

2011 ENGINE

Engine Controls and Fuel - 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L - CTS

REPAIR INSTRUCTIONS

ENGINE CONTROL MODULE REPLACEMENT

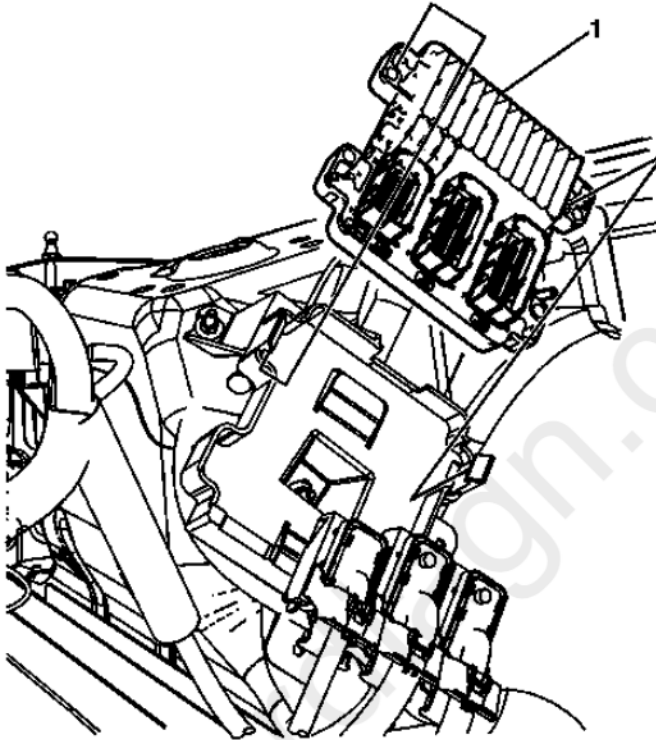


Fig. 1: Identifying Engine Control Module
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Engine Control Module (ECM) Procedure 1. Record the current engine oil life percentage and use a scan tool to update the NEW ECM, if replacing. 2. Disconnect the ECM harness connectors. The ECM harness connectors are equipped with locking levers. Rotate the levers upward to the connectors to disengage the connector. 3. Disengage the ECM bracket retaining tabs. 4. If replacing, program the ECM. Refer to <u>Control Module References</u> .

CRANKSHAFT POSITION SYSTEM VARIATION LEARN

NOTE: The Crankshaft Position System Variation Learn procedure is also required when the following service procedures have been performed, regardless of whether DTC P0315 is set:

- An engine replacement
- A engine control module (ECM) replacement
- A crankshaft balancer replacement
- A crankshaft replacement
- A crankshaft position sensor replacement
- Any engine repairs which disturb the crankshaft to crankshaft position sensor relationship.

NOTE: The ECM monitors certain component signals to determine if all the conditions are met to continue with the crankshaft position System Variation Learn Procedure.

1. Monitor the engine control module (ECM) for DTCs with a scan tool. If other DTCs are set, except DTC P0315, refer to **Diagnostic Trouble Code (DTC) List - Vehicle** for the applicable DTC that set.
2. Select the Crankshaft Pos. Variation Learn procedure with a scan tool.

NOTE: Close the hood.

NOTE: Observe the appropriate RPM values for fuel cut-off.

NOTE: The engine must be at operating temperature.

3. The scan tool instructs you to perform the following:
 1. Block drive wheels.
 2. Set parking brake.
 3. Cycle the ignition.
 4. Apply and hold brake pedal.

NOTE: The vehicle must remain in PARK/NEUTRAL.

5. Start and idle the engine.

NOTE: The scan tool monitors certain component signals to determine if all the conditions are met to continue with the procedure. The scan tool only displays the condition that inhibits the procedure. The scan tool monitors the following components:

2011 Cadillac CTS

2011 ENGINE Engine Controls and Fuel - 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L - CTS

- **CKP sensors activity**-If there is a CKP sensor condition, refer to the applicable DTC that set.
- **Camshaft position (CMP) sensor activity**-If there is a CMP sensor condition, refer to the applicable DTC that set.
- **Engine coolant temperature (ECT)**-If the ECT is not warm enough, idle the engine until the engine coolant temperature reaches the correct temperature.

4. Enable the CKP System Variation Learn Procedure with a scan tool.

NOTE: Do not accelerate beyond the RPM values for fuel cut-off.

5. Accelerate to wide open throttle (WOT). Release when fuel cut-off occurs.
6. Test in progress.
7. The scan tool displays Learn Status: Learned this ignition.

NOTE: Verify that DTC P0315 ran and passed; then the CKP Variation Learn Procedure is complete. If the scan tool indicates DTC P0315 failed or did not run, or any other DTCs set, refer to Diagnostic Trouble Code (DTC) List - Vehicle for the applicable DTC.

8. Once the Learn Procedure has successfully completed, and in order to store the crankshaft position system variation values in the ECM, turn OFF the ignition and verify all vehicle systems are OFF. This may take up to 2 minutes.

THROTTLE/IDLE LEARN

Description

The engine control module (ECM) learns the airflow through the throttle body to ensure the correct idle. The learned airflow values are stored within the ECM. These values are learned to adjust for production variation and will continuously learn during the life of the vehicle to compensate for reduced airflow due to throttle body coking. Anytime the throttle body airflow rate changes, for example due to cleaning or replacing, the values must be relearned.

An engine that had a heavily coked throttle body that has been cleaned or replaced may take several drive cycles to learn out the coking. To accelerate the process, the scan tool has the ability to reset all learned values back to zero. A new ECM will also have values set to zero.

The idle may be unstable or a DTC may set if the learned values do not match the actual airflow.

Conditions for Running the Throttle Learn Procedure

Reset Procedure

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2011 ENGINE Engine Controls and Fuel - 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L - CTS

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0120, P0122, P0123, P0128, P0171, P0172, P0174, P0175, P0201, P0202, P0203, P0204, P0205, P0206, P0220, P0222, P0223, P0300, P0351, P0352, P0353, P0496, P0601, P0604, P0606, P060D, P0641, P0651, P1516, P2101, P2119, P2120, P2122, P2123, P2125, P2127, P2128, P2135, P2138, or P2176 are not set.
- Ignition ON, engine OFF.
- The vehicle speed sensor (VSS) is 0 km/h (0 mph).

Learn Procedure

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0120, P0122, P0123, P0128, P0171, P0172, P0174, P0175, P0201, P0202, P0203, P0204, P0205, P0206, P0220, P0222, P0223, P0300, P0351, P0352, P0353, P0496, P0601, P0604, P0606, P060D, P0641, P0651, P1516, P2101, P2119, P2120, P2122, P2123, P2125, P2127, P2128, P2135, P2138, or P2176 are not set.
- The engine speed is between 450-4,000 RPM.
- The manifold absolute pressure (MAP) is greater than 5 kPa.
- The mass air flow (MAF) is greater than 2 g/s.
- The ignition voltage is greater than 10 volts.

Throttle Learn

Reset Procedure (Performed after the throttle body is cleaned or replaced)

1. Ignition ON, engine OFF, perform the Idle Learn Reset in Module Setup with a scan tool.
2. Start the engine and monitor the TB Idle Airflow Compensation parameter. The TB Idle Airflow Compensation value should equal 0 percent and the engine should be idling at a normal idle speed.
3. Clear the DTCs and return to the diagnostic that referred you here.

Learn Procedure (Performed after the ECM is flashed or replaced)

NOTE: Do NOT perform this procedure if DTCs are set. Refer to Diagnostic Trouble Code (DTC) List - Vehicle.

1. Start and idle the engine for 3 minutes.
2. With a scan tool, monitor the Desired Idle Speed and the actual Engine Speed.
3. The ECM will start to learn the new idle cells and Desired Idle Speed should start to decrease.
4. Ignition OFF for 60 seconds.
5. Start and idle the engine for 3 minutes.
6. After the 3 minute run time the engine should be idling normal.

NOTE: During the drive cycle the check engine light may come on with idle speed DTCs. If idle speed codes are set, clear codes so the ECM can continue to learn.

- If the engine idle speed has not been learned the vehicle will need to be driven at speeds above 70 km/h (44 mph) with several decelerations and extended idles.
- 7. After the drive cycle, the engine should be idling normally.
 - If the engine idle speed has not been learned, turn OFF the ignition for 60 seconds and repeat step 6.
- 8. Once the engine speed has returned to normal, clear DTCs and return to the diagnostic that referred you here.

ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT

Removal Procedure

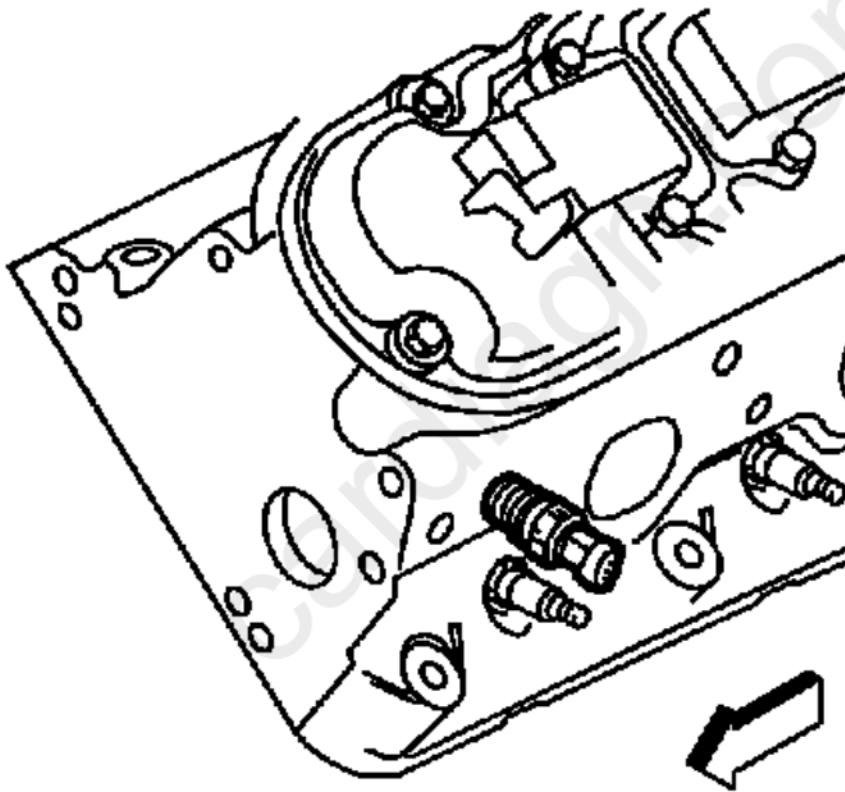


Fig. 2: View of ECT Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Turn OFF the ignition.
2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle**.
3. Drain the engine coolant below the level of the engine coolant temperature (ECT) sensor. Refer to **Cooling System Draining and Filling (Static Fill LF1, LLT)** or **Cooling System Draining and Filling**.

(Static Fill LSA) or Cooling System Draining and Filling (GE 47716 LF1, LLT) or Cooling System Draining and Filling (GE 47716 LSA) .

4. Lower the vehicle.
5. Disconnect the harness connector from the ECT sensor.

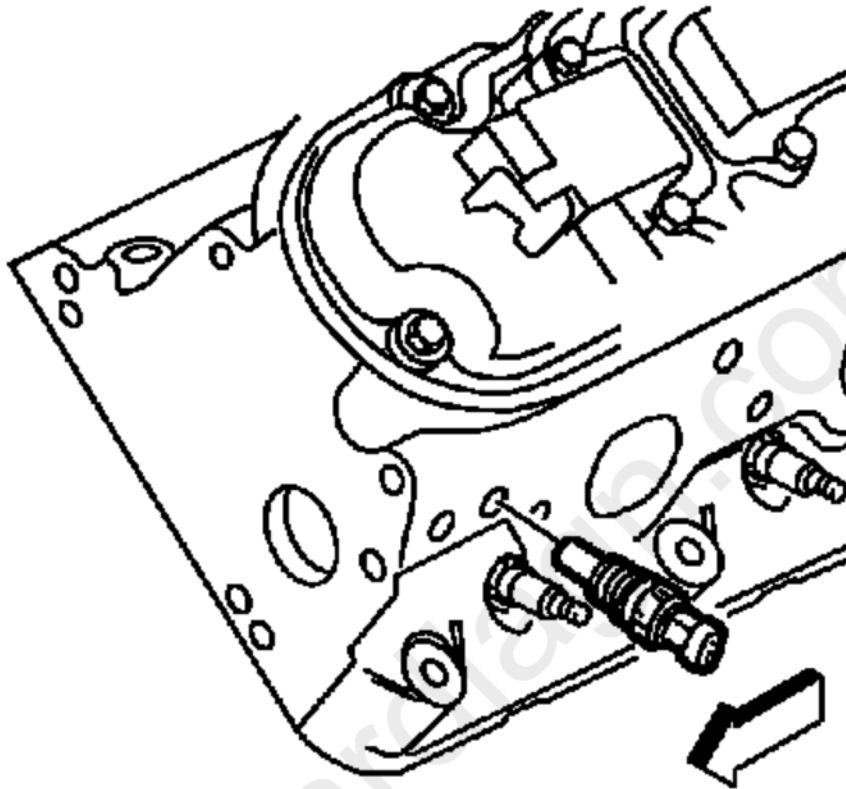


Fig. 3: ECT Sensor

Courtesy of GENERAL MOTORS CORP.

CAUTION: Use care when handling the coolant sensor. Damage to the coolant sensor will affect the operation of the fuel control system.

6. Remove the ECT sensor.

Installation Procedure

CAUTION: Replacement components must be the correct part number for the application. Components requiring the use of the thread locking compound, lubricants, corrosion inhibitors, or sealants are identified in the service procedure. Some replacement components may come

with these coatings already applied. Do not use these coatings on components unless specified. These coatings can affect the final torque, which may affect the operation of the component. Use the correct torque specification when installing components in order to avoid damage.

CAUTION: Use care when handling the coolant sensor. Damage to the coolant sensor will affect the operation of the fuel control system.

1. Coat the ECT sensor threads with sealer P/N 12346004 (Canadian P/N 10953480) or the equivalent.

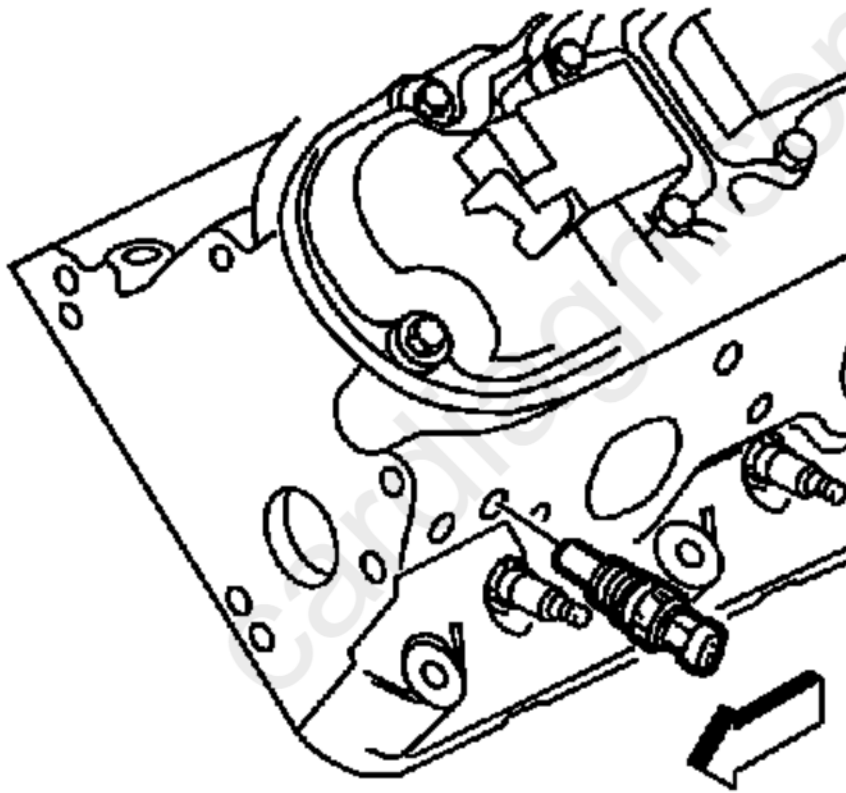


Fig. 4: ECT Sensor

Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

2. Install the ECT sensor and tighten to 20 N.m (15 lb ft).

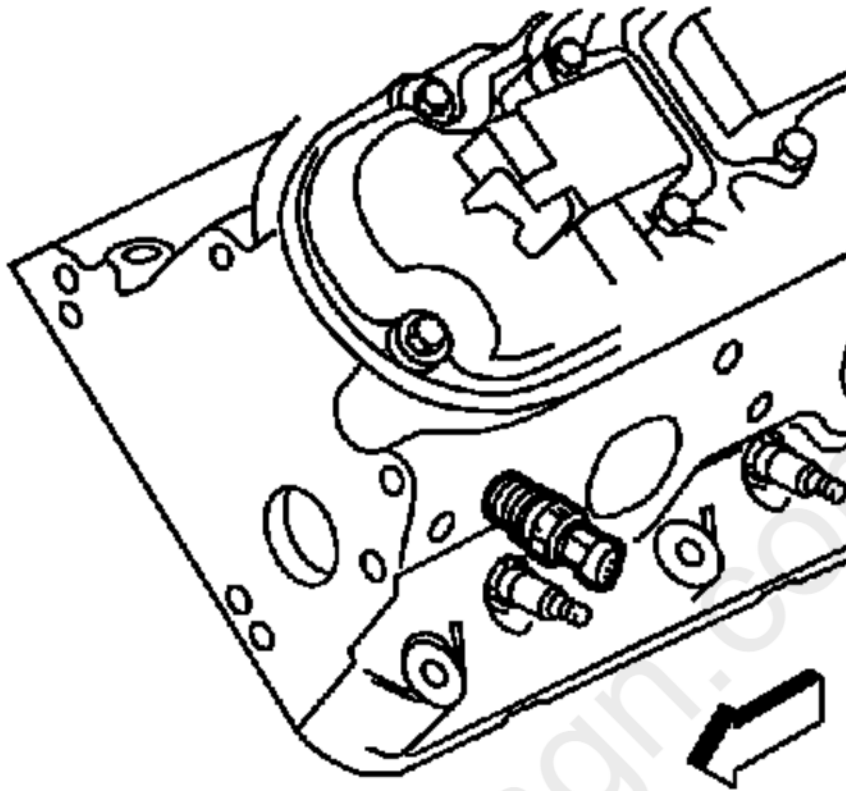


Fig. 5: View of ECT Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the ECT sensor electrical connector.
4. Refill the engine coolant. Refer to Cooling System Draining and Filling (Static Fill LF1, LLT) or Cooling System Draining and Filling (Static Fill LSA) or Cooling System Draining and Filling (GE 47716 LF1, LLT) or Cooling System Draining and Filling (GE 47716 LSA) .

INTAKE AIR TEMPERATURE SENSOR REPLACEMENT

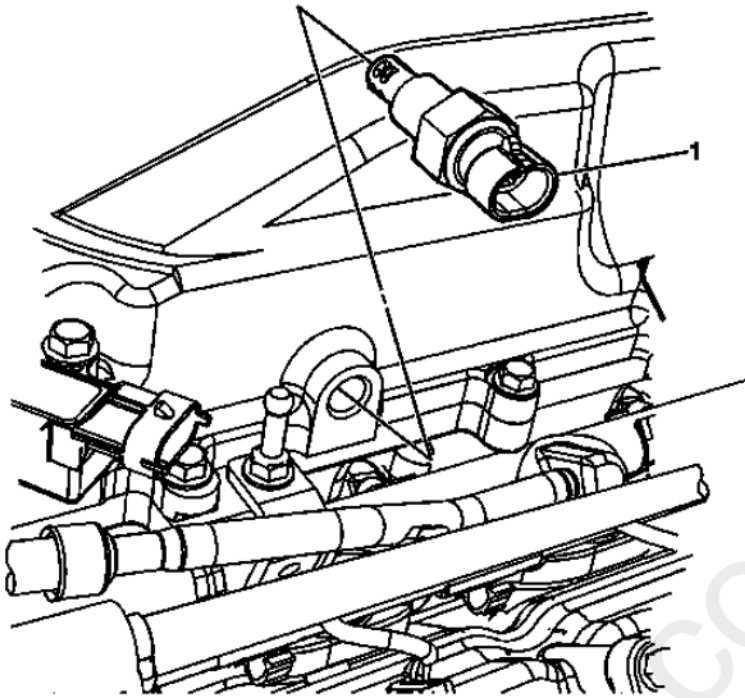


Fig. 6: Identifying Intake Air Temperature Sensor
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the front intake manifold cover. Refer to <u>Intake Manifold Cover Replacement - Front</u> .	
1	Intake Air Temperature Sensor CAUTION: Refer to <u>FASTENER CAUTION</u> . Procedure: Disconnect the intake air temperature sensor harness connector. Tighten: 20 N.m (15 lb ft)

MASS AIRFLOW SENSOR WITH INTAKE AIR TEMPERATURE SENSOR REPLACEMENT (LSA)

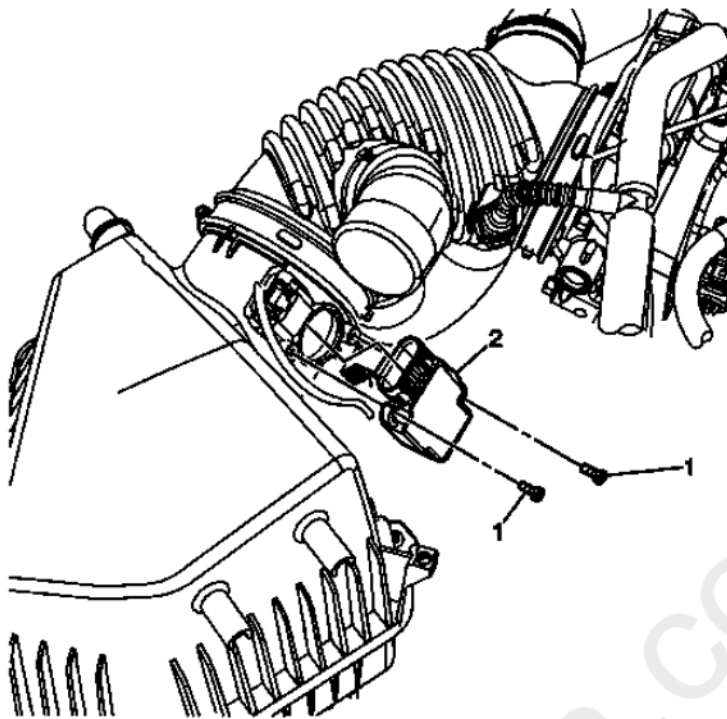


Fig. 7: Identifying Mass Airflow Sensor
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Mass Airflow Sensor Fastener (Qty: 2) CAUTION: Refer to. Tighten: 1.5 N.m (13 lb in)
2	Mass Airflow Sensor Procedure: Disconnect the mass airflow harness connector.

BAROMETRIC PRESSURE SENSOR REPLACEMENT

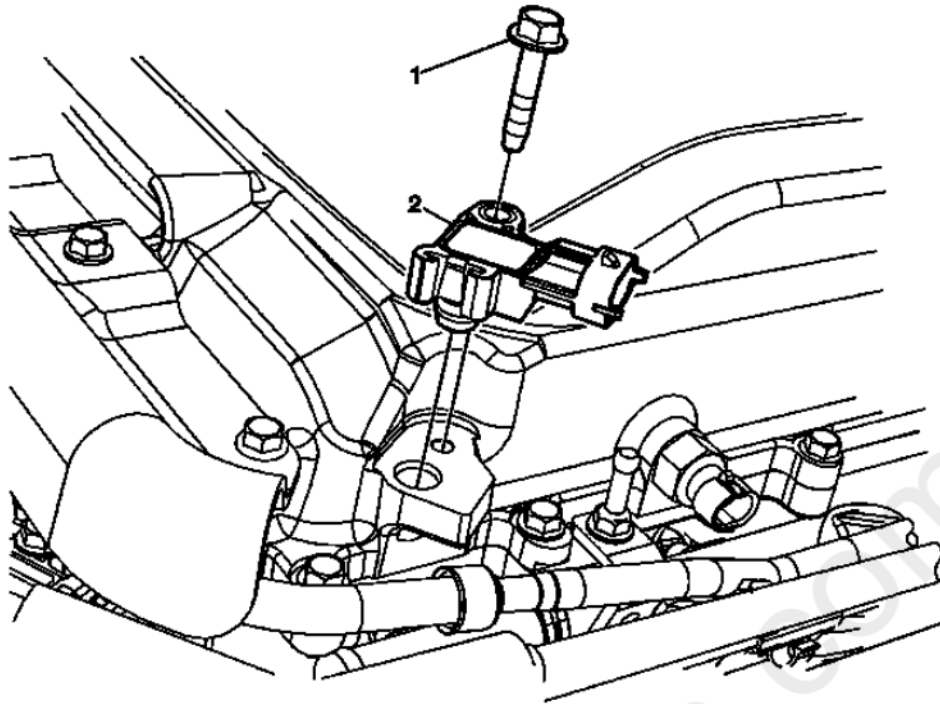


Fig. 8: Identifying Barometric Pressure Sensor
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the front manifold cover. Refer to <u>Intake Manifold Cover Replacement - Front</u> .	
1	Barometric Pressure Sensor Bolt CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 10 N.m (89 lb in)
2	Barometric Pressure Sensor Procedure: Disconnect the Baro sensor harness connector. Tip: Always install the NEW O-ring provided with the BARO sensor.

HEATED OXYGEN SENSOR REPLACEMENT - BANK 1 SENSOR 1

Removal Procedure

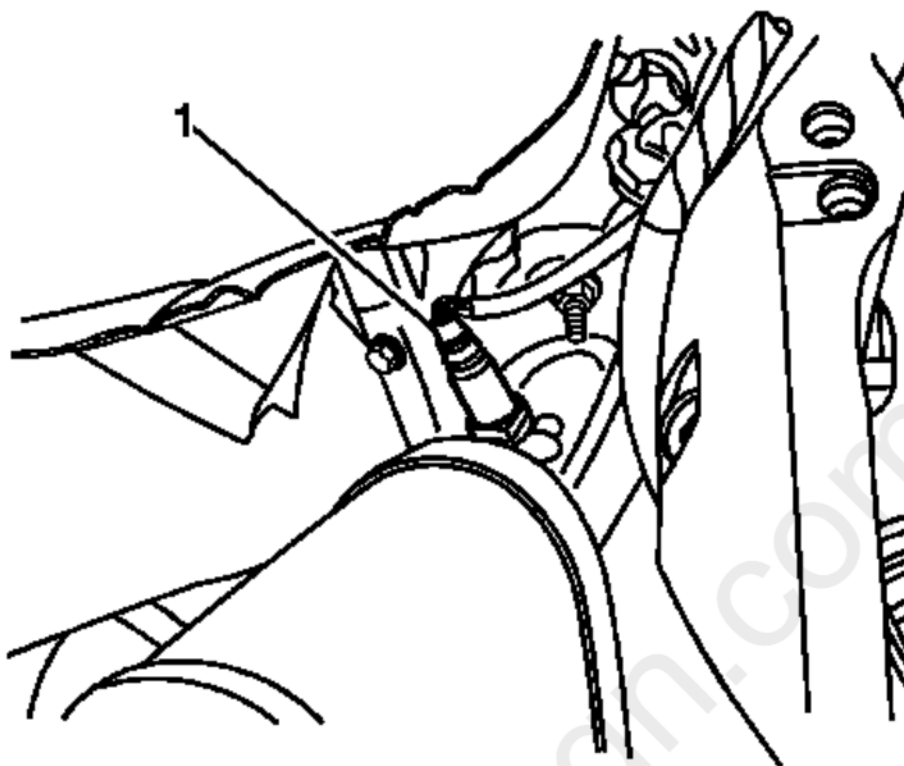


Fig. 9: Identifying HO2S (Bank 1 Sensor 1)
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fuel and Evaporative Emission Hose/Pipe Connection Cleaning Caution .

1. Raise the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Disconnect the heated oxygen sensor (HO2S) electrical connector.
3. Remove any wire harness retainers and note the wire harness routing for reassembly.
4. Carefully remove the HO2S (1).

Installation Procedure

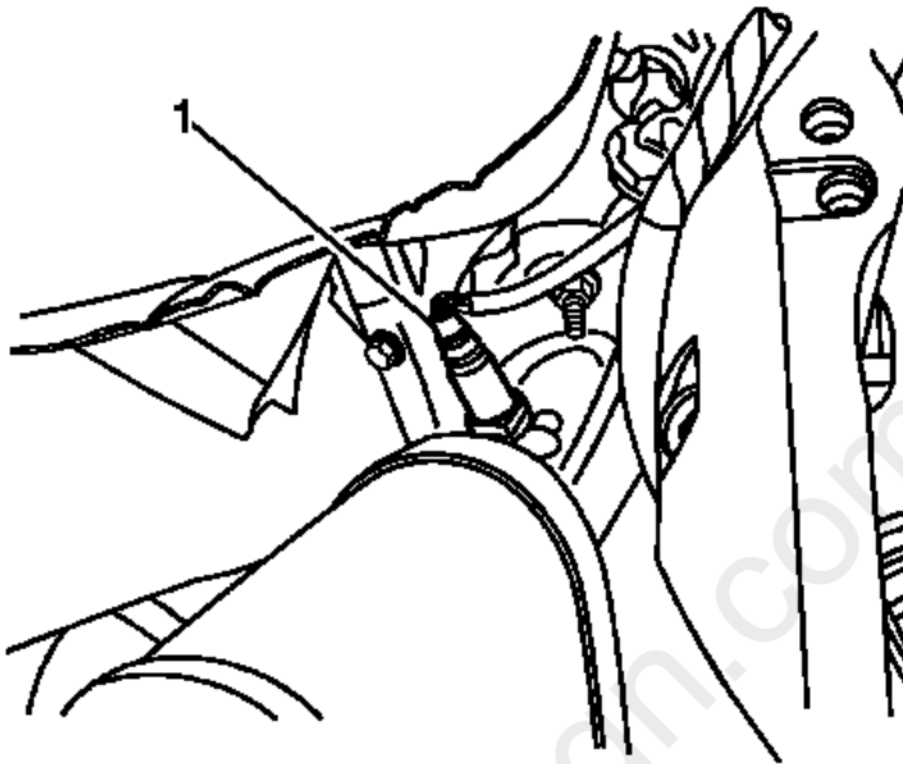


Fig. 10: Identifying HO2S (Bank 1 Sensor 1)
Courtesy of GENERAL MOTORS CORP.

NOTE: Use special anti-seize compound on the HO2S threads. The compound consists of graphite suspended in fluid and glass beads. The graphite burns away, but the glass beads remain, making the sensor easier to remove. New or service sensors already have the compound applied to the threads. If you remove an oxygen sensor and if for any reason you must reinstall the same oxygen sensor, apply the anti-seize compound to the threads before reinstallation.

1. Coat the threads of the HO2S with the anti-seize compound P/N 5613695, or the equivalent if necessary.

CAUTION: Refer to **FASTENER CAUTION** .

2. Install the HO2S (1) and tighten to 41 N.m (30 lb ft).
3. Connect the HO2S electrical connector.
4. Route and attach the wire harness as noted during disassembly.
5. Lower the vehicle.

HEATED OXYGEN SENSOR REPLACEMENT - BANK 1 SENSOR 2

Removal Procedure

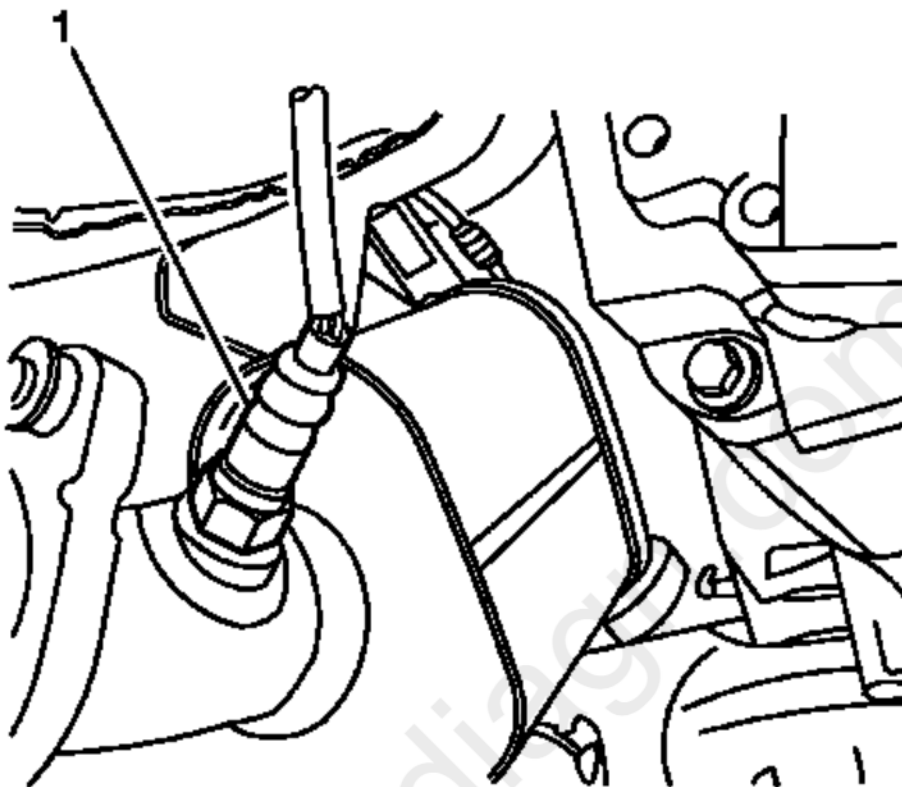


Fig. 11: Identifying HO2S (Bank 1 Sensor 2)
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fuel and Evaporative Emission Hose/Pipe Connection Cleaning Caution .

1. Raise the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Disconnect the heated oxygen sensor (HO2S) electrical connector. Note the harness routing and retainers for reassembly.
3. Remove the HO2S (1).

Installation Procedure

NOTE: Use special anti-seize compound on the HO2S threads. The compound consists of graphite suspended in fluid and glass beads. The graphite burns away, but the glass beads remain, making the sensor easier to

remove. New or service sensors already have the compound applied to the threads. If you remove an oxygen sensor and if for any reason you must reinstall the same oxygen sensor, apply the anti-seize compound to the threads before reinstallation.

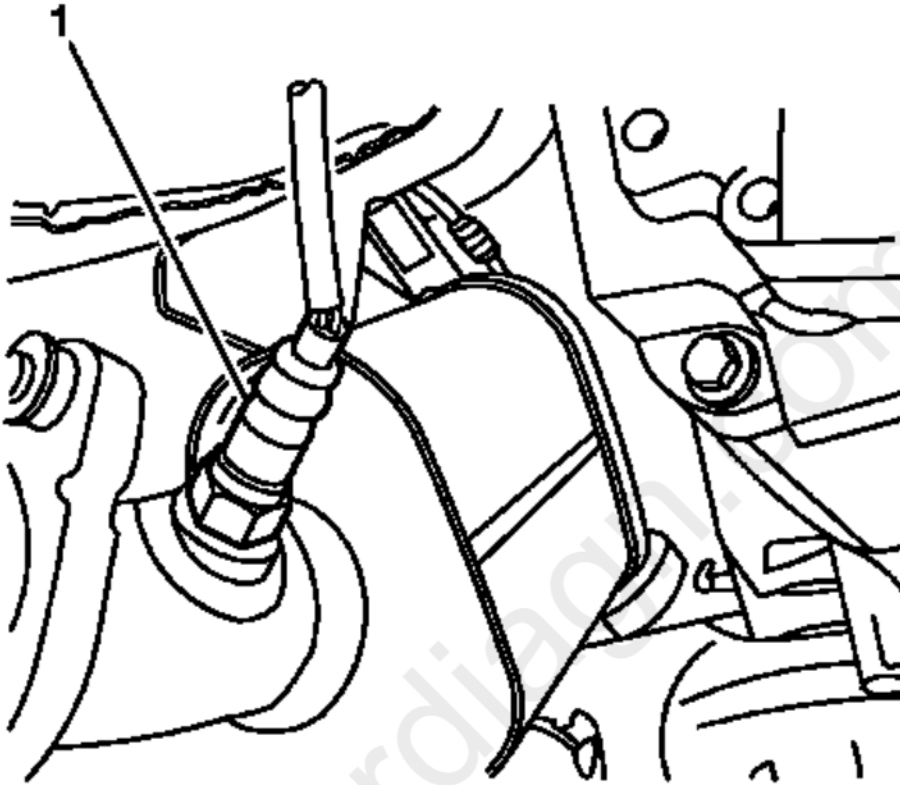


Fig. 12: Identifying HO2S (Bank 1 Sensor 2)
Courtesy of GENERAL MOTORS CORP.

1. Coat the threads of the HO2S with the anti-seize compound P/N 5613695, or the equivalent if necessary.

CAUTION: Refer to FASTENER CAUTION .

2. Install the HO2S (1) and tighten to 41 N.m (30 lb ft).
3. Connect the HO2S electrical connector. Ensure that the harness is routed and retained as noted during disassembly.
4. Lower the vehicle.

HEATED OXYGEN SENSOR REPLACEMENT - BANK 2 SENSOR 1

Removal Procedure

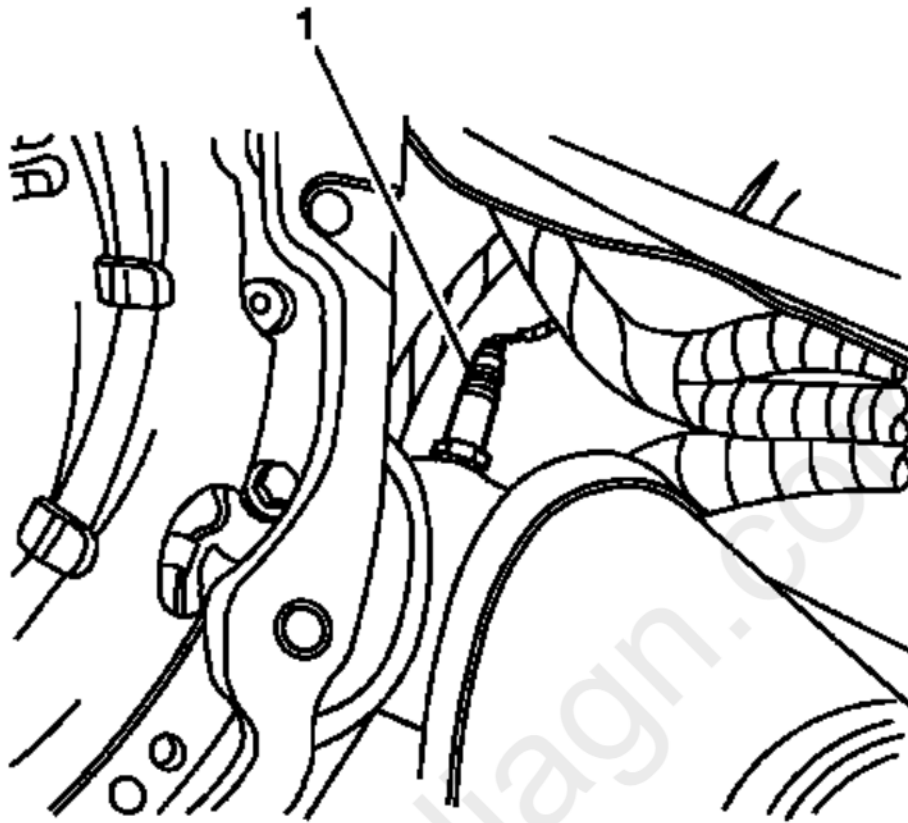


Fig. 13: View Of HO2S - Bank 2 Sensor 1
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fuel and Evaporative Emission Hose/Pipe Connection Cleaning Caution .

1. Raise the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Disconnect the heated oxygen sensor (HO2S) electrical connectors. Note the harness routing and retainers for reassembly.
3. Remove the right side catalytic converter. Refer to Catalytic Converter Replacement - Right Side (LF1) or Catalytic Converter Replacement - Right Side (LLT) or Catalytic Converter Replacement - Right Side (LSA) .
4. Remove the HO2S (1).

Installation Procedure

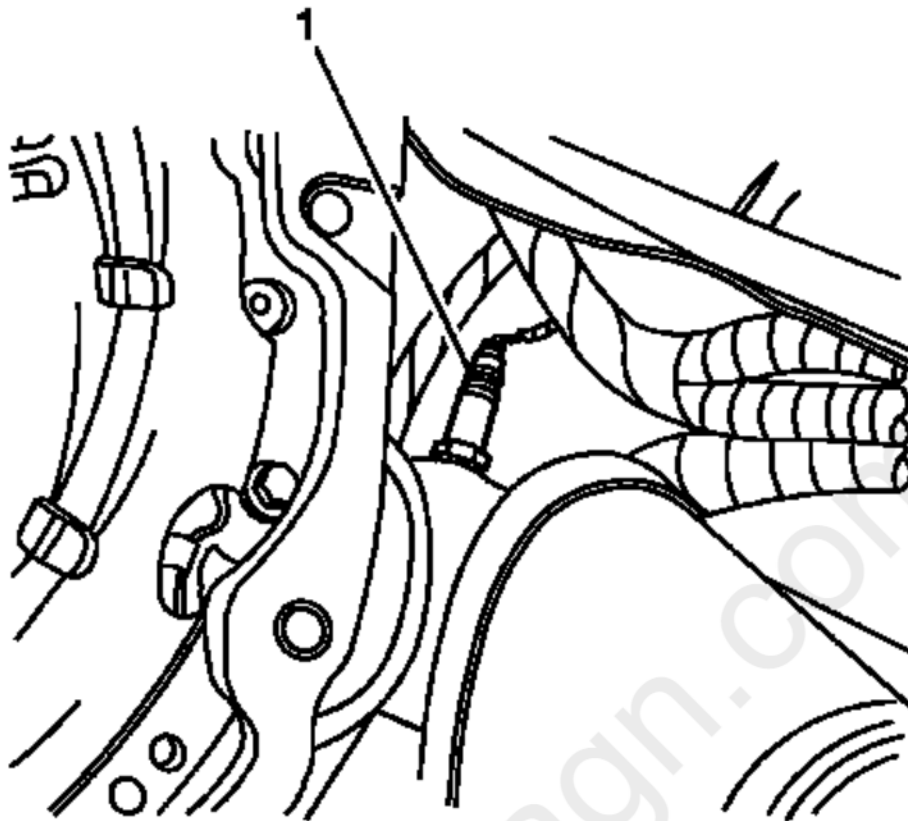


Fig. 14: View Of HO2S - Bank 2 Sensor 1
Courtesy of GENERAL MOTORS CORP.

NOTE: Use special anti-seize compound on the HO2S threads. The compound consists of graphite suspended in fluid and glass beads. The graphite burns away, but the glass beads remain, making the sensor easier to remove. New or service sensors already have the compound applied to the threads. If you remove an oxygen sensor and if for any reason you must reinstall the same oxygen sensor, apply the anti-seize compound to the threads before reinstallation.

1. Coat the threads of the HO2S with the anti-seize compound P/N 5613695, or the equivalent if necessary.

CAUTION: Refer to **FASTENER CAUTION** .

2. Install the HO2S (1) and tighten to 41 N.m (30 lb ft).
3. Install the right side catalytic converter. Refer to **Catalytic Converter Replacement - Right Side (LF1)** or **Catalytic Converter Replacement - Right Side (LLT)** or **Catalytic Converter Replacement - Right Side (LSA)** .

4. Connect the HO2S electrical connector. Ensure that the harness is routed and retained as noted during disassembly.
5. Lower the vehicle.

HEATED OXYGEN SENSOR REPLACEMENT - BANK 2 SENSOR 2

Removal Procedure

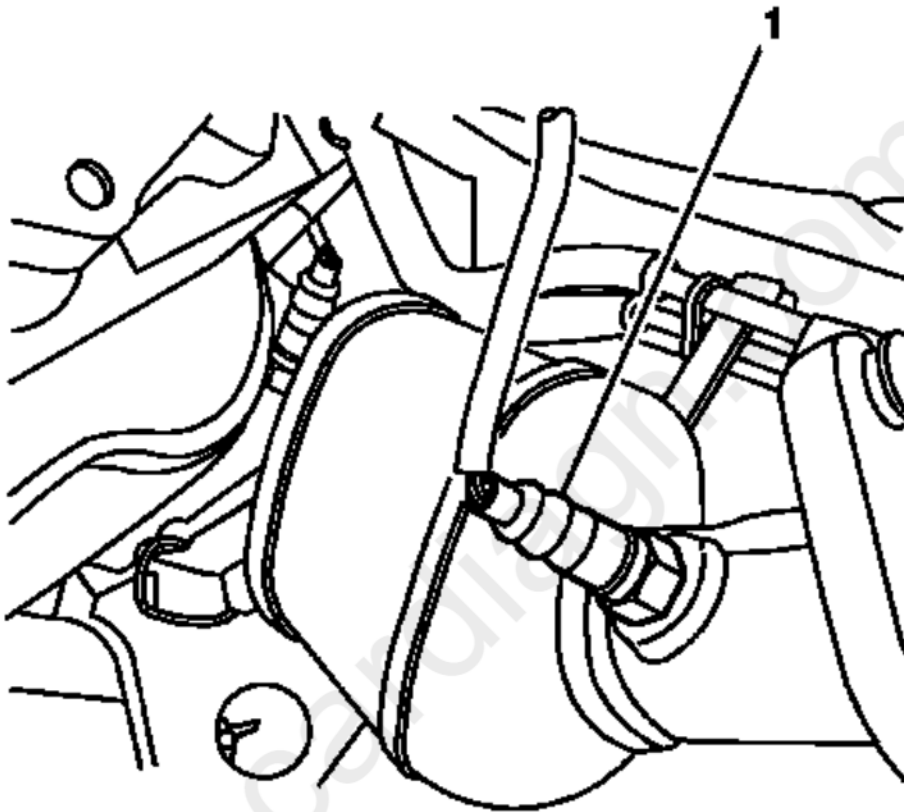


Fig. 15: View Of HO2S - Bank 2 Sensor 2
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fuel and Evaporative Emission Hose/Pipe Connection Cleaning Caution .

1. Raise the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Disconnect the heated oxygen sensor (HO2S) electrical connector. Note the harness routing and retainers for reassembly.
3. Remove the HO2S (1).

Installation Procedure

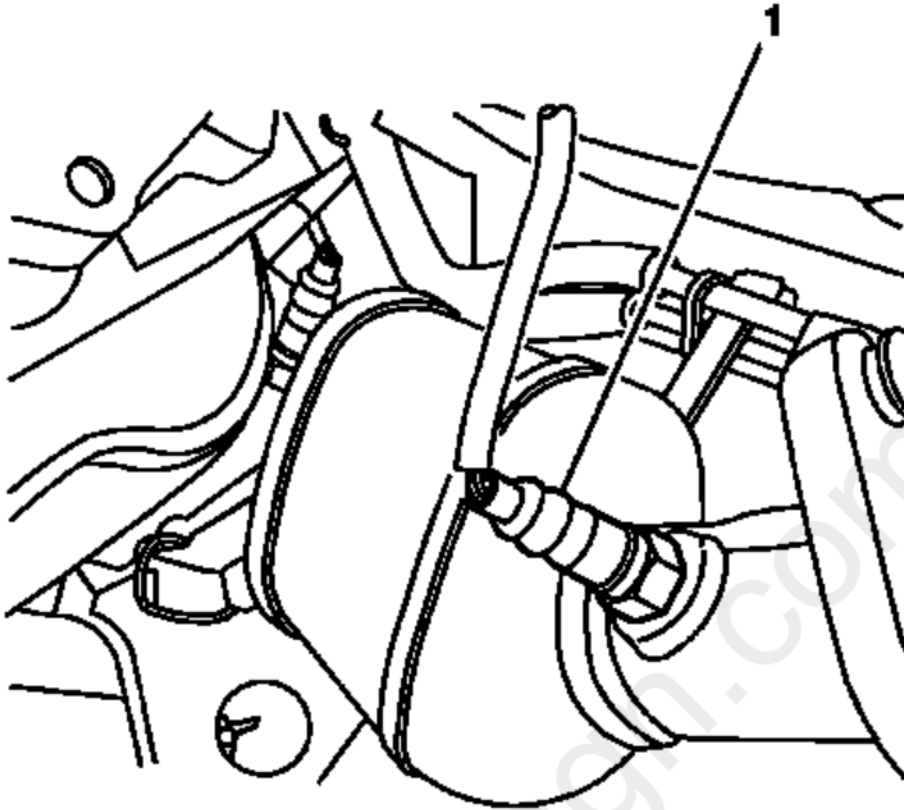


Fig. 16: View Of HO2S - Bank 2 Sensor 2
Courtesy of GENERAL MOTORS CORP.

NOTE: Use special anti-seize compound on the HO2S threads. The compound consists of graphite suspended in fluid and glass beads. The graphite burns away, but the glass beads remain, making the sensor easier to remove. New or service sensors already have the compound applied to the threads. If you remove an oxygen sensor and if for any reason you must reinstall the same oxygen sensor, apply the anti-seize compound to the threads before reinstallation.

1. Coat the threads of the HO2S with the anti-seize compound P/N 5613695, or the equivalent if necessary.

CAUTION: Refer to **FASTENER CAUTION** .

2. Install the HO2S (1) and tighten to 41 N.m (30 lb ft).
3. Connect the HO2S electrical connector. Ensure that the harness is routed and retained as noted during disassembly.
4. Lower the vehicle.

ACCELERATOR PEDAL POSITION SENSOR REPLACEMENT**Removal Procedure**

1. Remove the closeout/insulator panel from under the dashboard on the drivers side. Refer to **Instrument Panel Insulator Replacement - Left Side (Left Hand Drive)** or **Instrument Panel Insulator Replacement - Left Side (Right Hand Drive)** or **Instrument Panel Insulator Replacement - Right Side (Left Hand Drive)** or **Instrument Panel Insulator Replacement - Right Side (Right Hand Drive)** .

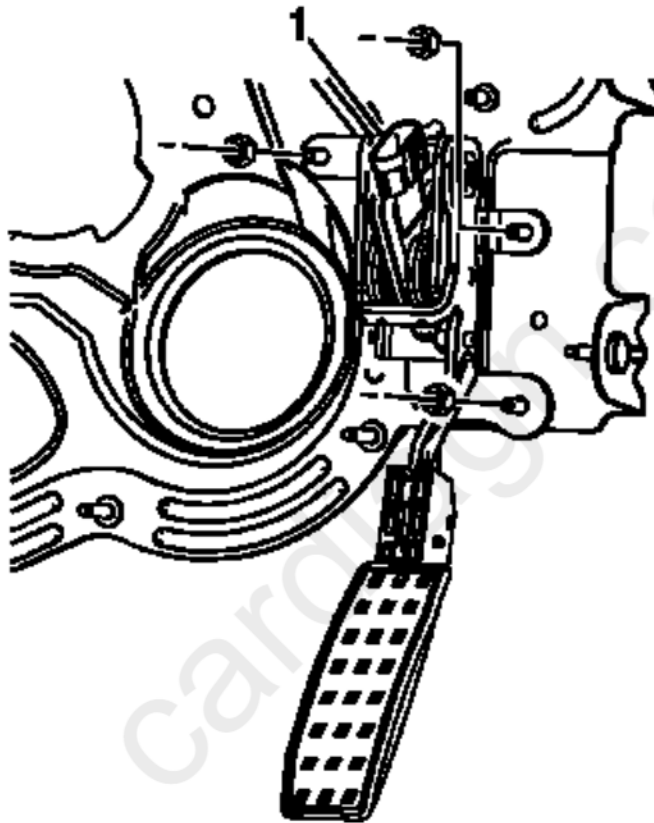


Fig. 17: APP Sensor

Courtesy of GENERAL MOTORS CORP.

CAUTION: Handle the electronic throttle control components carefully. Use cleanliness in order to prevent damage. Do not drop the electronic throttle control components. Do not roughly handle the electronic throttle control components. Do not immerse the electronic throttle control components in cleaning solvents of any type.

