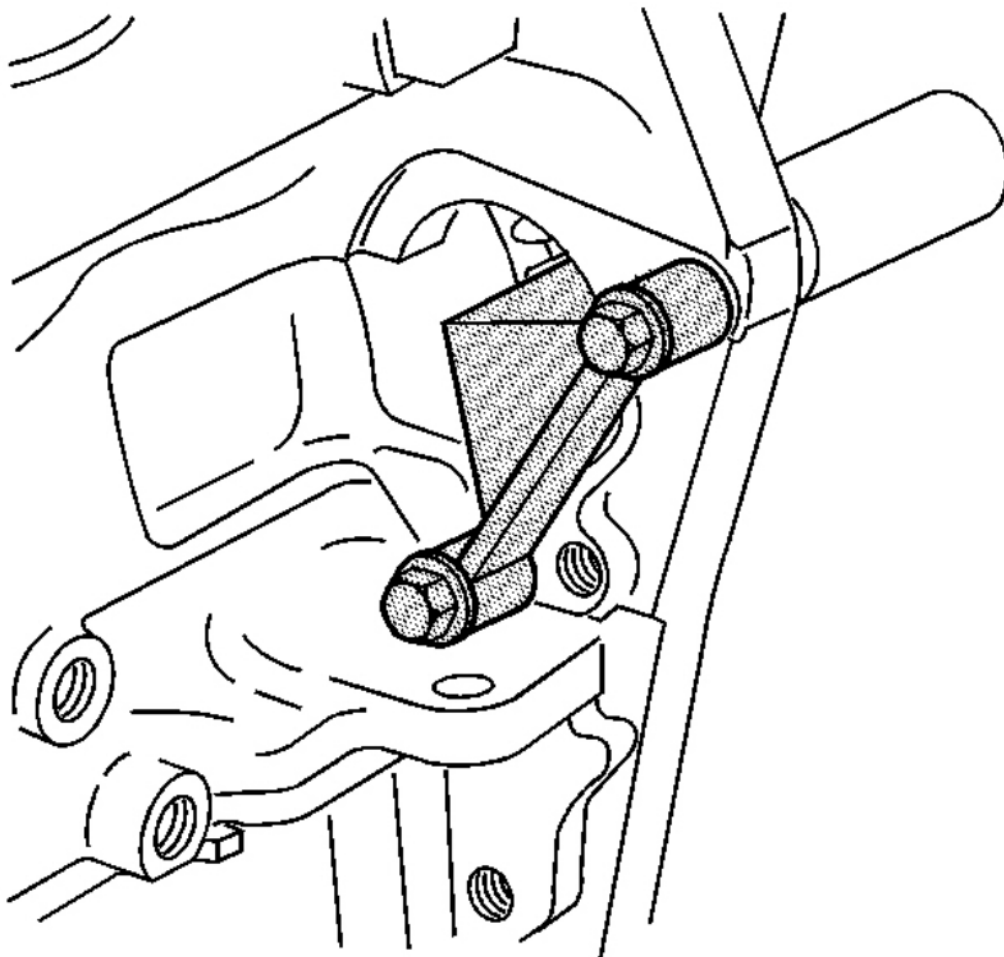


Fig. 193: View Of Tool EN 46106

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If the EN 46106 is not installed, the crankshaft may rotate. See Special Tools . If the crankshaft rotates, disassembly and reassembly of the entire camshaft timing system may be required.

2. Install the **EN 46106** in order to prevent crankshaft rotation. See Special Tools .
3. Remove the camshafts and rocker arms. Refer to Camshaft Replacement - Right.
4. Remove the spark plug from the applicable cylinder. Refer to Spark Plug Replacement in Engine Controls - 2.8L.
5. Install the **J 39313** to the applicable cylinder. See Special Tools .
6. Connect the **J 39313** to a compressed air source. See Special Tools .

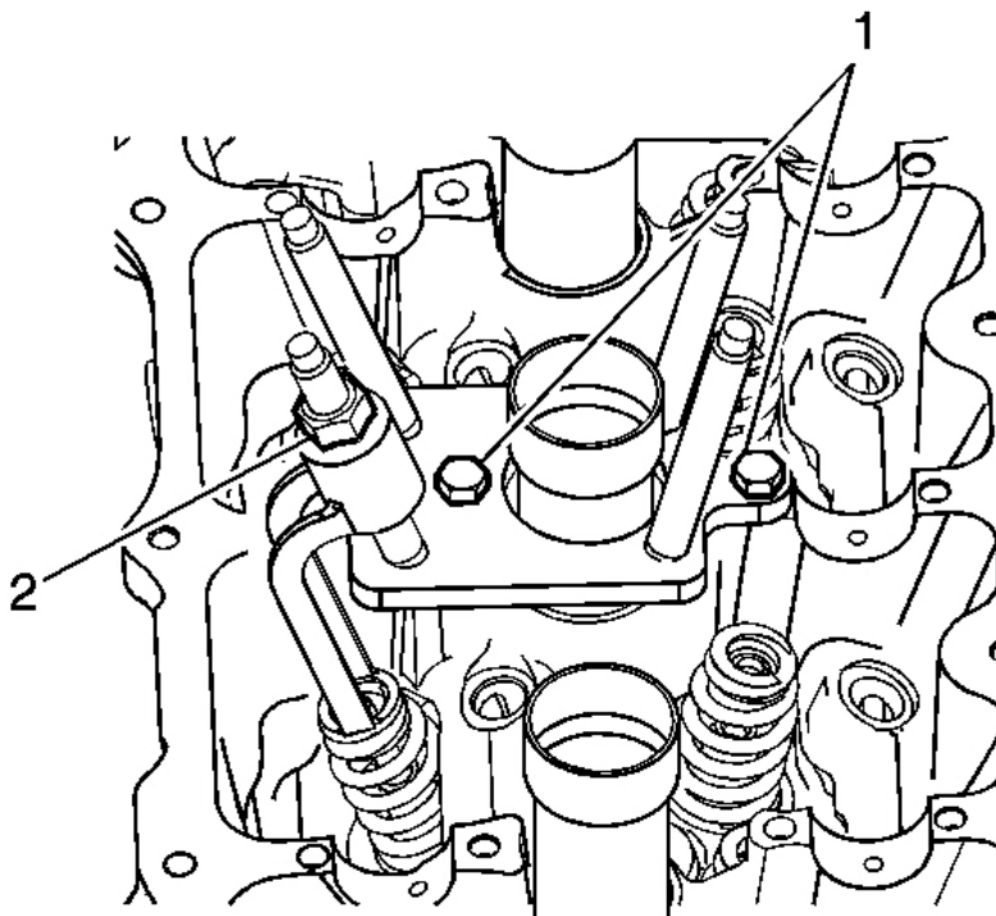


Fig. 194: View Of Installed Valve Spring Compressor Tool
Courtesy of GENERAL MOTORS CORP.

7. Install the **EN 46110** above the applicable cylinder as shown. See **Special Tools** .
8. Tighten the **EN 46110** valve spring compressor nut (2). See **Special Tools** .

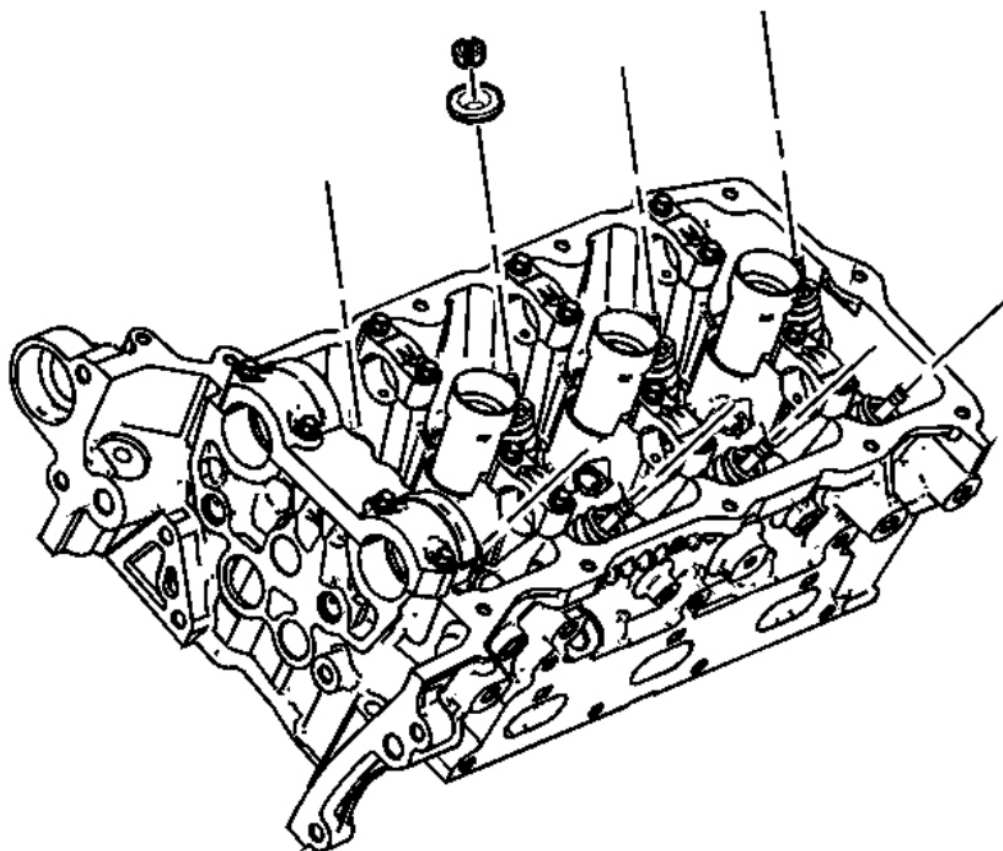


Fig. 195: View Of Valve Spring Keepers
Courtesy of GENERAL MOTORS CORP.

9. Remove the valve keepers.
10. Loosen the **EN 46110** valve spring compressor nut. See **Special Tools** .
11. Remove the valve spring retainer.

