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

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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

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Ignition System Specifications

Application	Specification	
	Metric	English
Firing Order	1-2-3-4-5-6	
Spark Plug Gap	1.02 mm	0.040 in
Spark Plug Torque	15 N·m	11 lb ft
Spark Plug Type	GM P/N 12591131 AC Delco #41-100	
Spark Plug Wire Resistance	4,044 ohms per meter (1,236 ohms per ft)	
Refer to Engine Mechanical Specifications		

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Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accelerator Pedal Bolt	10 N·m	89 lb in
Air Cleaner Assembly Bolt	6 N·m	53 lb in
Air Cleaner Inlet Duct Bolt	6 N·m	53 lb in
Air Cleaner Outlet Duct Clamp	3 N·m	27 lb in
Air Cleaner Upper Housing Screw	3 N·m	27 lb in
Camshaft Position (CMP) Sensor Bolt	10 N·m	89 lb in
Crankshaft Position (CKP) Sensor Stud	10 N·m	89 lb in
Engine Coolant Temperature (ECT) Sensor	20 N·m	15 lb ft
Engine Wiring Harness Heat Shield Bolt/Nut	10 N·m	89 lb in
Evaporative Emission (EVAP) Canister Nut	8 N·m	71 lb in
Evaporative Emission (EVAP) Canister Purge Solenoid Bolt	16 N·m	12 lb ft
Fuel Fill Pipe Hose Clamp	5 N·m	44 lb in
Fuel Injector Wiring Harness Electrical Connector Bracket Bolt	14 N·m	10 lb ft
Fuel Pressure Sensor	15 N·m	11 lb ft
Fuel Pump Flow Control Module Bolt	10 N·m	89 lb in
Fuel Rail Bolt	10 N·m	89 lb in
Fuel Tank Fill Pipe Bracket Bolt	4 N·m	35 lb in
Fuel Tank Fill Pipe Housing to Fuel Tank Fill Pipe Screw	10 N·m	89 lb in
Fuel Tank Strap Bolt	20 N·m	15 lb ft
Heated Oxygen Sensor (HO2S)	42 N·m	31 lb ft
Ignition Coil Bolt/Nut	25 N·m	18 lb ft
Ignition Coil Bracket Stud	25 N·m	18 lb ft
Intake Manifold Upper Bolt	25 N·m	18 lb ft
Knock Sensor Bolt	25 N·m	18 lb ft
Mass Airflow (MAF)/Intake Air Temperature (IAT) Sensor Bolt	4 N·m	34 lb in
Rear Brake Pipe Fitting to Brake Pressure Modulator Valve (BPMV)	21 N·m	16 lb ft
Rear Brake Pipe Fitting to Rear Brake Crossover Pipe Fitting	18 N·m	13 lb ft
Rear Brake Pipe Fitting to Rear Brake Hose Fitting	18 N·m	13 lb ft
Spark Plug	15 N·m	11 lb ft
Throttle Body Bolt/Nut	10 N·m	89 lb in

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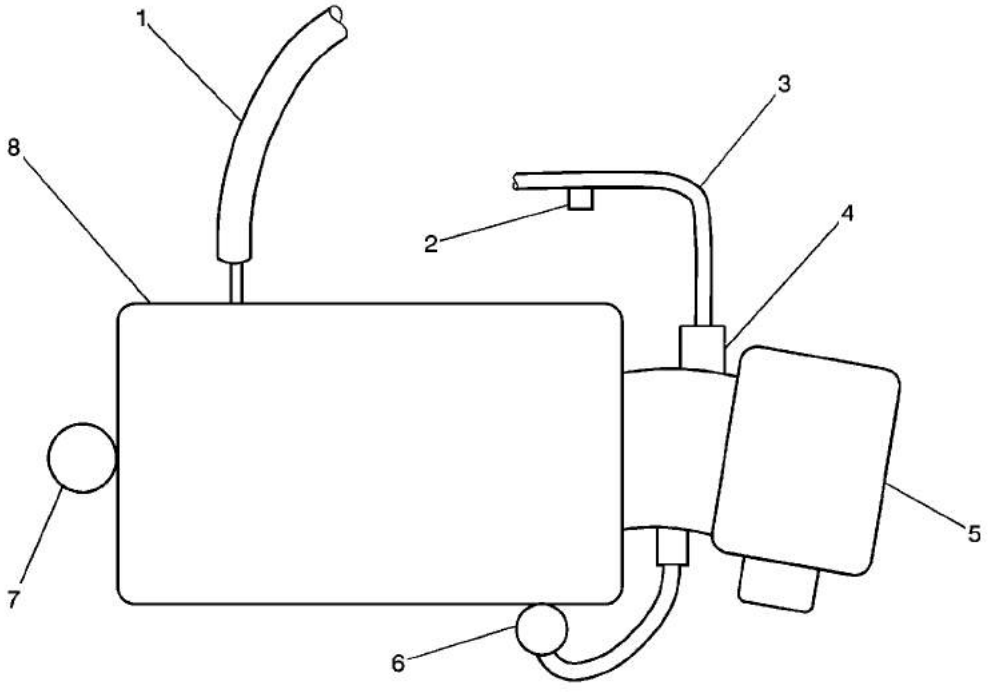
Emission Hose Routing Diagram



(1) To Brake Booster
(2) EVAP Service Port
(3) EVAP Purge Line
(4) EVAP Canister Purge Solenoid Valve
(5) Throttle Actuator Control
(6) PCV Valve
(7) Camshaft Position (CMP) Sensor
(8) Intake Manifold

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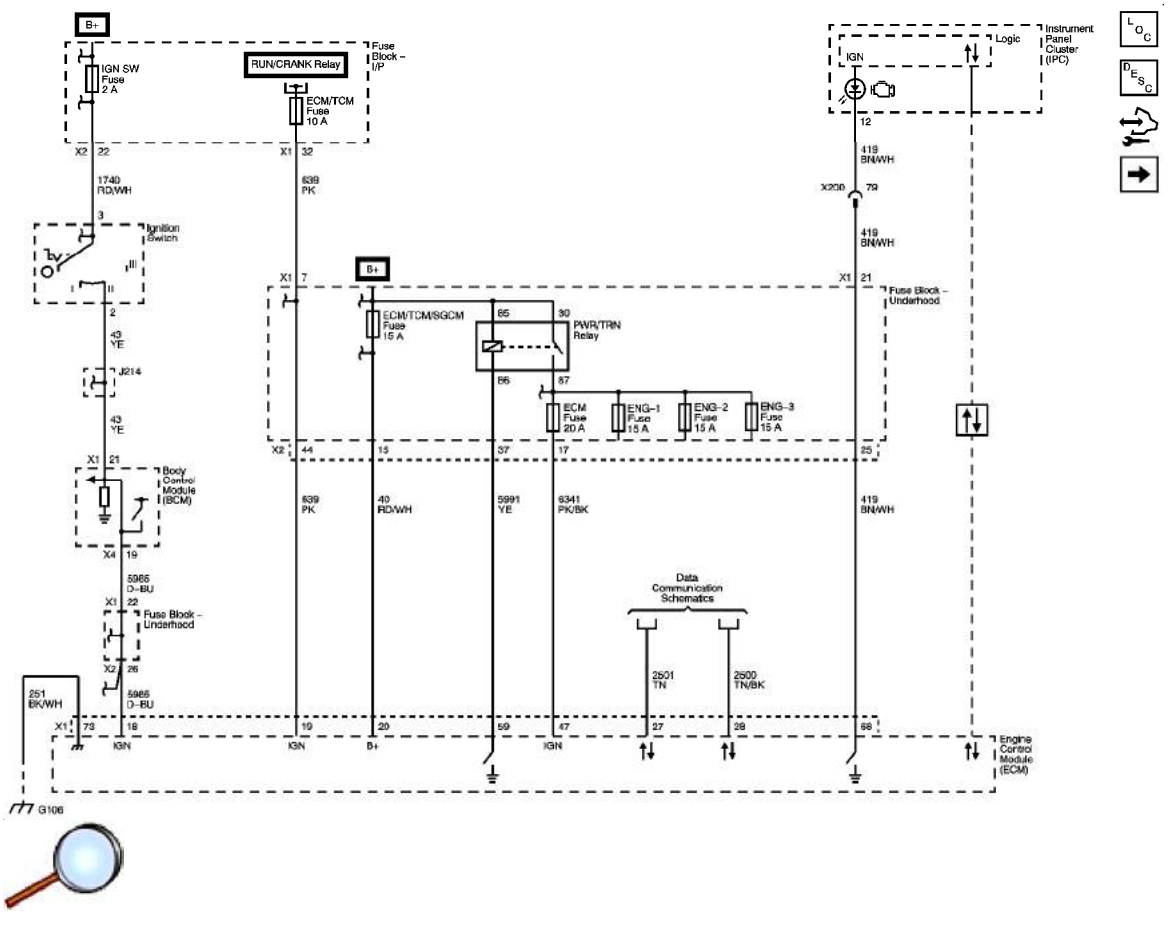
Module Power, Ground, Serial Data, and MIL (LZ4)



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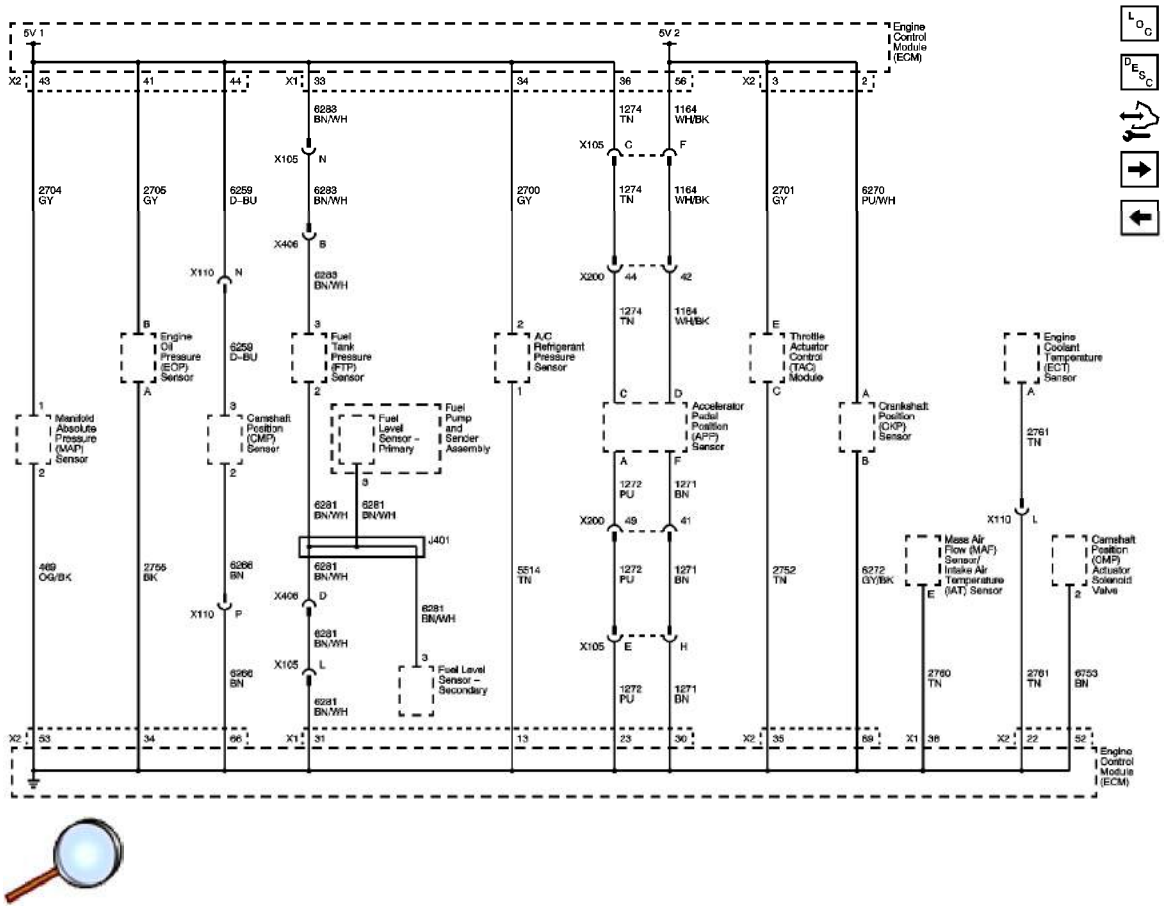
Engine Data Sensors - 5-Volt 1 and Low Reference (LZ4)



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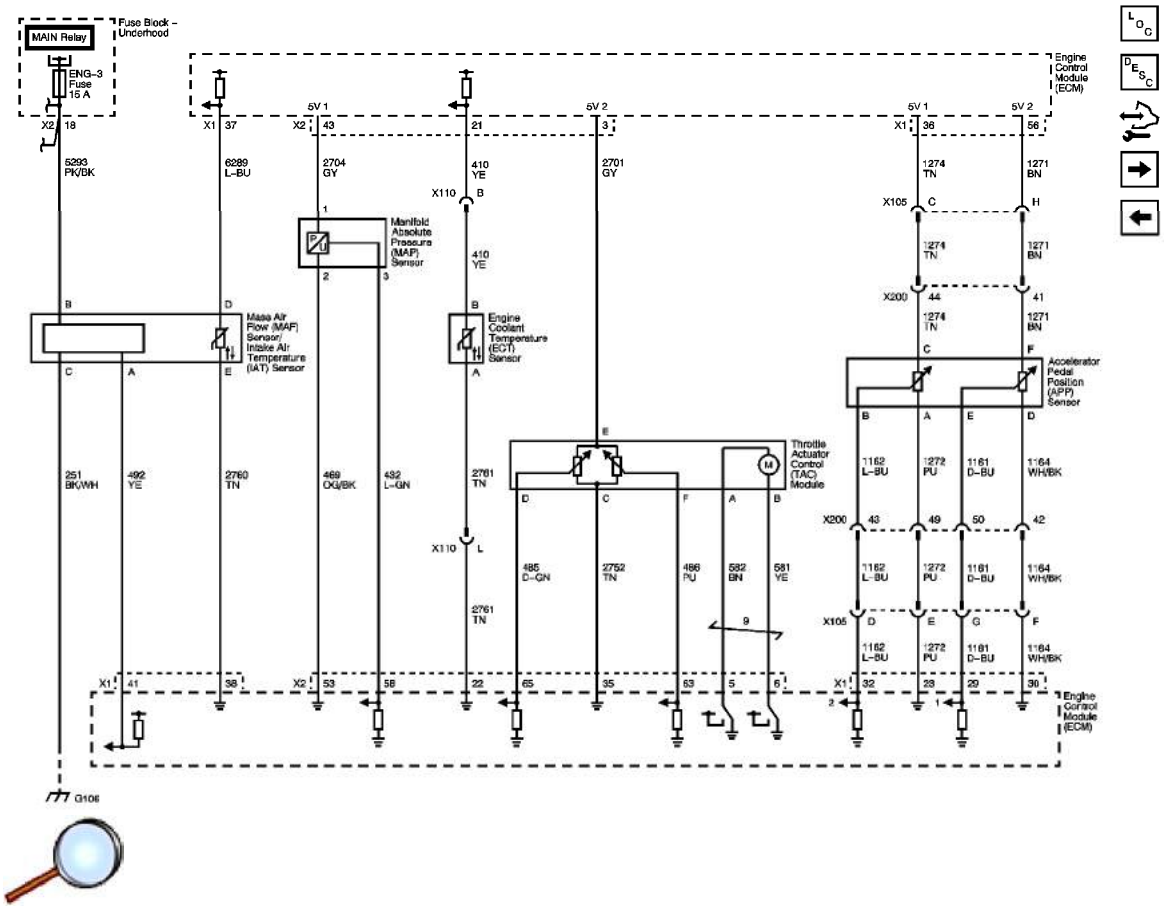
Engine Data Sensors - Pressure and Temperature (LZ4)



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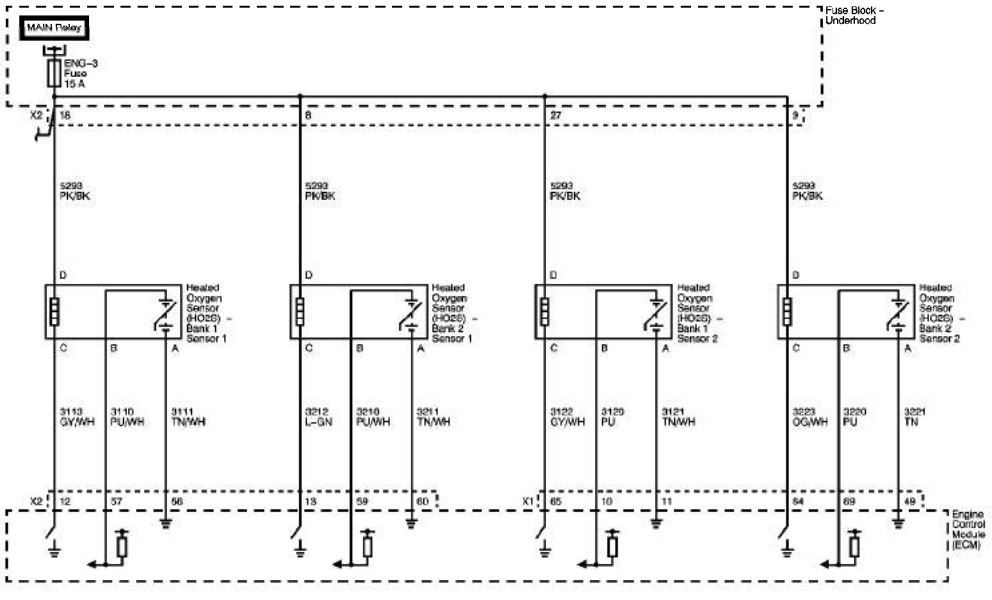
Engine Data Sensors - Heated Oxygen Sensors (HO2S) (LZ4)



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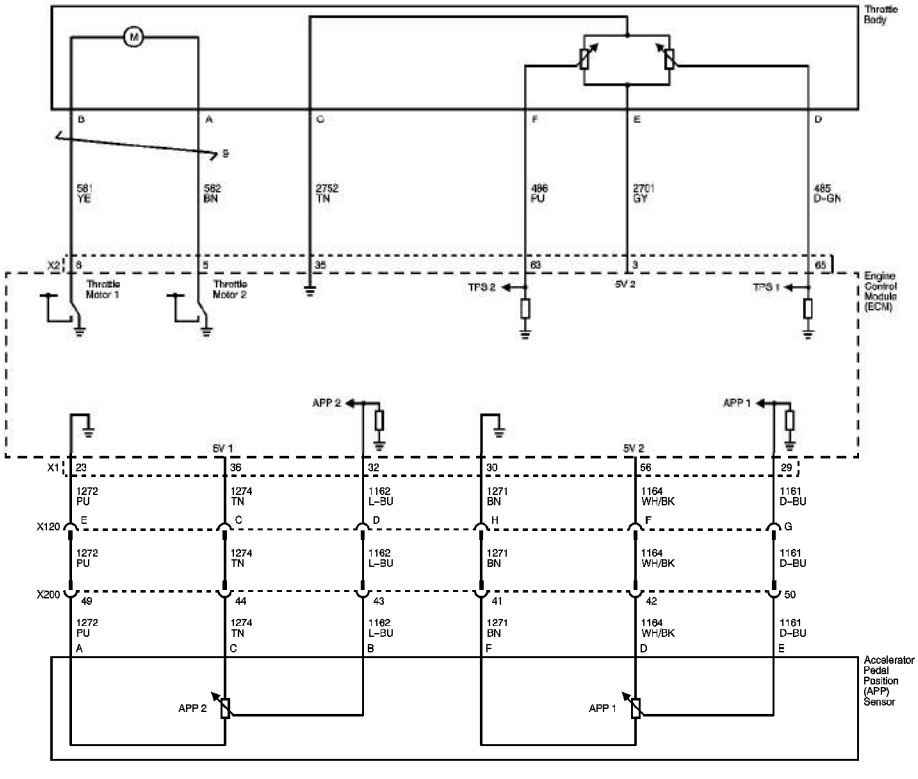
Engine Data Sensors - Throttle Actuator Controls (LZ4)



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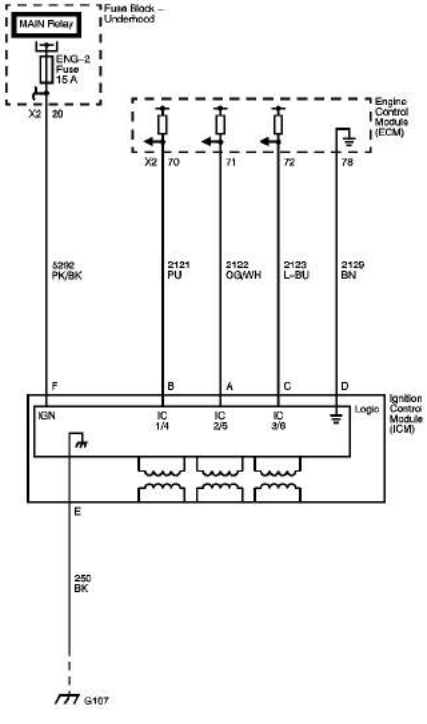
Ignition Controls - Ignition System (LZ4)



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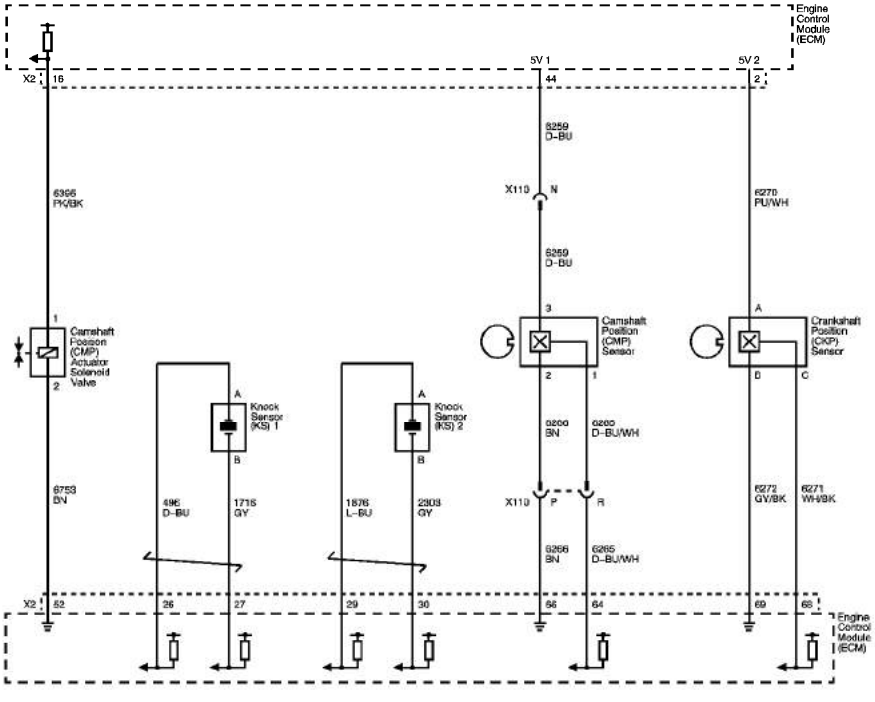
Ignition Controls - CKP and KS Sensors (LZ4)



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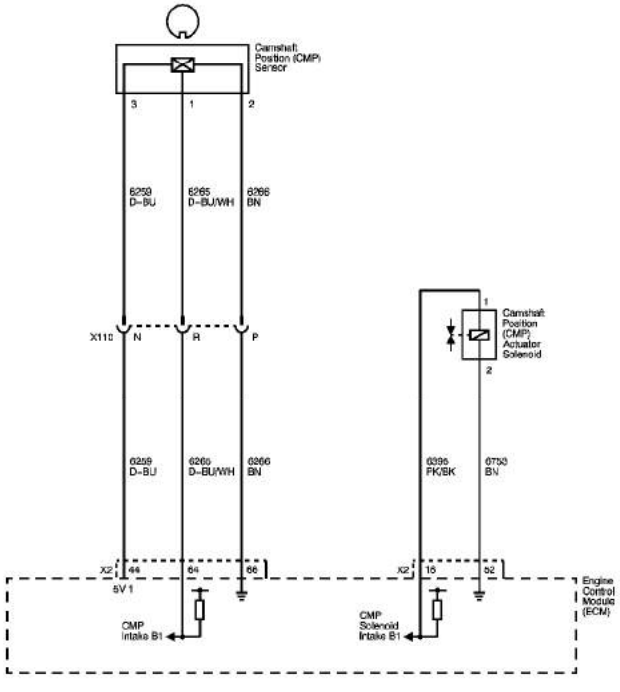
Ignition Controls - CMP Sensors and Actuator Solenoids (LZ4)



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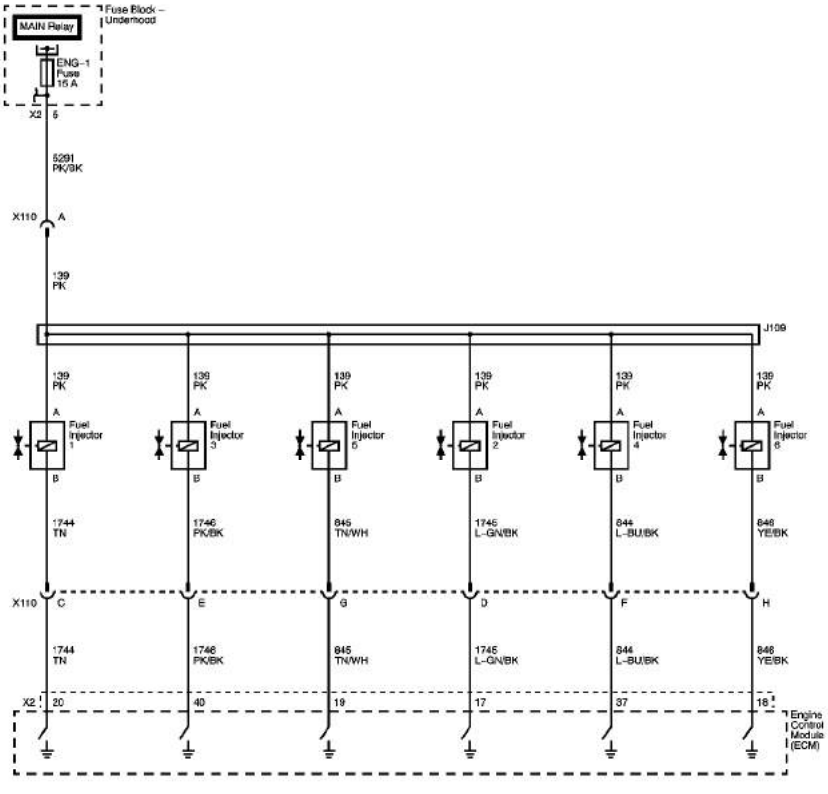
Fuel Controls - Fuel Injectors (LZ4)



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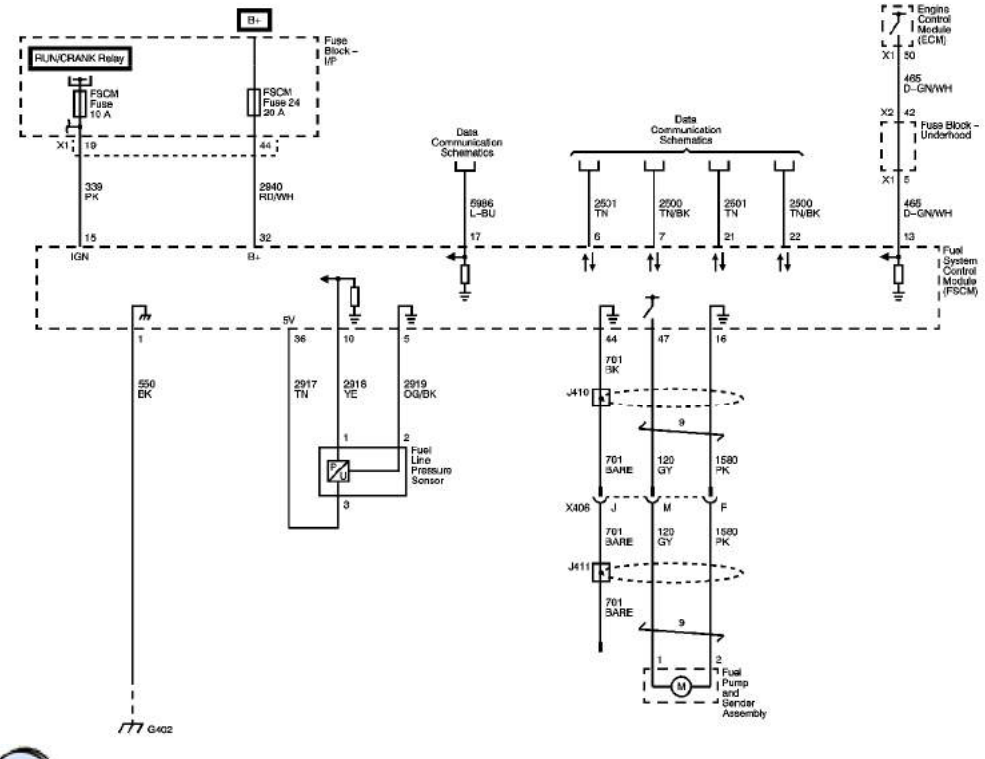
Fuel Controls - Fuel Pump Controls (LZ4)



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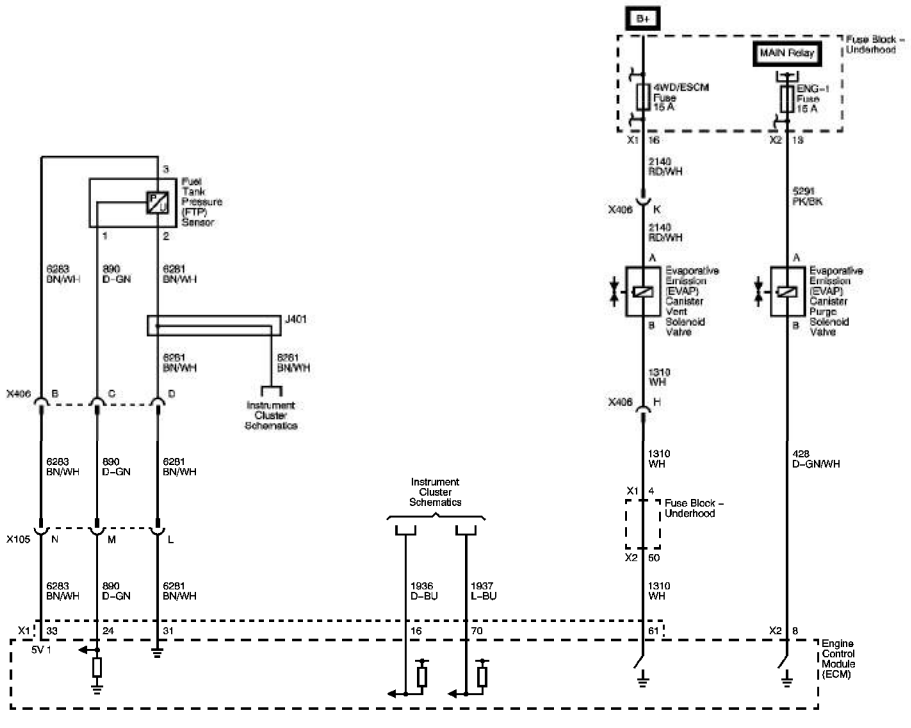
Fuel Controls - Evaporative Emissions (EVAP) Controls (LZ4)



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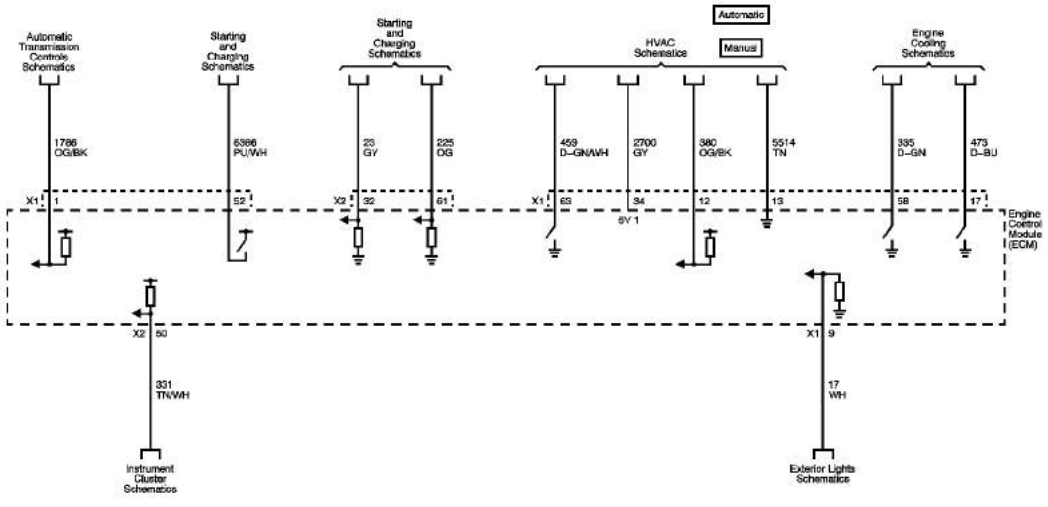
Controlled / Monitored Subsystem References (LZ4)



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Engine Control Module Replacement

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 no 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 programed 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.
- It is necessary to record the remaining automatic transmission fluid life. If the replacement module is not programed with the remaining automatic transmission fluid life, the automatic transmission fluid life will default to 100 percent. If the replacement module is not programmed with the remaining automatic transmission fluid life, the automatic transmission fluid will need to be changed at 83 000 km (50,000 mi) from the last automatic transmission fluid change.

Removal Procedure

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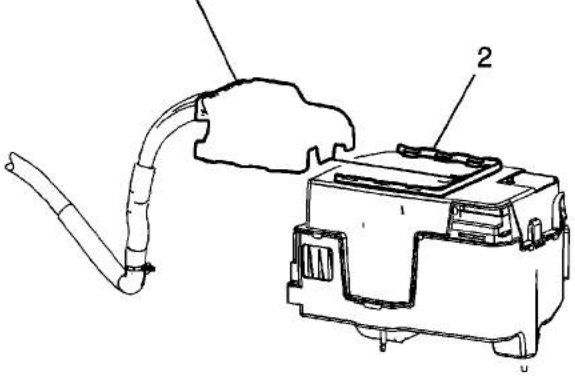
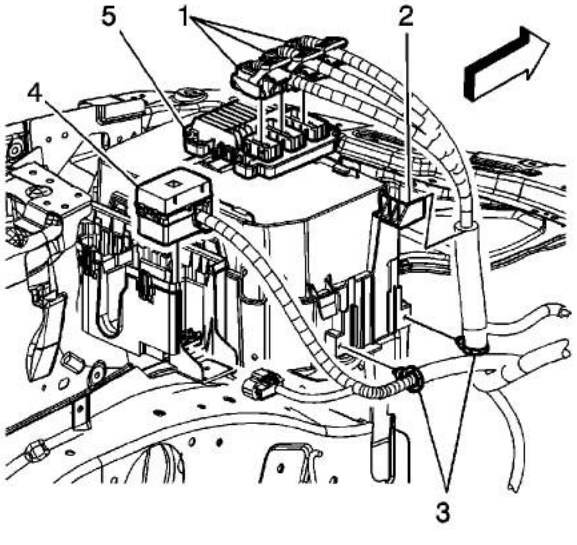


1. Using a scan tool, retrieve the percentage of remaining engine oil and the remaining automatic transmission fluid life. Record the remaining engine oil and the remaining automatic transmission fluid life.
2. Release the electronic control module (ECM) bracket (1) from the battery cover (2).



3. Release the retaining tabs on the ECM bracket and slide the ECM out of it.
4. Disconnect the engine wiring harness electrical connectors (1) from the ECM (5).

Installation Procedure

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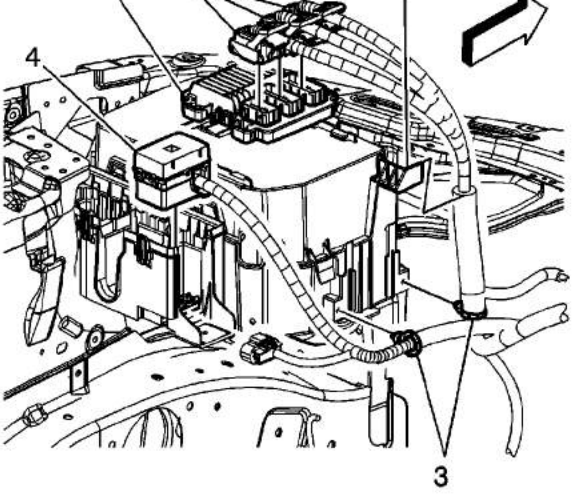
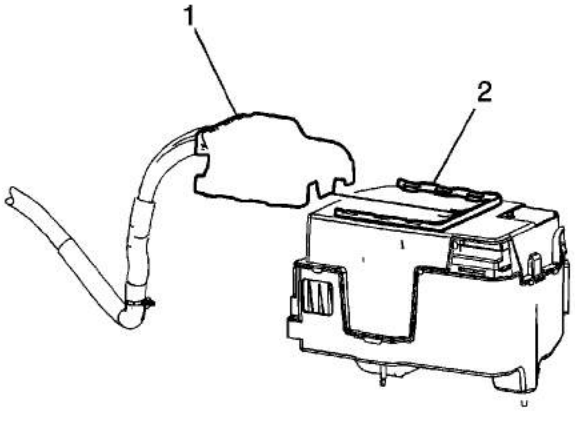


1. Connect the engine wiring harness electrical connectors (1) to the ECM (5).
2. Slide the ECM into the ECM bracket until it locks into place.



3. Install the ECM bracket (1) onto the air cleaner assembly cover (2) until it locks in place.
4. If replacing the ECM, program the ECM. Refer to Control Module References.

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Crankshaft Position System Variation Learn

Important: The Crankshaft Position (CKP) system variation learn procedure is also required when the following service procedures have been performed, regardless of whether DTC P0315 is set:

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

Important: The ECM monitors certain component signals to determine if all the conditions are met to continue with the CKP System Variation Learn Procedure. The scan tool only displays the condition that inhibits the procedure. The scan tool displays the signals of the following components:

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

1. Install a scan tool.
2. Monitor the 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. With a scan tool, select the CKP System Variation Learn Procedure and perform the following:
   3.1. Block drive wheels.
   3.2. Set parking brake.
   3.3. DO NOT apply brake pedal.
   3.4. Cycle ignition from OFF to ON.
   3.5. Apply and hold brake pedal for the duration of the procedure.
   3.6. Start and idle engine.
   3.7. Turn the air conditioning (A/C) OFF.
   3.8. The vehicle must remain in Park or Neutral.

   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.

   3.9. Accelerate to wide open throttle (WOT) and release when the fuel cut-off occurs.
4. 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, or another DTC is present, refer to Diagnostic Trouble Code (DTC) List - Vehicle and perform the appropriate diagnostic procedure.
5. Turn OFF the ignition for 30 seconds after the learn procedure is completed successfully in order to store the CKP system variation values in the ECM memory.

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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, with a scan tool, perform the Idle Learn Reset in Module Setup.

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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.

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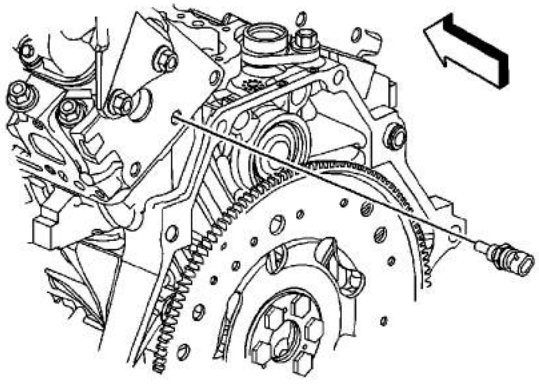
Engine Coolant Temperature Sensor Replacement

Removal Procedure

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

1. Drain the cooling system. Refer to Cooling System Draining and Filling.
2. Remove the intake manifold cover, if required. Refer to Intake Manifold Cover Replacement.
3. Disconnect the engine coolant temperature (ECT) sensor electrical connector.



