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	1-3-4-2	
Spark Plug Torque	20 N·m	15 lb ft
Spark Plug Gap	1.1-0.95 mm	0.043-0.037 in

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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 Intake 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) Actuator Solenoid Valve Bolt	10 N·m	89 lb in
Camshaft Position (CMP) Sensor Bolt	10 N·m	89 lb in
Crankshaft Position (CKP) Sensor Bolt	10 N·m	89 lb in
Engine Coolant Temperature (ECT) Sensor	20 N·m	15 lb ft
Evaporative Emission (EVAP) Canister Nut	8 N·m	71 lb in
Evaporative Emission (EVAP) Canister Purge Valve Bracket Bolt	25 N·m	18 lb ft
Fuel Fill Hose Clamp	5 N·m	44 lb in
Fuel Fill Pipe Bracket Nut	4 N·m	35 lb in
Fuel Injector Fuel Rail Bolt	10 N·m	89 lb in
Fuel Pressure Sensor	15 N·m	11 lb ft
Fuel Pump Flow Control Module Bolt	10 N·m	89 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	10 N·m	89 lb in
Knock Sensor (KS)	25 N·m	18 lb ft
Mass Air Flow (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 Hose Fitting	18 N·m	13 lb ft
Rear Brake Pipe Fitting to Rear Crossover Pipe Fitting	18 N·m	13 lb ft
Spark Plug	20 N·m	15 lb ft
Throttle Body Bolt	10 N·m	89 lb in

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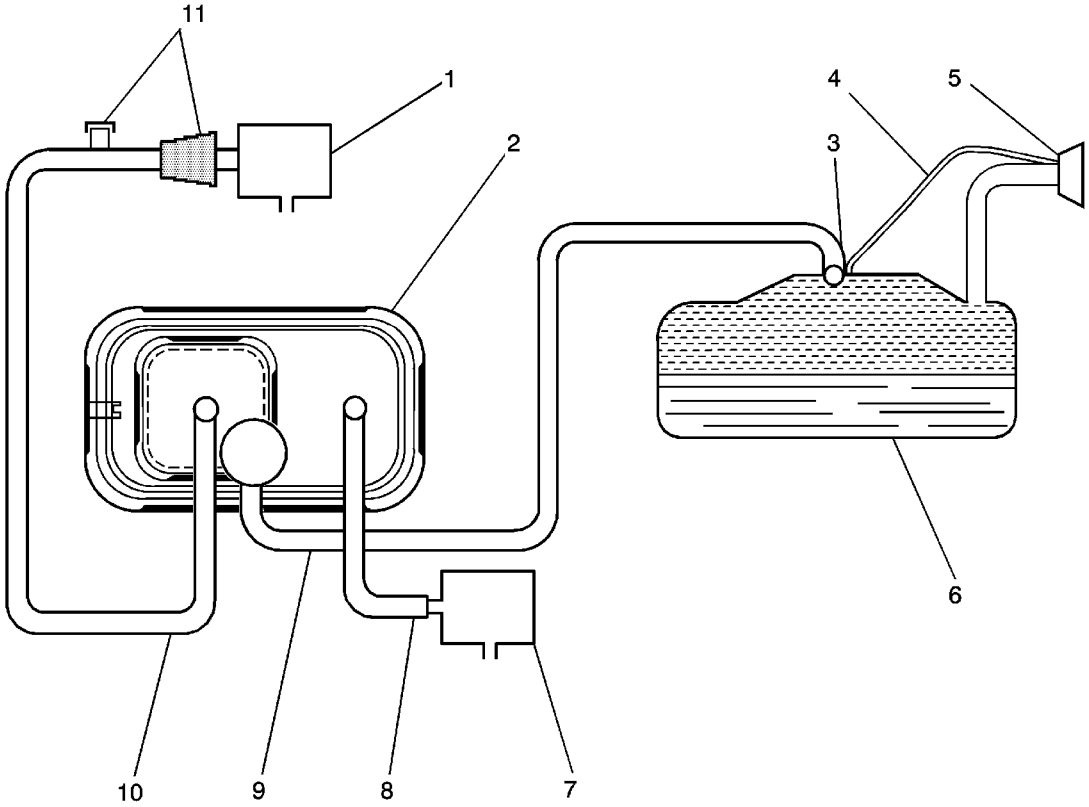
Evaporative Emissions Hose Routing Diagram



