

2011 ENGINE

Engine Mechanical - 3.5L - Repair Instructions - On Vehicle - Impala

INTAKE MANIFOLD COVER REPLACEMENT

REMOVAL PROCEDURE

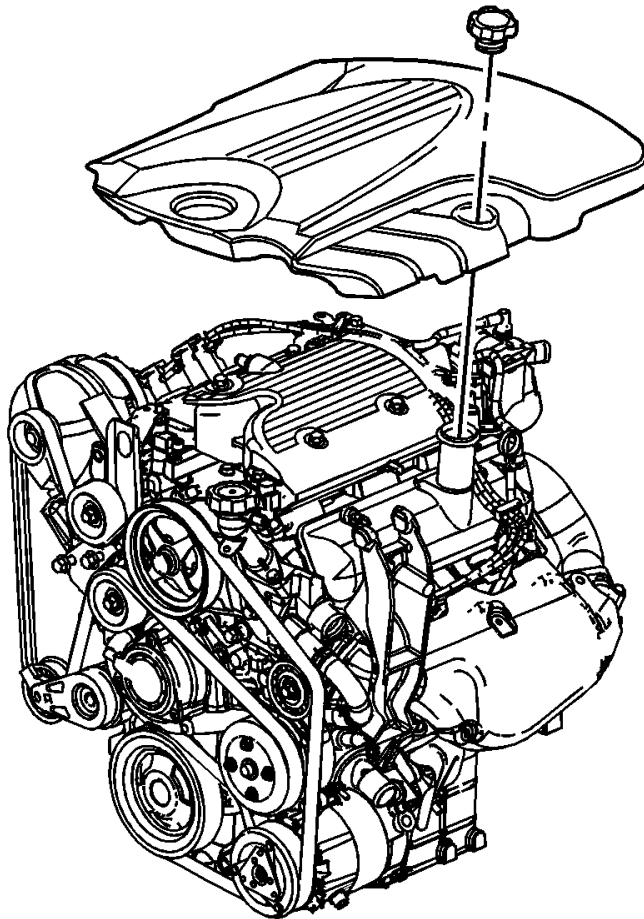


Fig. 1: Engine Oil Fill Cap

Courtesy of GENERAL MOTORS CORP.

1. Remove the engine oil fill cap.
2. Pull up on the cover in order to disengage the cover from the studs.

INSTALLATION PROCEDURE

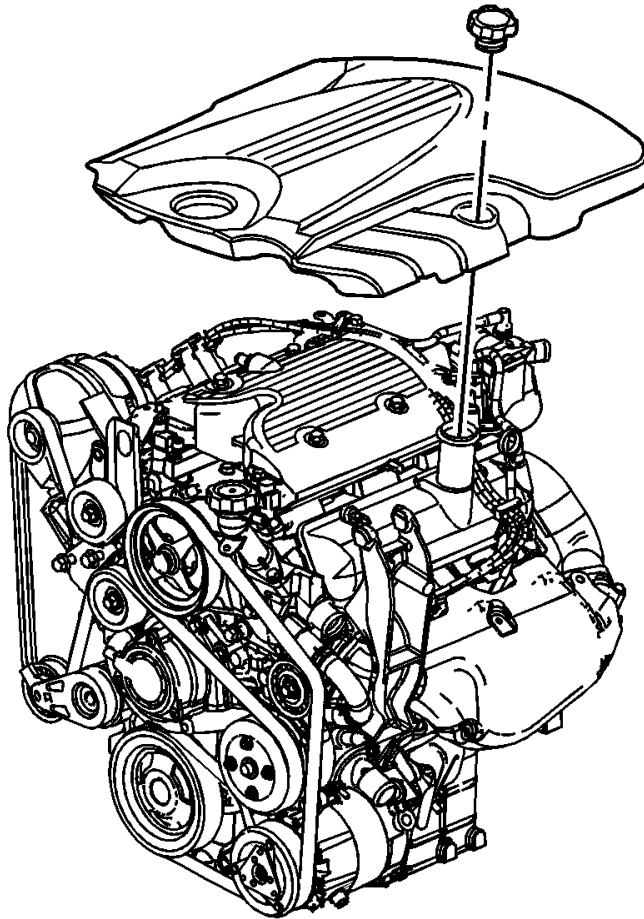


Fig. 2: Engine Oil Fill Cap

Courtesy of GENERAL MOTORS CORP.

1. Align the cover to the studs on the engine, push down on the cover above the studs in order to engage the cover to the studs.
2. Install the engine oil fill cap.

DRIVE BELT REPLACEMENT

REMOVAL PROCEDURE

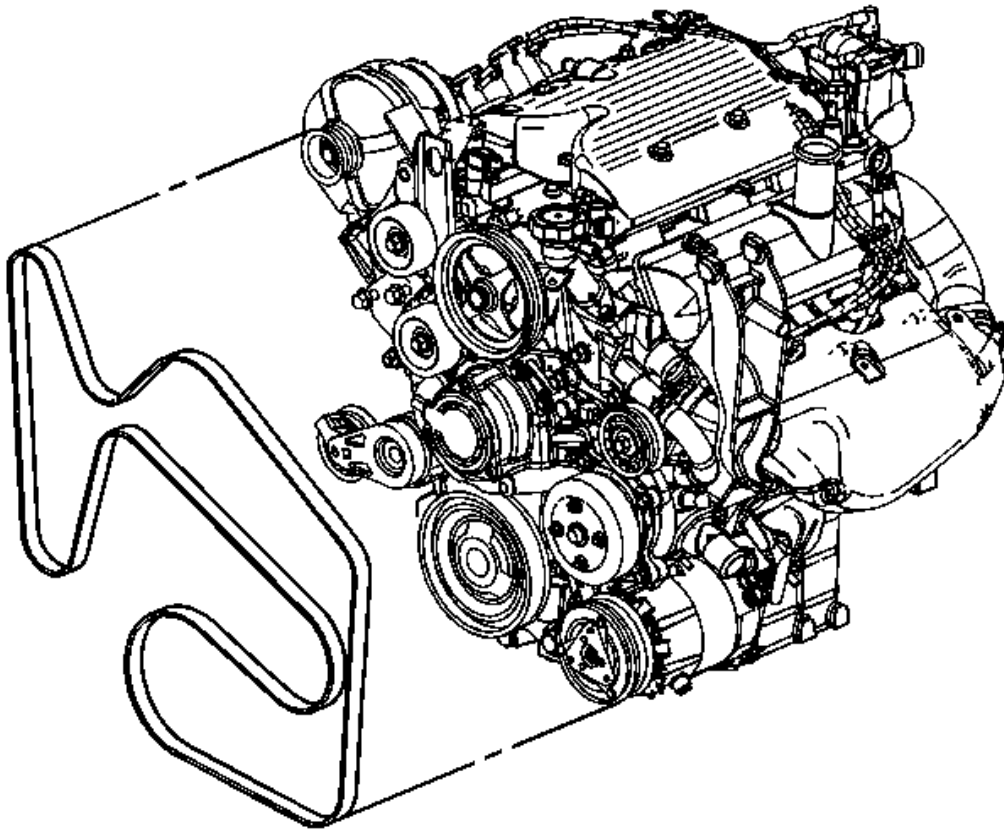


Fig. 3: View Of Drive Belt Routing
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Rotate the drive belt tensioner clockwise in order to release the spring tension.
3. Remove the drive belt from around the tensioner pulley.
4. Remove the drive belt from around all the other pulleys.
5. Remove the drive belt from the vehicle.

INSTALLATION PROCEDURE

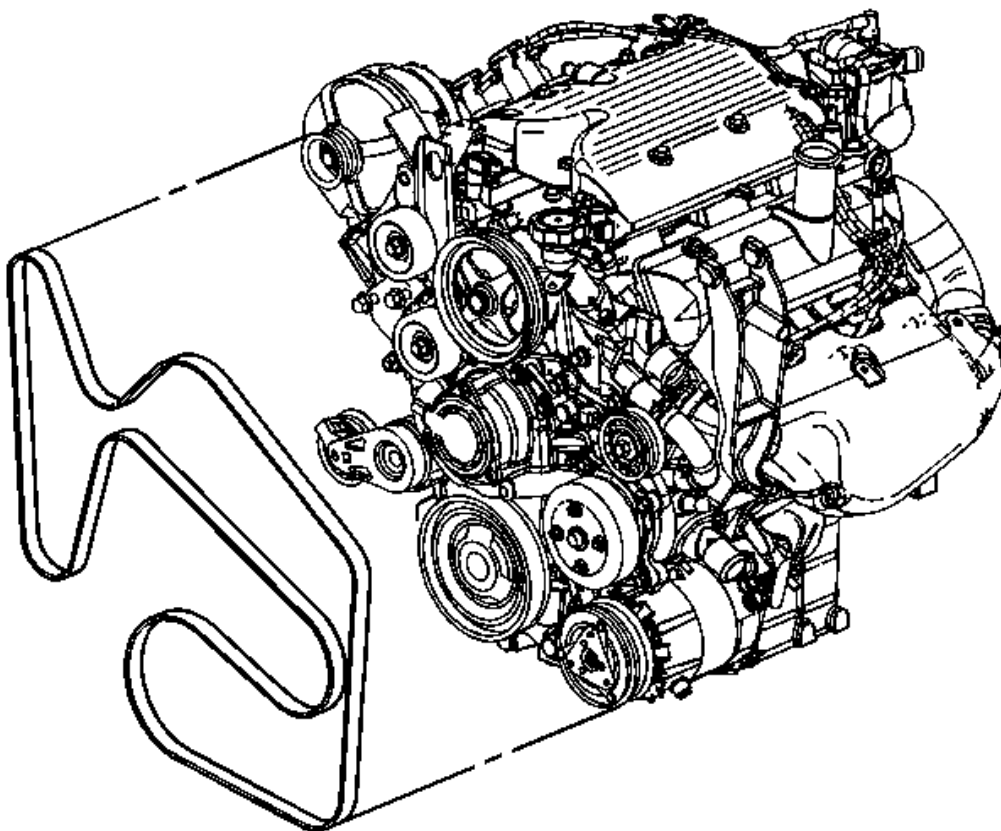


Fig. 4: View Of Drive Belt Routing
Courtesy of GENERAL MOTORS CORP.

1. Install the drive belt to the vehicle.
2. Starting at the generator, route the drive belt around all of the pulleys, except for tensioner.
3. Rotate the drive belt tensioner clockwise in order to release the spring tension.
4. Install the drive belt around the tensioner.
5. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

DRIVE BELT IDLER PULLEY REPLACEMENT

REMOVAL PROCEDURE

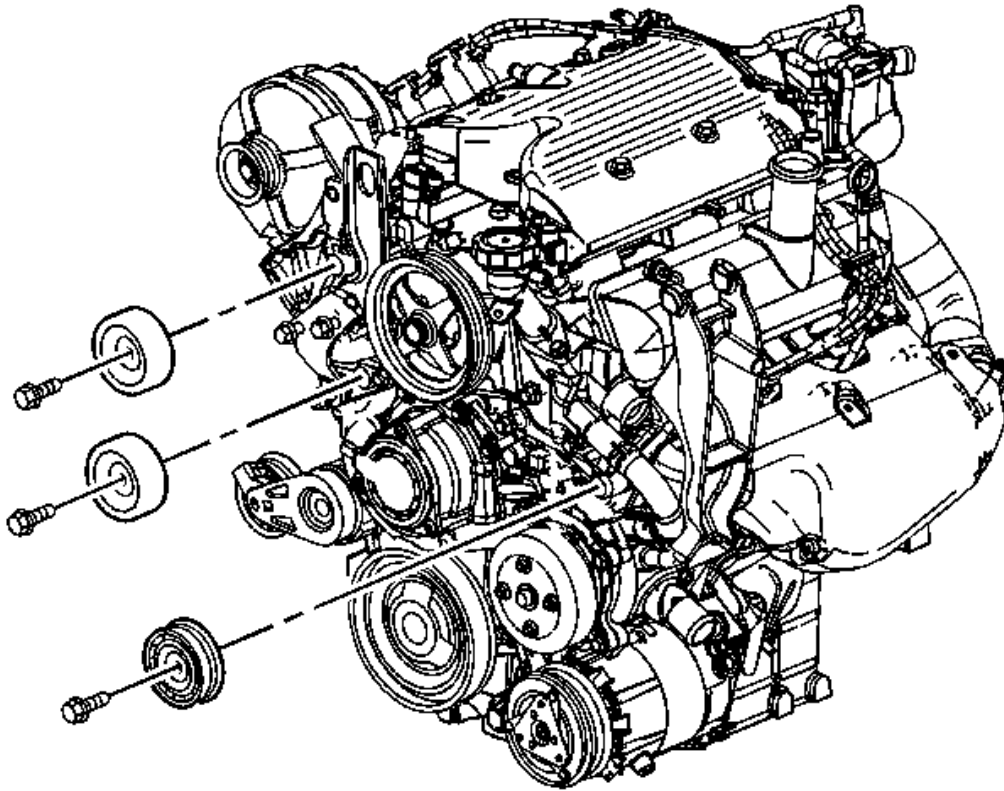


Fig. 5: Locating Drive Belt Idler Pulleys
Courtesy of GENERAL MOTORS CORP.

1. Remove the drive belt. Refer to **Drive Belt Replacement**.
2. Loosen the required drive belt idler pulley bolt.
3. Remove the required drive belt idler pulley.

INSTALLATION PROCEDURE

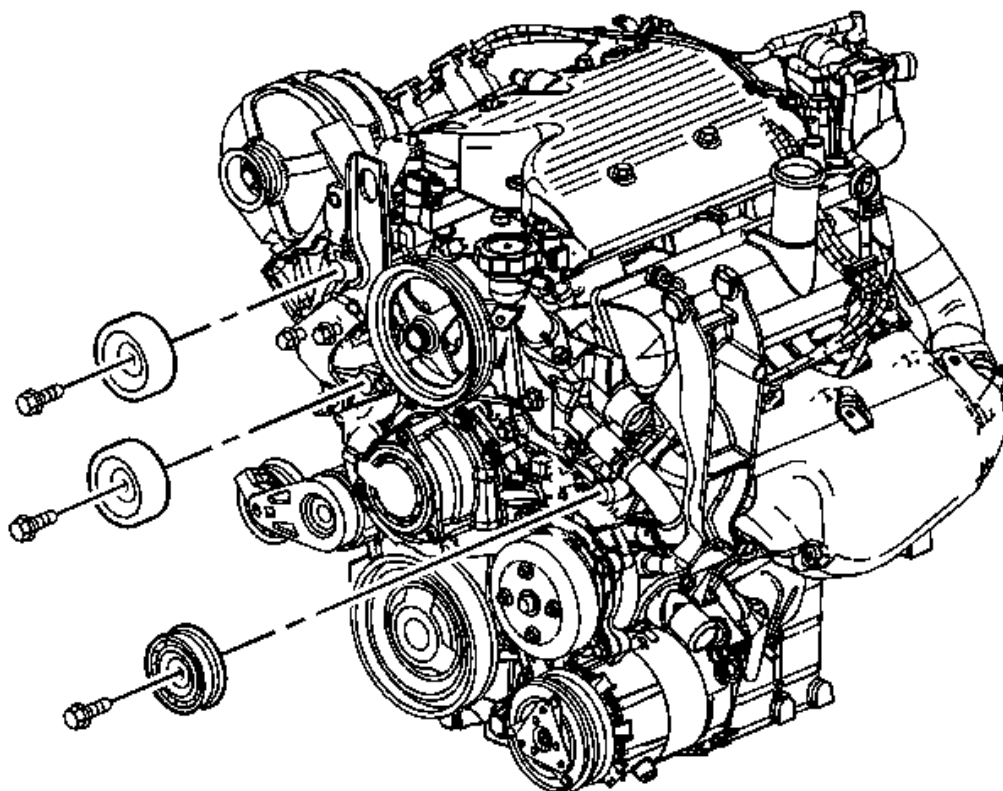


Fig. 6: Locating Drive Belt Idler Pulleys
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the required drive belt idler pulley.
2. Tighten the required drive belt idler pulley bolt.

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

3. Install the drive belt. Refer to Drive Belt Replacement.

DRIVE BELT TENSIONER REPLACEMENT

REMOVAL PROCEDURE

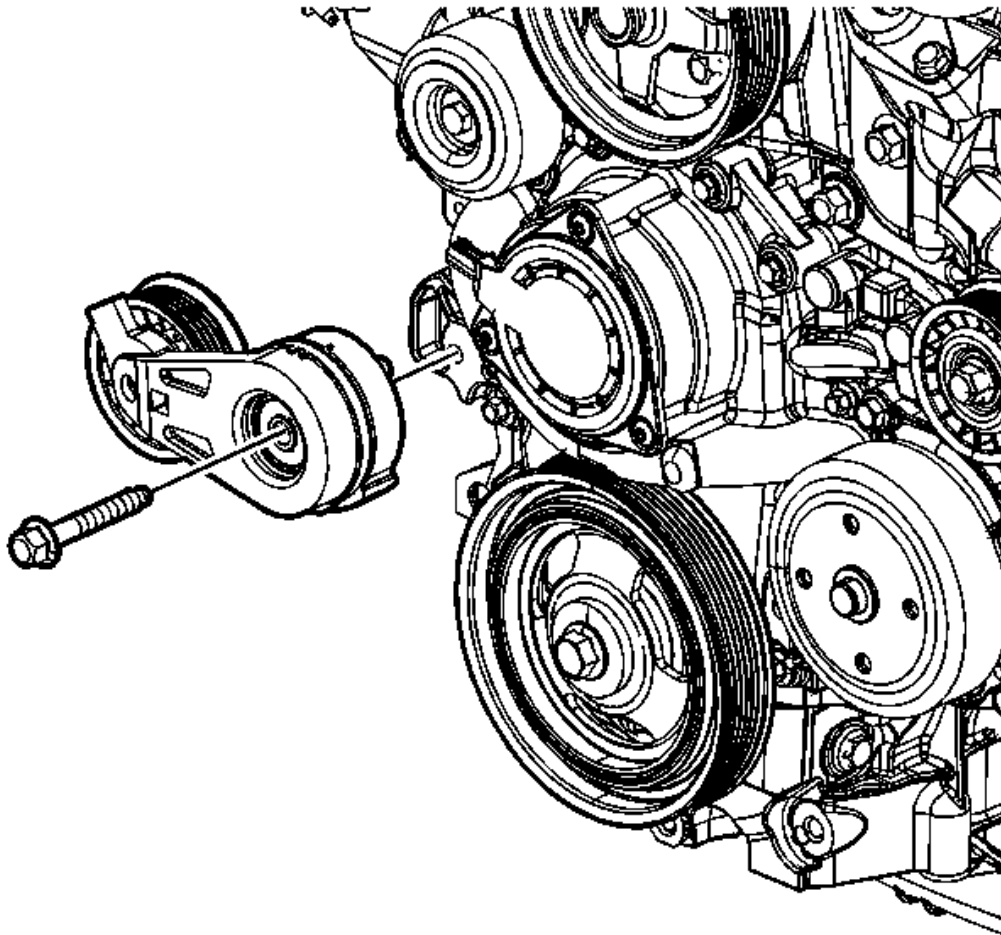


Fig. 7: Identifying Drive Belt Tensioner & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the drive belt. Refer to **Drive Belt Replacement**.
2. Remove the drive belt tensioner bolt.
3. Remove the drive belt tensioner.

INSTALLATION PROCEDURE

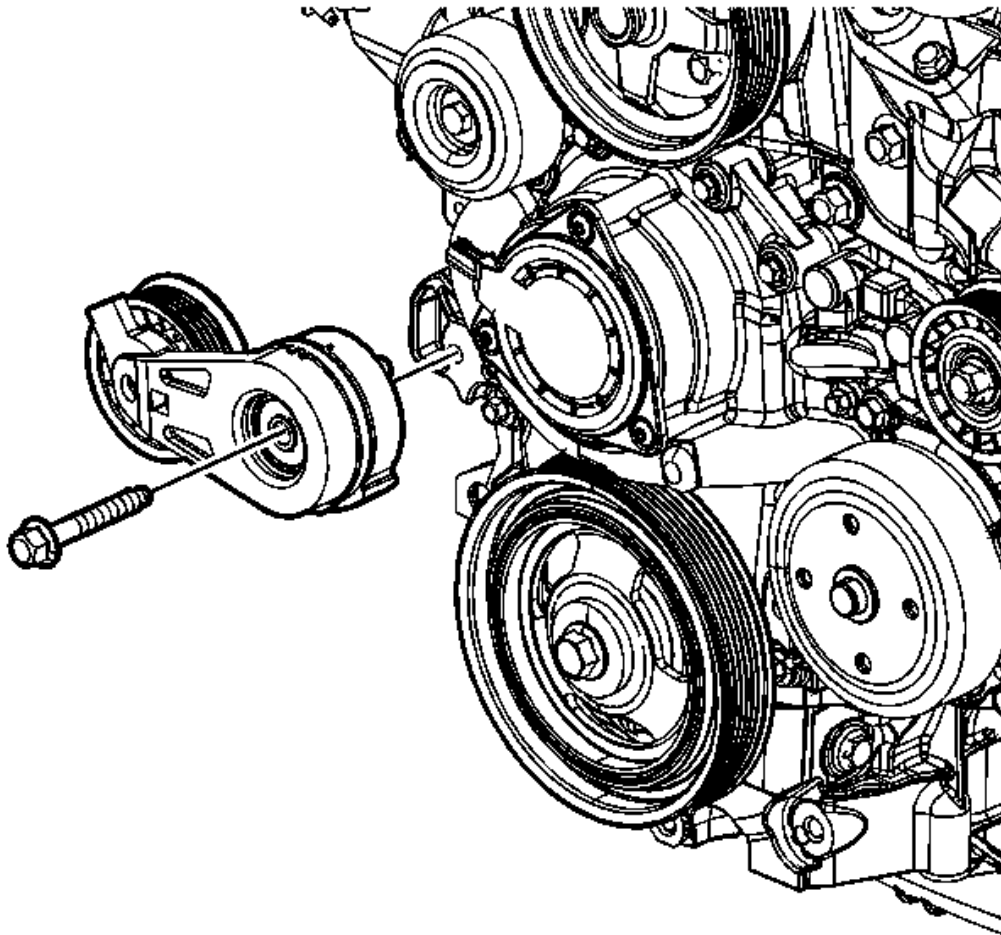


Fig. 8: Identifying Drive Belt Tensioner & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the drive belt tensioner.

CAUTION: Refer to Fastener Caution .

2. Install the drive belt tensioner bolt.

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

3. Install the drive belt. Refer to Drive Belt Replacement.

ENGINE SUPPORT FIXTURE

TOOLS REQUIRED

- **J 28467-B** Engine Support Fixture. See Special Tools .
- **J 36462** Engine Support Adapter Leg. See Special Tools .

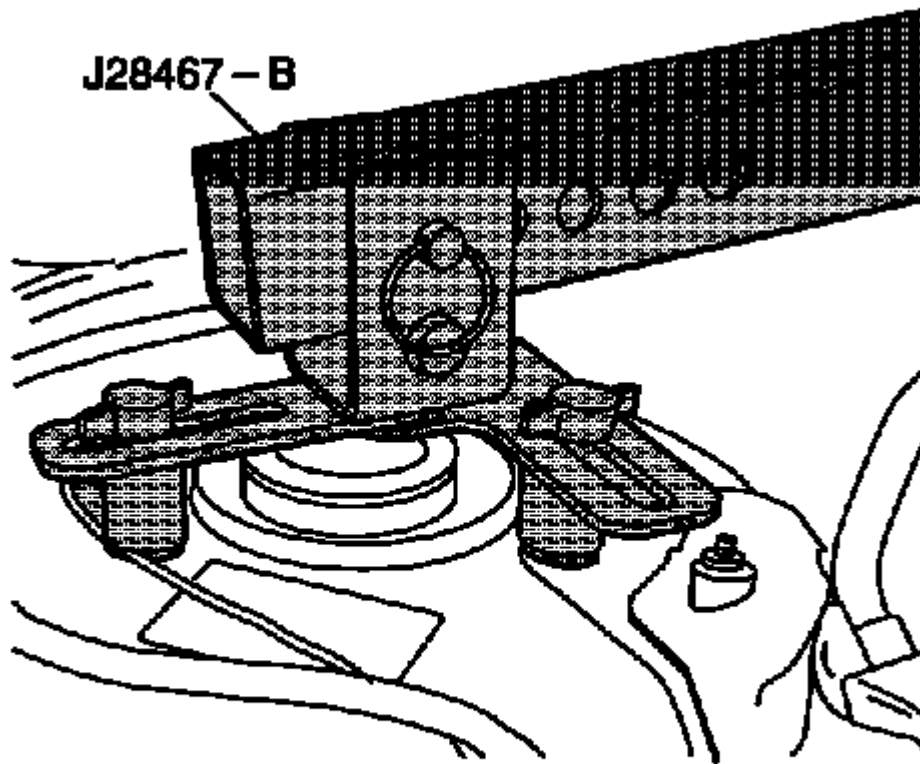


Fig. 9: Identifying Thread Support Nuts (J 28467-33A)
Courtesy of GENERAL MOTORS CORP.

1. Raise the hood.
2. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.
3. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection (LGD/LZE) .
4. Install the thread support nuts J 28467-33A onto the strut attaching studs.
5. Install the strut tower support assemblies J 28467-5A over the thread support nuts J 28467-33A.
6. Install the T-bolts J 28467-5 with 5/16 inch washers through the strut tower support assemblies J 28467-5A into the thread support nuts J 28467-33A. Hand tighten the bolts.
7. Install the 2 cross bracket assemblies J 28467-1A over the strut tower tube J 28467-3.

8. Install the strut tower tube J 28467-3 into the strut tower support assemblies J 28467-5A.
9. Install the 1/2 inch x 2.5 inch quick release pin J 28467-10 through the strut tower support assemblies J 28467-5A and the strut tower tube J 28467-3 on one side only.

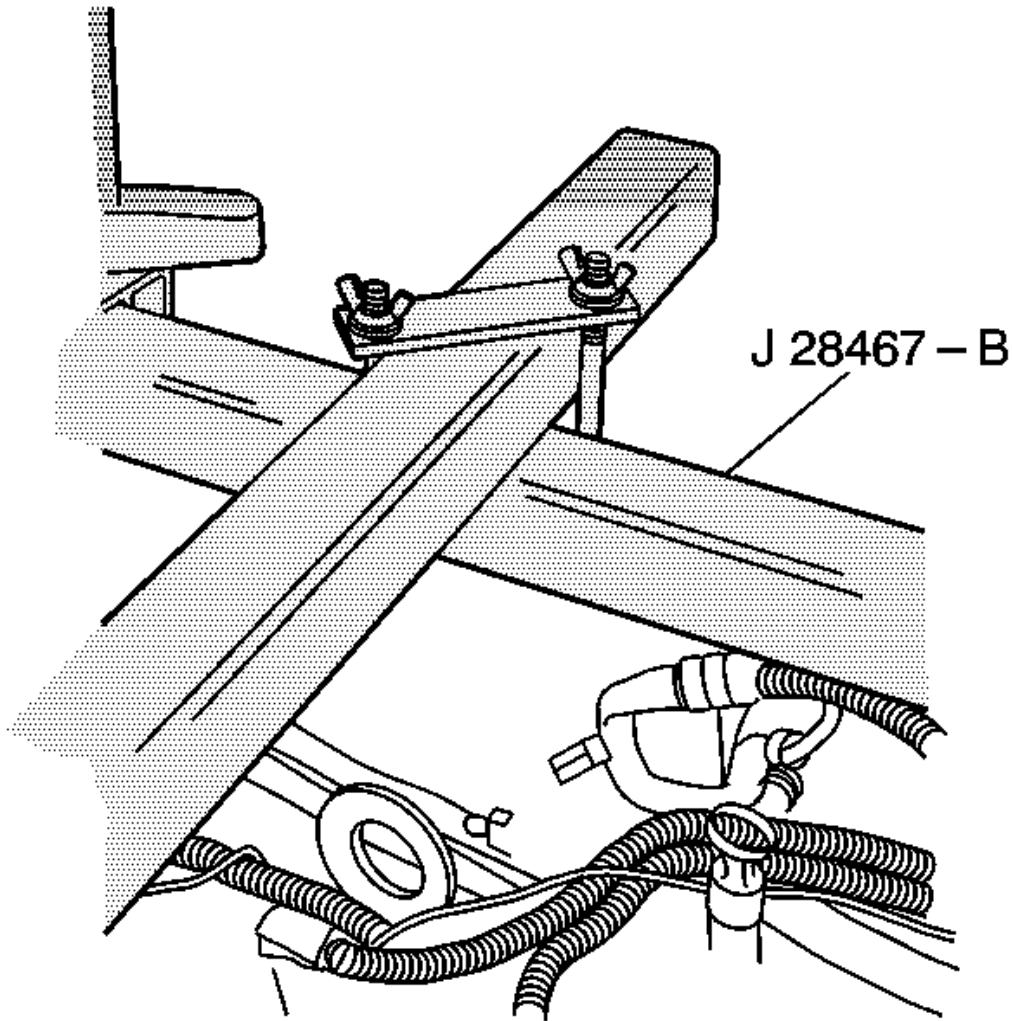


Fig. 10: Radiator Shelf Tube
Courtesy of GENERAL MOTORS CORP.

10. Install the radiator shelf tube J 28467-2A through the driver side cross bracket assembly J 28467-1A on the top of the strut tower tube J 28467-3.
11. Place the rubber padded foot of the front support assembly J 28467-4A on the vehicle radiator shelf. The foot position used in the front support assembly J 28467-4A depends on the vehicle application.

12. Install the 7/16 inch x 2.0 inch quick release pin J 28467-9 through the hole in the front support assembly J 28467-4A in order to level the radiator shelf tube J 28467-2A. The hole used in the front support assembly J 28467-4A depends on the vehicle application.
13. Install the lift hook J 28467-7A through the lift hook bracket J 28467-6A.
14. Install the 1/2 inch lift hook washer and lift hook wing nut J 28467-34 onto the lift hook J 28467-7A.
15. Install the assembled lift hook bracket J 28467-6A over the radiator shelf tube J 28467-2A.
16. Adjust the radiator shelf tube J 28467-2A and the assemblage lift hook bracket J 28467-6A in order to align the hook with the left (front), rear of engine, lift hook bracket part of the left engine mount strut bracket.
17. Hand tighten the driver side cross bracket assembly J 28467-1A wing nuts.
18. Install the second radiator shelf tube J 28467-2A through the passenger side cross bracket assembly (J 28467-1A) on the top of the strut tower tube J 28467-3.
19. Place the rubber padded foot of the front support assembly J 28467-4A on the vehicle radiator shelf. The foot position used in the front support assembly J 28467-4A depends on the vehicle application.
20. Install the 7/16 inch x 2.0 inch quick release pin J 28467-9 through the hole in the front support assembly J 28467-4A in order to level the radiator shelf tube J 28467-2A. The hole used in the front support assembly J 28467-4A depends on the vehicle application.
21. Install the lift hook J 28467-7A through the lift hook bracket J 28467-6A.
22. Install the 1/2 inch lift hook washer and lift hook wing nut J 28467-34 onto the lift hook J 28467-7A.
23. Install the assemblage lift hook bracket J 28467-6A over the radiator shelf tube J 28467-2A.
24. Adjust the radiator shelf tube J 28467-2A and the assemblage lift hook bracket J 28467-6A in order to align the hook with the right rear, front of engine, lift hook bracket located next to the generator.
25. Hand tighten the passenger side cross bracket assembly J 28467-1A wing nuts.
26. Hand tighten the lift hook wing nuts J 28467-34 securely in order to remove all slack from the engine support fixture assembly.

ENGINE MOUNT INSPECTION

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

1. Install the engine support fixture. Refer to Engine Support Fixture.
2. Observe the engine mount while raising the engine. Raising the engine removes the weight from the engine mount and creates slight tension on the rubber.
3. Replace the engine mount if the engine mount exhibits any of the following conditions:
 - The hard rubber 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 engine mount itself is leaking fluid.
4. For engine mount replacement. Refer to Engine Mount Replacement.

ENGINE MOUNT REPLACEMENT

REMOVAL PROCEDURE

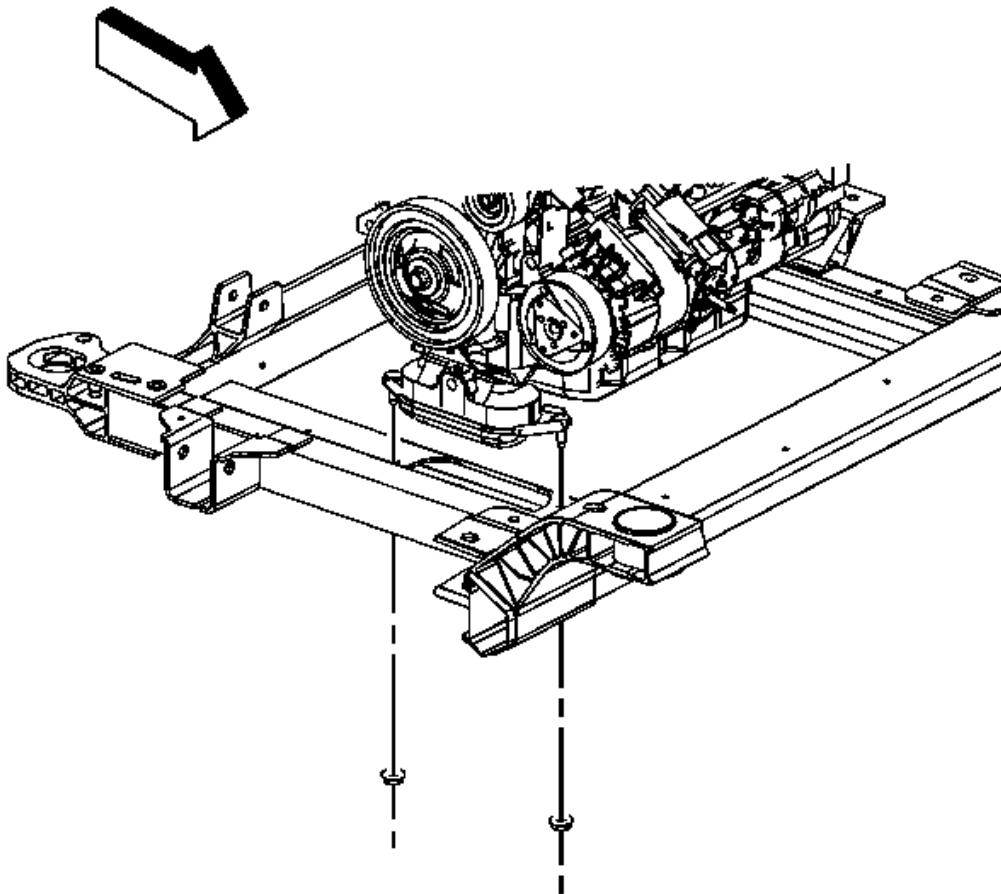


Fig. 11: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

1. Remove the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
2. Remove the engine splash shield. Refer to **Engine Splash Shield Replacement (Right)** or **Engine Splash Shield Replacement (Left)** .
3. Remove the engine mount to frame nuts.

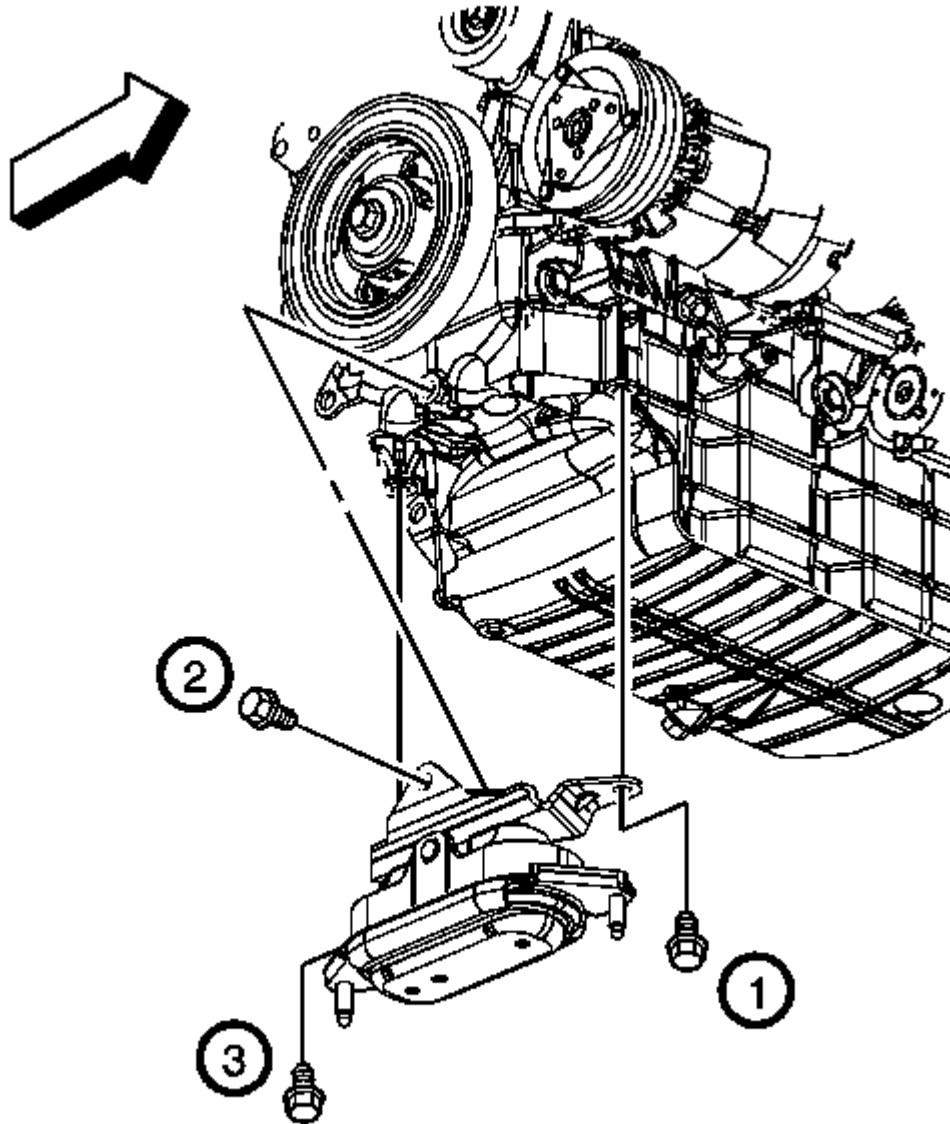


Fig. 12: Locating Engine Mount Bracket Bolts
 Courtesy of GENERAL MOTORS CORP.

4. Place an adjustable jack and a block of wood under the oil pan.
5. Remove the engine mount bracket bolts.
6. Using the adjustable jack and block of wood, raise the engine until the engine mount/bracket can be removed.

7. Remove the engine mount/bracket from the vehicle.

INSTALLATION PROCEDURE

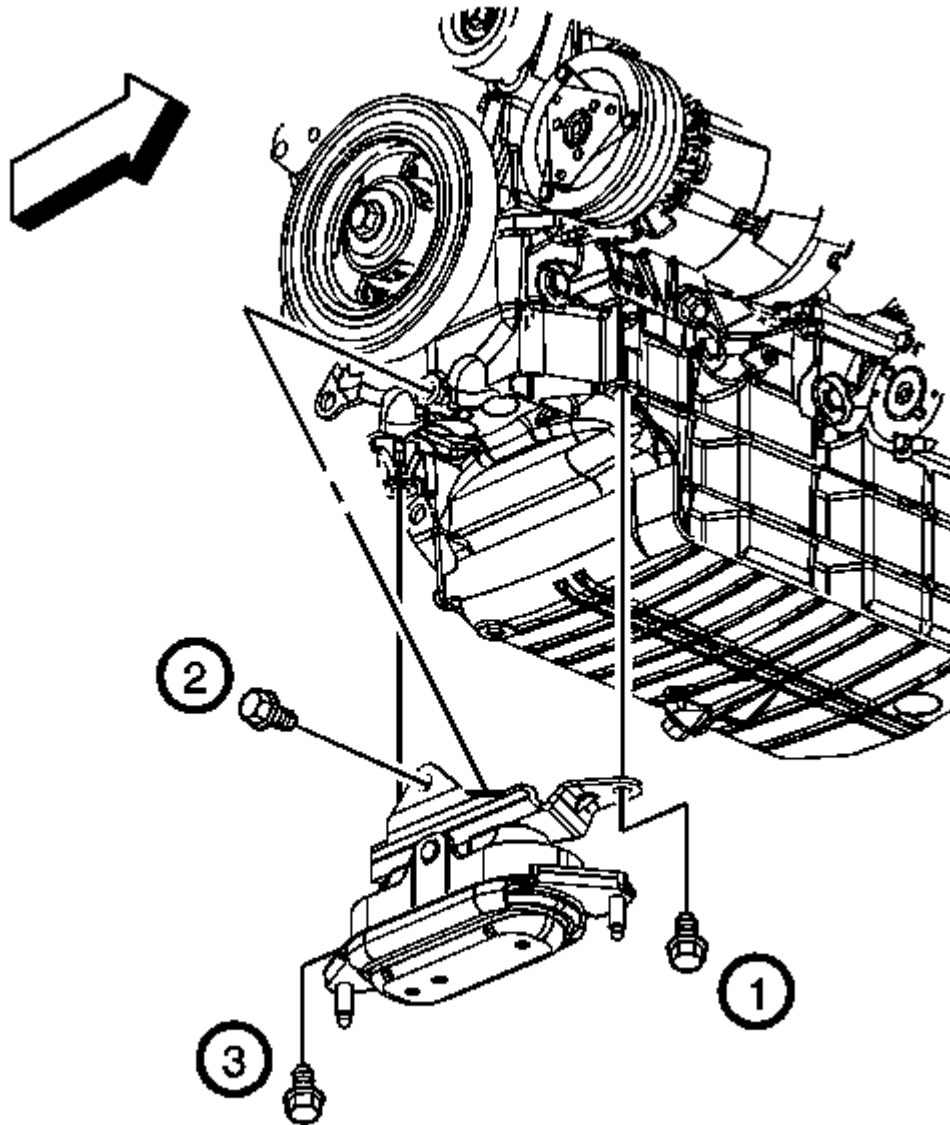


Fig. 13: Locating Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

1. Position the engine mount/bracket to the engine.

2. Install the engine mount bracket bolts.

CAUTION: Refer to Fastener Caution .

3. Tighten the engine mount bracket bolts.

Tighten: Tighten the bolts in the sequence shown to 58 N.m (43 lb ft).

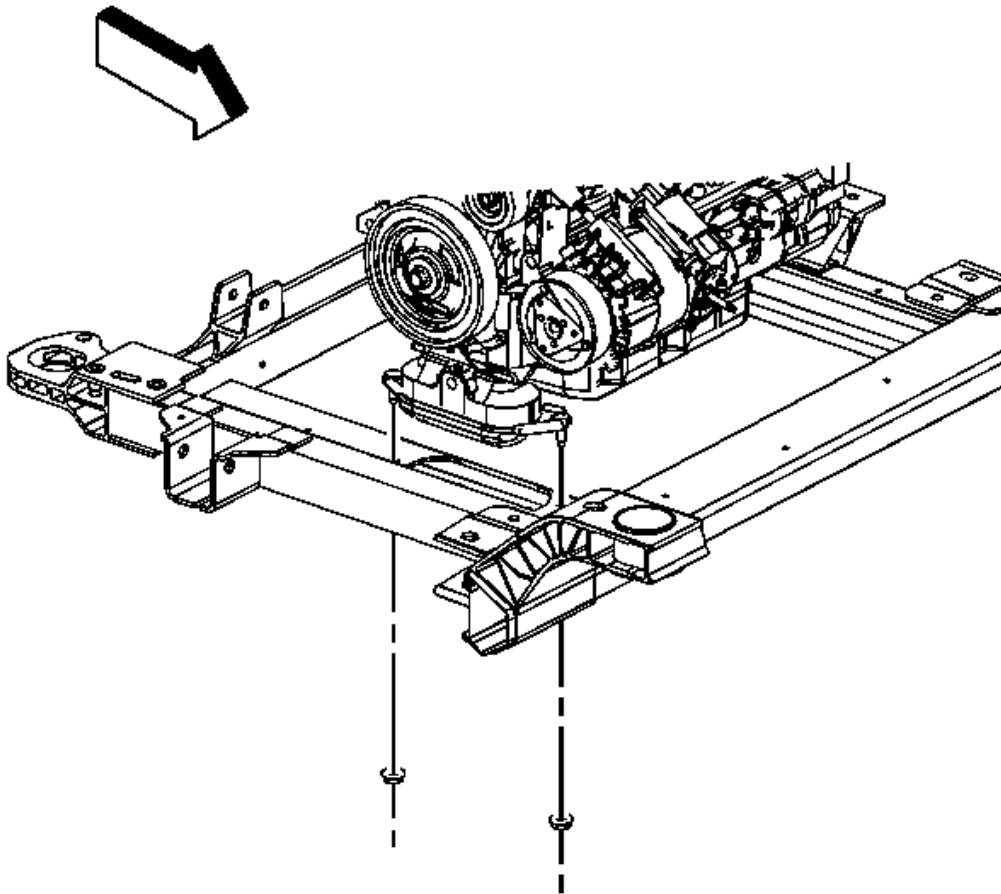


Fig. 14: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

4. Lower the engine using the adjustable jack until the engine mount rests on the frame.
5. Remove the adjustable jack and block of wood from under the vehicle.

6. Install the engine mount to frame nuts.

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

7. Install the engine splash shield. Refer to **Engine Splash Shield Replacement (Right)** or **Engine Splash Shield Replacement (Left)** .
8. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .

ENGINE MOUNT BRACKET REPLACEMENT

REMOVAL PROCEDURE

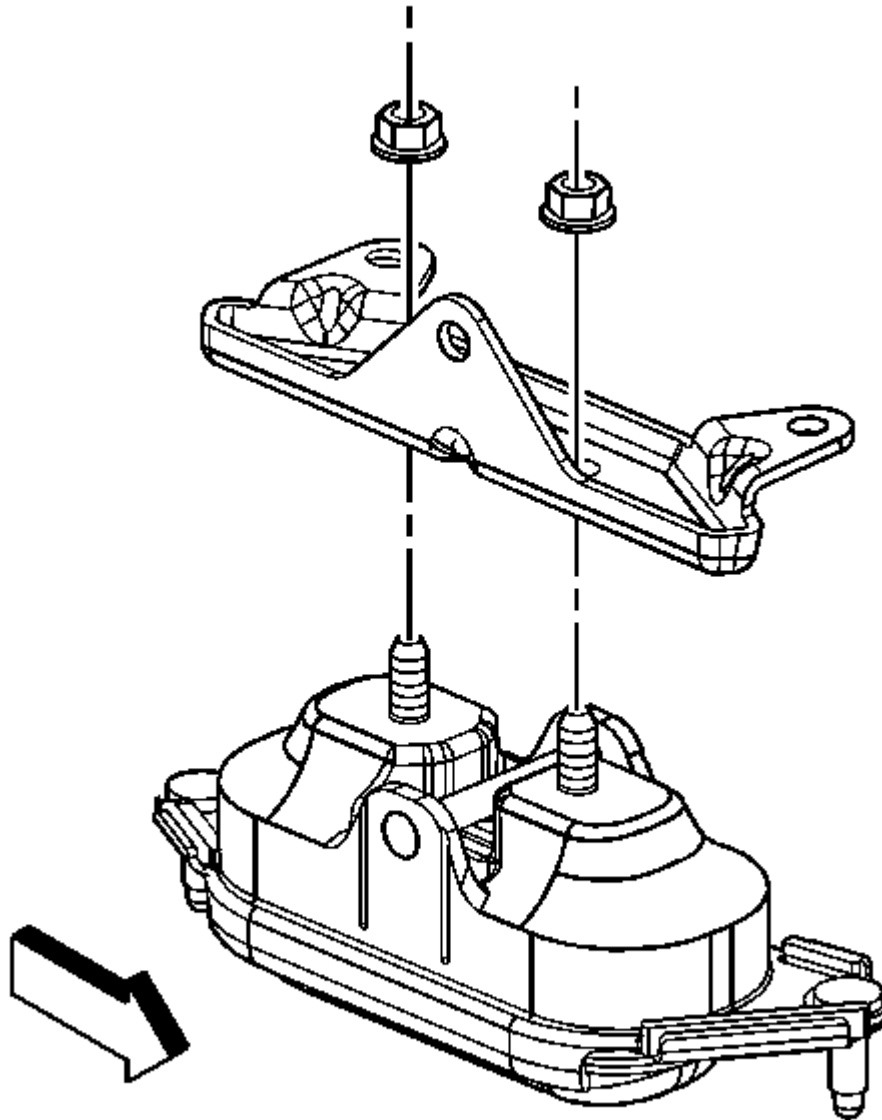


Fig. 15: View Of Engine Mount & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount. Refer to **Engine Mount Replacement**.
2. Remove the engine mount bracket to mount nuts.
3. Remove the engine mount bracket.

INSTALLATION PROCEDURE

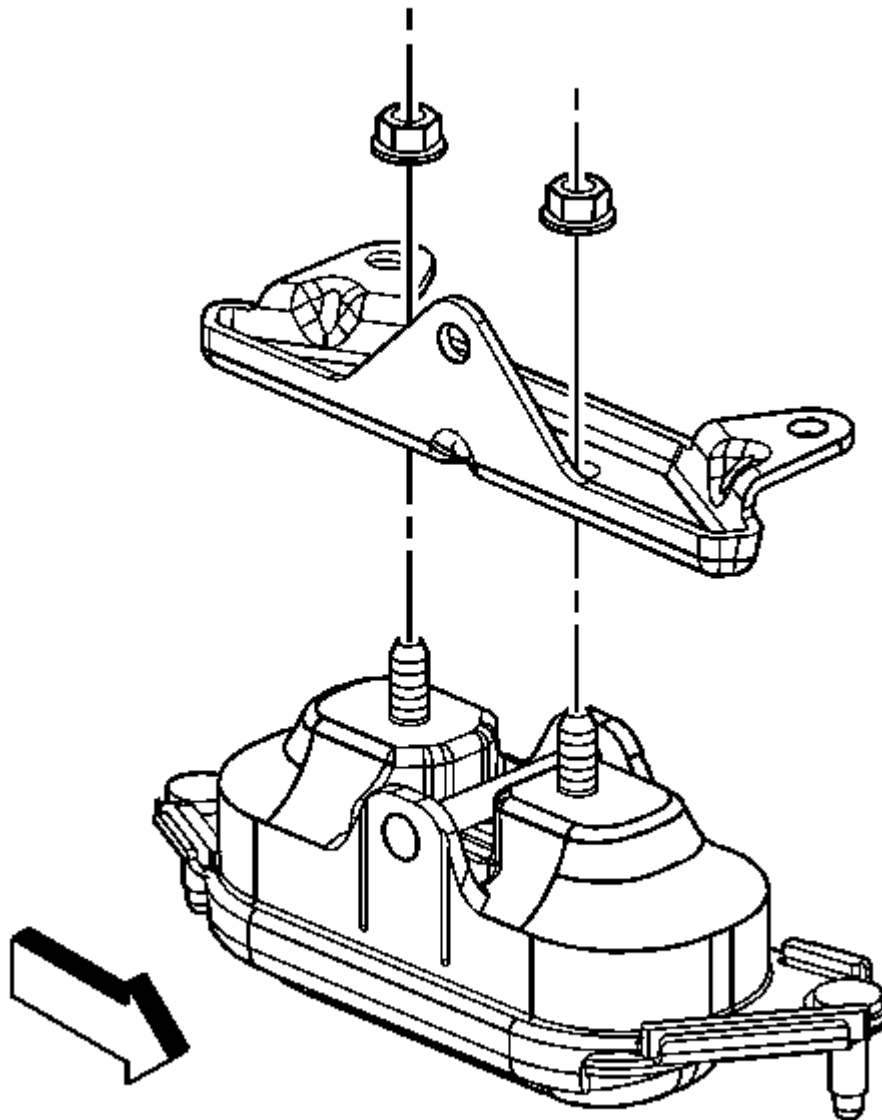


Fig. 16: View Of Engine Mount & Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the engine mount bracket to the mount.
2. Install the engine mount bracket to mount nuts.

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

3. Install the engine mount. Refer to **Engine Mount Replacement**.

ENGINE MOUNT STRUT REPLACEMENT

REMOVAL PROCEDURE

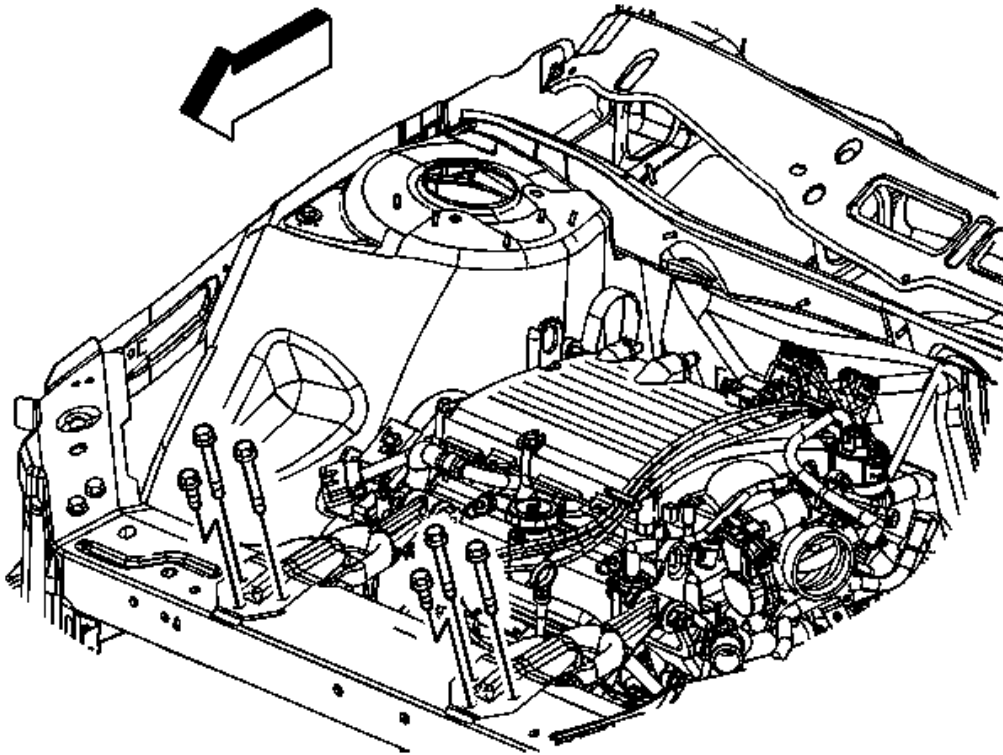


Fig. 17: View Of Engine Mount Strut & Radiator Support Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount strut to radiator support bolts.

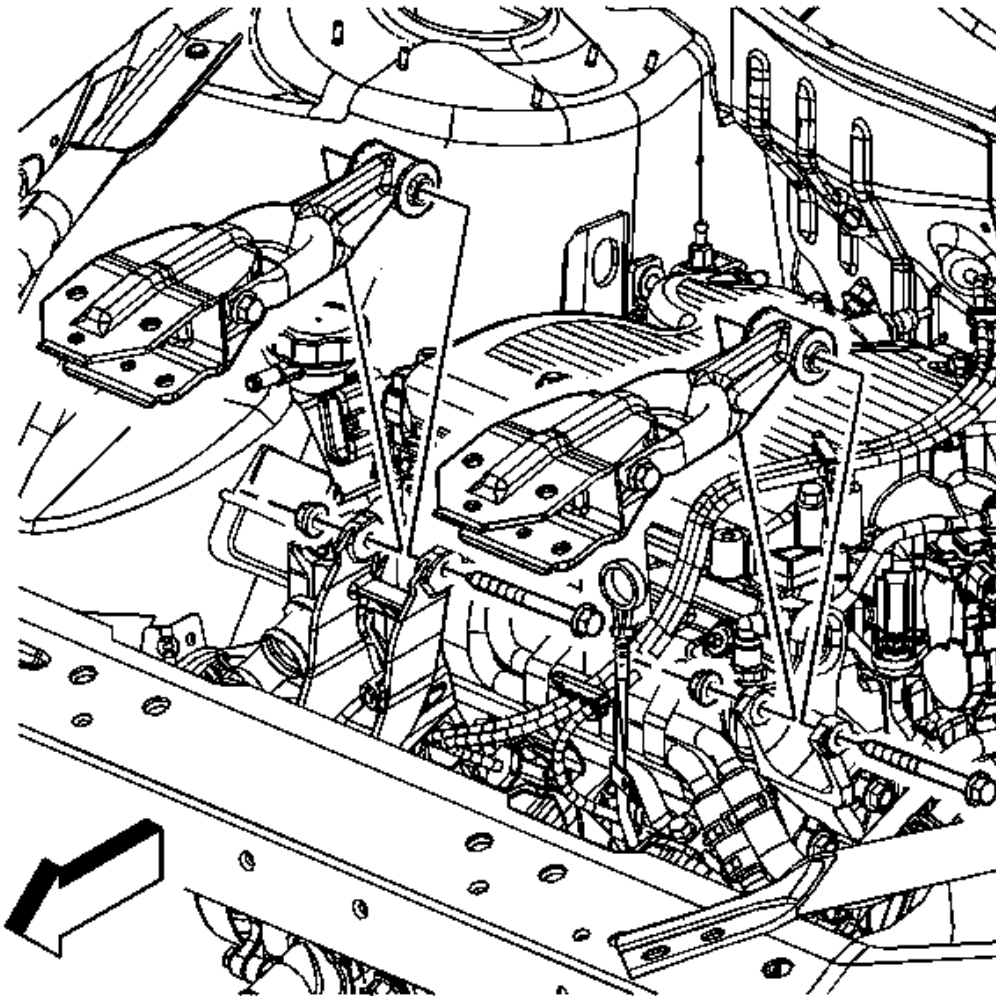


Fig. 18: View Of Engine Mount Struts
Courtesy of GENERAL MOTORS CORP.

2. Remove the engine mount strut to engine mount strut bracket bolts/nuts.
3. Remove the engine mount strut(s).

INSTALLATION PROCEDURE

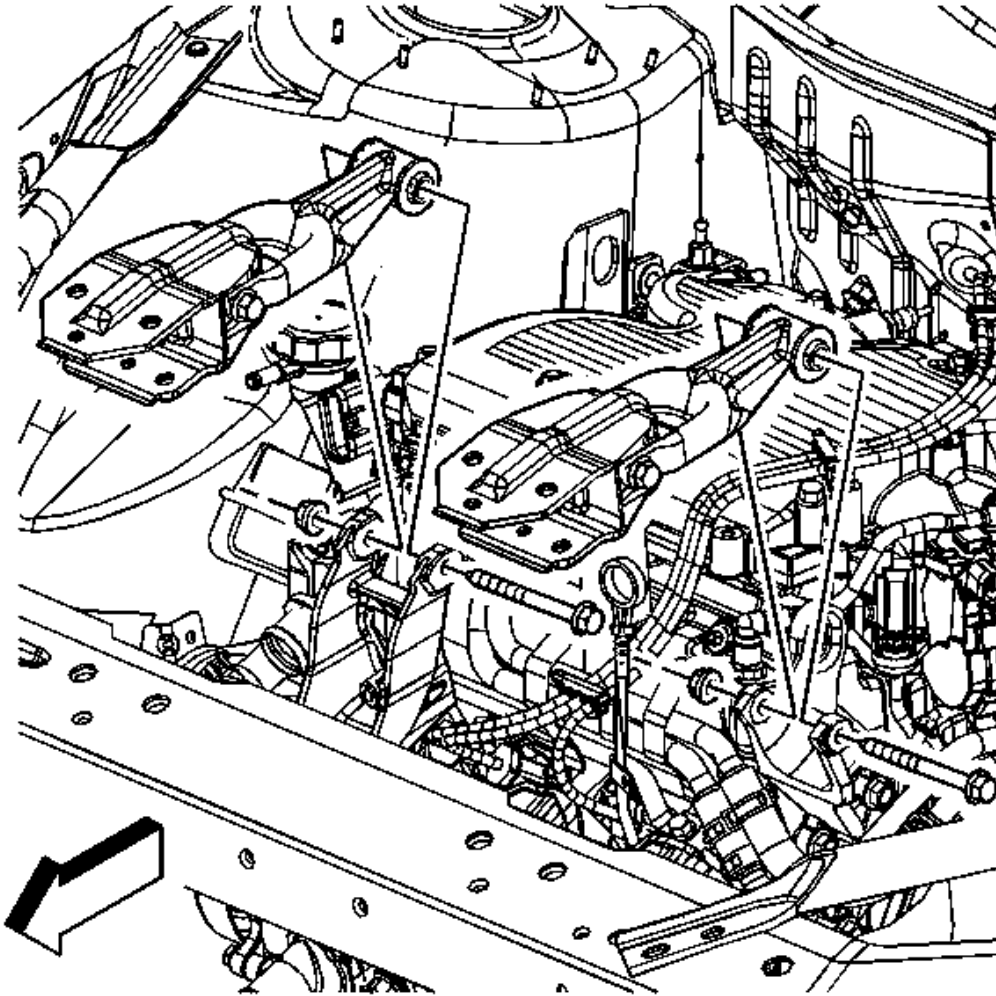


Fig. 19: View Of Engine Mount Struts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount strut(s).
2. Install the engine mount strut to engine mount strut bracket bolts/nuts.

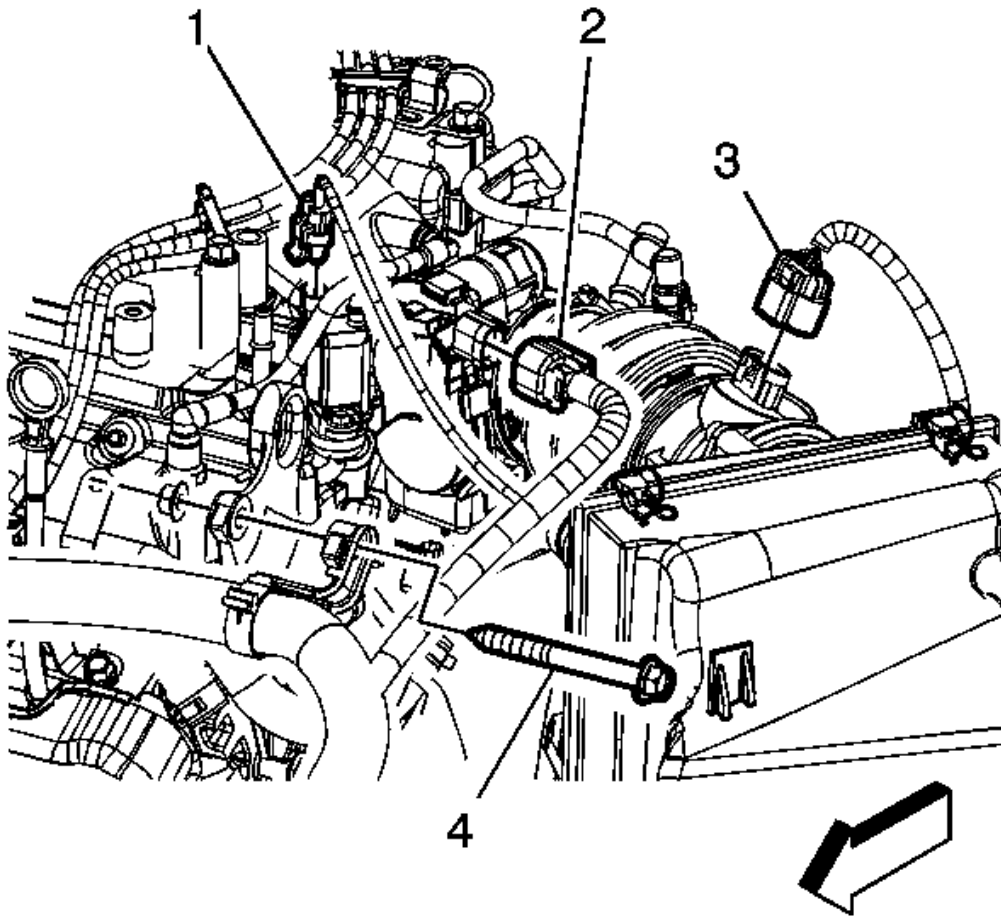


Fig. 20: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. On the right side, ensure that the engine harness clamp is sandwiched between the bolt (4) and the strut bracket.

CAUTION: Refer to Fastener Caution .

4. Tighten the engine mount strut to engine mount strut bracket bolts/nuts.

Tighten: Tighten the bolts/nuts to 50 N.m (37 lb ft).

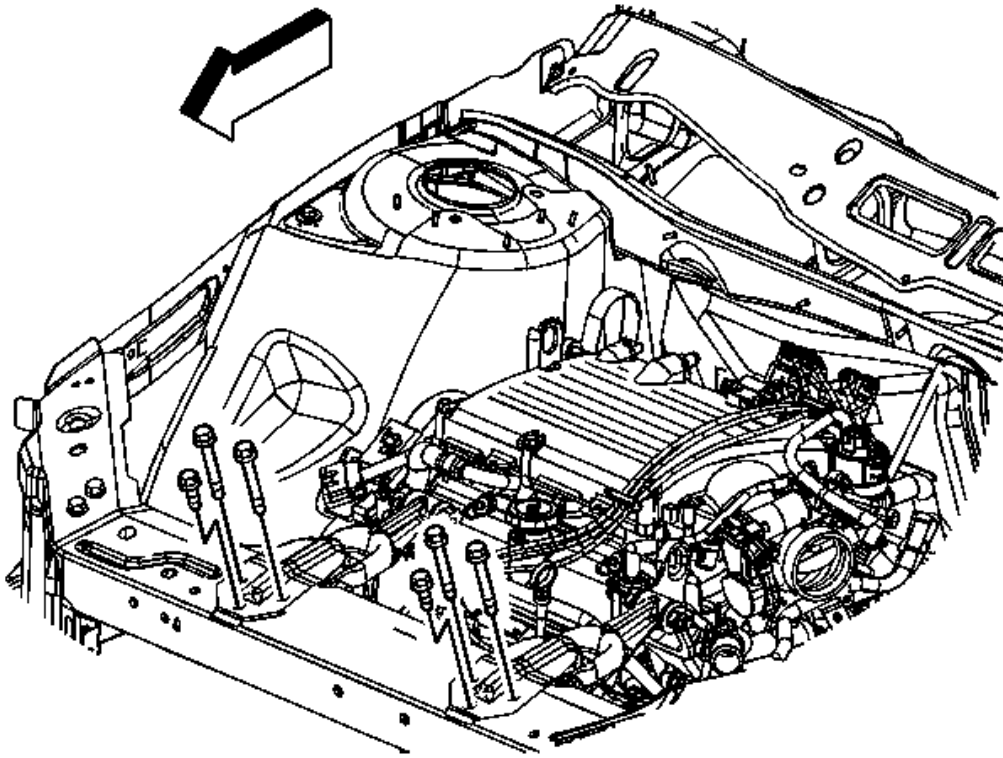


Fig. 21: View Of Engine Mount Strut & Radiator Support Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the engine mount strut to radiator support bolts.

Tighten: Tighten the M10 bolts to 58 N.m (43 lb ft) and Tighten the M8 bolts to 26 N.m (19 lb ft).

ENGINE MOUNT STRUT BRACKET REPLACEMENT - LEFT SIDE

REMOVAL PROCEDURE

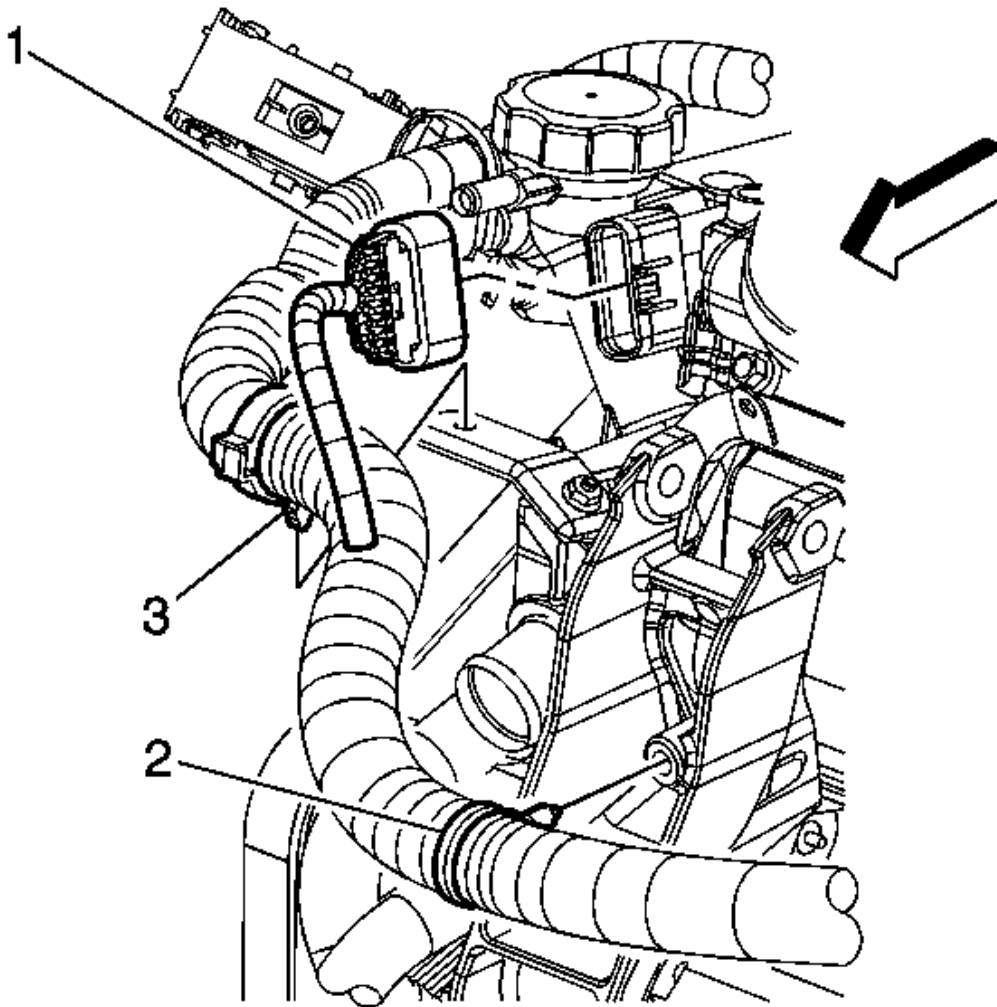


Fig. 22: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount strut. Refer to **Engine Mount Strut Replacement**.
2. Remove the engine harness clip (2) from the strut bracket.

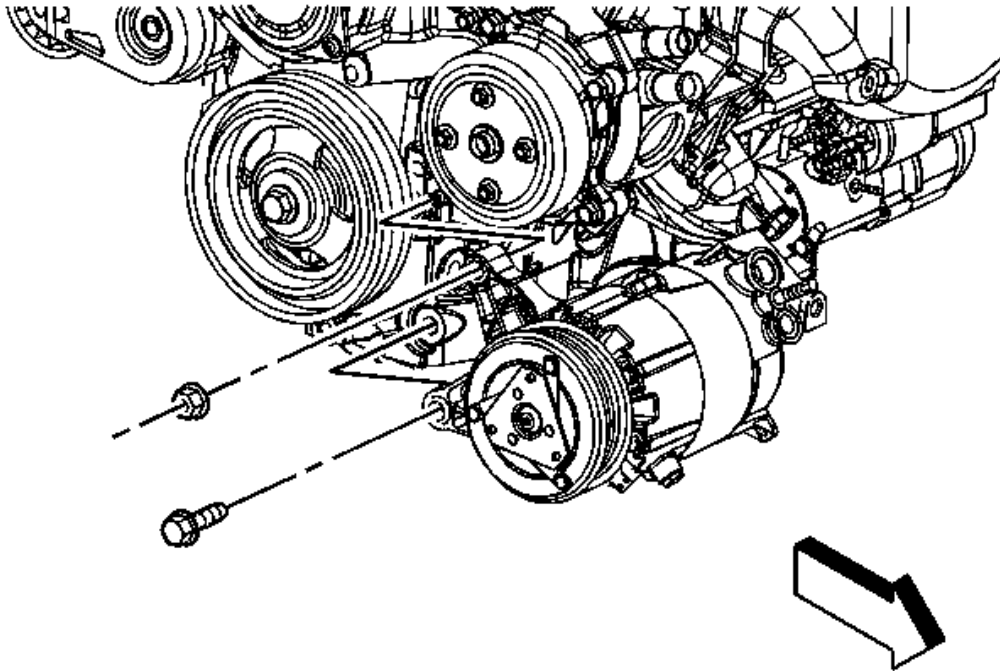


Fig. 23: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
4. Remove the air conditioning (A/C) compressor front bolt/nut.

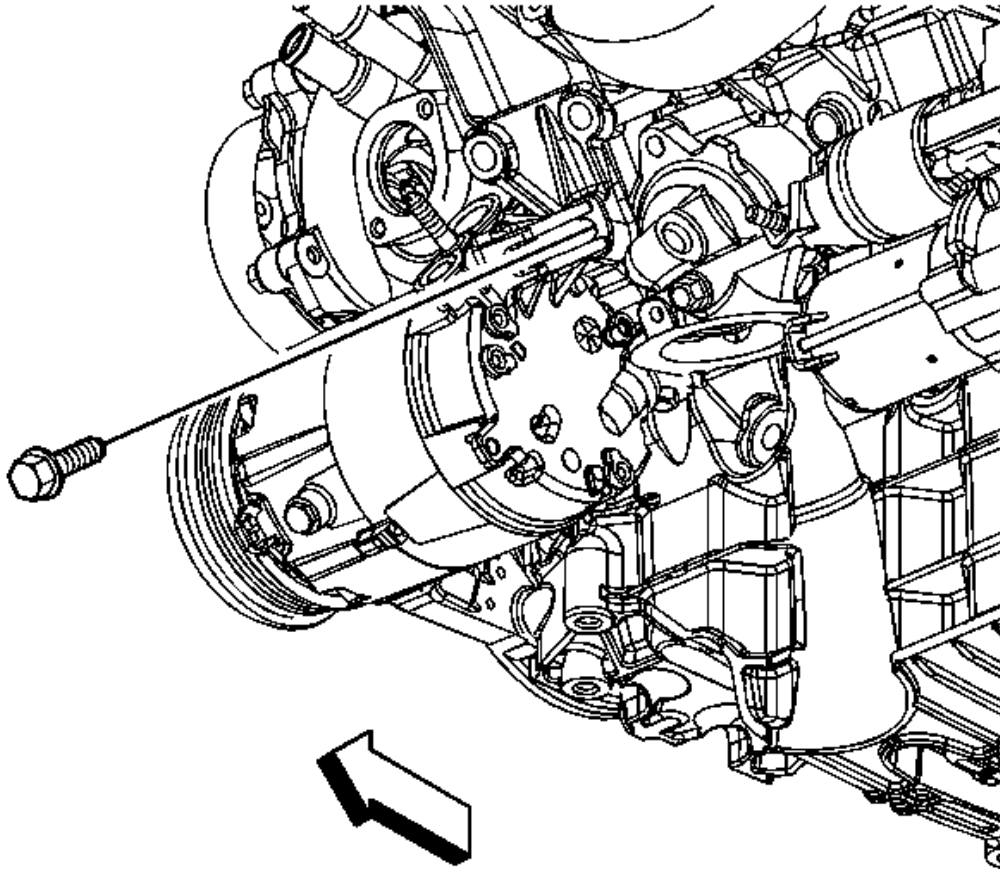


Fig. 24: A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the A/C compressor rear bolt.
6. Reposition the A/C compressor.

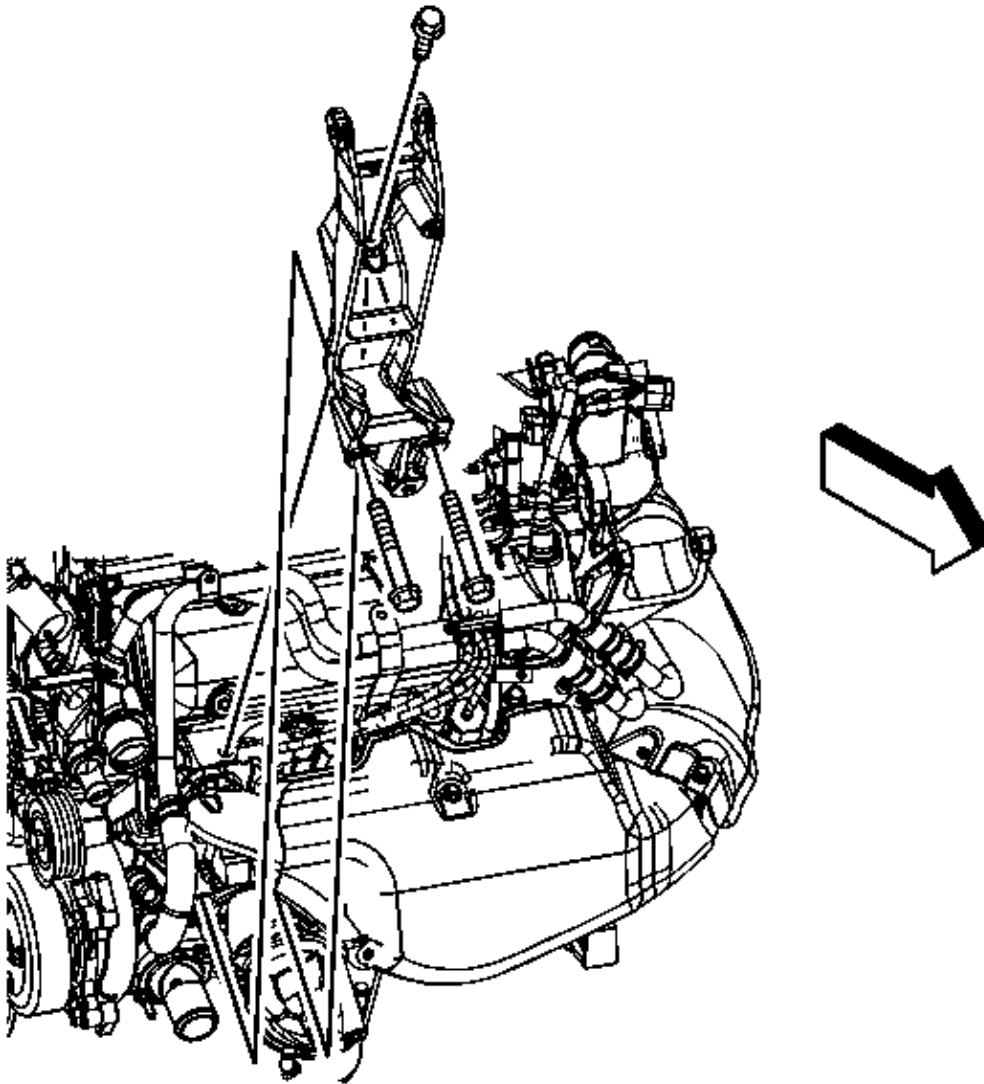


Fig. 25: Locating Engine Mount Strut Bracket & Lower Engine Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the engine mount strut bracket to engine lower bolts.
8. Lower the vehicle.
9. Remove the engine mount strut bracket to engine upper bolt.
10. Remove the engine mount strut bracket.

INSTALLATION PROCEDURE

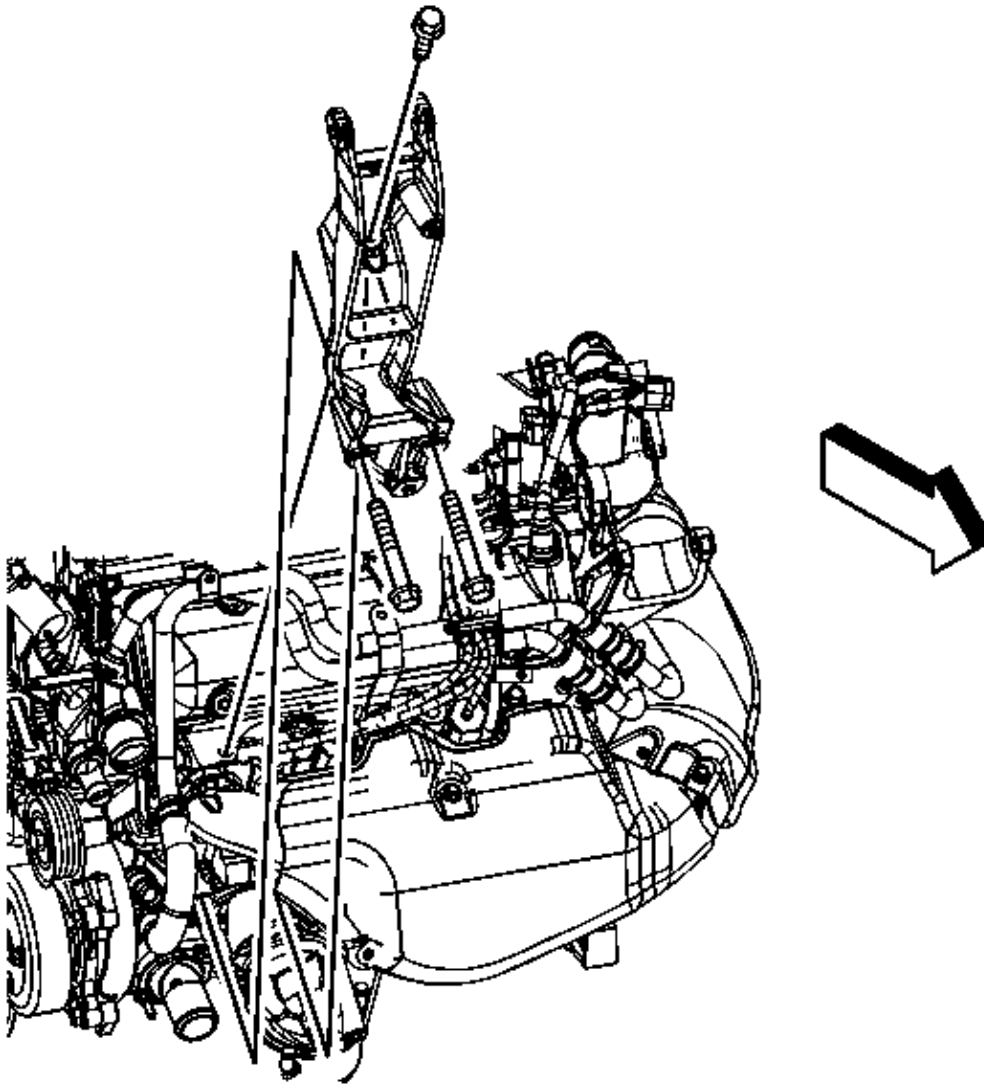


Fig. 26: Locating Engine Mount Strut Bracket & Lower Engine Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount strut bracket.
2. Loosely install the engine mount strut bracket to engine upper bolt.
3. Raise and support the vehicle.

CAUTION: Refer to Fastener Caution .

4. Install the engine mount strut bracket to engine lower bolts.

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

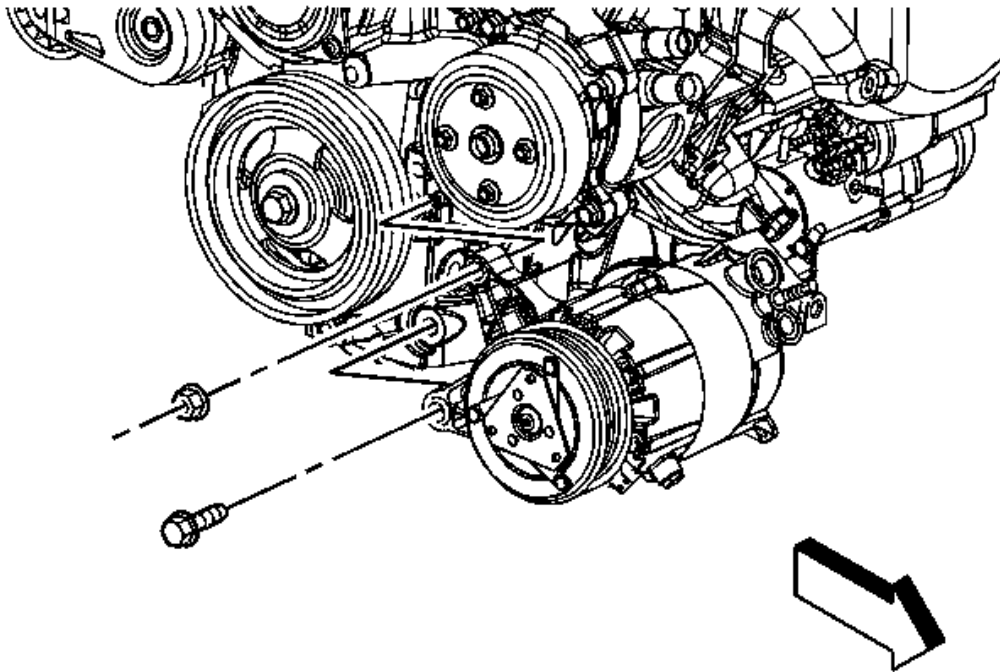


Fig. 27: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

5. Position the A/C compressor to the engine block.
6. Install until snug, the A/C compressor front nut and bolt.

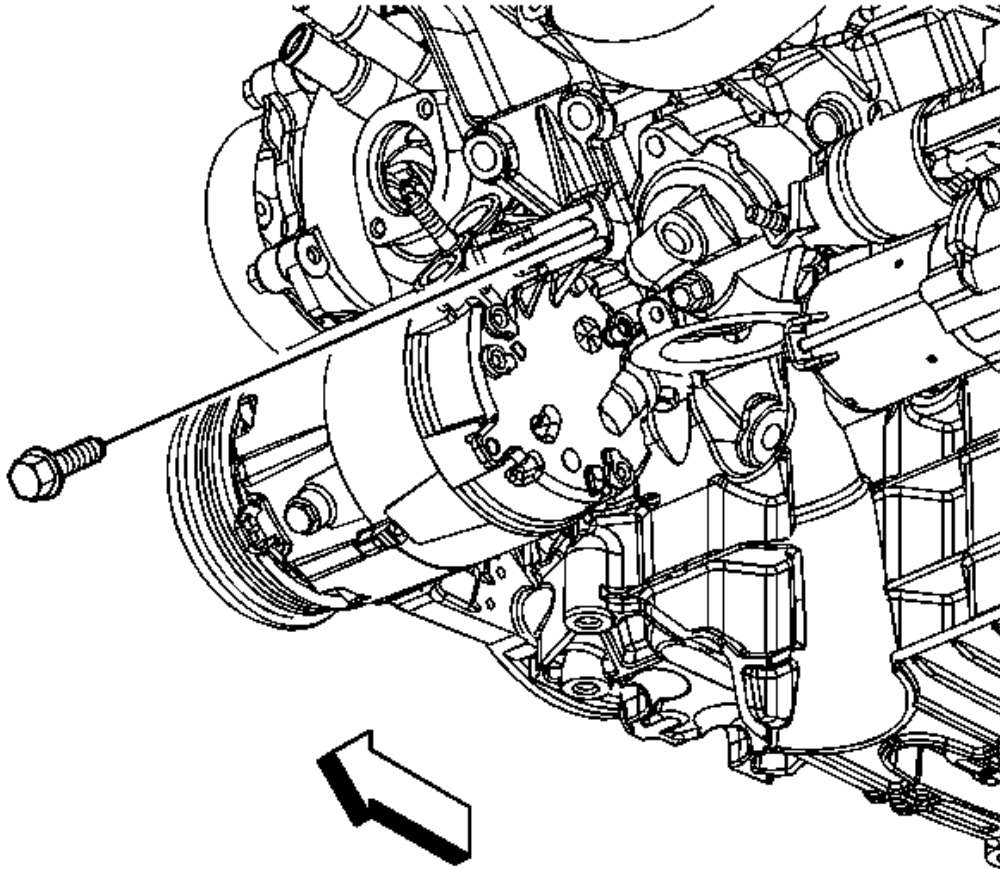


Fig. 28: A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

7. Install until snug, the A/C compressor rear bolt.
8. Tighten the A/C compressor nut first, then the rear bolt and finally the front bolt.

Tighten: Tighten the bolts/nut to 50 N.m (37 lb ft).

9. Lower the vehicle.

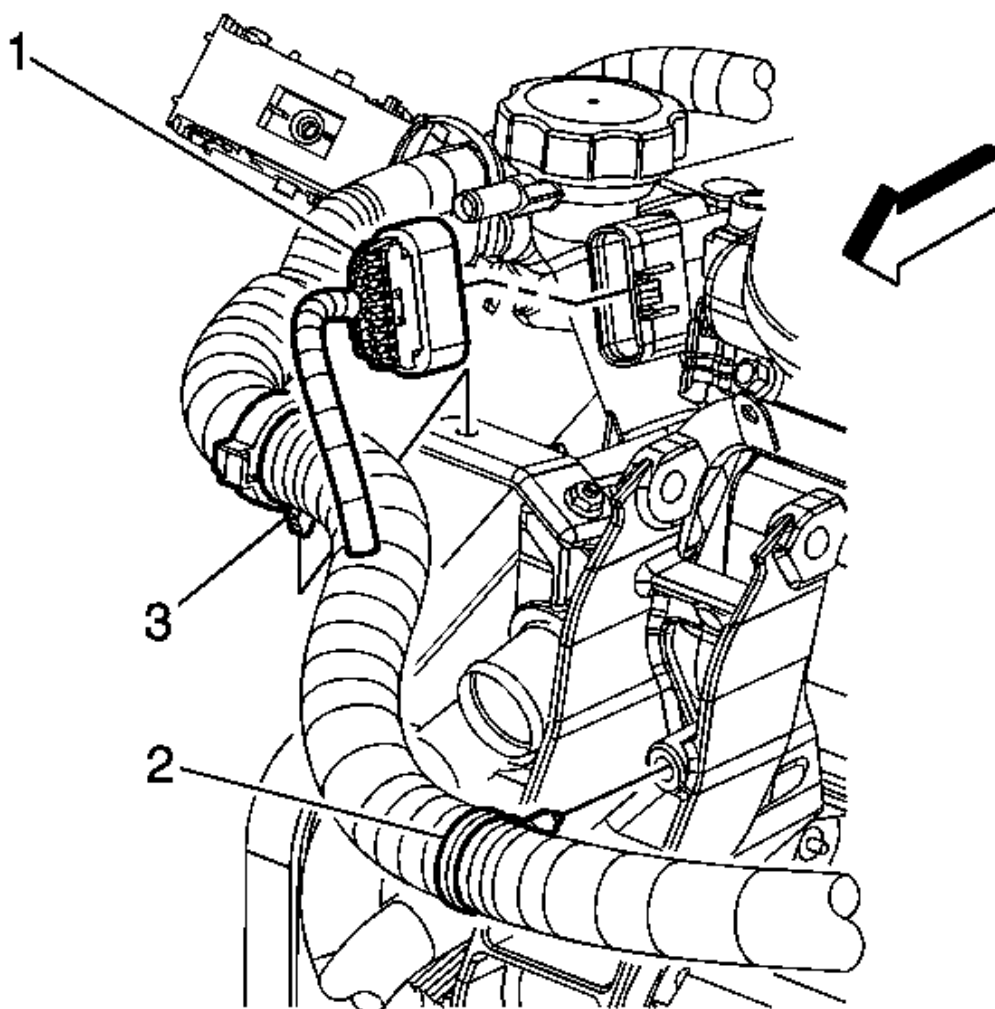


Fig. 29: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

10. Tighten the engine mount strut bracket to engine upper bolt.

Tighten: Tighten the bolts to 25 N.m (18 lb ft).

11. Install the engine harness clip (2) to the strut bracket.
12. Install the engine mount strut. Refer to **Engine Mount Strut Replacement**.

