

Temperature Versus Resistance

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
150	302	47
140	284	60
130	266	77
120	248	100
110	230	132
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
-5	23	12300
-10	14	16180
-15	5	21450
-20	-4	28680
-30	-22	52700
-40	-40	100700

Altitude Versus Barometric Pressure

Altitude Measured in Meters (m)	Altitude Measured in Feet (ft)	Barometric Pressure Measured in Kilopascals (kPa)
Determine your altitude by contacting a local weather station or by using another reference source.		
4 267	14,000	56-64
3 962	13,000	58-66
3 658	12,000	61-69
3 353	11,000	64-72
3 048	10,000	66-74
2 743	9,000	69-77
2 438	8,000	71-79
2 134	7,000	74-82
1 829	6,000	77-85
1 524	5,000	80-88
1 219	4,000	83-91
914	3,000	87-95
610	2,000	90-98
305	1,000	94-102
0	0 Sea Level	96-104
-305	-1,000	101-105

[2009 Chevrolet Express - AWD](#) | [Express, Savana \(VIN G/H\) Service Manual](#) | [Engine](#) | [Engine Controls and Fuel - 4.3L](#) | [Specifications](#) | **Document ID: 1900798**

Ignition System Specifications

Application	Specification	
	Metric	English
Firing Order	1-6-5-4-3-2	
Spark Plug Wire Resistance	1,200-1,500 ohms per ft	
Spark Plug Torque	15 N·m	11 lb ft
Spark Plug Gap	1.5 mm	0.06 in
Spark Plug Type	GM P/N 12607234	
	AC Delco P/N 41-993	

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Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accelerator Pedal Bolt	33 N·m	24 lb ft
Air Cleaner Assembly Bolt	11 N·m	97 lb in
Air Cleaner Outlet Duct Clamp	5 N·m	44 lb in
Camshaft Position Sensor Bolt	10 N·m	89 lb in
Crankshaft Position Sensor Bolt	10 N·m	89 lb in
Engine Coolant Temperature (ECT) Sensor	20 N·m	15 lb ft
Evaporative Emission (EVAP) Canister Purge Solenoid Valve Bolt	10 N·m	89 lb in
Fuel/Evaporative Emission (EVAP) Pipe Assembly Bolt	13 N·m	115 lb in
Fuel Feed/Evaporative Emission (EVAP) Pipe Bracket to Bellhousing Stud Nut	25 N·m	18 lb ft
Fuel Fill Hose Clamp	2.75 N·m	24 lb in
Fuel Fill Tube Ground Strap Bolt	8 N·m	70 lb in
Fuel Pipe Bracket Bolt	6 N·m	53 lb in
Fuel Pipe Retainer Nut	3 N·m	27 lb in
Fuel Tank Fill Pipe to Housing Bolt	4 N·m	35 lb in
Fuel Tank Strap Bolt	25 N·m	18 lb ft
Heated Oxygen Sensor (HO2S)	42 N·m	31 lb ft
Ignition Coil Bolt	12 N·m	106 lb in
Ignition Coil Bracket Upper Bolt	40 N·m	30 lb ft
Ignition Coil Bracket Upper Bolt	12 N·m	106 lb in
Injector Retainer Lock Nut	3 N·m	27 lb in
Knock Sensor (KS) Bolt	25 N·m	18 lb ft
Mass Air Flow (MAF)/Intake Air Temperature Sensor Bolt	9 N·m	80 lb in
Manifold Absolute Pressure (MAP) Sensor Bolt	10 N·m	89 lb in
Spark Plug	15 N·m	11 lb ft
Throttle Body Bolt	10 N·m	89 lb in

Engine Control Module Replacement

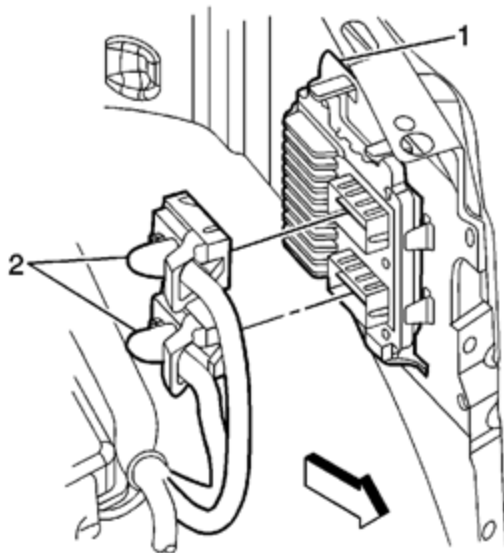
Removal Procedure

Service of the engine control module (ECM) should consist of either replacement of the ECM or programming of the electrically erasable programmable read only memory (EEPROM). If the diagnostic procedures call for the ECM to be replaced, the replacement ECM should be checked to ensure that the correct part is being used. If the correct part is being used, remove the faulty ECM and install the new service ECM.

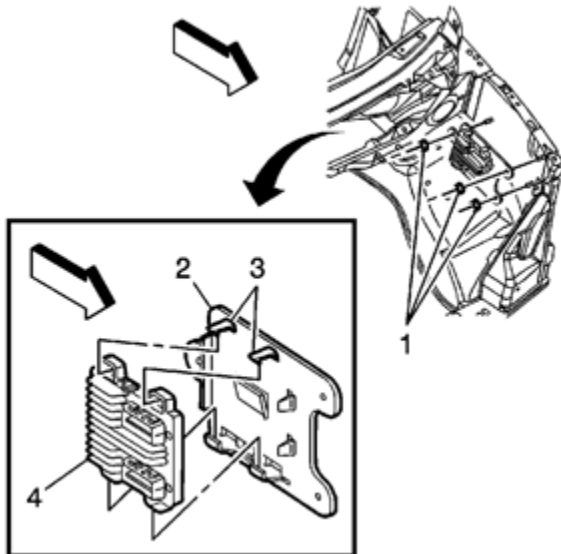
Caution:

- Turn the ignition OFF when installing or removing the control module connectors and disconnecting or reconnecting the power to the control module (battery cable, powertrain control module (PCM)/engine control module (ECM)/transaxle control module (TCM) pigtail, control module fuse, jumper cables, etc.) in order to prevent internal control module damage.
- Control module damage may result when the metal case contacts battery voltage. DO NOT contact the control module metal case with battery voltage when servicing a control module, using battery booster cables, or when charging the vehicle battery.
- In order to prevent any possible electrostatic discharge damage to the control module, do not touch the connector pins or the soldered components on the circuit board.
- Remove any debris from around the control module connector surfaces before servicing the control module. Inspect the control module connector gaskets when diagnosing or replacing the control module. Ensure that the gaskets are installed correctly. The gaskets prevent contaminant intrusion into the control module.
- The replacement control module must be programmed.

Note: It is necessary to record the remaining engine oil life. If the replacement module is not programmed with the remaining engine oil life, the engine oil life will default to 100 percent. If the replacement module is not programmed with the remaining engine oil life, the engine oil will need to be changed at 5 000 km (3,000 mi) from the last engine oil change.

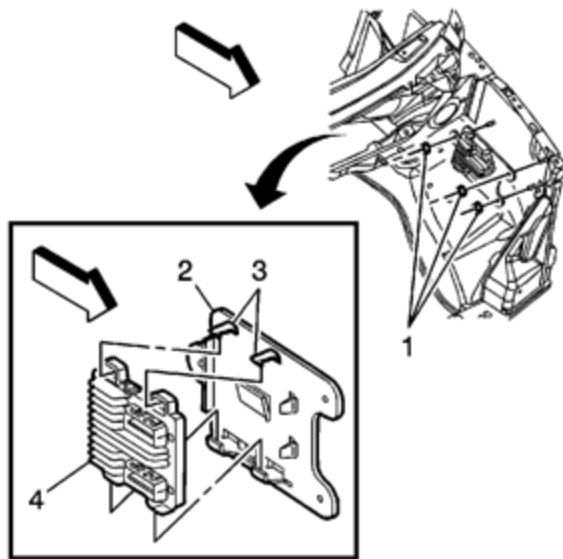


1. Using a scan tool, retrieve the percentage of remaining engine oil. Record the remaining engine oil life.
2. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#).
3. Disconnect the engine wiring harness electrical connectors (2) from the ECM (1).

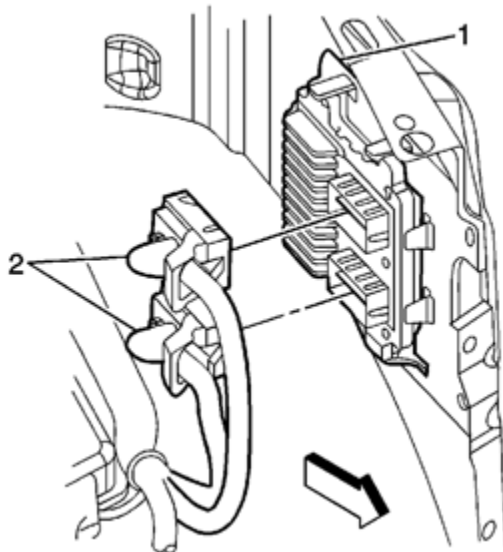


4. Release the ECM bracket tabs (3).
5. Remove the ECM (4) from the bracket (2).

Installation Procedure



1. Install the ECM (4) to the bracket (2).
2. Ensure that the ECM bracket tabs (3) fully engage the ECM.



3. Connect the engine wiring harness electrical connectors (2) to the ECM (1).
4. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#).
5. If a new ECM was installed, program the ECM. Refer to [Control Module References](#).
6. Using a scan tool, set the remaining engine oil life.

Crankshaft Position System Variation Learn

1. Install a scan tool.
2. 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.
3. Select the crankshaft position (CKP) variation learn procedure with a scan tool.
4. The scan tool instructs you to perform the following:
 - 4.1. Accelerate to wide open throttle (WOT).
 - 4.2. Release throttle when fuel cut-off occurs.
 - 4.3. Observe fuel cut-off for applicable engine.
 - 4.4. Engine should not accelerate beyond calibrated RPM value.
 - 4.5. Release throttle immediately if value is exceeded.
 - 4.6. Block drive wheels.
 - 4.7. Set parking brake.
 - 4.8. DO NOT apply brake pedal.
 - 4.9. Cycle ignition from OFF to ON.
 - 4.10. Apply and hold brake pedal.
 - 4.11. Start and idle engine.
 - 4.12. Turn A/C OFF.
 - 4.13. Vehicle must remain in Park or Neutral.
 - 4.14. 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:
 - 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.
5. Enable the CKP system variation learn procedure with a scan tool.

Important: While the learn procedure is in progress, release the throttle immediately when the engine starts to decelerate. The engine control is returned to the operator and the engine responds to throttle position after the learn procedure is complete.

6. Accelerate to WOT.
7. Release when the fuel cut-off occurs.
8. Test in progress
9. The scan tool displays Learn Status: Learned this ignition. If the scan tool indicates that DTC P0315 ran and passed, the CKP variation learn procedure is complete. If the scan tool indicates DTC P0315 failed or did not run, refer to [DTC P0315](#). If any other DTCs set, refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for the applicable DTC that set.
10. Turn OFF the ignition for 30 seconds after the learn procedure is completed successfully.
11. The CKP system variation learn procedure is also required when the following service procedures have been performed, regardless of whether DTC P0315 is set:

- A CKP sensor replacement
- An engine replacement
- A ECM replacement
- A harmonic balancer replacement
- A crankshaft replacement
- Any engine repairs which disturb the CKP sensor relationship

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Throttle 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 coking. Anytime the throttle body airflow rate changes, for example due to cleaning or replacing, the values must be relearned.

A vehicle 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

With Scan Tool - Reset 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.
- Ignition ON, engine OFF.
- The vehicle speed sensor (VSS) is 0 km/h (0 mph).

Without Scan Tool - 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 1 voltage is greater than 10 volts.

Throttle Learn

With Scan Tool - Reset Procedure

1. Ignition ON, engine OFF. Press **Reset** in Module Setup.

2. Start the engine, 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.

Without Scan Tool - Learn Procedure

Important: Do NOT perform this procedure if DTCs are set. Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

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

Important: 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.

Throttle Body Cleaning

1. Remove the air cleaner outlet duct. Refer to [Air Cleaner Outlet Resonator Replacement](#).

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

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

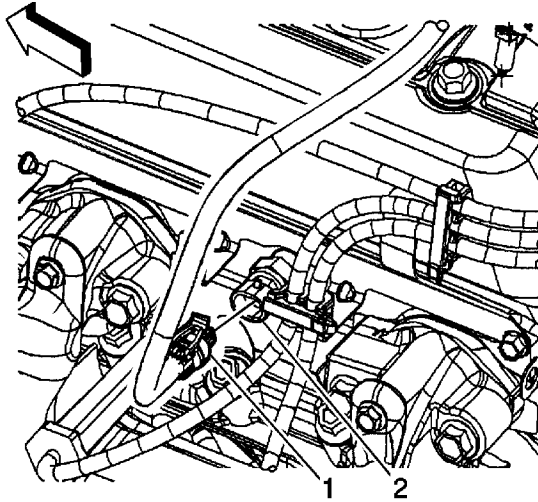
2. Inspect the throttle body bore and throttle plate for deposits. You need to open the throttle plate in order to inspect all surfaces.

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

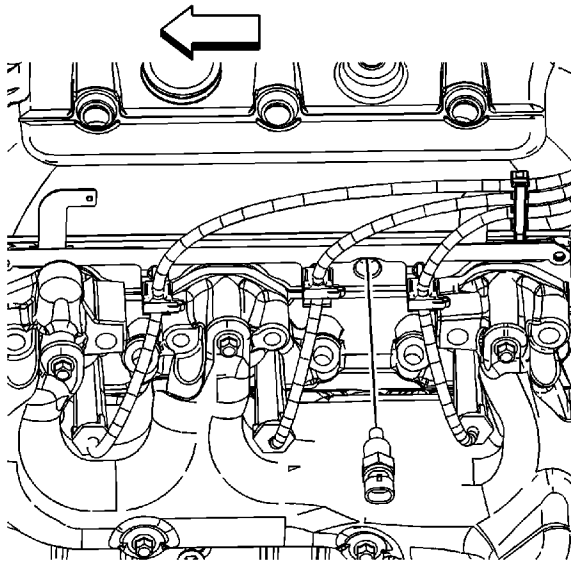
3. Clean the throttle body bore and the throttle plate using a clean shop towel with GM Top Engine Cleaner, P/N 1052626 (Canadian P/N 993026), or AC-Delco Carburetor Tune-Up Conditioner, P/N X66-P, or an equivalent product.
4. Install the air cleaner outlet duct. Refer to [Air Cleaner Outlet Resonator Replacement](#).

Engine Coolant Temperature Sensor Replacement

Removal Procedure



1. Remove the engine cover. Refer to [Engine Cover Replacement](#).
2. Drain the cooling system. Refer to [Cooling System Draining and Filling](#).
3. Disconnect the engine wiring harness electrical connector (1) from the engine coolant temperature (ECT) sensor (2).



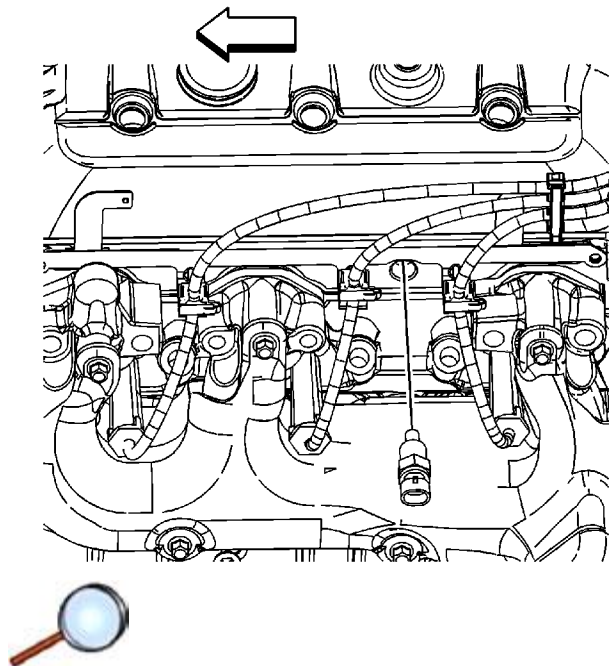
Caution: Use care when handling the coolant sensor. Damage to the coolant sensor will affect the operation of the fuel control system.

4. Remove the ECT sensor from the cylinder head.

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.

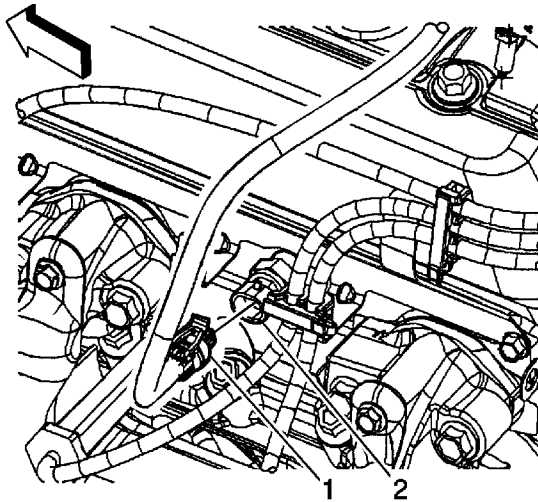
Caution: Use care when handling the coolant sensor. Damage to the coolant sensor will affect the operation of the fuel control system.



1. If re-installing the old sensor, coat the threads with sealant GM P/N 12346004 (Canadian P/N 10953480), or equivalent.

Caution: Refer to [Fastener Caution](#) in the Preface section.

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

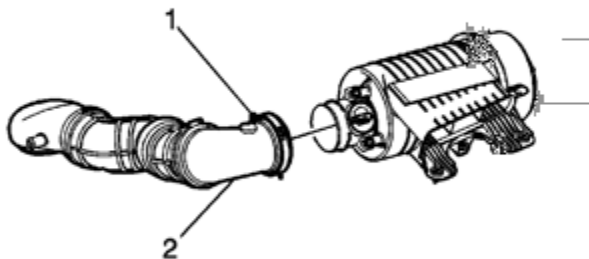


3. Connect the engine wiring harness electrical connector (1) to the ECT sensor (2).
4. Fill the cooling system. Refer to [Cooling System Draining and Filling](#).
5. Install the engine cover. Refer to [Engine Cover Replacement](#).

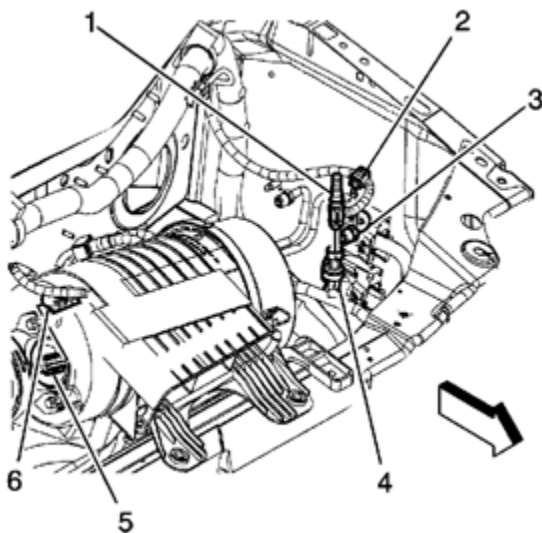
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Mass Airflow Sensor with Intake Air Temperature Sensor Replacement

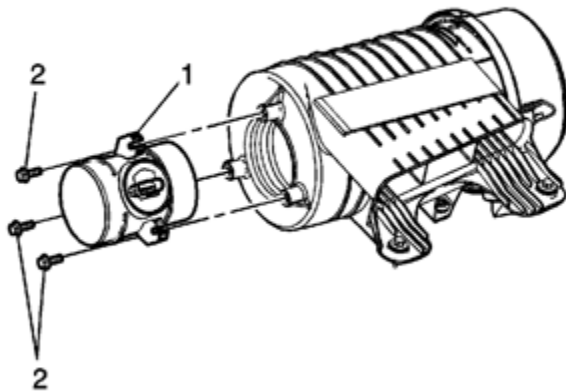
Removal Procedure



1. Loosen the air cleaner outlet duct clamp (1) at the mass airflow (MAF)/Intake air temperature (IAT) sensor.
2. Remove the air cleaner outlet duct (2) from the MAF/IAT sensor and position out of the way.

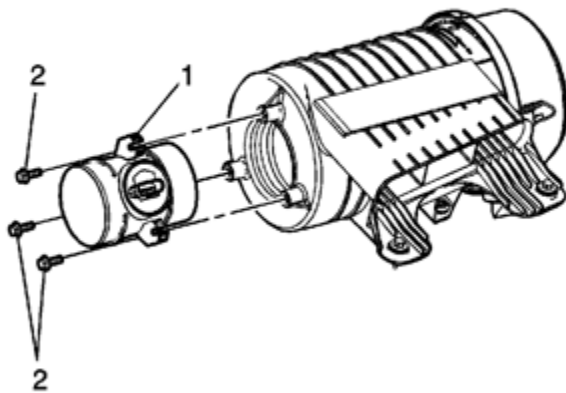


3. Disconnect the engine wiring harness electrical connector (6) from the MAF/IAT sensor (5).



4. Remove the MAF/IAT sensor bolts (2).
5. Remove the MAF/IAT sensor (1) from the air cleaner housing.

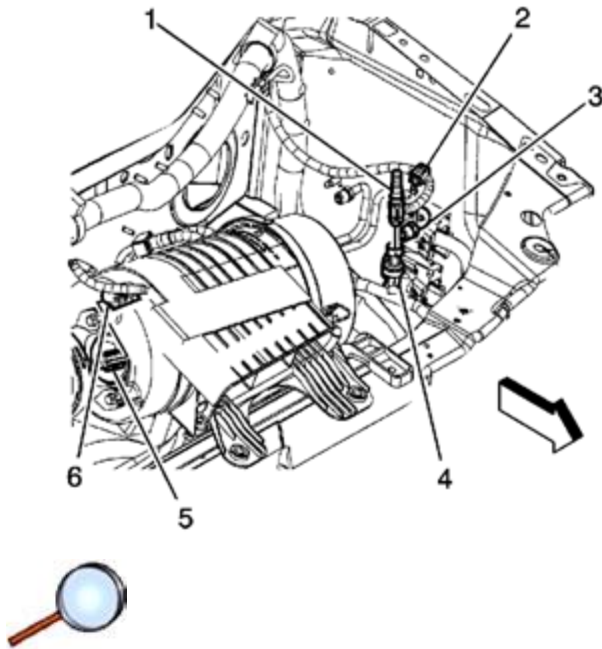
Installation Procedure



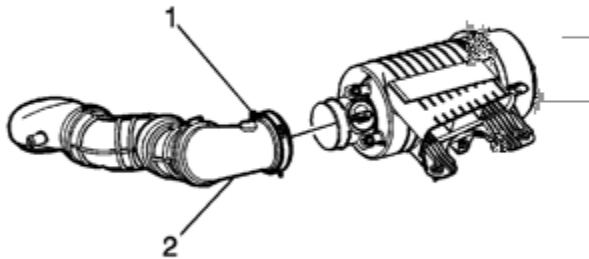
1. Install the MAF/IAT sensor (1) to the air cleaner housing.

Caution: Refer to [Fastener Caution](#) in the Preface section.

2. Install the MAF/IAT sensor bolts (2) and tighten to **9 N·m (80 lb in)**.



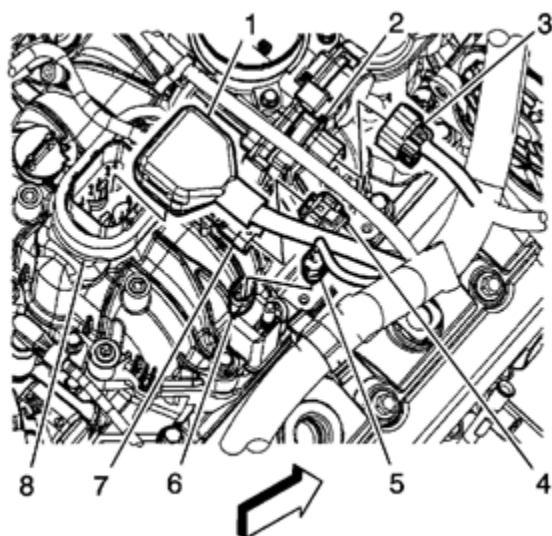
3. Connect the engine wiring harness electrical connector (6) to the MAF/IAT sensor (5).



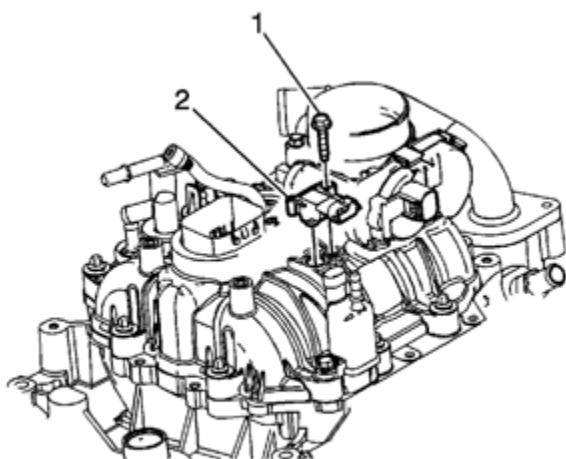
4. Position and install the air cleaner outlet duct (2) to the MAF/IAT sensor.
5. Tighten the air cleaner outlet duct clamp (1) at the MAF/IAT sensor and tighten to **5 N·m (44 lb in)**.

Manifold Absolute Pressure Sensor Replacement

Removal Procedure



1. Remove the engine cover. Refer to [Engine Cover Replacement](#).
2. Disconnect the engine wiring harness electrical connector (4) from the manifold absolute pressure (MAP) sensor (7).



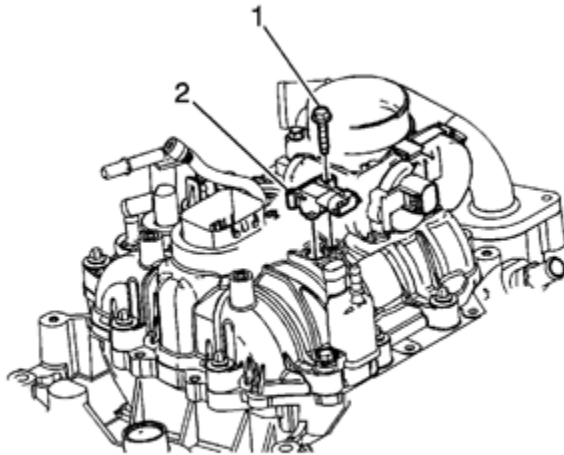
Caution: Do not rotate or pry on the MAP sensor when removing. Damage to the MAP sensor

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or the intake manifold may result.

3. Remove the MAP sensor bolt (1).
4. Using a slight rocking motion while pulling straight up, remove the MAP sensor (2) from the upper intake manifold.
5. Inspect the MAP sensor seal for damage, replace the seal if necessary.

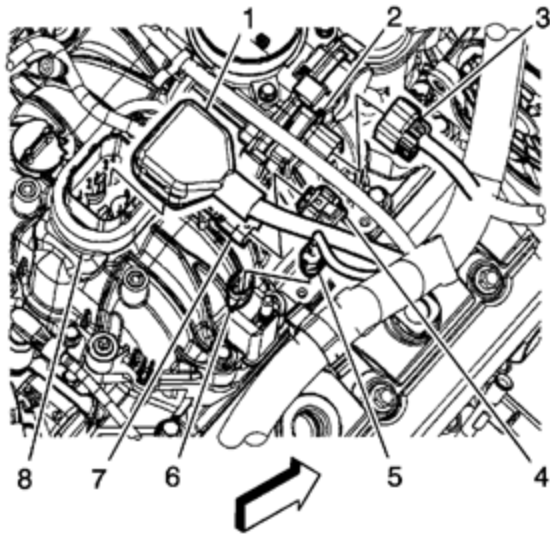
Installation Procedure



1. Install a NEW MAP sensor seal to the MAP sensor, if necessary.
2. Install the MAP sensor (2) to the upper intake manifold.

Caution: Refer to [Fastener Caution](#) in the Preface section.

3. Install the MAP sensor bolt (1) and tighten to **10 N·m (89 lb in)**.

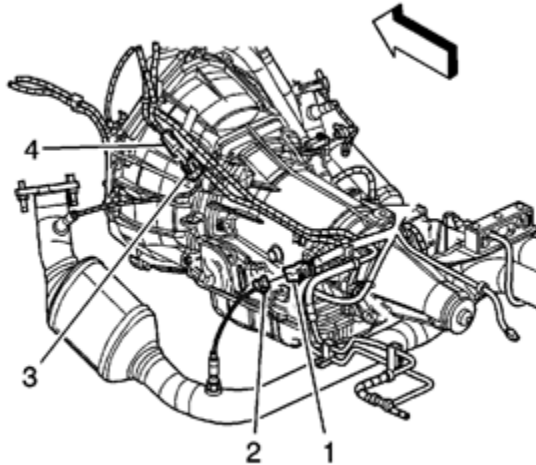


4. Connect the engine wiring harness electrical connector (4) to the MAP sensor (7).
5. Install the engine cover. Refer to [Engine Cover Replacement](#).

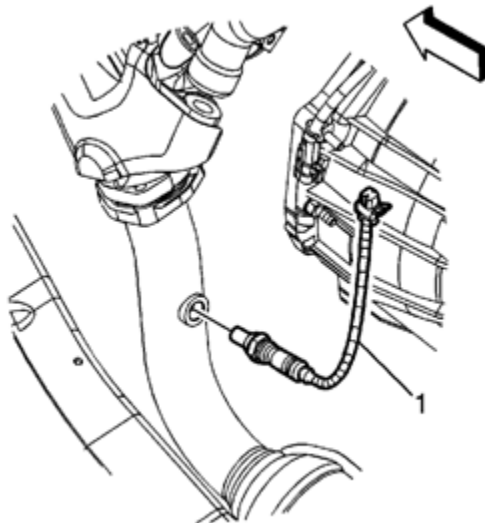
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Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 Removal Procedure

Caution: Refer to [Heated Oxygen and Oxygen Sensor Caution](#) in the Preface section.



1. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
2. Remove the connector position assurance (CPA) retainer.
3. Disconnect the HO2S electrical connector (3) from the engine wiring harness electrical connector (4).

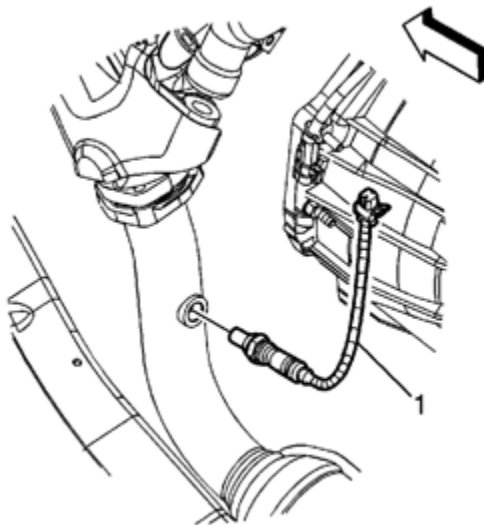




4. Remove the HO2S (1).

Installation Procedure

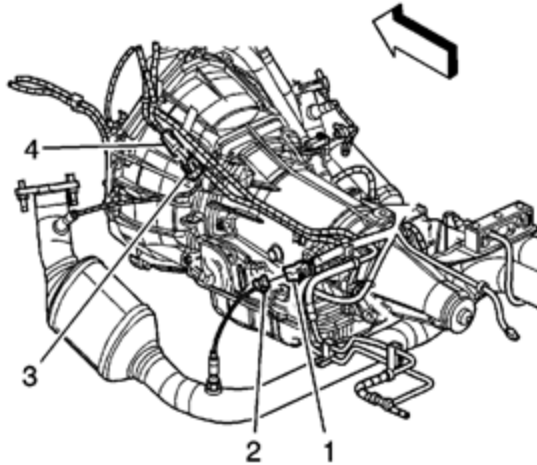
Note: A special anti-seize compound is used on the HO2S threads. The compound consists of liquid graphite and glass beads. The graphite tends to burn away, but the glass beads remain, making the sensor easier to remove. New, or service replacement sensors already have the compound applied to the threads. If the sensor is removed from an exhaust component and if for any reason the sensor is to be reinstalled, the threads must have anti-seize compound applied before the reinstallation.



1. If reinstalling the old sensor, coat the threads with anti-seize compound GM P/N 12377953, or equivalent.

Caution: Refer to [Component Fastener Tightening Caution](#) in the Preface section.

2. Install the HO2S (1) and tighten to **42 N·m (31 lb ft)**.

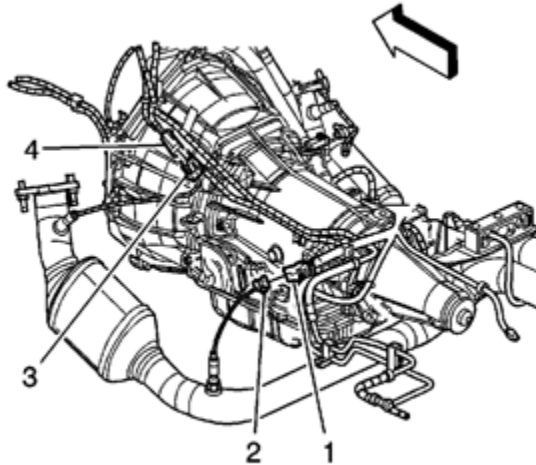


3. Connect the HO2S electrical connector (3) to the engine wiring harness electrical connector (4).
4. Install the CPA retainer.
5. Lower the vehicle.