(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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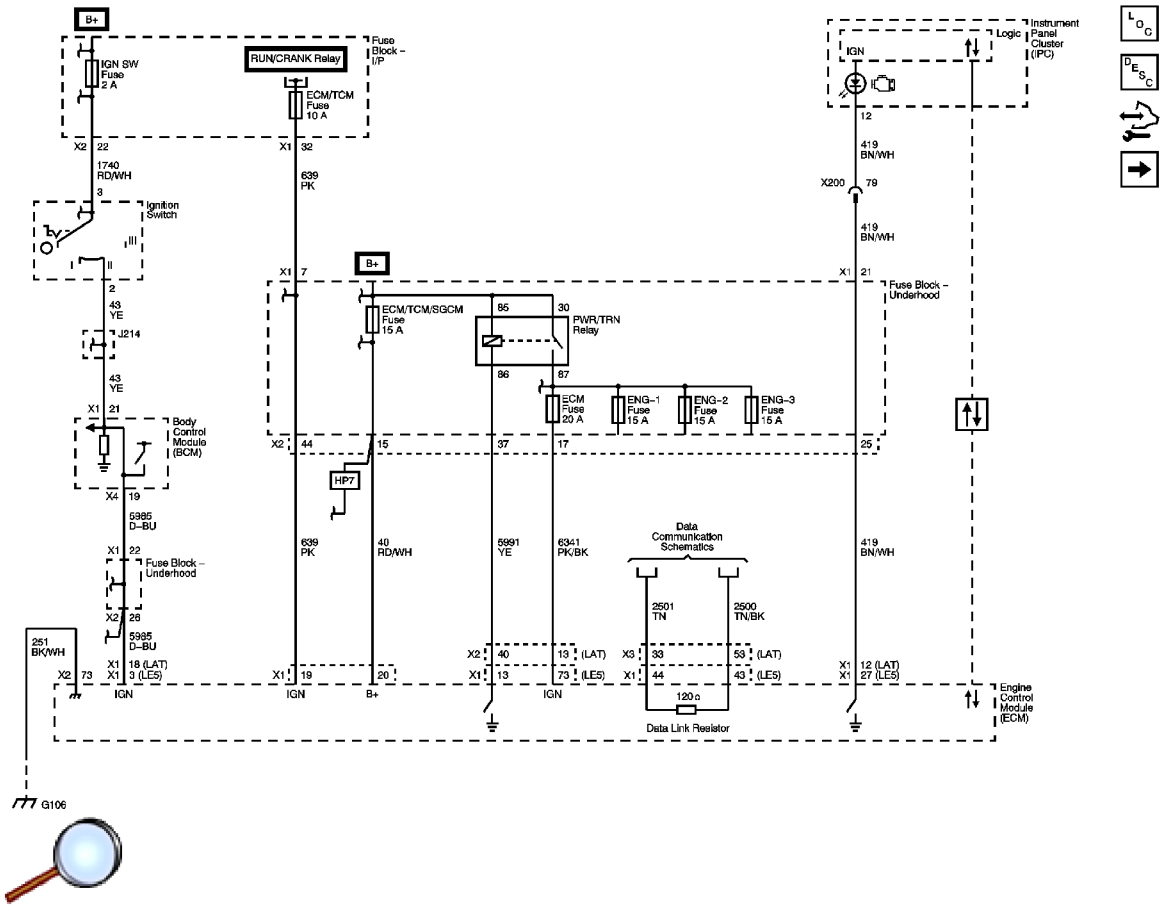
Power, Ground, Serial Data and MIL (LAT/LE5)