ENGINE MOUNT STRUT BRACKET REPLACEMENT - RIGHT SIDE

REMOVAL PROCEDURE

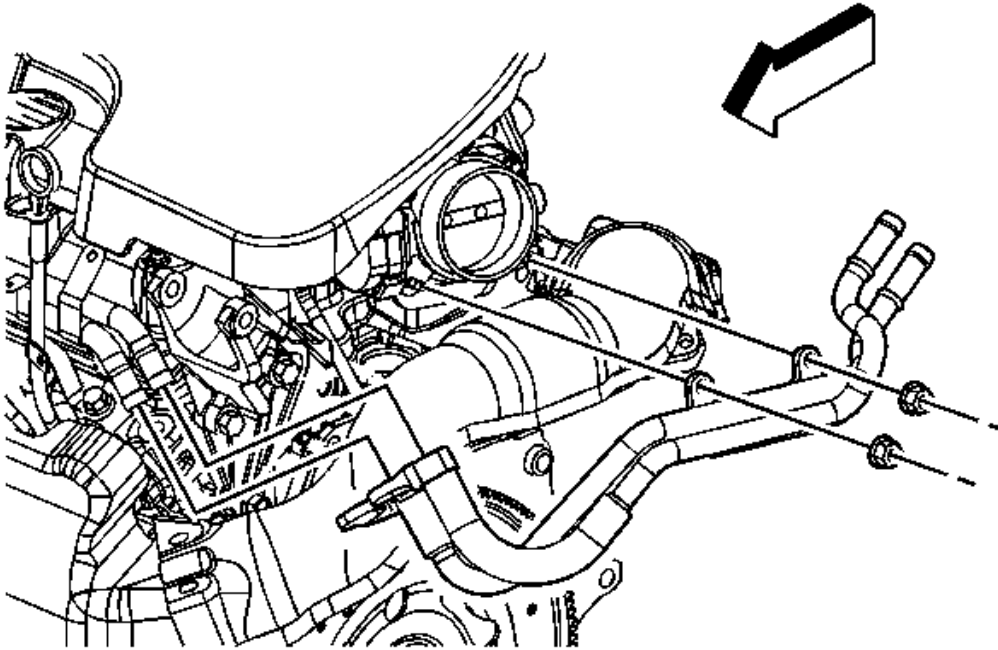


Fig. 30: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (LZE, LGD Static Fill)** or **Cooling System Draining and Filling (LZE, LGD GE47716 Fill)** .
2. Remove the engine mount strut. Refer to **Engine Mount Strut Replacement**.
3. Remove the heater inlet and outlet hose clamp nuts from the throttle body studs.
4. Reposition the heater inlet and outlet hose clamps at the pipes.
5. Remove the heater inlet and outlet hoses from the engine pipes.
6. Remove the heater inlet and outlet hose clamp from the throttle body studs.
7. Reposition the inlet and outlet hoses.

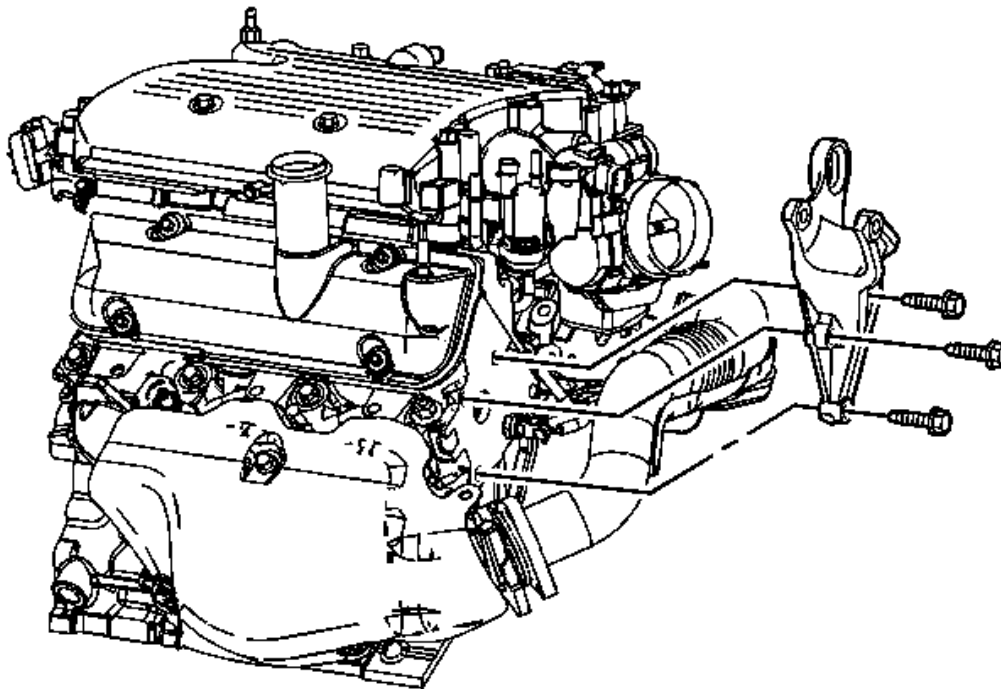


Fig. 31: View Of Engine Mount Strut Bracket & Cylinder Head
Courtesy of GENERAL MOTORS CORP.

8. Remove the engine mount strut bracket to cylinder head bolts.
9. Remove the engine mount strut bracket.

INSTALLATION PROCEDURE

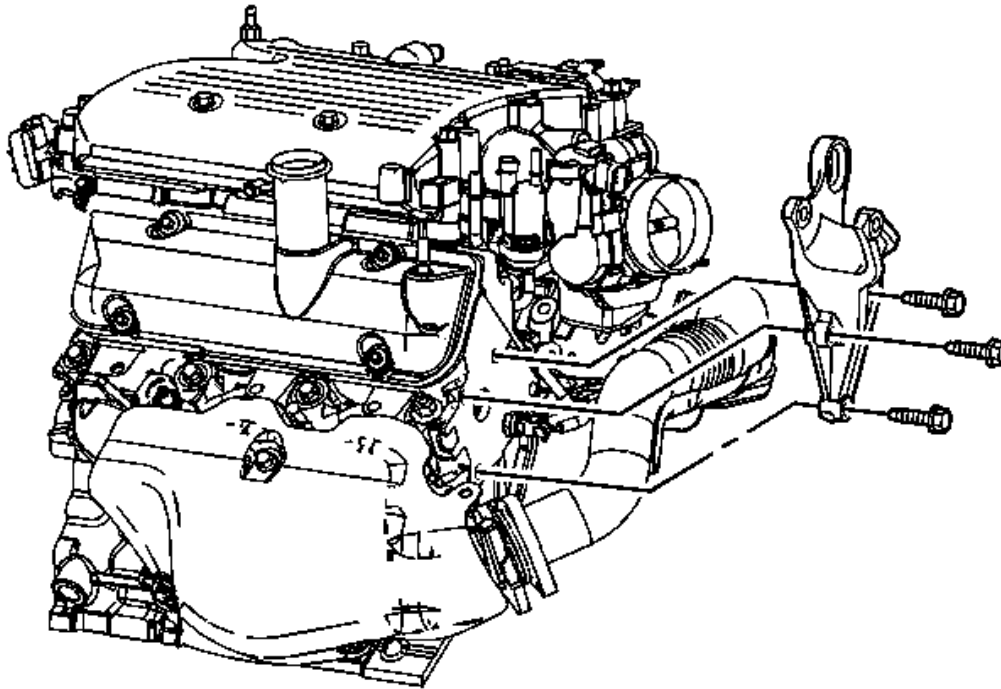


Fig. 32: View Of Engine Mount Strut Bracket & Cylinder Head
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Position the engine mount strut bracket to the cylinder head.
2. Install the engine mount strut bracket to cylinder head bolts.

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

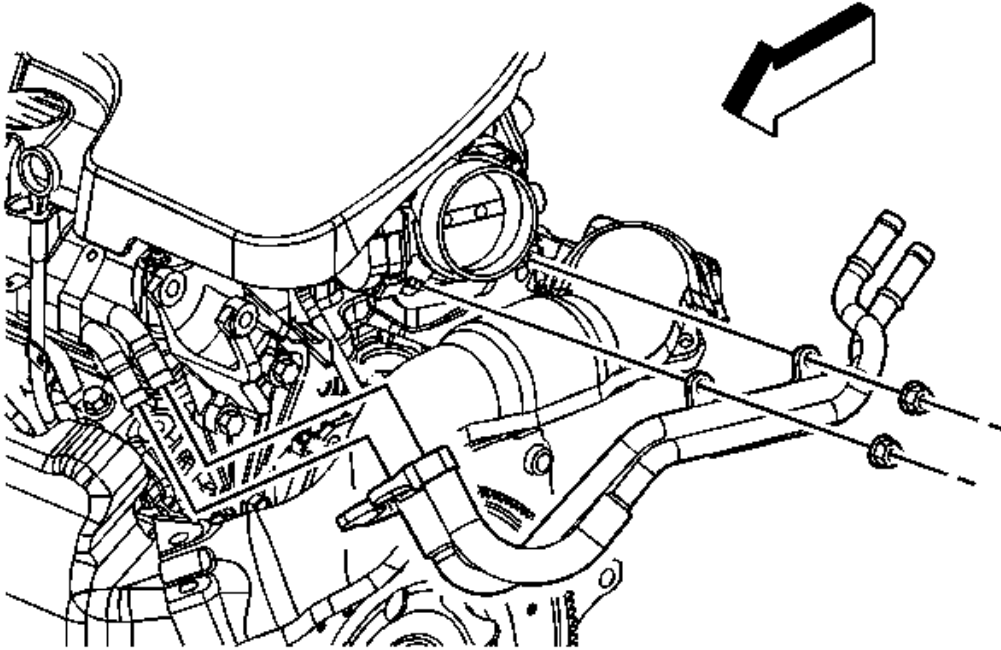


Fig. 33: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

3. Position and install the heater inlet and outlet hoses to the engine pipes.
4. Install the heater inlet and outlet hose clamp to the throttle body studs.
5. Position the heater inlet and outlet hose clamps at the pipes.
6. Install the heater inlet and outlet hose clamp nuts to the throttle body studs.

Tighten: Tighten the nuts to 10 N.m (89 lb ft).

7. Install the engine mount strut. Refer to **Engine Mount Strut Replacement**.
8. Fill the cooling system. Refer to **Cooling System Draining and Filling (LZE, LGD Static Fill)** or **Cooling System Draining and Filling (LZE, LGD GE47716 Fill)** .

OIL FILTER ADAPTER AND BYPASS VALVE ASSEMBLY REPLACEMENT

REMOVAL PROCEDURE

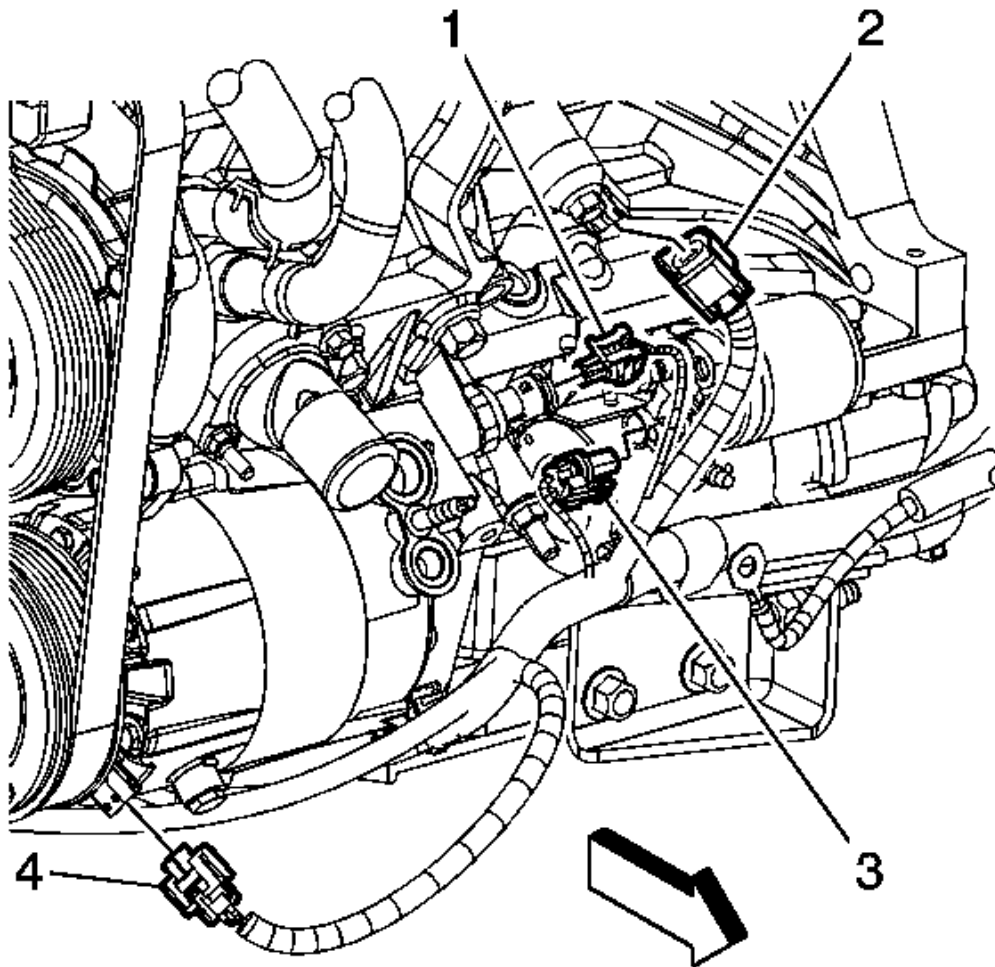


Fig. 34: Identifying Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Remove the drive belt. Refer to **Drive Belt Replacement** .
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Disconnect the oil pressure sensor electrical connector (1).

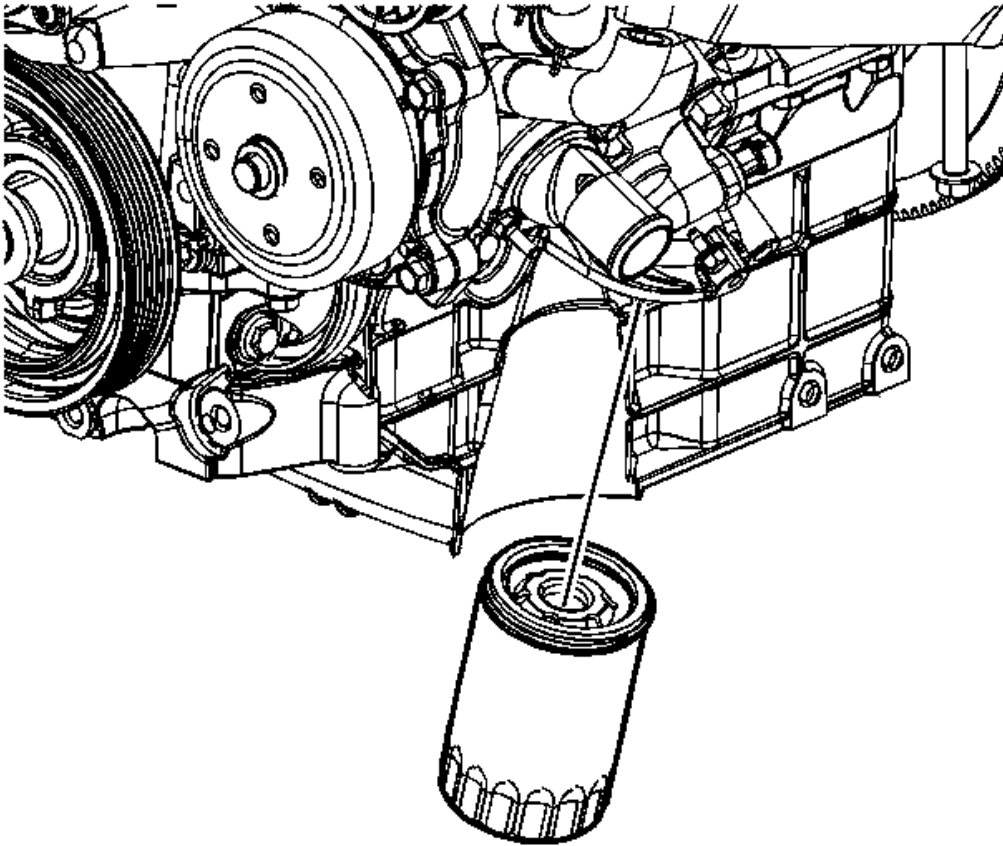


Fig. 35: View Of Oil Filter

Courtesy of GENERAL MOTORS CORP.

4. Remove the oil filter.
5. Remove A/C compressor bolt and nut and reposition the a/c compressor. It is not necessary to discharge the a/c system.

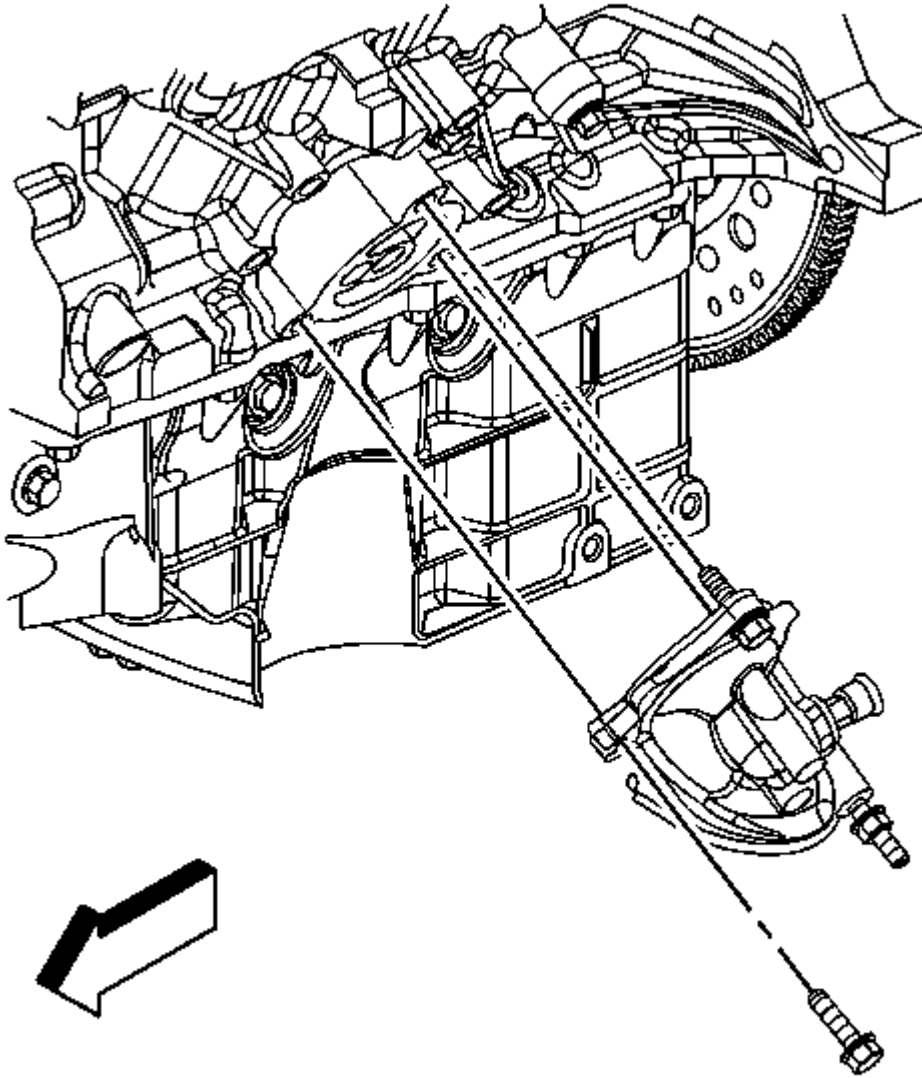


Fig. 36: Identifying Oil Filter Adapter Bolts & Stud
Courtesy of GENERAL MOTORS CORP.

6. Remove the oil filter adapter bolts and stud.
7. Remove the oil filter adapter and gasket.

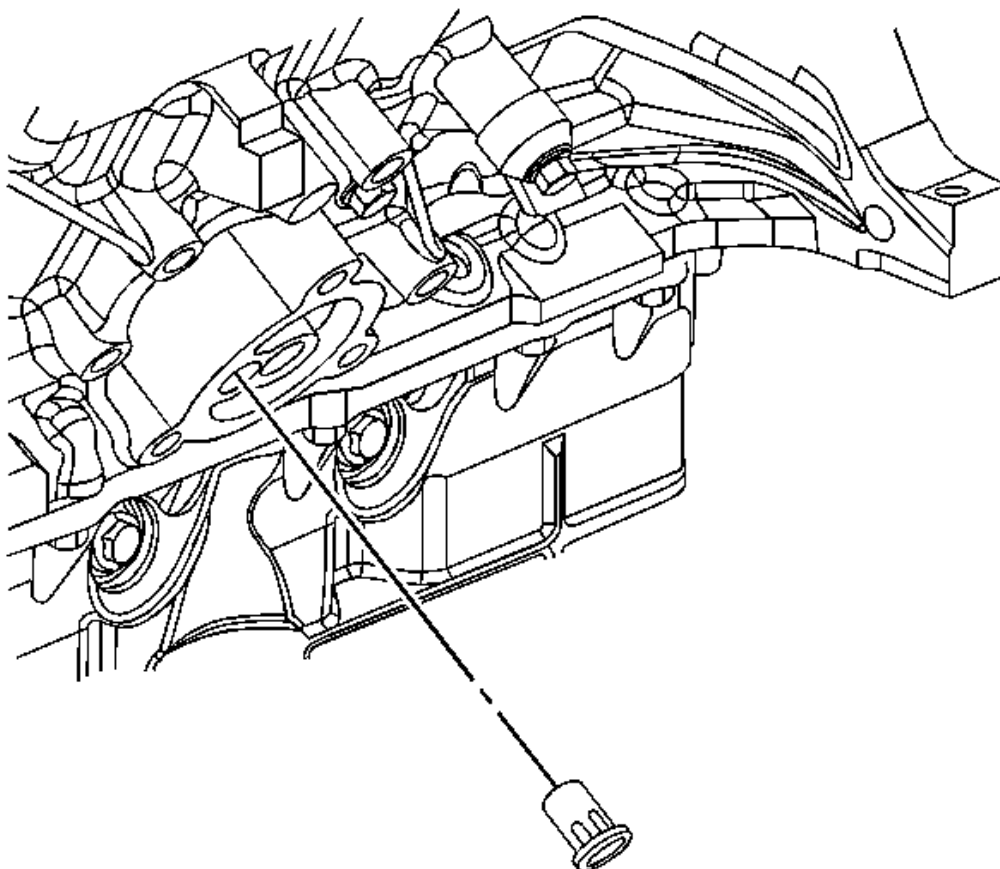


Fig. 37: Oil Filter Bypass Valve
Courtesy of GENERAL MOTORS CORP.

8. Insert a flat-bladed tool into the oil filter bypass hole and remove the oil filter bypass valve.

INSTALLATION PROCEDURE

CAUTION: Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical **MAY** reduce gasket sealing capability.

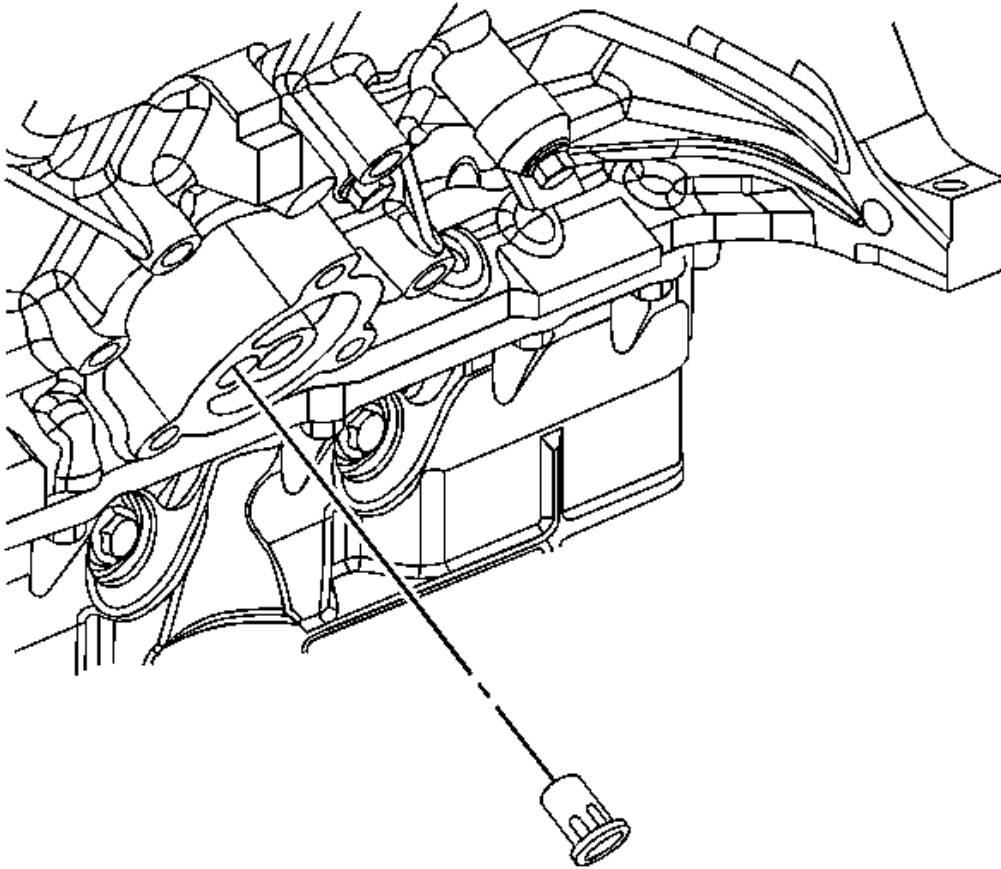


Fig. 38: Oil Filter Bypass Valve
Courtesy of GENERAL MOTORS CORP.

1. Install the oil filter bypass valve. Seat the valve fully below the bypass valve hole chamfer.

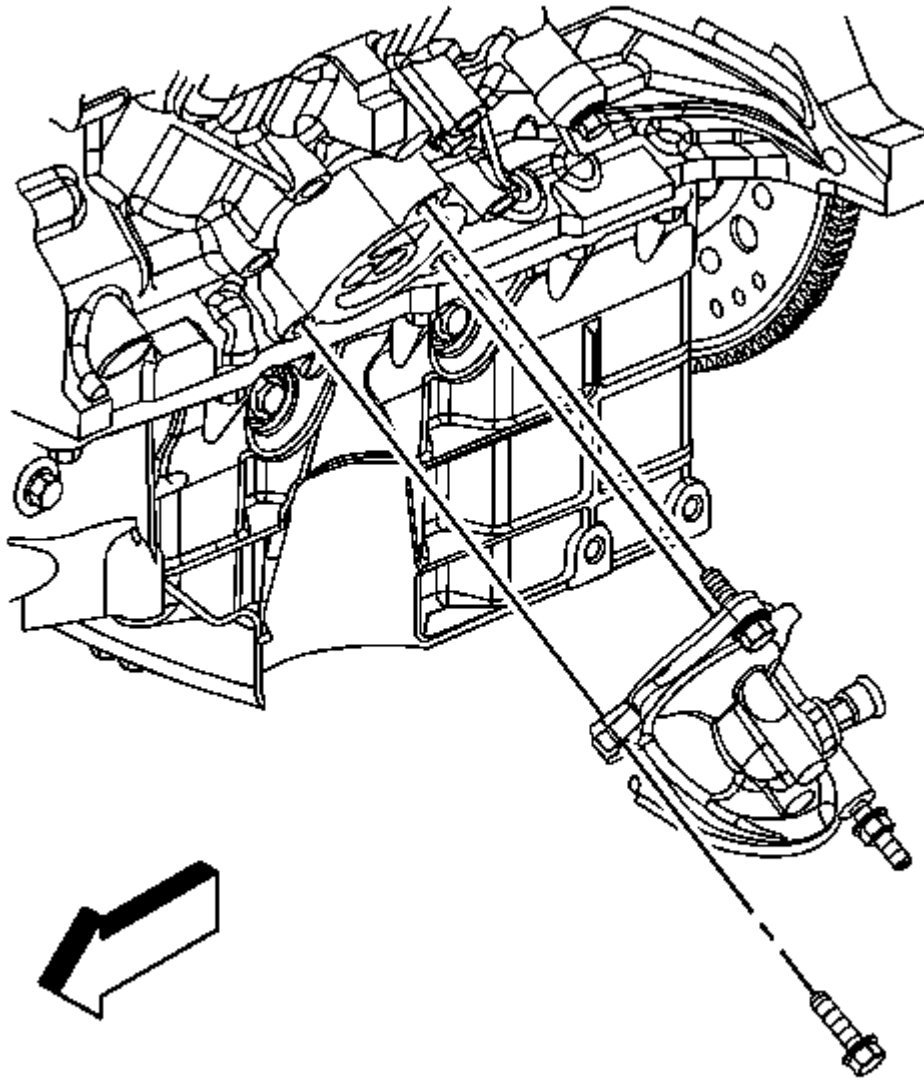


Fig. 39: Identifying Oil Filter Adapter Bolts & Stud
Courtesy of GENERAL MOTORS CORP.

2. Position the oil filter adapter and gasket to the engine.
3. Apply threadlock to the bolt/stud threads, if required. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .

CAUTION: Refer to Fastener Caution .

4. Install the oil filter adapter bolts and stud.

Tighten: Tighten the bolts and stud to 25 N.m (18 lb ft).

5. Install the A/C compressor, the bolts and nut.

Tighten: Tighten the A/C compressor mounting bolts and nut to 50 N.m (37 lb ft).

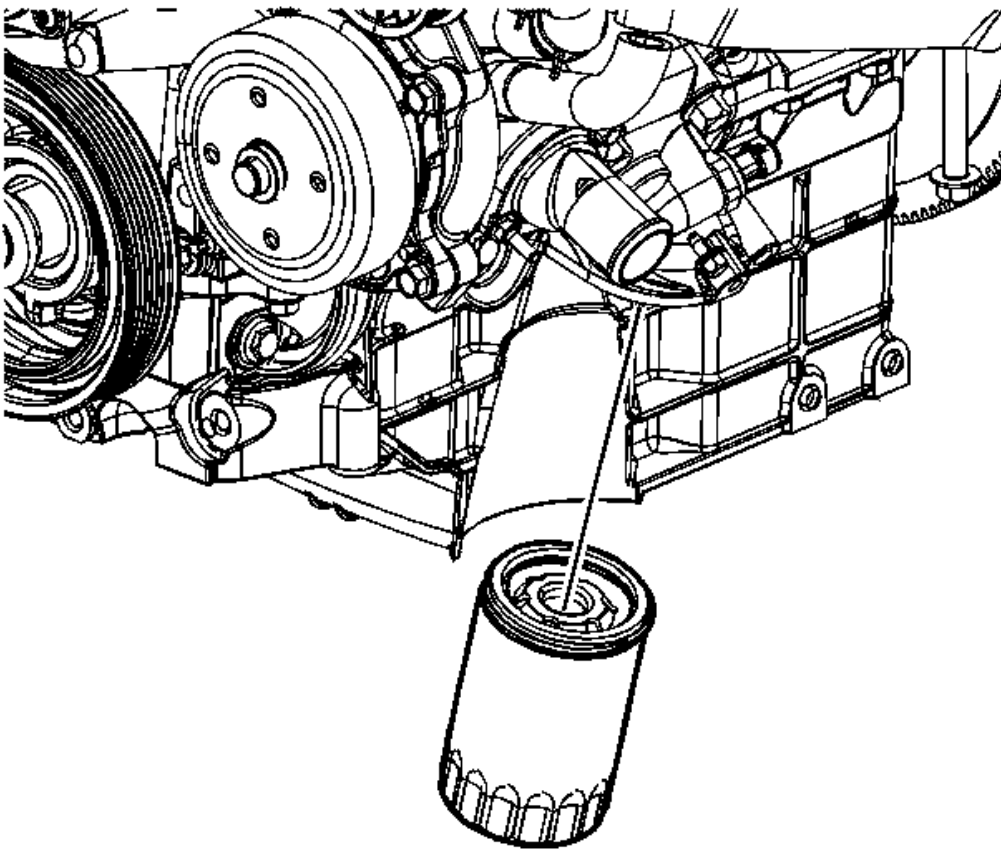


Fig. 40: View Of Oil Filter

Courtesy of GENERAL MOTORS CORP.

6. Install the oil filter.

Tighten: Tighten the filter to 30 N.m (22 lb ft).

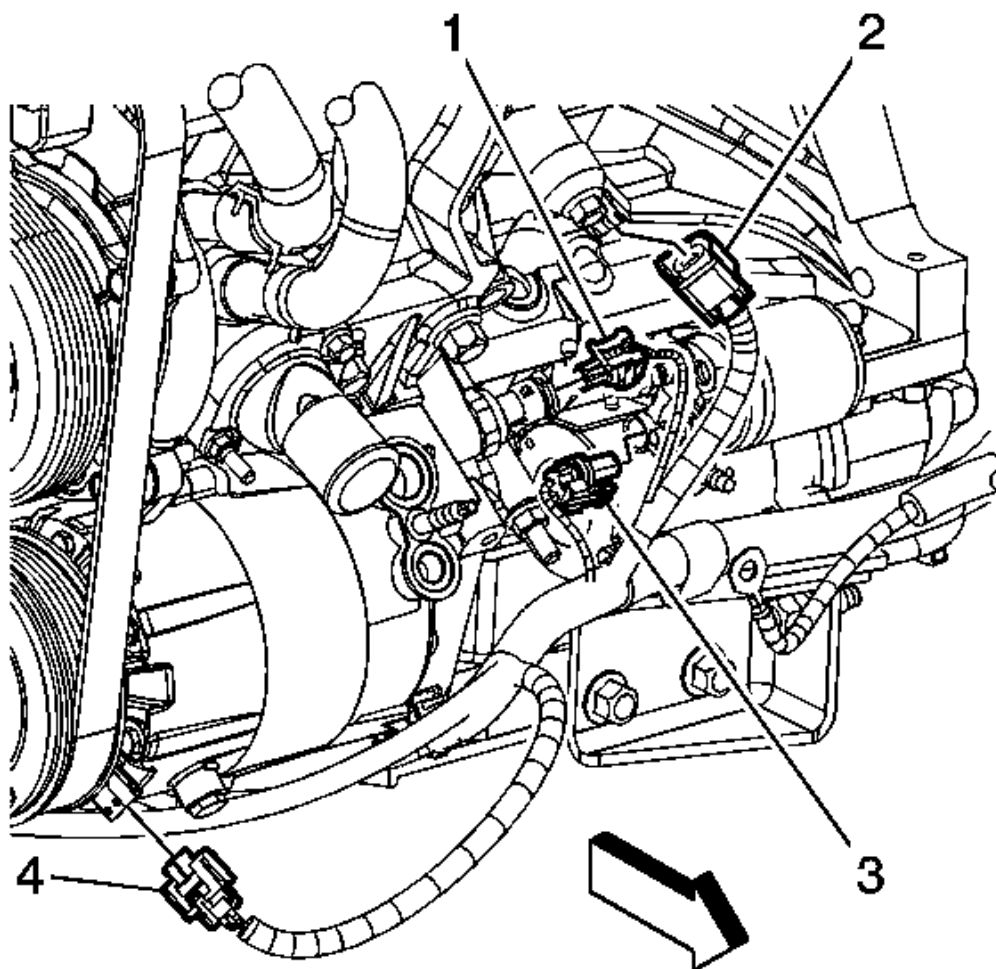


Fig. 41: Identifying Electrical Connector
Courtesy of GENERAL MOTORS CORP.

7. Connect the oil pressure sensor electrical connector (1).
8. Lower the vehicle.
9. Install the drive belt. Refer to **Drive Belt Replacement**.
10. Check and fill the crankcase, if necessary.

OIL LEVEL INDICATOR TUBE REPLACEMENT

REMOVAL PROCEDURE

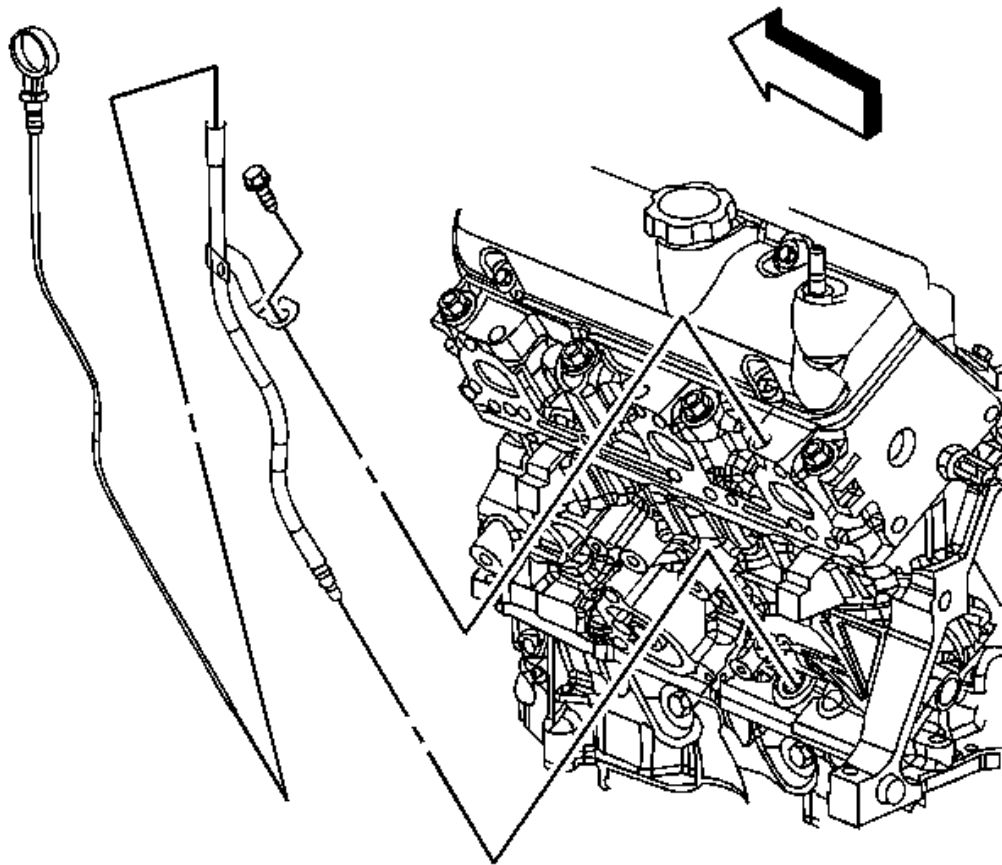


Fig. 42: Identifying Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil level indicator.
2. Remove the oil level indicator tube bracket bolt.
3. Remove the oil level indicator tube.
4. Inspect the oil level indicator tube O-ring seal, for damage, replace as necessary.

INSTALLATION PROCEDURE

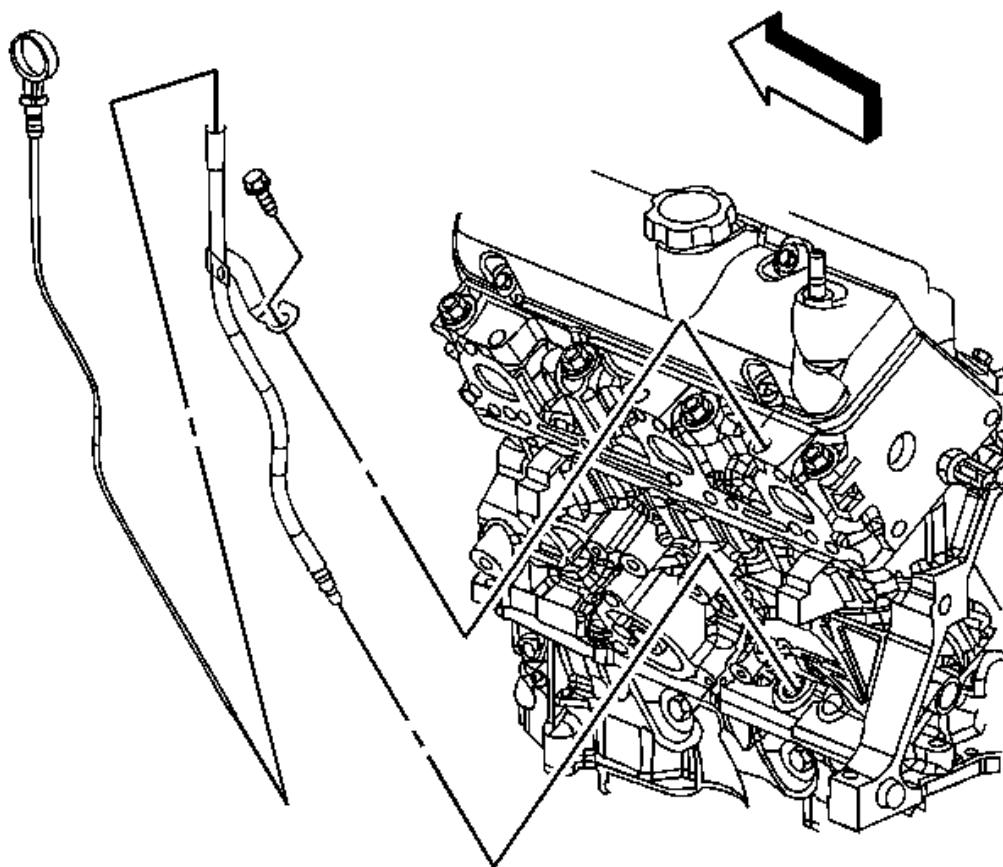


Fig. 43: Identifying Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the oil level indicator tube O-ring seal with clean engine oil.
2. Install the oil level indicator tube into the engine block.

CAUTION: Refer to Fastener Caution .

3. Install the oil level indicator tube bracket bolt.

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

4. Install the oil level indicator.

UPPER INTAKE MANIFOLD REPLACEMENT

REMOVAL PROCEDURE

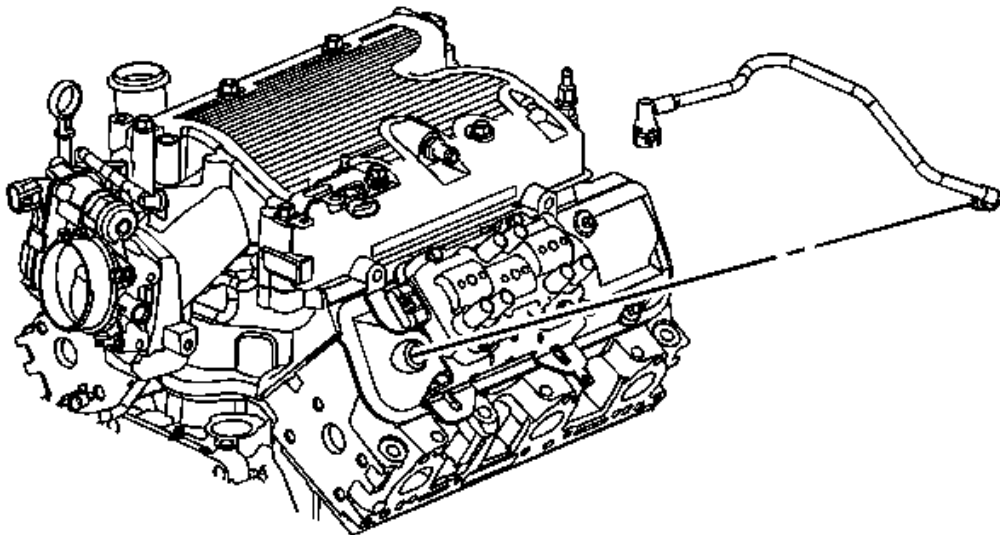


Fig. 44: View Of PCV Tube & Air Inlet Duct
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (LGD/LZE)** .
2. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
3. Drain the cooling system. Refer to **Cooling System Draining and Filling (LZE, LGD Static Fill)** or **Cooling System Draining and Filling (LZE, LGD GE47716 Fill)** .
4. Remove the positive crankcase ventilation (PCV) fresh air tube. Refer to **Plastic Collar Quick Connect Fitting Service** .

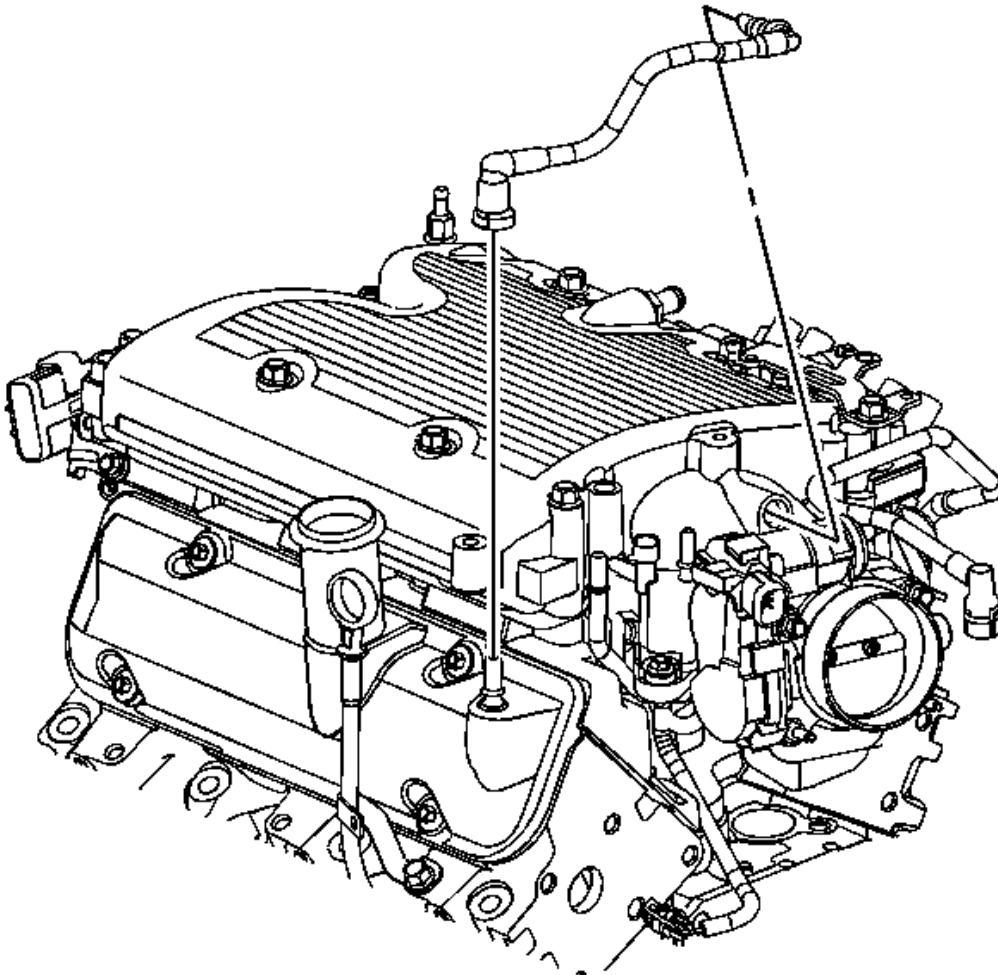


Fig. 45: Locating PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Remove the PCV foul air tube. Refer to **Plastic Collar Quick Connect Fitting Service** .

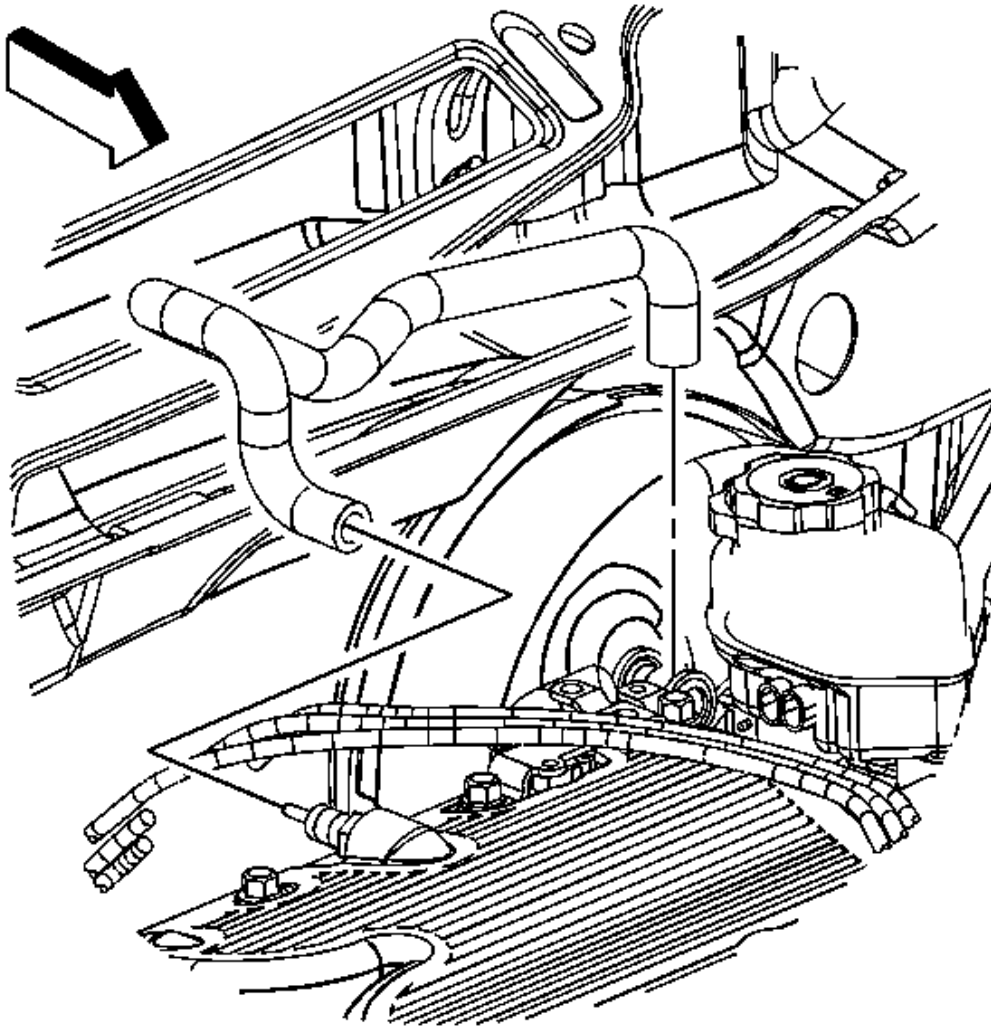


Fig. 46: View Of Brake Booster Vacuum Hose & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

6. Remove the vacuum hose from the intake manifold.

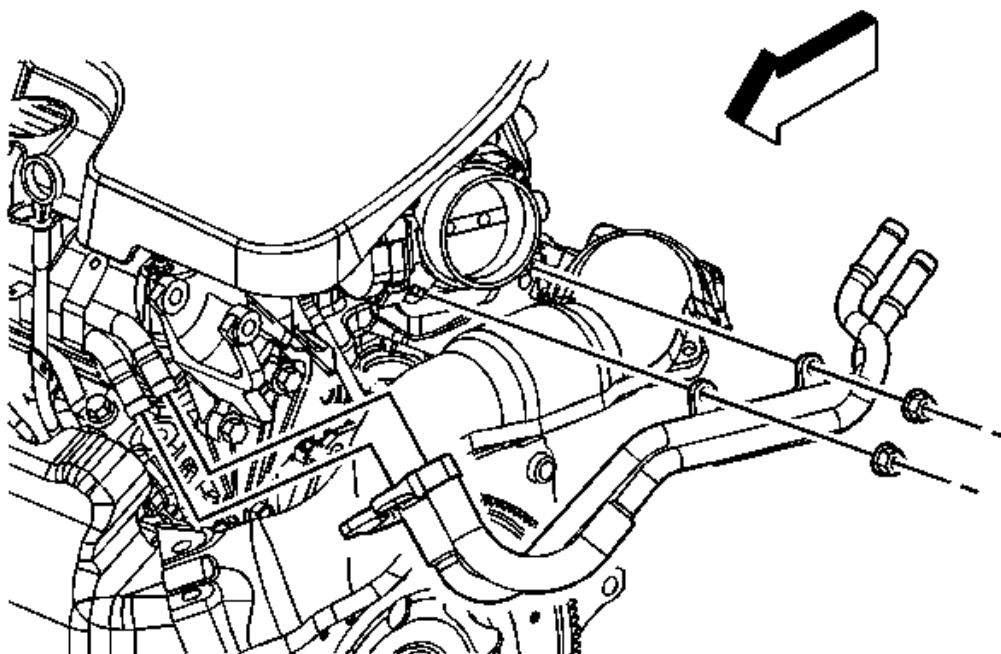


Fig. 47: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

7. Reposition the heater inlet and outlet hose/pipe clamps at the engine pipes.
8. Remove the heater inlet and outlet hose/pipe clamp nuts from the throttle body studs.
9. Remove the heater inlet and outlet hoses/pipes from the engine pipes and the throttle body studs.
10. Reposition the hoses/pipes out of the way.

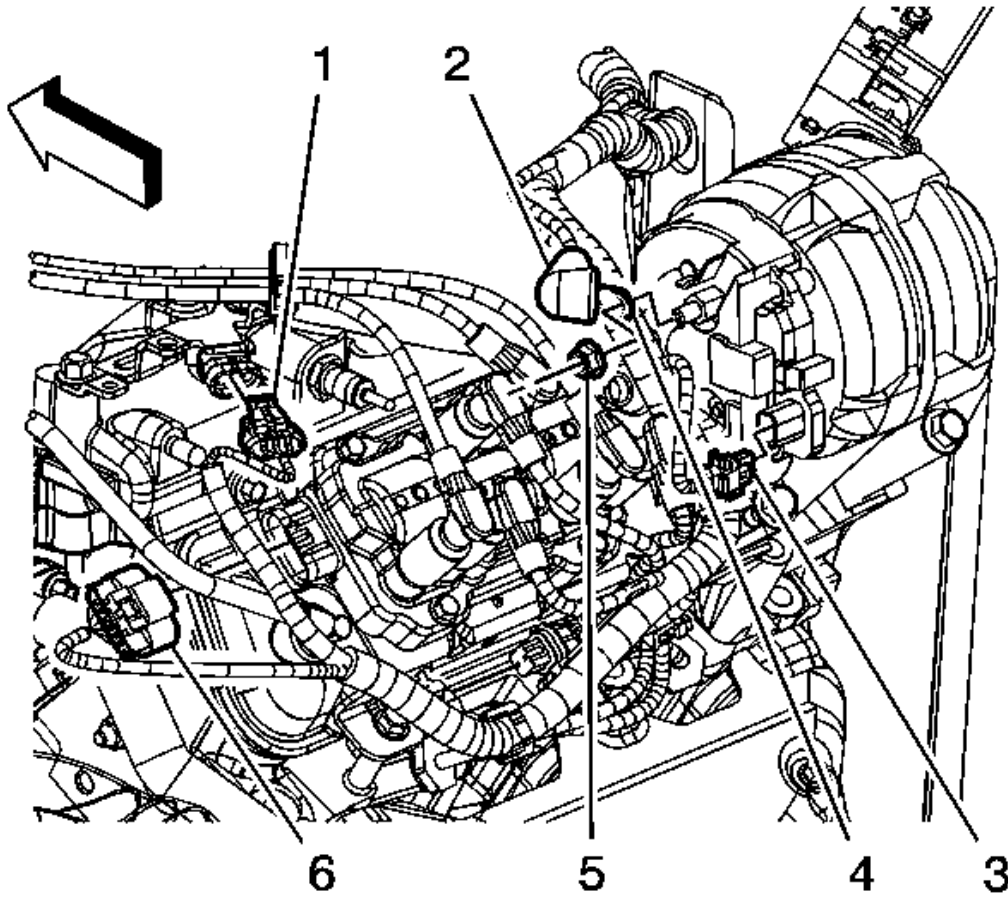


Fig. 48: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

11. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).

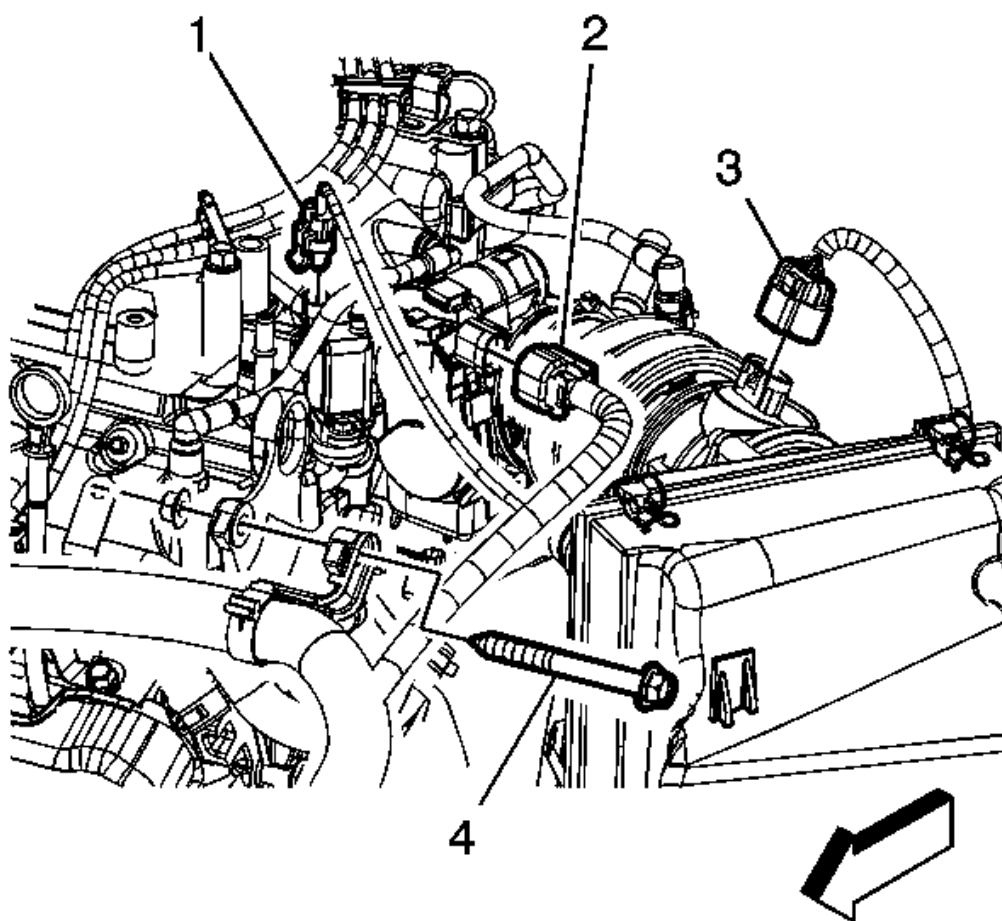


Fig. 49: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

12. Disconnect the evaporative emission (EVAP) canister purge solenoid electrical connector (1).
13. Disconnect the chassis EVAP line quick connect fitting from the purge solenoid. Refer to **Plastic Collar Quick Connect Fitting Service**.
14. Disconnect the electronic throttle control (ETC) electrical connector (2).

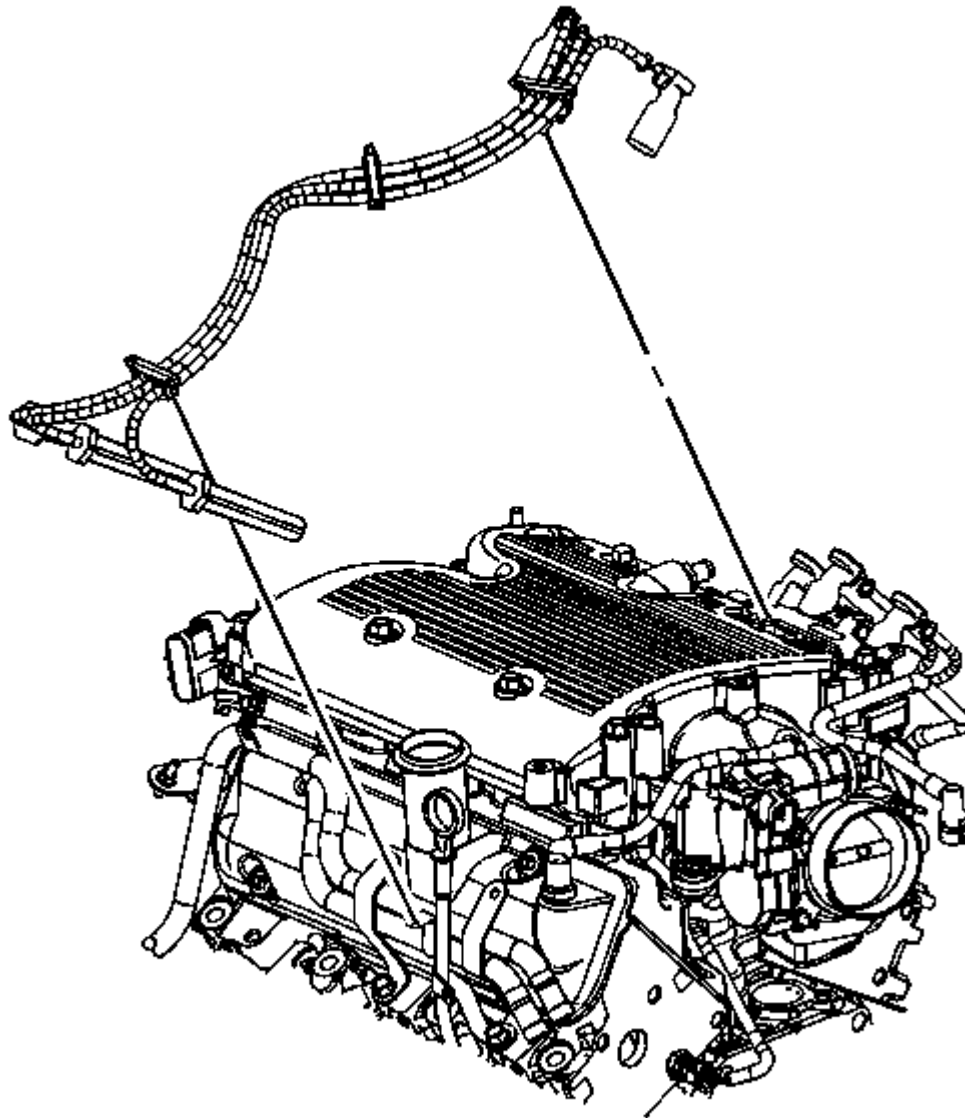


Fig. 50: View Of Left Side Spark Plug Wires
 Courtesy of GENERAL MOTORS CORP.

15. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
16. Disconnect the left side spark plug wires from the spark plugs.
17. Disconnect the left side spark plug wires from the ignition coil.
18. Disengage the spark plug wire retainer clips from the intake manifold bracket and the heater inlet/outlet

hose/pipe bracket.

19. Remove the left side spark plug wires.

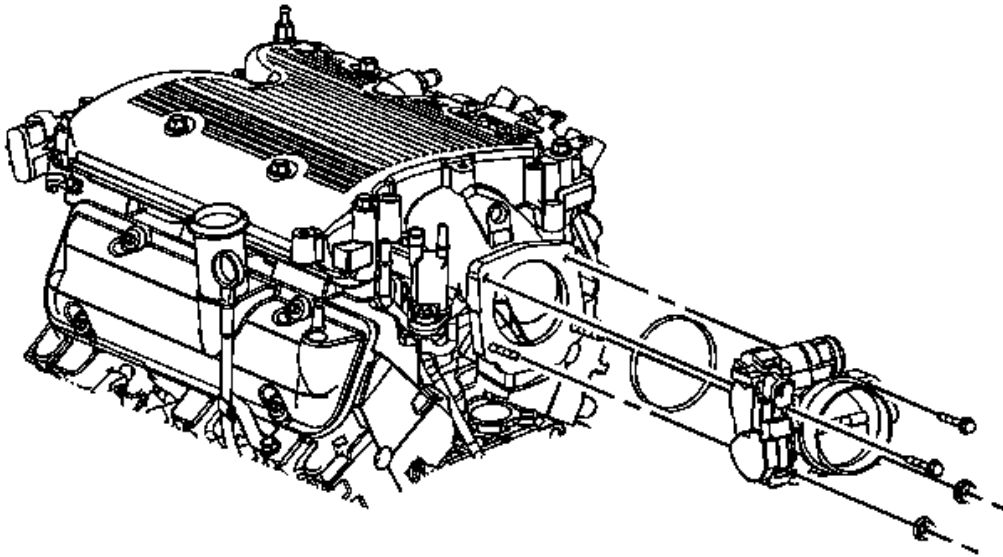


Fig. 51: Identifying Throttle Body, Throttle Body Seal & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

20. Remove the throttle body bolts and nuts.
21. Remove the throttle body and gasket.

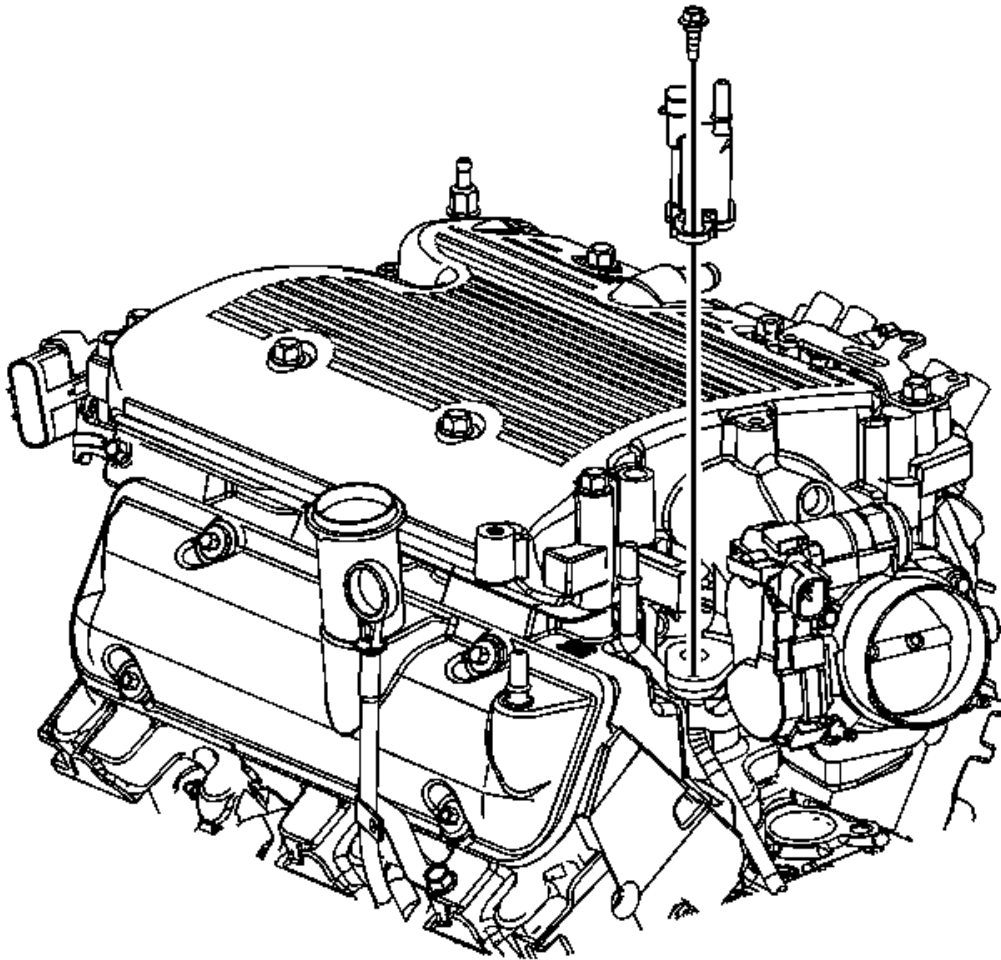


Fig. 52: Identifying EVAP Canister Purge Valve
Courtesy of GENERAL MOTORS CORP.

22. Remove the EVAP canister purge solenoid valve bolt.
23. Remove the EVAP canister purge solenoid valve.

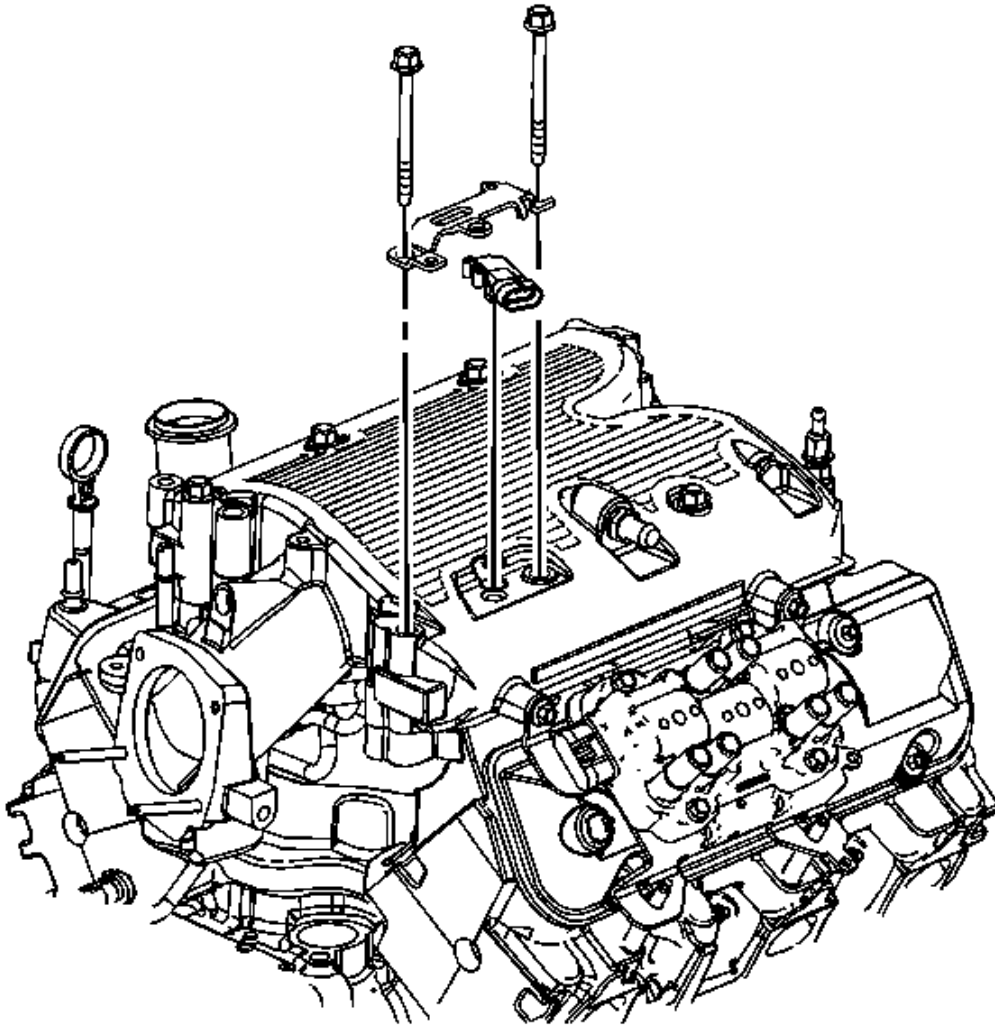


Fig. 53: View Of MAP Sensor Seal & Upper Intake Manifold
Courtesy of GENERAL MOTORS CORP.

24. Remove the MAP sensor bracket bolts.
25. Remove the MAP sensor bracket and sensor.

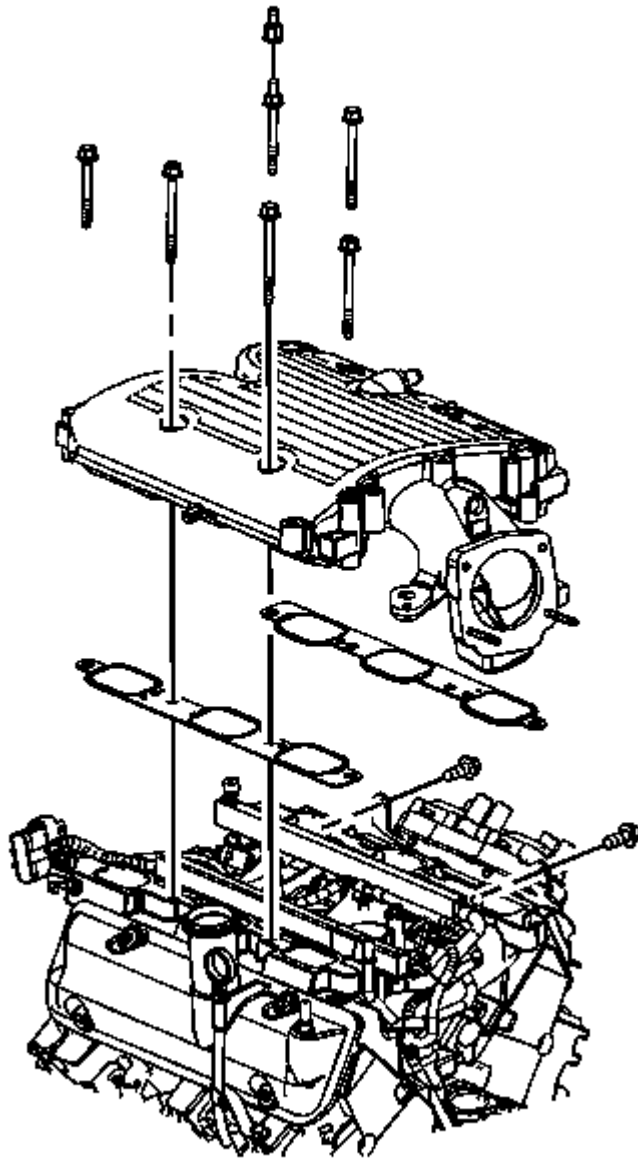


Fig. 54: View Of Upper Intake Manifold & Lower Intake Manifold
 Courtesy of GENERAL MOTORS CORP.

26. Remove the ignition coil bracket (to intake manifold) bolts.
27. Remove the intake manifold cover ball stud nut from the intake manifold stud.
28. Remove the upper intake manifold bolts and stud.

29. Separate and remove the upper intake manifold from the lower intake manifold.
30. Remove the upper to lower intake manifold gaskets.
31. Clean the upper intake to lower intake gasket mating surfaces.

INSTALLATION PROCEDURE

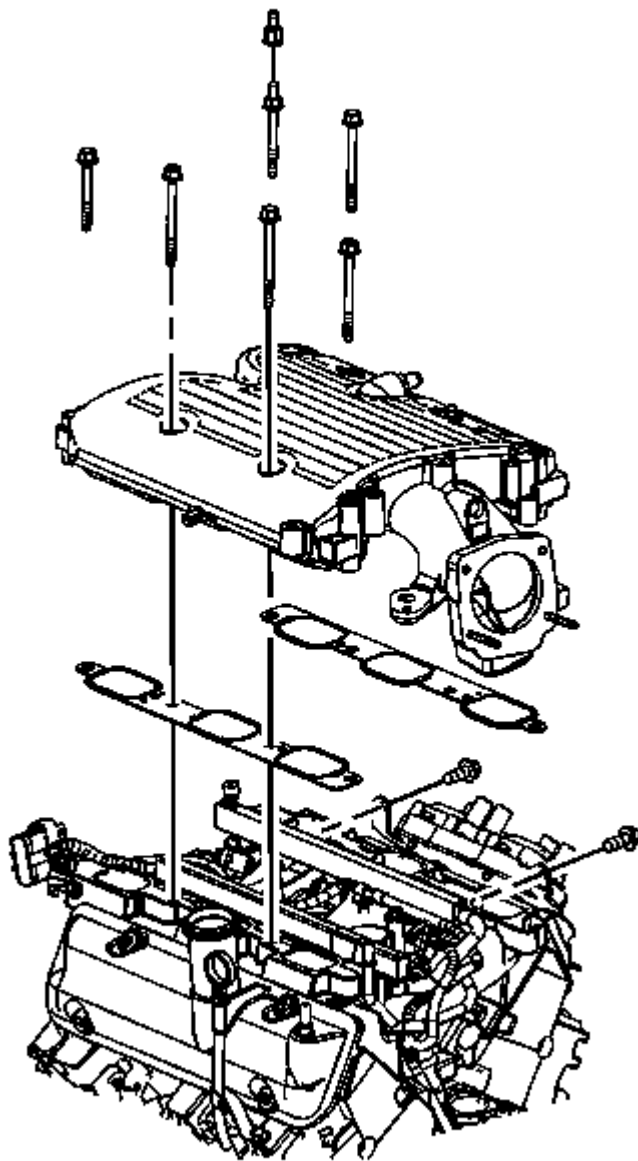


Fig. 55: View Of Upper Intake Manifold & Lower Intake Manifold
Courtesy of GENERAL MOTORS CORP.

1. Install NEW upper to lower intake manifold gaskets.
2. Install the upper intake manifold onto the lower intake manifold.
3. Apply threadlock to the upper intake manifold bolts/stud threads. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .

CAUTION: Refer to Fastener Caution .

4. Install the upper intake manifold bolts and stud.

Tighten: Tighten the bolts and stud to 25 N.m (18 lb ft).

5. Install the intake manifold cover ball stud nut to the intake manifold stud.

Tighten: Tighten the nut to 5 N.m (44 lb in).

6. Install the ignition coil bracket (to intake manifold) bolts.

Tighten: Tighten the bolts to 25 N.m (18 lb ft).

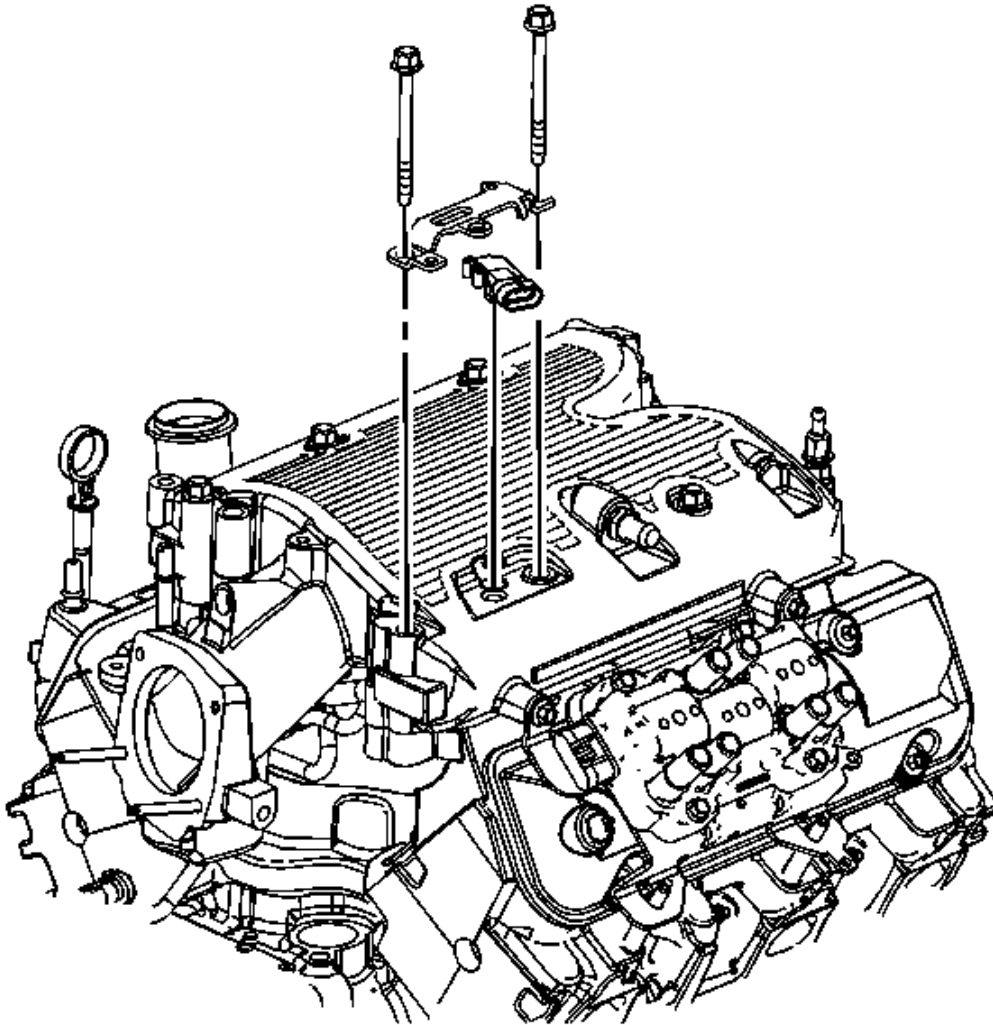


Fig. 56: View Of MAP Sensor Seal & Upper Intake Manifold
Courtesy of GENERAL MOTORS CORP.

7. Install the MAP sensor and bracket.
8. Install the MAP sensor bracket bolts.

Tighten: Tighten the bolts to 25 N.m (18 lb ft).

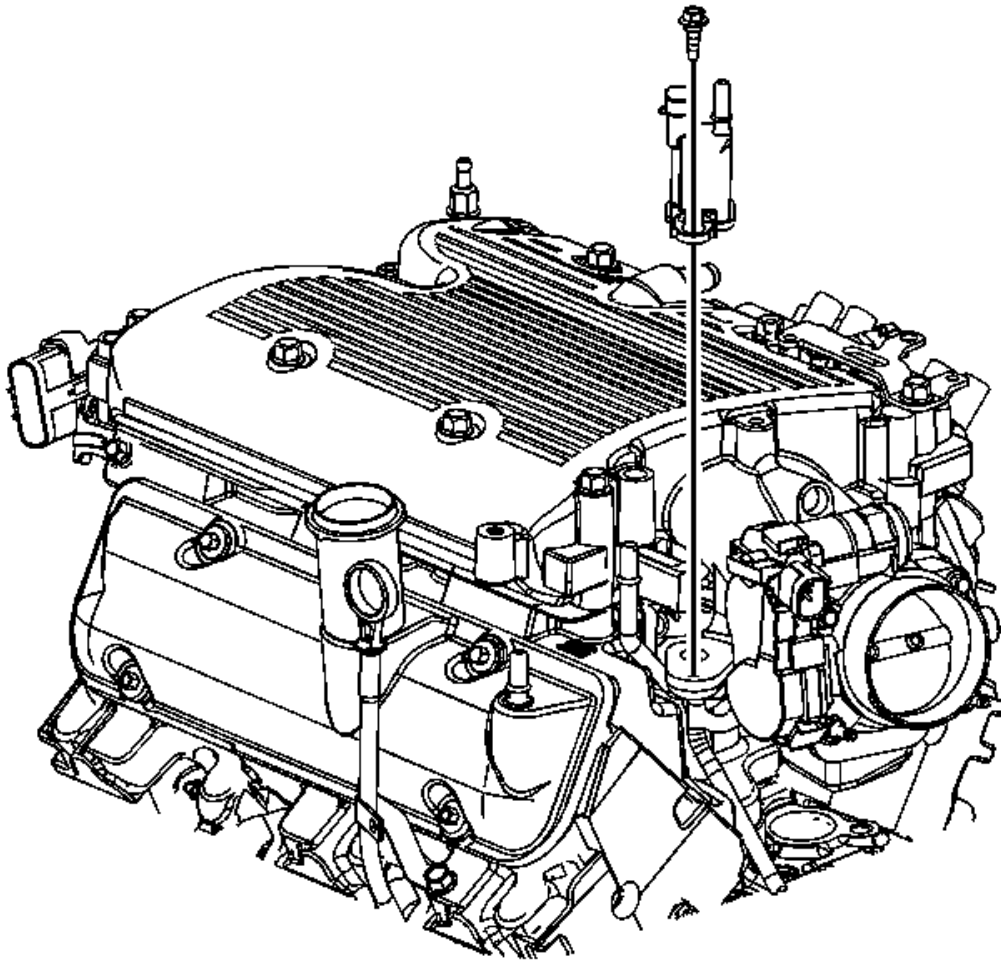


Fig. 57: Identifying EVAP Canister Purge Valve
Courtesy of GENERAL MOTORS CORP.

9. Install the EVAP canister purge solenoid valve.
10. Install the EVAP canister purge solenoid valve bolt.

Tighten: Tighten the bolts to 16 N.m (12 lb ft).

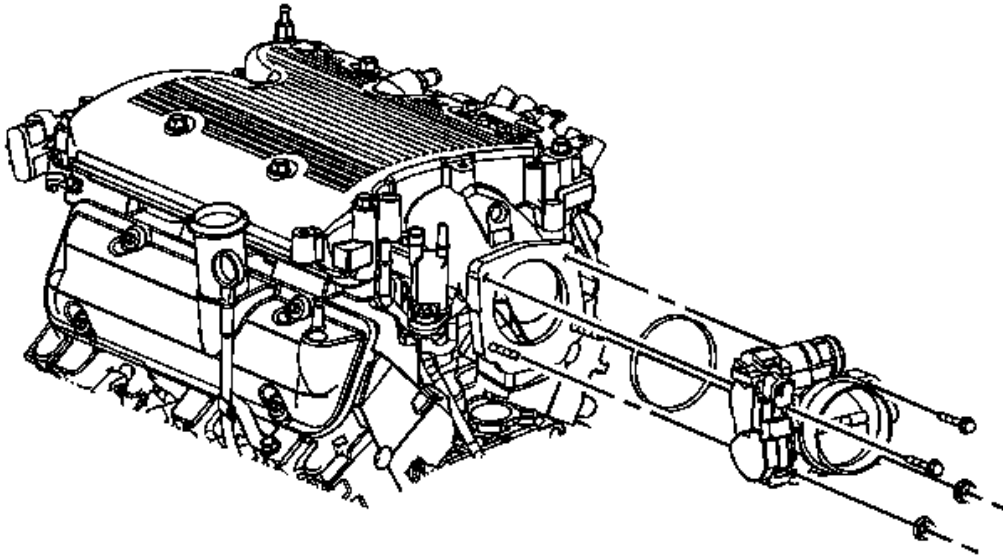


Fig. 58: Identifying Throttle Body, Throttle Body Seal & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

11. Inspect the throttle body seal for damage, replace as necessary.
12. Apply threadlock to the throttle body bolts/studs threads. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .
13. Position the throttle body gasket and throttle body to the intake.
14. Install the throttle body bolts and nuts.

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

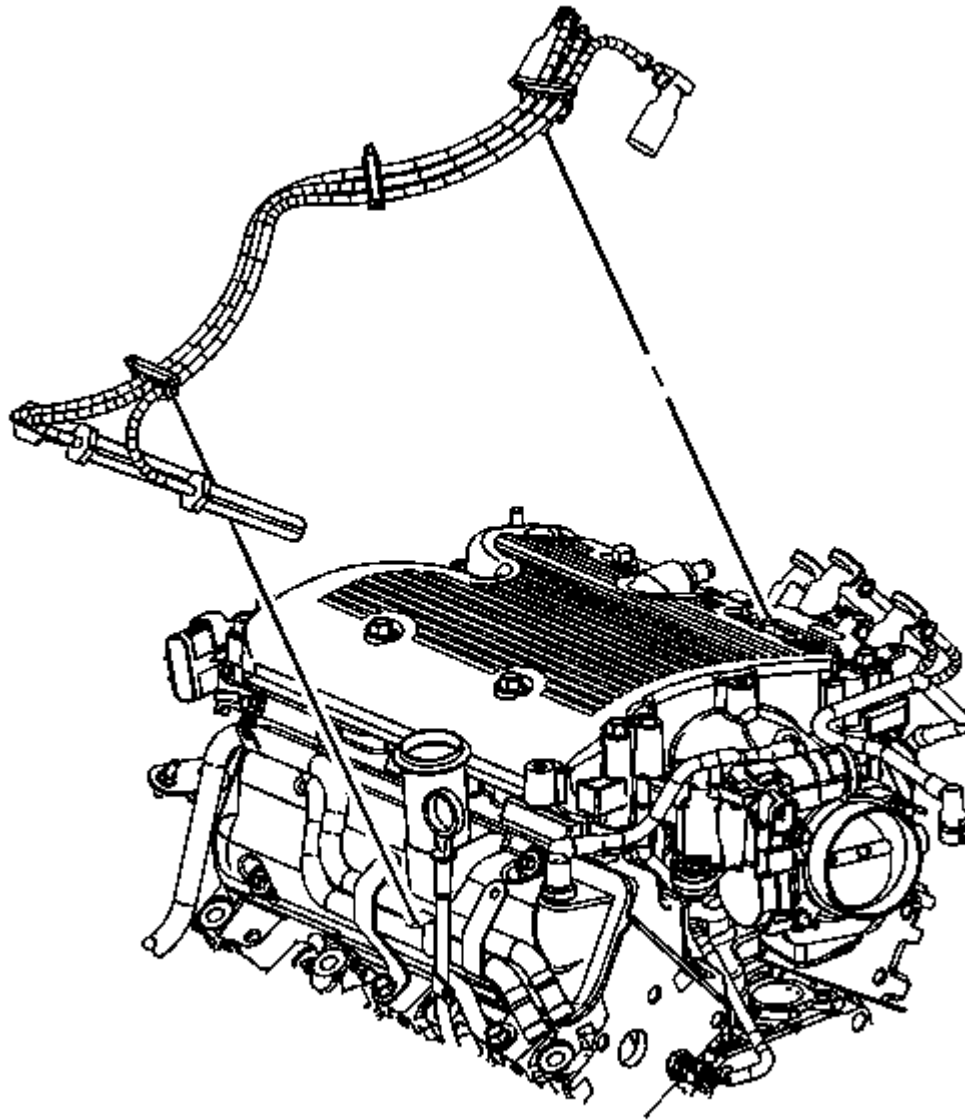


Fig. 59: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

15. Install the left side spark plug wires.
16. Engage the spark plug wire retainer clips to the intake manifold bracket and the heater inlet/outlet hose/pipe bracket.
17. Connect the left side spark plug wires to the ignition coil.

18. Connect the left side spark plug wires to the spark plugs.
19. Install the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#) .

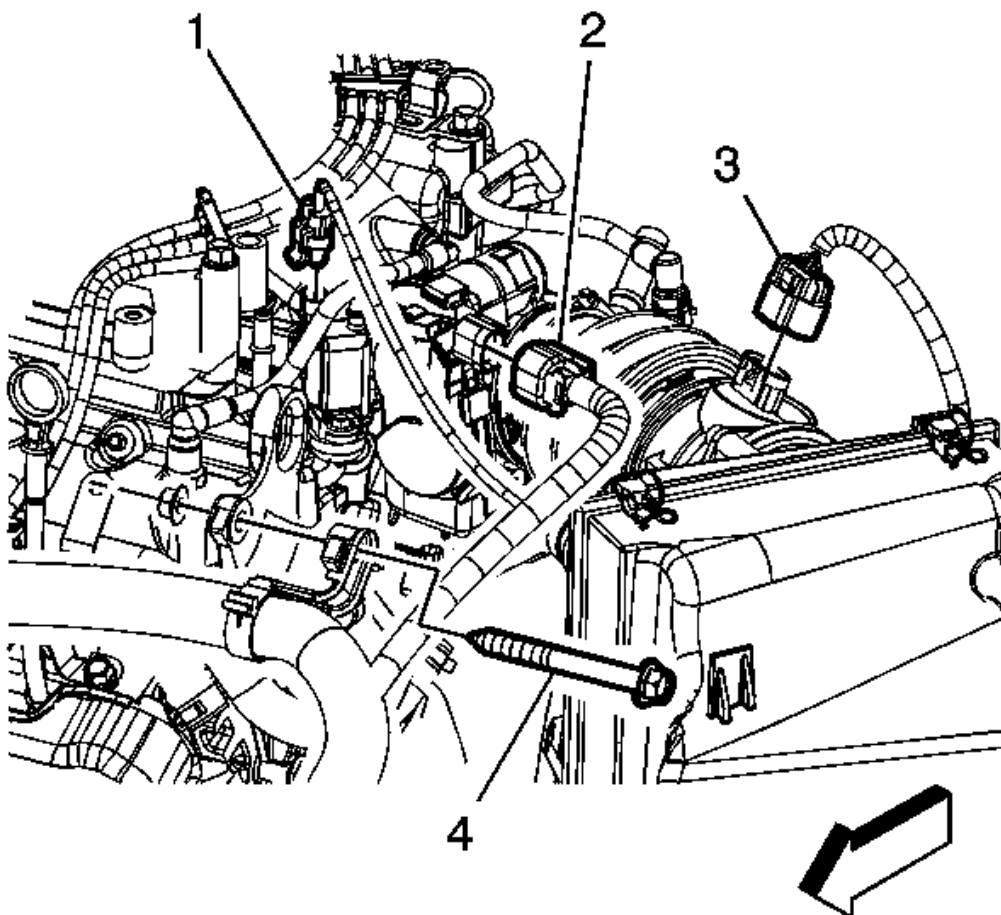


Fig. 60: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

20. Connect the EVAP canister purge solenoid electrical connector (1).
21. Connect the chassis EVAP line quick connect fitting to the purge solenoid. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
22. Connect the ETC electrical connector (2).