4. Remove the ECT sensor.

Installation Procedure

Caution: Replacement components must be the correct part number for the application. Components requiring the use of the thread locking compound, lubricants, corrosion inhibitors, or sealants are identified in the service procedure. Some replacement components may come with these coatings already applied. Do not use these coatings on components unless specified. These coatings can affect the final torque, which may affect the operation of the component. Use the correct torque specification when installing components in order to avoid damage.

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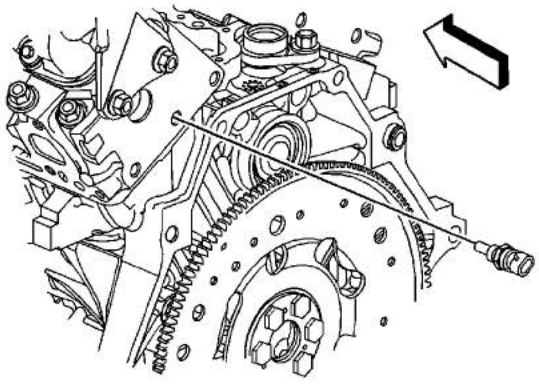

1. Coat the threads of the ECT sensor with sealer GM P/N 13246004 (Canadian P/N 10953480) or equivalent.

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the ECT sensor.

   Tighten
   Tighten the ECT sensor to 20 N·m (15 lb ft).

3. Connect the ECT electrical connector.
4. Install the intake manifold cover, if required. Refer to Intake Manifold Cover Replacement.
5. Fill the cooling system. Refer to Cooling System Draining and Filling.

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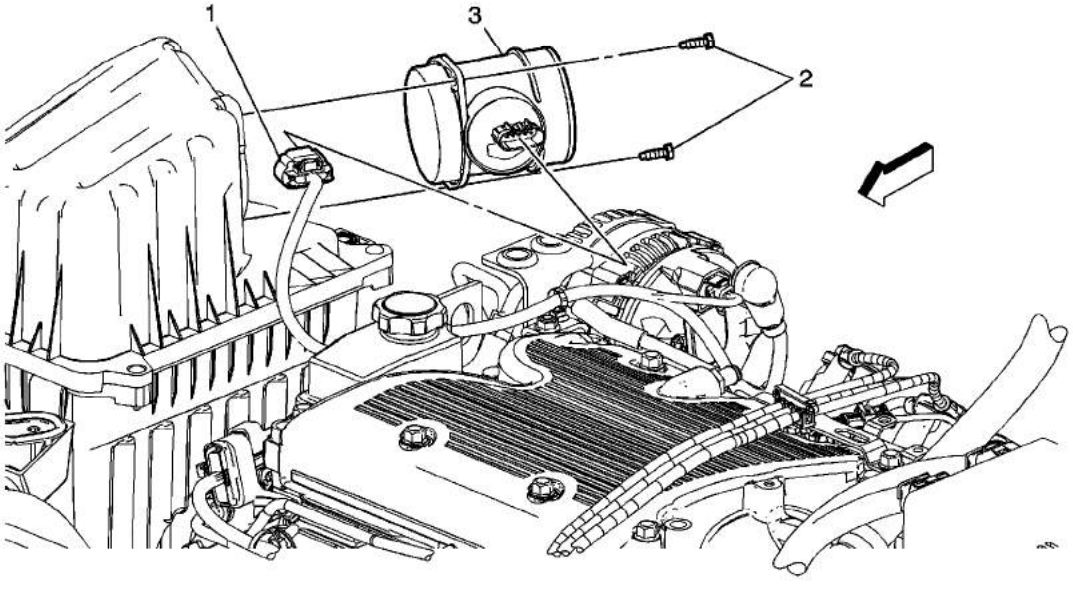
Mass Airflow Sensor with Intake Air Temperature Sensor Replacement



Callout	Component Name
Preliminary Procedure Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.	
1	Mass Airflow Sensor/Intake Air Temperature Sensor Electrical Connector
2	Mass Airflow Sensor/Intake Air Temperature Sensor Bolt (Qty: 2) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 4 N·m (34 lb in)
3	Mass Airflow Sensor/Intake Air Temperature Sensor

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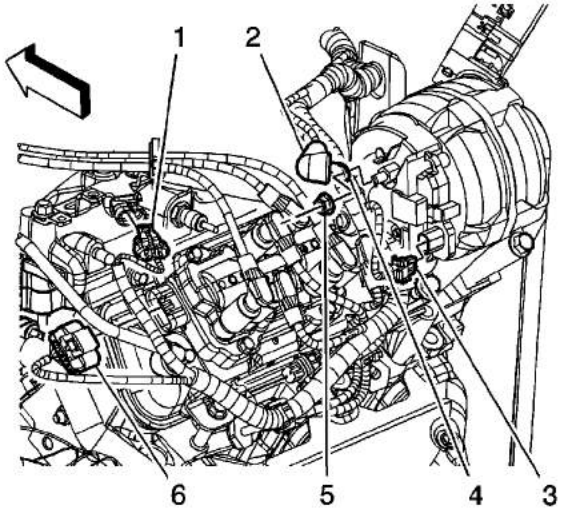
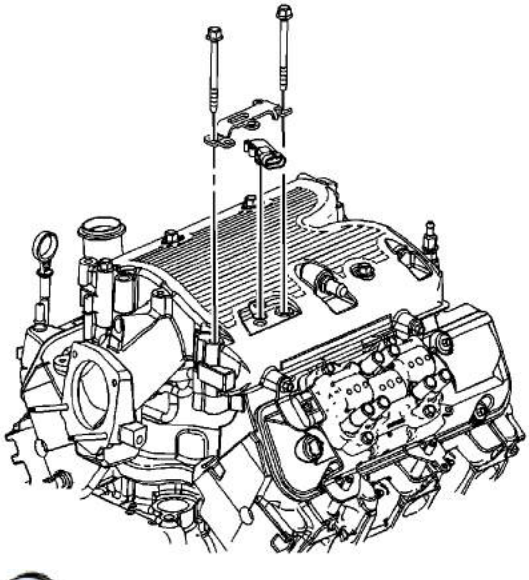
Manifold Absolute Pressure Sensor Replacement

Removal Procedure

1. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.



2. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).
3. Remove the spark plug wire clip from the intake manifold bracket.



4. Remove the upper intake manifold bolts.
5. Remove the MAP sensor and bracket.
6. Remove the MAP sensor seal from the upper intake manifold.

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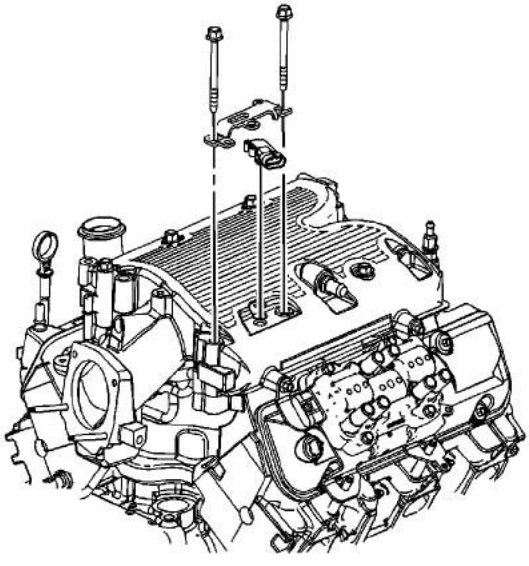
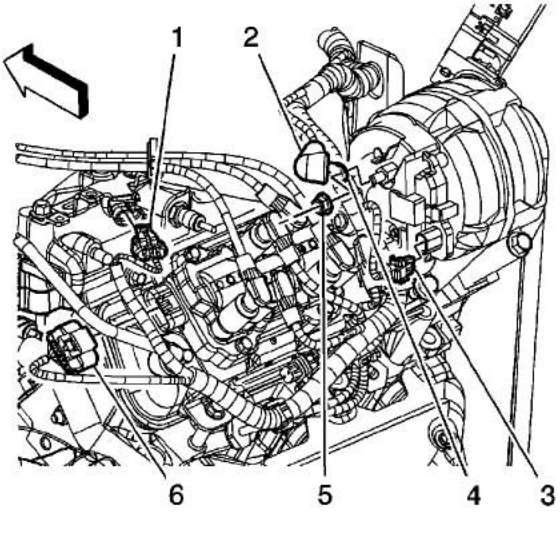


1. Install the MAP sensor seal into the upper intake manifold.
2. Install the MAP sensor and bracket.

Caution: Refer to Fastener Caution in the Preface section.

3. Install the upper intake manifold bolts.

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



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4. Install the spark plug wire clip to the intake manifold bracket.
5. Connect the MAP sensor electrical connector (1).
6. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.

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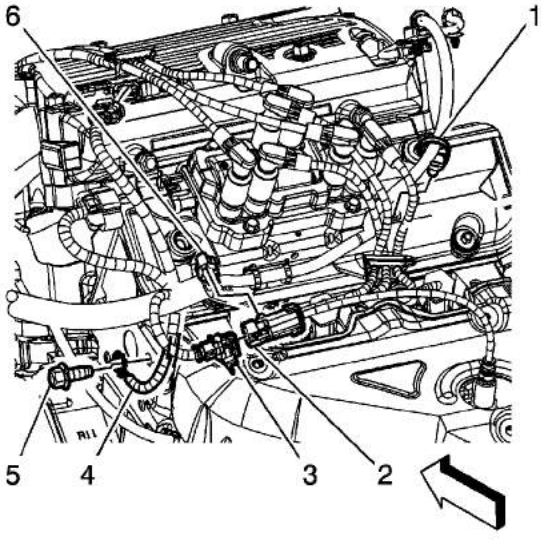
Heated Oxygen Sensor Replacement - Bank 1 Sensor 1

Special Tools

J 39194-B Heated Oxygen Sensor Wrench

Removal Procedure

Caution: Refer to Heated Oxygen Sensor Resistance Learn Reset Caution in the Preface section.



1. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
2. Remove the connector position assurance (CPA) retainer.
3. Disconnect the engine wiring harness electrical connector (3) from the heated oxygen sensor (HO2S) electrical connector (2).
4. Remove the HO2S electrical connector rosebud clip from the engine wiring harness retaining strap (6).

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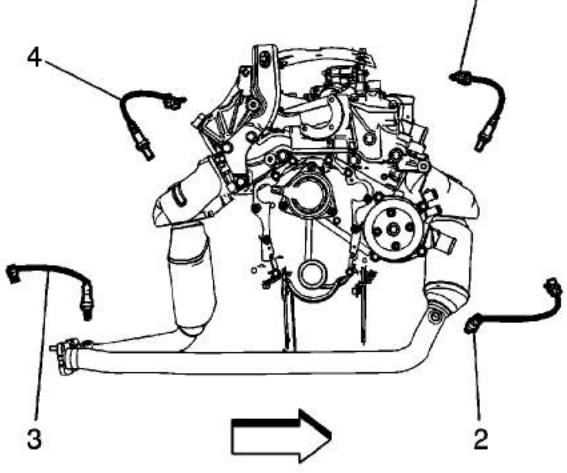
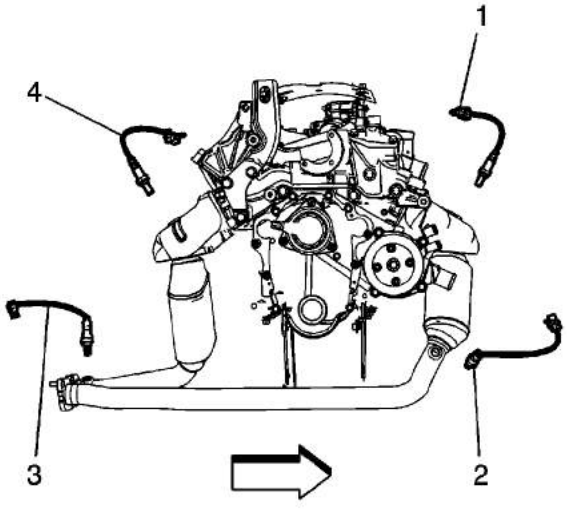


Caution: The oxygen sensor may be difficult to remove when the engine temperature is below 48°C (120°F). Excessive force may damage threads in the exhaust manifold or the exhaust pipe.

5. Remove the HO2S (4). Use the J 39194-B , if necessary.

Installation Procedure



Note: A special anti-seize compound is used on the HO2S threads. The compound consists of

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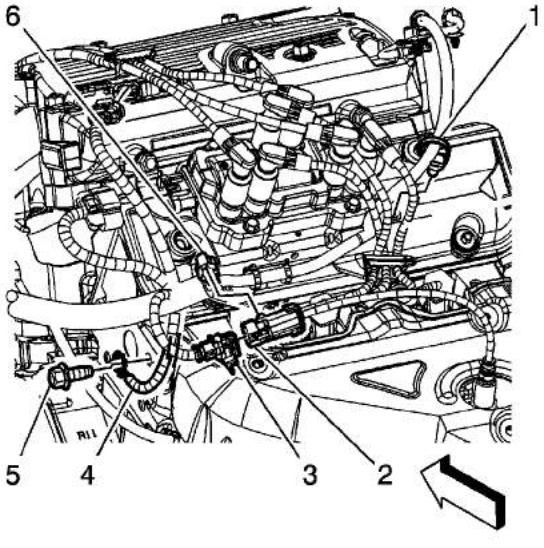
the compound applied to the threads. If a sensor is removed from an engine and is to be reinstalled, the threads must have anti-seize compound applied before the reinstallation.

1. Coat the threads of the HO2S with anti-seize compound GM P/N 12377953 or equivalent, if necessary.

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the HO2S (4). Use the J 39194-B , if necessary.

   Tighten
   Tighten the sensor to 42 N·m (31 lb ft).



3. Connect the engine wiring harness electrical connector (3) to the HO2S electrical connector (2).
4. Install the CPA retainer.
5. Install the HO2S electrical connector rosebud clip to the engine wiring harness retaining strap (6).
6. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.

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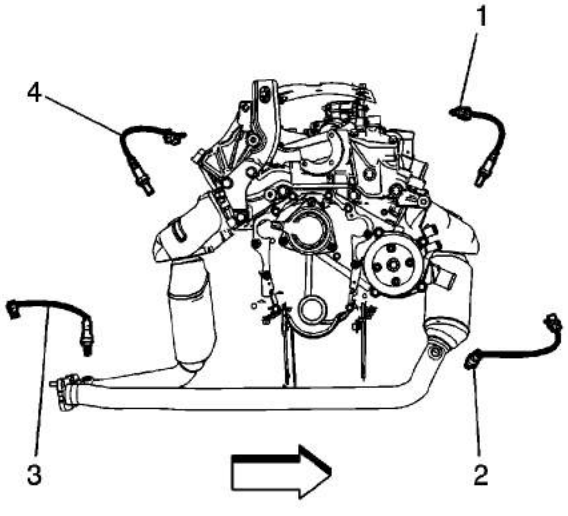
Heated Oxygen Sensor Replacement - Bank 1 Sensor 2

Special Tools

J 39194-B Heated Oxygen Sensor Wrench

Removal Procedure

Caution: Refer to Heated Oxygen Sensor Resistance Learn Reset Caution in the Preface section.



Caution: The oxygen sensor may be difficult to remove when the engine temperature is below 48°C (120°F). Excessive force may damage threads in the exhaust manifold or the exhaust pipe.

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Remove the connector position assurance (CPA) retainer.
3. Disconnect the heated oxygen sensor (HO2S) electrical connector from the engine wiring harness electrical connector.
4. Remove the HO2S (3). Use the J 39194-B , if necessary.

Installation Procedure

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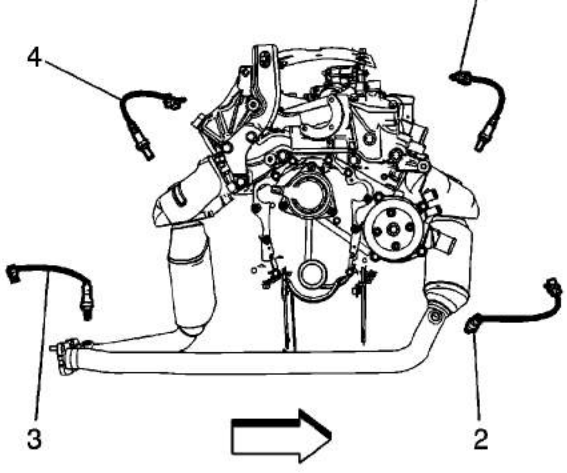

Note: A special anti-seize compound is used on the HO2S 2 threads. The compound consists of graphite suspended in fluid and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove. New or service sensors will already have the compound applied to the threads. If a sensor is removed from an engine and is to be reinstalled, the threads must have anti-seize compound applied before reinstallation.

1. Coat the threads of the HO2S with anti-seize compound GM P/N 12377953 or equivalent, if necessary.

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the HO2S (3). Use the J 39194-B , if necessary.

   Tighten
   Tighten the sensor to 42 N·m (31 lb ft).

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

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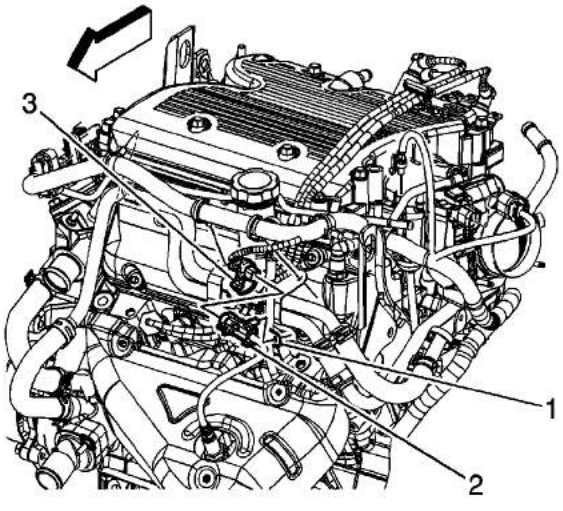
Heated Oxygen Sensor Replacement - Bank 2 Sensor 1

Special Tools

J 39194-B Heated Oxygen Sensor Wrench

Removal Procedure

Caution: Refer to Heated Oxygen Sensor Resistance Learn Reset Caution in the Preface section.



1. Remove the intake manifold cover, if necessary. Refer to Intake Manifold Cover Replacement.
2. Remove the connector position assurance (CPA) retainer.
3. Disconnect the engine wiring harness electrical connector (3) from the heated oxygen sensor (HO2S) electrical connector (2).
4. Remove the HO2S rosebud clip from the oil level indicator tube tab (1).

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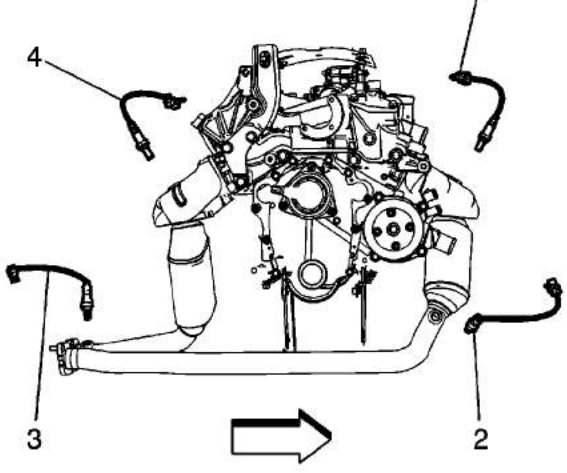
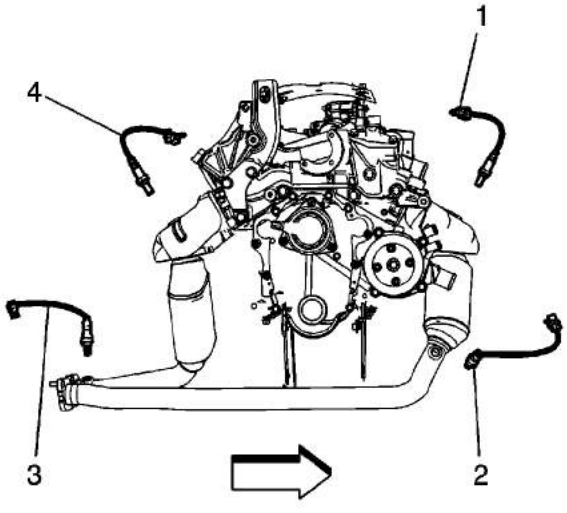


Caution: The oxygen sensor may be difficult to remove when the engine temperature is below 48°C (120°F). Excessive force may damage threads in the exhaust manifold or the exhaust pipe.

5. Remove the HO2S (1). Use the J 39194-B , if necessary.

Installation Procedure



Note: A special anti-seize compound is used on the HO2S 1 threads. The compound consists

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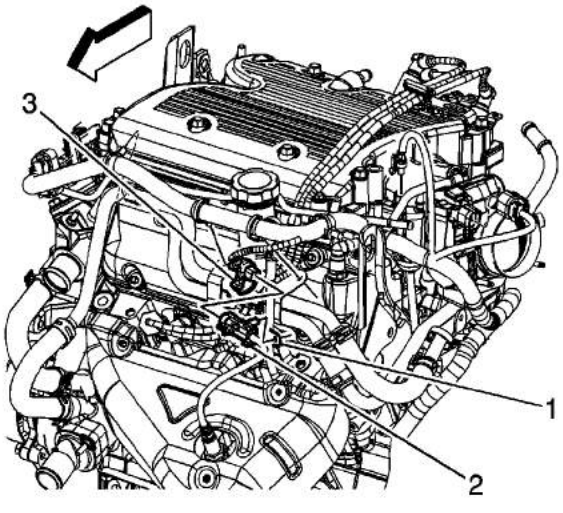
have the compound applied to the threads. If a sensor is removed from an engine and is to be reinstalled, the threads must have anti-seize compound applied before the reinstallation.

1. Coat the threads of the HO2S with anti-seize compound GM P/N 12377953 or equivalent, if necessary.

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the HO2S (1). Use the J 39194-B , if necessary.

   Tighten
   Tighten the sensor to 42 N·m (31 lb ft).



3. Connect the engine wiring harness electrical connector (3) to the HO2S electrical connector (2).
4. Install the CPA retainer.
5. Install the HO2S rosebud clip to the oil level indicator tube tab (1).

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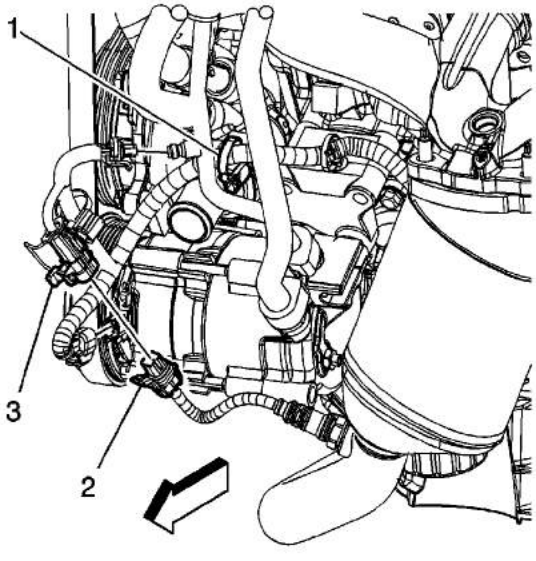
Heated Oxygen Sensor Replacement - Bank 2 Sensor 2

Special Tools

J 39194-B Heated Oxygen Sensor Wrench

Removal Procedure

Caution: Refer to Heated Oxygen Sensor Resistance Learn Reset Caution in the Preface section.



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

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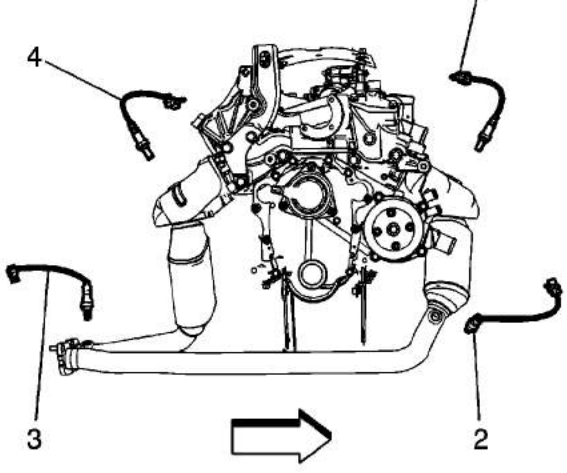
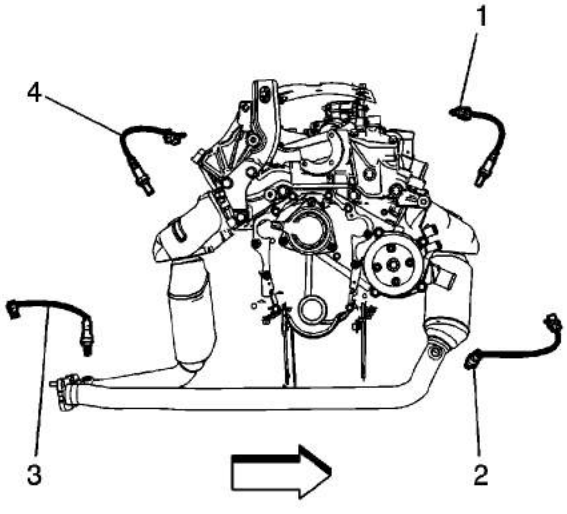


Caution: The oxygen sensor may be difficult to remove when the engine temperature is below 48°C (120°F). Excessive force may damage threads in the exhaust manifold or the exhaust pipe.

4. Remove the HO2S (2). Use the J 39194-B , if necessary.

Installation Procedure



Note: A special anti-seize compound is used on the HO2S 2 threads. The compound consists

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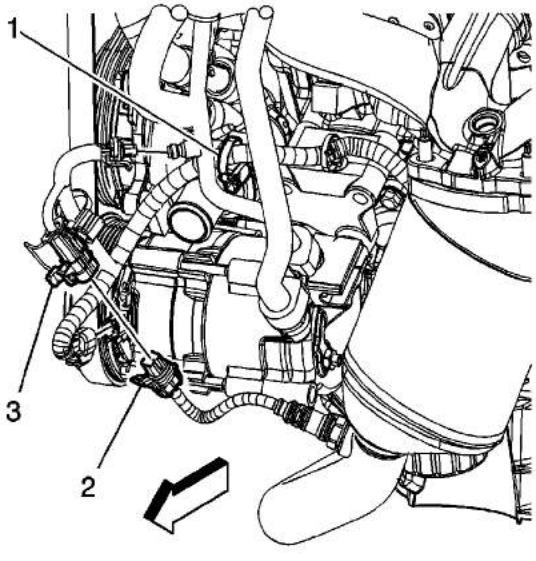
have the compound applied to the threads. If a sensor is removed from an engine and is to be reinstalled, the threads must have anti-seize compound applied before reinstallation.

1. Coat the threads of the HO2S with anti-seize compound GM P/N 12377953 or equivalent, if necessary.

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the HO2S (2). Use the J 39194-B , if necessary.

   Tighten
   Tighten the sensor to 42 N·m (31 lb ft).



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

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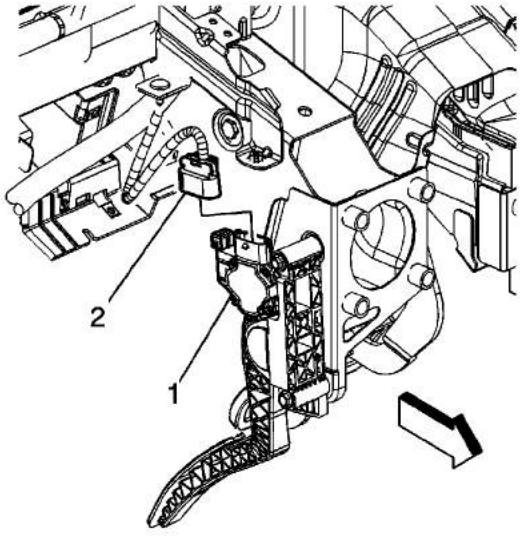
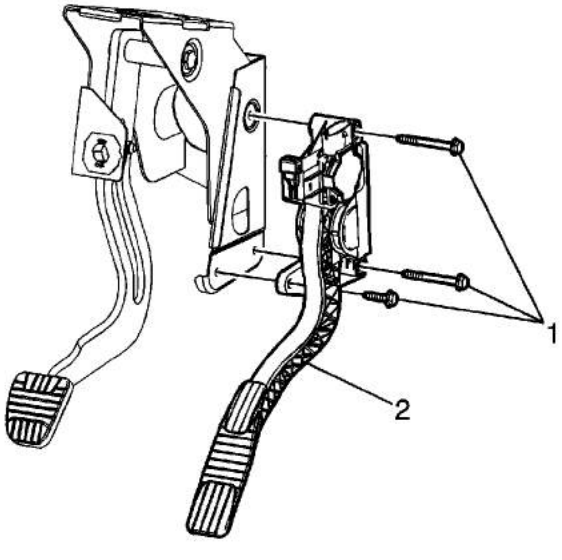
Accelerator Pedal Position Sensor Replacement

Removal Procedure



1. Remove the driver knee bolster reinforcement. Refer to Driver Knee Bolster Reinforcement Replacement.
2. Disconnect the instrument panel wiring harness electrical connector (2) from the accelerator pedal position (APP) sensor (1).



3. Remove the APP sensor bolts (1).

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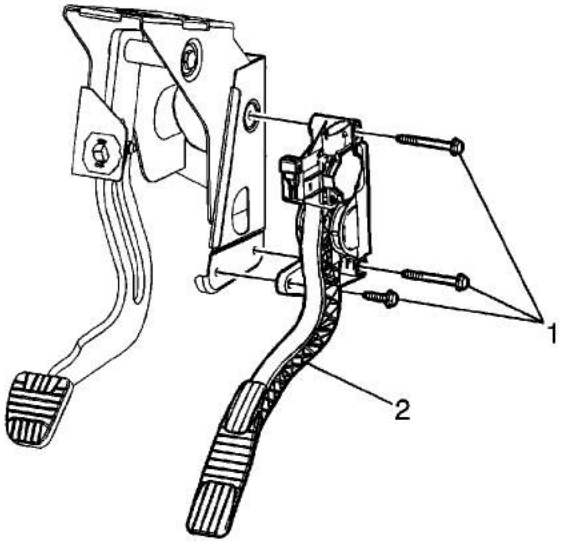
Installation Procedure

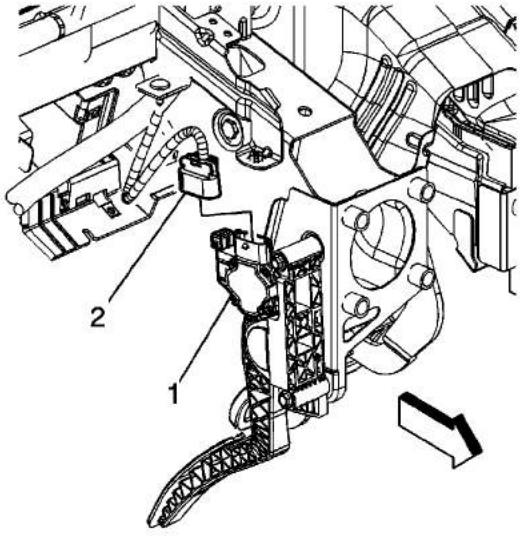


1. Position the APP sensor (2) against the brake pedal assembly.

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the APP sensor bolts (1).

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



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3. Connect the instrument panel wiring harness electrical connector (2) to the APP sensor (1).
4. Install the driver knee bolster reinforcement. Refer to Driver Knee Bolster Reinforcement Replacement.

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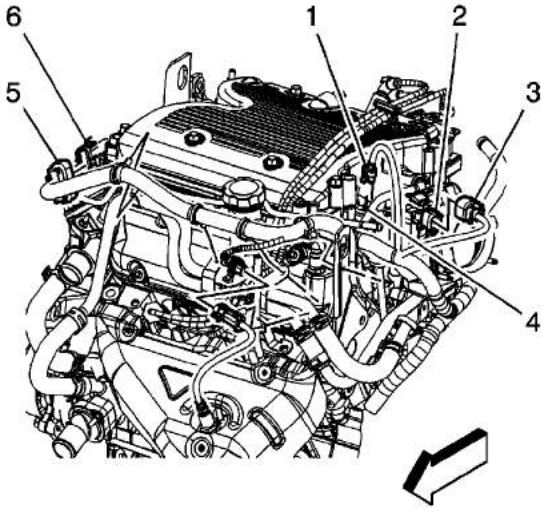
Throttle Body Assembly Replacement

Removal Procedure

Caution: Do not use solvent of any type when cleaning the gasket surfaces on the intake manifold and the throttle body assembly, as damage to the gasket surfaces and throttle body assembly may result.

Use care in cleaning the gasket surfaces on the intake manifold and the throttle body assembly, as sharp tools may damage the gasket surfaces.



1. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
2. Disconnect the engine wiring harness electrical connector (3) from the electronic throttle control (ETC) (2).

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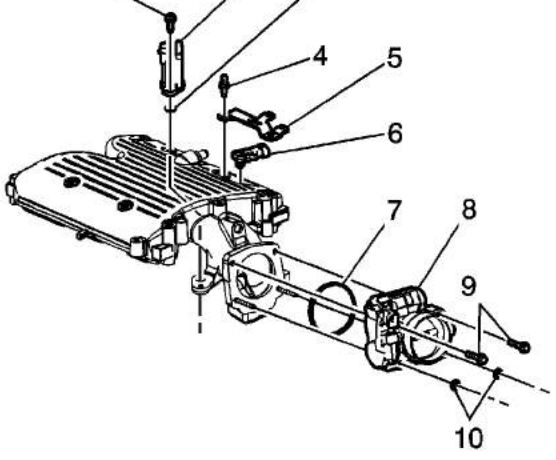
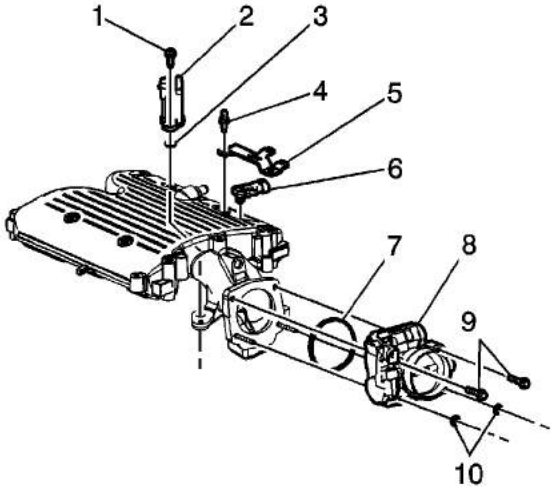


3. Remove the throttle body bolts (9) and nuts (10).
4. Remove the throttle body (8).
5. Remove and discard the throttle body gasket (7).

Installation Procedure



1. Install a NEW throttle body gasket (7).
2. Install the throttle body (8).

Caution: Refer to Fastener Caution in the Preface section.

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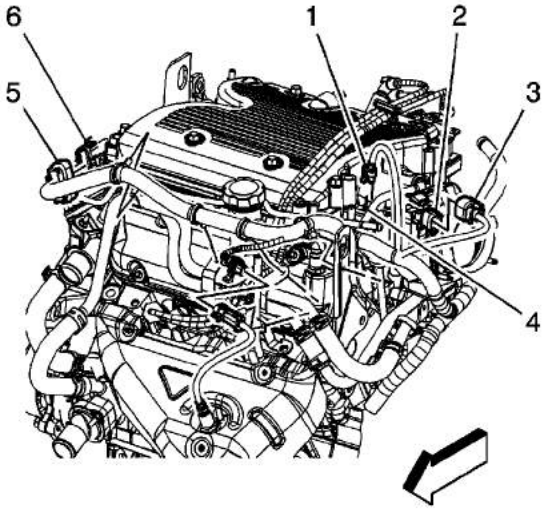
Tighten
Tighten the bolts/nuts to 10 N·m (89 lb in).



4. Connect the engine wiring harness electrical connector (3) to the ETC (2).
5. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
6. Perform the throttle learn procedure. Refer to Throttle Learn.

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Throttle Body Cleaning

1. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct 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 the throttle plate for deposits. You will 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 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 Duct Replacement.
5. Perform the Throttle Learn Procedure. Refer to Throttle Learn.

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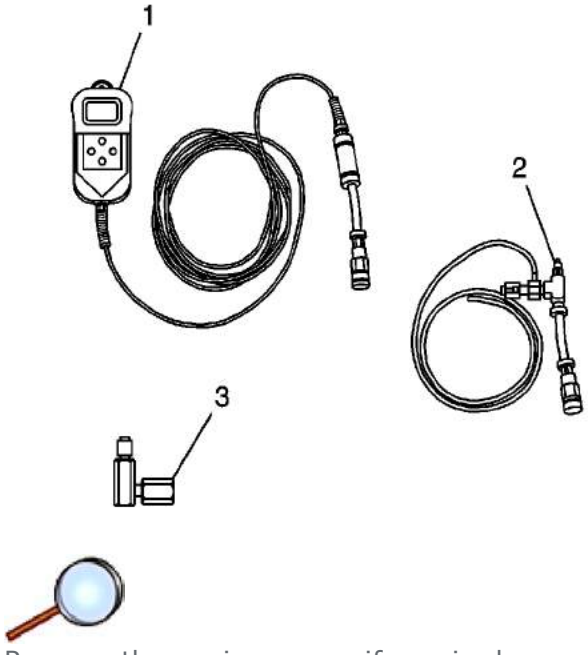
Fuel Pressure Relief (With CH 48027-100)

Special Tools

CH-48027-100 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. Remove the engine cover, if required.
2. Loosen the fuel fill cap in order to relieve the fuel tank vapor pressure.
3. 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.

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

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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.

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

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Fuel Pressure Relief (Without CH 48027-100)

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. Loosen the fuel fill cap in order to relieve the fuel tank vapor pressure.
2. Remove the engine cover, if required.
3. Remove the fuel rail service port cap.
4. 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.
5. Remove the shop towel from around the fuel rail service port, and place in an approved gasoline container.
6. Install the fuel rail service port cap.
7. Install the engine cover, if required.
8. Tighten the fuel fill cap.

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Fuel Pressure Gage Installation and Removal

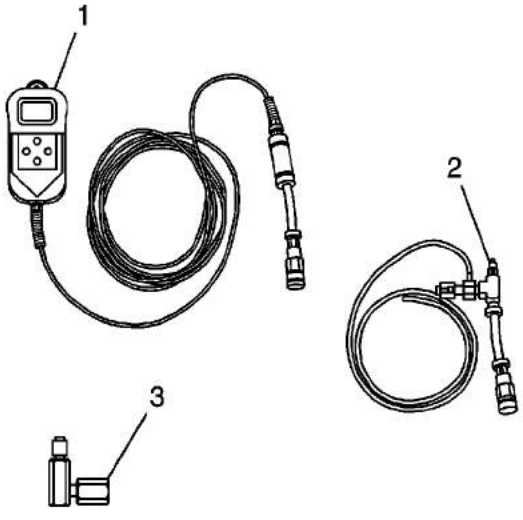
Special Tools

CH-48027-100 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-48027-100 , refer to the manufacture's directions.

Removal Procedure

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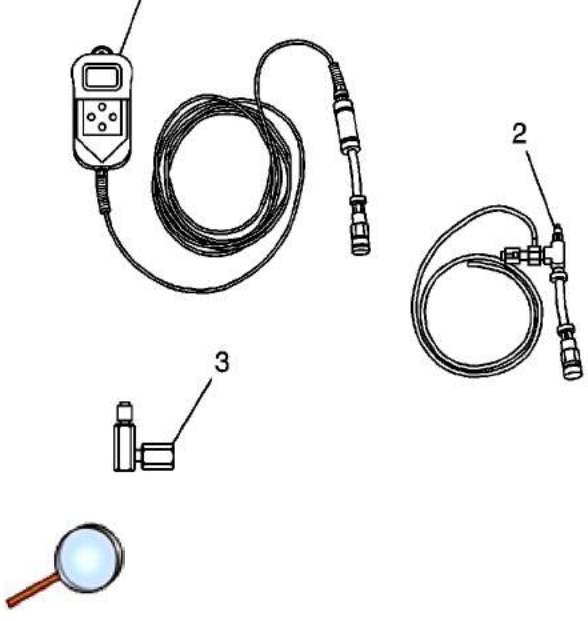

Warning: Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gage. Place the towel in an approved container when the connection of the fuel pressure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

1. Relieve the fuel system pressure, if required. Perform the following steps:
   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 (3).
4. Disconnect the CH-48027-3 (3) 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.