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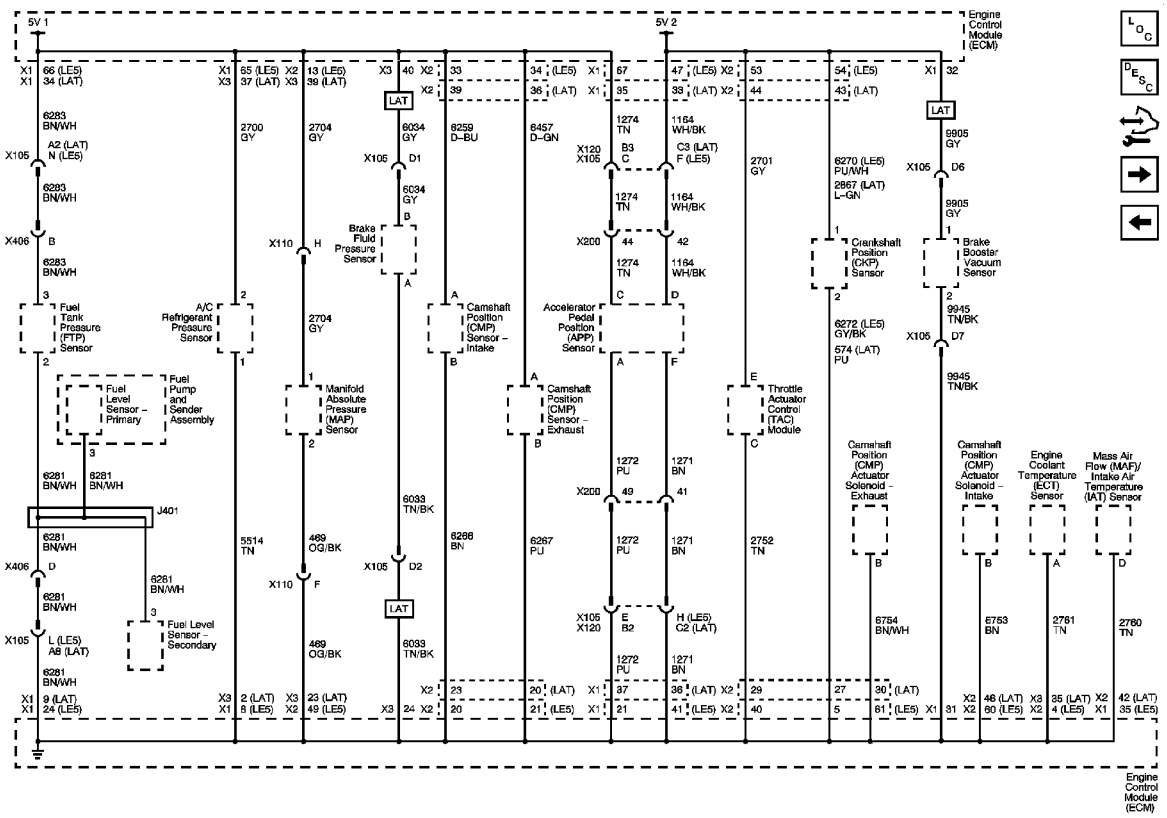
Engine Data Sensors - 5-Volt and Low Reference (LAT/LE5)



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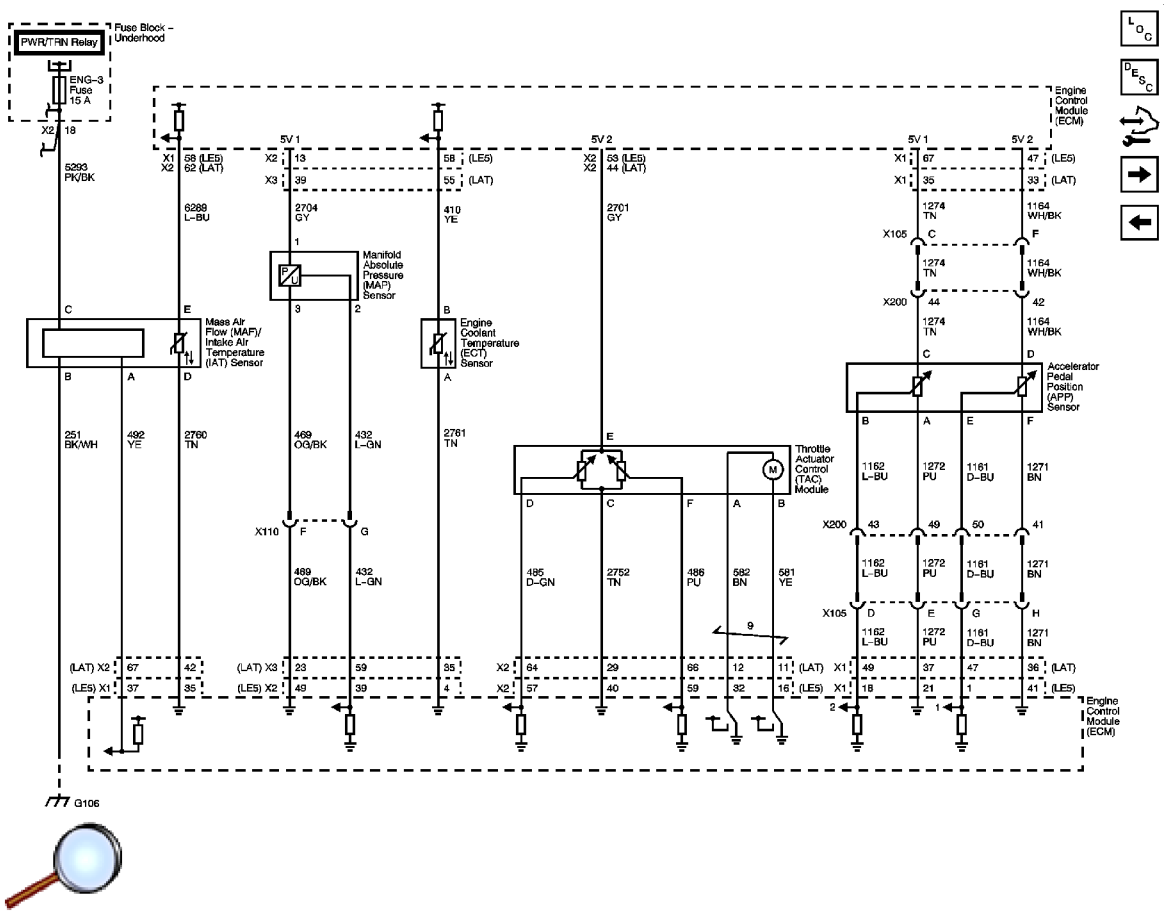
Engine Data Sensors - Pressure, Temperature and MAF/IAT (LAT/LE5)