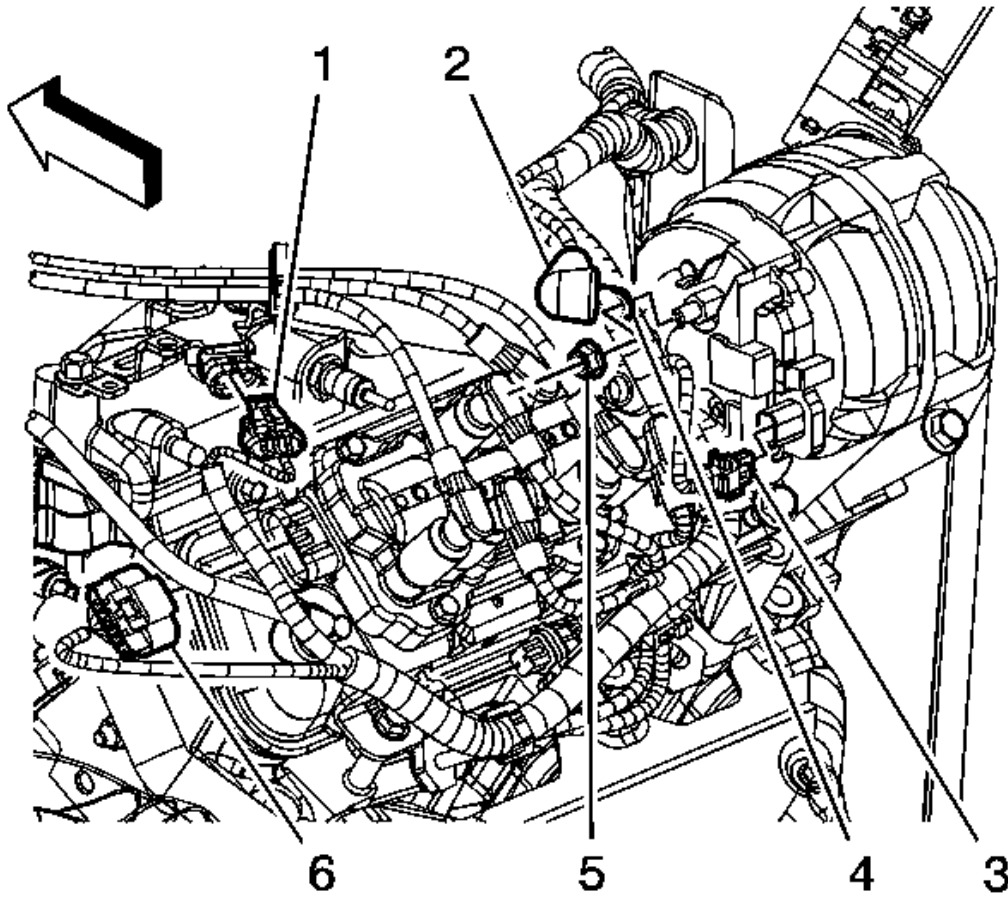


Fig. 61: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

23. Connect the MAP sensor electrical connector (1).

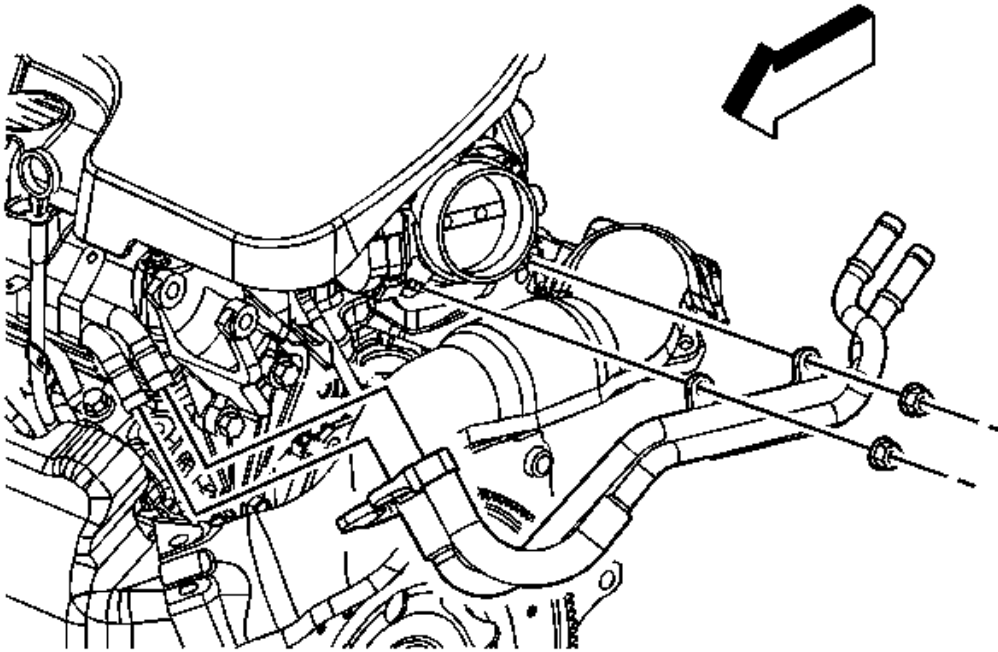


Fig. 62: Coolant Inlet And Outlet Hoses/Pipes
 Courtesy of GENERAL MOTORS CORP.

24. Position the hoses/pipes.
25. Install the heater inlet and outlet hoses/pipes to the engine pipes and the throttle body studs.
26. Install the heater inlet and outlet hose/pipe clamp nuts to the throttle body studs.

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

27. Position the heater inlet and outlet hose/pipe clamps at the engine pipes.

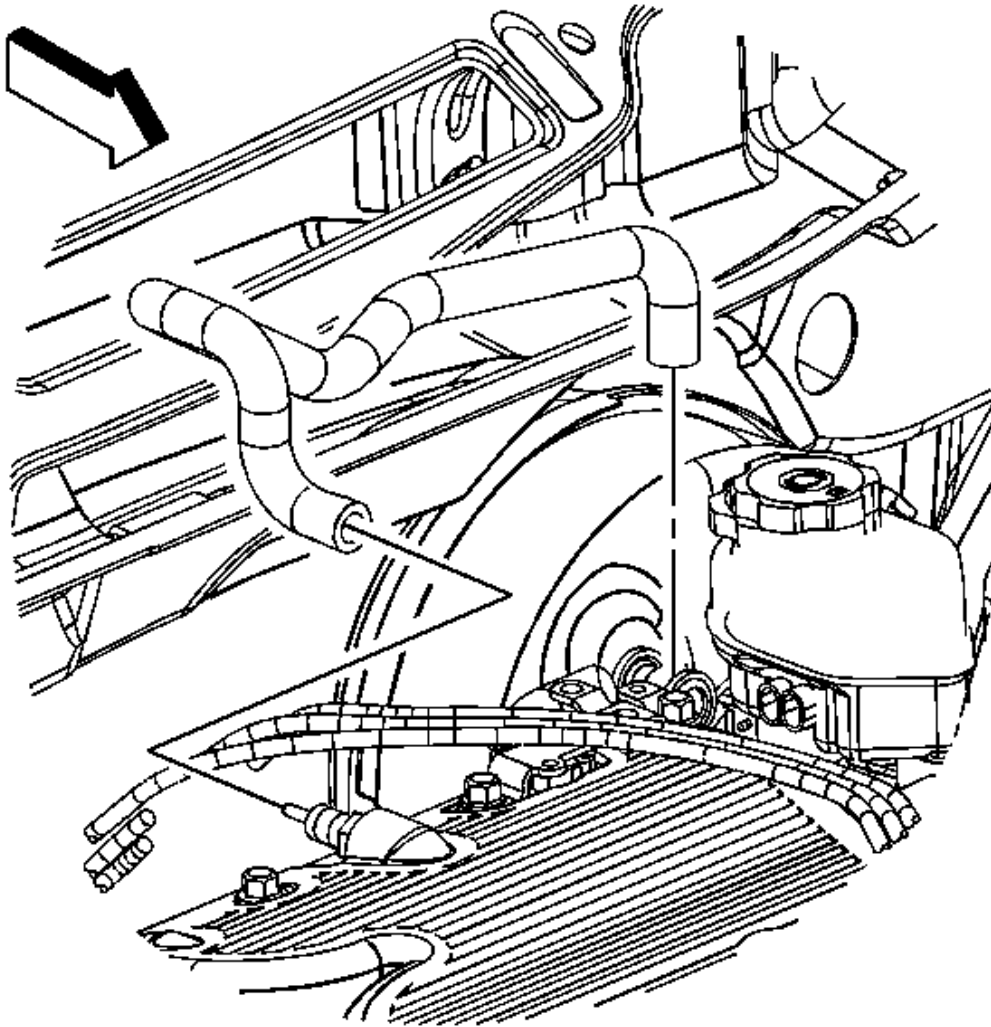


Fig. 63: View Of Brake Booster Vacuum Hose & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

28. Install the vacuum hose to the intake manifold.

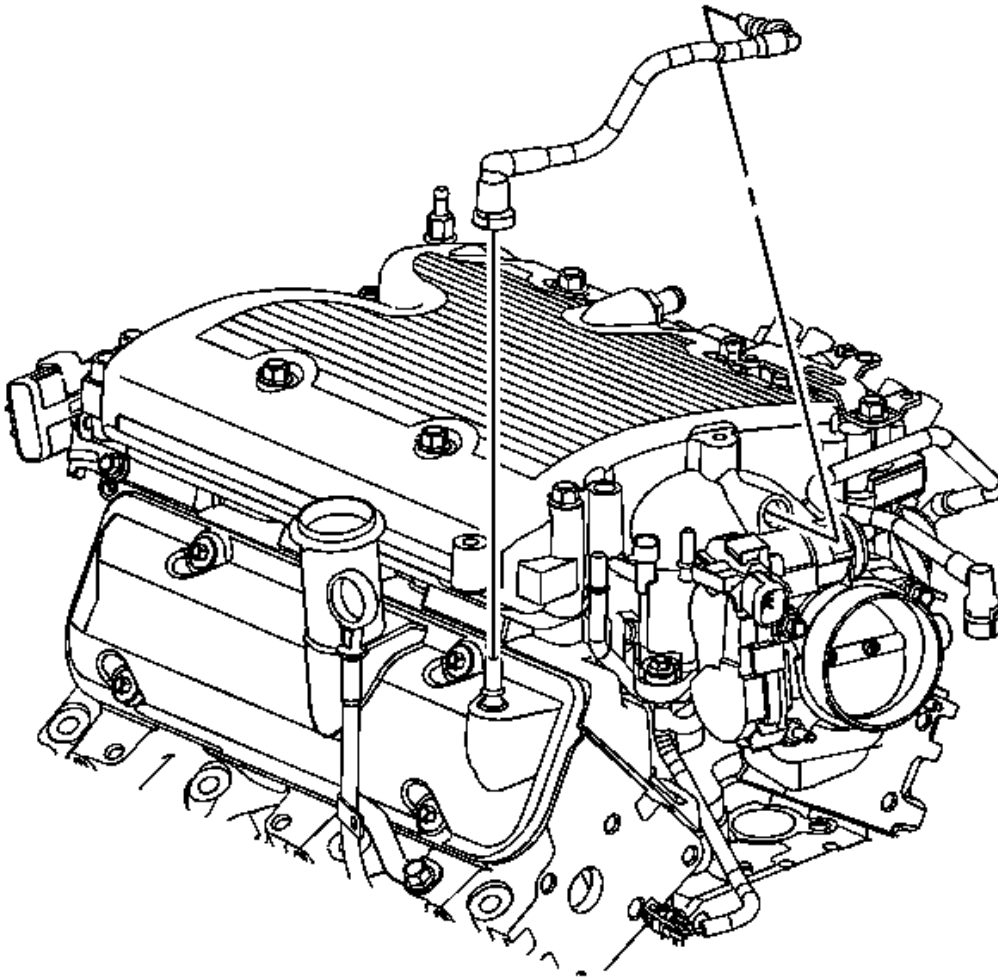


Fig. 64: Locating PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

29. Install the PCV foul air tube. Refer to **Plastic Collar Quick Connect Fitting Service** .

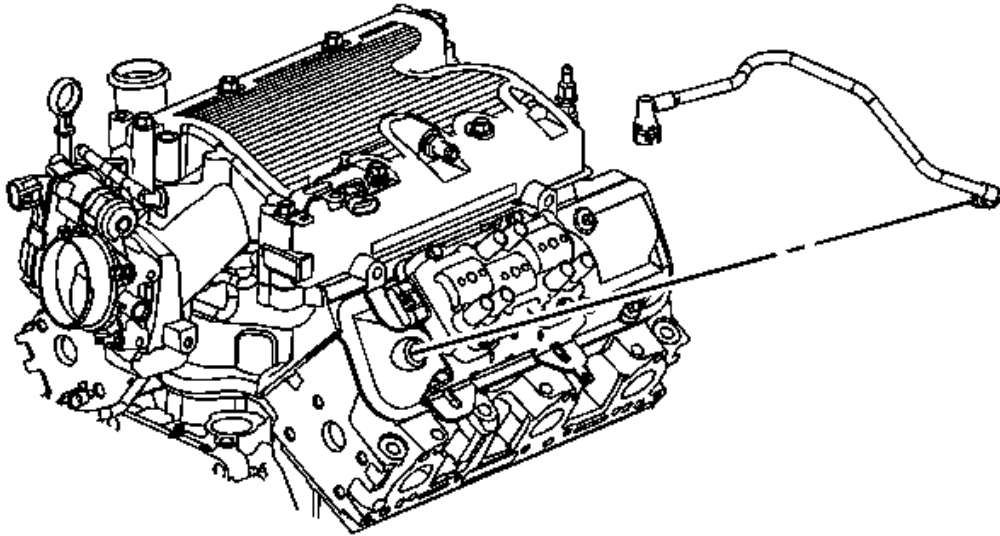


Fig. 65: View Of PCV Tube & Air Inlet Duct
Courtesy of GENERAL MOTORS CORP.

30. Install the PCV fresh air tube. Refer to **Plastic Collar Quick Connect Fitting Service** .
31. Fill the cooling system. Refer to **Cooling System Draining and Filling (LZE, LGD Static Fill)** or **Cooling System Draining and Filling (LZE, LGD GE47716 Fill)** .
32. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (LGD/LZE)** .
33. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

LOWER INTAKE MANIFOLD REPLACEMENT

REMOVAL PROCEDURE

NOTE: This engine uses a sequential multiport fuel injection system. Injector wiring harness connectors must be connected to their appropriate fuel injector or exhaust emissions and engine performance may be seriously affected.

1. Disconnect the battery ground negative cable. Refer to **Battery Negative Cable Disconnection and Connection (LGD/LZE)** .
2. Remove the upper intake manifold. Refer to **Upper Intake Manifold Replacement**.
3. Remove the left valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Left Side**.

4. Remove the right valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Right Side**.
5. Disconnect the fuel feed line from the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service**.

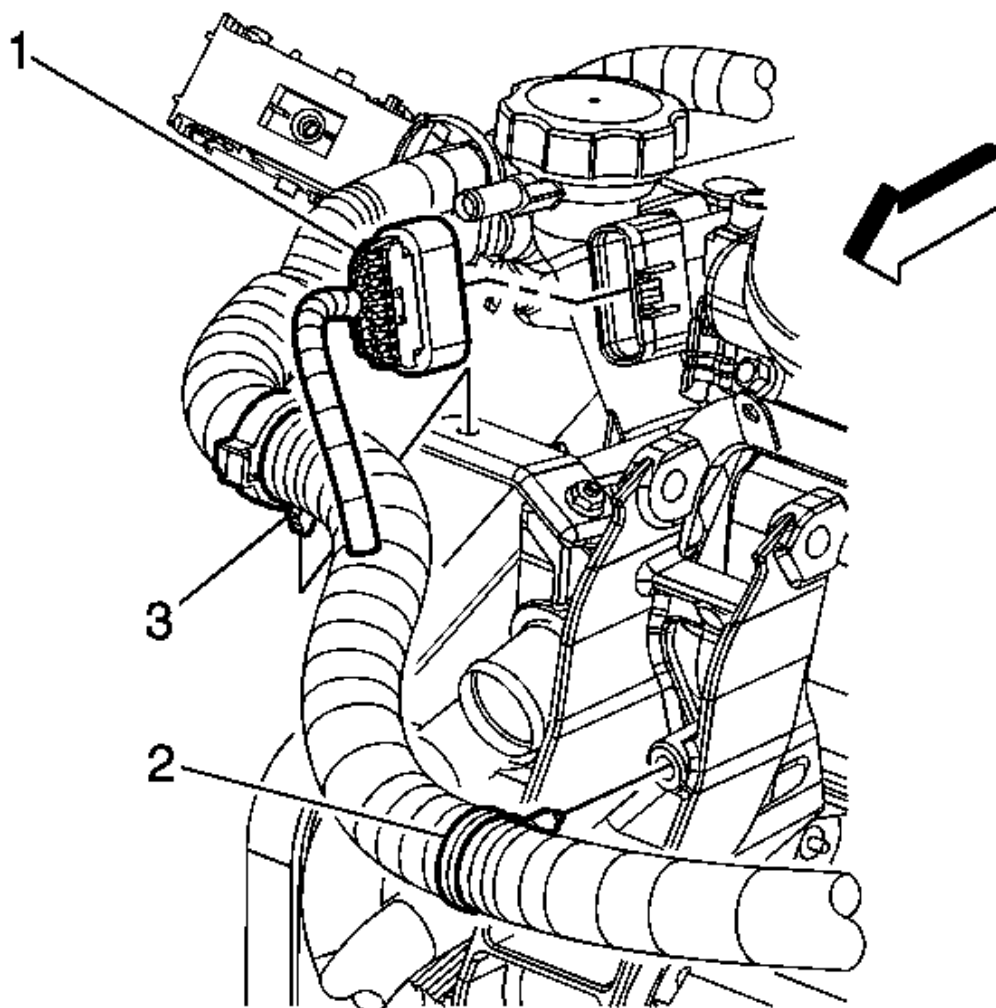


Fig. 66: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

6. Disconnect fuel injector inline connector (1).

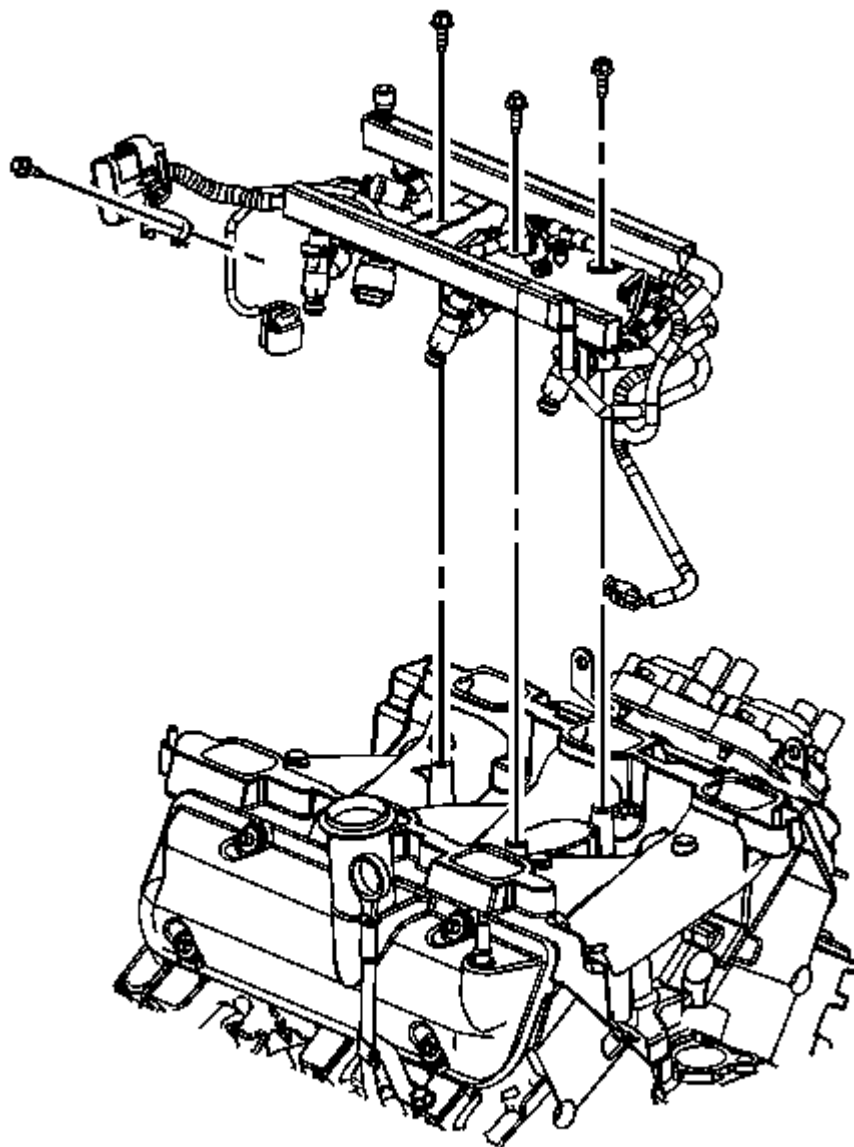


Fig. 67: View Of Fuel Rail Assembly & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

7. Remove the fuel injector harness connector bracket bolt from the intake manifold.
8. Disconnect the engine coolant temperature (ECT) electrical connector.
9. Disconnect the camshaft position (CMP) sensor electrical connector.
10. Remove the fuel injector rail bolts.

11. Remove the fuel rail.

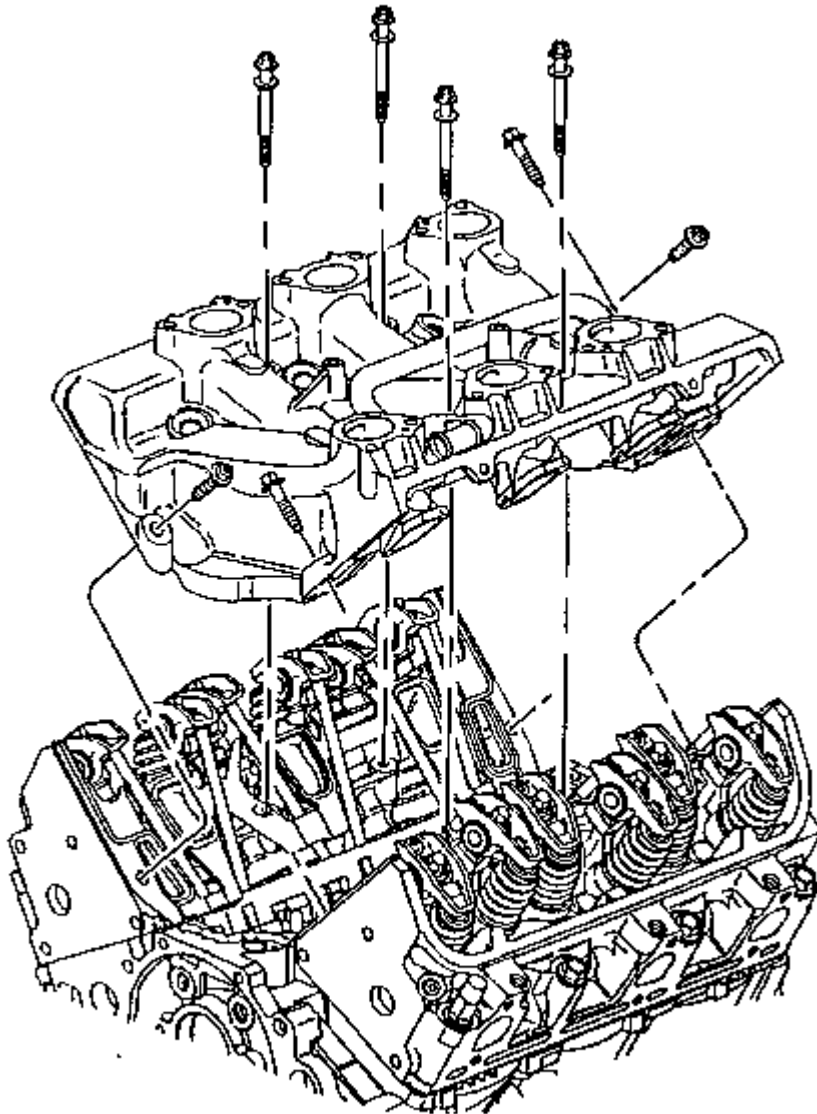


Fig. 68: View Of Lower Intake Manifold & Bolts
Courtesy of GENERAL MOTORS CORP.

- 12. Remove the lower intake manifold bolts.
- 13. Remove the lower intake manifold.

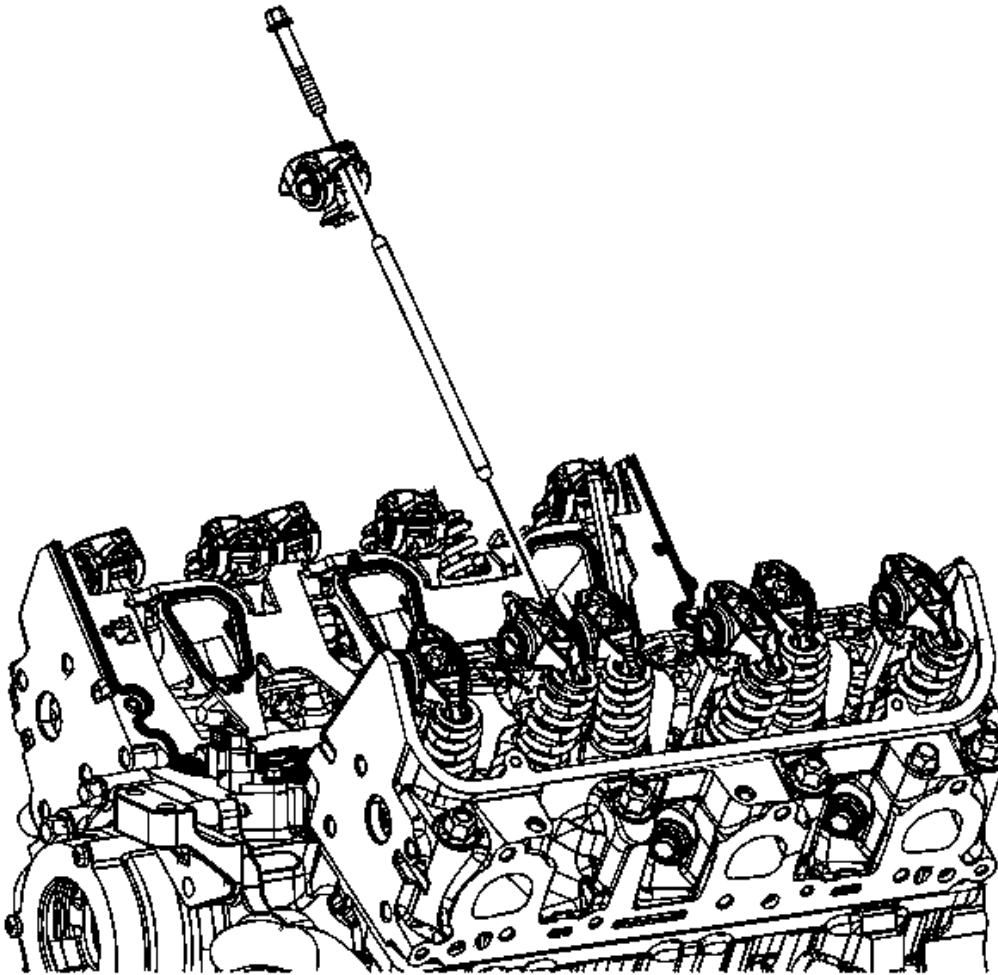


Fig. 69: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

14. Loosen the valve rocker arm bolts.

NOTE: Place the valve train components in a rack in order to ensure that the components are installed in the same location from which they were removed.

15. Remove the valve rocker arms.
16. Remove the push rods.
 - The intake push rods measure 147.51 mm (5.81 in).

- The exhaust push rods measure 154.87 mm (6.1 in).

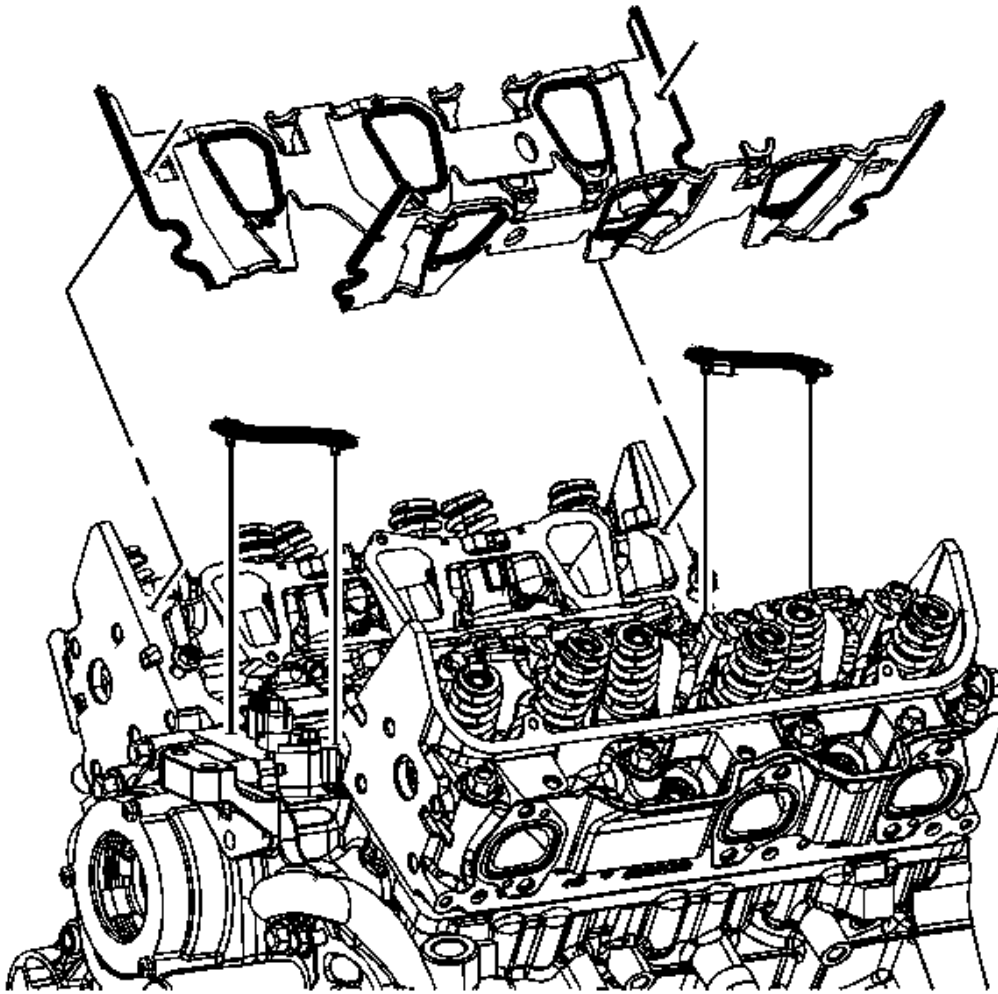


Fig. 70: Identifying Intake Manifold Gaskets & Seals
Courtesy of GENERAL MOTORS CORP.

17. Remove the lower intake manifold gaskets and seals.
18. Clean the lower intake manifold gasket and seal surfaces on the cylinder heads and the engine block.
19. Clean the gasket and seal surfaces on the lower intake manifold with degreaser.
20. Remove all the loose room temperature vulcanizing (RTV) sealer.

INSTALLATION PROCEDURE

NOTE: All gasket mating surfaces need to be free of oil and foreign material. Use cleaner to clean the surfaces. Refer to Adhesives, Fluids, Lubricants, and Sealers .

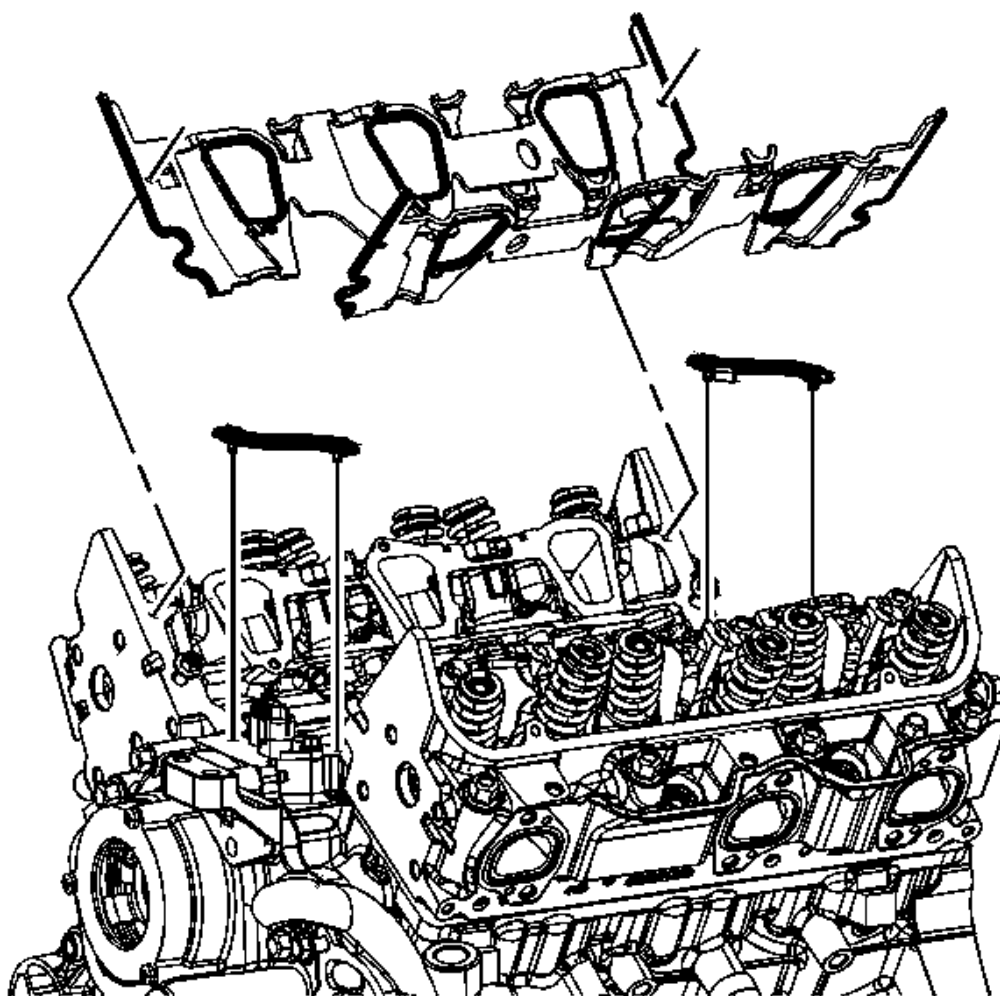


Fig. 71: Identifying Intake Manifold Gaskets & Seals
Courtesy of GENERAL MOTORS CORP.

NOTE: RTV sealer is NOT to be placed under the lower intake manifold gaskets.

1. Install the lower intake manifold gaskets and seals.

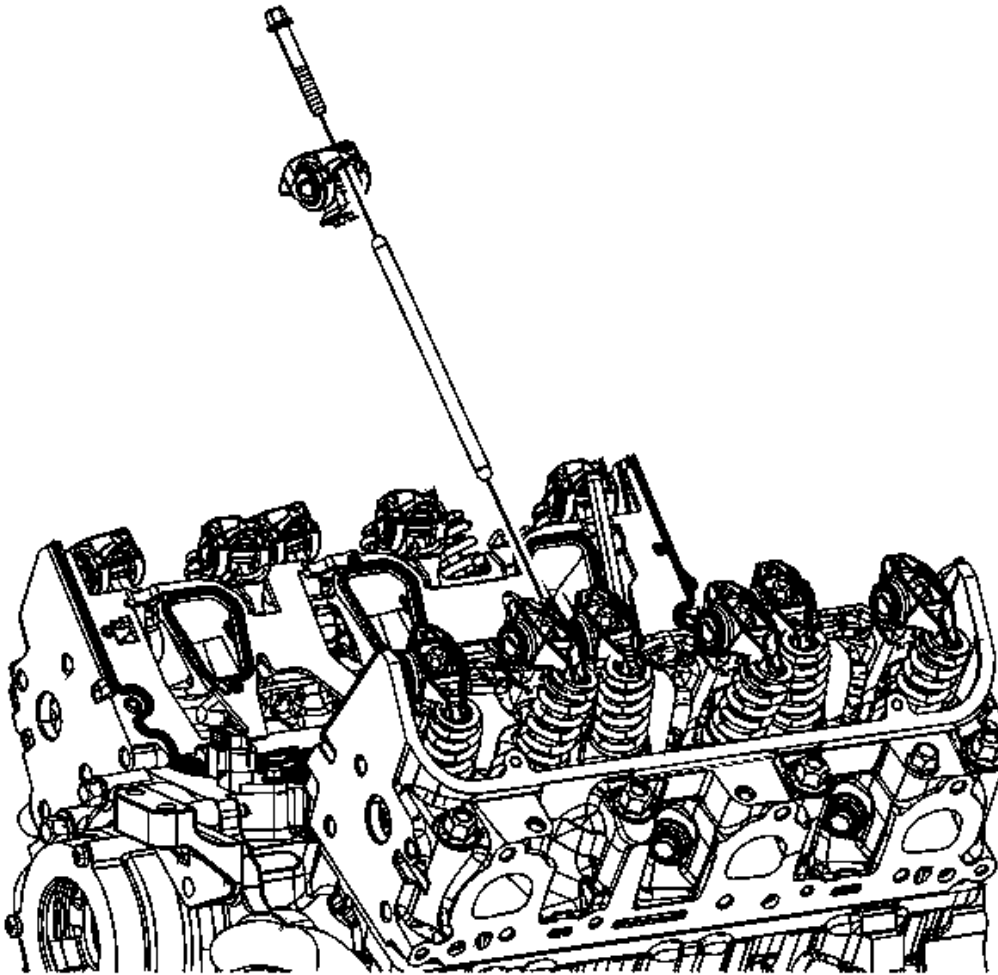


Fig. 72: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

2. Coat the ends of the push rods using prelube. Refer to Adhesives, Fluids, Lubricants, and Sealers .

NOTE: The intake valve push rods measure 146.0 mm (5.75 in) and the exhaust valve push rods measure 152.5 mm (6.0 in).

3. Install the push rods in their original location.
4. Coat the rocker arm friction surfaces using prelube. Refer to Adhesives, Fluids, Lubricants, and Sealers .

NOTE: Shims (P/N 88894006) may be required under the valve rocker arm pedestals if reconditioning has been performed on the cylinder head or its components.

CAUTION: Refer to Fastener Caution .

5. Install the valve rocker arms in their original positions.
6. Install the valve rocker arm bolts and tighten to 34 N.m (25 lb ft).

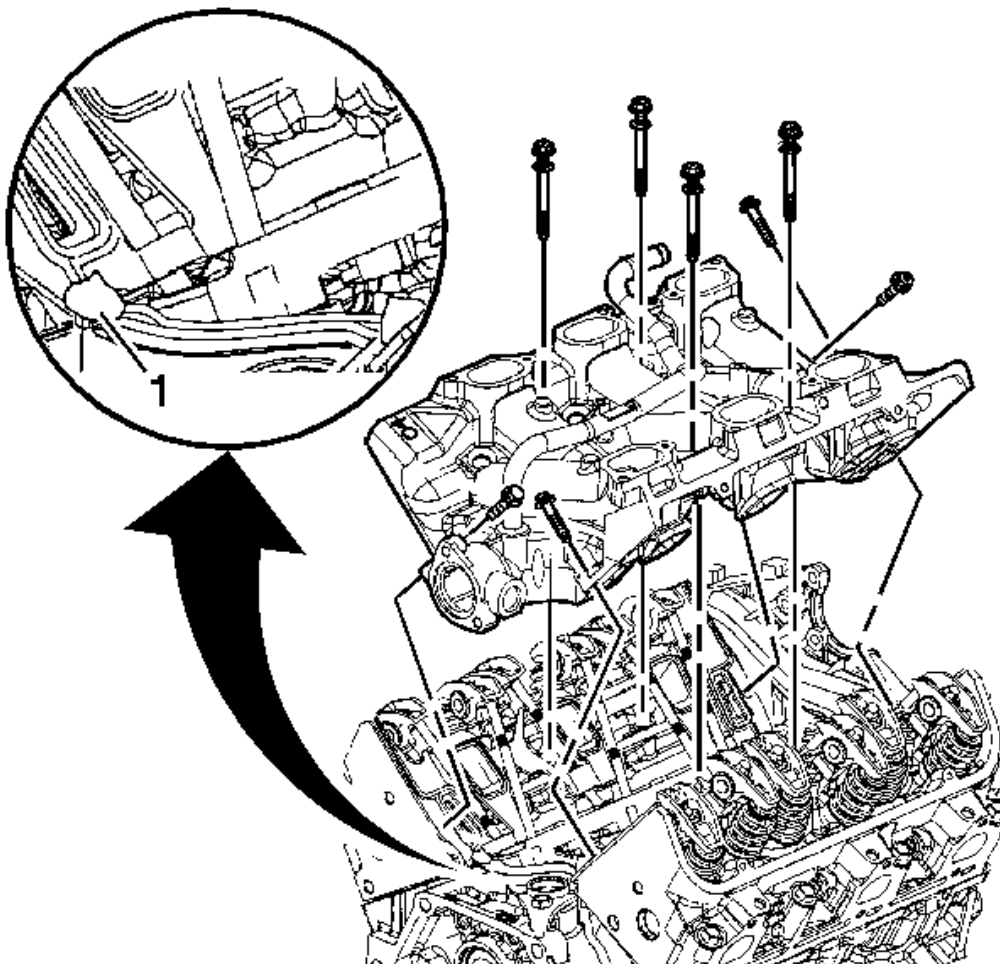


Fig. 73: View Of Lower Intake Manifold
Courtesy of GENERAL MOTORS CORP.

7. With the NEW gaskets and seals in place, apply a small drop, 8-10 mm (0.31-0.39 in) of RTV sealer to the 4 corners of the intake manifold to engine block joints (1). Refer to **Adhesives, Fluids, Lubricants, and Sealers**.
8. Install the lower intake manifold.

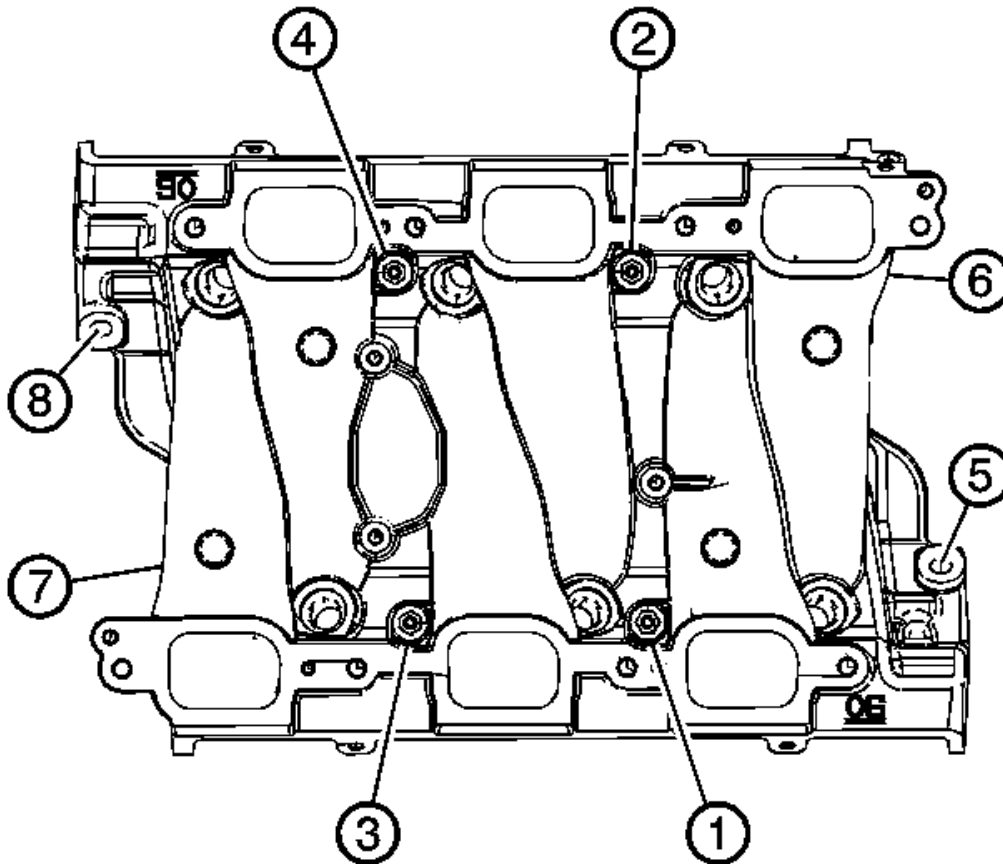


Fig. 74: Identifying Lower Intake Manifold Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Maximum gasket performance is achieved when using new fasteners, which contain a thread-locking patch. If the fasteners are not replaced, a thread locking chemical must be applied to the fastener threads. Failure to replace the fasteners or apply a thread-locking chemical MAY reduce gasket sealing capability.

CAUTION: Failure to tighten vertical bolts before the diagonal bolts may cause

an oil leak.

9. Apply sealer to the lower intake manifold bolt threads. Refer to **Adhesives, Fluids, Lubricants, and Sealers**.
10. Install the lower intake manifold bolts.
11. Tighten the lower intake manifold bolts in the sequence shown.
 1. Tighten the lower intake manifold bolts (1, 2, 3, 4, 5, 8, 6, 7, 8) in sequence to 7 N.m (62 lb in)
 2. Tighten the center lower intake manifold bolts (1, 2, 3, 4) in sequence to 16 N.m (12 lb ft).
 3. Tighten the visible corner lower intake manifold bolts (5, 8) to 25 N.m (18 lb ft).
 4. Tighten the hidden corner lower intake manifold bolts (6, 7) to 25 N.m (18 lb ft).

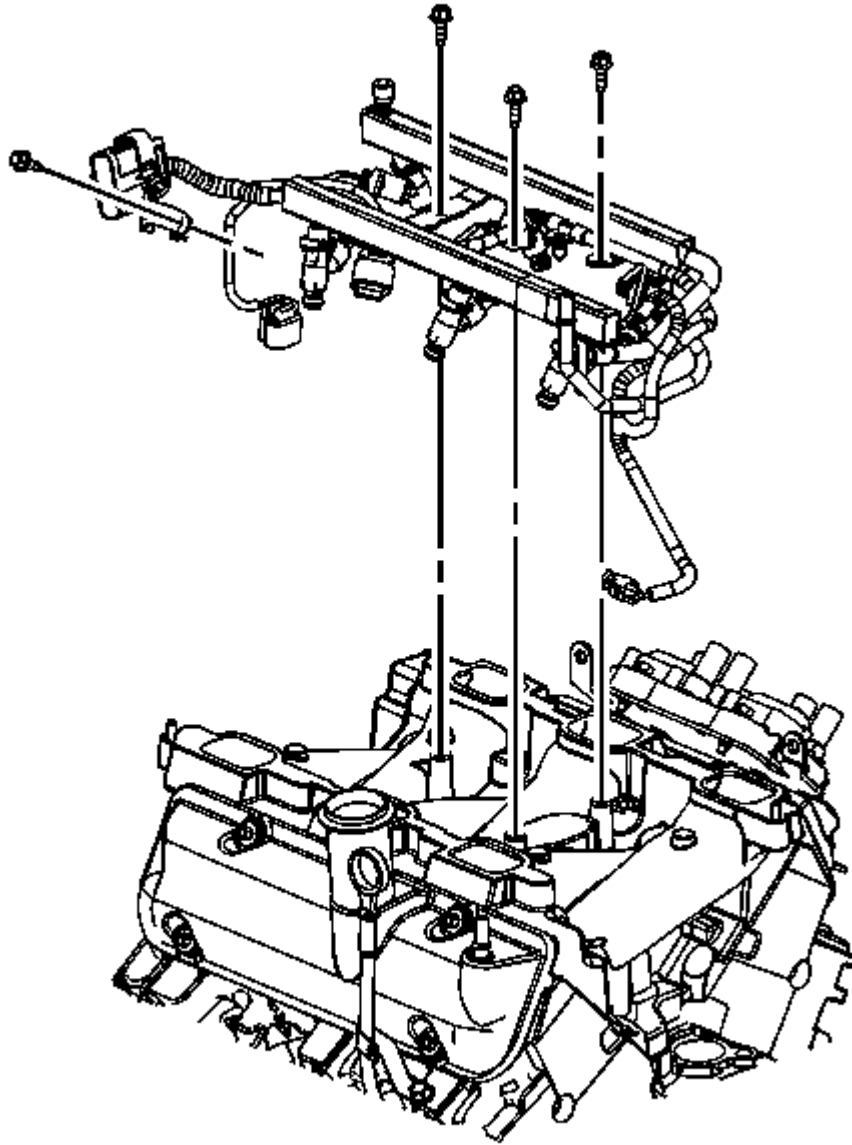


Fig. 75: View Of Fuel Rail Assembly & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

12. Inspect the fuel rail, fuel injectors and fuel injector O-rings for damage and replace, as necessary.
13. Lubricate the fuel injector O-rings using engine oil. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .
14. Install the injector nozzles into the lower intake manifold injector bores.

15. Press on the injector rail using the palms of both hands until the injector are fully seated.
16. Install the fuel injector rail bolts and tighten to 10 N.m (89 lb in).
17. Connect the CMP sensor electrical connector.
18. Connect the ECT electrical connector.
19. Position the fuel injector harness connector bracket to the intake manifold.
20. Install the fuel injector harness connector bracket bolt and tighten to 8 N.m (71 lb in).

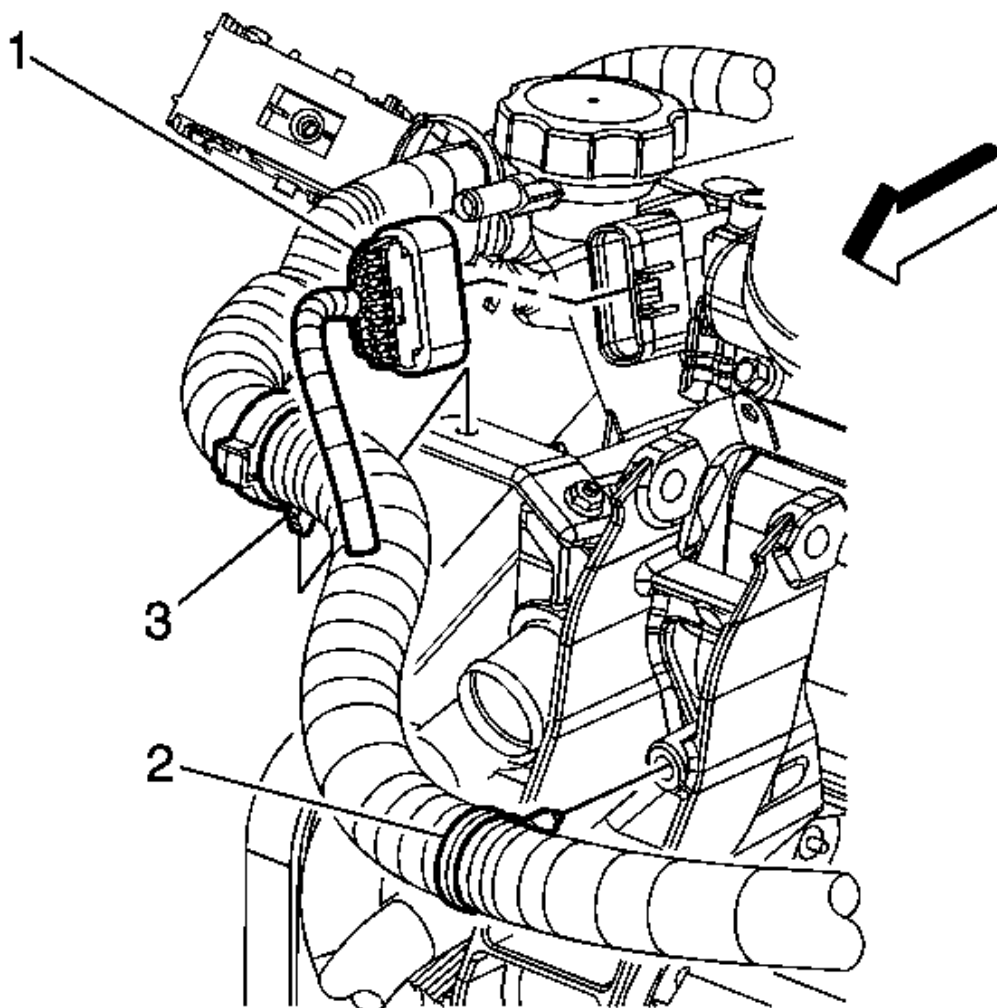


Fig. 76: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

21. Connect fuel injector inline connector (1).
22. Connect the fuel feed line to the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .
23. Install the right valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Right Side**.
24. Install the left valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Left Side**.
25. Install the upper intake manifold. Refer to **Upper Intake Manifold Replacement**.
26. Connect the battery ground negative cable. Refer to **Battery Negative Cable Disconnection and Connection (LGD/LZE)** .

POSITIVE CRANKCASE VENTILATION HOSE/PIPE/TUBE REPLACEMENT

REMOVAL PROCEDURE

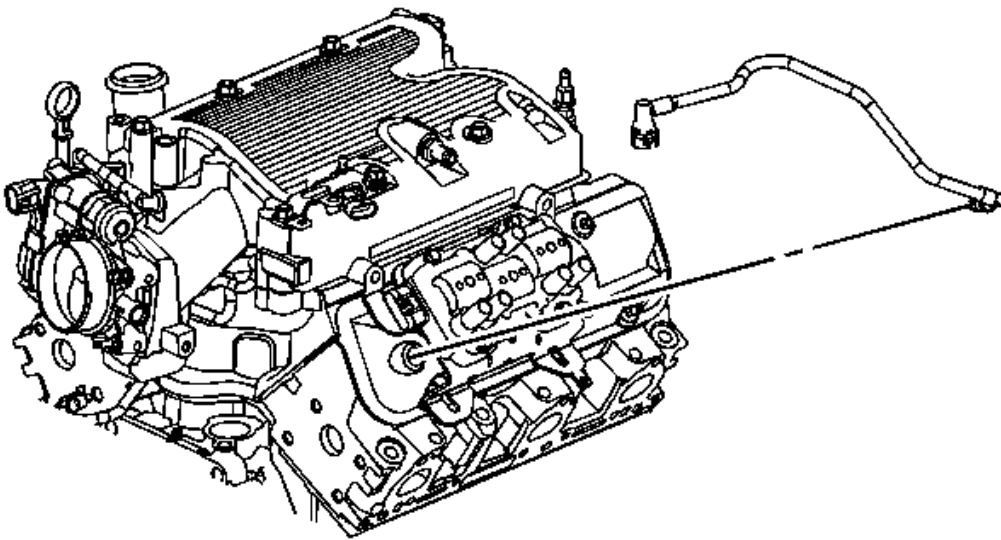


Fig. 77: View Of PCV Tube & Air Inlet Duct
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Disconnect the positive crankcase ventilation (PCV) fresh air tube from the air cleaner outlet duct. Refer to **Plastic Collar Quick Connect Fitting Service** .
3. Remove the PCV fresh air tube from the rocker arm cover.
4. Remove the PCV fresh air tube from the vehicle.

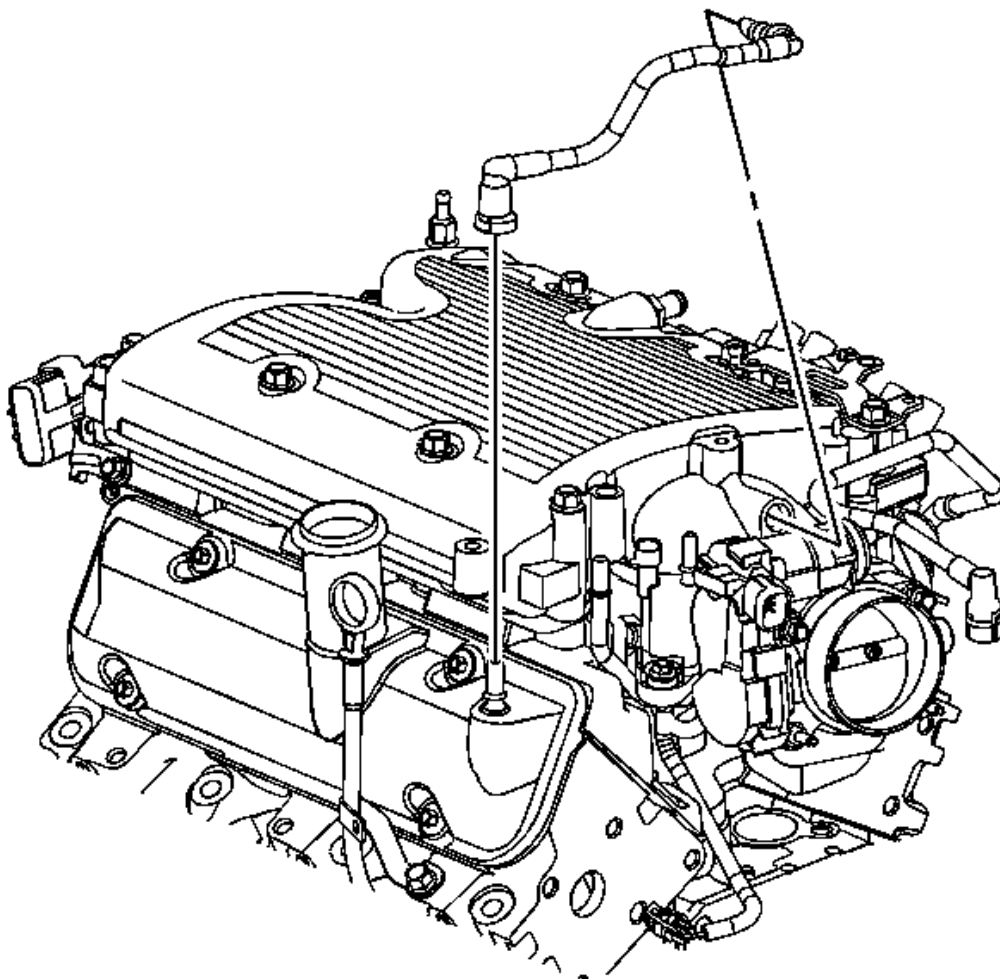


Fig. 78: Locating PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the PCV foul air tube from the PCV valve. Refer to **Plastic Collar Quick Connect Fitting Service** .
6. Remove the PCV foul air tube from the intake manifold.
7. Remove the PCV foul air tube from the vehicle.

INSTALLATION PROCEDURE

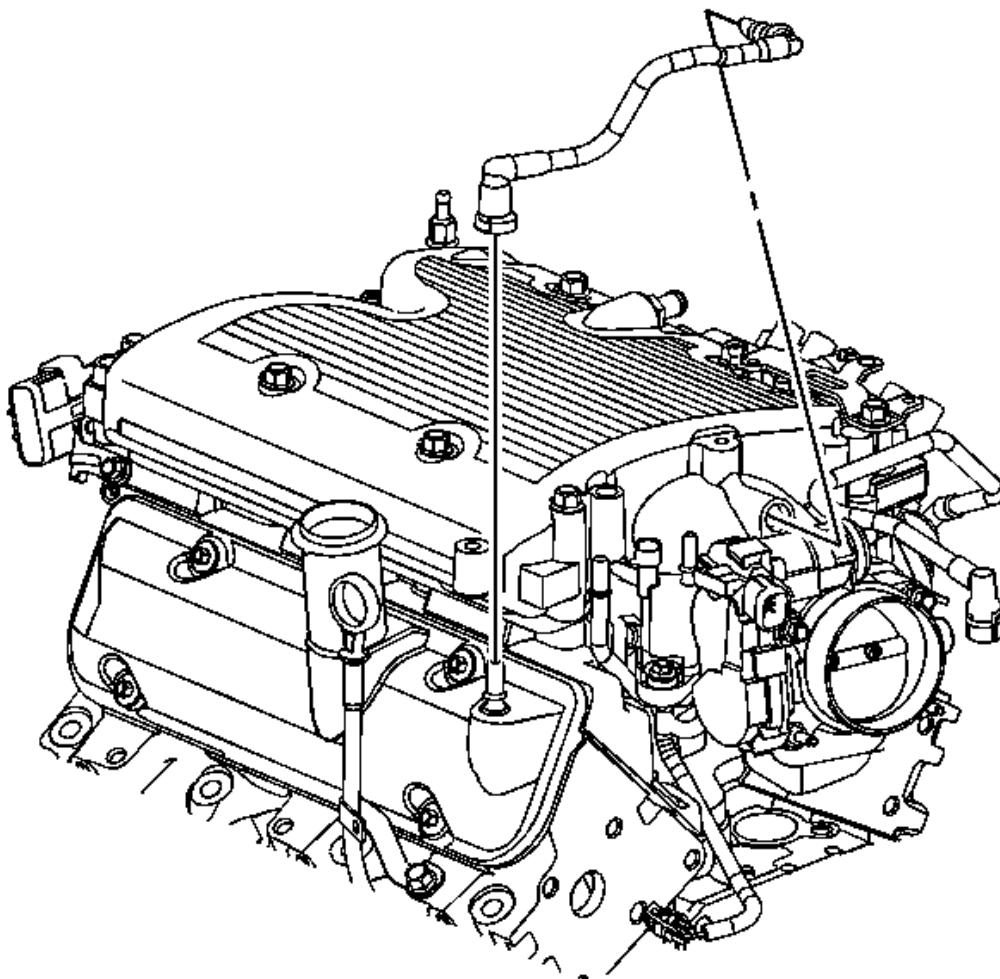


Fig. 79: Locating PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

1. Install the PCV foul air tube to the vehicle.
2. Install the PCV foul air tube to the intake manifold.
3. Connect the PCV foul air tube to the PCV valve. Refer to **Plastic Collar Quick Connect Fitting Service** .

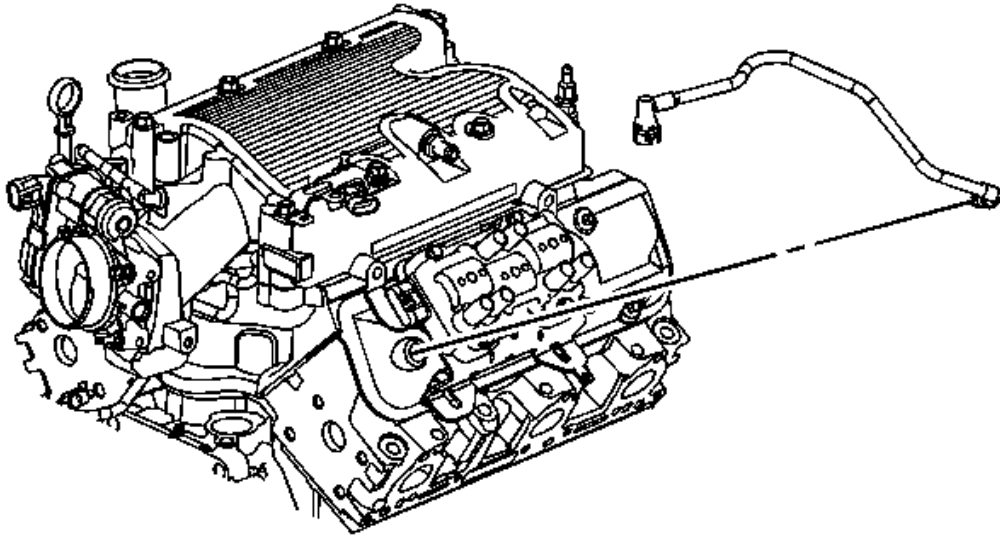


Fig. 80: View Of PCV Tube & Air Inlet Duct
Courtesy of GENERAL MOTORS CORP.

4. Install the PCV fresh air tube to the vehicle.
5. Install the PCV fresh air tube to the rocker arm cover.
6. Connect the PCV fresh air tube to the air cleaner outlet duct. Refer to **Plastic Collar Quick Connect Fitting Service**.
7. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

VALVE ROCKER ARM COVER REPLACEMENT - LEFT SIDE

REMOVAL PROCEDURE

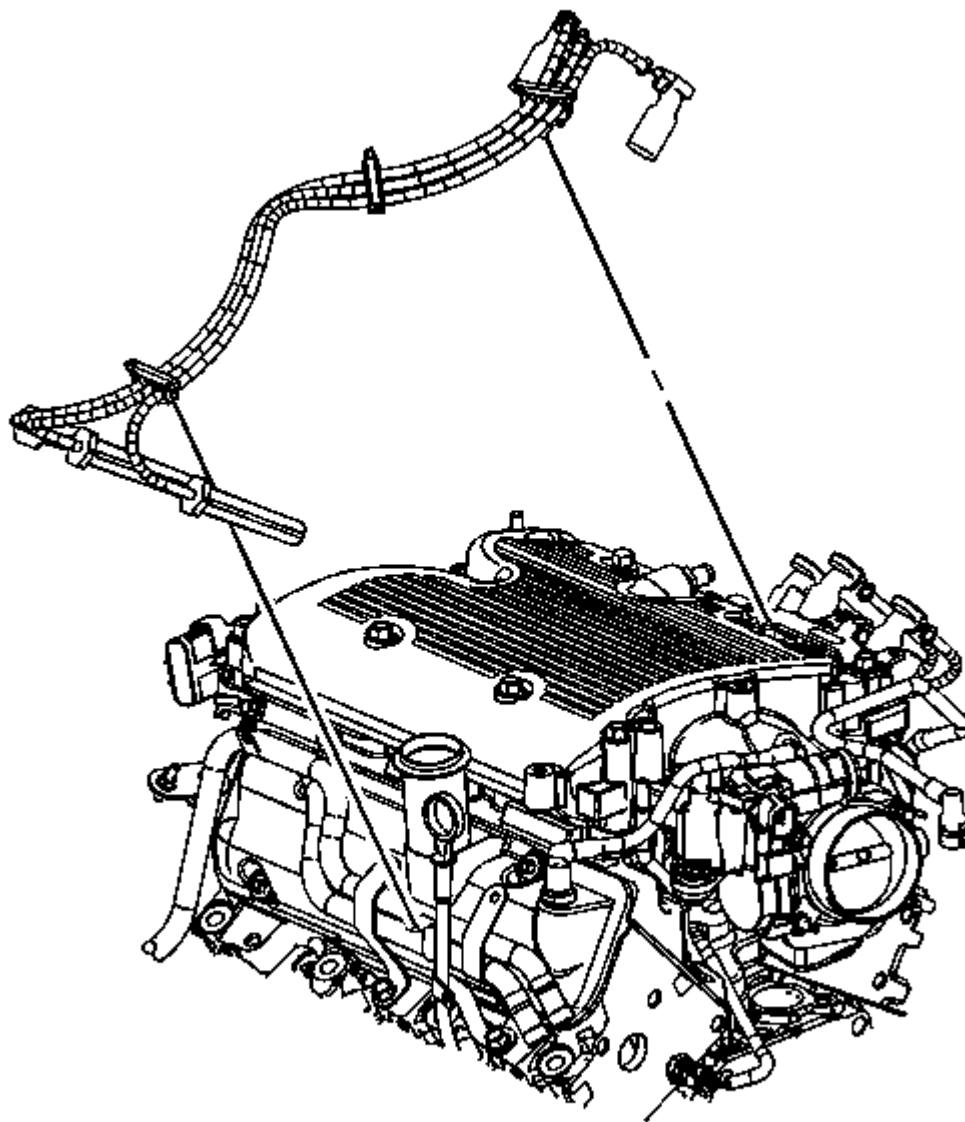


Fig. 81: View Of Left Side Spark Plug Wires
 Courtesy of GENERAL MOTORS CORP.

1. Partially drain the cooling system. Refer to Cooling System Draining and Filling (LZE, LGD Static Fill) or Cooling System Draining and Filling (LZE, LGD GE47716 Fill) .
2. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.
3. Remove the oil level indicator tube. Refer to Oil Level Indicator Tube Replacement.

4. Disconnect the left spark plug wires from the spark plugs.
5. Remove the spark plug wire harness clip from the heater inlet and outlet front pipe bracket.
6. Reposition the spark plug harness.

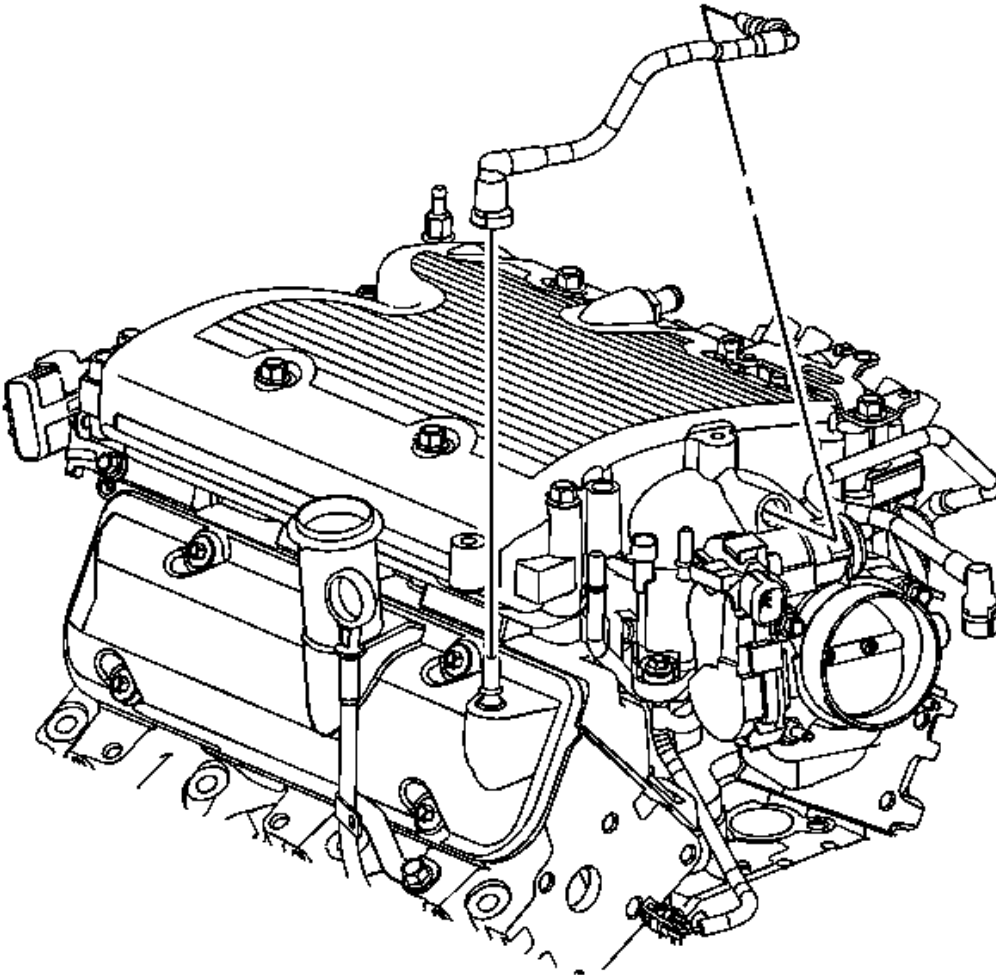


Fig. 82: Locating PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

7. Remove the positive crankcase ventilation (PCV) foul air tube. Refer to **Plastic Collar Quick Connect Fitting Service**.
8. Remove the left engine mount strut bracket. Refer to **Engine Mount Strut Bracket Replacement - Left Side**.

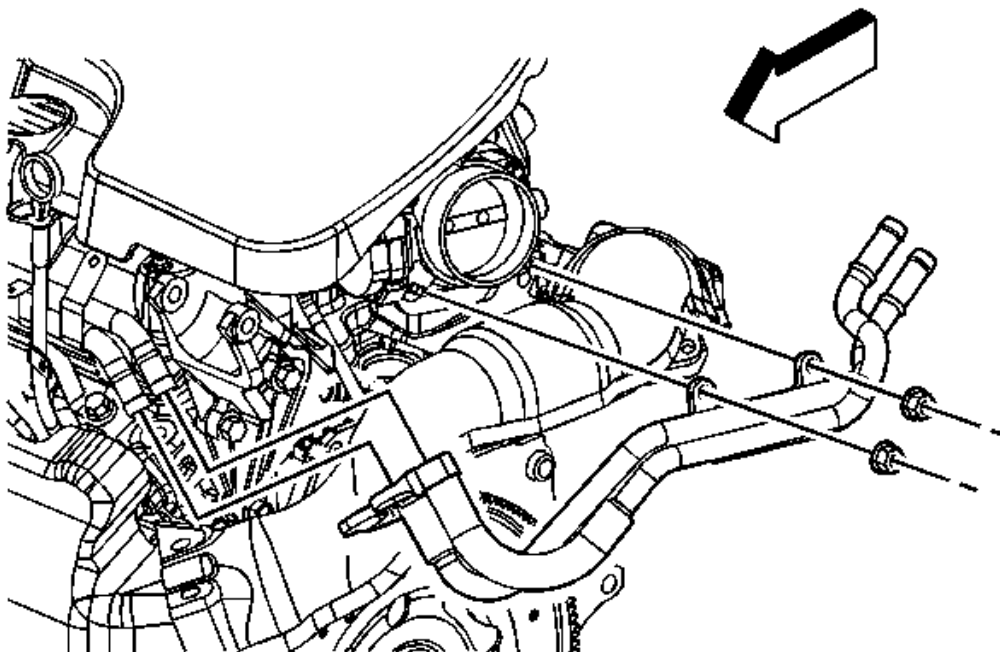


Fig. 83: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

9. Reposition the heater inlet and outlet hose/pipe clamps at the engine inlet and outer pipes.
10. Remove the heater inlet and outlet hose/pipe clip nuts at the throttle body.
11. Remove the heater inlet and outer hoses/pipes from the engine inlet and outlet pipes.
12. Remove the clips from the throttle body studs. Reposition the hose/pipe assembly.

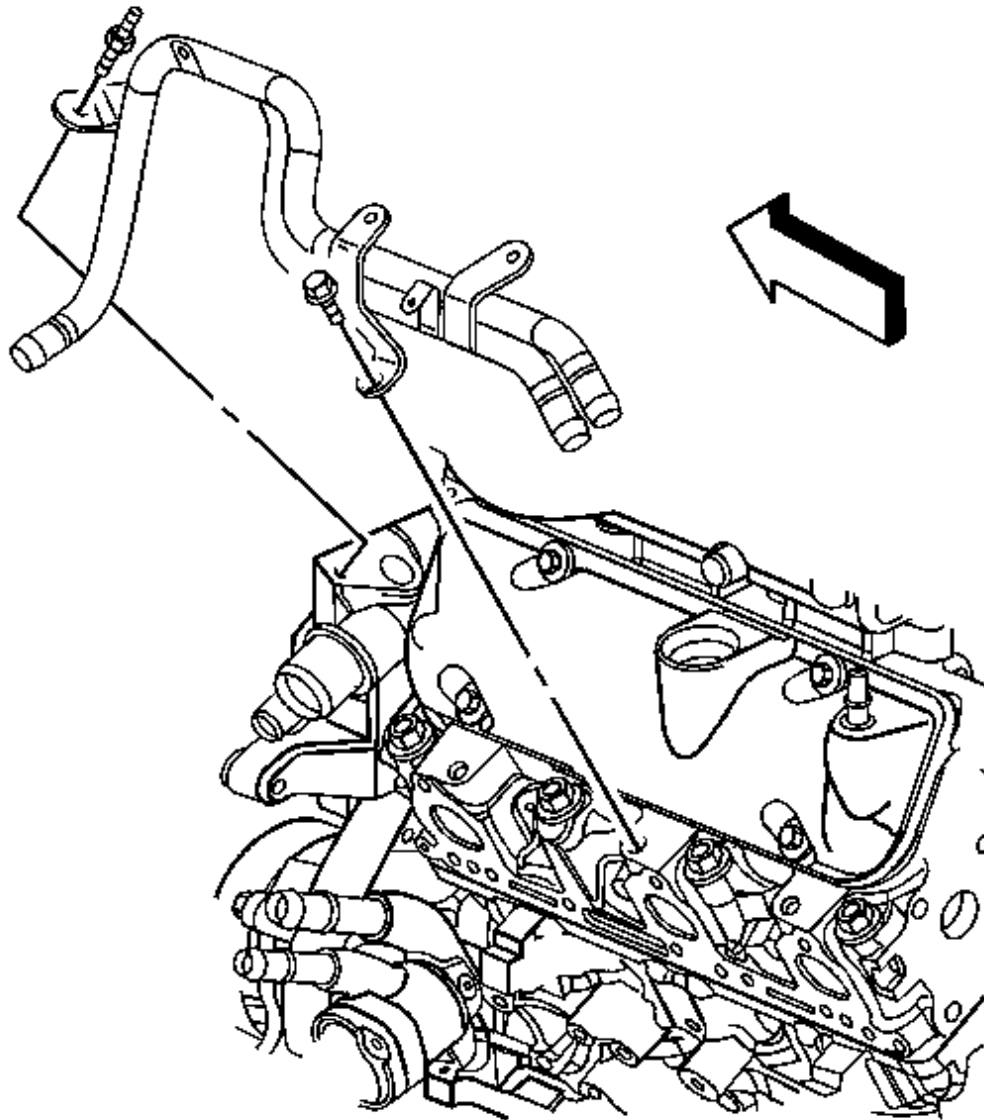


Fig. 84: Locating Heater Inlet & Outlet Pipe To Vehicle
Courtesy of GENERAL MOTORS CORP.

13. Remove the front heater outlet hose from the outlet heater pipe.
14. Remove the heater inlet and outlet pipe bolt and stud.
15. Remove the heater inlet and outlet pipe from the vehicle.

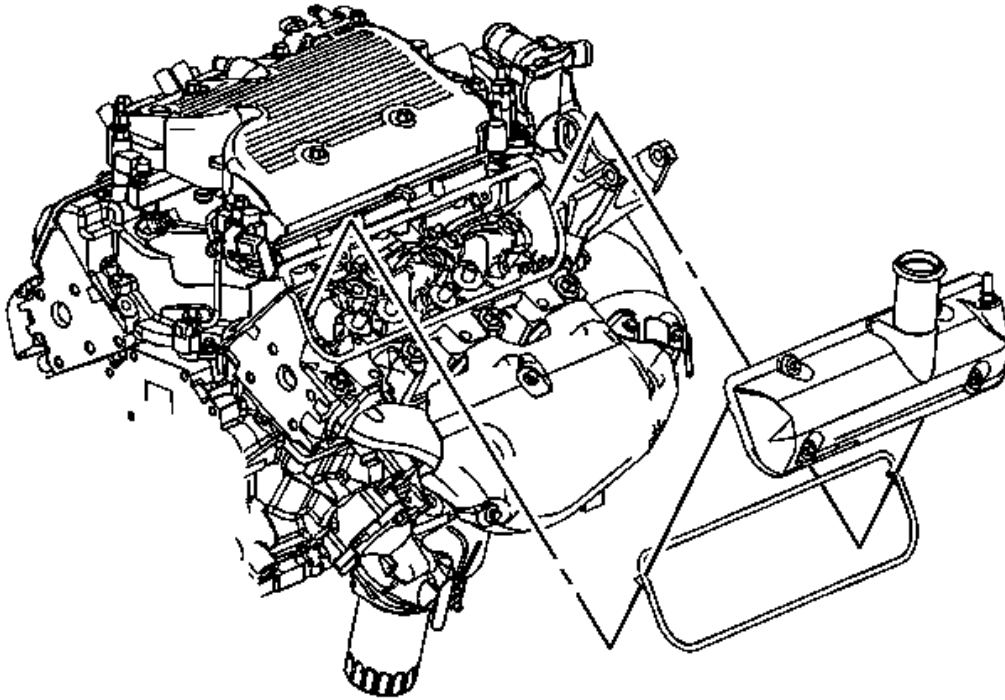


Fig. 85: Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

16. Loosen the valve rocker arm cover bolts.

NOTE: When removing the valve rocker arm cover, ensure the gasket stays in place attached to the cylinder head.

17. Remove the valve rocker arm cover. If necessary, bump the end of the cover with the palm of your hand or a soft rubber mallet if the cover adheres to the cylinder head.
18. Cut the RTV in the channel where the intake, cylinder head and valve rocker arm cover meet with a suitable tool.
19. Remove the valve cover gasket.
20. Clean the sealing surface on the cylinder head with degreaser.

INSTALLATION PROCEDURE

NOTE: All gasket mating surfaces need to be free of oil and foreign material. Use cleaner to clean the surfaces. Refer to Adhesives, Fluids, Lubricants, and Sealers .

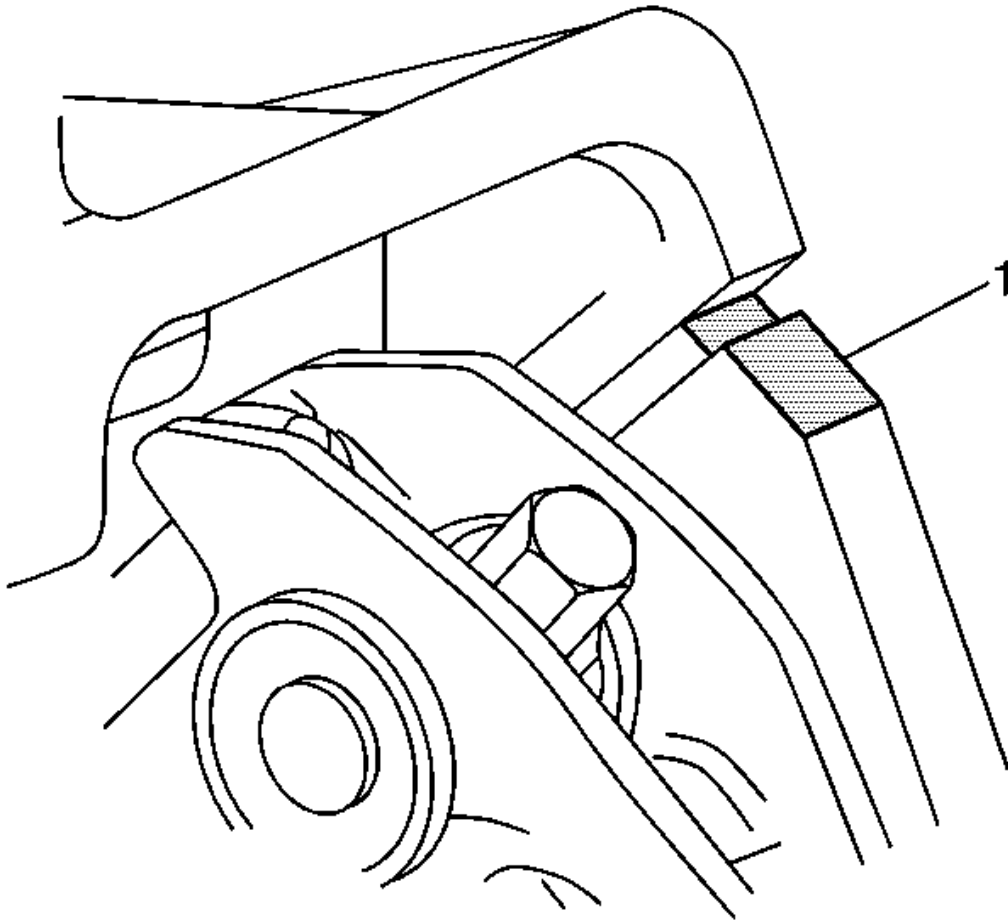


Fig. 86: Cylinder Head To Lower Intake Manifold Joint
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW valve rocker arm cover gasket into the groove in the valve rocker arm cover. Ensure that the gasket is properly seated in the groove of the valve rocker arm cover.
2. Apply sealant at the cylinder head to the surfaces where the cylinder head and intake manifold meet (1). Refer to **Adhesives, Fluids, Lubricants, and Sealers** .

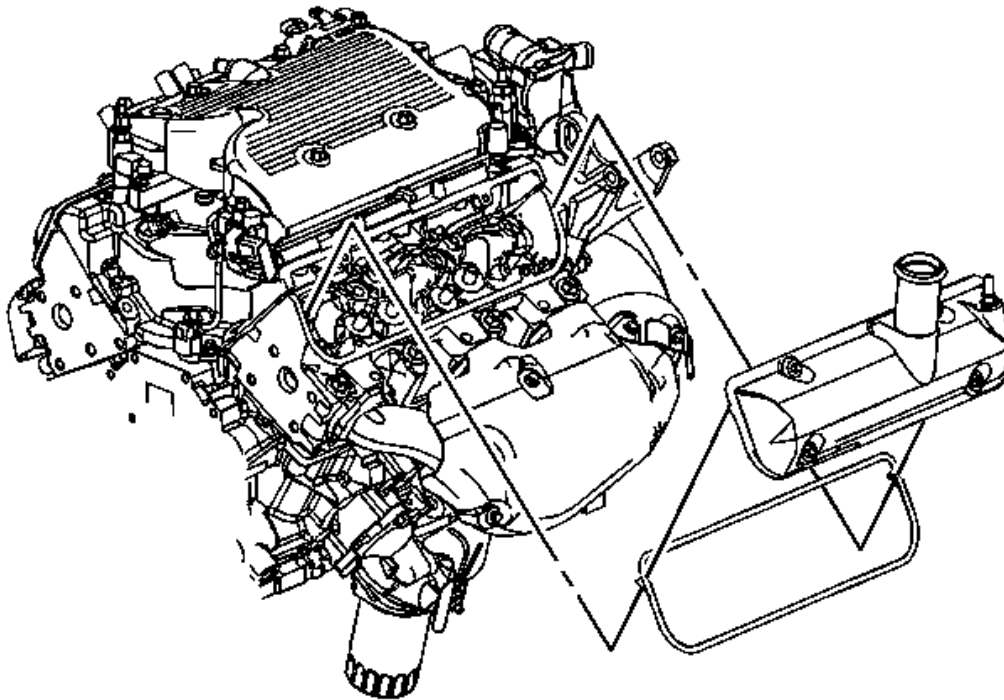


Fig. 87: Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

3. Install the valve rocker arm cover.
4. Install the valve rocker arm cover bolts. Refer to **Valve Rocker Arm Cover Installation - Left Side**.

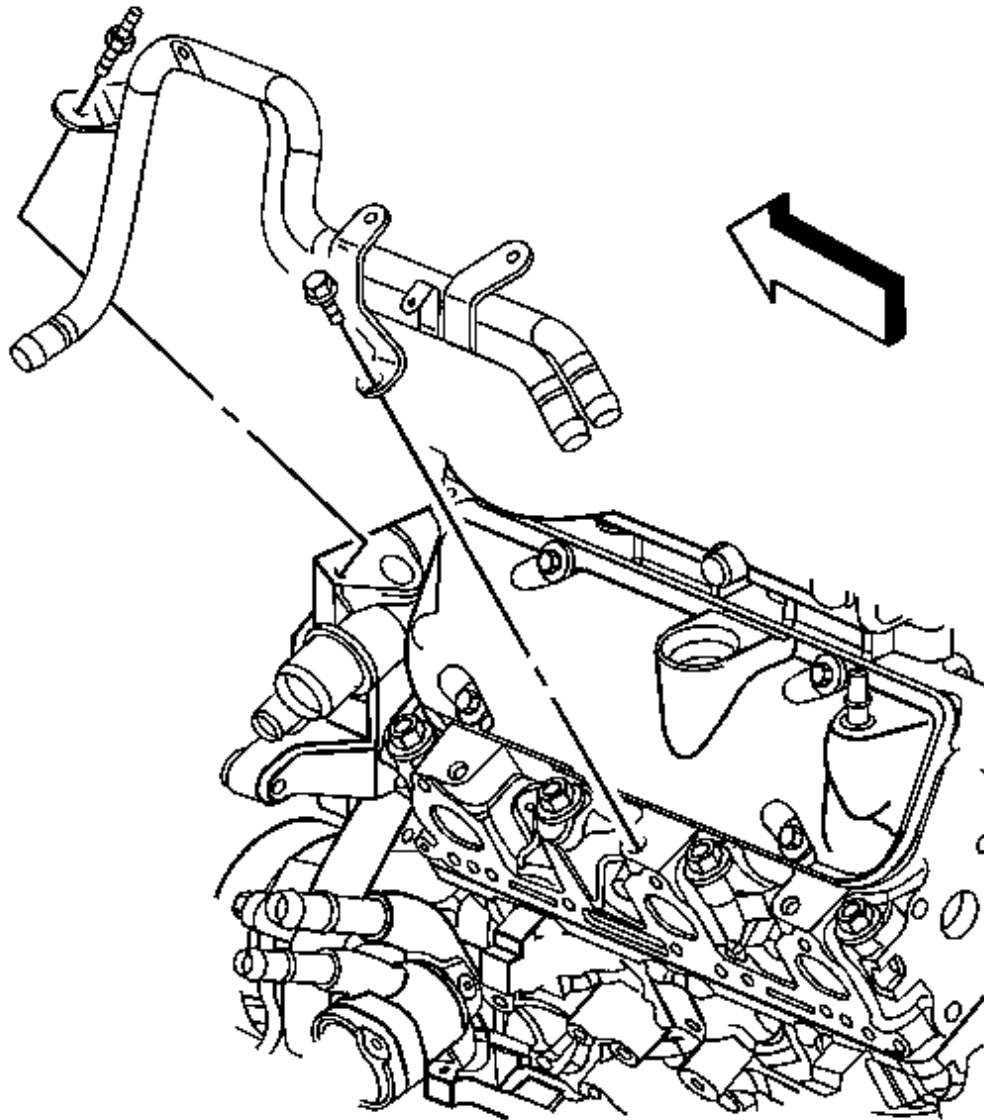


Fig. 88: Locating Heater Inlet & Outlet Pipe To Vehicle
Courtesy of GENERAL MOTORS CORP.

5. Install the heater inlet and outlet pipe to the vehicle.

CAUTION: Refer to Fastener Caution .

6. Install the heater inlet and outlet pipe bolt and stud.

Tighten:

- Tighten the bolt to 25 N.m (18 lb ft).
- Tighten the stud to 10 N.m (89 lb in).