2. Disconnect the accelerator pedal position (APP) sensor electrical connector from the accelerator pedal module.

3. Remove the nuts from the APP sensor mounting plate and remove the APP sensor (1) from the front of dash.

Installation Procedure

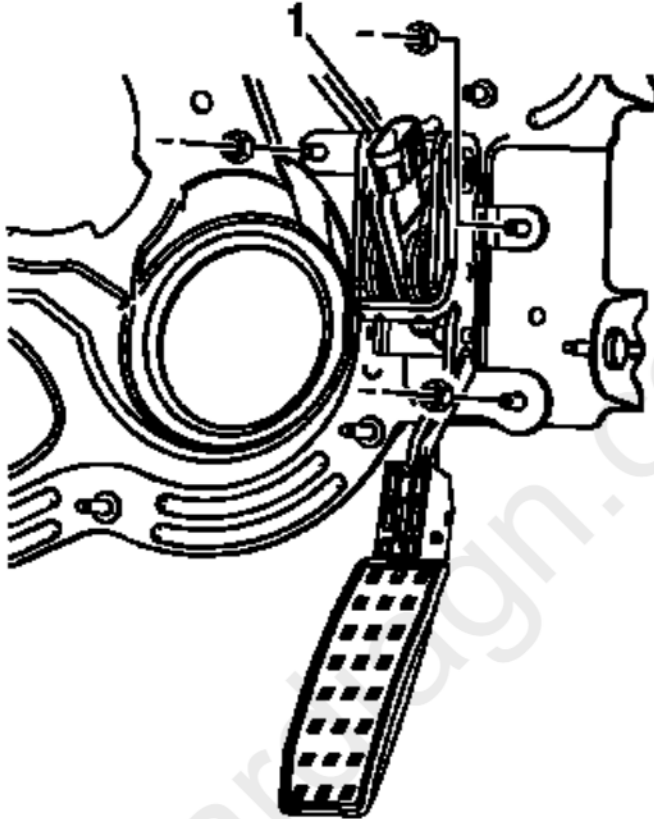


Fig. 18: APP Sensor
Courtesy of GENERAL MOTORS CORP.

1. Install the APP sensor (1) to the front of dash.

CAUTION: Refer to **FASTENER CAUTION** .

2. Install the APP sensor mounting nuts and tighten to 9 N.m (80 lb in).
3. Connect the APP sensor electrical connector.
4. Operate the accelerator pedal and observe the APP angles using a scan tool. The accelerator pedal should operate freely, without binding between closed throttle and wide open throttle.
5. Install the closeout/insulator panel. Refer to **Instrument Panel Insulator Replacement - Left Side (Left Hand Drive)** or **Instrument Panel Insulator Replacement - Left Side (Right Hand Drive)** or **Instrument Panel Insulator Replacement - Right Side (Left Hand Drive)** or **Instrument Panel**

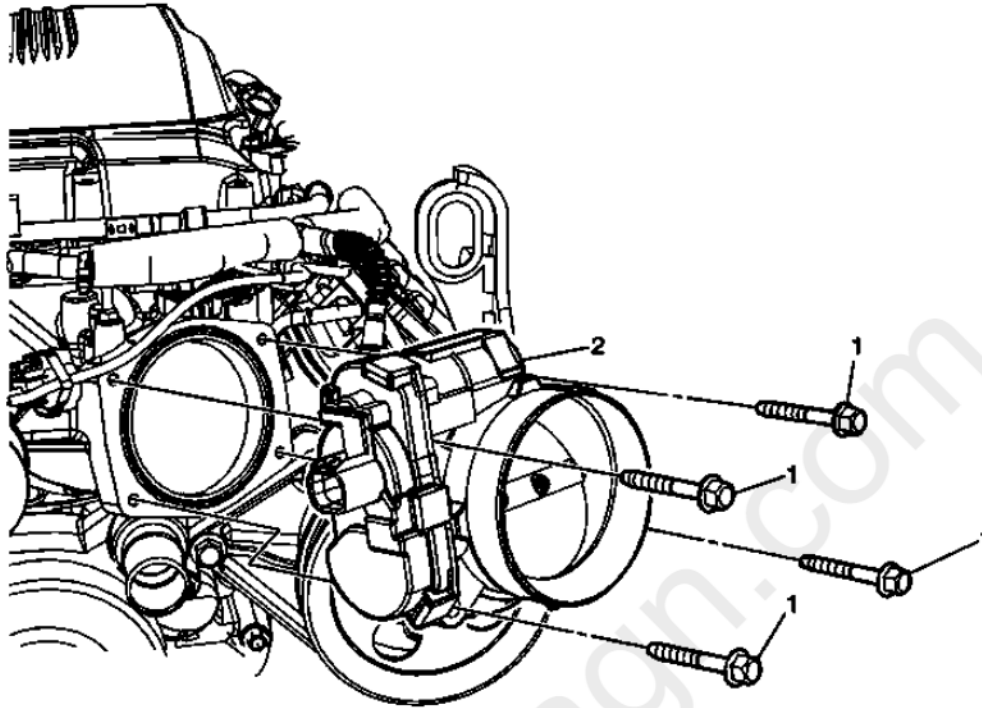
Insulator Replacement - Right Side (Right Hand Drive) .**THROTTLE BODY ASSEMBLY REPLACEMENT**

Fig. 19: Identifying Throttle Body Assembly
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
CAUTION: Handle the electronic throttle control components carefully. Use cleanliness in order to prevent damage. Do not drop the electronic throttle control components. Do not roughly handle the electronic throttle control components. Do not immerse the electronic throttle control components in cleaning solvents of any type.	
Preliminary Procedures 1. Remove the air cleaner outlet duct. Refer to <u>Air Cleaner Resonator Outlet Duct Replacement</u>. 2. An 8-digit part identification number is stamped on the throttle body casting. Refer to this number if servicing, or if a part replacement is required.	
1	Throttle Body Bolt (Qty: 4) CAUTION: Refer to.

Tip: In order to prevent possible contamination, cover or plug any opening when servicing the throttle body.

Tighten: 10 N.m (89 lb ft)

Throttle Body

2

Procedure

1. Disconnect the throttle body harness connector.
2. Perform the throttle learn procedure. Refer to **Throttle/Idle Learn**.

THROTTLE BODY CLEANING

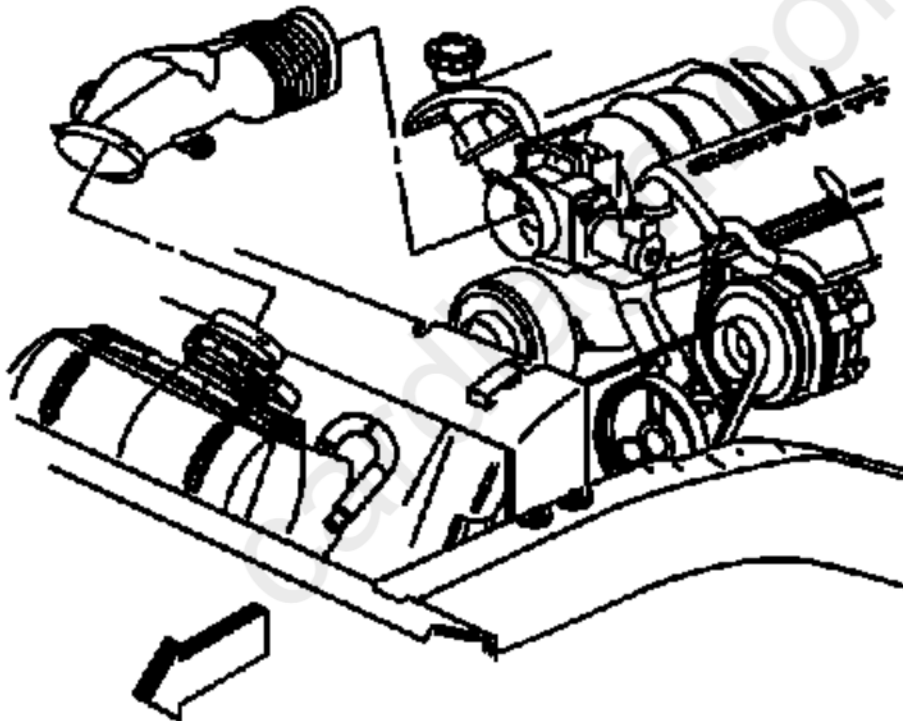


Fig. 20: Air Intake Duct & Clamp
Courtesy of GENERAL MOTORS CORP.

WARNING: Turn OFF the ignition before inserting fingers into the throttle bore. Unexpected movement of the throttle blade could cause personal injury.

1. Remove the air intake duct.

CAUTION: Do not insert any tools into the throttle body bore in order to avoid damage to the throttle valve plate.

2. Inspect the throttle body bore and the throttle valve plate for deposits. If necessary, open the throttle valve to inspect all surfaces.

CAUTION: Do not use any solvent that contains Methyl Ethyl Ketone (MEK). This solvent may damage fuel system components.

3. Clean the throttle body bore and the throttle valve plate using a clean shop towel with an appropriate cleaning substance, such one of the following:
 - GM Top Engine Cleaner
 - P/N 1052626
 - ACDelco Carburetor Tune-Up Conditioner
 - P/N X66-P
4. Install the air intake duct.
5. Perform the throttle learn procedure. Refer to Throttle/Idle Learn.

FUEL PRESSURE GAUGE INSTALLATION AND REMOVAL

Special Tools

CH-48027 Digital Pressure Gauge

Installation Procedure

WARNING: Refer to GASOLINE/GASOLINE VAPORS WARNING .

WARNING: Remove the fuel tank cap and relieve the fuel system pressure before servicing the fuel system in order to reduce the risk of personal injury. After you relieve the fuel system pressure, a small amount of fuel may be released when servicing the fuel lines, the fuel injection pump, or the connections. In order to reduce the risk of personal injury, cover the fuel system components with a shop towel before disconnection. This will catch any fuel that may leak out. Place the towel in an approved container when the disconnection is complete.

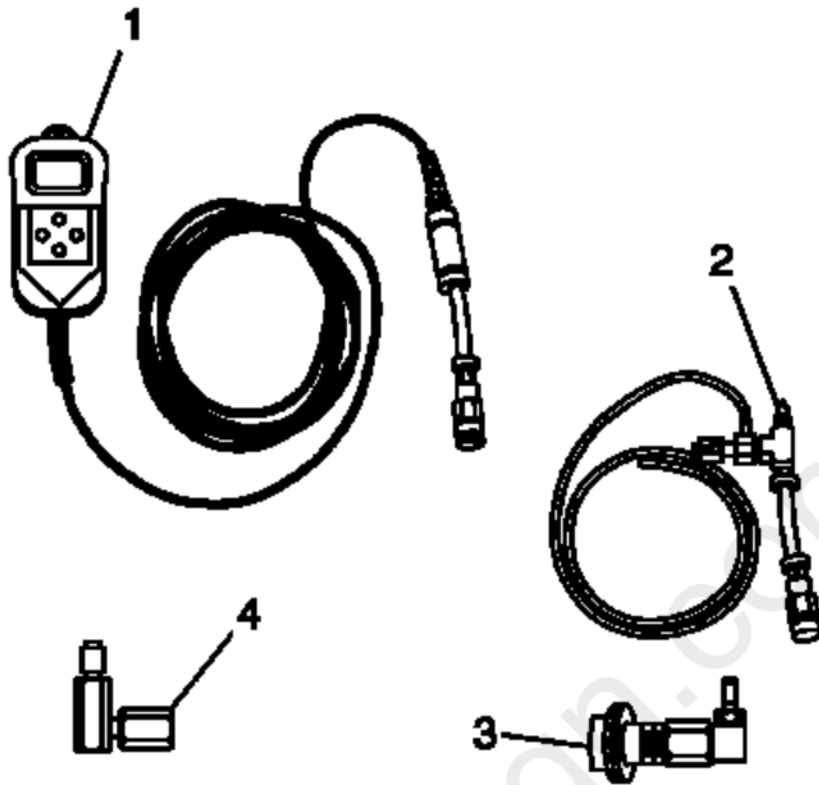


Fig. 21: View Of Digital Pressure Gauge, Special Tools & Components
Courtesy of GENERAL MOTORS CORP.

1. Relieve the fuel system pressure. Refer to Fuel Pressure Relief (Without CH 48027) or Fuel Pressure Relief (CH 48027).
2. Connect the CH-48027-1 (1) to the CH-48027-2 (2).
3. Remove the shop towel from around the fuel rail service port, and place in an approved gasoline container.
4. Perform any tests and/or diagnostics as needed. For the proper usage of the **CH-48027** , refer to the manufacture's directions.

Removal Procedure

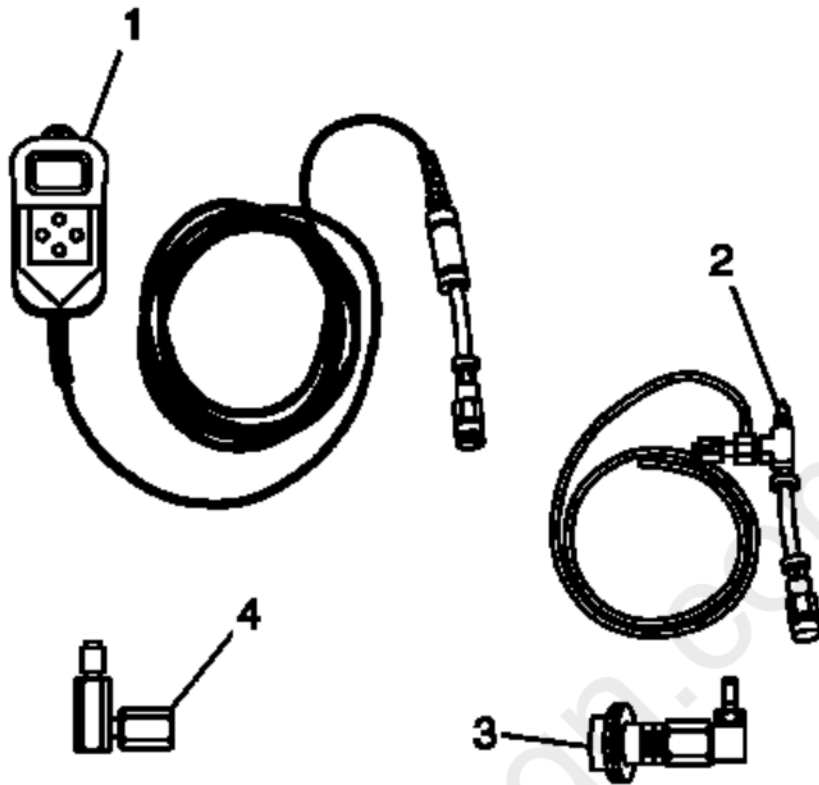


Fig. 22: View Of Digital Pressure Gauge, Special Tools & Components
Courtesy of GENERAL MOTORS CORP.

1. Relieve the fuel system pressure, if required. Perform the following steps:

WARNING: Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.

1. Wrap a shop towel around the fuel rail service port.
2. Place the hose on the CH-48027-2 (2) into an approved gasoline container.
3. Open the valve on the CH-48027-2 (2) in order to bleed any fuel from the fuel rail.
4. Close the valve on the CH-48027-2 (2).
5. Remove the hose on the CH-48027-2 (2) from the approved gasoline container.
6. Remove the shop towel from around the fuel rail service port, and place in an approved gasoline container.

CAUTION: Clean all of the following areas before performing any disconnections in order to avoid possible contamination in the system:

- The fuel pipe connections
- The hose connections
- The areas surrounding the connections

2. Disconnect the CH-48027-1 (1) from the CH-48027-2 (2).
3. Disconnect the CH-48027-2 (2) from the CH-48027-3 (4).
4. Disconnect the CH-48027-3 (4) from the fuel rail service port.
5. Install the fuel rail service port cap.
6. Install the engine cover, if required.
7. Tighten the fuel fill cap.

FUEL PRESSURE RELIEF (WITHOUT CH 48027)

WARNING: Refer to **GASOLINE/GASOLINE VAPORS WARNING** .

WARNING: Refer to **RELIEVING FUEL PRESSURE WARNING** .

1. If the fuel system requires repair, prevent fuel spillage by removing the fuel pump fuse. Refer to **Electrical Center Identification Views** .
2. Loosen the fuel fill cap in order to relieve the fuel tank vapor pressure.
3. Remove the engine cover, if required.
4. Remove the fuel rail service port cap.
5. Wrap a shop towel around the fuel rail service port and using a small flat-bladed tool, depress (open) the fuel rail test port valve.
6. Remove the shop towel from around the fuel rail service port, and place in an approved gasoline container.
7. Install the fuel rail service port cap.
8. Install the engine cover, if required.
9. Tighten the fuel fill cap.

FUEL PRESSURE RELIEF (CH 48027)

Special Tools

CH-48027 Digital Pressure Gauge

WARNING: Refer to GASOLINE/GASOLINE VAPORS WARNING .

WARNING: Refer to RELIEVING FUEL PRESSURE WARNING .

1. If the fuel system requires repair, prevent fuel spillage by removing the fuel pump fuse. Refer to Electrical Center Identification Views .

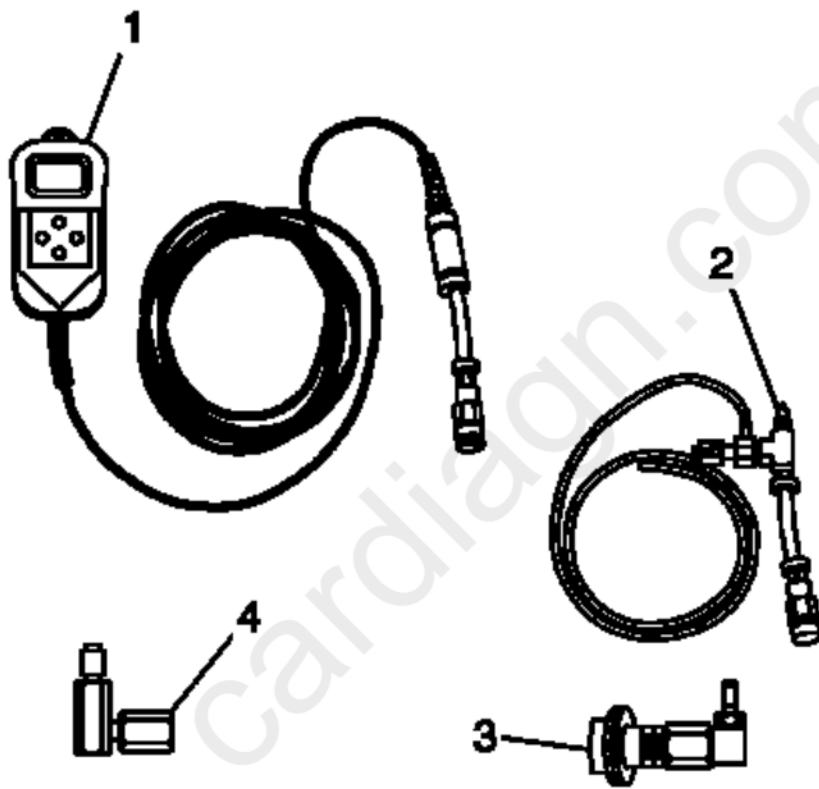


Fig. 23: View Of Digital Pressure Gauge, Special Tools & Components
Courtesy of GENERAL MOTORS CORP.

2. Remove the engine cover, if required.
3. Loosen the fuel fill cap in order to relieve the fuel tank vapor pressure.
4. Remove the fuel rail service port cap.

WARNING: Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure

2011 Cadillac CTS

2011 ENGINE Engine Controls and Fuel - 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L - CTS

gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.

5. Wrap a shop towel around the fuel rail service port.
6. Connect the CH-48027-3 (4) to the fuel rail service port.
7. Connect the CH-48027-2 (2) to the CH-48027-3 (4).
8. Place the hose on the CH-48027-2 (2) into an approved gasoline container.
9. Open the valve on the CH-48027-2 (2) in order to bleed any fuel from the fuel rail.
10. Close the valve on the CH-48027-2 (2).
11. Remove the hose on the CH-48027-2 (2) from the approved gasoline container.

CAUTION: Clean all of the following areas before performing any disconnections in order to avoid possible contamination in the system:

- The fuel pipe connections
- The hose connections
- The areas surrounding the connections

NOTE: If relieving the fuel pressure for the fuel pressure gauge installation and removal, it is NOT necessary to proceed with the following steps.

12. Disconnect the CH-48027-2 (2) from the CH-48027-3 (4).
13. Disconnect the CH-48027-3 (4) from the fuel rail service port.
14. Remove the shop towel from around the fuel rail service port, and place in an approved gasoline container.
15. Install the fuel rail service port cap.
16. Install the engine cover, if required.
17. Tighten the fuel fill cap.

METAL COLLAR QUICK CONNECT FITTING SERVICE

Special Tools

- **J 37088-A** Fuel Line Disconnect Tool Set
- **J 44581** Fuel Line Disconnect Tool

Removal Procedure

WARNING: Refer to **GASOLINE/GASOLINE VAPORS WARNING** .

1. Relieve the fuel system pressure. Refer to **Fuel Pressure Relief**.

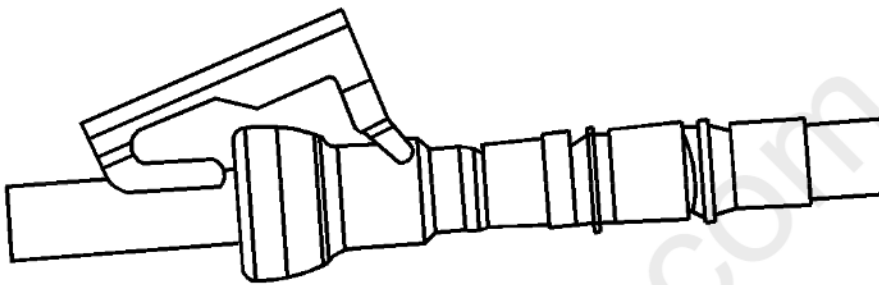


Fig. 24: View Of Quick-Connect Fitting Retainer
Courtesy of GENERAL MOTORS CORP.

2. Remove the retainer from the quick-connect fitting.

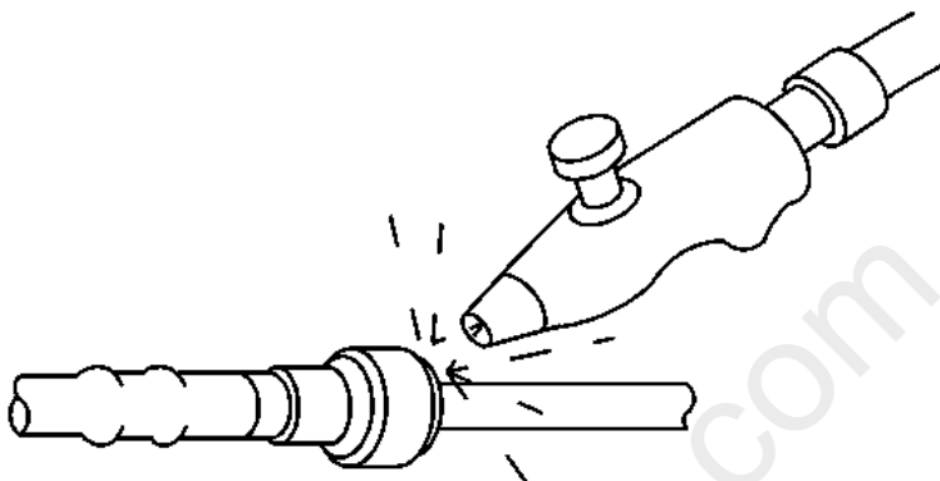


Fig. 25: Blowing Dirt Out Of Fitting (Metal Collar)
Courtesy of GENERAL MOTORS CORP.

WARNING: Wear safety glasses when using compressed air, as flying dirt particles may cause eye injury.

3. Blow dirt out of the fitting using compressed air.

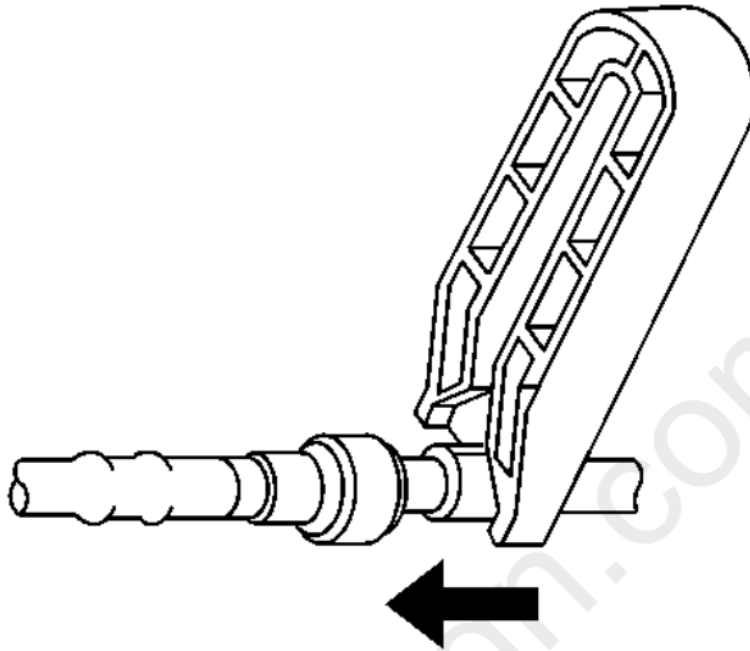


Fig. 26: View Of Quick Connect Locking Tabs (Metal Collar)
Courtesy of GENERAL MOTORS CORP.

4. Depending on the fuel line size and ability to access the fitting, choose the appropriate tool: **J 37088-A** or **J 44581** . Insert the **J 37088-A** or **J 44581** into the female connector, then push inward to release the locking tabs.

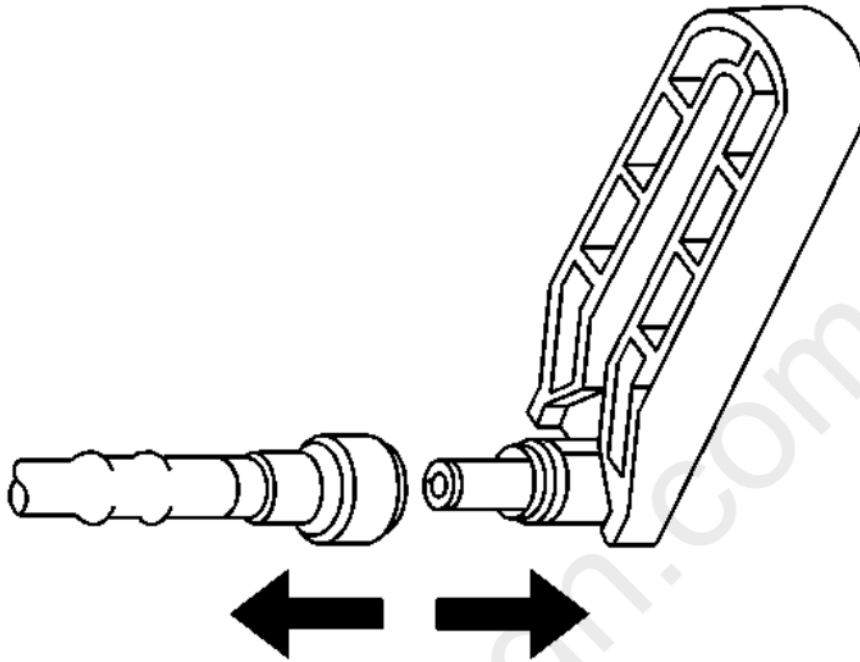


Fig. 27: View Of Quick Connect Locking Tabs (Metal Collar)
Courtesy of GENERAL MOTORS CORP.

5. Pull the connection apart.

CAUTION: If necessary, remove rust or burrs from the fuel pipes with an emery cloth. Use a radial motion with the fuel pipe end in order to prevent damage to the O-ring sealing surface. Use a clean shop towel in order to wipe off the male tube ends. Inspect all the connections for dirt and burrs. Clean or replace the components and assemblies as required.

6. Using a clean shop towel, wipe off the male pipe end.
7. Inspect both ends of the fitting for dirt and burrs.
8. Clean or replace the components as required.

Installation Procedure

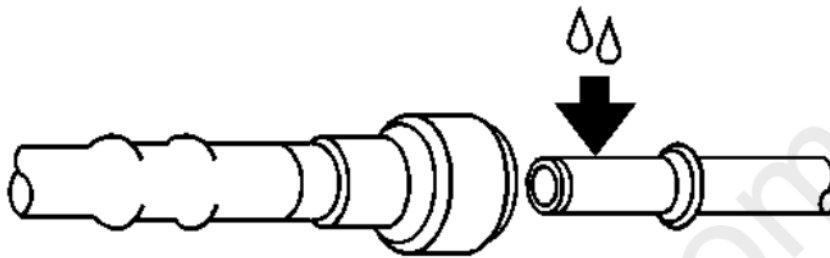


Fig. 28: Oiling Male Pipe Ends (Metal Collar)
Courtesy of GENERAL MOTORS CORP.

WARNING: In order to reduce the risk of fire and personal injury, before connecting fuel pipe fittings, always apply a few drops of clean engine oil to the male pipe ends. This will ensure proper reconnection and prevent a possible fuel leak. During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.

1. Apply a few drops of clean engine oil to the male pipe end.

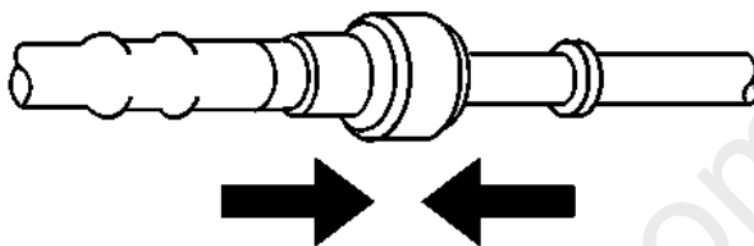


Fig. 29: View Of Connectors (Metal Collar)
Courtesy of GENERAL MOTORS CORP.

2. Push both sides of the quick-connect fitting together to cause the retaining tabs to snap into place.

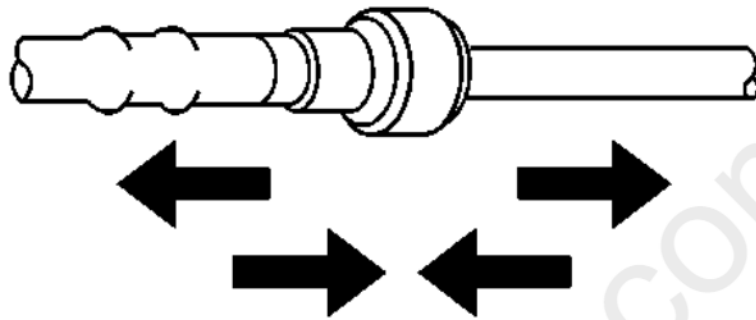


Fig. 30: Quick-Connect Fitting

Courtesy of GENERAL MOTORS CORP.

3. Pull on both sides of the quick-connect fitting to make sure the connection is secure.

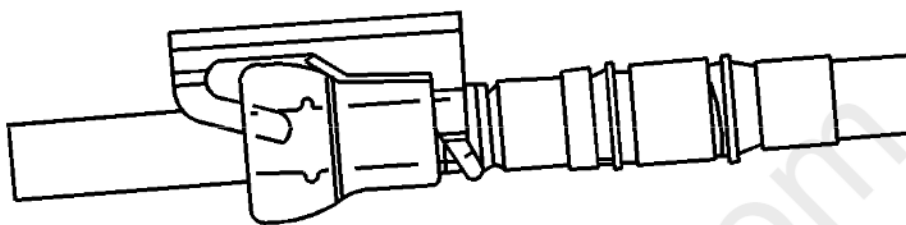


Fig. 31: View Of Fuel Pipe Retainer
Courtesy of GENERAL MOTORS CORP.

4. Install the retainer to the quick-connect fitting.
5. Inspect for leaks using the following procedure:
 1. Turn the ignition ON, with the engine OFF for 2 seconds.
 2. Turn the ignition OFF, for 10 seconds.
 3. Turn the ignition ON, with the engine OFF for 2 seconds.
 4. Turn the ignition OFF.
 5. Inspect for leaks.

PLASTIC COLLAR QUICK CONNECT FITTING SERVICE

Disconnect Procedure

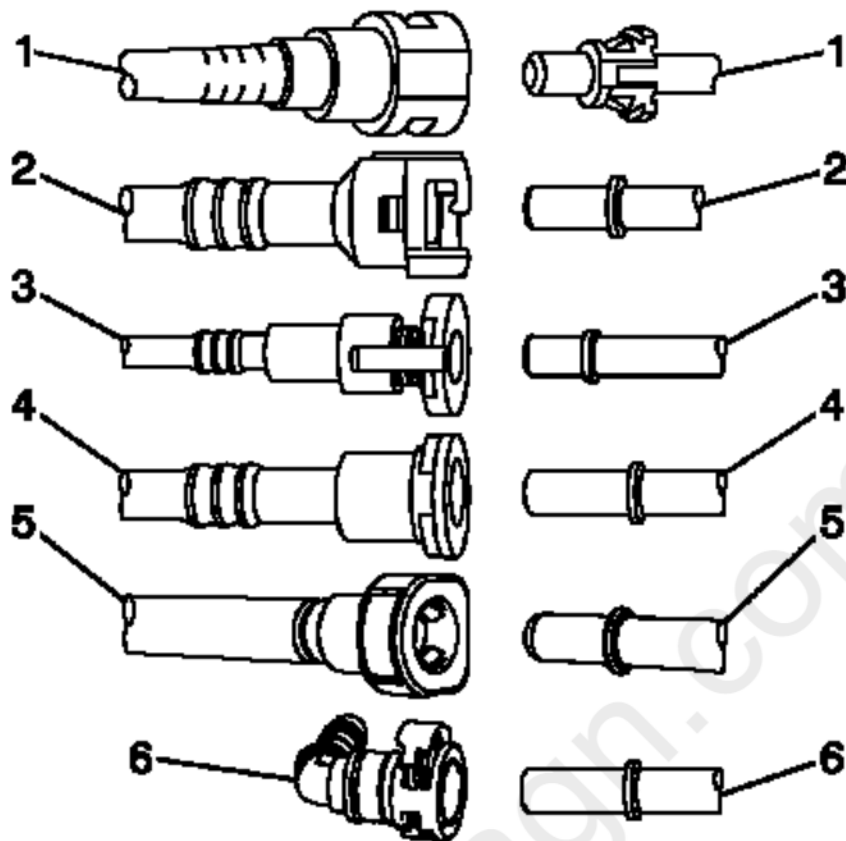


Fig. 32: Identifying Plastic Collar Fuel & Evaporative Emission Quick Connect Fittings
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to GASOLINE/GASOLINE VAPORS WARNING .

NOTE: There are several types of Plastic Collar Fuel and Evaporative Emission Quick Connect Fittings used on this vehicle.

- Bartholomew (1)
- Q Release (2)
- Squeeze to Release (3)
- Sliding Retainer (4)
- Push Down TI (5)

The following instructions apply to all of these types of Plastic Collar Quick Connect Fittings except where indicated.

1. Relieve the fuel system pressure. Refer to Fuel Pressure Relief .

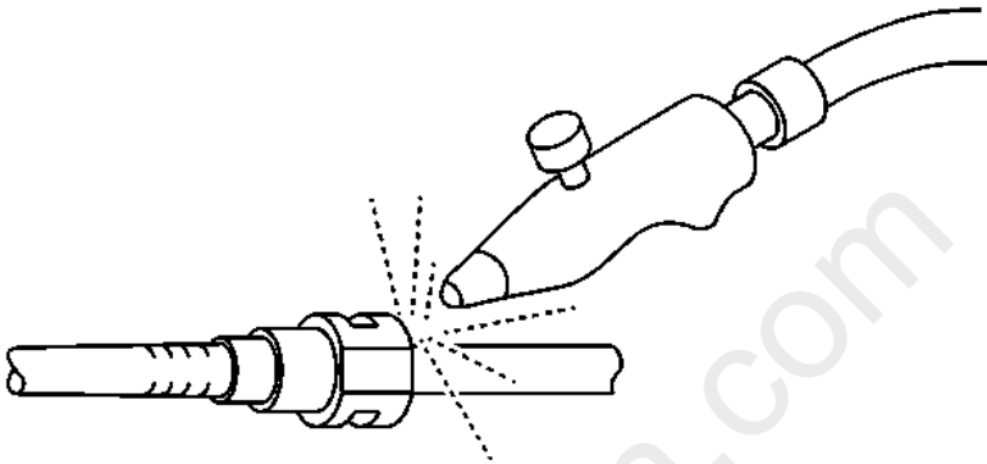


Fig. 33: Blowing Dirt Out Of Fitting (Plastic Collar)
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to SAFETY GLASSES WARNING .

CAUTION: Refer to Fuel and Evaporative Emission Hose/Pipe Connection Cleaning Caution .

2. Using compressed air, blow any dirt or debris from around the connection.

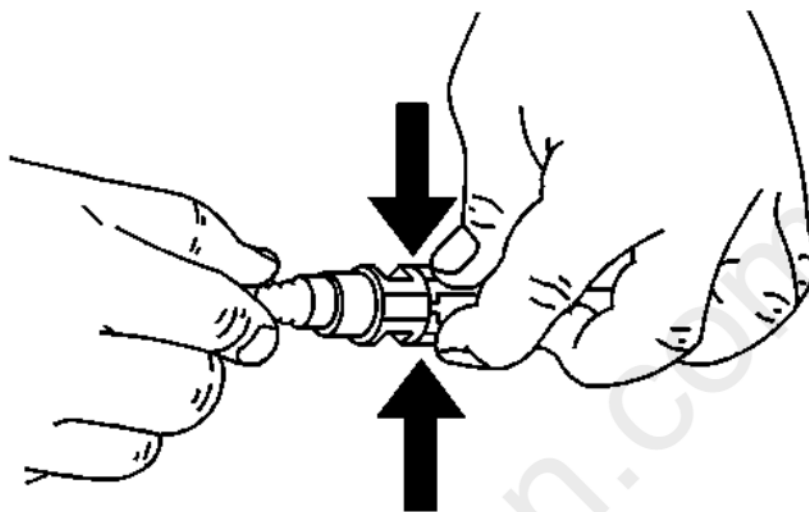


Fig. 34: View Of Quick Connect Fitting Release Tabs (Plastic Collar)
Courtesy of GENERAL MOTORS CORP.

3. This step applies to Bartholomew style connector ONLY. Squeeze the plastic quick connect fitting release tabs.

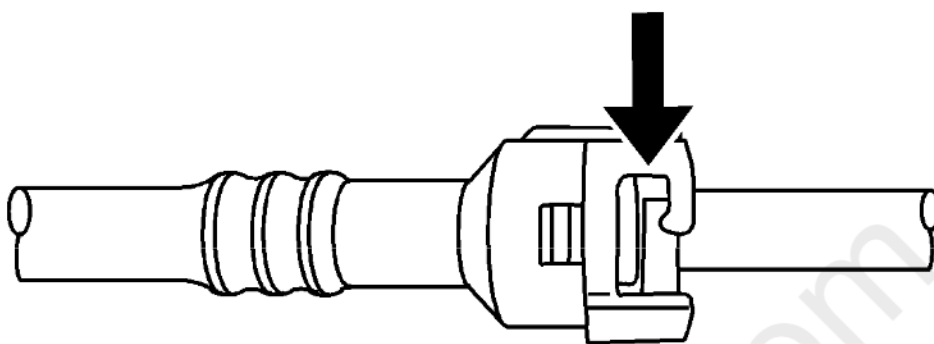


Fig. 35: Releasing Q Release Style Connectors (Plastic Collar)
Courtesy of GENERAL MOTORS CORP.

4. This step applies to Release Tab style connector ONLY. Release the fitting by pushing the tab toward the other side of the slot in the fitting.

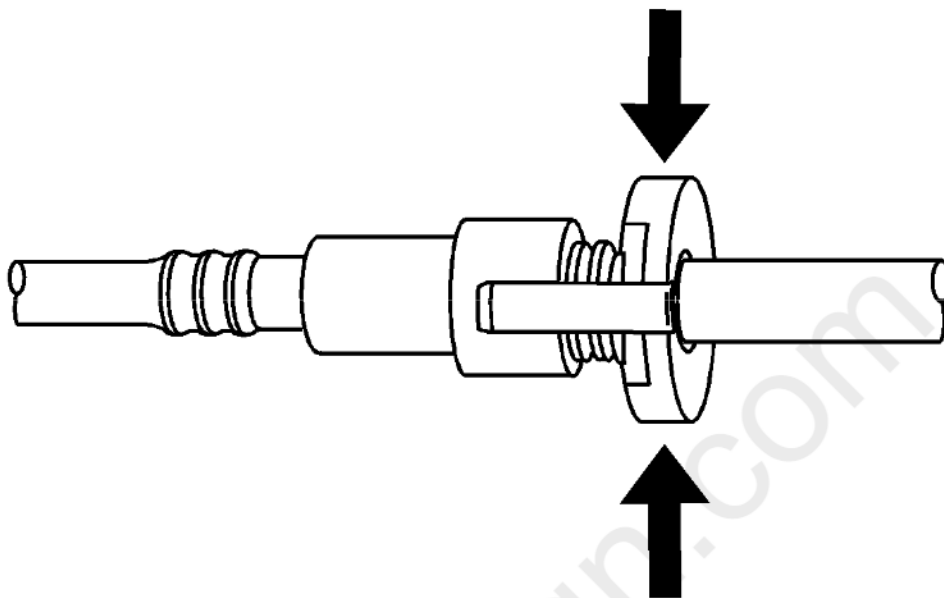


Fig. 36: Quick Connect Fitting (Plastic Collar)
Courtesy of GENERAL MOTORS CORP.

5. This step applies to the Squeeze to Release style connector ONLY. Squeeze where indicated by the arrows shown above on both sides of the plastic ring surrounding the quick connect fitting.

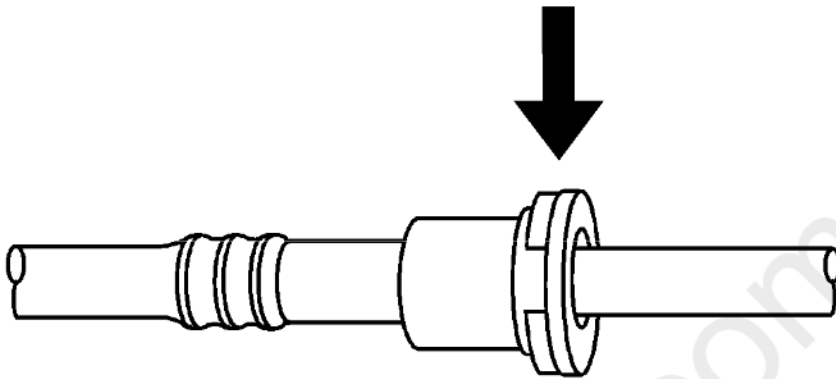


Fig. 37: View Of Sliding Retainer Style Connector
Courtesy of GENERAL MOTORS CORP.

6. This step applies to the Sliding Retainer style connector ONLY. Release the fitting by pressing on one side of the release tab causing it to push in slightly. If the tab does not move try pressing the tab in from the opposite side. The tab will only move in one direction.

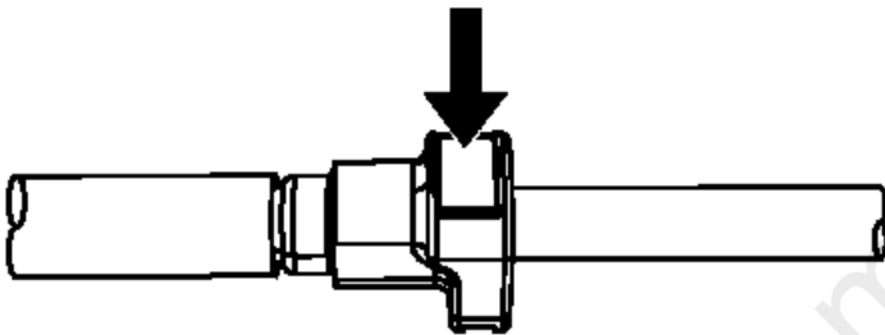


Fig. 38: View Of Push Down TI Style Connector
Courtesy of GENERAL MOTORS CORP.

7. This step applies to the Push Down TI style connector ONLY. Release the fitting by pressing on the tab indicated by the arrow.

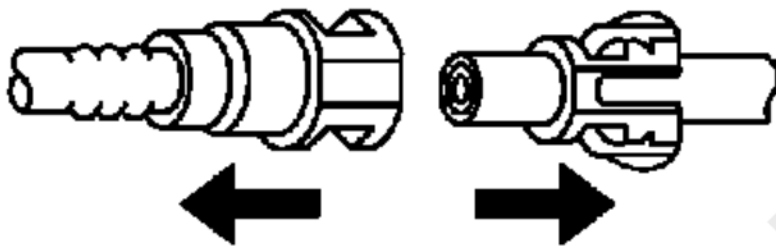


Fig. 39: View Of Pulling Connection Apart (Plastic Collar)
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to RELIEVING FUEL PRESSURE WARNING .

8. Pull the connection apart.

Connect Procedure

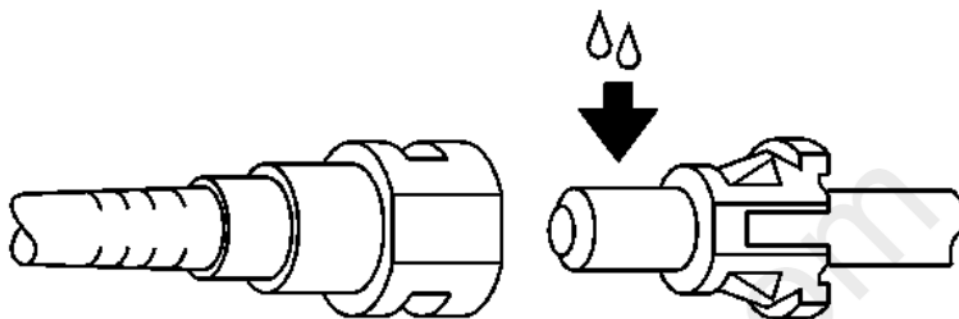


Fig. 40: Lubricating Male Pipe End
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to Fuel Pipe Fitting Warning .

1. Apply a few drops of clean engine oil to the male connection end.

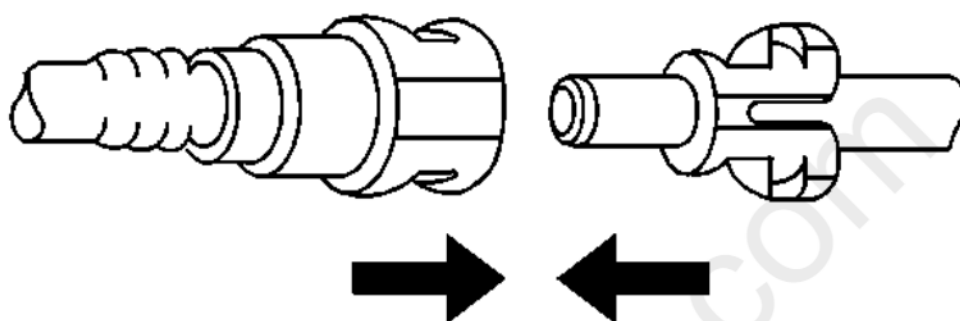


Fig. 41: Quick-Connect Fittings

Courtesy of GENERAL MOTORS CORP.

2. Push both sides of the quick-connect fitting together in order to cause the retaining feature to snap into place.

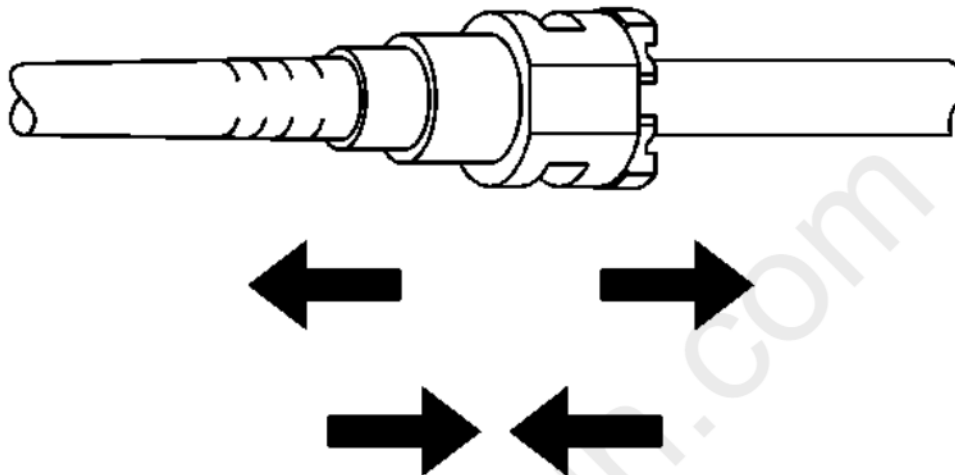


Fig. 42: View Of Quick-Connect Fitting
Courtesy of GENERAL MOTORS CORP.

3. Once installed, pull on both sides of the connection in order to make sure the connection is secure.

FUEL PUMP FLOW CONTROL MODULE REPLACEMENT (COUPE)

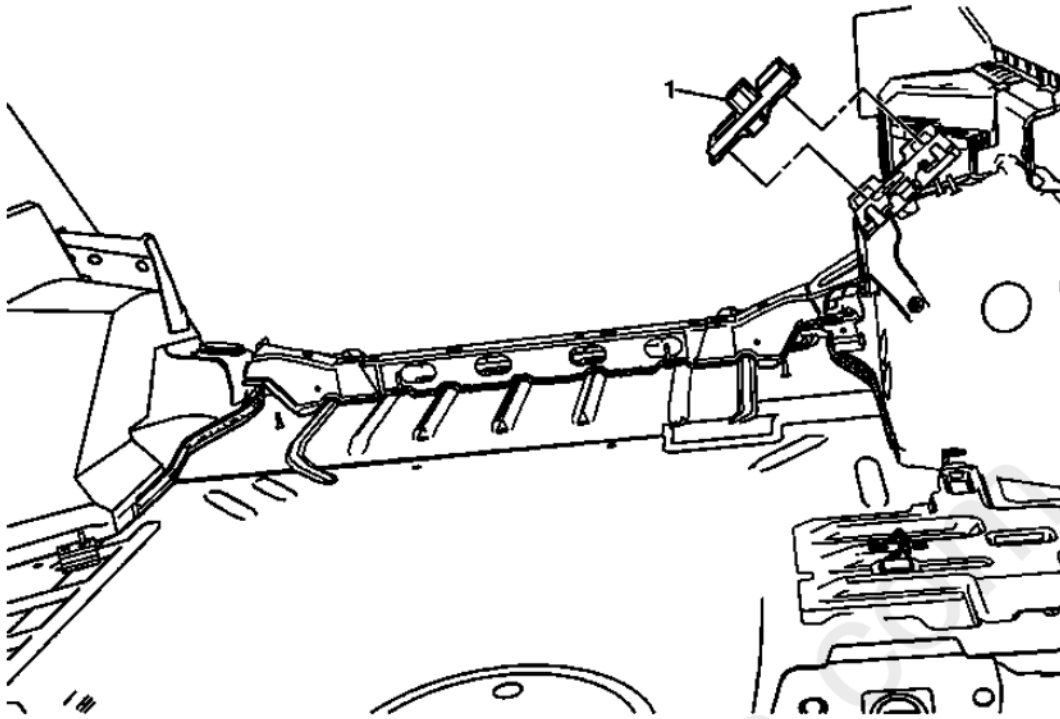


Fig. 43: Identifying Fuel Pump Flow Control Module

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Partially remove the right side rear compartment trim panel. Refer to <u>Rear Compartment Side Trim Panel Replacement (Sedan)</u> or <u>Rear Compartment Side Trim Panel Replacement (Coupe)</u> .	
1	Fuel Pump Flow Control Module Procedure 1. Disconnect the electrical connector. 2. Release the two integral retainer tabs and remove the module. 3. If replacing the fuel pump flow control module, program the control module. Refer to <u>Control Module References</u> .

FUEL PUMP FLOW CONTROL MODULE REPLACEMENT (WAGON)

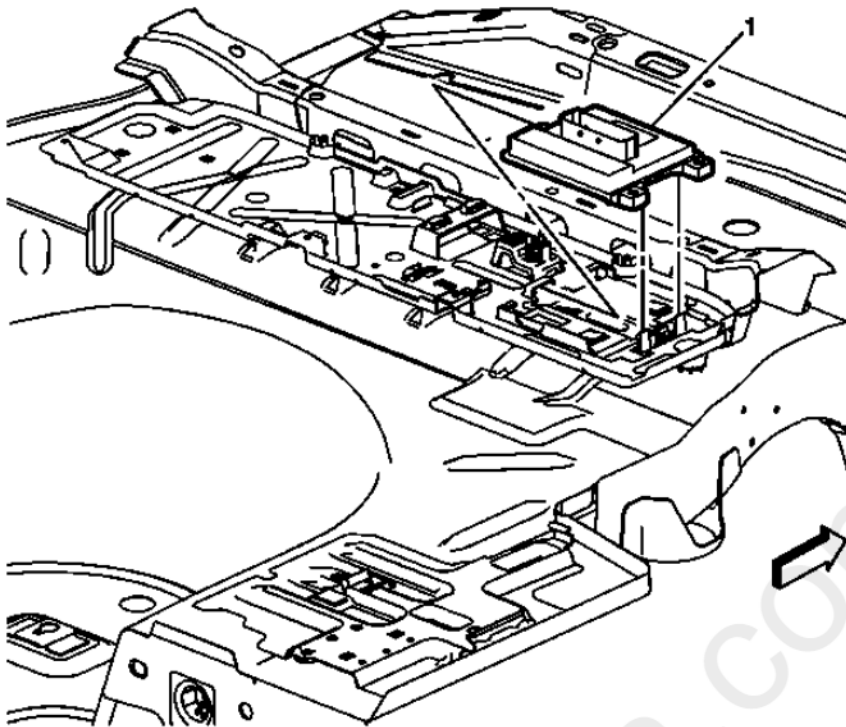


Fig. 44: Fuel Pump Flow Control Module
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the rear compartment stowage cover. Refer to <u>Rear Compartment Floor Stowage Compartment Cover Replacement (Wagon)</u> .	
1	Fuel Pump Flow Control Module Fastener CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 9 N.m(80 lb in)
2	Fuel Pump Flow Control Module Procedure 1. Disconnect the electrical connector. 2. If replacing, reprogram the control module.