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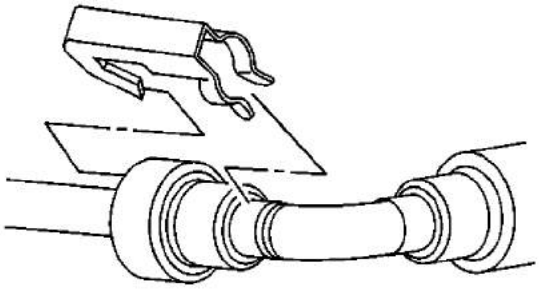
Metal Collar Quick Connect Fitting Service

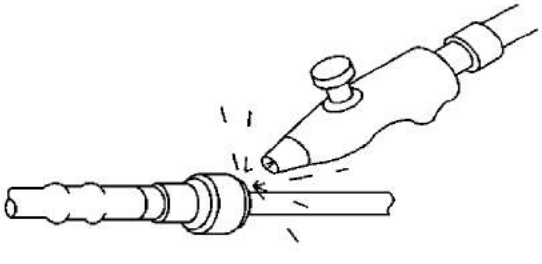
Special Tool

J 37088-A Fuel Line Disconnect Tool Set

Removal Procedure



1. Relieve the fuel system pressure before servicing any fuel system connection. Refer to the Metal Collar Quick Connect Fitting Service.
2. Remove the retainer from the quick-connect fitting.



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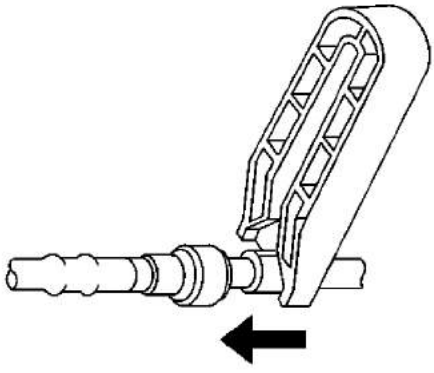
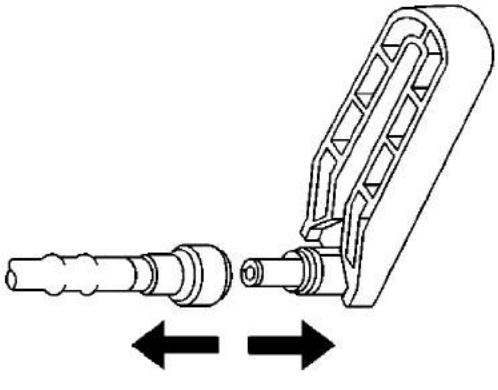
Warning: Wear safety glasses when using compressed air, as flying dirt particles may cause eye injury.

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



4. Choose the correct tool from the J 37088-A for the size of the fitting. Insert the tool into the female connector, then push inward in order to release the locking tabs.



5. Pull the connection apart.

Caution: If necessary, remove rust or burrs from the fuel pipes with an emery cloth. Use a

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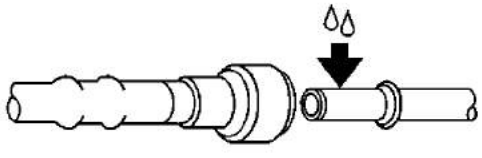
for dirt and burrs. Clean or replace the components and assemblies as required.

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

Installation Procedure



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

This will ensure proper reconnection and prevent a possible fuel leak.

During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.

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

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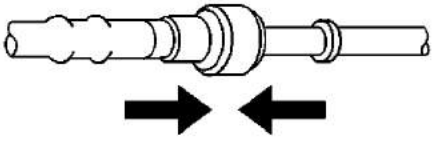
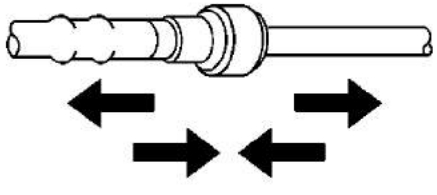


2. Push both sides of the fitting together in order to snap the retaining tabs into place.



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

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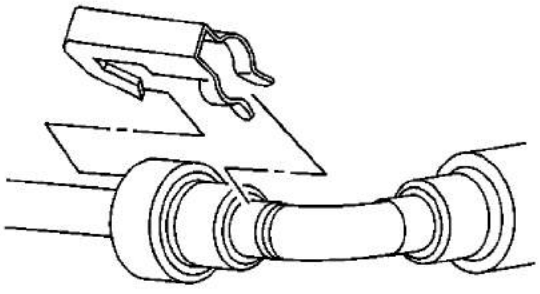

4. Install the retainer to the quick-connect fitting.

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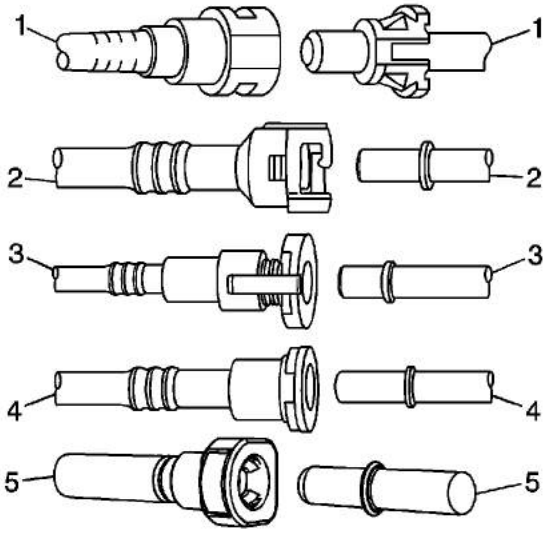
Plastic Collar Quick Connect Fitting Service

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 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.

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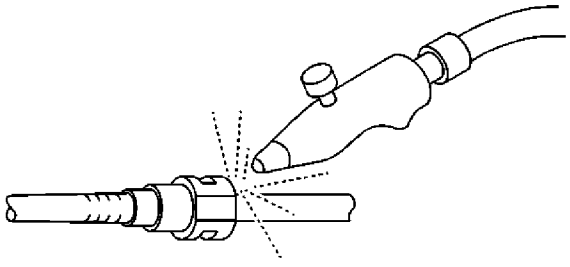
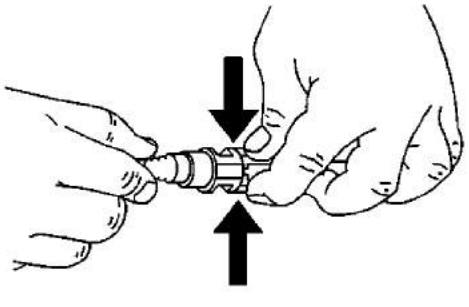


2. Using compressed air, blow any dirt or debris from around the connection.



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

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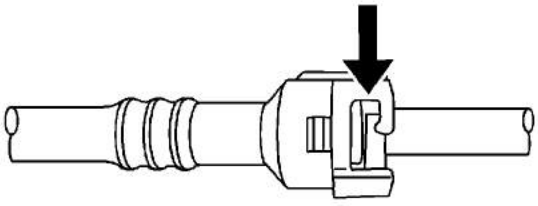
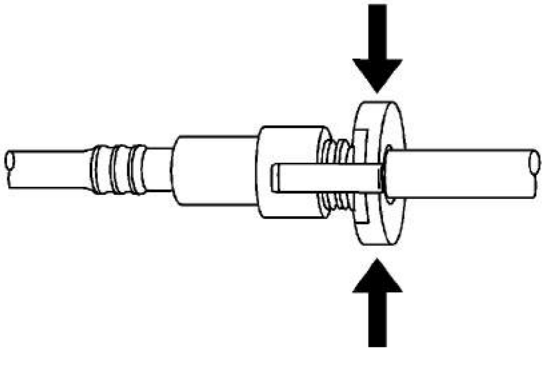


4. This step applies to Release Tab style connectors ONLY. Release the fitting by pushing the tab toward the other side of the slot in the fitting.



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

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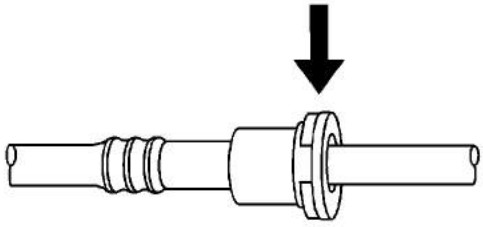
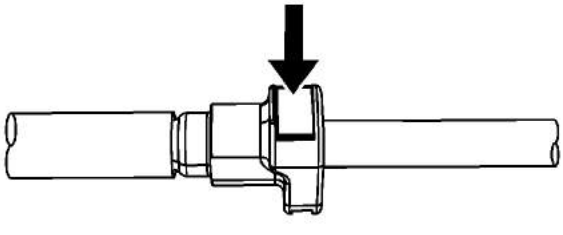


6. This step applies to the Sliding Retainer style connector ONLY. Release the fitting be pressing on one side of the release tab causing it to push in slightly. If the tab doesn't move try pressing the tab in from the opposite side. The tab will only move in one direction.



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

Warning: Refer to Relieving Fuel Pressure Warning in the Preface section.

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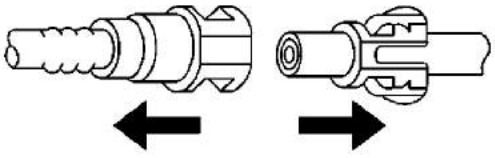
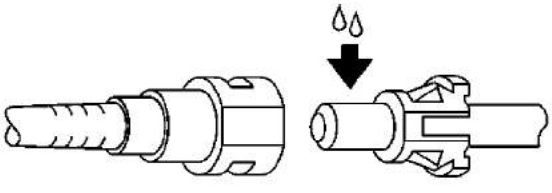


8. Pull the connection apart.
9. Wipe off the male pipe end using a clean shop towel.
10. Inspect both ends of the fitting for dirt and burrs.
11. Clean or replace the components as required.

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.

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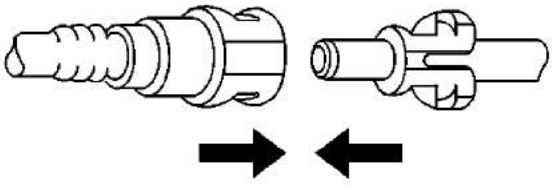
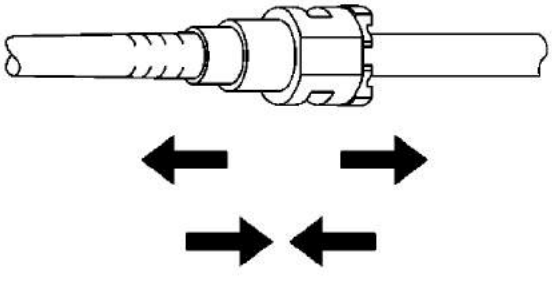


2. Push both sides of the quick-connect fitting together in order to cause the retaining feature to snap into place.



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

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Fuel Tank Draining

Special Tools

- SA9127E-7 Fuel Pressure/Flow Adapter
- SA9804E Fuel Tank Drain Hose

For any operation requiring removal of the fuel tank, there should be no more than 11.4 L (3 gal) of fuel remaining. This minimizes the weight of the fuel tank assembly and eases handling. The fuel level can be determined by reading the fuel level gage. A reading below 1/4 full indicates that no more than 11.4 L (3 gal) are remaining.

Using The Fuel Pump

Warning: Do not allow smoking or the use of open flames in the area where work on the fuel or EVAP system is taking place. Anytime work is being done on the fuel system, disconnect the negative battery cable, except for those tests where battery voltage is required.

Warning: Never drain or store fuel in an open container due to the possibility of fire or explosion.

Using the fuel pump to drain the tank is the easiest procedure if the fuel pump is operable. The fuel can be pumped out with the vehicle on the ground or on a hoist.

On The Ground

Warning: Fuel supply lines will remain pressurized for long periods of time after the engine is shutdown. This pressure must be relieved before servicing the fuel system.

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

   Warning: Whenever fuel line fittings are loosened or removed, wrap a shop cloth around the fitting and have an approved container available to collect any fuel.

2. Disconnect the fuel feed quick connect fitting from the fuel rail. Refer Metal Collar Quick Connect Fitting Service.
3. Install the 3/8 in. x 1/4 in fitting from the SA9127E-7 into the fuel feed quick connect fitting.
4. Connect a suitable drain hose to the other end of the adapter and connect the drain hose to a certified fuel handling cart.
5. Connect a scan tool to the vehicle diagnostic connector and turn the ignition ON.
6. Energize the fuel pump using the scan tool.
7. Pump out the fuel until no more than 1/4 tank of fuel remains.

On The Hoist

Warning: Fuel supply lines will remain pressurized for long periods of time after the engine is shutdown. This pressure must be relieved before servicing the fuel system.

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Warning: Ensure that the vehicle is properly supported and squarely positioned. To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle on the opposite end from which the components are being removed.

3. Raise the vehicle on a hoist to a comfortable working height, keeping the scan tool outside of the vehicle and accessible from under the car.

   Warning: Whenever fuel line fittings are loosened or removed, wrap a shop cloth around the fitting and have an approved container available to collect any fuel.

4. Disconnect the fuel tank fuel feed line quick connect fitting from the chassis fuel feed pipe. Refer Plastic Collar Quick Connect Fitting Service.
5. Install the 3/8 in. x 1/4 in fitting from the SA9127E-7 into the fuel feed quick connect fitting.
6. Connect a suitable drain hose to the other end of the adapter and connect the drain hose to a certified fuel handling cart.
7. Energize the fuel pump using the scan tool.
8. Pump out the fuel until no more than 1/4 tank of fuel remains.

Siphoning The Fuel Tank

Warning: Do not allow smoking or the use of open flames in the area where work on the fuel or EVAP system is taking place. Anytime work is being done on the fuel system, disconnect the negative battery cable, except for those tests where battery voltage is required.

If the fuel pump is inoperative, the tank can be drained by siphoning from the tank. A suitable means is through the fuel fill pipe with the correct type and stiffness of tubing as used with the SA9804E .

Warning: Do not allow smoking or the use of open flames in the area where work on the fuel or EVAP system is taking place. Anytime work is being done on the fuel system, disconnect the negative battery cable, except for those tests where battery voltage is required.

1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
2. Open the fuel fill door and remove the gas cap.

   Caution: Do not attempt to insert any other type of siphon hose or tube into the fuel filler pipe. The design of the inlet check valve at the end of the fuel filler tube restricts the insertion of a hose and, most importantly, prevents the removal of this hose. See Fuel Inlet Check Valve in this section. If the siphon hose becomes stuck in the check valve, the fuel filler pipe will not be able to be removed from the fuel tank without damage to the fill pipe or fuel tank.

3. Insert the siphon hose guide/funnel into the fuel fill pipe opening.

   Note: The siphon hose will reach the bottom of the tank on the primary side only, within about 25.4 cm (10 in) of the end fitting and tag. When connecting the siphon hose to another length of hose that is connected to the drain tank, DO NOT insert the siphon hose into the fill pipe funnel past the tag at the fitting end. If inserted too far, the upper portion of the siphon

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4. Insert the hose into the guide funnel and into the fuel fill pipe. Some resistance may be encountered when the tip of the siphon hose reaches the inlet check valve. Repeated probing may be necessary to slide the hose tip through the check valve cage.

   Warning: Whenever fuel lines are removed, catch fuel in an approved container. Container opening must be a minimum of 300 mm (12 in) diameter to adequately catch the fluid.

   Note: The fuel flow rate from the siphon hose will range from 1.1 L/min (0.3 gal/min) up to 3.8 L/min (1 gal/min), depending on whether it is gravity siphoned or with an air-powered pump.

5. Begin the fuel siphoning process. Place the fuel into an approved fuel container.
6. Remove the siphon hose from the fuel fill pipe after draining is complete.

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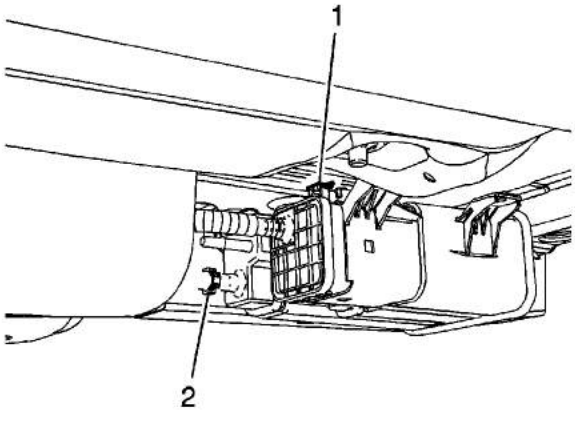
Fuel Tank Replacement

Removal Procedure

Warning: Do not allow smoking or the use of open flames in the area where work on the fuel or EVAP system is taking place. Anytime work is being done on the fuel system, disconnect the negative battery cable, except for those tests where battery voltage is required.

Warning: Fuel supply lines will remain pressurized for long periods of time after the engine is shutdown. This pressure must be relieved before servicing the fuel system.



1. Disconnect the fuel tank wiring harness electrical connector (1) from the EVAP canister vent solenoid valve.

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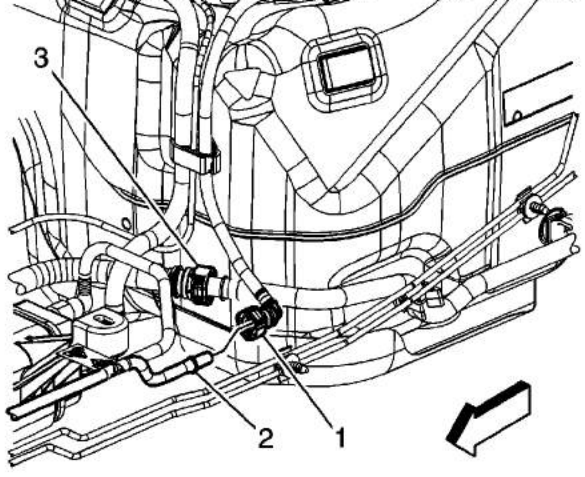
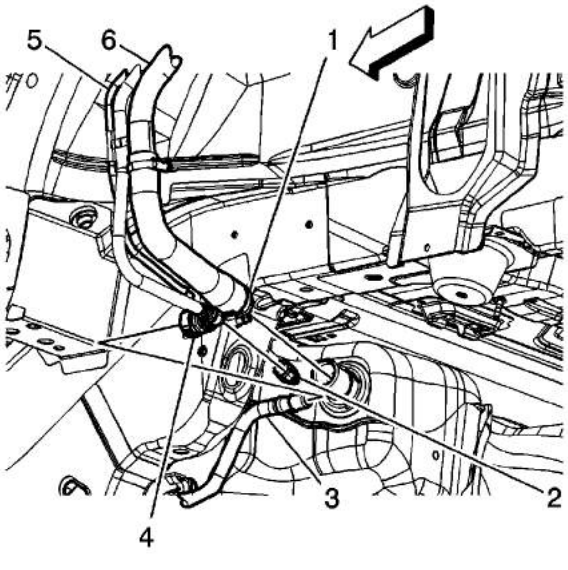


Warning: Whenever fuel lines are removed, catch fuel in an approved container. Container opening must be a minimum of 300 mm (12 in) diameter to adequately catch the fluid.

Caution: Clean all fuel pipe connections and surrounding areas before disconnecting the fuel pipes to avoid contamination of the fuel system.

2. Disconnect the fuel tank fuel feed line quick connect fitting (1) from the chassis fuel feed line (2), if necessary. Refer to Plastic Collar Quick Connect Fitting Service.



3. Disconnect the fill pipe vent line quick connect fitting (4) from the fuel tank fresh air line (3). Refer to Plastic Collar Quick Connect Fitting Service.
4. Disconnect the fuel tank vapor line quick connect fitting (2) from the fill pipe recirculation line (5). Refer to Plastic Collar Quick Connect Fitting Service.

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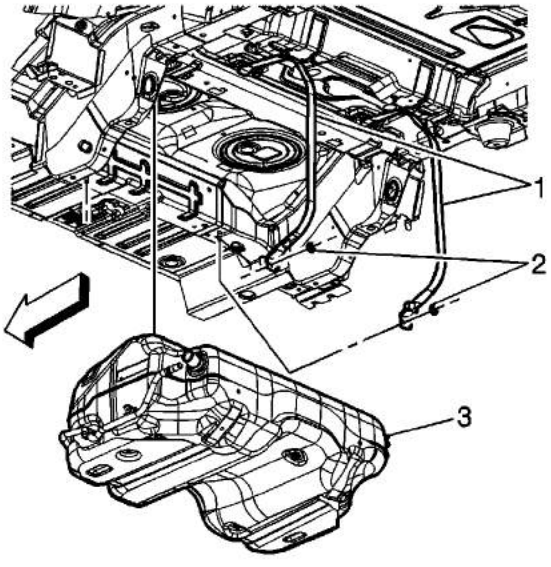

7. Using a suitable adjustable jack, support the fuel tank.

   Caution: Do not bend the fuel tank straps. Bending the fuel tank straps may cause damage to the straps.

8. Remove the fuel tank strap nuts (2) and straps (1).

   Note: It is not necessary to remove the rear drive module (RDM) in order to remove the fuel tank.

9. Using the adjustable jack, slowly lower and reposition the fuel tank (3) in order to remove the tank from the vehicle.
10. If replacing the fuel tank perform the following steps, otherwise proceed to the installation procedure.

Disassembly Procedure

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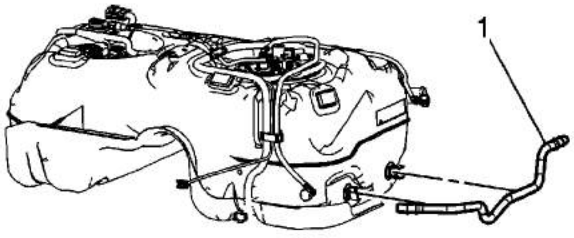
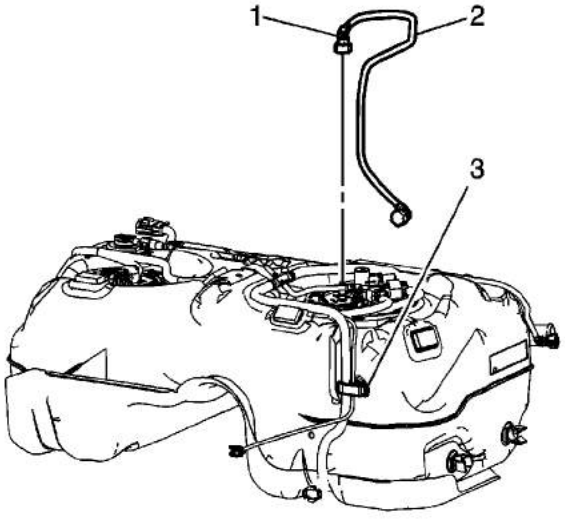


1. Disengage the fresh air line (1) from the fuel tank clips and remove the fresh air line.



2. Disconnect the fuel feed line quick connect fitting (1) from the fuel tank fuel pump module. Refer to Plastic Collar Quick Connect Fitting Service.
3. Open the retaining clip (3) on the fuel tank and remove the fuel feed line (2).

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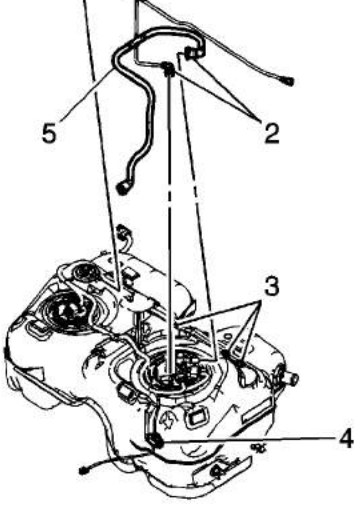
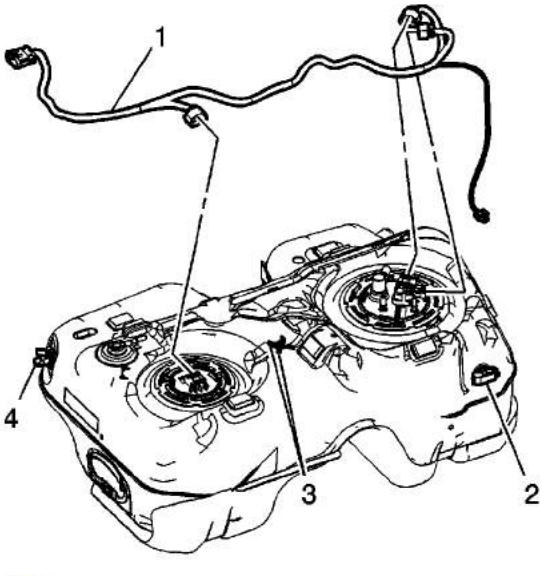


4. Disconnect the vapor line quick connect fitting (1) from the fuel tank vent valve. Refer to Plastic Collar Quick Connect Fitting Service.
5. Disconnect the vapor line quick connect fittings (2) from the fuel tank fuel pump module. Refer to Plastic Collar Quick Connect Fitting Service.
6. Remove the vapor line (5) from the retaining clip (4) and the retaining features (3) molded into the fuel tank.



7. Disconnect the fuel tank wiring harness (1) electrical connectors from the following:
   - Primary fuel tank fuel pump module
   - Fuel tank pressure sensor
   - Secondary fuel tank fuel pump module
8. Remove the fuel tank wiring harness from the retaining clips (2 and 4) and the retaining features (3) molded into the fuel tank.

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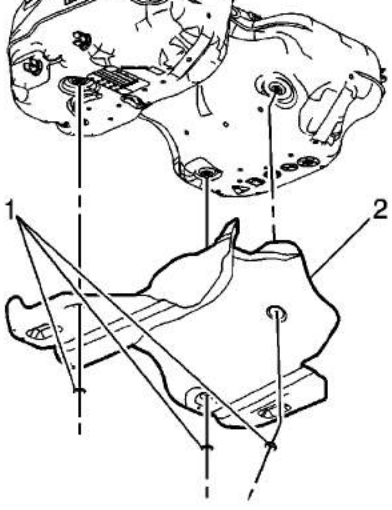
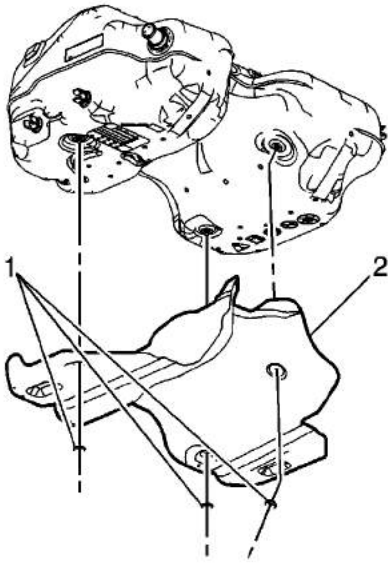


9. Remove the fuel tank shield retainers (1) and shield (2).
10. Remove the fuel tank fuel pump modules. Refer to Fuel Tank Fuel Pump Module Replacement and Fuel Tank Fuel Pump Module Replacement - Secondary.

Assembly Procedure



1. Install the fuel tank fuel pump modules. Refer to Fuel Tank Fuel Pump Module Replacement and Fuel Tank Fuel Pump Module Replacement - Secondary.
2. Install the fuel tank shield (2) and retainers (1).

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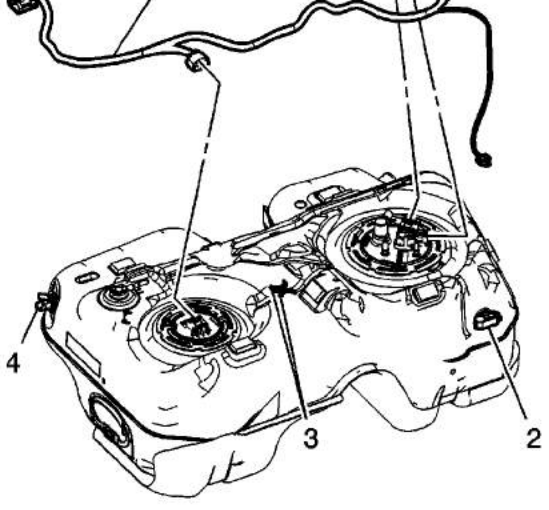
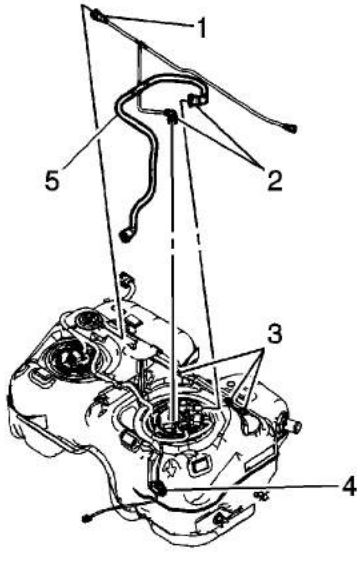


3. Connect the fuel tank wiring harness (1) electrical connectors to the following:
   - Secondary fuel tank fuel pump module
   - Fuel tank pressure sensor
   - Primary fuel tank fuel pump module
4. Install the fuel tank wiring harness to the retaining clips (2 and 4) and the retaining features (3) molded into the fuel tank.



5. Lay the vapor line (5) into position and connect the vapor line quick connect fittings (2) to the fuel tank fuel pump module. Refer to Plastic Collar Quick Connect Fitting Service.
6. Connect the vapor line quick connect fitting (1) to the fuel tank vent valve. Refer to Plastic Collar Quick Connect Fitting Service.
7. Install the vapor line to the retaining clip (4) and the retaining features (3) molded into the fuel tank.

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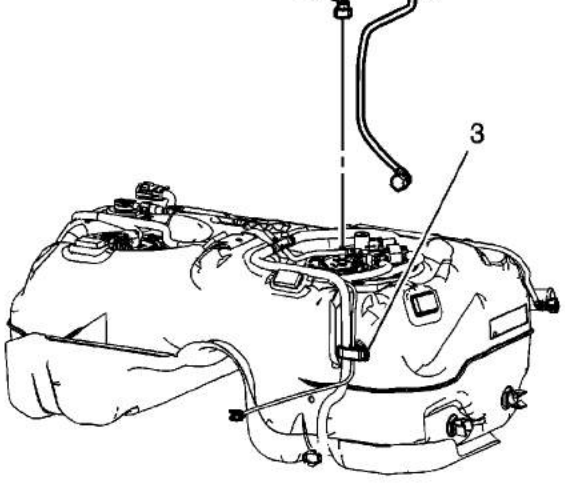
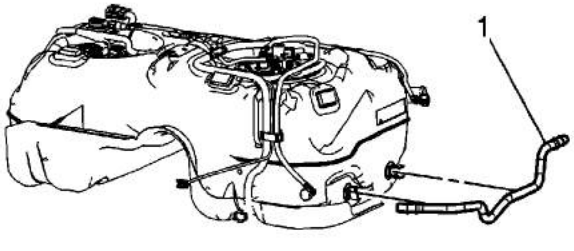


8. Lay the fuel feed line (2) into position and connect the fuel feed line quick connect fitting (1) to the fuel tank fuel pump module. Refer to Plastic Collar Quick Connect Fitting Service.
9. Close the retaining clip (3) on the fuel tank.



10. Position the fresh air line (1) to the fuel tank clips and install the fresh air line.

Installation Procedure

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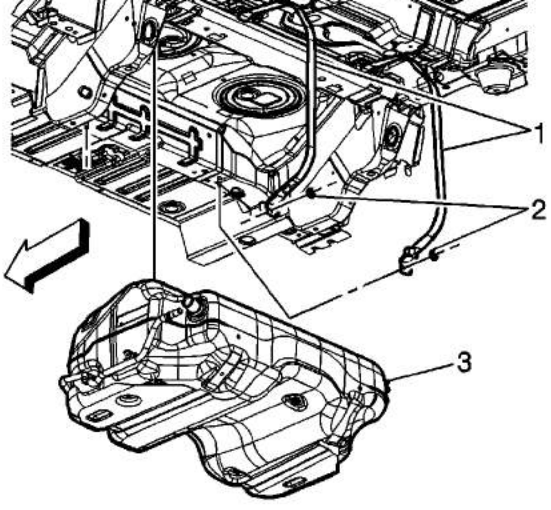


1. Using the adjustable jack, slowly raise and reposition the fuel tank (3) in order to install the tank to the vehicle.

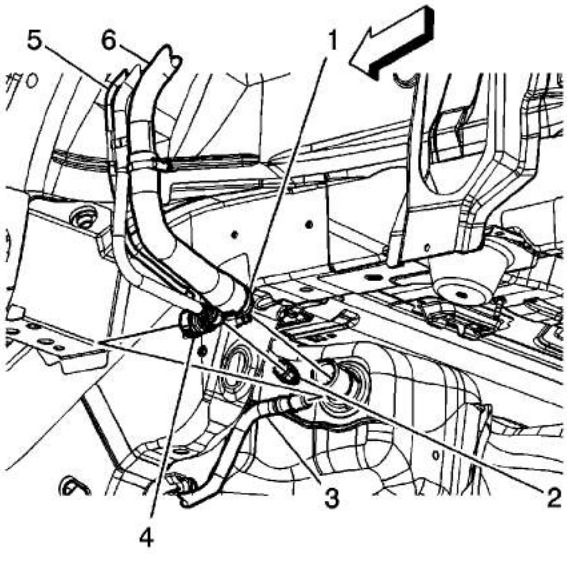
   Caution: Refer to Fastener Caution in the Preface section.

   Caution: Do not bend the fuel tank straps. Bending the fuel tank straps may cause damage to the straps.

2. Install the fuel tank straps (1) and nuts (2).

   Tighten
   Tighten the nuts to 20 N·m (15 lb ft).

3. Remove the adjustable jack from under the fuel tank.



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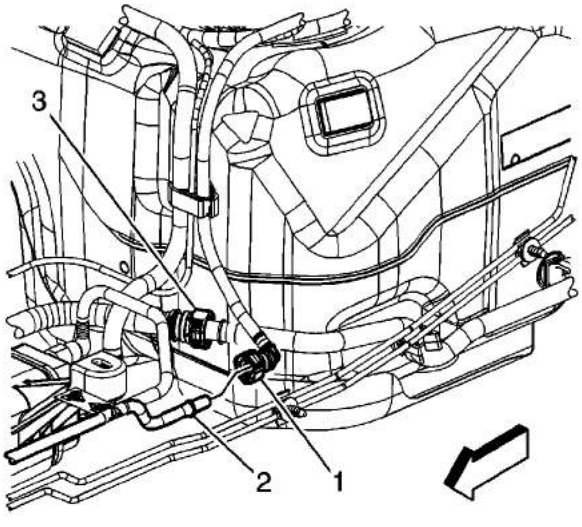
Note: Ensure that the notch in the fuel fill pipe hose aligns with the locating tab on the fuel tank.

4. Install the fuel fill pipe (6) hose to the fuel tank.
5. Tighten the fuel fill pipe hose clamp (1) at the fuel tank.

Tighten
Tighten the clamp to 5 N·m (44 lb in).

6. Connect the fuel tank vapor line quick connect fitting (2) to the fill pipe recirculation line (5). Refer to Plastic Collar Quick Connect Fitting Service.
7. Connect the fill pipe vent line quick connect fitting (4) to the fuel tank fresh air line (3). Refer to Plastic Collar Quick Connect Fitting Service.



8. Connect the fuel tank fuel feed line quick connect fitting (1) to the chassis fuel feed line (2). Refer to Plastic Collar Quick Connect Fitting Service.

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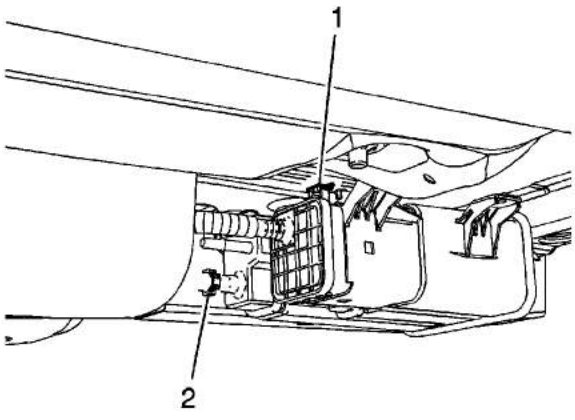
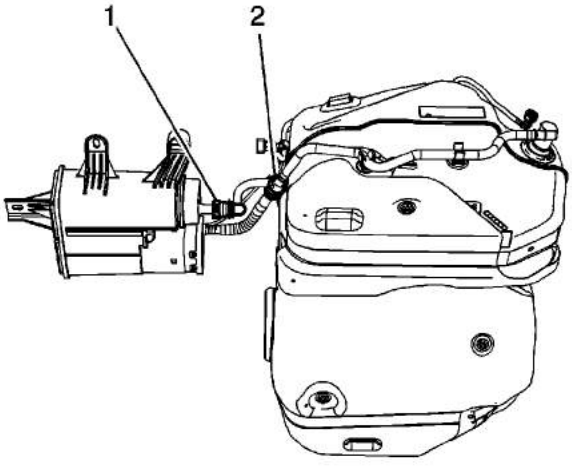


9. Connect the fuel tank wiring harness electrical connector (1) to the EVAP canister vent solenoid valve.



10. Connect the EVAP canister fresh air line quick connect fitting (2) to the fuel tank fresh air line. Refer to Plastic Collar Quick Connect Fitting Service.
11. Connect the fuel tank vapor line quick connect fitting (1) to the EVAP canister. Refer to Plastic Collar Quick Connect Fitting Service.
12. If equipped with AWD, install the propeller shaft. Refer to Propeller Shaft Replacement.
13. Install the muffler. Refer to Exhaust Muffler Replacement.
14. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
15. Perform the following procedure in order to inspect for leaks.
    - Turn the ignition ON, with the engine OFF, for 2 seconds.
    - Turn the ignition OFF for 10 seconds.

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- Inspect for fuel leaks.

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

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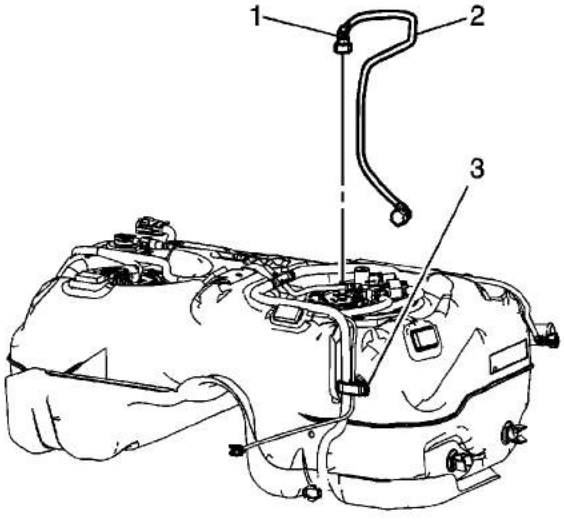
Fuel Tank Fuel Pump Module Replacement

Special Tools

J 45722 Fuel Sender Lock Ring Wrench

Removal Procedure

Caution: Clean all fuel pipe and hose connections and surrounding areas before disassembling to avoid possible contamination of the fuel system. Spray the fuel pump module cam-lock ring tang with penetrating oil prior to attempting removal.



1. Remove the secondary fuel tank fuel pump module. Refer to Fuel Tank Fuel Pump Module Replacement - Secondary.
2. Disconnect the fuel feed line quick connect fitting (1) from the fuel tank fuel pump module. Refer to Plastic Collar Quick Connect Fitting Service.
3. Open the retaining clip (3) on the fuel tank and remove the fuel feed line (2).