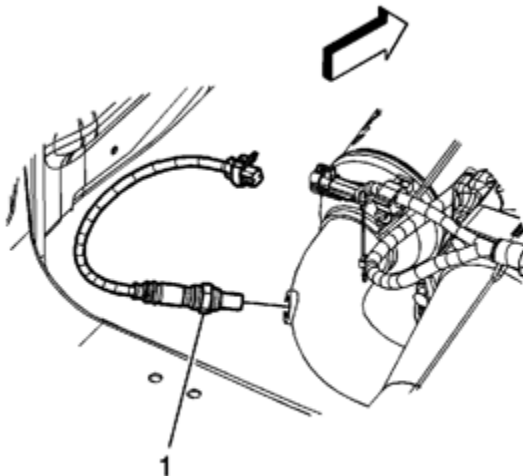
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Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 Removal Procedure

Caution: Refer to [Heated Oxygen and Oxygen Sensor Caution](#) in the Preface section.



1. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
2. Remove the connector position assurance (CPA) retainer.
3. Disconnect the HO2S electrical connector (2) from the engine wiring harness electrical connector (1).

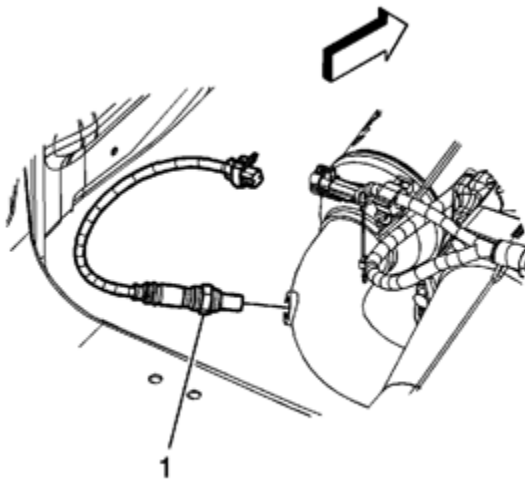




4. Remove the HO2S (1).

Installation Procedure

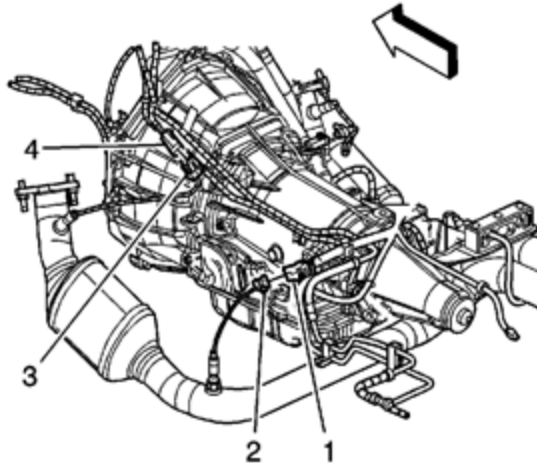
Note: A special anti-seize compound is used on the HO2S threads. The compound consists of liquid graphite and glass beads. The graphite tends to burn away, but the glass beads remain, making the sensor easier to remove. New, or service replacement sensors already have the compound applied to the threads. If the sensor is removed from an exhaust component and if for any reason the sensor is to be reinstalled, the threads must have anti-seize compound applied before the reinstallation.



1. If reinstalling the old sensor, coat the threads with anti-seize compound GM P/N 12377953, or equivalent.

Caution: Refer to [Component Fastener Tightening Caution](#) in the Preface section.

2. Install the HO2S (1) and tighten to **42 N·m (31 lb ft)**.

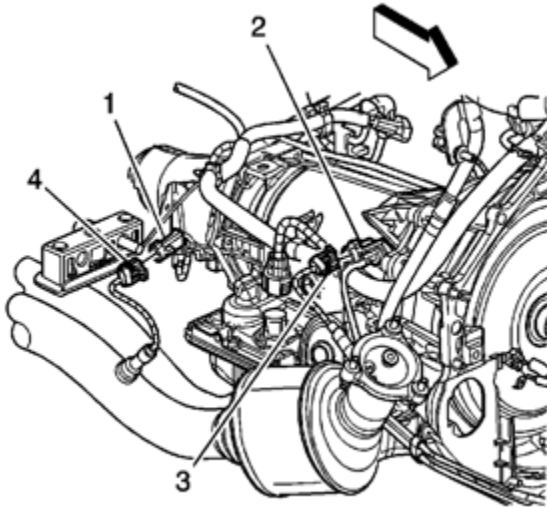


3. Connect the HO2S electrical connector (2) to the engine wiring harness electrical connector (1).
4. Install the CPA retainer.
5. Lower the vehicle.

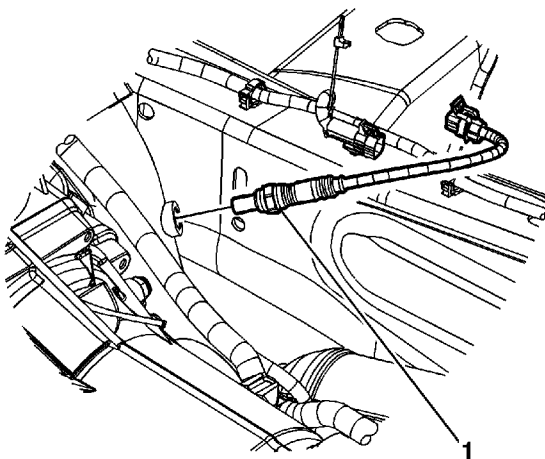
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Heated Oxygen Sensor Replacement - Bank 2 Sensor 1 Removal Procedure

Caution: Refer to [Heated Oxygen and Oxygen Sensor Caution](#) in the Preface section.



1. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
2. Remove the connector position assurance (CPA) retainer.
3. Disconnect the HO2S electrical connector (3) from the engine wiring harness electrical connector (2).

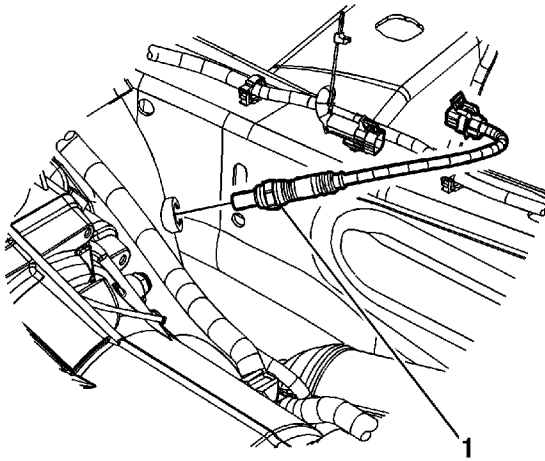




4. Remove the HO2S (1).

Installation Procedure

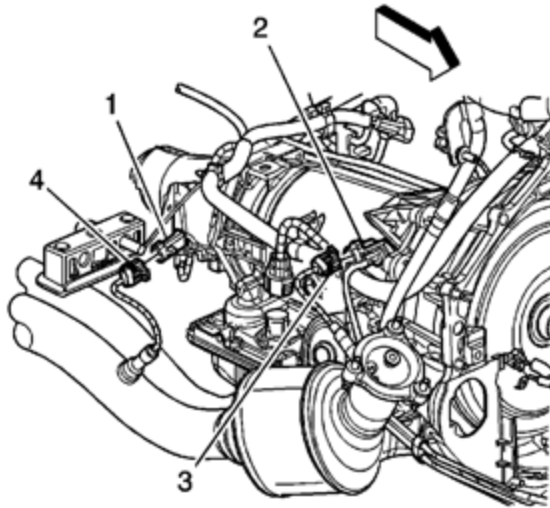
Note: A special anti-seize compound is used on the HO2S threads. The compound consists of liquid graphite and glass beads. The graphite tends to burn away, but the glass beads remain, making the sensor easier to remove. New, or service replacement sensors already have the compound applied to the threads. If the sensor is removed from an exhaust component and if for any reason the sensor is to be reinstalled, the threads must have anti-seize compound applied before the reinstallation.



1. If reinstalling the old sensor, coat the threads with anti-seize compound GM P/N 12377953, or equivalent.

Caution: Refer to [Component Fastener Tightening Caution](#) in the Preface section.

2. Install the HO2S (1) and tighten to **42 N·m (31 lb ft)**.



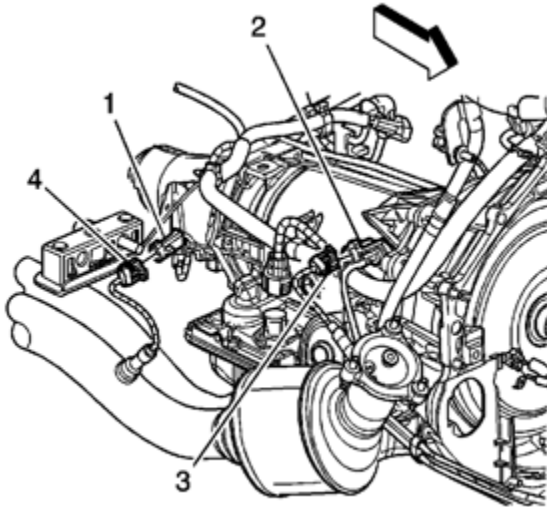
3. Connect the HO2S electrical connector (3) to the engine wiring harness electrical connector (2).
4. Install the CPA retainer.
5. Lower the vehicle.

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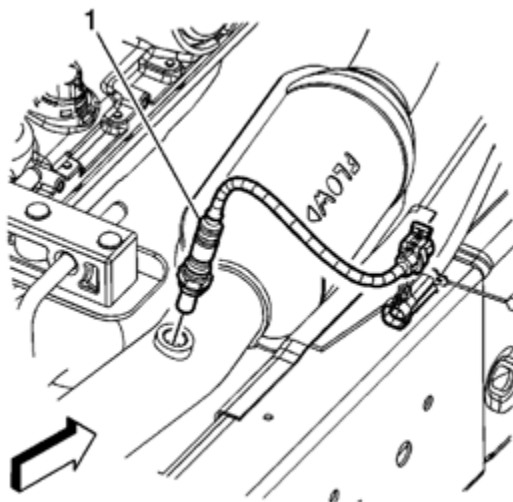
Heated Oxygen Sensor Replacement - Bank 2 Sensor 2

Removal Procedure

Caution: Refer to [Heated Oxygen and Oxygen Sensor Caution](#) in the Preface section.



1. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
2. Remove the connector position assurance (CPA) retainer.
3. Disconnect the HO2S electrical connector (4) from the engine wiring harness electrical connector (1).

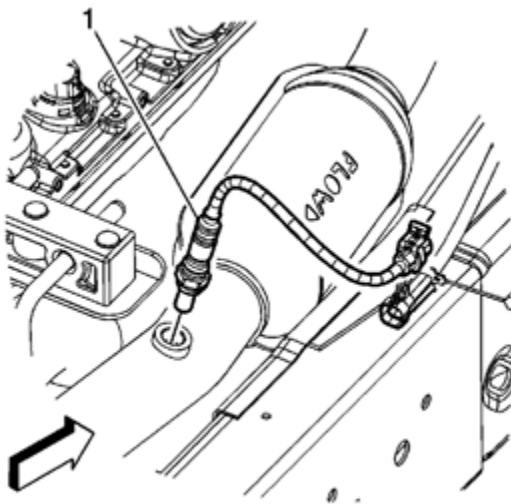




4. Remove the HO2S (1).

Installation Procedure

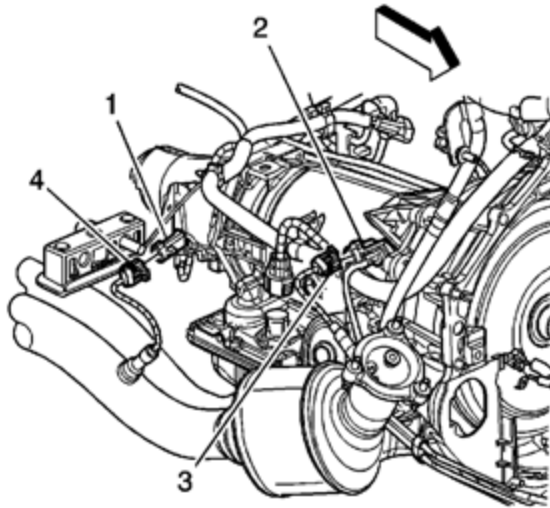
Note: A special anti-seize compound is used on the HO2S threads. The compound consists of liquid graphite and glass beads. The graphite tends to burn away, but the glass beads remain, making the sensor easier to remove. New, or service replacement sensors already have the compound applied to the threads. If the sensor is removed from an exhaust component and if for any reason the sensor is to be reinstalled, the threads must have anti-seize compound applied before the reinstallation.



1. If reinstalling the old sensor, coat the threads with anti-seize compound GM P/N 12377953, or equivalent.

Caution: Refer to [Component Fastener Tightening Caution](#) in the Preface section.

2. Install the HO2S (1) and tighten to **42 N·m (31 lb ft)**.



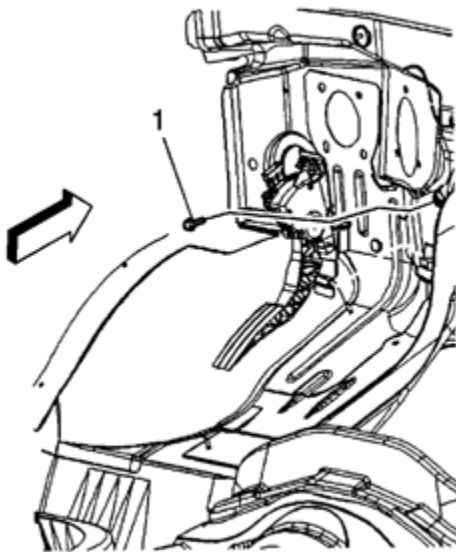
3. Connect the HO2S electrical connector (4) to the engine wiring harness electrical connector (1).
4. Install the CPA retainer.
5. Lower the vehicle.

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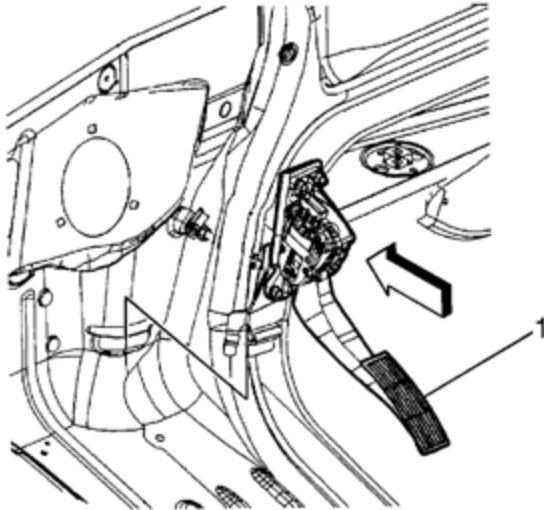
Accelerator Pedal Position Sensor Replacement

Removal Procedure

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.

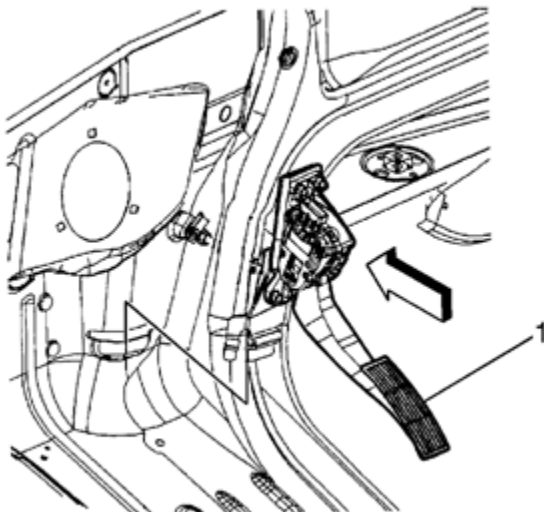


1. Remove the connector position assurance (CPA) retainer.
2. Disconnect the electrical connector from the accelerator pedal position (APP) sensor.
3. Remove the accelerator pedal bolt (1).



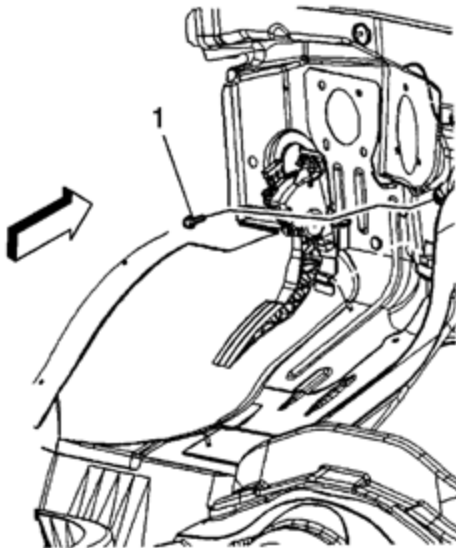
4. Remove the accelerator pedal assembly (1) from the dash panel.

Installation Procedure



1. Install the accelerator pedal assembly (1) to the dash panel.

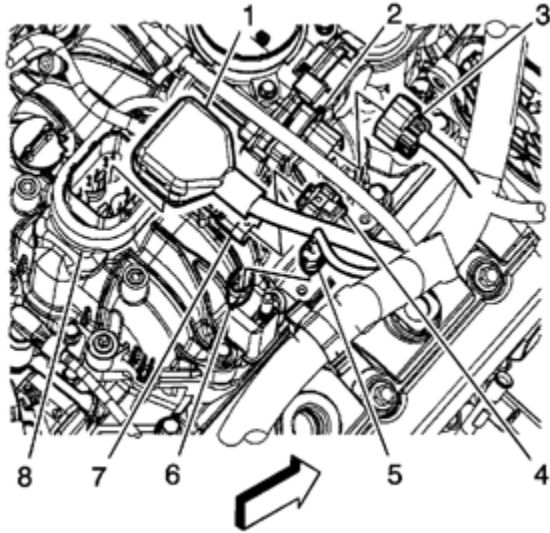
Caution: Refer to [Fastener Caution](#) in the Preface section.



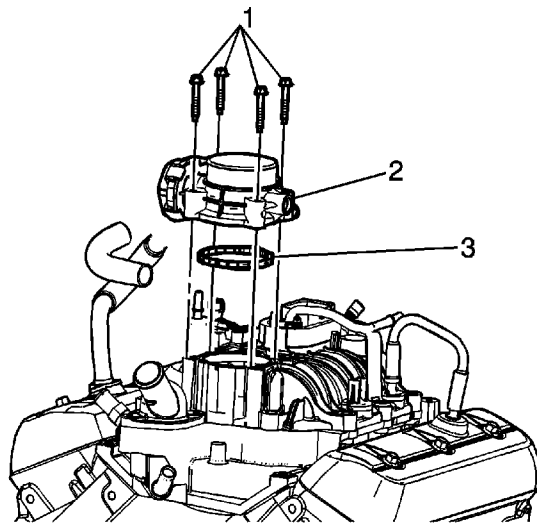
2. Install the accelerator pedal bolt (1) and tighten to **33 N·m (24 lb ft)**.
3. Connect the electrical connector to the APP sensor.
4. Install the CPA retainer.
5. Connect a scan tool in order to test for proper throttle-opening and throttle-closing range.
6. Operate the accelerator pedal and monitor the throttle angles. The accelerator pedal should operate freely, without binding, between a closed throttle, and a wide open throttle (WOT).
7. Verify that the vehicle meets the following conditions:
 - The vehicle is not in a reduced engine power mode.
 - The ignition is ON.
 - The engine is OFF.

Throttle Body Assembly Replacement

Removal Procedure

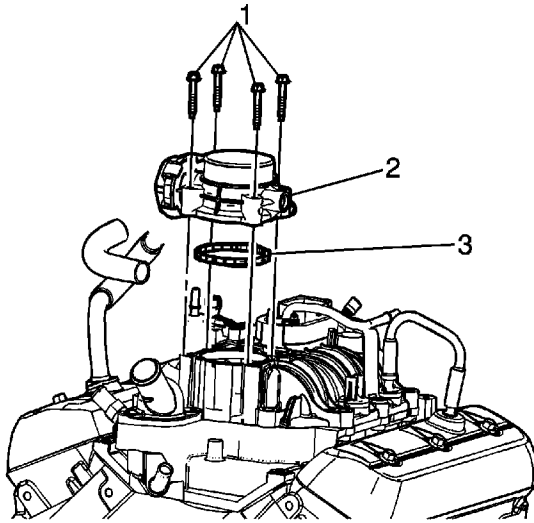


1. Remove the air cleaner outlet resonator. Refer to [Air Cleaner Outlet Resonator Replacement](#).
2. Disconnect the engine wiring harness electrical connector (3) from the throttle actuator (2).



3. Remove the throttle body bolts (1).
4. Remove the throttle body (2) and gasket (3). Discard the gasket.

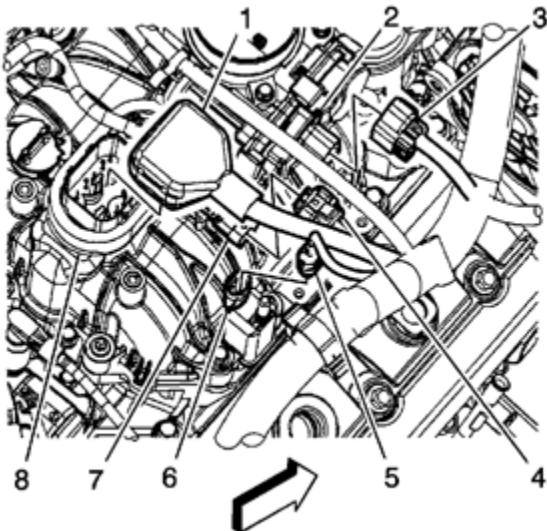
Installation Procedure



1. Install a NEW throttle body gasket (3) into the upper intake manifold.
2. Place the throttle body (2) onto the upper intake manifold.

Caution: Refer to [Fastener Caution](#) in the Preface section.

3. Install the throttle body bolts (1) and tighten to **10 N·m (89 lb in)**.



4. Connect the engine wiring harness electrical connector (3) to the throttle actuator (2).
5. Install the air cleaner outlet resonator. Refer to [Air Cleaner Outlet Resonator Replacement](#).

Fuel Pressure Relief (With CH-48027)

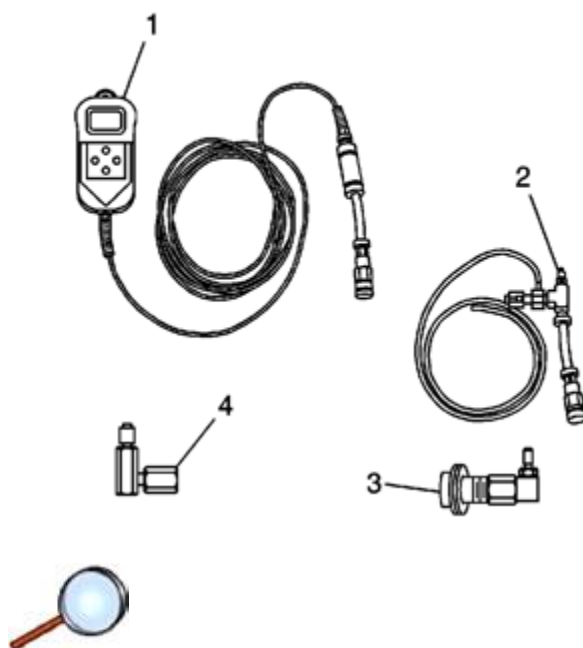
Special Tools

CH-48027 Digital Pressure Gage

Warning: Refer to [Gasoline/Gasoline Vapors Warning](#) in the Preface section.

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.

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



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 gage. Place the towel in an approved container when the connection of the fuel pressure gage 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 gage 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.

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Fuel Pressure Relief (Without CH-48027)

Warning: Refer to [Gasoline/Gasoline Vapors Warning](#) in the Preface section.

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.

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.

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Fuel Pressure Gage Installation and Removal

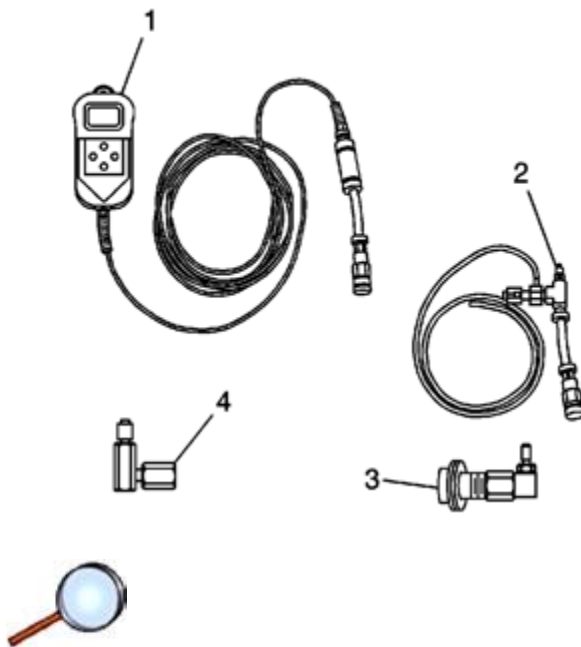
Special Tools

[CH-48027](#) Digital Pressure Gage

Installation Procedure

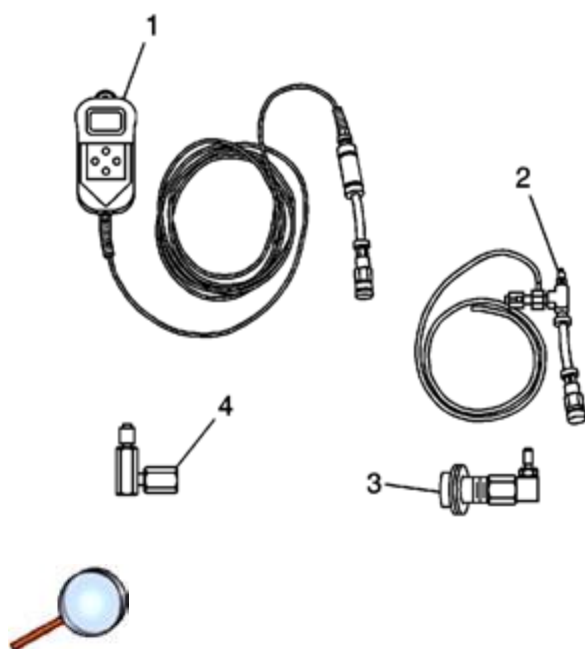
Warning: Refer to [Gasoline/Gasoline Vapors Warning](#) in the Preface section.

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.



1. Relieve the fuel system pressure. Refer to [Fuel Pressure Relief](#).
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



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

- 1.1. Wrap a shop towel around the fuel rail service port.
- 1.2. Place the hose on the CH-48027-2 (2) into an approved gasoline container.
- 1.3. Open the valve on the CH-48027-2 (2) in order to bleed any fuel from the fuel rail.
- 1.4. Close the valve on the CH-48027-2 (2).
- 1.5. Remove the hose on the CH-48027-2 (2) from the approved gasoline container.
- 1.6. 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

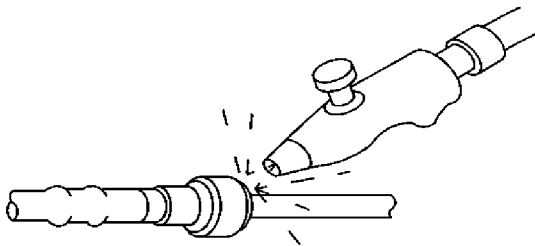
2. Disconnect the CH-48027-1 (1) from the CH-48027-2 (2).
3. Disconnect the CH-48027-2 (2) from the CH-48027-3 (4).
4. Disconnect the CH-48027-3 (4) from the fuel rail service port.
5. Install the fuel rail service port cap.
6. Install the engine cover, if required.
7. Tighten the fuel fill cap.

Metal Collar Quick Connect Fitting Service

Special Tools

[J 41769](#) Fuel Line Quick Disconnect Tool

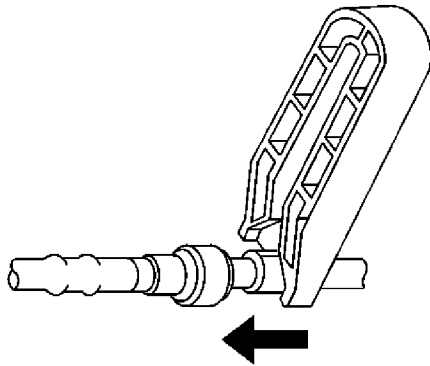
Removal Procedure



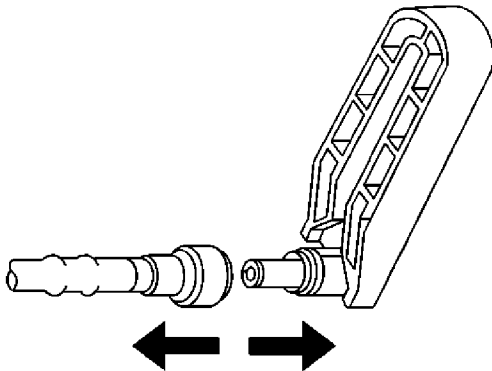
1. Relieve the fuel system pressure. Refer to [Fuel Pressure Relief](#).

Warning: Wear safety glasses when using compressed air in order to prevent eye injury.

2. Using compressed air, blow any debris from around the fittings.



3. Using [J 41769](#) , insert the correct size tool into the female connector, then push inward to release the locking tabs.

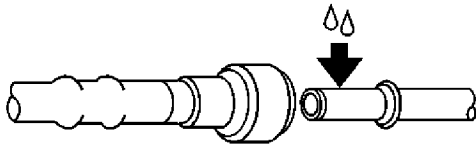


4. Pull the fuel line connection apart.

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.

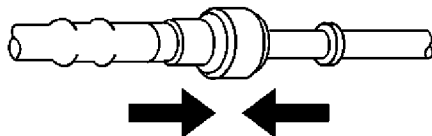
5. Using a clean shop towel, wipe off the male pipe end.
6. Inspect both ends of the fuel line connections for dirt and burrs. Clean or replace the components as required.

Installation Procedure

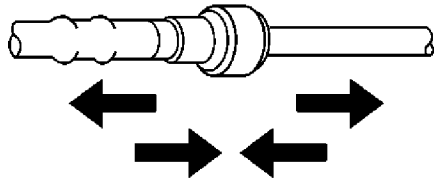


Warning: Always apply a few drops of clean engine oil to the male pipe ends before connecting the fuel pipe fittings in order to reduce the risk of fire and personal injury. This will ensure proper reconnection and prevent a possible fuel leak. During normal operation, the O-rings located in the female 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.



2. Push both sides of the fuel line connections together in order to snap the retaining tabs into place.



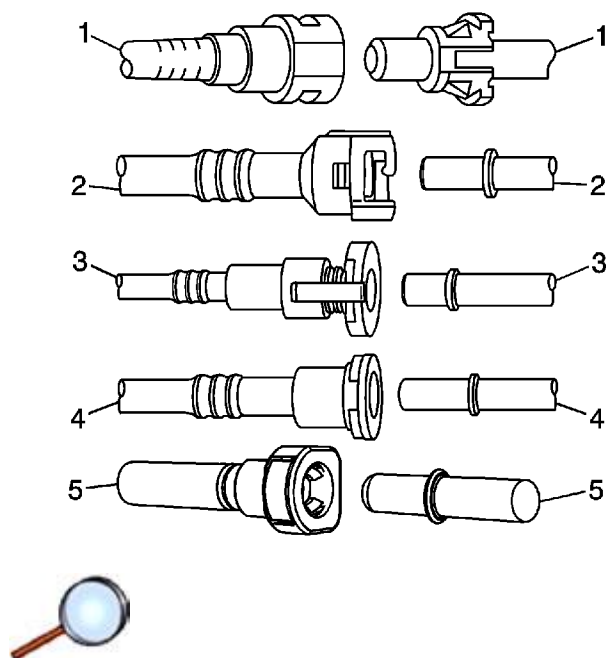
3. Once installed, pull on both sides of the fuel line connections to ensure that the connection is secure.

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Plastic Collar Quick Connect Fitting Service

Disconnect Procedure

Warning: Refer to [Gasoline/Gasoline Vapors Warning](#) in the Preface section.



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

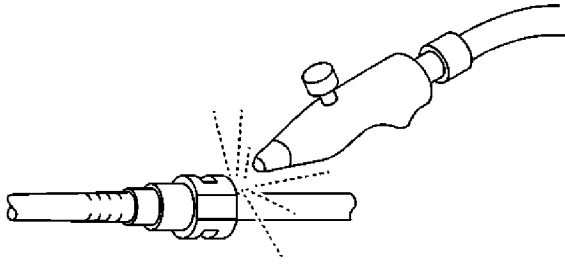
- Bartholomew (1)
- Q Release (2)
- Squeeze to Release (3)
- Sliding Retainer (4)
- Push Down TI (5)

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

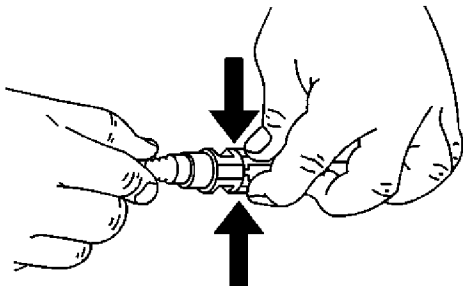
1. Relieve the fuel system pressure. Refer to [Fuel Pressure Relief](#).

Warning: Refer to [Safety Glasses Warning](#) in the Preface section.

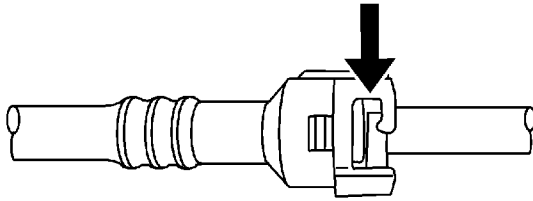
Caution: Refer to [Fuel and Evaporative Emission Hose/Pipe Connection Cleaning Caution](#) in the Preface section.



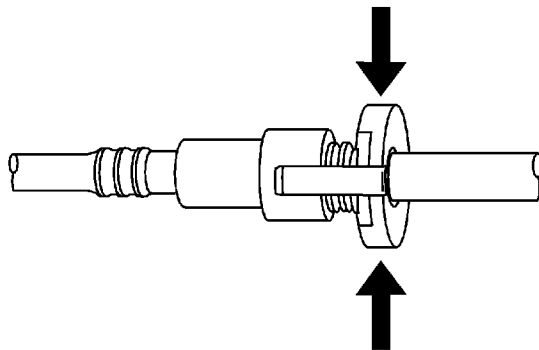
2. Using compressed air, blow any dirt or debris from around the connection.