7. Install the front heater outlet hose to the outlet heater pipe.

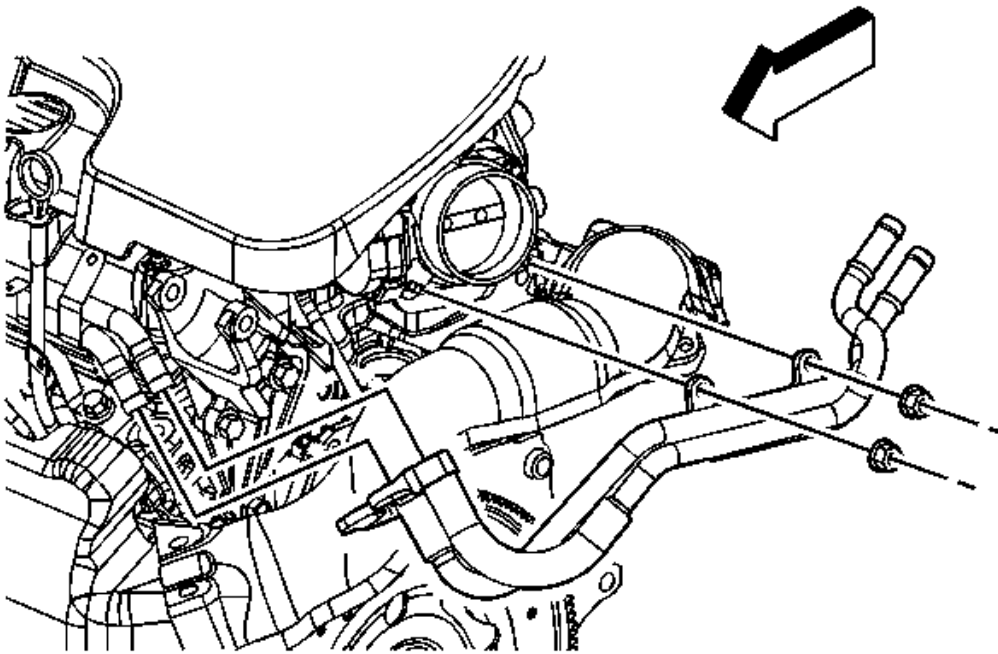


Fig. 89: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

8. Position the hose/pipe assembly. Install the clips to the throttle body studs.
9. Install the heater inlet and outer hoses/pipes to the engine inlet and outlet pipes.
10. Install the heater inlet and outlet hose/pipe clip nuts at the throttle body.

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

11. Position the heater inlet and outlet hose/pipe clamps at the engine inlet and outer pipes.
12. Install the left engine mount strut bracket. Refer to **Engine Mount Strut Bracket Replacement - Left Side**.

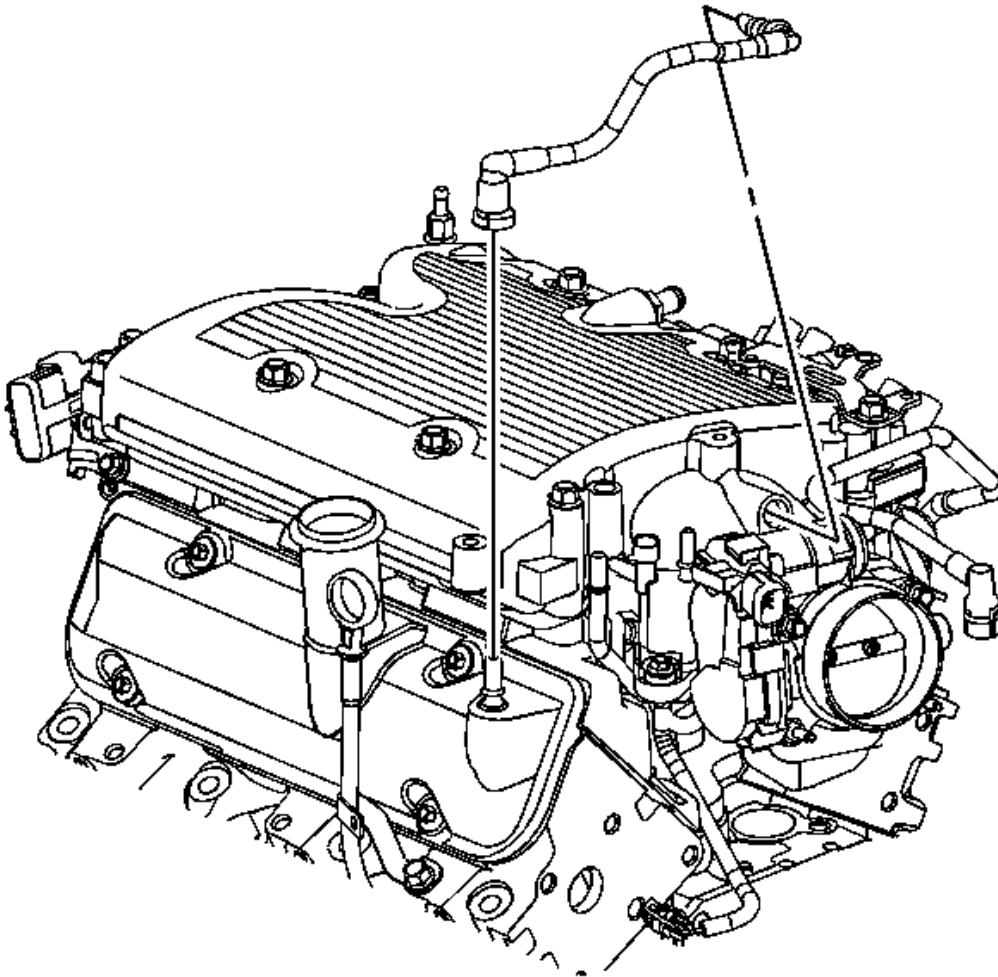


Fig. 90: Locating PCV Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

13. Install the PCV foul air tube. Refer to **Plastic Collar Quick Connect Fitting Service** .

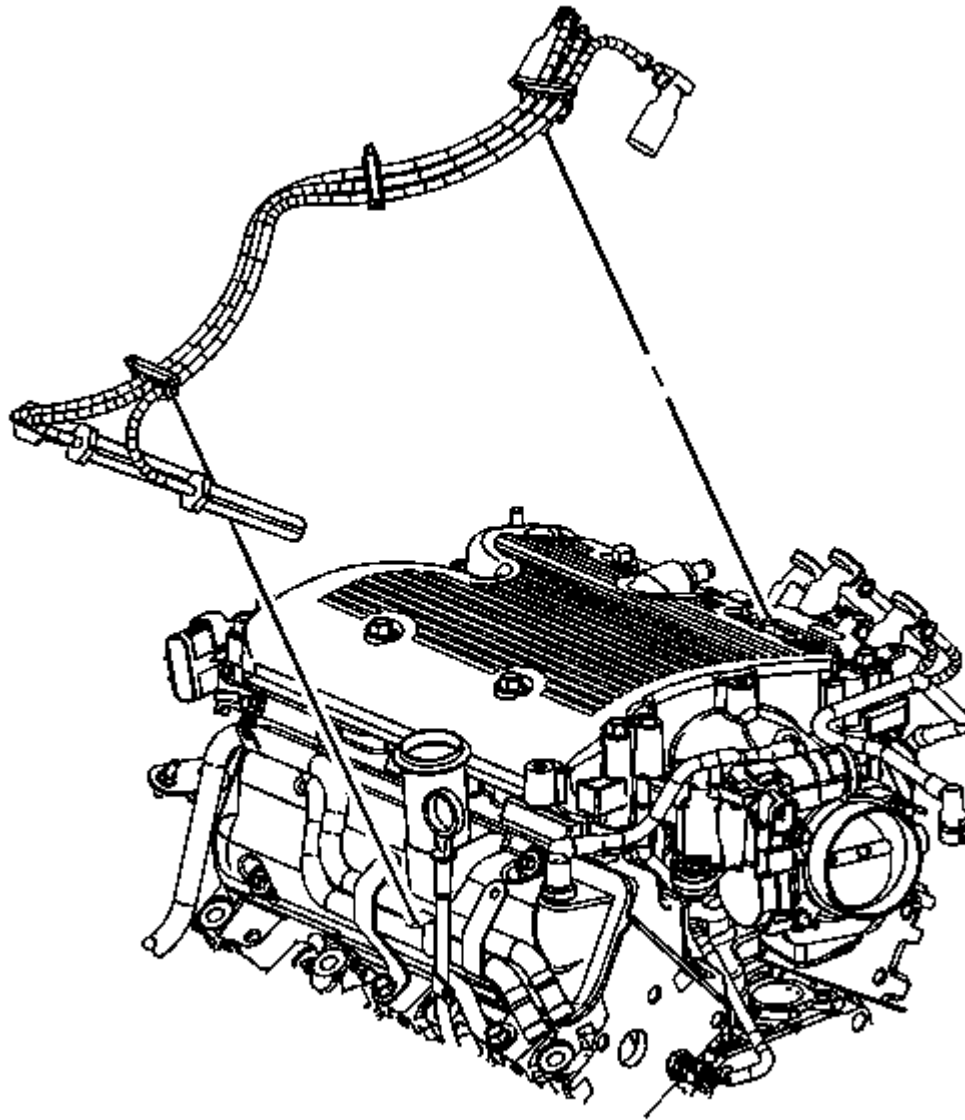


Fig. 91: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

14. Position the spark plug harness.
15. Install the spark plug wire harness clip to the heater inlet and outlet front pipe bracket.
16. Connect the left spark plug wires to the spark plugs.
17. Install the oil level indicator tube. Refer to **Oil Level Indicator Tube Replacement**.

18. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
19. Fill the cooling system. Refer to **Cooling System Draining and Filling (LZE, LGD Static Fill)** or **Cooling System Draining and Filling (LZE, LGD GE47716 Fill)**.

VALVE ROCKER ARM COVER REPLACEMENT - RIGHT SIDE

REMOVAL PROCEDURE

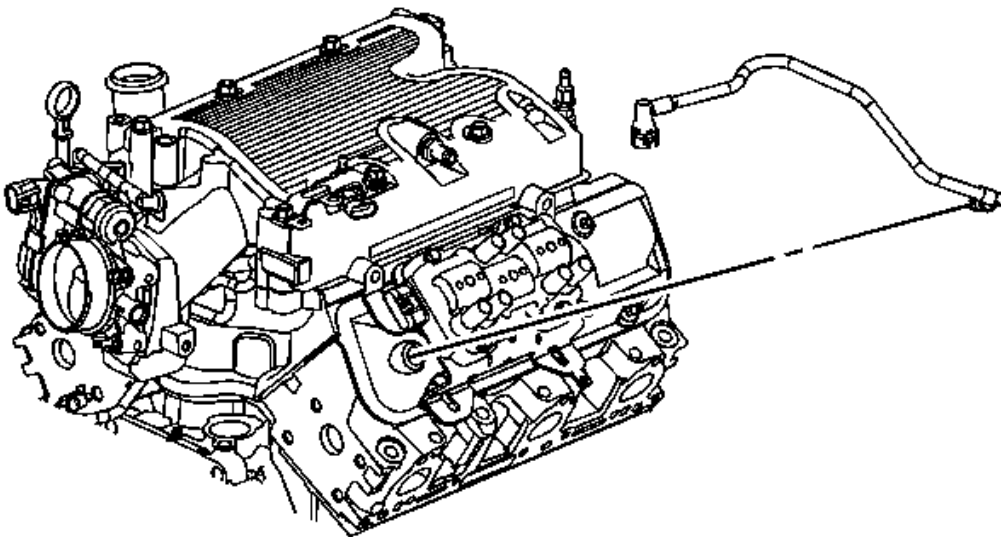


Fig. 92: View Of PCV Tube & Air Inlet Duct
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator. Refer to **Generator Replacement (LGD/LZE)**.
2. Disconnect the positive crankcase ventilation (PCV) fresh air tube from the air cleaner outlet duct. Refer to **Plastic Collar Quick Connect Fitting Service**.
3. Remove the PCV fresh air tube from the right side valve rocker arm cover.

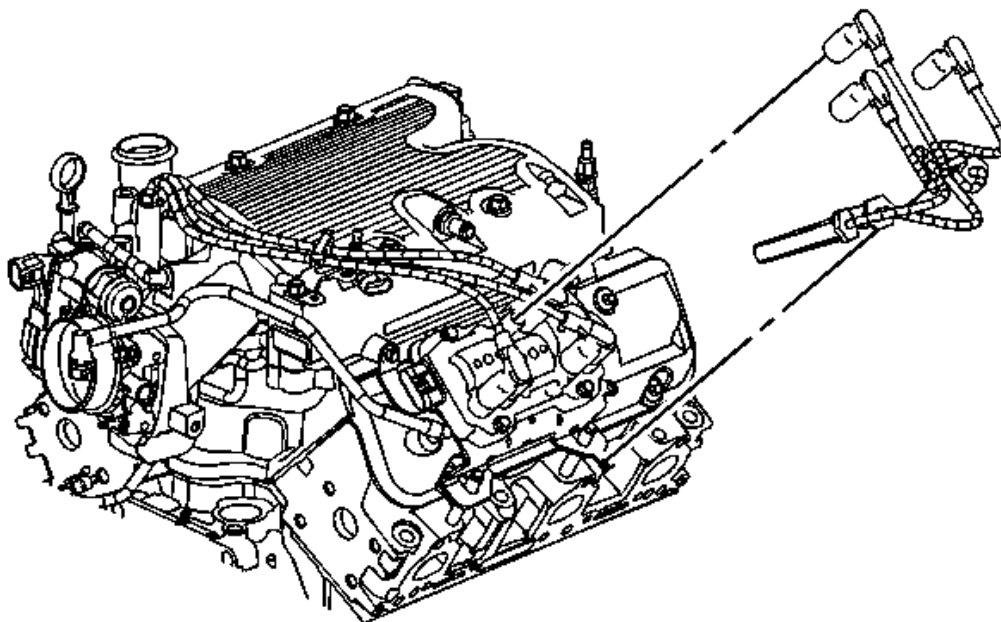


Fig. 93: Right Side Spark Plug Wires & Ignition Coil
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the right side spark plug wires from the spark plugs.
5. Disconnect the right side spark plug wires from the ignition coil.
6. Remove the right side spark plug harness clip from the ignition coil bracket.
7. Remove the spark plug harness.

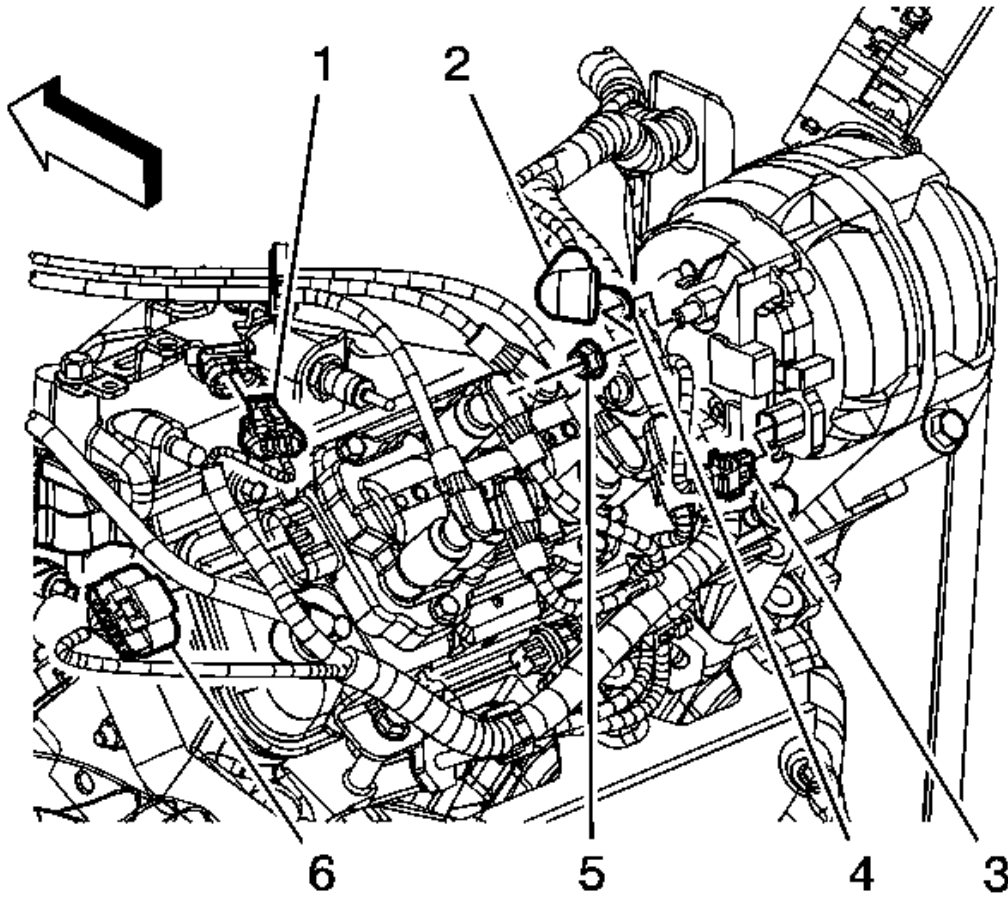


Fig. 94: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).
9. Disconnect the ignition coil electrical connector (6).
10. Remove the engine harness clip from the ignition coil bracket.

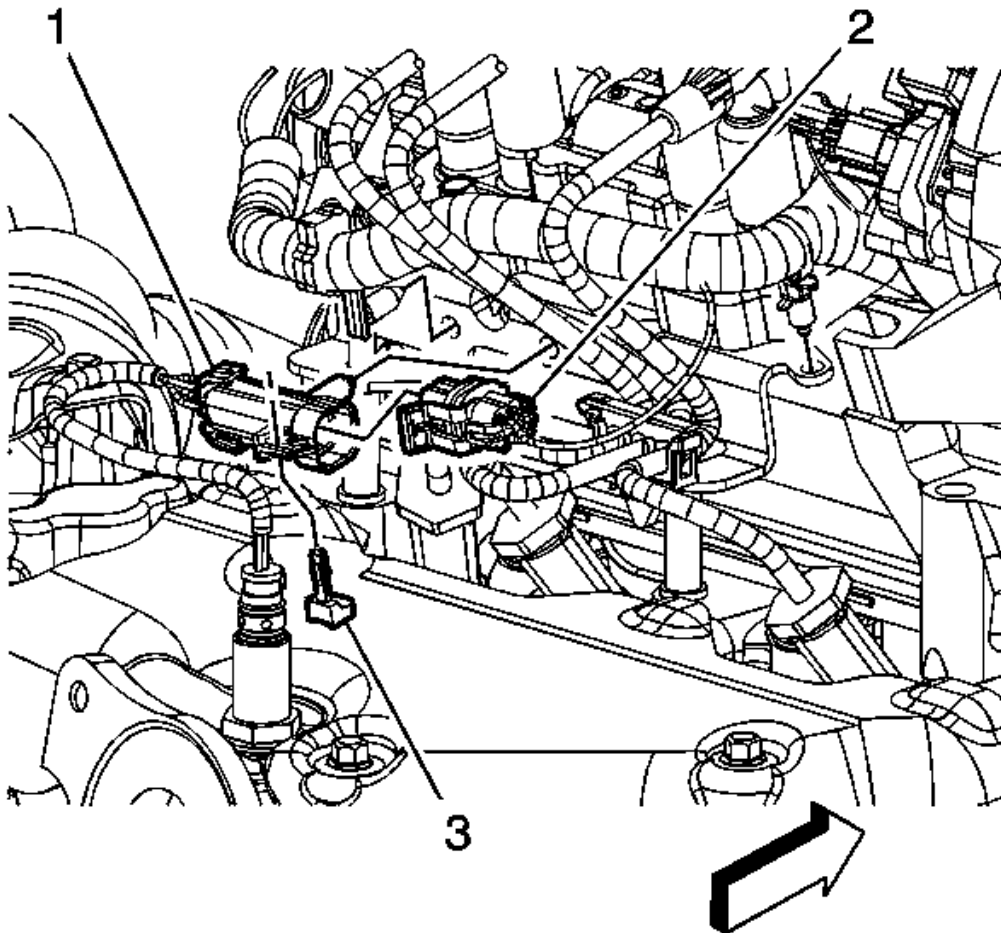


Fig. 95: View Of HO2S Electrical Connector Clip (1) & Ignition Coil Bracket
Courtesy of GENERAL MOTORS CORP.

11. Remove the heated oxygen sensor (HO2S) electrical connector clip (1) from the ignition coil bracket.

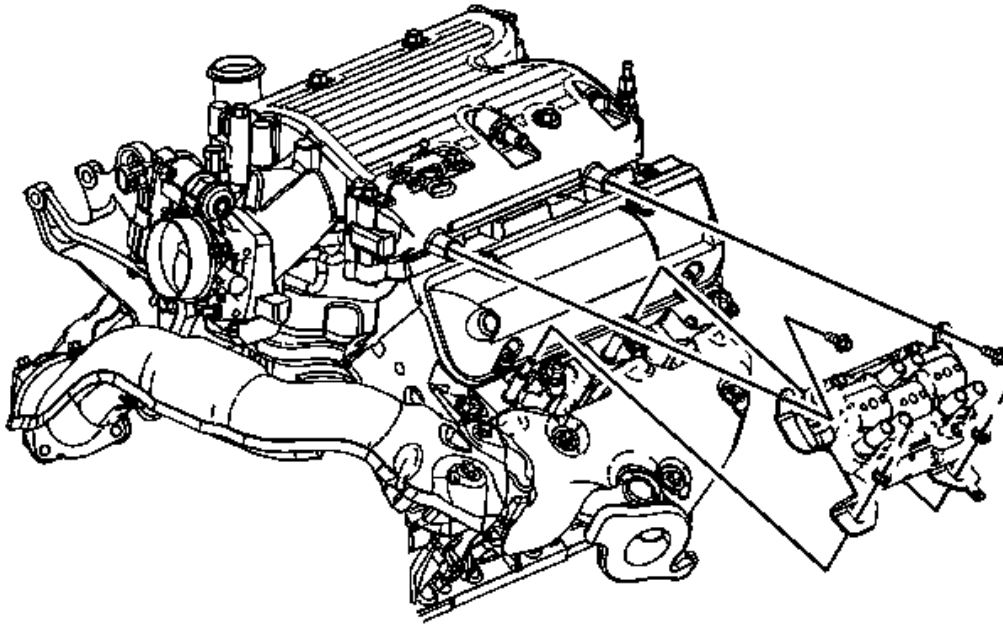


Fig. 96: View Of Ignition Coil
Courtesy of GENERAL MOTORS CORP.

12. Remove the ignition coil bracket nuts.
13. Remove the ignition coil bracket bolts.
14. Remove the ignition coil.
15. Remove the coolant crossover pipe. Refer to **Engine Coolant Crossover Pipe Replacement (LGD/LZE)** .

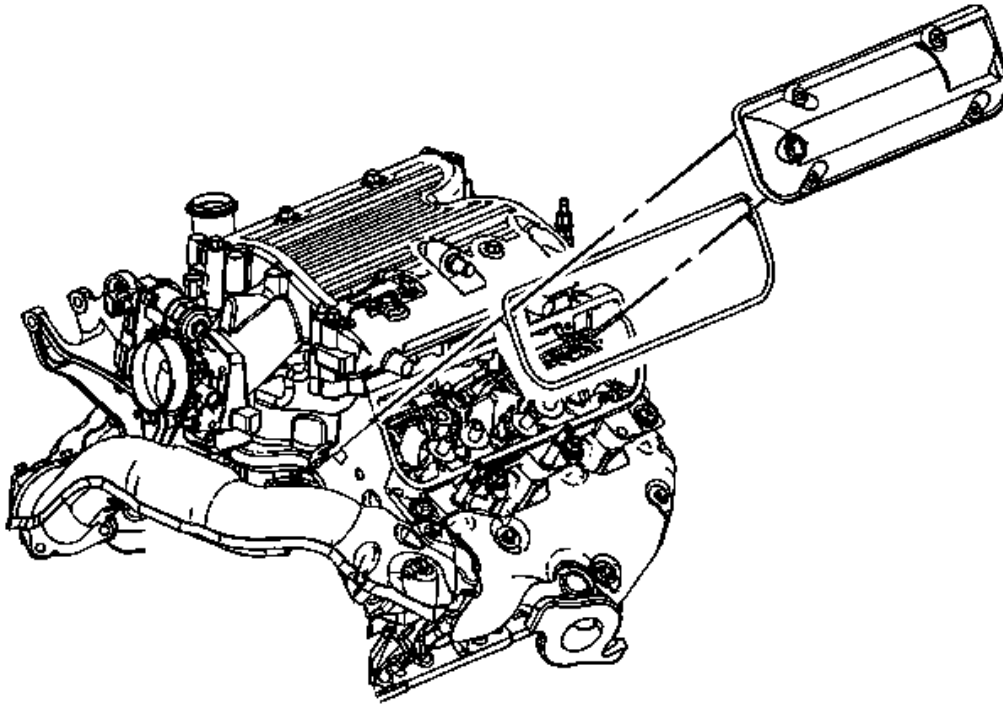


Fig. 97: View Of Valve Rocker Arm Cover & Gasket
Courtesy of GENERAL MOTORS CORP.

16. Loosen the valve rocker arm cover bolts.

NOTE: When removing the valve rocker arm cover, ensure the gasket stays in place attached to the cylinder head.

17. Remove the valve rocker arm cover. Bump the end of the cover with the palm of your hand or a soft rubber mallet if the cover adheres to the cylinder head.
18. Cut the room temperature vulcanizing (RTV) sealer in the channel where the intake, cylinder head and valve rocker arm cover meet with a suitable tool.
19. Remove the valve cover gasket.
20. Clean the sealing surface on the cylinder head with degreaser.

INSTALLATION PROCEDURE

NOTE: All gasket mating surfaces need to be free of oil and foreign material. Use cleaner to clean the surfaces. Refer to Adhesives, Fluids, Lubricants, and

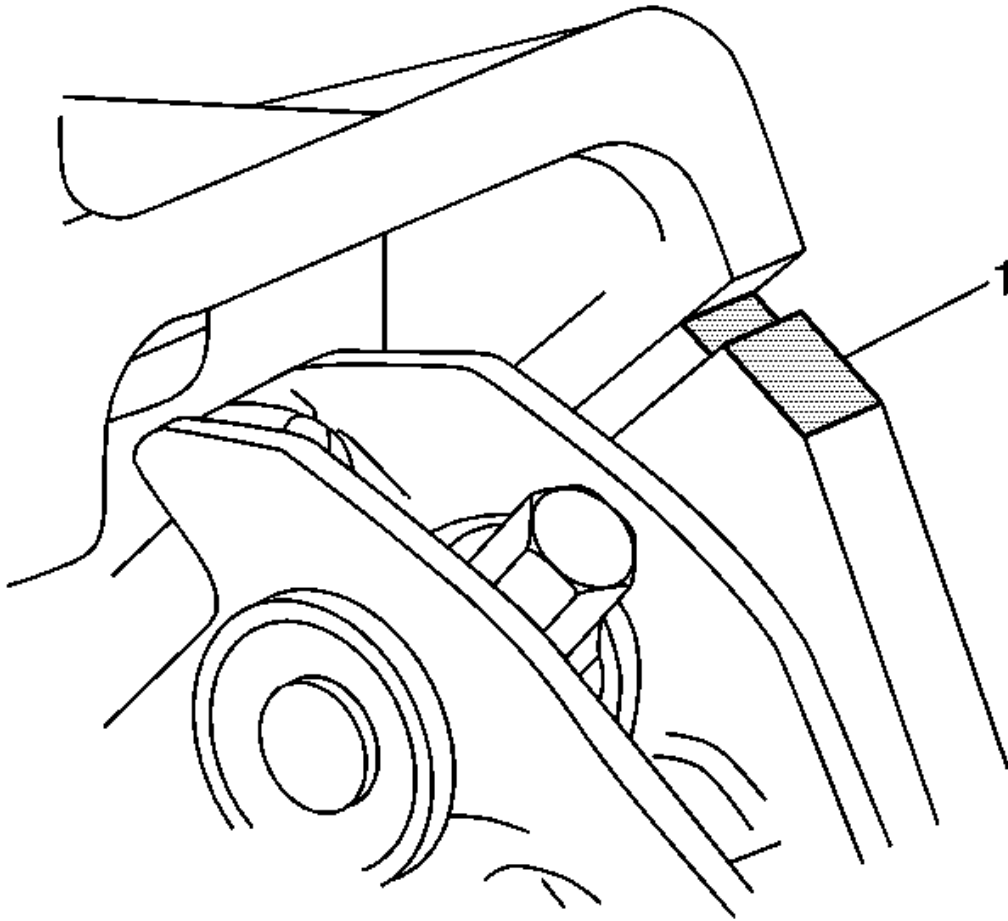
Sealers .

Fig. 98: Cylinder Head To Lower Intake Manifold Joint
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW valve rocker arm cover gasket into the groove in the valve rocker arm cover. Ensure that the gasket is properly seated in the groove of the valve rocker arm cover.
2. Apply sealant at the cylinder head to the surfaces where the cylinder head and intake manifold meet (1). Refer to **Adhesives, Fluids, Lubricants, and Sealers** .

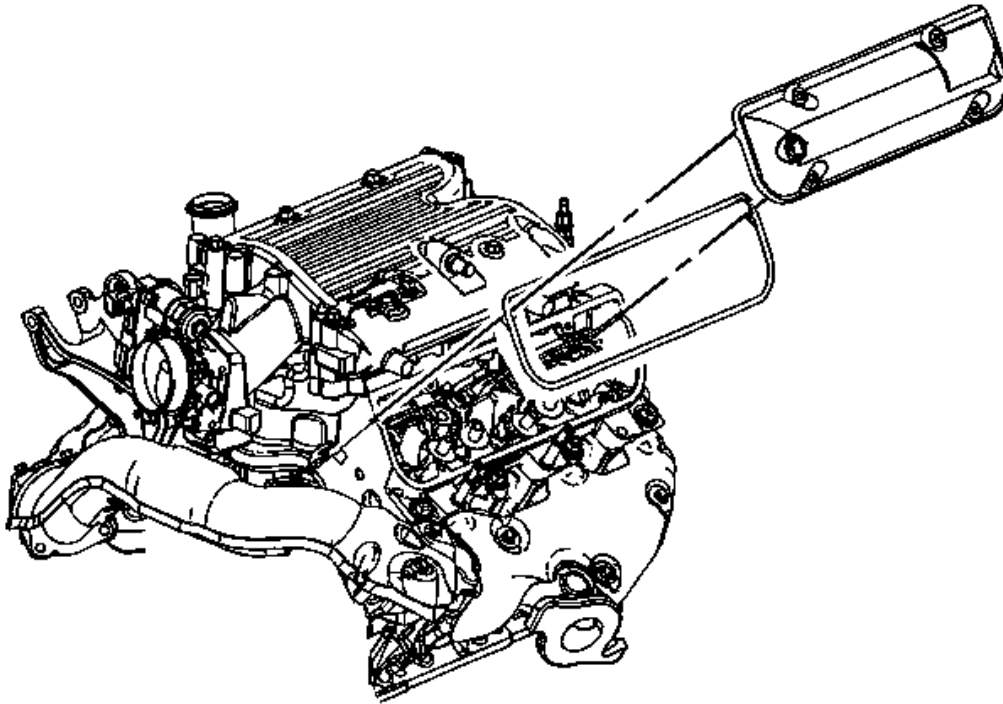


Fig. 99: View Of Valve Rocker Arm Cover & Gasket
Courtesy of GENERAL MOTORS CORP.

3. Install a new gasket to the valve rocker arm cover. Ensure that the gasket is properly seated in the groove of the valve rocker arm cover.
4. Install the right valve rocker arm cover.
5. Install the valve rocker arm cover bolts. Refer to **Valve Rocker Arm Cover Installation - Right Side** .
6. Install the coolant crossover pipe. Refer to **Engine Coolant Crossover Pipe Replacement (LGD/LZE)** .

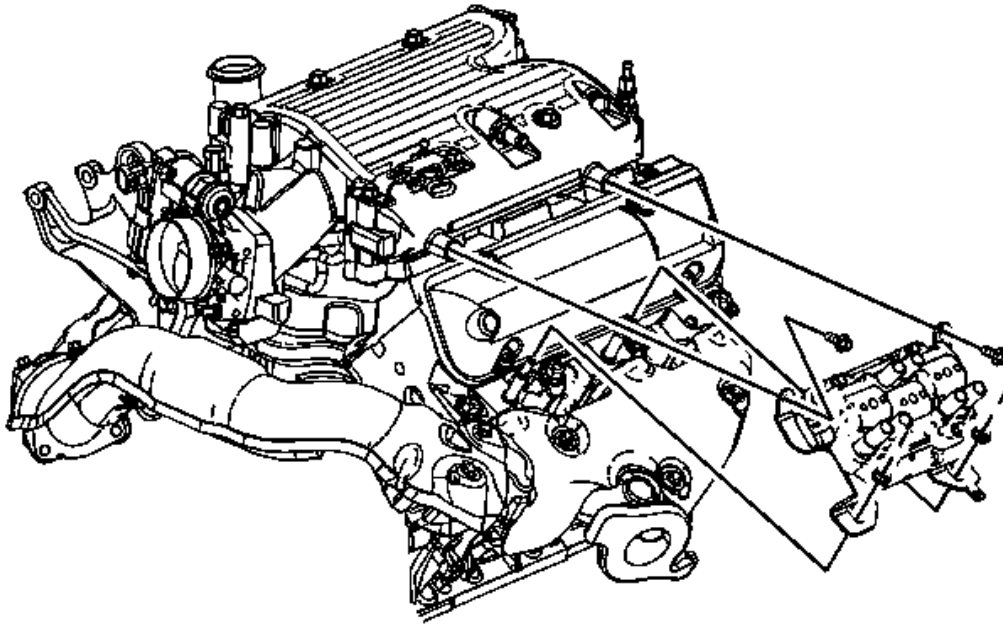


Fig. 100: View Of Ignition Coil
Courtesy of GENERAL MOTORS CORP.

7. Install the ignition coil.
8. Install the ignition coil bracket bolts.

CAUTION: Refer to Fastener Caution .

9. Install the ignition coil bracket nuts.

Tighten: Tighten the bolts/nuts to 25 N.m (18 lb ft).

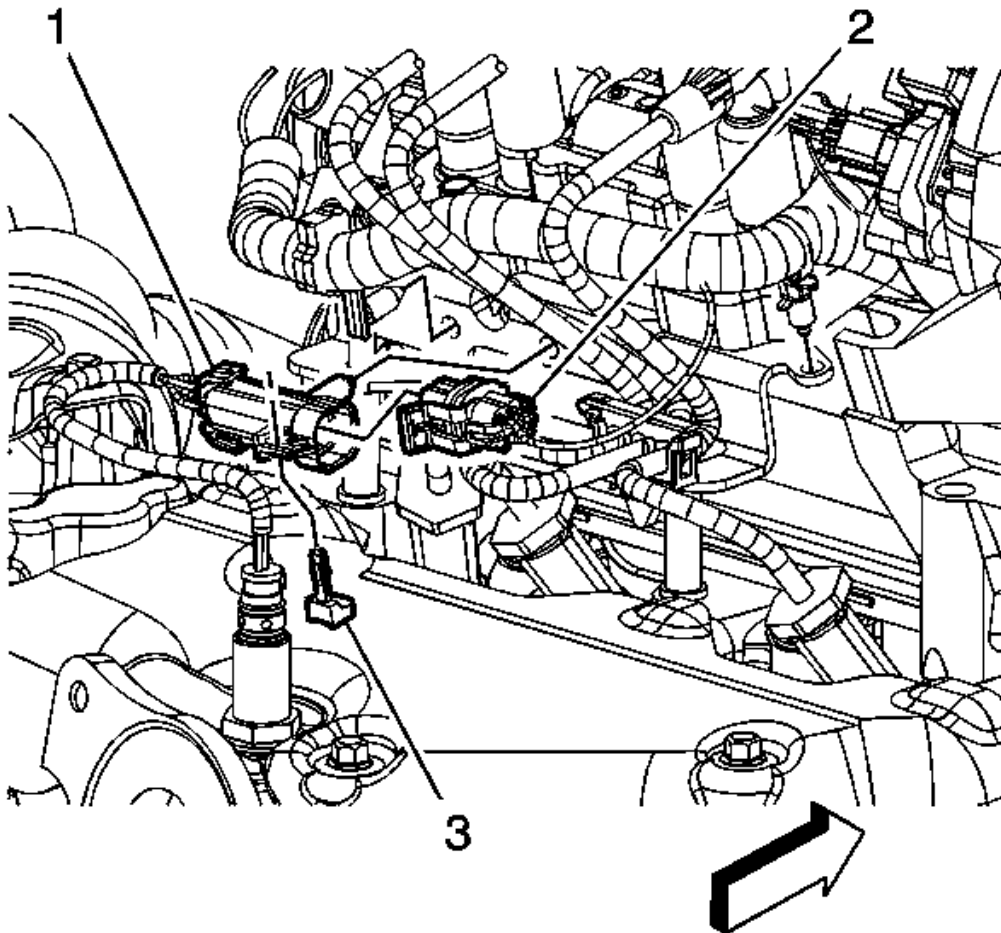


Fig. 101: View Of HO2S Electrical Connector Clip (1) & Ignition Coil Bracket
Courtesy of GENERAL MOTORS CORP.

10. Install the HO2S electrical connector clip (1) to the ignition coil bracket.

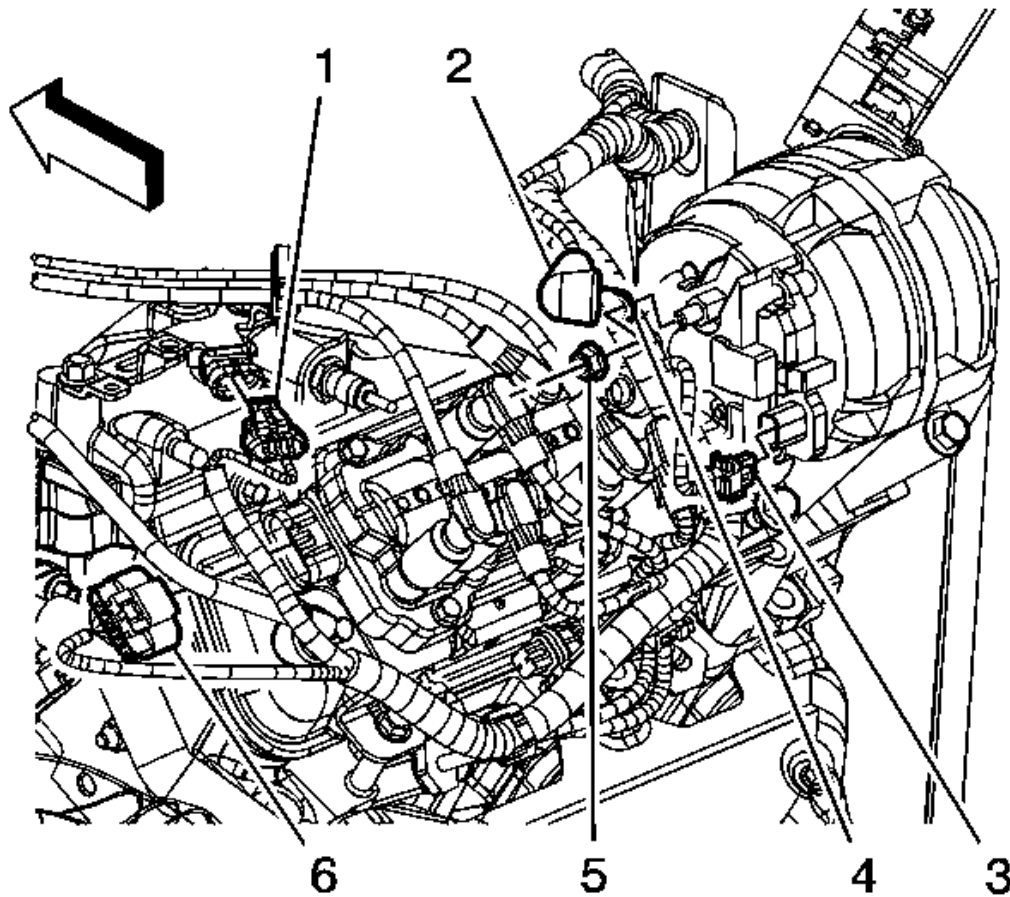


Fig. 102: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

11. Install the engine harness clip to the ignition coil bracket.
12. Connect the ignition coil electrical connector (6).
13. Connect the MAP sensor electrical connector (1).

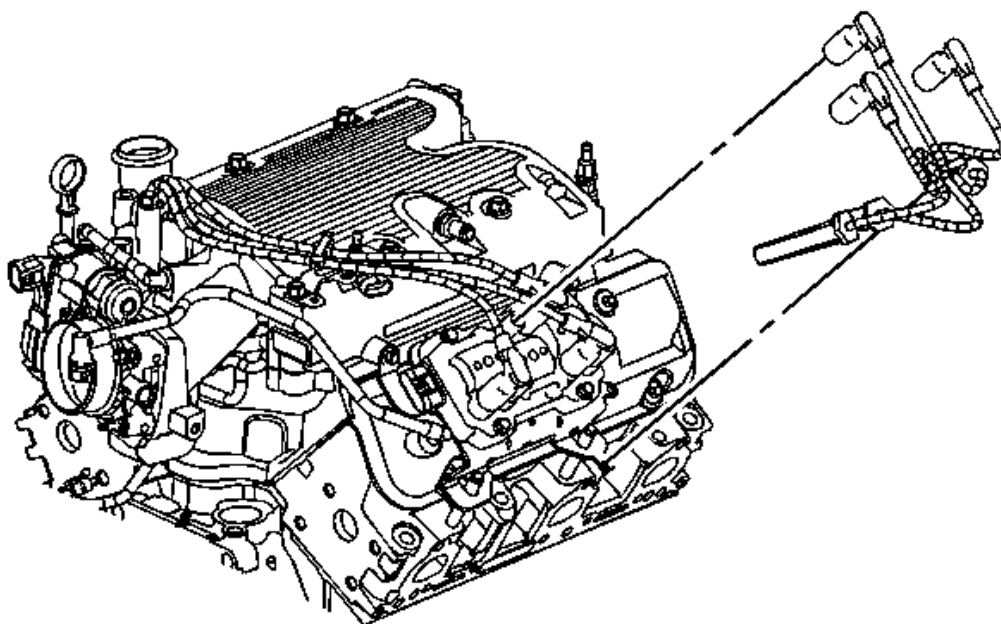


Fig. 103: Right Side Spark Plug Wires & Ignition Coil
Courtesy of GENERAL MOTORS CORP.

14. Install the spark plug harness.
15. Connect the right side spark plug wires to the spark plugs.
16. Connect the right side spark plug wires to the ignition coil.
17. Install the right side spark plug harness clip to the ignition coil bracket.

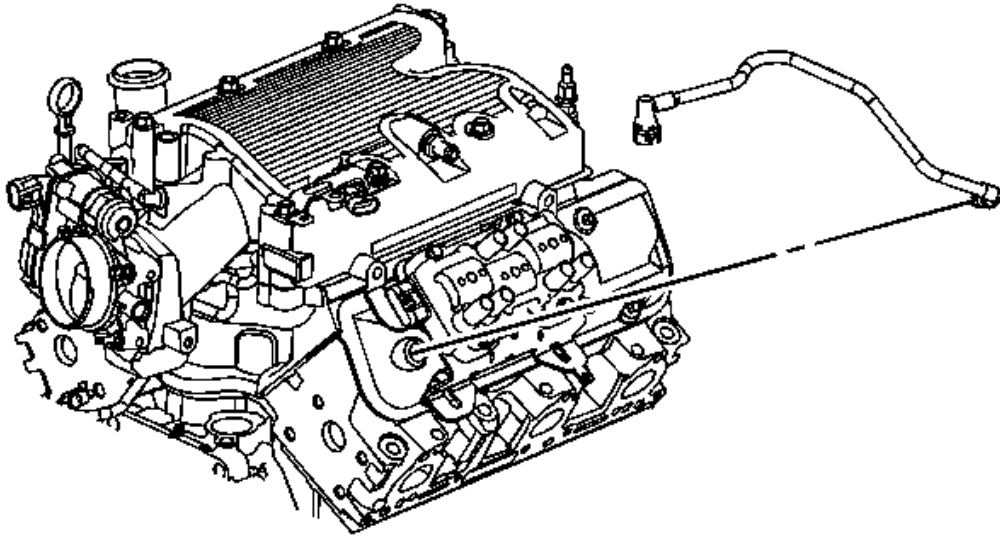


Fig. 104: View Of PCV Tube & Air Inlet Duct
Courtesy of GENERAL MOTORS CORP.

18. Install the PCV fresh air tube to the right side valve rocker arm cover.
19. Connect the PCV fresh air tube to the air cleaner outlet duct. Refer to **Plastic Collar Quick Connect Fitting Service** .
20. Install the generator. Refer to **Generator Replacement (LGD/LZE)** .

VALVE ROCKER ARM AND PUSH ROD REPLACEMENT

REMOVAL PROCEDURE

NOTE: Place the valve train components in a rack in order to ensure that the components are installed in the same location from which they were removed.

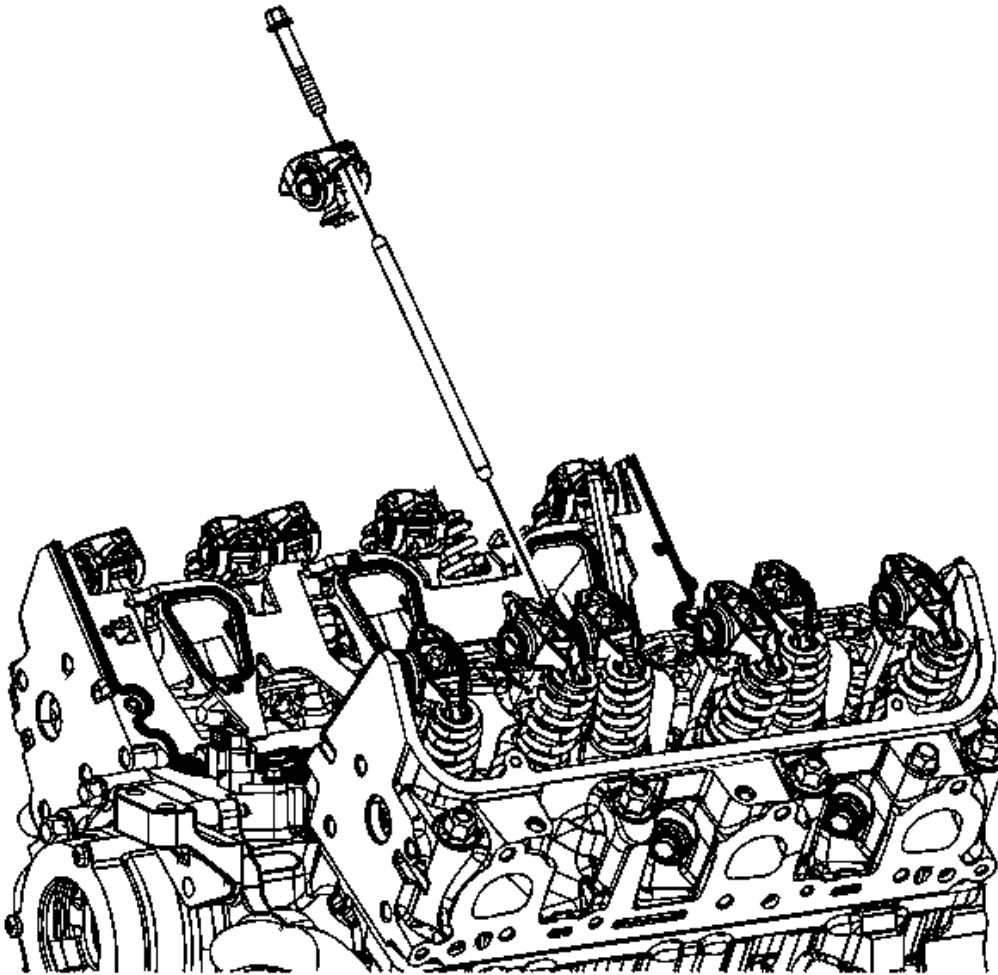


Fig. 105: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the valve rocker arm cover(s). Refer to Valve Rocker Arm Cover Replacement - Left Side or Valve Rocker Arm Cover Replacement - Right Side.
2. Loosen the valve rocker arm bolts.
3. Remove the rocker arms.
4. Remove the pushrods.
 - The intake push rods measure 147.51 mm (5.81 in).
 - The exhaust push rods measure 154.87 mm (6.1 in).

INSTALLATION PROCEDURE

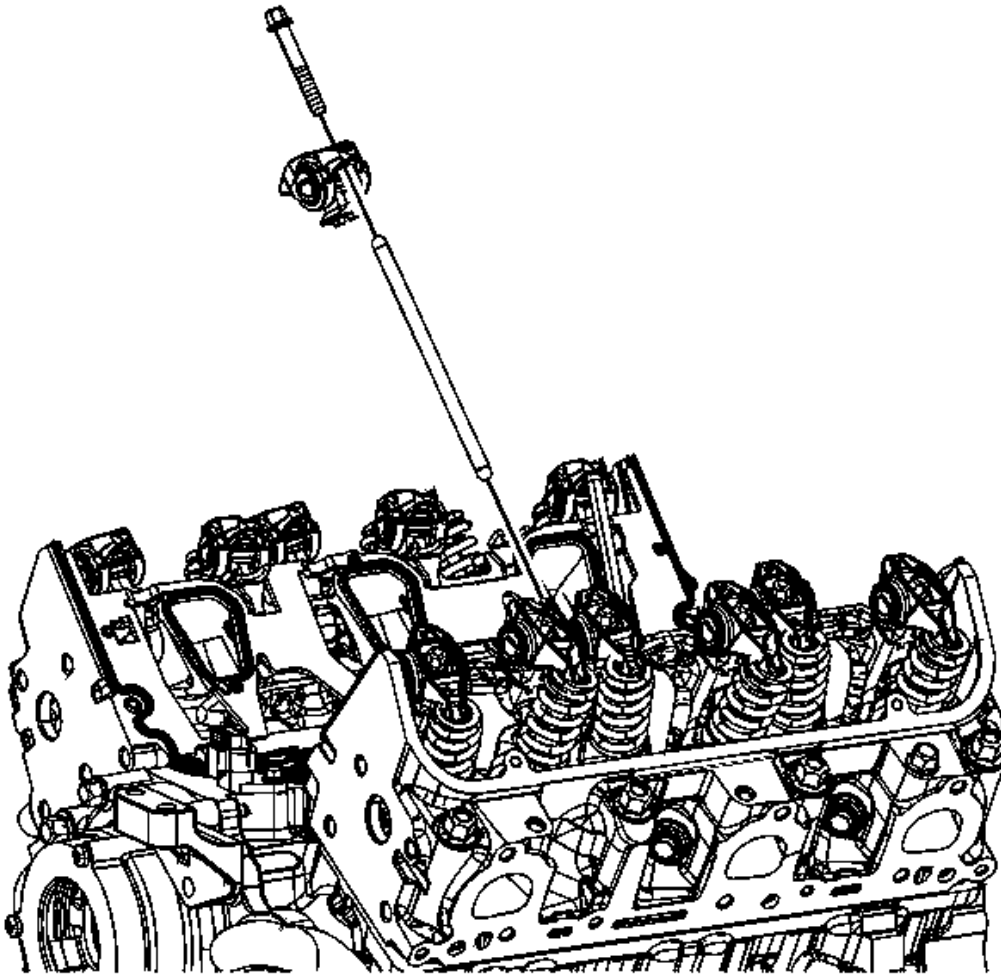


Fig. 106: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Coat the ends of the pushrods using prelube. Refer to Adhesives, Fluids, Lubricants, and Sealers .
2. Install the pushrods.
 - The intake push rods measure 147.51 mm (5.81 in).
 - The exhaust push rods measure 154.87 mm (6.1 in).
3. Ensure that the pushrods seat in the lifter bore.
4. Coat the rocker arm friction surfaces using prelube. Refer to Adhesives, Fluids, Lubricants, and Sealers .

NOTE: Shims (88894006) may be required under the valve rocker arm pedestals if

reconditioning has been performed on the cylinder head or its components.

5. Install the rocker arms.
6. Install the rocker arm bolts. Refer to **Valve Rocker Arm and Push Rod Installation** .
7. Install the valve rocker arm cover(s). Refer to **Valve Rocker Arm Cover Replacement - Left Side** or **Valve Rocker Arm Cover Replacement - Right Side**.

VALVE STEM OIL SEAL AND VALVE SPRING REPLACEMENT

TOOLS REQUIRED

- **EN-47823** Valve Spring Compressor Adapter. See **Special Tools** .
- **J 22794** Spark Plug Port Adapter. See **Special Tools** .
- **J 5892-D** Valve Spring Compressor. See **Special Tools** .

REMOVAL PROCEDURE

IMPORTANT:

- **Before removing the valve locks, rotate the engine so that the piston in the cylinder you are working on is at top dead center (TDC). This will eliminate the possibility of the valve accidentally falling inside the cylinder.**
- **Loosen the spark plug, and clean any dirt and/or debris from the spark plug recess area before removing.**

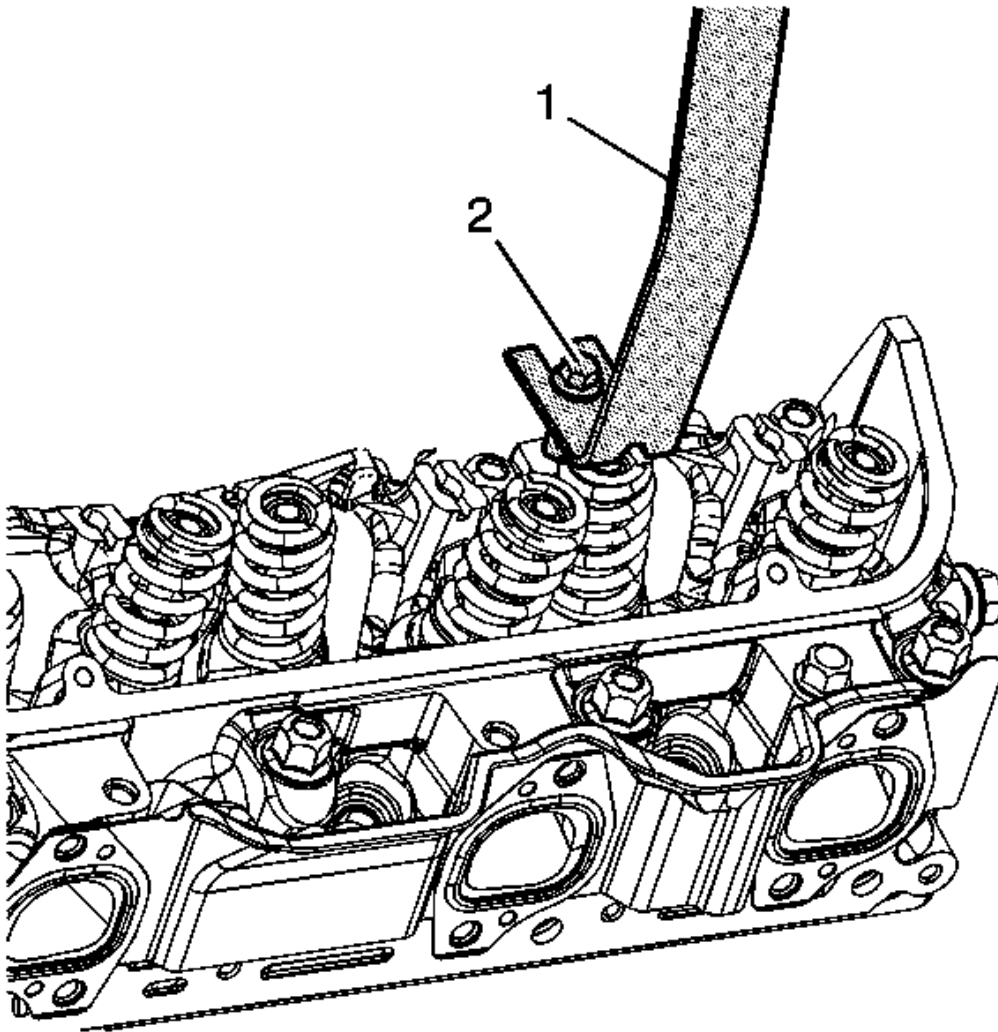


Fig. 107: Identifying Valve Spring Compressing Tools
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug. Refer to **Spark Plug Replacement**.
2. Remove the rocker arm. Refer to **Valve Rocker Arm and Push Rod Replacement**.
3. Install the **J 22794** into the spark plug port. Apply compressed air in order to hold the valve in place. See **Special Tools**.
4. Using caution so as not to damage the valve spring or valve spring dampener, compress the valve spring using the **J 5892-D** (1) and the **EN-47823** (2). See **Special Tools**.

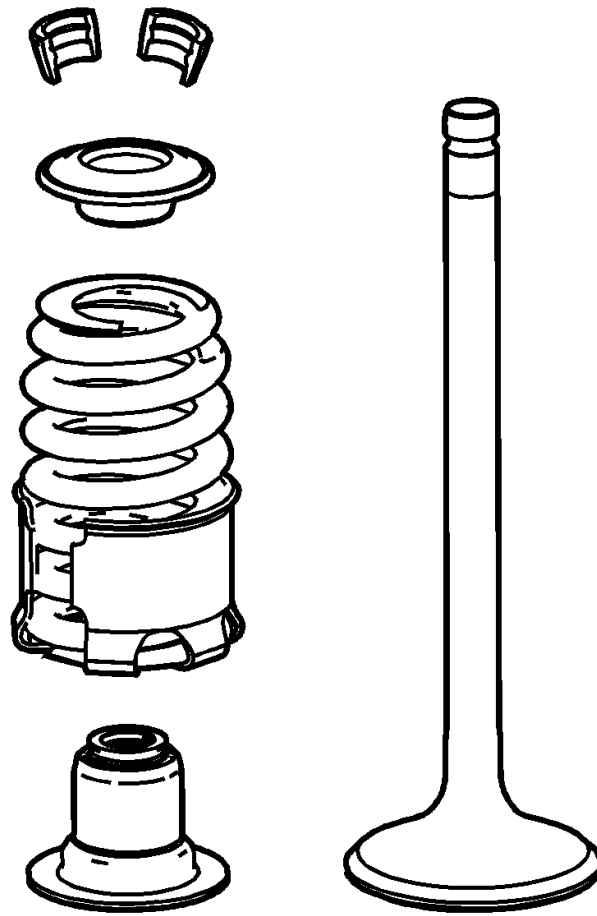


Fig. 108: Identifying Valve Components
Courtesy of GENERAL MOTORS CORP.

5. Remove the valve spring cap keys.
6. Remove the valve cap.
7. Remove the valve spring.
8. Remove the valve stem oil seal.

INSTALLATION PROCEDURE

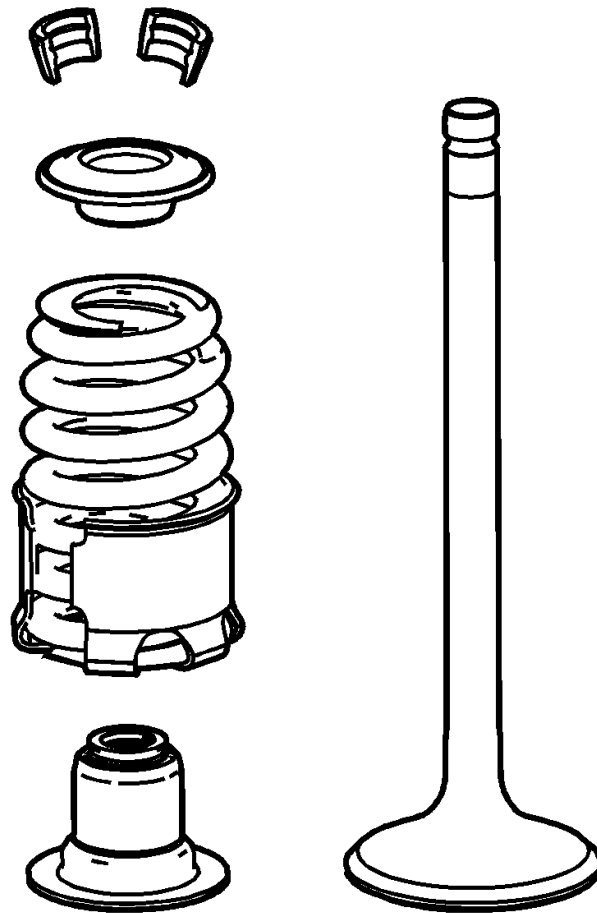


Fig. 109: Identifying Valve Components
 Courtesy of GENERAL MOTORS CORP.

1. Lubricate the valve stem with clean engine oil.
2. Install the valve stem oil seal, ensuring the proper seals (intake - black seal and exhaust - brown seal) are installed.
3. Install the valve spring.
4. Install the valve cap.

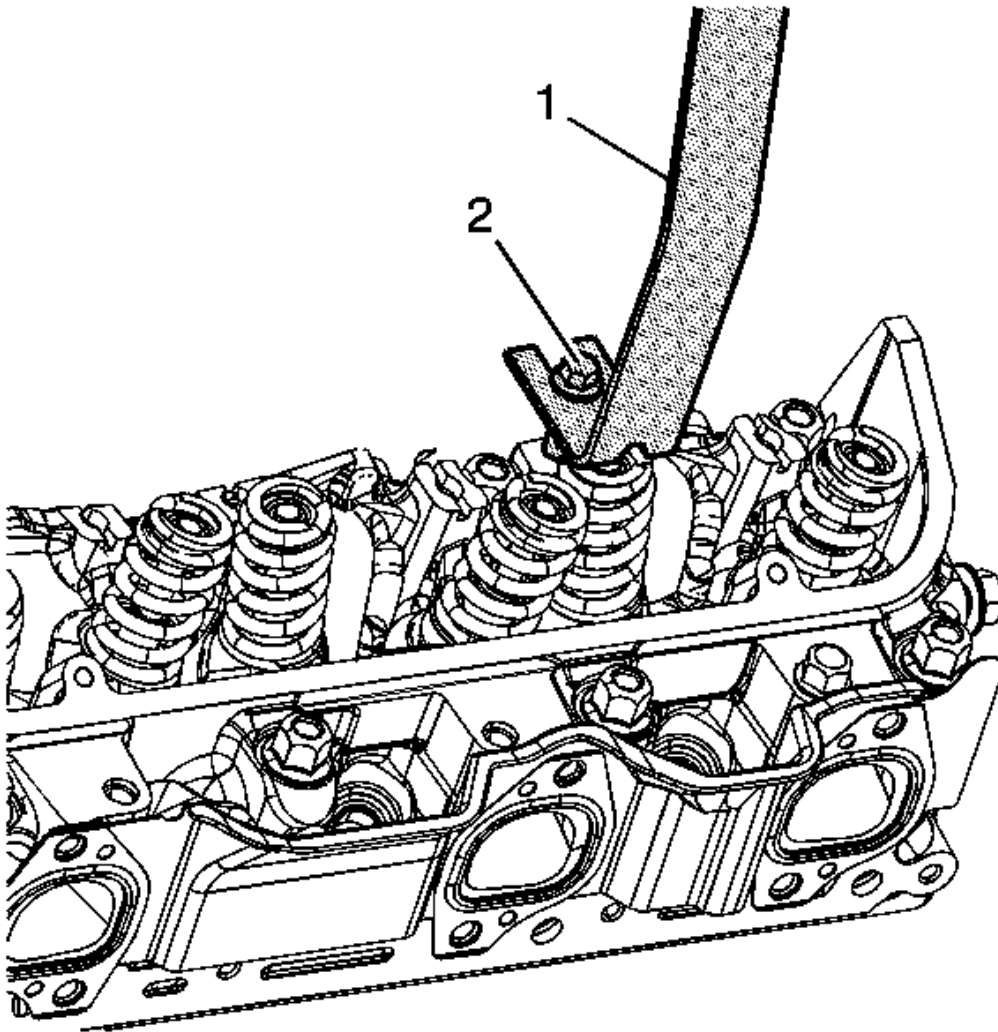


Fig. 110: Identifying Valve Spring Compressing Tools
Courtesy of GENERAL MOTORS CORP.

5. Using caution so as not to damage the valve spring or valve spring dampener, compress the valve spring using the **J 5892-D** (1) and the **EN-47823** (2). See **Special Tools** .
6. Install the valve cap keys. If necessary, use grease in order to hold the valve cap keys in place.
7. Ensure the valve cap keys are seated.
8. Remove the compressed air and remove the **J 22794** from the spark plug port. See **Special Tools** .
9. Install the rocker arm. Refer to **Valve Rocker Arm and Push Rod Replacement**.
10. Install the spark plug. Refer to **Spark Plug Replacement** .

VALVE LIFTER REPLACEMENT

REMOVAL PROCEDURE

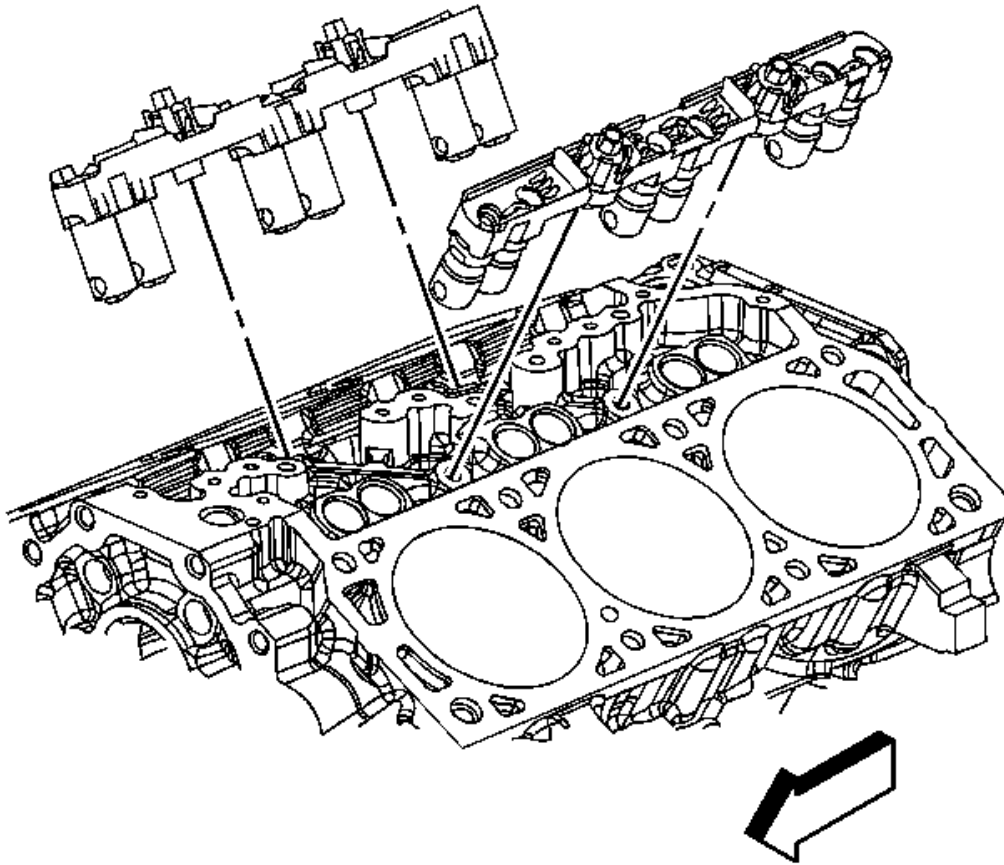


Fig. 111: Identifying Valve Lifter Guides
Courtesy of GENERAL MOTORS CORP.

1. Remove the lower intake manifold. Refer to **Lower Intake Manifold Replacement**.
2. Remove the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.

NOTE: The valve lifter guide bolts are not removable.

3. Loosen the valve lifter guide bolts.
4. Remove the valve lifter guides.

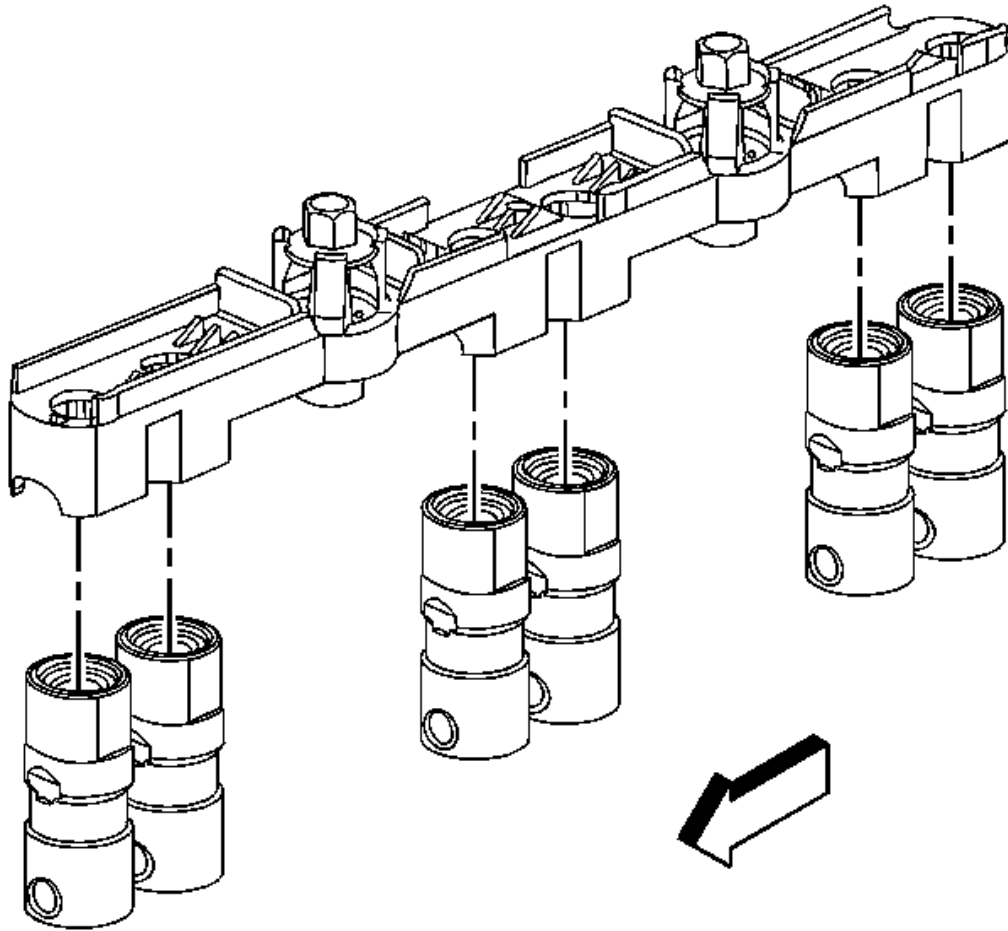


Fig. 112: Identifying Valve Lifters
Courtesy of GENERAL MOTORS CORP.

5. Remove the valve lifters from the valve lifter guides.
6. Clean all gasket surfaces with degreaser.

INSTALLATION PROCEDURE

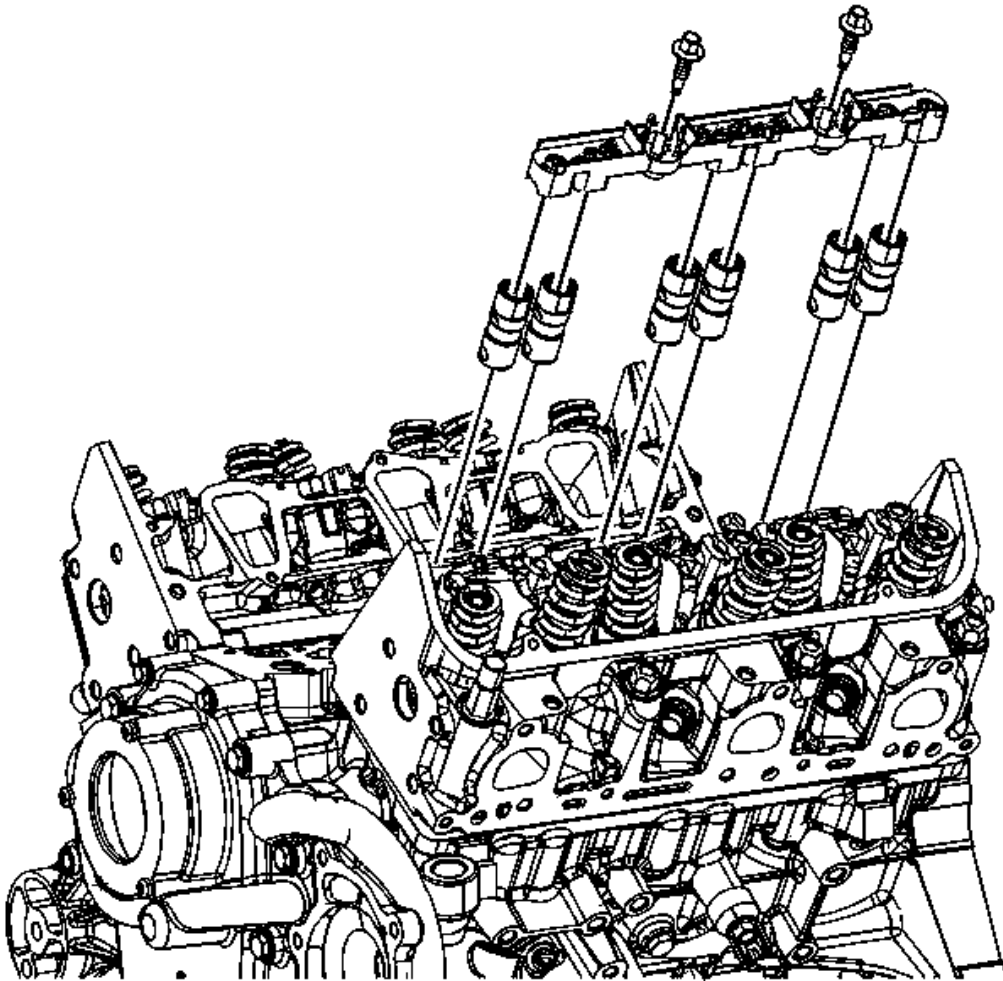


Fig. 113: View Of Valve Lifter Guides
Courtesy of GENERAL MOTORS CORP.

1. Coat the valve lifters using prelube. Refer to Adhesives, Fluids, Lubricants, and Sealers .
2. Install the valve lifters to the cylinder bores.
3. Apply threadlock to the valve lifter guide bolt threads. Refer to Adhesives, Fluids, Lubricants, and Sealers .
4. Install the valve lifter guides.

CAUTION: Refer to Fastener Caution .

5. Tighten the valve lifter guide bolts.

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

6. Install the valve rocker arms and pushrods. Refer to Valve Rocker Arm and Push Rod Replacement.
7. Install the lower intake manifold. Refer to Lower Intake Manifold Replacement.

CRANKSHAFT BALANCER REPLACEMENT

SPECIAL TOOLS

- **EN 46359** Puller End Protector. See Special Tools .
- **J 29113** Balancer and Crank Sprocket Installer. See Special Tools .
- **J 37096** Flywheel Holder. See Special Tools .
- **J 41816** Harmonic Balancer Remover. See Special Tools .
- **J 45059** Angle Meter

REMOVAL PROCEDURE

CAUTION: The inertial weight section of the crankshaft balancer is assembled to the hub with a rubber type material. The correct installation procedures (with the proper tool) must be followed or movement of the inertial weight section of the hub will destroy the tuning of the crankshaft balancer.

1. Remove the drive belt. Refer to Drive Belt Replacement.
2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
3. Remove the right front tire and wheel. Refer to Tire and Wheel Removal and Installation .
4. Remove the right engine splash shield. Refer to Engine Splash Shield Replacement (Right) or Engine Splash Shield Replacement (Left) .
5. Install adjustable jack stands under the frame.
6. Loosen the left side frame bolts and remove the right side frame bolts.
7. Using the jack stands, lower the right side of the frame in order to access the crankshaft balancer.
8. Remove the torque converter covers.
9. Install the **J 37096** to the flywheel in order to prevent flywheel rotation. See Special Tools .

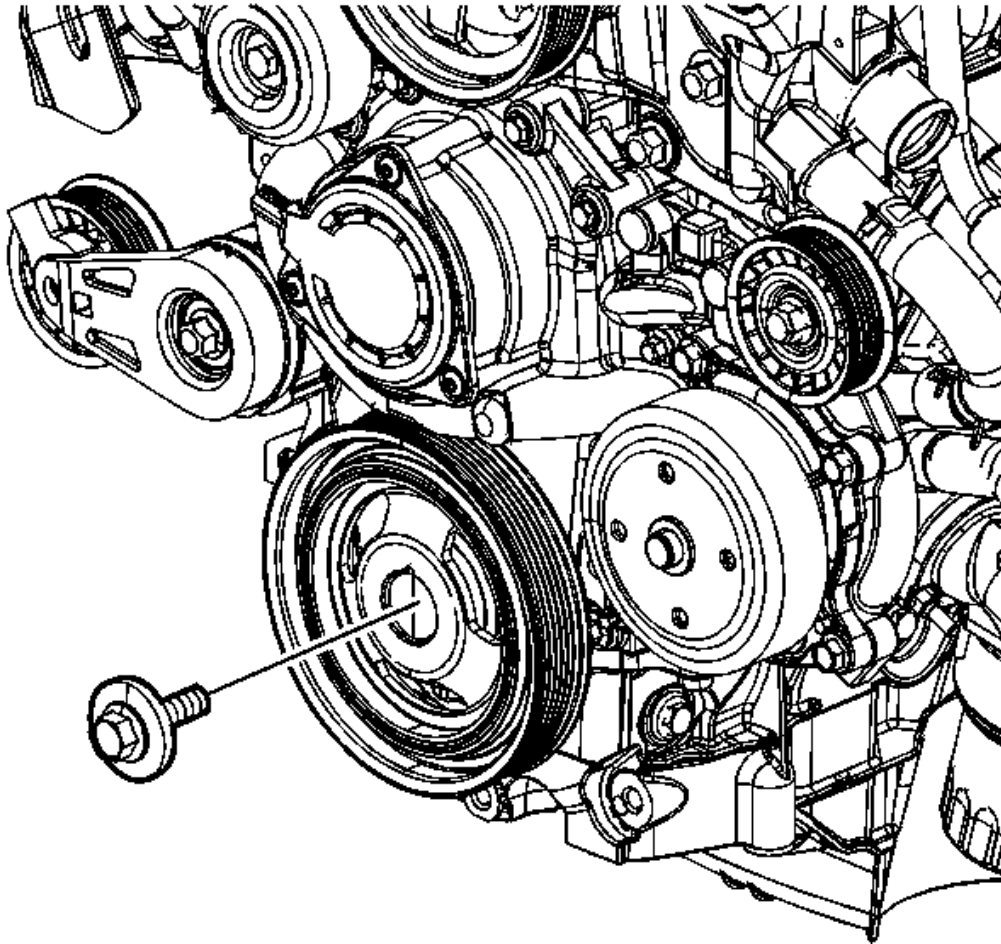


Fig. 114: Identifying Crankshaft Balancer Bolt & Washer
Courtesy of GENERAL MOTORS CORP.

10. Remove the crankshaft balancer bolt and the washer.

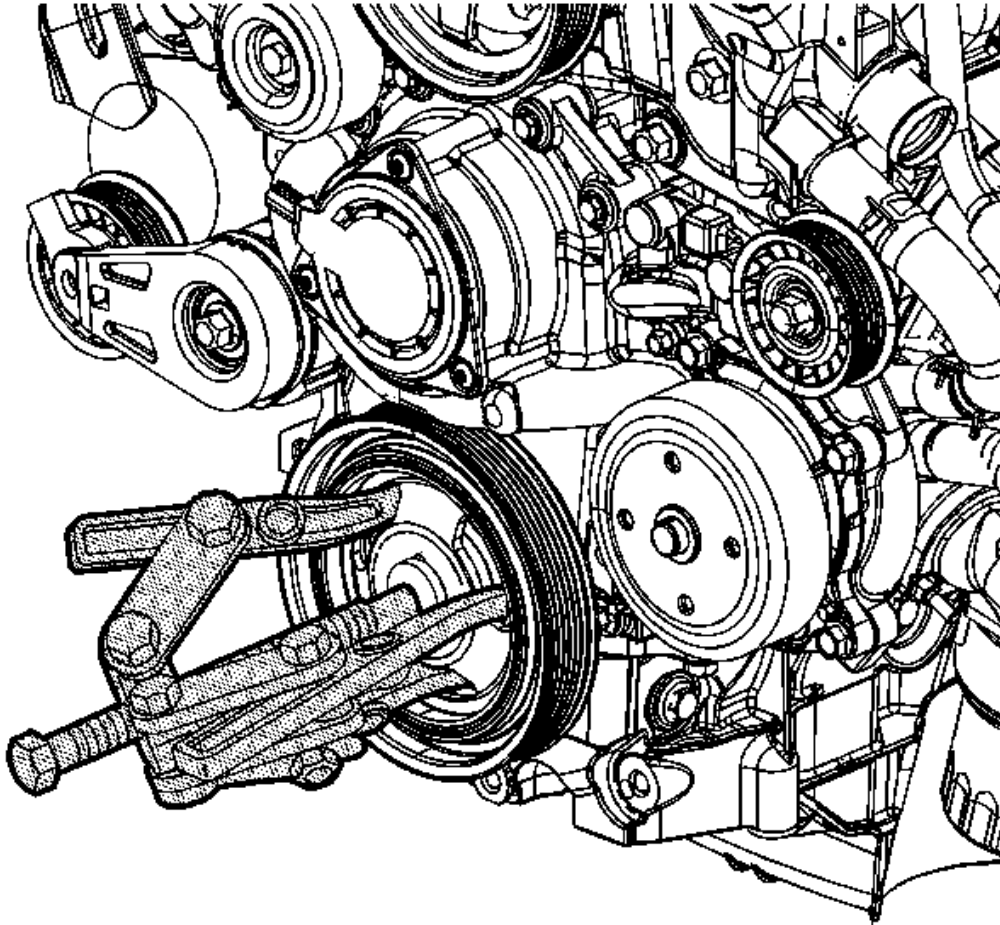


Fig. 115: Identifying Crankshaft Balancer Removing Tool J 41816
Courtesy of GENERAL MOTORS CORP.

CAUTION: Do NOT use a power-assisted tool with the special tool in order to remove or install this component. You cannot properly control the alignment of this component using a power-assisted tool, and this can damage the component.

11. Remove the crankshaft balancer using the J 41816 and EN 46359 . See Special Tools .

INSTALLATION PROCEDURE

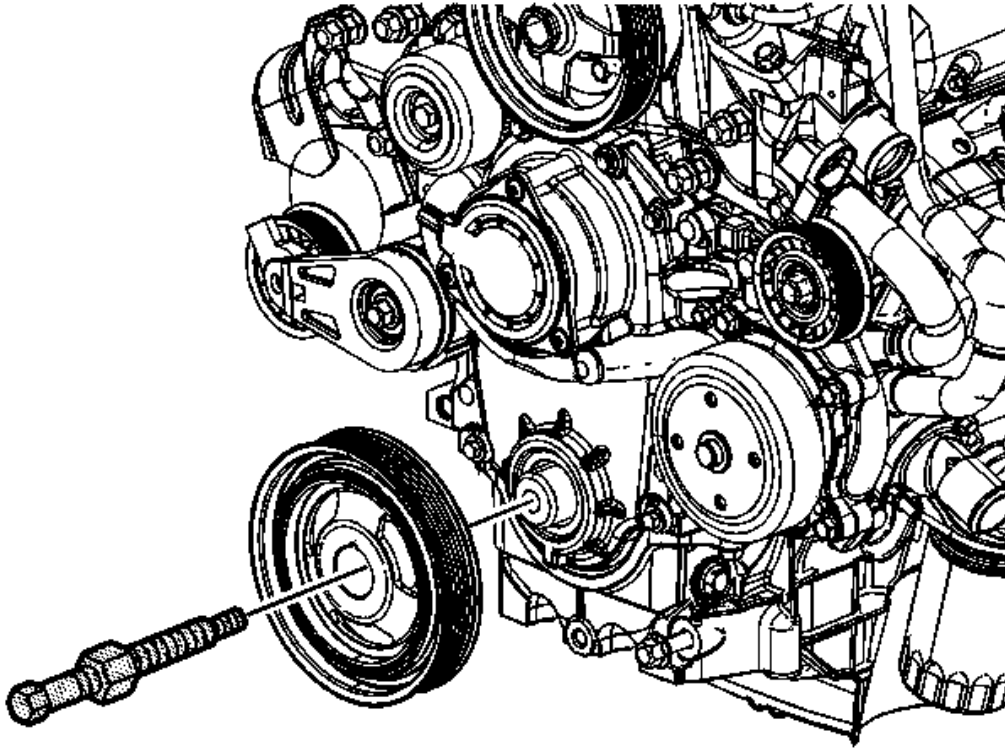


Fig. 116: View Of Balancer & Crank Sprocket Puller (J 29113)
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer to the keyway of the crankshaft balancer. Refer to Adhesives, Fluids, Lubricants, and Sealers .
2. Place the crankshaft balancer into position over the key in the crankshaft.

CAUTION: Do NOT use a power-assisted tool with the special tool in order to remove or install this component. You cannot properly control the alignment of this component using a power-assisted tool, and this can damage the component.

3. Thread the **J 29113** into the crankshaft. See Special Tools .
4. Rotate the hex nut on the **J 29113** in order to install the crankshaft balancer onto the crankshaft. See Special Tools .
5. Remove the **J 29113** from the crankshaft. See Special Tools .

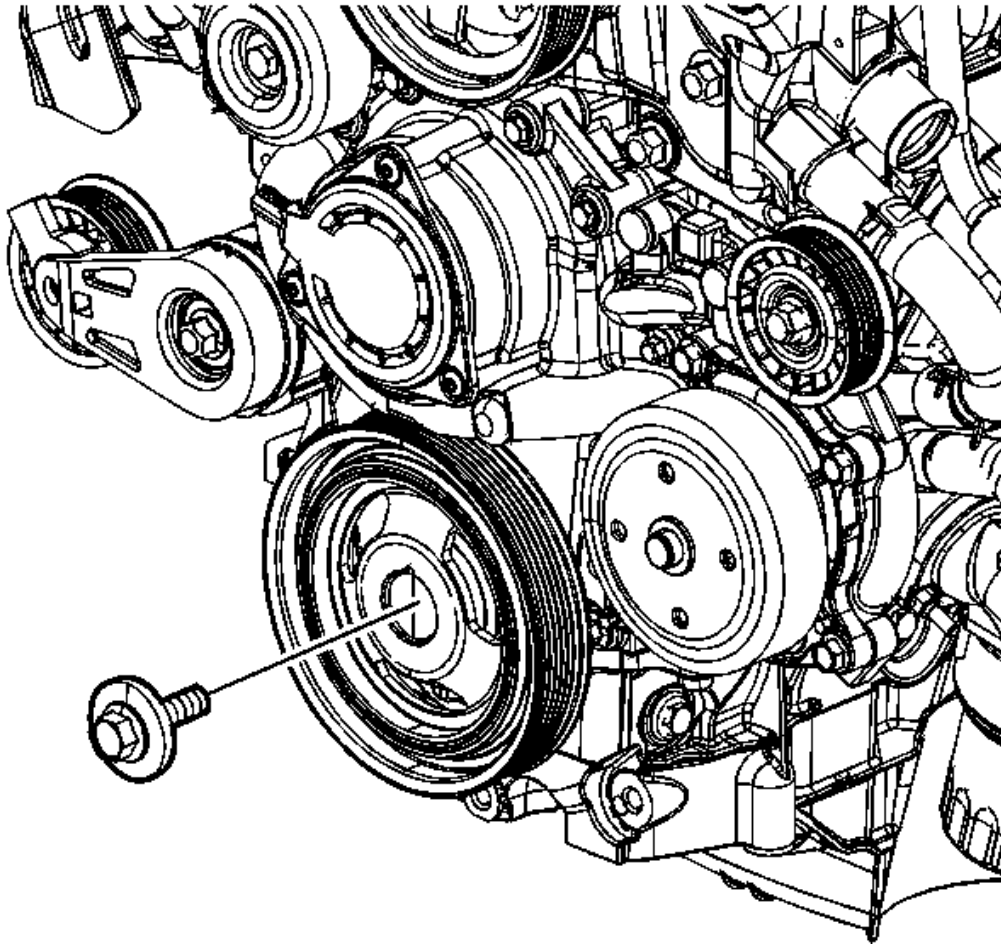


Fig. 117: Identifying Crankshaft Balancer Bolt & Washer
Courtesy of GENERAL MOTORS CORP.

6. Install the crankshaft balancer washer and the bolt.

CAUTION: Refer to Fastener Caution .

7. Install the used crankshaft balancer bolt.

Tighten: Tighten the used crankshaft balancer bolt to 125 N.m (92 lb ft).

8. Remove the used crankshaft balancer bolt.

9. Install the NEW crankshaft balancer bolt.

Tighten:

1. Tighten the crankshaft balancer bolt a first pass to 125 N.m (92 lb ft).
 2. Tighten the crankshaft balancer bolt a final pass to 130 degrees using the **J 45059** .
10. Remove the **J 37096** from the flywheel. See **Special Tools** .
 11. Install the torque converter covers.
 12. Raise the frame into the original position.
 13. Install and tighten the right and left side frame bolts.
- Tighten:** Tighten the bolts to 100 N.m (74 lb ft) plus an additional 90 degrees using the **J 45059** .
14. Install the right engine splash shield. Refer to **Engine Splash Shield Replacement (Right)** or **Engine Splash Shield Replacement (Left)** .
 15. Install the right front tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
 16. Lower the vehicle.
 17. Install the drive belt. Refer to **Drive Belt Replacement**.

OIL PAN REPLACEMENT

SPECIAL TOOLS

J 39505 Torque Wrench Adapter. See **Special Tools** .

REMOVAL PROCEDURE

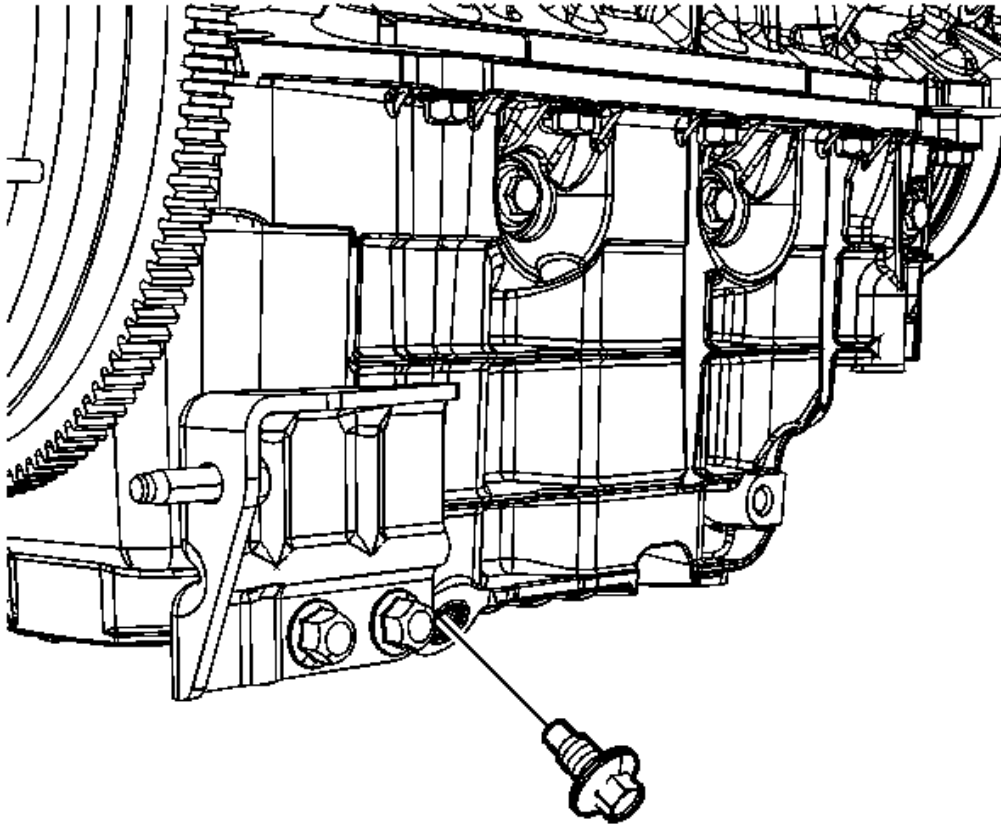


Fig. 118: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (LGD/LZE)** .
2. Remove the engine mount struts. Refer to **Engine Mount Strut Replacement**.
3. Install the engine support fixture. Refer to **Engine Support Fixture**.
4. Remove the catalytic converter. Refer to **Catalytic Converter Replacement (LGD/LZE)** .
5. Remove the oil pan drain plug.
6. Drain the crankcase.
7. Reinstall the oil pan drain plug.
8. Remove the oil filter adapter. Refer to **Oil Filter Adapter and Bypass Valve Assembly Replacement**.
9. Remove the starter. Refer to **Starter Replacement (LGD/LZE)** .