FUEL TANK DRAINING

Special Tools

- J 36850 Transjel Lubricant

- **J 45004** Fuel Drain Hose

WARNING: Refer to **GASOLINE/GASOLINE VAPORS WARNING** .

WARNING: Never drain or store fuel in an open container. Always use an approved fuel storage container in order to reduce the chance of fire or explosion.

WARNING: Place a dry chemical (Class B) fire extinguisher nearby before performing any on-vehicle service procedures. Failure to follow these precautions may result in personal injury.

1. Remove the fuel filler cap.

NOTE: Lubricate the fuel drain hose with J 36850 or equivalent to aid in hose insertion and removal. Do not use an unapproved lubricant.

2. Insert the **J 45004** into the fuel tank until the hose reaches the bottom of the fuel tank.
3. Use an air operated pump device in order to drain the fuel into an approved gasoline container.

Up to 26 liters (7 gallons) of residual fuel may remain in the secondary side of the fuel tank.

4. Simultaneously twist and pull in order to remove the **J 45004** from the fuel tank.

FILLER TUBE REPLACEMENT

Removal Procedure

1. Remove the fuel filler cap.
2. Drain the fuel tank below the level of the fuel filler hose. Refer to **Fuel Tank Draining**.

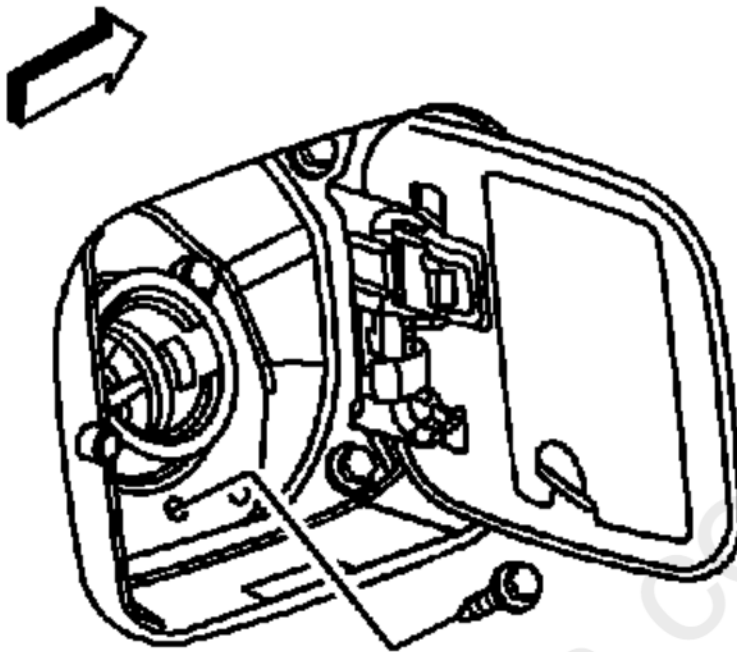


Fig. 45: Fuel Filler Tube Bolts

Courtesy of GENERAL MOTORS CORP.

3. Remove the bolts securing the fuel filler tube to the body.
4. Remove the right rear wheel. Refer to **Tire and Wheel Removal and Installation** .
5. Remove the right rear wheelhouse liner. Refer to **Rear Wheelhouse Panel Liner Replacement (Coupe)** or **Rear Wheelhouse Panel Liner Replacement (Sedan and Wagon)** .

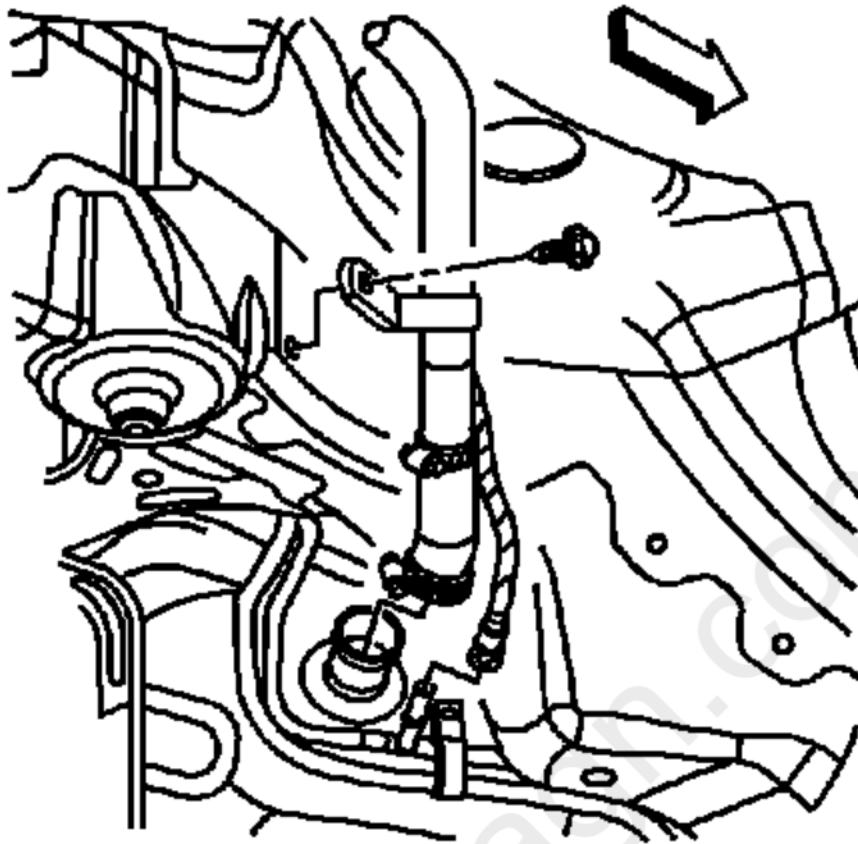


Fig. 46: View Of Fuel Filler Tube Brace Bolt
Courtesy of GENERAL MOTORS CORP.

6. Remove the fuel filler tube brace bolt.

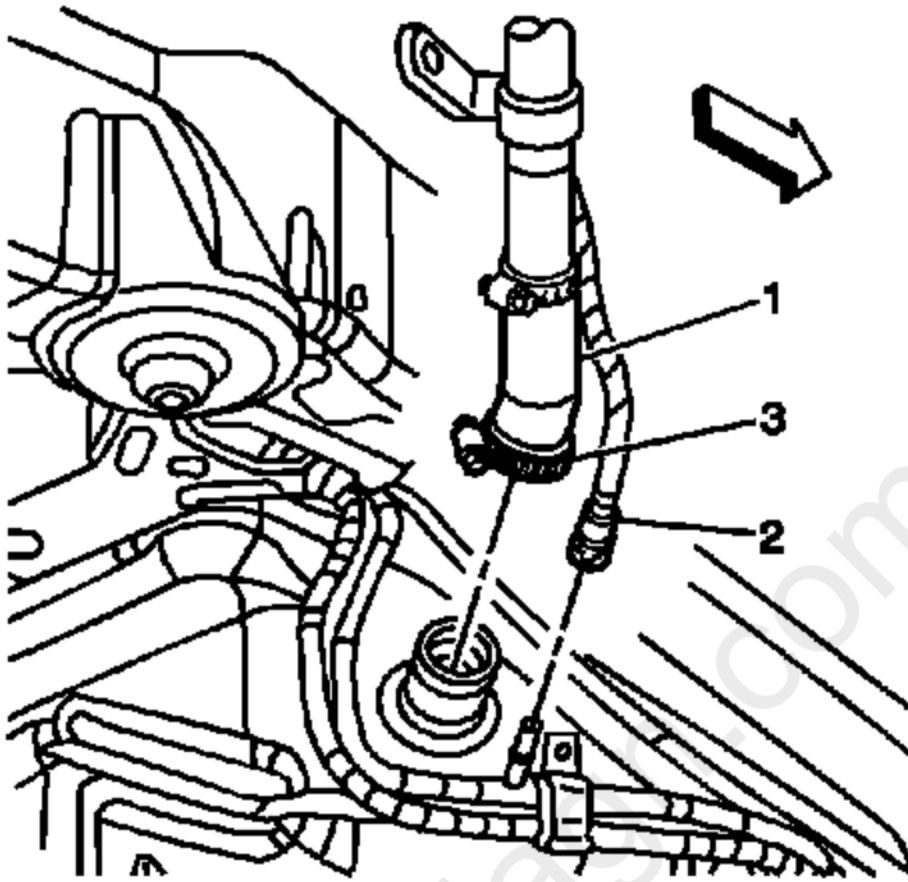


Fig. 47: Identifying Fuel Filler Hose To Fuel tank
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the fuel filler hose (1) from the fuel tank.
8. Disconnect the filler vent tube (2) from the evaporative emission (EVAP) hose. Refer to **Evaporative Emission System Hose/Pipe Replacement**.
9. Remove the fuel filler tube from the vehicle.

Installation Procedure

1. Position the fuel filler tube to the vehicle.

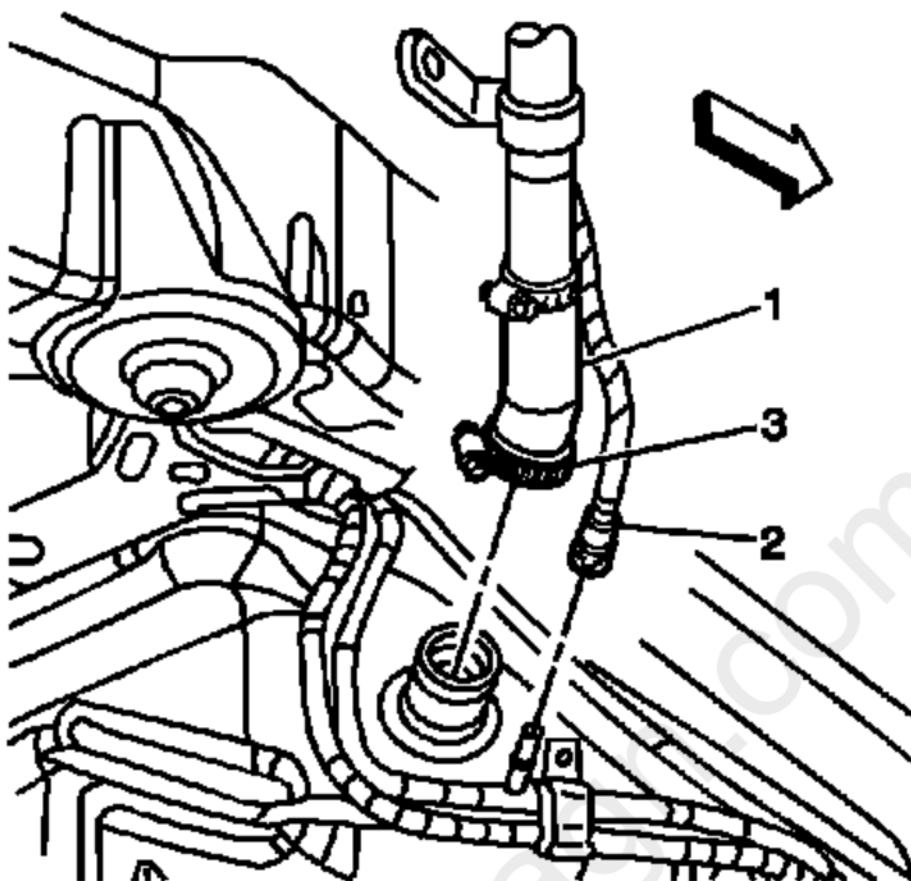


Fig. 48: Identifying Fuel Filler Hose To Fuel tank
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to COMPONENT FASTENER TIGHTENING CAUTION .

2. Connect the filler hose (1) to the fuel tank and tighten to 3.5 N.m (31 lb in).
3. Connect the filler vent tube (2) to the EVAP hose. Refer to Evaporative Emission System Hose/Pipe Replacement.

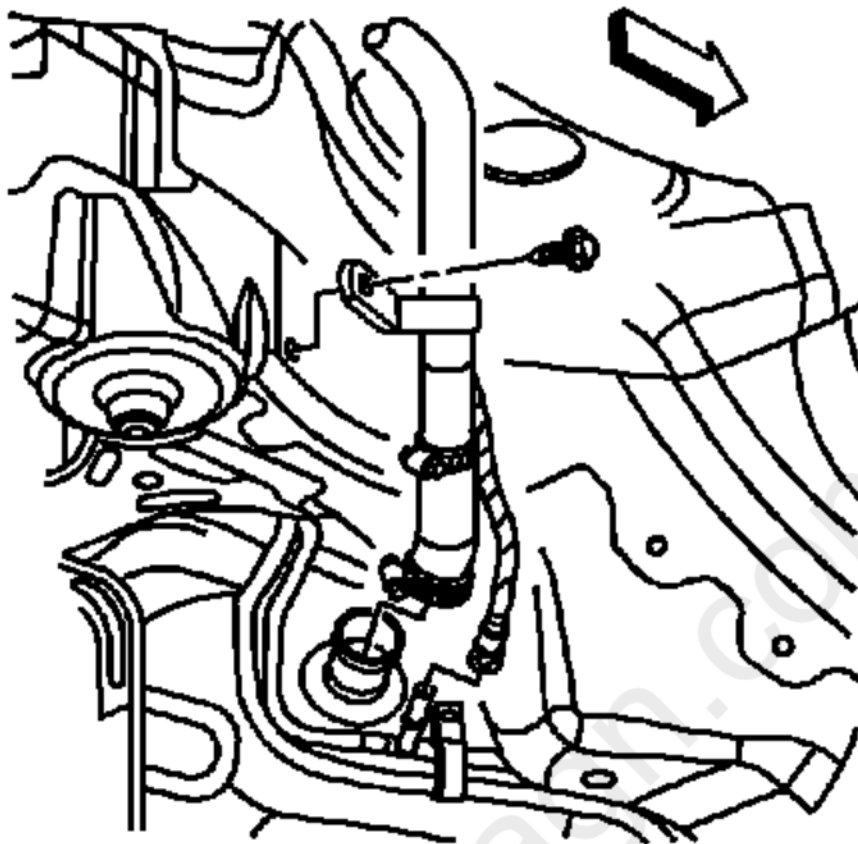


Fig. 49: View Of Fuel Filler Tube Brace Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

4. Install the fuel filler tube brace bolt and tighten to 9 N.m (80 lb in).

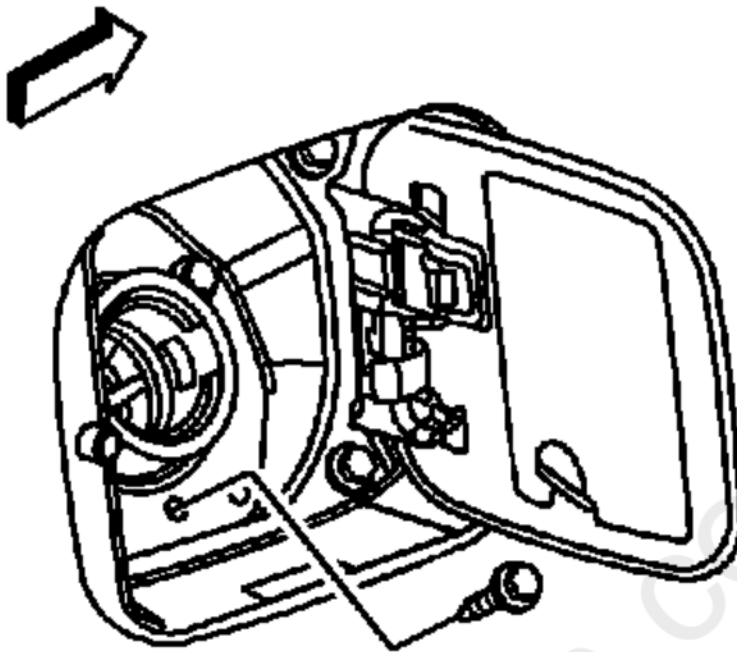


Fig. 50: Fuel Filler Tube Bolts

Courtesy of GENERAL MOTORS CORP.

5. Install the bolts securing the fuel filler tube to the body and tighten to 3.5 N.m (31 lb in).
6. Install the right rear wheelhouse liner. Refer to **Rear Wheelhouse Panel Liner Replacement (Coupe)** or **Rear Wheelhouse Panel Liner Replacement (Sedan and Wagon)** .
7. Install the right rear wheel. Refer to **Tire and Wheel Removal and Installation** .
8. Add fuel to the fuel tank.
9. Inspect for fuel leaks.
10. Install the fuel filler cap.

FUEL TANK FILLER PIPE REPLACEMENT

Removal Procedure

1. Remove the fuel filler cap.
2. Drain the fuel tank below the level of the fuel filler hose. Refer to **Fuel Tank Draining**.

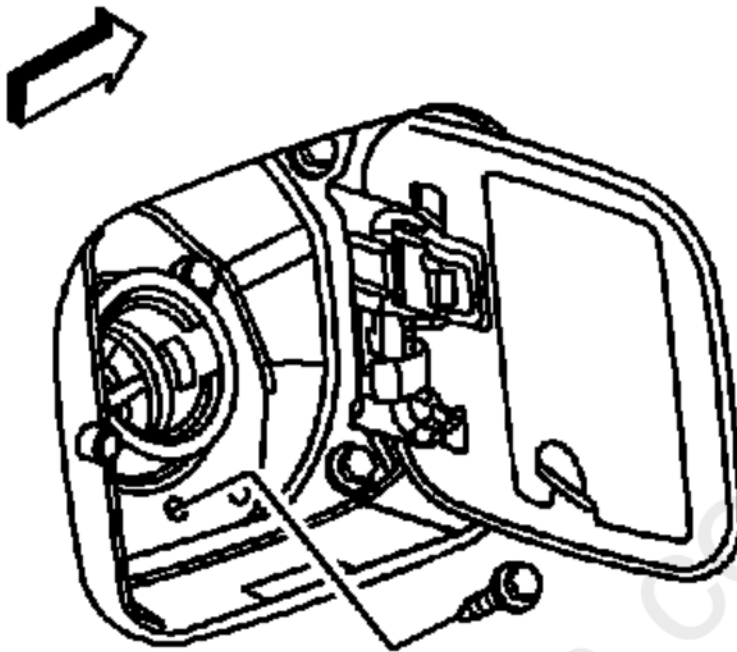


Fig. 51: Fuel Filler Tube Bolts

Courtesy of GENERAL MOTORS CORP.

3. Remove the bolts securing the fuel filler tube to the body.
4. Remove the right rear wheel. Refer to **Tire and Wheel Removal and Installation** .
5. Remove the right rear wheelhouse liner. Refer to **Rear Wheelhouse Panel Liner Replacement (Coupe)** or **Rear Wheelhouse Panel Liner Replacement (Sedan and Wagon)** .

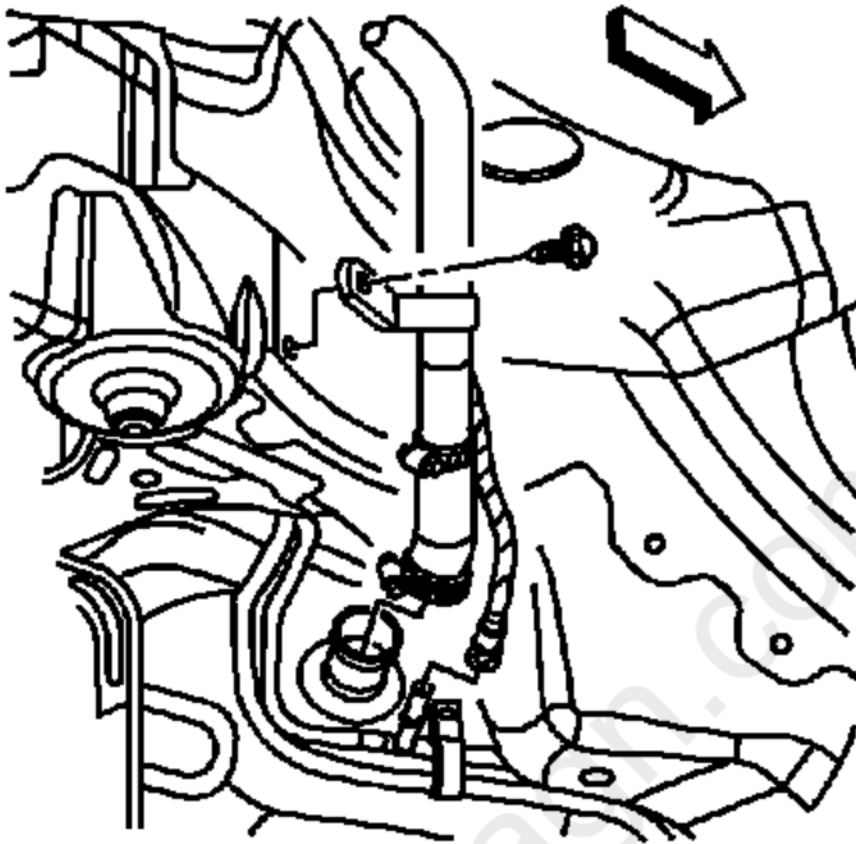


Fig. 52: View Of Fuel Filler Tube Brace Bolt
Courtesy of GENERAL MOTORS CORP.

6. Remove the fuel filler tube brace bolt.

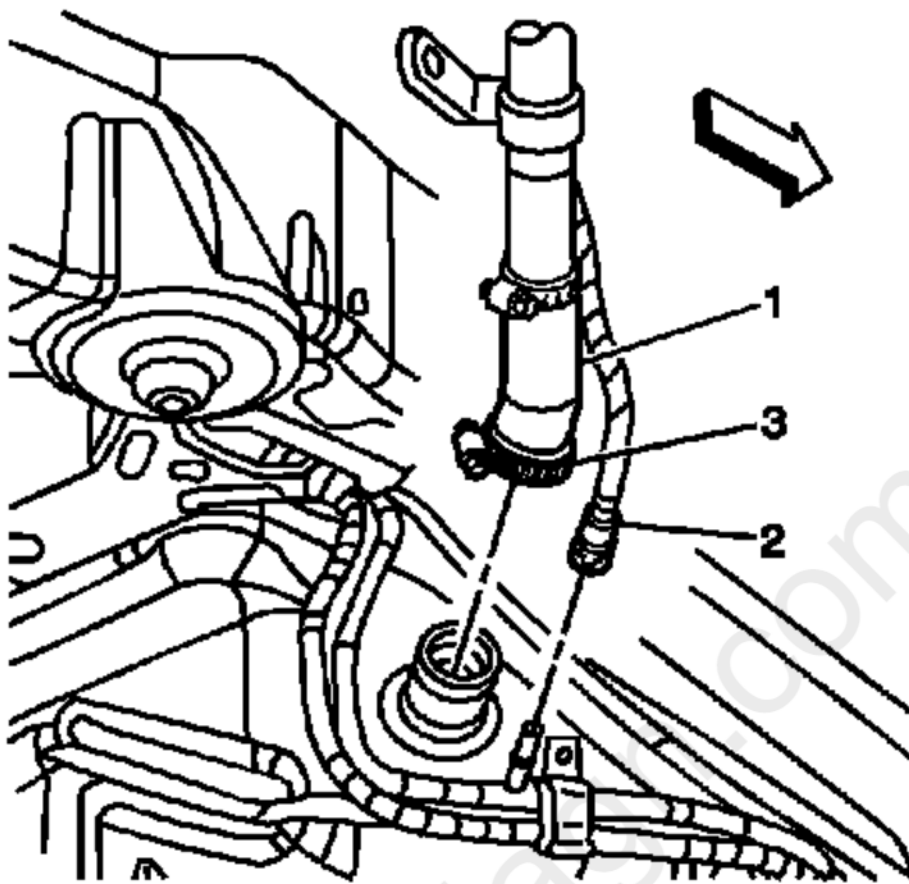


Fig. 53: Identifying Fuel Filler Hose To Fuel tank
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the fuel filler hose (1) from the fuel tank.
8. Disconnect the filler vent tube (2) from the evaporative emission (EVAP) hose. Refer to **Evaporative Emission System Hose/Pipe Replacement**.
9. Remove the fuel filler tube from the vehicle.

Installation Procedure

1. Position the fuel filler tube to the vehicle.

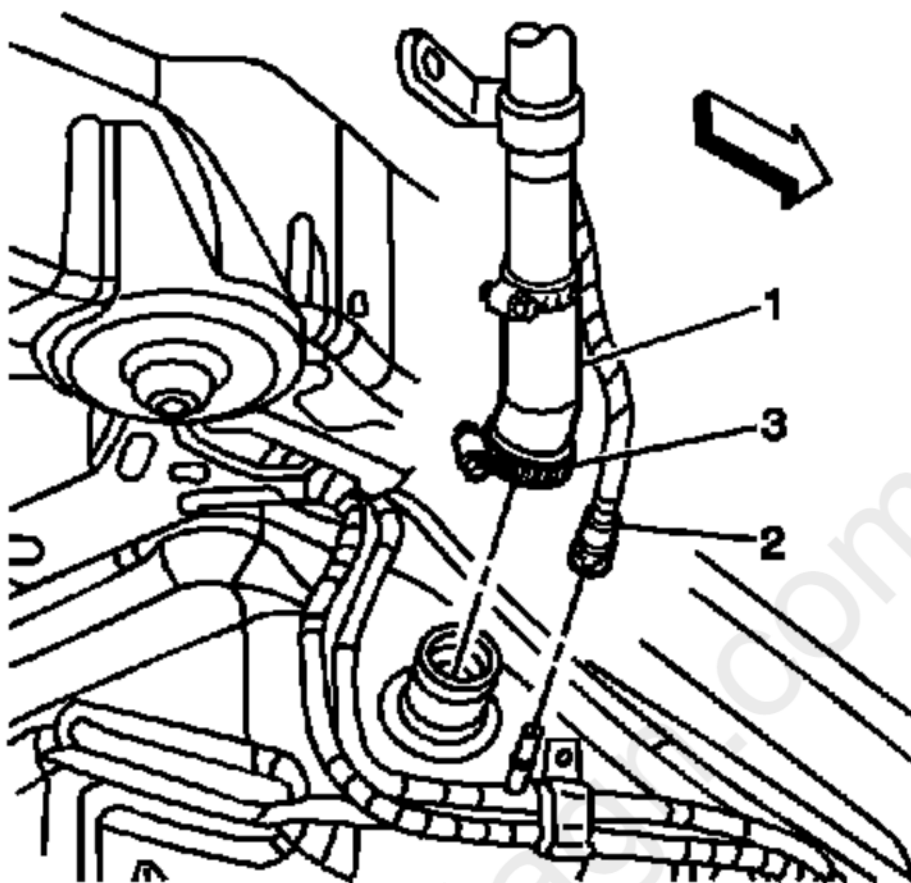


Fig. 54: Identifying Fuel Filler Hose To Fuel tank
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to **FASTENER CAUTION** .

2. Connect the filler hose (1) to the fuel tank and tighten to 3.5 N.m (31 lb in).
3. Connect the filler vent tube (2) to the EVAP hose. Refer to **Evaporative Emission System Hose/Pipe Replacement**.

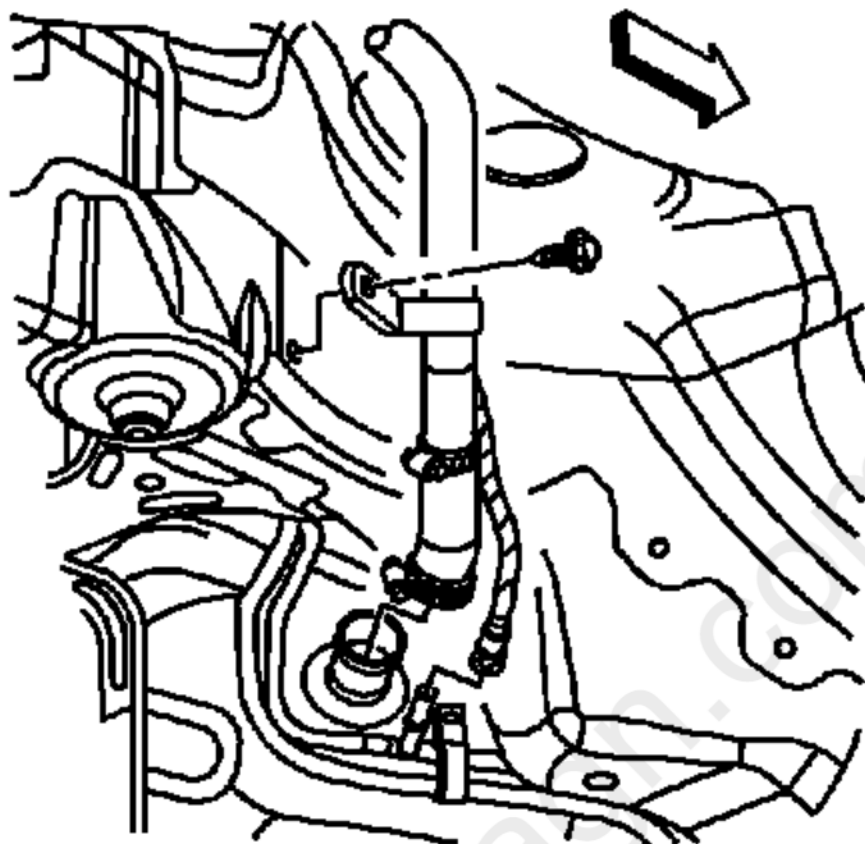


Fig. 55: View Of Fuel Filler Tube Brace Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

4. Install the fuel filler tube brace bolt and tighten to 9 N.m (80 lb in).

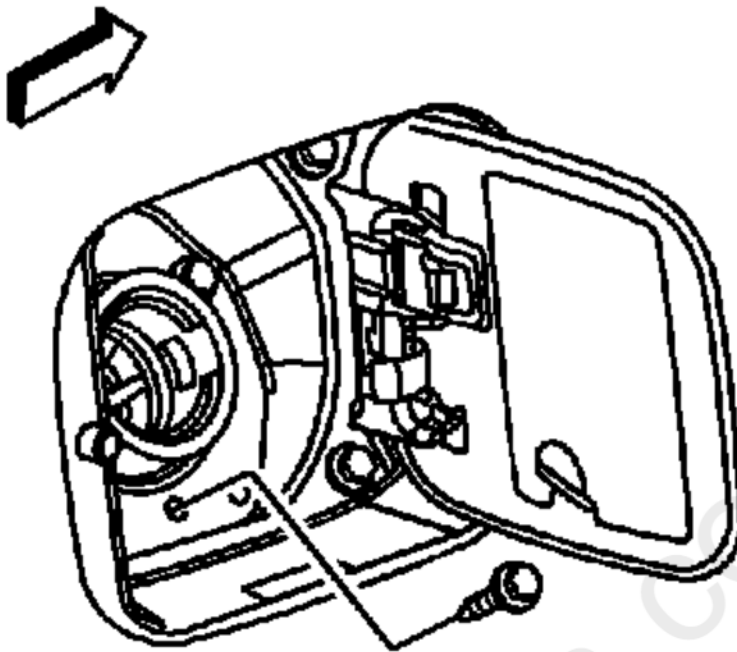


Fig. 56: Fuel Filler Tube Bolts

Courtesy of GENERAL MOTORS CORP.

5. Install the bolts securing the fuel filler tube to the body and tighten to 3.5 N.m (31 lb in).
6. Install the right rear wheelhouse liner. Refer to Rear Wheelhouse Panel Liner Replacement (Coupe) or Rear Wheelhouse Panel Liner Replacement (Sedan and Wagon) .
7. Install the right rear wheel. Refer to Tire and Wheel Removal and Installation .
8. Add fuel to the fuel tank.
9. Inspect for fuel leaks.
10. Install the fuel filler cap.

FUEL TANK REPLACEMENT

Removal Procedure

WARNING: Refer to GASOLINE/GASOLINE VAPORS WARNING .

1. Drain the fuel tank. Refer to Fuel Tank Draining.
2. Relieve the fuel system pressure. Refer to Fuel Pressure Relief (Without CH 48027) or Fuel Pressure

Relief (CH 48027).

3. Remove the muffler assembly. Refer to **Exhaust System Replacement (LF1-Single)** or **Exhaust System Replacement (LSA-Coupe)** or **Exhaust System Replacement (LF1-Sedan/Wagon)** or **Exhaust System Replacement (LLT-Coupe)** or **Exhaust System Replacement (LLT-Sedan/Wagon)** or **Exhaust System Replacement (LSA-Sedan/Wagon)** .
4. Remove the rear propeller shaft. Refer to **Rear Propeller Shaft Replacement (RPO LLT, LF1 with MXO)** or **Rear Propeller Shaft Replacement (RPO LLT/LF1with MX7 or MN6)** or **Rear Propeller Shaft Replacement (RPO LSA)** .

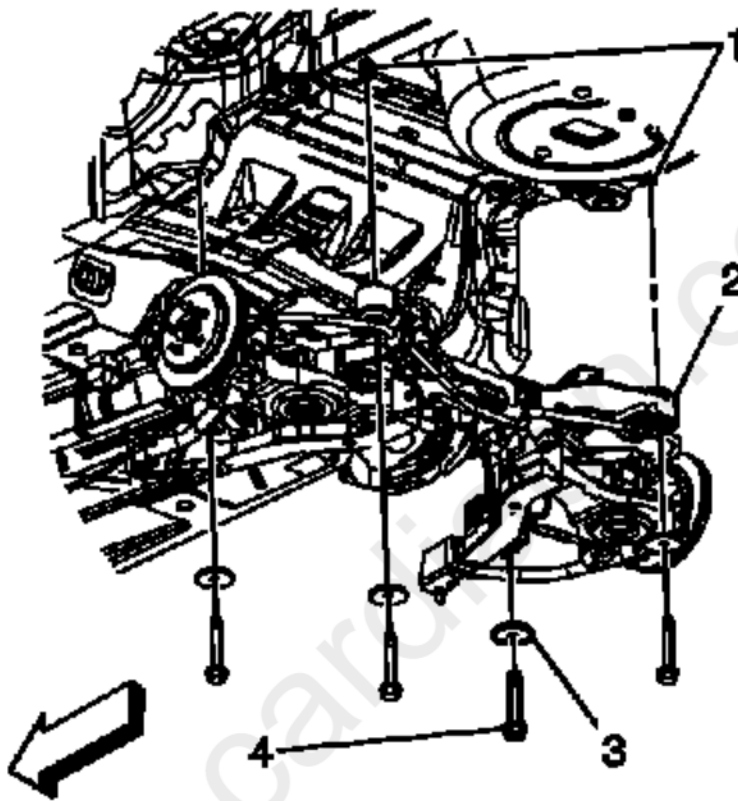


Fig. 57: Frame-To-Body Mounting Bolts & Washers
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not remove any components from the rear frame assembly once the rear frame assembly is removed from the vehicle.

5. Remove the rear frame assembly (2). Refer to **Rear Frame Replacement** .

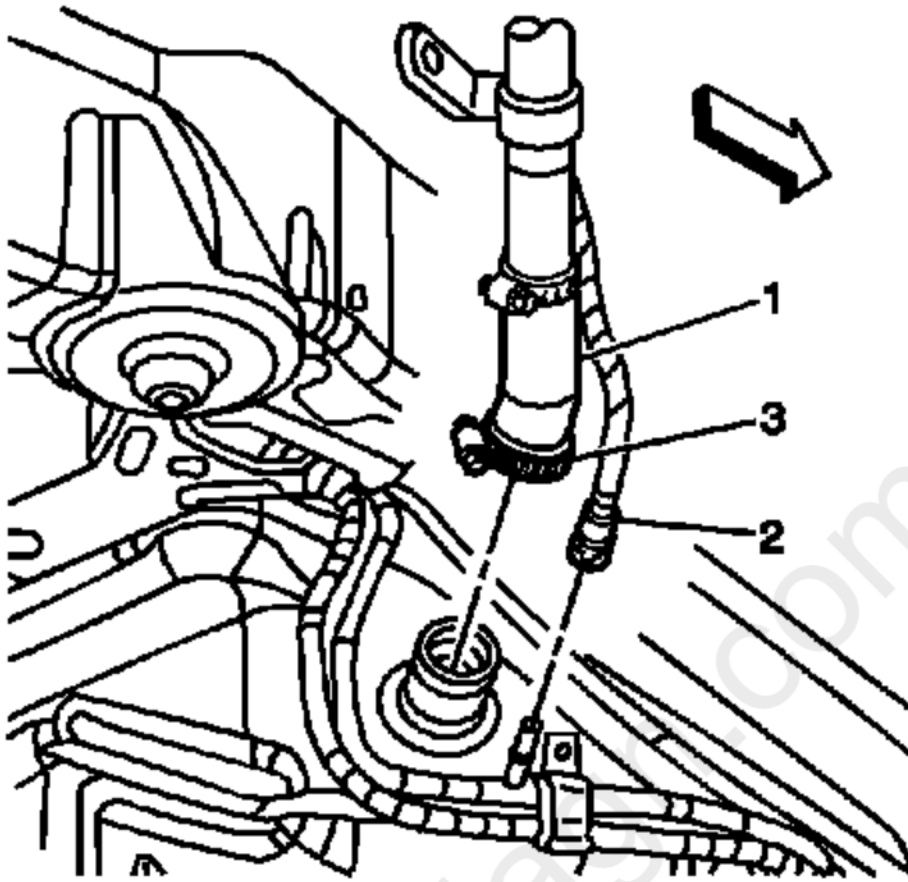


Fig. 58: Identifying Fuel Filler Hose To Fuel tank
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the filler hose (1) from the fuel tank.
7. Disconnect the filler vent tube (2) from the evaporative emission (EVAP) hose. Refer to **Evaporative Emission System Hose/Pipe Replacement**.

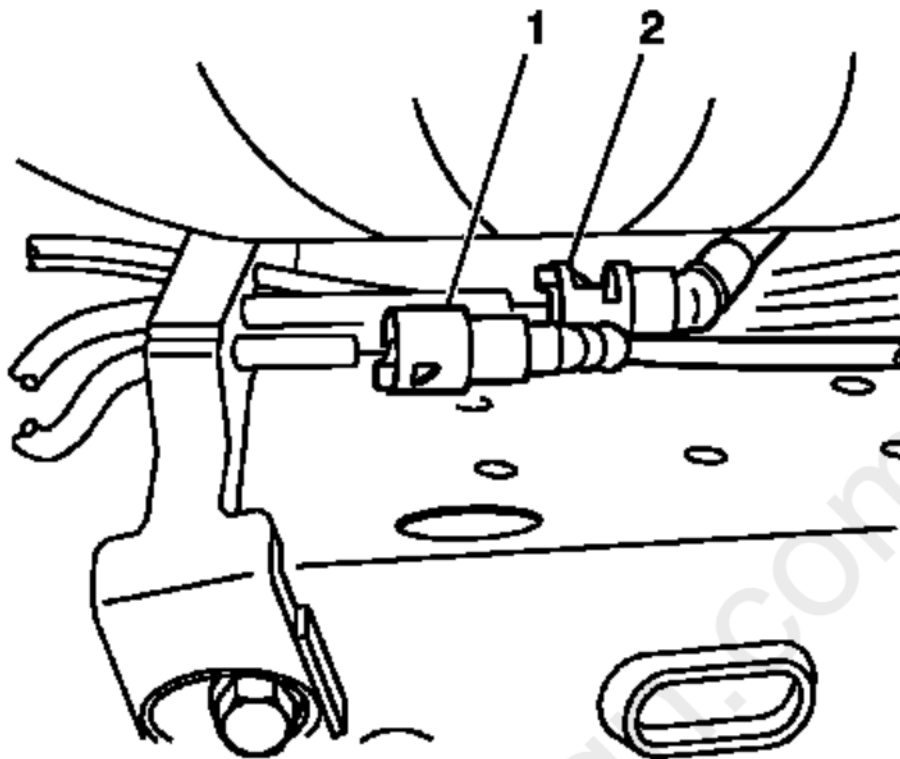


Fig. 59: Identifying Fuel Feed Pipe And Evap Hose
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the fuel feed pipe (1) and fuel EVAP hose (2) from the chassis bundle. Refer to **Fuel Line Replacement - Chassis**.

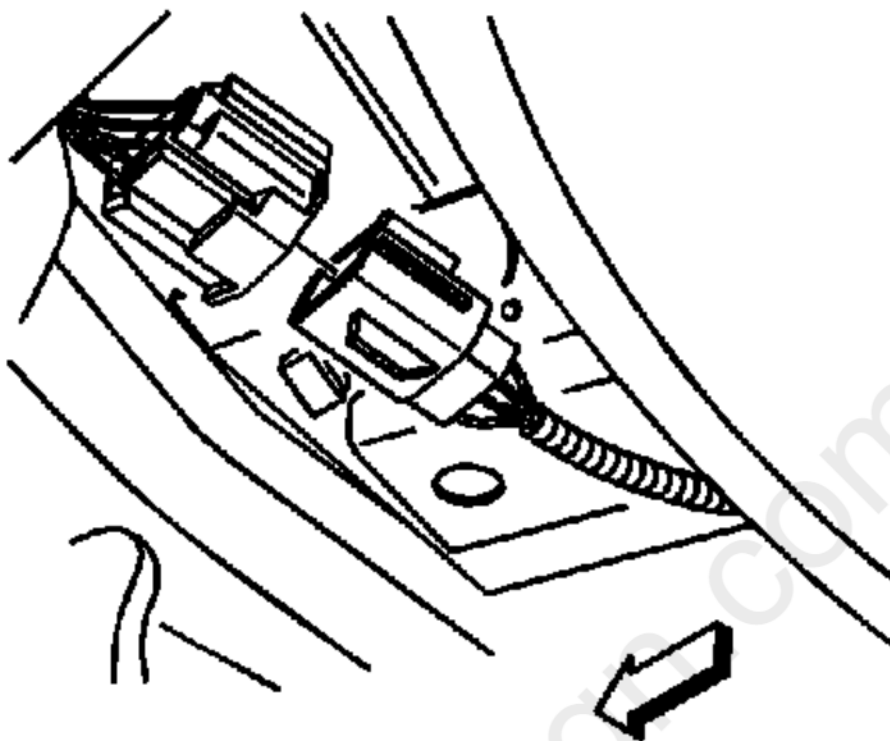


Fig. 60: View Of Fuel Tank Electrical Connector
Courtesy of GENERAL MOTORS CORP.

9. Release the electrical connector interlock and disconnect the fuel tank electrical connector.
10. Remove the fuel tank electrical connector retainer from the chassis.
11. Remove the fuel tank electrical harness from the chassis mounted retainer.

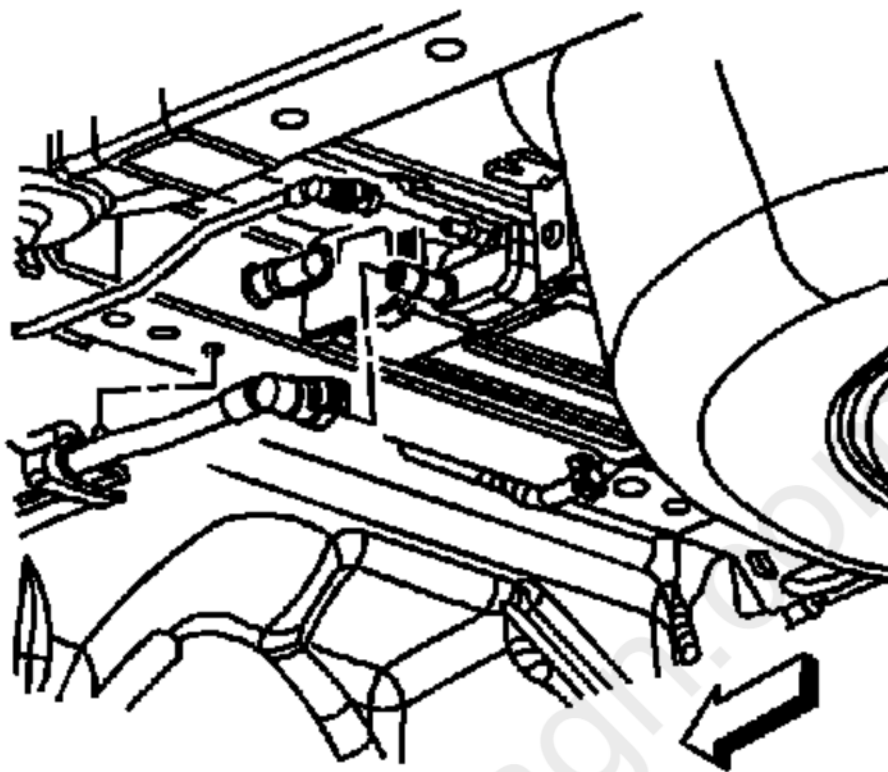


Fig. 61: Identifying EVAP Hoses At EVAP Canister
Courtesy of GENERAL MOTORS CORP.

12. Disconnect the EVAP hoses from the EVAP canister.
13. Pull outward on the retainer tab in order to disengage the retainer from the chassis.

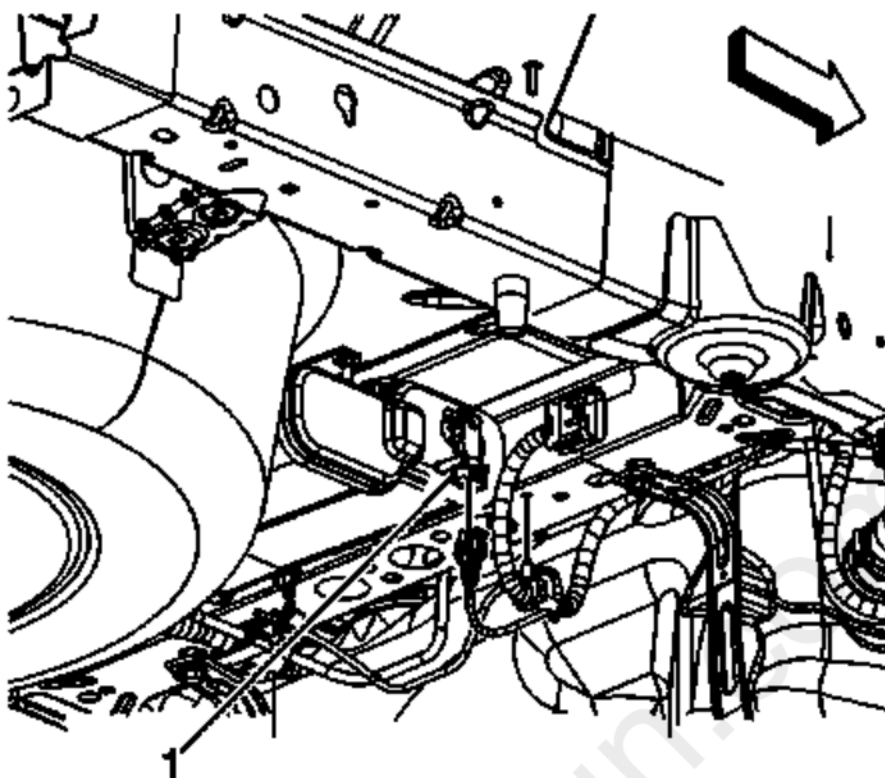


Fig. 62: View Of Fuel Tank Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

14. Disconnect the electrical connector from the fuel tank pressure sensor (1).
15. Disconnect the electrical connector from the EVAP canister vent valve.

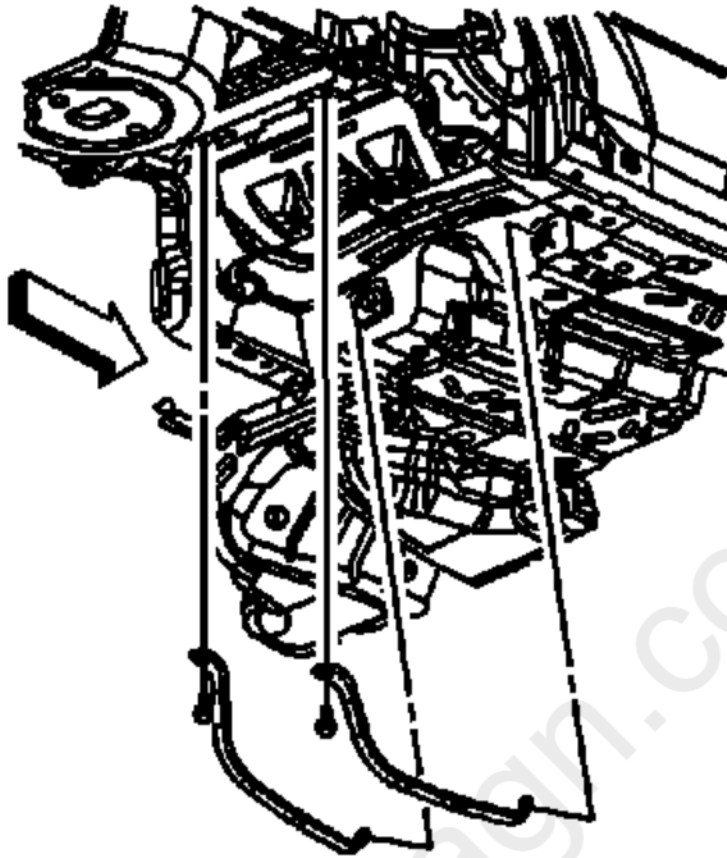


Fig. 63: View Of Fuel Tank Straps
Courtesy of GENERAL MOTORS CORP.

16. Support the fuel tank with a suitable jack.
17. Remove the fuel tank strap bolts.
18. Remove the fuel tank straps.

NOTE: Ensure the following are free from the surrounding components while lowering the fuel tank:

- The fuel tank wiring harness
- The EVAP wiring harness
- The EVAP hoses at the EVAP
- The fuel/EVAP hoses at the chassis pipes

19. With the aid of an assistant, carefully lower the fuel tank from the vehicle.
20. Remove the following components if replacing just the fuel tank:
 - The fuel tank pump module-Refer to Fuel Tank Fuel Pump Module Replacement - Right Side.
 - The Fuel level sensor assembly-Refer to Fuel Level Sensor Replacement - Left Side.

Installation Procedure

1. Install the following components if fuel tank replacement was necessary:
 - The fuel tank pump module-Refer to **Fuel Tank Fuel Pump Module Replacement - Right Side.**
 - The Fuel level sensor assembly-Refer to **Fuel Level Sensor Replacement - Left Side.**

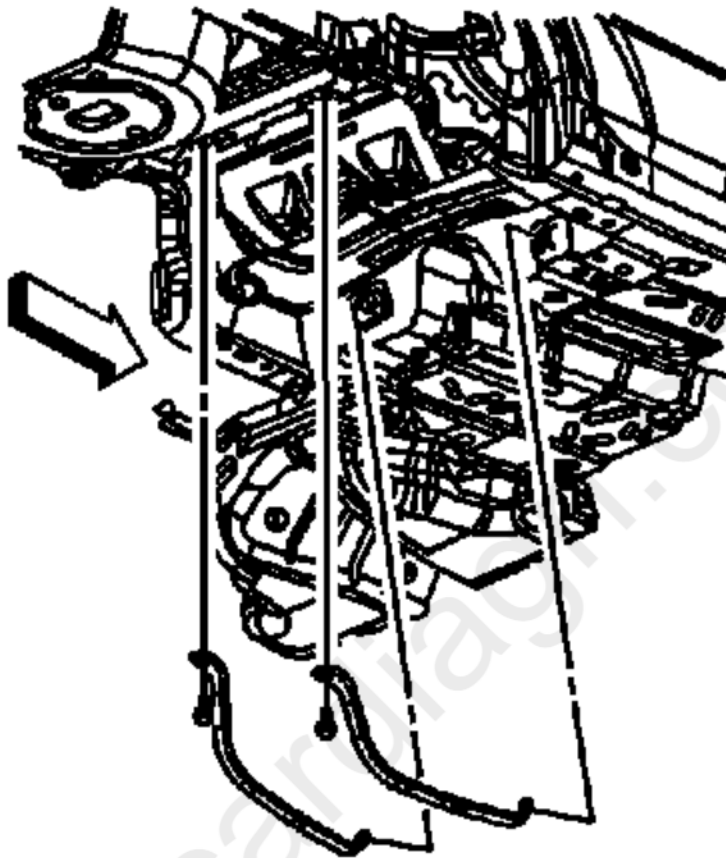


Fig. 64: View Of Fuel Tank Straps
Courtesy of GENERAL MOTORS CORP.

NOTE: Ensure the following are properly routed while raising the fuel tank:

- The fuel tank wiring harness
 - The EVAP wiring harness
 - The EVAP hoses at the EVAP
 - The fuel/EVAP hoses at the chassis pipes
2. With the aid of an assistant, carefully raise the fuel tank to the vehicle.
 3. Install the fuel tank straps to the vehicle.