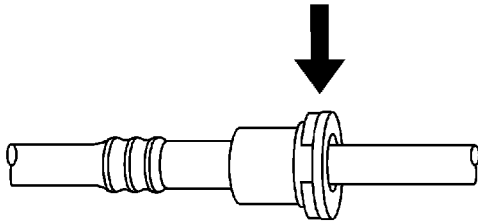
3. This step applies to Bartholomew style connector ONLY. Squeeze the plastic quick connect fitting release tabs.



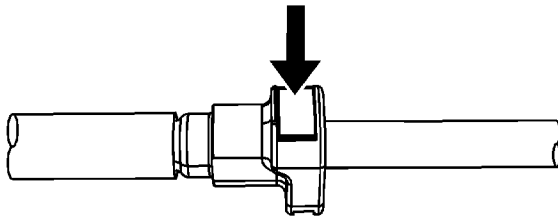
4. This step applies to Release Tab style connector ONLY. Release the fitting by pushing the tab toward the other side of the slot in the fitting.



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.

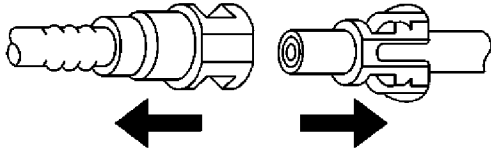


6. This step applies to the Sliding Retainer style connector ONLY. Release the fitting by pressing on one side of the release tab causing it to push in slightly. If the tab does not move try pressing the tab in from the opposite side. The tab will only move in one direction.



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

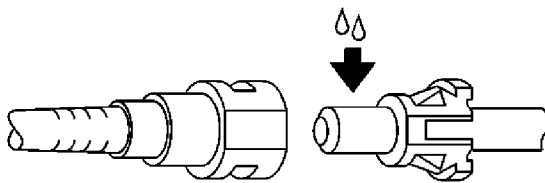
Warning: Refer to [Relieving Fuel Pressure Warning](#) in the Preface section.



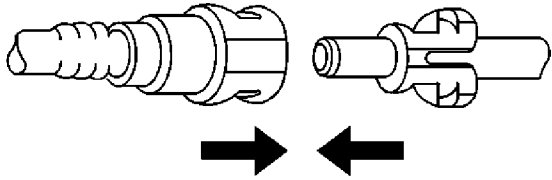
8. Pull the connection apart.

Connect Procedure

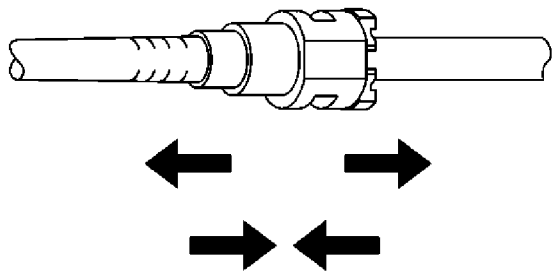
Warning: Refer to [Fuel Pipe Fitting Warning](#) in the Preface section.



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



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

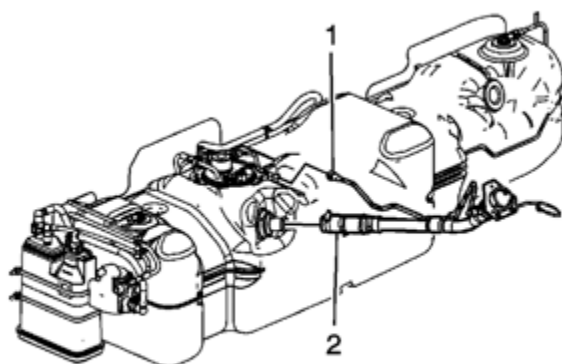


3. Once installed, pull on both sides of the connection in order to make sure the connection is secure.

Fuel Tank Draining (with L59)

Warning: Refer to [Gasoline/Gasoline Vapors Warning](#) in the Preface section.

1. Remove the fuel filler cap.
2. Raise the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
3. Clean the area around the fuel filler pipe to tank connection.
4. Place a drain pan under the fuel filler pipe connection.



5. Disconnect the fuel fill hose (1) at the fuel tank.
6. Use a hand or air operated pump device in order to drain as much fuel through the fuel tank filler pipe opening as possible.

Caution: Refer to [Fastener Caution](#) in the Preface section.

7. If not removing the fuel tank, connect the fuel fill hose to the fuel tank and tighten the clamp to **2.75 N·m (24 lb in)**.

Fuel Tank Draining (without L59)

Warning: Gasoline or gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

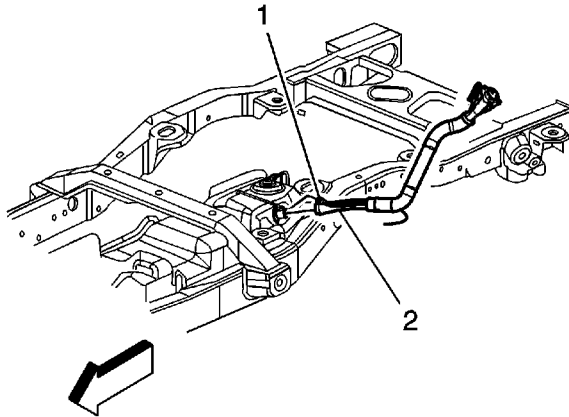
Warning: Refer to [Battery Disconnect Warning](#) in the Preface section.

1. Disconnect the negative battery cable.
2. Use a hand operated pump device in order to remove the fuel through the fuel filler pipe.

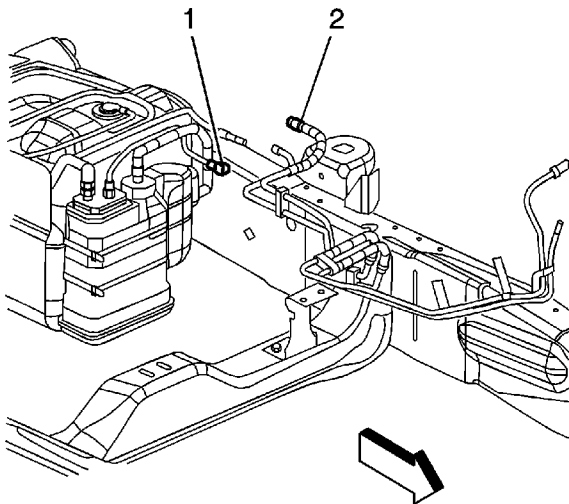
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Fuel Tank Replacement (with E26)

Removal Procedure

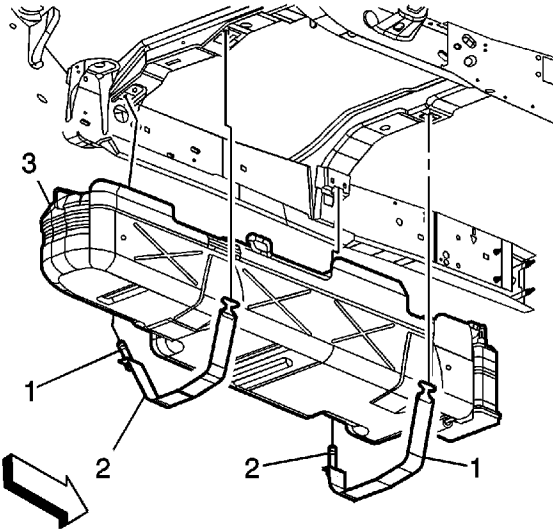


1. Relieve the fuel system pressure. Refer to [Fuel Pressure Relief](#).
2. Drain the fuel tank. Refer to [Fuel Tank Draining](#).
3. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
4. Disconnect the fuel fill pipe evaporative emission (EVAP) line quick connect fitting (1) from the fuel tank EVAP line. Refer to [Plastic Collar Quick Connect Fitting Service](#).
5. Loosen the fuel fill hose clamp (2) at the fuel tank and remove the hose from the tank.

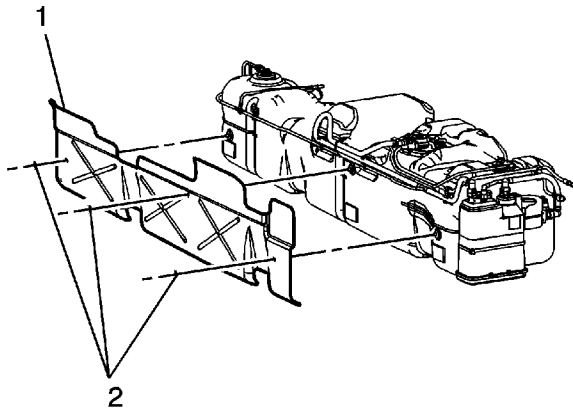




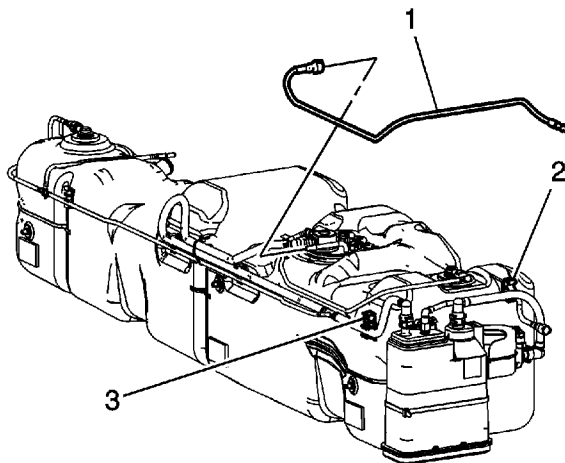
6. Clean the fuel and EVAP pipe connections and the surrounding areas prior to disconnecting the lines in order to avoid possible contamination of the fuel and or EVAP system.
7. Disconnect the chassis fuel feed pipe quick connect fitting (2) from the fuel tank fuel feed pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
8. Disconnect the EVAP canister purge pipe quick connect fitting (1) from the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
9. Disconnect the chassis wiring harness electrical connector from the EVAP canister vent solenoid valve.



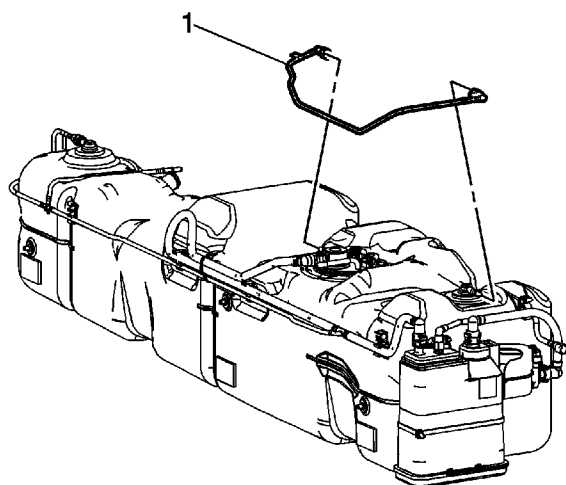
10. Support the fuel tank with an adjustable jack.
11. Remove the fuel tank strap bolts (1).
12. Remove the fuel tank straps (2).
13. With the aid of an assistant, carefully lower the fuel tank (3) until the fuel tank module connections can be accessed.
14. Disconnect the chassis wiring harness electrical connectors from the fuel tank pressure sensor and fuel tank module.
15. With the aid of the assistant, completely lower the fuel tank.
16. With the aid of the assistant, place the fuel tank in a suitable work area.
17. If replacing the fuel tank proceed to the next step, otherwise proceed to step 15 in the installation procedure.



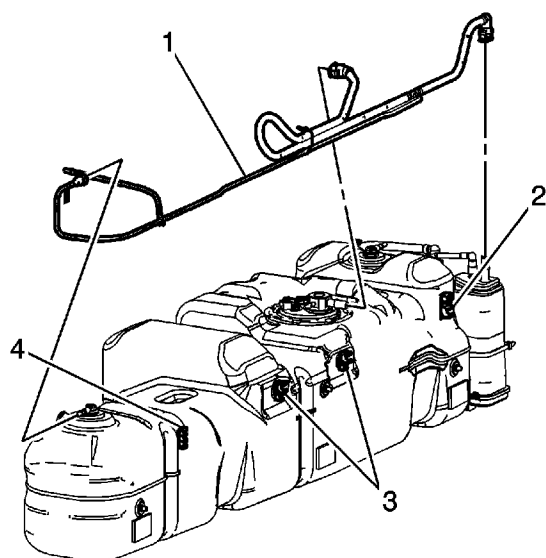
18. Remove the fuel tank shield push on retainers (2).
19. Remove the fuel tank shield (1) from the fuel tank clips.



20. Disconnect the fuel feed pipe quick connect fitting from the fuel tank module. Refer to [Plastic Collar Quick Connect Fitting Service](#).
21. Remove the fuel feed pipe from the fuel tank clips (2 and 3).
22. Remove the fuel feed pipe (1) from under the EVAP front pipe.

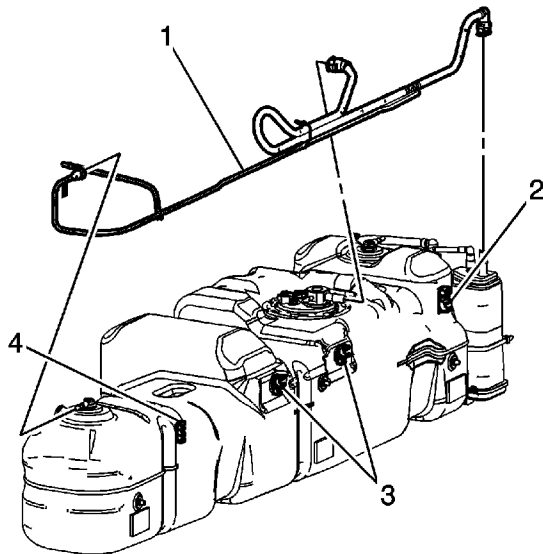


23. Disconnect the EVAP front pipe quick connect fittings from the fuel tank module and roll over valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).
24. Remove the EVAP front pipe (1) from under the EVAP pipe.

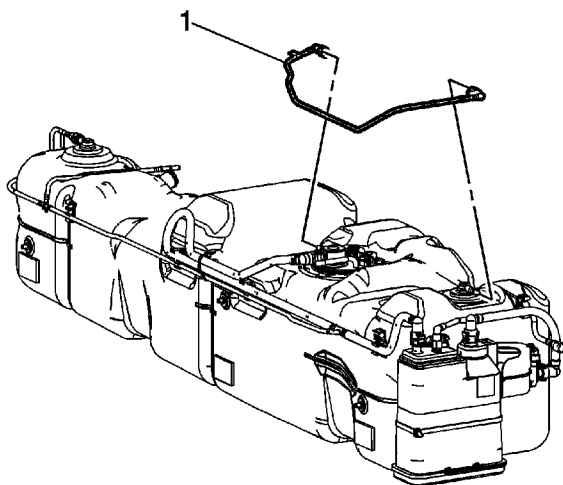


25. Disconnect the EVAP pipe quick connect fitting from the fuel tank roll over valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).
26. Remove the adhesive tape securing the EVAP pipe to the fuel tank, if necessary.
27. Disconnect the EVAP pipe quick connect fitting from the fuel tank module. Refer to [Plastic Collar Quick Connect Fitting Service](#).
28. Disconnect the EVAP pipe quick connect fitting from the EVAP canister. Refer to [Plastic Collar Quick Connect Fitting Service](#).
29. Remove the EVAP pipe (1) from the fuel tank retainers (2, 3, and 4).
30. Remove the EVAP canister. Refer to [Evaporative Emission Canister Replacement](#).
31. Remove the fuel tank module. Refer to [Fuel Tank Fuel Pump Module Replacement](#).

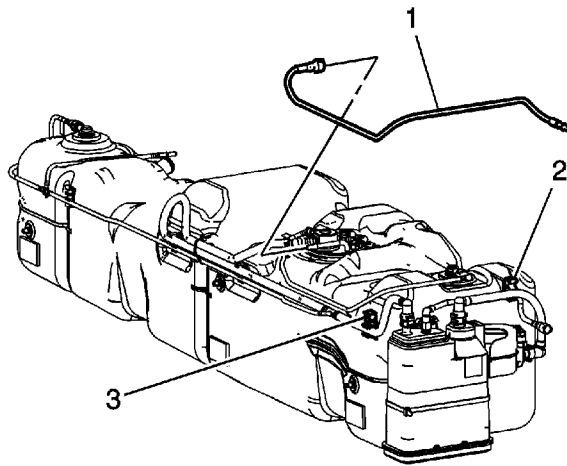
Installation Procedure



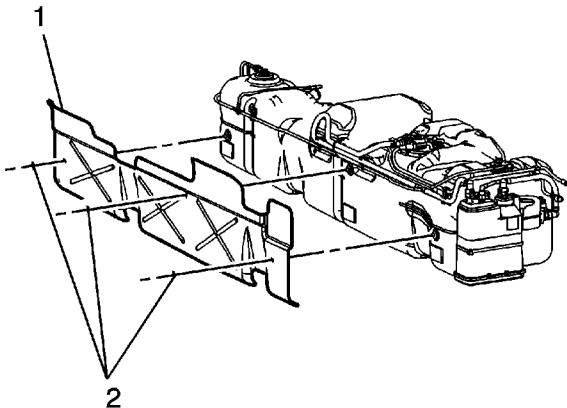
1. Install the fuel tank module. Refer to [Fuel Tank Fuel Pump Module Replacement](#).
2. Install the EVAP canister. Refer to [Evaporative Emission Canister Replacement](#).
3. Install the EVAP pipe (1) to the fuel tank retainers (2, 3, and 4).
4. Connect the EVAP pipe quick connect fitting to the EVAP canister. Refer to [Plastic Collar Quick Connect Fitting Service](#).
5. Connect the EVAP pipe quick connect fitting to the fuel tank module. Refer to [Plastic Collar Quick Connect Fitting Service](#).
6. Connect the EVAP pipe quick connect fitting to the fuel tank roll over valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).
7. Secure the EVAP pipe to the fuel tank with adhesive tape, if necessary.



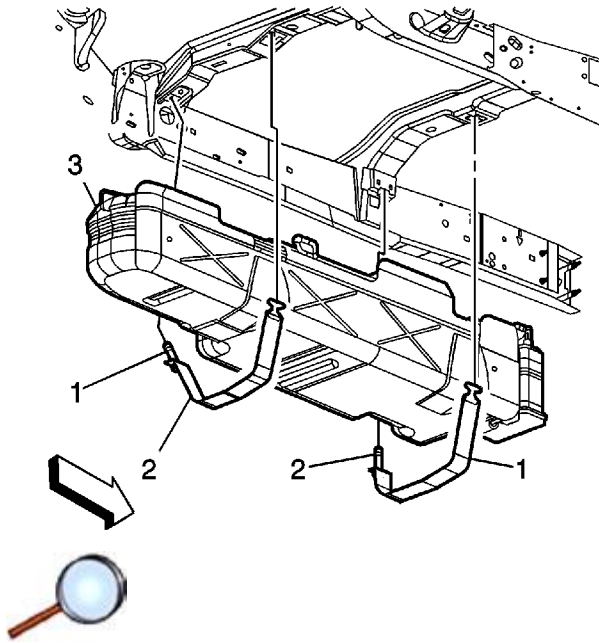
8. Install and route the EVAP front pipe (1) under the EVAP line.
9. Connect the EVAP front pipe quick connect fittings to the fuel tank module and roll over valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).



10. Install and route the fuel feed pipe (1) under the EVAP front pipe.
11. Connect the fuel feed pipe quick connect fitting to the fuel tank module. Refer to [Plastic Collar Quick Connect Fitting Service](#).
12. Install the fuel feed pipe to the fuel tank clips (2 and 3).



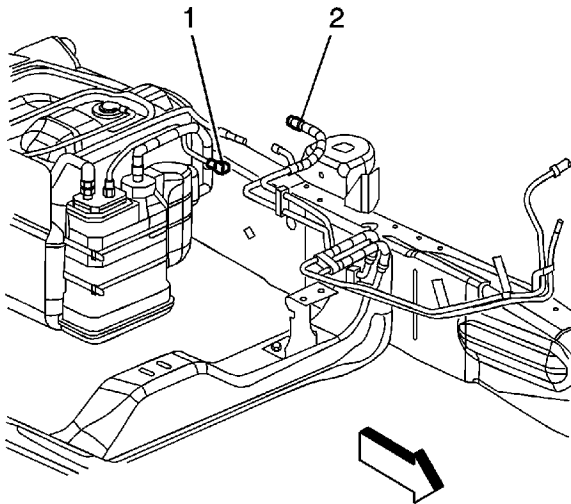
13. Install the fuel tank shield onto the tank clips (1).
14. Install the fuel tank shield push on retainers (2).



15. With the aid of an assistant, place the fuel tank on the adjustable jack.
16. With the aid of the assistant, carefully raise the fuel tank (3) until the fuel tank module connections can be made.
17. Connect the chassis wiring harness electrical connectors to the fuel tank pressure sensor and fuel tank module.
18. With the aid of the assistant, completely raise the fuel tank.
19. Install the fuel tank straps (2).

Caution: Refer to [Fastener Caution](#) in the Preface section.

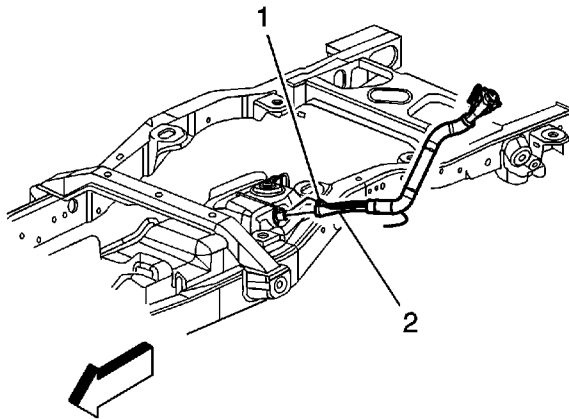
20. Install the fuel tank strap bolts (1) and tighten to **25 N·m (18 lb ft)**.
21. Remove the adjustable jack from under the fuel tank.



22. Connect the chassis wiring harness electrical connector to the EVAP canister vent solenoid

valve.

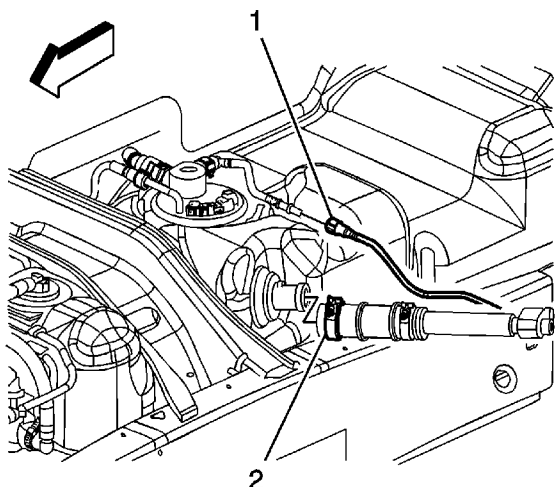
23. Connect the EVAP canister purge pipe quick connect fitting (1) to the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
24. Connect the fuel feed pipe quick connect fitting (2) to the fuel tank fuel feed pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).



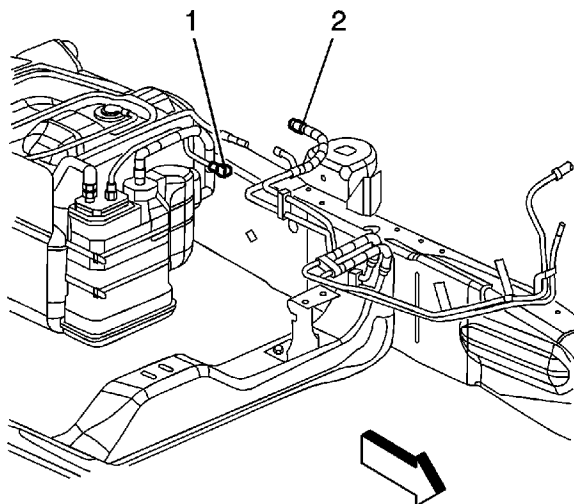
25. Install the fuel tank fill hose to the fuel tank.
26. Connect the fuel fill pipe EVAP line quick connect fitting (1) to the fuel tank EVAP line. Refer to [Plastic Collar Quick Connect Fitting Service](#).
27. Tighten the fuel fill hose clamp (2) at the fuel tank to **2.75 N·m (24 lb in)**.
28. Refill the fuel tank.
29. Install the fuel cap.
30. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#).
31. Perform the following procedure in order to inspect for leaks:
 - 31.1. Turn the ignition ON, with the engine OFF, for 2 seconds.
 - 31.2. Turn the ignition OFF for 10 seconds.
 - 31.3. Turn the ignition ON, with the engine OFF.
 - 31.4. Inspect for fuel leaks.

Fuel Tank Replacement (without E26)

Removal Procedure

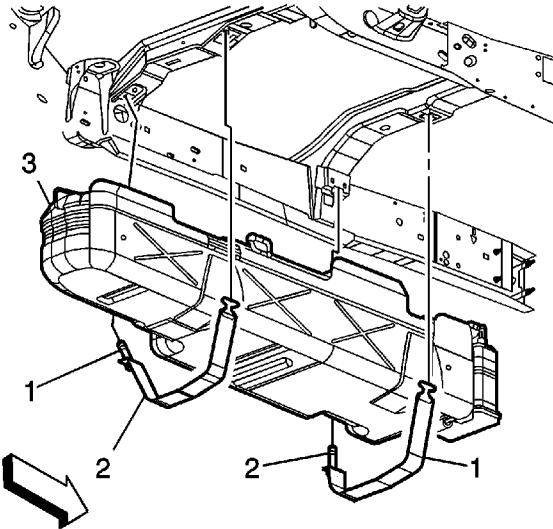


1. Relieve the fuel system pressure. Refer to [Fuel Pressure Relief](#).
2. Drain the fuel tank. Refer to [Fuel Tank Draining](#).
3. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
4. Disconnect the fuel fill pipe evaporative emission (EVAP) line quick connect fitting (1) from the fuel tank EVAP line. Refer to [Plastic Collar Quick Connect Fitting Service](#).
5. Loosen the fuel fill hose clamp (2) at the fuel tank and remove the hose from the tank.

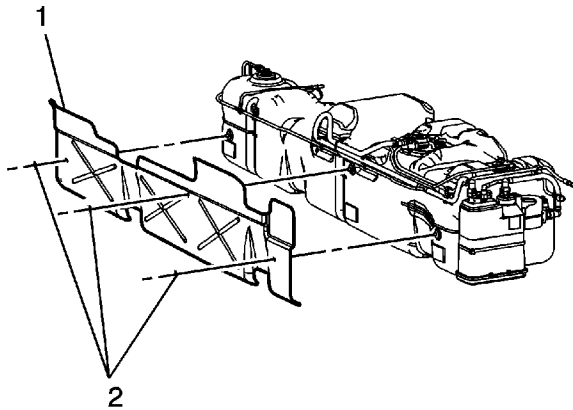




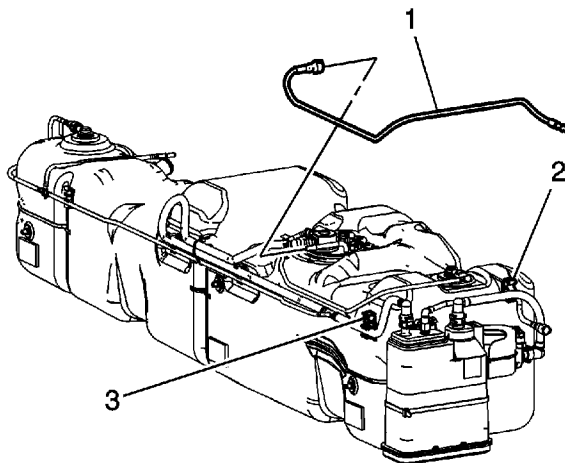
6. Clean the fuel and EVAP pipe connections and the surrounding areas prior to disconnecting the lines in order to avoid possible contamination of the fuel and or EVAP system.
7. Disconnect the chassis fuel feed pipe quick connect fitting (2) from the fuel tank fuel feed pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
8. Disconnect the EVAP canister purge pipe quick connect fitting (1) from the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
9. Disconnect the chassis wiring harness electrical connector from the EVAP canister vent solenoid valve.



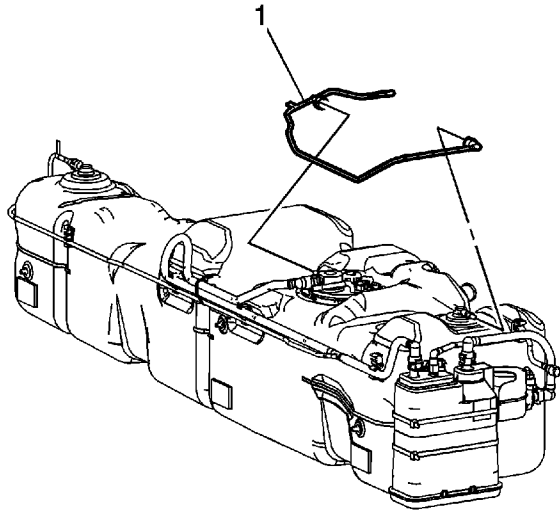
10. Support the fuel tank with an adjustable jack.
11. Remove the fuel tank strap bolts (1).
12. Remove the fuel tank straps (2).
13. With the aid of an assistant, carefully lower the fuel tank (3) until the fuel tank module connections can be accessed.
14. Disconnect the chassis wiring harness electrical connectors from the fuel tank pressure sensor and fuel tank module.
15. With the aid of the assistant, completely lower the fuel tank.
16. With the aid of the assistant, place the fuel tank in a suitable work area.
17. If replacing the fuel tank proceed to the next step, otherwise proceed to step 15 in the installation procedure.



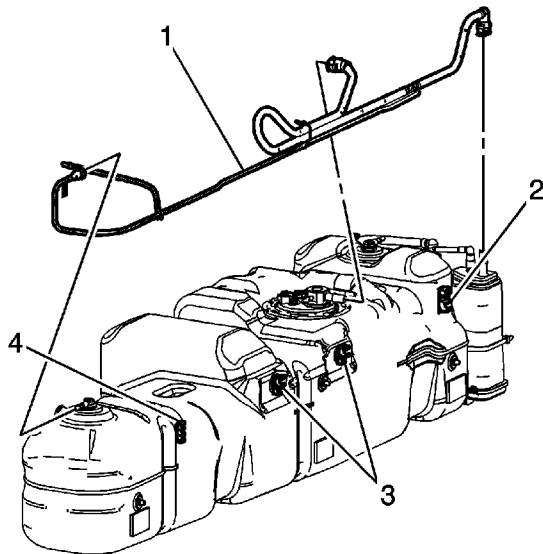
18. Remove the fuel tank shield push on retainers (2).
19. Remove the fuel tank shield (1) from the fuel tank clips.



20. Disconnect the fuel feed pipe quick connect fitting from the fuel tank module. Refer to [Plastic Collar Quick Connect Fitting Service](#).
21. Remove the fuel feed pipe from the fuel tank clips (2 and 3).
22. Remove the fuel feed pipe (1) from under the EVAP front pipe.

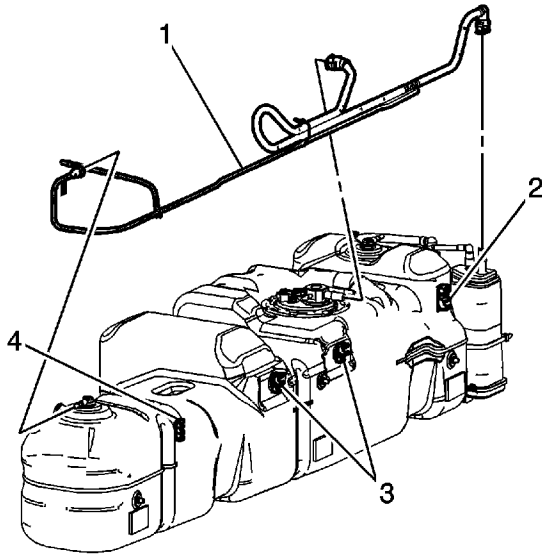


23. Disconnect the EVAP front pipe quick connect fittings from the fuel tank module and roll over valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).
24. Remove the EVAP front pipe (1) from under the EVAP pipe.

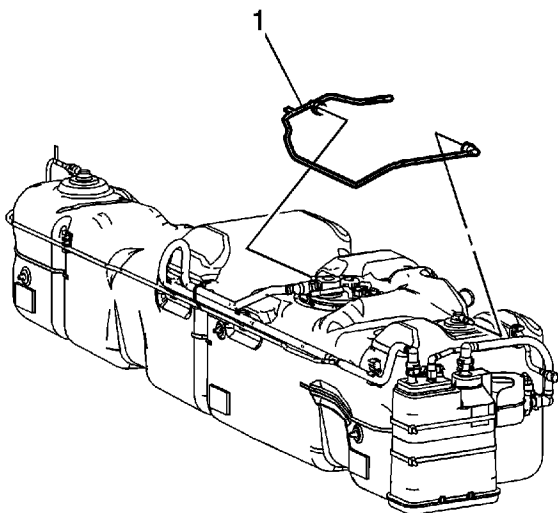


25. Disconnect the EVAP pipe quick connect fitting from the fuel tank roll over valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).
26. Remove the adhesive tape securing the EVAP pipe to the fuel tank, if necessary.
27. Disconnect the EVAP pipe quick connect fitting from the fuel tank module. Refer to [Plastic Collar Quick Connect Fitting Service](#).
28. Disconnect the EVAP pipe quick connect fitting from the EVAP canister. Refer to [Plastic Collar Quick Connect Fitting Service](#).
29. Remove the EVAP pipe (1) from the fuel tank retainers (2, 3, and 4).
30. Remove the EVAP canister. Refer to [Evaporative Emission Canister Replacement](#).
31. Remove the fuel tank module. Refer to [Fuel Tank Fuel Pump Module Replacement](#).