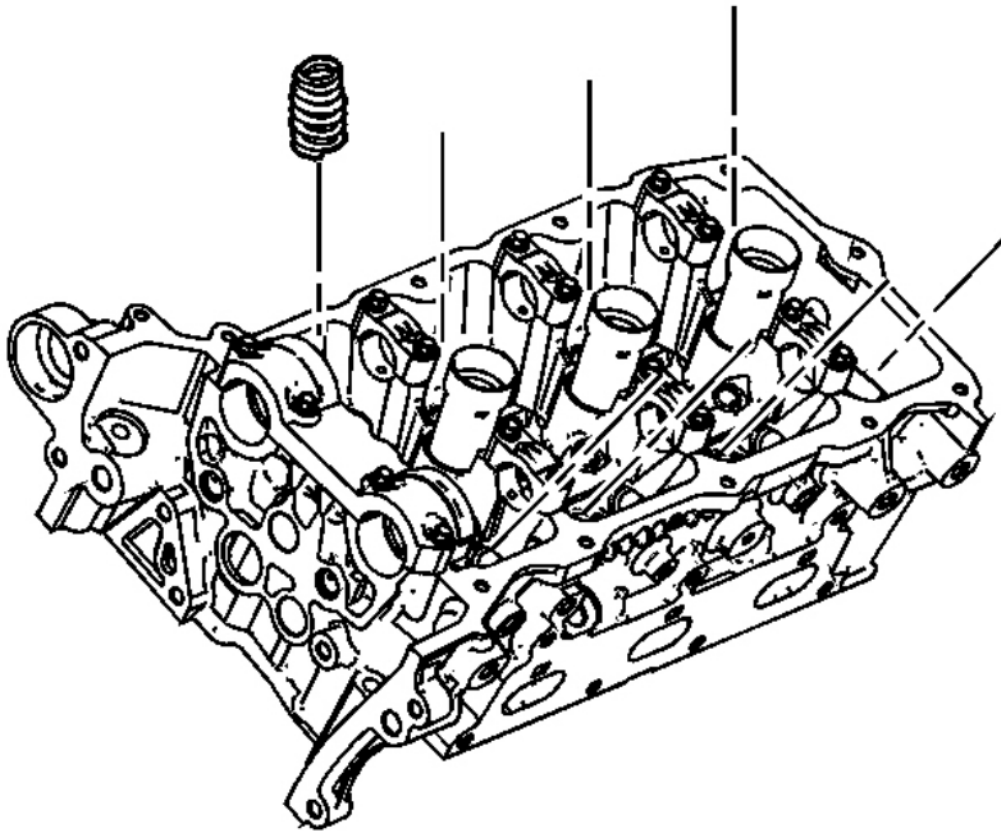


Fig. 196: View Of Valve Spring
Courtesy of GENERAL MOTORS CORP.

12. Remove the valve springs.

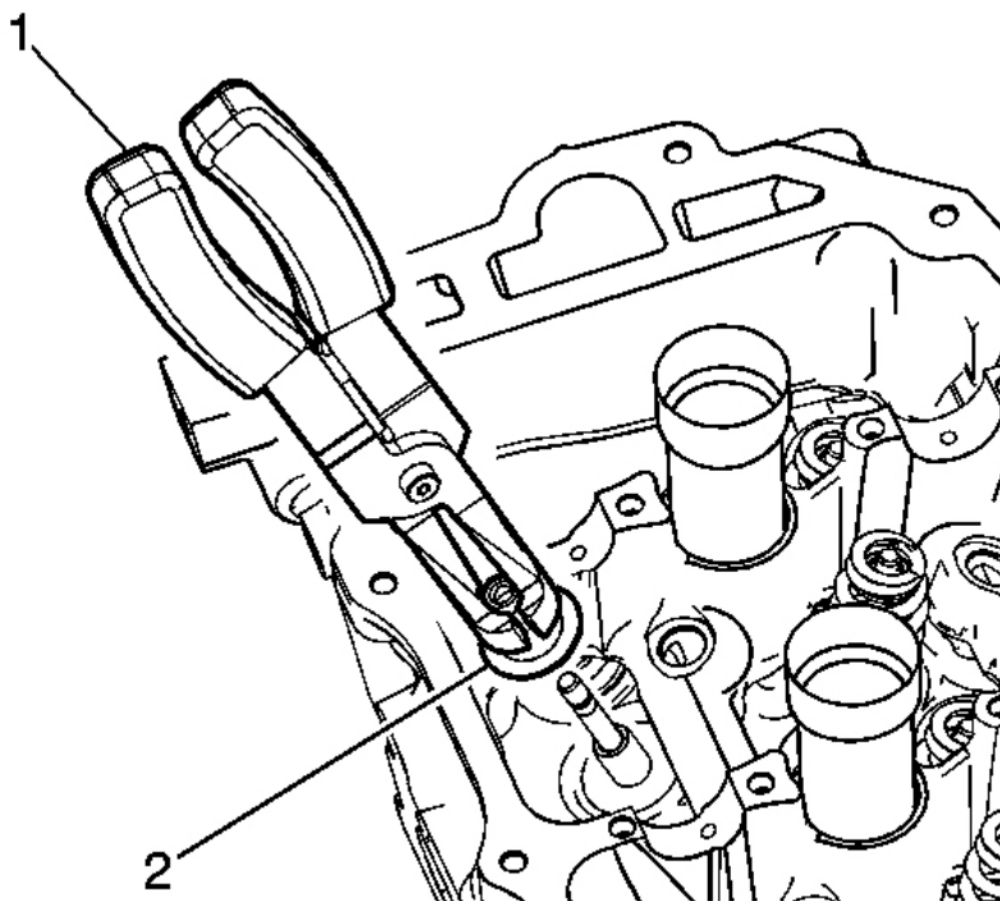


Fig. 197: Removing/Installing Valve Stem Seal
Courtesy of GENERAL MOTORS CORP.

13. Use the **EN 46116** (1) in order to remove the valve stem seal (2). See **Special Tools** .

INSTALLATION PROCEDURE

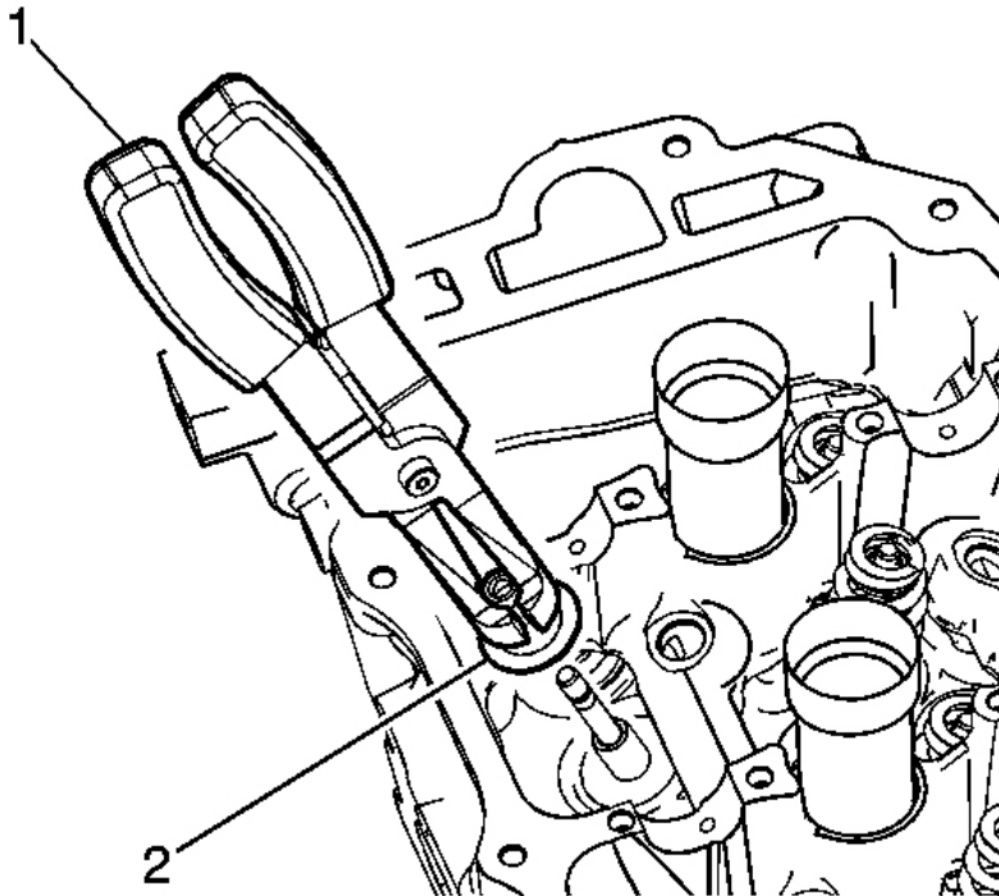


Fig. 198: Removing/Installing Valve Stem Seal
Courtesy of GENERAL MOTORS CORP.

1. Use the **EN 46116** in order to install the valve stem seals. See **Special Tools** .

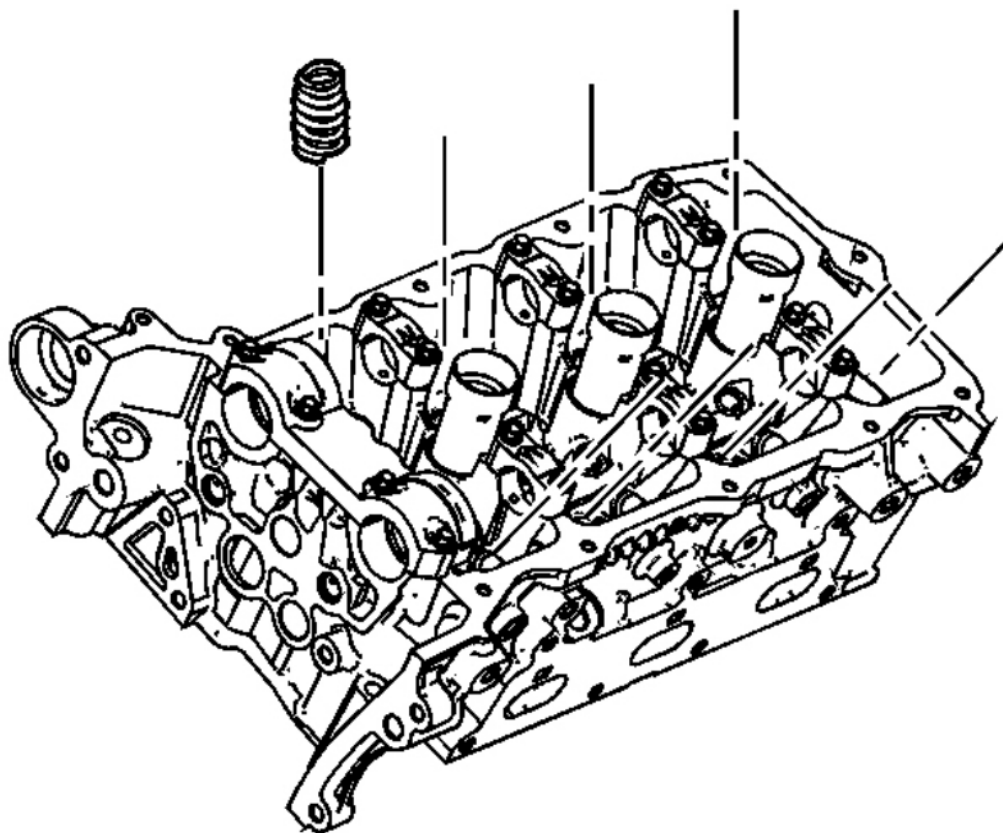


Fig. 199: View Of Valve Spring

Courtesy of GENERAL MOTORS CORP.