CAUTION: Refer to **FASTENER CAUTION** .

4. Install the fuel tank strap bolts and tighten to 50 N.m (37 lb ft).

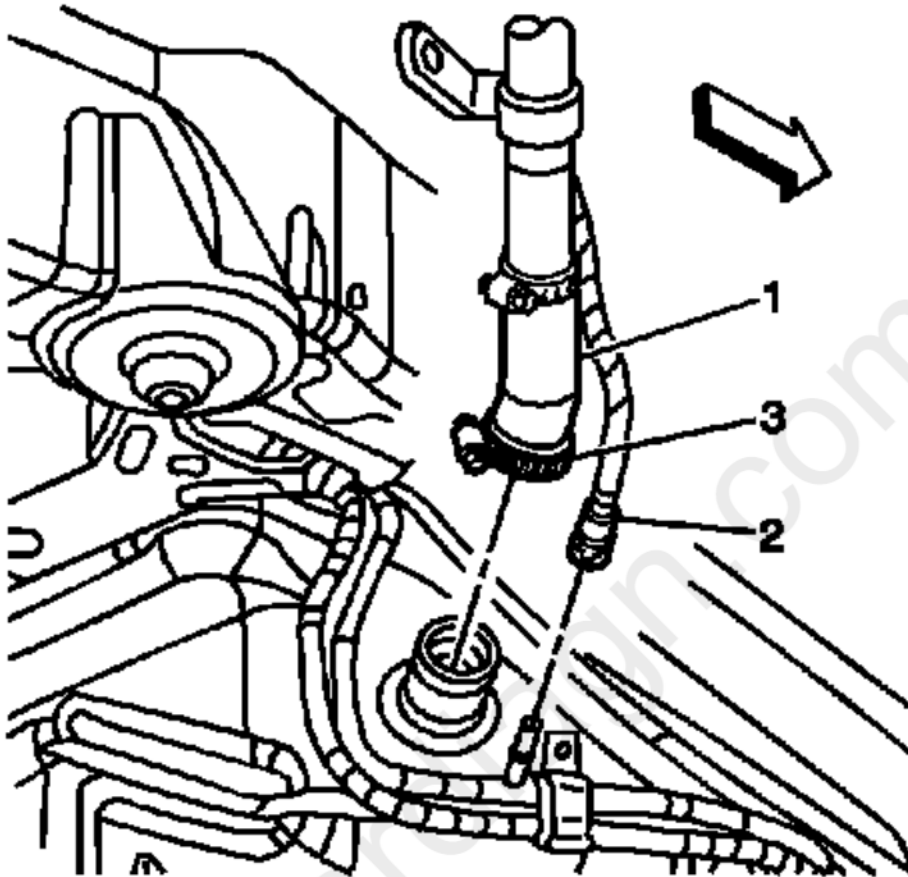


Fig. 65: Identifying Fuel Filler Hose To Fuel tank
Courtesy of GENERAL MOTORS CORP.

5. Connect the filler hose (1) to the fuel tank and tighten to 3.5 N.m (31 lb in).
6. Connect the filler vent tube (2) to the EVAP hose. Refer to **Fuel Line Replacement - Chassis**.

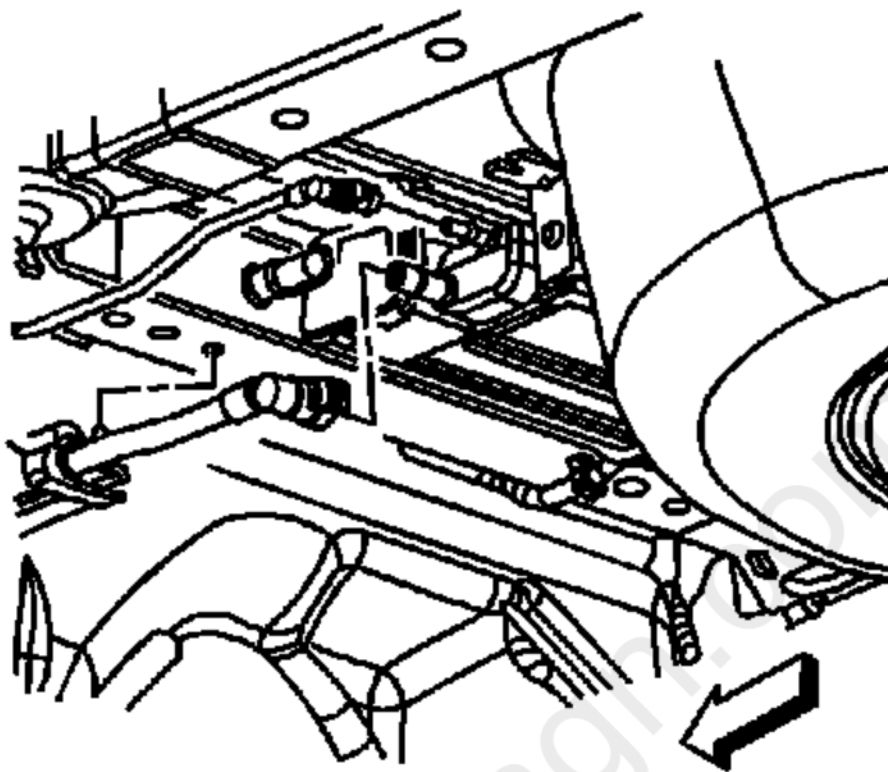


Fig. 66: Identifying EVAP Hoses At EVAP Canister
Courtesy of GENERAL MOTORS CORP.

7. Connect the EVAP hoses to the EVAP canister.
8. Connect the EVAP purge valve and fuel tank pressure sensor electrical connectors.

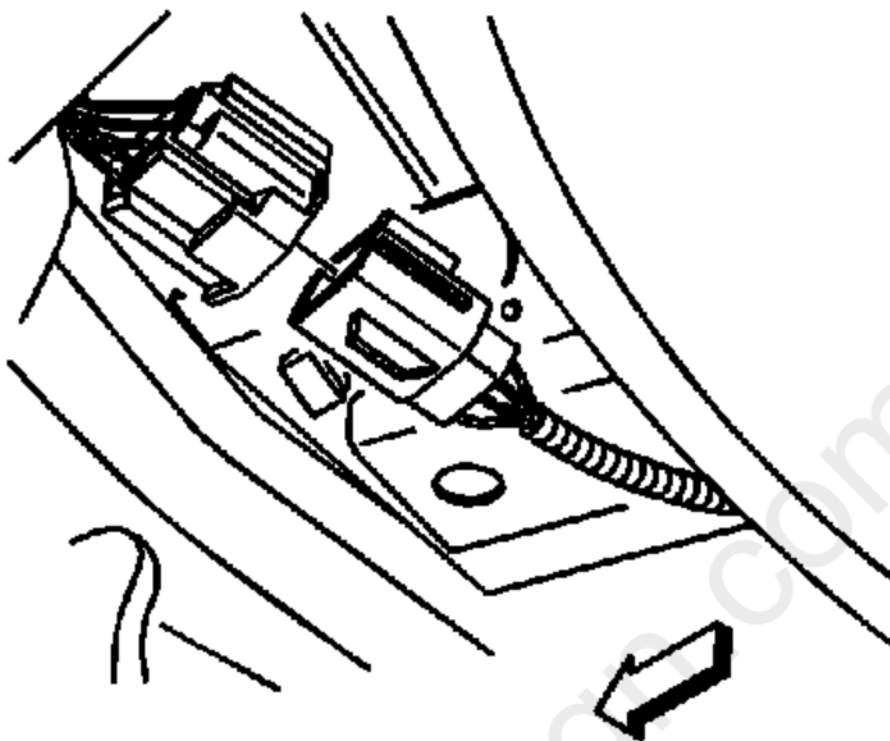


Fig. 67: View Of Fuel Tank Electrical Connector
Courtesy of GENERAL MOTORS CORP.

9. Install the fuel tank wire harness and wire harness connector to the retainers on the chassis.
10. Connect the fuel tank electrical connector, and engage the connector interlock.

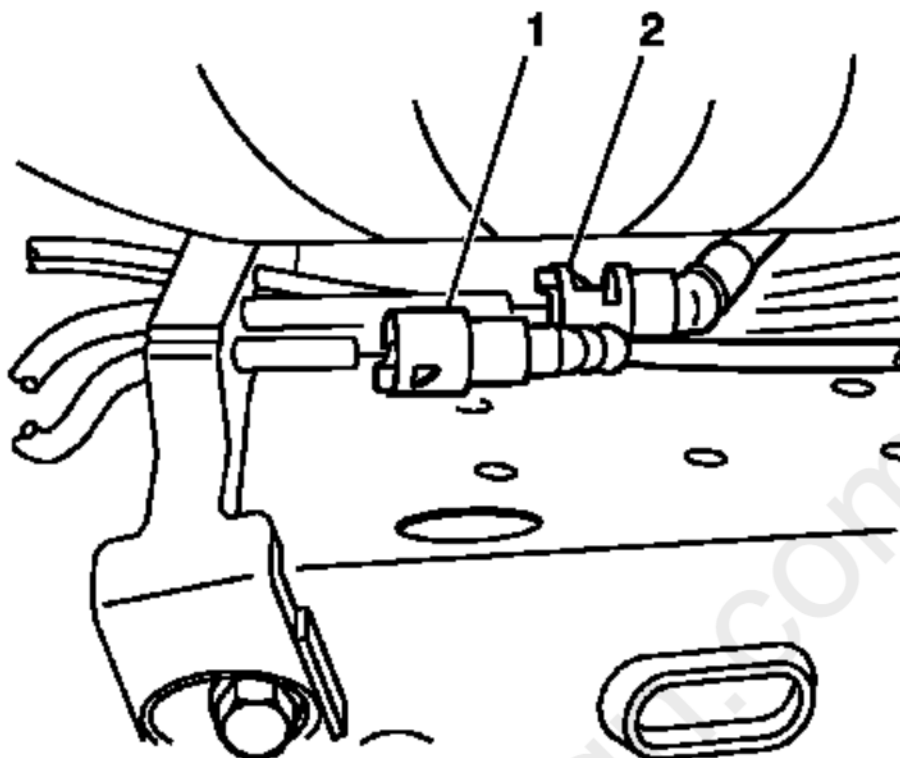


Fig. 68: Identifying Fuel Feed Pipe And Evap Hose
Courtesy of GENERAL MOTORS CORP.

11. Connect the fuel EVAP hose (2) and the fuel feed pipe (1) to the chassis bundle. Refer to **Fuel Line Replacement - Chassis**.

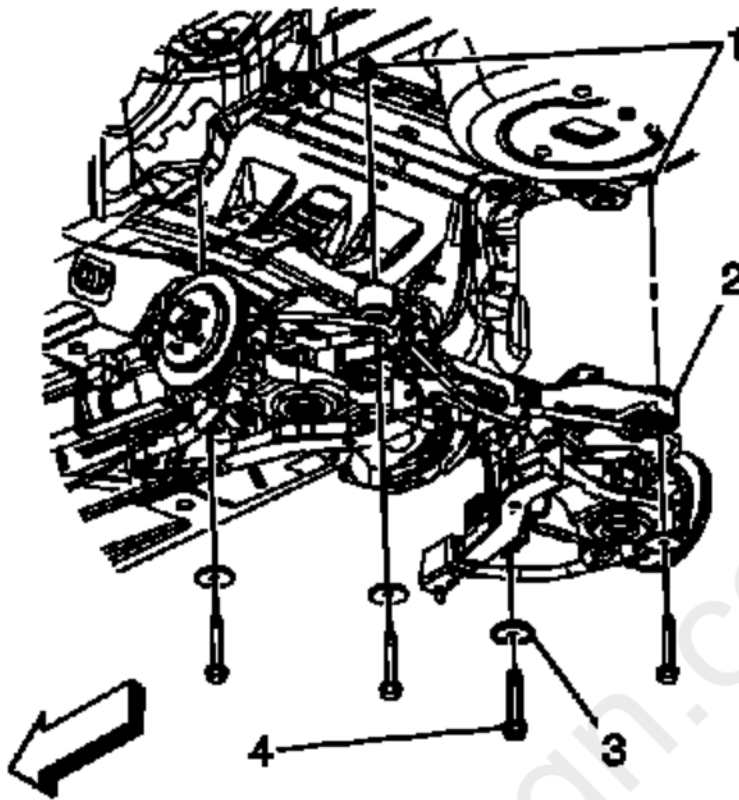


Fig. 69: Frame-To-Body Mounting Bolts & Washers
Courtesy of GENERAL MOTORS CORP.

12. Install the rear frame assembly (2). Refer to **Rear Frame Replacement** .
13. Install the propeller shaft. Refer to **Rear Propeller Shaft Replacement (RPO LLT, LF1 with MXO)** or **Rear Propeller Shaft Replacement (RPO LLT/LF1with MX7 or MN6)** or **Rear Propeller Shaft Replacement (RPO LSA)** .
14. Install muffler assembly. Refer to **Exhaust System Replacement (LF1-Single)** or **Exhaust System Replacement (LSA-Coupe)** or **Exhaust System Replacement (LF1-Sedan/Wagon)** or **Exhaust System Replacement (LLT-Coupe)** or **Exhaust System Replacement (LLT-Sedan/Wagon)** or **Exhaust System Replacement (LSA-Sedan/Wagon)** .
15. Refill the fuel tank.
16. Install the fuel fill cap.
17. Inspect for fuel leaks.

FUEL TANK PRESSURE SENSOR REPLACEMENT

Removal Procedure

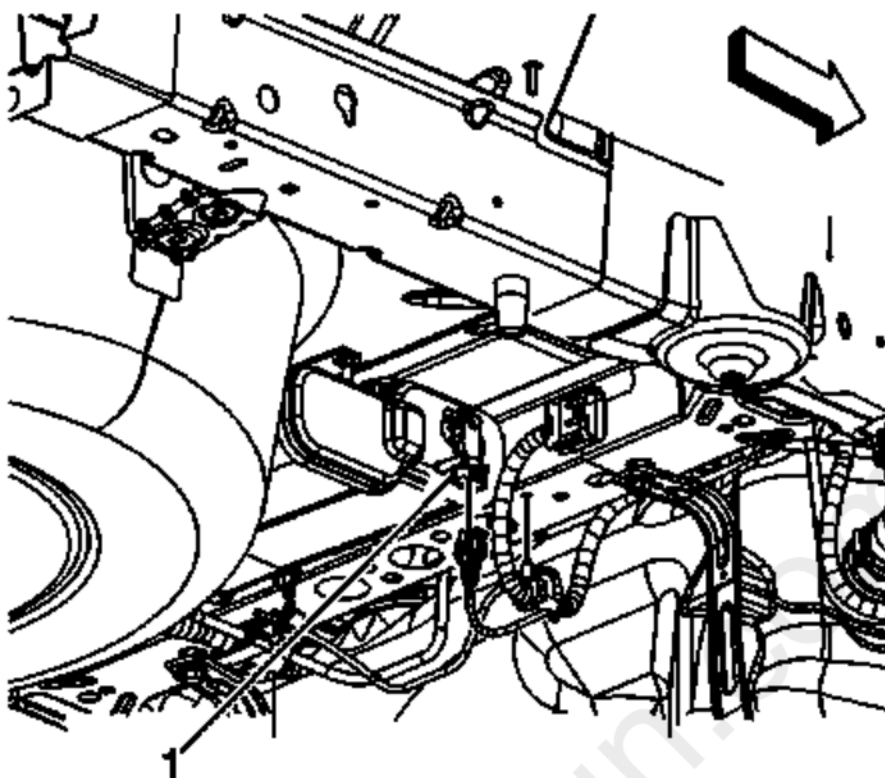


Fig. 70: View Of Fuel Tank Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Disconnect the fuel tank pressure sensor electrical connector (1).

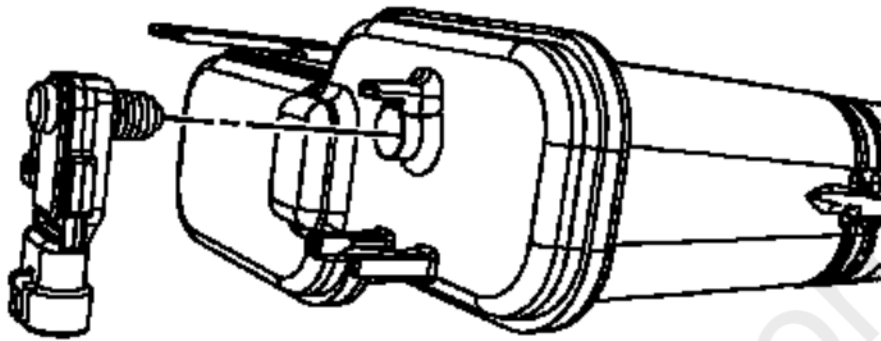


Fig. 71: Fuel Tank Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

NOTE: There are alignment features on the canister, however, there are no locking tabs on the sensor/canister. The sensor is held into the canister by the tight fit of the multi-lip seal.

3. Remove the fuel tank pressure sensor from the evaporative emission (EVAP) canister.

Installation Procedure

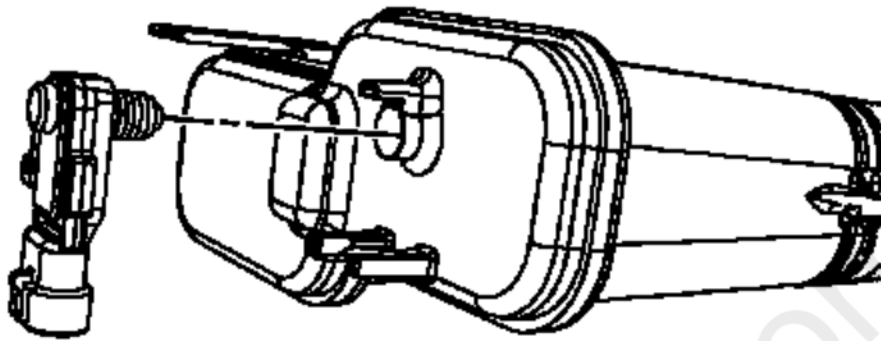


Fig. 72: Fuel Tank Pressure Sensor
Courtesy of GENERAL MOTORS CORP.

NOTE: There are alignment features on the canister, however, there are no locking tabs on the sensor/canister. The sensor is held into the canister by the tight fit of the multi-lip seal.

1. Install the fuel tank pressure sensor to the EVAP canister until fully seated.

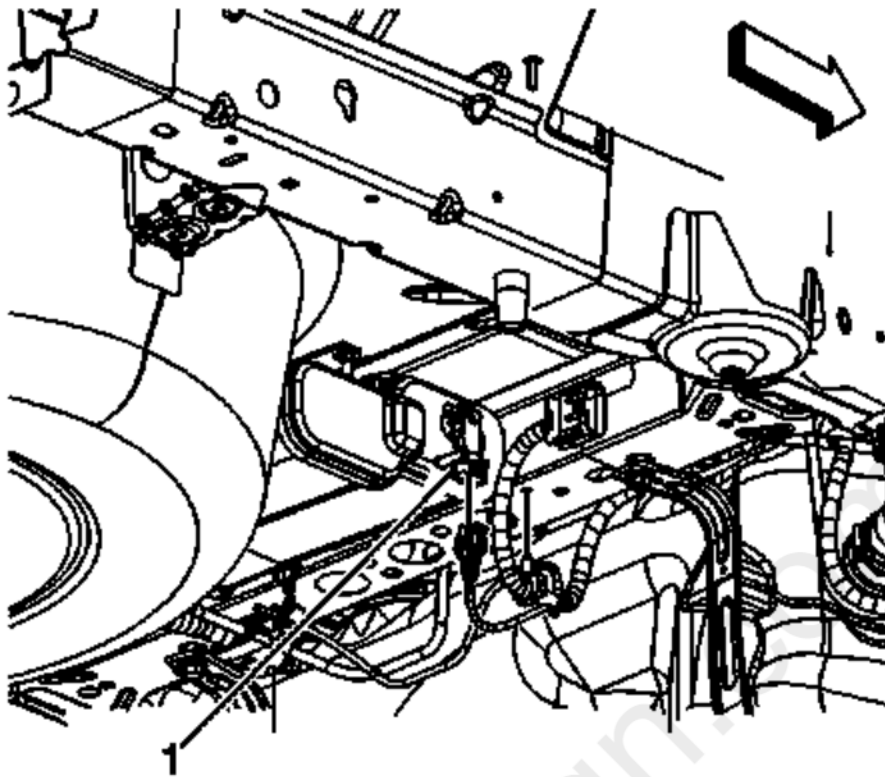


Fig. 73: View Of Fuel Tank Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Connect the fuel tank pressure sensor electrical connector (1).
3. Lower the vehicle.

FUEL TANK FUEL PUMP MODULE REPLACEMENT - RIGHT SIDE

Special Tools

J 45722: Fuel Sender Lock Ring Wrench

Removal Procedure

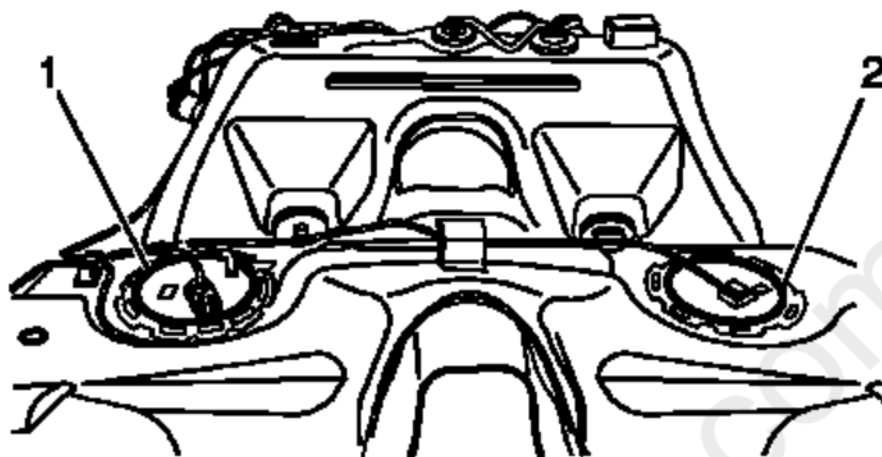


Fig. 74: Fuel Tank Module And Fuel Feed Hose
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to GASOLINE/GASOLINE VAPORS WARNING .

1. Remove the fuel tank in order to gain access to the primary fuel tank module (1). Refer to **Fuel Tank Replacement**.

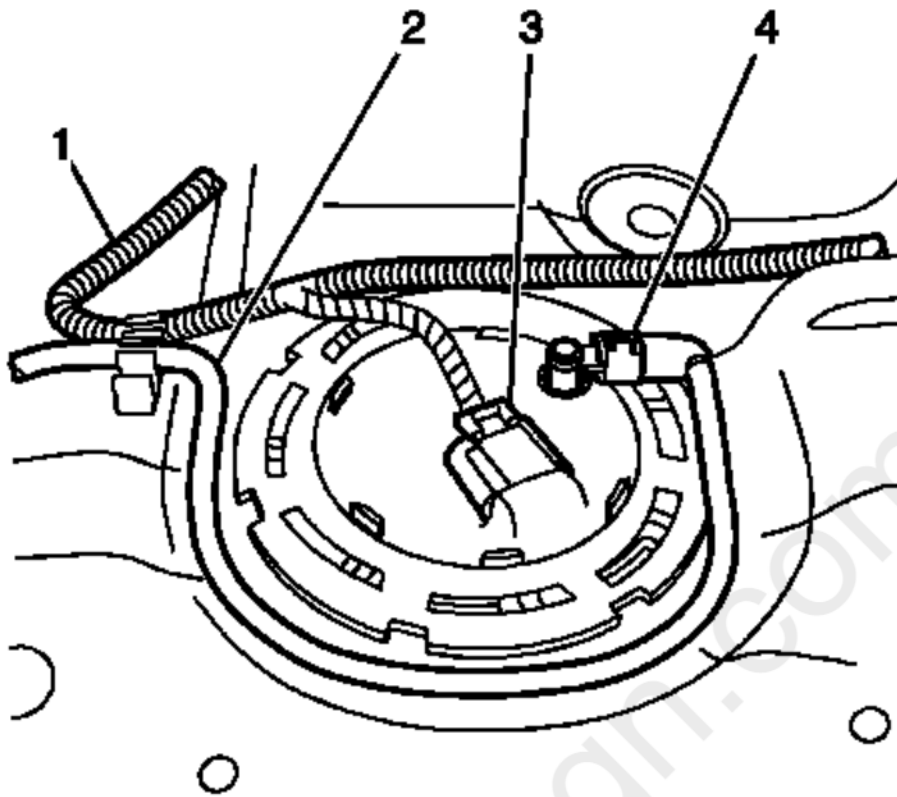


Fig. 75: Identifying Wire Harness, Fuel Feed Hose And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the fuel feed hose quick connect fitting (4) from the primary fuel tank module. Refer to **Plastic Collar Quick Connect Fitting Service**.
3. Remove the fuel feed hose (2) from the retainer on the fuel tank and position the hose aside.
4. Release the interlock and disconnect the electrical connector (3) from the primary fuel tank module.
5. Remove the wire harness (1) from the retainer on the fuel tank and position the harness aside.

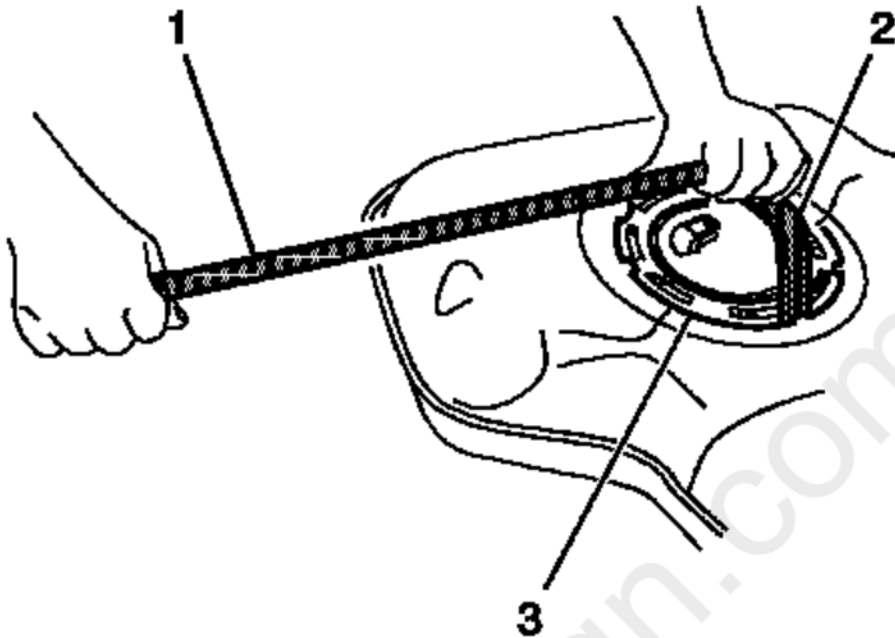


Fig. 76: Identifying J 45722, Breaker-Bar And Fuel Tank Module Lock Ring
Courtesy of GENERAL MOTORS CORP.

CAUTION: Avoid damaging the lock ring. Use only J-45722 to prevent damage to the lock ring.

CAUTION: Do Not handle the fuel sender assembly by the fuel pipes. The amount of leverage generated by handling the fuel pipes could damage the joints.

NOTE:

- **DO NOT** use impact tools. Significant force will be required to release the lock ring. The use of a hammer and screwdriver is not recommended. Secure the fuel tank in order to prevent fuel tank rotation.
- Do not allow the tool to come in contact with the fuel pipe while unlocking the cam lock ring.

6. Use the **J 45722**: wrench (2) and a long breaker-bar (1) in order to unlock the fuel tank module lock ring (3), by turning counterclockwise.
7. Remove the cam lock ring.

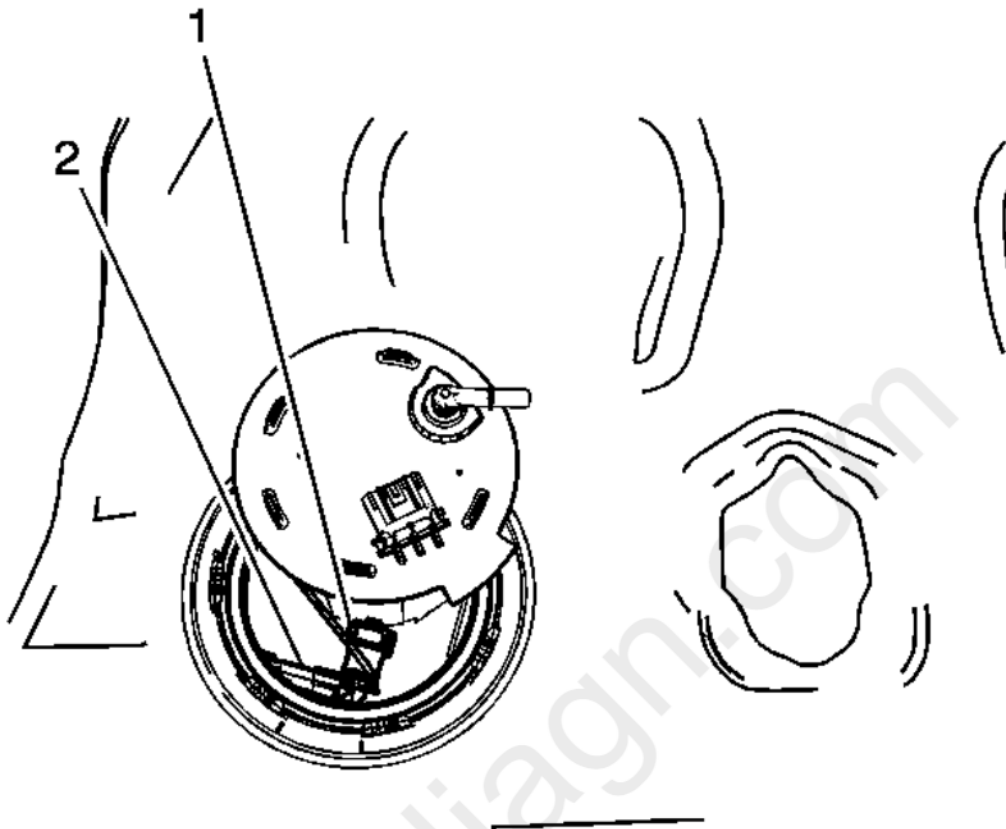


Fig. 77: Identifying Fuel Transfer Hose Quick Connect Fitting & Electrical Connector
Courtesy of GENERAL MOTORS CORP.

8. Partially remove the fuel tank module in order to disconnect the fuel transfer hose quick connect fitting (1) and the electrical connector (2). Refer to **Plastic Collar Quick Connect Fitting Service** .
9. Remove the primary fuel tank module from the fuel tank.
10. Discard the fuel tank module seal.

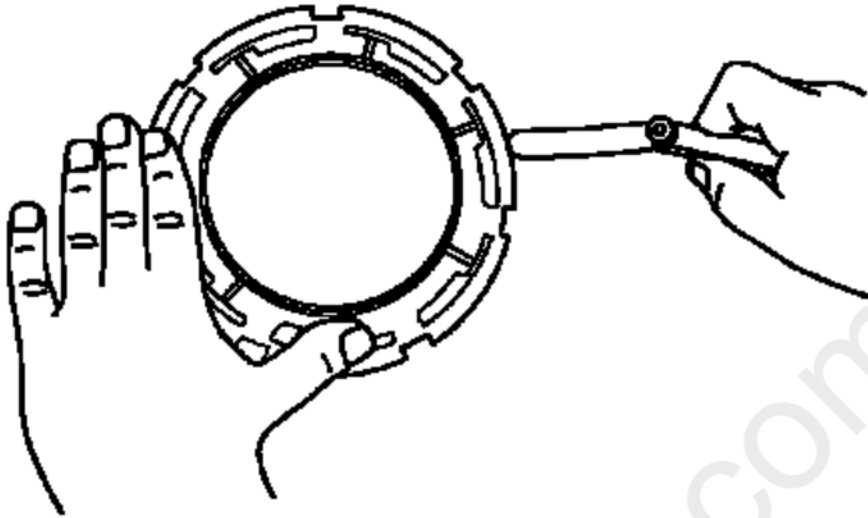


Fig. 78: Checking Lock Ring For Flatness
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Some lock rings were manufactured with "DO NOT REUSE" stamped into them. These lock rings may be reused if the lock rings are not damaged or warped.
- Inspect the lock ring for damage due to improper removal or installation procedures. If damage is found, install a NEW lock ring.
- Check the lock ring for flatness.

11. Place the lock ring on a flat surface. Measure the clearance between the lock ring and the flat surface using a feeler gauge at 7 points.
12. If warpage is less than 0.41 mm (0.016 in), the lock ring does not require replacement.
13. If warpage is greater than 0.41 mm (0.016 in), the lock ring must be replaced.

Installation Procedure

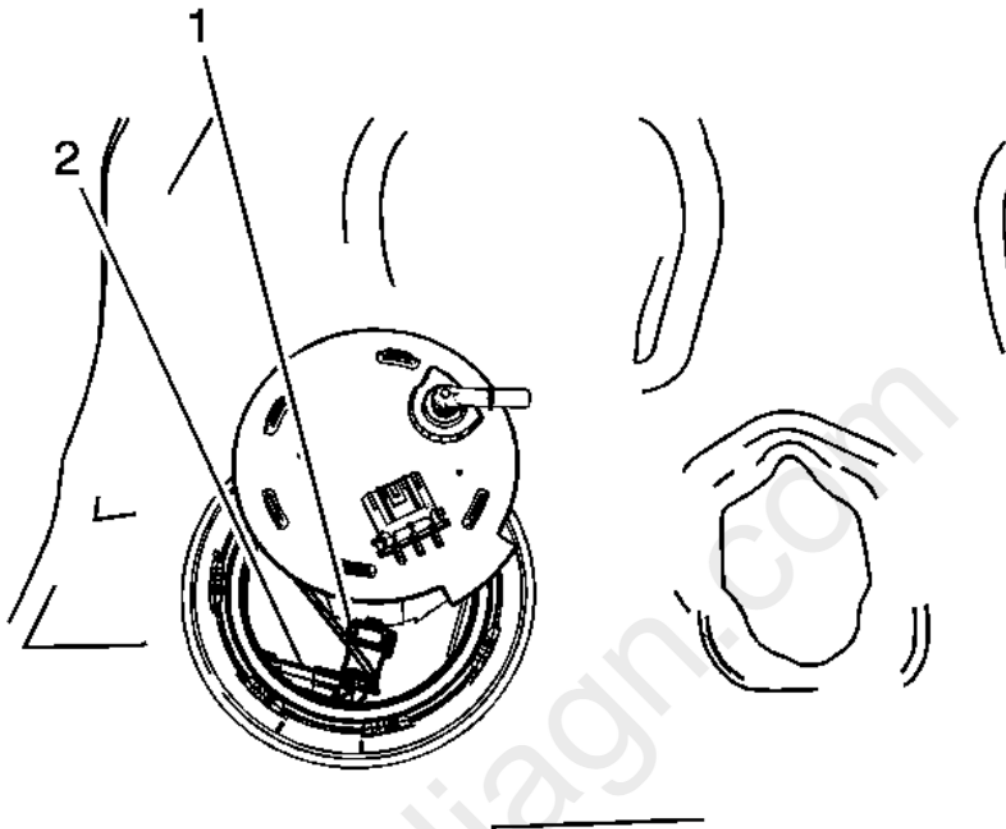


Fig. 79: Identifying Fuel Transfer Hose Quick Connect Fitting & Electrical Connector
Courtesy of GENERAL MOTORS CORP.

NOTE: Always replace the fuel tank module seal when installing the fuel tank module assembly. Replace the lock ring if necessary. DO NOT apply any type of lubrication in the seal groove.

1. Install a NEW fuel tank module seal.
2. Grasp the fuel transfer hose and electrical connector from inside the fuel tank.
3. Partially install the primary fuel tank module and connect the fuel transfer hose quick connect fitting (1) and the electrical connector (2). Refer to **Plastic Collar Quick Connect Fitting Service** .

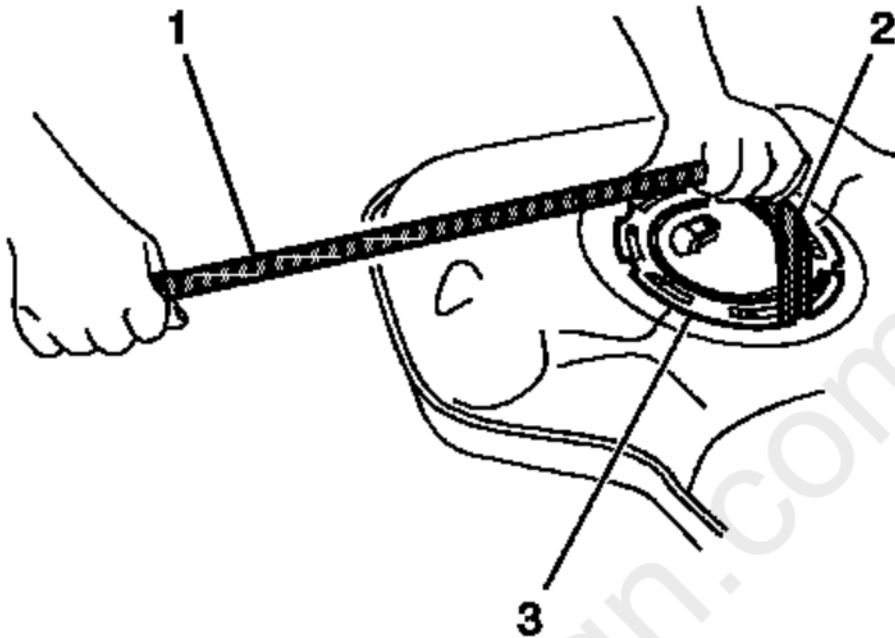


Fig. 80: Identifying J 45722, Breaker-Bar And Fuel Tank Module Lock Ring
Courtesy of GENERAL MOTORS CORP.

4. Press the primary fuel tank module downward, aligning the module to the encapsulated ring.

NOTE: Ensure the lock ring is installed with the correct side facing upward. A correctly installed lock ring will only turn in a clockwise direction.

5. Position the cam lock ring (3) to the fuel tank.

NOTE: DO NOT use impact tools. Significant force will be required to install the lock ring. The use of a hammer and screwdriver is not recommended. Secure the fuel tank in order to prevent fuel tank rotation.

6. Use the **J 45722**: wrench (2) and a long breaker-bar (1) to install the fuel tank module lock ring (3), by turning clockwise, until fully seated.

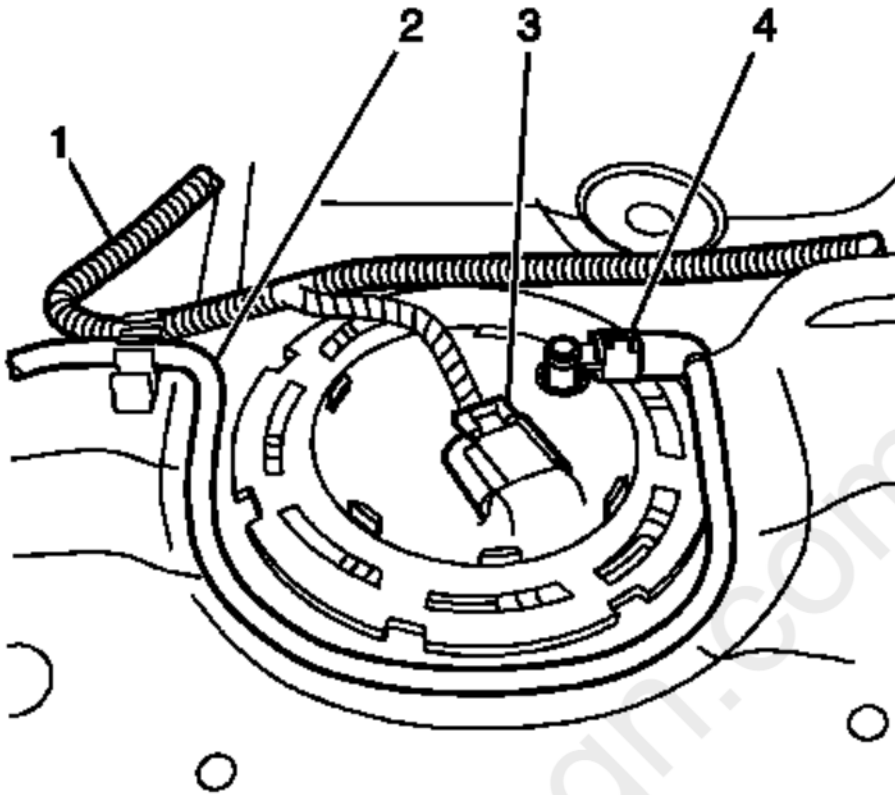


Fig. 81: Identifying Wire Harness, Fuel Feed Hose And Electrical Connector
Courtesy of GENERAL MOTORS CORP.

7. Connect the electrical connector (3) to the primary fuel tank module and engage the connector interlock.
8. Install the wire harness (1) to the retainer on the fuel tank.
9. Connect the fuel feed hose quick connect fitting (4) to the primary fuel tank module. Refer to **Plastic Collar Quick Connect Fitting Service**.
10. Install the fuel feed hose (2) to the retainer on the fuel tank.
11. Install the fuel tank. Refer to **Fuel Tank Replacement**.

FUEL LEVEL SENSOR REPLACEMENT - LEFT SIDE

Special Tools

J 45722: Fuel Sender Lock Ring Wrench

Removal Procedure

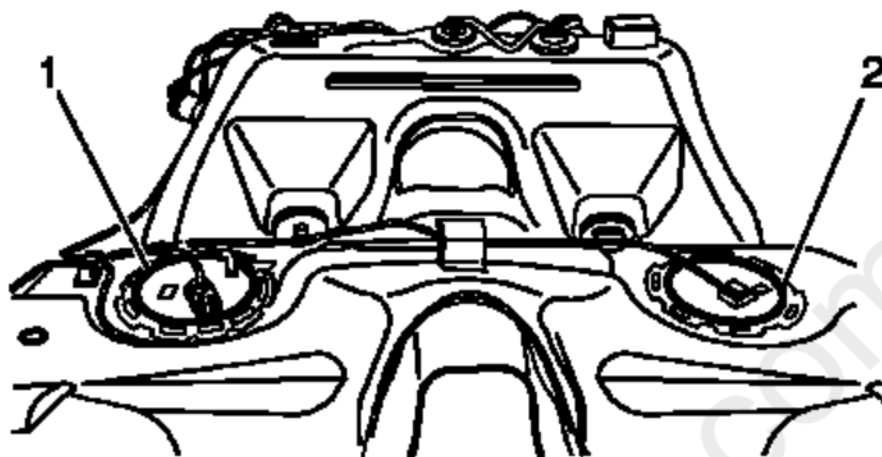


Fig. 82: Fuel Tank Module And Fuel Feed Hose
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to GASOLINE/GASOLINE VAPORS WARNING .

1. Remove the fuel tank in order to gain access to the secondary fuel tank module (2). Refer to **Fuel Tank Replacement**.

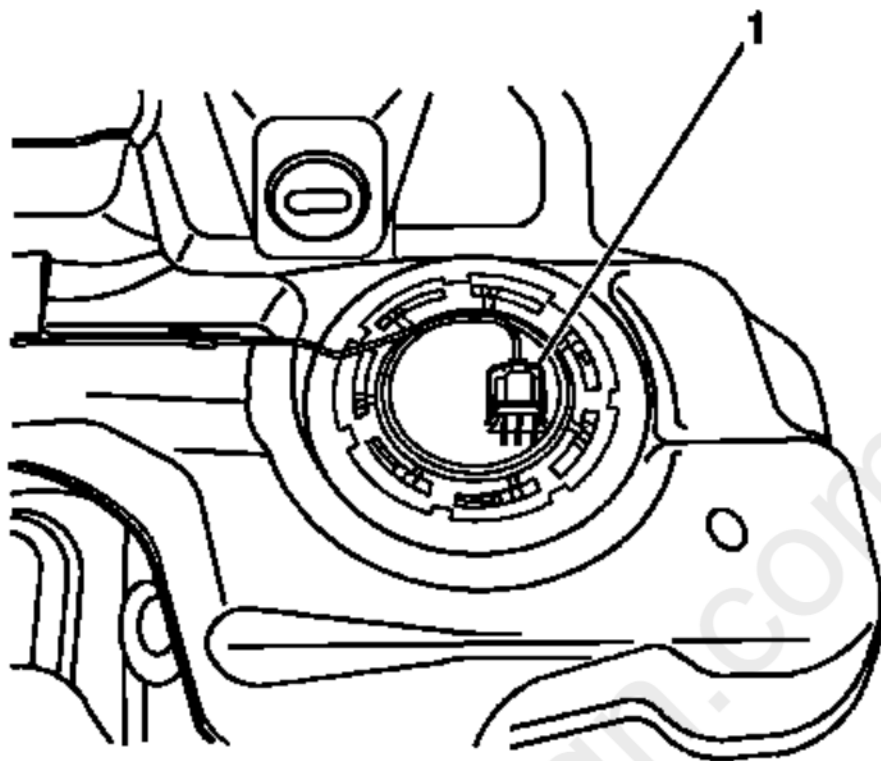


Fig. 83: View Of Electrical Connector Fuel Tank Module
Courtesy of GENERAL MOTORS CORP.

2. Release the interlock and disconnect the electrical connector (1) from the secondary fuel tank module. Position the connector and wire harness aside.

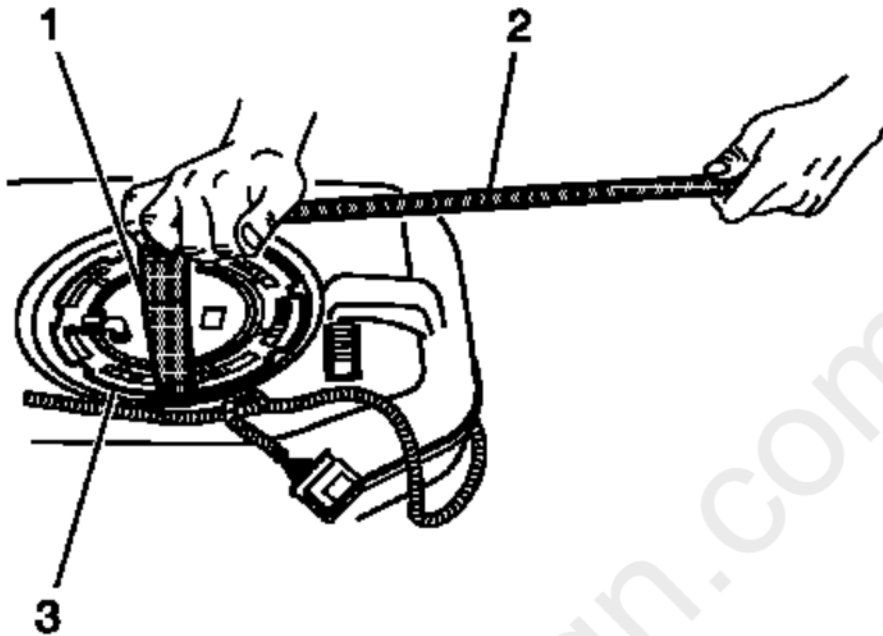


Fig. 84: Identifying J-45722, Long Breaker-Bar And Lock Ring
Courtesy of GENERAL MOTORS CORP.

CAUTION: Avoid damaging the lock ring. Use only J-45722 to prevent damage to the lock ring.

NOTE:

- **DO NOT** use impact tools. Significant force will be required to release the lock ring. The use of a hammer and screwdriver is not recommended. Secure the fuel tank in order to prevent fuel tank rotation.
- Do not allow the tool to come in contact with the fuel pipe while unlocking the cam lock ring.

3. Use the **J 45722: Fuel Sender Lock Ring Wrench** (1) and a long breaker-bar (2) in order to unlock the fuel tank module lock ring (3), by turning counterclockwise.
4. Remove the cam lock ring.

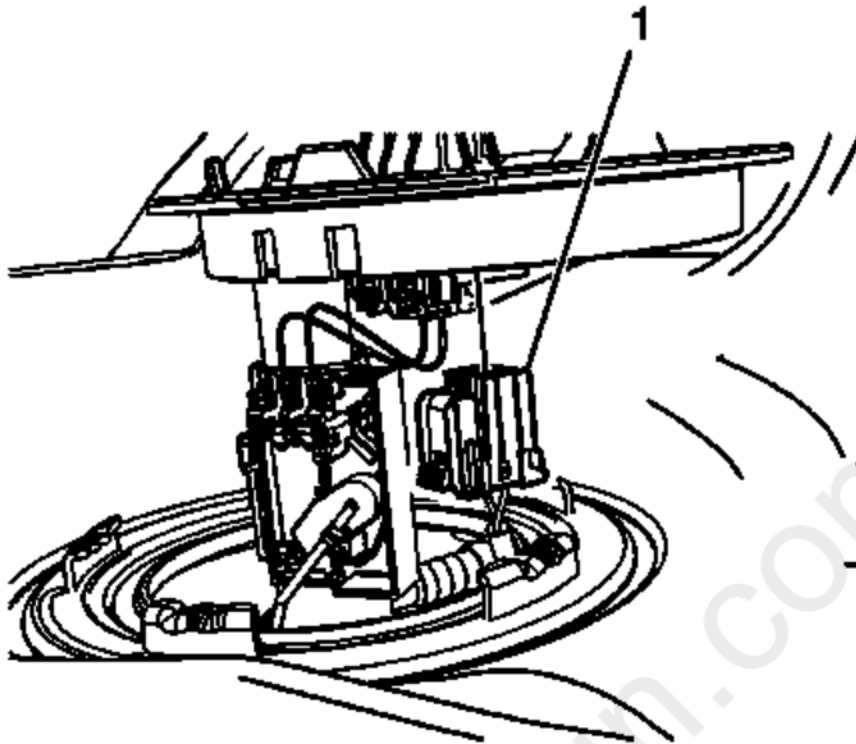


Fig. 85: Identifying Secondary Fuel Tank Module Electrical Connector
Courtesy of GENERAL MOTORS CORP.

5. Partially remove the secondary fuel tank module and disconnect the electrical connector (1).

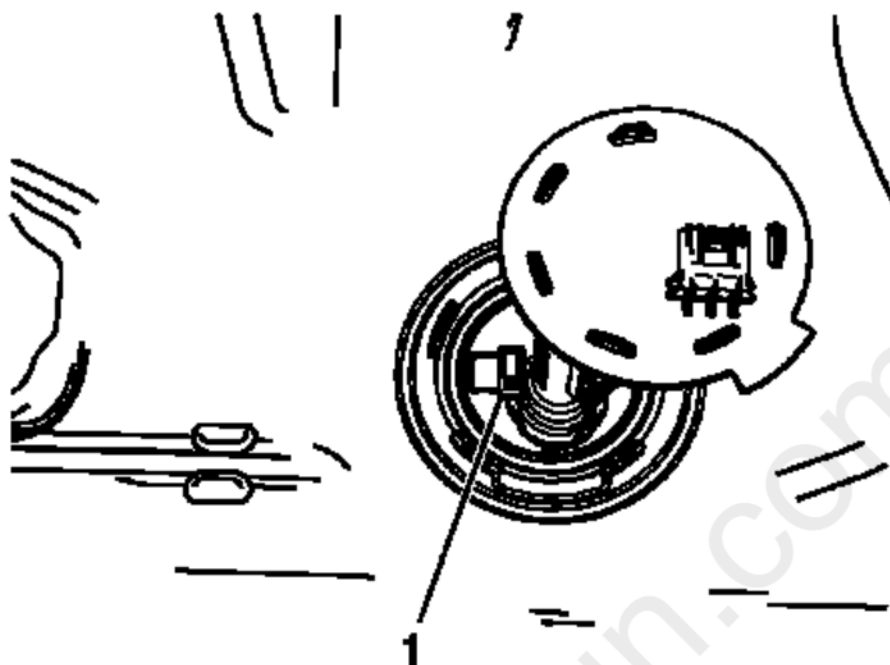


Fig. 86: Identifying Fuel Transfer Hose Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the fuel transfer hose quick connect fitting (1). Refer to **Plastic Collar Quick Connect Fitting Service**.
7. Remove the secondary fuel tank module from the fuel tank.
8. Discard the fuel tank module seal.