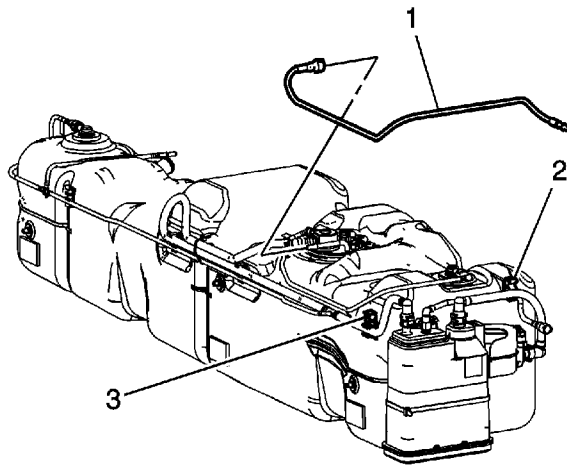
Installation Procedure



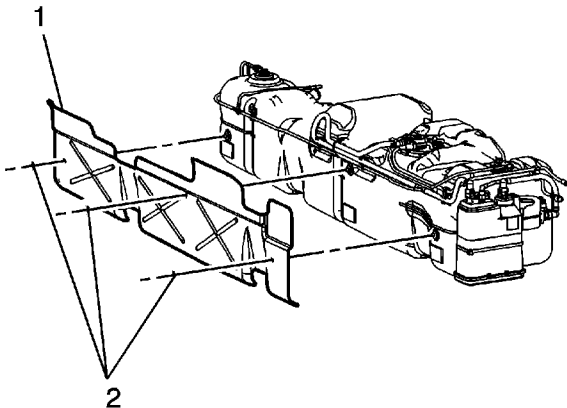
1. Install the fuel tank module. Refer to [Fuel Tank Fuel Pump Module Replacement](#).
2. Install the EVAP canister. Refer to [Evaporative Emission Canister Replacement](#).
3. Install the EVAP pipe (1) to the fuel tank retainers (2, 3, and 4).
4. Connect the EVAP pipe quick connect fitting to the EVAP canister. Refer to [Plastic Collar Quick Connect Fitting Service](#).
5. Connect the EVAP pipe quick connect fitting to the fuel tank module. Refer to [Plastic Collar Quick Connect Fitting Service](#).
6. Connect the EVAP pipe quick connect fitting to the fuel tank roll over valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).
7. Secure the EVAP pipe to the fuel tank with adhesive tape, if necessary.



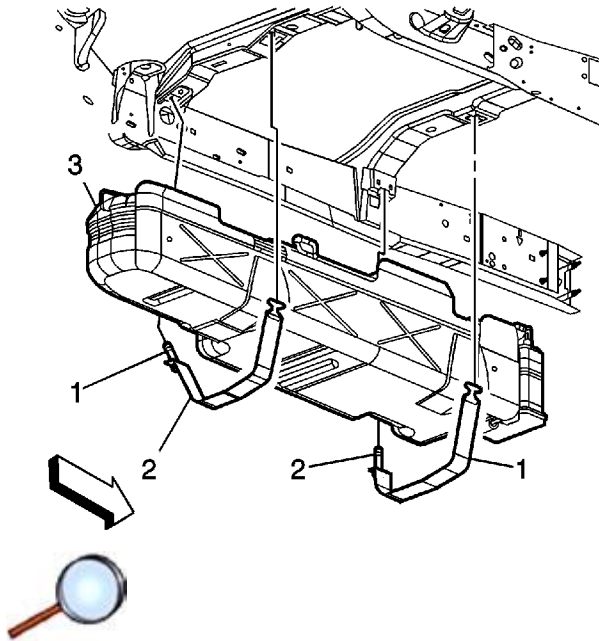
8. Install and route the EVAP front pipe (1) under the EVAP line.
9. Connect the EVAP front pipe quick connect fittings to the fuel tank module and roll over valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).



10. Install and route the fuel feed pipe (1) under the EVAP front pipe.
11. Connect the fuel feed pipe quick connect fitting to the fuel tank module. Refer to [Plastic Collar Quick Connect Fitting Service](#).
12. Install the fuel feed pipe to the fuel tank clips (2 and 3).



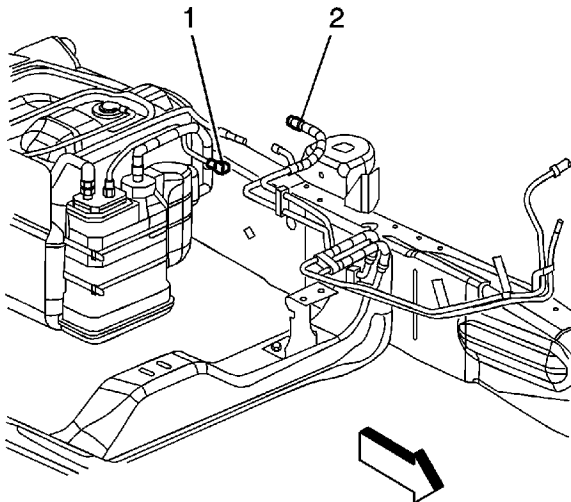
13. Install the fuel tank shield onto the tank clips (1).
14. Install the fuel tank shield push on retainers (2).



15. With the aid of an assistant, place the fuel tank on the adjustable jack.
16. With the aid of the assistant, carefully raise the fuel tank (3) until the fuel tank module connections can be made.
17. Connect the chassis wiring harness electrical connectors to the fuel tank pressure sensor and fuel tank module.
18. With the aid of the assistant, completely raise the fuel tank.
19. Install the fuel tank straps (2).

Caution: Refer to [Fastener Caution](#) in the Preface section.

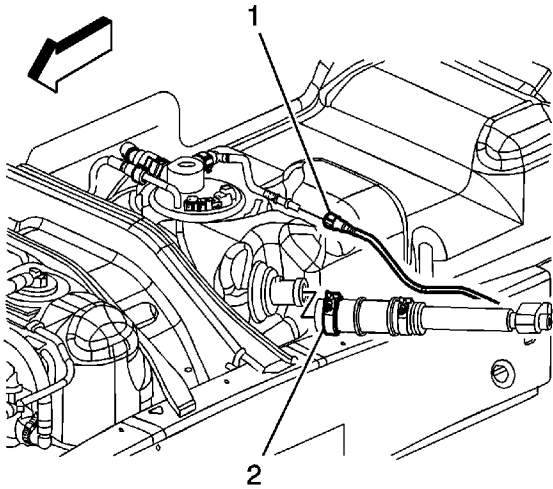
20. Install the fuel tank strap bolts (1) and tighten to **25 N·m (18 lb ft)**.
21. Remove the adjustable jack from under the fuel tank.



22. Connect the chassis wiring harness electrical connector to the EVAP canister vent solenoid

valve.

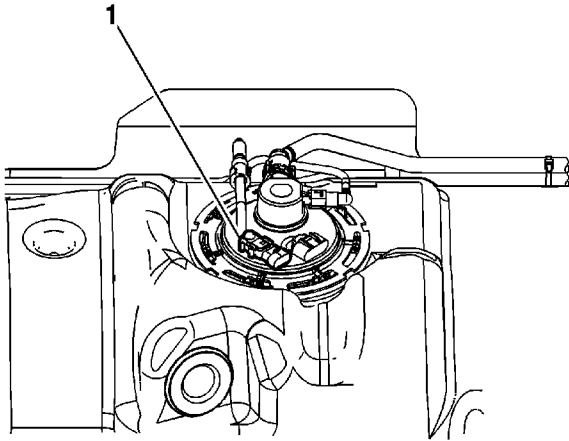
23. Connect the EVAP canister purge pipe quick connect fitting (1) to the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
24. Connect the fuel feed pipe quick connect fitting (2) to the fuel tank fuel feed pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).



25. Install the fuel tank fill hose to the fuel tank.
26. Connect the fuel fill pipe EVAP line quick connect fitting (1) to the fuel tank EVAP line. Refer to [Plastic Collar Quick Connect Fitting Service](#).
27. Tighten the fuel fill hose clamp (2) at the fuel tank to **2.75 N·m (24 lb in)**.
28. Refill the fuel tank.
29. Install the fuel cap.
30. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#).
31. Perform the following procedure in order to inspect for leaks:
 - 31.1. Turn the ignition ON, with the engine OFF, for 2 seconds.
 - 31.2. Turn the ignition OFF for 10 seconds.
 - 31.3. Turn the ignition ON, with the engine OFF.
 - 31.4. Inspect for fuel leaks.

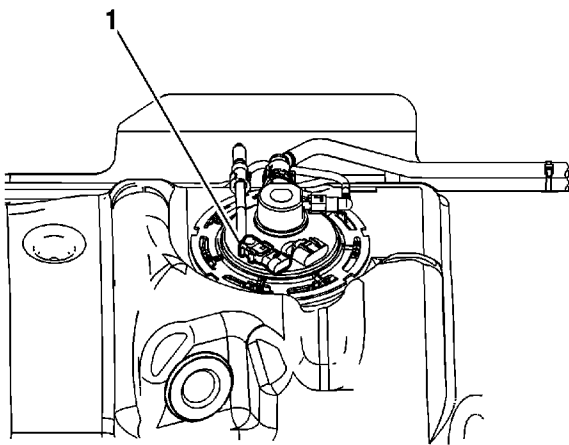
Fuel Tank Pressure Sensor Replacement

Removal Procedure



1. Remove the fuel tank. Refer to [Fuel Tank Replacement](#) .
2. Remove the fuel tank pressure sensor (1) by pulling straight up using a slight rocking motion.

Installation Procedure



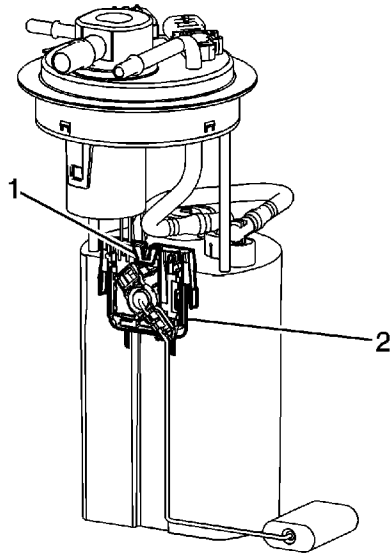


1. Install the fuel pressure sensor (1).
2. Install the fuel tank. Refer to [Fuel Tank Replacement](#) .

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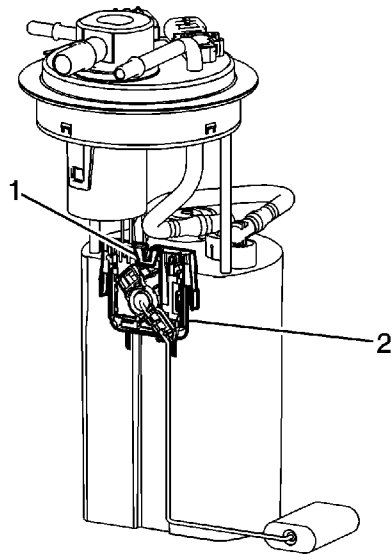
Fuel Level Sensor Replacement

Removal Procedure



1. Remove the fuel tank fuel pump module. Refer to [Fuel Tank Fuel Pump Module Replacement](#).
2. Disconnect the fuel level sensor wiring pigtail electrical connector from the module cover.
3. Gently lift up the fuel level sensor retainer (1), disengaging the retainer from the sensor.
4. Slide the fuel level sensor (2) down from the reservoir.

Installation Procedure



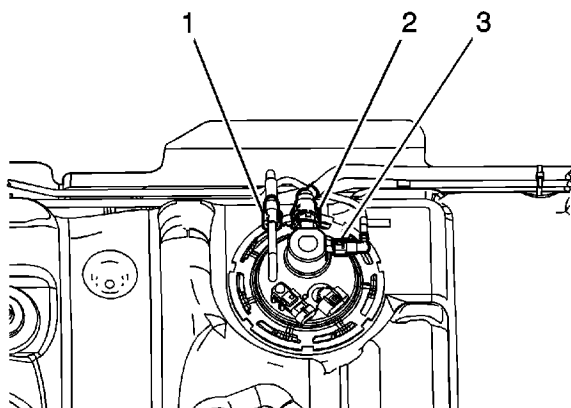
1. Slide the fuel level sensor (2) up onto the reservoir.
2. Gently lift up the fuel level sensor retainer (1) in order to engage the retainer to the sensor.
3. Connect the fuel level sensor wiring pigtail electrical connector to the module cover.
4. Install the fuel tank fuel pump module. Refer to [Fuel Tank Fuel Pump Module Replacement](#) .

Fuel Tank Fuel Pump Module Replacement

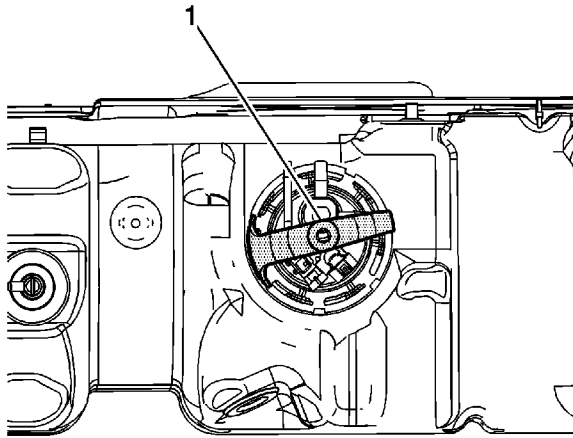
Special Tools

[J 45722](#) Fuel Sender Lock Nut Wrench

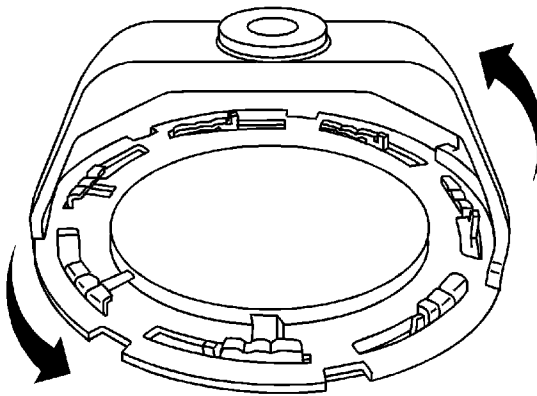
Removal Procedure



1. Remove the fuel tank. Refer to [Fuel Tank Replacement](#).
2. Disconnect the fuel tank fuel feed pipe quick connect fitting (1) from the module. Refer to [Plastic Collar Quick Connect Fitting Service](#).
3. Disconnect the evaporative emission (EVAP) pipe quick connect fitting (2) from the module. Refer to [Plastic Collar Quick Connect Fitting Service](#).
4. Disconnect the EVAP front pipe quick connect fitting (3) from the module. Refer to [Plastic Collar Quick Connect Fitting Service](#).
5. Reposition the fuel and EVAP pipe ends out of the way.



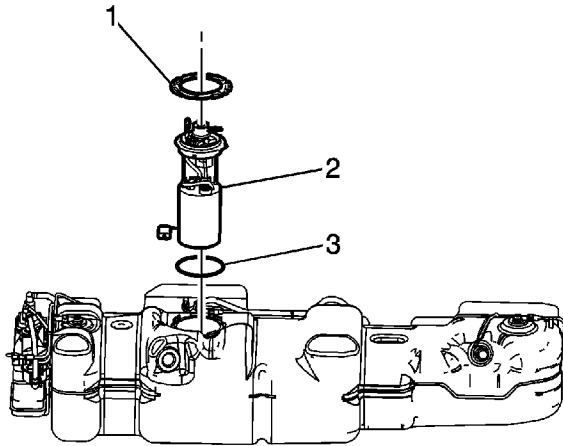
6. Install the [J 45722](#) (1) to the fuel tank module lock ring.



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.

7. Using the [J 45722](#) , and a long breaker-bar, rotate the lock ring clockwise unlocking the fuel tank module lock ring.



8. Remove the fuel tank module lock ring (1).

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.

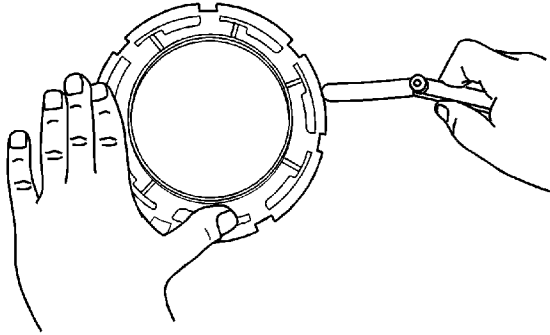
9. Slowly raise the module (2) until the fuel level sensor float arm is just visible.

Note: When removing the module from the fuel tank, be aware that the module bucket is full of fuel. The module must be tipped slightly during removal to avoid bending the fuel level sensor float arm.

10. Tilt the module towards the left of the fuel tank to allow the level sensor to clear the tank opening. Remove the module from the tank.
11. Carefully discard the fuel in the module reservoir bucket into an approved container.

Note: DO NOT reuse the old fuel tank module O-ring seal.

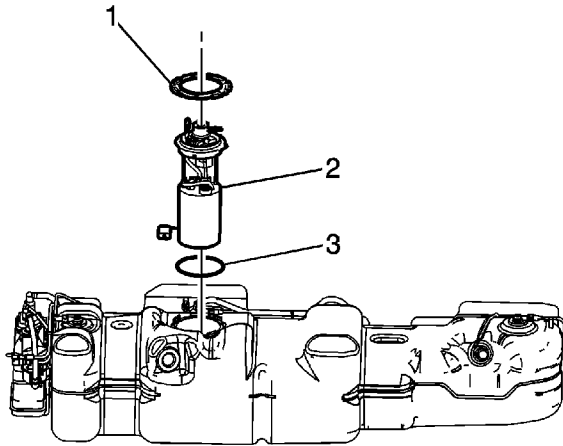
12. Remove and discard the fuel tank module O-ring seal (3).

**Note:**

- Some lock rings were manufactured with "DO NOT REUSE" stamped into them. These lock rings may be reused if they 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.

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

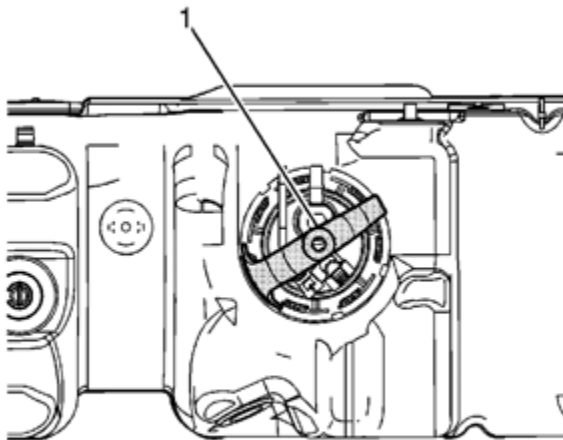
Installation Procedure



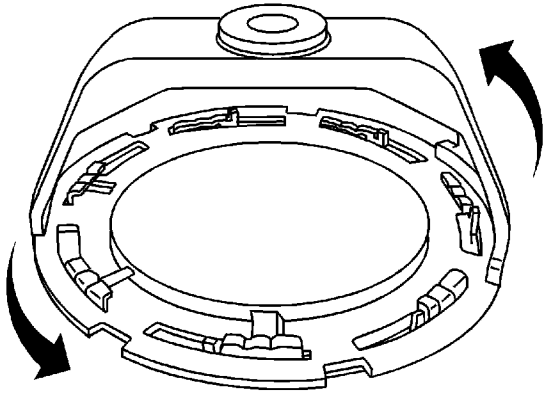
1. Install a NEW fuel tank module O-ring seal (3) onto the fuel tank.

Note: The bucket must be tipped slightly during installation to avoid bending the fuel level sensor float arm.

2. Tilt the module toward the left side of the fuel tank to allow the fuel level sensor float arm to clear the tank opening. Install the module into the fuel tank.
3. Lower the module assembly (2) into the tank.
4. Position and install the fuel tank module lock ring (1).



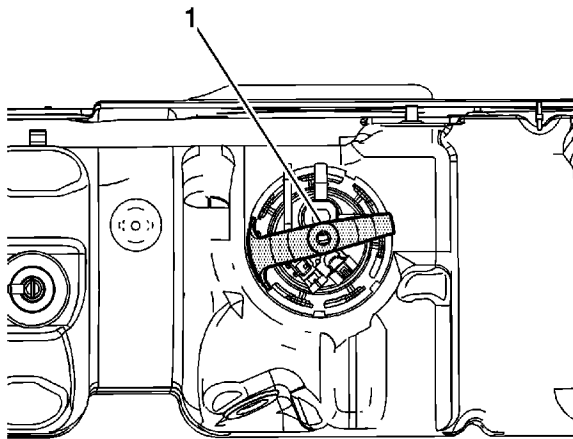
5. Install the [J 45722](#) (1) to the fuel tank module lock ring.



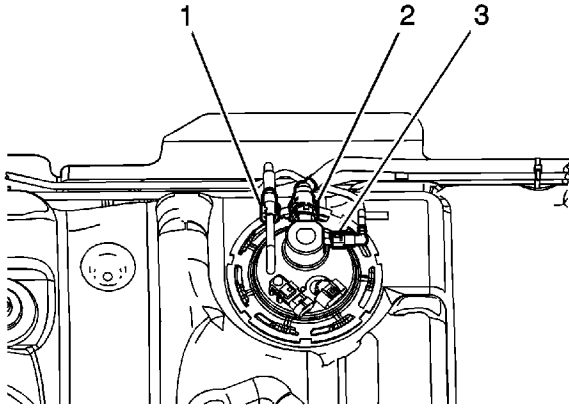
Note: Always replace the fuel tank module seal when installing the fuel tank module. Replace the lock ring if necessary. DO NOT apply any type of lubrication in the seal groove.

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

6. Using the [J 45722](#) , and a long breaker-bar, rotate the lock ring counterclockwise, locking the fuel tank module lock ring.



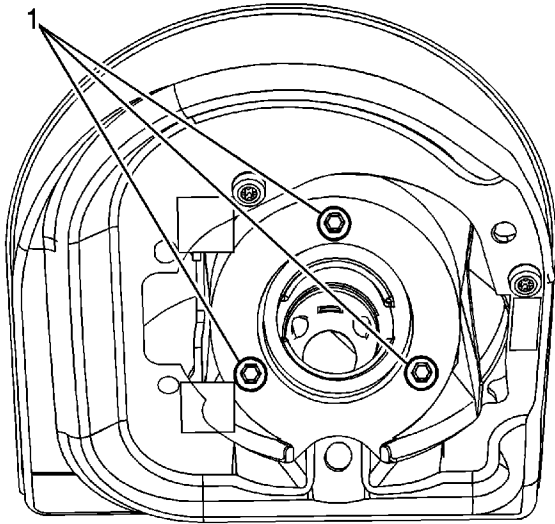
7. Remove the [J 45722](#) (1).



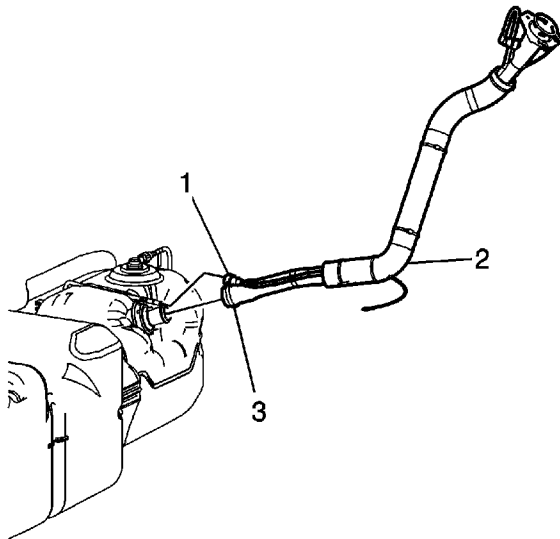
8. Position the fuel and EVAP pipe ends to the module.
9. Connect the EVAP front pipe quick connect fitting (3) to the module. Refer to [Plastic Collar Quick Connect Fitting Service](#).
10. Connect the EVAP pipe quick connect fitting (2) to the module. Refer to [Plastic Collar Quick Connect Fitting Service](#).
11. Connect the fuel tank fuel feed pipe quick connect fitting (1) to the module. Refer to [Plastic Collar Quick Connect Fitting Service](#).
12. Install the fuel tank. Refer to [Fuel Tank Replacement](#).

Filler Tube Replacement (with E26)

Removal Procedure



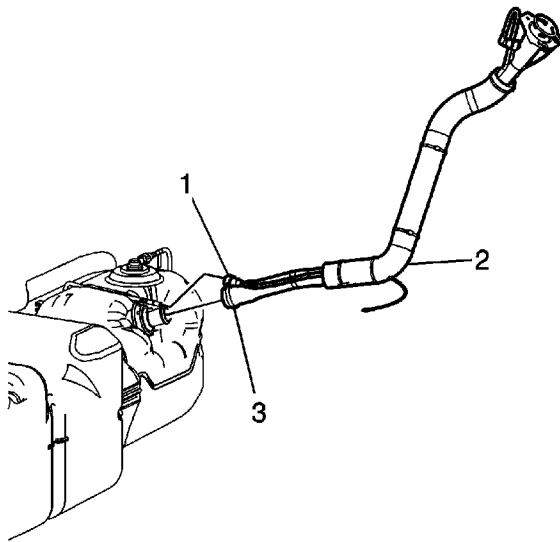
1. Clean all the fuel pipe and hose connections and the surrounding areas before disconnecting in order to avoid contamination of the fuel system.
2. Drain the fuel tank as necessary. Refer to [Fuel Tank Draining](#).
3. Remove the 3 fuel tank fill pipe to housing bolts (1).
4. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
5. Remove the fuel fill tube ground strap bolt.





6. Disconnect the fuel fill pipe evaporative emission (EVAP) pipe quick connect fitting (1) from the fuel tank EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
7. Loosen the fuel fill pipe hose clamp (3) at the fuel tank.
8. Remove the fuel fill pipe (2) from the fuel tank.
9. Cap the fuel tank inlet in order to prevent fuel system contamination.

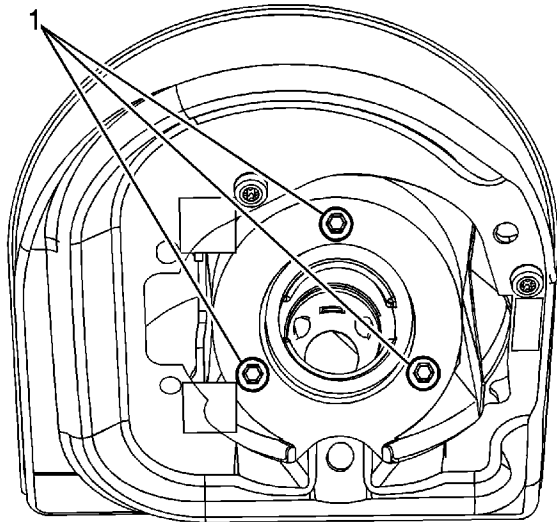
Installation Procedure



1. Remove the cap from the fuel tank inlet.
2. Install the fuel fill pipe (2) to the fuel tank.

Caution: Refer to [Fastener Caution](#) in the Preface section.

3. Tighten the fuel fill pipe hose clamp (1) at the fuel tank to **2.75 N·m (24 lb in)**.
4. Connect the fuel fill pipe EVAP pipe quick connect fitting (3) to the fuel tank EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).

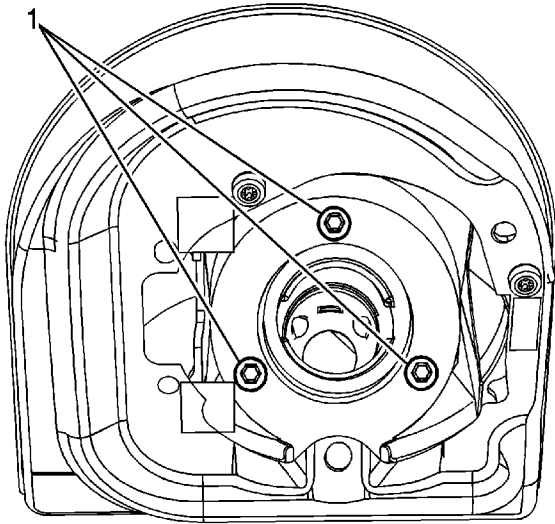


5. Position the ground strap and install the fuel fill tube ground strap bolt and tighten to **8 N·m (70 lb in)**.
6. Lower the vehicle.
7. Position the fuel fill pipe to the housing and install the 3 fuel tank fill pipe to housing bolts (1). Tighten to **4 N·m (35 lb in)**.
8. Fill the fuel tank as necessary. Refer to [Fuel Tank Draining](#).
9. Install the fuel fill cap.

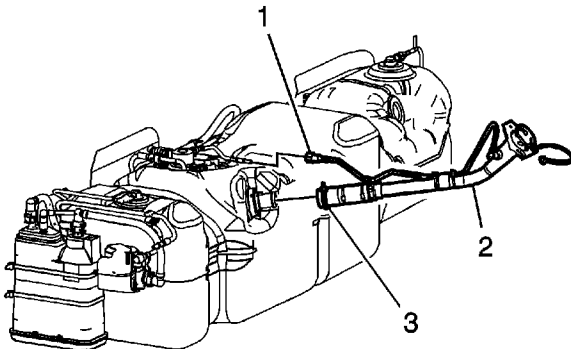
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Filler Tube Replacement (without E26)

Removal Procedure



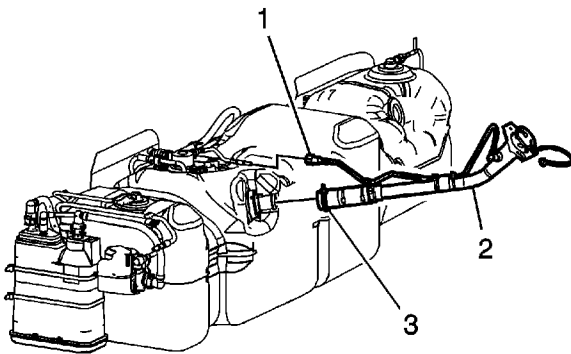
1. Clean all the fuel pipe and hose connections and the surrounding areas before disconnecting in order to avoid contamination of the fuel system.
2. Drain the fuel tank as necessary. Refer to [Fuel Tank Draining](#).
3. Remove the 3 fuel tank fill pipe to housing bolts (1).
4. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
5. Remove the fuel fill tube ground strap bolt.





6. Disconnect the fuel fill pipe evaporative emission (EVAP) pipe quick connect fitting (1) from the fuel tank EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
7. Loosen the fuel fill pipe hose clamp (3) at the fuel tank.
8. Remove the fuel fill pipe (2) from the fuel tank.
9. Cap the fuel tank inlet in order to prevent fuel system contamination.

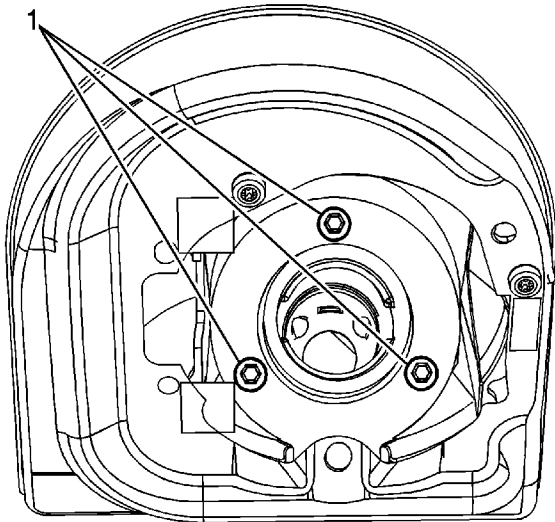
Installation Procedure



1. Remove the cap from the fuel tank inlet.
2. Install the fuel fill pipe (2) to the fuel tank.

Caution: Refer to [Fastener Caution](#) in the Preface section.

3. Tighten the fuel fill pipe hose clamp (1) at the fuel tank to **2.75 N·m (24 lb in)**.
4. Connect the fuel fill pipe EVAP pipe quick connect fitting (3) to the fuel tank EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).



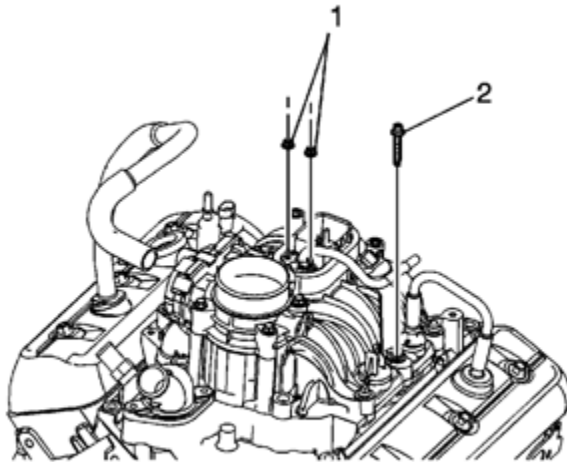
5. Position the ground strap and install the fuel fill tube ground strap bolt and tighten to **8 N·m (70 lb in)**
6. Lower the vehicle.
7. Position the fuel fill pipe to the housing and install the 3 fuel tank fill pipe to housing bolts (1). Tighten to **4 N·m (35 lb in)**
8. Fill the fuel tank as necessary. Refer to [Fuel Tank Draining](#).
9. Install the fuel fill cap.

