

2010 ENGINE

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

INTAKE MANIFOLD COVER REPLACEMENT

REMOVAL PROCEDURE

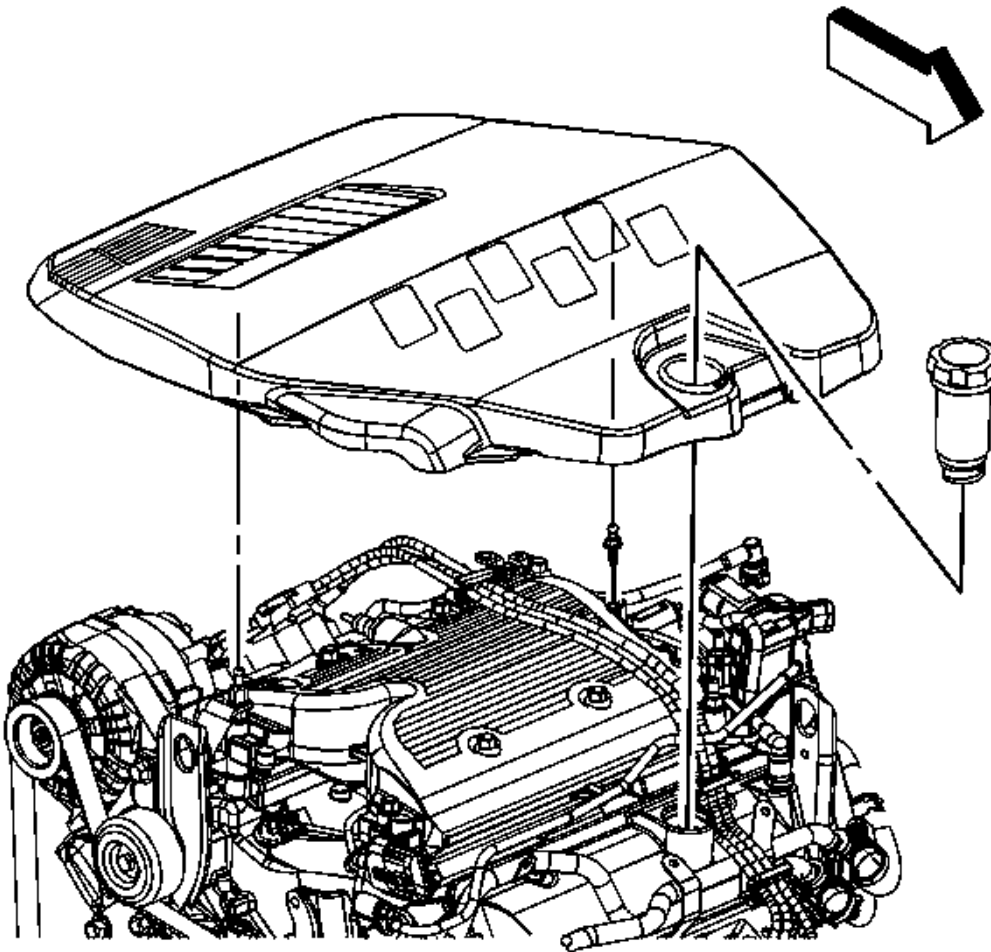


Fig. 1: Identifying Engine Oil Fill Cap And Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine oil fill cap and tube.
2. If equipped with electric power steering, grasp the cover by the sides and pull up, disengaging the cover

from grommets from the ball studs.

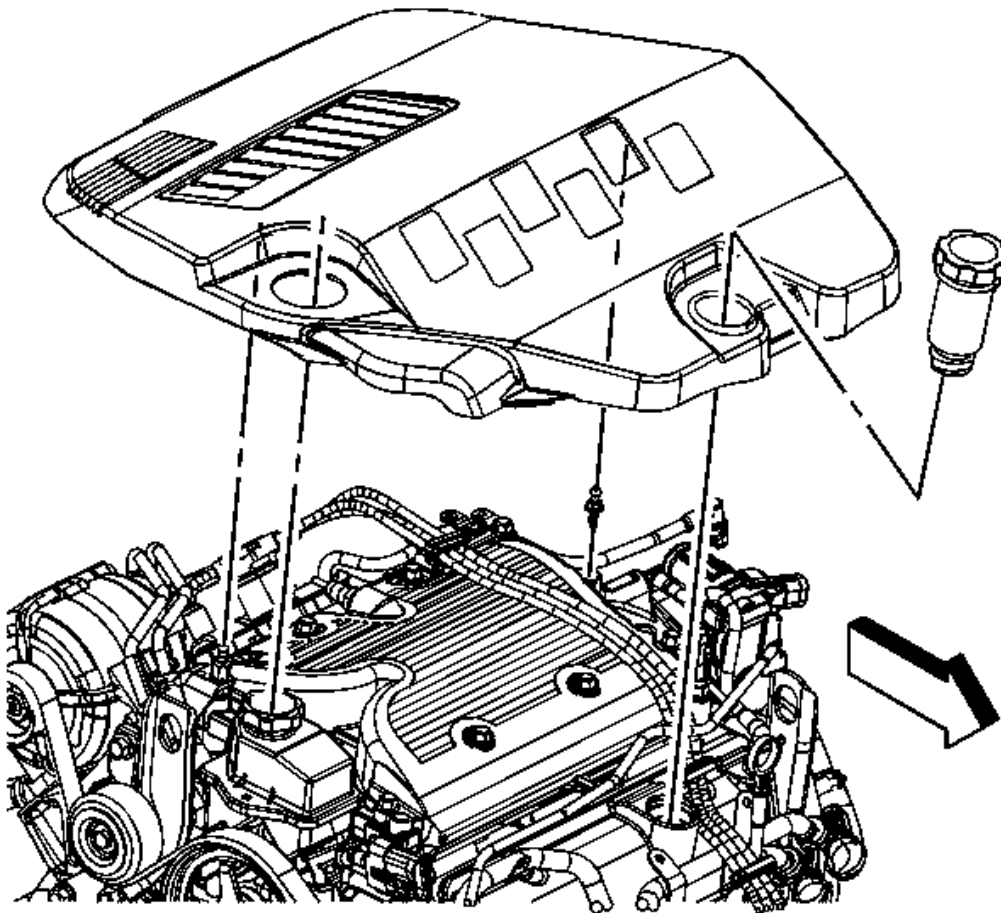


Fig. 2: View Of Hydraulic Power Steering
Courtesy of GENERAL MOTORS CORP.

3. If equipped with hydraulic power steering, grasp the cover by the sides and pull up, disengaging the cover from grommets from the ball studs.

INSTALLATION PROCEDURE

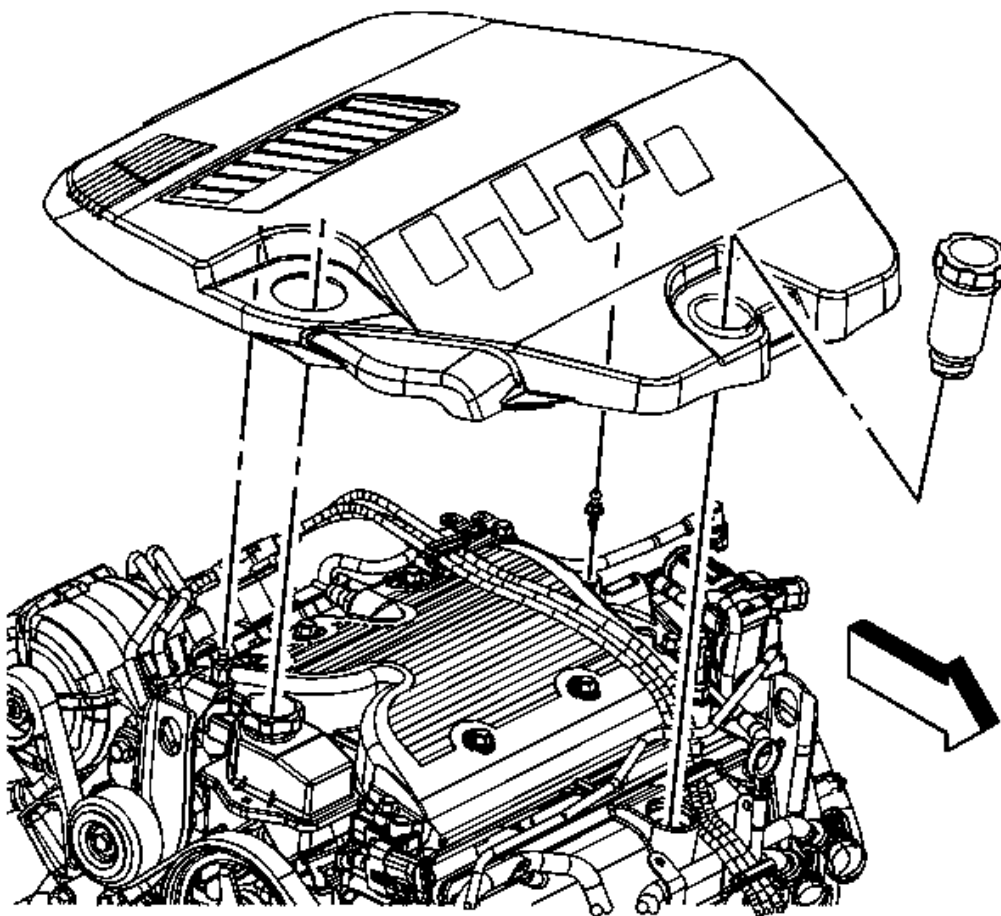


Fig. 3: View Of Hydraulic Power Steering
Courtesy of GENERAL MOTORS CORP.

1. If equipped with hydraulic power steering, place the cover over the ball studs, aligning the cover openings with the power steering reservoir cap and oil fill tube opening.
2. Push down on the cover above the studs in order to engage the cover grommets to the studs.

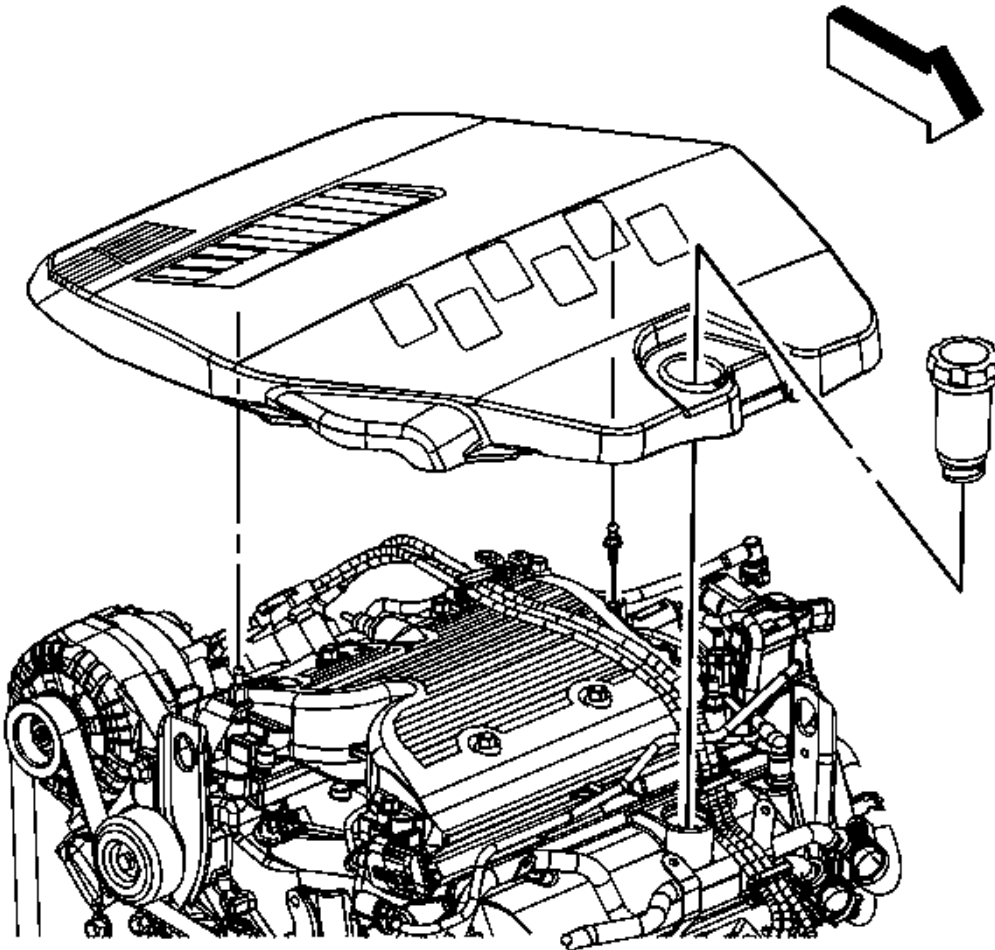
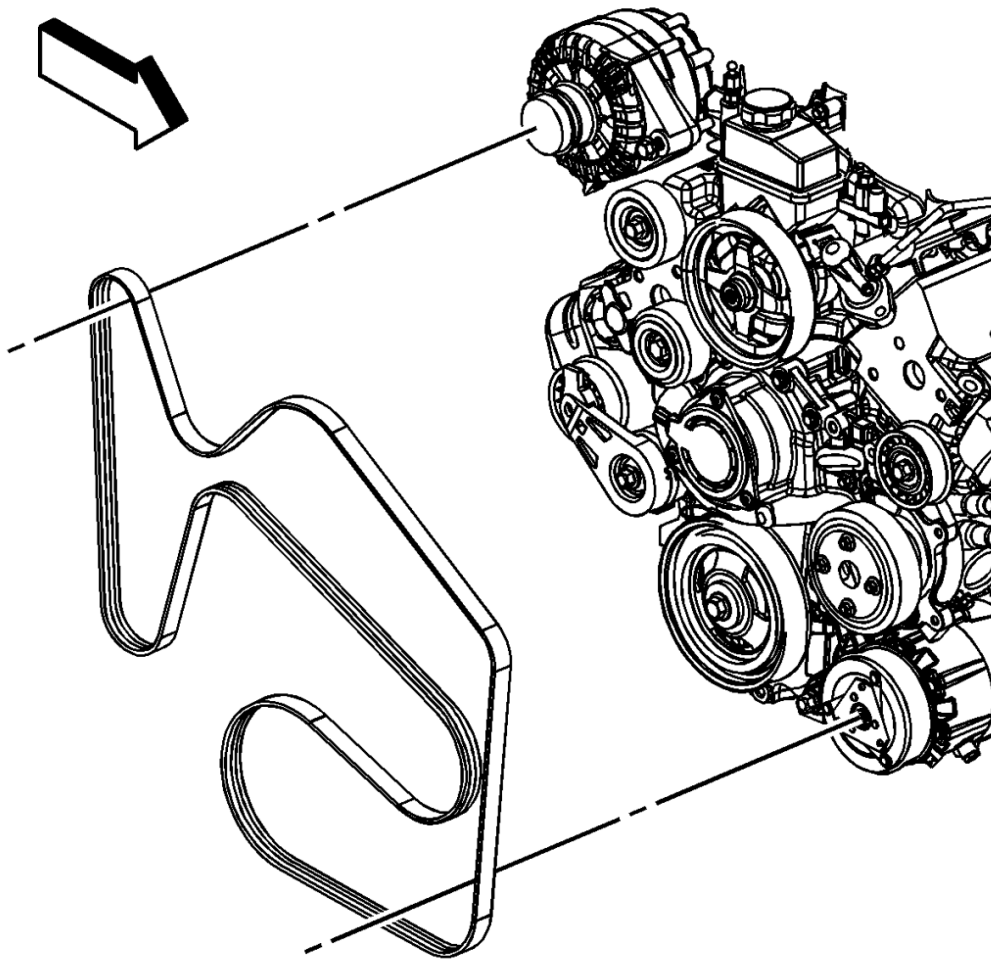


Fig. 4: Identifying Engine Oil Fill Cap And Tube
Courtesy of GENERAL MOTORS CORP.

3. If equipped with electric power steering, place the cover over the ball studs, aligning the cover opening with the oil fill tube opening.
4. Push down on the cover above the studs in order to engage the cover grommets to the studs.
5. Install the engine oil fill tube and cap.

DRIVE BELT REPLACEMENT

REMOVAL PROCEDURE

**Fig. 5: Drive Belt Routing**

Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#) .
2. Remove the engine mount snubber. Refer to [Engine Mount Snubber Replacement](#).
3. Install a breaker bar to the drive belt tensioner.
4. Rotate the drive belt tensioner counterclockwise to release the spring tension.

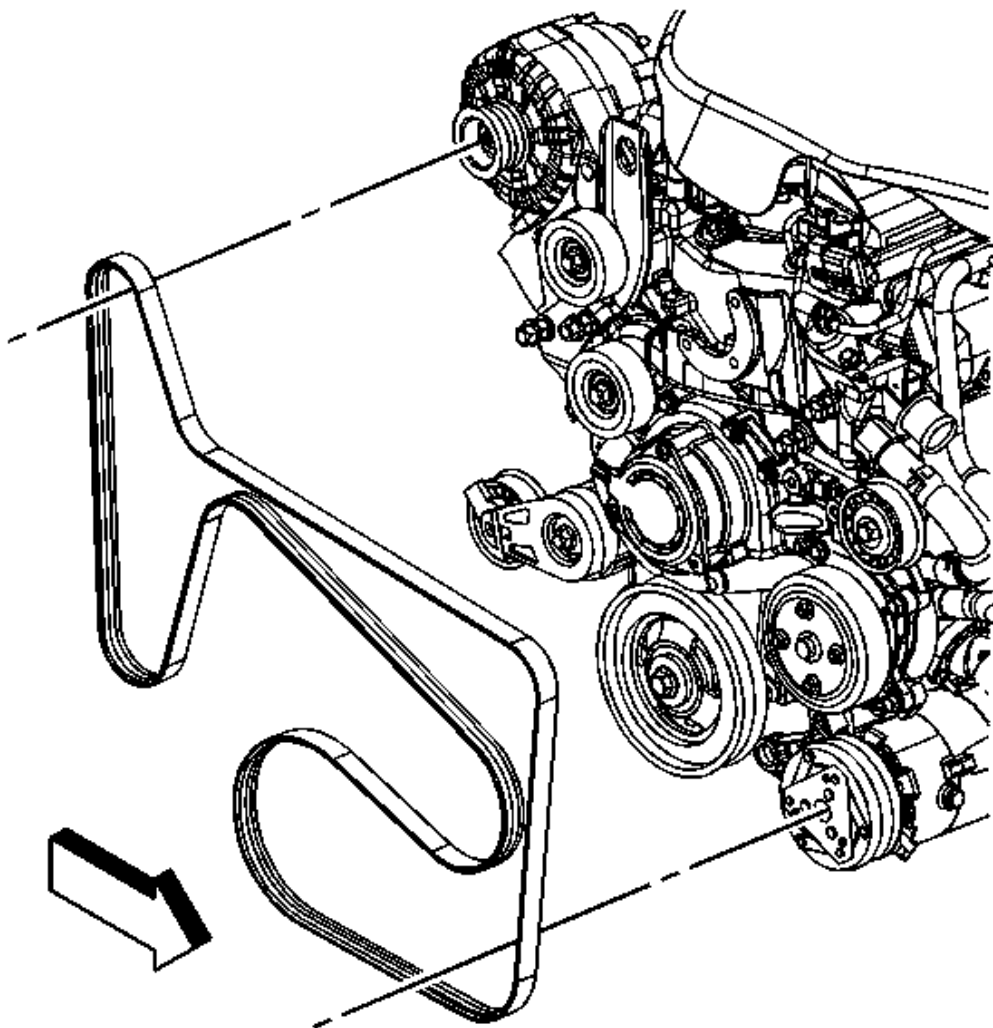


Fig. 6: Drive Belt Routing - With Power Steering
Courtesy of GENERAL MOTORS CORP.

5. Remove the drive belt.

INSTALLATION PROCEDURE

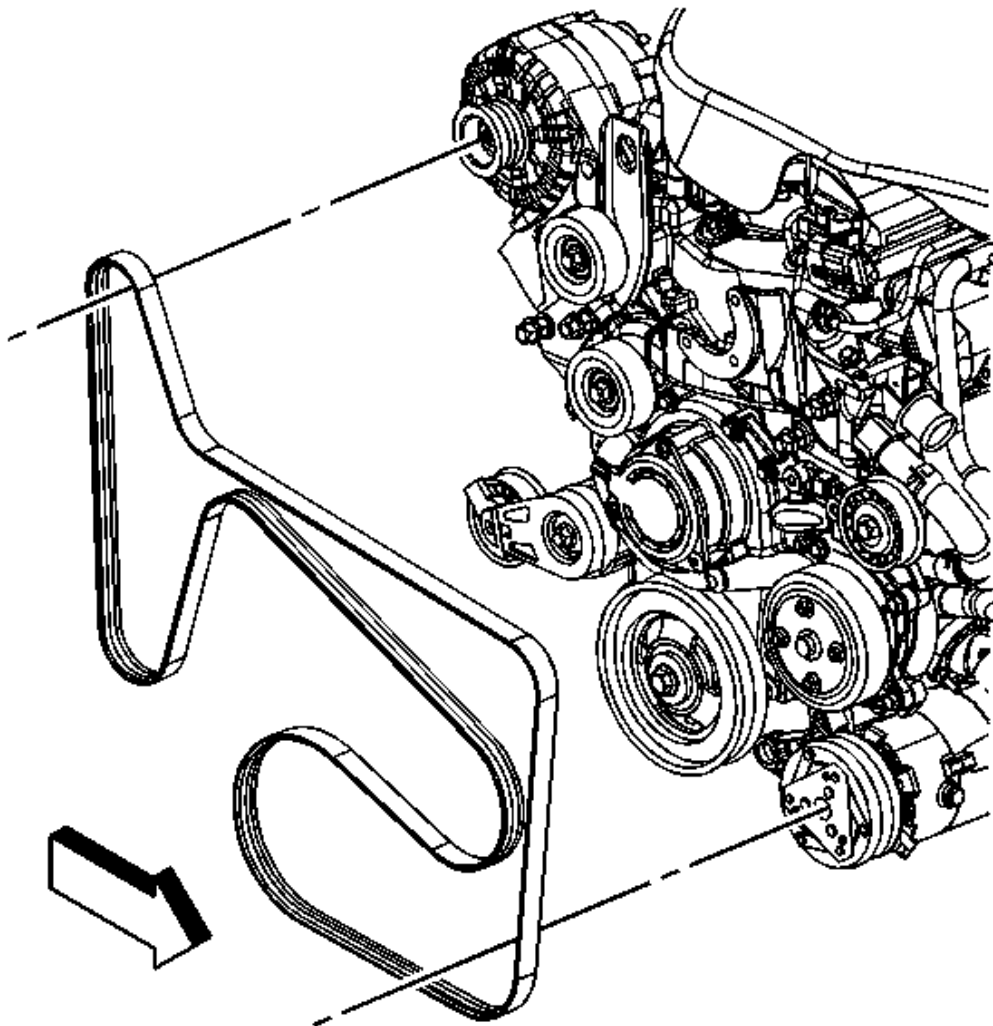


Fig. 7: Drive Belt Routing - With Power Steering
Courtesy of GENERAL MOTORS CORP.

1. Install a breaker bar to the drive belt tensioner.
2. Rotate the drive belt tensioner counterclockwise to release the spring tension.
3. Route and install the drive belt, if equipped with hydraulic power steering.

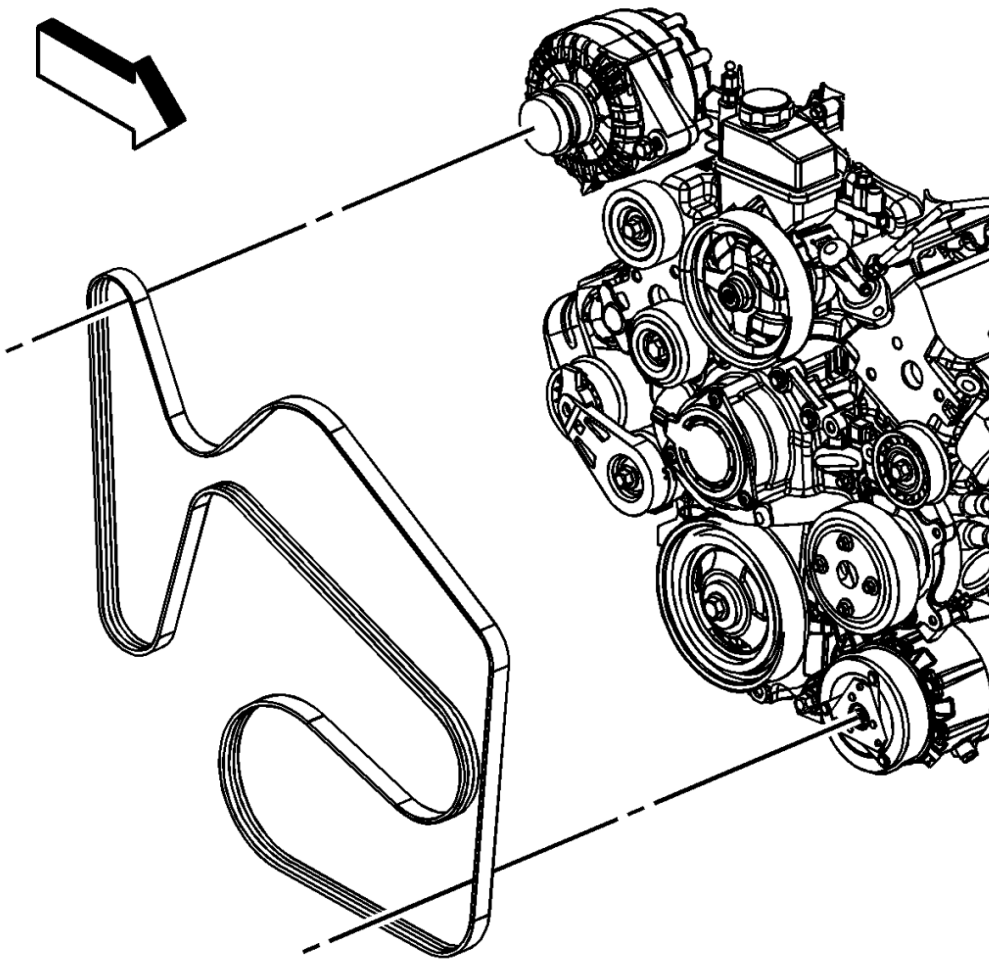


Fig. 8: Drive Belt Routing
Courtesy of GENERAL MOTORS CORP.

4. Route and install the drive belt, if equipped with electric power steering.
5. Install the engine mount snubber. Refer to **Engine Mount Snubber Replacement**.
6. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.

DRIVE BELT IDLER PULLEY REPLACEMENT

REMOVAL PROCEDURE

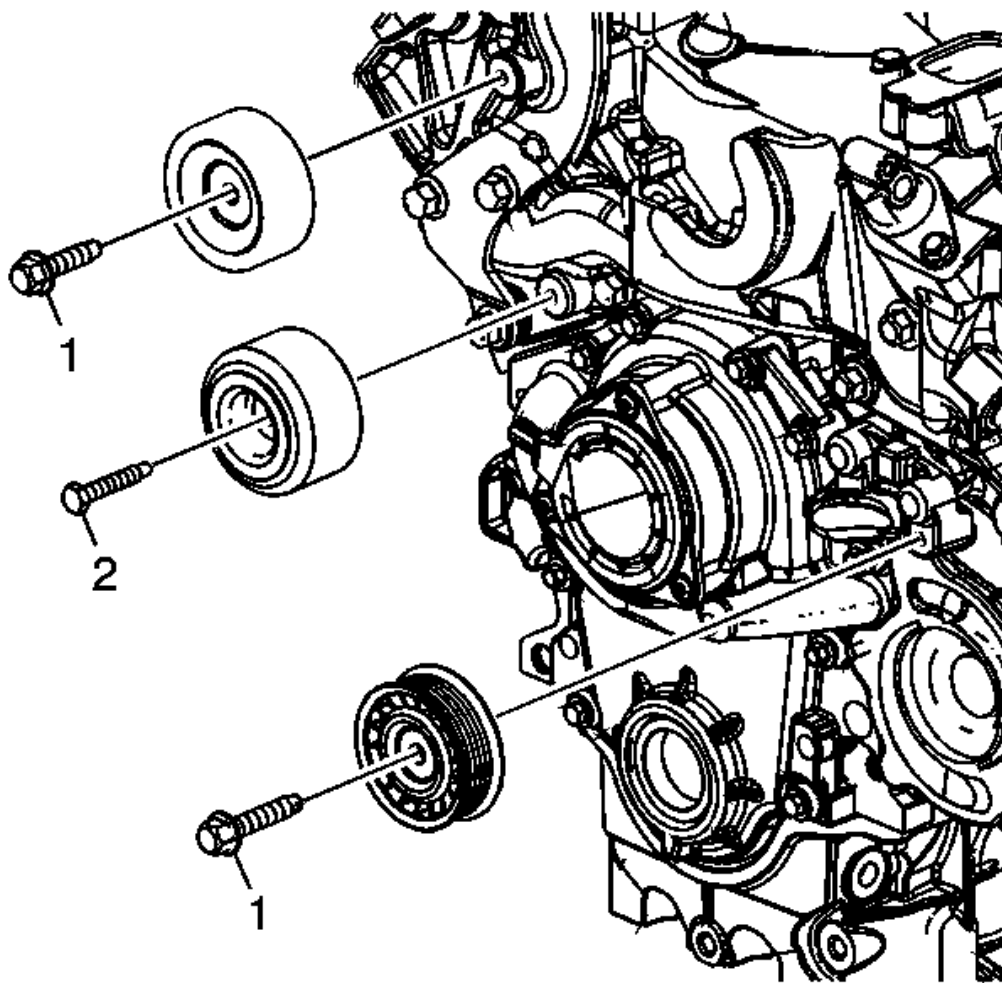


Fig. 9: Identifying Idler Pulley Bolts & Pulleys
Courtesy of GENERAL MOTORS CORP.

1. Remove the drive belt. Refer to **Drive Belt Replacement**.
2. Loosen the appropriate drive belt idler pulley bolt (1, 2).
3. Remove the appropriate drive belt idler pulley.

INSTALLATION PROCEDURE

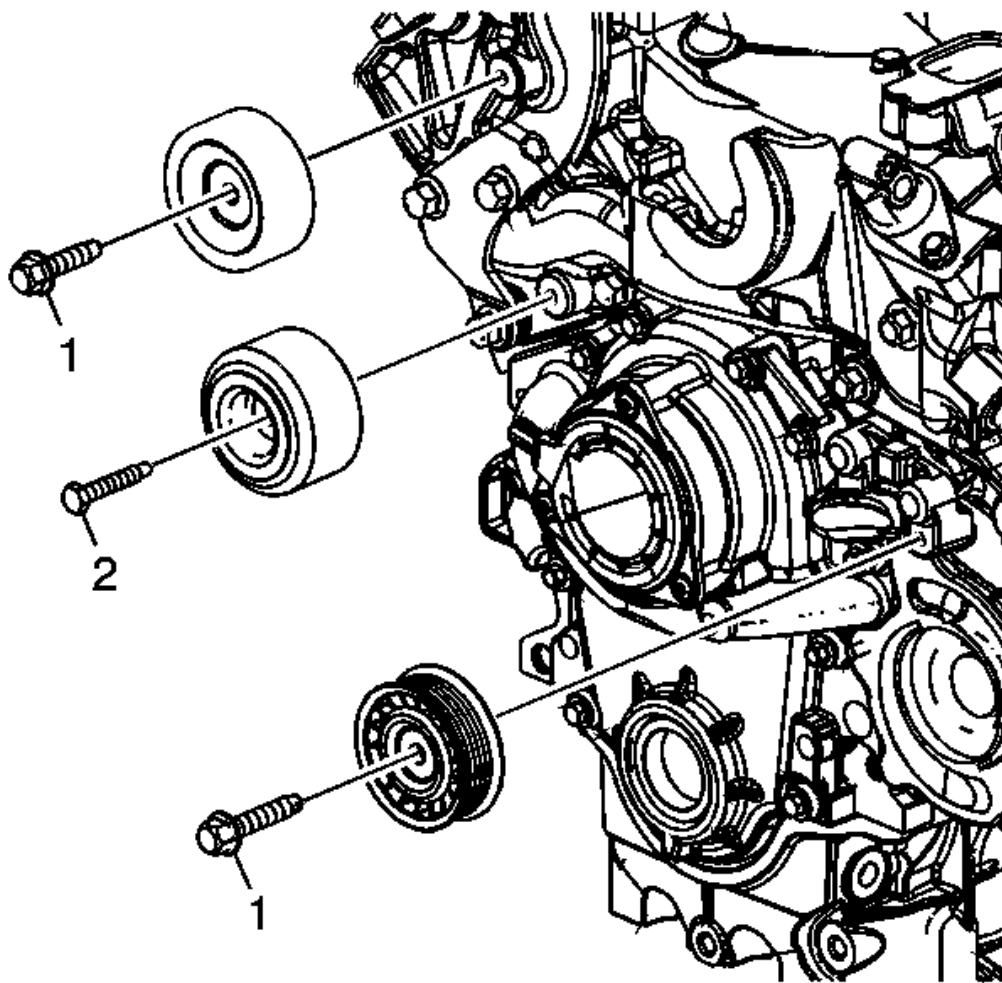


Fig. 10: Identifying Idler Pulley Bolts & Pulleys
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the appropriate drive belt idler pulley.
2. Tighten the appropriate drive belt idler pulley bolt (1, 2).

Tighten:

- Tighten the bolt (1) to 50 N.m (37 lb ft).
- Tighten the bolt (2) to 30 N.m (22 lb ft).

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

DRIVE BELT TENSIONER REPLACEMENT

REMOVAL PROCEDURE

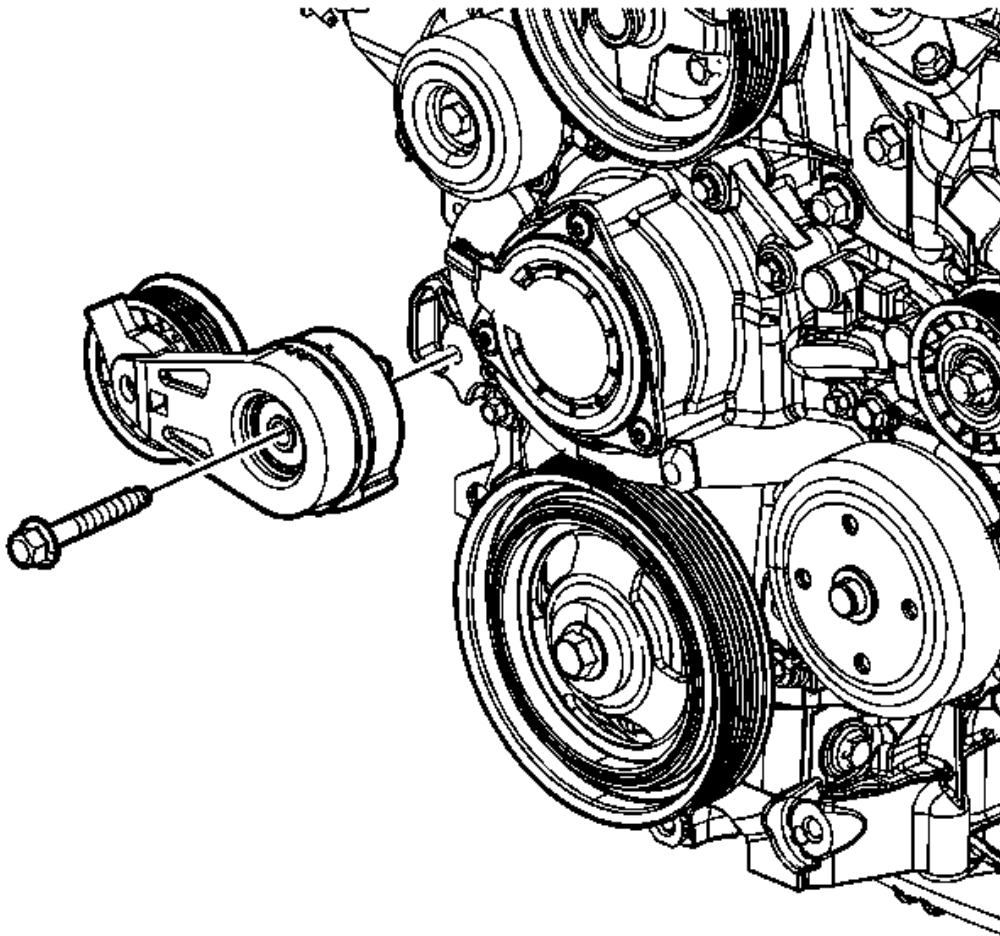


Fig. 11: Identifying Drive Belt Tensioner & Bolt
Courtesy of GENERAL MOTORS CORP.

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

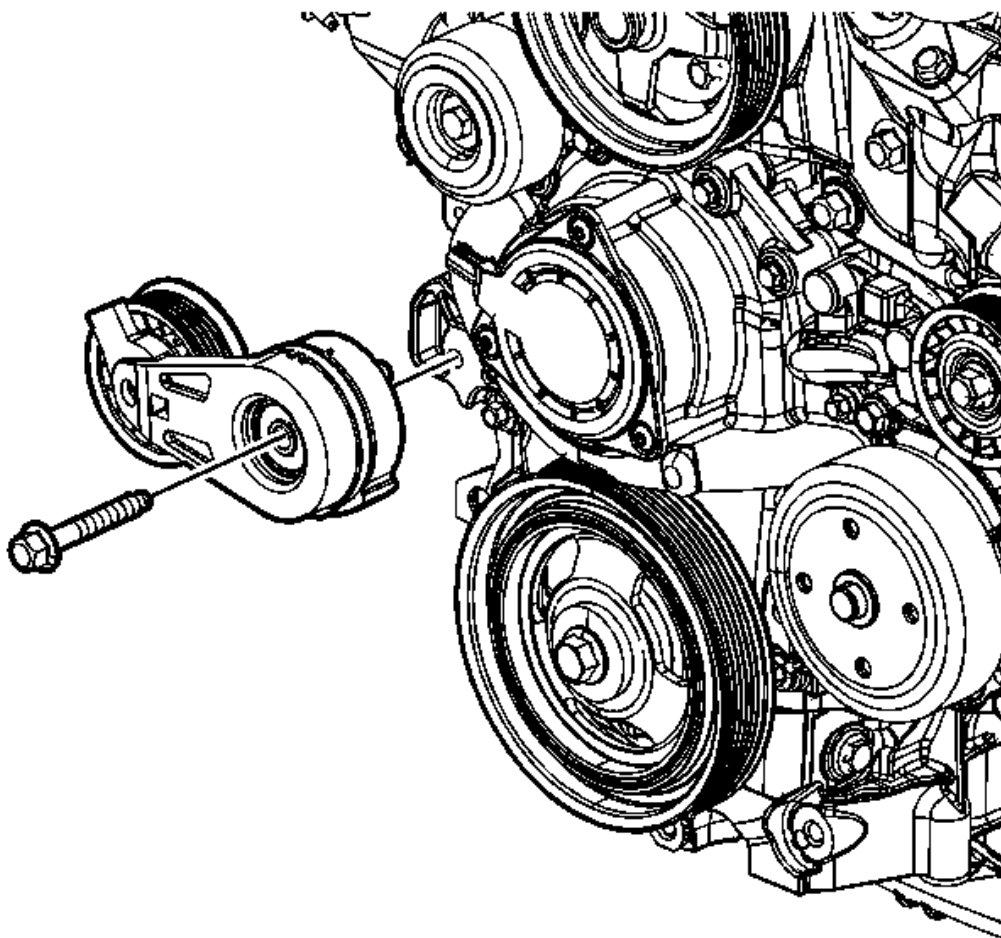


Fig. 12: Identifying Drive Belt Tensioner & Bolt
Courtesy of GENERAL MOTORS CORP.

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
- **J 36462** Engine Support Adapter Leg. See [Special Tools](#) .

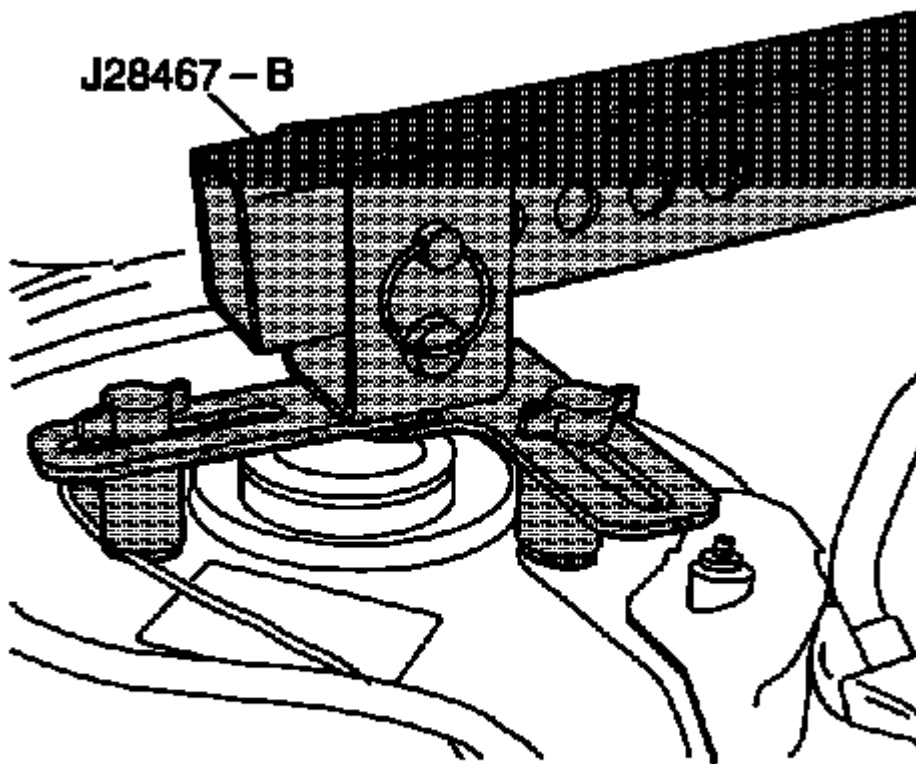


Fig. 13: Installing Thread Support Nuts (J 28467-33A)
Courtesy of GENERAL MOTORS CORP.

1. Raise the hood.
2. Remove the intake manifold cover. Refer to [Intake Manifold Cover Replacement](#).
3. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(LE5, LE9, LZ4, LZE, or LY7\)](#) .
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.

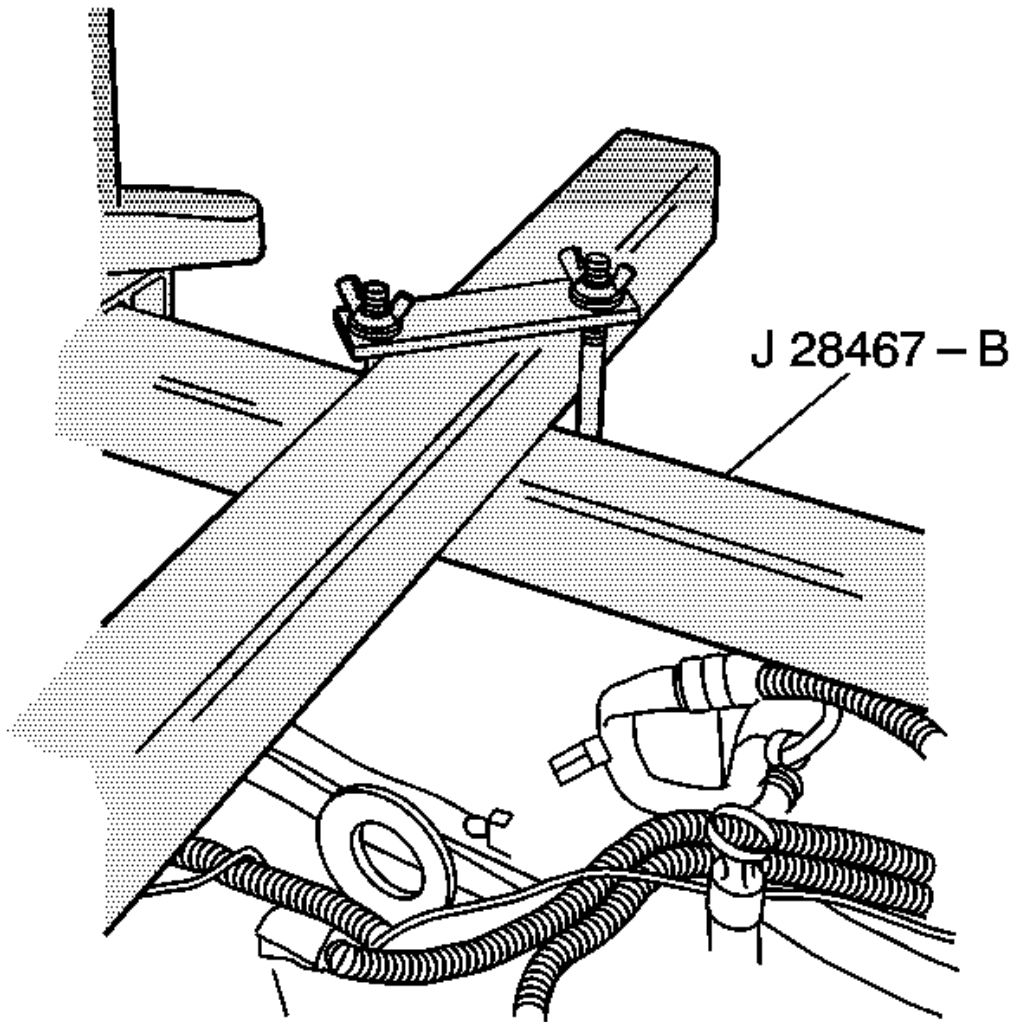


Fig. 14: Installing Radiator Shelf Tube (J 28467-2A)
 Courtesy of GENERAL MOTORS CORP.

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

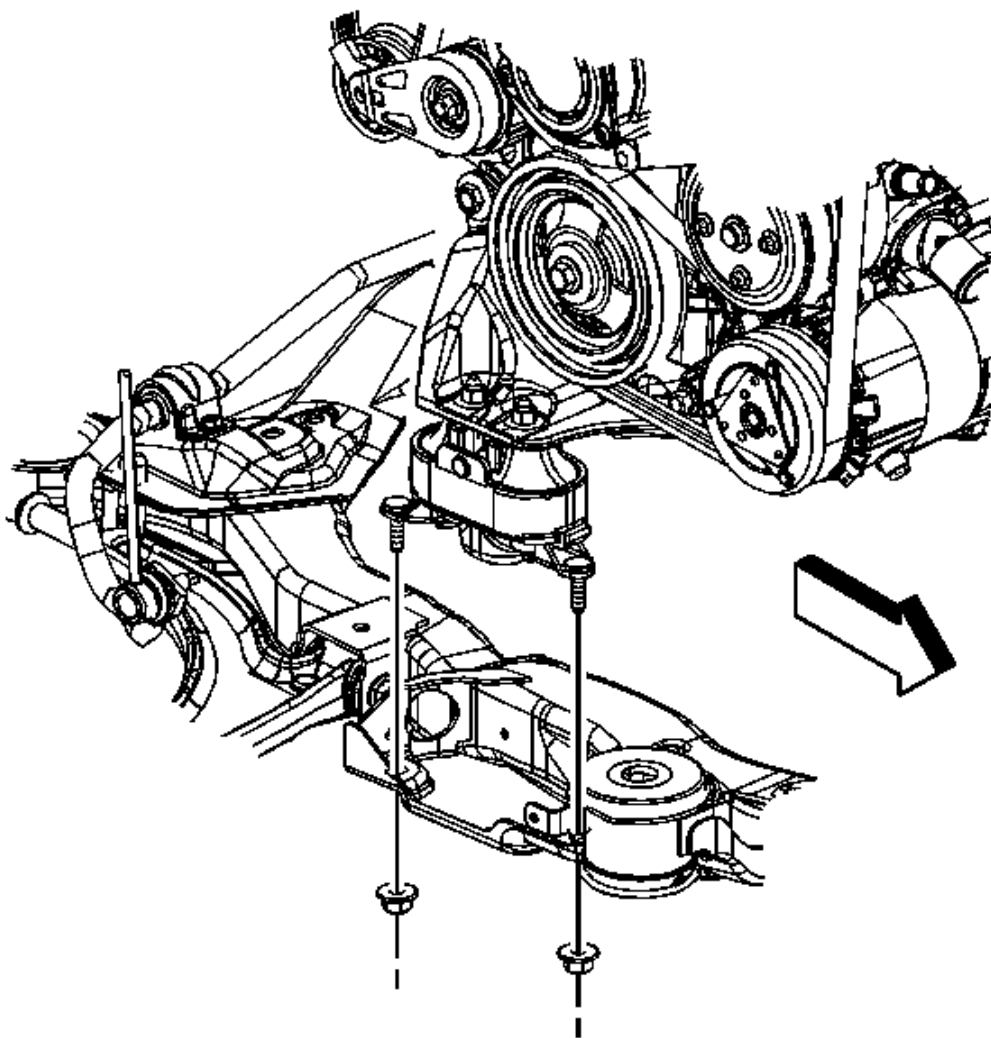


Fig. 15: Identifying Engine Mount To Frame Nuts
Courtesy of GENERAL MOTORS CORP.

1. Remove the tire and wheel. Refer to Tire and Wheel Removal and Installation .

2. Remove the engine splash shield. Refer to **Radiator Air Lower Baffle and Deflector Replacement** .
3. Remove the engine mount to frame nuts.

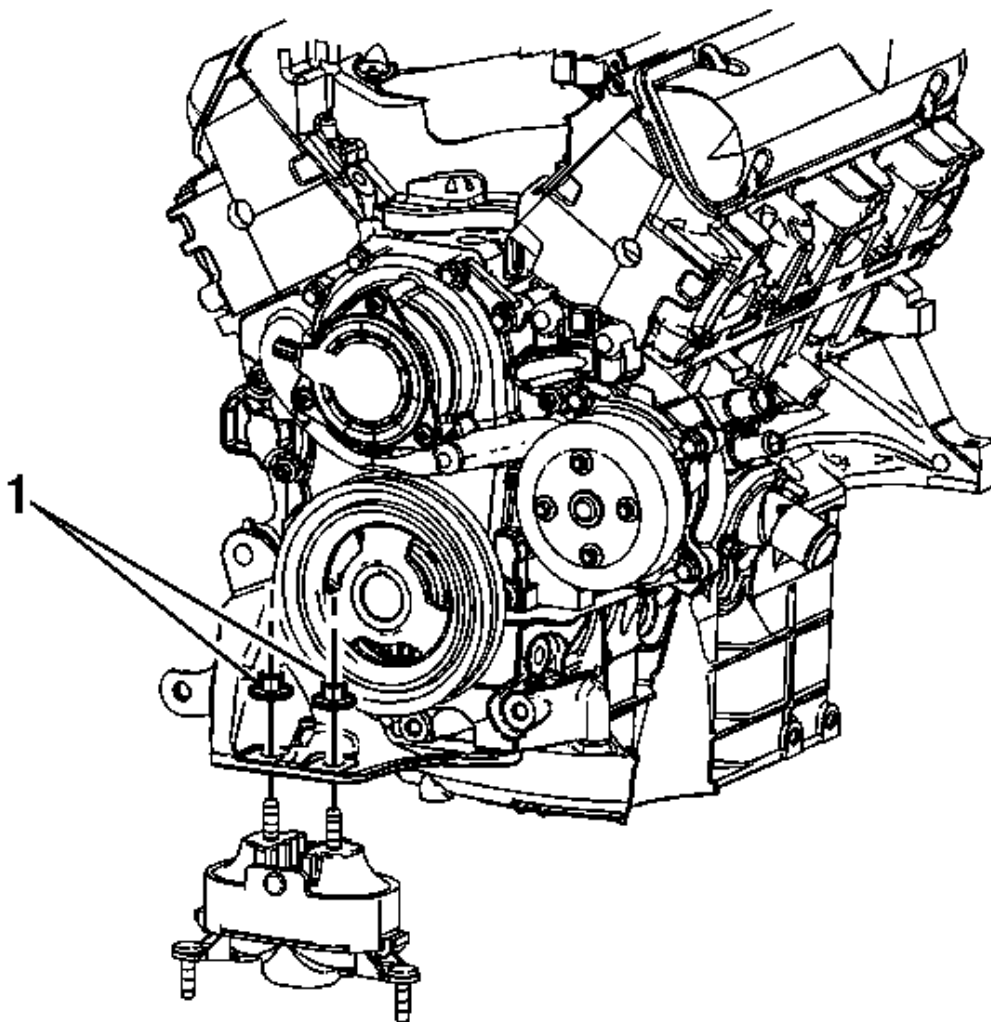


Fig. 16: Identifying Engine Mount Bracket Nuts
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine mount to engine mount bracket nuts (1).
5. Using a suitable jackstand, Place the jackstand with a block of wood under the oil pan.
6. Remove the engine mount.

INSTALLATION PROCEDURE

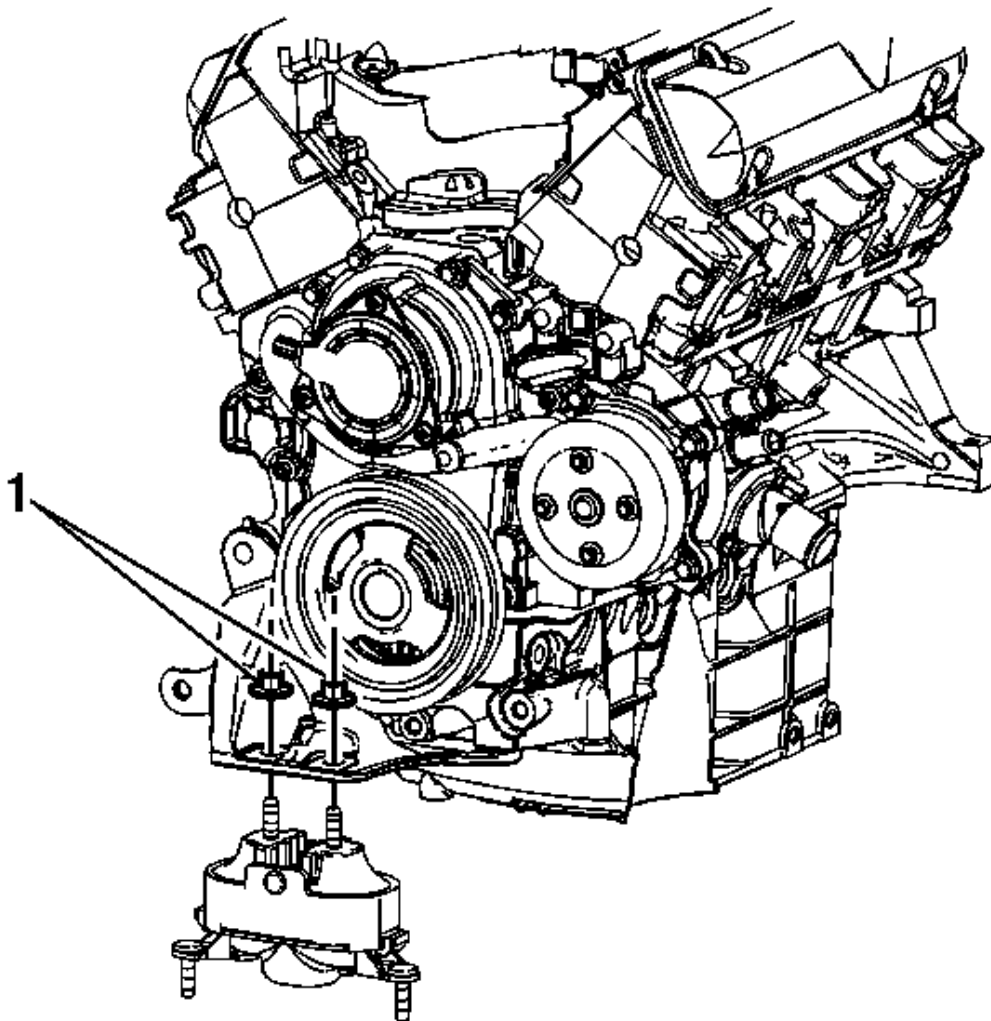


Fig. 17: Identifying Engine Mount Bracket Nuts
Courtesy of GENERAL MOTORS CORP.

1. Position the motor mount onto the frame.
2. Use the jackstand to lower the engine mount bracket on to the engine mount.

CAUTION: Refer to Fastener Caution .

3. Install the engine mount to engine mount bracket nuts (1).

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

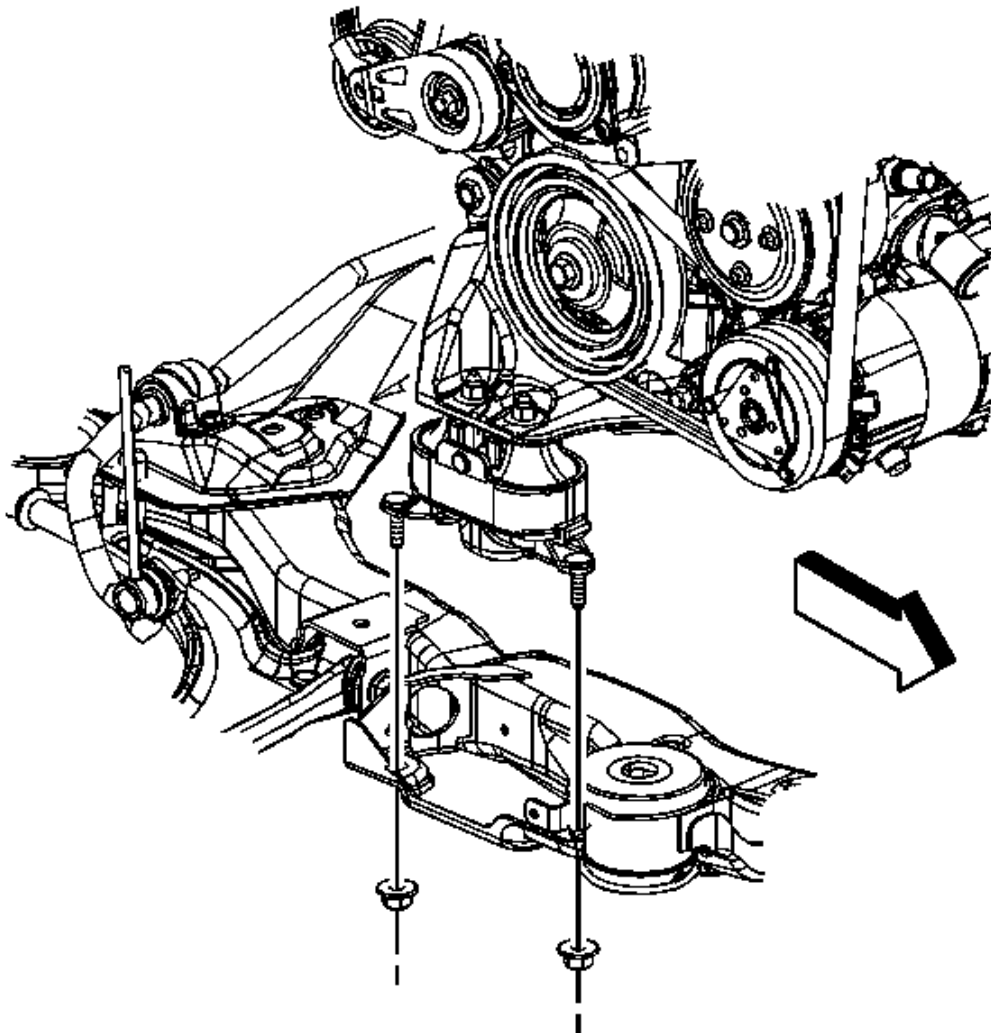


Fig. 18: Identifying Engine Mount To Frame Nuts
Courtesy of GENERAL MOTORS CORP.

4. Install the engine mount to frame nuts.

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

5. Install the engine splash shield. Refer to **Radiator Air Lower Baffle and Deflector Replacement** .
6. Install the tire and wheel. Refer to **Tire and Wheel Removal and Installation** .

ENGINE MOUNT BRACKET REPLACEMENT

REMOVAL PROCEDURE

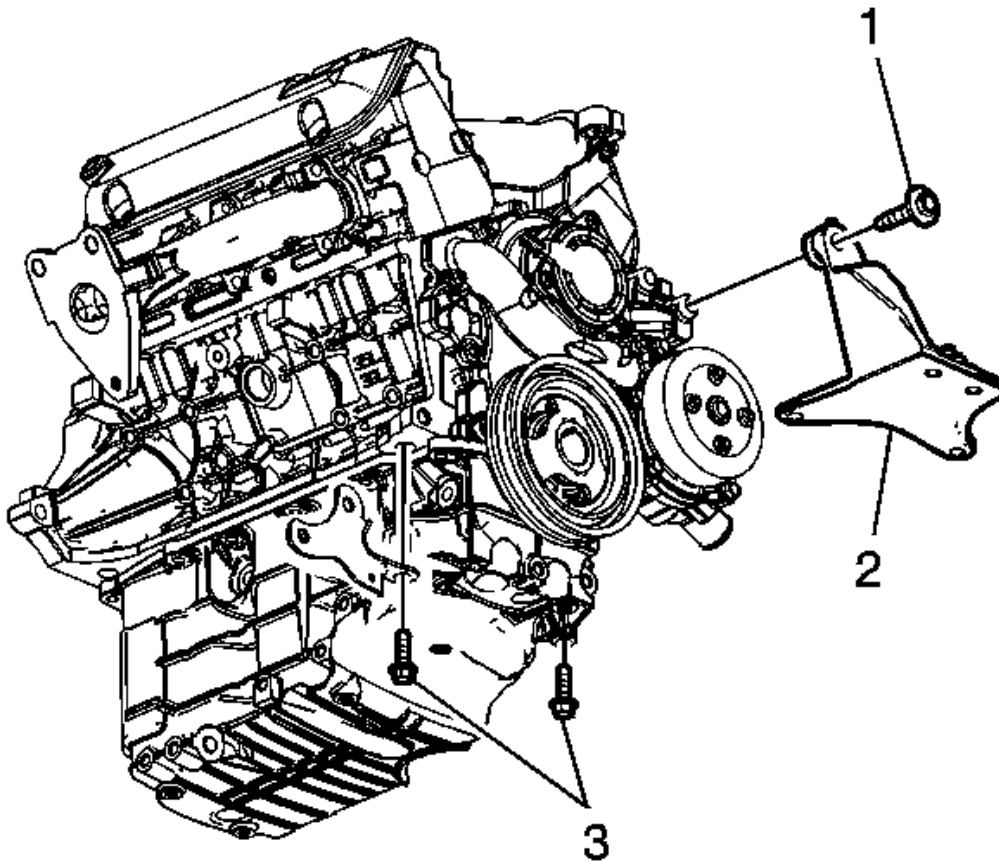


Fig. 19: Identifying Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount. Refer to **Engine Mount Replacement**.
2. Remove the engine mount bracket bolts (1, 3) from the engine.
3. Remove the engine mount bracket (2).

INSTALLATION PROCEDURE

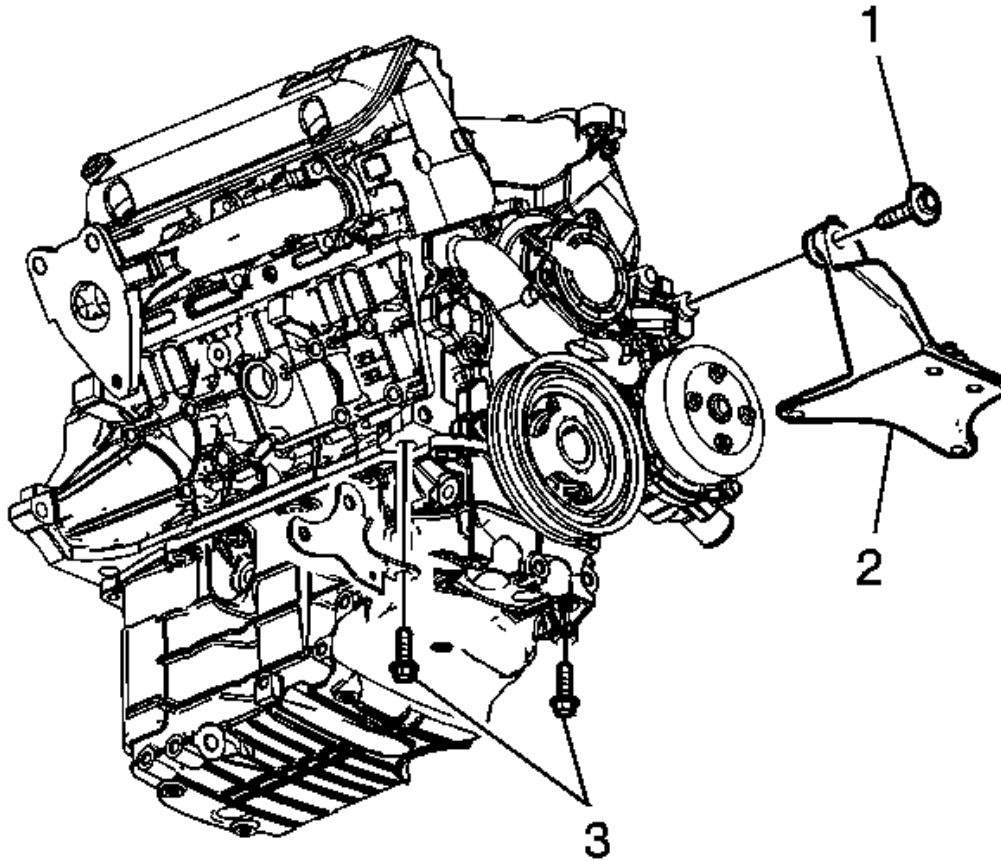


Fig. 20: Identifying Engine Mount Bracket
 Courtesy of GENERAL MOTORS CORP.

1. Position the engine mount bracket to the engine.

CAUTION: Refer to Fastener Caution .

2. Loosely install the engine mount bracket bolts.
3. Hold the engine mount bracket firmly to the front of the engine and snug the oil pan bolts (3) so that the bracket is just seated to the oil pan.
4. Tighten the engine mount bracket to engine bolt.

Tighten: Tighten the bolt to 90 N.m (66 lb ft).

5. Tighten the engine mount bracket to oil pan bolts.

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

6. Install the engine mount. Refer to Engine Mount Replacement.

ENGINE MOUNT SNUBBER REPLACEMENT

REMOVAL PROCEDURE

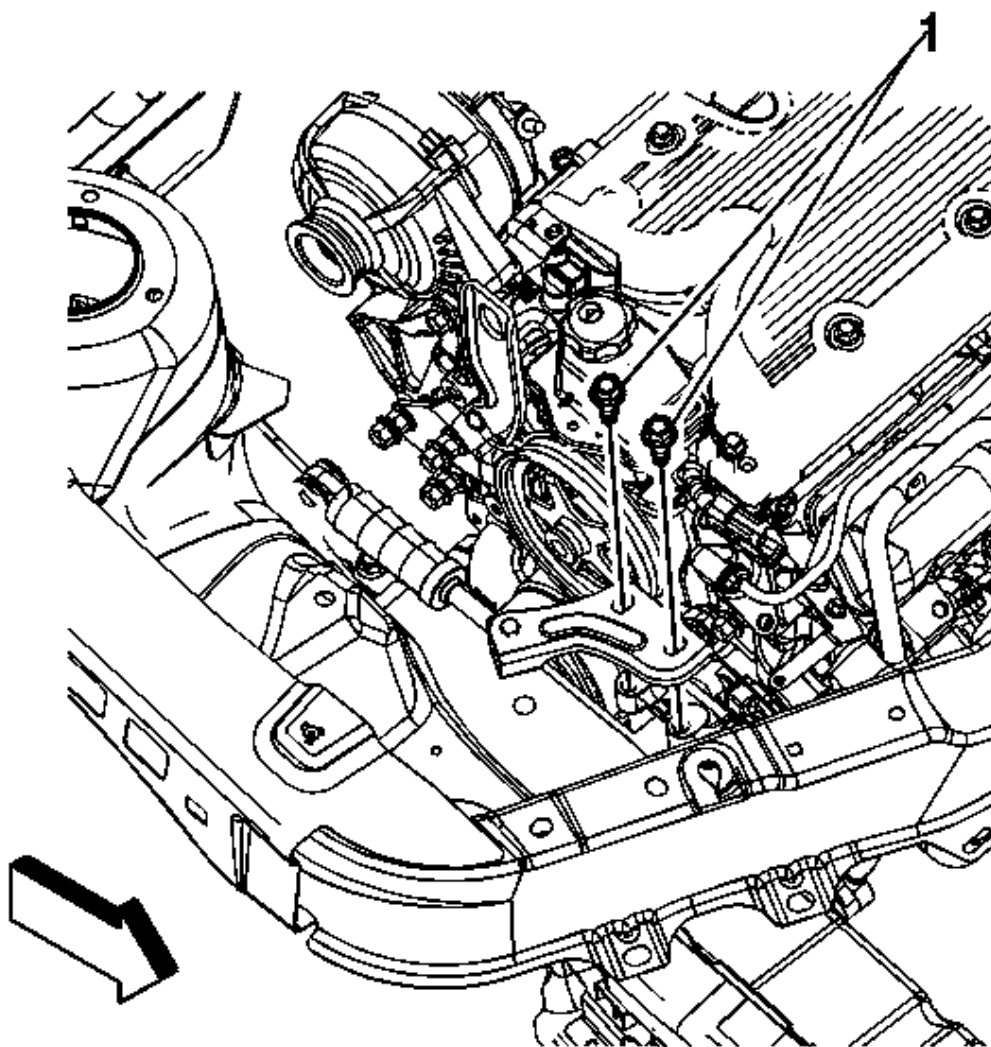


Fig. 21: Identifying Engine Mount Strut To Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement.
2. Remove the engine mount snubber to engine mount snubber bracket bolts (1).

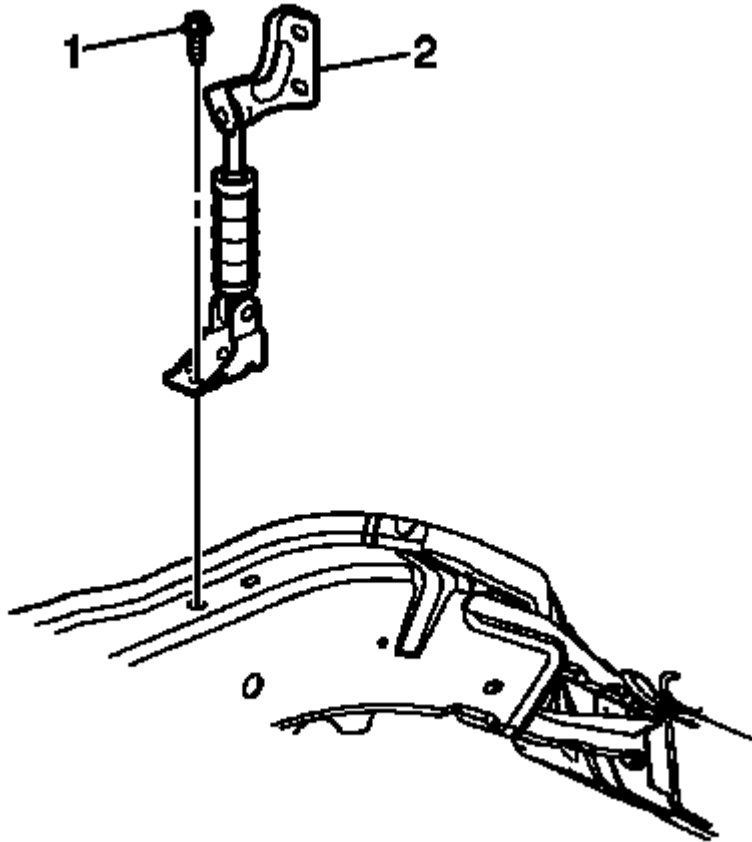


Fig. 22: Identifying Strut & Side Rail Bolts
Courtesy of GENERAL MOTORS CORP.

3. Rotate the engine mount snubber (2) to the vertical position in order to access the lower bolt.
4. Remove the engine mount snubber bolt (1).
5. Remove the engine mount snubber.

INSTALLATION PROCEDURE

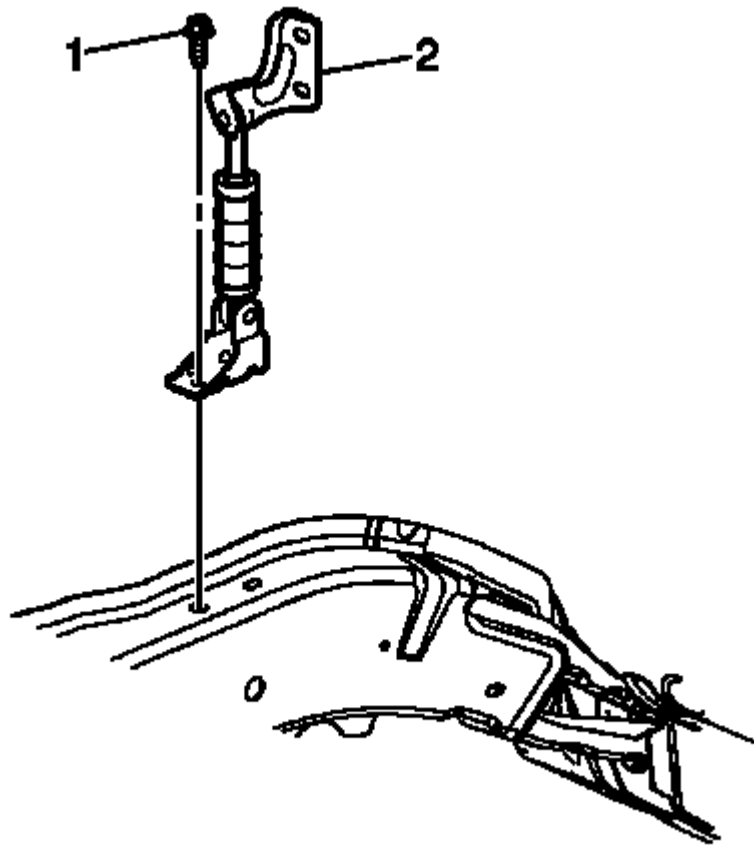


Fig. 23: Identifying Strut & Side Rail Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount snubber (2) in to the engine compartment side rail. Ensure that the tab on the snubber is inserted into the hole in the side rail.

CAUTION: Refer to Fastener Caution .

2. Install the engine mount snubber bolt (1) and tighten to 50 N.m (37 lb ft).
3. Rotate the engine mount snubber to the horizontal position.

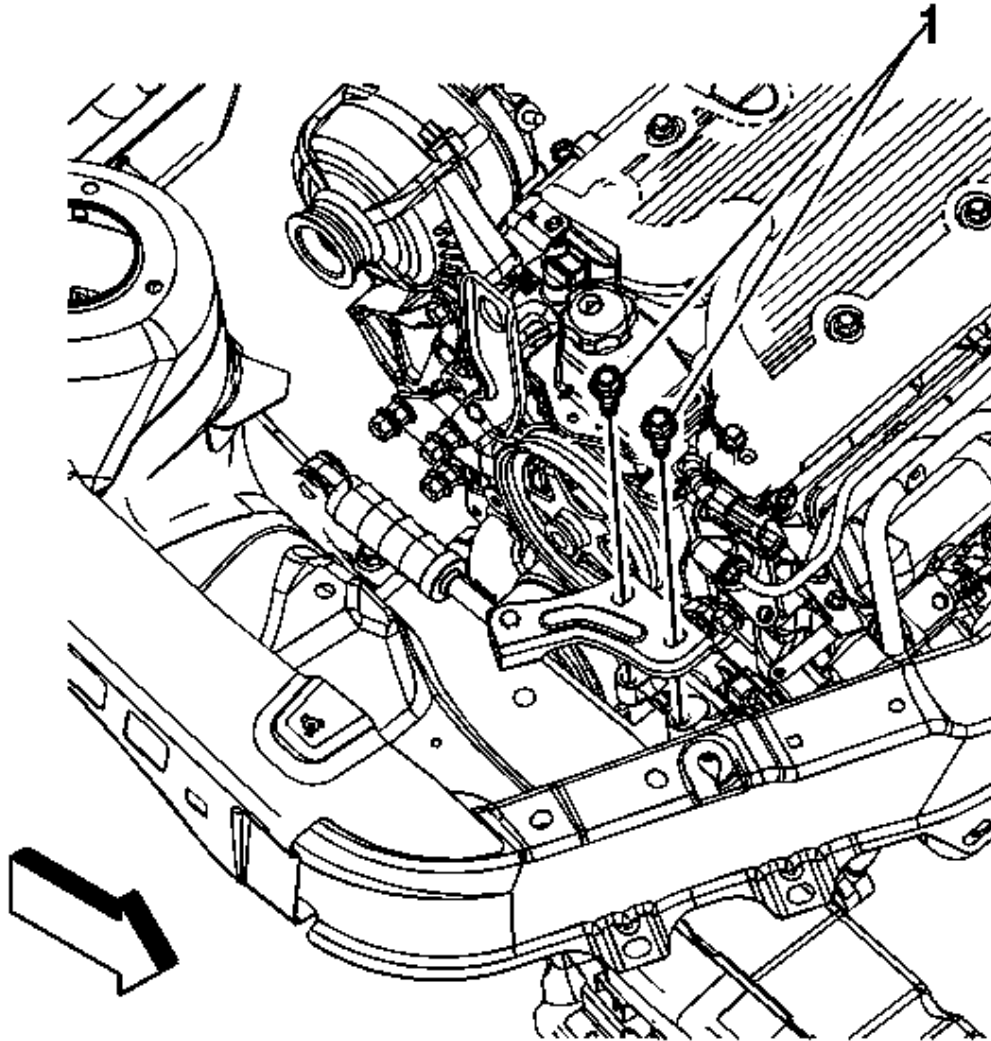


Fig. 24: Identifying Engine Mount Strut To Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the engine mount snubber to engine mount snubber bracket bolts (1) and tighten the bolts to 50 N.m (37 lb ft).
5. Install the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#) .

ENGINE MOUNT SNUBBER BRACKET REPLACEMENT

REMOVAL PROCEDURE

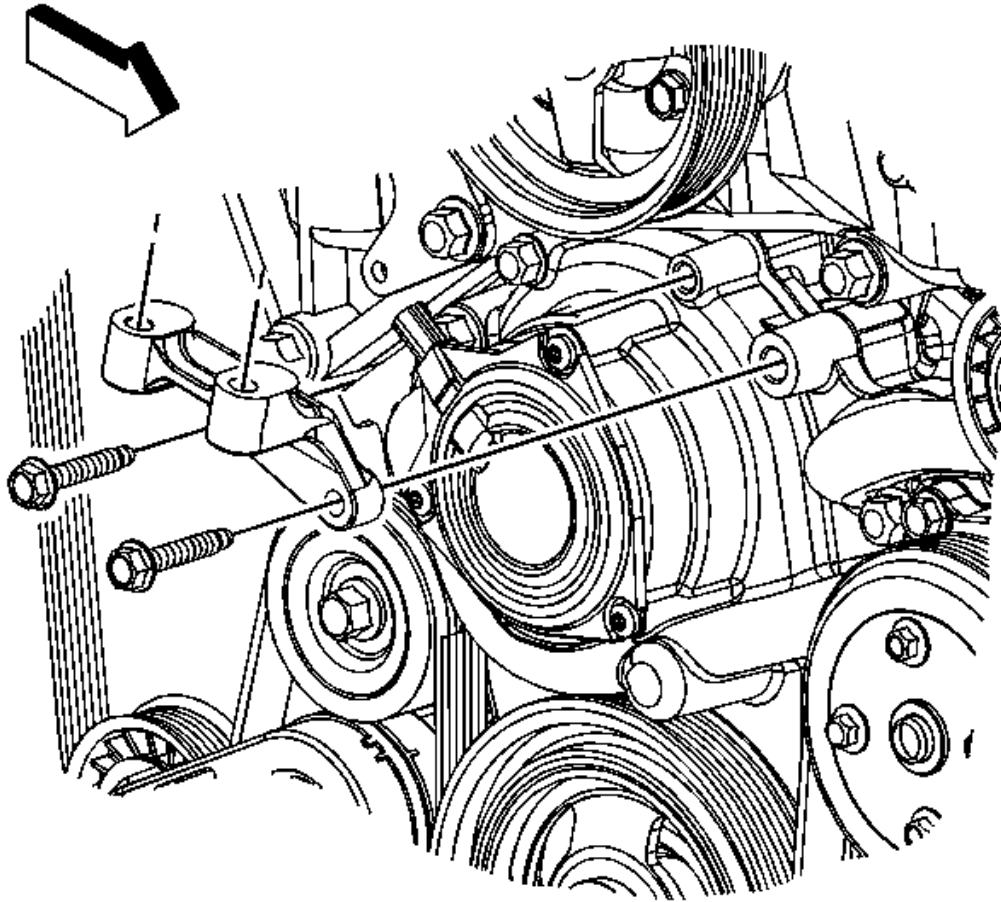


Fig. 25: Identifying Engine Mount Strut Bracket
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount snubber. Refer to **Engine Mount Snubber Replacement**.
2. Remove the engine mount snubber bracket to engine bolts.
3. Remove the engine mount snubber bracket.

INSTALLATION PROCEDURE

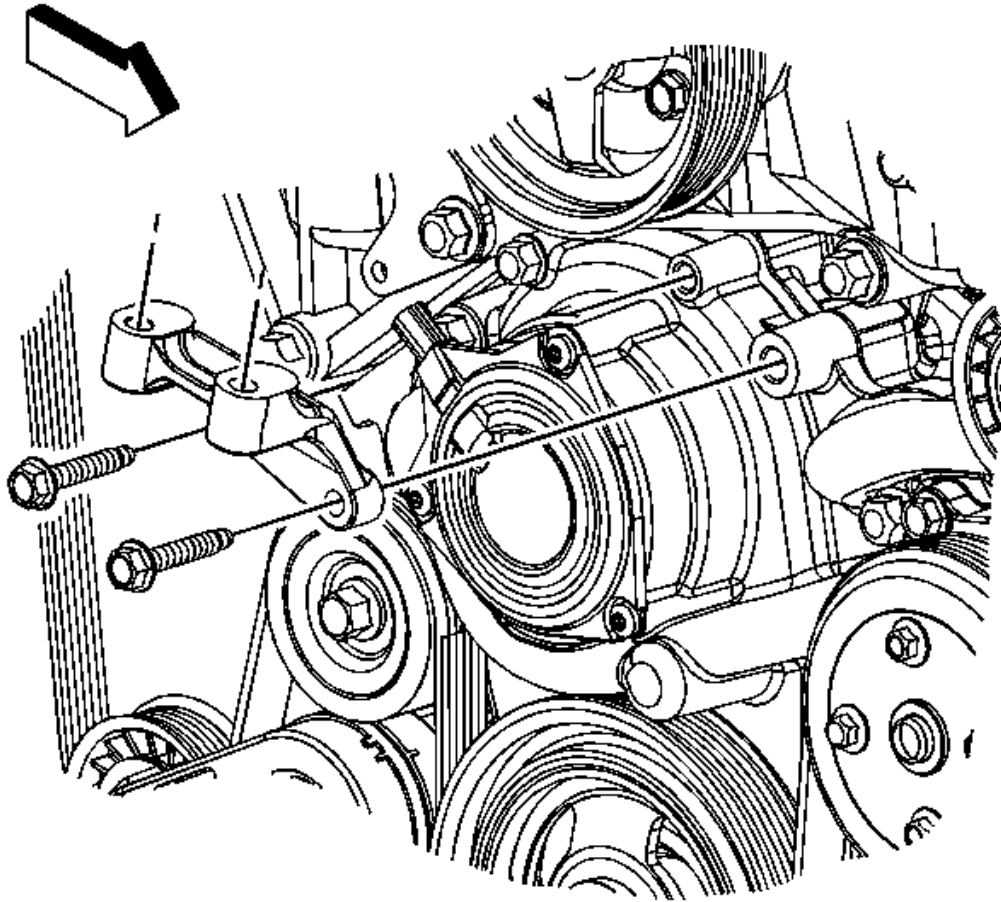


Fig. 26: Identifying Engine Mount Strut Bracket
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

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

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

2. Install the engine mount snubber. Refer to Engine Mount Snubber Replacement.

POWERTRAIN MOUNT BALANCING

NOTE: Follow the balance procedure in the order listed in the following steps. Powertrain mounts must be tightened in sequence.

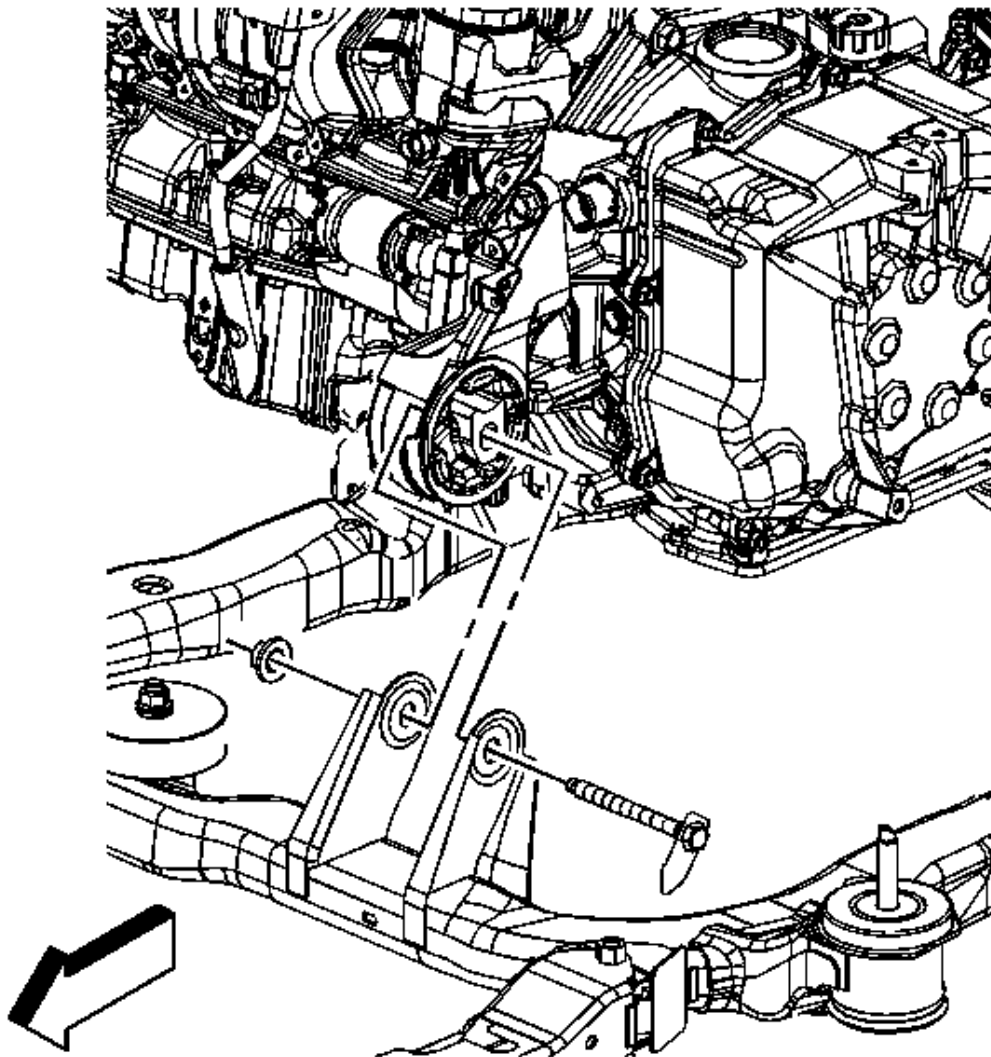


Fig. 27: Identifying Front Transmission Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Loosen, but DO NOT REMOVE the front transmission mount through bolt.

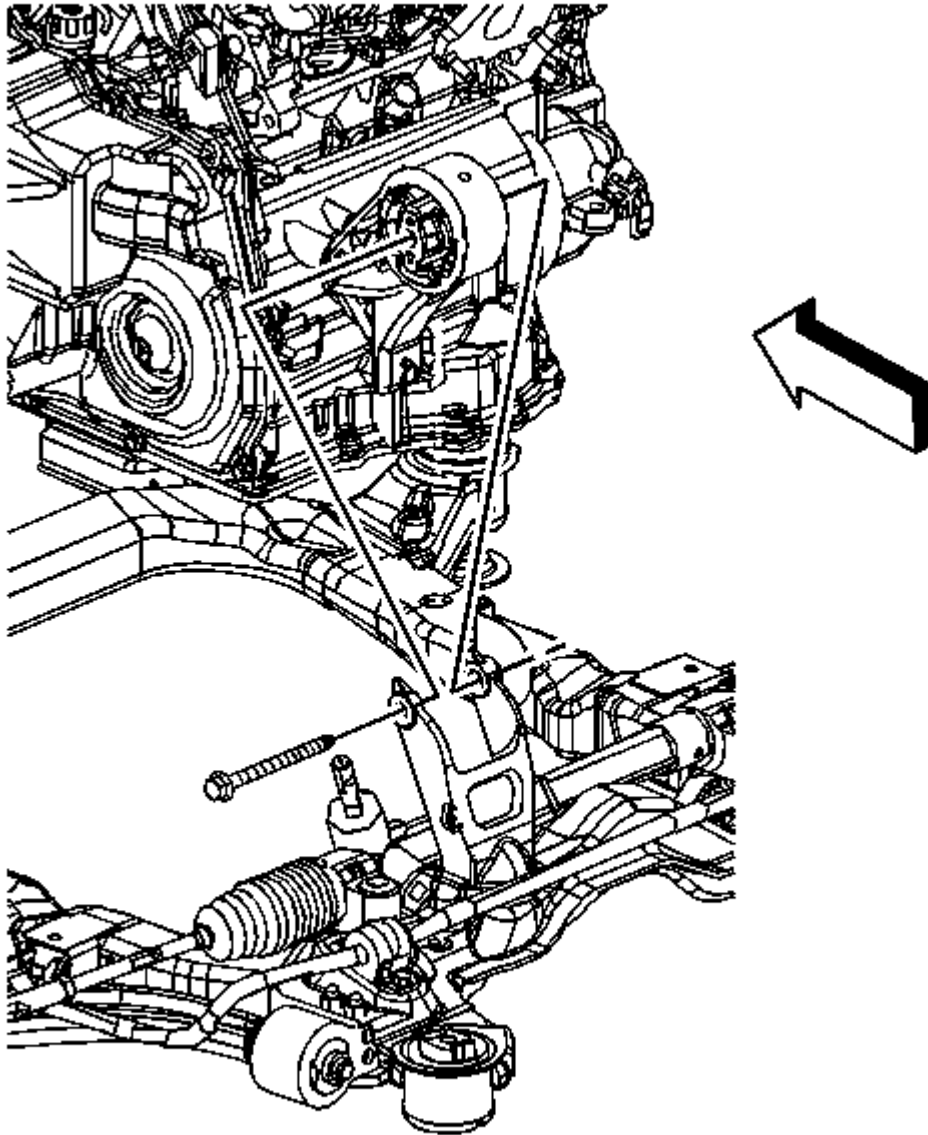


Fig. 28: Identifying Rear Transmission Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

3. Loosen, but DO NOT REMOVE the rear transmission mount through bolt.
4. Position 2 floor jacks with wood blocks under the engine and transmission to support the powertrain.

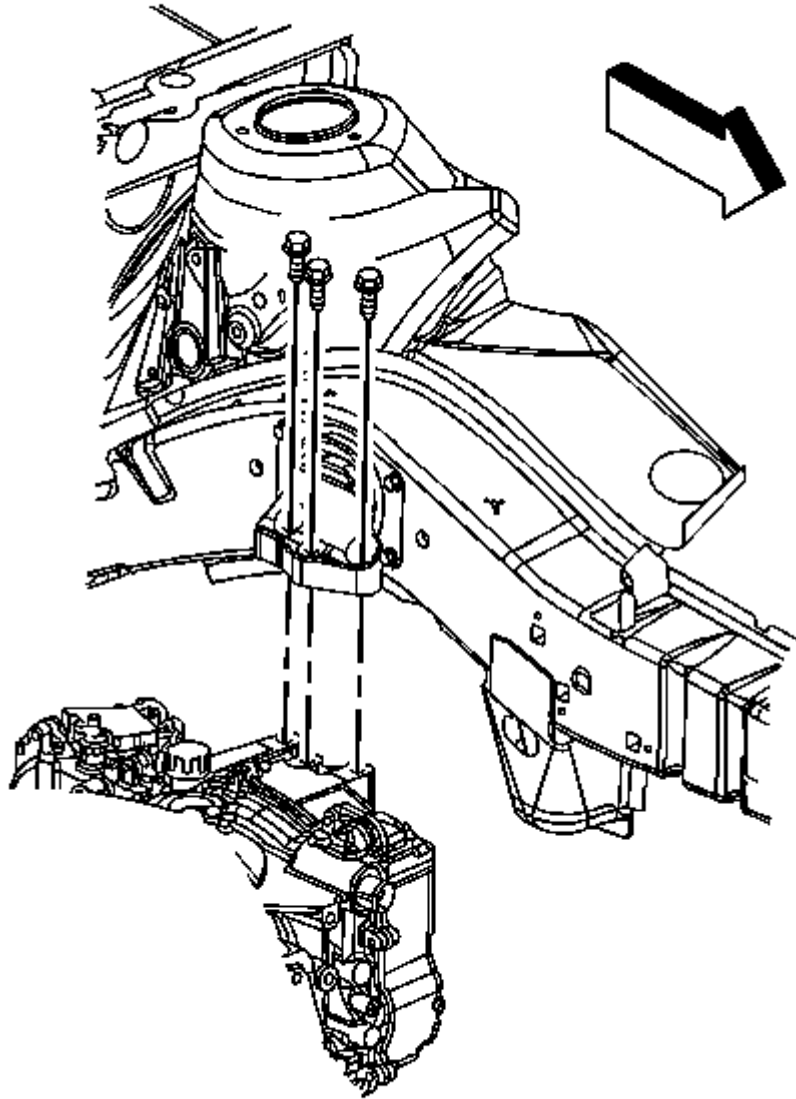


Fig. 29: Identifying Transmission Mount Bracket-To-Transmission Bolts
Courtesy of GENERAL MOTORS CORP.

5. From inside the engine compartment, loosen the transmission mount bracket to transmission bolts.

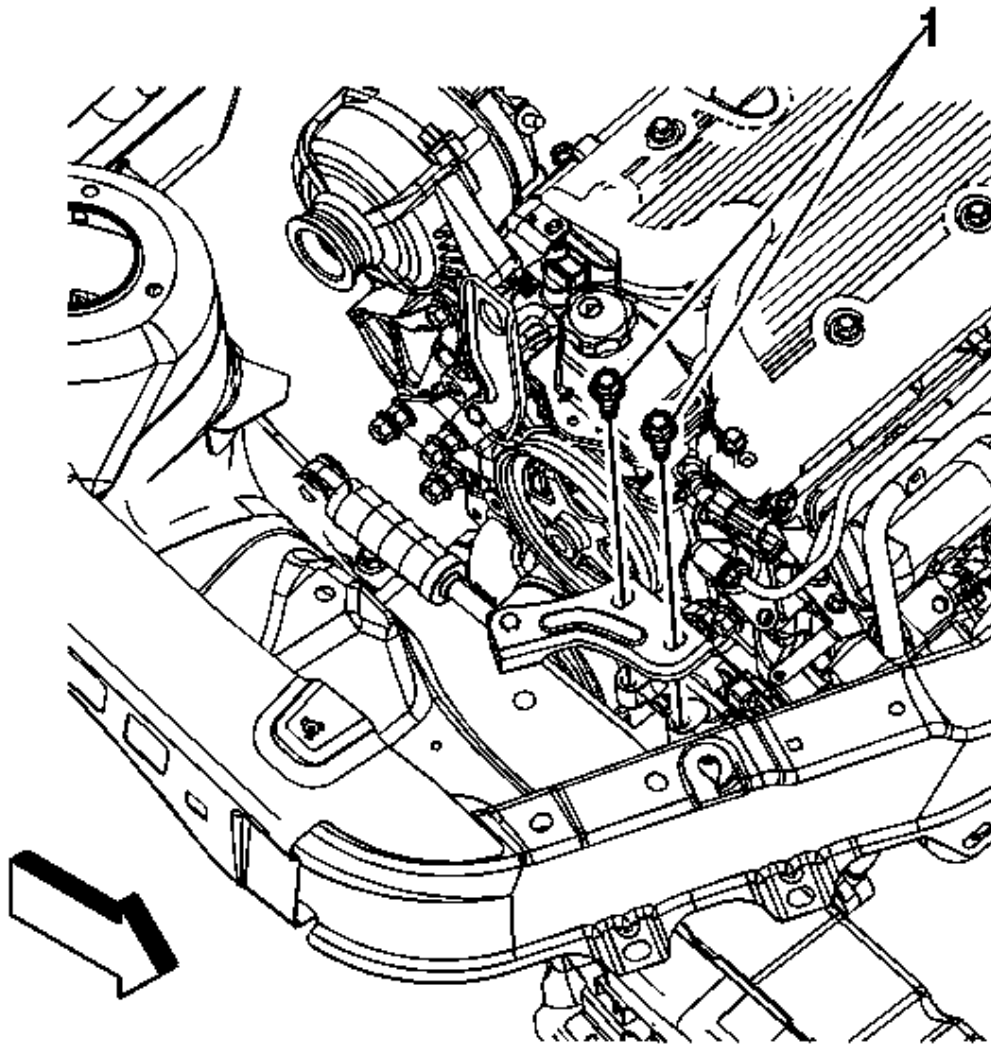


Fig. 30: Identifying Engine Mount Strut To Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

6. Loosen the engine mount strut to engine mount strut bracket bolts (1).
7. Reposition the floor jacks to allow a 1/8 inch gap between the engine mount and engine mount bracket.

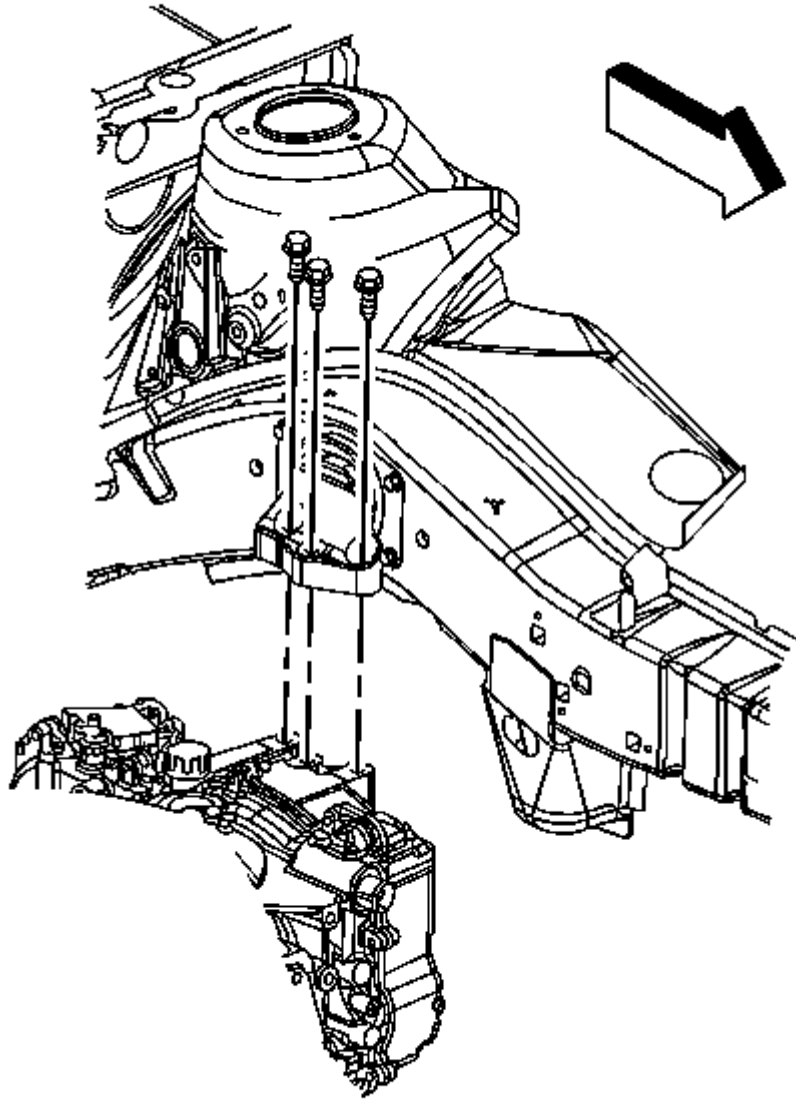


Fig. 31: Identifying Transmission Mount Bracket-To-Transmission Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

8. Tighten the transmission mount bracket to transmission bolts using the following sequence:
 1. Rear bolt

2. Middle bolt
3. Front bolt

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

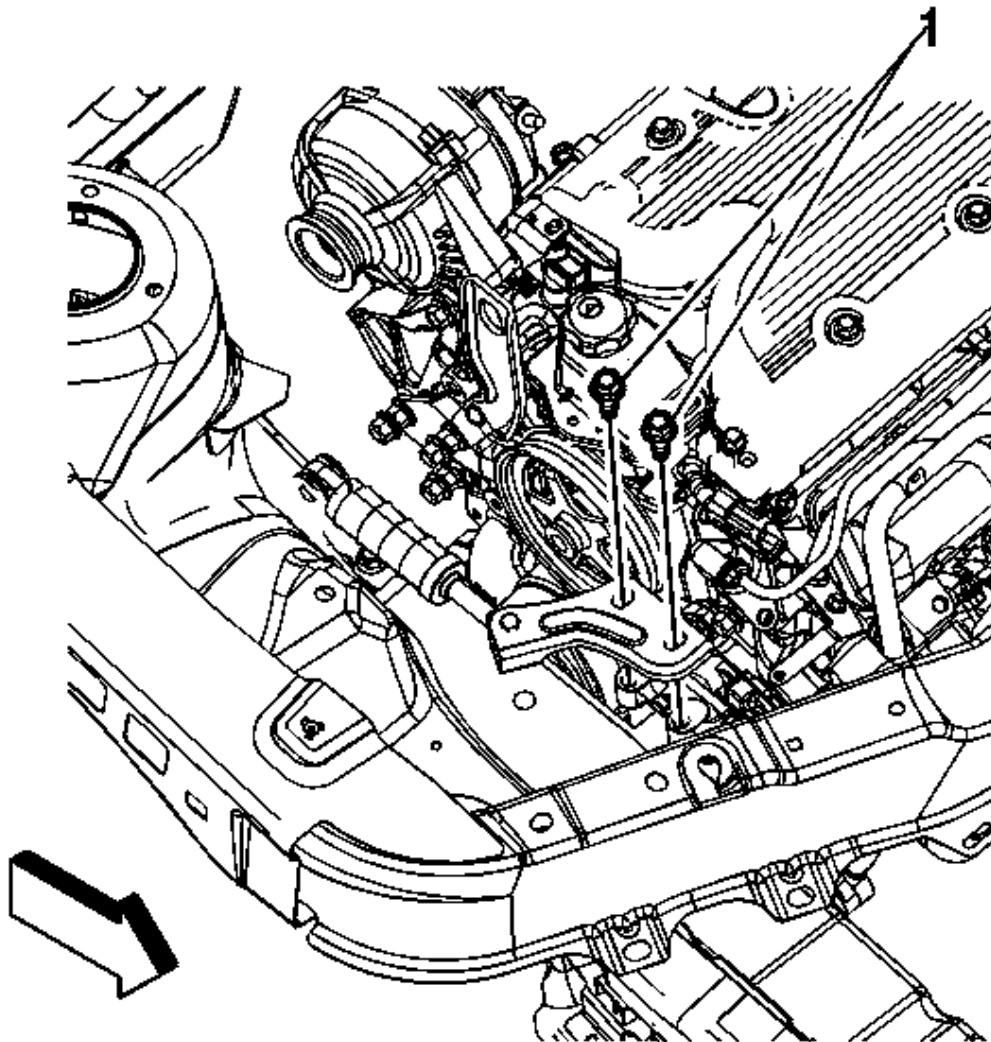


Fig. 32: Identifying Engine Mount Strut To Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

9. Tighten the engine mount strut to engine mount strut bracket bolts (1).

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

10. Remove the floor jacks.
11. Rock the powertrain vigorously from front to rear and allow the powertrain to settle.

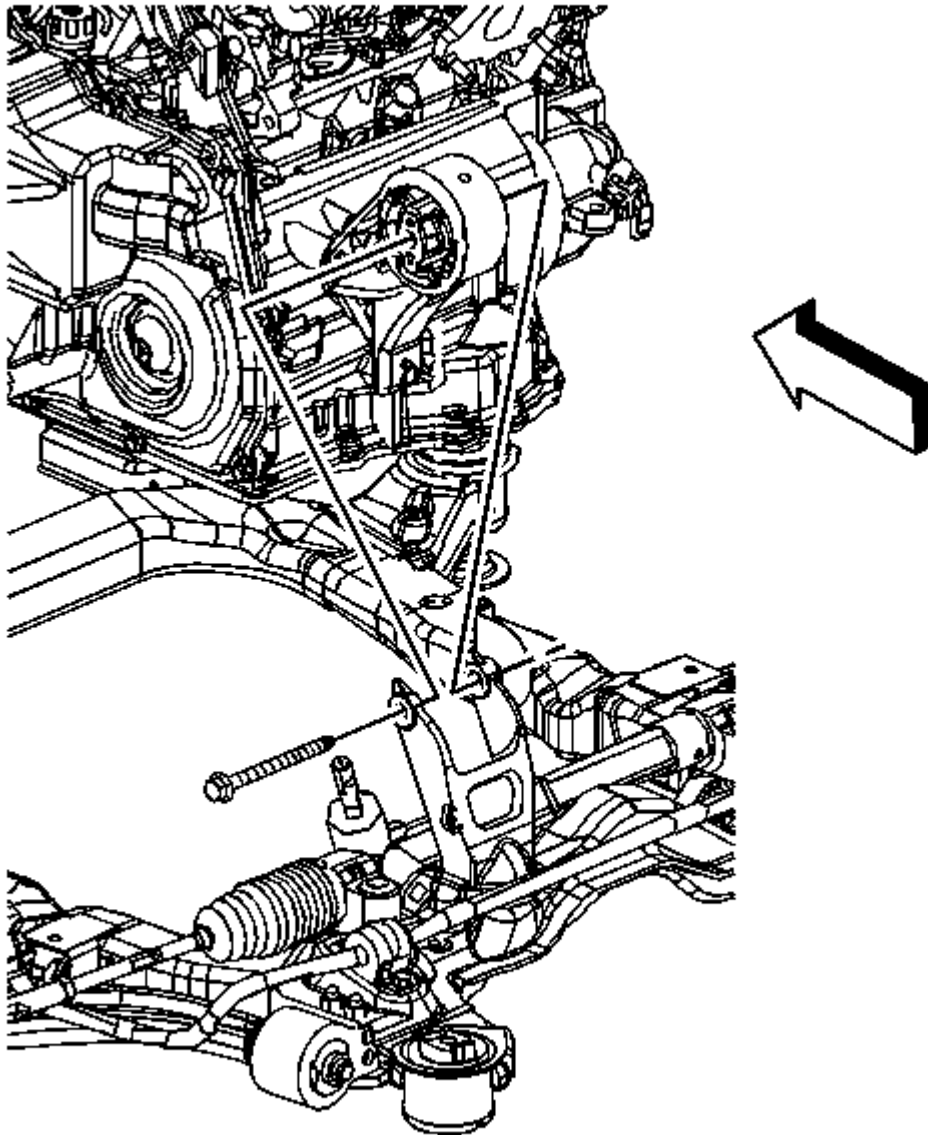


Fig. 33: Identifying Rear Transmission Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

12. Tighten the rear transmission mount through bolt.

Tighten: Tighten the bolt to 90 N.m (66 lb ft).

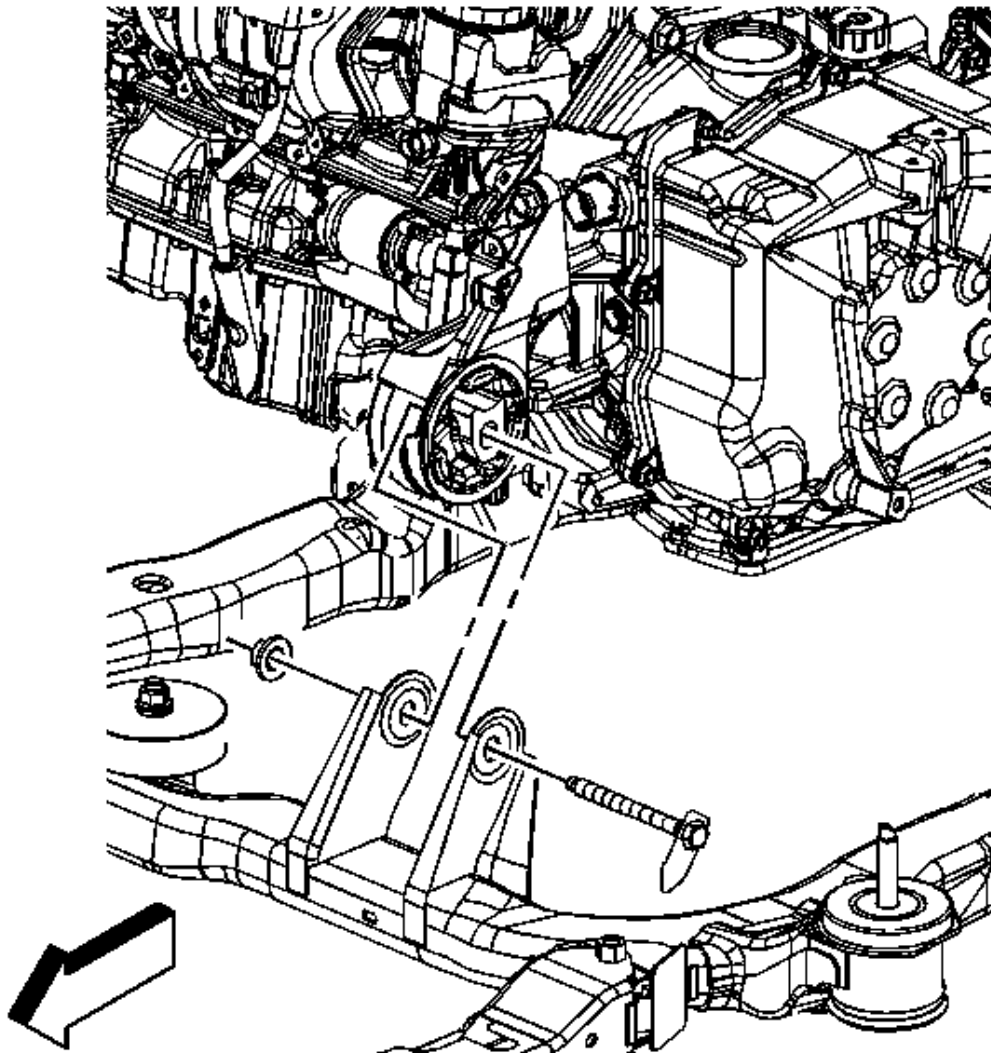


Fig. 34: Identifying Front Transmission Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

13. Tighten the front transmission mount through bolt.

Tighten: Tighten the bolt to 90 N.m (66 lb ft).

