

2010 ENGINE

Engine Mechanical - 3.9L - Repair Instructions - On Vehicle - G6

INTAKE MANIFOLD COVER REPLACEMENT

REMOVAL PROCEDURE

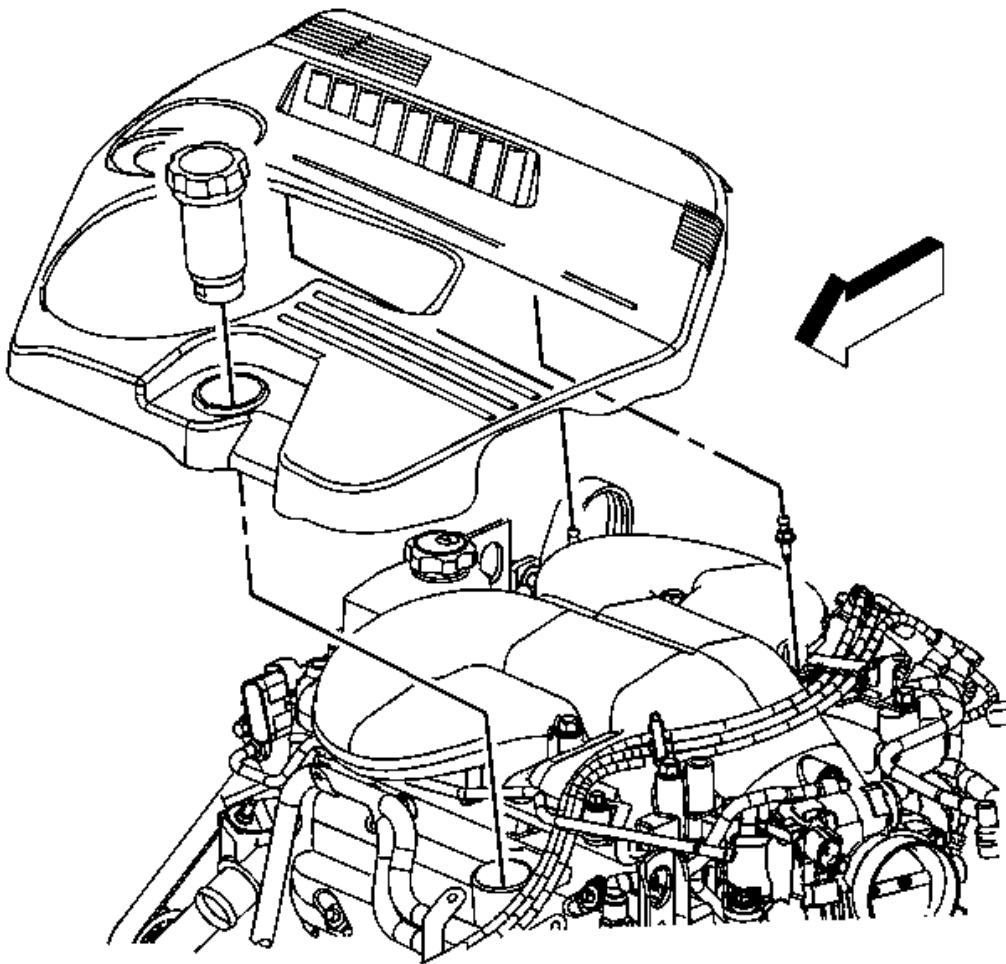


Fig. 1: Intake Manifold Cover
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine oil fill cap and tube.
2. Grasp the cover by the sides and pull up, disengaging the cover grommets from the ball studs.

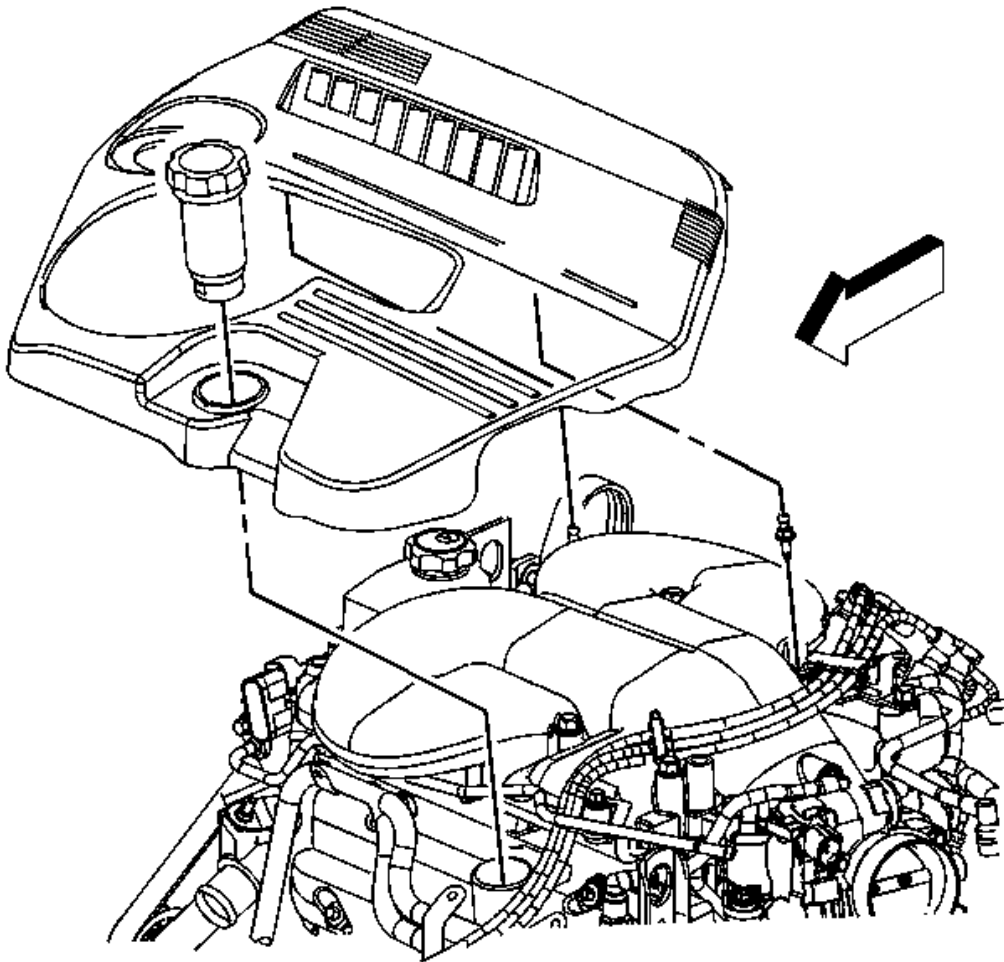
INSTALLATION PROCEDURE

Fig. 2: Intake Manifold Cover
Courtesy of GENERAL MOTORS CORP.

1. Place the cover over the ball studs, aligning the cover with the power steering reservoir cap and the oil fill tube opening.
2. Push down on the cover above the studs in order to engage to cover grommets to the studs.
3. Install the engine oil fill cap and tube.

DRIVE BELT REPLACEMENT (COUPE)**REMOVAL PROCEDURE**

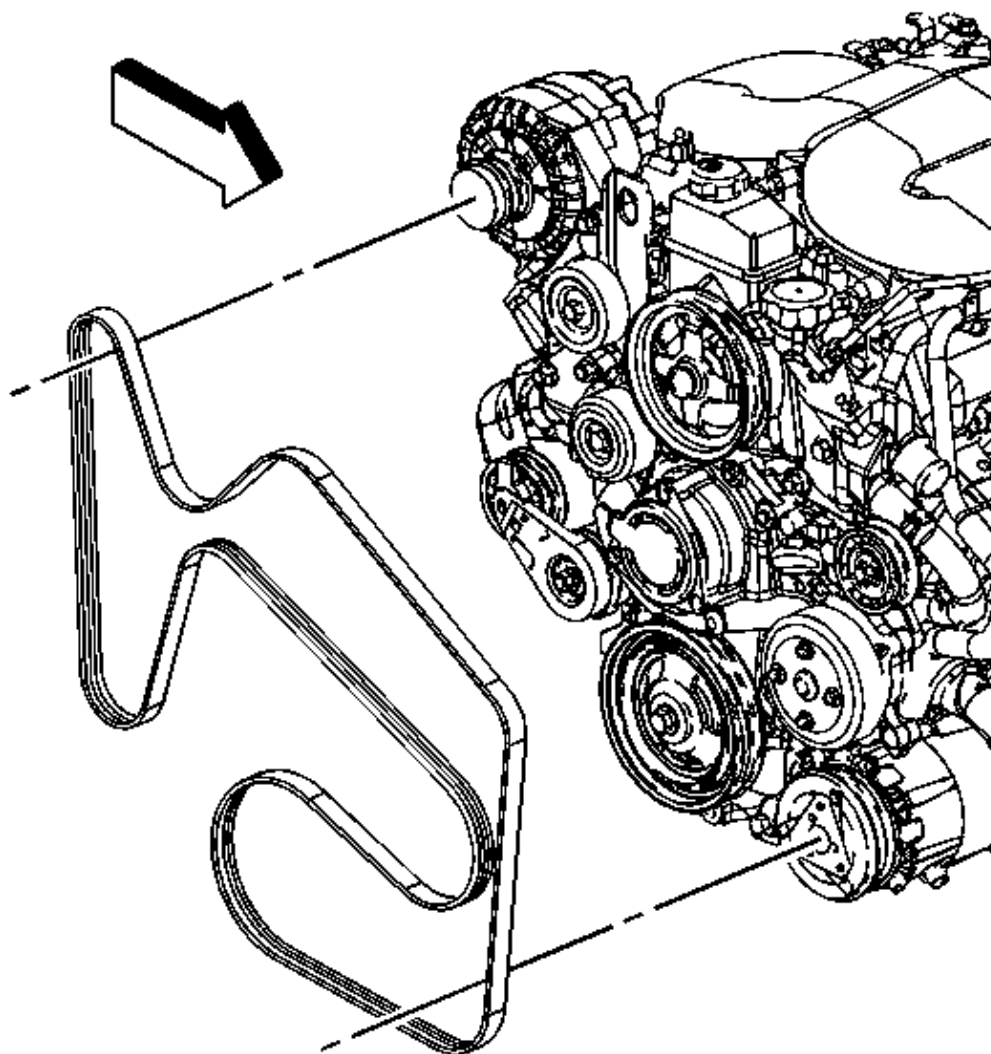


Fig. 3: Drive Belt Routing

Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner. Refer to **Air Cleaner Assembly Replacement** .
2. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
3. Remove the engine mount snubber. Refer to **Engine Mount Snubber Bracket Replacement**.
4. Rotate the drive belt tensioner counterclockwise in order to release the tensioner spring tension.
5. Remove the drive belt.

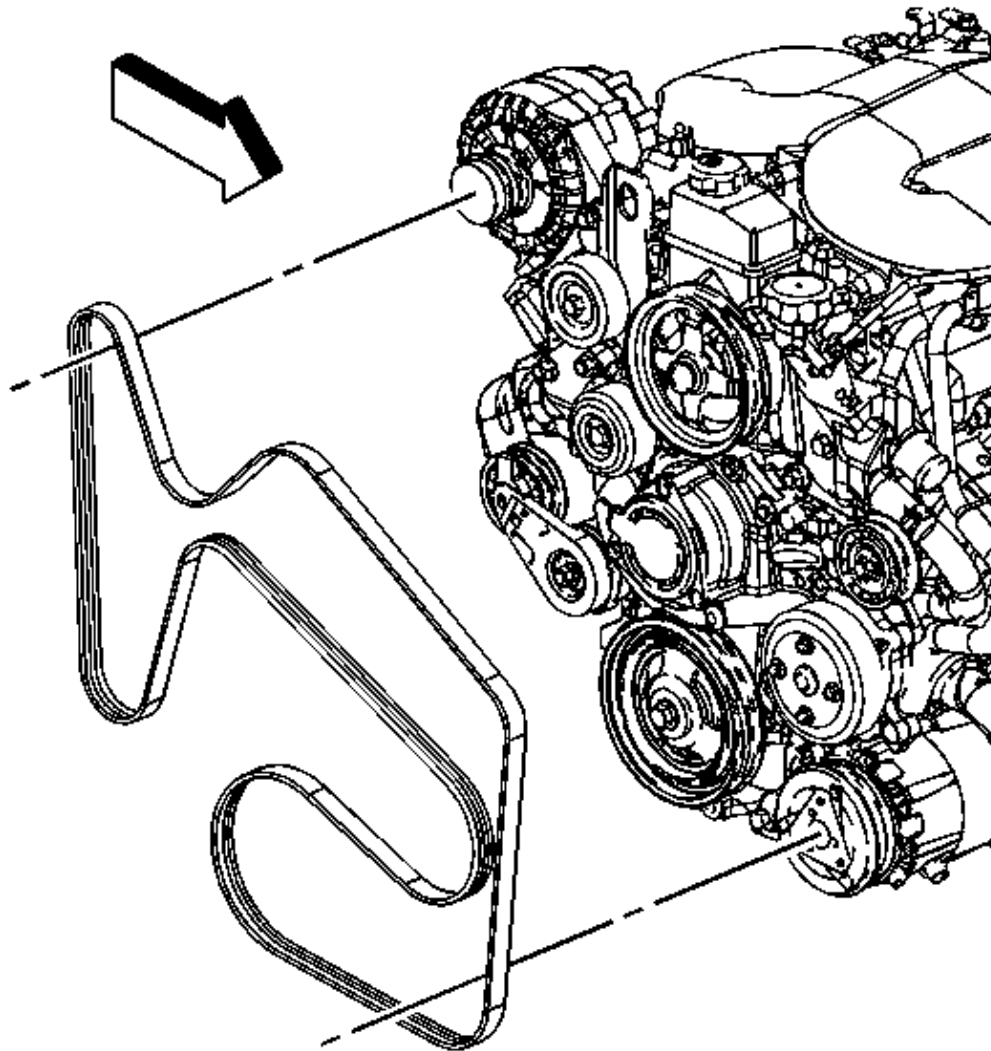
INSTALLATION PROCEDURE

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

1. Rotate the drive belt tensioner counterclockwise in order to release the tensioner spring tension.
2. Install the drive belt.
3. Install the engine mount snubber. Refer to **Engine Mount Snubber Bracket Replacement**.
4. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

5. Install the air cleaner. Refer to [Air Cleaner Assembly Replacement](#) .

DRIVE BELT REPLACEMENT (CONVERTIBLE)

REMOVAL PROCEDURE

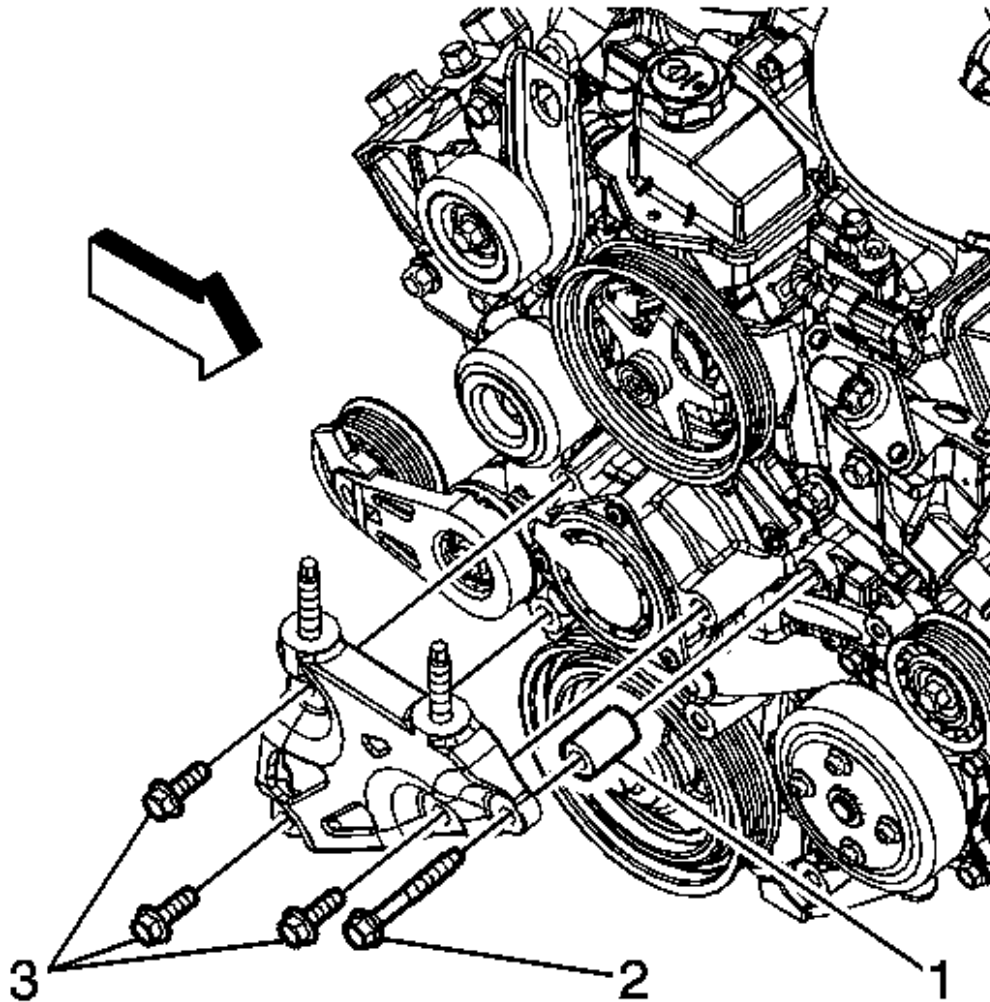


Fig. 5: Engine Mount Bracket, Spacer & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#) .
2. Remove the intake manifold cover. Refer to [Intake Manifold Cover Replacement](#).

3. Remove the engine mount bracket bolt (2).
4. Remove the engine mount bracket spacer (1).

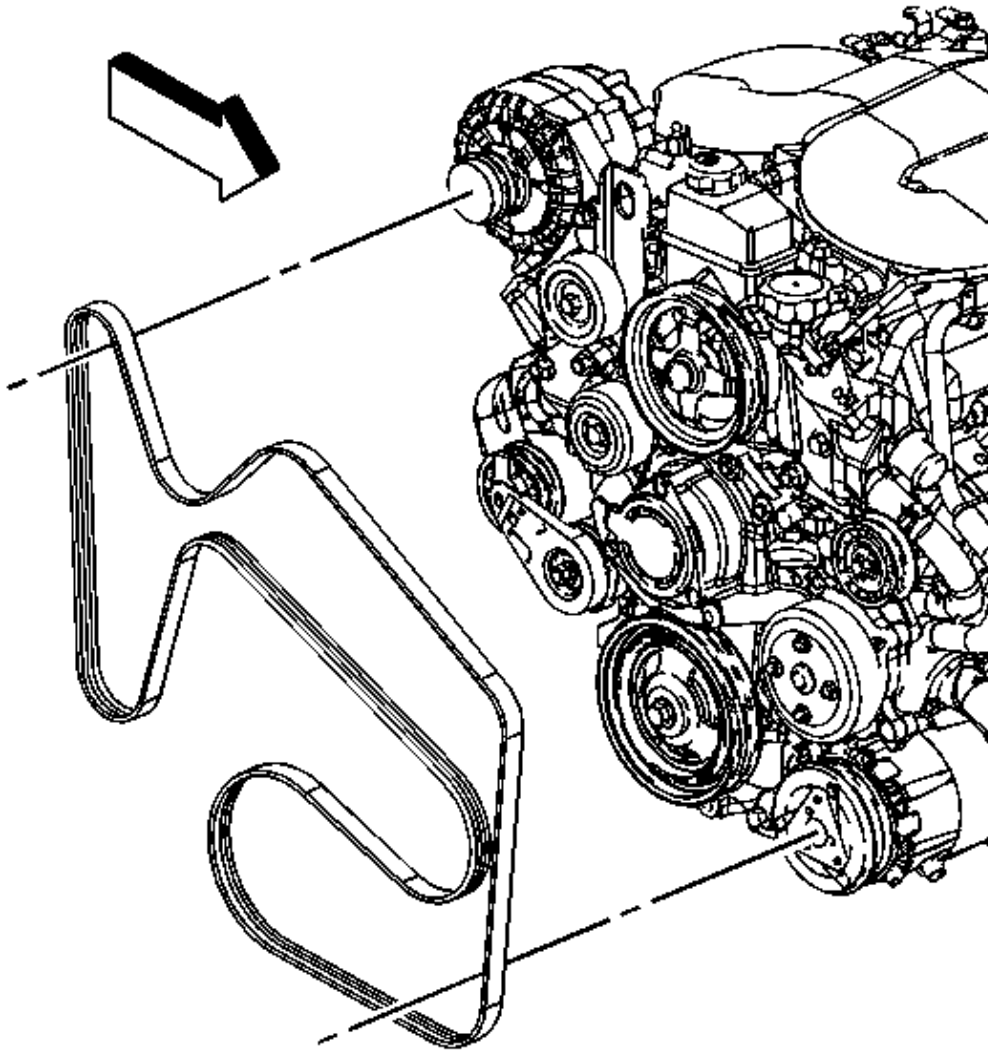


Fig. 6: Drive Belt Routing
Courtesy of GENERAL MOTORS CORP.

5. Rotate the drive belt tensioner counterclockwise in order to release the tensioner spring tension.
6. Remove the drive belt.

INSTALLATION PROCEDURE

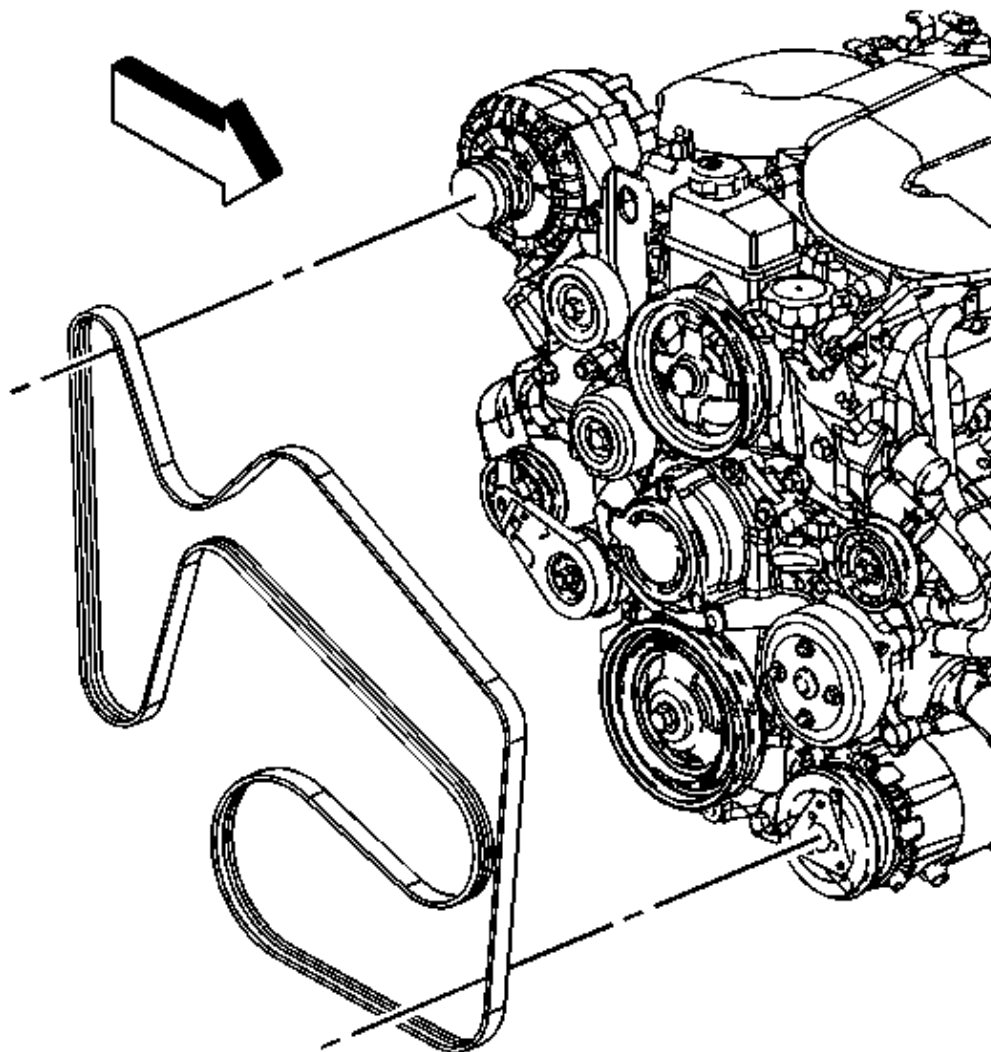


Fig. 7: Drive Belt Routing

Courtesy of GENERAL MOTORS CORP.

1. Rotate the drive belt tensioner counterclockwise in order to release the tensioner spring tension.
2. Install the drive belt.

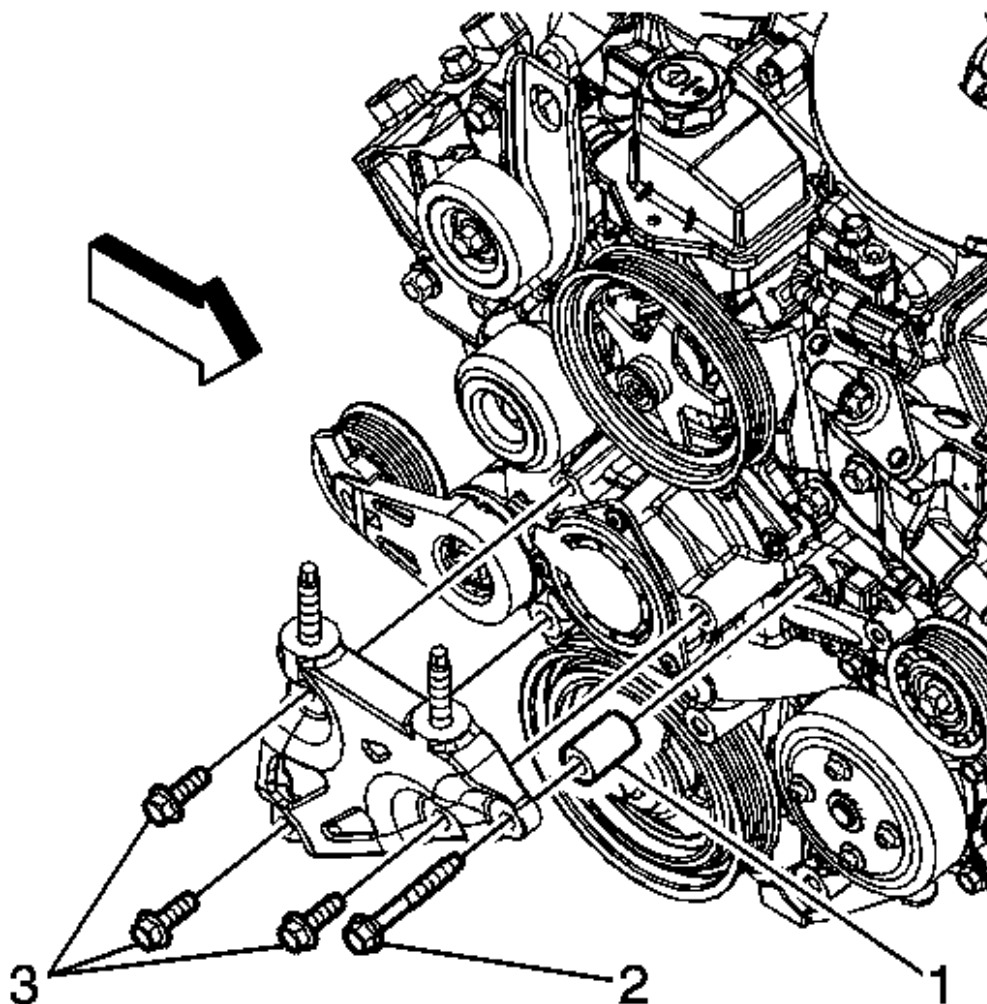


Fig. 8: Engine Mount Bracket, Spacer & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The spacer has a nominal length of 36.0 mm (1.42 in). If the spacer cannot be reinstalled, the spacer will require the ends to be buffed slightly using a crocus cloth or emery paper in order to bring the length to a minimum of 35.80 mm (1.41 in).

3. Install the engine mount bracket spacer (1).

CAUTION: Refer to Fastener Caution .

4. Install the engine mount bracket bolt (2).

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

5. Install the intake manifold cover. Refer to [Intake Manifold Cover Replacement](#).
6. Install the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#).

DRIVE BELT IDLER PULLEY REPLACEMENT

REMOVAL PROCEDURE

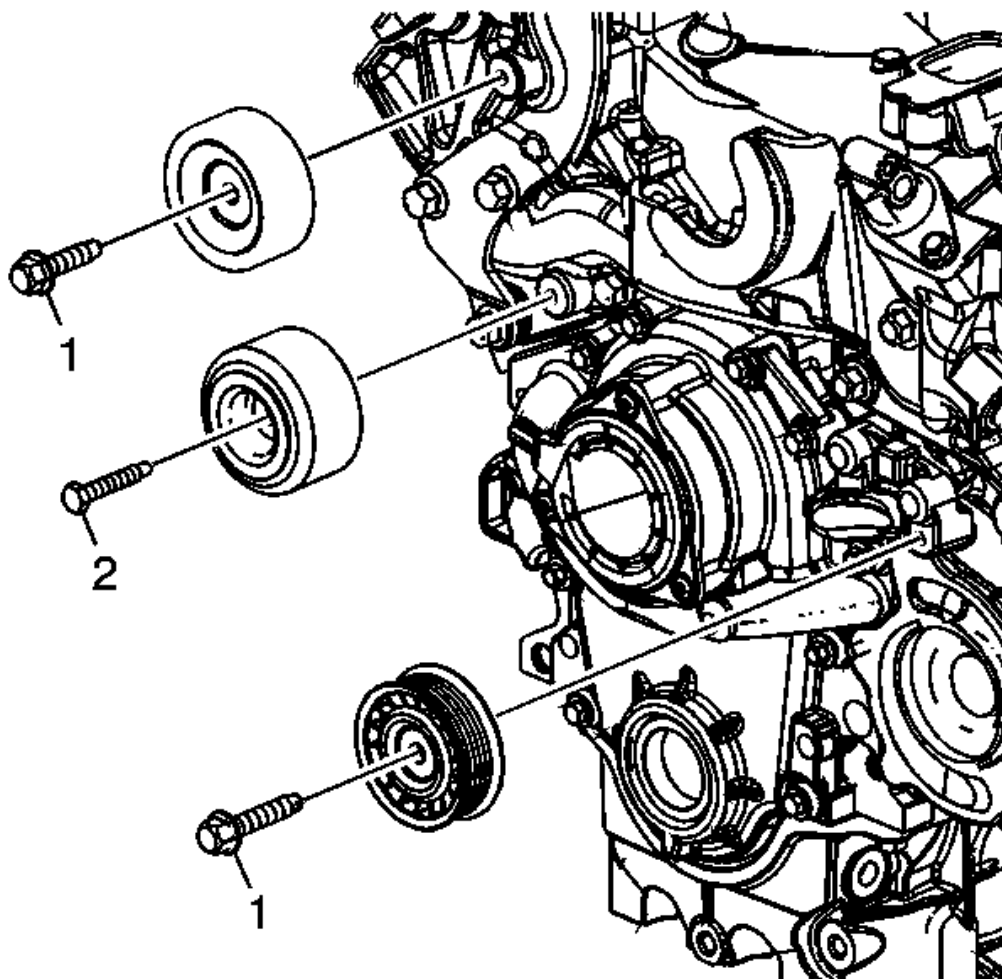


Fig. 9: Idler Pulley Bolts & Pulleys
Courtesy of GENERAL MOTORS CORP.

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

INSTALLATION PROCEDURE

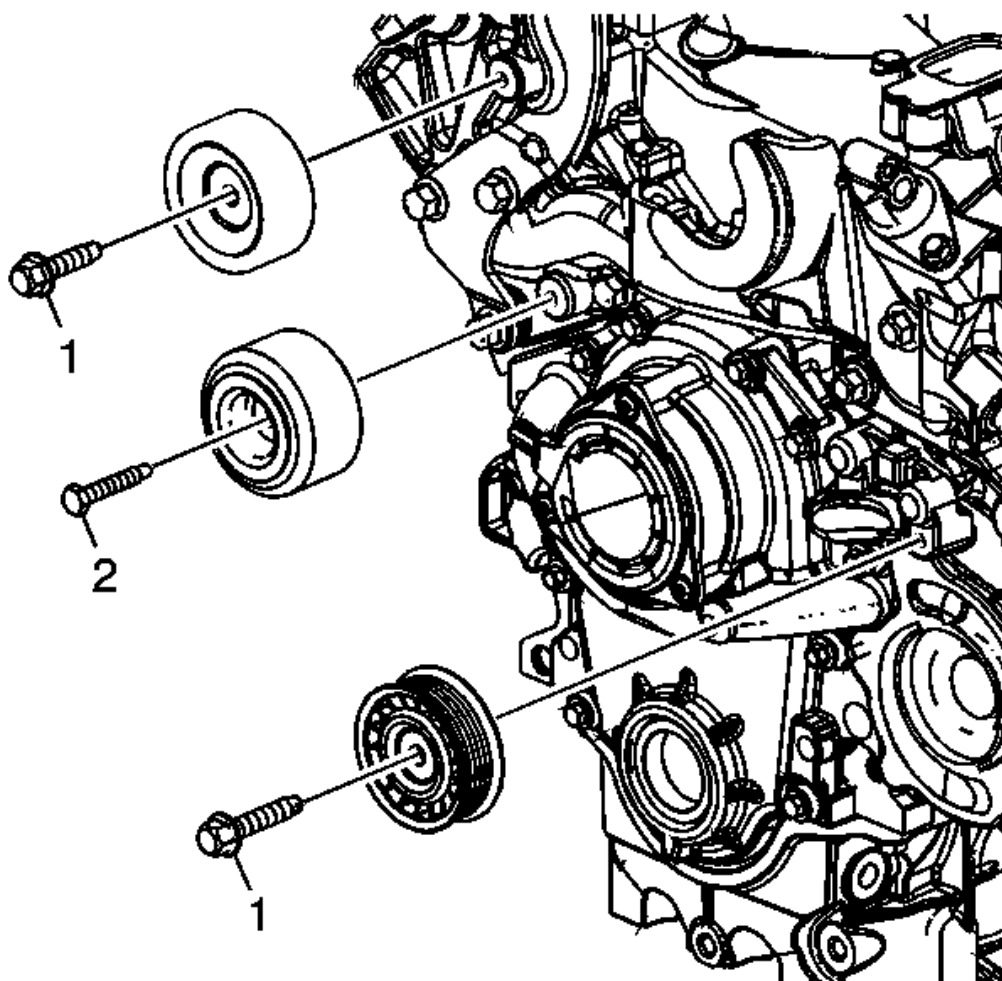


Fig. 10: Idler Pulley Bolts & Pulleys
Courtesy of GENERAL MOTORS CORP.

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 (Coupe)** or **Drive Belt Replacement (Convertible)**.

DRIVE BELT TENSIONER REPLACEMENT**REMOVAL PROCEDURE**

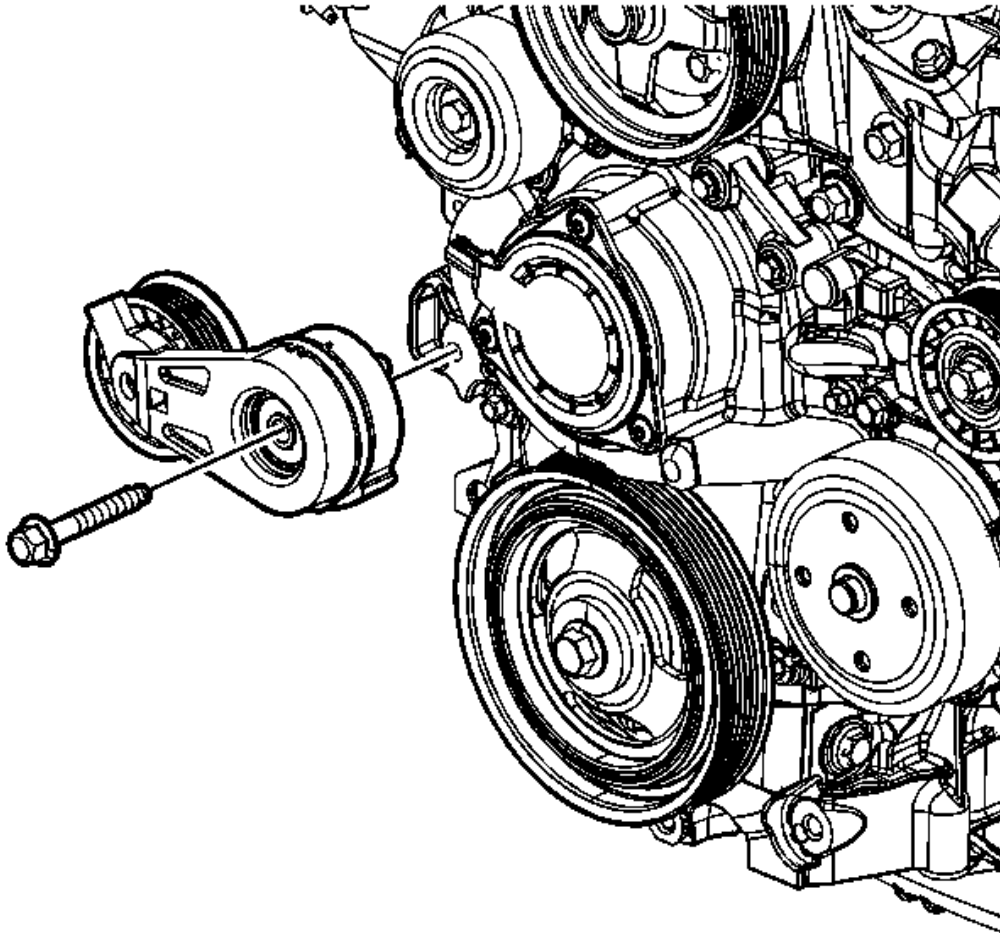


Fig. 11: Drive Belt Tensioner & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the drive belt. Refer to **Drive Belt Replacement (Coupe)** or **Drive Belt Replacement (Convertible)**.
2. Remove the drive belt tensioner bolt.
3. Remove the drive belt tensioner.

INSTALLATION PROCEDURE

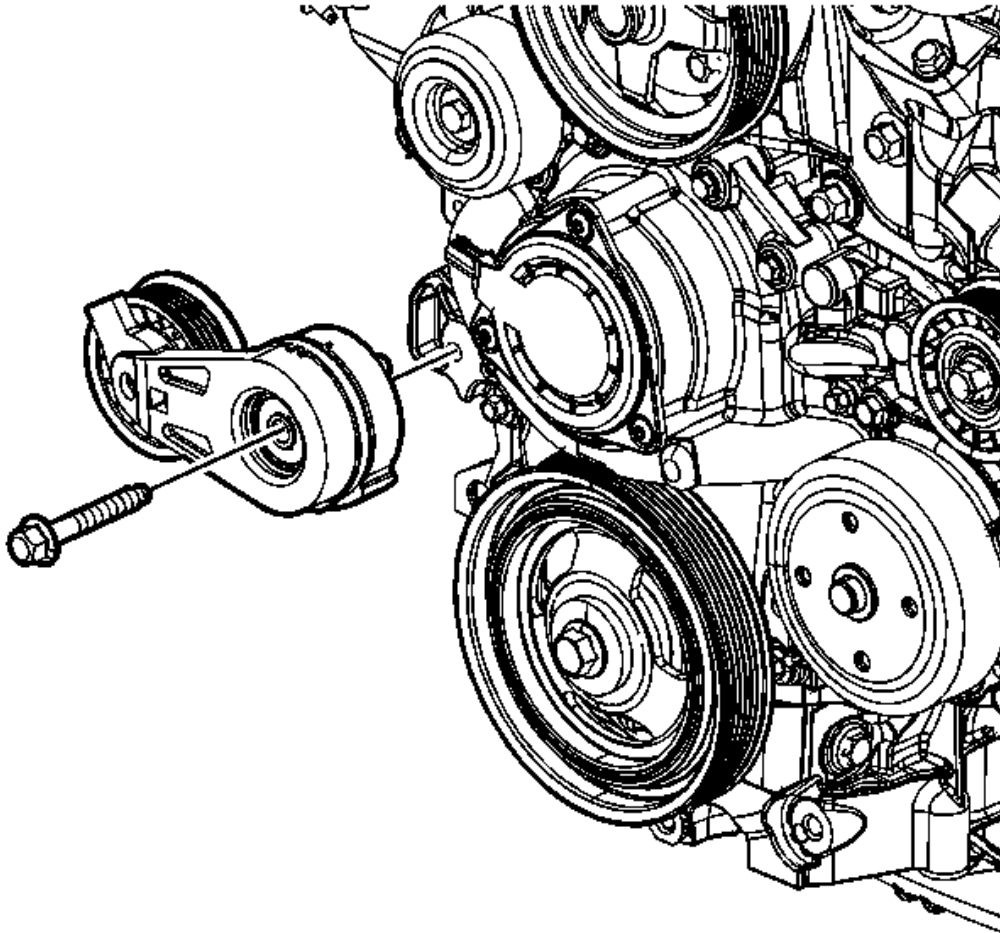


Fig. 12: Drive Belt Tensioner & Bolt
Courtesy of GENERAL MOTORS CORP.

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 (Coupe) or Drive Belt Replacement (Convertible).

ENGINE SUPPORT FIXTURE

Tools Required

- J 28467-B Engine Support Fixture
- J 36462 Engine Support Adapter Leg

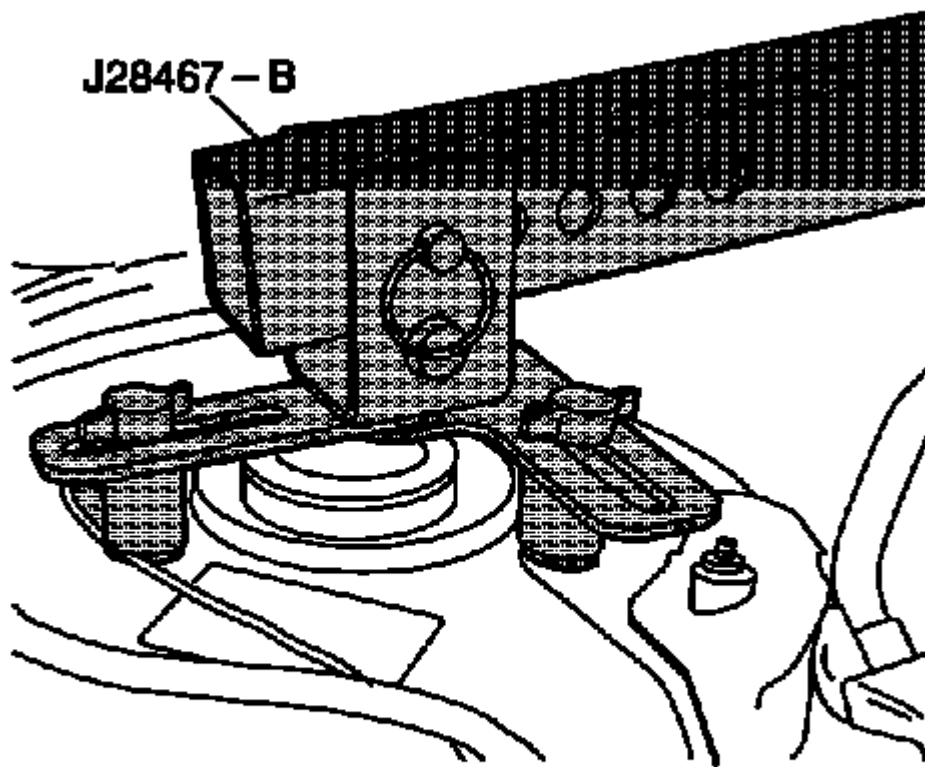


Fig. 13: Engine Support Fixture
Courtesy of GENERAL MOTORS CORP.

1. Raise the hood.
2. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.
3. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
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.

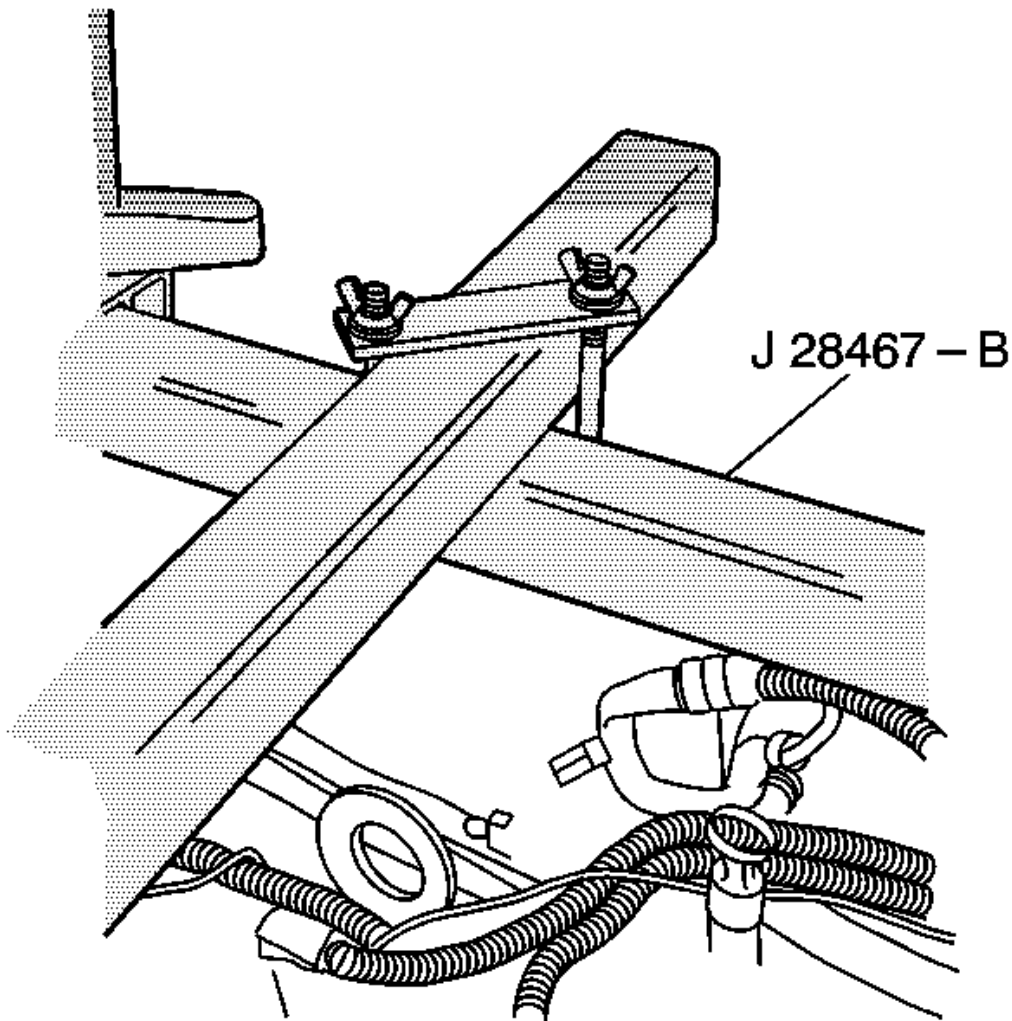


Fig. 14: Engine Support Fixture
Courtesy of GENERAL MOTORS CORP.

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 (Coupe) or Engine Mount Replacement (Convertible).

ENGINE MOUNT REPLACEMENT (COUPE)

REMOVAL PROCEDURE

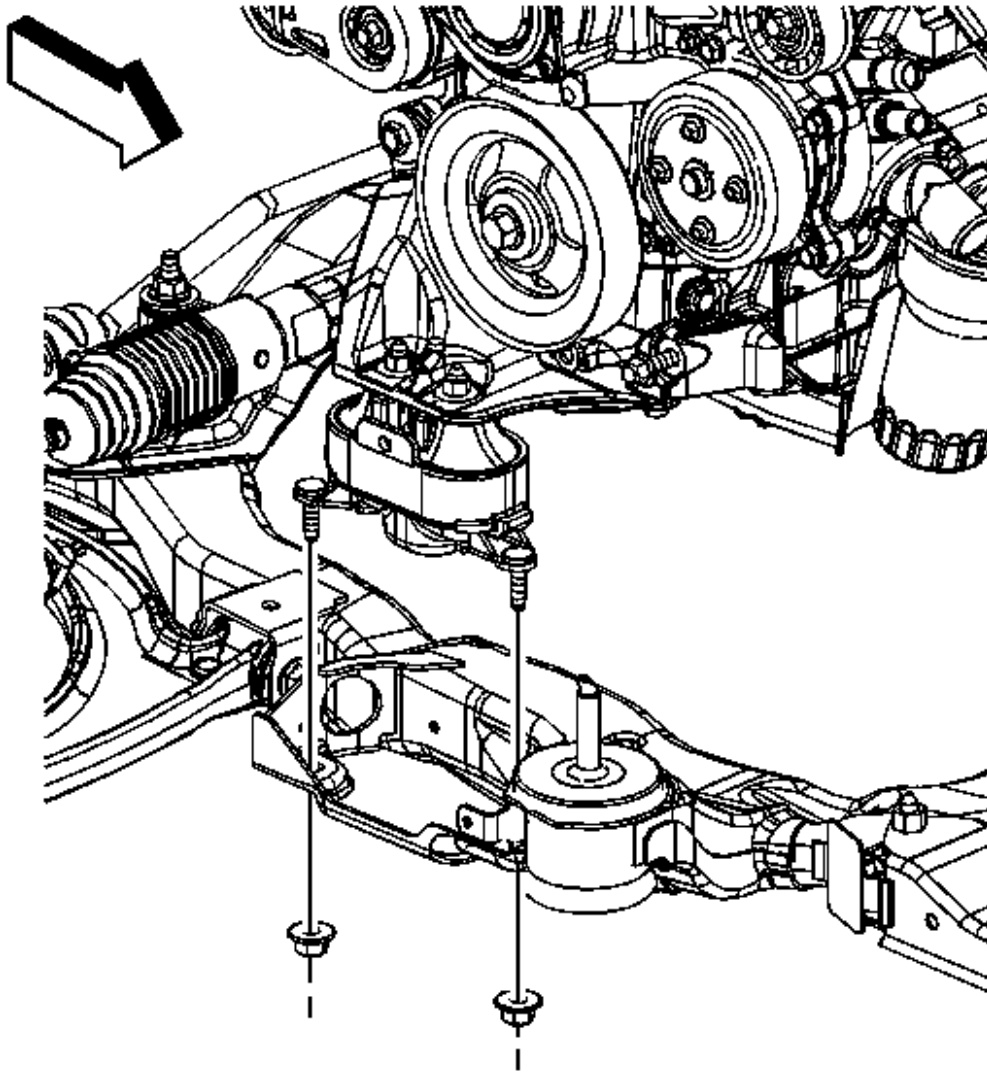


Fig. 15: Engine Mount & Nuts

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 engine mount bracket nuts.
4. Remove the engine mount to frame nuts.
5. Using an adjustable jack, raise the engine.
6. Remove the engine mount from the frame.

INSTALLATION PROCEDURE

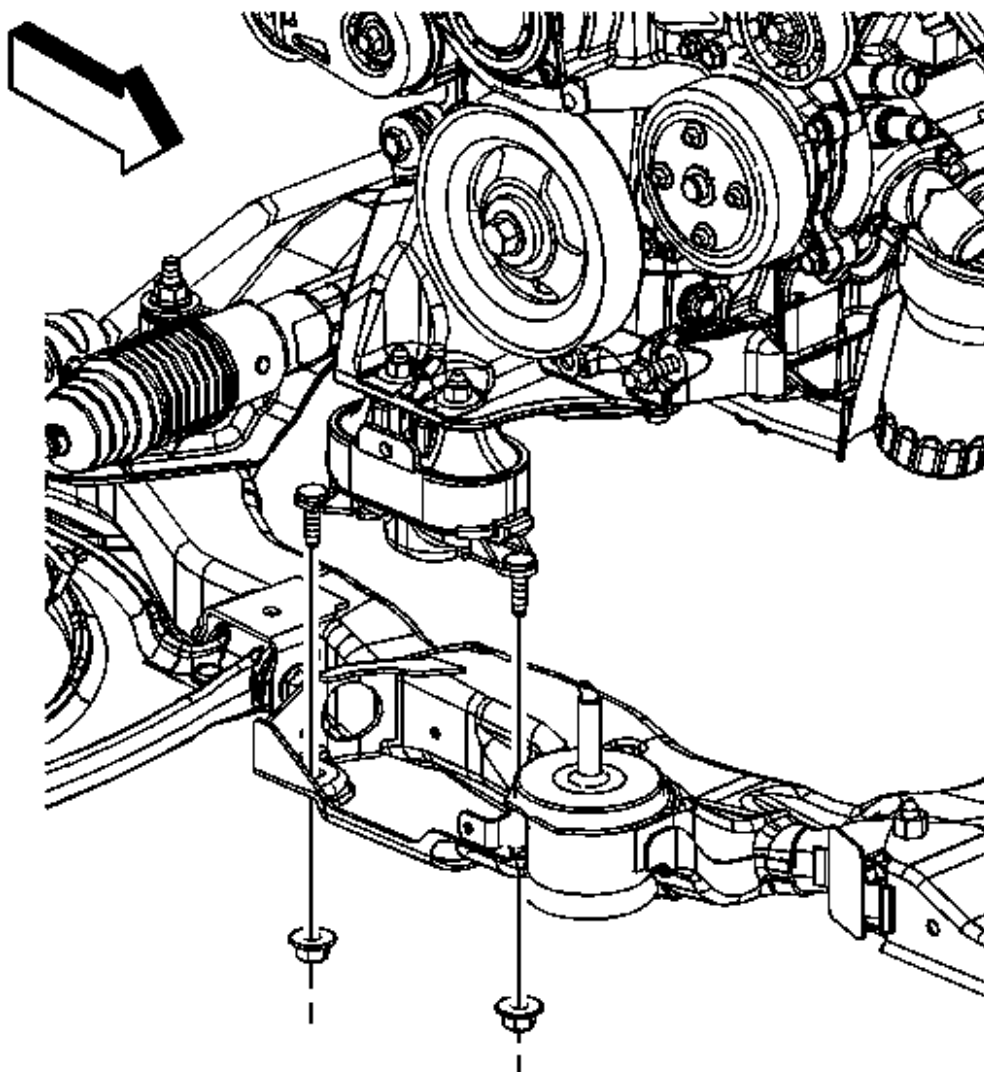


Fig. 16: Engine Mount & Nuts
Courtesy of GENERAL MOTORS CORP.

1. Position the engine mount onto the frame
2. Lower the engine using the adjustable jack.

CAUTION: Refer to Fastener Caution .

3. Install the engine mount to frame nuts.

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

4. Install the engine mount to engine mount bracket nuts.

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

5. Remove the adjustable jack from under the vehicle.
6. Install the engine splash shield. Refer to Radiator Air Lower Baffle and Deflector Replacement .
7. Install the tire and wheel. Refer to Tire and Wheel Removal and Installation .

ENGINE MOUNT REPLACEMENT (CONVERTIBLE)

REMOVAL PROCEDURE

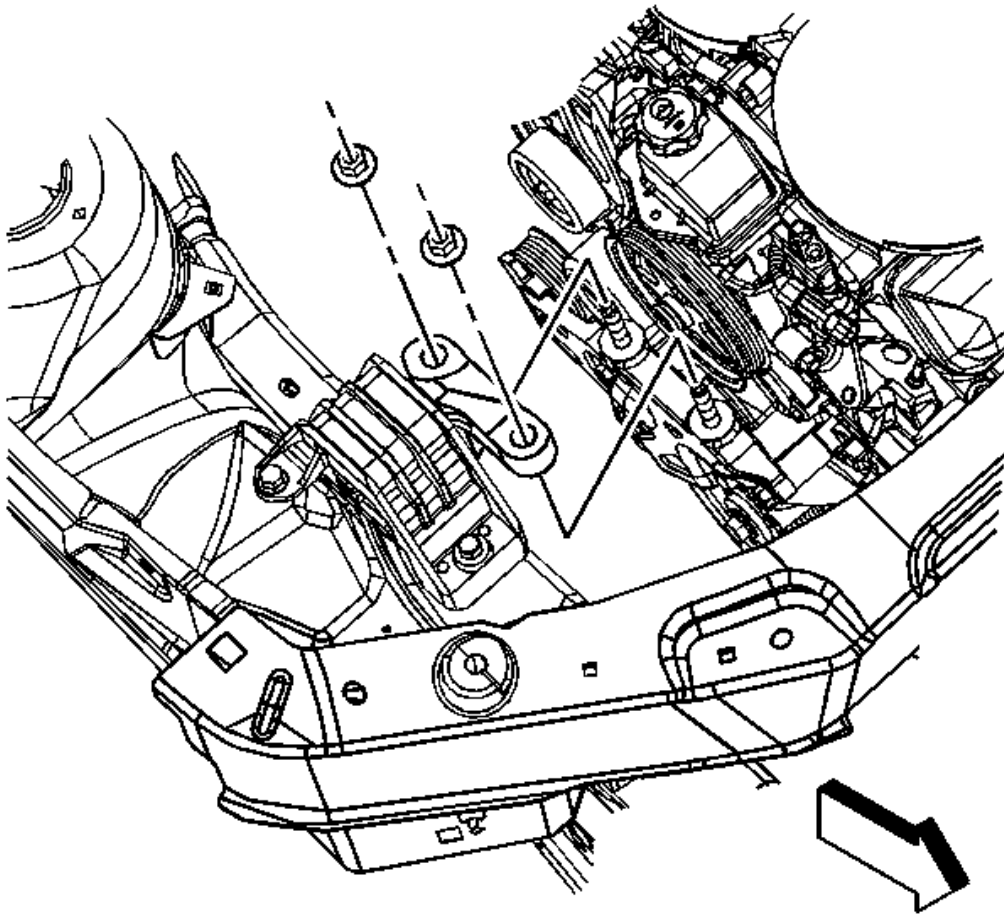


Fig. 17: Engine Mount Bracket Nuts
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#) .
2. Place a block of wood on a adjustable floor jack, and place the jack under the oil pan in order to support the engine.
3. Remove the engine mount to engine mount bracket nuts.

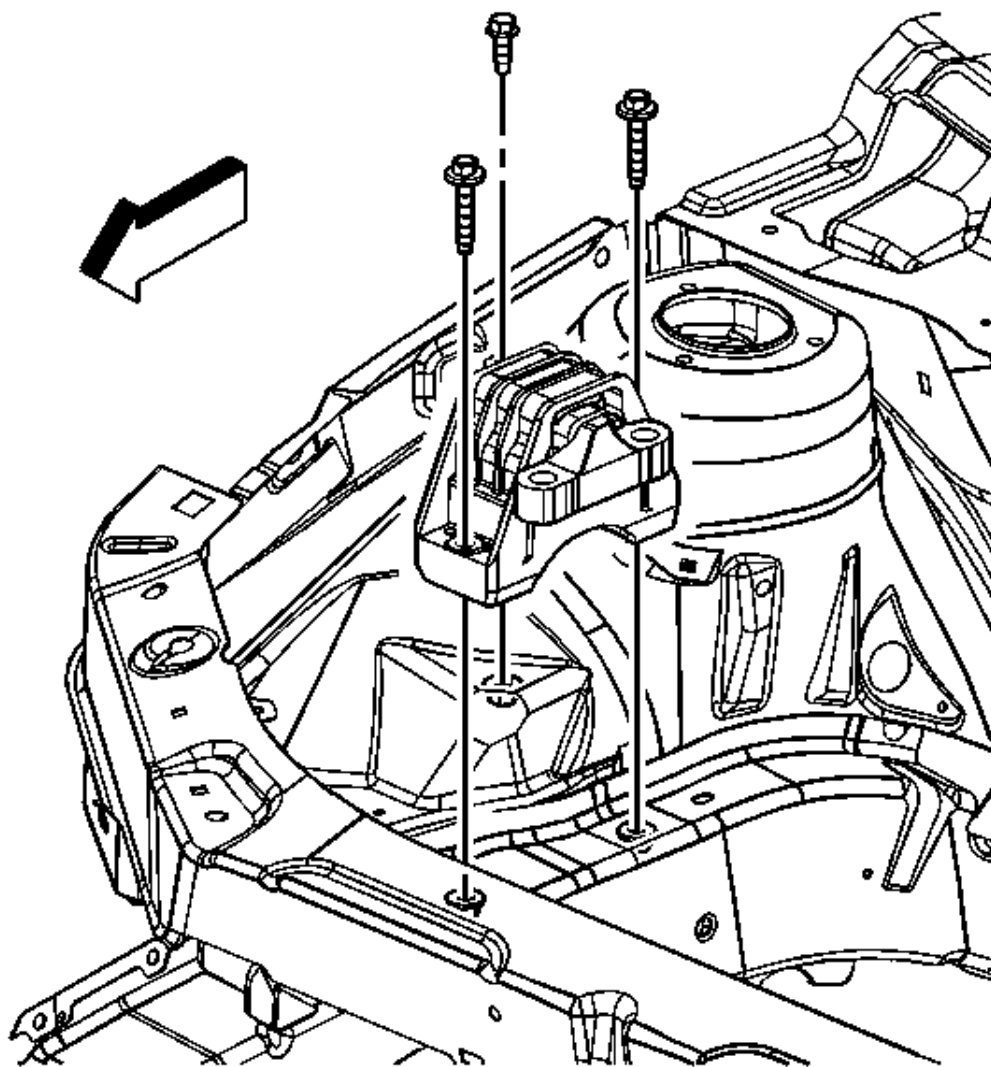


Fig. 18: Engine Mount & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine mount bolts.
5. Remove the engine mount.

INSTALLATION PROCEDURE

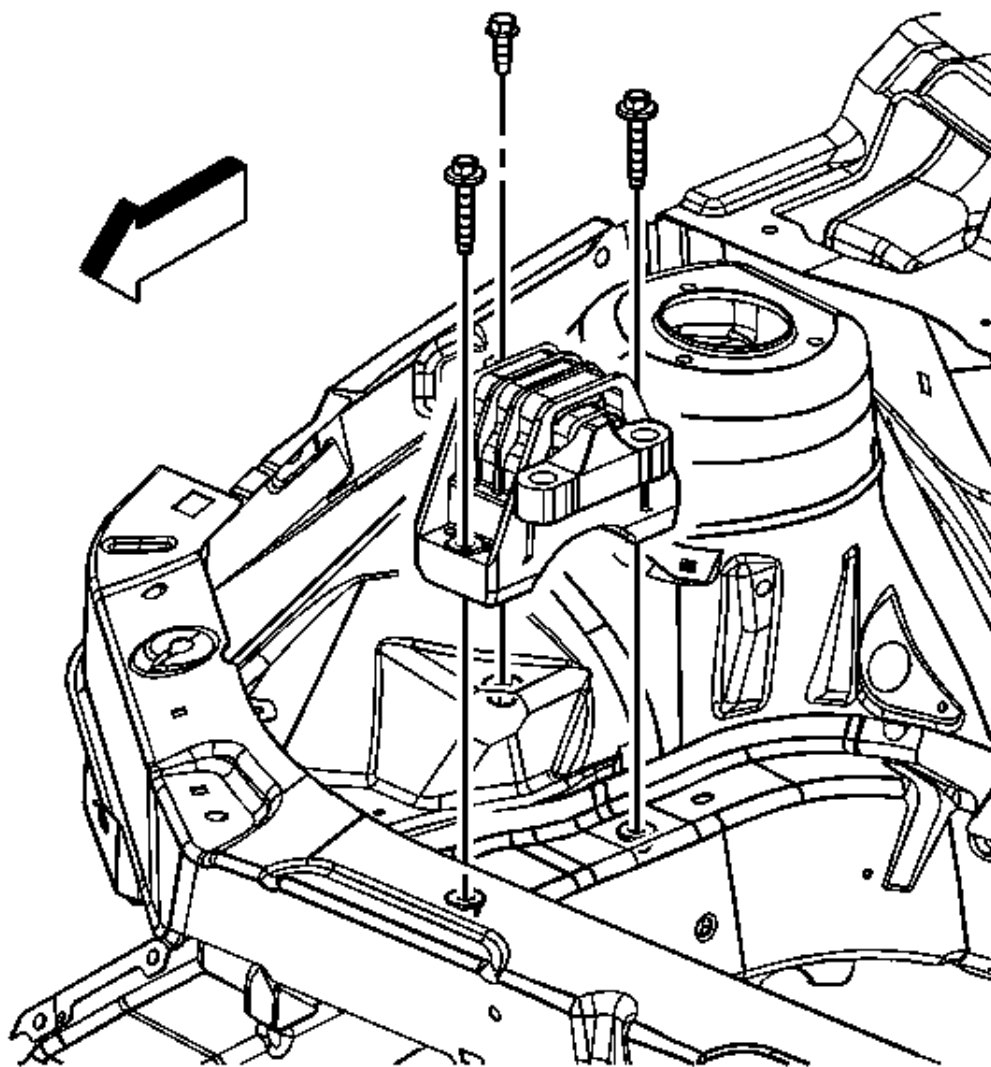


Fig. 19: Engine Mount & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Place the engine mount into position on the engine compartment side rail.

CAUTION: Refer to Fastener Caution .

2. Install the engine mount bolts.

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

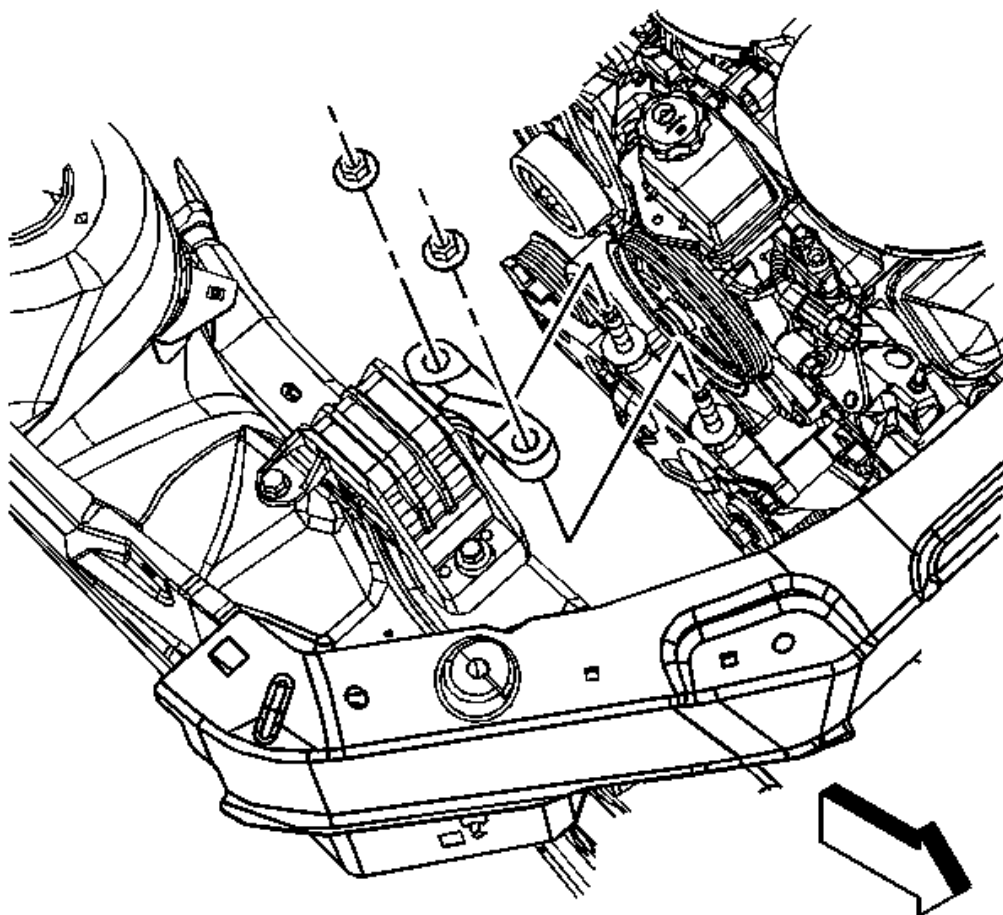


Fig. 20: Engine Mount Bracket Nuts
Courtesy of GENERAL MOTORS CORP.

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

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

4. Remove the floor jack and block of wood from under the oil pan.
5. Install the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#) .

ENGINE MOUNT BRACKET REPLACEMENT (CONVERTIBLE)

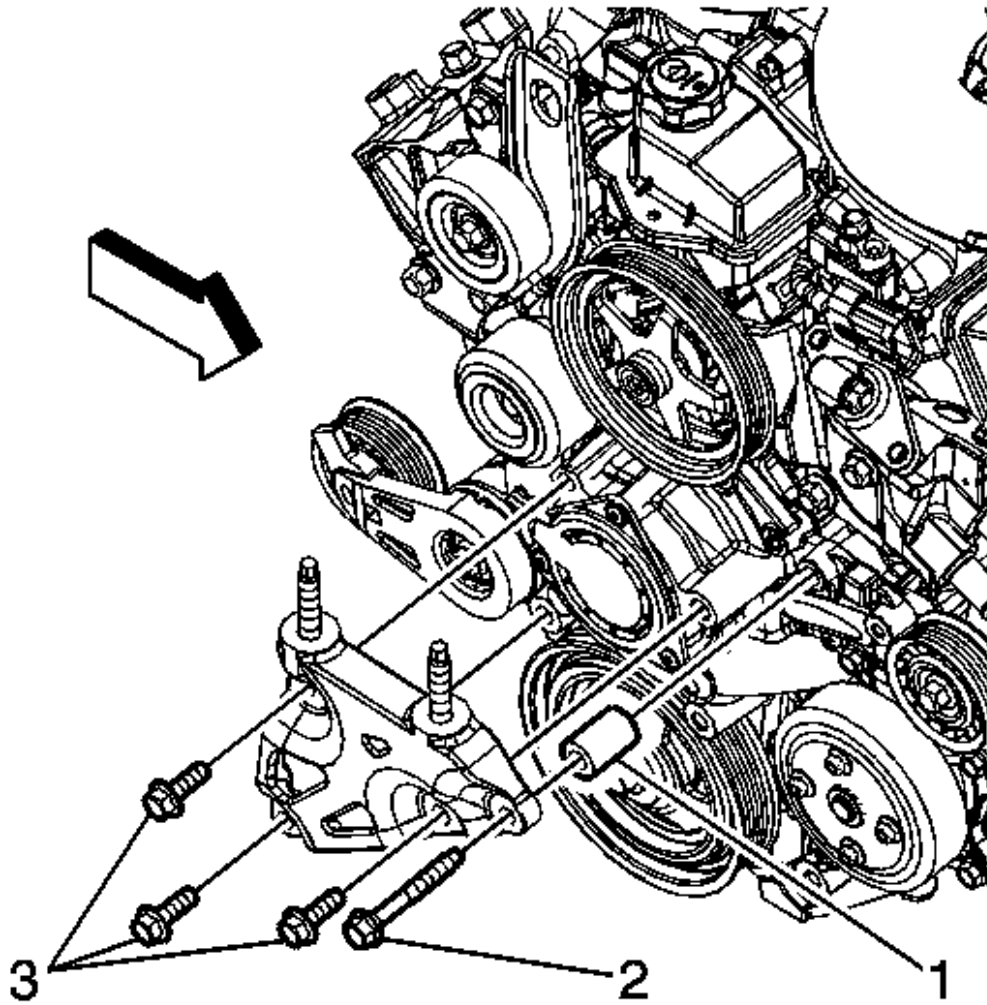
REMOVAL PROCEDURE

Fig. 21: Engine Mount Bracket, Spacer & Bolts
Courtesy of GENERAL MOTORS CORP.

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

INSTALLATION PROCEDURE

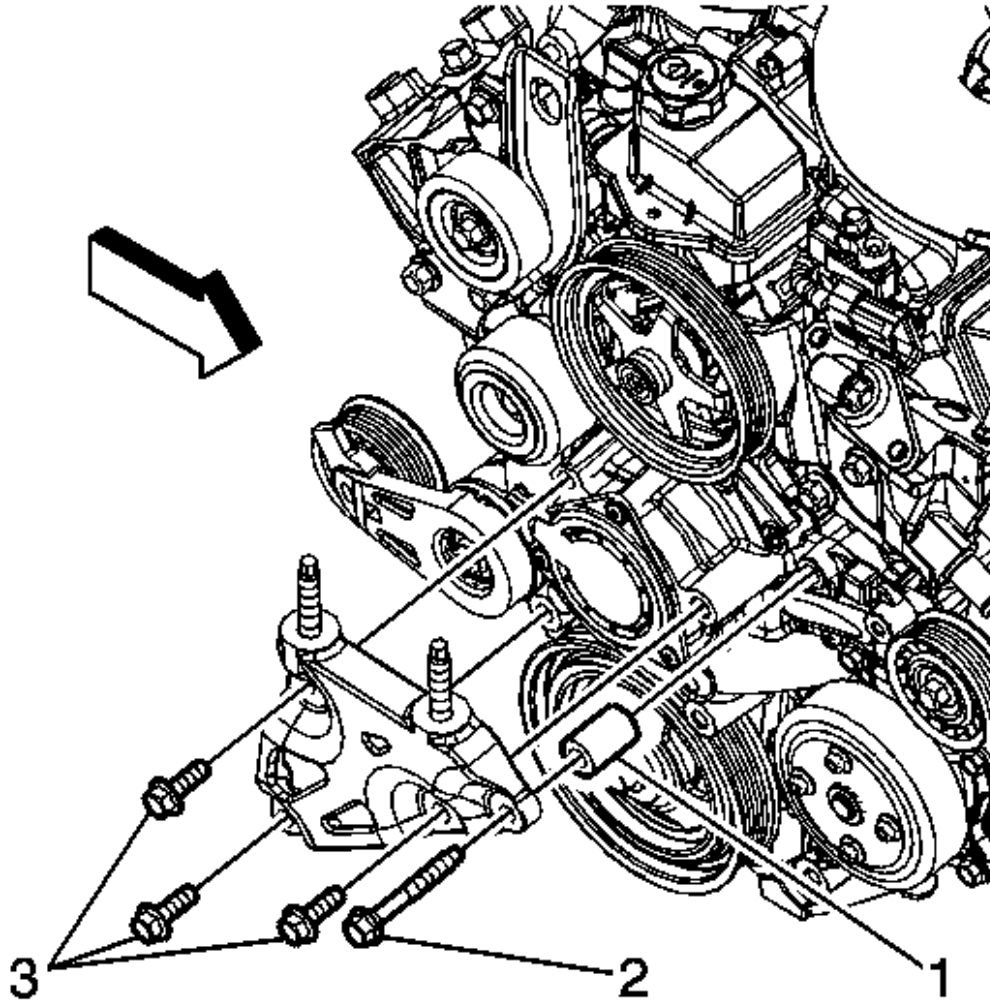


Fig. 22: Engine Mount Bracket, Spacer & Bolts
 Courtesy of GENERAL MOTORS CORP.

1. Position the engine mount bracket and spacer (1) to the engine front cover.
2. Hold the bracket firmly to the engine front cover and install the engine mount bracket bolts (2, 3).

CAUTION: Refer to Fastener Caution .

3. Tighten the engine mount bracket bolts.

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

4. Install the engine mount. Refer to **Engine Mount Replacement (Coupe)** or **Engine Mount Replacement (Convertible)**.

ENGINE MOUNT BRACKET REPLACEMENT (COUPE)

REMOVAL PROCEDURE

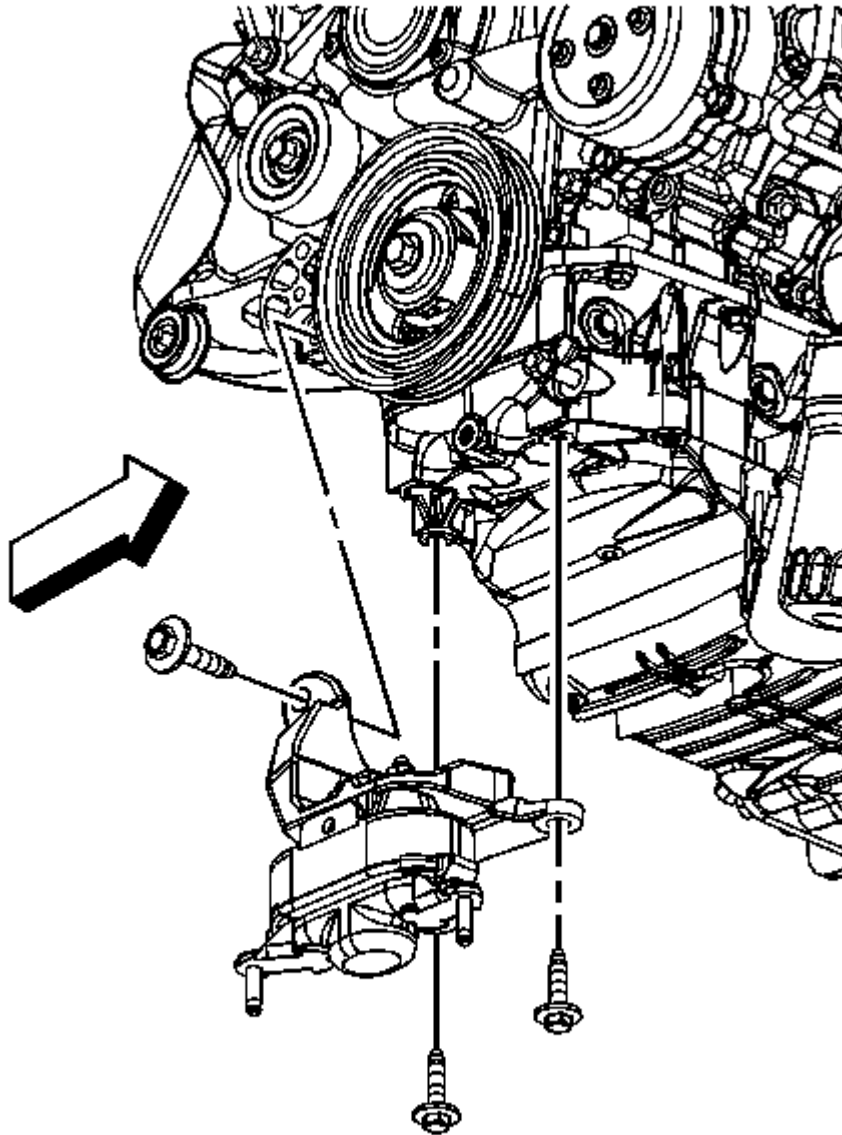


Fig. 23: Engine Mount Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine mount. Refer to **Engine Mount Replacement (Coupe)** or **Engine Mount Replacement (Convertible)**.
2. Remove the engine mount bracket bolt from the engine.
3. Remove the engine mount bracket bolts from the oil pan.

4. Remove the engine mount bracket from the vehicle.

INSTALLATION PROCEDURE

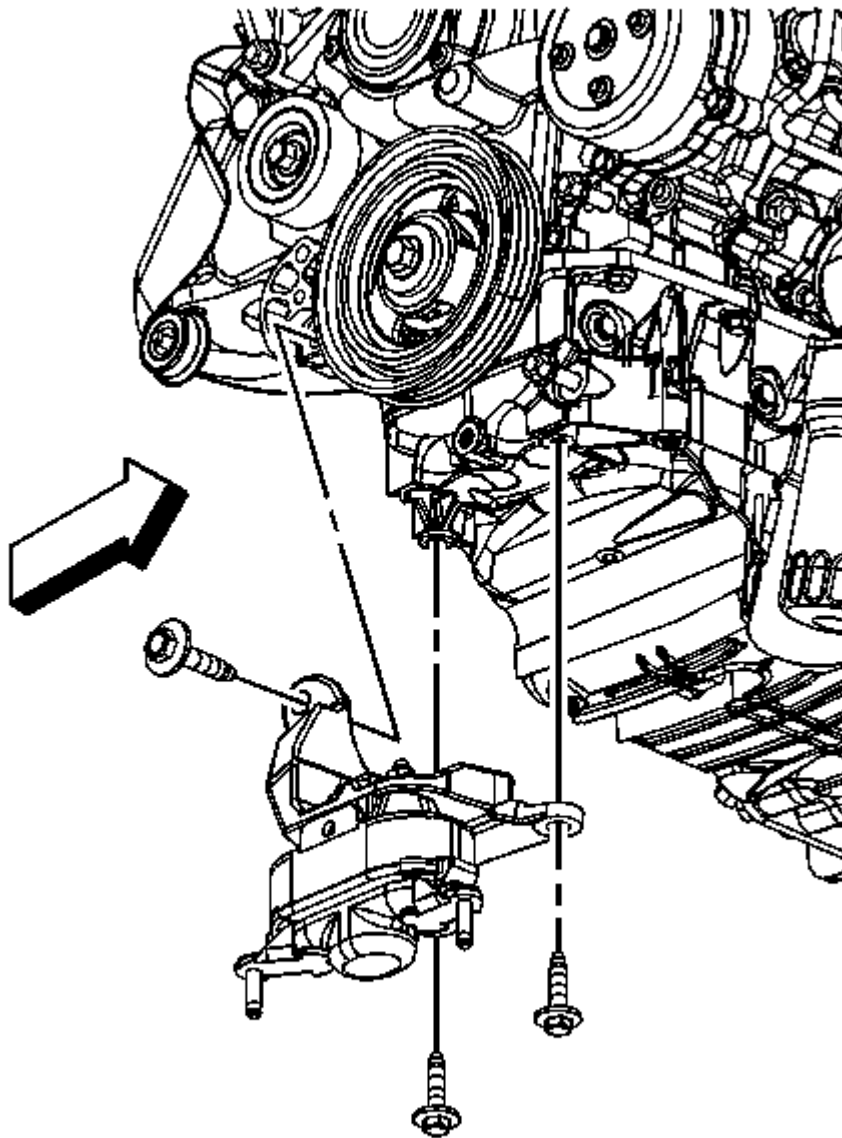


Fig. 24: Engine Mount Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Position the engine mount bracket to the engine.
2. Loose assemble the engine mount bracket to oil pan and engine.
3. Hold the bracket firmly to the front of the engine and snug the engine mount bracket bolts.

CAUTION: Refer to Fastener Caution .

4. Tighten the engine mount bracket bolts.

Tighten:

1. Tighten the engine mount bracket to engine bolt to 90 N.m (66 lb ft).
 2. Tighten the engine mount bracket to oil pan bolts to 50 N.m (37 lb ft).
5. Install the engine mount. Refer to Engine Mount Replacement (Coupe) or Engine Mount Replacement (Convertible).

ENGINE MOUNT POSITION ADJUSTMENT

Special Tools

J 23498-A Driveshaft Inclinometer. See Special Tools .

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.

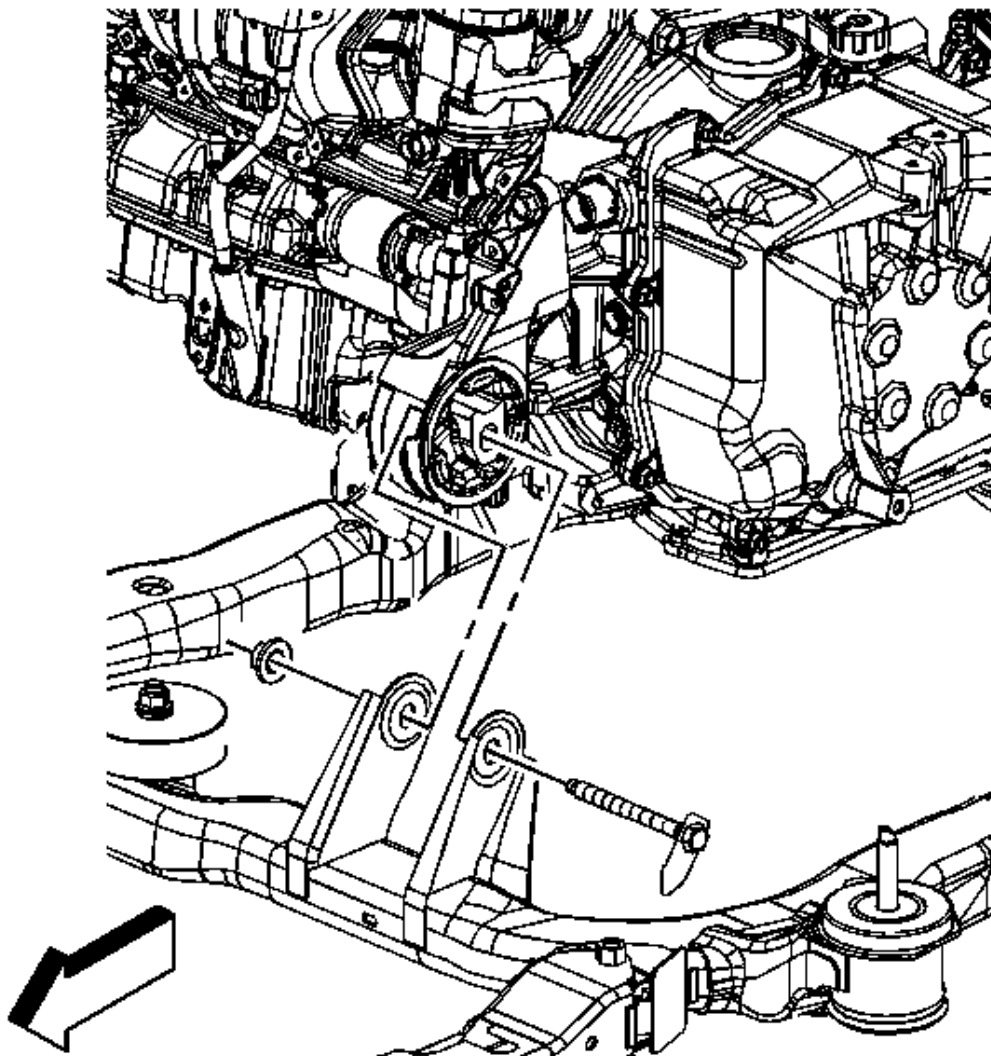


Fig. 25: Front Transmission Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

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.

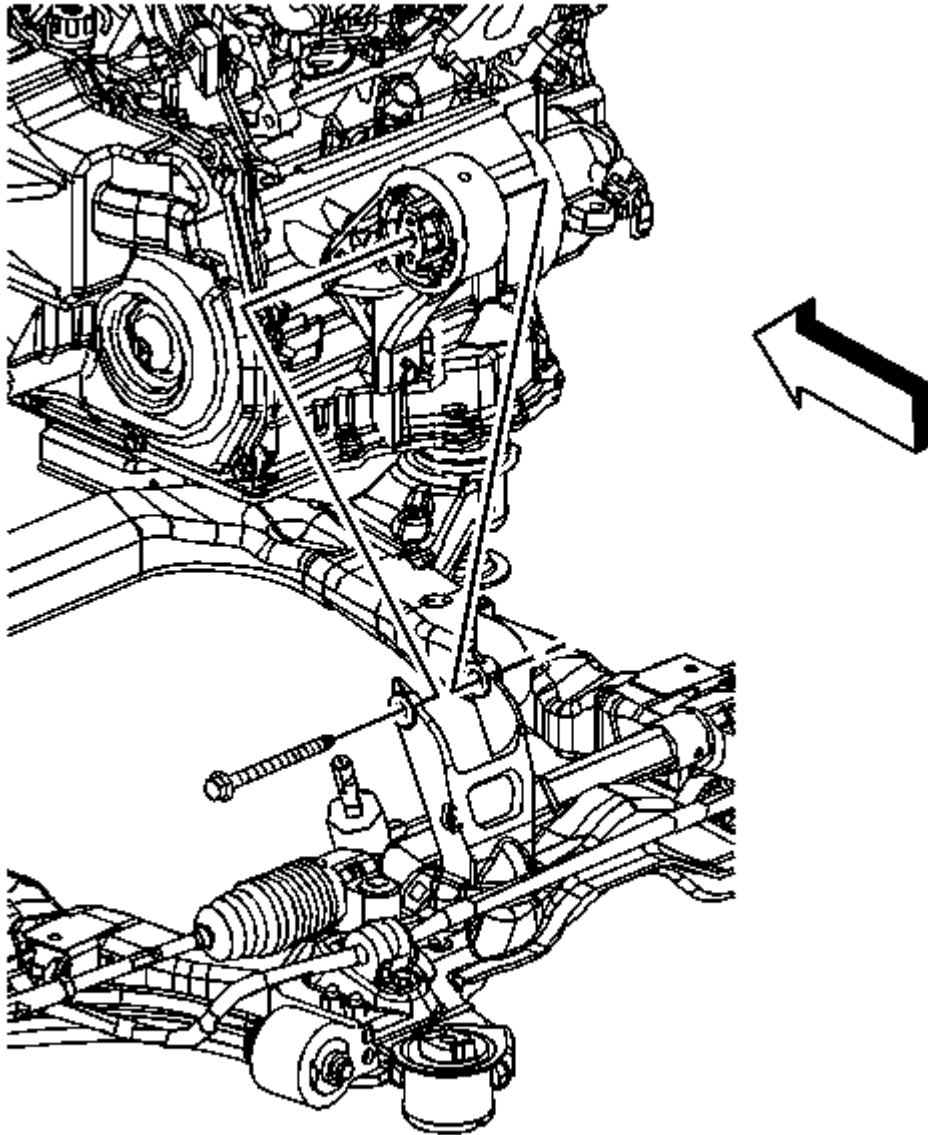


Fig. 26: Rear Transmission Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

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. See **Special Tools** .
5. Rock the engine by hand until the **J 23498-A** reading is as close to "0" degrees as possible. See **Special Tools** .

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.

ENGINE MOUNT SNUBBER REPLACEMENT**REMOVAL PROCEDURE**

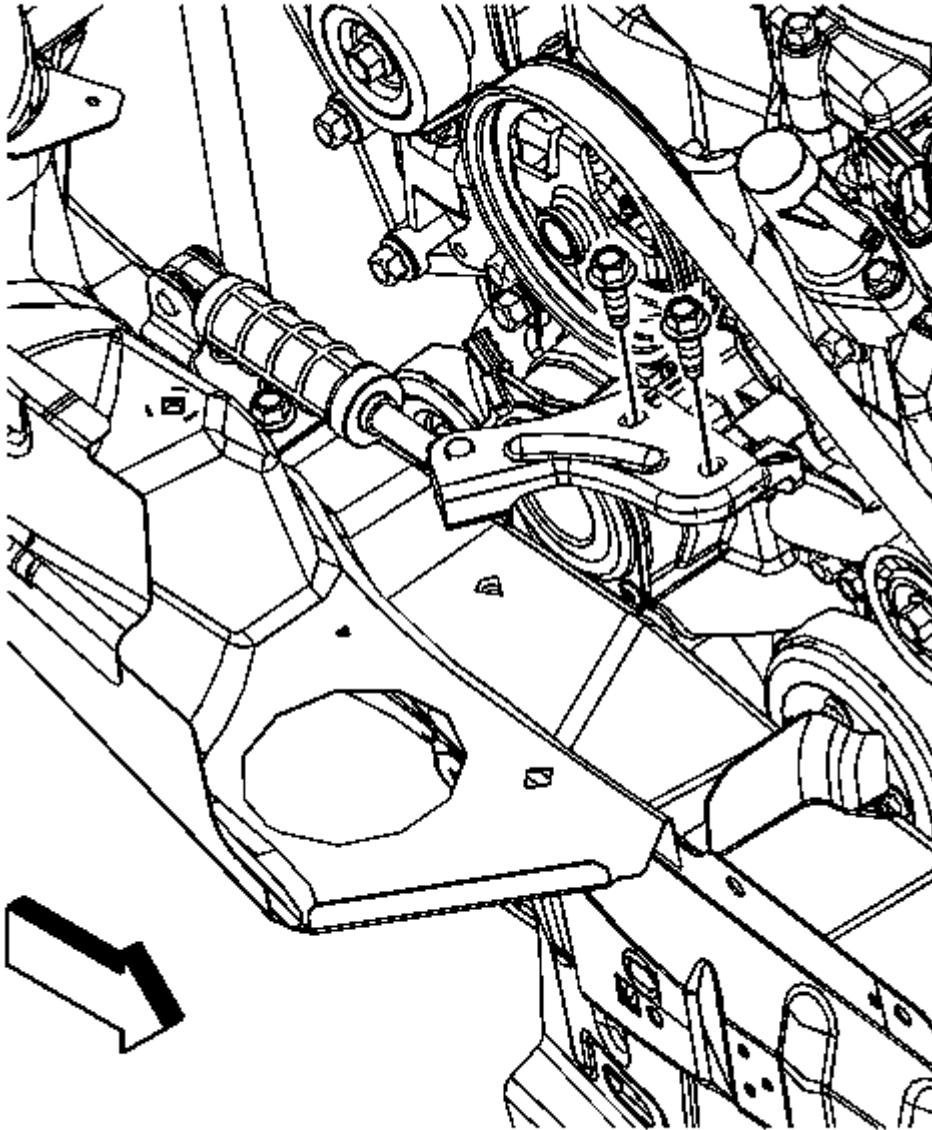


Fig. 27: Engine Mount Snubber To Engine Mount Snubber Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner. Refer to [Air Cleaner Assembly Replacement](#) .
2. Remove the engine mount snubber to engine mount snubber bracket bolts.
3. Lift the engine mount snubber into the vertical position.

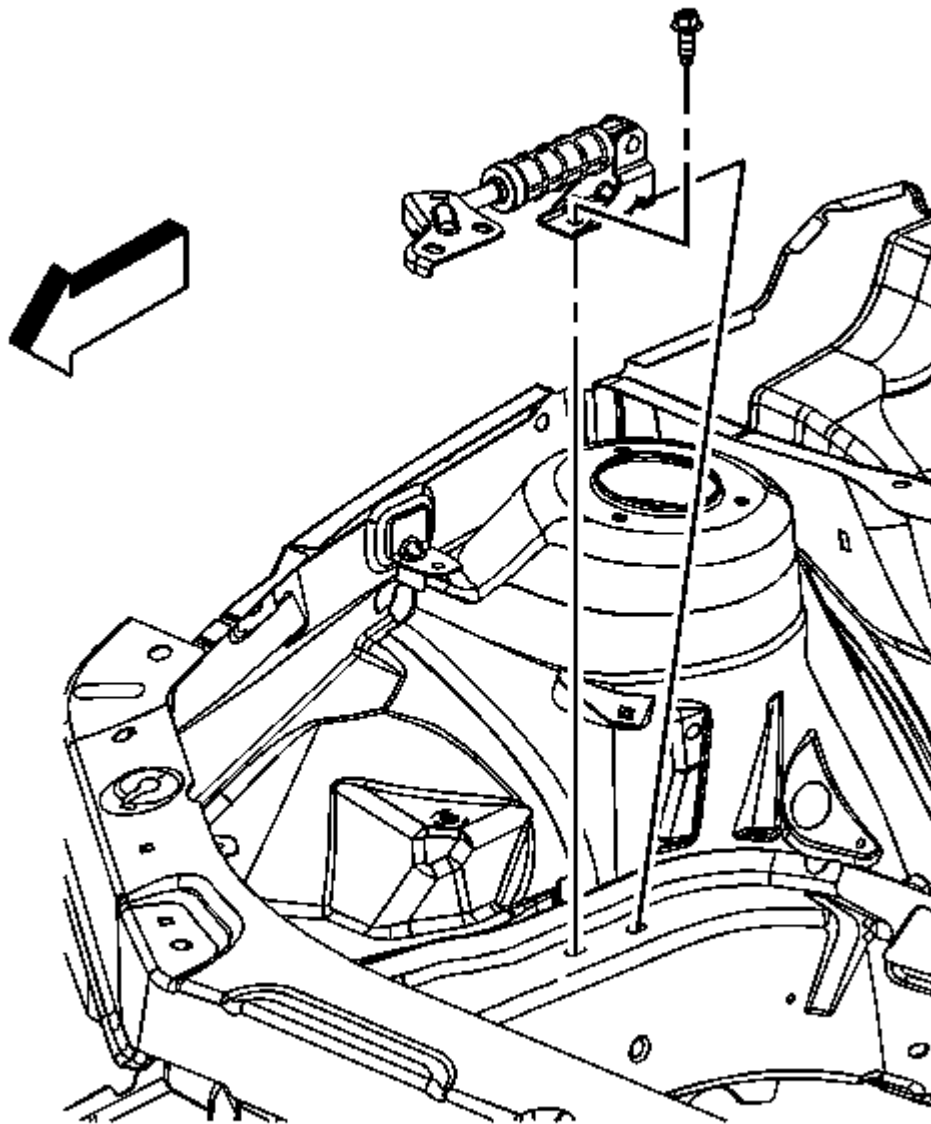


Fig. 28: Engine Mount Snubber To Engine Compartment Side Rail & Bolt
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine mount snubber to engine compartment side rail bolt.
5. Slide the engine mount snubber rearward and remove.

INSTALLATION PROCEDURE

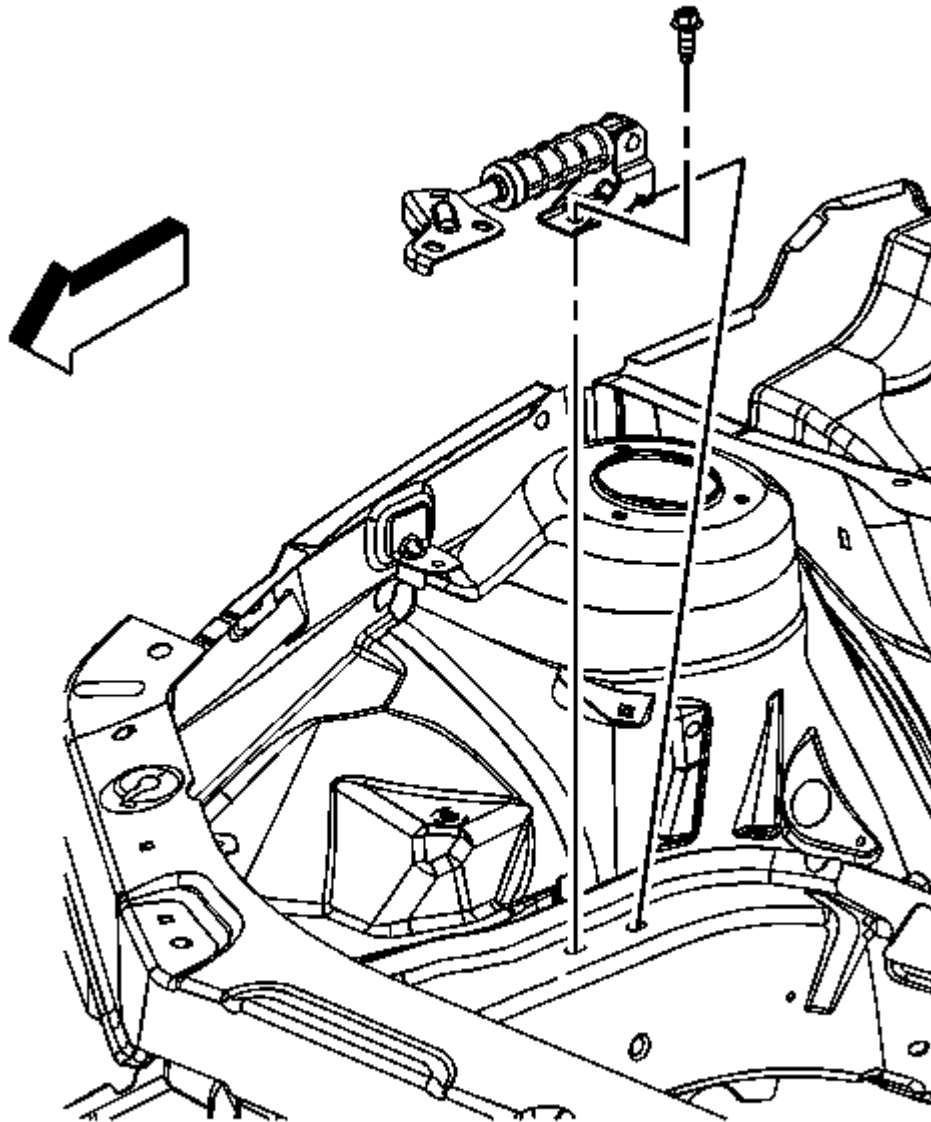


Fig. 29: Engine Mount Snubber To Engine Compartment Side Rail & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Position the engine mount snubber tab into the hole and slide the snubber forward until the bolt hole aligns.