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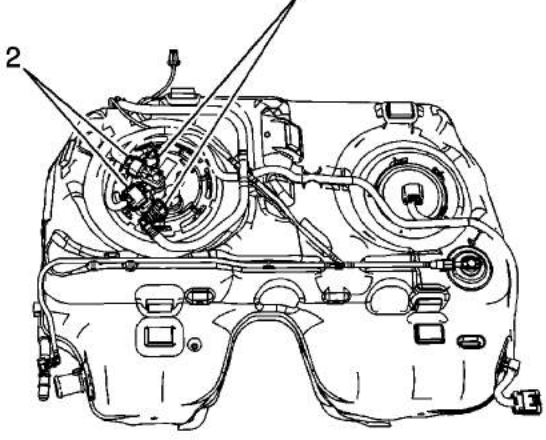
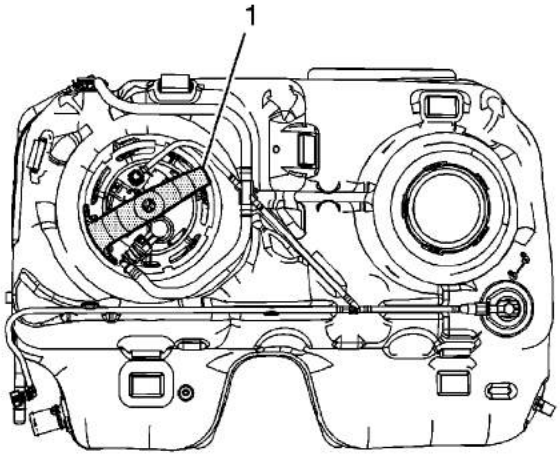


4. Disconnect the engine wiring harness electrical connectors (2) from the fuel tank fuel pump primary module and the fuel tank pressure sensor.
5. Disconnect the vapor line quick connect fittings (1) from the fuel tank fuel pump module. Refer to Plastic Collar Quick Connect Fitting Service.



6. Install the J 45722 (1) to the fuel tank fuel pump module lock ring.

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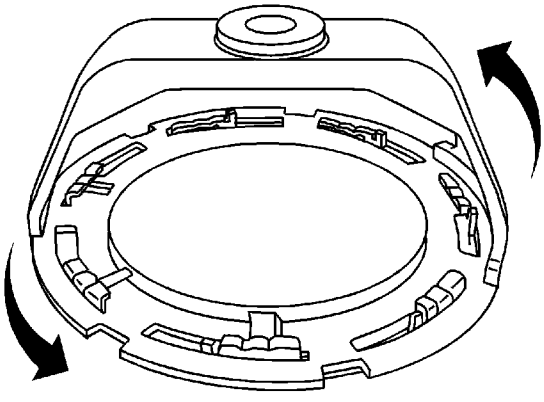
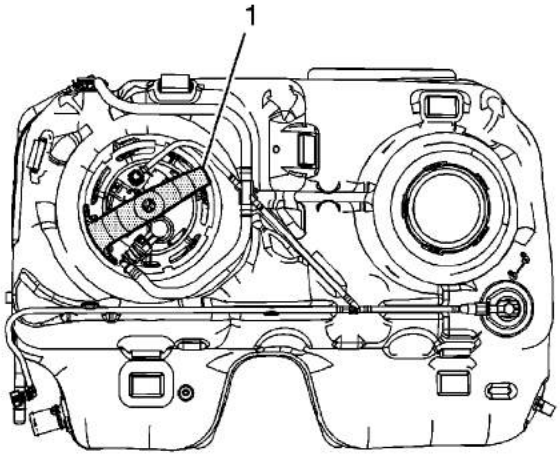


Caution: Avoid damaging the lock ring. Use only J-45722 to prevent damage to the lock ring.

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 counterclockwise unlocking the fuel tank fuel pump module lock ring.



8. Remove the J 45722 (1).

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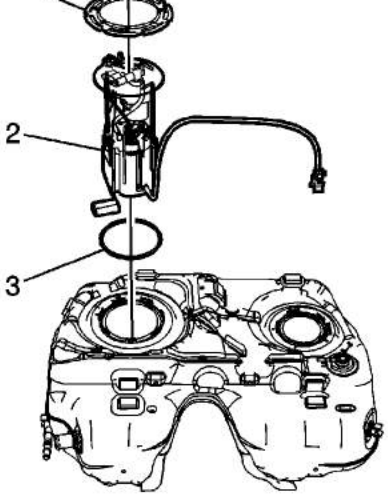

9. Remove the fuel tank fuel pump module lock ring (1).

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.

10. 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 reservoir bucket is full of fuel. The module must be tipped slightly during removal to avoid bending the fuel level sensor float arm.

11. Tilt the module toward the rear of the fuel tank to allow the level sensor float arm to clear the tank opening. Remove the module from the tank.
12. Carefully discard the fuel in the module reservoir bucket into an approved fuel container.

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

13. Remove and discard the fuel tank fuel pump module O-ring seal (3).
14. If replacing the fuel tank fuel pump module, remove the fuel level sensor, if required. Refer to Fuel Level Sensor Replacement.

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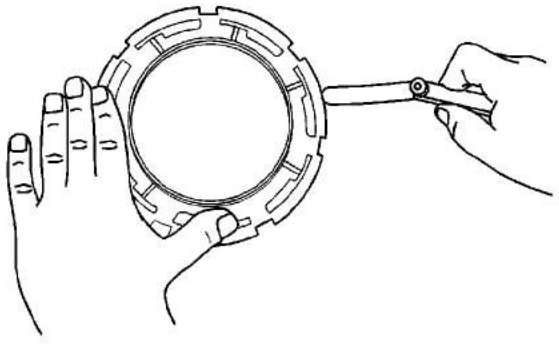

Note:

- 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.

15. 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.
16. If warpage is less than 0.41 mm (0.016 in), the lock ring does not require replacement.
17. If warpage is greater than 0.41 mm (0.016 in), the lock ring must be replaced.

Installation Procedure

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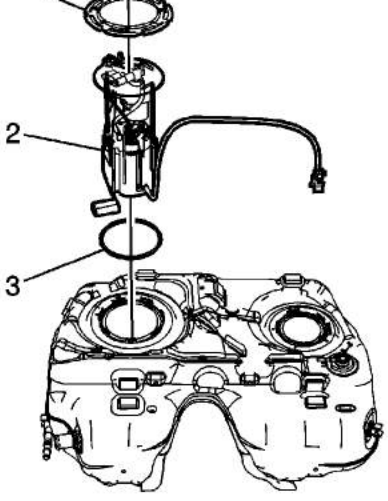
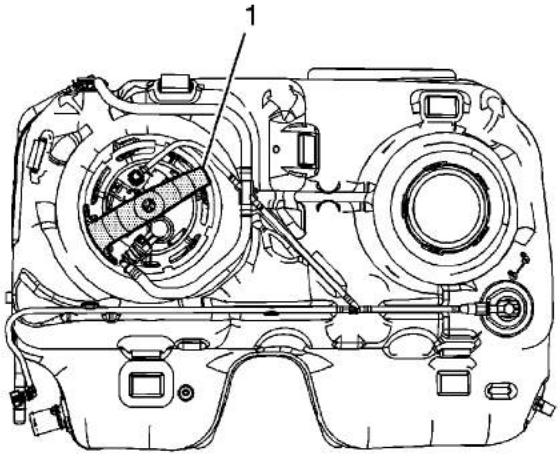


1. If the fuel tank fuel pump module was replaced, install the fuel level sensor, if required. Refer to Fuel Level Sensor Replacement.
2. Install a NEW fuel tank module O-ring seal (3) onto the fuel tank.
3. Tilt the module toward the rear of the fuel tank to allow the fuel level sensor float arm to clear the tank opening. Install the module into the fuel tank.
4. Lower the module assembly (2) into the tank.
5. Position and install the fuel tank module lock ring (1).



6. Install the J 45722 (1) to the fuel tank fuel pump module lock ring.

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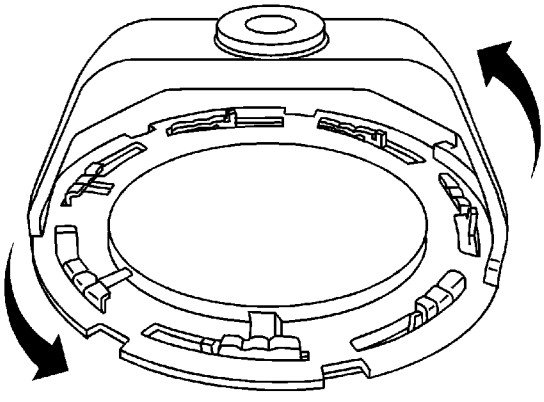
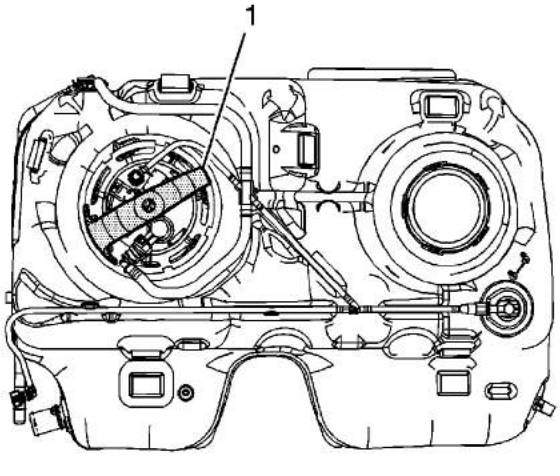


Note: Always replace the fuel tank module seal when installing the fuel tank module. Replace the lock ring if necessary. DO NOT apply any type of lubrication in the seal groove.

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

7. Use the J 45722 and a long breaker bar, rotate the lock ring clockwise locking the fuel tank module lock ring.



8. Remove the J 45722 (1) from the fuel tank fuel pump module lock ring.

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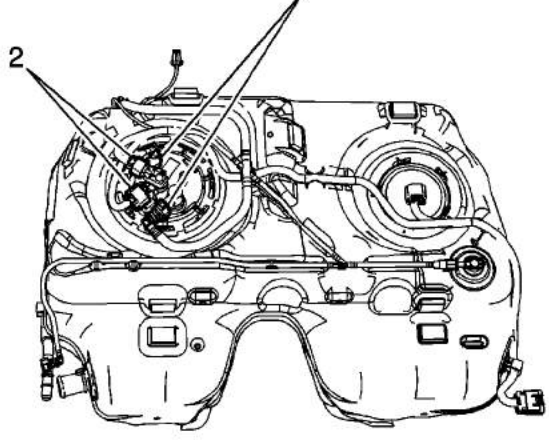
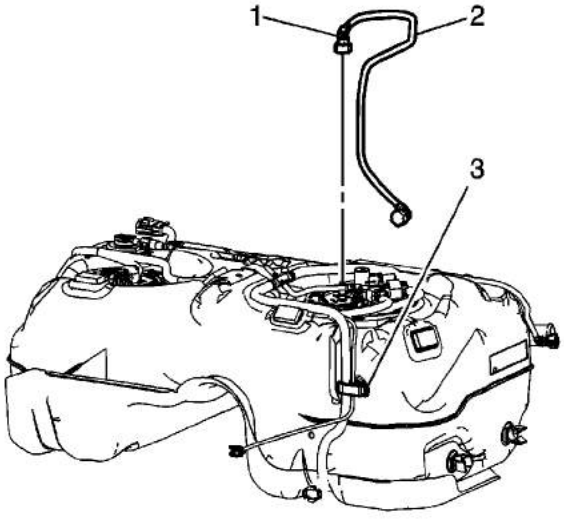


9. Connect the vapor line quick connect fittings (2) to the fuel tank fuel pump module. Refer to Plastic Collar Quick Connect Fitting Service.
10. Connect the engine wiring harness electrical connectors (1) to the fuel tank fuel pump primary module and the fuel tank pressure sensor.



11. Lay the fuel feed line (2) into position and connect the fuel feed line quick connect fitting (1) to the fuel tank fuel pump module. Refer to Plastic Collar Quick Connect Fitting Service.
12. Close the retaining clip (3) on the fuel tank.
13. Install the secondary fuel tank fuel pump module. Refer to Fuel Tank Fuel Pump Module Replacement - Secondary.

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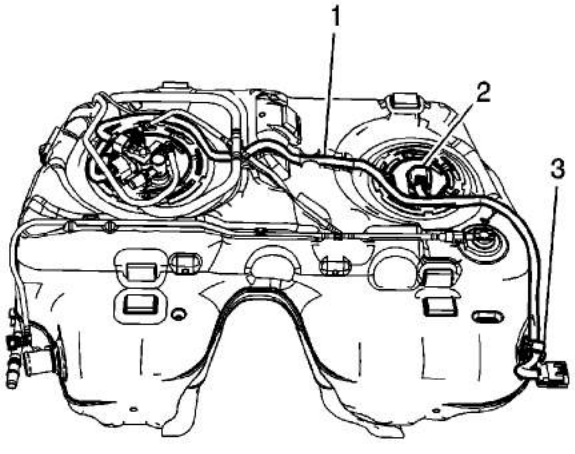
Fuel Tank Fuel Pump Module Replacement - Secondary

Special Tools

CH-48482 Fuel Sender Lock Ring Wrench

Removal Procedure



1. Remove the fuel tank. Refer to Fuel Tank Replacement .
2. Disconnect the fuel tank wiring harness electrical connector (2) from the secondary fuel tank fuel pump module.
3. Remove the fuel tank wiring harness from the retaining clip (3).
4. Reposition the fuel tank wiring harness (1) out of the way.
5. Install the CH-48482 to the fuel tank fuel pump module lock ring.
6. Using the CH-48482 and a long breaker bar, rotate the lock ring counterclockwise unlocking the fuel tank fuel pump module lock ring.
7. Remove the CH-48482 .

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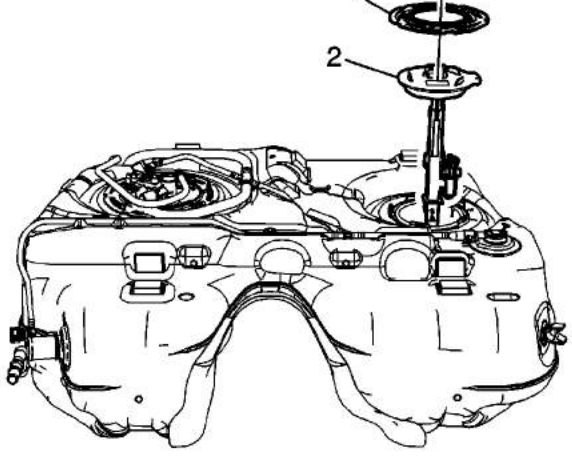
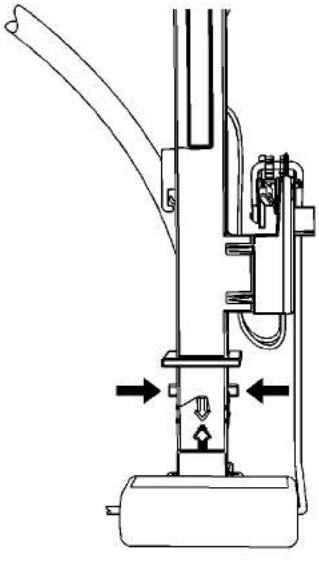


8. Remove the fuel tank module lock ring (1).
9. Slowly raise the fuel tank fuel pump module (2) until the fuel level sensor float arm and primary fuel tank fuel pump module suction port are just visible.



10. Squeeze in the primary fuel tank fuel pump module suction port tabs on either side of the port in order to disengage the primary fuel tank fuel pump module suction port from the secondary fuel tank fuel pump module.

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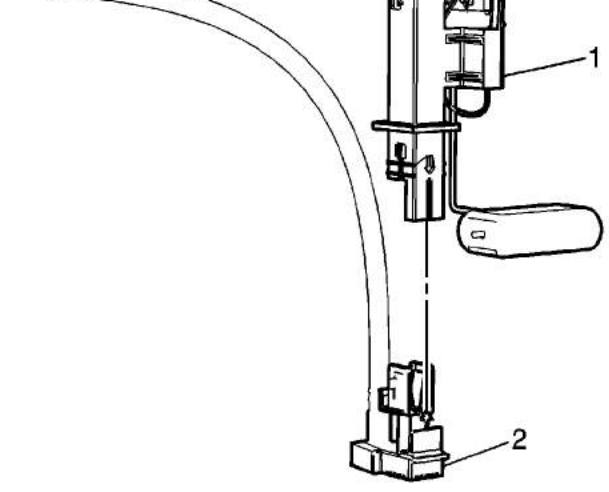
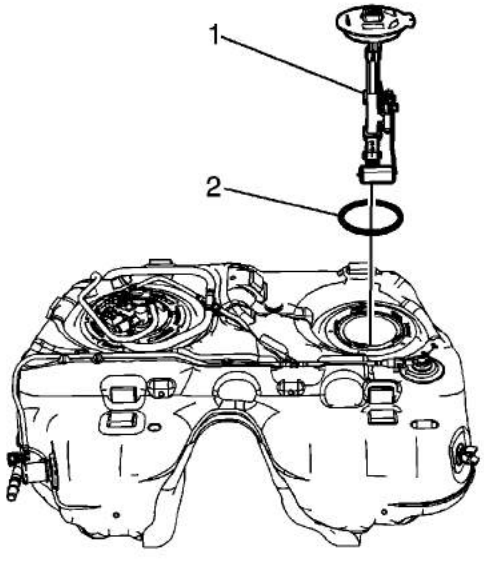


11. Remove the primary fuel tank fuel pump module suction port (2) from the secondary fuel tank fuel pump module (1).



12. Tilt the module toward the rear of the fuel tank to allow the level sensor float arm to clear the tank opening. Remove the module (1) from the tank.
13. Remove and discard the fuel tank module O-ring seal (2).
14. If the secondary fuel tank fuel pump module is being replaced, remove the secondary fuel level sensor, if required. Refer to Secondary Fuel Level Sensor Replacement .

Installation Procedure

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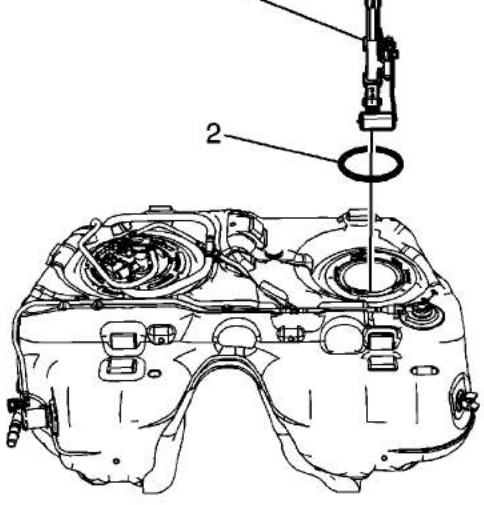
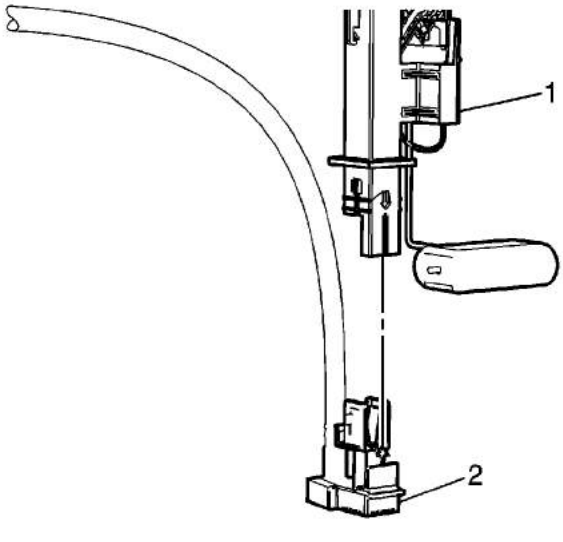


1. If the secondary fuel tank fuel pump module was replaced, install the secondary fuel level sensor, if required. Refer to Secondary Fuel Level Sensor Replacement .
2. Install a NEW fuel tank module O-ring seal (2) onto the fuel tank.
3. Tilt the module toward the rear of the fuel tank to allow the fuel level sensor float arm to clear the tank opening. Install the module (1) into the fuel tank.



4. Align the arrow (2) on the primary fuel tank fuel pump module suction port to the arrow (1) on the secondary fuel tank fuel pump module. Install the primary fuel tank fuel pump module suction port to the secondary fuel tank fuel pump module.

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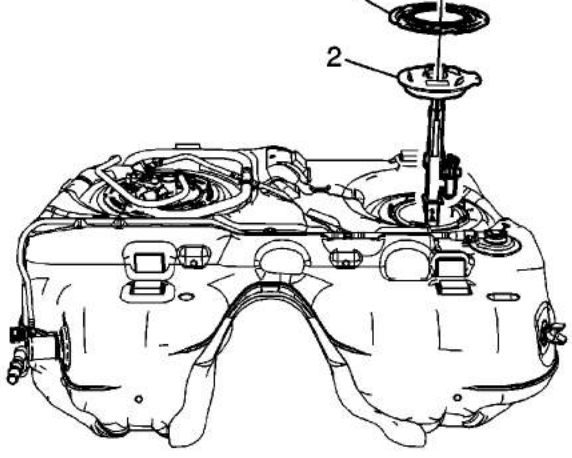
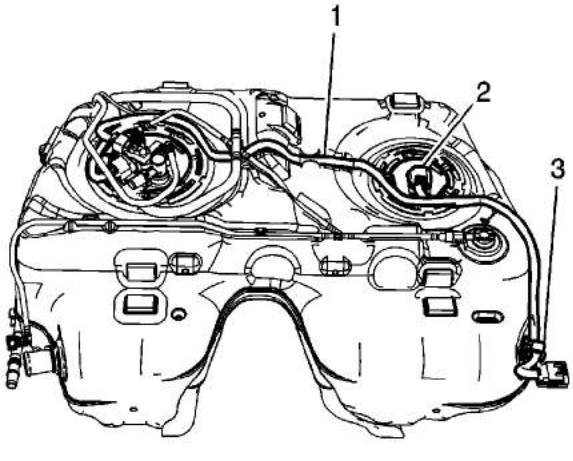


5. Lower the fuel tank fuel pump module (2) into the fuel tank.
6. Install the fuel tank module lock ring (1).



7. Install the CH-48482 to the fuel tank fuel pump module lock ring.
8. Using the CH-48482 and a long breaker bar, rotate the lock ring clockwise locking the fuel tank fuel pump module lock ring.
9. Remove the CH-48482 from the fuel tank fuel pump module lock ring.
10. Position the fuel tank wiring harness (1) to the module.
11. Connect the fuel tank wiring harness electrical connector (2) to the secondary fuel tank fuel pump module.
12. Install the fuel tank wiring harness to the retaining clip (3).
13. Install the fuel tank. Refer to Fuel Tank Replacement .

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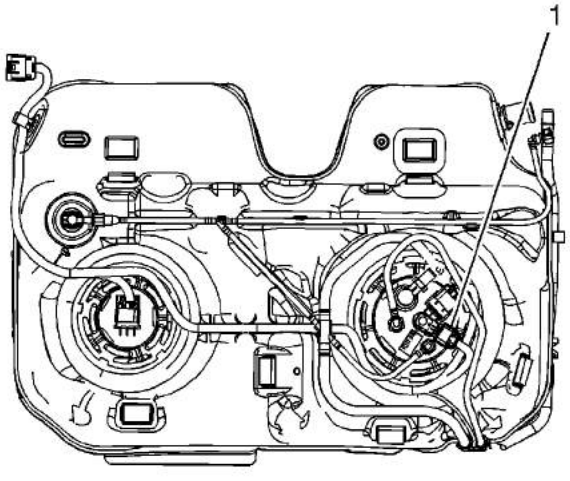
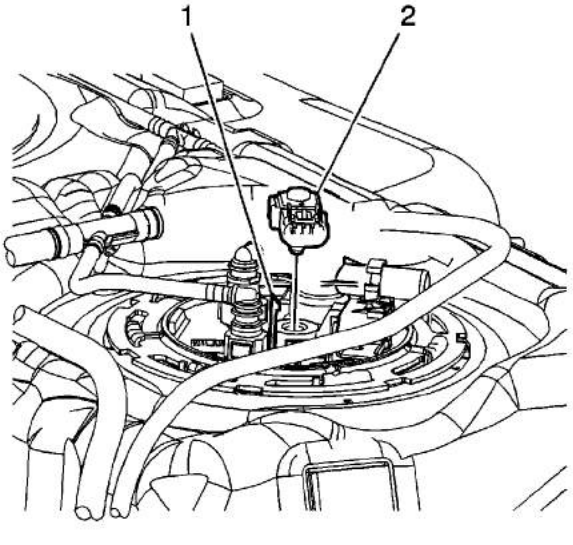
Fuel Tank Pressure Sensor Replacement

Removal Procedure



1. Remove the fuel tank. Refer to Fuel Tank Replacement.
2. Disconnect the fuel tank wiring harness electrical connector (1) from the fuel tank pressure sensor.



3. Disengage the retaining tab (1) securing the fuel tank pressure sensor.
4. Carefully lift and remove the fuel tank pressure sensor (2) from the fuel pump module.

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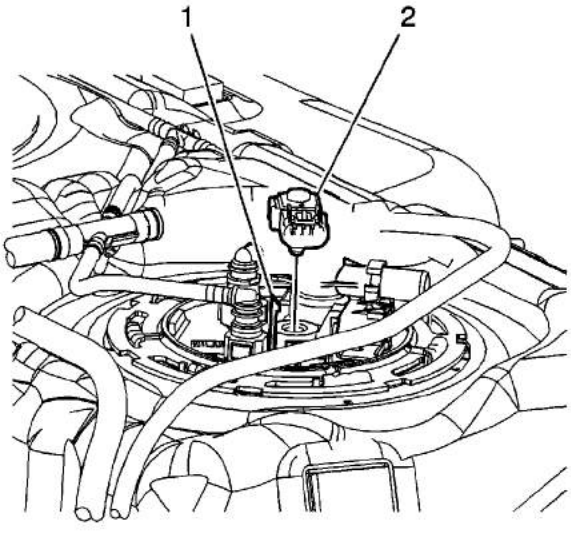
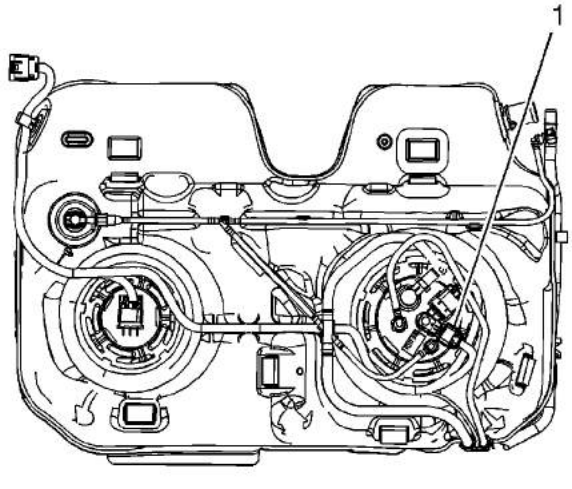


1. Install the fuel tank pressure sensor (2) to the fuel pump module assembly until the sensor engages the retaining tab (1).



2. Connect the fuel tank wiring harness electrical connector (1) to the fuel tank pressure sensor.
3. Install the fuel tank. Refer to Fuel Tank Replacement.

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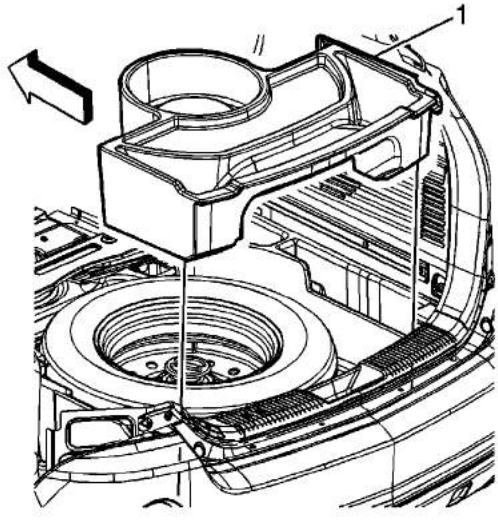
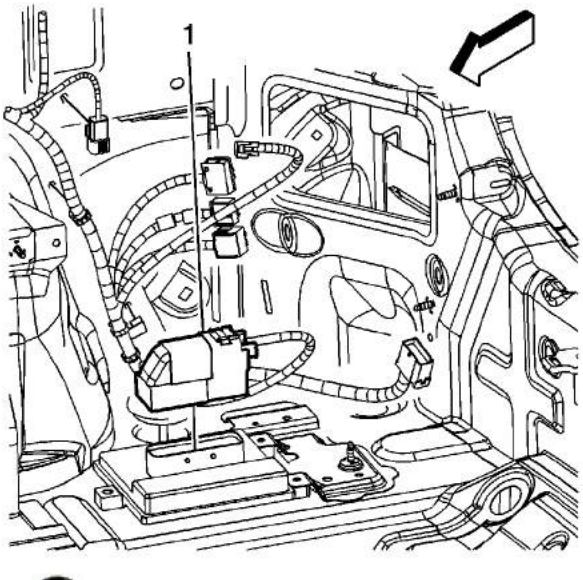
Fuel Pump Flow Control Module Replacement

Removal Procedure



1. Open the rear compartment floor stowage compartment cover.
2. Remove the spare tire spacer (1).
3. Remove the rear compartment floor stowage compartment. Refer to Rear Compartment Floor Stowage Compartment Replacement.



4. Disconnect the body wiring harness electrical connector (1) from the fuel pump flow control

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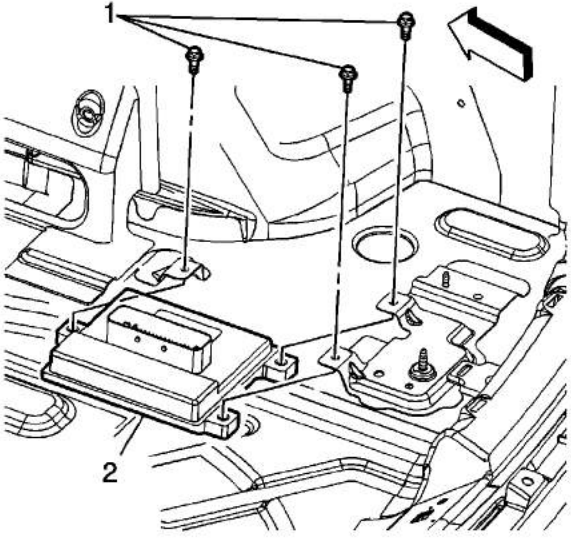
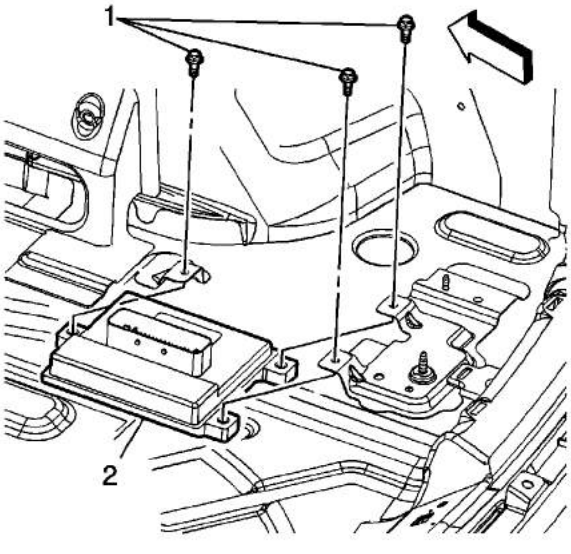


5. Remove the fuel pump flow control module bolts (1).
6. Slide the fuel pump flow control module towards the driver side of the vehicle.
7. Remove the fuel pump flow control module (2) from the vehicle.

Installation Procedure



1. Install the fuel pump flow control module (2) to the vehicle.
2. Slide the fuel pump flow control module towards the passenger side of the vehicle.

Caution: Refer to Fastener Caution in the Preface section.

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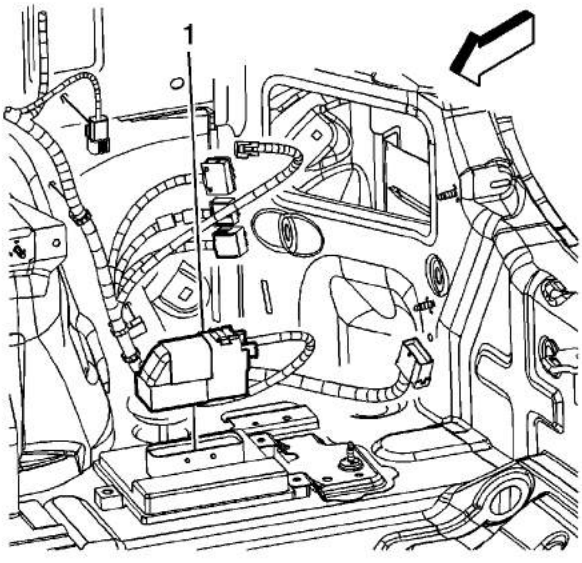
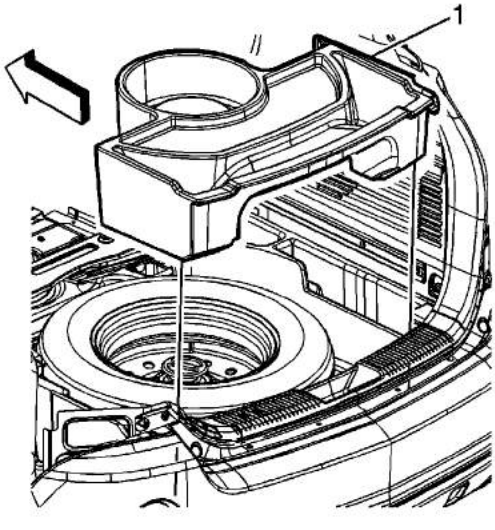
Tighten
Tighten the bolts to 10 N·m (89 lb in).



4. Connect the body wiring harness electrical connector (1) to the fuel pump flow control module.



5. Install the rear compartment floor stowage compartment. Refer to Rear Compartment Floor Stowage Compartment Replacement.
6. Install the spare tire spacer (1).
7. Close the rear compartment floor stowage compartment cover.
8. Program the fuel pump flow control module. Refer to Control Module References.

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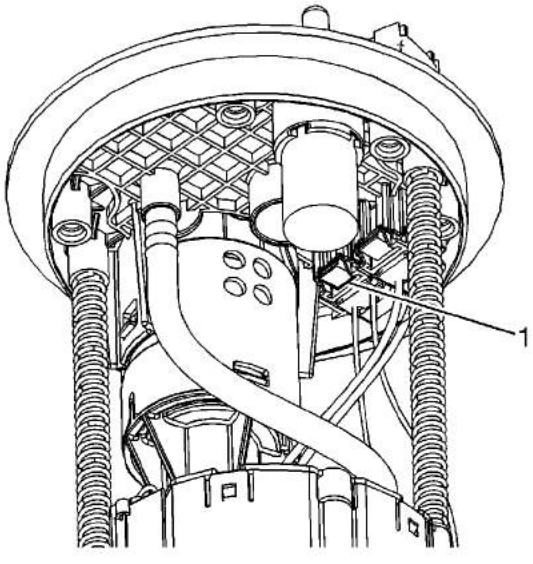
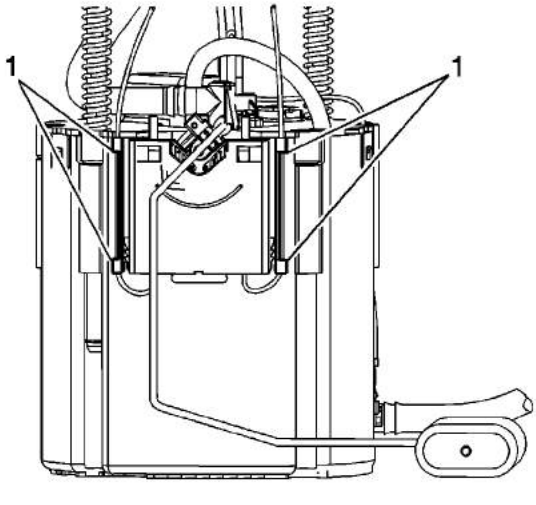
Fuel Level Sensor Replacement

Removal Procedure

Important: There are 2 fuel level sensor assemblies in the fuel tank. There is one located on each fuel pump module. The fuel level sensors are NOT the same for each of the fuel pump modules.



1. Remove the fuel pump module. Refer to Fuel Tank Fuel Pump Module Replacement.
2. Disconnect the fuel level sensor electrical connector (1) from the fuel tank fuel pump module cover.



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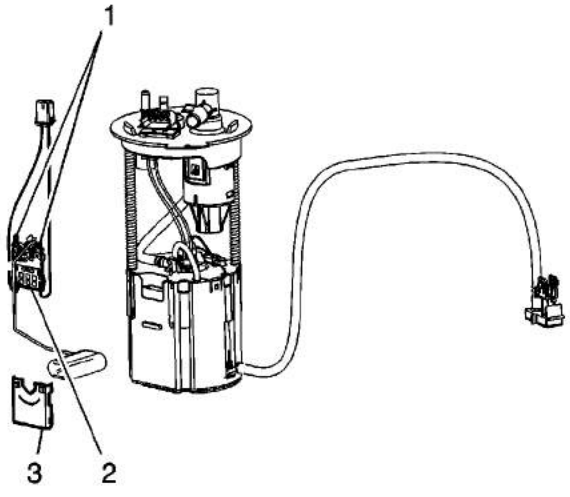
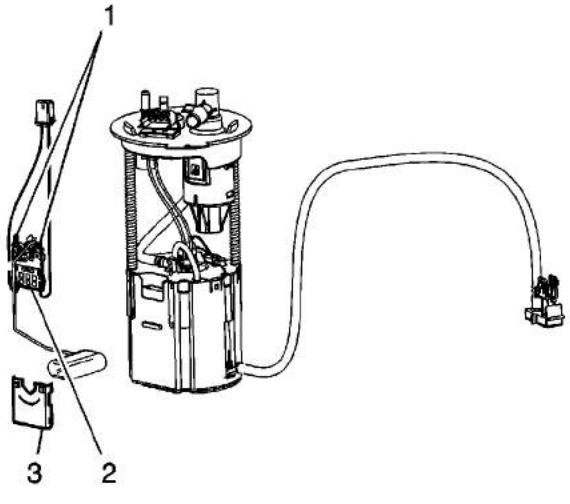
3. Remove the fuel level sensor wiring from behind the retaining features (1) molded into the fuel tank fuel pump module reservoir.



4. Slide the fuel level sensor up and remove the sensor from the fuel tank fuel pump module.
5. Place the fuel level sensor on a clean work surface.
6. Push in the fuel level sensor retainers (1), in order to remove the sensor from the cover.
7. Remove the fuel level sensor (2) from the cover (3).

Installation Procedure



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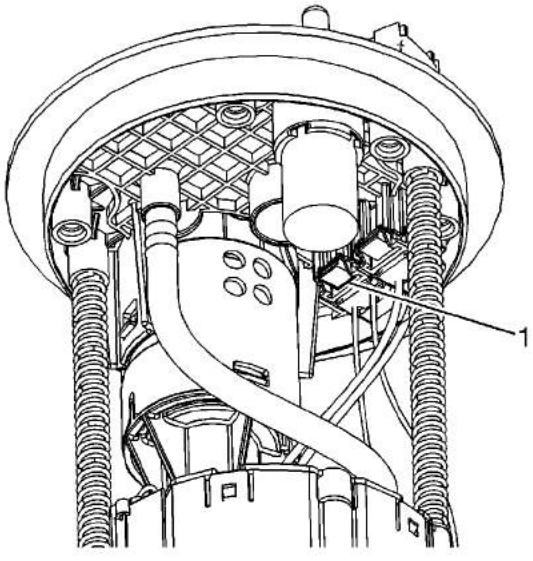
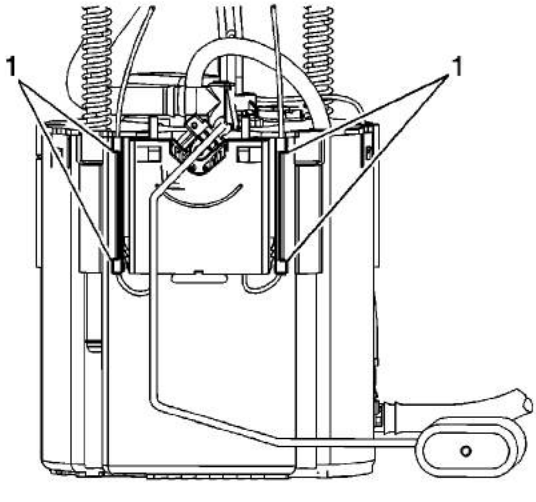
3. Position the fuel level sensor to the fuel tank fuel pump module and slide the sensor down into position.