14. Lower the vehicle.

ENGINE MOUNT POSITION ADJUSTMENT

SPECIAL TOOLS

J 23498-A Driveshaft Inclinometer

NOTE: If for some reason there is pressure or preload against the powertrain, it can be put out of design position and this will put stress on the flex coupling in the exhaust system when the vehicle is driven and the out of position powertrain may cause the exhaust downpipe to hit the heat shield in the exhaust tunnel during torque loads.

NOTE: When lifting the vehicle to perform this procedure, the vehicle **MUST** be lifted using a frame contact hoist, in order for the wheels and suspension to hang free.

ADJUSTMENT

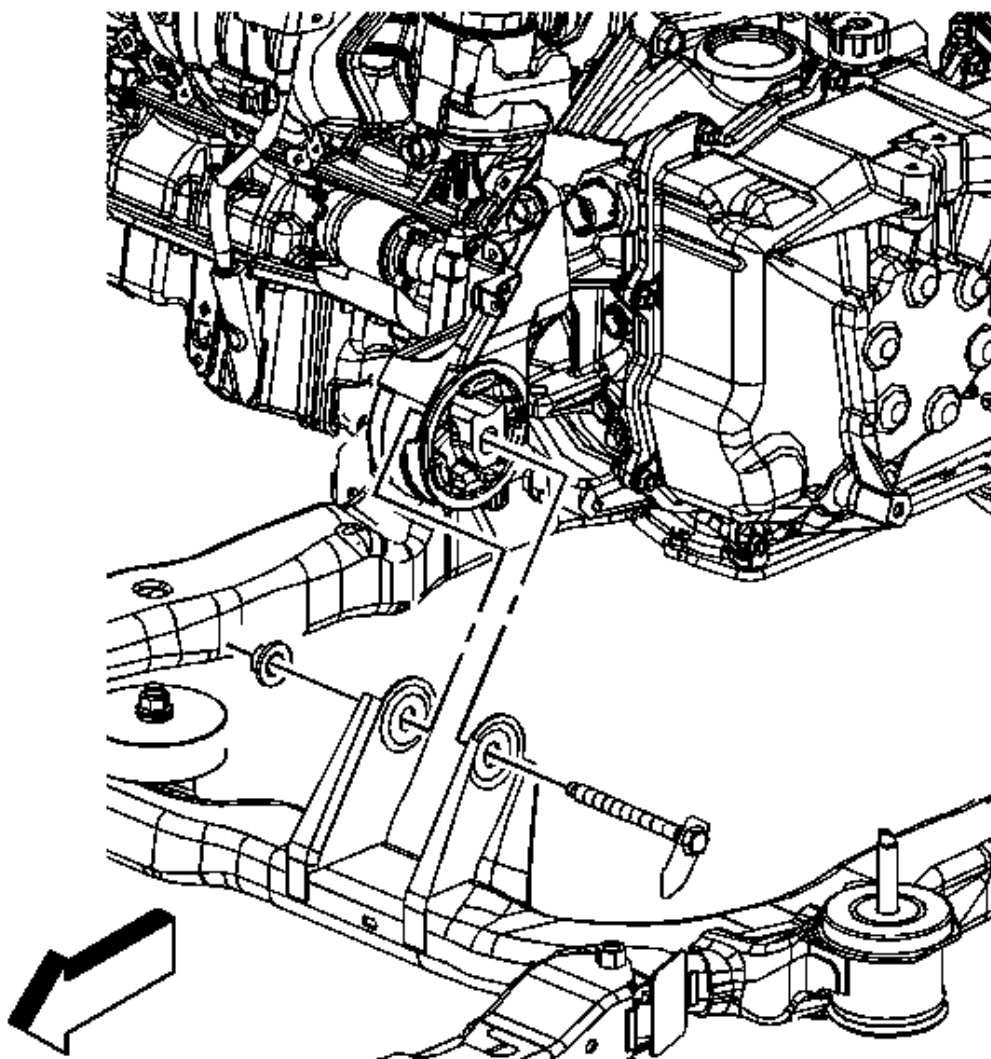


Fig. 35: Identifying Front Transmission Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Loosen, but DO NOT REMOVE the front transaxle mount through bolt.

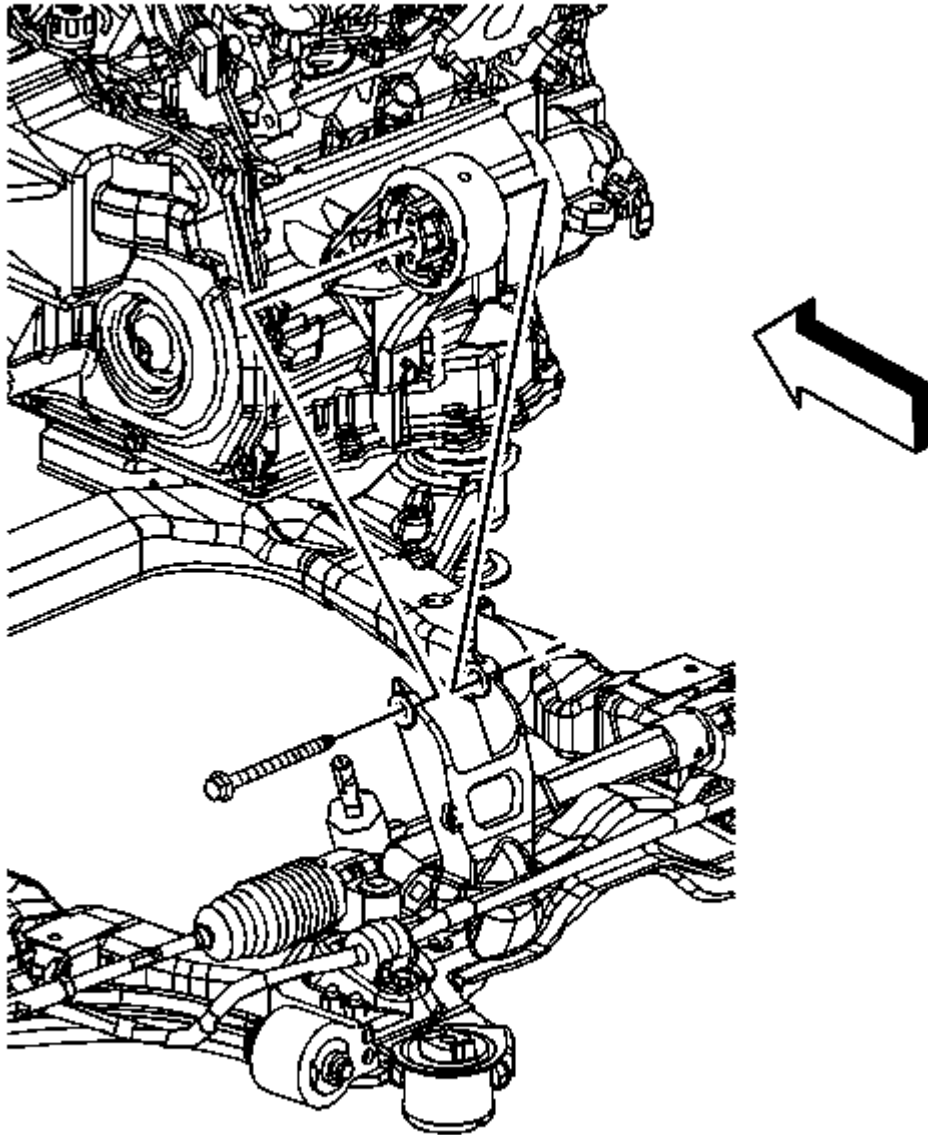


Fig. 36: Identifying Rear Transmission Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

3. Loosen, but DO NOT REMOVE the rear transaxle mount through bolt.
4. Install the **J 23498-A** on the bottom of the flex coupling of the exhaust pipe.
5. Rock the engine by hand until the **J 23498-A** reading is as close to "0" degrees as possible.

CAUTION: Refer to Fastener Caution .

6. While still holding the powertrain in position, tighten the front through bolt.
7. Tighten the rear through bolt.
8. After the through bolts have been tightened, re-check the angle.
9. There should be no more than "5" degrees of angle in the flex coupling with the powertrain in the static position.
10. If there is no more than "5" degrees of angle, tighten the through bolts to specifications.

Tighten: Tighten the bolts to 90 N.m (66 lb ft).

11. If there is more than "5" degrees of angle, loosen the through bolts and return to step 5.

OIL FILTER ADAPTER AND BYPASS VALVE ASSEMBLY REPLACEMENT**REMOVAL PROCEDURE**

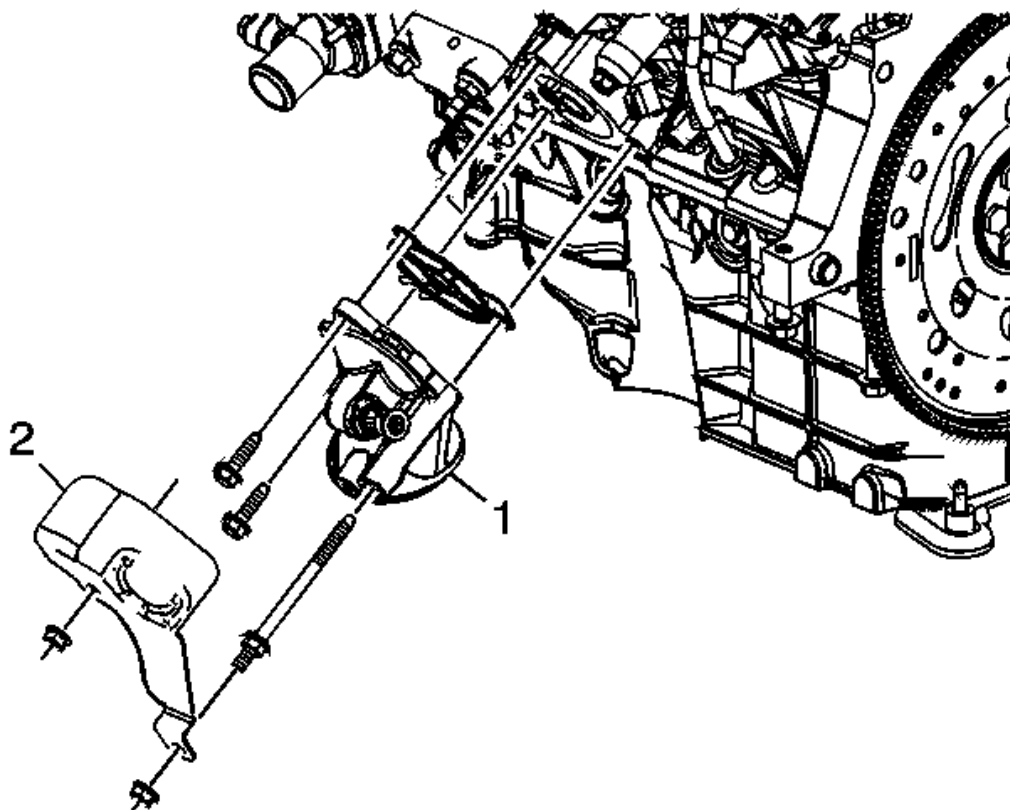


Fig. 37: Identifying Oil Filter Adapter & Heat Shield
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the oil filter adapter heat shield nuts.
3. Remove the oil filter adapter heat shield (2).

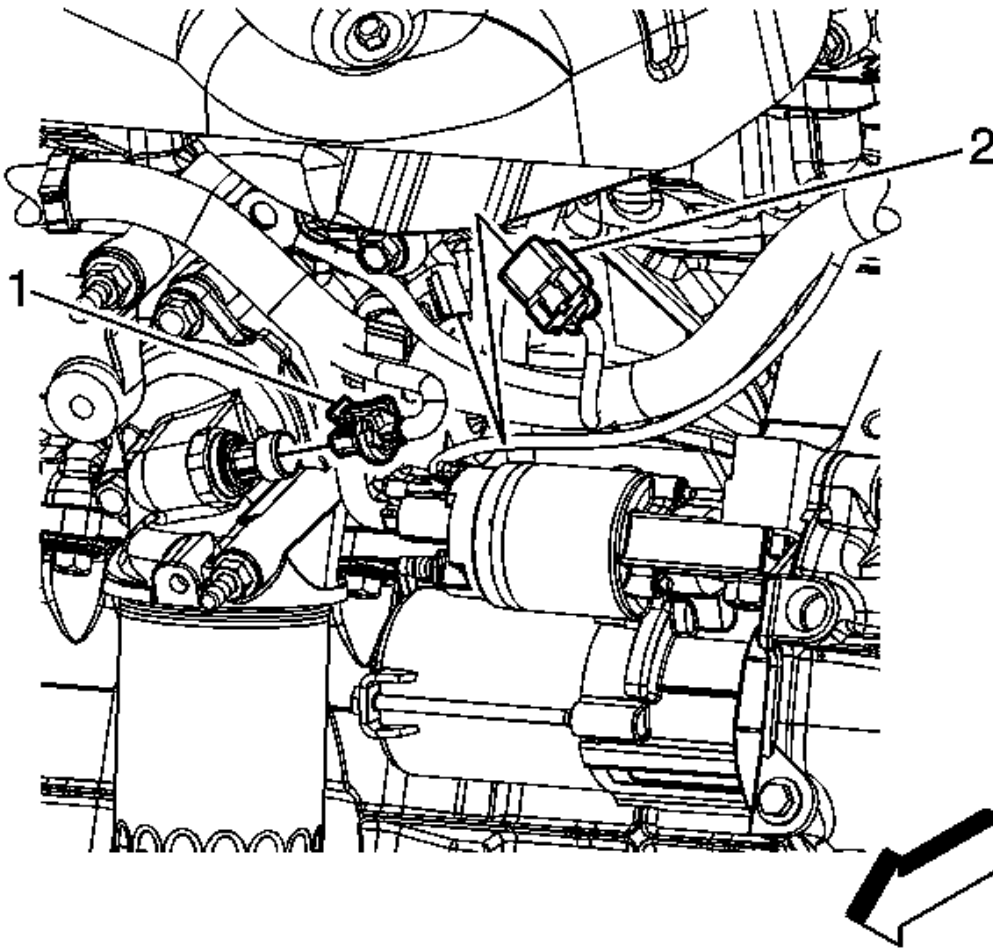


Fig. 38: Identifying Knock Sensor & Oil Pressure Sensor Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the engine wiring harness electrical connector (1) from the oil pressure sensor.

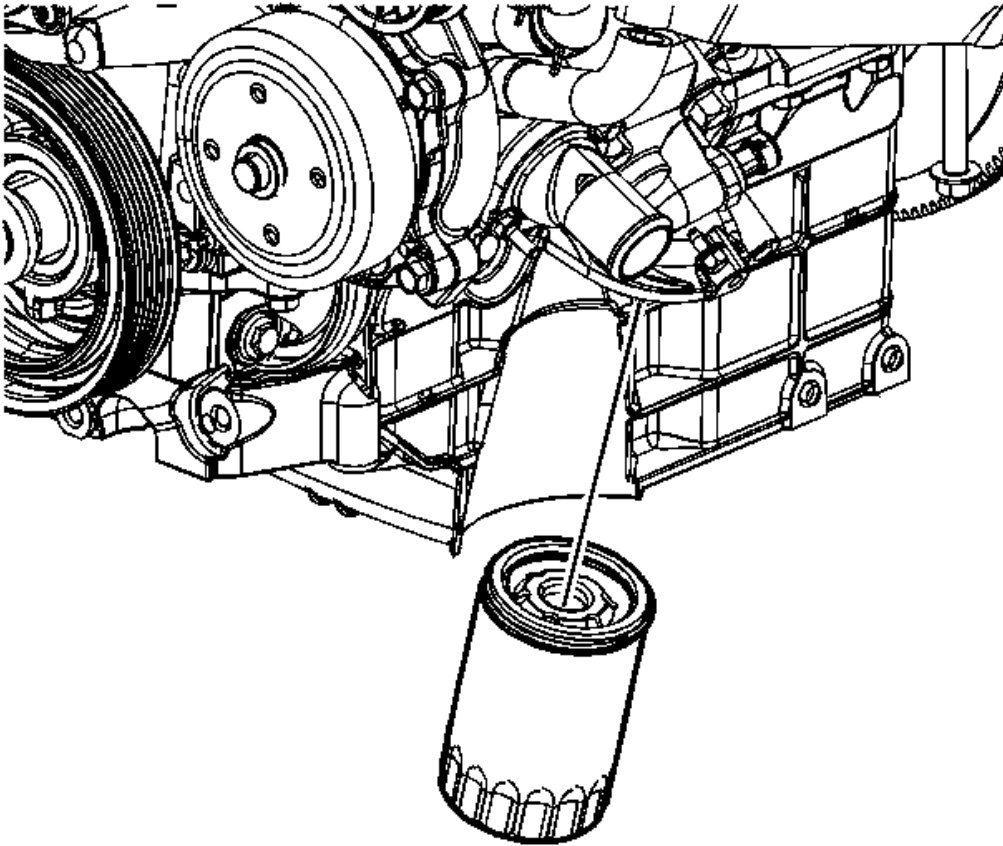


Fig. 39: View Of Oil Filter

Courtesy of GENERAL MOTORS CORP.

5. Remove the oil filter.

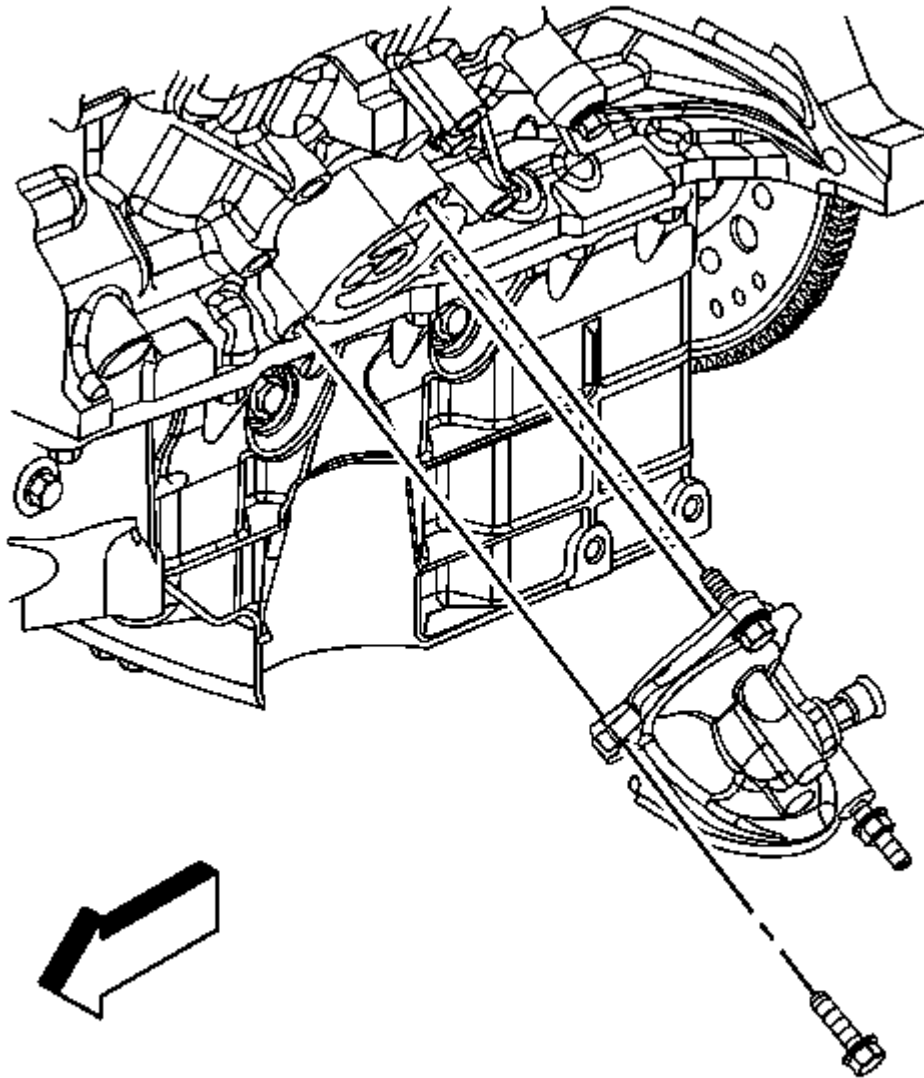


Fig. 40: Identifying Oil Filter Adapter Bolts & Stud
Courtesy of GENERAL MOTORS CORP.

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

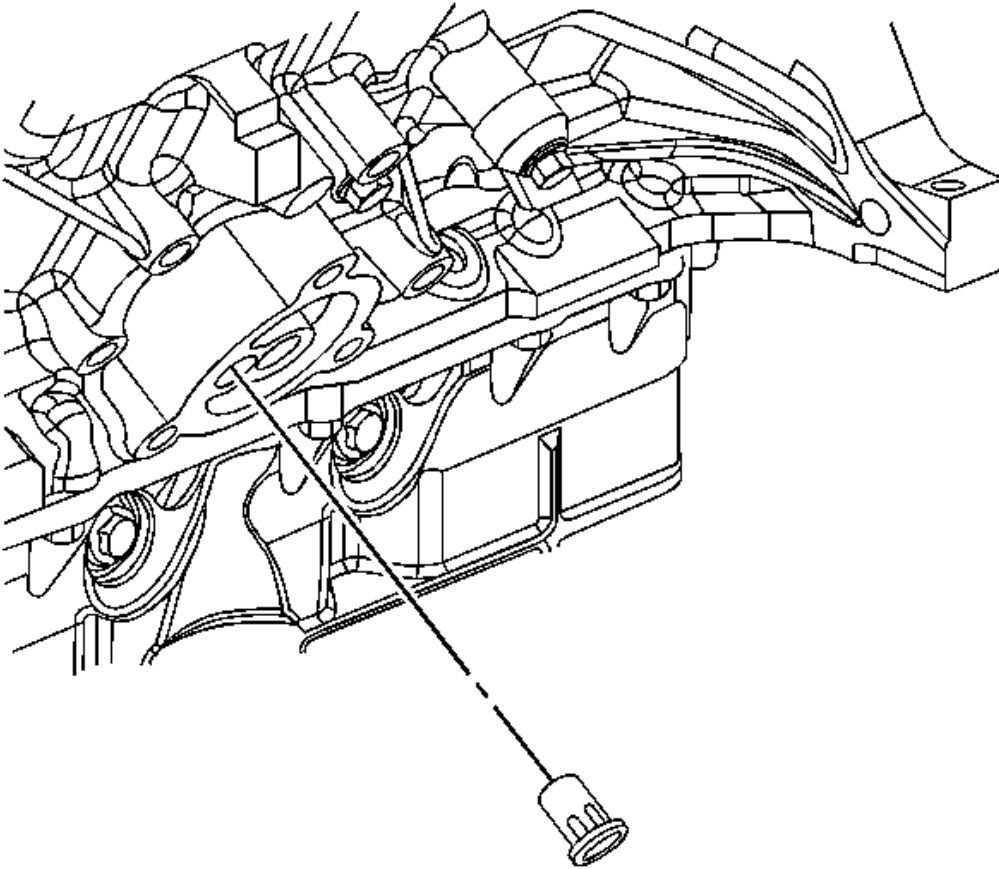


Fig. 41: Locating Oil Filter Bypass Hole & Bypass Valve
Courtesy of GENERAL MOTORS CORP.

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.

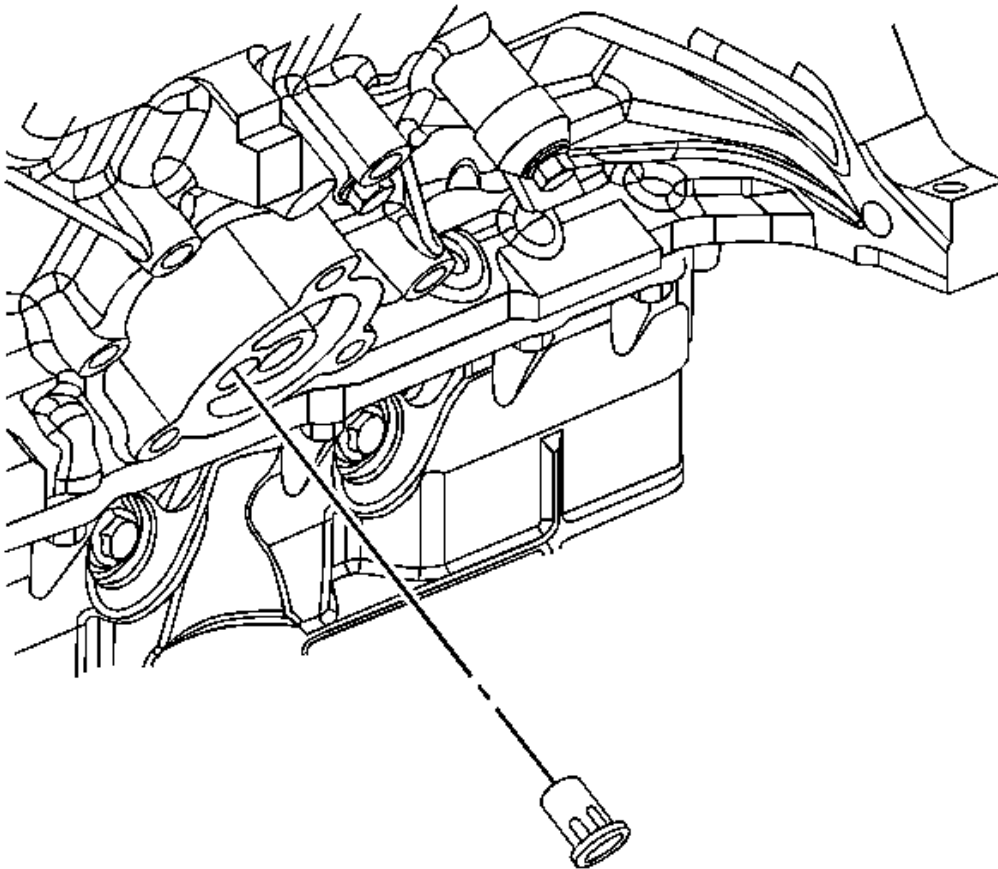


Fig. 42: Locating Oil Filter Bypass Hole & Bypass Valve
Courtesy of GENERAL MOTORS CORP.

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

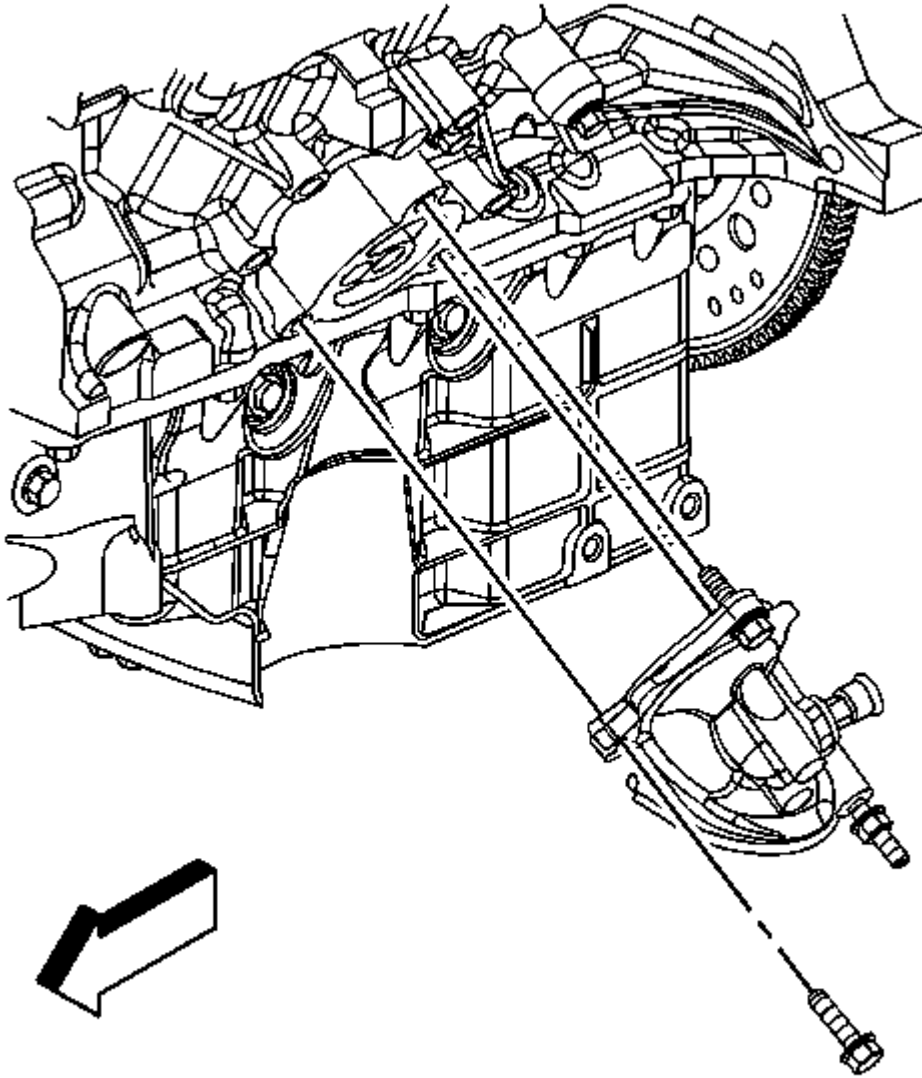


Fig. 43: Identifying Oil Filter Adapter Bolts & Stud
Courtesy of GENERAL MOTORS CORP.

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/stud to 25 N.m (18 lb ft).

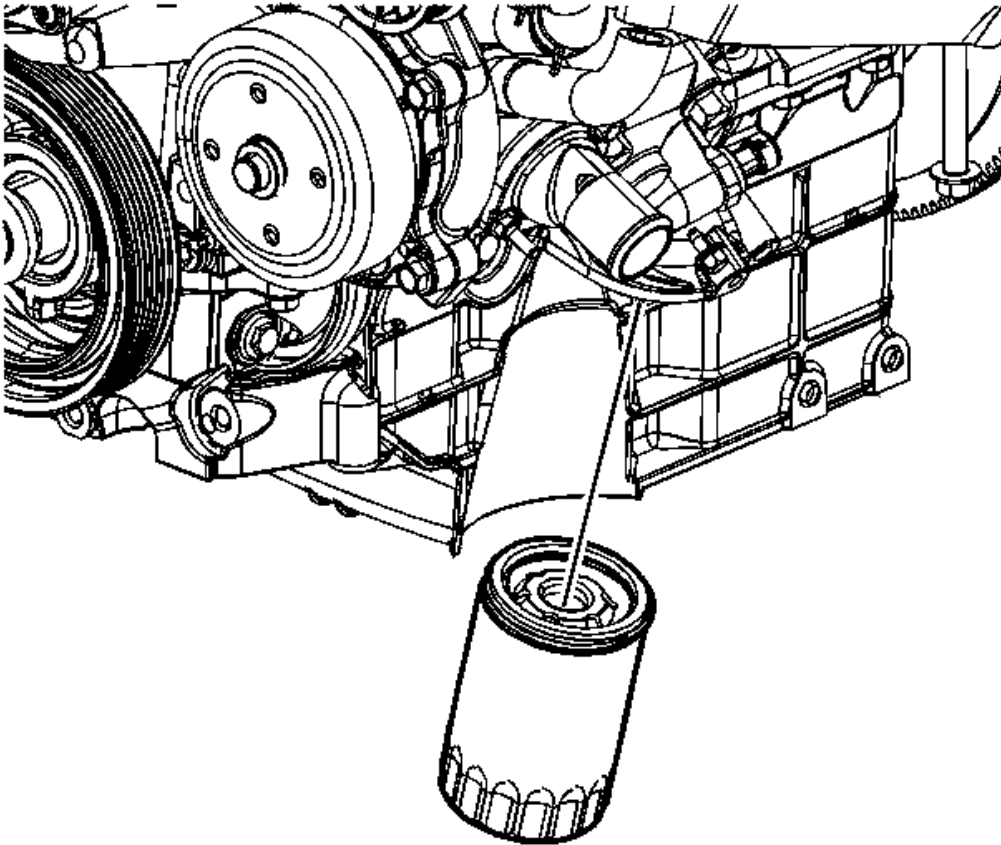


Fig. 44: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

5. Install the oil filter.

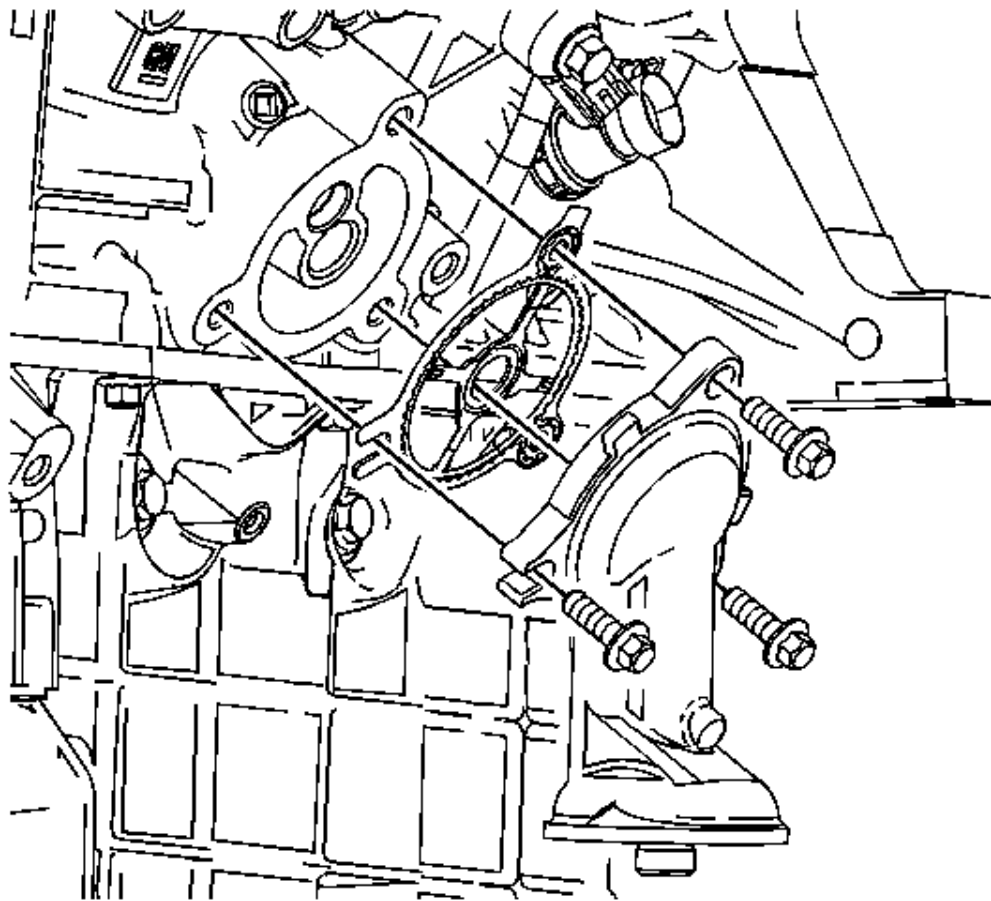


Fig. 45: View Of Oil Filter Adapter And Gasket
Courtesy of GENERAL MOTORS CORP.

6. Connect the engine wiring harness electrical connector (1) to the oil pressure sensor.

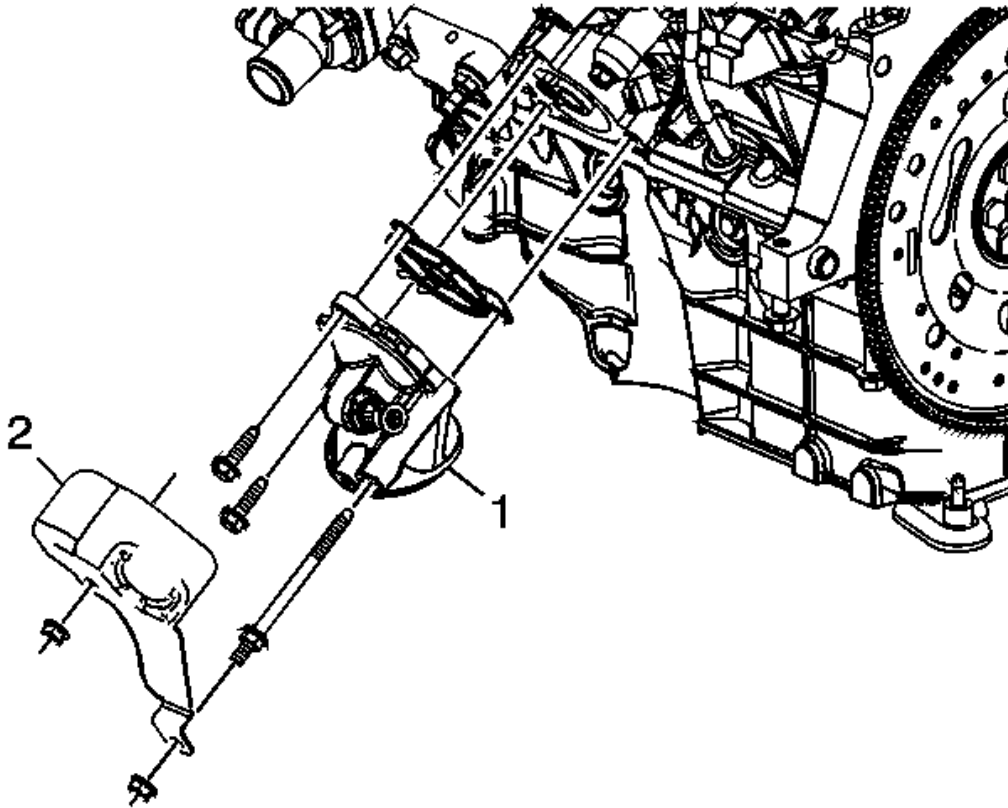


Fig. 46: Identifying Oil Filter Adapter & Heat Shield
Courtesy of GENERAL MOTORS CORP.

7. Install the oil filter adapter heat shield (2).
8. Install the oil filter adapter heat shield nuts.

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

9. Lower the vehicle.
10. Check and fill the crankcase, if necessary.

OIL LEVEL INDICATOR TUBE REPLACEMENT

REMOVAL PROCEDURE

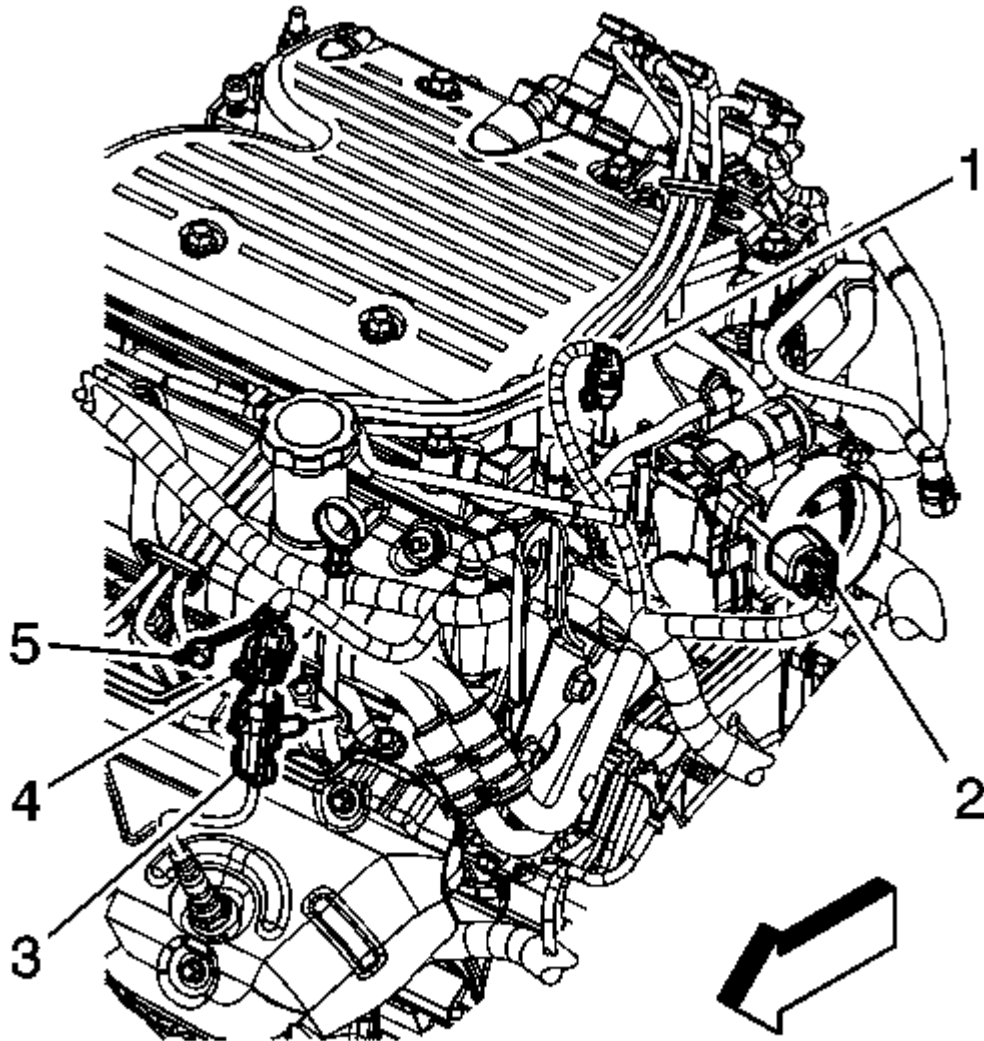


Fig. 47: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug wire from the number 6 cylinder spark plug.
2. Remove the heated oxygen sensor (HO2S) electrical connector (3) clip from the indicator tube tab.

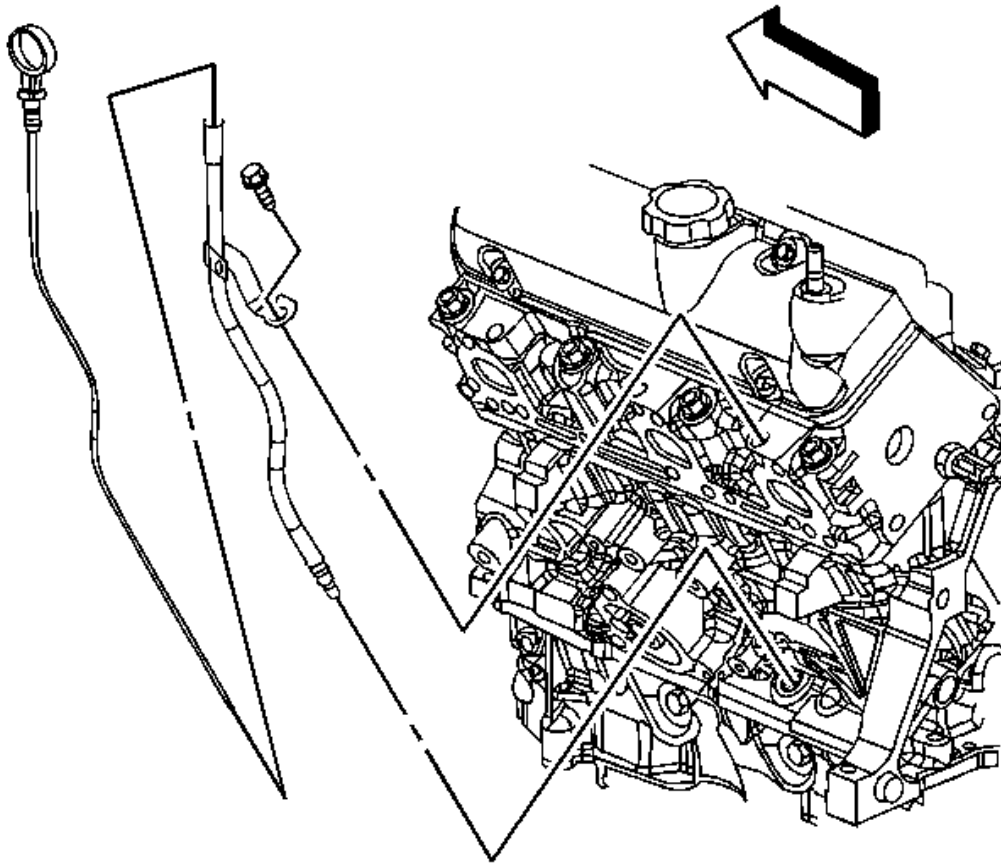


Fig. 48: Identifying Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

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

INSTALLATION PROCEDURE

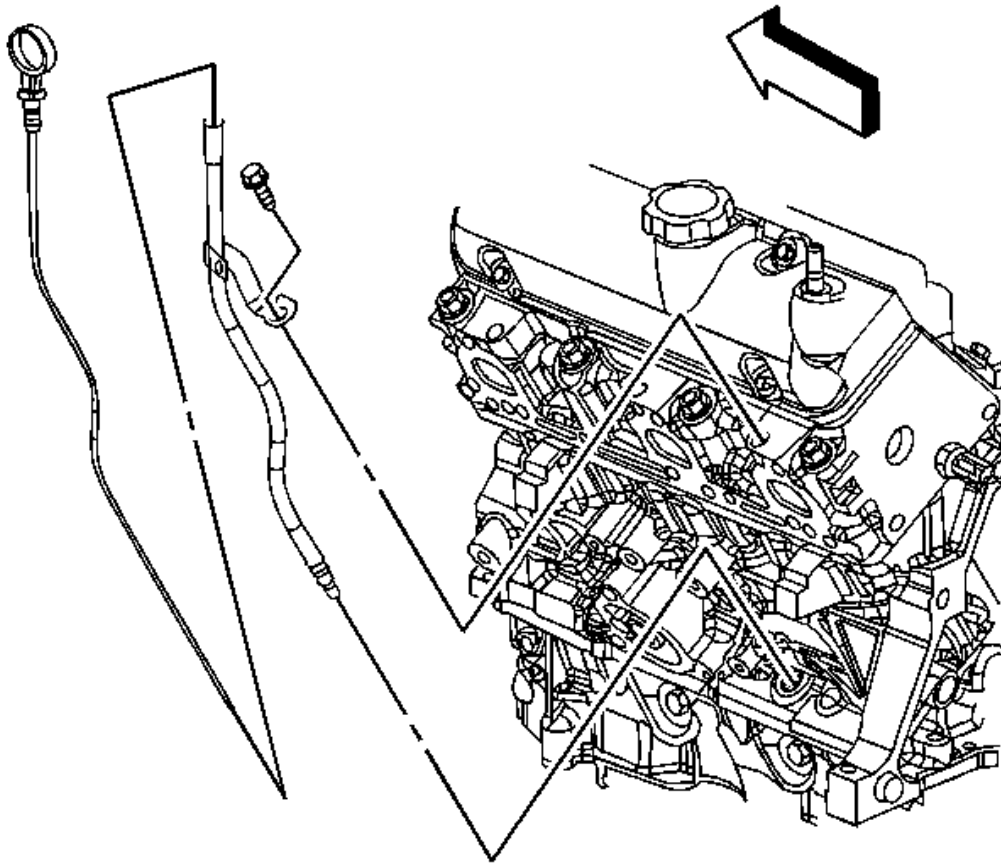


Fig. 49: Identifying Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

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.

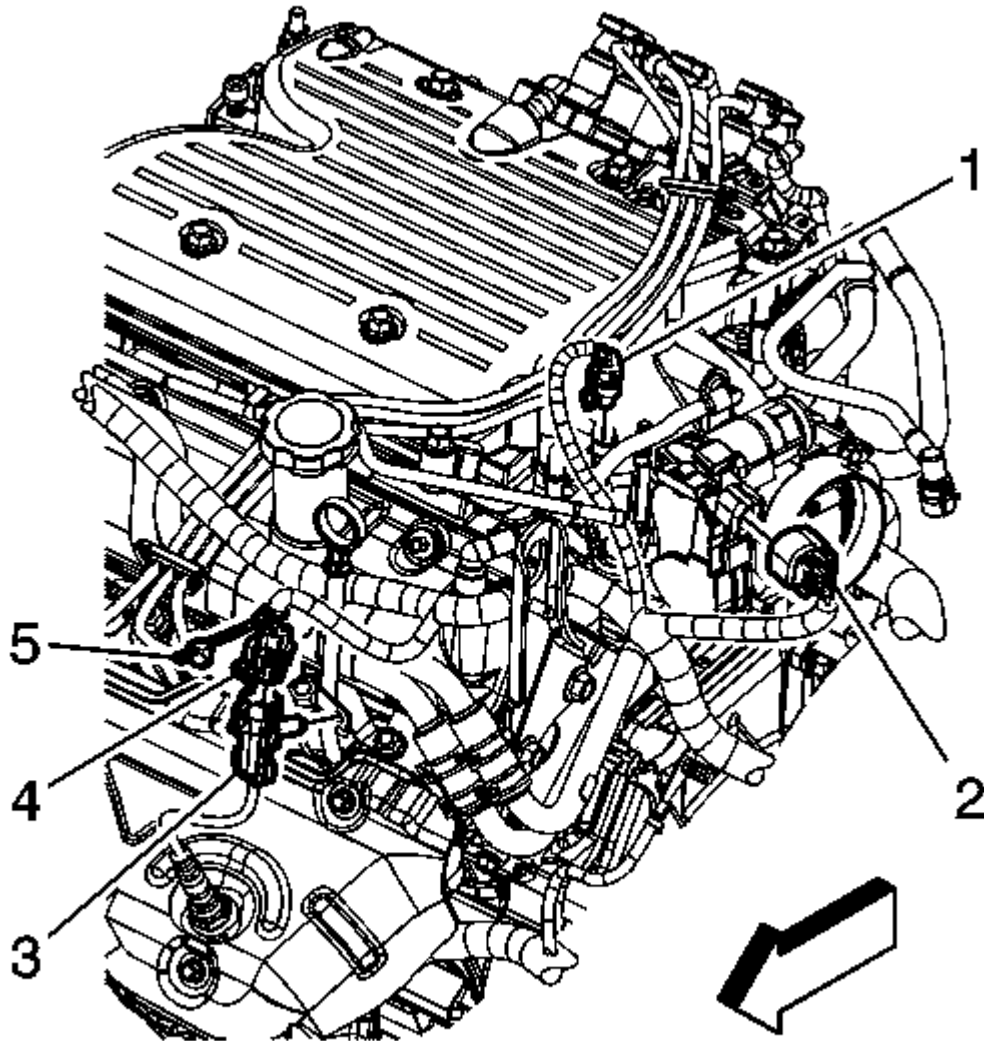


Fig. 50: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

5. Install the HO2S electrical connector (3) to from the indicator tube tab.
6. Install the spark plug wire to the number 6 cylinder spark plug.

UPPER INTAKE MANIFOLD REPLACEMENT

REMOVAL PROCEDURE

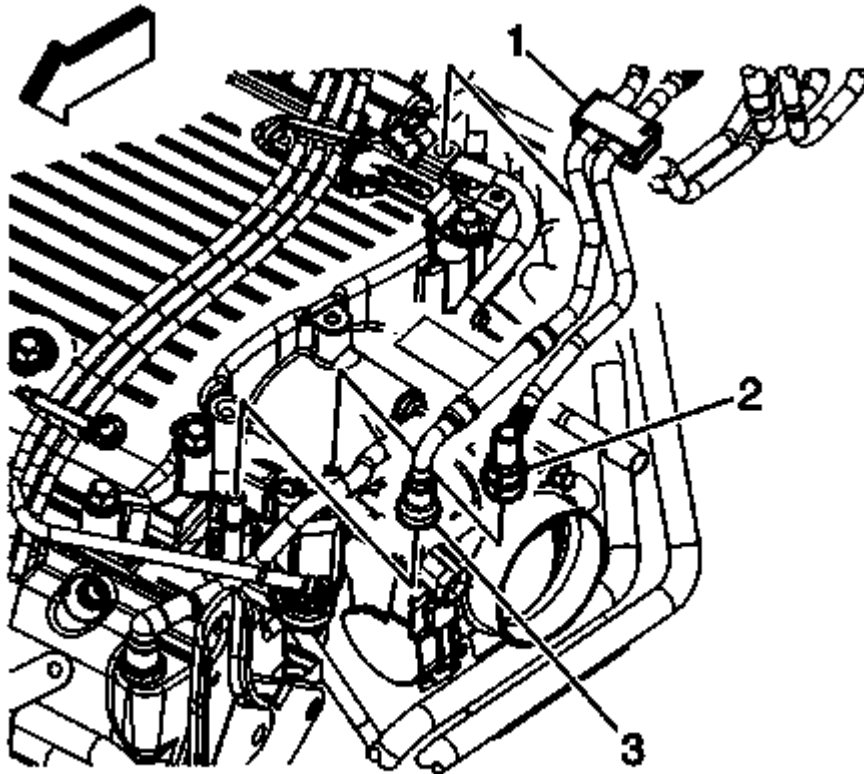


Fig. 51: View Of Fuel Feed & EVAP Pipes
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Disconnect the fuel feed pipe quick connect fitting (3) from the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service**.
3. Disconnect the evaporative emission (EVAP) pipe quick connect fitting (2) from the purge solenoid. Refer to **Plastic Collar Quick Connect Fitting Service**.
4. Remove the fuel line clip (1) from the manifold absolute pressure (MAP) sensor bracket.
5. Reposition the fuel/EVAP lines out of the way.

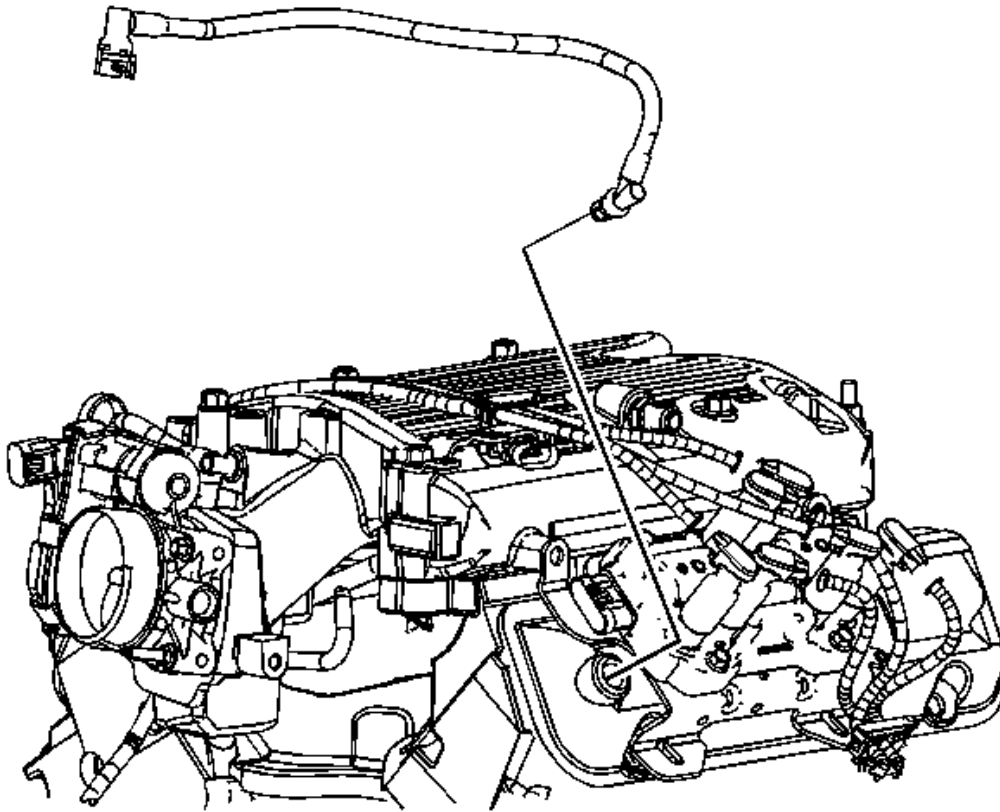


Fig. 52: Identifying Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

6. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill-LY7, LZE, LZ4)** or **Cooling System Draining and Filling (GE 47716)**.
7. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement**.
8. Remove the positive crankcase ventilation (PCV) fresh air tube from the rocker cover.

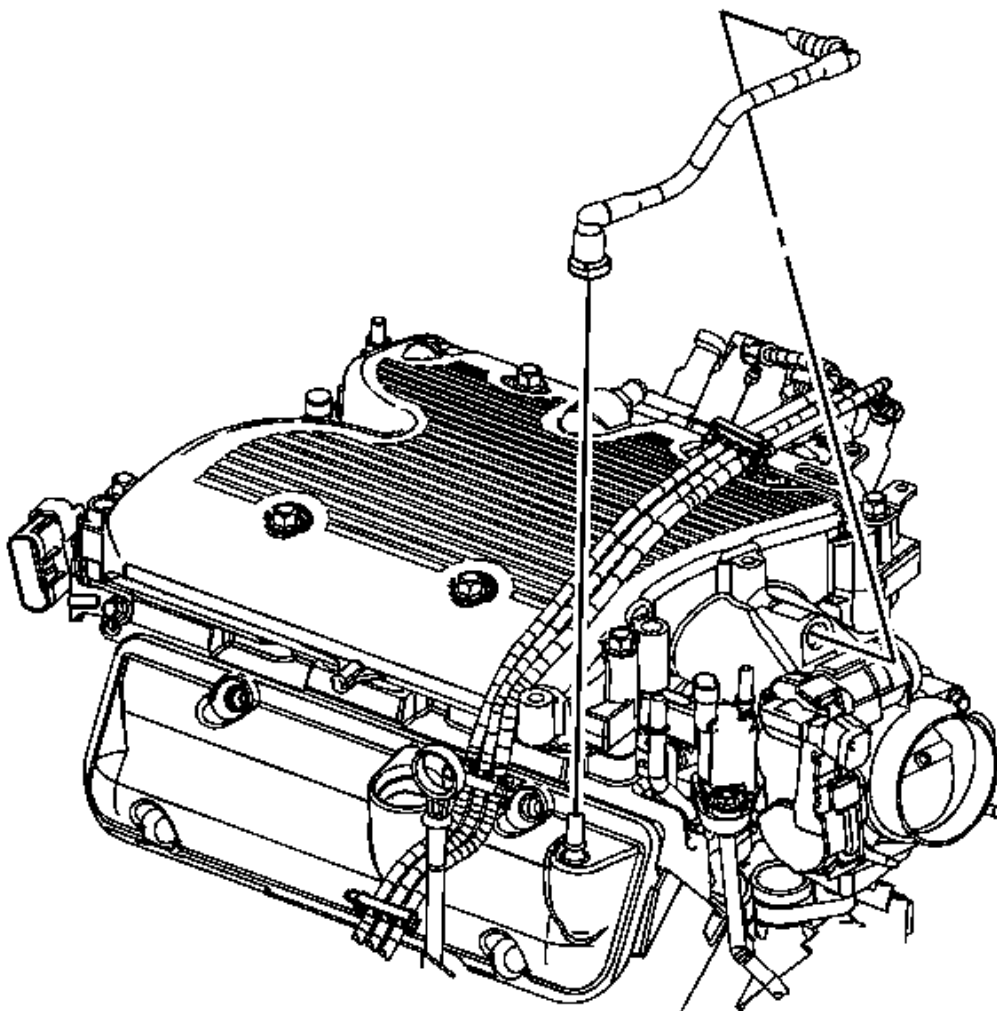


Fig. 53: View Of PCV Foul Air Tube Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

9. Remove the PCV foul air tube quick connect fitting from the rocker cover. Refer to **Plastic Collar Quick Connect Fitting Service** .
10. Remove the PCV foul air tube from the intake manifold.

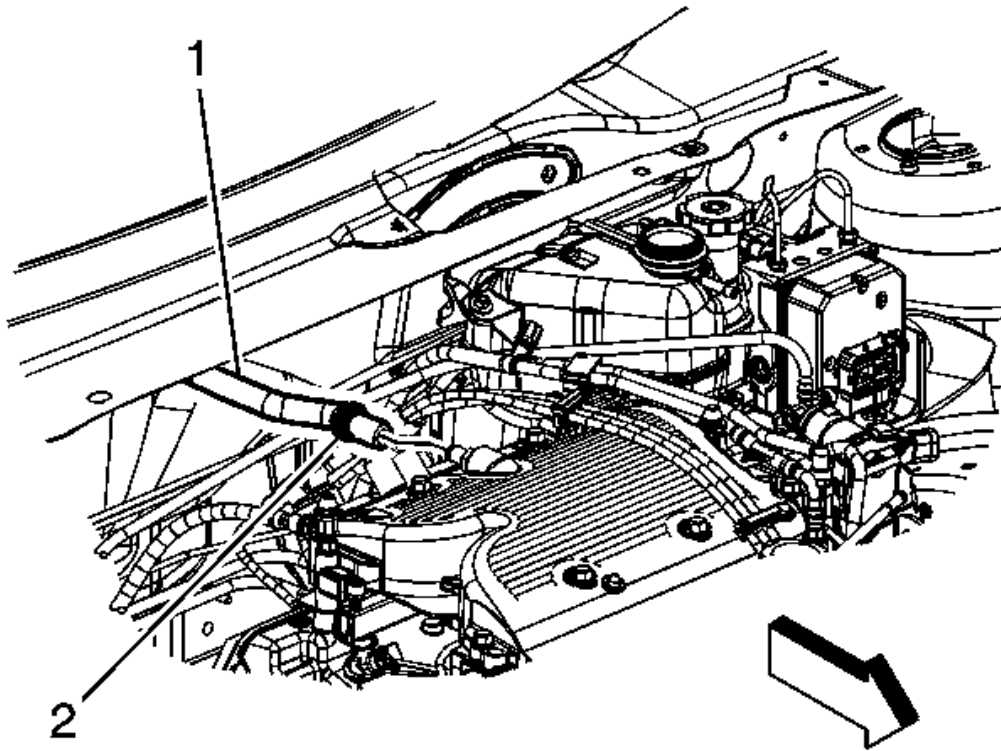


Fig. 54: View Of Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

11. Reposition the brake booster vacuum hose clamp (2) at the intake manifold.
12. Remove the brake booster vacuum hose (1) from the intake manifold.

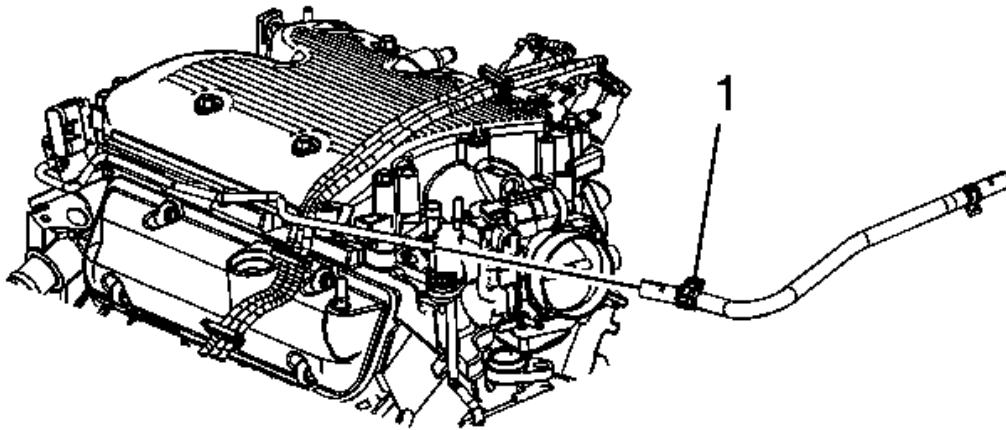


Fig. 55: Locating Radiator Surge Tank Inlet Hose Clamp
Courtesy of GENERAL MOTORS CORP.

13. Reposition the radiator surge tank inlet hose clamp (1).
14. Remove the radiator surge tank inlet hose from the inlet pipe.

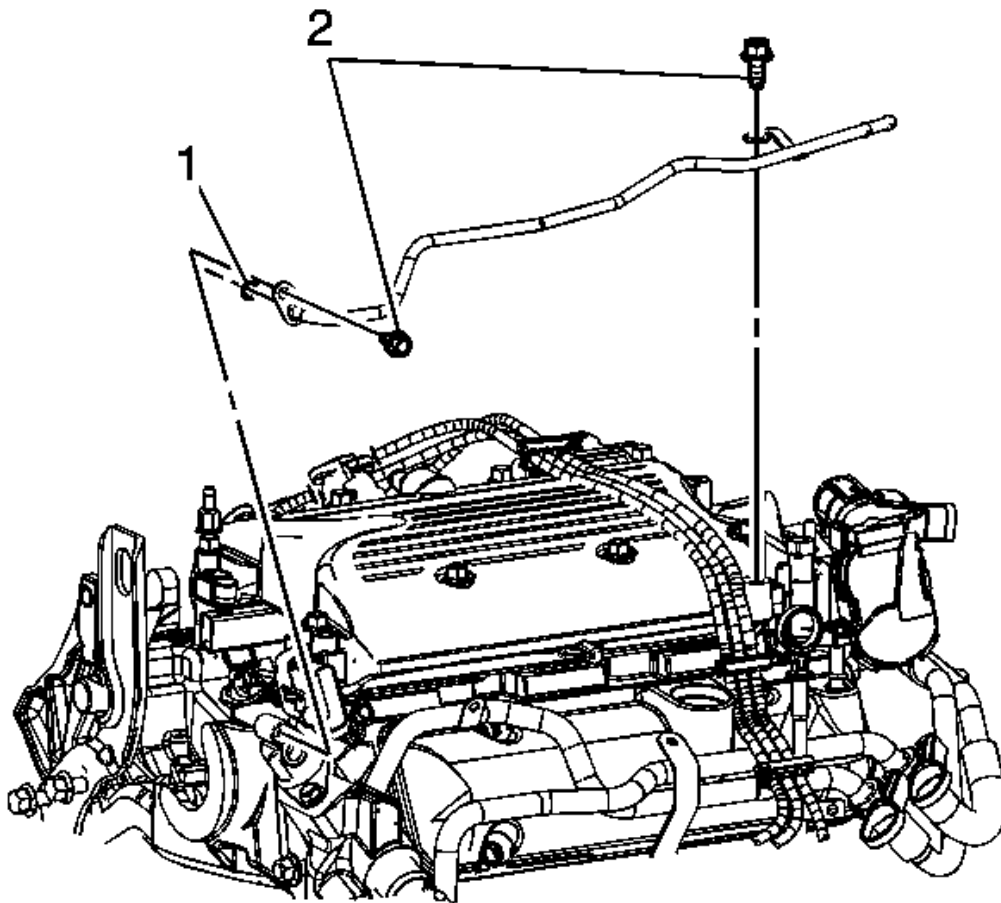


Fig. 56: Identifying Radiator Surge Tank Inlet Pipe Bolts
Courtesy of GENERAL MOTORS CORP.

15. Remove the radiator surge tank inlet pipe bolts (2).
16. Remove the radiator surge tank inlet pipe.
17. Remove and discard the O-ring seal (1).

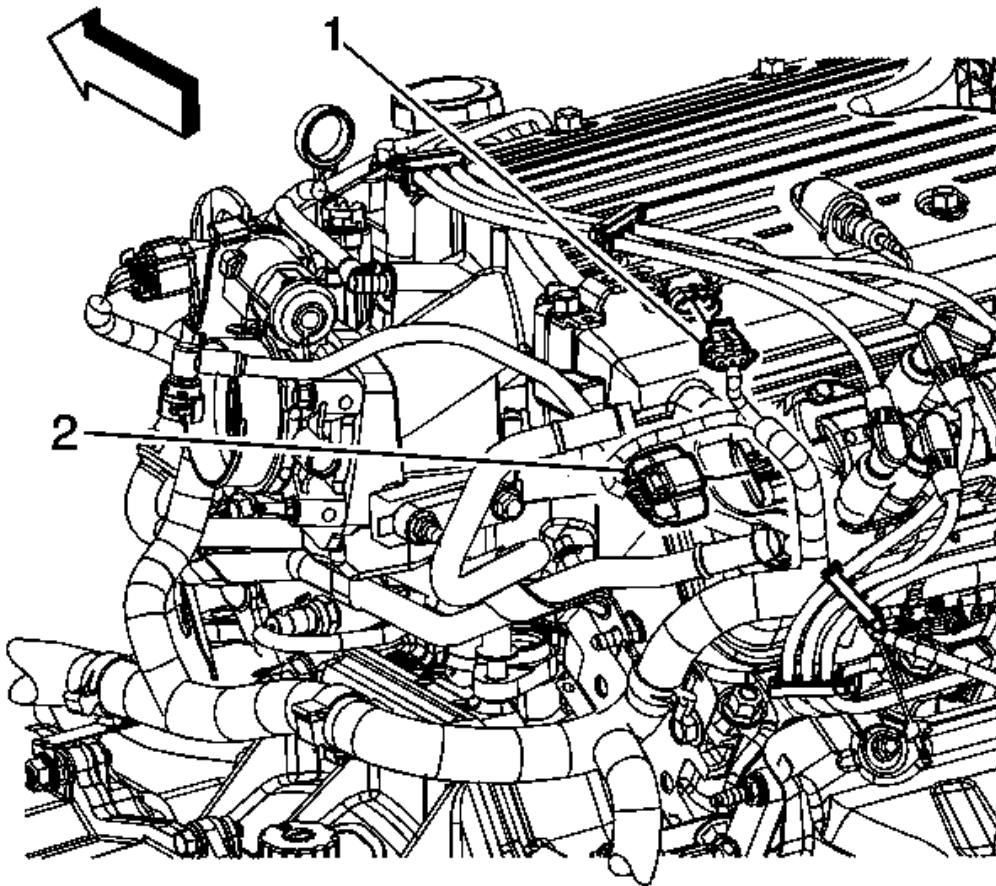


Fig. 57: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

18. Disconnect the engine wiring harness electrical connector (1) from the MAP sensor.

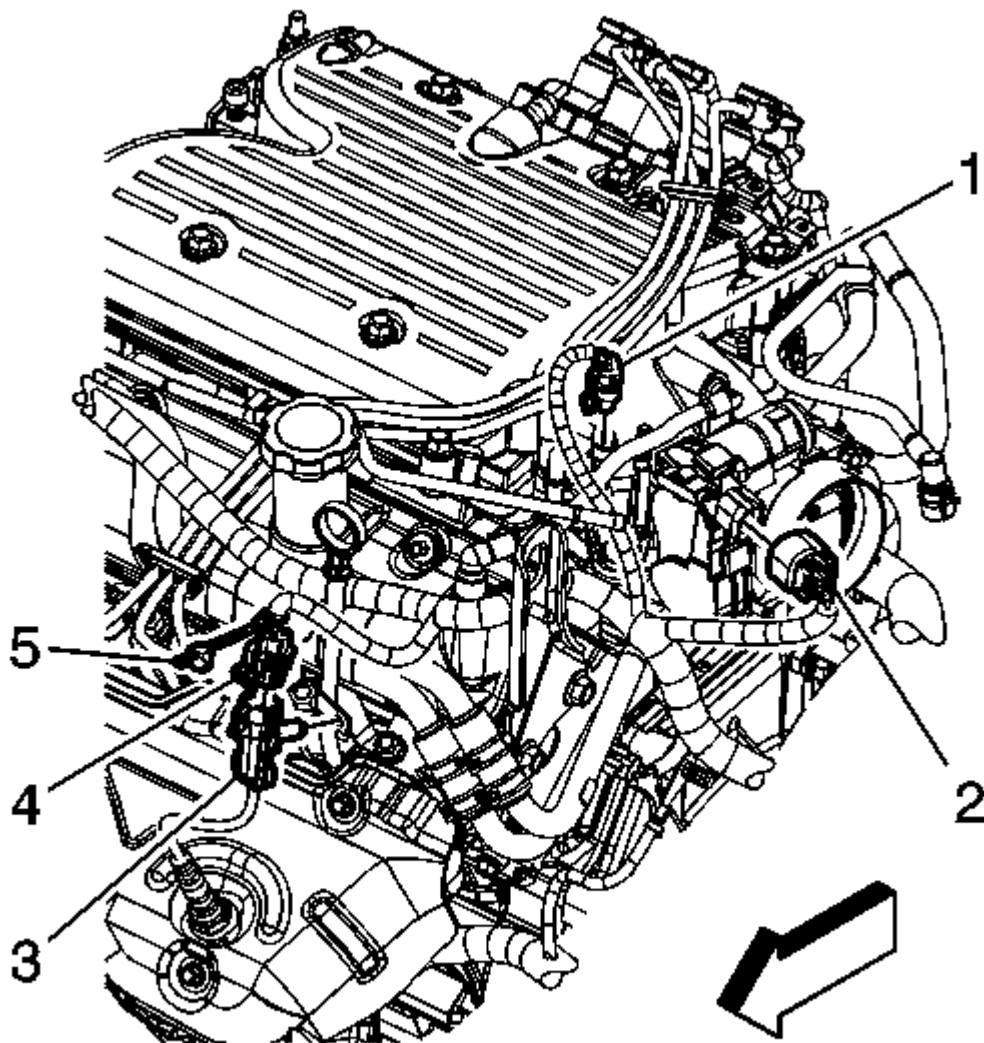


Fig. 58: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

19. Disconnect the engine wiring harness electrical connector (1) from the EVAP canister purge solenoid.
20. Disconnect the engine wiring harness electrical connector (2) from the electronic throttle control (ETC).

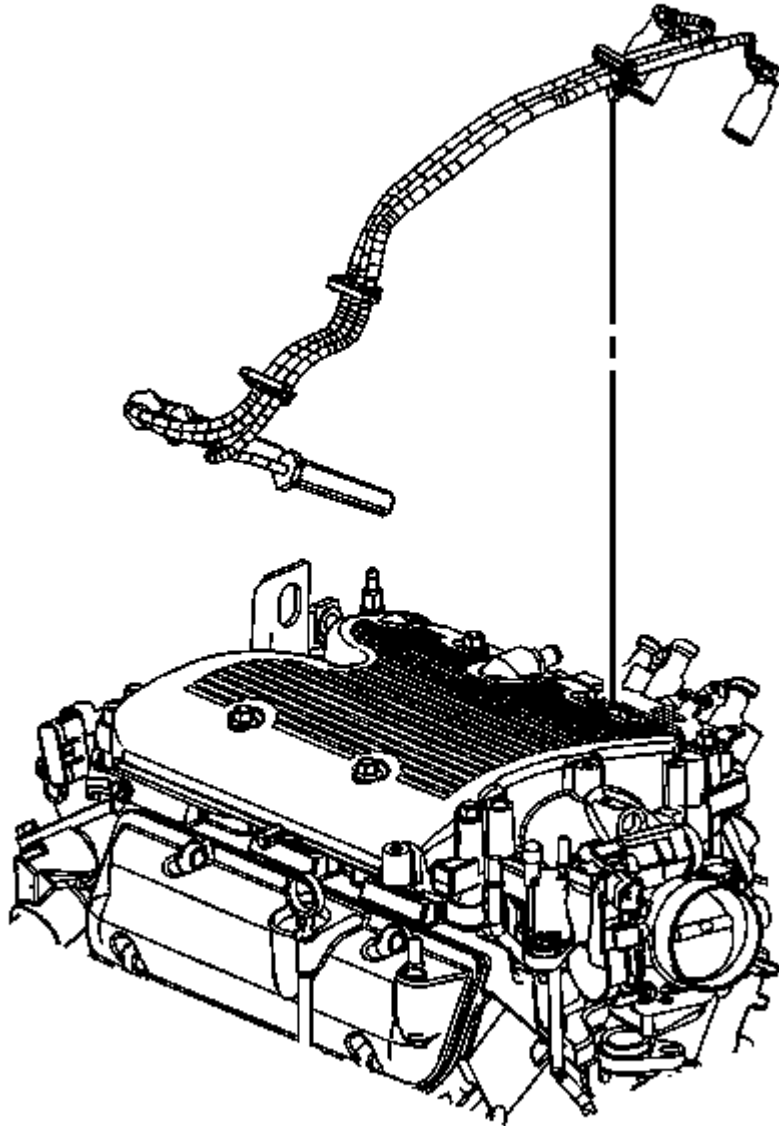


Fig. 59: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

21. Disconnect the left side spark plug wires from the spark plugs.
22. Disconnect the left side spark plug wires from the ignition coil.
23. Disengage the spark plug wire retainer clips from the heater inlet and outlet pipe bracket and the MAP sensor bracket.

24. Remove the left side spark plug wires.

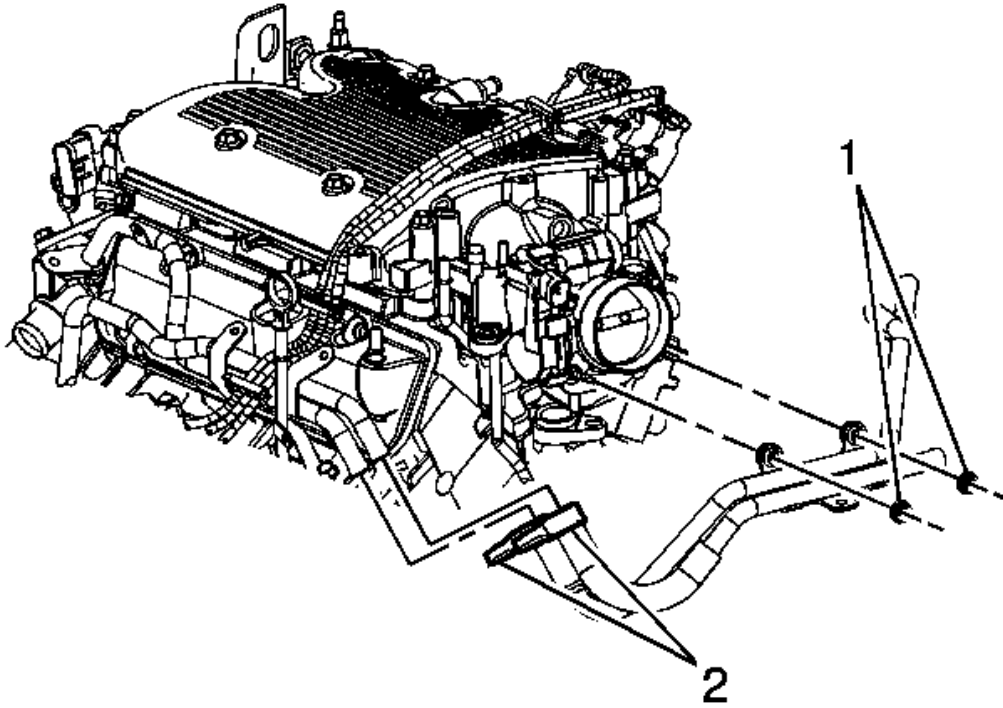


Fig. 60: Identifying Heater Inlet And Outlet Pipe Nuts
Courtesy of GENERAL MOTORS CORP.

25. Remove the heater inlet and outlet pipe nuts (1) from the throttle body studs.
26. Reposition the heater inlet and outlet hose clamps (2) from the pipes.
27. Remove the heater inlet and outlet hoses from the heater inlet and outlet pipes.
28. Remove the heater inlet and outlet pipe bracket from the throttle body studs. Reposition the inlet and outlet pipe out of the way.

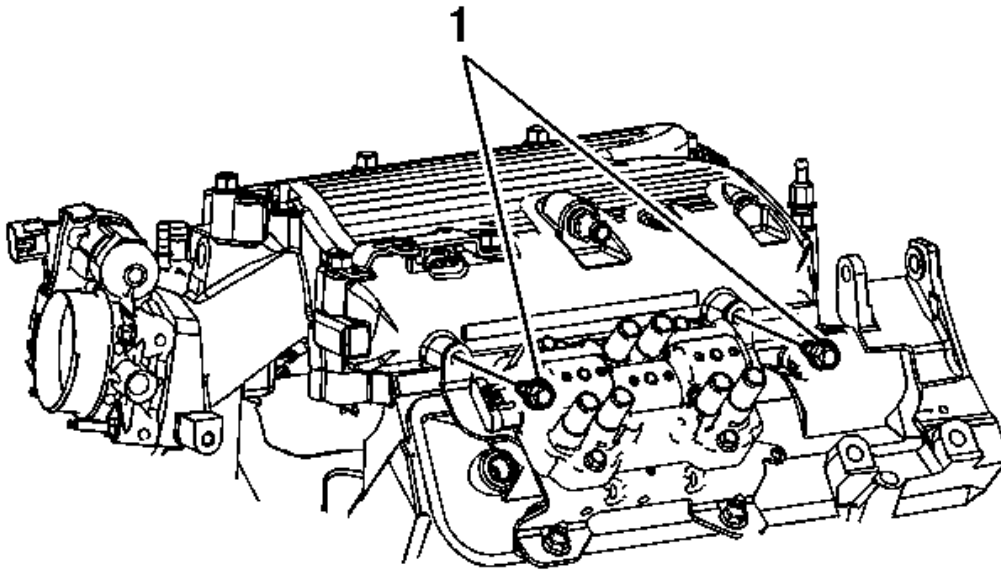


Fig. 61: Identifying Ignition Coil Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

29. Remove the ignition coil bracket bolts (1).

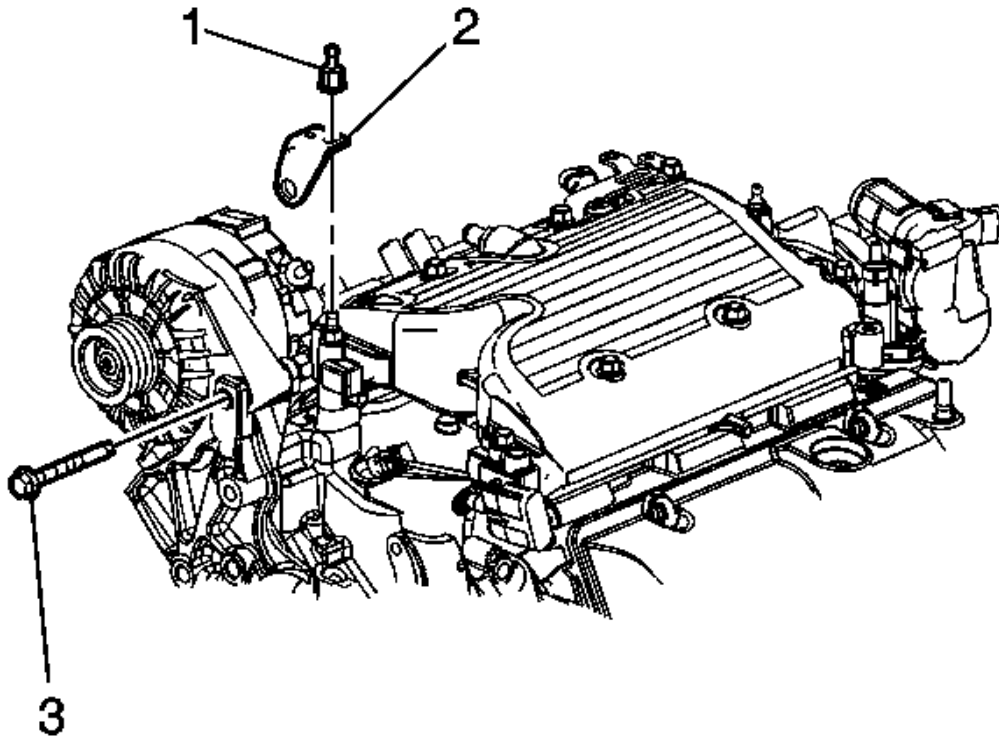


Fig. 62: View Of Generator Rear Brace Upper Nut
Courtesy of GENERAL MOTORS CORP.

30. Remove the generator rear brace upper nut (1).
31. Remove the generator through bolt (3).
32. Remove the generator rear brace (2).

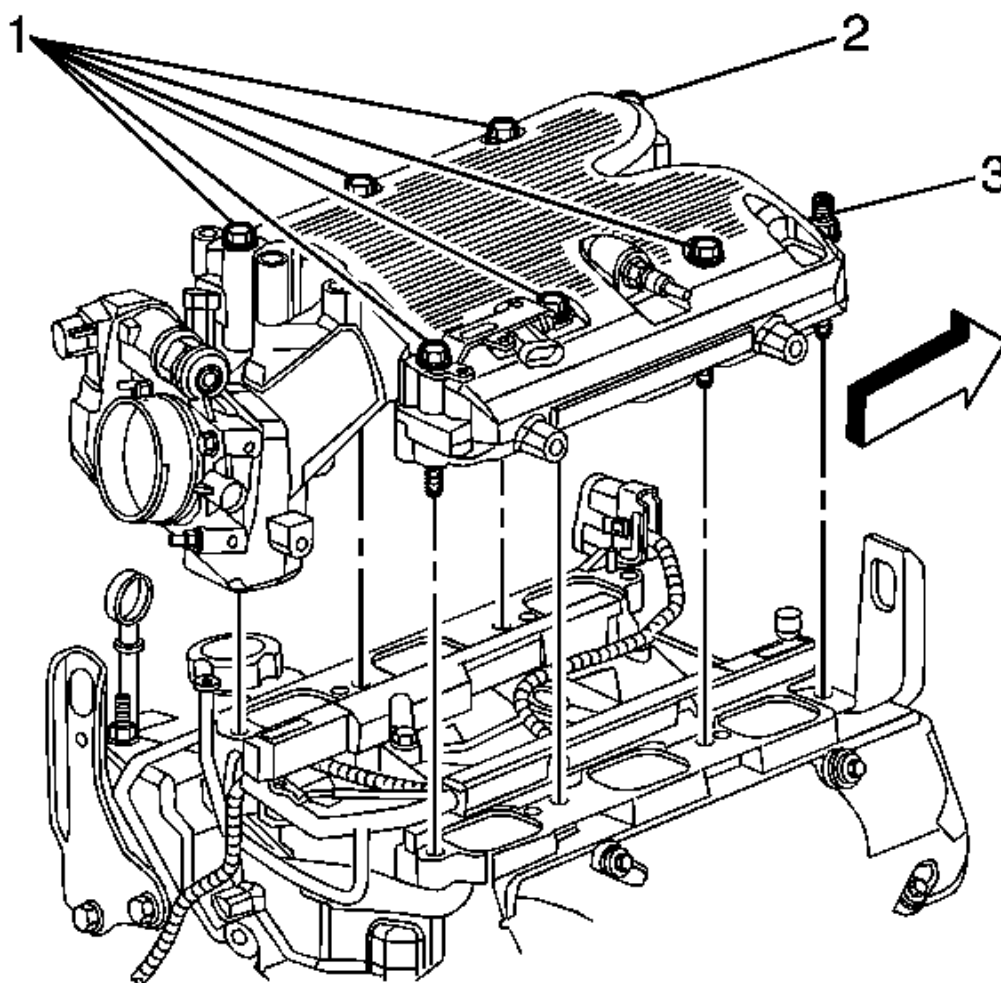


Fig. 63: Identifying Upper Intake Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

33. Remove the upper intake manifold bolts (1, 2) and stud (3).
34. Separate and remove the upper intake manifold from the lower intake manifold.

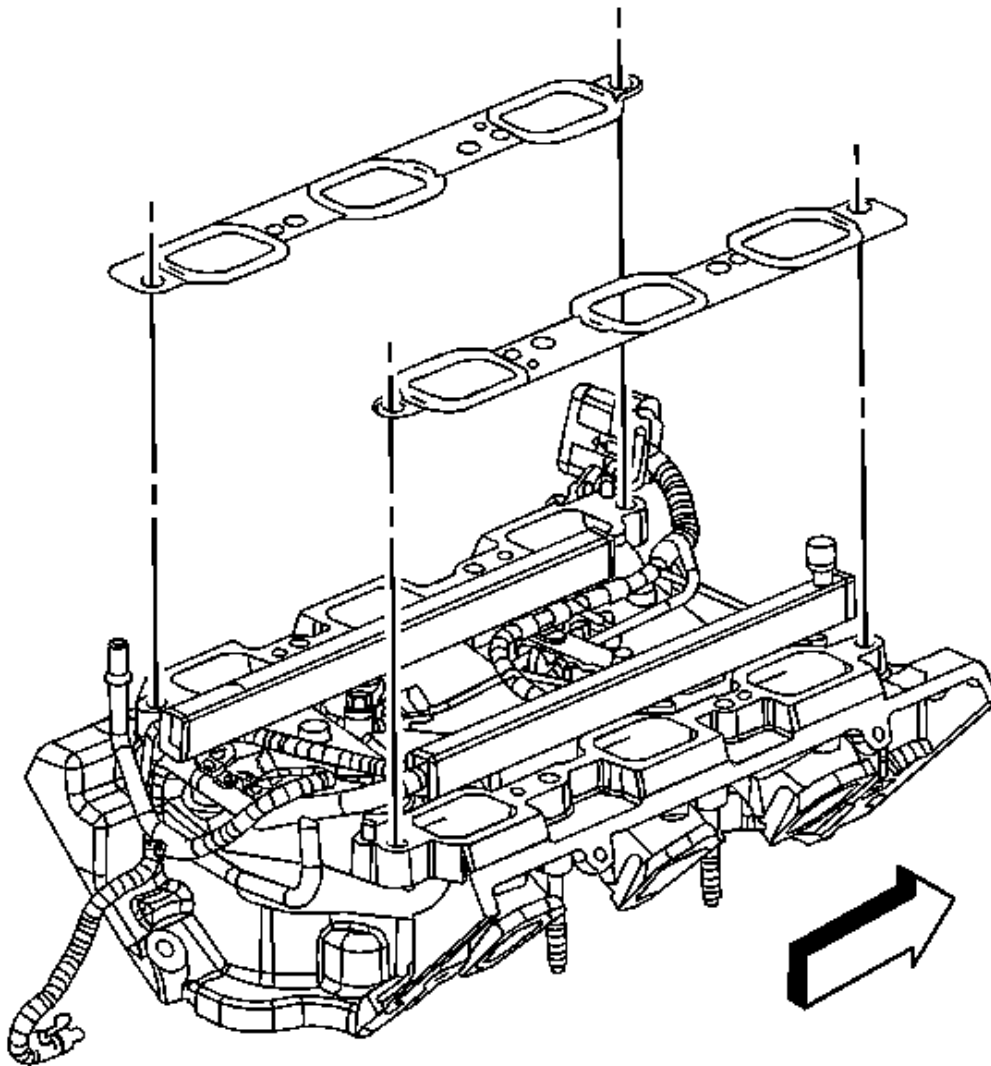


Fig. 64: Identifying Upper Intake Manifold Gaskets
Courtesy of GENERAL MOTORS CORP.

35. Remove the upper to lower intake manifold gaskets.

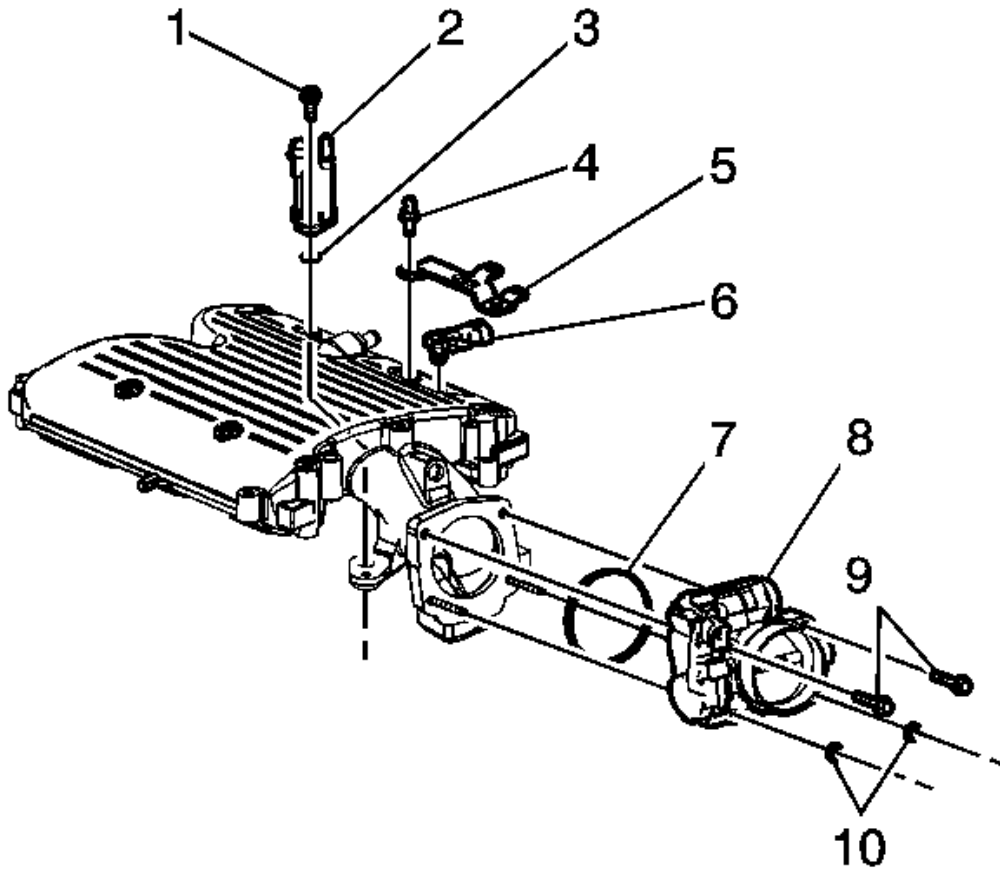


Fig. 65: View Of Upper Intake Manifold
Courtesy of GENERAL MOTORS CORP.

36. If replacing the upper intake manifold, perform the following steps otherwise proceed to step 8 in the Installation Procedure.
37. Remove the EVAP canister purge solenoid valve bolt (1), valve (2).
38. Remove and discard the EVAP canister purge solenoid O-ring seal (3).
39. Remove the intake manifold cover ball stud (4).
40. Remove the MAP sensor bracket (5) and MAP sensor (6).
41. Remove the throttle body bolts (9) and nuts (10).
42. Remove the throttle body (8) and throttle body O-ring seal (7).

INSTALLATION PROCEDURE

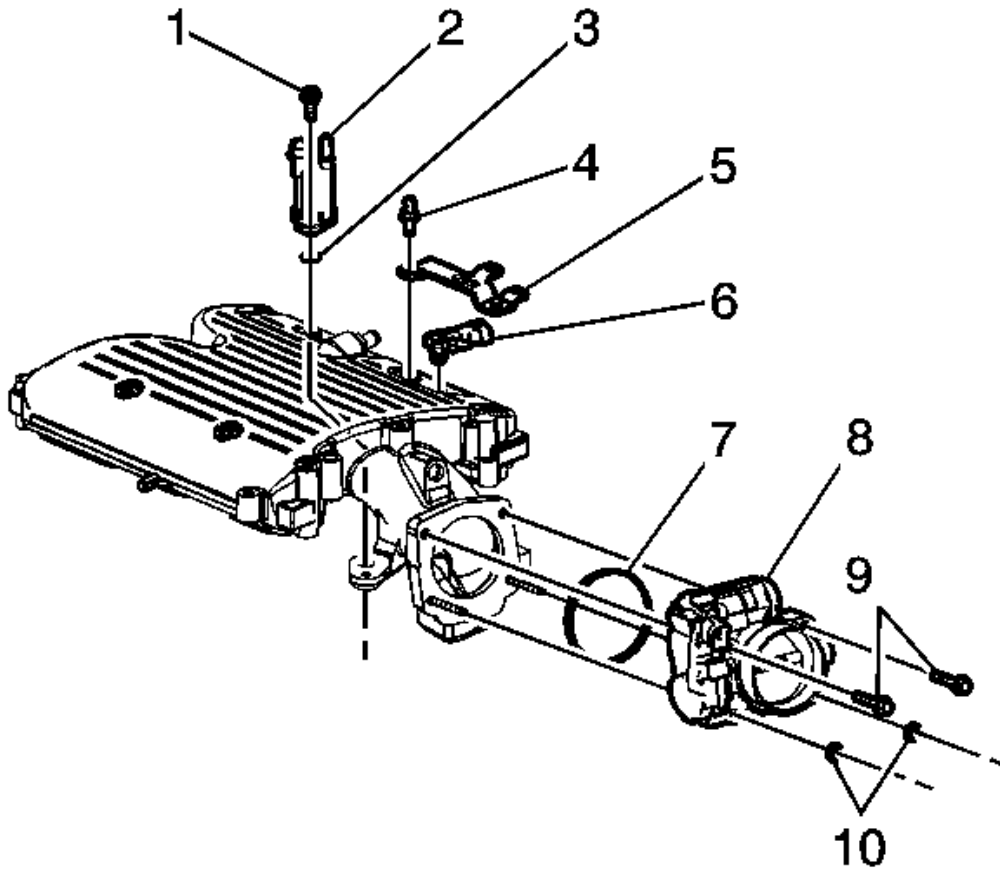


Fig. 66: View Of Upper Intake Manifold
Courtesy of GENERAL MOTORS CORP.

1. If replacing the upper intake manifold, perform the following steps otherwise proceed to step 8.
2. Install a NEW throttle body O-ring seal (7) into the groove on the throttle body and install the throttle body (8).

CAUTION: Refer to Fastener Caution .

3. Install the throttle body bolts (9) and nuts (10).

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

4. Lubricate the MAP sensor seal and install the MAP sensor (6), place the bracket (5) into position.

5. Install the intake manifold cover ball stud (4).

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

6. Lubricate and install a NEW EVAP canister purge solenoid O-ring seal (3) onto the solenoid.
7. Install the EVAP canister purge solenoid valve (2) and bolt (1).

Tighten: Tighten the bolt to 12 N.m (106 lb in).

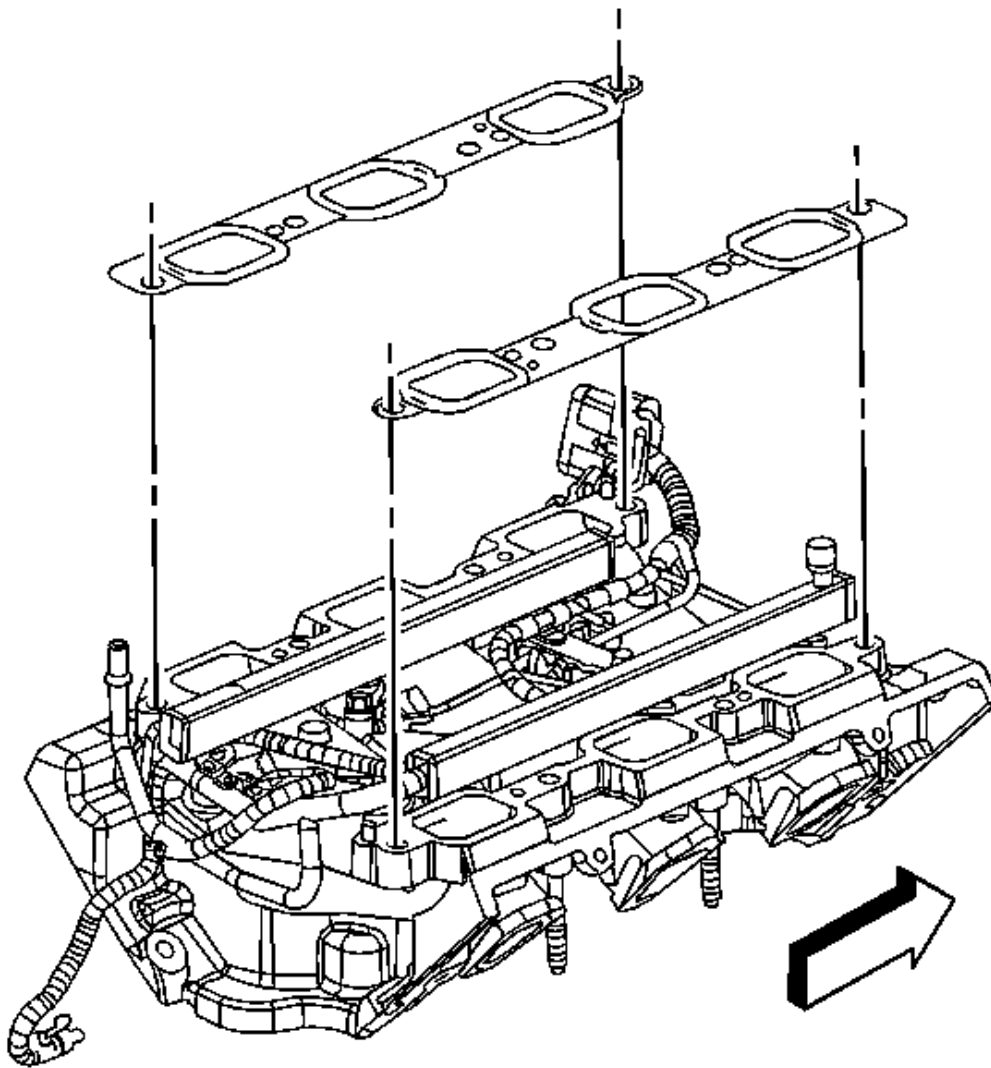


Fig. 67: Identifying Upper Intake Manifold Gaskets

Courtesy of GENERAL MOTORS CORP.

8. Install the NEW upper to lower intake manifold gaskets.

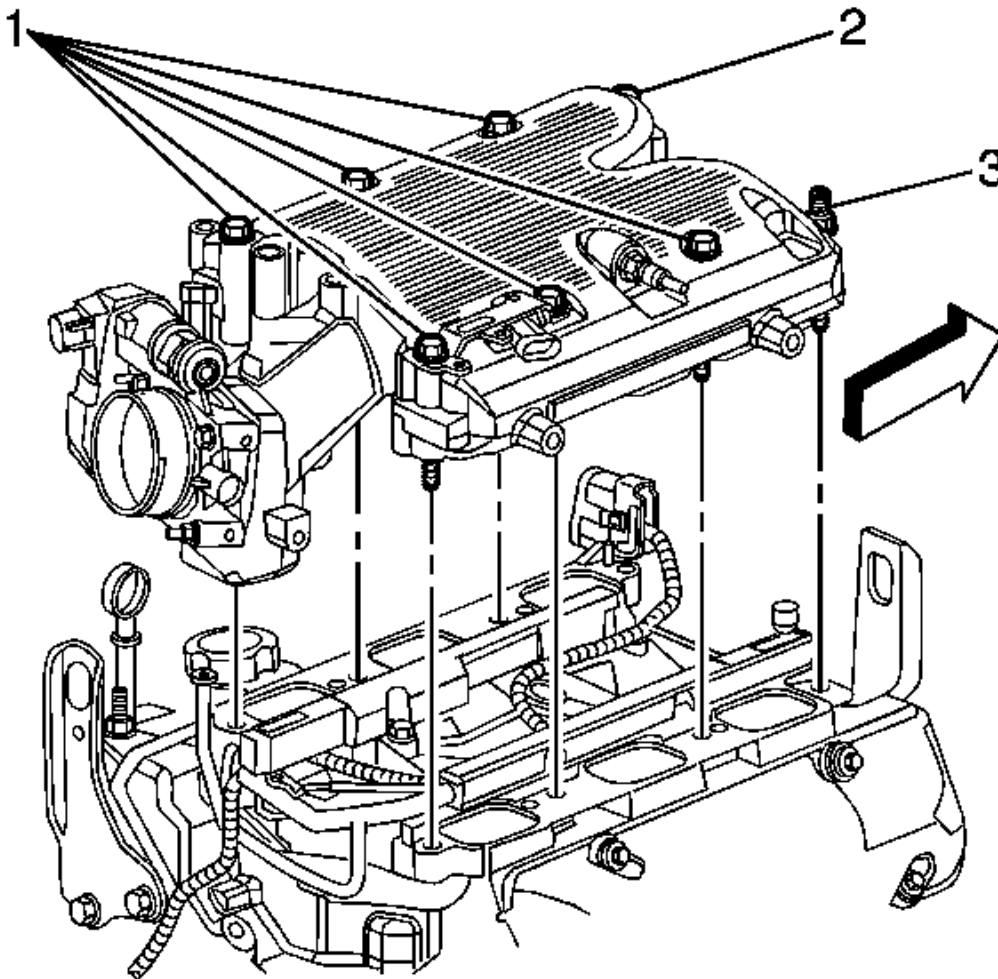


Fig. 68: Identifying Upper Intake Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

9. Set the upper intake manifold onto the lower intake manifold.
10. Apply threadlock to the upper intake manifold bolts/stud threads. Refer to **Adhesives, Fluids, Lubricants, and Sealers**.
11. Install the upper intake manifold bolts (1, 2) and stud (3).

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

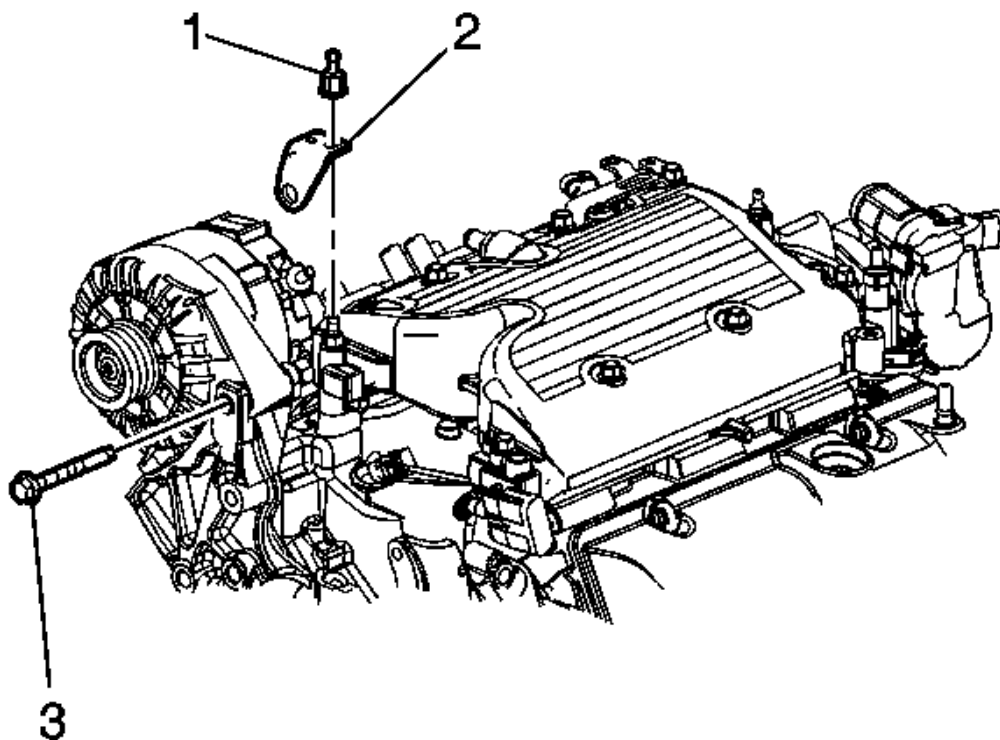


Fig. 69: View Of Generator Rear Brace Upper Nut
Courtesy of GENERAL MOTORS CORP.

12. Place the generator rear brace (2) onto the stud.
13. Install the generator through bolt (3) until snug.
14. Install the generator rear brace upper nut (1) until snug.

Tighten:

- Tighten the generator through bolt to 50 N.m (37 lb ft).
- Tighten the generator rear brace upper nut to 25 N.m (18 lb ft).

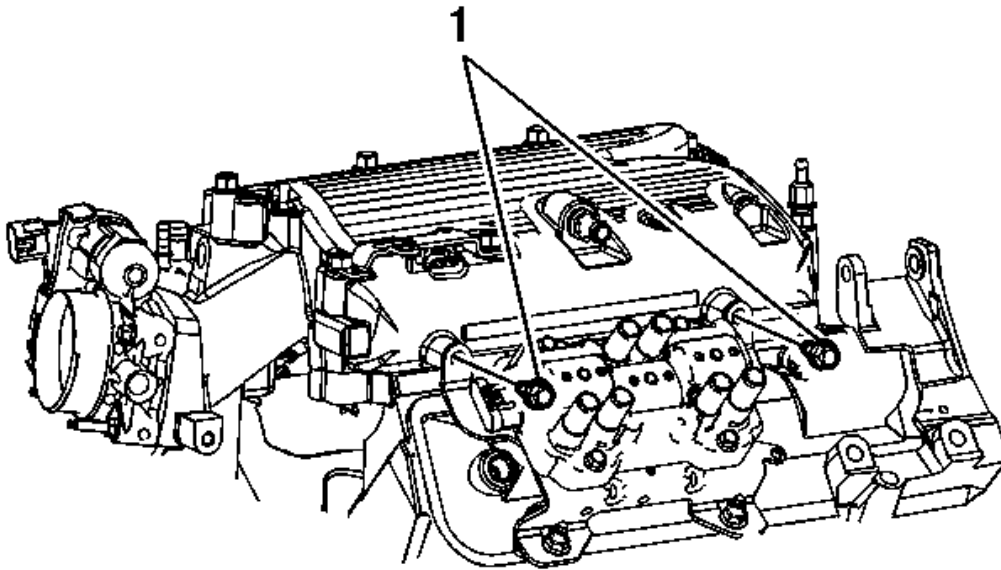


Fig. 70: Identifying Ignition Coil Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

15. Install the ignition coil bracket bolts (1).

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

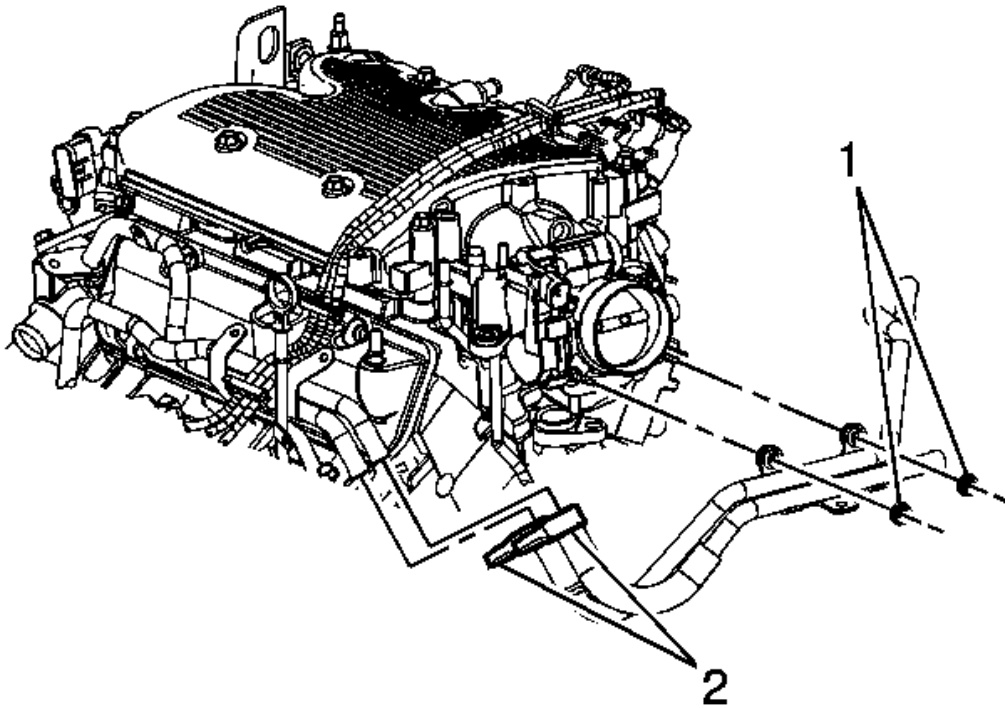


Fig. 71: Identifying Heater Inlet And Outlet Pipe Nuts
Courtesy of GENERAL MOTORS CORP.