CAUTION: Refer to Fastener Caution .

2. Install and tighten the engine mount snubber to engine compartment side rail bolt to 50 N.m (37 lb ft).
3. Push the engine mount snubber into the horizontal position.

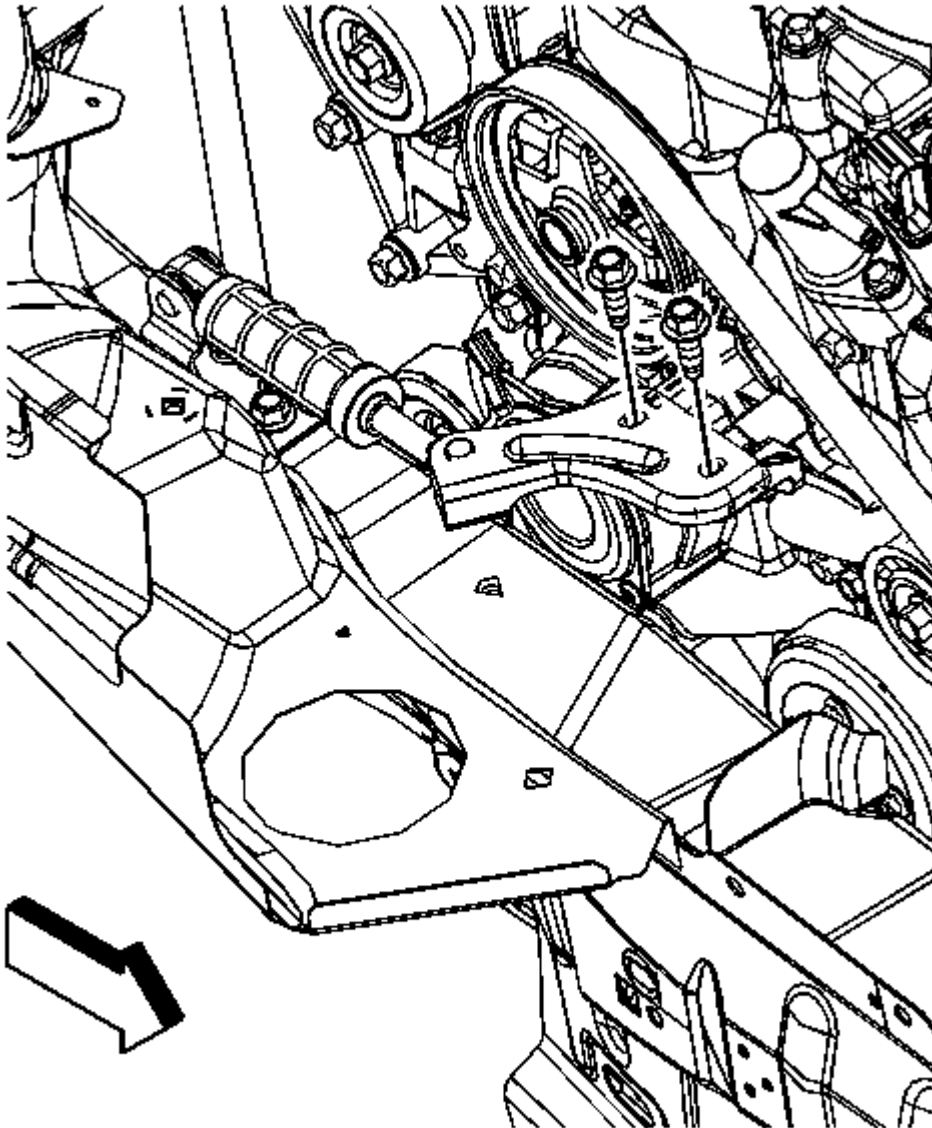


Fig. 30: Engine Mount Snubber, Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

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

ENGINE MOUNT SNUBBER BRACKET REPLACEMENT

REMOVAL PROCEDURE

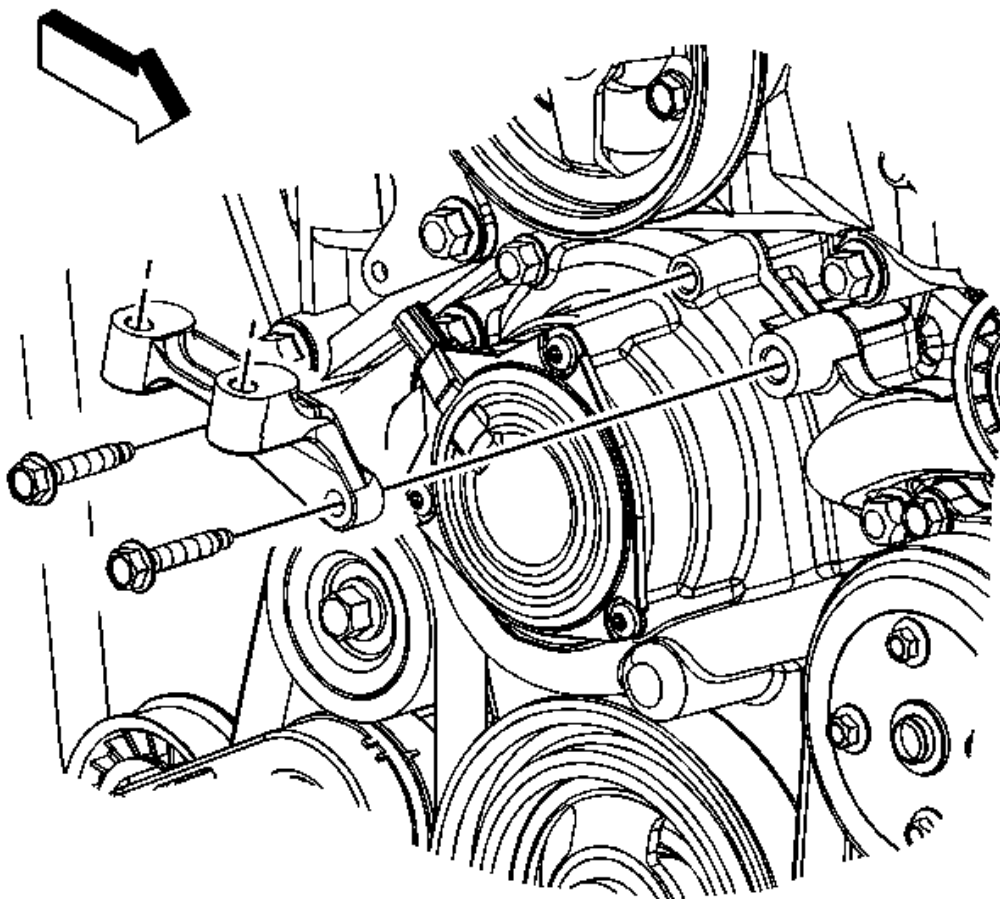


Fig. 31: Engine Mount Snubber Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

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.

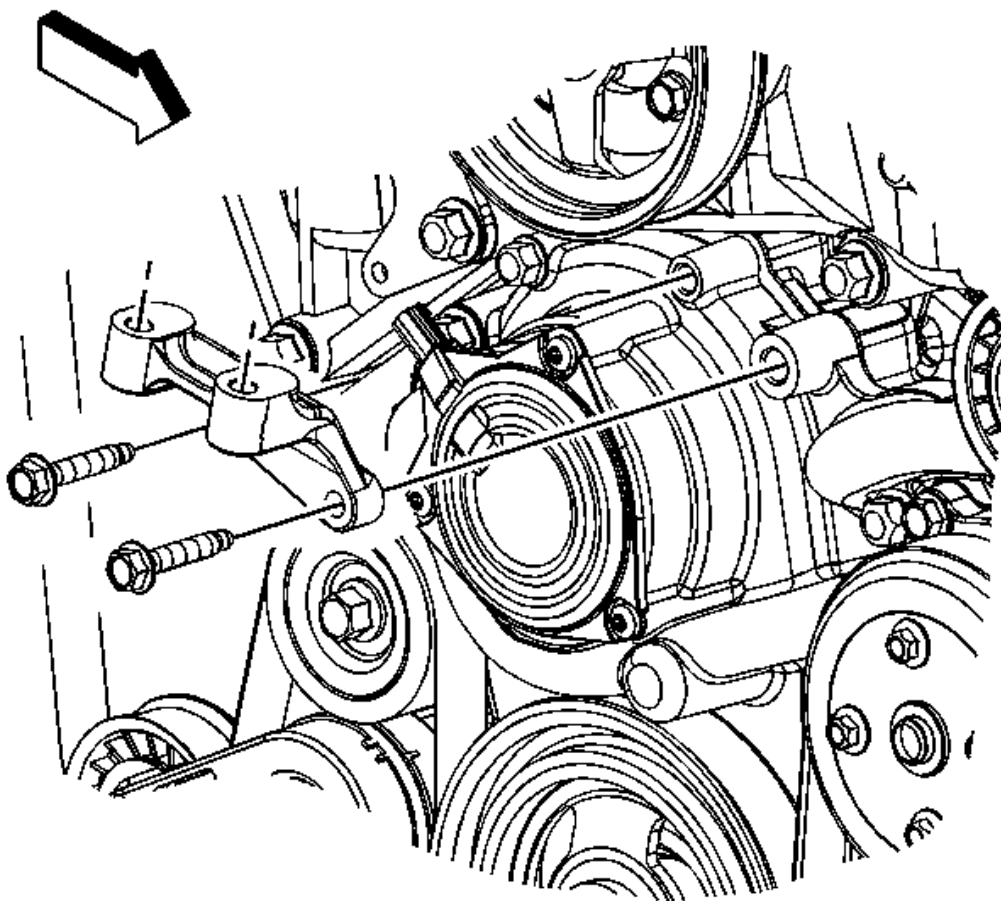
INSTALLATION PROCEDURE

Fig. 32: Engine Mount Snubber Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Position the engine mount snubber bracket to the engine.
2. Install the engine mount snubber bracket to engine bolts and tighten to 25 N.m (18 lb ft).
3. Install the engine mount snubber. Refer to Engine Mount Snubber Replacement.

OIL FILTER ADAPTER AND BYPASS VALVE ASSEMBLY REPLACEMENT

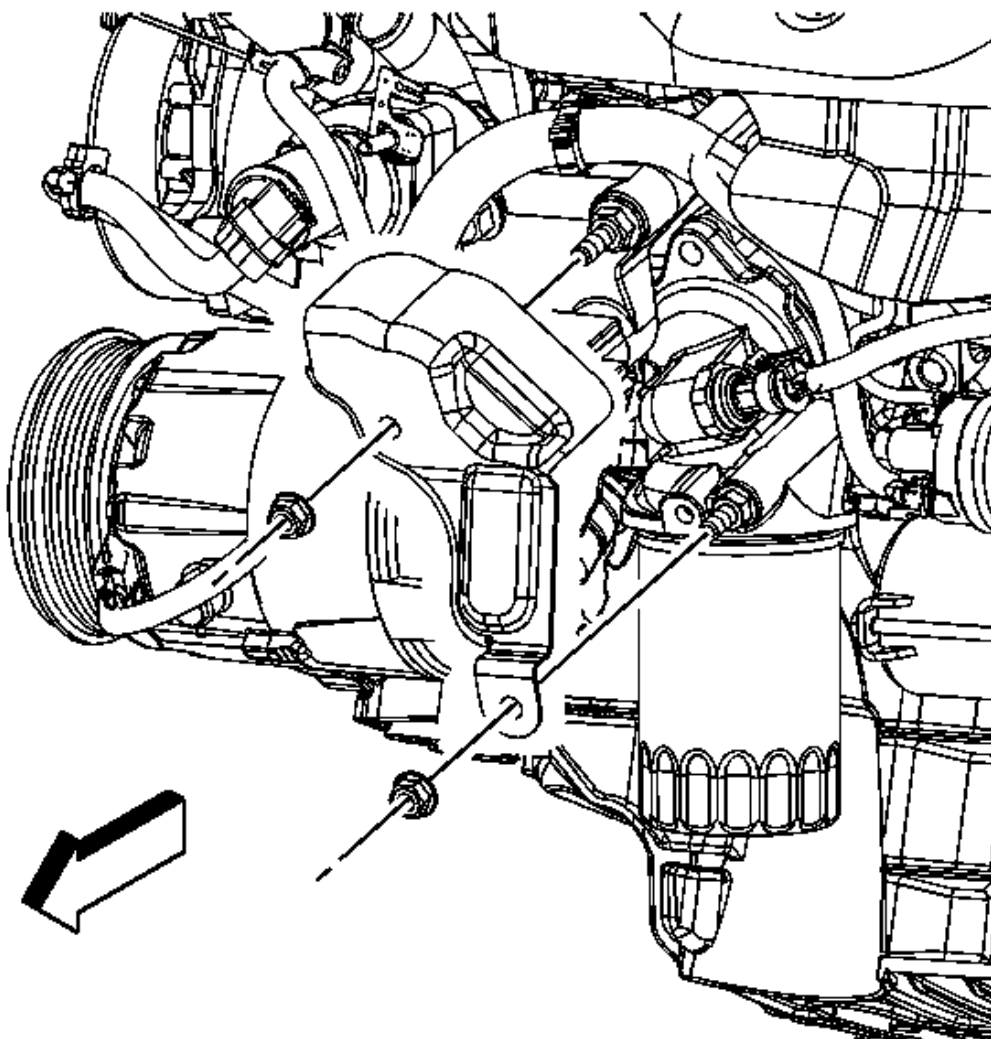
REMOVAL PROCEDURE

Fig. 33: 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.

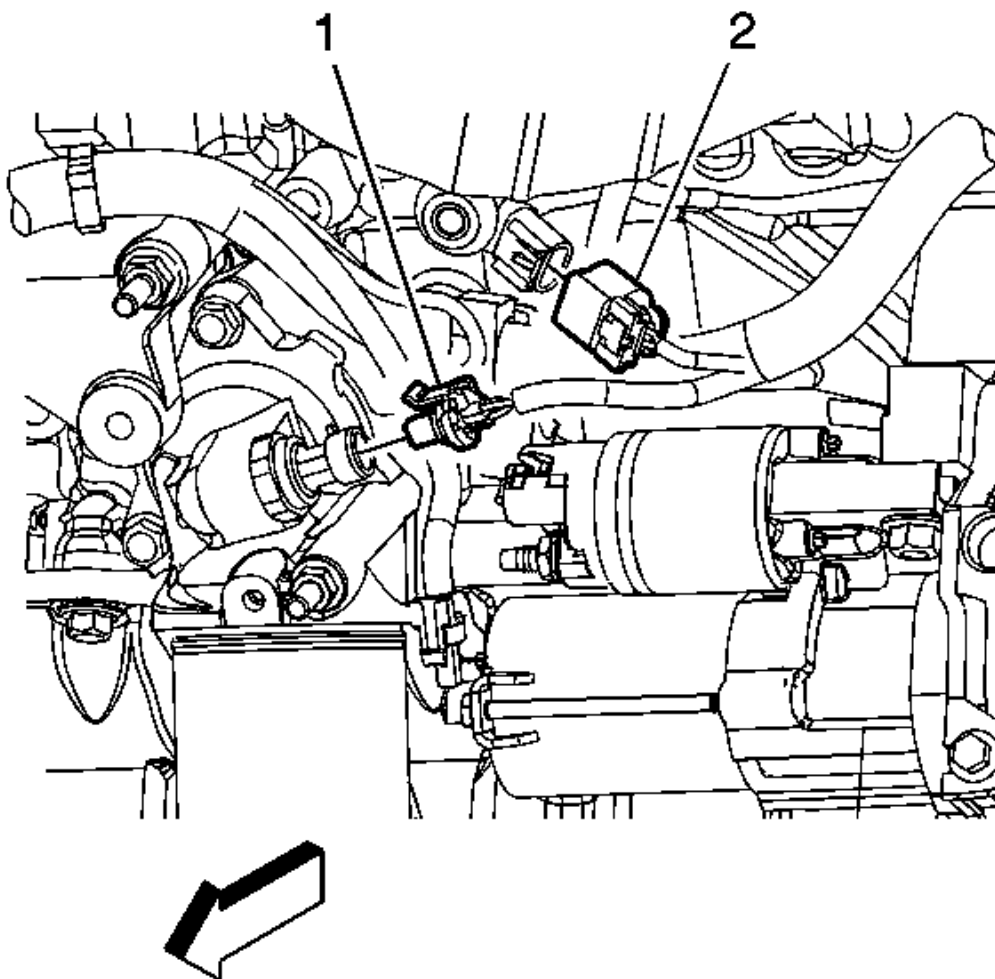


Fig. 34: Knock Sensor & Oil Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

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

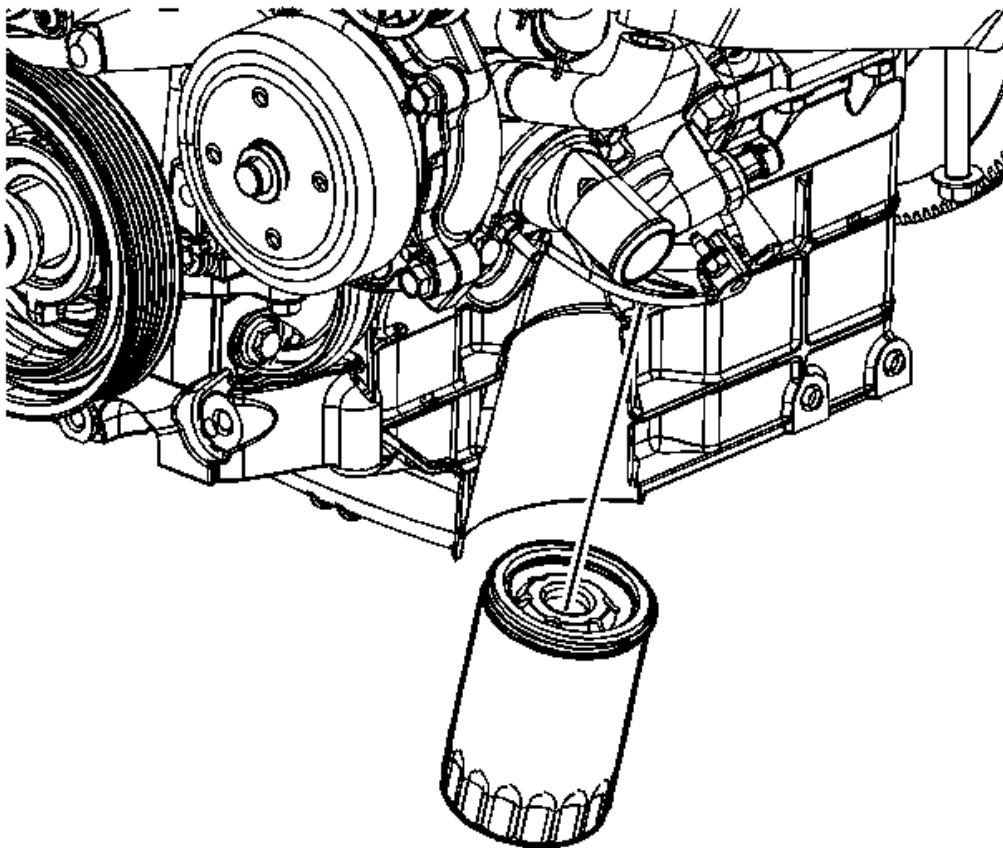


Fig. 35: Oil Filter

Courtesy of GENERAL MOTORS CORP.

4. Remove the oil filter.

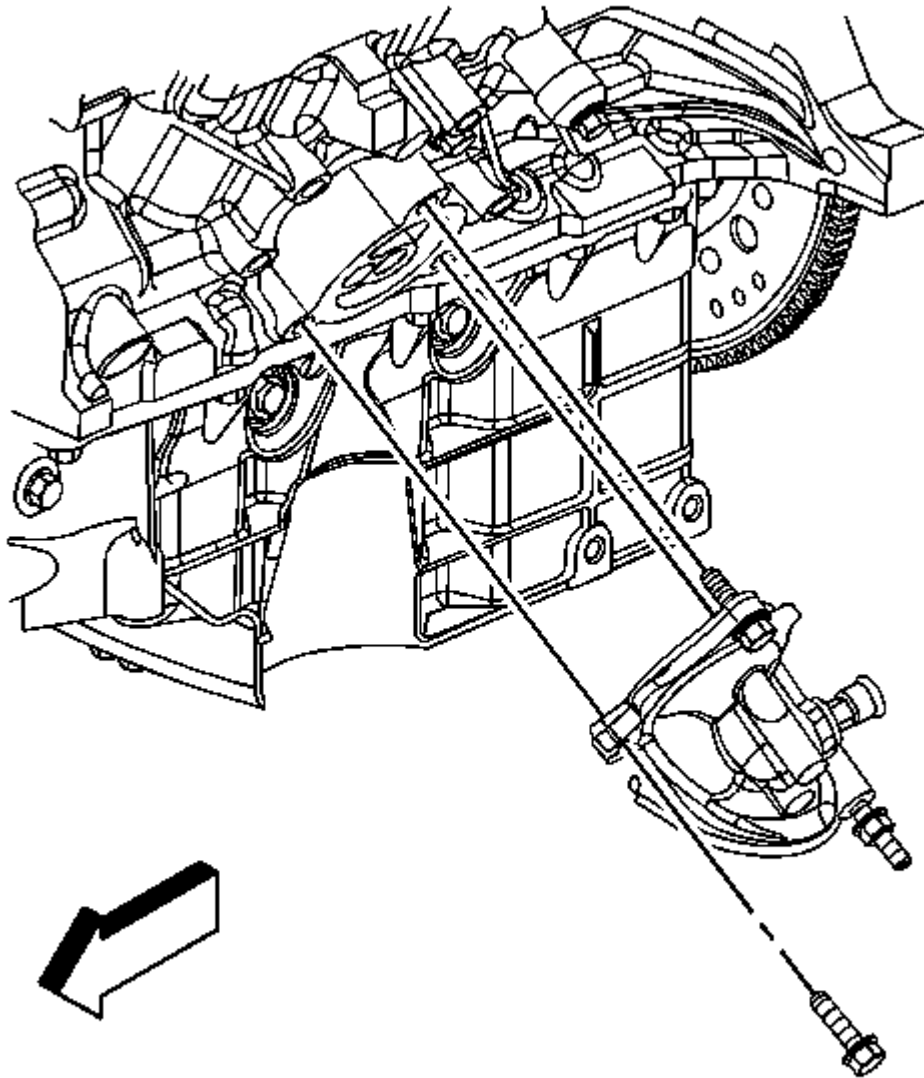


Fig. 36: Oil Filter Adapter, Bolts & Stud
Courtesy of GENERAL MOTORS CORP.

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

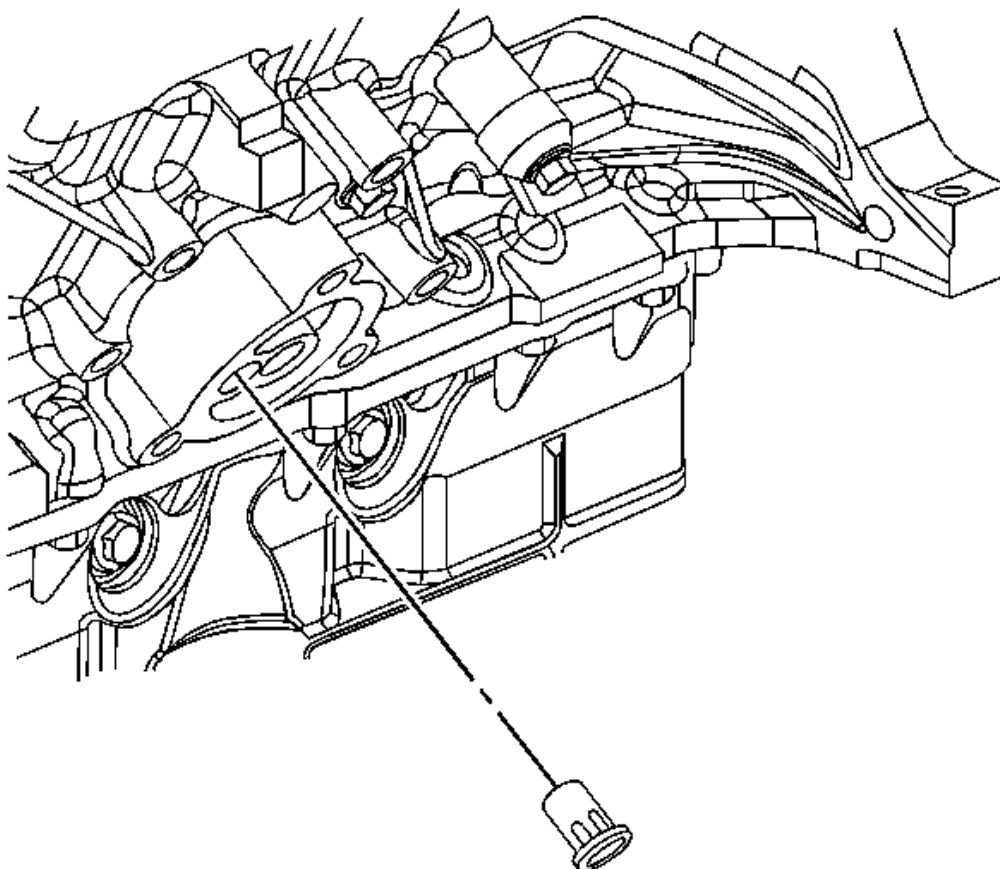


Fig. 37: Oil Filter Bypass Valve
Courtesy of GENERAL MOTORS CORP.

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

INSTALLATION PROCEDURE

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

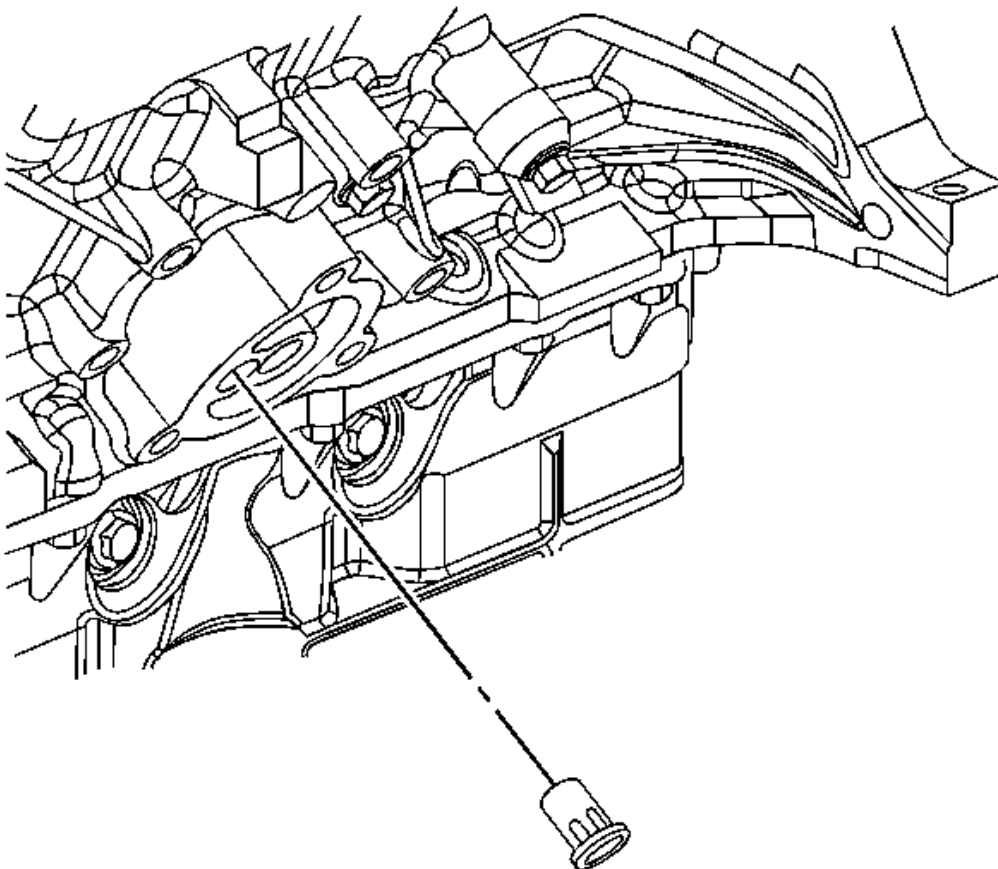


Fig. 38: Oil Filter Bypass Valve
Courtesy of GENERAL MOTORS CORP.

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

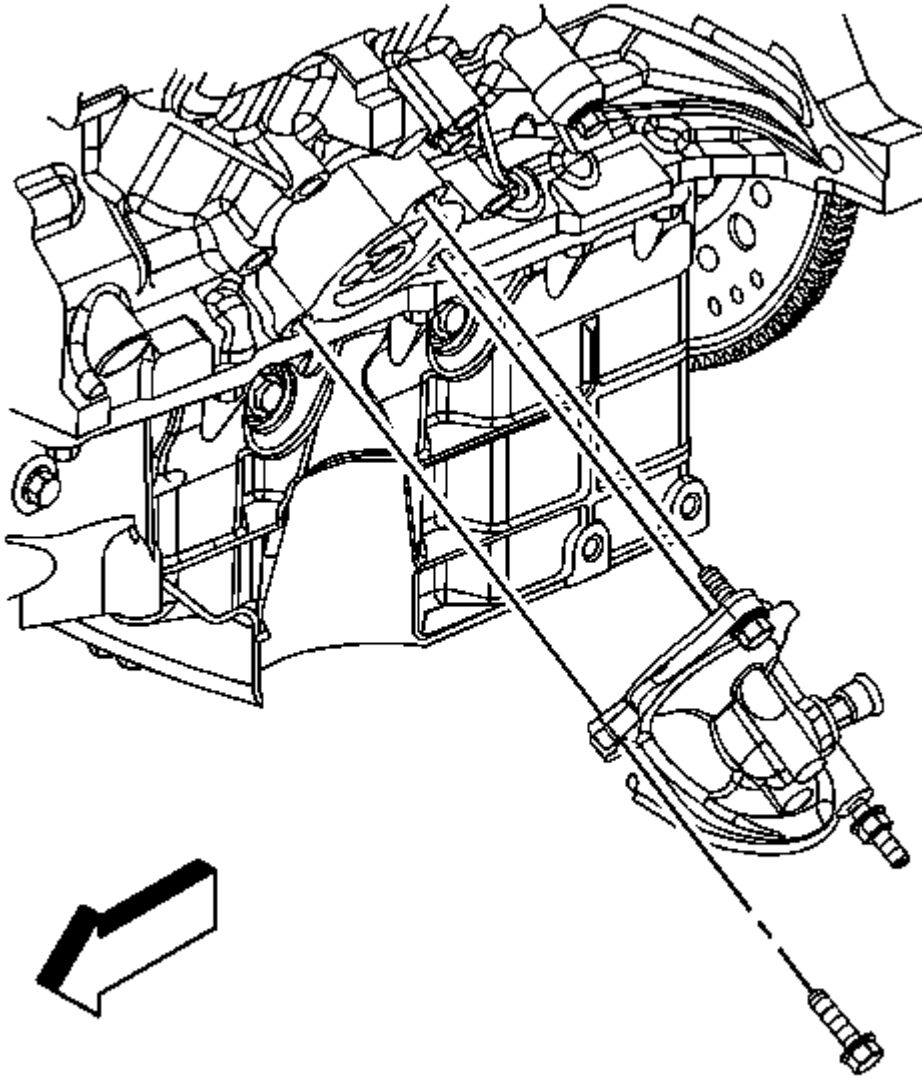


Fig. 39: Oil Filter Adapter, Bolts & Stud
Courtesy of GENERAL MOTORS CORP.

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** for the correct part number.

CAUTION: Refer to Fastener Caution .

4. Install the oil filter adapter bolts and stud.

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

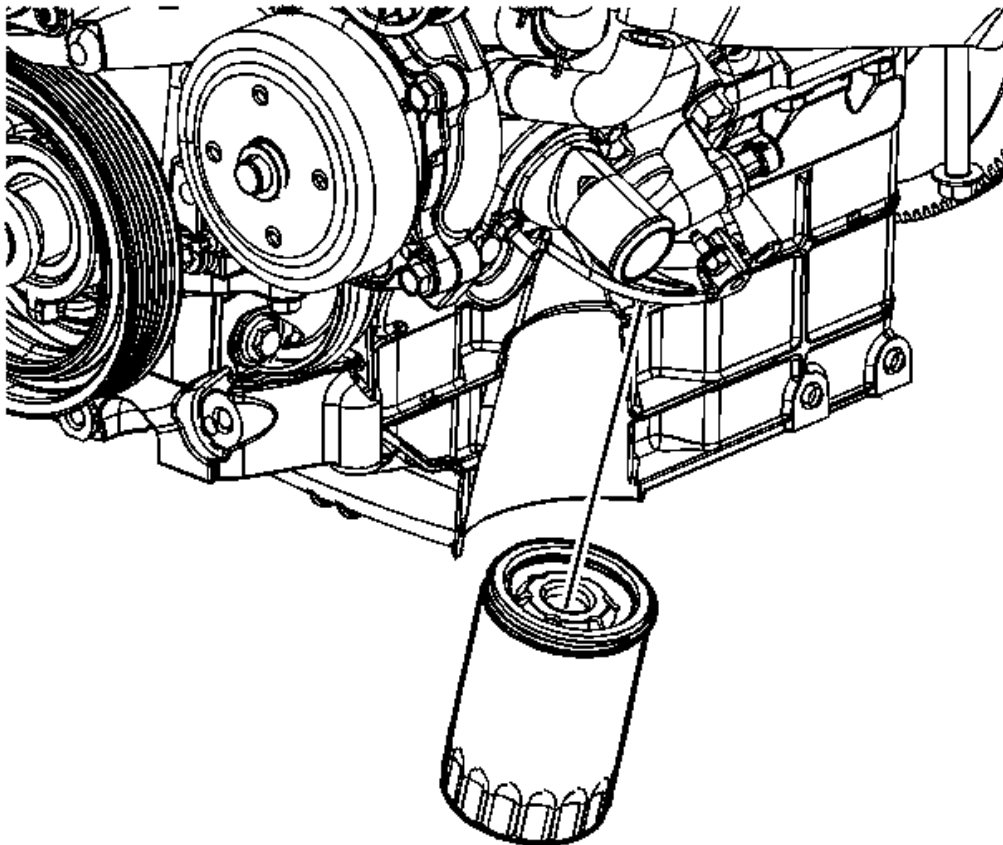


Fig. 40: Oil Filter

Courtesy of GENERAL MOTORS CORP.

5. Install the oil filter.

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

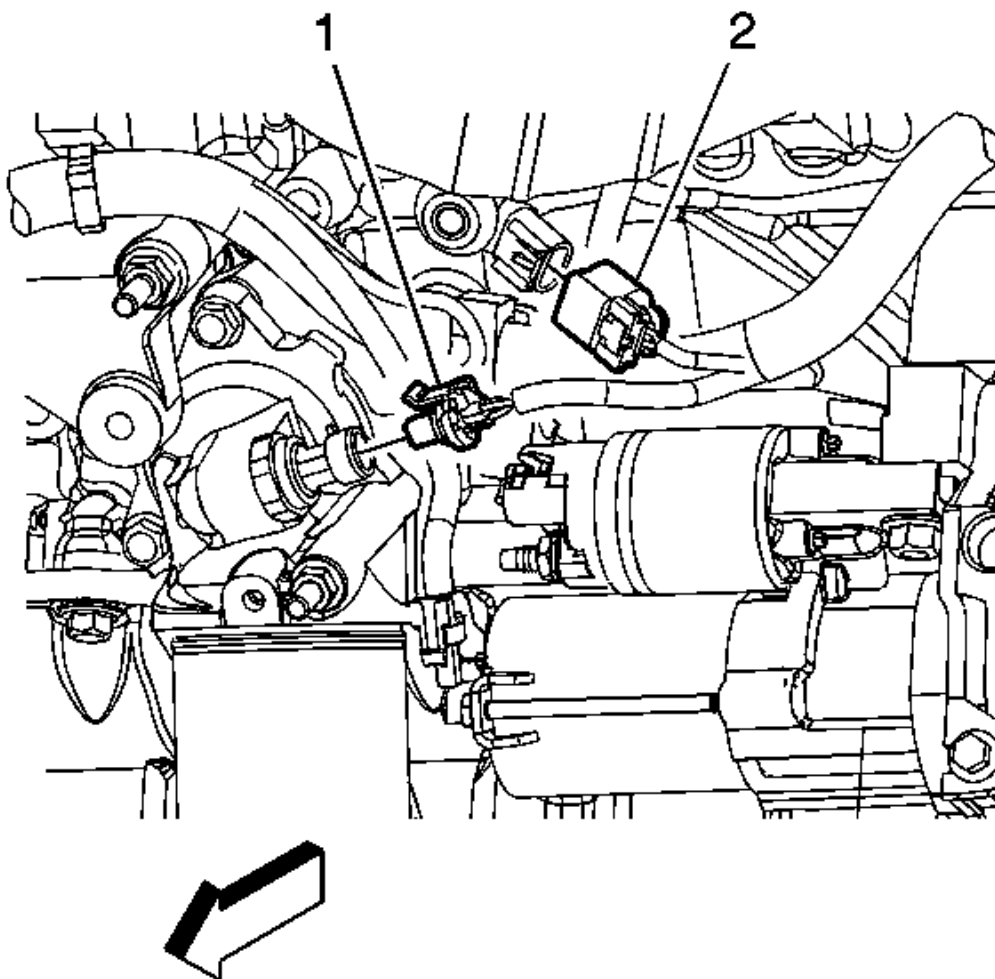


Fig. 41: Knock Sensor & Oil Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

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

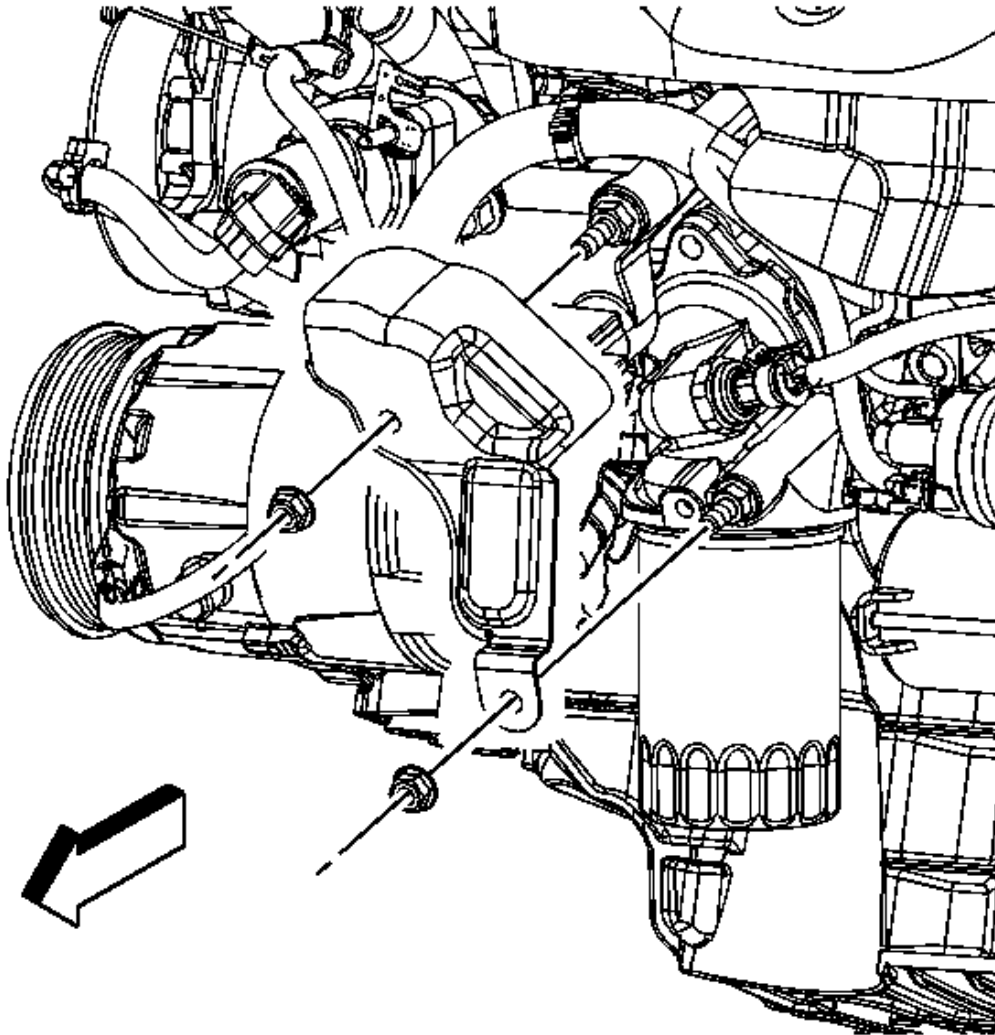


Fig. 42: Oil Pressure Heat Shield & Bolts
 Courtesy of GENERAL MOTORS CORP.

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

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

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

ENGINE OIL COOLER REPLACEMENT

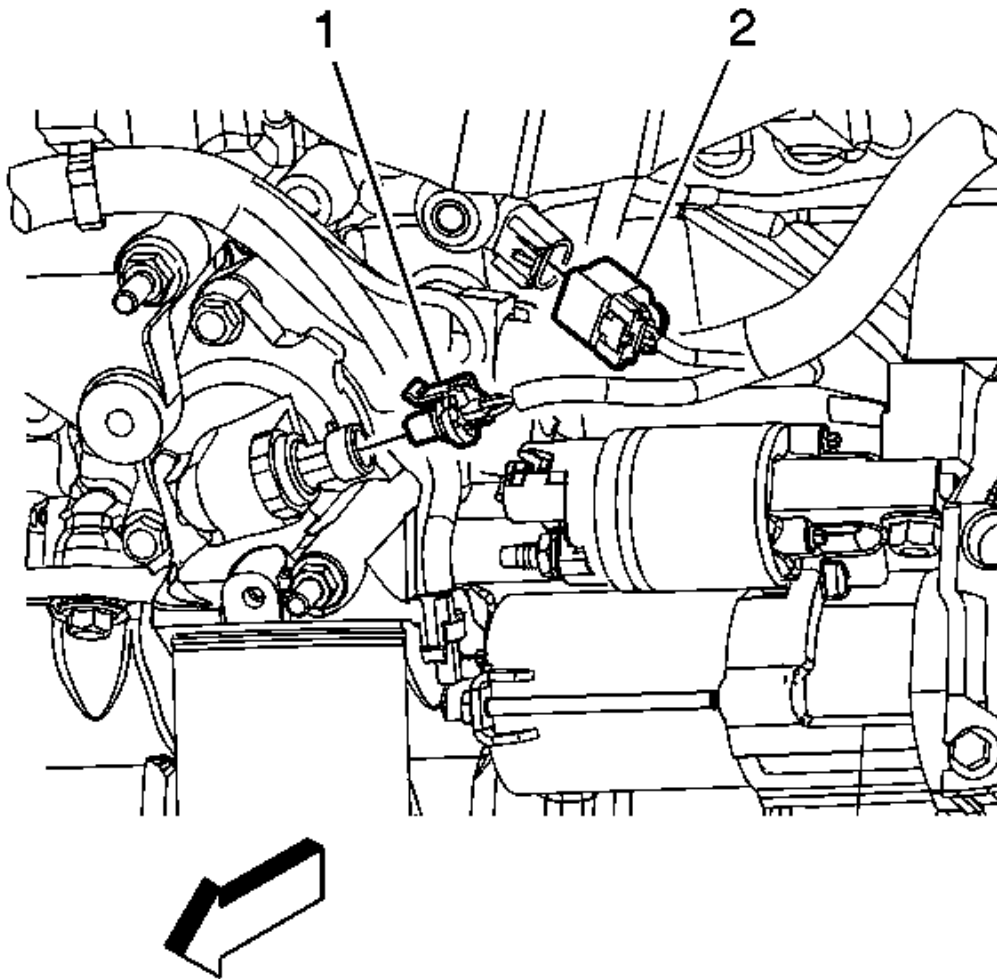
REMOVAL PROCEDURE

Fig. 43: Knock Sensor & Oil Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to **Cooling System Draining and Filling (GE 47716 Fill)** or **Cooling System Draining and Filling (LY7, LZE, LZ4, LZ9)** .
2. Disconnect the oil pressure sensor electrical connector (1).

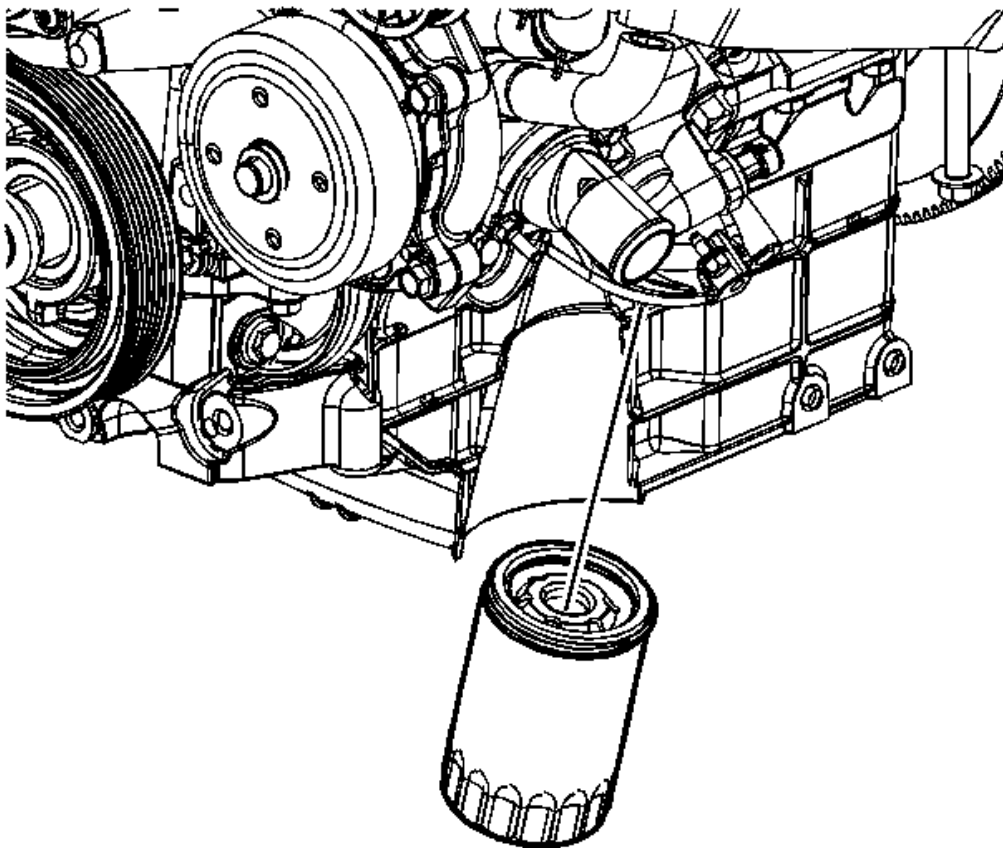


Fig. 44: Oil Filter

Courtesy of GENERAL MOTORS CORP.

3. Remove the oil filter.

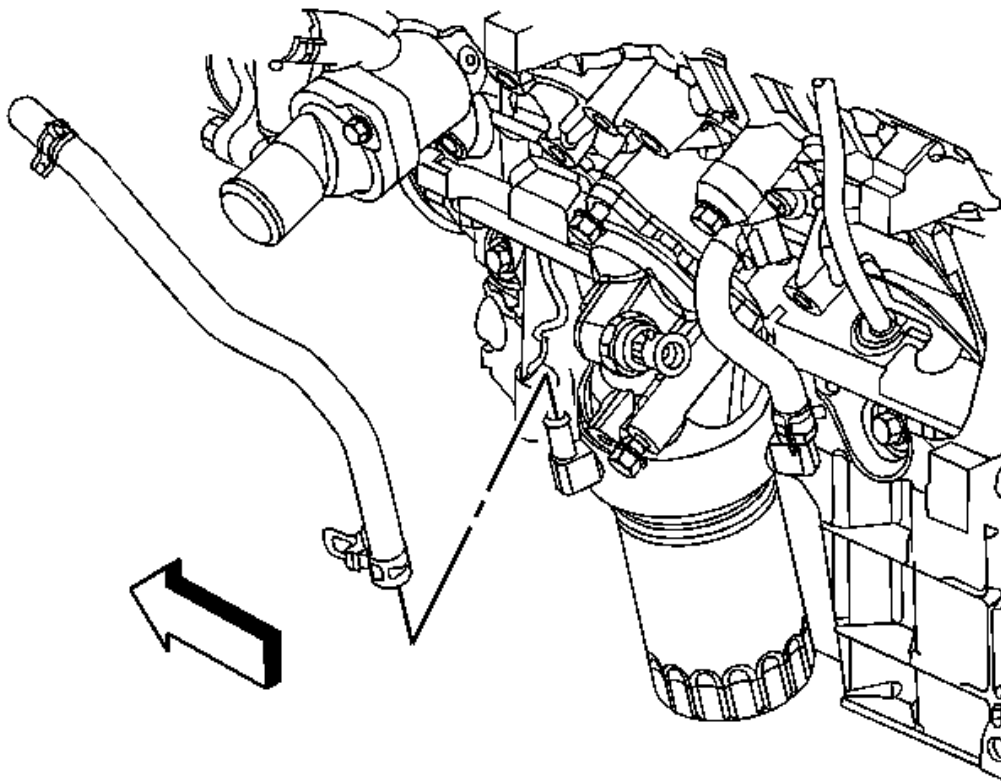


Fig. 45: Oil Cooler Outlet Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

4. Reposition the oil cooler outlet hose clamp at the oil cooler.
5. Remove the oil cooler outlet hose from the oil cooler fitting.

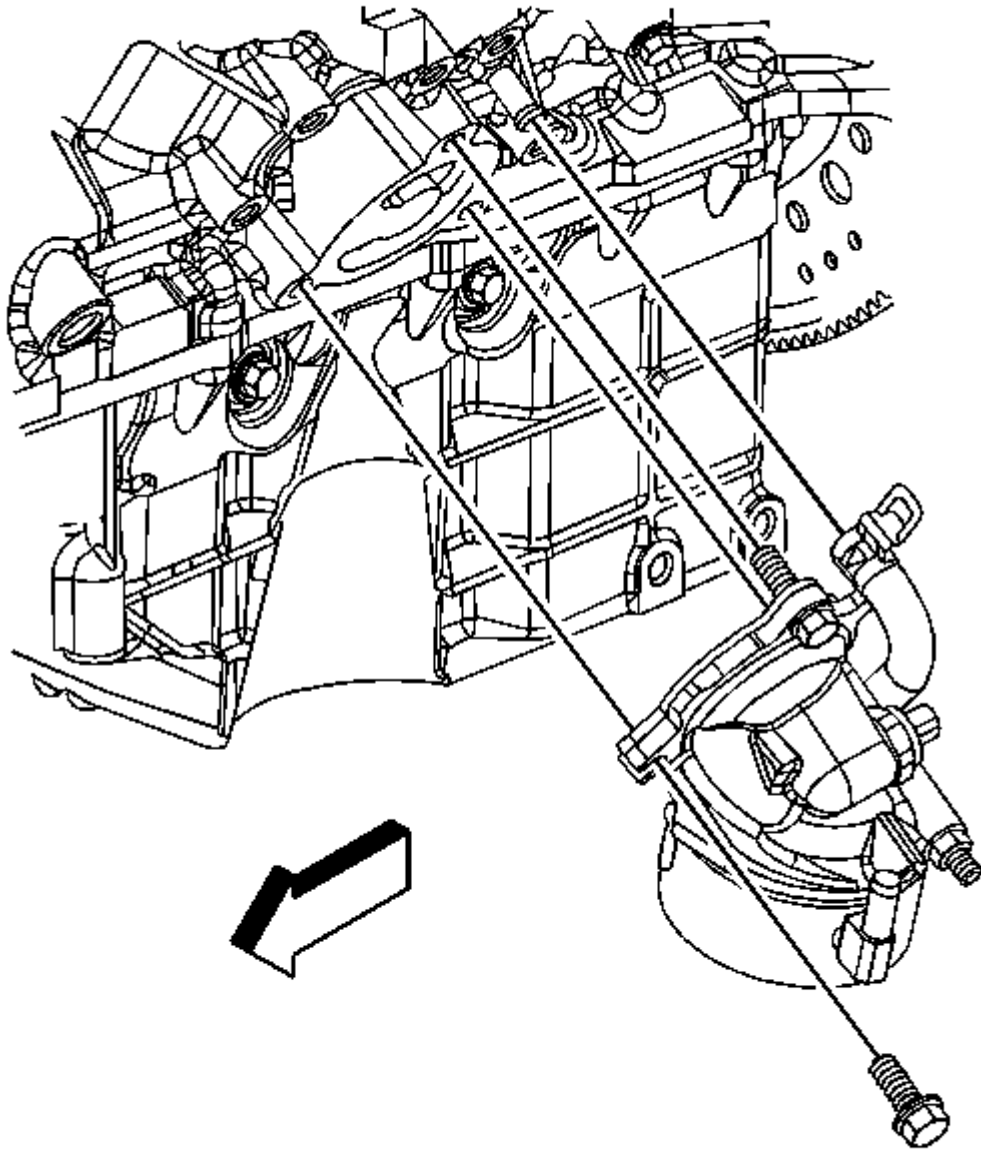


Fig. 46: Oil Cooler Inlet Hose & Stud
Courtesy of GENERAL MOTORS CORP.

6. Reposition the oil cooler inlet hose at the engine.
7. Remove the oil cooler inlet hose from the engine fitting.
8. Remove the oil cooler bolts and stud.
9. Remove the oil cooler and gasket.

INSTALLATION PROCEDURE

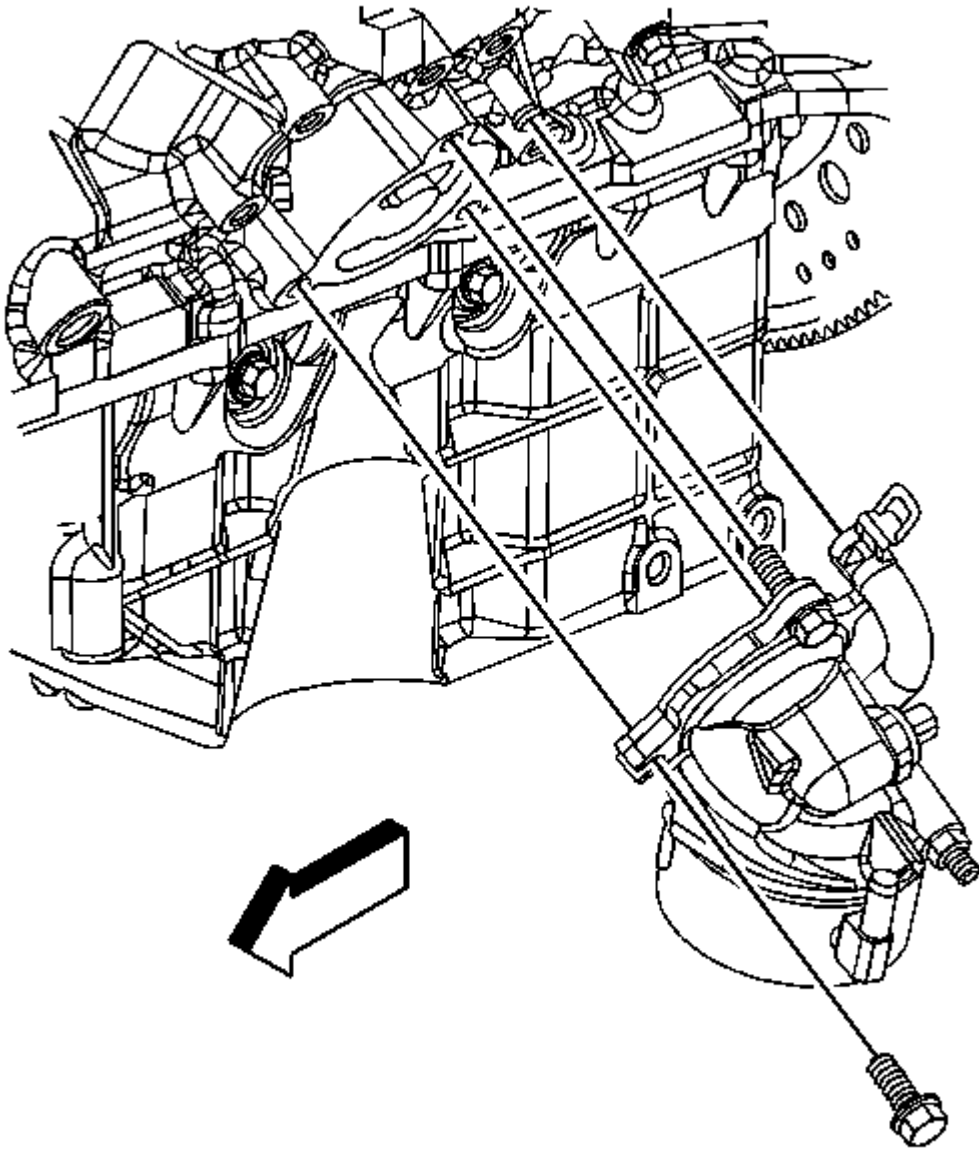


Fig. 47: Oil Cooler Inlet Hose & Stud
Courtesy of GENERAL MOTORS CORP.

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.

1. Apply threadlock to the bolt/stud threads, if required. Refer to **Adhesives, Fluids, Lubricants, and Sealers** for the correct part number.
2. Position the oil cooler and gasket to the engine.

CAUTION: Refer to Fastener Caution .

3. Install the oil cooler bolts and stud.

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

4. Install the oil cooler inlet hose to the engine fitting.
5. Position the oil cooler inlet hose at the engine.

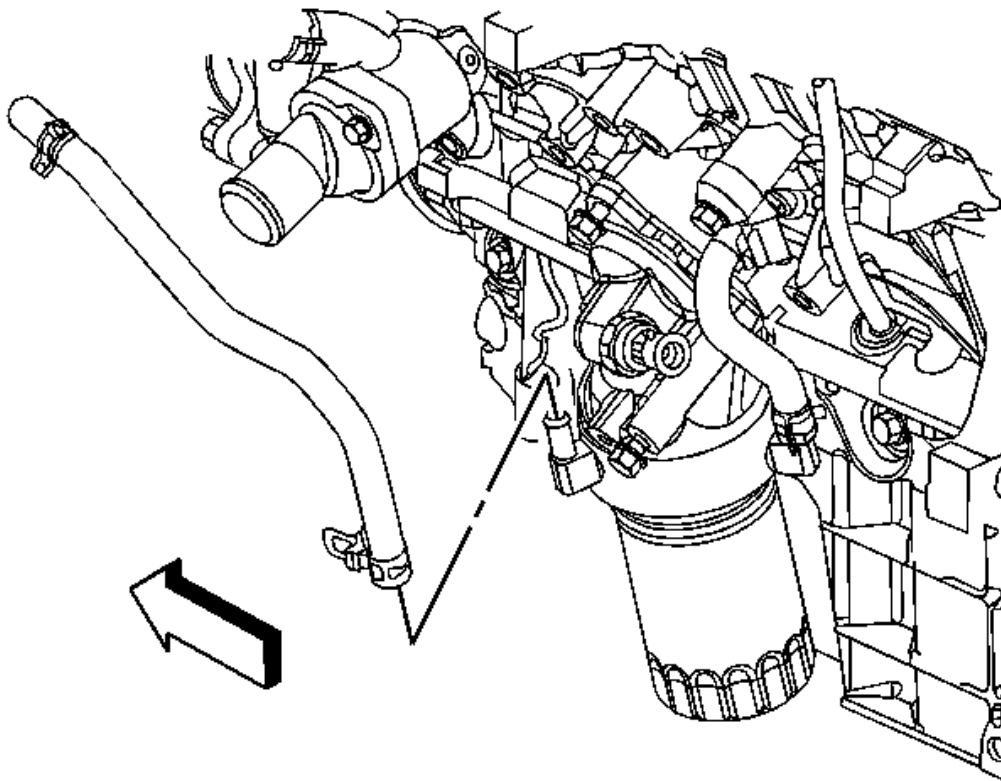


Fig. 48: Oil Cooler Outlet Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

6. Install the oil cooler outlet hose to the oil cooler fitting.
7. Position the oil cooler outlet hose clamp at the oil cooler.

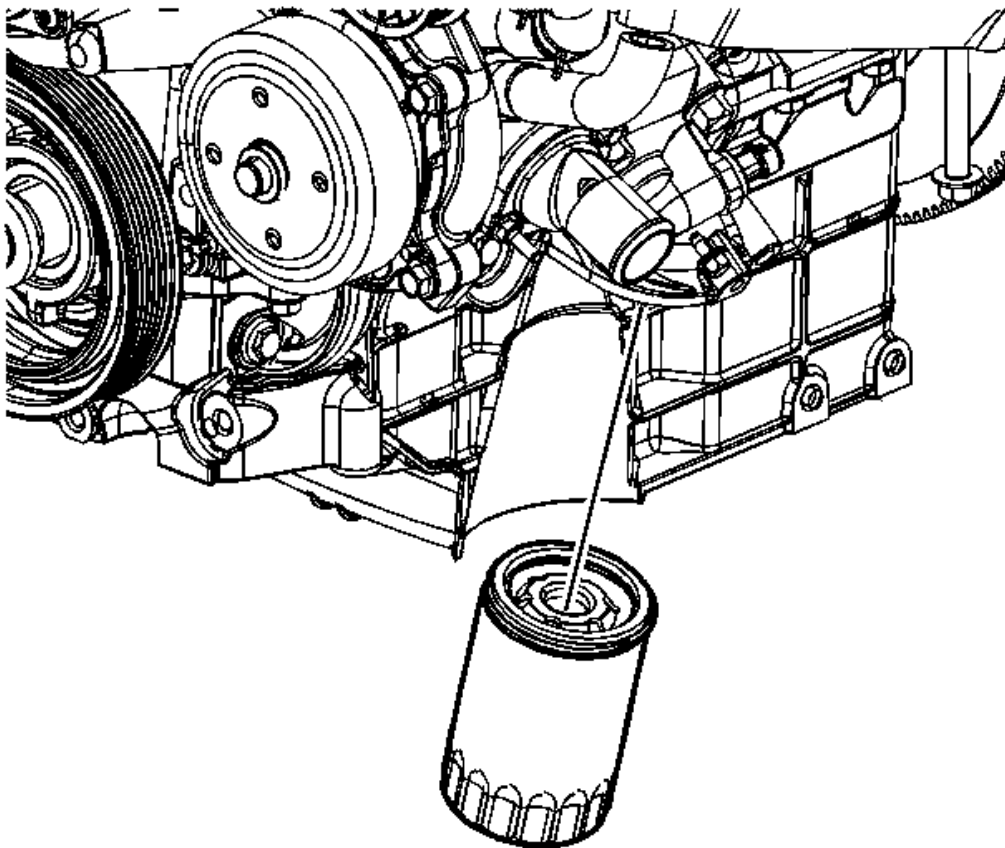


Fig. 49: Oil Filter

Courtesy of GENERAL MOTORS CORP.

8. Install the oil filter.

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

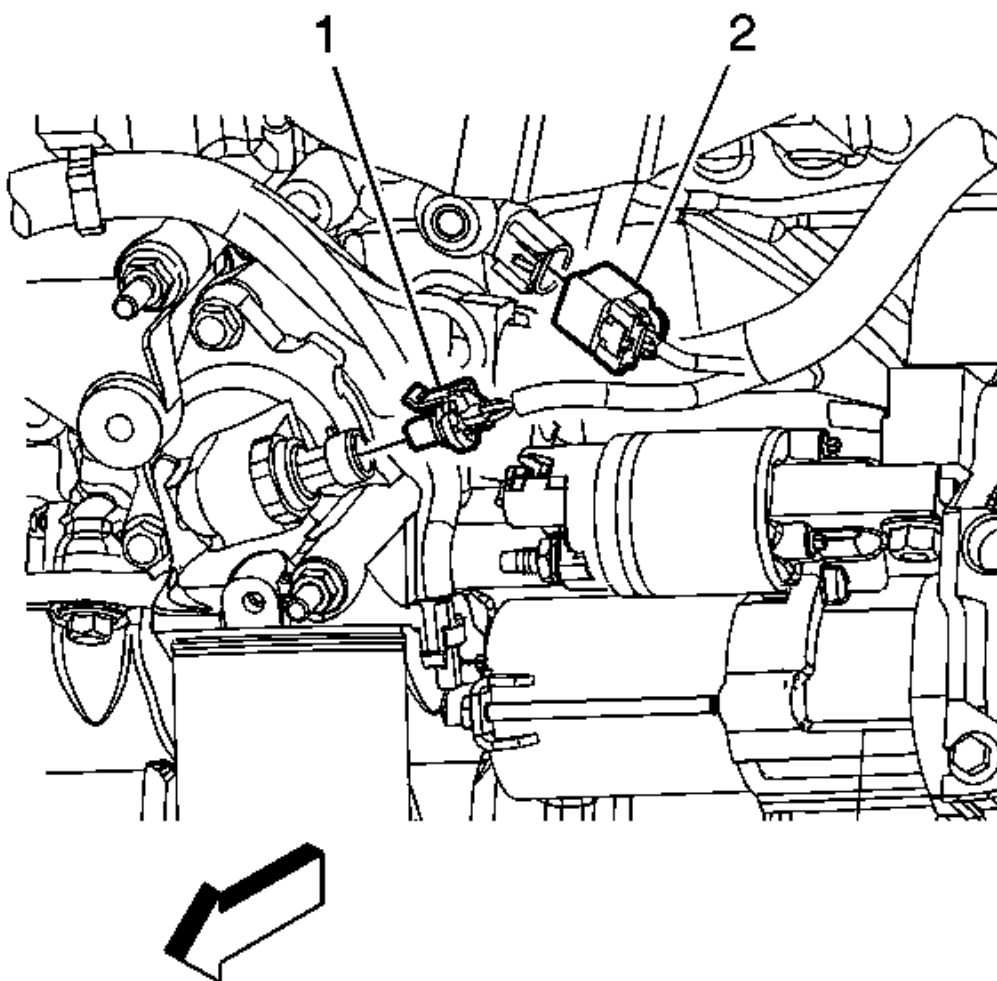


Fig. 50: Knock Sensor & Oil Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

9. Disconnect the oil pressure sensor electrical connector (1).
10. Fill the cooling system. Refer to Cooling System Draining and Filling (GE 47716 Fill) or Cooling System Draining and Filling (LY7, LZE, LZ4, LZ9).
11. Check and fill the crankcase, if necessary.

OIL LEVEL INDICATOR TUBE REPLACEMENT

REMOVAL PROCEDURE

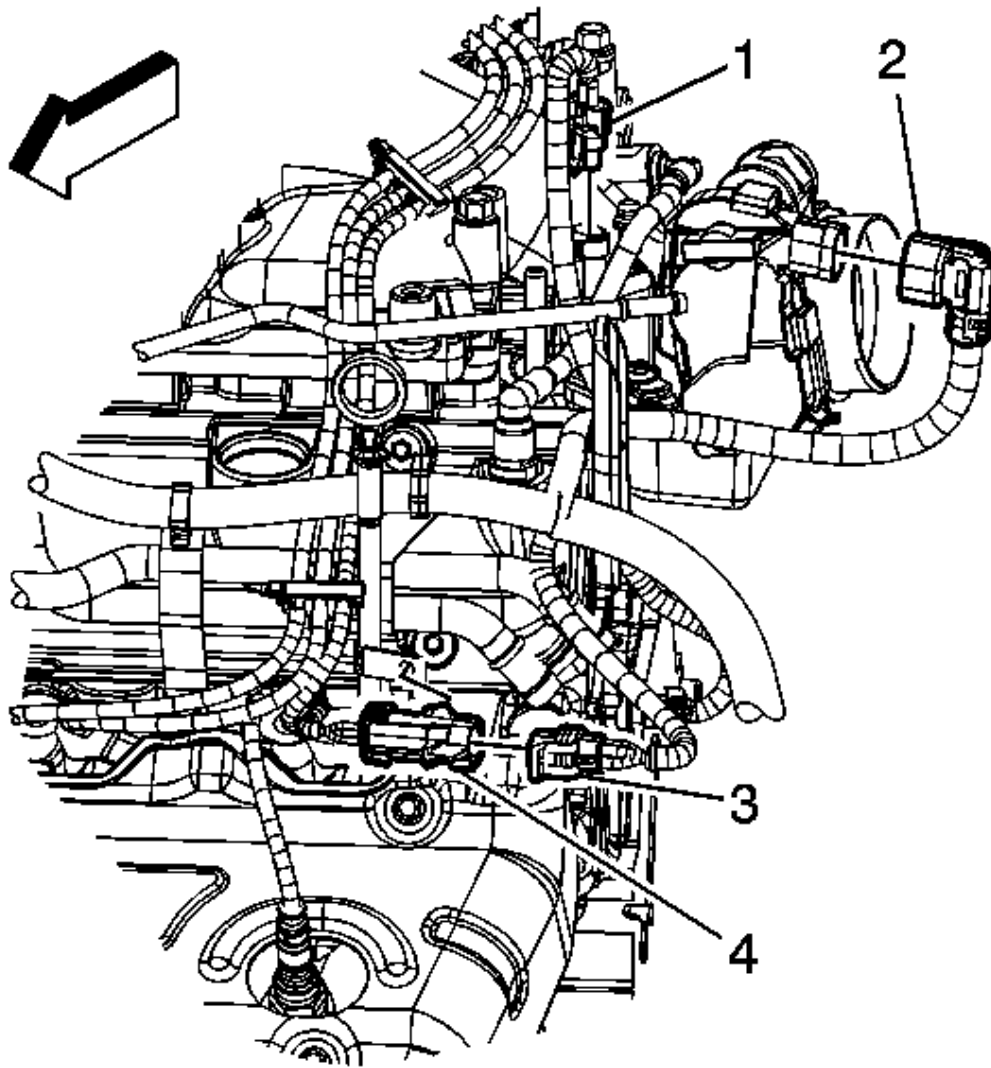


Fig. 51: EVAP Canister Purge Solenoid, ETC & HO2S Connectors
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug wire from the number 6 cylinder spark plug.
2. Remove the heated oxygen sensor (HO2S) clip (3) from the fill tube bracket.

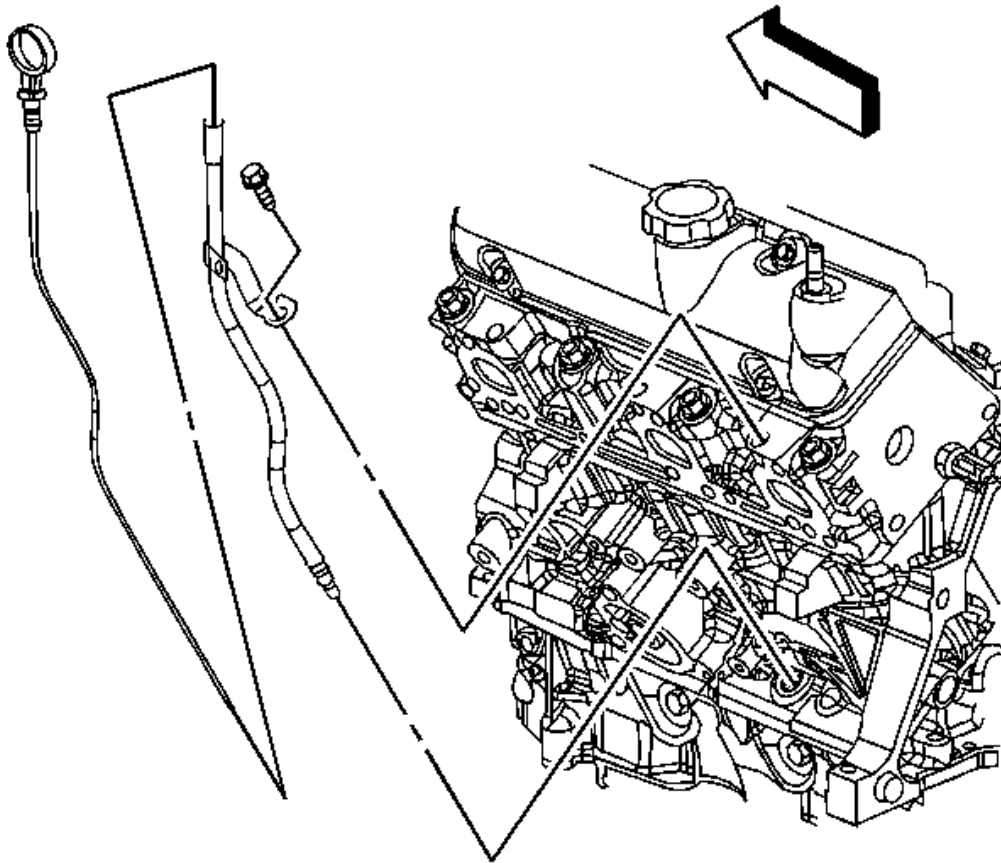


Fig. 52: Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

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

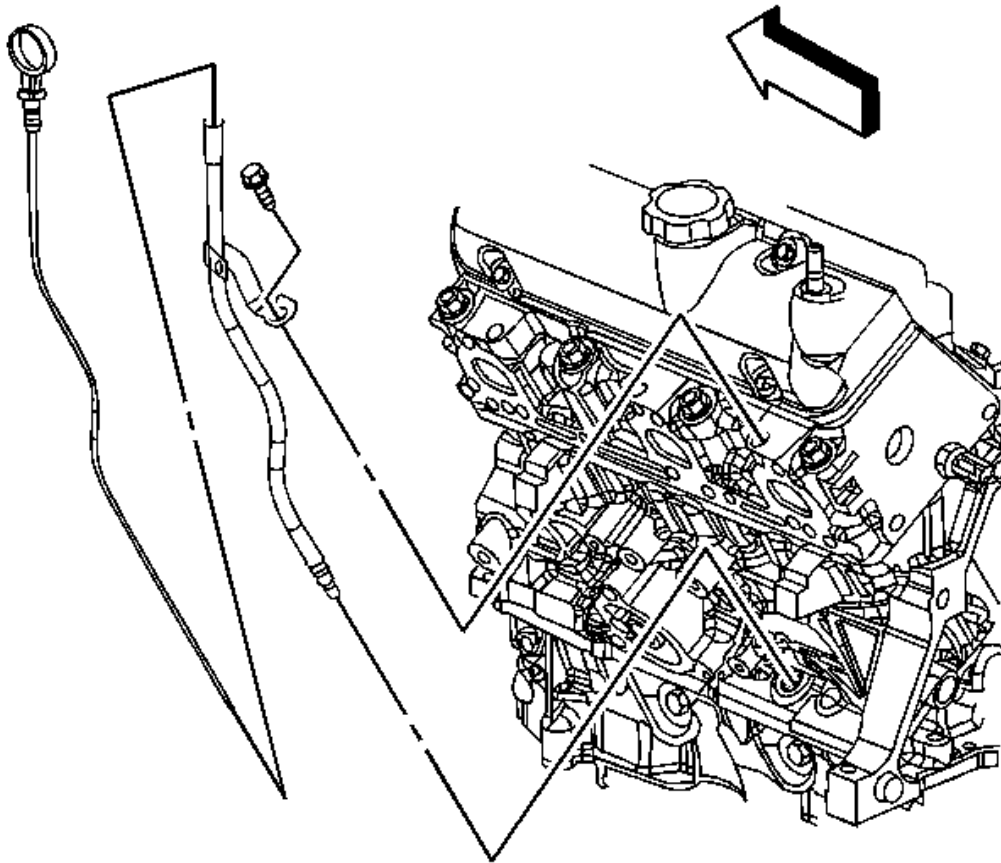


Fig. 53: Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

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.

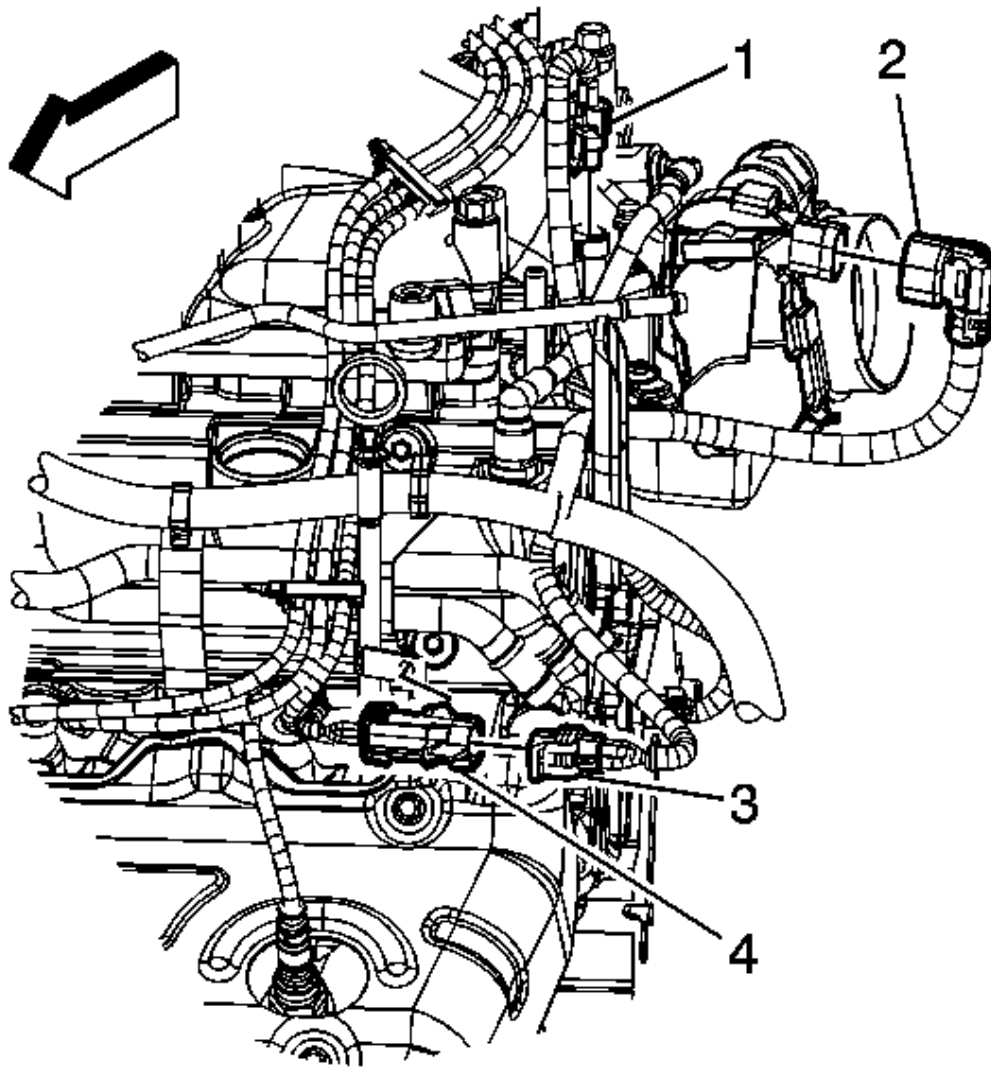


Fig. 54: EVAP Canister Purge Solenoid, ETC & HO2S Connectors
Courtesy of GENERAL MOTORS CORP.

5. Install the HO2S clip (3) to the fill tube bracket.
6. Install the spark plug wire to the number 6 cylinder spark plug.

UPPER INTAKE MANIFOLD REPLACEMENT

REMOVAL PROCEDURE

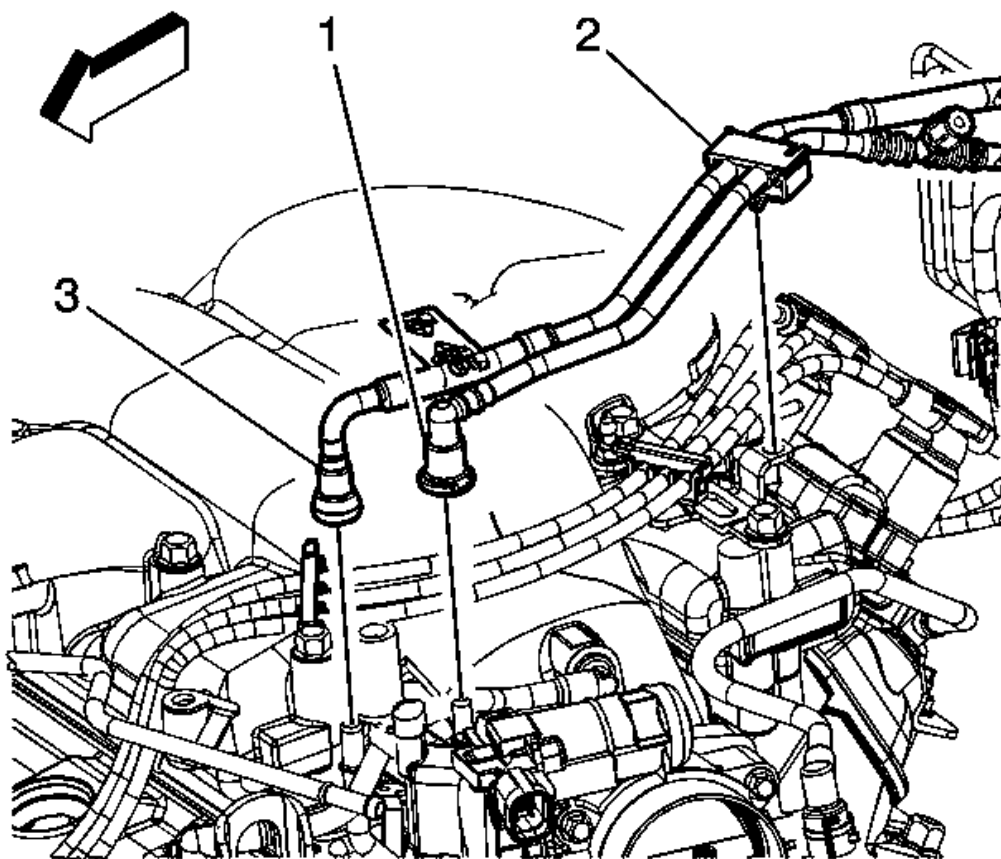


Fig. 55: Fuel Feed/EVAP Pipes

Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
2. Relieve the fuel system pressure. Refer to **Fuel Pressure Relief (With CH 48027)** or **Fuel Pressure Relief (Without CH 48027)**.
3. Disconnect the fuel feed pipe (3) quick connect fitting from the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service**.
4. Disconnect the evaporative (EVAP) emission pipe (1) from the purge solenoid. Refer to **Plastic Collar Quick Connect Fitting Service**.
5. Open the retaining clip (2), and remove the fuel and EVAP pipes from the clip.

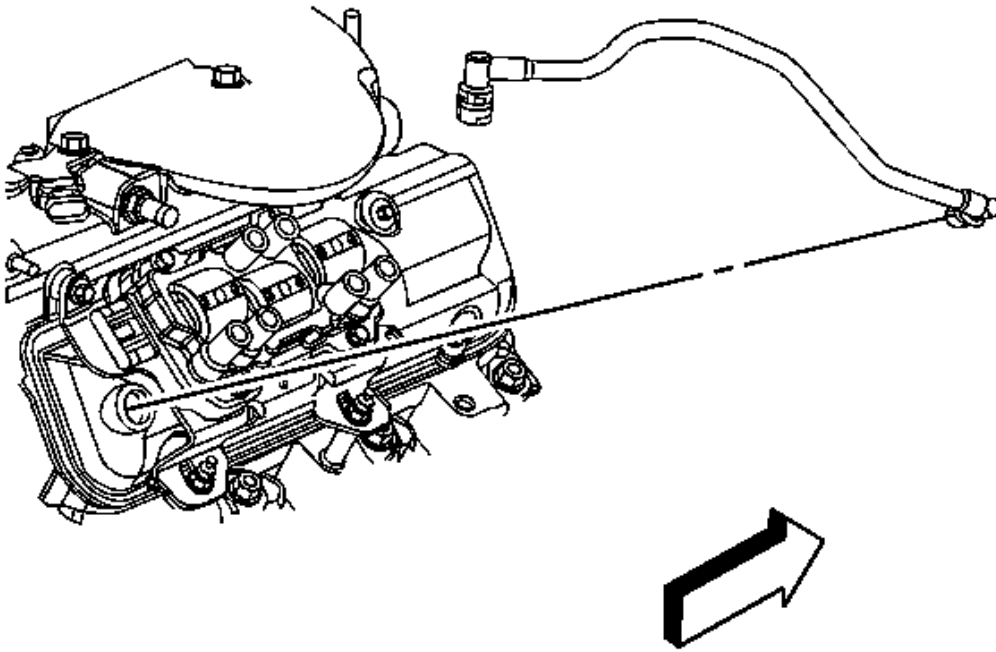


Fig. 56: Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

6. Drain the cooling system. Refer to **Cooling System Draining and Filling (LY7, LZE, LZ4, LZ9)** .
7. Remove the positive crankcase ventilation (PCV) fresh air tube. Refer to **Plastic Collar Quick Connect Fitting Service** .

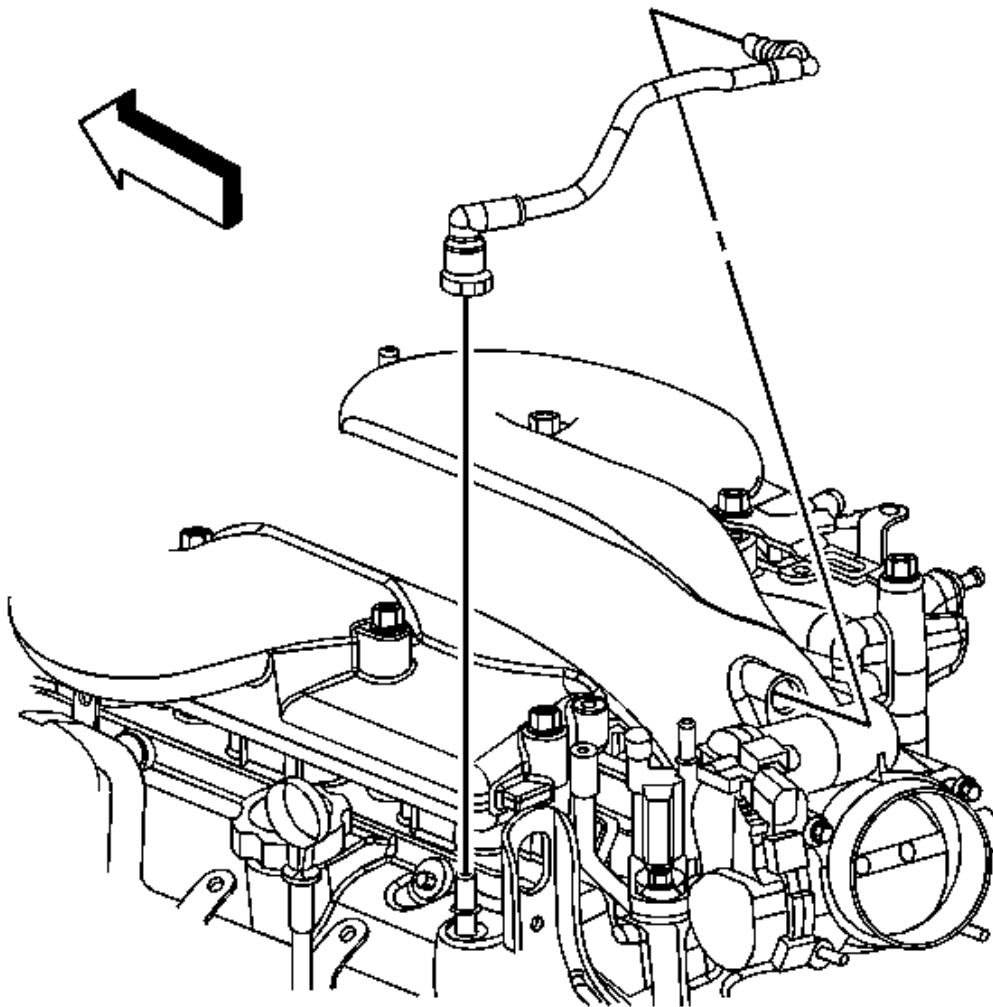


Fig. 57: Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

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

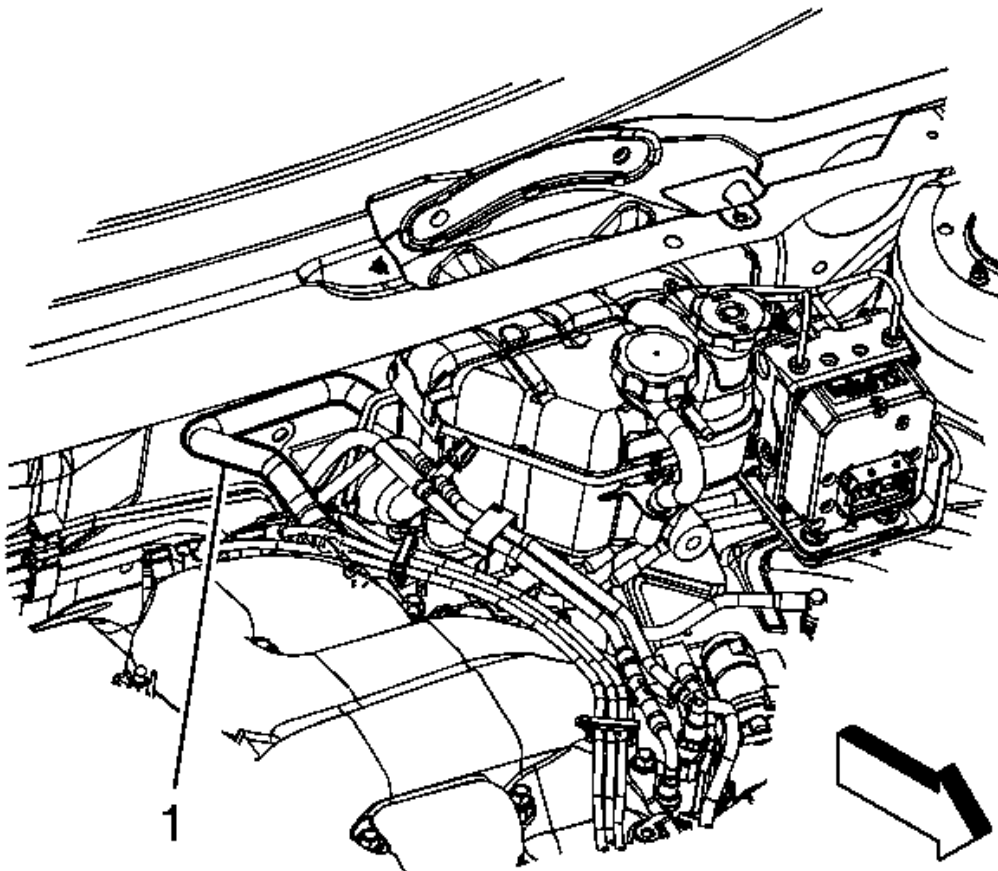


Fig. 58: Brake Booster Vacuum Hose To Intake Manifold
Courtesy of GENERAL MOTORS CORP.

9. Reposition the brake booster vacuum hose clamp at the intake manifold.
10. Remove the vacuum hose (1) from the intake manifold.

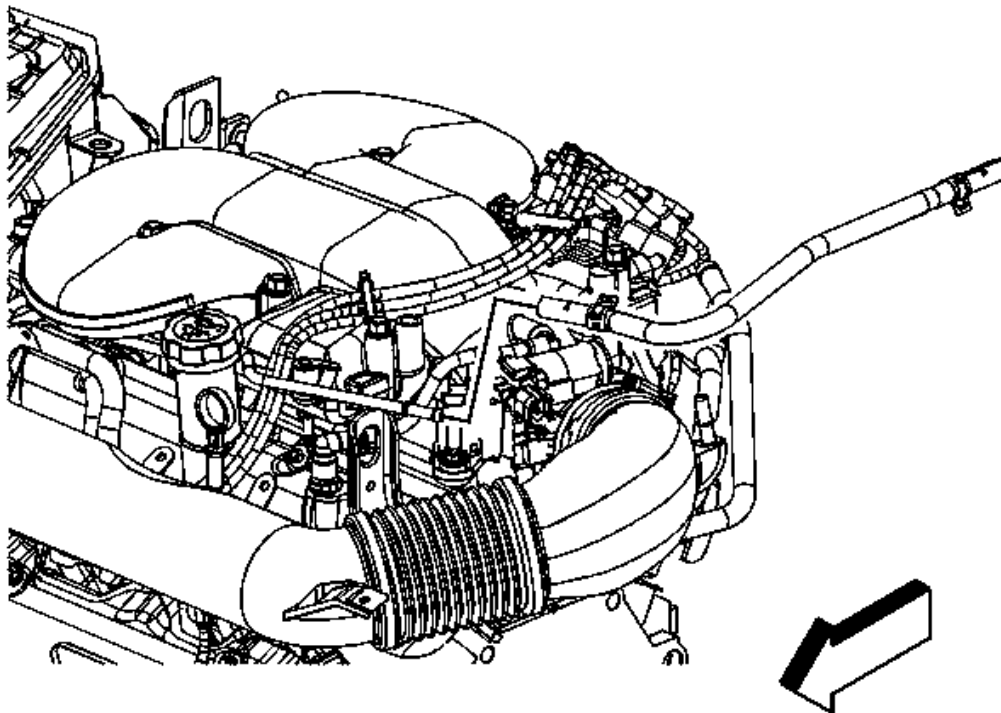


Fig. 59: Radiator Surge Tank Inlet Hose & Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

11. Reposition the radiator surge tank inlet hose clamp.
12. Remove the radiator surge tank inlet hose from the inlet pipe.

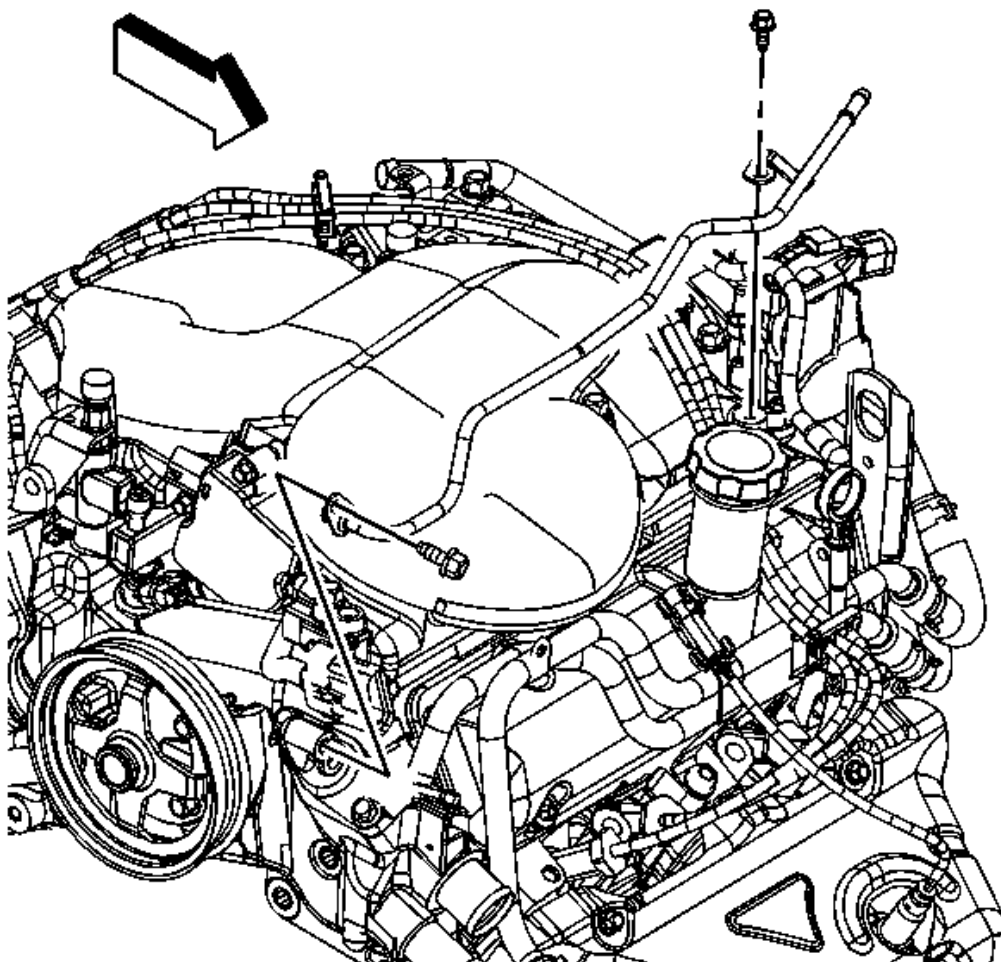


Fig. 60: Identifying Radiator Surge Tank Pipe Bolts
Courtesy of GENERAL MOTORS CORP.