2. Install the valve spring.
3. Install the valve spring retainer.

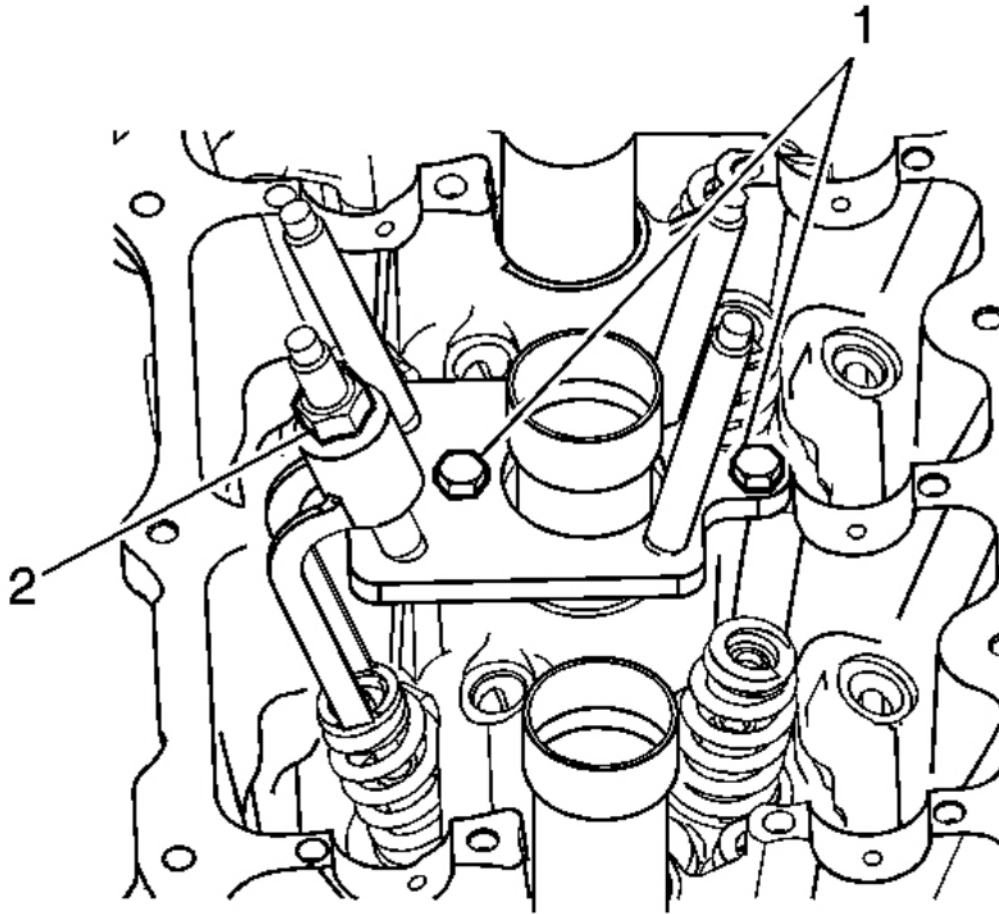


Fig. 200: View Of Installed Valve Spring Compressor Tool
Courtesy of GENERAL MOTORS CORP.

4. Install the **EN 46110** above the applicable valve spring as shown. See **Special Tools** .
Tighten the **EN 46110** valve spring compressor nut (2). See **Special Tools** .

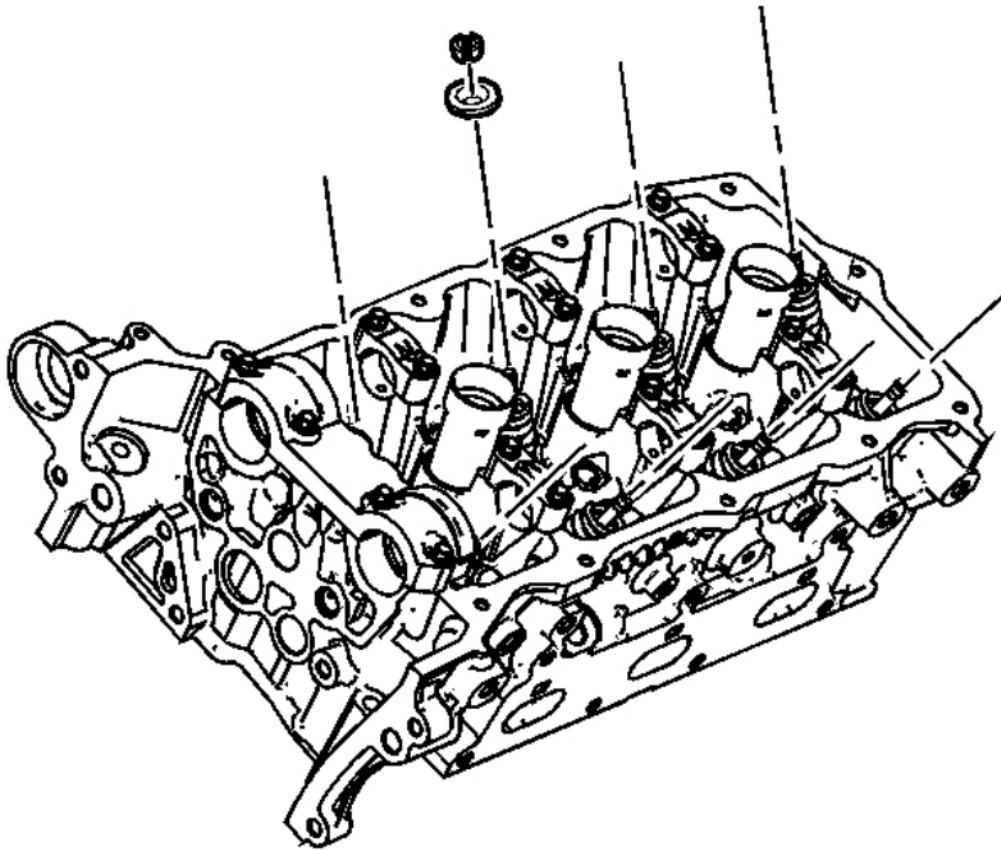


Fig. 201: View Of Valve Spring Keepers
Courtesy of GENERAL MOTORS CORP.

5. Install the valve spring keepers.
6. Remove the **EN 46110** . See **Special Tools** .
7. Disconnect the **J 39313** from the compressed air source. See **Special Tools** .
8. Remove the **J 39313** . See **Special Tools** .
9. Install the spark plugs. Refer to **Spark Plug Replacement** in Engine Controls - 2.8L.
10. Install the rocker arms and camshafts. Refer to **Camshaft Replacement - Right** .
11. Remove the **EN 46106** . See **Special Tools** .
12. Install the starter motor. Refer to **Starter Motor Replacement (LP1, LY7)** in Engine Electrical.

CYLINDER HEAD REPLACEMENT - LEFT

REMOVAL PROCEDURE

1. Remove the left bank secondary timing chain. Refer to [Secondary Camshaft Drive Chain Replacement - Left](#).
2. Remove the oil level indicator. Refer to [Oil Level Indicator and Tube Replacement](#).

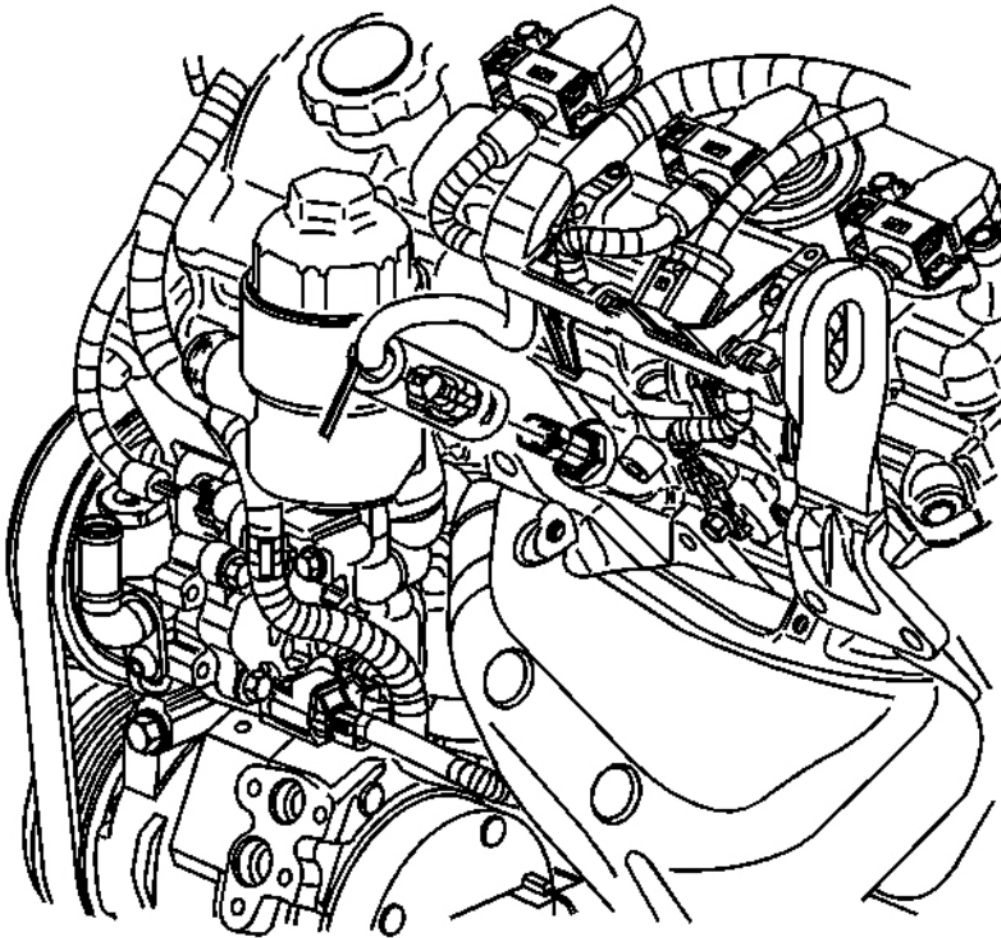


Fig. 202: View Of Coolant Temperature Sensor And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Remove the heat shield from the coolant temperature sensor and disconnect the coolant temperature sensor electrical connector.