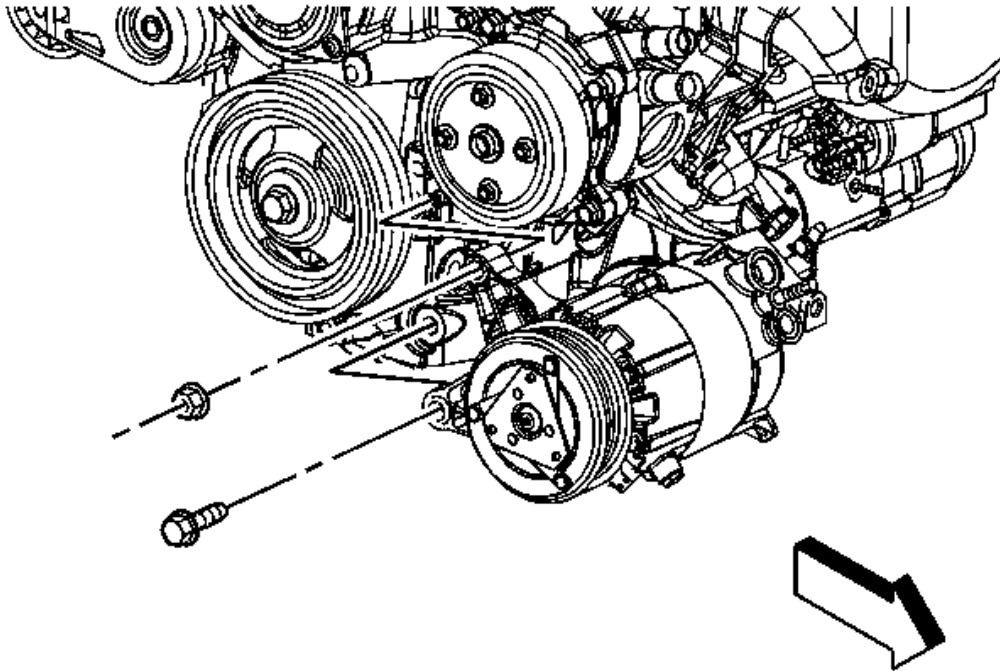


Fig. 119: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

10. Remove the air conditioning (A/C) compressor nut and bolt.

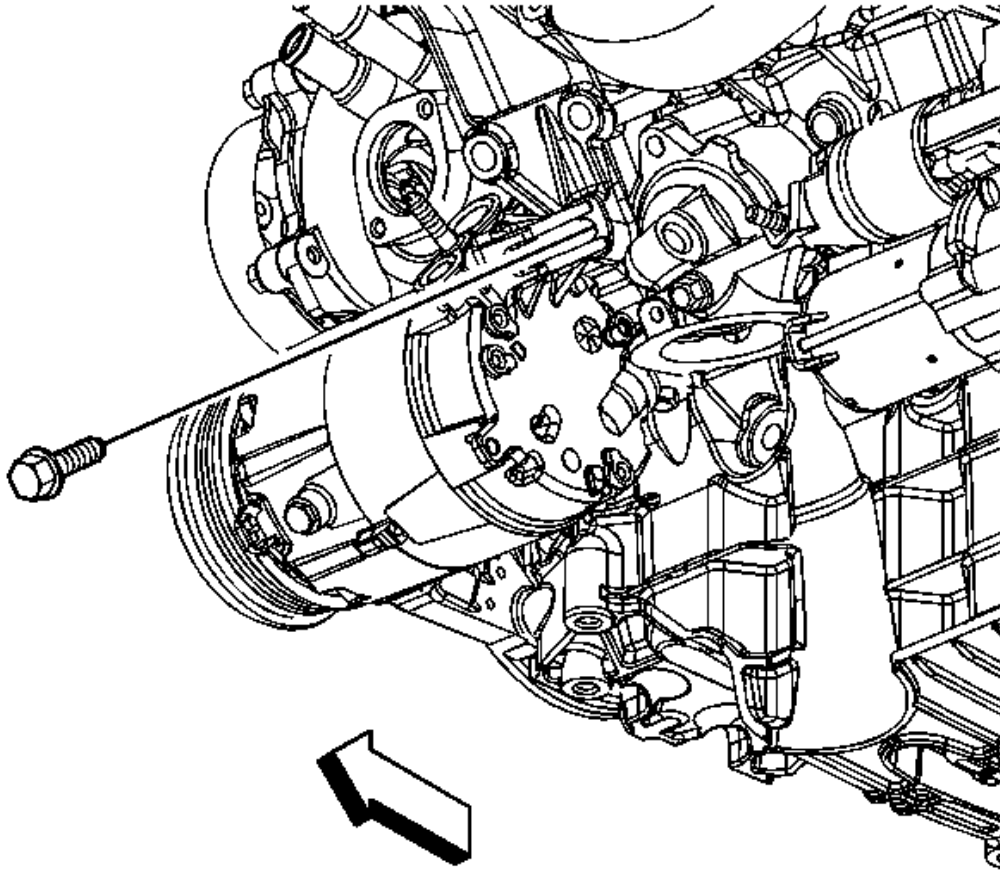


Fig. 120: A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

11. Remove the A/C compressor rear bolt and position the compressor aside.

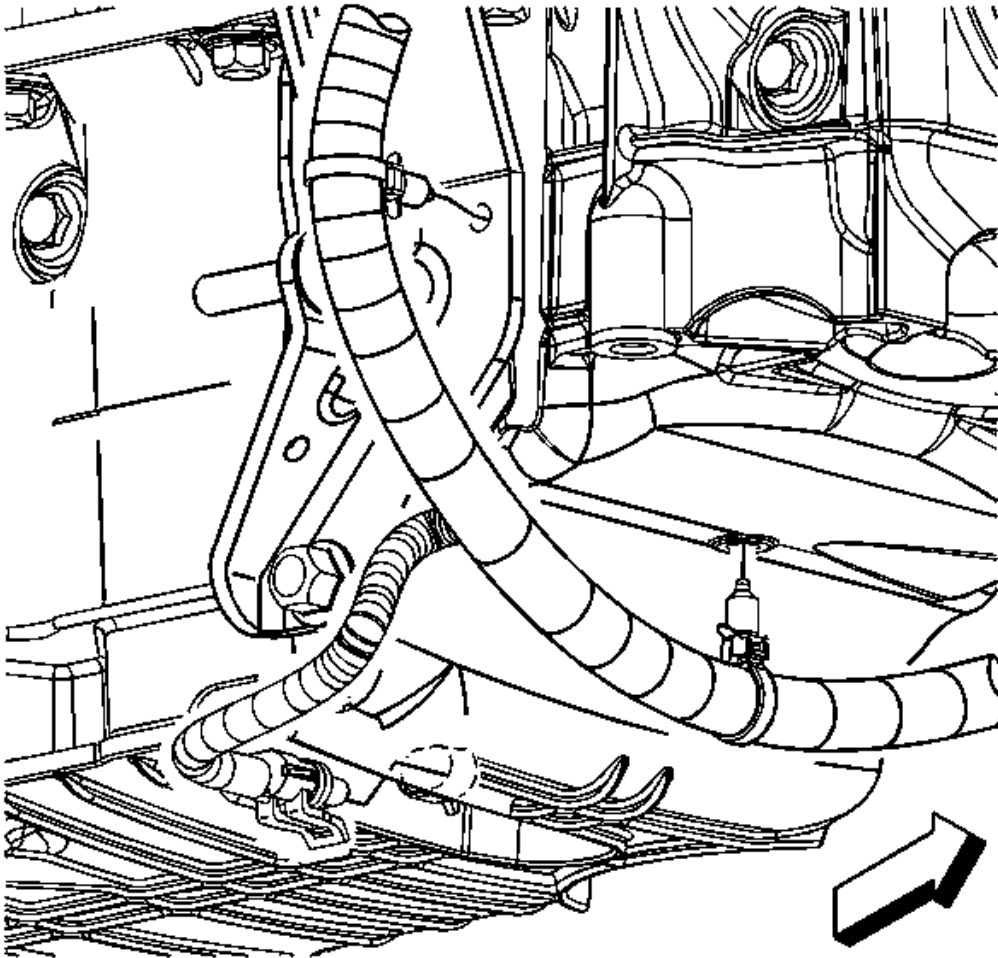


Fig. 121: Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

12. Disconnect the oil level sensor electrical connector.
13. Remove the engine harness clips from the oil pan and the transaxle brace.

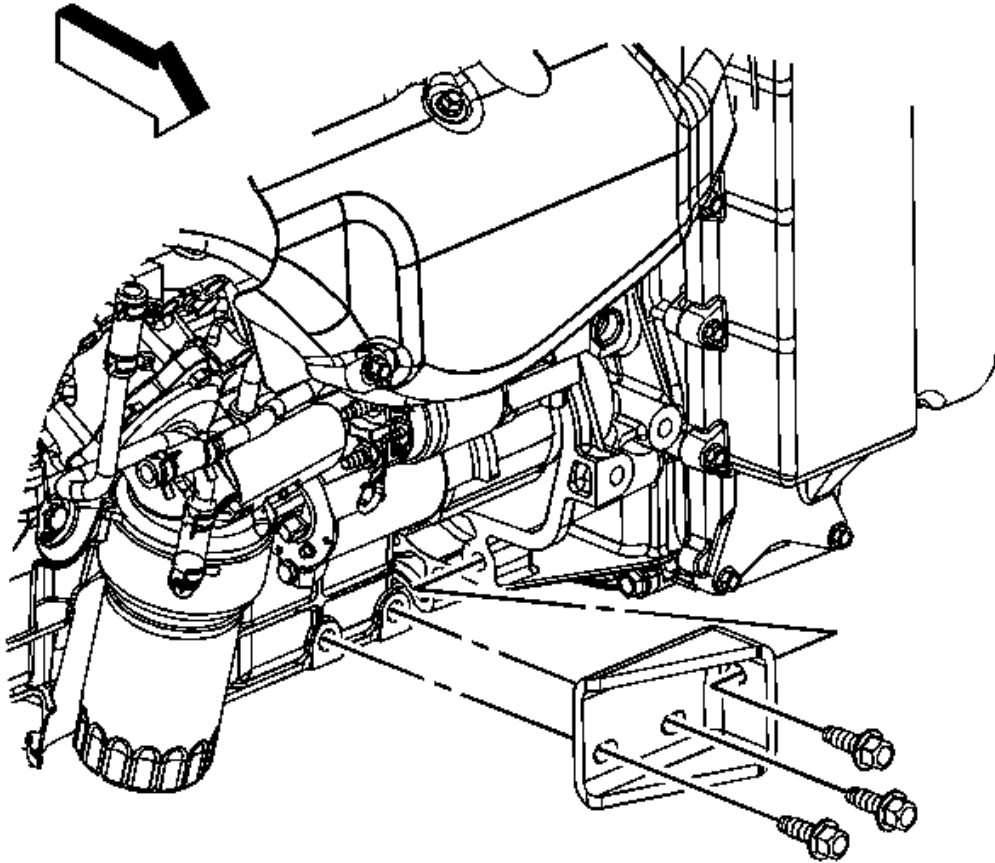


Fig. 122: View Of Front Transaxle Brace & Engine Bolts
Courtesy of GENERAL MOTORS CORP.

14. Remove the front transaxle brace to engine bolts and the brace.

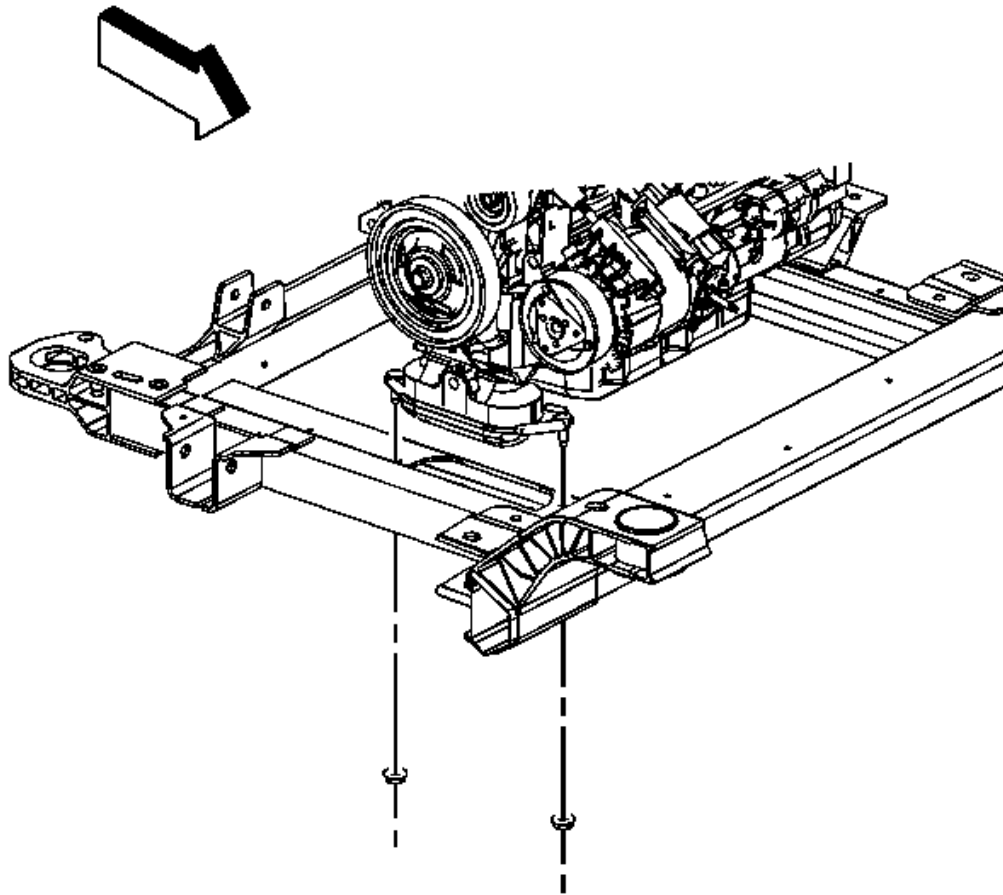


Fig. 123: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

15. Remove the engine mount lower nuts.
16. Loosen the transaxle mount lower nuts. Refer to **Transmission Mount Replacement - Left Side** .

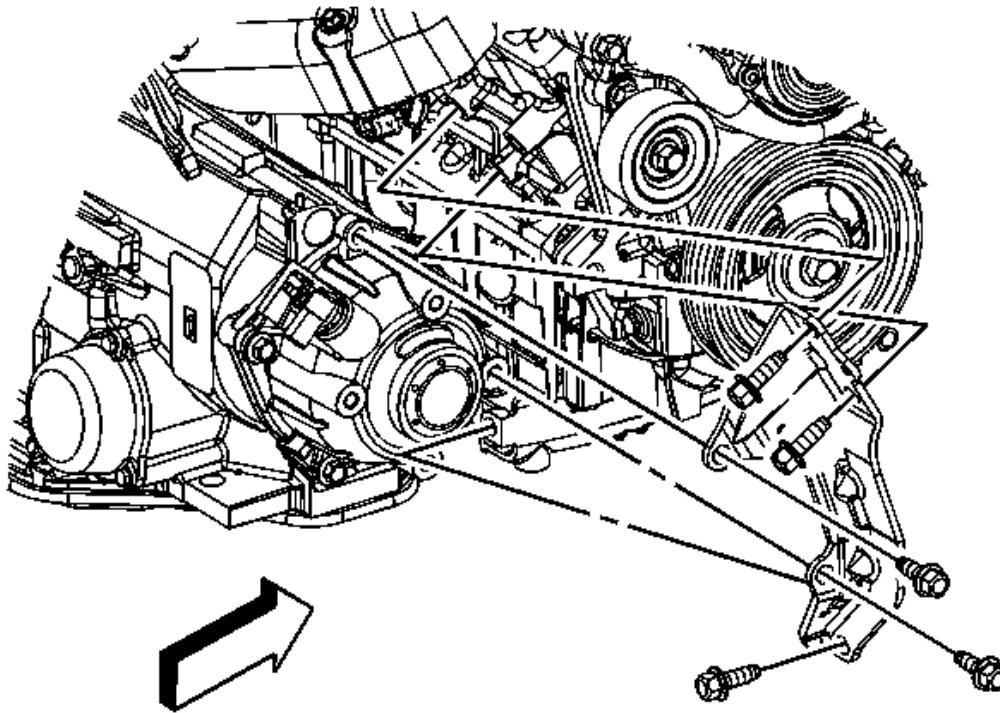


Fig. 124: Locating Rear Transaxle Brace To Engine/Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

17. Remove the rear transaxle brace to engine/oil pan bolts.
18. Lower the vehicle.
19. Using the engine support fixture, raise the engine.
20. Raise the engine.
21. Remove the steering shaft intermediate pinch bolt. Refer to **Intermediate Steering Shaft Replacement** .

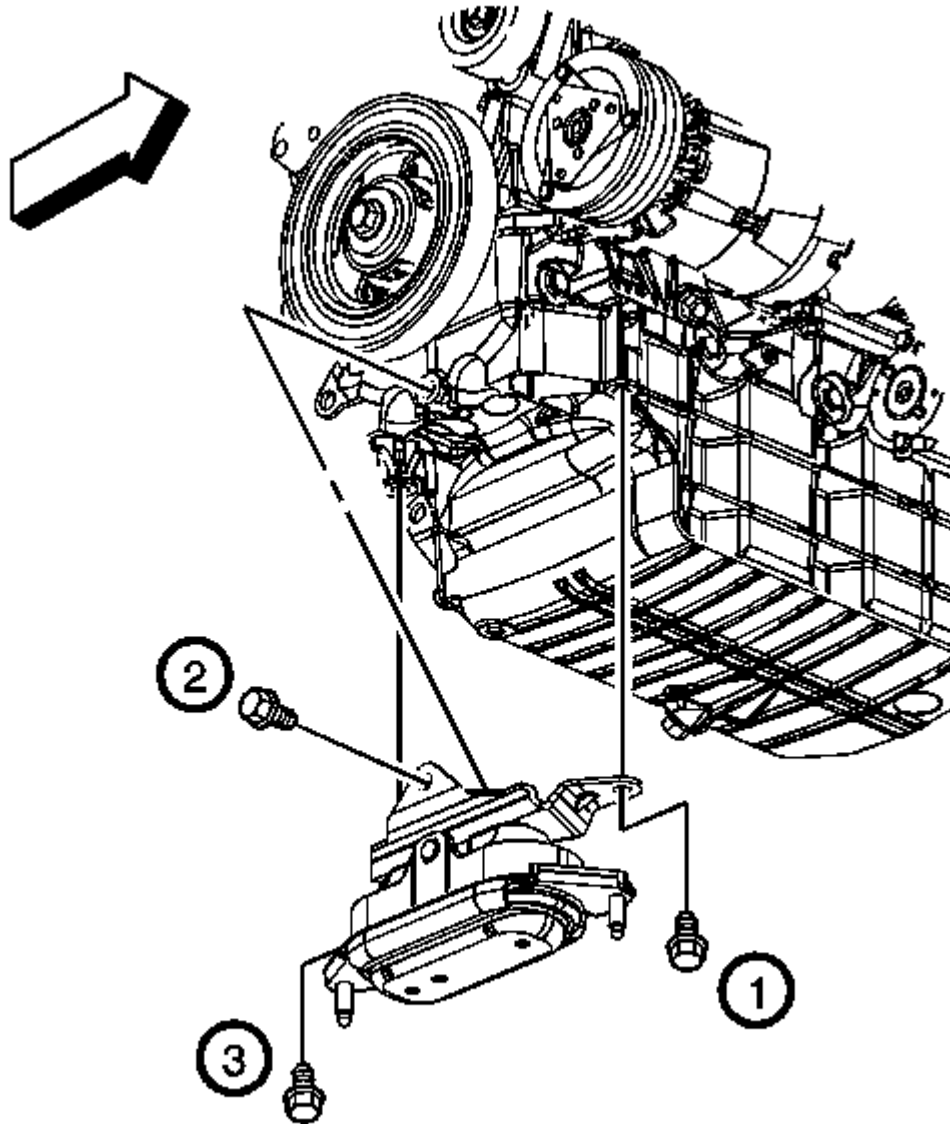


Fig. 125: Locating Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

22. Remove the engine mount bracket bolts.
23. Remove the engine mount and bracket.
24. Remove the right side lower ball joint from the steering knuckle. Refer to **Lower Control Arm Ball Joint Replacement**.

25. Remove the right side outer tie rod from the steering knuckle. Refer to **Steering Linkage Outer Tie Rod Replacement** .
26. Remove the right side stabilizer link. Refer to **Stabilizer Shaft Link Replacement** .
27. Install the jackstands to the frame.
28. Remove the right side frame bolts and loosen the left side frame bolts. Refer to **Frame Replacement** .
29. Using the jackstands lower the right side of the frame.

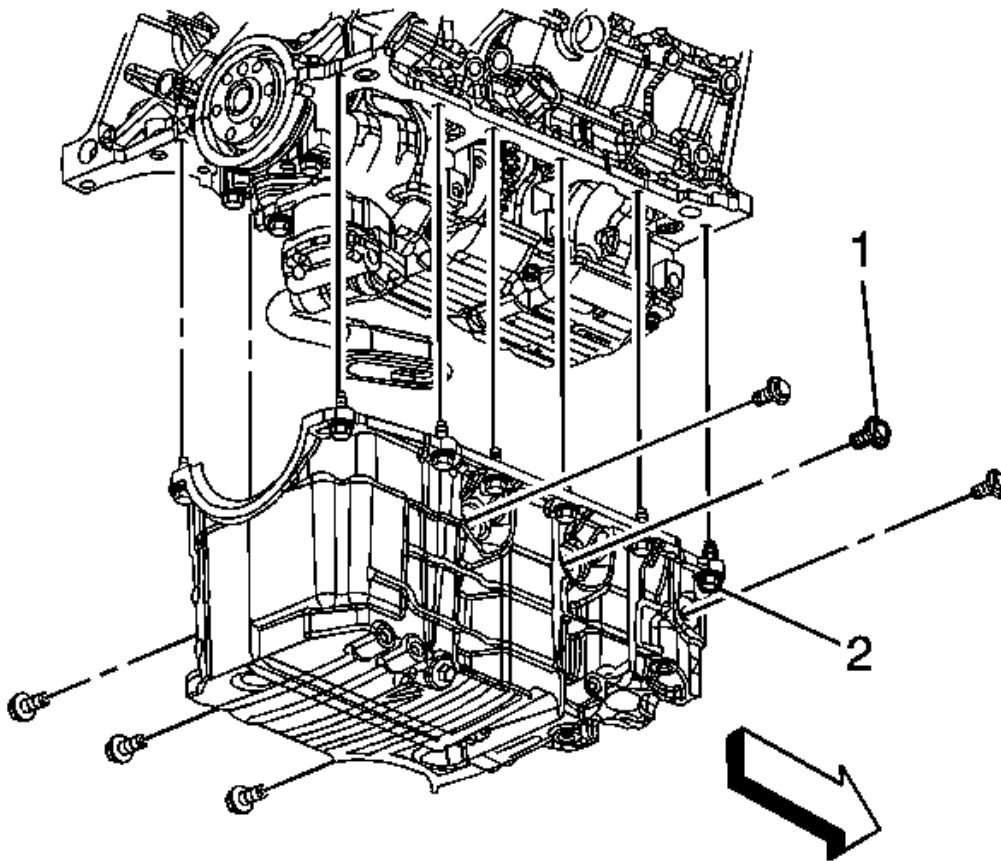


Fig. 126: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

30. Using the **J 39505** , remove the right side oil pan side bolts. See **Special Tools** .
31. Remove the left side oil pan side bolts (1).
32. Remove the oil pan bolts (2).
33. Remove the oil pan.

34. Remove the oil pan gasket.
35. Clean the following items:
 - The oil pan flanges
 - The oil pan rail
 - The front cover
 - The rear main bearing cap
 - The threaded holes

INSTALLATION PROCEDURE

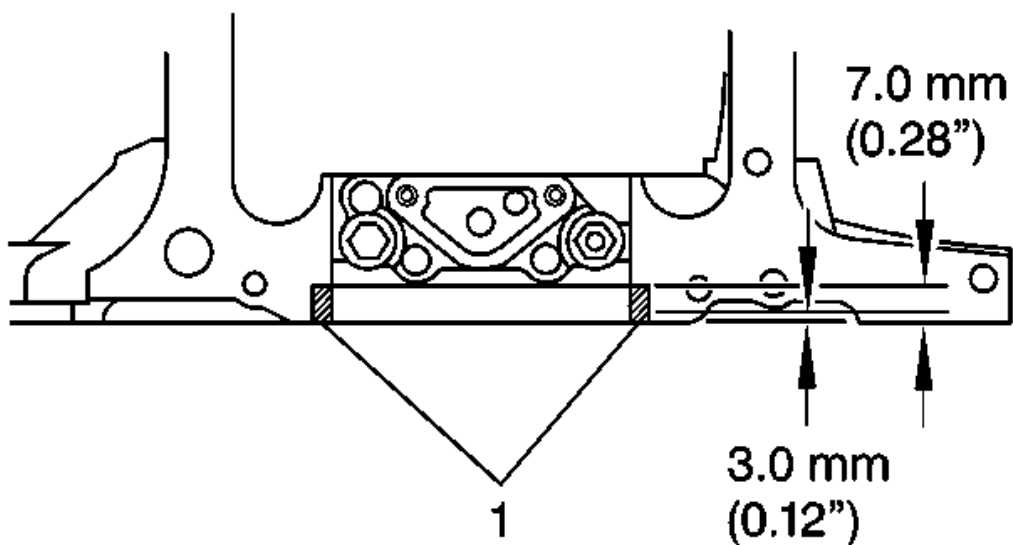


Fig. 127: Crankshaft Rear Main Bearing Cap
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer to both sides of the crankshaft rear main bearing cap (1). Refer to **Adhesives, Fluids, Lubricants, and Sealers** . Press the sealer into the gap using a putty knife.

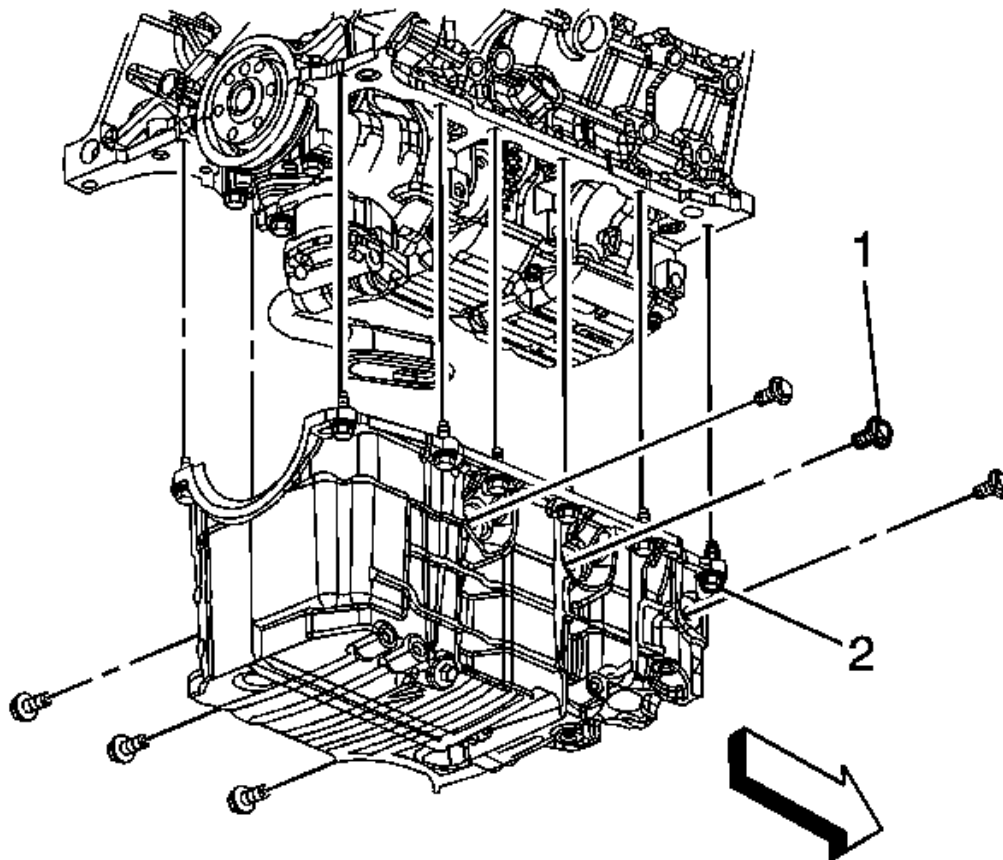


Fig. 128: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install a NEW oil pan gasket.
3. Position the oil pan to the engine.

CAUTION: Refer to Fastener Caution .

4. Install the oil pan bolts (2).

Tighten: Tighten the bolts to 25 N.m (18 lb ft).

5. Install the left side oil pan side bolts (1).
6. Using the **J 39505** , install the right side oil pan side bolts. See Special Tools .

Tighten: Tighten the bolts to 50 N.m (37 lb ft) + 50 degrees.

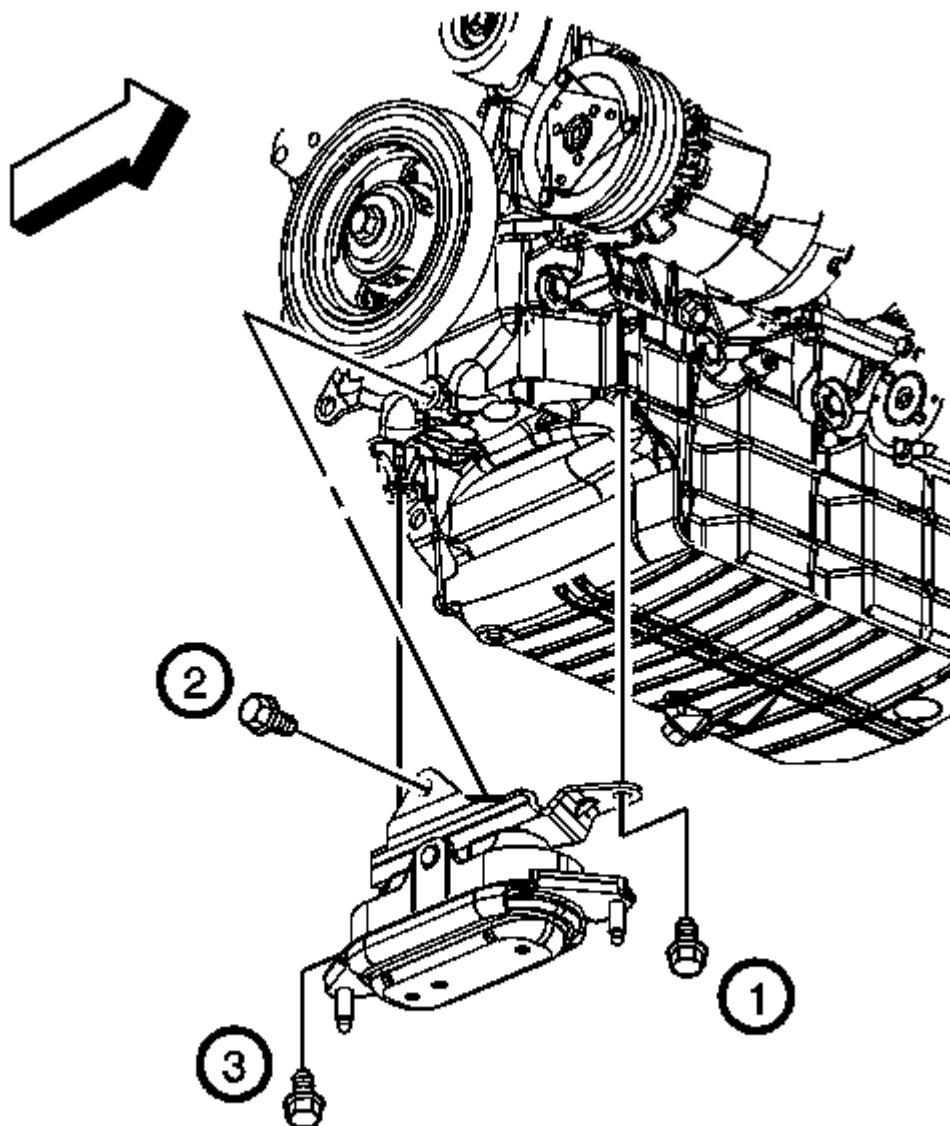


Fig. 129: Locating Engine Mount Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

7. Using the jackstands raise the right side of the frame to the original position.
8. Install the right side frame bolts and tighten the left and right side frame bolts. Refer to **Frame Replacement**.

9. Remove the jackstands from under the frame.
10. Install the right side stabilizer link. Refer to **Stabilizer Shaft Link Replacement** .
11. Install the right side outer tie rod to the steering knuckle. Refer to **Steering Linkage Outer Tie Rod Replacement** .
12. Install the right side lower ball joint to the steering knuckle. Refer to **Lower Control Arm Ball Joint Replacement** .
13. Position the engine mount and bracket to the oil pan.
14. Install the engine mount bracket bolts.

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

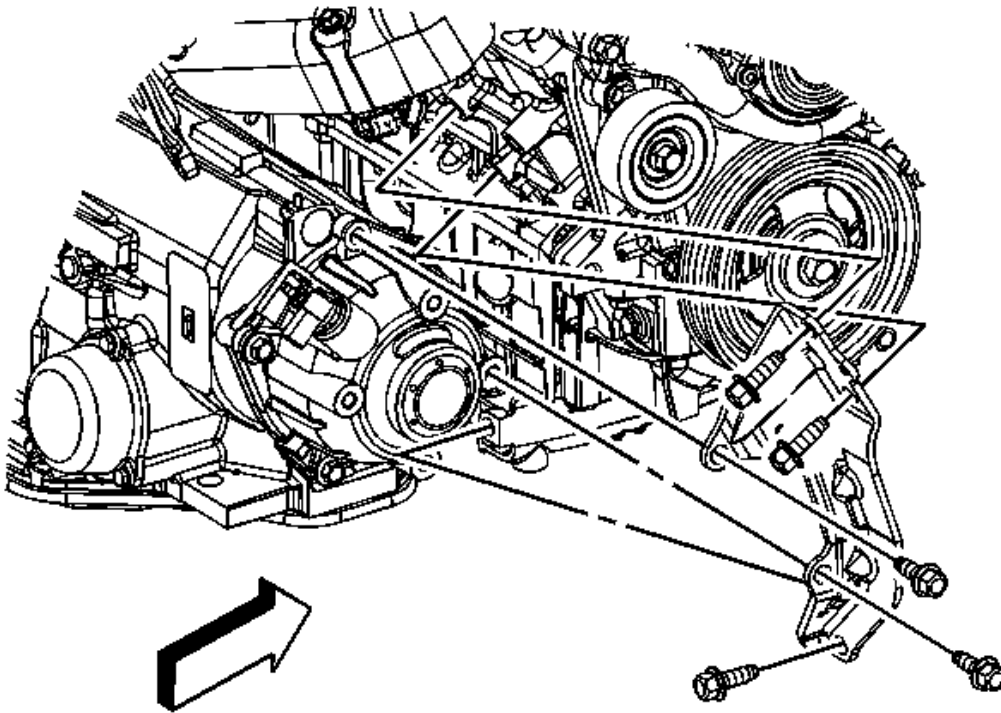


Fig. 130: Locating Rear Transaxle Brace To Engine/Oil Pan Bolts
 Courtesy of GENERAL MOTORS CORP.

15. Install the steering shaft intermediate pinch bolt. Refer to **Intermediate Steering Shaft Replacement** .
16. Lower the vehicle.
17. Using the engine support fixture, lower the engine.
18. Raise the vehicle.

19. Install the rear transaxle brace to engine/oil pan bolts.

Tighten: Tighten the bolts to 63 N.m (46 lb ft).

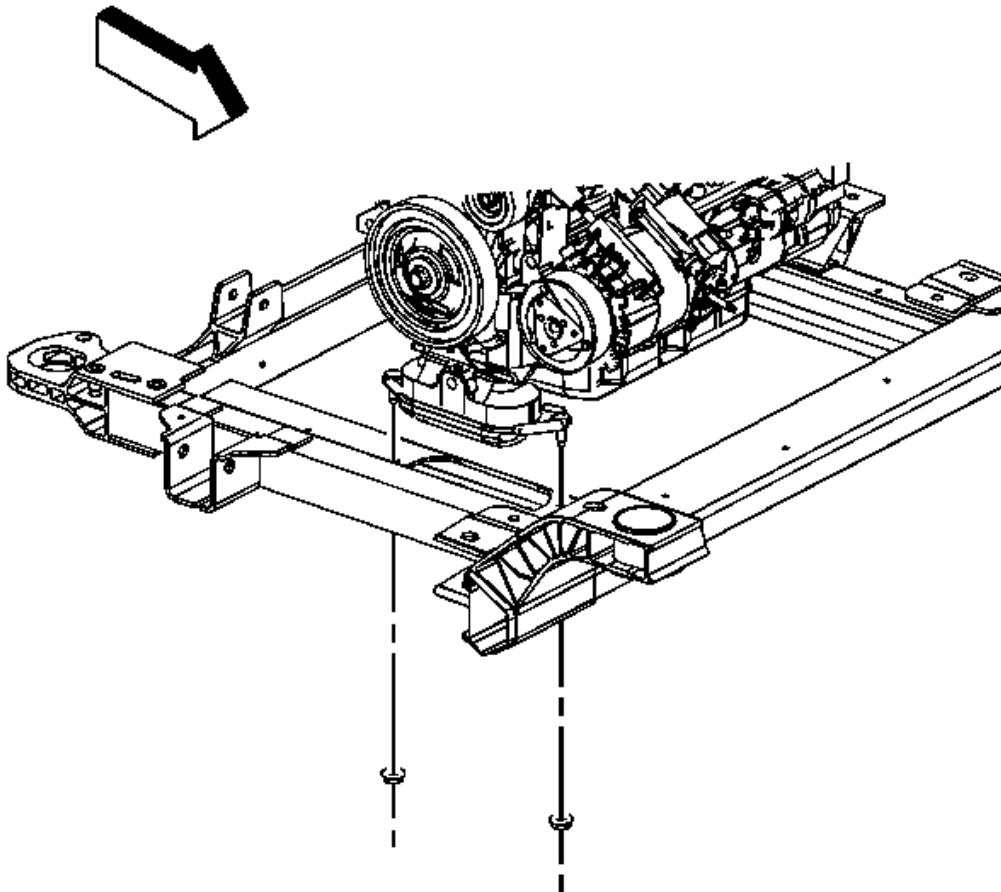


Fig. 131: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

20. Install the engine mount lower nuts.

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

21. Tighten the transaxle mount lower nuts. Refer to Transmission Mount Replacement - Left Side .

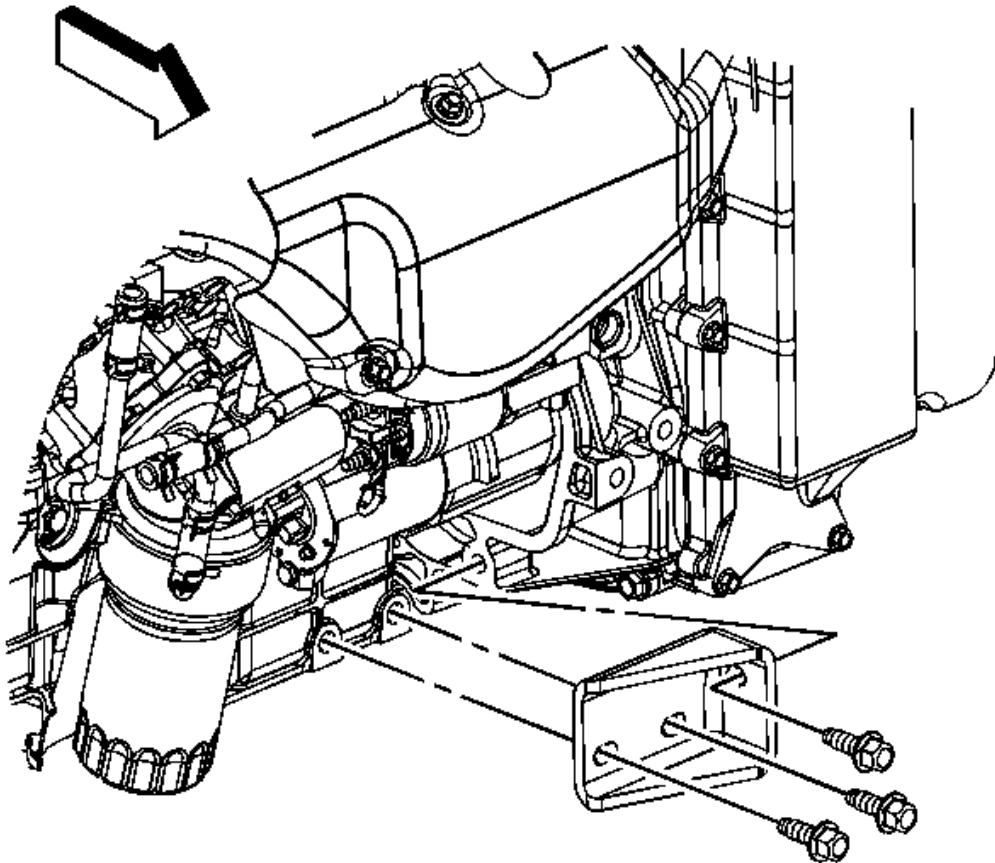


Fig. 132: View Of Front Transaxle Brace & Engine Bolts
 Courtesy of GENERAL MOTORS CORP.

22. Install the front transaxle brace and the brace to engine bolts.

Tighten: Tighten the bolts to 63 N.m (46 lb ft).

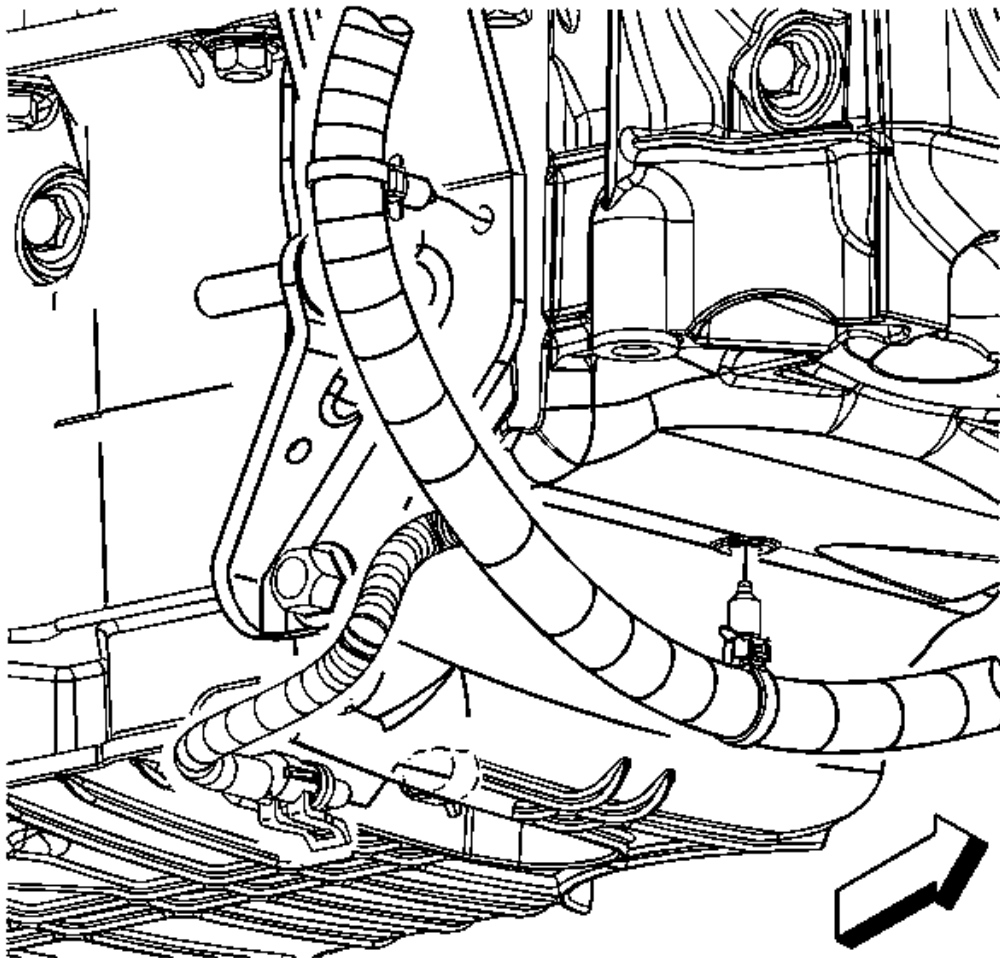


Fig. 133: Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

23. Connect the oil level sensor electrical connector.
24. Install the engine harness clips to the oil pan and the transaxle brace.

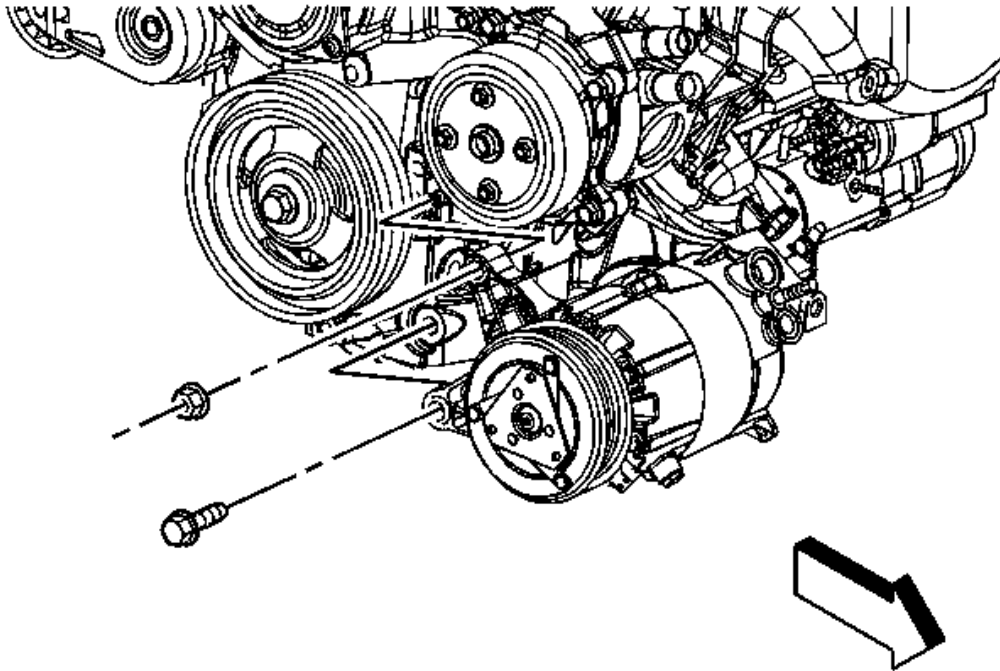


Fig. 134: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

25. Position the A/C compressor, and install the A/C compressor nut and bolt.

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

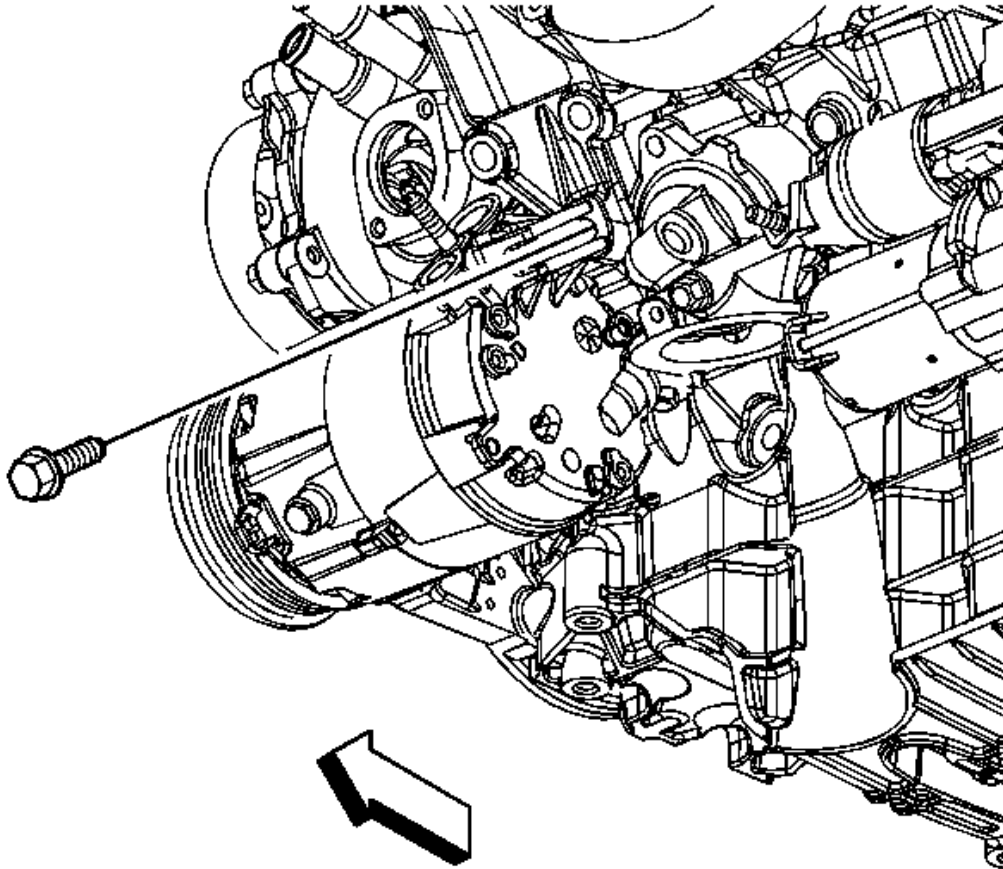


Fig. 135: A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

26. Install the A/C compressor rear bolt.

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

27. Install the starter. Refer to **Starter Replacement (LGD/LZE)** .
28. Install the oil filter adapter. Refer to **Oil Filter Adapter and Bypass Valve Assembly Replacement**.
29. Install the catalytic converter. Refer to **Catalytic Converter Replacement (LGD/LZE)** .
30. Lower the vehicle.
31. Remove the engine support fixture.
32. Install the engine mount struts. Refer to **Engine Mount Strut Replacement**.
33. Fill the crankcase with new engine oil.

34. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (LGD/LZE)** .

ENGINE OIL PRESSURE SENSOR AND/OR SWITCH REPLACEMENT

REMOVAL PROCEDURE

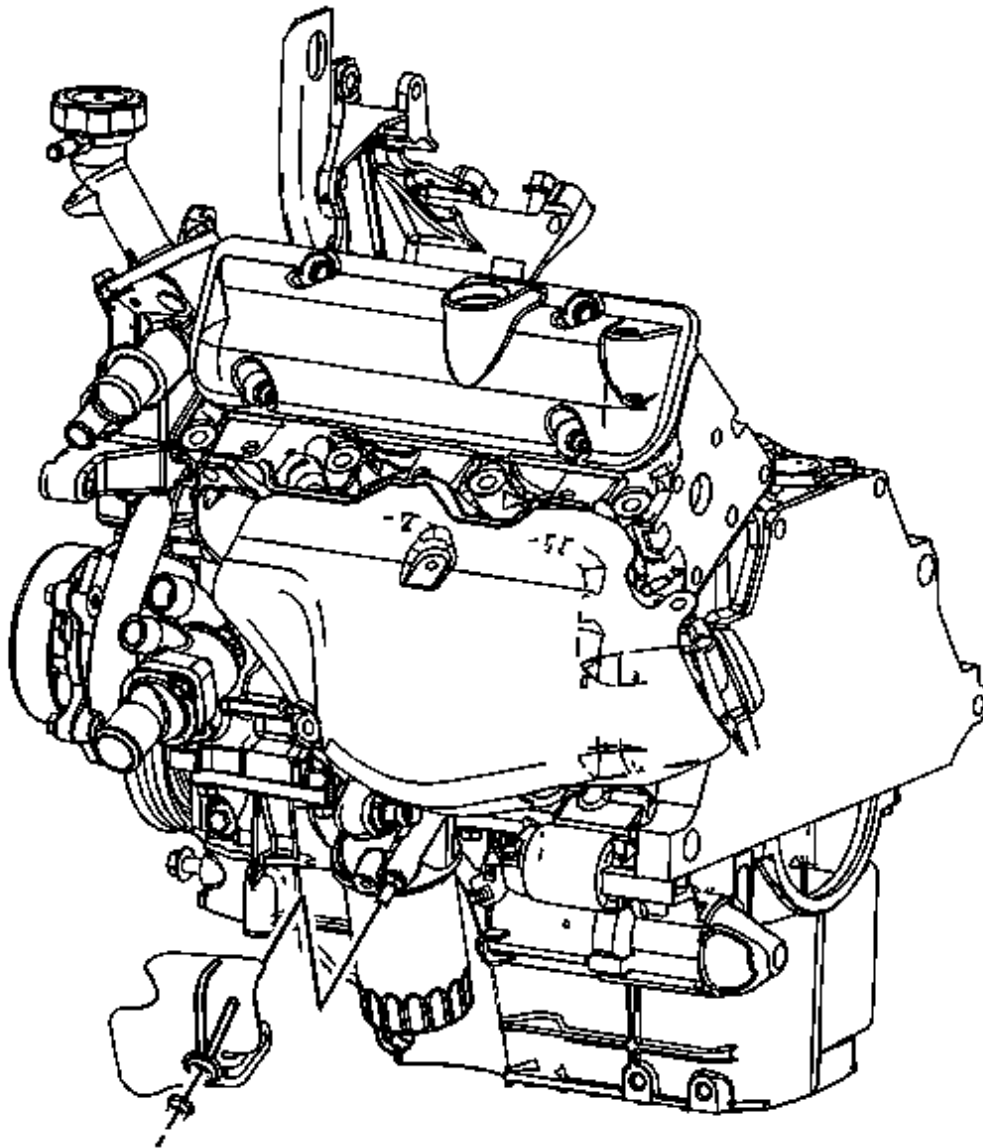


Fig. 136: Oil Pressure Sensor Heat Shield & Nut
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pressure sensor heat shield nut and shield.

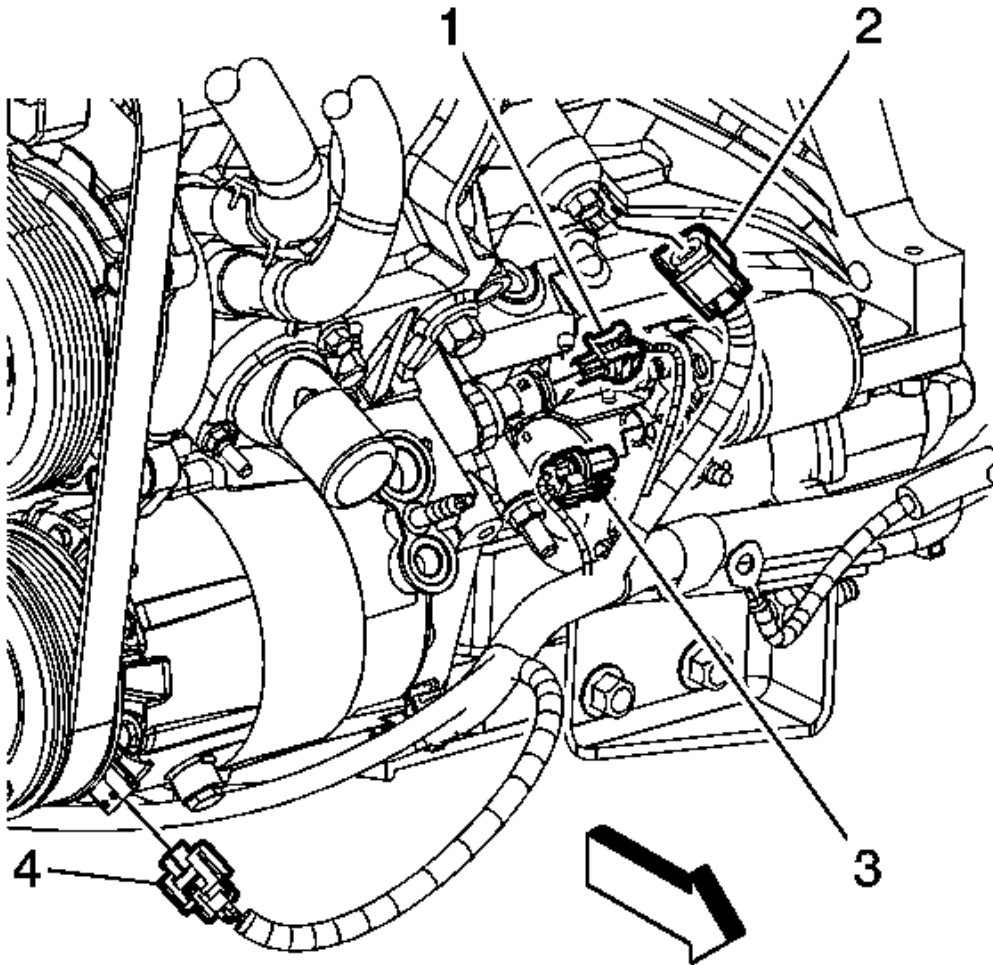


Fig. 137: Identifying Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the engine oil pressure sensor electrical connector (1).

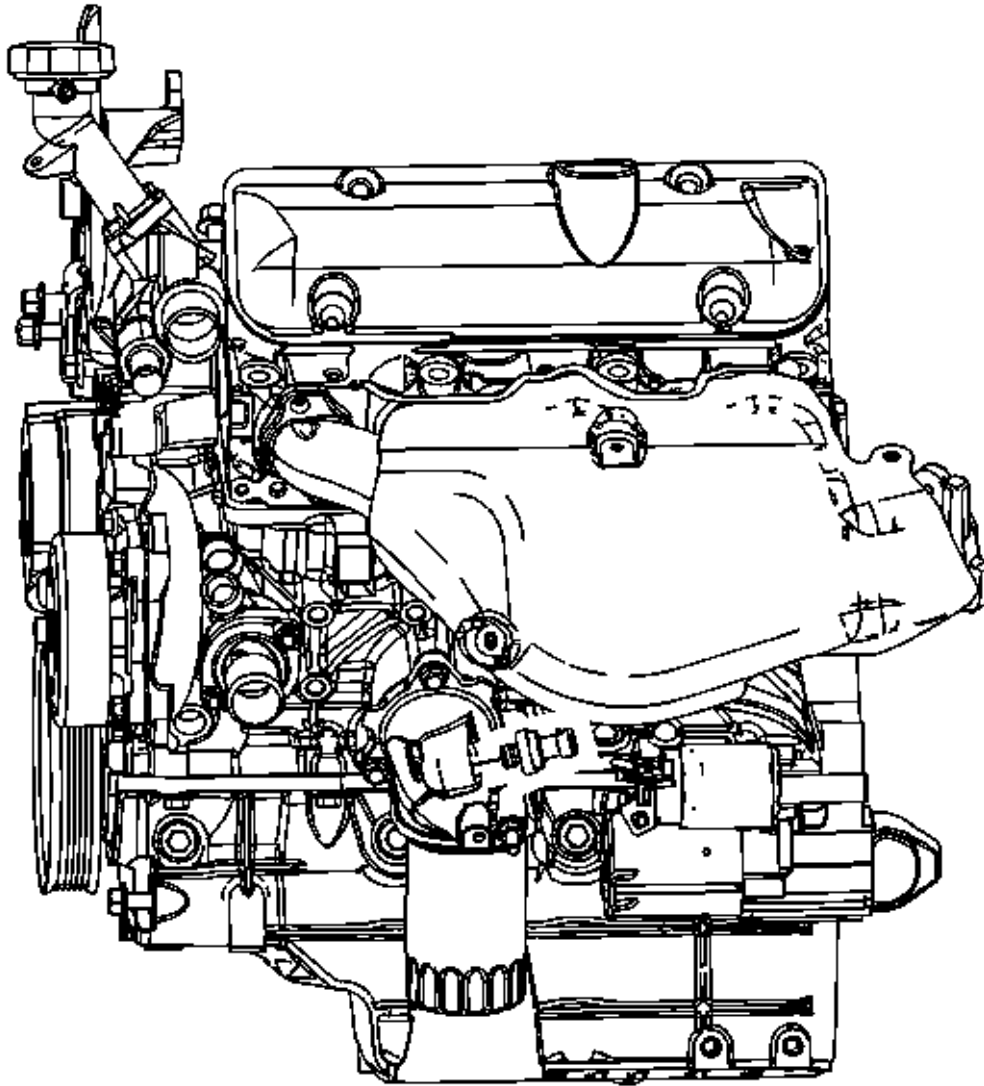


Fig. 138: Engine Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

3. Remove the engine oil pressure sensor.

INSTALLATION PROCEDURE

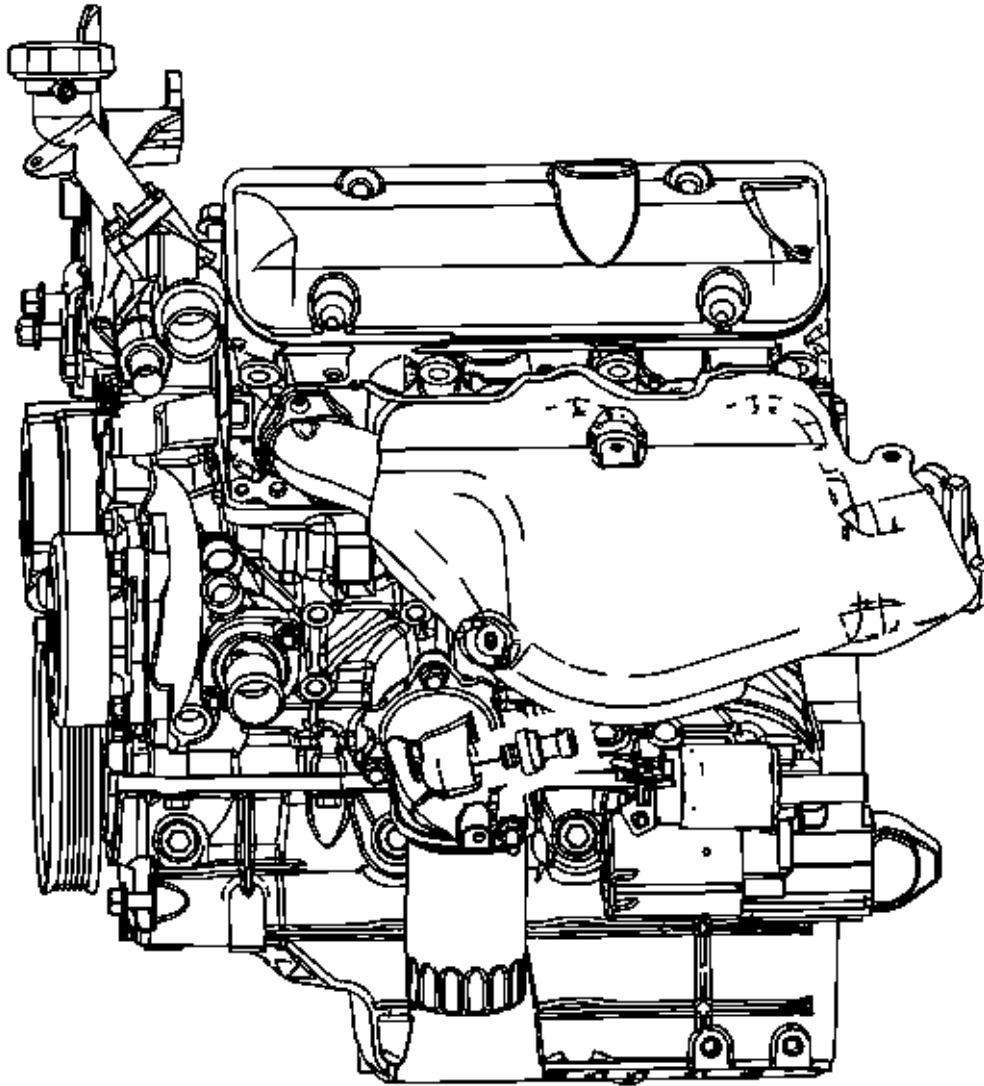


Fig. 139: Engine Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the engine oil pressure sensor.

Tighten: Tighten the sensor to 16 N.m (12 lb ft).

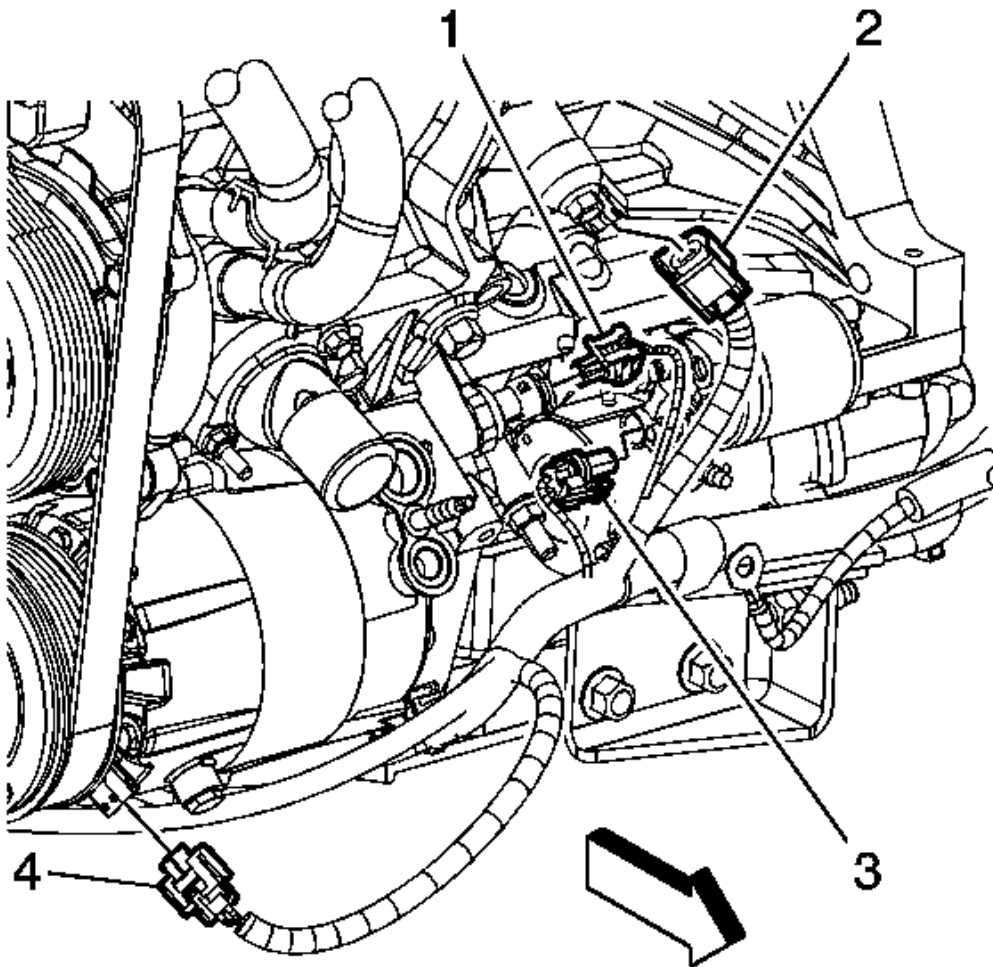


Fig. 140: Identifying Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Connect the engine oil pressure sensor electrical connector (1).

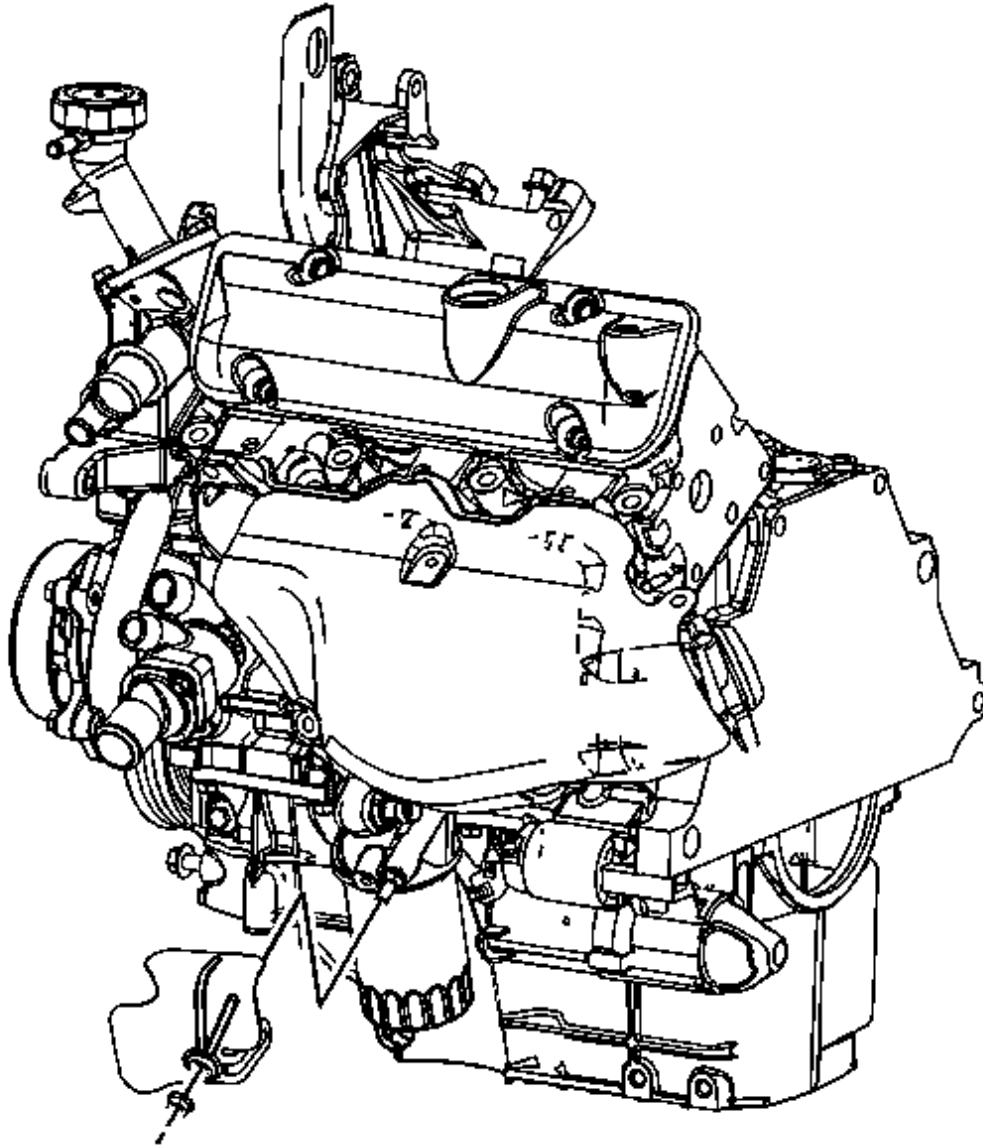


Fig. 141: Oil Pressure Sensor Heat Shield & Nut
Courtesy of GENERAL MOTORS CORP.

3. Install the oil pressure sensor heat shield and nut.

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

OIL PUMP REPLACEMENT

REMOVAL PROCEDURE

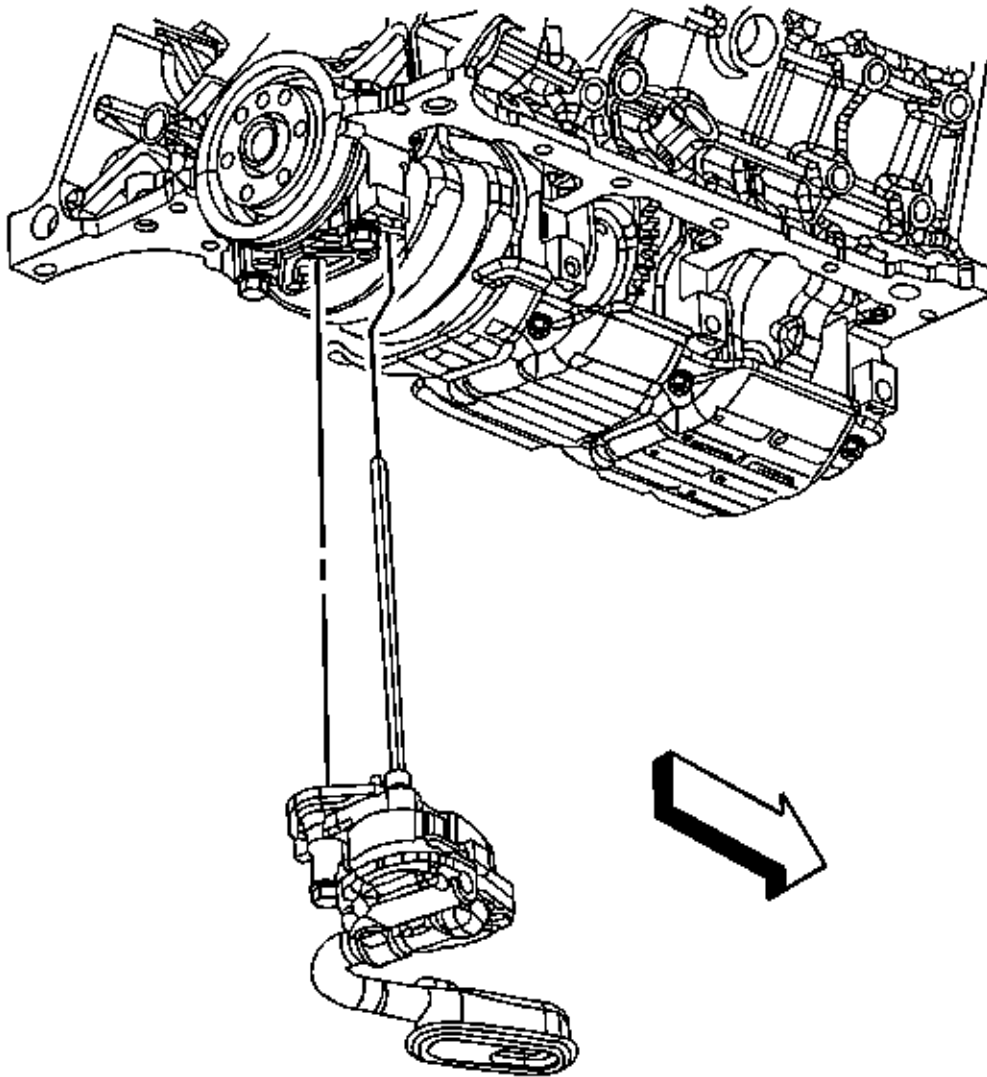


Fig. 142: Identifying Oil Pump & Oil Pump Drive Shaft
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pan. Refer to **Oil Pan Replacement**.
2. Remove the oil pump bolt.

3. Remove the oil pump and the oil pump drive shaft.

INSTALLATION PROCEDURE

NOTE: Rotate the oil pump drive shaft as necessary in order to obtain the engagement with the oil pump drive unit.

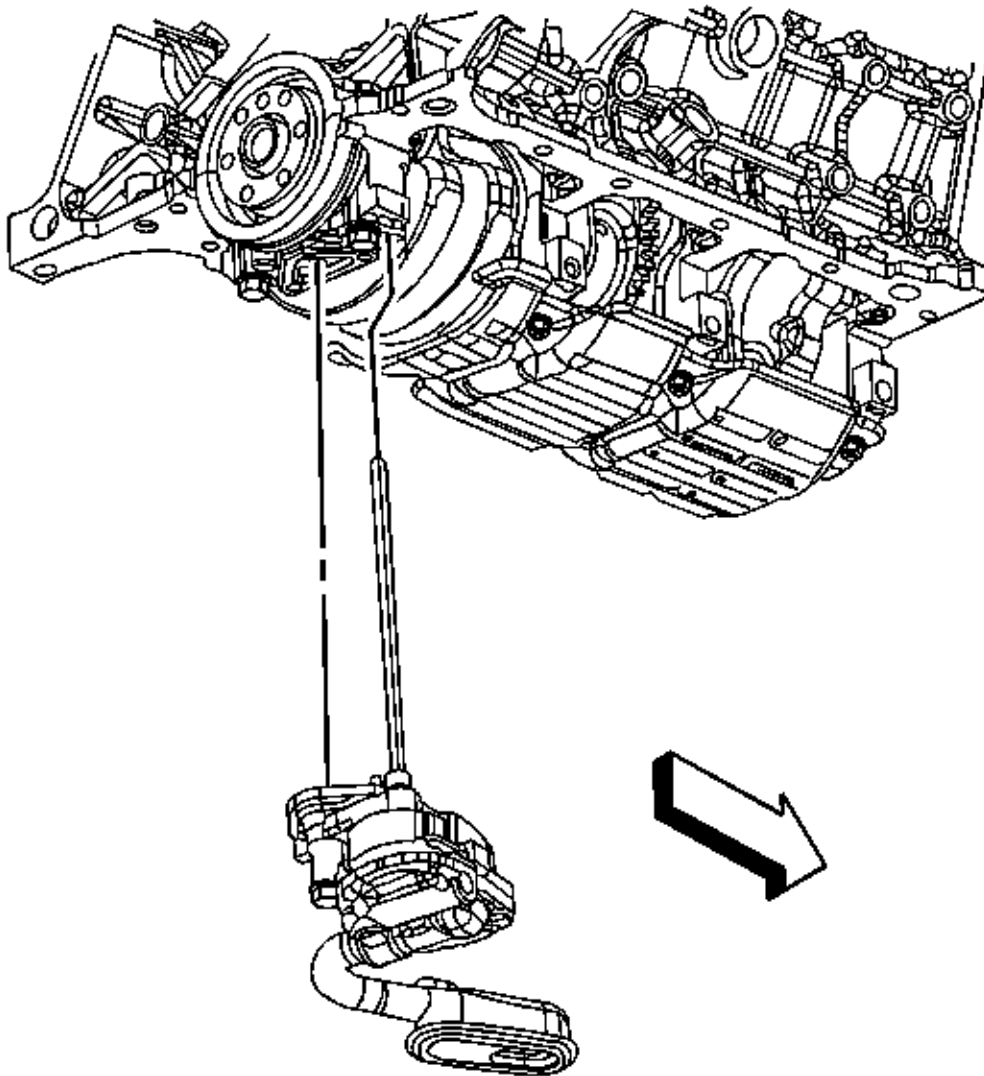


Fig. 143: Identifying Oil Pump & Oil Pump Drive Shaft
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the oil pump drive shaft and the oil pump.
2. Install the oil pump bolt.

Tighten: Tighten the bolt to 41 N.m (30 lb ft).

3. Install the oil pan. Refer to Oil Pan Replacement.

OIL PUMP DRIVE REPLACEMENT**REMOVAL PROCEDURE**

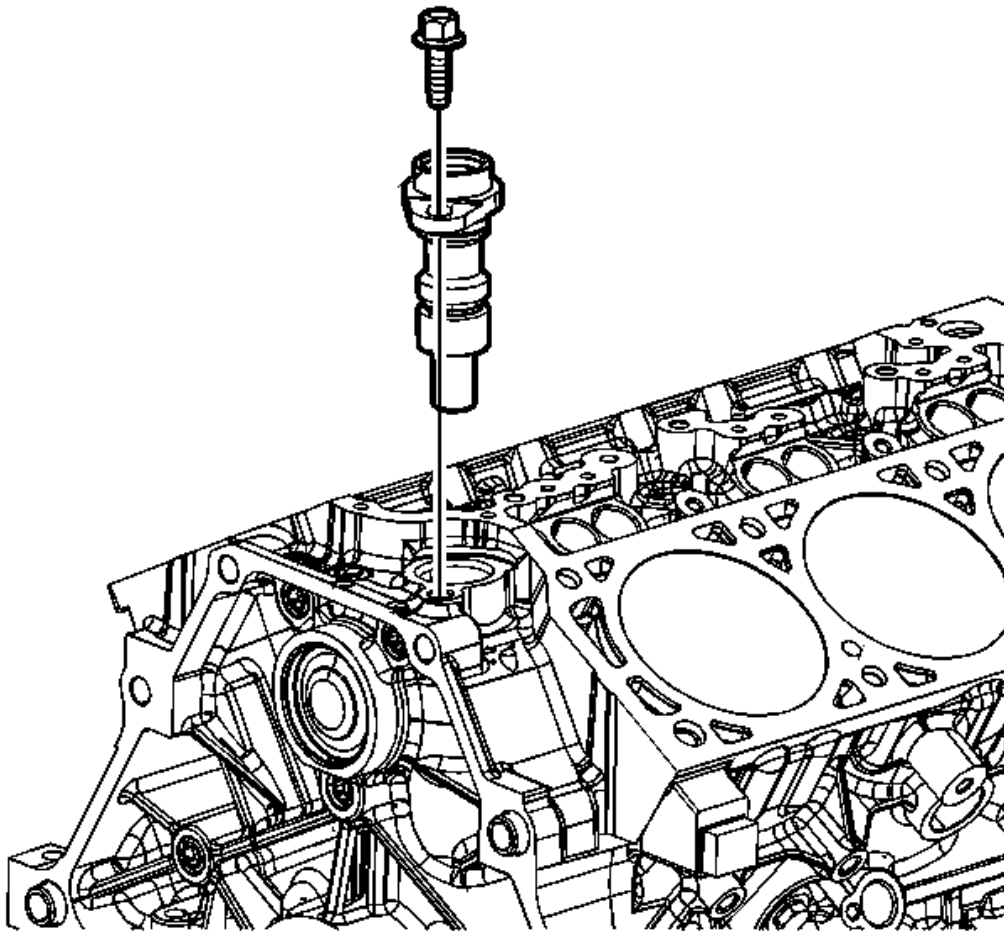


Fig. 144: Identifying Oil Pump Drive
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Remove the oil pump drive bolt.
3. Remove the oil pump drive.
4. Remove the oil pump drive seal.

INSTALLATION PROCEDURE

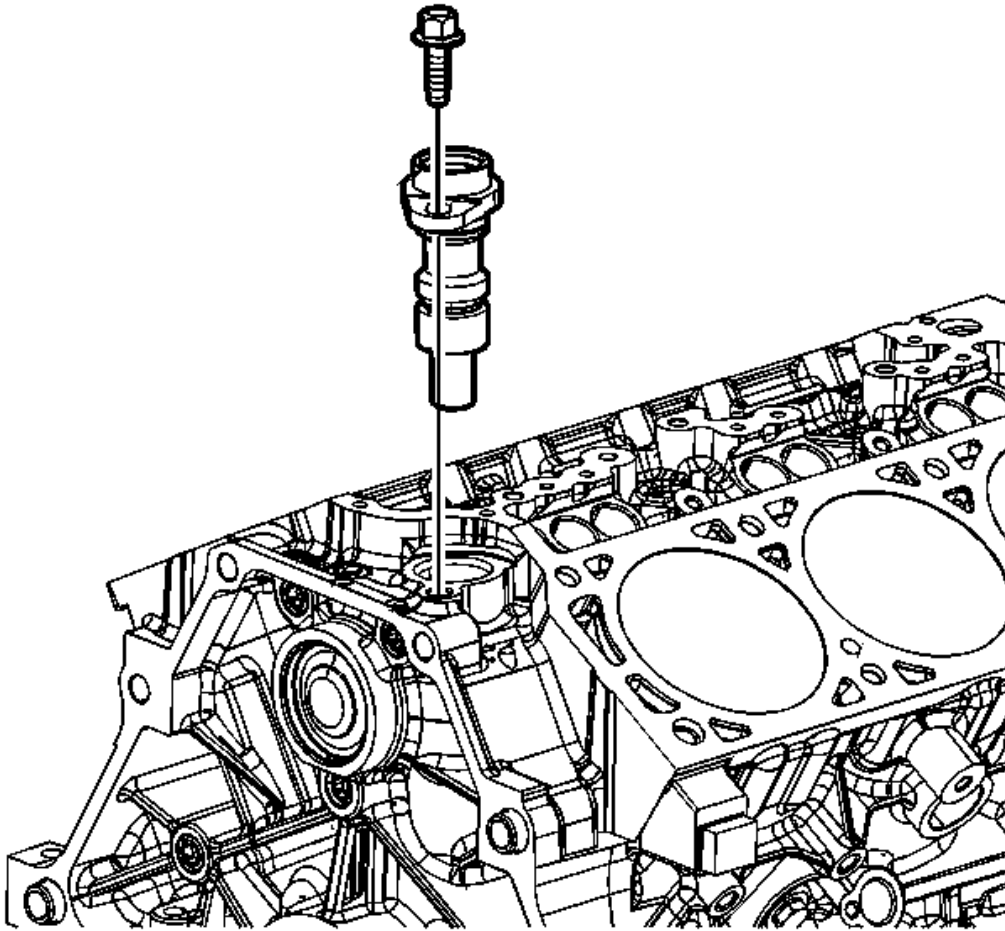


Fig. 145: Identifying Oil Pump Drive
Courtesy of GENERAL MOTORS CORP.

1. Install the oil pump drive seal. Coat the seal or bore in the engine block with clean engine oil.
2. Apply prelube to the oil pump drive gear. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .
3. Install the oil pump drive.

CAUTION: Refer to **Fastener Caution** .

4. Install the oil pump drive bolt.

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

5. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

SPECIAL TOOLS

EN-48869: Front Crankshaft Seal Installer

For equivalent regional tools, refer to **Special Tools** .

REMOVAL PROCEDURE

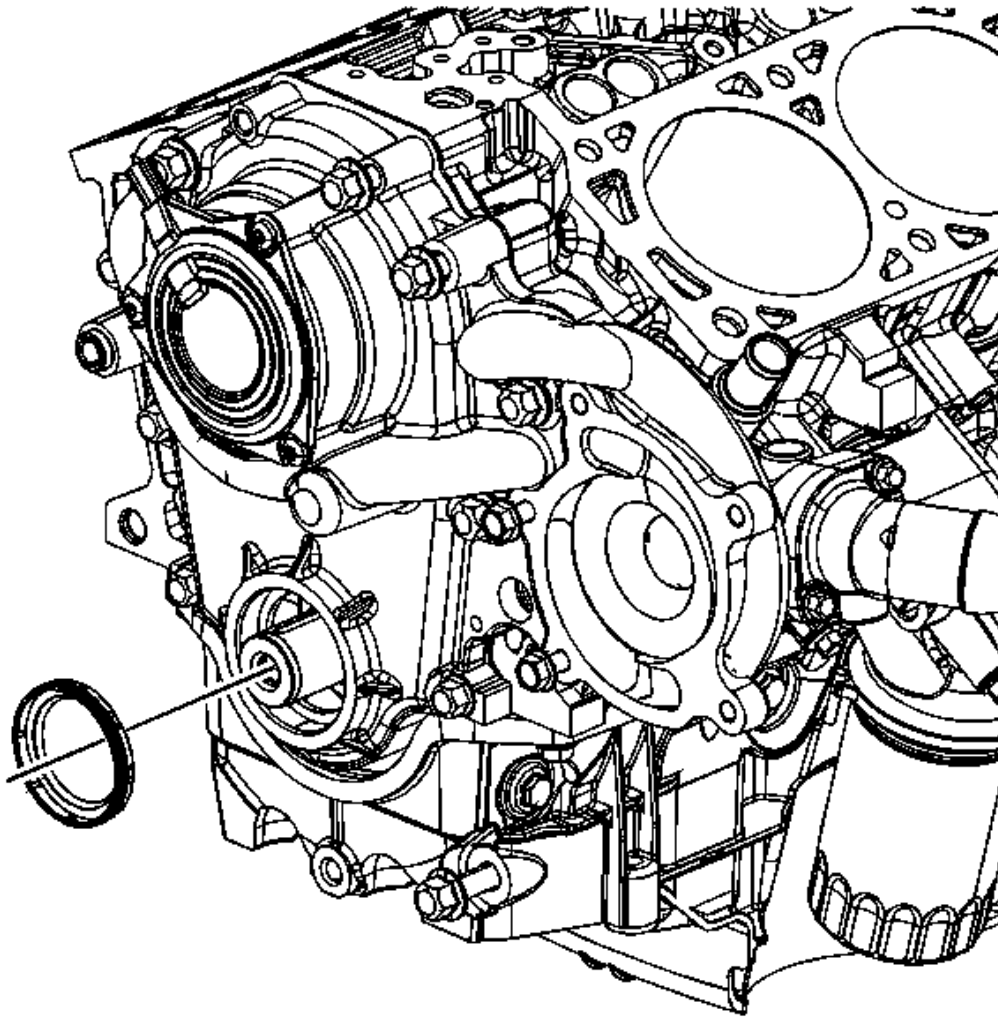


Fig. 146: Identifying Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
2. Remove the crankshaft key from the keyway.
3. Pry out the crankshaft front oil seal using a suitable tool. Use care not to damage the engine front cover or the crankshaft.

INSTALLATION PROCEDURE

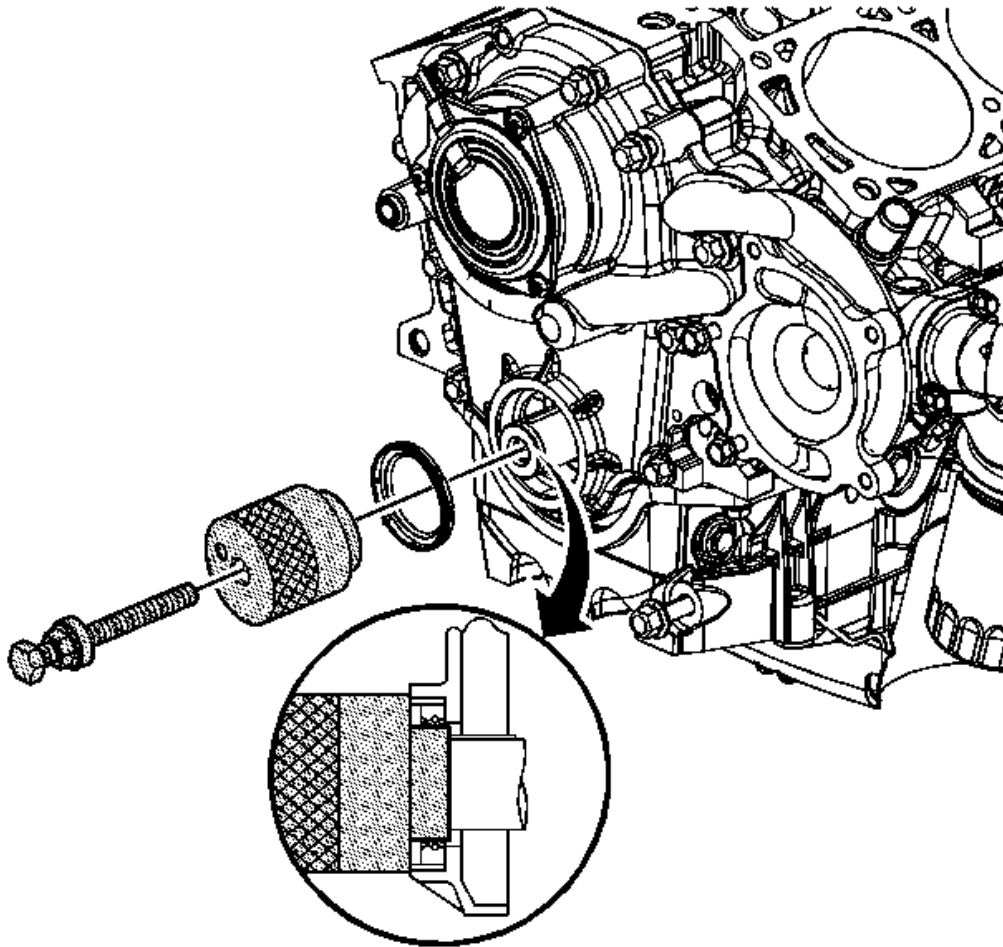


Fig. 147: Thread Forcing Bolt With Bearing
Courtesy of GENERAL MOTORS CORP.