13. Remove the radiator surge tank inlet pipe bolts.
14. Remove the radiator surge tank inlet pipe.

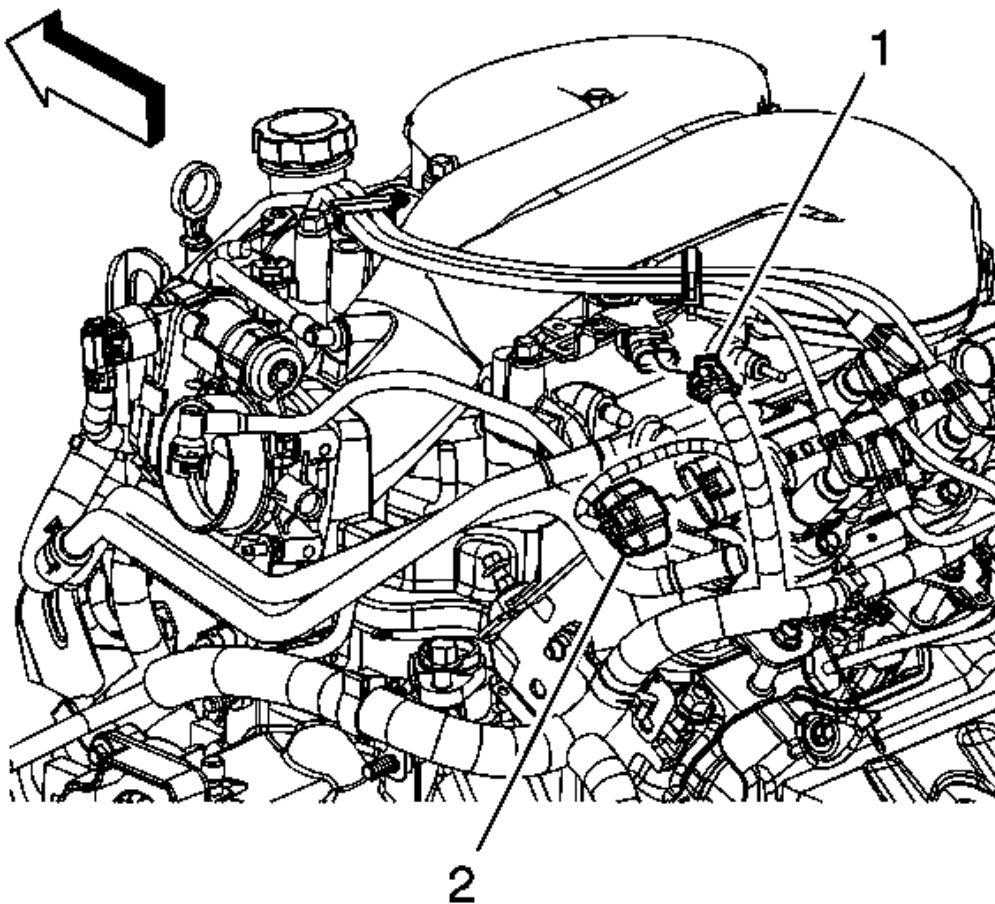


Fig. 61: ECM & MAP Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

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

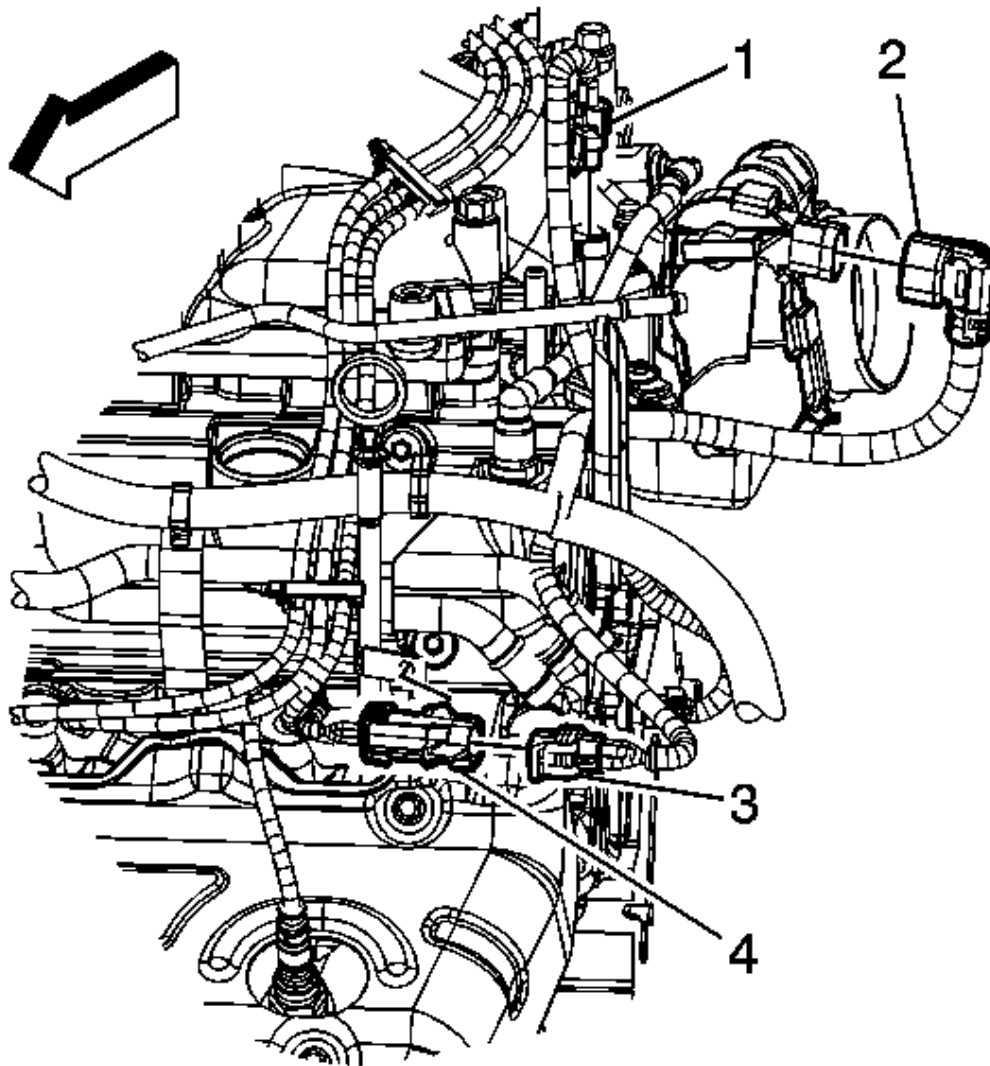


Fig. 62: EVAP Canister Purge Solenoid, ETC & HO2S Connectors
Courtesy of GENERAL MOTORS CORP.

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

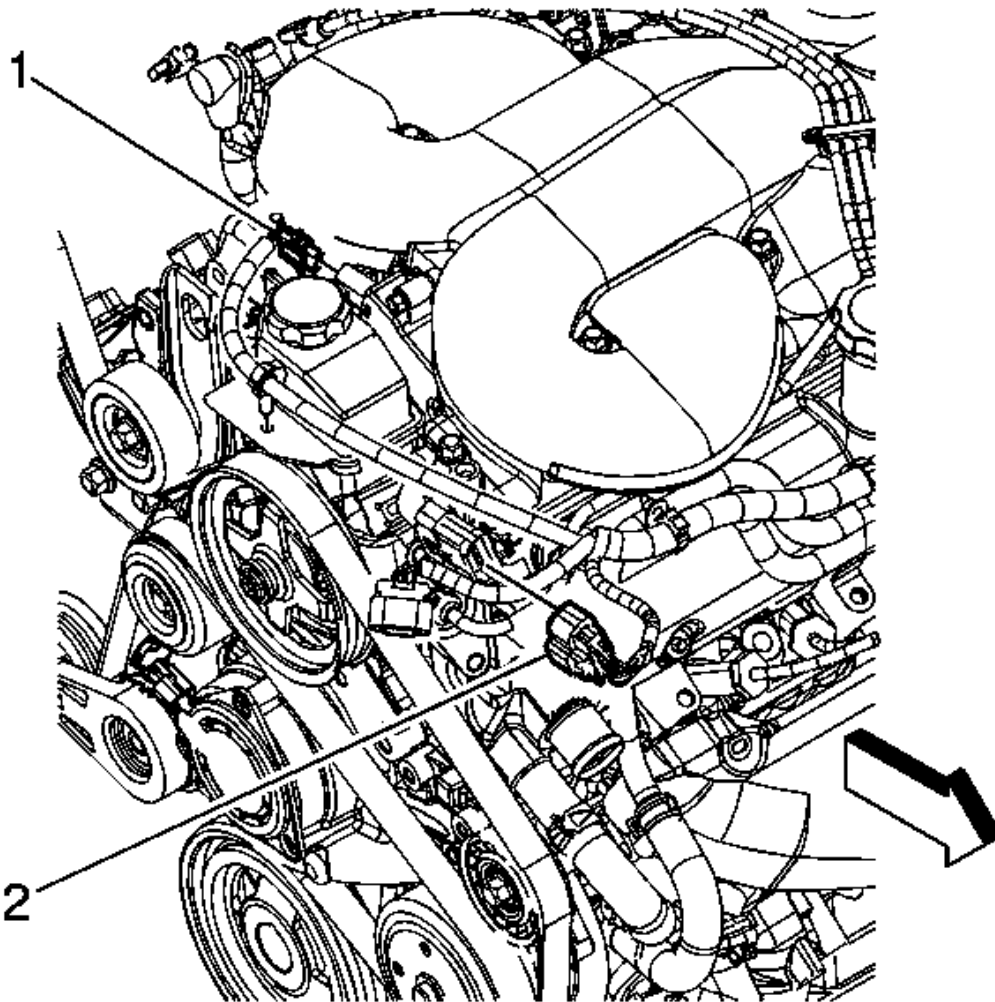


Fig. 63: Intake Manifold Tuning Valve & Injector Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

18. Disconnect the inlet manifold valve electrical connector (1).

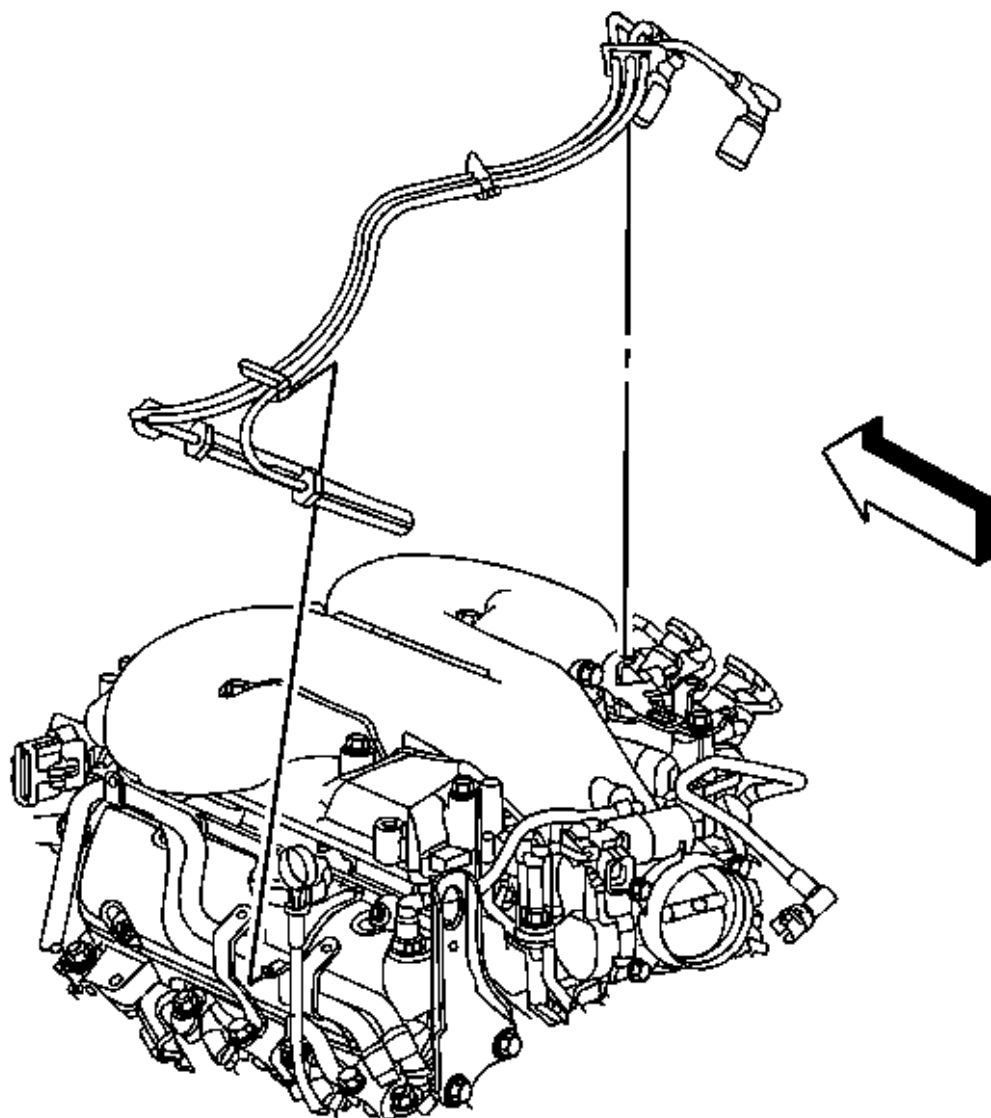


Fig. 64: Left Spark Plug/Coil Harness
Courtesy of GENERAL MOTORS CORP.

19. Remove the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#) .
20. Disconnect the left side spark plug wires from the spark plugs.
21. Disconnect the left side spark plug wires from the ignition coil.
22. Disengage the spark plug wire retainer clips from the intake manifold bracket and the heater inlet/outlet pipe.

23. Remove the left side spark plug wires.

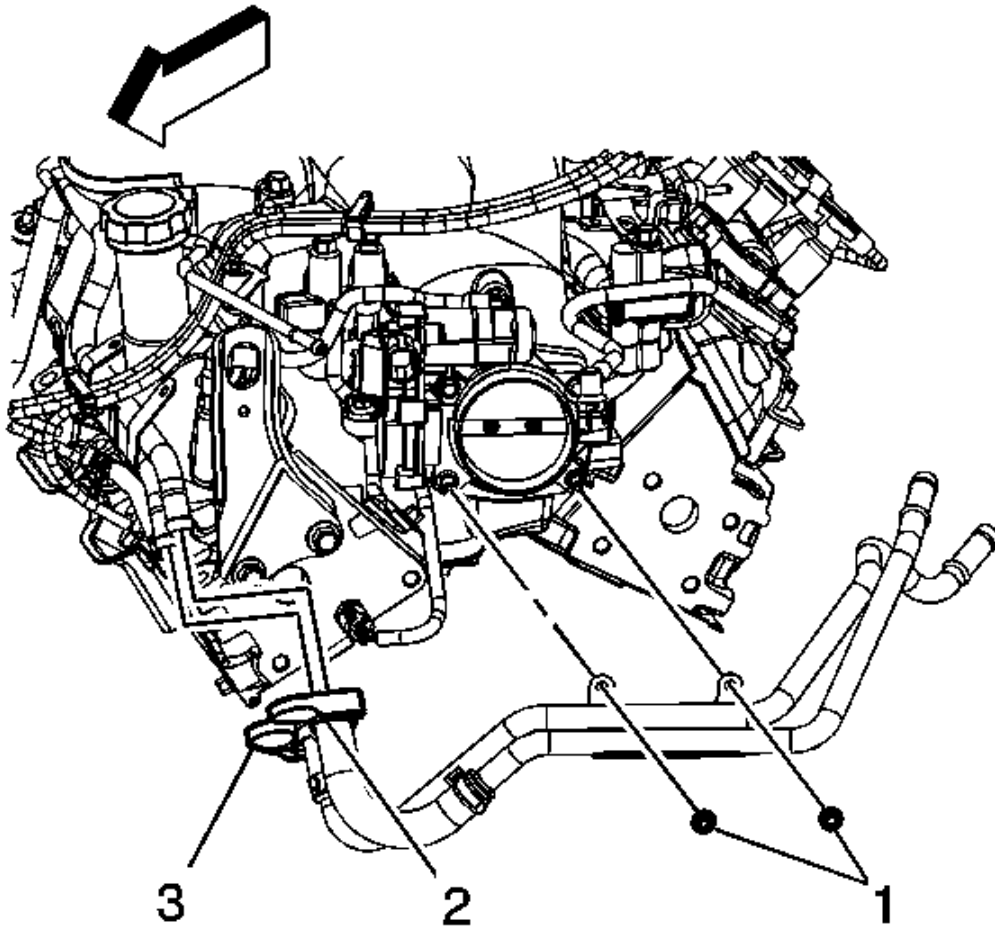


Fig. 65: Heater Inlet & Outlet Pipe & Nuts
Courtesy of GENERAL MOTORS CORP.

24. Remove the heater inlet and outlet pipe nuts (1) from the throttle body studs.
25. Remove the inlet and outlet pipe (2, 3) from the studs.

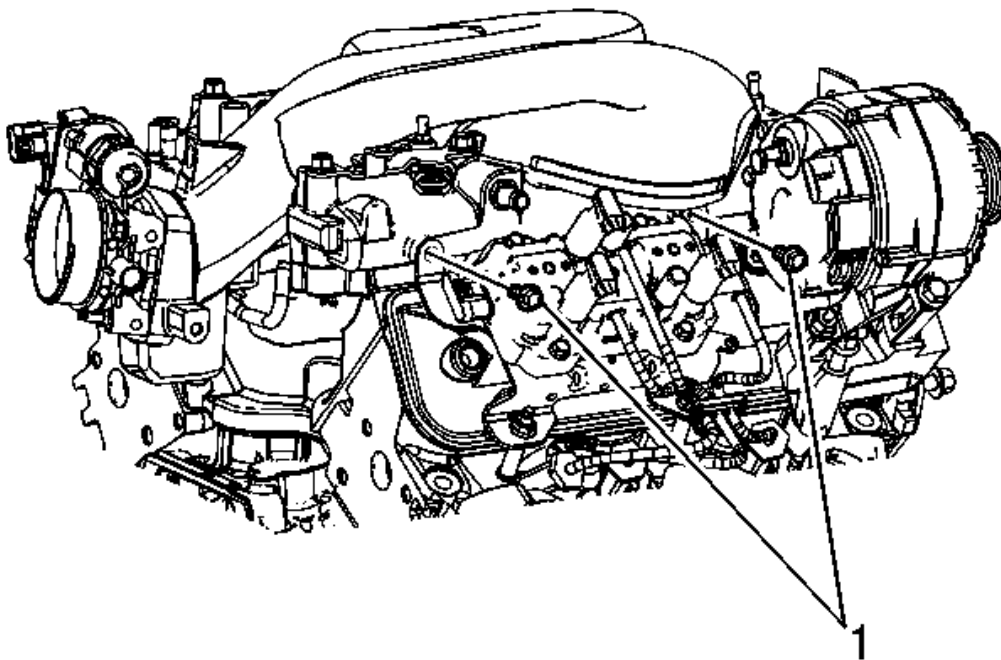


Fig. 66: Ignition Coil Bolts

Courtesy of GENERAL MOTORS CORP.

26. Remove the 2 ignition coil bolts (1).

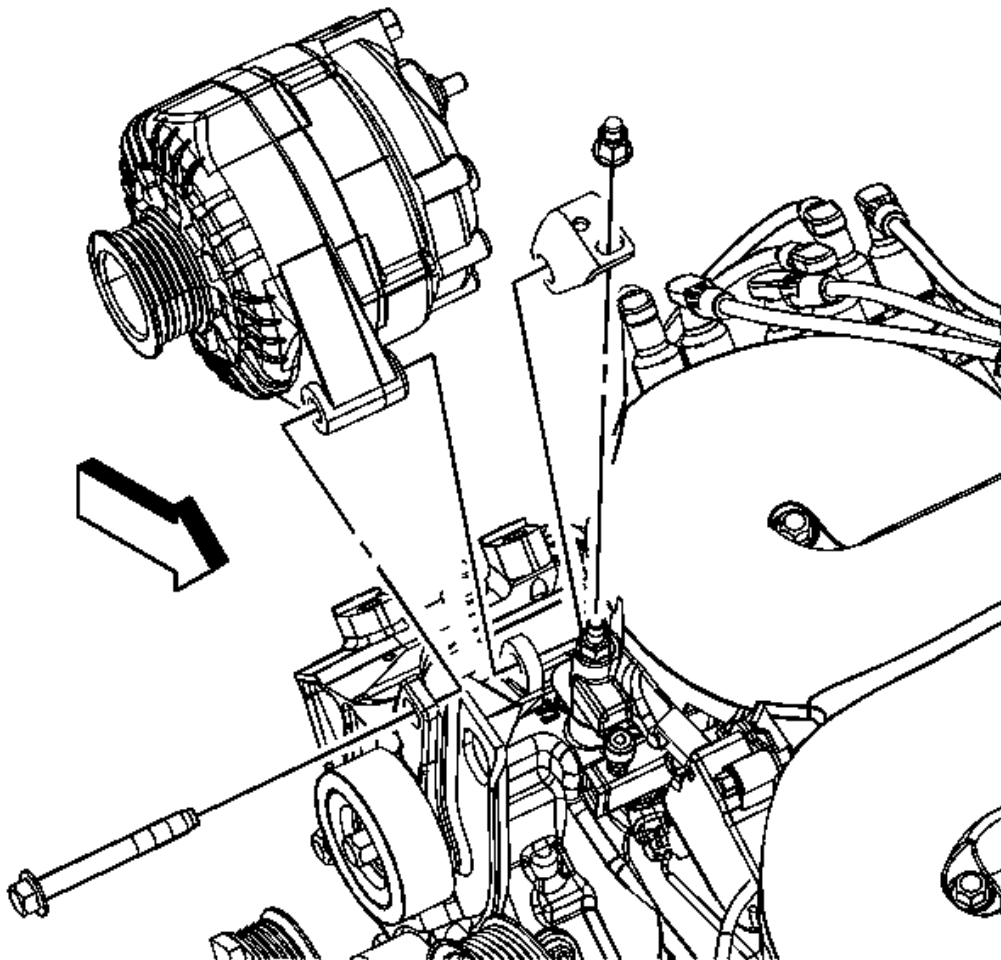


Fig. 67: Generator, Brace & Bolts
Courtesy of GENERAL MOTORS CORP.

27. Remove the generator upper bolt.
28. Remove the generator ball stud.
29. Remove the generator rear brace.

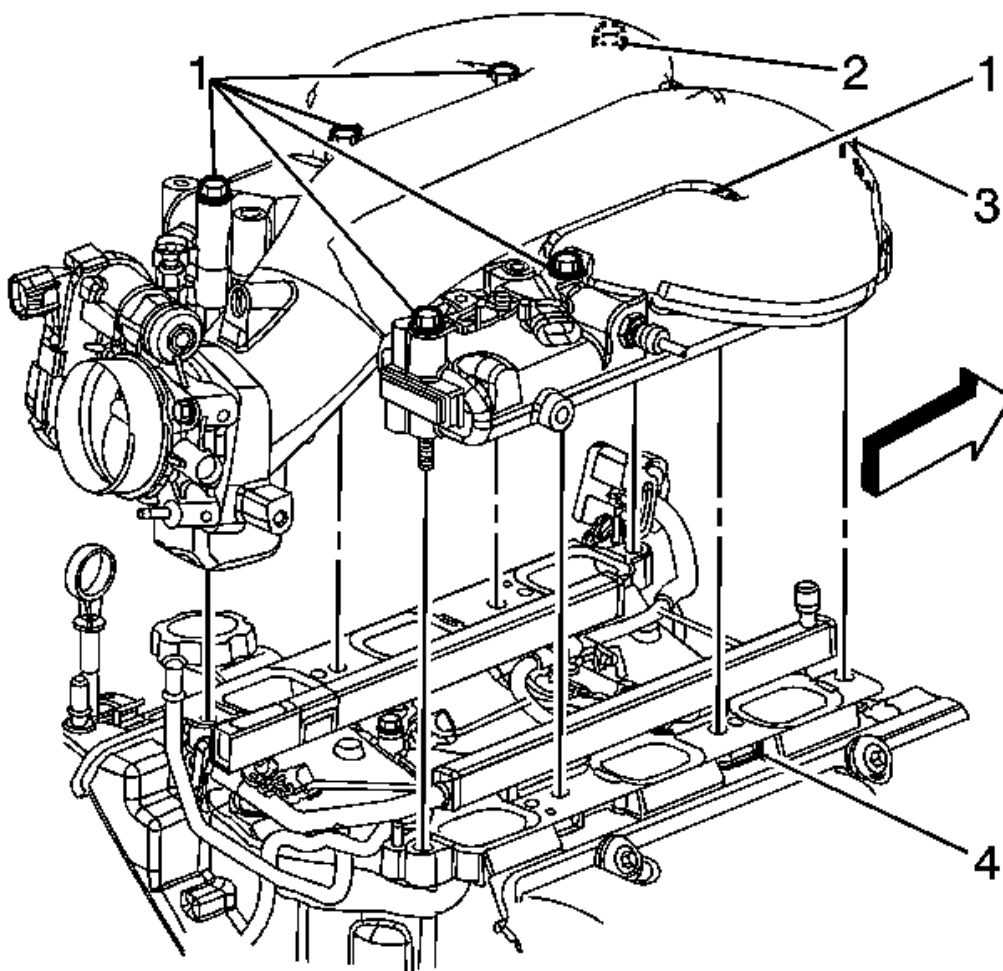


Fig. 68: Upper Intake Manifold, Bolts & Stud
Courtesy of GENERAL MOTORS CORP.

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

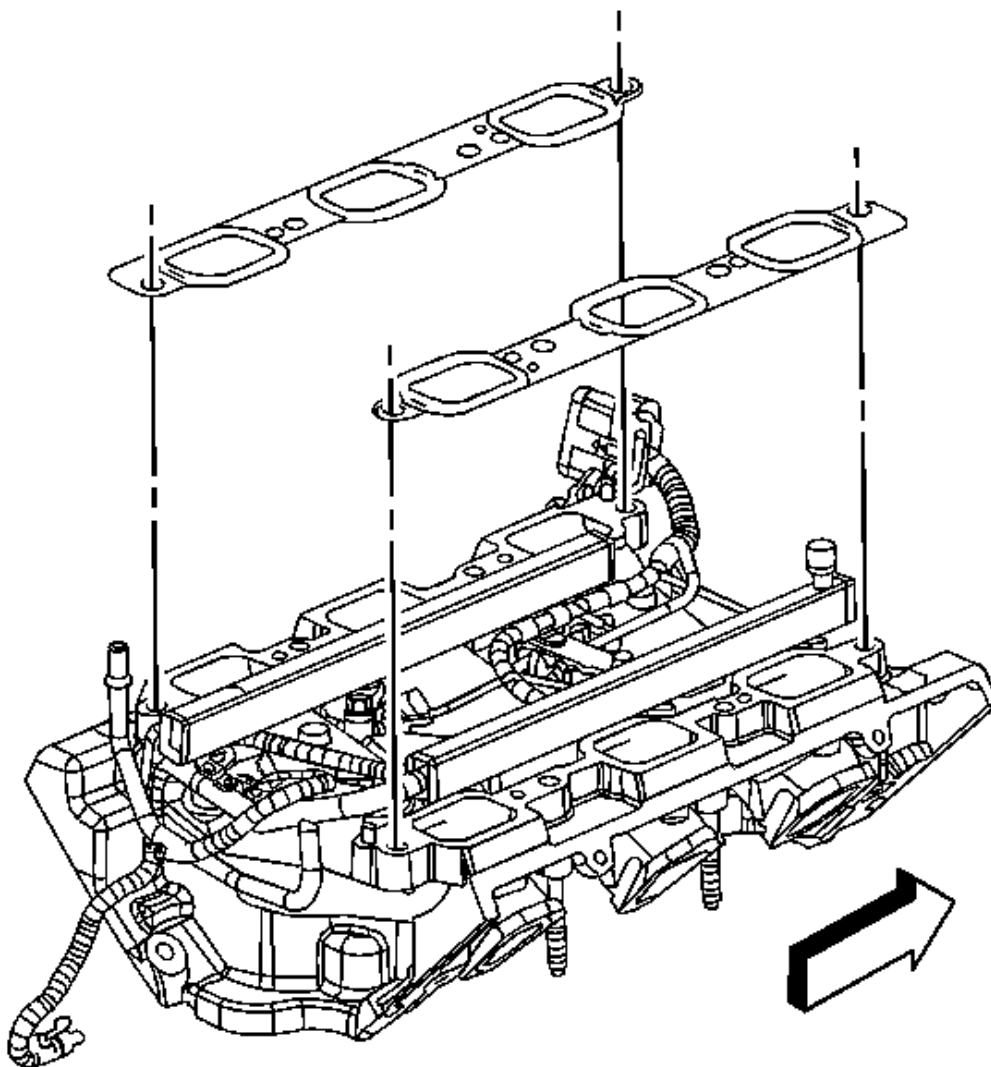


Fig. 69: Upper To Lower Intake Manifold Gaskets
Courtesy of GENERAL MOTORS CORP.

32. Remove the upper to lower intake manifold gaskets.

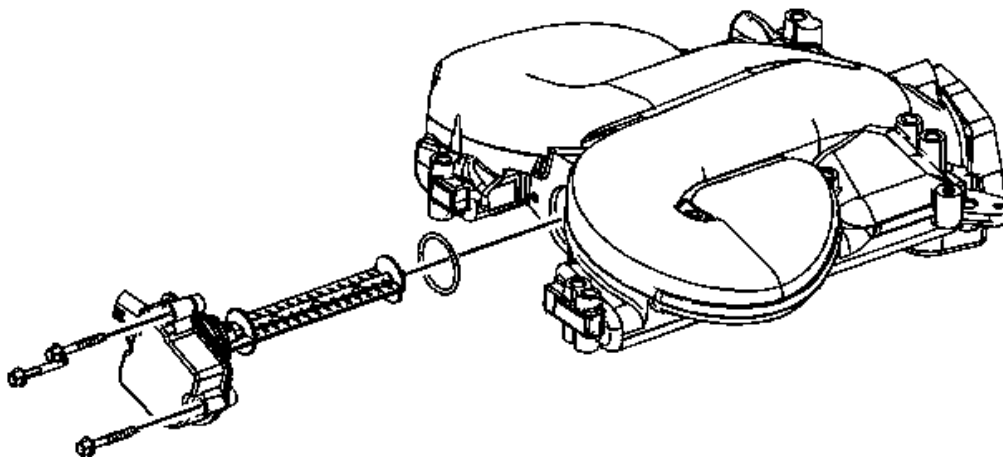


Fig. 70: Intake Manifold Tuning Valve & Bolts
Courtesy of GENERAL MOTORS CORP.

33. Remove the inlet manifold tuning valve bolts and valve.

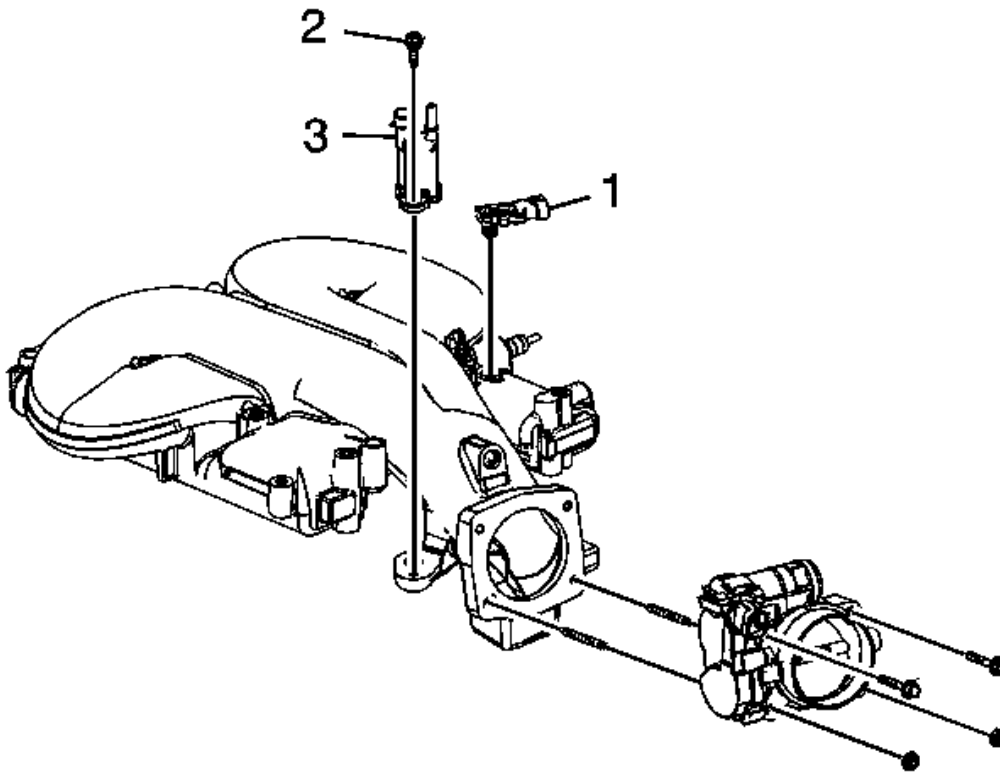


Fig. 71: Upper Intake Manifold Components
Courtesy of GENERAL MOTORS CORP.

34. Remove the throttle body bolts/studs and throttle body.
35. Remove the MAP sensor bracket and sensor (1).
36. Remove the EVAP canister purge solenoid valve bolt (2) and valve (3).
37. Clean the upper intake to lower intake gasket mating surfaces.

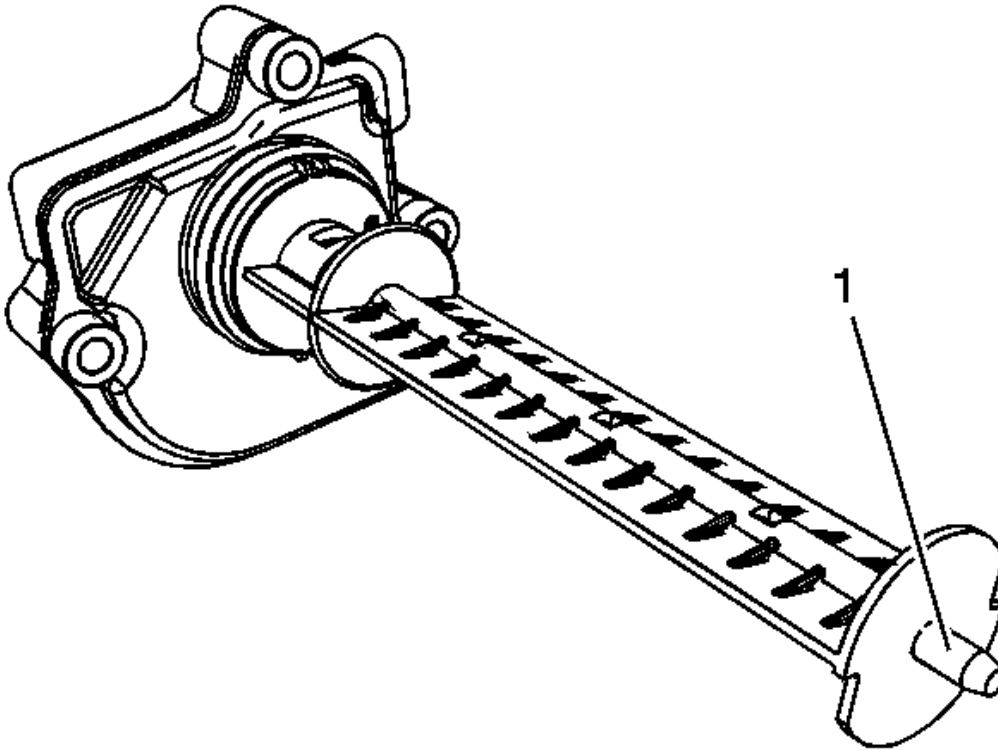


Fig. 72: Tuning Valve Blade

Courtesy of GENERAL MOTORS CORP.

38. Inspect the intake manifold tuning valve seal for damage. The tuning valve blade attachment to the motor should be tight, with no looseness or slack present, Replace as necessary.
39. Apply lubricant to the nose of the valve blade (1). Refer to **Adhesives, Fluids, Lubricants, and Sealers** for the correct part number.

INSTALLATION PROCEDURE

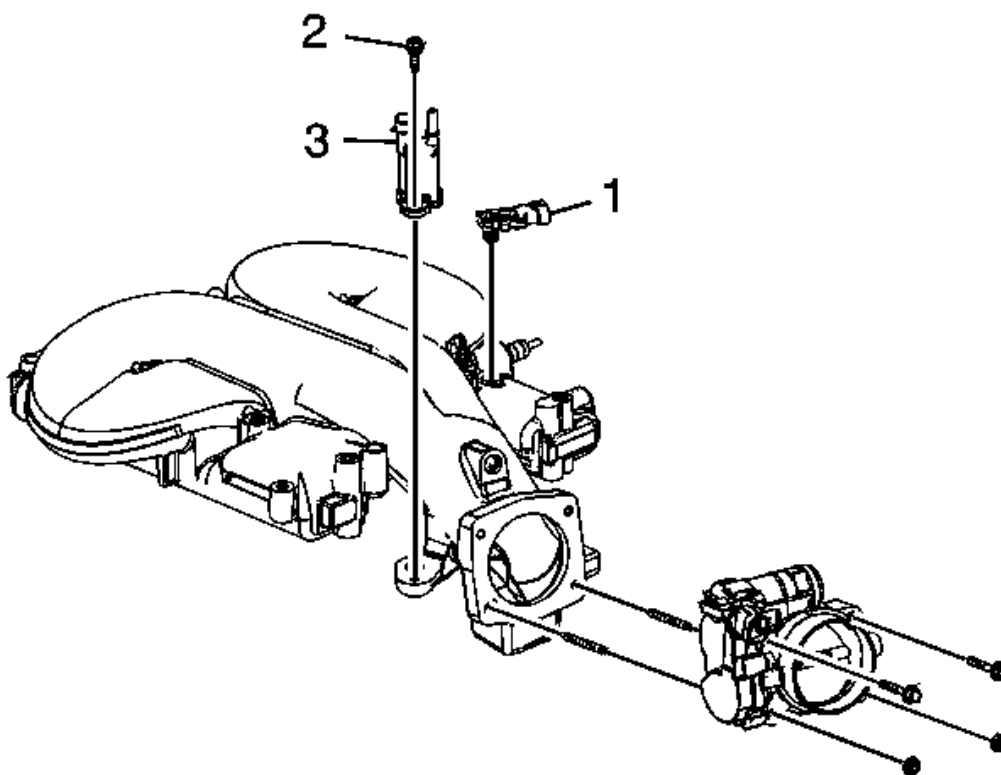


Fig. 73: Upper Intake Manifold Components
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Inspect the EVAP canister purge solenoid valve seal for damage, replace as necessary.
2. Install the EVAP canister purge solenoid valve (3) and bolt (2).

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

3. Inspect the MAP sensor seal for damage, replace as necessary.
4. Install the MAP sensor and bracket.
5. Inspect the throttle body seal for damage, replace as necessary.
6. Apply threadlock to the throttle body bolts/studs threads. Refer to Adhesives, Fluids, Lubricants, and Sealers for the correct part number.
7. Install the throttle body and bolts/studs.

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

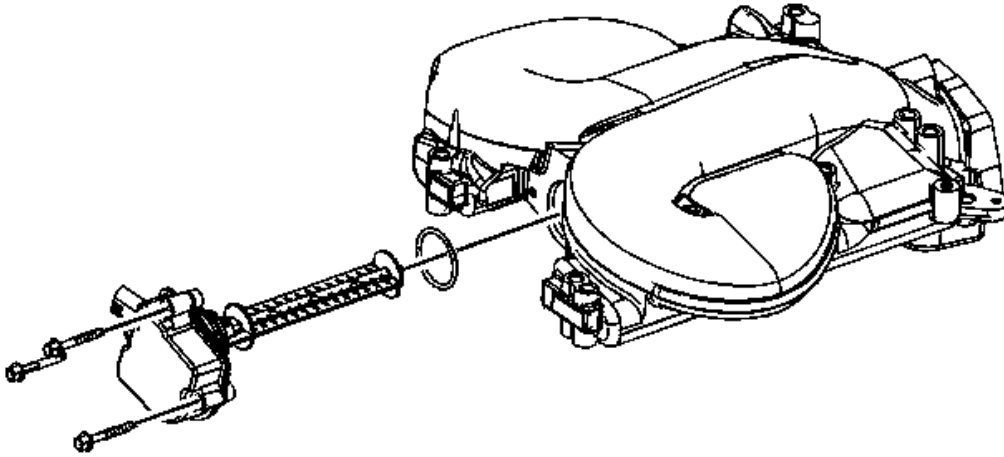


Fig. 74: Intake Manifold Tuning Valve & Bolts
Courtesy of GENERAL MOTORS CORP.

8. Install the inlet manifold tuning valve, and bolts.

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

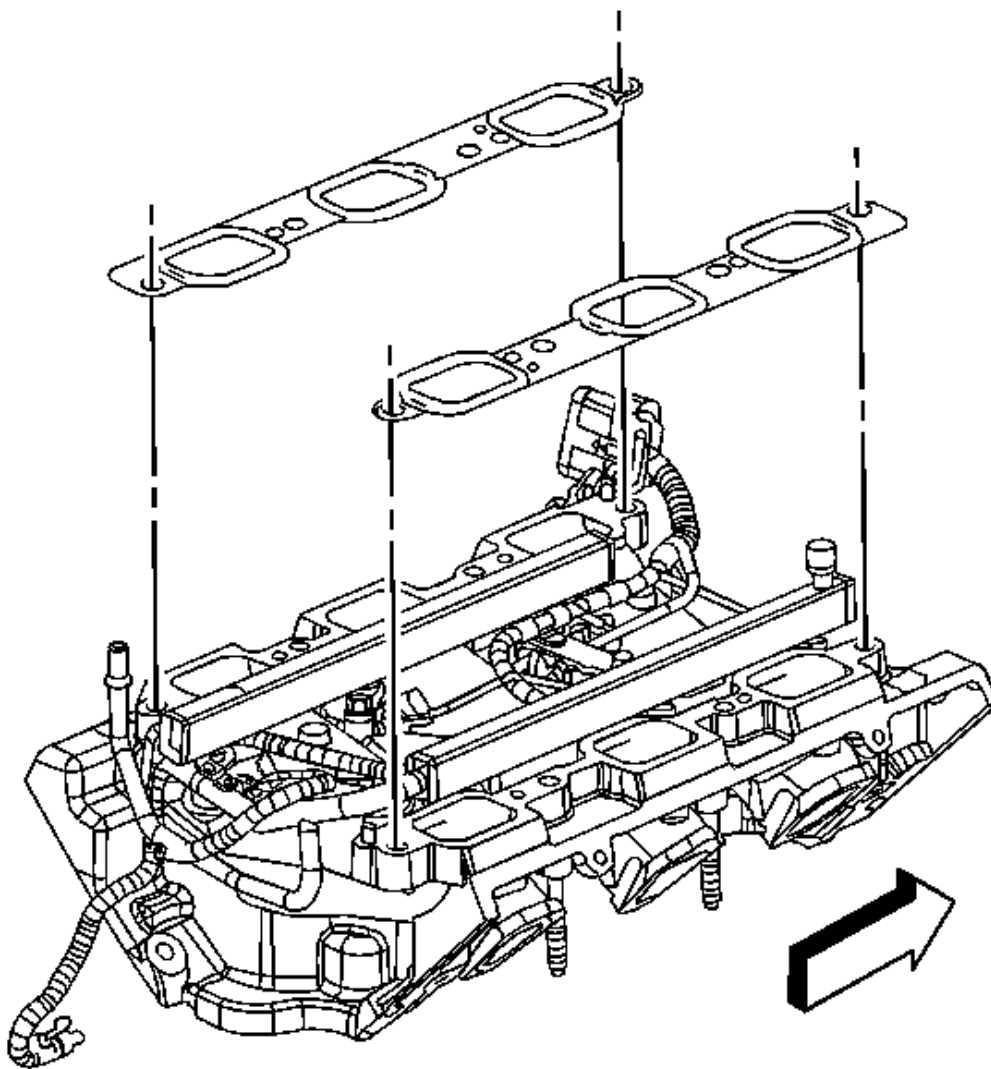


Fig. 75: Upper To Lower Intake Manifold Gaskets
Courtesy of GENERAL MOTORS CORP.

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

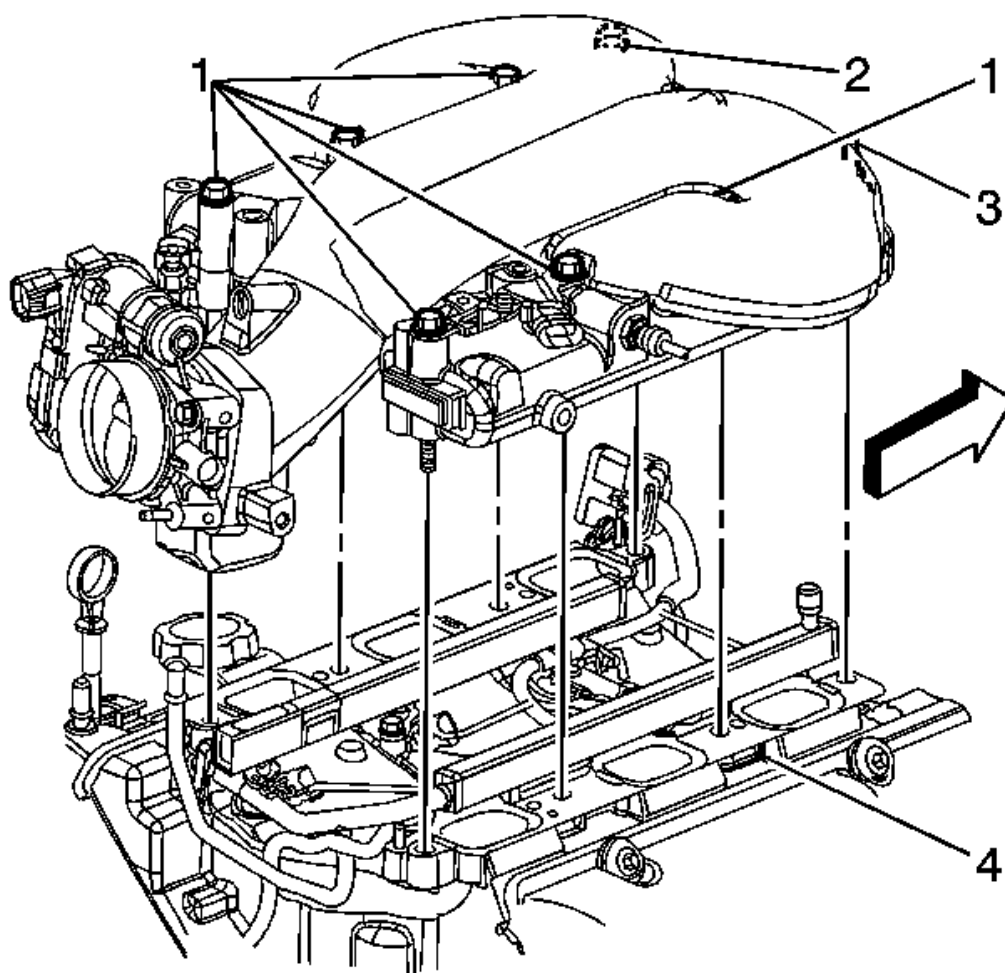


Fig. 76: Upper Intake Manifold, Bolts & Stud
Courtesy of GENERAL MOTORS CORP.

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

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

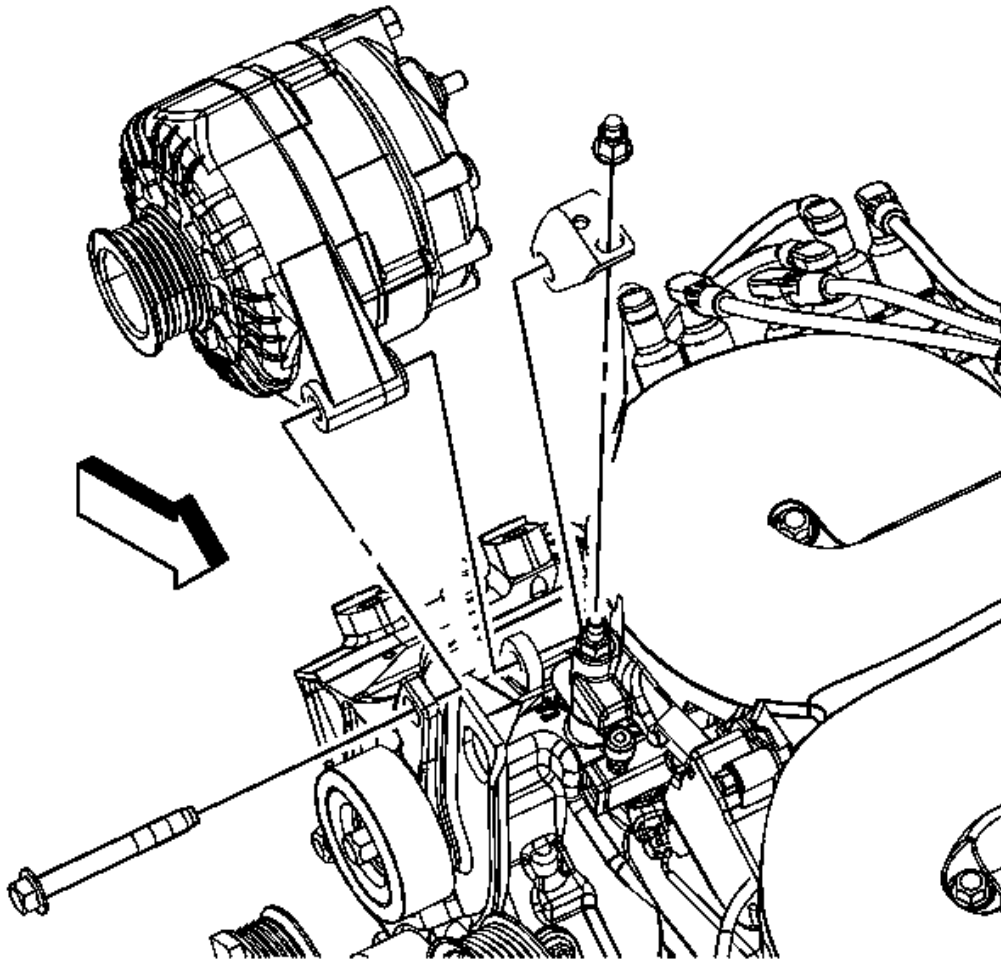


Fig. 77: Generator, Brace & Bolts
Courtesy of GENERAL MOTORS CORP.

13. Install the generator rear brace.
14. Install the generator ball stud.

Tighten: Tighten the bolt to 20 N.m (15 lb ft).

15. Install the generator upper bolt.

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

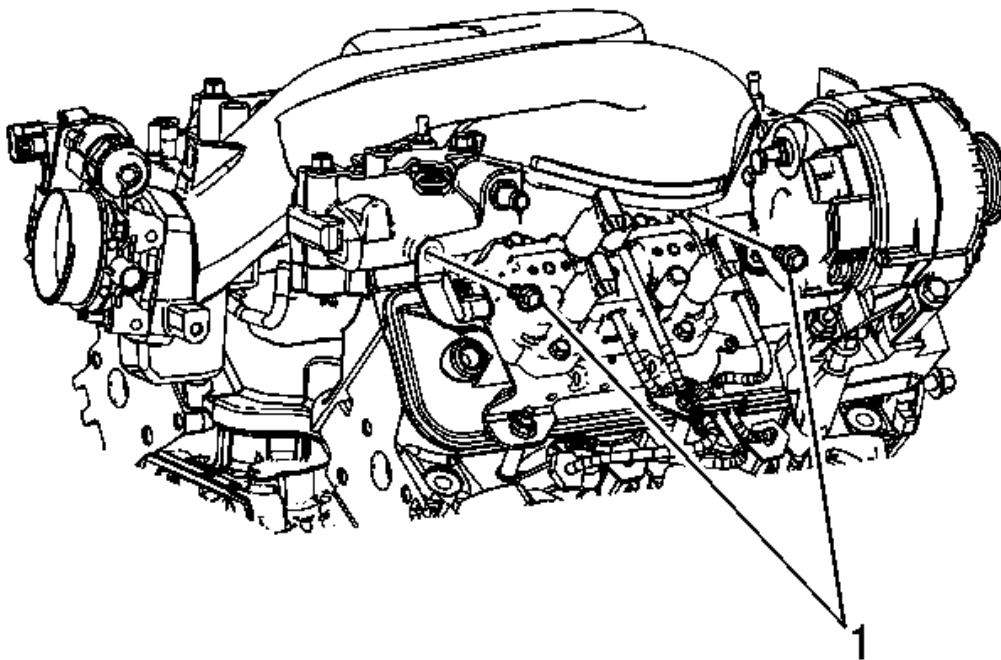


Fig. 78: Ignition Coil Bolts

Courtesy of GENERAL MOTORS CORP.

16. Install the 2 ignition coil bolts (1).

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

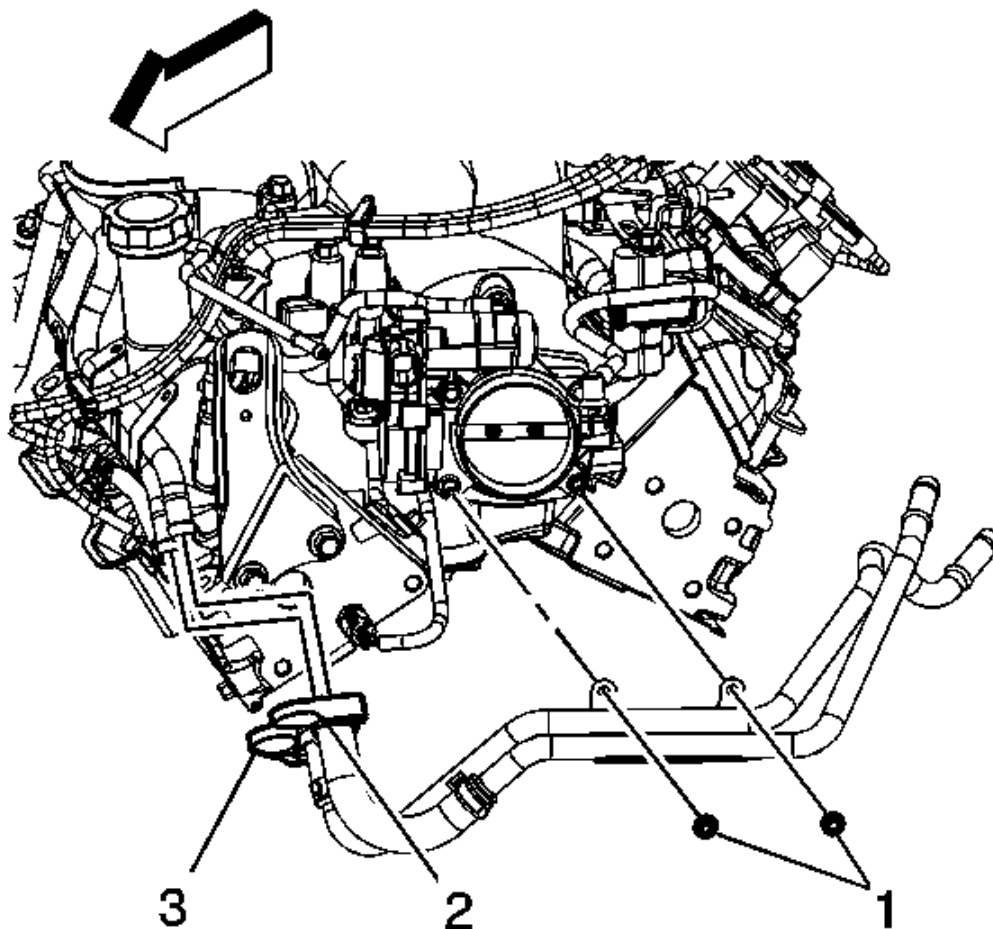


Fig. 79: Heater Inlet & Outlet Pipe & Nuts
Courtesy of GENERAL MOTORS CORP.

17. Install the inlet and outlet pipe (2, 3) to the studs.
18. 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).

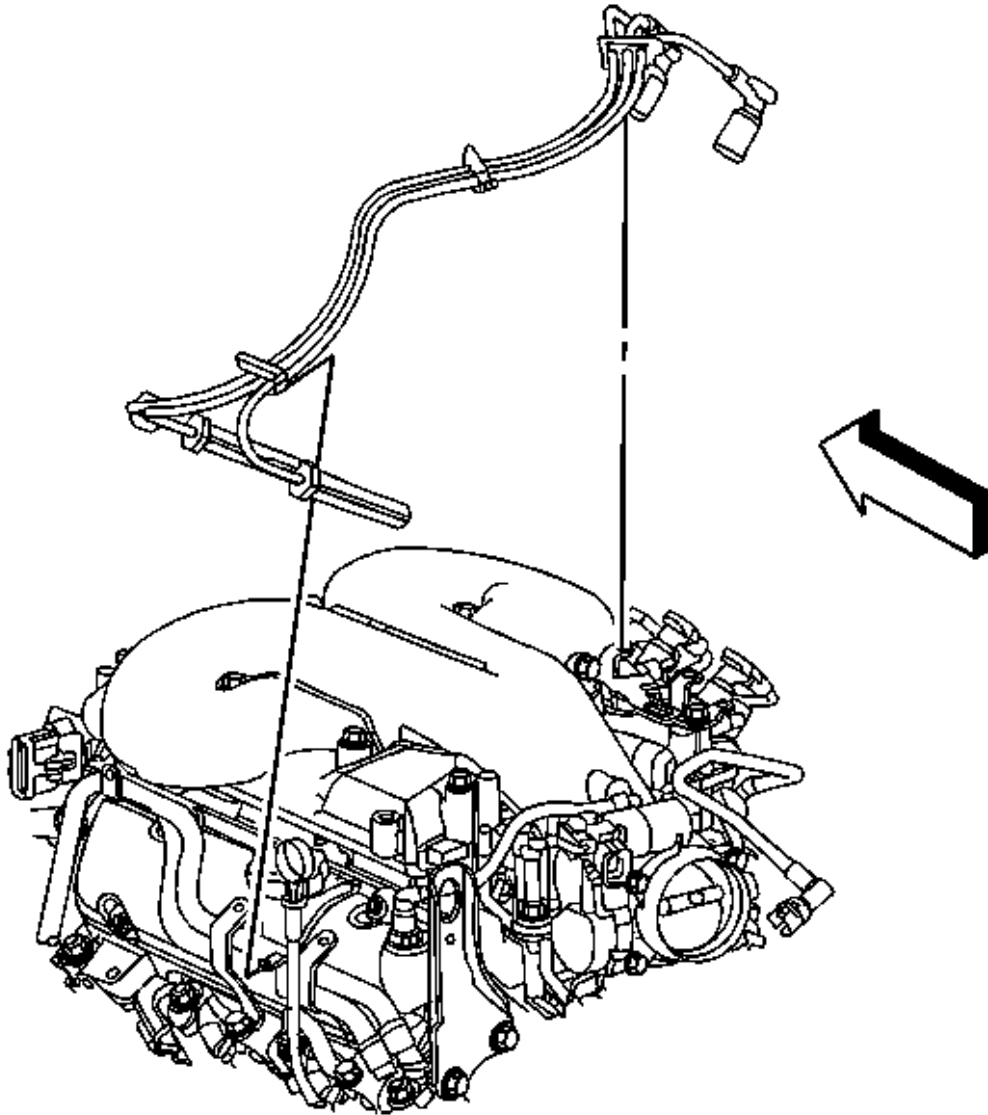


Fig. 80: Left Spark Plug/Coil Harness
Courtesy of GENERAL MOTORS CORP.

19. Install the left side spark plug wires.
20. Connect the left side spark plug wires to the spark plugs.
21. Connect the left side spark plug wires to the ignition coil.
22. Engage the spark plug wire retainer clips to the intake manifold bracket and the heater inlet/outlet pipe.

23. Install the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#) .

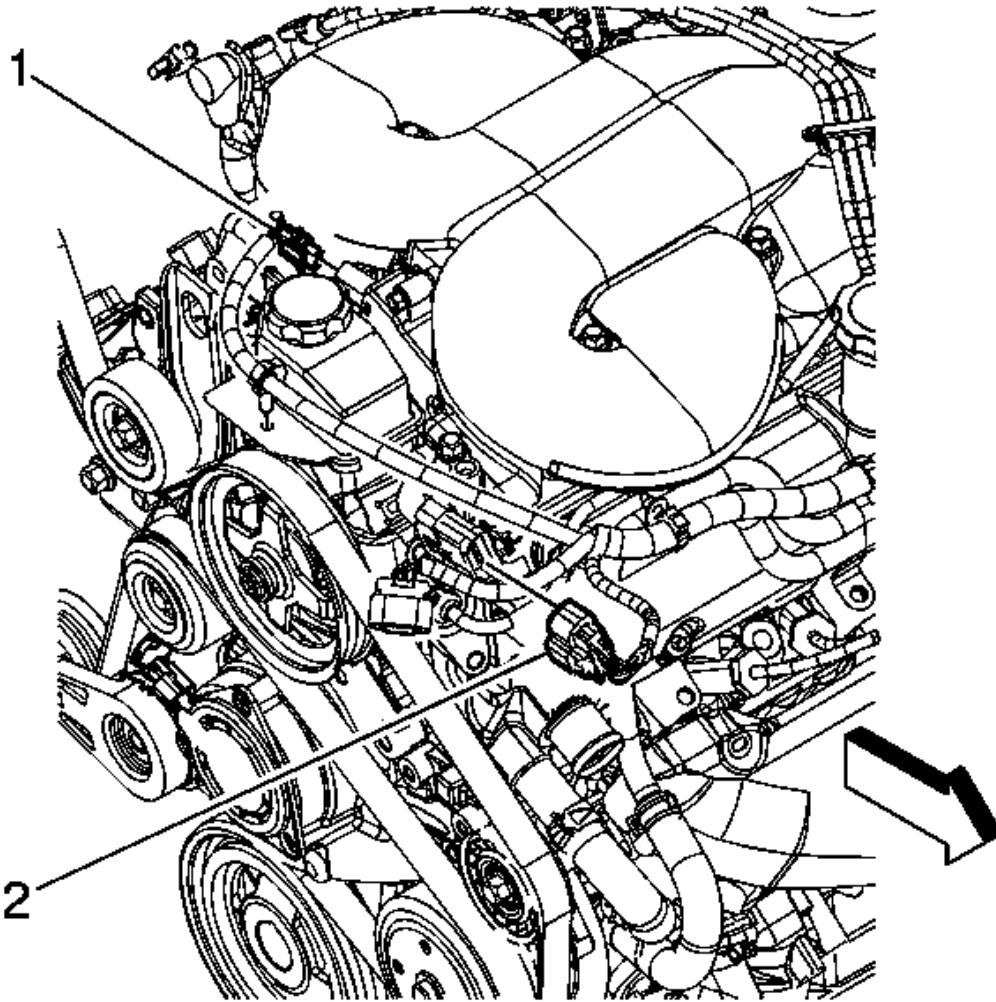


Fig. 81: Intake Manifold Tuning Valve & Injector Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

24. Connect the inlet manifold valve electrical connector (1).

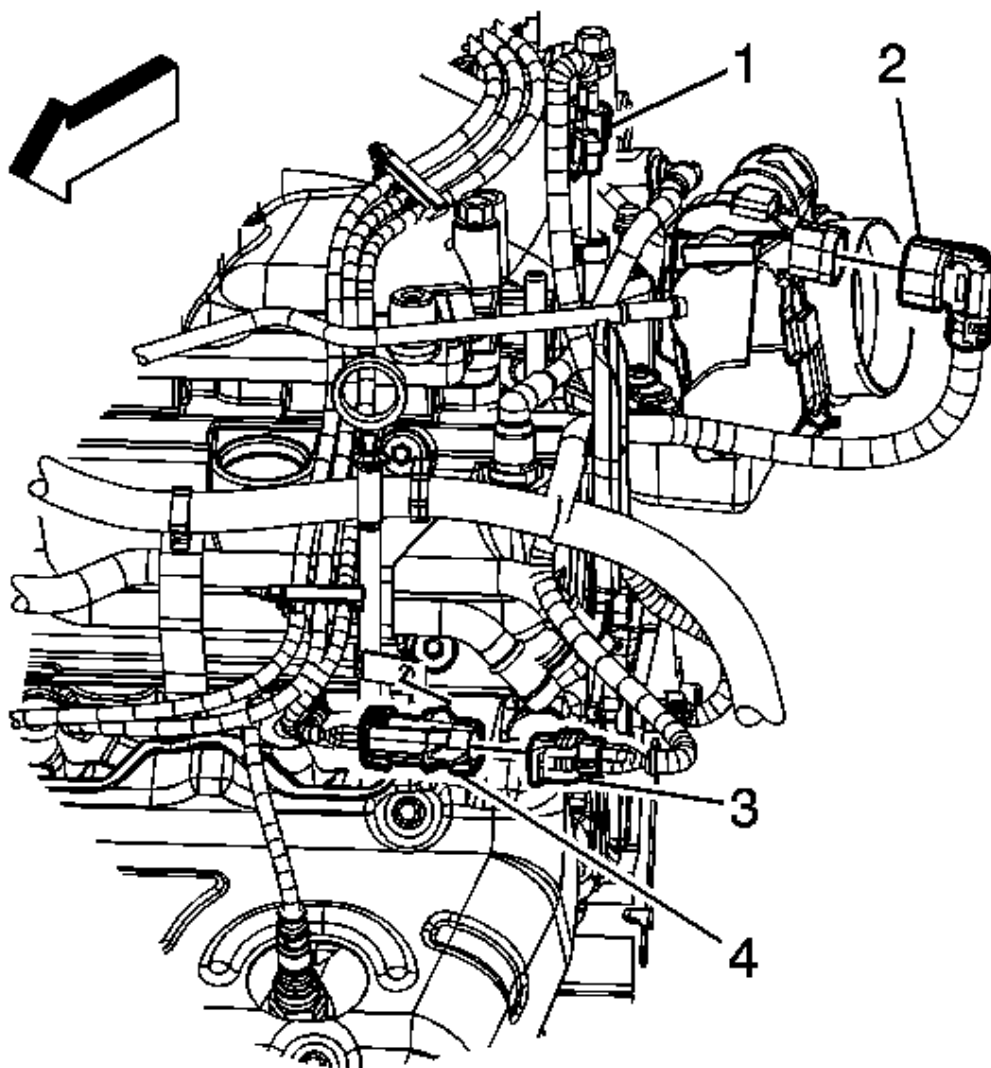


Fig. 82: EVAP Canister Purge Solenoid, ETC & HO2S Connectors
Courtesy of GENERAL MOTORS CORP.

25. Connect the EVAP canister purge solenoid electrical connector (1).
26. Connect the ETC electrical connector (2).

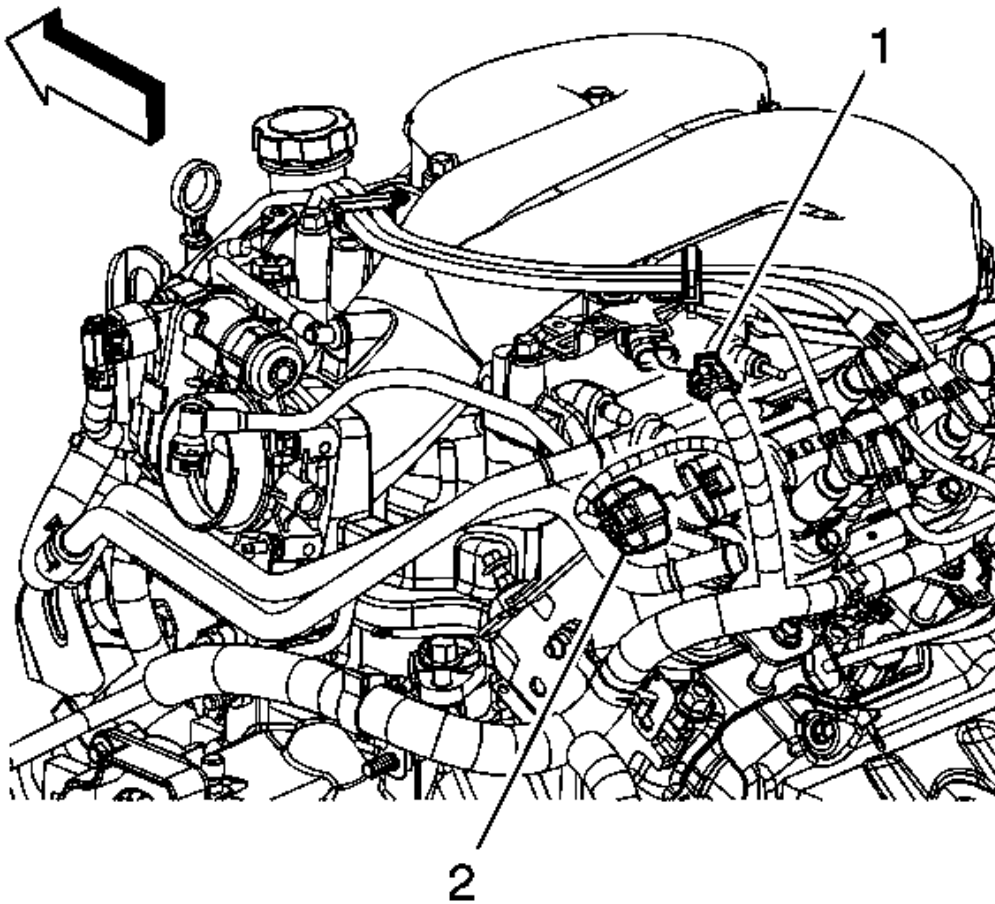


Fig. 83: ECM & MAP Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

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

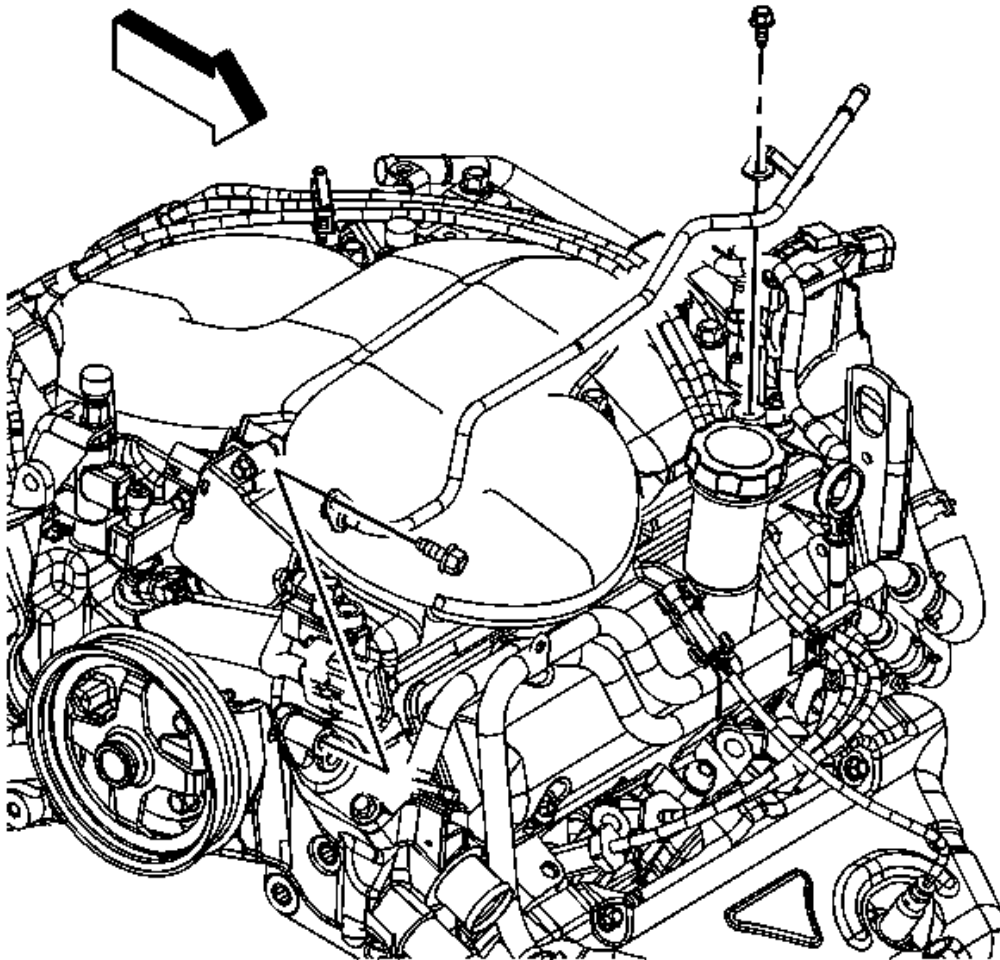


Fig. 84: Identifying Radiator Surge Tank Pipe Bolts
 Courtesy of GENERAL MOTORS CORP.

28. Install the radiator surge tank inlet pipe.
29. Install the radiator surge tank inlet pipe bolts.

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

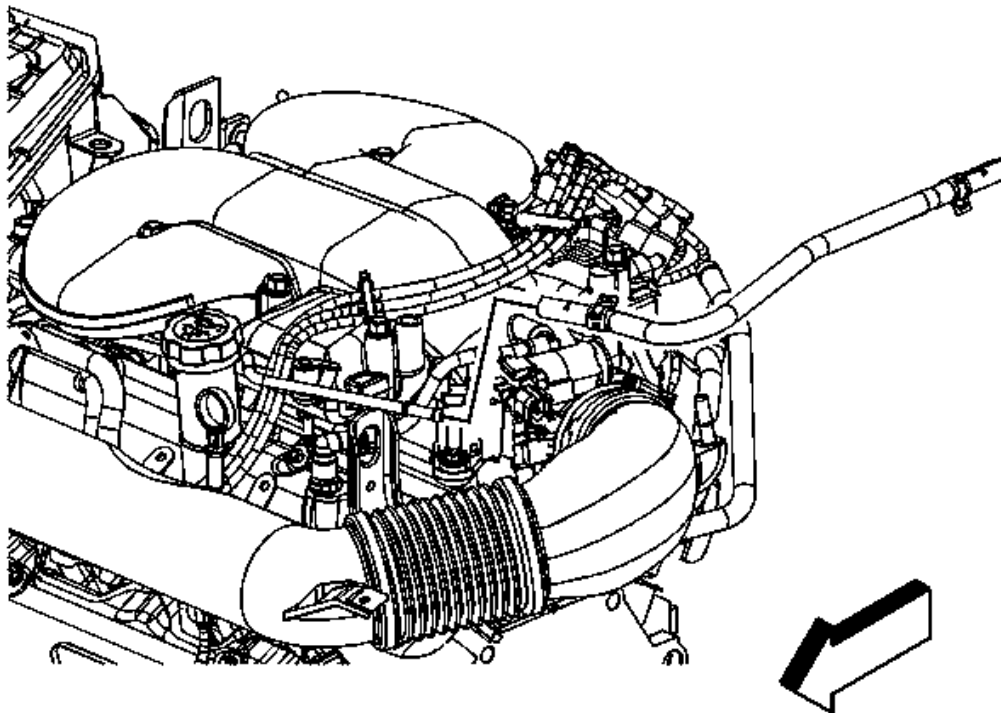


Fig. 85: Radiator Surge Tank Inlet Hose & Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

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

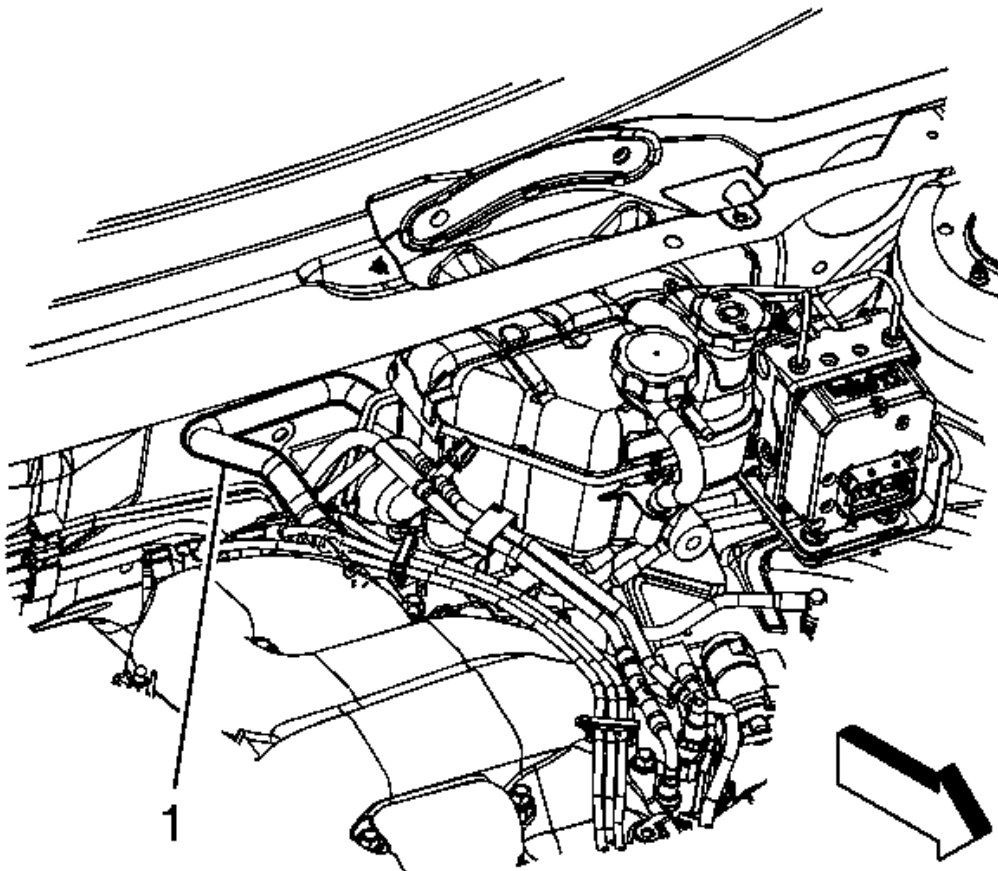


Fig. 86: Brake Booster Vacuum Hose To Intake Manifold
Courtesy of GENERAL MOTORS CORP.

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

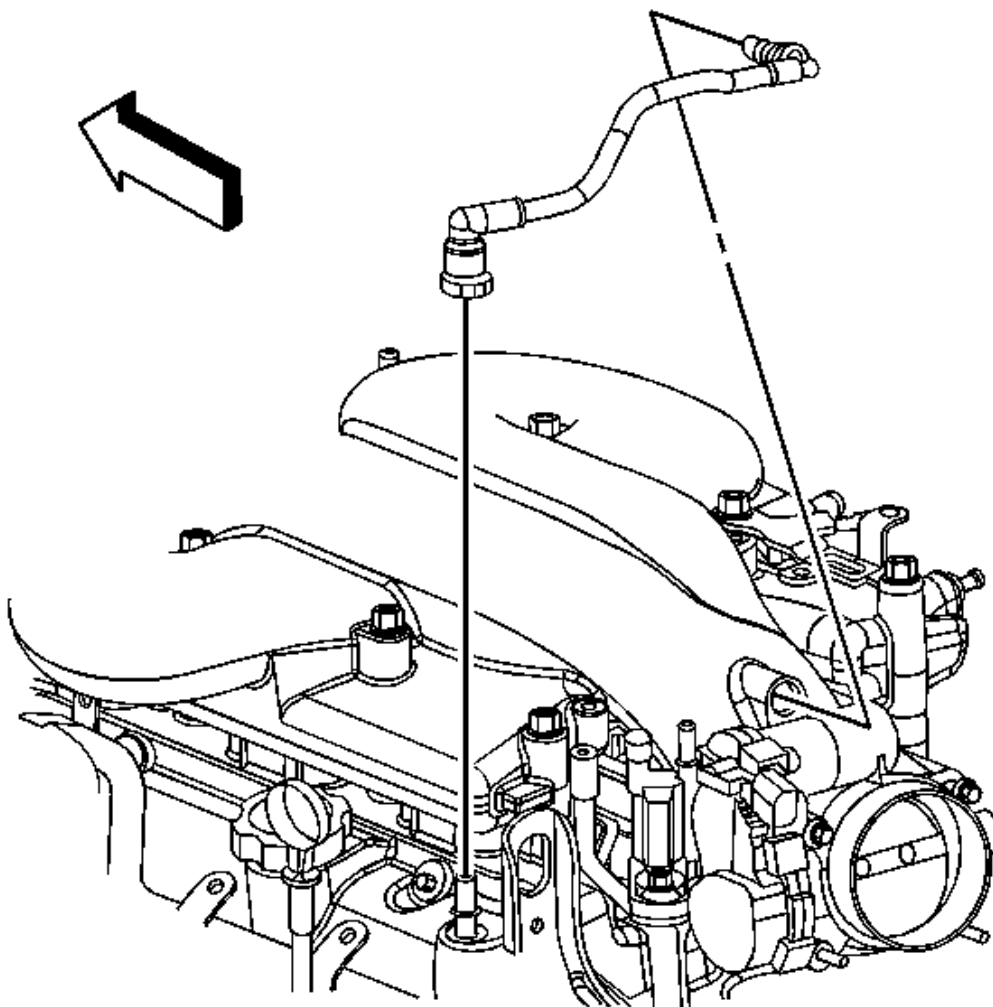


Fig. 87: Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

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

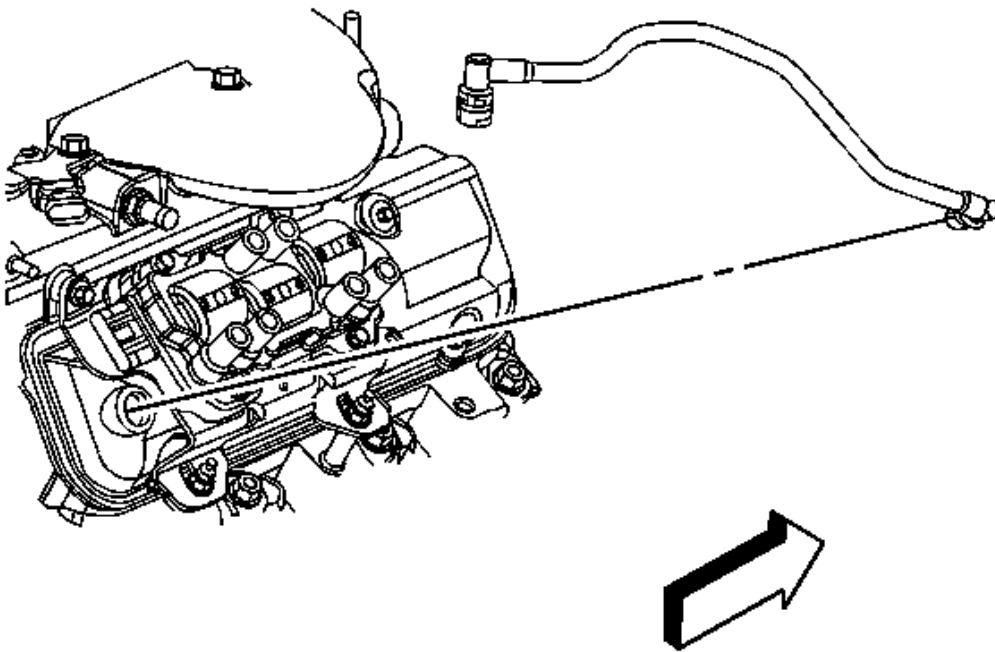


Fig. 88: Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

35. Install the PCV fresh air tube. Refer to **Plastic Collar Quick Connect Fitting Service** .

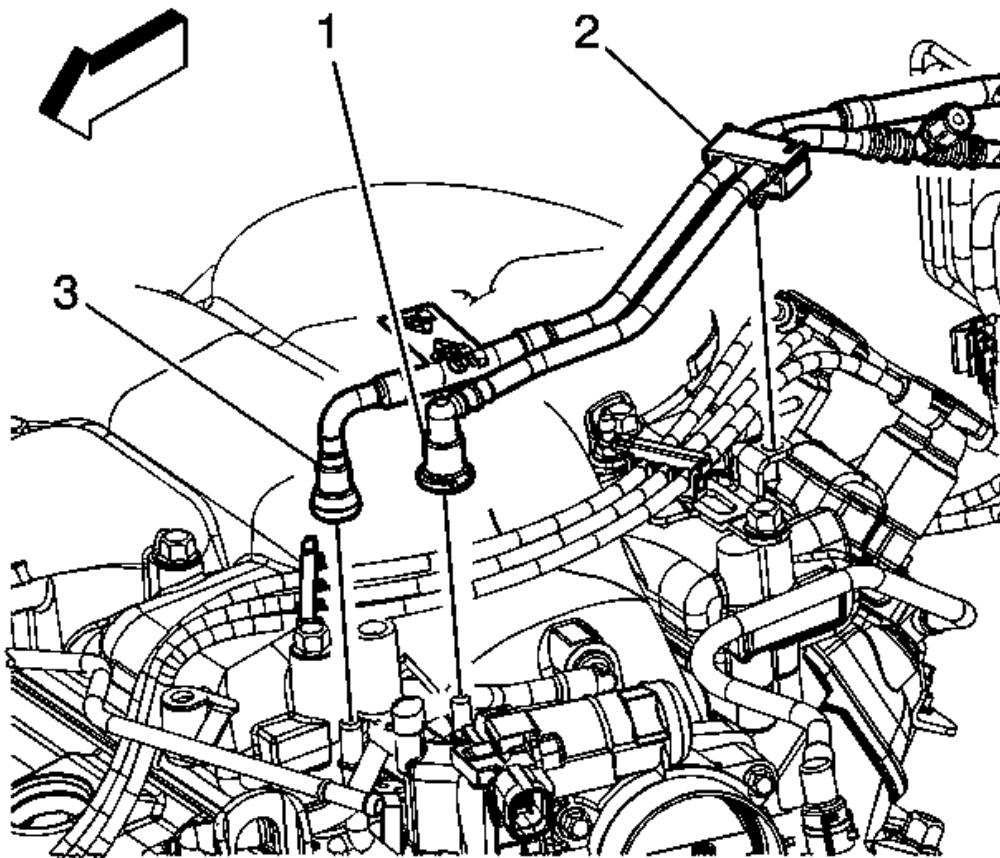


Fig. 89: Fuel Feed/EVAP Pipes

Courtesy of GENERAL MOTORS CORP.

36. Install the fuel and EVAP pipes to the retainer clip (2) and close the clip.
37. Connect the fuel feed pipe (3) quick connect fitting to the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .
38. Connect the EVAP emission pipe (1) to the purge solenoid. Refer to **Plastic Collar Quick Connect Fitting Service** .
39. Fill the cooling system. Refer to **Cooling System Draining and Filling (GE 47716 Fill)** or **Cooling System Draining and Filling (LY7, LZE, LZ4, LZ9)** .
40. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
41. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .

LOWER INTAKE MANIFOLD REPLACEMENT

REMOVAL PROCEDURE

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

1. Remove the coolant crossover pipe. Refer to **Engine Coolant Crossover Pipe Replacement (LZ9)** .
2. Remove the upper intake manifold. Refer to **Upper Intake Manifold Replacement**.
3. Remove the left valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Left Side**.
4. Remove the right valve rocker arm cover. Refer to **Valve Rocker Arm Cover Replacement - Right Side**.
5. Disconnect the engine coolant temperature (ECT) electrical connector.
6. Disconnect the fuel feed line from the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .

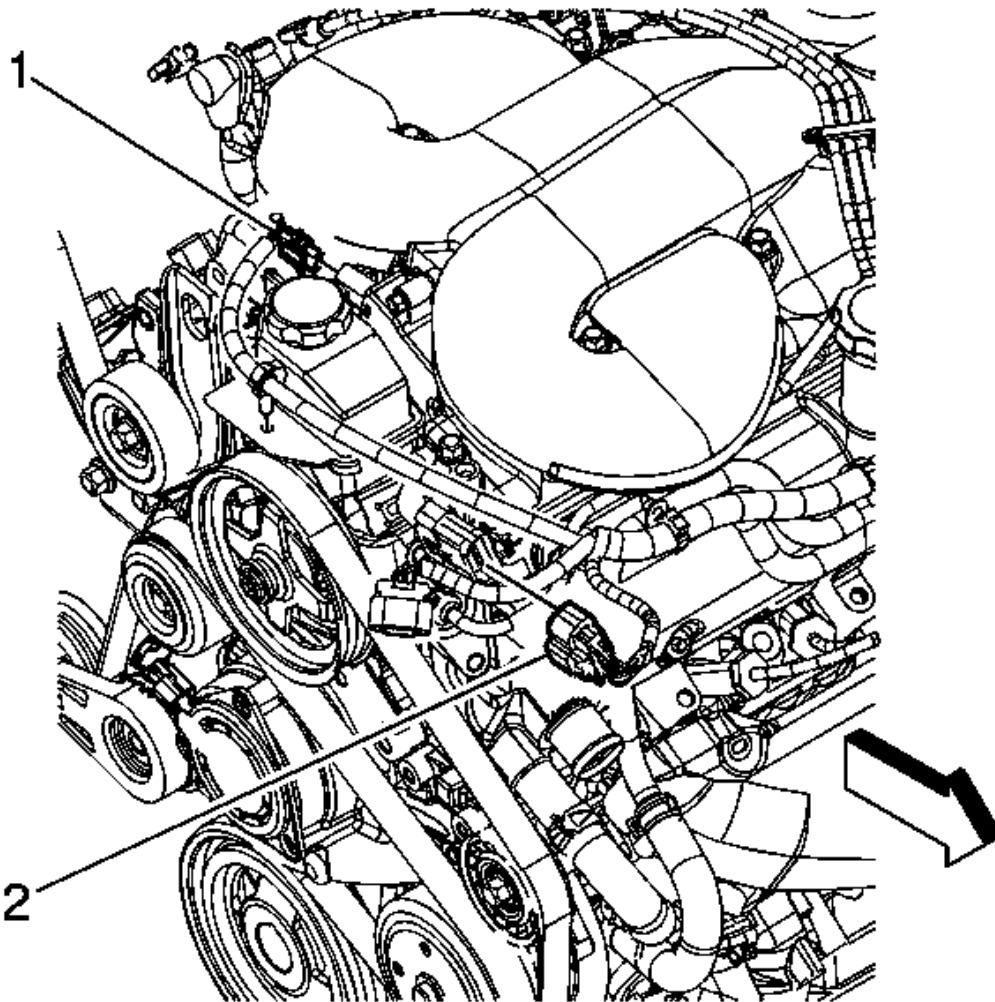


Fig. 90: Intake Manifold Tuning Valve & Injector Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the fuel injector inline connector (2).

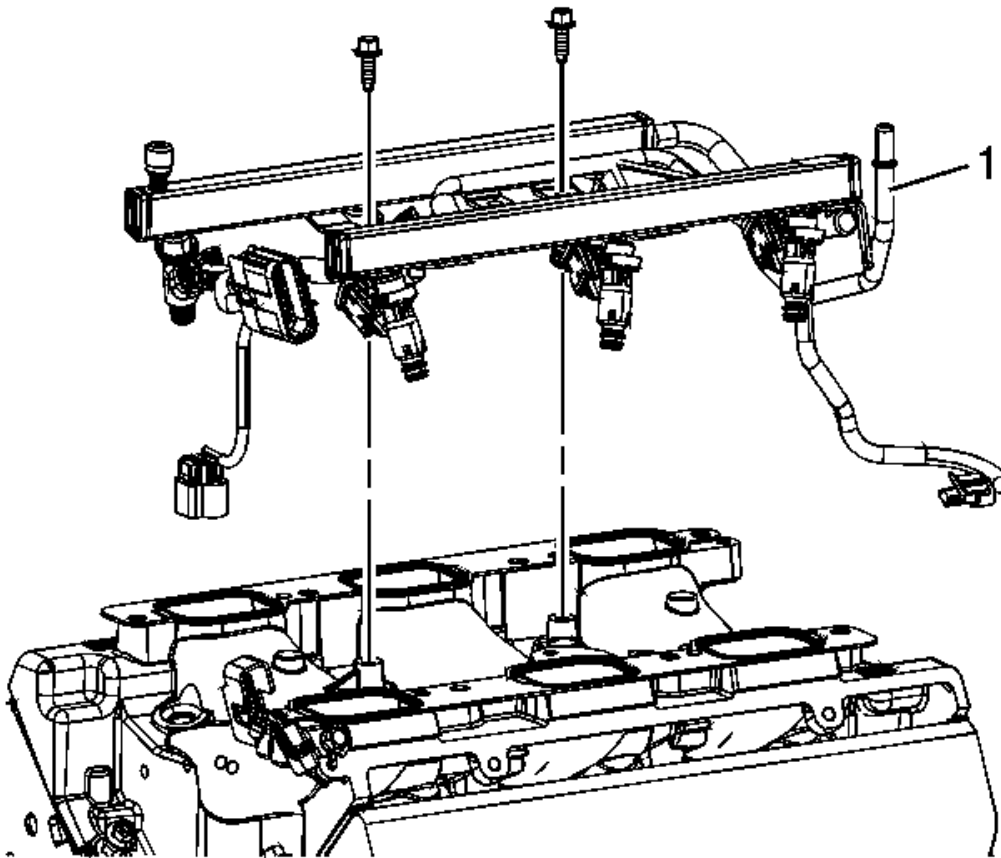


Fig. 91: Fuel Rail & Bolts

Courtesy of GENERAL MOTORS CORP.

8. Remove the fuel injector harness connector bracket bolt from the intake manifold.
9. Disconnect the camshaft position (CMP) sensor electrical connector.
10. Remove the fuel injector rail bolts.
11. Remove the fuel rail (1).

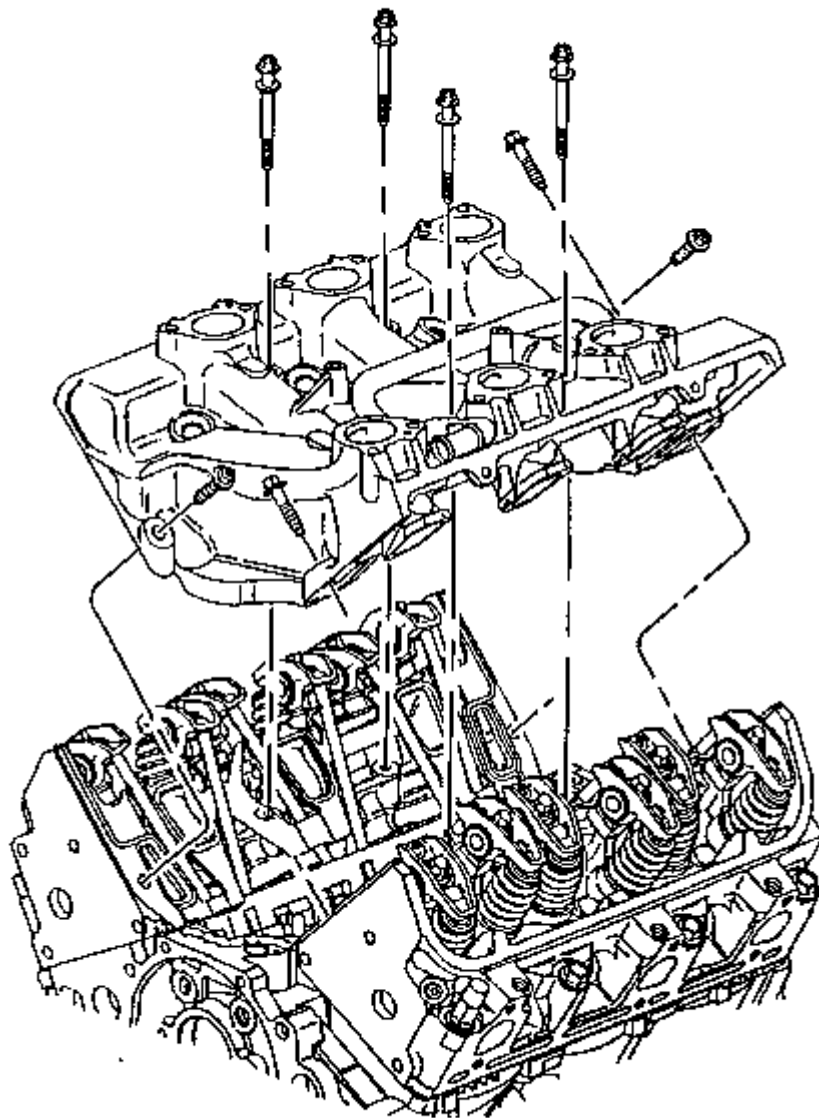


Fig. 92: Lower Intake Manifold & Bolts
Courtesy of GENERAL MOTORS CORP.

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

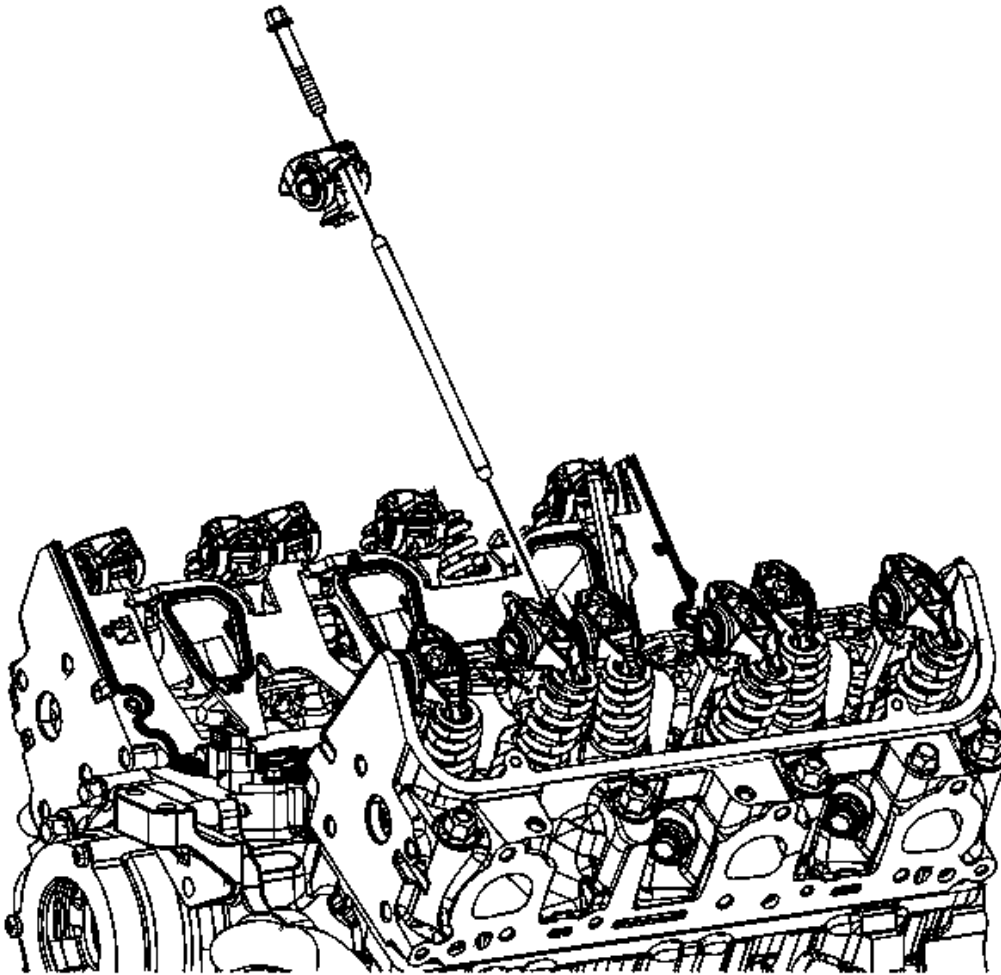


Fig. 93: Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

14. Loosen the valve rocker arm bolts.

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

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

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

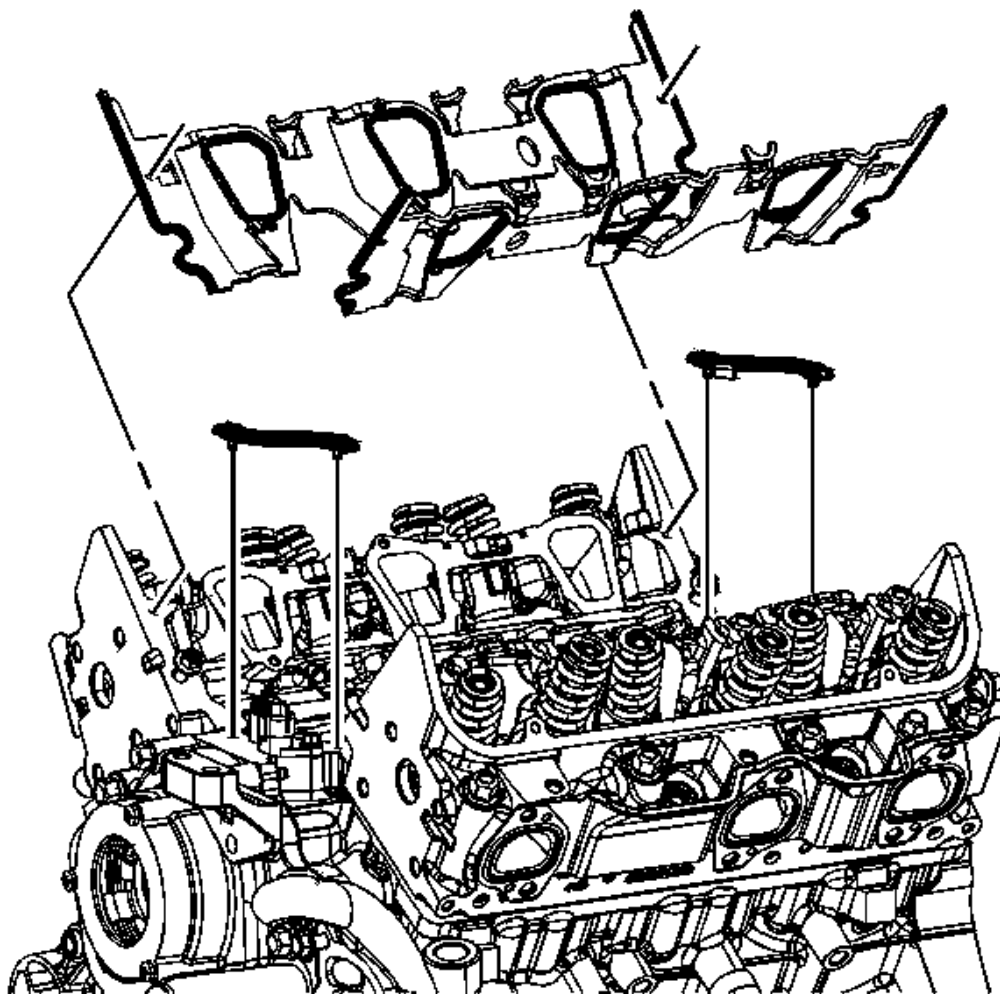


Fig. 94: Lower Intake Manifold Gaskets & Seals
Courtesy of GENERAL MOTORS CORP.