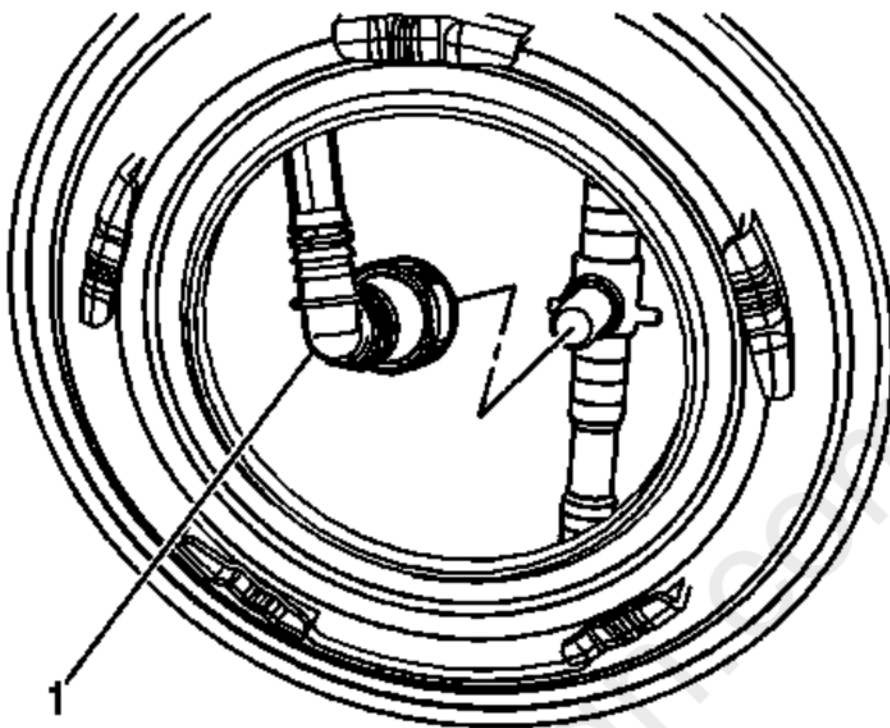


Fig. 87: Identifying Transfer Hose Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

9. If replacing the remote pickup line assembly, Disconnect the transfer hose quick connect fitting (1). Refer to **Plastic Collar Quick Connect Fitting Service** .

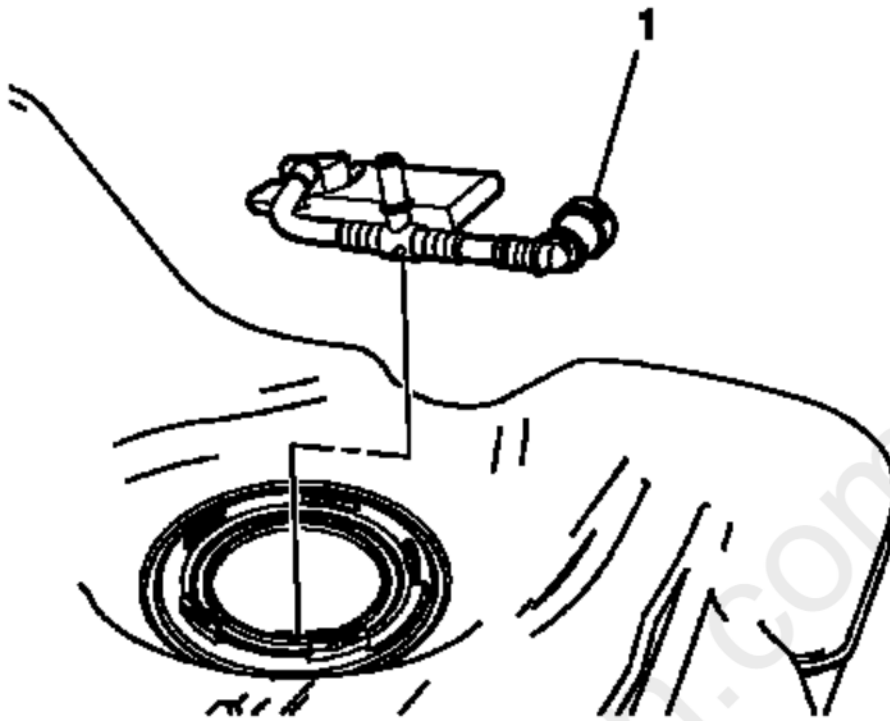


Fig. 88: Identifying Remote Pickup Line Assembly
Courtesy of GENERAL MOTORS CORP.

10. Remove the remote pickup line assembly (1).

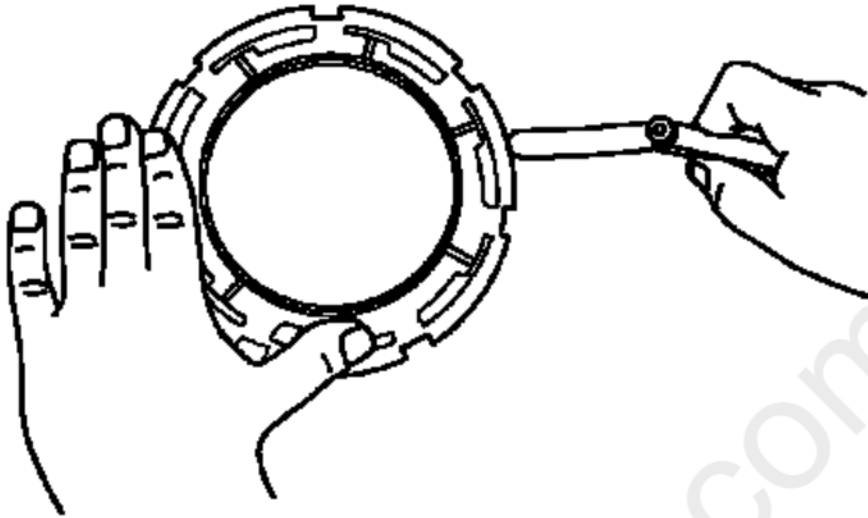


Fig. 89: Checking Lock Ring For Flatness
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Some lock rings were manufactured with "DO NOT REUSE" stamped into them. These lock rings may be reused if the lock rings are not damaged or warped.
- Inspect the lock ring for damage due to improper removal or installation procedures. If damage is found, install a NEW lock ring.
- Check the lock ring for flatness.

11. Place the lock ring on a flat surface. Measure the clearance between the lock ring and the flat surface using a feeler gauge at 7 points.
12. If warpage is less than 0.41 mm (0.016 in), the lock ring does not require replacement.
13. If warpage is greater than 0.41 mm (0.016 in), the lock ring must be replaced.

Installation Procedure

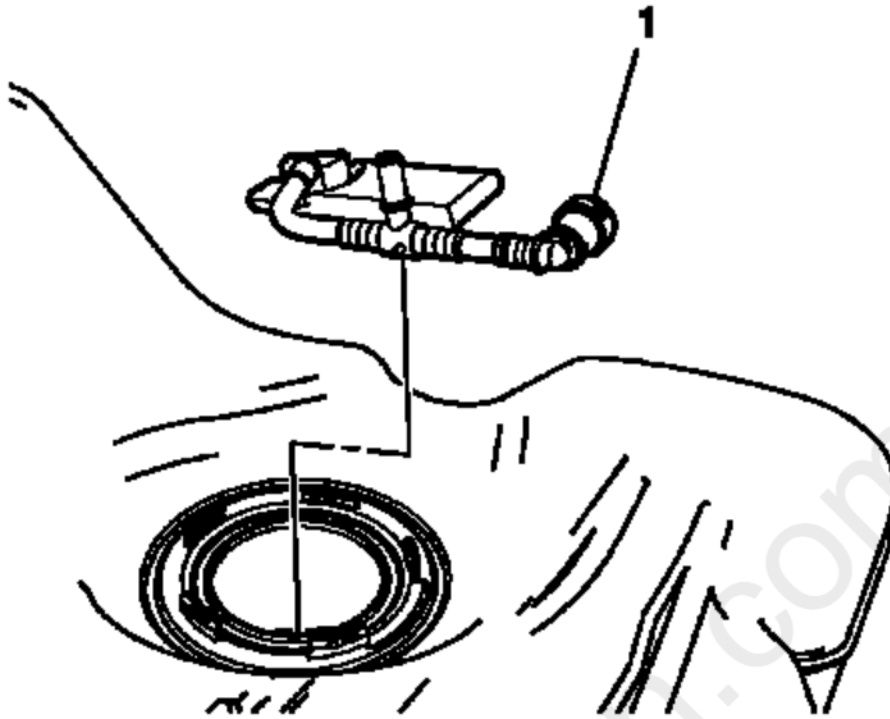


Fig. 90: Identifying Remote Pickup Line Assembly
Courtesy of GENERAL MOTORS CORP.

1. If replacing, install the remote pickup line assembly (1).

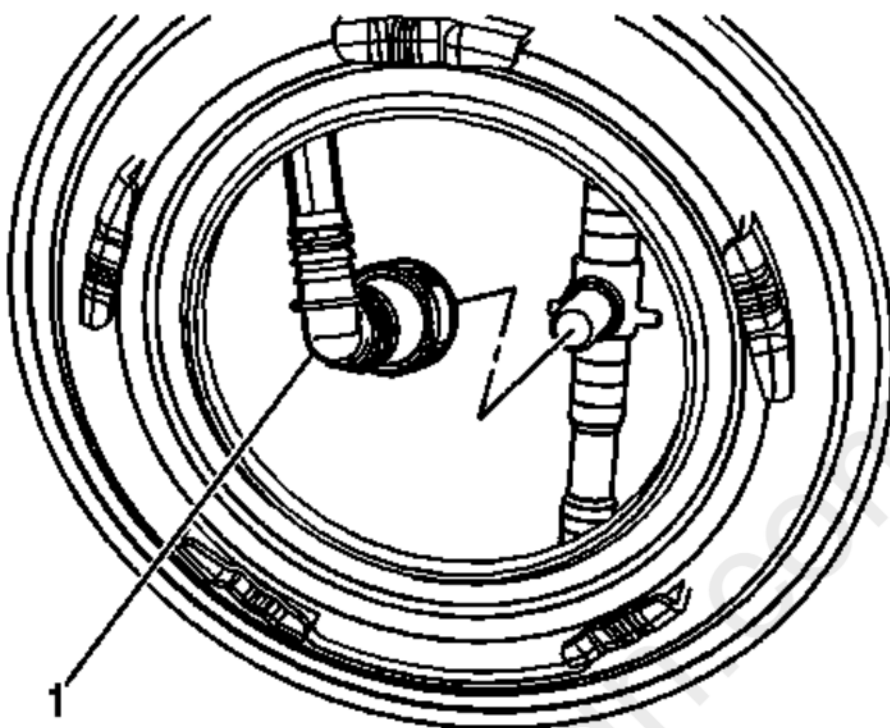


Fig. 91: Identifying Transfer Hose Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

2. If replacing the remote pickup line assembly, Connect the transfer hose quick connect fitting (1). Refer to **Plastic Collar Quick Connect Fitting Service** .

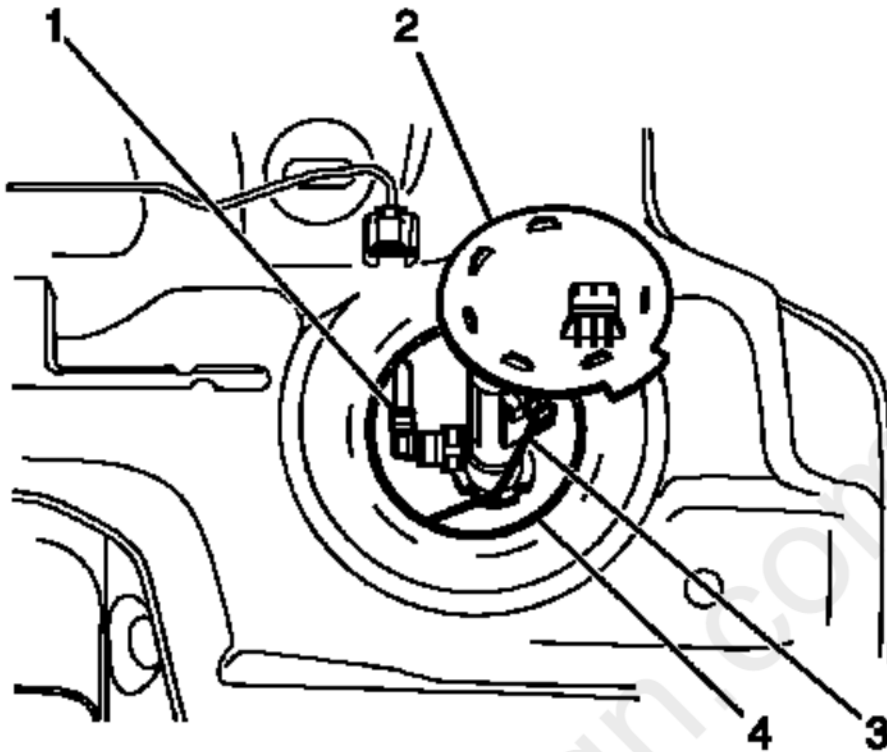


Fig. 92: Secondary Fuel Tank Module, Hose Quick Connect Fitting And Fuel Tank Module Seal
Courtesy of GENERAL MOTORS CORP.

NOTE: Always replace the fuel tank module seal when installing the fuel tank module assembly. Replace the lock ring if necessary. **DO NOT** apply any type of lubrication in the seal groove.

3. Install a NEW fuel tank module seal (4).
4. Grasp the fuel transfer hose from inside the fuel tank.
5. Partially install the secondary fuel tank module (2) to the fuel tank.
6. Connect the fuel transfer hose quick connect fitting (1) to the port on the fuel tank module.

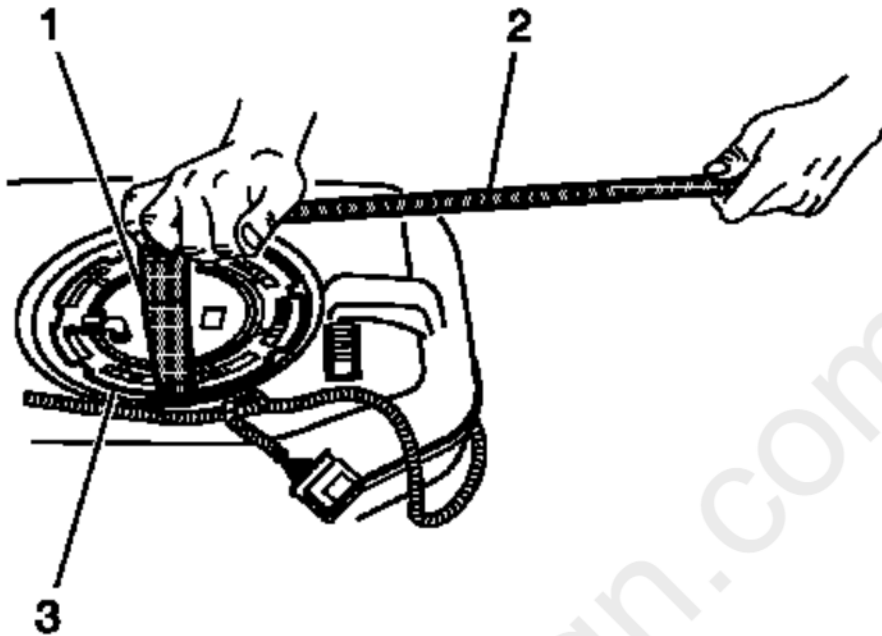


Fig. 93: Identifying J-45722, Long Breaker-Bar And Lock Ring
Courtesy of GENERAL MOTORS CORP.

7. Press the secondary fuel tank module downward, aligning the module to the encapsulated ring.

NOTE: Ensure the lock ring is installed with the correct side facing upward. A correctly installed lock ring will only turn in a clockwise direction.

8. Position the cam lock ring (3) to the fuel tank.

NOTE: DO NOT use impact tools. Significant force will be required to install the lock ring. The use of a hammer and screwdriver is not recommended. Secure the fuel tank in order to prevent fuel tank rotation.

9. Use the **J 45722**: wrench (1) and a long breaker-bar (2) to install the fuel tank module lock ring (3), by turning clockwise, until fully seated.

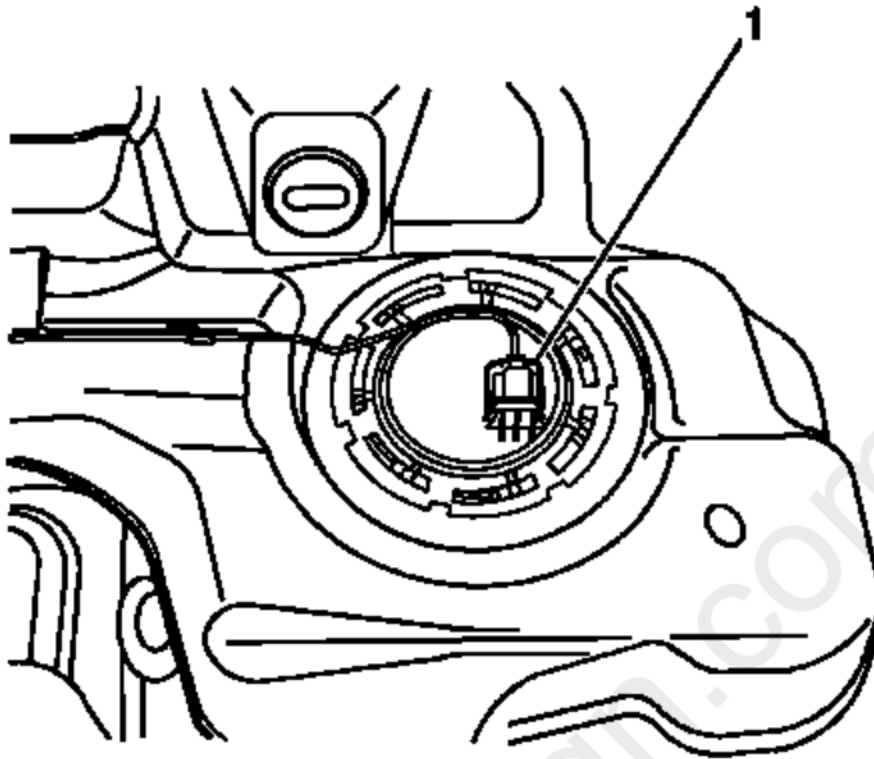


Fig. 94: View Of Electrical Connector Fuel Tank Module
Courtesy of GENERAL MOTORS CORP.

10. Connect the electrical connector (1) to the secondary fuel tank module and engage the connector interlock.
11. Install the fuel tank. Refer to **Fuel Tank Replacement**.

FUEL LEVEL SENSOR REPLACEMENT - RIGHT SIDE

Removal Procedure

WARNING: Refer to **GASOLINE/GASOLINE VAPORS WARNING** .

1. Remove the fuel tank pump module. Refer to **Fuel Tank Fuel Pump Module Replacement - Right Side**.

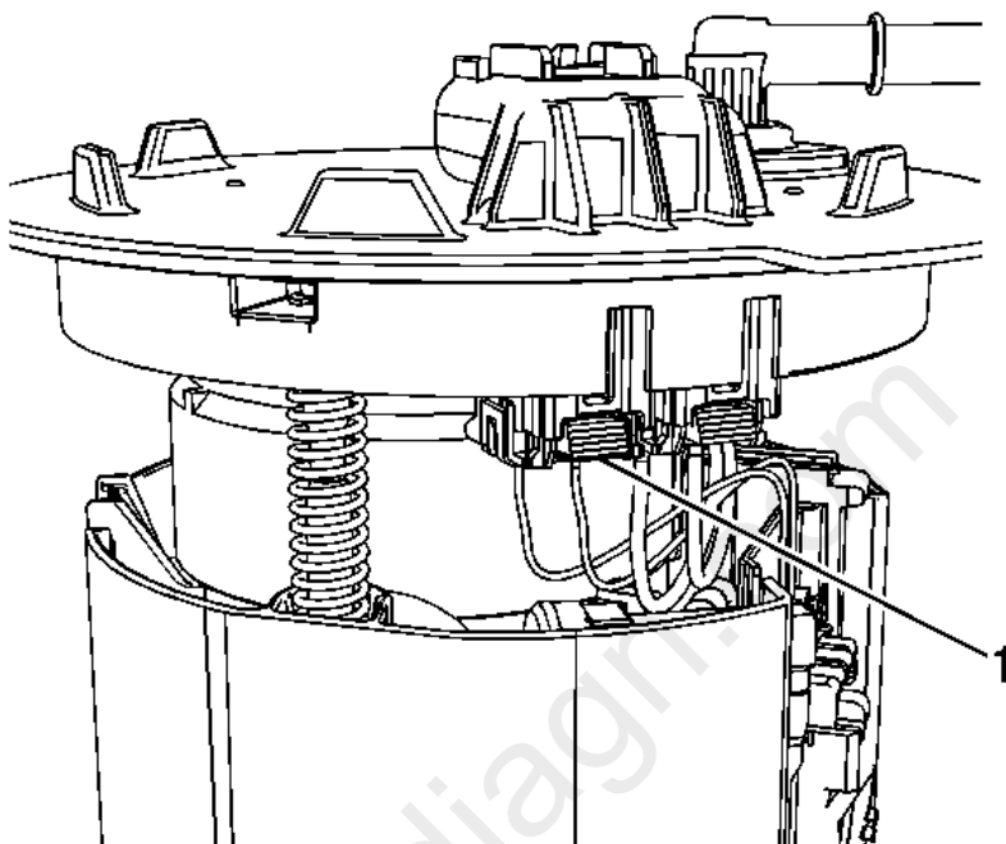


Fig. 95: Identifying Fuel Level Sensor Electrical Connector Locking Tab
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not pull on the connector wires.

2. Press in the locking tab (1) and disconnect the fuel level sensor electrical connector.

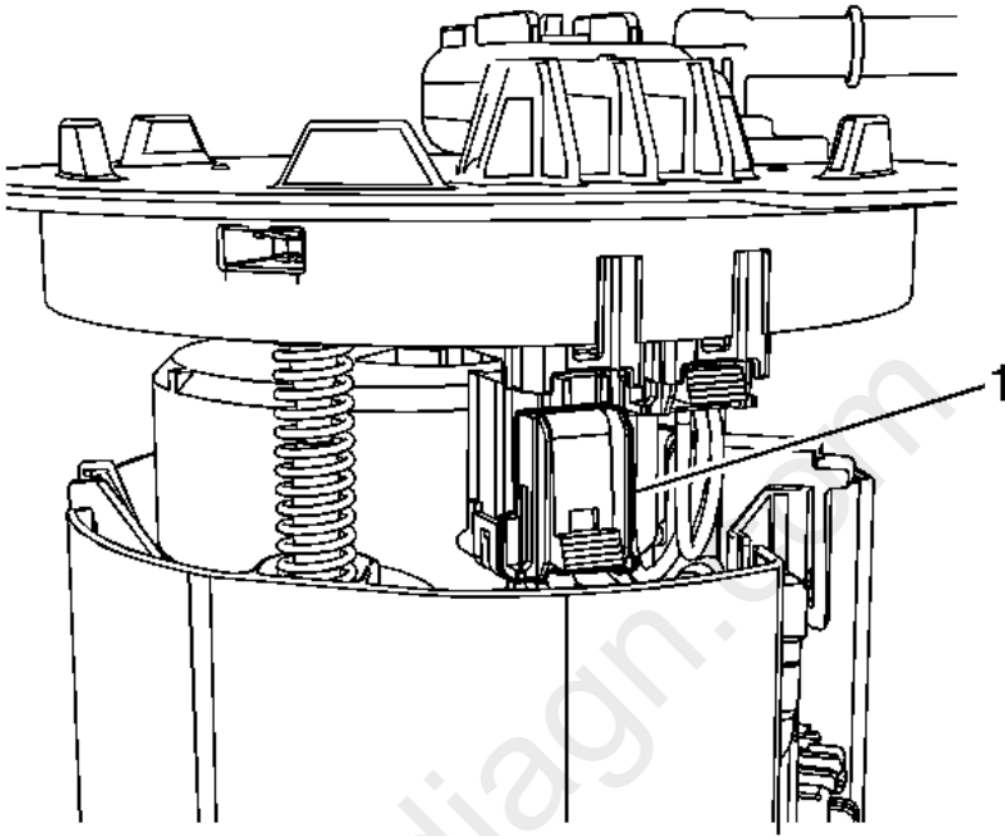


Fig. 96: Identifying Fuel Level Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the fuel level sensor electrical connector (1).

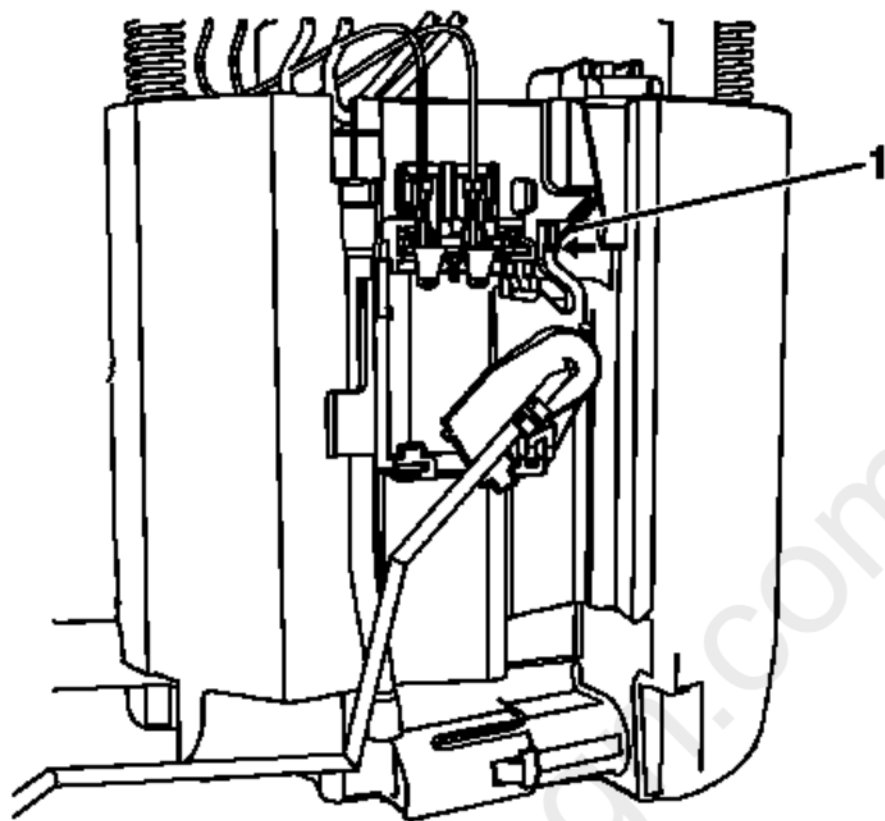


Fig. 97: Identifying Fuel Level Sensor Locking Tab
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not touch the resistor circuit board.

4. Disengage the locking tab (1) on the fuel level sensor by pushing inward.

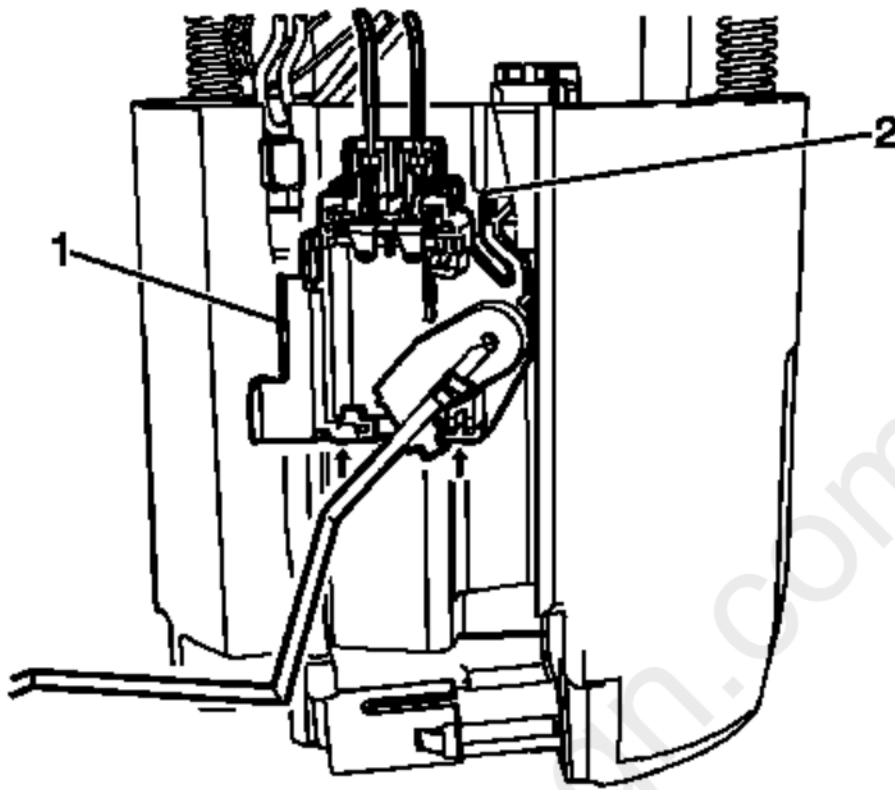


Fig. 98: Identifying Fuel Level Sensor & Stationary Lock
Courtesy of GENERAL MOTORS CORP.

5. Slide the fuel level sensor (1) upward to the stationary lock (2).

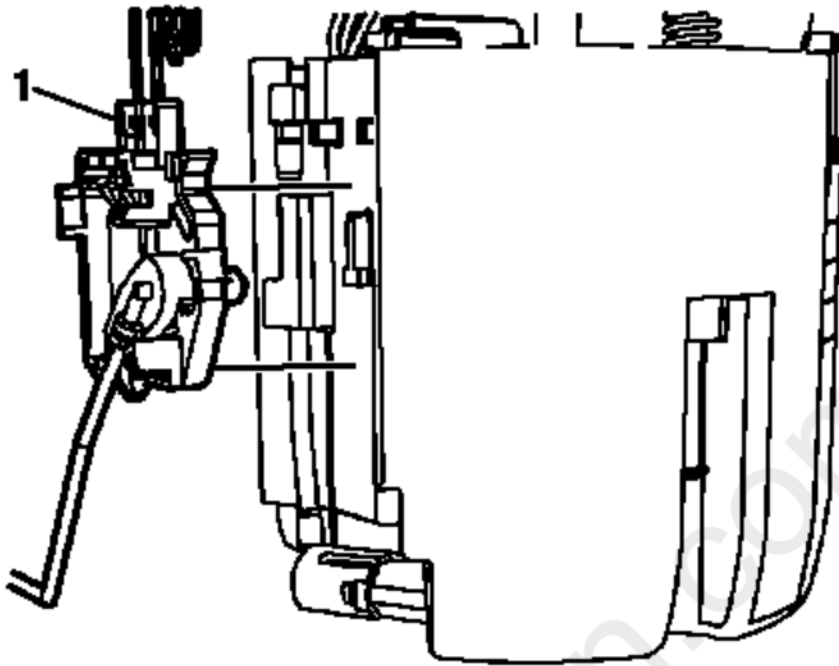


Fig. 99: Identifying Fuel Level Sensor
Courtesy of GENERAL MOTORS CORP.

6. Remove the fuel level sensor (1).

Installation Procedure

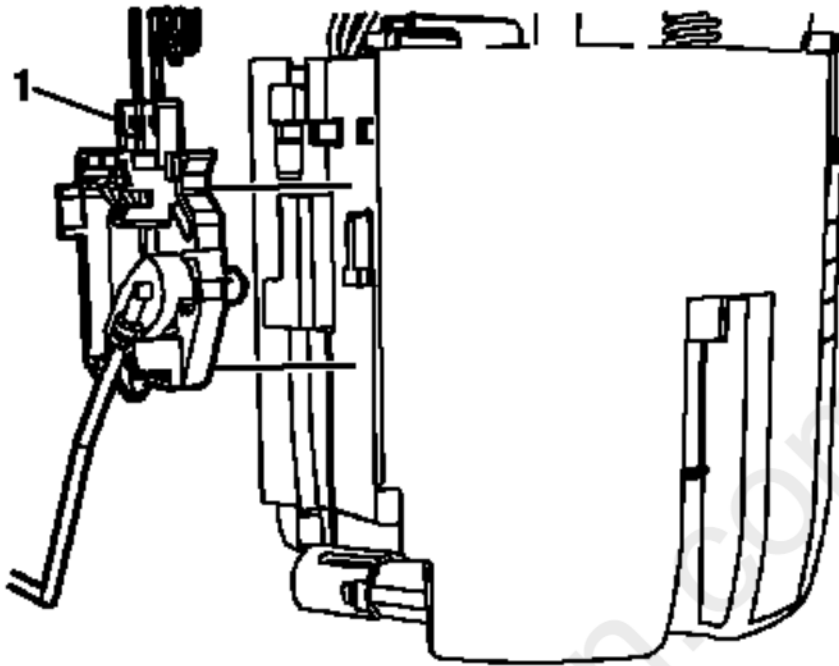


Fig. 100: Identifying Fuel Level Sensor
Courtesy of GENERAL MOTORS CORP.

1. Install the fuel level sensor (1).

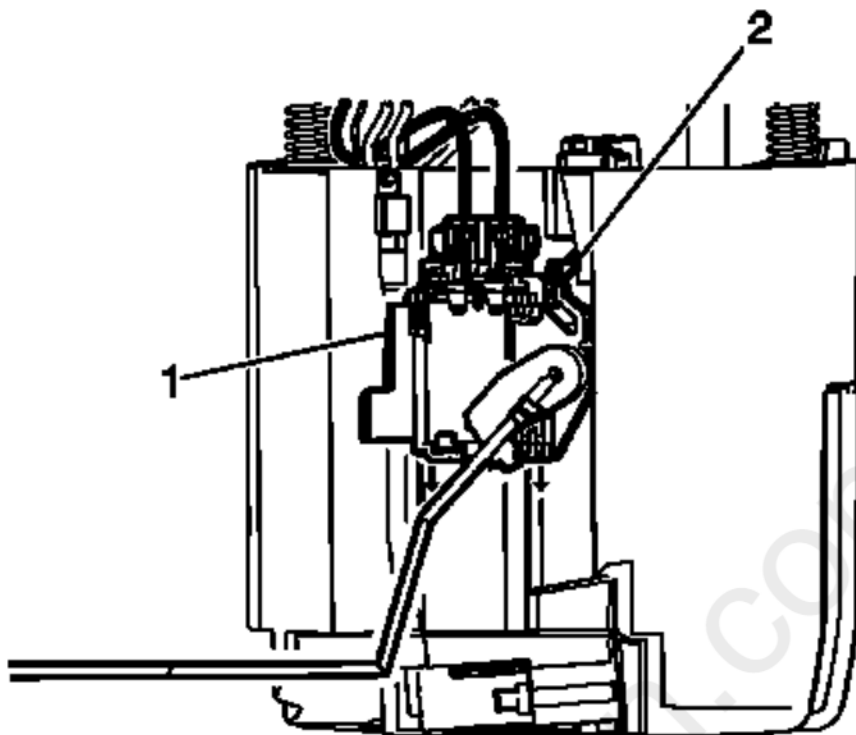


Fig. 101: Locking Fuel Level Sensor Locking Tab
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not push on the electrical terminals.

2. Slide the fuel level sensor (1) downward until the locking tab (2) locks into place.

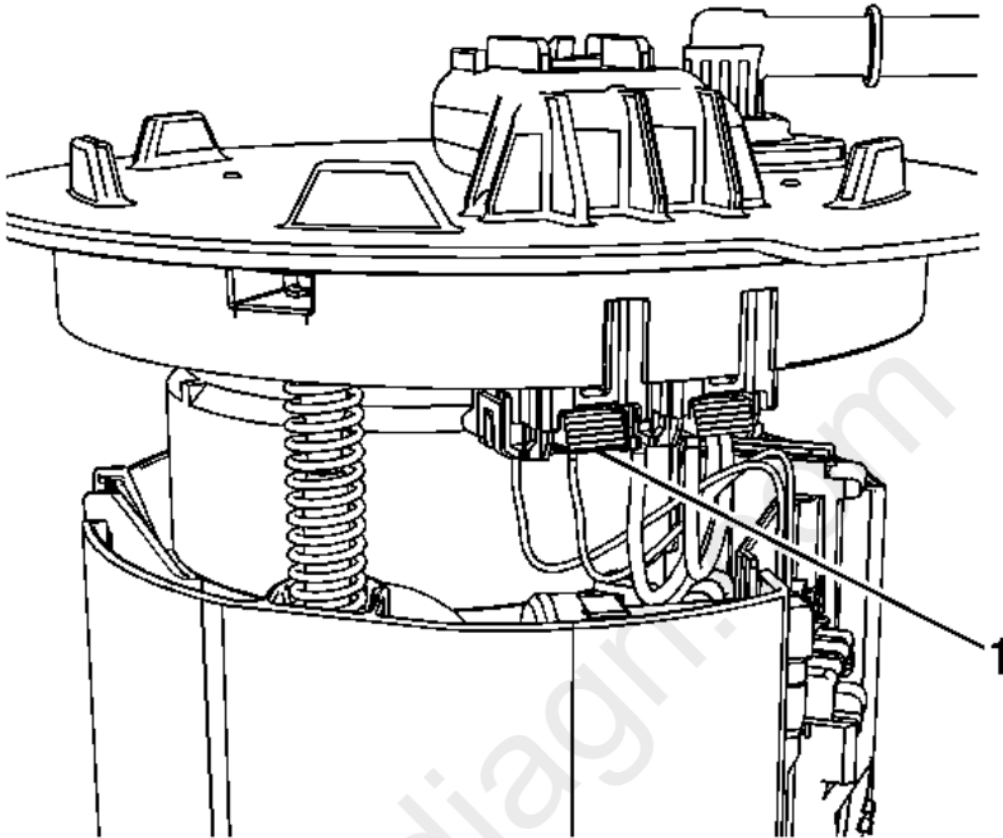


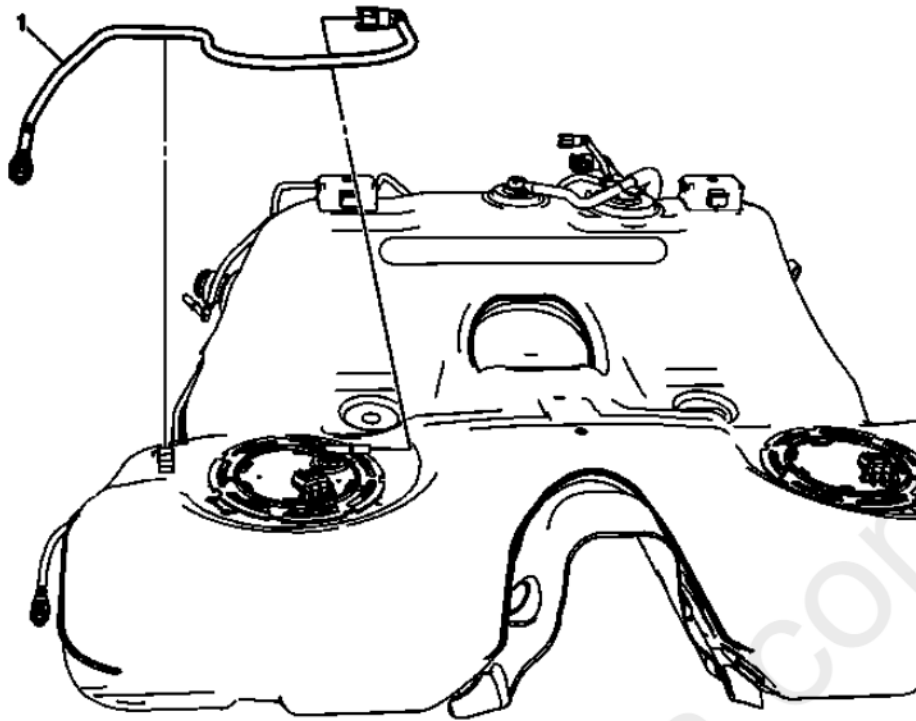
Fig. 102: Identifying Fuel Level Sensor Electrical Connector Locking Tab
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not push on the electrical wires.

NOTE: Ensure the connector locking tab is fully seated into the flange.

3. Connect the fuel level sensor electrical connector (1).
4. Install the fuel tank pump module. Refer to **Fuel Tank Fuel Pump Module Replacement - Right Side.**

FUEL FEED REAR PIPE REPLACEMENT

**Fig. 103: Fuel Feed Rear Pipe**

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure	
1. Remove the fuel tank. Refer to <u>Fuel Tank Replacement</u> .	
2. Disconnect the quick connect connector. Refer to <u>Plastic Collar Quick Connect Fitting Service</u> .	
1	Fuel Feed Rear Pipe

FUEL LINE REPLACEMENT - CHASSIS**Removal Procedure**

The fuel system hose/pipes are serviceable individually or as a complete fuel/brake bundle assembly, the following procedure is servicing the fuel hose/pipes individually.

WARNING: Refer to **RELIEVING FUEL PRESSURE WARNING** .

1. Relieve the fuel system pressure. Refer to **Fuel Pressure Relief (Without CH 48027)** or **Fuel Pressure Relief (CH 48027)**.

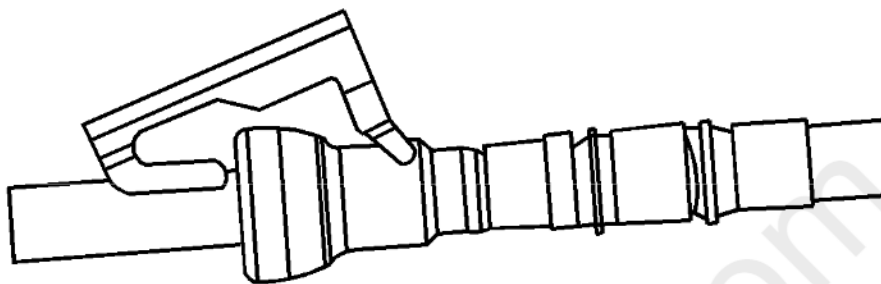


Fig. 104: View Of Quick-Connect Fitting Retainer
Courtesy of GENERAL MOTORS CORP.

2. Remove the fuel pipe retaining clip from the fuel pipe. Refer to **Metal Collar Quick Connect Fitting Service** .

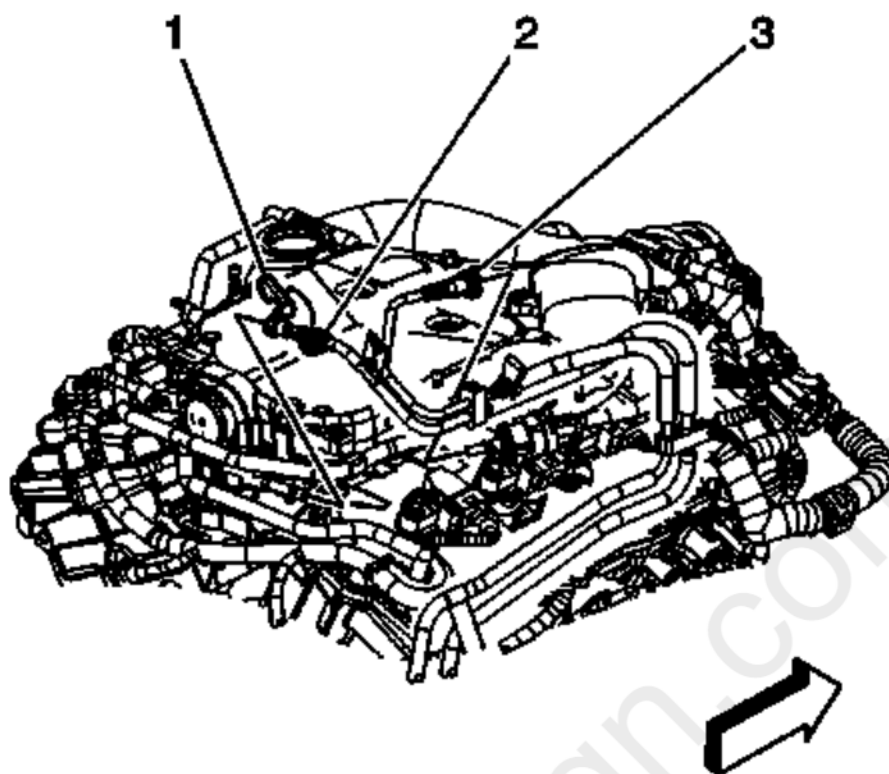


Fig. 105: Top Of Engine View

Courtesy of GENERAL MOTORS CORP.

3. Disconnect the fuel pipe (2) from the fuel rail. Refer to **Plastic Collar Quick Connect Fitting Service** .
4. Disconnect the evaporative emission (EVAP) purge line (3) from the purge solenoid.
5. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

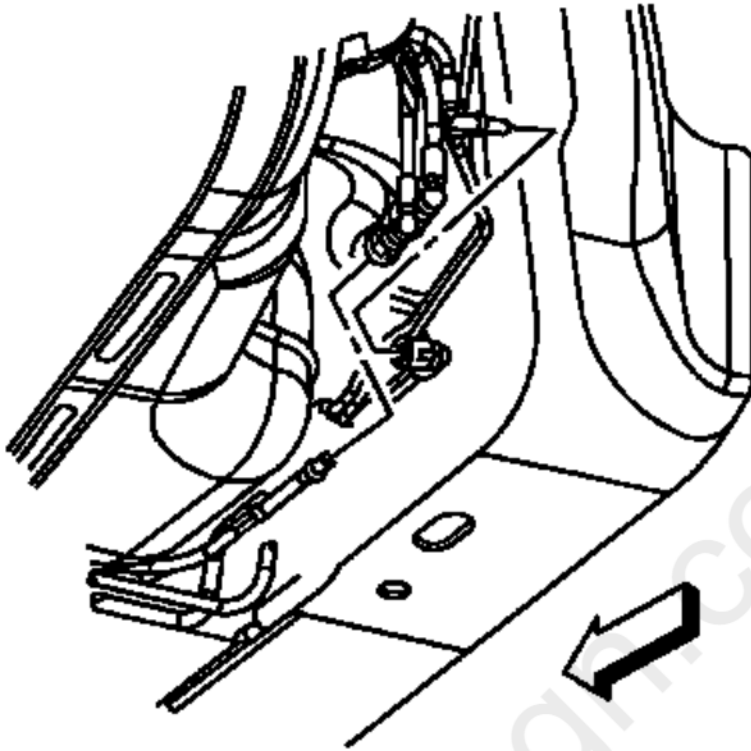


Fig. 106: View Of Fuel Pipes And Fuel Tank Bundle
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the fuel pipes from the fuel tank bundle.

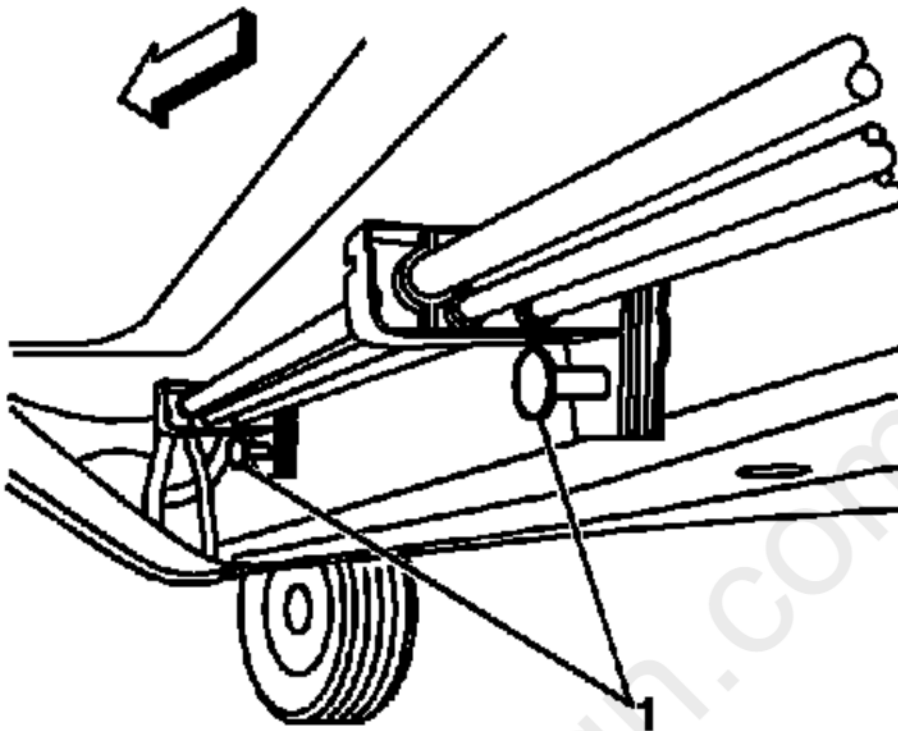


Fig. 107: Fuel/Brake Bundle Chassis Pipe Retainers Locking Mechanisms
Courtesy of GENERAL MOTORS CORP.

7. Pull the locking mechanism (1) outward in order to disengage the fuel/brake bundle chassis pipe retainers from the rail.

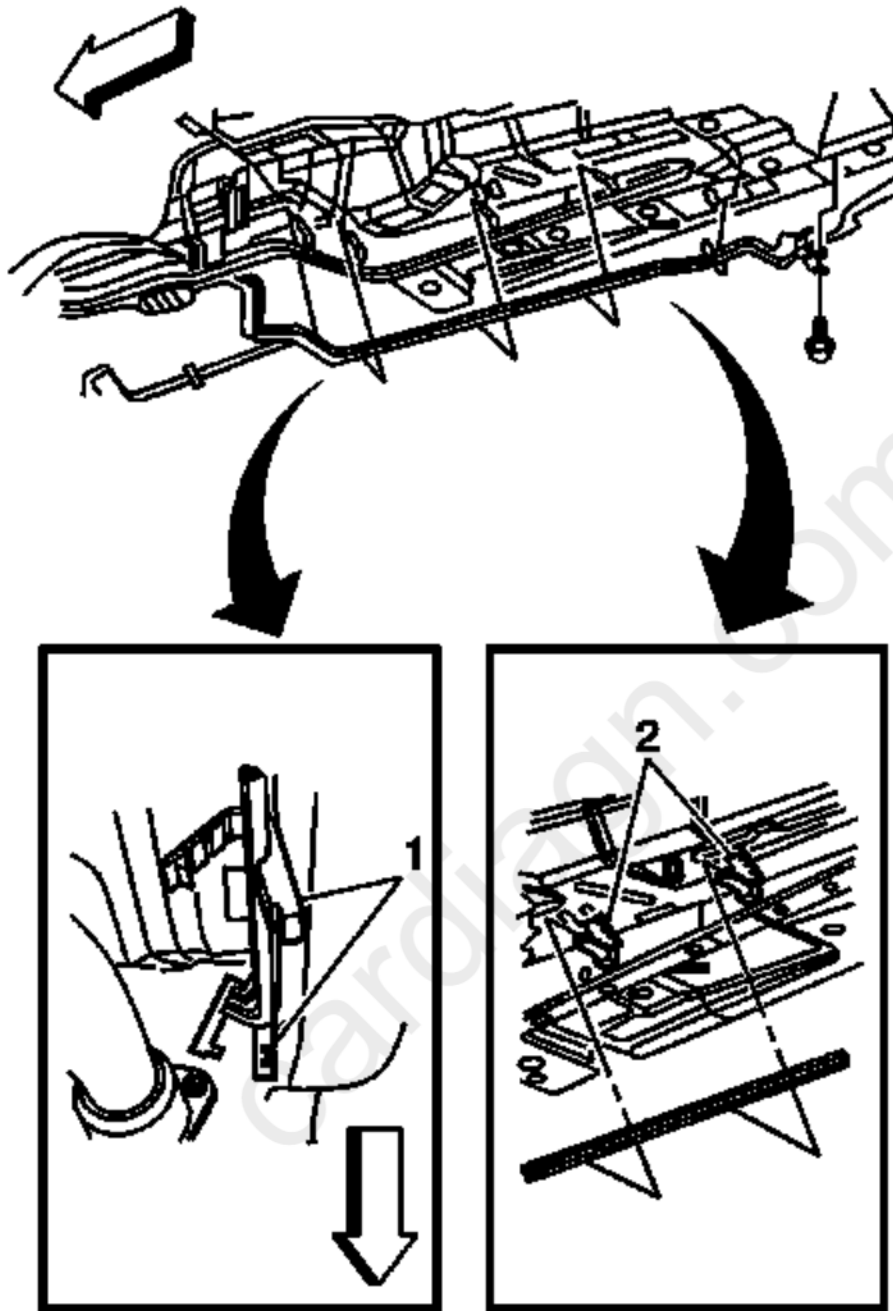


Fig. 108: Exploded View Of Chassis Hose/Pipes Retainers
Courtesy of GENERAL MOTORS CORP.

8. Open the retainers (1) located at the forward portion of the rail in order to remove the chassis hose/pipes.
9. Complete the following in order to remove the chassis hose/pipes from the retainers (2) located at the rearward portion of the rail.
 1. Pull the retainers (2) free from the rail.
 2. Open the retainers (2) at the top.