1. Align the **EN-48869**: installer and the crankshaft front oil seal with the engine front cover and crankshaft.
2. Install the crankshaft front oil seal using **EN-48869**: installer and a suitable tool.
3. Install the crankshaft key into the keyway.
4. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

CAMSHAFT POSITION ACTUATOR MAGNET REPLACEMENT

REMOVAL PROCEDURE

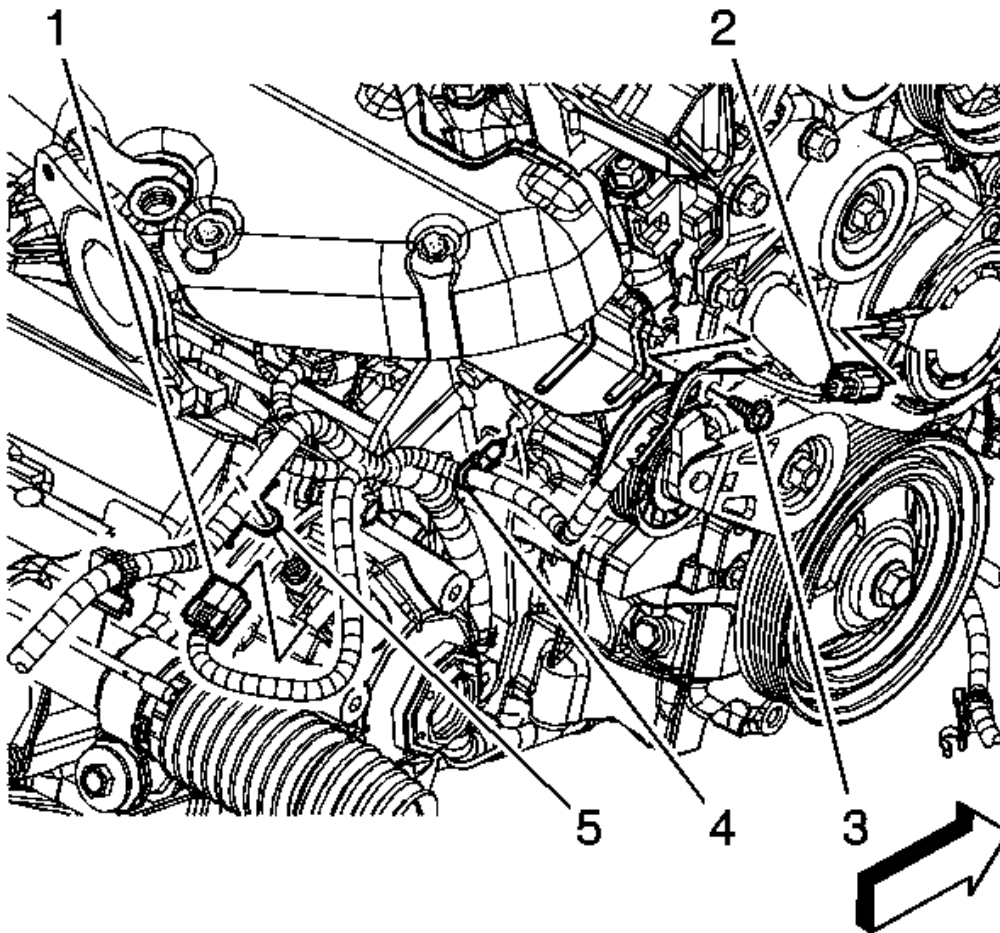


Fig. 148: Camshaft Position Actuator Magnet Electrical Connector

Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Disconnect the camshaft position actuator magnet electrical connector (2).

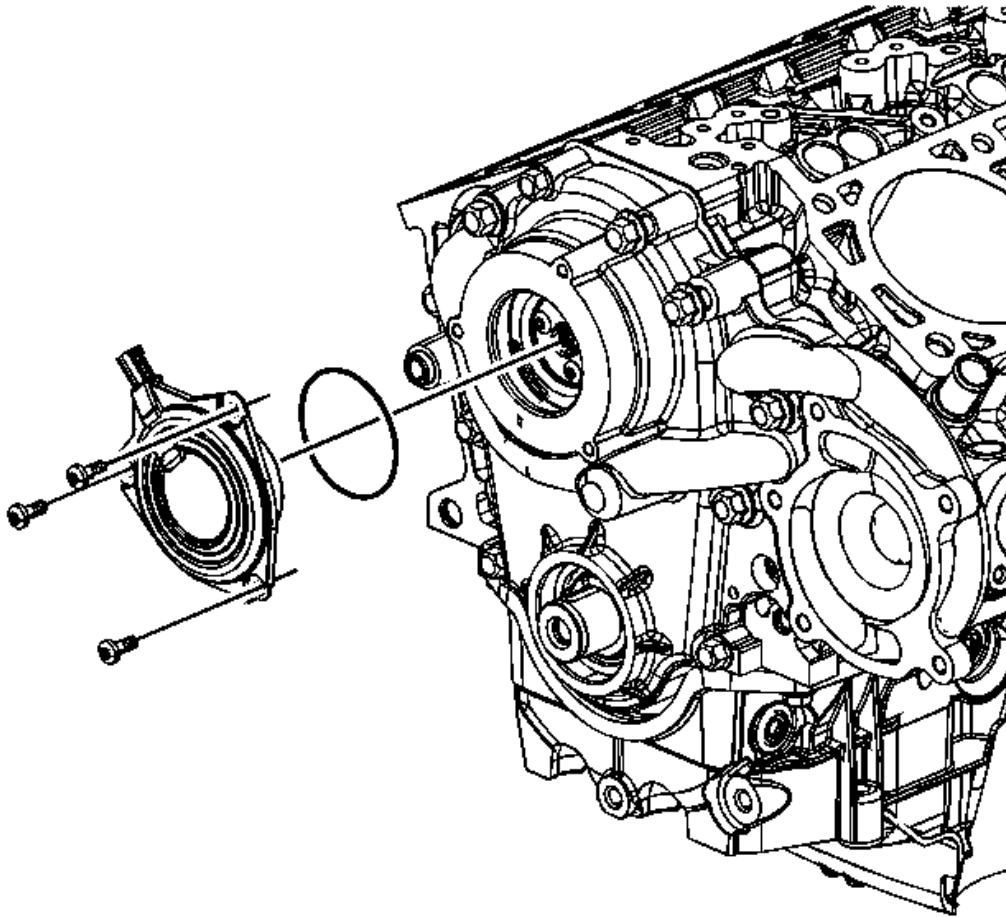


Fig. 149: Identifying Camshaft Position Actuator Magnet & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the camshaft position actuator magnet bolts.
4. Remove the camshaft position actuator magnet and O-ring seal.

INSTALLATION PROCEDURE

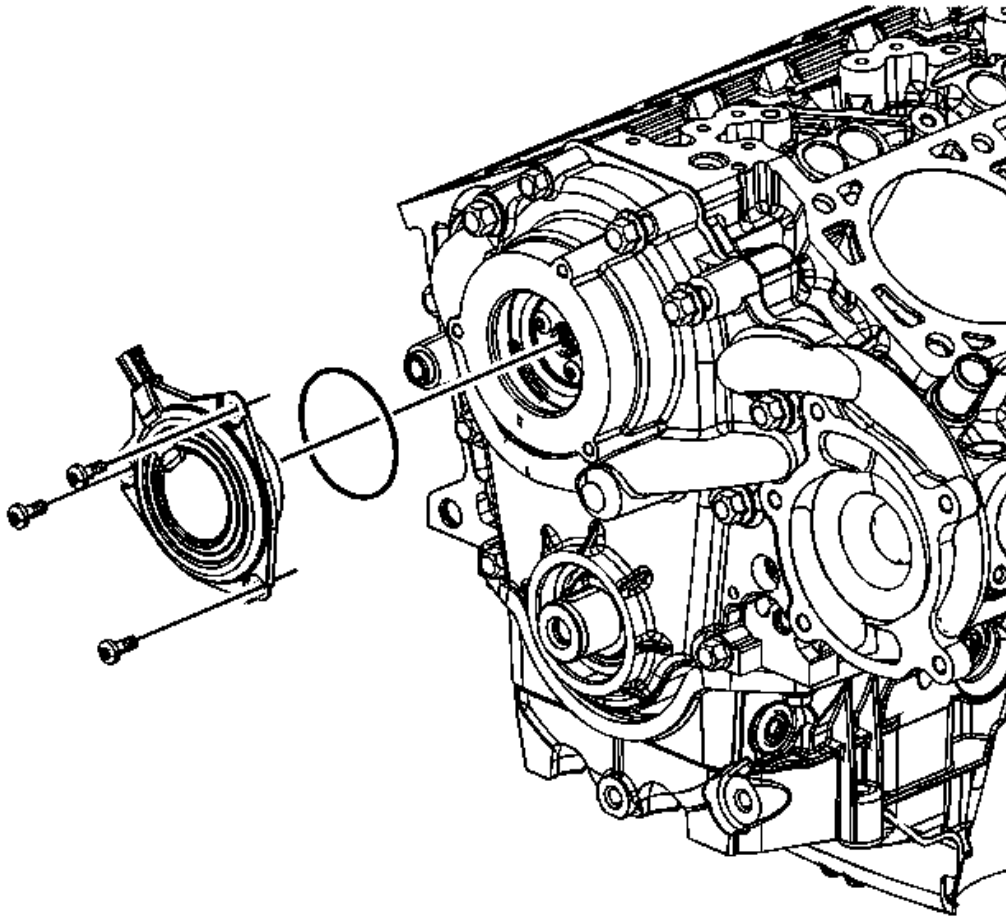


Fig. 150: Identifying Camshaft Position Actuator Magnet & Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the camshaft position actuator magnet O-ring seal and magnet.
2. Install the camshaft position actuator magnet bolts.

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

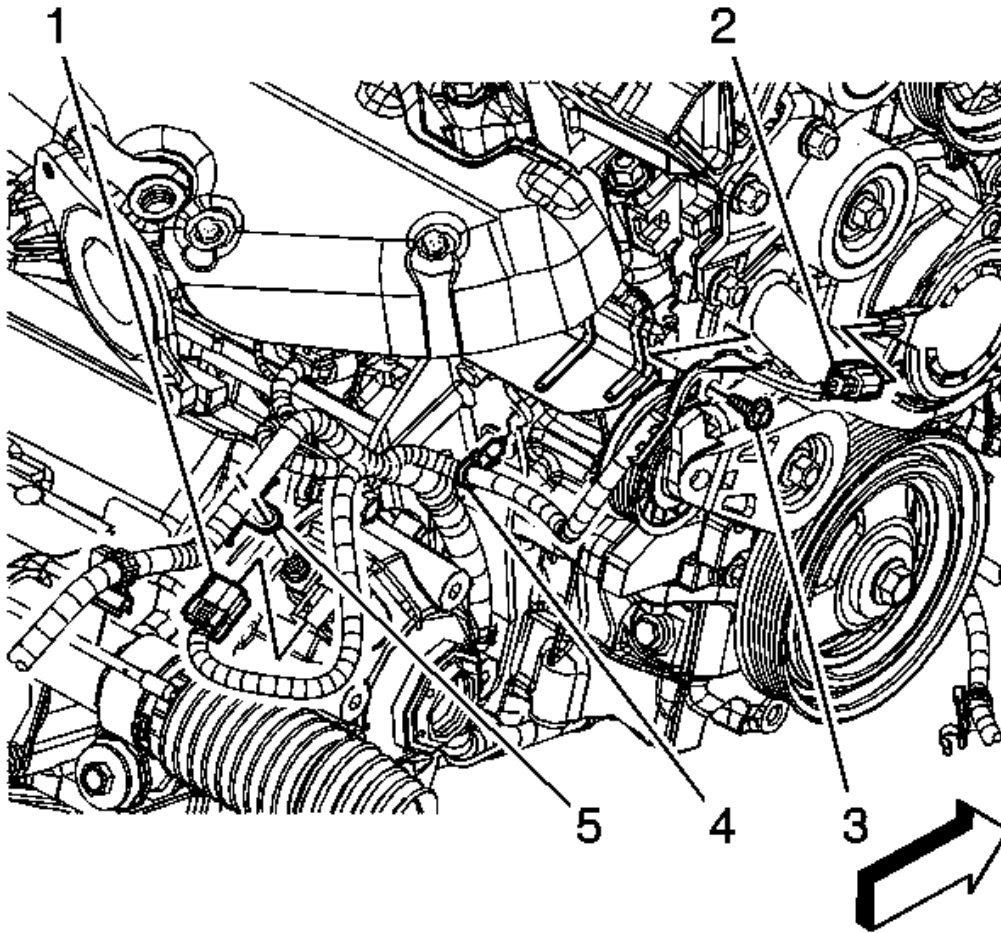


Fig. 151: Camshaft Position Actuator Magnet Electrical Connector

Courtesy of GENERAL MOTORS CORP.

3. Connect the camshaft position actuator magnet electrical connector (2).
4. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

ENGINE FRONT COVER REPLACEMENT

REMOVAL PROCEDURE

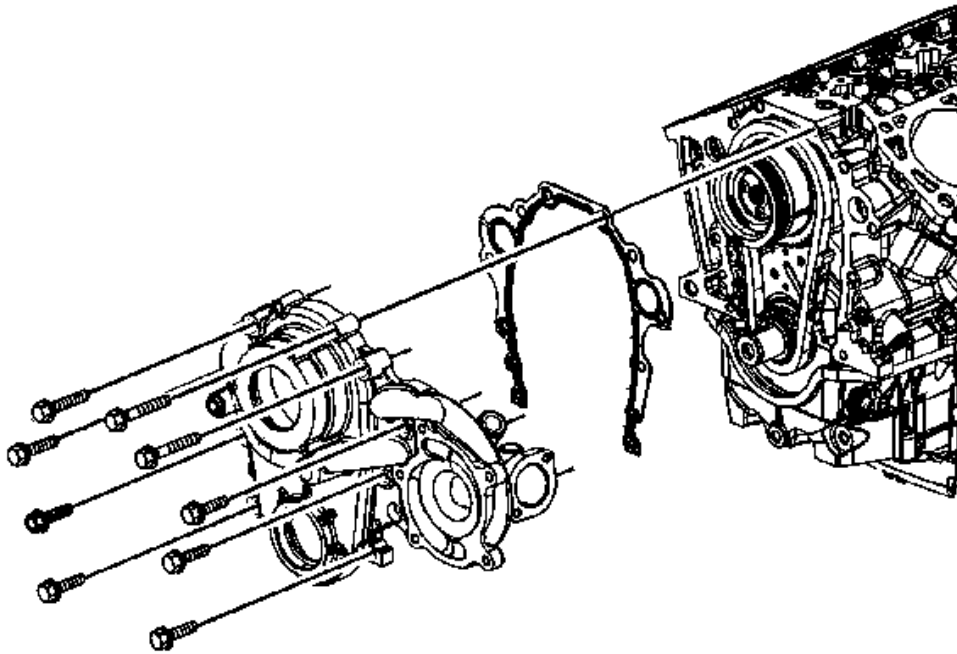


Fig. 152: Identifying Engine Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (LZE, LGD Static Fill)** or **Cooling System Draining and Filling (LZE, LGD GE47716 Fill)** .
2. Remove the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
3. Remove the oil pan. Refer to **Oil Pan Replacement**.
4. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
5. Remove the crankshaft position actuator magnet. Refer to **Camshaft Position Actuator Magnet Replacement**.
6. Remove the thermostat housing. Refer to **Engine Coolant Thermostat Housing Replacement (LGD/LZE)** .
7. Remove the water pump. Refer to **Water Pump Replacement (LGD/LZE)** .
8. Remove the engine front cover bolts.
9. Remove the engine front cover.

10. Remove the engine front cover gasket.

INSTALLATION PROCEDURE

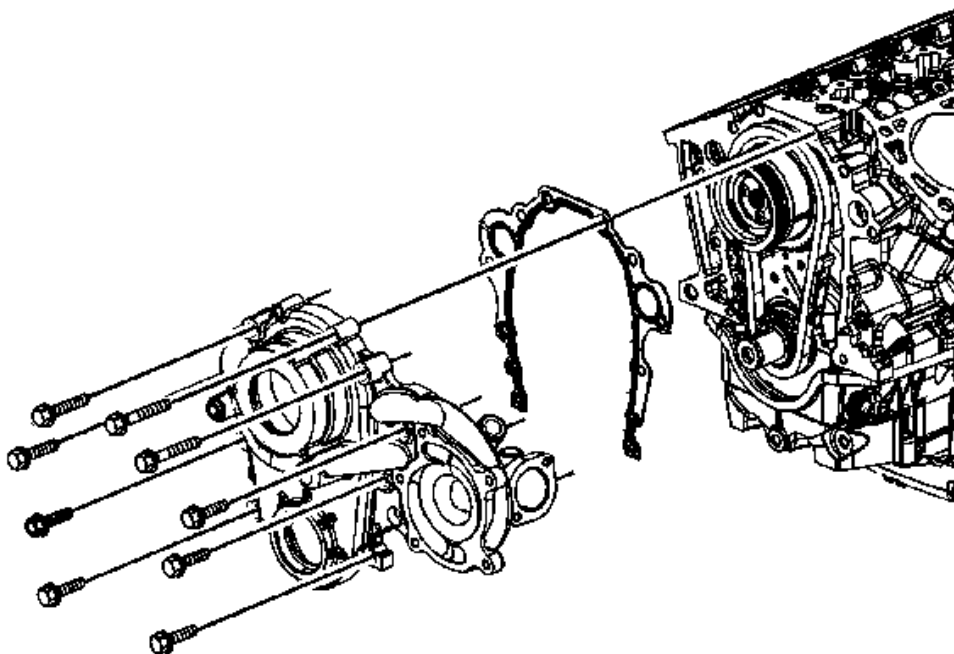


Fig. 153: Identifying Engine Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the engine front cover gasket.
2. Install the engine front cover.

CAUTION: Refer to Fastener Caution .

3. Install the engine front cover bolts.

Tighten: Tighten the bolts to 257 N.m (18 lb ft).

4. Install the water pump. Refer to **Water Pump Replacement (LGD/LZE)** .
5. Install the thermostat housing. Refer to **Engine Coolant Thermostat Housing Replacement (LGD/LZE)** .
6. Install the crankshaft position actuator magnet. Refer to **Camshaft Position Actuator Magnet Replacement**.
7. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
8. Install the oil pan. Refer to **Oil Pan Replacement**.
9. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
10. Fill the cooling system. Refer to **Cooling System Draining and Filling (LZE, LGD Static Fill)** or **Cooling System Draining and Filling (LZE, LGD GE47716 Fill)** .

CAMSHAFT TIMING CHAIN AND SPROCKET REPLACEMENT

SPECIAL TOOLS

EN-47719 Tensioner Compressor. See **Special Tools** .

REMOVAL PROCEDURE

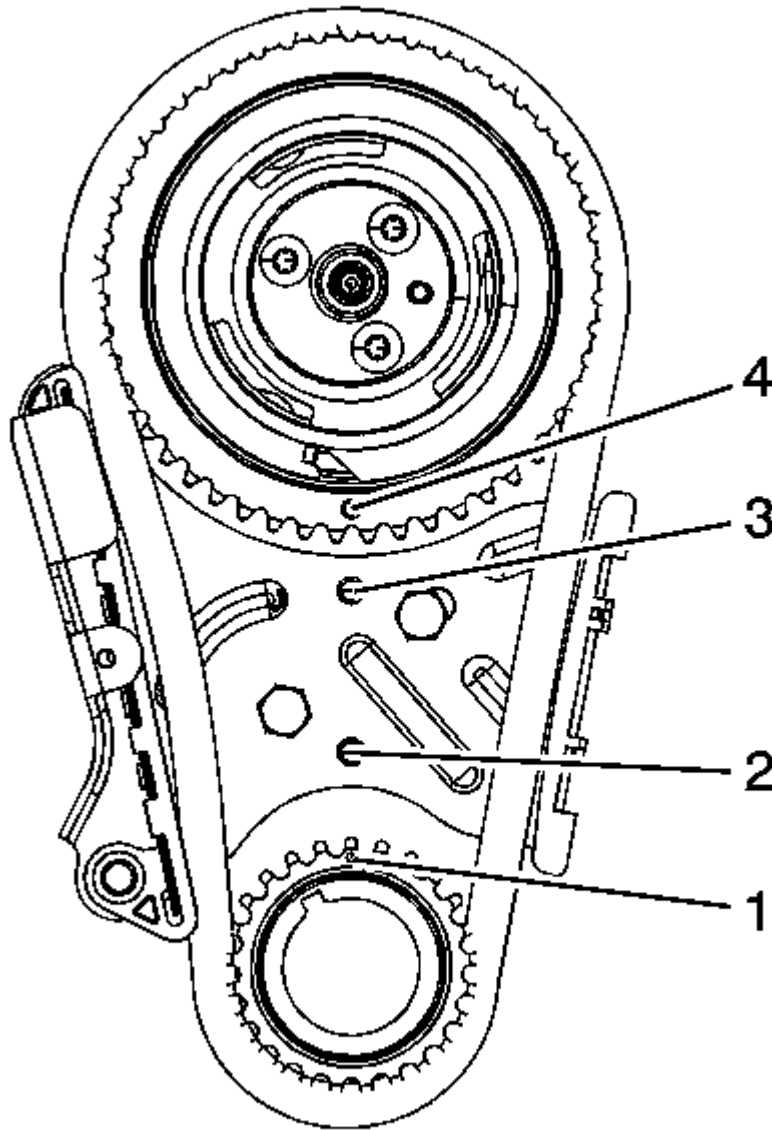


Fig. 154: Identifying Timing Marks & Chain Tensioners
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine front cover. Refer to **Engine Front Cover Replacement**.
2. Align the crankshaft timing mark (1) to the timing mark on the bottom of the timing chain tensioner (2).
3. Align the timing mark on the camshaft position actuator gear (4) with the timing mark on top of the timing chain tensioner (3).

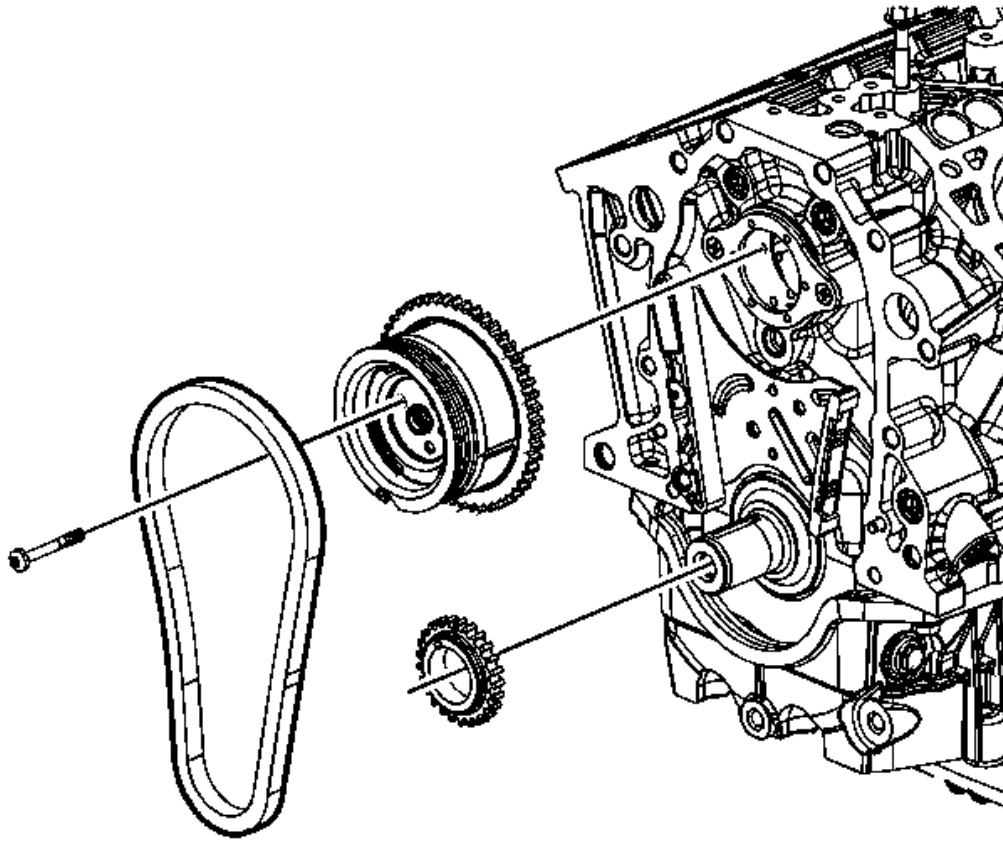


Fig. 155: View Of Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

4. Remove the camshaft position actuator bolts.
5. Remove the timing chain, camshaft position actuator, and crankshaft sprockets.

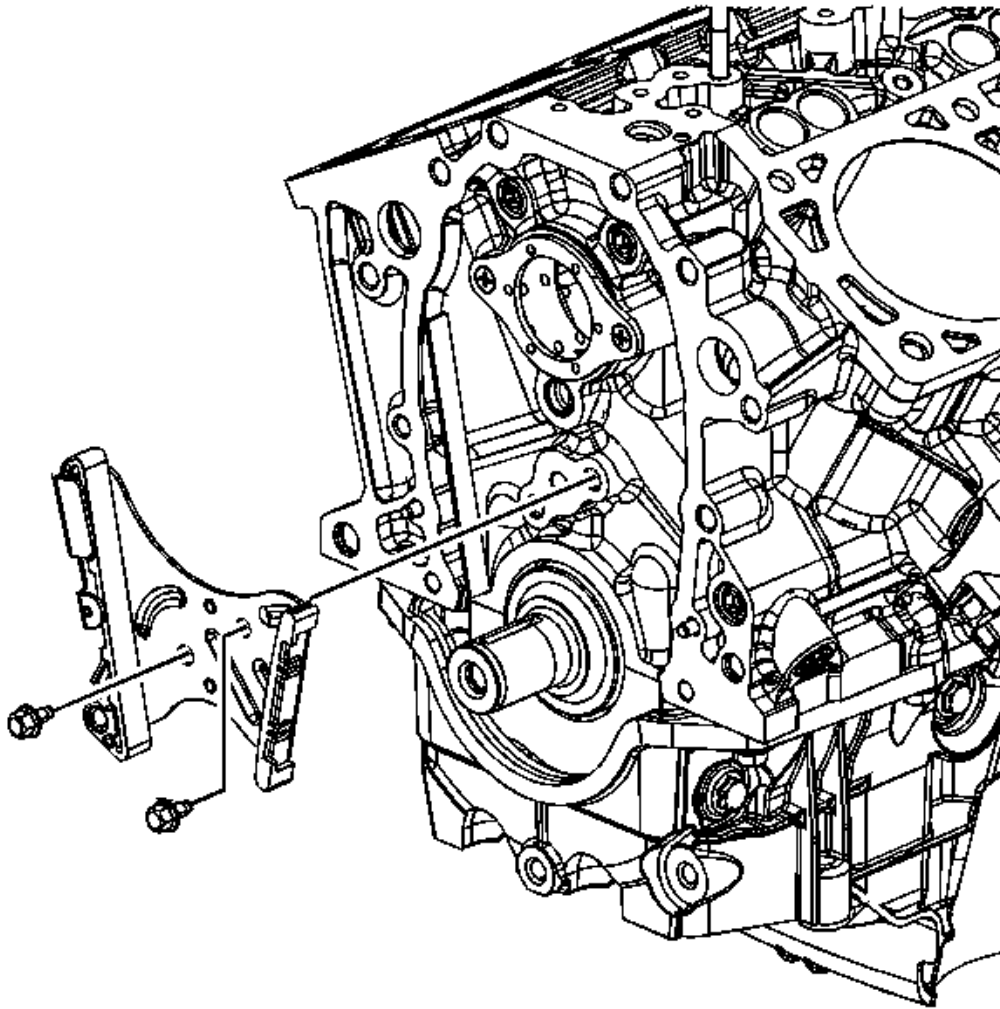


Fig. 156: View Of Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the timing chain tensioner bolts.
7. Remove the timing chain tensioner.

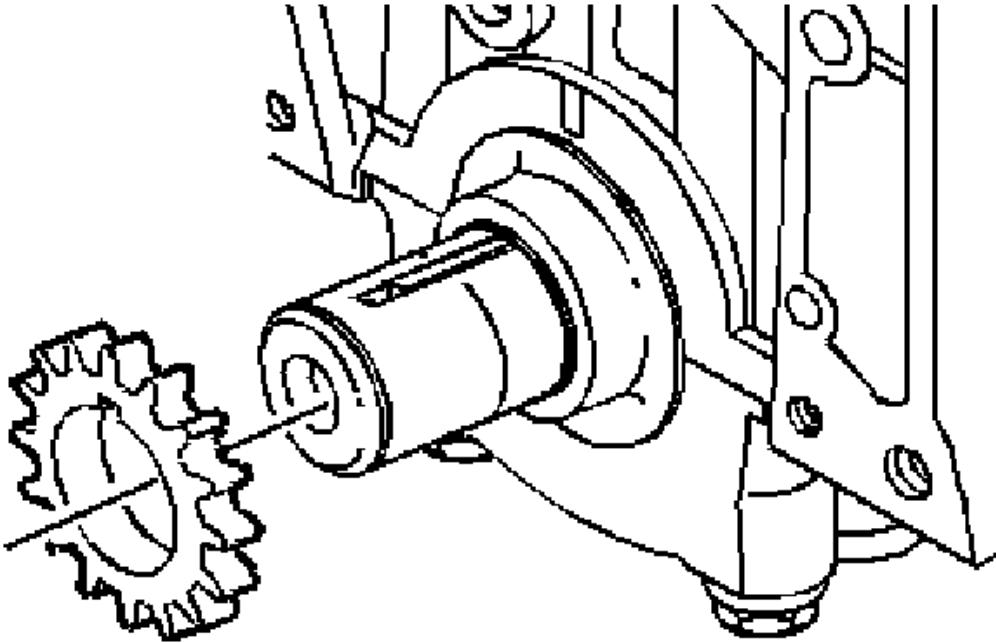


Fig. 157: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

8. Remove the crankshaft sprocket.

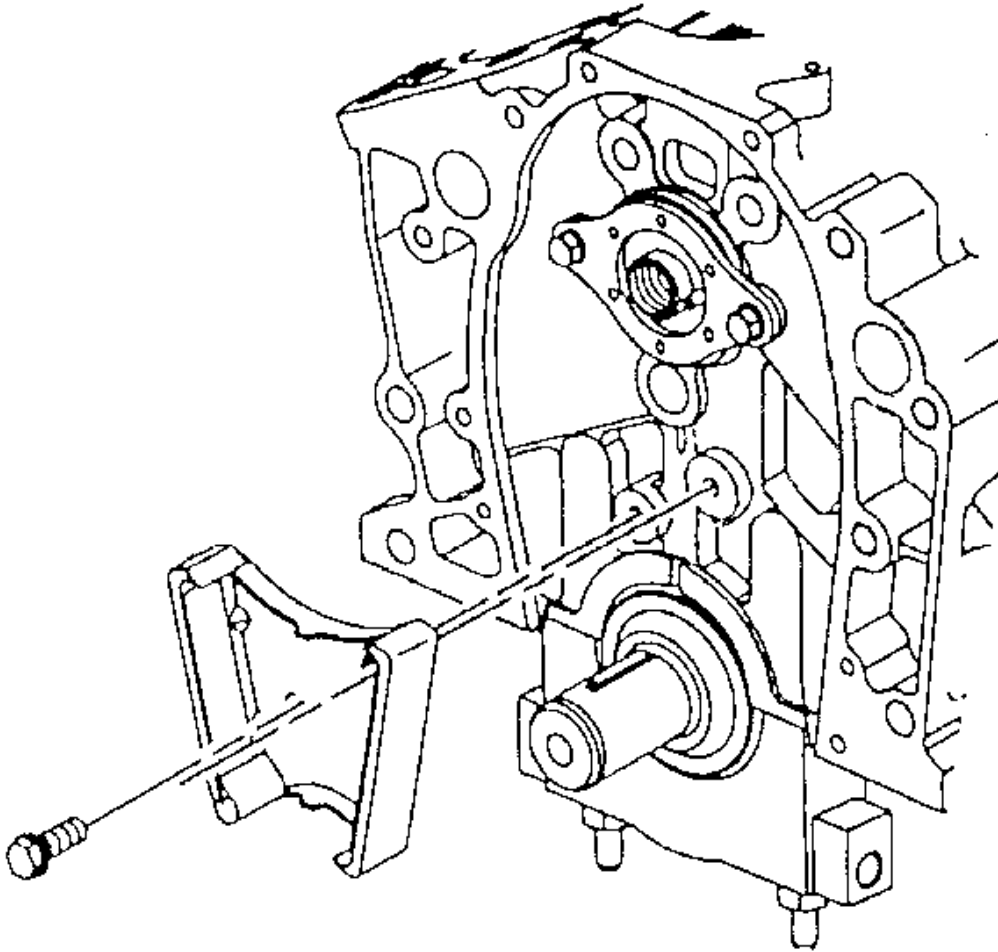


Fig. 158: View Of Timing Chain Dampener & Bolts
Courtesy of GENERAL MOTORS CORP.

9. Remove the timing chain dampener bolts.
10. Remove the timing chain dampener.

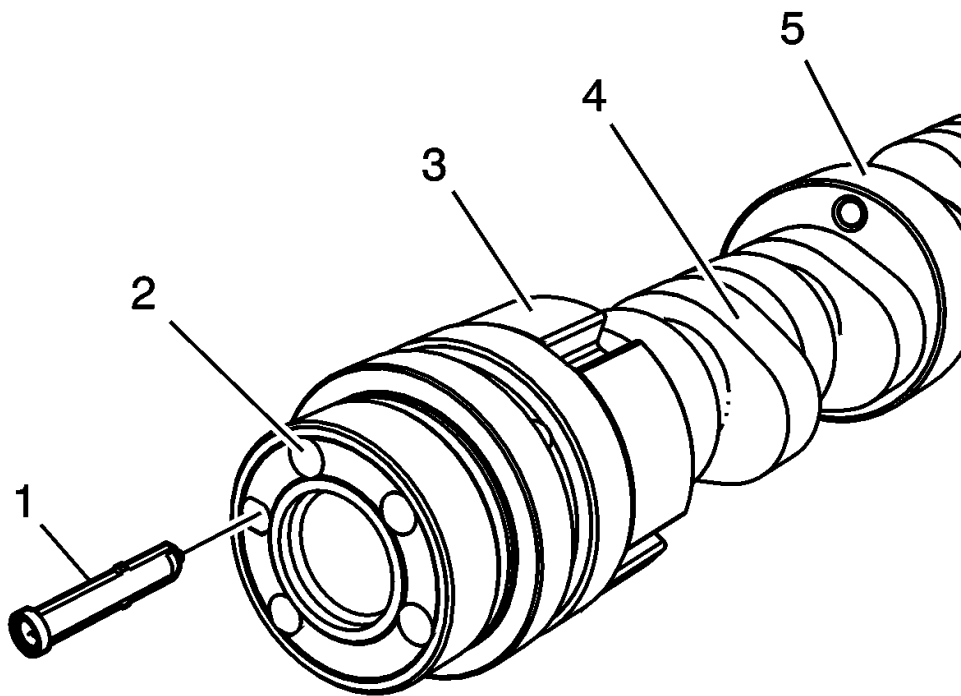


Fig. 159: View Of Camshaft & Actuator Filter
Courtesy of GENERAL MOTORS CORP.

11. Remove and discard the camshaft position actuator filter (1) from the end of the camshaft.

INSTALLATION PROCEDURE

NOTE: Always install a NEW camshaft position actuator filter anytime the camshaft actuator is removed.



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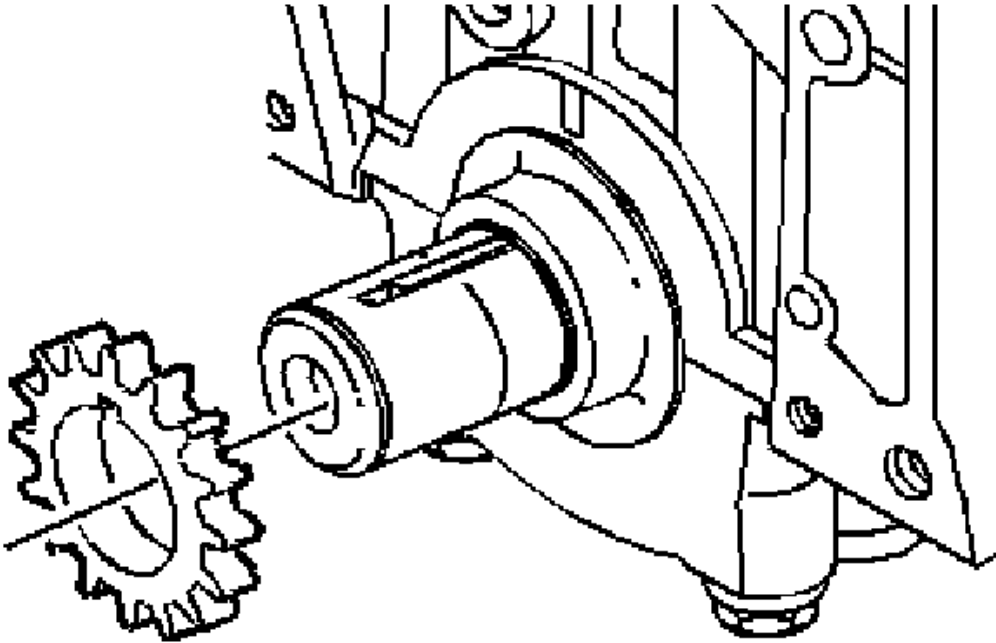


Fig. 161: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

2. Install the crankshaft sprocket.
3. Apply prelube to the crankshaft sprocket thrust surface. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .

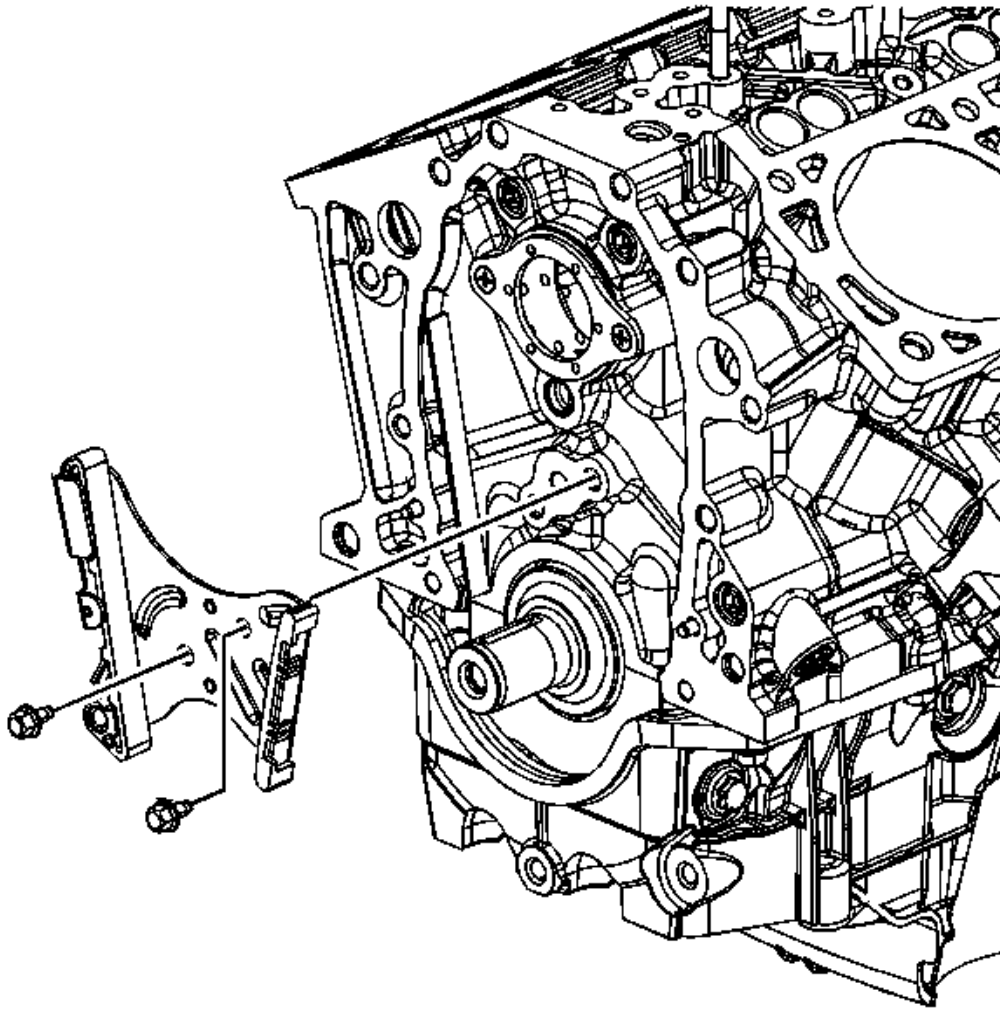


Fig. 162: View Of Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the timing chain tensioner.

CAUTION: Refer to Fastener Caution .

5. Install the timing chain tensioner bolts.

Tighten: Tighten the bolts to 21 N.m (15 lb ft).

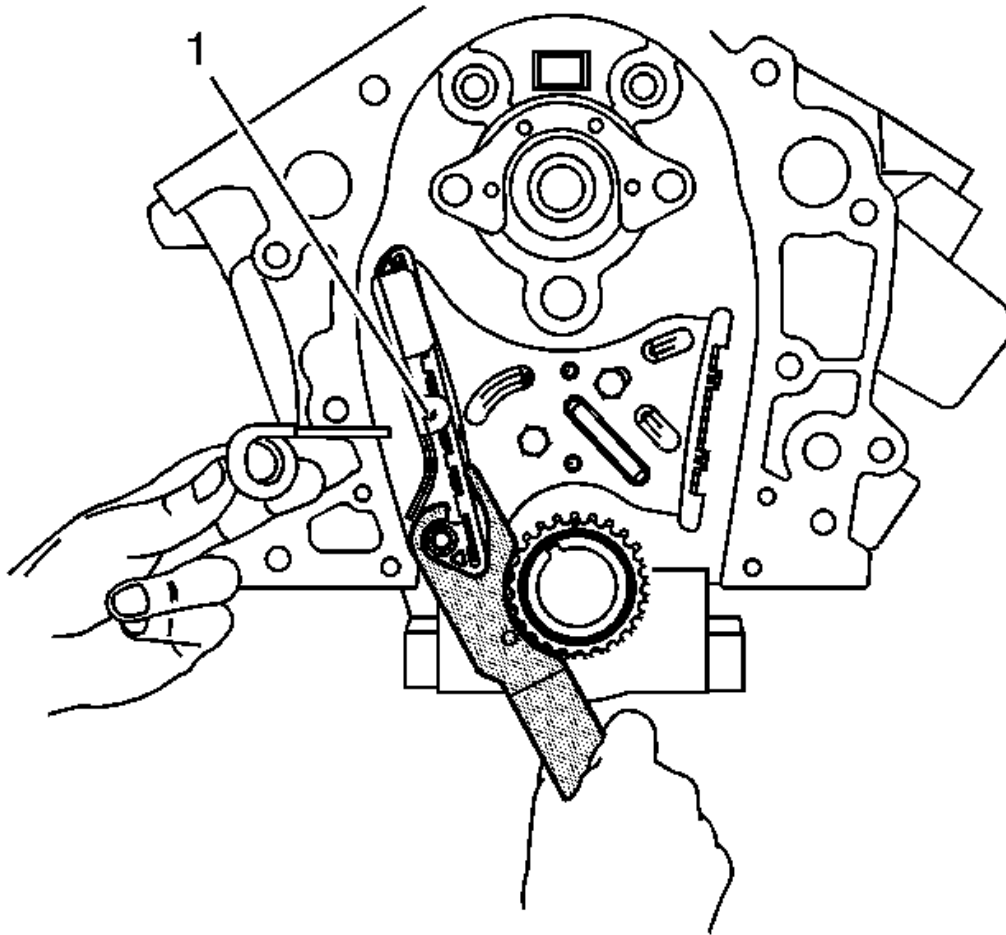


Fig. 163: Identifying Tensioner Collapsing Procedure
Courtesy of GENERAL MOTORS CORP.

6. Using the **EN-47719** , fully collapse the tensioner, and place the tensioner retaining pin into the retaining hole (1). See **Special Tools** .

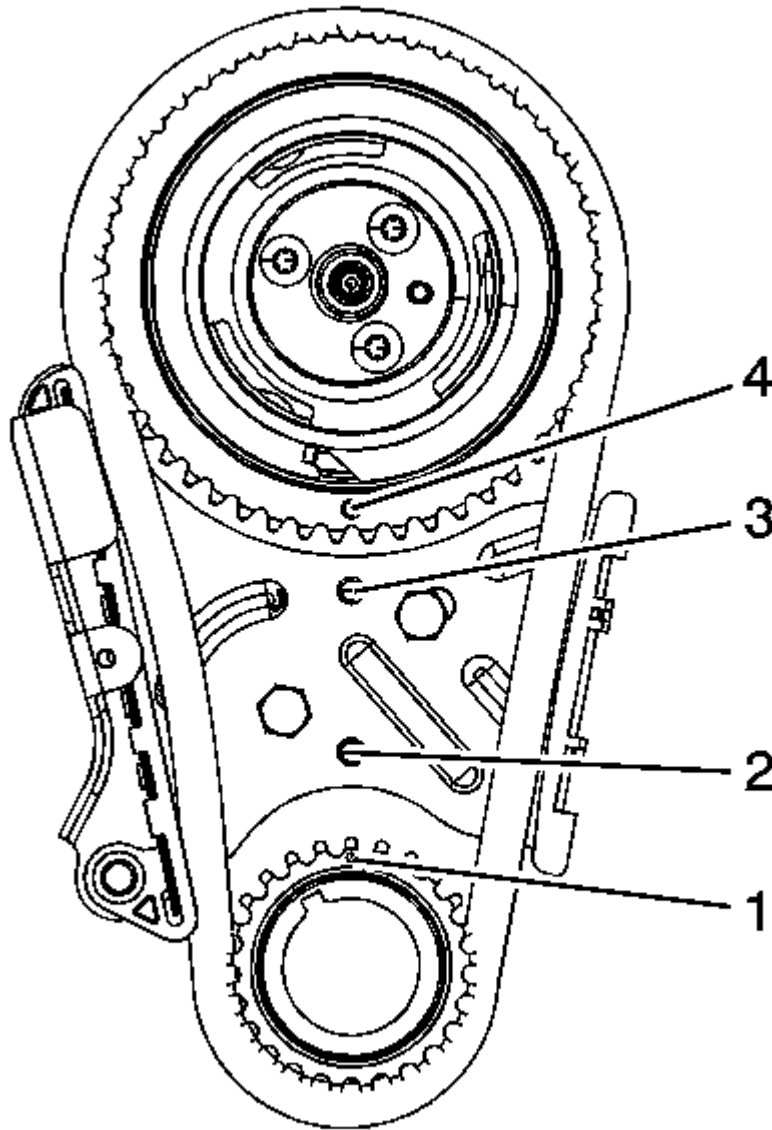


Fig. 164: Identifying Timing Marks & Chain Tensioners
Courtesy of GENERAL MOTORS CORP.

7. Align the crankshaft timing mark (1) to the timing mark on the bottom of the timing chain tensioner (2).
8. Hold the camshaft sprocket with the timing chain hanging down and install the timing chain to the crankshaft gear.
9. Align the timing mark on the camshaft position actuator gear (4) with the timing mark on top of the

timing chain tensioner (3).

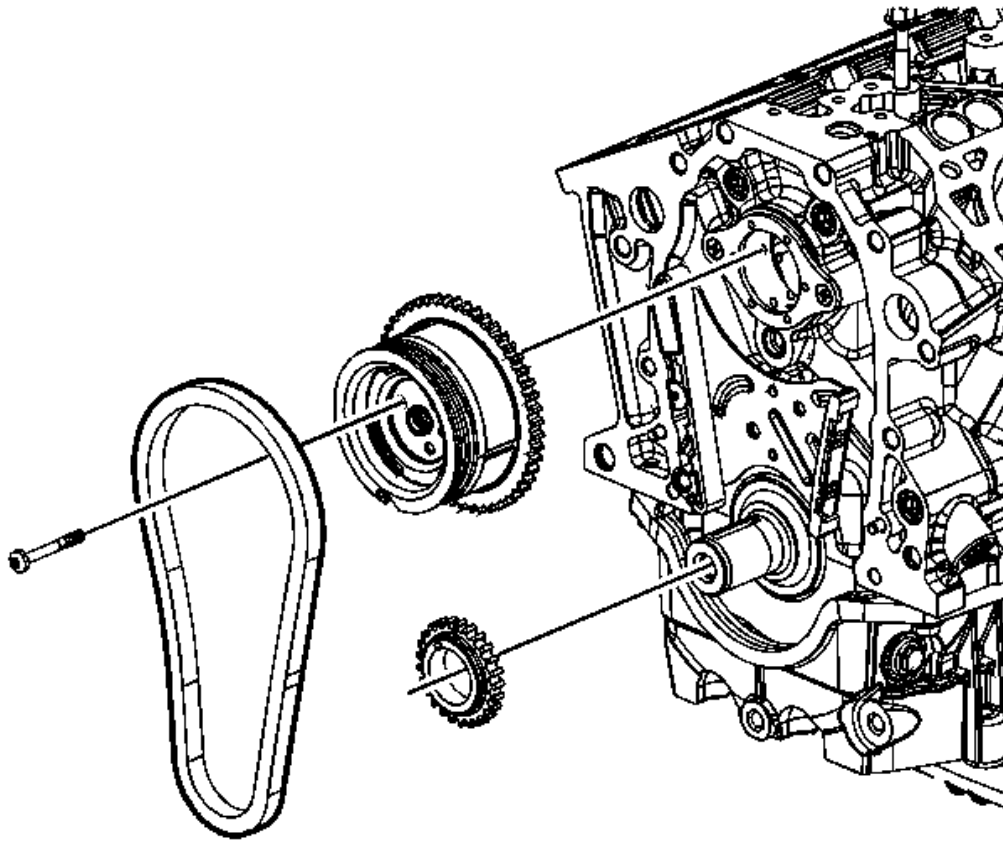


Fig. 165: Identifying Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

10. Align the dowel in the camshaft position actuator with the dowel hole in the camshaft.
11. Install the camshaft position actuator bolts.

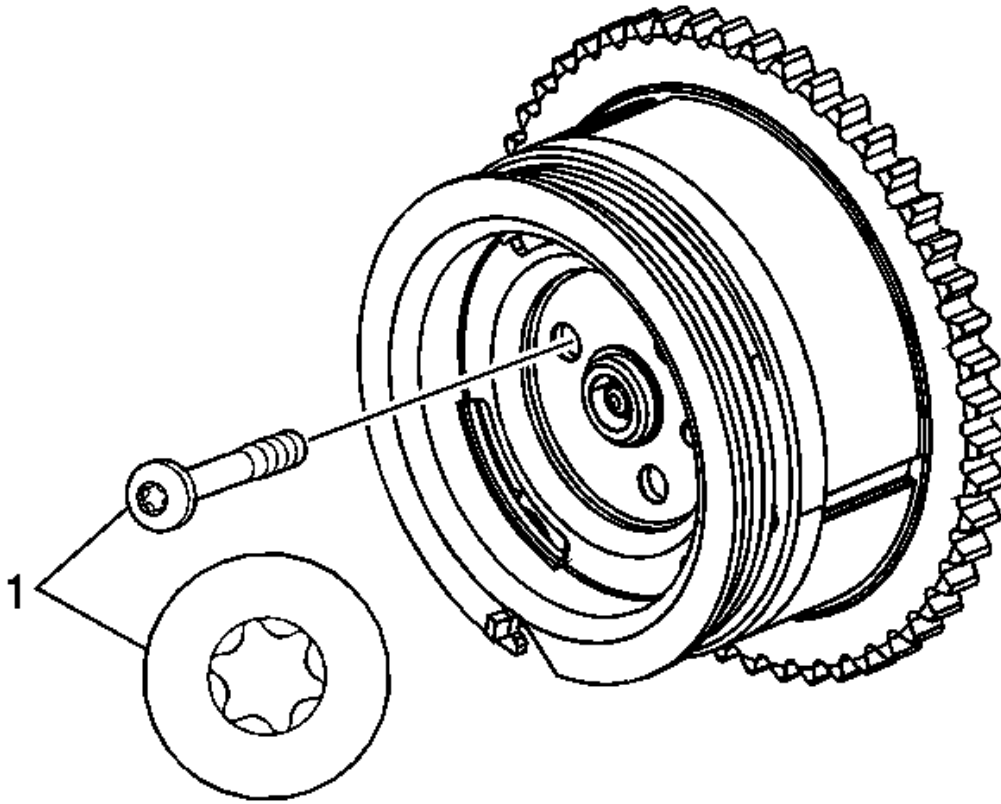


Fig. 166: Identifying Camshaft Position Actuator & Fasteners
Courtesy of GENERAL MOTORS CORP.

CAUTION: Use only a Torx Plus® Bit when removing or installing the camshaft position actuator fasteners (1). The Torx Plus® design differs from typical Torx® fastener. Use of a standard Torx® bit on Torx Plus® fasteners may result in a rounded out fastener head or incorrect faster torque.

NOTE: DO NOT use any type of threadlocking compound on the camshaft position actuator bolts. Usage of a threadlocking compound on the threads could lead to contamination of the camshaft position actuator, possibly resulting in potential damage to the actuator.

12. Draw the camshaft actuator onto the camshaft using the bolts.

Tighten: Tighten the bolts to 16 N.m (12 lb ft).

13. Remove the retaining pin from the timing chain tensioner in order to make the tensioner active.
14. Coat the crankshaft and camshaft sprockets with clean engine oil.
15. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

CYLINDER HEAD REPLACEMENT - LEFT SIDE

SPECIAL TOOLS

J 45059 Angle Meter

REMOVAL PROCEDURE

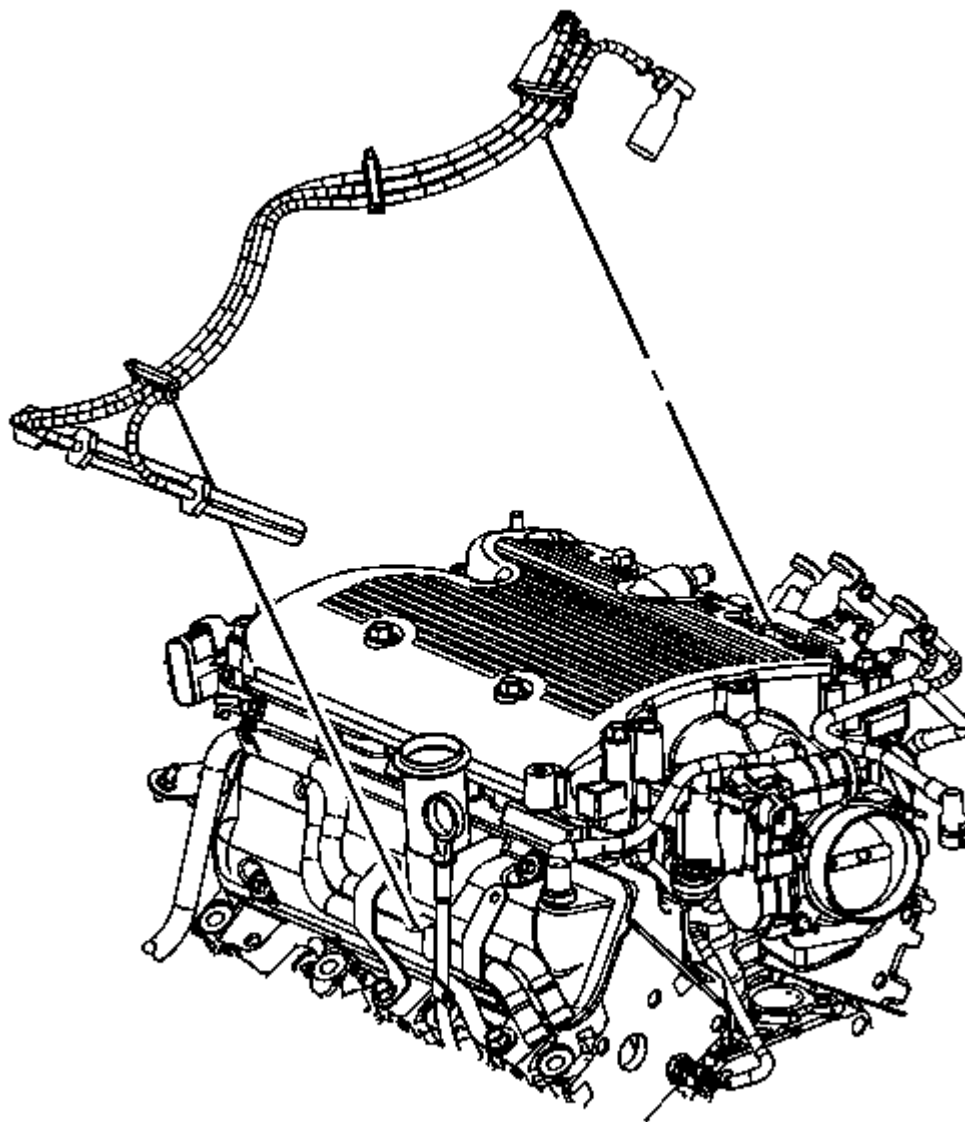


Fig. 167: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (LZE, LGD Static Fill)** or **Cooling System Draining and Filling (LZE, LGD GE47716 Fill)** .
2. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
3. Lower the vehicle.

4. Remove the lower intake manifold. Refer to **Lower Intake Manifold Replacement**.
5. Remove the valve rocker arms and the pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
6. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement - Left Side (LGD/LZE)** .
7. Remove the oil level indicator tube. Refer to **Oil Level Indicator Tube Replacement**.
8. Disconnect the left spark plug wires from the spark plugs.
9. Remove the spark plug wire clips from the brackets.
10. Disconnect and remove the left spark plug wires from the ignition coil.

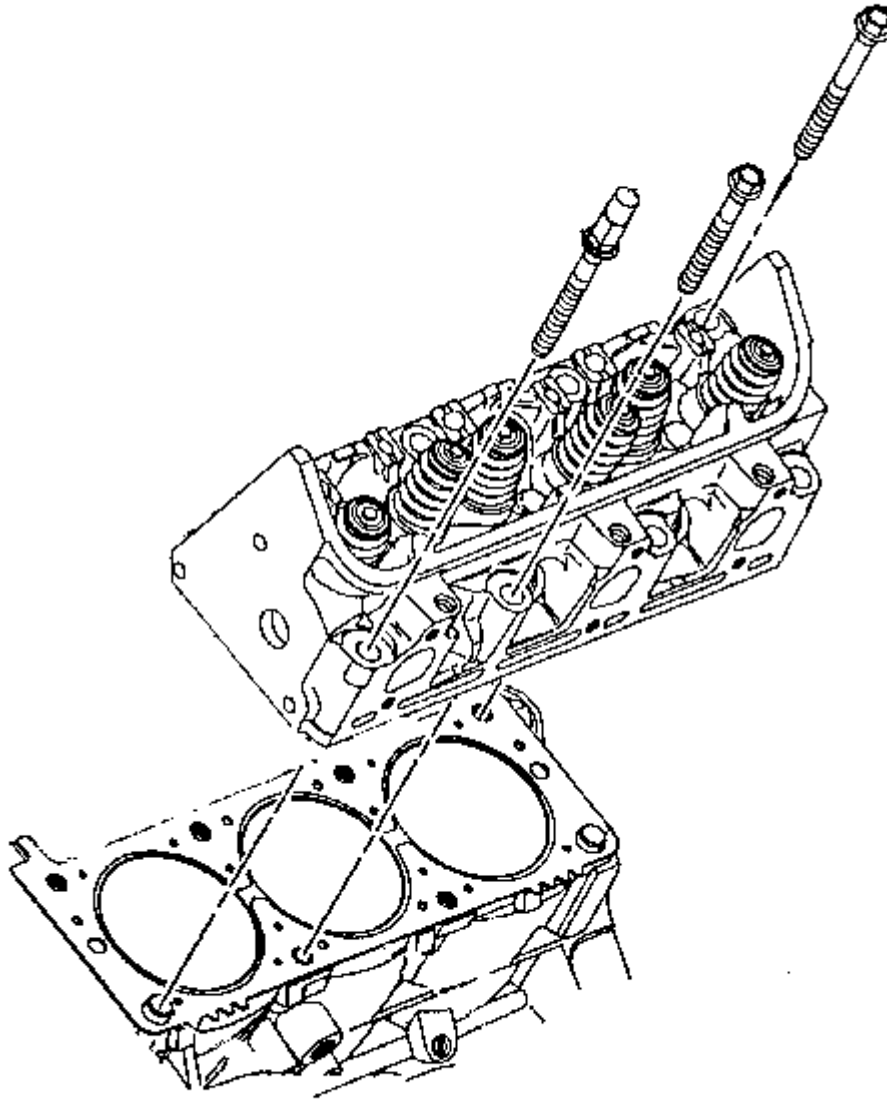


Fig. 168: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

11. Remove the left spark plugs. Refer to **Spark Plug Replacement** .
12. Remove and discard the cylinder head bolts.
13. Remove the cylinder head.

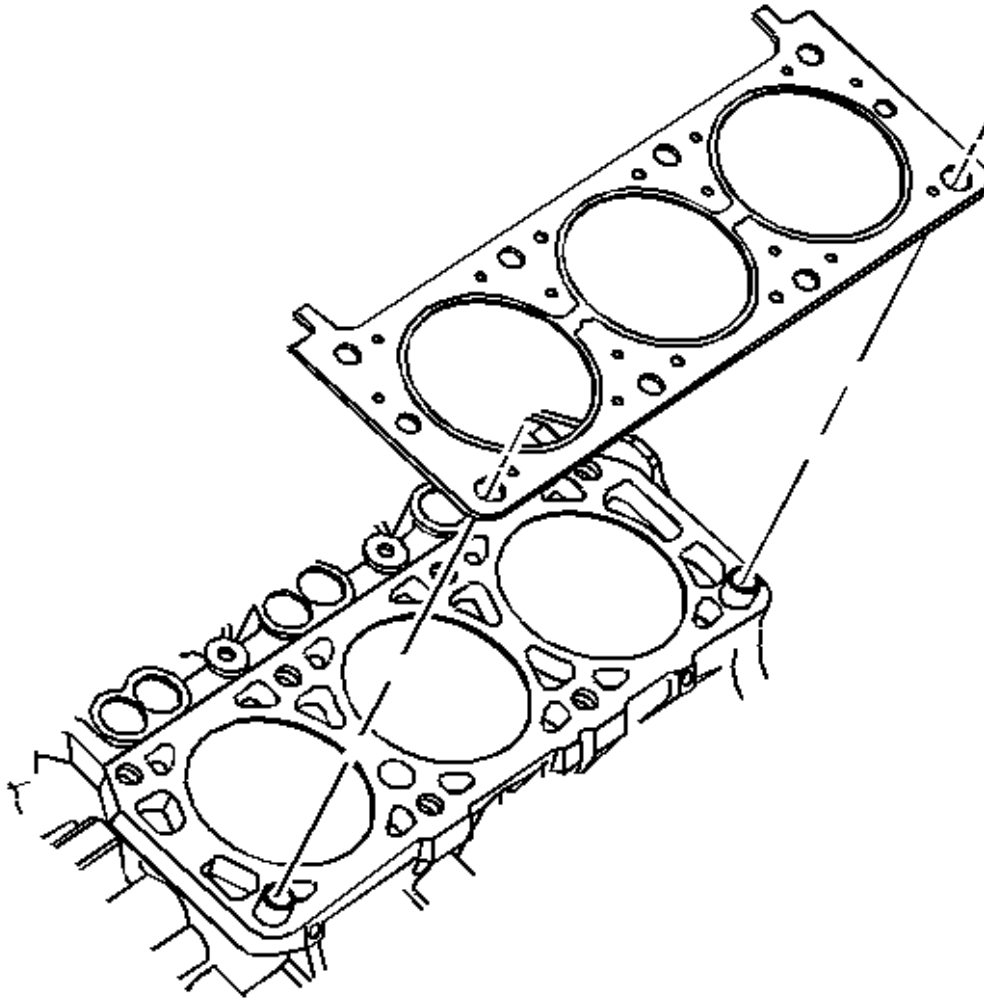


Fig. 169: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

14. Remove and discard the cylinder head gasket.
15. Remove the cylinder head locator dowel pins, if necessary.

INSTALLATION PROCEDURE

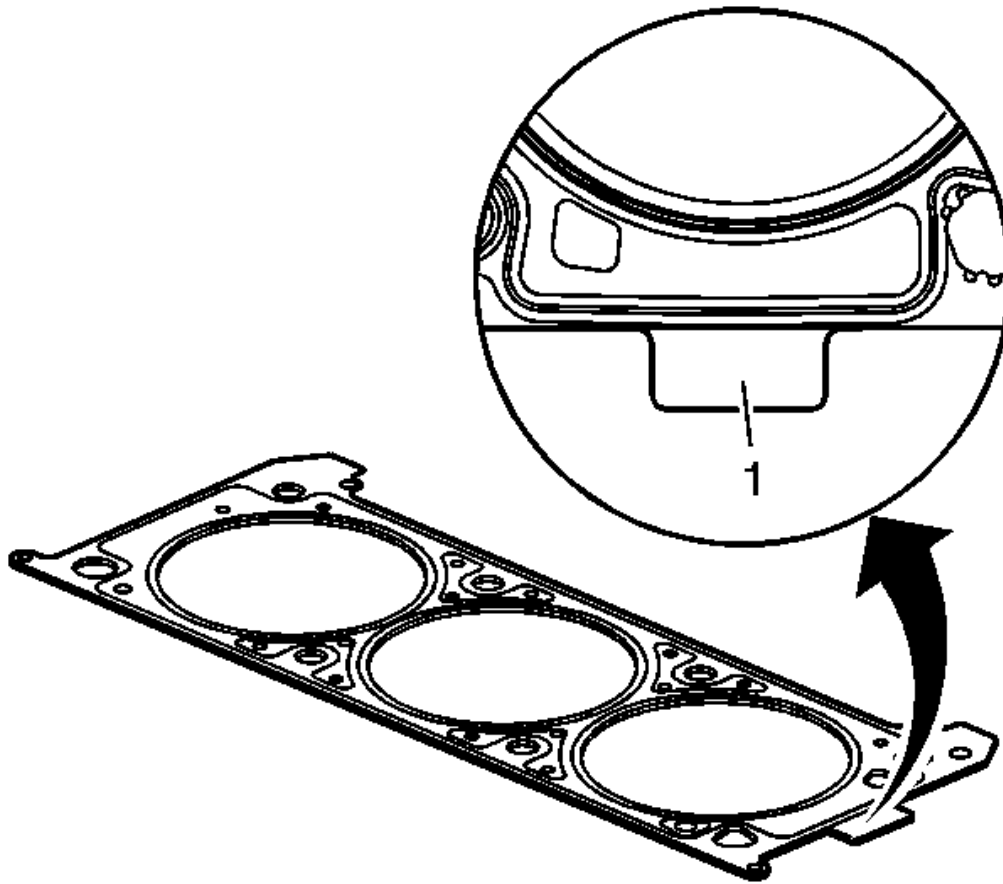


Fig. 170: Identifying Proper Cylinder Head Gasket Installation
Courtesy of GENERAL MOTORS CORP.

CAUTION: Head gaskets are specific for right hand and left hand applications, and also must be installed with the correct side facing up. Note the markings (1) on the head gaskets for proper installation. Failure to do so may lead to engine damage.

1. Install the cylinder head locator dowel pins, if necessary.
2. Inspect the cylinder head locator dowel pins for proper installation.

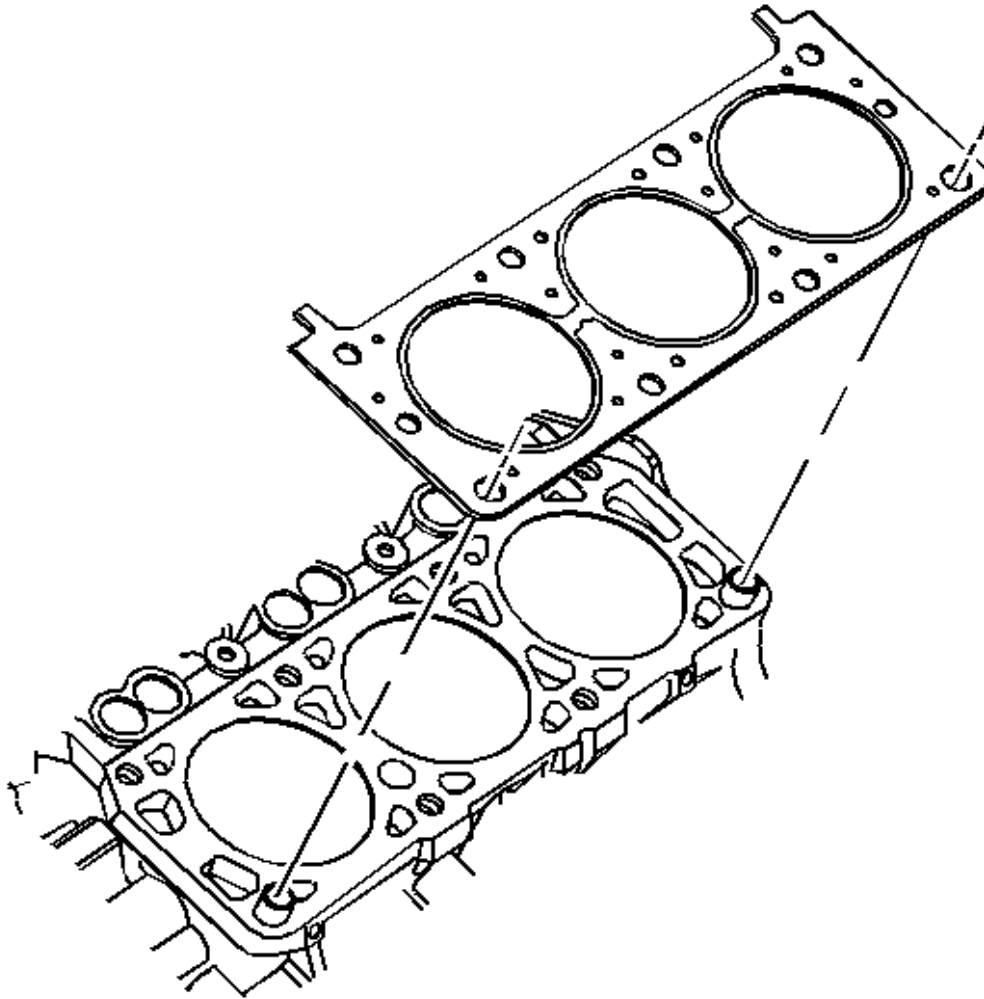


Fig. 171: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Install a NEW cylinder head gasket.

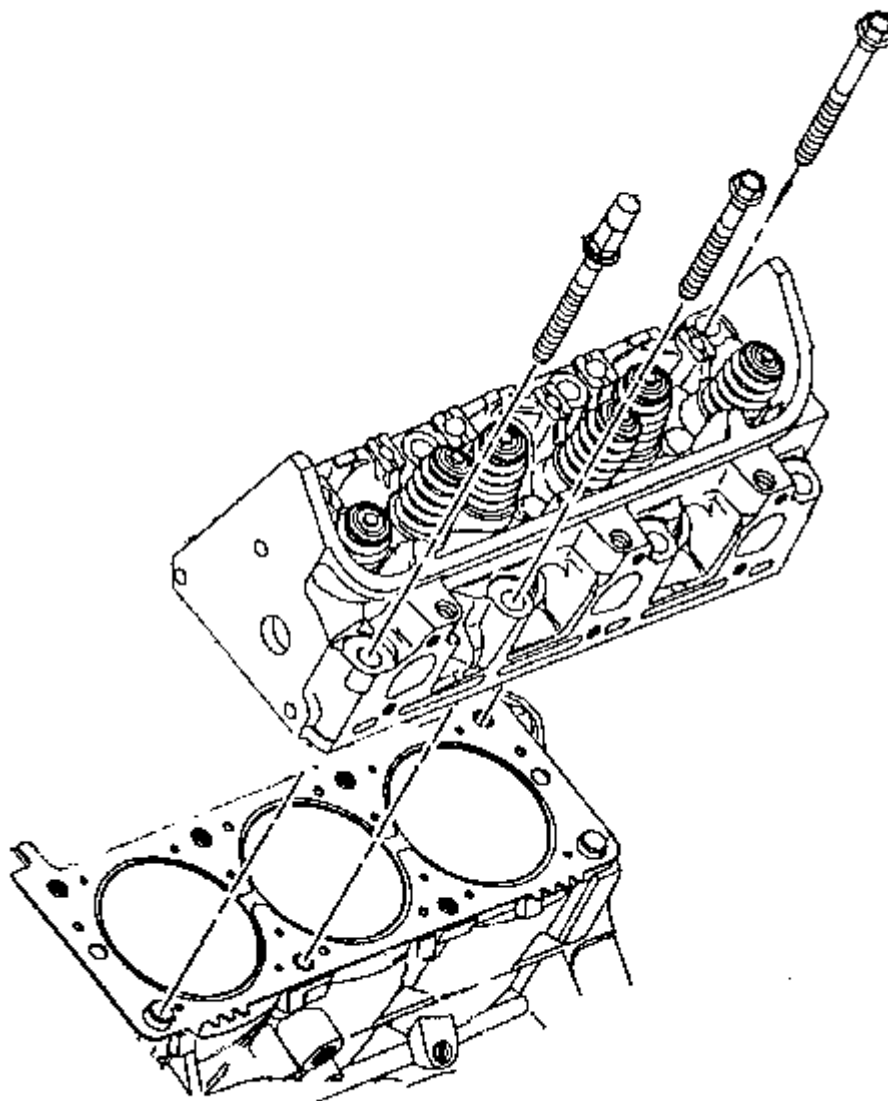


Fig. 172: View Of Cylinder Head

Courtesy of GENERAL MOTORS CORP.

CAUTION: This component uses torque-to-yield bolts. When servicing this component do not reuse the bolts, New torque-to-yield bolts must be installed. Reusing used torque-to-yield bolts will not provide proper bolt torque and clamp load. Failure to install NEW torque-to-yield bolts may lead to engine damage.

4. Install the cylinder head onto the locator pins and the engine.
5. Install NEW cylinder head bolts finger tight.

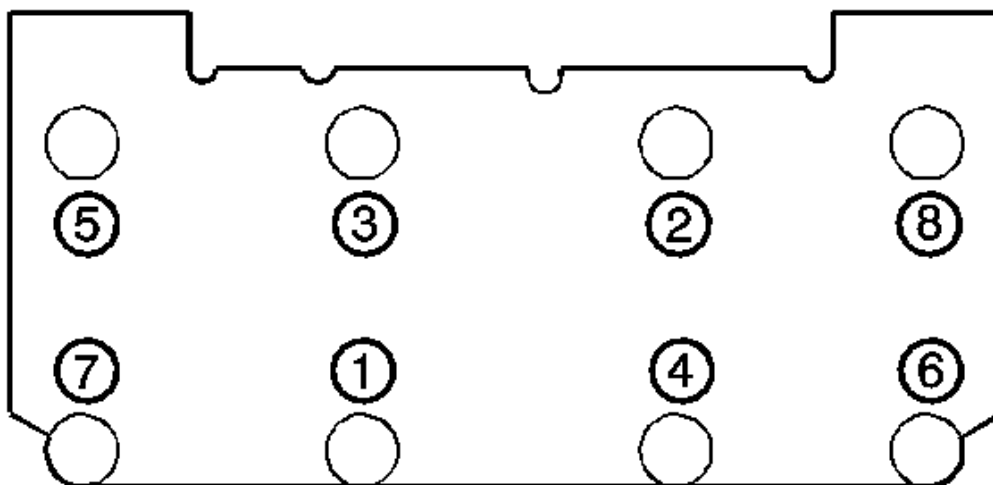


Fig. 173: View Of Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

6. Install the NEW small hex cylinder head bolts (5 and 8).
7. Install the NEW large hex cylinder head bolts (1, 2, 3, 4, 6 and 7).

Tighten:

1. Tighten the cylinder head bolts a first pass in sequence to 60 N.m (44 lb ft).
 2. Tighten the cylinder head bolts a final pass in sequence to 140 degrees using the **J 45059** .
8. Install the left spark plugs. Refer to Spark Plug Replacement .

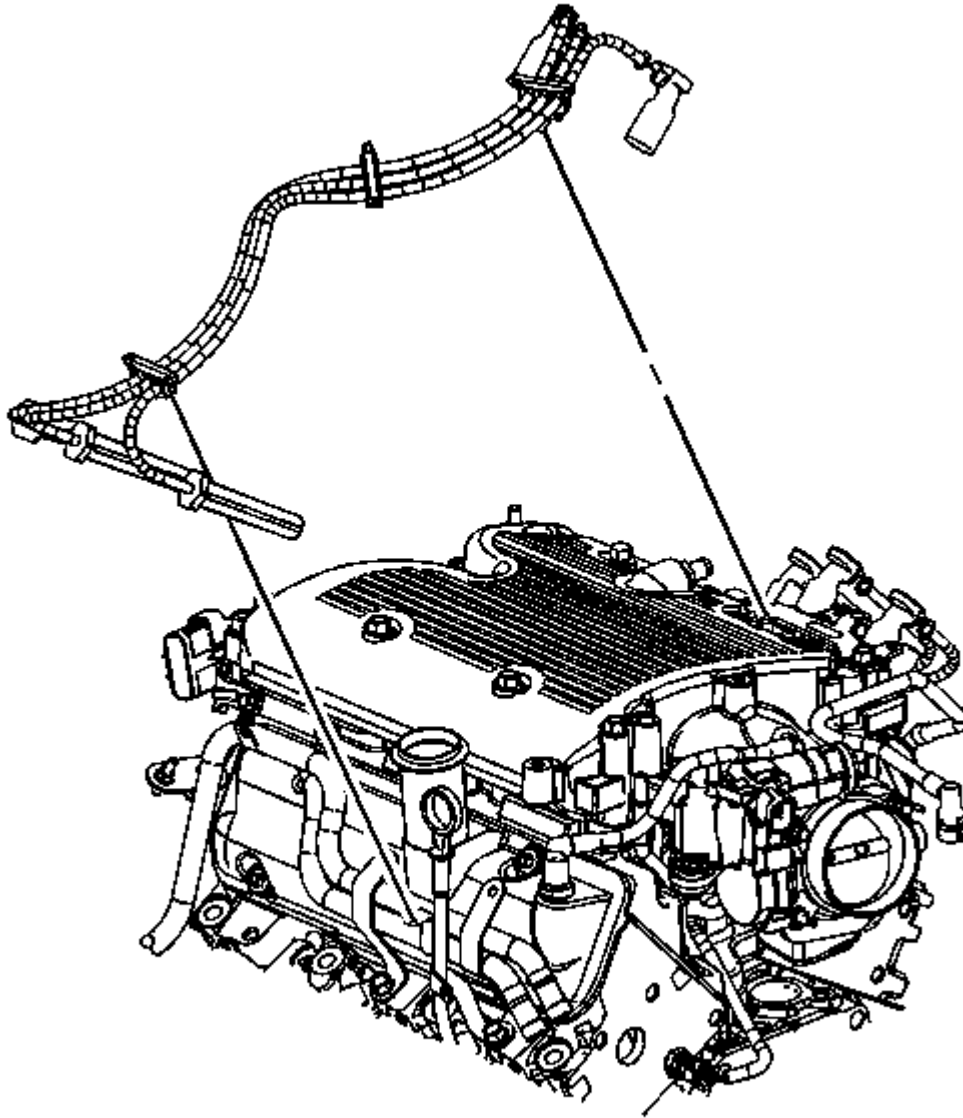


Fig. 174: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

9. Install and connect the left spark plug wires to the ignition coil.
10. Install the spark plug wire clips to the brackets.
11. Connect the left spark plug wires to the spark plugs.
12. Install the oil level indicator tube. Refer to **Oil Level Indicator Tube Replacement**.

13. Install the exhaust manifold. Refer to **Exhaust Manifold Replacement - Left Side (LGD/LZE)** .
14. Install the valve rocker arms and the pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
15. Install the lower intake manifold. Refer to **Lower Intake Manifold Replacement**.
16. Fill the engine with oil. Refer to **Engine Oil and Oil Filter Replacement**.
17. Fill the cooling system. Refer to **Cooling System Draining and Filling (LZE, LGD Static Fill)** or **Cooling System Draining and Filling (LZE, LGD GE47716 Fill)** .
18. Inspect for leaks.

CYLINDER HEAD REPLACEMENT - RIGHT SIDE

SPECIAL TOOLS

J 45059 Angle Meter

REMOVAL PROCEDURE

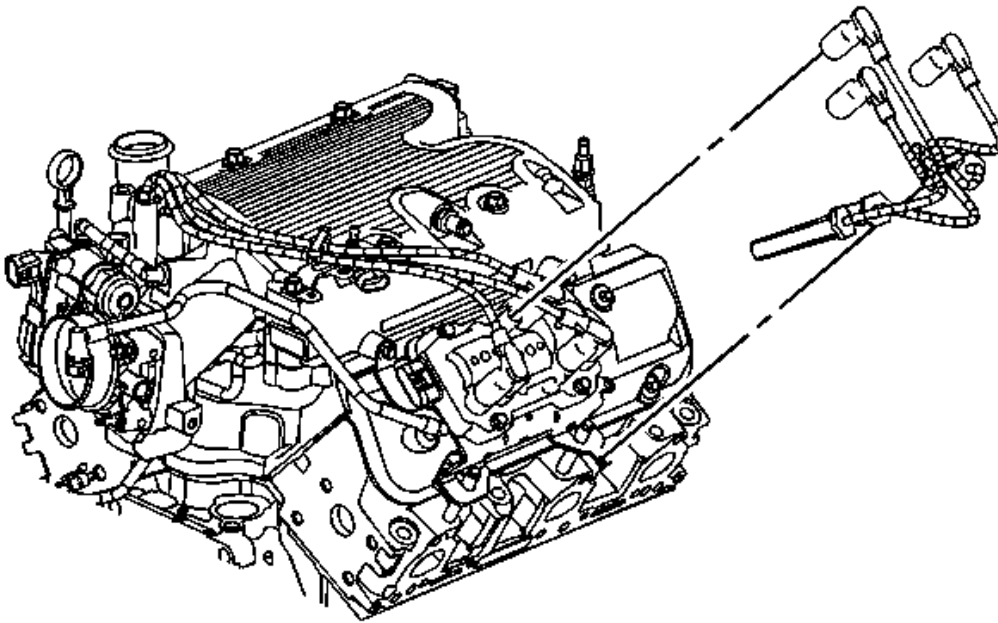


Fig. 175: Right Side Spark Plug Wires & Ignition Coil
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (LZE, LGD Static Fill)** or

Cooling System Draining and Filling (LZE, LGD GE47716 Fill) .

2. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
3. Lower the vehicle.
4. Remove the lower intake manifold. Refer to **Lower Intake Manifold Replacement**.
5. Remove the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
6. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement - Right Side (LGD/LZE) .**
7. Disconnect the right spark plug wires from the spark plugs.
8. Remove the spark plug wire clip from the bracket.
9. Disconnect and remove the right spark plug wires from the ignition coil.
10. Remove the right spark plugs. Refer to **Spark Plug Replacement** .
11. Remove the generator. Refer to **Generator Replacement (LGD/LZE) .**

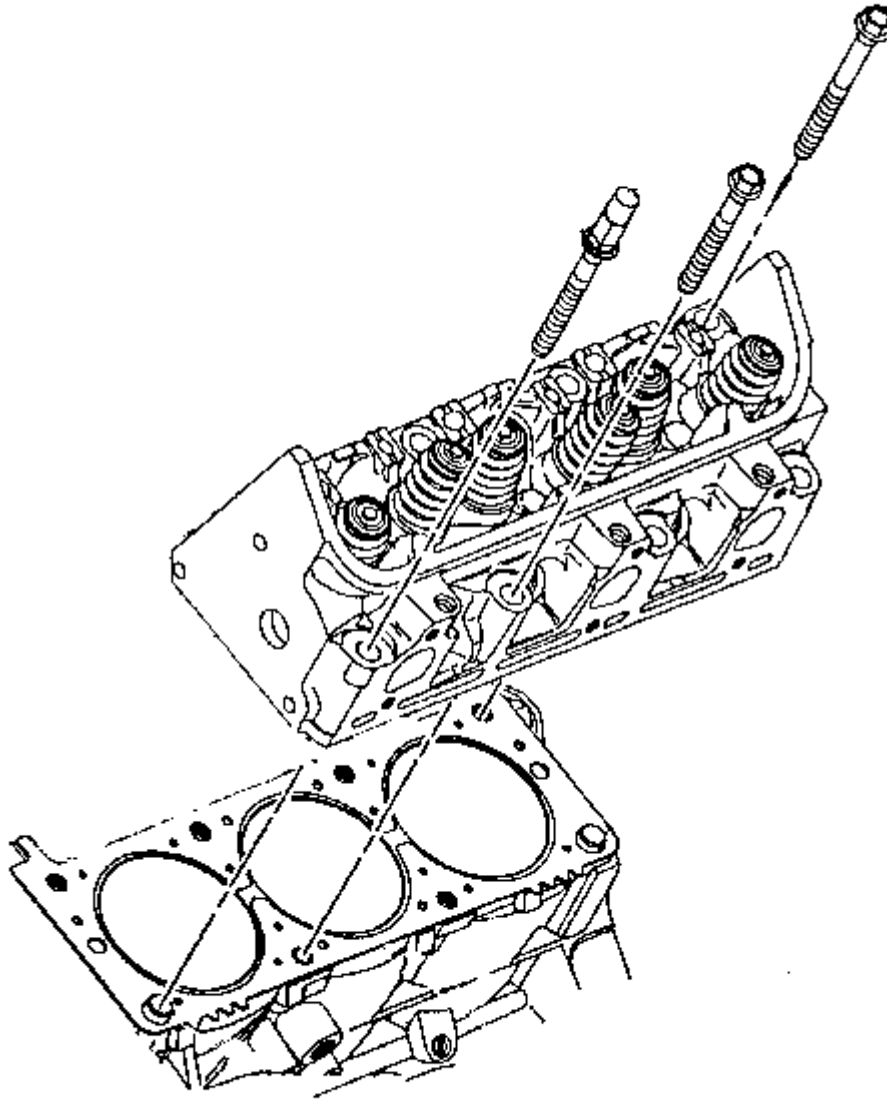


Fig. 176: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

12. Remove and discard the cylinder head bolts.
13. Remove the cylinder head.

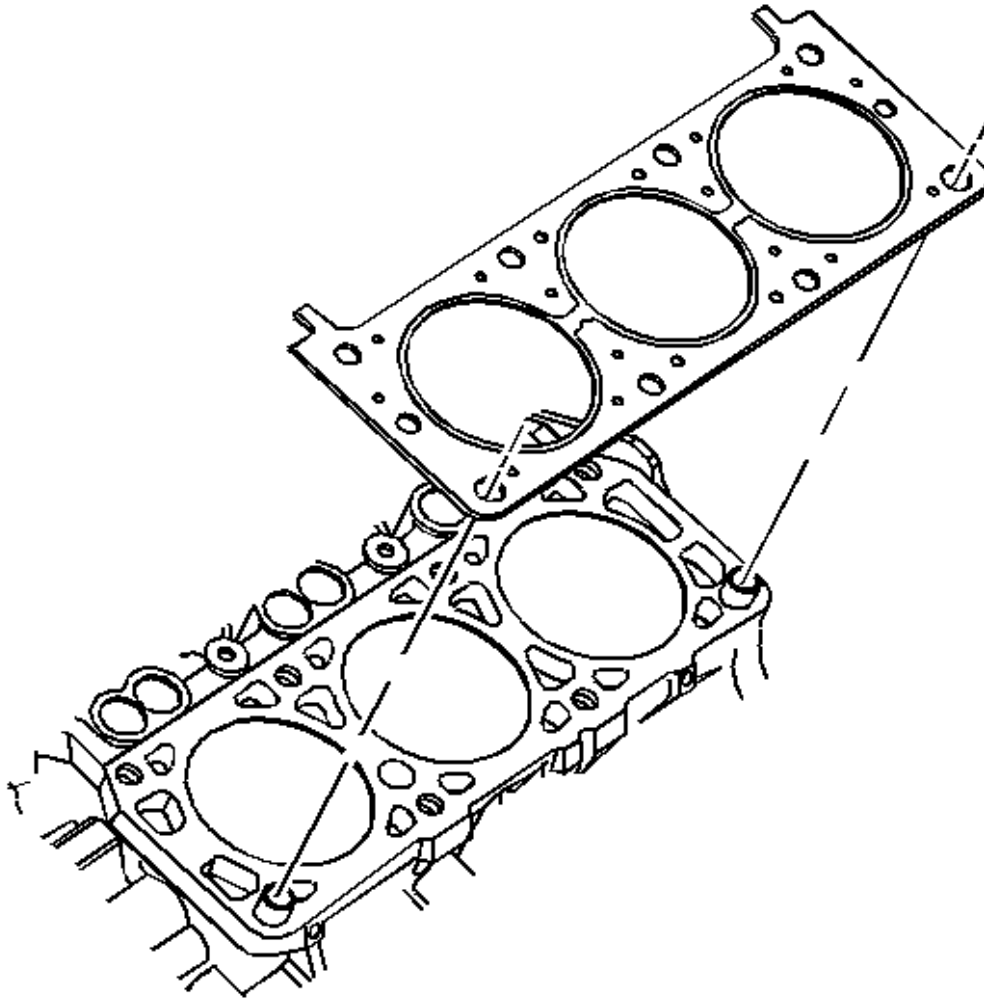


Fig. 177: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

14. Remove and discard the cylinder head gasket.
15. Remove the cylinder head locator dowel pins, if necessary.

INSTALLATION PROCEDURE

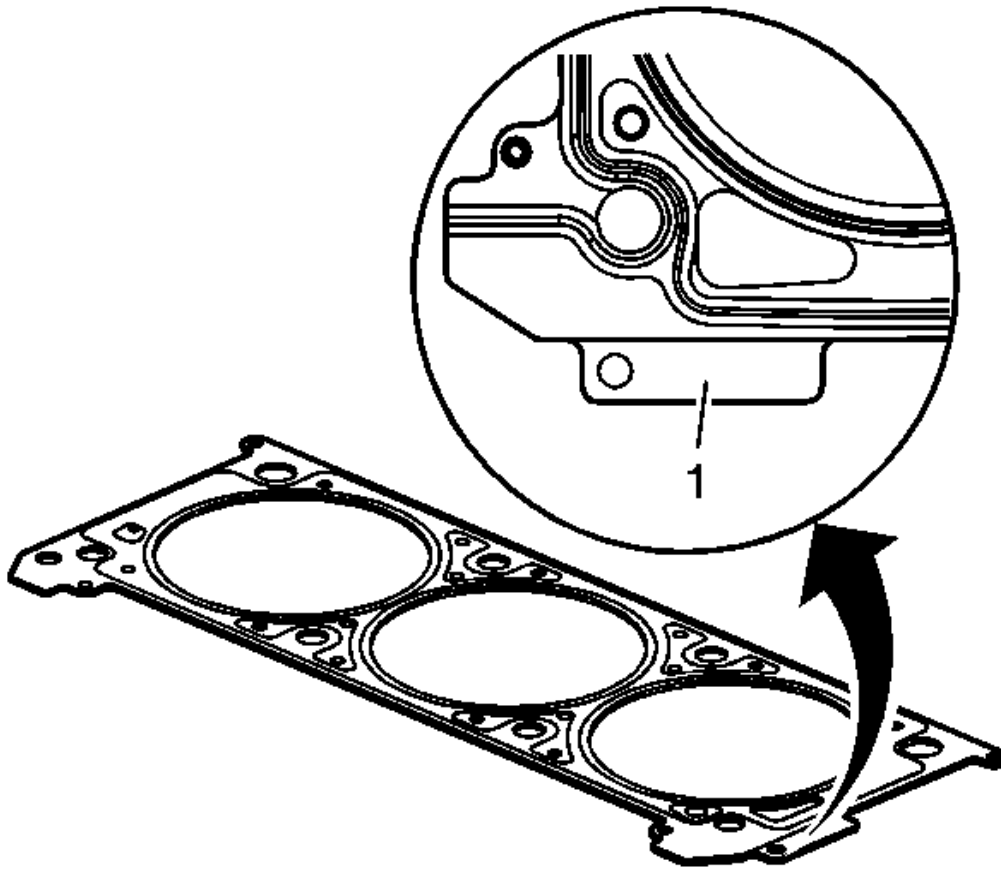


Fig. 178: Identifying Proper Cylinder Head Gasket Installation
Courtesy of GENERAL MOTORS CORP.