16. Position the inlet and outlet pipe and install the heater inlet and outlet pipe bracket to the throttle body studs.
17. Install the heater inlet and outlet hoses to the heater inlet and outlet pipes.
18. Position the heater inlet and outlet hose clamps (2) to the pipes.
19. Install the heater inlet and outlet pipe nuts (1) to the throttle body studs.

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

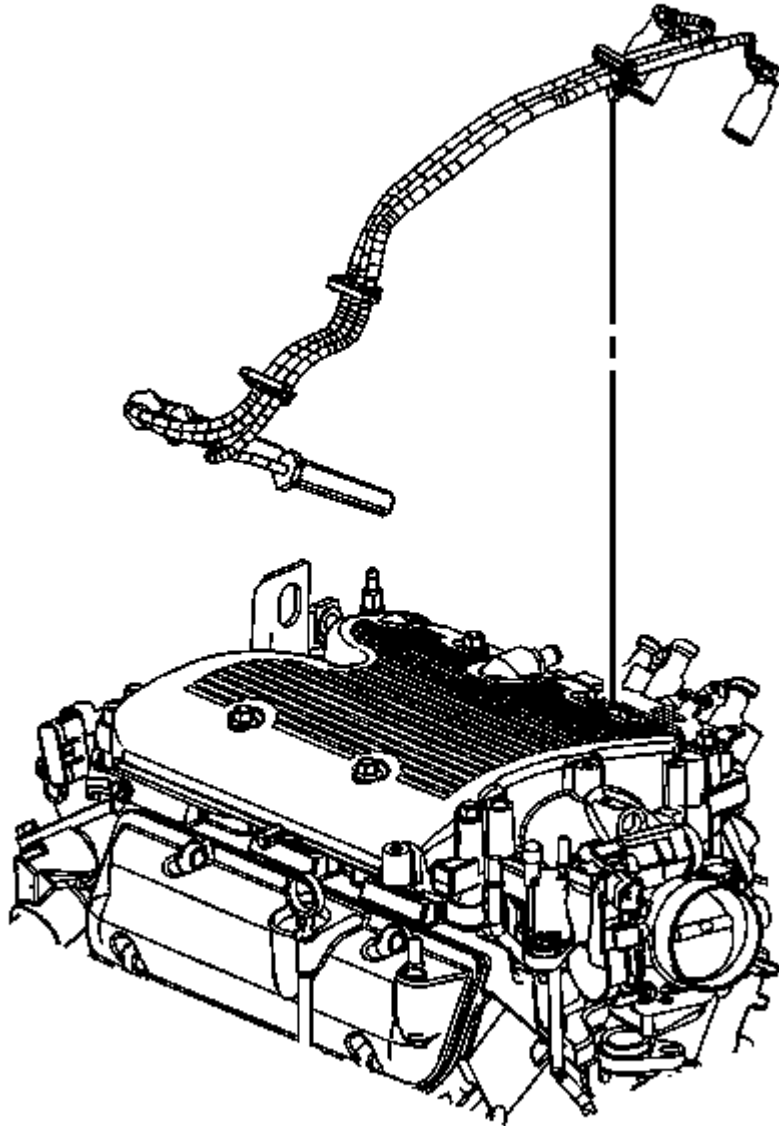


Fig. 72: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

20. Install the left side spark plug wires.
21. Connect the left side spark plug wires to the spark plugs.
22. Connect the left side spark plug wires to the ignition coil.
23. Engage the spark plug wire retainer clips to the heater inlet and outlet pipe bracket and the MAP sensor

bracket.

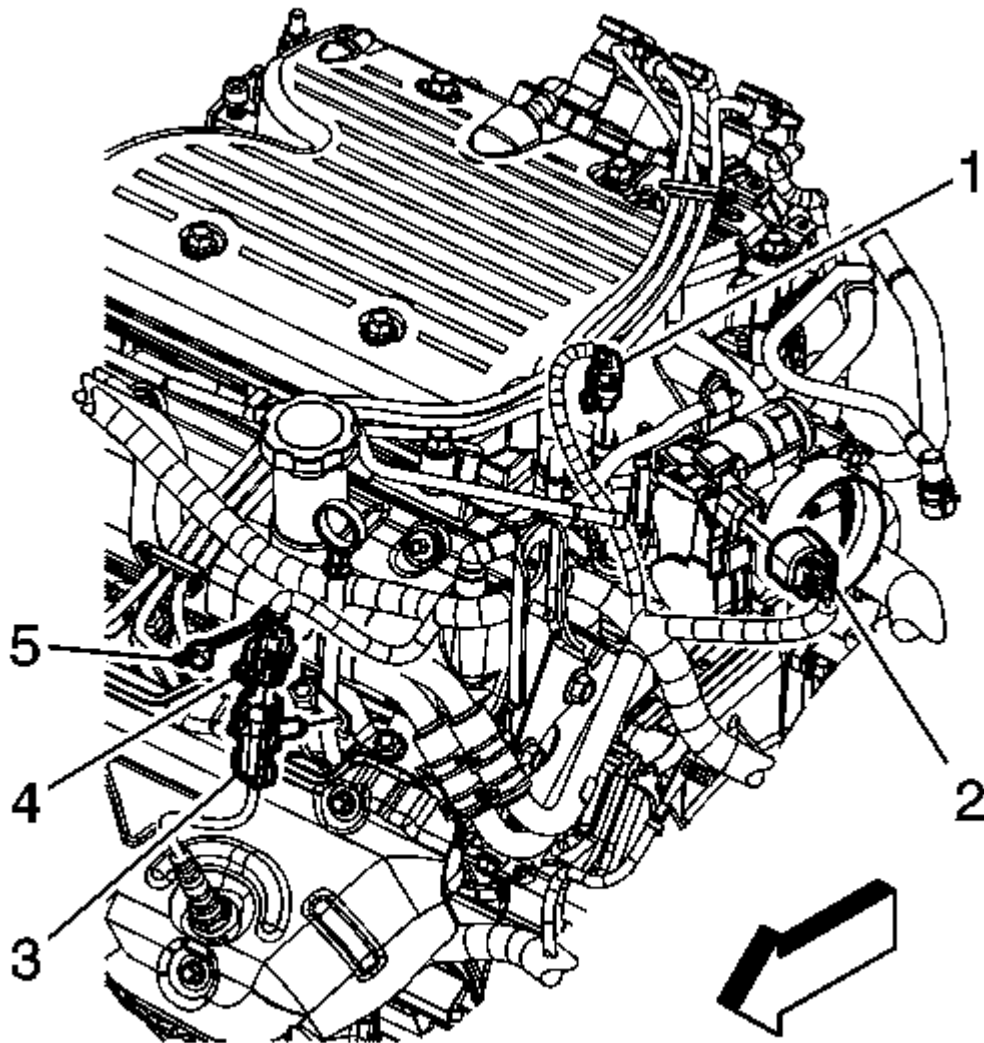


Fig. 73: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

24. Connect the engine wiring harness electrical connector (1) to the EVAP canister purge solenoid.
25. Connect the engine wiring harness electrical connector (2) to the ETC.

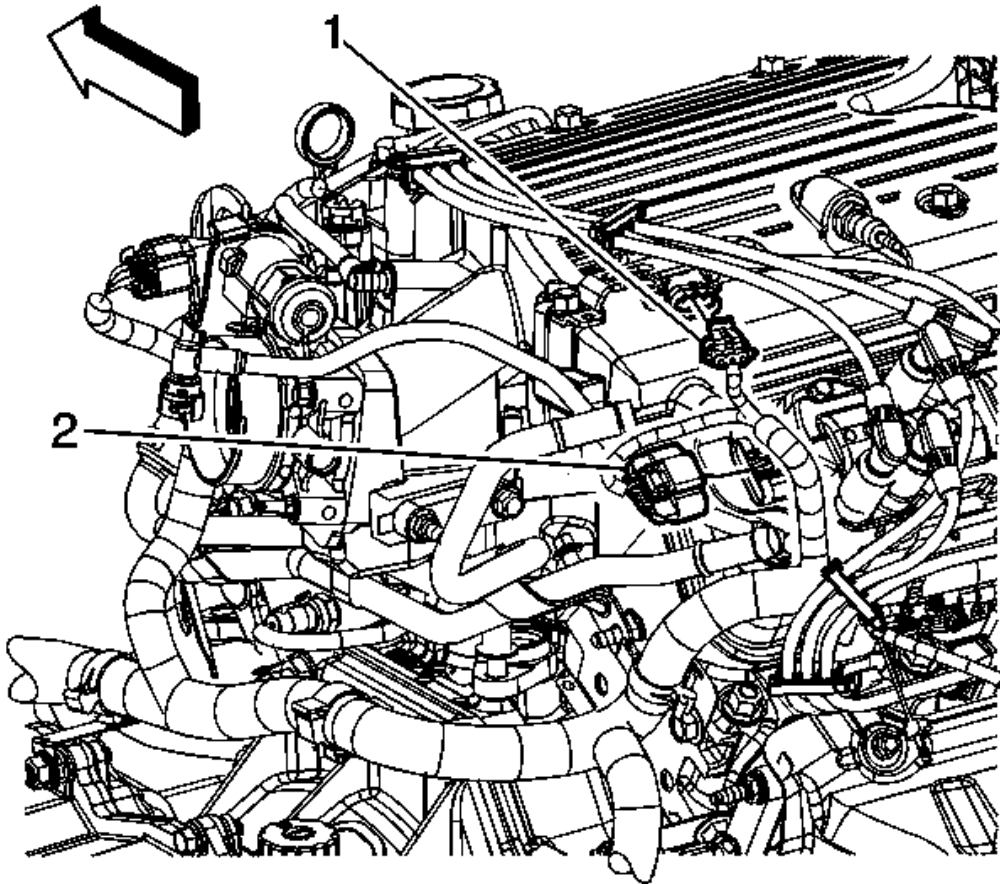


Fig. 74: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

26. Connect the engine wiring harness electrical connector (1) to the MAP sensor.

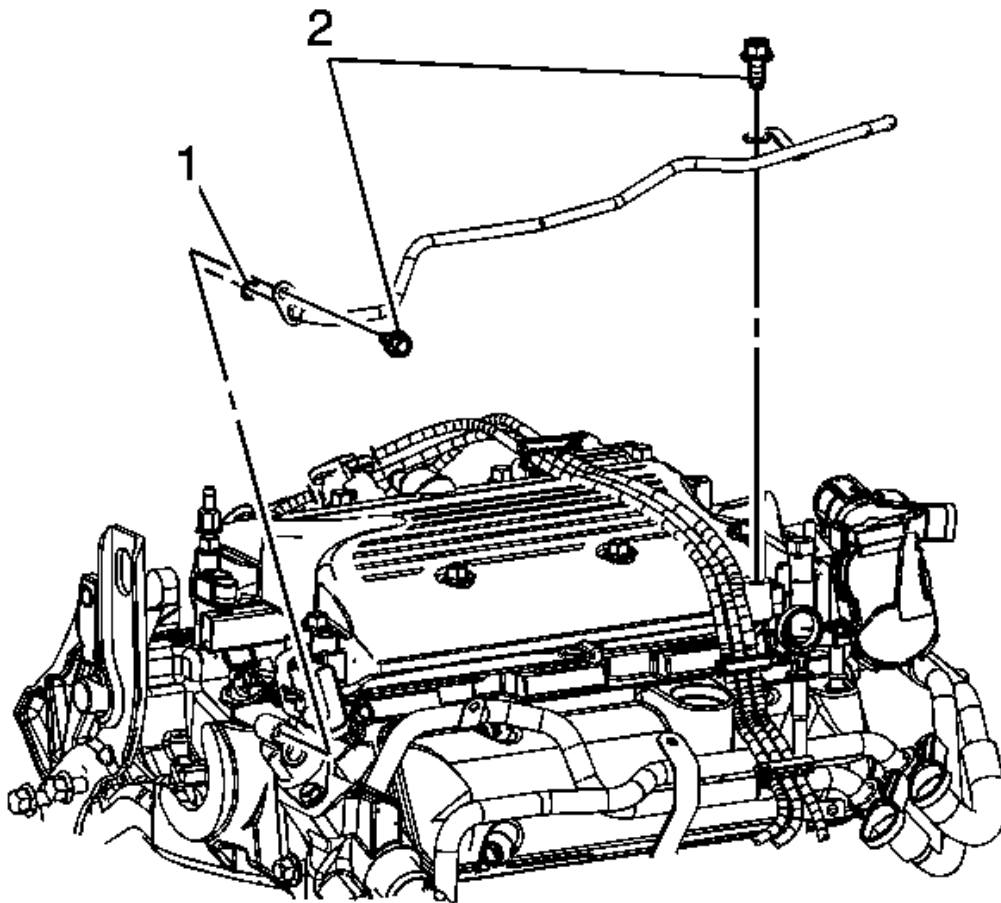


Fig. 75: Identifying Radiator Surge Tank Inlet Pipe Bolts
Courtesy of GENERAL MOTORS CORP.

27. Install a NEW O-ring seal (1) to the inlet pipe.
28. Install the radiator surge tank inlet pipe.
29. Install the radiator surge tank inlet pipe bolts (2).

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

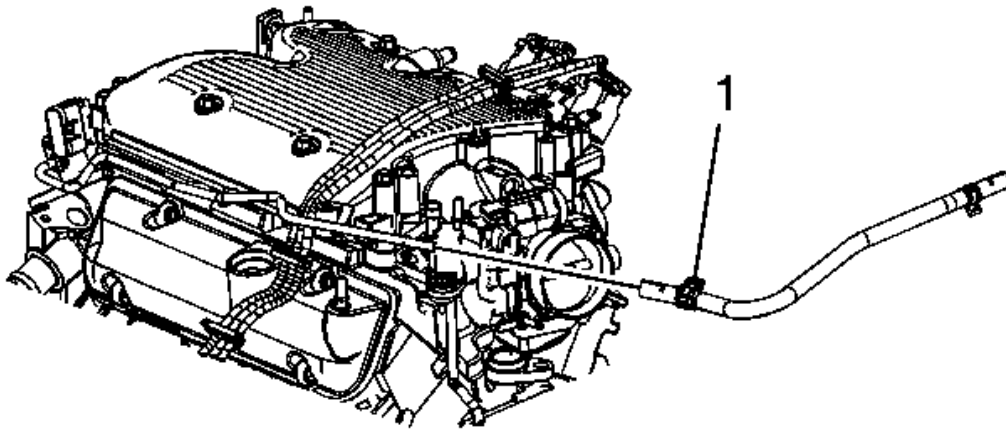


Fig. 76: Locating Radiator Surge Tank Inlet Hose Clamp
Courtesy of GENERAL MOTORS CORP.

30. Install the radiator surge tank inlet hose to the inlet pipe.
31. Position the radiator surge tank inlet hose clamp (1).

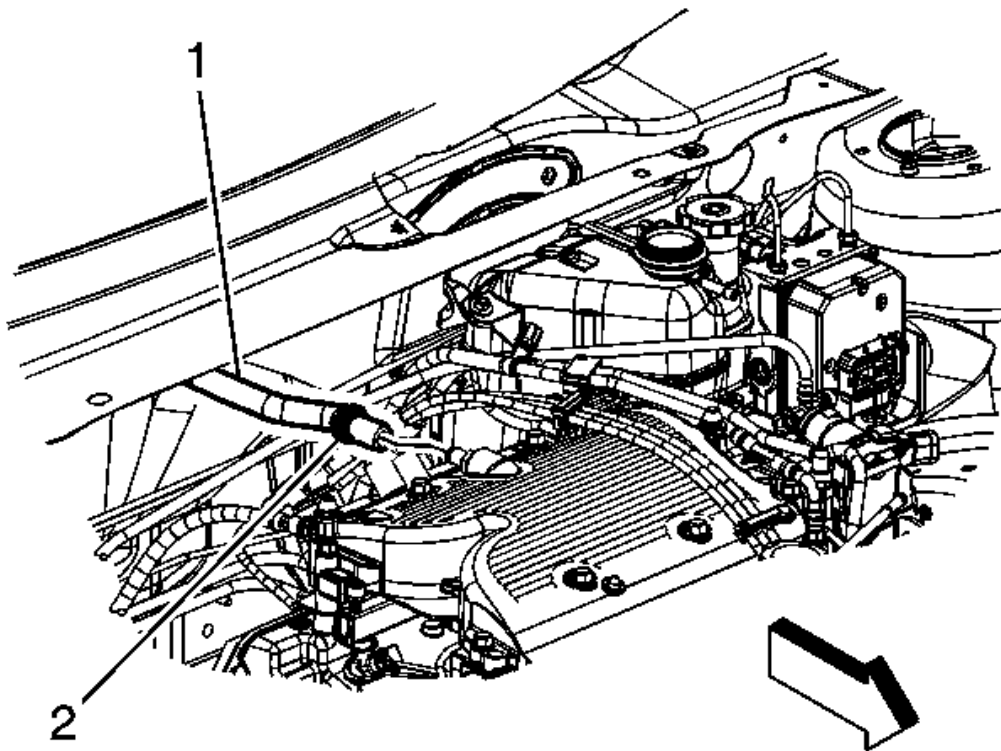


Fig. 77: View Of Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

32. Install the brake booster vacuum hose (1) to the intake manifold.
33. Position the brake booster vacuum hose clamp (2) at the intake manifold.

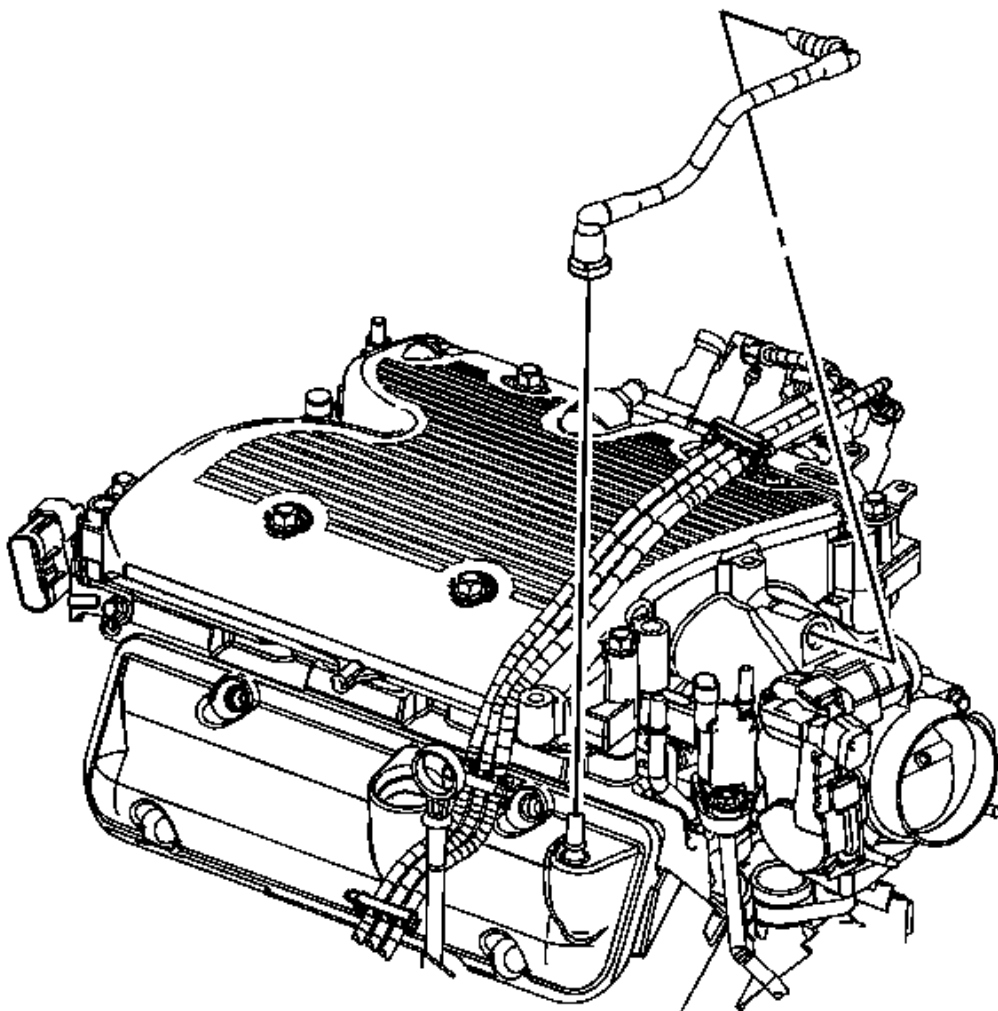


Fig. 78: View Of PCV Foul Air Tube Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

34. Install the PCV foul air tube to the intake manifold.
35. Install the PCV foul air tube quick connect fitting to the rocker cover. Refer to **Plastic Collar Quick Connect Fitting Service** .

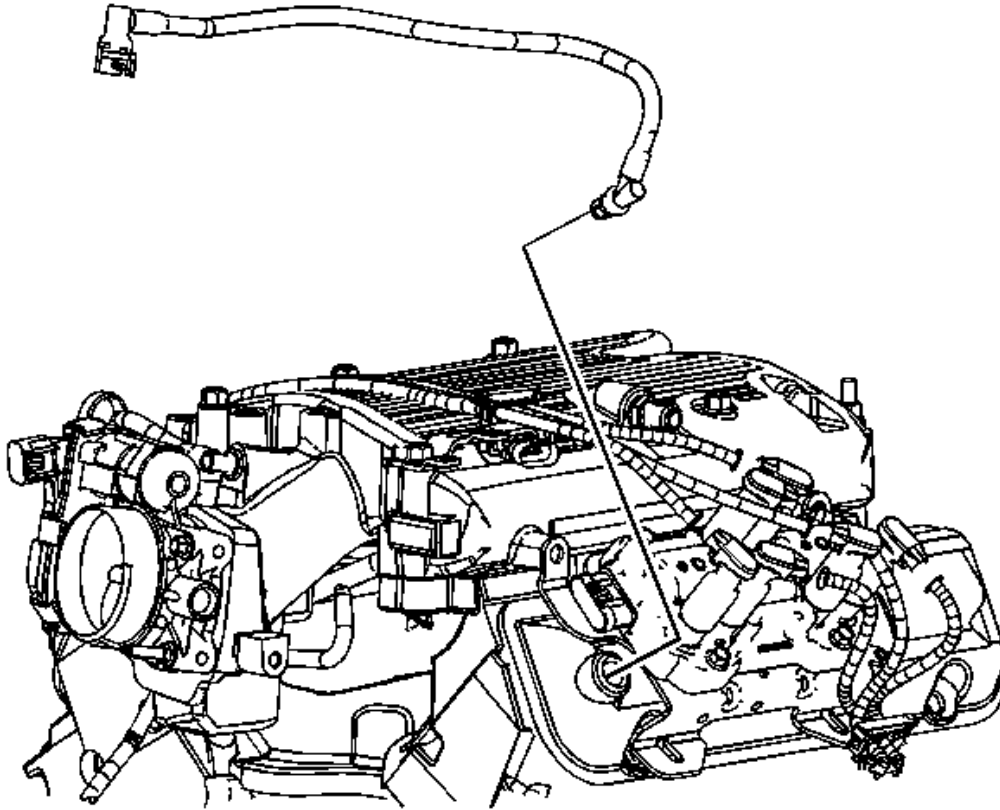


Fig. 79: Identifying Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

36. Install the PCV fresh air tube to the rocker cover.
37. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
38. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill-LY7, LZE, LZ4)** or **Cooling System Draining and Filling (GE 47716)** .

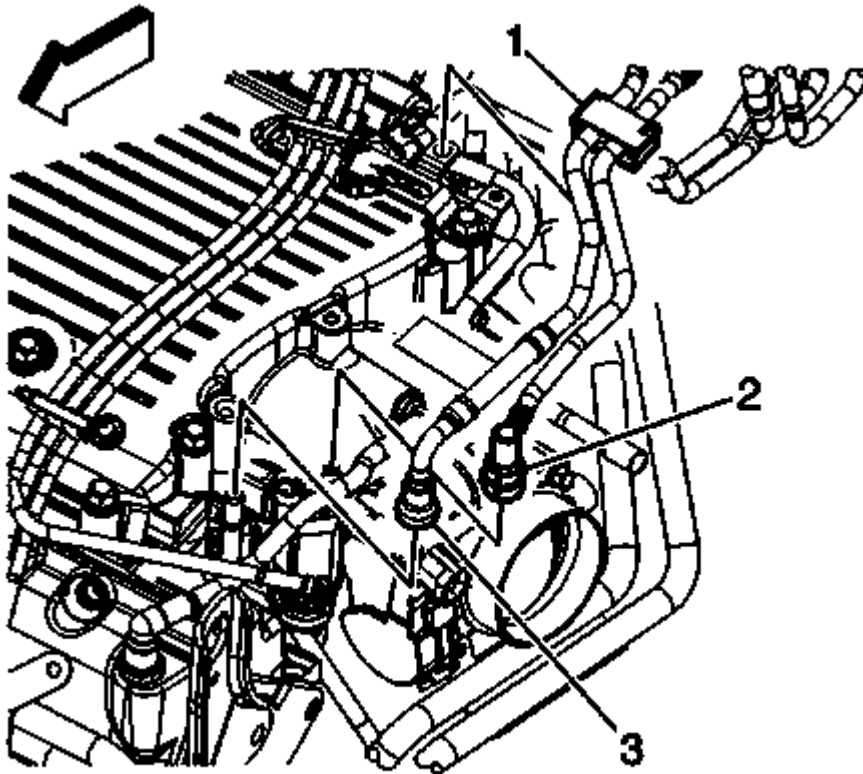


Fig. 80: View Of Fuel Feed & EVAP Pipes
Courtesy of GENERAL MOTORS CORP.

39. Position the fuel/EVAP lines.
40. Install the fuel line clip (1) to the MAP sensor bracket.
41. Connect the fuel feed pipe quick connect fitting (3) to the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .
42. Connect the EVAP pipe quick connect fitting (2) to the purge solenoid. Refer to **Plastic Collar Quick Connect Fitting Service** .
43. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
44. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (LE5, LE9, LZ4, LZE, or LY7)** .

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.

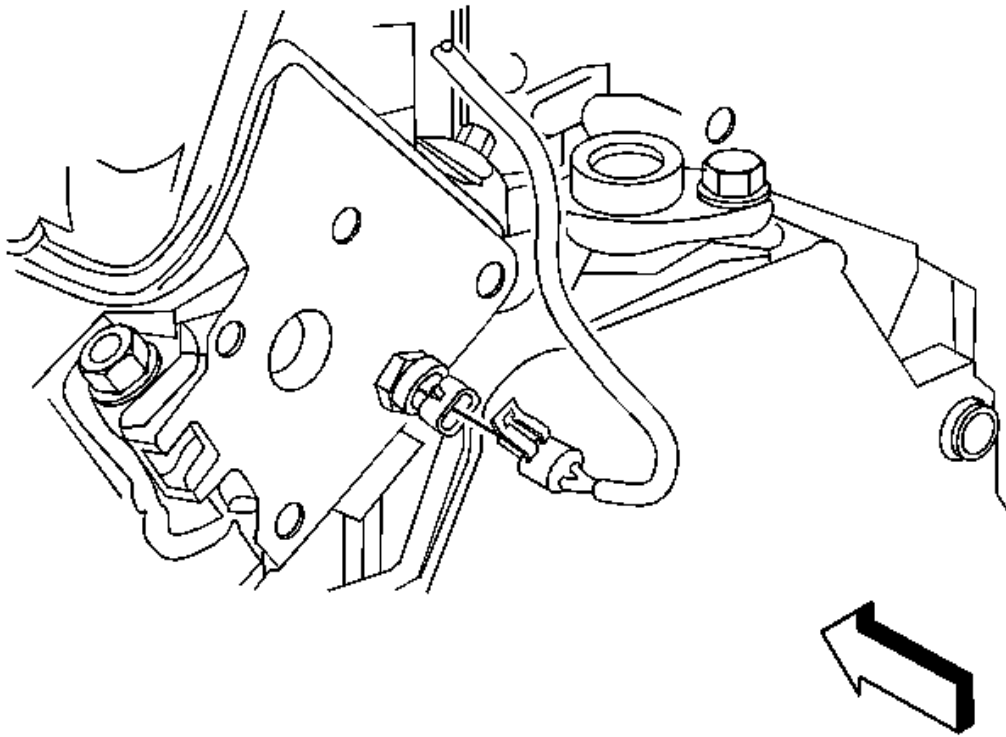


Fig. 81: View Of Upper Intake Manifold
Courtesy of GENERAL MOTORS CORP.

1. Remove the upper intake manifold. Refer to **Upper Intake Manifold Replacement**.
2. Cooling System Draining and Filling. Refer to **Cooling System Draining and Filling (Static Fill-LY7, LZE, LZ4)** or **Cooling System Draining and Filling (GE 47716)**
3. Remove the valve rocker arm covers. Refer to **Valve Rocker Arm Cover Replacement - Left Side** and **Valve Rocker Arm Cover Replacement - Right Side**.
4. Remove the coolant crossover pipe. Refer to **Engine Coolant Crossover Pipe Replacement (LZ4)** .
5. Disconnect the fuel injector wiring harness electrical connector from the engine coolant temperature (ECT) sensor.

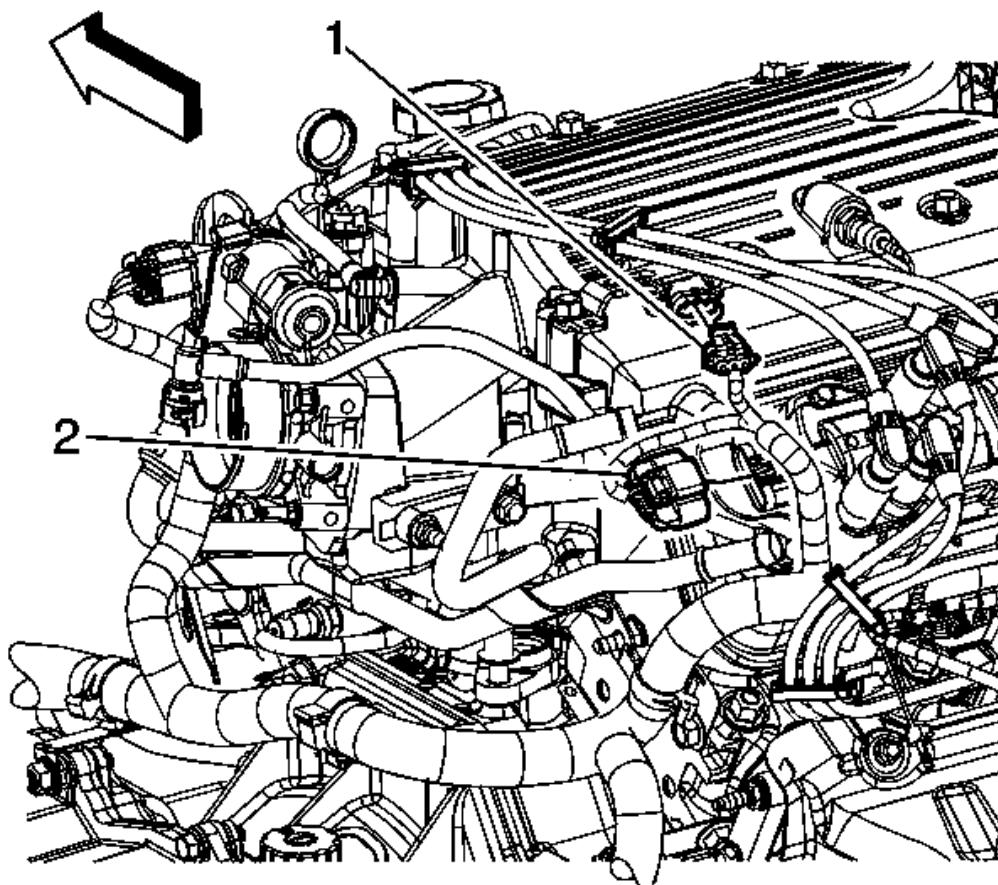


Fig. 82: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the engine wiring harness electrical connector (2) from the fuel injector inline electrical connector.

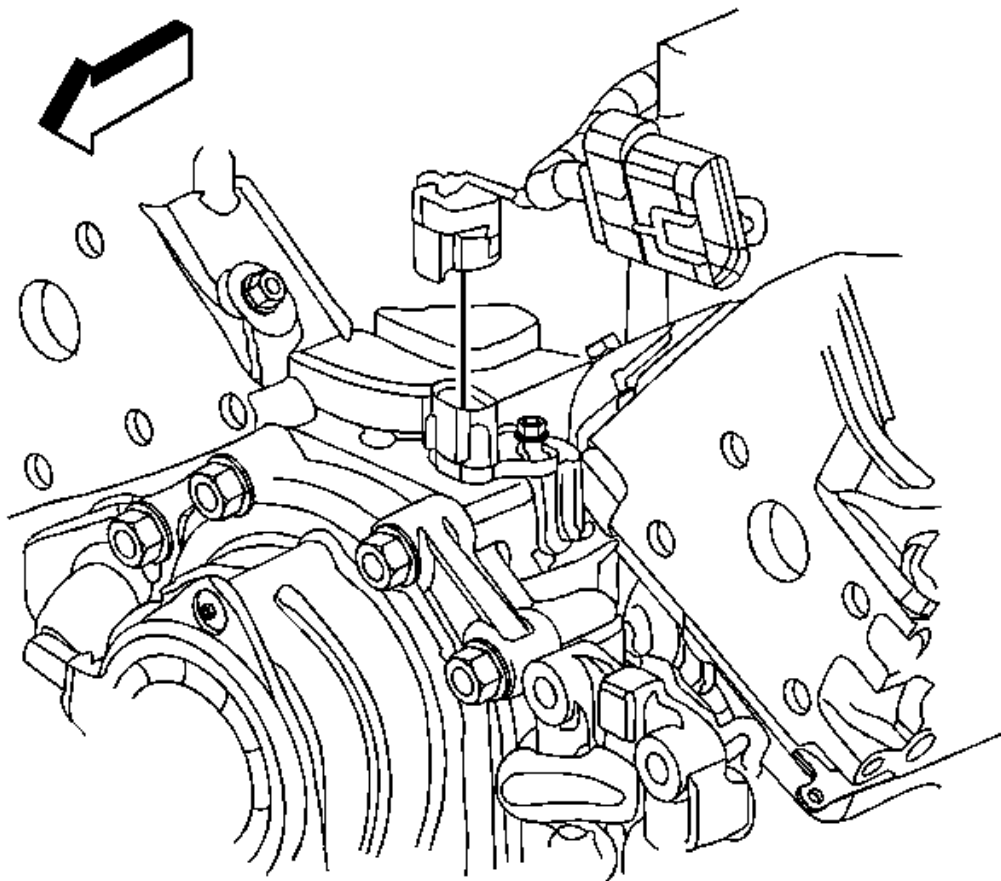


Fig. 83: View Of Fuel Injector Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the fuel injector wiring harness electrical connector from the camshaft position (CMP) sensor.

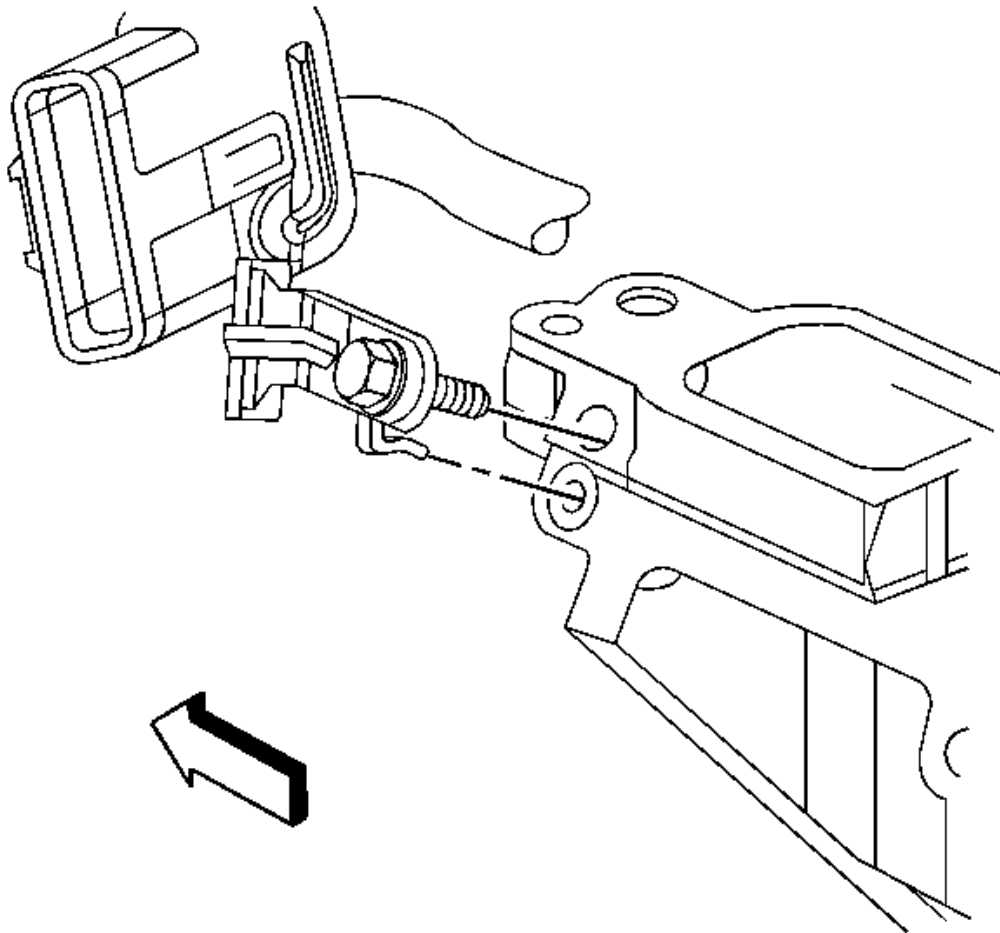


Fig. 84: Identifying Fuel Injector Wiring Harness Connector Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

8. Remove the fuel injector wiring harness connector bracket bolt from the intake manifold.

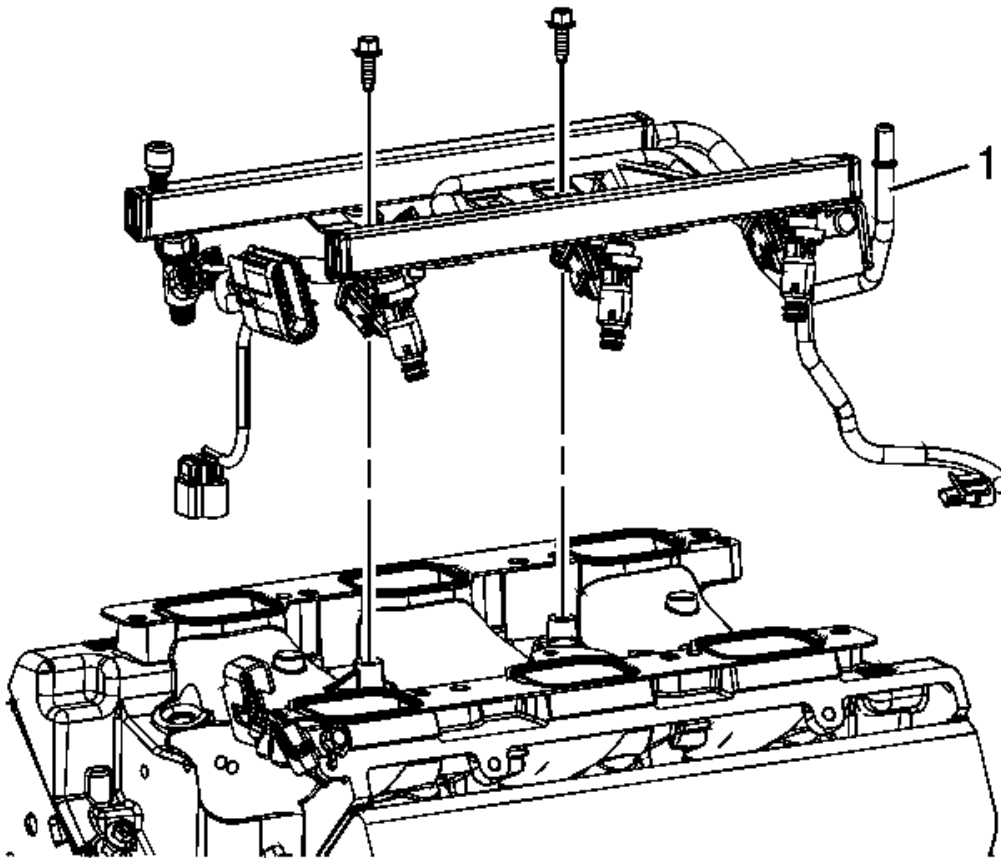


Fig. 85: Identifying Fuel Rail

Courtesy of GENERAL MOTORS CORP.

9. Remove the fuel rail bolts and rail (1).

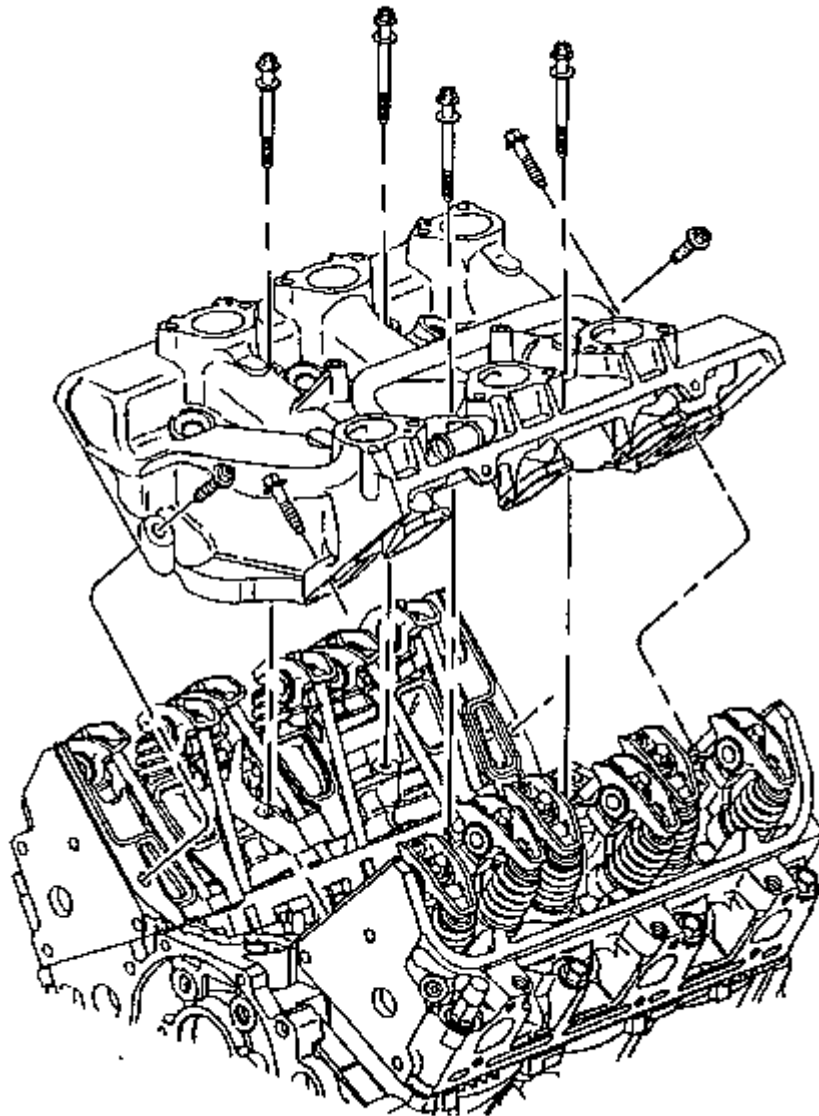


Fig. 86: View Of Lower Intake Manifold & Bolts
Courtesy of GENERAL MOTORS CORP.

10. Remove the lower intake manifold bolts.
11. Remove the lower intake manifold.

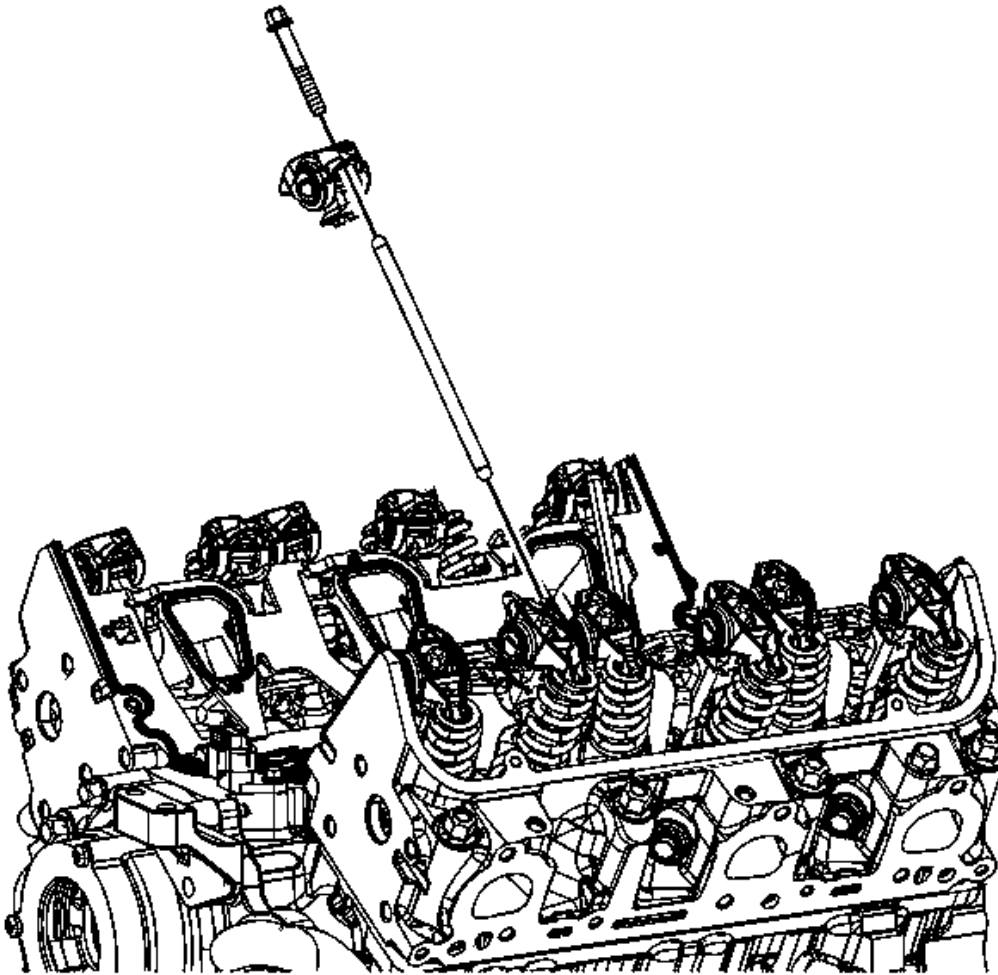


Fig. 87: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

12. Loosen the 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.

13. Remove the rocker arms.
14. 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).

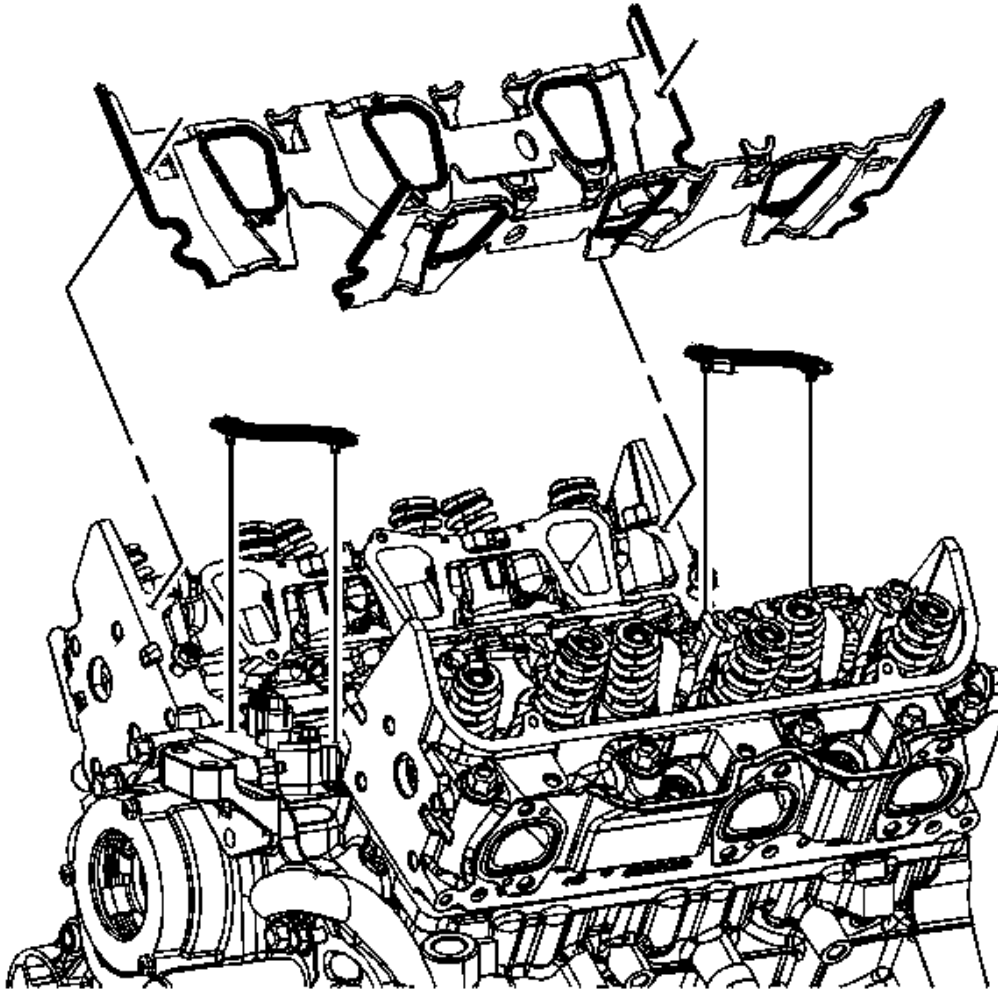


Fig. 88: Identifying Intake Manifold Gaskets & Seals
Courtesy of GENERAL MOTORS CORP.

15. Remove the lower intake manifold gaskets and seals.
16. Clean the lower intake manifold gasket and seal surfaces on the cylinder heads and the engine block.
17. Clean the gasket and seal surfaces on the lower intake manifold with degreaser.
18. 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 .

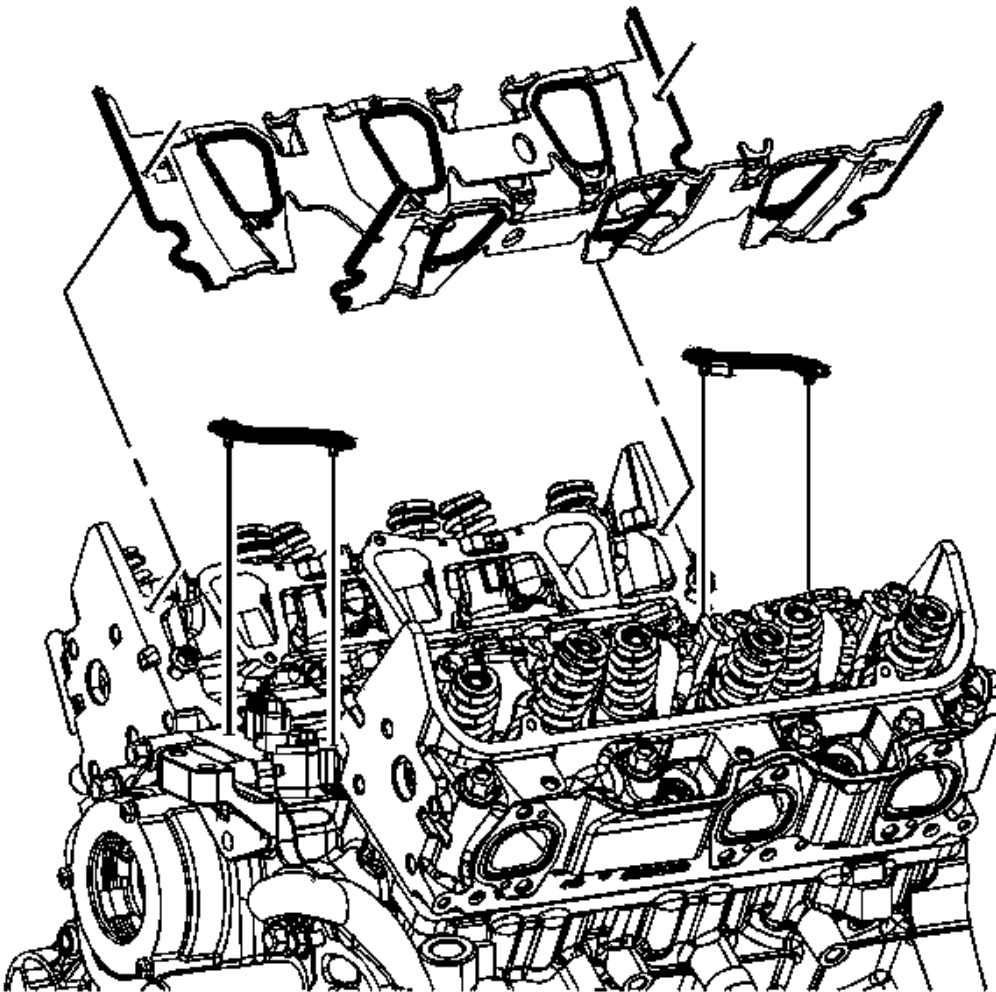


Fig. 89: Identifying Intake Manifold Gaskets & Seals
Courtesy of GENERAL MOTORS CORP.

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

1. Install the lower intake manifold gaskets and seals.

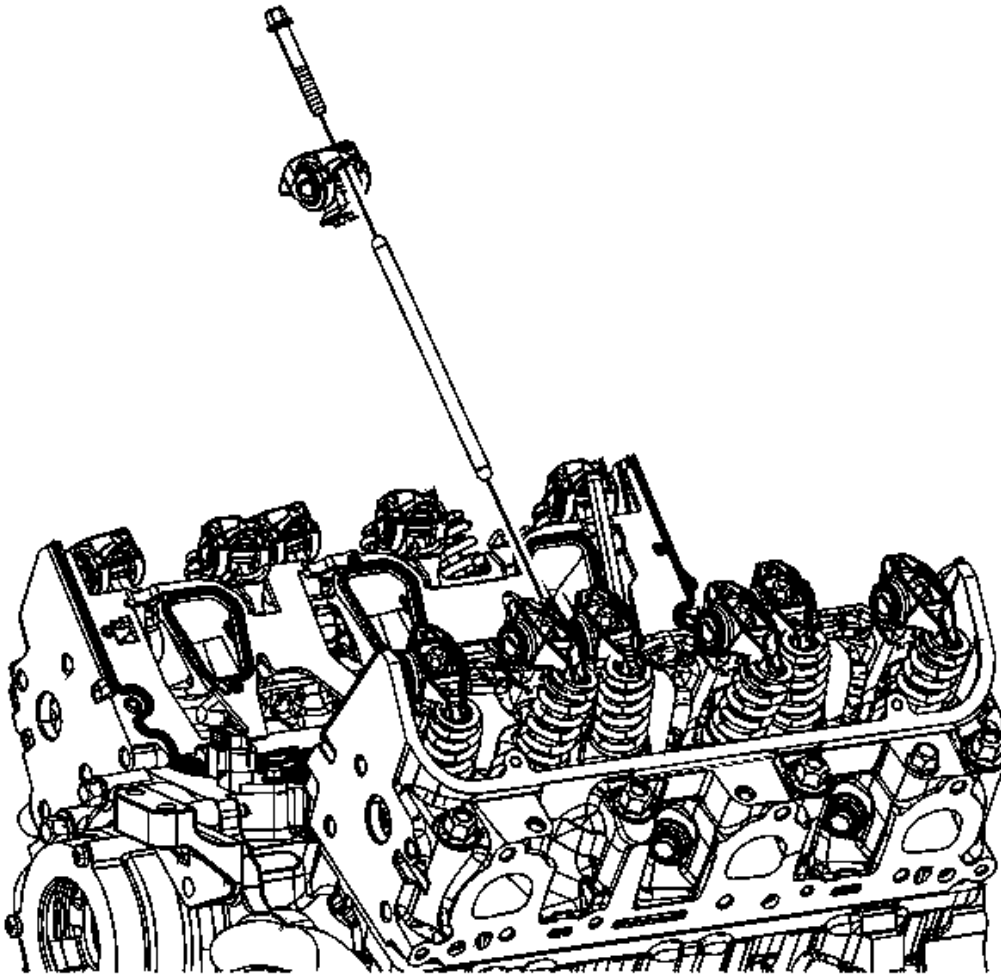


Fig. 90: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

2. Coat the ends of the push rods using prelube. Refer to Adhesives, Fluids, Lubricants, and Sealers .
3. Install push rods in their original location.
 - The intake pushrods are identified with yellow stripes.
 - The exhaust pushrods are identified with green stripes.
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.

5. Install the rocker arms in their original locations.

CAUTION: Refer to Fastener Caution .

6. Install the rocker arm bolts and tighten to 34 N.m (25 lb ft).

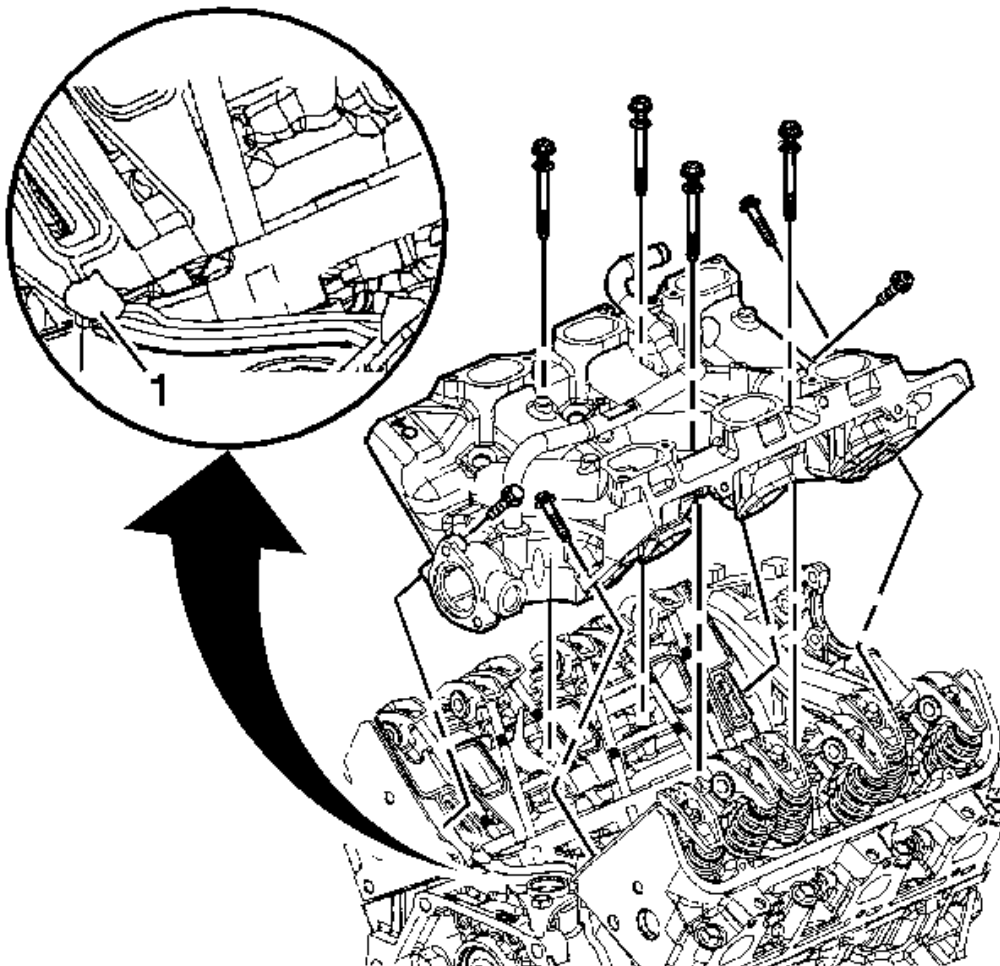


Fig. 91: View Of Lower Intake Manifold
Courtesy of GENERAL MOTORS CORP.

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 block joints (1). Refer to **Adhesives, Fluids, Lubricants, and Sealers** .
8. Install the lower intake manifold.

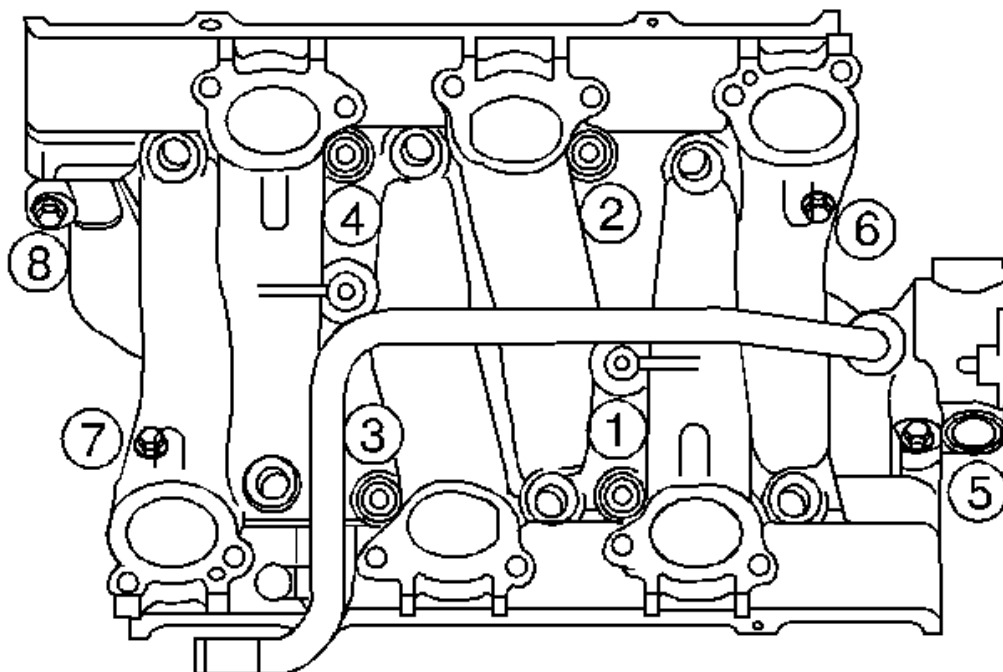


Fig. 92: Lower Intake Manifold Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

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).

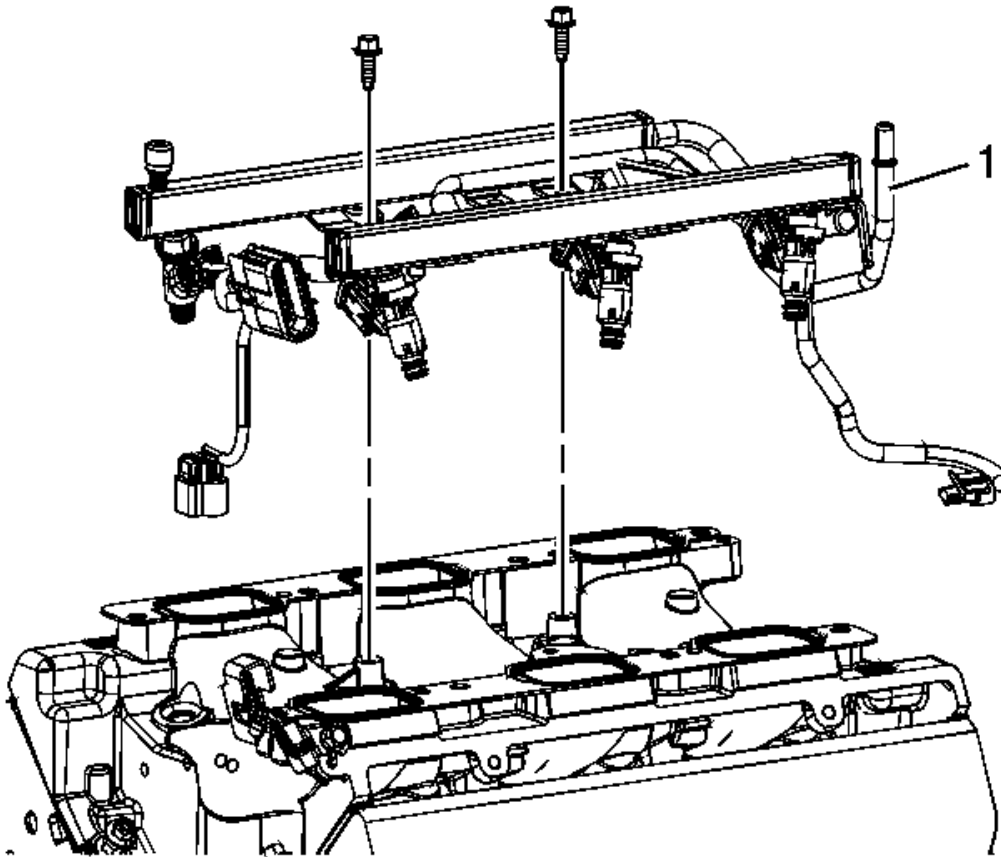


Fig. 93: Identifying Fuel Rail
Courtesy of GENERAL MOTORS CORP.

12. Inspect the fuel rail (1), fuel injectors for damage and replace as necessary.
13. Lubricate and install NEW injector lower O-rings seals onto the injectors. 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 injectors are fully seated.

16. Install the fuel injector rail bolts and tighten to 10 N.m (89 lb in).

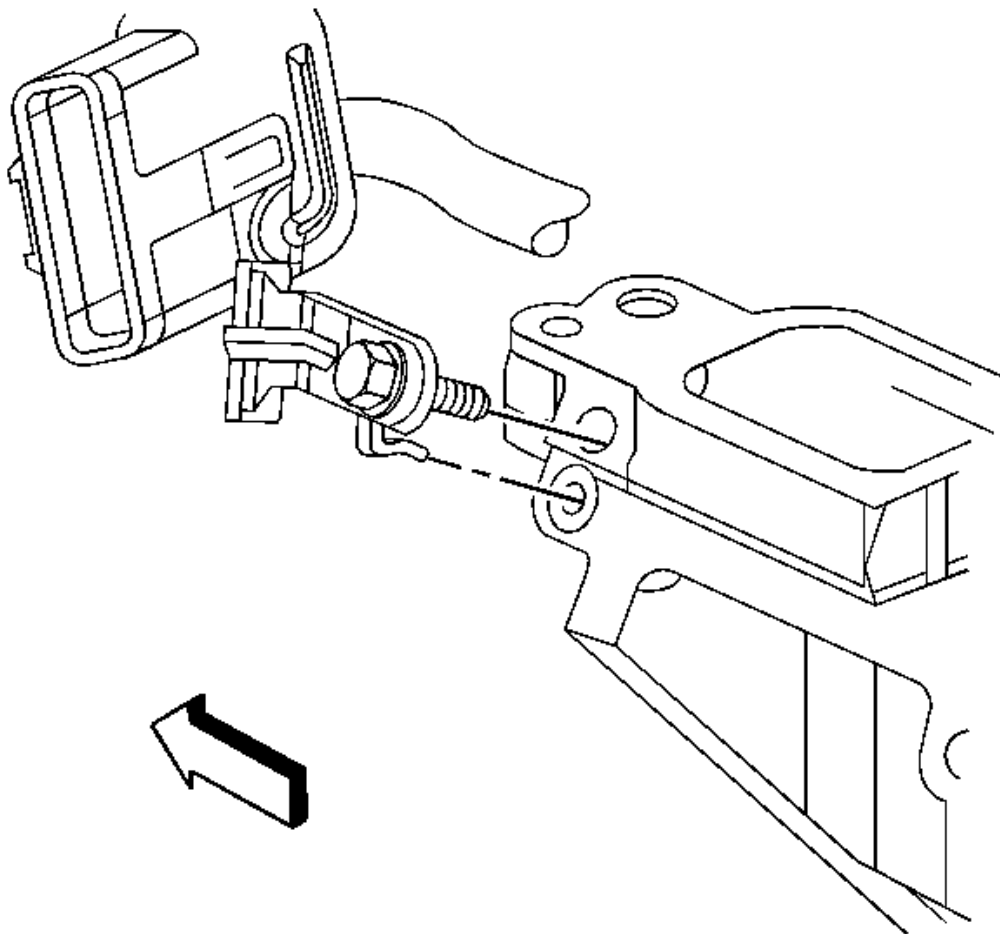


Fig. 94: Identifying Fuel Injector Wiring Harness Connector Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

17. Position the fuel injector wiring harness electrical connector bracket to the intake manifold and install the bolt. Tighten the bolt to 14 N.m (10 lb ft).

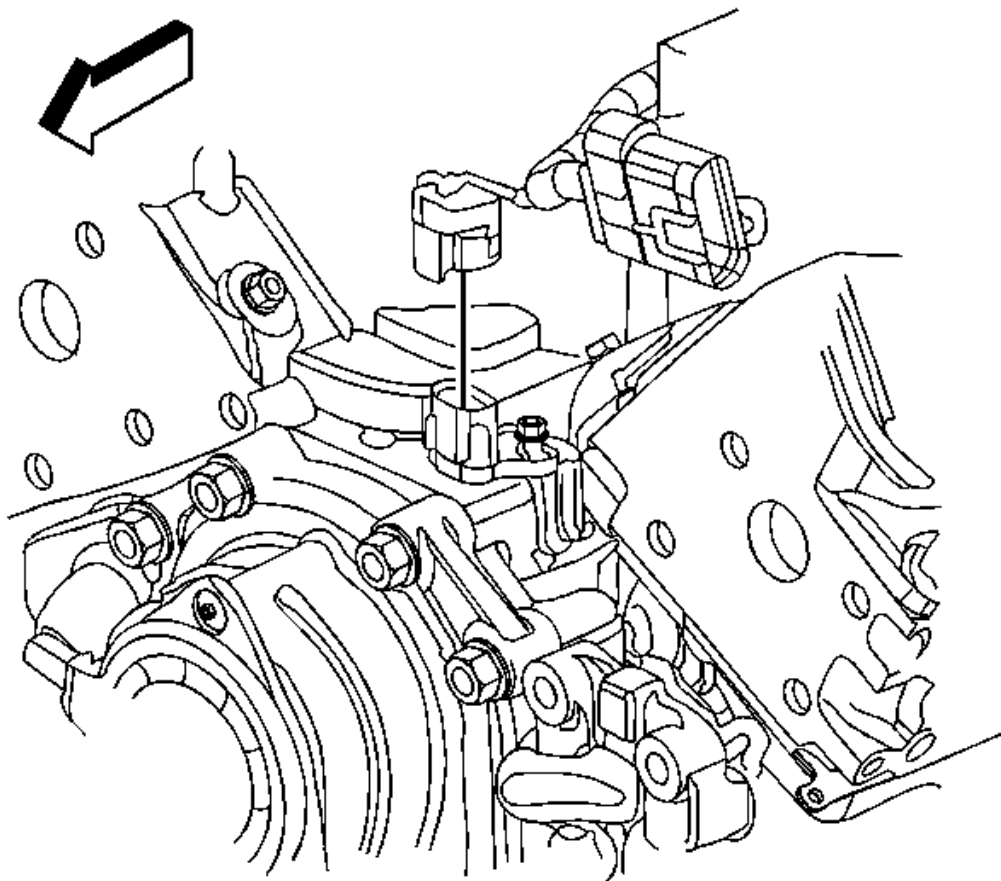


Fig. 95: View Of Fuel Injector Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

18. Connect the fuel injector wiring harness electrical connector to the CMP sensor.

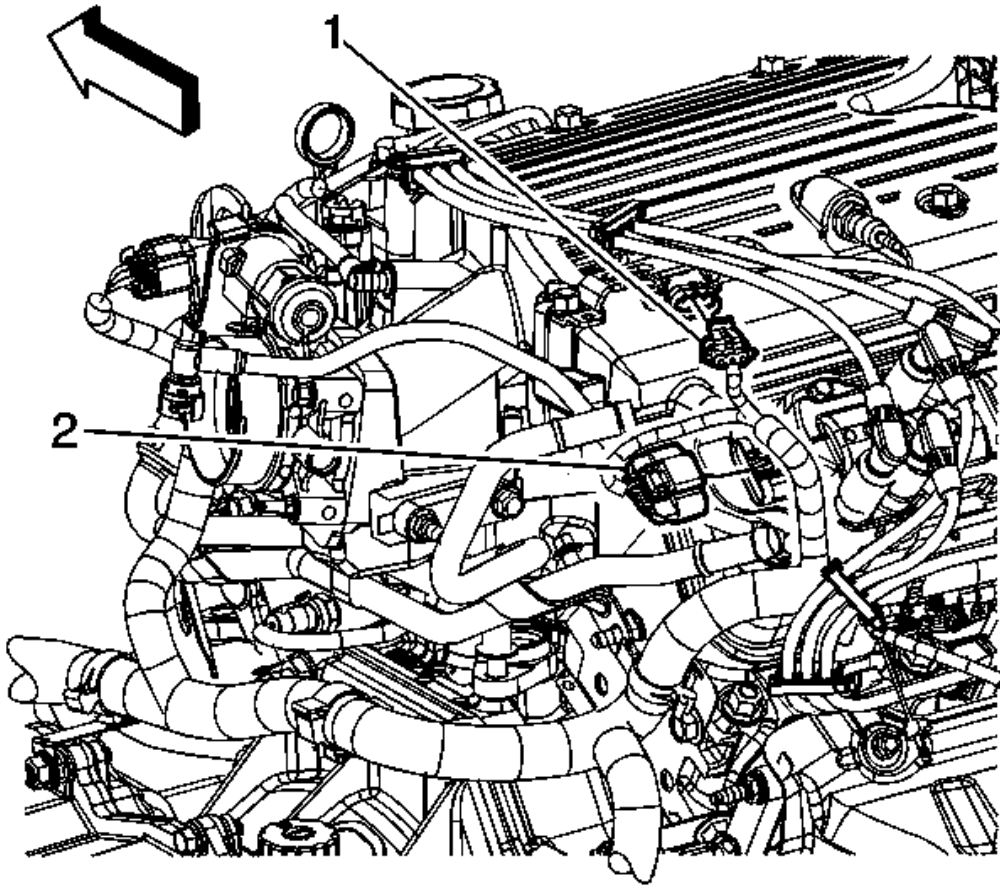


Fig. 96: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

19. Connect the engine wiring harness electrical connector (2) to the fuel injector inline electrical connector.

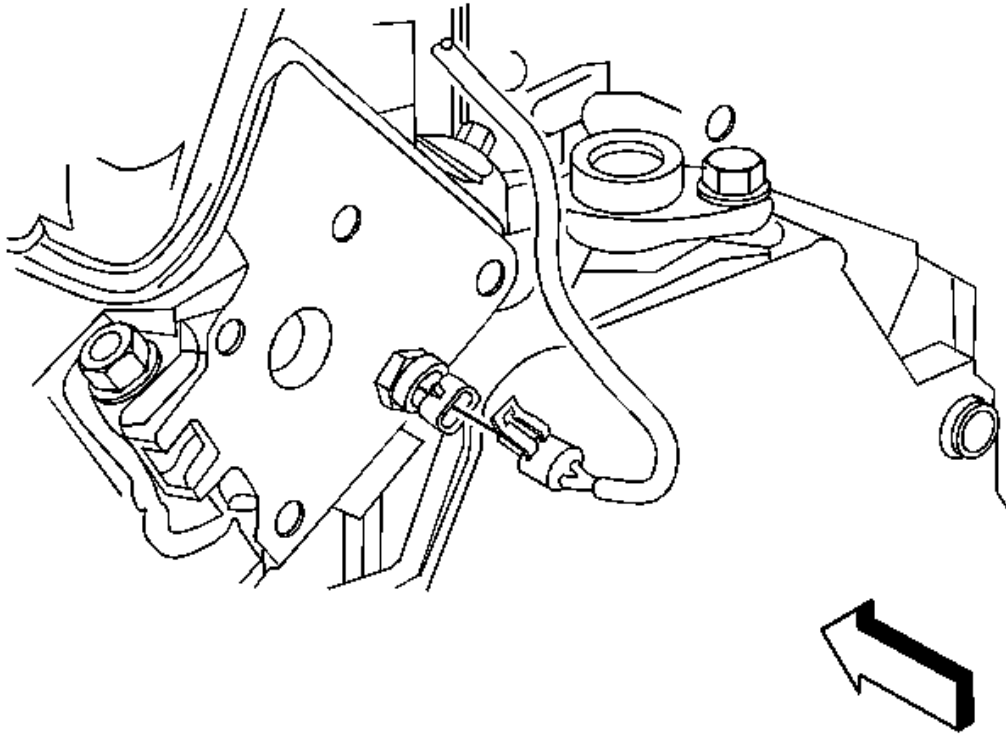


Fig. 97: View Of Upper Intake Manifold
Courtesy of GENERAL MOTORS CORP.

20. Connect the fuel injector wiring harness electrical connector to the ECT sensor.
21. Install the coolant crossover pipe. Refer to **Engine Coolant Crossover Pipe Replacement (LZ4)** .
22. Install the valve rocker arm covers. Refer to **Valve Rocker Arm Cover Replacement - Left Side** and **Valve Rocker Arm Cover Replacement - Right Side**.
23. Install the upper intake manifold. Refer to **Upper Intake Manifold Replacement**.
24. Fill the coolant system. refer to **Cooling System Draining and Filling (Static Fill-LY7, LZE, LZ4)** or **Cooling System Draining and Filling (GE 47716)**

VALVE ROCKER ARM COVER REPLACEMENT - LEFT SIDE

REMOVAL PROCEDURE

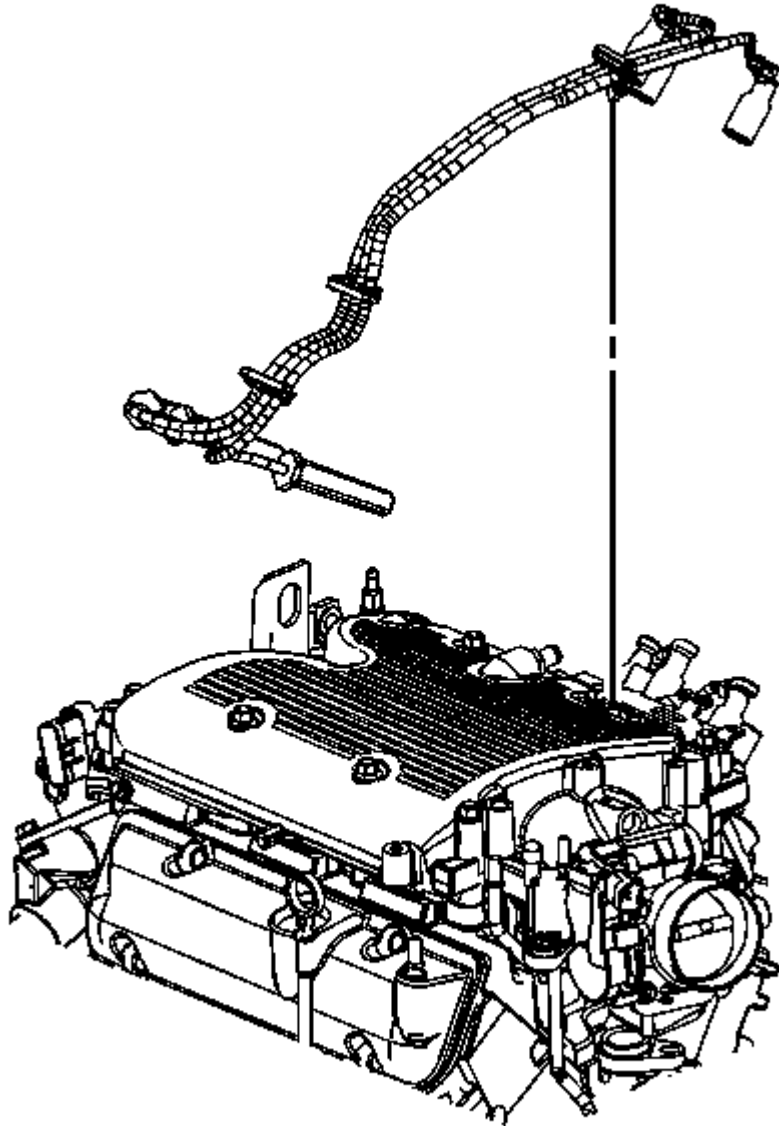


Fig. 98: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

1. Partially drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill-LY7, LZE, LZ4)** or **Cooling System Draining and Filling (GE 47716)** .
2. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
3. Remove the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .

4. Disconnect the left side spark plug wires from the spark plugs.
5. Disengage the spark plug wire retainer clips from the heater inlet and outlet pipe bracket and the MAP sensor bracket.
6. Remove the heater inlet and outlet pipe. Refer to **Heater Inlet Hose/Pipe and Heater Outlet Hose/Pipe Replacement** .

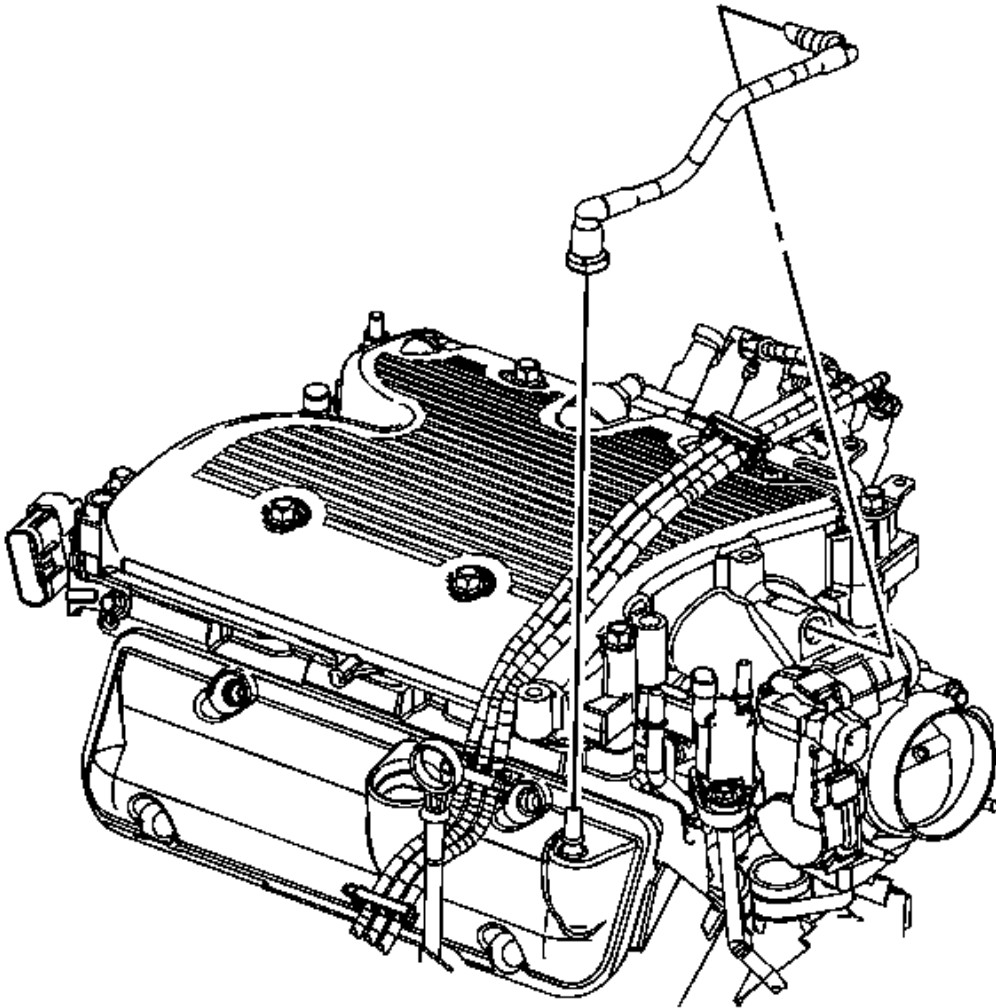


Fig. 99: View Of PCV Foul Air Tube Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the positive crankcase ventilation (PCV) foul air tube quick connect fitting from the PCV fitting. Refer to **Plastic Collar Quick Connect Fitting Service** .

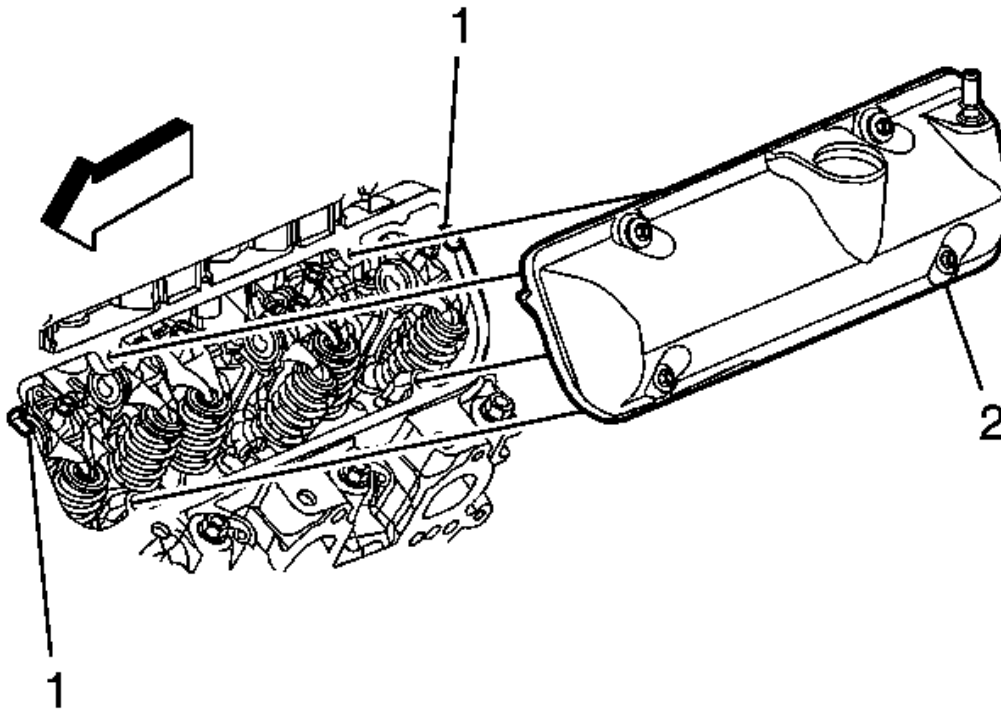


Fig. 100: Identifying Rocker Arm Cover Bolts
Courtesy of GENERAL MOTORS CORP.

8. Loosen the rocker arm cover bolts.

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

9. Remove the rocker arm cover (2). 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.
10. Cut the room temperature vulcanizing (RTV) sealer in the channel where the intake, cylinder head, and rocker cover meet with a suitable tool.
11. Remove the rocker arm cover gasket.

INSTALLATION PROCEDURE

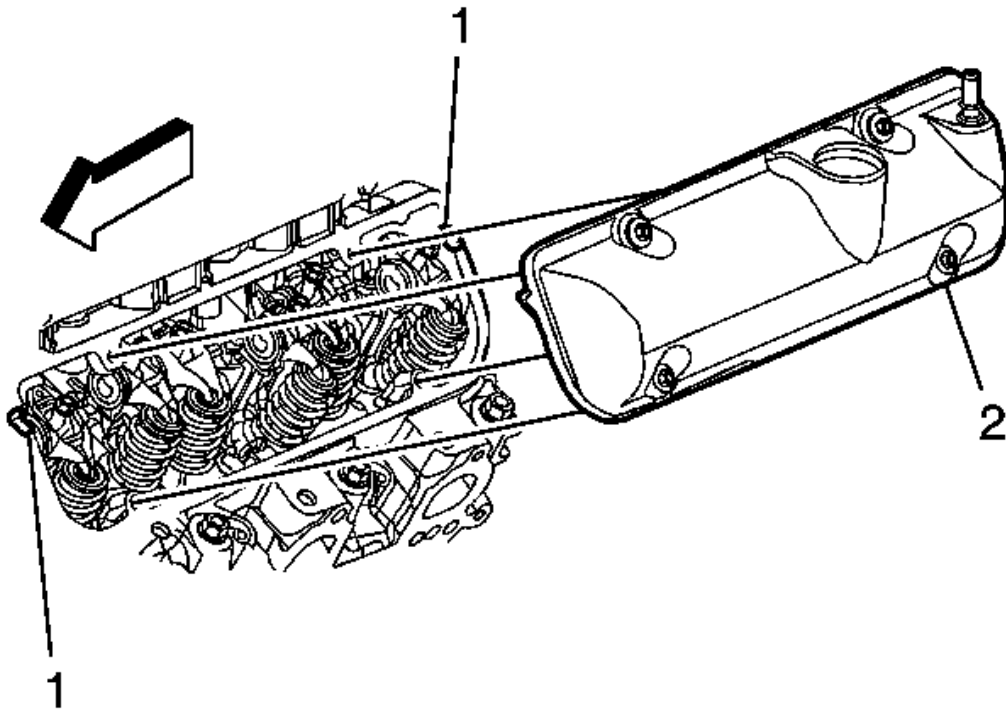


Fig. 101: Identifying Rocker Arm Cover Bolts
Courtesy of GENERAL MOTORS CORP.

1. All gasket mating surfaces need to be free of oil and foreign material.
2. Install the rocker arm cover gasket into the rocker arm cover.
3. Apply sealer to the surfaces where the cylinder head and the intake manifold meet (1). Refer to **Adhesives, Fluids, Lubricants, and Sealers** .
4. Place the rocker arm cover (2) onto the cylinder head.
5. Install the rocker arm cover bolts. Refer to **Valve Rocker Arm Cover Installation - Left Side** .

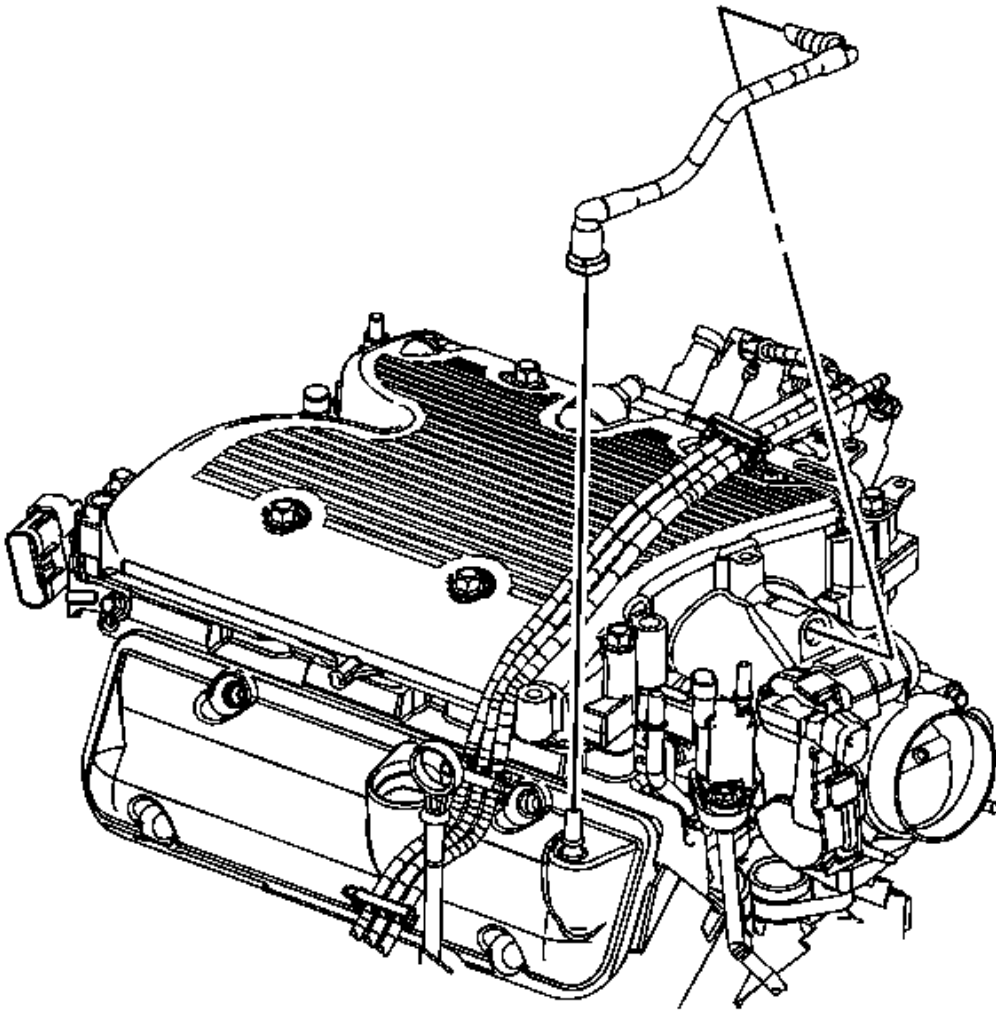


Fig. 102: View Of PCV Foul Air Tube Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

6. Connect the PCV foul air tube quick connect fitting to the PCV fitting. Refer to **Plastic Collar Quick Connect Fitting Service** .
7. Install the heater inlet and outlet pipe. Refer to **Heater Inlet Hose/Pipe and Heater Outlet Hose/Pipe Replacement** .

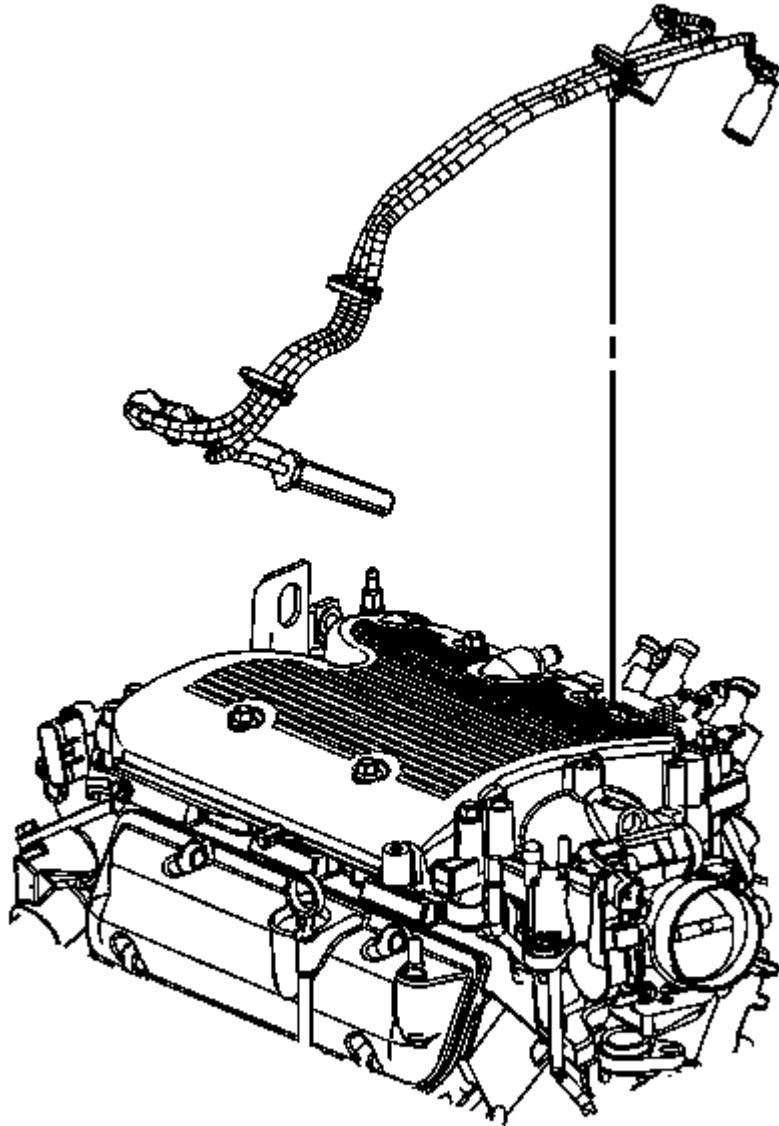


Fig. 103: View Of Left Side Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

8. Engage the spark plug wire retainer clips to the heater inlet and outlet pipe bracket and the MAP sensor bracket.
9. Connect the left side spark plug wires to the spark plugs.
10. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

11. Install the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#) .
12. Fill the cooling system. Refer to [Cooling System Draining and Filling \(Static Fill-LY7, LZE, LZ4\)](#) or [Cooling System Draining and Filling \(GE 47716\)](#) .

VALVE ROCKER ARM COVER REPLACEMENT - RIGHT SIDE

REMOVAL PROCEDURE

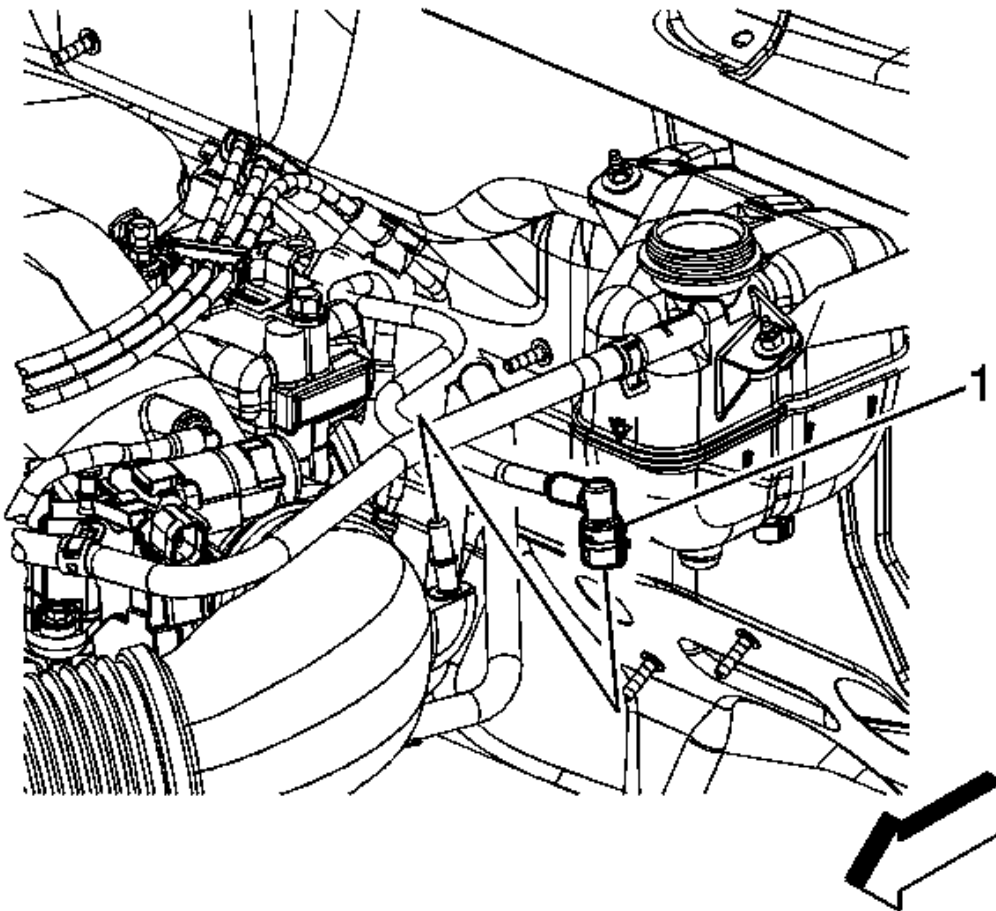


Fig. 104: Identifying PCV Fresh Air Tube (at Air Cleaner Outlet Duct)
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator. Refer to [Generator Replacement \(LZ4\)](#) .
2. Remove the engine coolant crossover pipe. Refer to [Engine Coolant Crossover Pipe Replacement \(LZ4\)](#) .

3. Disconnect the positive crankcase ventilation (PCV) fresh air tube (1) from the air cleaner outlet duct. Refer to **Plastic Collar Quick Connect Fitting Service**.

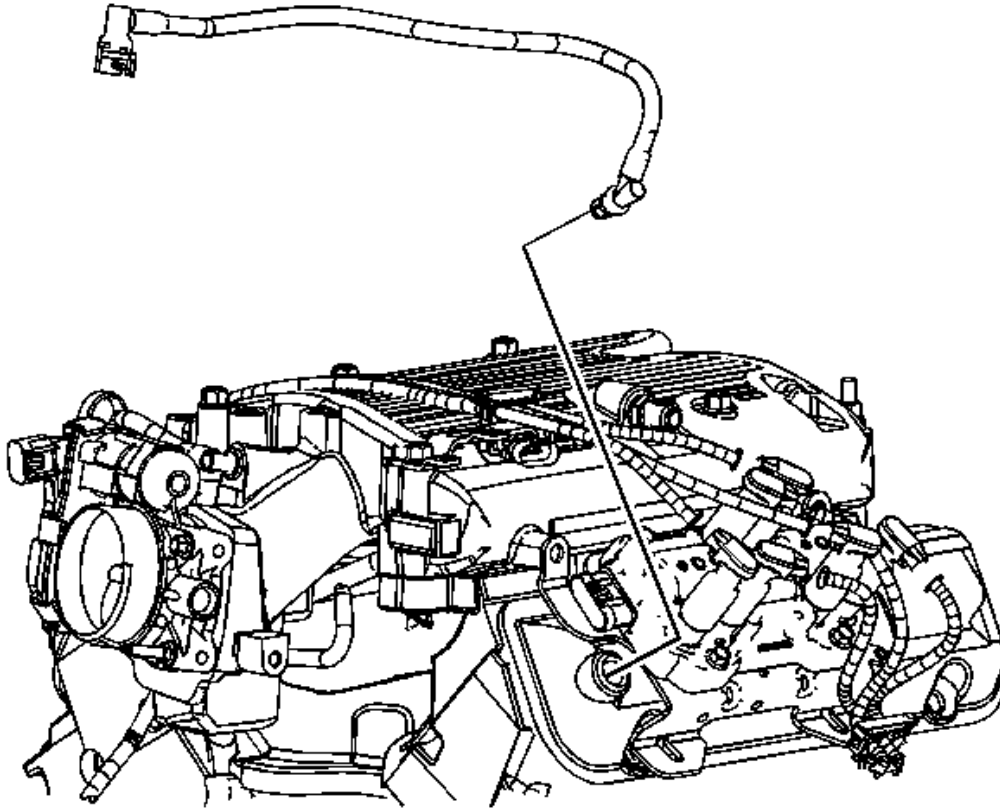


Fig. 105: Identifying Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

4. Remove the PCV fresh air tube from the right rocker arm cover.

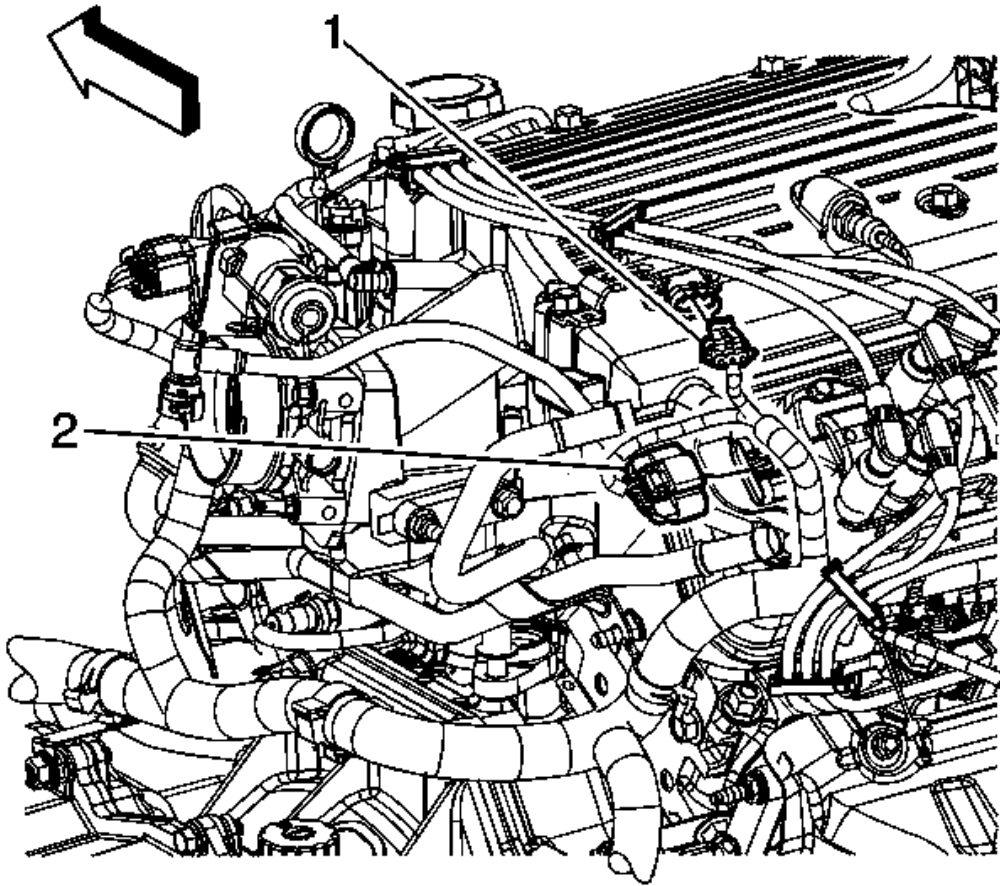


Fig. 106: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the engine wiring harness electrical connector (1) from the manifold absolute pressure (MAP) sensor.
6. Disconnect the engine wiring harness electrical connector (2) from the fuel injector wiring harness electrical connector.
7. Remove the ignition coil assembly. Refer to **Ignition Coil Replacement**

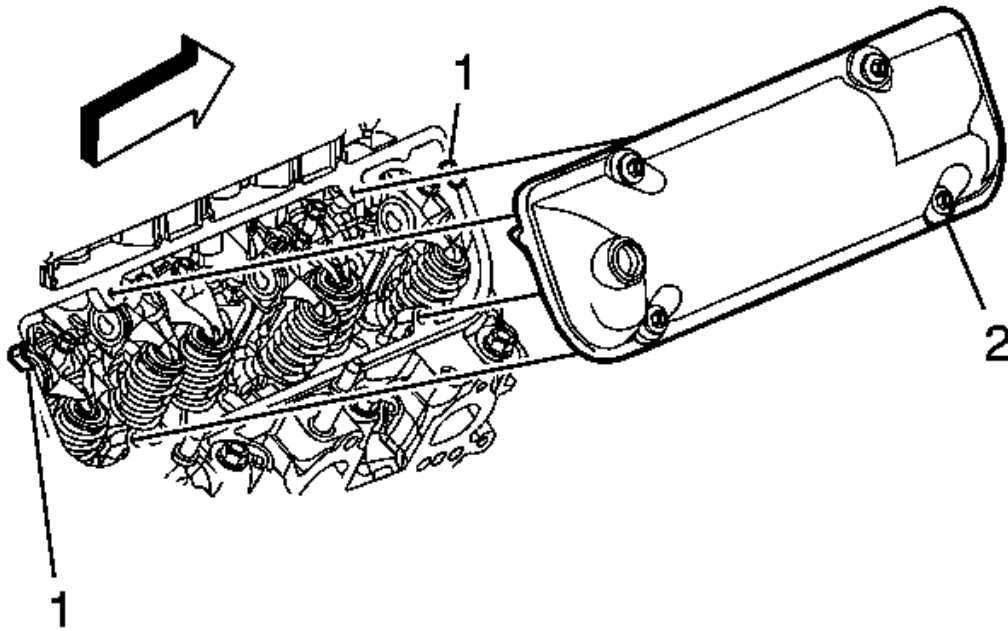


Fig. 107: Identifying Rocker Arm Cover & Bolts
 Courtesy of GENERAL MOTORS CORP.

8. Loosen the rocker arm cover bolts.

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

9. Remove the rocker arm cover (2). 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.
10. Cut the room temperature vulcanizing (RTV) sealer in the channel where the intake, cylinder head, and rocker cover meet with a suitable tool.
11. Remove the rocker arm cover gasket.