3. Remove the chassis hose/pipes from the retainers (2).

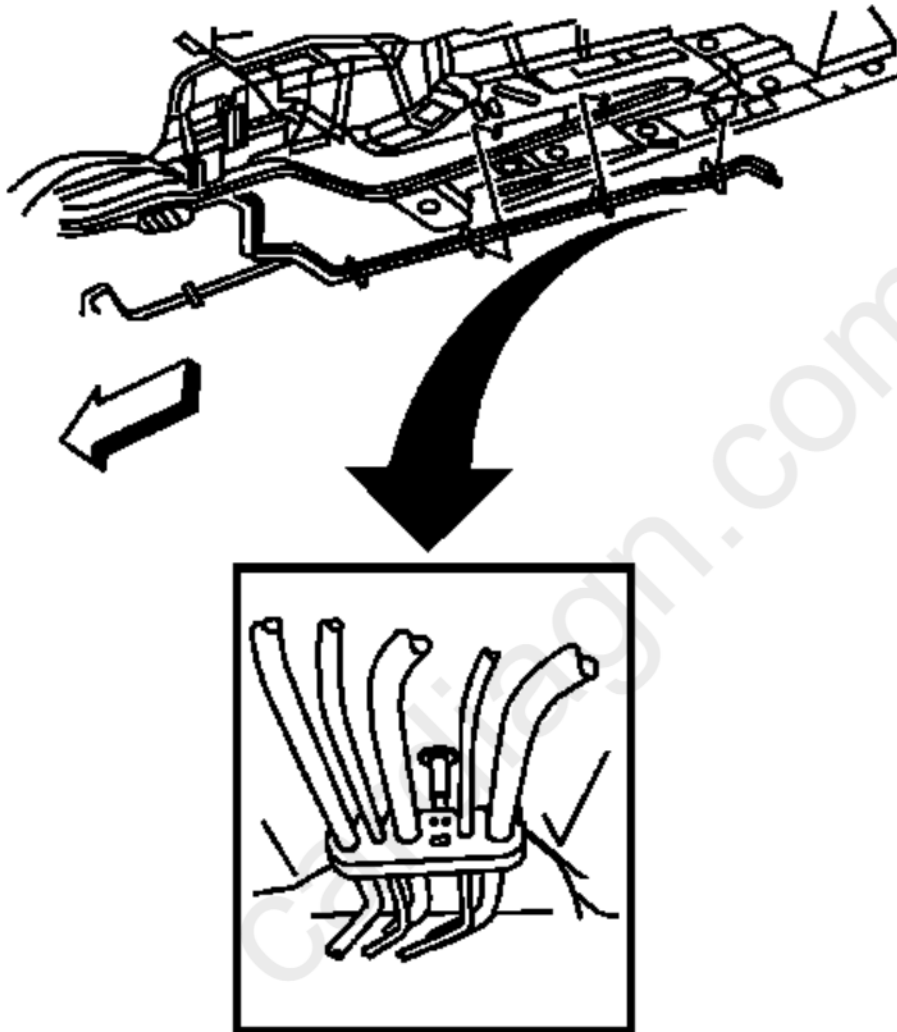


Fig. 109: Exploded View Of Fuel/Brake Bundle Chassis Pipe Retainer
Courtesy of GENERAL MOTORS CORP.

10. Pull downward in order to disconnect the fuel/brake bundle chassis pipe retainer from the underbody.
11. Remove the EVAP hose from the retainer.

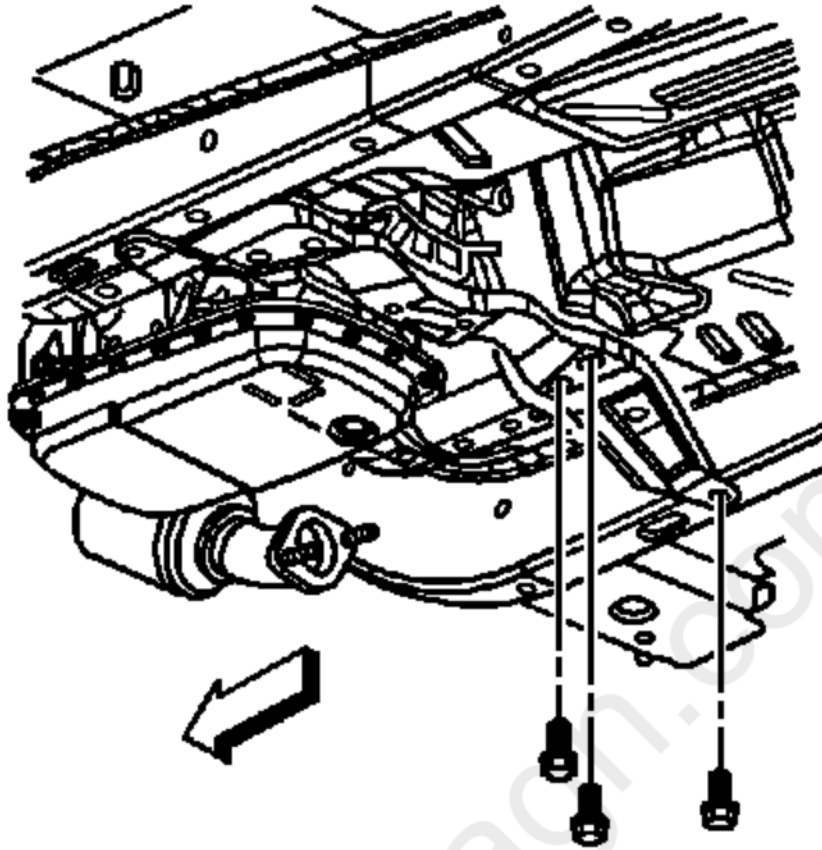


Fig. 110: View Of Transmission Support Bolts
Courtesy of GENERAL MOTORS CORP.

12. Remove the bolts securing the transmission support to the underbody, from the right side only.

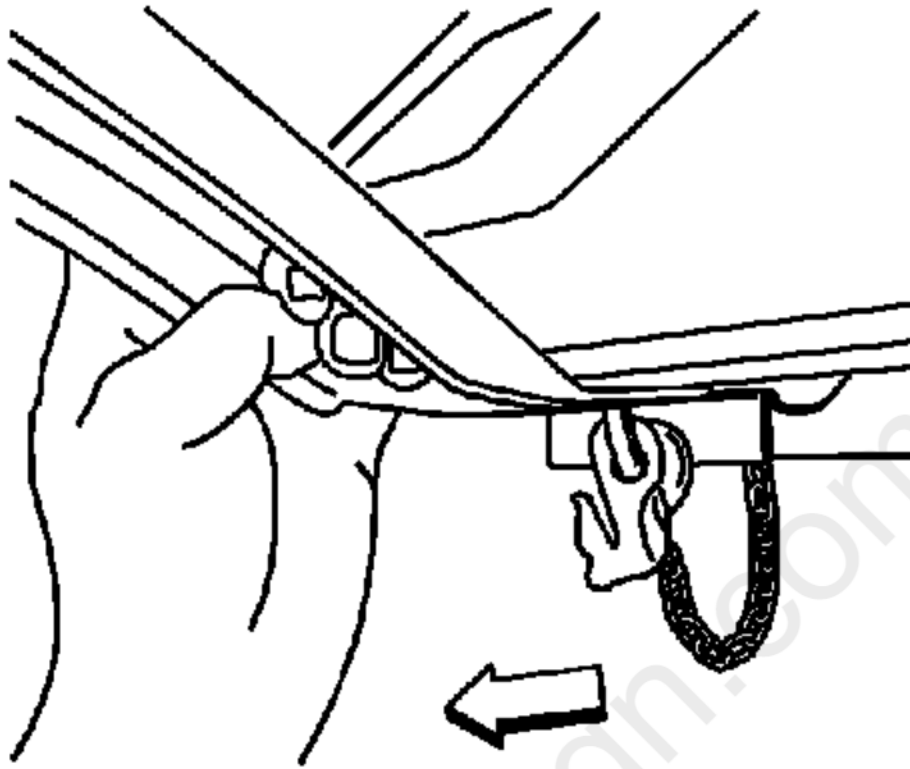


Fig. 111: Pulling Right Side Transmission Support Down
Courtesy of GENERAL MOTORS CORP.

13. Pull the right side transmission support down only enough to allow removal of the chassis fuel hose/pipes.
14. Partially lower the hoist only enough to simultaneously gain access to both the front and rear portions of the chassis fuel hose/pipes.
15. With the aid of an assistant, carefully guide the chassis fuel hose/pipes down through the engine compartment, removing from the bottom.

Installation Procedure

1. Clean any of the contamination from the male line ends and apply a few drops of clean engine oil.
2. With the aid of an assistant, carefully guide the chassis fuel hose/pipes up through the engine compartment into position.

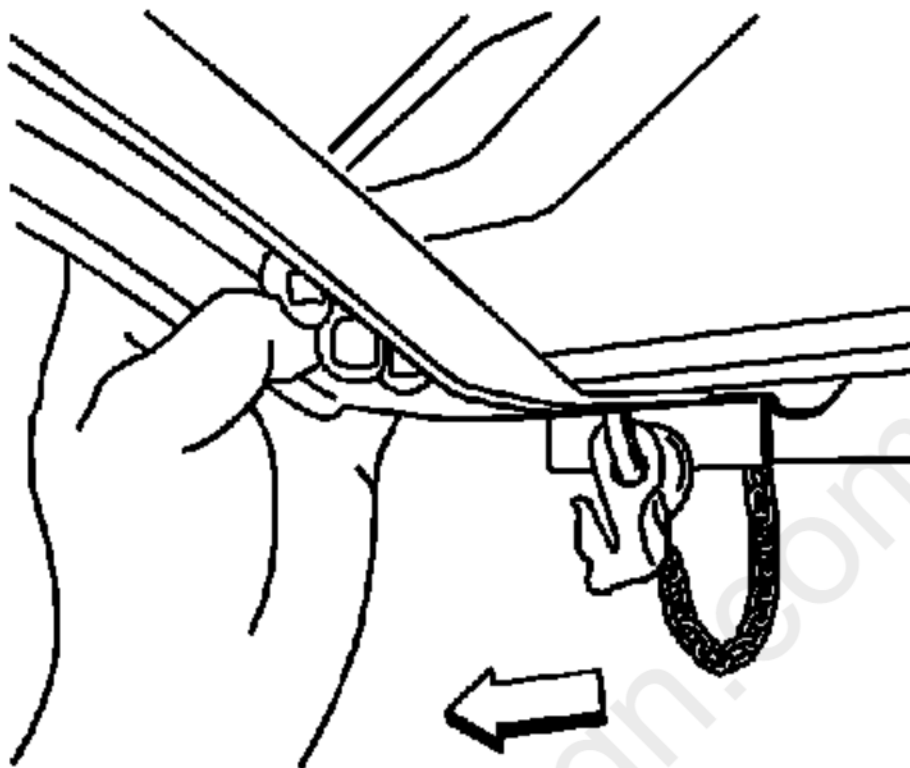


Fig. 112: Pulling Right Side Transmission Support Down
Courtesy of GENERAL MOTORS CORP.

3. Pull the right side transmission support down only enough to allow installation of the chassis fuel hose/pipes.

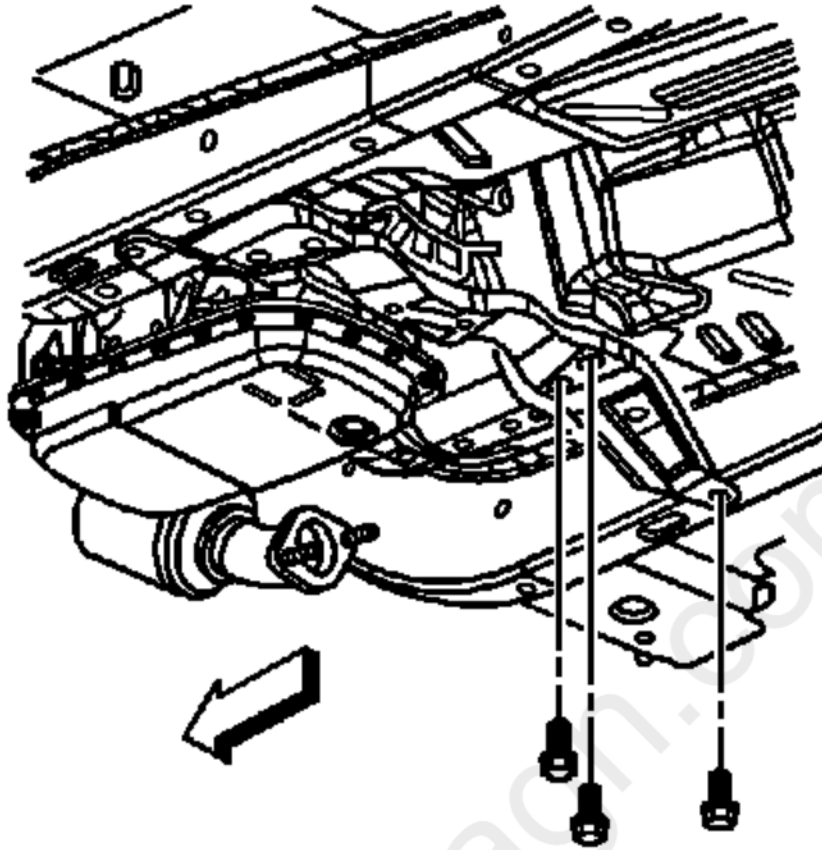


Fig. 113: View Of Transmission Support Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the transmission support right side bolts. Refer to **Transmission Support Replacement (Automatic AWD)** or **Transmission Support Replacement (Automatic CTS-V)** or **Transmission Support Replacement (Automatic RWD except CTS-V)** or **Transmission Support Replacement (Manual CTS-V)** or **Transmission Support Replacement (Manual except CTS-V)** .

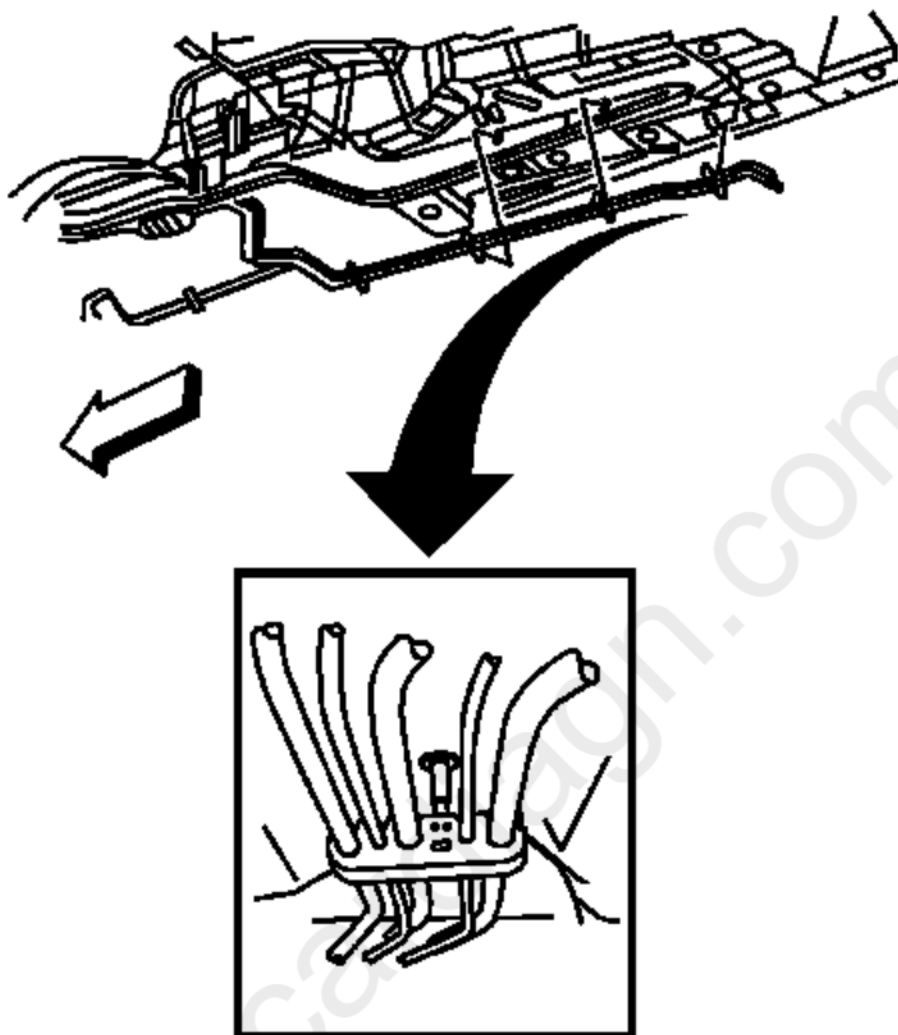


Fig. 114: Exploded View Of Fuel/Brake Bundle Chassis Pipe Retainer
Courtesy of GENERAL MOTORS CORP.

5. Install the EVAP hose to the retainer.
6. Install the fuel/brake bundle to the underbody.

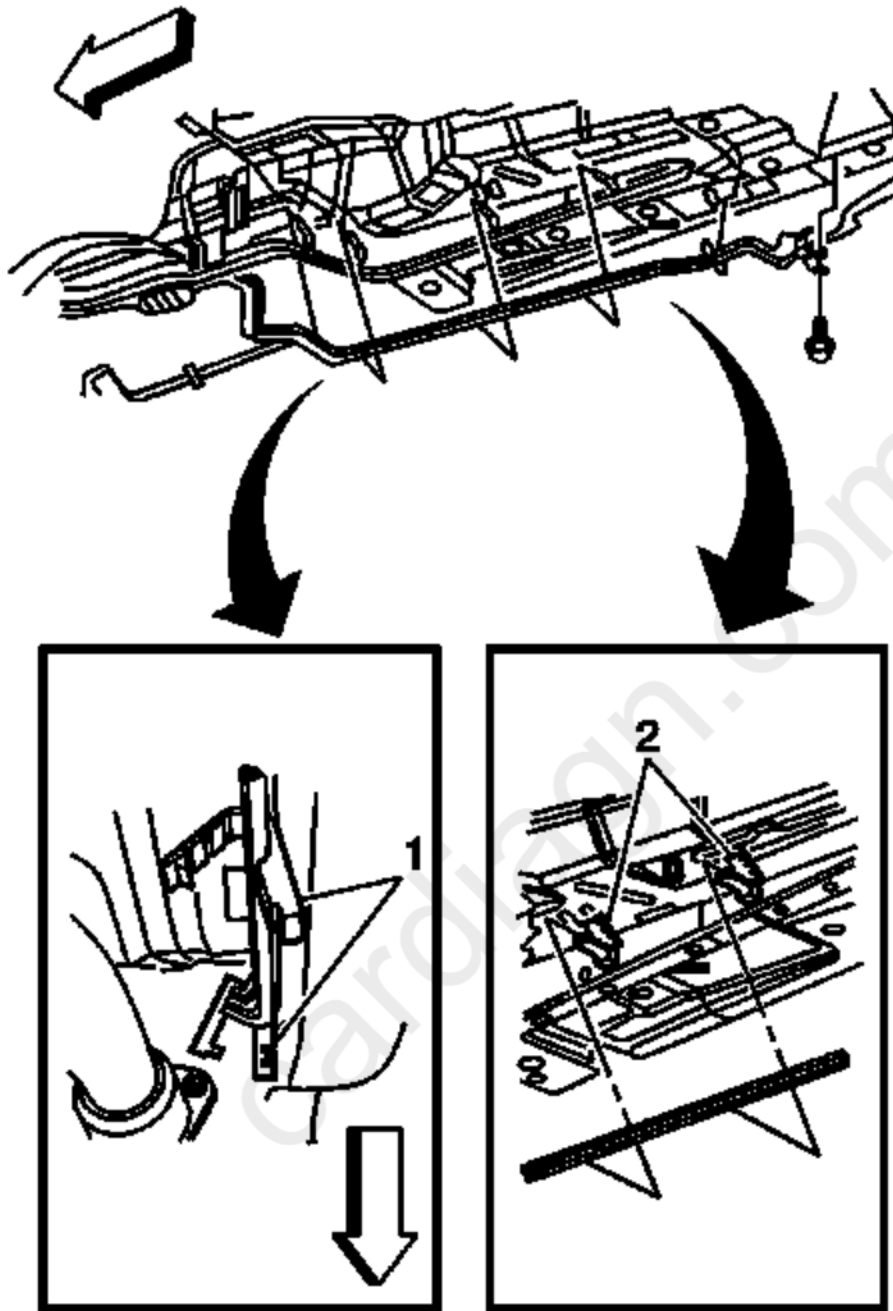


Fig. 115: Exploded View Of Chassis Hose/Pipes Retainers
Courtesy of GENERAL MOTORS CORP.

7. Complete the following in order to install the chassis hose/pipes to the retainers (2) located at the rearward portion of the rail:
 1. Install the chassis hose/pipes into the retainers (2).
 2. Close the retainers (2) at the top.
 3. Insert the retainers (2) into the rail.

8. Install the chassis hose/pipes into the retainers (1) located at the forward portion of the rail.
9. Close the retainers.

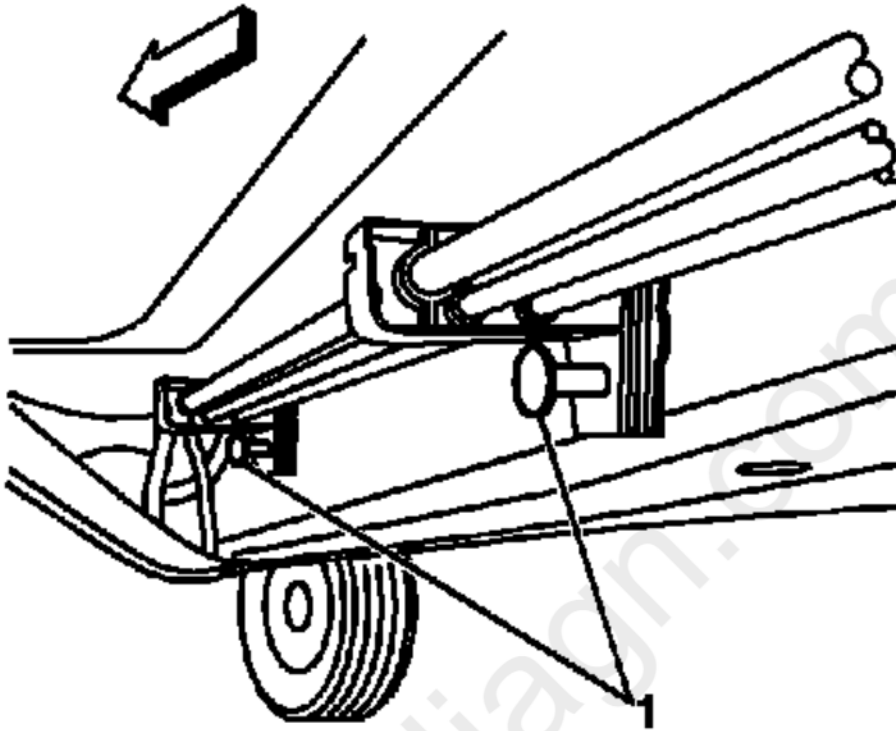


Fig. 116: Fuel/Brake Bundle Chassis Pipe Retainers Locking Mechanisms
Courtesy of GENERAL MOTORS CORP.

10. Push the locking mechanism (1) inward in order to engage the fuel/brake bundle chassis pipe retainers to the rail.

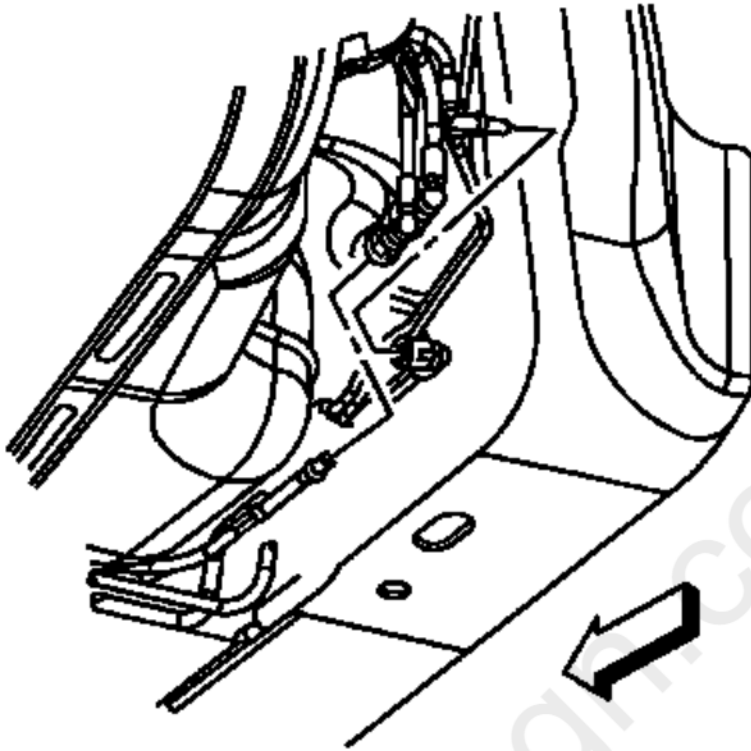


Fig. 117: View Of Fuel Pipes And Fuel Tank Bundle
Courtesy of GENERAL MOTORS CORP.

11. Connect the fuel feed pipe and the EVAP hose to the fuel bundle.
12. Lower the vehicle.

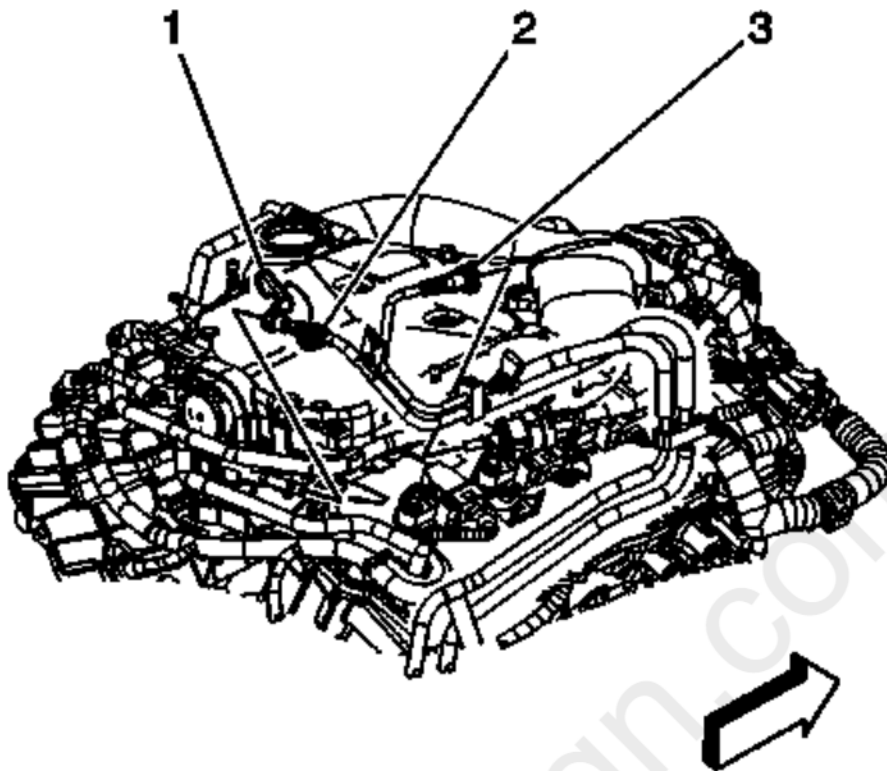


Fig. 118: Top Of Engine View

Courtesy of GENERAL MOTORS CORP.

13. Connect the evaporative emission (EVAP) purge line (3) to the purge solenoid.
14. Connect the fuel feed pipe (1) to the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service** .

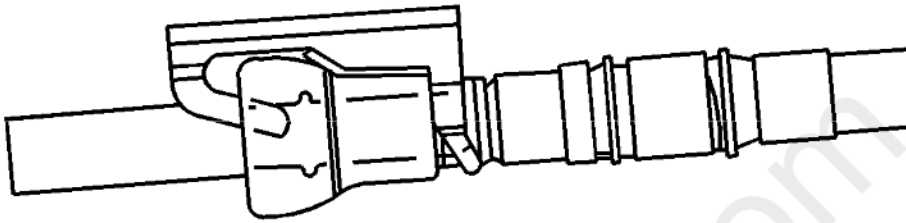


Fig. 119: View Of Fuel Pipe Retainer
Courtesy of GENERAL MOTORS CORP.

15. Install the fuel pipe retaining clip.

FUEL PRESSURE SENSOR REPLACEMENT

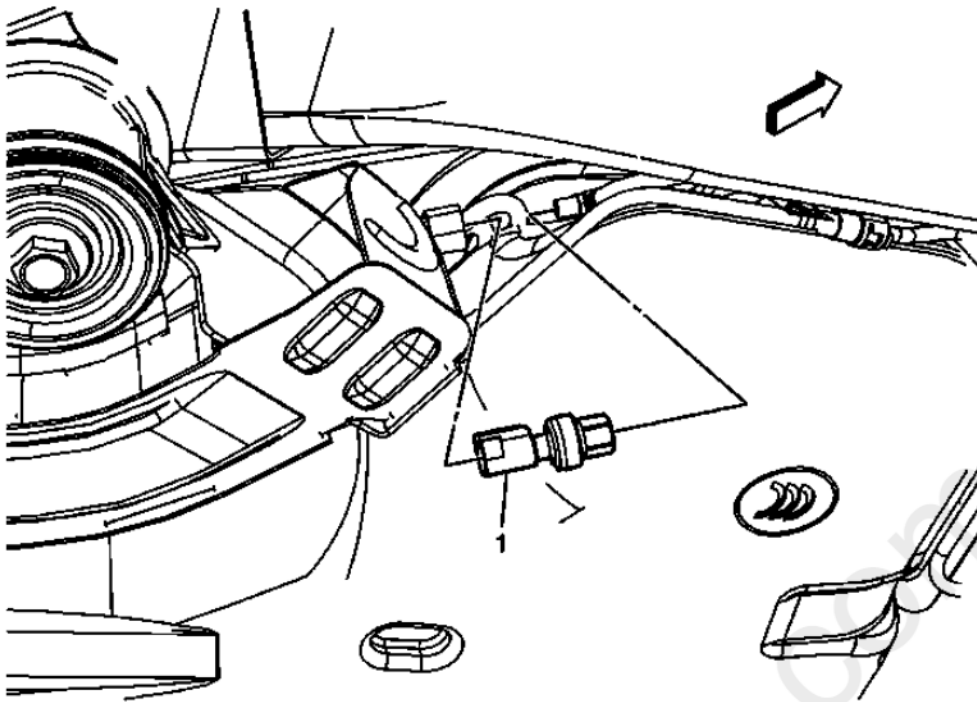


Fig. 120: Identifying Fuel Pressure Sensor
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .	
1	Fuel Pressure Sensor CAUTION: Refer to FASTENER CAUTION . Procedure 1. Lubricate a NEW fuel pressure sensor O-ring seal with clean engine oil. 2. Install the NEW fuel pressure sensor O-ring seal onto the fuel line fitting. 3. Wrap a shop towel around the fuel pressure sensor fitting in order to absorb any fuel that may leak out. Tip: The fuel pressure sensor is located in the fuel pipe to the right of the fuel tank. Tighten: 10 N.m (89 lb in)

FUEL SYSTEM CLEANING

WARNING: Refer to GASOLINE/GASOLINE VAPORS WARNING .

The following procedure covers the disassembly and the inspection of the complete fuel supply system. If the fuel system is contaminated, the fuel system can be cleaned. You can usually determine the extent of the fuel system contamination during the disassembly.

1. Remove the fuel tank fuel pump module. Refer to **Fuel Tank Fuel Pump Module Replacement - Right Side**.
2. Remove the fuel level sender assembly. Refer to **Fuel Level Sensor Replacement - Left Side**
3. Locate the tank in a suitable work area away from any heat, any flame, or any other source of ignition.
4. Perform the following procedures:
 - Inspect the fuel sender strainer. Replace the primary fuel tank module if the strainer is contaminated.
 - Inspect the secondary fuel tank module for debris. Clean the secondary fuel tank module if debris is found.

WARNING: Wear safety glasses when using compressed air, as flying dirt particles may cause eye injury.

- Use compressed air in order to apply air pressure to the transfer tube.

NOTE: When flushing the fuel tank, handle the fuel and water mixture as a hazardous material. Handle the fuel and water in accordance with all applicable local, state, and federal laws and regulations.

5. Flush the fuel tank with running hot water for at least five minutes. Pour the water out of the fuel sender assembly opening. Rock the tank in order to ensure that the removal of the water from the tank is complete.
6. Refer to **Metal Collar Quick Connect Fitting Service** in order to disconnect the following quick connect fittings from the fuel rail:
 - The feed hose/pipe
 - The return hose/pipe
7. Use compressed air in order to apply air pressure to the fuel lines in the opposite direction from the normal fuel flow.
8. Remove the fuel injectors. Refer to **Fuel Injector Replacement**.
9. Clean and inspect the fuel injectors and fuel rail.

Installation Procedure

Assemble the fuel system as follows:

1. Install the fuel injectors. Refer to **Fuel Injector Replacement**.

2. Install the fuel tank fuel pump module. Refer to **Fuel Tank Fuel Pump Module Replacement - Right Side**.
3. Install the fuel level sender assembly. Refer to **Fuel Level Sensor Replacement - Left Side**
4. Refer to **Metal Collar Quick Connect Fitting Service** in order to connect the following quick connect fittings to the fuel rail:
 - The feed hose/pipe
 - The return hose/pipe

FUEL INJECTION FUEL RAIL ASSEMBLY REPLACEMENT

Removal Procedure

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (Sedan, Wagon)** or **Battery Negative Cable Disconnection and Connection (Coupe)** .
2. Remove the front and rear intake manifold covers. Refer to **Intake Manifold Cover Replacement - Rear** .
3. Relieve the fuel system pressure. Refer to **Fuel Pressure Relief (Without CH 48027)** or **Fuel Pressure Relief (CH 48027)**
4. Disconnect the fuel pipe from the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service**

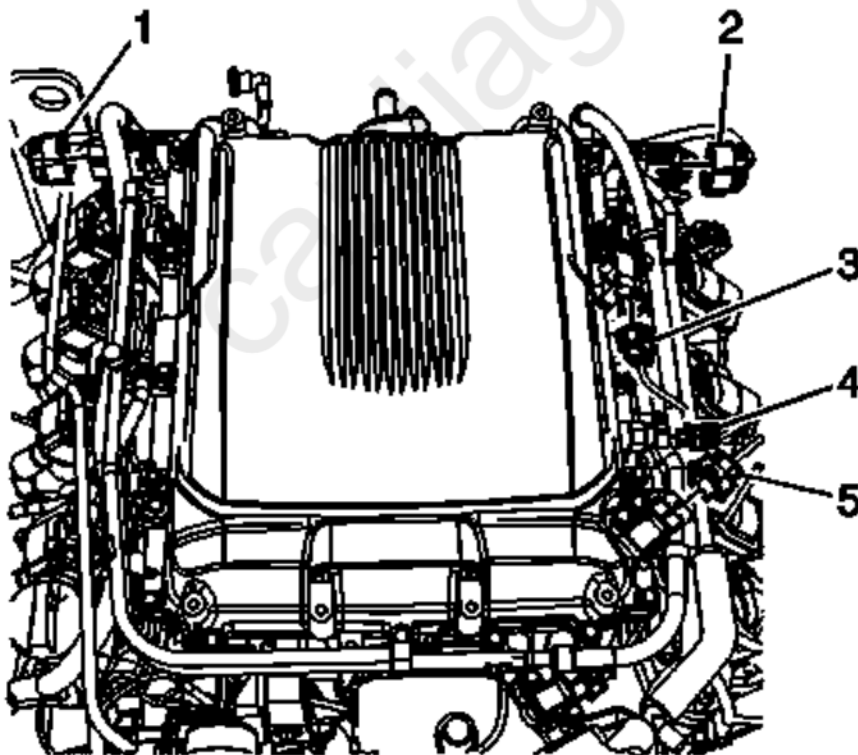


Fig. 121: Identifying Fuel Injection Harness Connectors
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the fuel injection Harness connectors (1, 2).
6. Disconnect the BARO sensor harness connector (5).
7. Disconnect the intake temperature sensor harness connector (4).
8. Disconnect the supercharger air outlet pressure sensor harness connector (3).

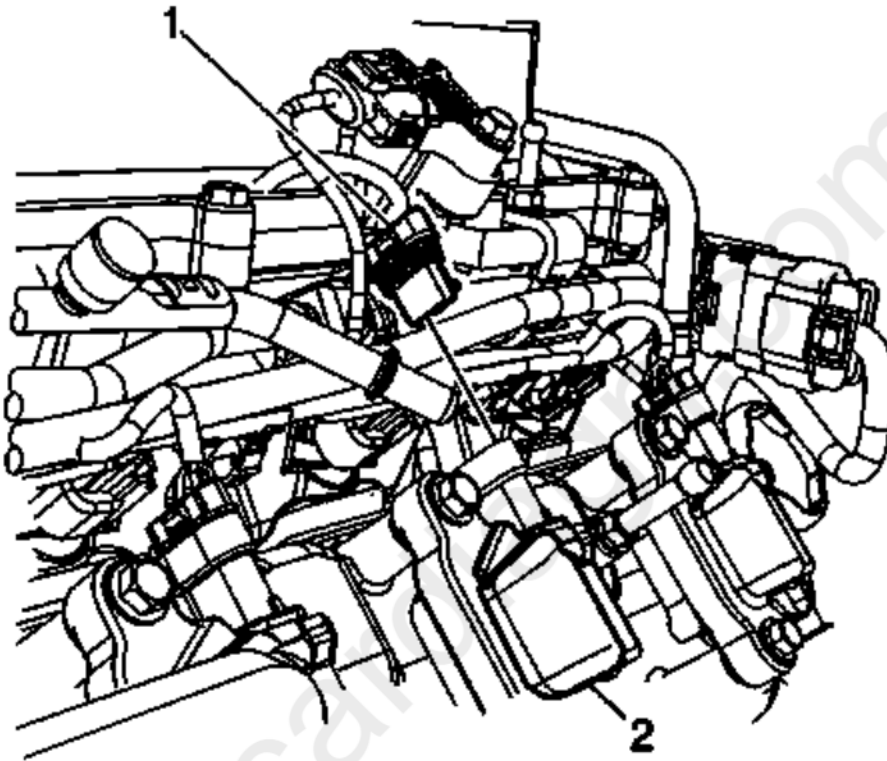


Fig. 122: Identifying Ignition Coil Harness Connector
Courtesy of GENERAL MOTORS CORP.

9. Disconnect all 8 ignition coil harness connectors (1).

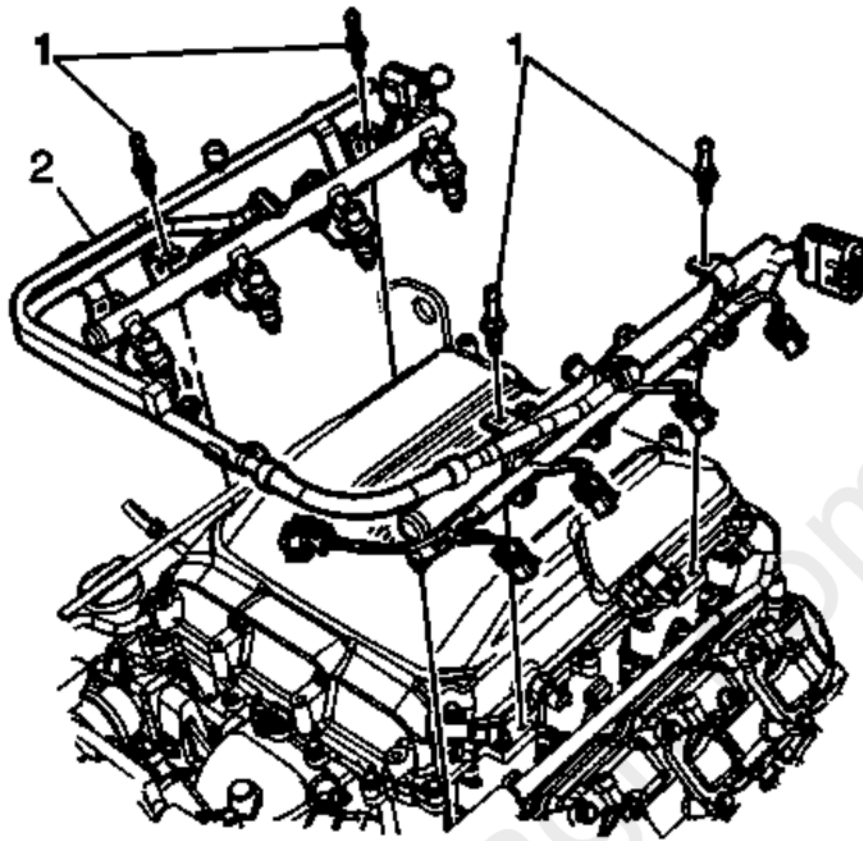


Fig. 123: Identifying Fuel Rail Ball Stud Fasteners
Courtesy of GENERAL MOTORS CORP.

10. Remove the front fuel rail fastener.
11. Remove the fuel rail ball stud fasteners (1).
12. Carefully disengage the fuel injectors from the supercharger.
13. Remove the fuel rail with the fuel injector harness from the engine.

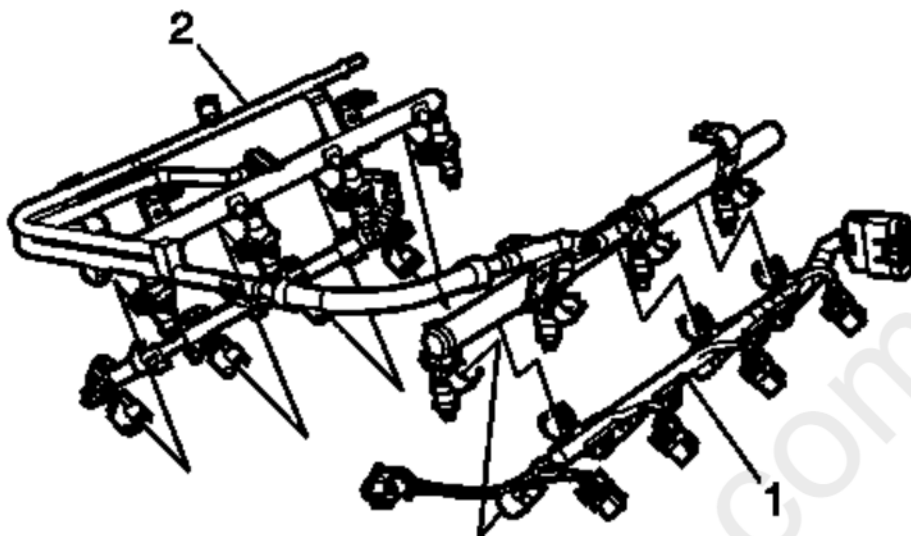


Fig. 124: Identifying Fuel Injection Wiring Harness
Courtesy of GENERAL MOTORS CORP.

14. Remove the fuel injection wiring harness (1, 2) from the fuel rail and fuel injectors.
15. If replacing the fuel rail of an injector. Refer to **Fuel Injector Replacement**.

Installation Procedure

1. Install the fuel injectors if removed. Refer to **Fuel Injector Replacement**.

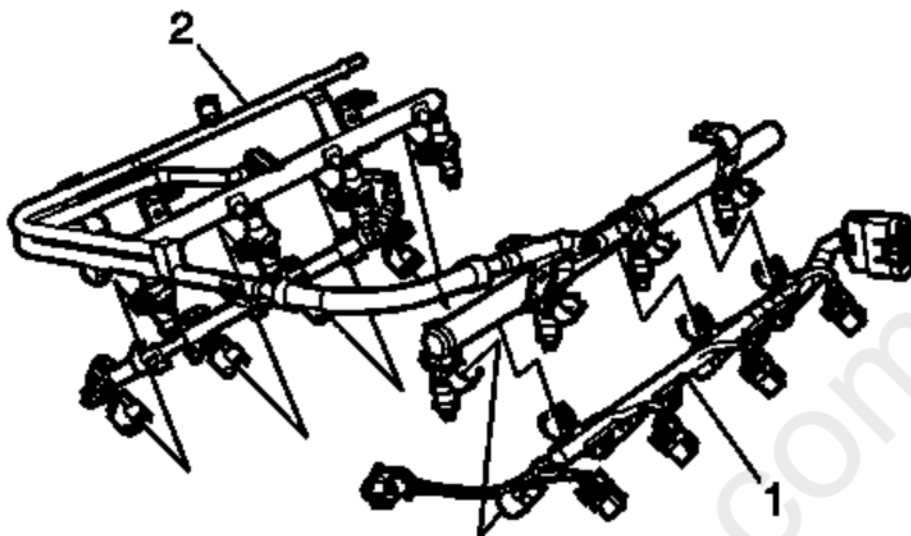


Fig. 125: Identifying Fuel Injection Wiring Harness
Courtesy of GENERAL MOTORS CORP.

2. Install the fuel injection wiring harness (1, 2) to the fuel rail and fuel injectors.

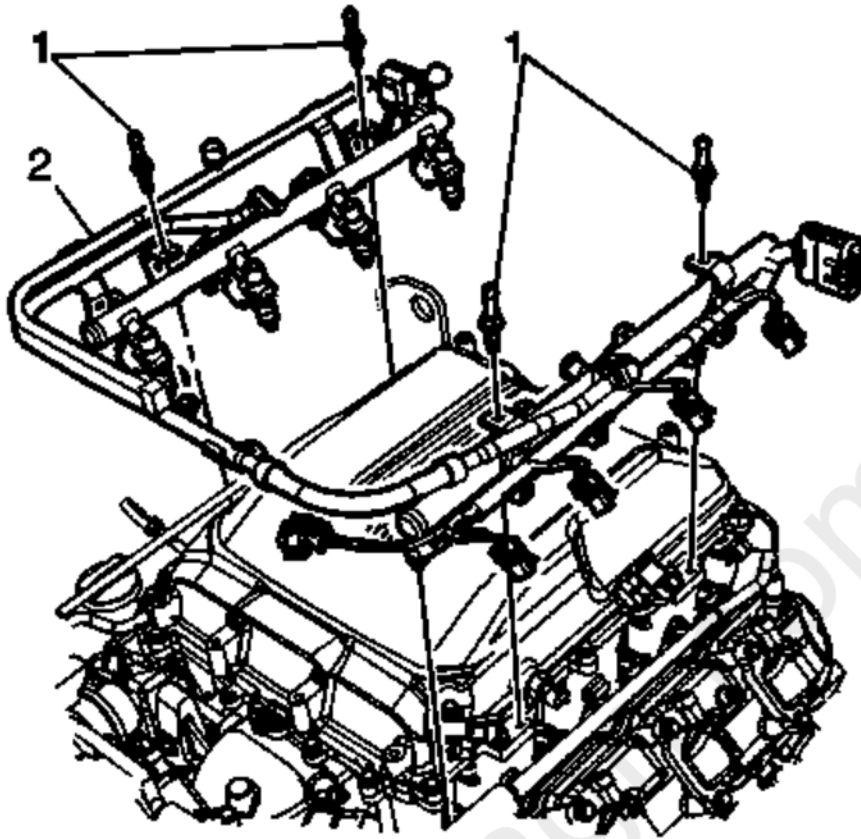


Fig. 126: Identifying Fuel Rail Ball Stud Fasteners
Courtesy of GENERAL MOTORS CORP.

3. install the fuel rail with the fuel injector harness (2) to the engine.
4. Carefully locate the fuel injectors into the supercharger. Install the left side first and then the right side.
5. Apply threadlock to the ball stud and fastener threads. Refer to **Adhesives, Fluids, Lubricants, and Sealers**.

CAUTION: Refer to FASTENER CAUTION.

6. Install the ball studs (1) and the forward fastener and tighten to 10 N.m (89 lb in).

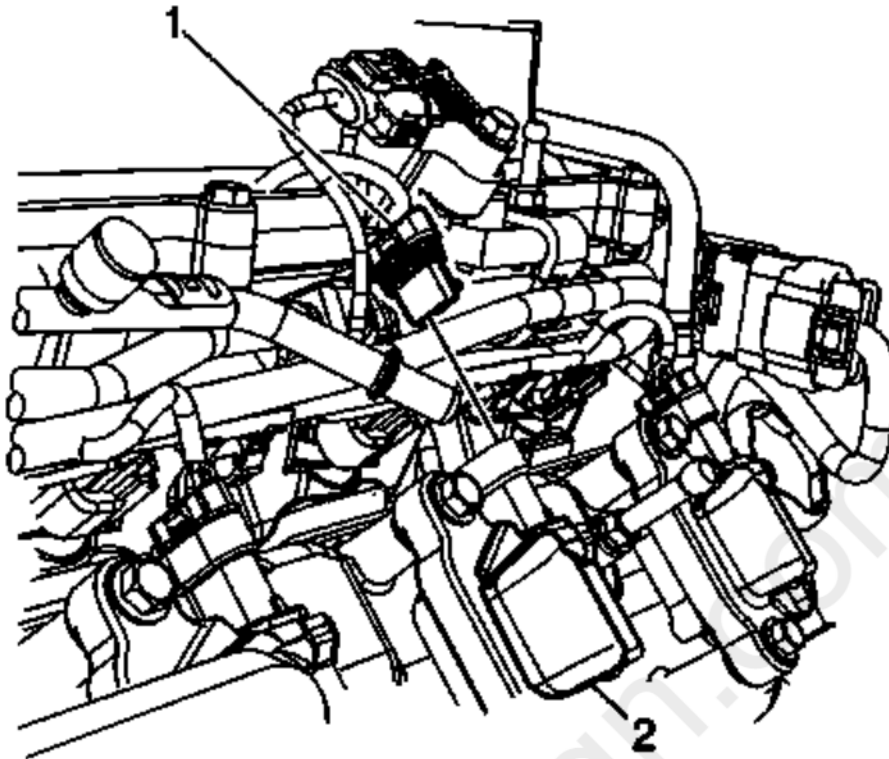


Fig. 127: Identifying Ignition Coil Harness Connector
Courtesy of GENERAL MOTORS CORP.

7. Connect all 8 ignition coil harness connectors (1).

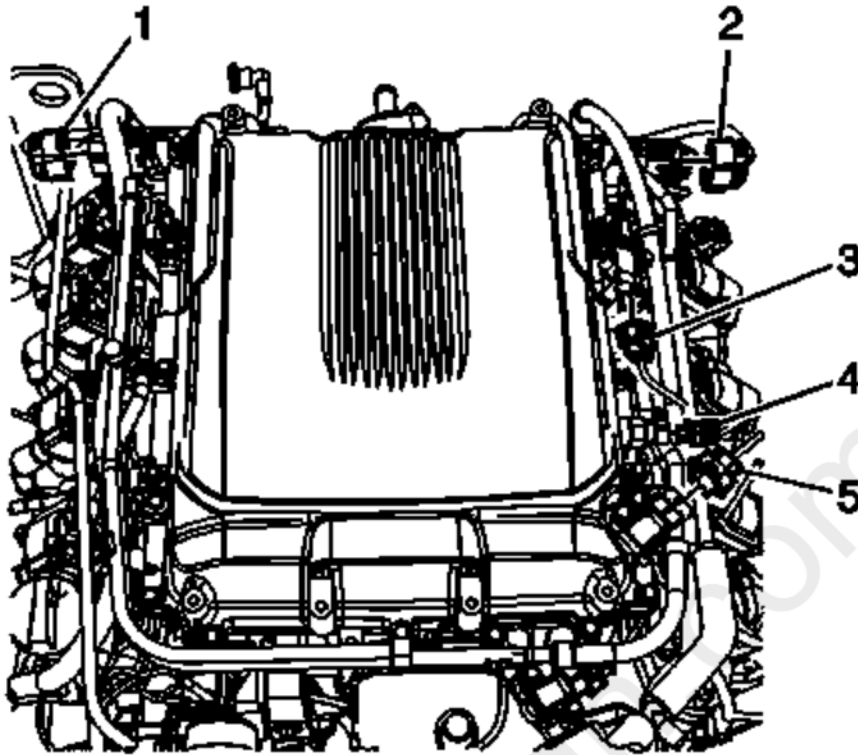
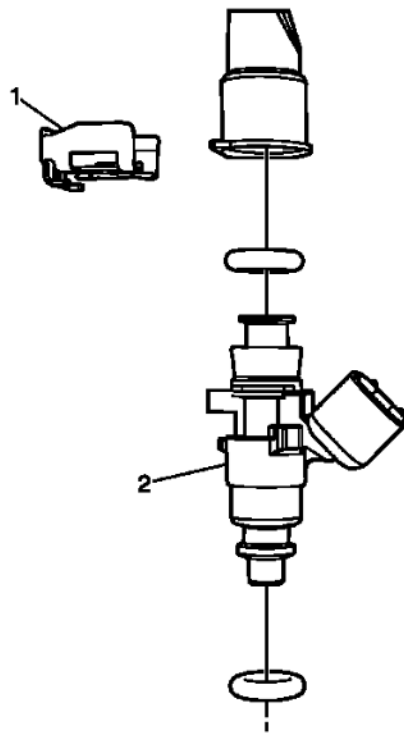


Fig. 128: Identifying Fuel Injection Harness Connectors
Courtesy of GENERAL MOTORS CORP.

8. Connect the fuel injection Harness connectors (1, 2).
9. Connect the barometric pressure sensor harness connector (5).
10. Connect the supercharger air output sensor harness connector (3).
11. Connect the intake temperature sensor harness connector (4).
12. Connect the fuel pipe to the fuel rail. Refer to **Metal Collar Quick Connect Fitting Service**
13. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection (Sedan, Wagon)** or **Battery Negative Cable Disconnection and Connection (Coupe)** .
14. Pressure the fuel system and check for fuel leaks.
15. Install the front and rear intake manifold covers. Refer to **Intake Manifold Cover Replacement - Rear** .