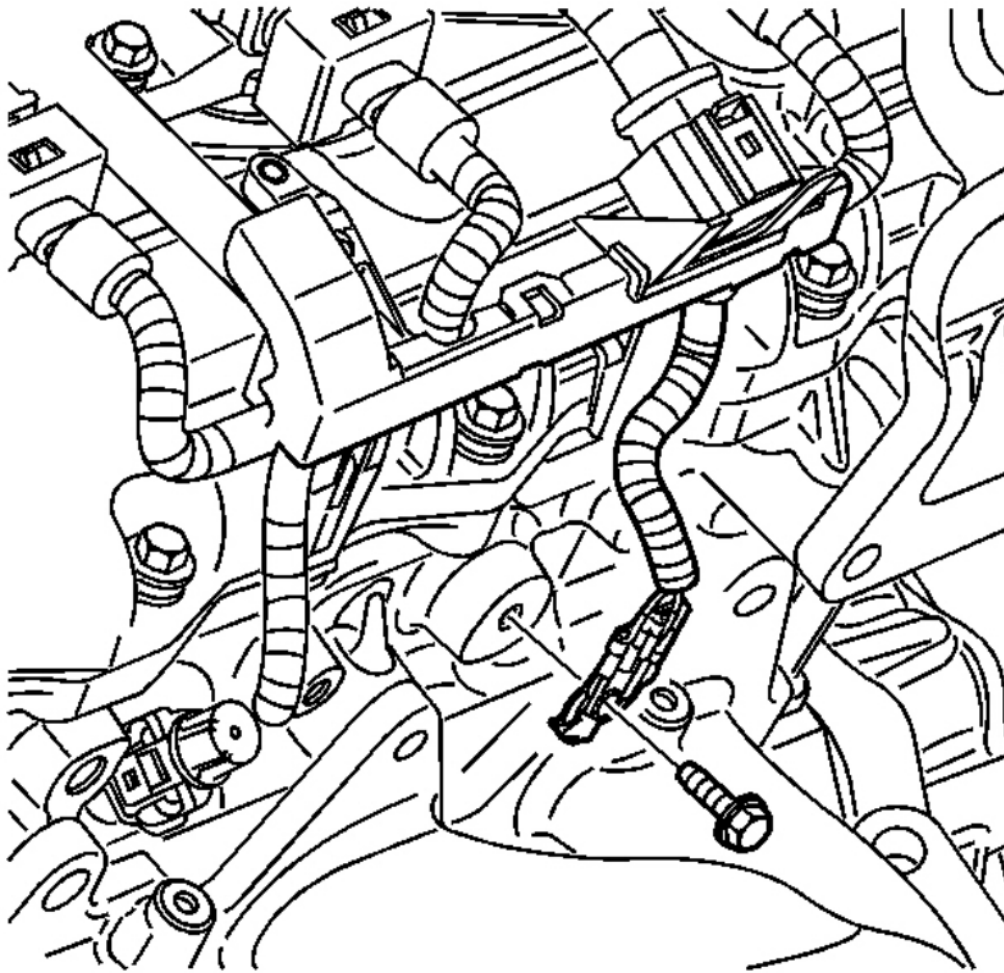


Fig. 203: View Of Left Cylinder Head Wiring Harness Ground Bolt
Courtesy of GENERAL MOTORS CORP.

4. Remove the wiring harness ground from the cylinder head.
5. Disconnect the wiring harness electrical connector located at the side of the cylinder head.
6. Remove the wiring harness connector bracket from the side of the cylinder head.

IMPORTANT: DO NOT disconnect the power steering pipes and/or hoses.

7. Remove the power steering pump bolts. Refer to **Power Steering Pump Removal** .
8. Remove the surge tank hose from the bracket at the rear of the cylinder head.
9. Remove the wiring harness bracket from the rear of the cylinder head.

10. Remove the catalytic converter. Refer to Catalytic Converter Replacement - Left (LP1, LY7) in Engine Exhaust.
11. Remove the oil level indicator tube. Refer to Oil Level Indicator and Tube Replacement.

IMPORTANT: Do not remove the oil filter adapter.

12. Remove the oil filter adapter upper bolt.

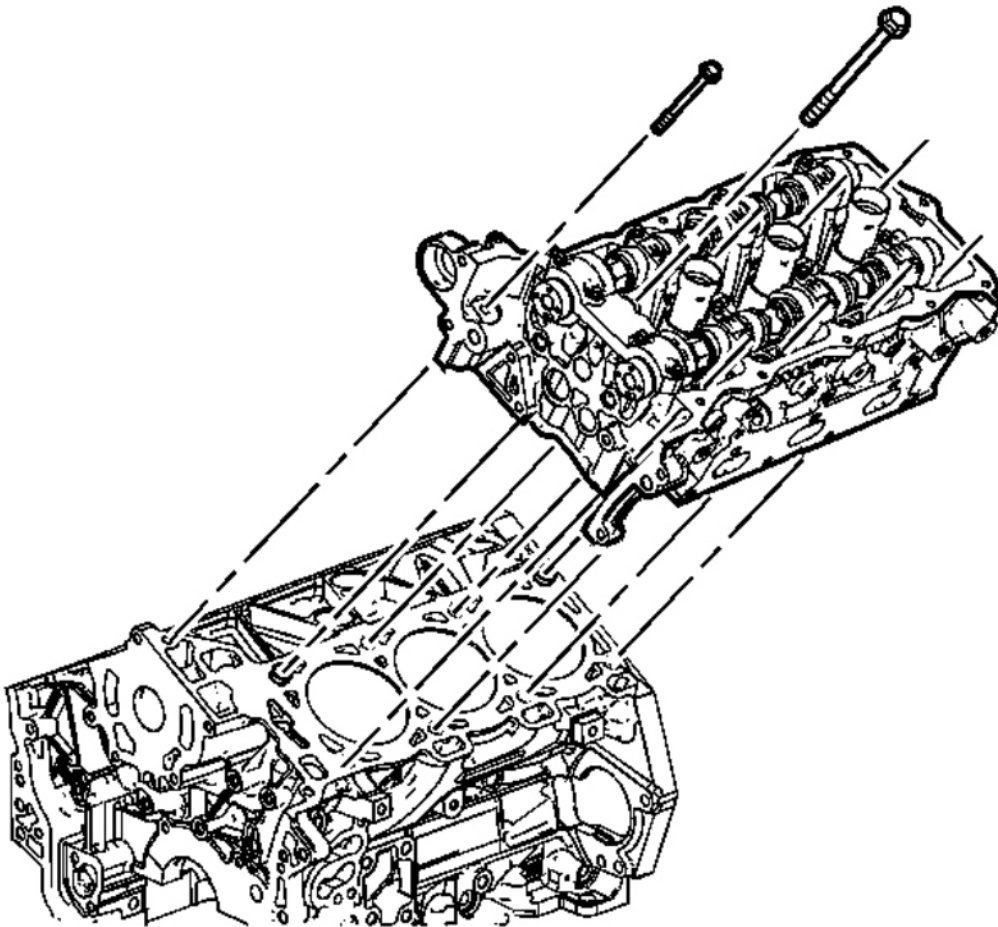


Fig. 204: View Of Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

13. Remove the cylinder head with the exhaust manifold. Refer to Cylinder Head Removal - Right.

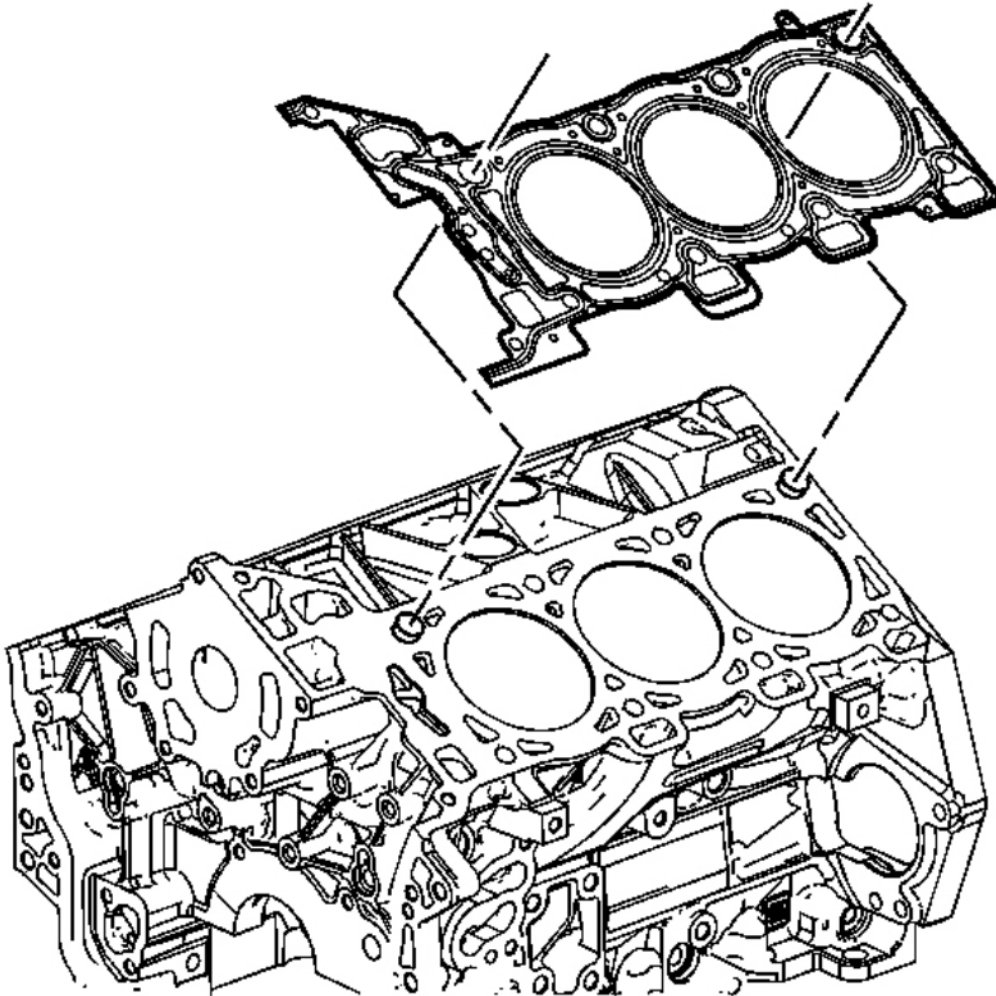


Fig. 205: View Of Left Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

14. Remove and discard the cylinder head gasket.
15. Clean and inspect the cylinder head and the engine block sealing surfaces. Refer to **Cylinder Head Cleaning and Inspection** and **Engine Block Cleaning and Inspection** .
16. If necessary, perform the following steps:
 - Remove the exhaust manifold from the cylinder head. Refer to **Exhaust Manifold Removal - Left** .
 - Disassemble the cylinder head. Refer to **Cylinder Head Disassemble** .