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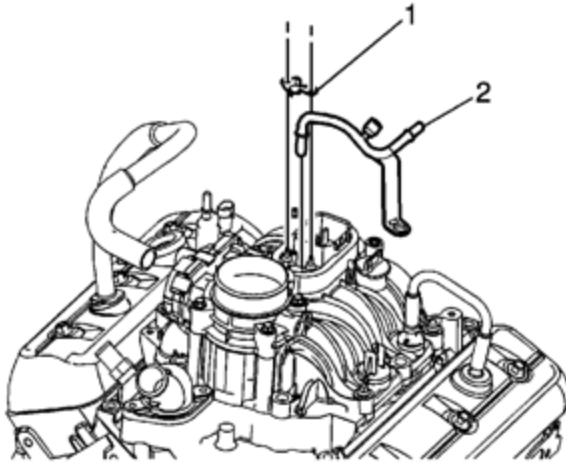
Fuel Hose / Pipes Replacement - Engine Compartment

Removal Procedure

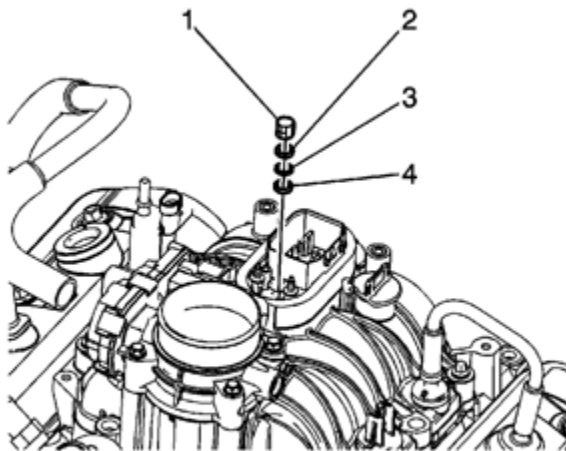
Note: Clean all the fuel pipe connections and surrounding areas before disconnecting the pipes in order to avoid possible fuel system contamination.



1. Relieve the fuel system pressure. Refer to [Fuel Pressure Relief](#).
2. Disconnect the chassis fuel feed pipe from the engine compartment feed pipe. Refer to [Metal Collar Quick Connect Fitting Service](#).
3. Cap the fuel pipe in order to prevent possible fuel system contamination.
4. Remove the fuel pipe retainer nuts (1).
5. Remove the fuel pipe bracket bolt (2).

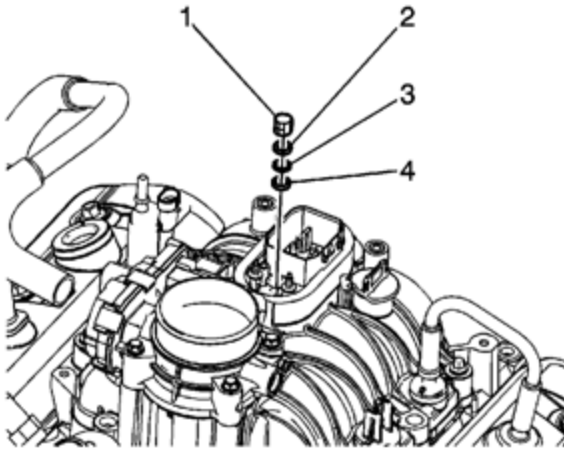


6. Remove the fuel pipe retainer (1).
7. Pull straight up on the pipe (2) in order to remove the pipe from the fuel meter body.

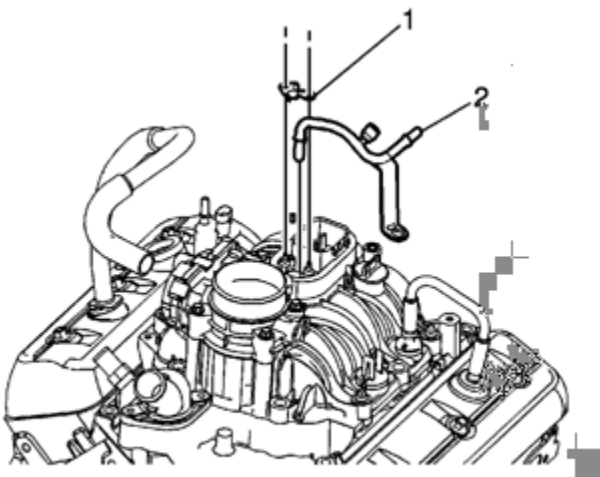


8. Remove and discard the following components from the fuel meter body.
 - Fuel seal retainer (1)
 - Upper fuel seal (2)
 - Spacer ring (3)
 - Lower fuel seal (4)

Installation Procedure



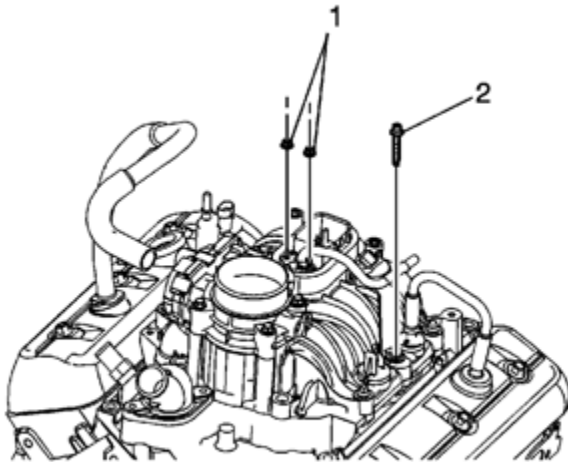
1. Install the following NEW components to the fuel meter body.
 - Lower fuel seal (4)
 - Spacer ring (3)
 - Upper fuel seal (2)
 - Fuel seal retainer (1)



Warning: Always apply a few drops of clean engine oil to the male pipe ends before connecting the fuel pipe fittings in order to reduce the risk of fire and personal injury. 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.

2. Apply a few drops of clean engine oil to the fuel pipe end.
3. Install the fuel pipe to the fuel meter body.
4. Install the fuel pipe retainer (1).

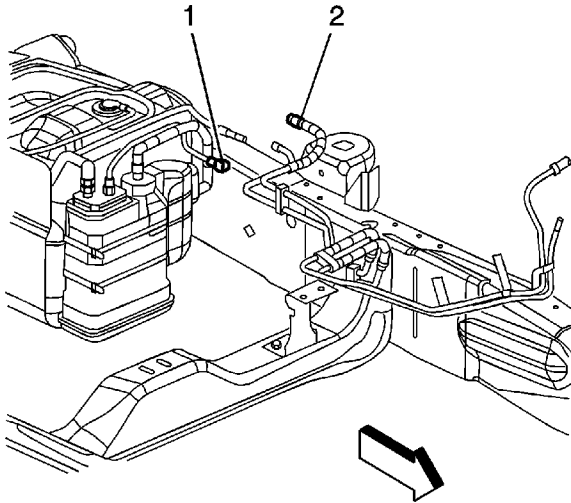
Caution: Refer to [Fastener Caution](#) in the Preface section.



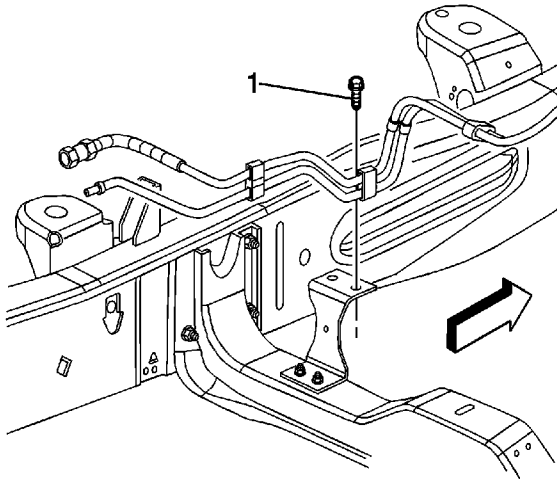
5. Install the fuel pipe bracket bolt (2) and tighten to **6 N·m (53 lb in)**.
6. Install the fuel pipe retainer nuts (1) and tighten to **3 N·m (27 lb in)**.
7. Remove the cap from the chassis fuel pipe.
8. Connect the chassis fuel feed pipe to the engine compartment feed pipe. Refer to [Metal Collar Quick Connect Fitting Service](#).
9. Install the engine cover. Refer to [Engine Cover Replacement](#).

Fuel Hose / Pipes Replacement - Chassis

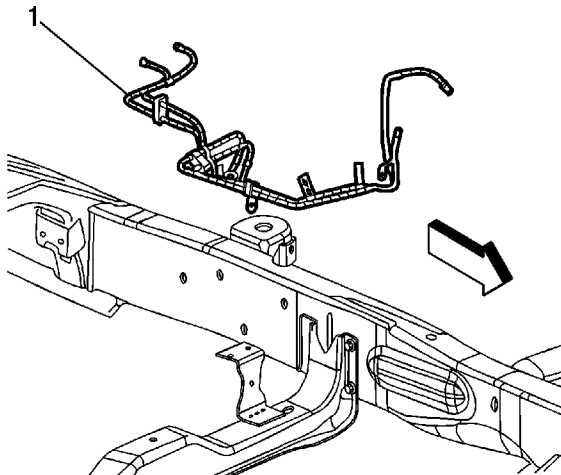
Removal Procedure



1. Relieve the fuel system pressure. Refer to [Fuel Pressure Relief](#).
2. Disconnect the chassis fuel feed pipe quick connect fitting from the engine compartment fuel pipe. Refer to [Metal Collar Quick Connect Fitting Service](#).
3. Disconnect the engine evaporative emission (EVAP) pipe quick connect fitting from the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
4. Cap the fuel and EVAP pipe connections in order to prevent fuel/EVAP system contamination.
5. Remove the fuel feed and EVAP pipe bracket nut from the bellhousing stud and remove the bracket from the stud.
6. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
7. Disconnect the chassis fuel feed pipe quick connect fitting (2) from the fuel tank fuel feed pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
8. Disconnect the EVAP canister purge pipe quick connect fitting (1) from the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).

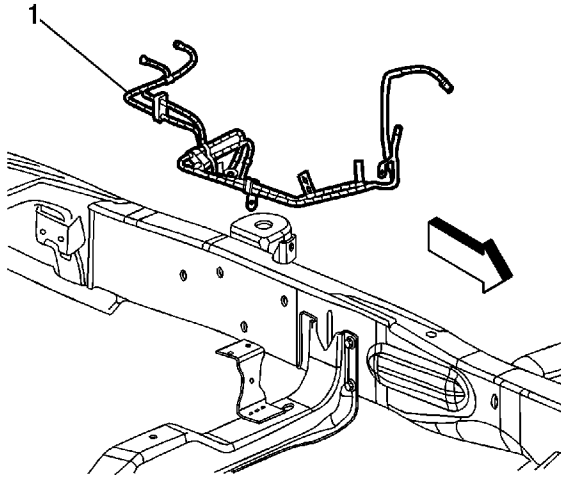


9. Remove the fuel/EVAP pipe assembly bolt (1).



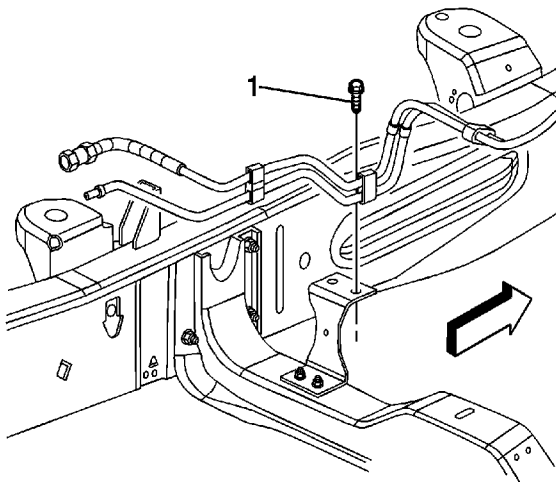
10. Remove the fuel/EVAP pipe assembly (1) from the vehicle.
11. Remove the fuel pipe from the fuel/EVAP pipe assembly.

Installation Procedure

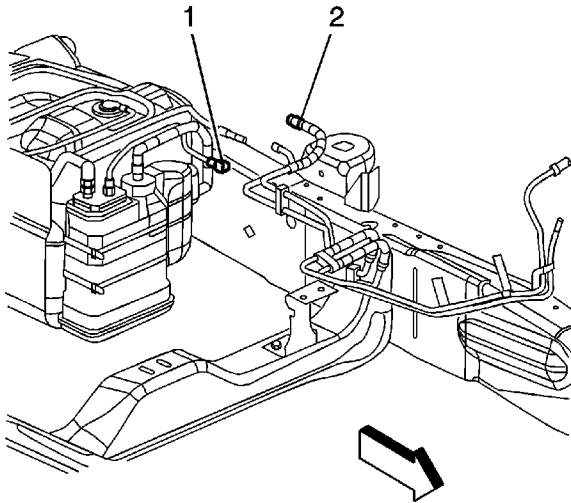


1. Install the fuel pipe to the fuel/EVAP pipe assembly.
2. Install the fuel/EVAP pipe assembly (1) to the vehicle.

Caution: Refer to [Fastener Caution](#) in the Preface section.



3. Install the fuel/EVAP pipe assembly bolt (1) and tighten to **13 N·m (115 lb in)**.



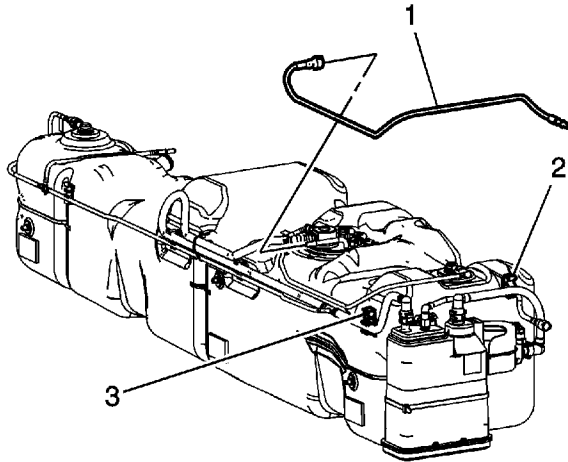
4. Connect the EVAP canister purge pipe quick connect fitting (1) to the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
5. Connect the chassis fuel feed pipe quick connect fitting (2) to the fuel tank fuel feed pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
6. Lower the vehicle.
7. Install the fuel feed and EVAP pipe bracket to the bellhousing stud and install the nut.

Tighten to **25 N·m (18 lb ft)**.

8. Remove the caps from the fuel and EVAP pipe connections.
9. Connect the engine EVAP pipe quick connect fitting to the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
10. Connect the chassis fuel feed pipe quick connect fitting to the engine compartment fuel pipe. Refer to [Metal Collar Quick Connect Fitting Service](#).
11. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#).
12. Perform the following procedure in order to inspect for leaks:
 - 12.1. Turn the ignition ON, with the engine OFF, for 2 seconds.
 - 12.2. Turn the ignition OFF for 10 seconds.
 - 12.3. Turn the ignition ON, with the engine OFF.
 - 12.4. Inspect for fuel leaks.
13. Install the engine cover. Refer to [Engine Cover Replacement](#).

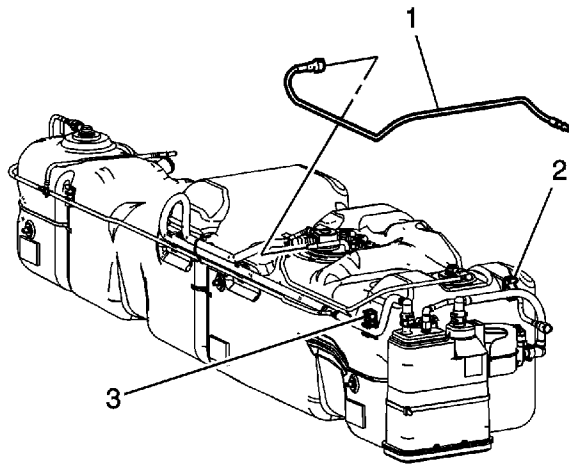
Fuel Hose / Pipes Assembly Replacement

Removal Procedure



1. Remove the fuel tank. Refer to [Fuel Tank Replacement](#) .
2. Disconnect the fuel feed pipe quick connect fitting from the fuel tank module. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
3. Remove the fuel feed pipe from the fuel tank clips (2 and 3).
4. Remove the fuel feed pipe (1) from under the EVAP front pipe.

Installation Procedure



1. Install and route the fuel feed pipe (1) under the EVAP front pipe.
2. Connect the fuel feed pipe quick connect fitting to the fuel tank module. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
3. Install the fuel feed pipe to the fuel tank clips (2 and 3).
4. Install the fuel tank. Refer to [Fuel Tank Replacement](#) .

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Fuel System Cleaning

Warning: Refer to [Battery Disconnect Warning](#) in the Preface section.

1. Disconnect the negative battery cable.
2. Relieve fuel system pressure. Refer to [Fuel Pressure Relief](#).
3. Drain fuel tank. Refer to [Fuel Tank Draining](#).
4. Remove the fuel tank. Refer to [Fuel Tank Replacement](#).
5. Remove the fuel tank fuel pump module. Refer to [Fuel Tank Fuel Pump Module Replacement](#).
6. Inspect the fuel strainer. Replace a contaminated strainer and inspect the fuel pump.
7. Inspect the fuel pump inlet for dirt and debris. Replace the fuel pump if you find dirt or debris in the fuel pump inlet.

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

8. Flush the fuel tank with hot water.
9. Pour the water out of the fuel sender assembly opening.
10. Rock the tank to ensure that removal of the water from the tank is complete.
11. Inspect the fuel filter for contamination.
12. Replace the fuel filter if the filter is plugged.

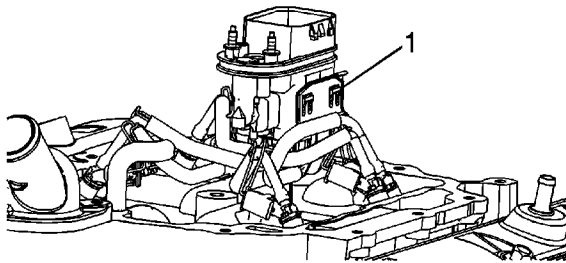
Note: Only use oil-free compressed air to blow out the fuel pipes.

13. Clean the fuel lines by applying air pressure in the opposite direction of the fuel flow.
14. Install the fuel tank fuel pump module with a new seal into the fuel tank. Refer to [Fuel Tank Fuel Pump Module Replacement](#).
15. Install the fuel tank. Refer to [Fuel Tank Replacement](#).
16. Inspect for leaks:
 - 16.1. Turn ON the ignition for 2 seconds.
 - 16.2. Turn OFF the ignition for 10 seconds.
 - 16.3. Turn ON the ignition.
 - 16.4. Inspect for fuel leaks.

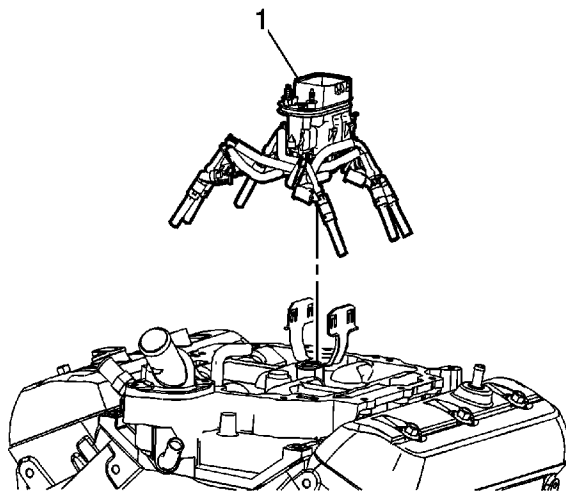
Fuel Meter Body Assembly Replacement

Removal Procedure

Note: An 8-digit part identification number is on a mylar label affixed to the fuel meter body. Refer to this number if servicing or part replacement is required.



1. Remove the upper intake manifold. Refer to [Upper Intake Manifold Replacement](#).
2. Reposition both sides of the fuel meter body bracket (1) until the tabs disengage from the fuel meter body, and lift the fuel meter body up.





3. Remove and discard the fuel meter body seal.

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

4. Prior to removal, clean the fuel meter body with a spray type engine cleaner, such as GM X-30A, or equivalent, if necessary. Follow the package instructions. Do not soak the fuel meter body in liquid cleaning solvent.

Note: When removing the injectors, mark the injectors with tape and their corresponding cylinder number in order to ensure correct injector placement upon installation.

5. Lightly pull on the fuel injector tube, and using a small pocket screwdriver, remove the fuel injector from the lower intake manifold bore.

Note: During the removal of the fuel meter body, the retainers that hold the injectors into the intake manifold may become worn. This is OK. Upon installation of the intake manifold, the injectors will be held fully seated, thus keeping them from backing out of the lower intake manifold.

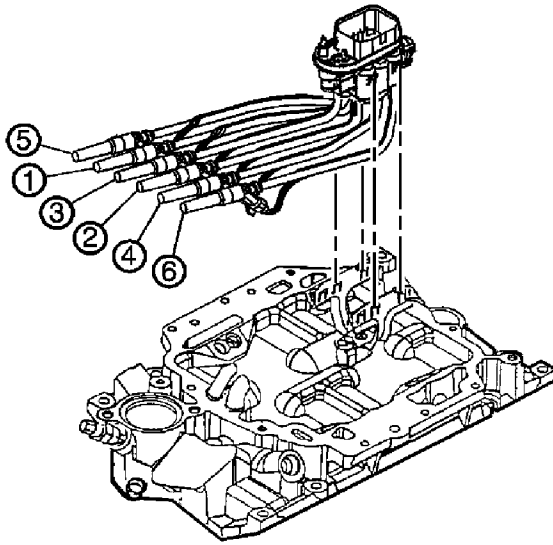
6. Remove the other 5 fuel injectors from the lower intake manifold bores.

Caution: Cover the injector sockets in order to prevent dirt and other contaminants from entering the open fuel passages.

7. Remove the fuel meter body (1) from the vehicle.

Installation Procedure

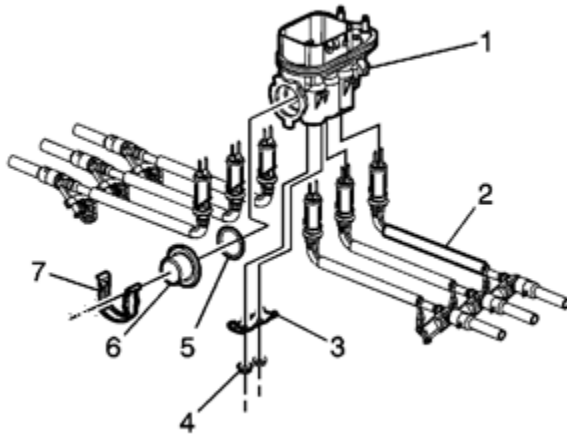
Note: All injector lines must face forward as the fuel meter body is snapped into the bracket. Also, the number 3 fuel tube must be positioned behind the number 1 fuel tube in order to eliminate interference with the upper intake manifold when installed.



1. Position the fuel tubes of the fuel meter body in the forward position.
2. Install the fuel meter body into the fuel meter body bracket on the lower intake manifold.
3. Install the 6 injectors into the proper lower intake manifold bores in proper sequence (5, 1, 3, 2, 4, 6).
4. Inspect the injectors in order to ensure that they are firmly seated and locked in the lower intake manifold bores.
5. Ensure that the electrical connections of the injectors are positioned so that they do not interfere with each other, and are pointing towards the center of the intake manifold. Rotate the electrical connections inboard if necessary. Also, ensure there is no tension on the injector wires.
6. Install the upper intake manifold. Refer to [Upper Intake Manifold Replacement](#).
7. Tighten the fuel fill cap.
8. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#).
9. Test for fuel leaks using the following procedure:
 - 9.1. Turn the ignition ON, with the engine OFF, for 2 seconds.
 - 9.2. Turn the ignition OFF for 10 seconds.
 - 9.3. Turn the ignition ON, with the engine OFF.
 - 9.4. Inspect for fuel leaks.

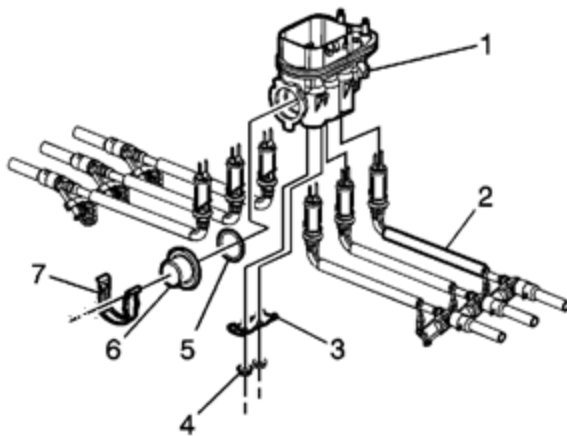
Fuel Pulse Dampener Replacement

Removal Procedure



1. Remove the upper intake manifold. Refer to [Upper Intake Manifold Replacement](#) .
2. Remove the fuel pressure dampener retaining clip (7).
3. Twist and pull the fuel pressure dampener (6) in order to remove the regulator from the housing using a shop towel to catch any spilled fuel.
4. Remove and discard the dampener O-ring seal (5).
5. Cover the fuel pressure dampener housing to prevent contamination from entering the fuel system.

Installation Procedure



1. Lubricate the NEW O-ring with clean engine oil.
2. Install the fuel pressure dampener O-ring seal (5).
3. Install the fuel pressure dampener (6).
4. Install the fuel pressure dampener retaining clip (7).
5. Install the upper intake manifold. Refer to [Upper Intake Manifold Replacement](#) .
6. Tighten the fuel fill cap.
7. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#) .
8. Inspect for leaks.
 - 8.1. Turn the ignition ON, for 2 seconds.
 - 8.2. Turn the ignition OFF, for 10 seconds.
 - 8.3. Turn the ignition ON.
 - 8.4. Inspect for fuel leaks.

Fuel Injector Cleaning

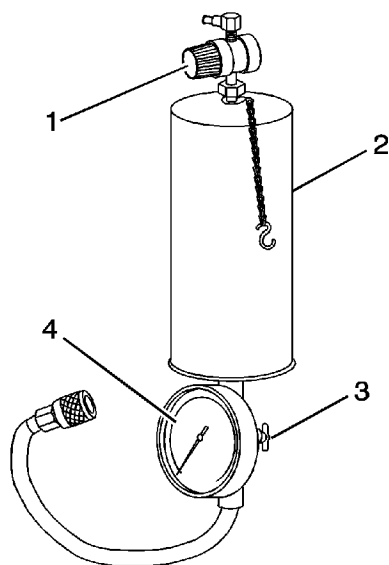
Special Tools

- [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.



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.

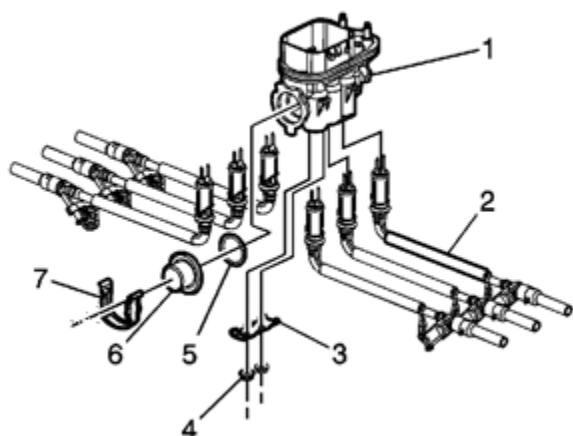
Regular use of GM Fuel System Treatment Plus should keep the customer from having to repeat the injector cleaning procedure.

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

Fuel Injector Replacement

Removal Procedure

Note: The engine oil may be contaminated with fuel if the fuel injectors are leaking.



1. Remove the fuel meter body. Refer to [Fuel Meter Body Assembly Replacement](#).
2. Remove the injector retainer lock nuts (4) and retainer (3).

Caution: Use care in removing the fuel injectors to prevent damage to the electrical connector terminals.

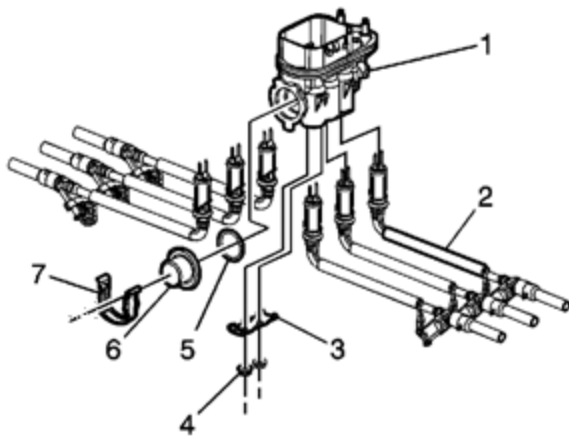
The fuel injector is serviced as a complete assembly only.

Also since the injectors are electrical components, these injectors should not be immersed in any type of liquid solvent or cleaner as damage may occur. Fuel injector cleaning is not recommended.

3. While pulling the fuel injector downward, push with a small tip punch down between the injector terminals until the injector is removed.

Installation Procedure

Note: When ordering new fuel injectors, be sure to order the correct injector for the application being serviced.



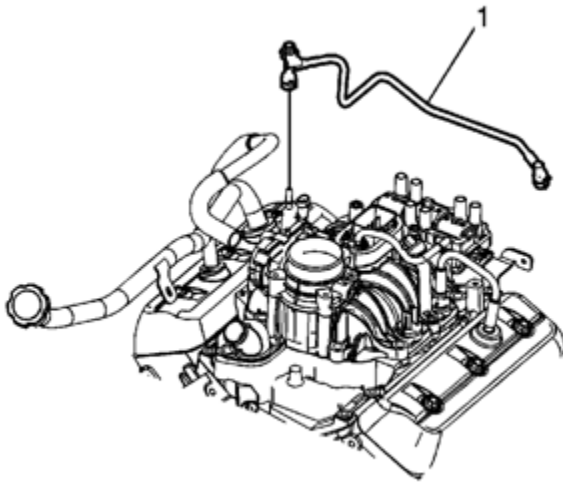
1. Lubricate the NEW injector O-ring seals with clean engine oil.

Caution: Refer to [Fastener Caution](#) in the Preface section.

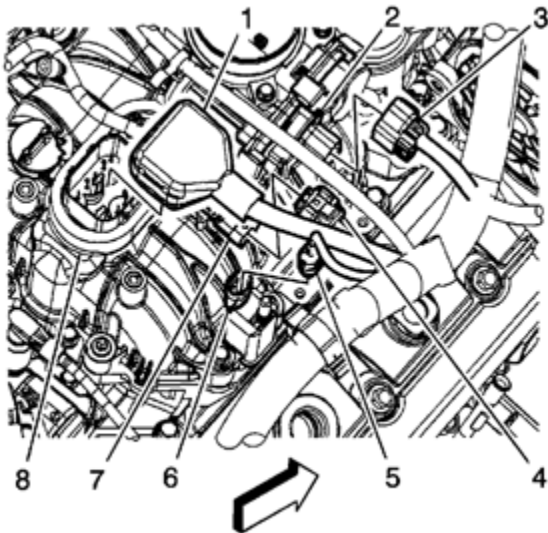
2. Install the fuel injector (2) into the fuel meter body injector socket.
3. Install the injector retainer (3) and the injector retainer lock nuts (4), then tighten to **3 N·m (27 lb in)**.
4. Install the fuel meter body. Refer to [Fuel Meter Body Assembly Replacement](#).

Evaporative Emission Canister Purge Solenoid Valve Replacement

Removal Procedure

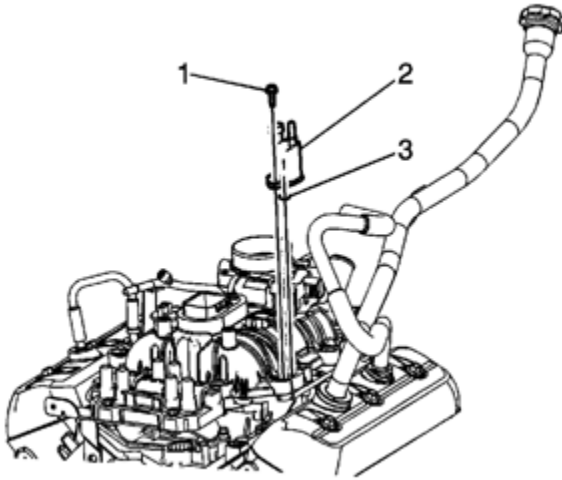


1. Remove the engine cover. Refer to [Engine Cover Replacement](#).
2. Disconnect the evaporative emission (EVAP) canister purge solenoid valve tube (1) quick connect fitting from the EVAP purge solenoid valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).
3. Reposition the tube out of the way.



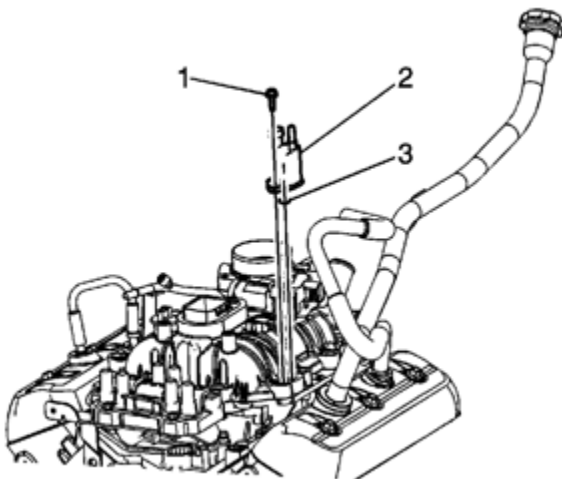


4. Disconnect the engine wiring harness electrical connector (5) from the EVAP purge valve solenoid.



5. Remove the EVAP canister purge solenoid valve bolt (1).
6. Remove the EVAP canister purge solenoid valve (2) from the upper intake manifold.
7. Remove the EVAP canister purge solenoid valve O-ring seal (3) from the upper intake manifold, if necessary.