FUEL INJECTOR REPLACEMENT

**Fig. 129: Identifying Fuel Injector**

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the fuel rail. Refer to Fuel Injection Fuel Rail Assembly Replacement .	
1	Fuel Injector Retainer Tip: A flat bladed tool can be used to release the retainer.
2	Fuel Injector Procedure: Remove and replace the O-rings as required.

FUEL INJECTOR CLEANING

Special Tools

- J 37287 Fuel Line Shut-Off Adapters
- J 35800-A Fuel Injector Cleaner
- J 42873-1 3/8 Fuel Line Shut-Off Valve
- J 42873-2 5/16 Return Pipe Shut-Off Valve
- J 42964-1 3/8 Fuel Pipe Shut-Off Valve
- J 42964-2 5/16 Fuel Pipe Shut-Off Valve

CAUTION:

- GM Upper Engine and Fuel Injector Cleaner is the only injector cleaning agent recommended. **DO NOT USE OTHER CLEANING AGENTS AS THEY MAY CONTAIN METHANOL, WHICH CAN DAMAGE FUEL SYSTEM COMPONENTS.**
- Under **NO** circumstances should the GM Upper Engine and Fuel Injector Cleaner be added to the vehicle fuel tank, as it may damage the fuel pump and other system components.
- Do not exceed the recommended cleaning solution concentration. Higher concentrations may damage fuel system components. Testing has demonstrated that exceeding the recommended cleaning solution concentration does not improve the effectiveness of this procedure.

NOTE: Vehicles with less than 160 km (100 mi) on the odometer should not have the injectors cleaned. These vehicles should have the injectors replaced.

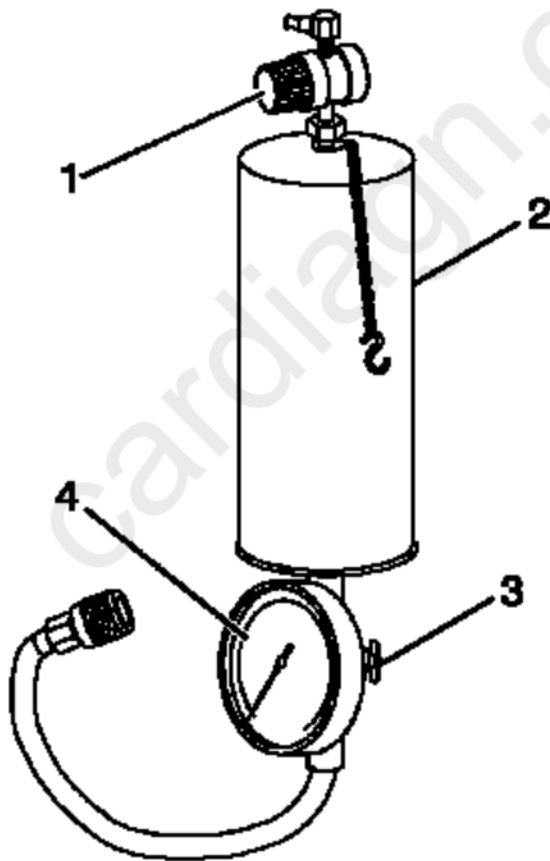


Fig. 130: Identifying Fuel Injector Cleaner
Courtesy of GENERAL MOTORS CORP.

1. Obtain J 35800-A (2).

NOTE: Make sure the valve at the bottom of the canister (3) is closed.

2. For 4, 5, and 6 cylinder engines, empty two of the 30 ml (1 oz) reservoirs of the GM Upper Engine and Fuel Injector Cleaner twin reservoir container into the **J 35800-A**, injector cleaning tank, then add 420 ml (14 oz) of regular unleaded gasoline. If you are using any other brand of cleaning tank, you will need a total of 60 ml (2 oz) of GM Upper Engine and Fuel Injector Cleaner mixed with 420 ml (14 oz) of regular unleaded gasoline.
3. For 8 cylinder engines, empty two of the 30 ml (1 oz) reservoirs of the GM Upper Engine and Fuel Injector Cleaner twin reservoir container into the **J 35800-A**, injector cleaning tank, then add 420 ml (14 oz) of regular unleaded gasoline. If you are using any other brand of cleaning tank, you will need a total of 60 ml (2 oz) of GM Upper Engine and Fuel Injector Cleaner mixed with 420 ml (14 oz) of regular unleaded gasoline.

This procedure will need to be repeated for an 8 cylinder engine. The 8 cylinder engines receive 960 ml total fluid-120 ml (4 oz) of GM Upper Engine and Fuel Injector Cleaner and 840 ml (28 oz) of gasoline.

4. Fill the injector cleaning tank with regular unleaded gasoline. Be sure to follow all additional instructions provided with the tool.
5. Electrically disable the vehicle fuel pump by removing the fuel pump relay and disconnecting the oil pressure switch connector, if equipped.
6. Disconnect the fuel feed and return line, if equipped, at the fuel rail. Plug the fuel feed and return line, if equipped, coming off the fuel rail with **J 37287**, or **J 42964-1**, and **J 42964-2** or **J 42873-1**, and **J 42873-2** as appropriate for the fuel system.
7. Connect the **J 35800-A** to the vehicle fuel rail.
8. Pressurize the **J 35800-A** to 510 kPa (75 psi).
9. Start and idle the engine until it stalls due to lack of fuel. This should take approximately 15-20 minutes.
10. Turn the ignition to the OFF position.
11. Injectors should be flow-tested at this point. If further cleaning is needed, a repeat of the above procedure should be done.

When the injector restriction returns to zero, proceed to step 12.

12. Disconnect the **J 35800-A** from the fuel rail.
13. Reconnect the vehicle fuel pump relay and oil pressure switch connector, if equipped.
14. Remove the **J 37287**, or **J 42964-1** and **J 42964-2**, or **J 42873-1** and **J 42873-2** and reconnect the vehicle fuel feed and return lines.
15. Start and idle the vehicle for an additional two minutes to ensure residual injector cleaner is flushed from the fuel rail and fuel lines.
16. Pour the entire contents of GM Fuel System Treatment Plus, GM P/N 88861011 (Canadian P/N 88861012) into a nearly empty tank and advise the customer to refuel with up to 76 L (20 gal) of fuel.
17. Advise the customer to use only a Top Tier Detergent gasoline and to add a bottle of GM Fuel System Treatment Plus to the fuel tank at every oil change.

Regular use of GM Fuel System Treatment Plus should keep the customer from having to repeat the

injector cleaning procedure.

18. Road test the vehicle to verify that the customer concern has been corrected.

EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE REPLACEMENT

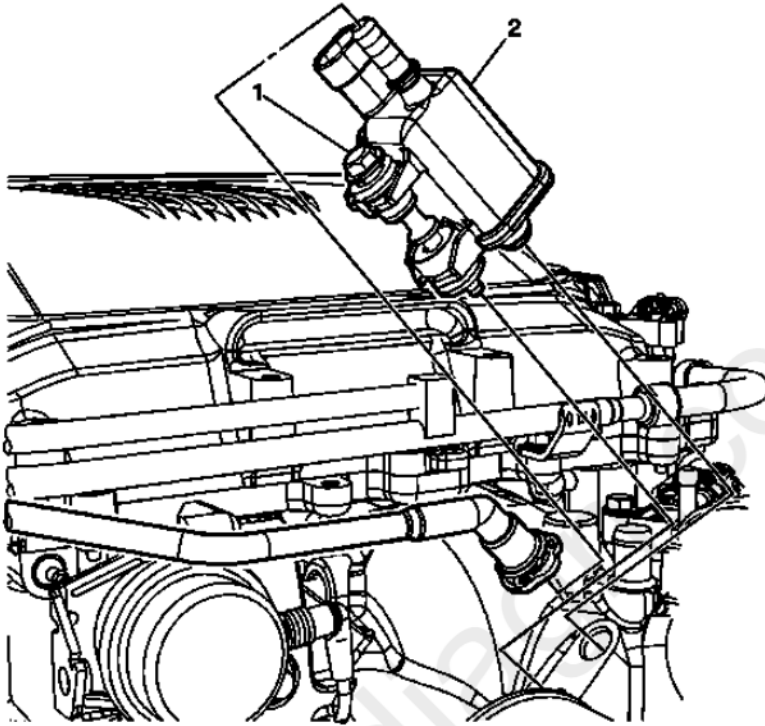


Fig. 131: Identifying Evaporative Emission Canister Purge Solenoid Valve
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the front manifold cover. Refer to <u>Intake Manifold Cover Replacement - Front</u>	
1	Bolt CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 10 N.m (89 lb in)
2	Evaporative Emission Canister Purge Valve Procedure 1. Disconnect the EVAP canister purge valve harness connector. 2. Disconnect the EVAP canister purge tube from the purge valve.

EVAPORATIVE EMISSION CANISTER VENT SOLENOID VALVE REPLACEMENT

Removal Procedure

1. Remove the exhaust system. Refer to **EXHAUST SYSTEM REPLACEMENT (LSA-COUPE)** or **EXHAUST SYSTEM REPLACEMENT (LSA-SEDAN/WAGON)**
2. Steps 3-5 apply to Sedan/Wagon only. Proceed to step 6 for Coupe
3. Place a jack stand under the rear differential assembly

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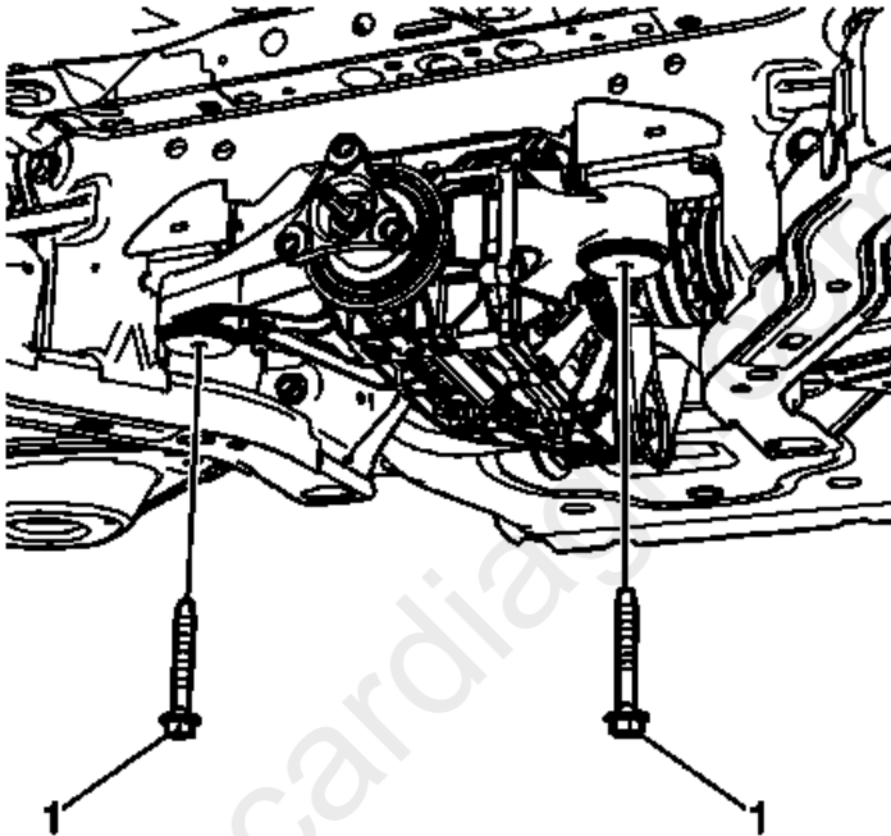


Fig. 132: View of Front Differential Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the two front differential mounting bolts.
5. Lower the differential slightly to provide additional clearance to the Evap canister
6. Remove the two EVAP canister retaining nuts and lower the rear of the canister enough to clear the weld studs
7. Slide the canister rearward from the body brace to gain access to the canister vent valve

8. Clean away any debris that may be present around the EVAP canister vent valve
9. Disconnect the electrical connector from the EVAP canister vent valve

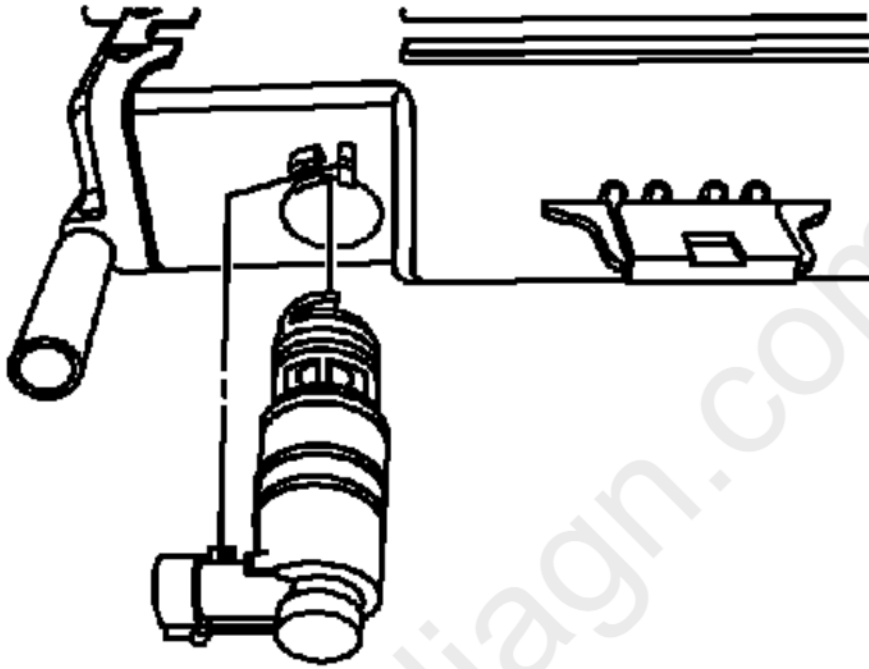


Fig. 133: View Of EVAP Canister Vent Valve
Courtesy of GENERAL MOTORS COMPANY

10. Twist the EVAP canister vent valve counterclockwise
11. Pull the EVAP canister vent valve from the EVAP canister

Installation Procedure

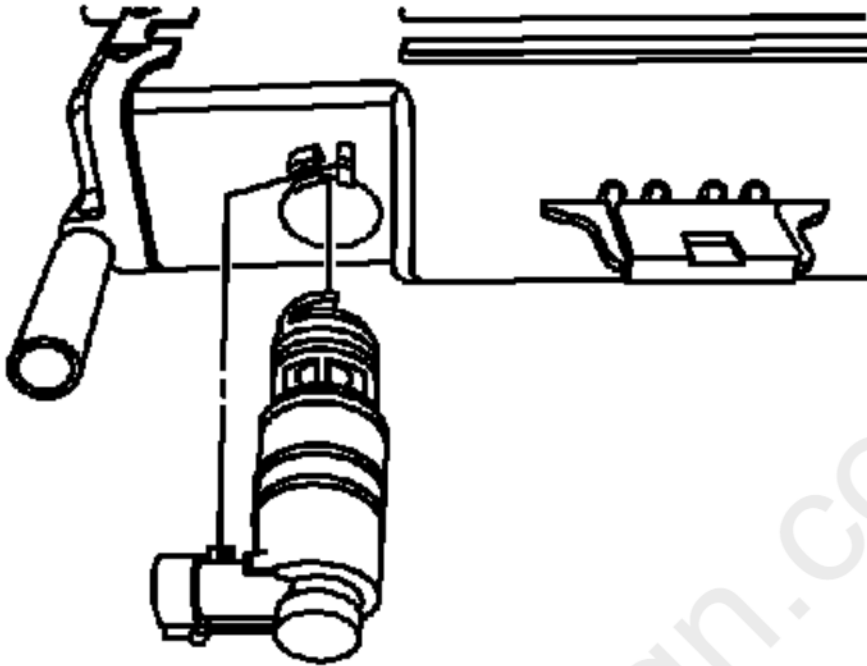


Fig. 134: View Of EVAP Canister Vent Valve
Courtesy of GENERAL MOTORS COMPANY

1. Insert the EVAP canister vent valve into the EVAP canister
2. Twist the EVAP canister vent valve clockwise into the locked position
3. Connect the electrical connector to the EVAP canister vent valve
4. Attach the EVAP canister to the body by inserting the fresh air tube and tab on the canister forward into the body brace.
5. Rotate the rear of the canister up over the 2 weld studs on the floor pan
6. Install the EVAP canister to the body and install the bolts and tighten to 6 N.m (53 lb in).

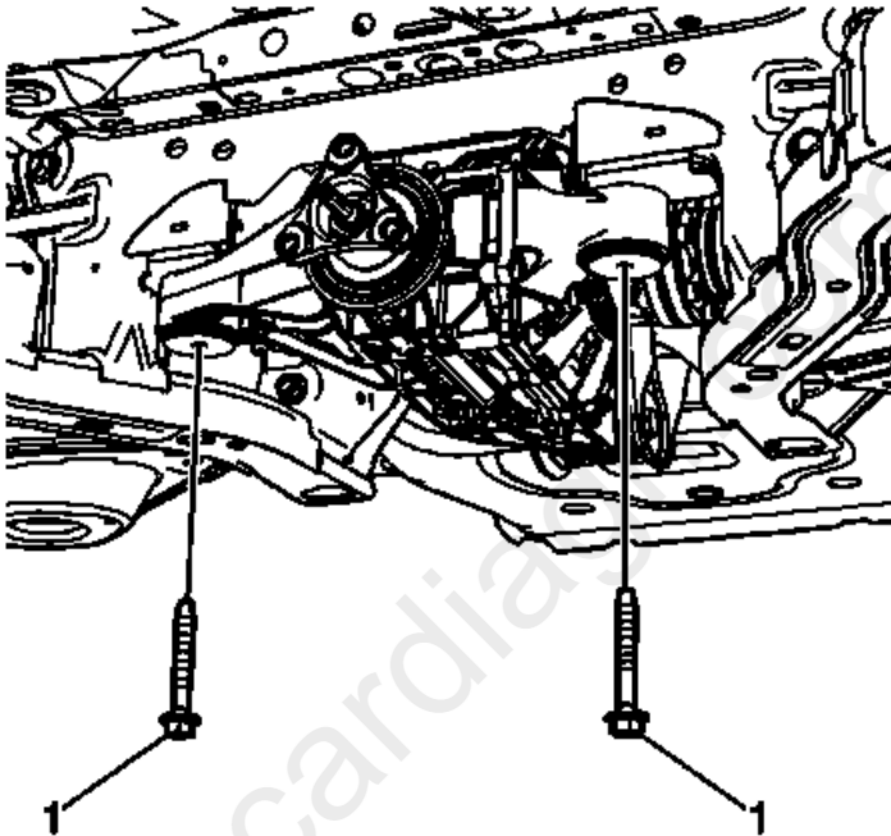


Fig. 135: View of Front Differential Mounting Bolts
Courtesy of GENERAL MOTORS COMPANY

7. Sedan/Wagon only: Raise the rear differential into position and install the front mounting bolts (1) and tighten to 175 N.m (129 lb ft).
8. Install the exhaust system. Refer to **EXHAUST SYSTEM REPLACEMENT (LSA-COUPE)** or **EXHAUST SYSTEM REPLACEMENT (LSA-SEDAN/WAGON)**

EVAPORATIVE EMISSION CANISTER PURGE TUBE REPLACEMENT

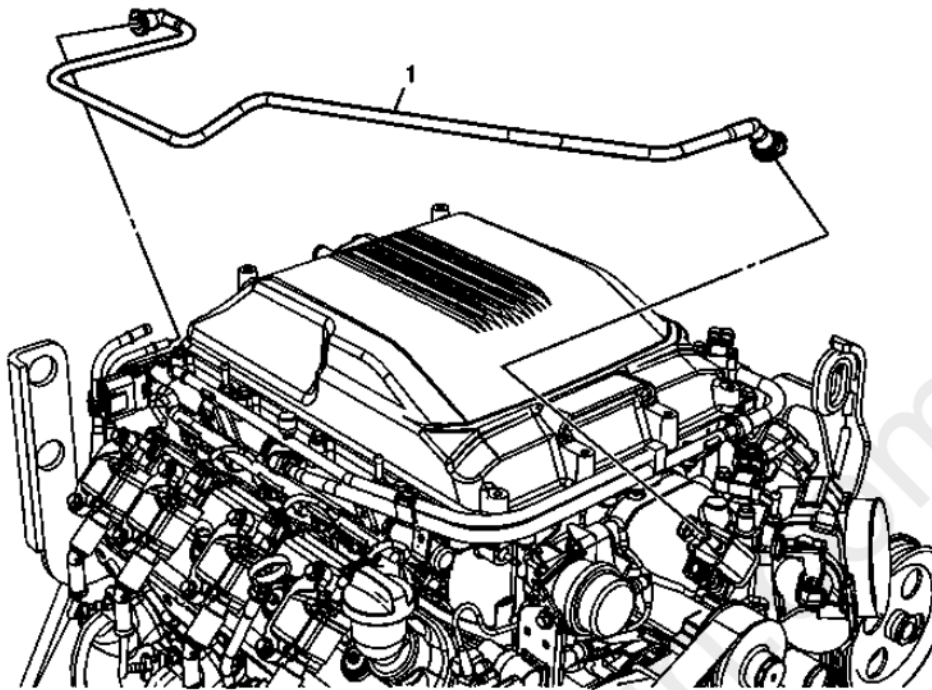


Fig. 136: Identifying Evaporative Emission Canister Purge Tube
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the front and rear manifold covers. Refer to <u>Intake Manifold Cover Replacement - Rear</u> .	
1	Evaporative Emission Canister Purge Tube Procedure 1. Disconnect the EVAP canister purge tube from the purge valve. 2. Disconnect the EVAP canister purge tube from the EVAP canister purge Pipe.

EVAPORATIVE EMISSION SYSTEM HOSE/PIPE REPLACEMENT

Removal Procedure

CAUTION:

- Do not attempt to straighten kinked nylon pipes. Replace any kinked nylon pipes in order to prevent damage to the vehicle.
- Do not attempt to repair sections of nylon pipes. Replace damaged nylon pipes.
- Replace the vapor hoses/pipes with original equipment or parts that

meet GM specifications.

1. Remove the fuel tank. Refer to Fuel Tank Replacement.

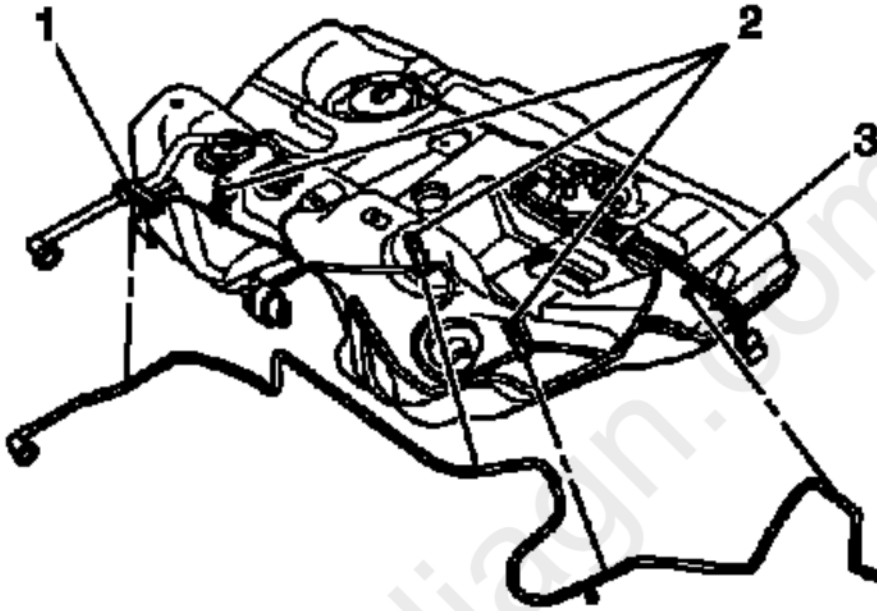


Fig. 137: View Of EVAP Hose Retainers
Courtesy of GENERAL MOTORS CORP.

2. Remove the chassis to canister evaporative emission (EVAP) hose from the following:
 - The body retainer (1)
 - The 3 retaining features (2) on the fuel tank
 - The retainer clip (3)
3. Remove the EVAP hose from the fuel tank.

Installation Procedure

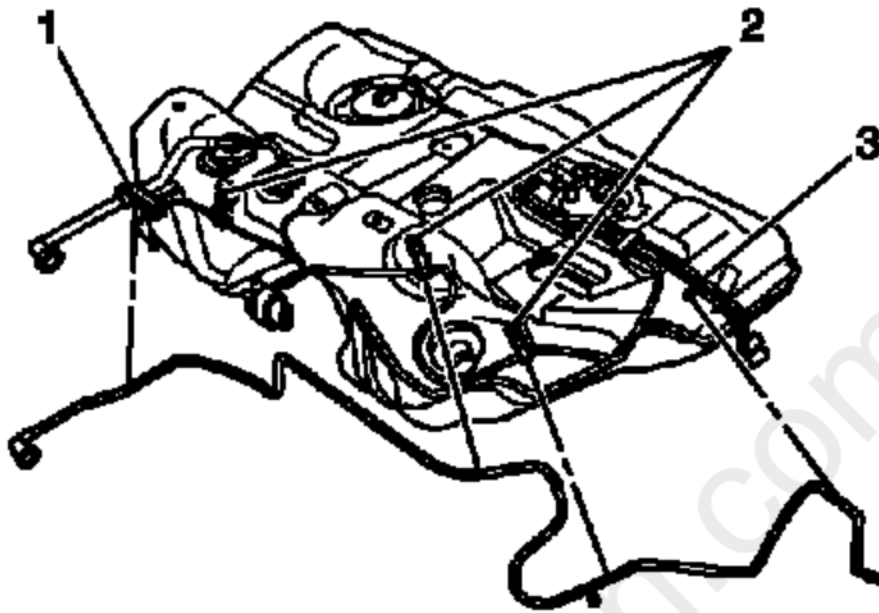


Fig. 138: View Of EVAP Hose Retainers
Courtesy of GENERAL MOTORS CORP.

1. Position the EVAP hose to the fuel tank.
2. Install the chassis to canister EVAP hose to the following:
 - The body retainer (1)
 - The 3 retaining features (2) on the fuel tank
 - The retainer clip (3)
3. Install the fuel tank. Refer to **Fuel Tank Replacement**.

EVAPORATIVE EMISSION CANISTER REPLACEMENT

Removal Procedure

1. Remove the rear frame. Refer to **Rear Frame Replacement**.

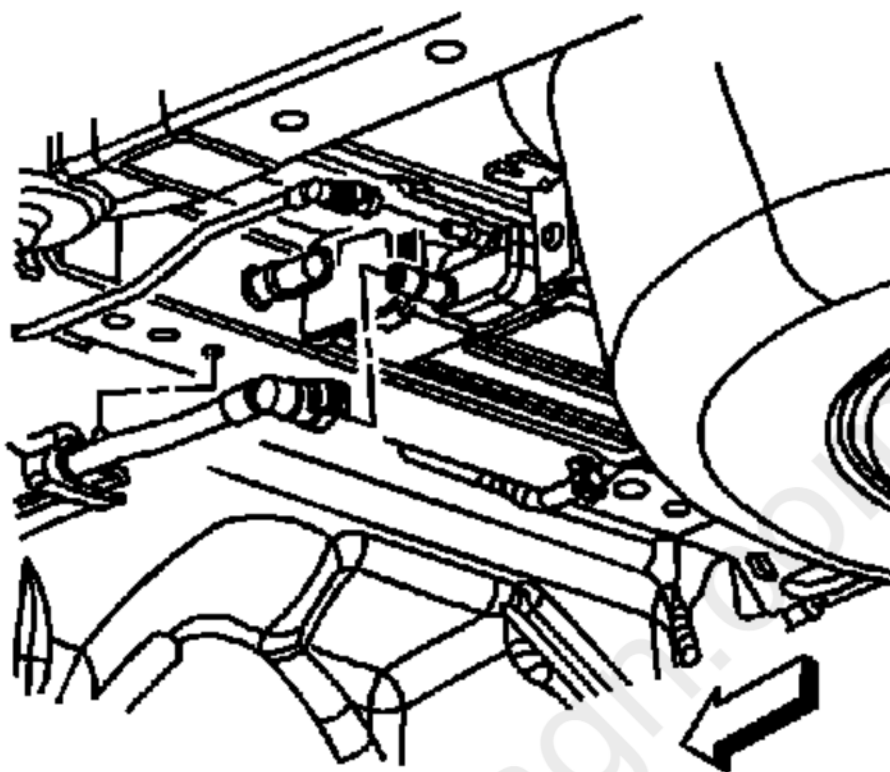


Fig. 139: Identifying EVAP Hoses At EVAP Canister
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the evaporative emission (EVAP) hoses from the EVAP canister.
3. Disconnect the electrical connector from the EVAP canister.

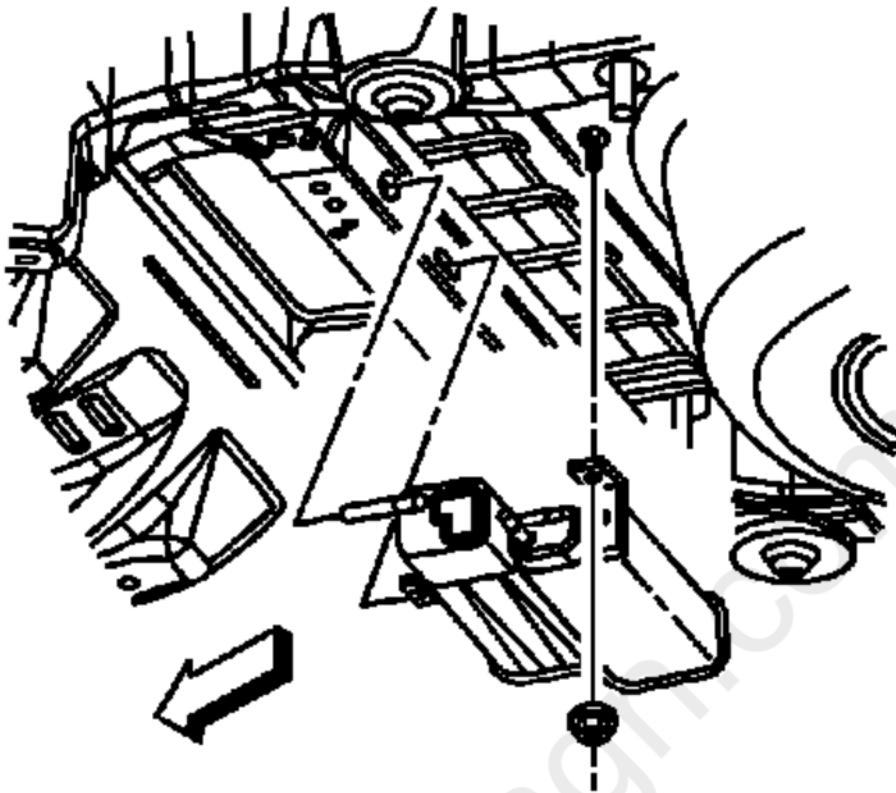


Fig. 140: View Of EVAP Canister Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

4. Remove the EVAP canister retaining nuts.
5. Complete the following in order to remove the EVAP canister:
 1. Lower the rear of the canister enough to clear the 2 weld studs.
 2. Slide the canister rearward from the body brace.

Installation Procedure

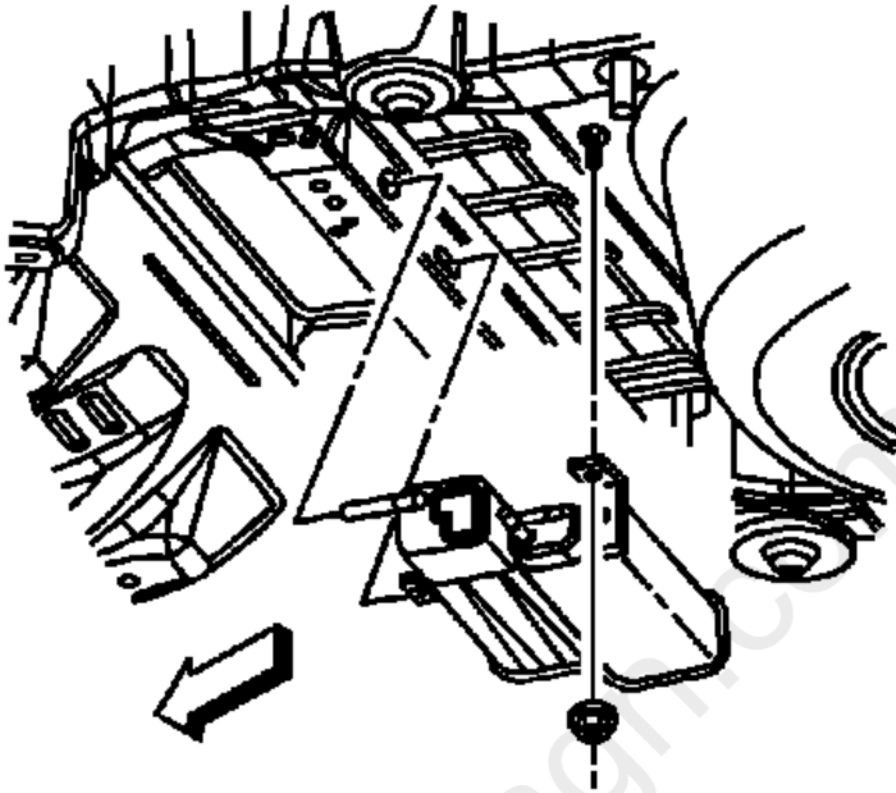


Fig. 141: View Of EVAP Canister Retaining Nuts
Courtesy of GENERAL MOTORS CORP.

1. Complete the following in order to install the EVAP canister:
 1. Insert the fresh air tube and tab on the canister forward into the body brace.
 2. Rotate the rear of the canister up over the 2 weld studs on the floor pan.

CAUTION: Refer to FASTENER CAUTION .

2. Install the EVAP canister retaining nuts and tighten to 6 N.m (53 lb in).

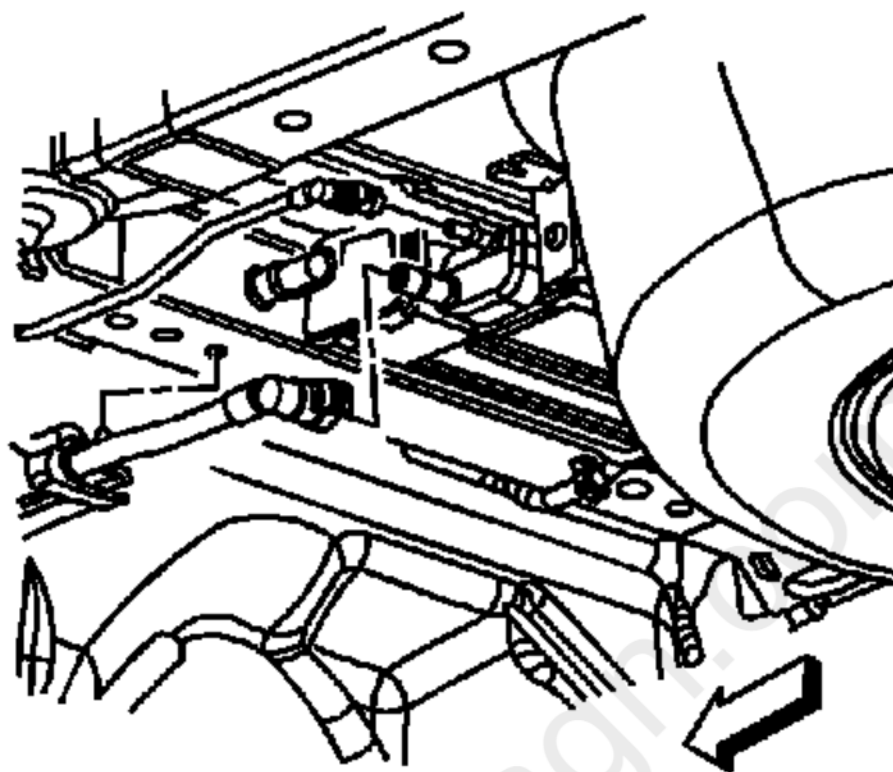
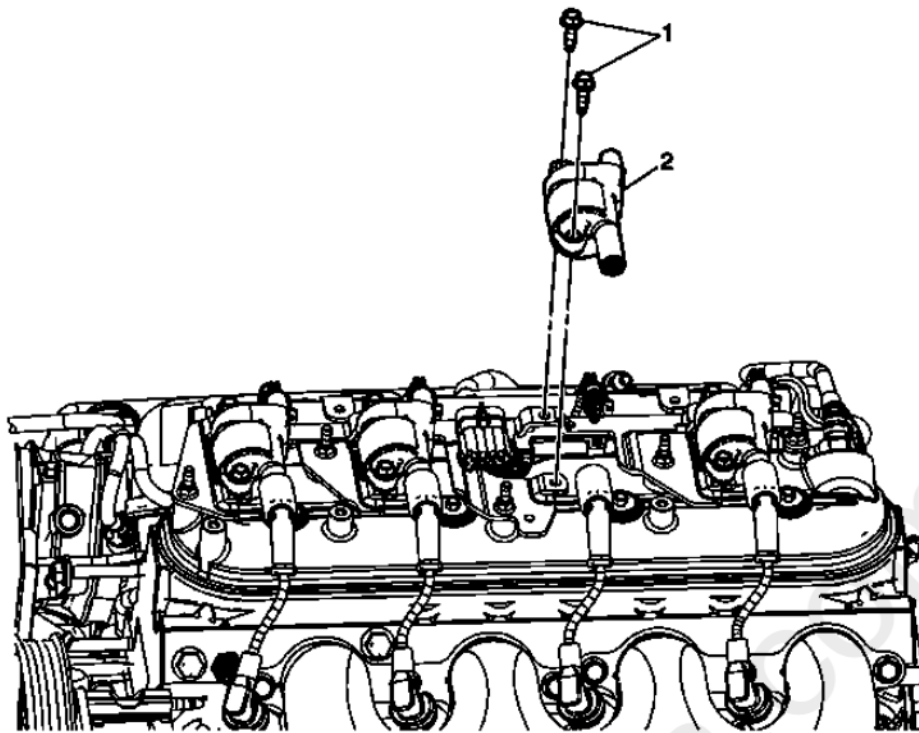


Fig. 142: Identifying EVAP Hoses At EVAP Canister
Courtesy of GENERAL MOTORS CORP.

3. Connect the EVAP hoses to the EVAP canister.
4. Connect the electrical connector to the EVAP canister.
5. Install the rear frame. Refer to **Rear Frame Replacement**.

IGNITION COIL REPLACEMENT

**Fig. 143: Ignition Coil**

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures 1. If replacing rear coils, remove the rear intake manifold cover. Refer to <u>Intake Manifold Cover Replacement - Rear</u>. 2. If replacing front coils, remove the front intake manifold cover. Refer to <u>Intake Manifold Cover Replacement - Front</u>.	
1	Ignition Coil Bolt CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 12 N.m (106 lb in)
2	Ignition Coil Procedure 1. Disconnect the electrical connector. 2. Disconnect the ignition cable.

SPARK PLUG WIRE INSPECTION

Spark plug wire integrity is vital for proper engine operation. A thorough inspection will be necessary to accurately identify conditions that may affect engine operation. Inspect for the following conditions:

1. Any signs of cracks or splits in the wires.
2. Inspect each boot for the following conditions:
 - Tearing
 - Piercing
 - Arcing
 - Carbon tracking
 - Corroded terminal

If corrosion, carbon tracking, or arcing are indicated on a spark plug wire boot or on a terminal, replace the wire and the component connected to the wire.

SPARK PLUG WIRE REPLACEMENT

Removal Procedure

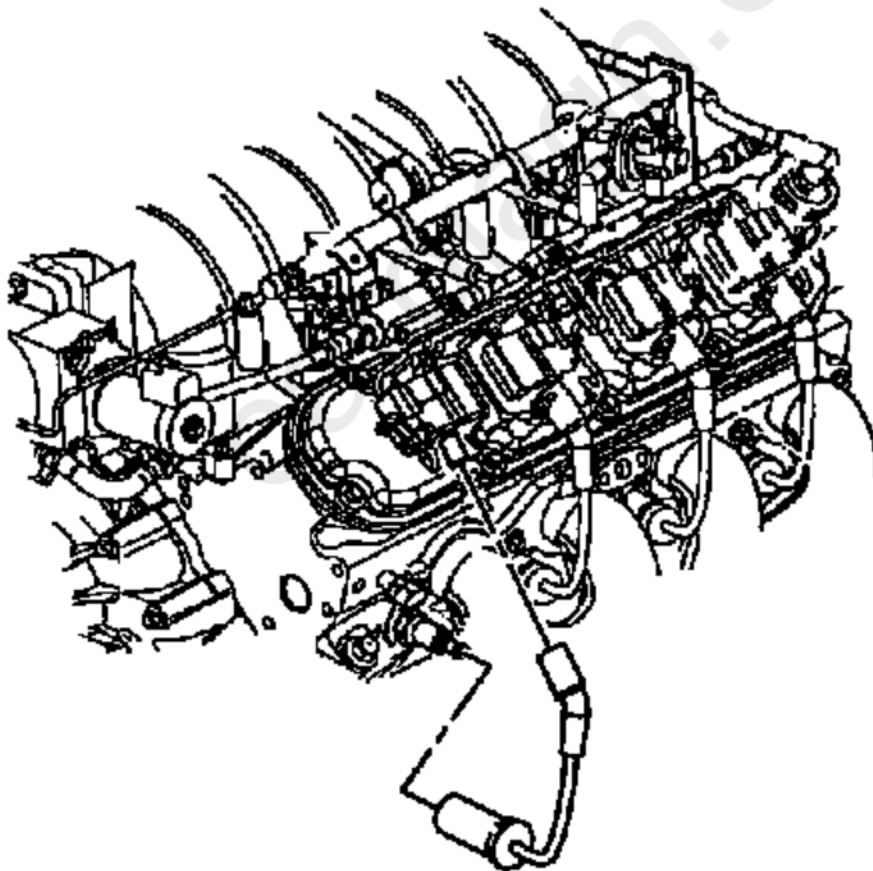
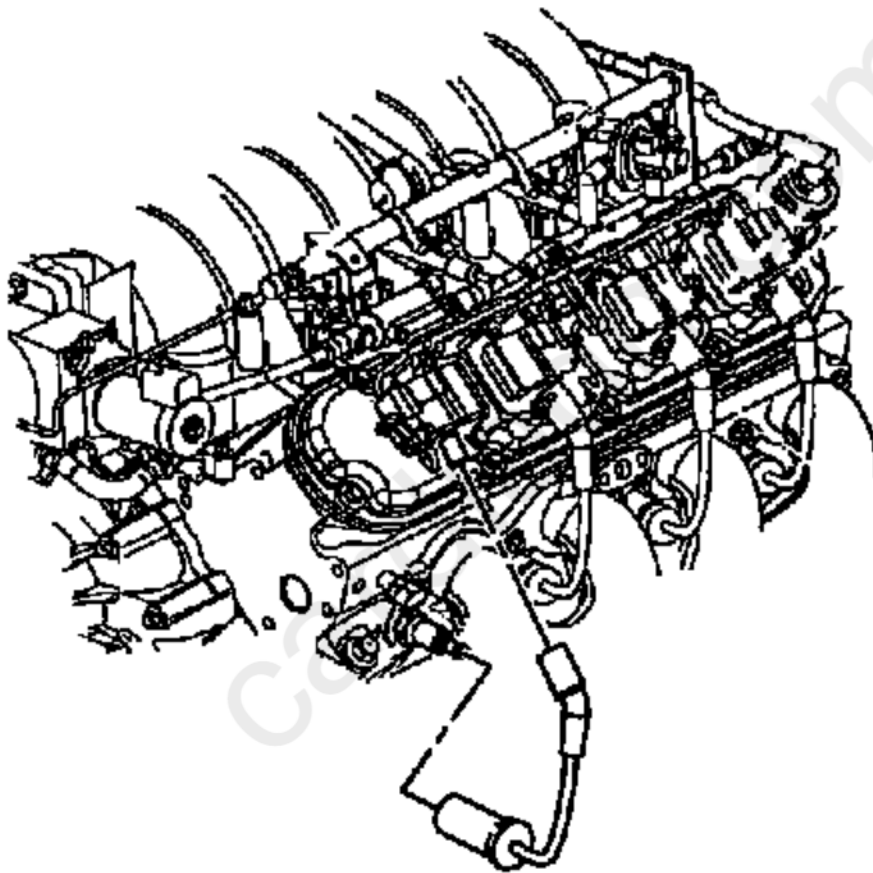


Fig. 144: Spark Plug & Wire

Courtesy of GENERAL MOTORS CORP.

1. Disconnect the spark plug wires at each spark plug:
 - Twist each spark plug boot 1/2 turn.
 - Pull only on the boot in order to remove the wire from each spark plug.
2. Disconnect the spark plug wires from the ignition coil:
 - Twist each spark plug boot 1/2 turn.
 - Pull only on the boot in order to remove the wires from the ignition coil.

Installation Procedure**Fig. 145: Spark Plug & Wire****Courtesy of GENERAL MOTORS CORP.**

1. Install the spark plug wires at the ignition coil.
2. Install the spark plug wire to each spark plug.
3. Inspect the wires for proper installation:
 - Push sideways on each boot in order to inspect the seating.

- Reinstall any loose boot.

SPARK PLUG INSPECTION

Spark Plug Usage

- Verify that the correct spark plug is installed. An incorrect spark plug causes driveability conditions. Refer to **Ignition System Specifications** for the correct spark plug.
- Ensure that the spark plug has the correct heat range. An incorrect heat range causes the following conditions:
 - Spark plug fouling - colder plug
 - Pre-ignition causing spark plug and/or engine damage - hotter plug

Spark Plug Inspection

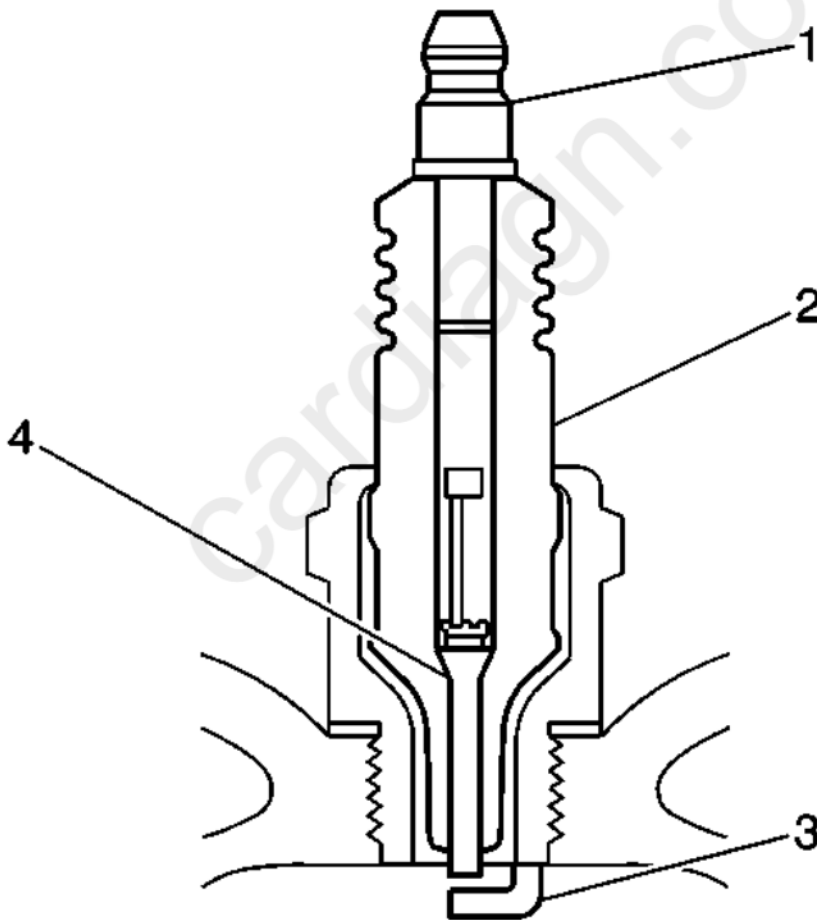


Fig. 146: Spark Plug Terminal Post
Courtesy of GENERAL MOTORS CORP.

- Inspect the terminal post (1) for damage.
 - Inspect for a bent or broken terminal post (1).
 - Test for a loose terminal post (1) by twisting and pulling the post. The terminal post (1) should NOT move.

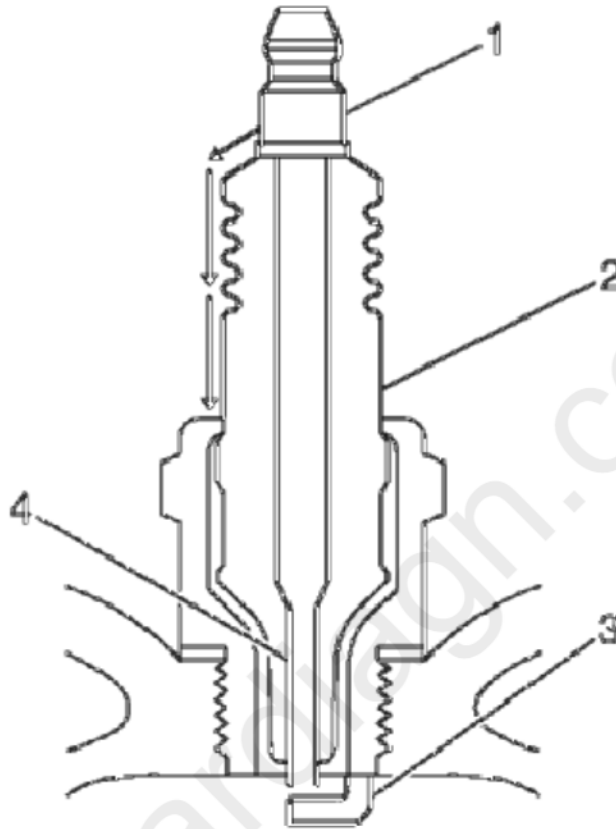


Fig. 147: Spark Plug Insulator And Terminal Post
Courtesy of GENERAL MOTORS CORP.

- Inspect the insulator (2) for flashover or carbon tracking, soot. This is caused by the electrical charge traveling across the insulator (2) between the terminal post (1) and ground. Inspect for the following conditions:
 - Inspect the spark plug boot for damage.
 - Inspect the spark plug recess area of the cylinder head for moisture, such as oil, coolant, or water. A spark plug boot that is saturated causes arcing to ground.

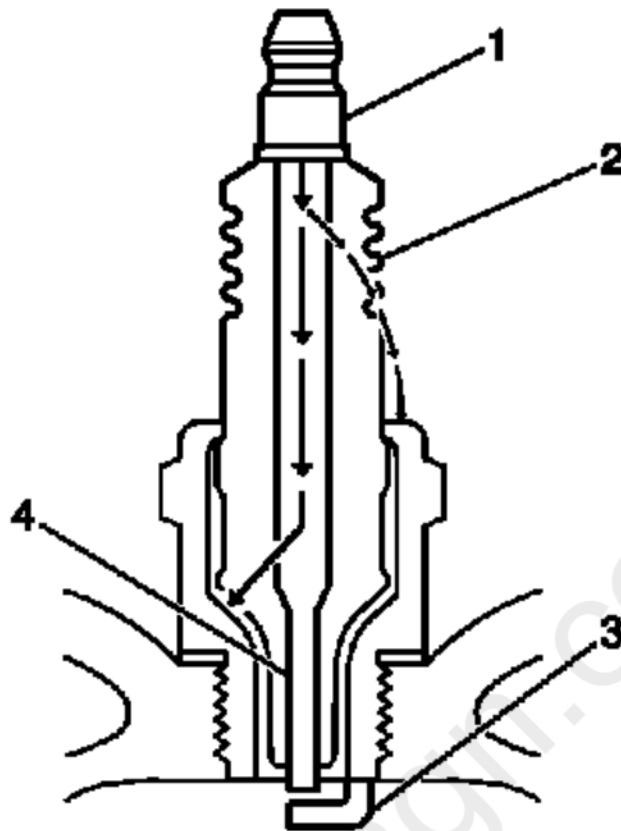


Fig. 148: Identifying Spark Plug Insulator & Electrodes
Courtesy of GENERAL MOTORS CORP.

- Inspect the insulator (2) for cracks. All or part of the electrical charge may arc through the crack instead of the electrodes (3, 4).