CAUTION: Head gaskets are specific for right hand and left hand applications, and also must be installed with the correct side facing up. Note the markings (1) on the head gaskets for proper installation. Failure to do so may lead to engine damage.

1. Install the cylinder head locator dowel pins, if necessary.
2. Inspect the cylinder head locator dowel pins for proper installation.

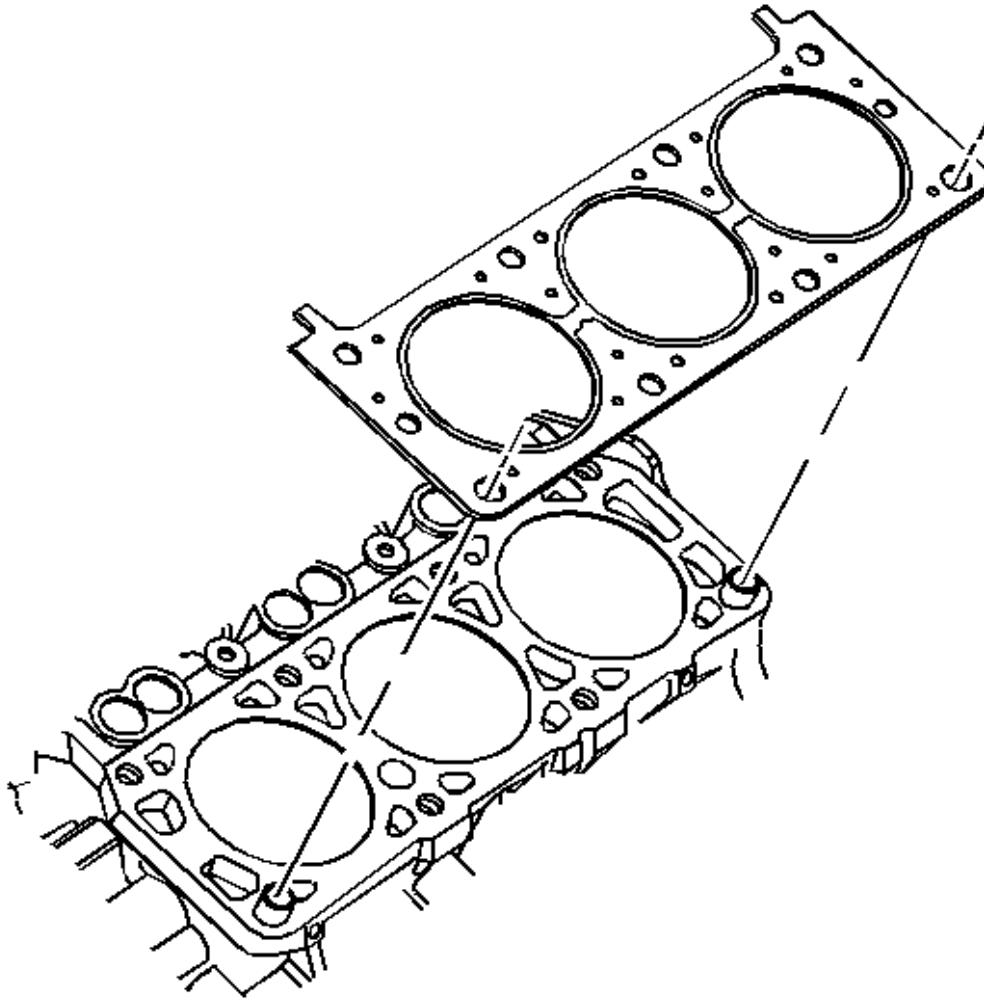


Fig. 179: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Install a NEW cylinder head gasket.

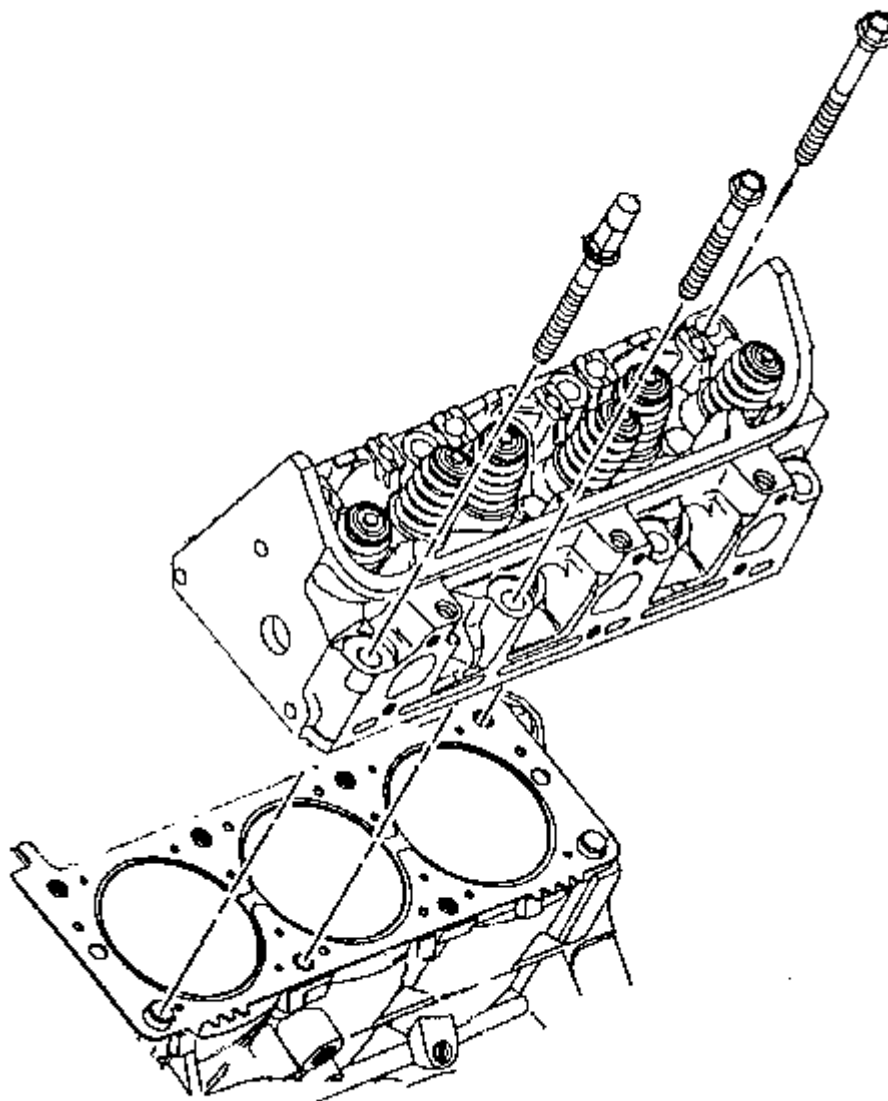


Fig. 180: View Of Cylinder Head

Courtesy of GENERAL MOTORS CORP.

CAUTION: This component uses torque-to-yield bolts. When servicing this component do not reuse the bolts, New torque-to-yield bolts must be installed. Reusing used torque-to-yield bolts will not provide proper bolt torque and clamp load. Failure to install NEW torque-to-yield bolts may lead to engine damage.

4. Install the cylinder head onto the locator pins and the engine.
5. Install NEW cylinder head bolts finger tight.

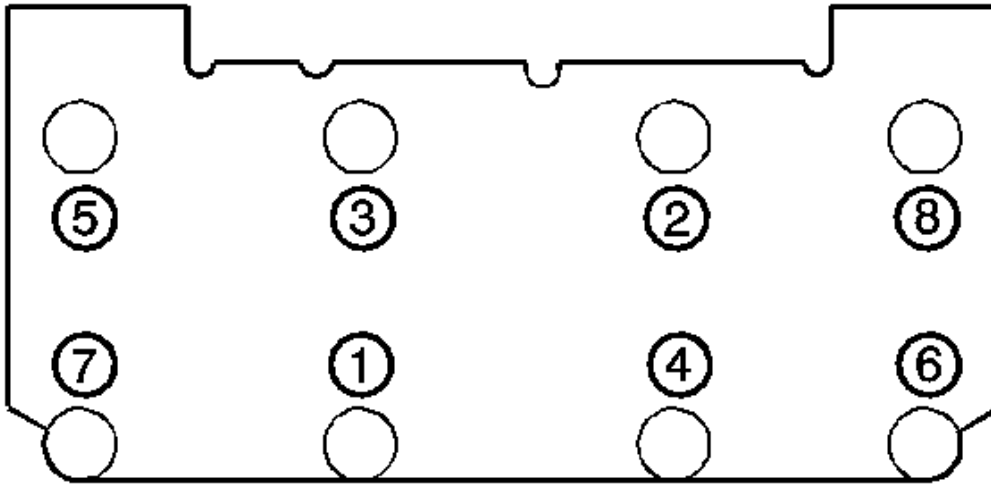


Fig. 181: View Of Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

6. Install the NEW small hex cylinder head bolts (5 and 8).
7. Install the NEW large hex cylinder head bolts (1, 2, 3, 4, 6 and 7).

Tighten:

1. Tighten the cylinder head bolts a first pass in sequence to 60 N.m (44 lb ft).
2. Tighten the cylinder head bolts a final pass in sequence to 140 degrees using the **J 45059** .
8. Install the generator. Refer to Generator Replacement (LGD/LZE) .
9. Install the right spark plugs. Refer to Spark Plug Replacement .

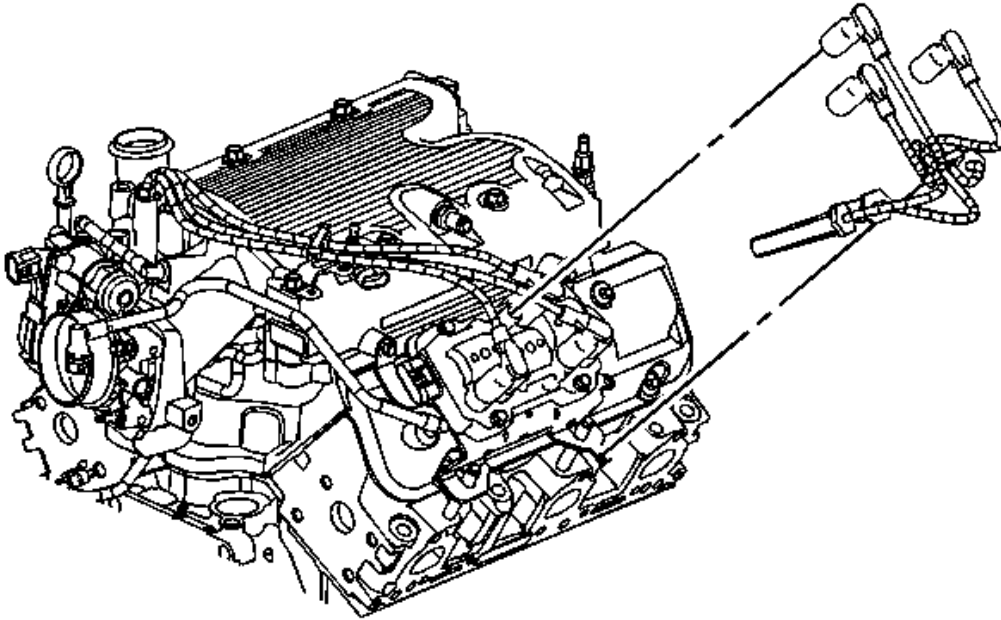


Fig. 182: Right Side Spark Plug Wires & Ignition Coil
Courtesy of GENERAL MOTORS CORP.

10. Install and connect the right spark plug wires to the ignition coil.
11. Install the spark plug wire clip to the bracket.
12. Connect the right spark plug wires to the spark plugs.
13. Install the exhaust manifold. Refer to **Exhaust Manifold Replacement - Right Side (LGD/LZE)** .
14. Install the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
15. Install the lower intake manifold. Refer to **Lower Intake Manifold Replacement**.
16. Fill the engine with oil. Refer to **Engine Oil and Oil Filter Replacement**.
17. Fill the cooling system. Refer to **Cooling System Draining and Filling (LZE, LGD Static Fill)** or **Cooling System Draining and Filling (LZE, LGD GE47716 Fill)** .
18. Inspect for leaks.

ENGINE FLYWHEEL REPLACEMENT

SPECIAL TOOLS

J 37096 Flywheel Holder. See **Special Tools** .

REMOVAL PROCEDURE

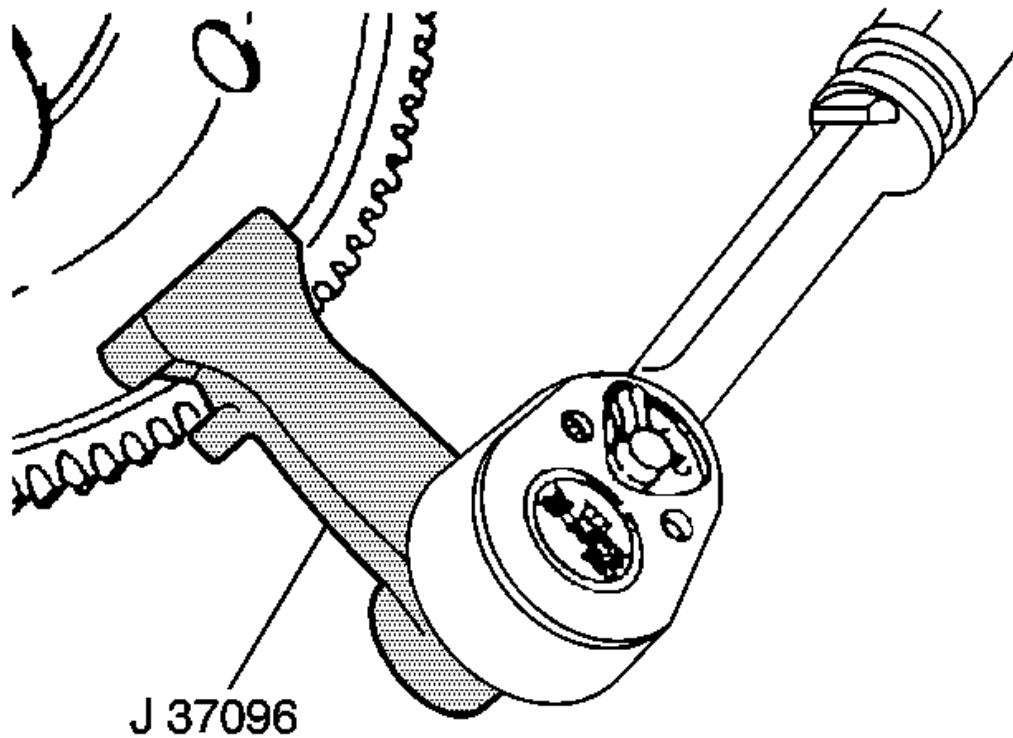


Fig. 183: Holding Flywheel

Courtesy of GENERAL MOTORS CORP.

1. Remove the automatic transaxle, if equipped. Refer to **Transmission Replacement (LZE and LZ9)**.
2. Use the **J 37096** to secure the flywheel in order to prevent the crankshaft from rotating. See **Special Tools**.

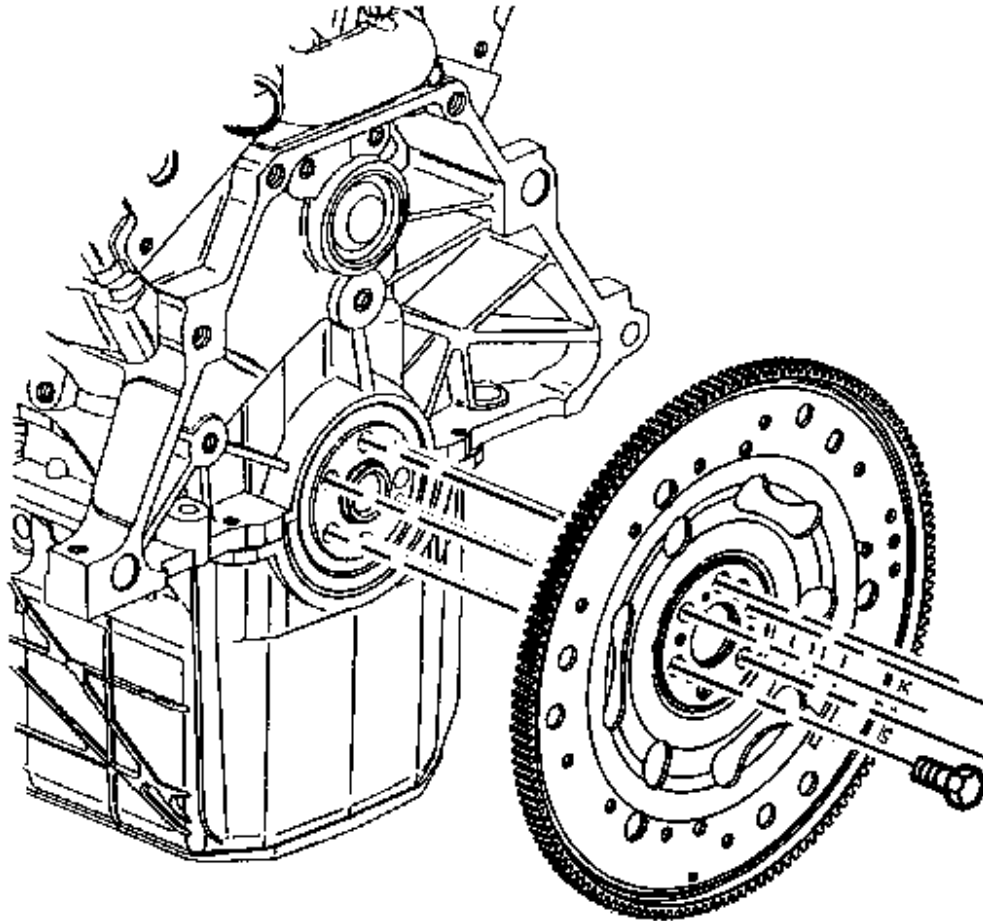


Fig. 184: View Of Flywheel

Courtesy of GENERAL MOTORS CORP.

3. Loosen the flywheel bolts.
4. Remove 5 of the 6 flywheel bolts leaving one bolt at the top of the crankshaft.
5. Grip the flywheel and remove the remaining bolt. Do not drop the flywheel when removing the final bolt.
6. Remove the engine flywheel.
7. Clean the engine flywheel bolt threads and bolt holes.

INSTALLATION PROCEDURE

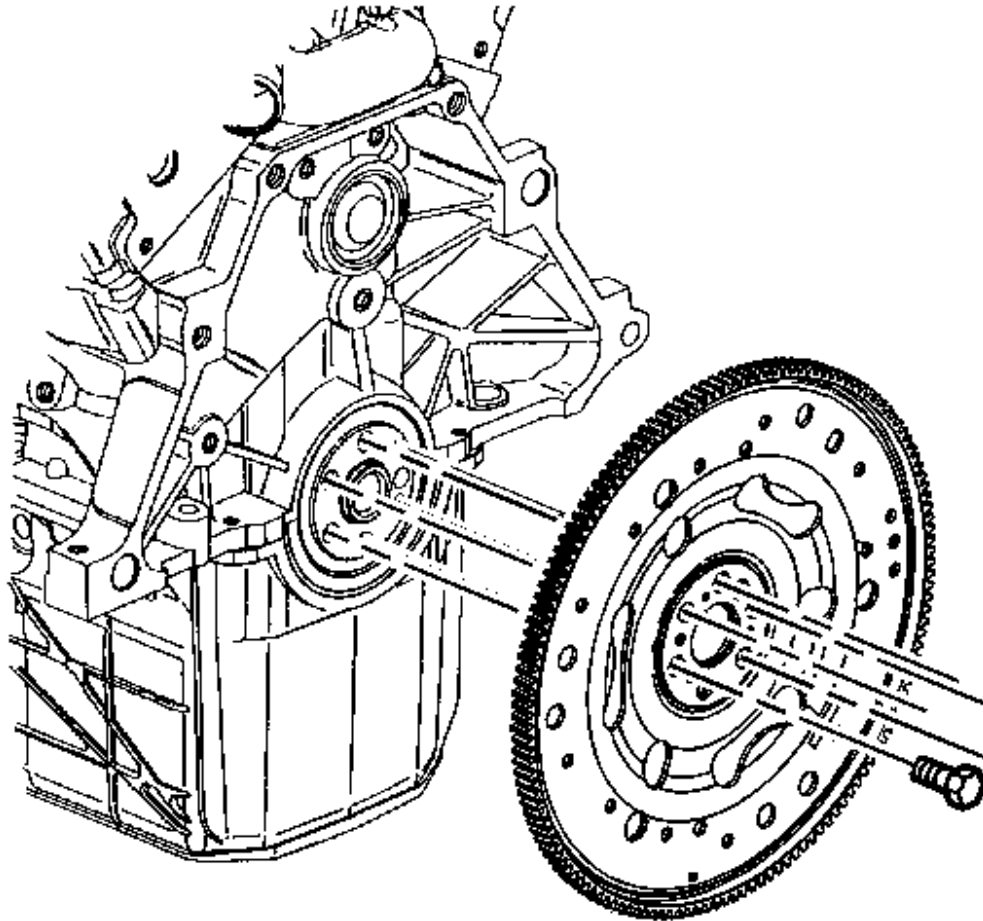


Fig. 185: View Of Flywheel

Courtesy of GENERAL MOTORS CORP.

1. Position the flywheel to the crankshaft.
2. Install the flywheel bolts finger tight.
3. Use the **J 37096** to secure the flywheel in order to prevent the crankshaft from rotating. See **Special Tools** .

CAUTION: Refer to **Fastener Caution** .

4. Tighten the engine flywheel bolts.

Tighten: Tighten the bolts to 70 N.m (52 lb ft).

5. Install the automatic transaxle, if equipped. Refer to [Transmission Replacement \(LZE and LZ9\)](#) .

CRANKSHAFT REAR OIL SEAL REPLACEMENT

REMOVAL PROCEDURE

1. Remove the flywheel. Refer to [Engine Flywheel Replacement](#).
2. Remove the crankshaft rear oil seal. Refer to [Crankshaft Rear Oil Seal Removal](#) .

INSTALLATION PROCEDURE

1. Install the rear main seal. Refer to [Crankshaft Rear Oil Seal Installation](#) .
2. Install the engine flywheel. Refer to [Engine Flywheel Replacement](#).

CAMSHAFT REAR BEARING HOLE PLUG REPLACEMENT

REMOVAL PROCEDURE

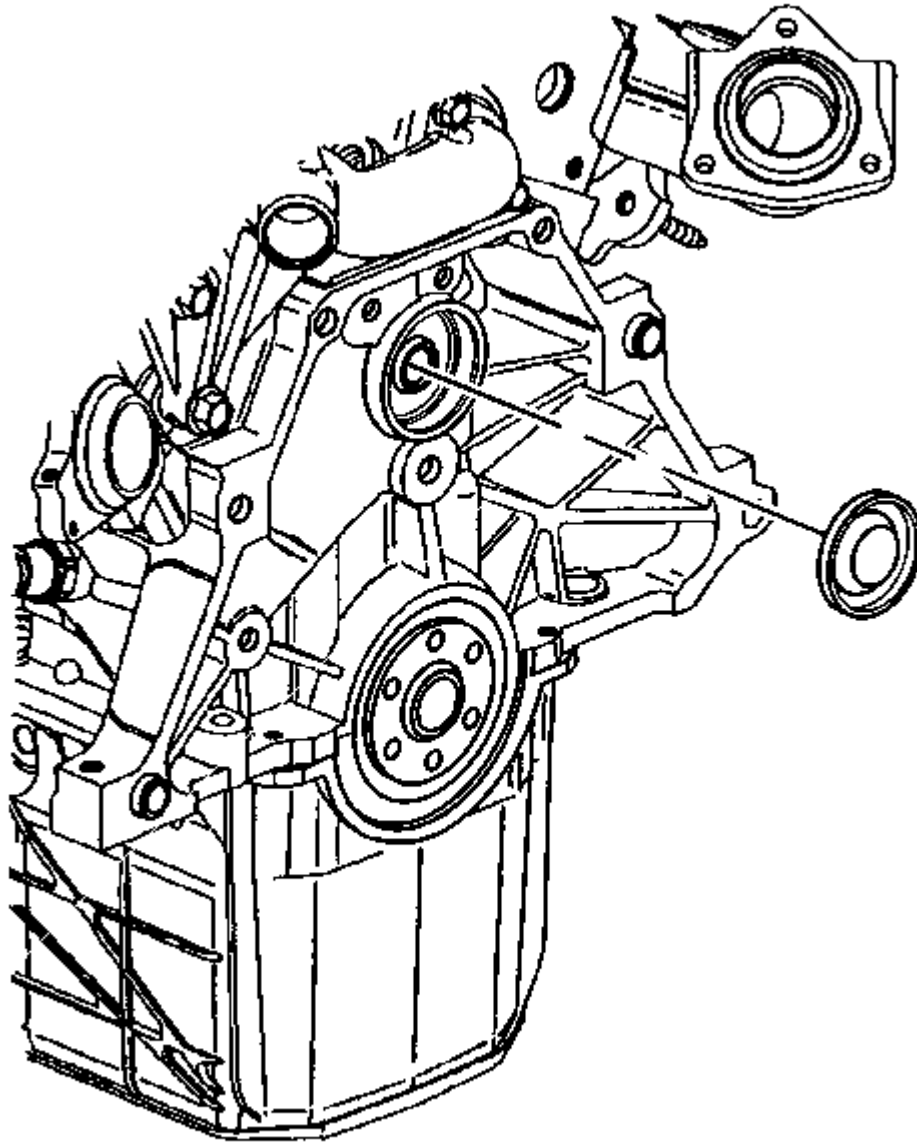


Fig. 186: View Of Camshaft Rear Bearing Hole Plug
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine flywheel. Refer to **Engine Flywheel Replacement**.
2. Remove the camshaft rear bearing hole plug.

INSTALLATION PROCEDURE

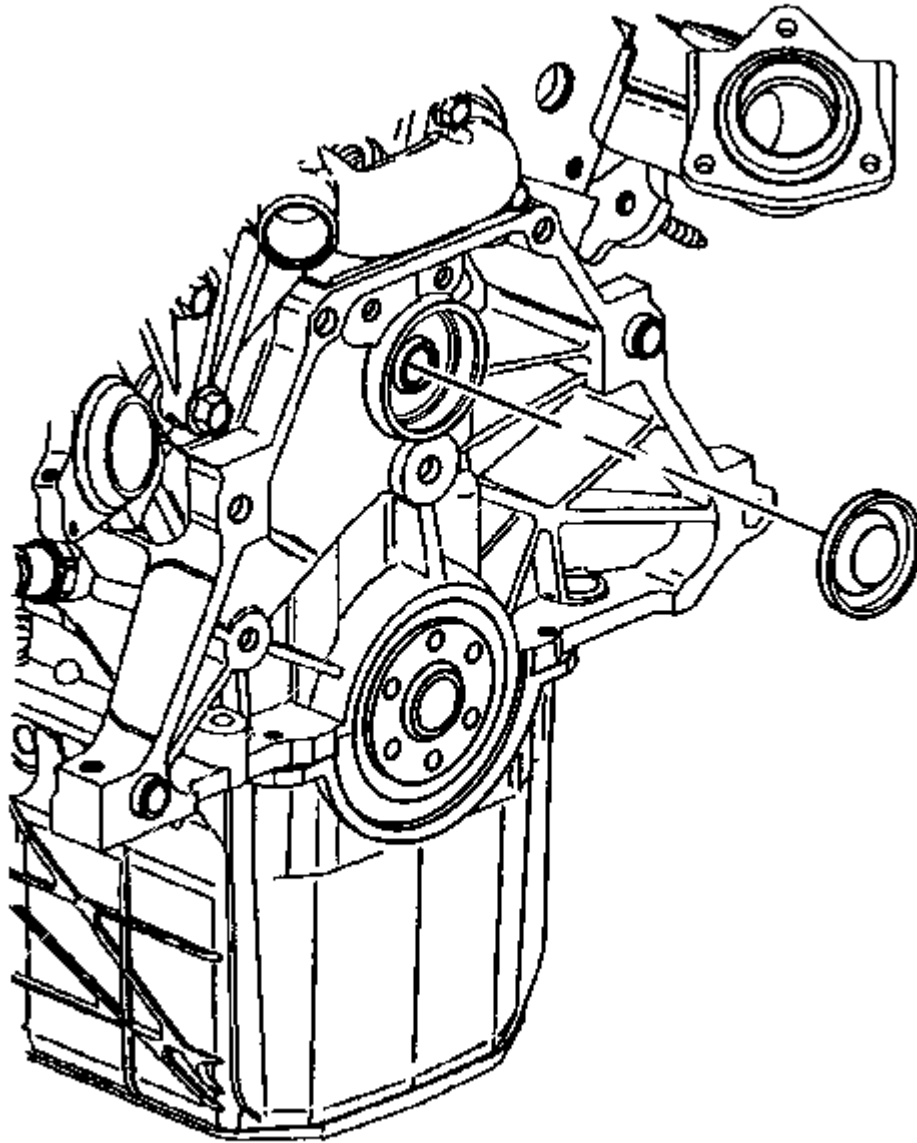


Fig. 187: View Of Camshaft Rear Bearing Hole Plug
Courtesy of GENERAL MOTORS CORP.

1. Coat the camshaft rear bearing hole plug with sealer. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .
2. Install the camshaft rear bearing hole plug.

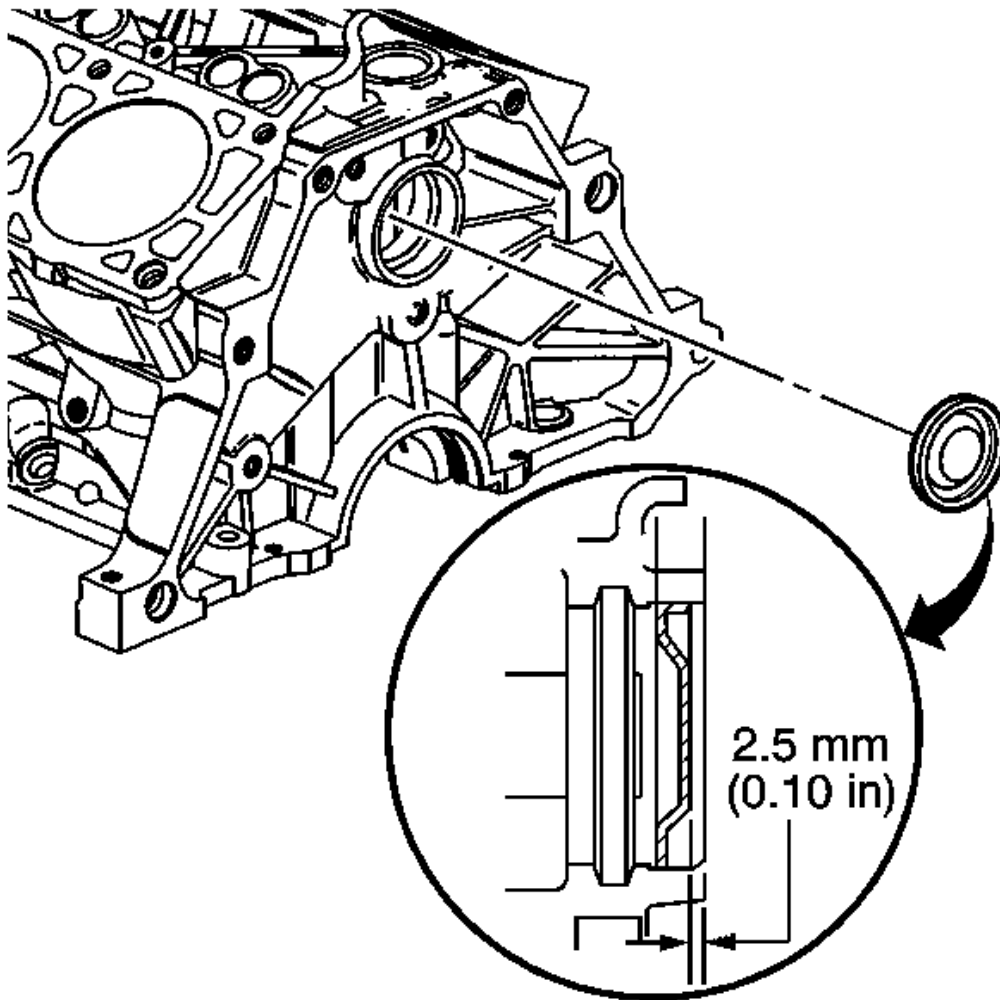


Fig. 188: Identifying Camshaft Rear Bearing Hole Plug Installation Depth
Courtesy of GENERAL MOTORS CORP.

3. Ensure that the camshaft rear bearing plug is installed to specifications.
4. Install the engine flywheel. Refer to **Engine Flywheel Replacement**.

ENGINE REPLACEMENT

REMOVAL PROCEDURE

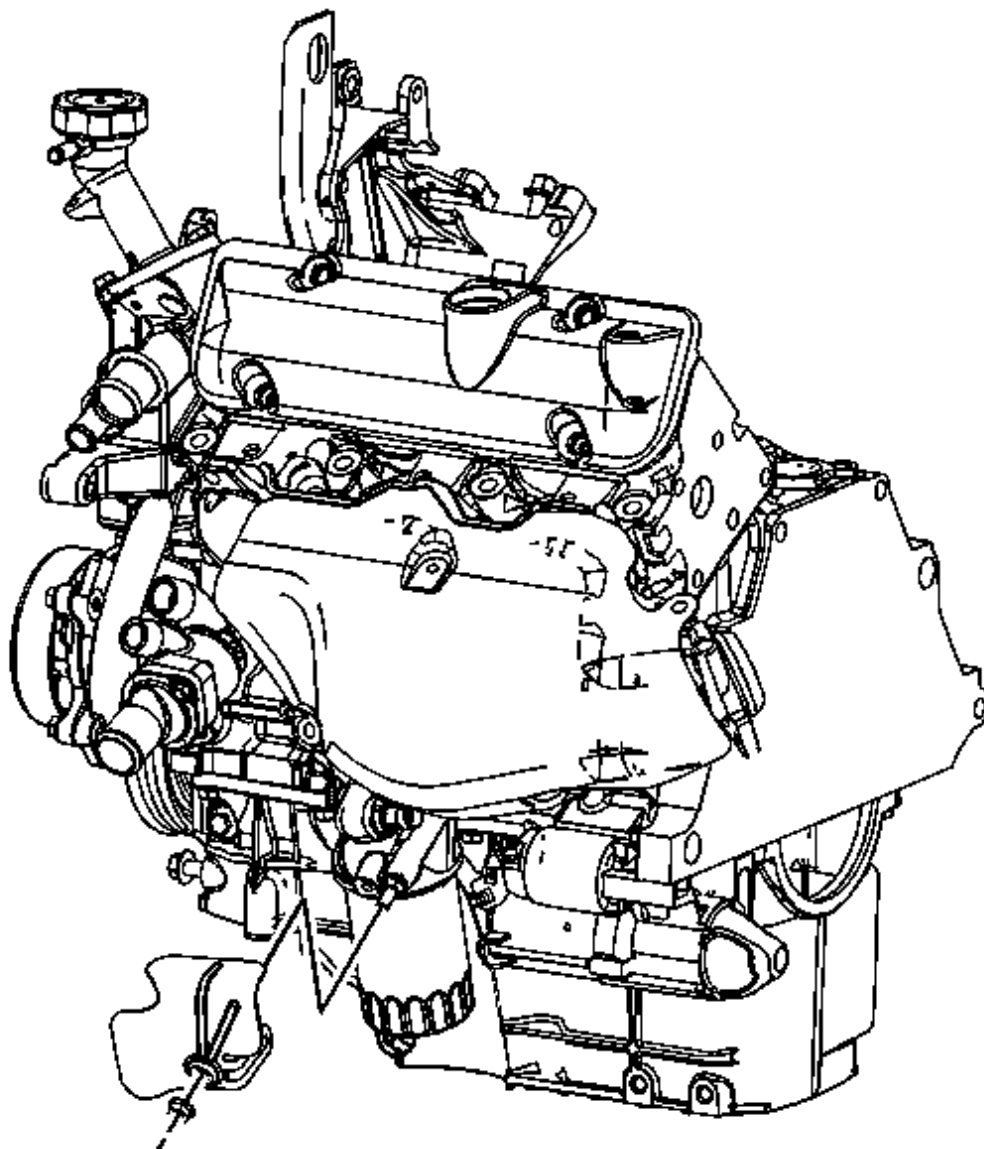


Fig. 189: Oil Pressure Sensor Heat Shield & Nut
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (LGD/LZE)** .
2. Remove the hood. Refer to **Hood Replacement** .
3. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

4. Remove the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#) .
5. Remove the engine mount struts. Refer to [Engine Mount Strut Replacement](#).
6. Remove the drive belt. Refer to [Drive Belt Replacement](#).
7. Drain the cooling system. Refer to [Cooling System Draining and Filling \(LZE, LGD Static Fill\)](#) or [Cooling System Draining and Filling \(LZE, LGD GE47716 Fill\)](#) .
8. Drain the engine oil. Refer to [Engine Oil and Oil Filter Replacement](#).
9. Remove the oil pressure sensor heat shield nuts and shield.

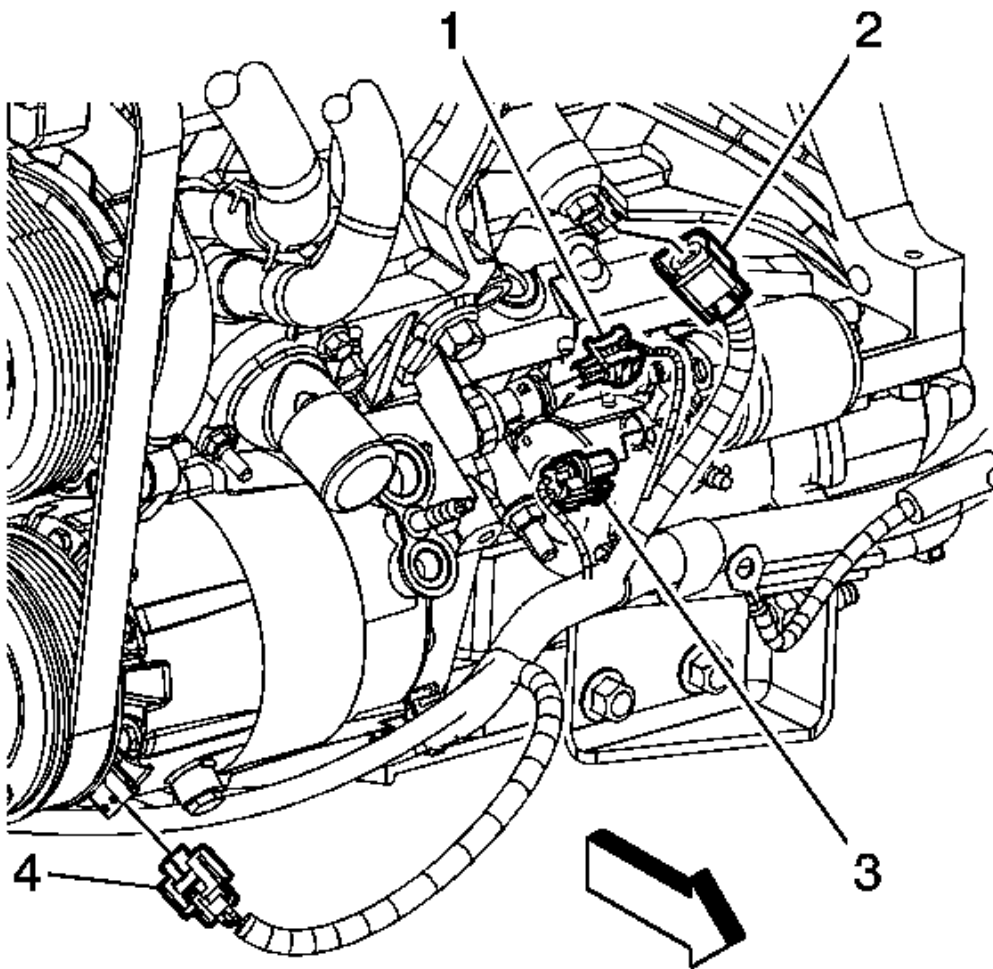


Fig. 190: Identifying Electrical Connector
 Courtesy of GENERAL MOTORS CORP.

10. Disconnect the oil pressure sensor electrical connector (1).

11. Disconnect the knock sensor electrical connector (2).
12. Disconnect the starter motor electrical connector (3).
13. Disconnect the air conditioning (A/C) compressor electrical connector (4).

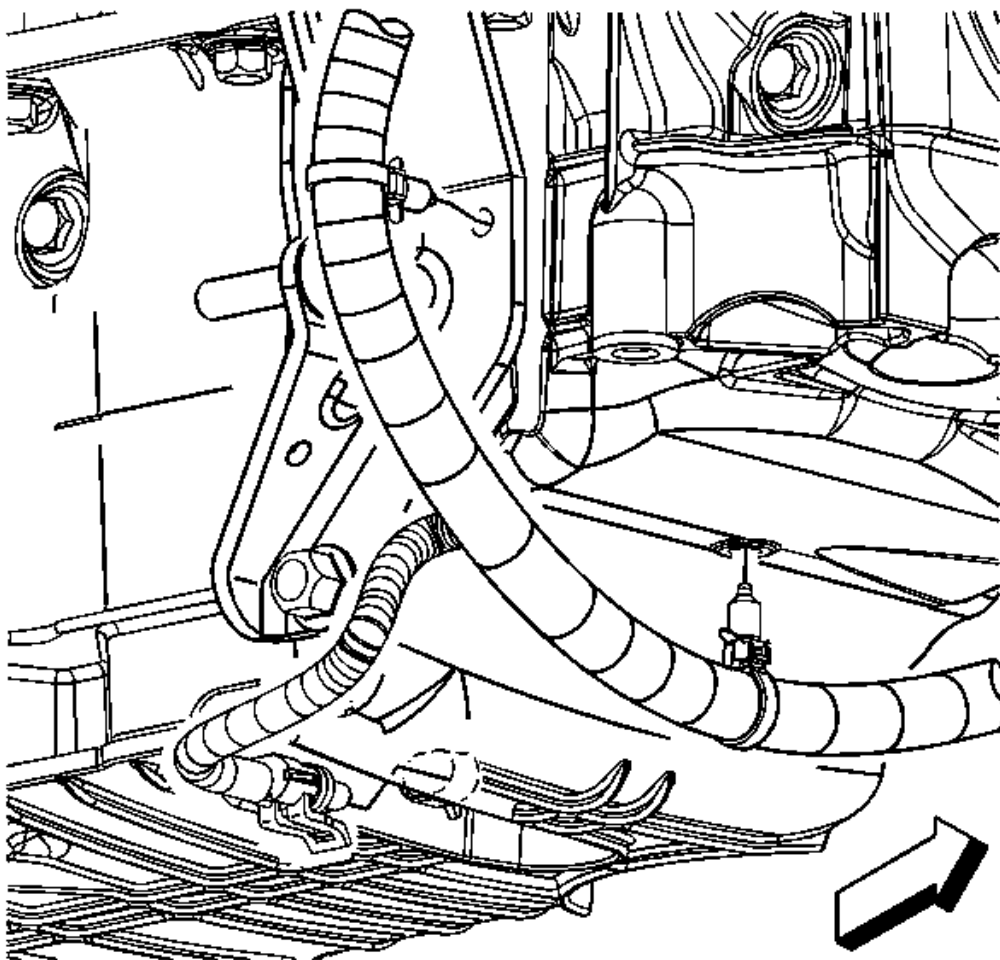


Fig. 191: Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

14. Disconnect the oil level sensor electrical connector.
15. Remove the engine harness clips from the transaxle brace and the oil pan.
16. Lower the vehicle.

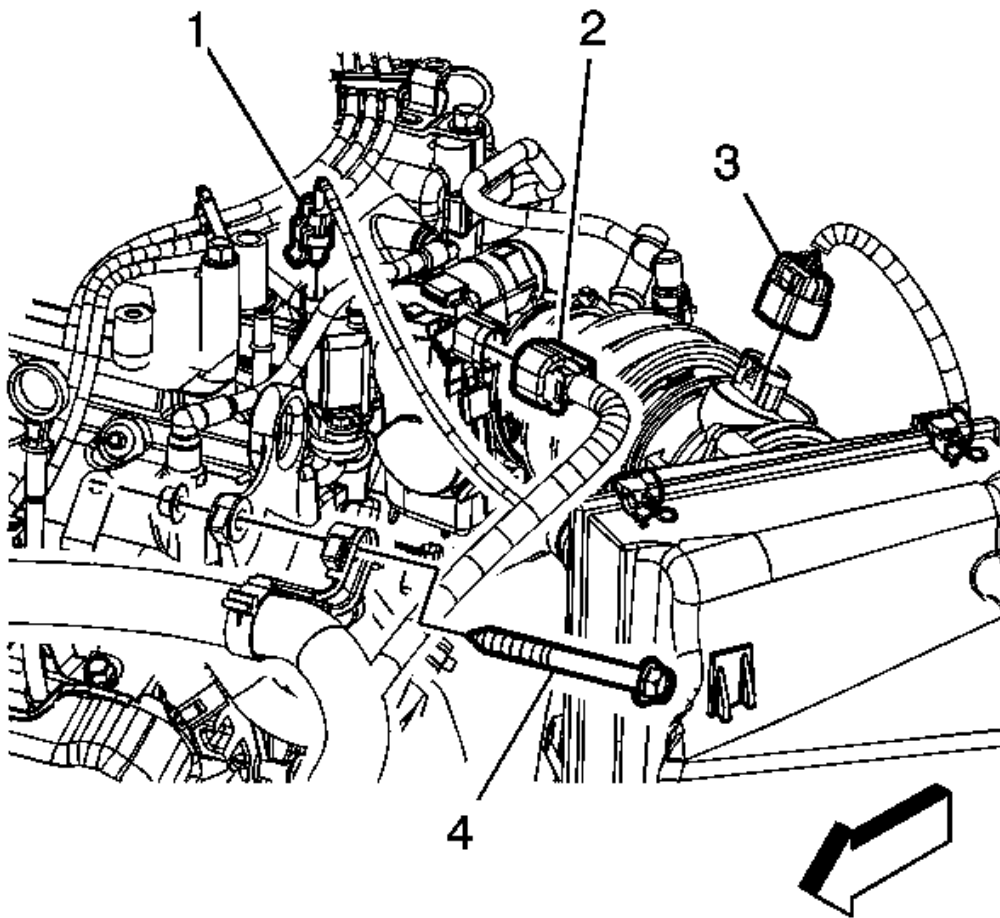


Fig. 192: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

17. Disconnect the evaporative emission (EVAP) canister purge solenoid electrical connector (1).
18. Disconnect the electronic throttle control (ETC) electrical connector (2).

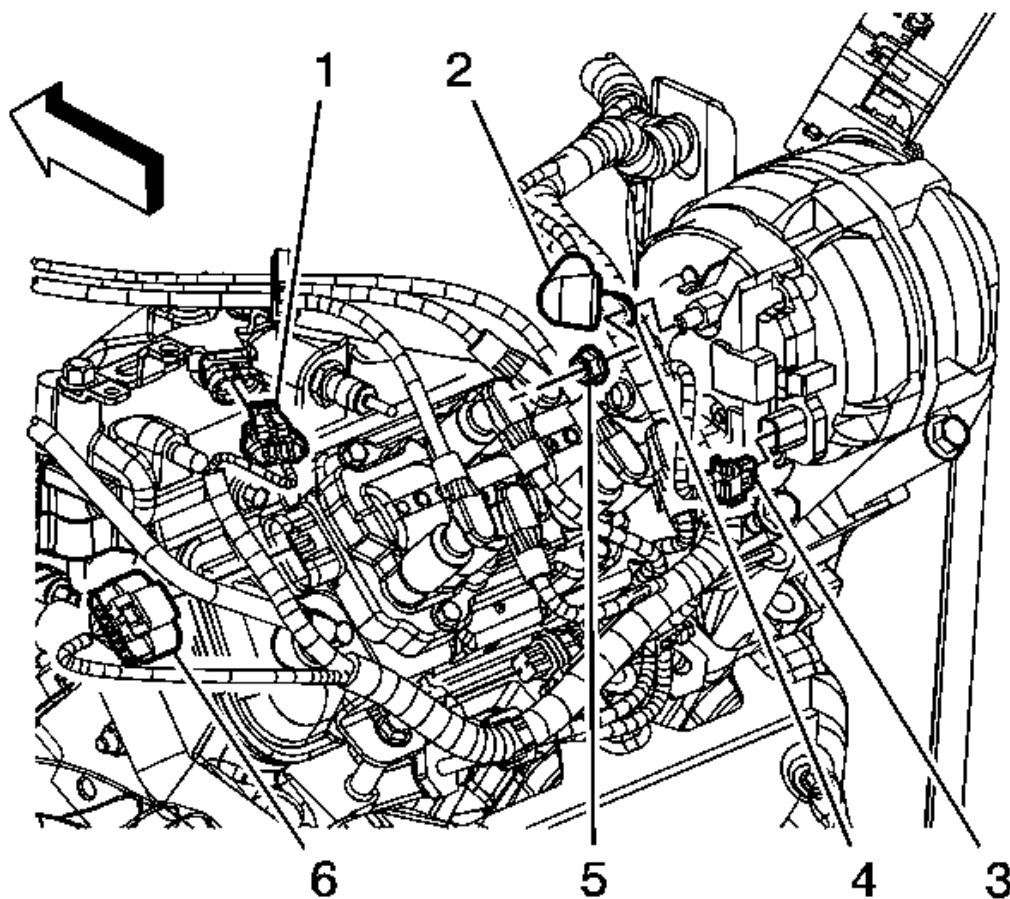


Fig. 193: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

19. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).
20. Reposition the generator terminal boot (2).
21. Remove the generator terminal nut (5).
22. Remove the generator terminal (4) from the stud.
23. Disconnect the generator electrical connector (3).
24. Disconnect the ignition coil electrical connector (6).

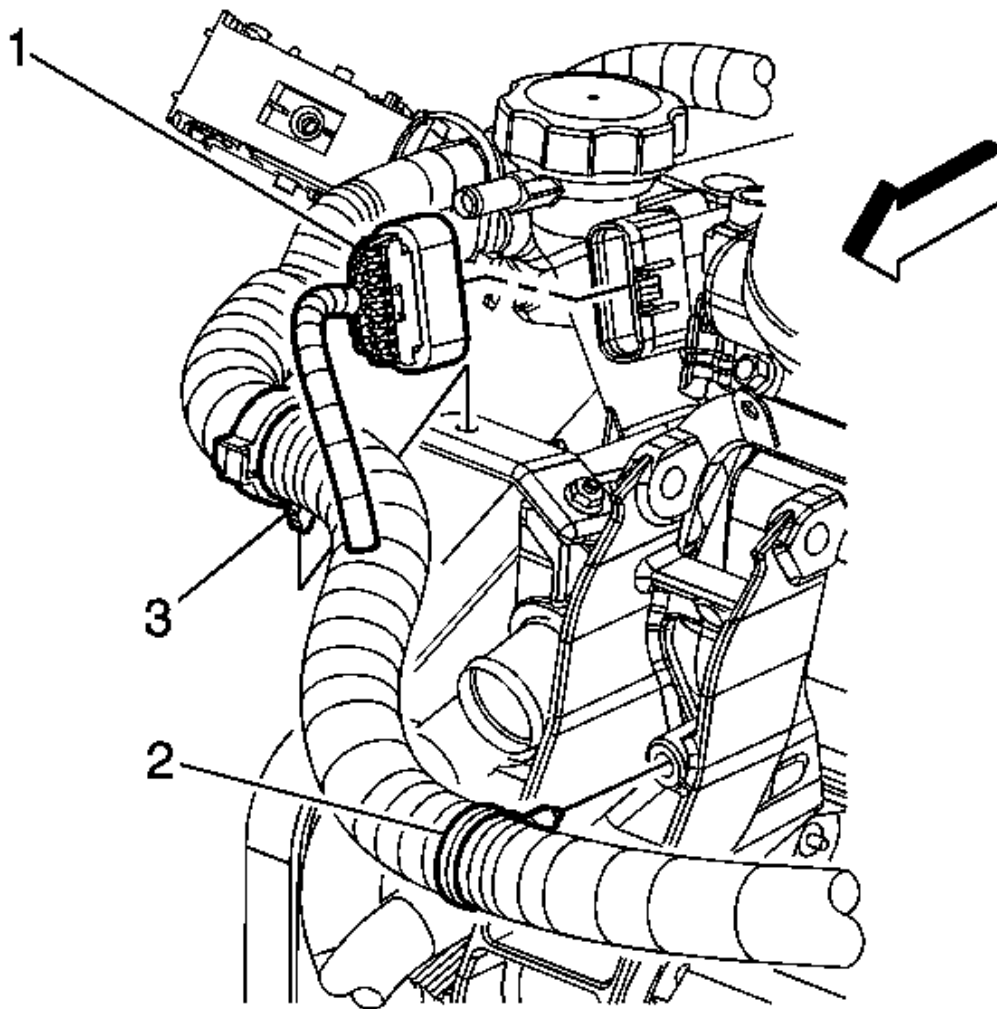


Fig. 194: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

25. Disconnect the fuel injector inline (1) electrical connector.
26. Remove the engine harness clips (2, 3) from the brackets.

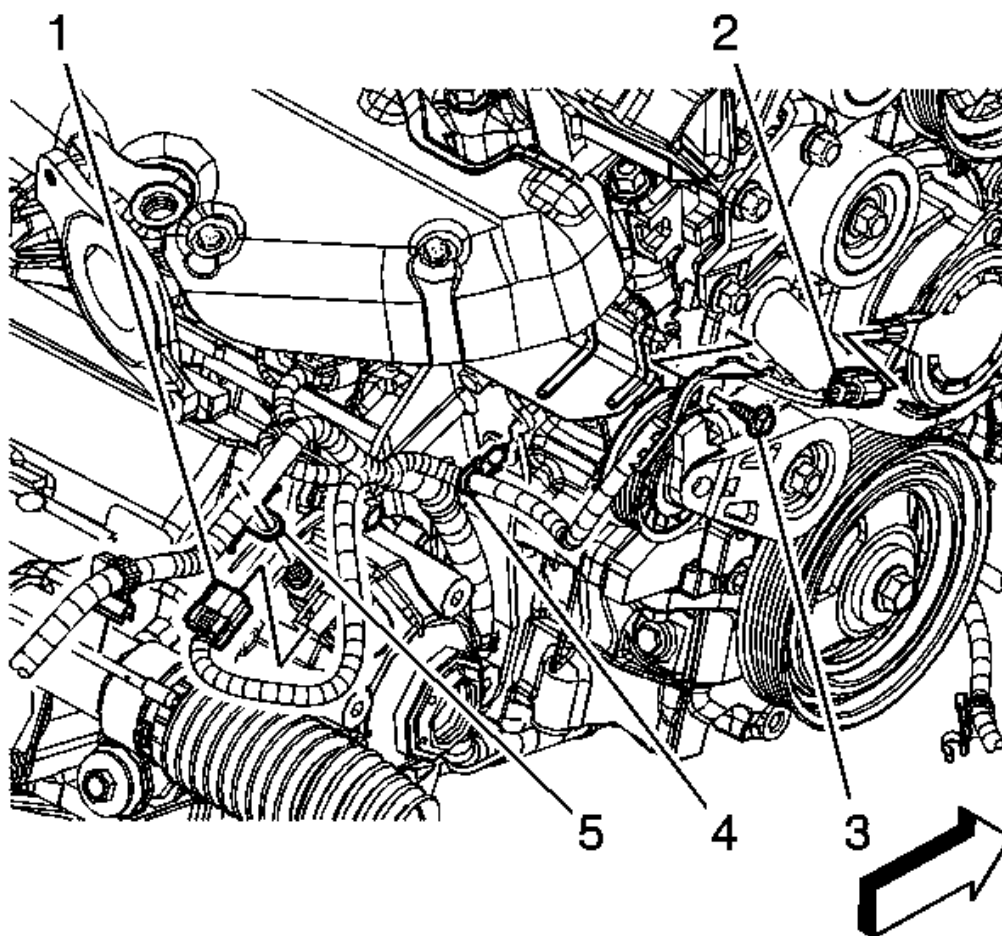


Fig. 195: Camshaft Position Actuator Magnet Electrical Connector
Courtesy of GENERAL MOTORS CORP.

27. Disconnect the camshaft phasor sensor electrical connector (2).
28. Remove the engine harness clip bolt (3).
29. Remove the engine harness clip (4) from the transaxle bracket.

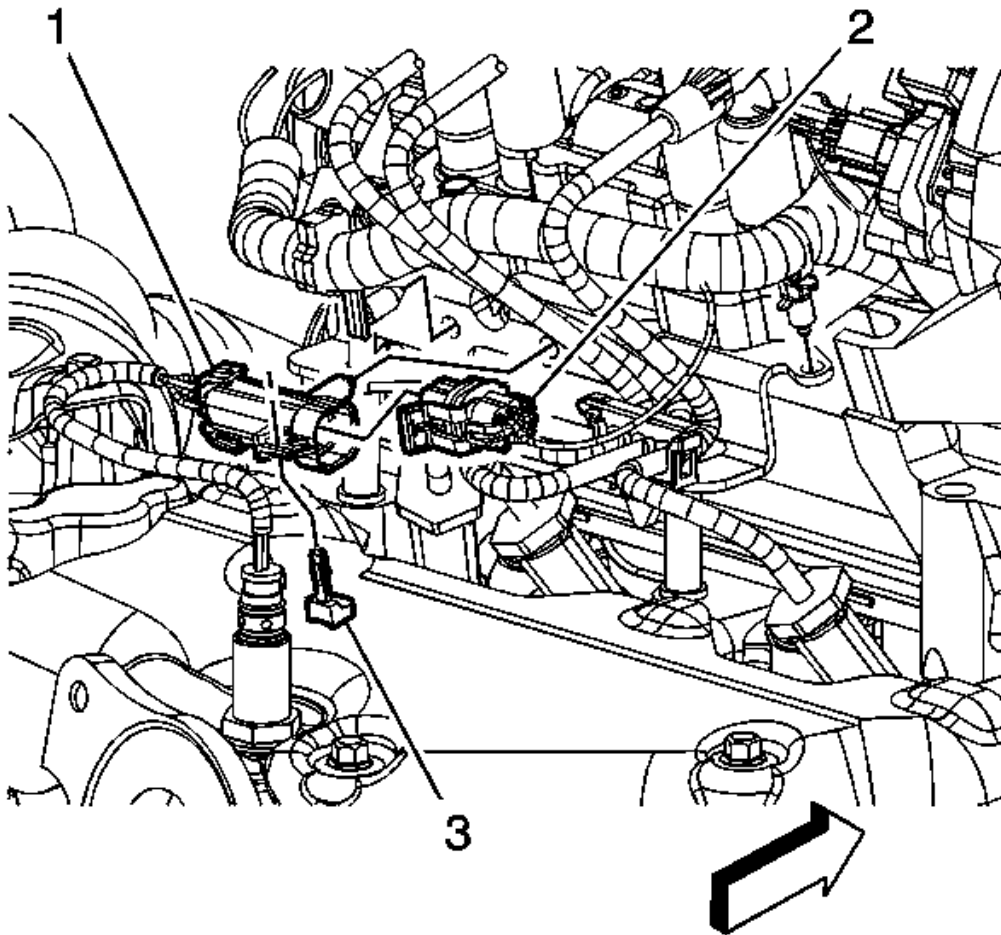


Fig. 196: View Of HO2S Electrical Connector Clip (1) & Ignition Coil Bracket
Courtesy of GENERAL MOTORS CORP.

30. Remove the connector position assurance (CPA) retainer (3).
31. Disconnect the rear upper heated oxygen sensor (HO2S) electrical connector (2).

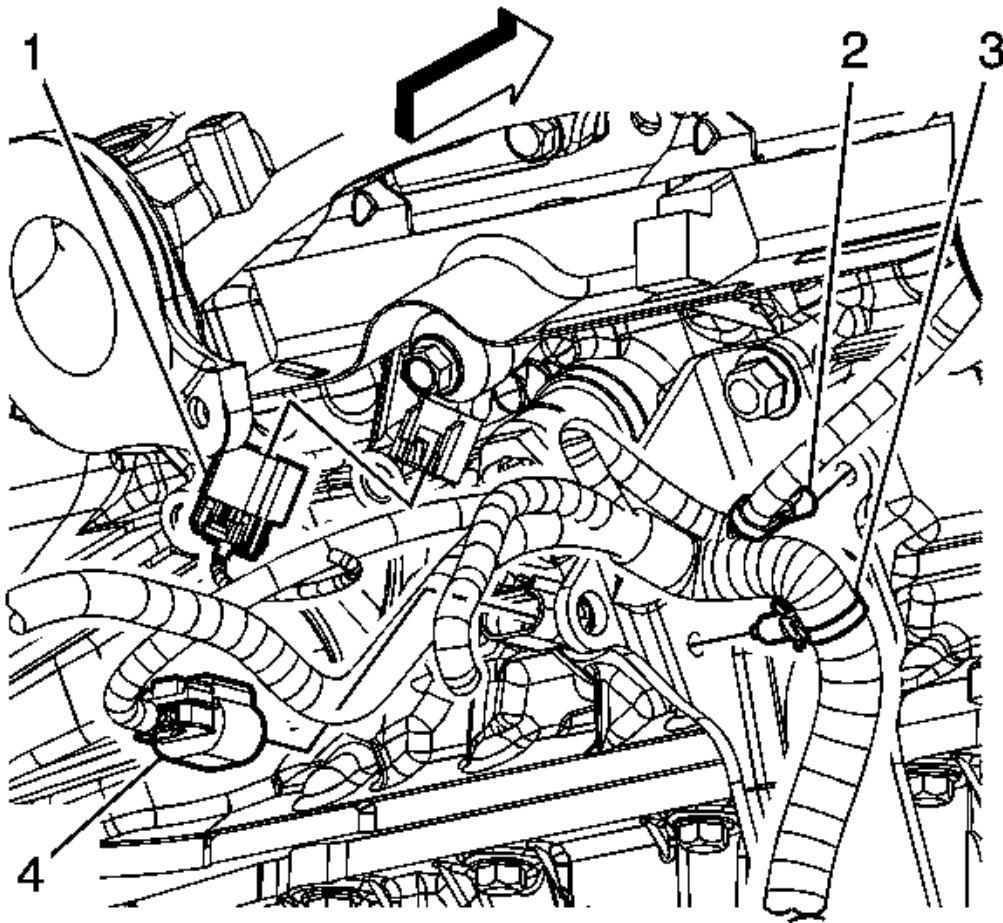


Fig. 197: Identifying Electrical Connector

Courtesy of GENERAL MOTORS CORP.

32. Disconnect the knock sensor electrical connector (1).
33. Disconnect the crankshaft position (CKP) sensor electrical connector (4).
34. Remove the engine harness clips (2, 3) from the transaxle brace.

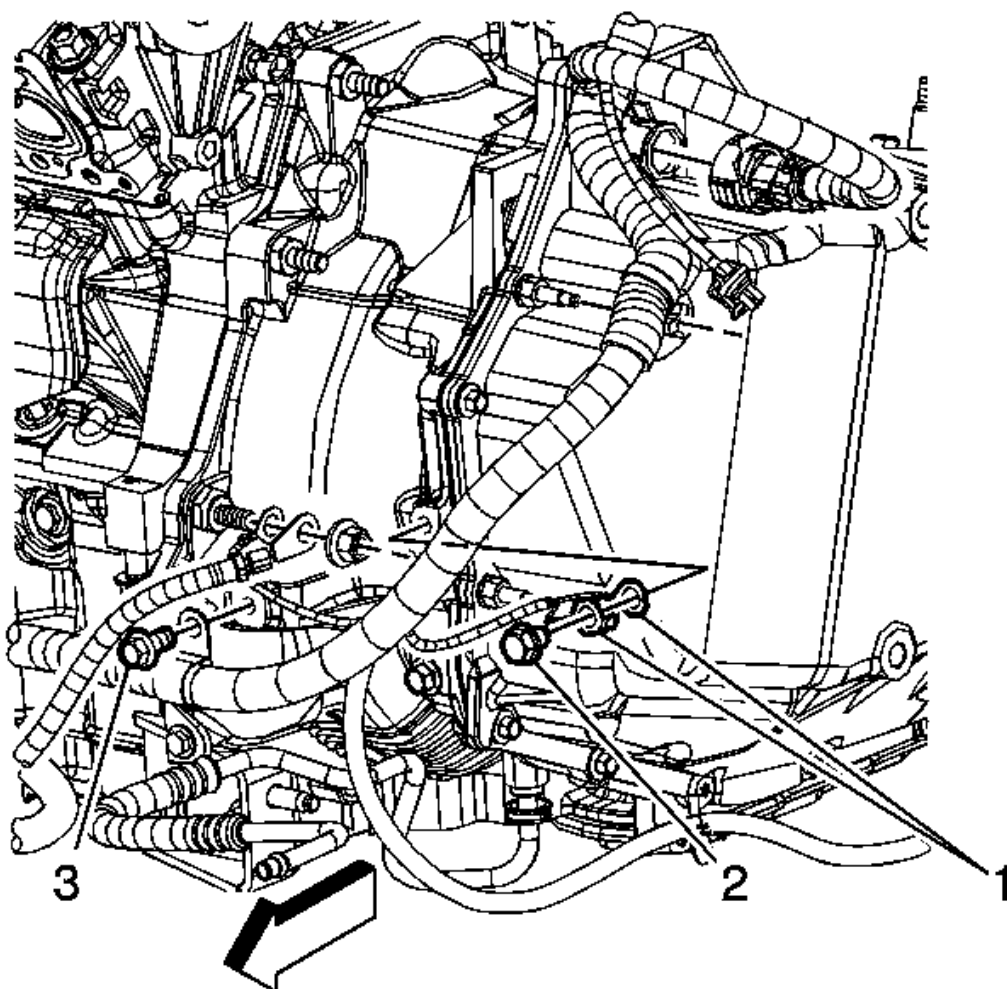


Fig. 198: View Of Engine Harness Ground Bolt
Courtesy of GENERAL MOTORS CORP.

35. Remove the engine harness ground bolt (2).
36. Remove the engine harness ground terminals (1) from the transmission.
37. Remove the engine harness clip bolt (3) from the transmission.
38. Reposition all branches of the engine harness out of the way.
39. Remove the catalytic converter. Refer to **Catalytic Converter Replacement (LGD/LZE)** .

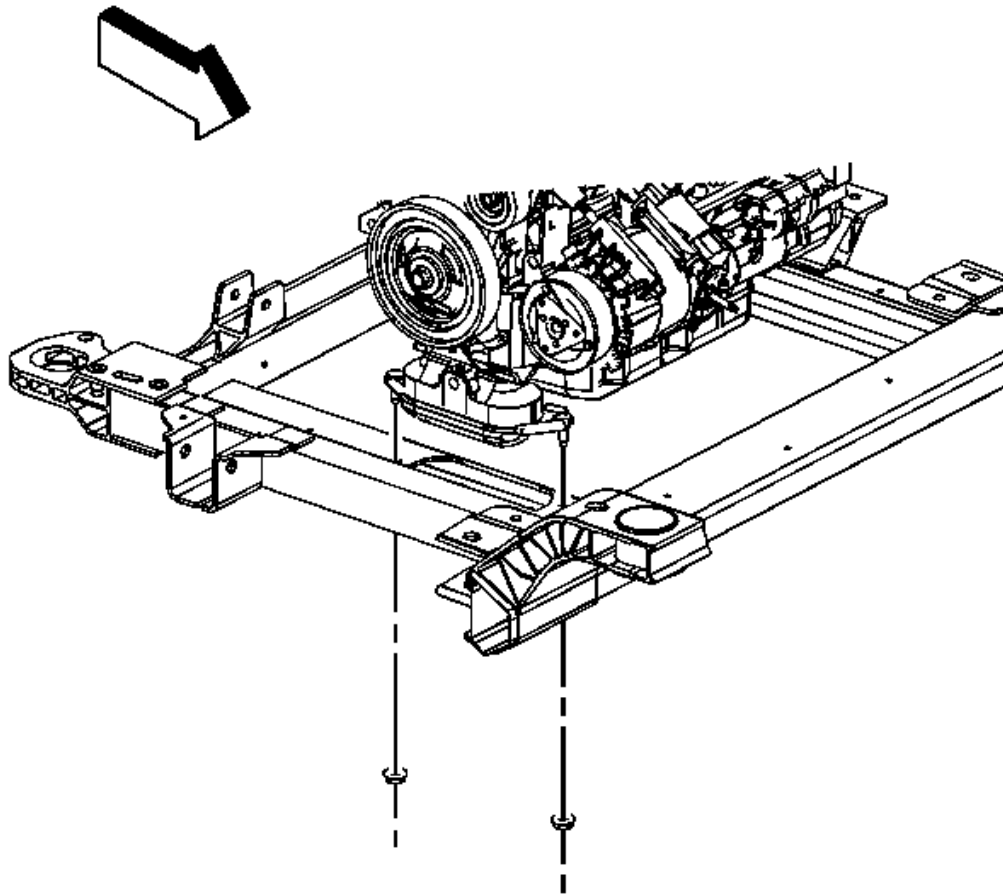


Fig. 199: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

40. Remove the engine mount lower nuts.

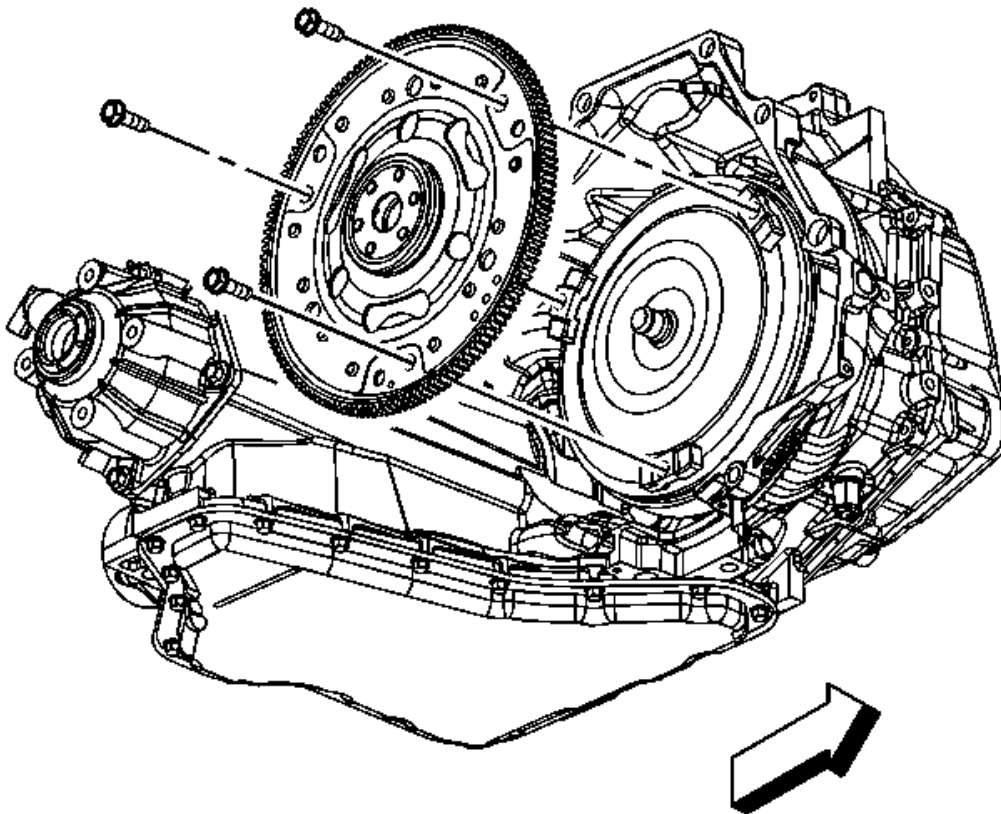


Fig. 200: Locating Torque Converter Bolts
Courtesy of GENERAL MOTORS CORP.

41. Remove the torque converter cover. Refer to **Torque Converter Cover Replacement** .
42. Remove the starter motor. Refer to **Starter Replacement (LGD/LZE)** .
43. Remove the torque converter bolts.

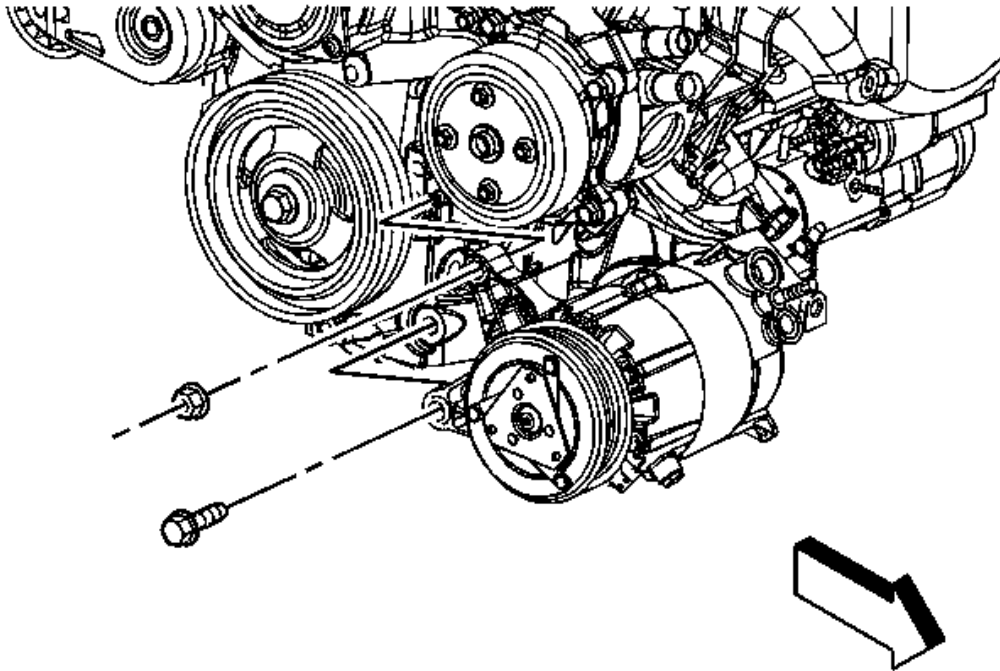


Fig. 201: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

44. Remove the A/C compressor front bolt and nut.

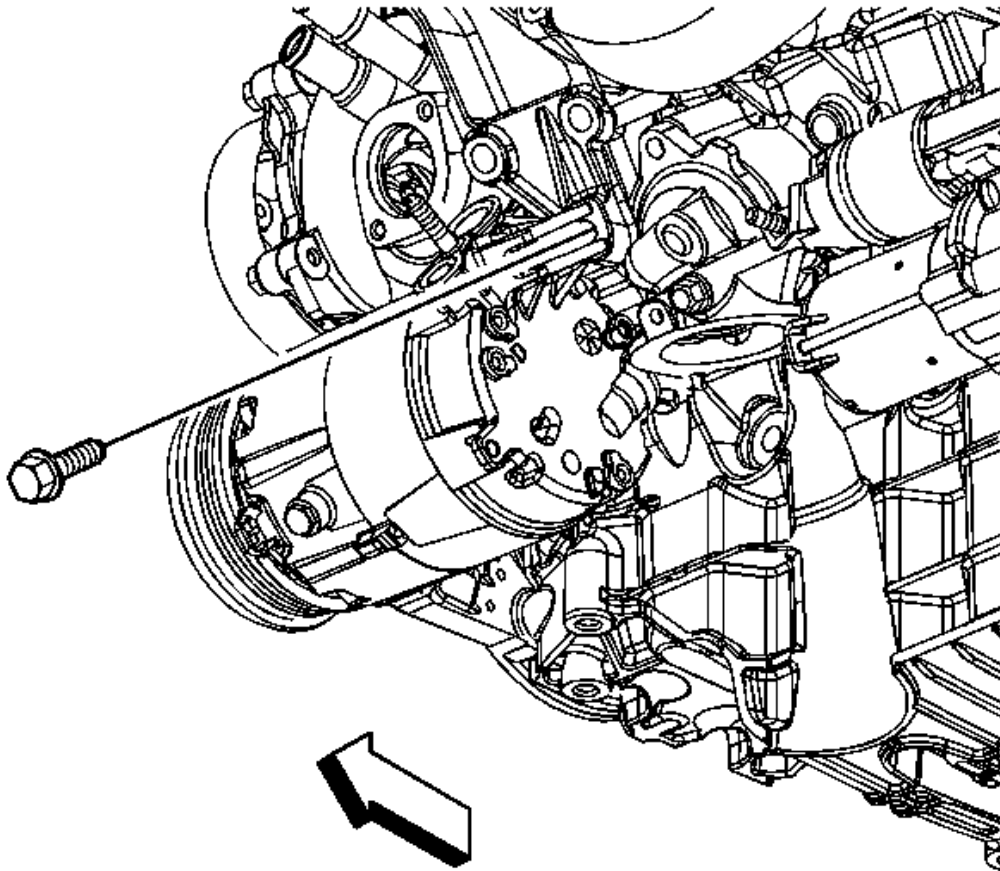


Fig. 202: A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

45. Remove the A/C compressor rear bolt and reposition the compressor off to the side. DO NOT discharge the A/C system.

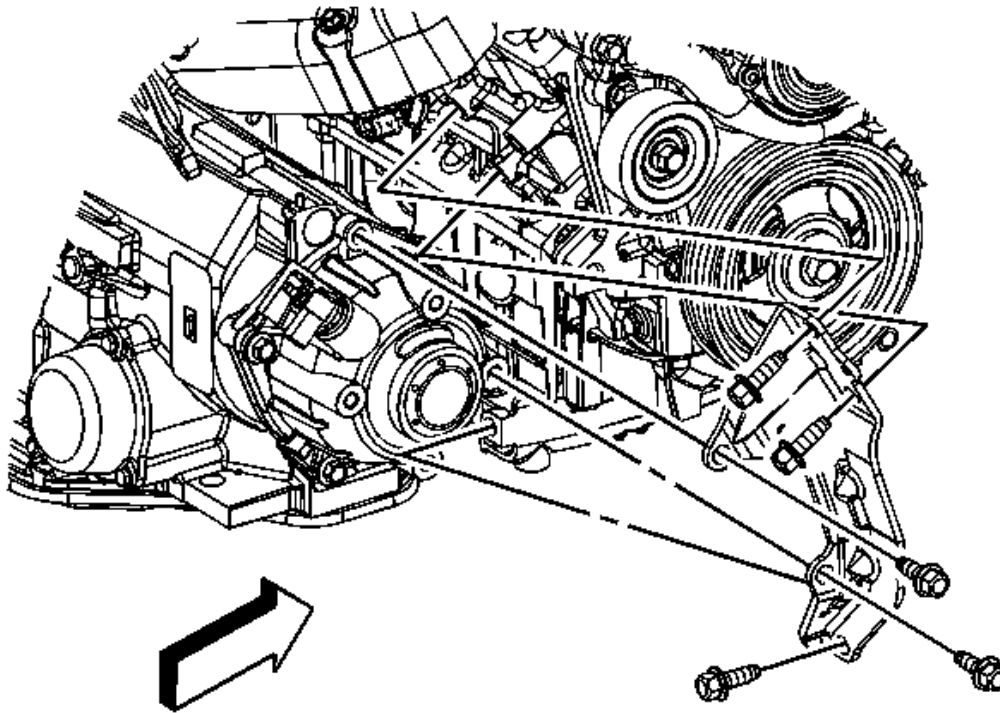


Fig. 203: Locating Rear Transaxle Brace To Engine/Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

46. Remove the transaxle brace to transaxle bolts.
47. Remove the transaxle brace to engine bolts.
48. Remove the transaxle brace.

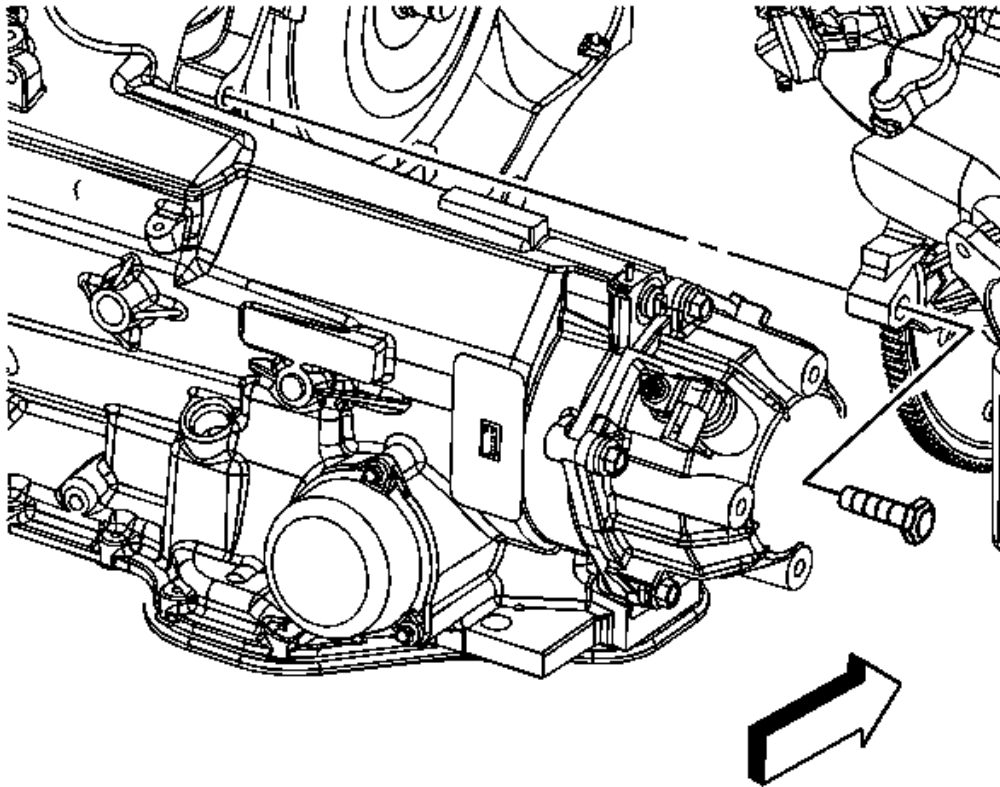


Fig. 204: View Of Transaxle-To-Engine Lower Rear Bolt
Courtesy of GENERAL MOTORS CORP.

49. Remove the transaxle-to-engine lower rear bolt.

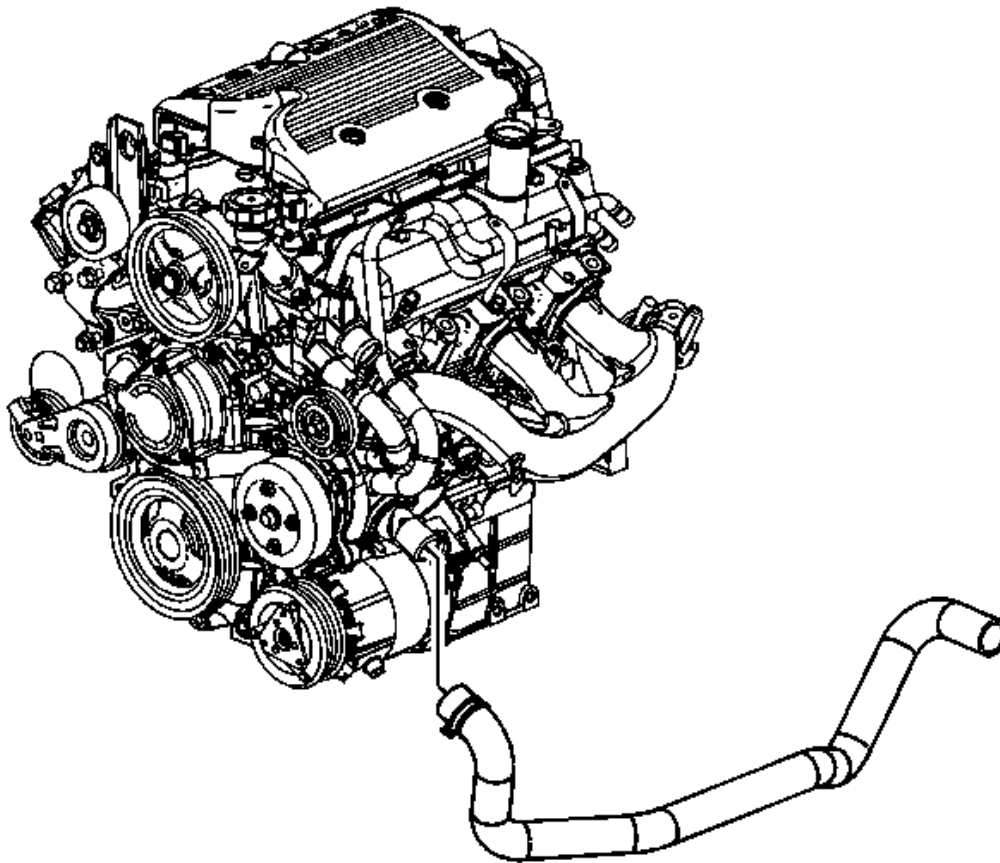


Fig. 205: Identifying Radiator Outlet Hose Clamp & Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

50. Reposition the radiator outlet hose clamp at the thermostat housing.
51. Remove the radiator outlet hose from the thermostat housing.
52. Lower the vehicle and support the transaxle.

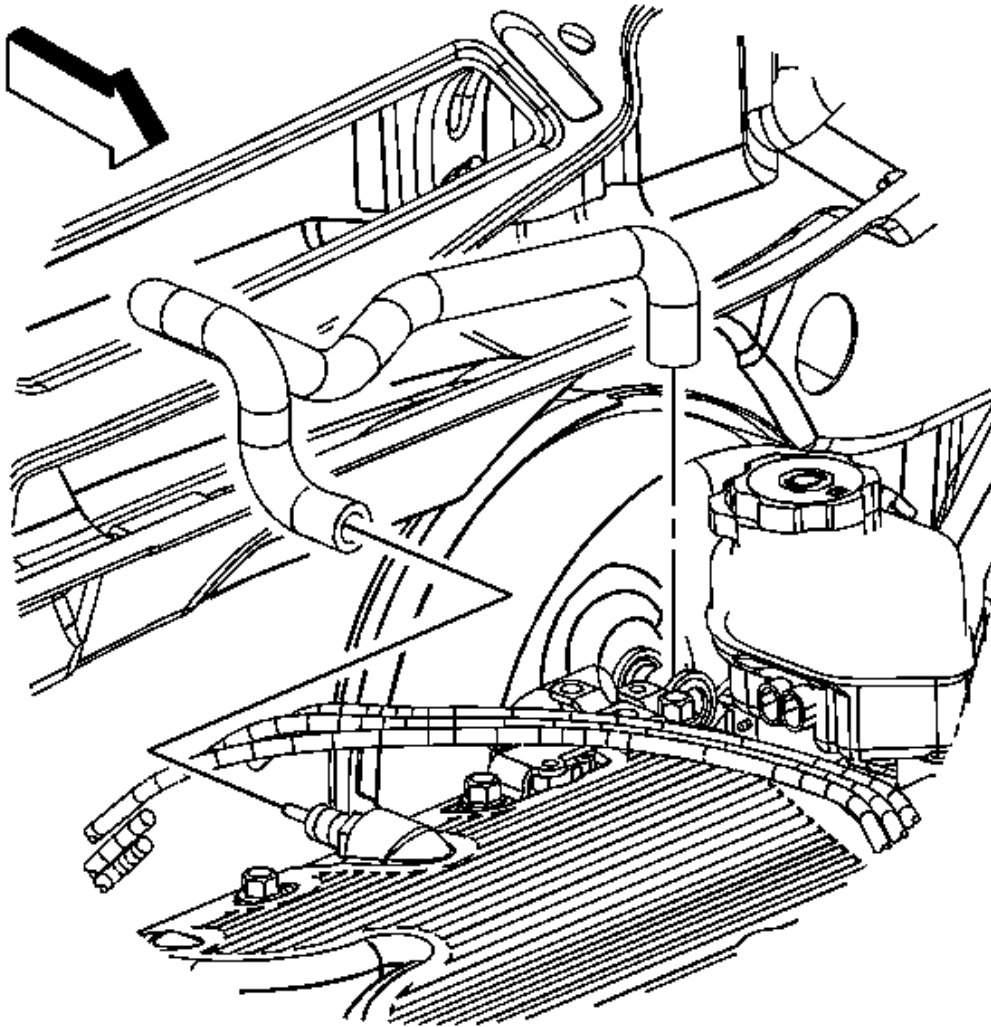


Fig. 206: View Of Brake Booster Vacuum Hose & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

53. Remove the brake booster vacuum hose from the intake manifold.

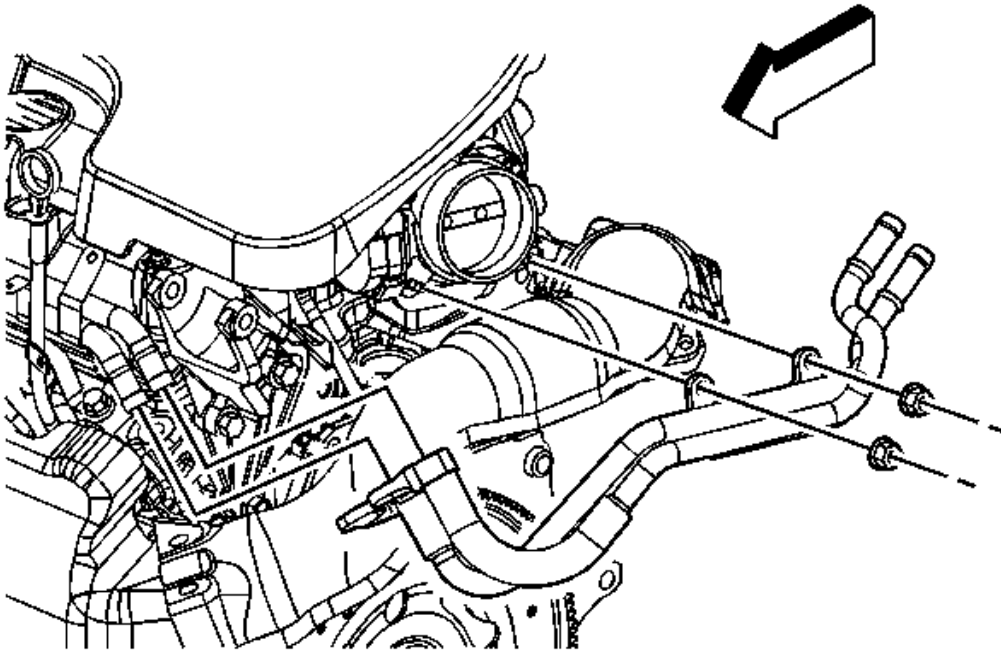


Fig. 207: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

54. Reposition the heater inlet and outlet hose clamps at the engine.
55. Remove the heater inlet and outlet hoses from the engine pipes.
56. Remove the exhaust crossover pipe. Refer to **Exhaust Crossover Pipe Replacement (LGD/LZE)** .
57. Disconnect the fuel feed line from the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .
58. Disconnect the EVAP purge line from the canister purge solenoid. Refer to **Plastic Collar Quick Connect Fitting Service** .