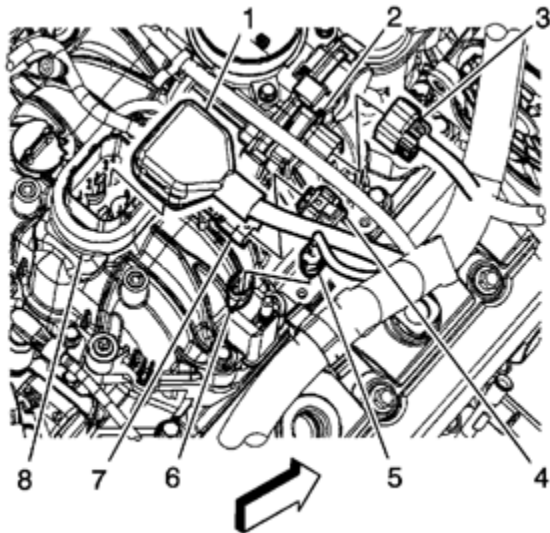
Installation Procedure



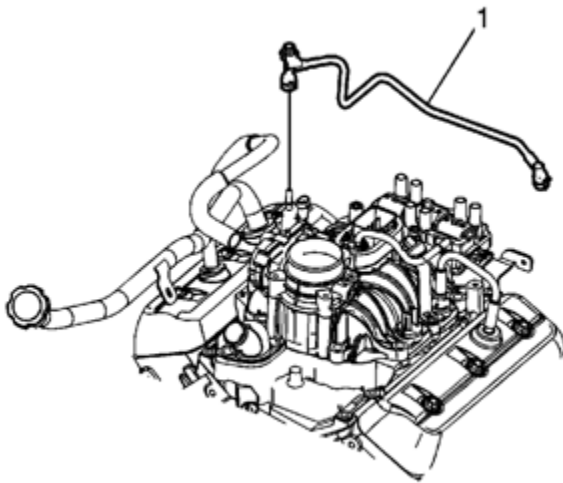
1. Lubricate the EVAP canister purge solenoid valve O-ring seal (3) with clean engine oil in order to aid with the installation.
2. Install the EVAP canister purge solenoid valve (2) into the upper intake manifold.

Caution: Refer to [Fastener Caution](#) in the Preface section.

3. Install the EVAP canister purge solenoid valve bolt (1) and tighten to **10 N·m (89 lb in)**.



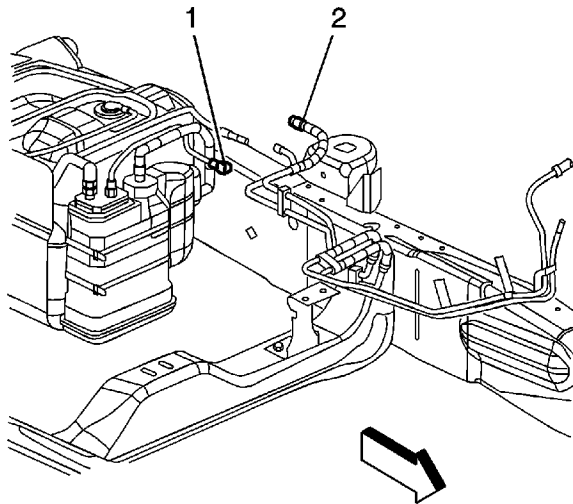
4. Connect the engine wiring harness electrical connector (5) to the EVAP purge valve solenoid.



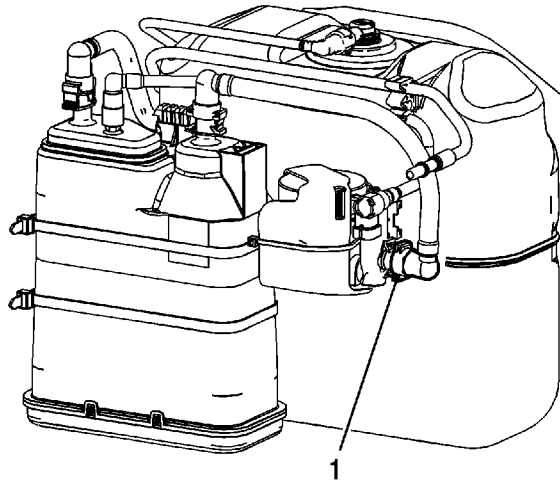
5. Position the EVAP canister purge solenoid tube (1), and connect the tube quick connect fitting to the EVAP purge solenoid valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).
6. Install the engine cover. Refer to [Engine Cover Replacement](#).

Evaporative Emission Canister Vent Solenoid Valve Replacement

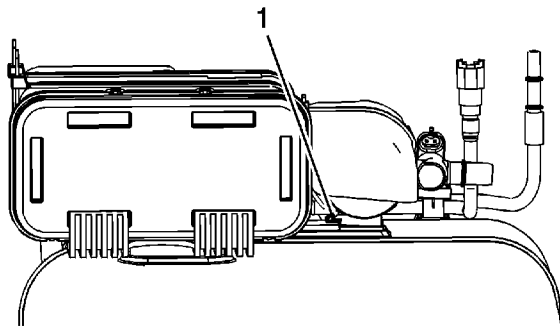
Removal Procedure



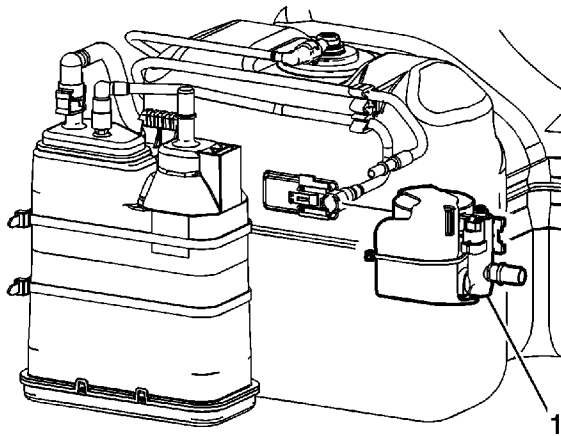
1. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
2. Clean the evaporative emission (EVAP) pipe connections and the surrounding areas prior to disconnecting the lines in order to avoid possible contamination of the EVAP system.
3. Disconnect the EVAP canister purge pipe quick connect fitting (1) from the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
4. Remove the fuel tank EVAP pipe from the tank clip and reposition the pipe out of the way.
5. Disconnect the chassis wiring harness electrical connector from the evaporative emission (EVAP) canister vent solenoid valve .



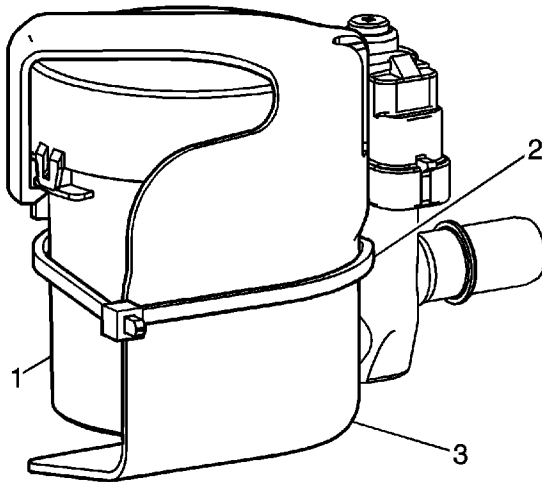
6. Disconnect the EVAP canister vent pipe quick connect fitting (1) from the EVAP canister vent solenoid valve. Refer to [Plastic Collar Quick Connect Fitting Service](#) .



7. Using a flat bladed tool, disengage the EVAP canister vent solenoid valve retainer (1).

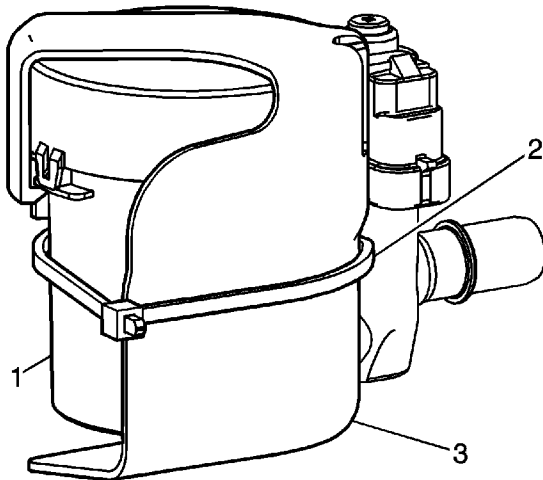


8. Slide the EVAP canister vent solenoid valve (1) off of the fuel tank bracket.

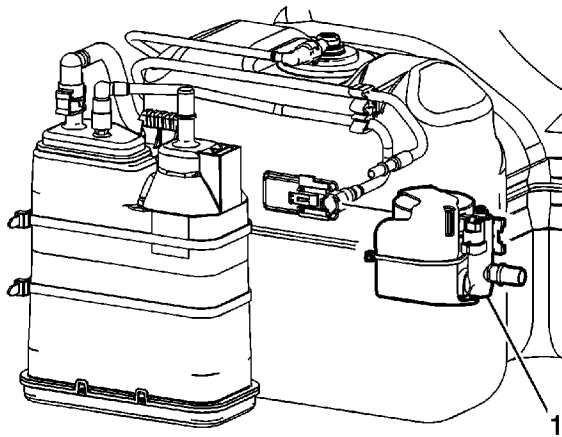


9. Cut the tie strap (2) securing the EVAP canister vent solenoid valve shield to the valve.
10. Disengage the shield retainer (1) and remove the shield (3) from the valve.

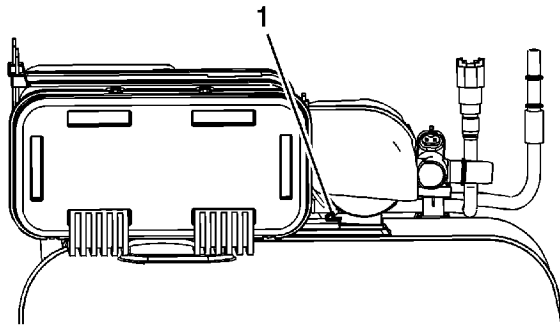
Installation Procedure



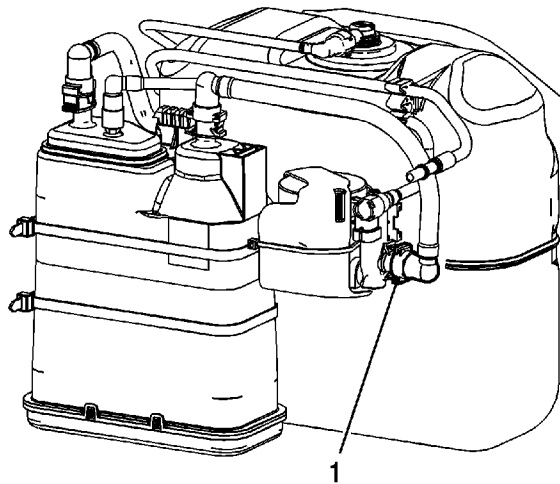
1. Install the shield (3) to the EVAP canister vent solenoid valve, ensure the shield retainer (1) is engaged.
2. Install a NEW tie strap (2) in order to secure the shield to the valve.



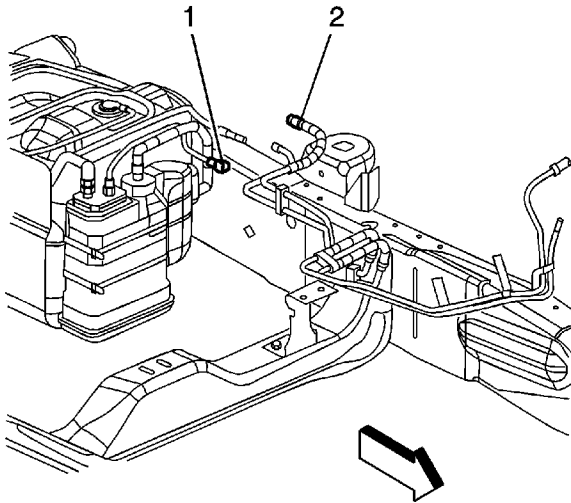
3. Slide the EVAP canister vent solenoid valve (1) onto of the fuel tank bracket.



4. Ensure that the EVAP canister vent solenoid valve engages the retainer (1).



5. Connect the EVAP canister vent pipe quick connect fitting (1) to the EVAP canister vent solenoid valve. Refer to [Plastic Collar Quick Connect Fitting Service](#) .

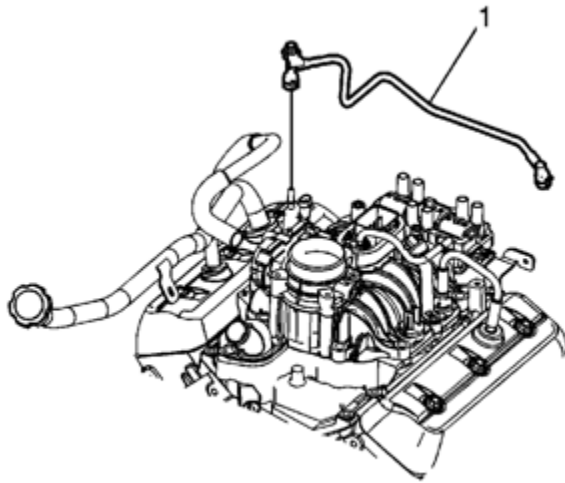


6. Connect the chassis wiring harness electrical connector to the EVAP canister vent solenoid valve .
7. Position and install the fuel tank EVAP pipe to the tank clip.
8. Connect the EVAP canister purge pipe quick connect fitting (1) to the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
9. Lower the vehicle.

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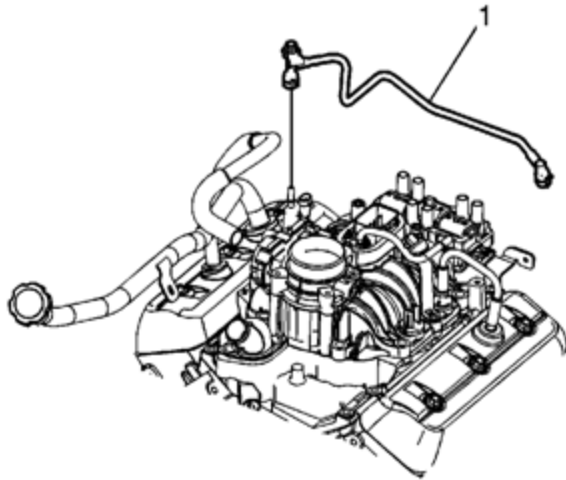
Evaporative Emission Hoses/Pipes Replacement - Engine

Removal Procedure



1. Remove the engine cover. Refer to [Engine Cover Replacement](#) .
2. Clean the evaporative emission (EVAP) pipe connections and the surrounding areas before disconnecting in order to avoid possible contamination of the EVAP system.
3. Disconnect the EVAP pipe quick connect fitting from the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
4. Disconnect the EVAP pipe quick connect fitting from the EVAP canister purge solenoid valve. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
5. Remove the EVAP pipe (1) from the vehicle.
6. Cap the EVAP canister purge valve and the chassis EVAP pipe in order to prevent possible EVAP system contamination.

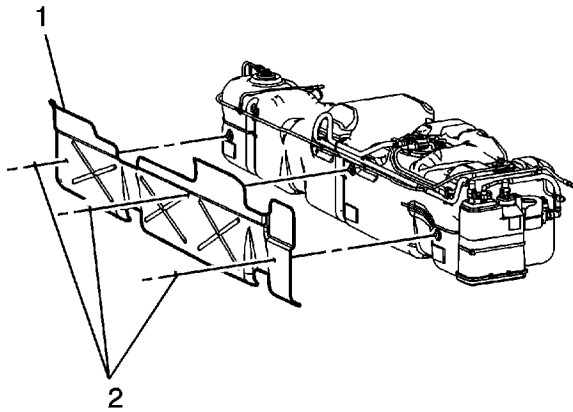
Installation Procedure



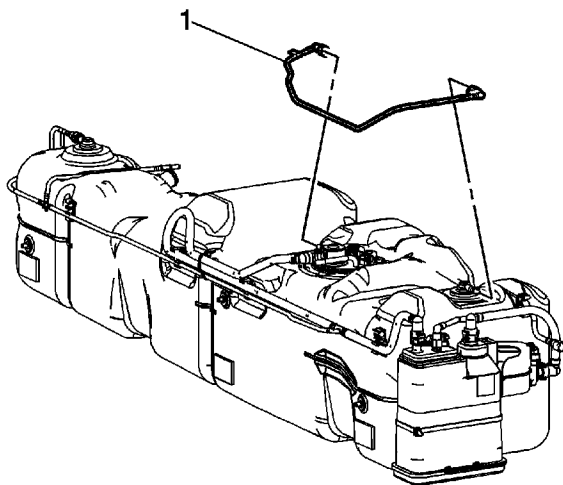
1. Remove the caps from the EVAP canister purge valve and the chassis EVAP pipe.
2. Connect the EVAP pipe (1) quick connect fitting to the EVAP canister purge solenoid valve. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
3. Connect the EVAP pipe (1) quick connect fitting to the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
4. Install the engine cover. Refer to [Engine Cover Replacement](#) .

Evaporative Emission Hoses/Pipes Replacement - Canister/Fuel Tank

Removal Procedure

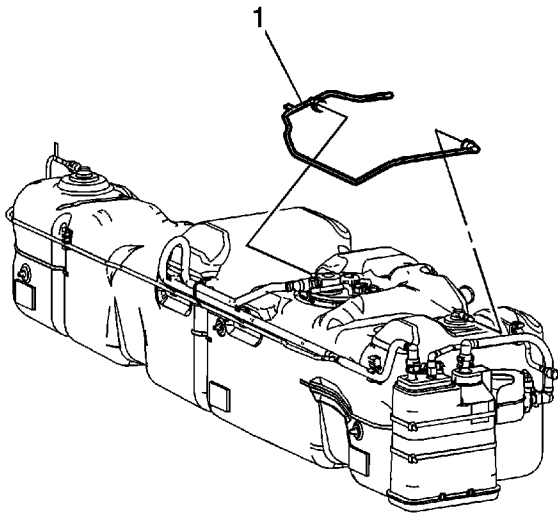


1. Remove the fuel tank. Refer to [Fuel Tank Replacement](#).
2. Clean the evaporative emission (EVAP) pipe connections and the surrounding areas before disconnecting in order to avoid possible contamination of the EVAP system.
3. Remove the fuel tank shield push on retainers (2).
4. Remove the fuel tank shield (1) from the fuel tank clips.

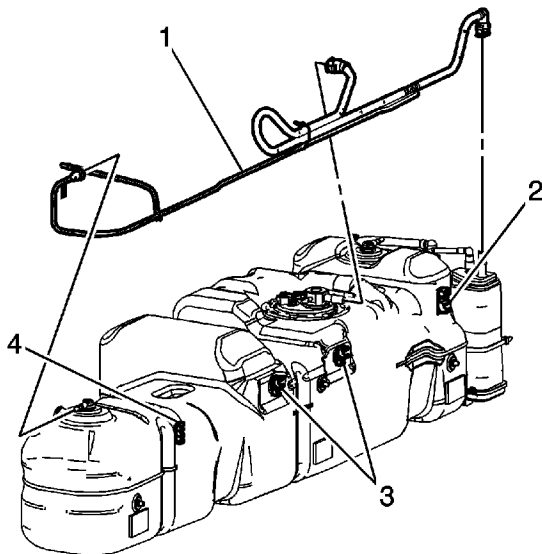




5. If equipped with regular production option (RPO) E26, disconnect the evaporative emission (EVAP) front pipe quick connect fittings from the fuel tank module and roll over valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).
6. Remove the EVAP front pipe (1) from under the EVAP pipe.



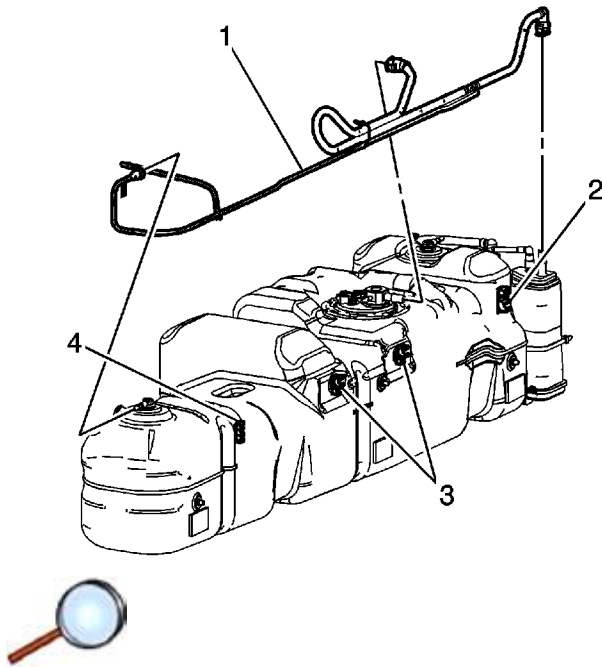
7. If equipped without RPO E26, disconnect the evaporative emission (EVAP) front pipe quick connect fittings from the fuel tank module and roll over valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).
8. Remove the EVAP front pipe (1) from under the EVAP pipe.



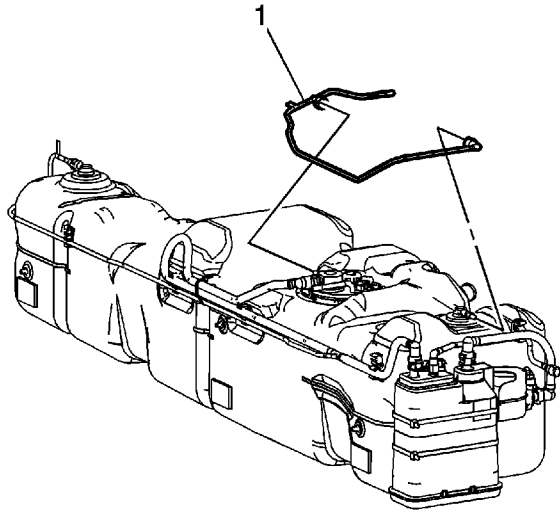
9. Disconnect the EVAP pipe quick connect fitting from the fuel tank roll over valve. Refer to [Plastic Collar Quick Connect Fitting Service](#).
10. Remove the adhesive tape securing the EVAP pipe to the fuel tank, if necessary.

11. Disconnect the EVAP pipe quick connect fitting from the fuel tank module. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
12. Disconnect the EVAP pipe quick connect fitting from the EVAP canister. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
13. Remove the EVAP pipe (1) from the fuel tank retainers (2, 3, and 4).

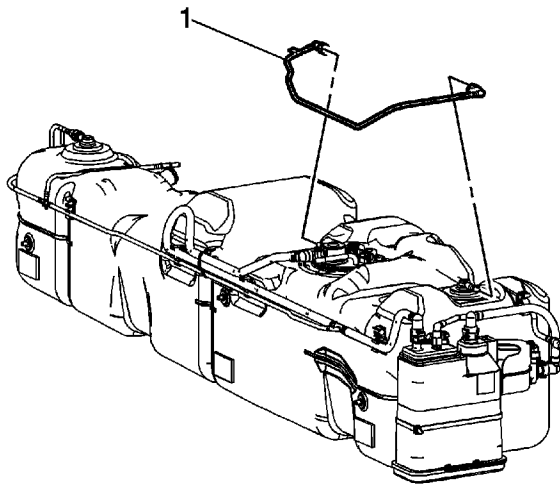
Installation Procedure



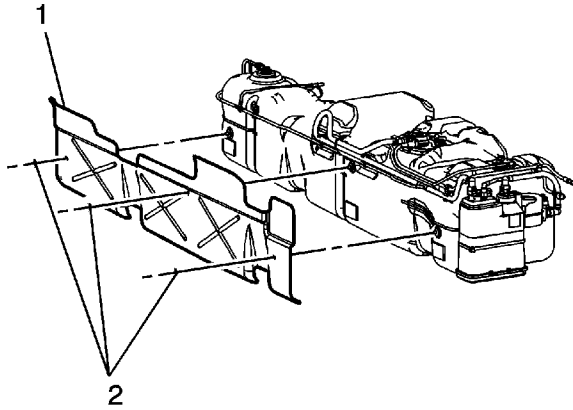
1. Install the EVAP pipe (1) to the fuel tank retainers (2, 3, and 4).
2. Connect the EVAP pipe quick connect fitting to the EVAP canister. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
3. Connect the EVAP pipe quick connect fitting to the fuel tank module. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
4. Connect the EVAP pipe quick connect fitting to the fuel tank roll over valve. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
5. Secure the EVAP pipe to the fuel tank with adhesive tape, if necessary.



6. If equipped without RPO E26, route and install the EVAP front pipe (1) under the EVAP pipe.
7. Connect the EVAP front pipe quick connect fittings to the fuel tank module and roll over valve. Refer to [Plastic Collar Quick Connect Fitting Service](#) .



8. If equipped with RPO E26, route and install the EVAP front pipe (1) under the EVAP pipe.
9. Connect the EVAP front pipe quick connect fittings to the fuel tank module and roll over valve. Refer to [Plastic Collar Quick Connect Fitting Service](#) .

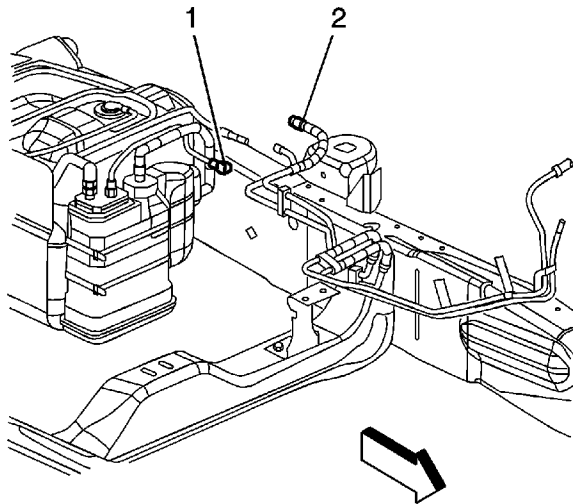


10. Install the fuel tank shield (1) to the fuel tank clips.
11. Install the fuel tank shield push on retainers (2).
12. Install the fuel tank. Refer to [Fuel Tank Replacement](#) .

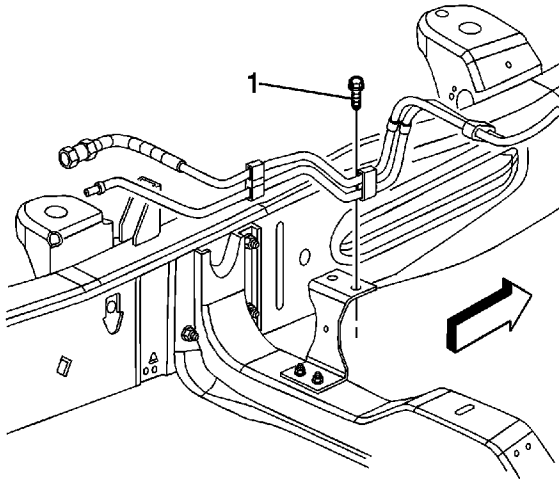
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Evaporative Emission Hoses/Pipes Replacement - Engine / Chassis

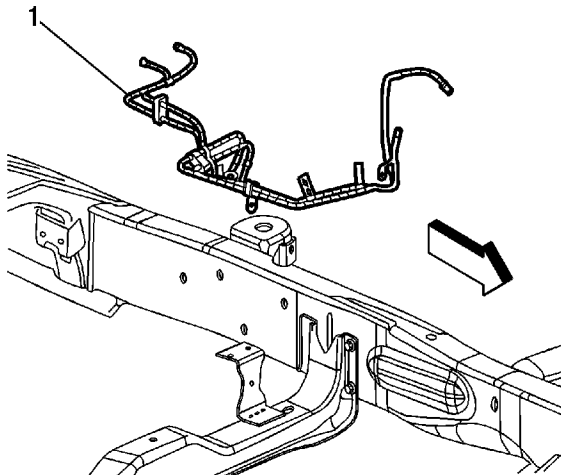
Removal Procedure



1. Relieve the fuel system pressure. Refer to [Fuel Pressure Relief](#).
2. Disconnect the chassis fuel feed pipe quick connect fitting from the engine compartment fuel pipe. Refer to [Metal Collar Quick Connect Fitting Service](#).
3. Disconnect the engine evaporative emission (EVAP) pipe quick connect fitting from the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
4. Cap the fuel and EVAP pipe connections in order to prevent fuel/EVAP system contamination.
5. Remove the fuel feed and EVAP pipe bracket nut from the bellhousing stud and remove the bracket from the stud.
6. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
7. Disconnect the chassis fuel feed pipe quick connect fitting (2) from the fuel tank fuel feed pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
8. Disconnect the EVAP canister purge pipe quick connect fitting (1) from the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).



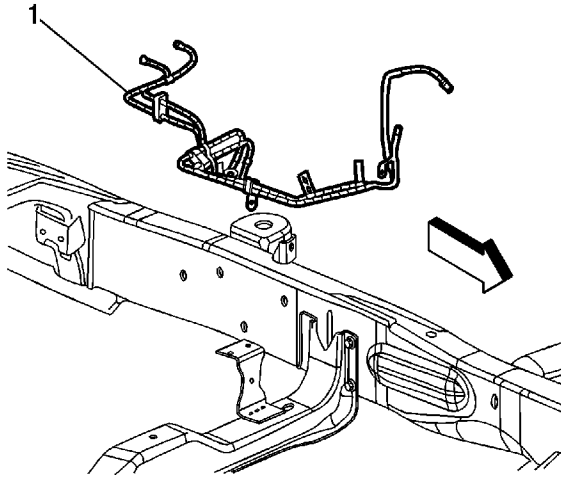
9. Remove the fuel/EVAP pipe assembly bolt (1).



10. Remove the fuel/EVAP pipe assembly (1) from the vehicle.

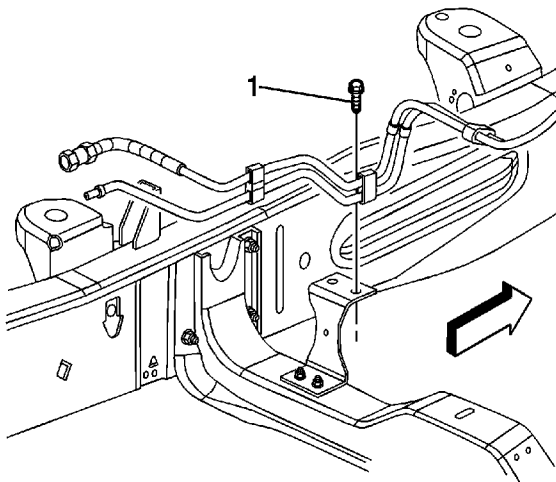
11. Remove the EVAP pipe from the fuel/EVAP pipe assembly.

Installation Procedure

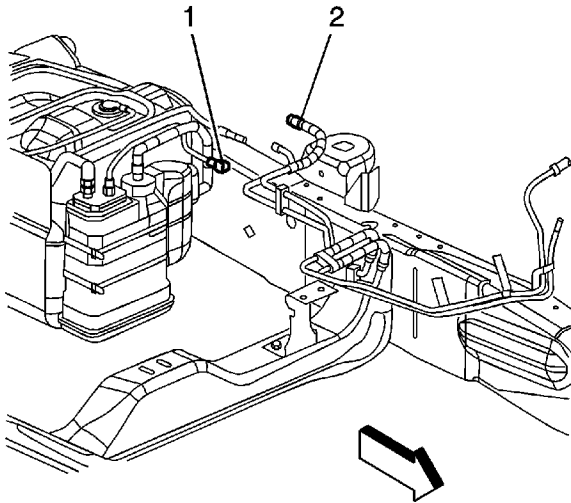


1. Install the EVAP pipe to the fuel/EVAP pipe assembly.
2. Install the fuel/EVAP pipe assembly (1) to the vehicle.

Caution: Refer to [Fastener Caution](#) in the Preface section.



3. Install the fuel/EVAP pipe assembly bolt (1) and tighten to **13 N·m (115 lb in)**.



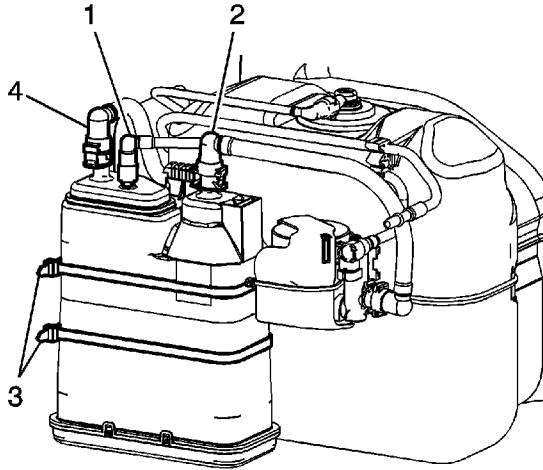
4. Connect the EVAP canister purge pipe quick connect fitting (1) to the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
5. Connect the chassis fuel feed pipe quick connect fitting (2) to the fuel tank fuel feed pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
6. Lower the vehicle.
7. Install the fuel feed and EVAP pipe bracket to the bellhousing stud and install the nut.

Tighten to **25 N·m (18 lb ft)**.

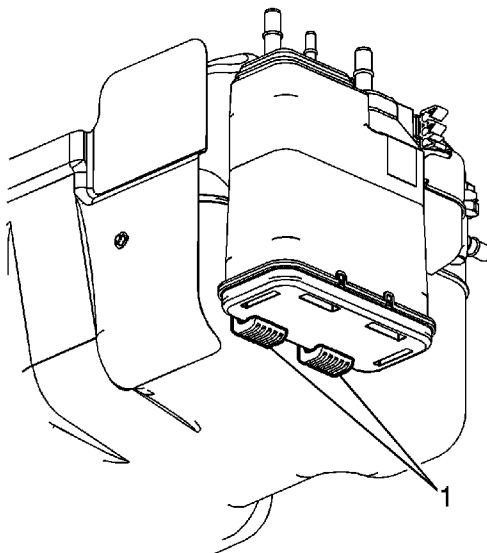
8. Remove the caps from the fuel and EVAP pipe connections.
9. Connect the engine EVAP pipe quick connect fitting to the chassis EVAP pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
10. Connect the chassis fuel feed pipe quick connect fitting to the engine compartment fuel pipe. Refer to [Metal Collar Quick Connect Fitting Service](#).
11. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection](#).
12. Perform the following procedure in order to inspect for leaks:
 - 12.1. Turn the ignition ON, with the engine OFF, for 2 seconds.
 - 12.2. Turn the ignition OFF for 10 seconds.
 - 12.3. Turn the ignition ON, with the engine OFF.
 - 12.4. Inspect for fuel leaks.
13. Install the engine cover. Refer to [Engine Cover Replacement](#).