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

INSTALLATION PROCEDURE

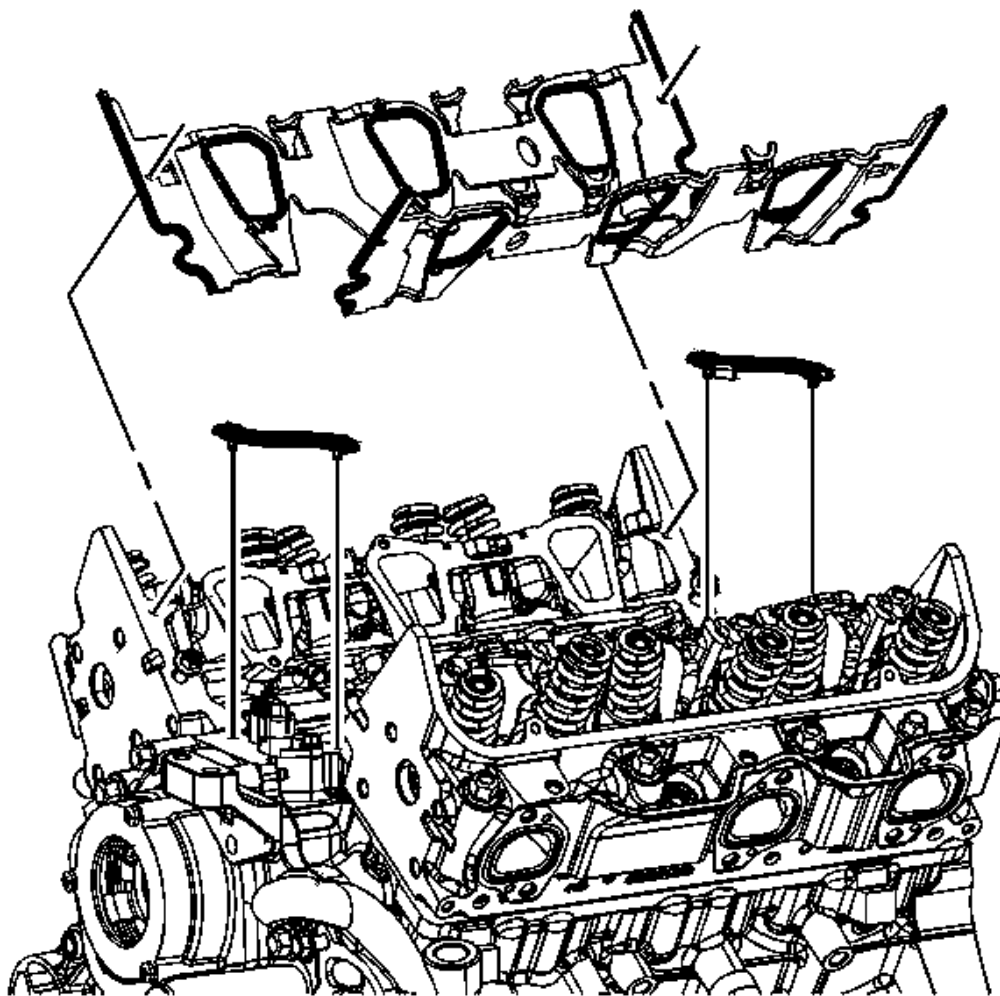


Fig. 95: Lower Intake Manifold Gaskets & Seals

Courtesy of GENERAL MOTORS CORP.

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

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

1. Install the lower intake manifold gaskets and seals.

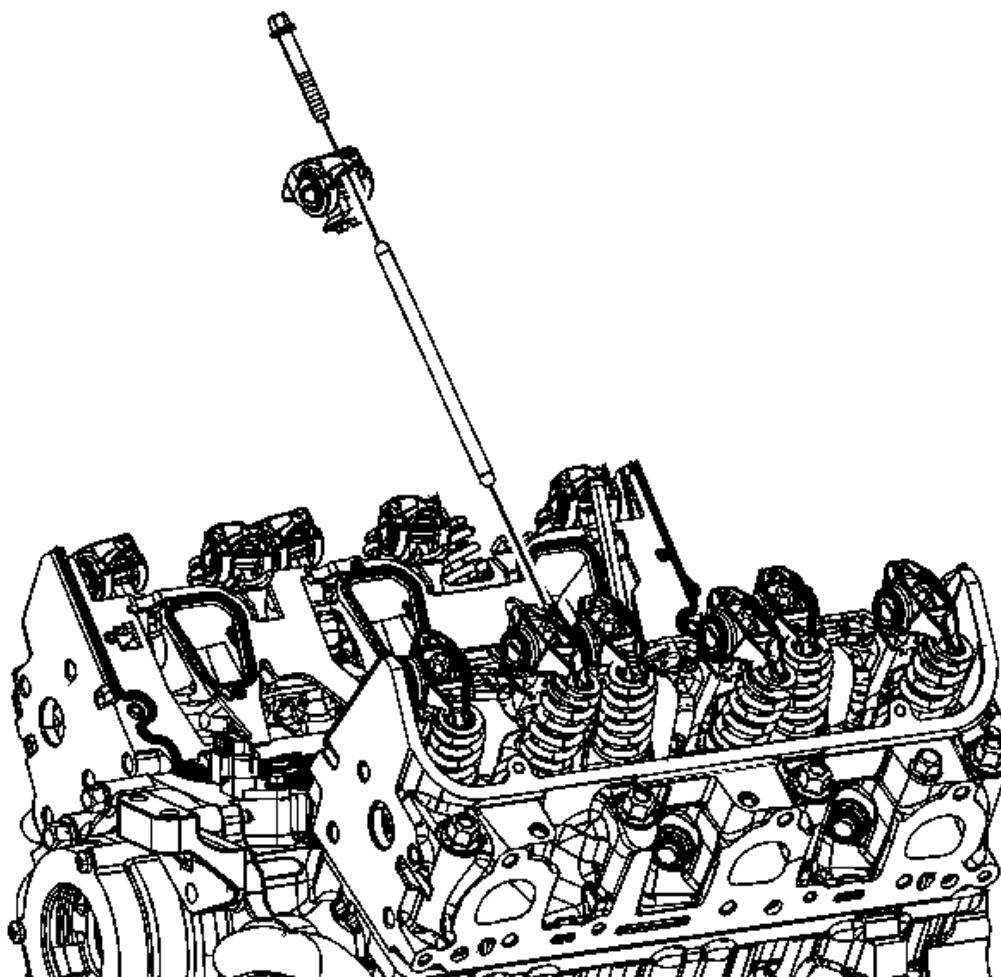


Fig. 96: Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

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

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

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

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

CAUTION: Refer to Fastener Caution .

5. Install the valve rocker arms in their original positions.
6. Install the valve rocker arm bolts.

Tighten: Tighten the bolts to 34 N.m (25 lb ft).

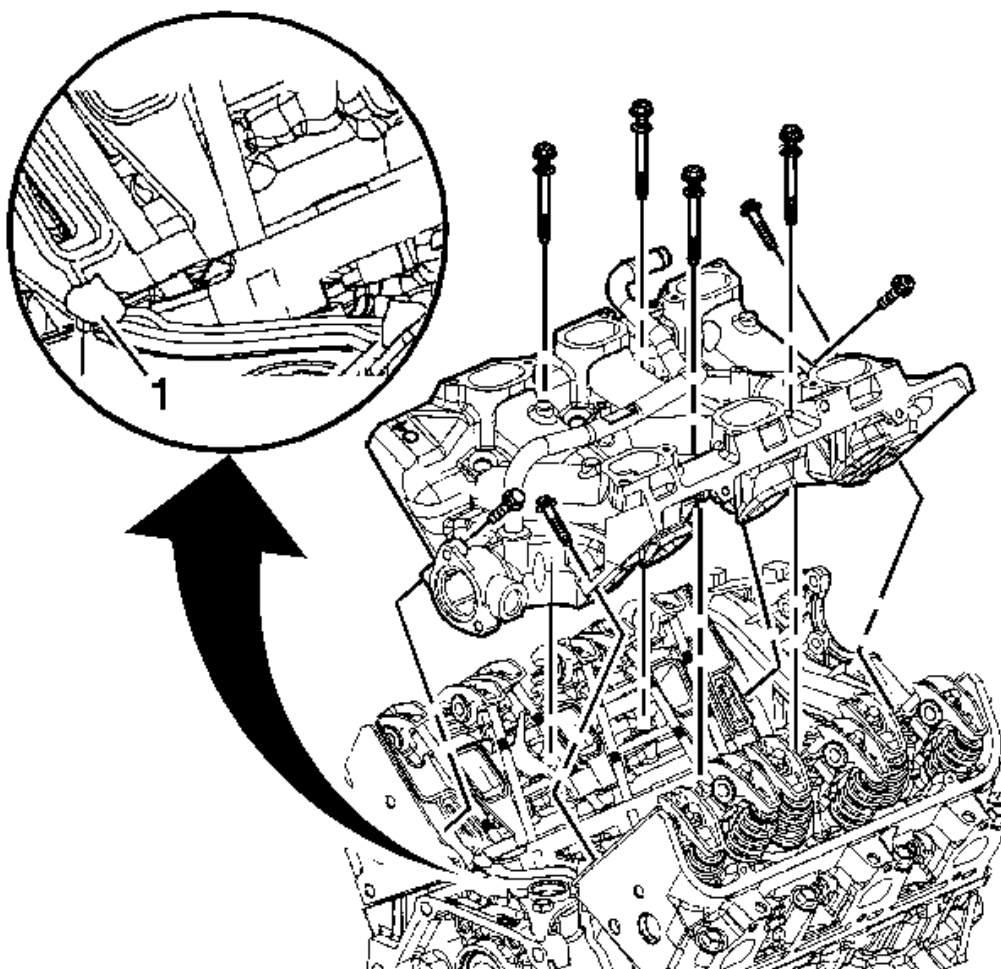
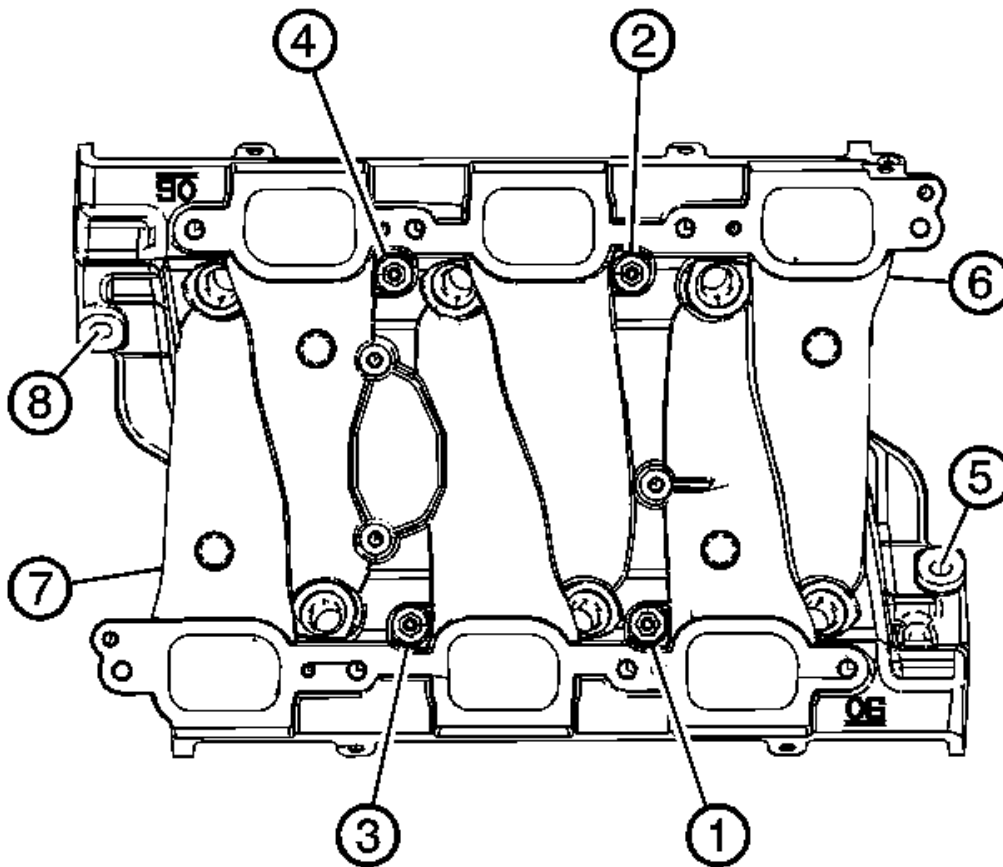


Fig. 97: Lower Intake Manifold

Courtesy of GENERAL MOTORS CORP.

7. With the NEW gaskets and seals in place, apply a small drop, 8-10 mm (0.031-0.39 in) of RTV sealer to the 4 corners of the intake manifold to engine block joints (1). Refer to **Adhesives, Fluids, Lubricants, and Sealers** for the correct part number.
8. Install the lower intake manifold.

**Fig. 98: Identifying 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 for the correct part number.
10. Install the lower intake manifold bolts.
11. Tighten the lower intake manifold bolts in the sequence shown.

Tighten:

1. Tighten the bolts (1, 2, 3, 4) in sequence to 16 N.m (12 lb ft).
2. Tighten the bolts (5, 6, 7, 8) in sequence to 25 N.m (18 lb ft).

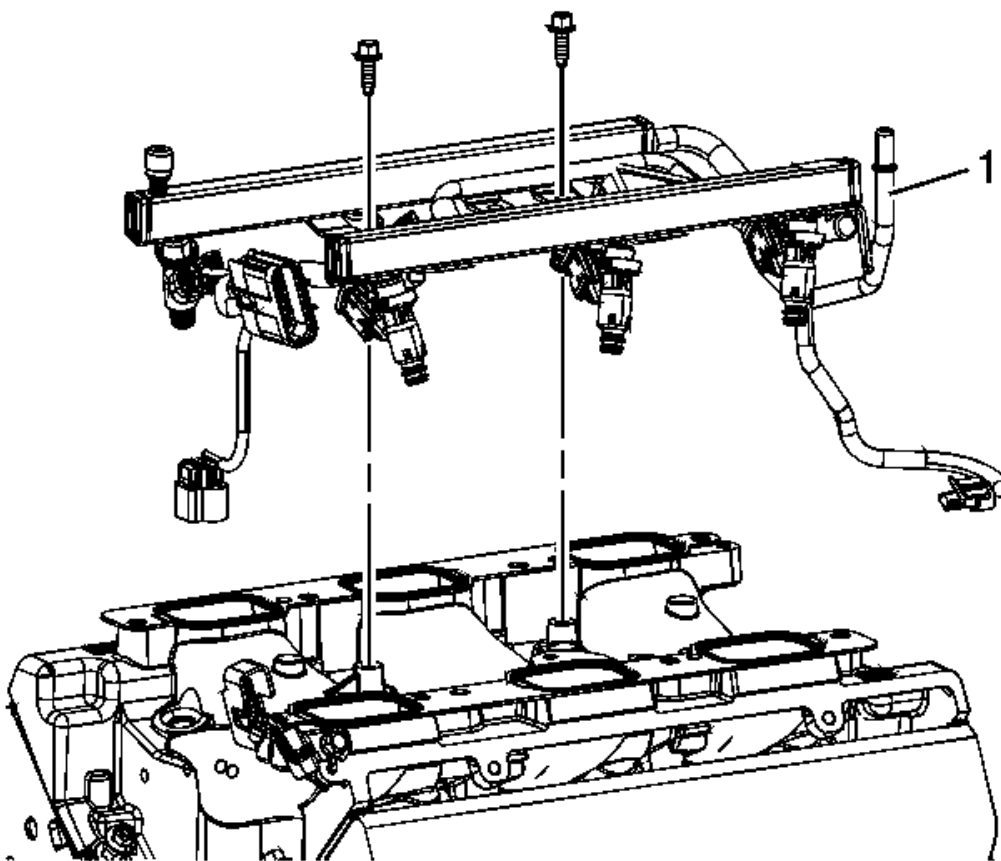


Fig. 99: Fuel Rail & Bolts

Courtesy of GENERAL MOTORS CORP.

12. Inspect the fuel rail, fuel injectors and fuel injector O-rings for damage and replace as necessary.
13. Lubricate the fuel injector O-rings using lubricant. Refer to **Adhesives, Fluids, Lubricants, and Sealers** for the correct part number.
14. Install the injector nozzles into the lower intake manifold injector bores.
15. Press on the injector rail (1) using the palms of both hands until the injector is fully seated.
16. Install the fuel injector rail bolts.

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

17. Connect the CMP sensor electrical connector.
18. Position the fuel injector harness connector bracket to the intake manifold.
19. Install the fuel injector harness connector bracket bolt.

Tighten: Tighten the bolt to 8 N.m (71 lb in).

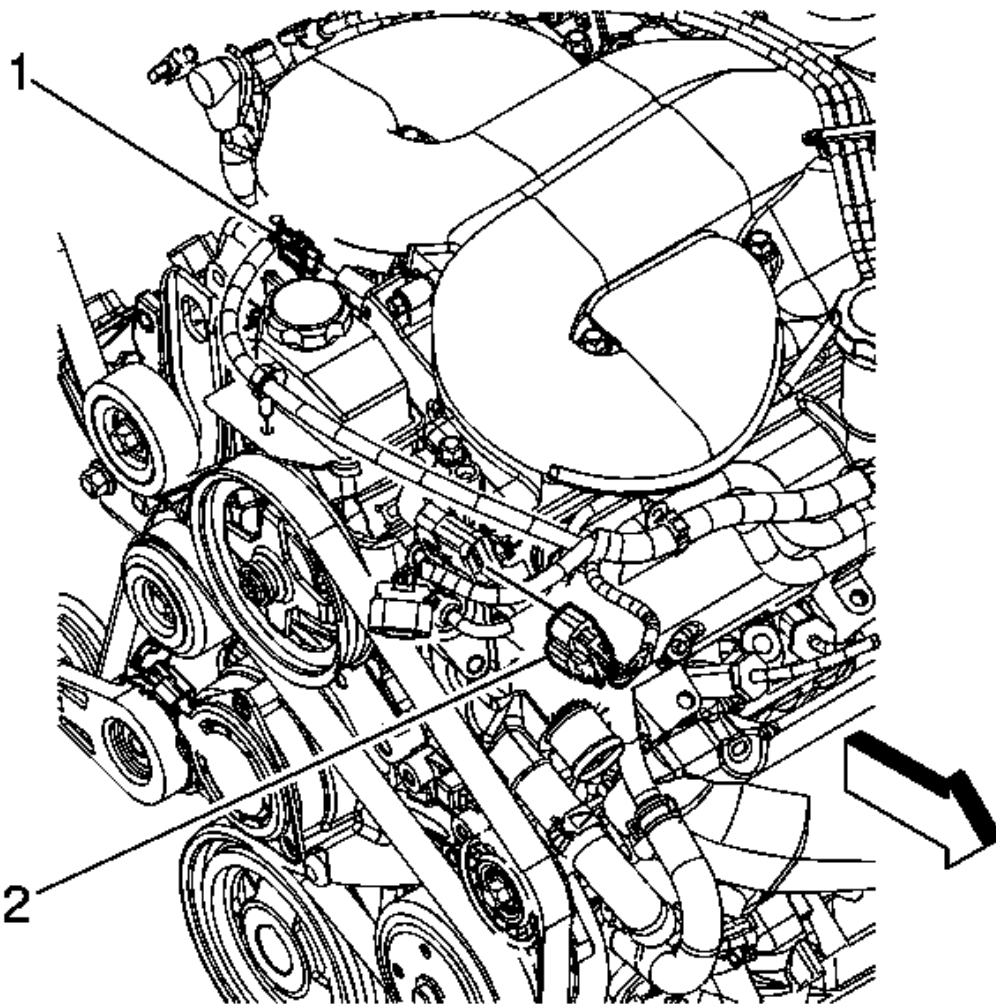


Fig. 100: Intake Manifold Tuning Valve & Injector Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

20. Connect the fuel injector inline connector (2).
21. Connect the fuel feed line to the fuel rail. Refer to Metal Collar Quick Connect Fitting Service .
22. Connect the ECT electrical connector.
23. Install the right valve rocker arm cover. Refer to Valve Rocker Arm Cover Replacement - Right Side.
24. Install the left valve rocker arm cover. Refer to Valve Rocker Arm Cover Replacement - Left Side.
25. Install the upper intake manifold. Refer to Upper Intake Manifold Replacement.
26. Install the coolant crossover pipe. Refer to Engine Coolant Crossover Pipe Replacement (LZE, LZ4) or Engine Coolant Crossover Pipe Replacement (LZ9) .

POSITIVE CRANKCASE VENTILATION HOSE/PIPE/TUBE REPLACEMENT

REMOVAL PROCEDURE

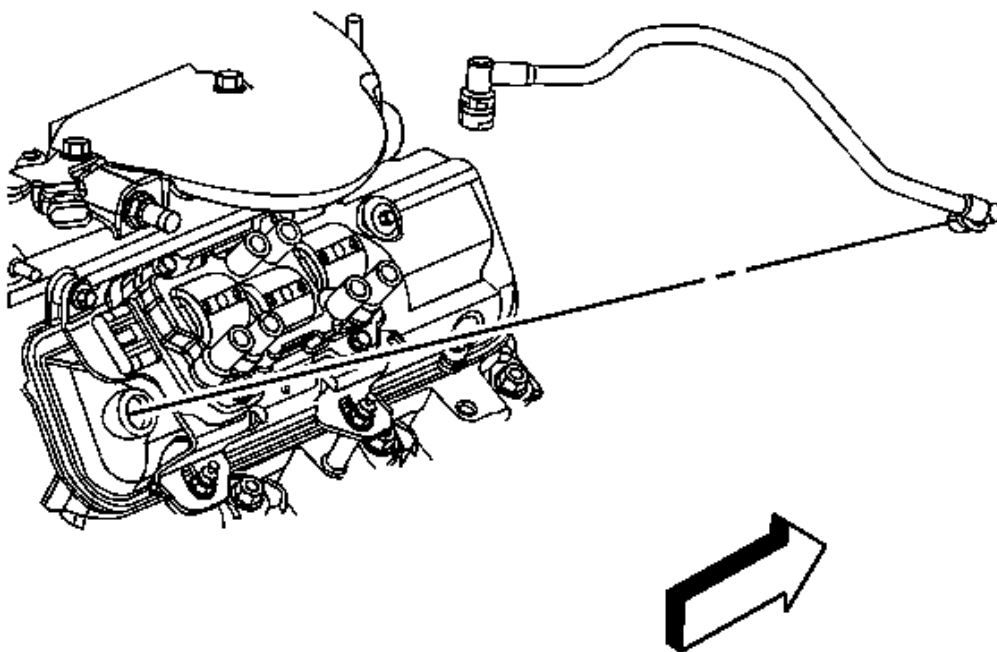


Fig. 101: Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

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

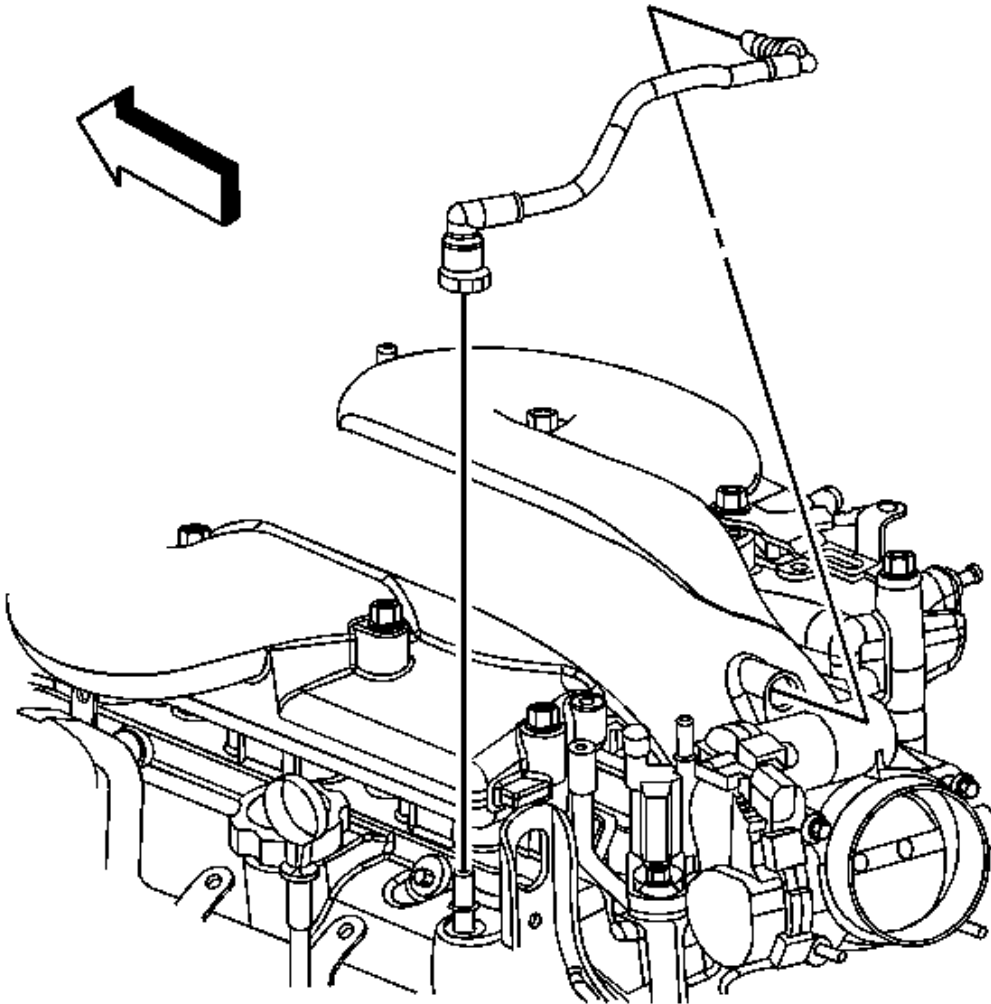


Fig. 102: Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

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

INSTALLATION PROCEDURE

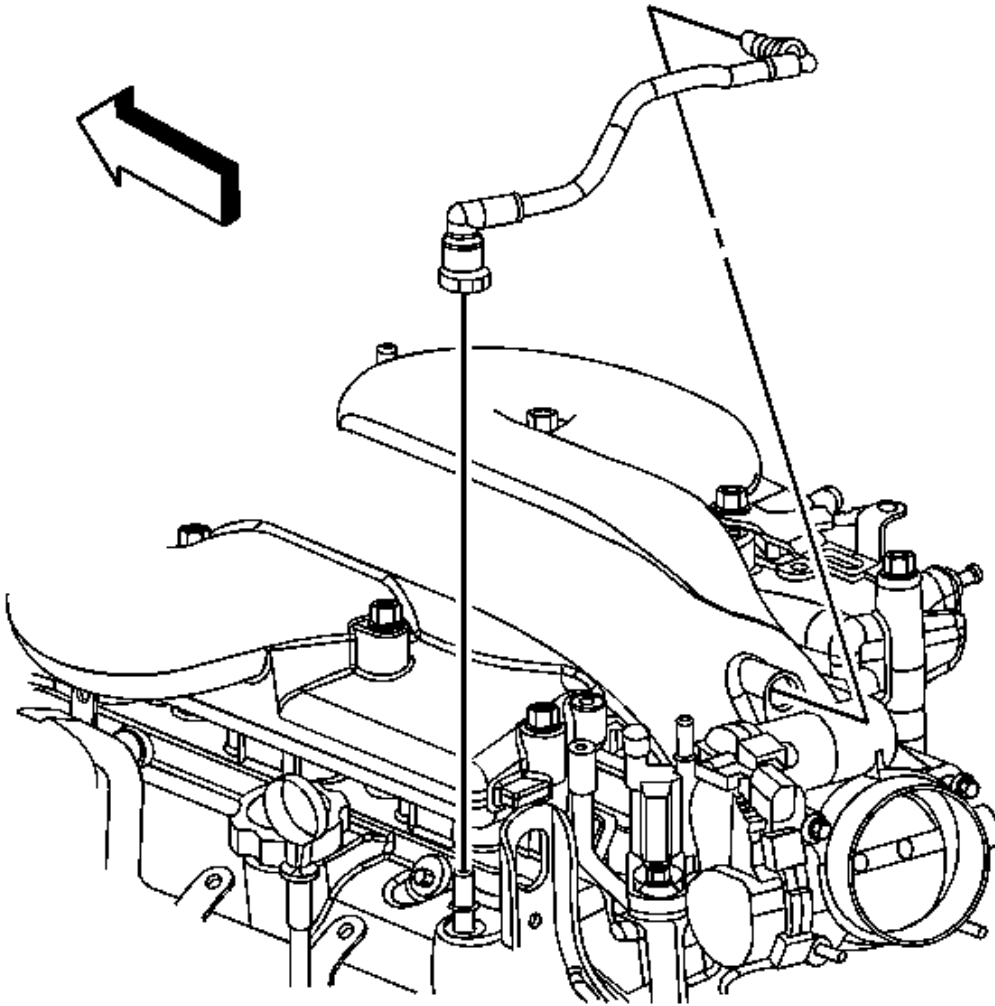


Fig. 103: Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

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

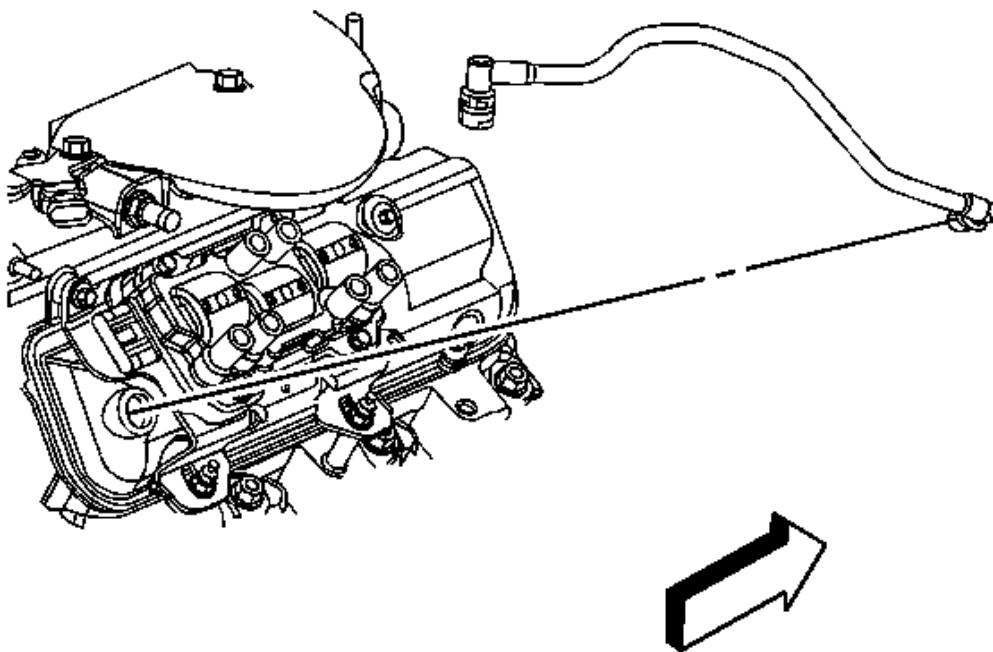


Fig. 104: Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

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

VALVE ROCKER ARM COVER REPLACEMENT - LEFT SIDE

REMOVAL PROCEDURE

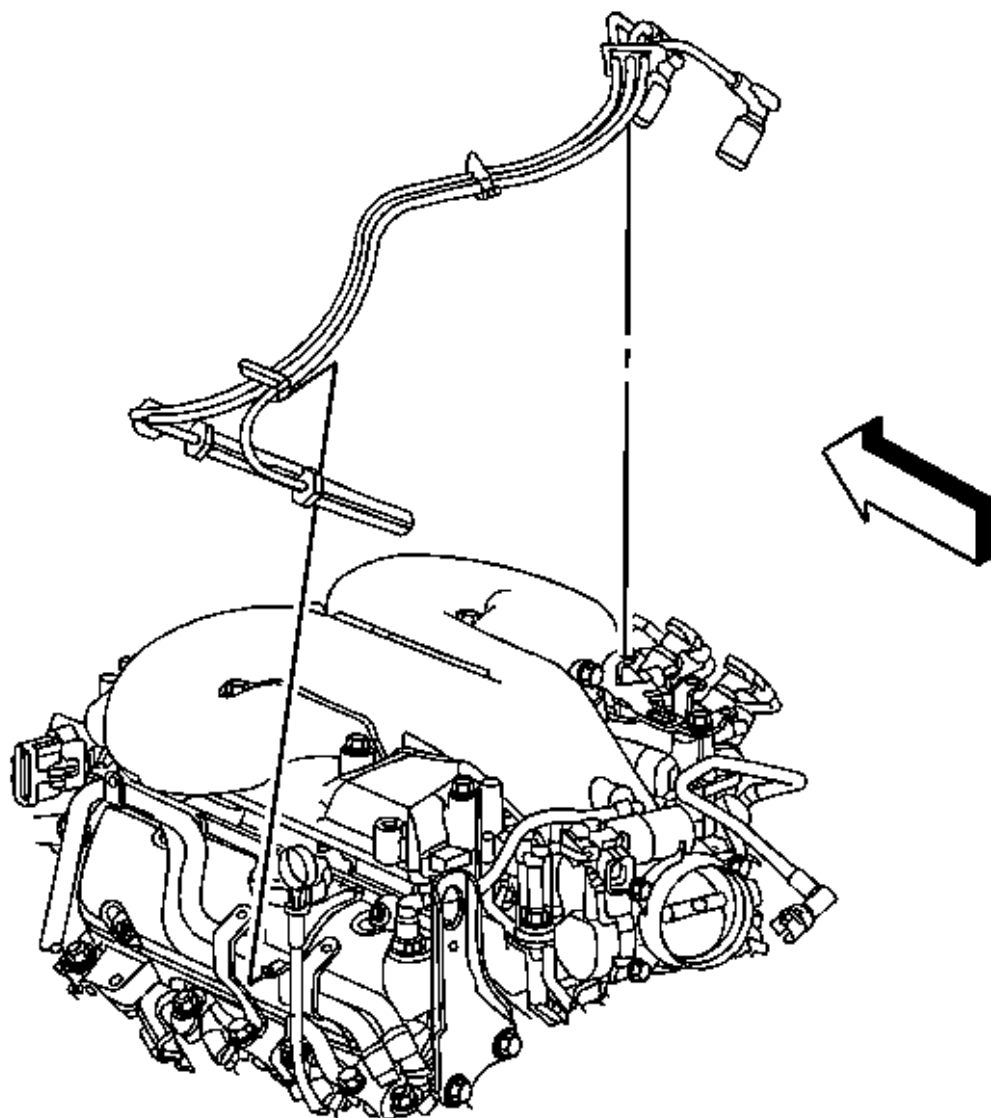


Fig. 105: Left Spark Plug/Coil Harness
Courtesy of GENERAL MOTORS CORP.

1. Partially drain the cooling system. Refer to **Cooling System Draining and Filling (GE 47716 Fill)** or **Cooling System Draining and Filling (LY7, LZE, LZ4, LZ9)** .
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 spark plug wires from the spark plugs.

5. Remove the spark plug wire harness clip from the heater inlet and outlet front pipe bracket.
6. Remove the heater inlet and outer front pipe. Refer to **Heater Inlet Hose/Pipe and Heater Outlet Hose/Pipe Replacement (LZE, LZ4, LZ9)**.

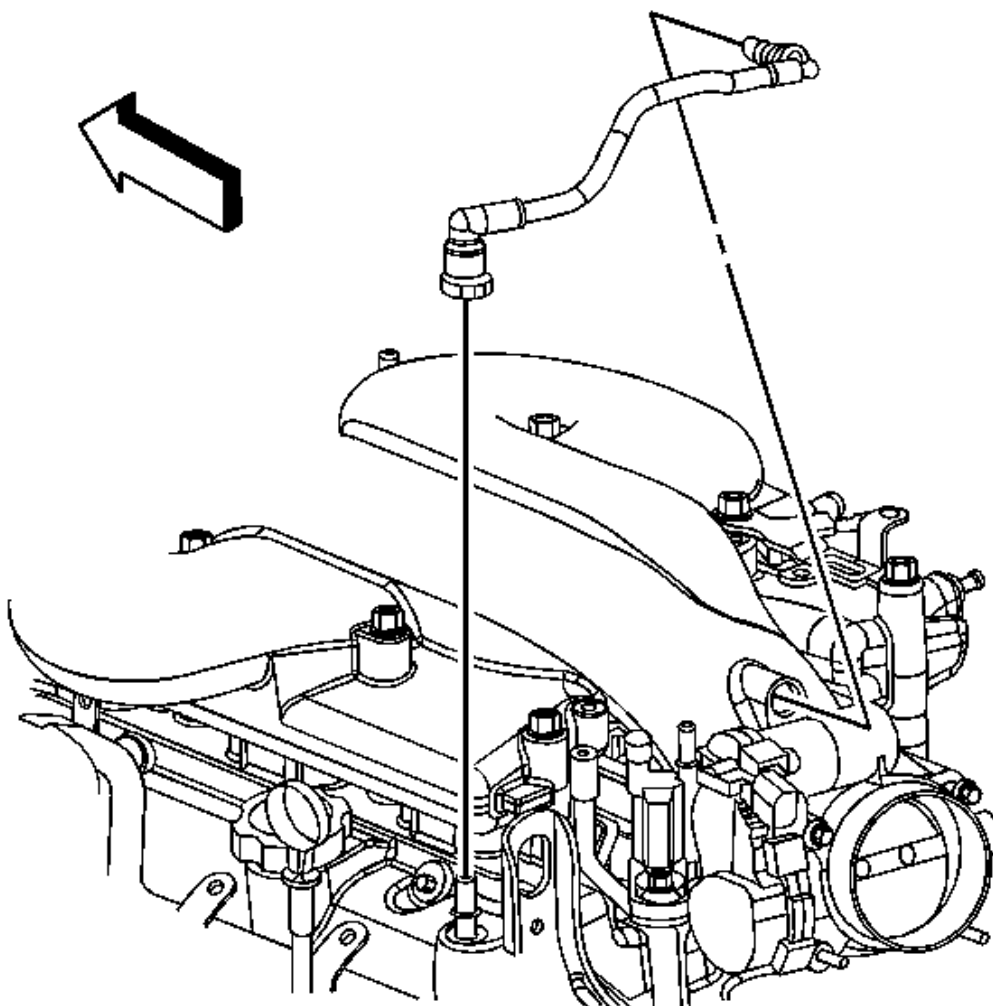


Fig. 106: Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

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

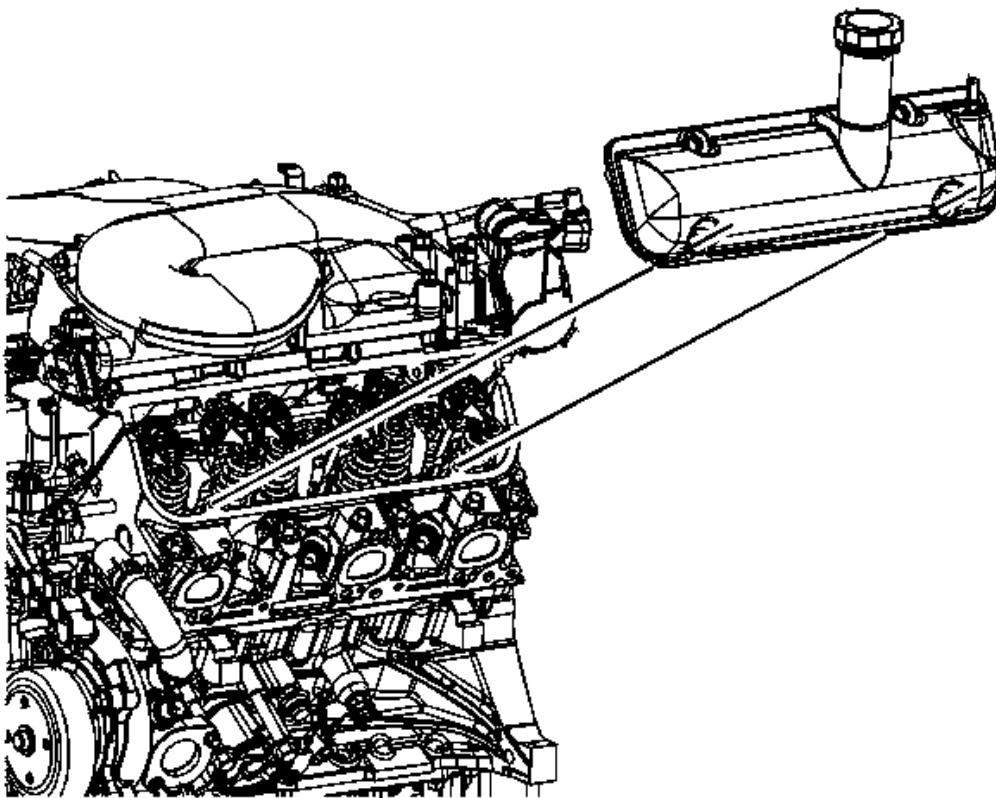


Fig. 107: Left Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

8. Remove the valve rocker arm cover bolts.

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

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

INSTALLATION PROCEDURE

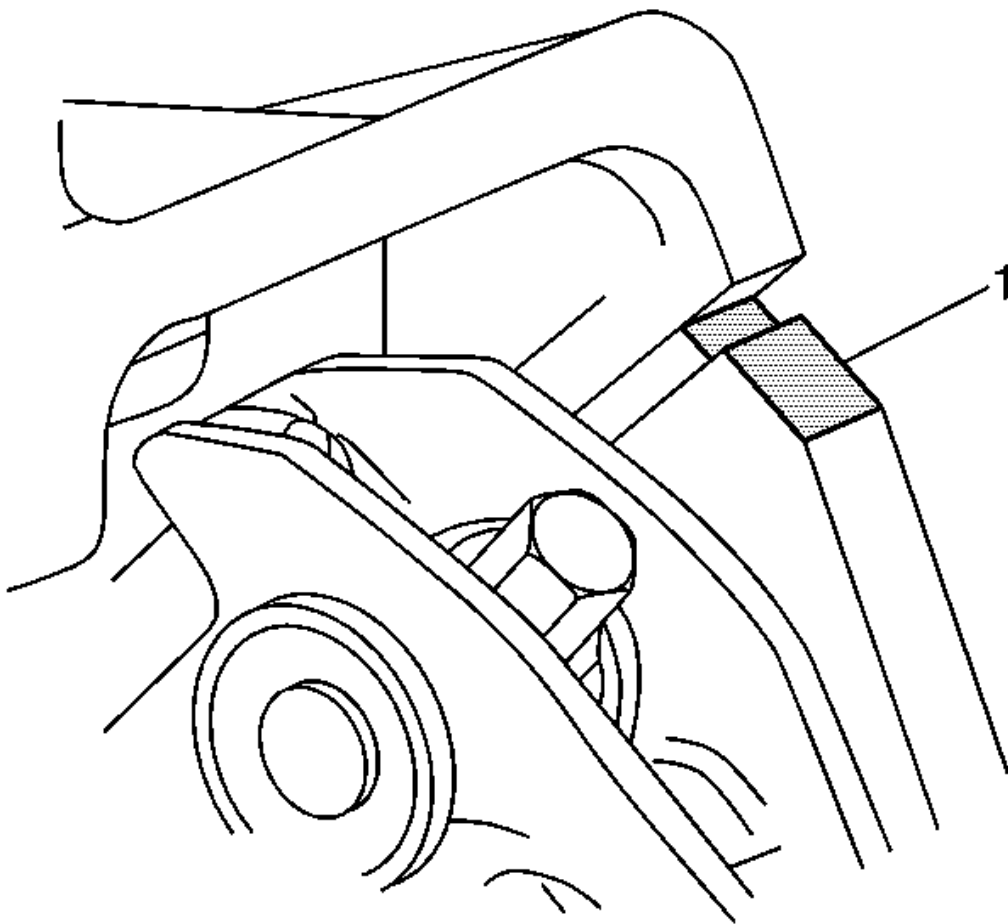


Fig. 108: Cylinder Head To Lower Intake Manifold Joint
Courtesy of GENERAL MOTORS CORP.

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

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

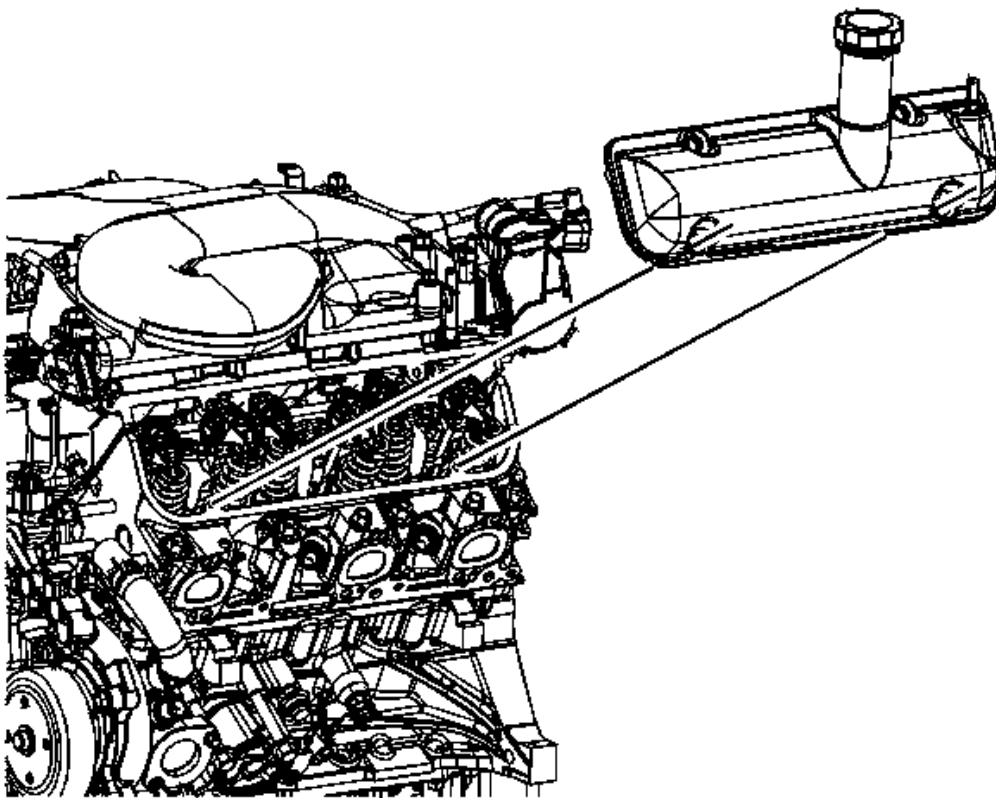


Fig. 109: Left Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

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

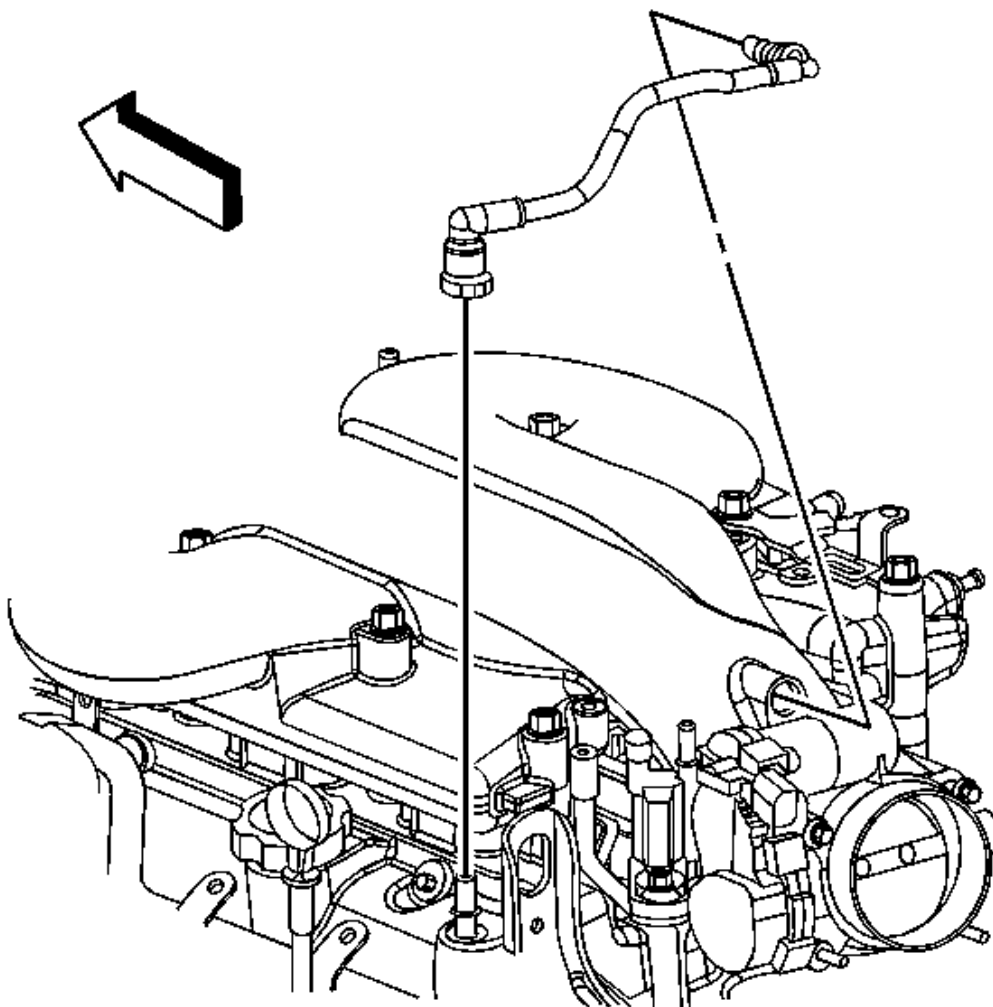


Fig. 110: Positive Crankcase Ventilation (PCV) Foul Air Tube
Courtesy of GENERAL MOTORS CORP.

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

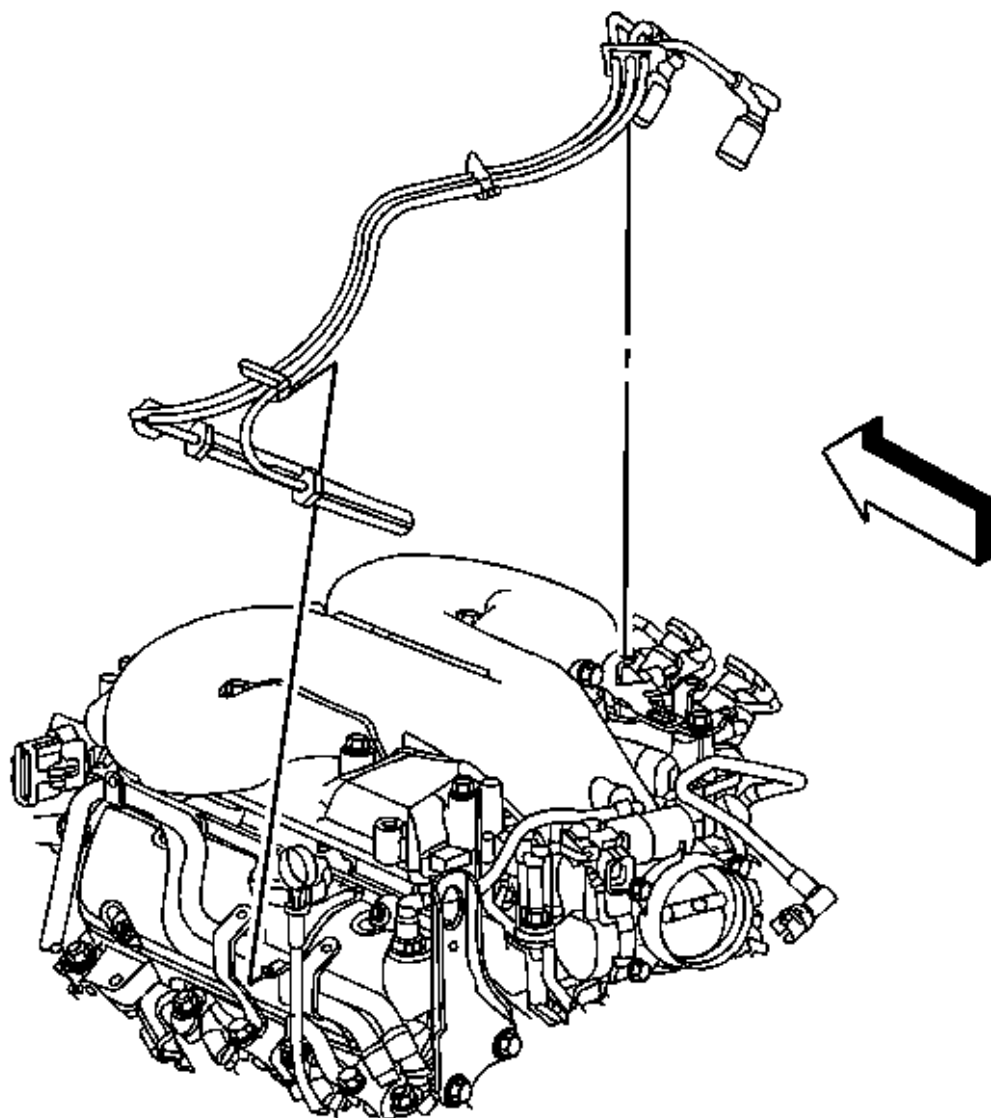


Fig. 111: Left Spark Plug/Coil Harness
Courtesy of GENERAL MOTORS CORP.

6. Install the heater inlet and outer front pipe. Refer to **Heater Inlet Hose/Pipe and Heater Outlet Hose/Pipe Replacement (LZE, LZ4, LZ9)**.
7. Install the spark plug wire harness clip to the heater inlet and outlet front pipe bracket.
8. Connect the left spark plug wires to the spark plugs.
9. Install the air cleaner outlet duct. Refer to **Air Cleaner Outlet Duct Replacement**.

10. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.
11. Fill the cooling system, as necessary. Refer to **Cooling System Draining and Filling (GE 47716 Fill)** or **Cooling System Draining and Filling (LY7, LZE, LZ4, LZ9)**.

VALVE ROCKER ARM COVER REPLACEMENT - RIGHT SIDE

REMOVAL PROCEDURE

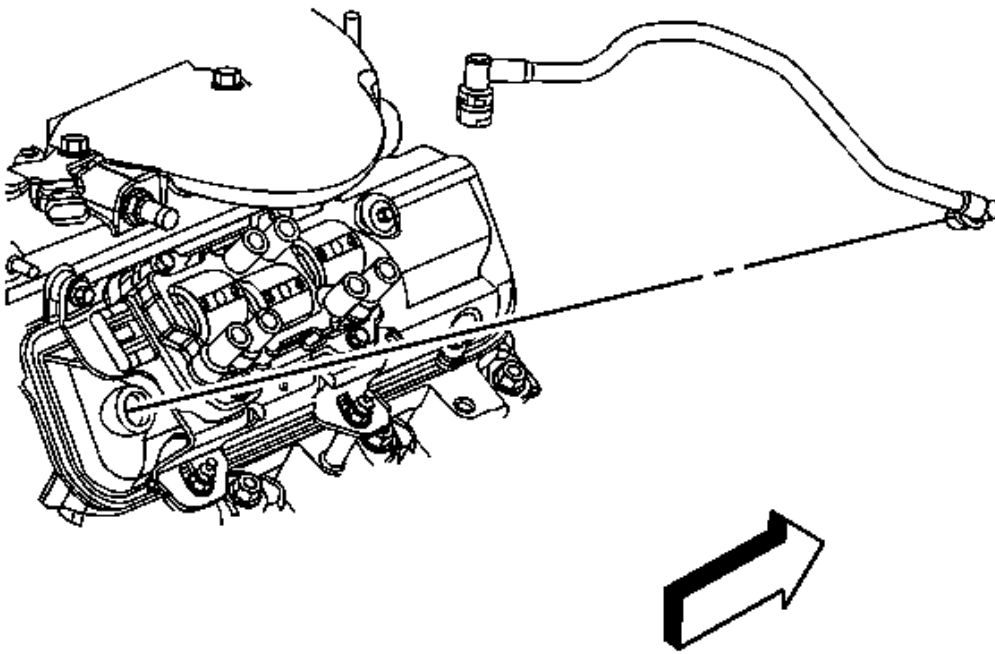


Fig. 112: Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator. Refer to **Generator Replacement (LZ9)**.
2. Remove the engine coolant crossover pipe. Refer to **Engine Coolant Crossover Pipe Replacement (LZ9)**.
3. Disconnect the positive crankcase ventilation (PCV) fresh air tube from the air cleaner outlet duct. Refer to **Plastic Collar Quick Connect Fitting Service**.
4. Remove the PCV fresh air tube from the right side valve rocker arm cover.

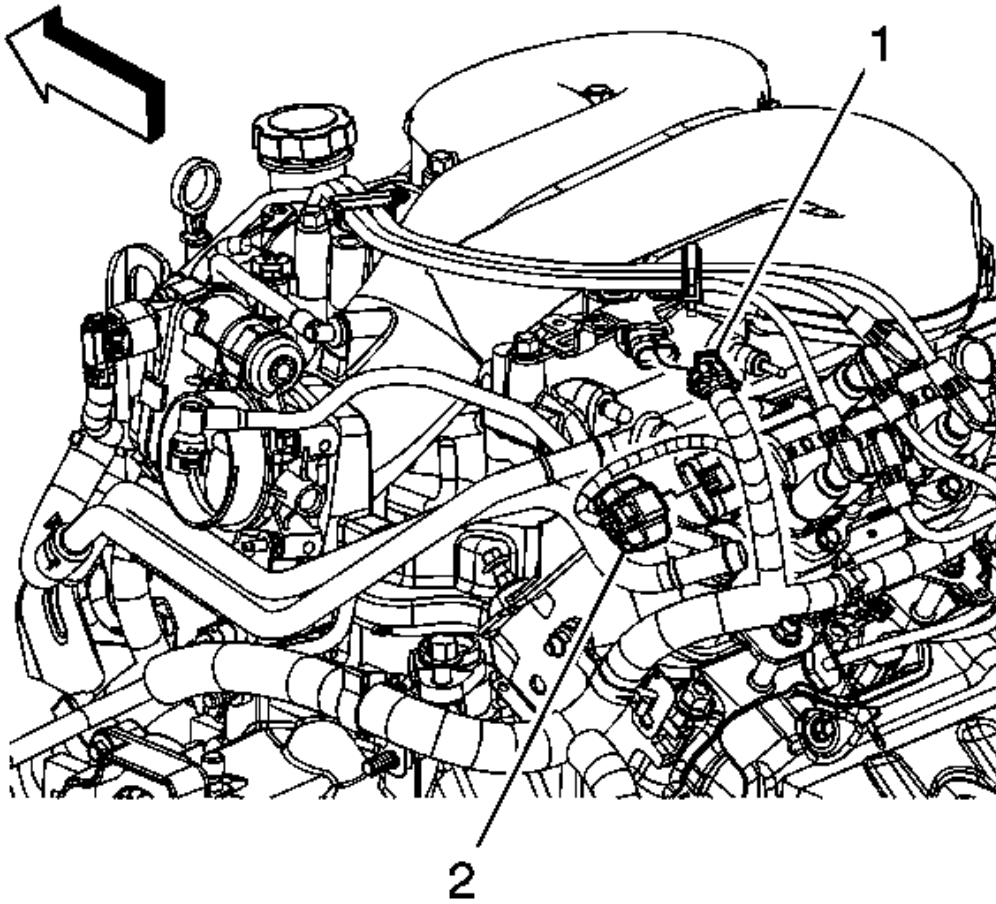


Fig. 113: ECM & MAP Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).
6. Disconnect the ignition coil electrical connector (2).
7. Remove the heated oxygen sensor (HO2S) electrical connector clip from the ignition coil bracket.

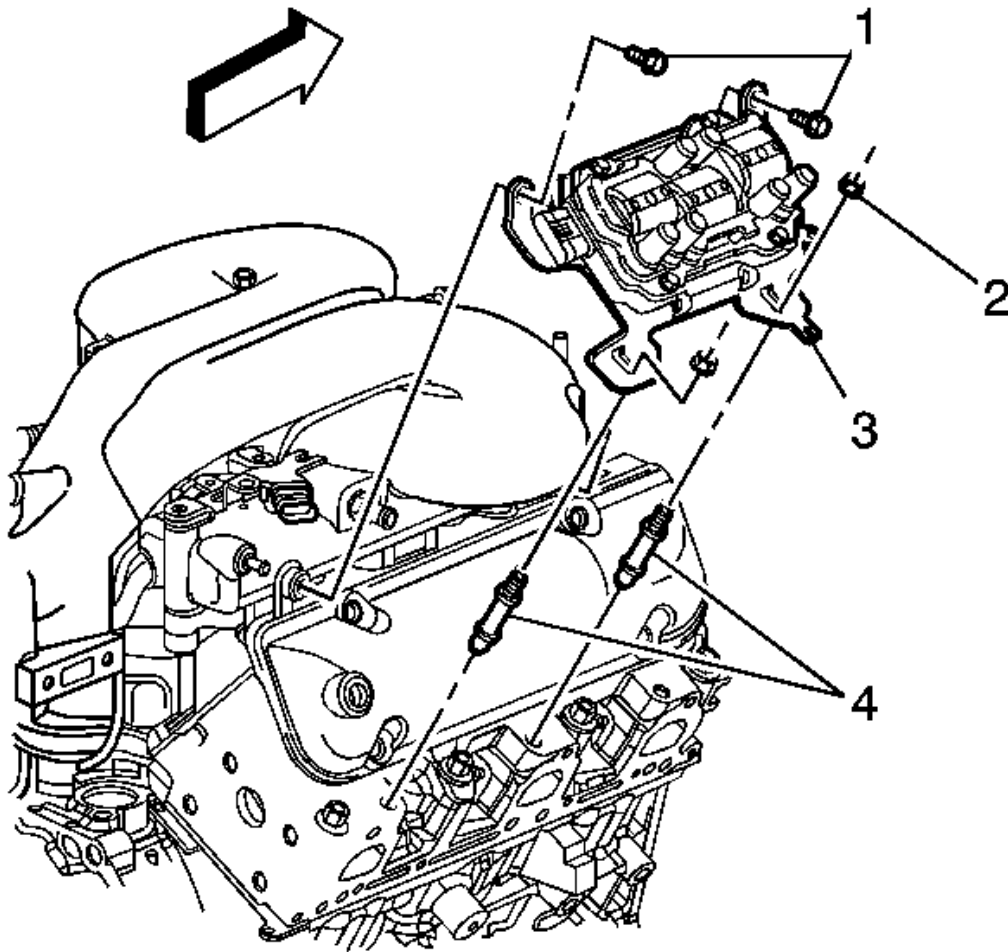


Fig. 114: Ignition Coil, Bracket, Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

8. Remove the spark plug wires from the ignition coil.
9. Remove the ignition coil bracket bolts (1) and nuts (2).
10. Remove the ignition coil with bracket (3) from the engine.

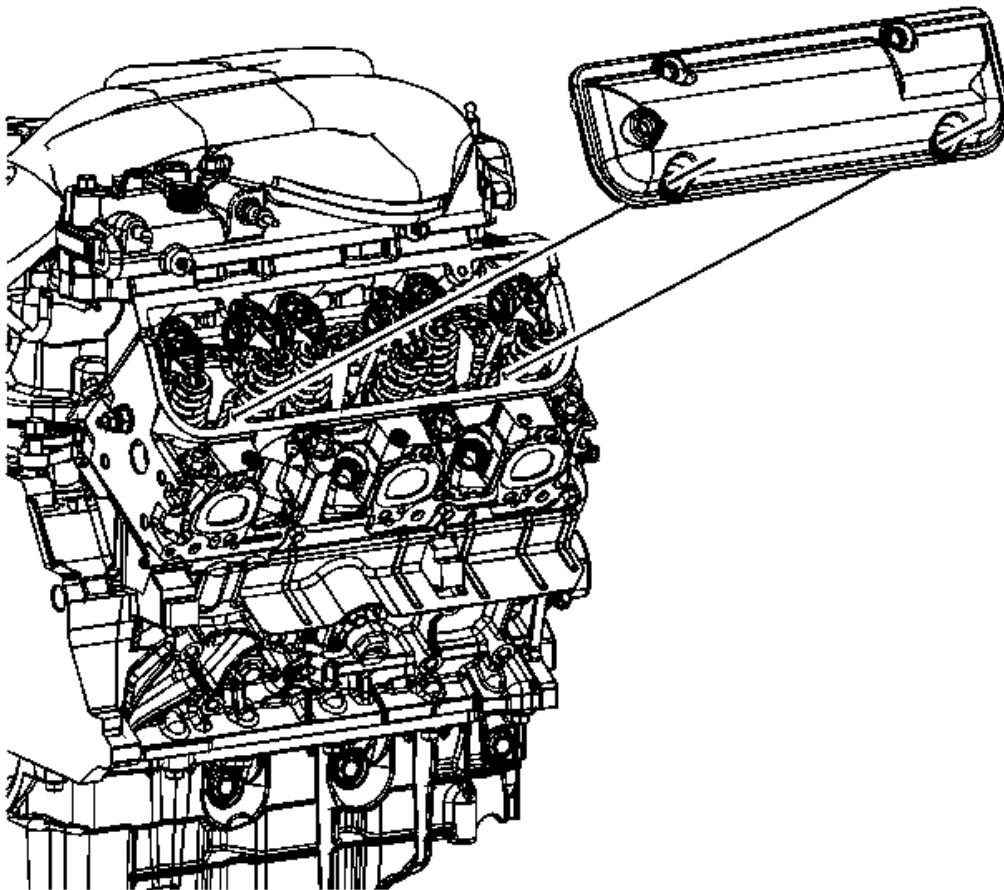


Fig. 115: Right Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

11. Remove the valve rocker arm cover bolts.

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

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

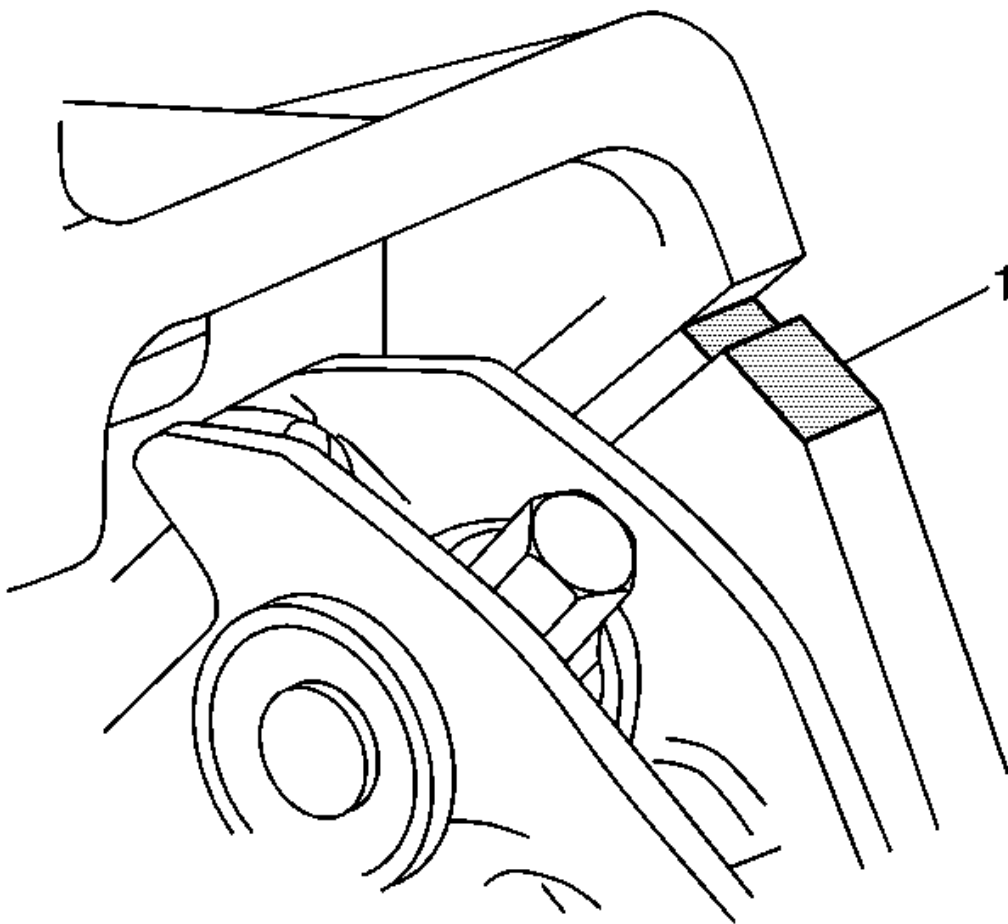
INSTALLATION PROCEDURE

Fig. 116: Cylinder Head To Lower Intake Manifold Joint
Courtesy of GENERAL MOTORS CORP.

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

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

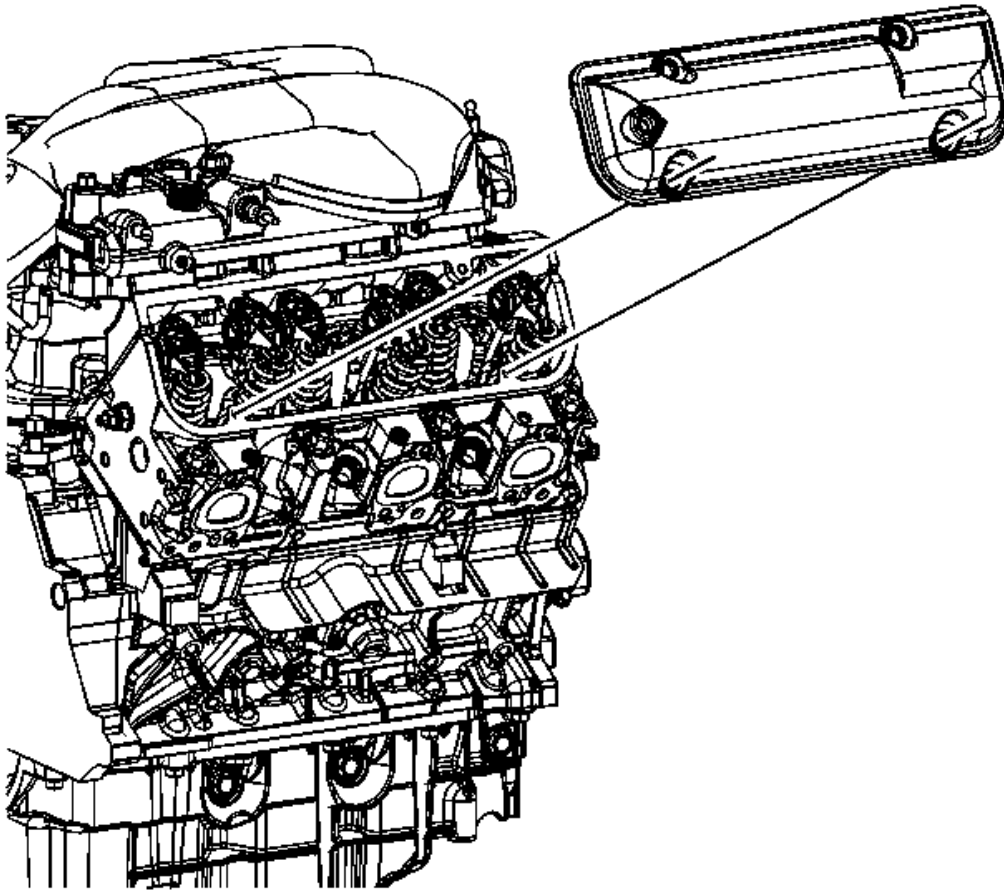


Fig. 117: Right Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

3. Install a new gasket to the valve rocker arm cover. Ensure that the gasket is properly seated in the groove of the valve rocker arm cover.
4. Install the right valve rocker arm cover.
5. Install the valve rocker arm cover bolts. Refer to **Valve Rocker Arm Cover Installation - Right Side** .

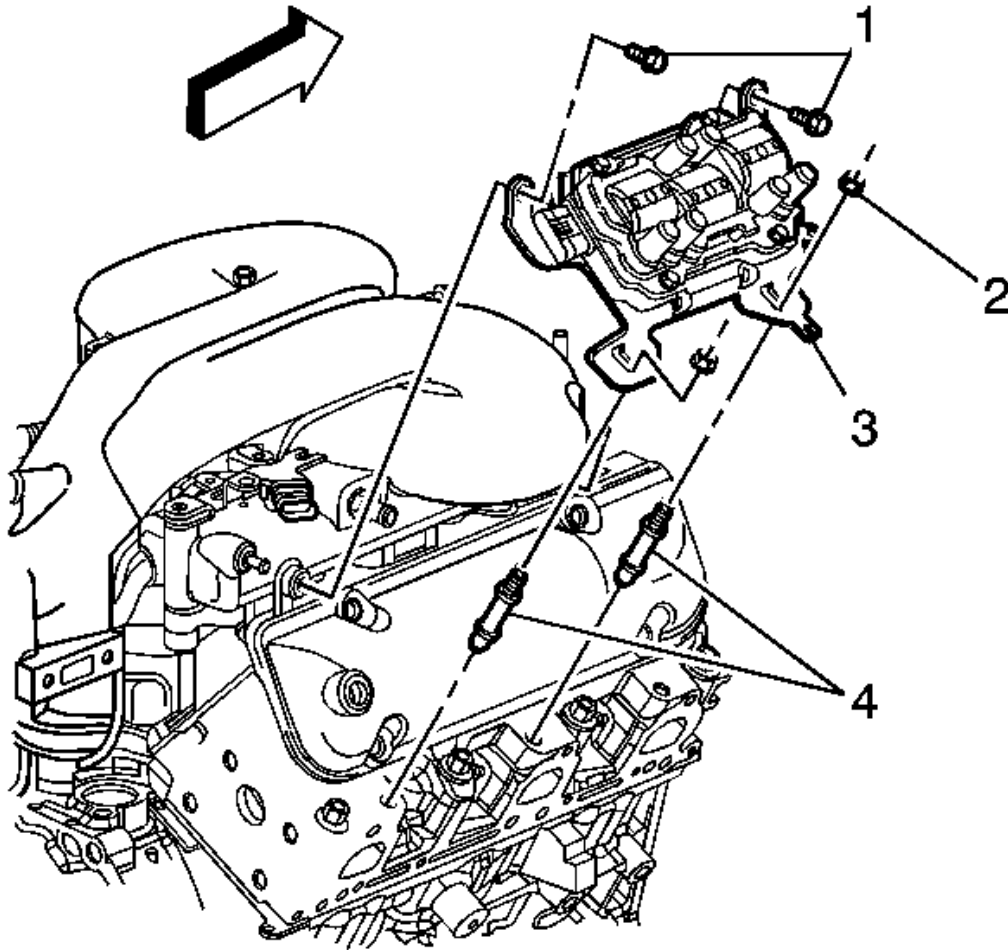


Fig. 118: Ignition Coil, Bracket, Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

6. Install the ignition coil with bracket (3) to the engine.

CAUTION: Refer to Fastener Caution .

7. Install the ignition coil bracket bolts (1) and nuts (2).

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

8. Install the spark plug wires to the ignition coil.

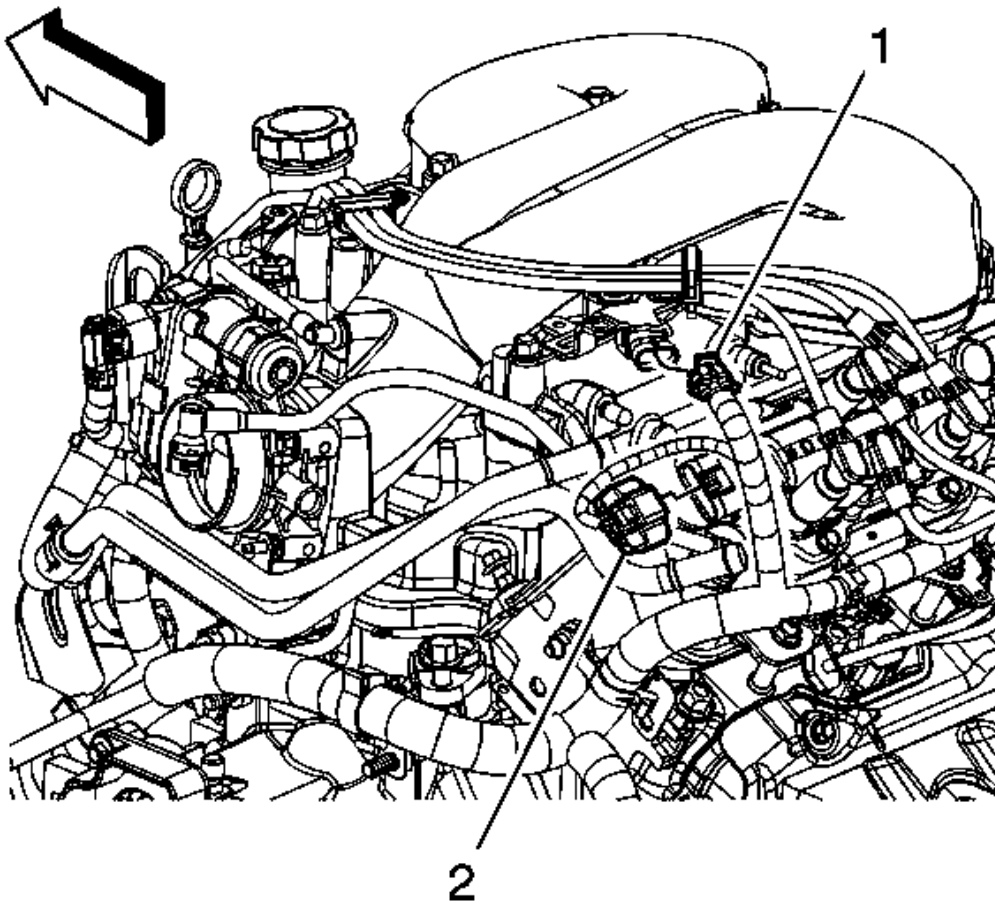


Fig. 119: ECM & MAP Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

9. Install the HO2S electrical connector clip to the ignition coil bracket.
10. Connect the ignition coil electrical connector (2).
11. Connect the MAP sensor electrical connector (1).

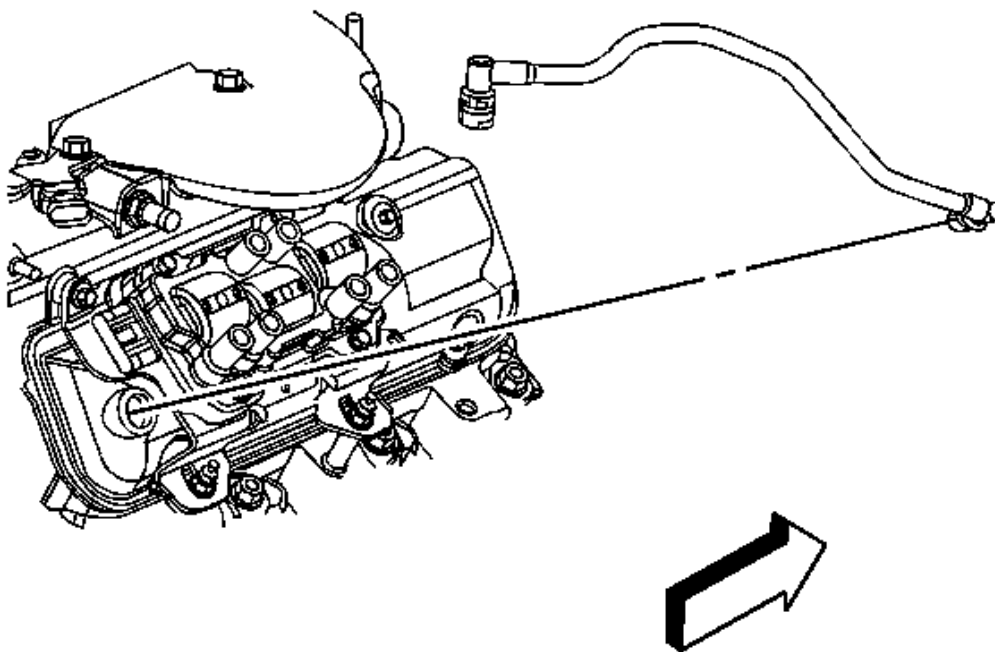


Fig. 120: Positive Crankcase Ventilation (PCV) Fresh Air Tube
Courtesy of GENERAL MOTORS CORP.

12. Install the PCV fresh air tube to the right side valve rocker arm cover.
13. Connect the PCV fresh air tube to the air cleaner outlet duct. Refer to **Plastic Collar Quick Connect Fitting Service** .
14. Install the engine coolant crossover pipe. Refer to **Engine Coolant Crossover Pipe Replacement (LZ9)** .
15. Install the generator. Refer to **Generator Replacement (LZ9)** .

VALVE ROCKER ARM AND PUSH ROD REPLACEMENT

REMOVAL PROCEDURE

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

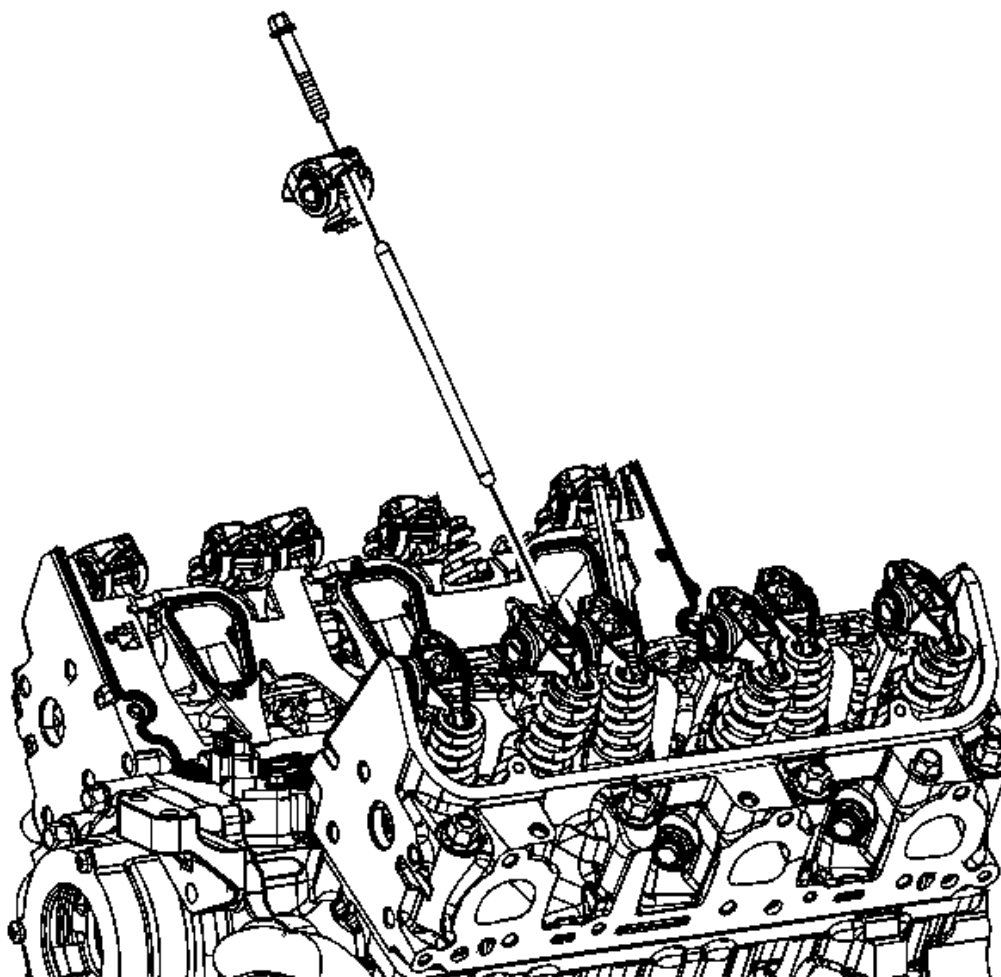


Fig. 121: Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

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 valve rocker arm bolts.
3. Remove the rocker arms.
4. Remove the pushrods.
 - The intake push rods measure 147.51 mm (5.81 in).
 - The exhaust push rods measure 154.87 mm (6.1 in).

INSTALLATION PROCEDURE

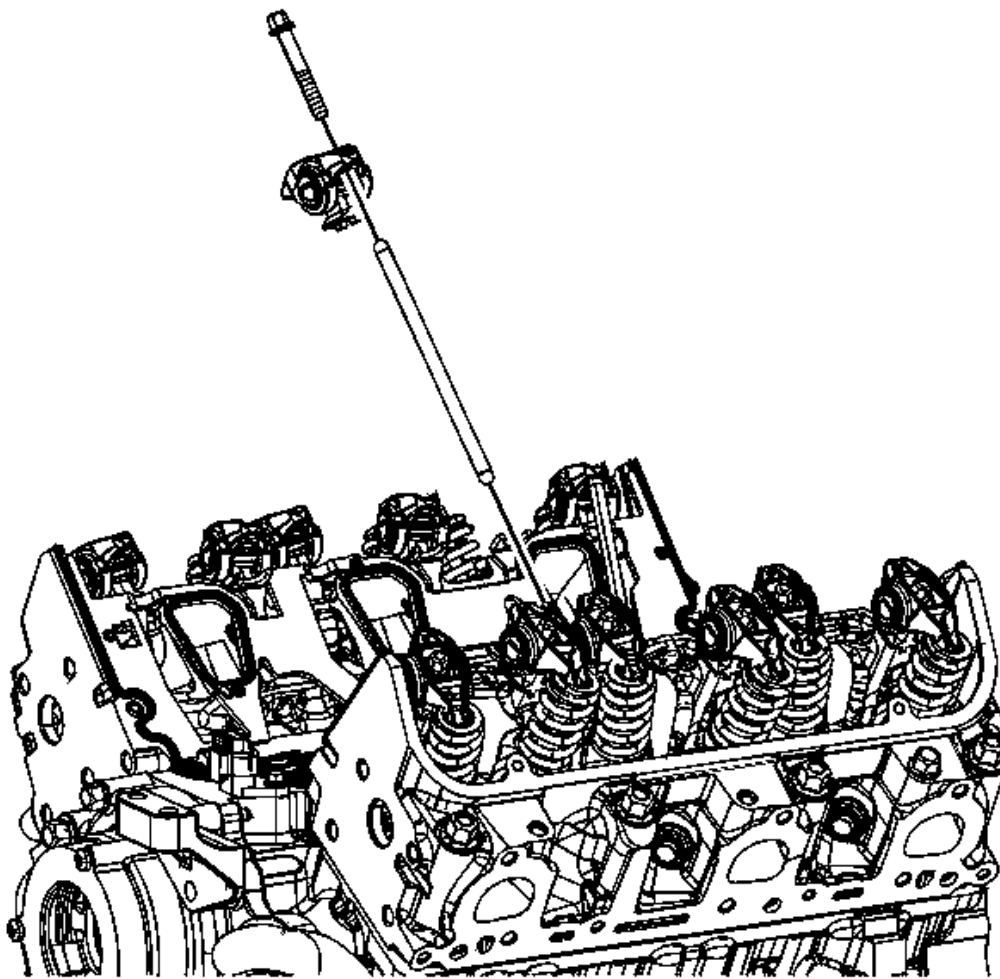


Fig. 122: Valve Rocker Arm & Bolt
Courtesy of GENERAL MOTORS CORP.

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 blue stripes.
 - The exhaust pushrods are identified with yellow 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 .

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

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

5. Install the rocker arms.
6. Install the rocker arm bolts. Refer to **Valve Rocker Arm and Push Rod Installation** .
7. Install the valve rocker arm 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
- **J 22794** Spark Plug Port Adapter
- **J 5892-D** Valve Spring Compressor

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.**

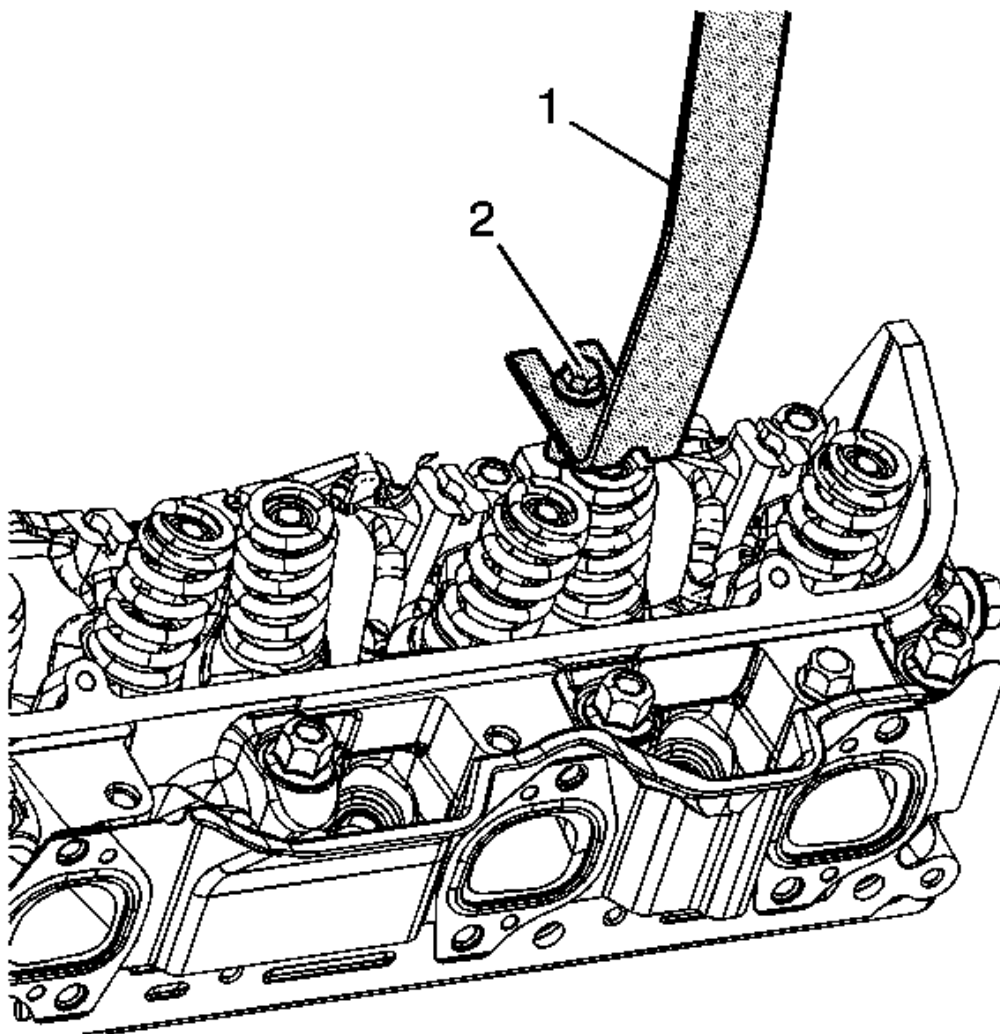


Fig. 123: Compressing Valve Spring
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug. Refer to **Spark Plug Replacement**.
2. Remove the rocker arm. Refer to **Valve Rocker Arm and Push Rod Replacement**.
3. Install the **J 22794** into the spark plug port. Apply compressed air in order to hold the valve in place.
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).

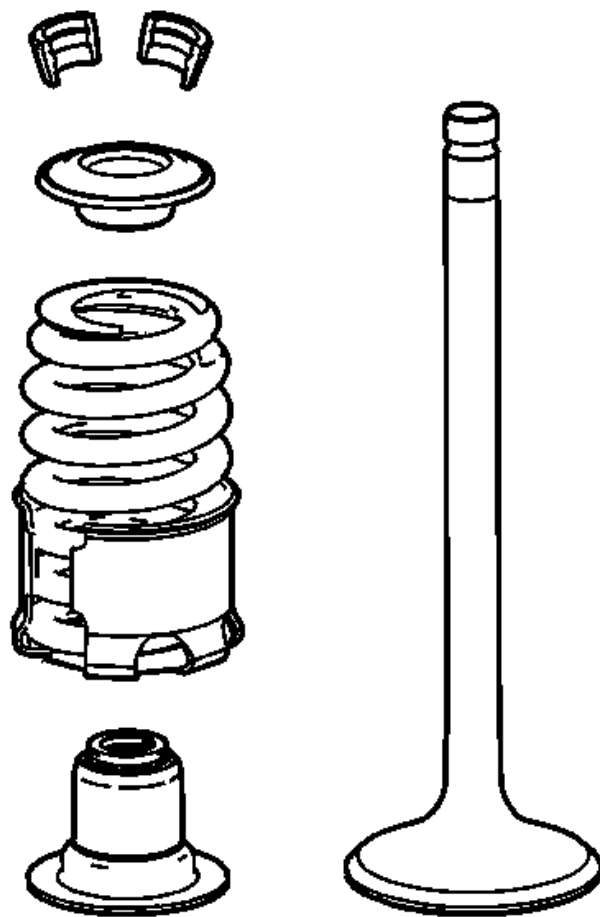


Fig. 124: Valve Components

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

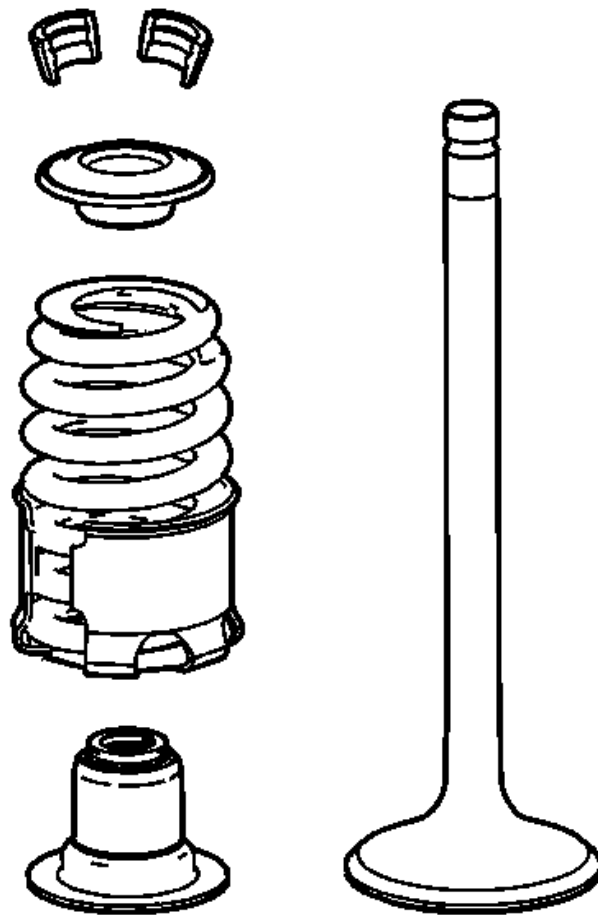


Fig. 125: Valve Components

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.

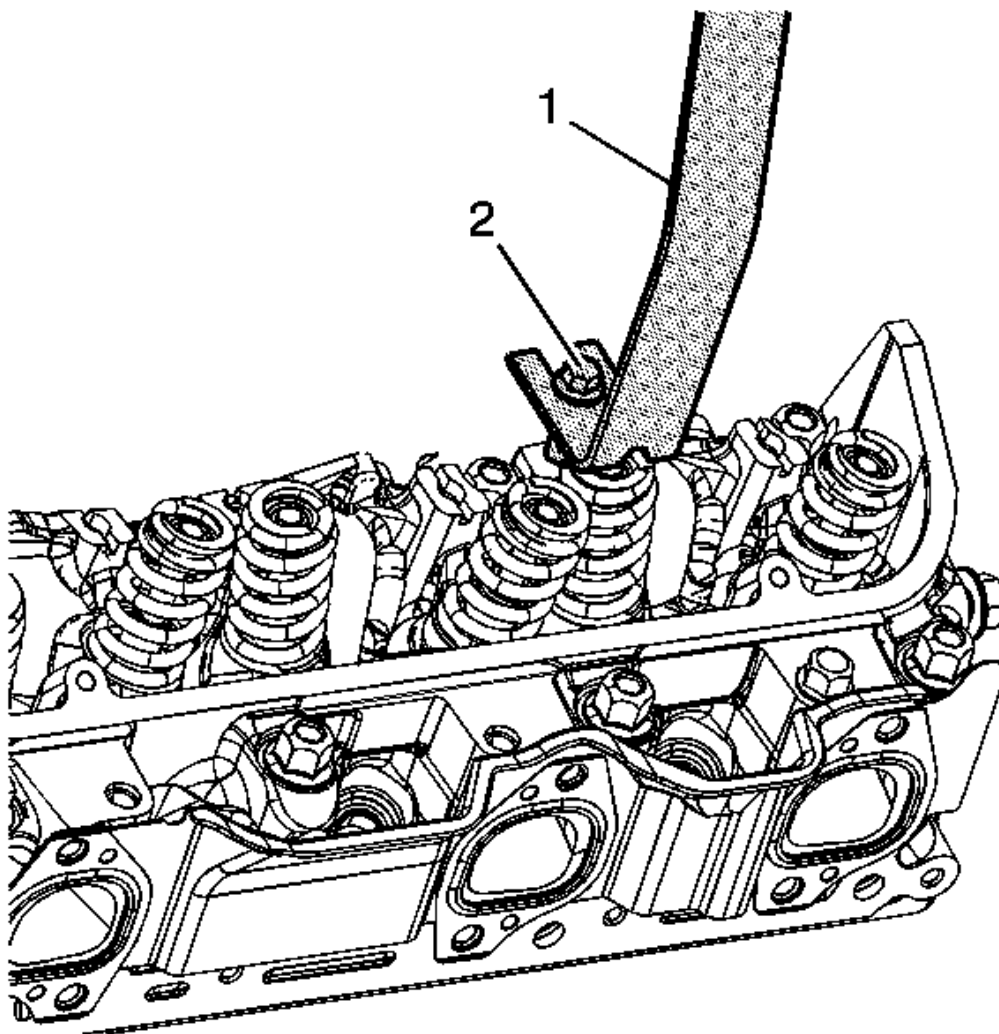


Fig. 126: Compressing Valve Spring
Courtesy of GENERAL MOTORS CORP.