INSTALLATION PROCEDURE

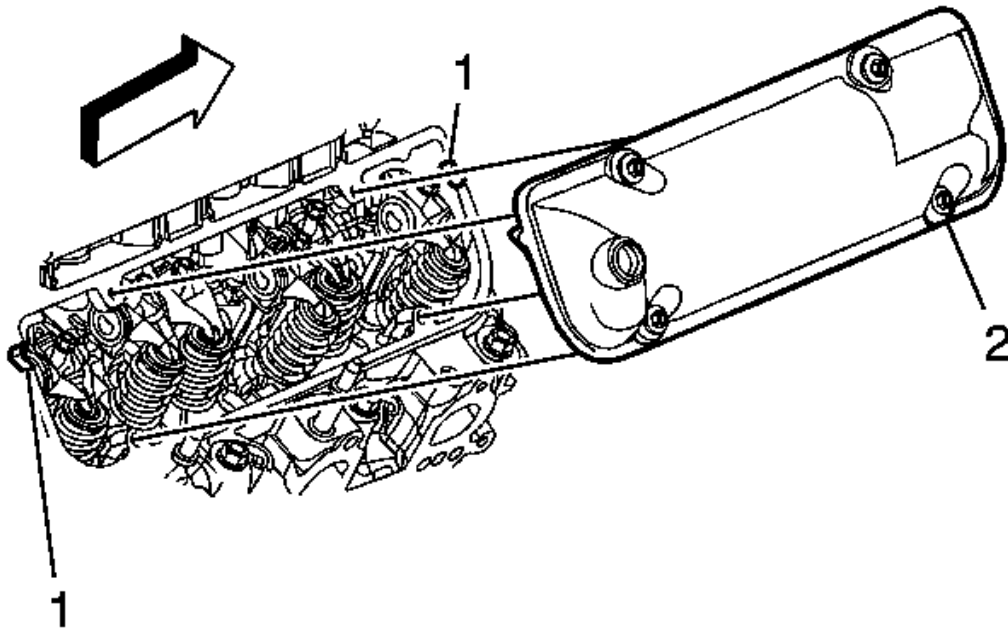


Fig. 108: Identifying Rocker Arm Cover & Bolts
Courtesy of GENERAL MOTORS CORP.

1. All gasket mating surfaces need to be free of oil and foreign material.
2. Install the rocker arm cover gasket into the rocker arm cover.
3. Apply sealer to the surfaces where the cylinder head and the intake manifold meet (1). Refer to **Adhesives, Fluids, Lubricants, and Sealers** .
4. Place the rocker arm cover (2) onto the cylinder head.
5. Install the rocker arm cover bolts. Refer to **Valve Rocker Arm Cover Installation - Right Side** .
6. Install the ignition coil assembly. Refer to **Ignition Coil Replacement** .

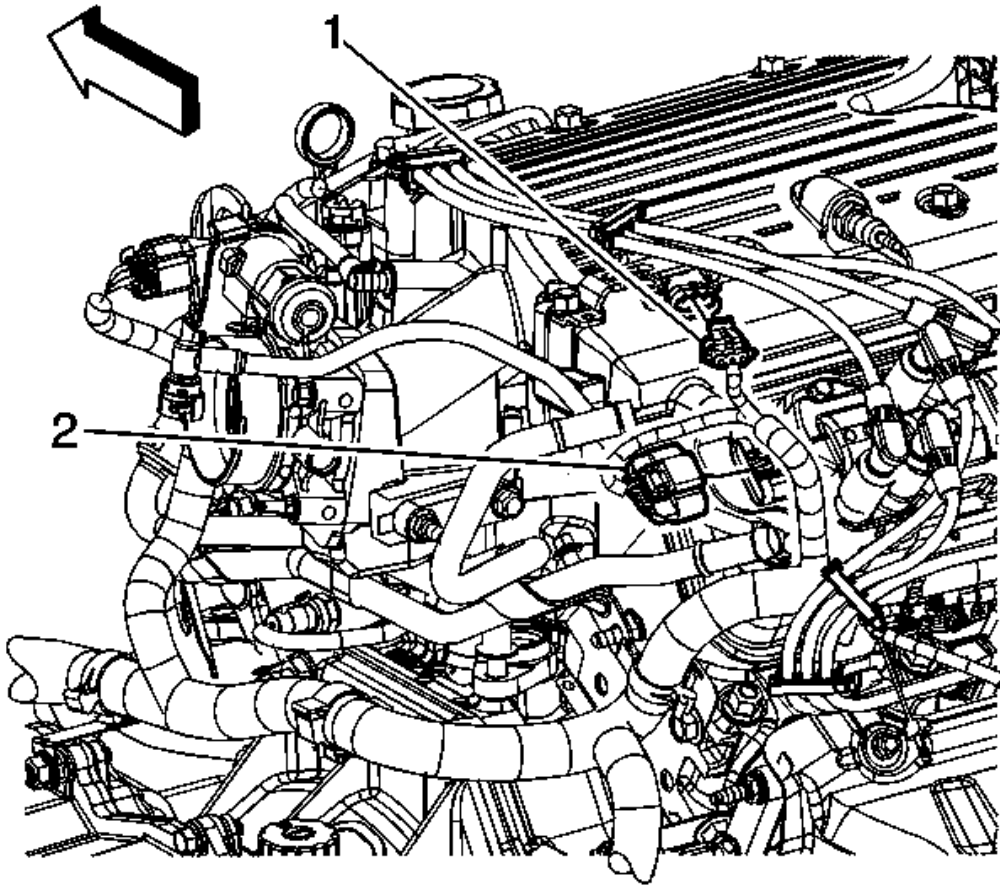


Fig. 109: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

7. Connect the engine wiring harness electrical connector (2) to the fuel injector wiring harness electrical connector.
8. Connect the engine wiring harness electrical connector (1) to the MAP sensor.

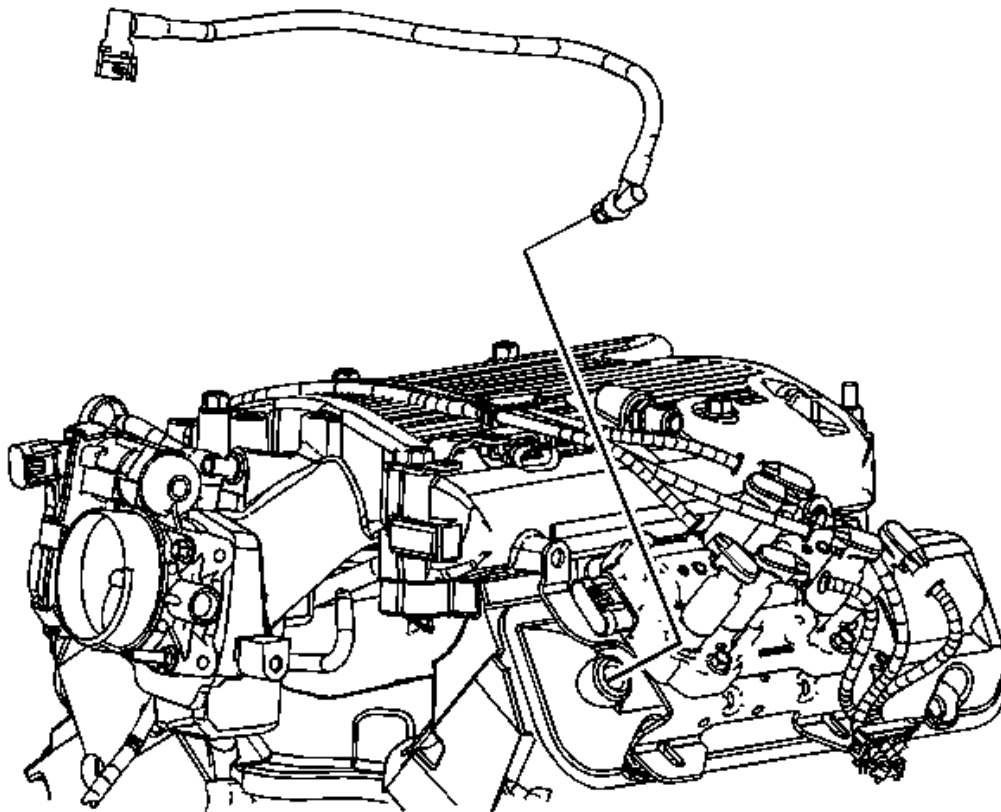


Fig. 110: Identifying Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

9. Install the PCV fresh air tube to the right rocker arm cover.

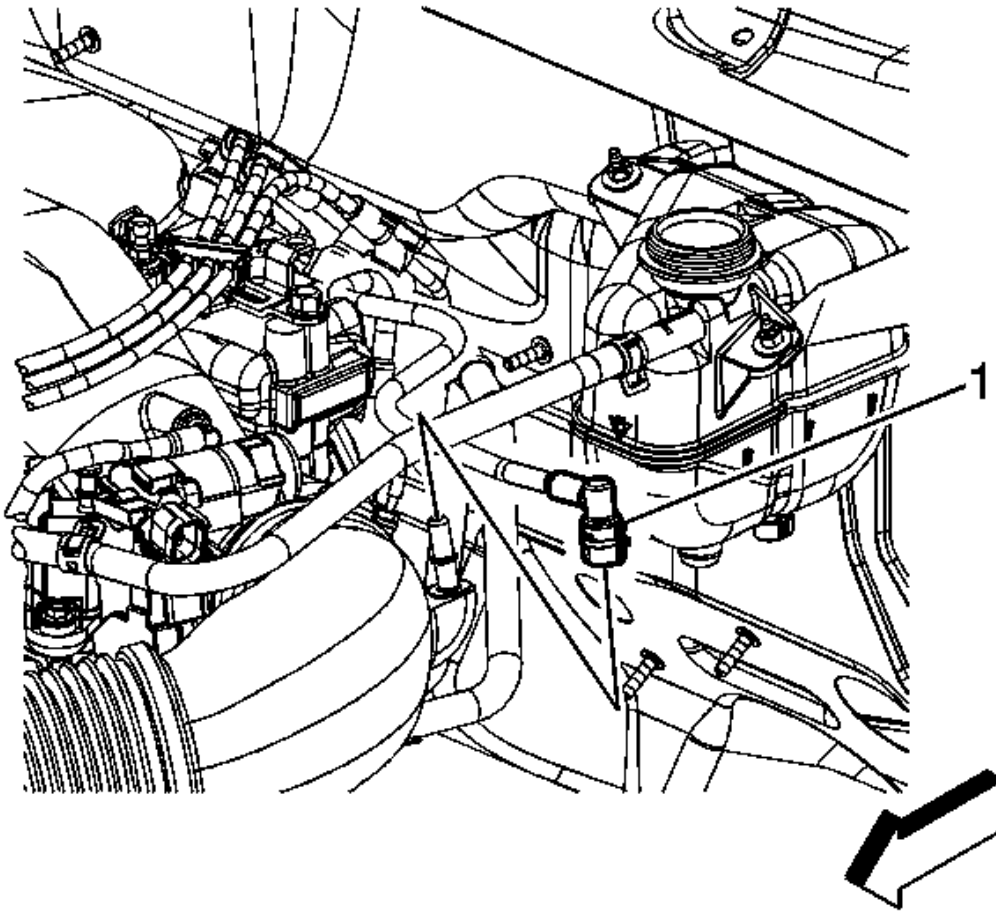


Fig. 111: Identifying PCV Fresh Air Tube (at Air Cleaner Outlet Duct)
Courtesy of GENERAL MOTORS CORP.

10. Connect the PCV fresh air tube (1) to the air cleaner outlet duct. Refer to **Plastic Collar Quick Connect Fitting Service** .
11. Install the engine coolant crossover pipe. Refer to **Engine Coolant Crossover Pipe Replacement (LZ4)** .
12. Install the generator. Refer to **Generator Replacement (LZ4)** .

VALVE ROCKER ARM AND PUSH ROD REPLACEMENT

REMOVAL PROCEDURE

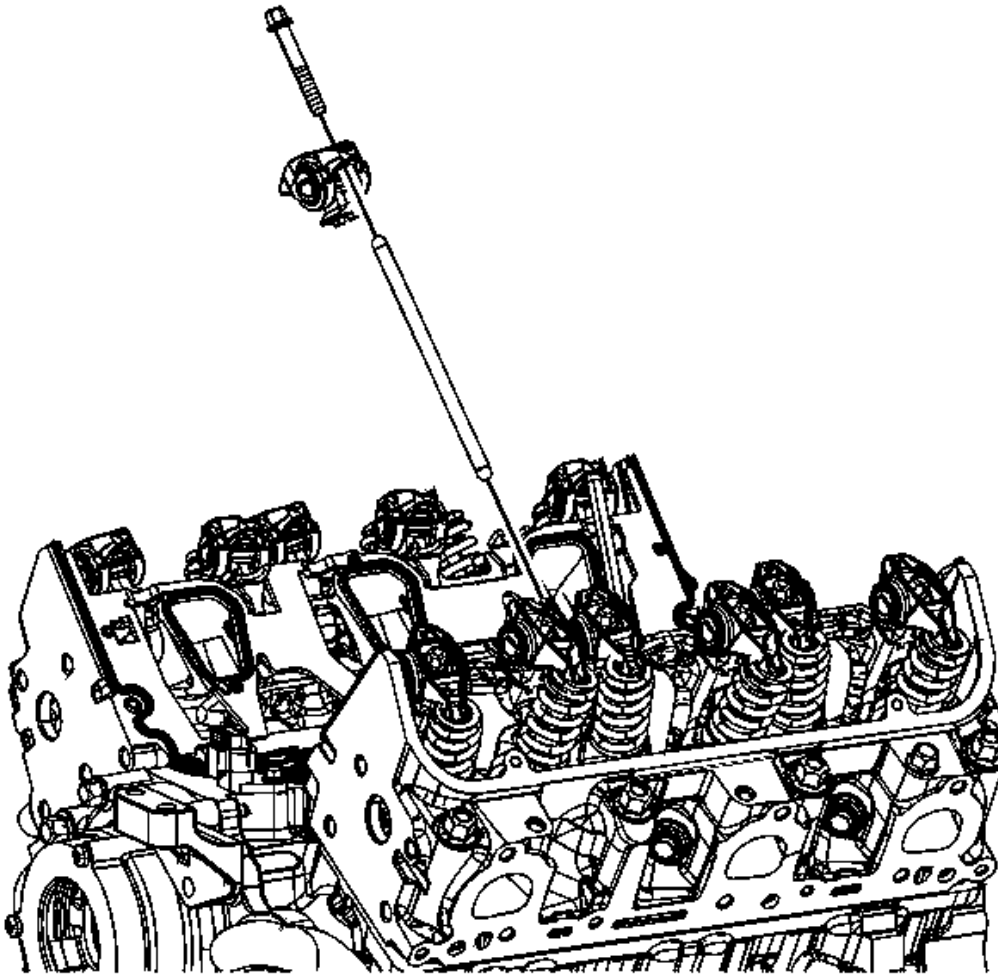


Fig. 112: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the valve rocker arm covers. Refer to **Valve Rocker Arm Cover Replacement - Left Side** or **Valve Rocker Arm Cover Replacement - Right Side**.
2. Remove the 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

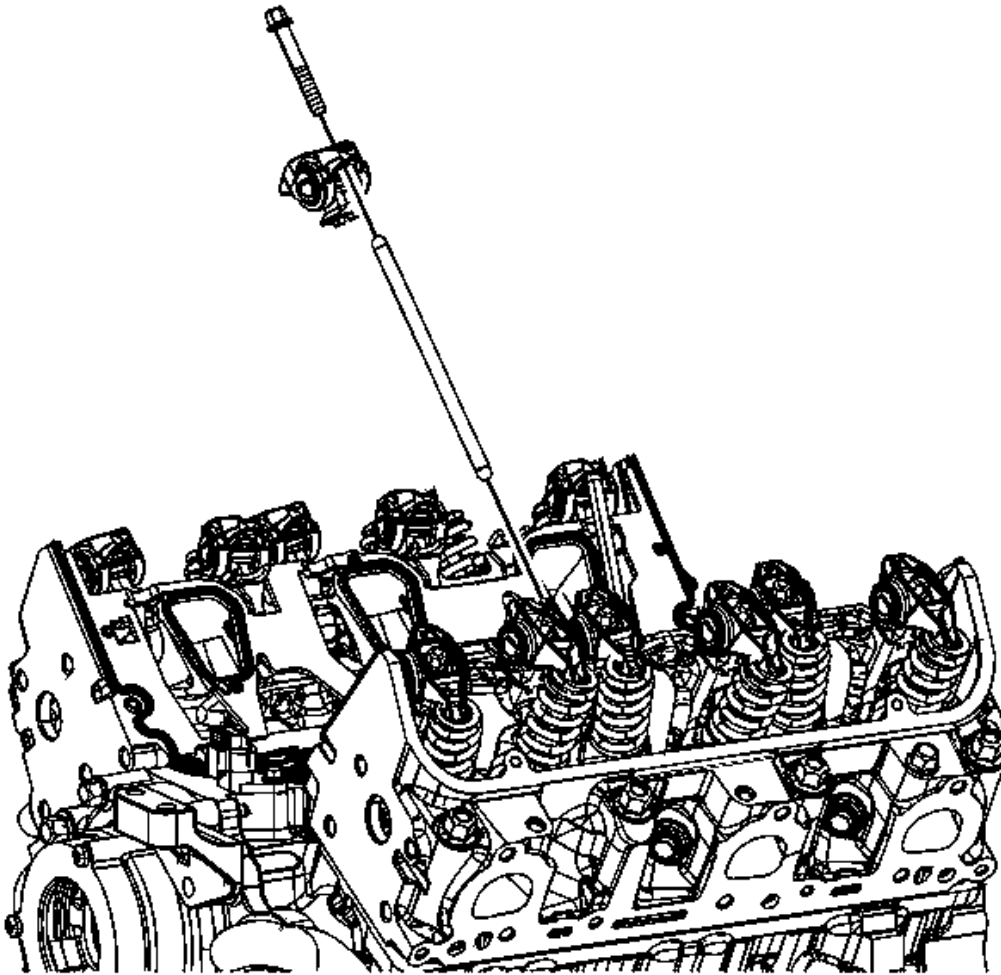


Fig. 113: Identifying Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Coat the ends of the pushrods using prelube. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .
2. Install the pushrods.
 - The intake pushrods are identified with yellow stripes.
 - The exhaust pushrods are identified with green stripes.
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** .
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 covers. 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.**

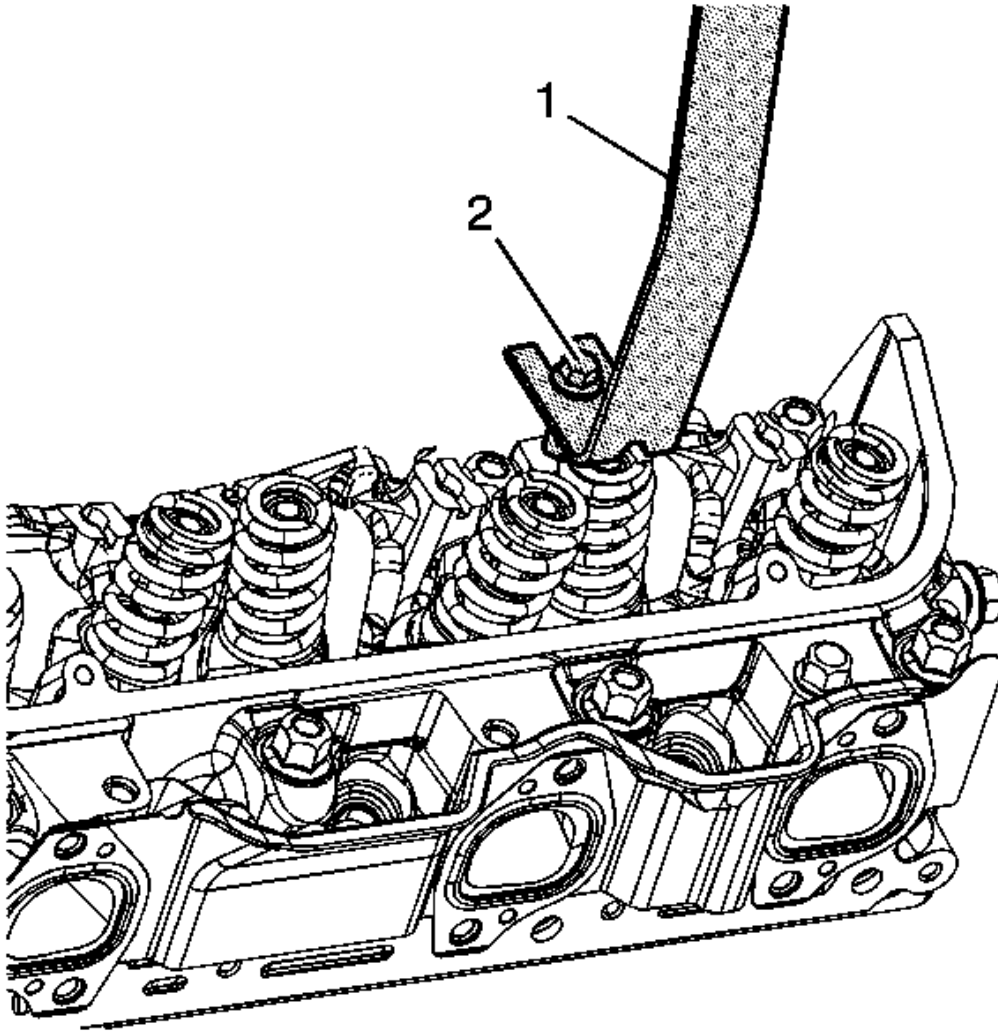


Fig. 114: Identifying Valve Spring Compressing Tools
Courtesy of GENERAL MOTORS CORP.

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. See **Special Tools**. Apply compressed air in order to hold the valve in place.
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**.

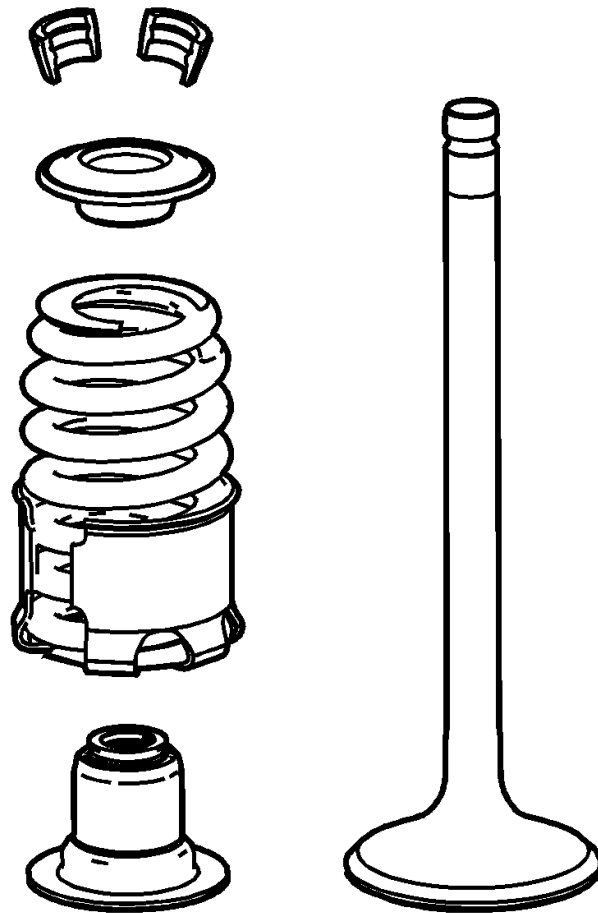


Fig. 115: Identifying Valve Components
Courtesy of GENERAL MOTORS CORP.

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

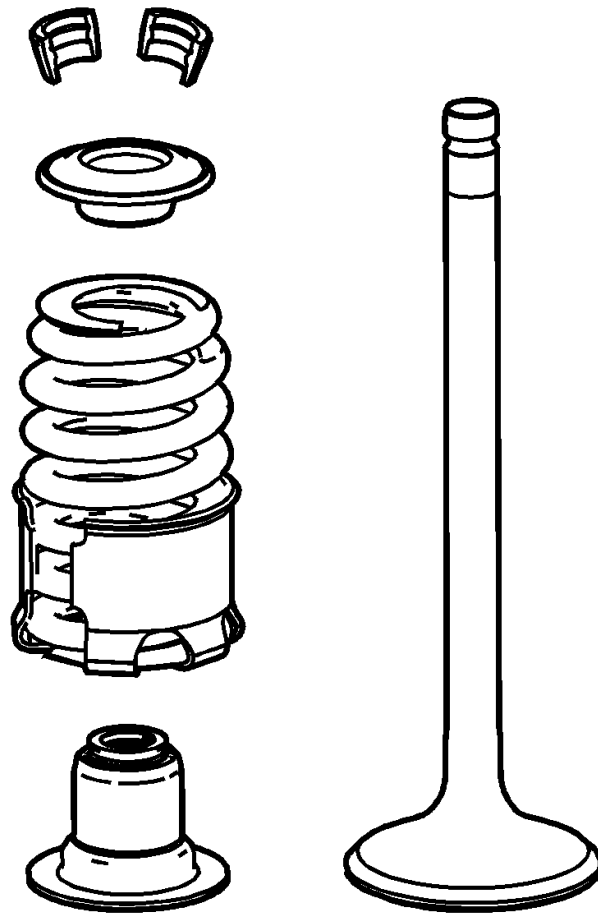


Fig. 116: Identifying Valve Components
Courtesy of GENERAL MOTORS CORP.

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.

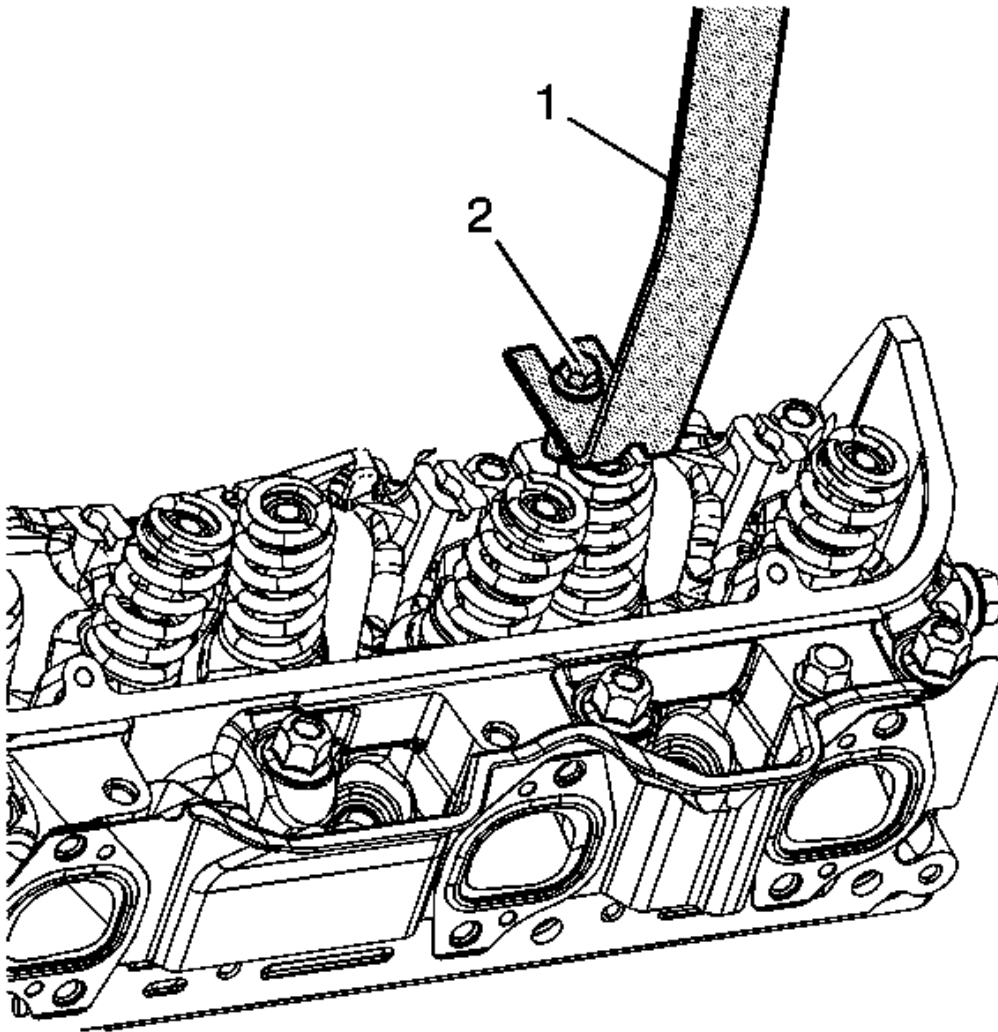


Fig. 117: Identifying Valve Spring Compressing Tools
Courtesy of GENERAL MOTORS CORP.

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

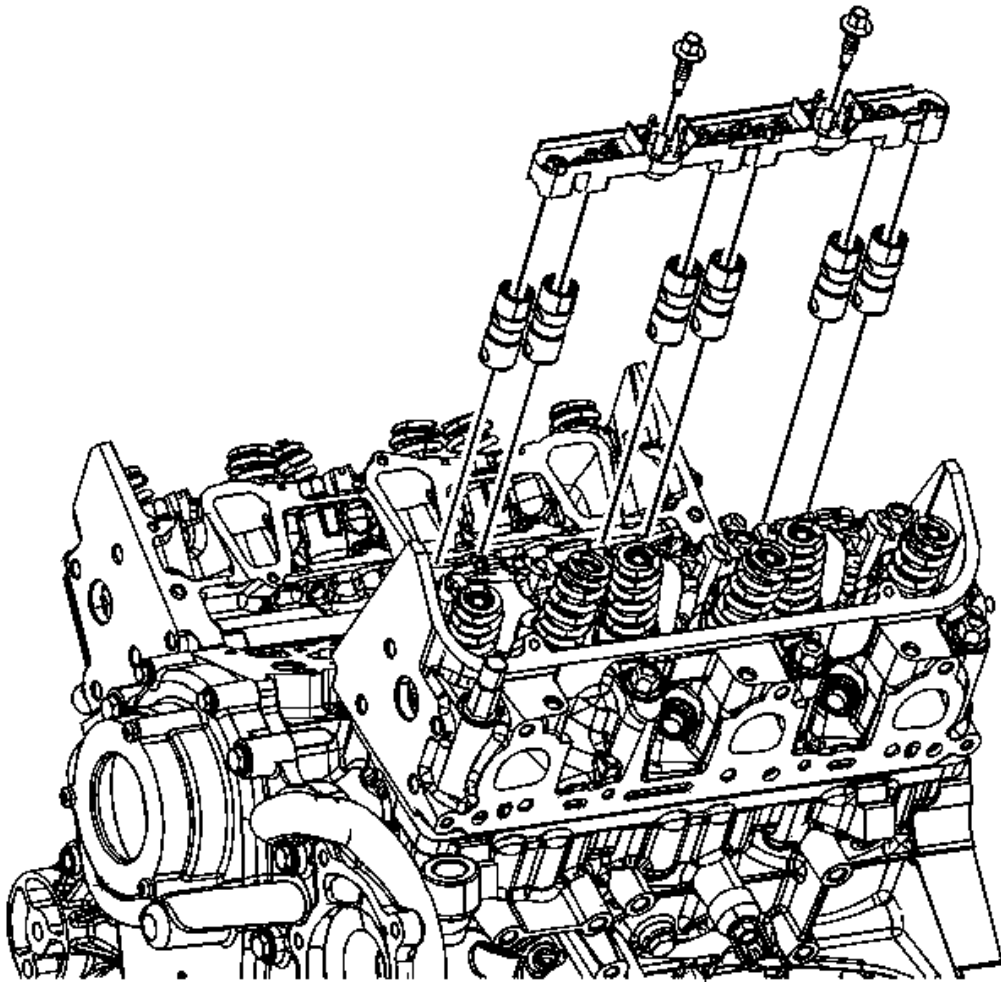


Fig. 118: View Of Valve Lifter Guides
Courtesy of GENERAL MOTORS CORP.

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**.
3. Remove the valve lifter guide bolts.
4. Remove the valve lifter guides.
5. Remove the valve lifters.

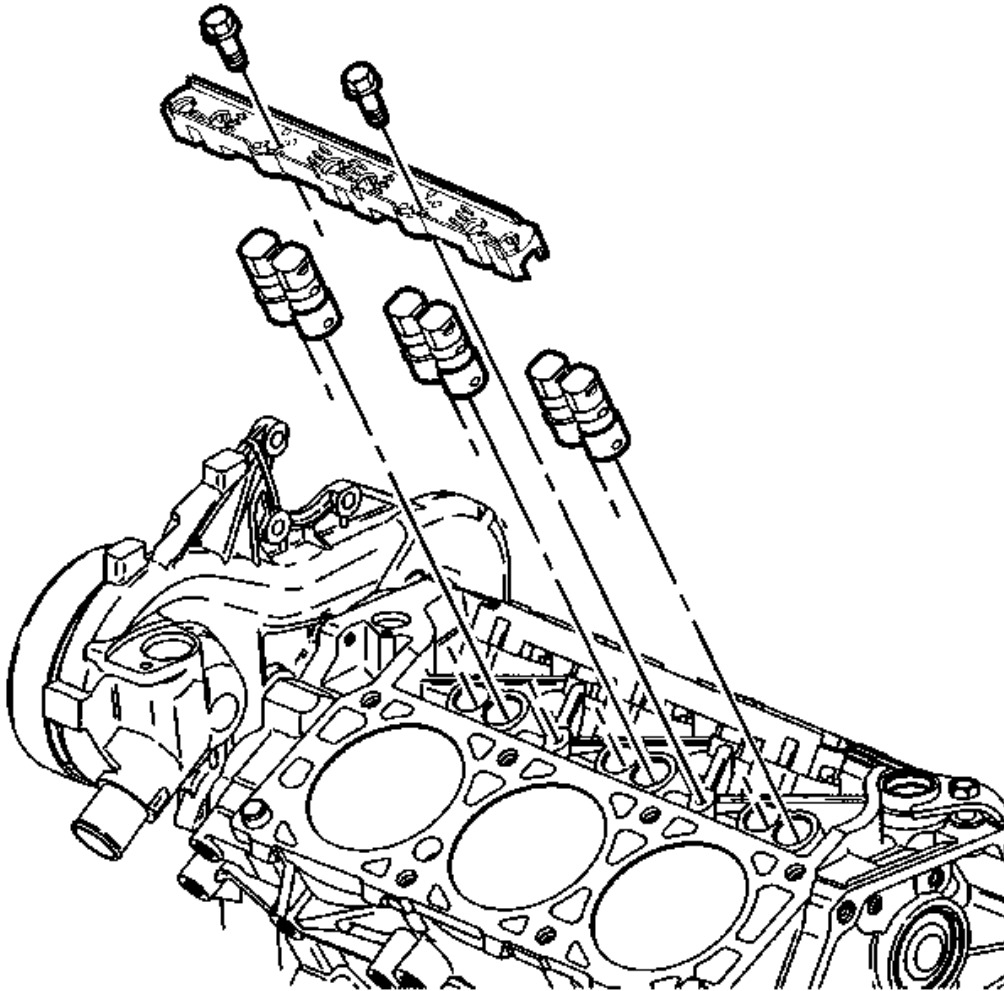
INSTALLATION PROCEDURE

Fig. 119: View Of Valve Lifters & Lifter Guides
Courtesy of GENERAL MOTORS CORP.

1. Coat the valve lifters with prelube. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .
2. Install the valve lifters.
3. Apply threadlock to the valve lifter guide bolt threads. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .

CAUTION: Refer to **Fastener Caution** .

4. Install the valve lifter guides and bolts.

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

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

CRANKSHAFT BALANCER REPLACEMENT

Special Tools

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

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 Radiator Air Side Baffle and Deflector Replacement .
5. Install the jack stands to the frame.
6. Loosen the left frame bolts and remove the right side frame bolts. Refer to Frame Replacement (3.5L) .
7. Using the jack stands, lower the right side of the frame to access the crankshaft balancer.
8. Remove the torque converter covers.
9. Install the **J 37096** and to the flywheel to prevent flywheel rotation. See Special Tools .

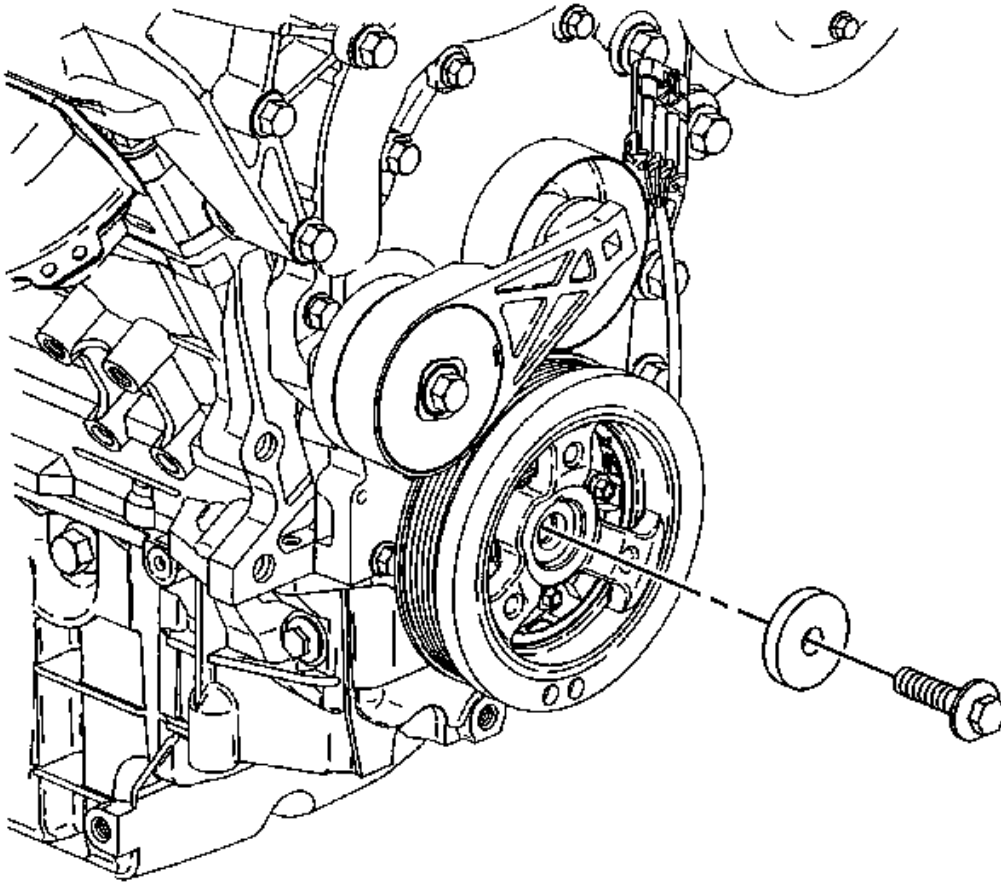


Fig. 120: Crankshaft Balancer Bolt & Washer
Courtesy of GENERAL MOTORS CORP.

10. Remove the crankshaft balancer bolt and the washer.

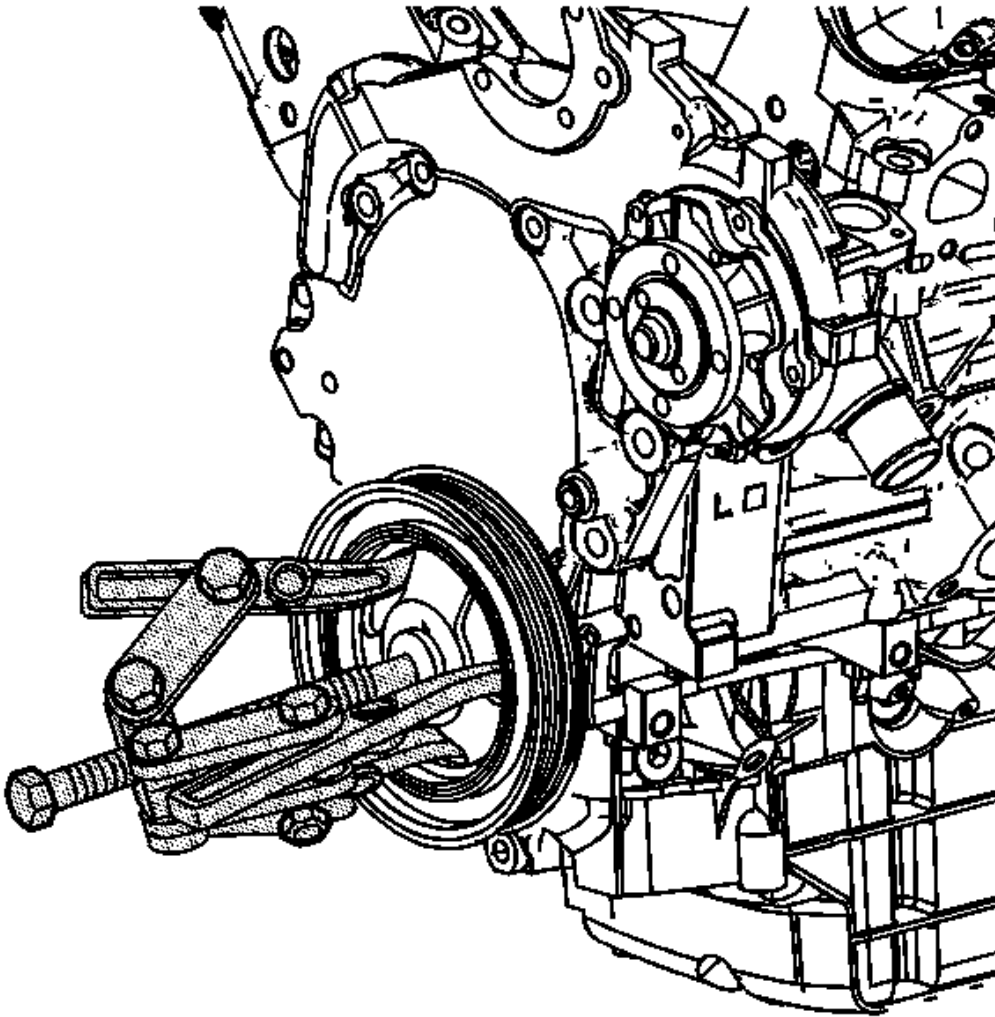


Fig. 121: View Of Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

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

INSTALLATION PROCEDURE

1. Apply sealant to the keyway of the balancer. Refer to **Adhesives, Fluids, Lubricants, and Sealers** for the correct part number.

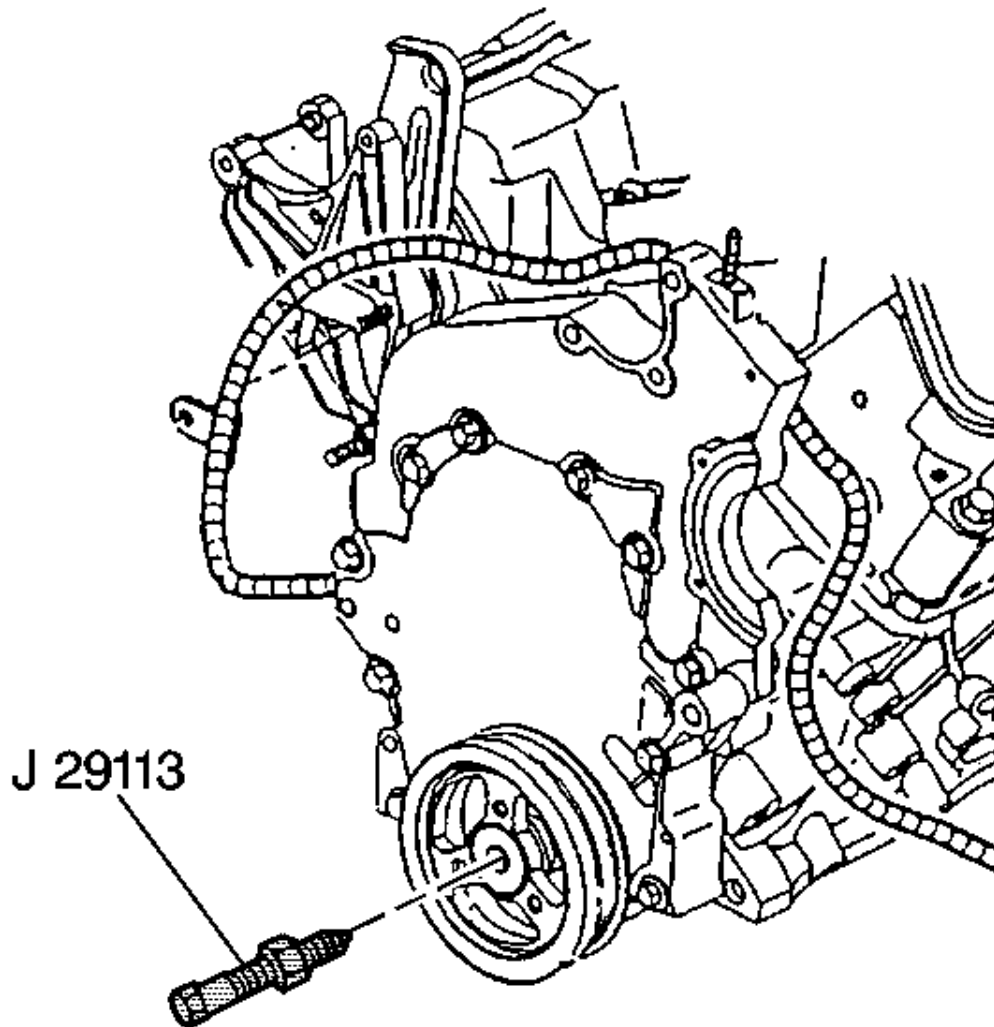


Fig. 122: Installing Crankshaft Balancer Using J 29113
Courtesy of GENERAL MOTORS CORP.

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.

2. Install the crankshaft balancer. Use the **J 29113** . See **Special Tools** .
3. Remove the **J 29113** . See **Special Tools** .

4. Install the **J 37096** to the flywheel to prevent flywheel rotation. See **Special Tools** .

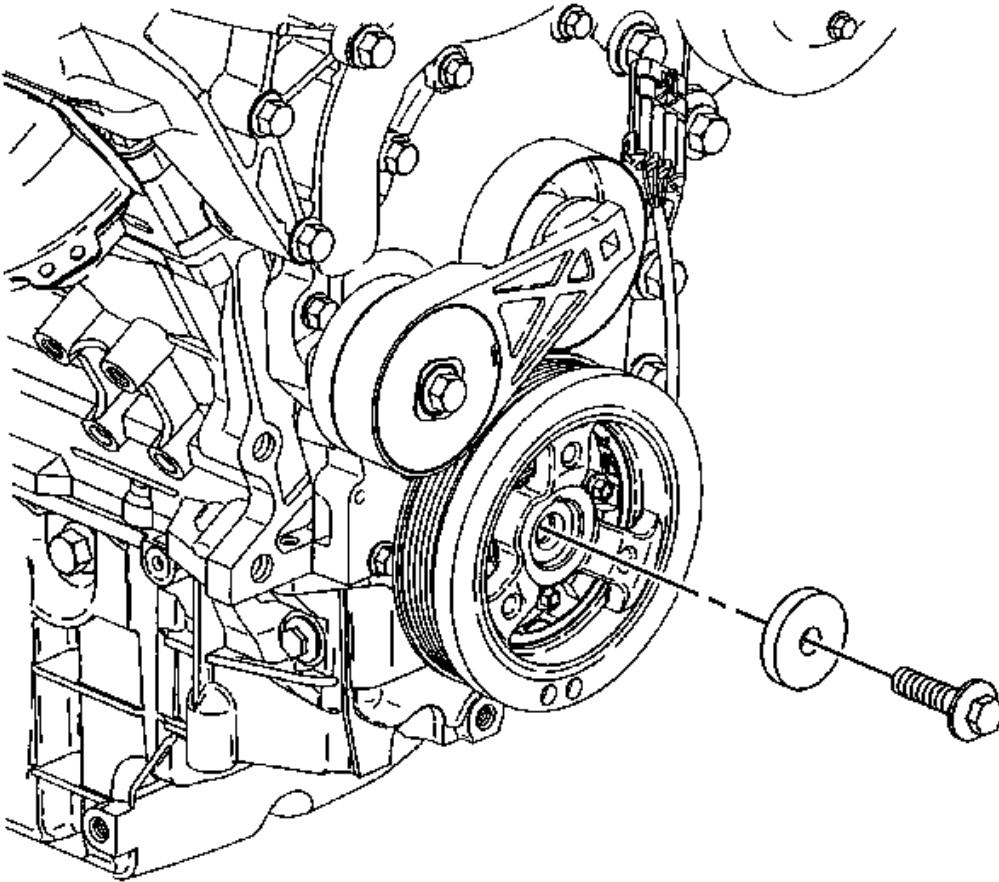


Fig. 123: Crankshaft Balancer Bolt & Washer
Courtesy of GENERAL MOTORS CORP.

5. Install the crankshaft balancer washer and the bolt.

CAUTION: Refer to **Fastener Caution** .

6. Install the used crankshaft balancer bolt.

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

7. Remove the used crankshaft balancer bolt.

8. 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** .
9. Remove the **J 37096** from the flywheel. See Special Tools .
 10. Install the torque converter covers.
 11. Raise the frame to the original position.
 12. Install and tighten the frame bolts. Refer to Frame Replacement (3.5L) .
 13. Install the right engine splash shield. Refer to Radiator Air Side Baffle and Deflector Replacement .
 14. Install the right front tire and wheel. Refer to Tire and Wheel Removal and Installation .
 15. Lower the vehicle.
 16. Install the drive belt. Refer to Drive Belt Replacement.

OIL PAN REPLACEMENT

REMOVAL PROCEDURE

NOTE: The vehicle is equipped with a automatic transaxle to oil pan lower brace. The brace boss on the transaxle may interfere with oil pan removal.

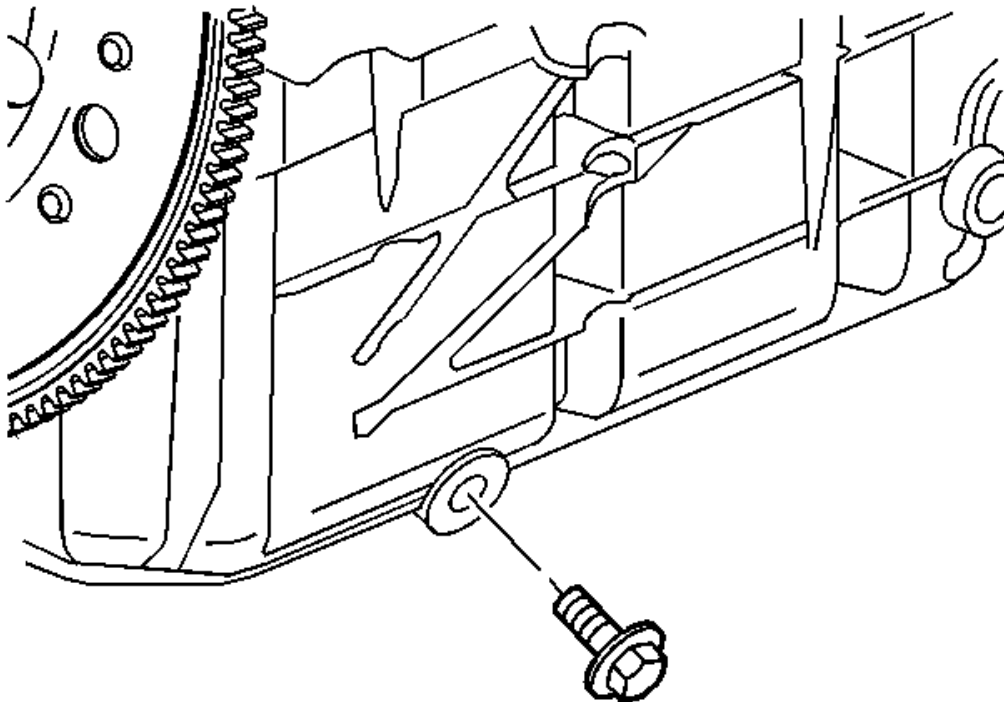


Fig. 124: View Of Oil Pan Drain Plug
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (LE5, LE9, LZ4, LZE, or LY7)** .
2. Remove the engine mount snubber and the drive belt. Refer to **Drive Belt Replacement**.
3. Remove the air cleaner inlet duct. Refer to **Air Cleaner Inlet Duct Replacement** .
4. Install the engine support fixture. Refer to **Engine Support Fixture**.
5. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
6. Place a suitable drain pan under the oil pan drain plug.
7. Remove the oil pan drain plug and drain the engine oil from the crankcase.

CAUTION: Refer to Fastener Caution .

8. Reinstall the oil pan drain plug and tighten to 26 N.m (19 lb ft).
9. Remove the right front splash shield. Refer to **Engine Splash Shield Replacement - Right Side** .
10. Remove the starter. Refer to **Starter Replacement (LZ4 or LZE)** .

11. Remove the oil filter adapter. Refer to **Oil Filter Adapter and Bypass Valve Assembly Replacement**.

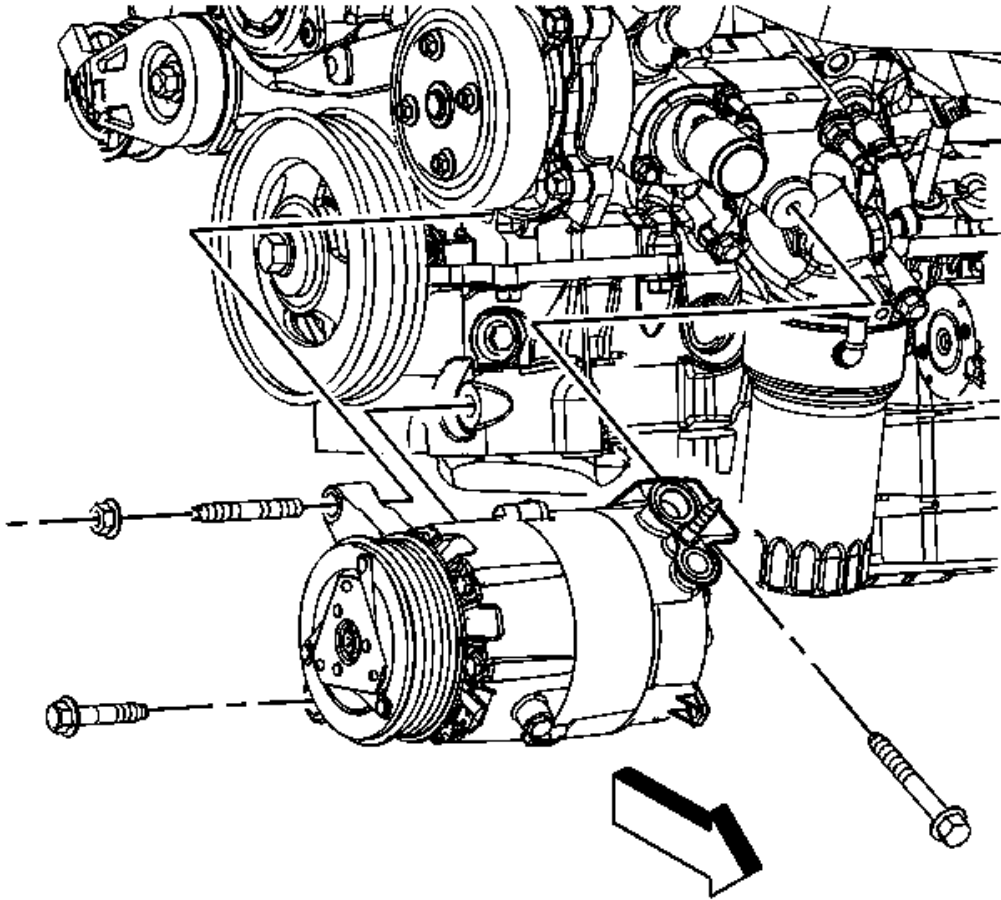


Fig. 125: View Of A/C compressor & Bolts
Courtesy of GENERAL MOTORS CORP.

12. Remove the air conditioning (A/C) compressor bolts/nut and position the compressor aside.
13. Remove the catalytic converters. Refer to **Catalytic Converter Replacement - Left Side (LZ4)** and **Catalytic Converter Replacement - Right Side (LZ4)**.

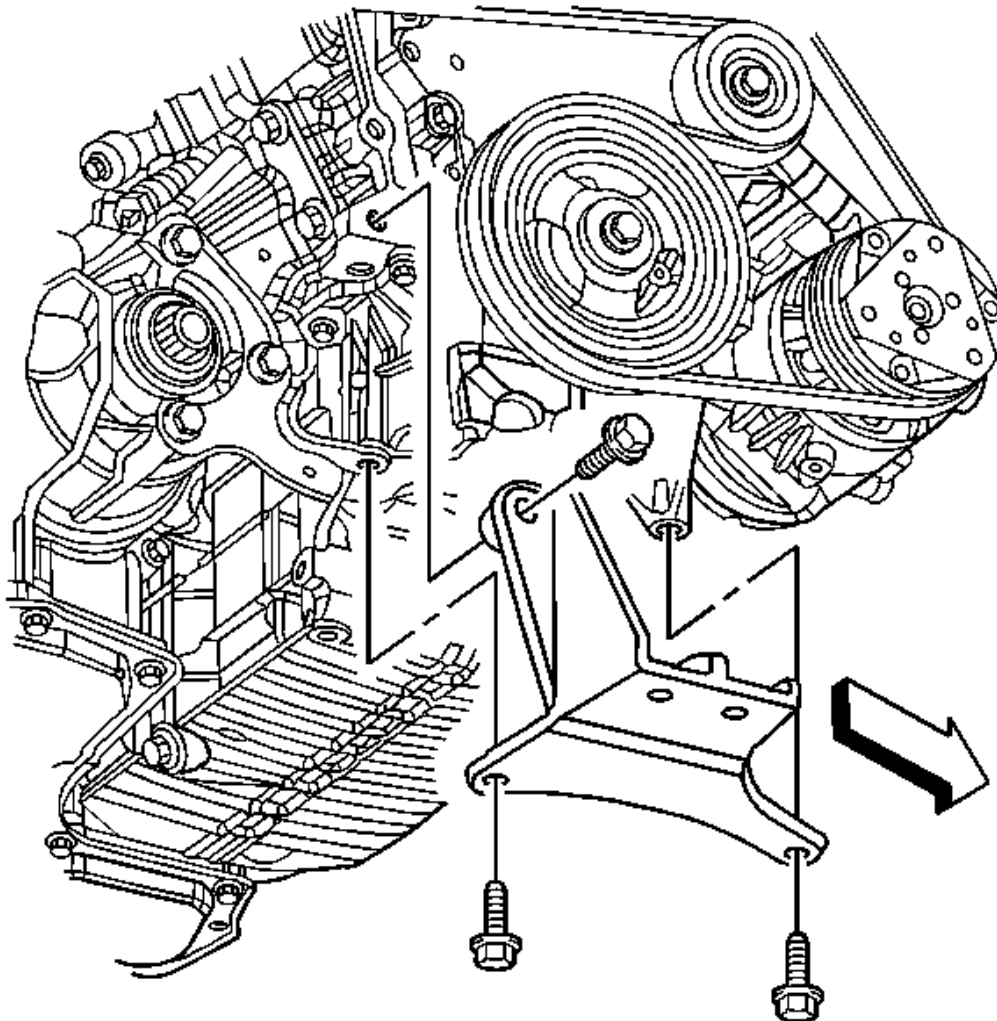


Fig. 126: View Of Engine Mount Bracket Bolts & Bracket
Courtesy of GENERAL MOTORS CORP.

14. Remove the engine mount bracket bolts and bracket.

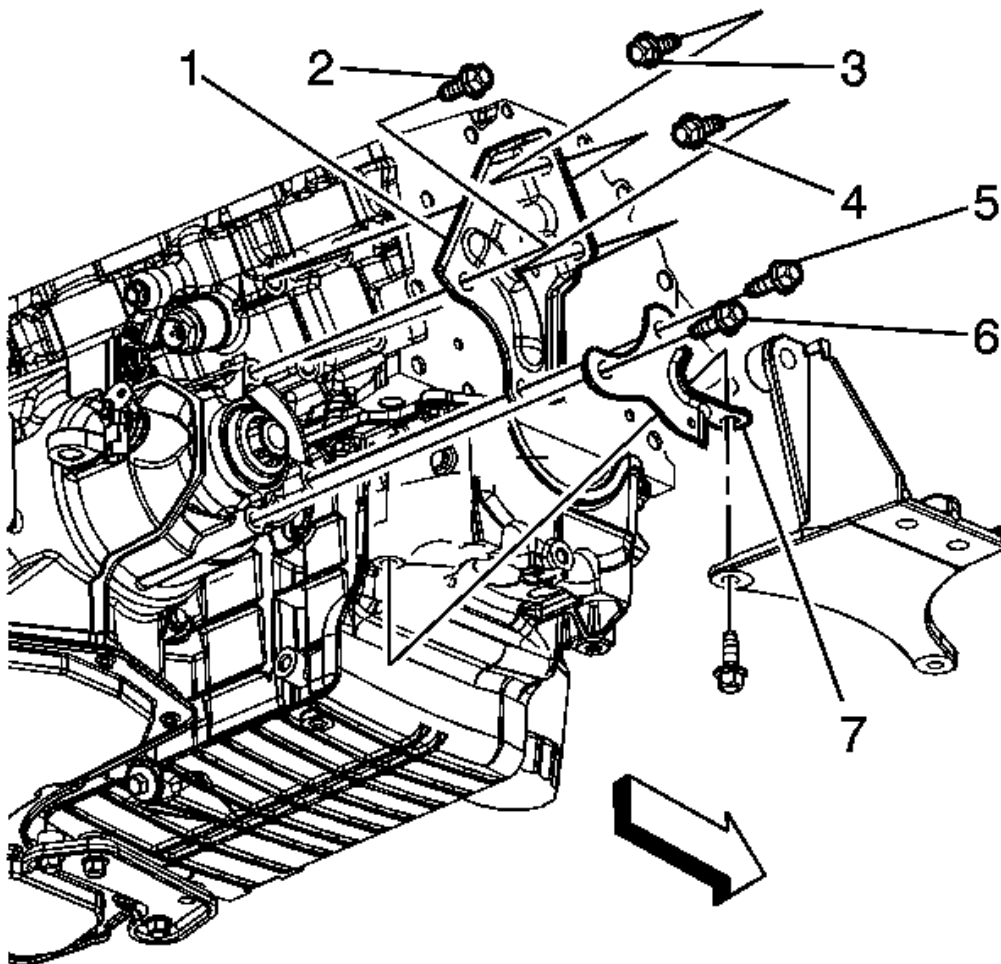


Fig. 127: Transaxle Brace Bolts
Courtesy of GENERAL MOTORS CORP.

15. Remove the transaxle brace bolts (5, 6) and remove the brace (7).

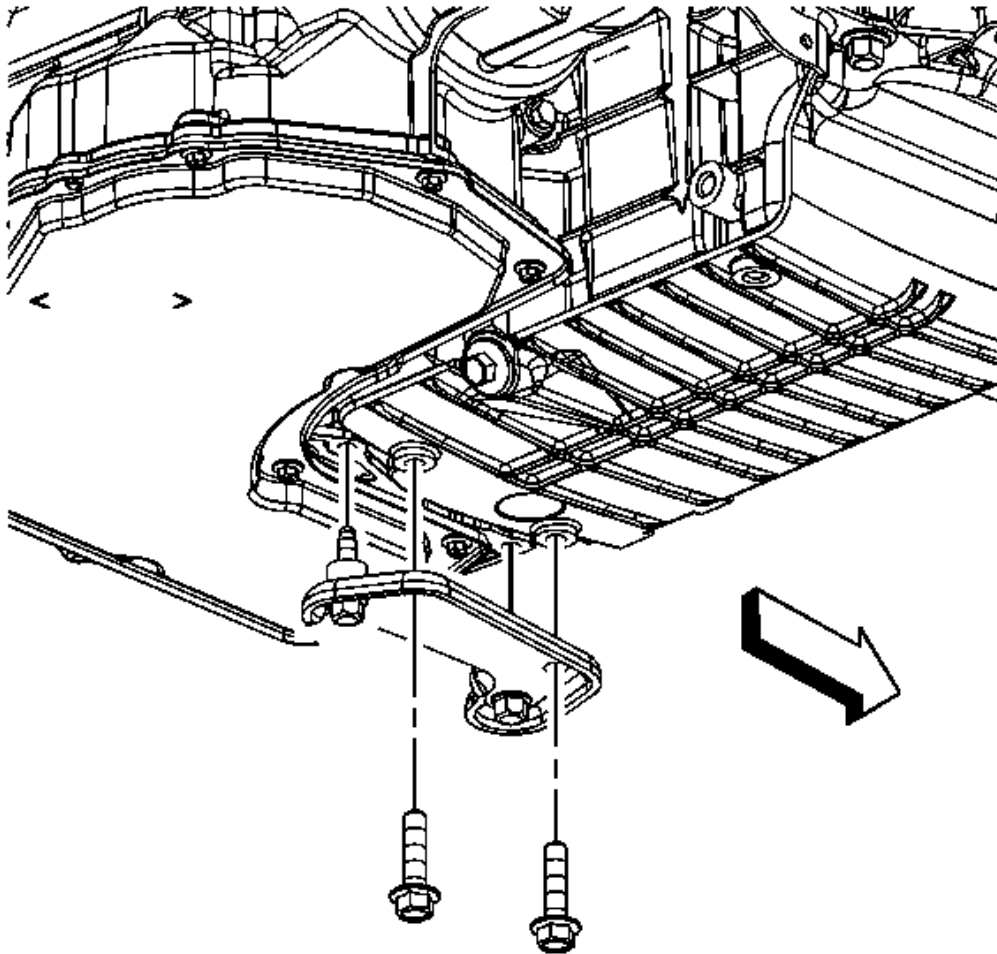


Fig. 128: Identifying Transmission To Engine Brace Bolts
Courtesy of GENERAL MOTORS CORP.

16. Remove the transaxle to oil pan brace bolts and brace.

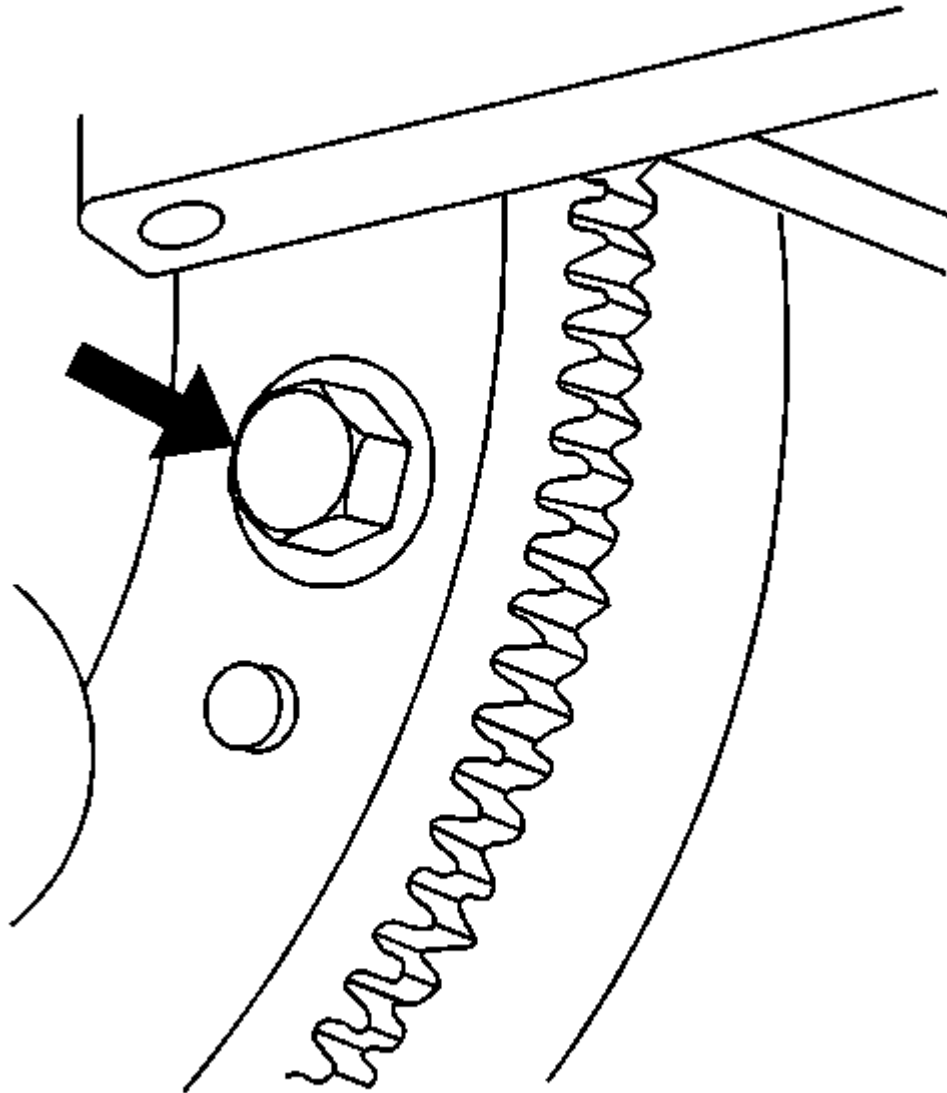


Fig. 129: View Of Flywheel To Torque Converter Bolts
Courtesy of GENERAL MOTORS CORP.

17. Remove the flexplate to torque converter bolts.
18. Lower the vehicle.

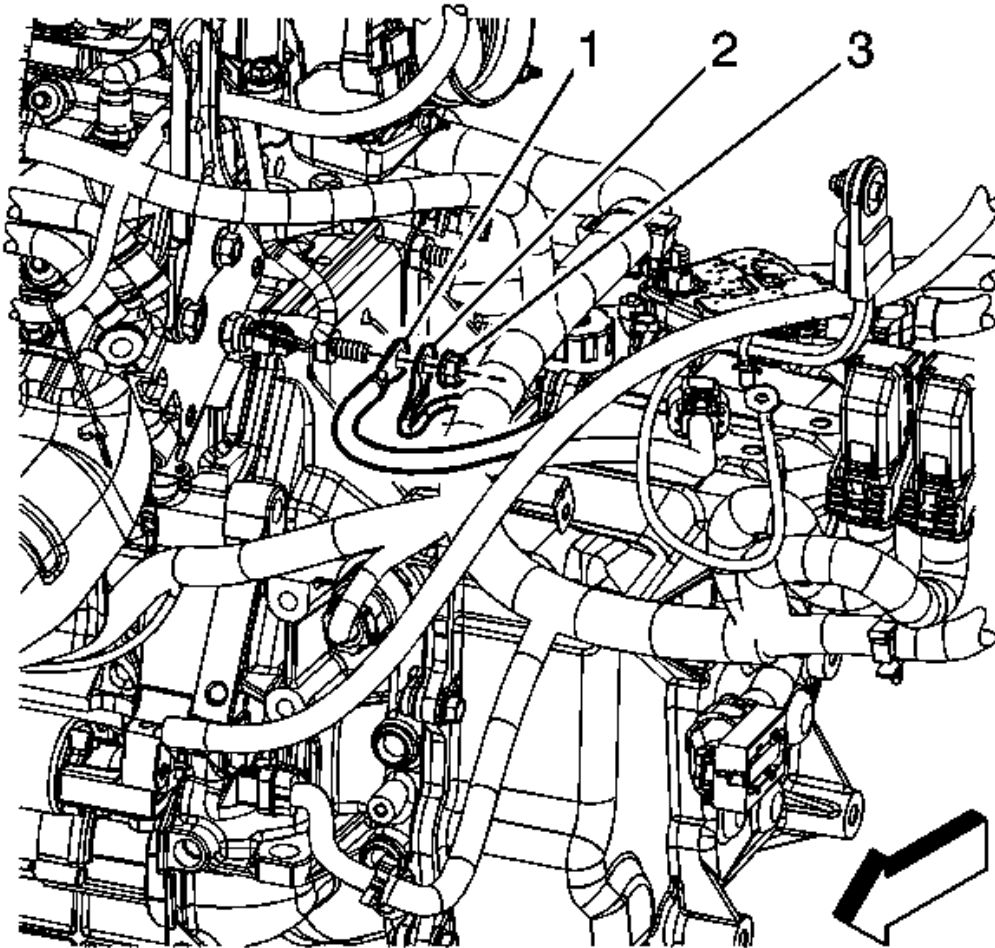


Fig. 130: Identifying Engine Wiring Harness Ground, & Negative Battery Cable Ground & Nut
Courtesy of GENERAL MOTORS CORP.

19. Remove the engine harness ground nut (3) from the transaxle stud.
20. Remove the engine wiring harness ground (2) and the negative battery cable ground (1) from the transaxle stud.

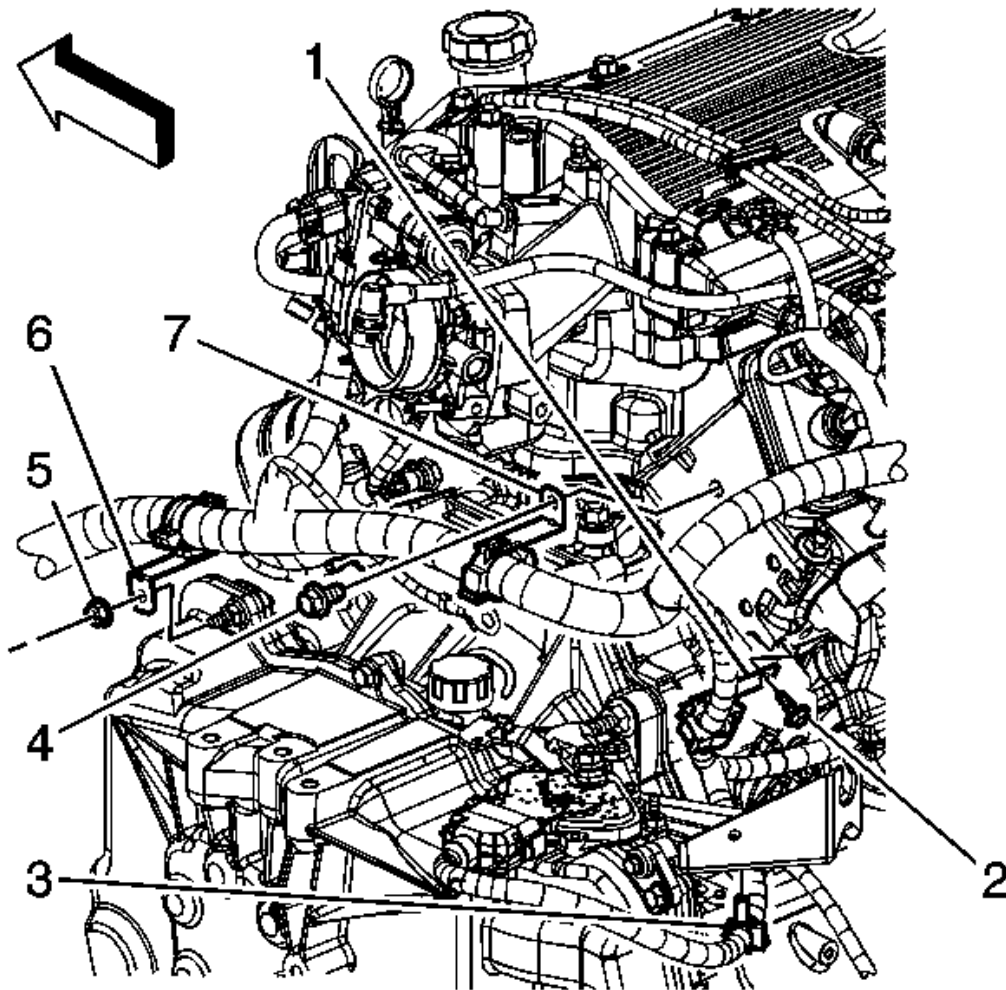


Fig. 131: Identifying Engine Wiring Harness Clip & Nut (at Transaxle Stud)
Courtesy of GENERAL MOTORS CORP.

21. Remove the engine wiring harness clip nut (5) from the transaxle stud.
22. Remove the engine wiring harness clip (6) from the transaxle stud.

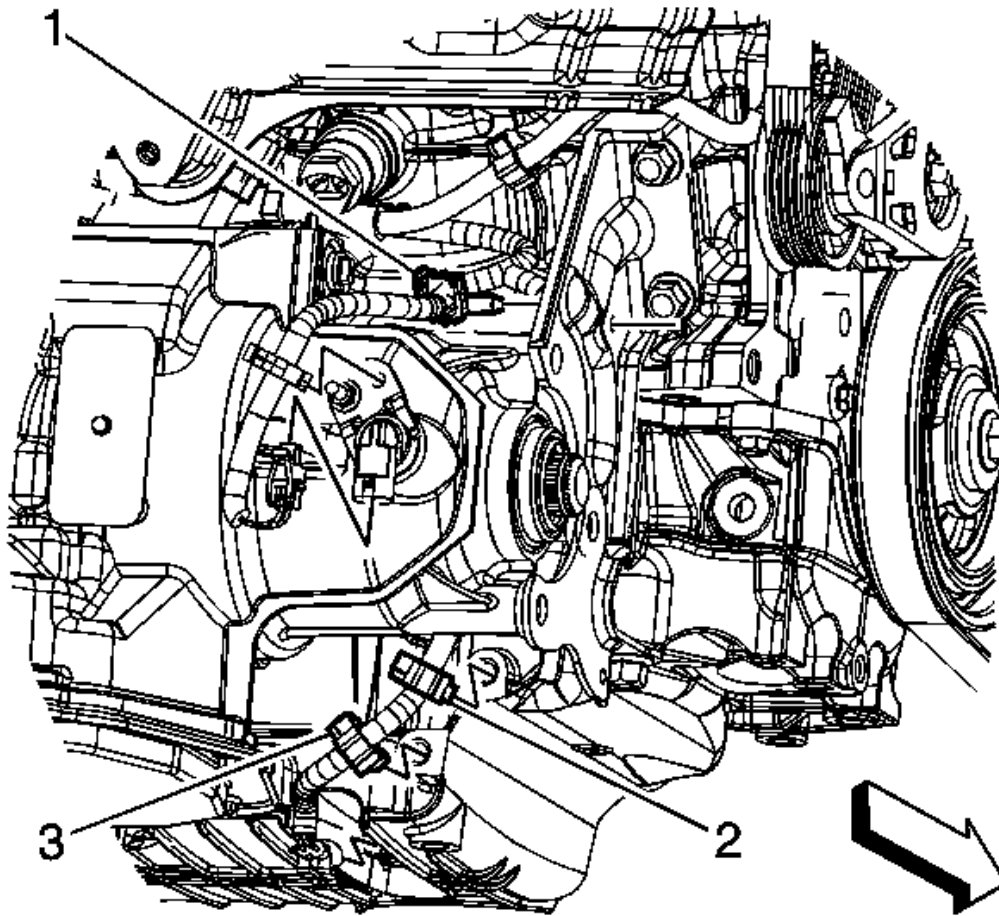


Fig. 132: Identifying Engine Wiring Harness Clip & Nut (at Oil Pan)
Courtesy of GENERAL MOTORS CORP.

23. Remove the engine wiring harness clips (2, 3) from the oil pan.

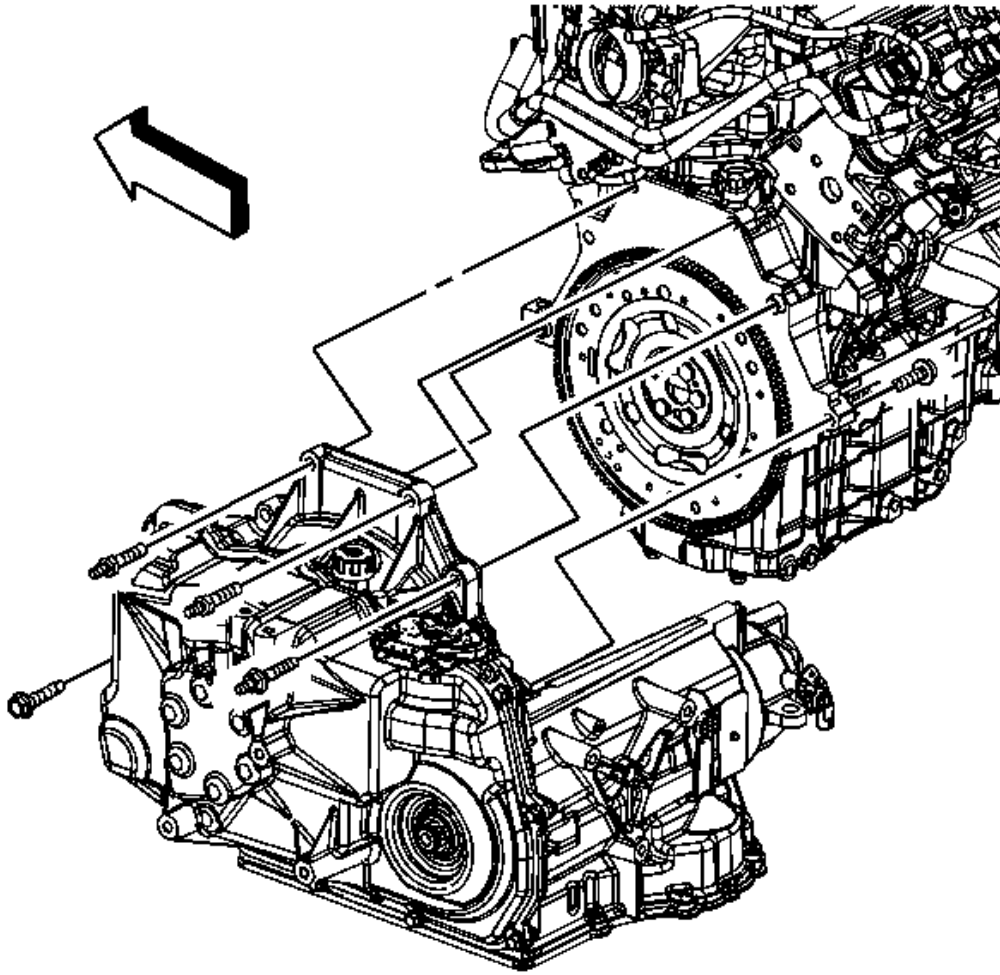


Fig. 133: Identifying Transaxle Studs And Bolts
Courtesy of GENERAL MOTORS CORP.

24. Loosen, DO NOT REMOVE the transaxle studs and bolts.
25. Using the engine support fixture, raise the engine and transaxle slightly.
26. Raise and support the vehicle.

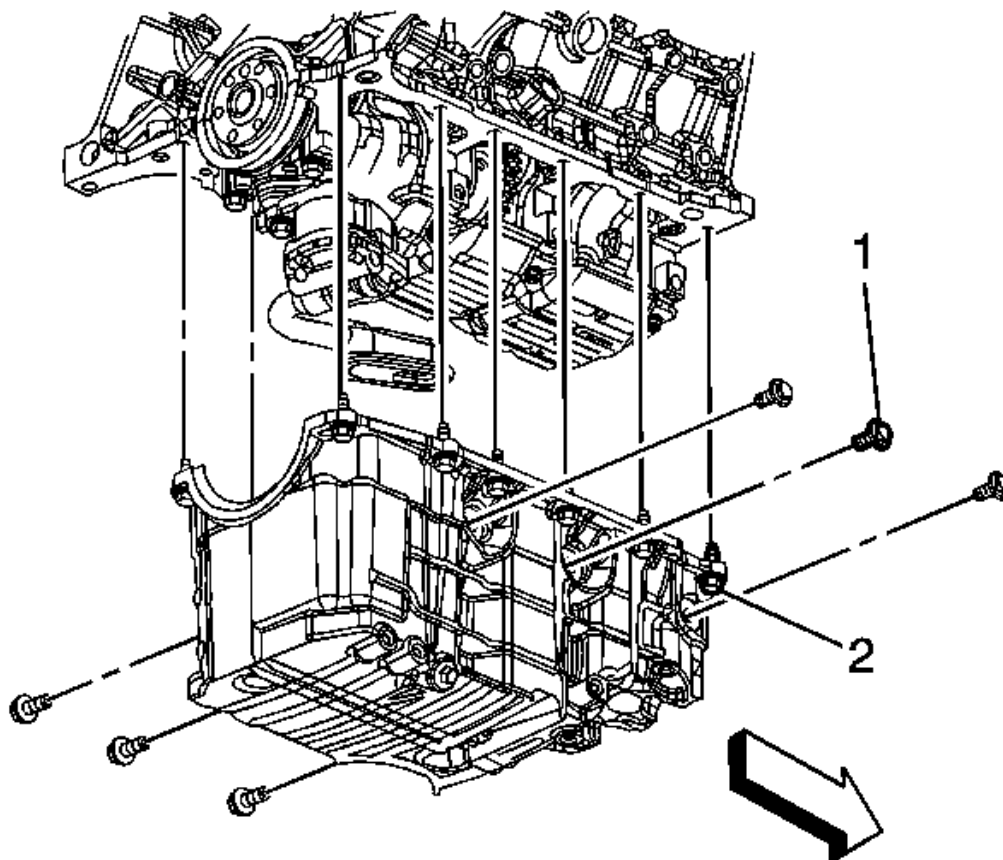


Fig. 134: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

27. Remove the oil pan bolts (1, 2).
28. Separate the engine and transaxle approximately 13 mm (1/2 inch).

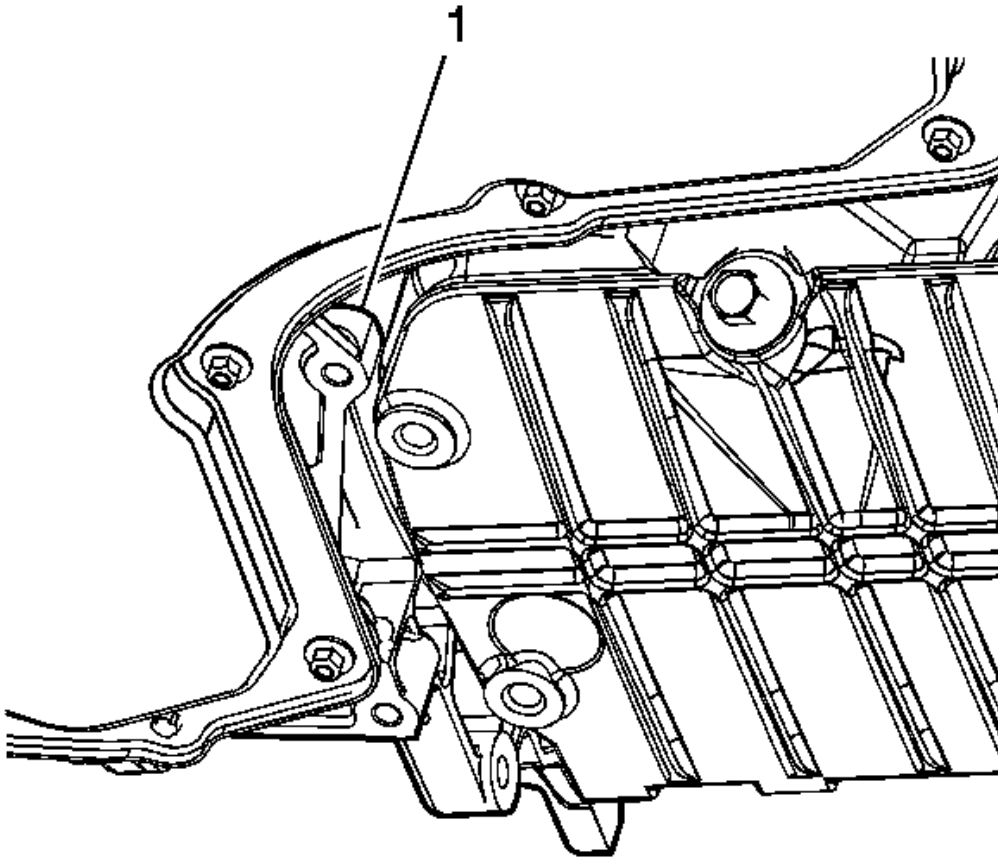


Fig. 135: Identifying Transaxle Boss
Courtesy of GENERAL MOTORS CORP.

29. Ensure that when removing the oil pan, the pan clears the boss (1) on the transaxle.
30. Remove the oil pan. If the oil pan cannot be removed, use the engine support fixture to raise the engine until the pan can be removed.
31. Remove and discard the oil pan gasket.
32. Clean the oil pan sealing surfaces.

INSTALLATION PROCEDURE

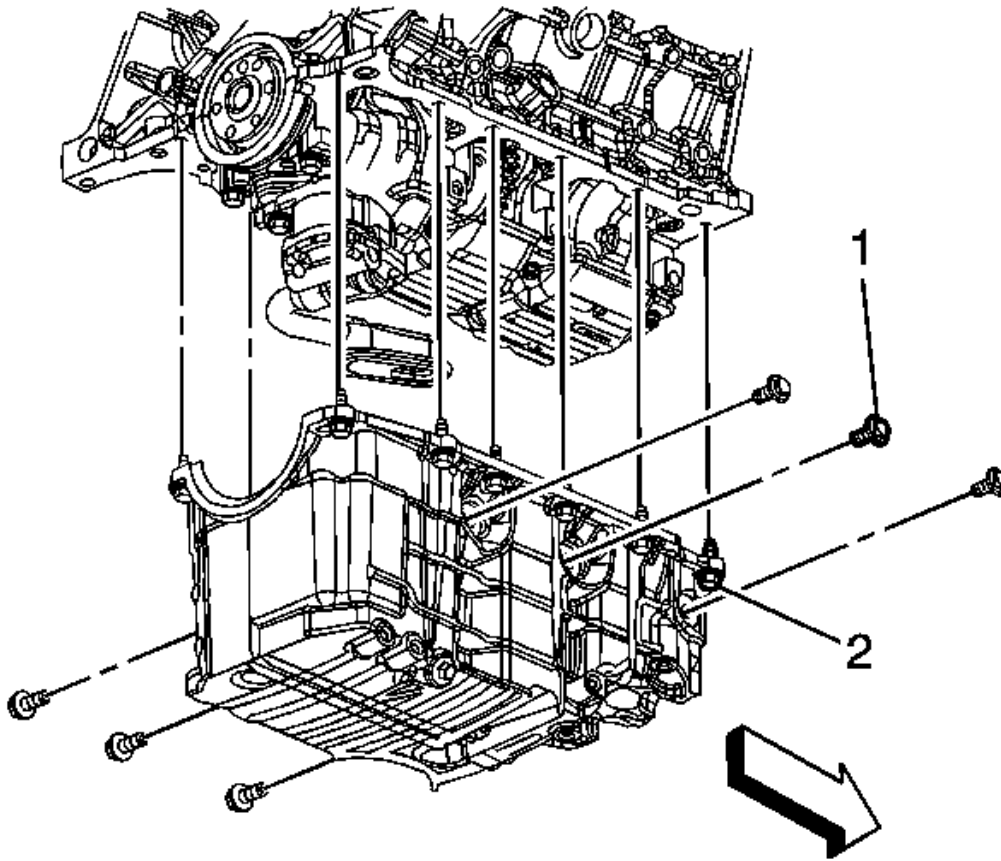


Fig. 136: View Of Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Apply sealer to both sides of the front cover/block mating area. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .
2. Apply sealer to both sides of the crankcase rear main bearing cap. Press the sealer into the gap using a putty knife. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .
3. Install a NEW oil pan gasket.
4. Install the oil pan.
5. Install the oil pan bolts (1, 2).
 - Tighten the bolts (1) to 50 N.m (37 lb ft) + 50 degrees.
 - Tighten the bolts (2) to 25 N.m (18 lb ft).

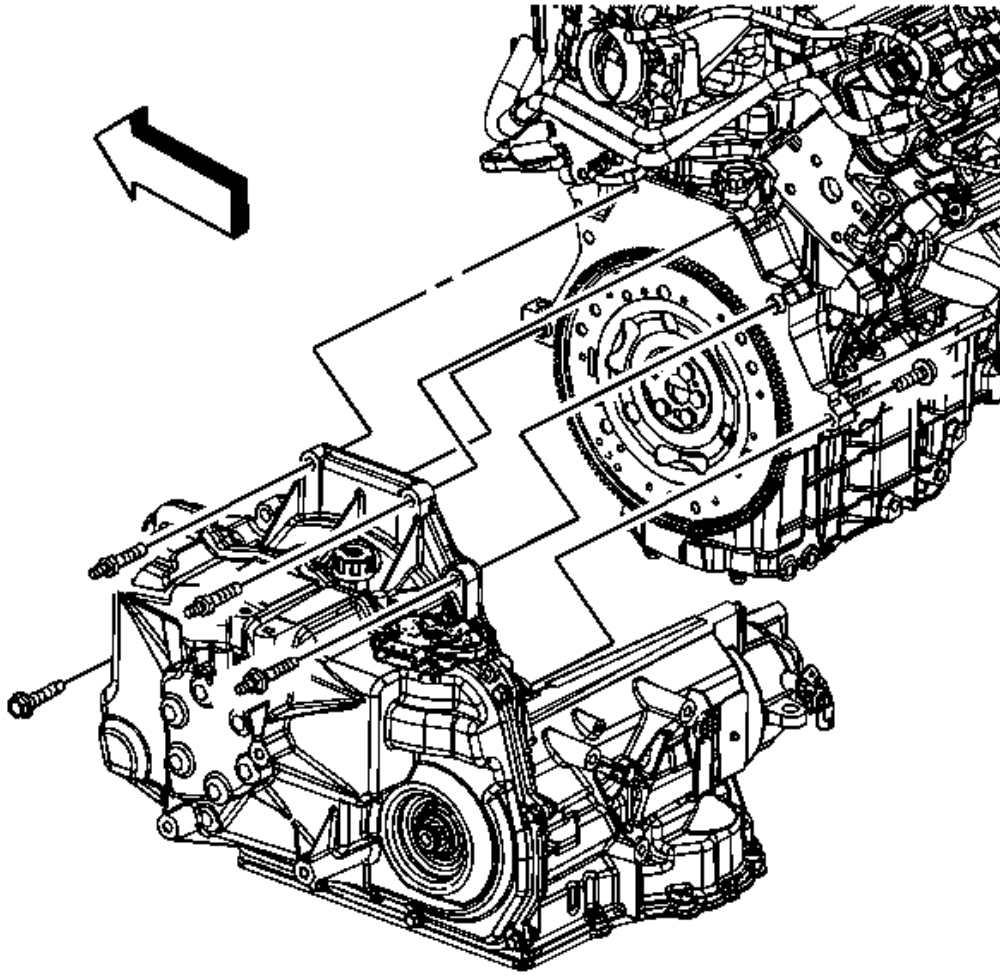


Fig. 137: Identifying Transaxle Studs And Bolts
Courtesy of GENERAL MOTORS CORP.

6. Lower the vehicle.
7. Using the engine support fixture, lower the engine and transaxle.
8. Tighten the transaxle studs and bolts to 75 N.m (55 lb ft).

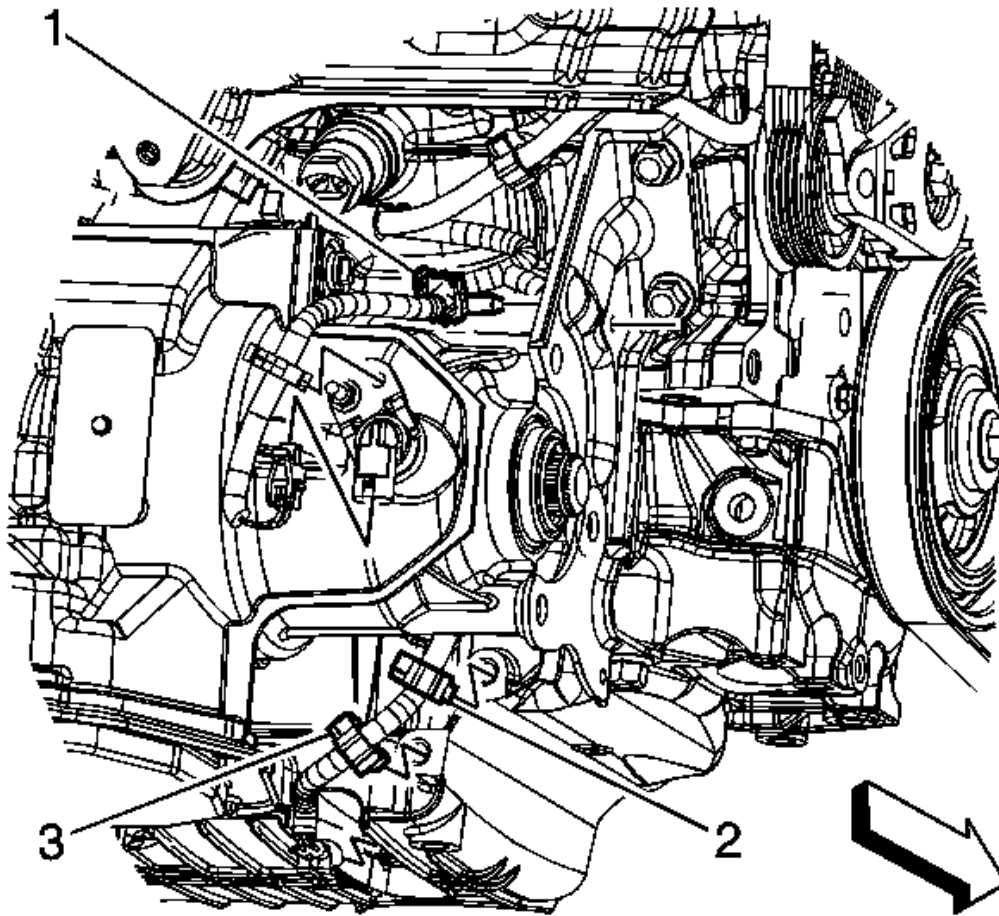


Fig. 138: Identifying Engine Wiring Harness Clip & Nut (at Oil Pan)
Courtesy of GENERAL MOTORS CORP.

9. Install the engine wiring harness clips (2, 3) to the oil pan.

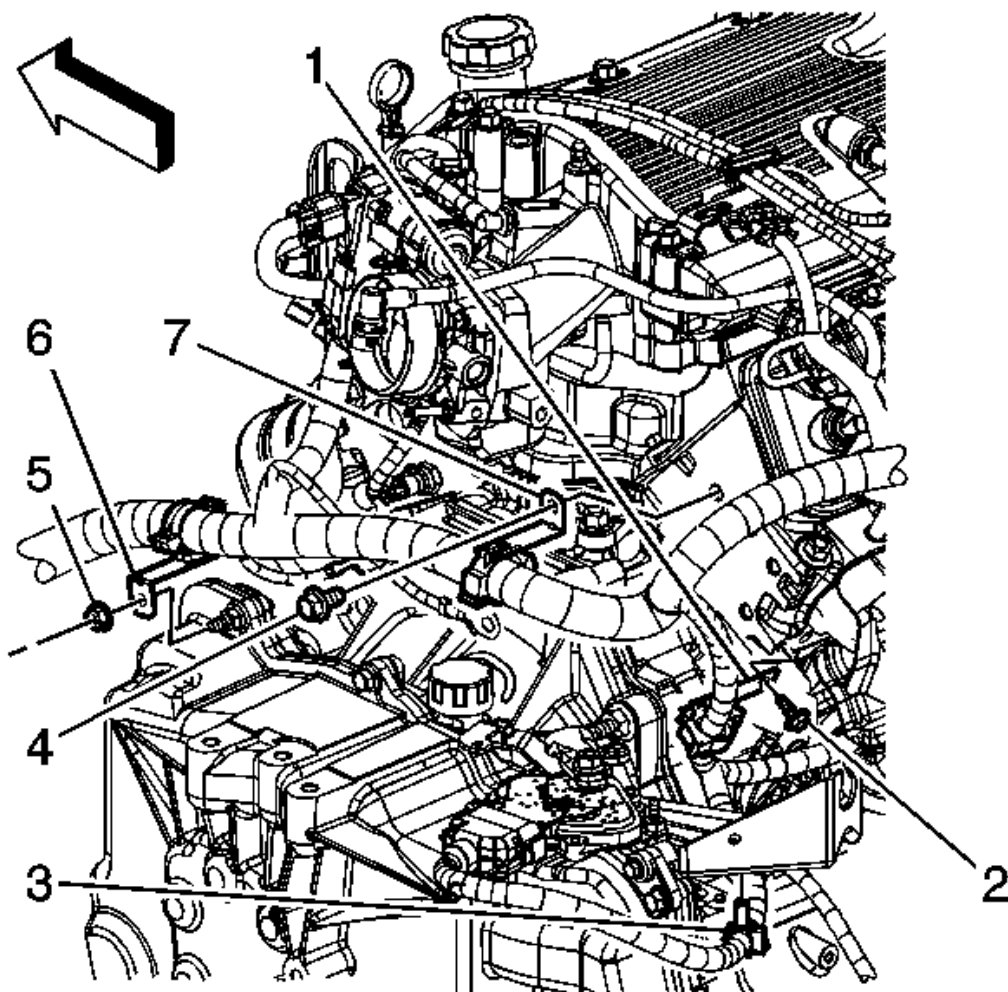


Fig. 139: Identifying Engine Wiring Harness Clip & Nut (at Transaxle Stud)
Courtesy of GENERAL MOTORS CORP.

10. Install the engine wiring harness clip (6) to the transaxle stud.
11. Install the engine wiring harness clip nut (5) to the transaxle stud and tighten to 25 N.m (18 lb ft).

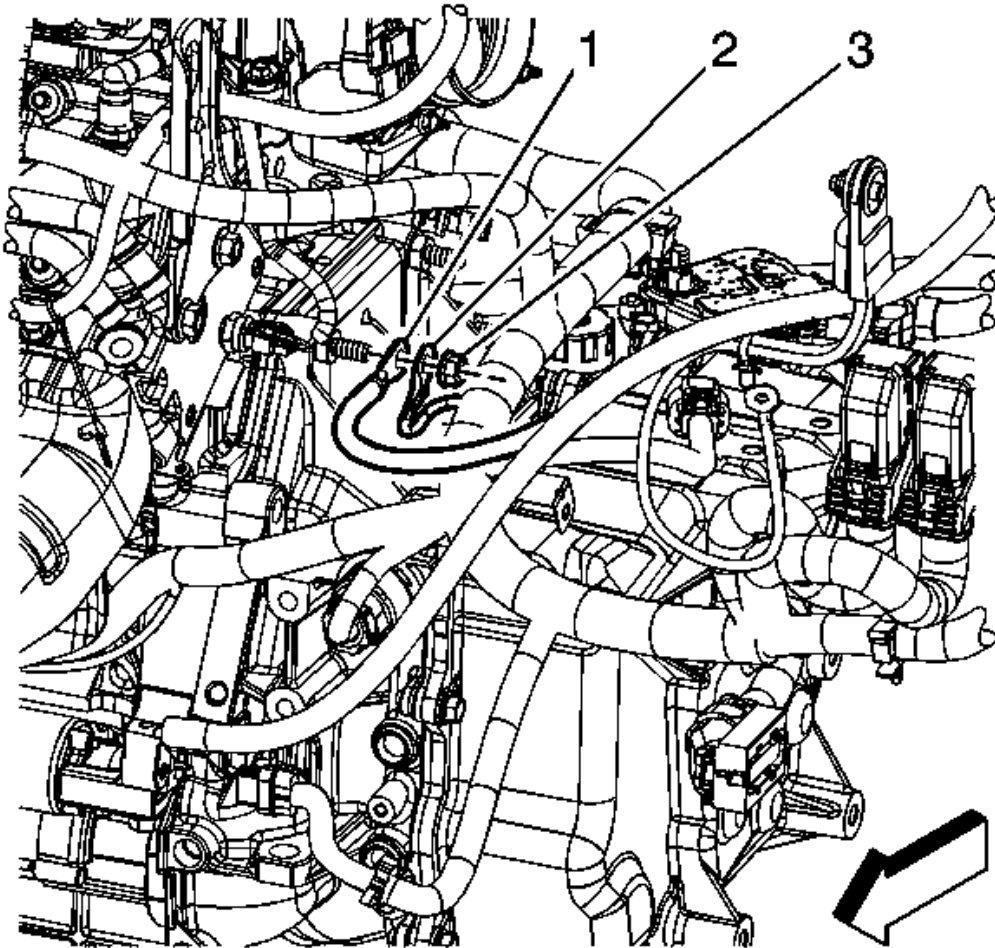


Fig. 140: Identifying Engine Wiring Harness Ground, & Negative Battery Cable Ground & Nut
Courtesy of GENERAL MOTORS CORP.

12. Install the negative battery cable ground (1) and the engine wiring harness ground (2) to the transaxle stud.
13. Install the engine harness ground nut (3) to the transaxle stud and tighten the nut to 25 N.m (18 lb ft).

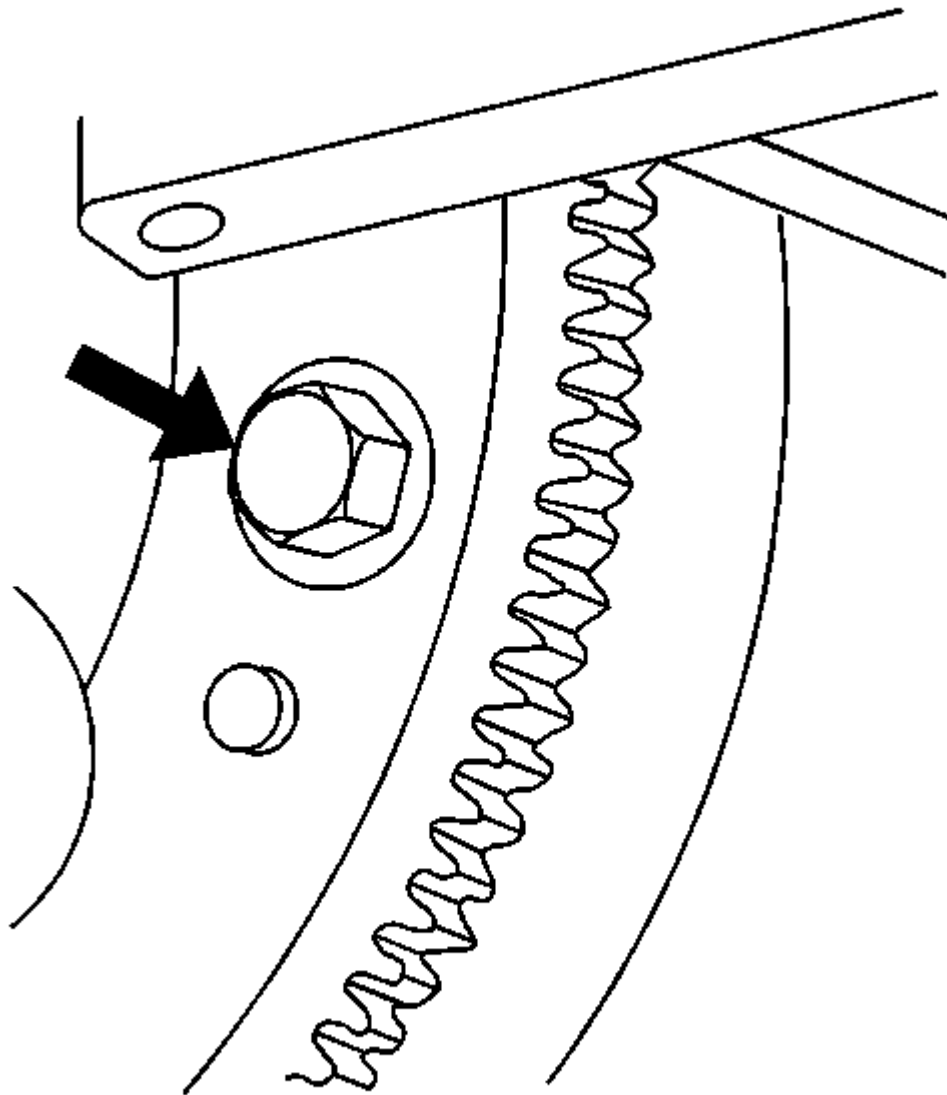


Fig. 141: View Of Flywheel To Torque Converter Bolts
Courtesy of GENERAL MOTORS CORP.

14. Raise and support the vehicle.
15. Install the flexplate to torque converter bolts and tighten to 62 N.m (46 lb ft).

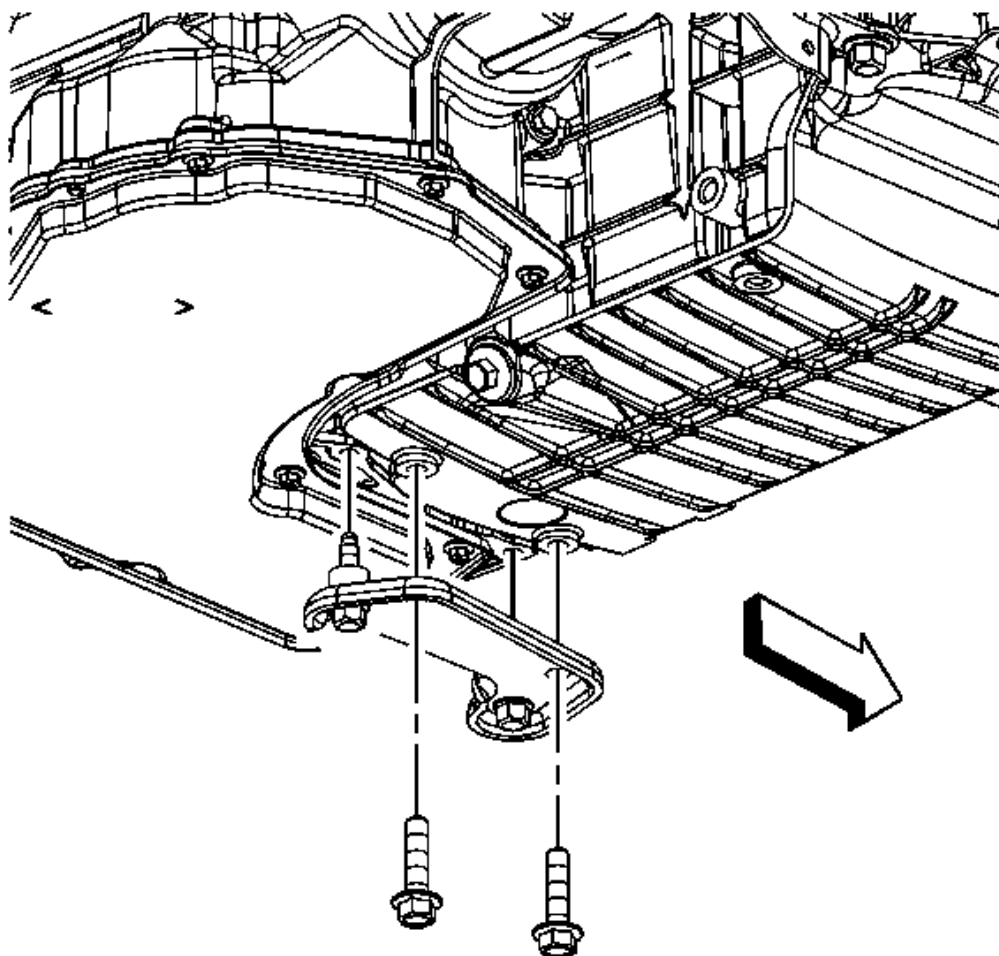


Fig. 142: Identifying Transmission To Engine Brace Bolts
Courtesy of GENERAL MOTORS CORP.