INSTALLATION PROCEDURE

1. If necessary, perform the following steps:
 - Assemble the cylinder head. Refer to Cylinder Head Assemble .
 - Install the exhaust manifold to the cylinder head. Refer to Exhaust Manifold Installation - Left .

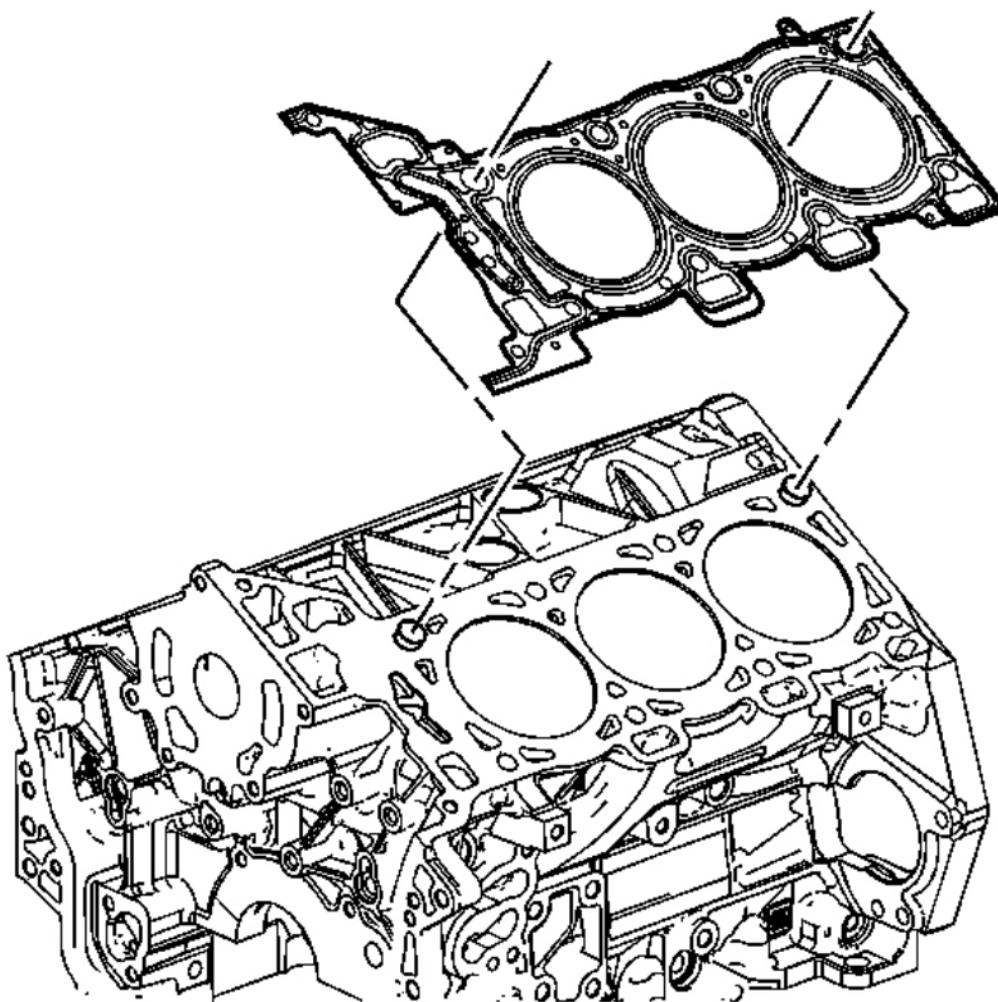


Fig. 206: View Of Left Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

2. Install a NEW cylinder head gasket.

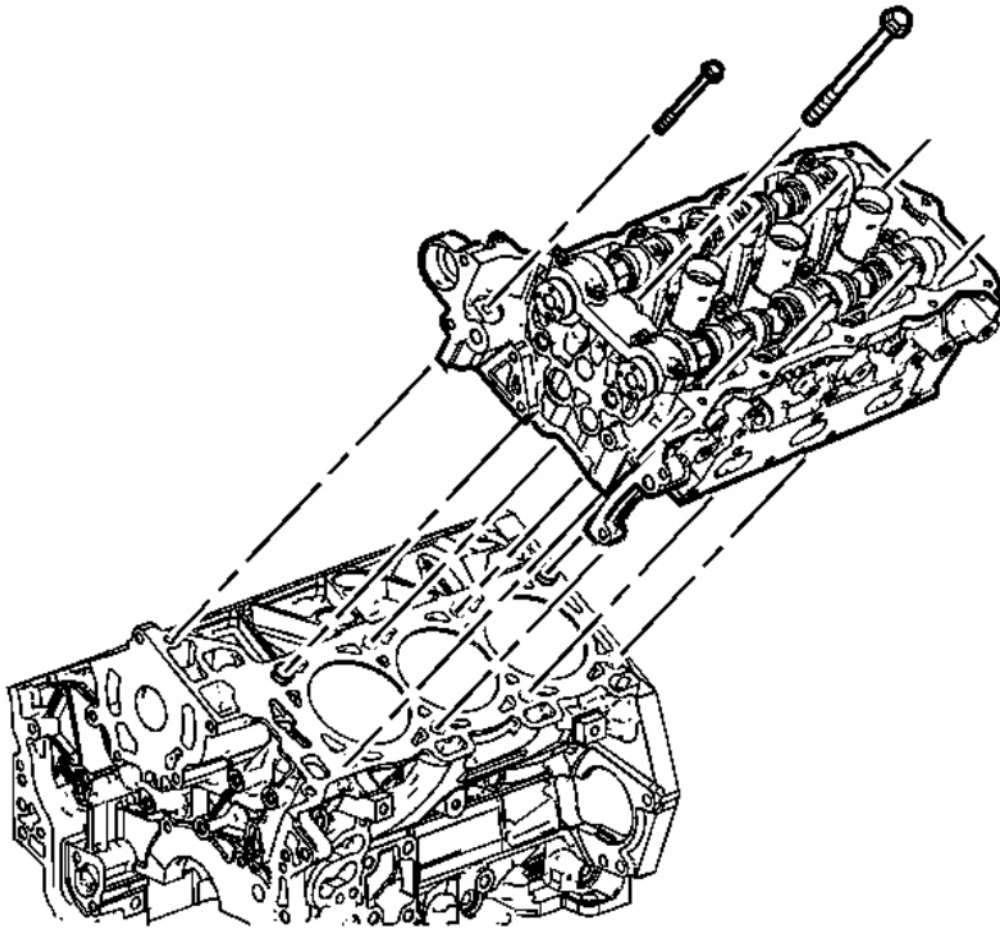


Fig. 207: View Of Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

3. Carefully, install the cylinder head with the exhaust manifold to the engine. Refer to **Camshaft Installation - Left**.
4. Install the oil filter adapter upper bolt. Refer to **Oil Filter Adapter Installation**.
5. Install the oil level indicator tube. Refer to **Oil Level Indicator and Tube Replacement**.
6. Install the catalytic converter to the exhaust manifold. Refer to **Catalytic Converter Replacement - Left (LP1, LY7)** in Engine Exhaust.
7. Install the wiring harness bracket to the rear of the cylinder head.
8. Install the surge tank hose to the bracket at the rear of the cylinder head.
9. Install the power steering pump bolts. Refer to **Power Steering Pump Installation**.

10. Install the wiring harness connector bracket from the side of the cylinder head.
11. Disconnect the wiring harness electrical connector located at the side of the cylinder head.

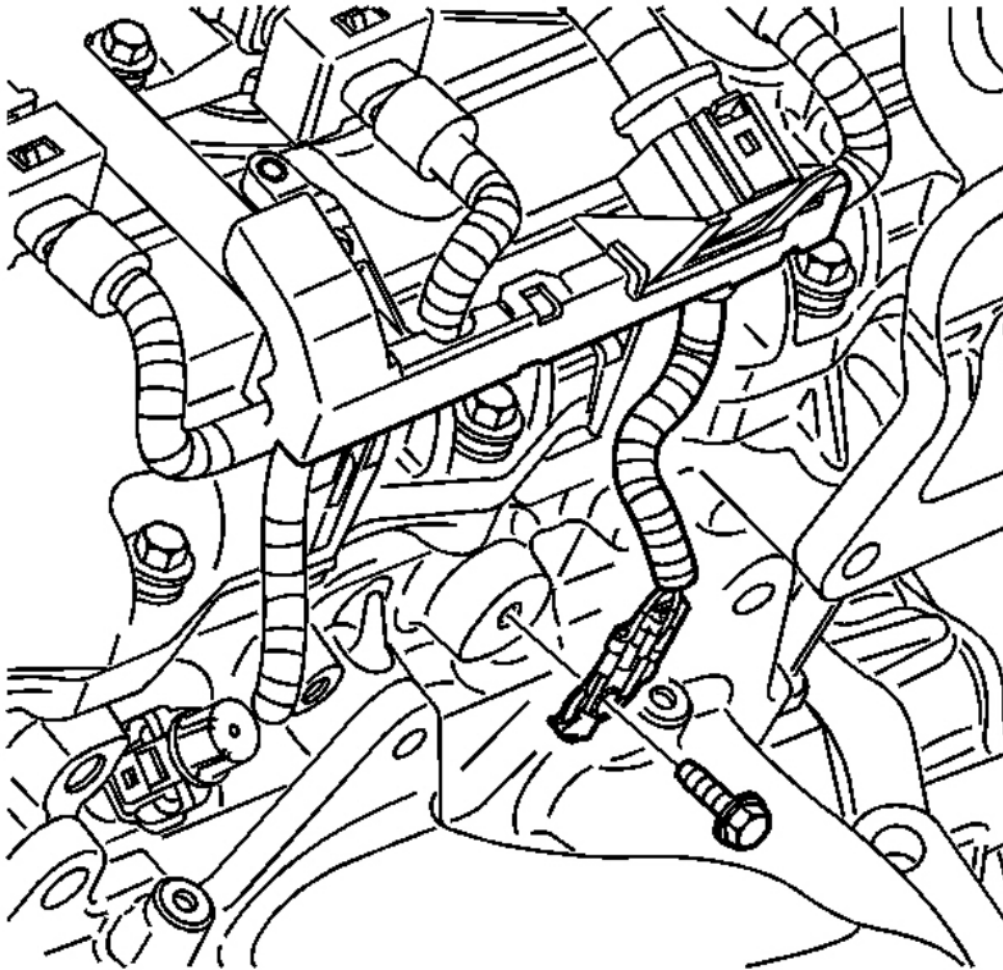


Fig. 208: View Of Left Cylinder Head Wiring Harness Ground Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

12. Install the wiring harness ground to the cylinder head.

Tighten: Tighten the wiring harness ground bolt to 10 N.m (89 lb in).