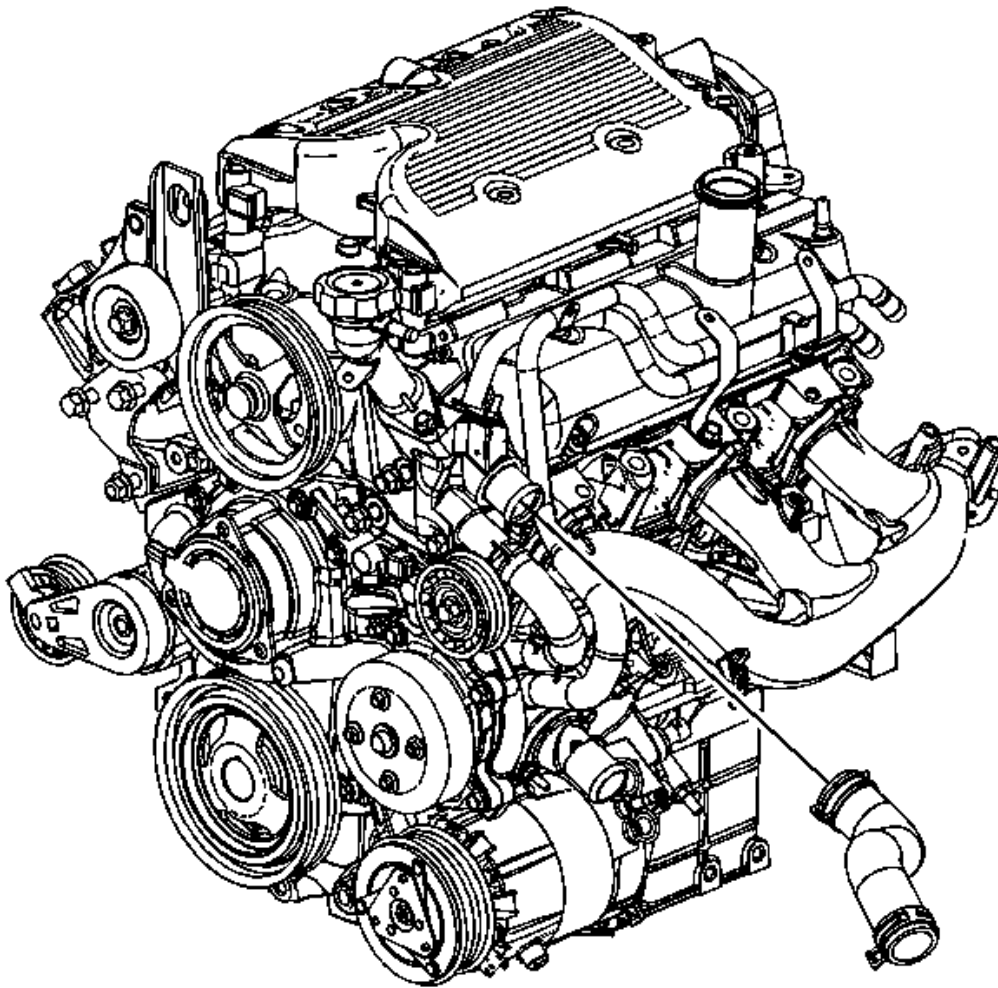


Fig. 208: View Of Radiator Inlet Hose & Crossover Pipe
Courtesy of GENERAL MOTORS CORP.

59. Reposition the radiator inlet hose clamp at the engine.
60. Remove the radiator inlet hose from the engine.

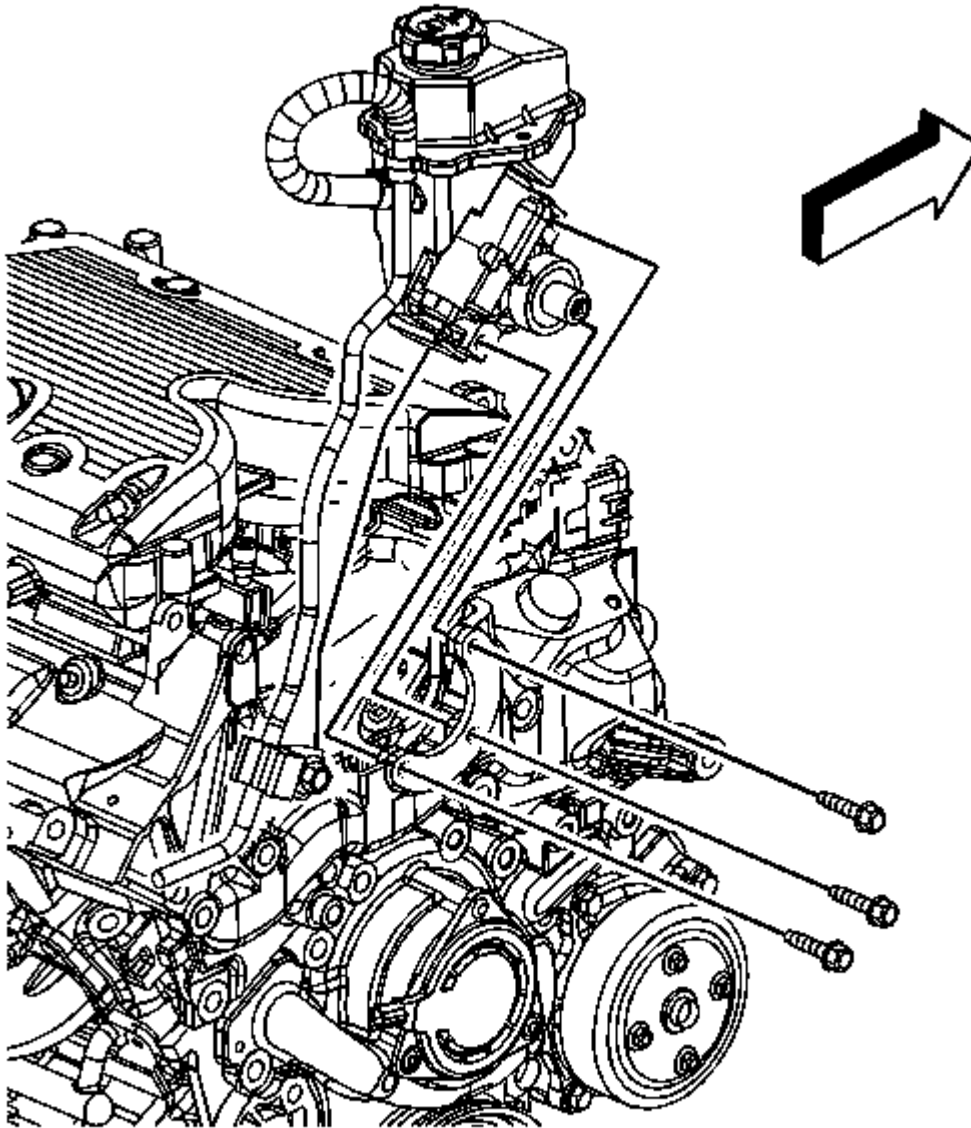


Fig. 209: Power Steering Pump & Bolts
 Courtesy of GENERAL MOTORS CORP.

61. Remove the power steering pump bolts and reposition. Refer to **Power Steering Pump Replacement (LZ4/LZE/LZ9)**.
62. Install a engine lifting device to the engine.

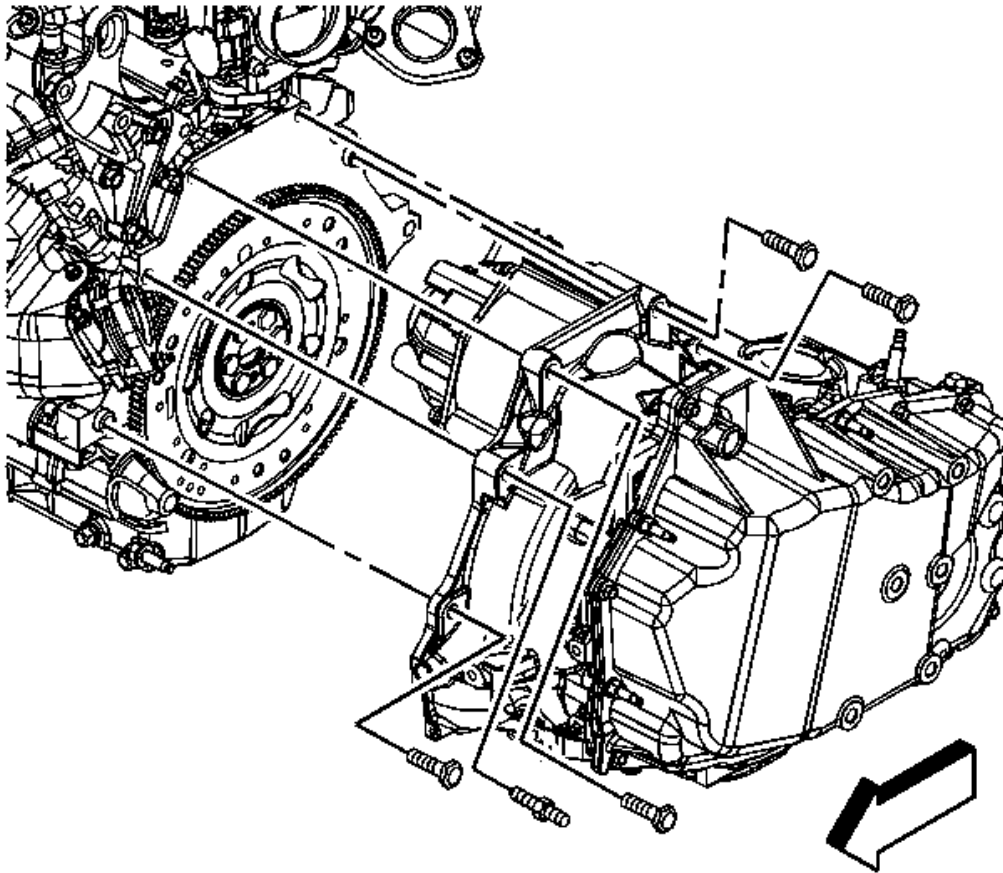


Fig. 210: View Of Transaxle-To-Engine Bolts/Studs
Courtesy of GENERAL MOTORS CORP.

63. Remove the transaxle-to-engine bolts/studs.
64. Remove the engine from the vehicle.
65. Remove the flywheel. Refer to **Engine Flywheel Removal (Automatic Transmission)** or **Engine Flywheel Removal (Manual Transmission)**.
66. Install the engine to a engine stand.

INSTALLATION PROCEDURE

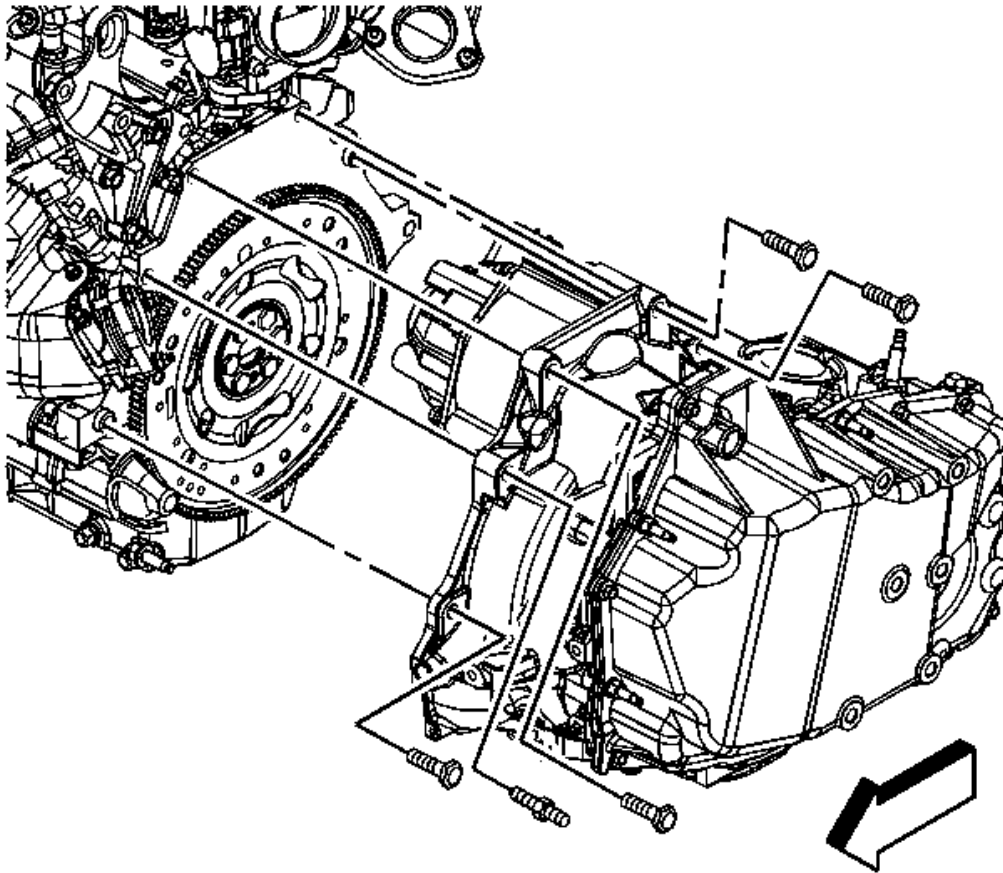


Fig. 211: View Of Transaxle-To-Engine Bolts/Studs
Courtesy of GENERAL MOTORS CORP.

1. Install a engine lifting devise to the engine.
2. Remove the engine from the engine stand.
3. Install the flywheel. Refer to **Engine Flywheel Installation (Automatic Transmission)** or **Engine Flywheel Installation (Manual Transmission)** .
4. Install the engine to the vehicle.

CAUTION: Refer to **Fastener Caution** .

5. Install the transaxle-to-engine bolts/studs.

Tighten: Tighten the bolts/stud to 75 N.m (55 lb ft).

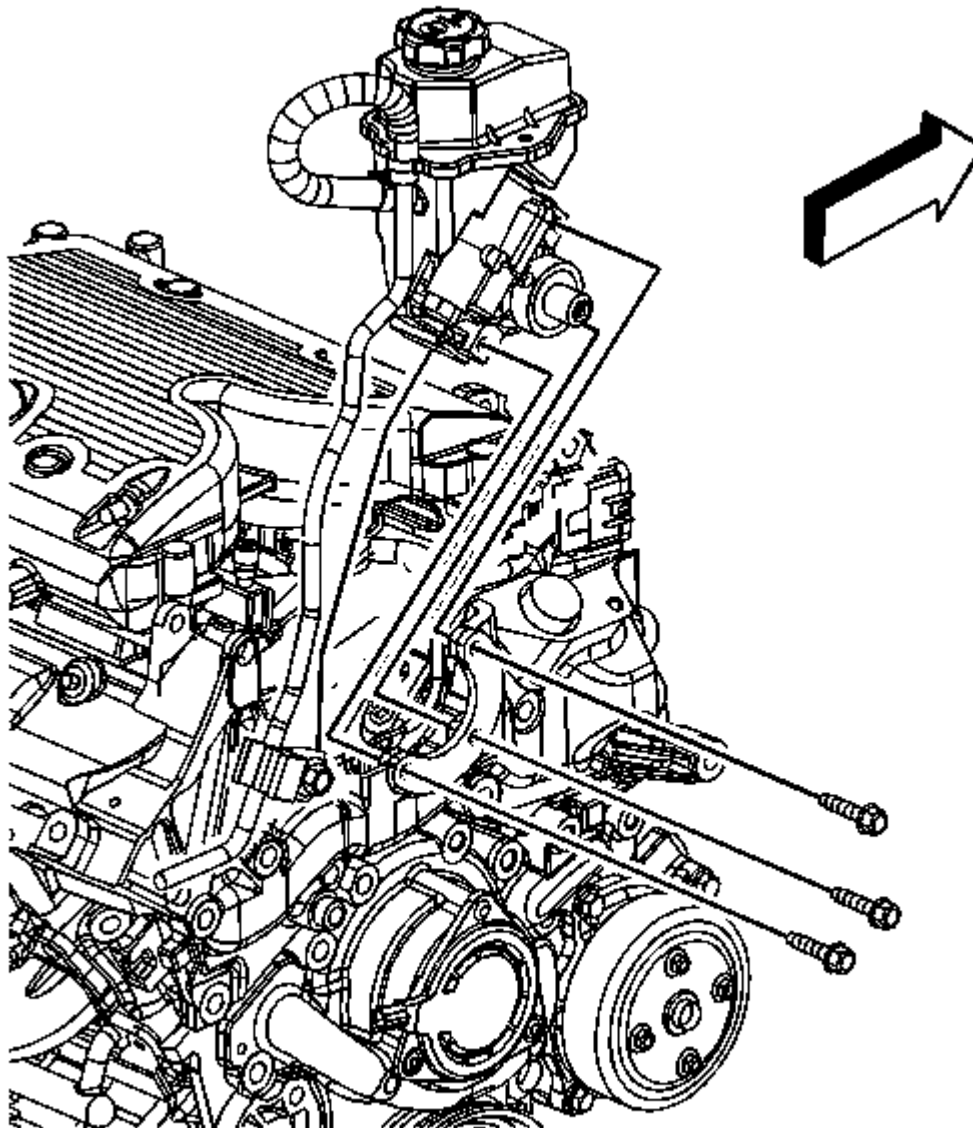


Fig. 212: Power Steering Pump & Bolts
 Courtesy of GENERAL MOTORS CORP.

6. Remove the engine lifting device from the engine.
7. Position and install the power steering pump bolts. Refer to **Power Steering Pump Replacement (LZ4/LZE/LZ9)**.

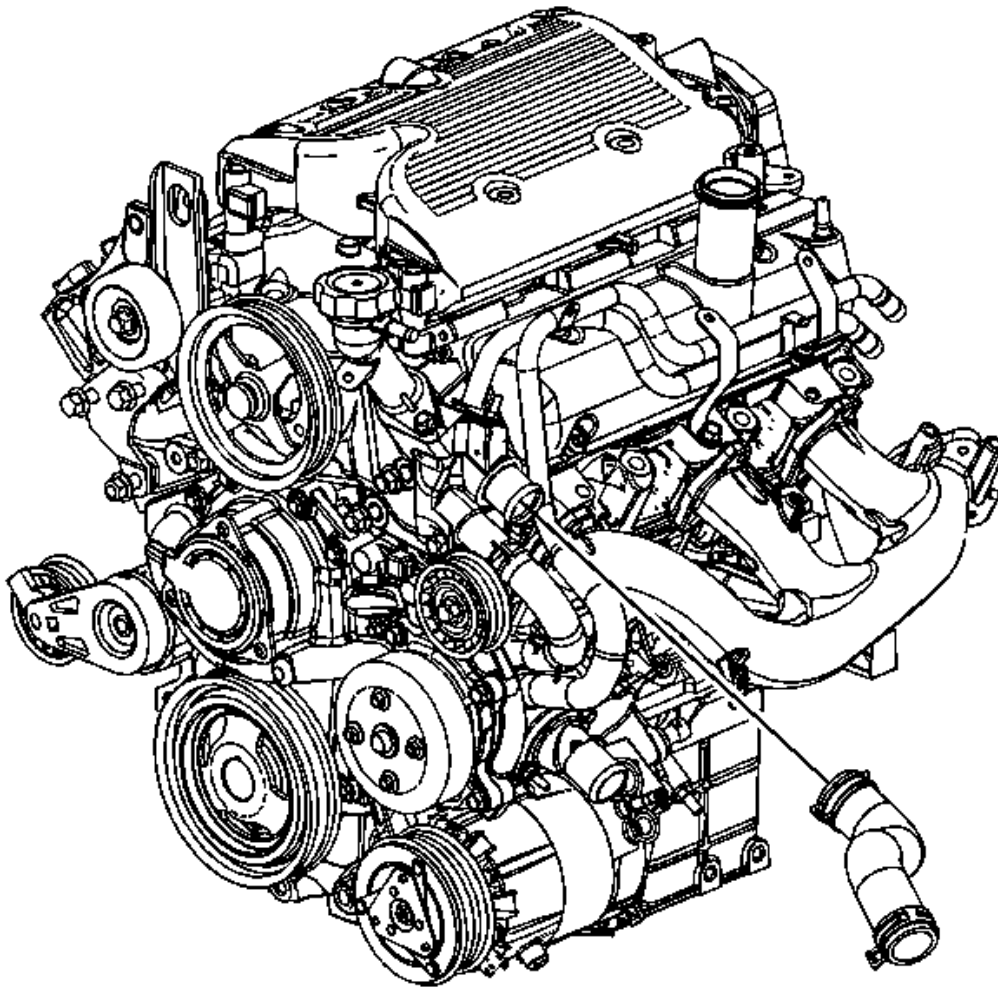


Fig. 213: View Of Radiator Inlet Hose & Crossover Pipe
Courtesy of GENERAL MOTORS CORP.

8. Install the radiator inlet hose to the engine.
9. Position the radiator inlet hose clamp at the engine.

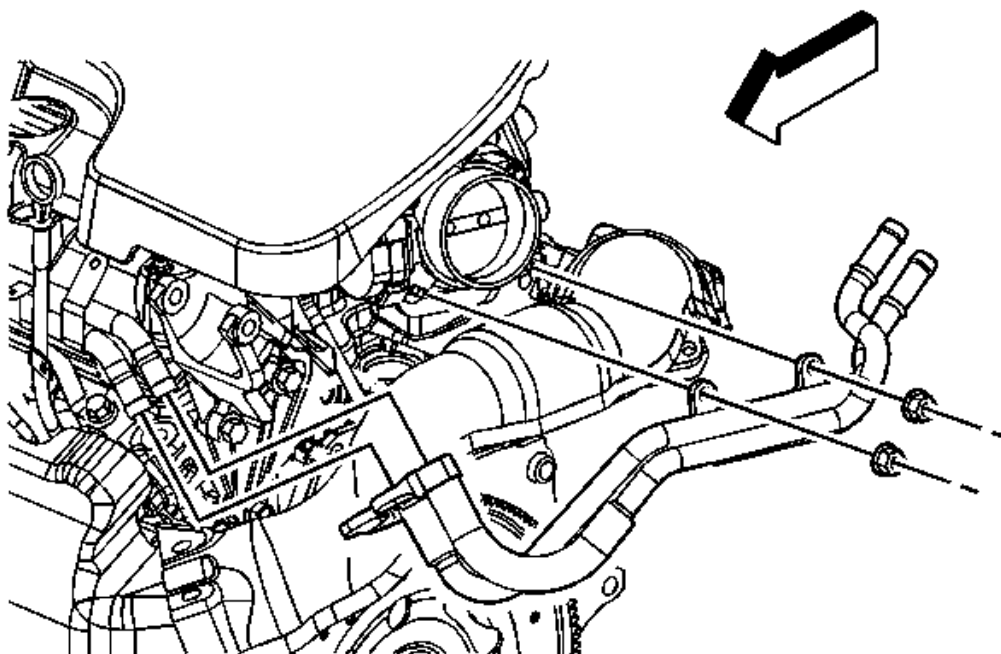


Fig. 214: Coolant Inlet And Outlet Hoses/Pipes
Courtesy of GENERAL MOTORS CORP.

10. Connect the EVAP purge line to the canister purge solenoid. Refer to **Plastic Collar Quick Connect Fitting Service** .
11. Connect the fuel feed line to the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .
12. Install the exhaust crossover pipe. Refer to **Exhaust Crossover Pipe Replacement (LGD/LZE)** .
13. Install the heater inlet and outlet hoses to the engine pipes.
14. Position the heater inlet and outlet hose clamps at the engine.

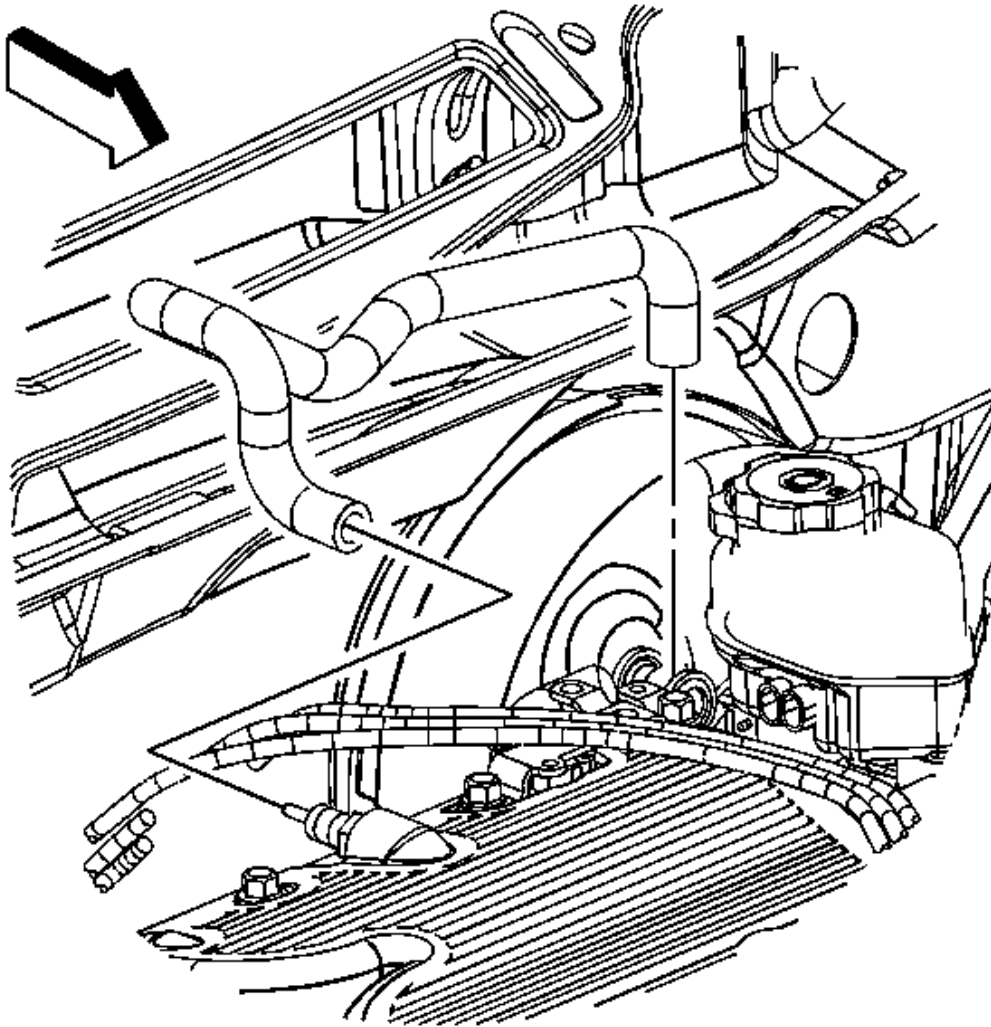


Fig. 215: View Of Brake Booster Vacuum Hose & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

15. Install the brake booster vacuum hose to the intake manifold.

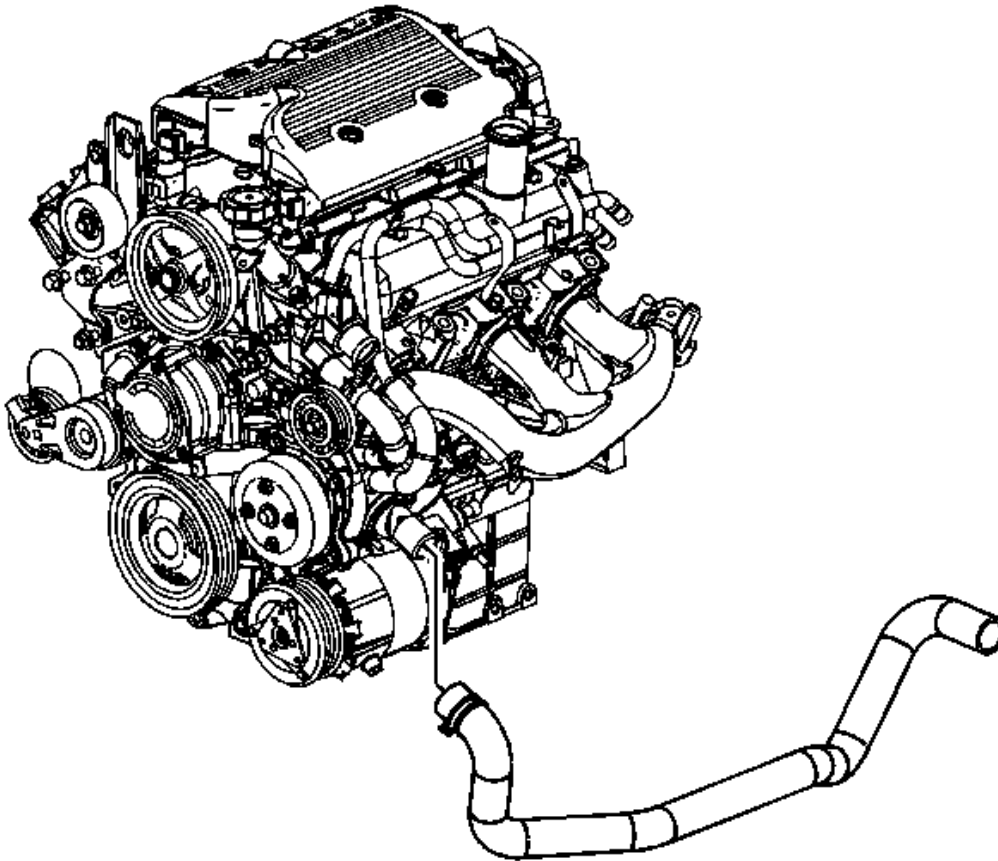


Fig. 216: Identifying Radiator Outlet Hose Clamp & Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

16. Install the radiator outlet hose to the thermostat housing.
17. Position the radiator outlet hose clamp at the thermostat housing.
18. Raise and support the vehicle.

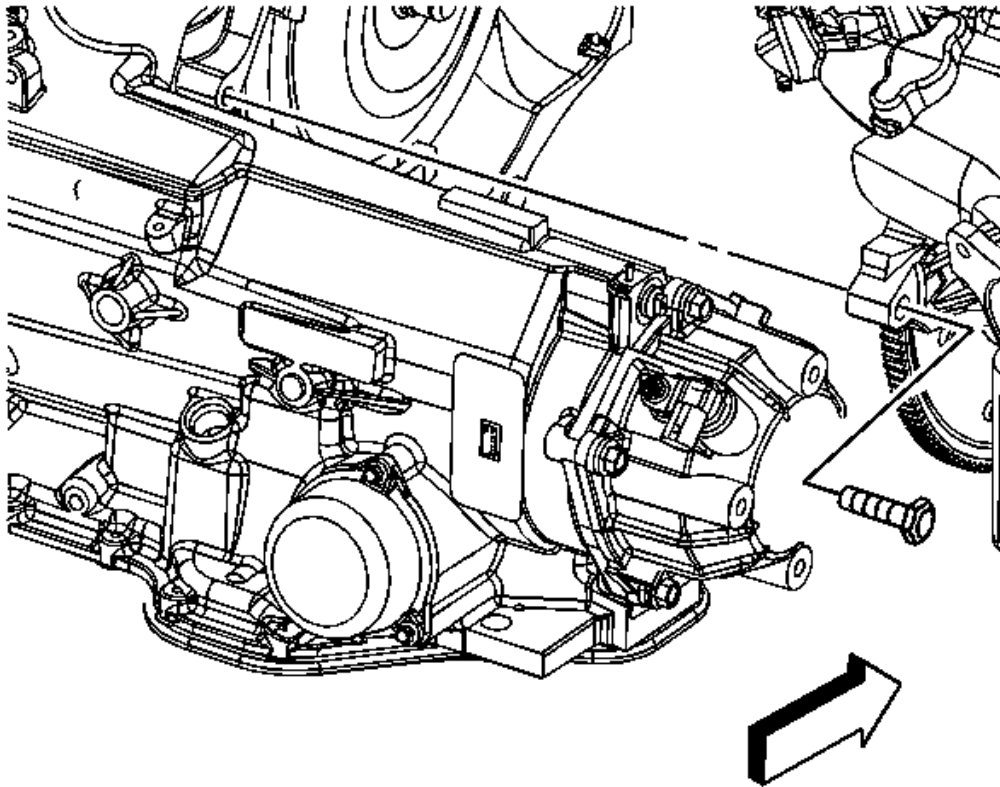


Fig. 217: View Of Transaxle-To-Engine Lower Rear Bolt
 Courtesy of GENERAL MOTORS CORP.

19. Install the transaxle-to-engine lower rear bolt.

Tighten: Tighten the bolt to 75 N.m (55 lb ft).

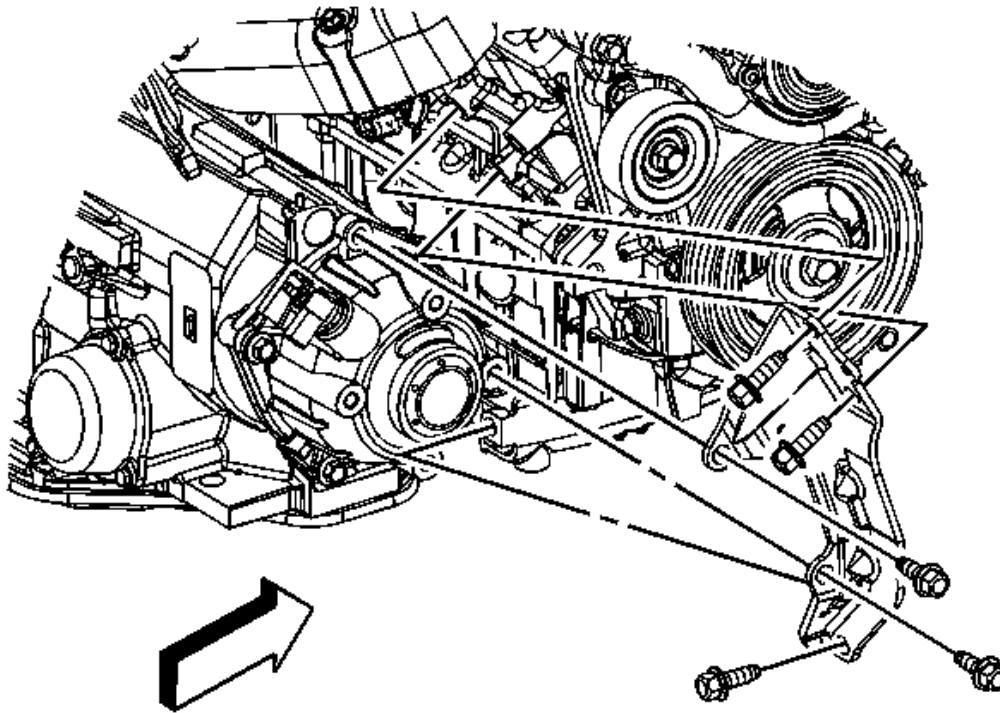


Fig. 218: Locating Rear Transaxle Brace To Engine/Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

20. Install the transaxle brace.
21. Install the transaxle brace to engine bolts.
22. Install the transaxle brace to transaxle bolts.

Tighten: Tighten the bolts to 63 N.m (46 lb ft).

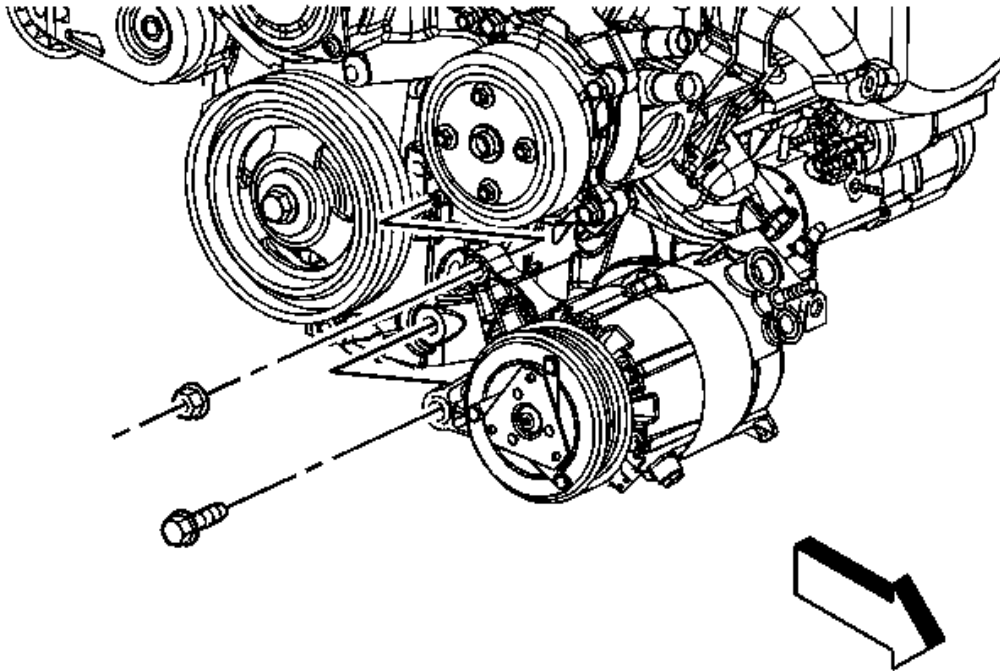


Fig. 219: View Of Air Conditioning (A/C) Compressor Front Bolt/Nut
Courtesy of GENERAL MOTORS CORP.

23. Position the A/C compressor and install the compressor front bolt and nut.

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

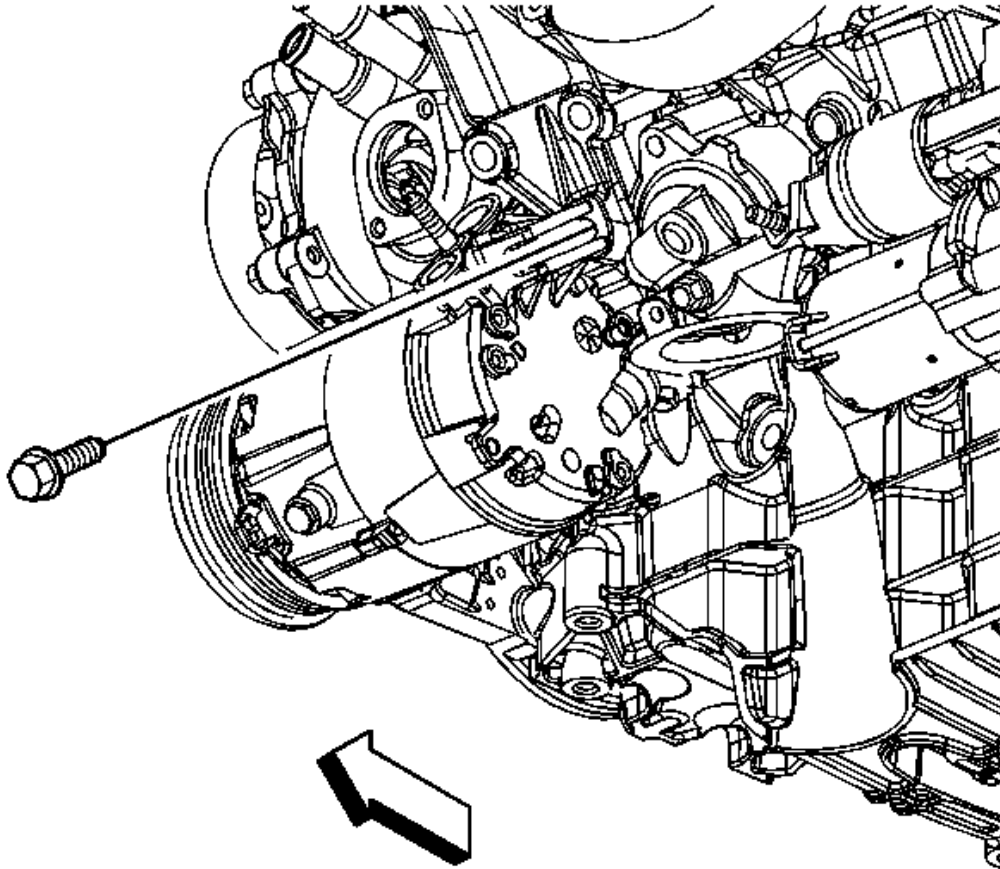


Fig. 220: A/C Compressor Rear Bolt
Courtesy of GENERAL MOTORS CORP.

24. Install the A/C compressor rear bolt.

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

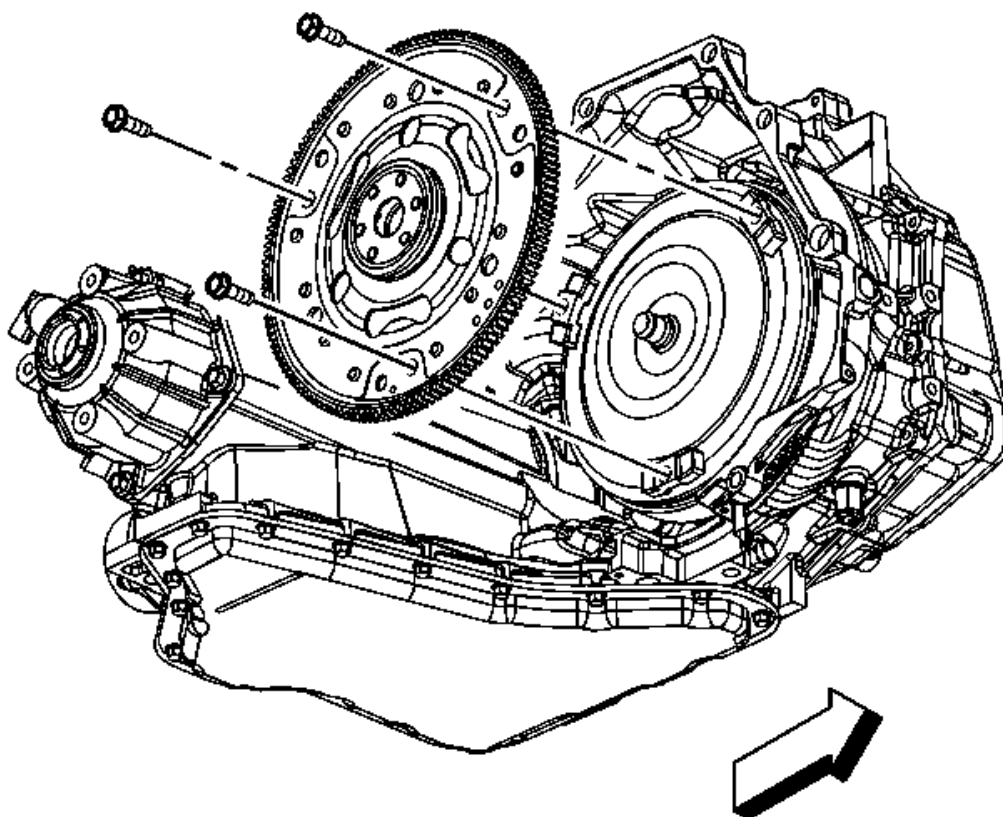


Fig. 221: Locating Torque Converter Bolts
Courtesy of GENERAL MOTORS CORP.

25. Install the torque converter bolts.

Tighten: Tighten the bolts to 63 N.m (46 lb ft).

26. Install the starter motor. Refer to **Starter Replacement (LGD/LZE)**.
27. Install the torque converter cover. Refer to **Torque Converter Cover Replacement**.

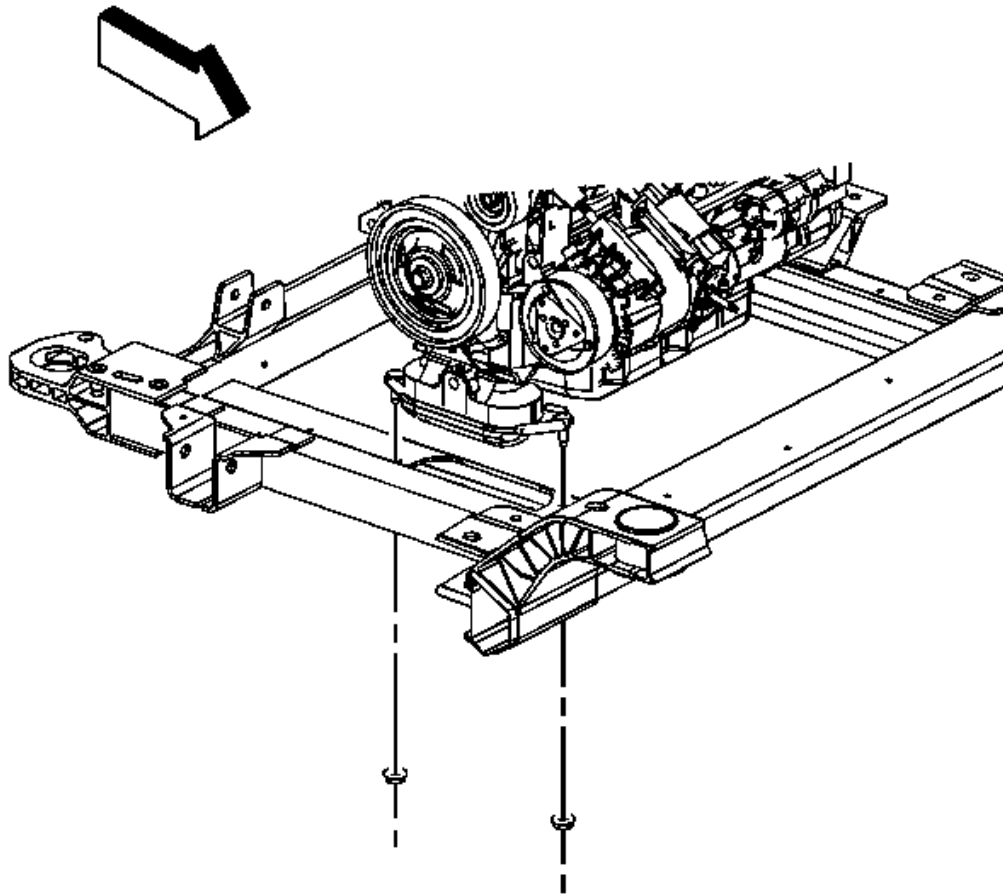


Fig. 222: View Of Engine Mount Lower Nuts
Courtesy of GENERAL MOTORS CORP.

28. Install the engine mount lower nuts.

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

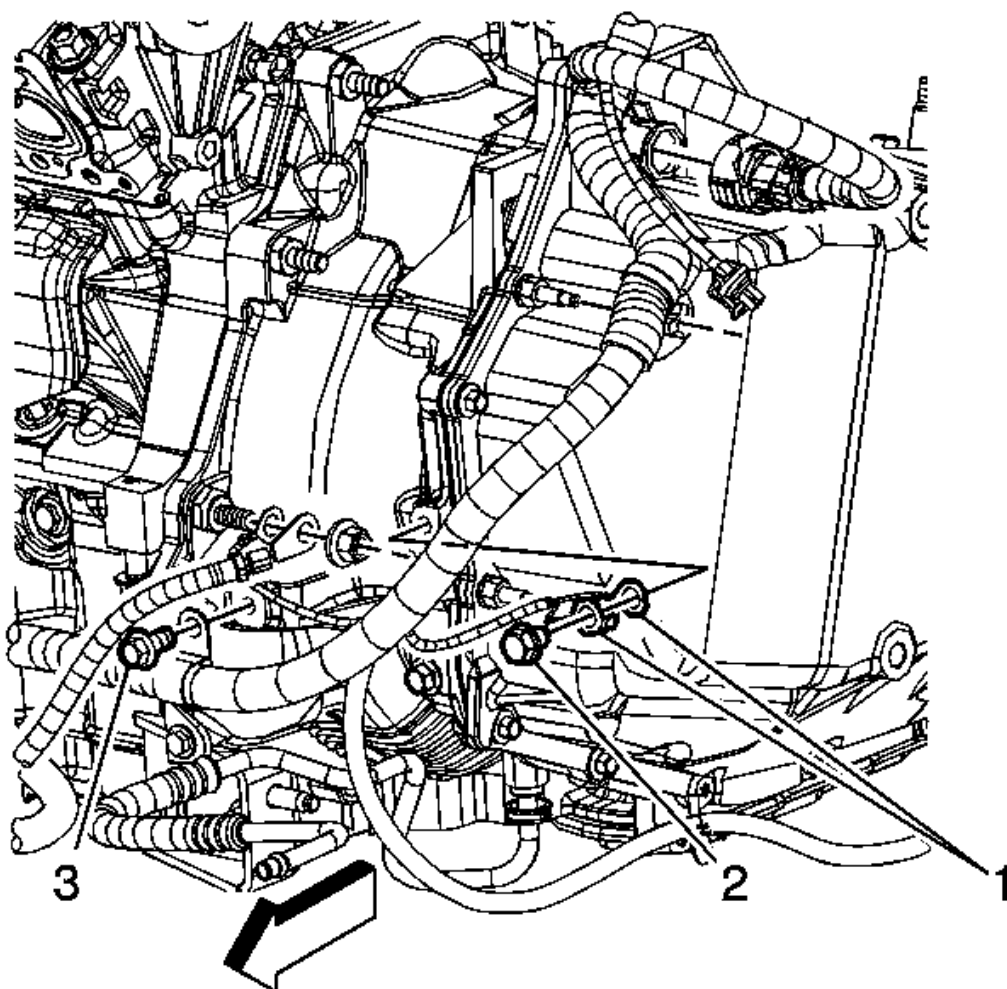


Fig. 223: View Of Engine Harness Ground Bolt
Courtesy of GENERAL MOTORS CORP.

29. Install the catalytic converter. Refer to **Catalytic Converter Replacement (LGD/LZE)** .
30. Position the engine harness over the engine.
31. Position the engine harness ground terminals (1) to the transmission.
32. Install the engine harness ground bolt (2).

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

33. Install the engine harness clip bolt (3) to the transmission.

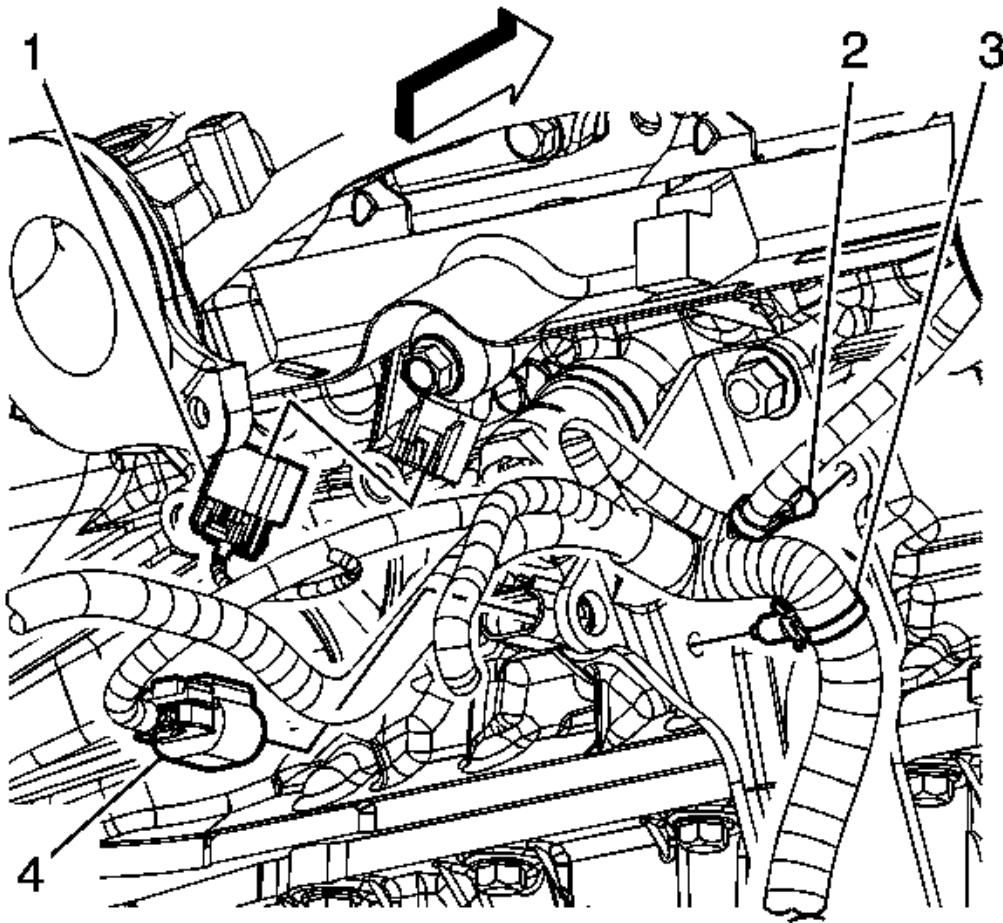


Fig. 224: Identifying Electrical Connector

Courtesy of GENERAL MOTORS CORP.

34. Connect the CKP sensor electrical connector (4).
35. Connect the knock sensor electrical connector (1).
36. Install the engine harness clips (2, 3) to the transaxle brace.
37. Lower the vehicle.

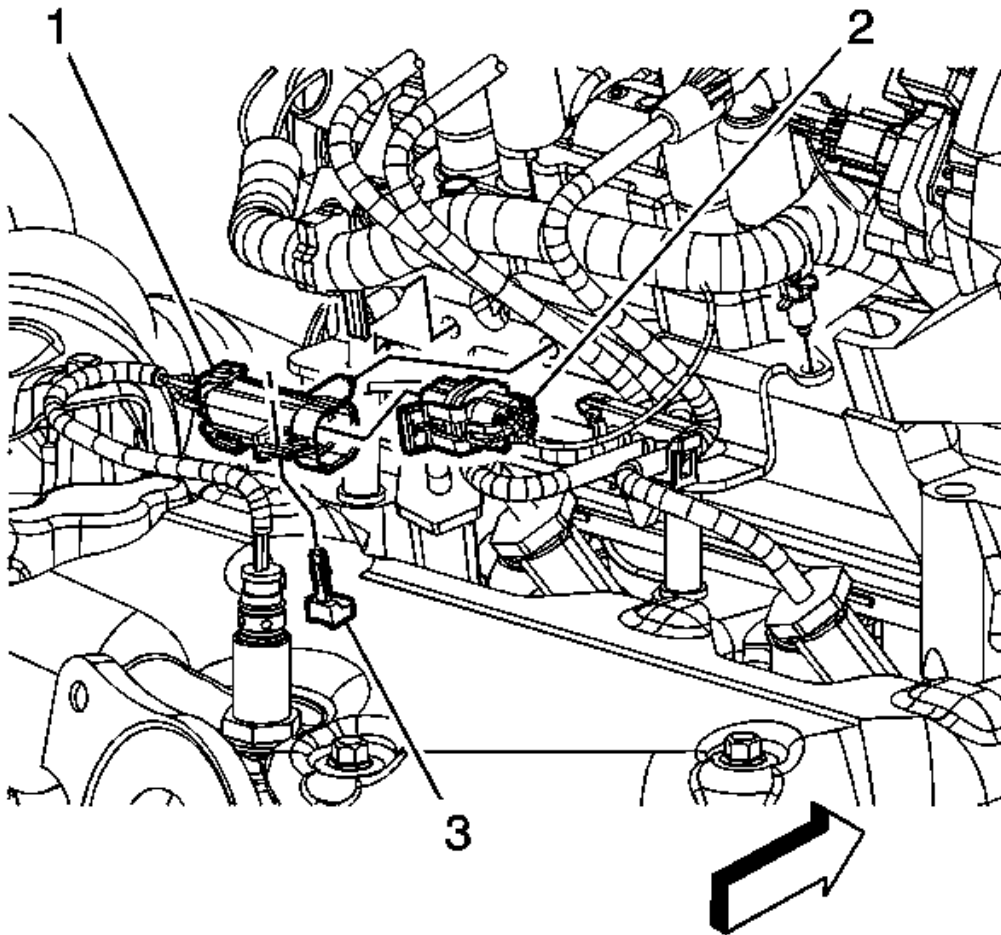


Fig. 225: View Of HO2S Electrical Connector Clip (1) & Ignition Coil Bracket
Courtesy of GENERAL MOTORS CORP.

38. Connect the rear upper HO2S electrical connector (2).
39. Install the CPA retainer (3).

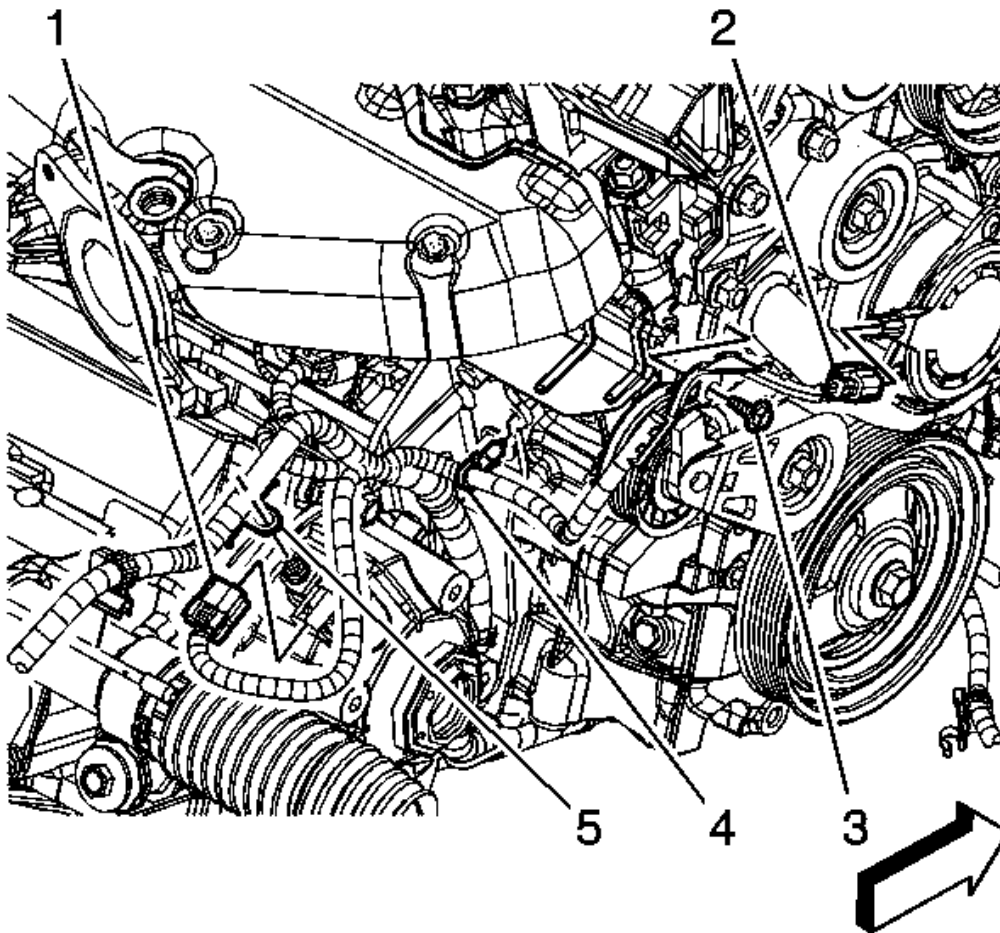


Fig. 226: Camshaft Position Actuator Magnet Electrical Connector
Courtesy of GENERAL MOTORS CORP.

40. Install the engine harness clip (4) to the transaxle bracket.
41. Install the engine harness clip bolt (3).

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

42. Connect the camshaft phasor sensor electrical connector (2).

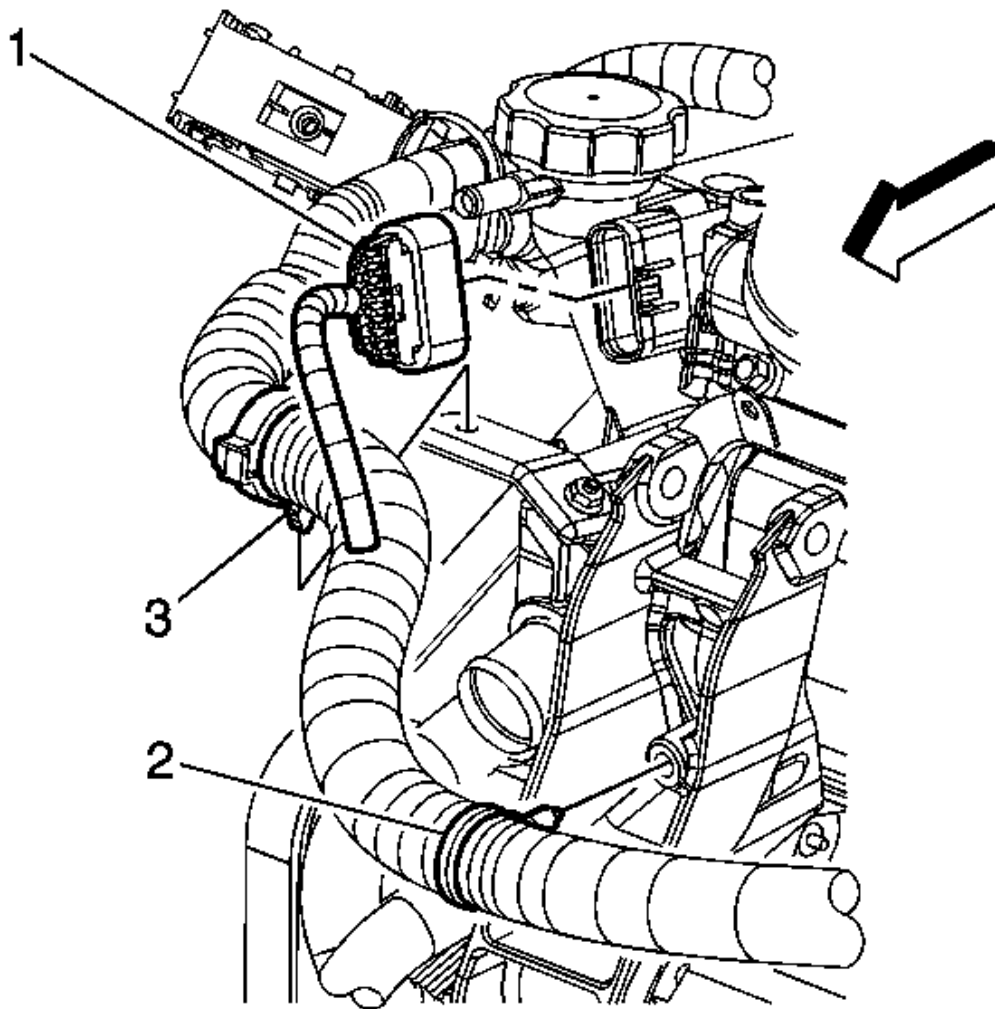


Fig. 227: Identifying Engine Harness Clip (2) & Strut Bracket
Courtesy of GENERAL MOTORS CORP.

43. Connect the fuel injector inline (1) electrical connector.
44. Install the engine harness clips (2, 3) to the brackets.

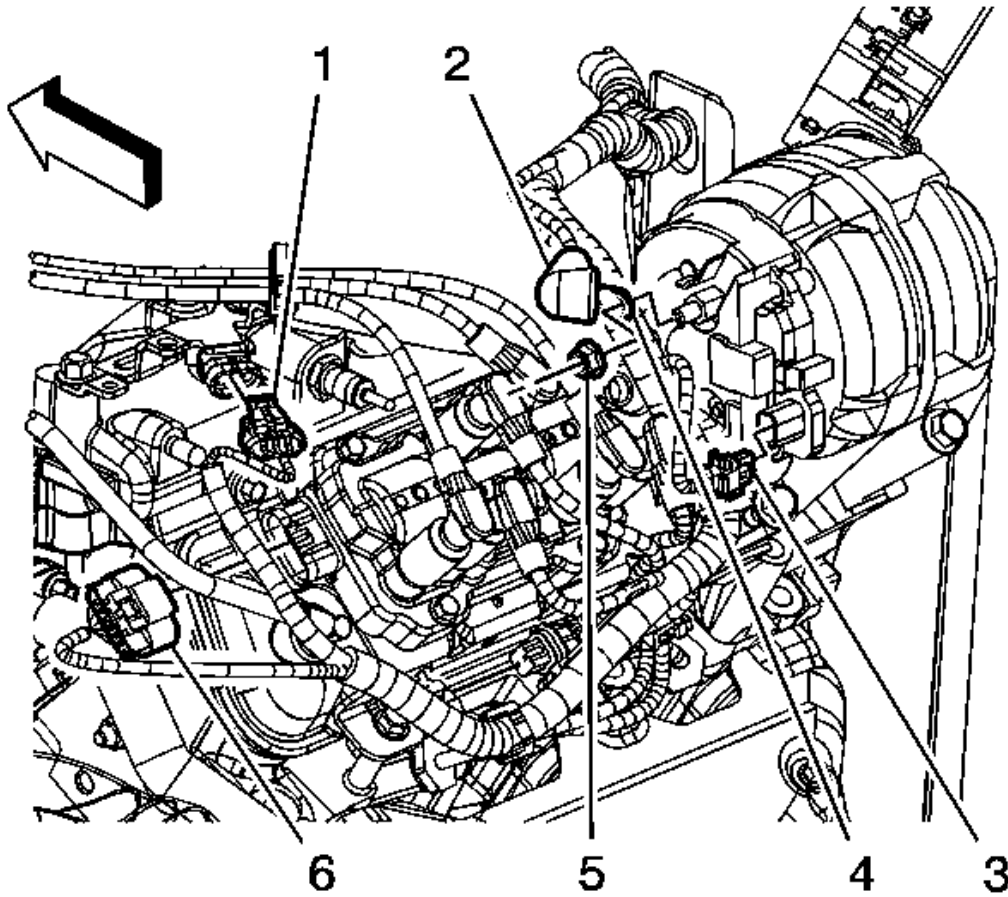


Fig. 228: View Of MAP Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

45. Connect the ignition coil electrical connector (6).
46. Connect the generator electrical connector (3).
47. Install the generator terminal (4).
48. Install the generator terminal nut (5).

Tighten: Tighten the nut to 30 N.m (22 lb ft).

49. Position the generator terminal boot (2).
50. Connect the MAP sensor electrical connector (1).

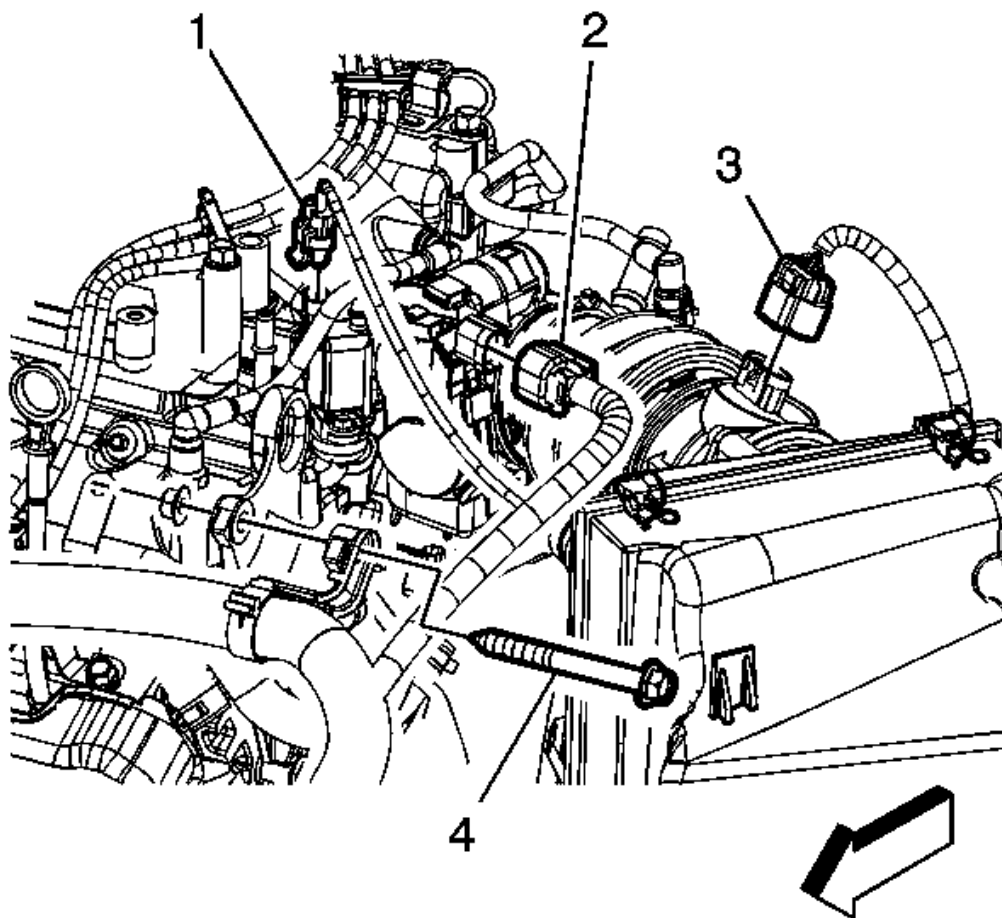


Fig. 229: View Of EVAP Canister Purge Solenoid Electrical Connector
Courtesy of GENERAL MOTORS CORP.

51. Connect the ETC (2) electrical connector.
52. Connect the EVAP canister purge solenoid (1) electrical connector.

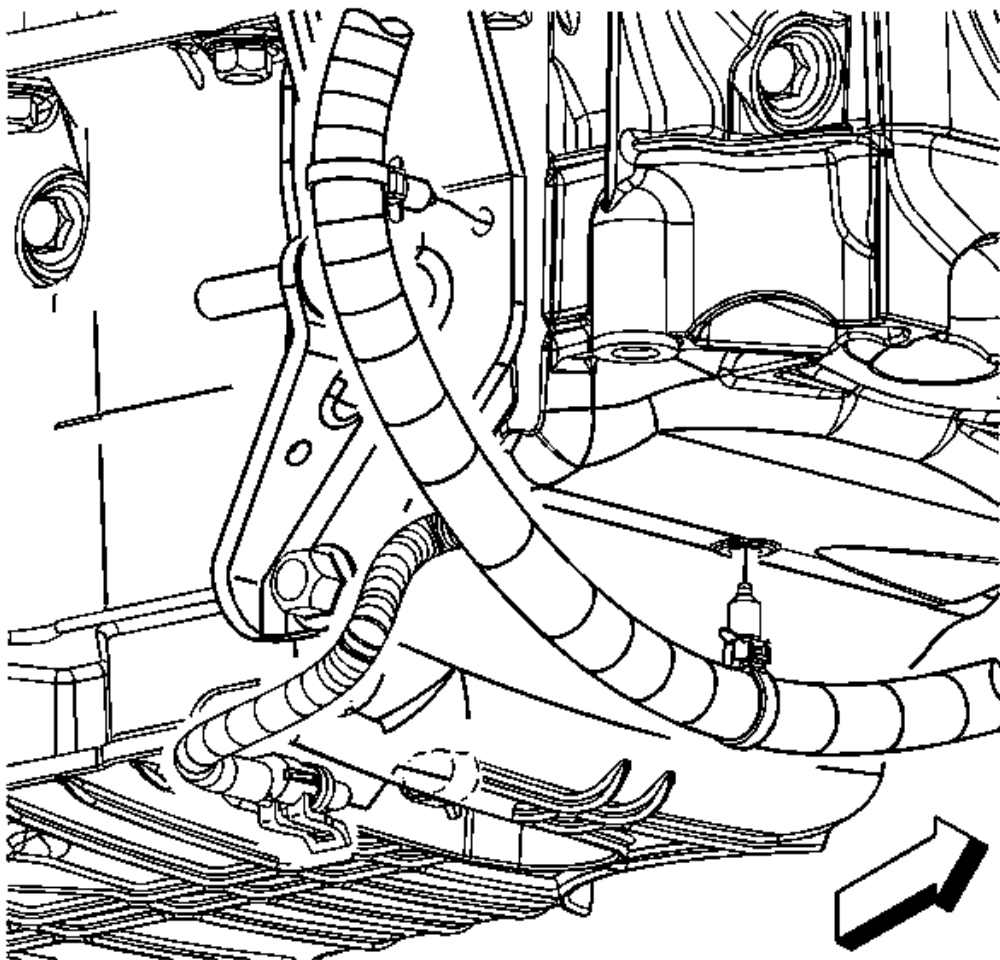


Fig. 230: Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

53. Raise the vehicle.
54. Connect the oil level sensor electrical connector.
55. Install the engine harness clips to the transaxle brace and the oil pan.

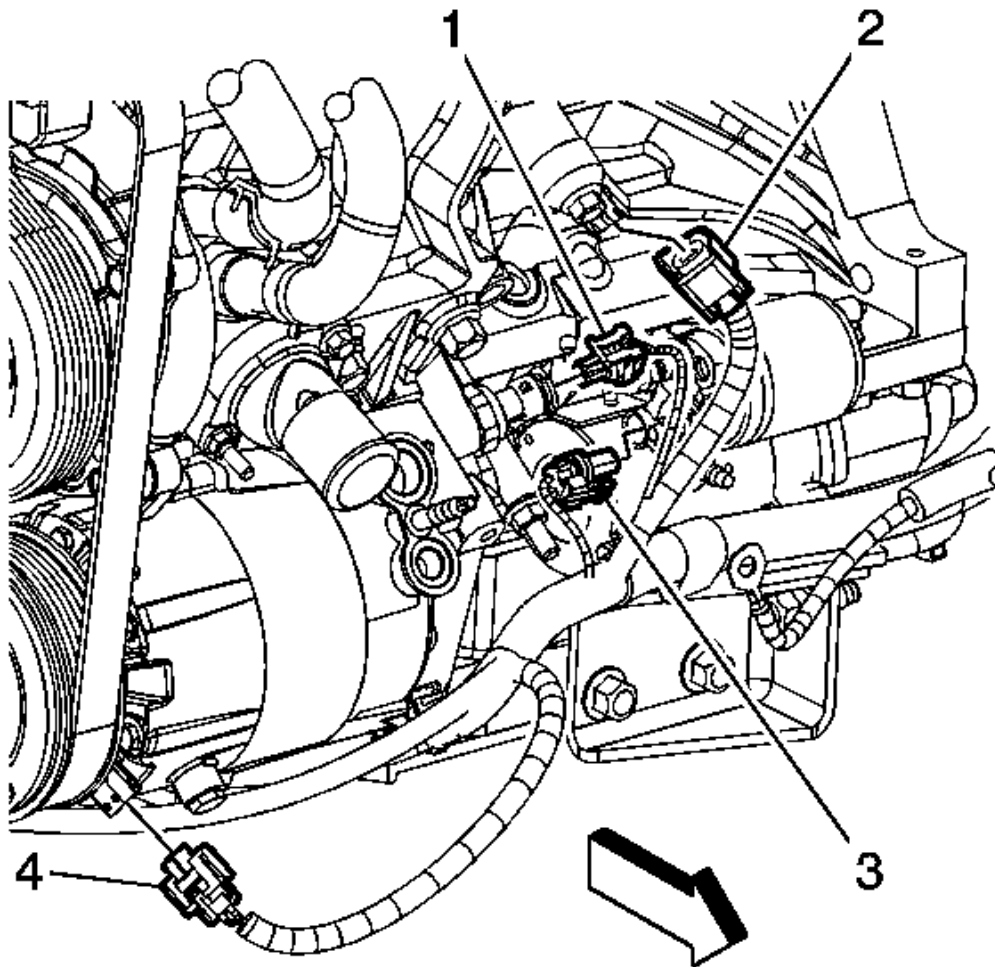


Fig. 231: Identifying Electrical Connector
Courtesy of GENERAL MOTORS CORP.

56. Connect the A/C compressor electrical connector (4).
57. Connect the starter motor electrical connector (3)
58. Connect the knock sensor (2) electrical connector.
59. Connect the oil pressure sensor (1) electrical connector.

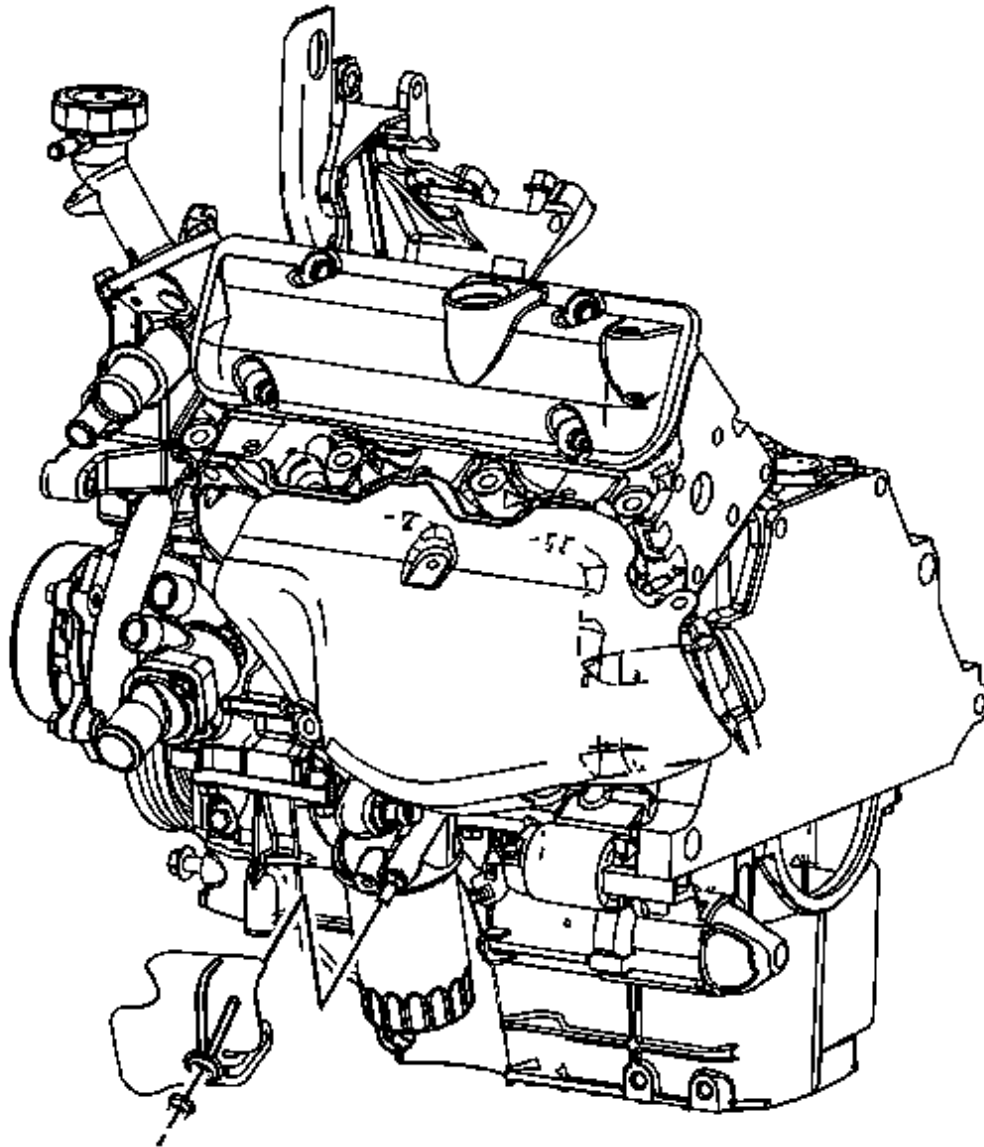


Fig. 232: Oil Pressure Sensor Heat Shield & Nut
Courtesy of GENERAL MOTORS CORP.

60. Install the oil pressure sensor heat shield and nuts.

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

61. Lower the vehicle.
62. Install the engine mount struts. Refer to **Engine Mount Strut Replacement**.
63. Install the drive belt. Refer to **Drive Belt Replacement**.
64. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
65. Install the hood. Refer to **Hood Replacement** .
66. Fill the engine with oil. Refer to **Engine Oil and Oil Filter Replacement**.
67. Fill the cooling system. Refer to **Cooling System Draining and Filling (LZE, LGD Static Fill)** or **Cooling System Draining and Filling (LZE, LGD GE47716 Fill)** .
68. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
69. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (LGD/LZE)** .

ENGINE OIL AND OIL FILTER REPLACEMENT

REMOVAL PROCEDURE

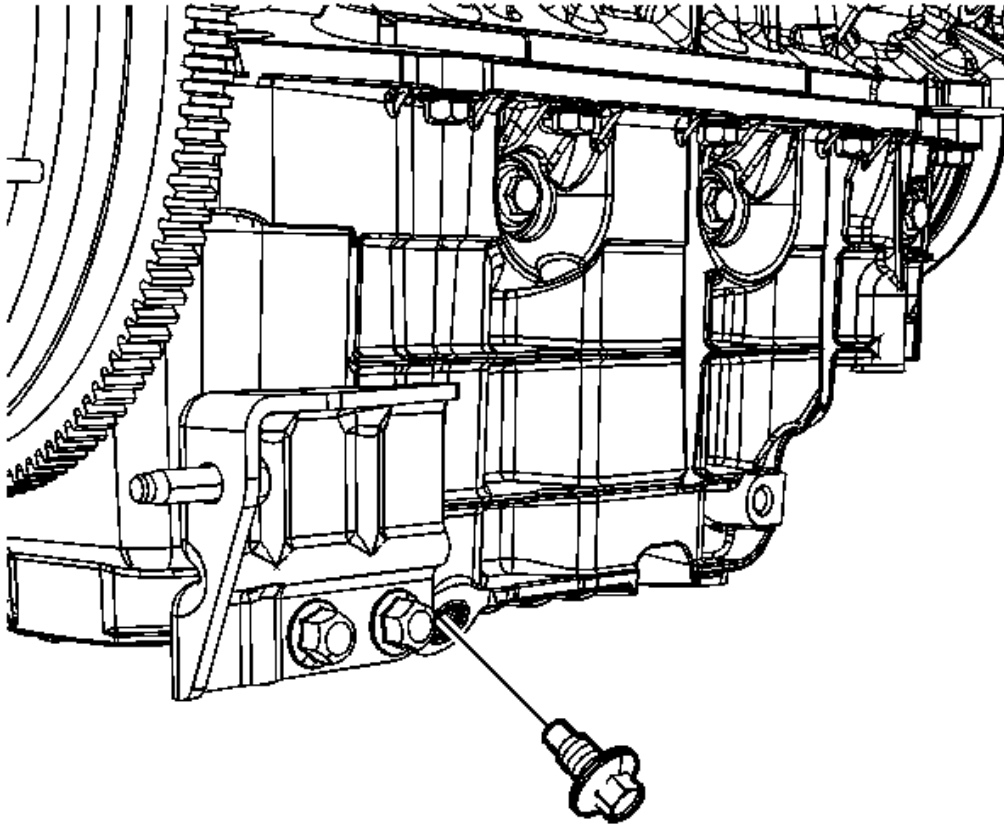


Fig. 233: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Position a suitable drain pan under the oil pan drain plug.
3. Remove the oil pan drain plug.
4. Allow the engine oil to drain completely.
5. Clean and inspect the oil pan drain plug sealing surface, replace the oil pan if necessary.
6. Wipe any remaining oil from the drain plug hole and reinstall the oil pan drain plug until snug.

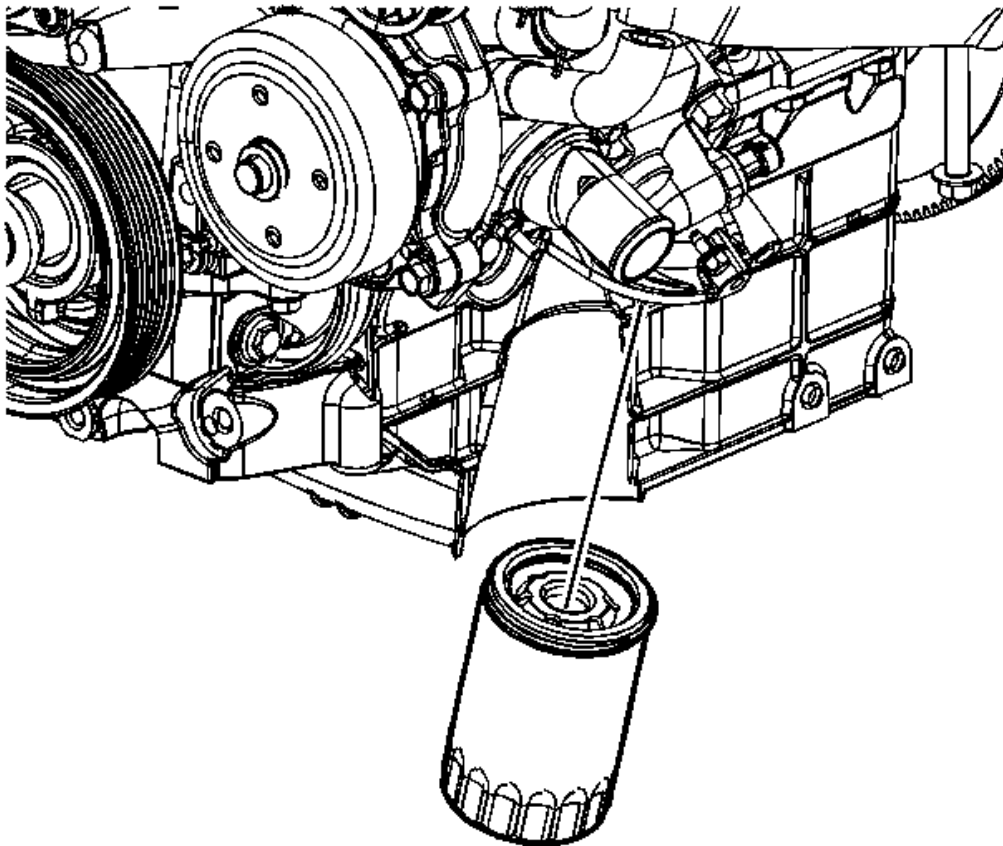


Fig. 234: View Of Oil Filter

Courtesy of GENERAL MOTORS CORP.

7. Position a suitable drain pan under the oil filter.
8. Remove the oil filter.
9. Ensure that the oil filter gasket is still on the old filter. If not remove the oil filter gasket from the adapter.

INSTALLATION PROCEDURE

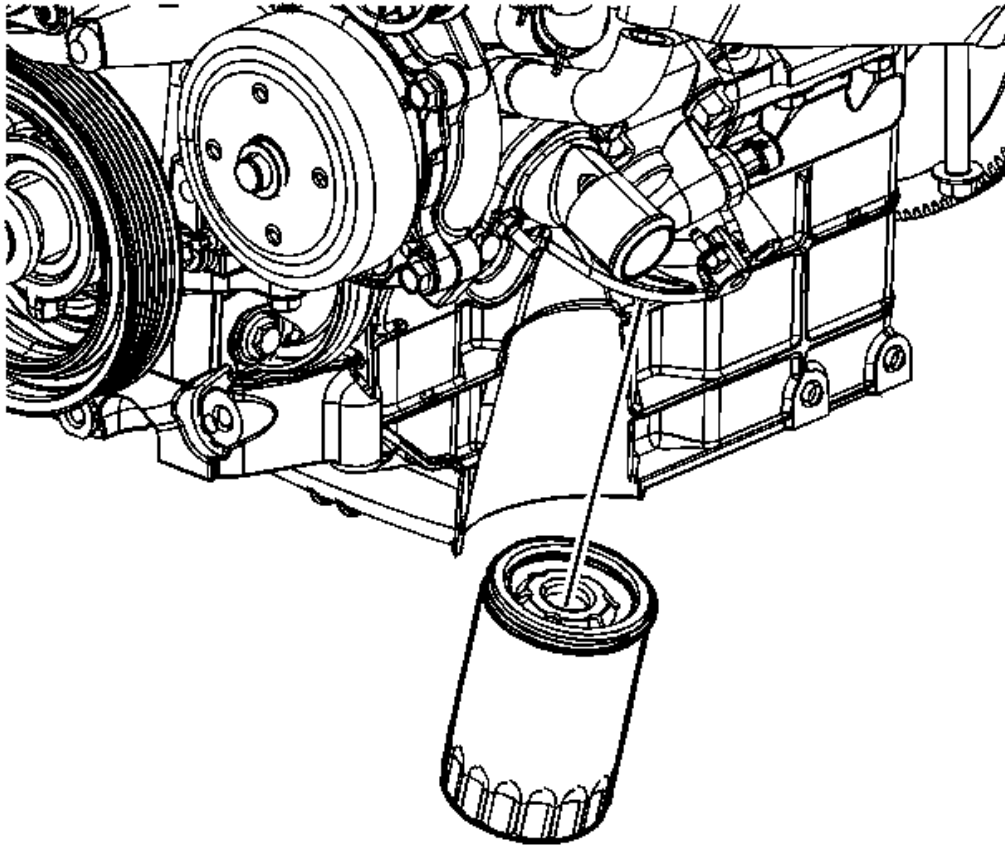


Fig. 235: View Of Oil Filter

Courtesy of GENERAL MOTORS CORP.

1. Apply clean engine oil to the NEW oil filter gasket.
2. Install the NEW oil filter.

Tighten: Tighten the new filter to 3/4 to 1 full turn, after the oil filter gasket contacts the adapter.

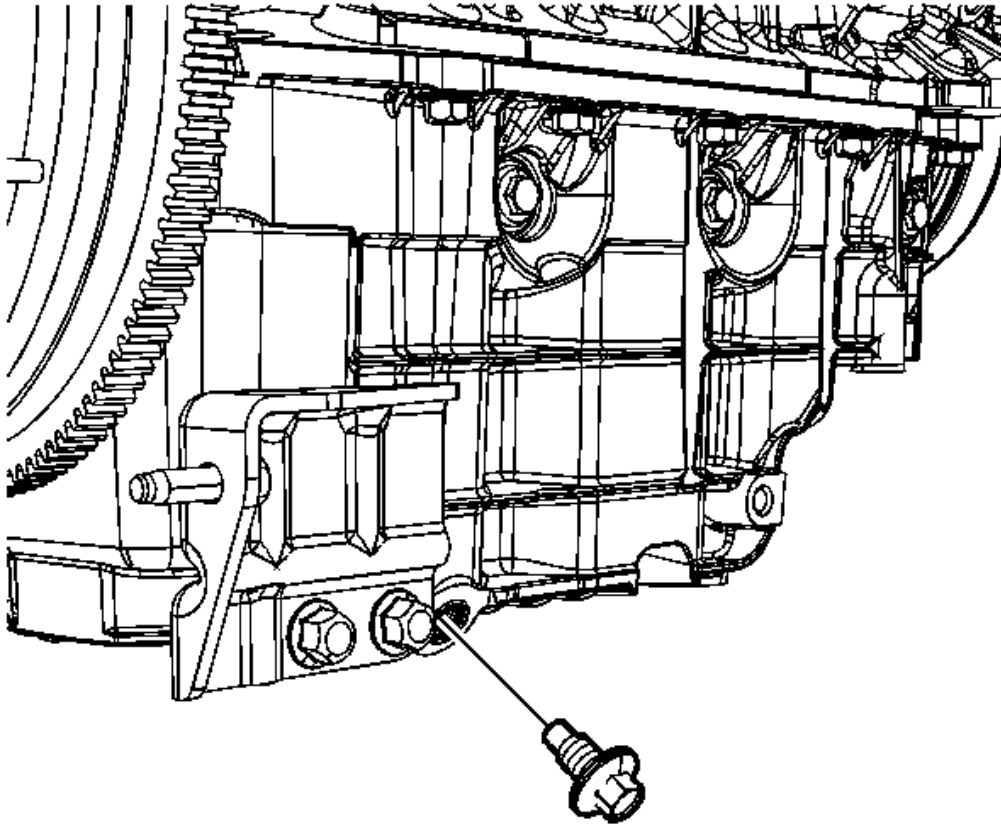


Fig. 236: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

3. Tighten the oil pan drain plug.

Tighten: Tighten the plug to 26 N.m (19 lb ft).

4. Remove the oil drain pan from under the vehicle.
5. Lower the vehicle.
6. Fill the engine with new engine oil. Refer to Approximate Fluid Capacities and Fluid and Lubricant Recommendations .
7. Start the engine.
8. Inspect the for oil leaks after engine start up.

9. Turn OFF the engine and allow the oil a few minutes to drain back into the oil pan.
10. Remove the oil level indicator from the oil level indicator tube.
11. Clean off the indicator end of the oil level indicator with a clean paper towel or cloth.
12. Install the oil level indicator into the oil level indicator tube until the oil level indicator handle contacts the top of the oil level indicator tube.
13. Again, remove the oil level indicator from the oil level indicator tube keeping the tip of the oil level indicator down.
14. Check the level of the engine oil on the oil level indicator.
15. If necessary, adjust the oil level by adding or draining oil.
16. Check for oil leaks.