4. Connect the fuel level sensor electrical connector (1) to the fuel tank fuel pump module cover.



5. Install the fuel level sensor wiring behind the retaining features (1) molded into the fuel tank fuel pump module reservoir.
6. Install the fuel pump module. Refer to Fuel Tank Fuel Pump Module Replacement.

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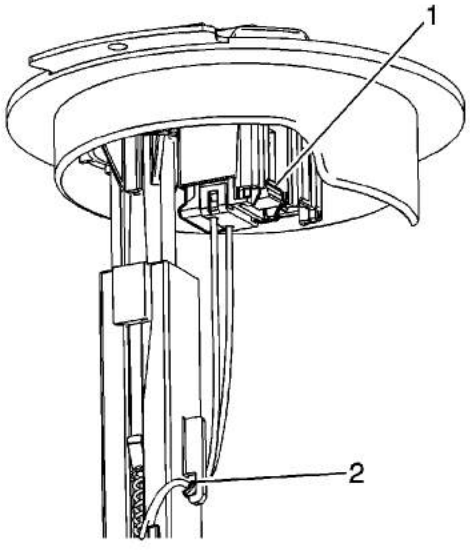
Secondary Fuel Level Sensor Replacement

Removal Procedure

Important: There are 2 fuel level sensor assemblies in the fuel tank. There is one located on each fuel pump module. The fuel level sensors are NOT the same for each of the fuel pump modules.



1. Remove the fuel pump module. Refer to Fuel Tank Fuel Pump Module Replacement - Secondary.
2. Disconnect the fuel level sender electrical connector (1) from the fuel tank fuel pump module cover.
3. Remove the fuel level sensor wiring from the retaining feature (2) on the fuel tank fuel pump module.

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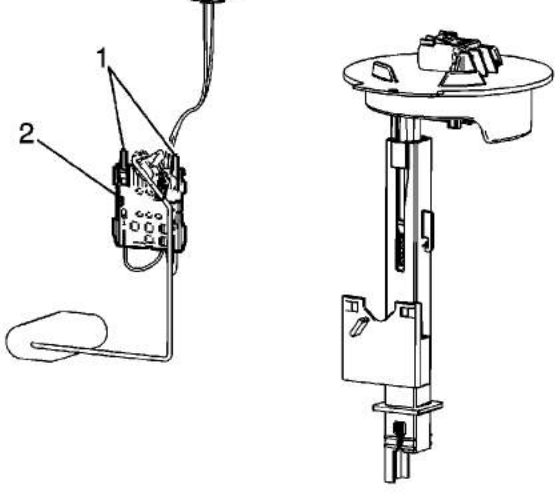
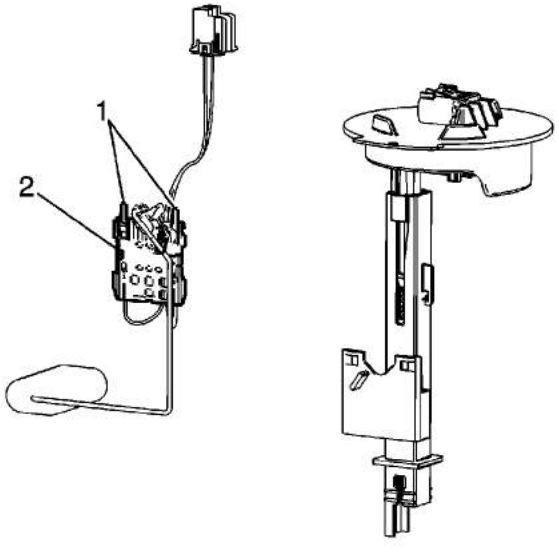


4. Push in the fuel level sensor retainers (1), in order to disengage the retainers from the module.
5. Slide the fuel level sensor (2) up, out of the fuel tank fuel pump module.

Installation Procedure



1. Position the fuel level sensor (2) to the fuel tank fuel pump module.
2. Push the fuel level sensor down until the retainers (1) engage the fuel tank fuel pump module.

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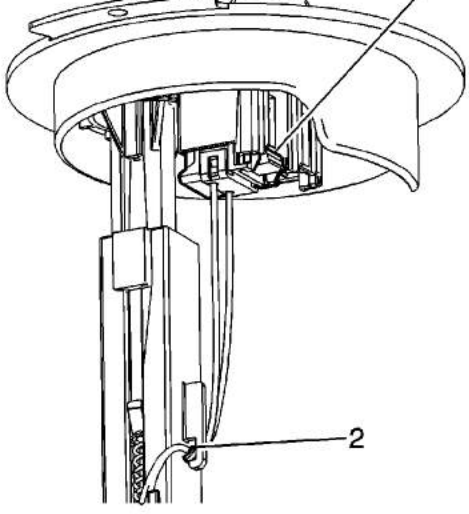

3. Connect the fuel level sender electrical connector (1) to the fuel tank fuel pump module cover.
4. Install the fuel level sensor wiring to the retaining feature (2) on the fuel tank fuel pump module.
5. Install the fuel pump module. Refer to Fuel Tank Fuel Pump Module Replacement - Secondary.

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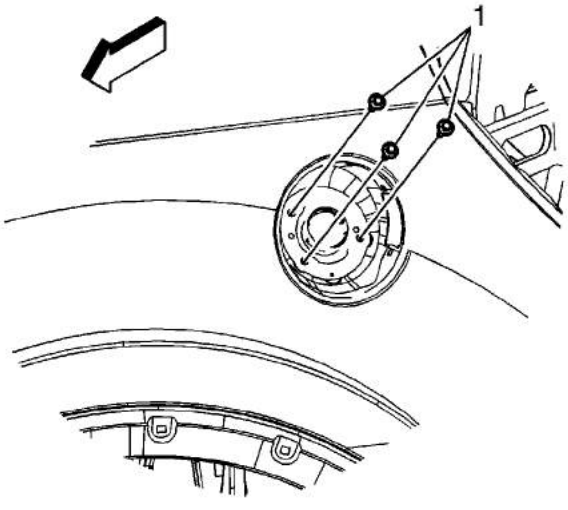
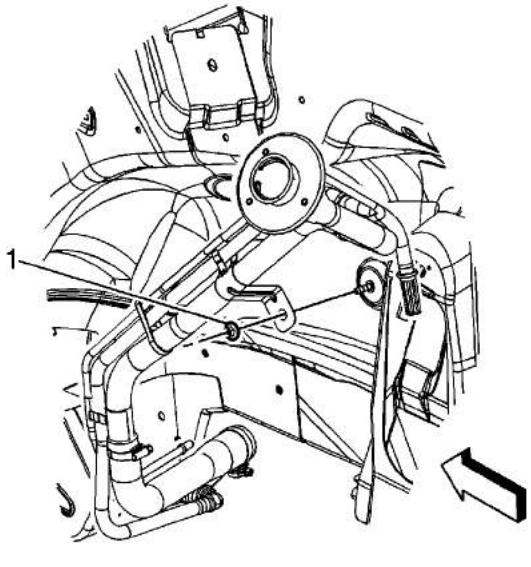
Filler Tube Replacement

Removal Procedure



1. Drain the fuel tank until the level in the tank is less than 1/4 full. Refer to Fuel Tank Draining.
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
3. Remove the fuel fill cap.
4. Remove the fuel tank fill pipe housing to fuel tank fill pipe screws (1).



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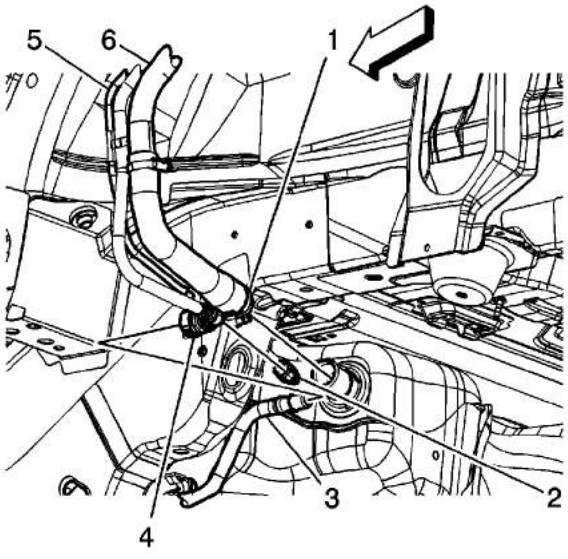
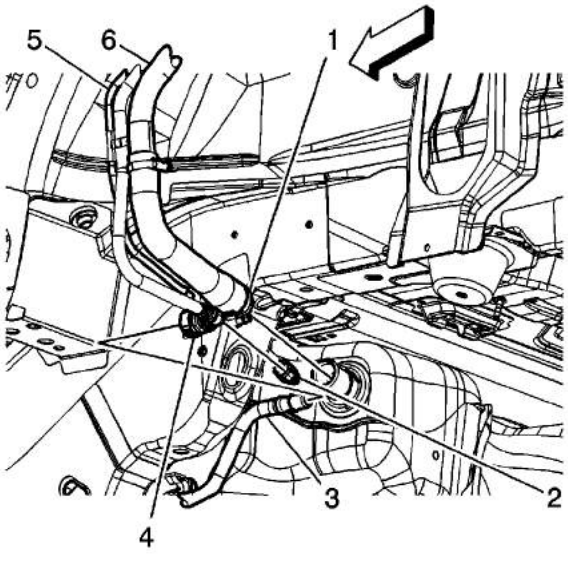


7. Disconnect the fill pipe vent line quick connect fitting (4) from the fuel tank fresh air line (3). Refer to Plastic Collar Quick Connect Fitting Service.
8. Disconnect the fuel tank vapor line quick connect fitting (2) from the fill pipe recirculation line (5). Refer to Plastic Collar Quick Connect Fitting Service.
9. Loosen the fuel fill pipe hose clamp (1) at the fuel tank.
10. Remove the fuel fill pipe (6) from the fuel tank.

Installation Procedure



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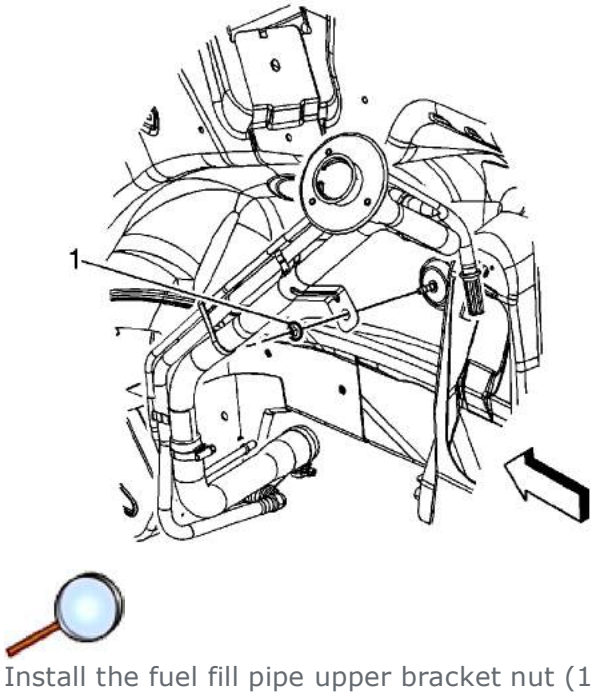
1. Install the fuel fill pipe (6) to the fuel tank.

   Caution: Refer to Fastener Caution in the Preface section.

2. Tighten the fuel fill pipe hose clamp (1) at the fuel tank.

   Tighten
   Tighten the clamp to 5 N·m (44 lb in).

3. Connect the fuel tank vapor line quick connect fitting (2) to the fill pipe recirculation line (5). Refer to Plastic Collar Quick Connect Fitting Service.
4. Connect the fill pipe vent line quick connect fitting (4) to the fuel tank fresh air line (3). Refer to Plastic Collar Quick Connect Fitting Service.



5. Install the fuel fill pipe upper bracket nut (1).

   Tighten
   Tighten the nut to 4 N·m (35 lb in).

6. Install the right rear wheelhouse liner. Refer to Rear Wheelhouse Panel Liner Replacement.

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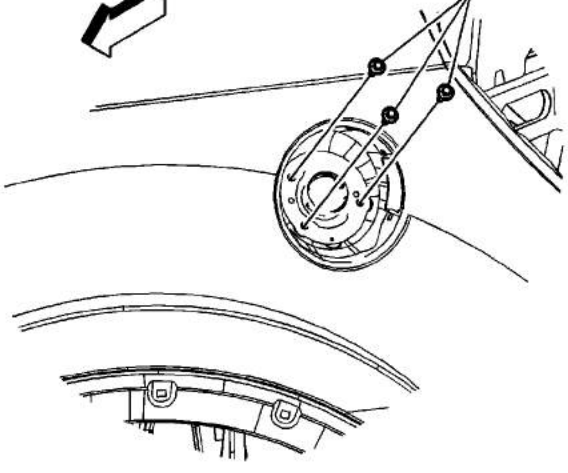

7. Install the fuel tank fill pipe housing to fuel tank fill pipe screws (1).

   Tighten
   Tighten the screws to 10 N·m (89 lb in).

8. Install the fuel fill cap.
9. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.

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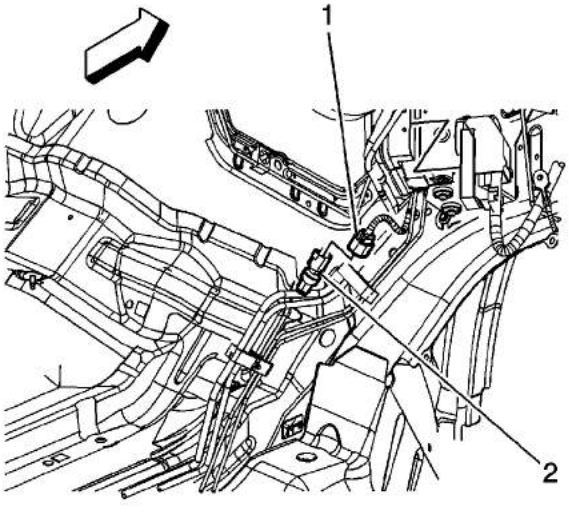
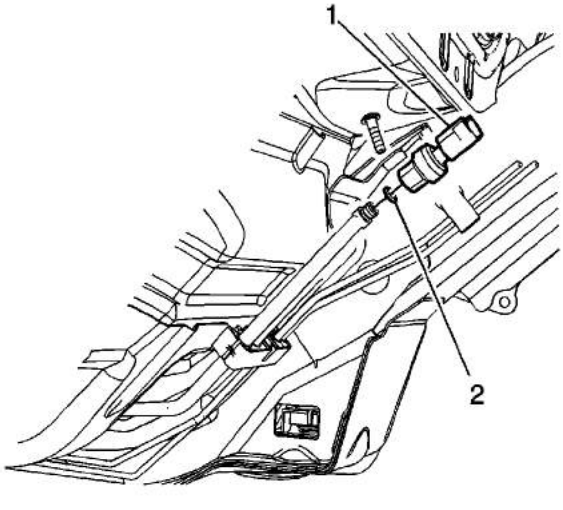
Fuel Pressure Sensor Replacement

Removal Procedure



1. Raise and suitably support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Disconnect the body wiring harness electrical connector (1) from the fuel pressure sensor (2).



3. Wrap a shop towel around the fuel pressure sensor fitting in order to absorb any fuel that may leak out.

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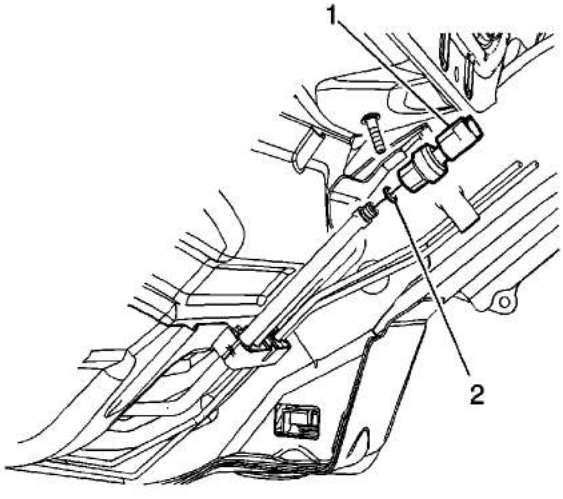
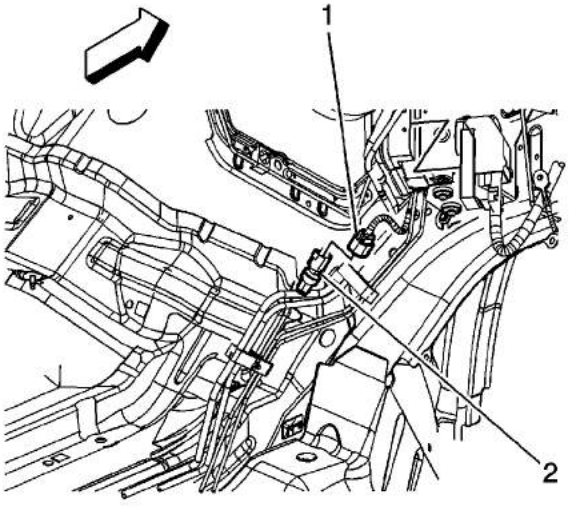
Installation Procedure



1. Lubricate a NEW fuel pressure sensor O-ring seal with clean engine oil.
2. Install the NEW fuel pressure sensor O-ring seal (2) onto the fuel line fitting.
3. Wrap a shop towel around the fuel pressure sensor fitting in order to absorb any fuel that may leak out.

   Caution: Refer to Fastener Caution in the Preface section.

4. Install the fuel pressure sensor (1) to the fuel line. Tighten the sensor to **15 N·m (11 lb ft)**.



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5. Connect the body wiring harness electrical connector (1) to the fuel pressure sensor (2).
6. Lower the vehicle.
7. Use the following procedure in order to inspect for leaks:
    7.1. Turn the ignition ON, with the engine OFF, for 2 seconds.
    7.2. Turn the ignition OFF for 10 seconds.
    7.3. Turn the ignition ON, with the engine OFF.
    7.4. Inspect for fuel leaks.

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Fuel Hose / Pipes Replacement - Chassis

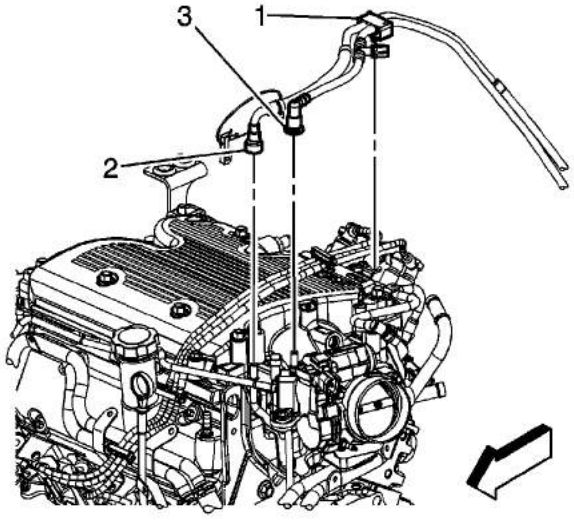
Removal Procedure

Warning: Ensure that the vehicle is properly supported and squarely positioned. To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle on the opposite end from which the components are being removed.

Warning: Do not allow smoking or the use of open flames in the area where work on the fuel or EVAP system is taking place. Anytime work is being done on the fuel system, disconnect the negative battery cable, except for those tests where battery voltage is required.

Warning: Whenever fuel lines are removed, catch fuel in an approved container. Container opening must be a minimum of 300 mm (12 in) diameter to adequately catch the fluid.

Caution: Fuel/Vapor lines cannot be spliced or repaired. The line must be replaced (if damaged) with the same type of line.



1. Relieve the fuel system pressure. Refer to Fuel Pressure Relief.
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
3. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
4. Disconnect the chassis fuel feed line quick connect fitting (2) from the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
5. Disconnect the chassis evaporative emission (EVAP) line quick connect fitting (3) from the EVAP canister purge solenoid valve. Refer to Plastic Collar Quick Connect Fitting Service.
6. Remove the retaining clip (1) attached to the manifold absolute pressure (MAP) sensor bracket.

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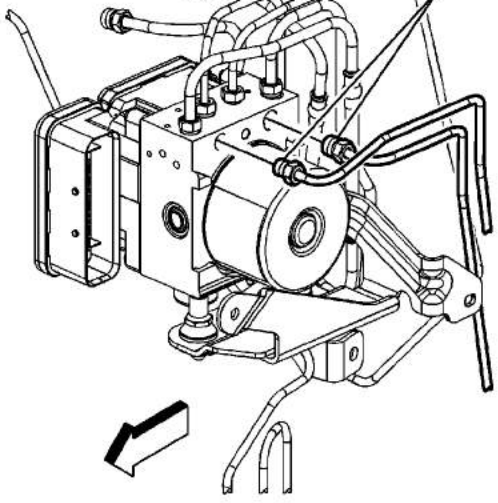
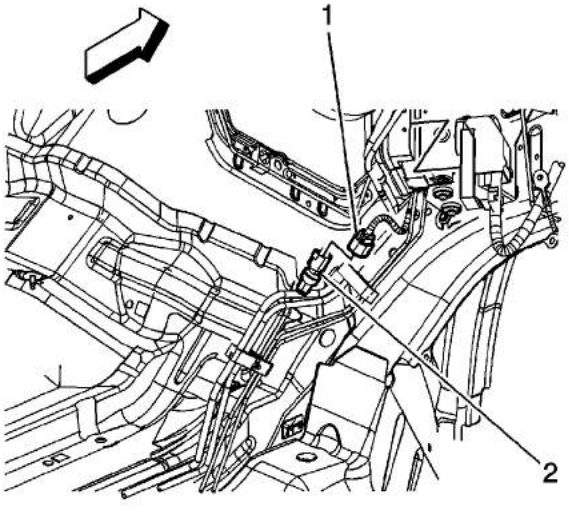


7. Remove the rear brake pipe fittings (1) from the brake pressure modulator valve (BPMV).
8. Cap the brake pipe fittings and plug the BPMV outlet ports in order to prevent brake fluid loss and contamination.



9. Remove the fuel tank. Refer to Fuel Tank Replacement.
10. Disconnect the body wiring harness electrical connector (1) from the fuel pressure sensor.

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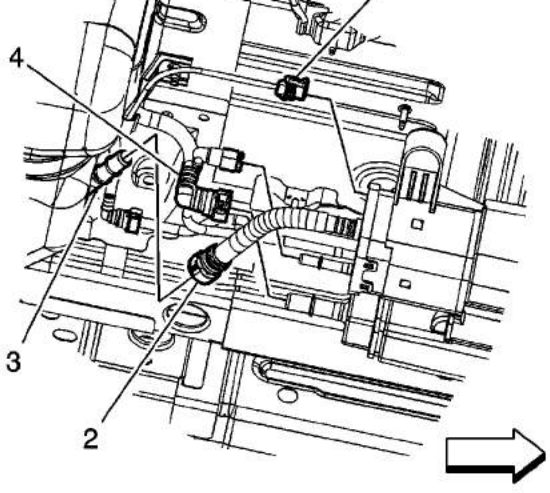
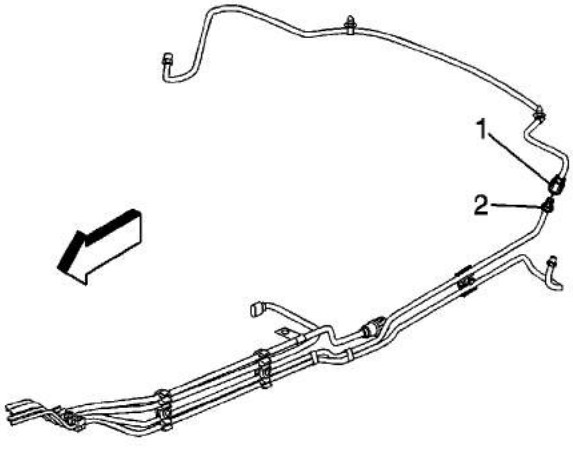


11. Disconnect the chassis EVAP line quick connect fitting (1) from the EVAP canister. Refer to Plastic Collar Quick Connect Fitting Service.



12. Remove the rear brake pipe fitting (2) from the rear brake crossover pipe fitting (1).
13. Cap the brake pipe fittings in order to prevent brake fluid loss and contamination.

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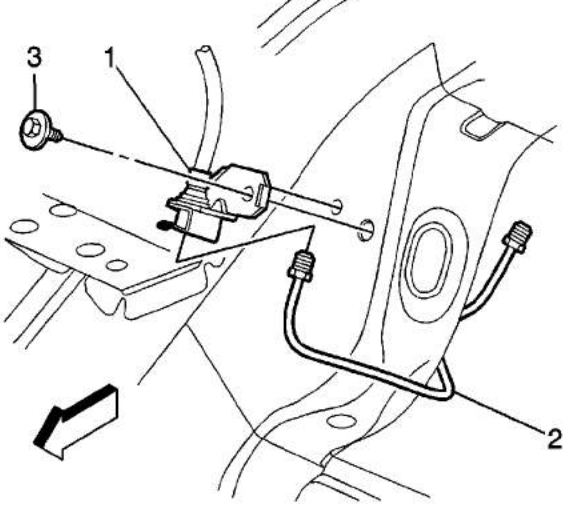
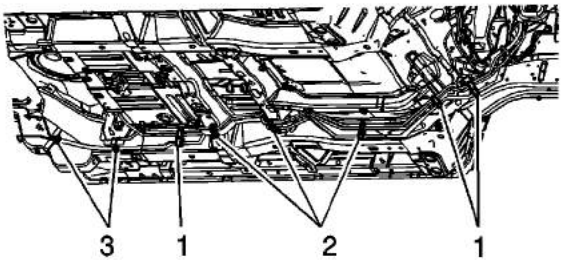


14. Remove the rear brake pipe (2) fitting from the rear brake hose fitting (1).
15. Cap the brake pipe fittings in order to prevent brake fluid loss and contamination.



16. Remove the brake, fuel and EVAP line retainers (1) from the underbody and side rail.
17. Remove the brake, fuel and EVAP line retainers (2) from the underbody studs.
18. Remove the brake line retainers (3) from the underbody side rail.

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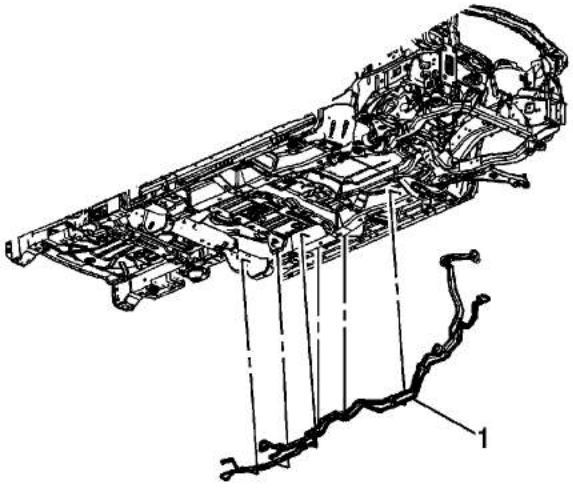
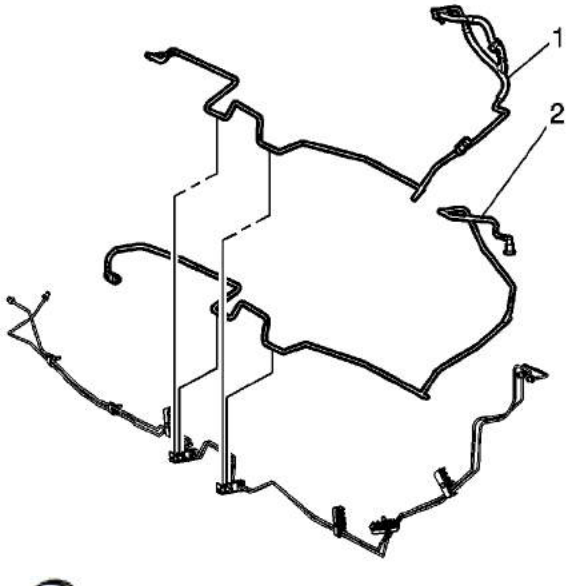


19. Remove the brake, fuel and EVAP line bundle (1) from the vehicle.



20. Open the upper fuel and EVAP line clip.
21. Remove the chassis fuel feed line (1) from the retainers.

Installation Procedure

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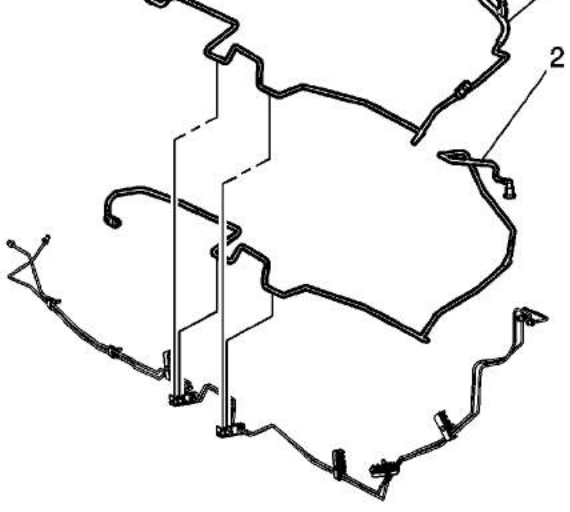
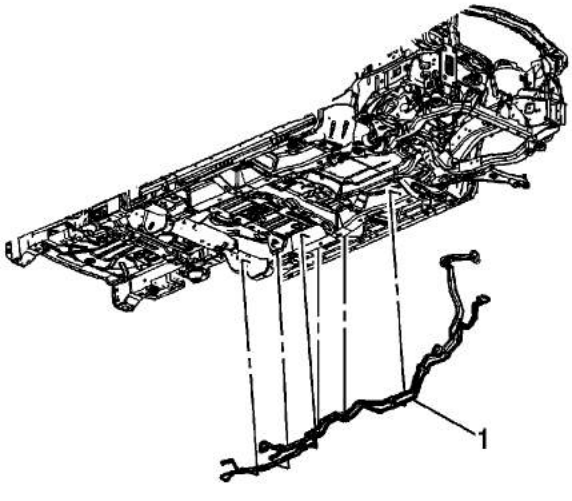


1. Install the chassis fuel feed line (1) to the retainers.
2. Close the upper fuel and EVAP line clip.



3. Install the brake, fuel and EVAP line bundle (1) to the vehicle.

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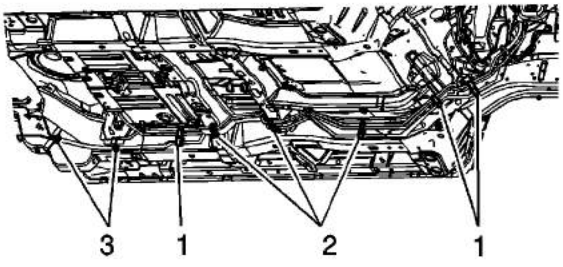
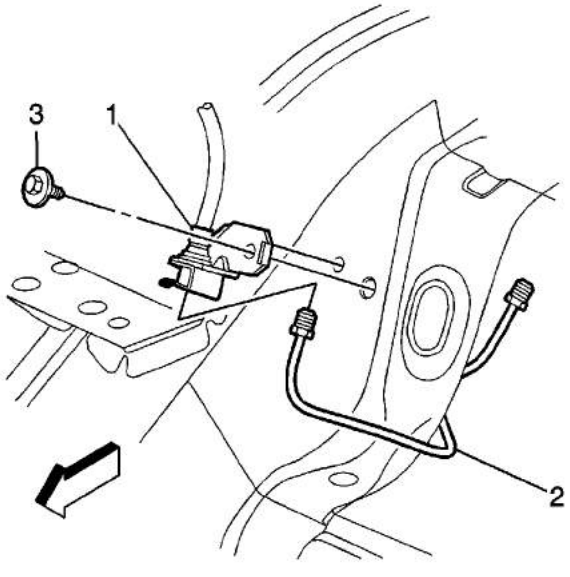


4. Install the brake, fuel and EVAP line retainers (1) to the underbody and side rail.
5. Install the brake, fuel and EVAP line retainers (2) to the underbody studs.
6. Install the brake line retainers (3) to the underbody side rail.



7. Remove the caps from the brake pipe fittings.

   Caution: Refer to Fastener Caution in the Preface section.

8. Install the rear brake pipe (2) fitting to the rear brake hose fitting (1).

   Tighten
   Tighten the fitting to 18 N·m (13 lb ft).

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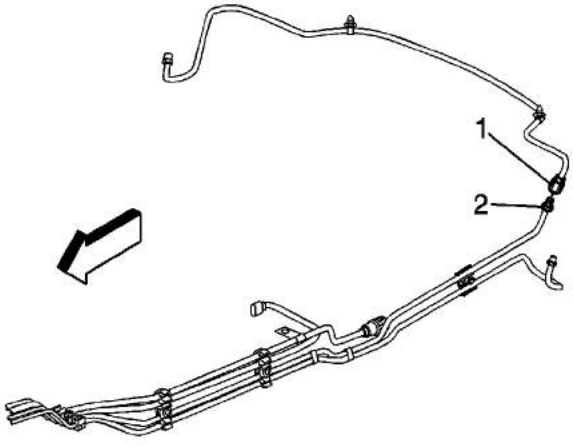
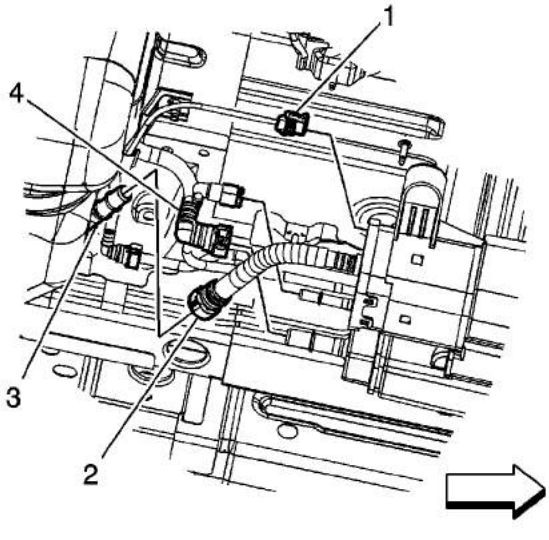


9. Remove the caps from the brake pipe fittings.
10. Install the rear brake pipe fitting (2) to the rear brake crossover pipe fitting (1).

Tighten
Tighten the fitting to 18 N·m (13 lb ft).



11. Connect the chassis EVAP line quick connect fitting (1) to the EVAP canister. Refer to Plastic Collar Quick Connect Fitting Service.

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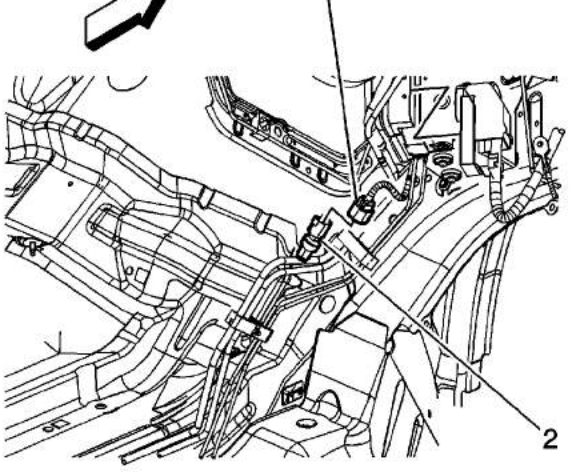
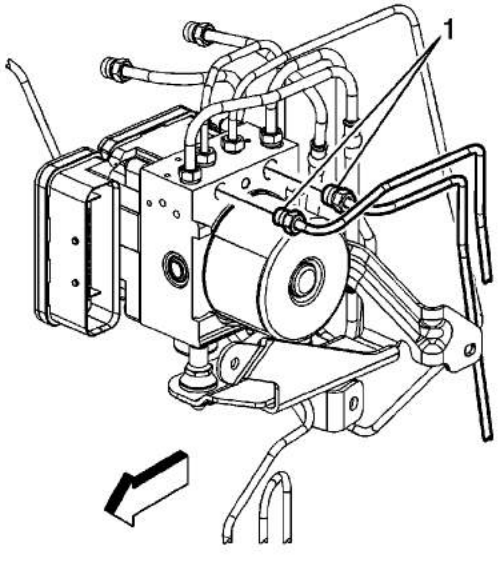


12. Connect the body wiring harness electrical connector (1) to the fuel pressure sensor.
13. Install the fuel tank. Refer to Fuel Tank Replacement.



14. Remove the caps and plugs from the brake pipe fittings and the BPMV outlet ports.
15. Install the rear brake pipe fittings (1) to the BPMV.

Tighten
Tighten the fittings to 21 N·m (16 lb ft).

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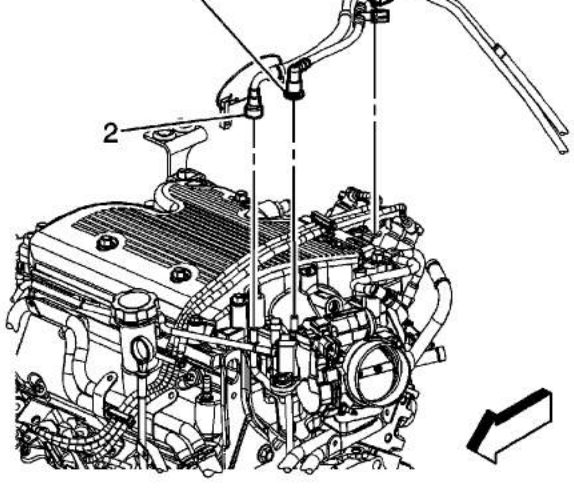

16. Connect the chassis fuel feed line quick connect fitting (2) to the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
17. Connect the chassis EVAP line quick connect fitting (3) to the EVAP canister purge solenoid valve. Refer to Plastic Collar Quick Connect Fitting Service.
18. Install the retaining clip (1) to the MAP sensor bracket.
19. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
20. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
21. Use the following procedure in order to inspect for leaks:
    21.1. Turn the ignition ON, with the engine OFF, for 2 seconds.
    21.2. Turn the ignition OFF for 10 seconds.
    21.3. Turn the ignition ON, with the engine OFF.
    21.4. Inspect for fuel leaks.
22. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.

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Fuel System Cleaning

Important: If the fuel filter is plugged, the fuel tank should be inspected internally and cleaned if necessary.

1. Remove the fuel tank. Refer to Fuel Tank Replacement .
2. Remove the fuel tank fuel pump module. Refer to Fuel Tank Fuel Pump Module Replacement and/or Fuel Tank Fuel Pump Module Replacement - Secondary.
3. Inspect the fuel pump module strainer. Replace the pump module assembly if the fuel strainer is contaminated.

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

4. Flush the fuel tank with hot water.
5. Pour the water out of the fuel sender assembly opening in the fuel tank. Rock the fuel tank in order to be sure that the removal of the water from the fuel tank is complete.
6. Allow the tank to dry completely before reassembly.
7. Disconnect the chassis fuel feed line quick connect fitting from the fuel rail. Refer to Metal Collar Quick Connect Fitting Service .

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

8. Clean the fuel pipes by applying air pressure in the opposite direction of the fuel flow.
9. Connect the chassis fuel feed line quick connect fitting to the fuel rail. Refer to Metal Collar Quick Connect Fitting Service .
10. Install the fuel pump module assembly. Refer to Fuel Tank Fuel Pump Module Replacement and/or Fuel Tank Fuel Pump Module Replacement - Secondary.
11. Install the fuel tank. Refer to Fuel Tank Replacement .