16. Position the transaxle to oil pan brace and install the bolts.

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

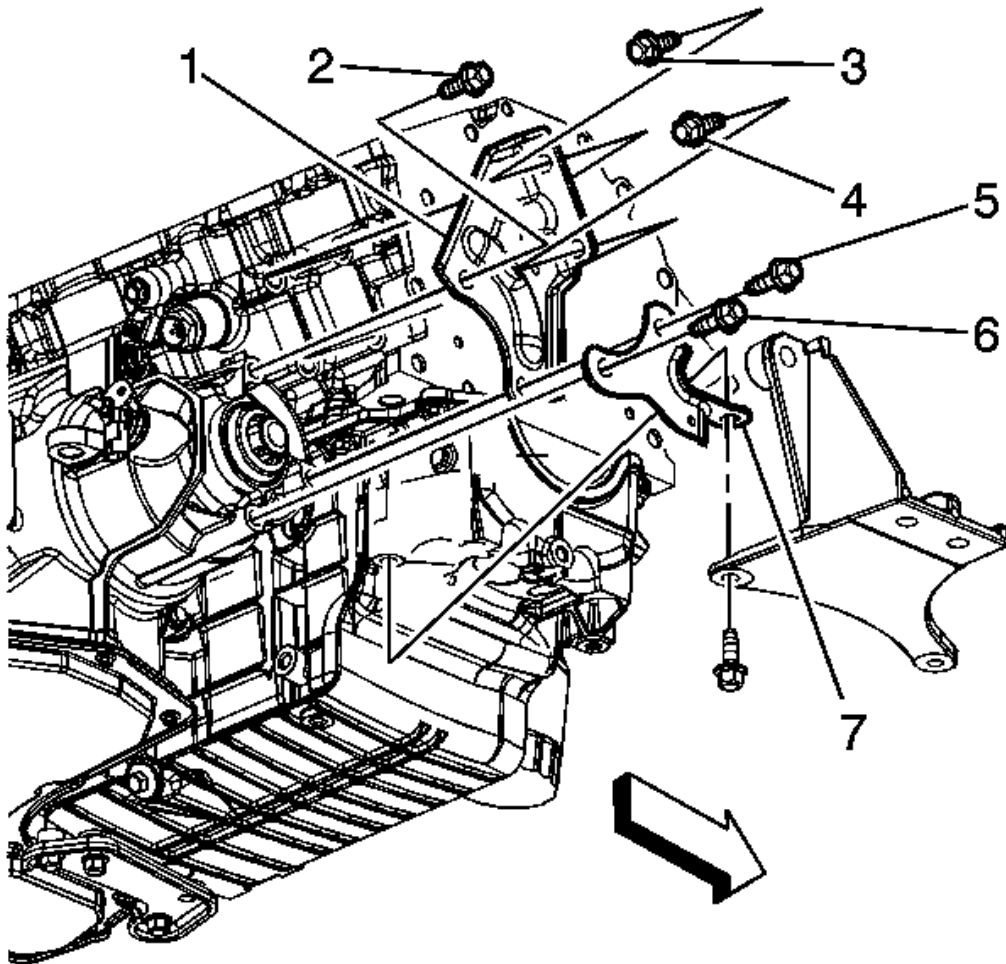


Fig. 143: Transaxle Brace Bolts

Courtesy of GENERAL MOTORS CORP.

17. Position the transaxle brace (7) to the transaxle and install the bolts (5, 6) until snug.
18. Install the engine wiring harness clip to the rear of the transaxle brace.

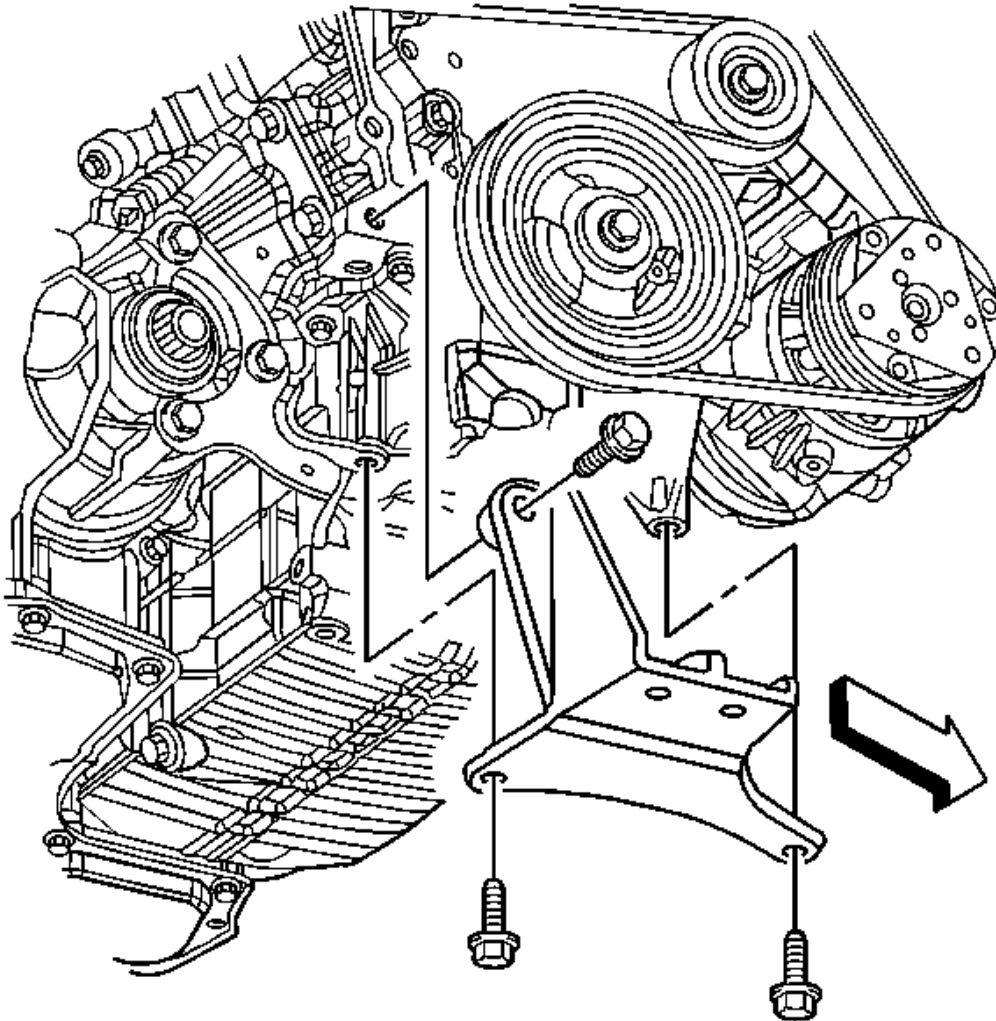


Fig. 144: View Of Engine Mount Bracket Bolts & Bracket
Courtesy of GENERAL MOTORS CORP.

19. Position the engine mount bracket to the engine and install the bolts until snug.
20. Tighten the engine mount bracket bolts and transaxle brace bolts.
 - Tighten the engine mount bracket upper bolt to 90 N.m (66 lb ft).
 - Tighten the engine mount bracket lower bolts to 50 N.m (37 lb ft).
 - Tighten the transaxle brace bolts to 72 N.m (53 lb ft).
21. Install the catalytic converters. Refer to **Catalytic Converter Replacement - Left Side (LZ4)** and **Catalytic Converter Replacement - Right Side (LZ4)**.

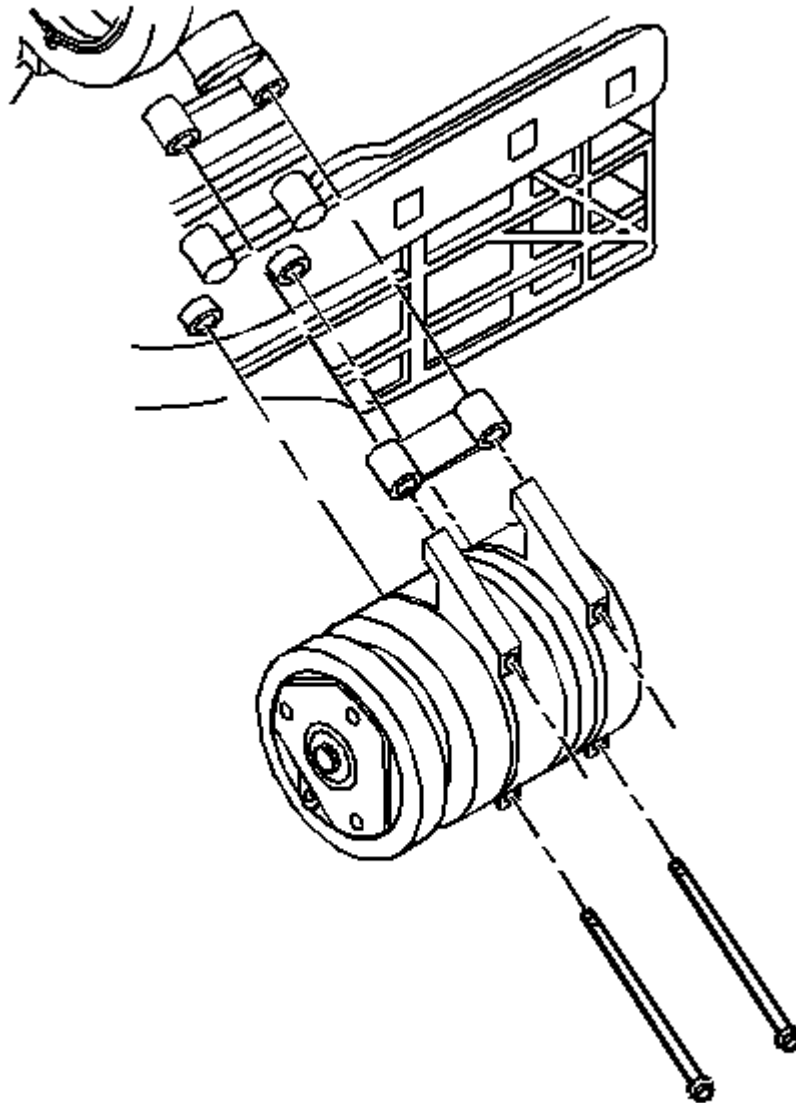


Fig. 145: View Of A/C Compressor, Bolts & Brace
Courtesy of GENERAL MOTORS CORP.

22. Position the A/C compressor and install the bolts. Tighten the bolts to 50 N.m (37 lb ft)

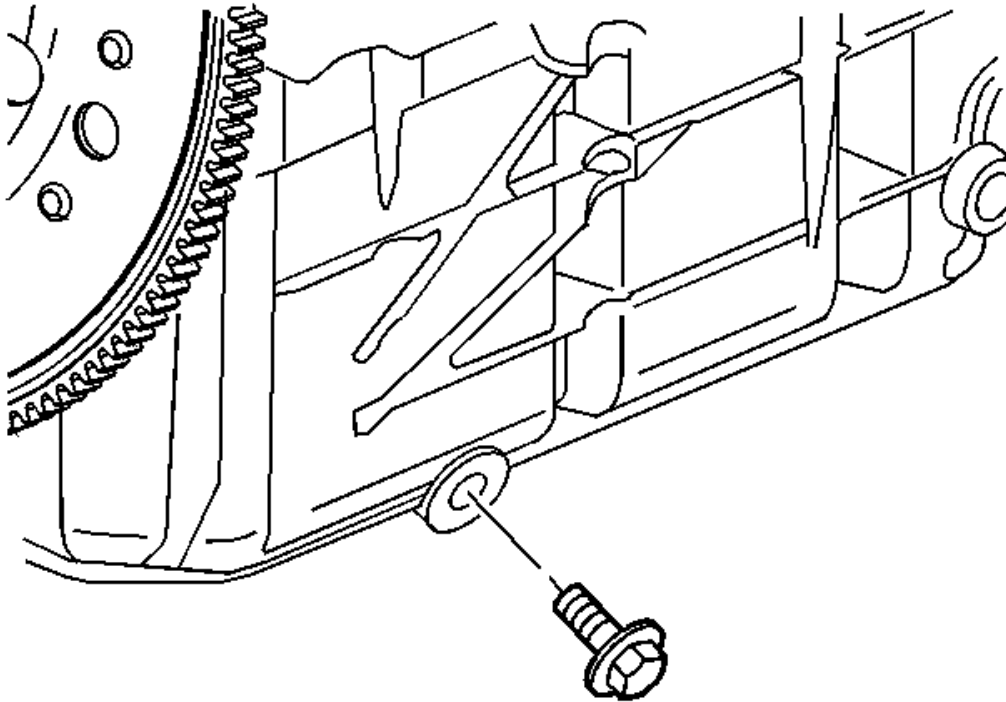


Fig. 146: View Of Oil Pan Drain Plug
Courtesy of GENERAL MOTORS CORP.

23. Install the oil filter adapter. Refer to **Oil Filter Adapter and Bypass Valve Assembly Replacement**.
24. Install the starter. Refer to **Starter Replacement (LZ4 or LZE)**.
25. Install the right front splash shield. Refer to **Engine Splash Shield Replacement - Right Side**.
26. Ensure that the oil pan drain plug is tighten to 26 N.m (19 lb ft).
27. Lower the vehicle.
28. Remove the engine support fixture.
29. Install the air cleaner inlet duct. Refer to **Air Cleaner Inlet Duct Replacement**.
30. Install the drive belt and the engine mount snubber. Refer to **Drive Belt Replacement**.
31. Fill the crankcase with oil.
32. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (LE5, LE9, LZ4, LZE, or LY7)**.
33. Start the engine and inspect for leaks.

ENGINE OIL PRESSURE SENSOR AND/OR SWITCH REPLACEMENT

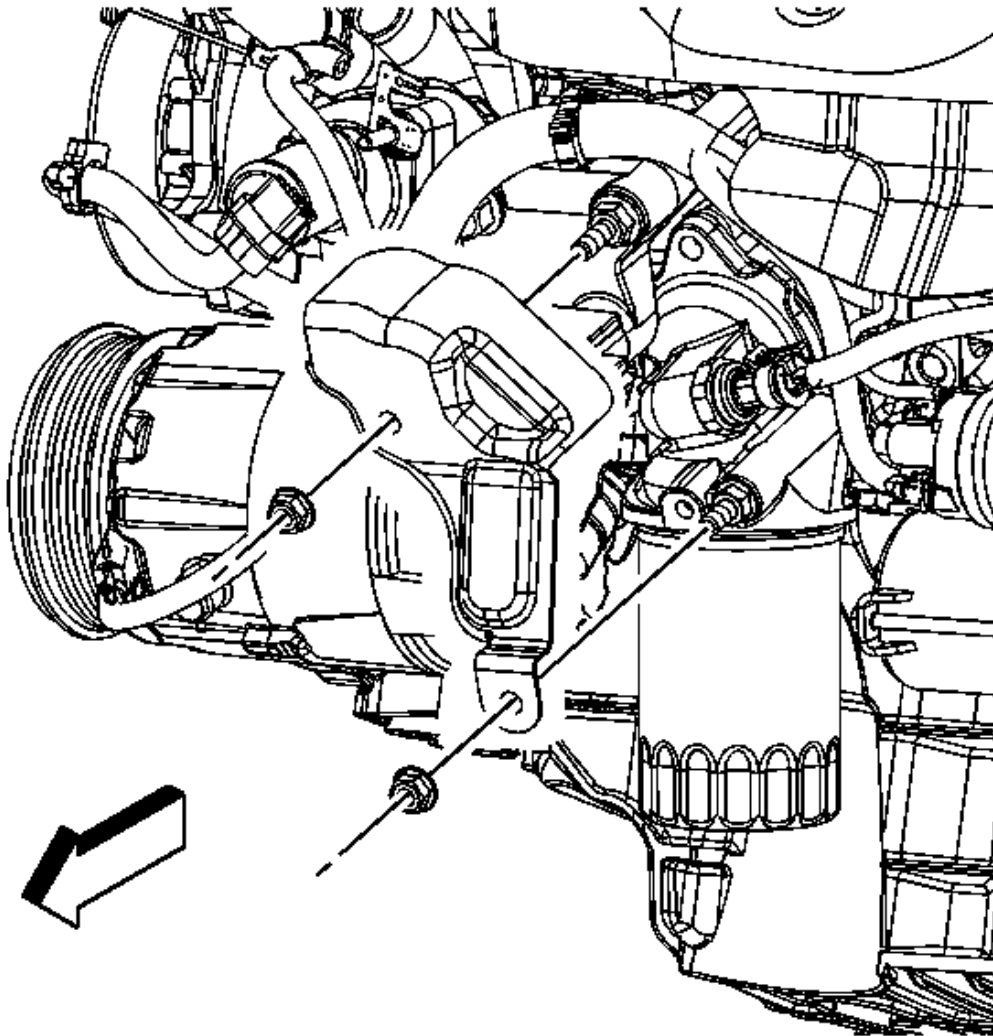
REMOVAL PROCEDURE

Fig. 147: Identifying Oil Pressure Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the oil pressure sensor heat shield bolts and shield.

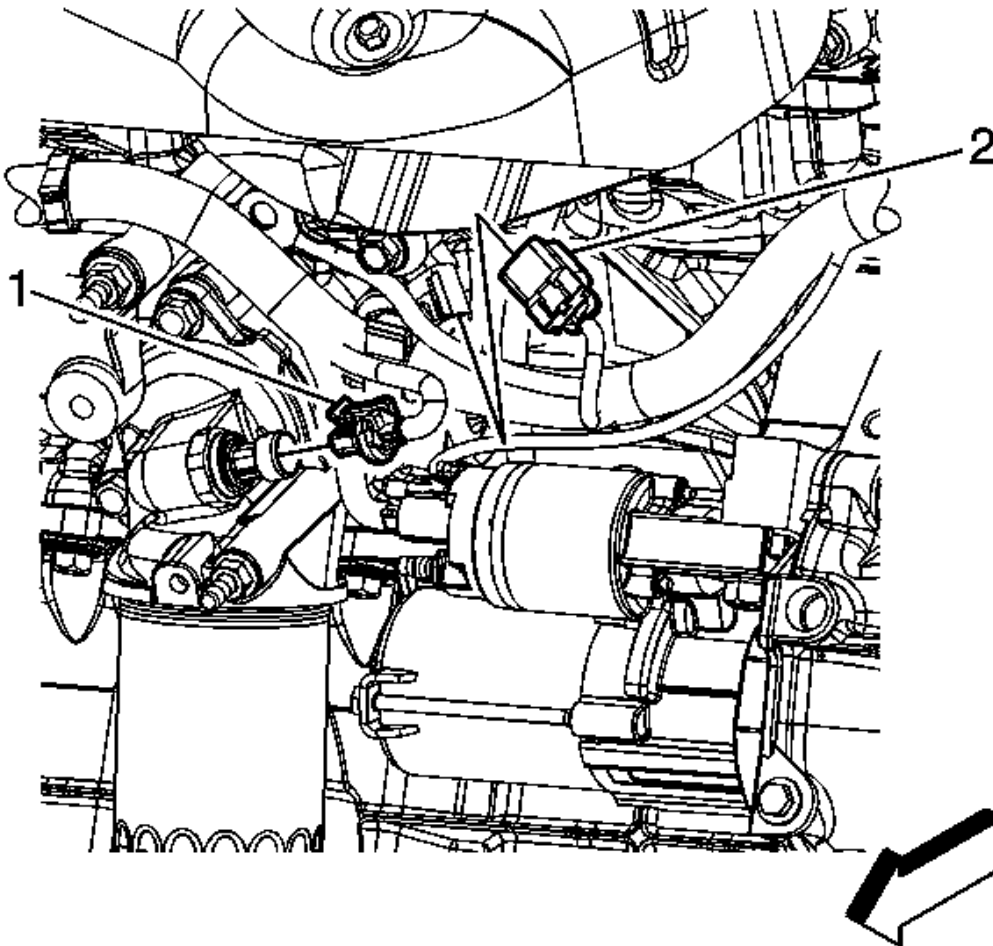


Fig. 148: Identifying Knock Sensor & Oil Pressure Sensor Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the engine wiring harness electrical connector (1) from the oil pressure sensor.

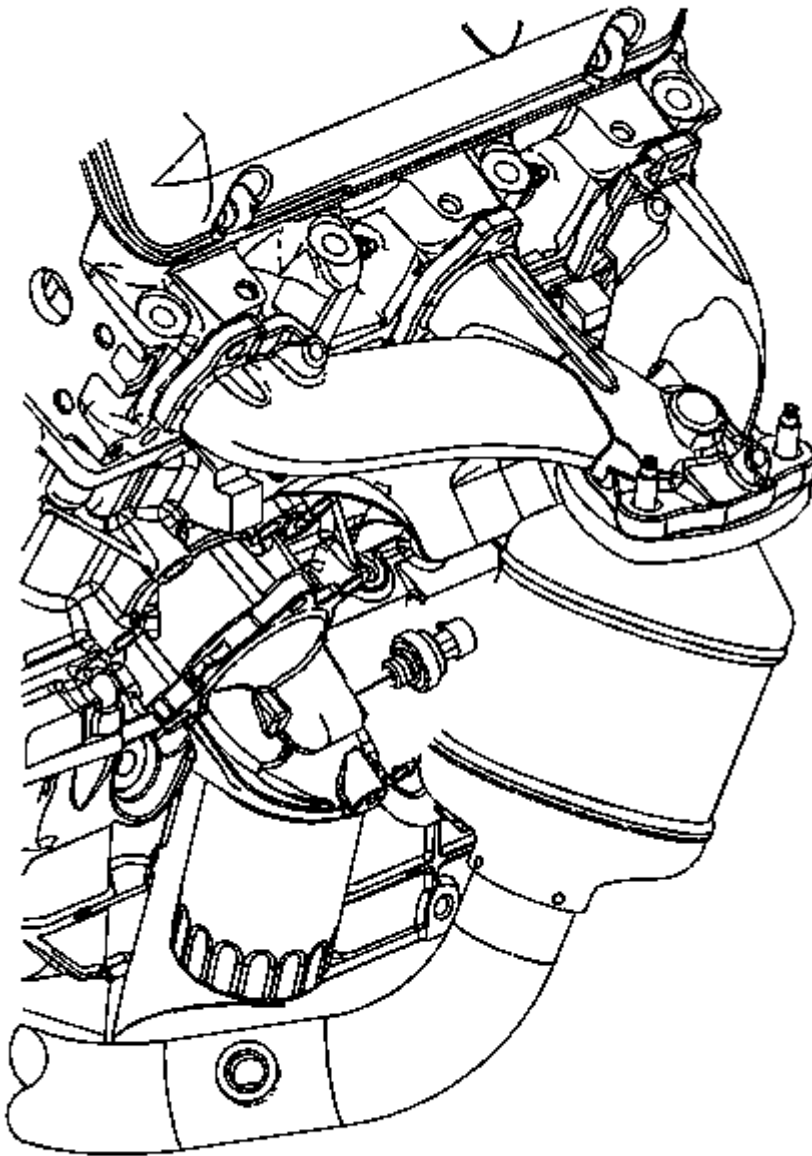


Fig. 149: Identifying Engine Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine oil pressure sensor.

INSTALLATION PROCEDURE

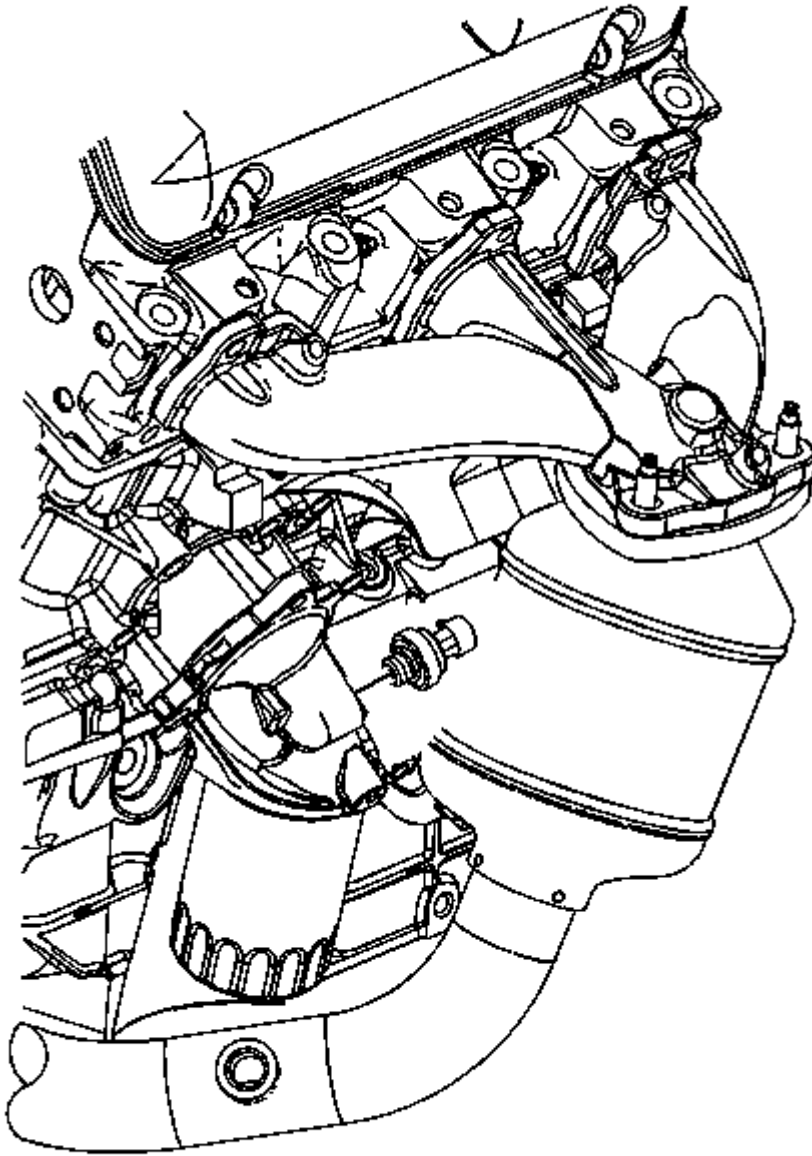


Fig. 150: Identifying Engine Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the engine oil pressure sensor.

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

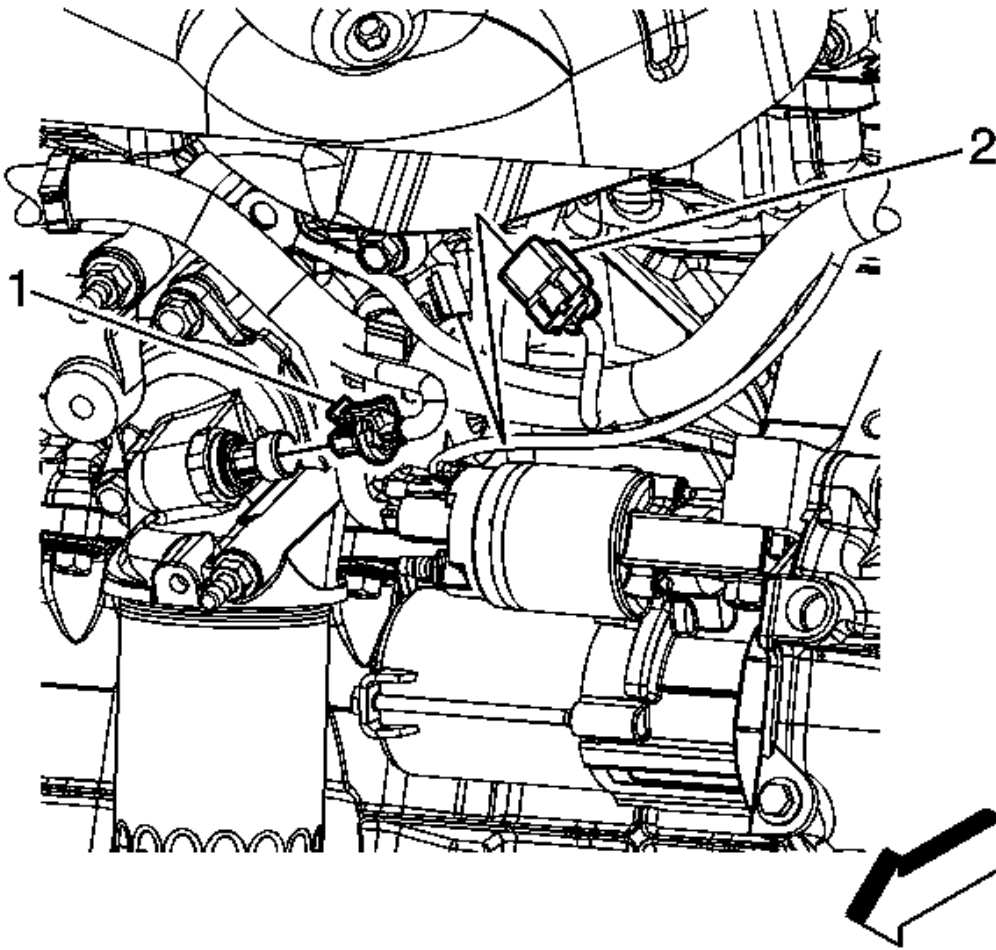


Fig. 151: Identifying Knock Sensor & Oil Pressure Sensor Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

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

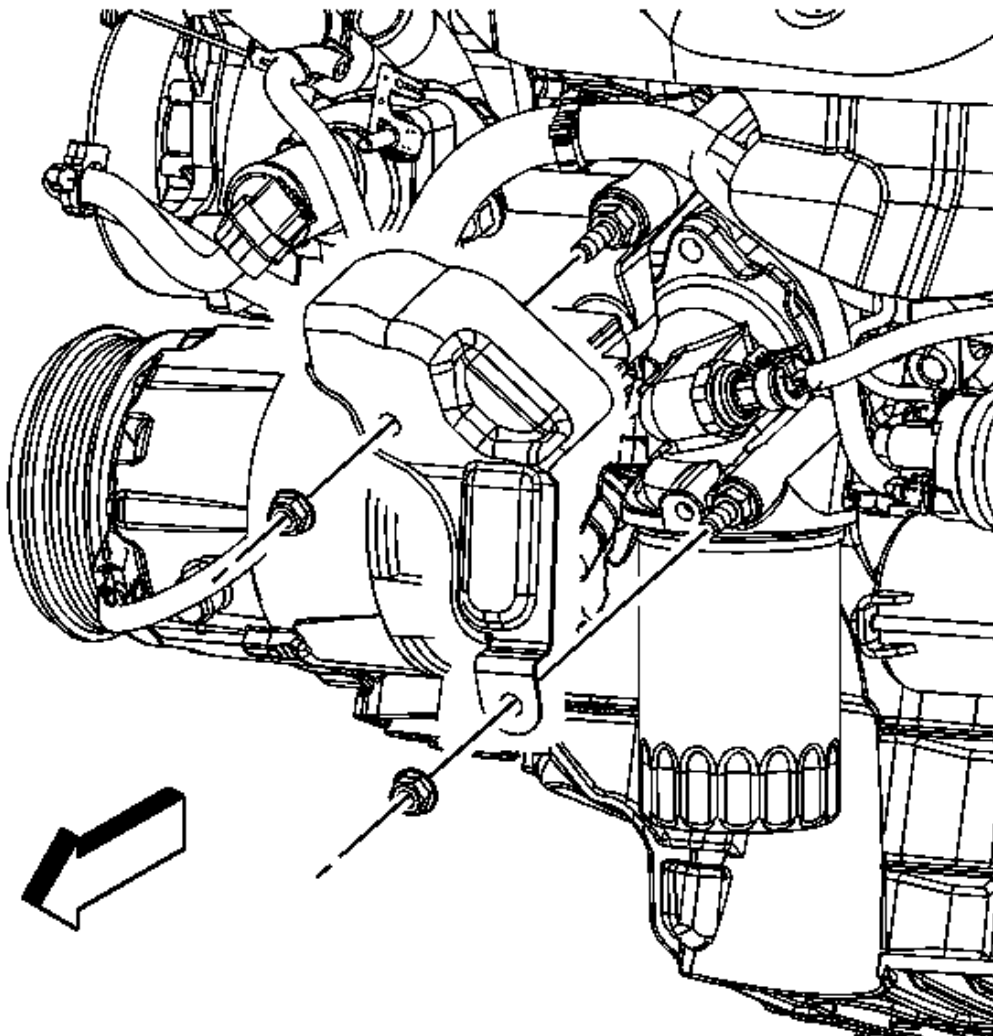


Fig. 152: Identifying Oil Pressure Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

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

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

4. Lower the vehicle.

OIL PUMP REPLACEMENT

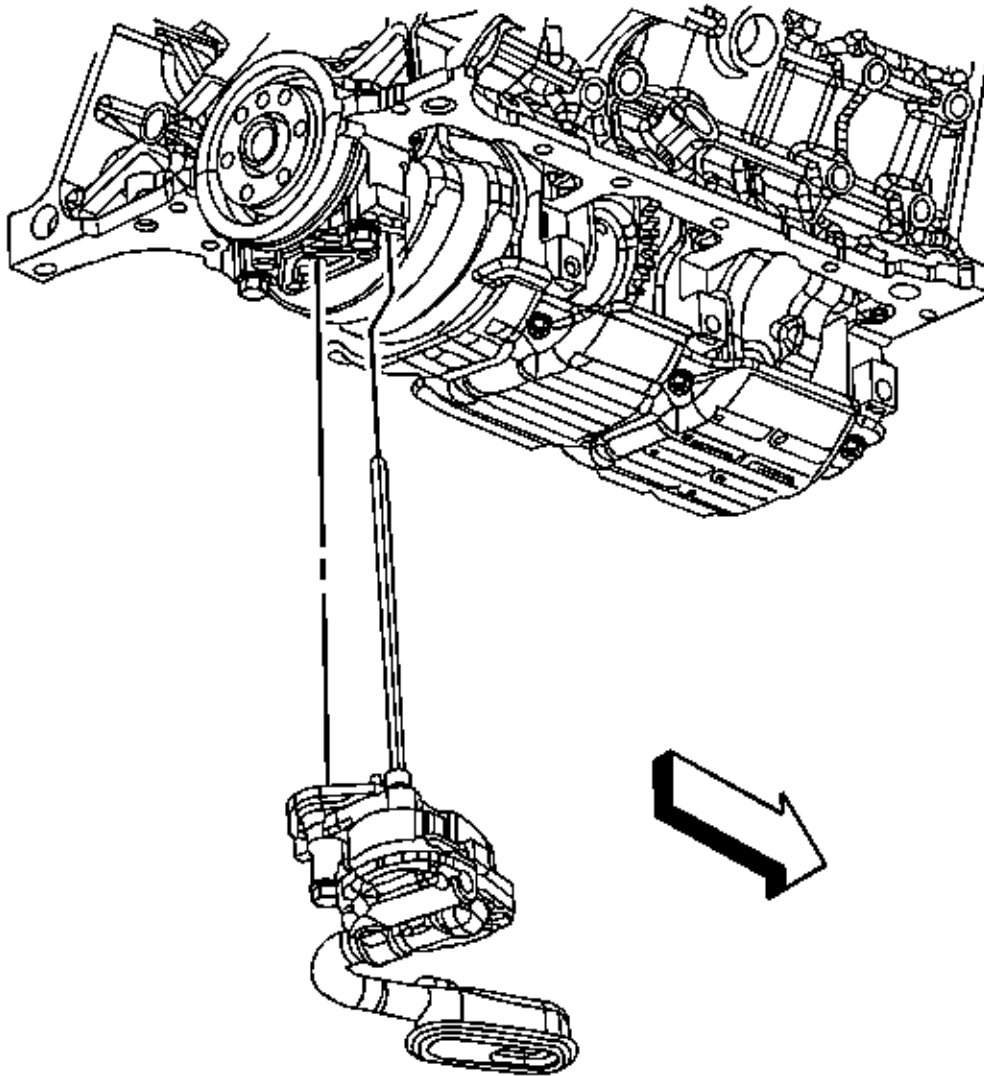
REMOVAL PROCEDURE

Fig. 153: 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.

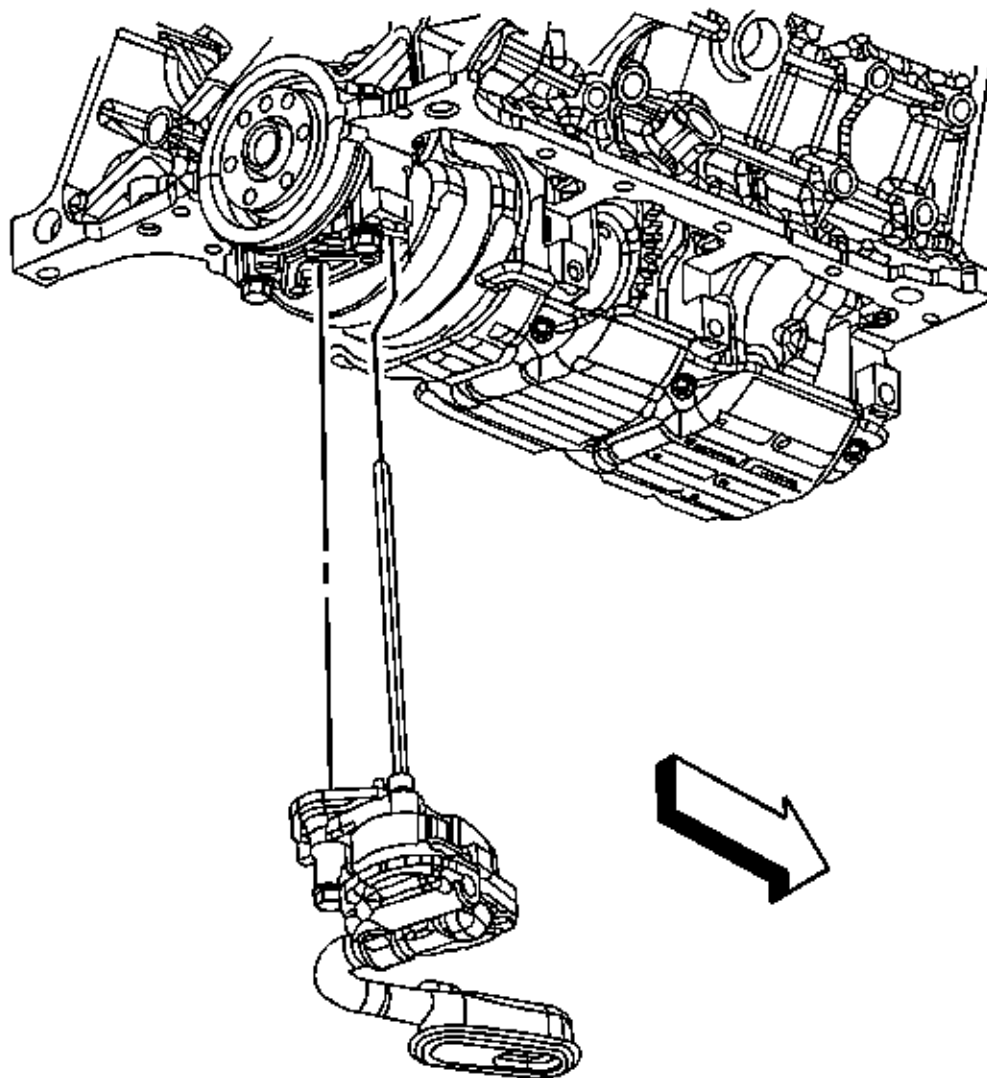


Fig. 154: Identifying Oil Pump & Oil Pump Drive Shaft
Courtesy of GENERAL MOTORS CORP.

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

CAUTION: Refer to Fastener Caution .

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

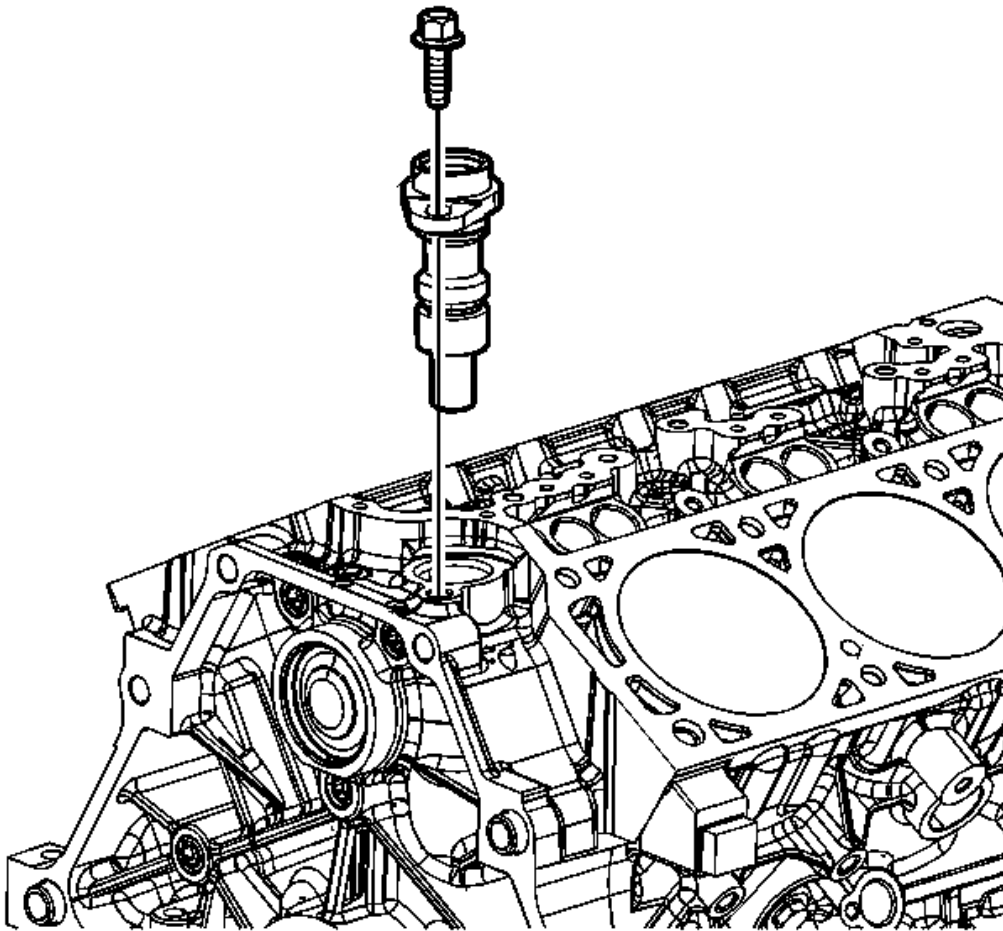


Fig. 155: Identifying Oil Pump Drive

Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to [Intake Manifold Cover Replacement](#).
2. Remove the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#)
3. Remove the oil pump drive bolt.
4. Remove the oil pump drive.

INSTALLATION PROCEDURE

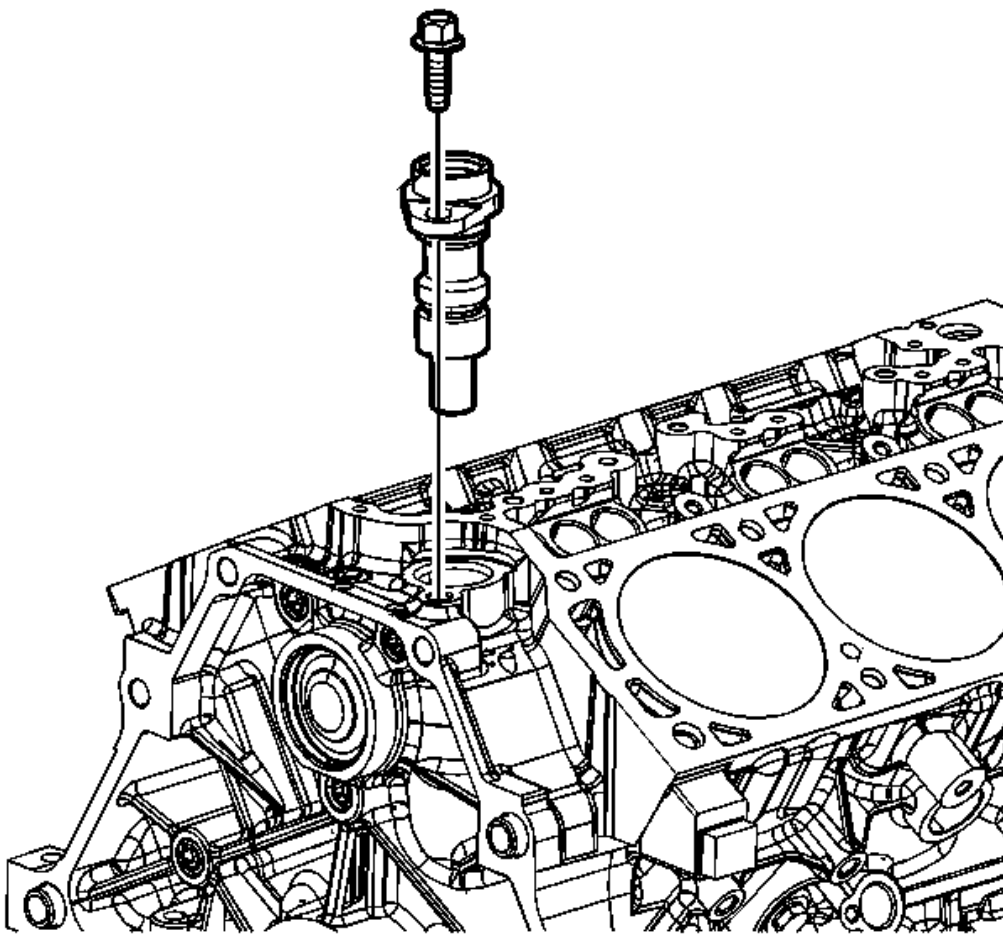


Fig. 156: Identifying Oil Pump Drive
Courtesy of GENERAL MOTORS CORP.

1. Coat the drive gear on the oil pump drive with prelube. Refer to [Adhesives, Fluids, Lubricants, and Sealers](#) .

2. Install the oil pump drive.

CAUTION: Refer to **Fastener Caution** .

3. Install the oil pump drive bolt.

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

4. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement** .
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. See **Special Tools** .

REMOVAL PROCEDURE

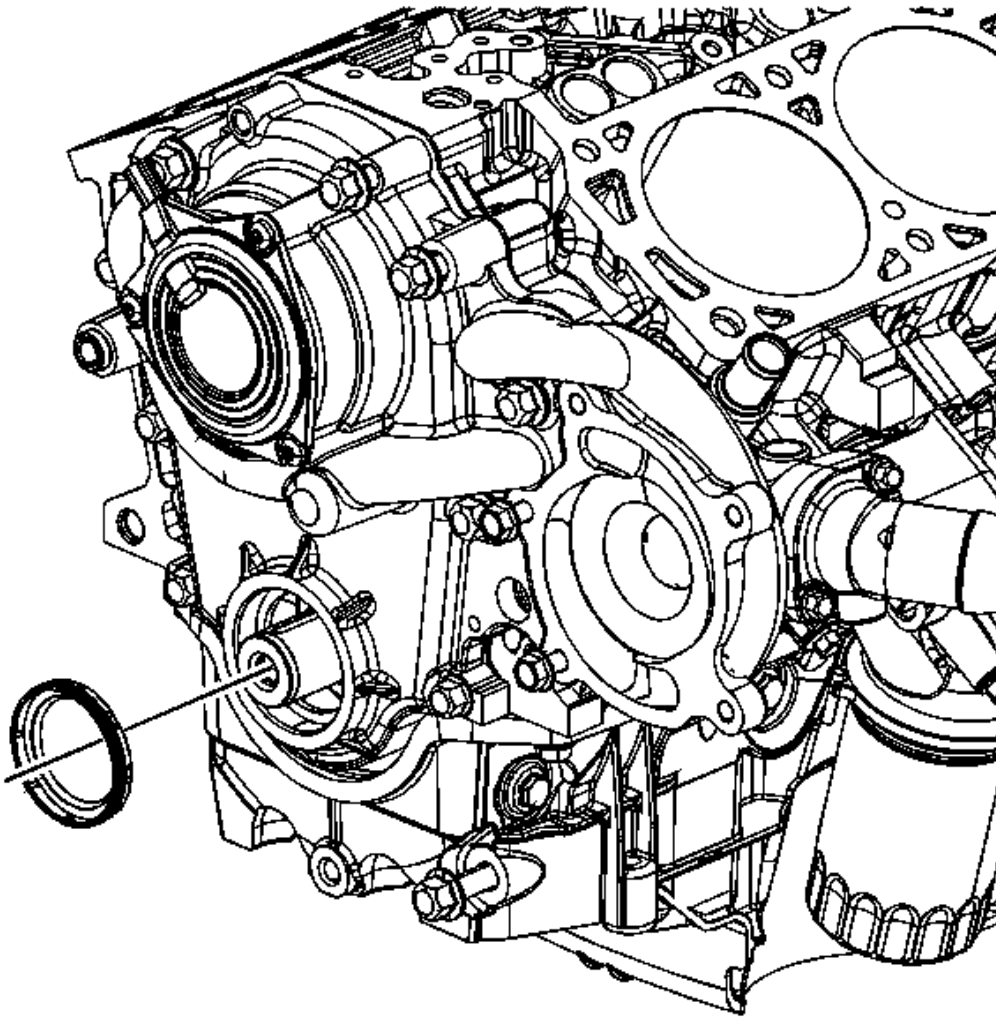


Fig. 157: Identifying Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

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

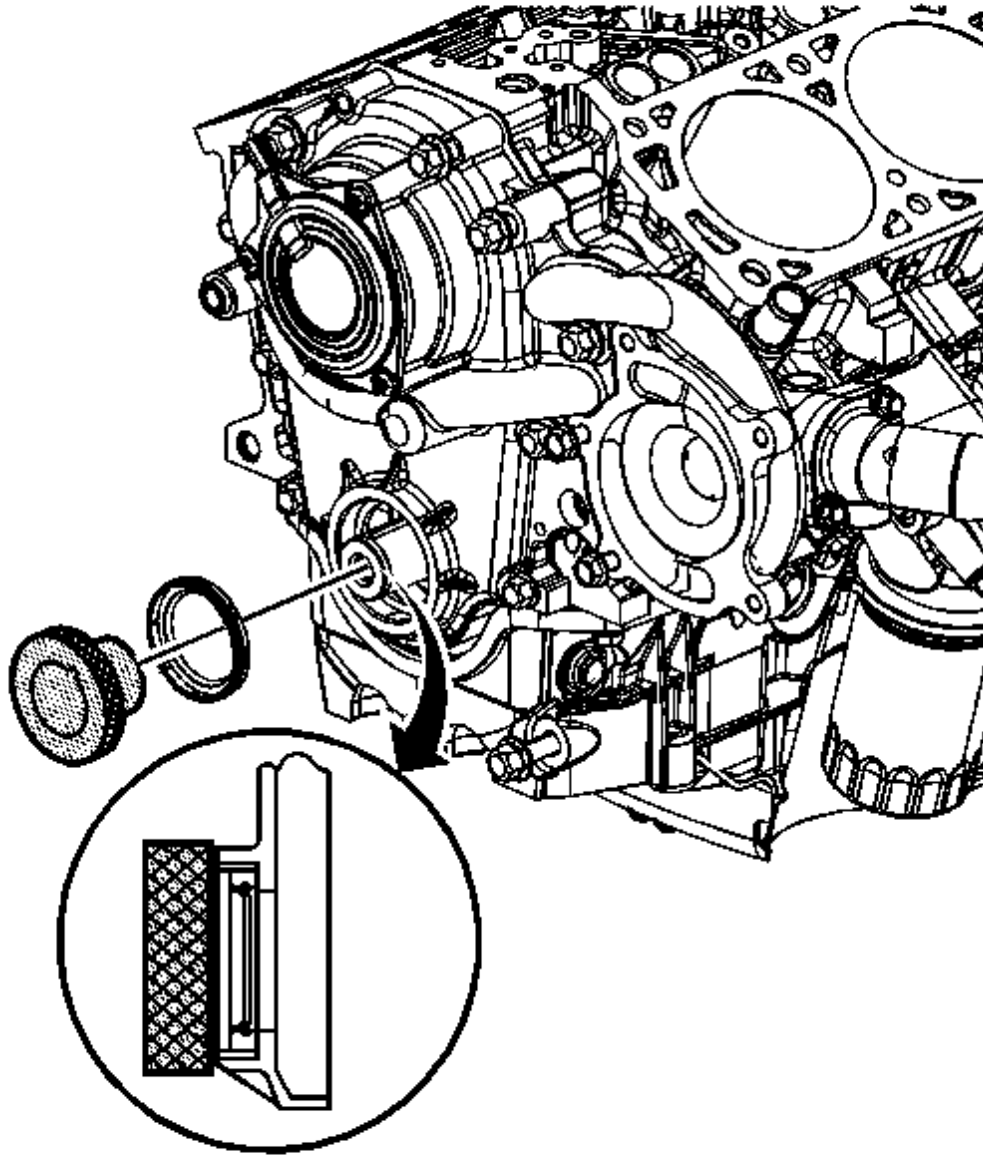


Fig. 158: View Of Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the NEW oil seal with clean engine oil.
2. Align the **EN-48869** and the crankshaft front oil seal with the engine front cover and crankshaft. See **Special Tools** .
3. Install the crankshaft front oil seal using **EN-48869** and a suitable tool. See **Special Tools** .

4. Install the crankshaft key into the keyway.
5. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.

CAMSHAFT POSITION ACTUATOR MAGNET REPLACEMENT

REMOVAL PROCEDURE

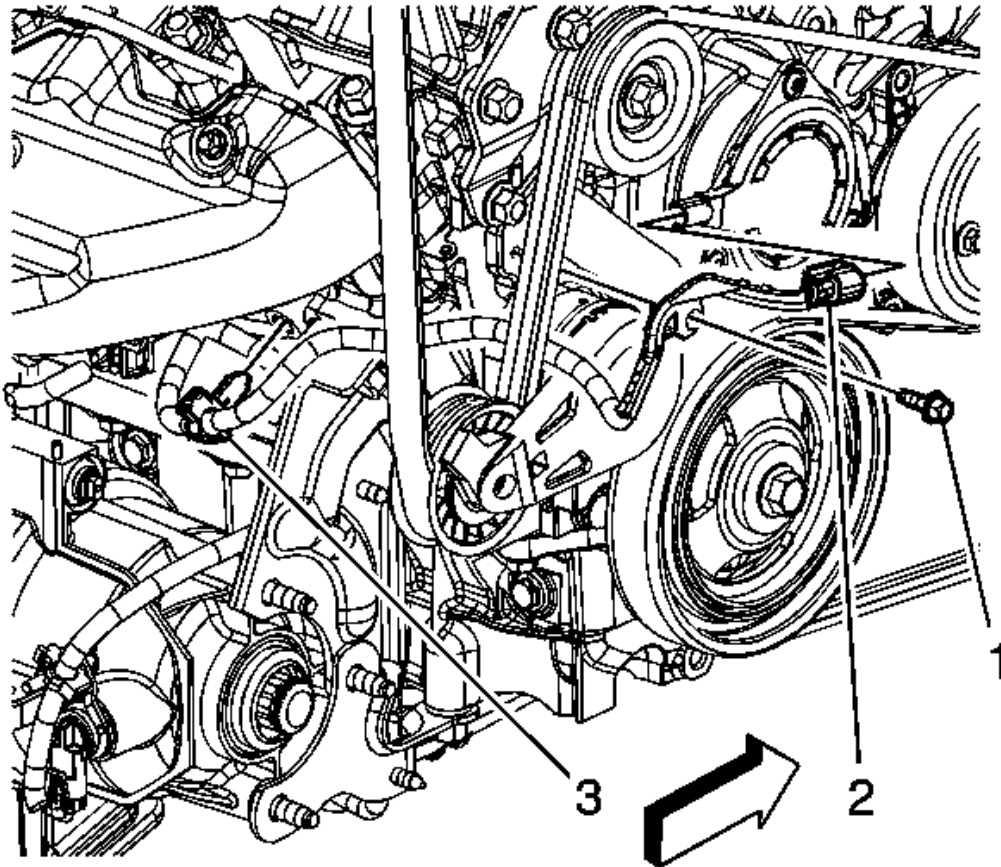


Fig. 159: View Of Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Remove the engine mount snubber bracket. Refer to **Engine Mount Snubber Bracket Replacement**.
3. Disconnect the engine wiring harness electrical connector (2) from the camshaft position actuator magnet.

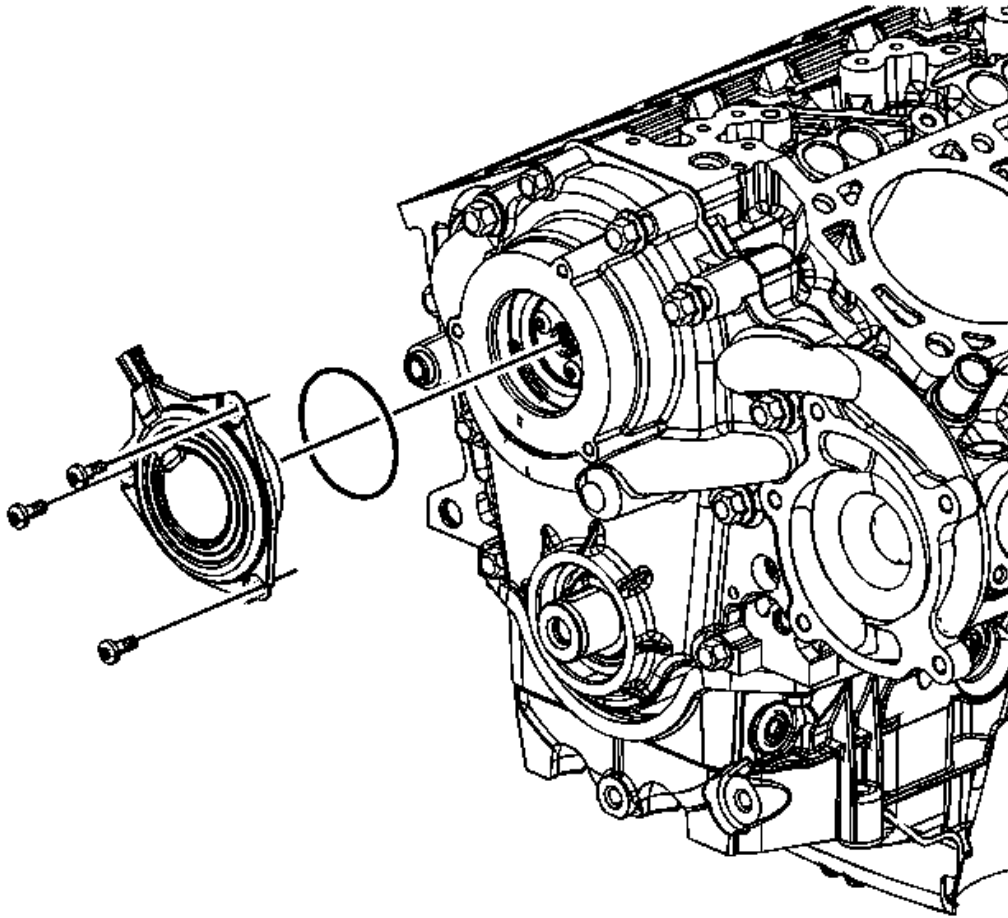


Fig. 160: Identifying Camshaft Position Actuator Magnet & Bolts
Courtesy of GENERAL MOTORS CORP.

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

INSTALLATION PROCEDURE

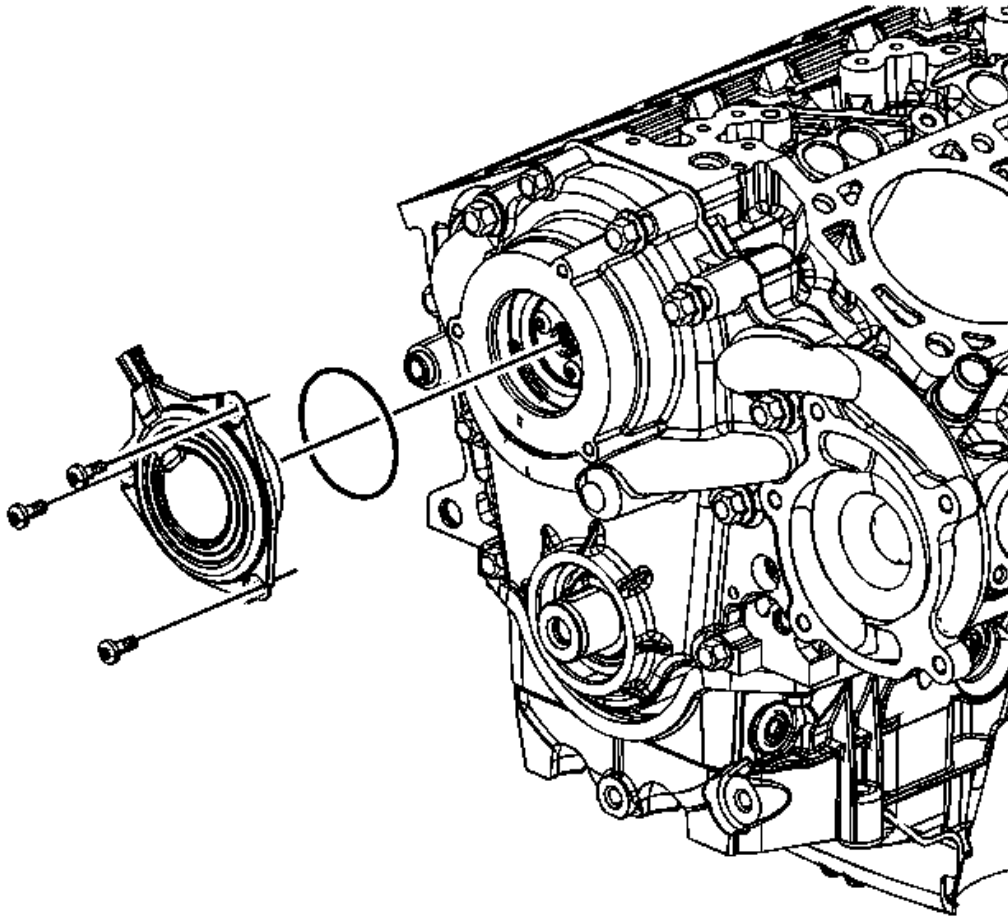


Fig. 161: Identifying Camshaft Position Actuator Magnet & Bolts
 Courtesy of GENERAL MOTORS CORP.

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

CAUTION: Refer to Fastener Caution .

2. Install the camshaft position actuator magnet bolts and tighten to 10 N.m (89 lb in).

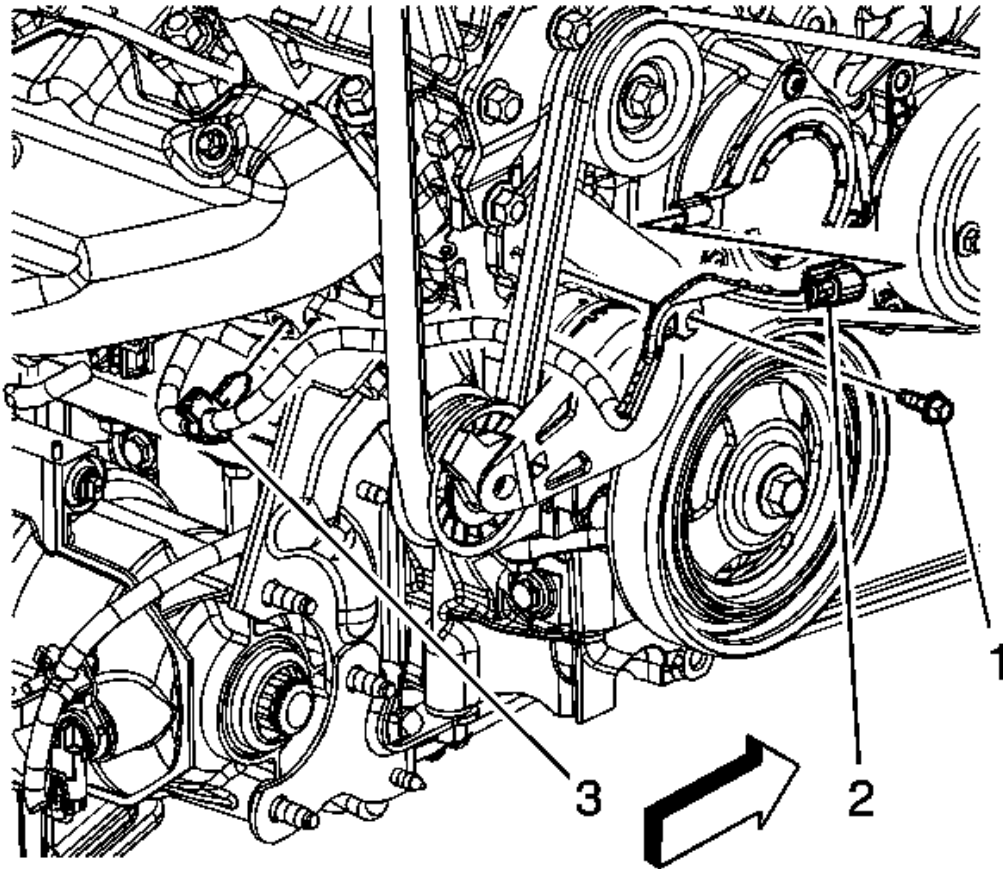


Fig. 162: View Of Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the engine wiring harness electrical connector (2) to the camshaft position actuator magnet.
4. Install the engine mount snubber bracket. Refer to **Engine Mount Snubber Bracket Replacement**.
5. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

ENGINE FRONT COVER REPLACEMENT

REMOVAL PROCEDURE

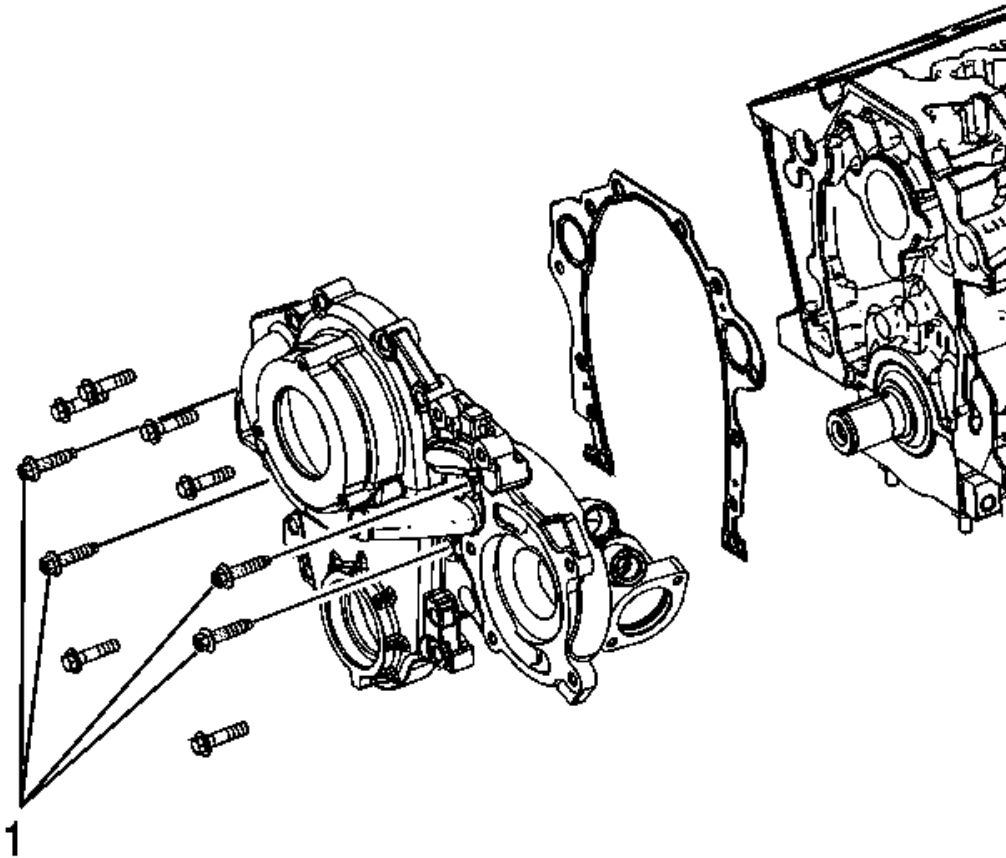


Fig. 163: Identifying Front Cover & Gasket
 Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill-LY7, LZE, LZ4)** or **Cooling System Draining and Filling (GE 47716)** .
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 (LZ4)** .
7. Remove the water pump. Refer to **Water Pump Replacement (LZ4)** .
8. Remove the engine front cover bolts (1).
9. Remove the engine front cover.

10. Remove the engine front cover gasket.

INSTALLATION PROCEDURE

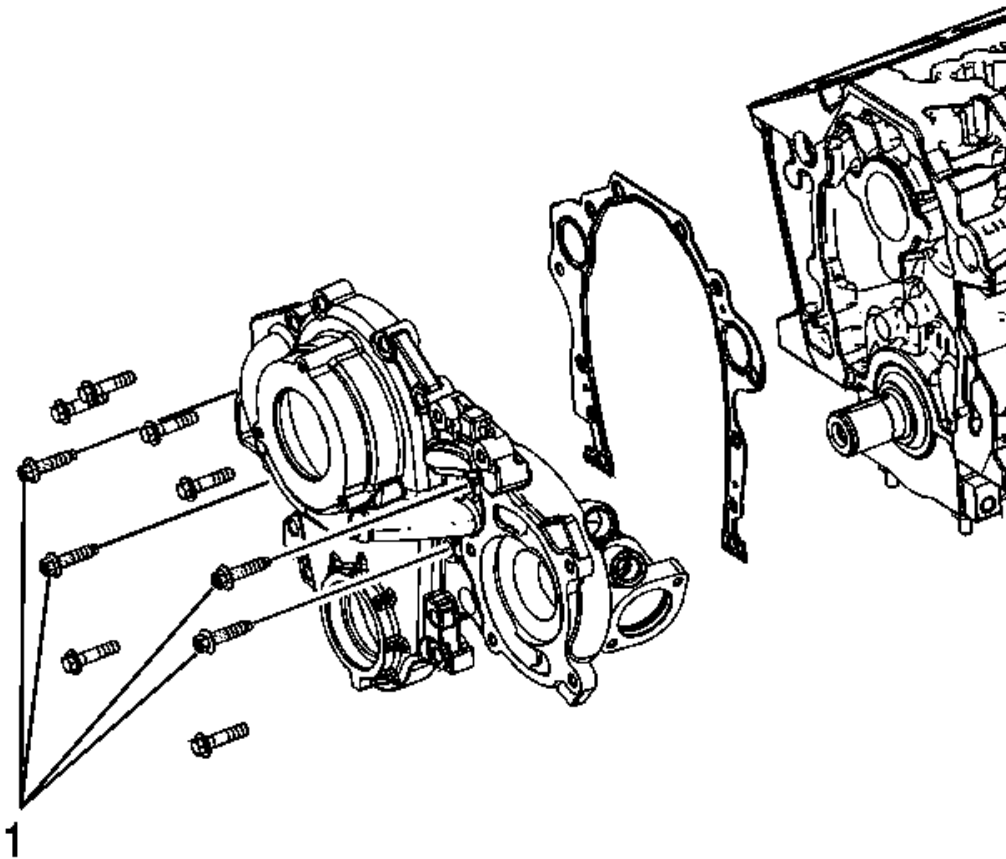


Fig. 164: Identifying Front Cover & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the engine front cover gasket.
2. Install the engine front cover.
3. Apply sealant to the bolts in the locations pointed out (1) in the graphic. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .

CAUTION: Refer to **Fastener Caution** .

4. Install the engine front cover bolts.

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

5. Install the water pump. Refer to **Water Pump Replacement (LZ4)** .
6. Install the thermostat housing. Refer to **Engine Coolant Thermostat Housing Replacement (LZ4)** .
7. Install the crankshaft position actuator magnet. Refer to **Camshaft Position Actuator Magnet Replacement**.
8. Install the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
9. Install the oil pan. Refer to **Oil Pan Replacement**.
10. Install the drive belt tensioner. Refer to **Drive Belt Tensioner Replacement**.
11. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill-LY7, LZE, LZ4)** or **Cooling System Draining and Filling (GE 47716)** .

CAMSHAFT TIMING CHAIN AND SPROCKET REPLACEMENT

SPECIAL TOOLS

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

REMOVAL PROCEDURE

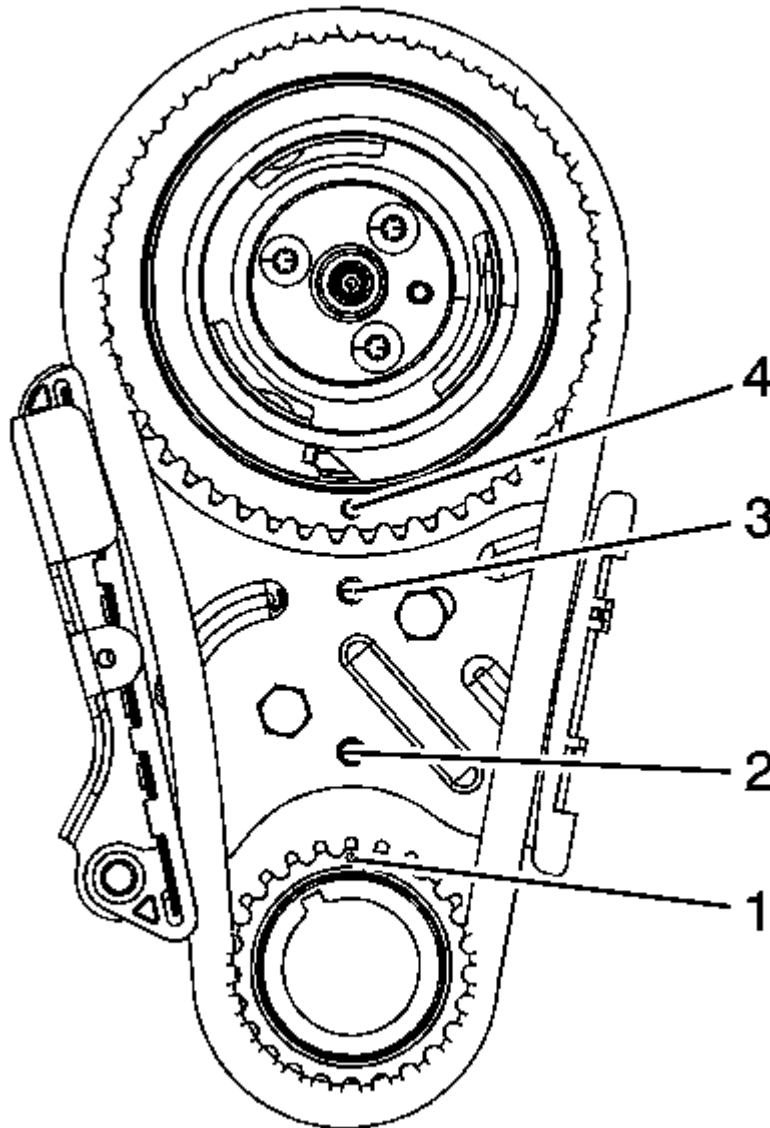


Fig. 165: Identifying Timing Marks & Chain Tensioners
Courtesy of GENERAL MOTORS CORP.

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).

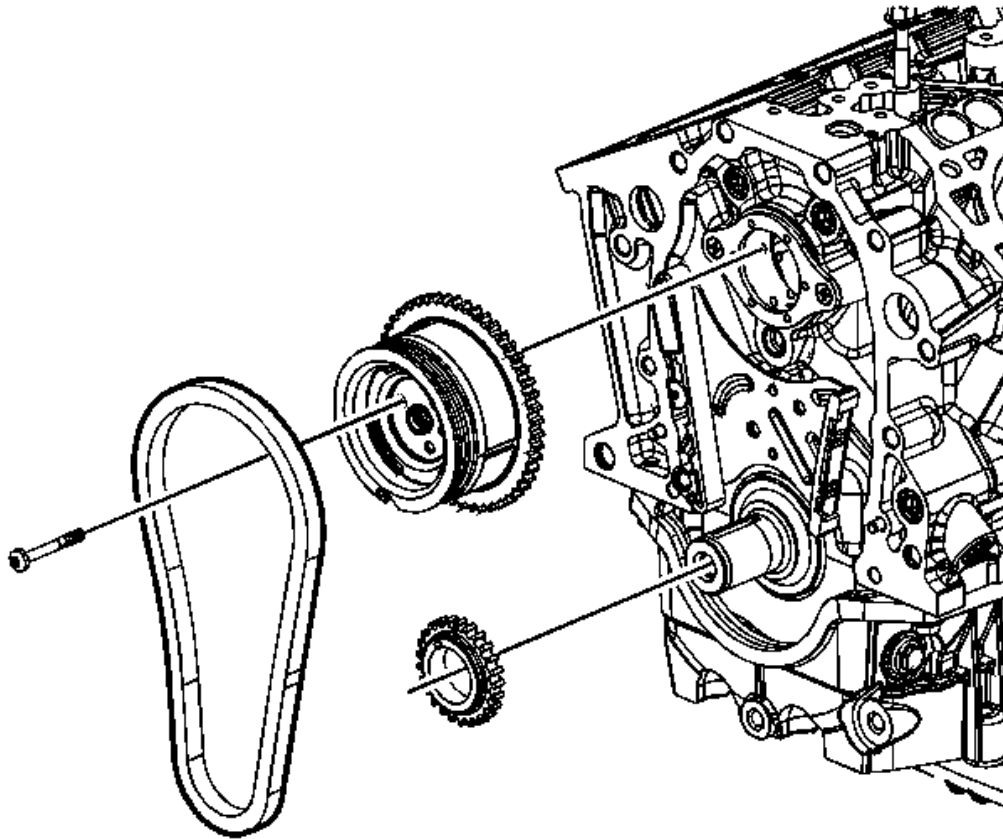


Fig. 166: View Of Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

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

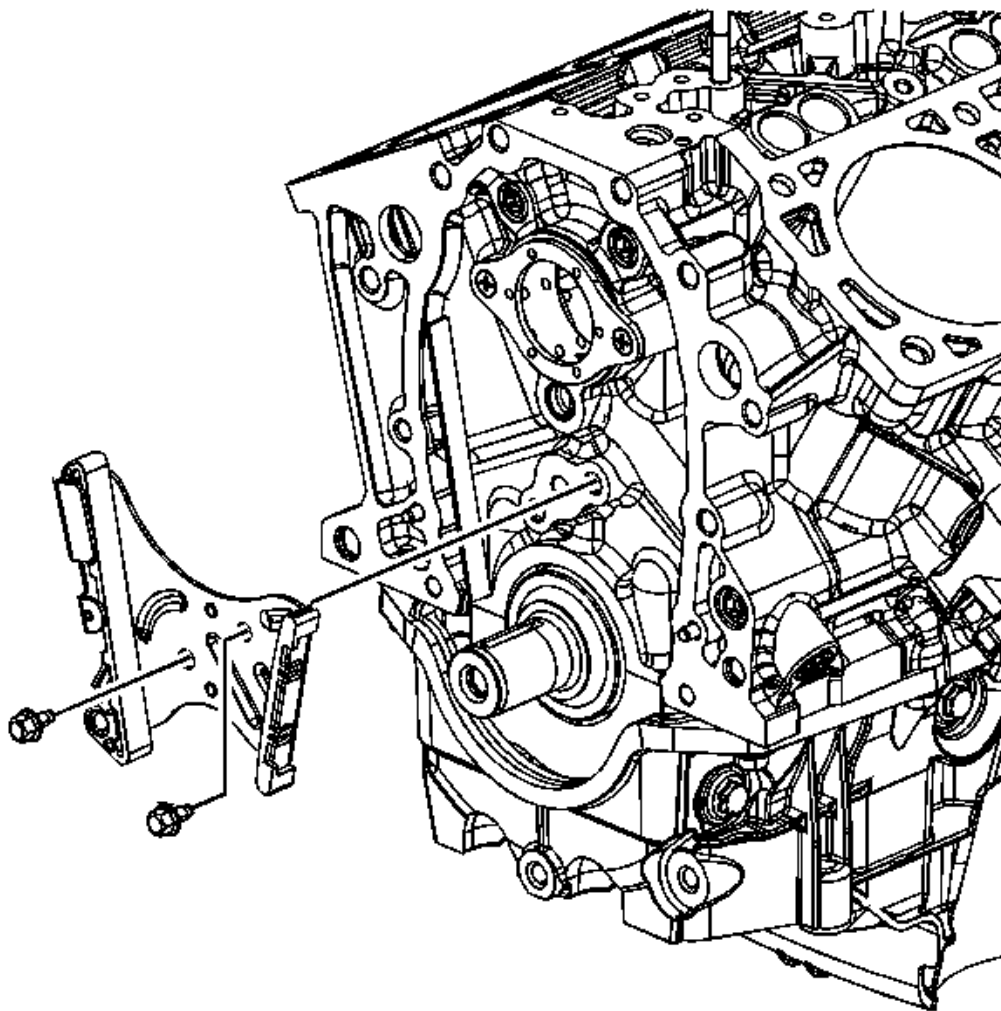


Fig. 167: View Of Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

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

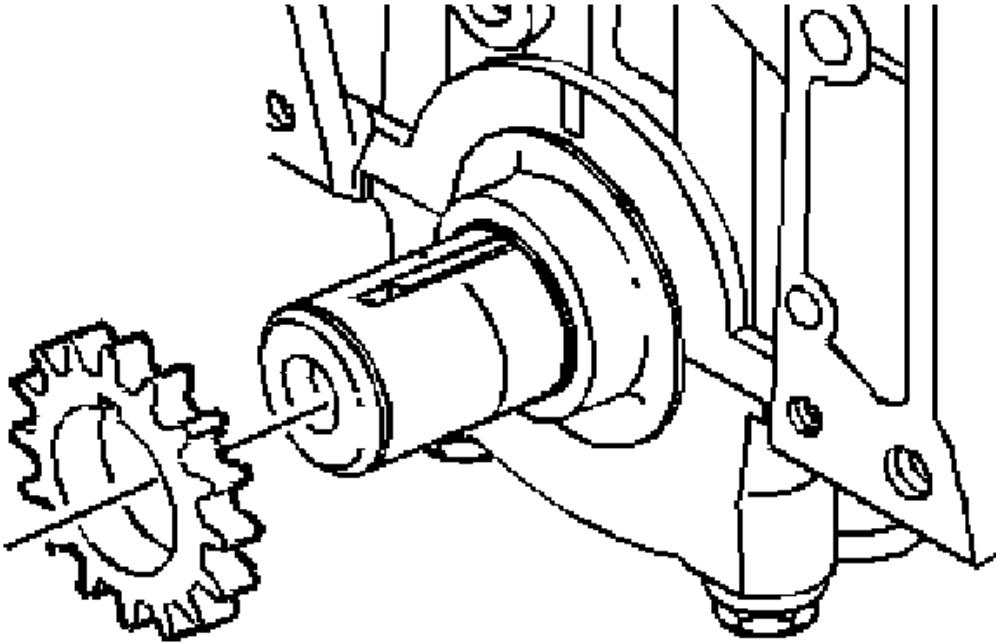


Fig. 168: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

8. Remove the crankshaft sprocket.

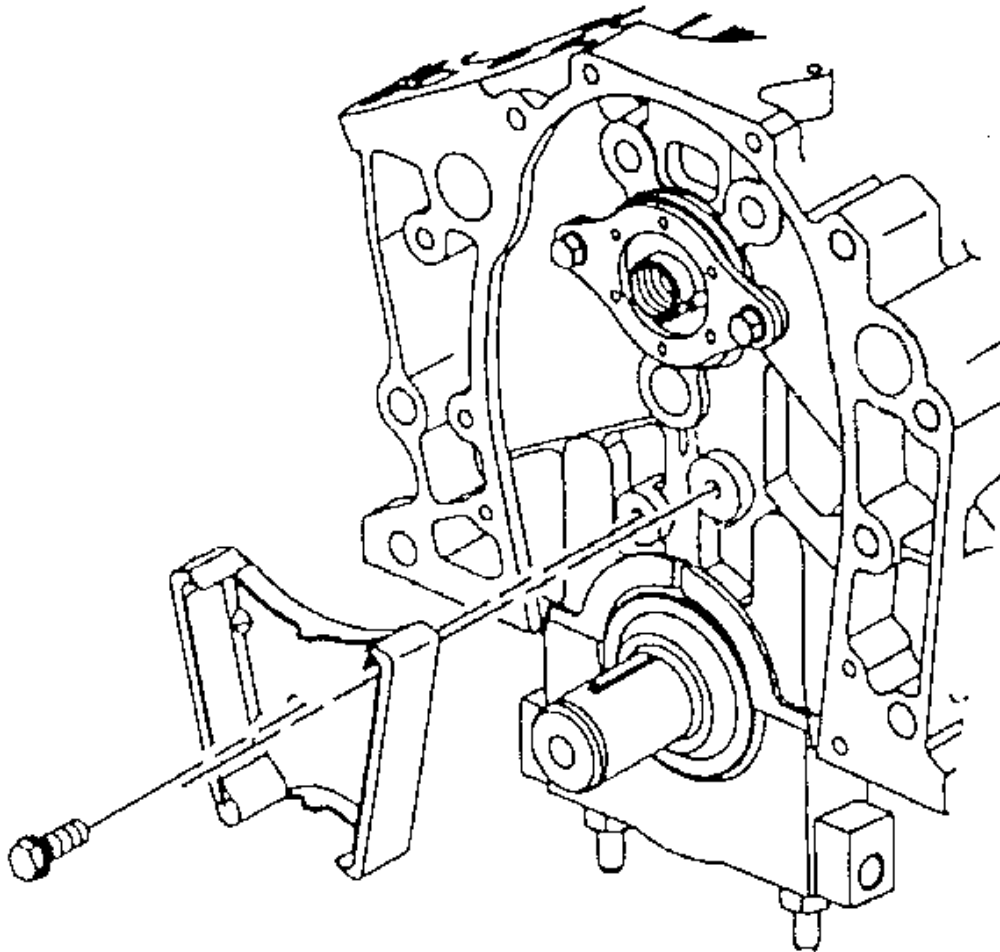


Fig. 169: View Of Timing Chain Dampener & Bolts
Courtesy of GENERAL MOTORS CORP.

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

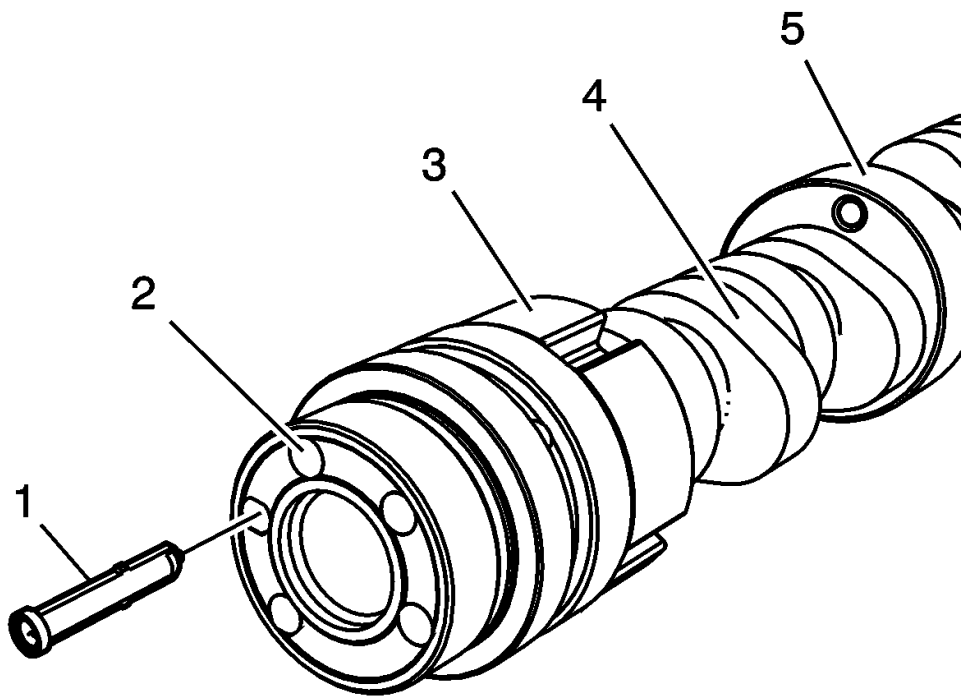


Fig. 170: View Of Camshaft & Actuator Filter
Courtesy of GENERAL MOTORS CORP.

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.

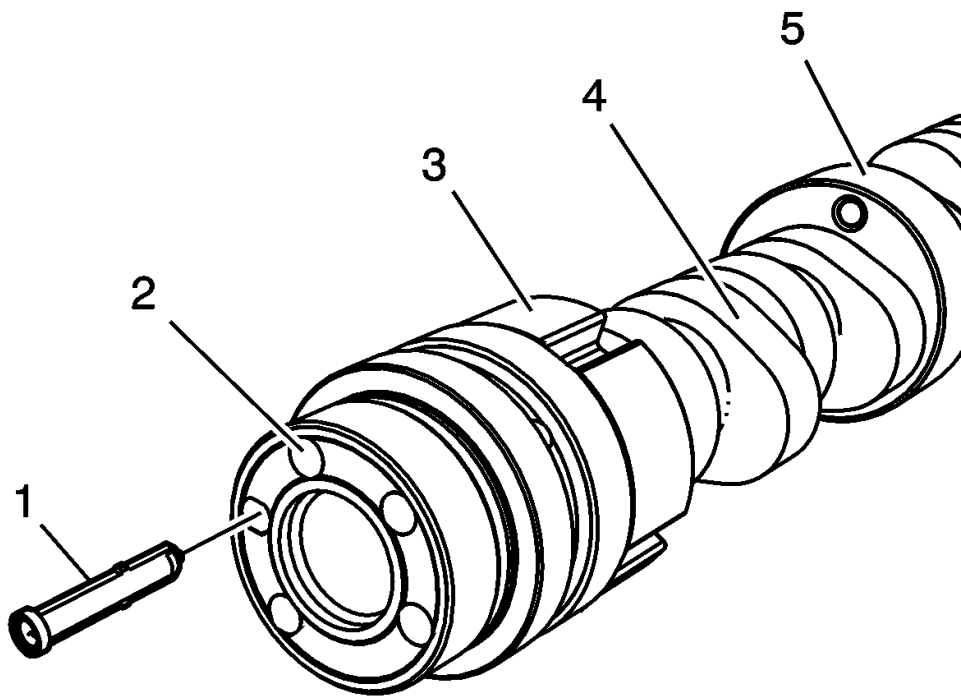


Fig. 171: View Of Camshaft & Actuator Filter
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW the camshaft position actuator filter (1) to the end of the camshaft.

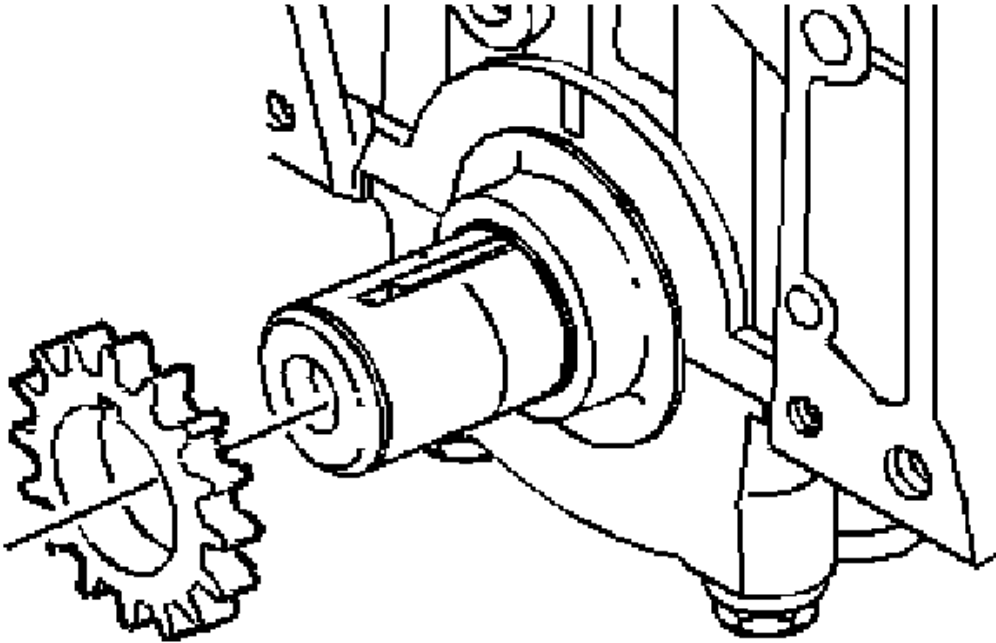


Fig. 172: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

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

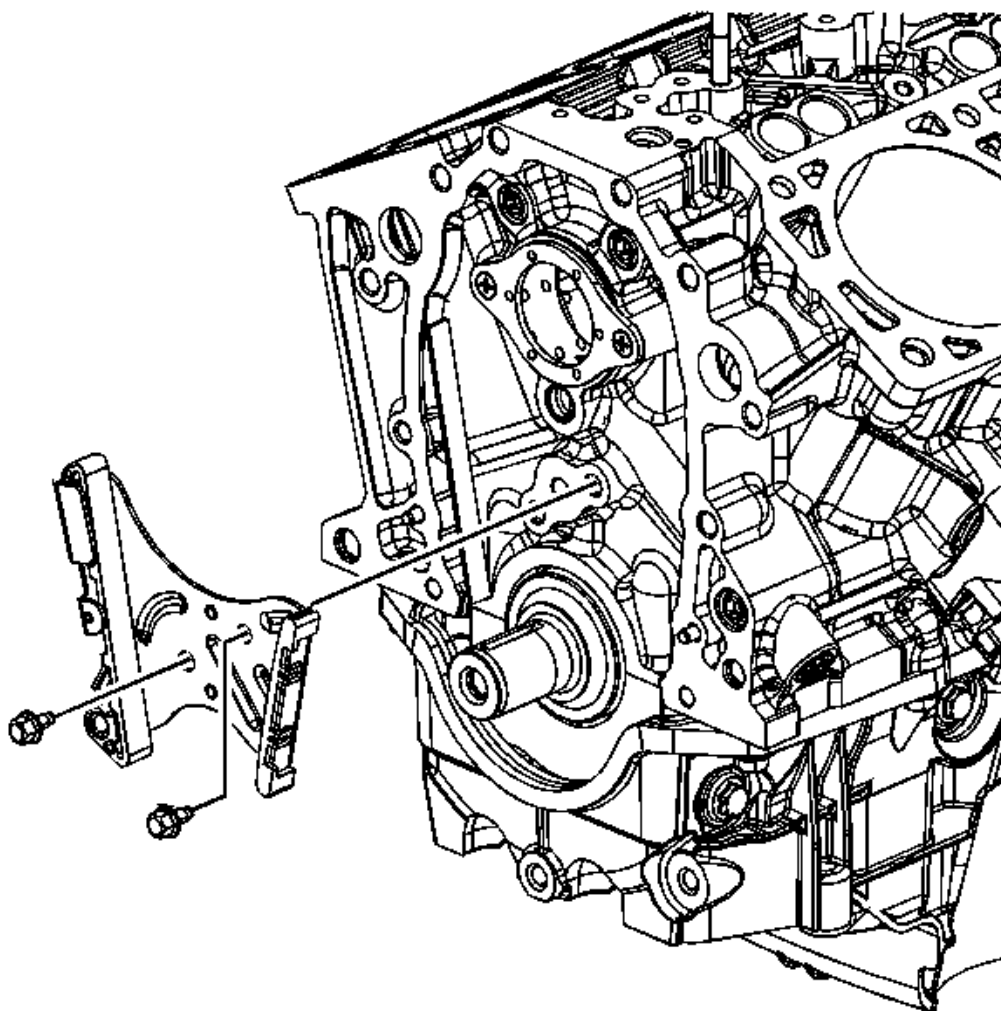


Fig. 173: View Of Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

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).

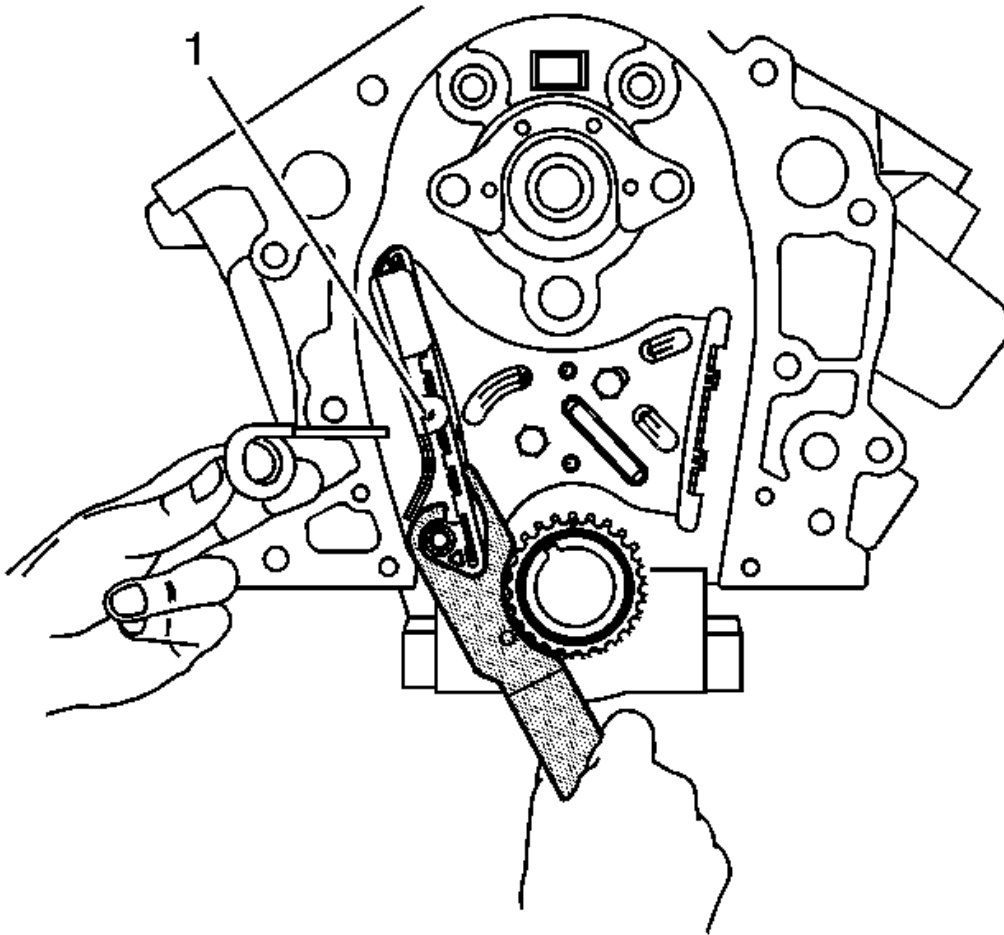


Fig. 174: Identifying Tensioner Collapsing Procedure
Courtesy of GENERAL MOTORS CORP.

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

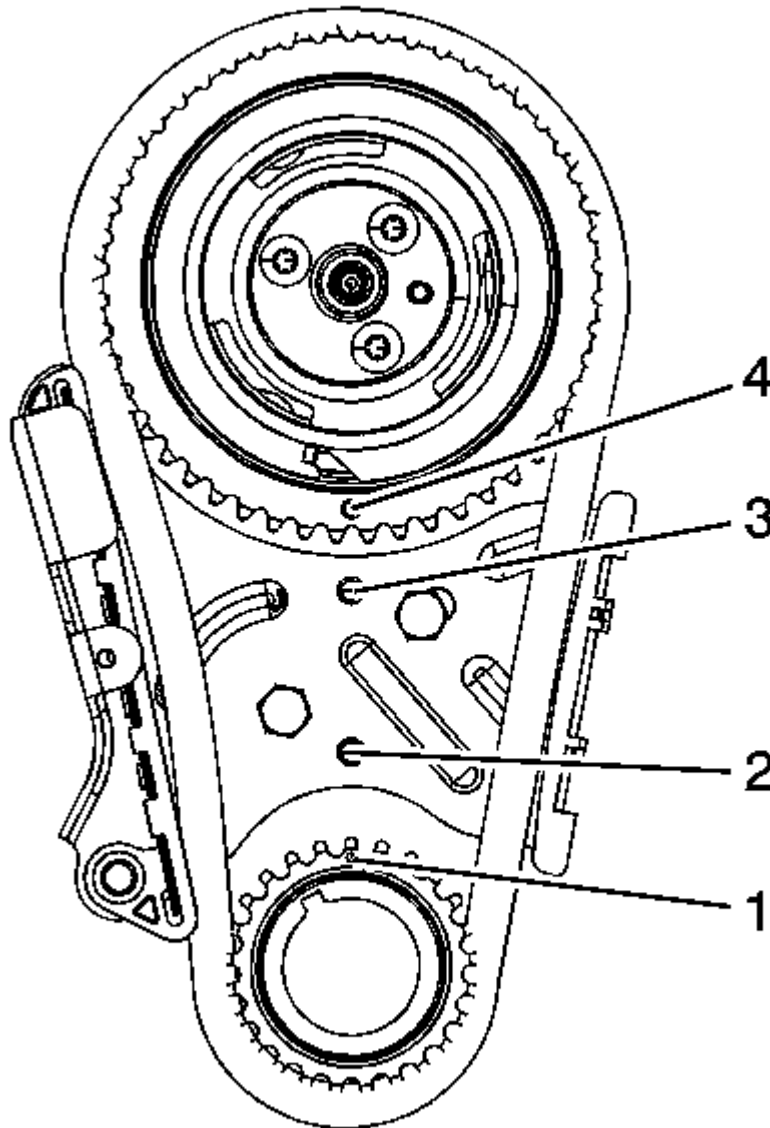


Fig. 175: Identifying Timing Marks & Chain Tensioners
Courtesy of GENERAL MOTORS CORP.

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).

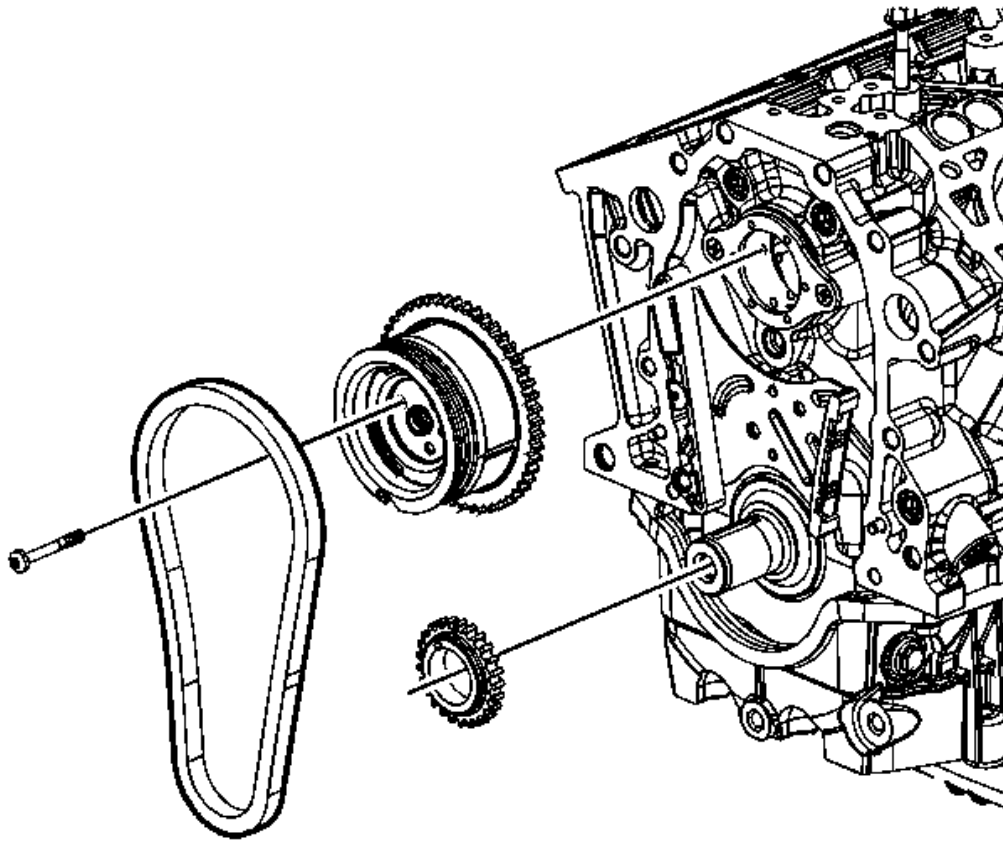


Fig. 176: Identifying Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

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

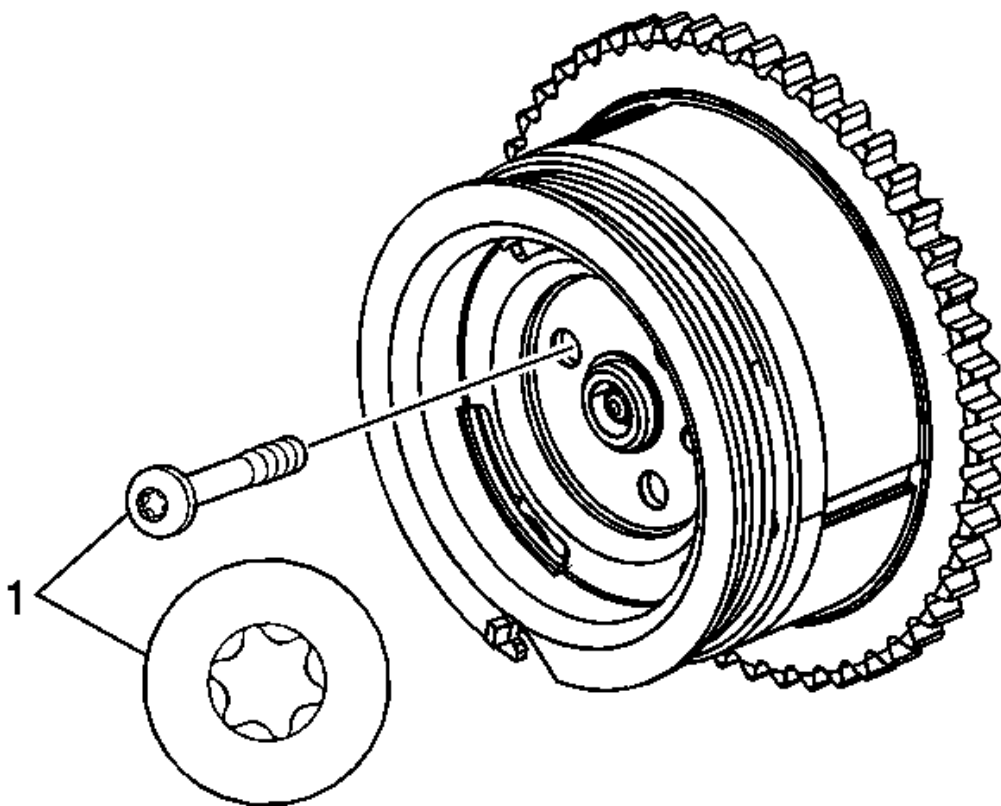


Fig. 177: Identifying Camshaft Position Actuator & Fasteners
Courtesy of GENERAL MOTORS CORP.

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

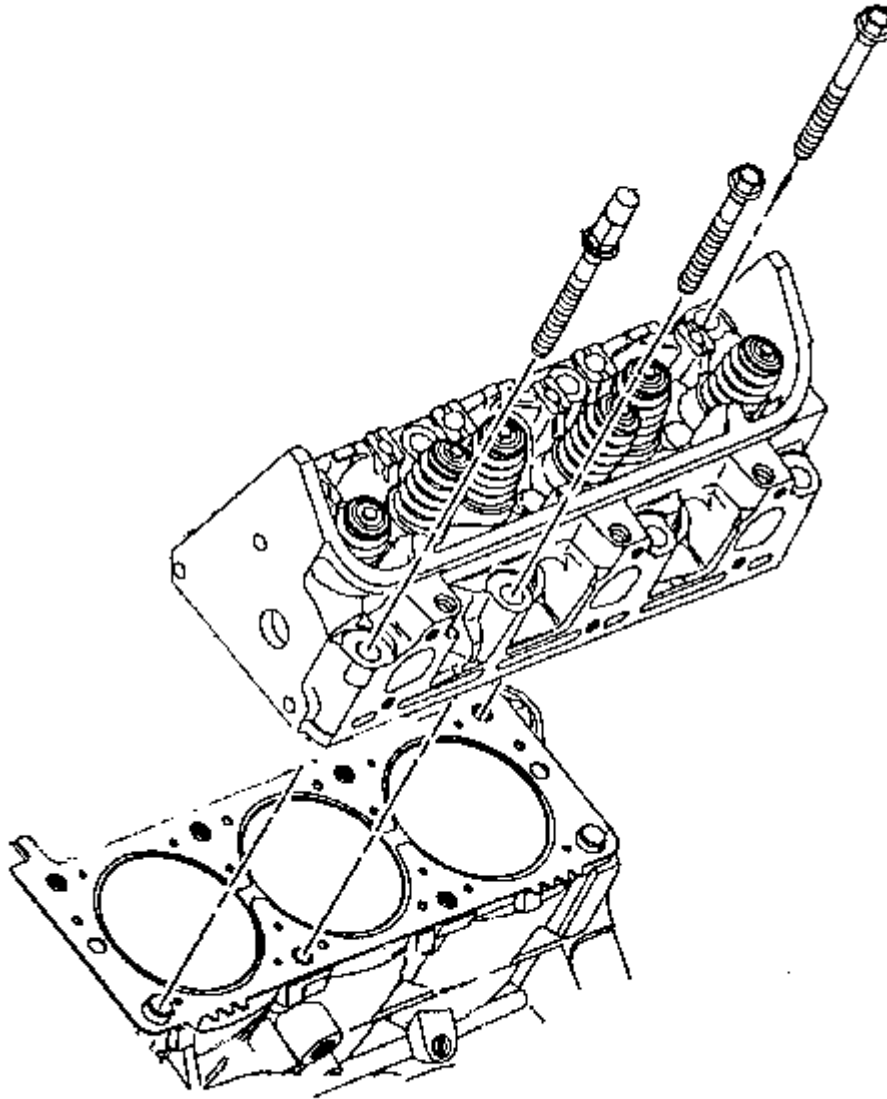


Fig. 178: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

1. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
2. Lower the vehicle.
3. Remove the lower intake manifold. Refer to **Lower Intake Manifold Replacement**.
4. Remove the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
5. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement - Left Side (LZ4)**.