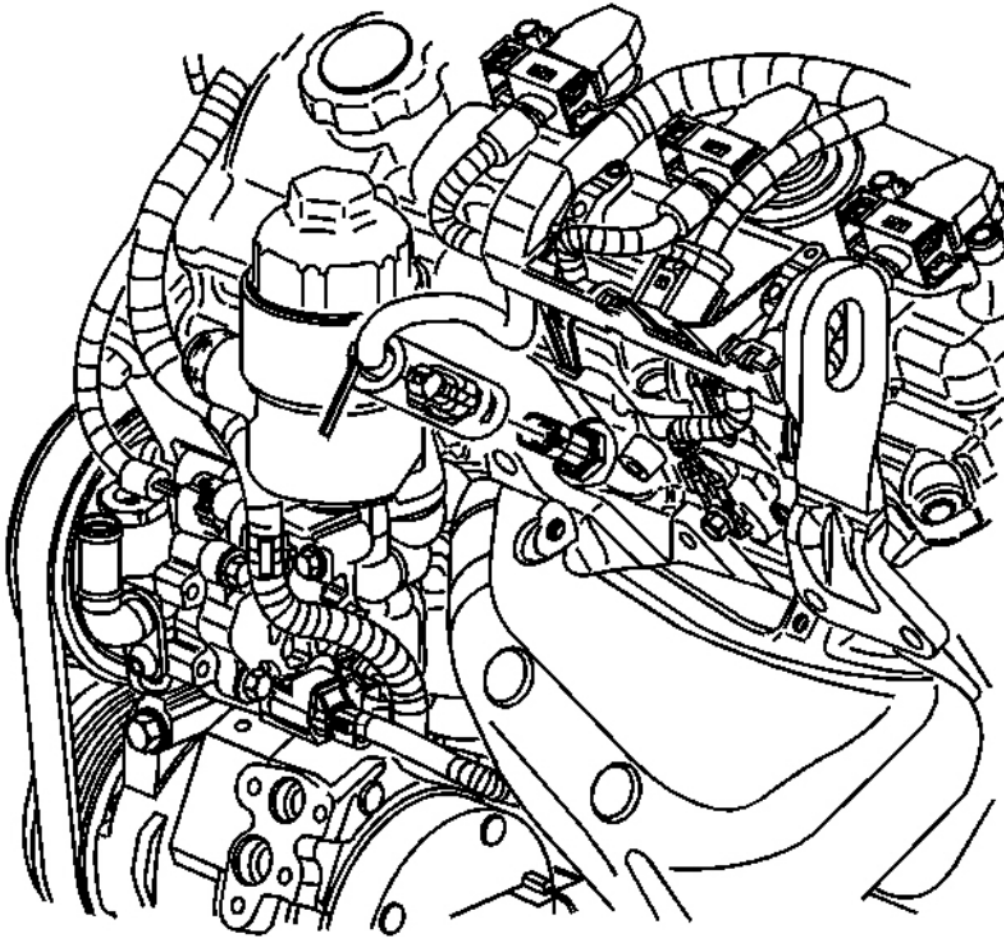


Fig. 209: View Of Coolant Temperature Sensor And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

13. Install the coolant temperature sensor electrical connector heat shield.
14. Install the oil level indicator. Refer to **Oil Level Indicator and Tube Replacement**.
15. Install the left bank secondary timing chain. Refer to **Secondary Camshaft Drive Chain Replacement - Left**.

CYLINDER HEAD REPLACEMENT - RIGHT

REMOVAL PROCEDURE

1. Remove the right bank secondary timing chain. Refer to **Secondary Camshaft Drive Chain**

Replacement - Right.

2. Remove the coolant inlet pipe bolts and reposition the coolant inlet pipe to provide access. Refer to **Coolant Pipe Replacement - Inlet (LP1, LY7)** in Engine Cooling.
3. Remove the catalytic converter. Refer to **Catalytic Converter Replacement - Right (LP1, LY7)** .

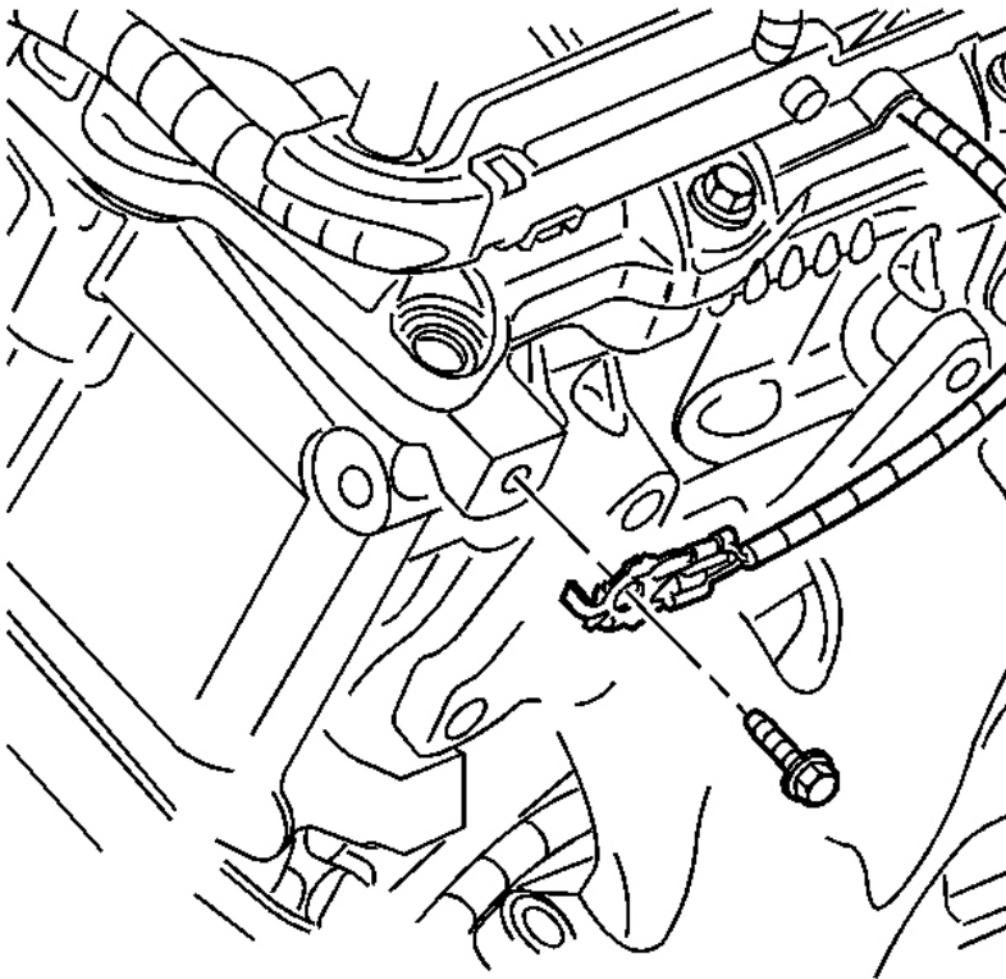


Fig. 210: View Of Wiring Harness Ground Bolt At Side Of Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Remove the wiring harness ground from the side of the cylinder head.

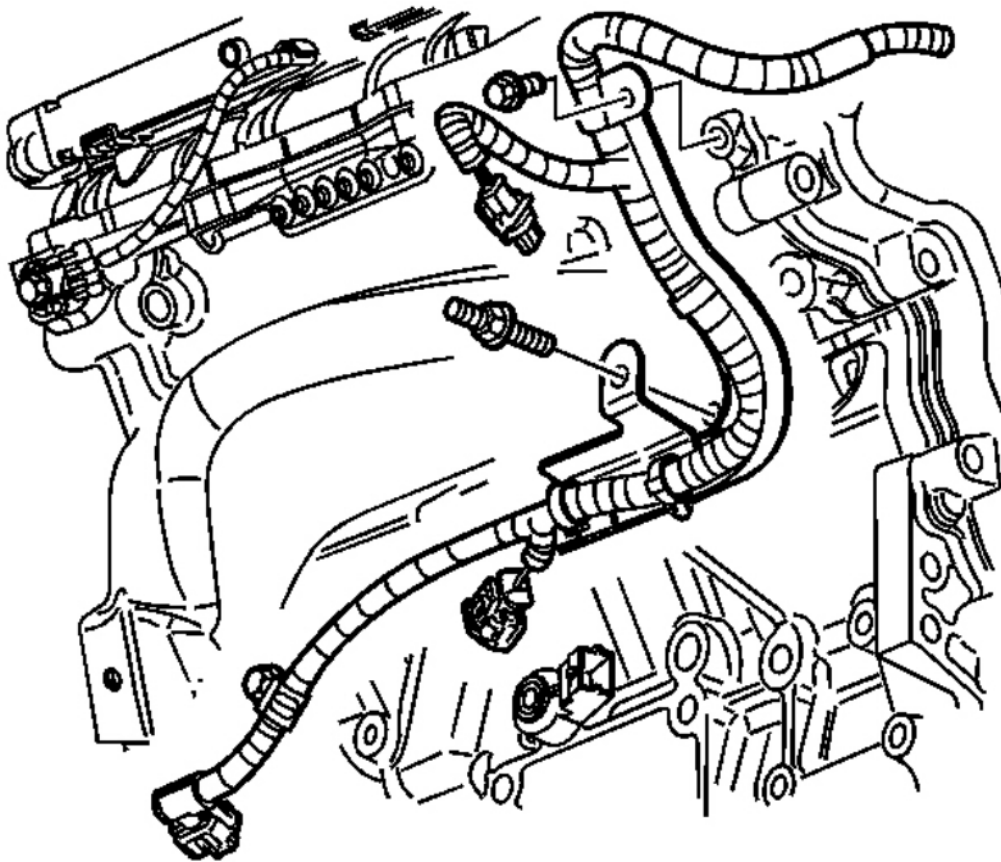


Fig. 211: Locating Engine Wiring Harness Bracket Bolt & Engine Wiring Harness Bracket Stud
Courtesy of GENERAL MOTORS CORP.