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).
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.
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

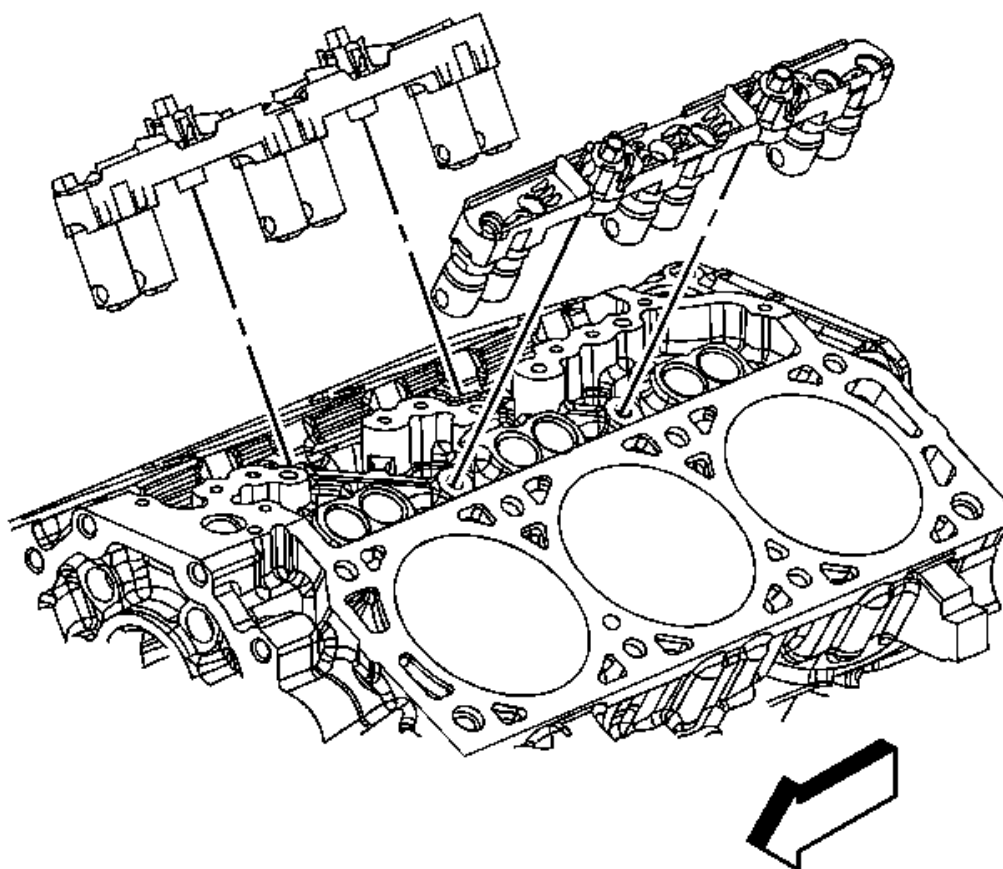


Fig. 127: Valve Lifter Guides

Courtesy of GENERAL MOTORS CORP.

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

NOTE: The valve lifter guide bolts are not removable.

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

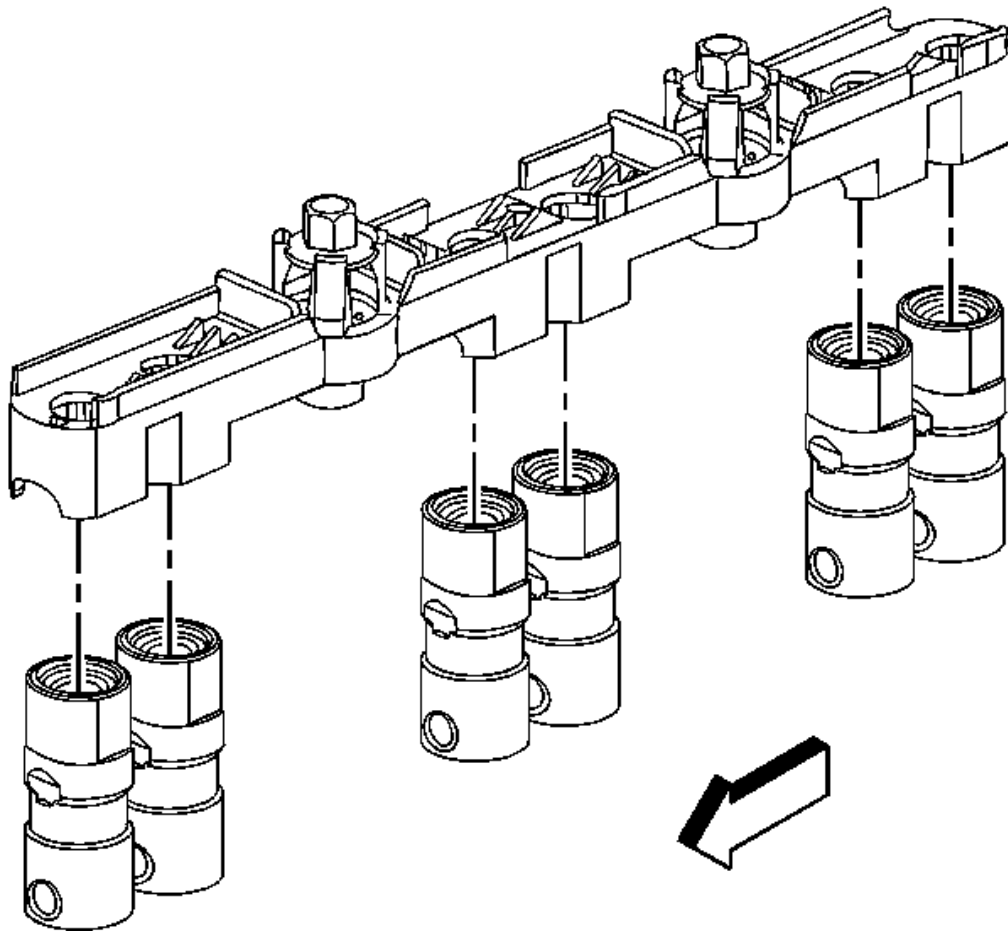


Fig. 128: Valve Lifters
Courtesy of GENERAL MOTORS CORP.

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

INSTALLATION PROCEDURE

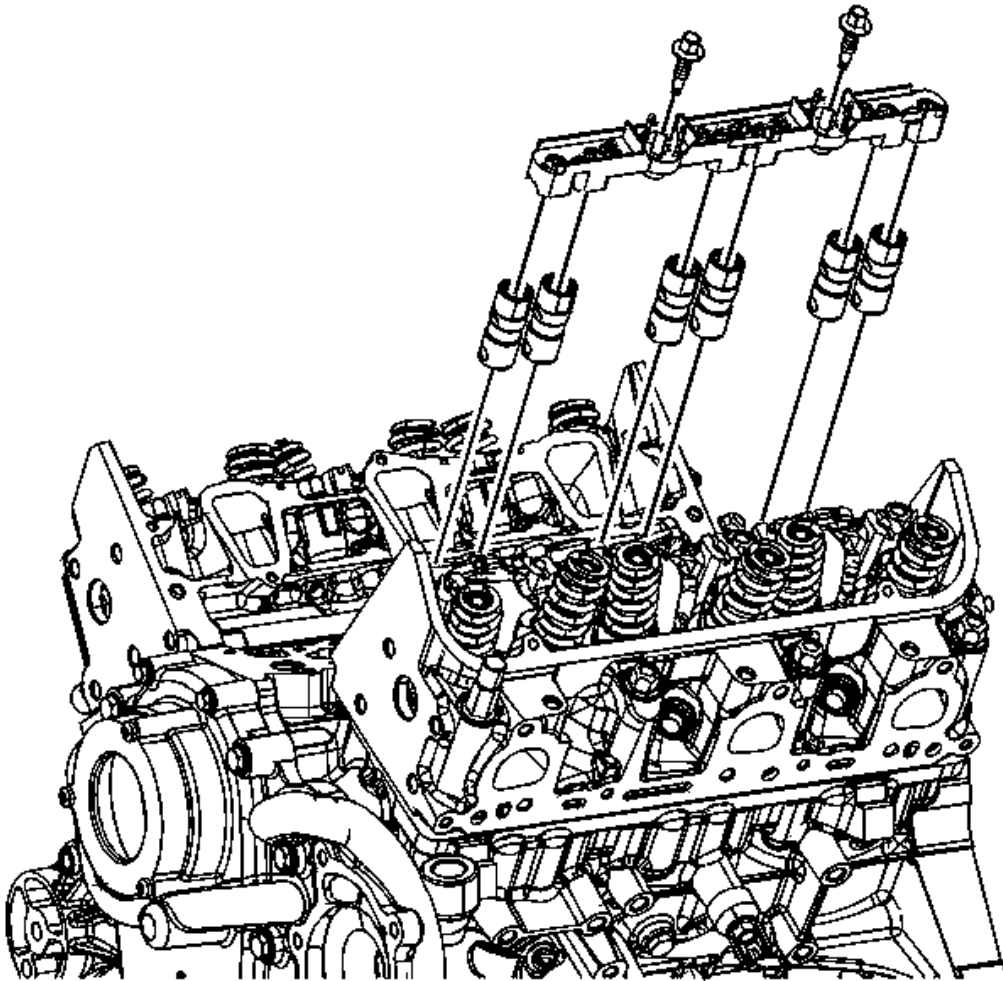


Fig. 129: Valve Lifter Guides & Bolts
Courtesy of GENERAL MOTORS CORP.

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

CAUTION: Refer to Fastener Caution .

5. Tighten the valve lifter guide bolts and tighten to 10 N.m (89 lb in).
6. Install the valve rocker arms and pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
7. Install the lower intake manifold. Refer to **Lower Intake Manifold Replacement**.

CRANKSHAFT BALANCER REPLACEMENT

Special Tools

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

REMOVAL PROCEDURE

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

1. Remove the drive belt. Refer to **Drive Belt Replacement (Coupe)** or **Drive Belt Replacement (Convertible)**.
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 adjustable jack stands under the frame.
6. Loosen the left side frame bolts and remove the right side frame bolts.
7. Using the jack stands, lower the right side of the frame in order to access the crankshaft balancer.
8. Remove the torque converter covers.
9. Install the **J 37096** to the flywheel in order to prevent flywheel rotation.

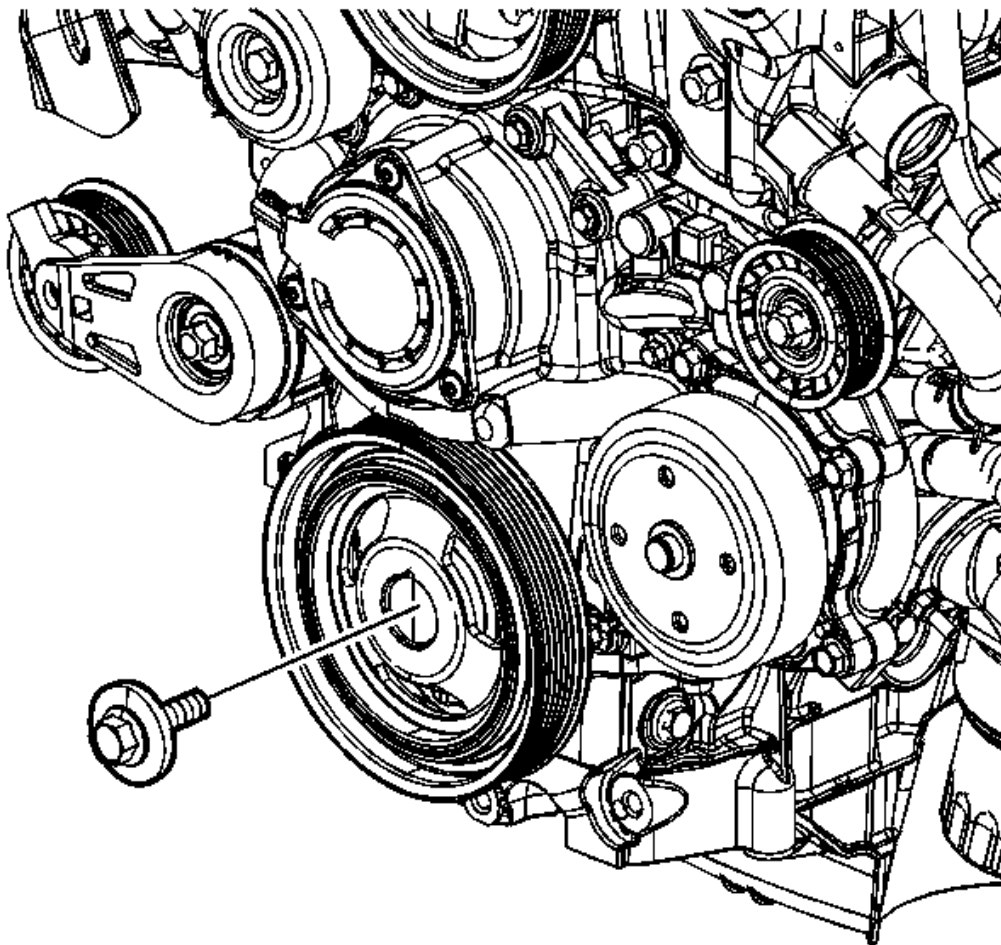


Fig. 130: Crankshaft Balancer Bolt & Washer
Courtesy of GENERAL MOTORS CORP.

10. Remove the crankshaft balancer bolt and the washer.

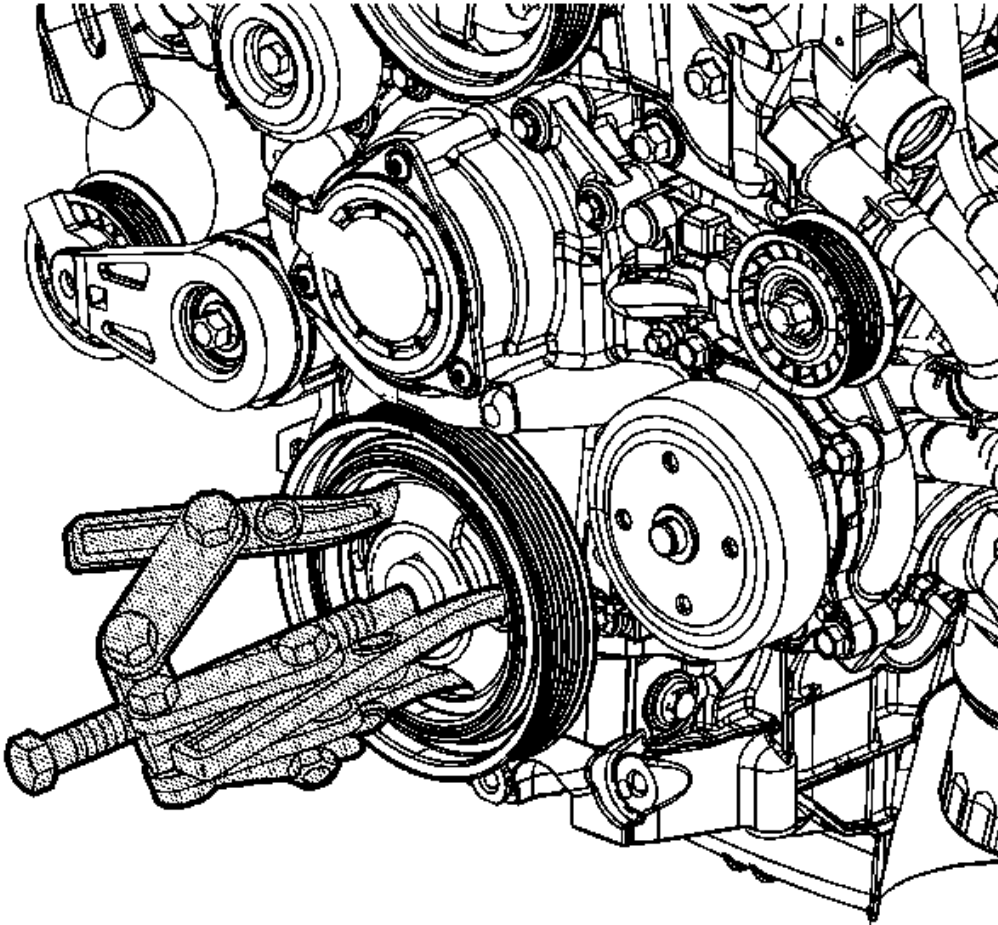


Fig. 131: Removing Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

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

11. Remove the crankshaft balancer using the **J 41816** and **EN 46359** .

INSTALLATION PROCEDURE

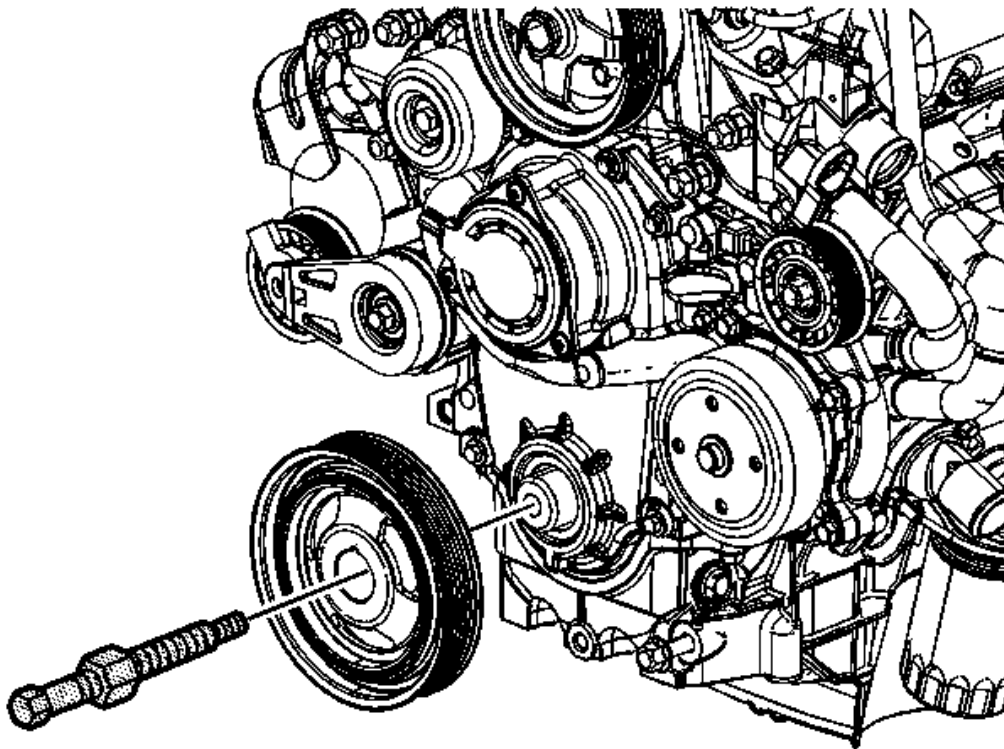


Fig. 132: Installing Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

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

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

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

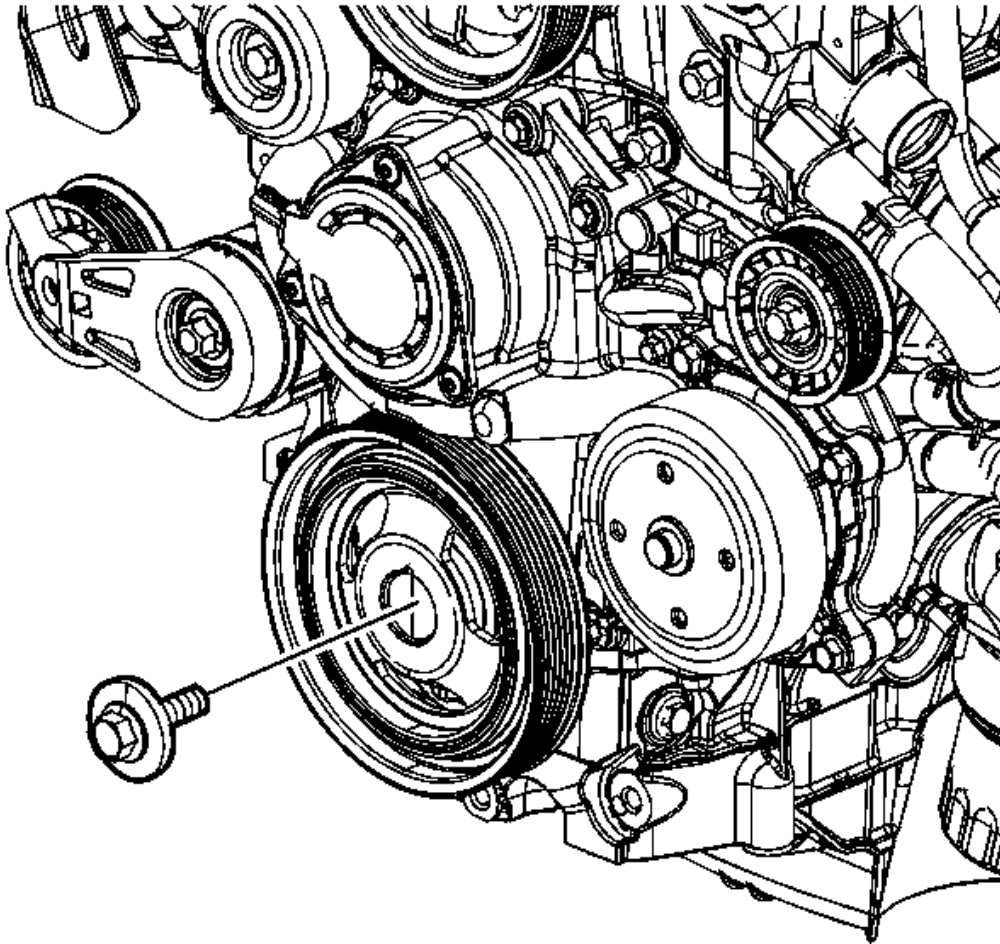


Fig. 133: Crankshaft Balancer Bolt & Washer
Courtesy of GENERAL MOTORS CORP.

6. Install the crankshaft balancer washer and the bolt.

CAUTION: Refer to Fastener Caution .

7. Install the used crankshaft balancer bolt.

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

8. Remove the used crankshaft balancer bolt.

9. Install the NEW crankshaft balancer bolt.

Tighten:

1. Tighten the crankshaft balancer bolt a first pass to 125 N.m (92 lb ft).
2. Tighten the crankshaft balancer bolt a final pass to 130 degrees using the **J 45059** .

10. Remove the **J 45059** from the flywheel.
11. Install the torque converter covers.
12. Raise the frame into the original position.
13. Install and tighten the right and left side frame bolts.

Tighten: Tighten the bolts to 100 N.m (74 lb ft) plus an additional 90 degrees using the **J 45059** .

14. Install the right engine splash shield. Refer to **Radiator Air Side Baffle and Deflector Replacement** .
15. Install the right front tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
16. Lower the vehicle.
17. Install the drive belt. Refer to **Drive Belt Replacement (Coupe)** or **Drive Belt Replacement (Convertible)**.

OIL PAN REPLACEMENT

SPECIAL TOOLS

J 45059 Angle Meter

REMOVAL PROCEDURE

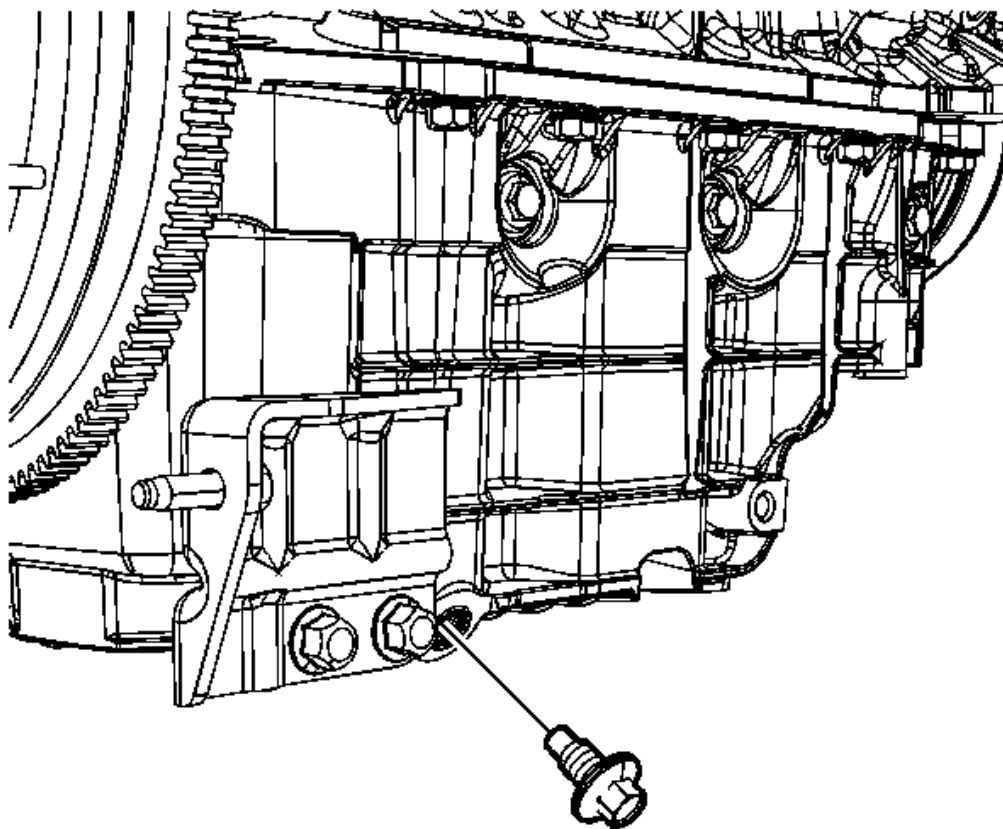


Fig. 134: Oil Pan Drain Plug

Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
2. Remove the engine mount snubber and drive belt. Refer to **Drive Belt Replacement (Coupe)** or **Drive Belt Replacement (Convertible)**.
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.
8. Reinstall the oil pan drain plug until snug.
9. Remove the right front splash shield. Refer to **Engine Splash Shield Replacement - Right Side** .
10. Remove the starter. Refer to **Starter Replacement (LZ9)** .

11. Remove the engine oil cooler. Refer to **Engine Oil Cooler Replacement**.
12. Remove the oil filter adapter. Refer to **Oil Filter Adapter and Bypass Valve Assembly Replacement**.

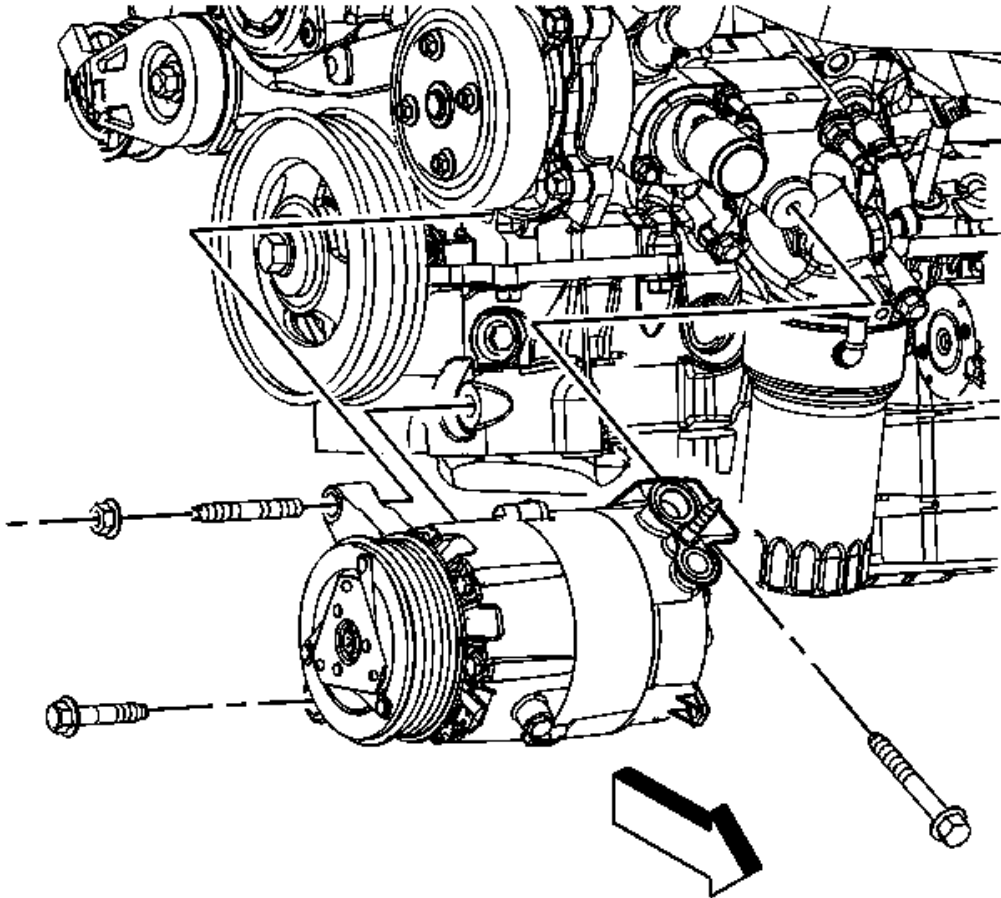


Fig. 135: A/C compressor & Bolts
Courtesy of GENERAL MOTORS CORP.

13. Remove the air conditioning (A/C) compressor bolts and position the compressor aside.

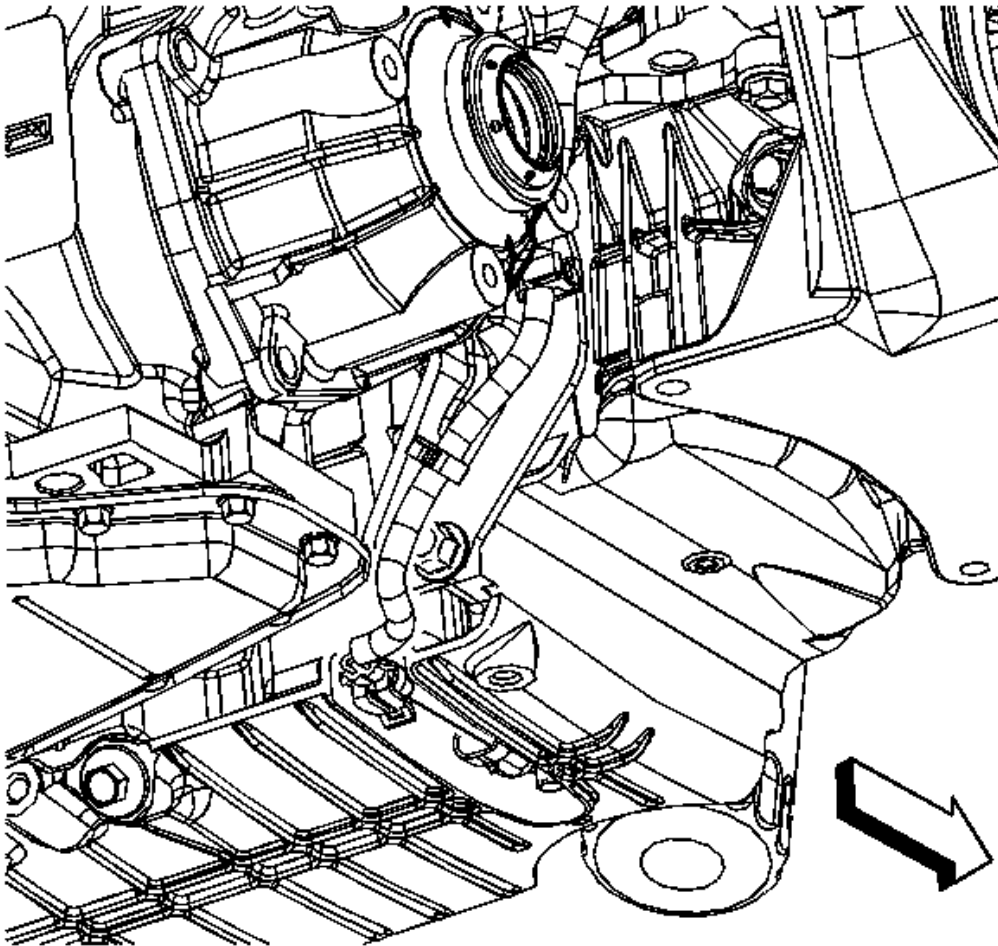


Fig. 136: Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

14. Disconnect the oil level sensor electrical connector.
15. Remove the catalytic converter. Refer to **Catalytic Converter Replacement - Left Side (LZ9)** and **Catalytic Converter Replacement - Right Side (LZ9 w/RPO M15)** or **Catalytic Converter Replacement - Right Side (LZ9 w/RPO MT2)** .

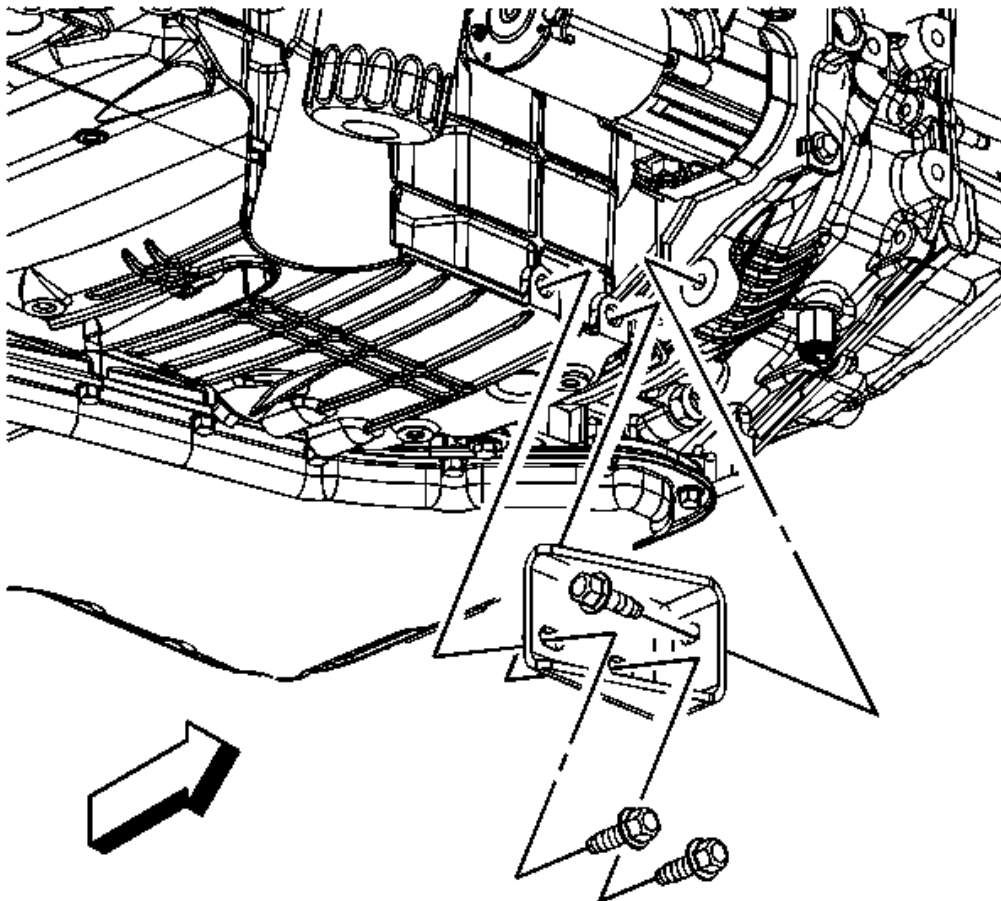


Fig. 137: Transaxle Brace & Bolts
Courtesy of GENERAL MOTORS CORP.

16. Remove the transaxle brace to oil pan bolts.
17. Remove the transaxle brace to transaxle bolt and remove the brace.

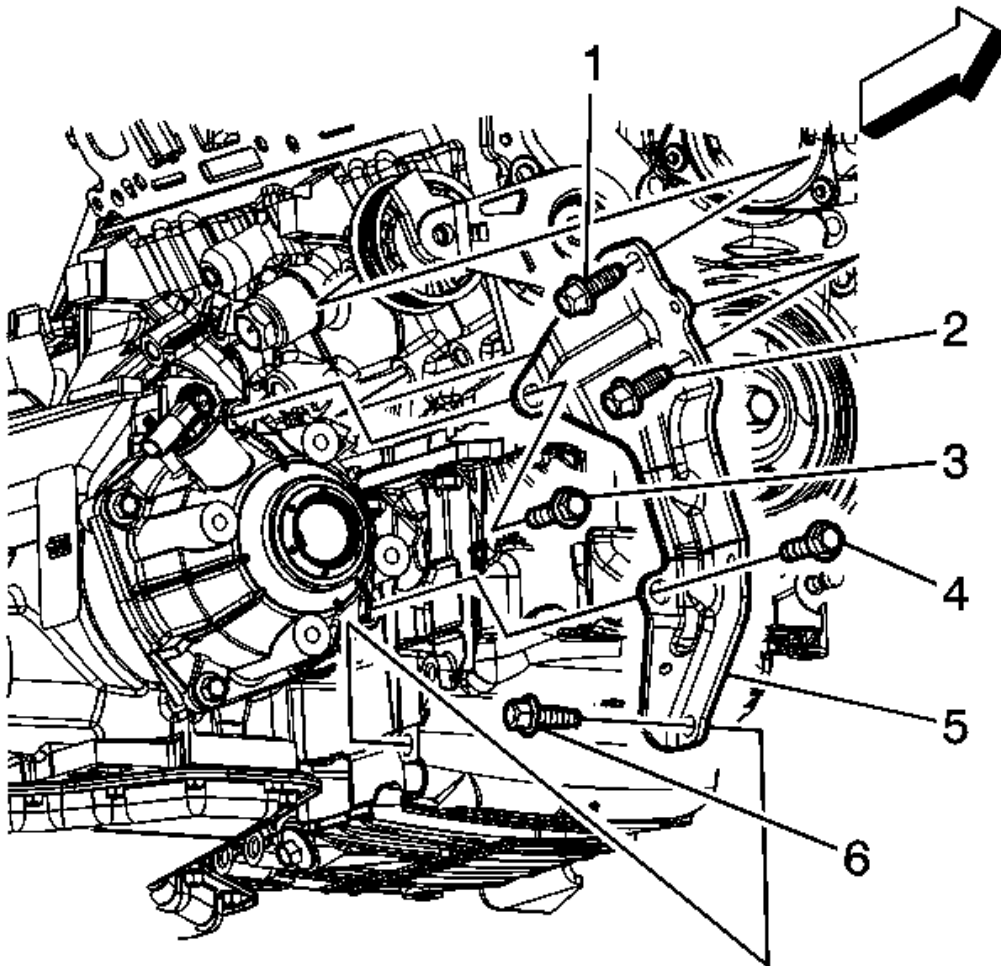


Fig. 138: Transaxle Brace-To-Oil Pan Lower Bolt
Courtesy of GENERAL MOTORS CORP.

18. Remove the transaxle brace to oil pan lower bolt (6), if equipped with regular production option (RPO) M15.

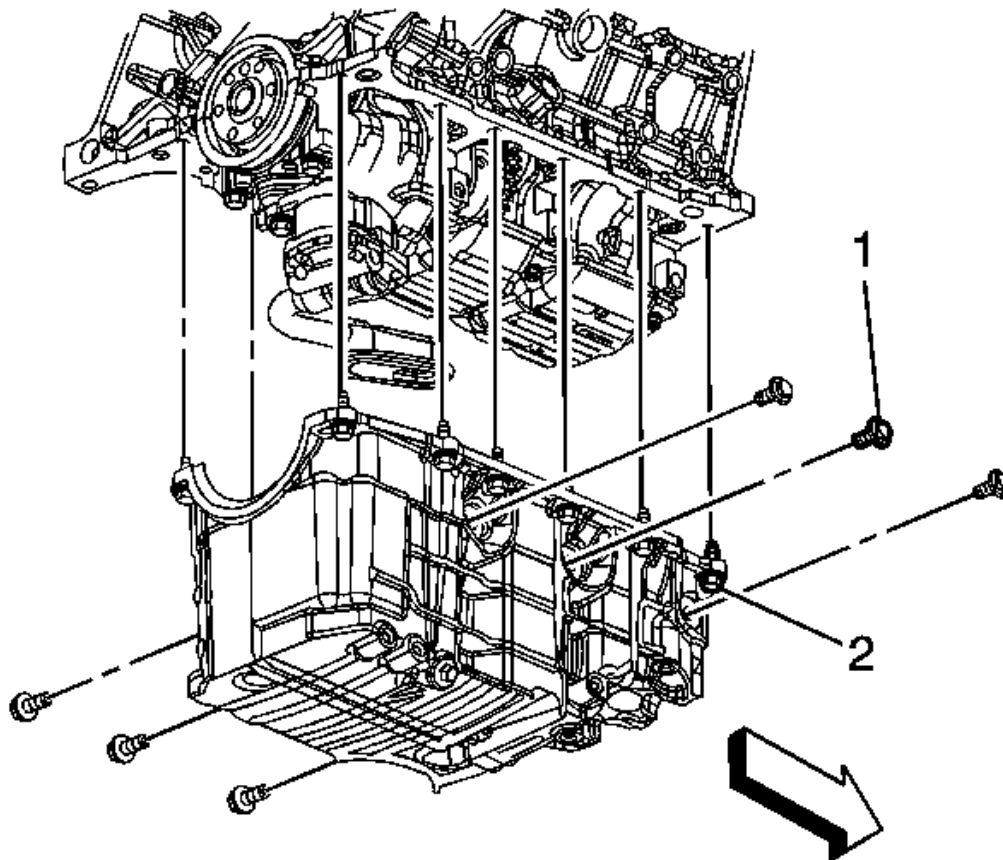


Fig. 139: Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

19. Remove the oil pan bolts (1, 2).
20. Remove the oil pan.
21. Remove and discard the oil pan gasket.
22. Clean the oil pan sealing surfaces.

INSTALLATION PROCEDURE

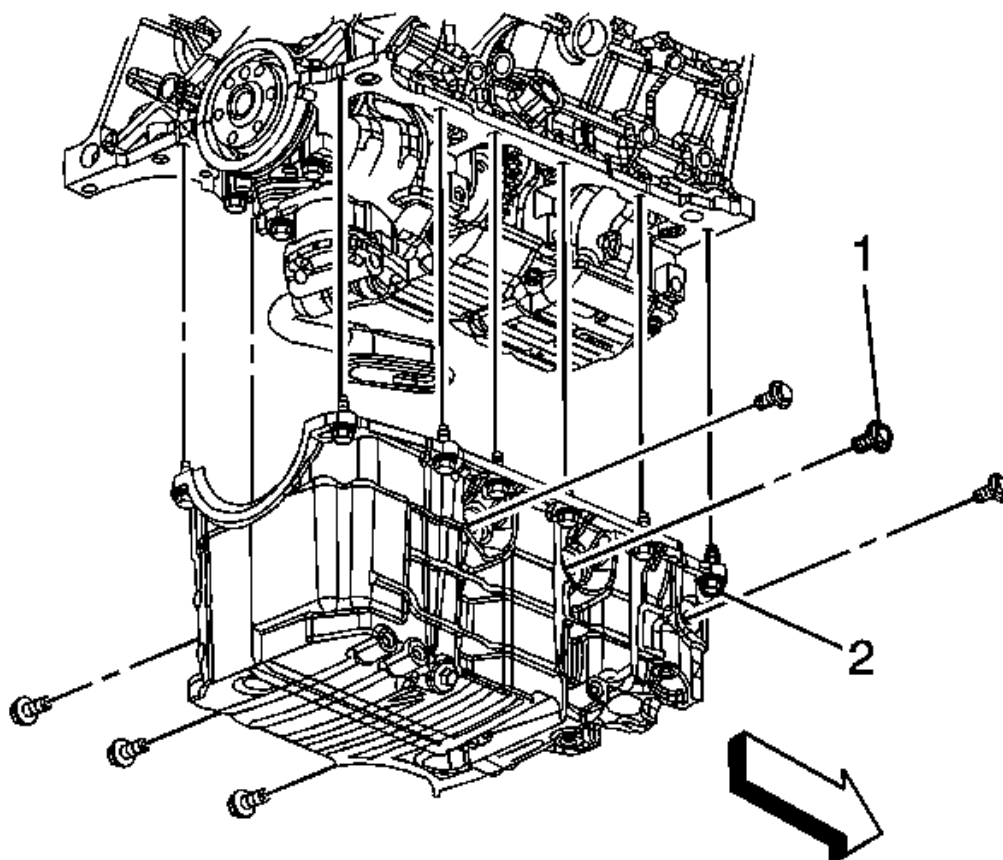


Fig. 140: Oil Pan & Bolts

Courtesy of GENERAL MOTORS CORP.

1. Apply sealer to both sides of the crankshaft rear main bearing cap. Press the sealer into the gap using a putty knife. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .
2. Apply sealer to both sides of the front cover/block mating area. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .
3. Install a NEW oil pan gasket.
4. Position the oil pan to the engine.

CAUTION: Refer to Fastener Caution .

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).

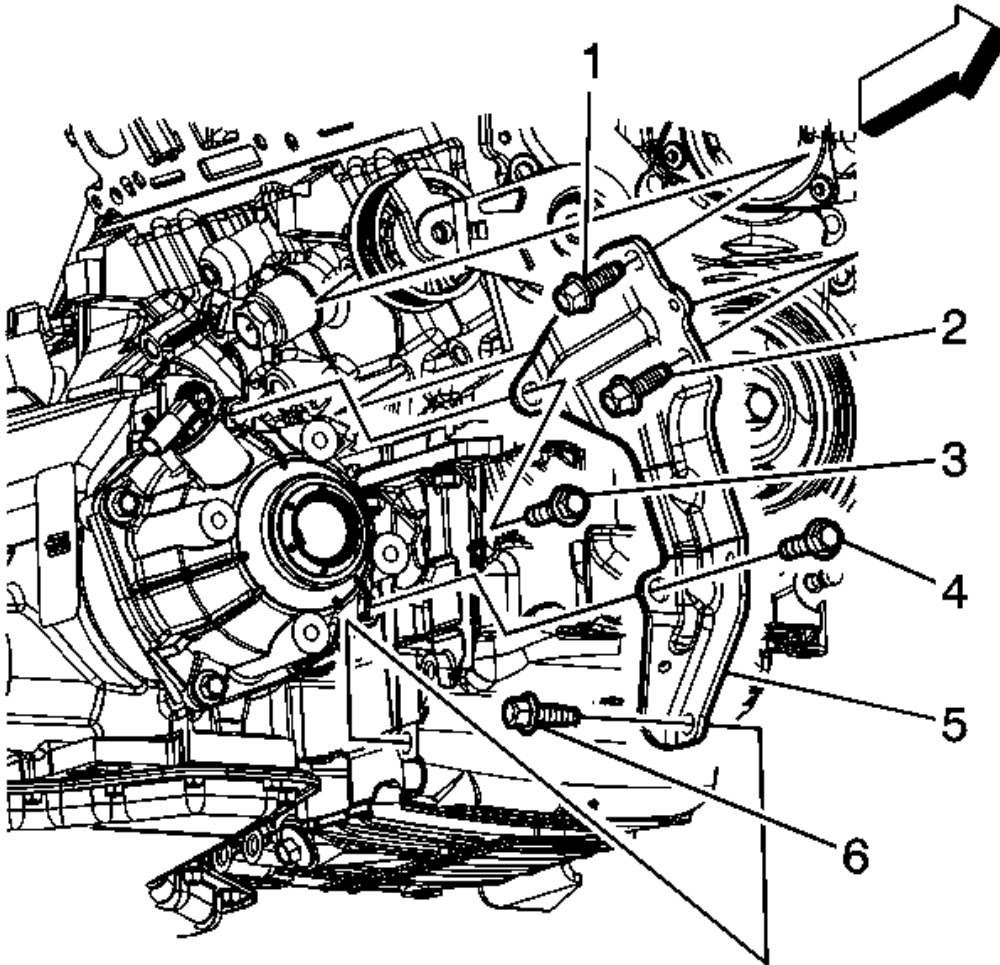


Fig. 141: Transaxle Brace-To-Oil Pan Lower Bolt
Courtesy of GENERAL MOTORS CORP.

6. Install the transaxle brace to oil pan lower bolt (6), if equipped with (RPO) M15 and tighten to 50 N.m (37 lb ft).

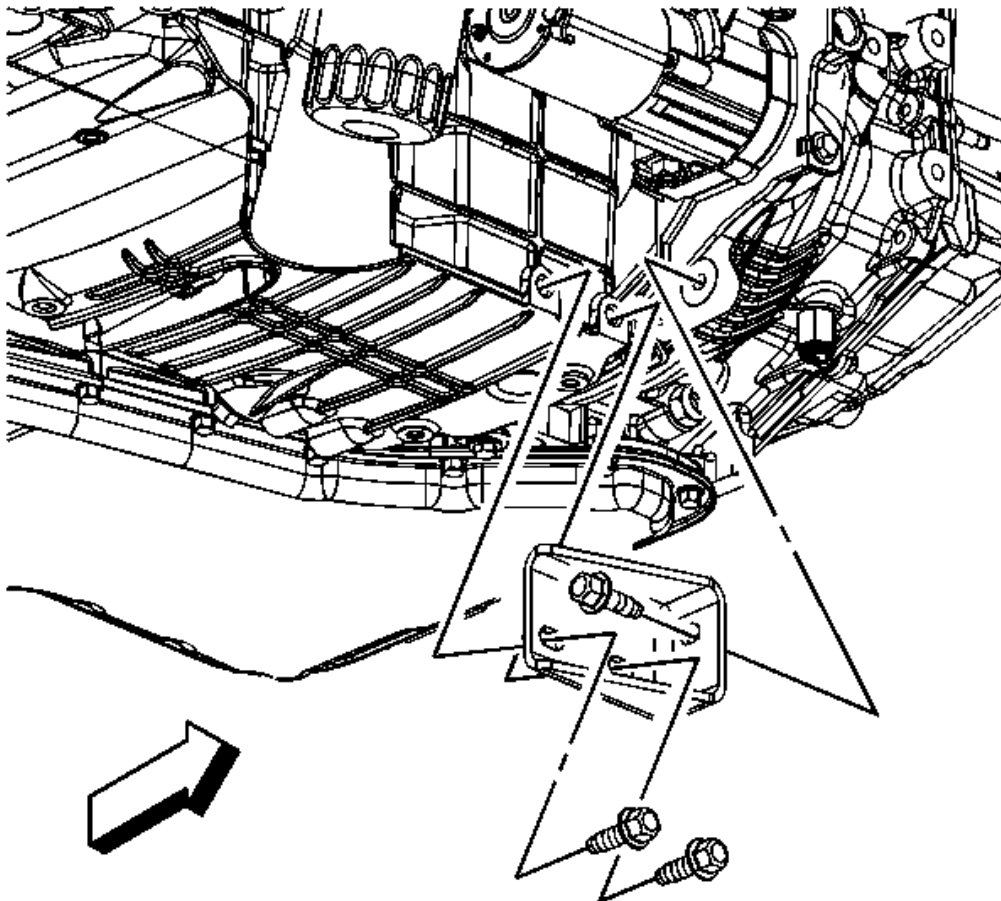


Fig. 142: Transaxle Brace & Bolts
Courtesy of GENERAL MOTORS CORP.

7. Position the transaxle brace and install the transaxle brace to transaxle bolt until snug.
8. Install the transaxle brace to oil pan bolts and tighten to 50 N.m (37 lb ft).

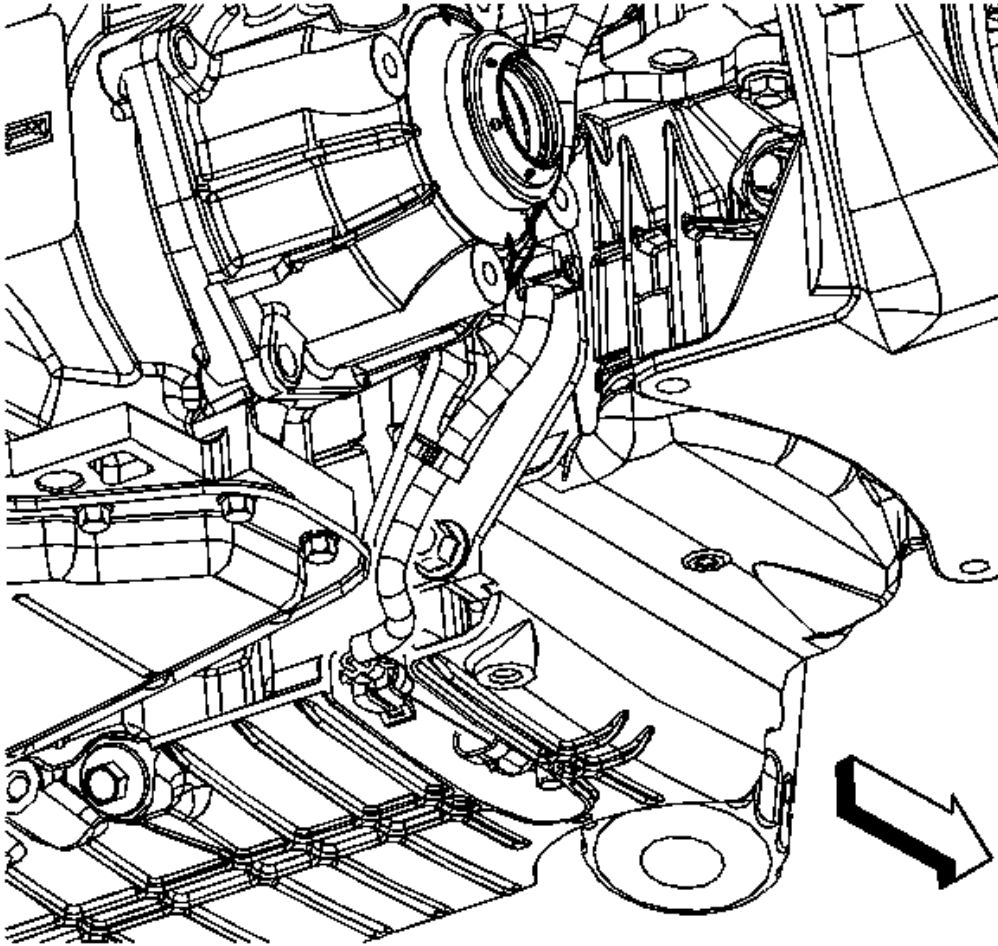


Fig. 143: Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

9. Connect the oil level sensor electrical connector.
10. Install the catalytic converter. Refer to **Catalytic Converter Replacement - Left Side (LZ9)** and **Catalytic Converter Replacement - Right Side (LZ9 w/RPO M15)** or **Catalytic Converter Replacement - Right Side (LZ9 w/RPO MT2)** .

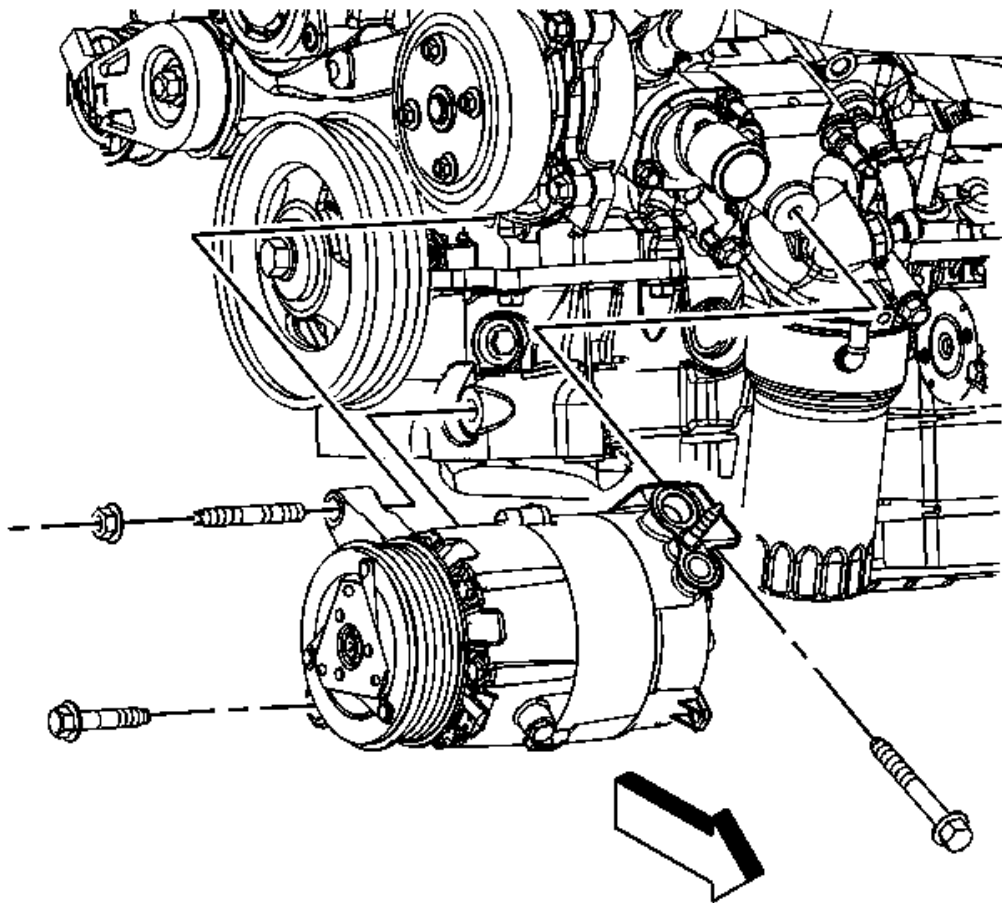


Fig. 144: A/C compressor & Bolts
Courtesy of GENERAL MOTORS CORP.

11. Position the A/C compressor and install the bolts. Tighten the bolts to 50 N.m (37 lb ft)
12. Install the right front splash shield. Refer to **Engine Splash Shield Replacement - Right Side** .
13. Install the starter. Refer to **Starter Replacement (LZ9)** .
14. Install the oil filter adapter. Refer to **Oil Filter Adapter and Bypass Valve Assembly Replacement**.
15. Install the oil cooler. Refer to **Engine Oil Cooler Replacement**.
16. Ensure that the oil pan drain plug is tighten.

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

17. Lower the vehicle.
18. Remove the engine support fixture.

19. Install the air cleaner inlet duct. Refer to [Air Cleaner Inlet Duct Replacement](#) .
20. Install the engine mount snubber and drive belt. Refer to [Drive Belt Replacement \(Coupe\)](#) or [Drive Belt Replacement \(Convertible\)](#).
21. Fill the crankcase.
22. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#) .

ENGINE OIL PRESSURE SENSOR AND/OR SWITCH REPLACEMENT

REMOVAL PROCEDURE

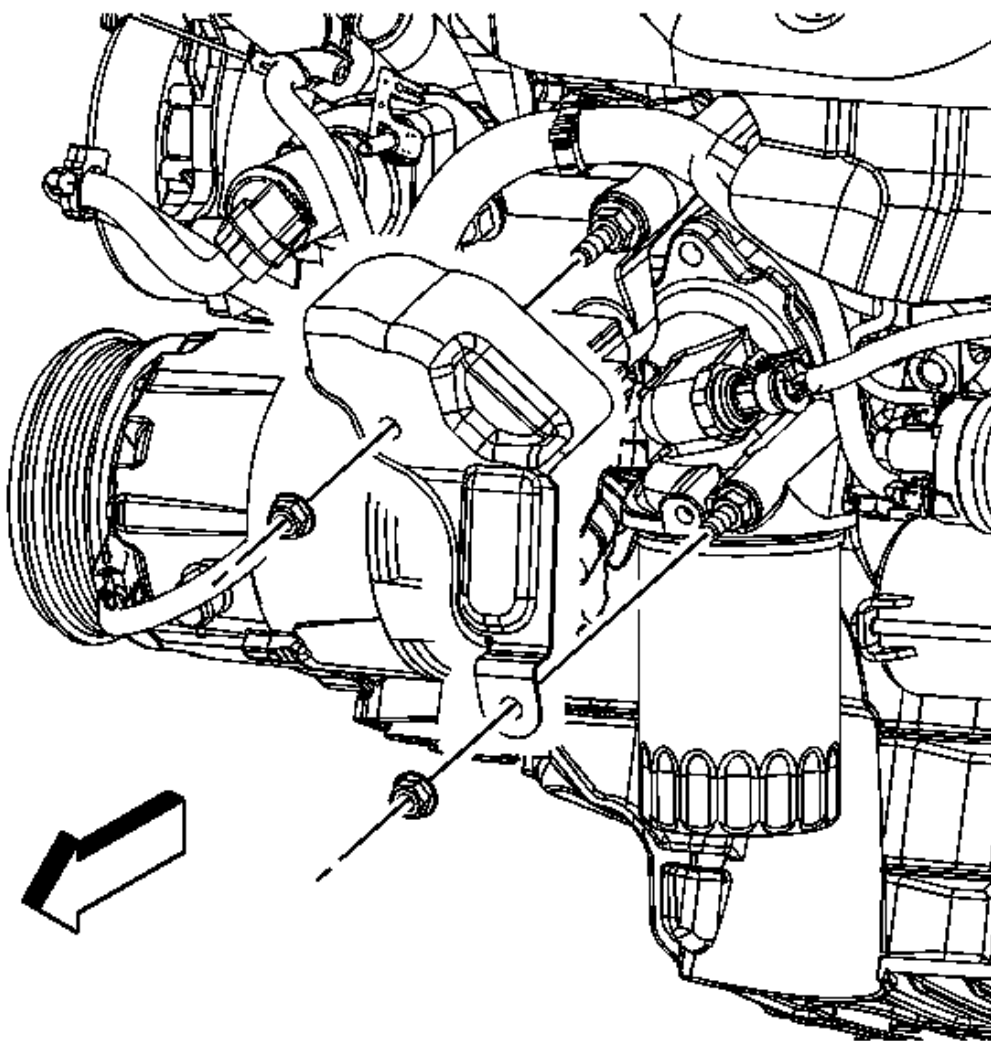


Fig. 145: Oil Pressure Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

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

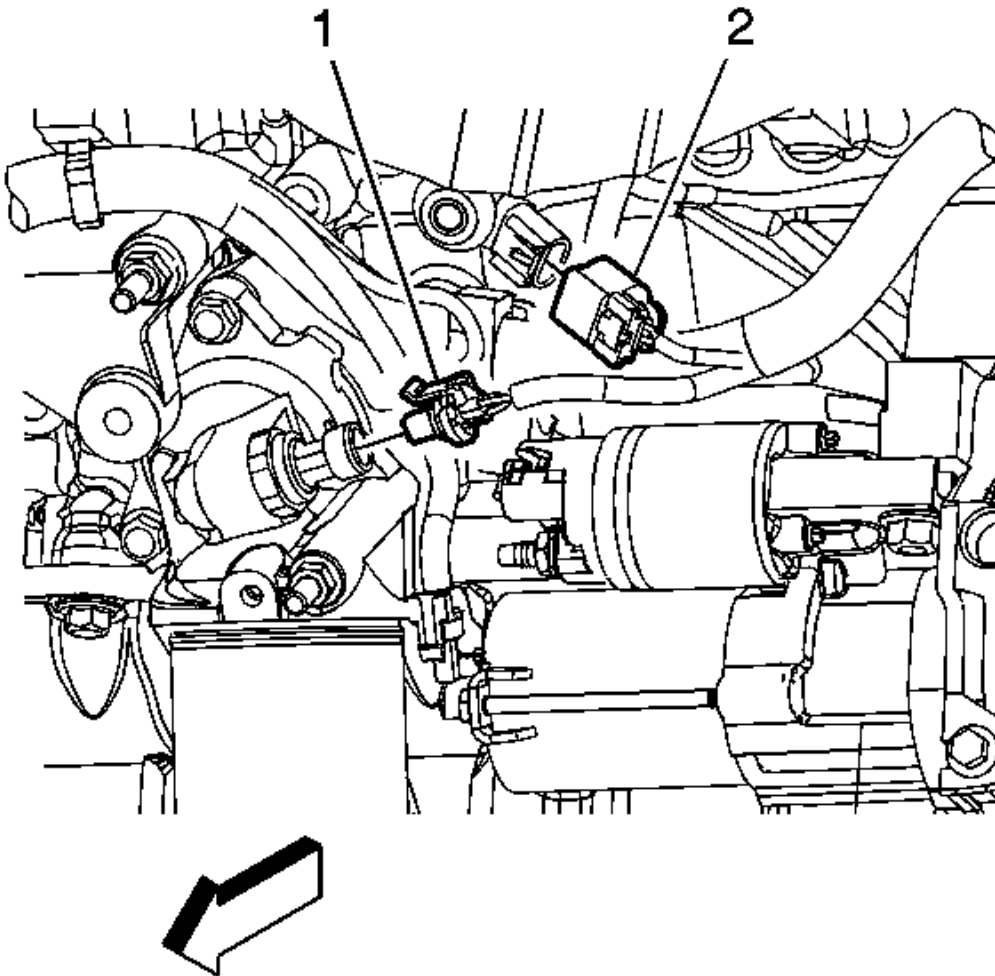


Fig. 146: Knock Sensor & Oil Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

3. Disconnect engine oil pressure sensor electrical connector (1).

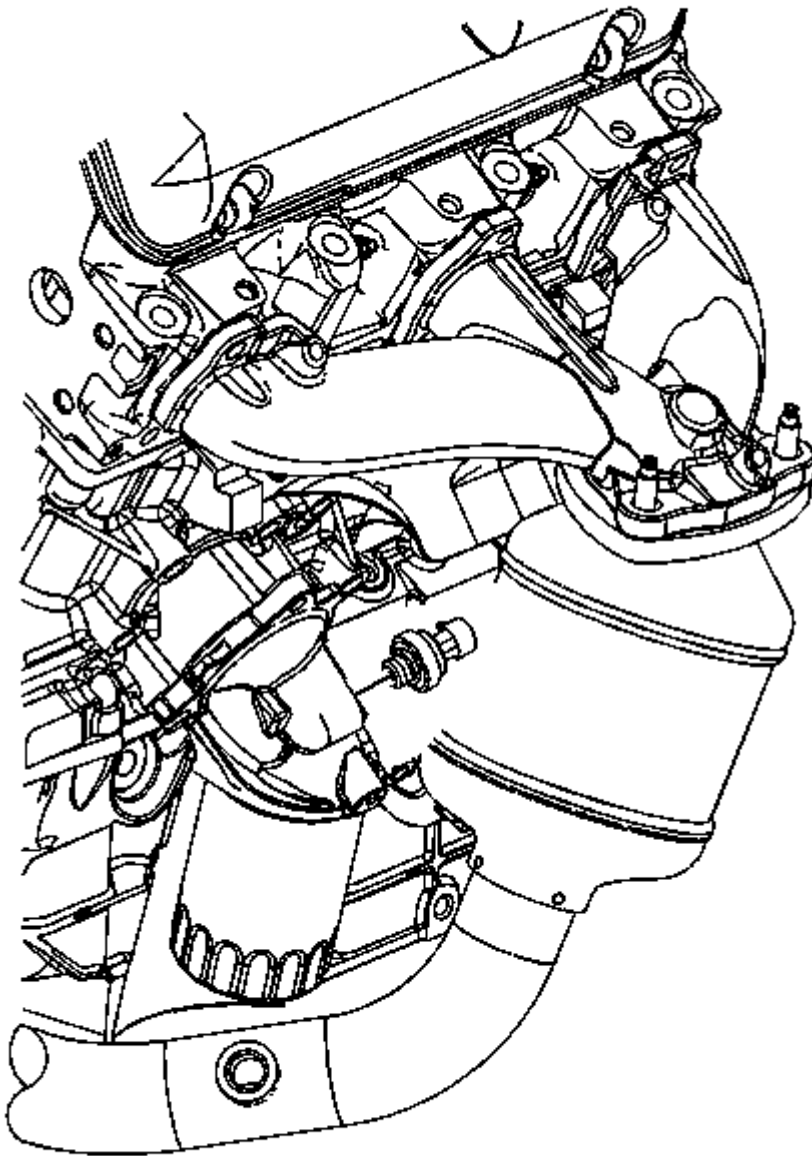


Fig. 147: Engine Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine oil pressure sensor.

INSTALLATION PROCEDURE

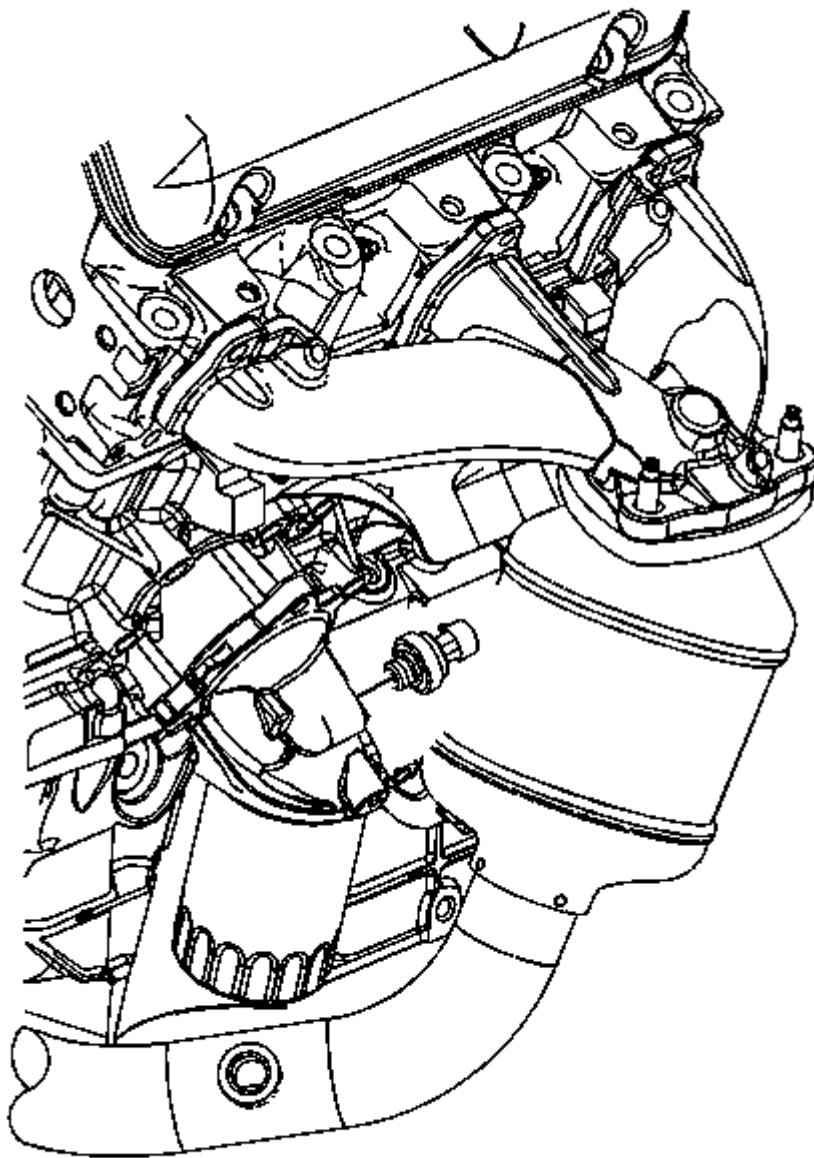


Fig. 148: Engine Oil Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the engine oil pressure sensor.

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

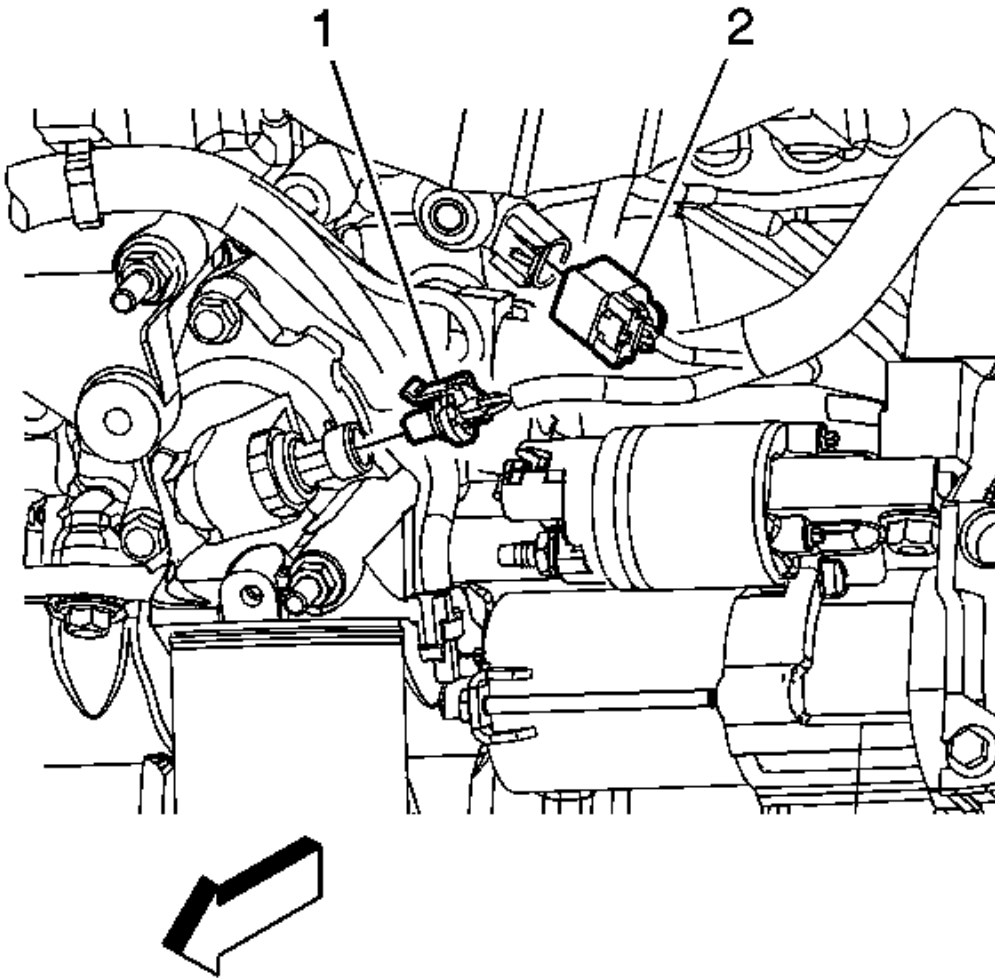


Fig. 149: Knock Sensor & Oil Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

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

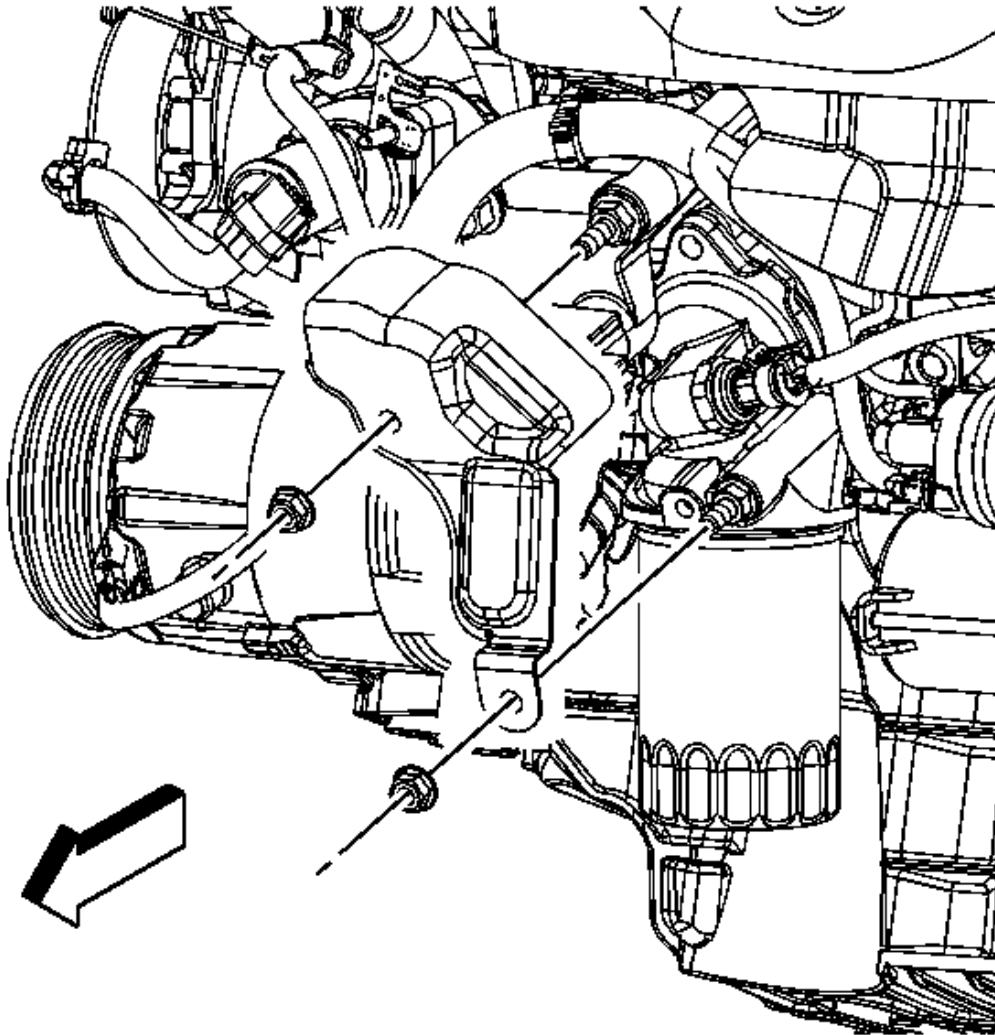


Fig. 150: Oil Pressure Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the oil pressure heat shield and bolts.

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

4. Lower the vehicle.

ENGINE OIL LEVEL SENSOR AND/OR SWITCH REPLACEMENT

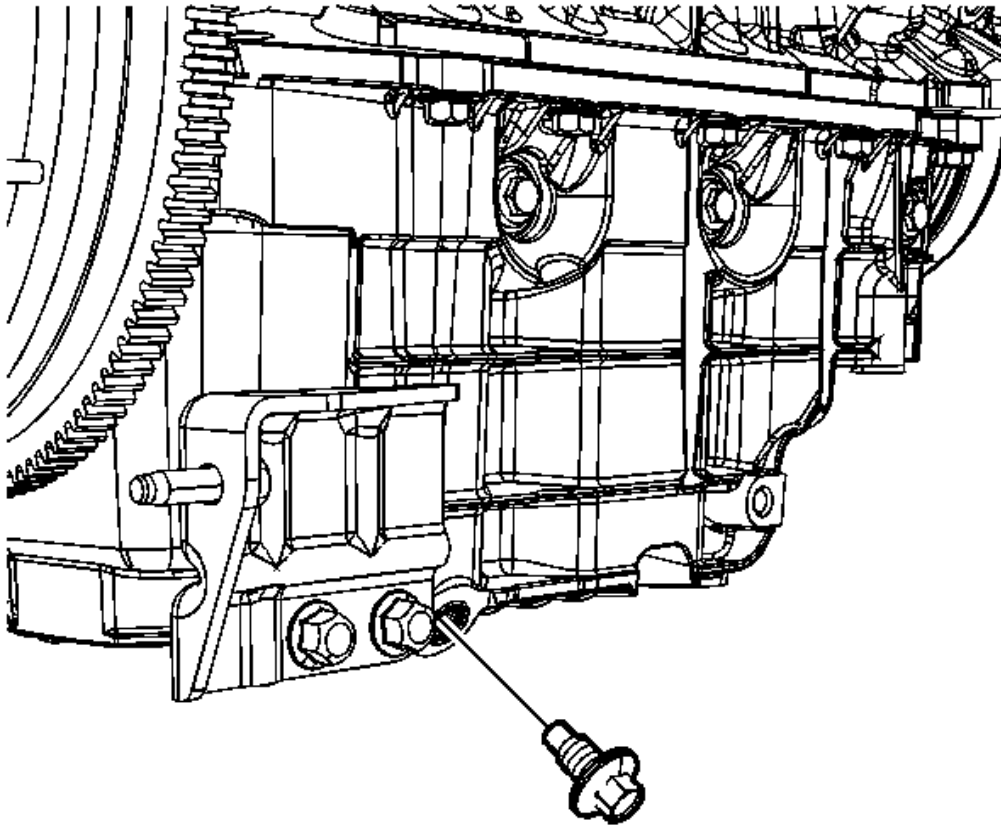
REMOVAL PROCEDURE

Fig. 151: Oil Pan Drain Plug
Courtesy of GENERAL MOTORS CORP.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Remove the oil pan drain plug.
3. Drain the crankcase.
4. Reinstall the oil pan drain plug.

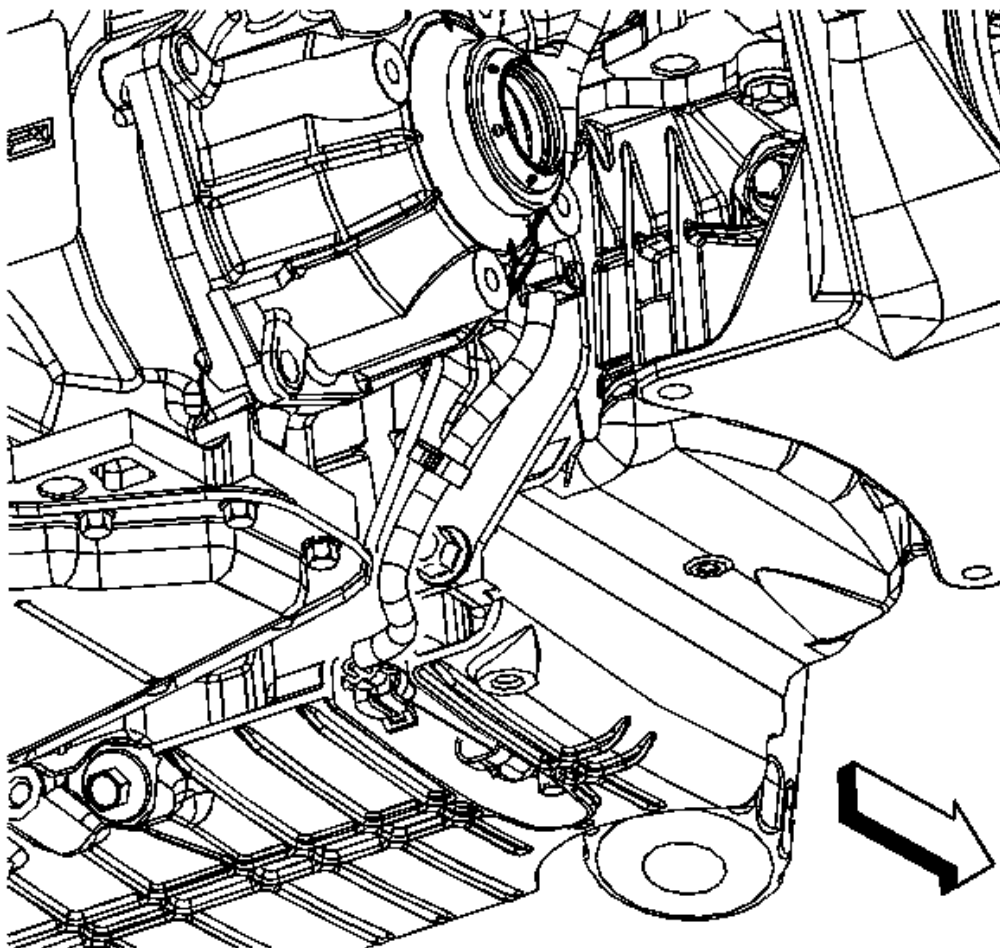


Fig. 152: Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the engine oil level sensor electrical connector.

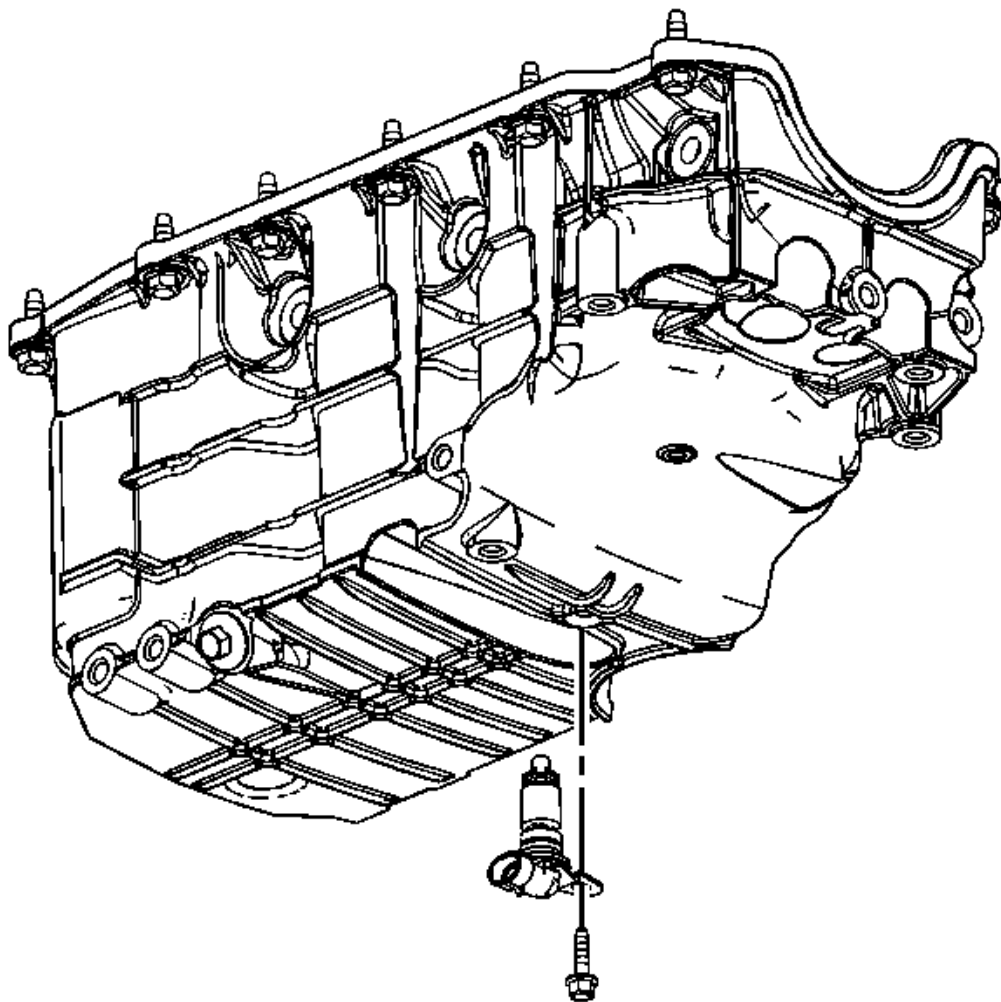


Fig. 153: Engine Oil Level Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

6. Remove the engine oil level sensor bolt and sensor.

INSTALLATION PROCEDURE

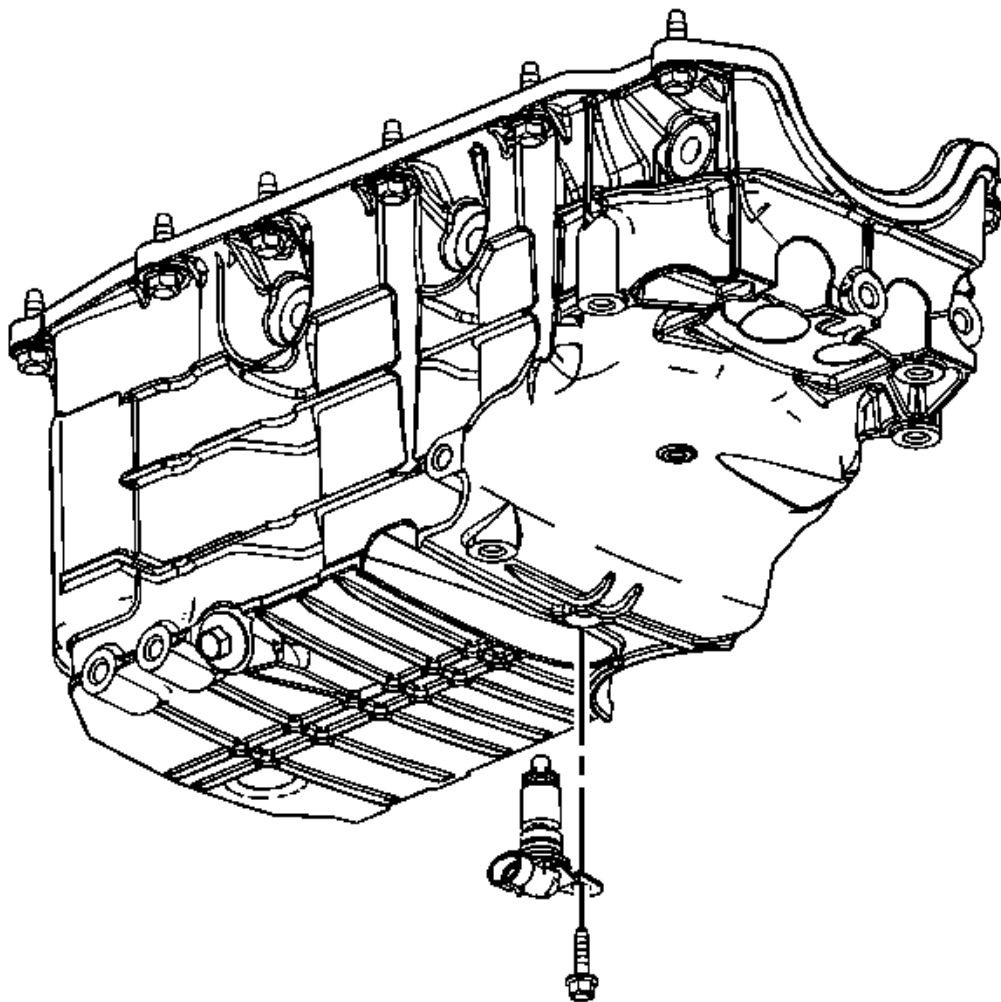


Fig. 154: Engine Oil Level Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the engine oil level sensor and bolt.

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

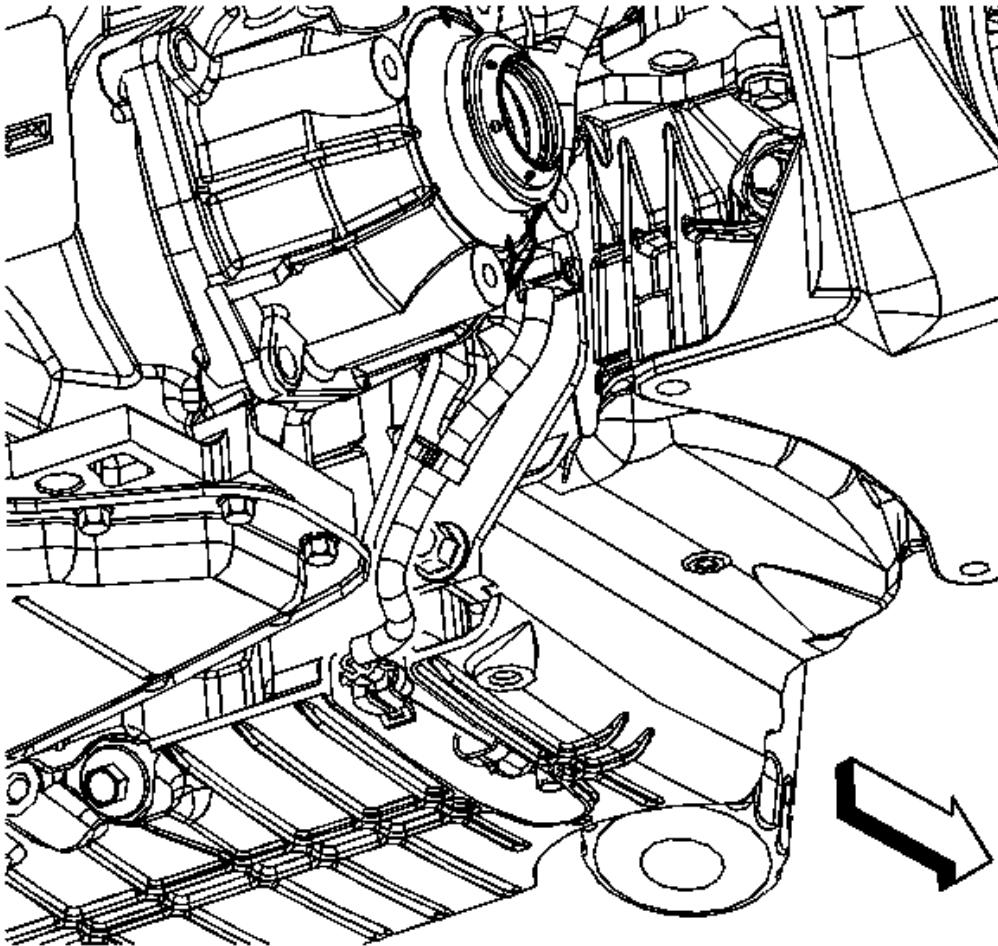


Fig. 155: Oil Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Connect the engine oil level sensor electrical connector.
3. Lower the vehicle.
4. Refill the crankcase with new engine oil.

OIL PUMP REPLACEMENT

REMOVAL PROCEDURE

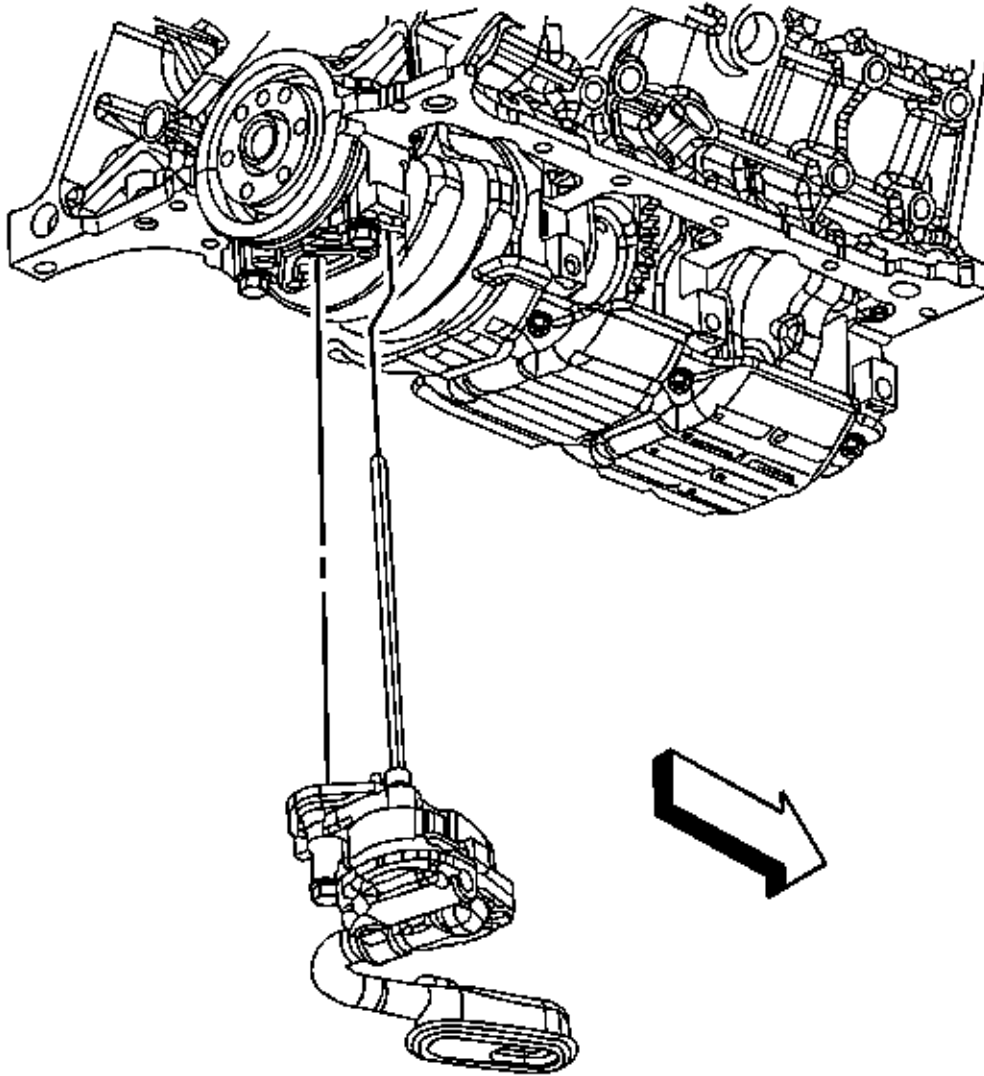


Fig. 156: Oil Pump & Oil Pump Drive Shaft
Courtesy of GENERAL MOTORS CORP.

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.

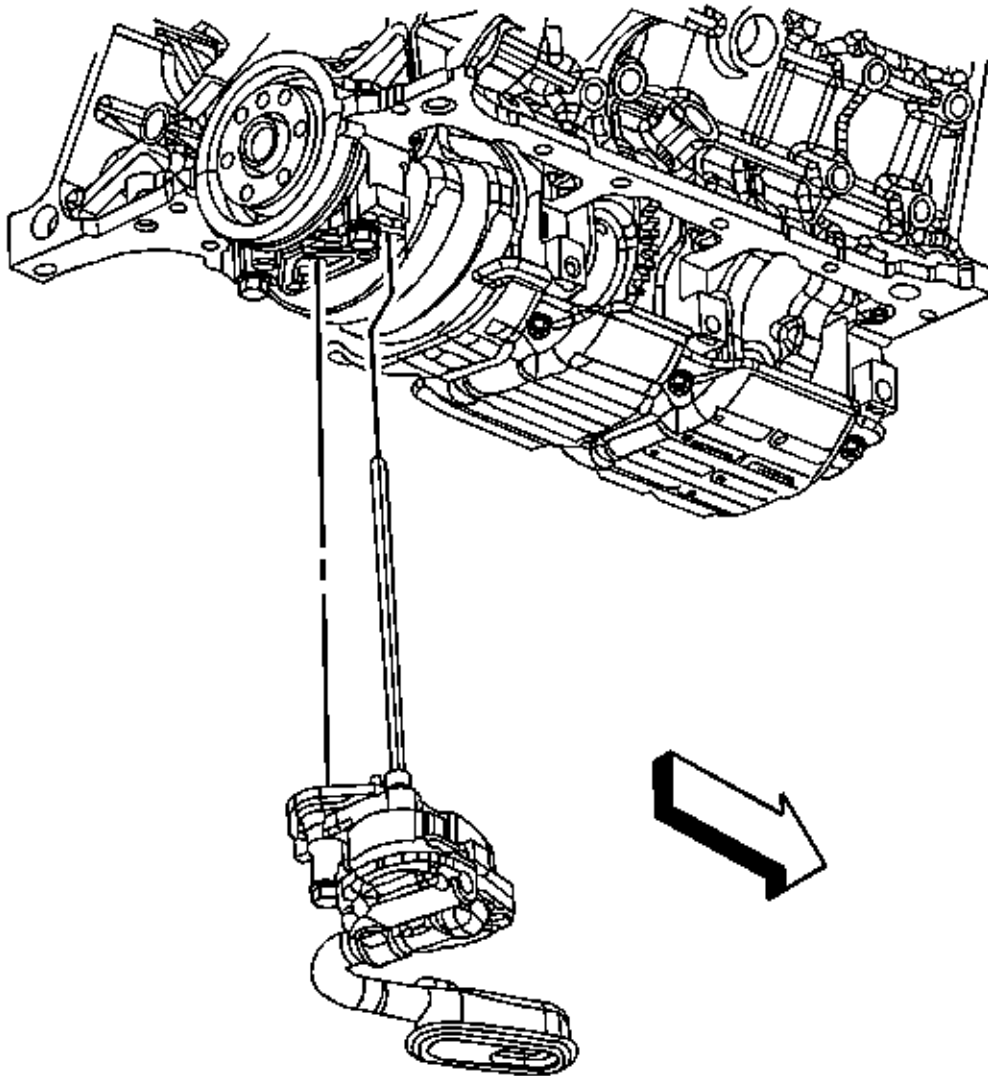


Fig. 157: Oil Pump & Oil Pump Drive Shaft
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the oil pump drive shaft and the oil pump.
2. Install the oil pump bolt and tighten to 41 N.m (30 lb ft).
3. Install the oil pan. Refer to **Oil Pan Replacement**.