6. Remove the oil level indicator tube. Refer to **Oil Level Indicator Tube Replacement**.
7. Remove the left spark plugs. Refer to **Spark Plug Replacement** .

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.

8. Remove and discard the cylinder head bolts.
9. Remove the cylinder head.

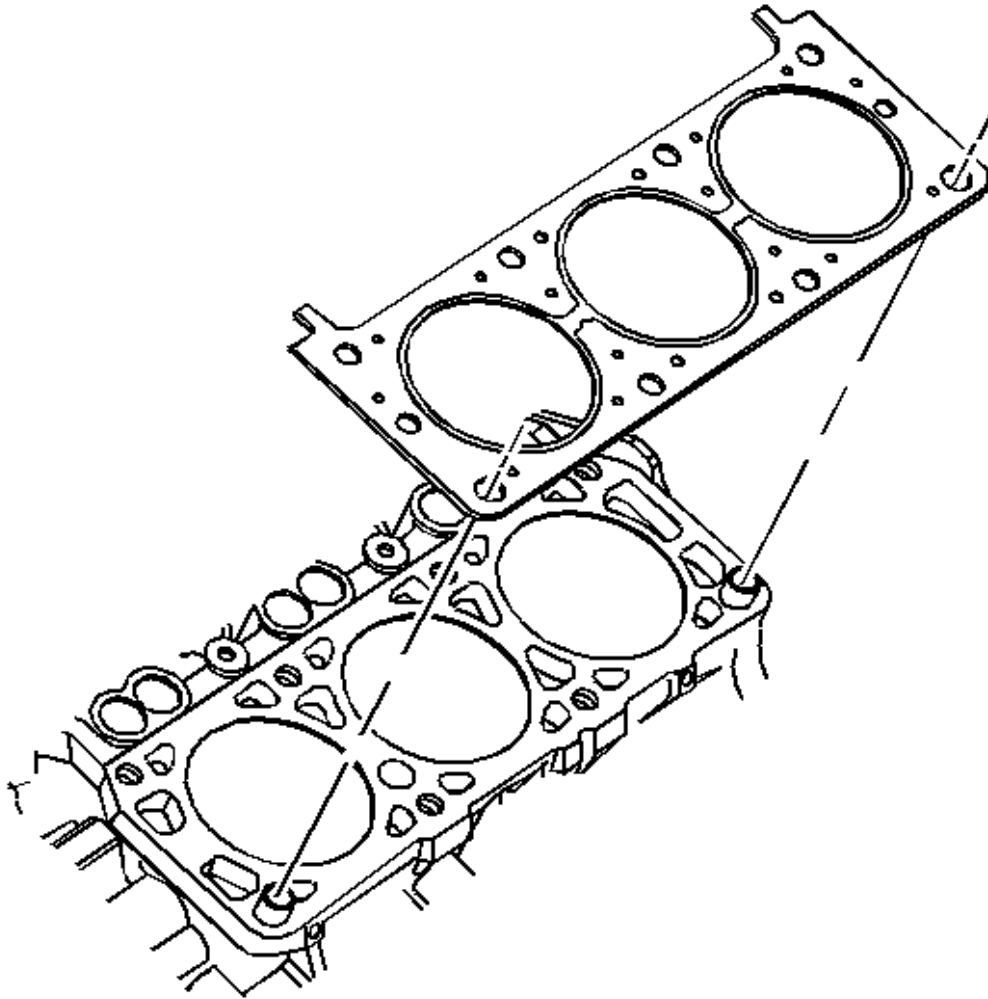


Fig. 179: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

10. Remove and discard the cylinder head gasket.
11. Remove the cylinder head locator dowel pins, if necessary.
12. Clean and inspect the cylinder head. Refer to **Cylinder Head Cleaning and Inspection** .

INSTALLATION PROCEDURE

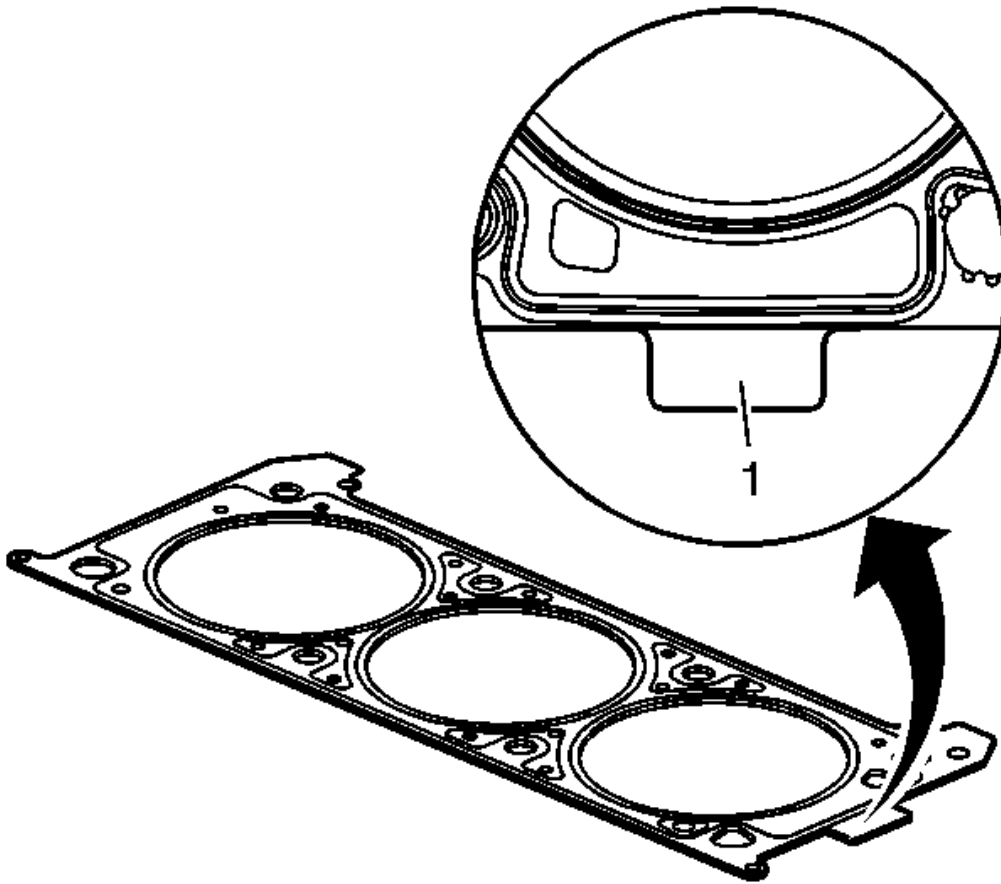


Fig. 180: Identifying Proper Cylinder Head Gasket Installation
Courtesy of GENERAL MOTORS CORP.

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.

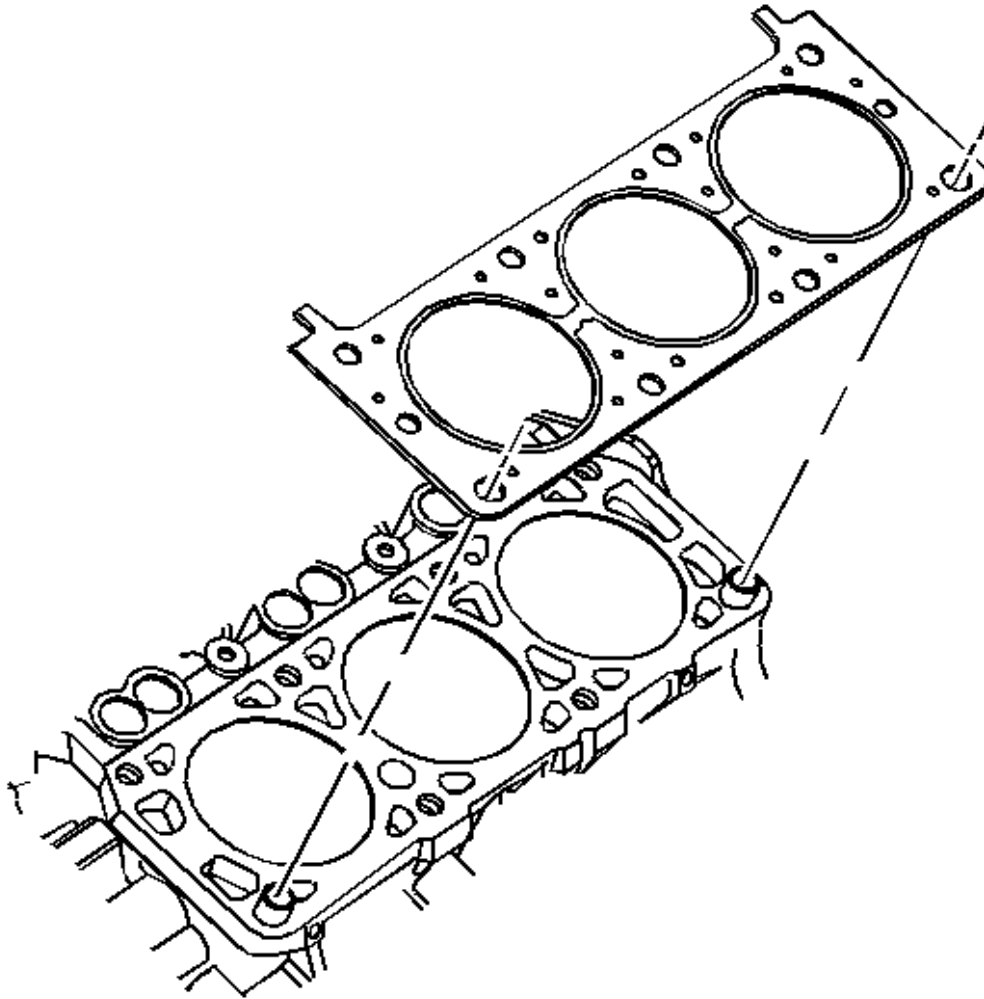


Fig. 181: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Install the cylinder head gasket.

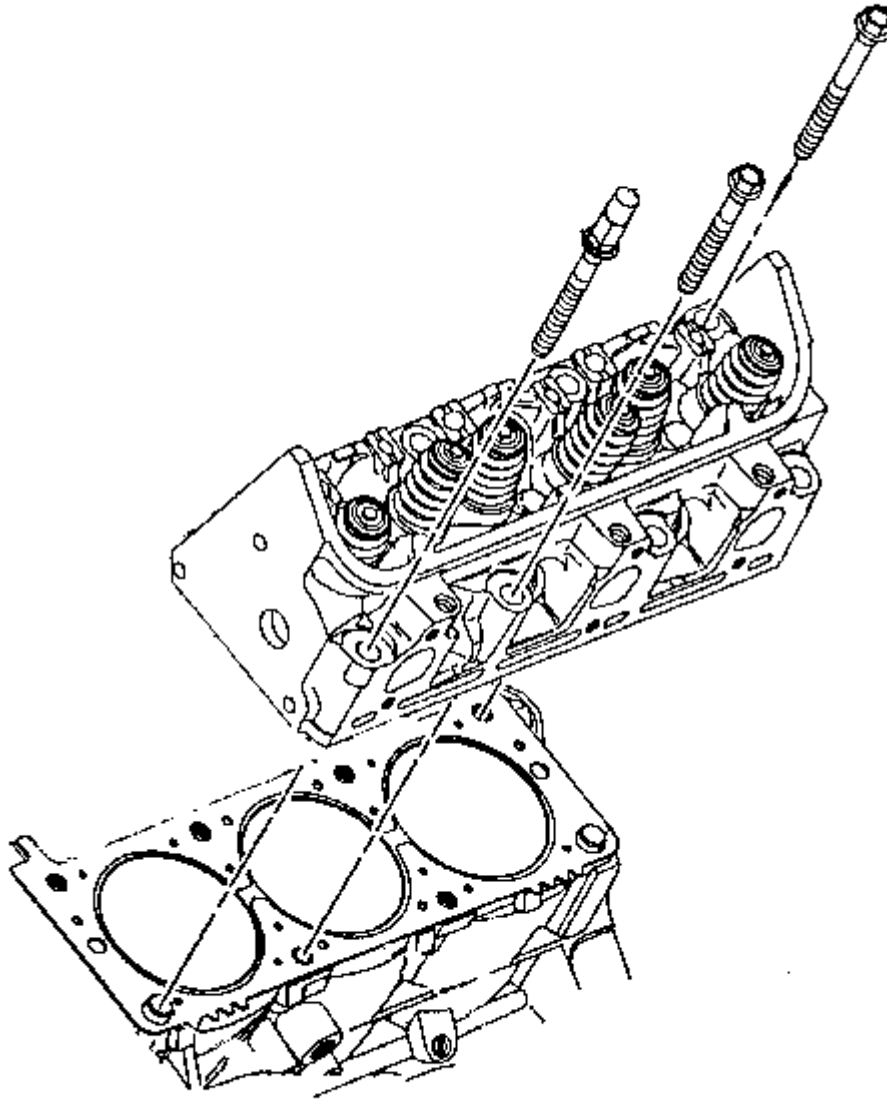


Fig. 182: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Install the cylinder head and bolts.

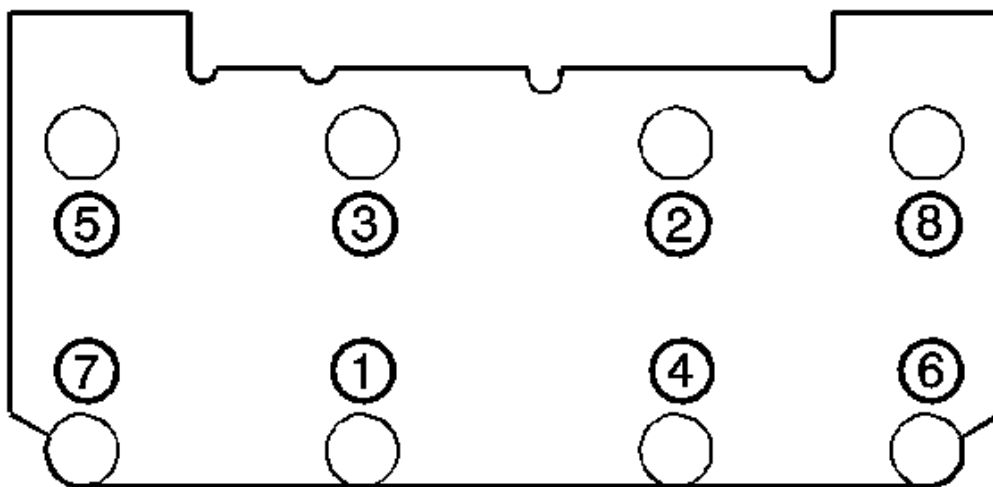


Fig. 183: View Of Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

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.

CAUTION: Refer to Fastener Caution .

5. Install the NEW small hex cylinder head bolts (5 and 8).
6. 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** .
7. Install the left spark plugs. Refer to Spark Plug Replacement .
 8. Install the oil level indicator tube. Refer to Oil Level Indicator Tube Replacement.
 9. Install the exhaust manifold. Refer to Exhaust Manifold Replacement - Left Side (LZ4) .
 10. Install the valve rocker arms and pushrods. Refer to Valve Rocker Arm and Push Rod Replacement.
 11. Install the lower intake manifold. Refer to Lower Intake Manifold Replacement.

12. Fill the engine with oil. Refer to **Engine Oil and Oil Filter Replacement**.
13. Inspect for leaks.

CYLINDER HEAD REPLACEMENT - RIGHT SIDE

SPECIAL TOOLS

J 45059 Angle Meter

REMOVAL PROCEDURE

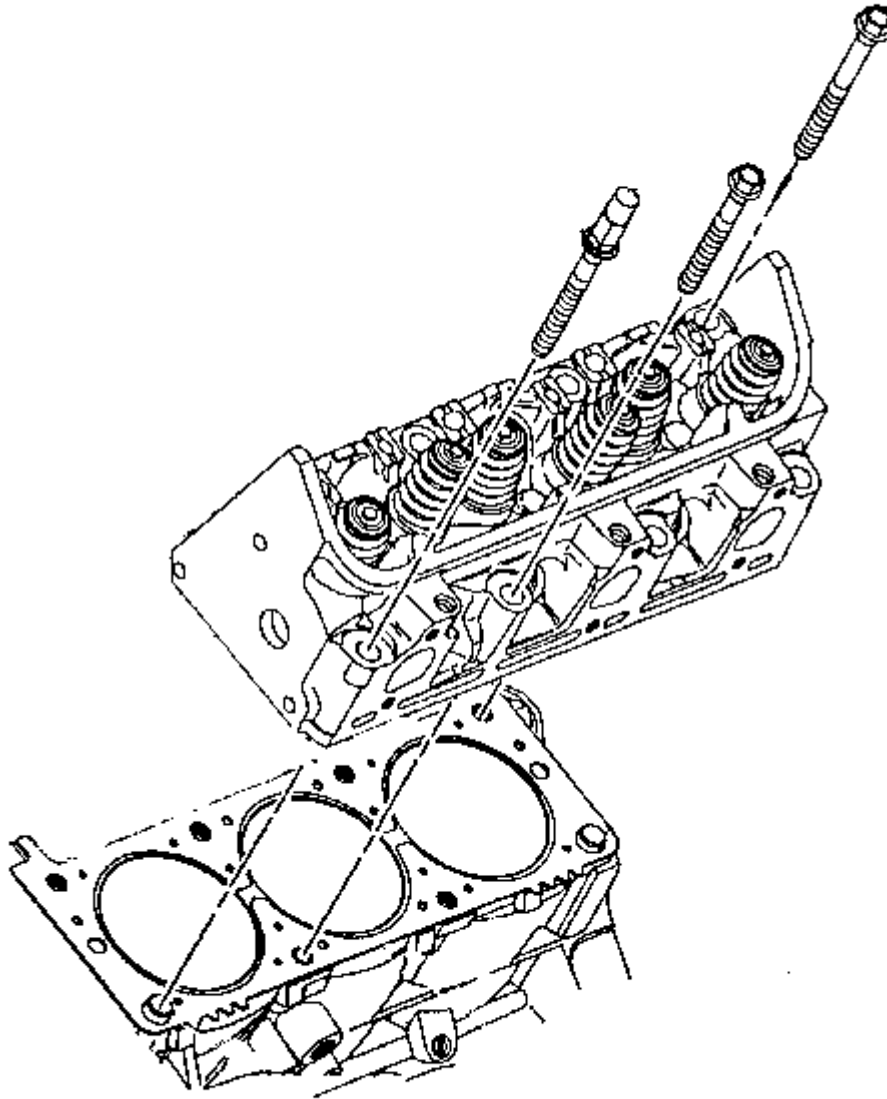


Fig. 184: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

1. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
2. Lower the vehicle.
3. Remove the lower intake manifold. Refer to **Lower Intake Manifold Replacement**.
4. Remove the valve rocker arms and push rods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
5. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement - Right Side (LZ4)**.

6. Remove the right spark plugs. Refer to **Spark Plug Replacement** .
7. Remove the generator. Refer to **Generator Replacement (LZ4)** .

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.

8. Remove and discard the cylinder head bolts.
9. Remove the cylinder head.

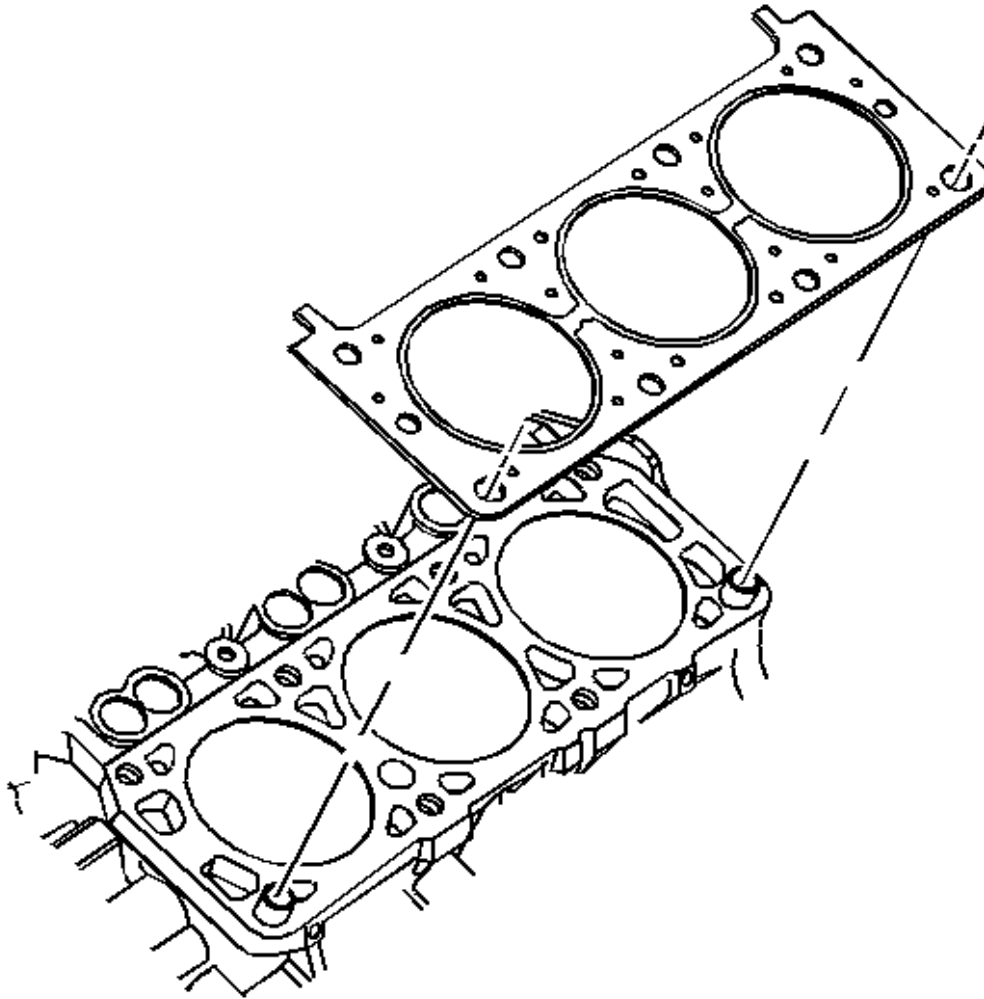


Fig. 185: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

10. Remove and discard the cylinder head gasket.
11. Remove the cylinder locator dowel pins, if necessary.
12. Clean and inspect the cylinder head. Refer to **Cylinder Head Cleaning and Inspection** .

INSTALLATION PROCEDURE

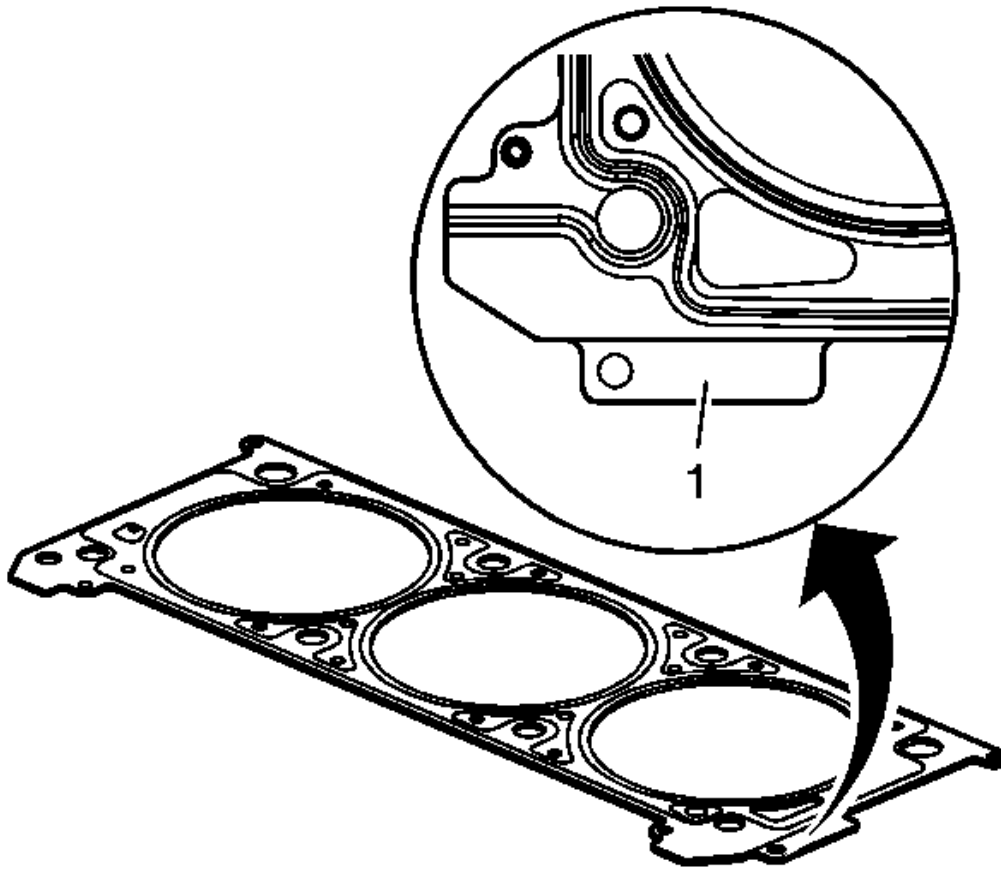


Fig. 186: Identifying Proper Cylinder Head Gasket Installation
Courtesy of GENERAL MOTORS CORP.

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.

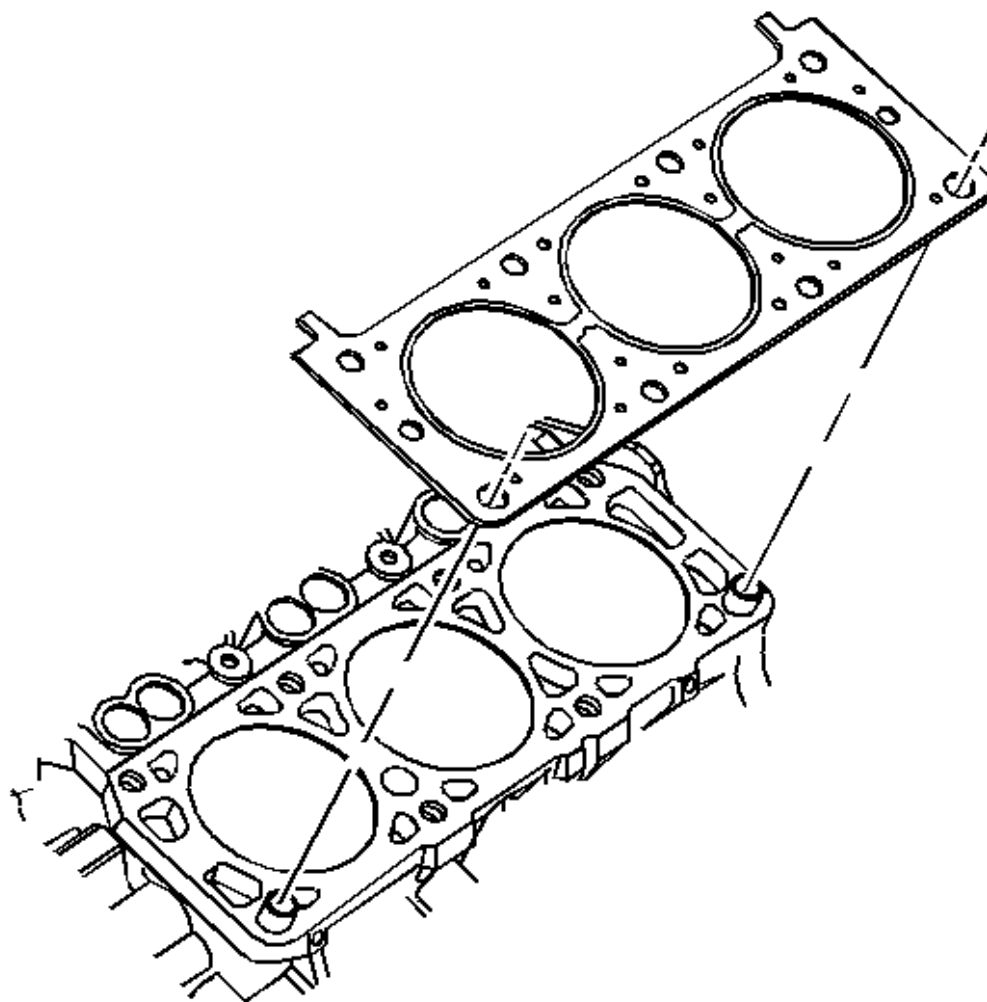


Fig. 187: View Of Cylinder Head Gasket And Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Install the cylinder head gasket.

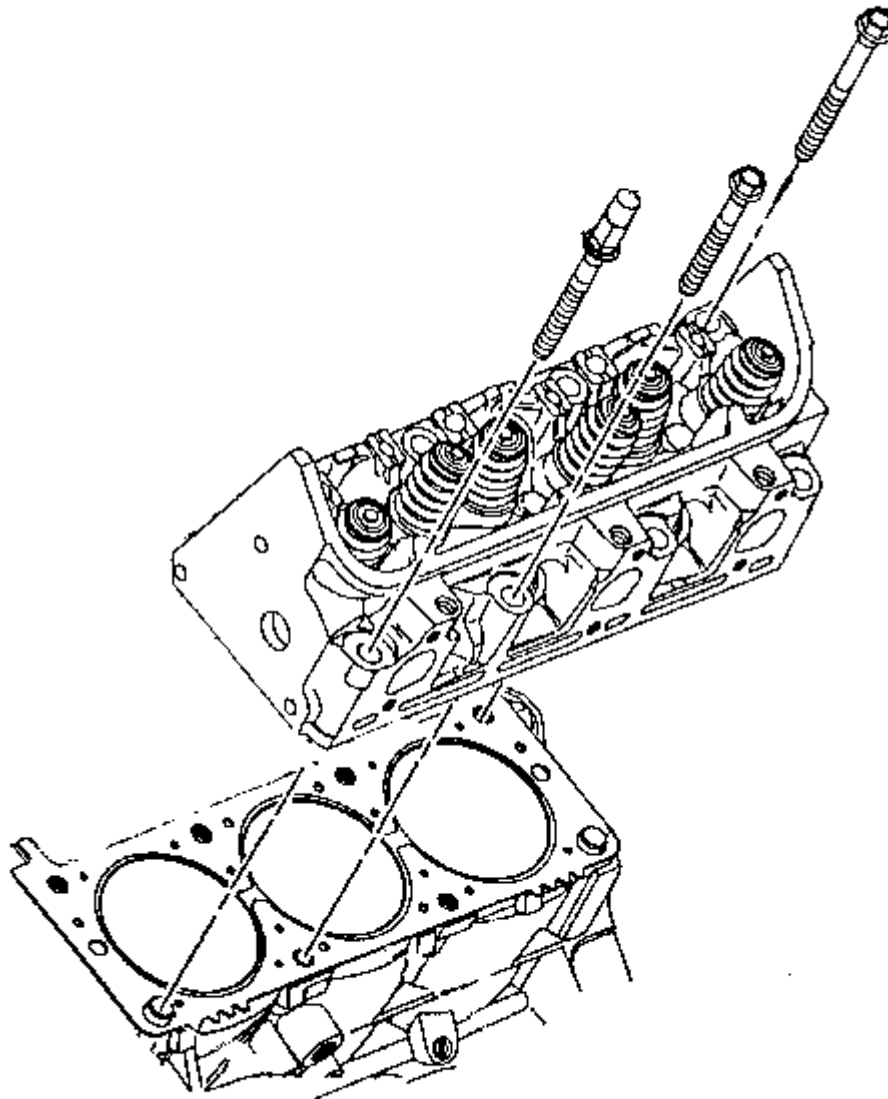


Fig. 188: View Of Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Install the cylinder head and bolts.

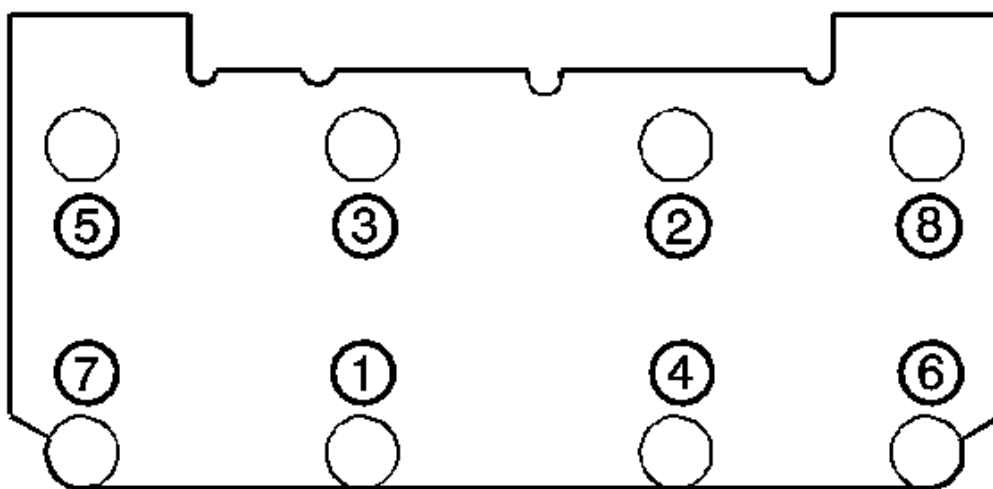


Fig. 189: View Of Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

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.

CAUTION: Refer to Fastener Caution .

5. Install the NEW small hex cylinder head bolts (5 and 8).
6. 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** .
7. Install the generator. Refer to Generator Replacement (LZ4) .
 8. Install the right spark plugs. Refer to Spark Plug Replacement .
 9. Install the exhaust manifold. Refer to Exhaust Manifold Replacement - Right Side (LZ4) .
 10. Install the valve rocker arms and push rods. Refer to Valve Rocker Arm and Push Rod Replacement .
 11. Install the lower intake manifold. Refer to Lower Intake Manifold Replacement .

12. Fill the engine with oil. Refer to **Engine Oil and Oil Filter Replacement**.
13. Inspect for leaks.

ENGINE FLYWHEEL REPLACEMENT

SPECIAL TOOLS

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

REMOVAL PROCEDURE

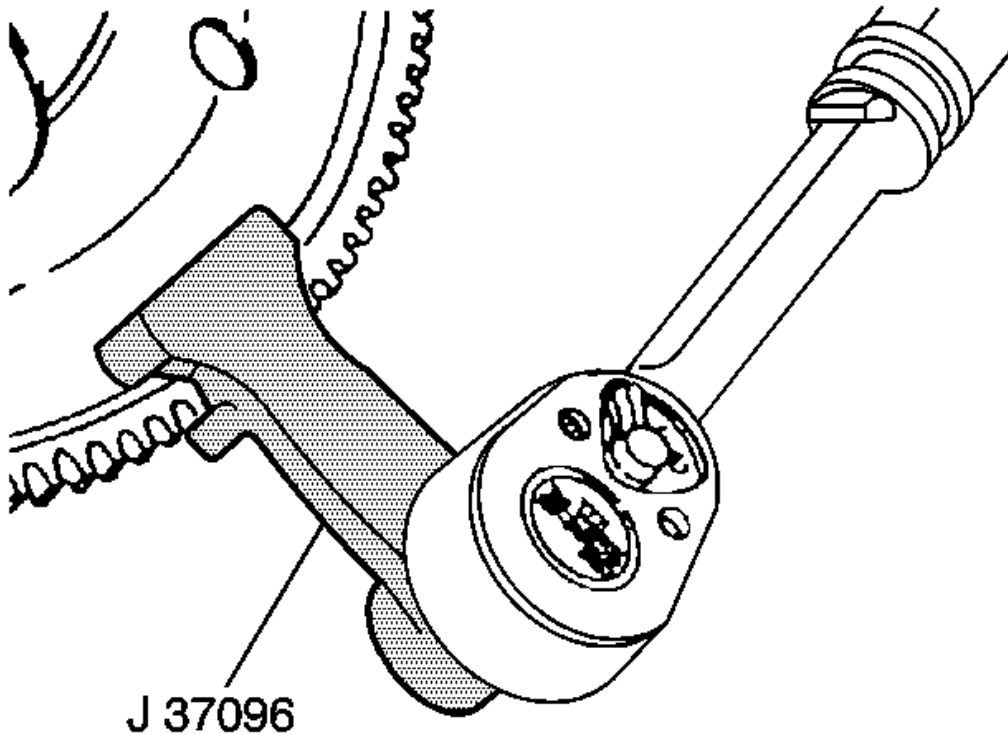


Fig. 190: Holding Flywheel
Courtesy of GENERAL MOTORS CORP.

1. Remove the automatic transaxle. Refer to **Transmission Replacement (3.5L (LZ4) W/MN5)** .
2. Use the **J 37096** to secure the flywheel in order to prevent the crankshaft from rotating. See **Special Tools** .

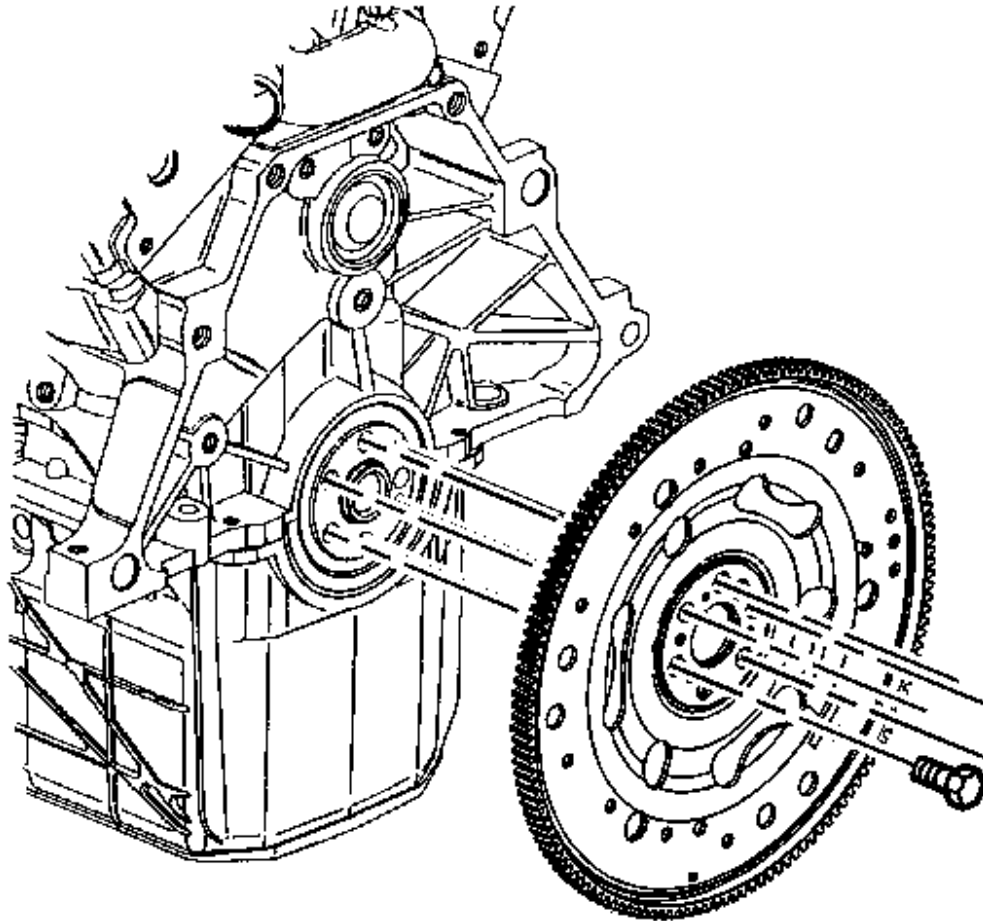


Fig. 191: View Of Flywheel

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

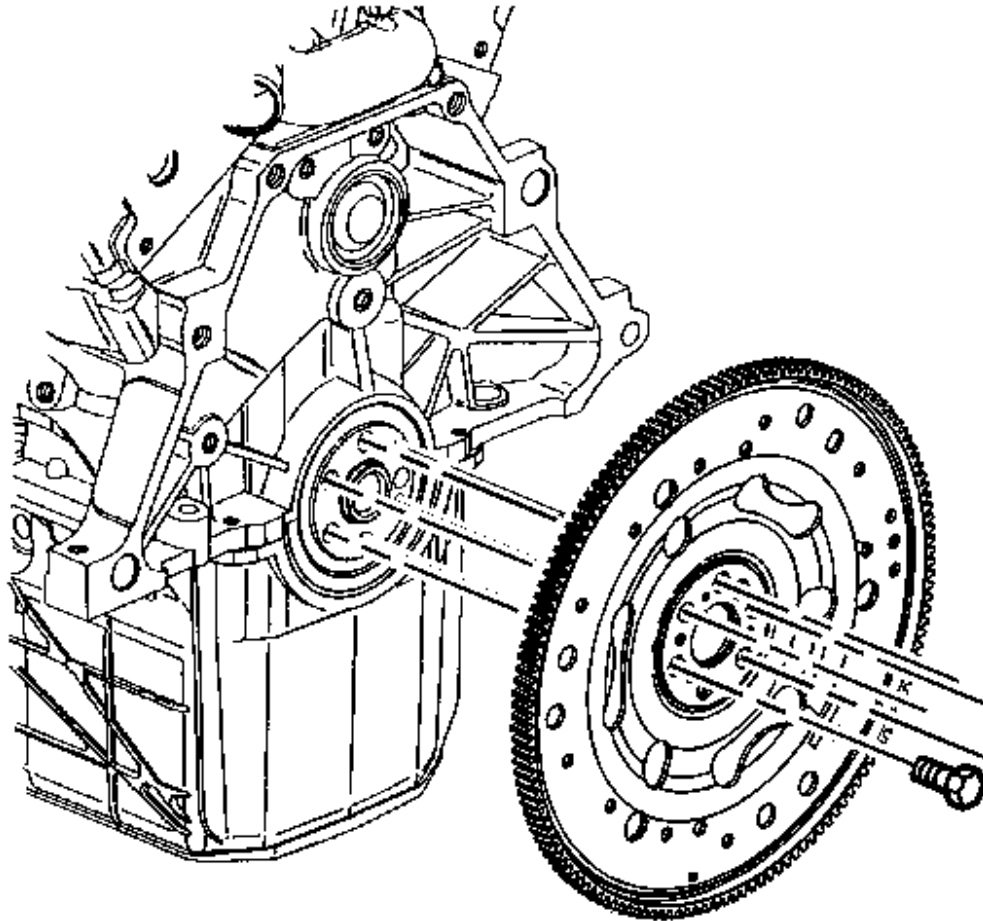


Fig. 192: View Of Flywheel

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. Install the engine flywheel bolts.

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

5. Install the automatic transaxle. Refer to [Transmission Replacement \(3.5L \(LZ4\) W/MN5\)](#) .

CRANKSHAFT REAR OIL SEAL REPLACEMENT

REMOVAL PROCEDURE

1. Remove the engine flywheel. Refer to [Engine Flywheel Replacement](#).
2. Remove the crankshaft rear main 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

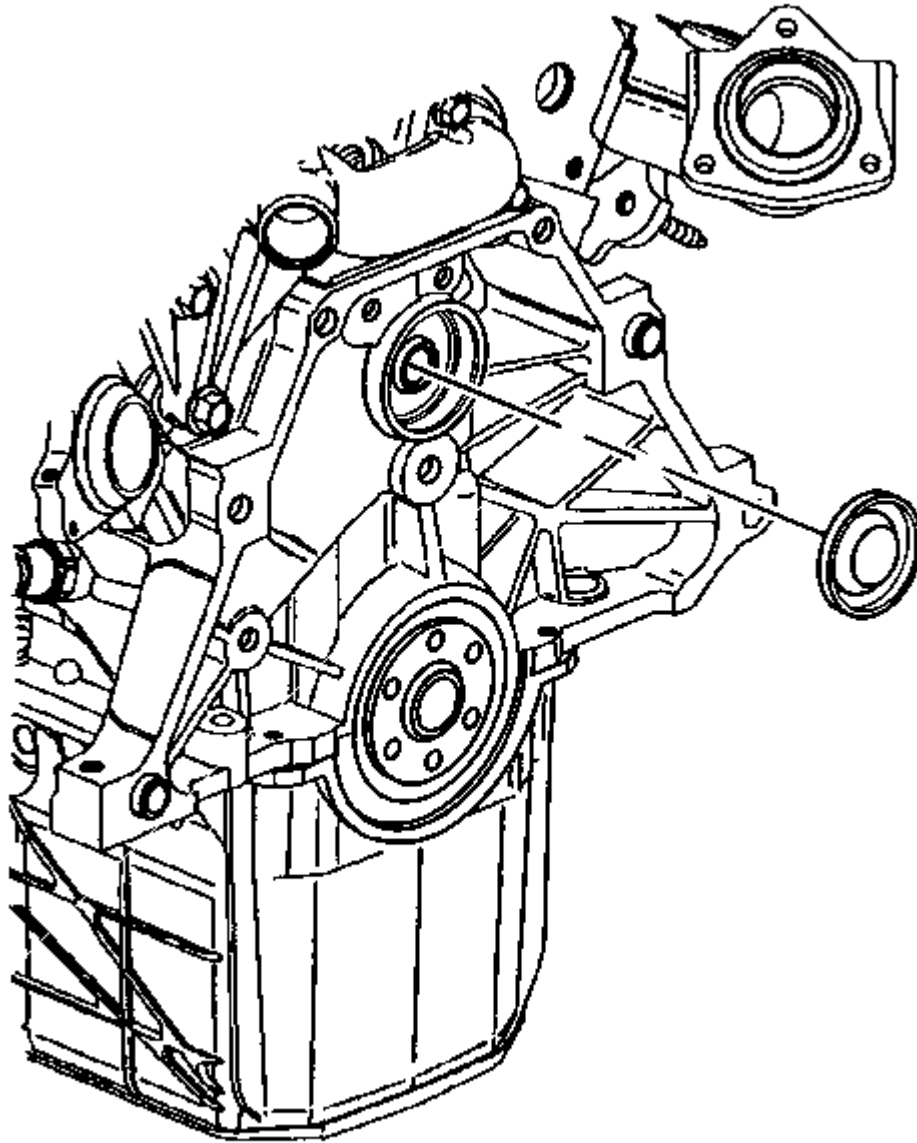


Fig. 193: View Of Camshaft Rear Bearing Hole Plug
Courtesy of GENERAL MOTORS CORP.

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

INSTALLATION PROCEDURE

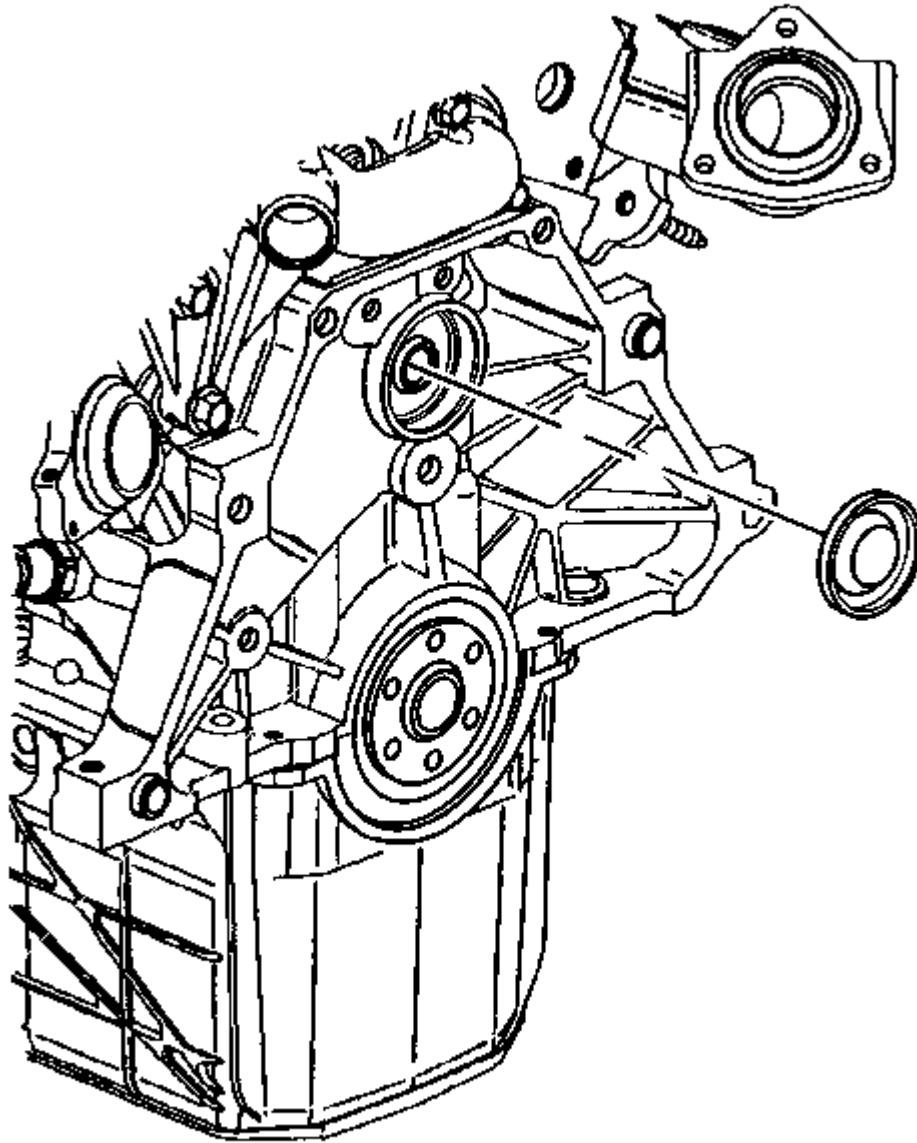


Fig. 194: View Of Camshaft Rear Bearing Hole Plug
Courtesy of GENERAL MOTORS CORP.

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.

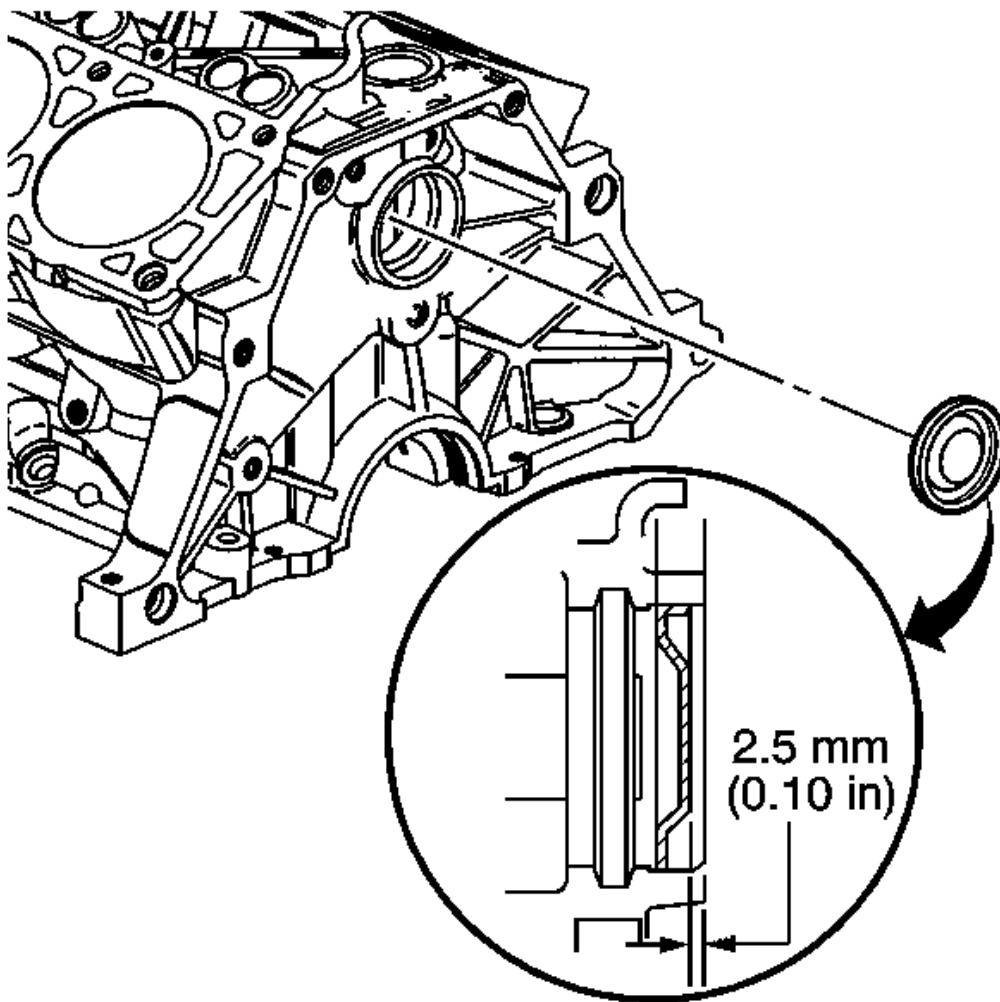


Fig. 195: Identifying Camshaft Rear Bearing Hole Plug Installation Depth
Courtesy of GENERAL MOTORS CORP.

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

ENGINE REPLACEMENT

Special Tools

- **J 37096** Flywheel Holder. See **Special Tools** .
- **J 25033-C** Pulley Installer

- J 25034-C Pulley Remover

REMOVAL PROCEDURE

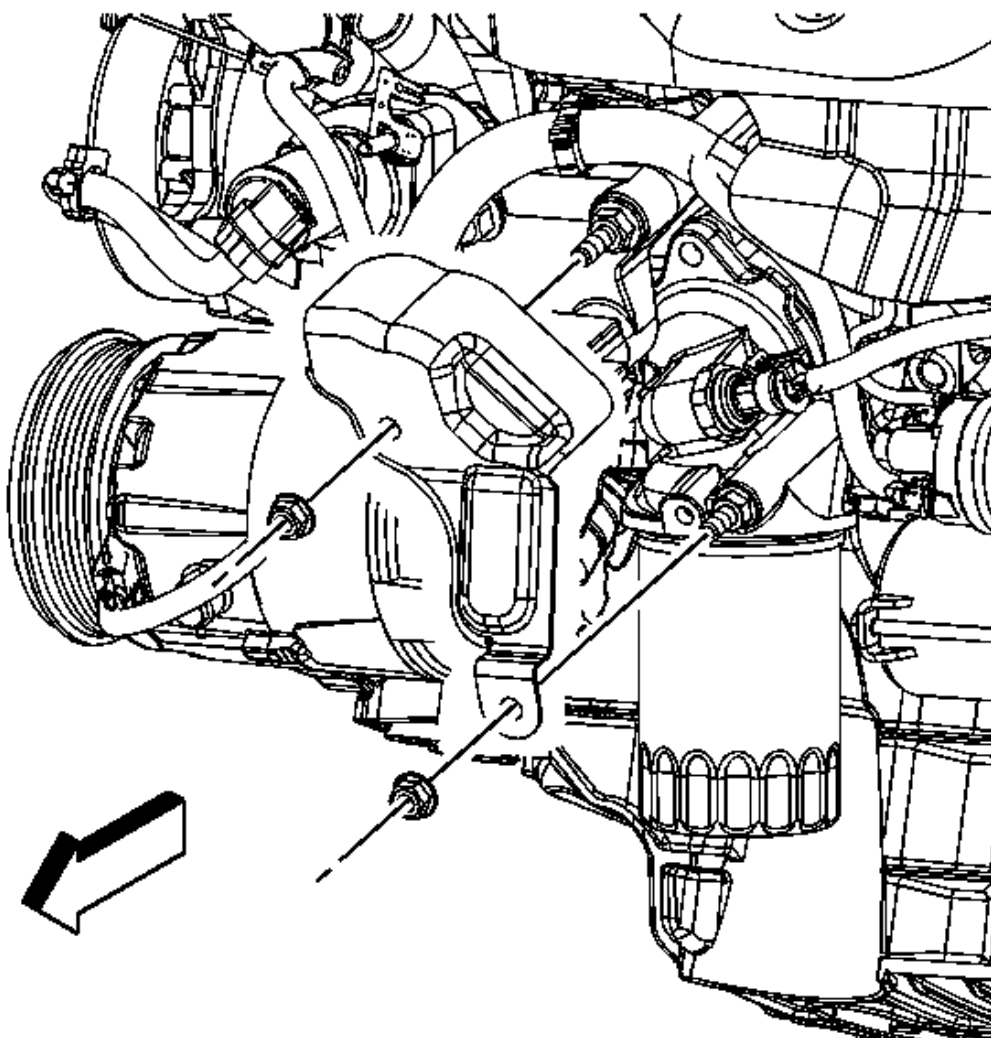


Fig. 196: Identifying Oil Pressure Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection (LE5, LE9, LZ4, LZE, or LY7) .
2. Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement .

3. Remove the hood. Refer to **Hood Replacement** .
4. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
5. Remove the engine mount snubber and drive belt. Refer to **Drive Belt Replacement**.
6. Drain the cooling system. Refer to **Cooling System Draining and Filling (Static Fill-LY7, LZE, LZ4) or Cooling System Draining and Filling (GE 47716)** .
7. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
8. Remove the starter motor. Refer to **Starter Replacement (LZ4 or LZE)** .
9. Remove the oil pressure sensor heat shield nuts and shield.

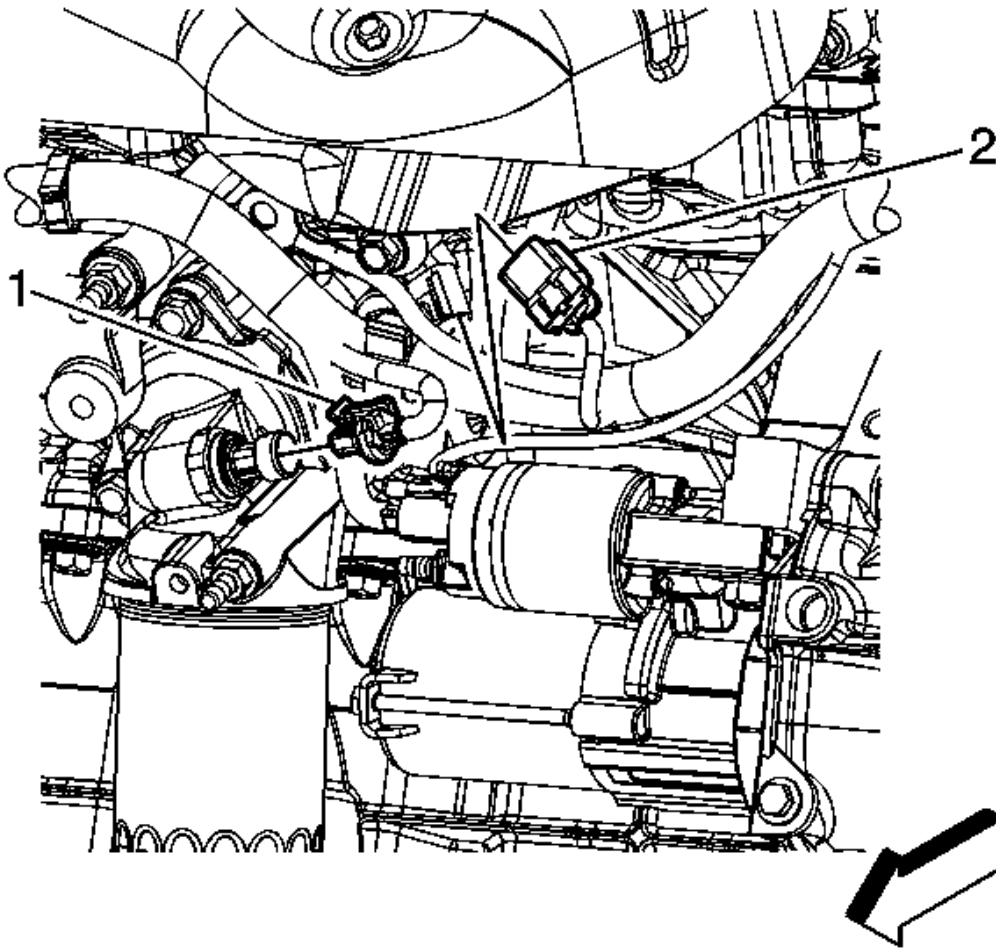


Fig. 197: Identifying Knock Sensor & Oil Pressure Sensor Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

10. Disconnect the engine wiring harness electrical connector (1) from the oil pressure sensor.
11. Disconnect the engine wiring harness electrical connector (2) from the knock sensor.

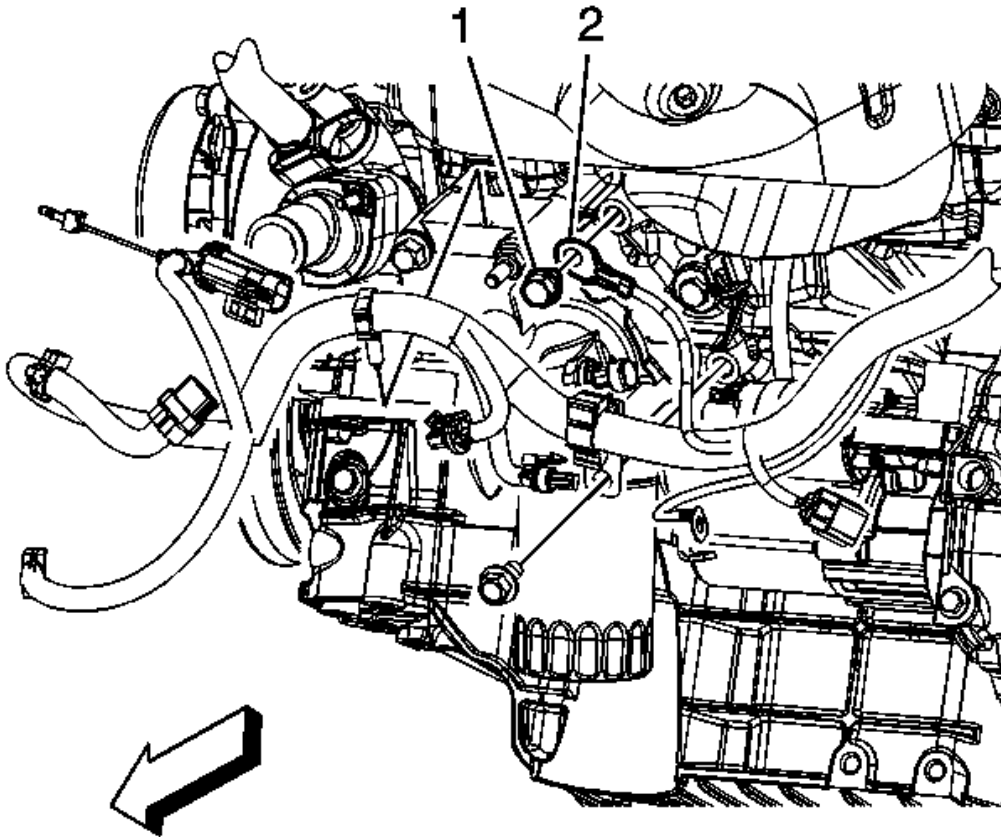


Fig. 198: Identifying Engine Wiring Harness Ground Bolt
Courtesy of GENERAL MOTORS CORP.

12. Remove the engine wiring harness ground bolt (1).
13. Separate the engine wiring harness ground terminal (2) from the engine boss.

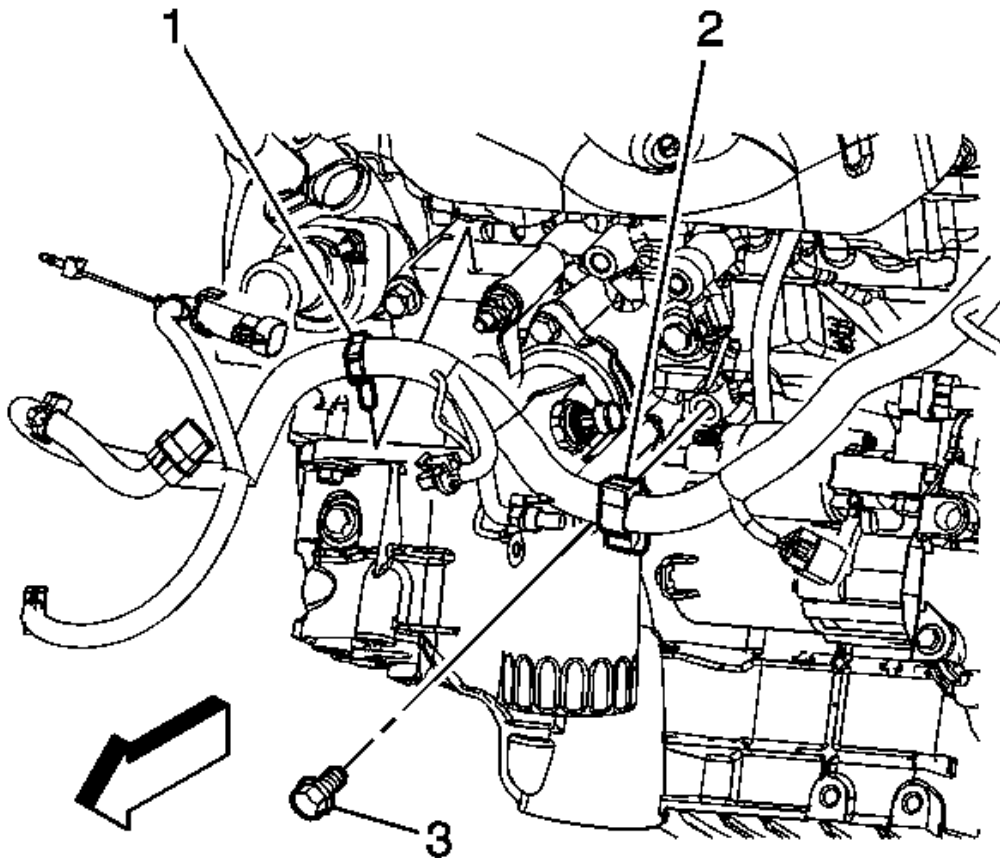


Fig. 199: Identifying Engine Wiring Harness Clip
Courtesy of GENERAL MOTORS CORP.

14. Remove the engine wiring harness clip (1) from the air conditioning (A/C) compressor bracket.
15. Remove the engine wiring harness clip bolt (3).
16. Separate the engine wiring harness clip (2) from the engine boss.

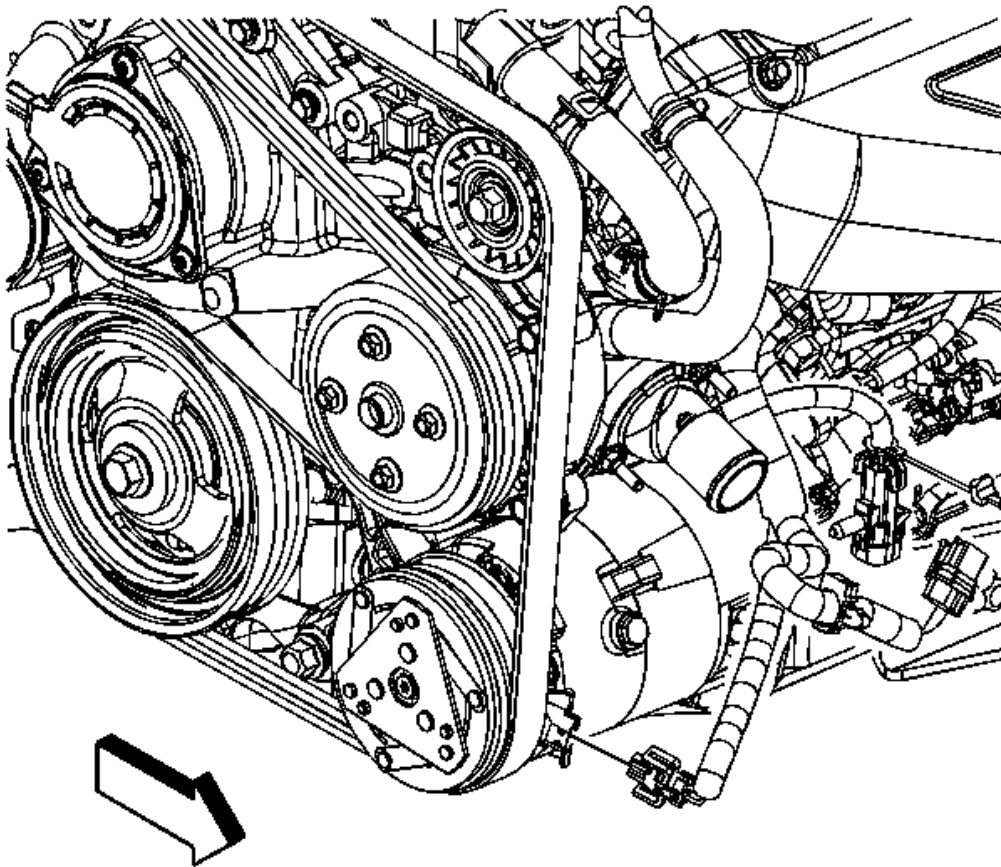


Fig. 200: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

17. Disconnect the engine wiring harness electrical connector from the A/C compressor.

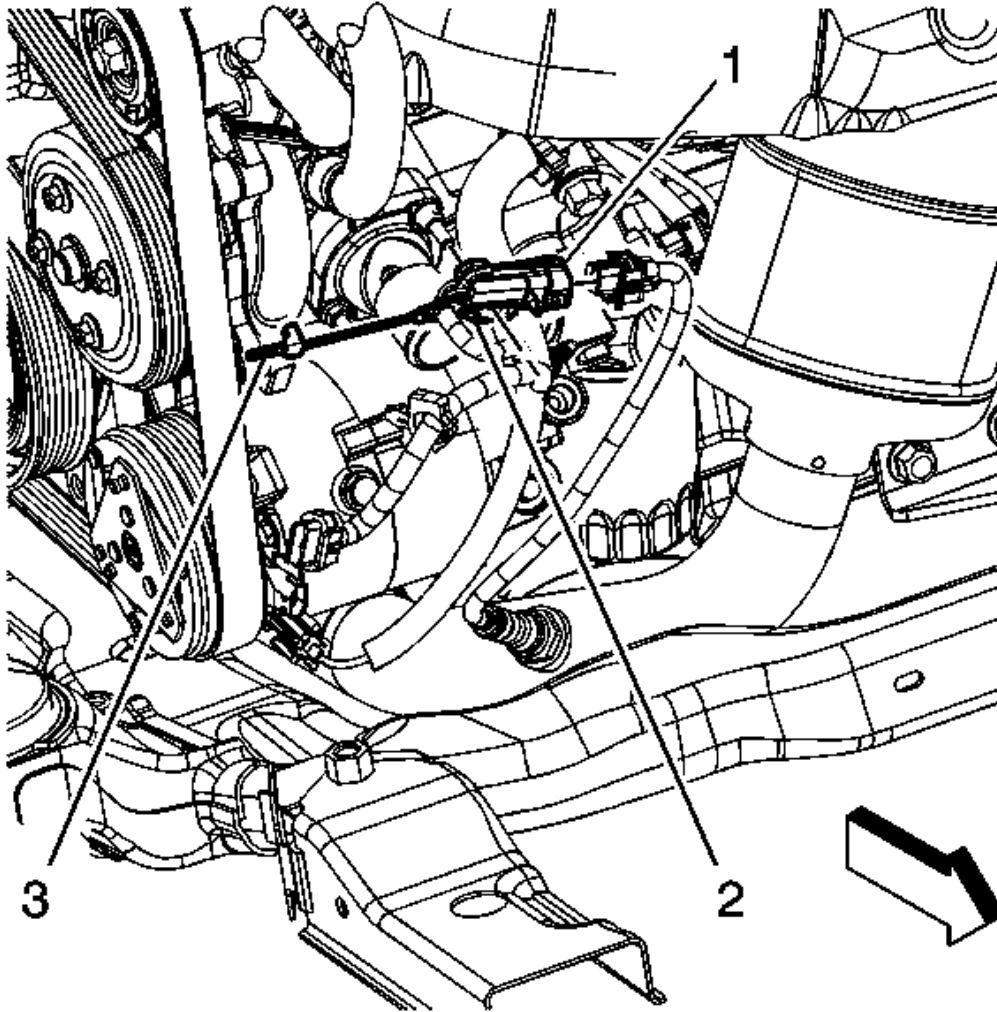


Fig. 201: Identifying Connector Position Assurance (CPA) Retainer
Courtesy of GENERAL MOTORS CORP.

18. Remove the connector position assurance (CPA) retainer (3).
19. Disconnect the lower front heated oxygen sensor (HO2S) electrical connector from the engine wiring harness electrical connector (1).
20. Remove the engine wiring harness electrical connector clip (2) from the thermostat housing stud.

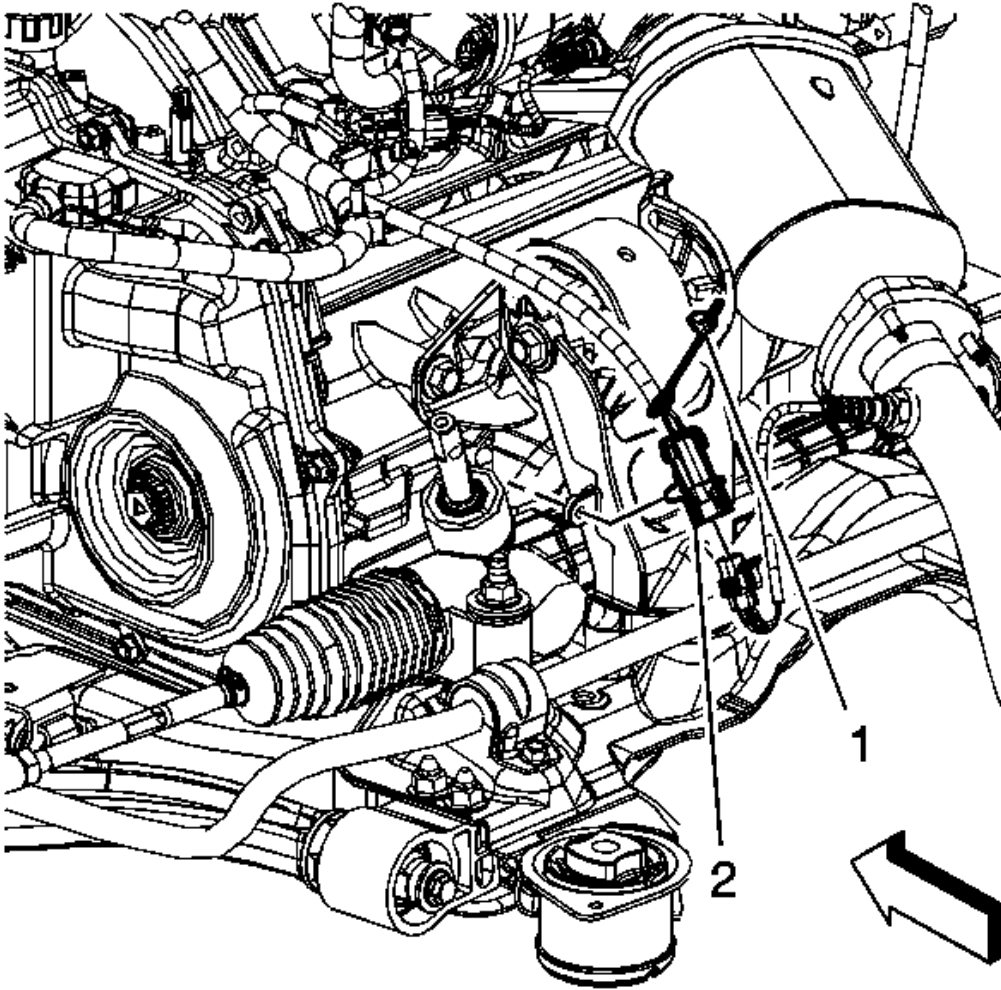


Fig. 202: Identifying CPA Retainer & HO2S Electrical Connector (Bank 1 Sensor 2)
Courtesy of GENERAL MOTORS CORP.

21. Remove the lower rear CPA retainer (1).
22. Disconnect the lower rear HO2S electrical connector from the engine wiring harness electrical connector (2).
23. Remove the engine wiring harness electrical connector (2) rosebud from the transaxle mount.

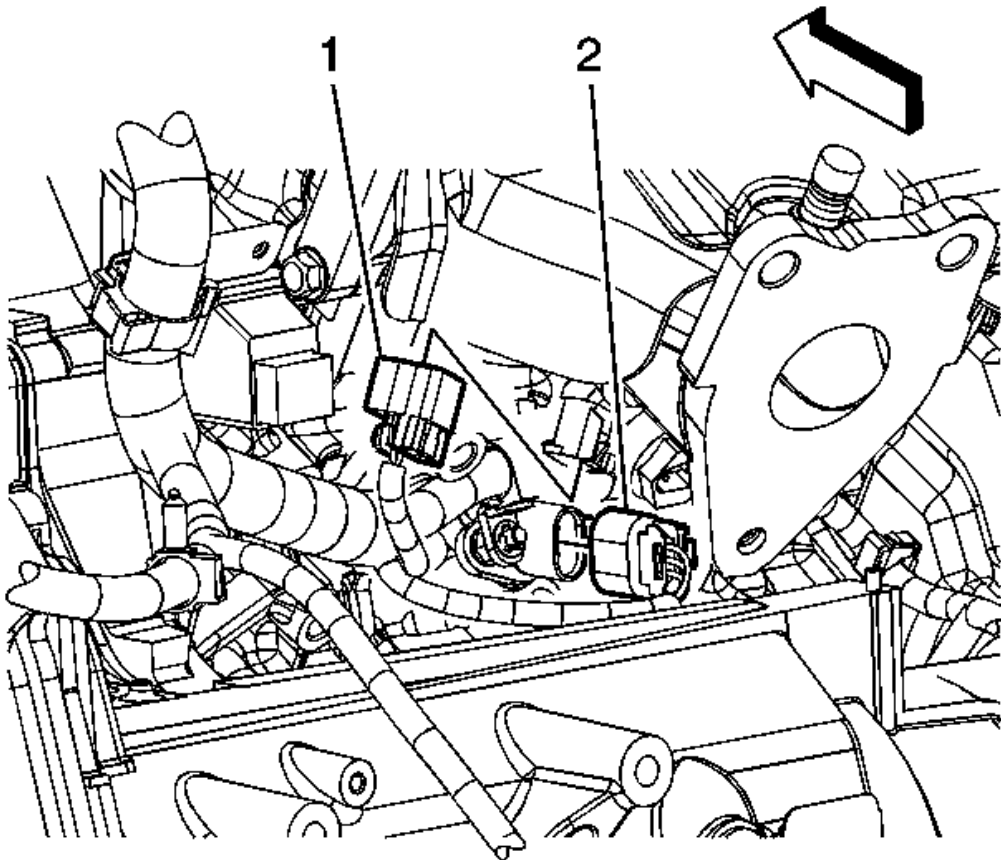


Fig. 203: Identifying Knock Sensor & CKP Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

24. Disconnect the engine wiring harness electrical connector (1) from the knock sensor.
25. Disconnect the engine wiring harness electrical connector (2) from the crankshaft position (CKP) sensor.

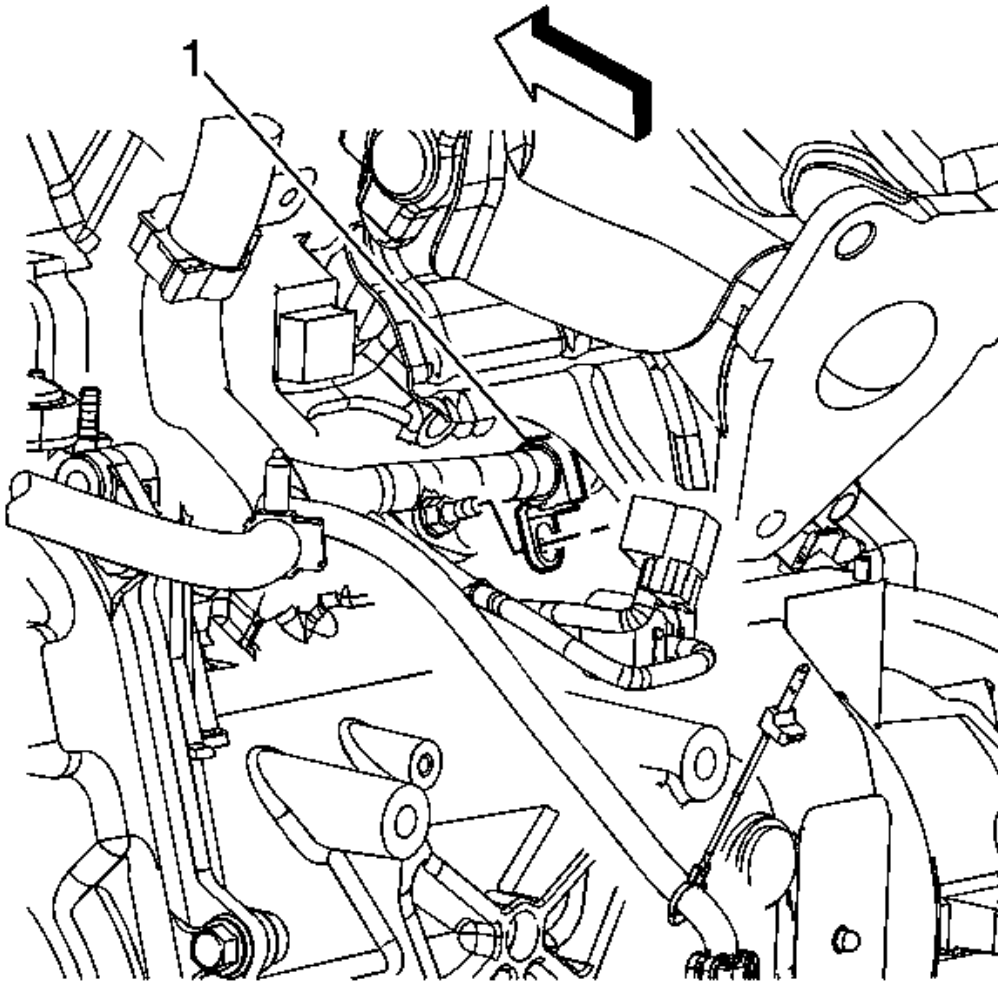


Fig. 204: Identifying Engine Wiring Harness Clip
Courtesy of GENERAL MOTORS CORP.

26. Remove the engine wiring harness clip (1) from the engine stud.
27. Lower the vehicle.

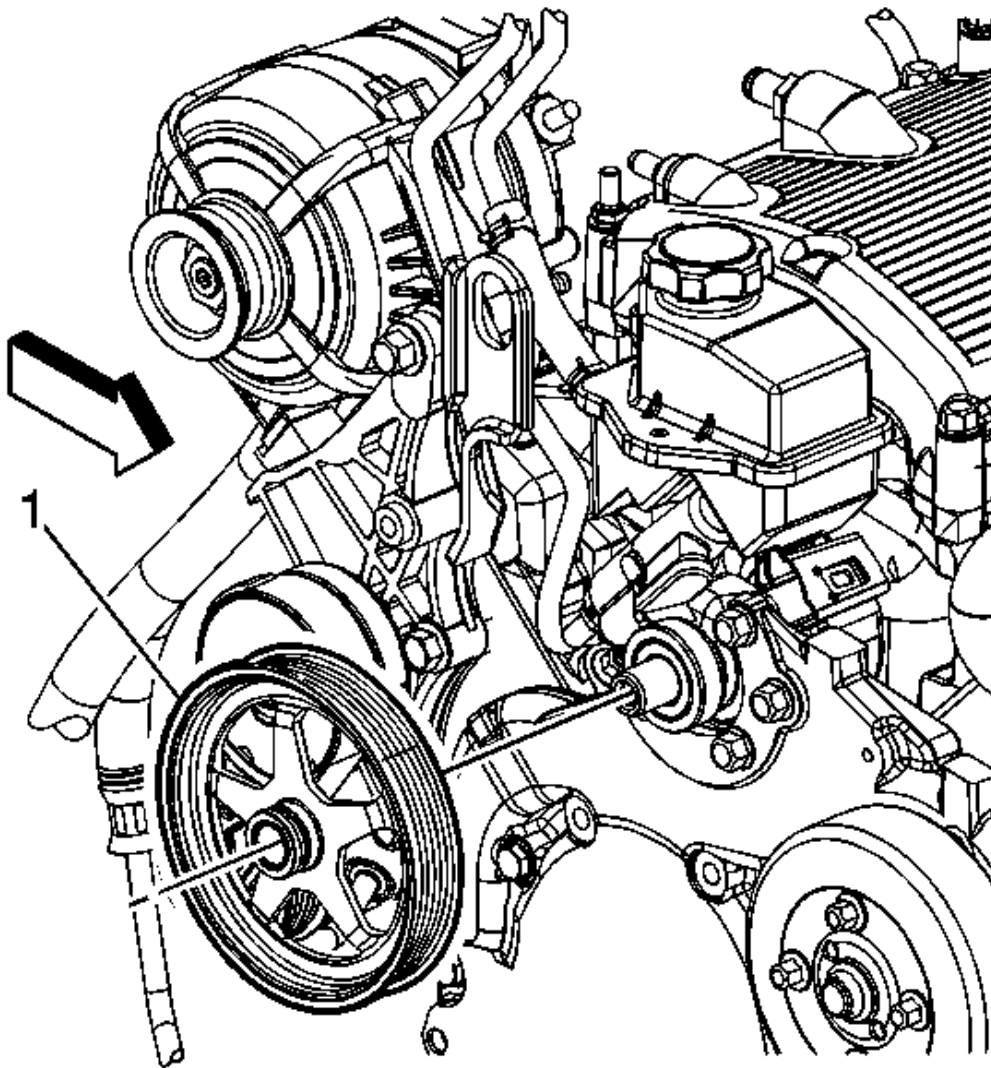


Fig. 205: View Of Power Steering Pump Pulley
Courtesy of GENERAL MOTORS CORP.

28. Using the **J 25034-C** , remove the power steering pump pulley.

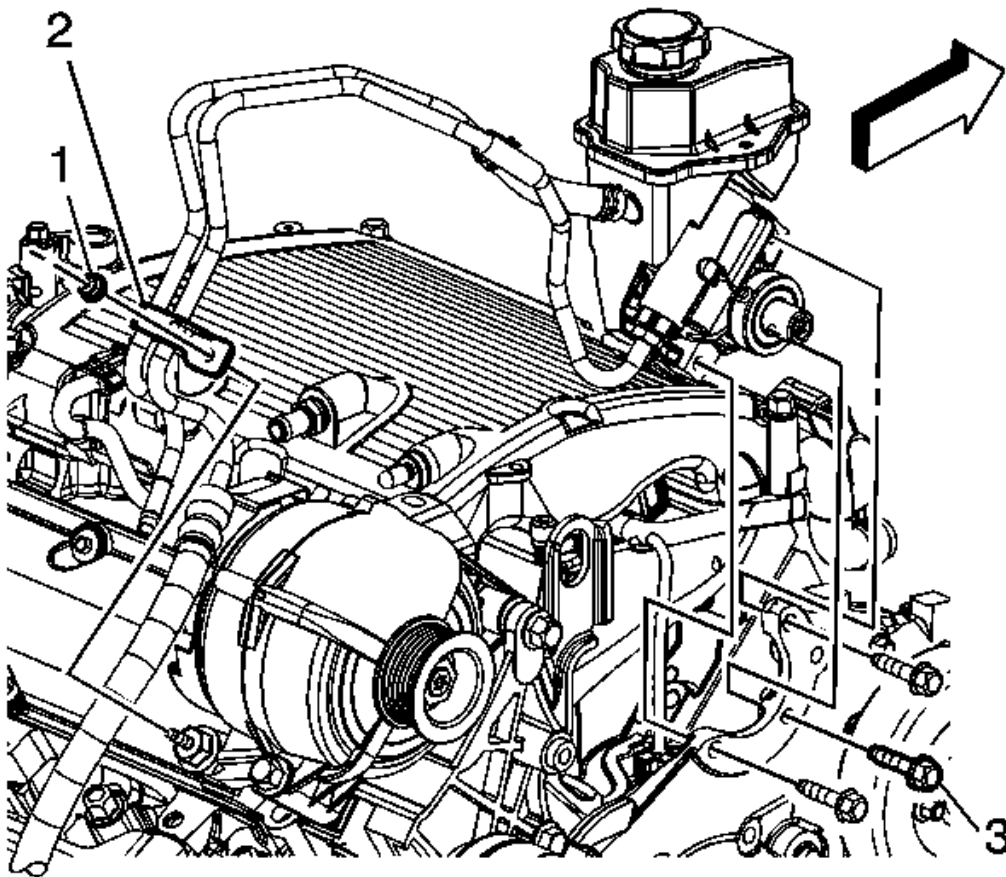


Fig. 206: View Of Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

29. Remove the power steering pump bolts (3).
30. Remove the power steering line clip bolt (1) from the generator stud.
31. Remove the power steering line clip (2) from the stud.
32. Reposition and secure the power steering pump assembly out of the way.

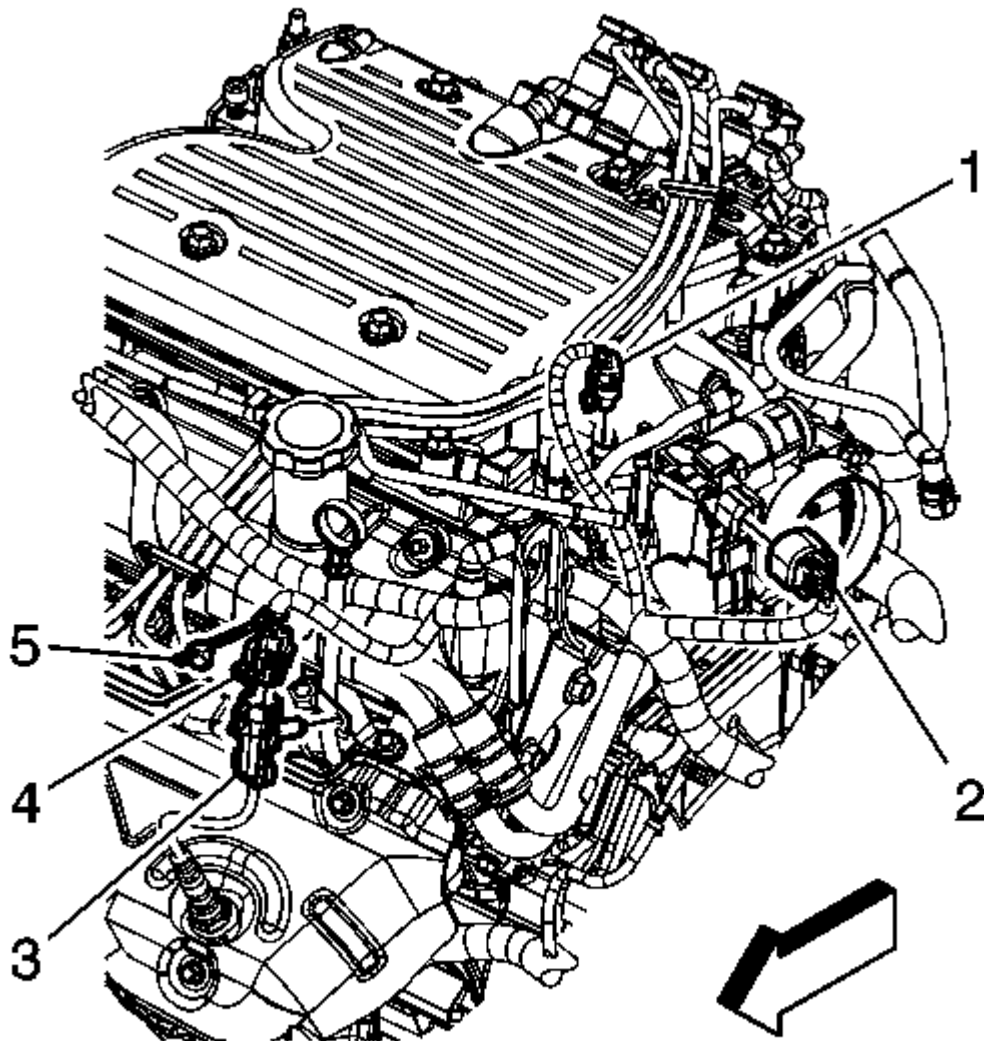


Fig. 207: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

33. Disconnect the engine wiring harness electrical connector (1) from the evaporative emission (EVAP) canister purge solenoid.
34. Disconnect the engine wiring harness electrical connector (2) from the electronic throttle control (ETC).
35. Remove the CPA retainer (5).
36. Disconnect the engine wiring harness electrical connector (4) from the HO2S.

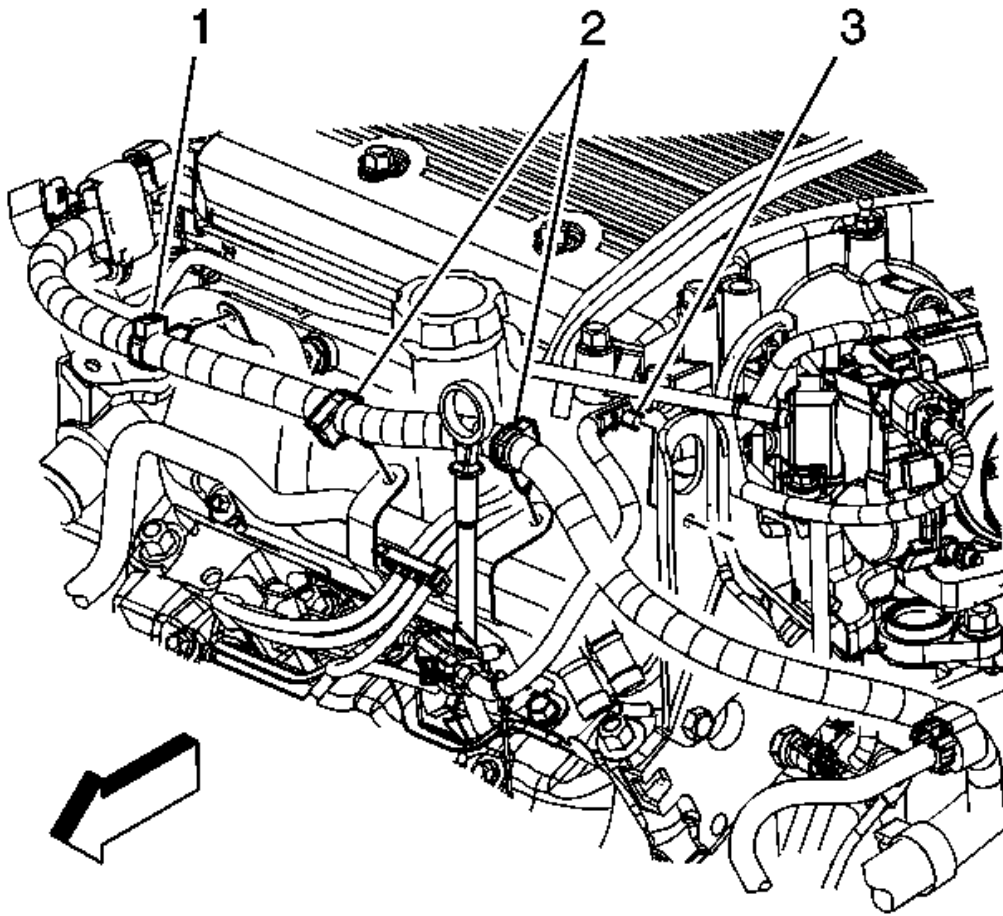


Fig. 208: Identifying Engine Wiring Harness Clips
Courtesy of GENERAL MOTORS CORP.

37. Disconnect the engine wiring harness clips (1, 2) from the heater inlet and outlet pipe brackets.
38. Disconnect the engine wiring harness clip (3) from the engine lift bracket.

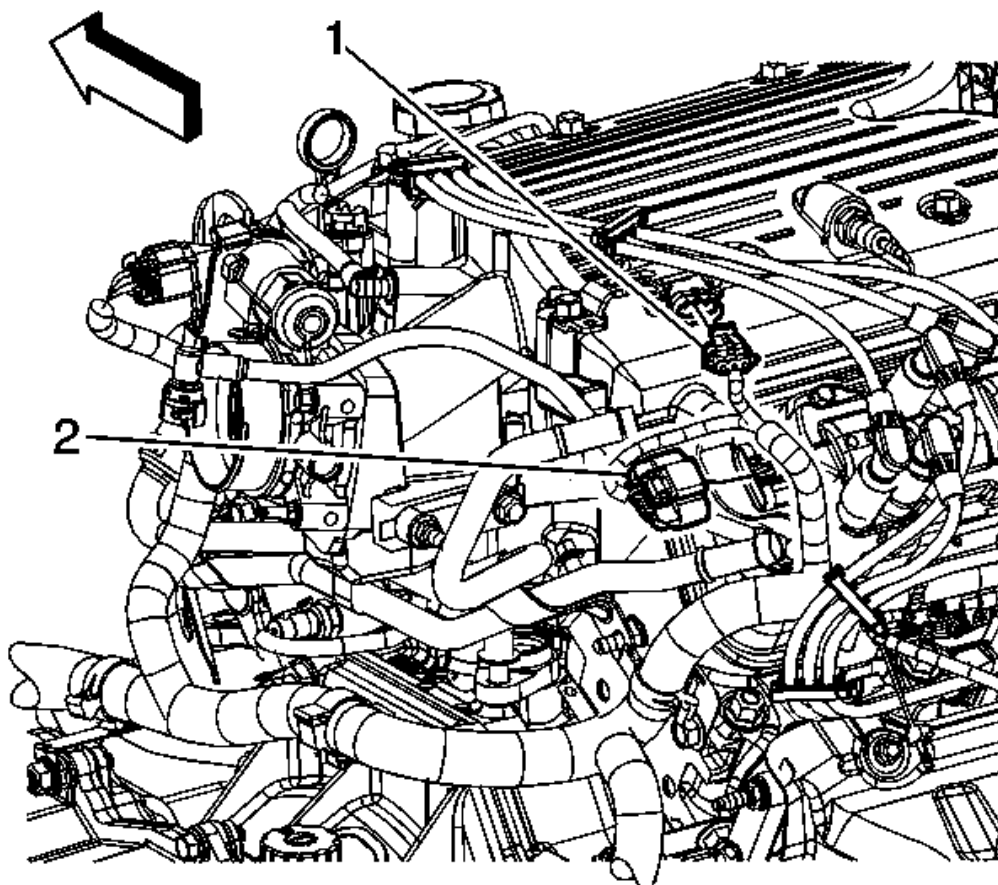


Fig. 209: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

39. Disconnect the engine wiring harness electrical connector (1) from the manifold absolute pressure (MAP) sensor.
40. Disconnect the engine wiring harness electrical connector (2) from the ignition control module.

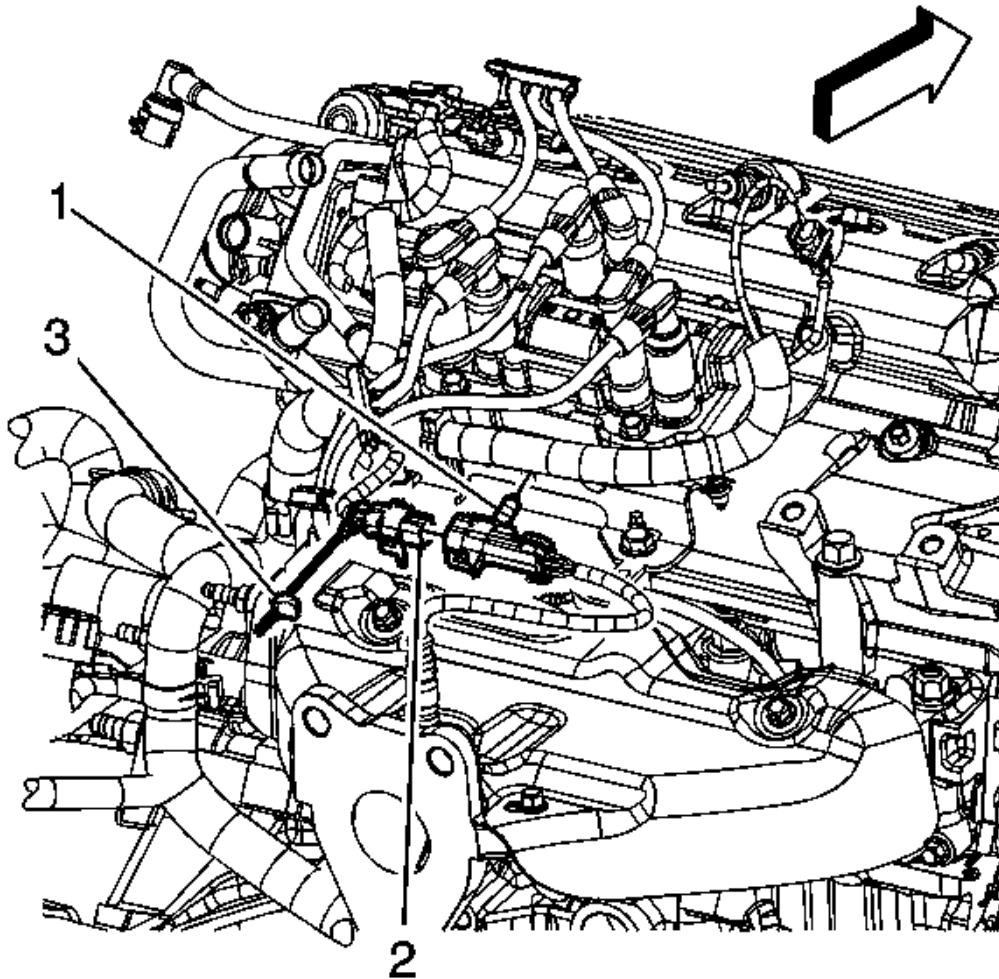


Fig. 210: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

41. Remove the CPA retainer (3).
42. Disconnect the engine wiring harness electrical connector (2) from the rear upper HO2S.

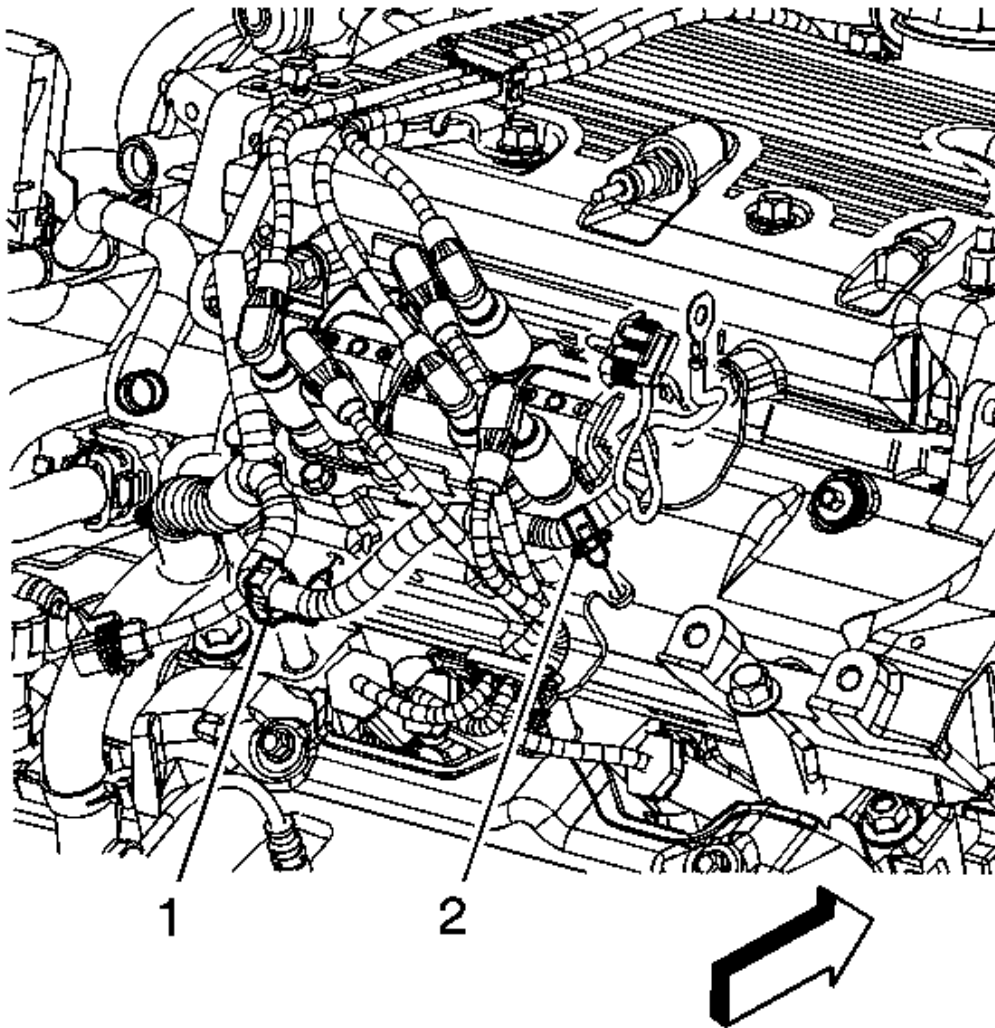


Fig. 211: Identifying Engine Wiring Harness Clips
Courtesy of GENERAL MOTORS CORP.

43. Remove the engine wiring harness clips (1, 2) from the ignition control module bracket.

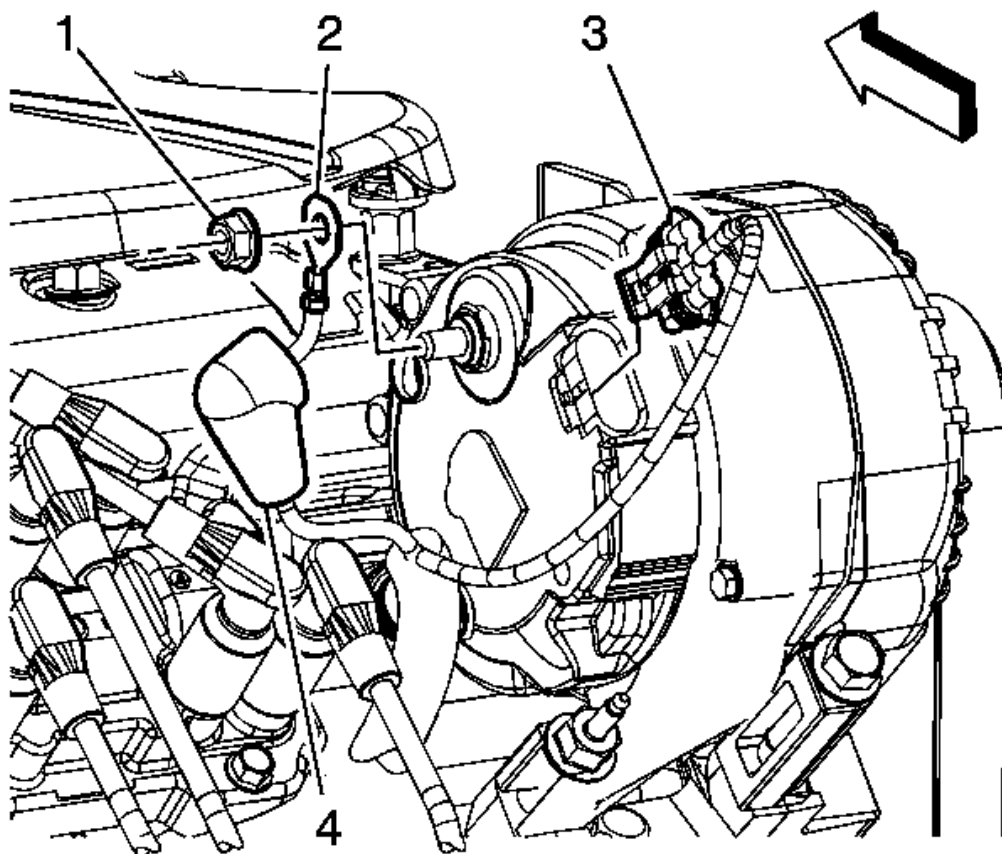


Fig. 212: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

44. Reposition the engine wiring harness terminal boot (4).
45. Remove the engine wiring harness to generator stud nut (1).
46. Remove the engine wiring harness terminal (2) from the generator.
47. Disconnect the engine wiring harness electrical connector (3) from the generator.