Evaporative Emission Canister Replacement

Removal Procedure

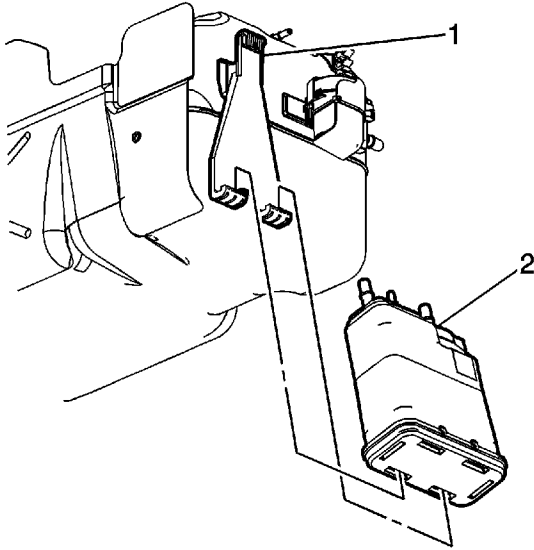


1. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
2. Disconnect the evaporative emission (EVAP) canister purge pipe quick connect fitting (1) from the EVAP canister. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
3. Disconnect the EVAP canister vent pipe quick connect fitting (2) from the EVAP canister. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
4. Disconnect the EVAP pipe quick connect fitting (4) from the EVAP canister. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
5. Cut the tie straps (3) securing the EVAP canister to the EVAP canister bracket.



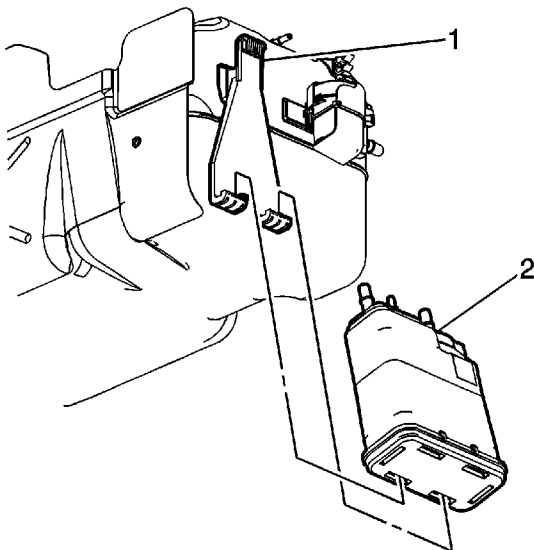


6. Using a flat bladed tool, disengage the EVAP canister retainers (1).

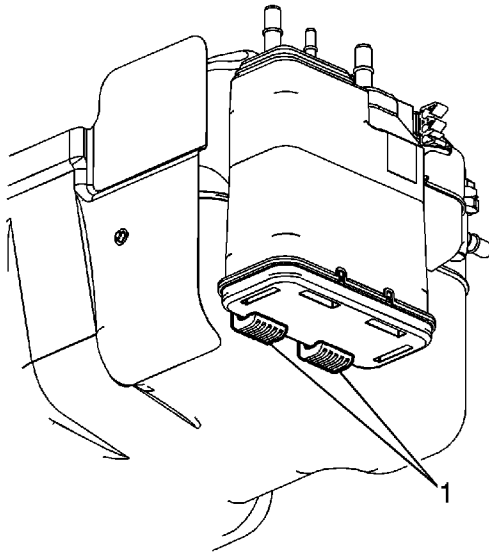


7. Rotate the bottom of the EVAP canister (2) away from the fuel tank and pull the canister down, in order to remove the top of the canister from the upper retainer (1).

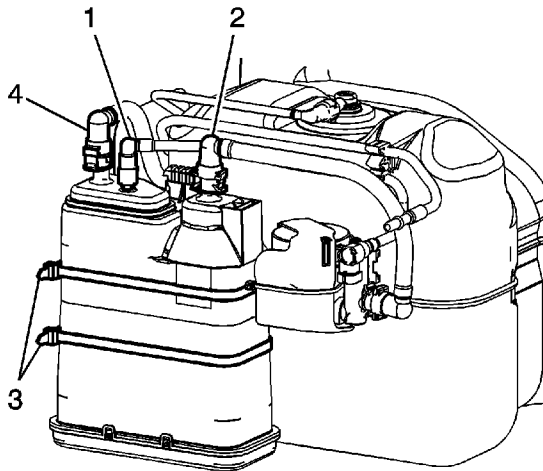
Installation Procedure



1. Insert the top opening on the EVAP canister (2) onto the upper retainer (1) and rotate the bottom of the canister towards the fuel tank.



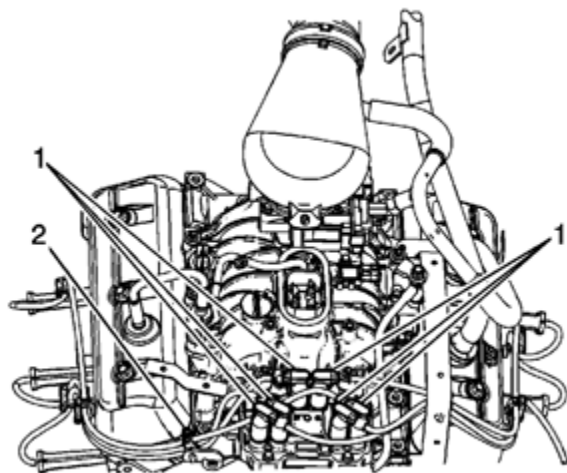
2. Using a flat bladed tool, engage the EVAP canister to the retainers (1).



3. Install NEW tie straps (3) securing the EVAP canister to the EVAP canister bracket.
4. Connect the EVAP pipe quick connect fitting (4) to the EVAP canister. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
5. Connect the EVAP canister vent pipe quick connect fitting (2) to the EVAP canister. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
6. Connect the EVAP canister purge pipe quick connect fitting (1) to the EVAP canister. Refer to [Plastic Collar Quick Connect Fitting Service](#) .
7. Lower the vehicle.

Ignition Coil Replacement

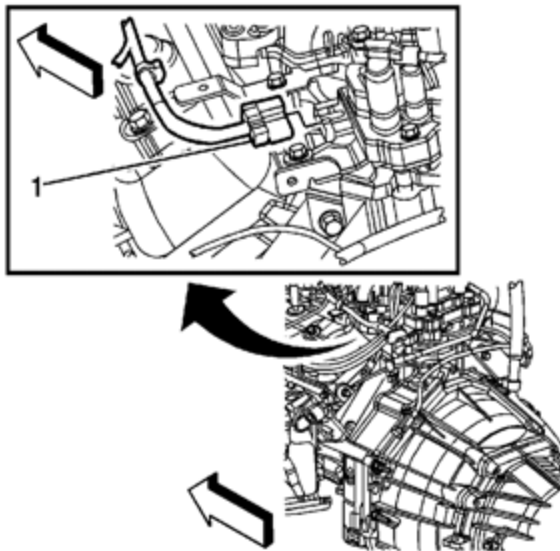
Removal Procedure



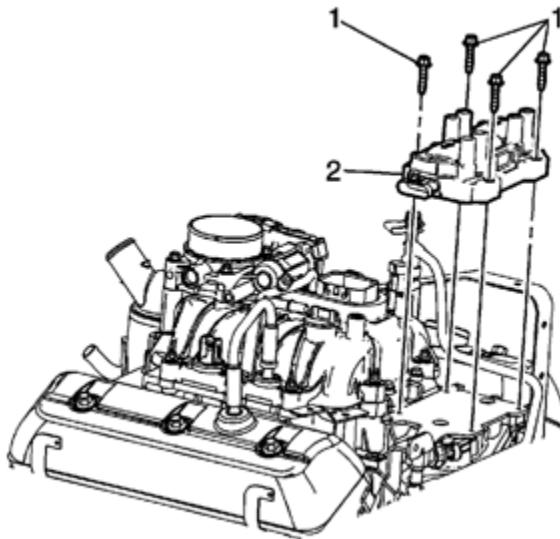
1. Remove the engine cover. Refer to [Engine Cover Replacement](#).
2. Disconnect the chassis fuel feed pipe quick connect fitting from the engine fuel feed pipe. Refer to [Metal Collar Quick Connect Fitting Service](#).

Note: Note the routing of the spark plug wires prior to disconnecting the wires from the ignition coil.

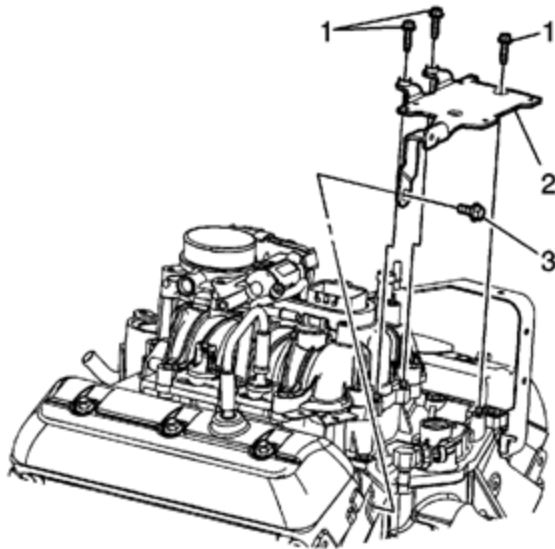
3. Disconnect the spark plug wires (1) from the ignition coil.
4. Remove the spark plug wire retainer (2) from the ignition coil bracket.
5. Reposition the spark plug wires out of the way.



6. Disconnect engine wiring harness electrical connector (1) from the ignition coil.



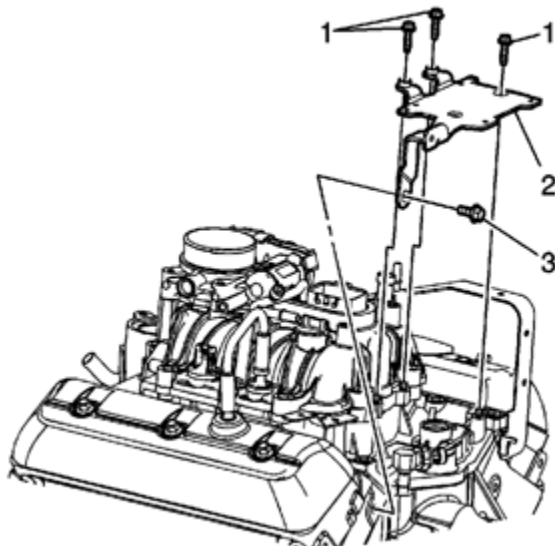
7. Remove the ignition coil bolts (1) and ignition coil (2) from the bracket.



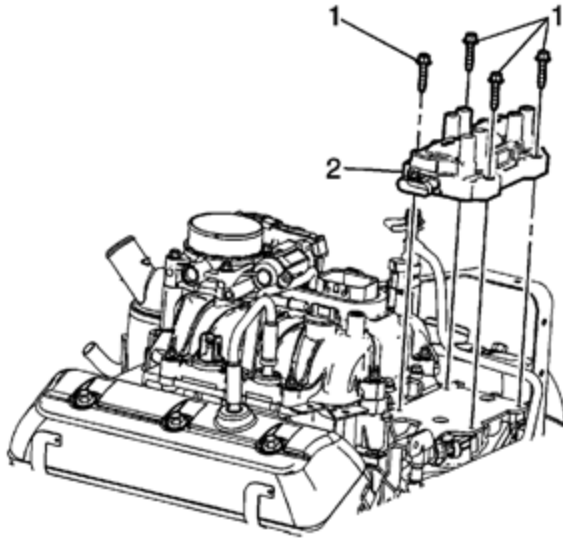
8. If required, remove the lower ignition coil bracket bolt (3).
9. Remove the engine wiring harness ground terminal from the ignition coil bracket.
10. Remove the upper ignition coil bracket bolts (1) and bracket (2).

Installation Procedure

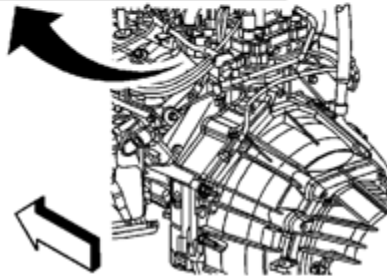
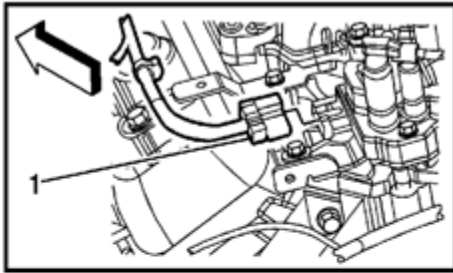
Caution: Refer to [Fastener Caution](#) in the Preface section.



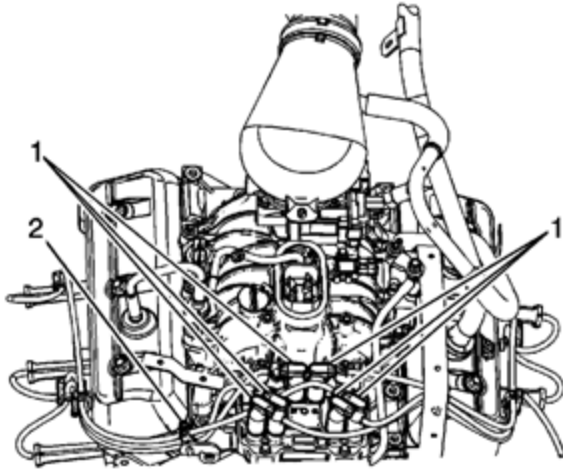
1. If required, position the ignition coil bracket to the lower intake manifold and install the upper bolts and tighten to **12 N·m (106 lb in)**.
2. Position the engine wiring harness ground terminal to the ignition coil bracket.
3. Install the lower ignition coil bracket bolt (3) and tighten to **40 N·m (30 lb ft)**.



4. Place the ignition coil (2) on top of the bracket and install the bolts (1) and tighten to **12 N·m (106 lb in)**.



5. Connect engine wiring harness electrical connector (1) to the ignition coil.



6. Position the spark plug wires and install the spark plug wire retainer (2) to the ignition coil bracket.
7. Connect the spark plug wires (1) to the ignition coil as noted during removal.
8. Connect the chassis fuel feed pipe quick connect fitting to the engine fuel feed pipe. Refer to [Metal Collar Quick Connect Fitting Service](#).
9. Install the engine cover. Refer to [Engine Cover Replacement](#).

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. Correct routing of the spark plug wires Incorrect routing may cause cross-firing.
2. Any signs of cracks or splits in the wires.
3. Inspect each boot for the following conditions:
 - Tearing
 - Piercing
 - Arcing
 - Carbon tracking
 - Corroded terminal

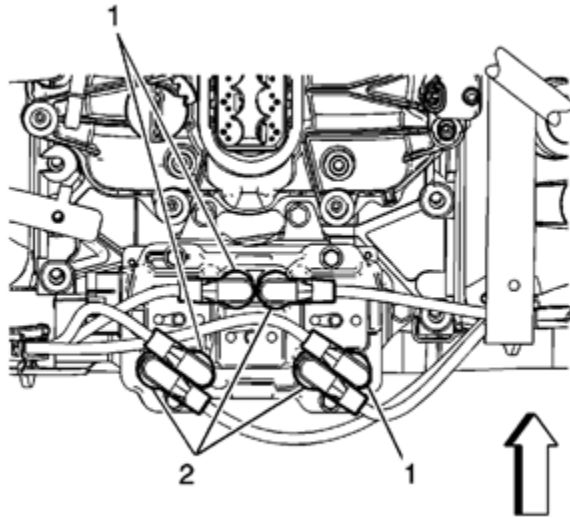
If corrosion, carbon tracking or arcing are indicated on a spark plug wire boot or on a terminal, replace the wire and the component connected to the wire.

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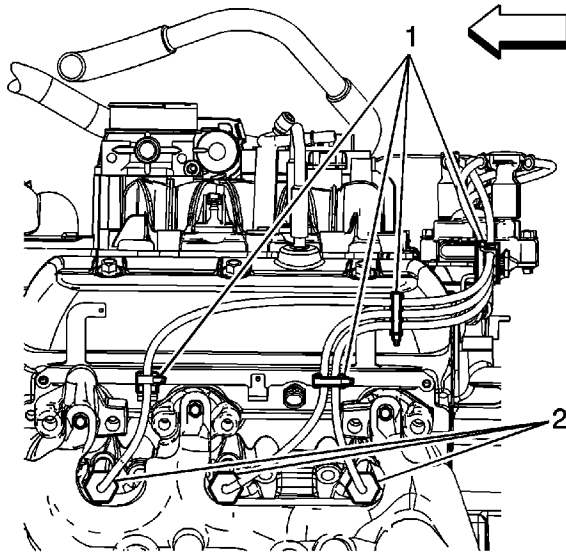
Spark Plug Wire Replacement

Removal Procedure

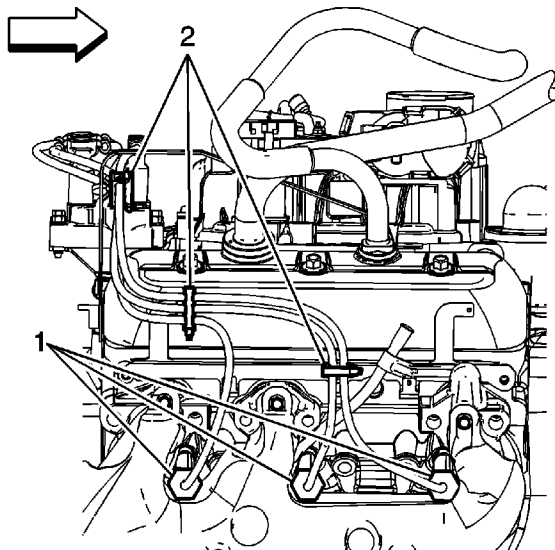
Note: Prior to removing the spark plug wire(s) note the correct routing of the wires as required.



1. Remove the engine cover. Refer to [Engine Cover Replacement](#).
2. Remove the appropriate bank 1 spark plug wire boot(s) (1), or bank 2 spark plug wires boot (s) (2) from the ignition coil.
 - 2.1. Twist the spark plug boot 1/2 turn.
 - 2.2. Pull ONLY on the spark plug boot or use a tool designed for this purpose, in order to remove the spark plug wire boot from the ignition coil.



3. If required, remove the appropriate left side spark plug wire boot(s) (2) from the spark plug (s).
 - 3.1. Twist the spark plug boot 1/2 turn.
 - 3.2. Pull ONLY on the spark plug boot or use a tool designed for this purpose in order to remove the spark plug wire boot from the spark plug.
4. Open the spark plug wire separators (1).
5. Remove the appropriate left side spark plug wire(s).

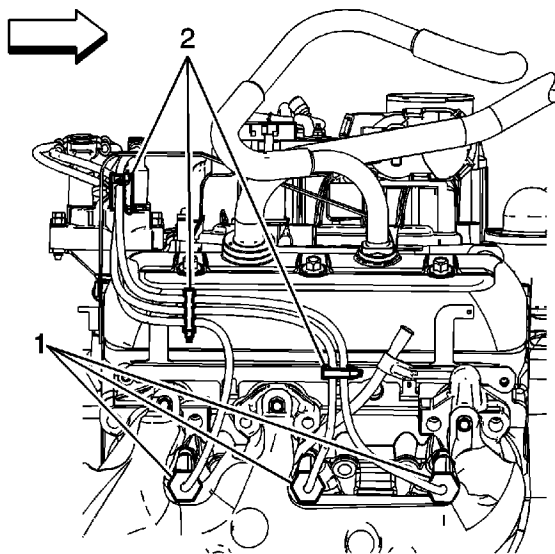


6. If required, remove the appropriate right side spark plug wire boot(s) (1) from the spark plug (s).
 - 6.1. Twist the spark plug boot 1/2 turn.
 - 6.2. Pull ONLY on the spark plug boot or use a tool designed for this purpose in order to remove the spark plug wire boot from the spark plug.

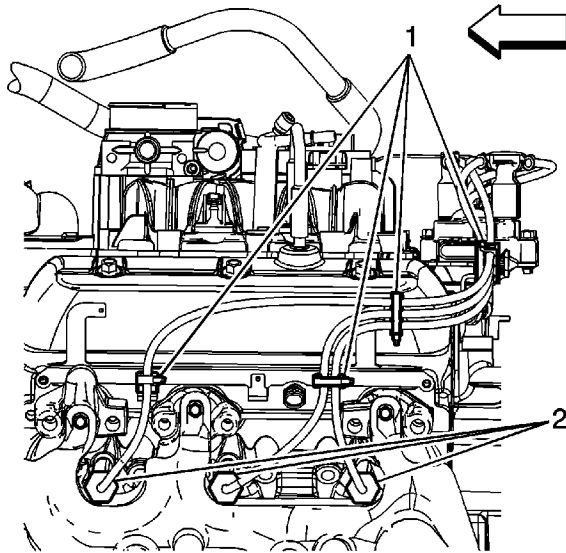
7. Open the spark plug wire separators (2).
8. Remove the appropriate right side spark plug wire(s).

Installation Procedure

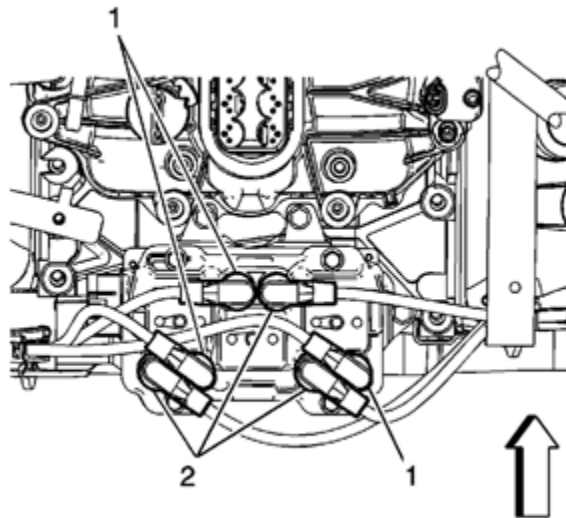
Caution: If the boot to wire movement has occurred, the boot will give a false visual impression of being fully seated. Ensure that the boots have been properly assembled by pushing sideways on the installed boots. Failure to properly seat the terminal onto the spark plug will lead to wire core erosion and result in an engine misfire or crossfire condition, and possible internal damage to the engine.



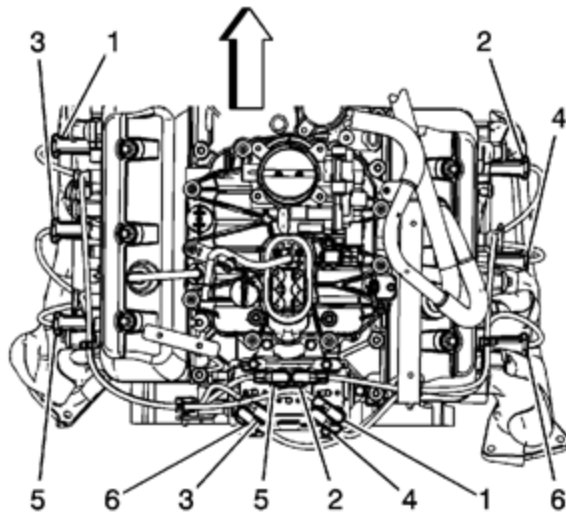
1. If reinstalling the old spark plug wires, apply dielectric grease GM PN 12345579 (Canadian PN 10953481), or equivalent to the inside of the spark plug wire boots.
2. If required, install the appropriate right side spark plug wire(s).
3. Close the spark plug wire separators (2).
4. Install the appropriate right side spark plug wire boot(s) (1) to the spark plug(s).



5. If required, install the appropriate left side spark plug wire(s).
6. Close the spark plug wire separators (1).
7. Install the appropriate left side spark plug wire boot(s) (2) to the spark plug(s).



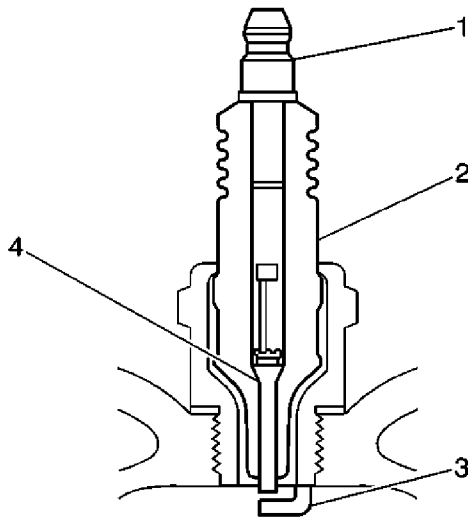
8. Install the appropriate bank 1 spark plug wire boot(s) (1), or bank 2 spark plug wires boot(s) (2) to the ignition coil.



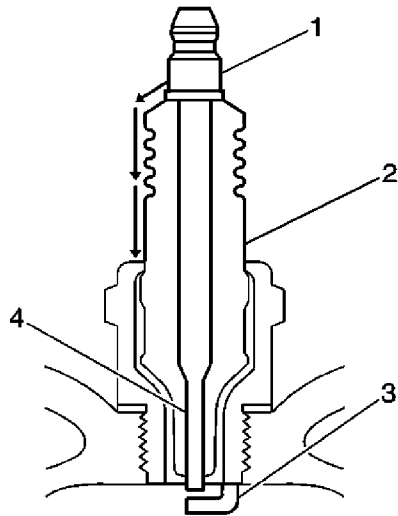
9. Inspect the spark plug wires for proper routing (1, 2, 3, 4, 5, 6) and installation.
 - 9.1. Push sideways on each boot in order to inspect the seating.
 - 9.2. Reinstall any loose boot.
 - 9.3. Any time the spark plug wire or boot is installed on the spark plug, new dielectric grease needs to be applied inside the boot.
10. Install the engine cover. Refer to [Engine Cover Replacement](#).

Spark Plug Inspection

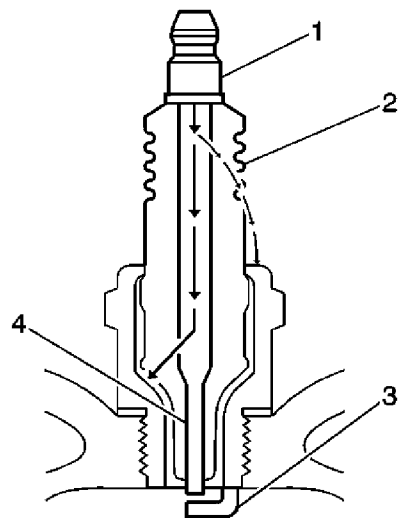
1. Verify that the correct spark plug is installed. An incorrect spark plug causes driveability conditions. Refer to [Ignition System Specifications](#) for the correct spark plug.
2. Ensure that the spark plug has the correct heat range. An incorrect heat range causes the following conditions:
 - Spark plug fouling--Colder plug
 - Pre-ignition causing spark plug and/or engine damage--Hotter plug



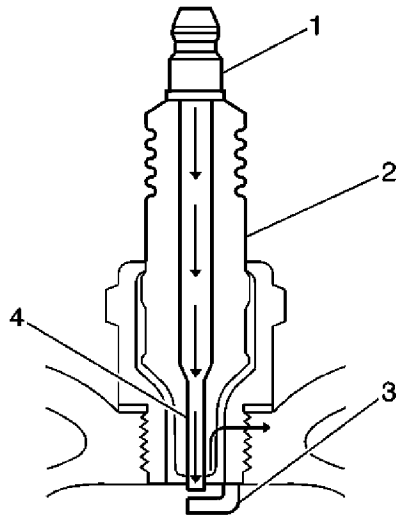
3. Inspect the terminal post (1) for damage.
 - Inspect for a bent or broken terminal post (1).
 - Test for a loose terminal post (1) by twisting and pulling the post. The terminal post (1) should not move.



4. Inspect the insulator (2) for flashover, carbon tracking, or 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.



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



6. 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 (3, 4) reduce or eliminates the gap.
 - Inspect for worn or missing platinum pads on the electrodes (3, 4), if equipped.
 - Inspect for excessive fouling.
7. 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.

Visual Inspection

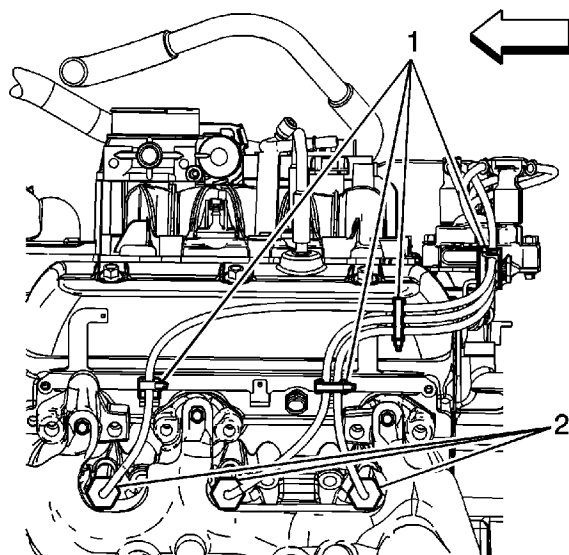
1. Normal operation--Brown to grayish tan with small amounts of white powdery deposits are normal combustion by-products from fuels with additives.
2. Carbon fouled--Dry, fluffy black carbon, or soot caused by the following conditions:
 - Rich fuel mixtures
 - Leaking fuel injectors
 - Excessive fuel pressure
 - Restricted air filter element

- Incorrect combustion
 - Reduced ignition system voltage output
 - Weak ignition 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.
3. Deposit fouling--Oil, coolant, or additives that include substances such as silicone, very white coating, reduces the spark intensity. Most powdery deposits will not affect spark intensity unless they form into a glazing over the electrode.

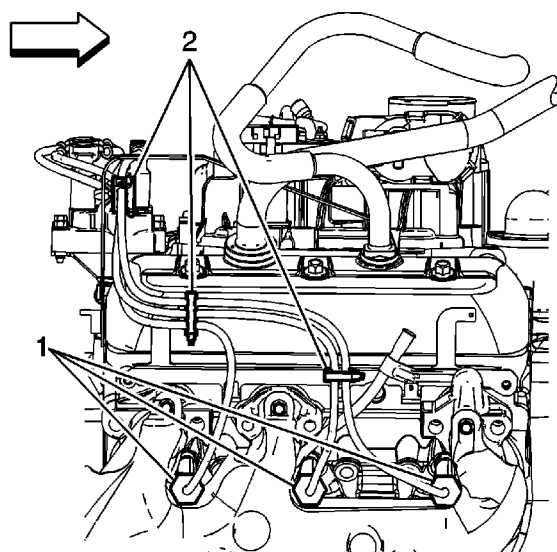
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Spark Plug Replacement

Removal Procedure

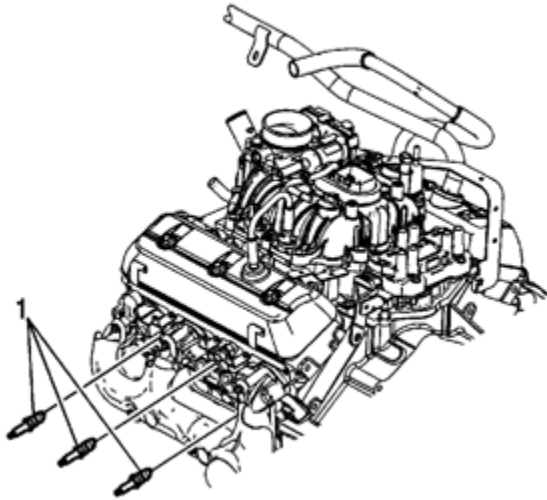


1. Remove the engine cover, if required. Refer to [Engine Cover Replacement](#).
2. If required, remove the appropriate left side spark plug wire boot(s) (2) from the spark plug (s).
 - 2.1. Twist the spark plug boot 1/2 turn.
 - 2.2. Pull ONLY on the spark plug boot or use a tool designed for this purpose in order to remove the spark plug wire boot from the spark plug.

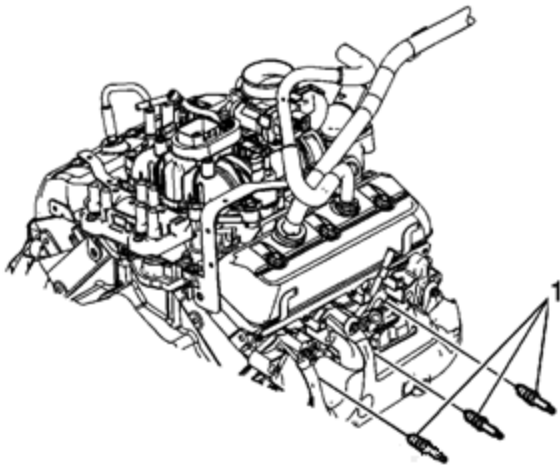




3. If required, remove the appropriate right side spark plug wire boot(s) (1) from the spark plug (s).
 - 3.1. Twist the spark plug boot 1/2 turn.
 - 3.2. Pull ONLY on the spark plug boot or use a tool designed for this purpose in order to remove the spark plug wire boot from the spark plug.

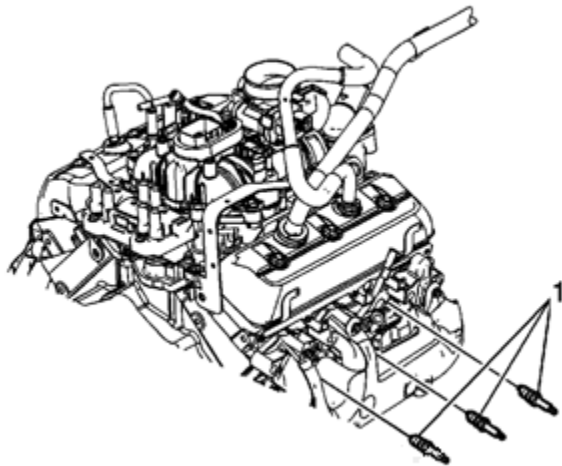


4. If required, loosen the appropriate left side spark plug 1 or 2 turns.
5. Brush or air blast away any dirt from around the spark plug.
6. Remove the appropriate left side spark plug (1). If removing more than 1 plug, place each plug in a tray marked with the corresponding cylinder number.