OIL PUMP DRIVE REPLACEMENT

REMOVAL PROCEDURE

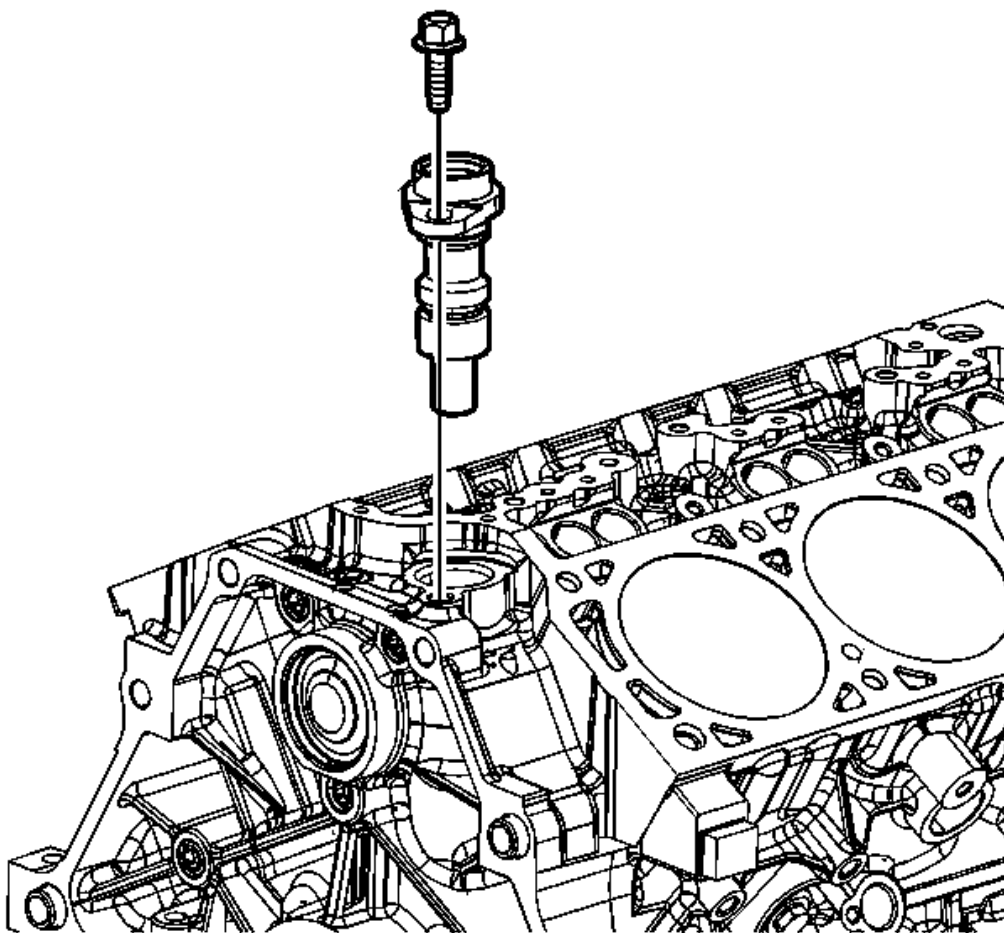


Fig. 158: Oil Pump Drive & Bolt
Courtesy of GENERAL MOTORS CORP.

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.

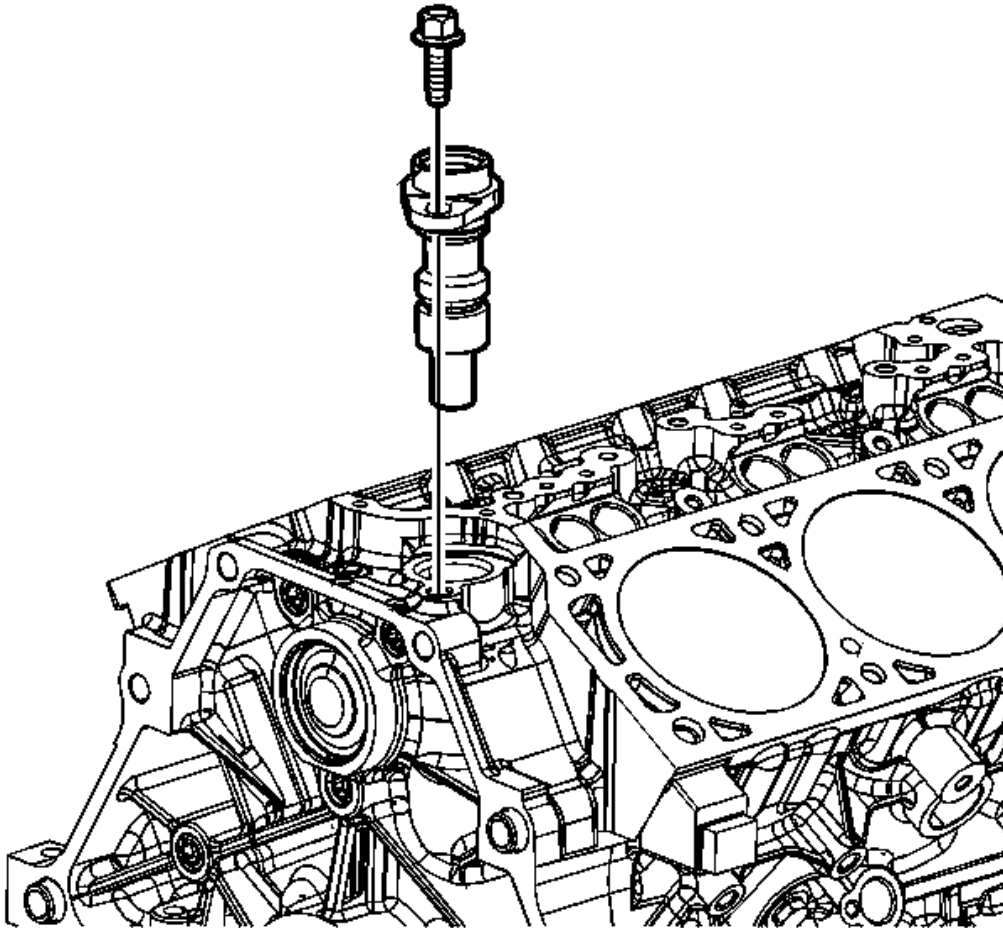
INSTALLATION PROCEDURE

Fig. 159: Oil Pump Drive & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Coat the seal or bore in the engine block 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

REMOVAL PROCEDURE

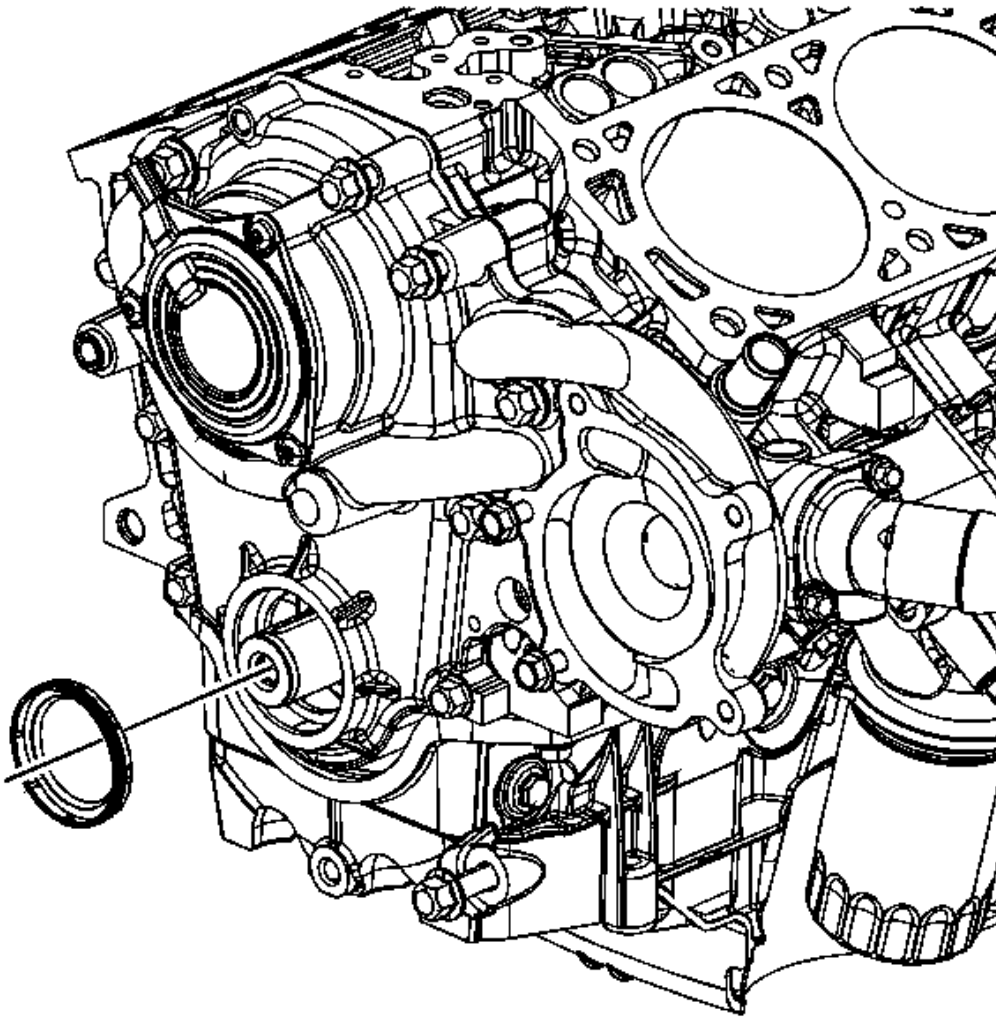


Fig. 160: Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the crankshaft balancer. Refer to **Crankshaft Balancer Replacement**.
2. 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

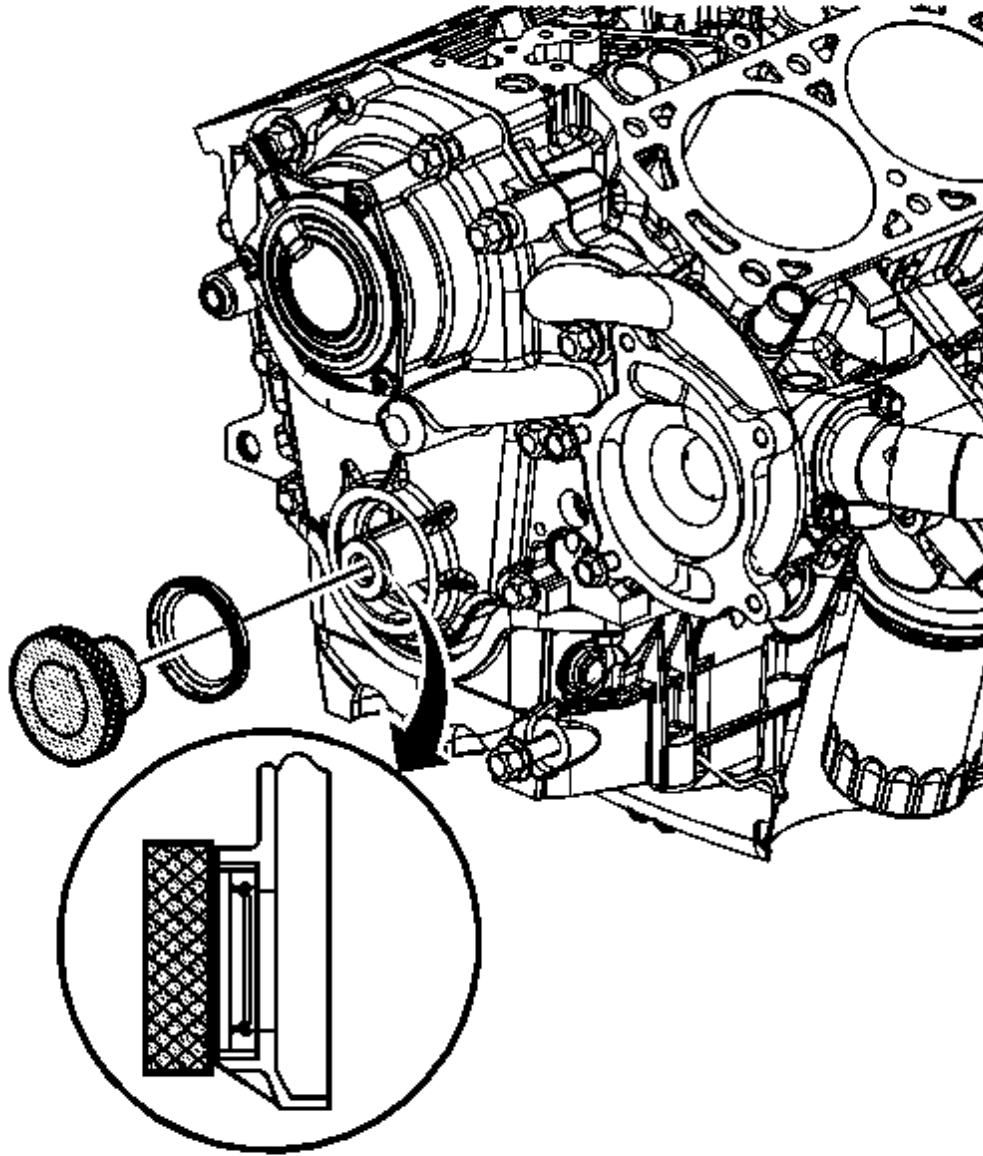


Fig. 161: Installing Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

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.
3. Install the crankshaft front oil seal using **EN-48869** and a suitable tool.

4. Install the crankshaft balancer. Refer to [Crankshaft Balancer Replacement](#).

CAMSHAFT POSITION ACTUATOR MAGNET REPLACEMENT

REMOVAL PROCEDURE

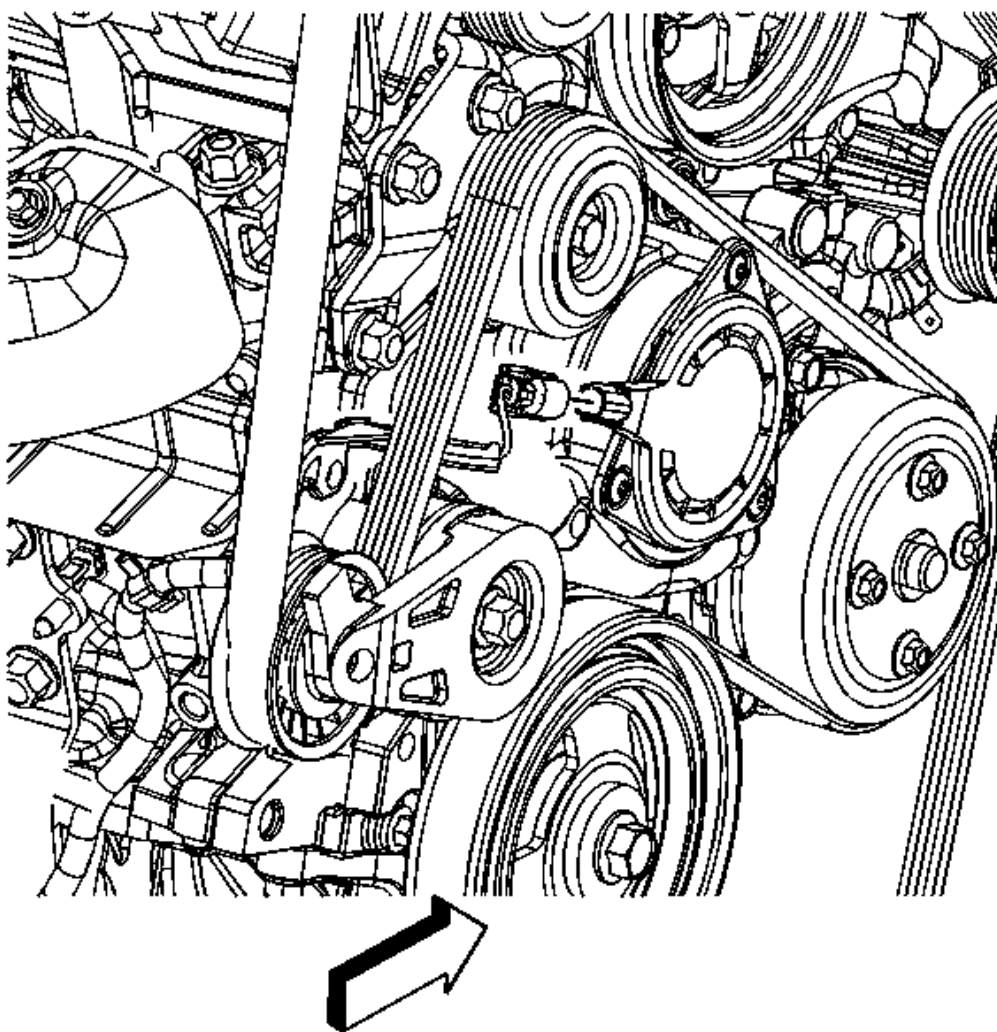


Fig. 162: Camshaft Position Actuator Magnet Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold cover. Refer to [Intake Manifold Cover Replacement](#).
2. Remove the air cleaner assembly. Refer to [Air Cleaner Assembly Replacement](#).

3. Remove the engine mount snubber bracket. Refer to **Engine Mount Snubber Bracket Replacement**.
4. Remove the engine mount bracket, if equipped with a convertible top. Refer to **Engine Mount Bracket Replacement (Convertible)** or **Engine Mount Bracket Replacement (Coupe)**.
5. Disconnect the camshaft position actuator magnet electrical connector.

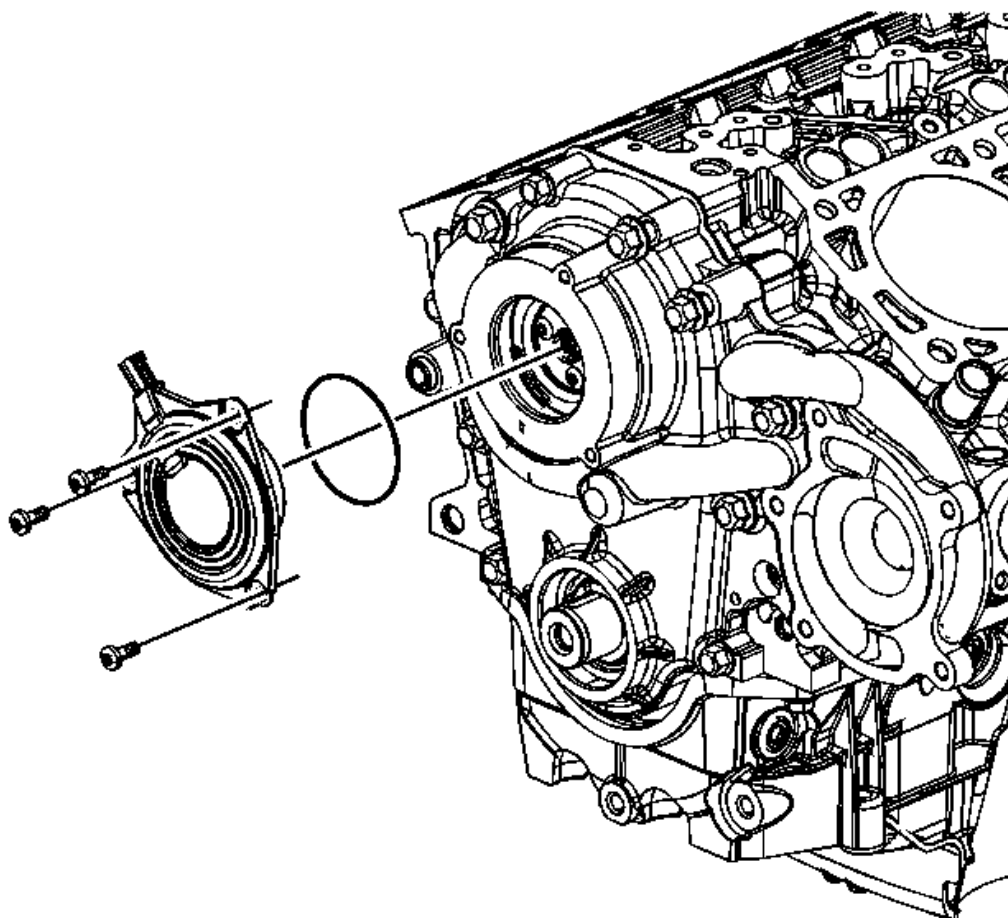


Fig. 163: Camshaft Position Actuator Magnet, Bolts & O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

6. Remove the camshaft position actuator magnet bolts.
7. Remove the camshaft position actuator magnet and O-ring seal.

INSTALLATION PROCEDURE

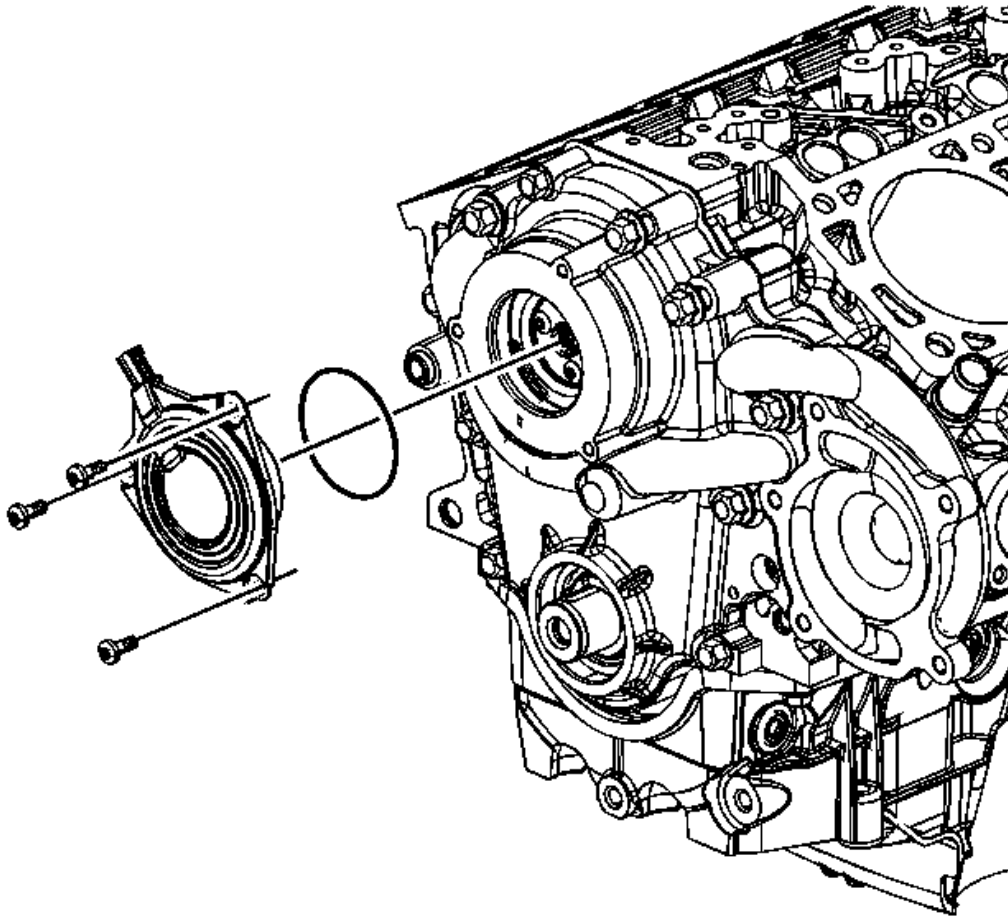


Fig. 164: Camshaft Position Actuator Magnet, Bolts & O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

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).

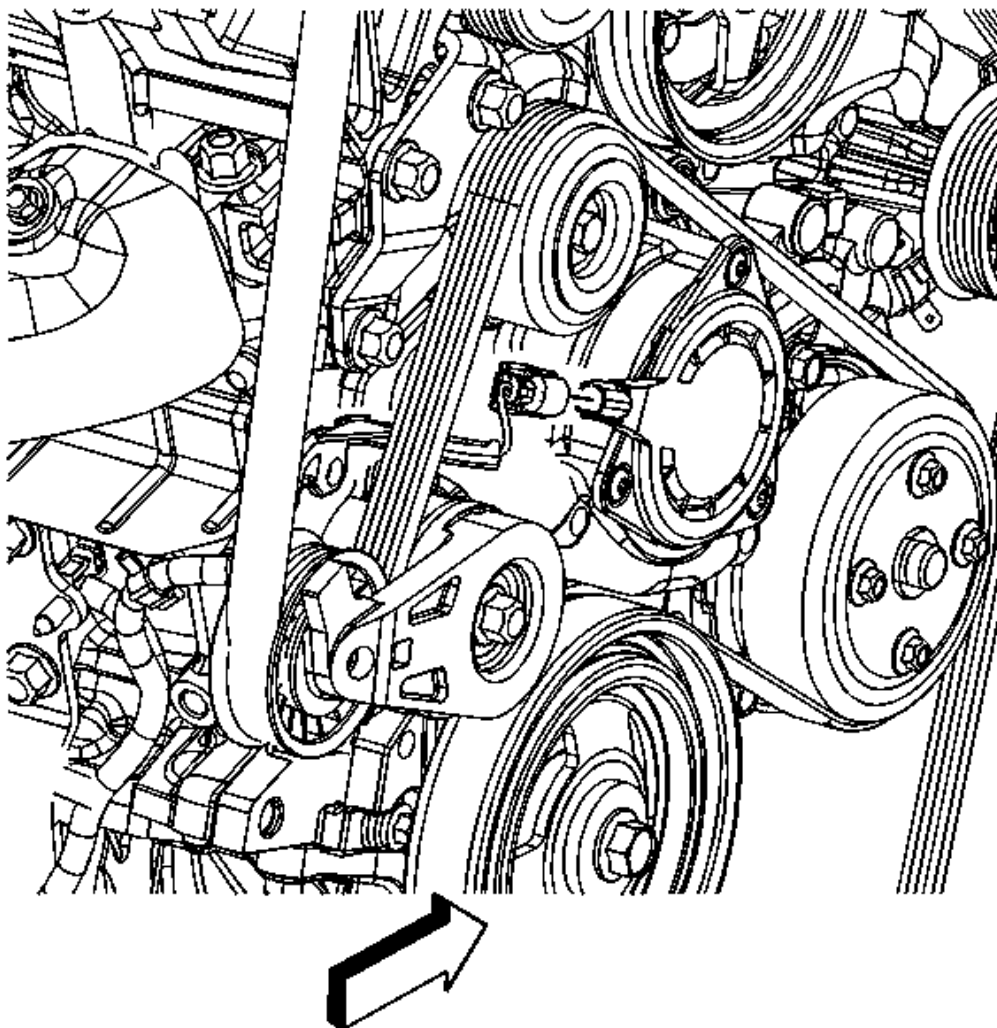


Fig. 165: Camshaft Position Actuator Magnet Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the camshaft position actuator magnet electrical connector.
4. Install the engine mount bracket, if equipped with a convertible top. Refer to **Engine Mount Bracket Replacement (Convertible)** or **Engine Mount Bracket Replacement (Coupe)**.
5. Install the engine mount snubber bracket. Refer to **Engine Mount Snubber Bracket Replacement**.
6. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement**.
7. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

ENGINE FRONT COVER REPLACEMENT

REMOVAL PROCEDURE

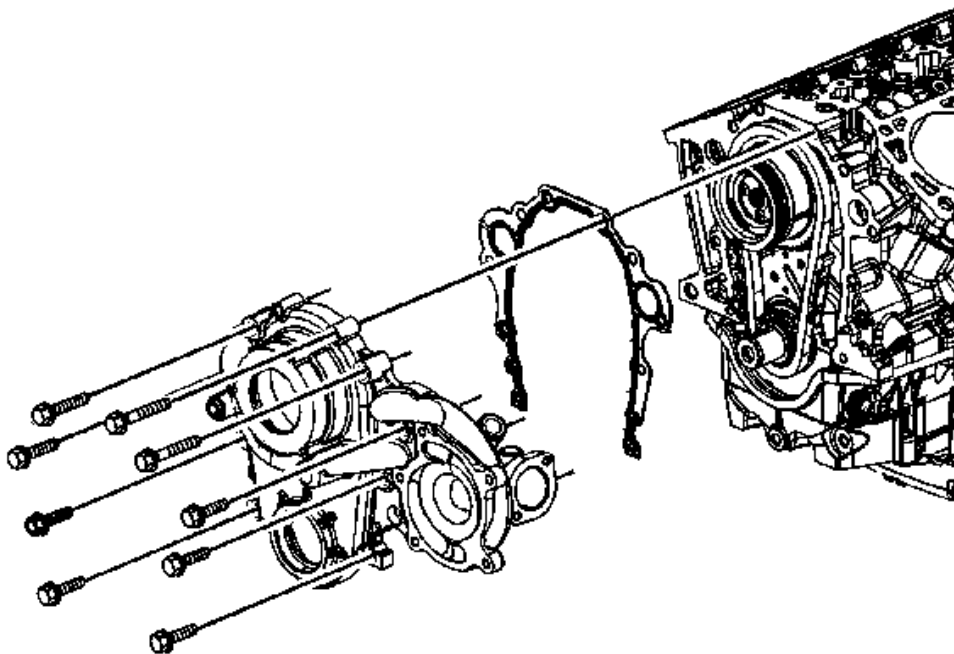


Fig. 166: Engine Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Drain the cooling system. Refer to Cooling System Draining and Filling (LY7, LZE, LZ4, LZ9) .
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 and LZ9) .

7. Remove the water pump. Refer to **Water Pump Replacement (LZ4 and LZ9)** .
8. Remove the engine front cover bolts.
9. Remove the engine front cover.
10. Remove the engine front cover gasket.

INSTALLATION PROCEDURE

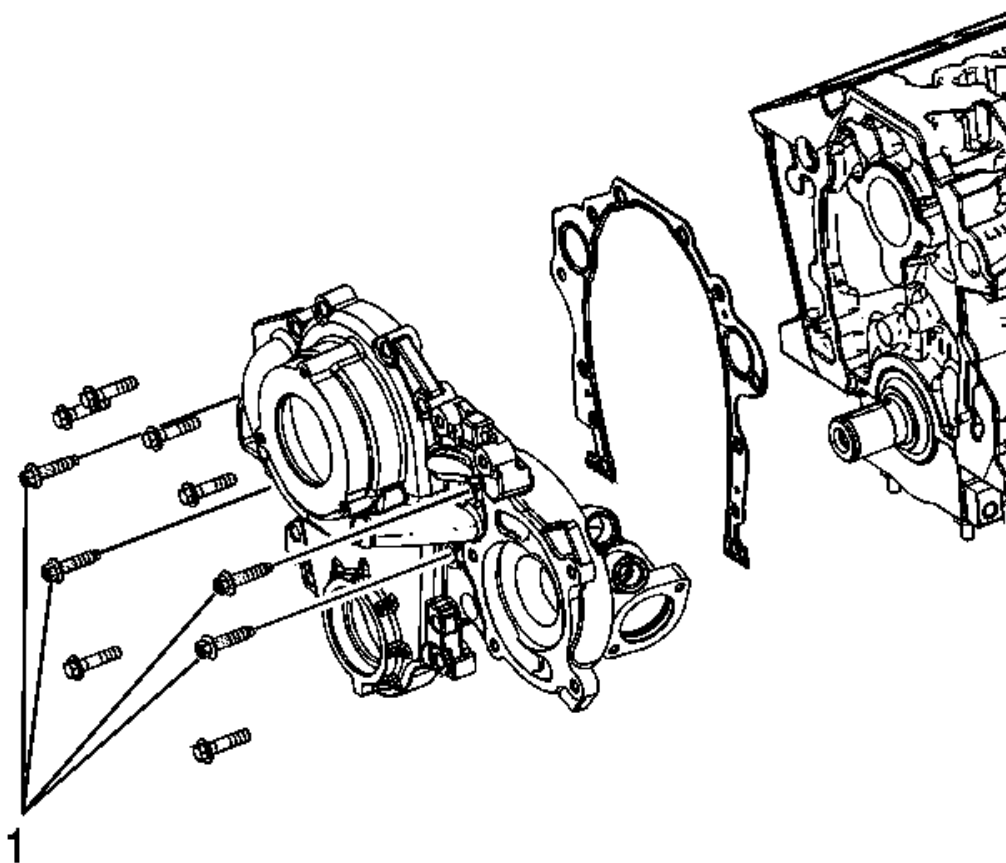


Fig. 167: Front Cover, Bolts & Gasket
Courtesy of GENERAL MOTORS CORP.

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

CAUTION: Refer to **Fastener Caution** .

3. Add sealant to the bolts in the locations pointed out in the graphic. Refer to **Adhesives, Fluids, Lubricants, and Sealers** for the correct part number.
4. Install the engine front cover bolts (1).

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

5. Install the water pump. Refer to **Water Pump Replacement (LZ4 and LZ9)** .
6. Install the thermostat housing. Refer to **Engine Coolant Thermostat Housing Replacement (LZ4 and LZ9)** .
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 (LY7, LZE, LZ4, LZ9)** .

CAMSHAFT TIMING CHAIN AND SPROCKET REPLACEMENT

SPECIAL TOOLS

EN-47719: Tensioner Compressor

REMOVAL PROCEDURE

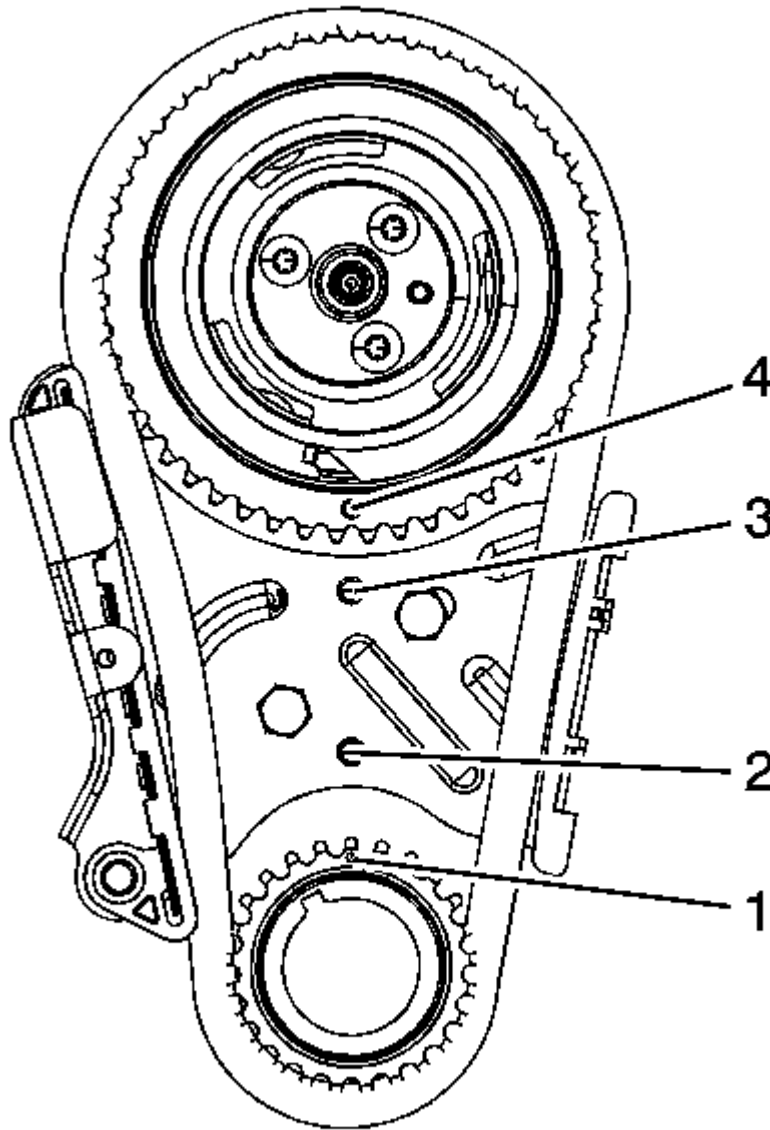


Fig. 168: Chain Tensioner, Crankshaft & Camshaft Gear Timing Marks
Courtesy of GENERAL MOTORS CORP.

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 gear (3) with the timing mark on top of the timing chain tensioner (4).

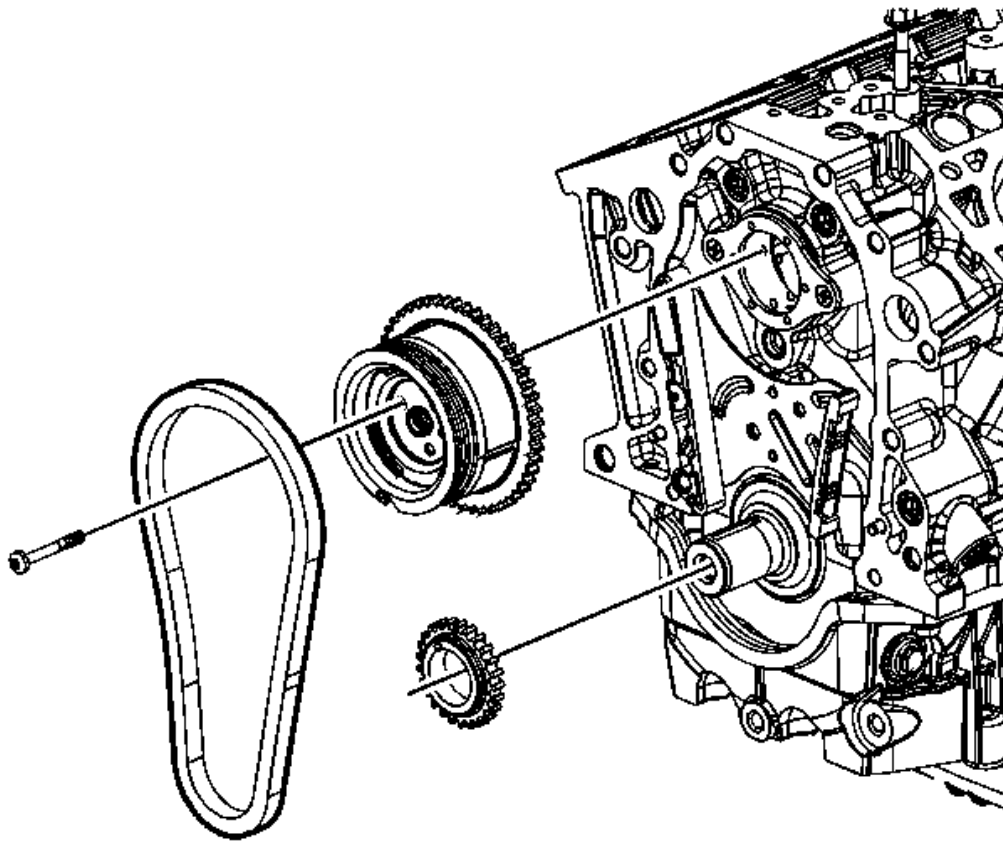


Fig. 169: Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

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

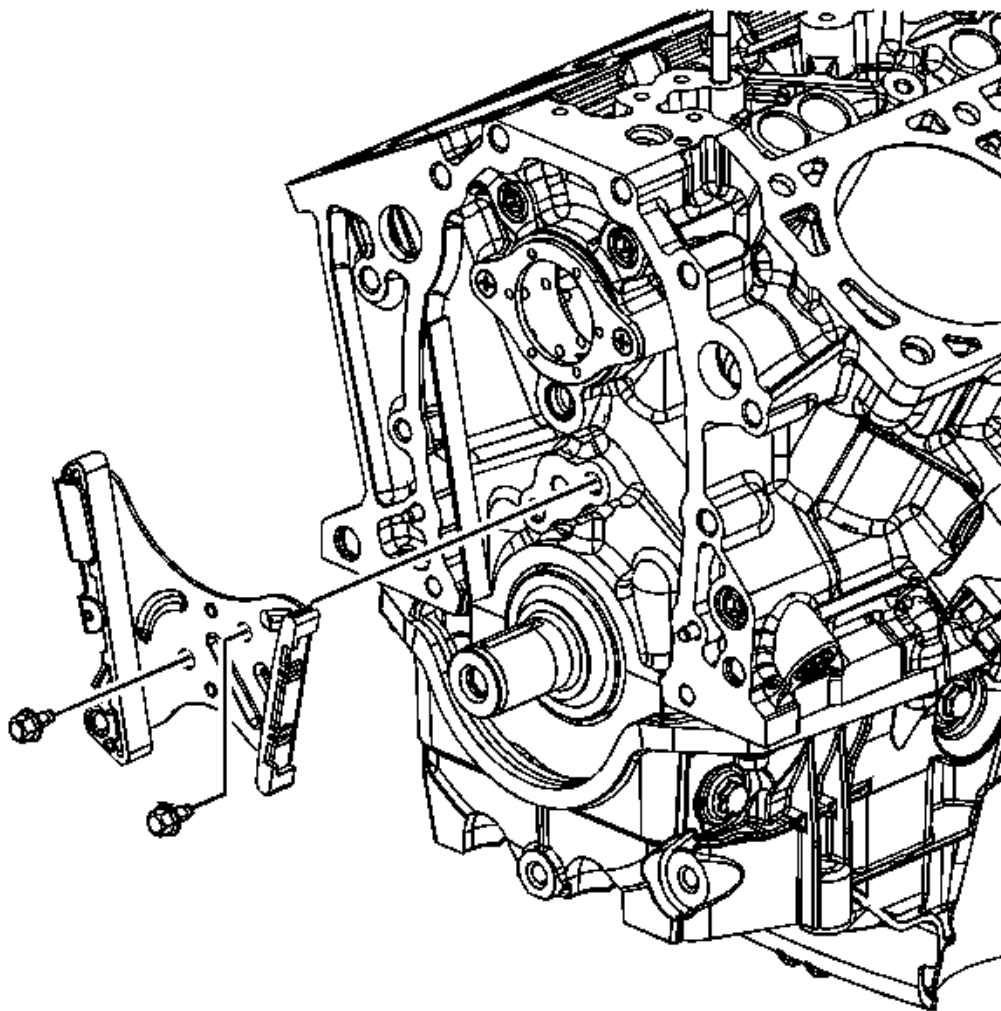


Fig. 170: Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

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

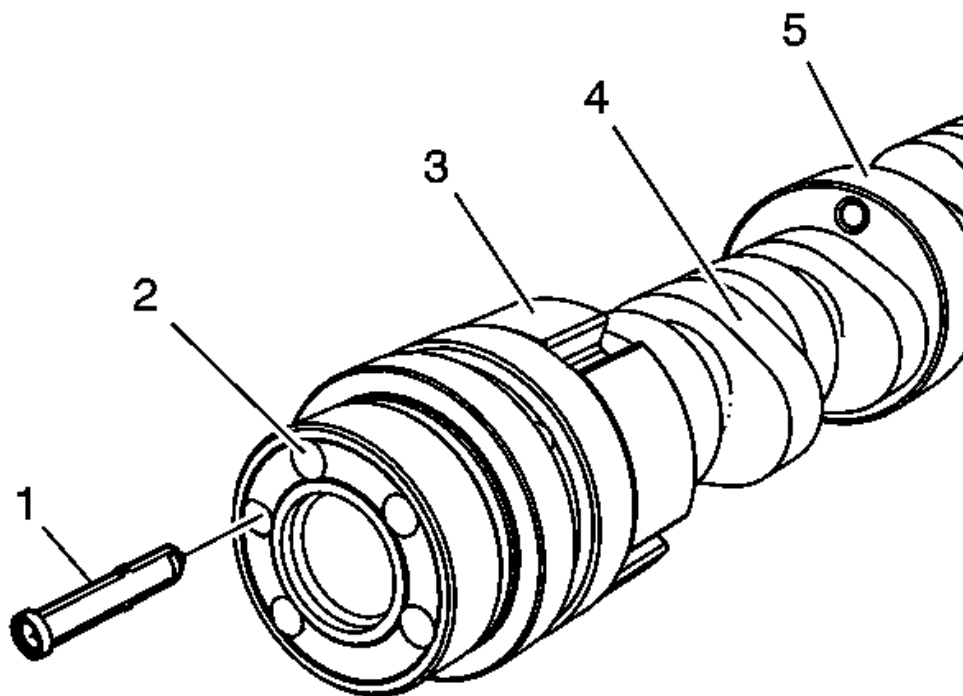


Fig. 171: Camshaft & Actuator Filter
Courtesy of GENERAL MOTORS CORP.

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

INSTALLATION PROCEDURE

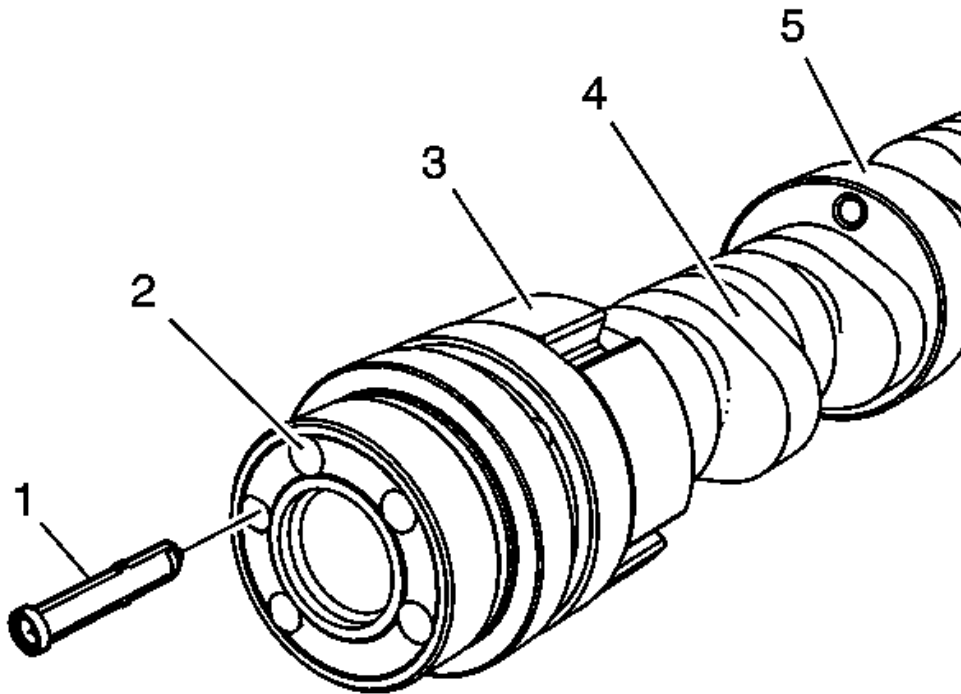


Fig. 172: Camshaft & Actuator Filter
Courtesy of GENERAL MOTORS CORP.

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

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

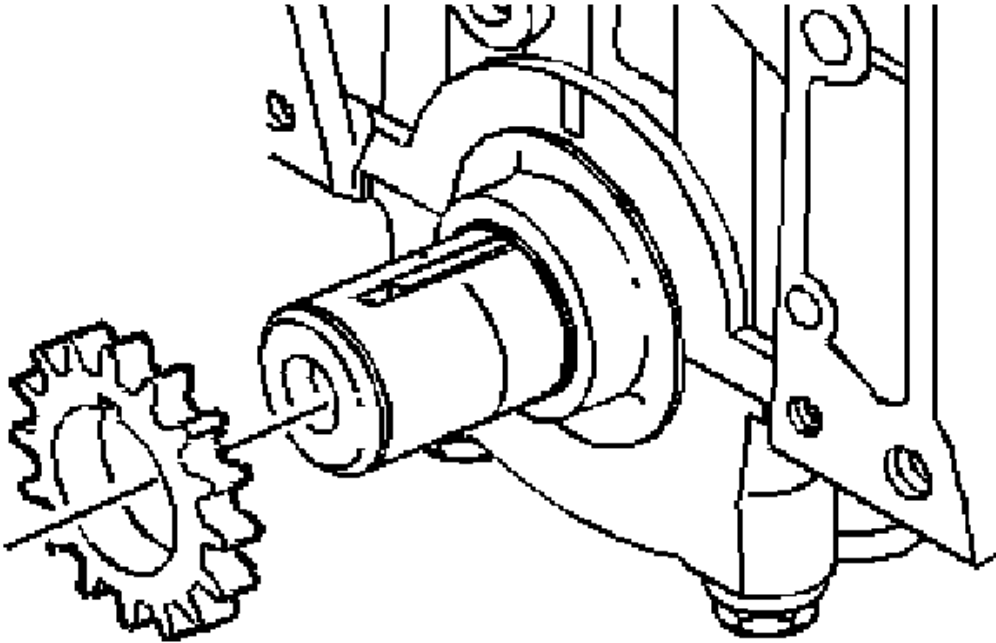


Fig. 173: Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

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

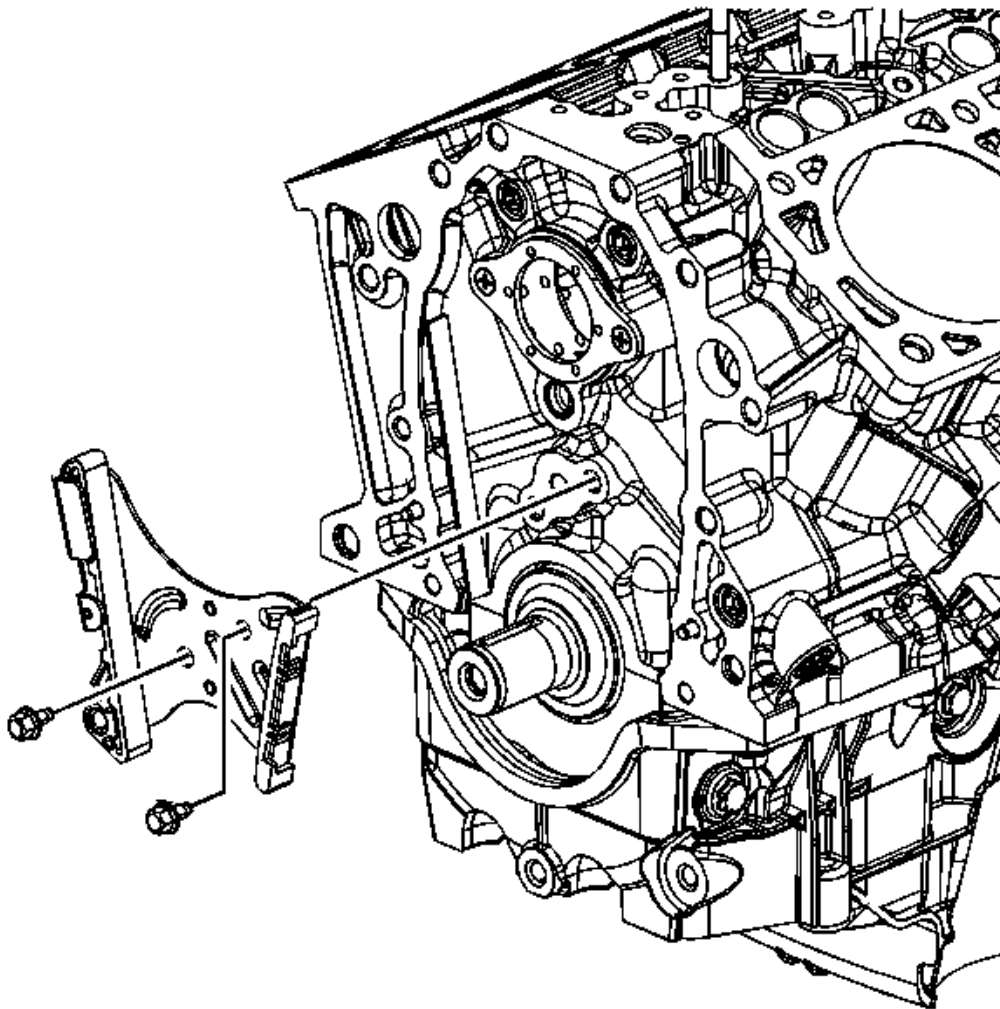


Fig. 174: Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

4. Install the timing chain tensioner.
5. Install the timing chain tensioner bolts and tighten to 21 N.m (15 lb ft).

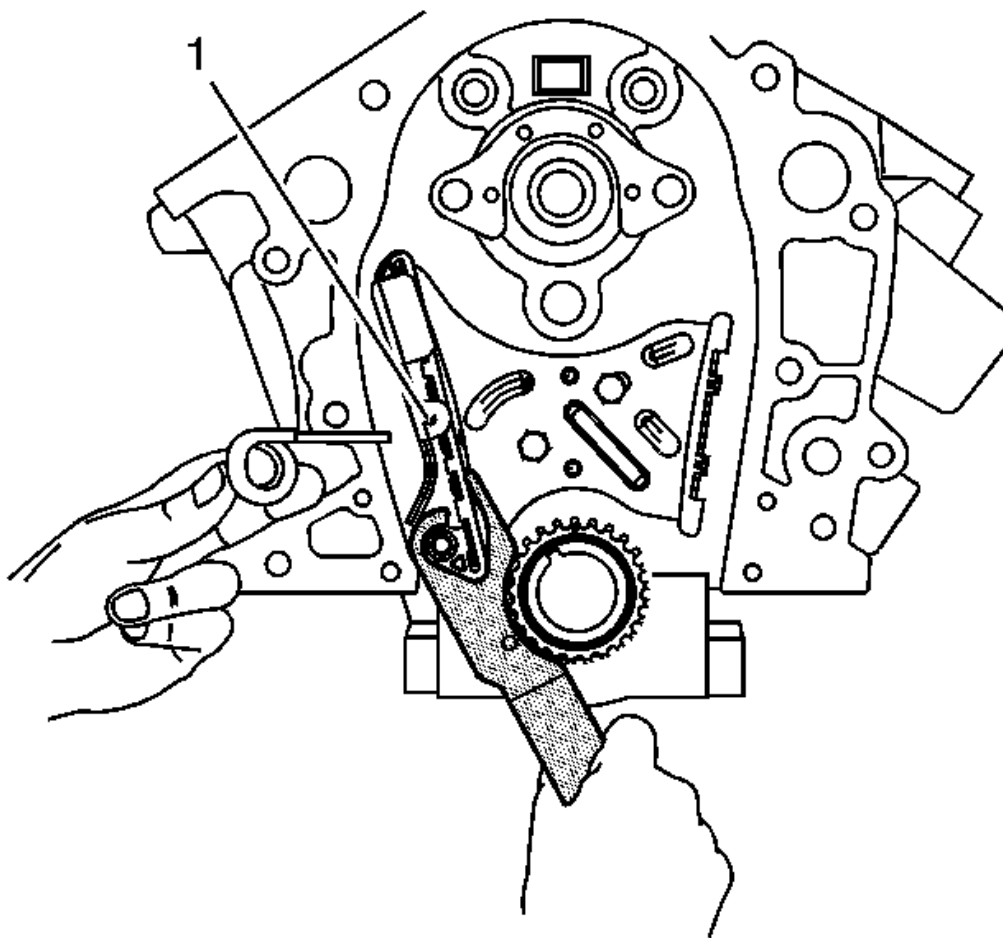


Fig. 175: Placing Tensioner Retaining Pin
Courtesy of GENERAL MOTORS CORP.

6. Using the **EN-47719: Tensioner Compressor**, fully collapse the tensioner, and place the tensioner retaining pin into the retaining hole (1).

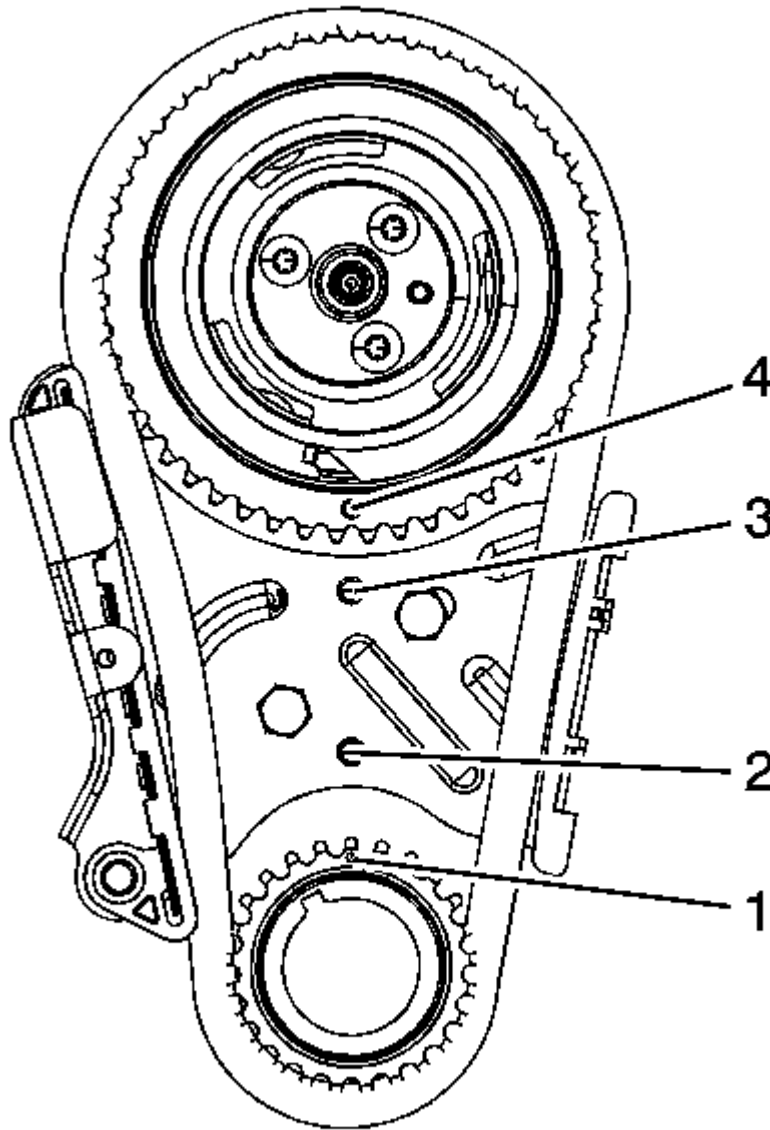


Fig. 176: Chain Tensioner, Crankshaft & Camshaft Gear Timing Marks
Courtesy of GENERAL MOTORS CORP.

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 gear (3) with the timing mark on top of the timing chain tensioner

(4).

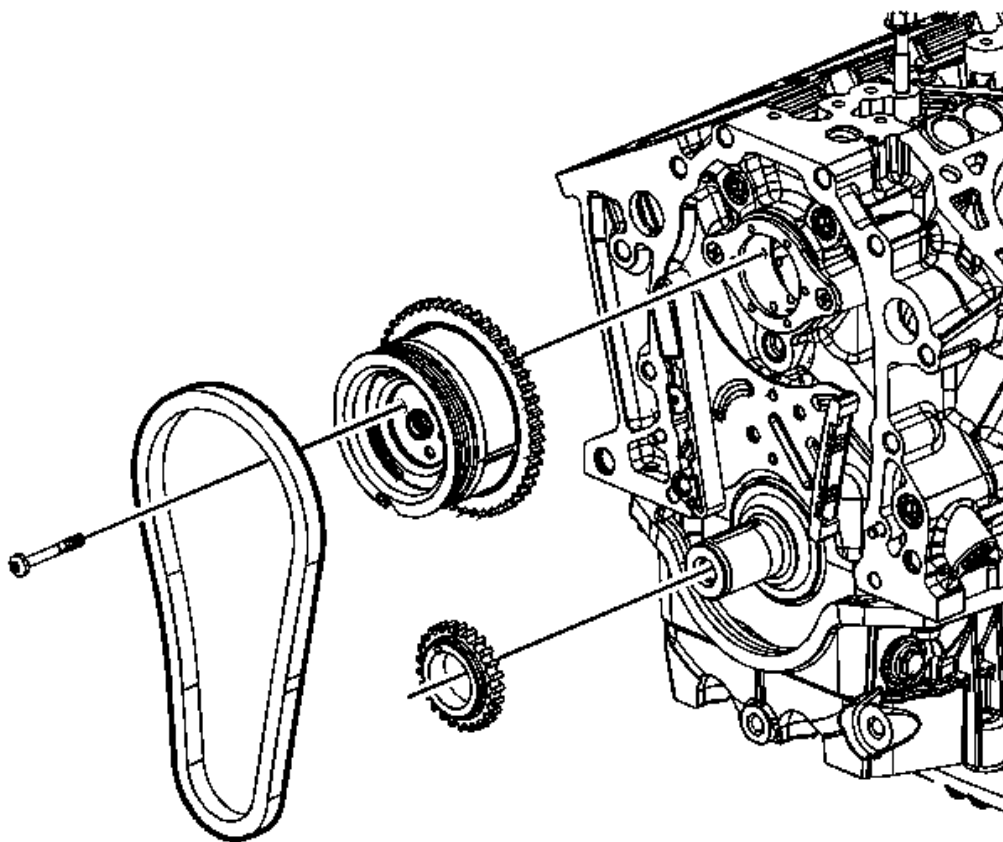


Fig. 177: Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

10. Align the dowel in the camshaft sprocket with the dowel hole in the camshaft.
11. Draw the camshaft sprocket onto the camshaft using the mounting bolts. Tighten the bolts to 16 N.m (12 lb ft).
12. Remove the retaining pin from the timing chain tensioner in order to make the tensioner active.
13. Coat the crankshaft and camshaft sprockets with clean engine oil.
14. Install the engine front cover. Refer to **Engine Front Cover Replacement**.

CYLINDER HEAD REPLACEMENT - LEFT SIDE

SPECIAL TOOLS

J 45059 Angle Meter

REMOVAL PROCEDURE

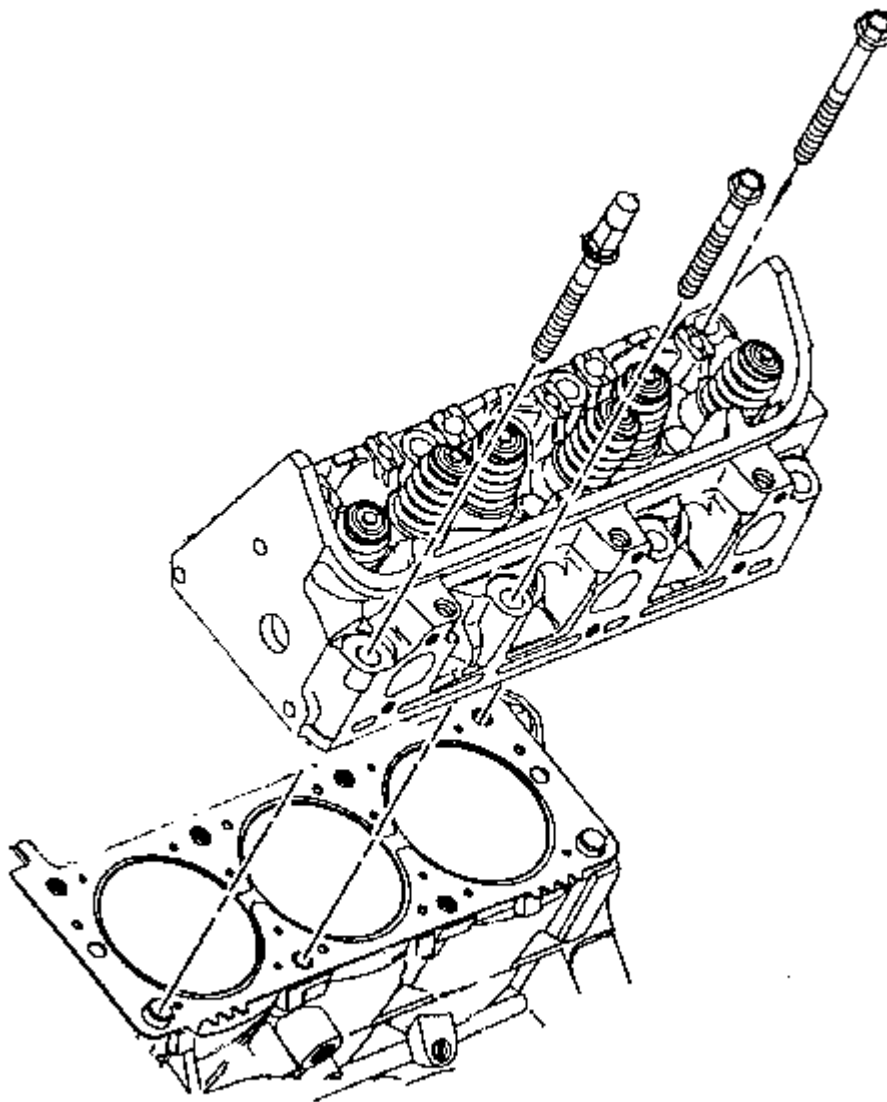


Fig. 178: Cylinder Head & Bolts
Courtesy of GENERAL MOTORS CORP.

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 the pushrods. Refer to **Valve Rocker Arm and Push Rod Replacement**.
5. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement - Left Side (LZ9)**.
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**.
8. Remove and discard the cylinder head bolts.
9. Remove the cylinder head.

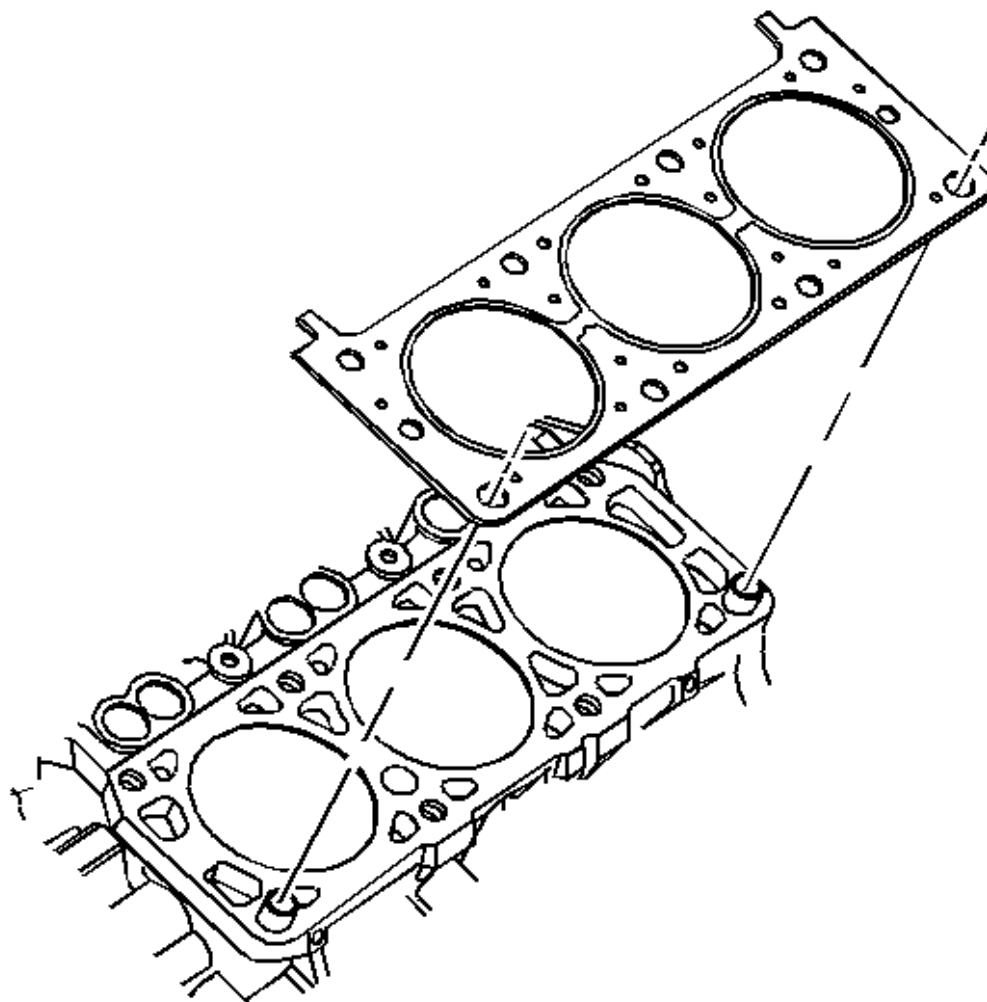


Fig. 179: Cylinder Head Gasket & Alignment Pins
Courtesy of GENERAL MOTORS CORP.

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

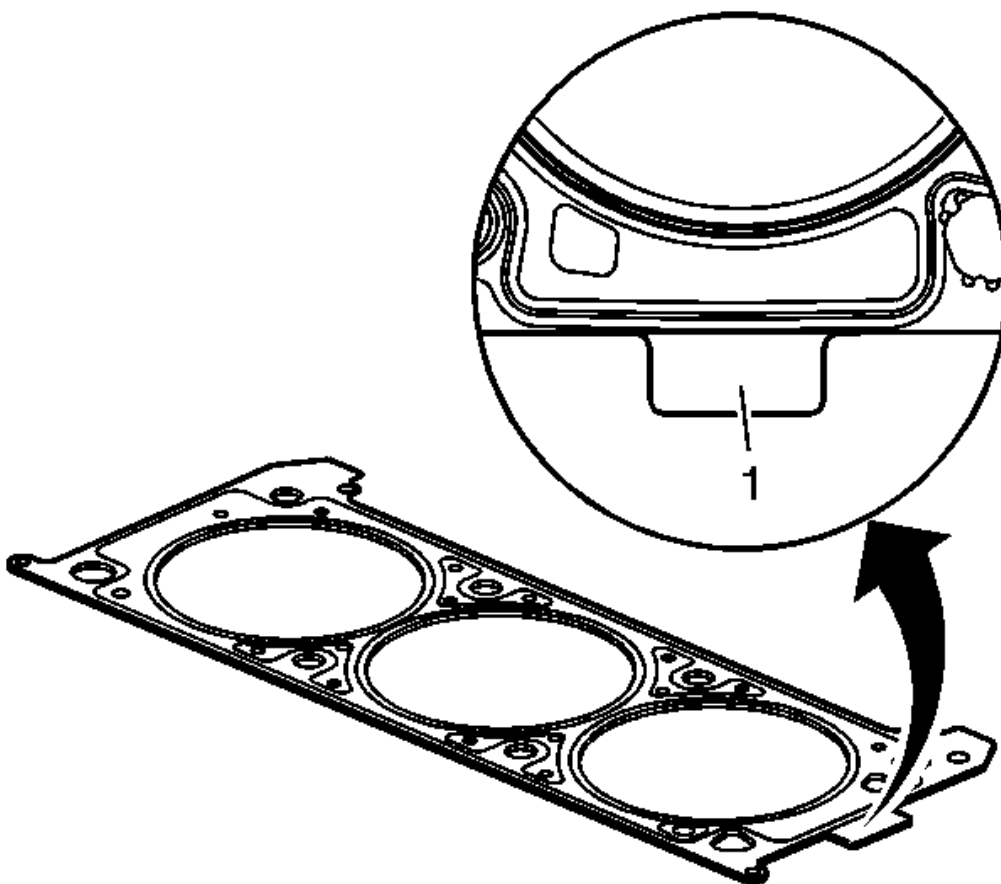


Fig. 180: Locating Cylinder Head Gasket Markings
Courtesy of GENERAL MOTORS CORP.

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.

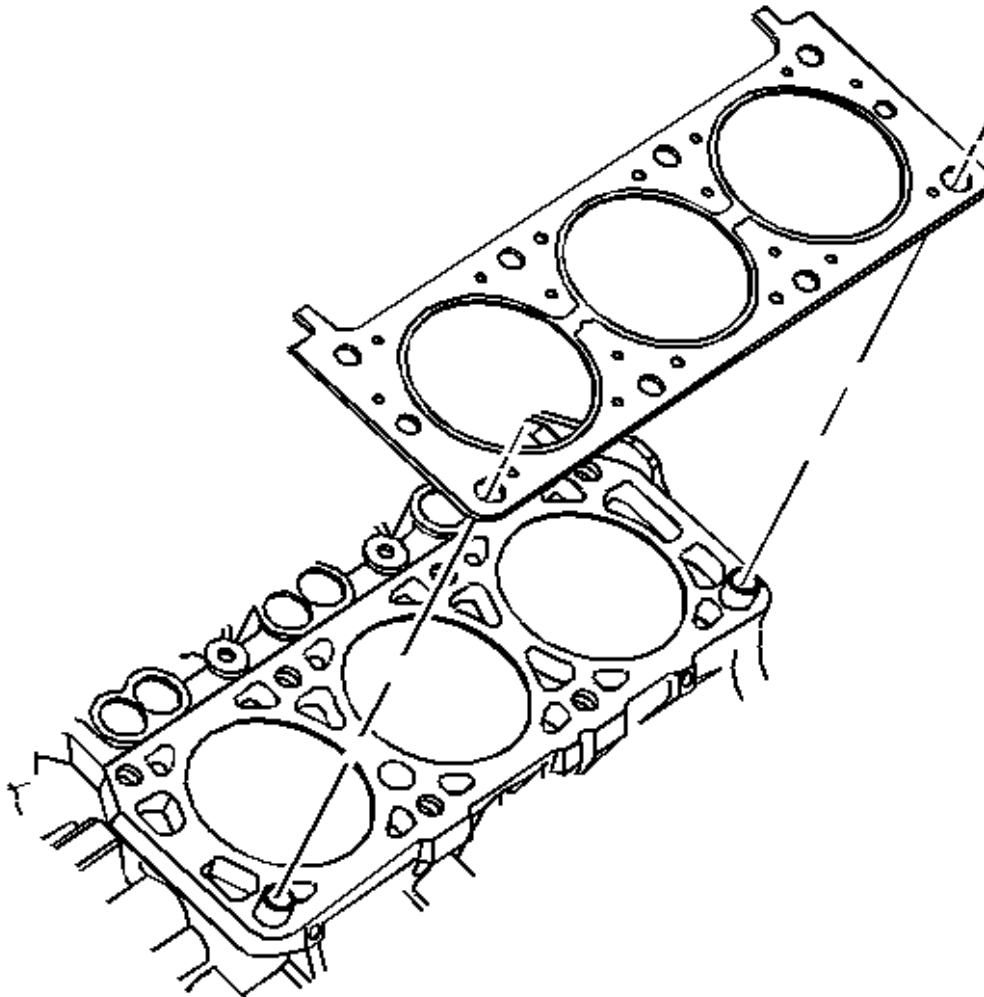


Fig. 181: Cylinder Head Gasket & Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Install a NEW cylinder head gasket.

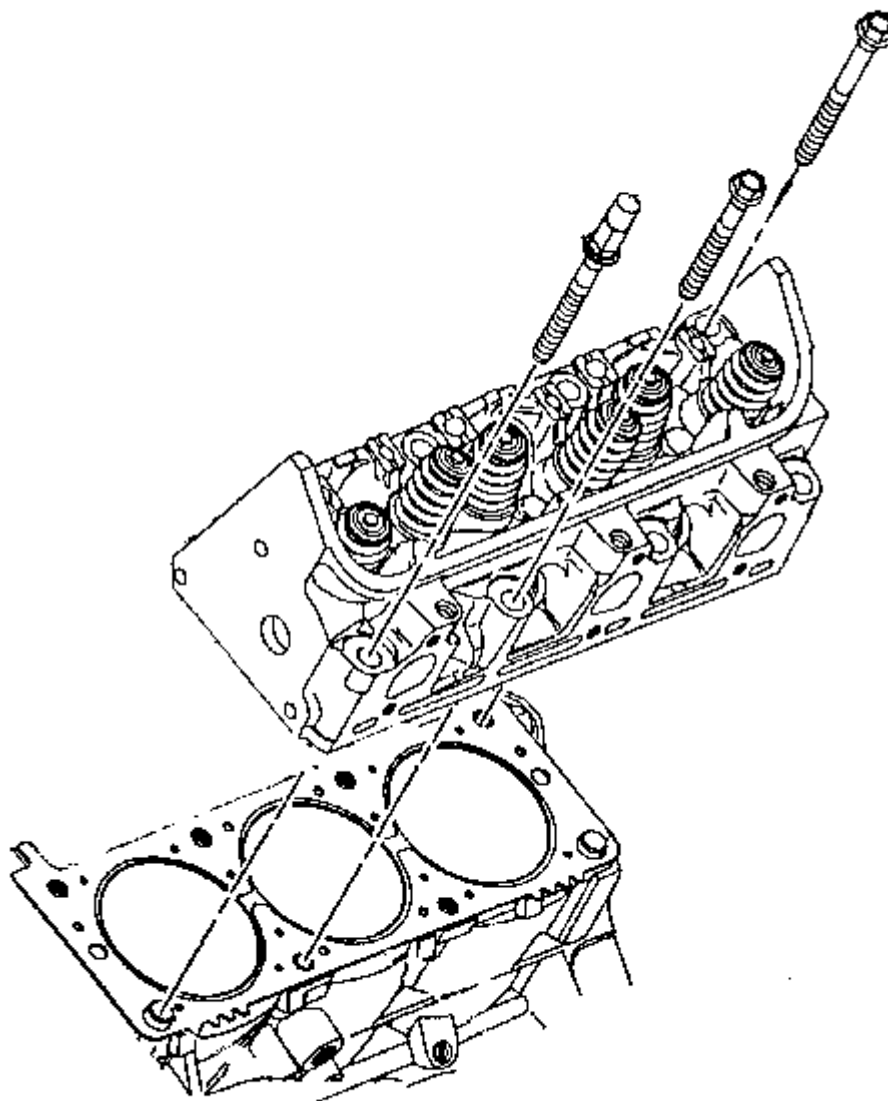


Fig. 182: Cylinder Head & Bolts

Courtesy of GENERAL MOTORS CORP.

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

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

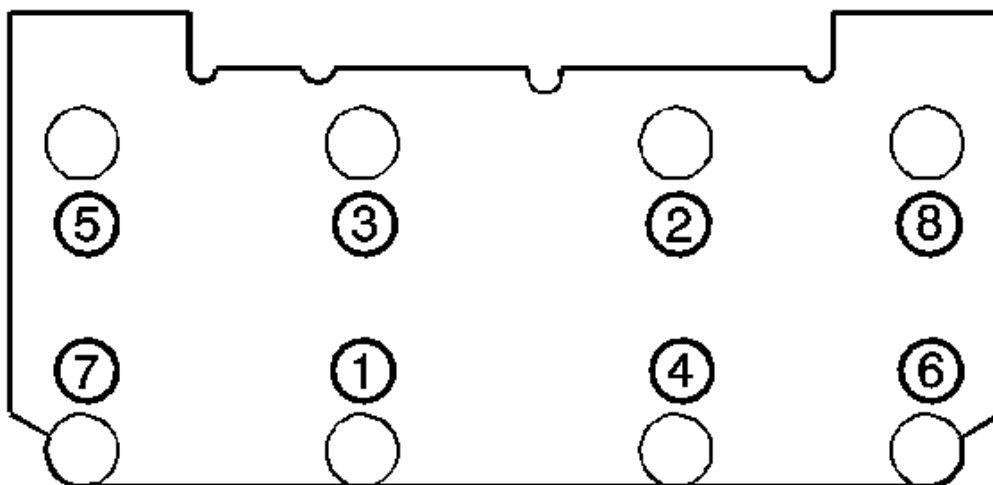


Fig. 183: Identifying Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

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

Tighten:

1. Tighten the cylinder head bolts a first pass in sequence to 60 N.m (44 lb ft).
 2. Tighten the cylinder head bolts a final pass in sequence to 140 degrees using the **J 45059** .
8. Install the left spark plugs. Refer to Spark Plug Replacement .
 9. Install the oil level indicator tube. Refer to Oil Level Indicator Tube Replacement.
 10. Install the exhaust manifold. Refer to Exhaust Manifold Replacement - Left Side (LZ9) .
 11. Install the valve rocker arms and the pushrods. Refer to Valve Rocker Arm and Push Rod Replacement.
 12. Install the lower intake manifold. Refer to Lower Intake Manifold Replacement.
 13. Fill the engine with oil. Refer to Engine Oil and Oil Filter Replacement.

14. Inspect for leaks.

CYLINDER HEAD REPLACEMENT - RIGHT SIDE

SPECIAL TOOLS

J 45059 Angle Meter

REMOVAL PROCEDURE

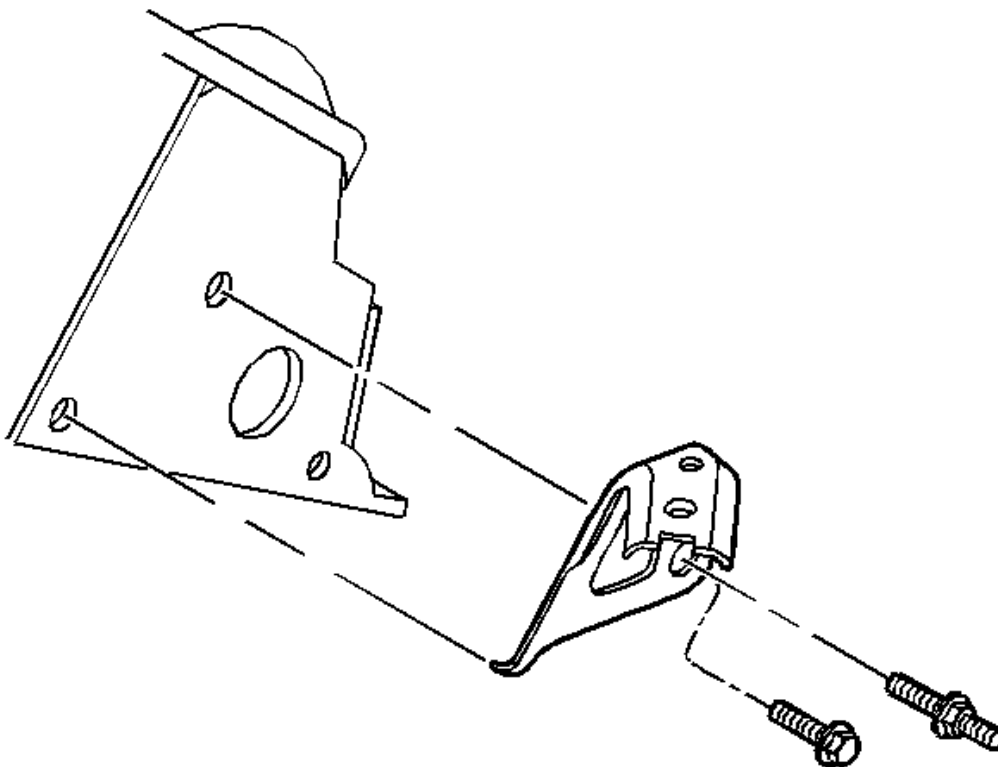


Fig. 184: Fuel Line Bracket, Bolt & Stud
Courtesy of GENERAL MOTORS CORP.

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 - Right Side (LZ9 w/RPO MT2)** or **Exhaust Manifold Replacement - Right Side (LZ9 w/RPO M15)** .
6. Remove the right spark plugs. Refer to **Spark Plug Replacement** .
7. Remove the fuel line bracket bolt and stud.
8. Remove the fuel line bracket.
9. Remove the generator. Refer to **Generator Replacement (LZ9)** .

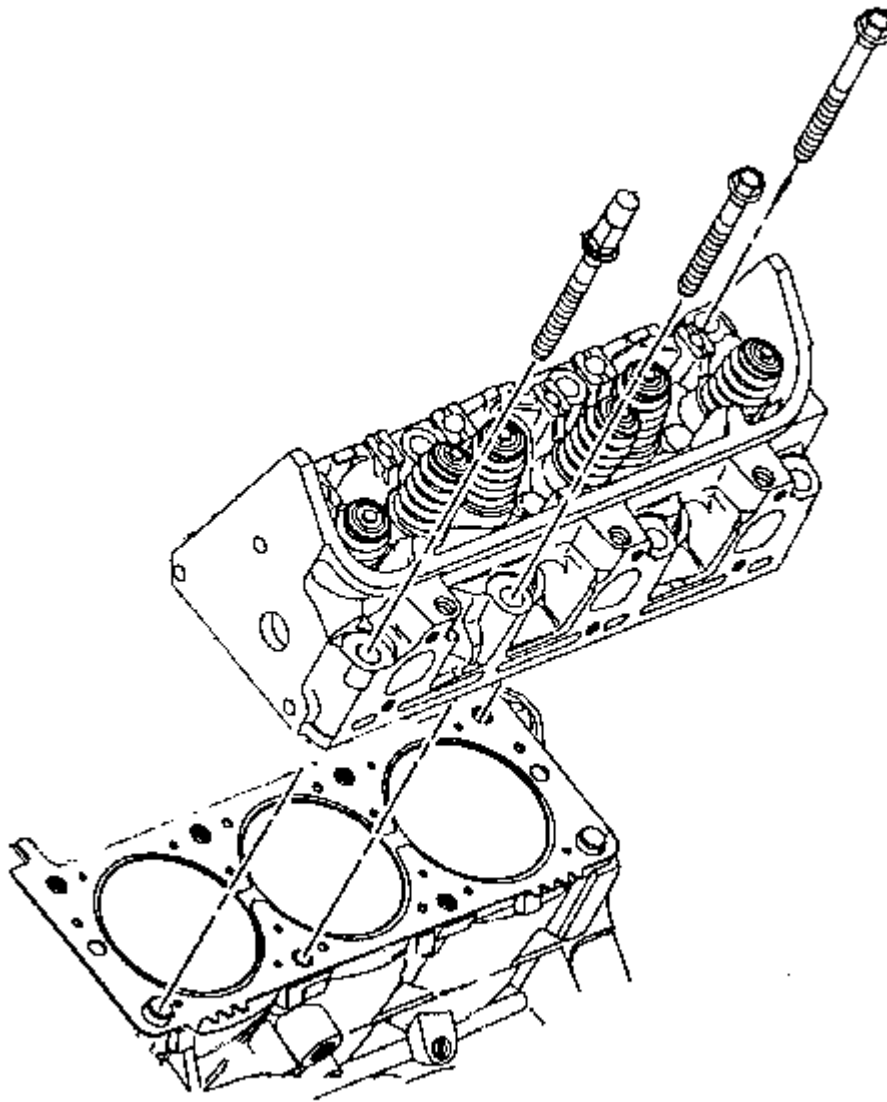
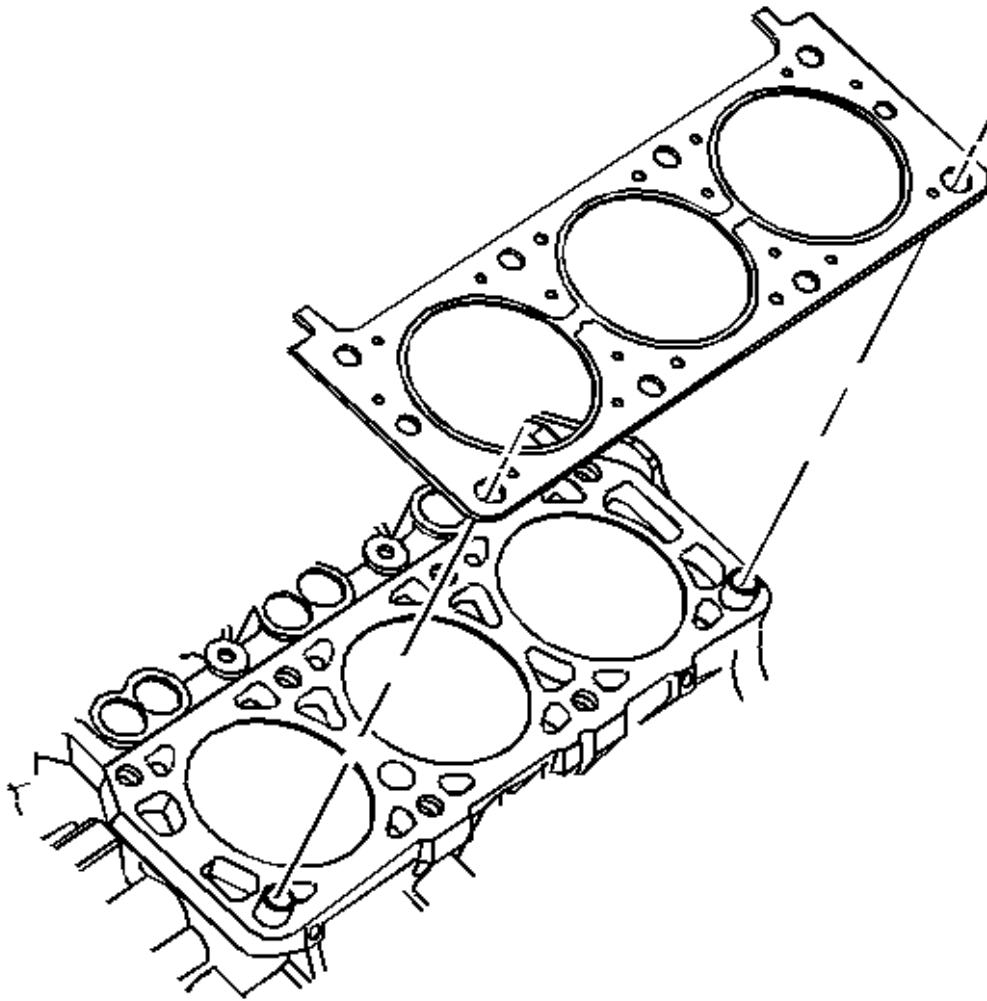


Fig. 185: Cylinder Head & Bolts**Courtesy of GENERAL MOTORS CORP.**

10. Remove and discard the cylinder head bolts.
11. Remove the cylinder head.

**Fig. 186: Cylinder Head Gasket & Alignment Pins****Courtesy of GENERAL MOTORS CORP.**

12. Remove and discard the cylinder head gasket.
13. Remove the cylinder head locator dowel pins, if necessary.

14. Clean and inspect the cylinder head. Refer to Cylinder Head Cleaning and Inspection .

INSTALLATION PROCEDURE

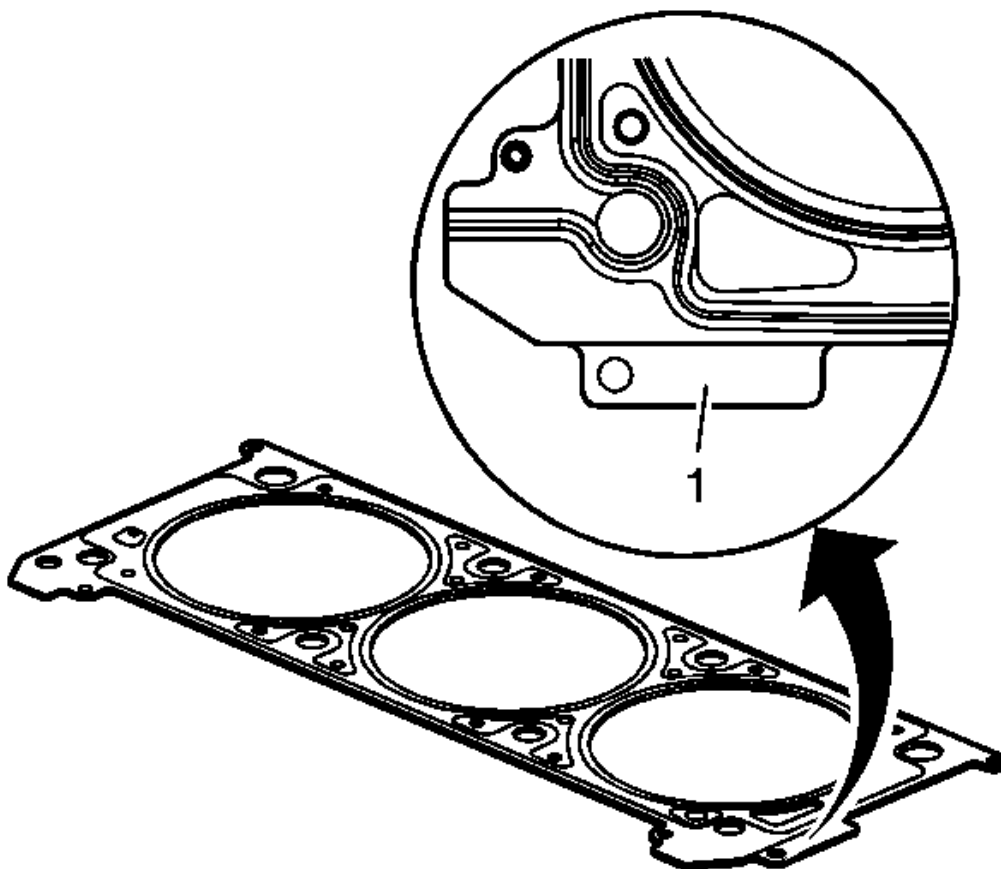


Fig. 187: Locating Cylinder Head Gasket Markings
Courtesy of GENERAL MOTORS CORP.

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.

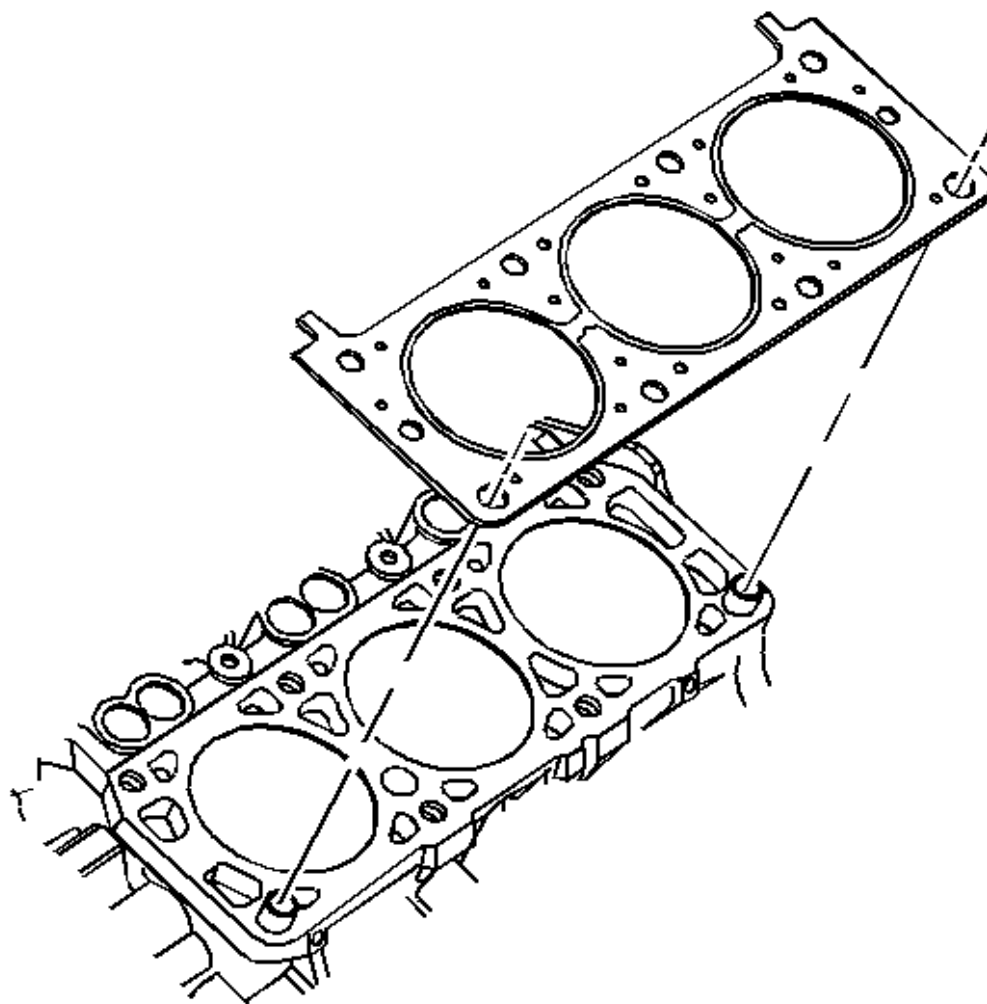


Fig. 188: Cylinder Head Gasket & Alignment Pins
Courtesy of GENERAL MOTORS CORP.

3. Install a NEW cylinder head gasket.

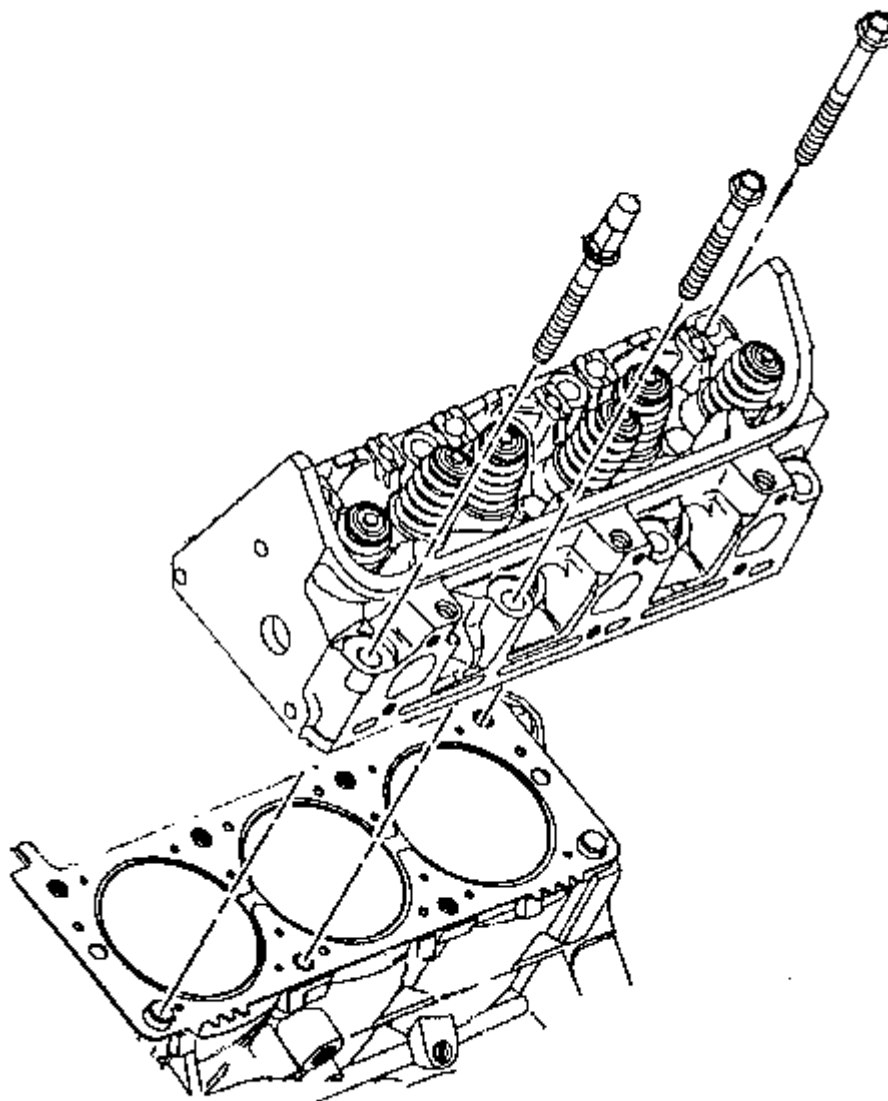


Fig. 189: Cylinder Head & Bolts

Courtesy of GENERAL MOTORS CORP.