5. Remove the wiring harness conduit upper bolt from the cylinder head and reposition the conduit to provide access.
6. Remove the battery cable from the cylinder head. Refer to **Battery Negative Cable Replacement (LP1, LY7)** or **Battery Negative Cable Replacement (RHD)** in Engine Electrical.

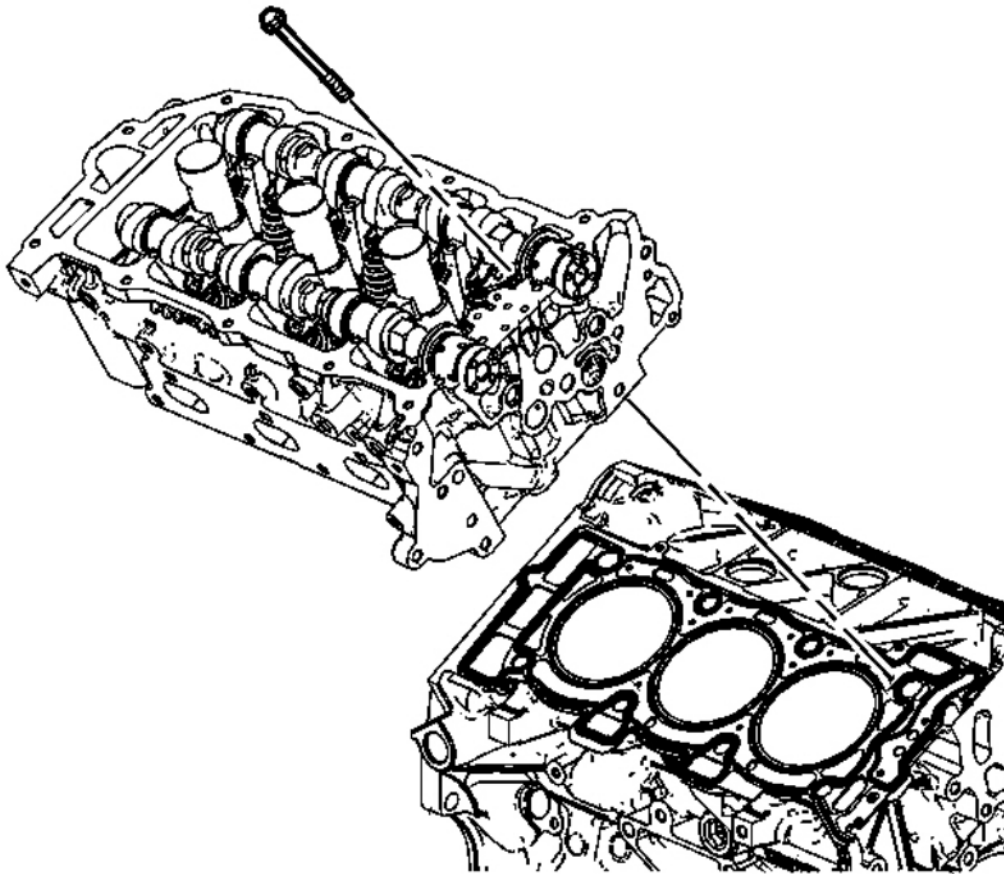


Fig. 212: View Of Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

7. Remove the cylinder head with the exhaust manifold. Refer to **Cylinder Head Removal - Right** .

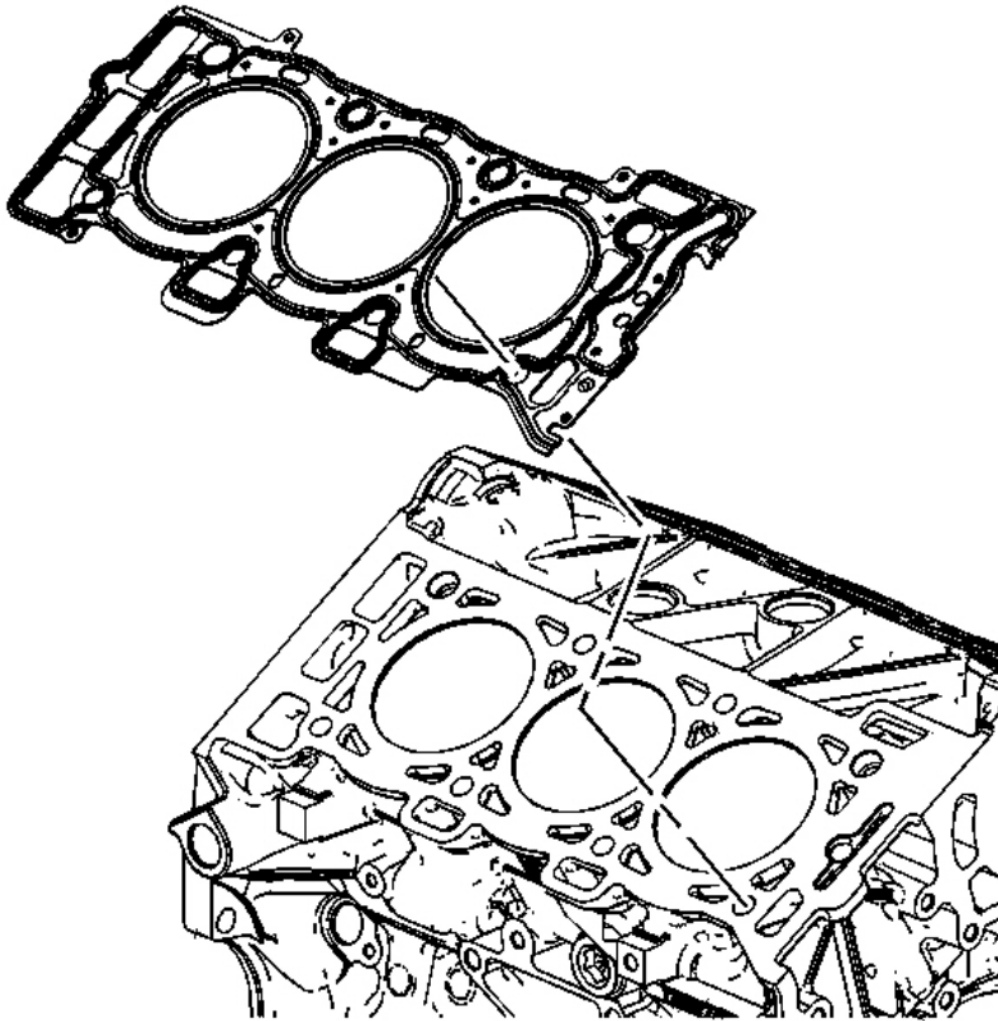


Fig. 213: View Of Right Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

8. Remove and discard the cylinder head gasket.
9. Clean and inspect the cylinder head and the engine block sealing surfaces. Refer to **Cylinder Head Cleaning and Inspection** and **Engine Block Cleaning and Inspection** .
10. If necessary, perform the following steps:
 - Remove the exhaust manifold from the cylinder head. Refer to **Exhaust Manifold Removal - Right** .
 - Disassemble the cylinder head. Refer to **Cylinder Head Disassemble** .

INSTALLATION PROCEDURE

1. If necessary, perform the following steps:

- Assemble the cylinder head. Refer to Cylinder Head Assemble .
- Install the exhaust manifold to the cylinder head. Refer to Exhaust Manifold Installation - Right .