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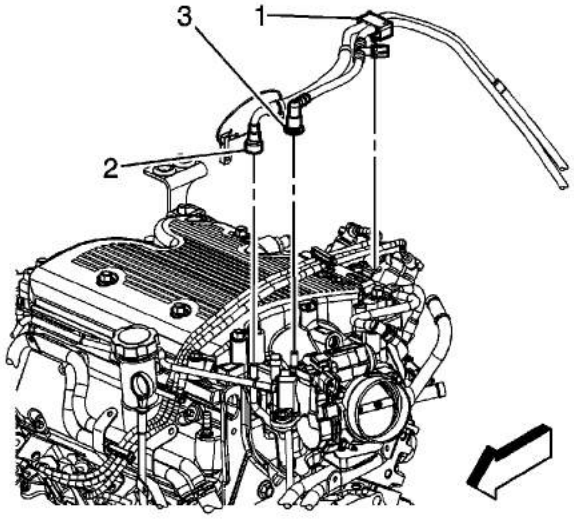
Fuel Injection Fuel Rail Assembly Replacement

Removal Procedure

Warning: In order to reduce the risk of fire and personal injury that may result from a fuel leak, always install the fuel injector O-rings in the proper position. If the upper and lower O-rings are different colors (black and brown), be sure to install the black O-ring in the upper position and the brown O-ring in the lower position on the fuel injector. The O-rings are the same size but are made of different materials.

Caution: Cap the fittings and plug the holes when servicing the fuel system in order to prevent dirt and other contaminants from entering the open pipes and passages.

An 8-digit identification number is stamped on the fuel rail. Refer to this number if servicing or part replacement is required.



1. Disconnect the chassis fuel feed line quick connect fitting (2) from the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
2. Remove the upper intake manifold. Refer to Upper Intake Manifold Replacement.

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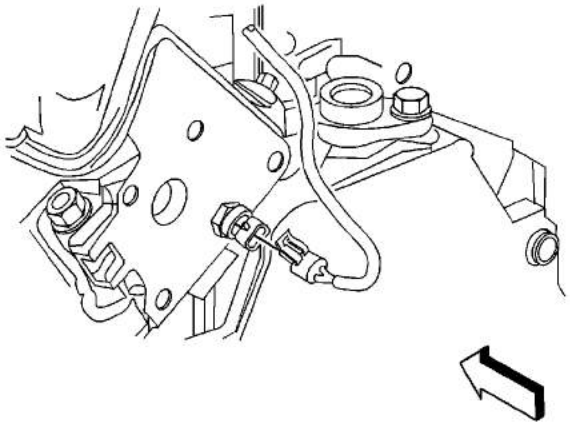
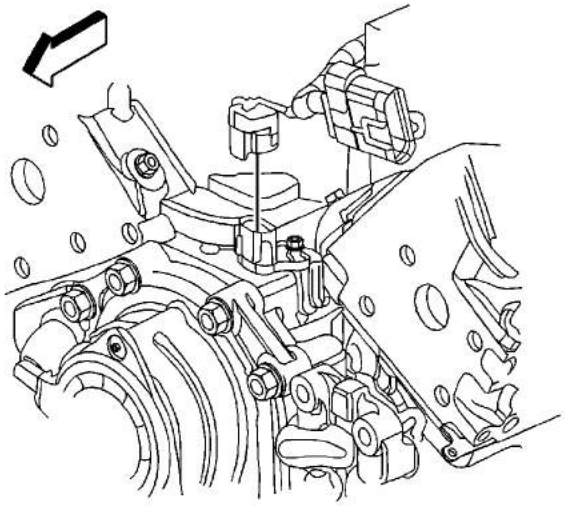


3. Disconnect the fuel injector wiring harness electrical connector from the engine coolant temperature (ECT) sensor.



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

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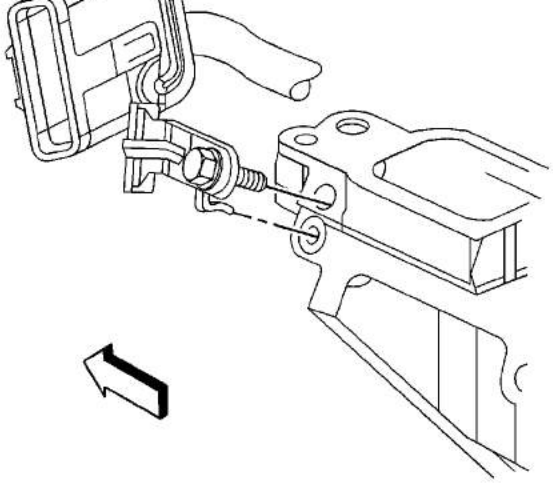
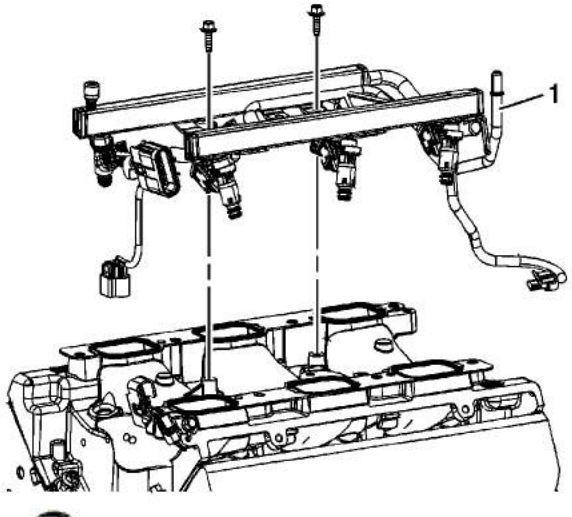


5. Remove the fuel injector wiring harness electrical connector bracket bolt from the intake manifold.



6. Remove the fuel rail bolts.
7. Remove the fuel rail (1).
8. Remove the fuel injector O-ring seal from the spray tip end of each injector, if the fuel rail was removed for other purposes.
9. If replacing the fuel rail proceed to the disassembly procedure, otherwise proceed to the Installation Procedure.

Disassembly Procedure

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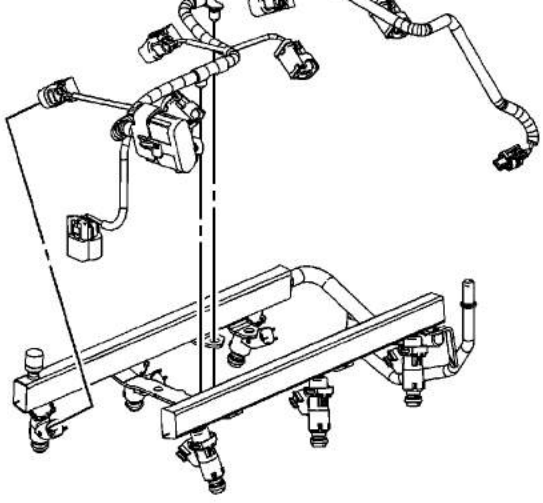
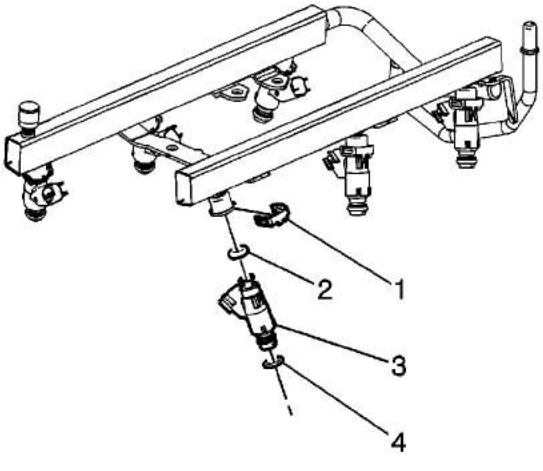


1. Disconnect the fuel injector wiring harness electrical connectors from the fuel injectors.
2. Remove the fuel injector wiring harness retainers from the fuel rail.
3. Remove the fuel injector wiring harness.



4. Remove the fuel injector retainers (1).
5. Remove the fuel injectors (3).
6. Remove the fuel injector upper (2) and lower (4) O-ring seals.

Assembly Procedure

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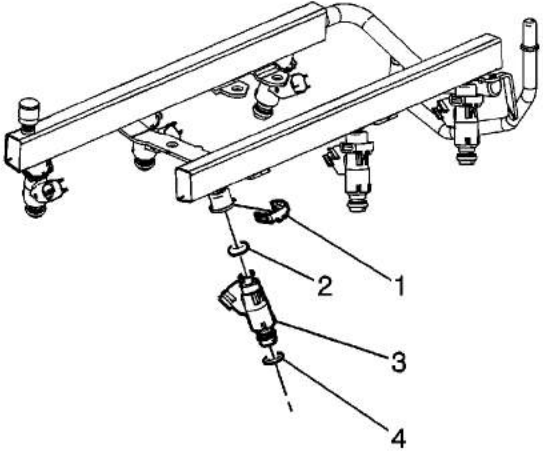
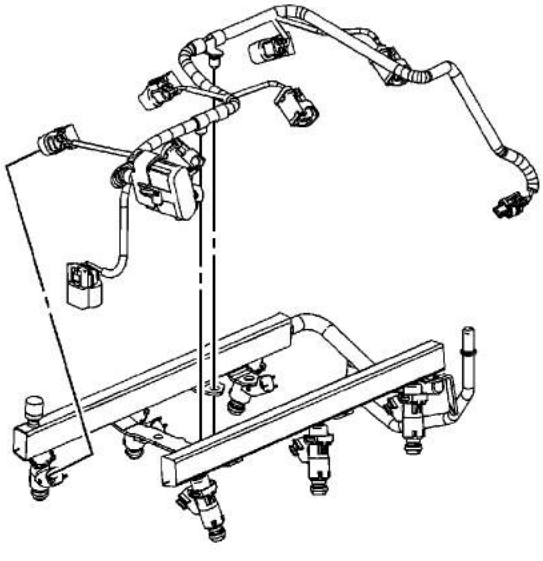


1. Lubricate the NEW injector O-ring seals with clean engine oil.
2. Install the NEW fuel injector upper (2) and lower (4) O-ring seals.
3. Install the fuel injectors (3).
4. Instal the fuel injector retainers (1).



5. Position the fuel injector wiring harness.
6. Install the fuel injector wiring harness retainers to the fuel rail.
7. Connect the fuel injector wiring harness electrical connectors to the fuel injectors.

Installation Procedure

Caution:

- Use care when servicing the fuel system components, especially the fuel injector electrical

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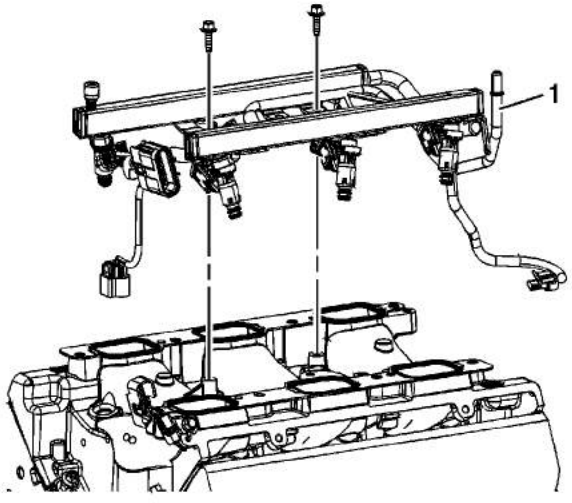
- Do not use compressed air to clean the fuel rail assembly as this may damage the fuel rail components.
- Do not immerse the fuel rail assembly in a solvent bath in order to prevent damage to the fuel rail assembly.



1. Install NEW fuel injector O-ring seals onto the spray tip end of each injector, if the fuel rail was removed for other purposes.
2. Install the fuel rail (1).

   Caution: Refer to Fastener Caution in the Preface section.

3. Install the fuel rail bolts.

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

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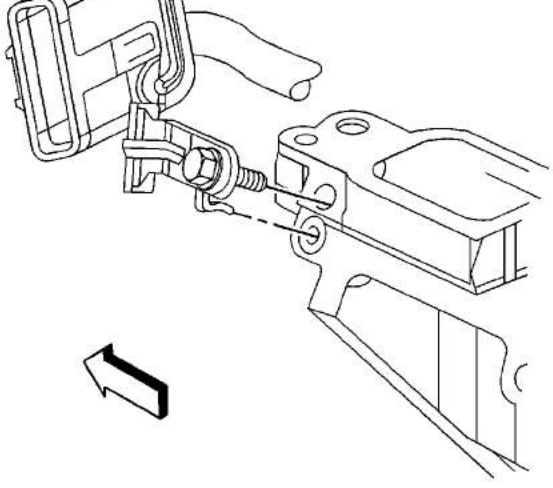
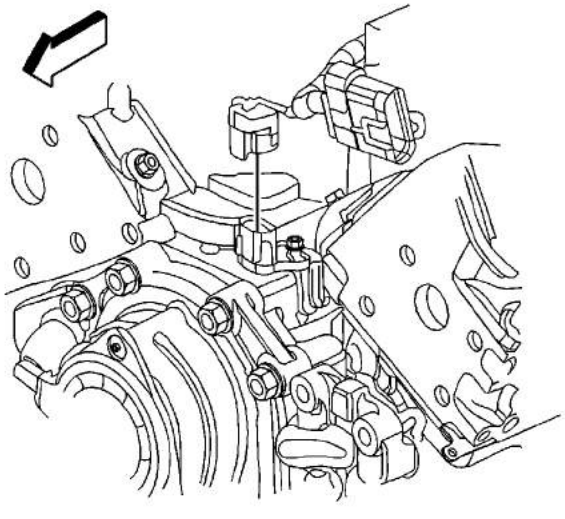


4. Align the bracket pin to the hole in the lower intake manifold.
5. Install the fuel injector wiring harness electrical connector bracket bolt to the intake manifold.

Tighten
Tighten the bolt to 14 N·m (10 lb ft).



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

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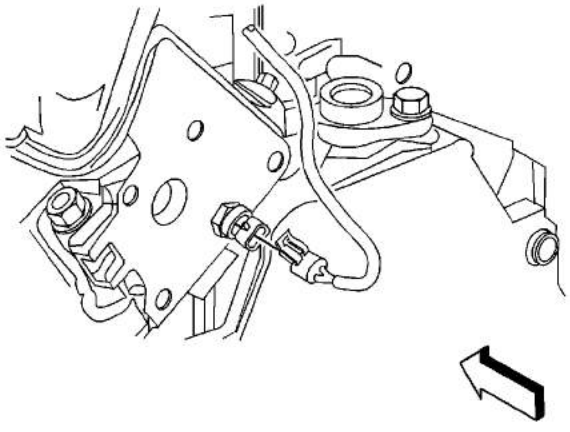
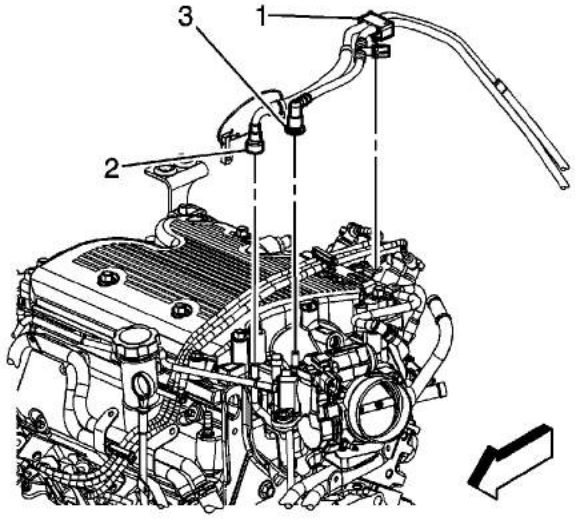


7. Connect the fuel injector wiring harness electrical connector to the ECT sensor.
8. Install the upper intake manifold. Refer to Upper Intake Manifold Replacement.



9. Connect the chassis fuel feed line quick connect fitting (2) to the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
10. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
11. Inspect for leaks.
    11.1. Turn ON the ignition, with the engine OFF for 10 seconds.
    11.2. Turn OFF the ignition for 10 seconds.
    11.3. Turn ON the ignition for 10 seconds.
    11.4. Inspect for fuel leaks.

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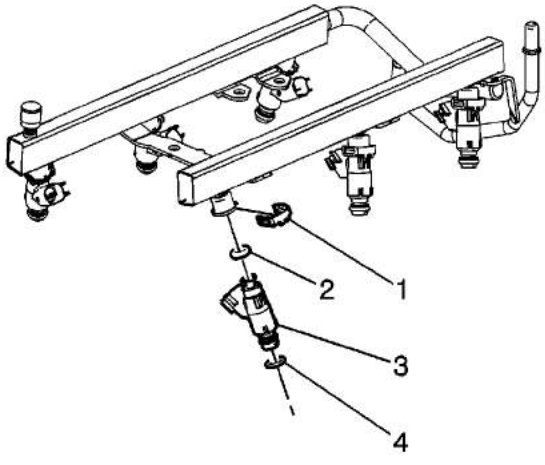
Fuel Injector Replacement

Removal Procedure

Caution: Use care in removing the fuel injectors in order to prevent damage to the fuel injector electrical connector pins or the fuel injector nozzles. Do not immerse the fuel injector in any type of cleaner. The fuel injector is an electrical component and may be damaged by this cleaning method.

Note: If the fuel injectors are found to be leaking, the engine oil may be contaminated with fuel.



1. Remove the fuel rail. Refer to Fuel Injection Fuel Rail Assembly Replacement.
2. Remove the fuel injector retainers (1).
3. Remove the fuel injectors (3).
4. Remove the fuel injector upper (2) and lower (4) O-ring seals.

Installation Procedure

Note: The fuel injector assembly is stamped with a part number identification. Be sure to use the correct part number when ordering replacement fuel injectors.

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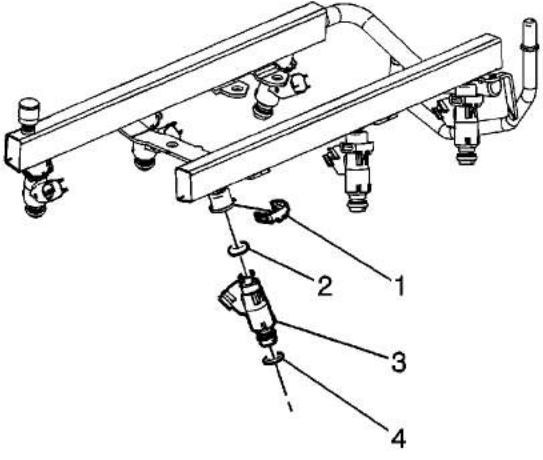

1. Lubricate the NEW injector O-ring seals with clean engine oil.
2. Install the NEW fuel injector upper (2) and lower (4) O-ring seals.
3. Install the fuel injectors (3).
4. Instal the fuel injector retainers (1).
5. Install the fuel rail. Refer to Fuel Injection Fuel Rail Assembly Replacement.

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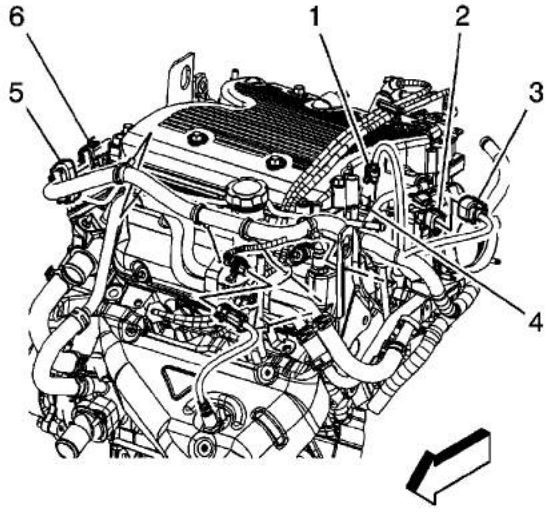
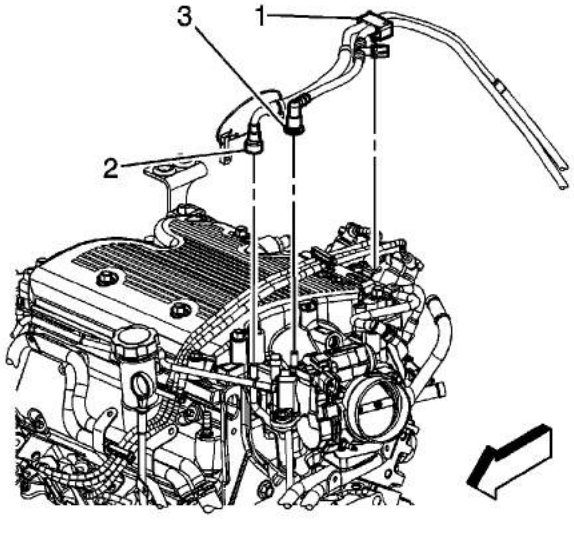
Evaporative Emission Canister Purge Solenoid Valve Replacement

Removal Procedure



1. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.
2. Disconnect the engine wiring harness electrical connector (1) from the evaporative emission (EVAP) canister purge solenoid (4).



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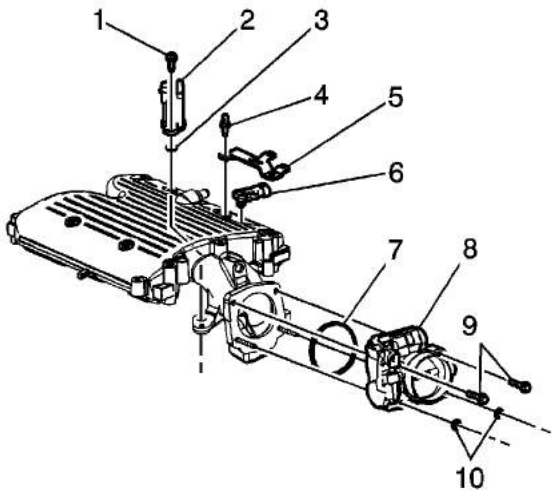
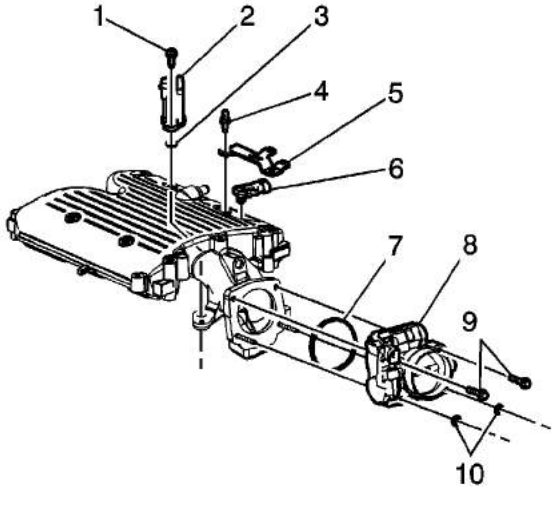


4. Remove the EVAP canister purge solenoid bolt (1).
5. Remove the EVAP canister purge solenoid (2) from the upper intake manifold.
6. Remove and discard the EVAP canister purge solenoid O-ring seal (3).

Installation Procedure



1. Install a NEW EVAP canister purge solenoid O-ring seal (3) to the upper intake manifold.
2. Install the EVAP canister purge solenoid (2) to the upper intake manifold.

Caution: Refer to Fastener Caution in the Preface section.

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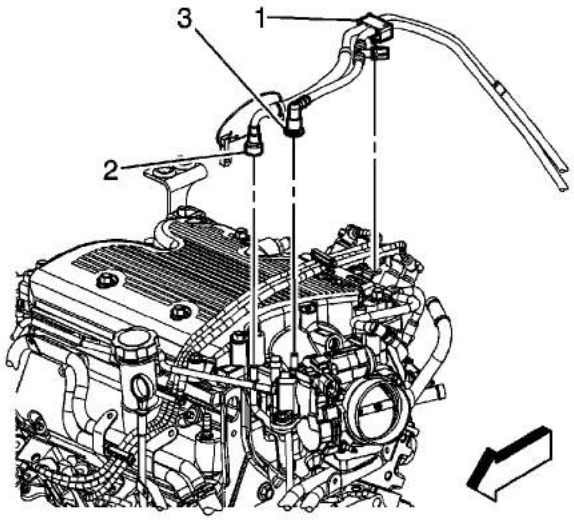
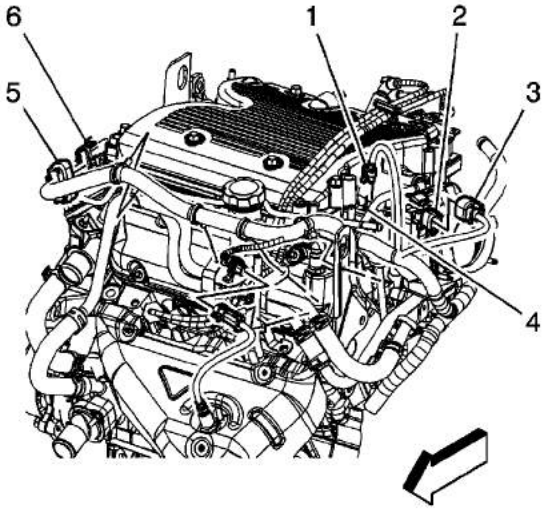
Tighten
Tighten the bolt to 16 N·m (12 lb ft).



4. Connect the chassis EVAP line quick connect fitting (3) to the EVAP canister purge solenoid. Refer to Plastic Collar Quick Connect Fitting Service.



5. Connect the engine wiring harness electrical connector (1) to the EVAP canister purge solenoid (4).
6. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.

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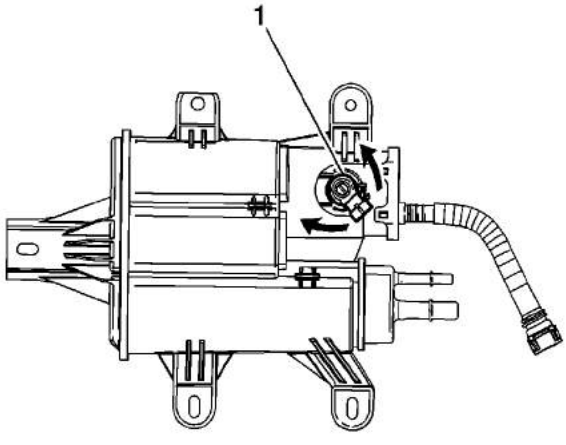
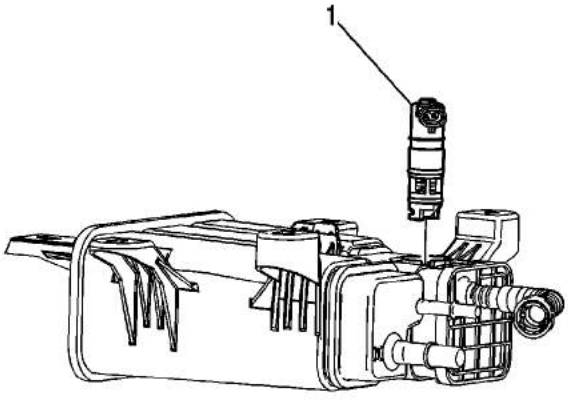
Evaporative Emission Canister Vent Solenoid Valve Replacement

Removal Procedure



1. Remove the evaporative emission (EVAP) canister. Refer to Evaporative Emission Canister Replacement.
2. Rotate the EVAP canister vent solenoid valve (1) clockwise.



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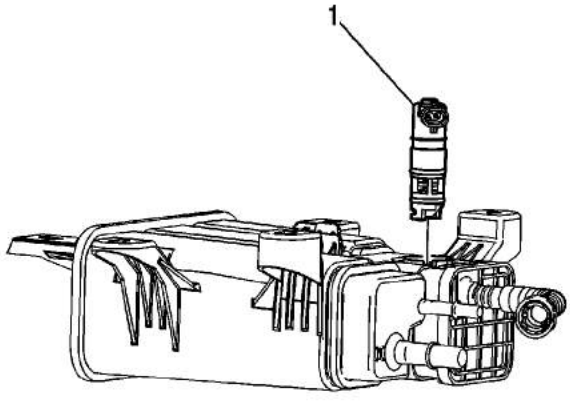
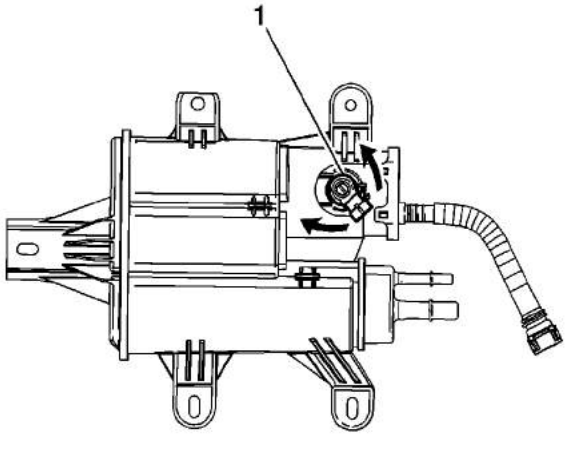
Installation Procedure



1. Install the EVAP canister vent solenoid valve (1) to the EVAP canister.



2. Rotate the EVAP canister vent solenoid valve counterclockwise until it reaches the positive stop.
3. Install the EVAP canister. Refer to Evaporative Emission Canister Replacement.

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Evaporative Emission Hoses / Pipes Replacement - Engine / Chassis

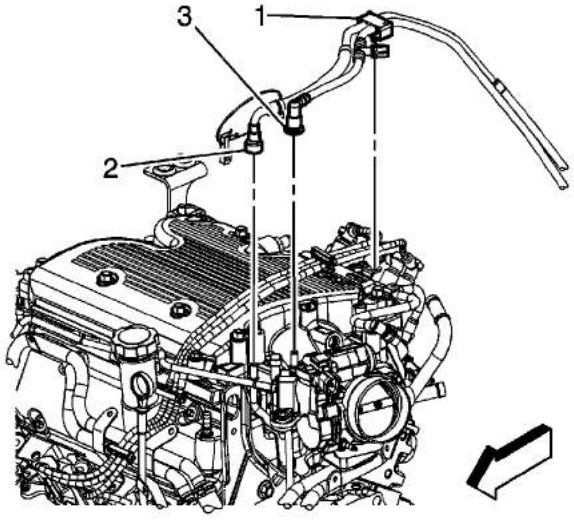
Removal Procedure

Warning: Ensure that the vehicle is properly supported and squarely positioned. To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle on the opposite end from which the components are being removed.

Warning: Do not allow smoking or the use of open flames in the area where work on the fuel or EVAP system is taking place. Anytime work is being done on the fuel system, disconnect the negative battery cable, except for those tests where battery voltage is required.

Warning: Whenever fuel lines are removed, catch fuel in an approved container. Container opening must be a minimum of 300 mm (12 in) diameter to adequately catch the fluid.

Caution: Fuel/Vapor lines cannot be spliced or repaired. The line must be replaced (if damaged) with the same type of line.



1. Relieve the fuel system pressure. Refer to Fuel Pressure Relief.
2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
3. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
4. Disconnect the chassis fuel feed line quick connect fitting (2) from the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
5. Disconnect the chassis evaporative emission (EVAP) line quick connect fitting (3) from the EVAP canister purge solenoid valve. Refer to Plastic Collar Quick Connect Fitting Service.
6. Remove the retaining clip (1) attached to the manifold absolute pressure (MAP) sensor bracket.

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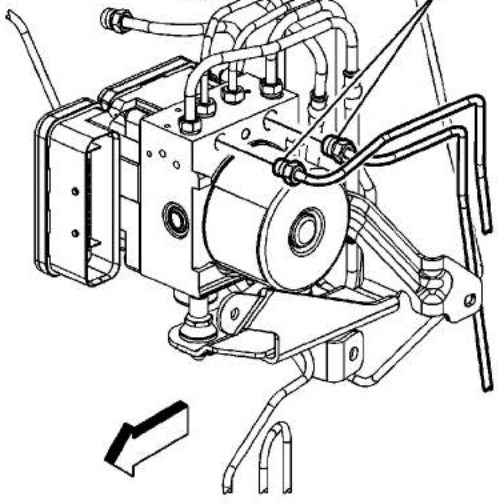
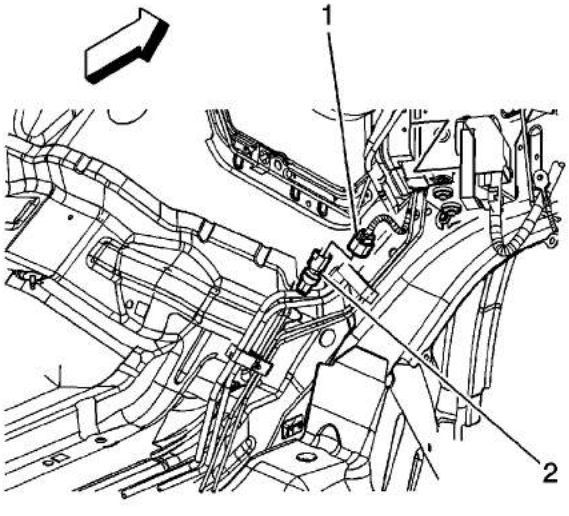


7. Remove the rear brake pipe fittings (1) from the brake pressure modulator valve (BPMV).
8. Cap the brake pipe fittings and plug the BPMV outlet ports in order to prevent brake fluid loss and contamination.



9. Remove the fuel tank. Refer to Fuel Tank Replacement.
10. Disconnect the body wiring harness electrical connector (1) from the fuel pressure sensor.

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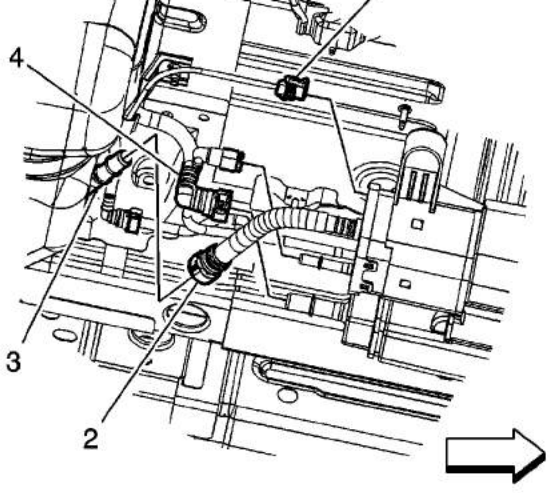
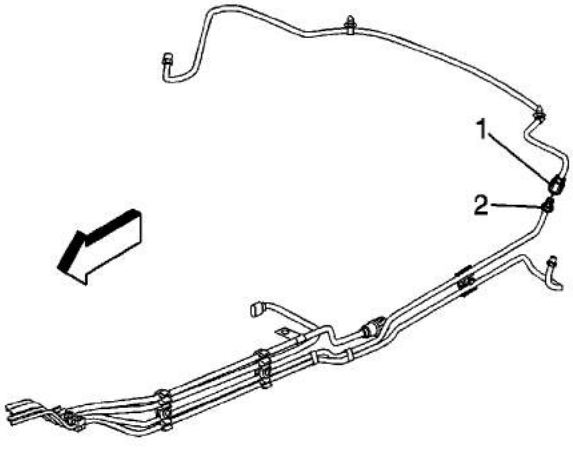


11. Disconnect the chassis EVAP line quick connect fitting (1) from the EVAP canister. Refer to Plastic Collar Quick Connect Fitting Service.



12. Remove the rear brake pipe fitting (2) from the rear brake crossover pipe fitting (1).
13. Cap the brake pipe fittings in order to prevent brake fluid loss and contamination.

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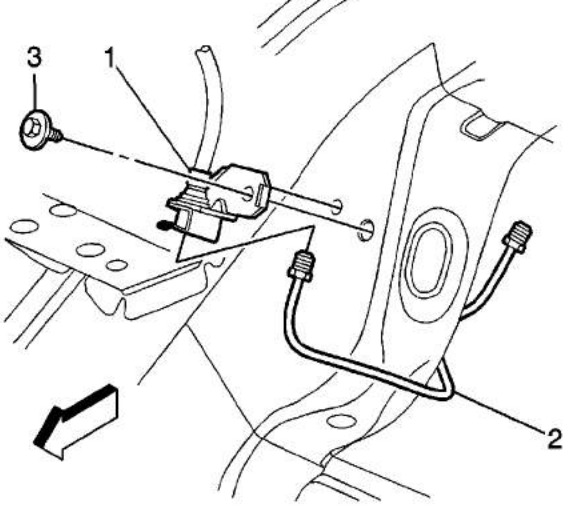
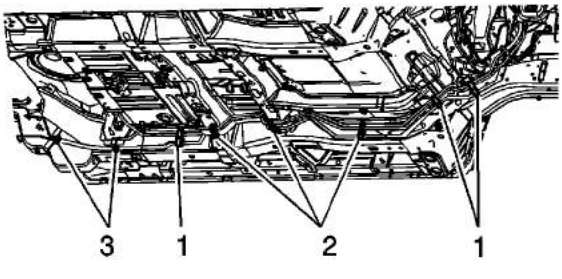


14. Remove the rear brake pipe (2) fitting from the rear brake hose fitting (1).
15. Cap the brake pipe fittings in order to prevent brake fluid loss and contamination.



16. Remove the brake, fuel and EVAP line retainers (1) from the underbody and side rail.
17. Remove the brake, fuel and EVAP line retainers (2) from the underbody studs.
18. Remove the brake line retainers (3) from the underbody side rail.

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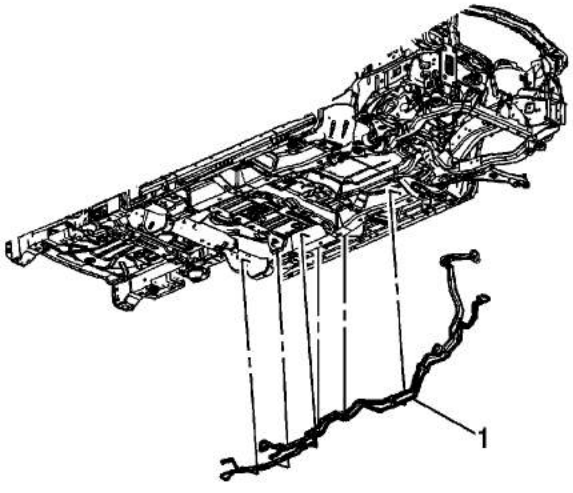
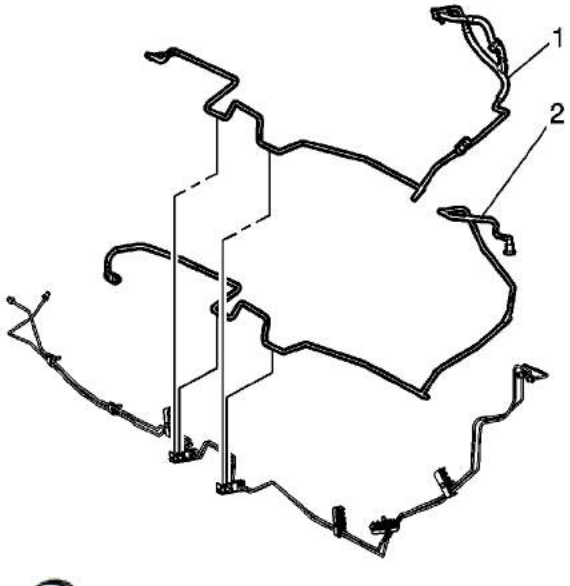


19. Remove the brake, fuel and EVAP line bundle (1) from the vehicle.



20. Open the upper fuel and EVAP line clip.
21. Remove the chassis EVAP line (2) from the retainers.

Installation Procedure

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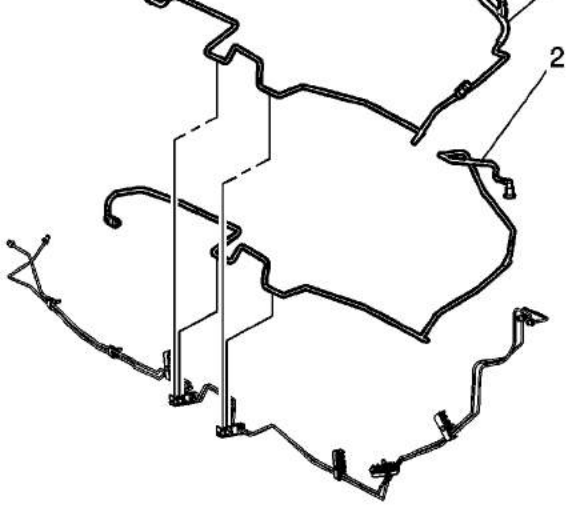
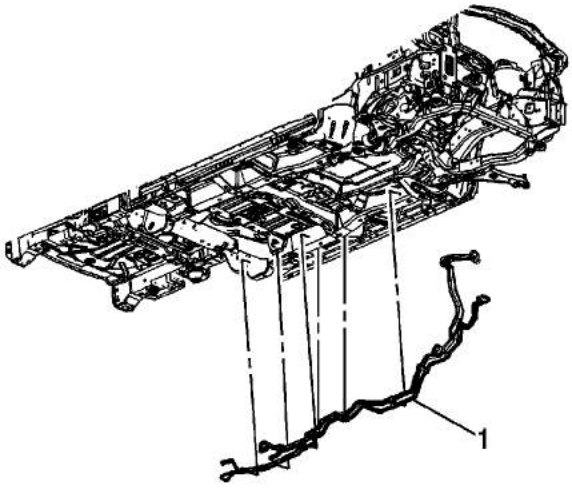


1. Install the chassis EVAP line (2) to the retainers.
2. Close the upper fuel and EVAP line clip.



3. Install the brake, fuel and EVAP line bundle (1) to the vehicle.

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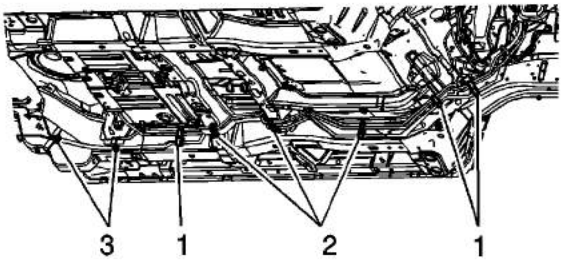
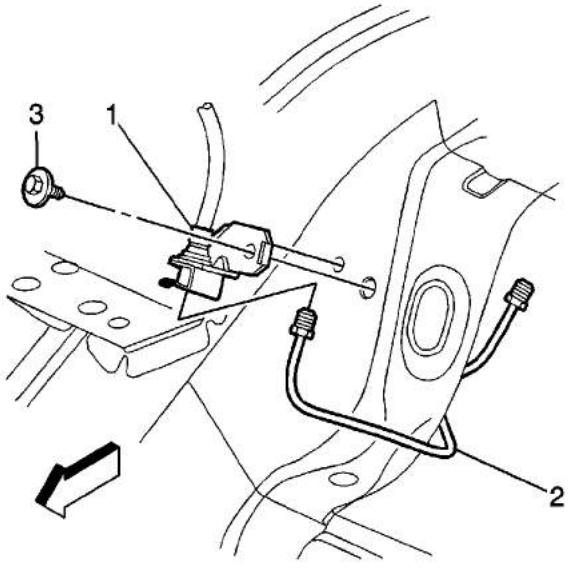


4. Install the brake, fuel and EVAP line retainers (1) to the underbody and side rail.
5. Install the brake, fuel and EVAP line retainers (2) to the underbody studs.
6. Install the brake line retainers (3) to the underbody side rail.