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

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

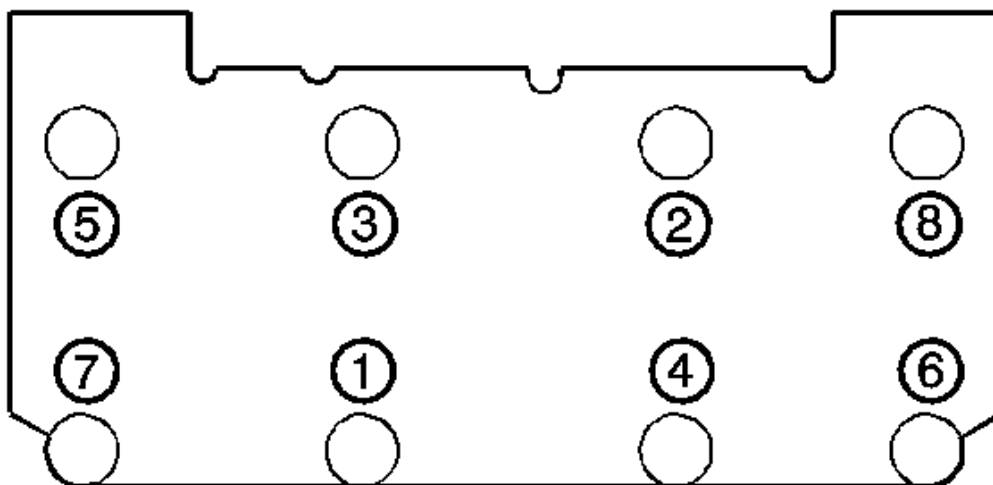


Fig. 190: Identifying Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

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

Tighten:

1. Tighten the cylinder head bolts a first pass in sequence to 60 N.m (44 lb ft).
 2. Tighten the cylinder head bolts a final pass in sequence to 140 degrees using the **J 45059** .
8. Install the generator. Refer to Generator Replacement (LZ9) .

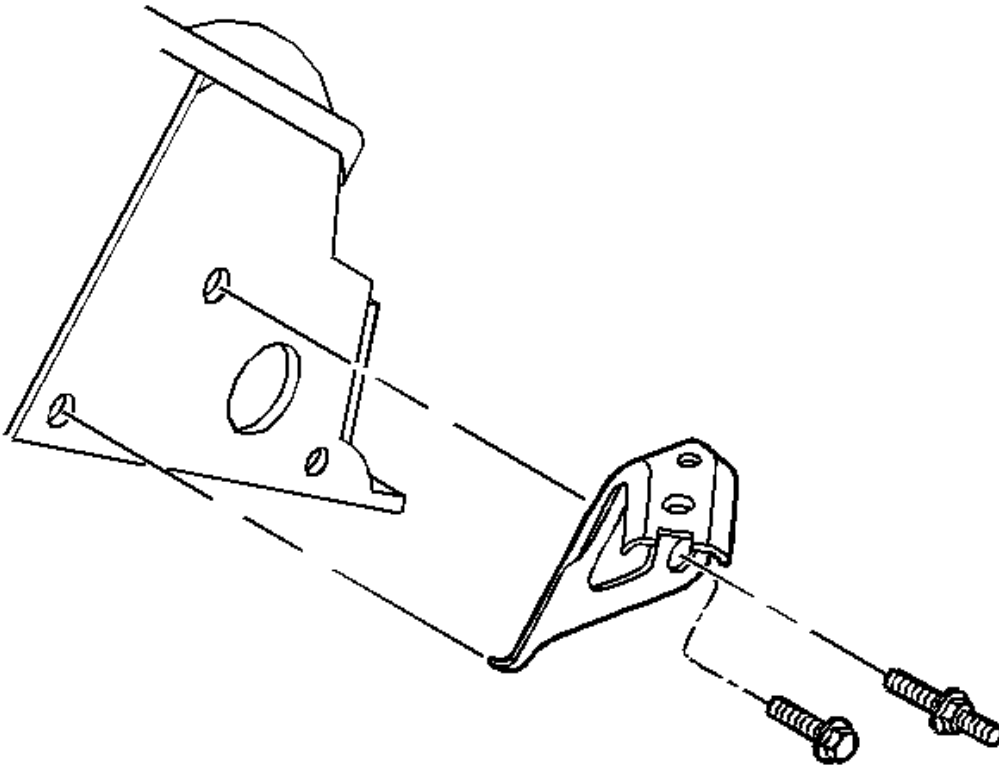


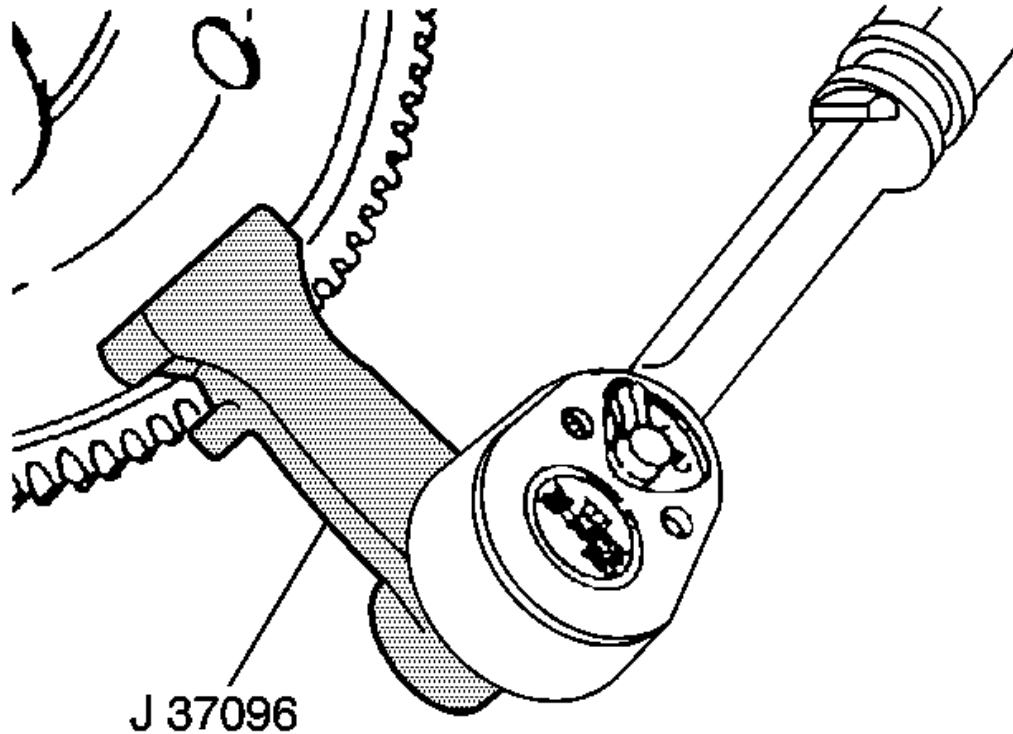
Fig. 191: Fuel Line Bracket, Bolt & Stud
Courtesy of GENERAL MOTORS CORP.

9. Position the fuel line bracket to the cylinder head.
10. Install the fuel line bracket bolt and stud.

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

11. Install the right spark plugs. Refer to [Spark Plug Replacement](#) .
12. Install the exhaust manifold. Refer to [Exhaust Manifold Replacement - Right Side \(LZ9 w/RPO MT2\)](#) or [Exhaust Manifold Replacement - Right Side \(LZ9 w/RPO M15\)](#) .
13. Install the valve rocker arms and pushrods. Refer to [Valve Rocker Arm and Push Rod Replacement](#).
14. Install the lower intake manifold. Refer to [Lower Intake Manifold Replacement](#).
15. Fill the engine with oil. Refer to [Engine Oil and Oil Filter Replacement](#) .
16. Inspect for leaks.

ENGINE FLYWHEEL REPLACEMENT

SPECIAL TOOLS**J 37096** Flywheel Holder**REMOVAL PROCEDURE****Fig. 192: Holding Flywheel****Courtesy of GENERAL MOTORS CORP.**

1. Remove the automatic transaxle. Refer to **Transmission Replacement** .
2. Use the **J 37096** to secure the flywheel in order to prevent the crankshaft from rotating.

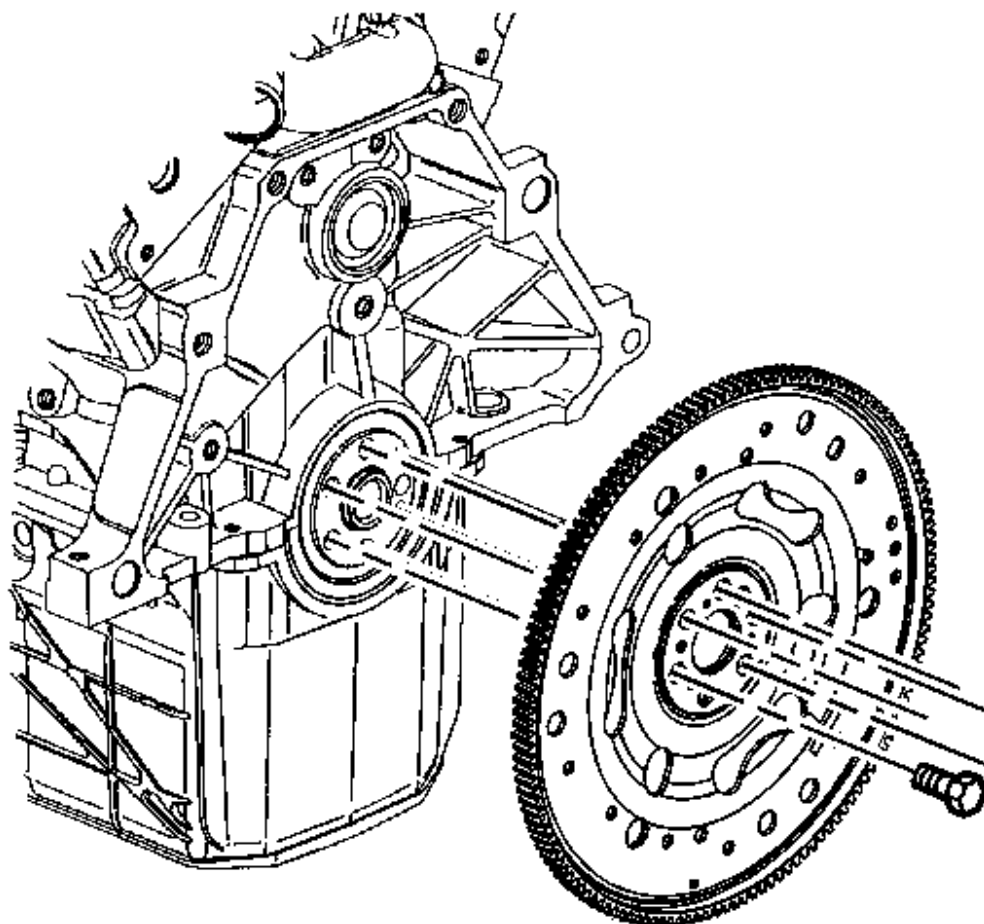


Fig. 193: Flywheel

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

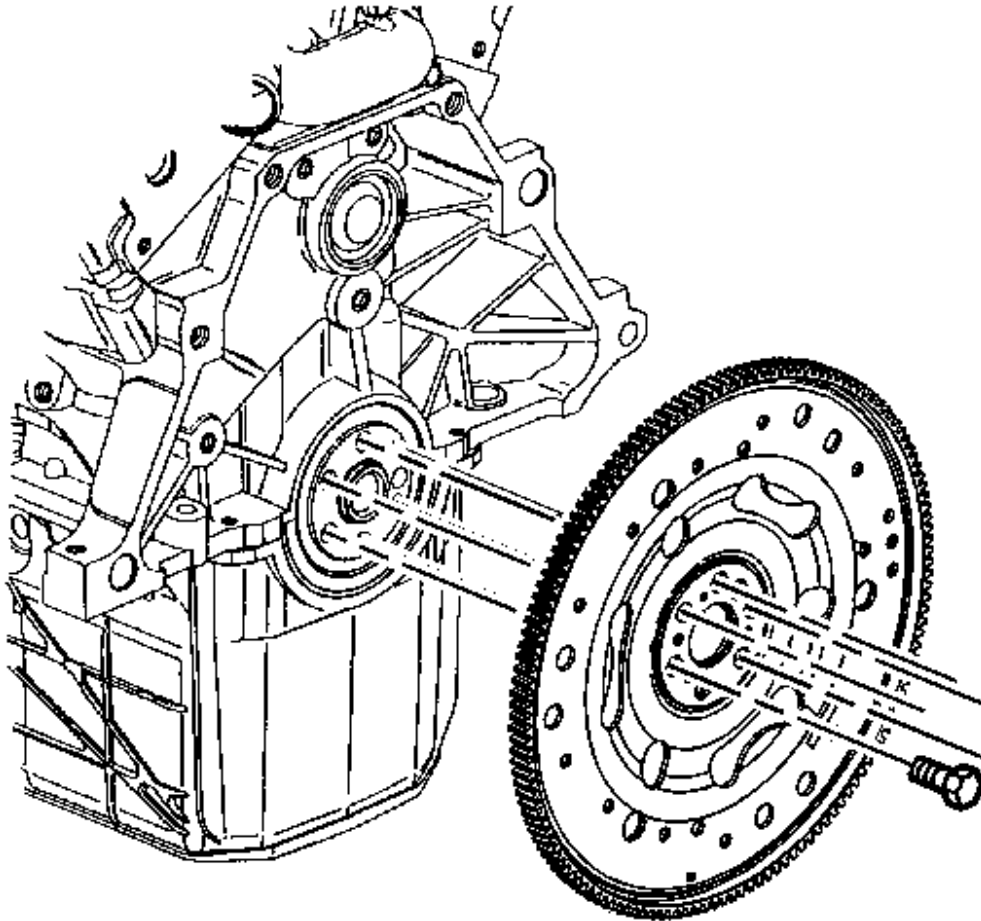


Fig. 194: Flywheel

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.

CAUTION: Refer to Fastener Caution .

4. Tighten the engine flywheel bolts.

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

5. Install the automatic transaxle. Refer to [Transmission Replacement](#) .

CRANKSHAFT REAR OIL SEAL REPLACEMENT

REMOVAL PROCEDURE

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

CAMSHAFT REAR BEARING HOLE PLUG REPLACEMENT

REMOVAL PROCEDURE

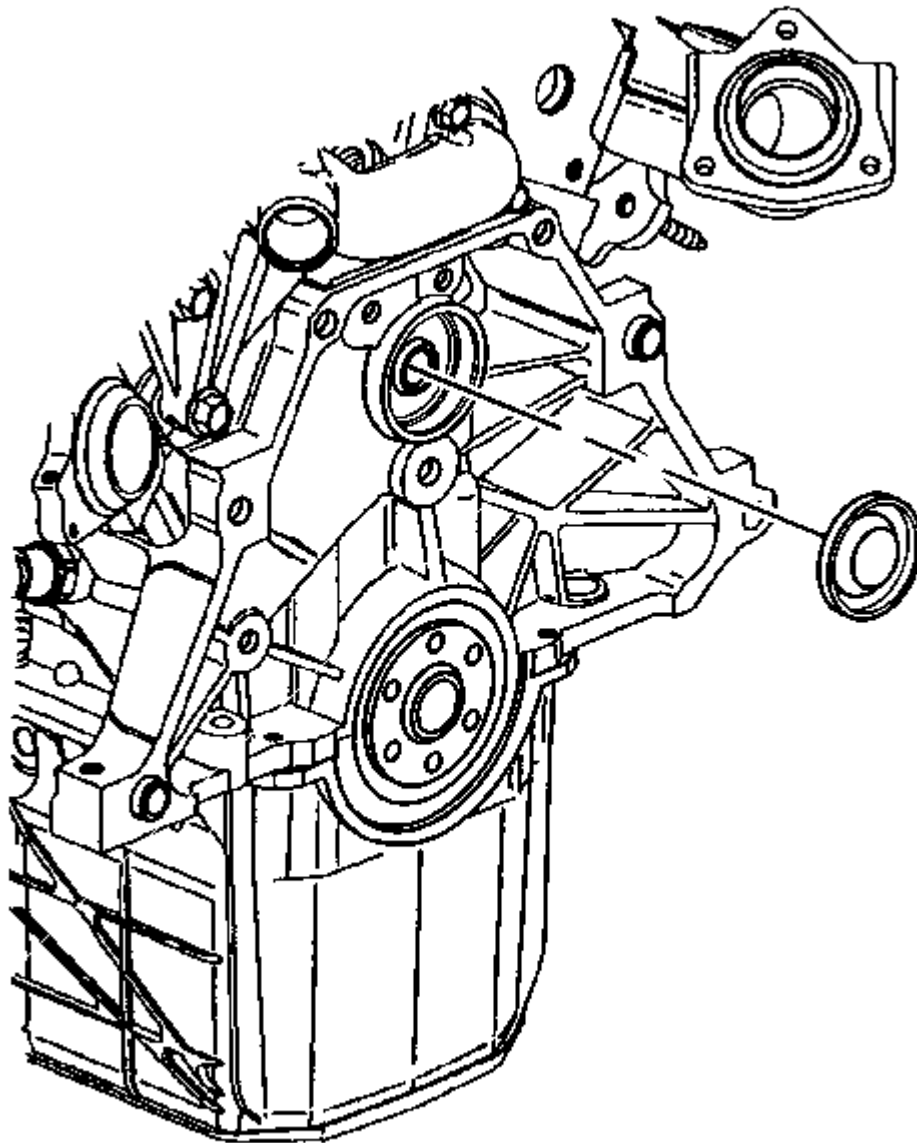


Fig. 195: Camshaft Rear Bearing Hole Plug
Courtesy of GENERAL MOTORS CORP.

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

INSTALLATION PROCEDURE

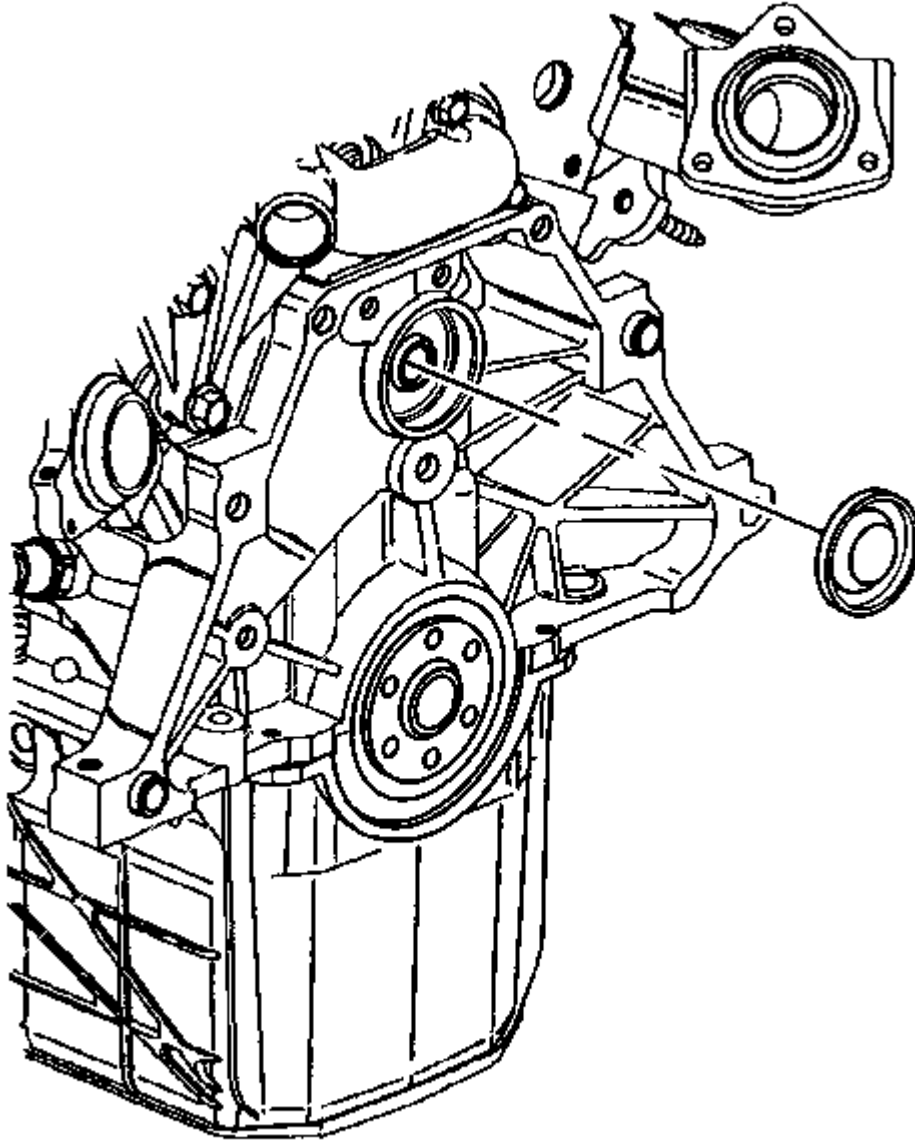


Fig. 196: Camshaft Rear Bearing Hole Plug
Courtesy of GENERAL MOTORS CORP.

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.

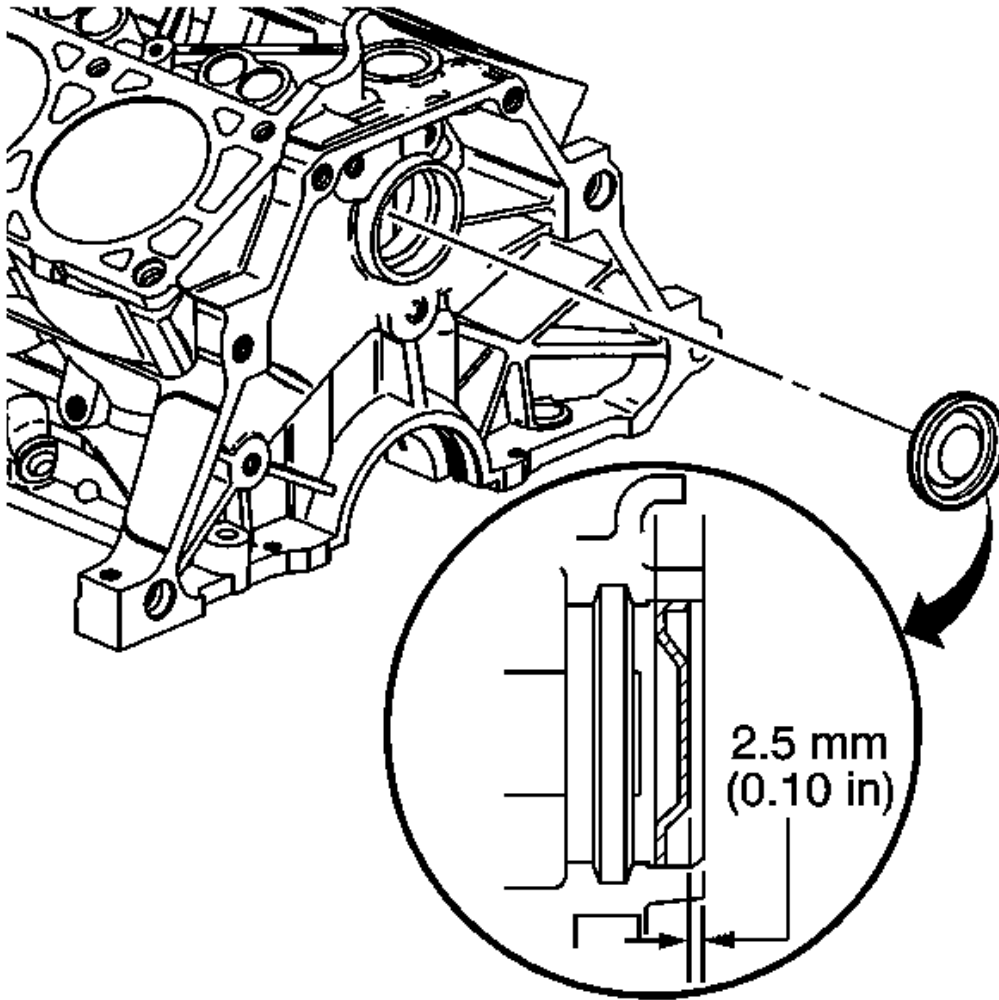


Fig. 197: Identifying Camshaft Rear Bearing Hole Plug Installation Depth
Courtesy of GENERAL MOTORS CORP.

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

ENGINE REPLACEMENT

REMOVAL PROCEDURE

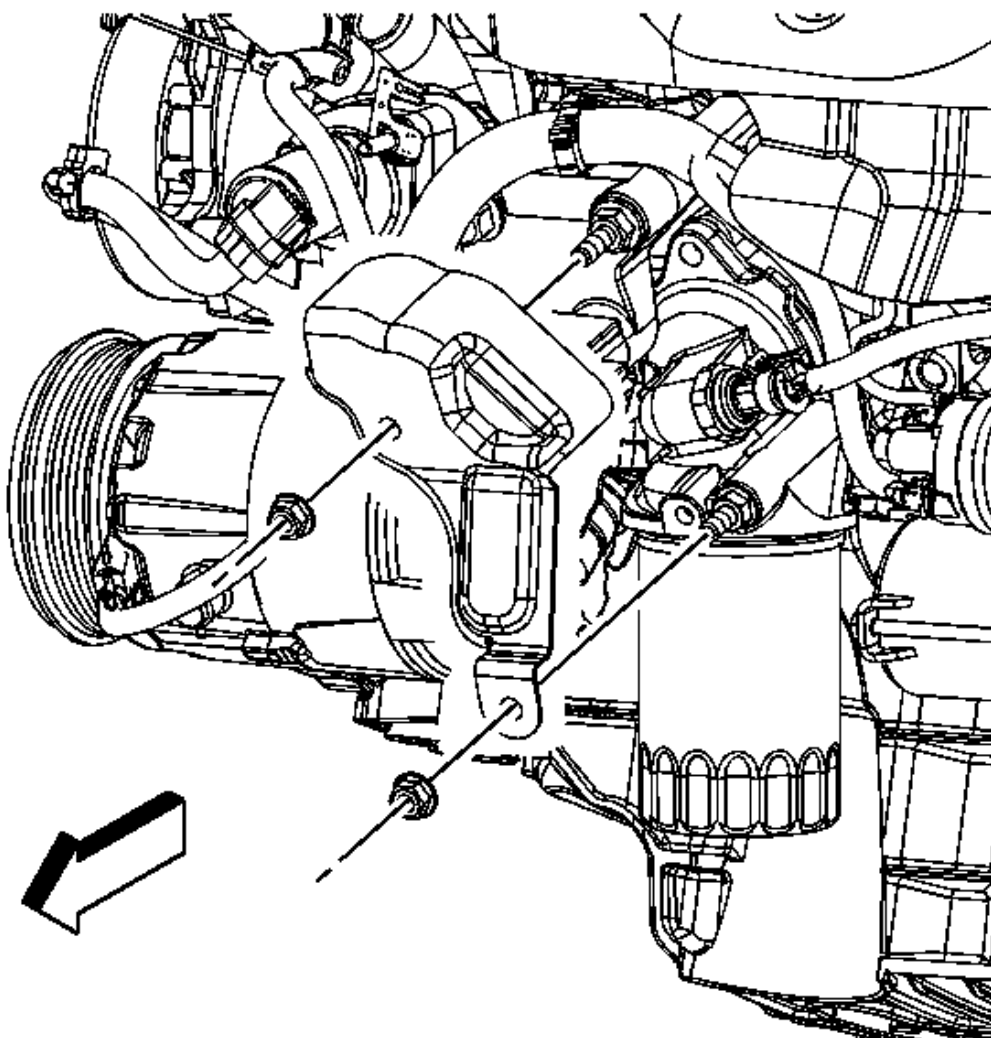


Fig. 198: Oil Pressure Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.
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 (Coupe)** or **Drive Belt Replacement (Convertible)**.

6. Remove the power steering pump and disconnect the power steering lines, if equipped. Refer to **Power Steering Pump Replacement (LZ4, LZ9)**.
7. Drain the cooling system. Refer to **Cooling System Draining and Filling (LY7, LZE, LZ4, LZ9)**.
8. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
9. Remove the oil pressure sensor heat shield nuts and shield.

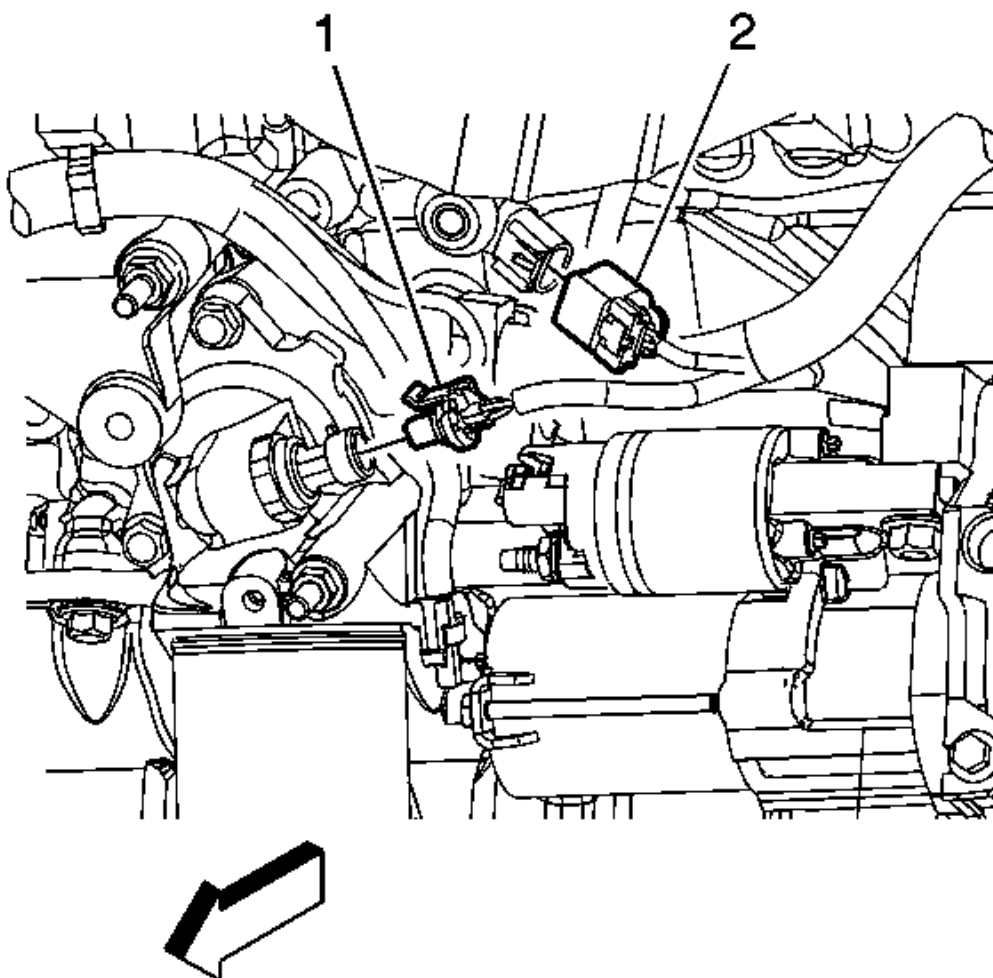


Fig. 199: Knock Sensor & Oil Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

10. Disconnect the oil pressure sensor (1) electrical connector.
11. Disconnect the knock sensor (2) electrical connector.

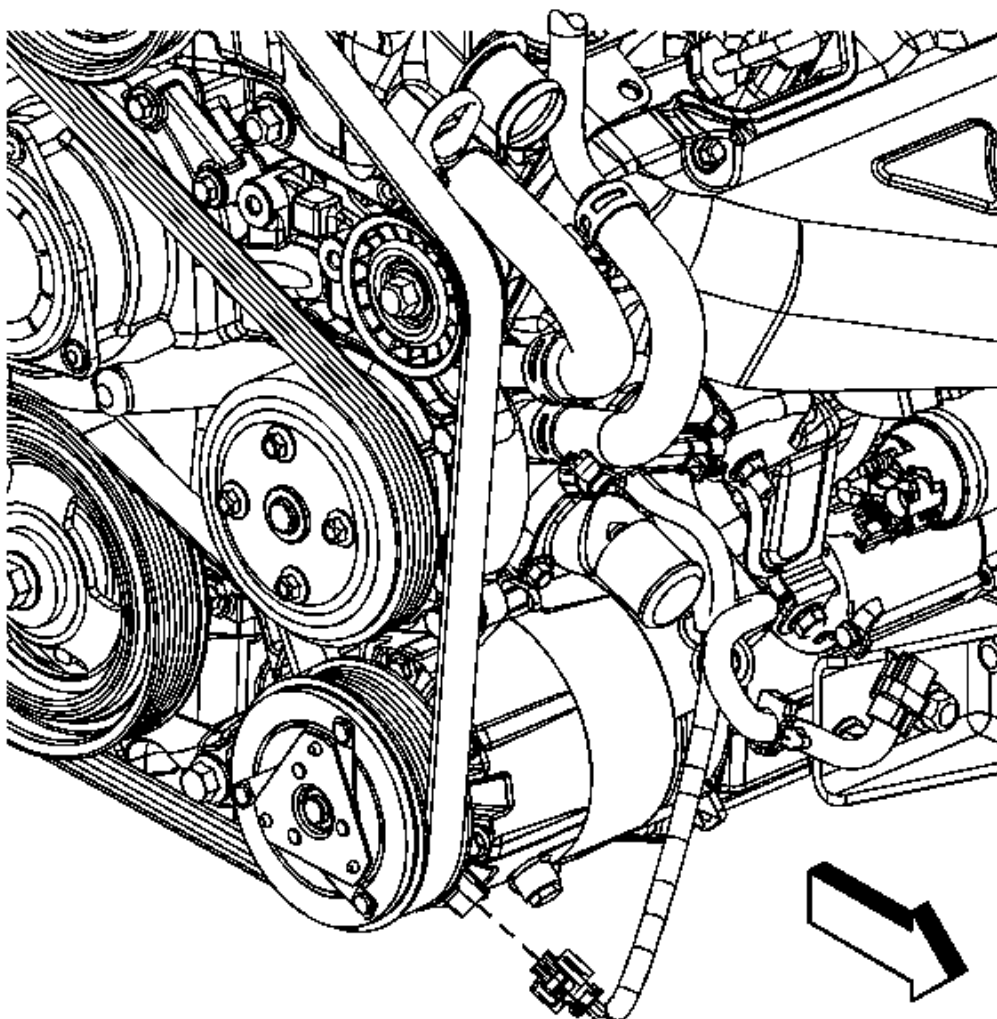


Fig. 200: A/C Compressor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

12. Disconnect the air conditioning (A/C) compressor electrical connector.
13. Lower the vehicle.

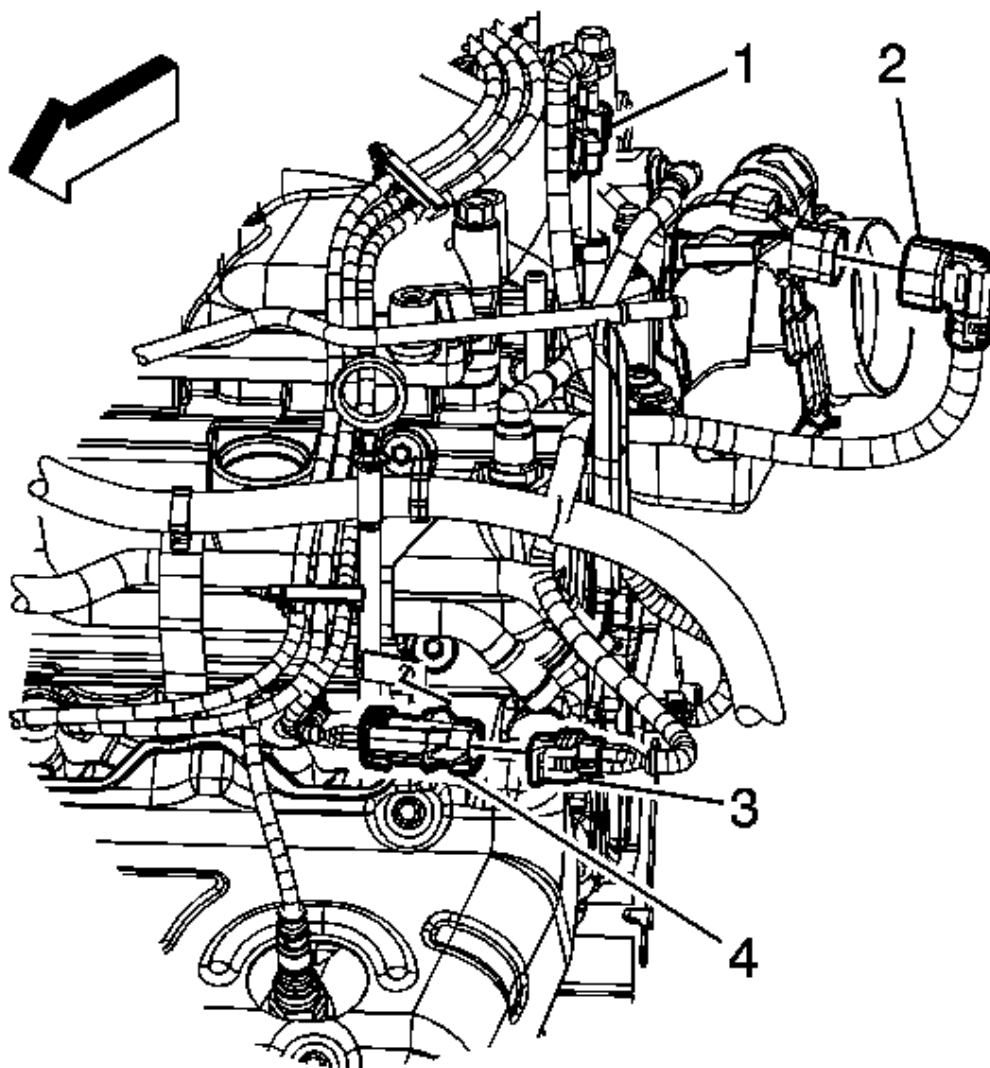


Fig. 201: EVAP Canister Purge Solenoid, ETC & HO2S Connectors
Courtesy of GENERAL MOTORS CORP.

14. Disconnect the evaporative emission (EVAP) canister purge solenoid (1) electrical connector.
15. Disconnect the electronic throttle control (ETC) (2) electrical connector.
16. Remove the connector position assurance (CPA) retainer.
17. Disconnect the heated oxygen sensor (HO2S) (3) electrical connector.

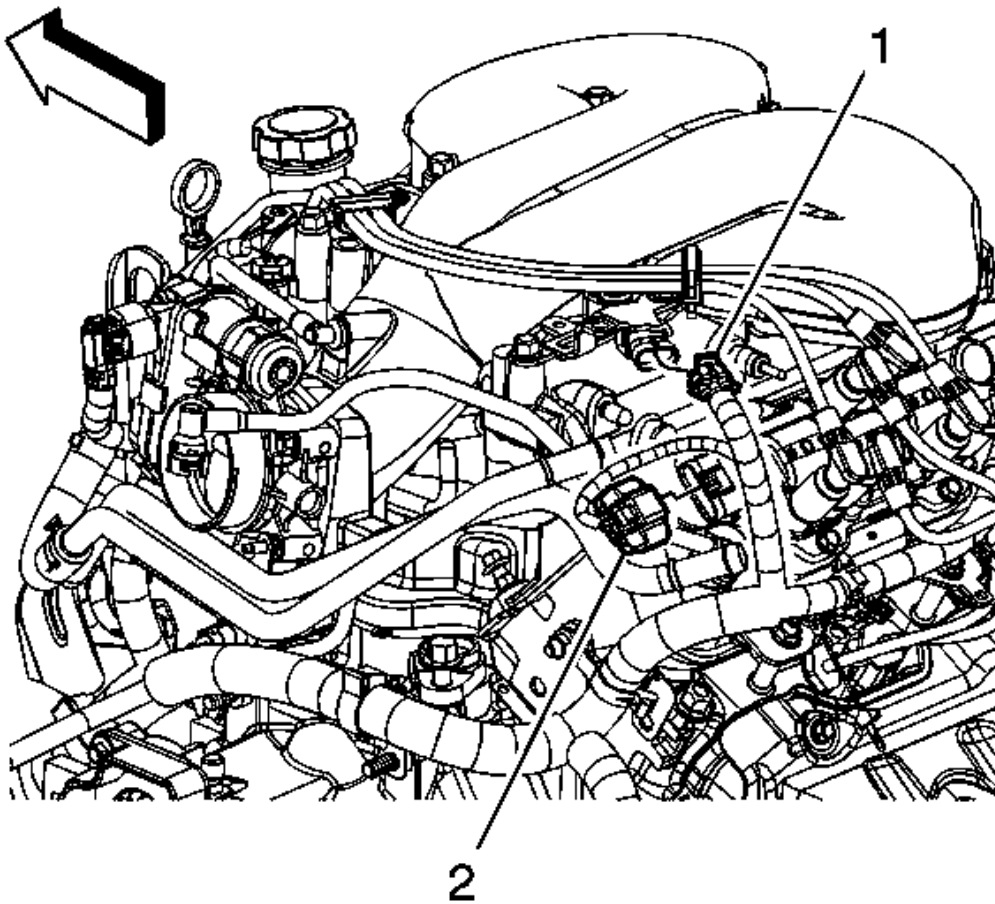


Fig. 202: ECM & MAP Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

18. Disconnect the manifold absolute pressure (MAP) sensor (1) electrical connector.
19. Disconnect the ignition control module (2) electrical connector.

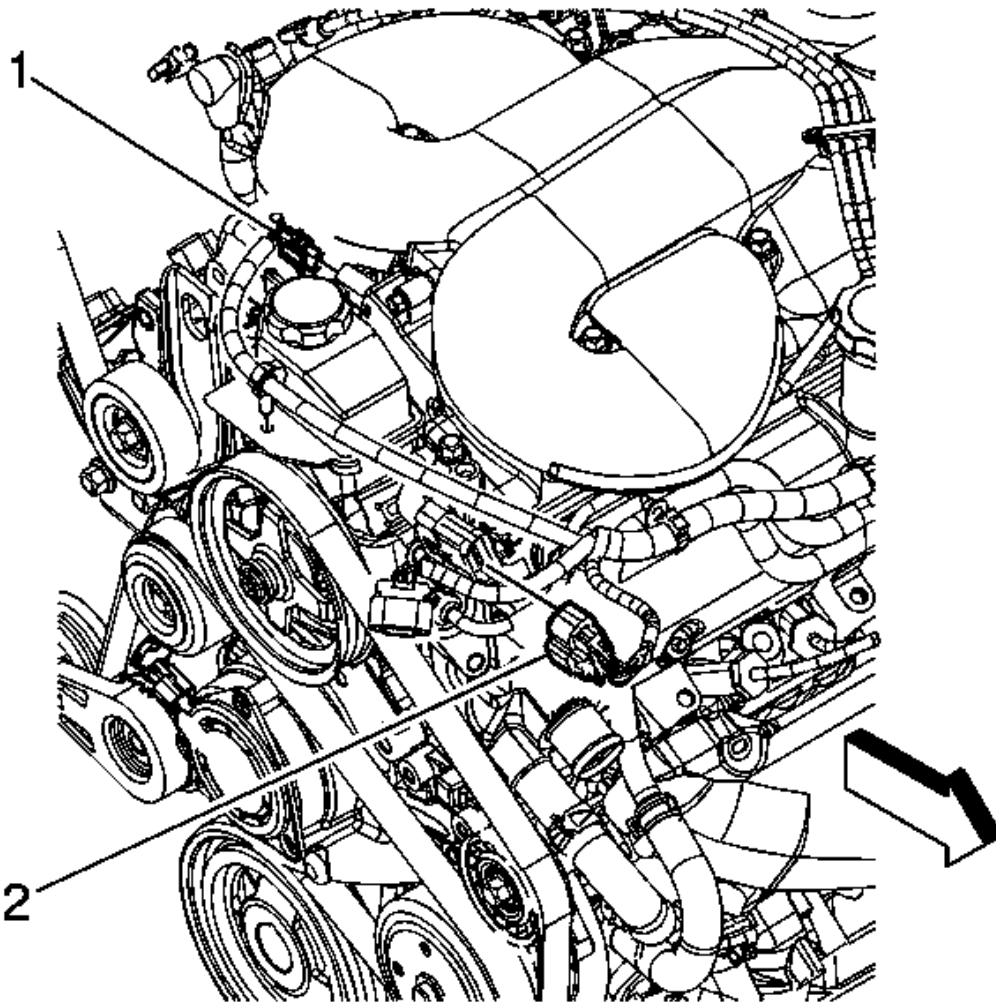


Fig. 203: Intake Manifold Tuning Valve & Injector Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

20. Disconnect the inlet manifold valve (1) electrical connector.
21. Disconnect the fuel injector inline (2) electrical connector.

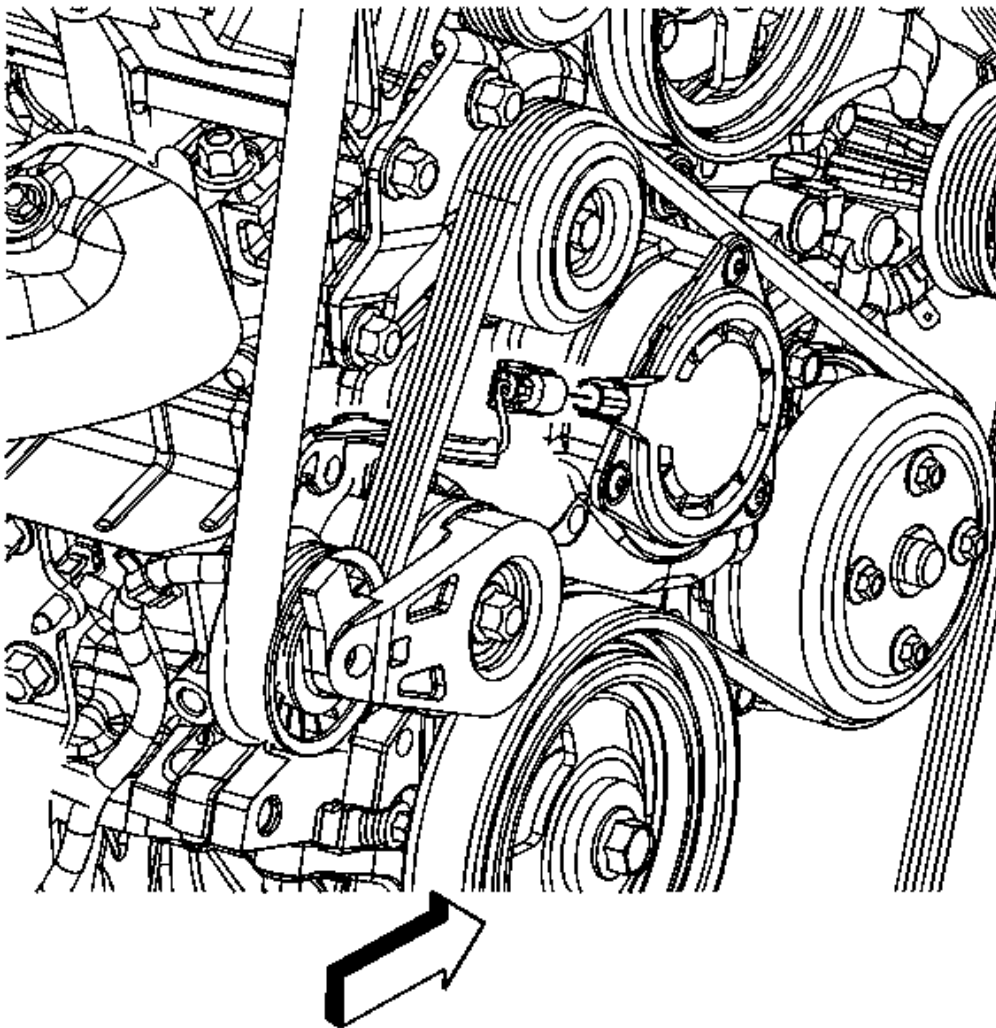


Fig. 204: Camshaft Position Actuator Magnet Electrical Connector
Courtesy of GENERAL MOTORS CORP.

22. Disconnect the camshaft phasor sensor electrical connector.

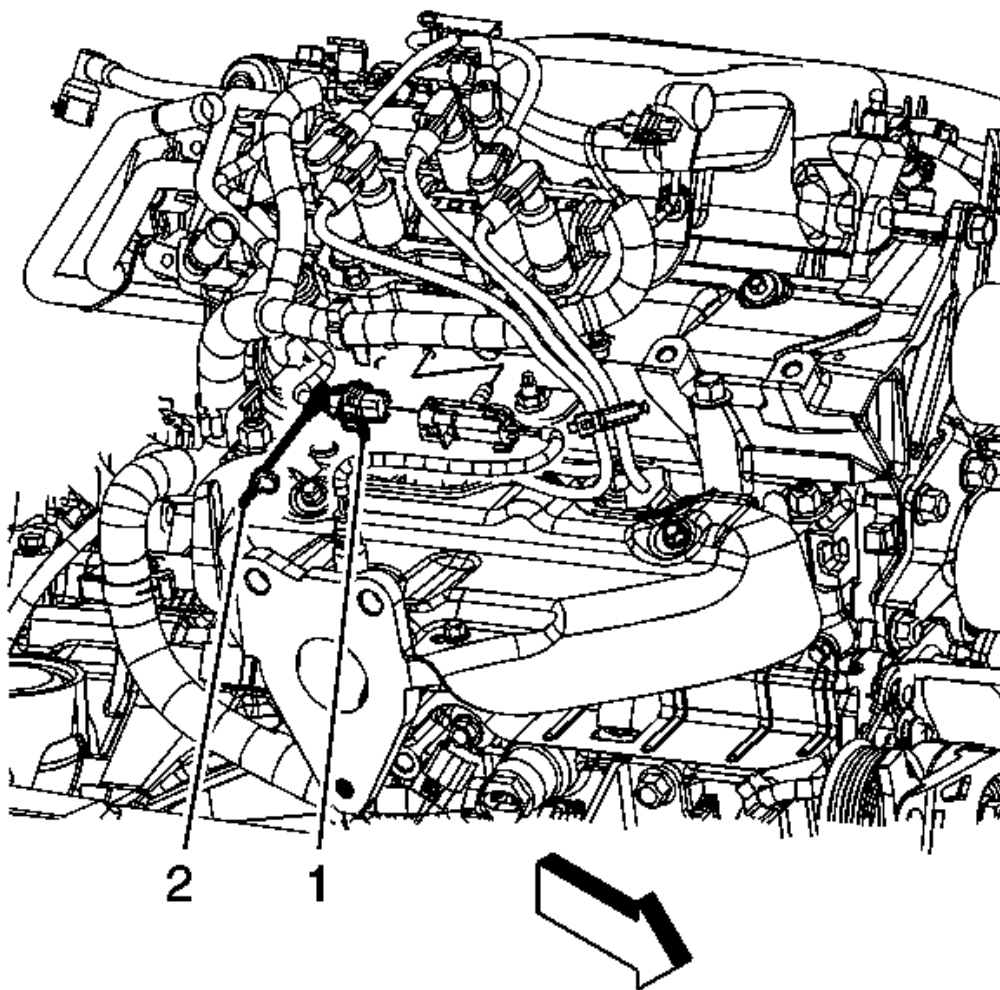


Fig. 205: HO2S Connector & CPA Retainer
Courtesy of GENERAL MOTORS CORP.

23. Remove the CPA retainer.
24. Disconnect the rear upper HO2S electrical connector (1).

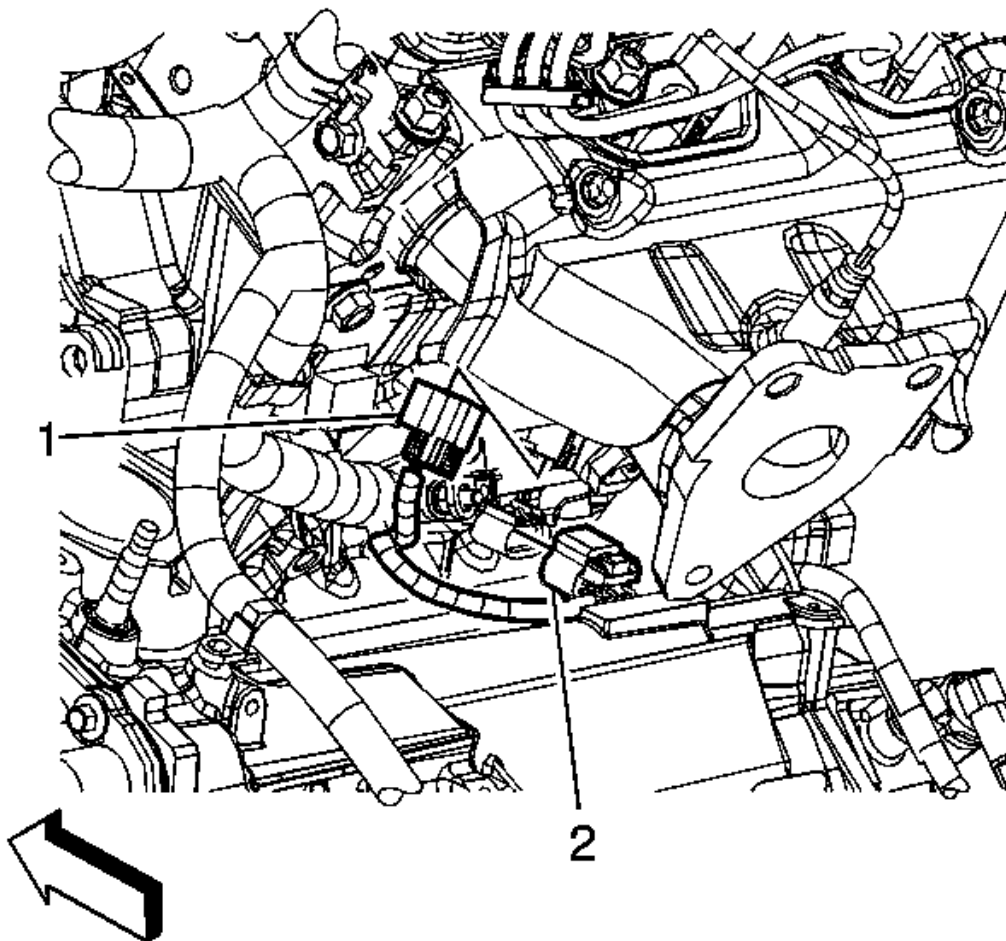


Fig. 206: KS & CKP Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

25. Disconnect the knock sensor electrical connector (1).
26. Disconnect the crankshaft position (CKP) sensor electrical connector (2).

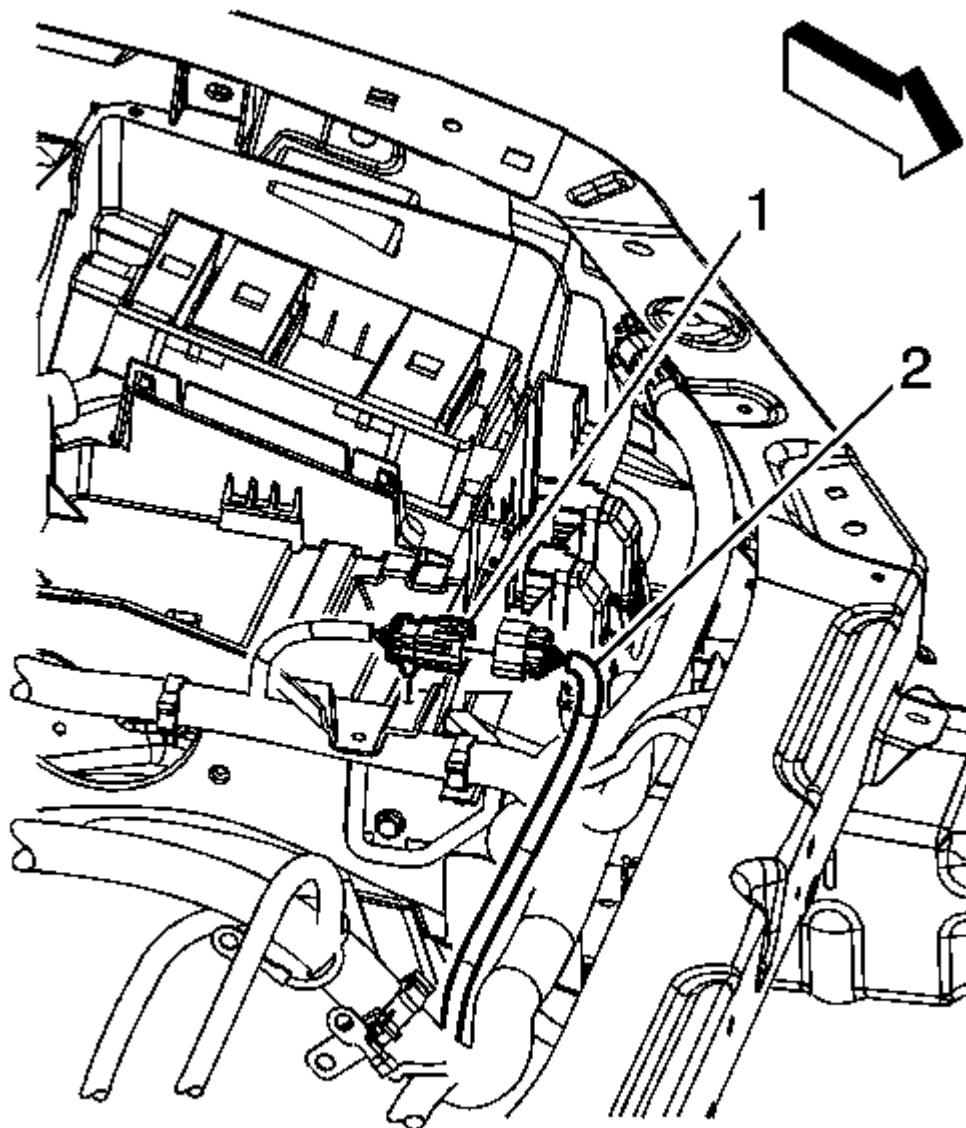


Fig. 207: Engine Harness Connector At Body Harness Connector
Courtesy of GENERAL MOTORS CORP.

27. Disconnect the engine harness connector (1) from the body harness connector (2).

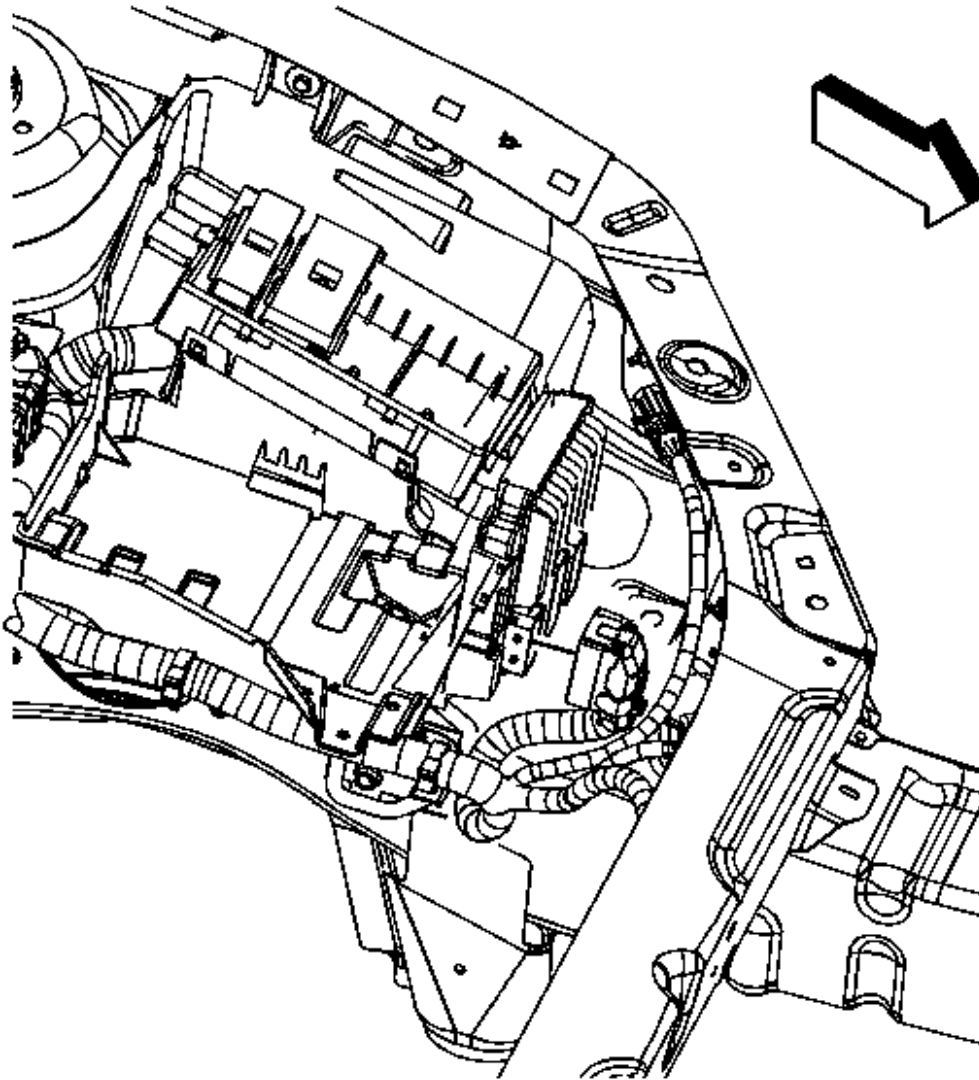


Fig. 208: Body Harness ECM/PCM Connector
Courtesy of GENERAL MOTORS CORP.

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

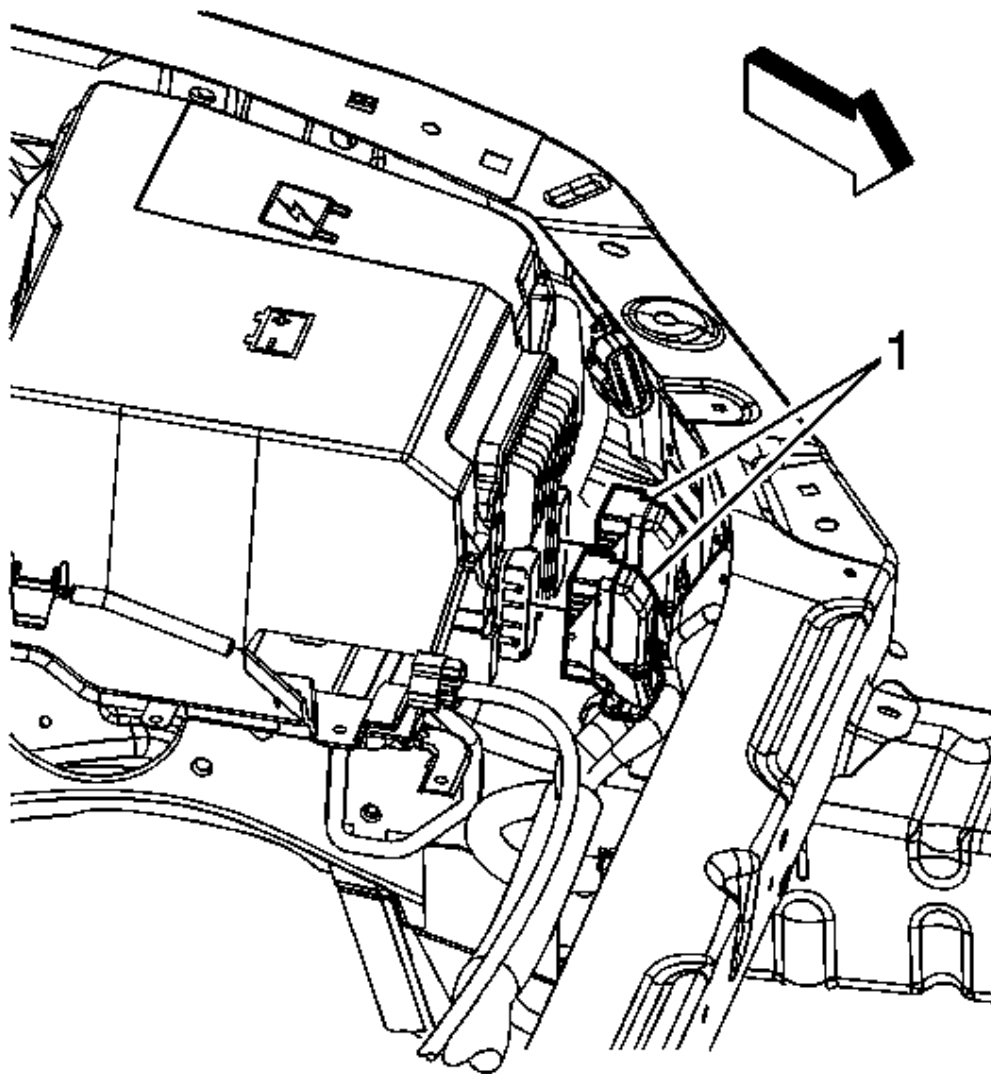


Fig. 209: Engine Harness ECM/PCM Connectors
Courtesy of GENERAL MOTORS CORP.

29. Disconnect the engine harness electrical connectors (1) from the PCM.

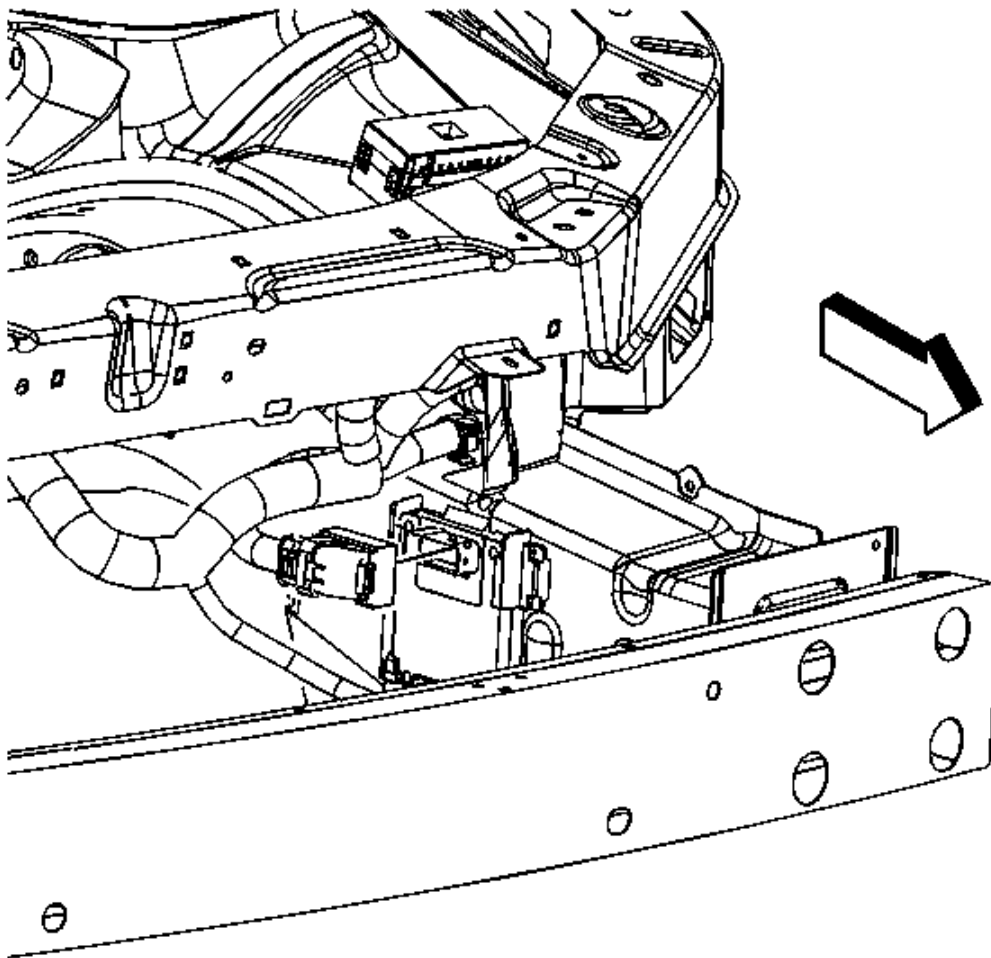


Fig. 210: Transmission Control Module (TCM) Engine Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

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

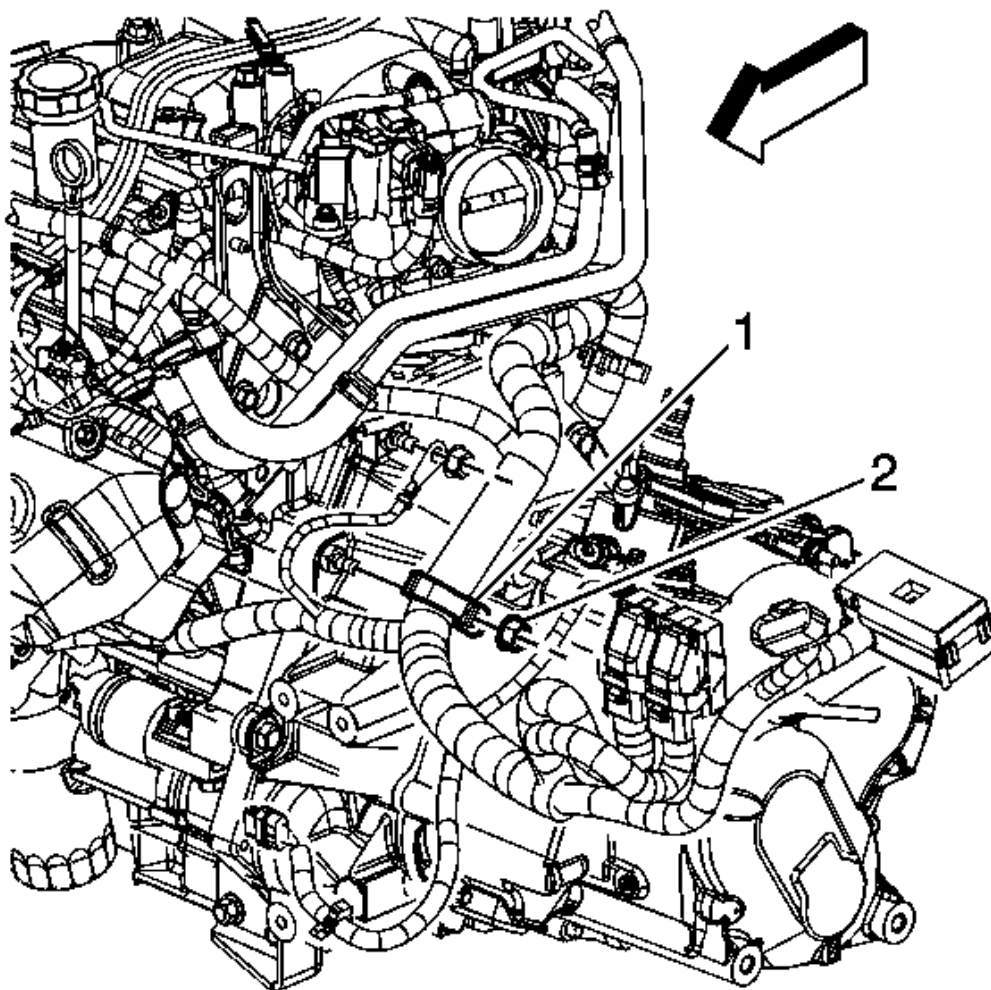


Fig. 211: Engine Harness Clip & Nut
Courtesy of GENERAL MOTORS CORP.

31. Remove the engine harness clip nut (2).
32. Remove the engine harness clip (1) from the transmission stud.

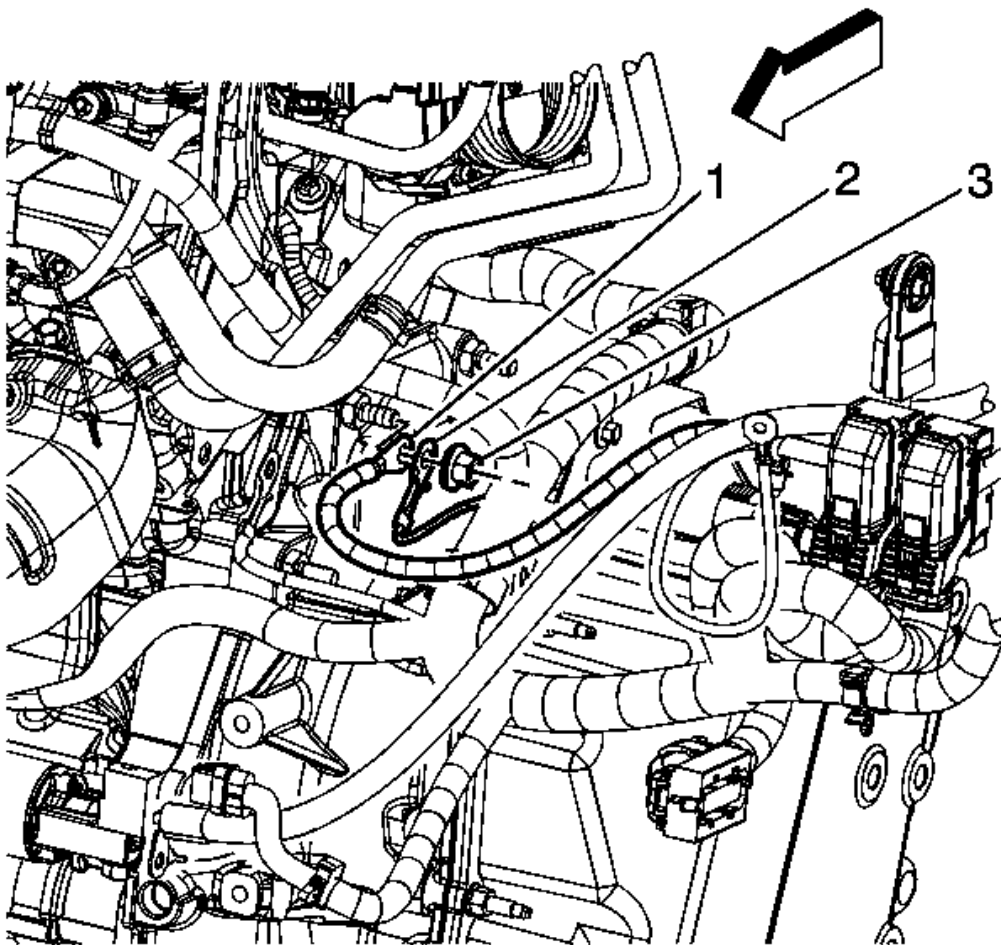


Fig. 212: Engine Wiring Harness Ground Terminal & Nut
Courtesy of GENERAL MOTORS CORP.

33. Remove the engine harness ground nut (2).
34. Remove the engine harness ground terminal (1) from the transmission stud.

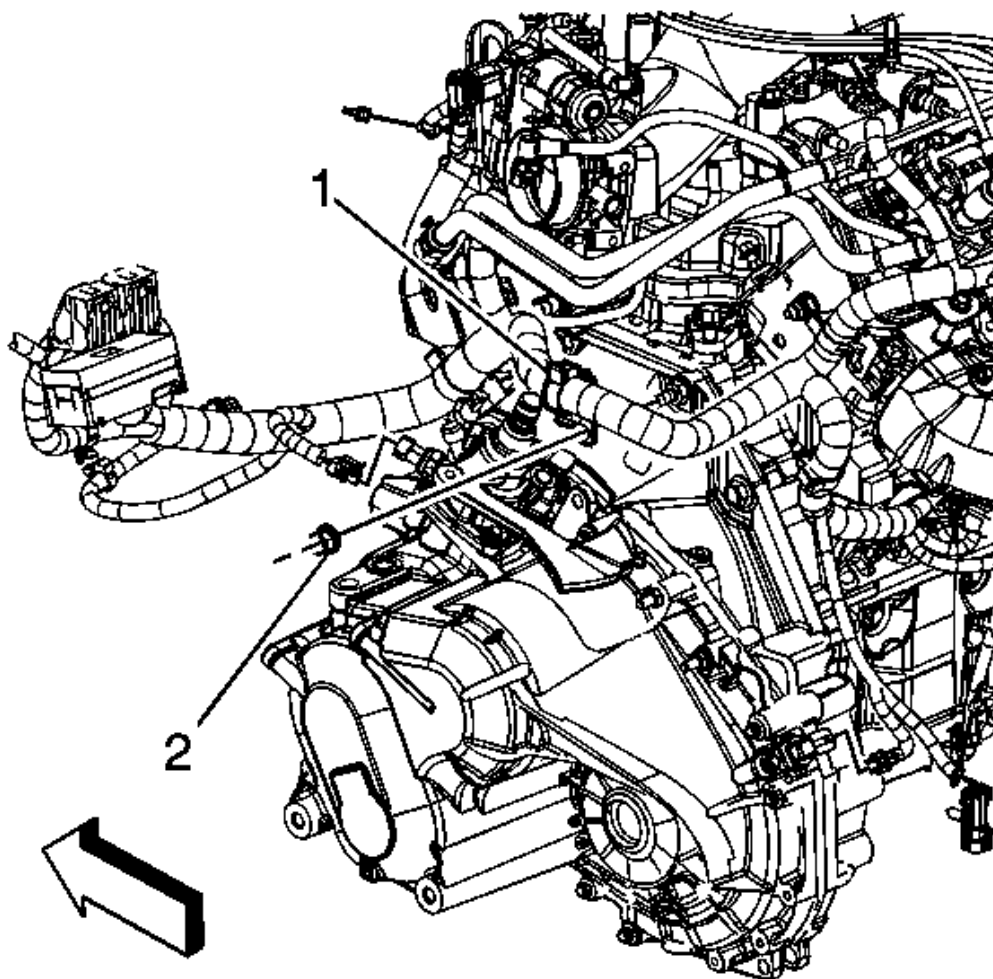


Fig. 213: Engine Harness Rear Clip & Nut
Courtesy of GENERAL MOTORS CORP.

35. Remove the engine harness rear clip nut (2).
36. Remove the engine harness rear clip (1) from the transmission stud.
37. Remove the catalytic converters. Refer to **Catalytic Converter Replacement - Left Side (LZ9)** and **Catalytic Converter Replacement - Right Side (LZ9 w/RPO M15)** or **Catalytic Converter Replacement - Right Side (LZ9 w/RPO MT2)**.
38. Remove the engine mount. Refer to **Engine Mount Replacement (Coupe)** or **Engine Mount Replacement (Convertible)**.
39. Remove the torque converter cover. Refer to **Torque Converter Cover Replacement**.
40. Remove the starter motor. Refer to **Starter Replacement (LZ9)**.

41. Remove the torque converter bolts. Refer to **Torque Converter Bolt Replacement** .
42. Unbolt and reposition the A/C compressor to the side. DO NOT discharge the A/C system.

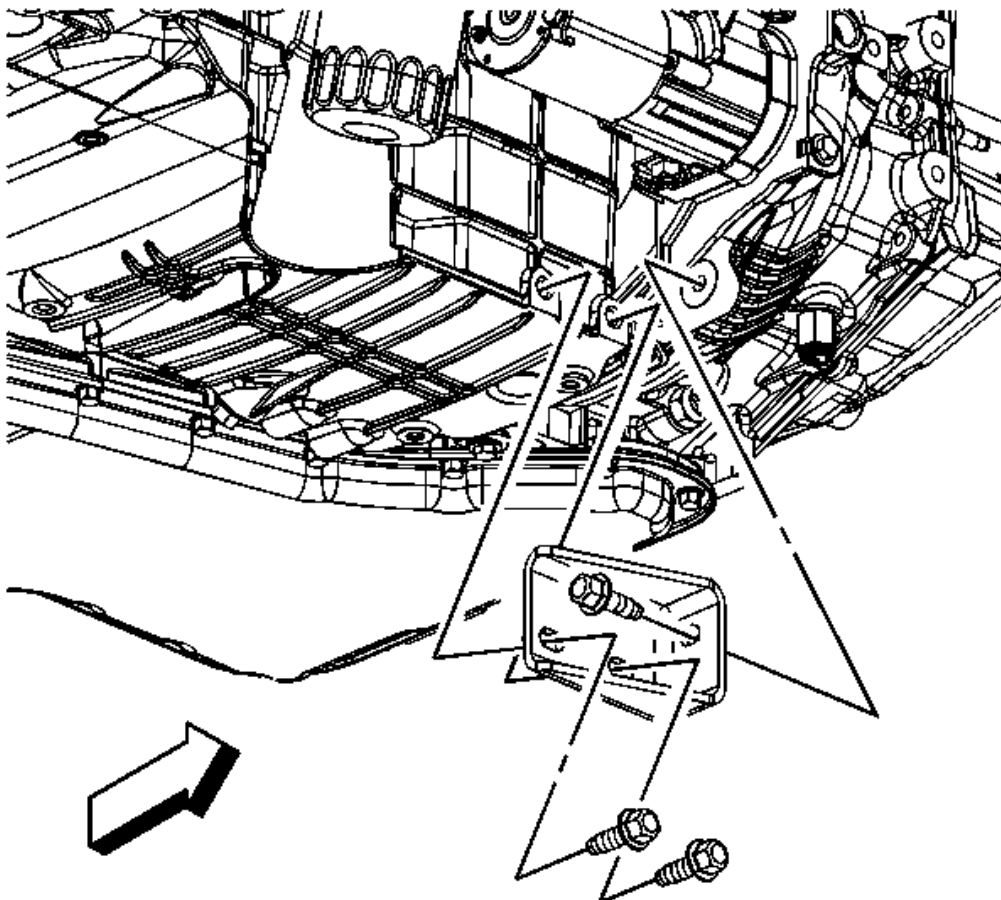


Fig. 214: Transaxle Brace & Bolts
Courtesy of GENERAL MOTORS CORP.

43. Remove the transaxle brace to oil pan bolts.
44. Remove the transaxle brace to transaxle bolt and remove the brace.

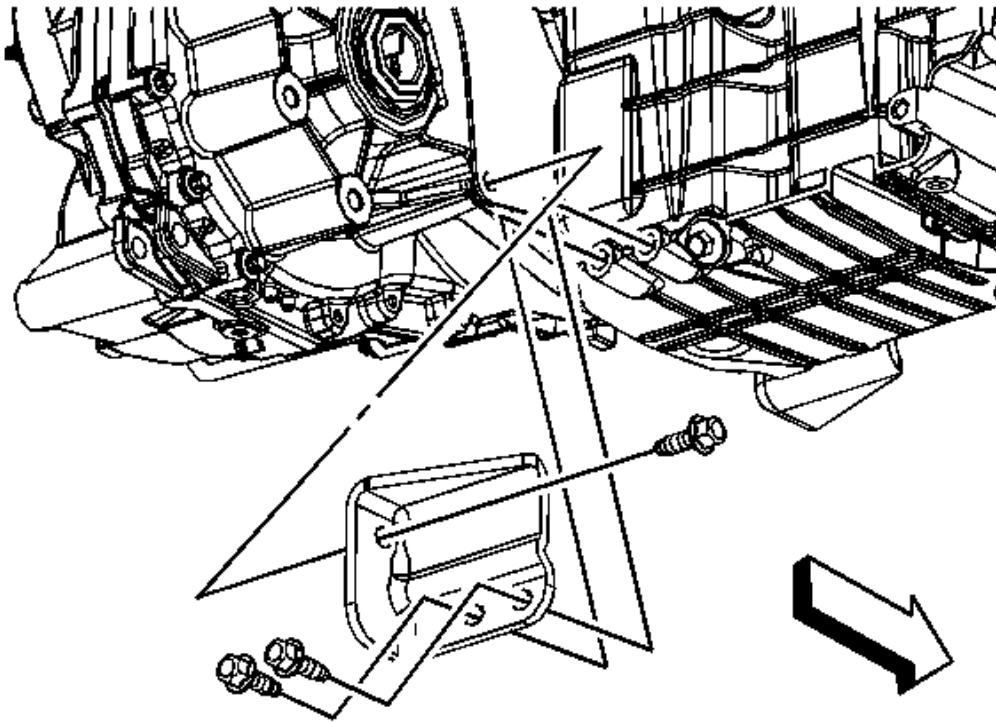


Fig. 215: Transaxle Brace-To-Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

45. Remove the transaxle brace to oil pan bolts, if equipped with regular production option (RPO) MT2.
46. Remove the transaxle brace to transaxle bolt and remove the brace, if equipped with RPO MT2.

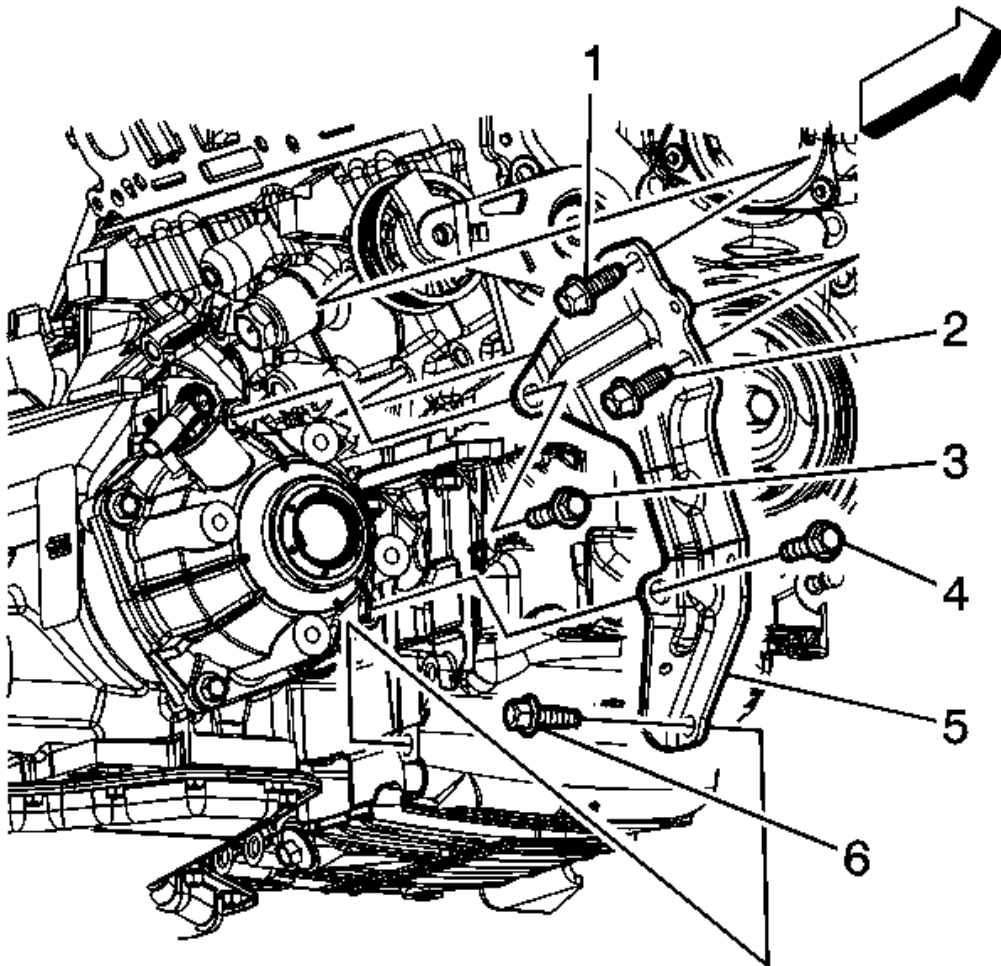


Fig. 216: Transaxle Brace-To-Oil Pan Lower Bolt
Courtesy of GENERAL MOTORS CORP.

47. Remove the transaxle brace to oil pan lower bolt (6), if equipped with RPO M15.
48. Remove the lower transaxle-to-engine bolt and stud.

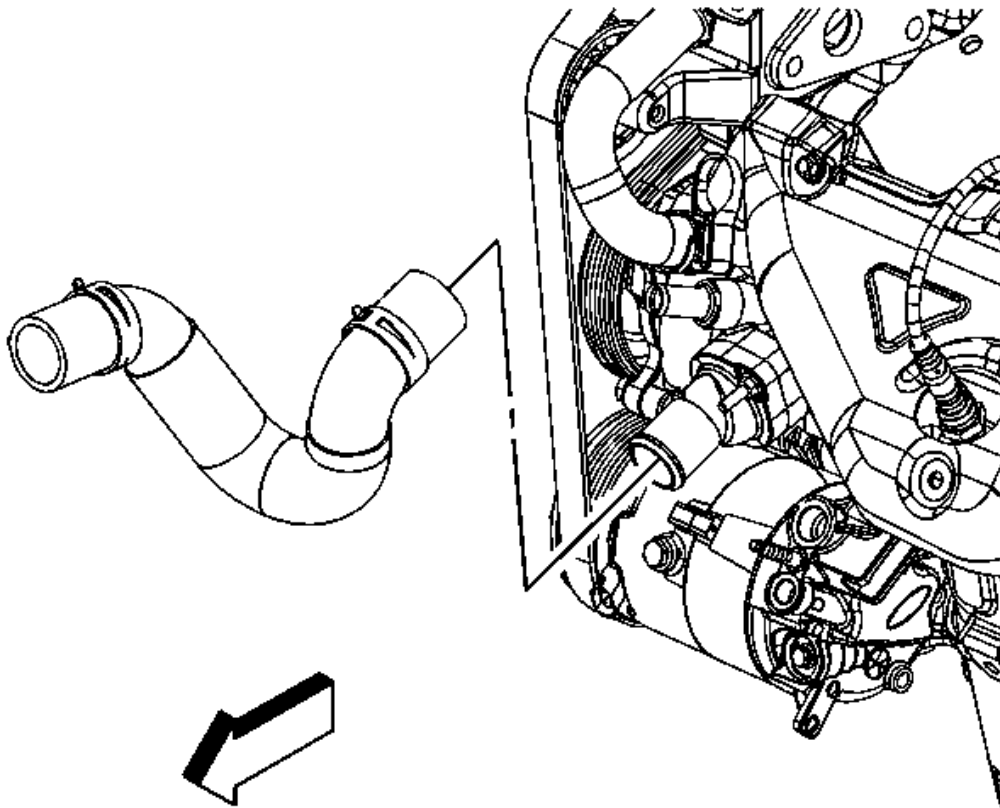


Fig. 217: Radiator Outlet Hose & Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

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

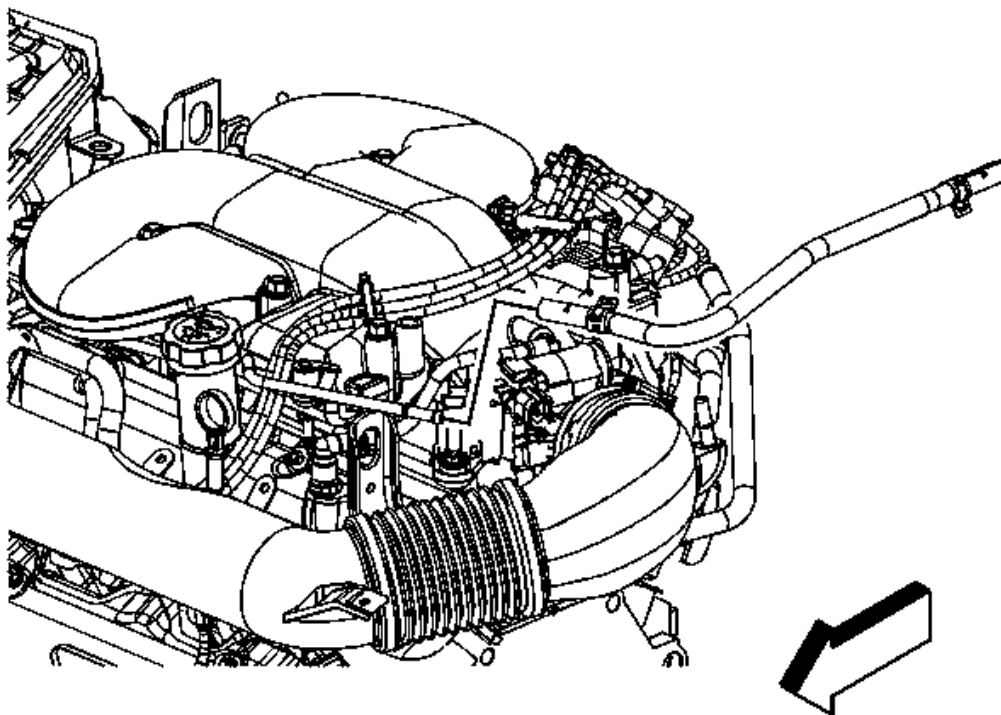


Fig. 218: Radiator Surge Tank Inlet Hose & Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

52. Reposition the radiator surge tank hose clamp at the surge tank pipe.
53. Remove the radiator surge tank hose from the surge tank pipe.

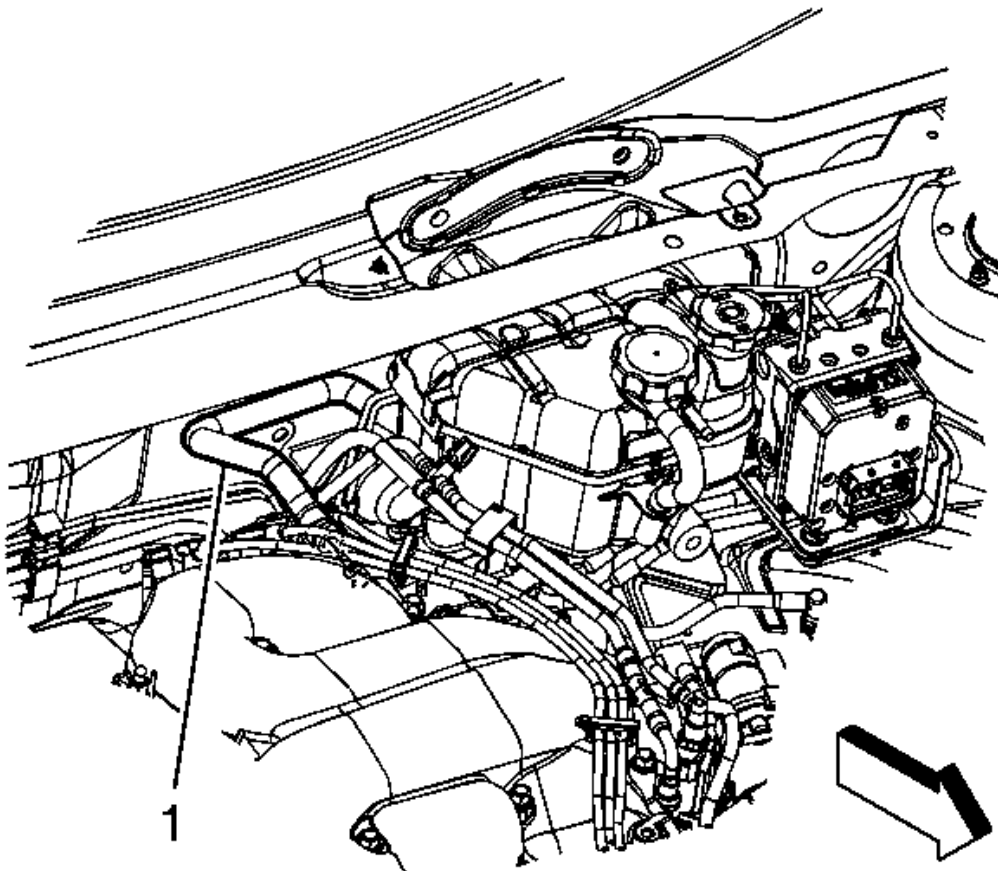


Fig. 219: Brake Booster Vacuum Hose To Intake Manifold
Courtesy of GENERAL MOTORS CORP.

54. Reposition the brake booster vacuum hose clamp at the intake manifold.
55. Remove the brake booster vacuum hose (1) from the intake manifold.
56. Reposition the heater inlet and outlet hose clamps at the engine.
57. Remove the heater outlet and inlet hoses from the engine.
58. Disconnect the fuel feed line from the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .
59. Disconnect the EVAP purge line from the canister purge solenoid. Refer to **Plastic Collar Quick Connect Fitting Service** .

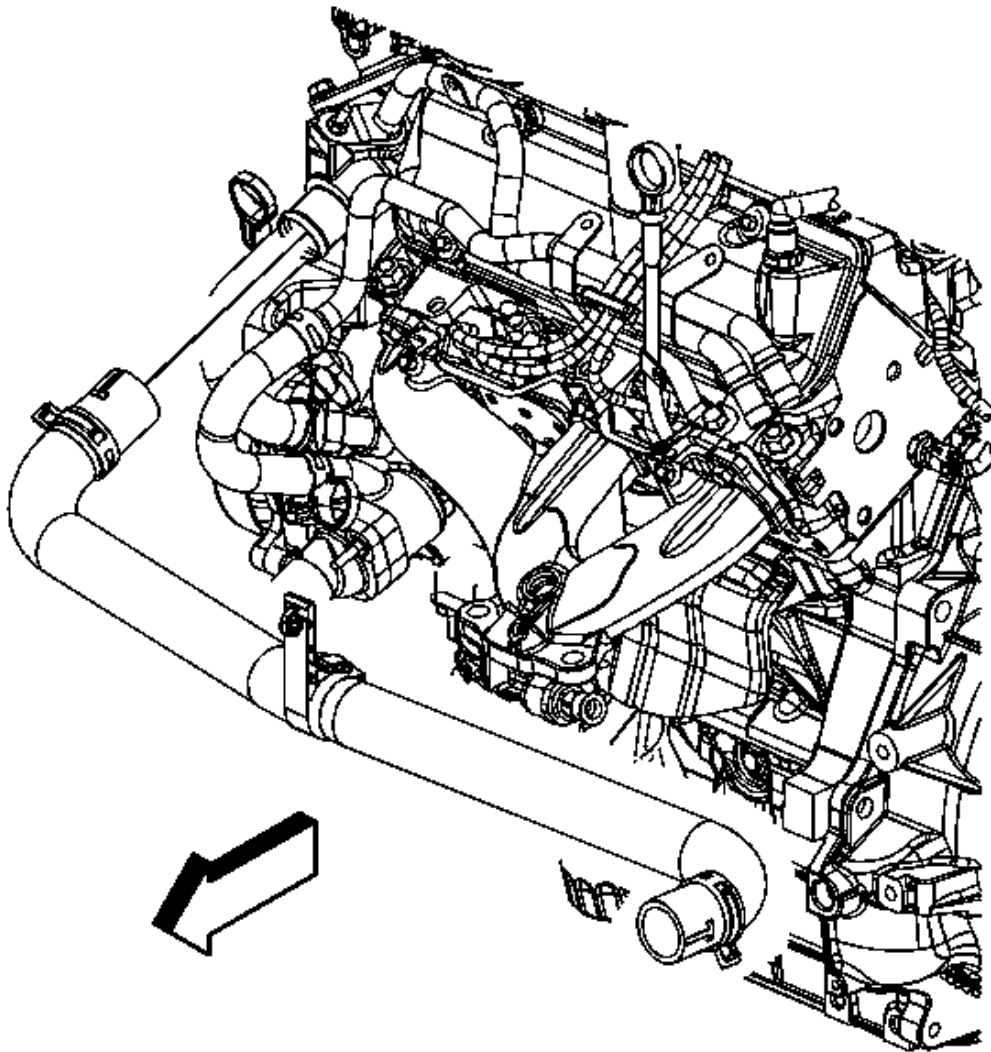


Fig. 220: Radiator Inlet Hose
Courtesy of GENERAL MOTORS CORP.