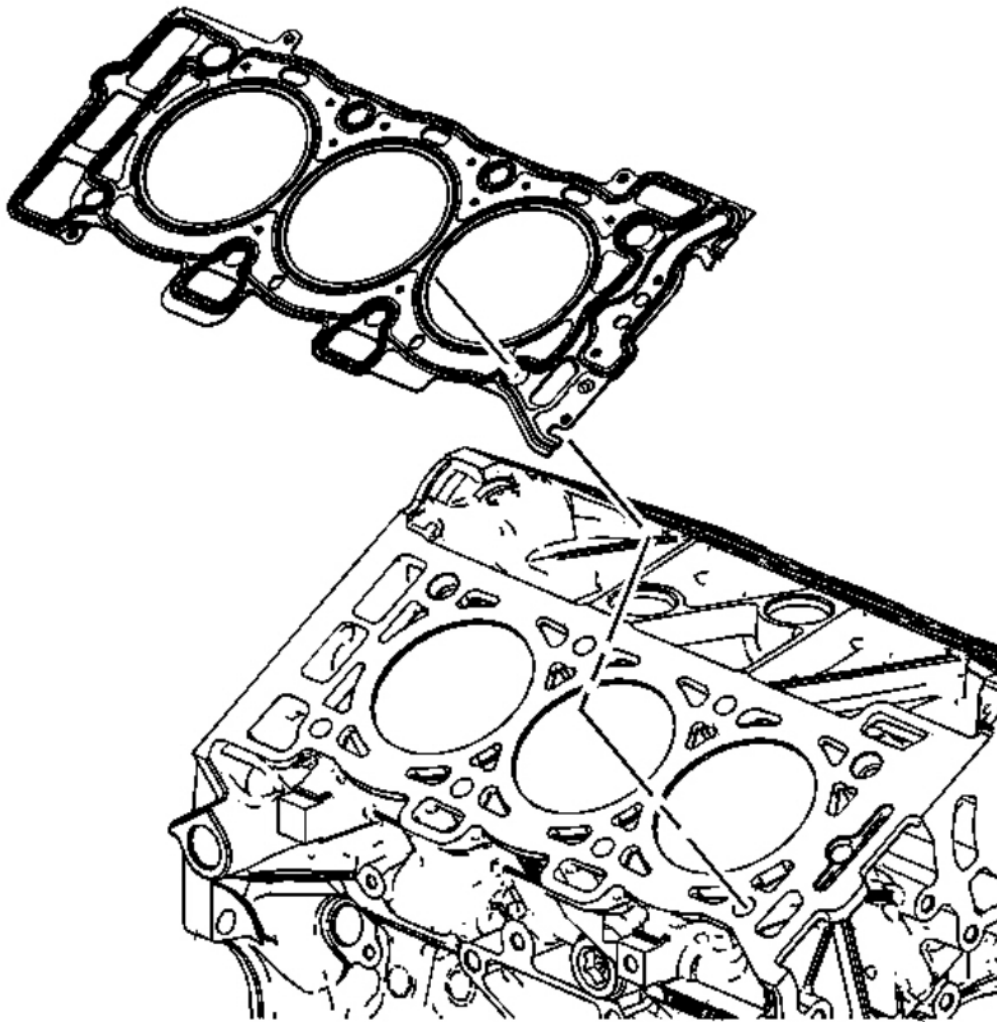


Fig. 214: View Of Right Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

2. Install a NEW cylinder head gasket.

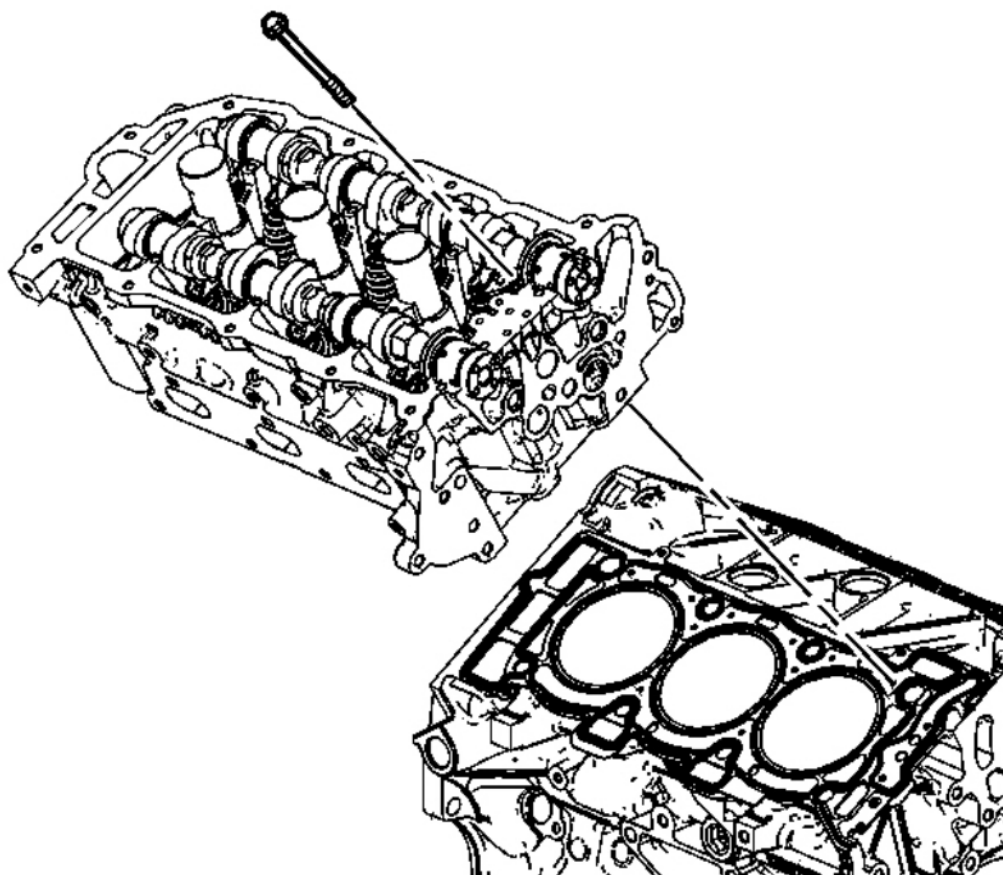


Fig. 215: View Of Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

3. Carefully, install the cylinder head with the exhaust manifold to the engine. Refer to **Cylinder Head Installation - Right** .
4. Connect the catalytic converter to the exhaust manifold.
5. Install the battery negative cable to the cylinder head. Refer to **Battery Negative Cable Replacement (LP1, LY7)** or **Battery Negative Cable Replacement (RHD)** in Engine Electrical.

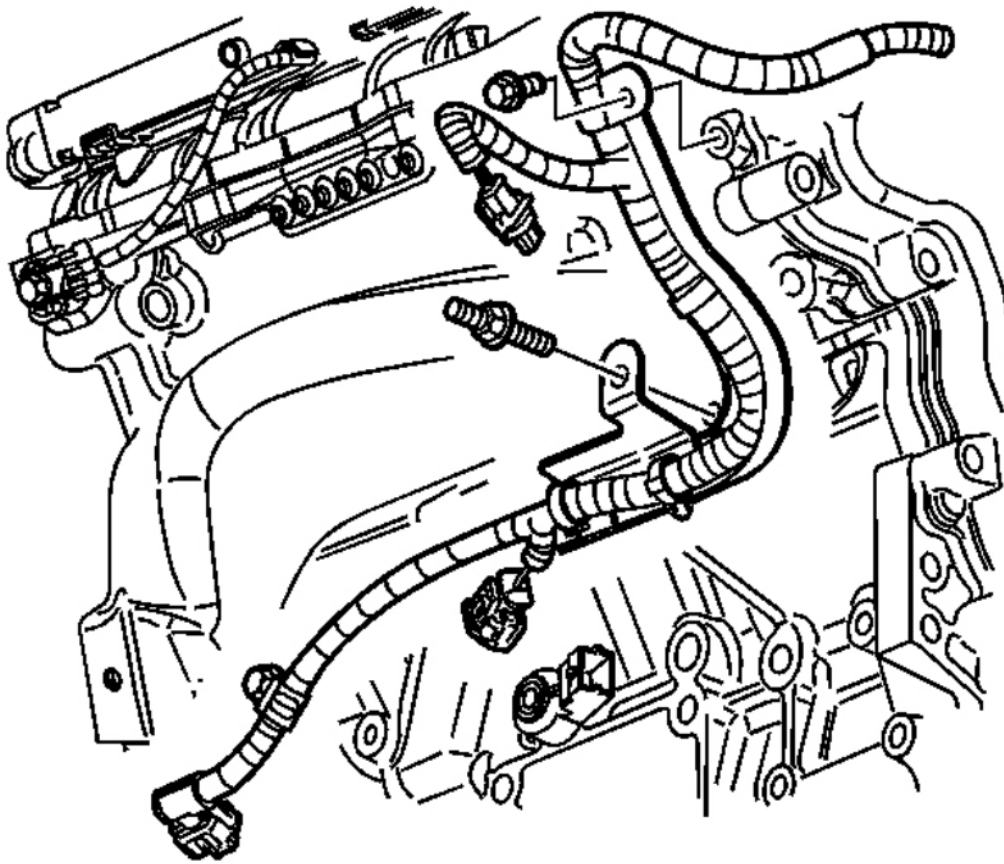


Fig. 216: Locating Engine Wiring Harness Bracket Bolt & Engine Wiring Harness Bracket Stud
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

6. Install the wiring harness conduit to the cylinder head.

Tighten: Tighten the wiring harness upper bolt to 10 N.m (89 lb in).

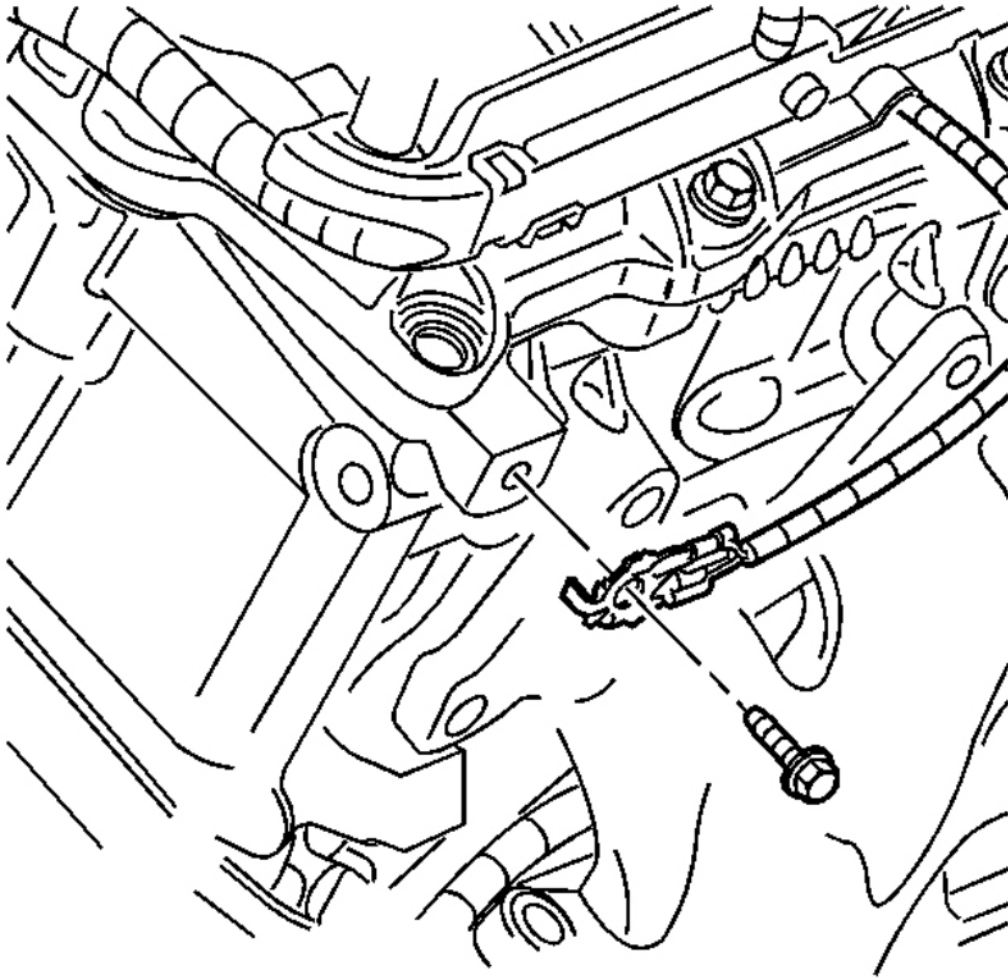


Fig. 217: View Of Wiring Harness Ground Bolt At Side Of Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

7. Install the wiring harness ground to the side of the cylinder head.

Tighten: Tighten the wiring harness ground bolt to 10 N.m (89 lb in).

8. Install the catalytic converter. Refer to **Catalytic Converter Replacement - Right (LP1, LY7)** .
9. Install the coolant inlet pipe. Refer to **Coolant Pipe Replacement - Inlet (LP1, LY7)** in Engine Cooling.
10. Install the right bank secondary timing chain. Refer to **Secondary Camshaft Drive Chain Replacement - Right**.