7. Remove the caps from the brake pipe fittings.

   Caution: Refer to Fastener Caution in the Preface section.

8. Install the rear brake pipe (2) fitting to the rear brake hose fitting (1).

   Tighten
   Tighten the fitting to 18 N·m (13 lb ft).

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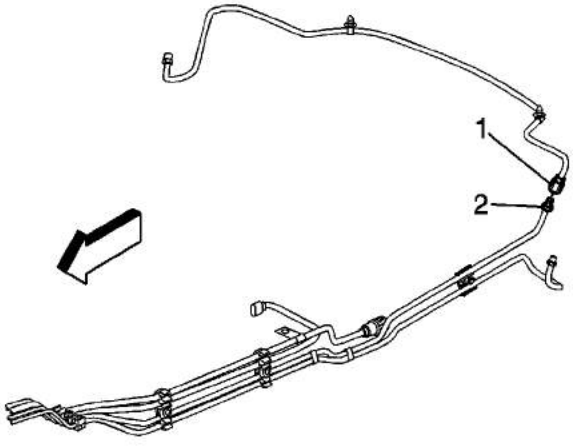
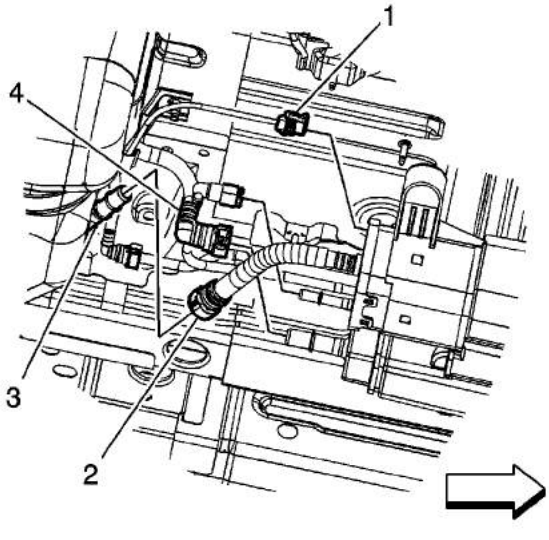


9. Remove the caps from the brake pipe fittings.
10. Install the rear brake pipe fitting (2) to the rear brake crossover pipe fitting (1).

Tighten
Tighten the fitting to 18 N·m (13 lb ft).



11. Connect the chassis EVAP line quick connect fitting (1) to the EVAP canister. Refer to Plastic Collar Quick Connect Fitting Service.

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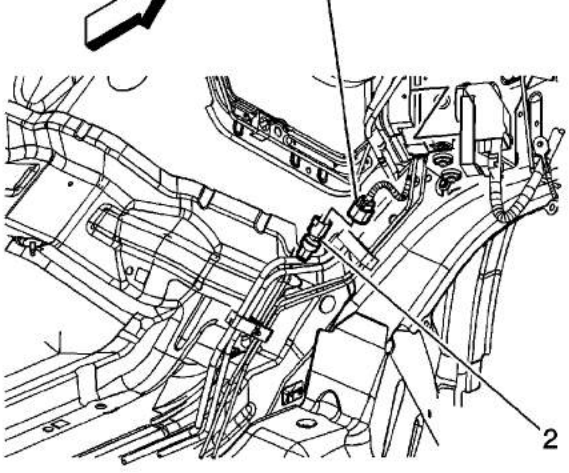
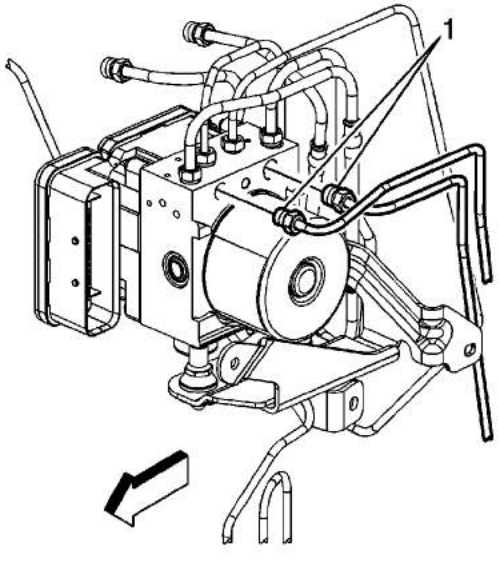


12. Connect the body wiring harness electrical connector (1) to the fuel pressure sensor.
13. Install the fuel tank. Refer to Fuel Tank Replacement.



14. Remove the caps and plugs from the brake pipe fittings and the BPMV outlet ports.
15. Install the rear brake pipe fittings (1) to the BPMV.

Tighten
Tighten the fittings to 21 N·m (16 lb ft).

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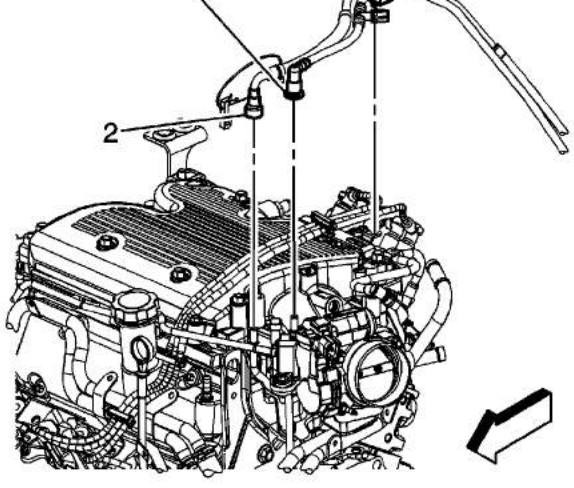

16. Connect the chassis fuel feed line quick connect fitting (2) to the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
17. Connect the chassis EVAP line quick connect fitting (3) to the EVAP canister purge solenoid valve. Refer to Plastic Collar Quick Connect Fitting Service.
18. Install the retaining clip (1) to the MAP sensor bracket.
19. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
20. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
21. Use the following procedure in order to inspect for leaks:
    21.1. Turn the ignition ON, with the engine OFF, for 2 seconds.
    21.2. Turn the ignition OFF for 10 seconds.
    21.3. Turn the ignition ON, with the engine OFF.
    21.4. Inspect for fuel leaks.
22. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.

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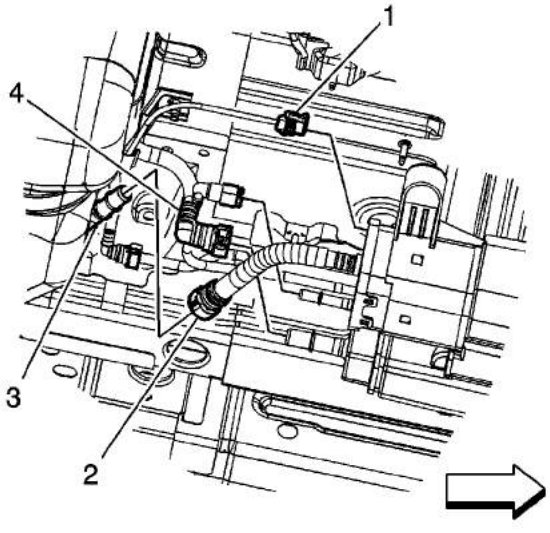
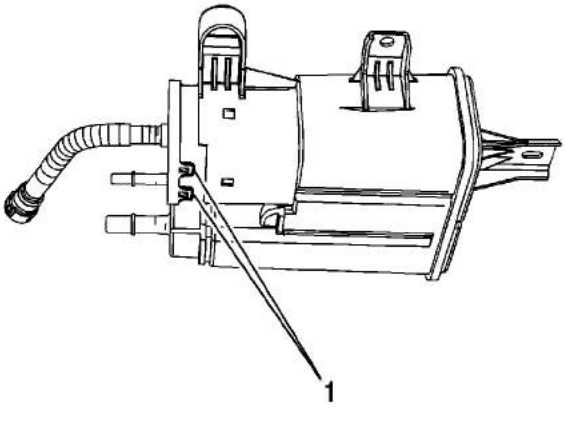
Evaporative Emission Canister Filter Replacement

Removal Procedure



1. Raise and suitably support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Disconnect the evaporative emission (EVAP) canister line quick connect fitting (2) from the fuel tank fresh air line (3). Refer to Plastic Collar Quick Connect Fitting Service.



3. Clean away any debris that may be present around the EVAP canister filter cover.
4. Using a small flat bladed tool, carefully release the EVAP canister filter cover lower retaining

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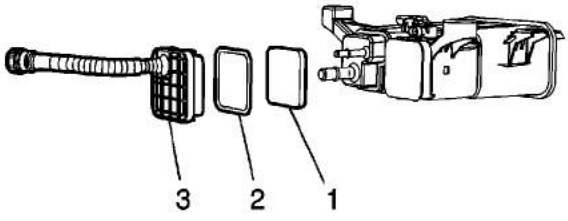
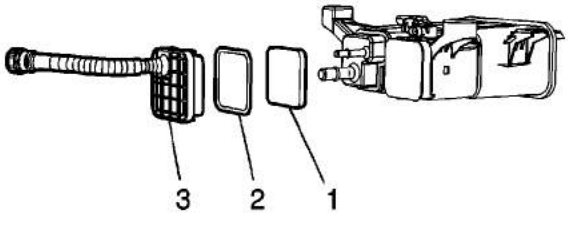


6. Remove the EVAP canister filter cover (3) from the EVAP canister.
7. Remove and discard the EVAP canister filter (1).
8. Remove and discard the filter cover seal (2).
9. Clean the inside of the EVAP canister filter housing with a clean shop towel.

Installation Procedure



1. Install a NEW filter cover seal (2) to the filter cover.
2. Install a NEW EVAP canister filter (1) to the EVAP canister.
3. Install the EVAP canister filter cover (3) to the EVAP canister.

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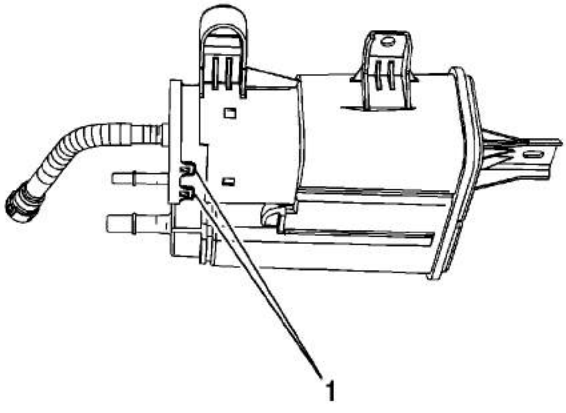
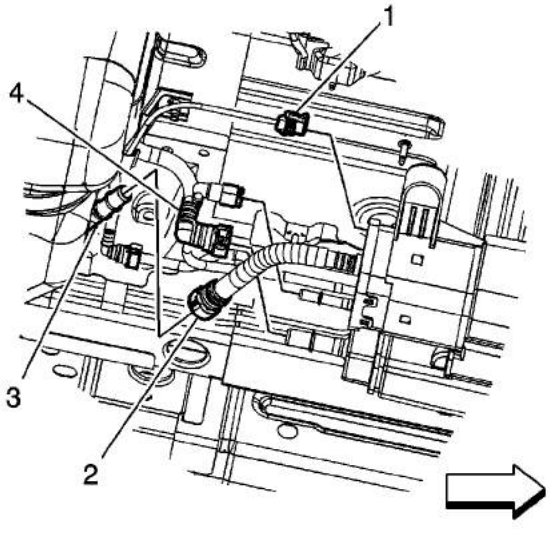


4. Ensure that the EVAP canister filter cover upper and lower retaining tabs (1) are fully engaged with the EVAP canister tabs.



5. Connect the EVAP canister line quick connect fitting (2) to the fuel tank fresh air line (3). Refer to Plastic Collar Quick Connect Fitting Service.
6. Lower the vehicle.

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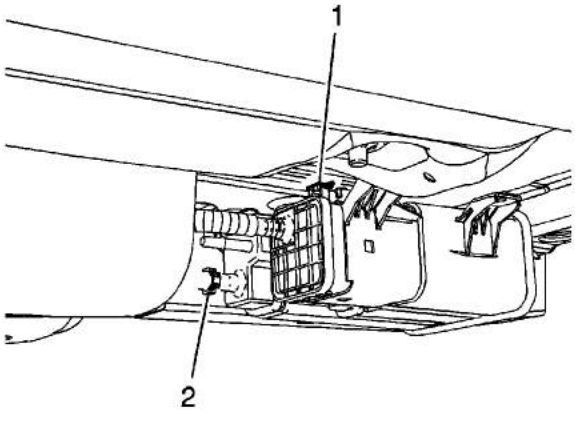
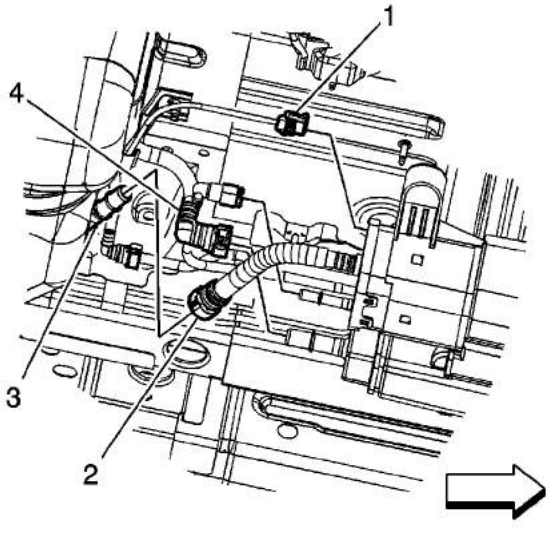
Evaporative Emission Canister Replacement

Removal Procedure

Warning: Ensure that the vehicle is properly supported and squarely positioned. To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle on the opposite end from which the components are being removed.



1. Raise and suitably support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Disconnect the fuel tank wiring harness electrical connector (1) from the evaporative emission (EVAP) canister vent solenoid valve.



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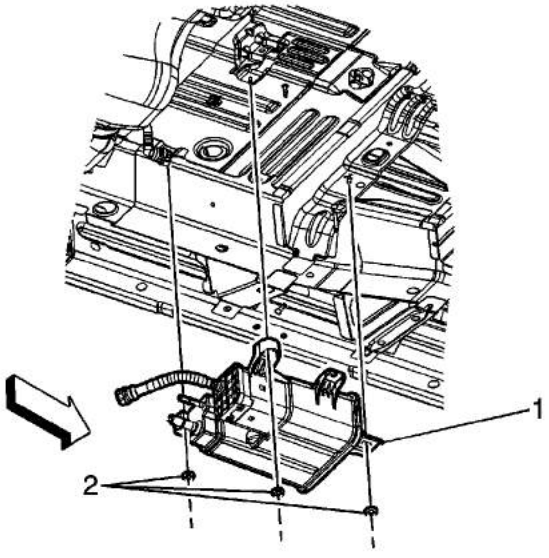
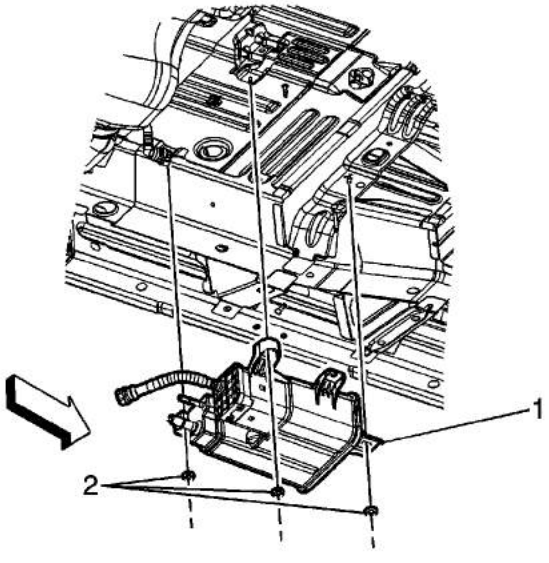
3. Disconnect the fuel tank vapor line quick connect fitting (4) from the EVAP canister. Refer to Plastic Collar Quick Connect Fitting Service.
4. Disconnect the chassis EVAP line quick connect fitting (1) from the EVAP canister. Refer to Plastic Collar Quick Connect Fitting Service.
5. Disconnect the EVAP canister line quick connect fitting (2) from the fuel tank fresh air line (3). Refer to Plastic Collar Quick Connect Fitting Service.



6. Remove the EVAP canisters nuts (2).
7. Remove the canister (1) from the vehicle underbody.

Installation Procedure



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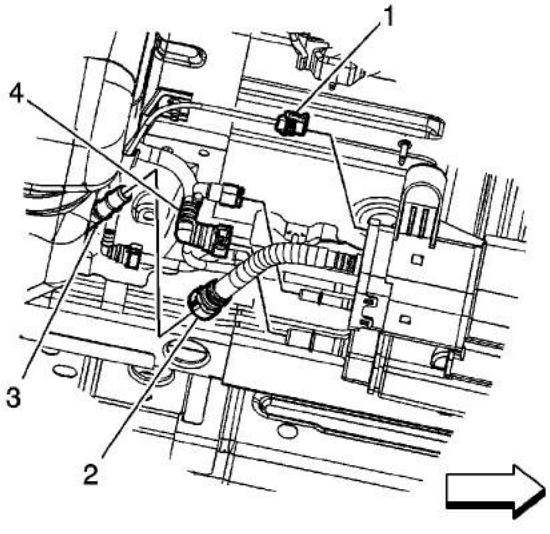
1. Position the EVAP canister (1) to the underbody studs.

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the EVAP canister nuts (2).

   Tighten
   Tighten the nuts to 8 N·m (71 lb in).



3. Connect the EVAP canister line quick connect fitting (2) to the fuel tank fresh air line (3). Refer to Plastic Collar Quick Connect Fitting Service.
4. Connect the fuel tank vapor line quick connect fitting (4) to the EVAP canister. Refer to Plastic Collar Quick Connect Fitting Service.
5. Connect the chassis EVAP line quick connect fitting (1) to the EVAP canister. Refer to Plastic Collar Quick Connect Fitting Service.

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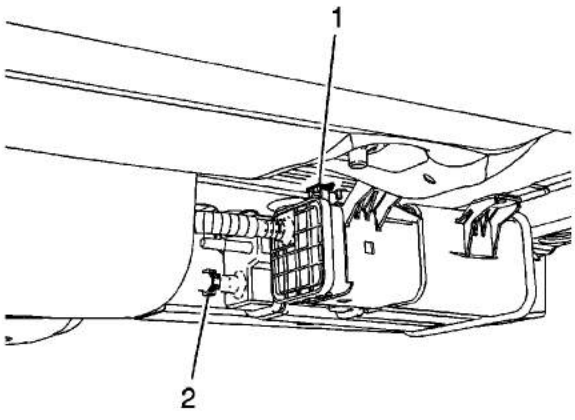

6. Connect the fuel tank wiring harness electrical connector (1) to the EVAP canister vent solenoid valve.
7. Lower the vehicle.

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Evaporative Emission System Cleaning

Special Tools

J 41413 EVAP Pressure and Purge Station

Inspection Procedure

Caution: Use the EVAP Pressure/Purge Diagnostic Station J 41413 in order to provide a clean, dry, low pressure gas source. Do not substitute any other pressurized gas source. Damage may result to the EVAP system.

Note: Proceed with the following procedure only if referenced by an evaporative emission (EVAP) diagnostic or repair procedure.

1. Turn OFF the ignition.
2. Remove the EVAP canister purge valve. Refer to Evaporative Emission Canister Purge Solenoid Valve Replacement.
3. Lightly tap the EVAP canister purge valve on a hard surface.
4. Inspect for carbon particles exiting either of the vacuum ports.
   - If no carbon particles were detected, but a blockage was detected during a diagnostic procedure, install the original EVAP canister purge valve. Continue with the cleaning procedure.
   - If carbon particles are found during the inspection procedure, continue with the cleaning procedure.
   - If a diagnostic procedure directed you to replace the EVAP canister purge valve and no carbon particles were detected, replace the EVAP canister purge valve. Return to the published service procedure.

Cleaning Procedure

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Remove the EVAP canister. Refer to Evaporative Emission Canister Replacement.
3. Turn OFF the main valve on the J 41413 .
4. Disconnect the hose from the diagnostic station pressure regulator.
5. Using a section of vacuum hose, connect one end onto the EVAP pressure/purge diagnostic station pressure regulator.
6. Connect the other end of the vacuum hose to the canister side of the purge pipe.
7. Turn ON the main nitrogen cylinder valve and continue to discharge nitrogen for 15 seconds.
8. If the nitrogen does not clear the blockage, replace the purge pipe.
9. Return the EVAP pressure/purge diagnostic station to the stations original condition.
10. Install a new EVAP canister. Refer to Evaporative Emission Canister Replacement.
11. Lower the vehicle.
12. Install a new EVAP canister purge valve. Refer to Evaporative Emission Canister Purge Solenoid Valve Replacement.
13. Return to the diagnostic table that sent you here.

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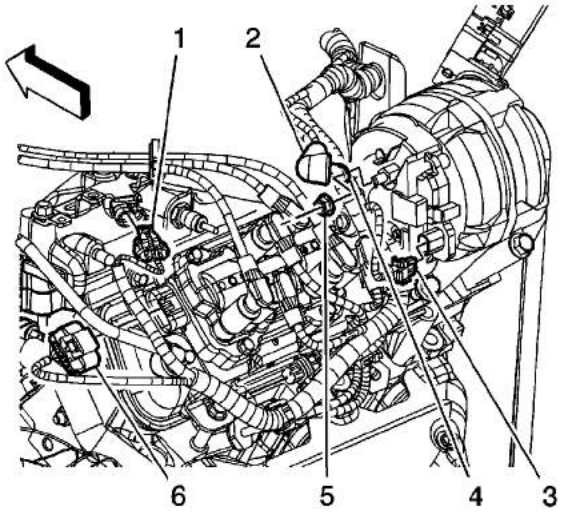
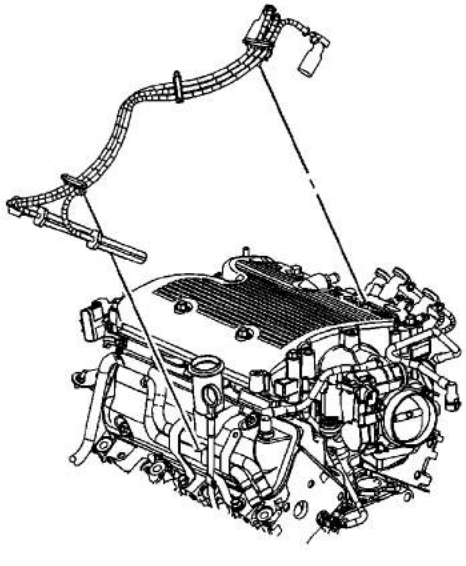
Ignition Coil Replacement

Removal Procedure

1. Remove the air cleaner outlet duct, if required. Refer to Air Cleaner Outlet Duct Replacement.



2. Disconnect the manifold absolute pressure (MAP) sensor electrical connector (1).
3. Disconnect the ignition coil electrical connector (6).



4. Disconnect the left side spark plug wires from the ignition coil.

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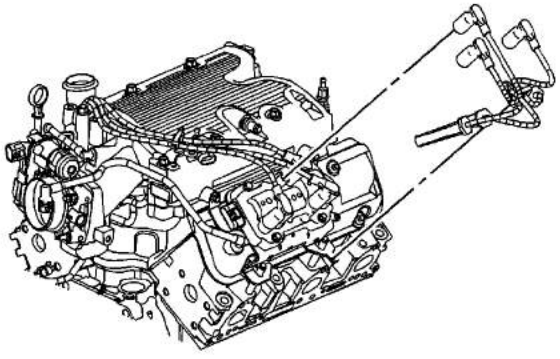
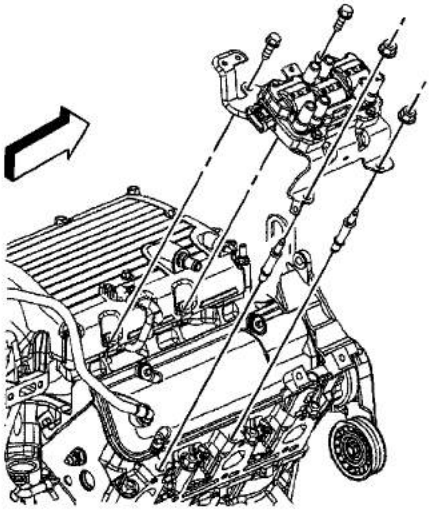


5. Disconnect the right side spark plug wires from the ignition coil.



6. Remove the ignition coil bracket bolts/nuts.
7. Remove the ignition coil assembly.
8. Remove the ignition coil bracket studs, if necessary.

Installation Procedure

Caution: Refer to Fastener Caution in the Preface section.

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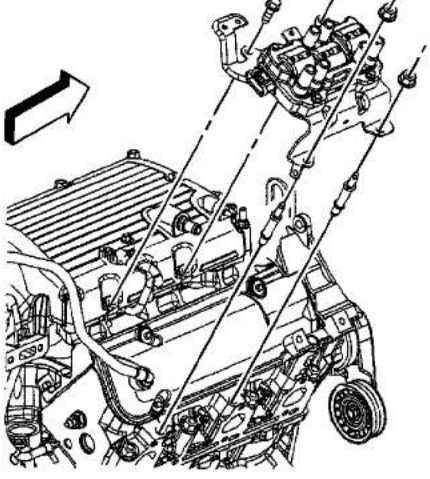
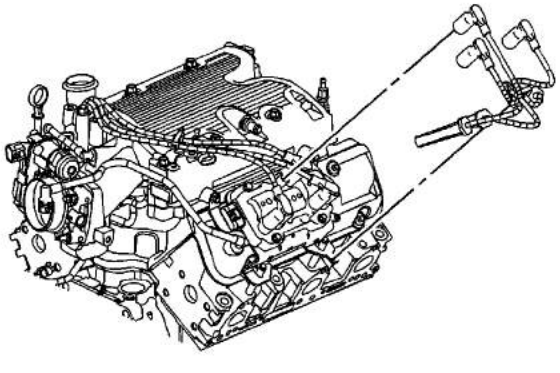


1. Install the ignition coil bracket studs, if necessary.

   Tighten
   Tighten the studs to 25 N·m (15 lb ft).

2. Install the ignition coil assembly.
3. Install the ignition coil bracket bolts/nuts.

   Tighten
   Tighten the bolts/nuts to 25 N·m (15 lb ft).



4. Connect the right side spark plug wires to the ignition coil.

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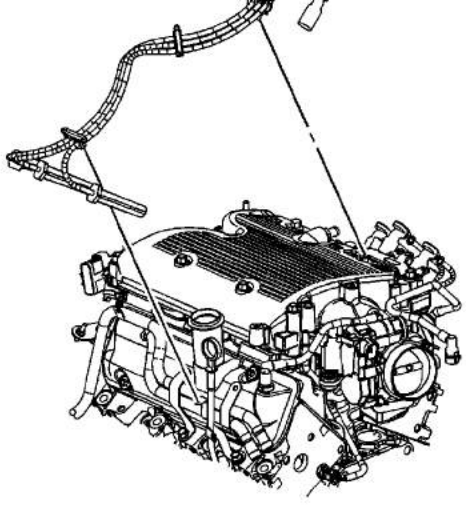
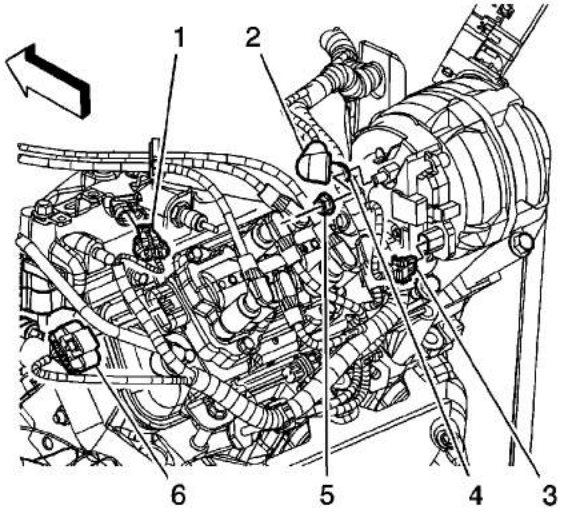


5. Connect the left side spark plug wires to the ignition coil.



6. Connect the ignition coil electrical connector (6).
7. Connect the MAP sensor electrical connector (1).
8. Install the air cleaner outlet duct, if required. Refer to Air Cleaner Outlet Duct Replacement.

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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. Refer to the list below for items to be inspected.

1. Inspect for correct routing of the spark plug wires. Improper routing may cause cross-firing. Refer to Spark Plug Wire Replacement.
2. Inspect each wire for any signs of cracks or splits in the wire.
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 terminal both the wire and the component connected to the wire should be replaced.

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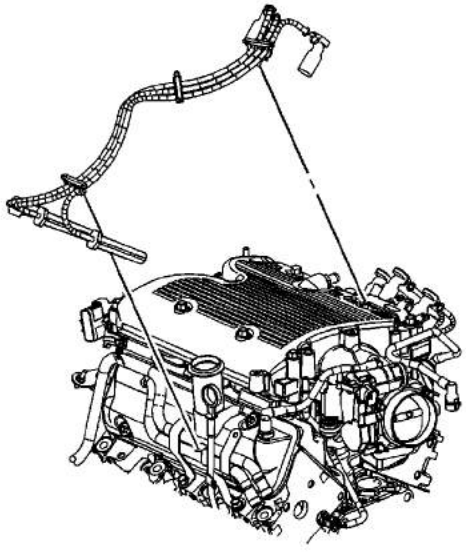
Spark Plug Wire Replacement

Removal Procedure

Notice: Twist the spark plug boot one-half turn in order to release the boot. Pull on the spark plug boot only. Do not pull on the spark plug wire or the wire could be damaged.

1. Remove the air cleaner outlet duct, if required. Refer to Air Cleaner Outlet Duct Replacement .



2. Disconnect the left side spark plug wires from the spark plugs.
3. Disconnect the left side spark plug wires from the ignition coil.
4. If replacing only one plug wire, open the retaining clips and remove the spark plug wire.
5. Remove the left side spark plug wire clips from the intake manifold bracket and heater inlet and outlet pipe.
6. Remove the spark plug wire assembly.

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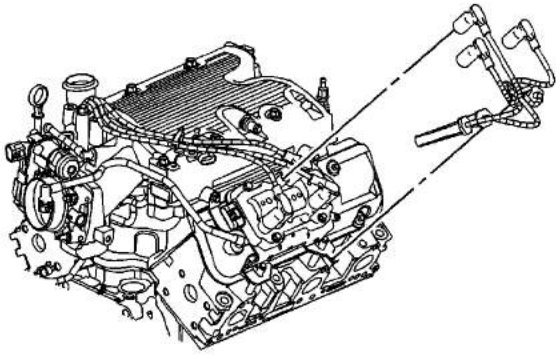
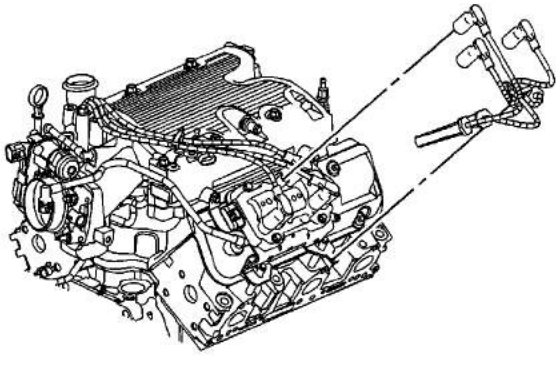


7. Disconnect the right side spark plug wires from the right side spark plugs.
8. Disconnect the left side spark plug wires from the ignition coil.
9. If replacing only one plug wire, open the retaining clips and remove the spark plug wire.
10. Remove the right side spark plug wire clip from the ignition coil bracket.
11. Remove the spark plug wire assembly.

Installation Procedure



1. Install the spark plug wire assembly.
2. Install the right side spark plug wire clip at the ignition coil bracket.
3. If only one plug wire was replaced, install the plug wire and close the retaining clip.
4. Connect the right side spark plug wires to the ignition coil.

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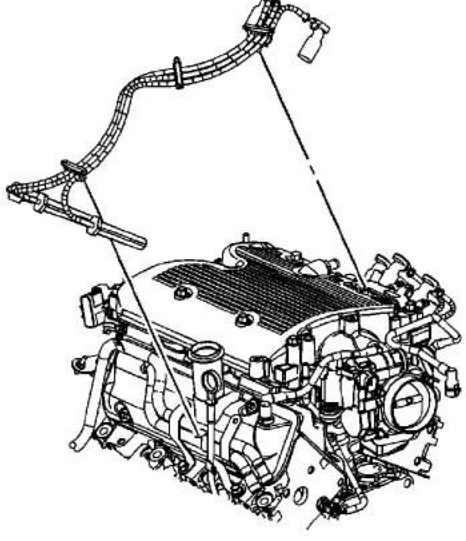

6. Install the spark plug wire assembly.
7. Install the left side spark plug wire clips at the intake manifold bracket and heater inlet and outlet pipe.
8. If only one plug wire was replaced, install the plug wire and close the retaining clips.
9. Connect the left side spark plug wires to the ignition coil.
10. Connect the left side spark plug wires to the spark plugs.
11. Install the air cleaner outlet duct, if required. Refer to Air Cleaner Outlet Duct Replacement .

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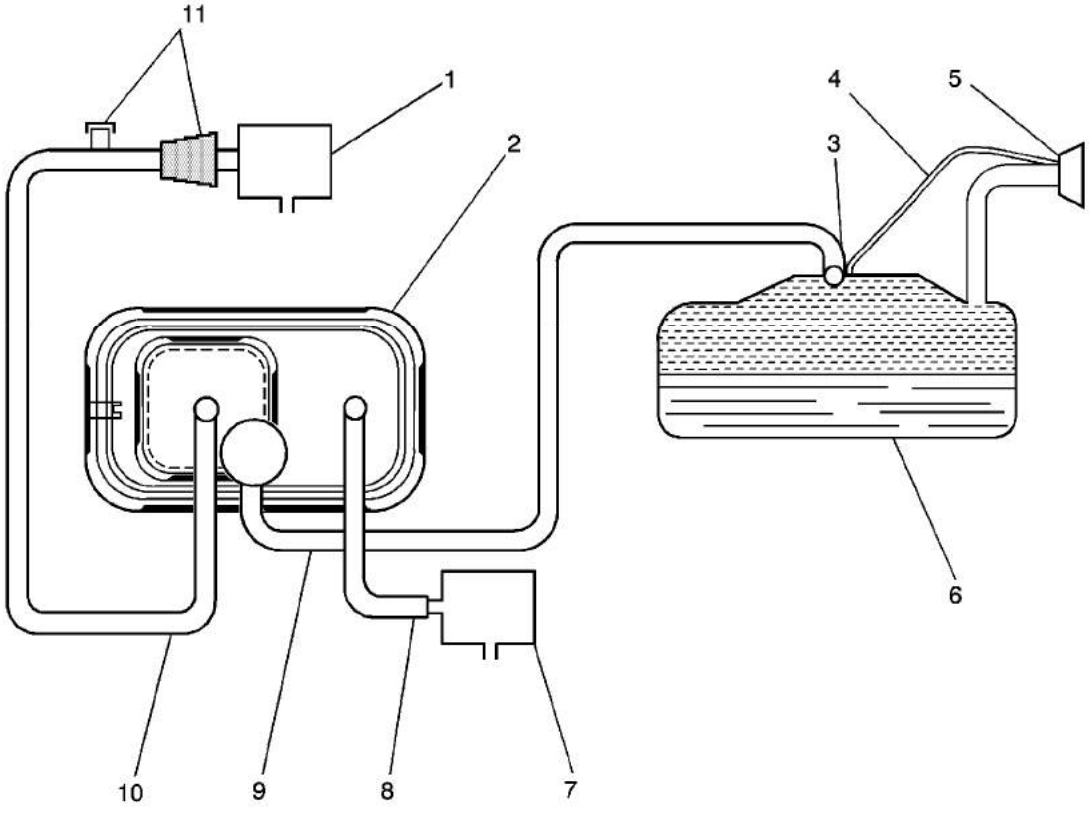
Evaporative Emissions Hose Routing Diagram



(1) EVAP Canister Purge Solenoid Valve
(2) EVAP Canister
(3) Fluid Level Vent Valve
(4) Vapor Recirculation tube
(5) Fuel Fill Neck and Fill Cap
(6) Fuel Tank
(7) EVAP Canister Vent Valve
(8) Vent Hose/Pipe
(9) EVAP Vapor tube
(10) EVAP Purge tube
(11) EVAP Service Port or Service Access Connector

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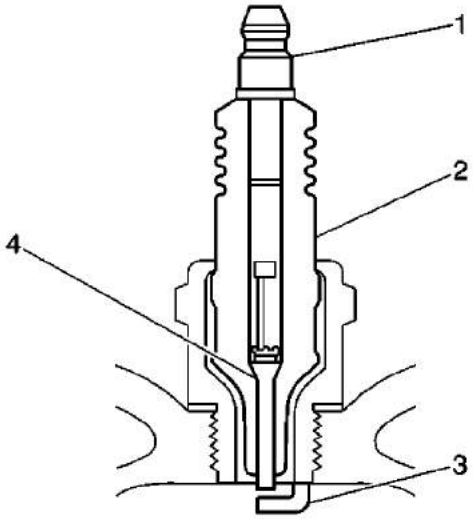
Spark Plug Inspection

Spark Plug Usage

- ı Ensure that the correct spark plug is installed. An incorrect spark plug causes driveability conditions. Refer to Ignition System Specifications for the correct spark plug.
- ı Ensure that the spark plug has the correct heat range. An incorrect heat range causes the following conditions:

- Spark plug fouling--Colder plug
- Pre-ignition causing spark plug and/or engine damage--Hotter plug

Spark Plug Inspection

- 

ı 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.