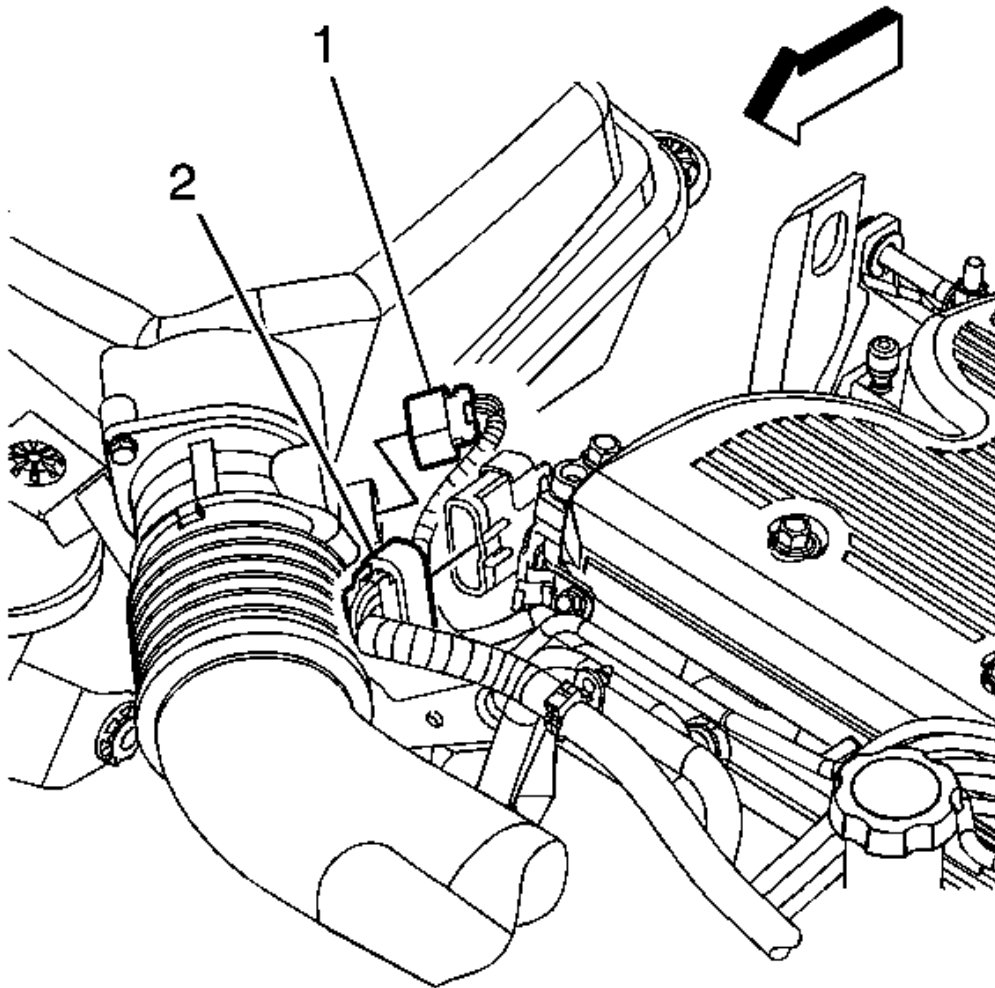


Fig. 213: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

48. Disconnect the engine wiring harness electrical connector (2) from the fuel injector inline electrical connector.

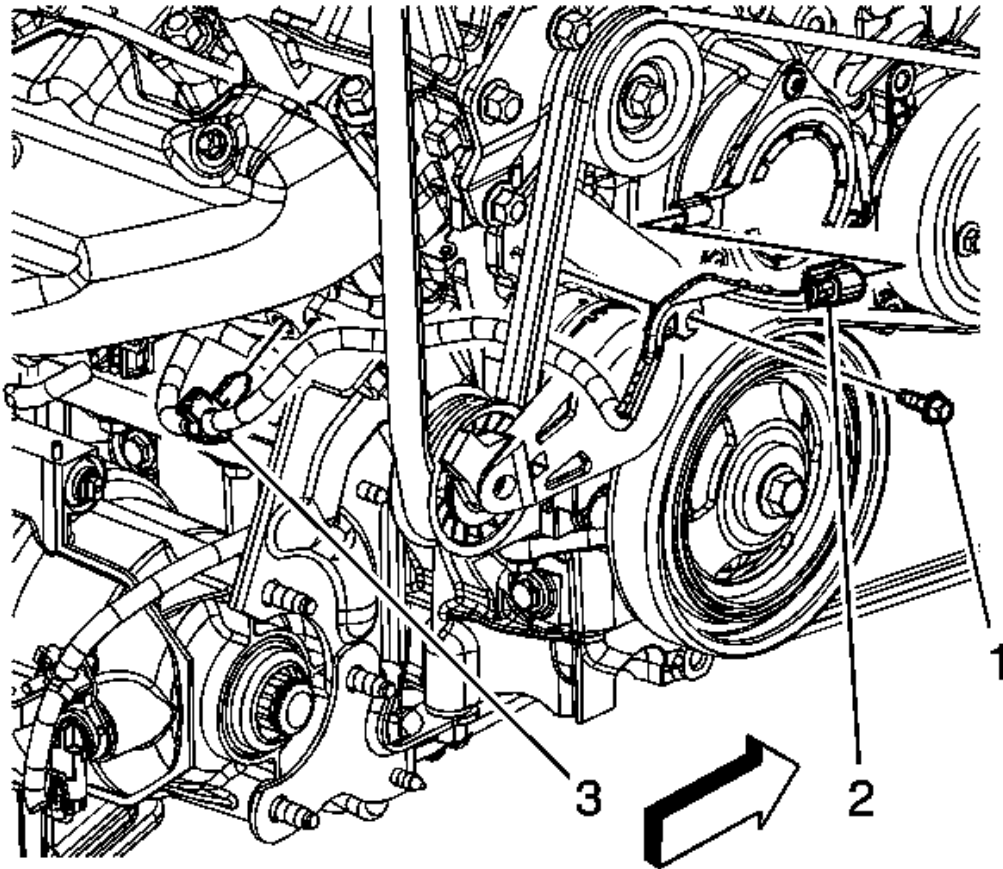


Fig. 214: View Of Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

49. Remove the engine wiring harness bolt (1).
50. Disconnect the engine wiring harness electrical connector (2) from the camshaft phasor.
51. Remove the engine wiring harness clip (3) from the engine.

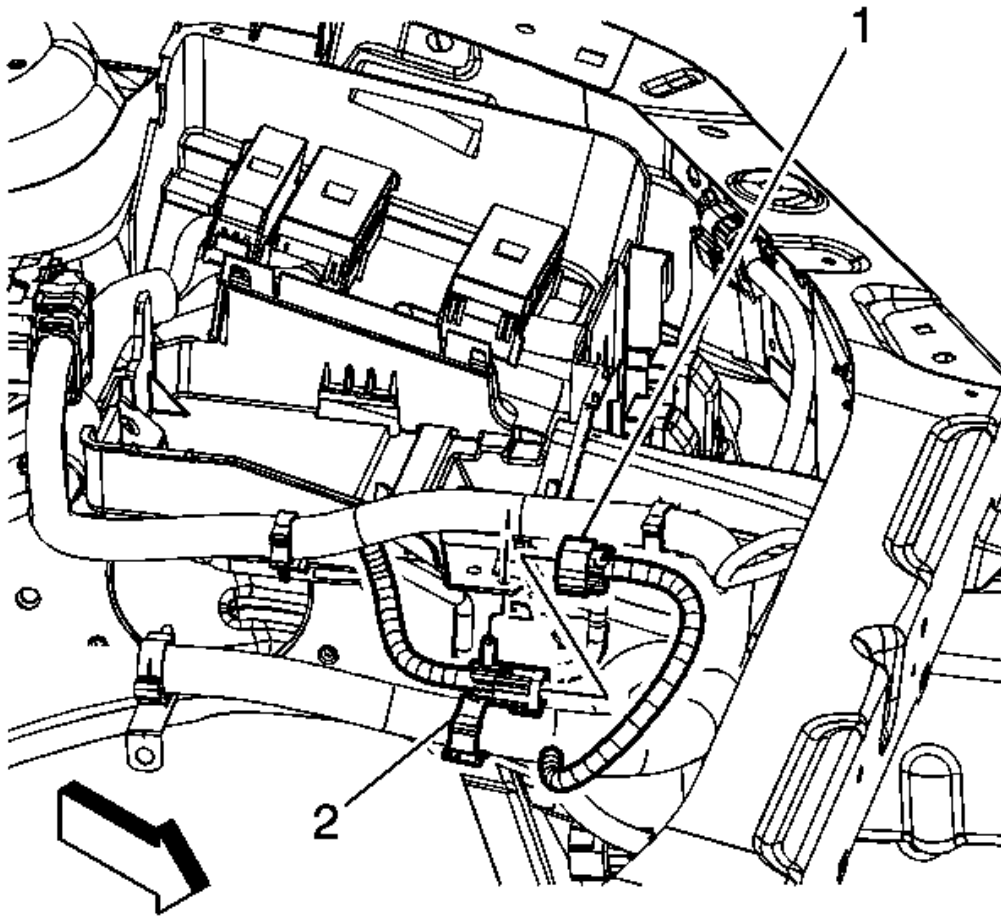


Fig. 215: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

52. Disconnect the engine wiring harness electrical connector (1) from the body wiring harness electrical connector (2).

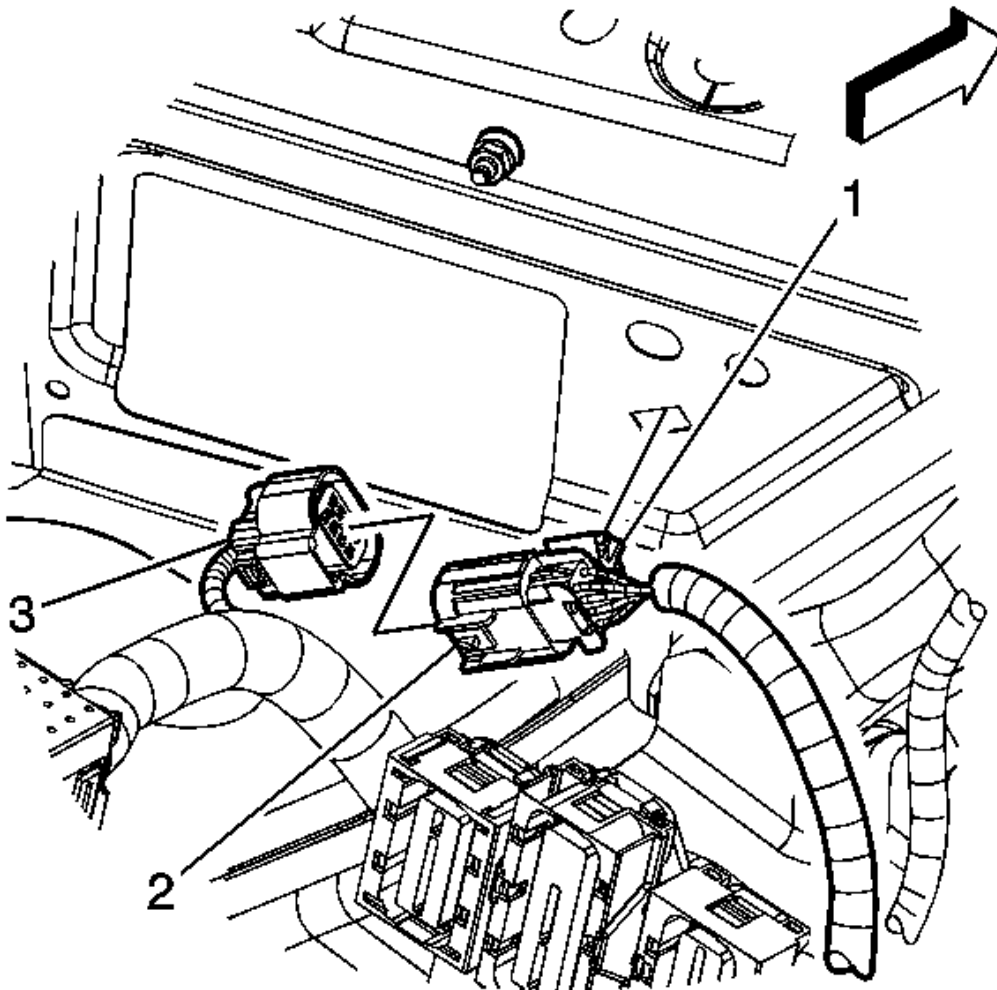


Fig. 216: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

53. Disconnect the engine wiring harness electrical connector (3) from the body wiring harness electrical connector (2).

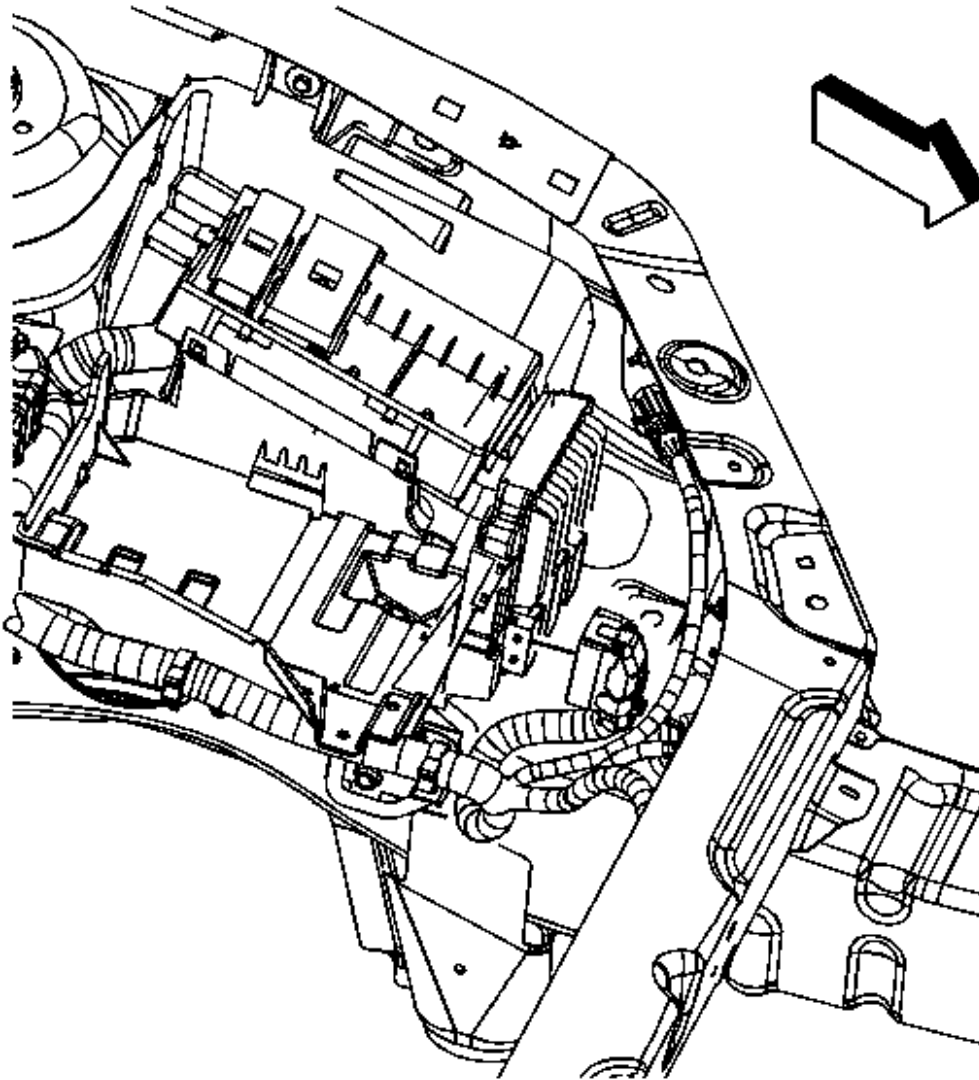


Fig. 217: View Of Body Harness ECM/PCM Connectors
Courtesy of GENERAL MOTORS CORP.

54. Disconnect the body harness electrical connector from the powertrain control module (PCM).

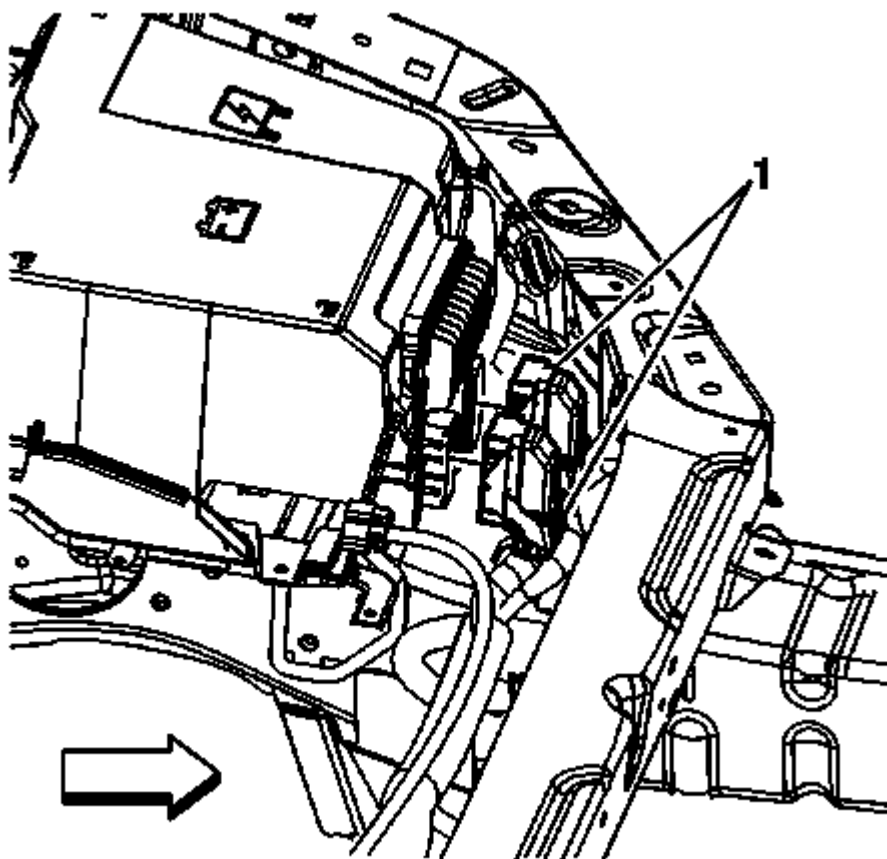


Fig. 218: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

55. Disconnect the engine wiring harness electrical connector (1) from the PCM.

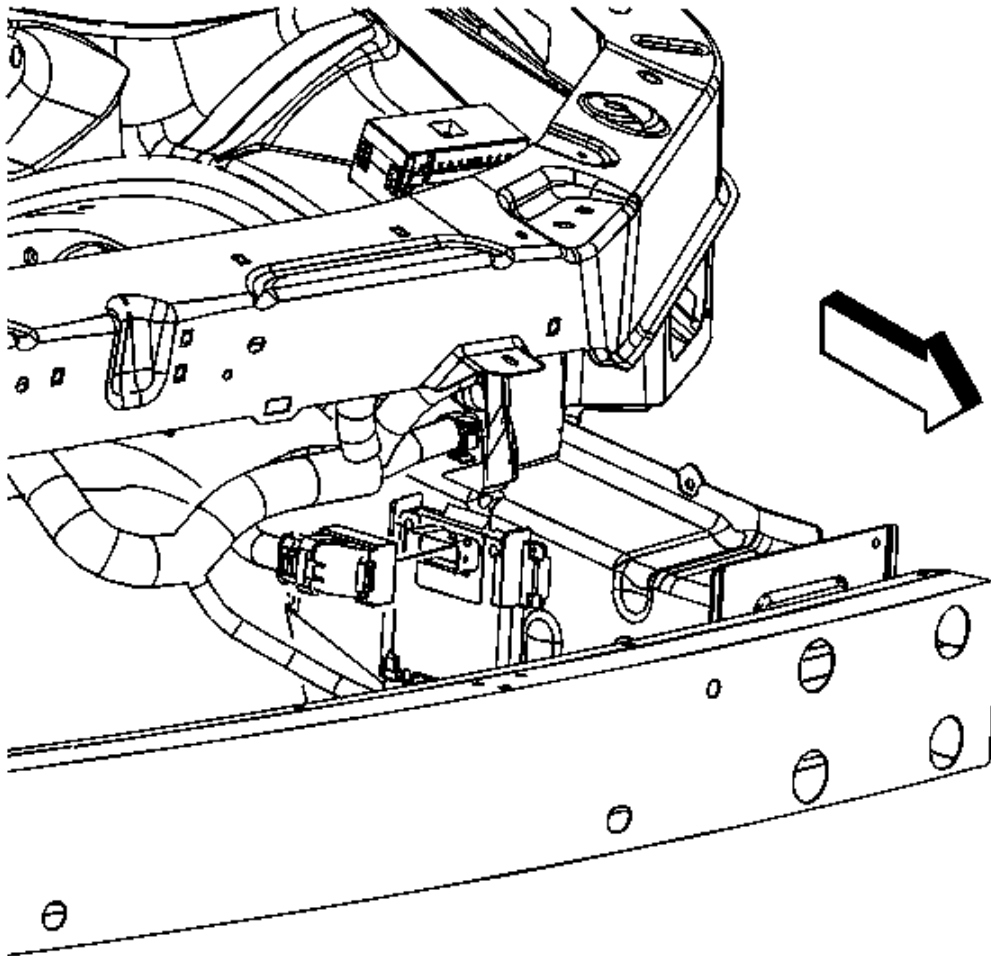


Fig. 219: Identifying Engine Harness Electrical Connector & Transmission Control Module (TCM)
Courtesy of GENERAL MOTORS CORP.

56. Disconnect the engine wiring harness electrical connector from the transmission control module (TCM).

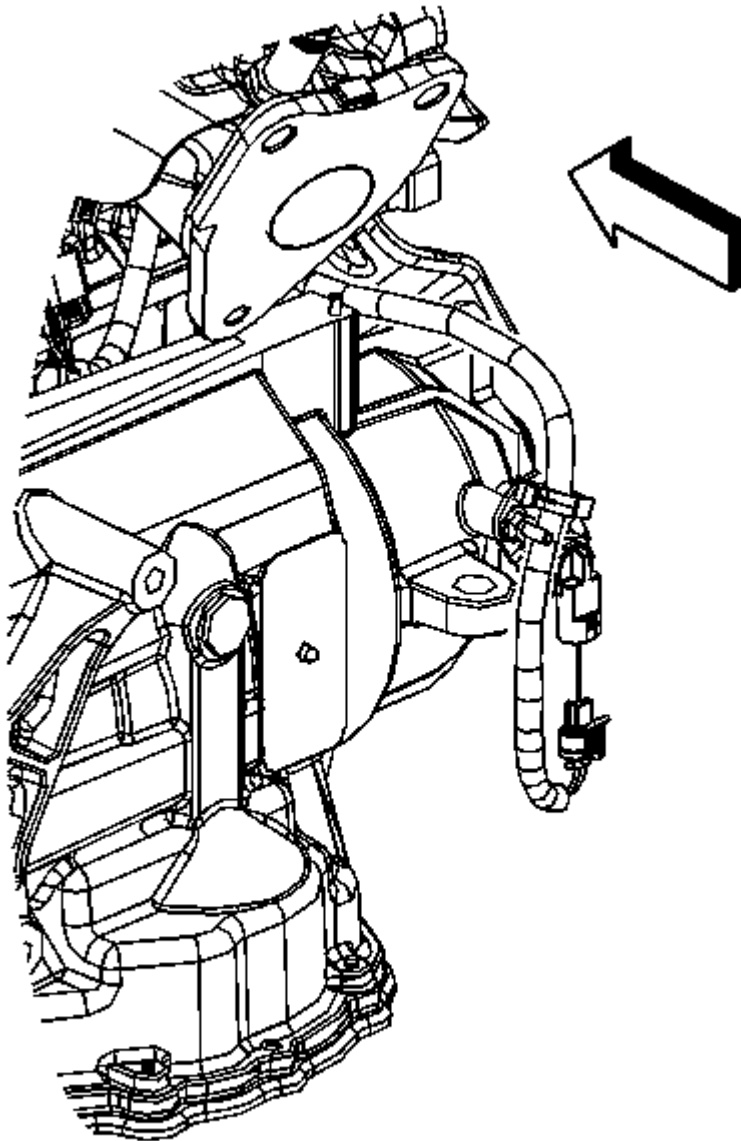


Fig. 220: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

57. Disconnect the engine wiring harness electrical connector from the vehicle speed sensor.

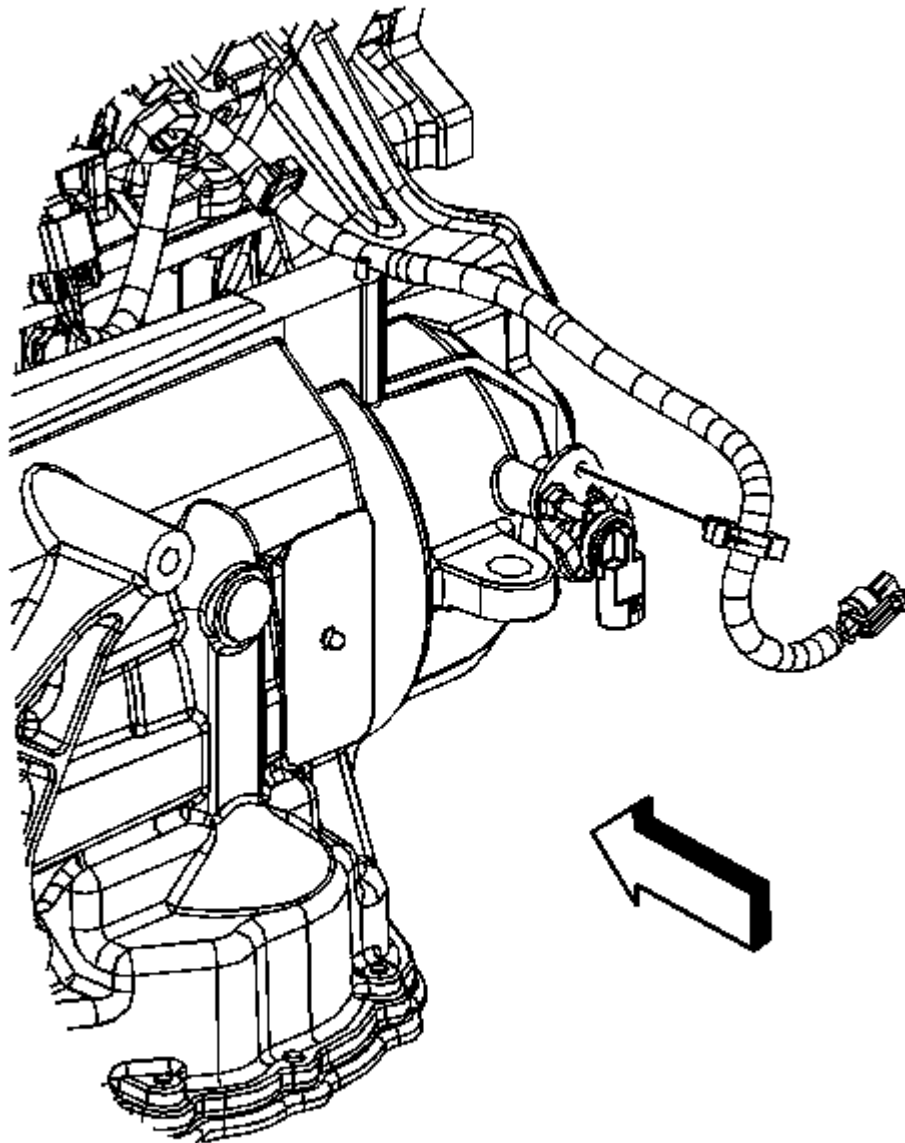


Fig. 221: Identifying Engine Wiring Harness Clip
Courtesy of GENERAL MOTORS CORP.

58. Remove the engine wiring harness clip from the vehicle speed sensor bracket.

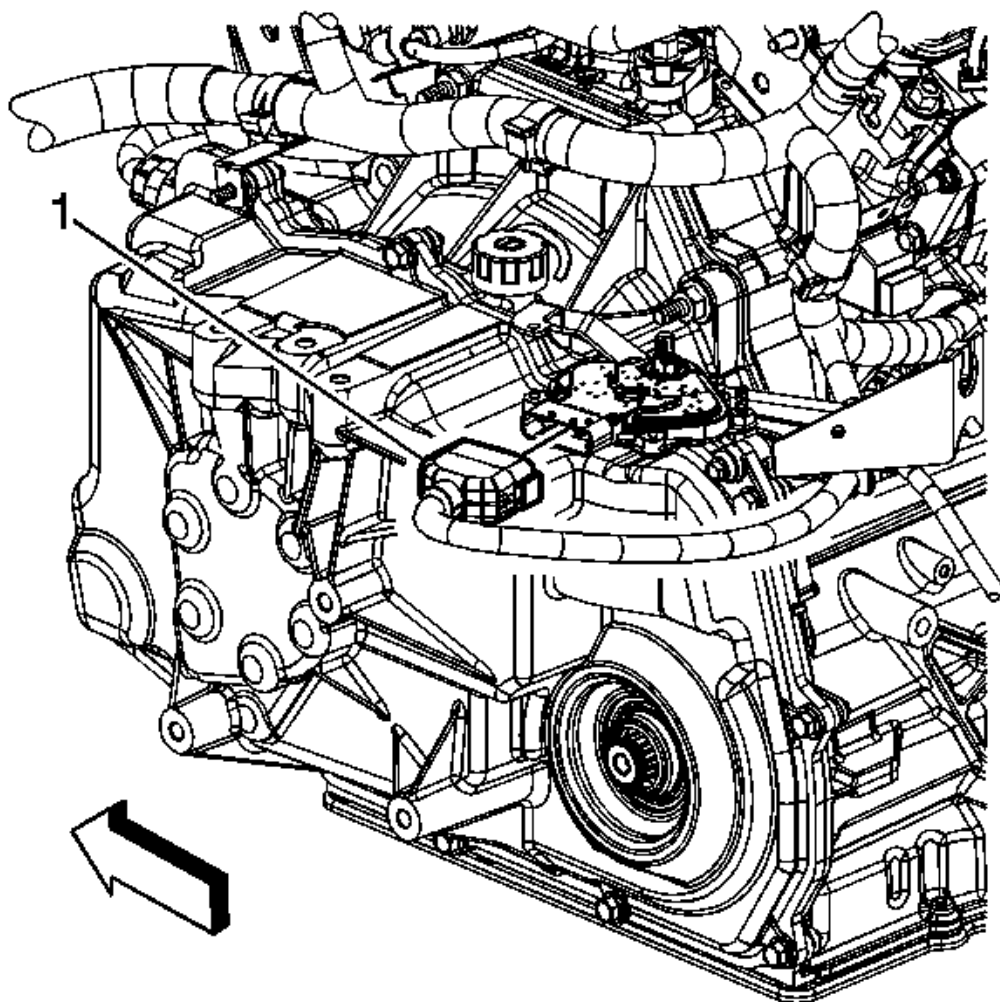


Fig. 222: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

59. Disconnect the engine wiring harness electrical connector (1) from the neutral safety backup switch.

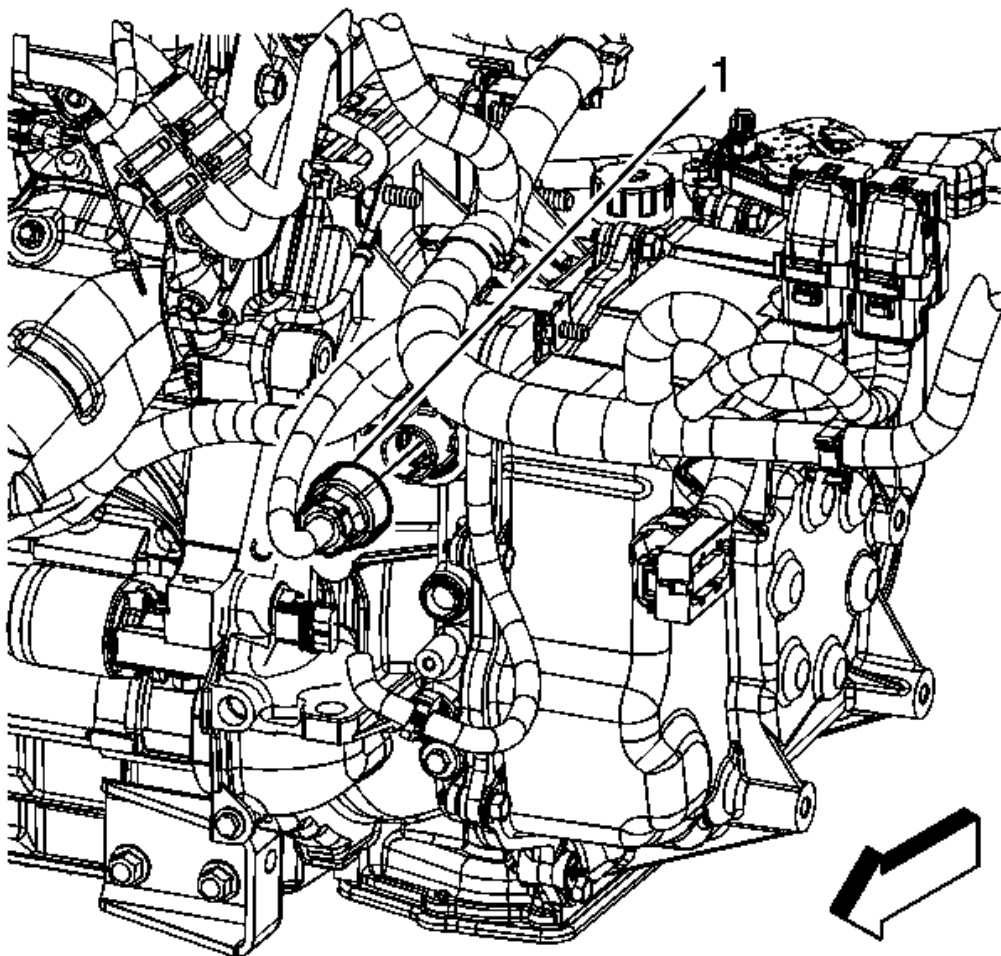


Fig. 223: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

60. Disconnect the engine wiring harness electrical connector (1) from the transaxle.

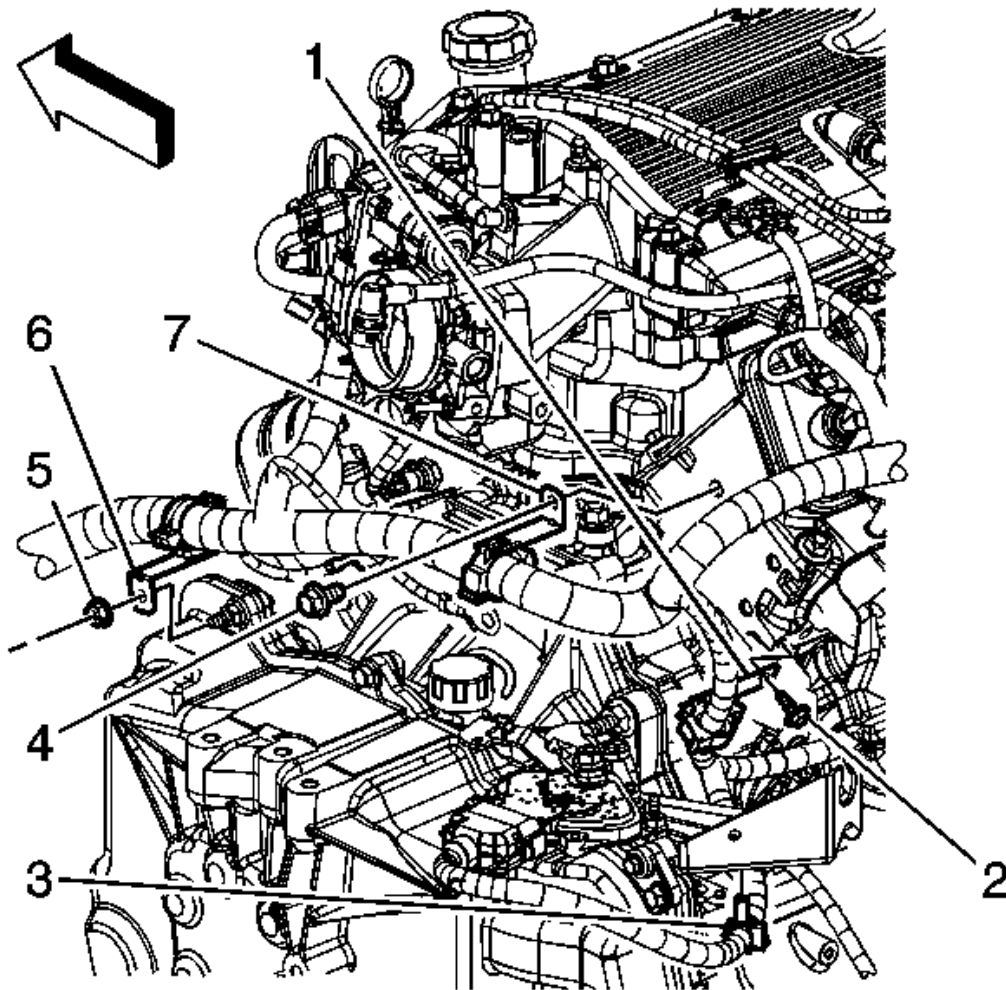


Fig. 224: Identifying Engine Wiring Harness Clip & Nut (at Transaxle Stud)
Courtesy of GENERAL MOTORS CORP.

61. Remove the engine wiring harness clip bolt (4).
62. Remove the engine wiring harness clip nut (5).
63. Remove the engine wiring harness clip (6) from the transaxle stud.

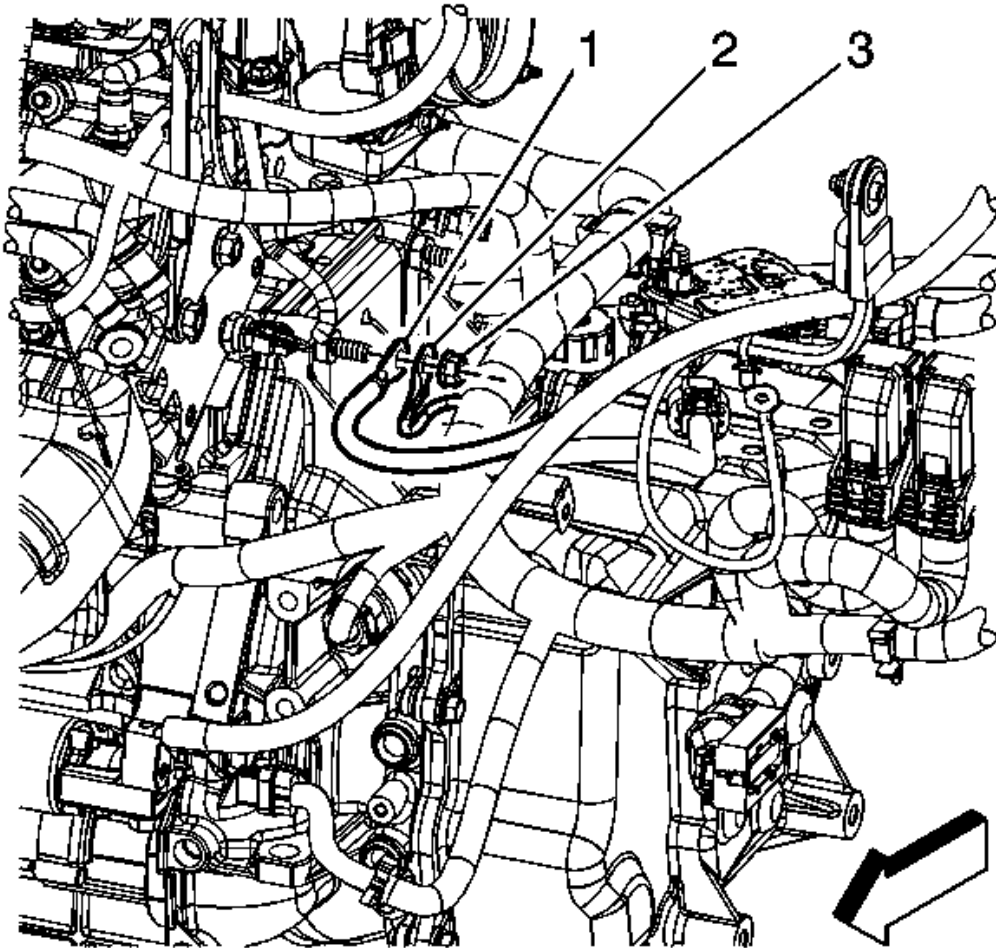


Fig. 225: Identifying Engine Wiring Harness Ground, & Negative Battery Cable Ground & Nut
Courtesy of GENERAL MOTORS CORP.

64. Remove the engine wiring harness ground nut (3).
65. Remove the engine wiring harness ground terminal (2) and the battery cable ground terminal (1) from the transaxle stud.
66. Gather all branches of the engine wiring harness and reposition the harness out of the way.
67. Remove the catalytic converter. Refer to **Catalytic Converter Replacement - Left Side (LZ4)** and/or **Catalytic Converter Replacement - Right Side (LZ4)**.
68. Remove the engine mount. Refer to **Engine Mount Replacement**.

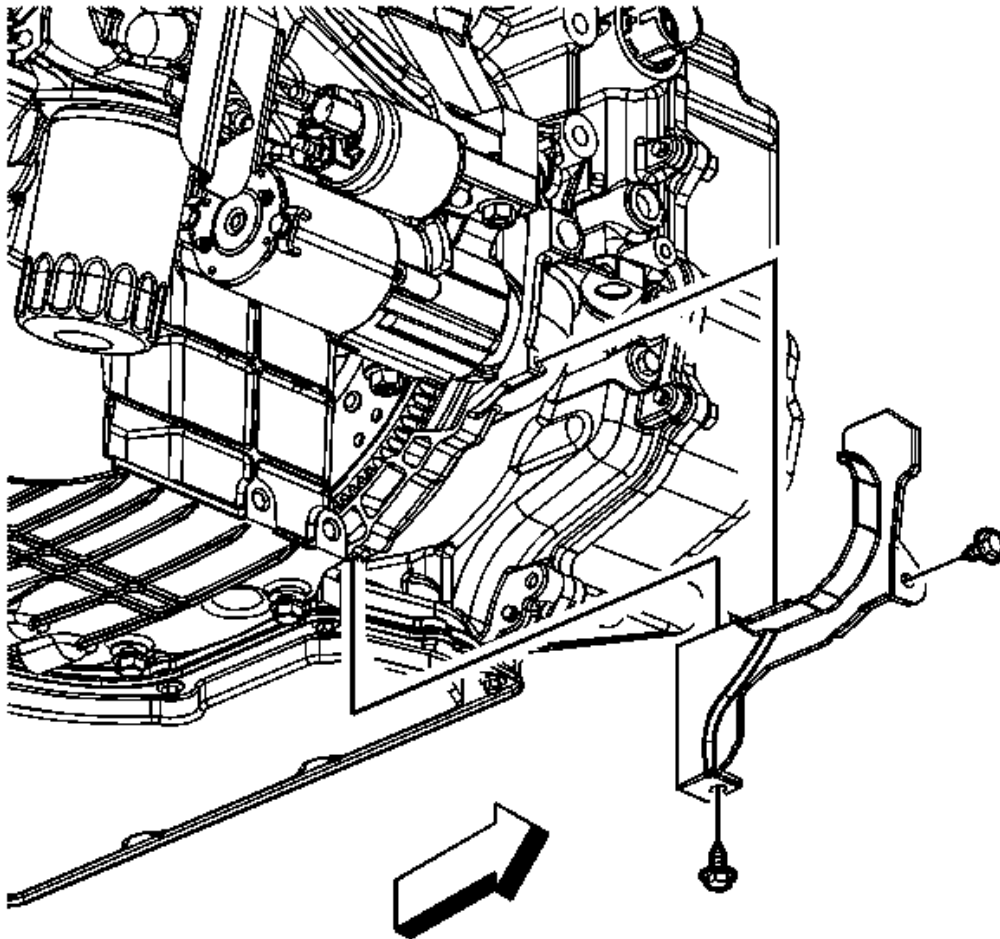


Fig. 226: Identifying Torque Converter Cover Bolts And Cover
Courtesy of GENERAL MOTORS CORP.

69. Remove the torque converter cover bolts and cover.

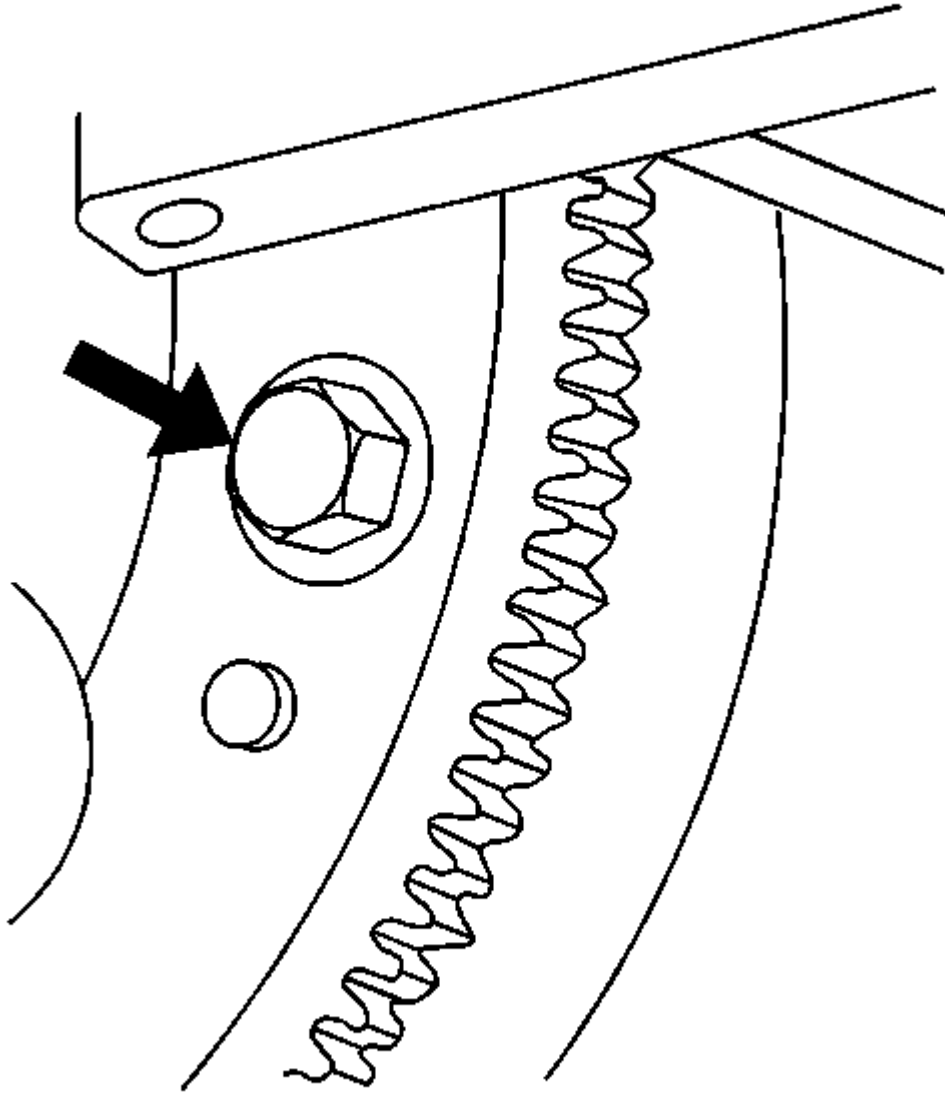


Fig. 227: View Of Flywheel To Torque Converter Bolts
Courtesy of GENERAL MOTORS CORP.

70. Remove the flexplate to torque converter bolts.

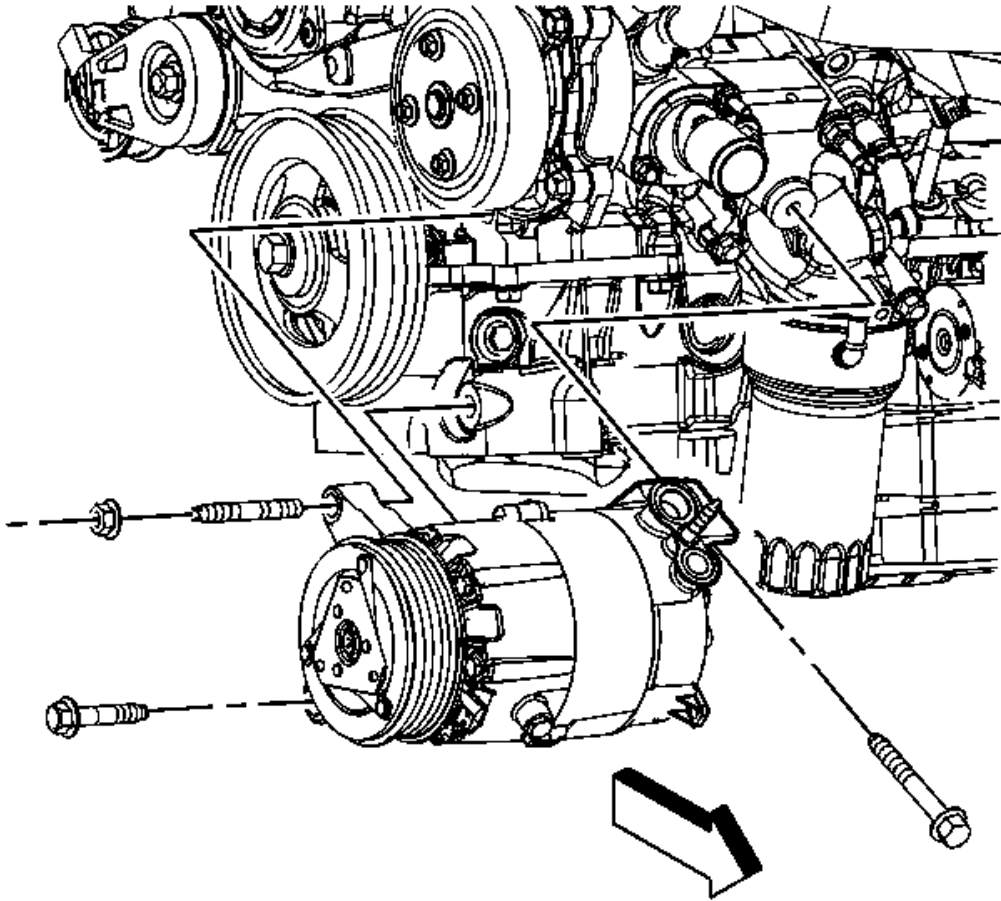


Fig. 228: View Of A/C compressor & Bolts
Courtesy of GENERAL MOTORS CORP.

71. Unbolt and reposition the A/C compressor off to the side. DO NOT discharge the A/C system.

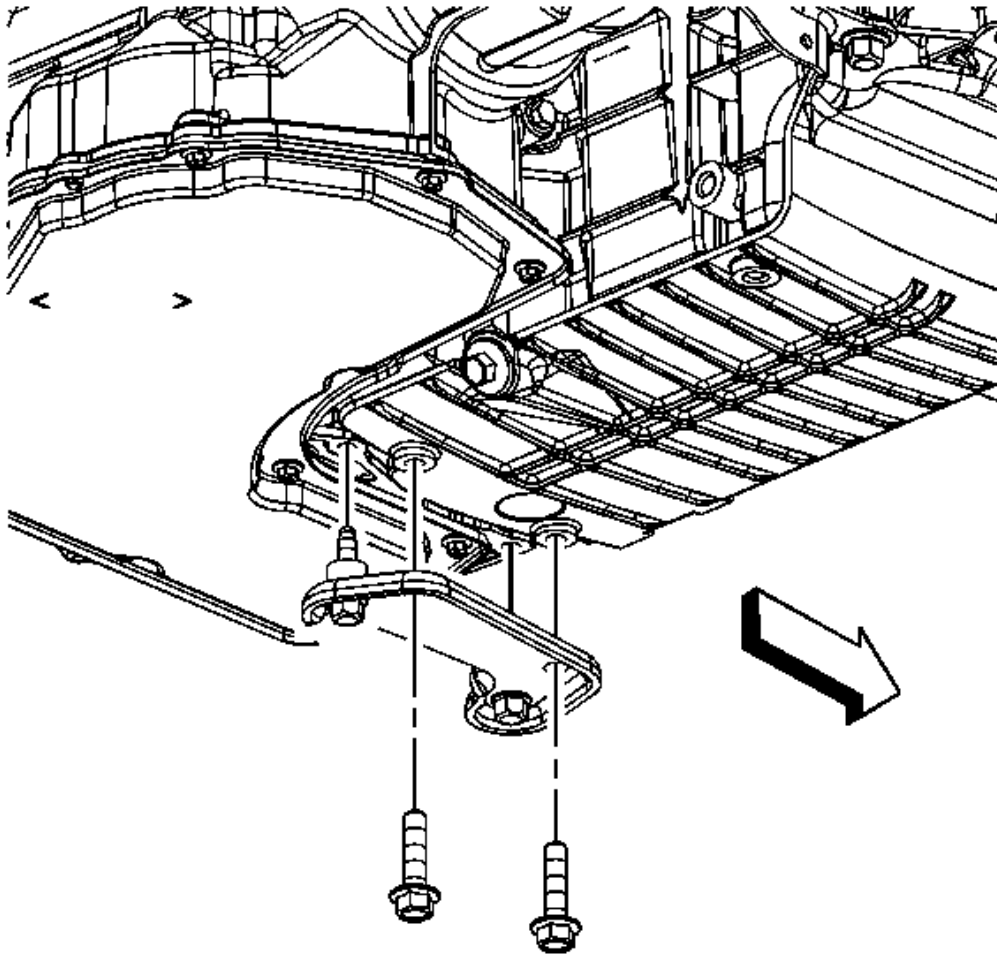


Fig. 229: Identifying Transmission To Engine Brace Bolts
Courtesy of GENERAL MOTORS CORP.

72. Remove the transaxle brace bolts and brace.

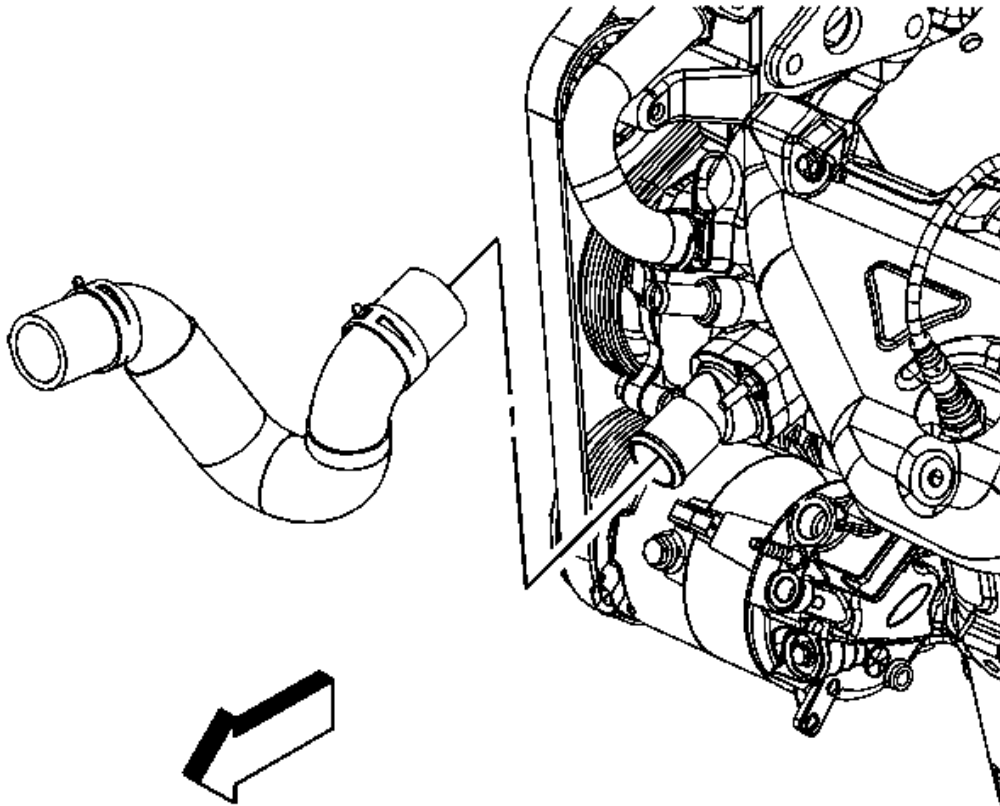


Fig. 230: Identifying Radiator Outlet Hose & Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

73. Reposition the radiator outlet hose clamp at the thermostat housing.
74. Remove the radiator outlet hose from the thermostat housing.
75. Lower the vehicle and support the transaxle.

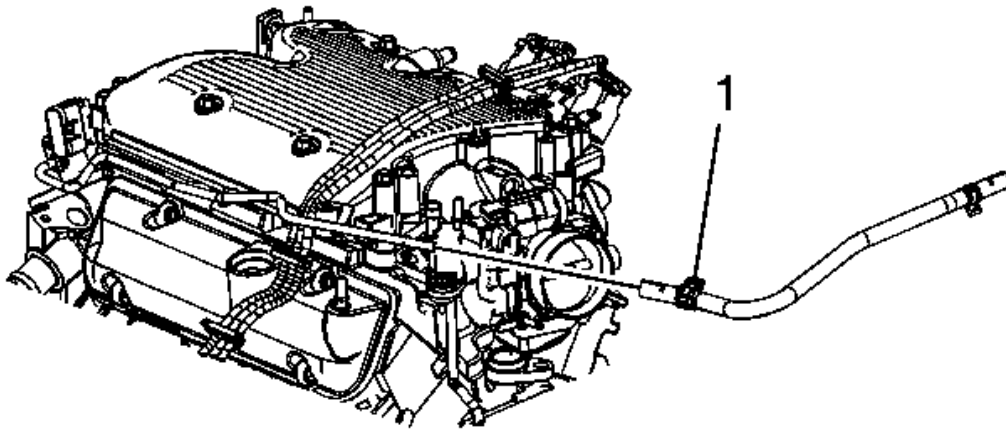


Fig. 231: Locating Radiator Surge Tank Inlet Hose Clamp
Courtesy of GENERAL MOTORS CORP.

76. Reposition the radiator surge tank hose clamp (1) at the surge tank pipe.
77. Remove the radiator surge tank hose from the surge tank pipe.

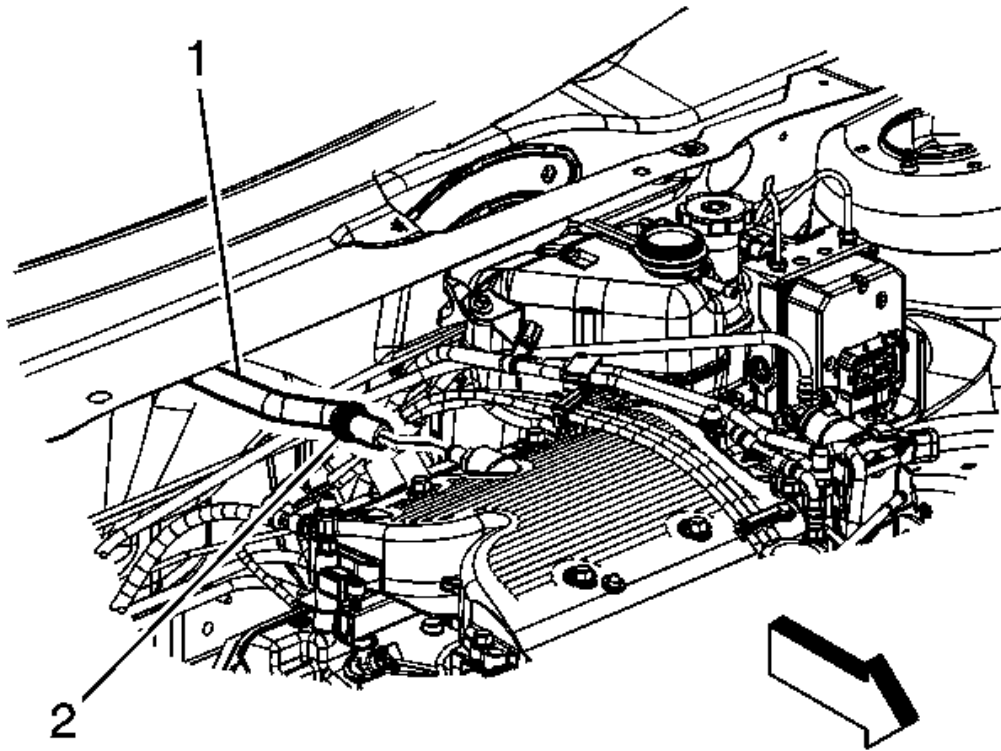


Fig. 232: View Of Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

78. Reposition the brake booster vacuum hose clamp (2) at the intake manifold.
79. Remove the brake booster vacuum hose (1) from the intake manifold.

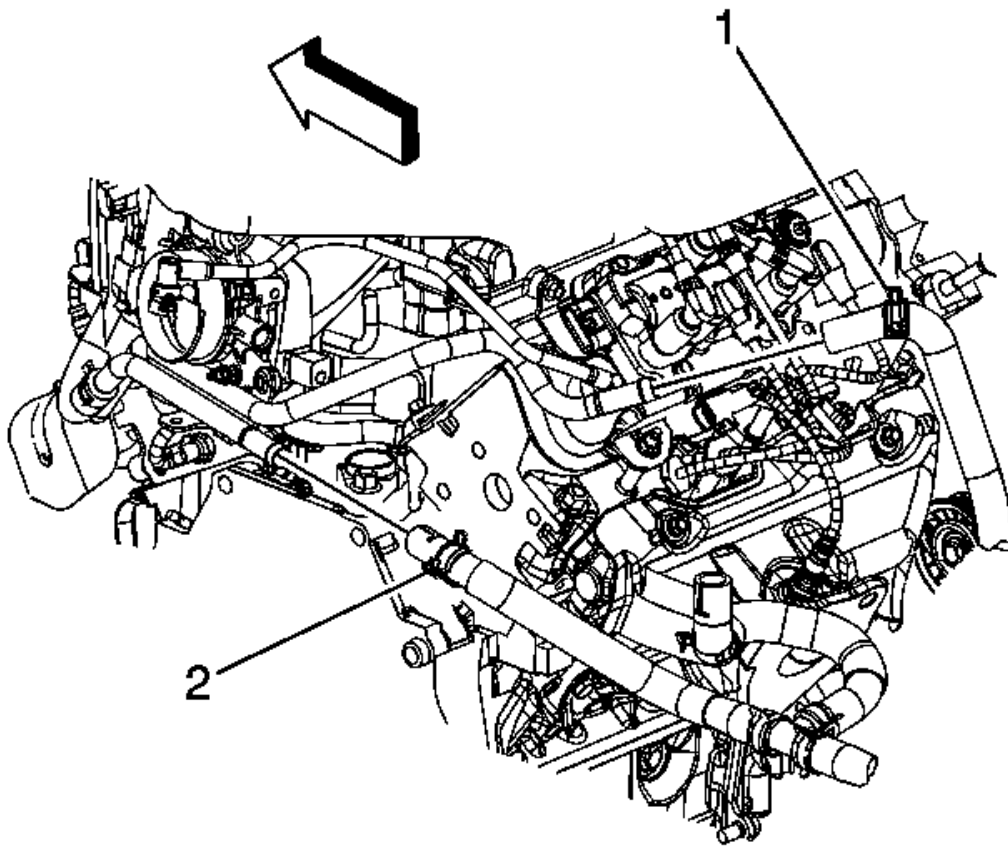


Fig. 233: View Of Heater Inlet (1) And Outlet (2) Hose Clamps
Courtesy of GENERAL MOTORS CORP.

80. Reposition the heater inlet (1) and outlet (2) hose clamps at the engine.
81. Remove the heater outlet and inlet hoses from the engine.

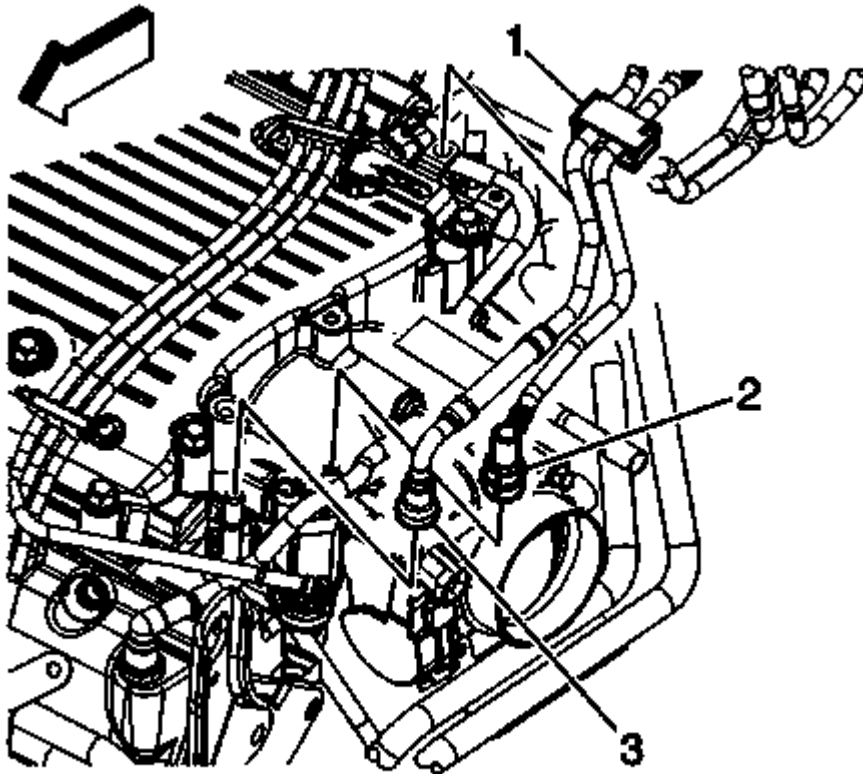


Fig. 234: View Of Fuel Feed & EVAP Pipes
Courtesy of GENERAL MOTORS CORP.

82. Disengage the fuel/EVAP line clip (1) from the MAP sensor bracket.
83. Disconnect the fuel feed line quick connect fitting (3) from the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .
84. Disconnect the EVAP purge line quick connect fitting (2) from the canister purge solenoid. Refer to **Plastic Collar Quick Connect Fitting Service** .

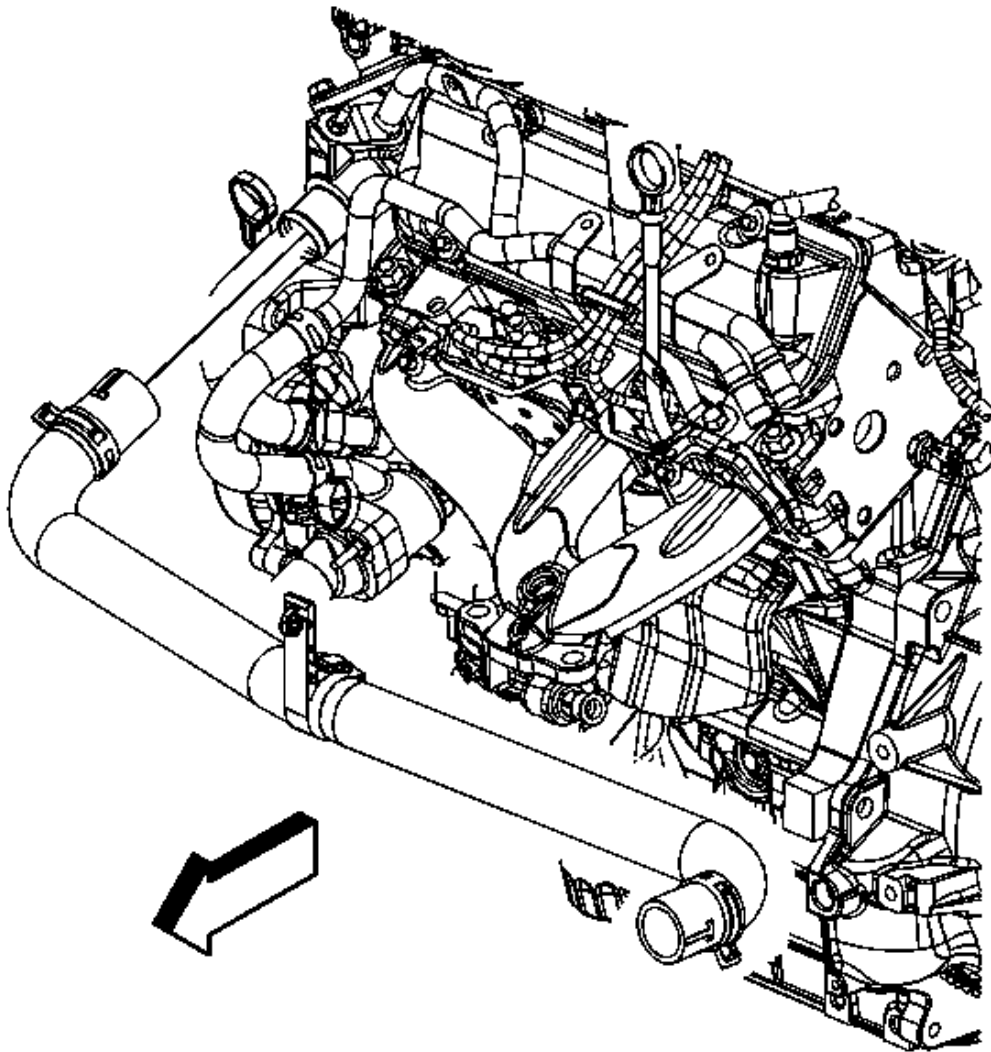


Fig. 235: Identifying Radiator Inlet Hose & Crossover Pipe
Courtesy of GENERAL MOTORS CORP.

85. Reposition the radiator inlet hose clamp at the engine.
86. Remove the radiator inlet hose from the engine.
87. Install a engine lifting device to the engine.

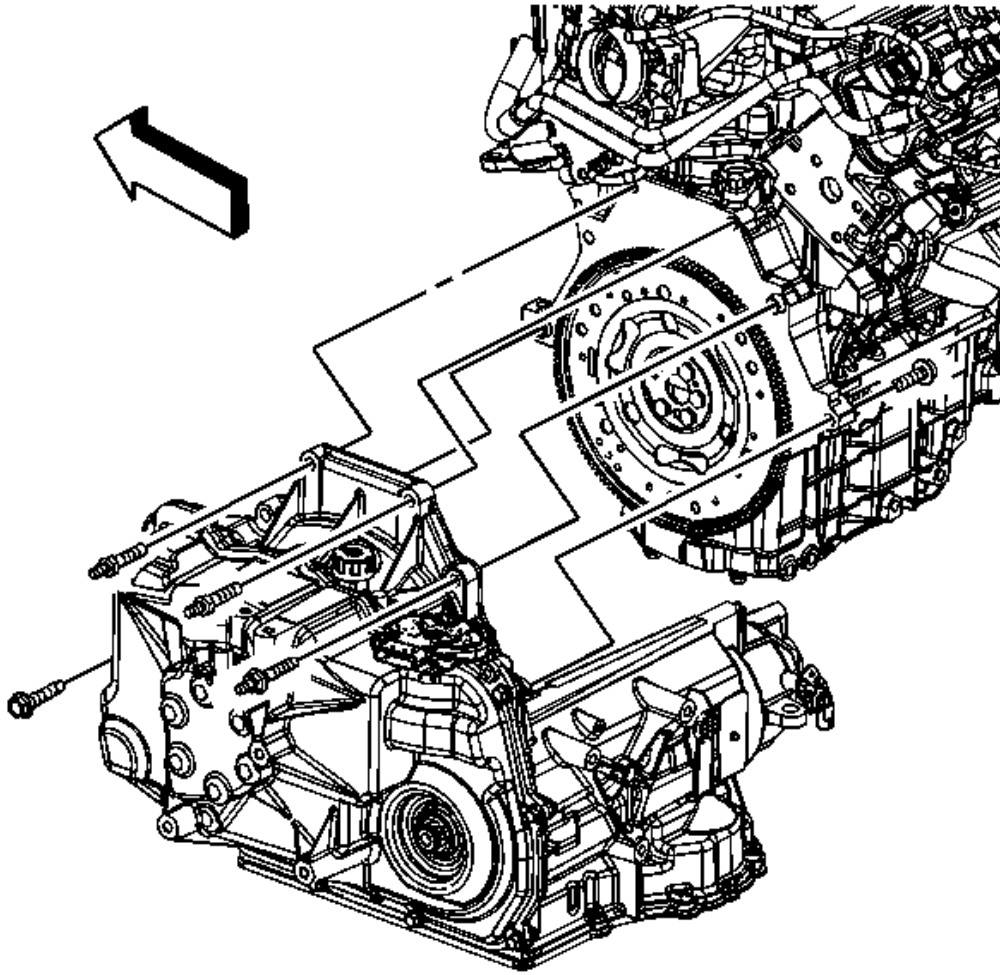


Fig. 236: Identifying Transaxle Studs And Bolts
Courtesy of GENERAL MOTORS CORP.

88. Remove the transaxle-to-engine bolts/studs.
89. Separate the engine from the transaxle and remove the engine from the vehicle.

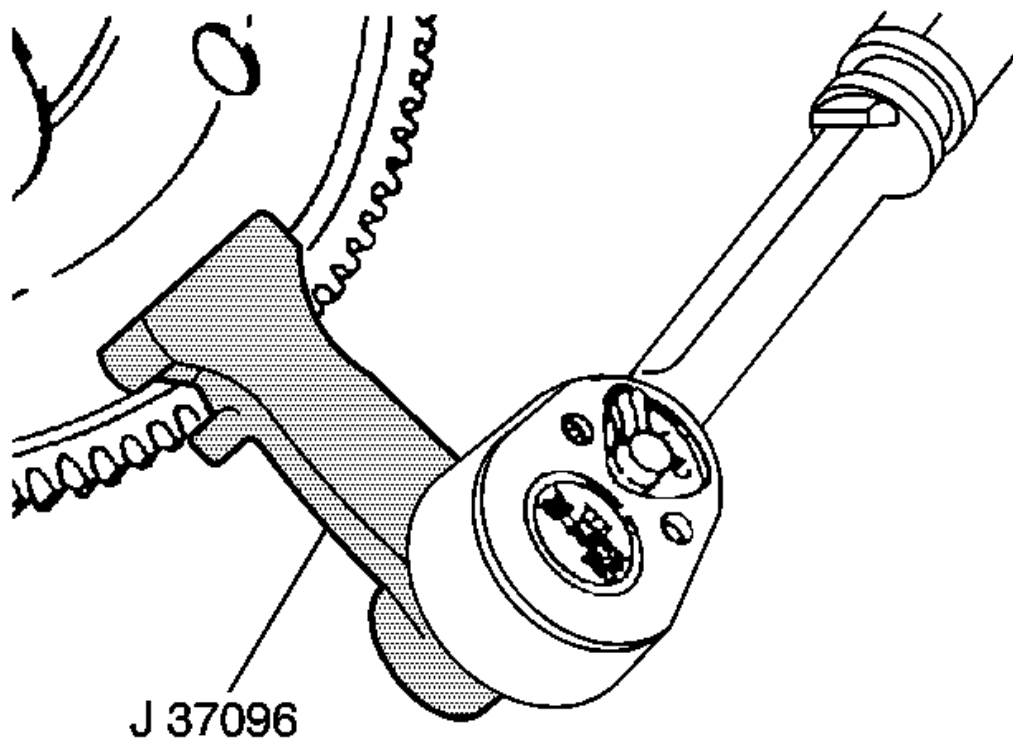


Fig. 237: Holding Flywheel

Courtesy of GENERAL MOTORS CORP.

90. Using the **J 37096** , secure the flexplate in order to prevent the flexplate from rotating. See **Special Tools** .

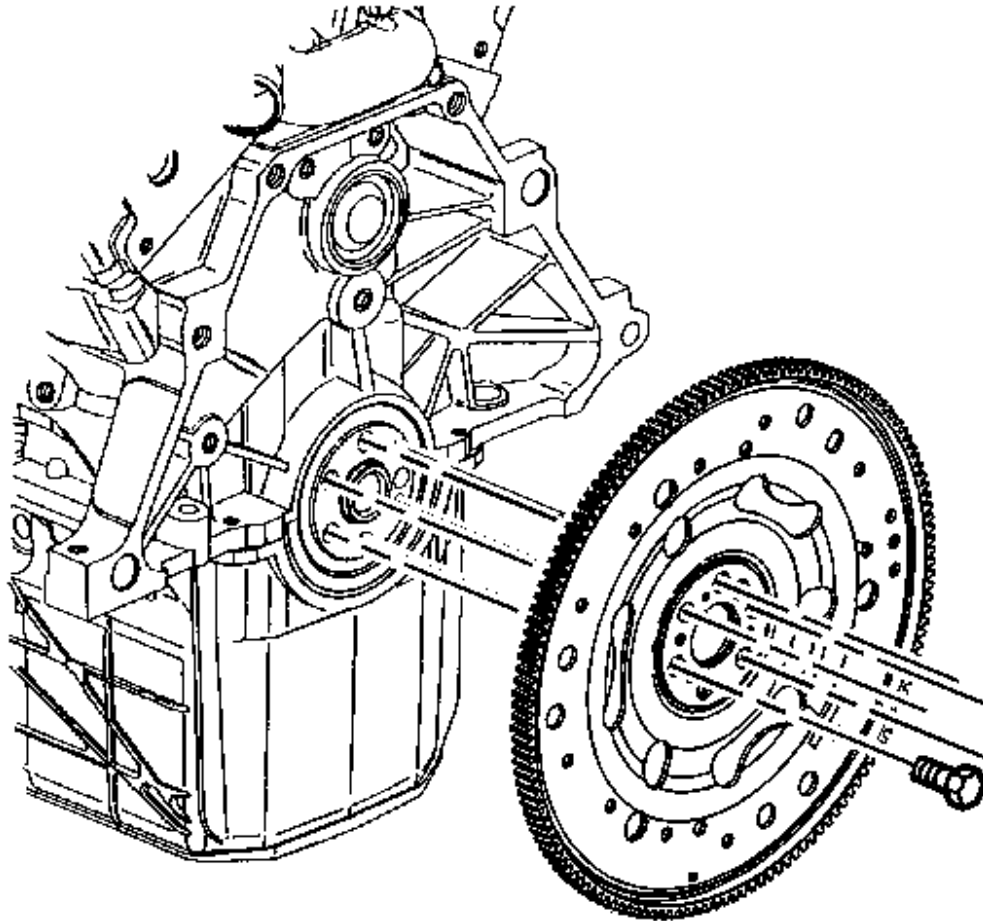


Fig. 238: View Of Flywheel

Courtesy of GENERAL MOTORS CORP.

91. Loosen the flexplate bolts.
92. Remove 5 of the 6 flexplate bolts leaving one bolt at the top of the crankshaft.
93. Grip the flexplate and remove the remaining bolt. Do not drop the flexplate when removing the final bolt.
94. Remove the flexplate.
95. Install the engine to the engine stand.

INSTALLATION PROCEDURE

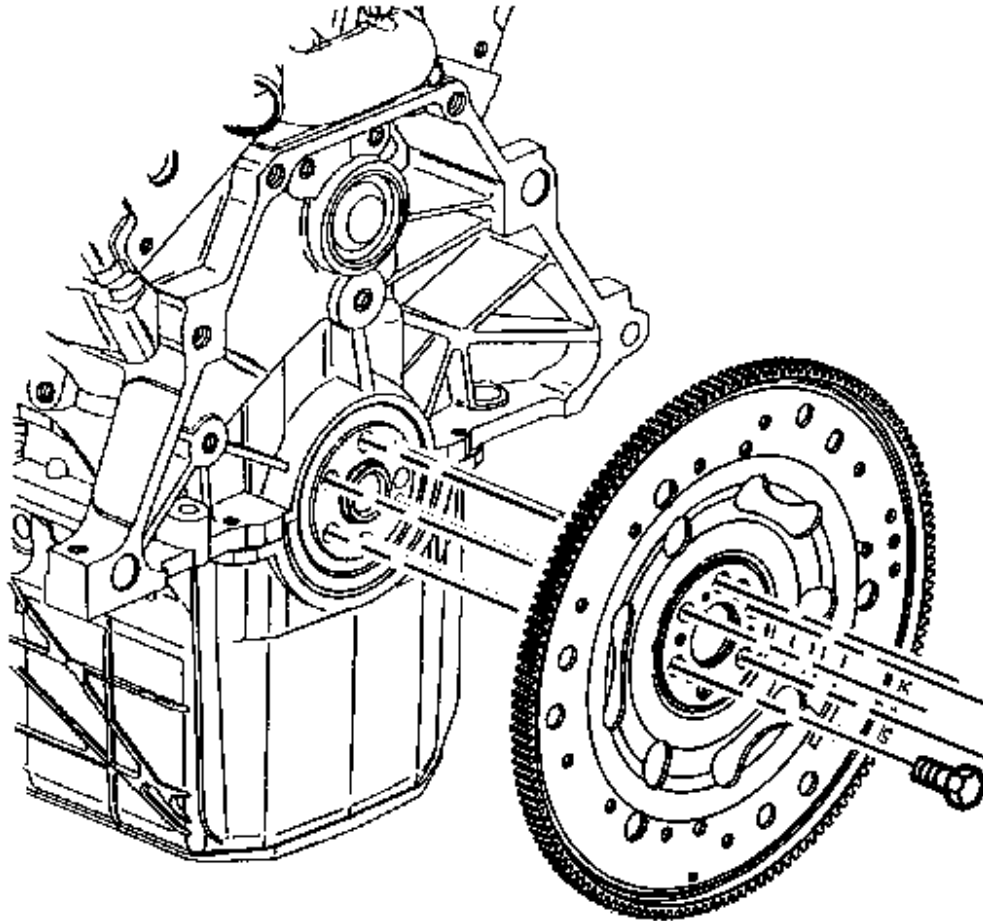


Fig. 239: View Of Flywheel
 Courtesy of GENERAL MOTORS CORP.

1. Install a engine lifting device to the engine.
2. Remove the engine from the engine stand.
3. Position the flexplate to the crankshaft.
4. Install the flywheel bolts finger tight.
5. Install the **J 37096** to the flexplate in order to prevent the flexplate from rotating. See **Special Tools** .

CAUTION: Refer to **Fastener Caution** .

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

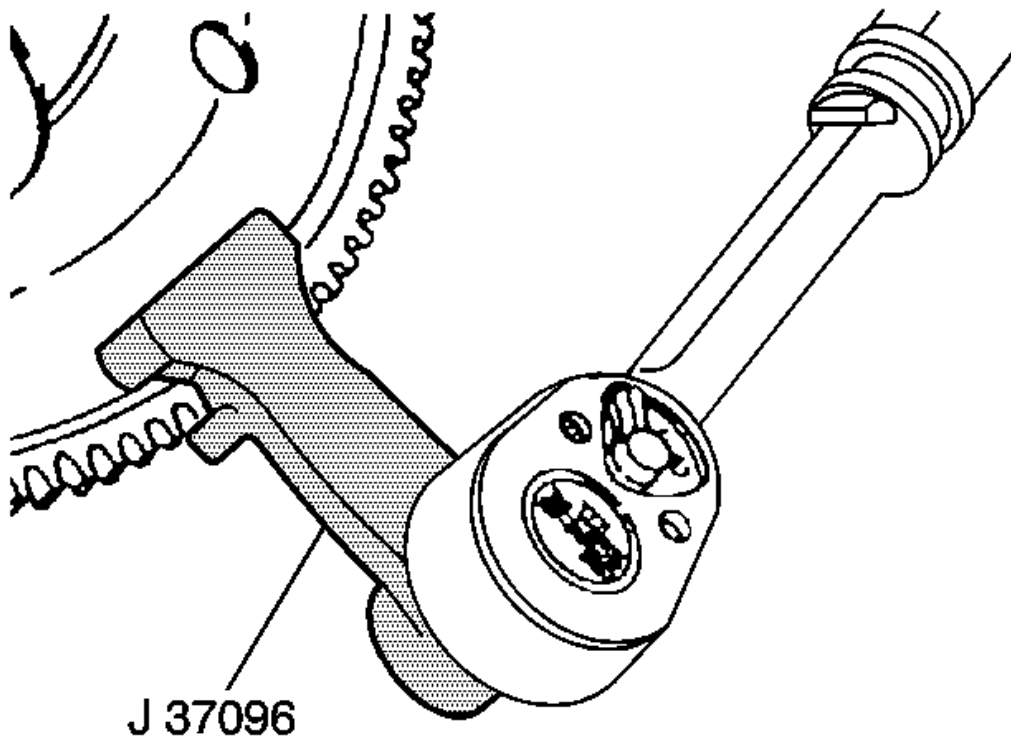


Fig. 240: Holding Flywheel
Courtesy of GENERAL MOTORS CORP.

7. Remove the **J 37096** . See Special Tools .

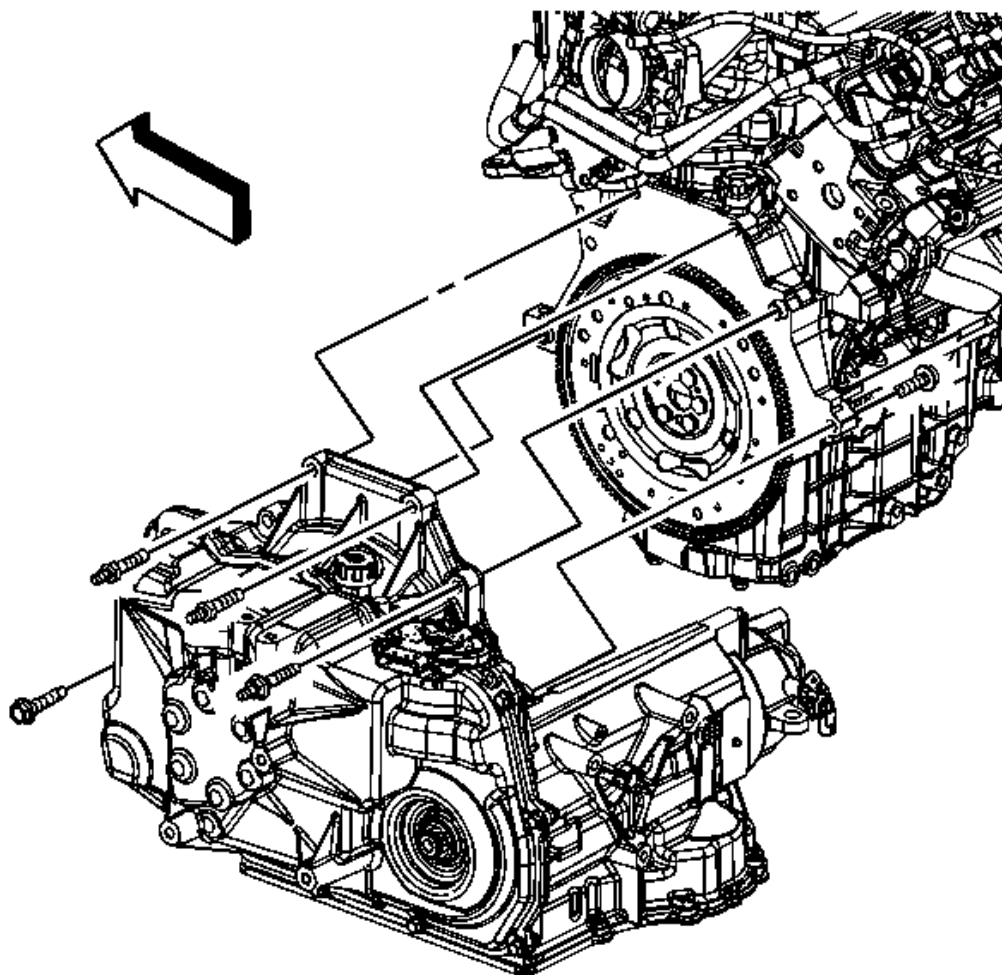


Fig. 241: Identifying Transaxle Studs And Bolts
Courtesy of GENERAL MOTORS CORP.

8. Install the engine to the vehicle and install the engine to the transaxle.
9. Install the transaxle-to-engine bolts/studs and tighten to 75 N.m (55 lb ft).

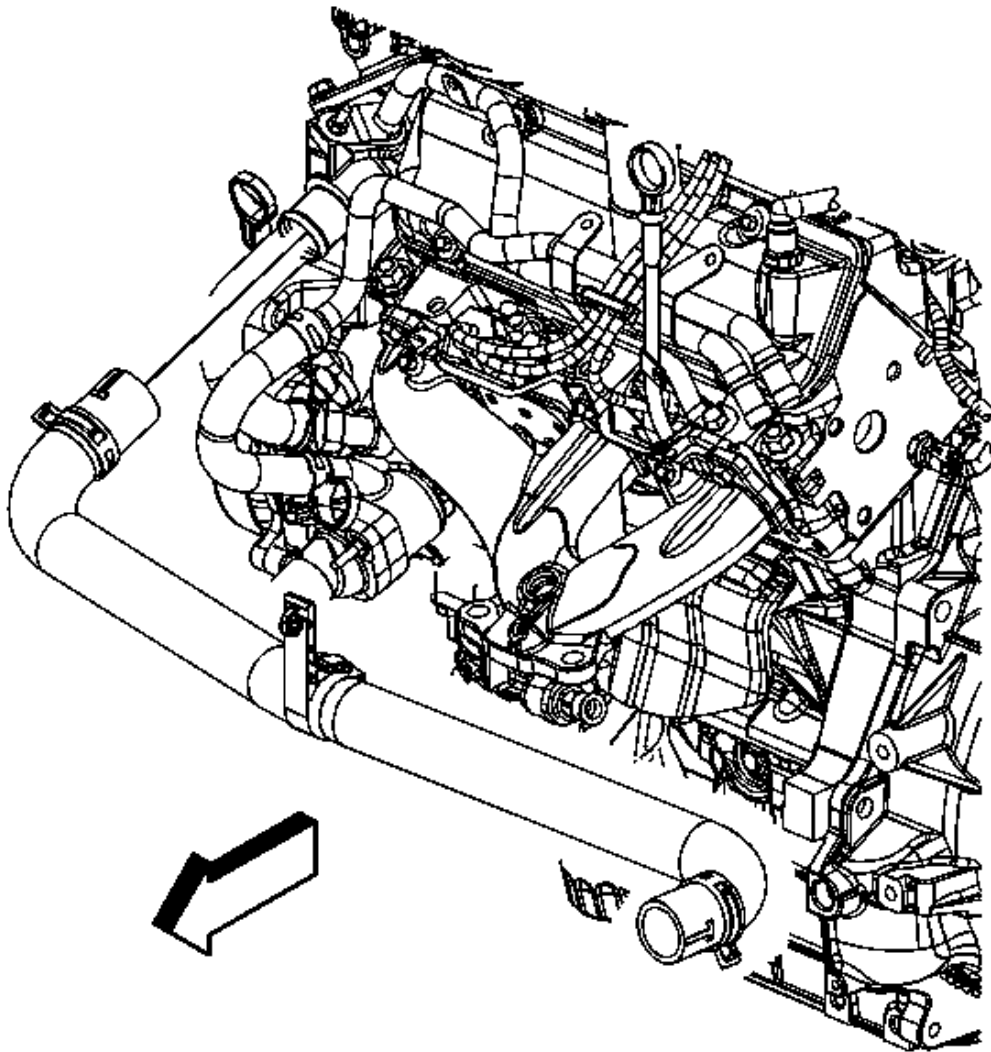


Fig. 242: Identifying Radiator Inlet Hose & Crossover Pipe
Courtesy of GENERAL MOTORS CORP.

10. Install the radiator inlet hose to the engine.
11. Position the radiator inlet hose clamp at the engine.

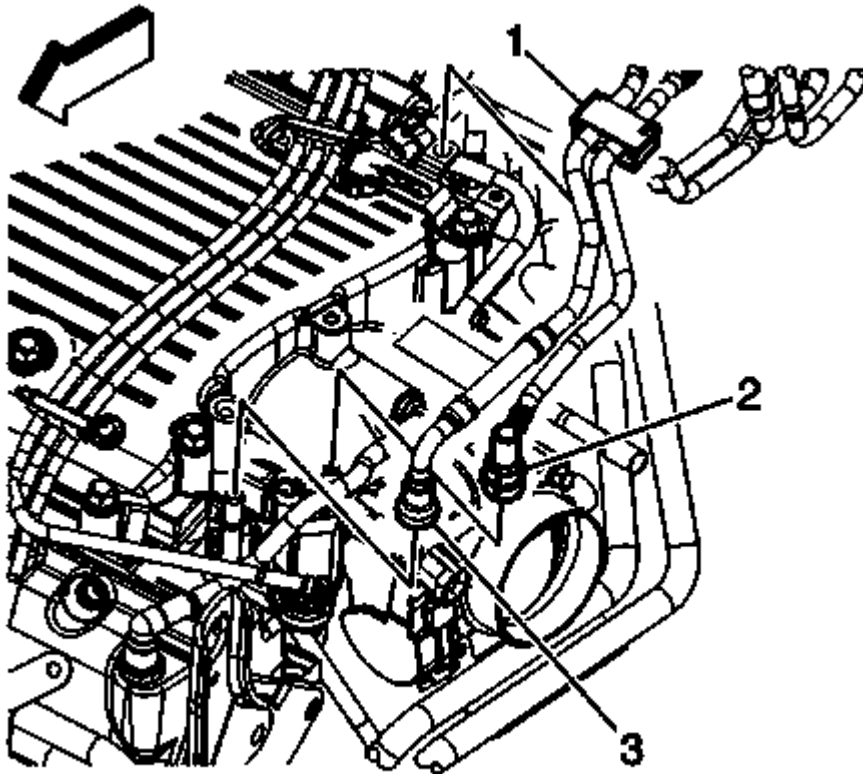


Fig. 243: View Of Fuel Feed & EVAP Pipes
Courtesy of GENERAL MOTORS CORP.

12. Connect the EVAP purge line quick connect fitting (2) to the canister purge solenoid. Refer to **Plastic Collar Quick Connect Fitting Service** .
13. Connect the fuel feed line quick connect fitting (3) to the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .
14. Engage the fuel/EVAP line clip (1) to the MAP sensor bracket.

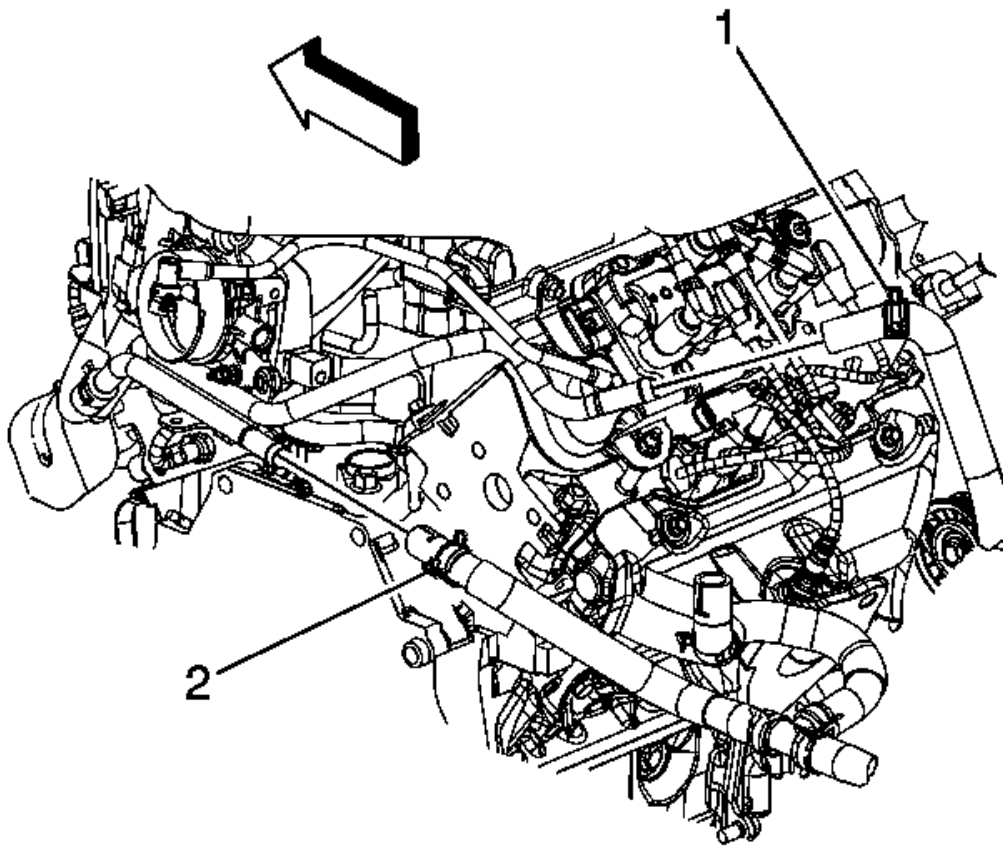


Fig. 244: View Of Heater Inlet (1) And Outlet (2) Hose Clamps
Courtesy of GENERAL MOTORS CORP.

15. Install the heater outlet and inlet hoses to the engine.
16. Position the heater inlet(1) and outlet (2) hose clamps at the engine.

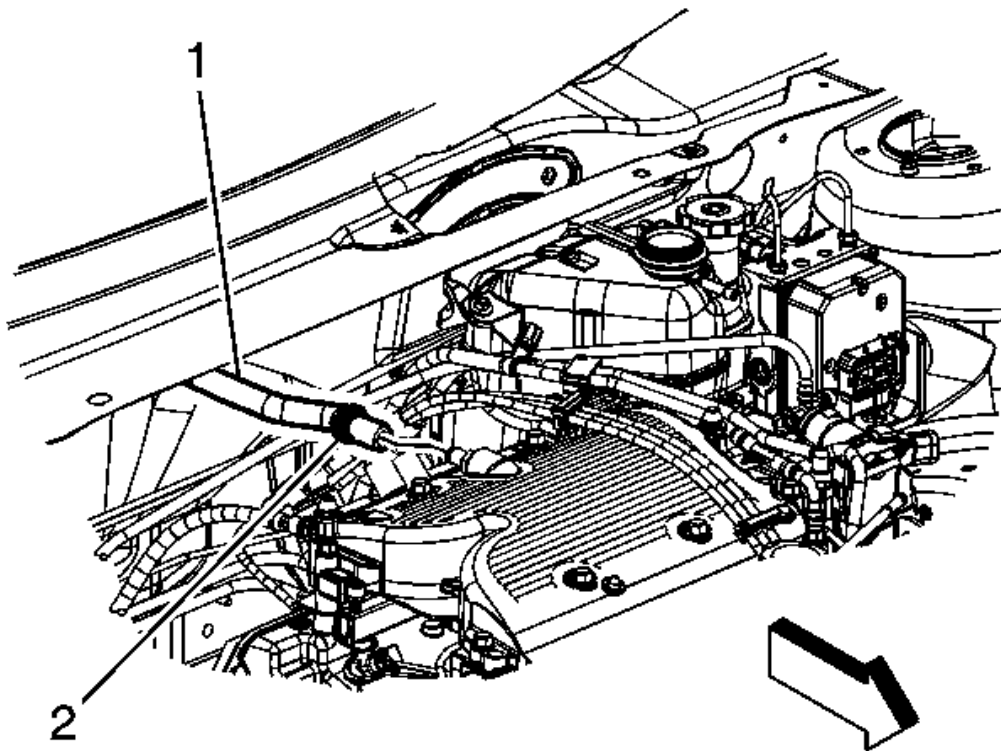


Fig. 245: View Of Brake Booster Vacuum Hose
Courtesy of GENERAL MOTORS CORP.

17. Install the brake booster vacuum hose (1) to the intake manifold.
18. Position the brake booster vacuum hose clamp (2) at the intake manifold.

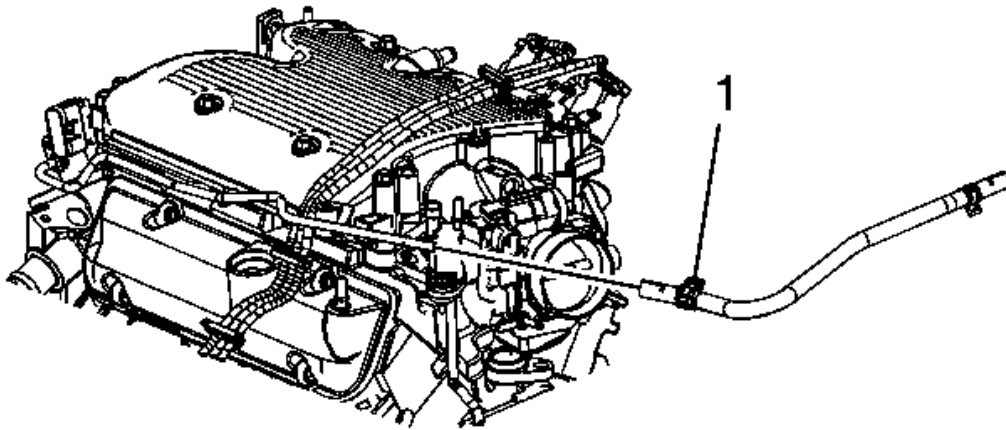


Fig. 246: Locating Radiator Surge Tank Inlet Hose Clamp
Courtesy of GENERAL MOTORS CORP.

19. Install the radiator surge tank hose to the surge tank pipe.
20. Position the radiator surge tank hose clamp (1) at the surge tank pipe.
21. Remove the support from the transaxle and raise the vehicle.

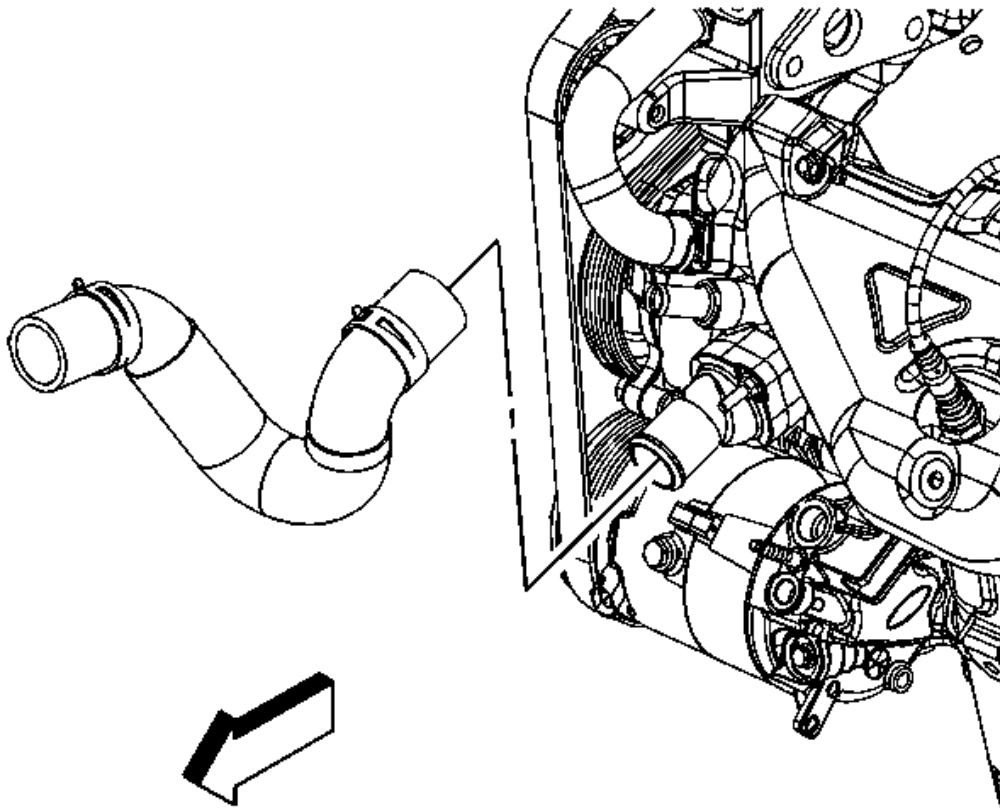


Fig. 247: Identifying Radiator Outlet Hose & Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

22. Install the radiator outlet hose to the thermostat housing.
23. Position the radiator outlet hose clamp at the thermostat housing.

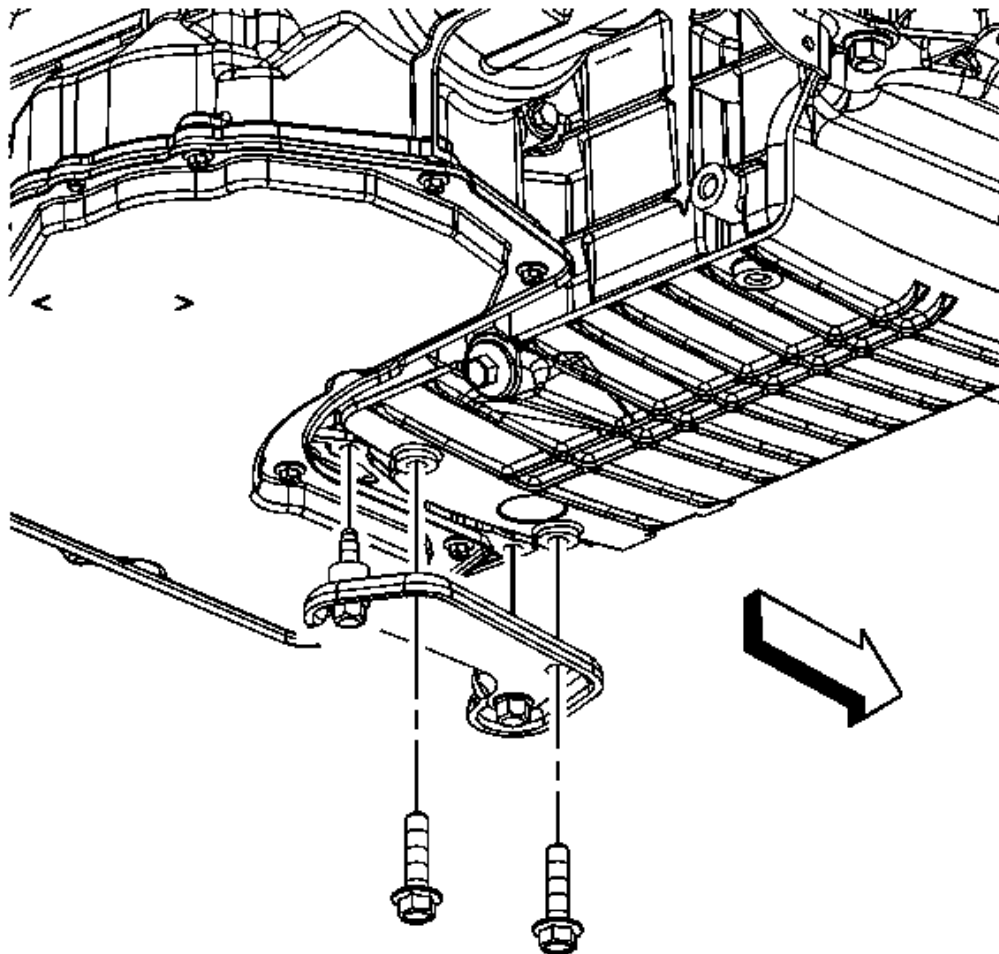


Fig. 248: Identifying Transmission To Engine Brace Bolts
Courtesy of GENERAL MOTORS CORP.

24. Install the transaxle brace and bolts and tighten the bolts to 50 N.m (37 lb ft).

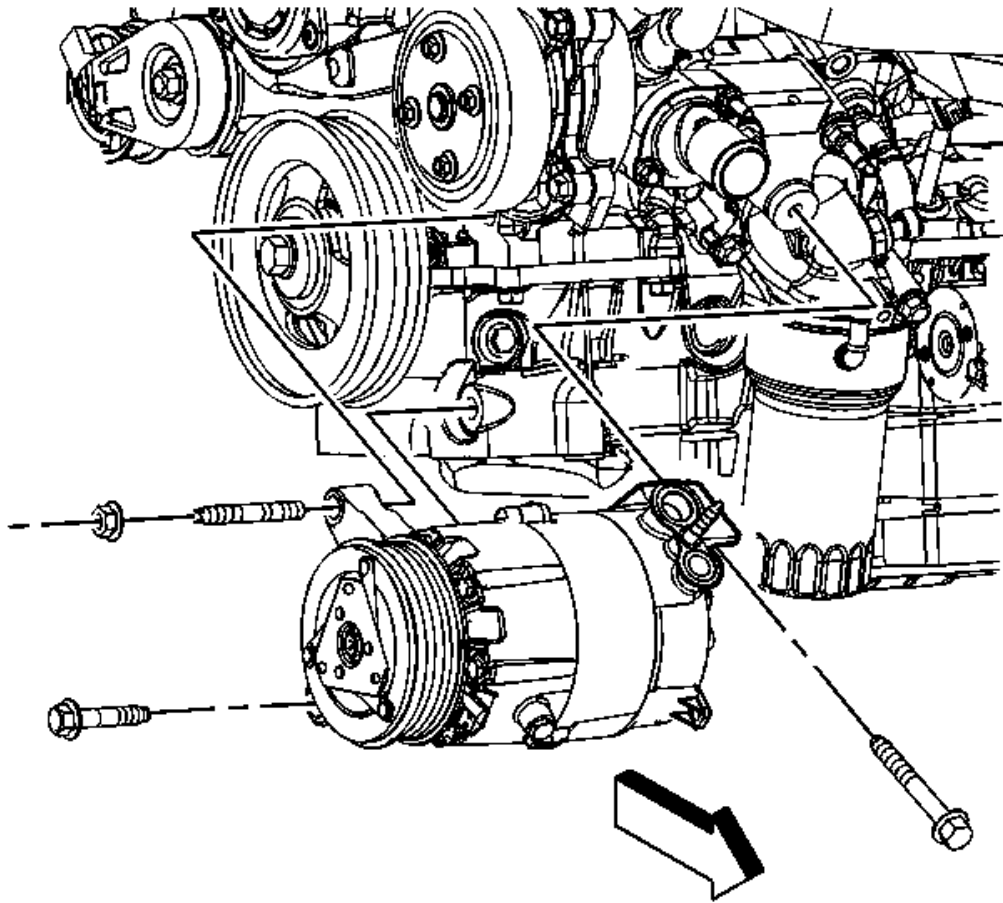


Fig. 249: View Of A/C compressor & Bolts
Courtesy of GENERAL MOTORS CORP.

25. Position and install the A/C compressor onto the stud.
26. Tighten the A/C compressor nut first, then the rear bolt, then the front bolt to 50 N.m (37 lb ft).