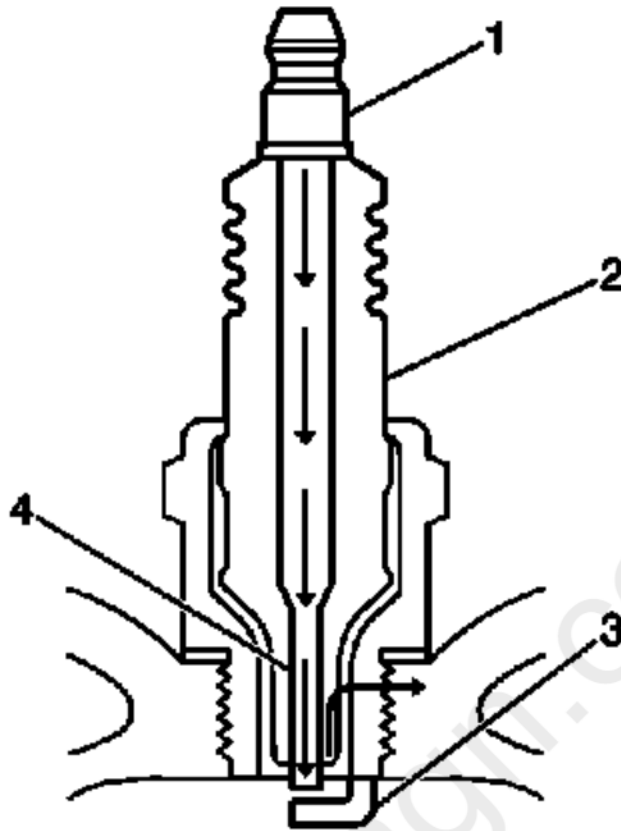


Fig. 149: Spark Plug Electrode
Courtesy of GENERAL MOTORS CORP.

- Inspect for evidence of improper arcing.
 - Measure the gap between the center electrode (4) and the side electrode (3) terminals. Refer to **Ignition System Specifications** . An excessively-wide electrode gap can prevent correct spark plug operation.
 - Inspect for the correct spark plug torque. Refer to **Ignition System Specifications** . Insufficient torque can prevent correct spark plug operation. An over-torqued spark plug, causes the insulator (2) to crack.
 - Inspect for signs of tracking that occurred near the insulator tip instead of the center electrode (4).
 - Inspect for a broken or worn side electrode (3).
 - Inspect for a broken, worn, or loose center electrode (4) by shaking the spark plug.
 - A rattling sound indicates internal damage.
 - A loose center electrode (4) reduces the spark intensity.
 - Inspect for bridged electrodes (3, 4). Deposits on the electrodes reduce or eliminates the gap.
 - Inspect for worn or missing platinum pads on the electrodes (3, 4), if equipped.
 - Inspect for excessive fouling.

- Inspect the spark plug recess area of the cylinder head for debris. Dirty or damaged threads can cause the spark plug not to seat correctly during installation.

Spark Plug Visual Inspection

- Normal operation - Brown to grayish-tan with small amounts of white powdery deposits are normal combustion by-products from fuels with additives.
- Carbon Fouled - Dry, fluffy black carbon, or soot caused by the following conditions:
 - Rich fuel mixtures
 - Leaking fuel injectors
 - Excessive fuel pressure
 - Restricted air filter element
 - Incorrect combustion
 - Reduced ignition system voltage output
 - Weak coils
 - Worn ignition wires
 - Incorrect spark plug gap
 - Excessive idling or slow speeds under light loads can keep spark plug temperatures so low that normal combustion deposits may not burn off.
- Deposit Fouling - Oil, coolant, or additives that include substances such as silicone, very white coating, reduces the spark intensity. Most powdery deposits will not effect spark intensity unless they form into a glazing over the electrode.

SPARK PLUG REPLACEMENT

Removal Procedure

1. Remove the Intake manifold front cover. Refer to **Intake Manifold Cover Replacement - Front**.

CAUTION: Allow the engine to cool before removing the spark plugs. Attempting to remove the spark plugs from a hot engine may cause the plug threads to seize, causing damage to cylinder head threads.

CAUTION: Clean the spark plug recess area before removing the spark plug. Failure to do so could result in engine damage because of dirt or foreign material entering the cylinder head, or by the contamination of the cylinder head threads. The contaminated threads may prevent the proper seating of the new plug. Use a thread chaser to clean the threads of any contamination.

2. Remove the spark plug wires. Refer to **Spark Plug Wire Replacement**.

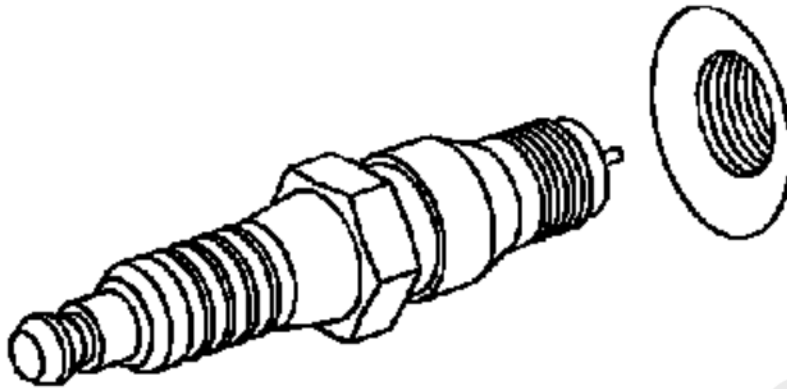


Fig. 150: View Of Spark Plug And Sparkplug Seat
Courtesy of GENERAL MOTORS CORP.

3. Loosen each spark plug 1 or 2 turns.
4. Brush or use compressed air to remove any dirt around the spark plugs.
5. Remove the spark plugs one at a time and place each plug in a tray marked with the corresponding cylinder numbers.

Installation Procedure

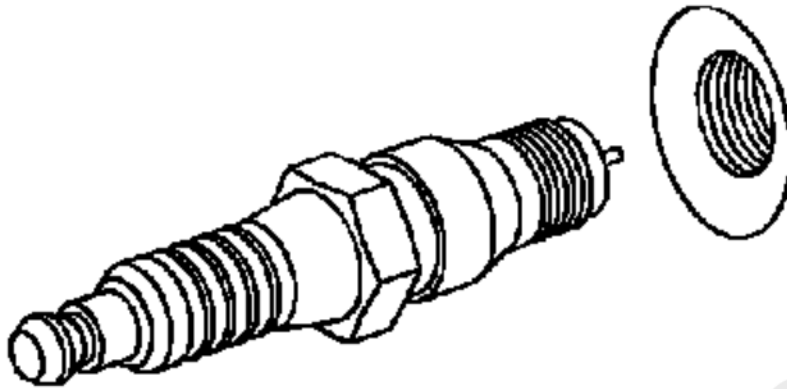


Fig. 151: View Of Spark Plug And Sparkplug Seat
Courtesy of GENERAL MOTORS CORP.

1. Inspect each spark plug gap and adjust as needed. Refer to **Ignition System Specifications** .
2. Hand start the spark plugs in the corresponding cylinders.

CAUTION: Refer to FASTENER CAUTION .

3. Tighten the spark plugs.
 - For cylinder head-new: Tighten the spark plugs to 20 N.m (15 lb ft).
 - For cylinder head-all subsequent installations: Tighten the spark plugs to 15 N.m (11 lb ft).
4. Install the spark plug wires. Refer to **Spark Plug Wire Replacement**.
5. Install the Intake manifold front cover. Refer to **Intake Manifold Cover Replacement - Front** .

CRANKSHAFT POSITION SENSOR REPLACEMENT

Removal Procedure

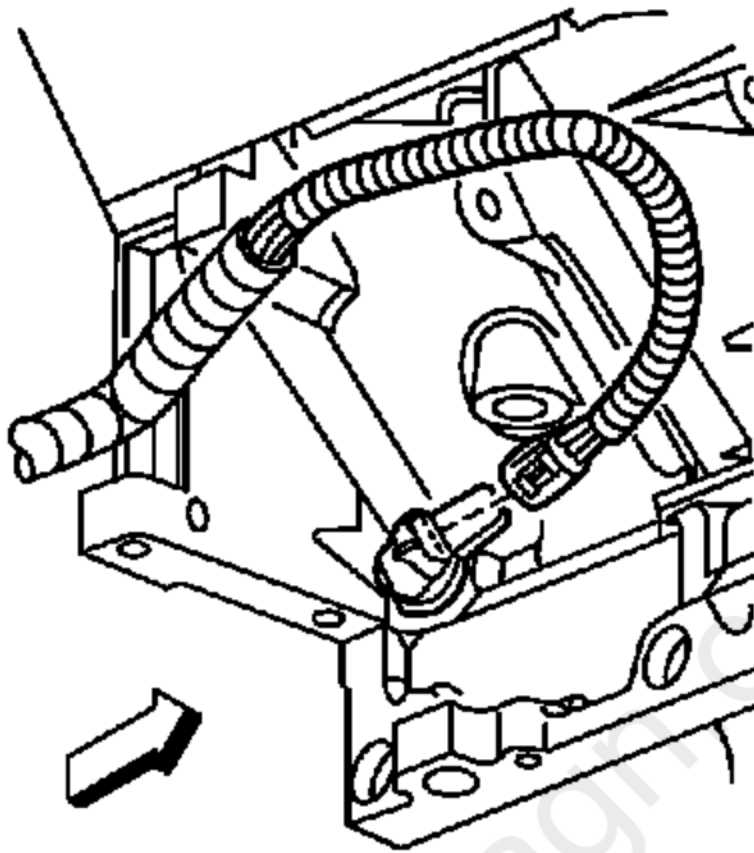


Fig. 152: Identifying Crankshaft Position (CKP) Sensor/Connector
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to BATTERY DISCONNECT WARNING .

1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection (Sedan, Wagon) or Battery Negative Cable Disconnection and Connection (Coupe) .
2. Raise the vehicle. Refer to Lifting and Jacking the Vehicle .
3. Remove the starter. Refer to Starter Replacement (LF1/LLT) or Starter Replacement (LSA) .
4. Disconnect the crankshaft position (CKP) sensor electrical connector.

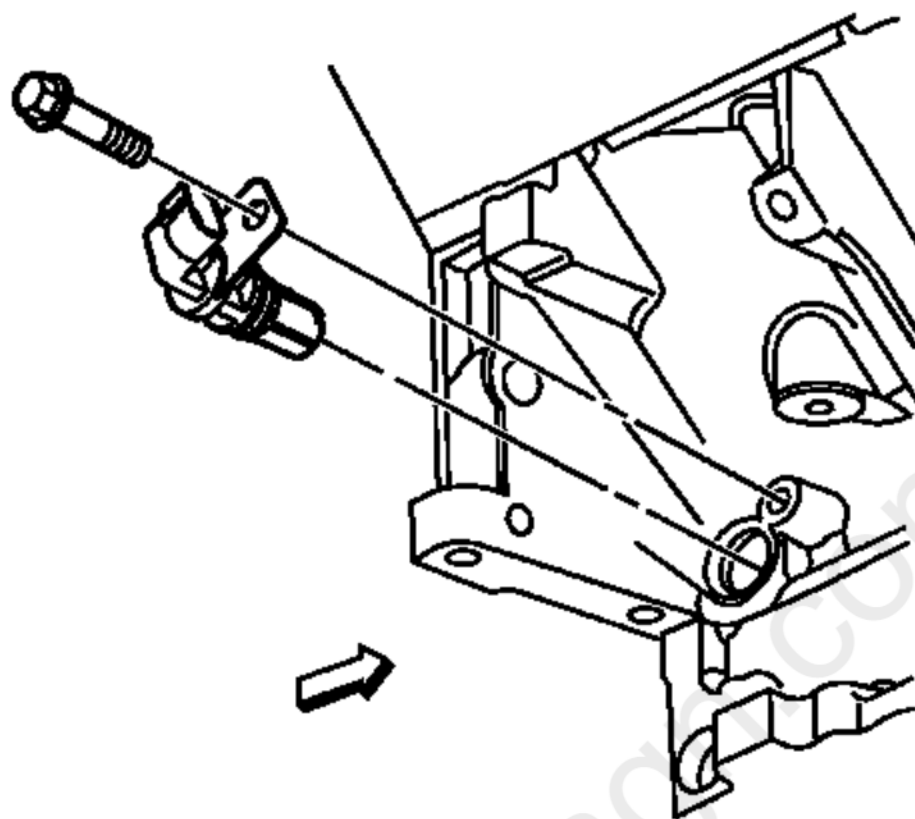


Fig. 153: View Of CKP Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Clean the area around the CKP before removal in order to avoid debris from entering the engine.

5. Remove the CKP sensor retaining bolt.
6. Remove the CKP sensor.

Installation Procedure

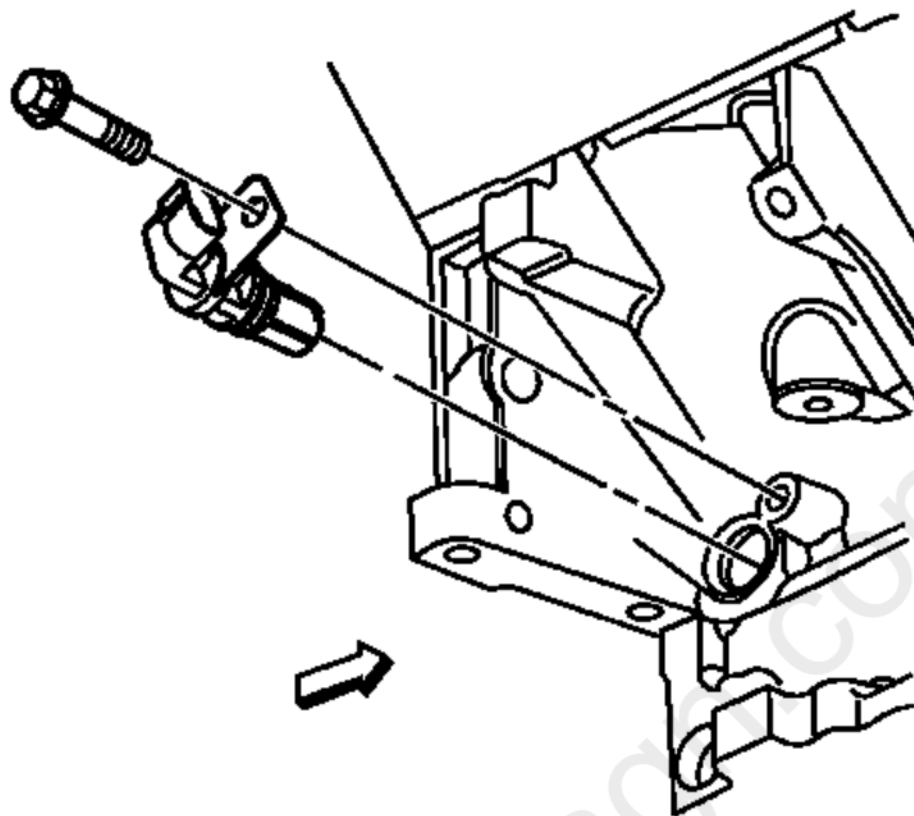


Fig. 154: View Of CKP Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Install the CKP sensor.

CAUTION: Refer to FASTENER CAUTION .

2. Install the CKP sensor retaining bolt and tighten to 25 N.m (18 lb ft).

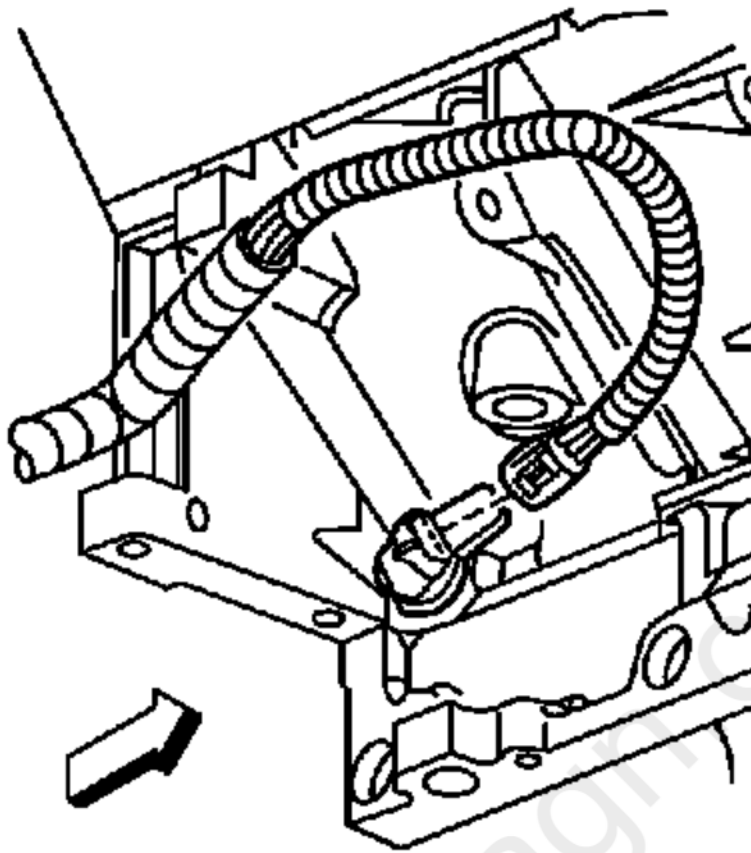


Fig. 155: Identifying Crankshaft Position (CKP) Sensor/Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the CKP sensor electrical connector.
4. Install the starter. Refer to **Starter Replacement (LF1/LLT)** or **Starter Replacement (LSA)** .
5. Lower the vehicle.
6. Connect the negative battery cable.
7. Perform the CKP System Variation Learn Procedure. Refer to **Crankshaft Position System Variation Learn**.

CAMSHAFT POSITION SENSOR REPLACEMENT

Removal Procedure

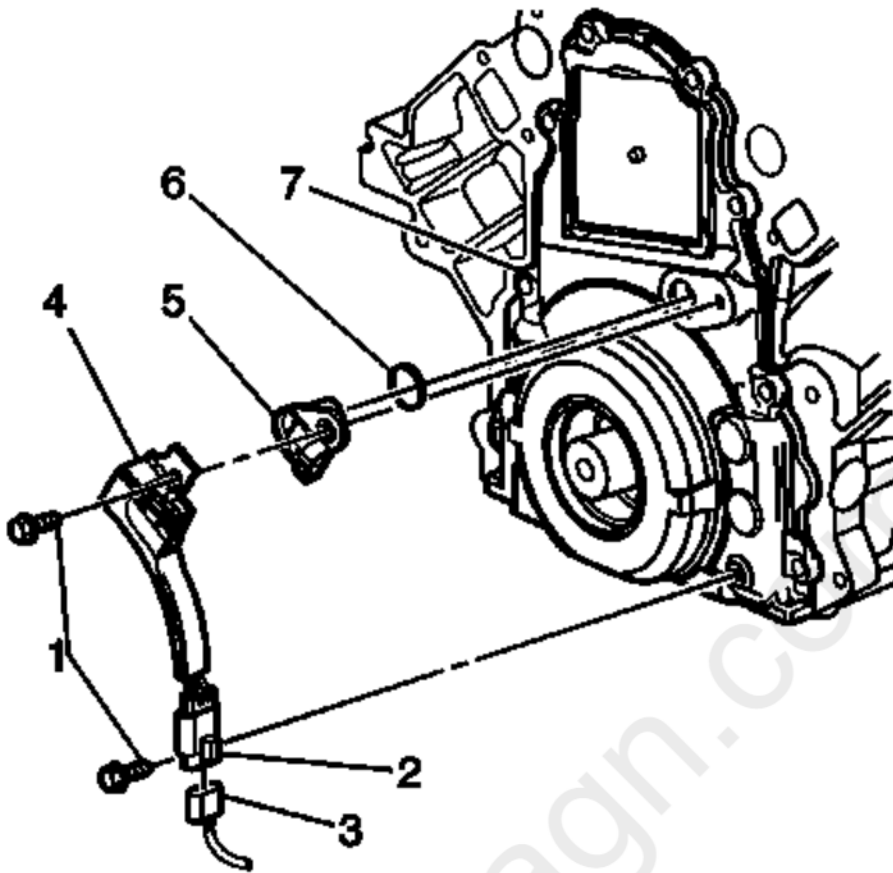


Fig. 156: Camshaft Position Sensor Assembly, Jumper Harness & Front Cover
Courtesy of GENERAL MOTORS CORP.

1. Remove the generator bracket assembly. Refer to **Generator Bracket Replacement (LSA)** .
2. Remove the camshaft position sensor mounting bolts (1).
3. Remove the camshaft position sensor assembly (4, 5, 6) from the front cover (7).
4. Disconnect the camshaft position sensor jumper harness (2) and the engine harness (3) electrical connectors.
5. Remove the camshaft sensor assembly (4, 5, 6).
6. Disconnect camshaft position sensor (5) from the jumper harness (4).

Installation Procedure

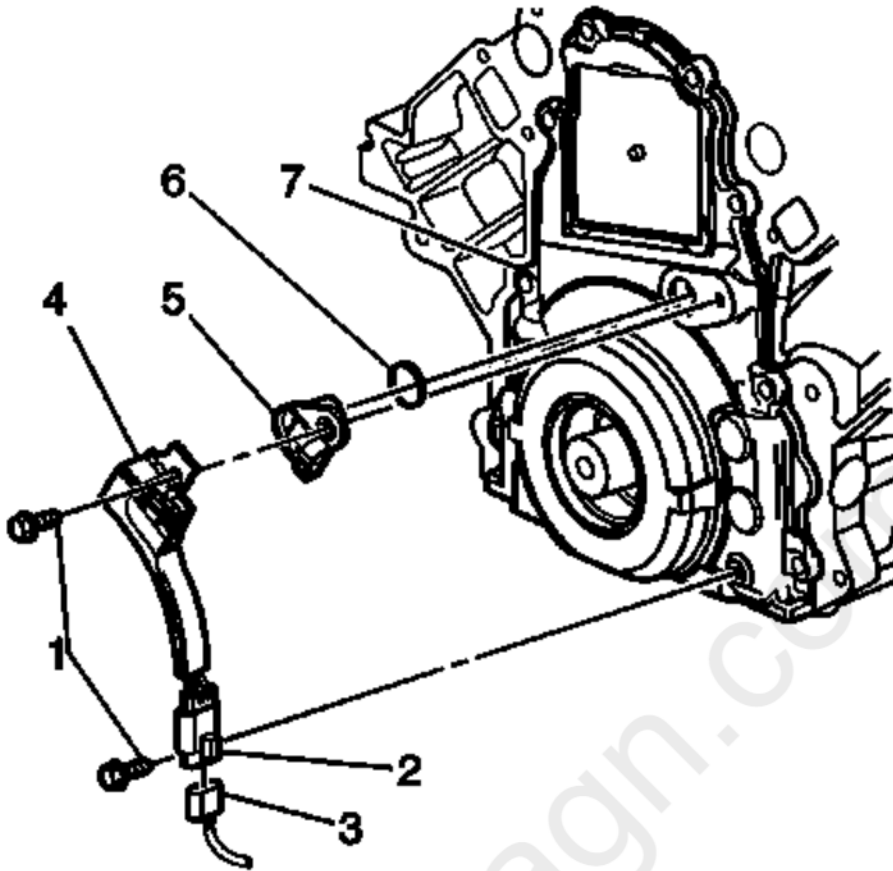


Fig. 157: Camshaft Position Sensor Assembly, Jumper Harness & Front Cover
Courtesy of GENERAL MOTORS CORP.

1. Reconnect the camshaft sensor (5) and the jumper harness (4).
2. Install the O-ring (6) on the camshaft sensor assembly (4 and 5).
3. Reconnect the camshaft position sensor assembly (4, 5 and 6) and the engine harness connector (3).

NOTE: Before installing the camshaft sensor assembly, apply a small amount of clean motor oil to the O-ring (6).

4. Install the camshaft position sensor assembly (4, 5 and 6) in the front cover (7).

CAUTION: Refer to FASTENER CAUTION .

5. Install the camshaft position sensor mounting bolts and tighten to 25 N.m (18 lb ft).
6. Install the generator assembly. Refer to Generator Bracket Replacement (LSA) .

KNOCK SENSOR 1 REPLACEMENT

Removal Procedure

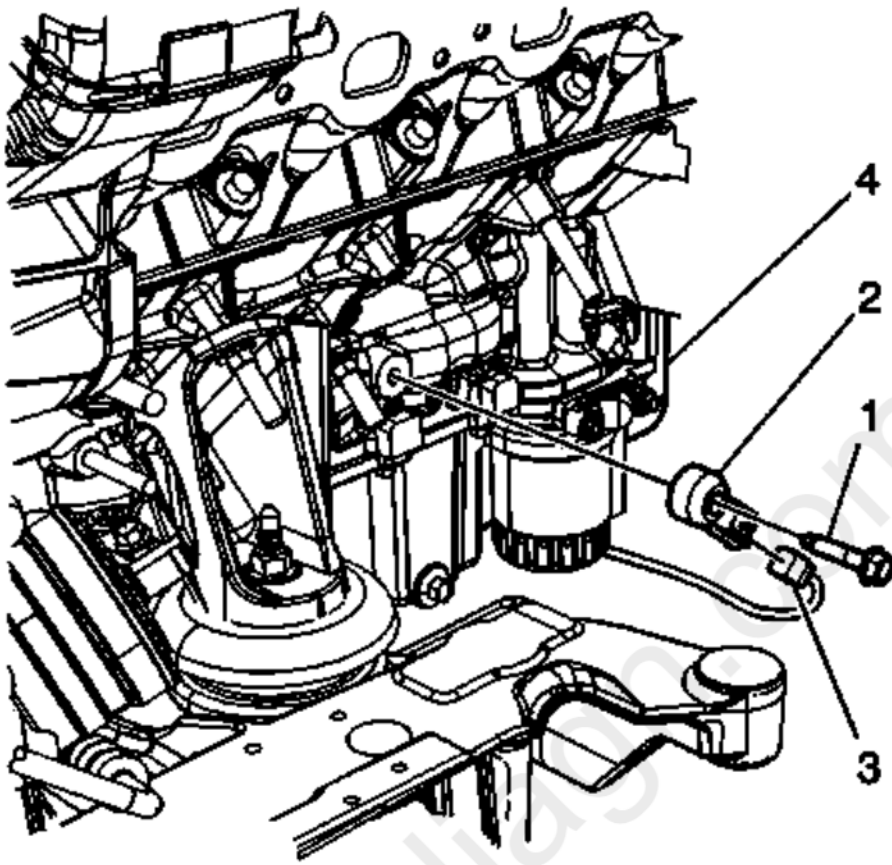


Fig. 158: Knock Sensor, Engine Harness & Engine Block - Left Side
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection (Sedan, Wagon) or Battery Negative Cable Disconnection and Connection (Coupe) .
2. Remove the left catalytic convertor. Refer to Catalytic Converter Replacement - Left Side (LF1) or Catalytic Converter Replacement - Left Side (LLT) or Catalytic Converter Replacement - Left Side (LSA) .
3. Remove the left exhaust manifold. Refer to Exhaust Manifold Replacement - Left Side (LLT) or Exhaust Manifold Replacement - Left Side (LSA) .
4. Remove the mounting bolt for the knock sensor 1.
5. Disconnect the electrical connector of the knock sensor from the engine harness (3).
6. Remove the knock sensor (2) from the engine block (4).

Installation Procedure

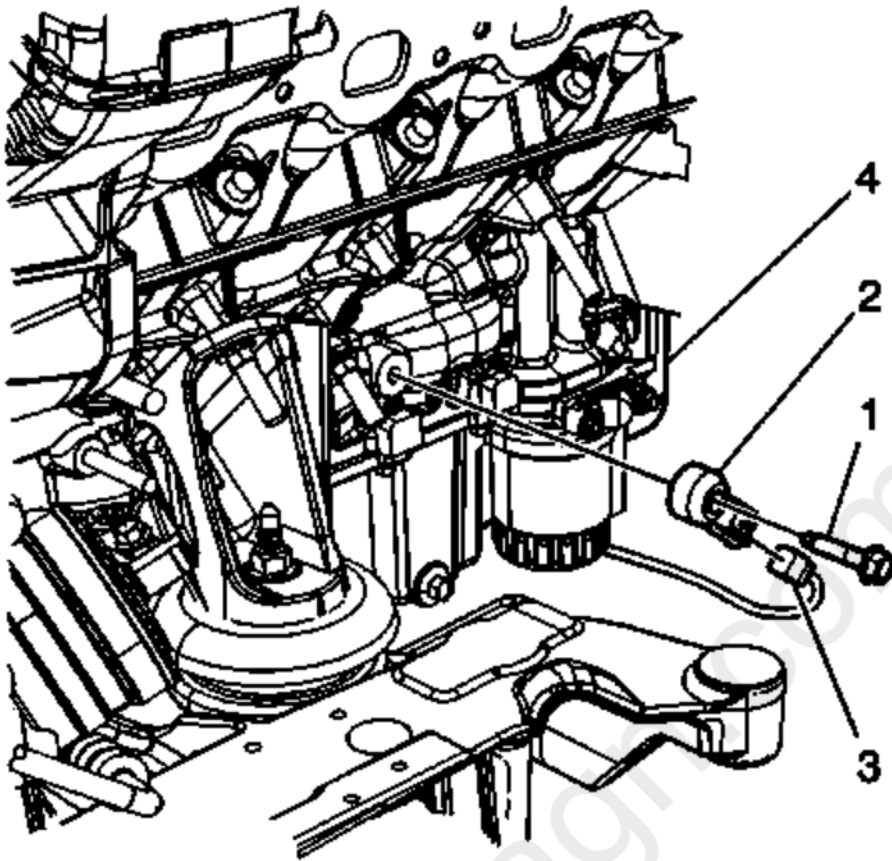


Fig. 159: Knock Sensor, Engine Harness & Engine Block - Left Side
Courtesy of GENERAL MOTORS CORP.

1. Reconnect the engine harness (3) and the knock sensor (2) electrical connectors.
2. Position the knock sensor 2 on the engine block (4).
3. Install the mounting bolt (1) for the knock sensor 2.

CAUTION: Refer to FASTENER CAUTION .

4. Tighten the knock sensor mounting bolt (1) and tighten to 20 N.m (15 lb ft).
5. Install the left exhaust manifold. Refer to Exhaust Manifold Replacement - Left Side (LLT) or Exhaust Manifold Replacement - Left Side (LSA) .
6. Install the left catalytic converter. Refer to Catalytic Converter Replacement - Left Side (LF1) or Catalytic Converter Replacement - Left Side (LLT) or Catalytic Converter Replacement - Left Side (LSA) .
7. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection (Sedan, Wagon) or Battery Negative Cable Disconnection and Connection (Coupe) .

KNOCK SENSOR 2 REPLACEMENT

Removal Procedure

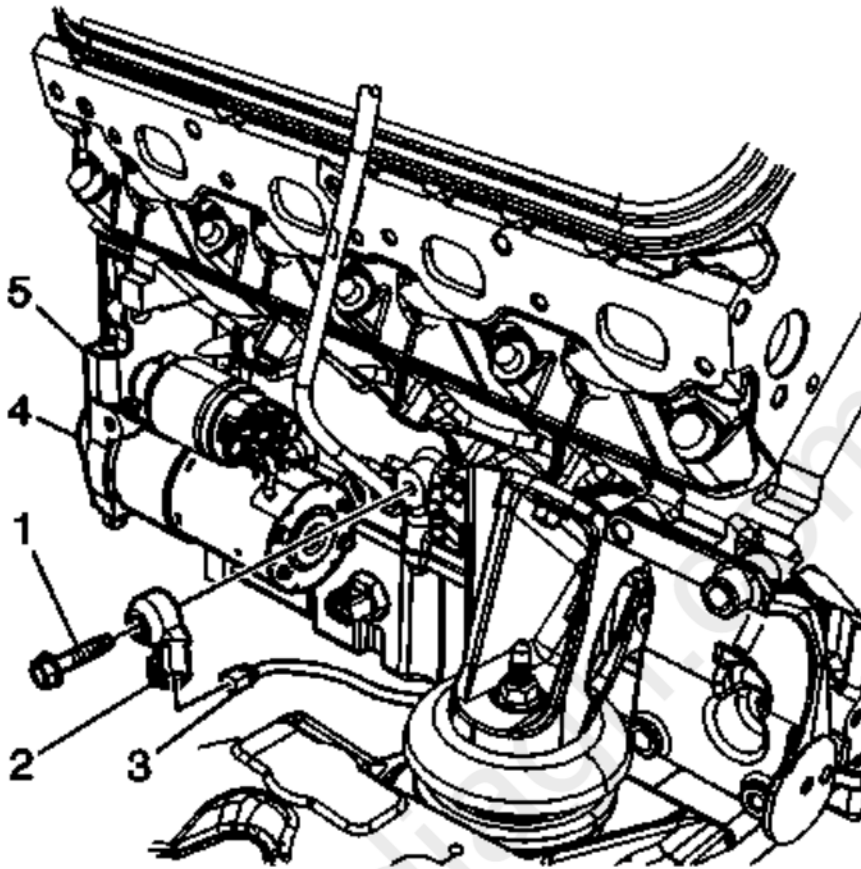


Fig. 160: Knock Sensor, Starter Assembly, Engine Electrical Connector & Engine Block - Right Side

Courtesy of GENERAL MOTORS CORP.

1. Remove the right exhaust manifold. Refer to **Exhaust Manifold Replacement - Right Side (LLT)** or **Exhaust Manifold Replacement - Right Side (LSA)** .
2. Remove the right catalytic converter. Refer to **Catalytic Converter Replacement - Right Side (LF1)** or **Catalytic Converter Replacement - Right Side (LLT)** or **Catalytic Converter Replacement - Right Side (LSA)** .

NOTE: In the following service procedure, it maybe necessary to remove the starter assembly to gain enough clearance to remove the knock sensor.

3. Remove the starter assembly (4), ONLY IF NEEDED. Refer to **Starter Replacement (LF1/LLT)** or **Starter Replacement (LSA)** .
4. Remove the knock sensor mounting (1).
5. Remove the knock sensor (2) from the engine block (5).
6. Disconnect the engine electrical connector (3) from the knock sensor (2).

7. Remove the knock sensor (2).

Installation Procedure

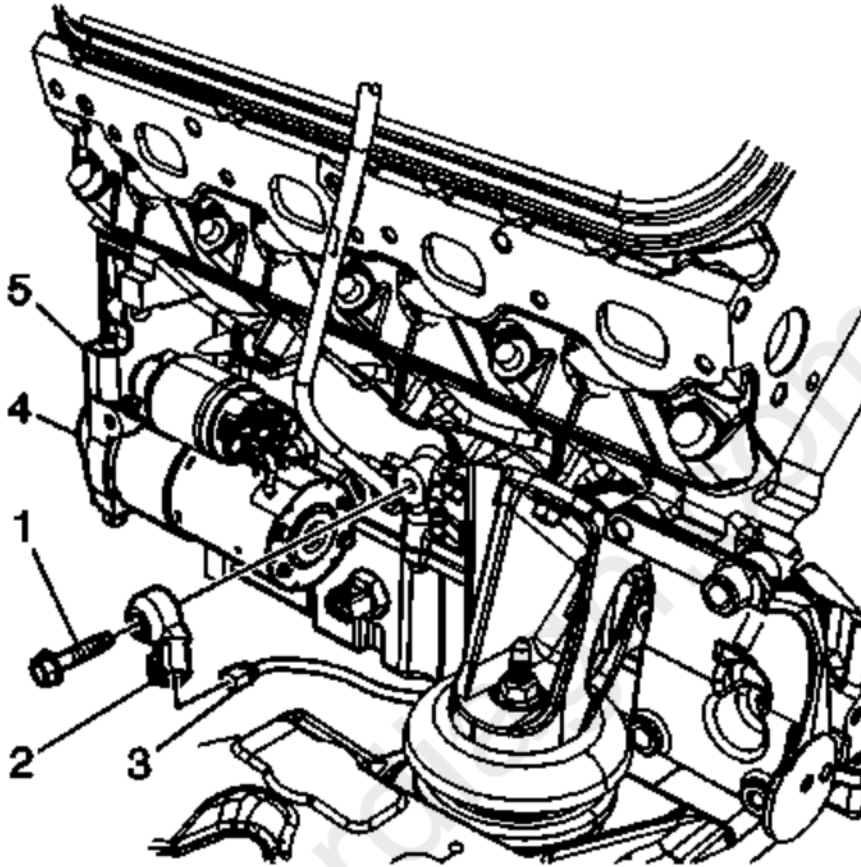


Fig. 161: Knock Sensor, Starter Assembly, Engine Electrical Connector & Engine Block - Right Side

Courtesy of GENERAL MOTORS CORP.

1. Reconnect electrical connector (3) for the engine harness to the knock sensor (2).
2. Position the knock sensor (2) on the engine block (5).
3. Install the mounting bolt (1) for the knock sensor (2).

CAUTION: Refer to FASTENER CAUTION .

4. Tighten the knock sensor mounting bolt (1) and tighten to 20 N.m (15 lb ft).
5. Install the starter assembly (4), ONLY IF REMOVED. Refer to **Starter Replacement (LF1/LLT)** or **Starter Replacement (LSA)** .
6. Install the right catalytic convertor. Refer to **Catalytic Converter Replacement - Right Side (LF1)** or **Catalytic Converter Replacement - Right Side (LLT)** or **Catalytic Converter Replacement - Right**

Side (LSA) .

7. Install the right exhaust manifold. Refer to **Exhaust Manifold Replacement - Right Side (LLT)** or **Exhaust Manifold Replacement - Right Side (LSA)** .

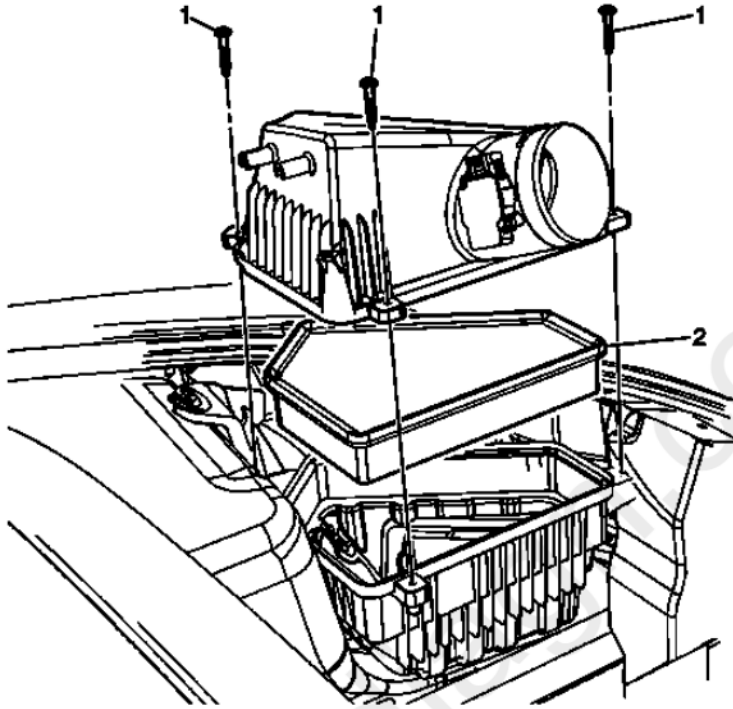
AIR CLEANER ELEMENT REPLACEMENT (LSA)

Fig. 162: Identifying Air Cleaner Element
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures	
1. Remove the sight shield. Refer to <u>Front Compartment Side Sight Shield Replacement</u> . 2. Remove the air cleaner duct. Refer to <u>Air Cleaner Resonator Outlet Duct Replacement</u> . 3. Disconnect the MAF/IAT sensor harness connector.	
1	Screw (Qty: 3) CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 4 N.m (35 lb in)
	Air Cleaner Element
	Procedure

2

1. Reposition the surge tank bypass hose as necessary.
2. Disconnect the MAF sensor wiring harness.
3. Lift the air cleaner cover in order to remove the air cleaner element.

AIR CLEANER ASSEMBLY REPLACEMENT

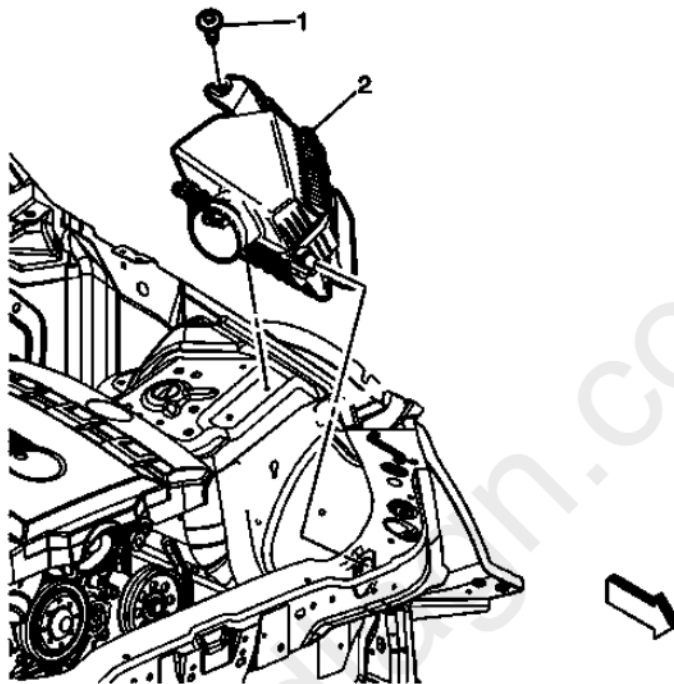


Fig. 163: Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedures	
1. Remove the sight shield. Refer to <u>Front Compartment Side Sight Shield Replacement</u> . 2. Remove the air cleaner outlet duct. Refer to <u>Air Cleaner Resonator Outlet Duct Replacement</u>. 3. Disconnect the MAF/IAT sensor electrical connector.	
1	Air Cleaner Assembly Fastener CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 9 N.m (80 lb in)
	Air Cleaner Assembly

Procedure

2

1. Reposition the surge tank bypass hose as necessary.
2. Disconnect the electrical connectors.
3. Tilt the assembly rear upward while disengaging the air cleaner isolator.

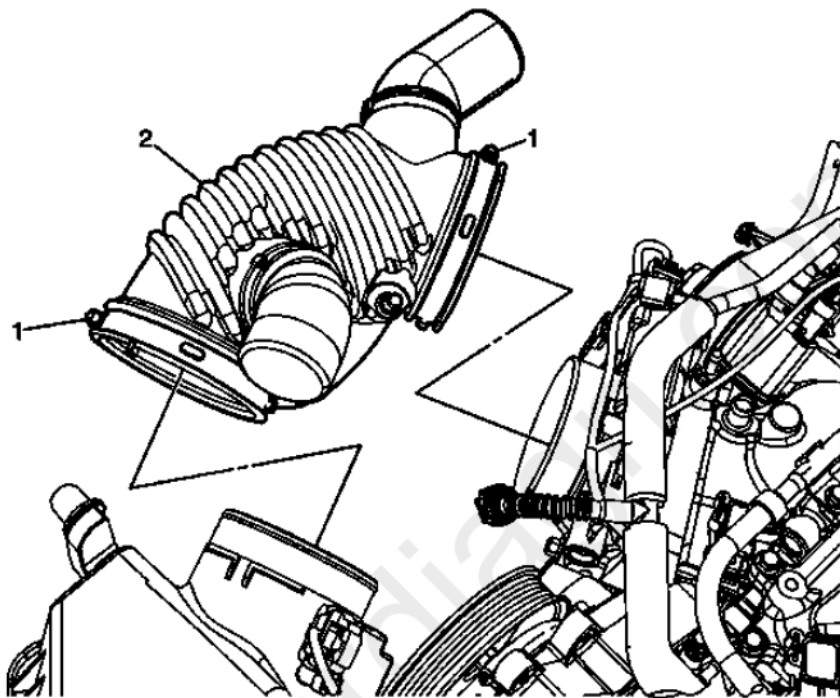
AIR CLEANER RESONATOR OUTLET DUCT REPLACEMENT

Fig. 164: Identifying Air Cleaner Resonator Outlet Duct
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure	
1. Remove the front manifold cover. Refer to <u>Intake Manifold Cover Replacement - Front</u> . 2. Disconnect the PCV tube from the outlet duct. Refer to <u>Positive Crankcase Ventilation Hose/Pipe/Tube Replacement</u>	
1	Clamp (Qty: 2) CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 4 N.m (35 lb in)
	Air Cleaner Resonator Outlet Duct

2

Procedure:

Align the air cleaner duct with the PCV vent tube during installation.

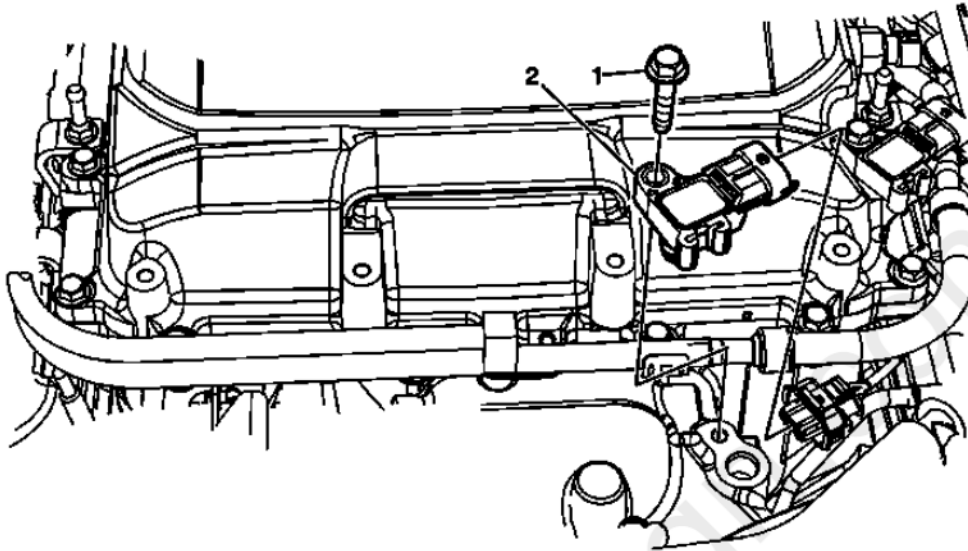
SUPERCHARGER AIR INLET PRESSURE SENSOR REPLACEMENT

Fig. 165: Identifying Supercharger Air Inlet Pressure Sensor
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the front manifold cover. Refer to Intake Manifold Cover Replacement - Front .	
1	Super Charger Air Pressure Sensor Bolt CAUTION: Refer to FASTENER CAUTION . Tighten: 10 N.m (89 lb in)
2	Super Charger Air Inlet Pressure Sensor Procedure: Disconnect the super charger pressure sensor harness connector. Tip: Always install the NEW O-ring provided with the super charger pressure sensor.

SUPERCHARGER AIR OUTLET PRESSURE SENSOR REPLACEMENT

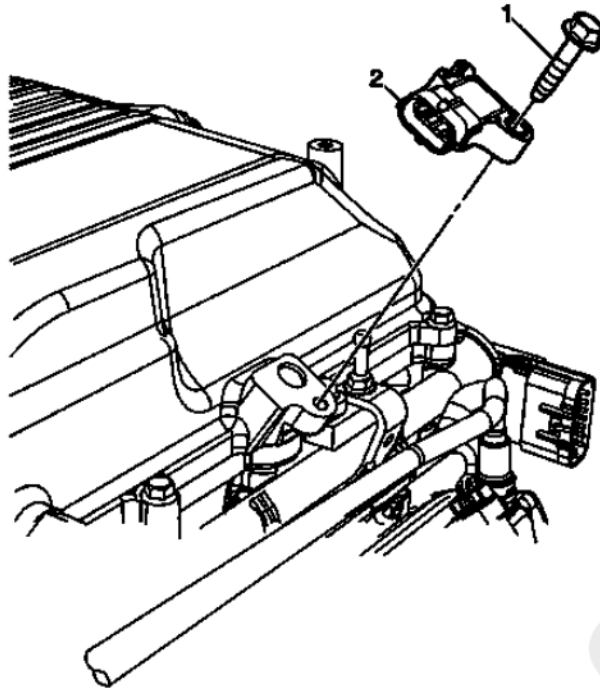


Fig. 166: Identifying Supercharger Air Outlet Pressure Sensor
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the front manifold cover. Refer to <u>Intake Manifold Cover Replacement - Front</u> .	
1	Super Charger Air Pressure Sensor Bolt CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 10 N.m (89 lb in)
2	Super Charger Air Outlet Pressure Sensor Procedure: Disconnect the super charger pressure sensor harness connector. Tip: Always install the NEW O-ring provided with the super charger pressure sensor.

CHARGE AIR BYPASS REGULATOR SOLENOID VALVE REPLACEMENT

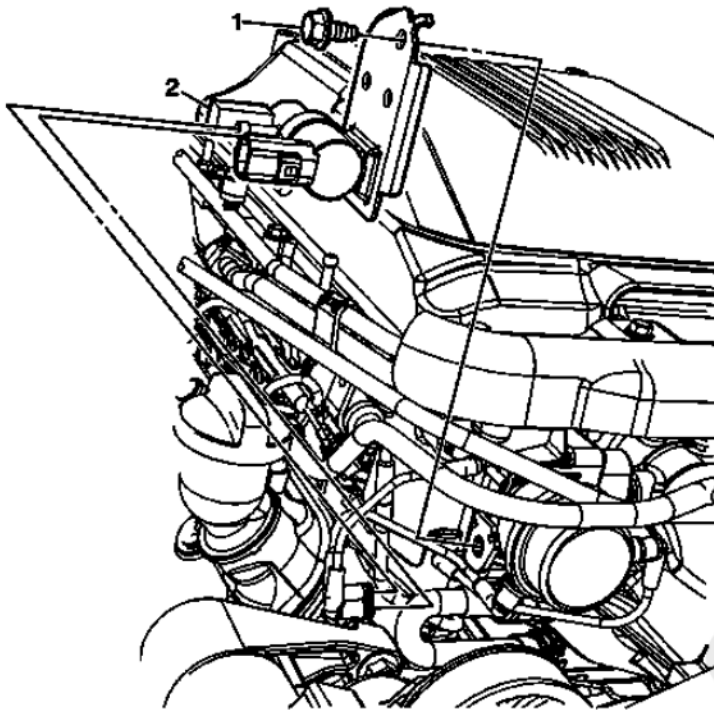


Fig. 167: Identifying Charge Air Bypass Regulator Solenoid Valve
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the front manifold cover. Refer to <u>Intake Manifold Cover Replacement - Front</u> .	
1	Charge Air Bypass Regulator Solenoid Fastener CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 10 N.m (89 lb in)
2	Charge Air Bypass Regulator Solenoid Procedure 1. Disconnect the harness connector. 2. Disconnect the vacuum tubes from the charge air bypass regulator solenoid.

SUPERCHARGER BYPASS VALVE ACTUATOR REPLACEMENT

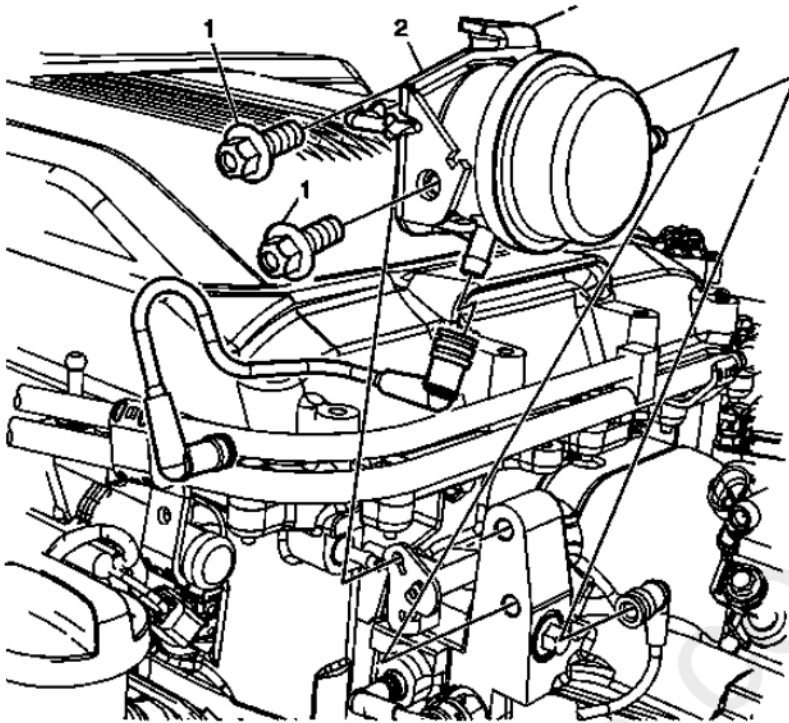


Fig. 168: Identifying Supercharger Bypass Valve Actuator
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure 1. Remove the charge air bypass regulator solenoid. Refer to <u>Charge Air Bypass Regulator Solenoid Valve Replacement</u> 2. Remove the three power steering pump bracket bolts. Refer to <u>Power Steering Pump Replacement (V6)</u> or <u>Power Steering Pump Replacement (V8)</u>	
1	Supercharger Air Bypass Regulator Actuator Fastener CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 10 N.m (89 lb in)
2	Supercharger Air Bypass Regulator Actuator Procedure 1. Disconnect the Vacuum Tube from the supercharger. 2. Disconnect the vacuum tubes from the supercharger air bypass regulator actuator. 3. Adjust the actuator. Refer to <u>Supercharger Assemble</u>