-

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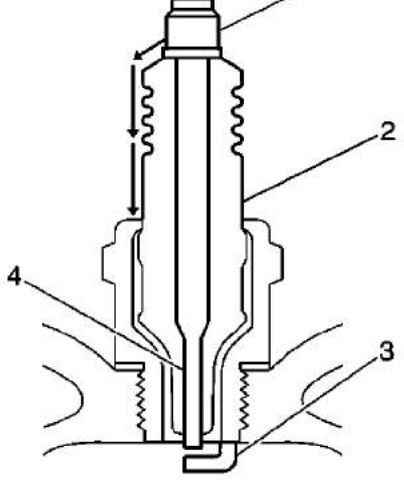
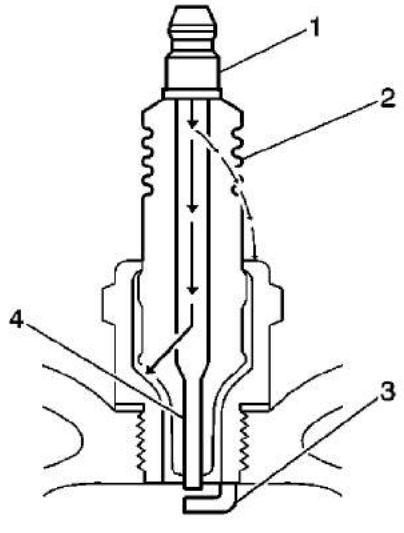


l Inspect the insulator (2) for flashover or carbon tracking, soot. This is caused by the electrical charge traveling across the insulator (2) between the terminal post (1) and ground. Inspect for the following conditions:

- Inspect the spark plug boot for damage.
- Inspect the spark plug recess area of the cylinder head for moisture, such as oil, coolant, or water. A spark plug boot that is saturated causes arcing to ground.



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

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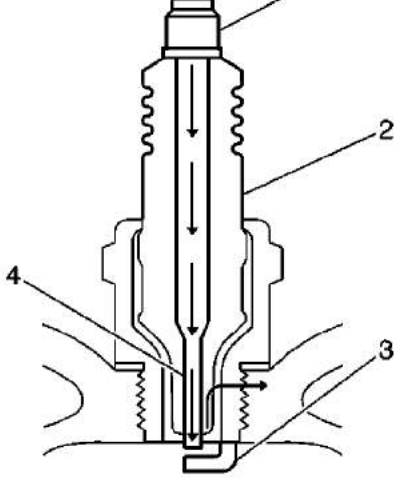

- Inspect for evidence of improper arcing.

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

Spark Plug Visual Inspection

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

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- Restricted air filter element
- Incorrect combustion
- Reduced ignition system voltage output
- Weak coils
- Worn ignition wires
- Incorrect spark plug gap
- Excessive idling or slow speeds under light loads can keep spark plug temperatures so low that normal combustion deposits may not burn off.
- Deposit Fouling--Oil, coolant, or additives that include substances such as silicone, very white coating, reduces the spark intensity. Most powdery deposits will not effect spark intensity unless they form into a glazing over the electrode.

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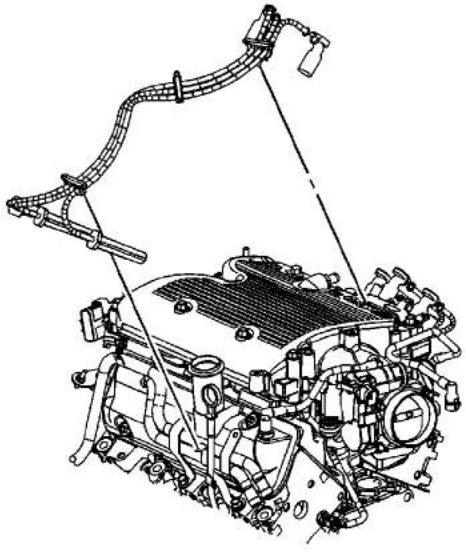
Spark Plug Replacement

Removal Procedure

Caution: Observe the following service precautions:

- Allow the engine to cool before removing the spark plugs. Attempting to remove spark plugs from a hot engine can cause the spark plugs to seize. This can damage the cylinder head threads.
- Clean the spark plug recess area before removing the spark plug. Failure to do so can result in engine damage due to dirt or foreign material entering the cylinder head, or in contamination of the cylinder head threads. Contaminated threads may prevent proper seating of the new spark plug.
- Use only the spark plugs specified for use in the vehicle. Do not install spark plugs that are either hotter or colder than those specified for the vehicle. Installing spark plugs of another type can severely damage the engine.

1. Remove the air cleaner outlet duct, if required. Refer to Air Cleaner Outlet Duct Replacement.



2. Remove the left side spark plug wires from the spark plugs, if required.

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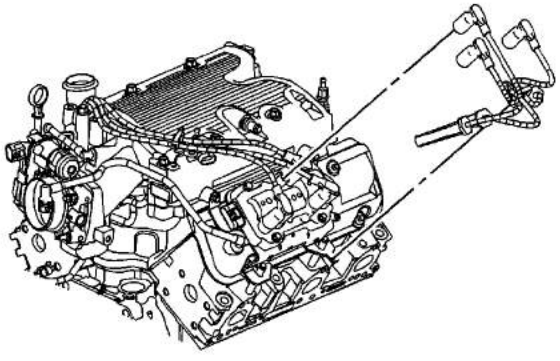
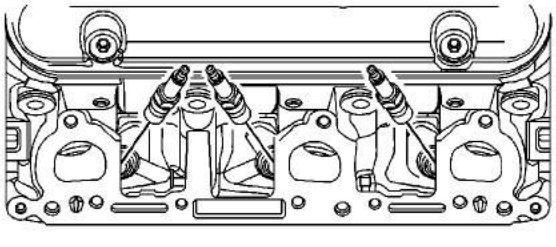


3. Remove the right side spark plug wires from the spark plugs, if required.



4. Remove the spark plugs as needed.

Installation Procedure

Caution: Check the gap of all new and reconditioned spark plugs before installation. The pre-set gaps may have changed during handling. Use a round feeler gage to ensure an accurate check. Installing the spark plugs with the wrong gap can cause poor engine performance and may even damage the engine.

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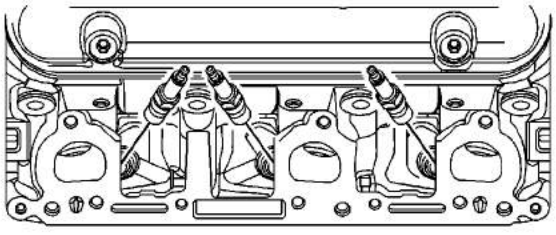
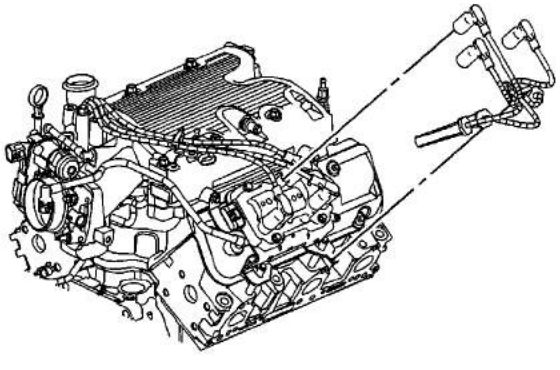


1. Gap the NEW spark plugs, if replacing. Refer to Ignition System Specifications.

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the spark plugs as needed.

   Tighten
   Tighten the plugs to 15 N·m (11 lb ft).



3. Install the right side spark plug wires to the spark plugs, if required.

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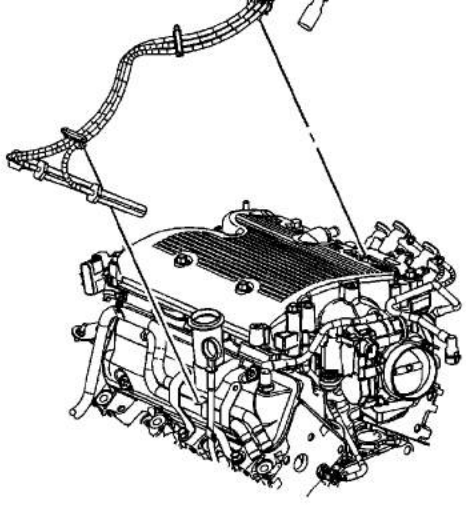

4. Install the left side spark plug wires to the spark plugs, if required.
5. Install the air cleaner outlet duct, if required. Refer to Air Cleaner Outlet Duct Replacement.

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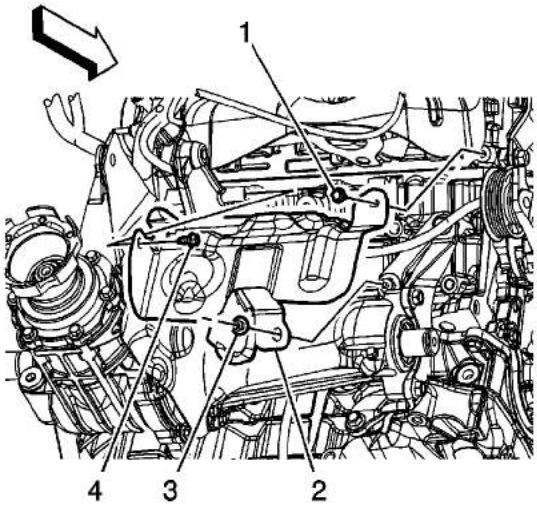
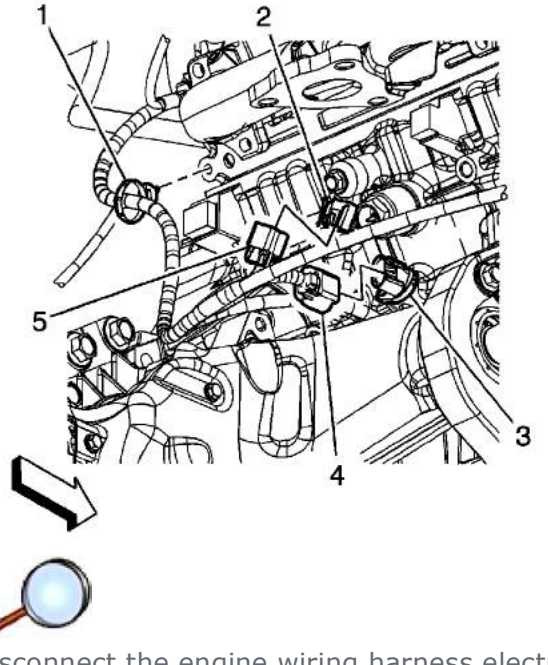
Crankshaft Position Sensor Replacement

Removal Procedure



1. Remove the right catalytic converter. Refer to Catalytic Converter Replacement - Right Side.
2. Remove the engine wiring harness heat shield nut (3).
3. Remove the engine wiring harness heat shield bolts (1 and 4).
4. Remove the engine wiring harness heat shield (2).



5. Disconnect the engine wiring harness electrical connector (4) from the crankshaft position

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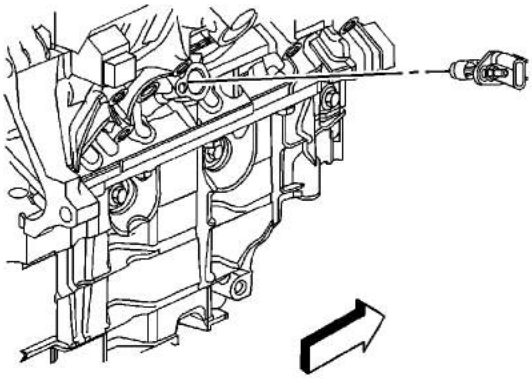
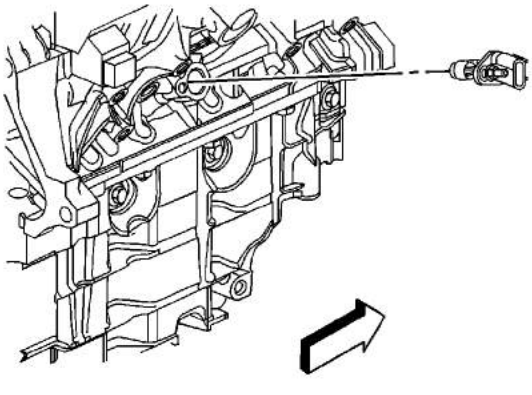


6. Remove the CKP sensor stud.
7. Remove the CKP sensor.

Installation Procedure



1. Lubricate the CKP sensor O-ring with clean engine oil.
2. Remove the CKP sensor.

Caution: Refer to Fastener Caution in the Preface section.

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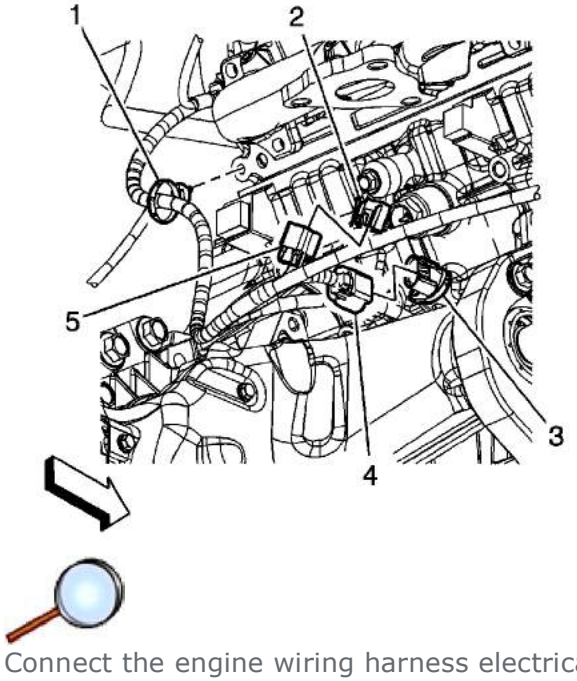
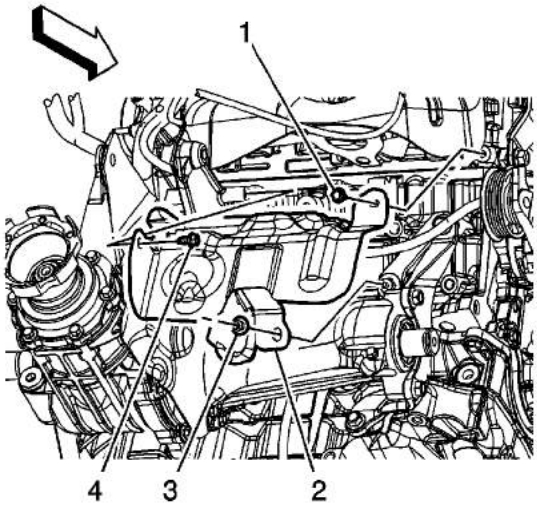
Tighten
Tighten the stud to 10 N·m (89 lb in).



4. Connect the engine wiring harness electrical connector (4) to the CKP sensor (3).



5. Install the engine wiring harness heat shield (2).
6. Install the engine wiring harness heat shield bolts (1 and 4).

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

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

8. Install the right catalytic converter. Refer to Catalytic Converter Replacement - Right Side.
9. Perform the CKP system variation learn procedure. Refer to Crankshaft Position System Variation Learn.

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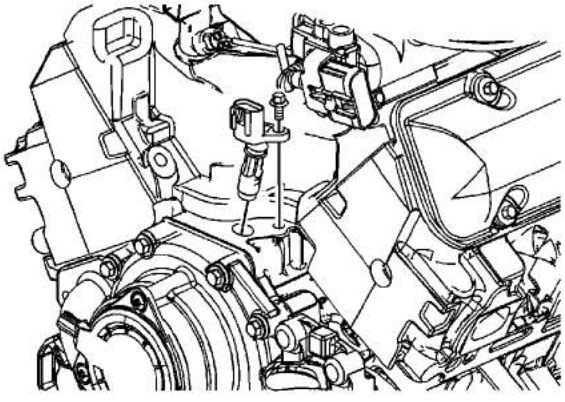
Camshaft Position Sensor Replacement

Removal Procedure

1. Remove the power steering pump. Refer to Power Steering Pump Replacement.



2. Disconnect the camshaft position (CMP) sensor electrical connector.
3. Remove the CMP sensor bolt.
4. Remove the CMP sensor.
5. Inspect the sensor O-ring for wear, cracks, or leakage if the sensor is not being replaced.

Installation Procedure

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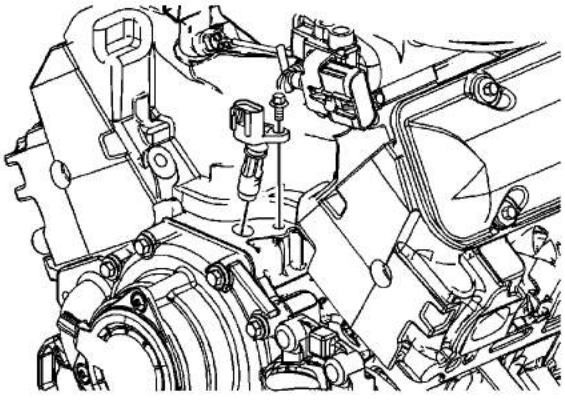

1. Replace the O-ring if damaged, lubricate the NEW O-ring with clean engine oil.
2. Install the CMP sensor.

   Caution: Refer to Fastener Caution in the Preface section.

3. Install the CMP sensor bolt.

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

4. Connect the CMP sensor electrical connector.
5. Install the power steering pump. Refer to Power Steering Pump Replacement.

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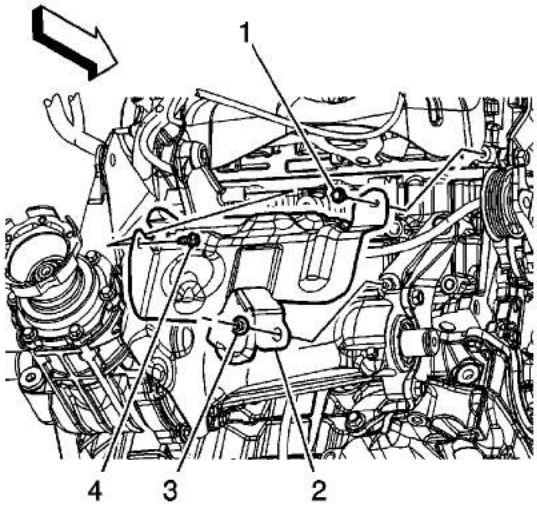
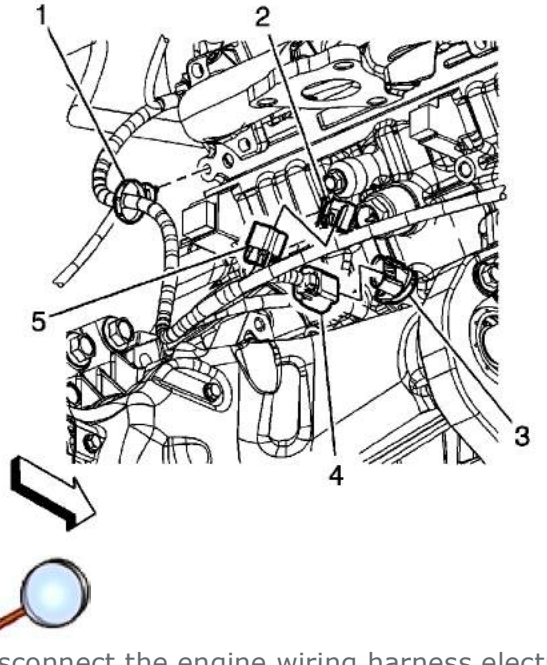
Knock Sensor Replacement - Bank 1

Removal Procedure



1. Remove the right catalytic converter. Refer to Catalytic Converter Replacement - Right Side.
2. Remove the engine wiring harness heat shield nut (3).
3. Remove the engine wiring harness heat shield bolts (1 and 4).
4. Remove the engine wiring harness heat shield (2).



5. Disconnect the engine wiring harness electrical connector (5) from the knock sensor (2).

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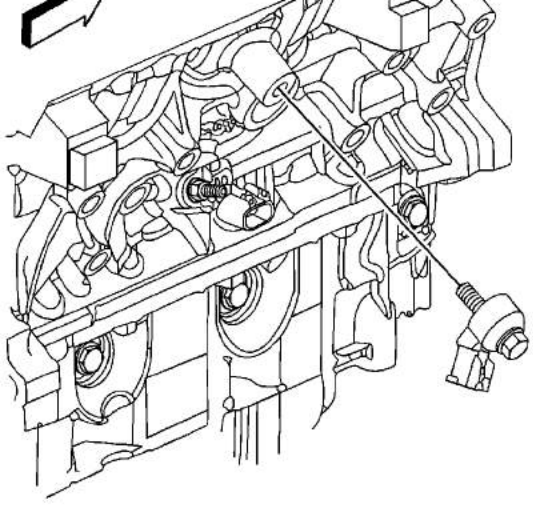
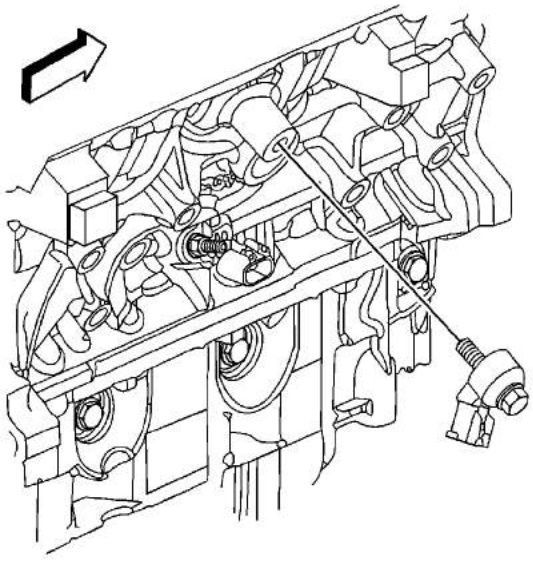


6. Remove the knock sensor bolt and sensor.

Installation Procedure

Caution: Refer to Fastener Caution in the Preface section.



1. Position the knock sensor to the engine block and install the knock sensor bolt.

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

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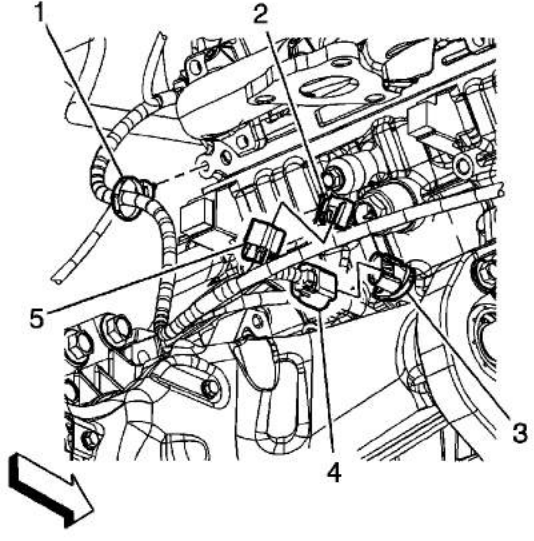
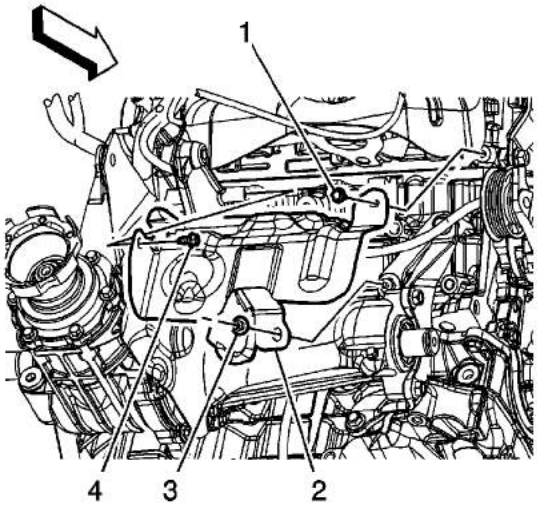


2. Connect the engine wiring harness electrical connector (5) to the knock sensor (2).



3. Install the engine wiring harness heat shield (2).
4. Install the engine wiring harness heat shield bolts (1 and 4).

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

5. Install the engine wiring harness heat shield nut (3).

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

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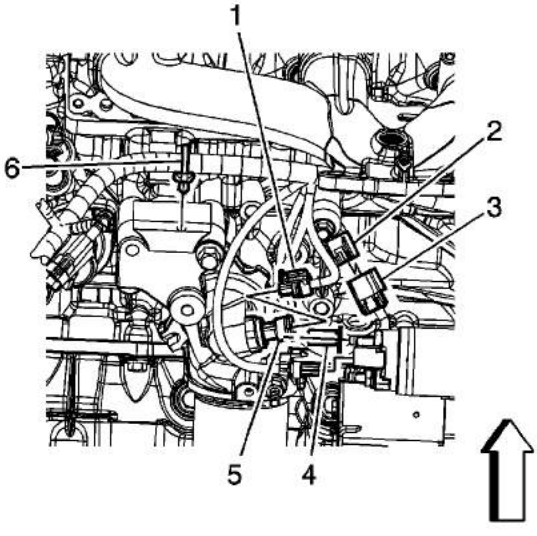
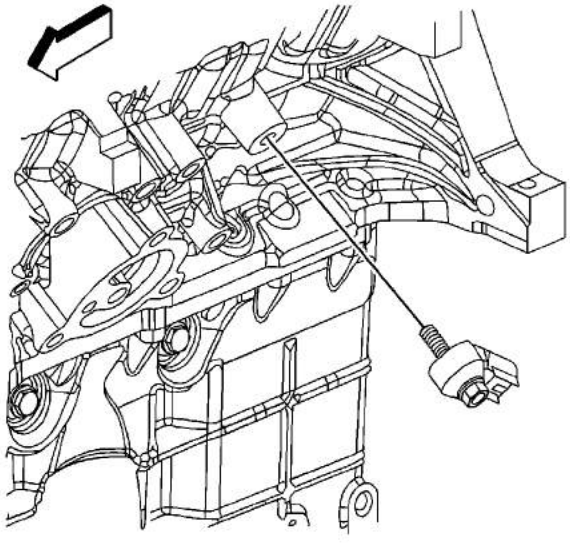
Knock Sensor Replacement - Bank 2

Removal Procedure



1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Disconnect the engine wiring harness electrical connector (3) from the knock sensor (2).



3. Remove the knock sensor bolt and sensor.

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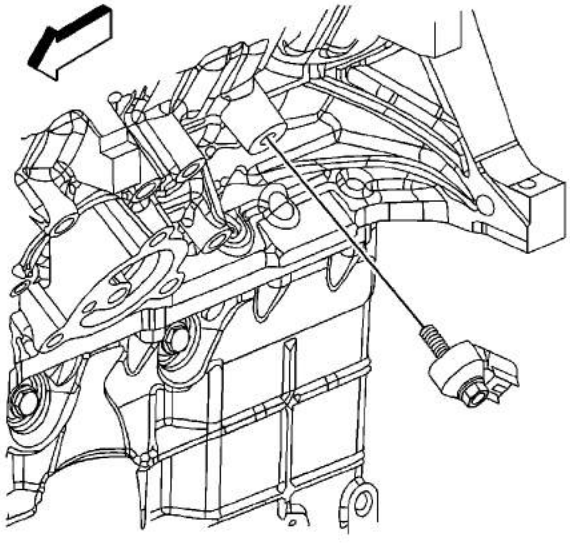
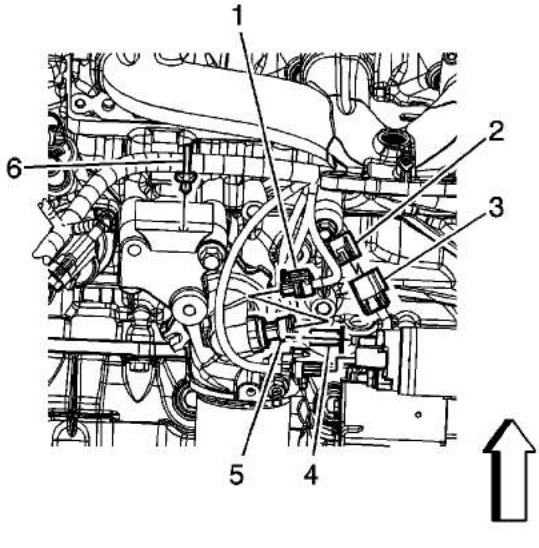
Caution: Refer to Fastener Caution in the Preface section.



1. Position the knock sensor to the engine block and install the knock sensor bolt.

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



2. Connect the engine wiring harness electrical connector (3) to the knock sensor (2).

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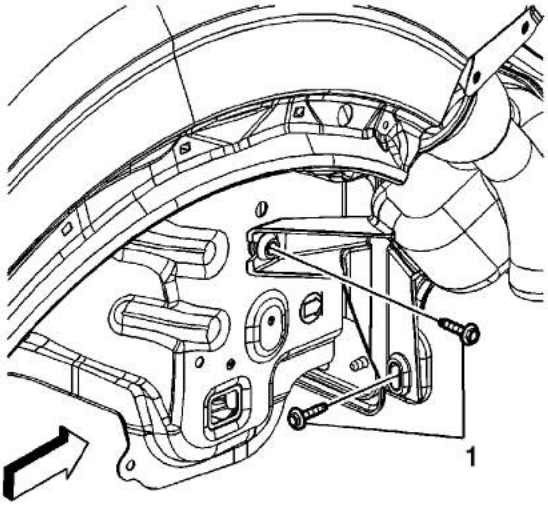
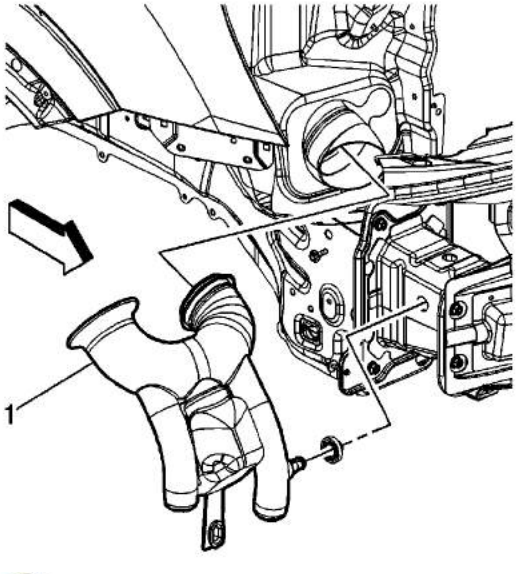
Air Cleaner Inlet Duct Replacement

Removal Procedure

1. Remove the front bumper fascia. Refer to Front Bumper Fascia Replacement.



2. Remove the air cleaner inlet duct bolts (1).



3. Pull on and dislocate the air cleaner inlet duct (1) from the air cleaner assembly and vehicle body grommet.

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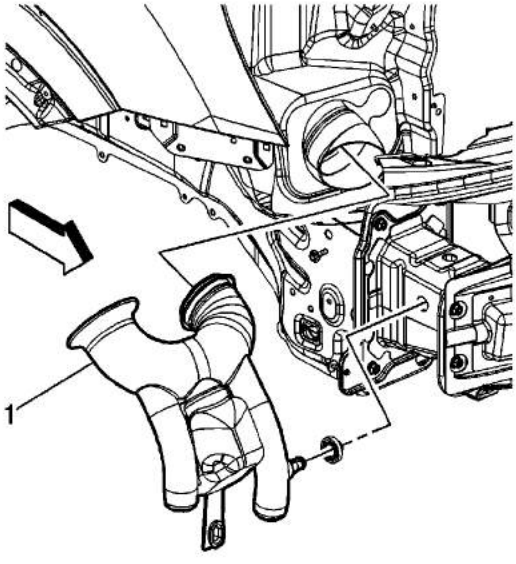
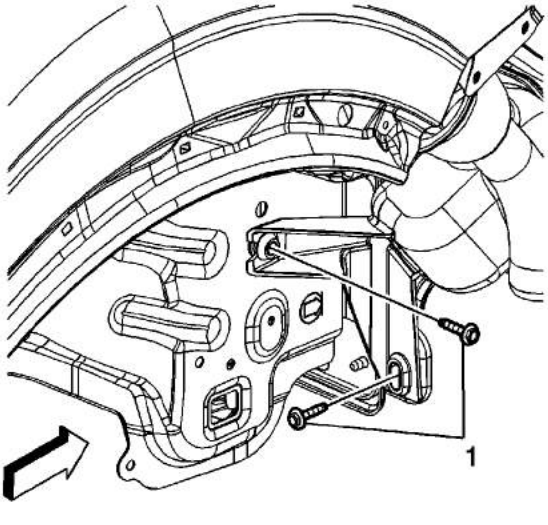


1. Position the air cleaner inlet duct (1) in the vehicle body grommet and air cleaner assembly.

   Caution: Refer to Fastener Caution in the Preface section.



2. Install the air cleaner inlet duct bolts (1).

   Tighten
   Tighten the bolts to 6 N·m (53 lb in).

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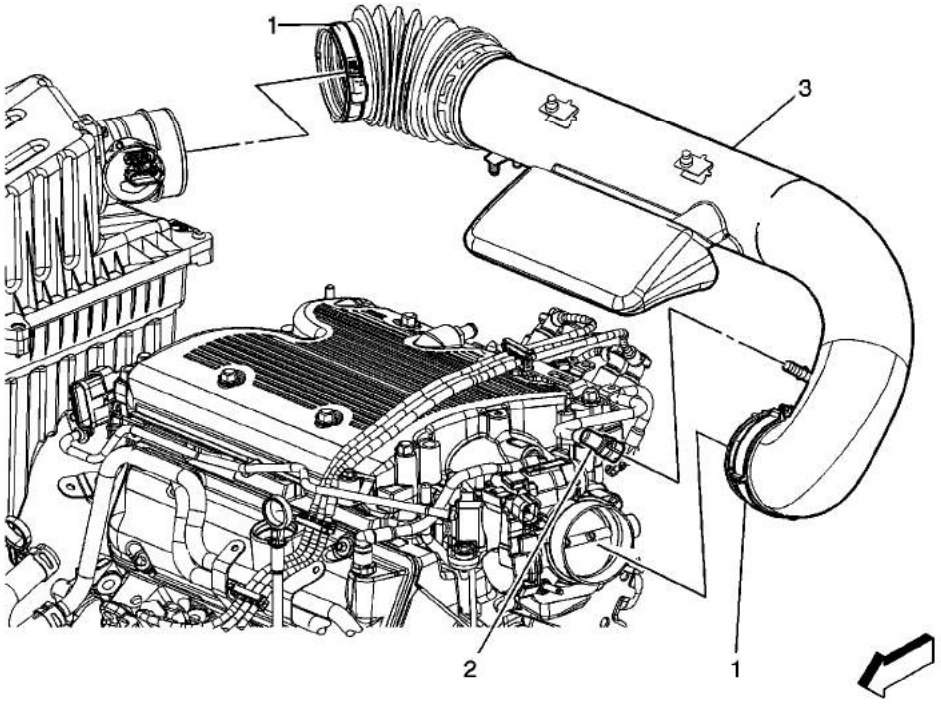
Air Cleaner Outlet Duct Replacement



Callout	Component Name
Preliminary Procedure Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.	
1	Air Cleaner Outlet Duct Clamp (Qty: 2) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 3 N·m (27 lb in)
2	Positive Crankcase Valve Tube **Tip** The PCV tube contains plastic collar quick connect fittings. Refer to Plastic Collar Quick Connect Fitting Service.
3	Air Cleaner Outlet Duct

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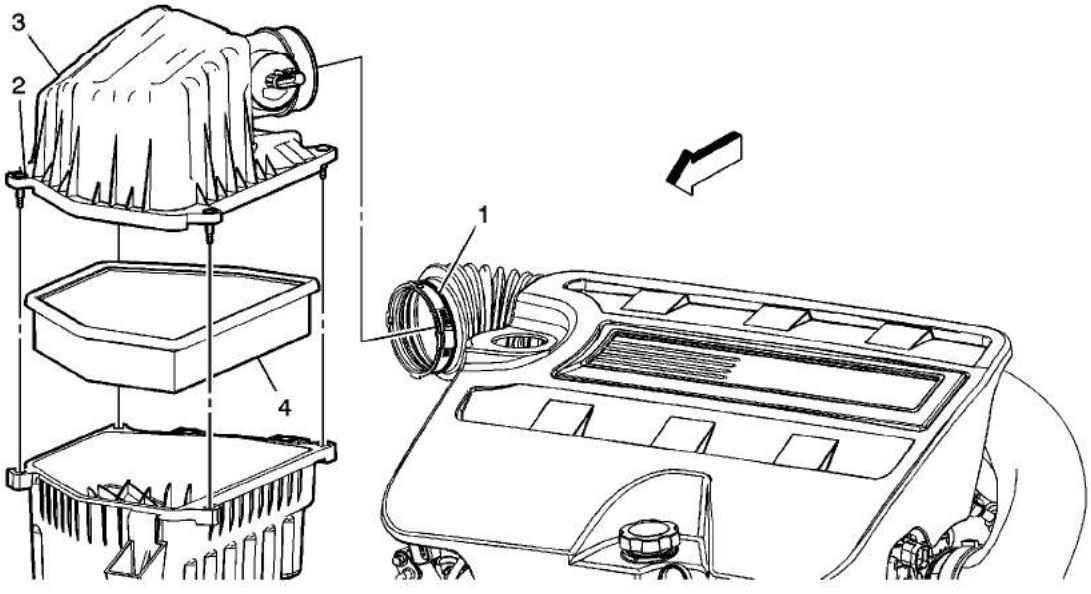
Air Cleaner Element Replacement



Callout	Component Name
1	Air Cleaner Outlet Duct Clamp **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 3 N·m (27 lb in)
2	Air Cleaner Assembly Upper Housing Screw (Qty: 4) **Tighten** 3 N·m (27 lb in)
3	Air Cleaner Assembly Upper Housing **Procedure** Disconnect the MAF/IAT Sensor Electrical Connector.
4	Air Cleaner Element

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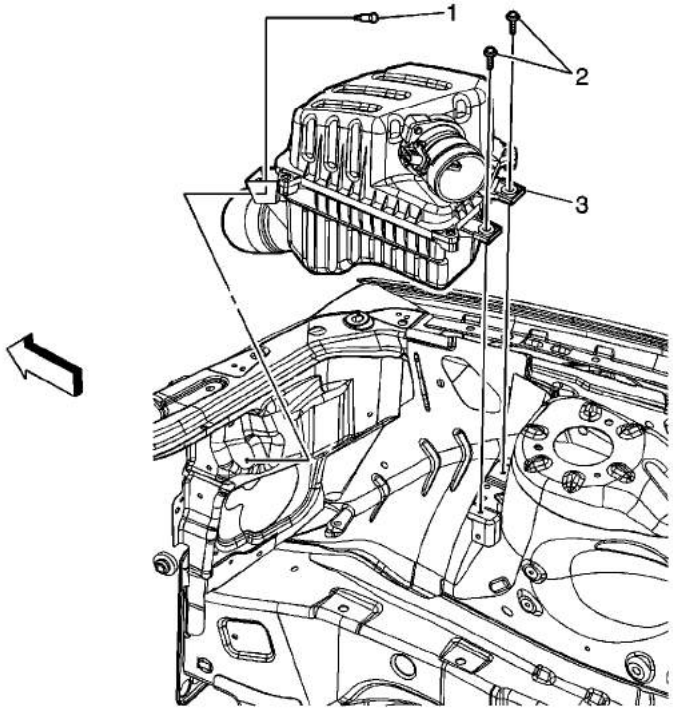
Air Cleaner Assembly Replacement



Callout	Component Name
Preliminary Procedure Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.	
1	Air Cleaner Assembly Bolt (Qty: 1) **Caution:** Refer to Fastener Caution in the Preface section. **Tighten** 8 N·m (71 lb in)
2	Air Cleaner Assembly Bolt (Qty: 2) **Tighten** 6 N·m (53 lb in)
3	Air Cleaner Assembly **Procedure** 1. Disconnect any electrical connectors as needed.

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