60. Reposition the radiator inlet hose clamp at the engine.
61. Remove the radiator inlet hose from the engine.
62. Install a engine lifting device to the engine.

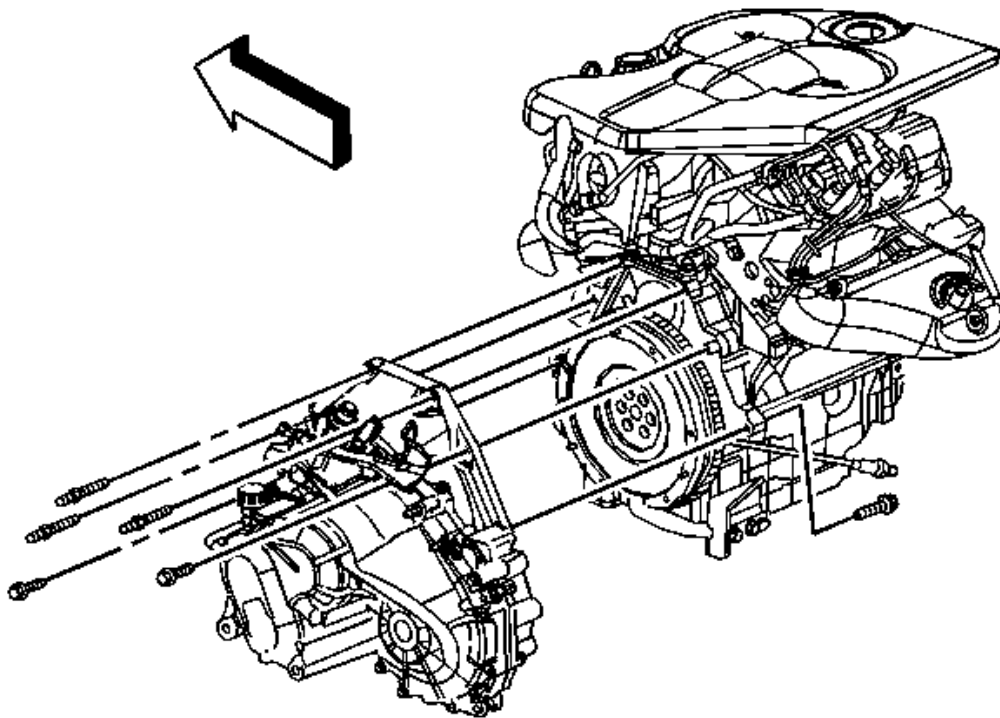


Fig. 221: Transaxle-To-Engine Bolts/Studs (M/T)
Courtesy of GENERAL MOTORS CORP.

63. Remove the remaining transaxle-to-engine bolts/studs if equipped with a manual transmission.

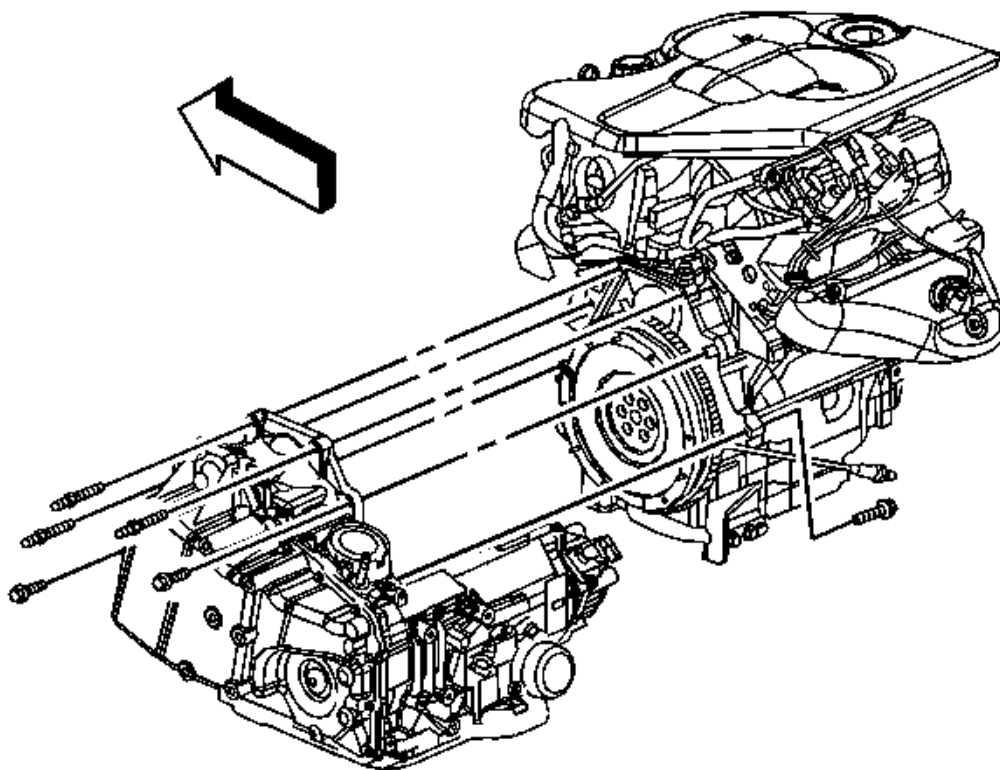


Fig. 222: Transaxle-To-Engine Bolts/Studs (A/T)
Courtesy of GENERAL MOTORS CORP.

64. Remove the remaining transaxle-to-engine bolts/studs if equipped with a automatic transmission.
65. Remove the engine from the vehicle.
66. Remove the flywheel. Refer to **Engine Flywheel Replacement**.
67. Install the engine to the engine stand.

INSTALLATION PROCEDURE

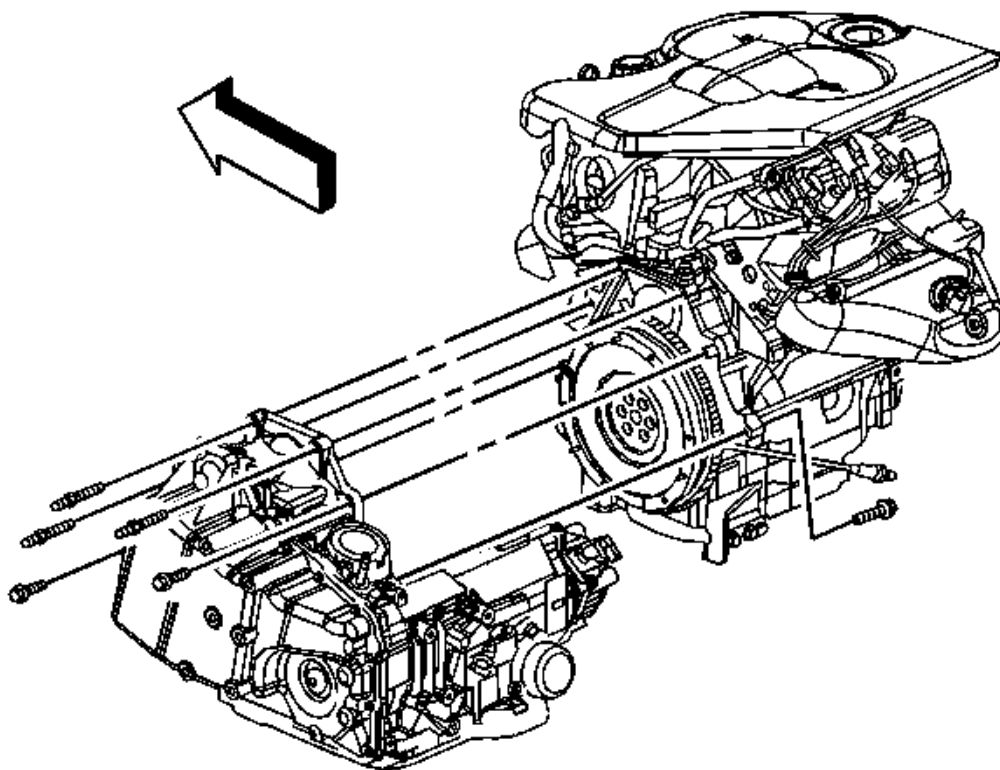


Fig. 223: Transaxle-To-Engine Bolts/Studs (A/T)
Courtesy of GENERAL MOTORS CORP.

1. Install an engine lifting device to the engine.
2. Remove the engine from the engine stand.
3. Install the flywheel. Refer to **Engine Flywheel Replacement**.
4. Install the engine to the vehicle.

CAUTION: Refer to Fastener Caution .

5. Install the transaxle-to-engine bolts/studs if equipped with a automatic transmission and tighten to 75 N.m (55 lb ft).

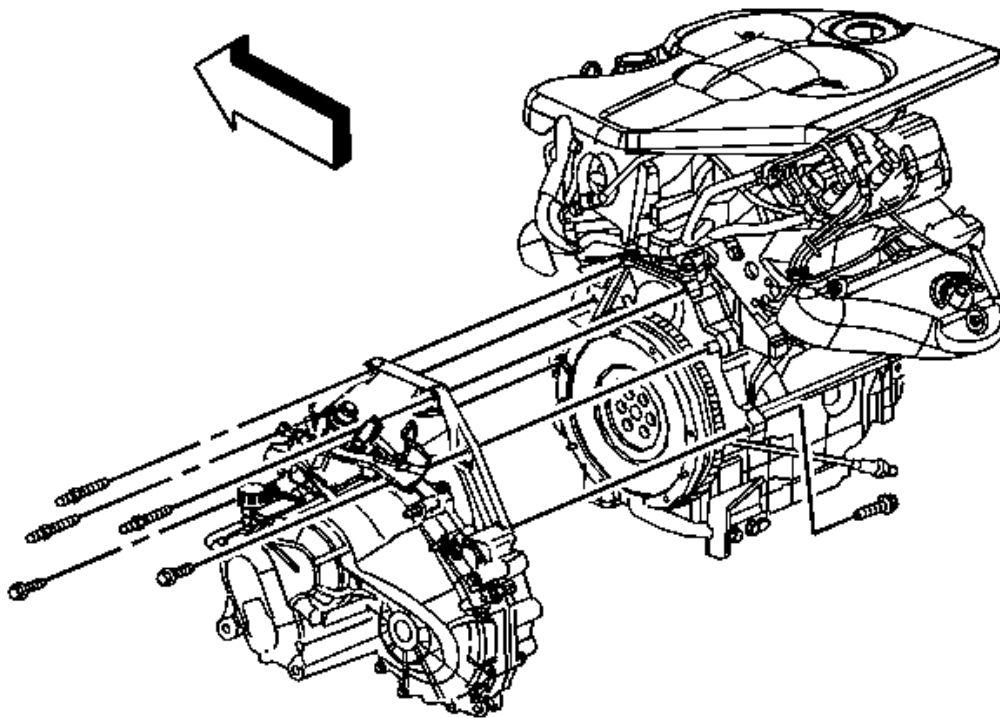


Fig. 224: Transaxle-To-Engine Bolts/Studs (M/T)
Courtesy of GENERAL MOTORS CORP.

6. Install the transaxle-to-engine bolts/studs if equipped with a manual transmission and tighten to 75 N.m (55 lb ft).

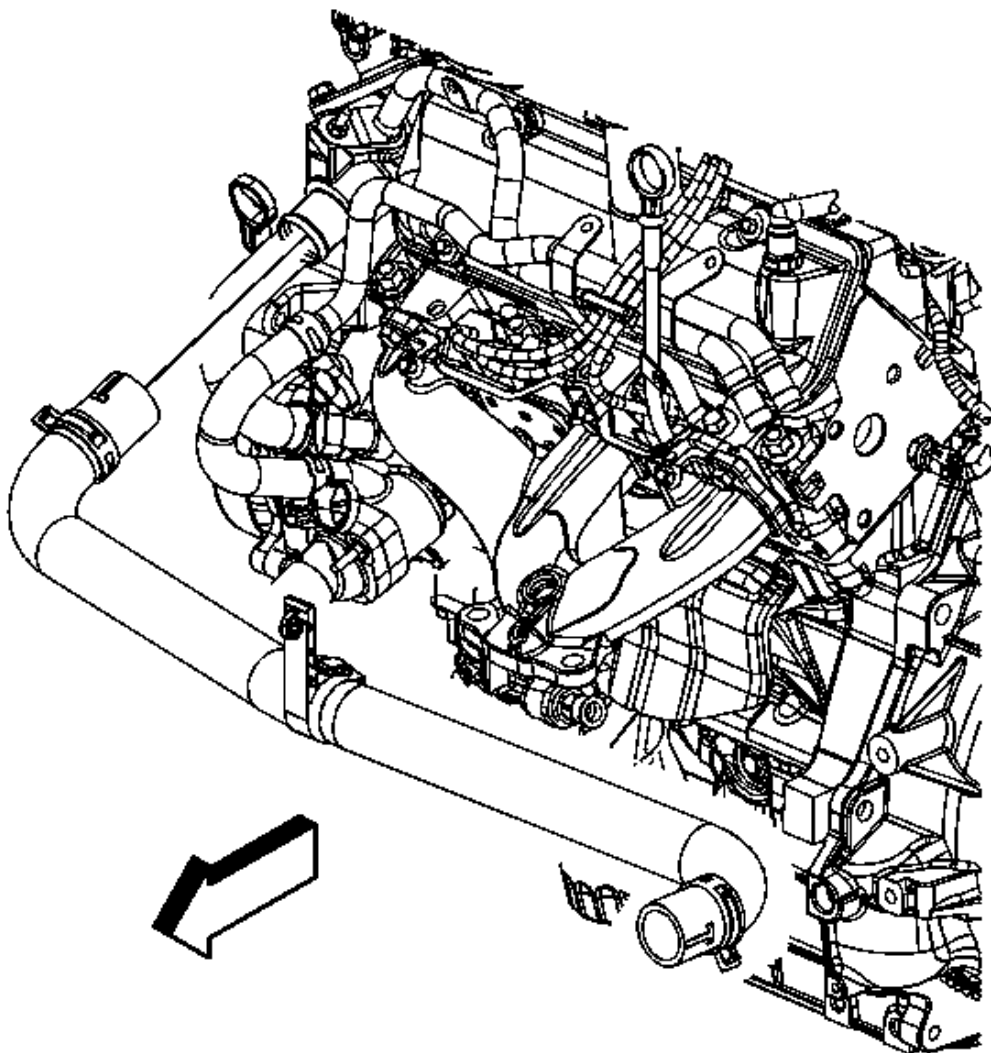


Fig. 225: Radiator Inlet Hose

Courtesy of GENERAL MOTORS CORP.

7. Remove the engine lifting device from the engine.
8. Install the radiator inlet hose to the engine.
9. Position the radiator inlet hose clamp at the engine.

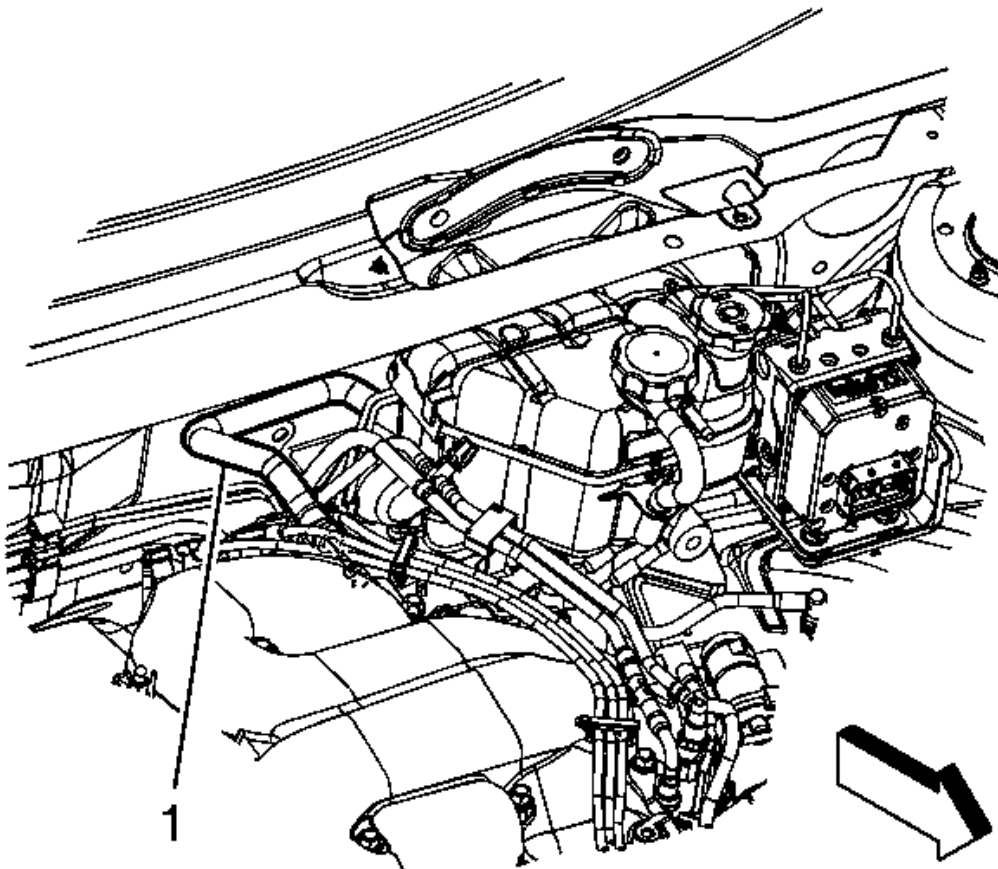


Fig. 226: Brake Booster Vacuum Hose To Intake Manifold
Courtesy of GENERAL MOTORS CORP.

10. Connect the EVAP purge line to the canister purge solenoid. Refer to **Plastic Collar Quick Connect Fitting Service** .
11. Connect the fuel feed line to the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .
12. Install the heater outlet and inlet hoses to the engine.
13. Position the heater inlet and outlet hose clamps at the engine.
14. Install the brake booster vacuum hose (1) to the intake manifold.
15. Position the brake booster vacuum hose clamp at the intake manifold.

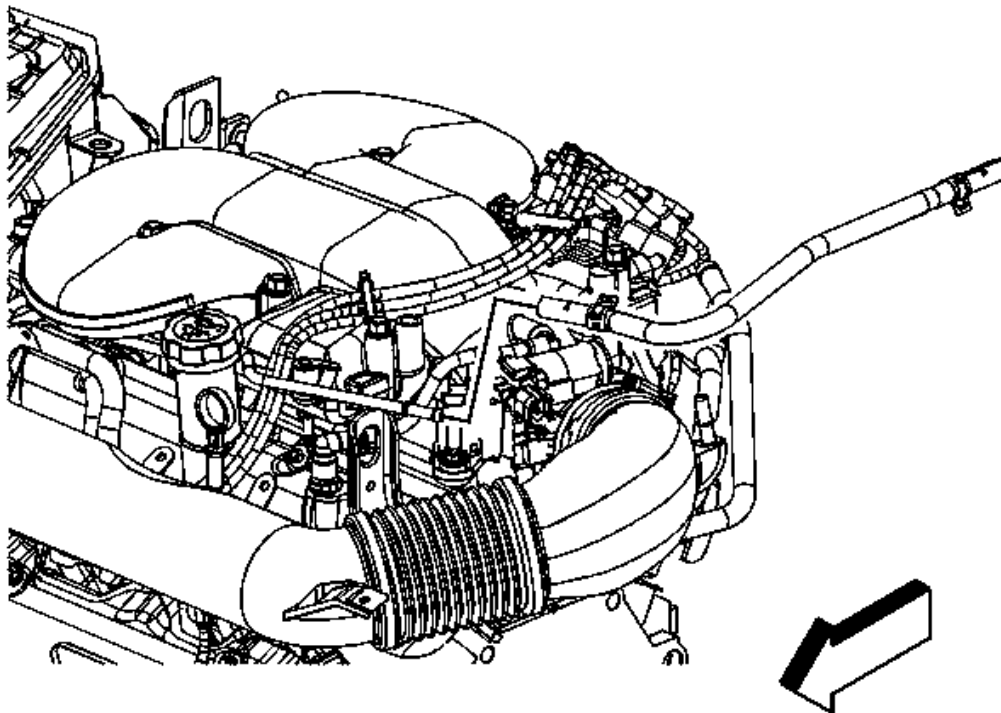


Fig. 227: Radiator Surge Tank Inlet Hose & Inlet Pipe
Courtesy of GENERAL MOTORS CORP.

16. Install the radiator surge tank hose to the surge tank pipe.
17. Position the radiator surge tank hose clamp at the surge tank pipe.

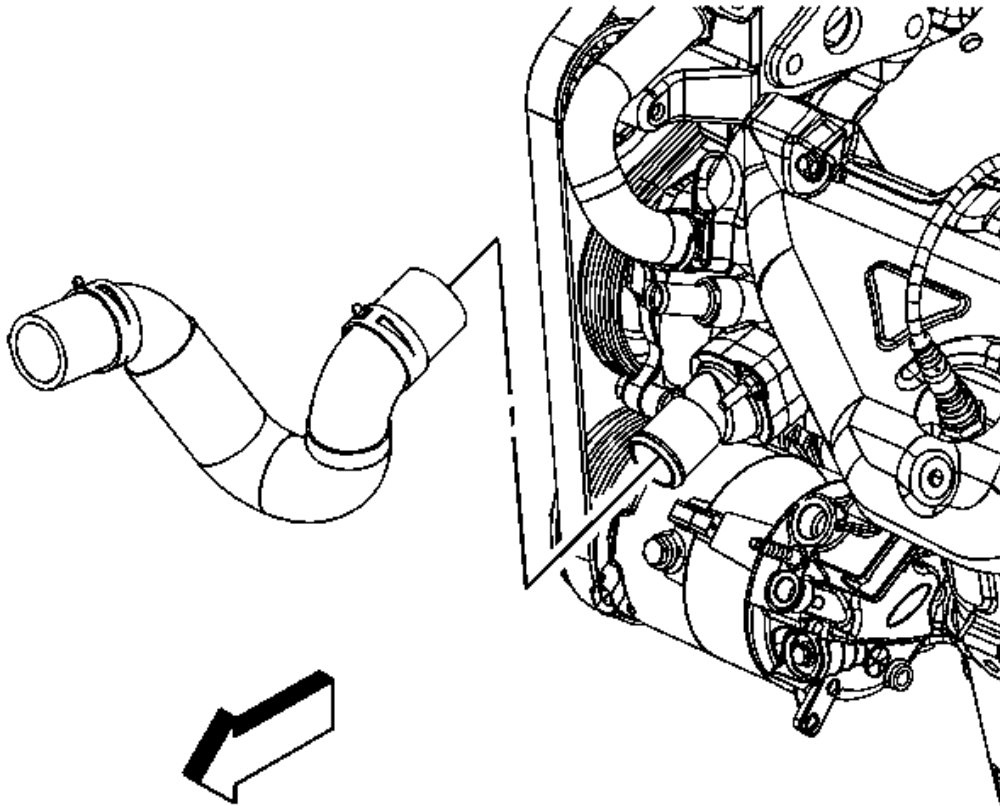


Fig. 228: Radiator Outlet Hose & Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

18. Raise and support the vehicle.
19. Install the radiator outlet hose to the thermostat housing.
20. Position the radiator outlet hose clamp at the thermostat housing.
21. Install the lower transaxle-to-engine bolt and stud and tighten to 75 N.m (55 lb ft).

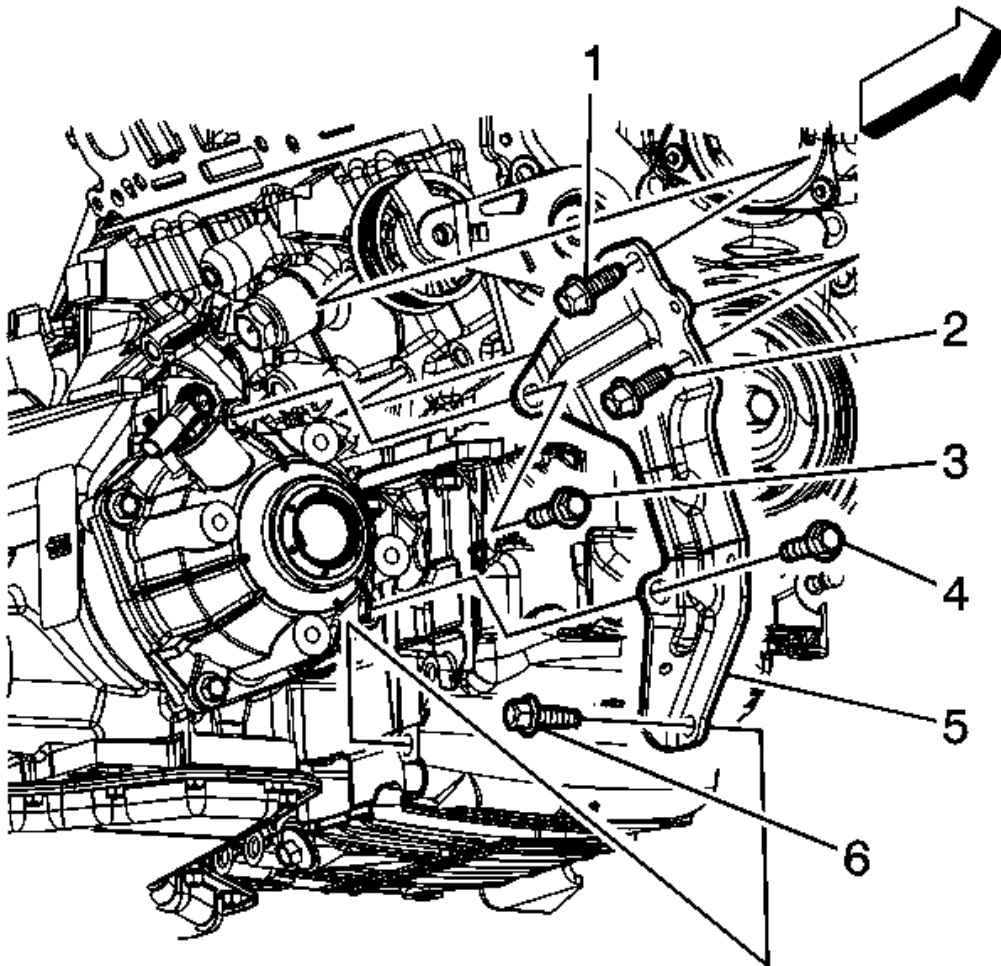


Fig. 229: Transaxle Brace-To-Oil Pan Lower Bolt
Courtesy of GENERAL MOTORS CORP.

22. Install the transaxle brace to oil pan lower bolt (6), if equipped with RPO M15 and tighten to 50 N.m (37 lb ft).

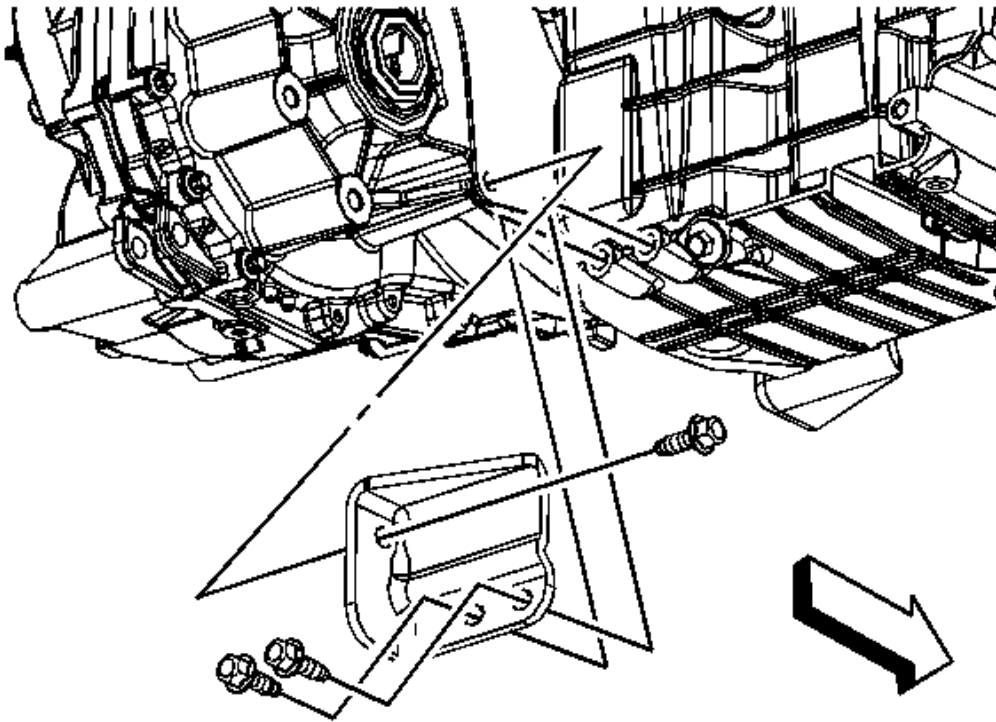


Fig. 230: Transaxle Brace-To-Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

23. Position the transaxle brace and install the transaxle brace to transaxle bolt until snug, if equipped with RPO MT2.
24. Install the transaxle brace to oil pan bolts, if equipped with RPO MT2 and tighten to 50 N.m (37 lb ft).

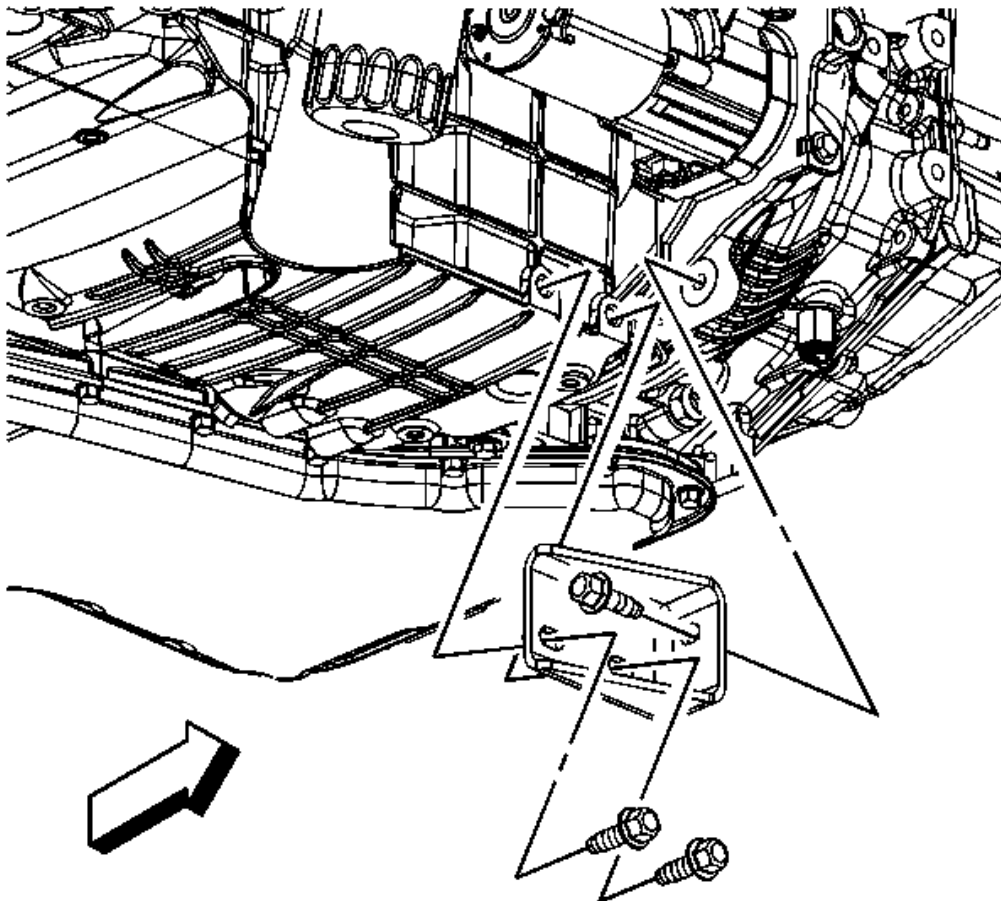


Fig. 231: Transaxle Brace & Bolts
Courtesy of GENERAL MOTORS CORP.

25. Position the transaxle brace and install the transaxle brace to transaxle bolt until snug.
26. Install the transaxle brace to oil pan bolts and tighten to 50 N.m (37 lb ft).
27. Position and bolt up the A/C compressor and tighten the bolt to 50 N.m (37 lb ft).
28. Install the torque converter bolts. Refer to **Torque Converter Bolt Replacement** .
29. Install the starter motor. Refer to **Starter Replacement (LZ9)** .
30. Install the torque converter cover. Refer to **Torque Converter Cover Replacement** .
31. Install the engine mount. Refer to **Engine Mount Replacement (Coupe)** or **Engine Mount Replacement (Convertible)**.

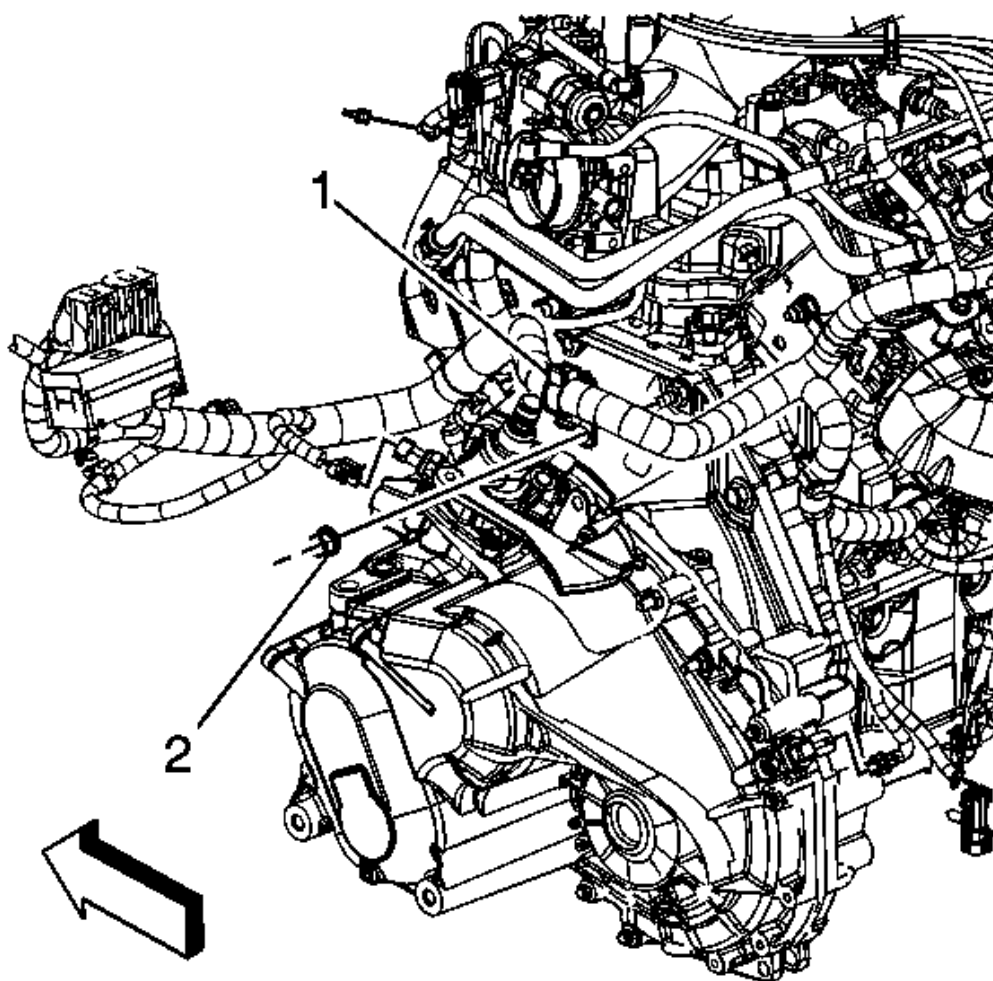


Fig. 232: Engine Harness Rear Clip & Nut
Courtesy of GENERAL MOTORS CORP.

32. Install the catalytic converters. Refer to Catalytic Converter Replacement - Left Side (LZ9) and Catalytic Converter Replacement - Right Side (LZ9 w/RPO M15) or Catalytic Converter Replacement - Right Side (LZ9 w/RPO MT2).
33. Install the engine harness rear clip (1) to the transmission stud.
34. Install the engine harness rear clip nut (2) and tighten to 25 N.m (18 lb ft).

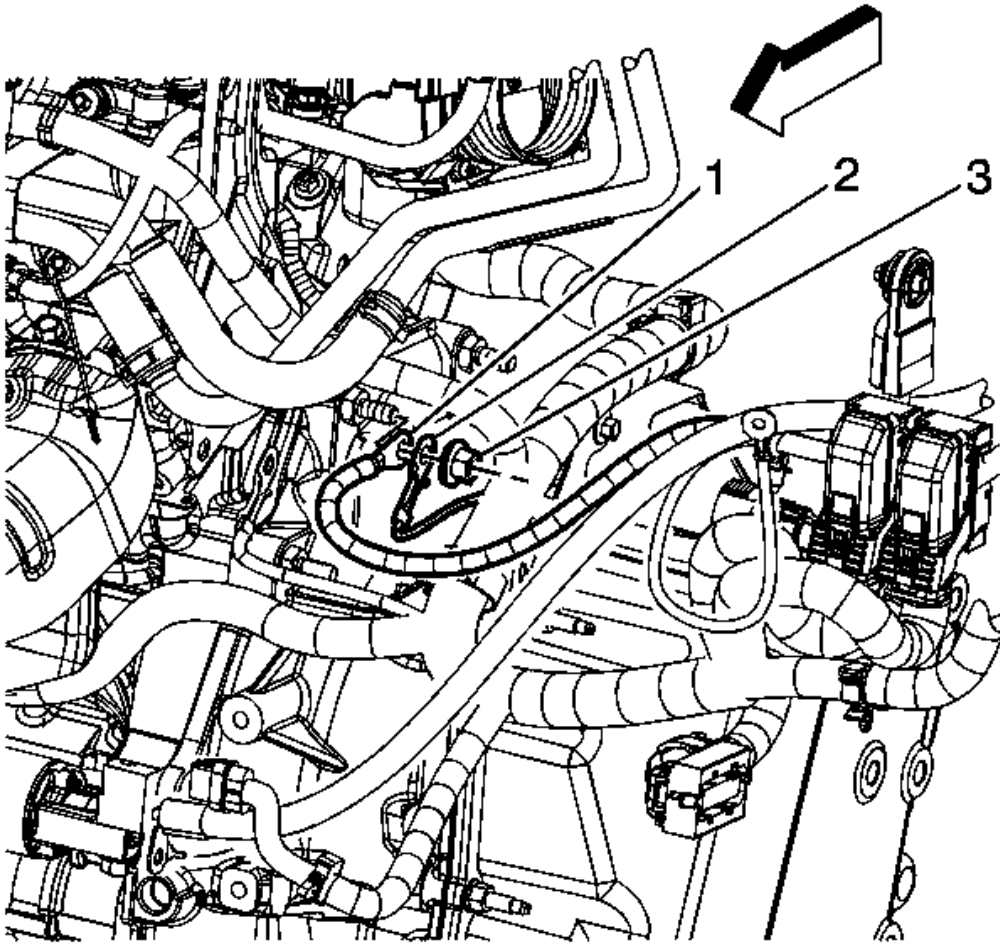


Fig. 233: Engine Wiring Harness Ground Terminal & Nut
Courtesy of GENERAL MOTORS CORP.

35. Install the engine harness ground terminal (1) to the transmission stud.
36. Install the engine harness ground nut (2) and tighten to 25 N.m (18 lb ft).

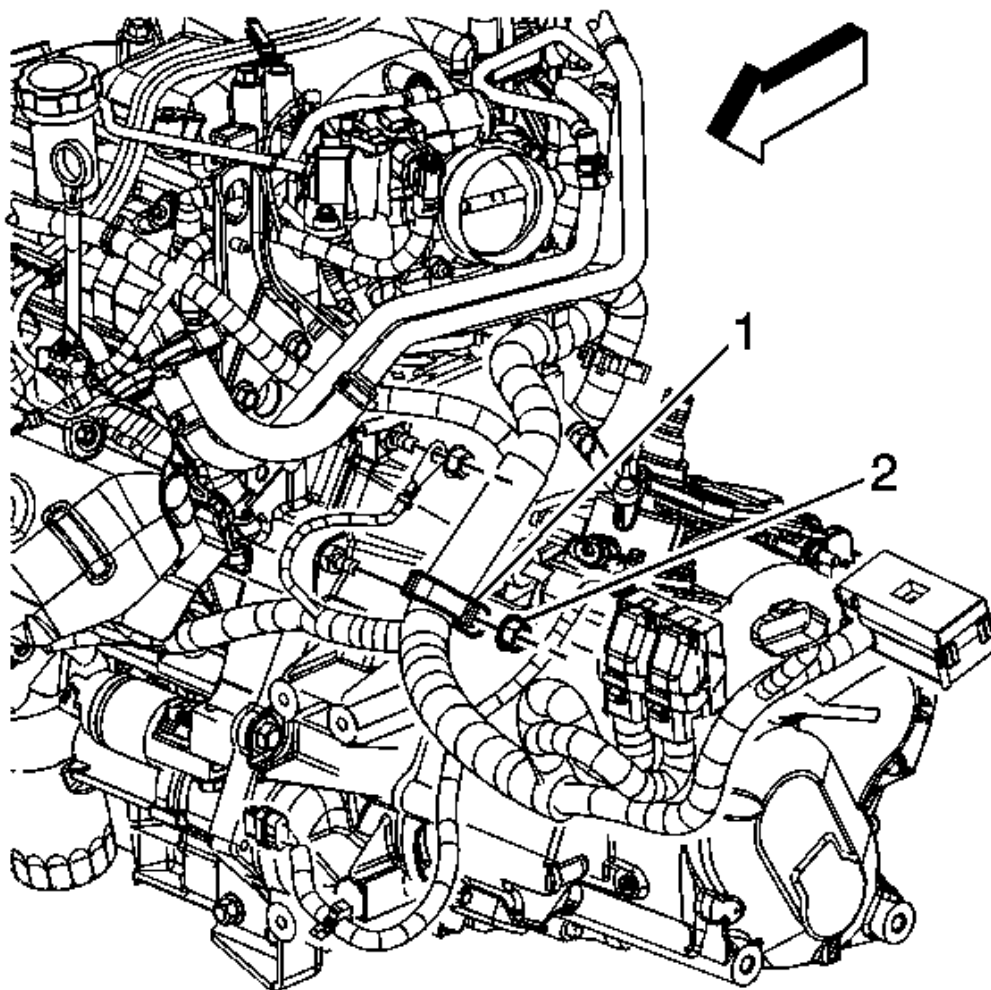


Fig. 234: Engine Harness Clip & Nut
Courtesy of GENERAL MOTORS CORP.

37. Install the engine harness clip (1) to the transmission stud.
38. Install the engine harness clip nut (2) and tighten to 25 N.m (18 lb ft).

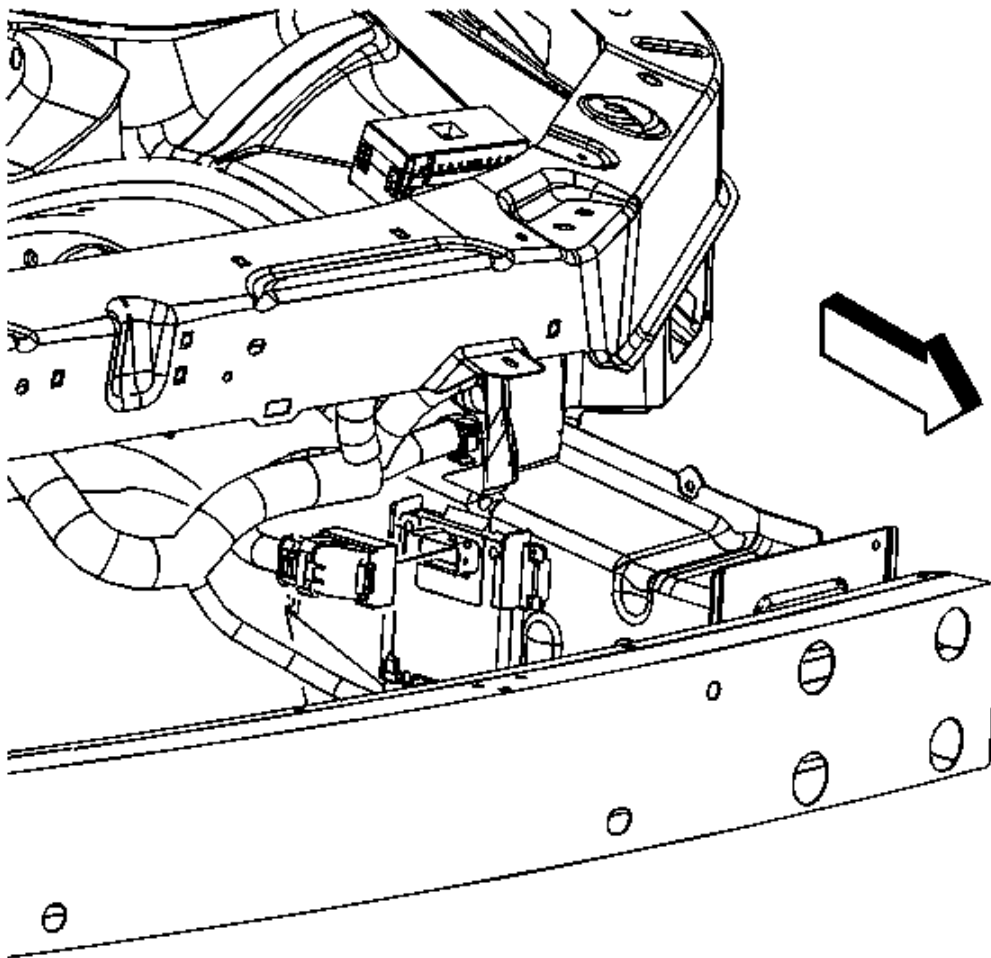


Fig. 235: Transmission Control Module (TCM) Engine Harness Electrical Connector
Courtesy of GENERAL MOTORS CORP.

39. Connect the engine harness electrical connector to the TCM.

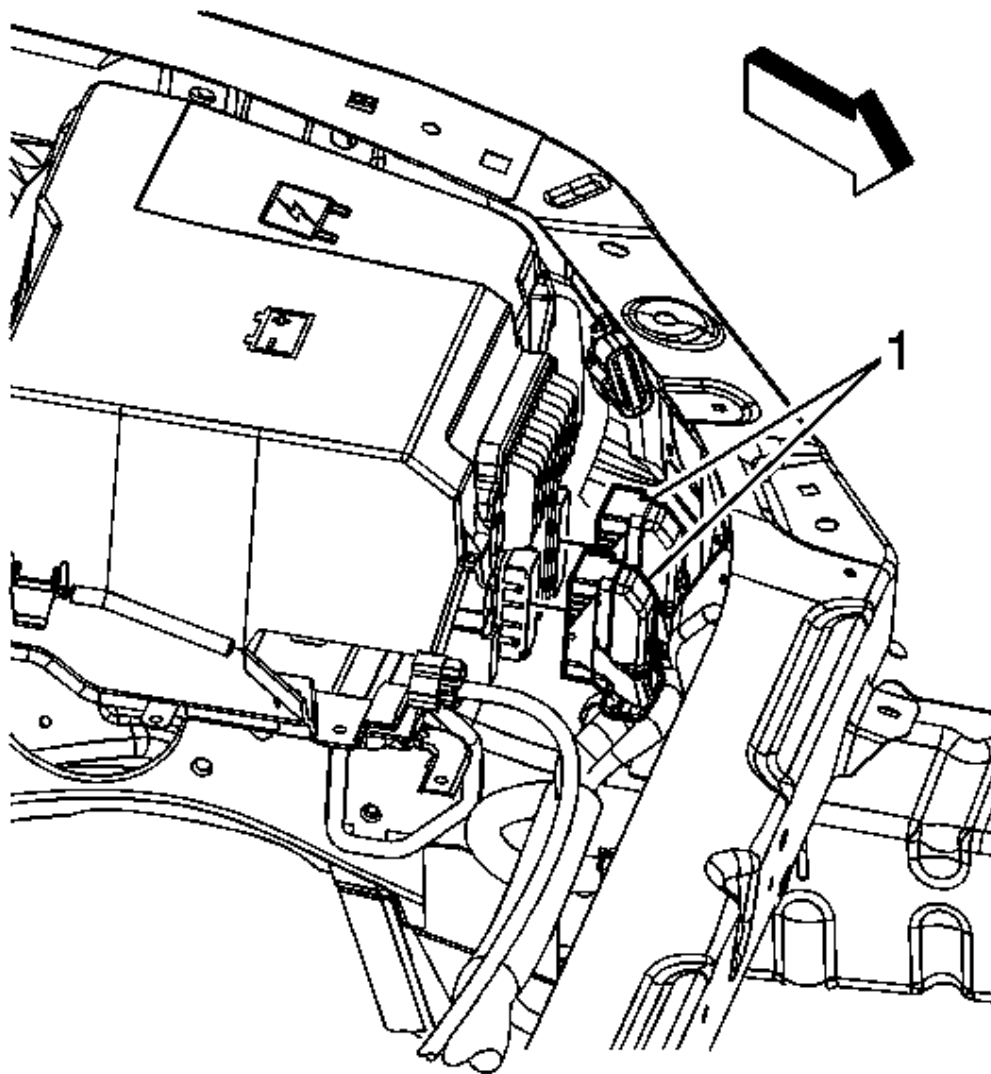


Fig. 236: Engine Harness ECM/PCM Connectors
Courtesy of GENERAL MOTORS CORP.

40. Connect the engine harness electrical connectors (1) to the PCM.

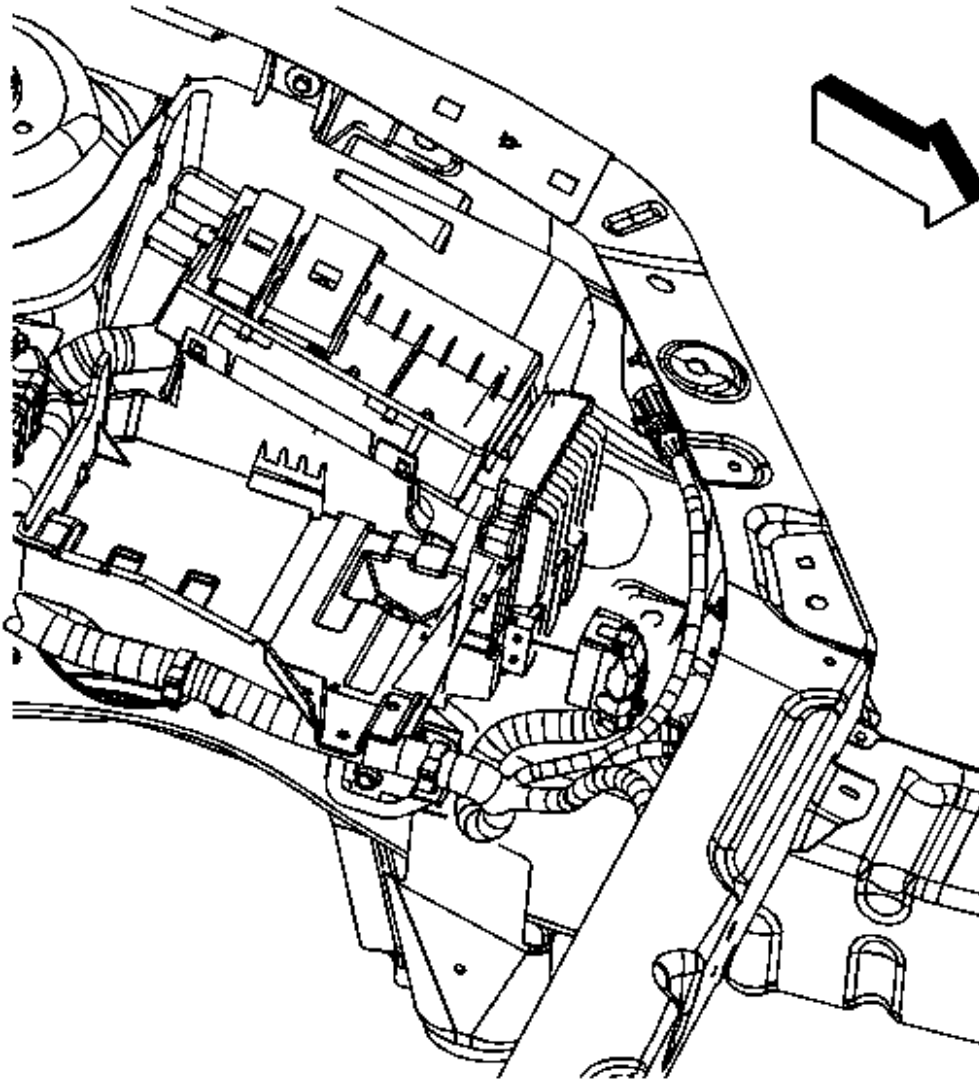


Fig. 237: Body Harness ECM/PCM Connector
Courtesy of GENERAL MOTORS CORP.

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

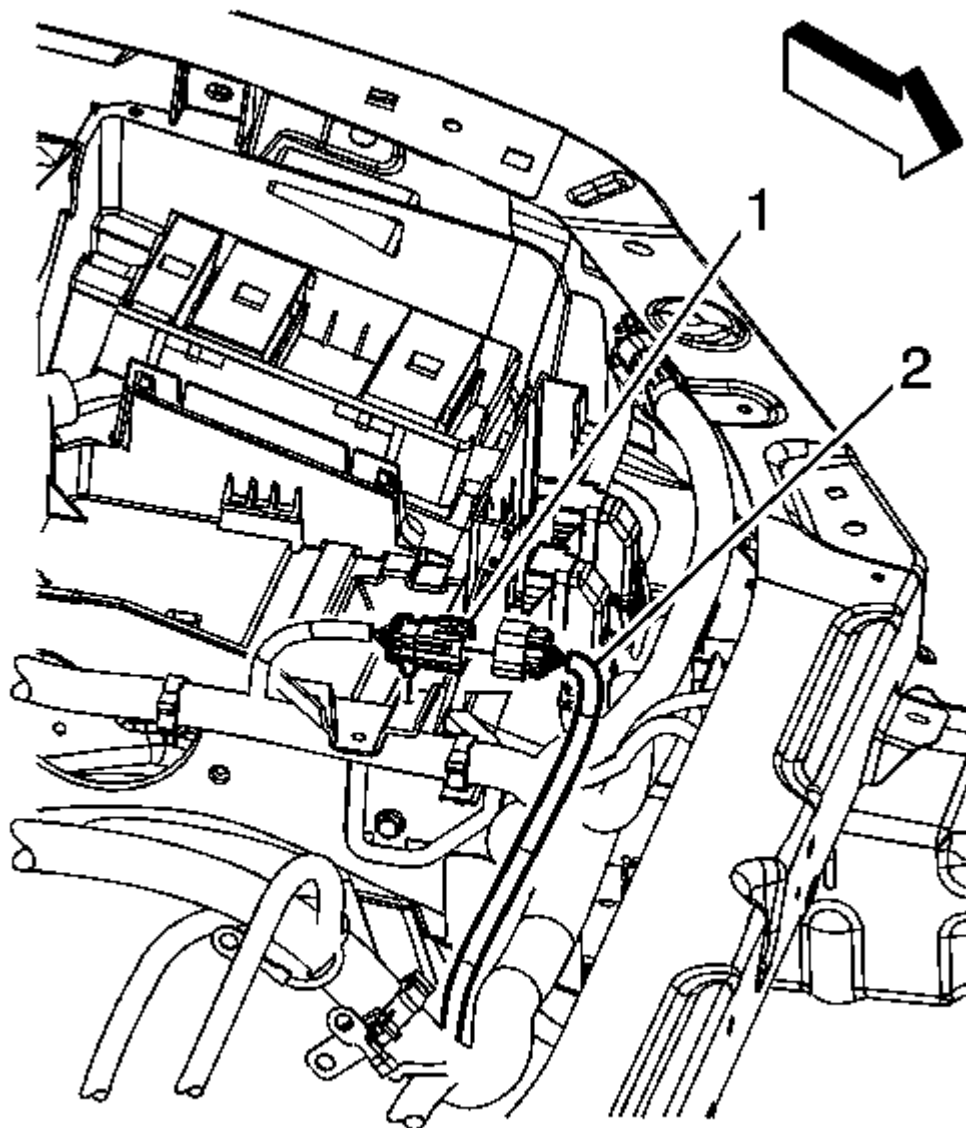


Fig. 238: Engine Harness Connector At Body Harness Connector
Courtesy of GENERAL MOTORS CORP.

42. Connect the engine harness connector (1) to the body harness connector (2).

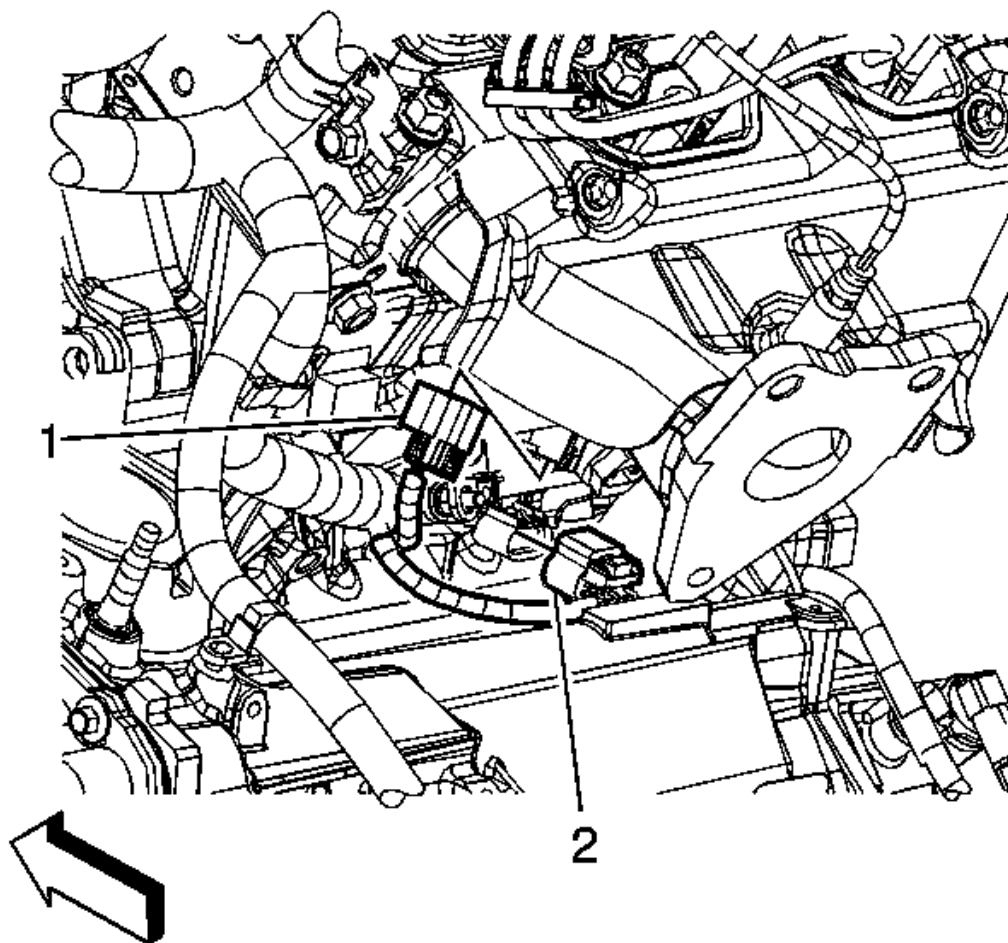


Fig. 239: KS & CKP Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

43. Connect the CKP sensor electrical connector (2).
44. Connect the knock sensor electrical connector (1).

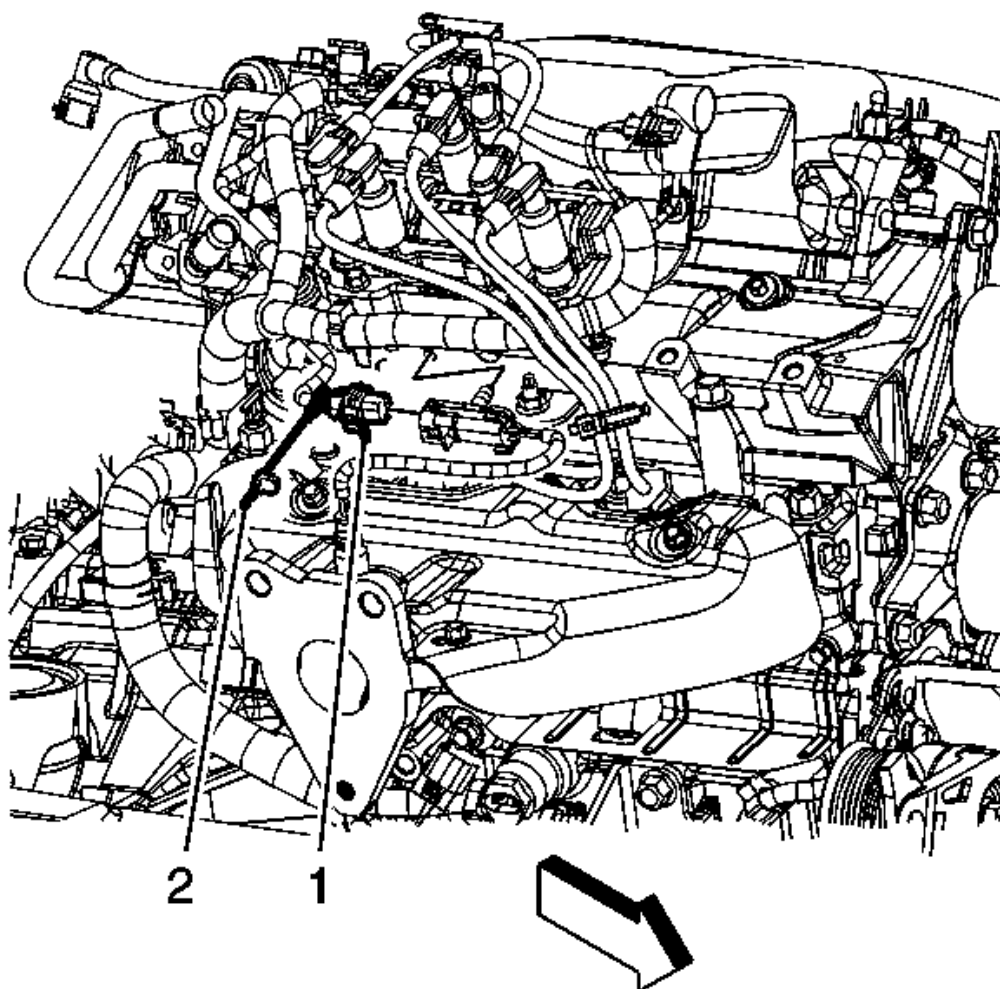


Fig. 240: HO2S Connector & CPA Retainer
Courtesy of GENERAL MOTORS CORP.

45. Connect the rear upper HO2S electrical connector (1).
46. Install the CPA retainer.

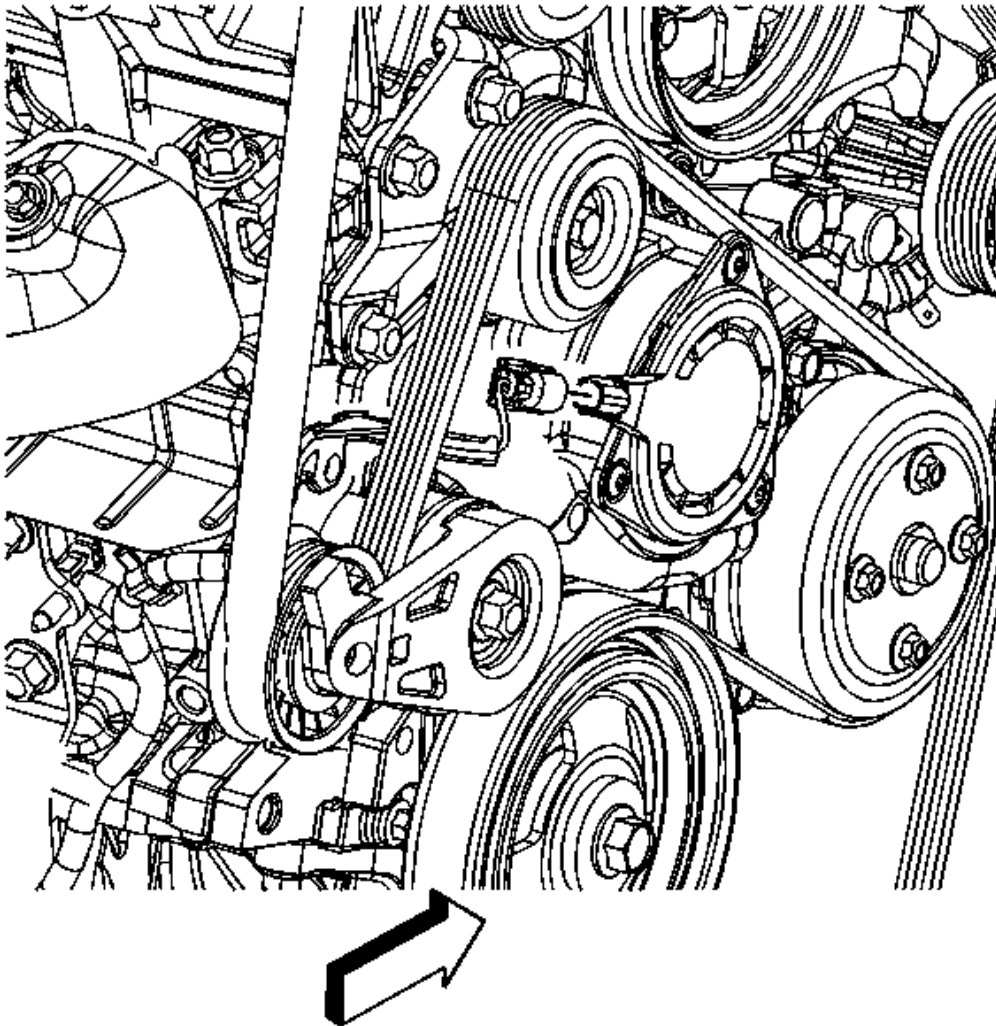


Fig. 241: Camshaft Position Actuator Magnet Electrical Connector
Courtesy of GENERAL MOTORS CORP.

47. Connect the camshaft phasor sensor electrical connector.

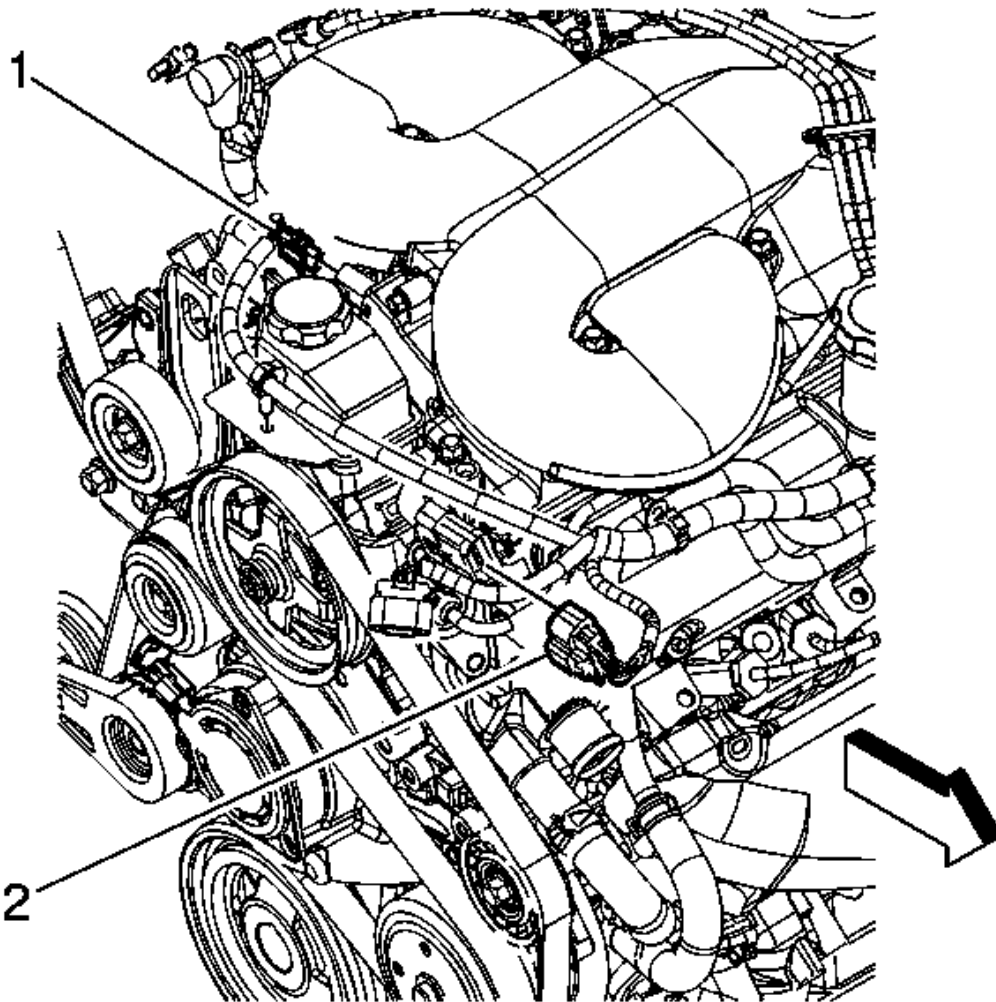


Fig. 242: Intake Manifold Tuning Valve & Injector Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

48. Connect the fuel injector inline (2) electrical connector.
49. Connect the inlet manifold valve (1) electrical connector.

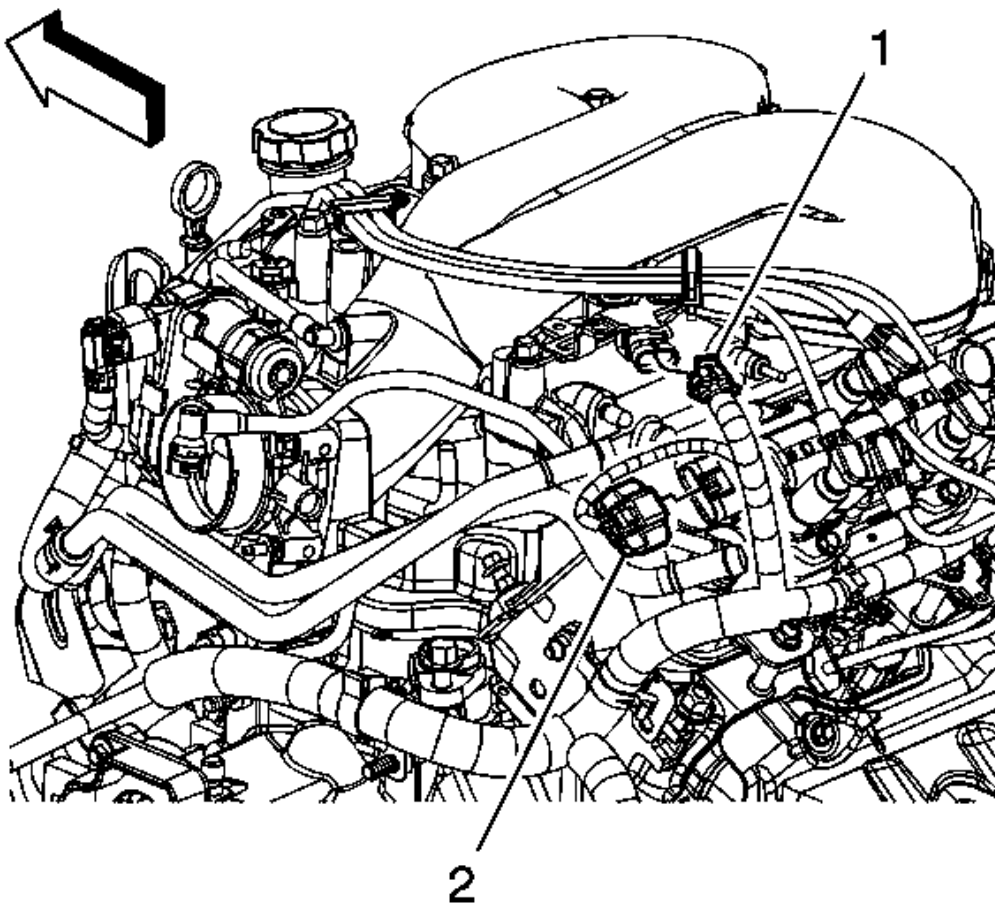


Fig. 243: ECM & MAP Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

50. Connect the ignition control module (2) electrical connector.
51. Connect the MAP sensor (1) electrical connector.

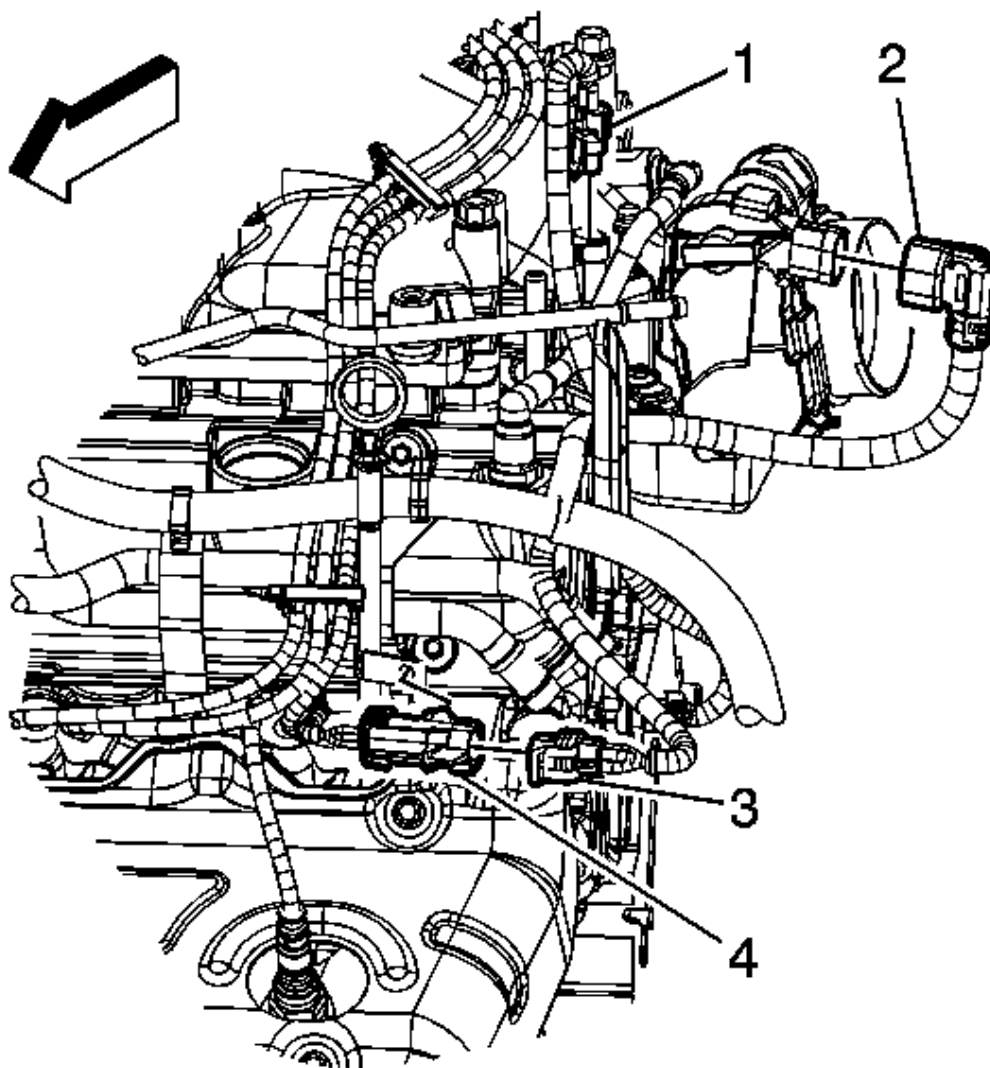


Fig. 244: EVAP Canister Purge Solenoid, ETC & HO2S Connectors
Courtesy of GENERAL MOTORS CORP.

52. Connect the HO2S (3) electrical connector.
53. Install the CPA retainer.
54. Connect the ETC (2) electrical connector.
55. Connect the EVAP canister purge solenoid (1) electrical connector.
56. Raise and support the vehicle.

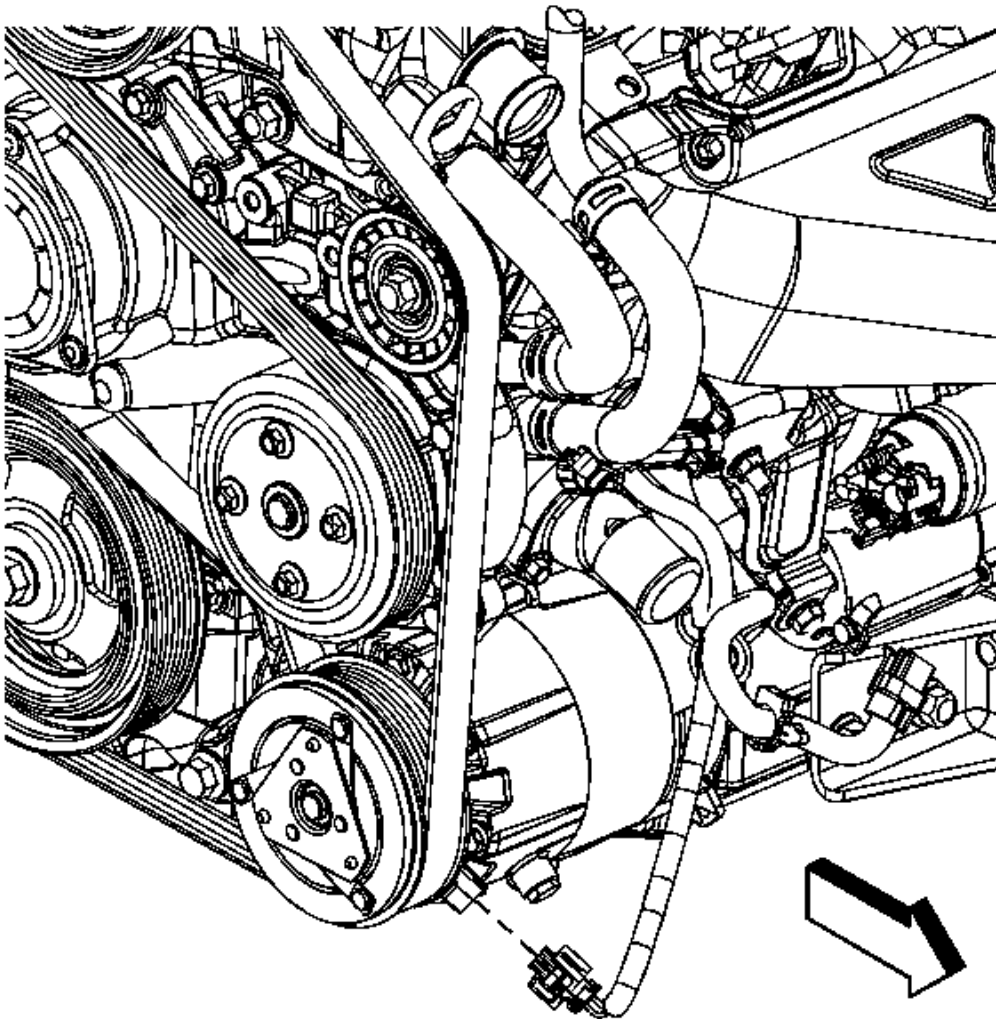


Fig. 245: A/C Compressor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

57. Connect the A/C compressor electrical connector.

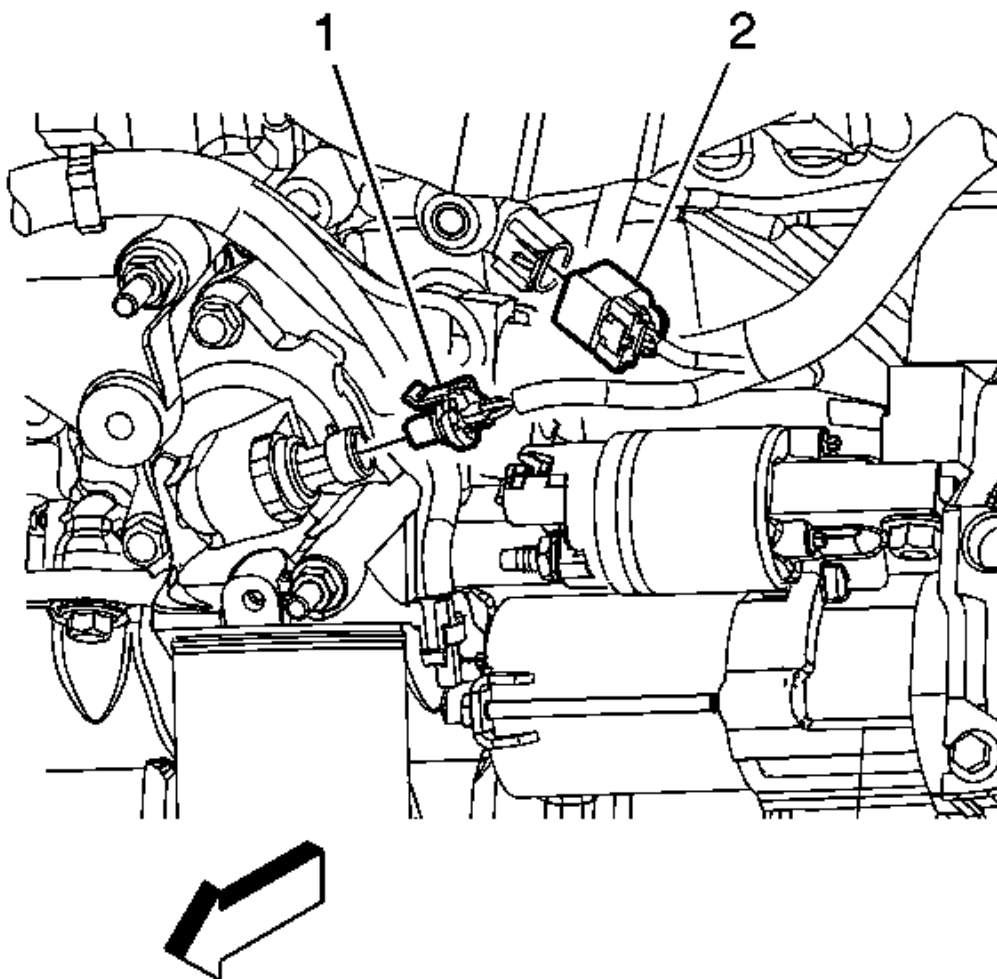


Fig. 246: Knock Sensor & Oil Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

58. Connect the knock sensor (2) electrical connector.
59. Connect the oil pressure sensor (1) electrical connector.

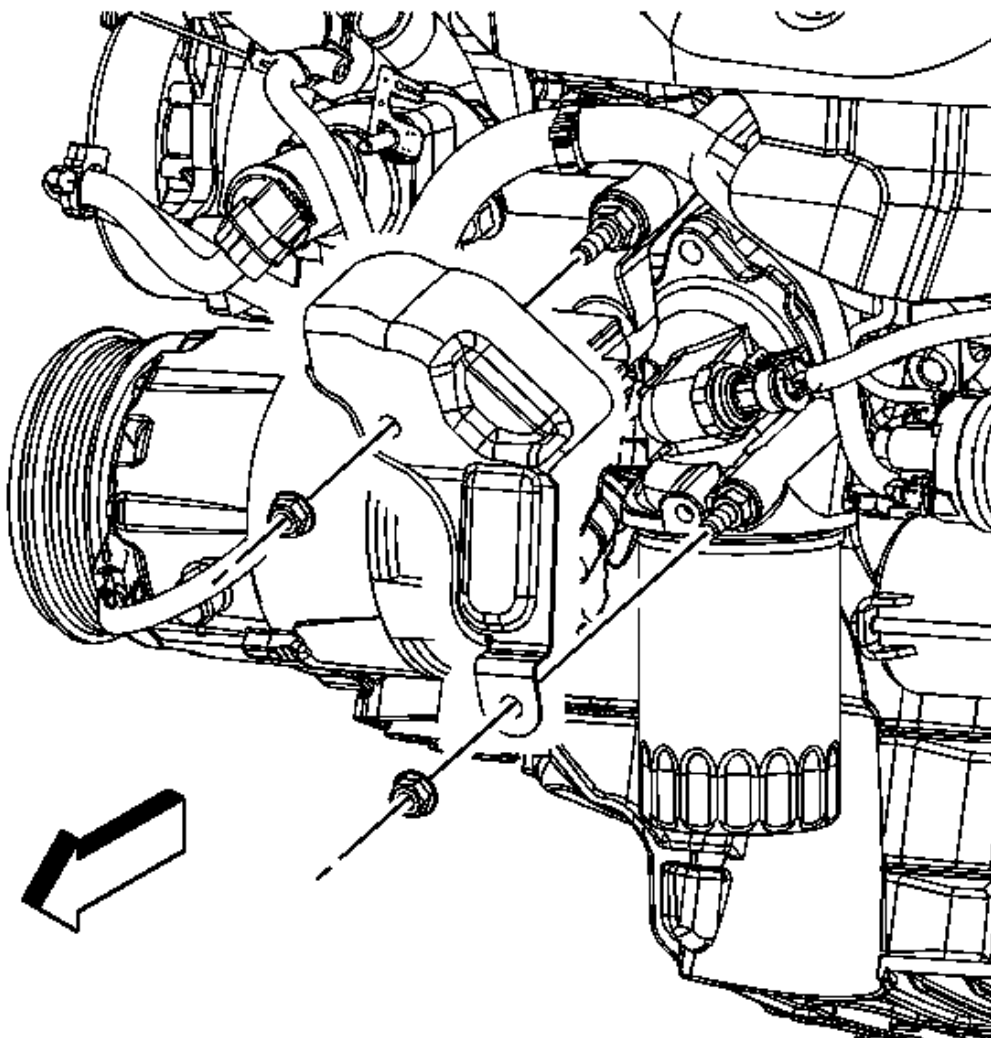


Fig. 247: Oil Pressure Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

60. Install the oil pressure sensor heat shield and nuts and tighten the nuts to 25 N.m (18 lb ft).
61. Lower the vehicle.
62. Connect the power steering lines and install the power steering pump, if equipped. Refer to **Power Steering Pump Replacement (LZ4, LZ9)**.
63. Install the drive belt and engine mount snubber. Refer to **Drive Belt Replacement (Coupe)** or **Drive Belt Replacement (Convertible)**.
64. Install the intake manifold cover. Refer to **Intake Manifold Cover Replacement**.

65. Install the hood. Refer to **Hood Replacement** .
66. Install the air cleaner assembly. Refer to **Air Cleaner Assembly Replacement** .
67. Fill the engine with oil. Refer to **Engine Oil and Oil Filter Replacement** .
68. Fill the cooling system. Refer to **Cooling System Draining and Filling (LY7, LZE, LZ4, LZ9)** .
69. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .
70. Inspect for leaks.

ENGINE OIL AND OIL FILTER REPLACEMENT

REMOVAL PROCEDURE

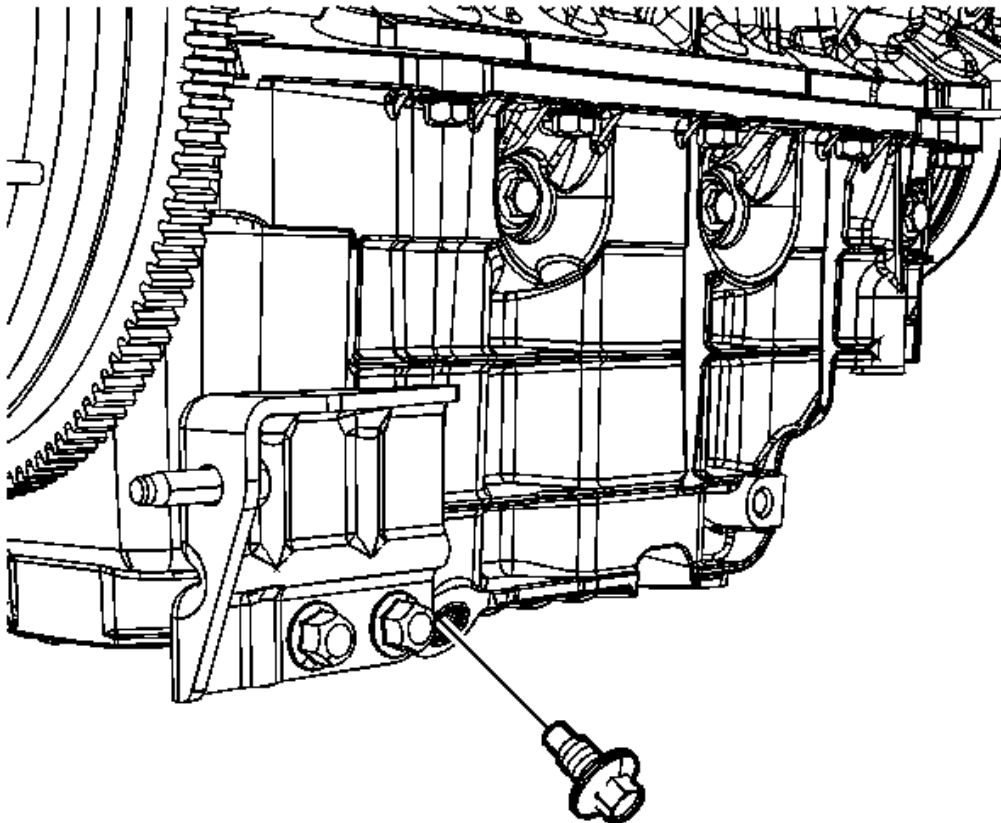


Fig. 248: Oil Pan Drain Plug
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

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

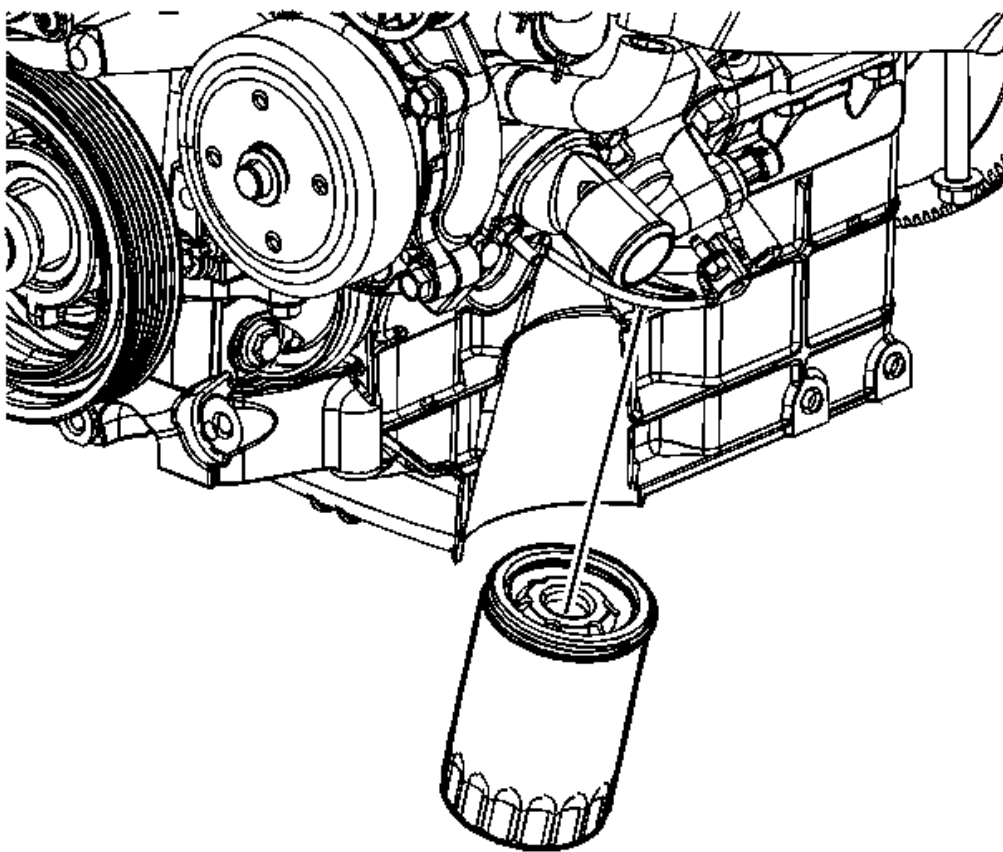


Fig. 249: Oil Filter

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

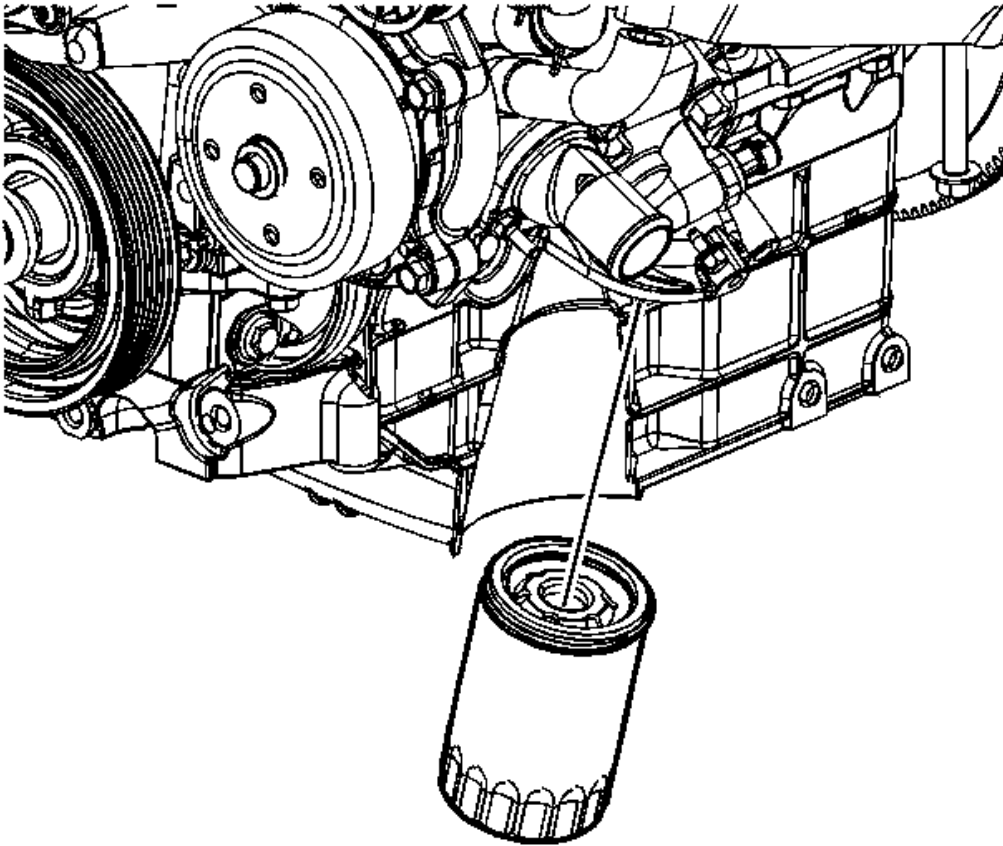


Fig. 250: Oil Filter

Courtesy of GENERAL MOTORS CORP.

1. Apply clean engine oil to the NEW oil filter gasket.
2. Install the NEW oil filter and tighten 3/4 to 1 full turn, after the oil filter gasket contacts the adapter.

CAUTION: Refer to Fastener Caution .

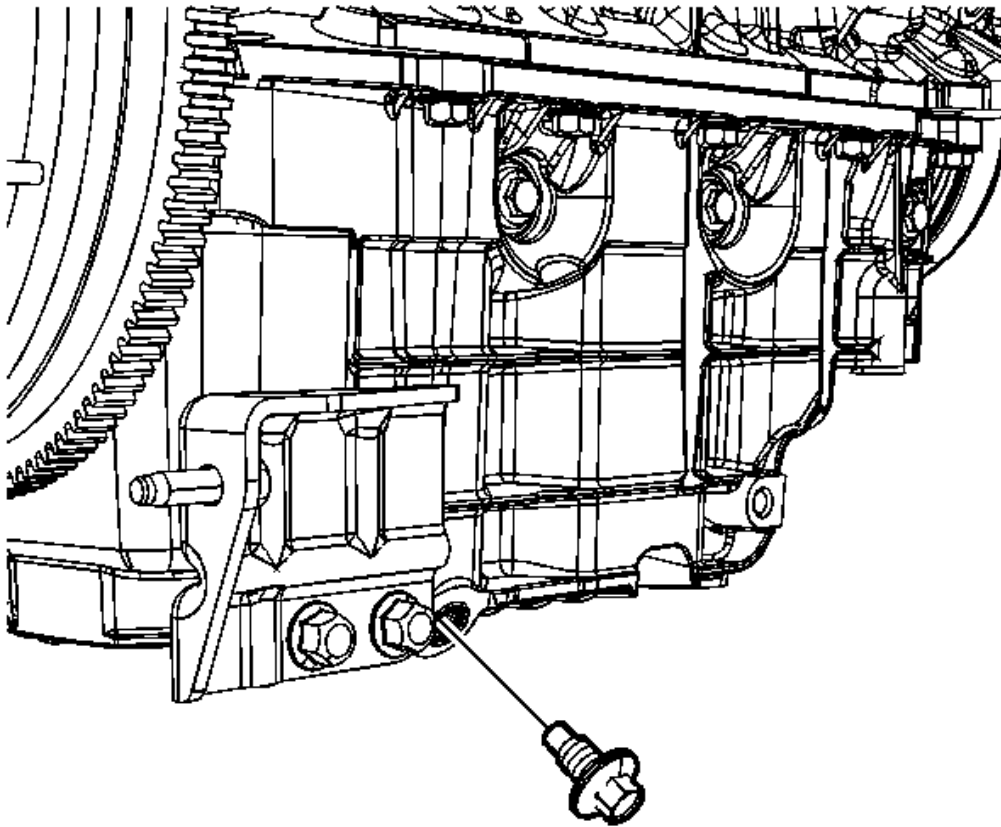


Fig. 251: Oil Pan Drain Plug

Courtesy of GENERAL MOTORS CORP.

3. Tighten the oil pan drain plug to 26 N.m (19 lb ft).
4. Remove the oil drain pan from under the vehicle.
5. Lower the vehicle.
6. Fill the engine with new engine oil. Refer to Approximate Fluid Capacities and Fluid and Lubricant Recommendations (USA and Canada).
7. Start the engine.
8. Inspect the for oil leaks after engine start up.
9. Turn OFF the engine and allow the oil a few minutes to drain back into the oil pan.
10. Remove the oil level indicator from the oil level indicator tube.
11. Clean off the indicator end of the oil level indicator with a clean paper towel or cloth.
12. Install the oil level indicator into the oil level indicator tube until the oil level indicator handle contacts the top of the oil level indicator tube.

13. Again, remove the oil level indicator from the oil level indicator tube keeping the tip of the oil level indicator down.
14. Check the level of the engine oil on the oil level indicator.
15. If necessary, adjust the oil level by adding or draining oil.
16. Check for oil leaks.