7. If required, loosen the appropriate right side spark plug 1 or 2 turns.
8. Brush or air blast away any dirt from around the spark plug.
9. Remove the appropriate right side spark plug (1). If removing more than 1 plug, place each plug in a tray marked with the corresponding cylinder number.

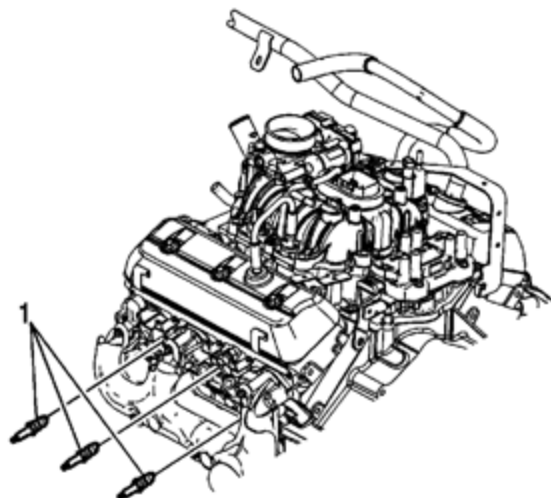
Installation Procedure



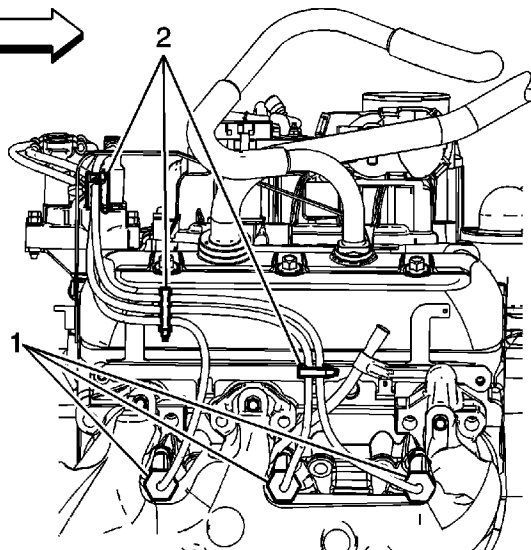
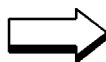
1. Ensure that the spark plug washer is positioned correctly.
2. Inspect the spark plug gap. Adjust the gap as needed. Refer to [Engine Mechanical Specifications](#).
3. Install the appropriate right side spark plug (1) into the cylinder head by hand.

Caution: Refer to [Fastener Caution](#) in the Preface section.

4. Tighten the spark plug to **15 N·m (11 lb ft)**.

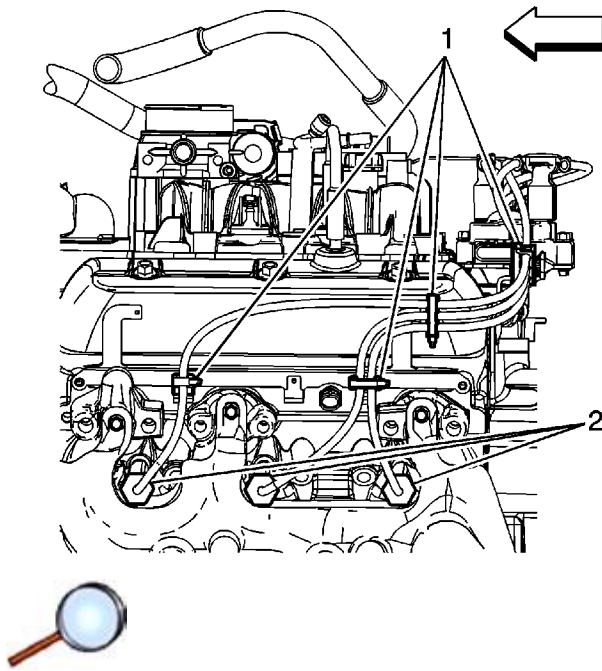


5. Install the appropriate left side spark plug (1) into the cylinder head by hand.
6. Tighten the spark plug to **15 N·m (11 lb ft)**.



Caution: If the boot to wire movement has occurred, the boot will give a false visual impression of being fully seated. Ensure that the boots have been properly assembled by pushing sideways on the installed boots. Failure to properly seat the terminal onto the spark plug will lead to wire core erosion and result in an engine misfire or crossfire condition, and possible internal damage to the engine.

7. If reinstalling the old spark plug wires, apply dielectric grease GM PN 12345579 (Canadian PN 10953481), or equivalent to the inside of the spark plug wire boots.
8. Install the appropriate right side spark plug wire boot(s) (1) to the spark plug(s).

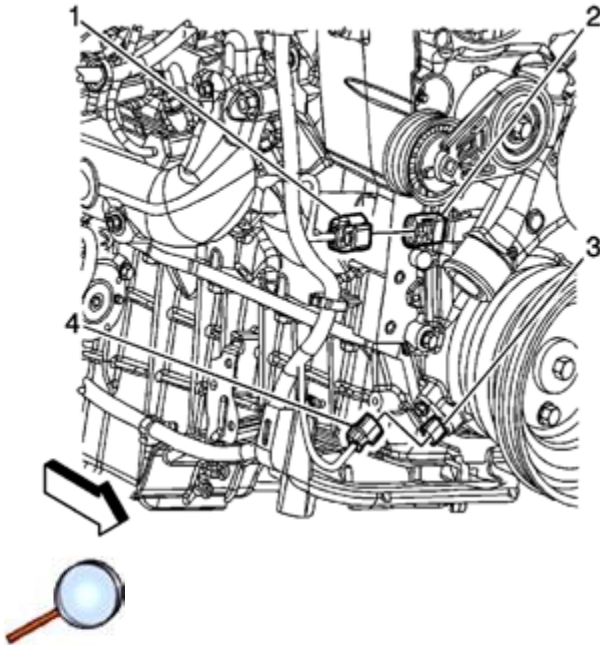


9. Install the appropriate left side spark plug wire boot(s) (2) to the spark plug(s).
10. Install the engine cover, if required. Refer to [Engine Cover Replacement](#).

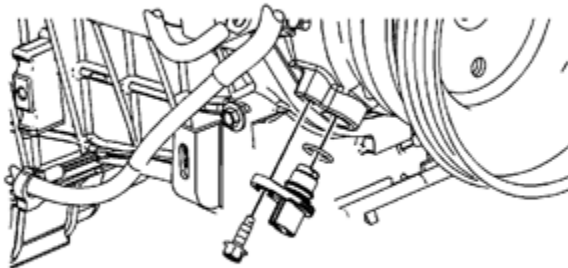
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Crankshaft Position Sensor Replacement

Removal Procedure



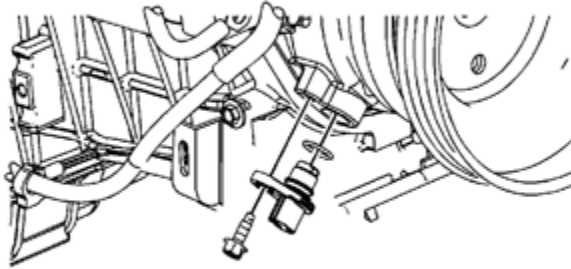
1. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
2. Disconnect the engine wiring harness electrical connector (4) from the crankshaft position (CKP) sensor (3).



3. Remove the CKP sensor bolt and sensor.

Installation Procedure

Note: When installing the CKP sensor, make sure the sensor is fully seated before tightening the bolt. A poorly seated CKP sensor may perform erratically and may set false diagnostic trouble codes (DTCs).

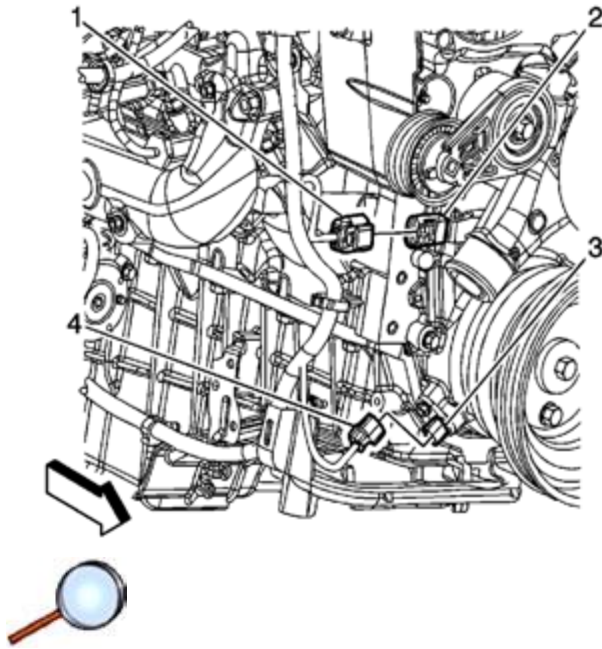


Note: Do not reuse the original O-ring seal.

1. If reinstalling the old CKP sensor, install a NEW O-ring seal onto the sensor.
2. Lubricate the O-ring seal with clean engine oil.

Caution: Refer to [Fastener Caution](#) in the Preface section.

3. Install the CKP sensor and bolt to tighten to **10 N·m (89 lb in)**.

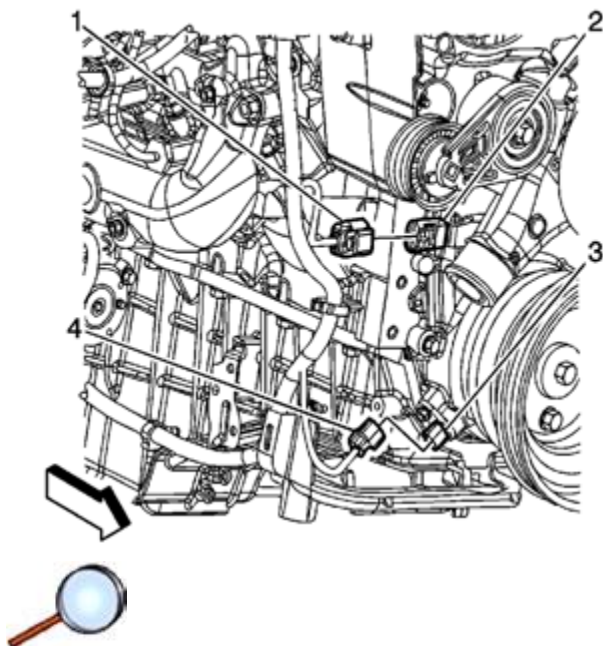


4. Connect the engine wiring harness electrical connector (4) to the CKP sensor (3).
5. Lower the vehicle.
6. Perform the crankshaft position system variation learn procedure. Refer to [Control Module References](#).

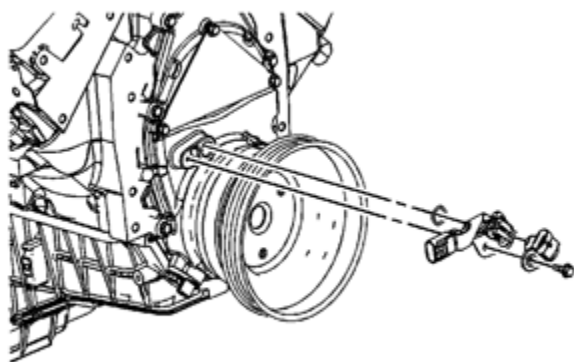
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Camshaft Position Sensor Replacement

Removal Procedure



1. Disconnect the engine wiring harness electrical connector (1) from the camshaft position (CMP) sensor wiring harness jumper (2).
2. Remove the water pump. Refer to [Water Pump Replacement](#).

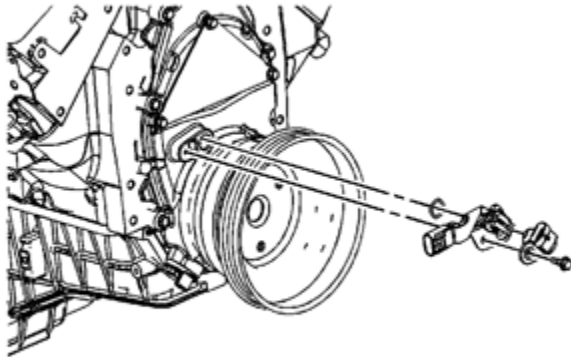


3. Remove the CMP sensor bolt.
4. Remove the CMP sensor and wiring harness jumper from the engine front cover.

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5. Disconnect the CMP sensor wiring harness jumper from the CMP sensor.
6. Remove the CMP sensor from the wiring harness jumper.

Installation Procedure

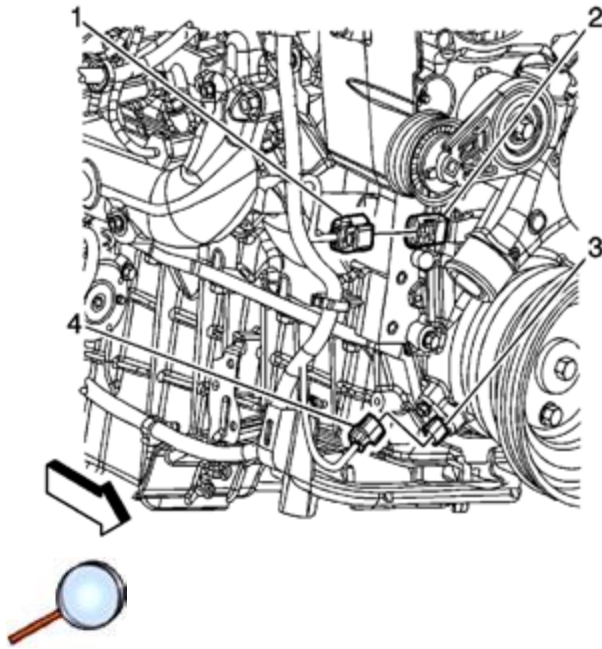


Note: Do not reuse the original O-ring seal.

1. If reinstalling the old CMP sensor, install a NEW O-ring seal onto the sensor.
2. Install the CMP sensor to the wiring harness jumper.
3. Connect the CMP sensor wiring harness jumper to the CMP sensor.
4. Lubricate the O-ring seal with clean engine oil.
5. Install the CMP sensor and wiring harness jumper to the engine front cover.

Caution: Refer to [Fastener Caution](#) in the Preface section.

6. Install the CMP sensor bolt and tighten to **10 N·m (89 lb in)**.

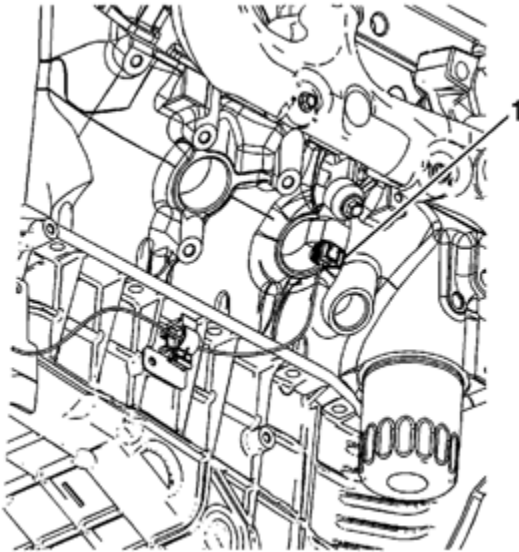


7. Install the water pump. Refer to [Water Pump Replacement](#).
8. Connect the engine wiring harness electrical connector (1) to the CMP sensor wiring harness jumper (2).

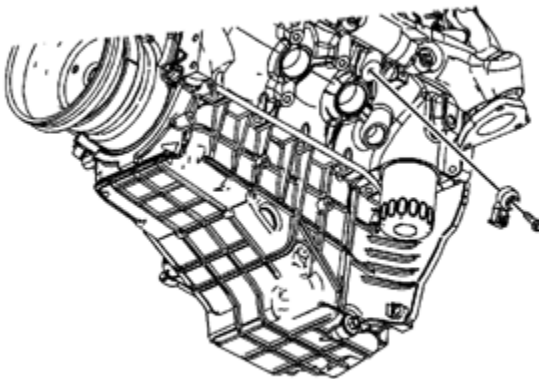
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Knock Sensor 1 Replacement

Removal Procedure



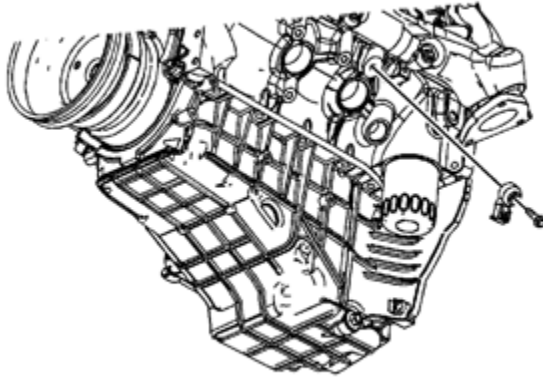
1. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
2. Reposition the knock sensor sleeve down, away from the knock sensor, if equipped.
3. Disconnect the engine wiring harness electrical connector (1) from the knock sensor.



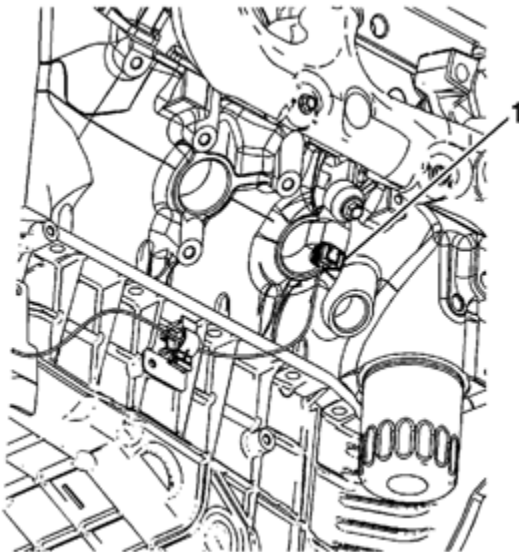
4. Remove the knock sensor bolt and sensor.

Installation Procedure

Caution: Refer to [Fastener Caution](#) in the Preface section.



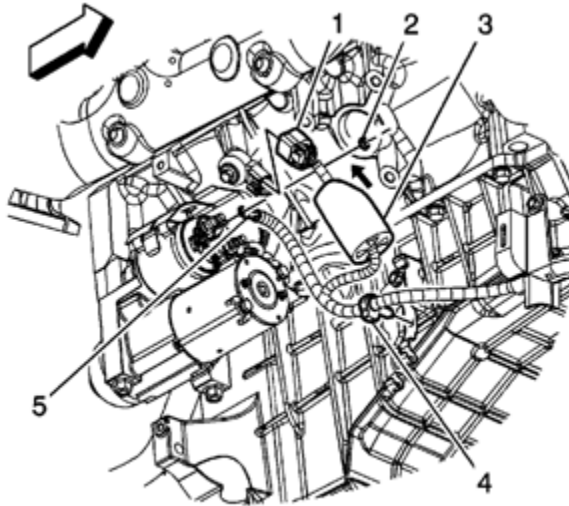
1. Position the knock sensor to the engine block and install the bolt. Tighten to **25 N·m (18 lb ft)**



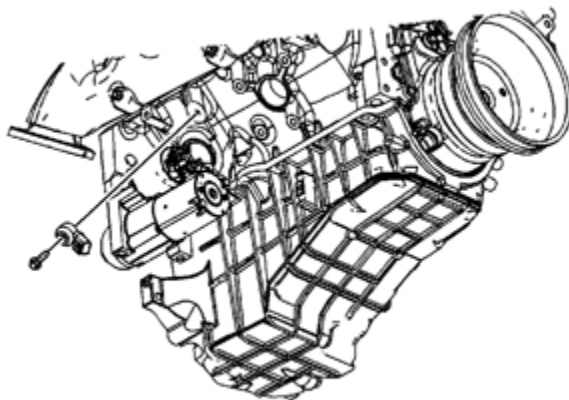
2. Connect the engine wiring harness electrical connector (1) to the knock sensor.
3. Position the knock sensor sleeve up and over the knock sensor, if equipped.
4. Lower the vehicle.

Knock Sensor 2 Replacement

Removal Procedure



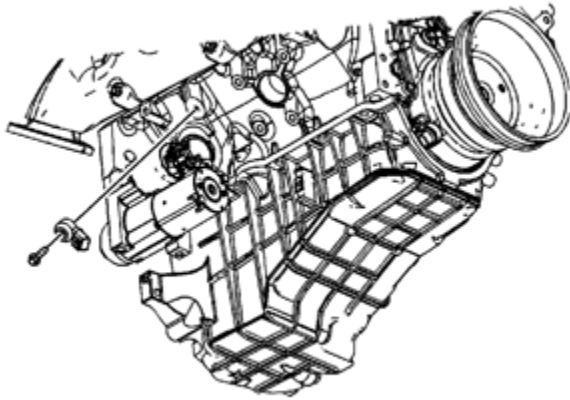
1. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
2. Reposition the knock sensor sleeve (2) down, away from the knock sensor.
3. Disconnect the engine wiring harness electrical connector from the knock sensor (1).



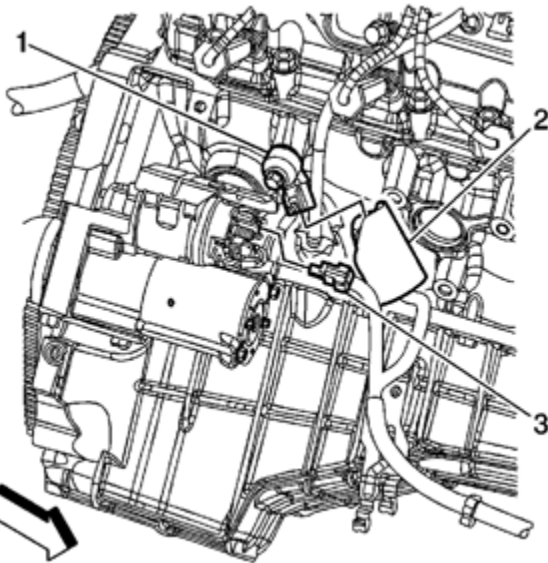
4. Remove the knock sensor bolt and sensor.

Installation Procedure

Caution: Refer to [Fastener Caution](#) in the Preface section.



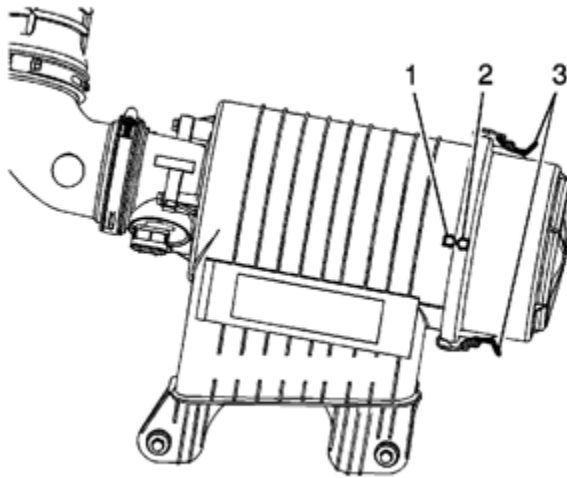
1. Position the knock sensor to the engine block and install the bolt and tighten to **25 N·m (18 lb ft)**.



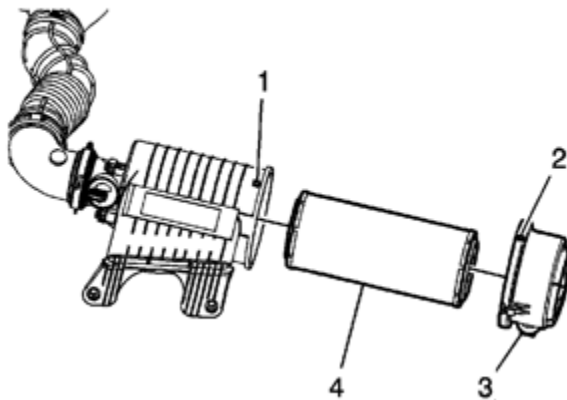
2. Connect the engine wiring harness electrical connector to the knock sensor (1).
3. Position the knock sensor sleeve (2) up and over the knock sensor.
4. Lower the vehicle.

Air Cleaner Element Replacement

Removal Procedure

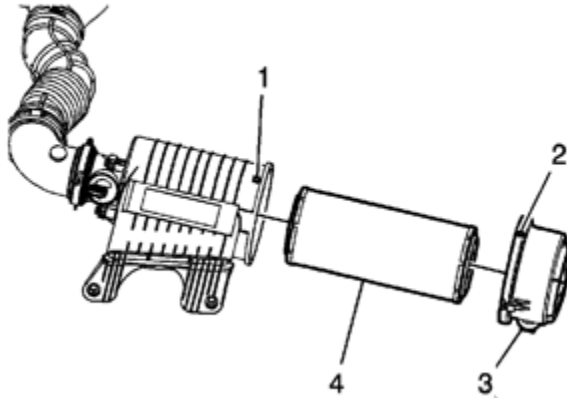


1. Disengage the 2 air cleaner housing cover retainers (1).

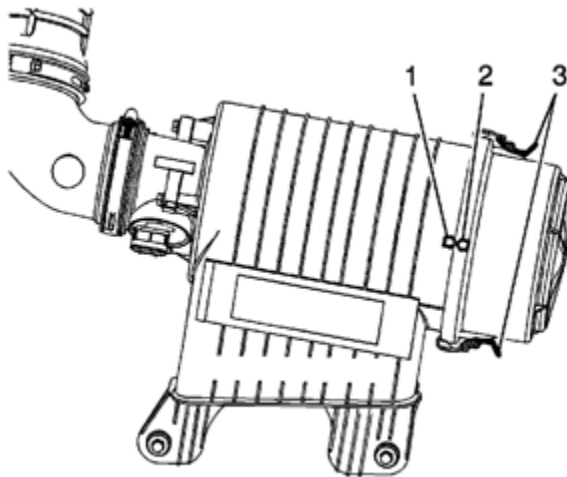


2. Remove the air cleaner housing cover (3) from the air cleaner housing.
3. Remove the air filter element (4).

Installation Procedure



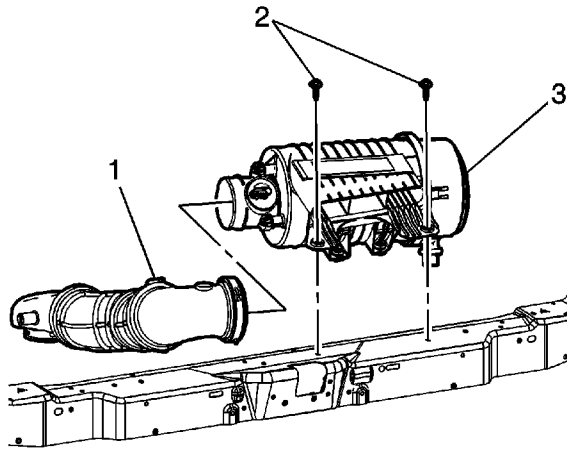
1. Install the NEW air filter element (4).
2. Align that the arrow on the air cleaner housing cover (2) with the arrow (1) on the air cleaner housing.
3. Install the air cleaner housing cover (3) to the air cleaner housing.



4. Ensure that the arrow on the housing (1) is still aligned with the arrow (2) on the cover.
5. Secure the air cleaner housing cover by engaging the 2 air cleaner housing cover retainers (1).

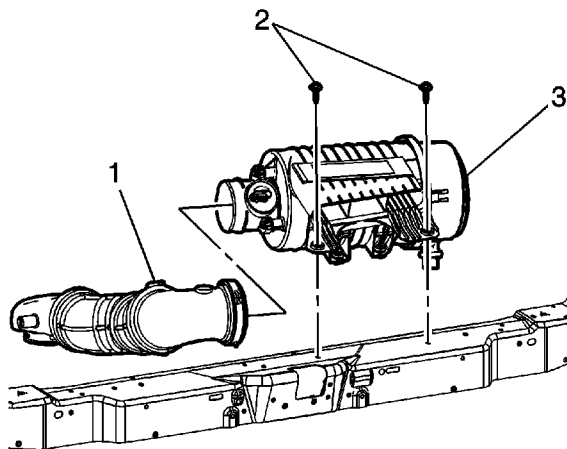
Air Cleaner Assembly Replacement

Removal Procedure



1. Loosen the air cleaner outlet duct clamp (1).
2. Remove the air cleaner assembly bolts (2).
3. Remove the air cleaner assembly (3).

Installation Procedure





1. Install air cleaner assembly (3).

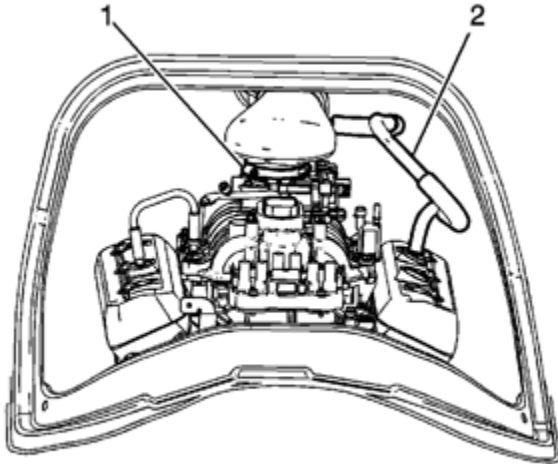
Caution: Refer to [Fastener Caution](#) in the Preface section.

2. Install the air cleaner assembly bolts (2) and tighten to **11 N·m (97 lb in)**.
3. Tighten the air cleaner outlet duct clamp (1) to **5 N·m (44 lb in)**.

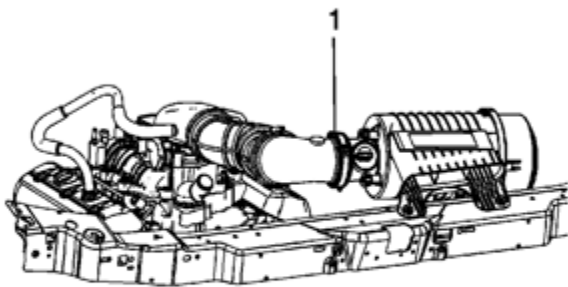
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Air Cleaner Outlet Resonator Replacement

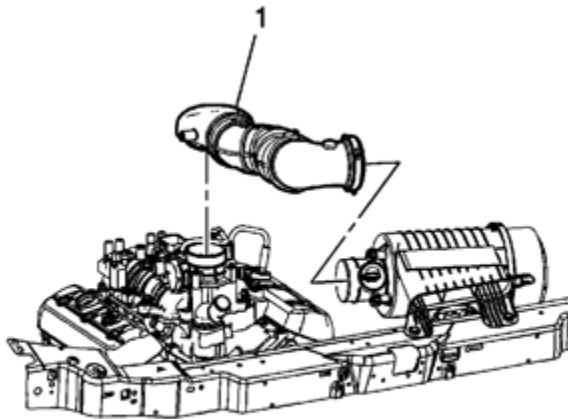
Removal Procedure



1. Remove the engine cover. Refer to [Engine Cover Replacement](#).
2. Remove the positive crankcase ventilation (PCV) hose (2) from the air cleaner outlet duct adapter.
3. Loosen the air cleaner outlet duct adapter clamp (1).
4. Remove the air cleaner outlet duct adapter from the throttle body.

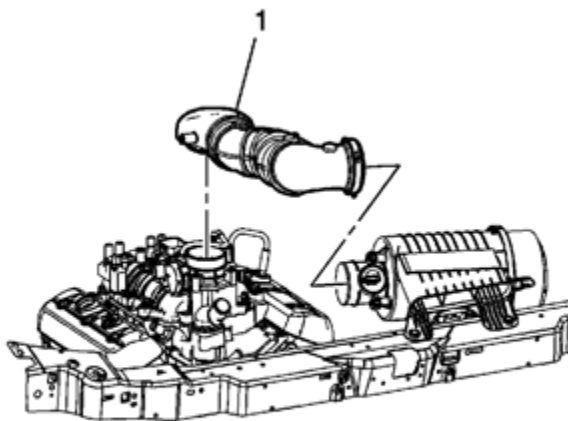


5. From under the hood, loosen the air cleaner outlet duct clamp (1) at the air cleaner assembly.



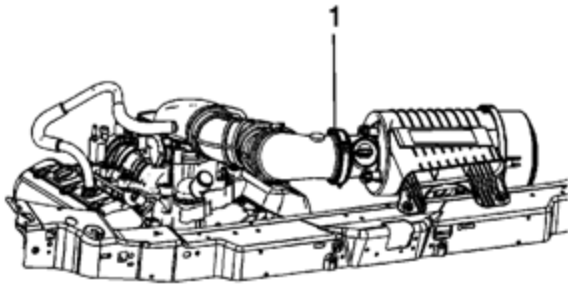
6. Remove the air cleaner outlet duct assembly (1).

Installation Procedure

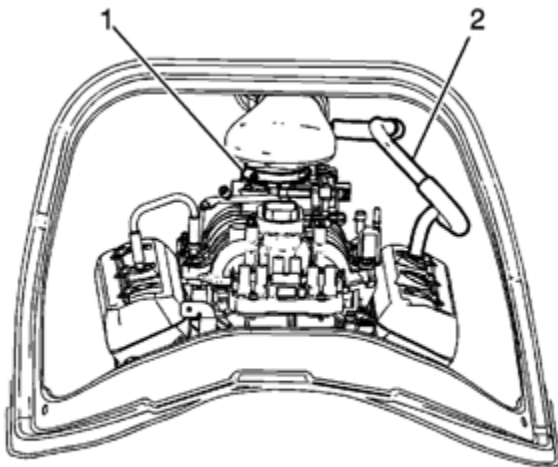


1. Install the air cleaner outlet duct assembly (1).

Caution: Refer to [Fastener Caution](#) in the Preface section.



2. Tighten the air cleaner outlet duct clamp (1) at the air cleaner assembly to **5 N·m (44 lb in)**.



3. Install the air cleaner outlet duct adapter to the throttle body.
4. Tighten the air cleaner outlet duct adapter clamp (1) to **5 N·m (44 lb in)**.
5. Install the PCV hose (2) to the air cleaner outlet duct adapter.
6. Install the engine cover. Refer to [Engine Cover Replacement](#).