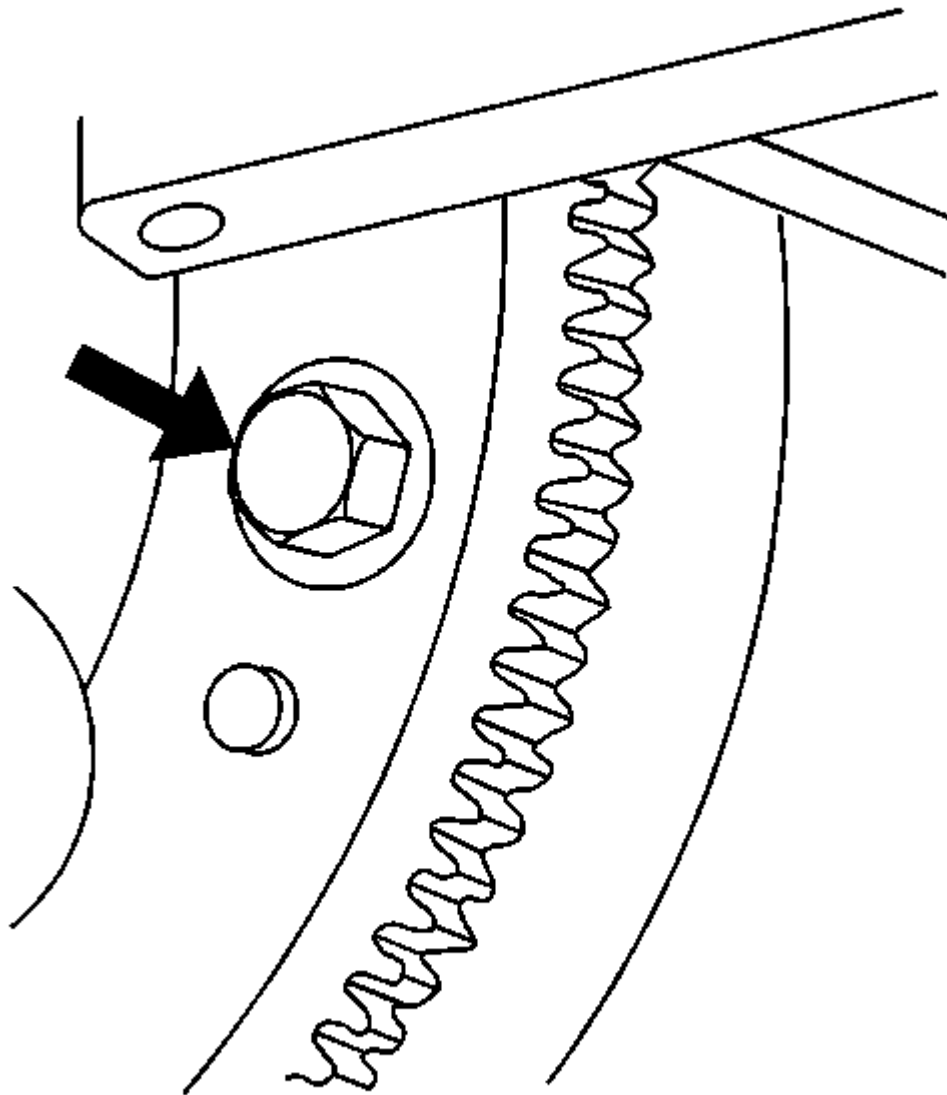


Fig. 250: View Of Flywheel To Torque Converter Bolts
Courtesy of GENERAL MOTORS CORP.

27. Install the flexplate to torque converter bolts and tighten to 62 N.m (46 lb ft).

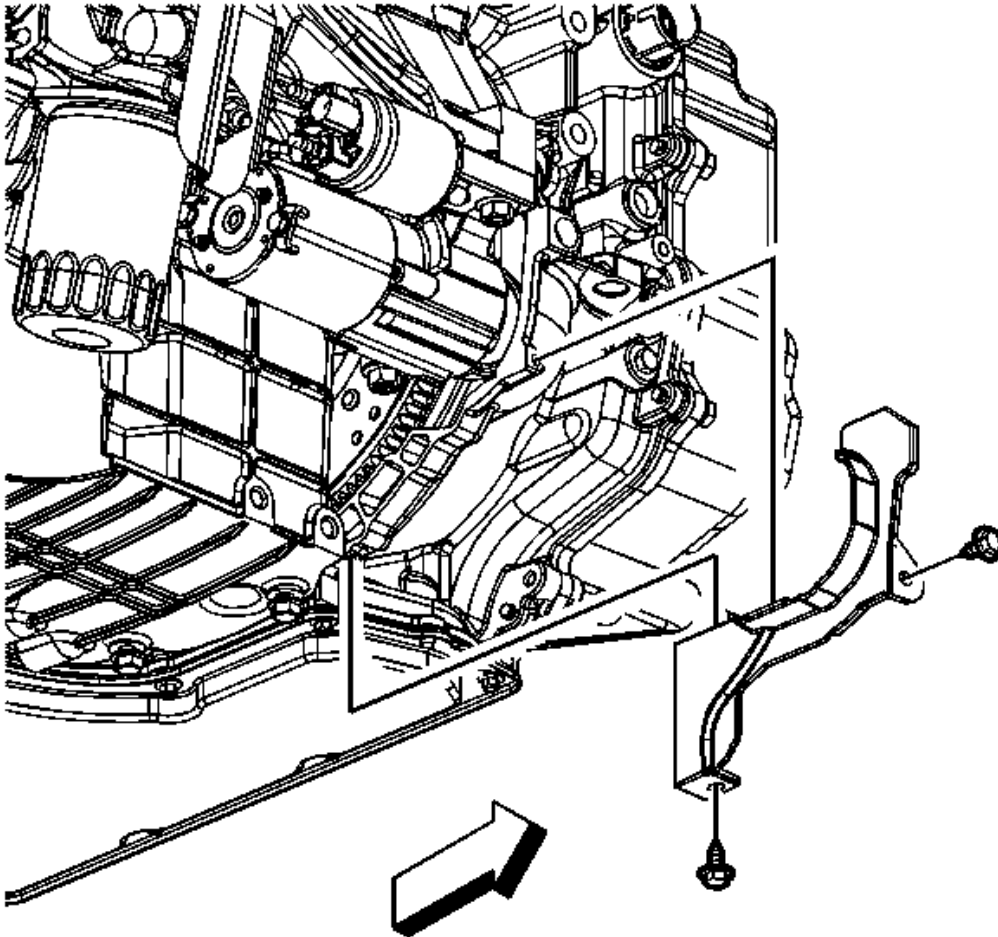


Fig. 251: Identifying Torque Converter Cover Bolts And Cover
Courtesy of GENERAL MOTORS CORP.

28. Install the torque converter cover and bolts and tighten to 10 N.m (89 lb in).
29. Install the catalytic converter. Refer to **Catalytic Converter Replacement - Left Side (LZ4)** and/or **Catalytic Converter Replacement - Right Side (LZ4)** .
30. Install the engine mount. Refer to **Engine Mount Replacement**.

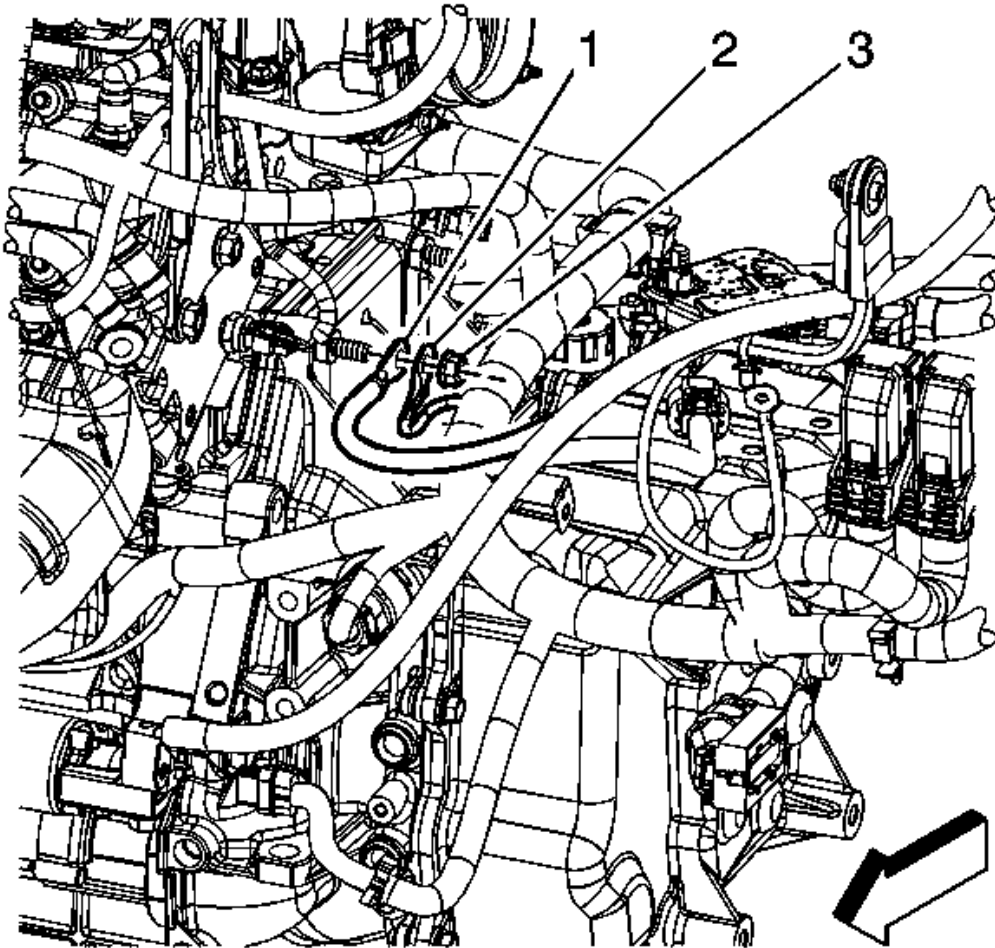


Fig. 252: Identifying Engine Wiring Harness Ground, & Negative Battery Cable Ground & Nut
Courtesy of GENERAL MOTORS CORP.

31. Position the branches of the engine wiring harness over the engine.
32. Install the battery cable ground terminal (1) and the engine wiring harness ground terminal (2) to the transaxle stud.
33. Install the engine wiring harness ground nut (3) and tighten to 25 N.m (18 lb ft).

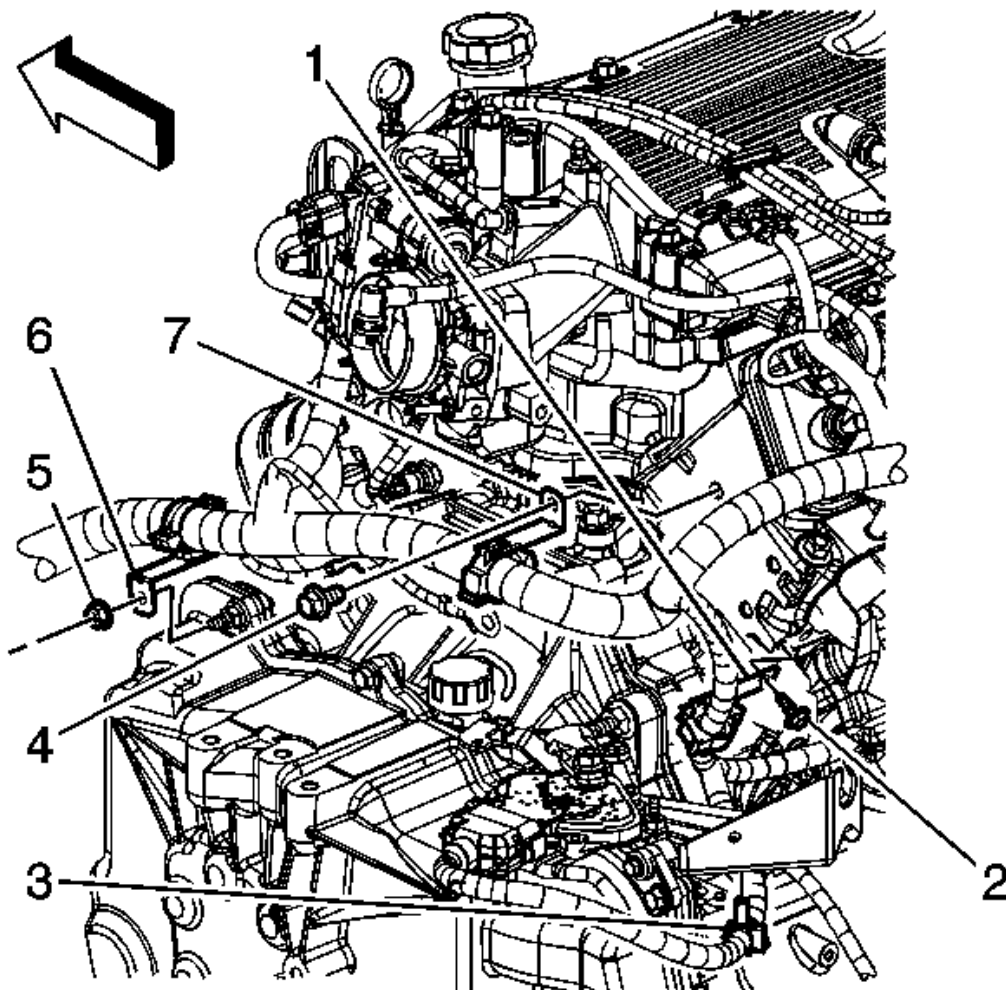


Fig. 253: Identifying Engine Wiring Harness Clip & Nut (at Transaxle Stud)
Courtesy of GENERAL MOTORS CORP.

34. Install the engine wiring harness clip (6) to the transaxle stud.
35. Install the engine wiring harness clip nut (5) and tighten to 25 N.m (18 lb ft).
36. Install the engine wiring harness clip bolt (4) and tighten to 25 N.m (18 lb ft).

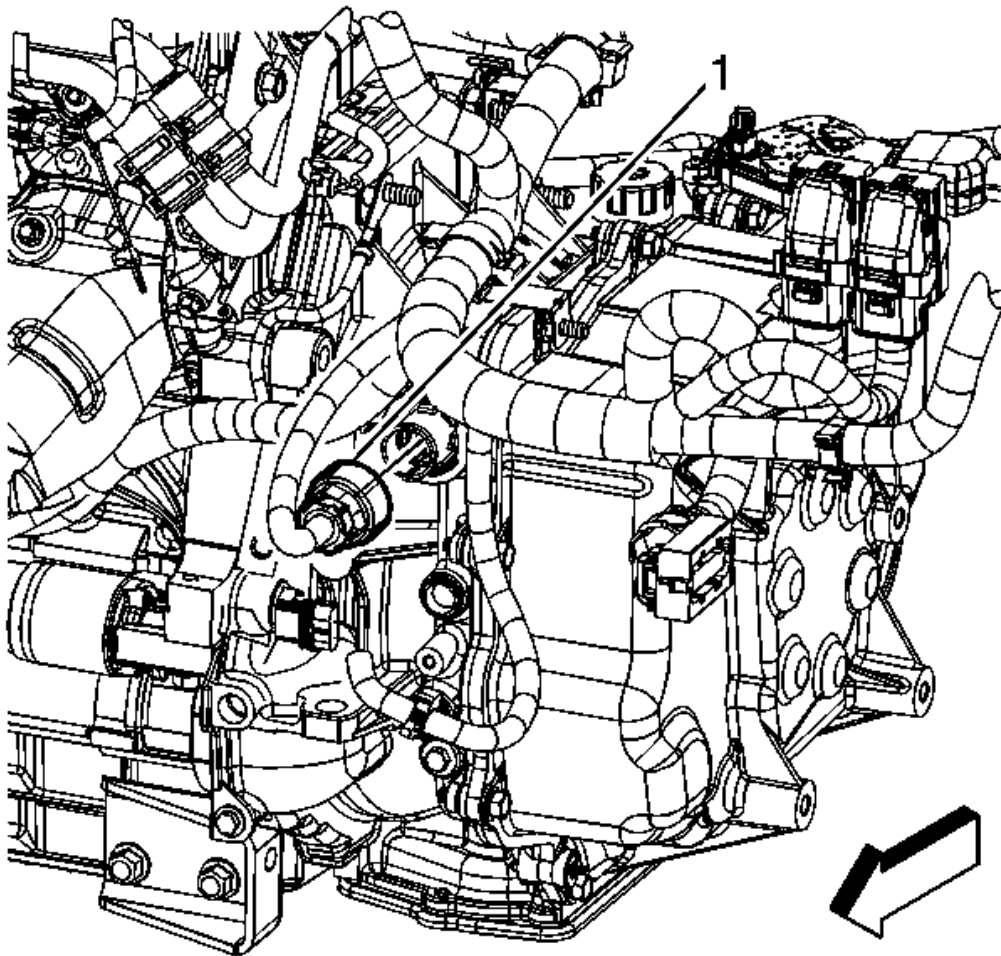


Fig. 254: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

37. Connect the engine wiring harness electrical connector (1) to the transaxle.

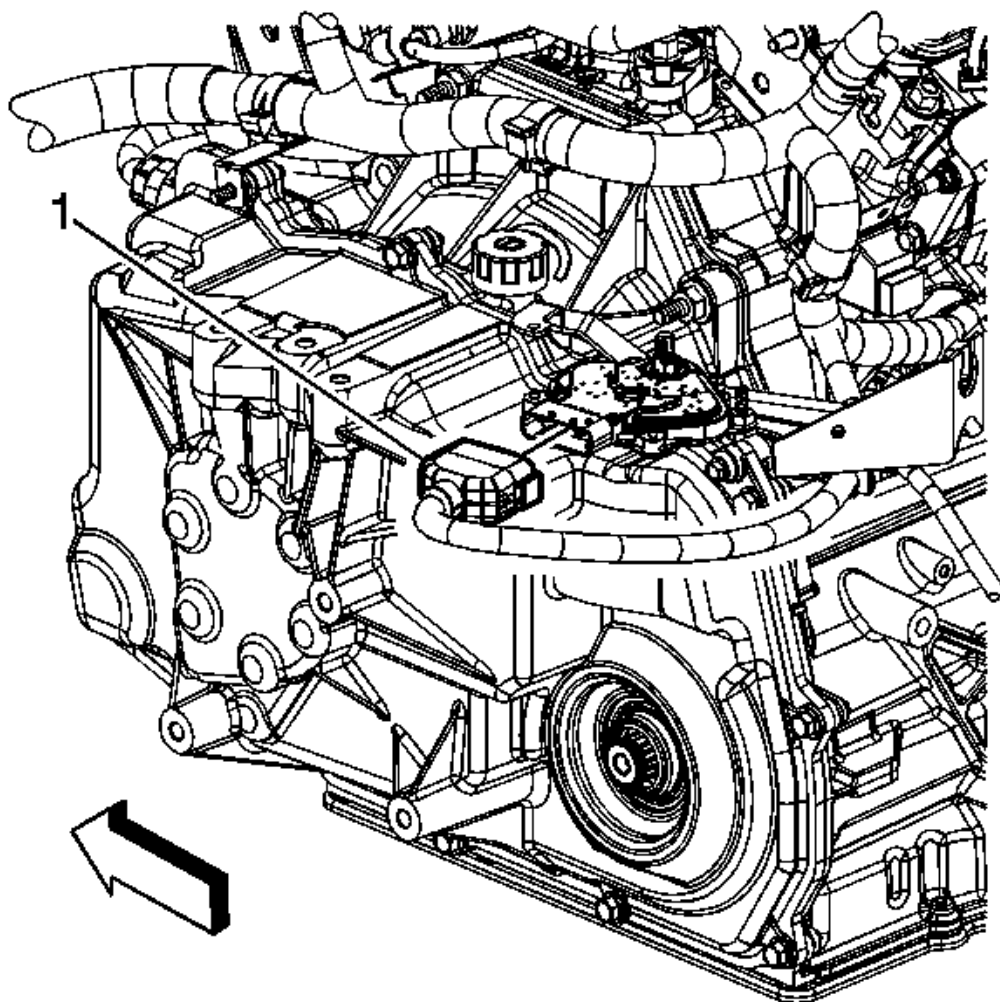


Fig. 255: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

38. Connect the engine wiring harness electrical connector (1) to the neutral safety backup switch.

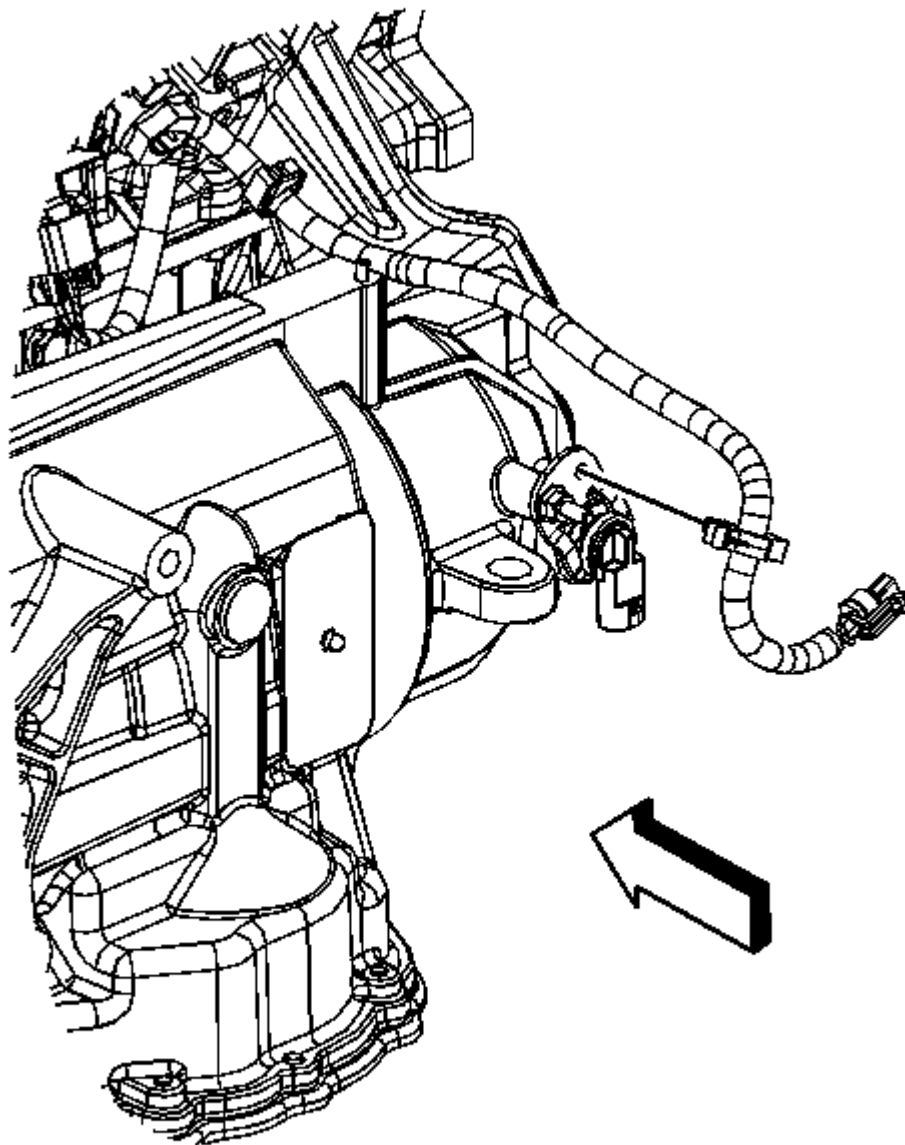


Fig. 256: Identifying Engine Wiring Harness Clip
Courtesy of GENERAL MOTORS CORP.

39. Install the engine wiring harness clip to the vehicle speed sensor bracket.

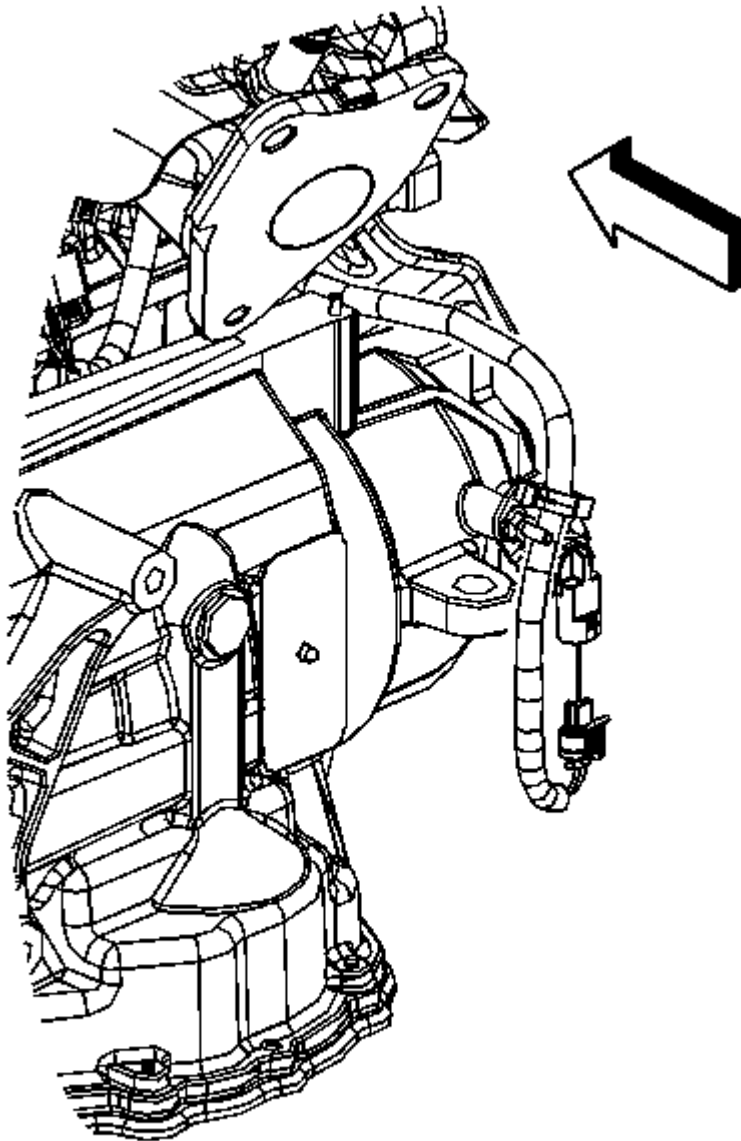


Fig. 257: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

40. Connect the engine wiring harness electrical connector to the vehicle speed sensor.

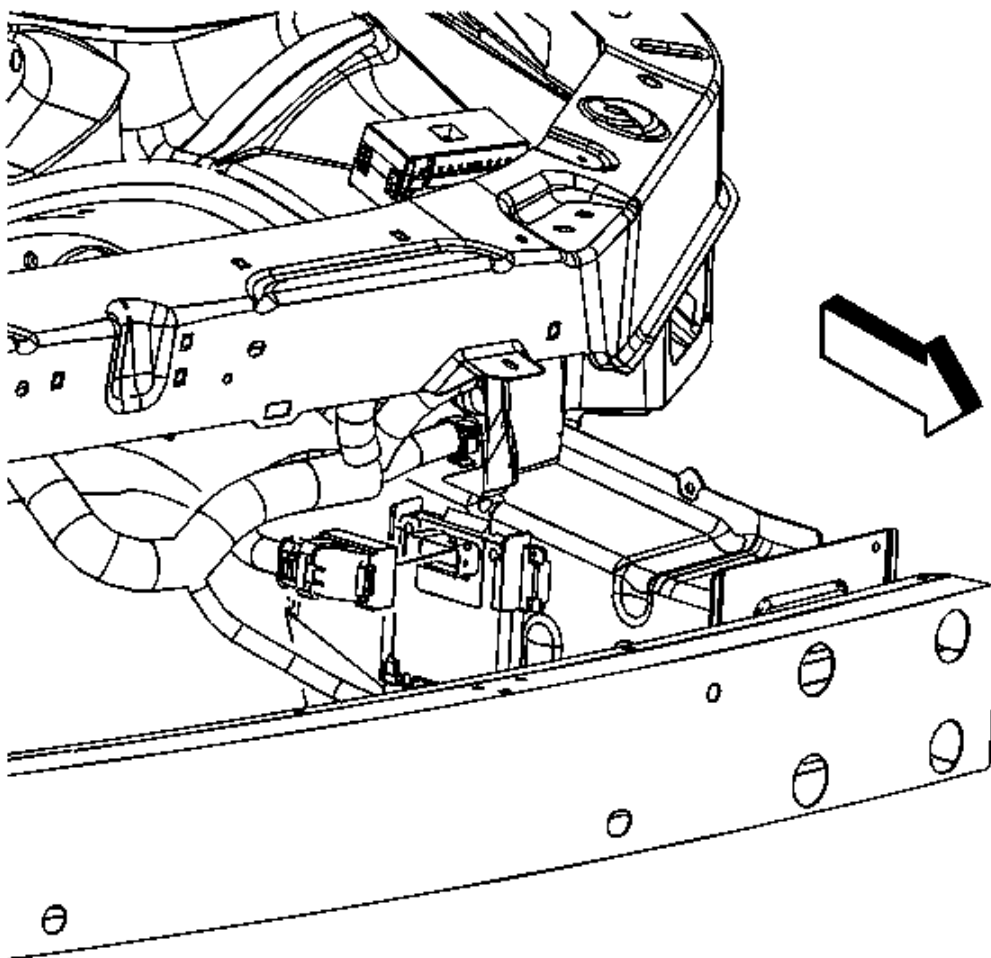


Fig. 258: Identifying Engine Harness Electrical Connector & Transmission Control Module (TCM)
Courtesy of GENERAL MOTORS CORP.

41. Connect the engine wiring harness electrical connector to the TCM.

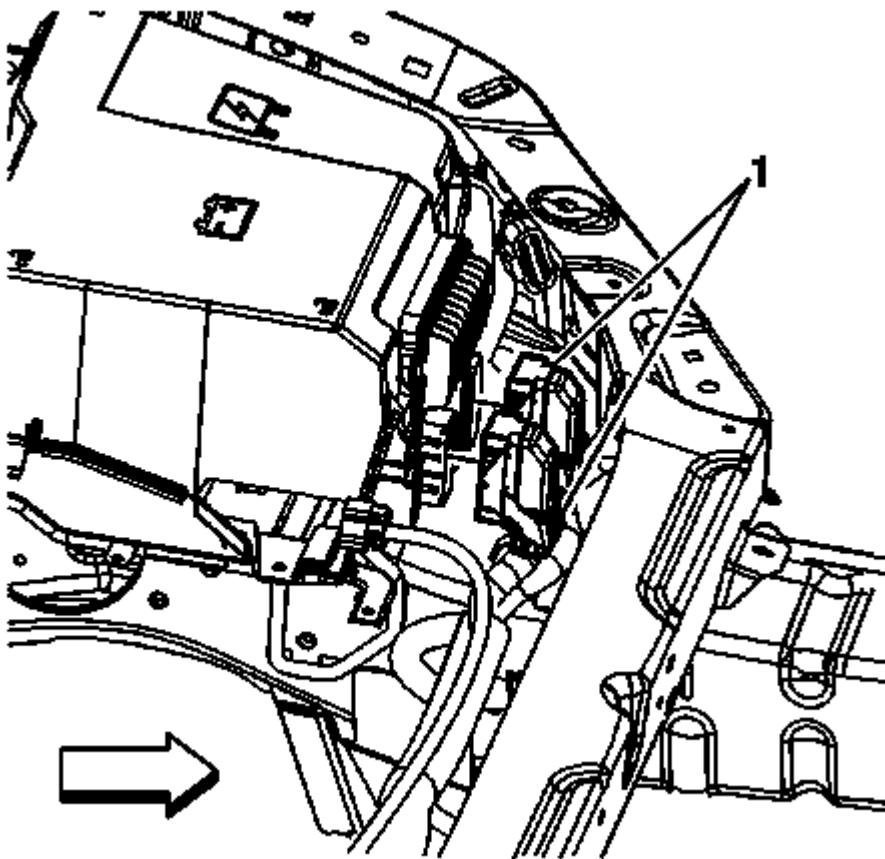


Fig. 259: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

42. Connect the engine wiring harness electrical connector (1) to the PCM.

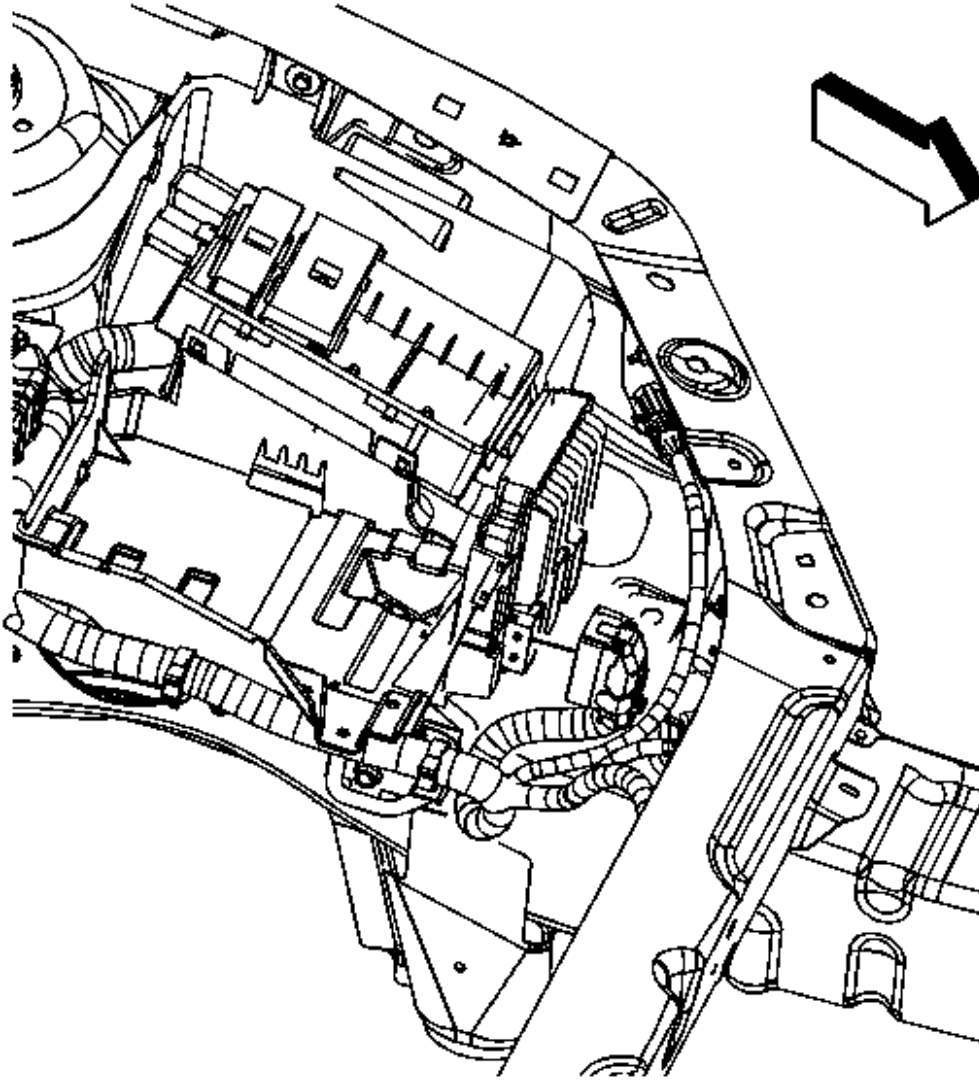


Fig. 260: View Of Body Harness ECM/PCM Connectors
Courtesy of GENERAL MOTORS CORP.

43. Connect the body harness electrical connector to the PCM.

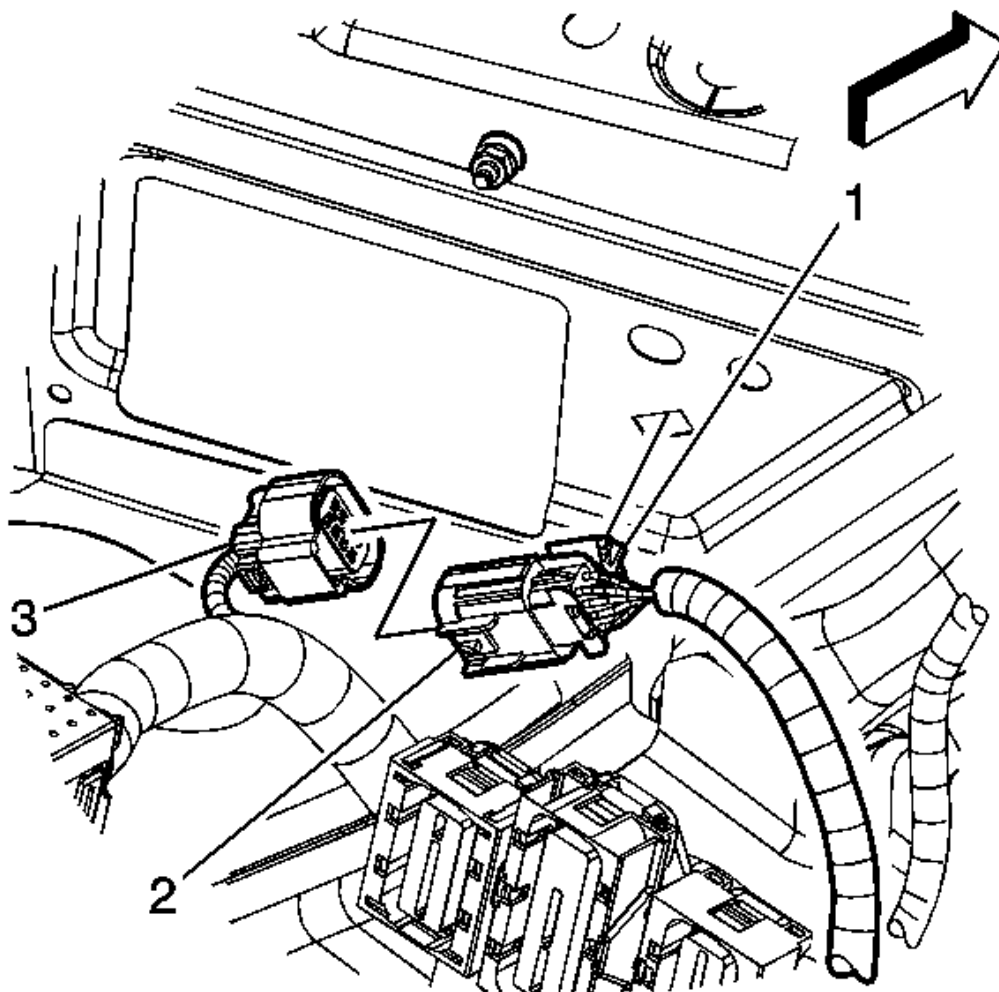


Fig. 261: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

44. Connect the engine wiring harness electrical connector (3) to the body wiring harness electrical connector (2).

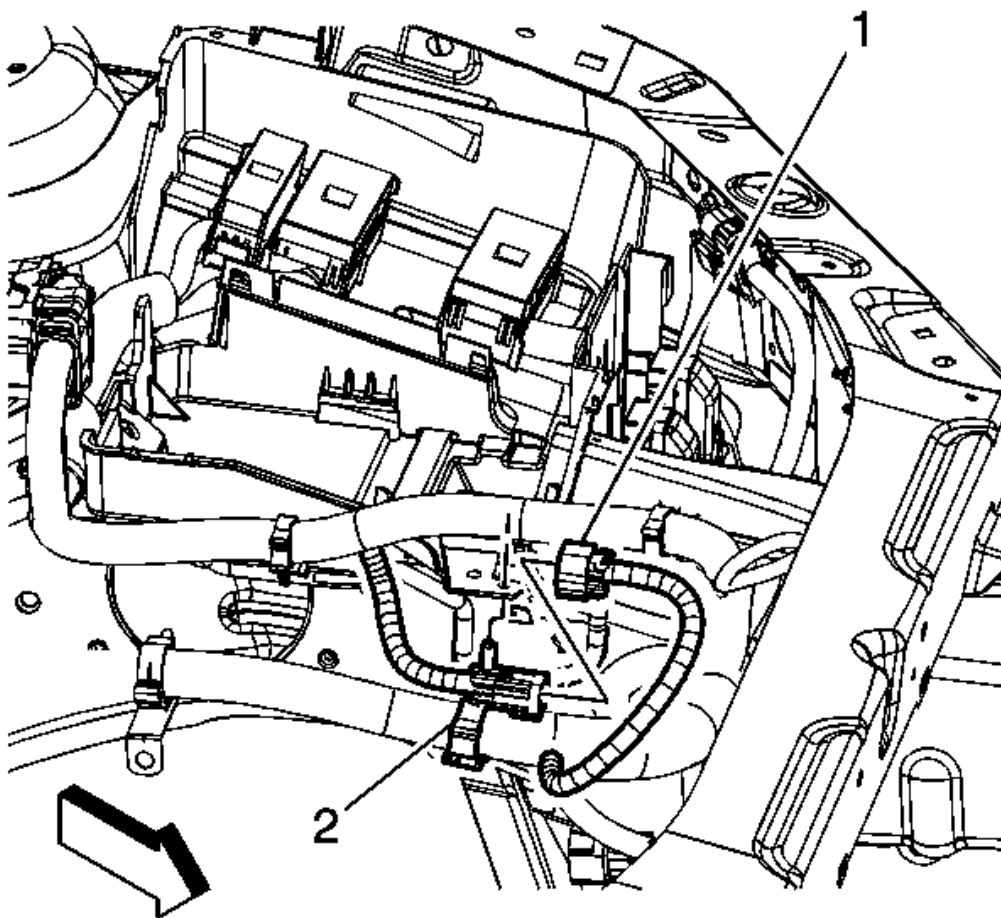


Fig. 262: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

45. Connect the engine wiring harness electrical connector (1) to the body wiring harness electrical connector (2).

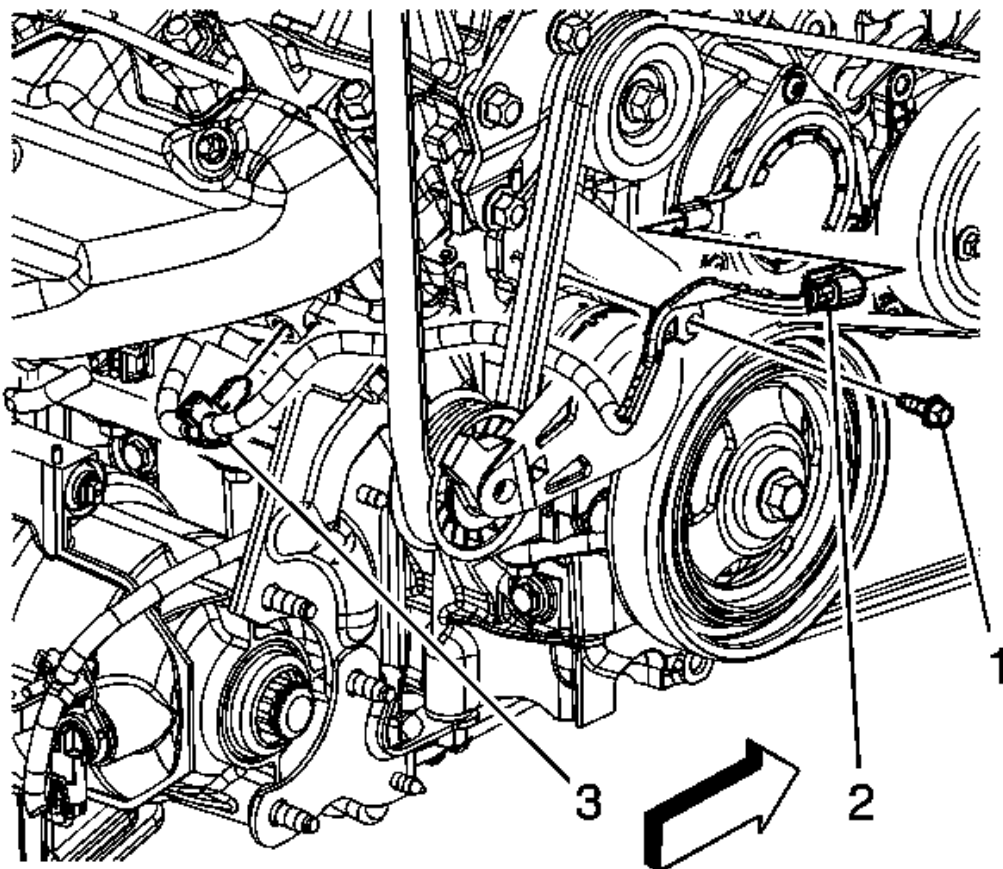


Fig. 263: View Of Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

46. Install the engine wiring harness clip (3) to the engine.
47. Connect the engine wiring harness electrical connector (2) to the camshaft phasor.
48. Install the engine wiring harness bolt (1) and tighten to 10 N.m (89 lb in).

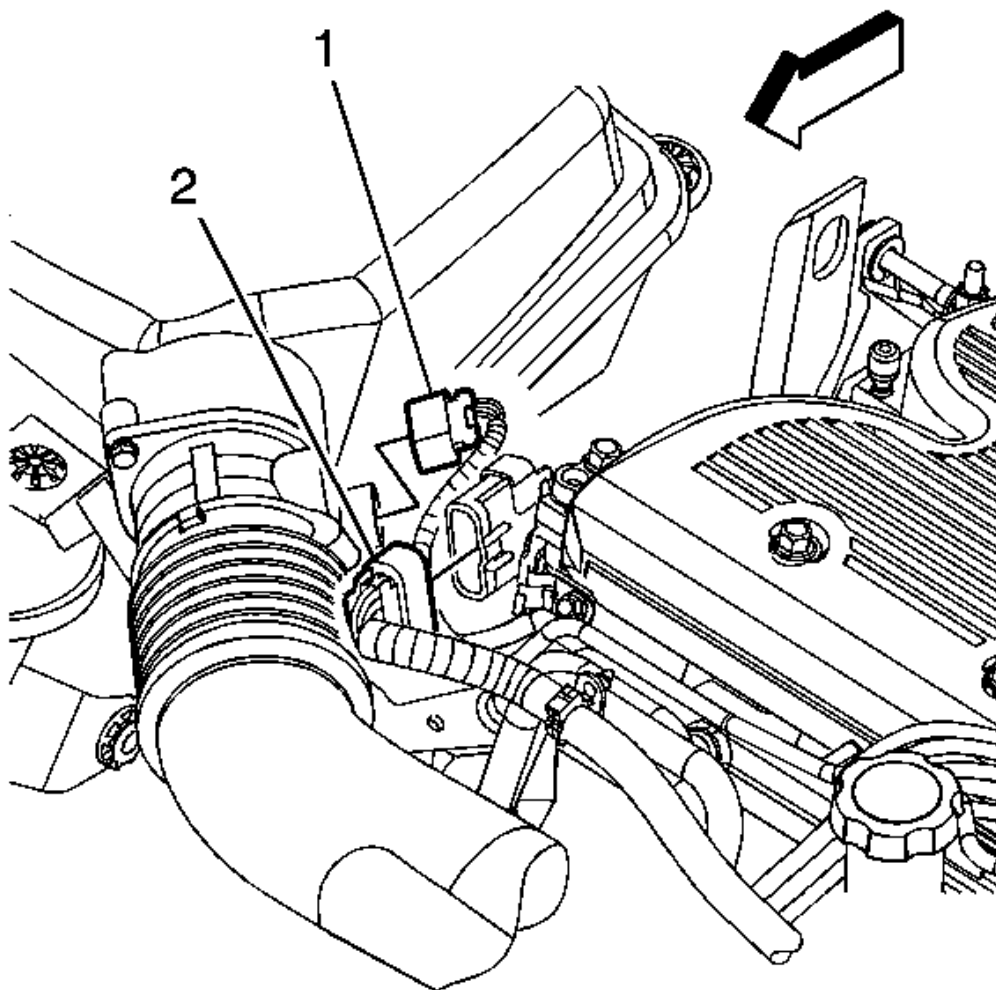


Fig. 264: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

49. Connect the engine wiring harness electrical connector (2) to the fuel injector inline electrical connector.

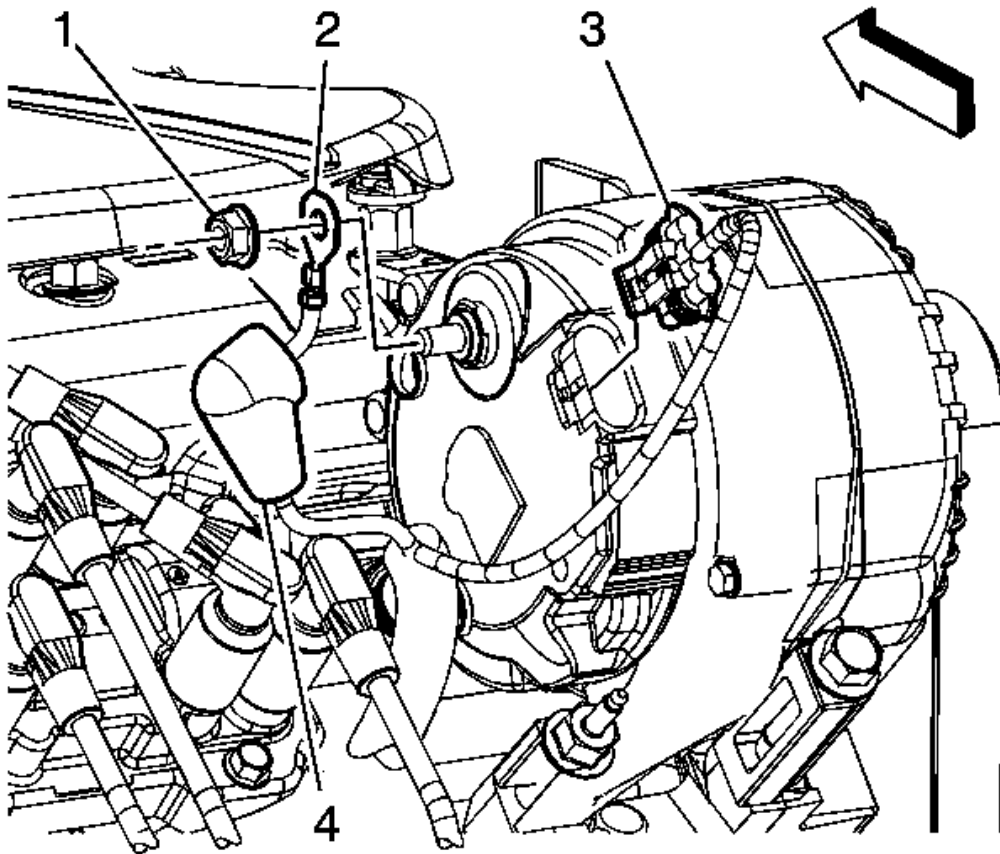


Fig. 265: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

50. Connect the engine wiring harness electrical connector (3) to the generator.
51. Install the engine wiring harness terminal (2) to the generator.
52. Install the engine wiring harness to generator stud nut (1) and tighten to 20 N.m (15 lb ft).
53. Position the engine wiring harness terminal boot (4).

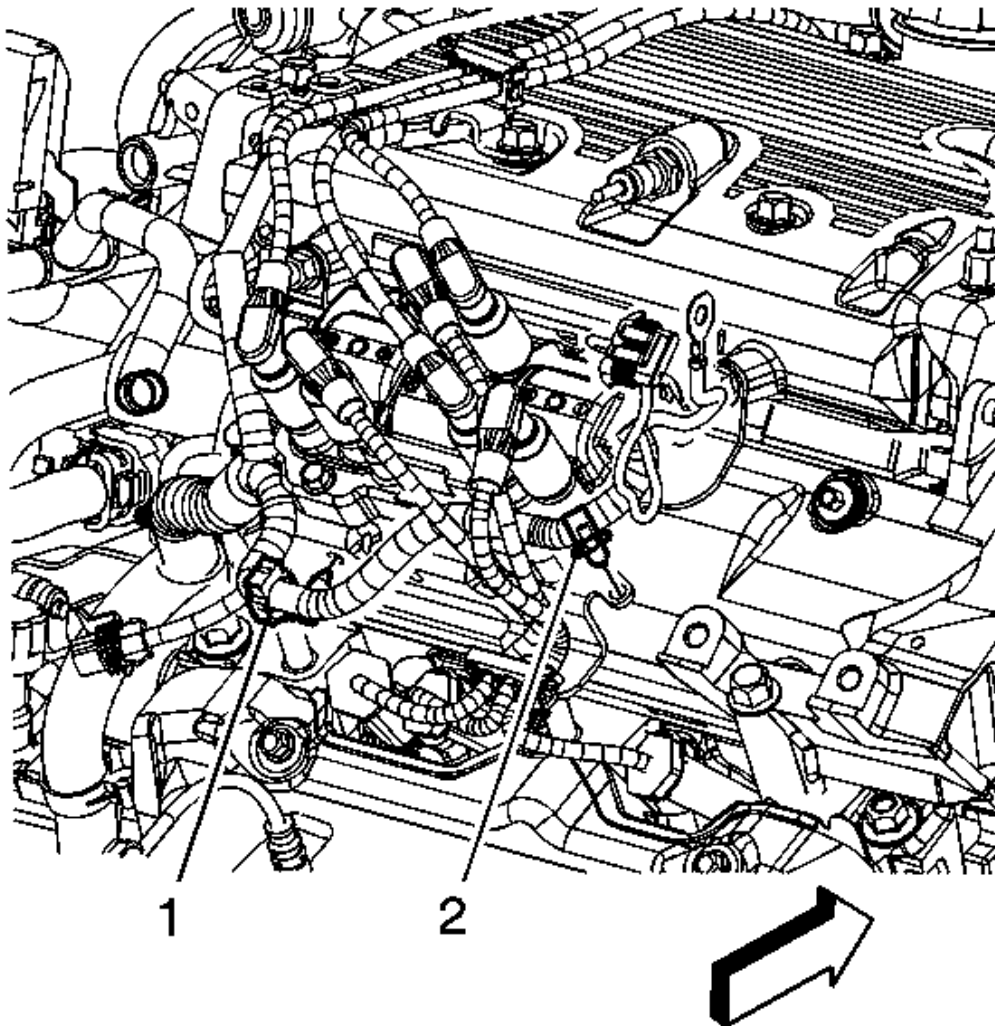


Fig. 266: Identifying Engine Wiring Harness Clips
Courtesy of GENERAL MOTORS CORP.

54. Install the engine wiring harness clips (1, 2) to the ignition control module bracket.

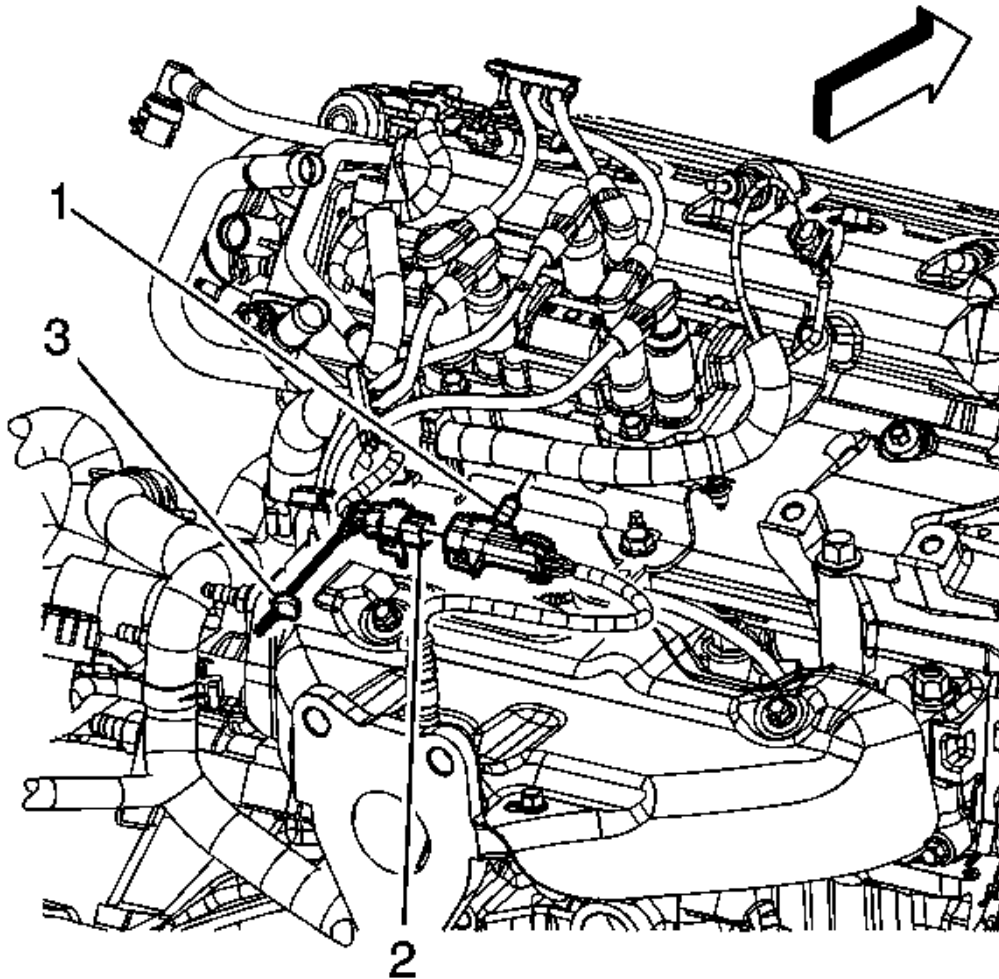


Fig. 267: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

55. Connect the engine wiring harness electrical connector (2) to the rear upper HO2S.
56. Install the CPA retainer (3).

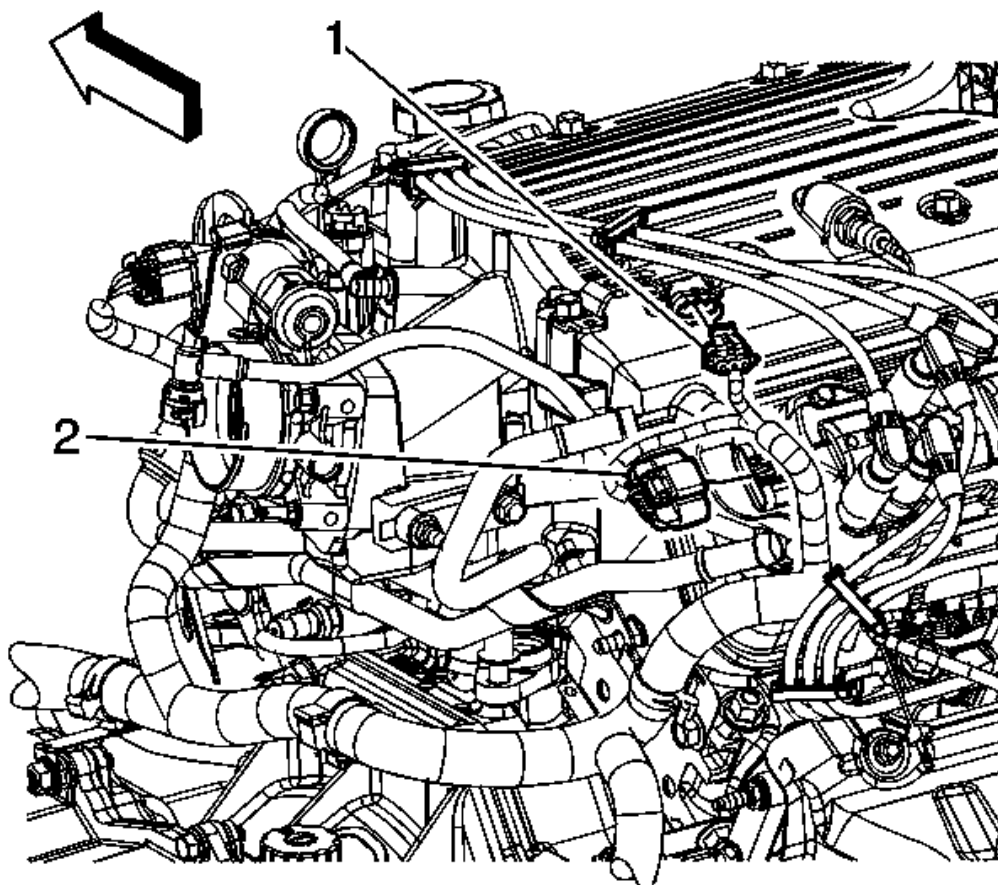


Fig. 268: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

57. Connect the engine wiring harness electrical connector (2) to the ignition control module.
58. Connect the engine wiring harness electrical connector (1) to the MAP sensor.

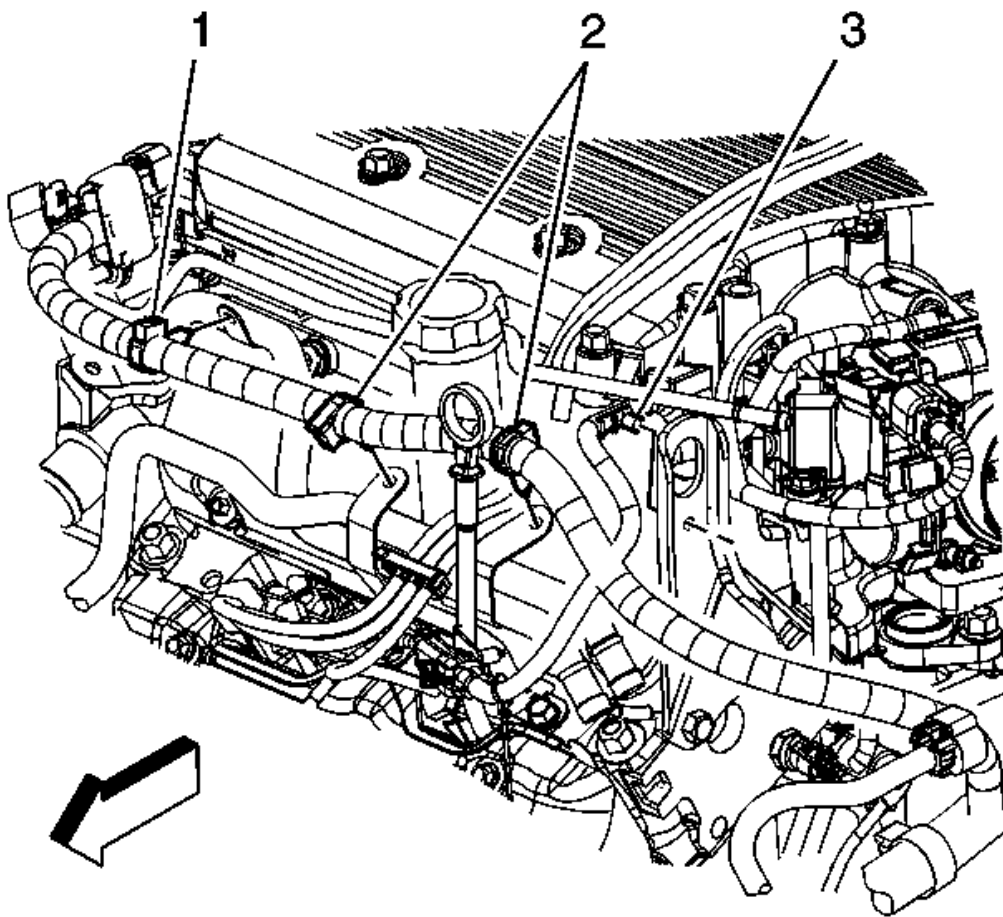


Fig. 269: Identifying Engine Wiring Harness Clips
 Courtesy of GENERAL MOTORS CORP.

59. Connect the engine wiring harness clip (3) to the engine lift bracket.
60. Connect the engine wiring harness clips (1, 2) to the heater inlet and outlet pipe brackets.

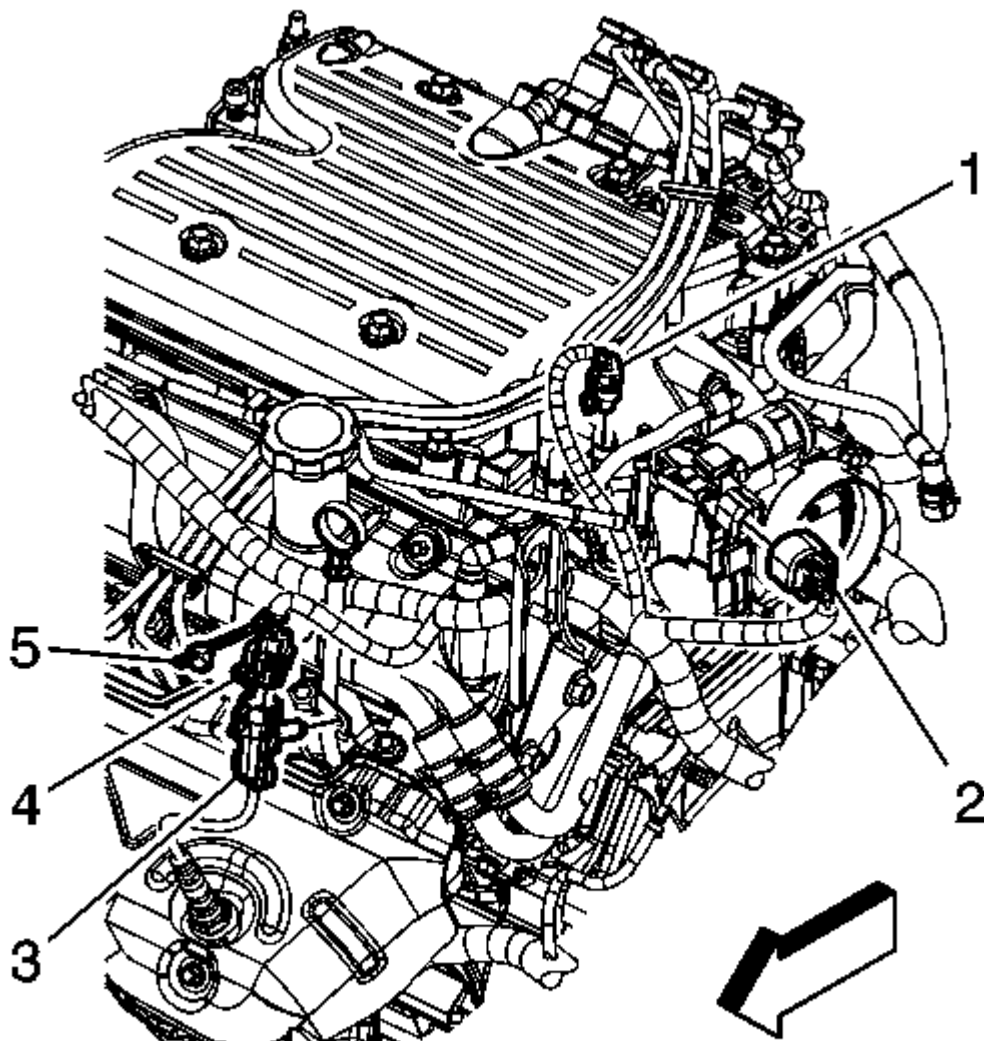


Fig. 270: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

61. Connect the engine wiring harness electrical connector (4) to the HO2S.
62. Install the CPA retainer (5).
63. Connect the engine wiring harness electrical connector (2) to the ETC.
64. Connect the engine wiring harness electrical connector (1) to the EVAP canister purge solenoid.

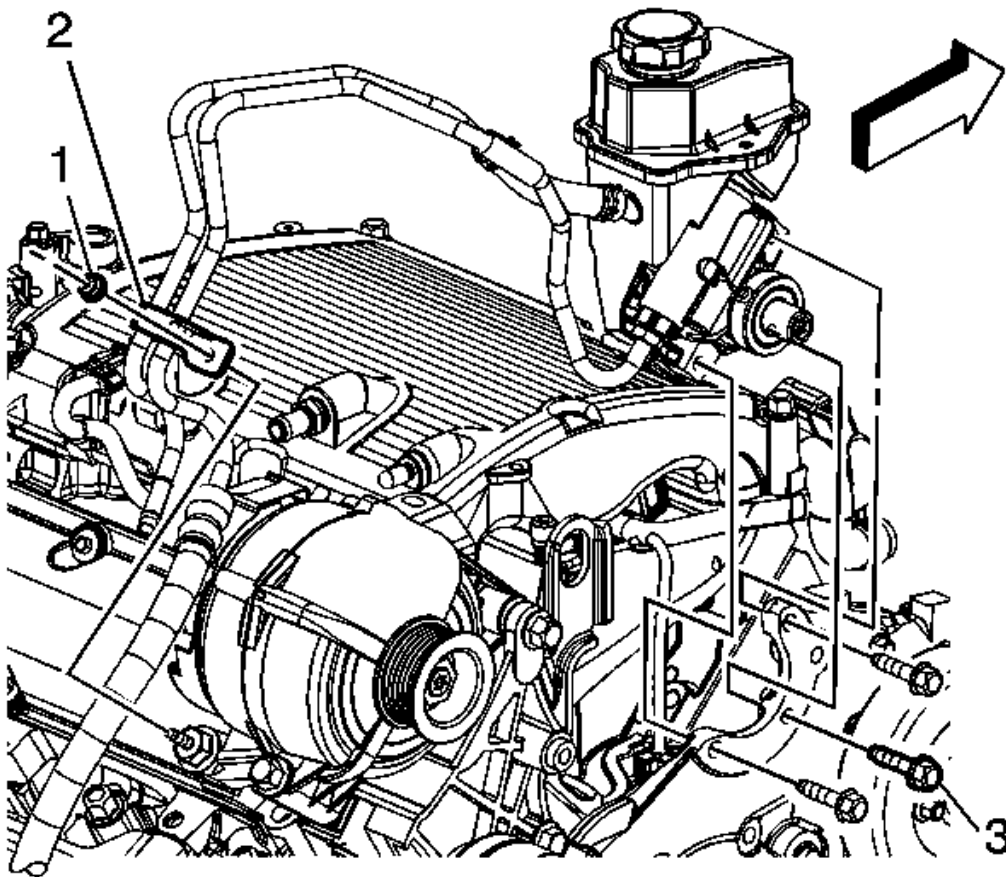


Fig. 271: View Of Power Steering Pump
Courtesy of GENERAL MOTORS CORP.

65. Unsecure and position the power steering pump.
66. Install the power steering line clip (2) to the stud.
67. Install the power steering line clip nut (1) to the generator stud and tighten the nut to 5 N.m (44 lb in).
68. Install the power steering pump bolts (3) and tighten to 25 N.m (18 lb ft).

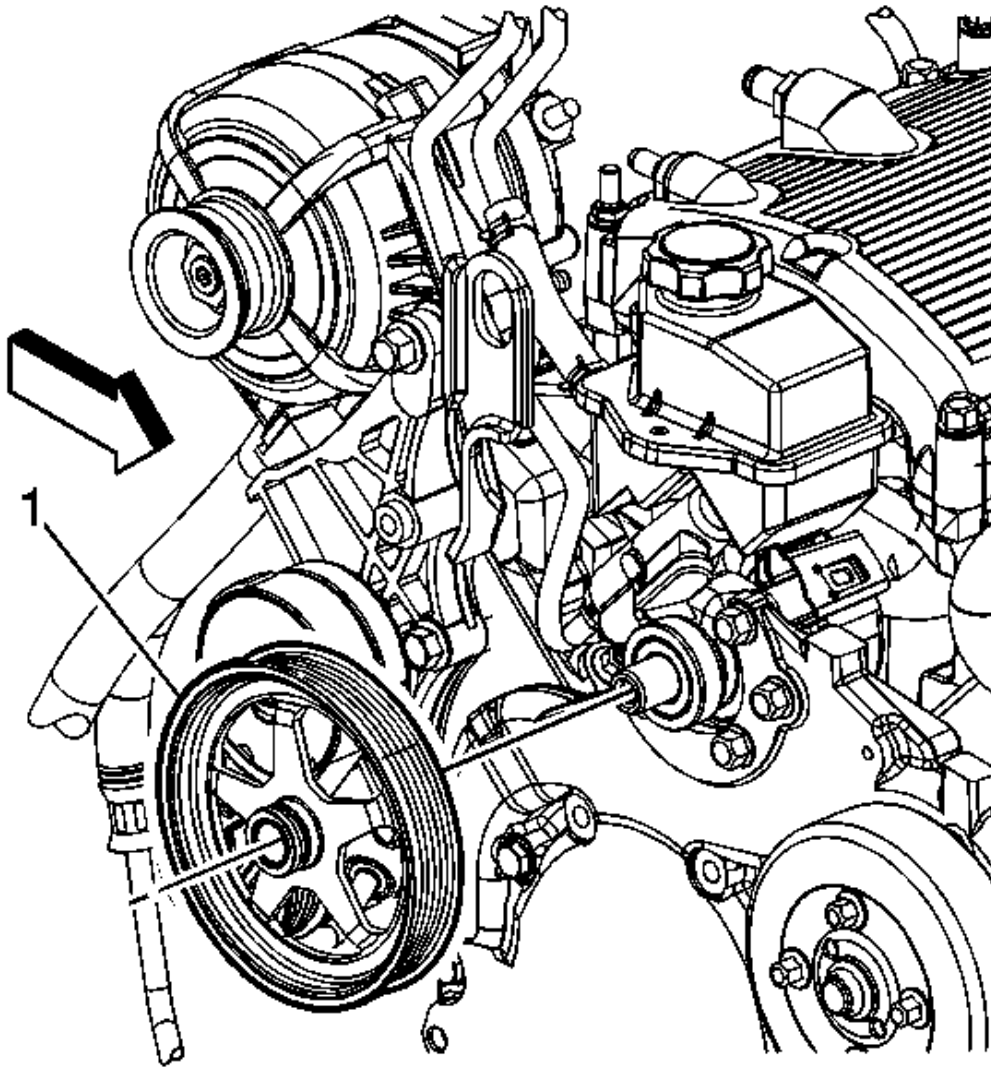


Fig. 272: View Of Power Steering Pump Pulley
Courtesy of GENERAL MOTORS CORP.

69. Using the **J 25033-C** , install the power steering pump pulley (1).

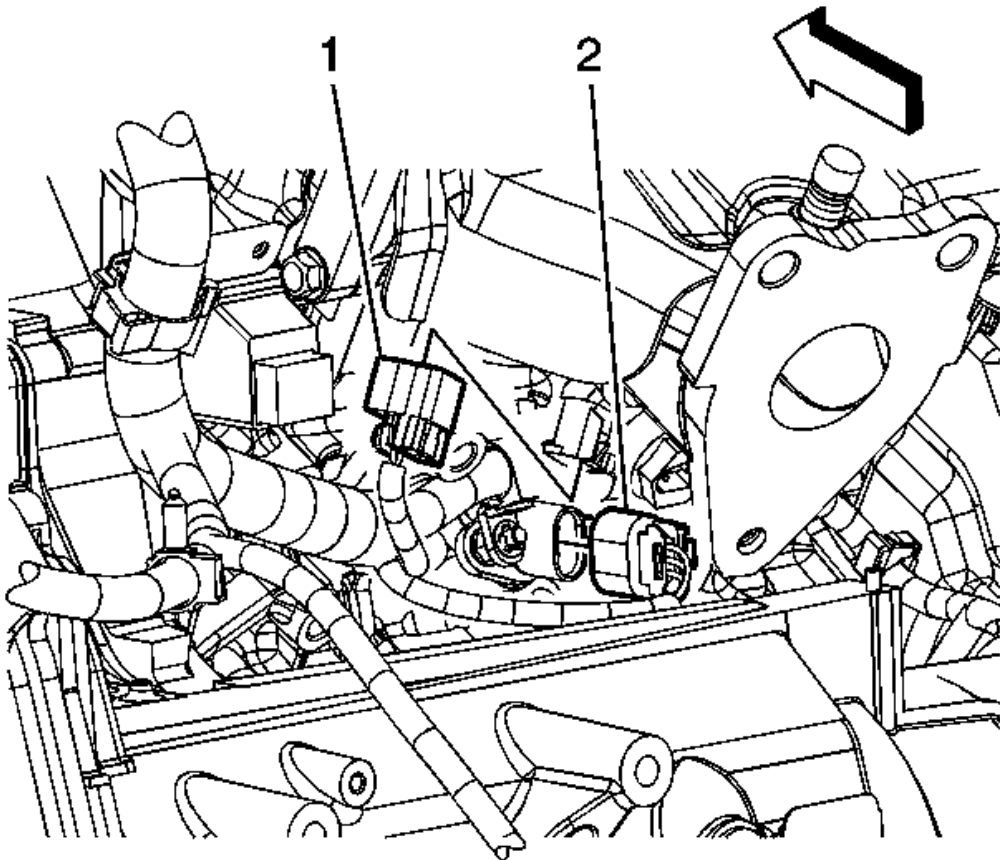


Fig. 273: Identifying Knock Sensor & CKP Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

70. Connect the engine wiring harness electrical connector (2) to the CKP sensor.
71. Connect the engine wiring harness electrical connector (1) to the knock sensor.

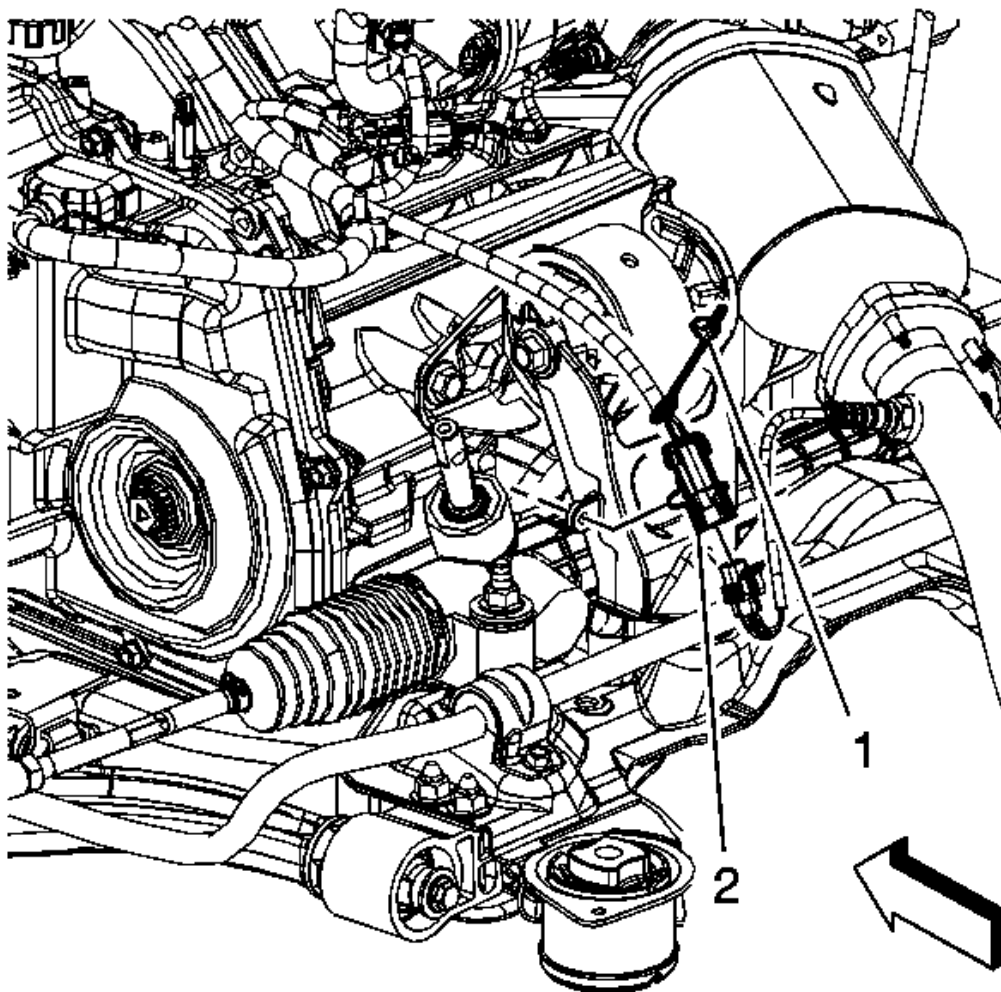


Fig. 274: Identifying CPA Retainer & HO2S Electrical Connector (Bank 1 Sensor 2)
Courtesy of GENERAL MOTORS CORP.

72. Install the engine wiring harness electrical connector (2) rosebud to the transaxle mount.
73. Connect the lower rear HO2S electrical connector to the engine wiring harness electrical connector (2).
74. Install the lower rear CPA retainer (1).

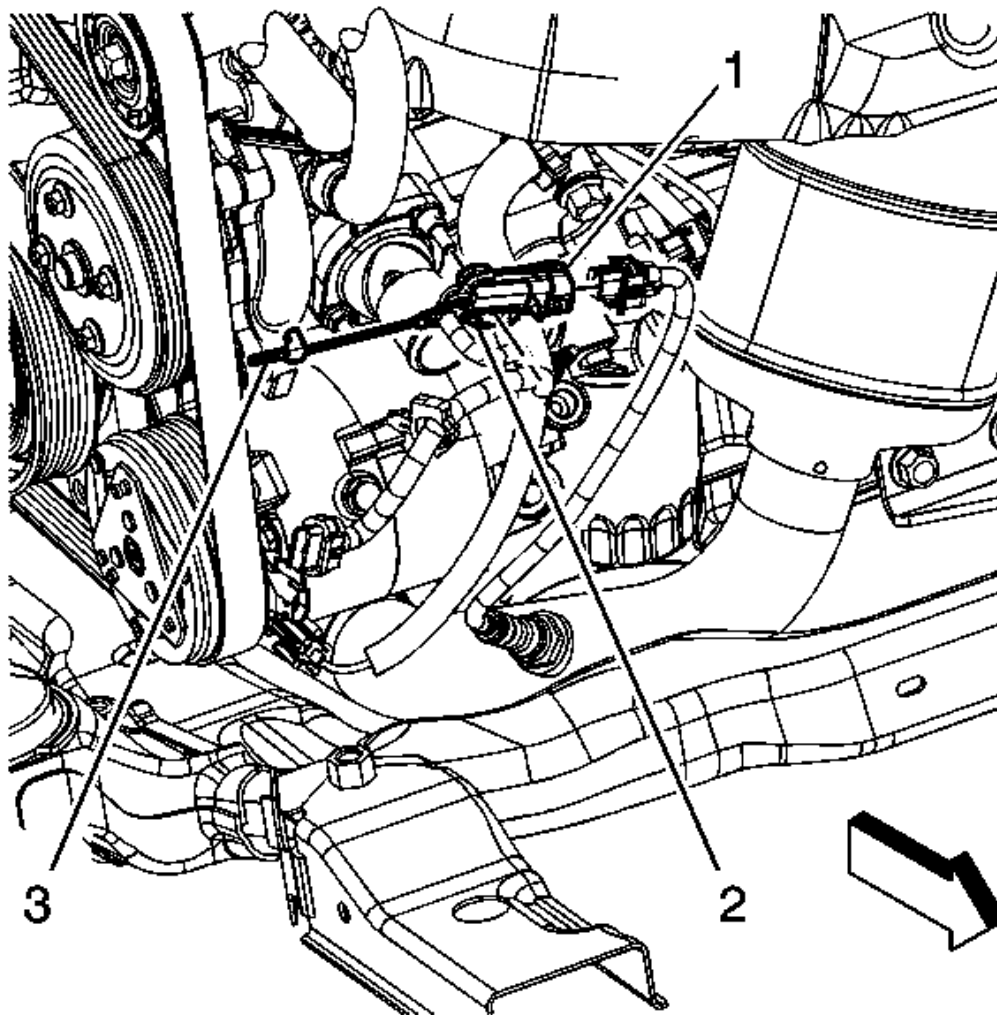


Fig. 275: Identifying Connector Position Assurance (CPA) Retainer
Courtesy of GENERAL MOTORS CORP.

75. Install the engine wiring harness electrical connector clip (2) to the thermostat housing stud.
76. Connect the lower front HO2S electrical connector to the engine wiring harness electrical connector (1).
77. Install the CPA retainer (3).

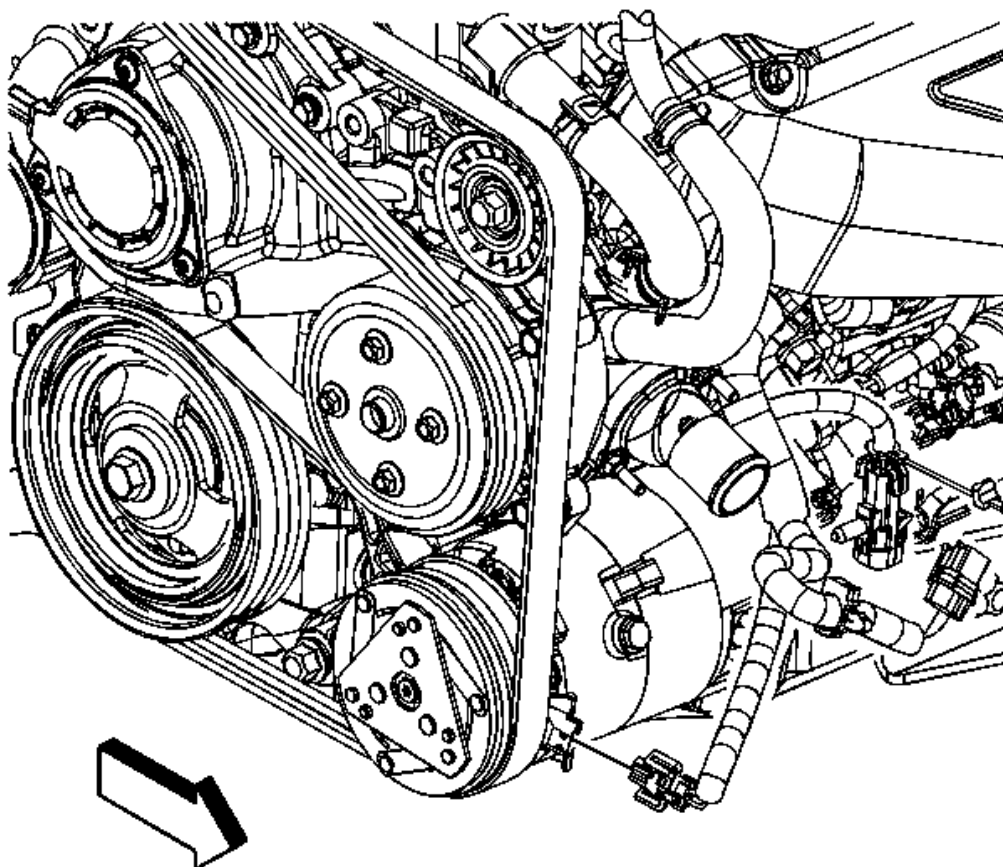


Fig. 276: Identifying Engine Wiring Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

78. Connect the engine wiring harness electrical connector to the A/C compressor.

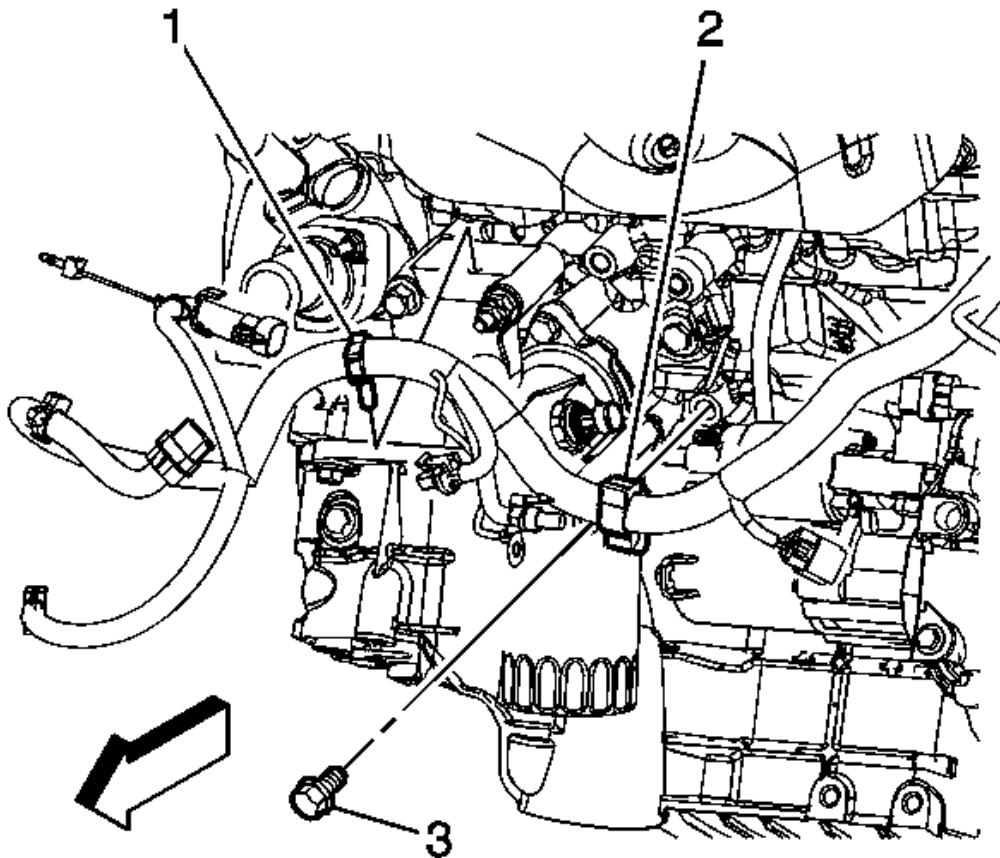


Fig. 277: Identifying Engine Wiring Harness Clip
Courtesy of GENERAL MOTORS CORP.

79. Install the engine wiring harness clip (2) to the engine boss.
80. Install the engine wiring harness clip bolt (3) and tighten to 25 N.m (18 lb ft).
81. Install the engine wiring harness clip (1) to the A/C compressor bracket.

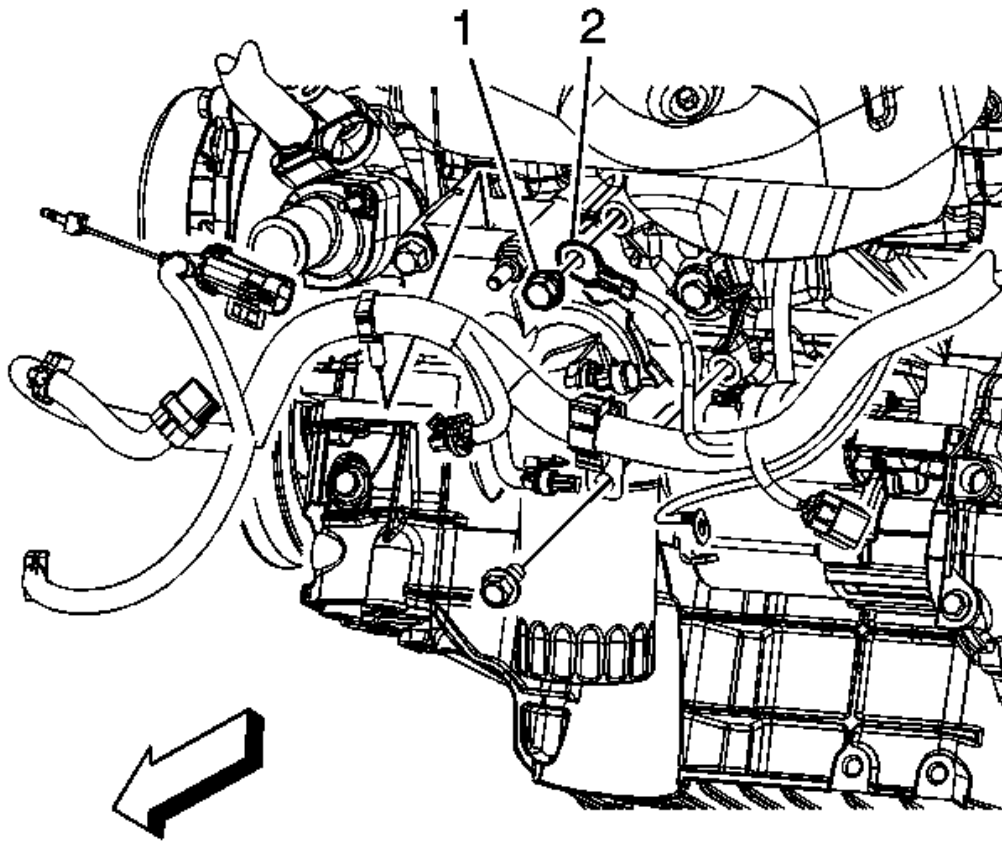


Fig. 278: Identifying Engine Wiring Harness Ground Bolt
Courtesy of GENERAL MOTORS CORP.

82. Install the engine wiring harness ground terminal (2) to the engine boss.
83. Install the engine wiring harness ground bolt (1) and tighten to 25 N.m (18 lb ft).

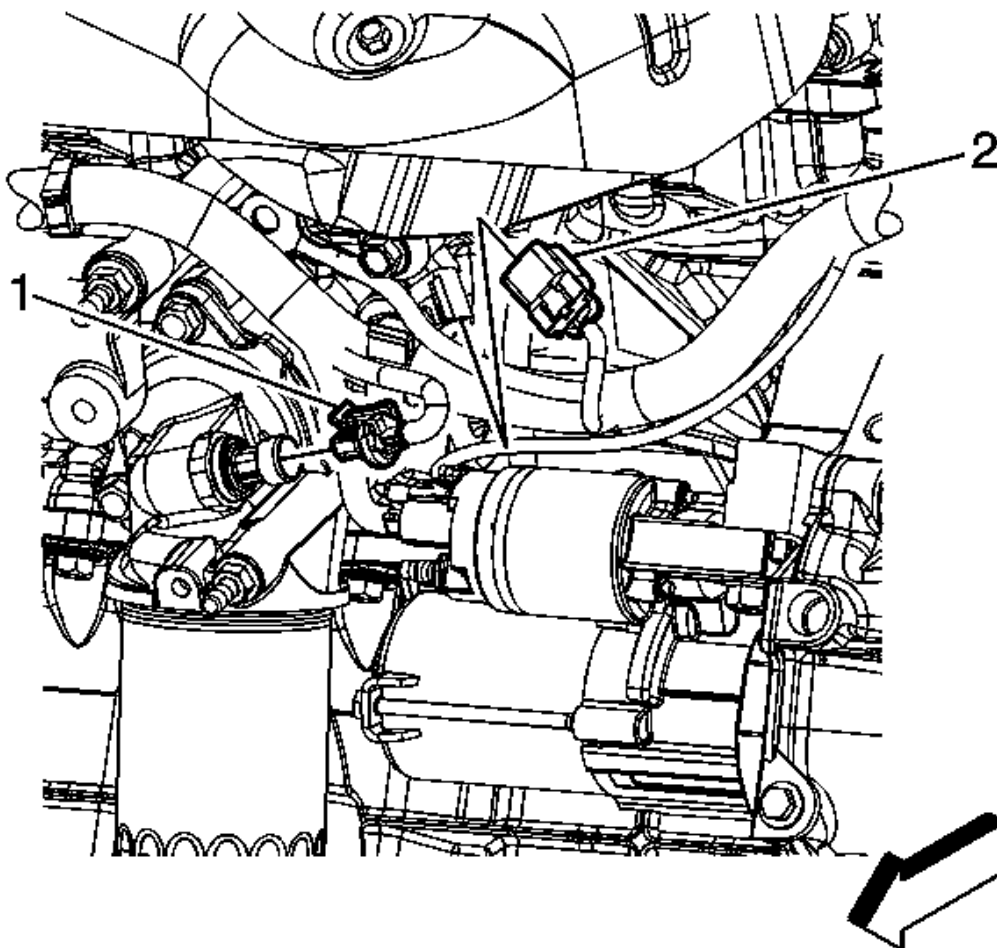


Fig. 279: Identifying Knock Sensor & Oil Pressure Sensor Engine Wiring Harness Connector
Courtesy of GENERAL MOTORS CORP.

84. Connect the engine wiring harness electrical connector (2) to the knock sensor.
85. Connect the engine wiring harness electrical connector (1) to the oil pressure sensor.

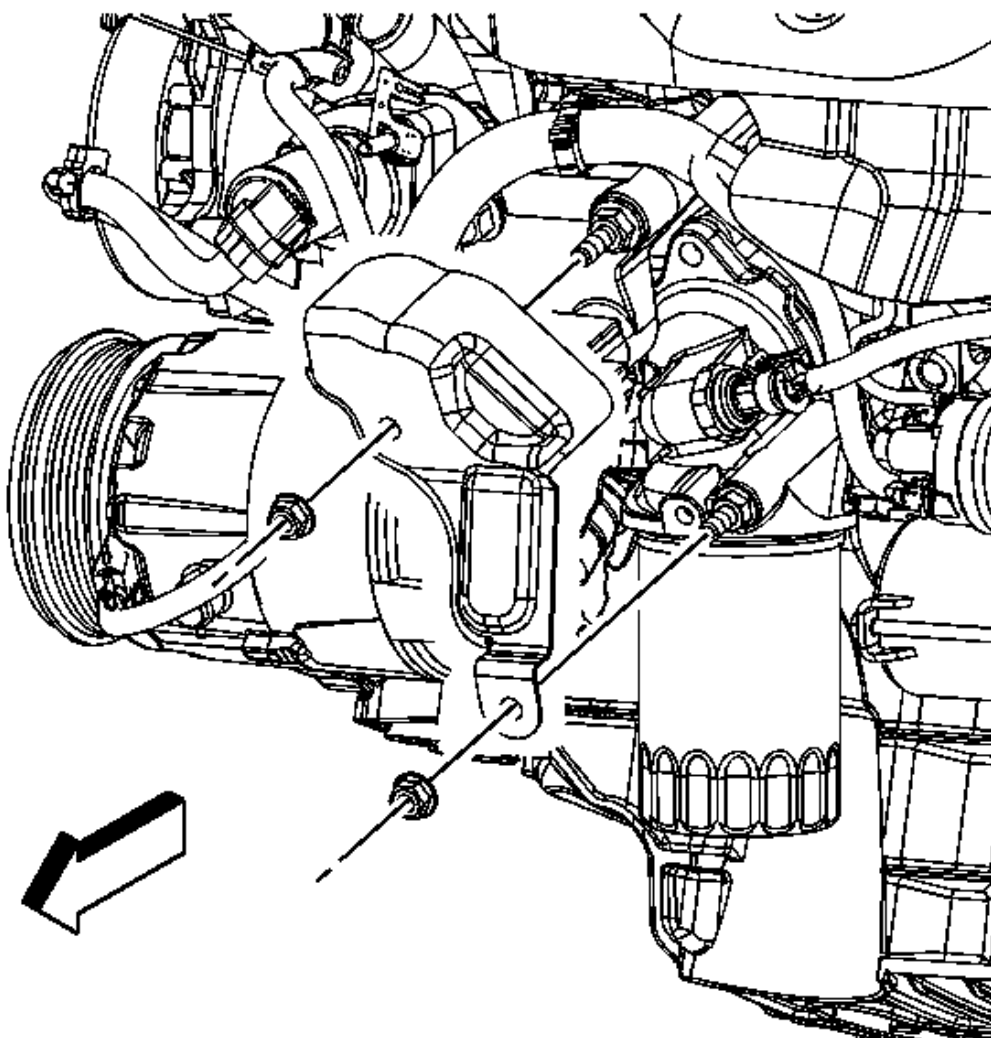


Fig. 280: Identifying Oil Pressure Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

86. Install the oil pressure sensor heat shield and nuts and tighten to 10 N.m (89 lb in).
87. Install the starter motor. Refer to **Starter Replacement (LZ4 or LZE)** .
88. Install the drive belt and the engine mount snubber. Refer to **Drive Belt Replacement**.
89. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
90. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
91. Install the hood. Refer to **Hood Replacement** .
92. Fill the cooling system. Refer to **Cooling System Draining and Filling (Static Fill-LY7, LZE, LZ4)** or

Cooling System Draining and Filling (GE 47716) .

93. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (LE5, LE9, LZ4, LZE, or LY7) .**
94. Prelube the engine. Refer to **Engine Prelubing .**
95. Perform the CKP system variation learn procedure. Refer to **Crankshaft Position System Variation Learn .**

NOTE: **After an overhaul the engine should be tested. Use the following procedure after the engine is installed in the vehicle.**

1. Disable the ignition system.
 2. Crank the engine several times. Listen for any unusual noises or evidence that parts are binding.
 3. Enable the ignition system.
 4. Start the engine and listen for unusual noises.
 5. Check the vehicle oil pressure gauge or light and confirm that the engine has acceptable oil pressure.
 6. Run the engine speed at about 1,000 RPM until the engine has reached normal operating temperature.
 7. Listen for sticking lifters or other unusual noises.
 8. Inspect for fuel, oil, and/or coolant leaks while the engine is running.
 9. Perform a final inspection for the proper oil and coolant levels.
96. Close the hood.

ENGINE OIL AND OIL FILTER REPLACEMENT**REMOVAL PROCEDURE**

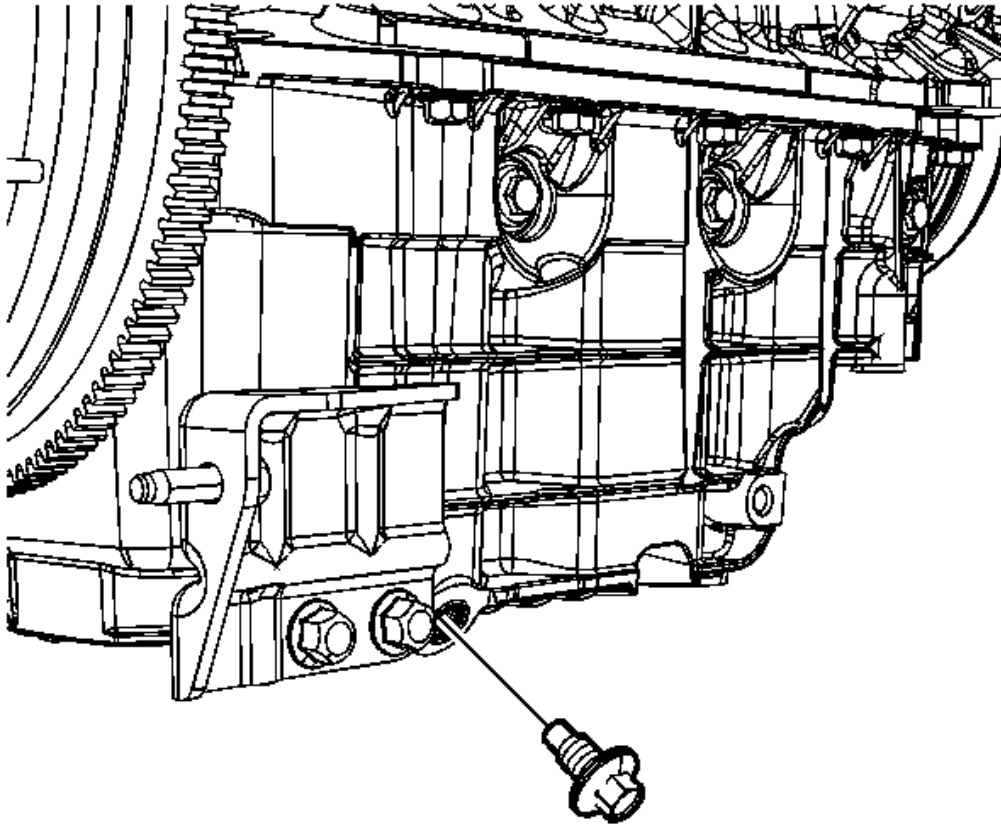


Fig. 281: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

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 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.

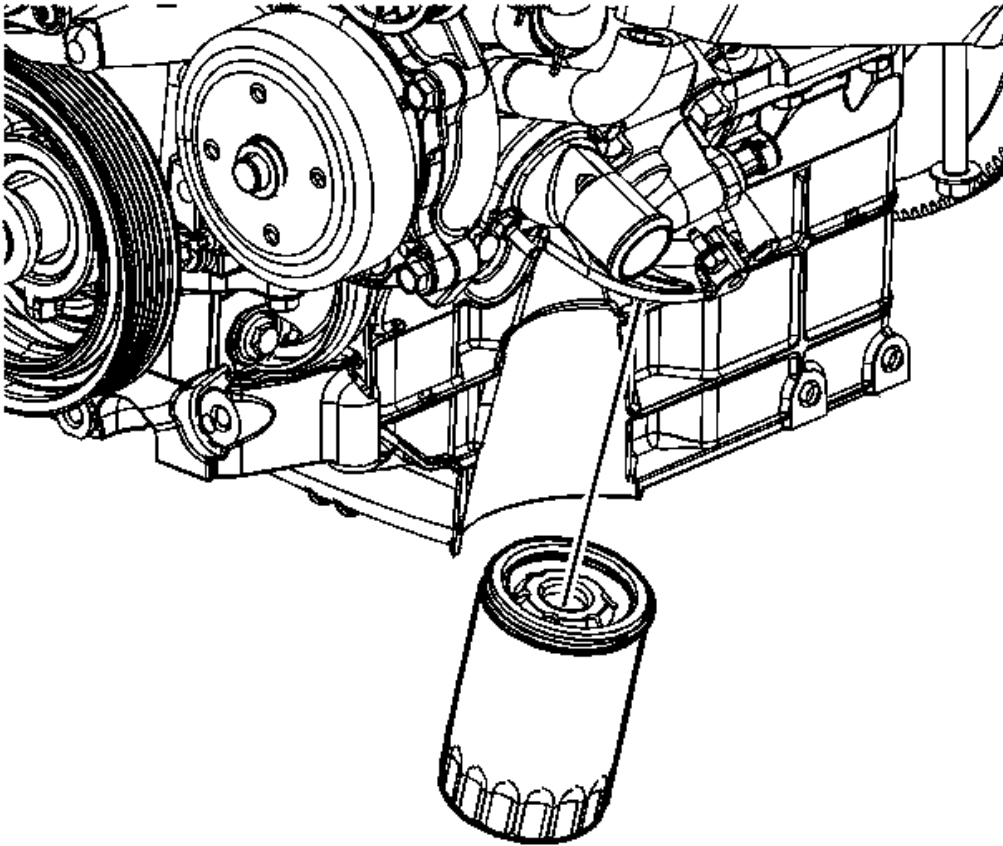


Fig. 282: View Of Oil Filter

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

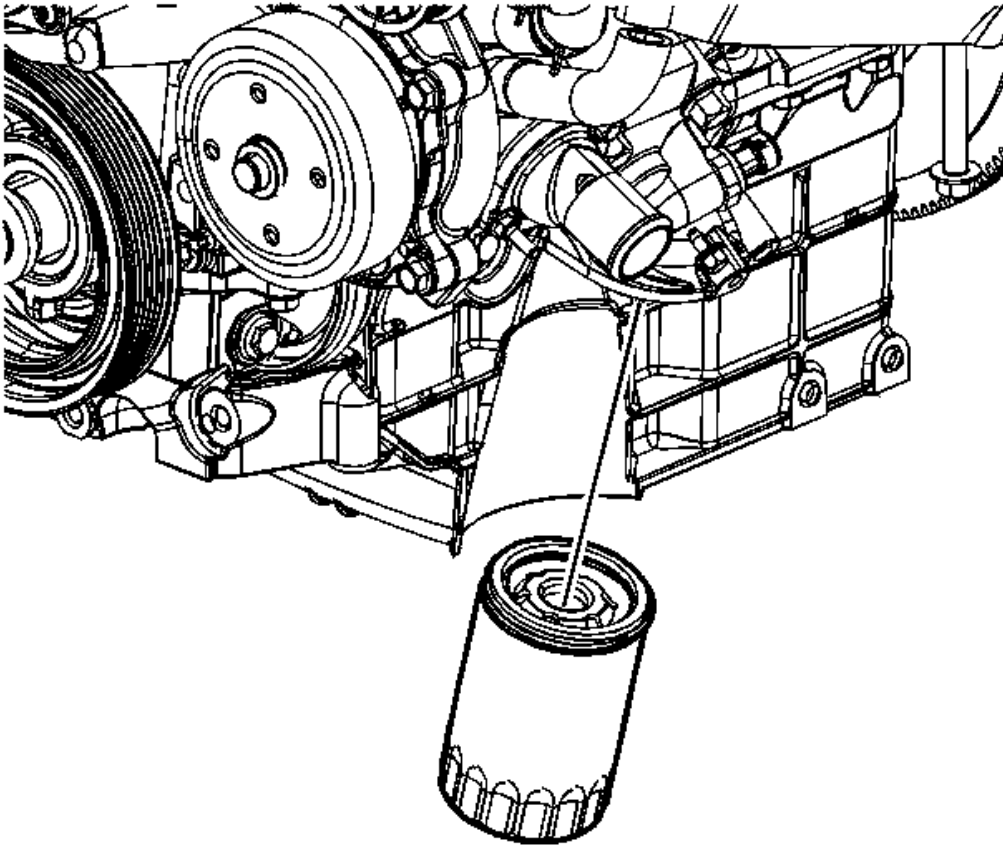


Fig. 283: View Of Oil Filter

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.

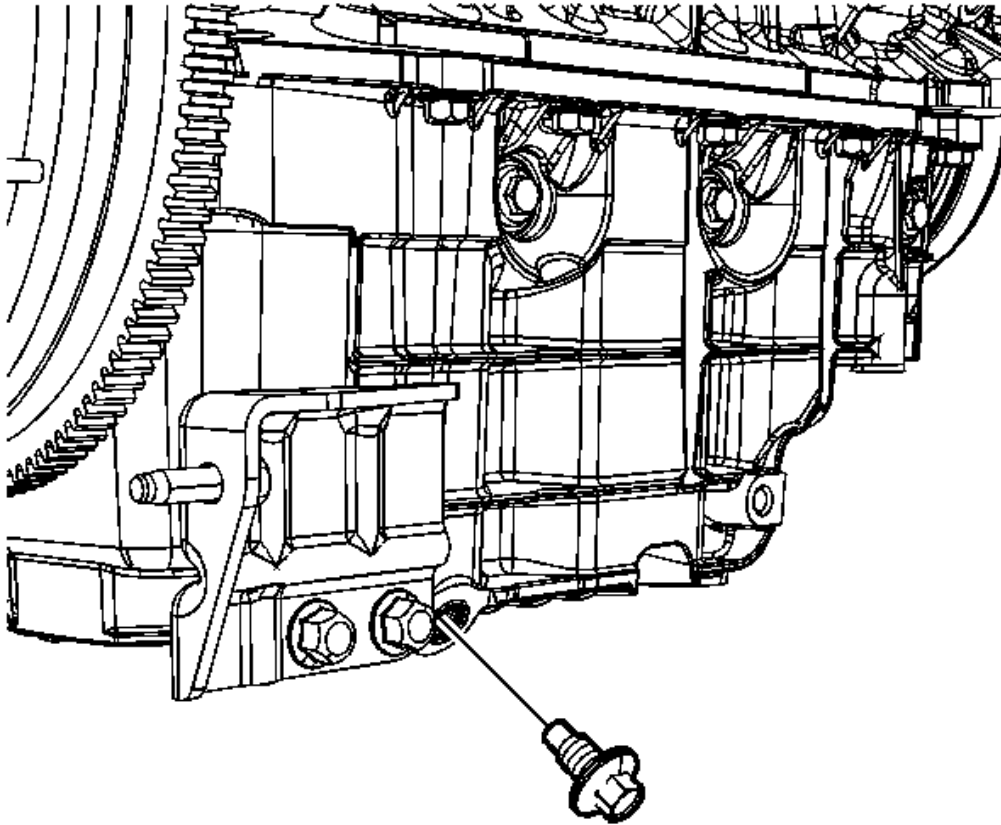


Fig. 284: View Of Oil Drain Plug
Courtesy of GENERAL MOTORS CORP.

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 (Except Hybrid) and Fluid and Lubricant Recommendations (USA and Canada) .
7. Start the engine.
8. Inspect 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.