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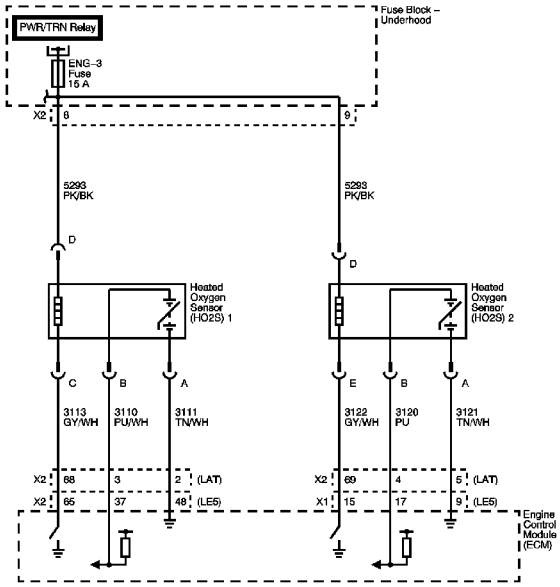
Engine Data Sensors - Heated Oxygen Sensors (HO2S) (LAT/LE5)



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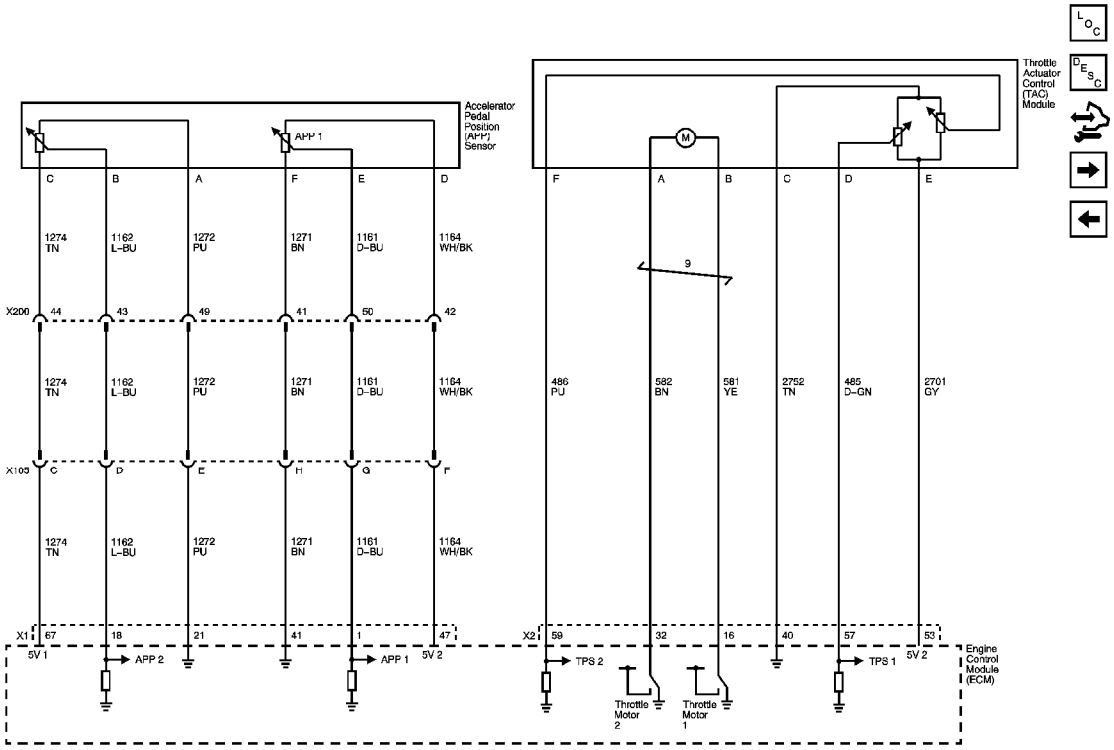
Engine Data Sensors - APP and TAC (LAT/LE5)



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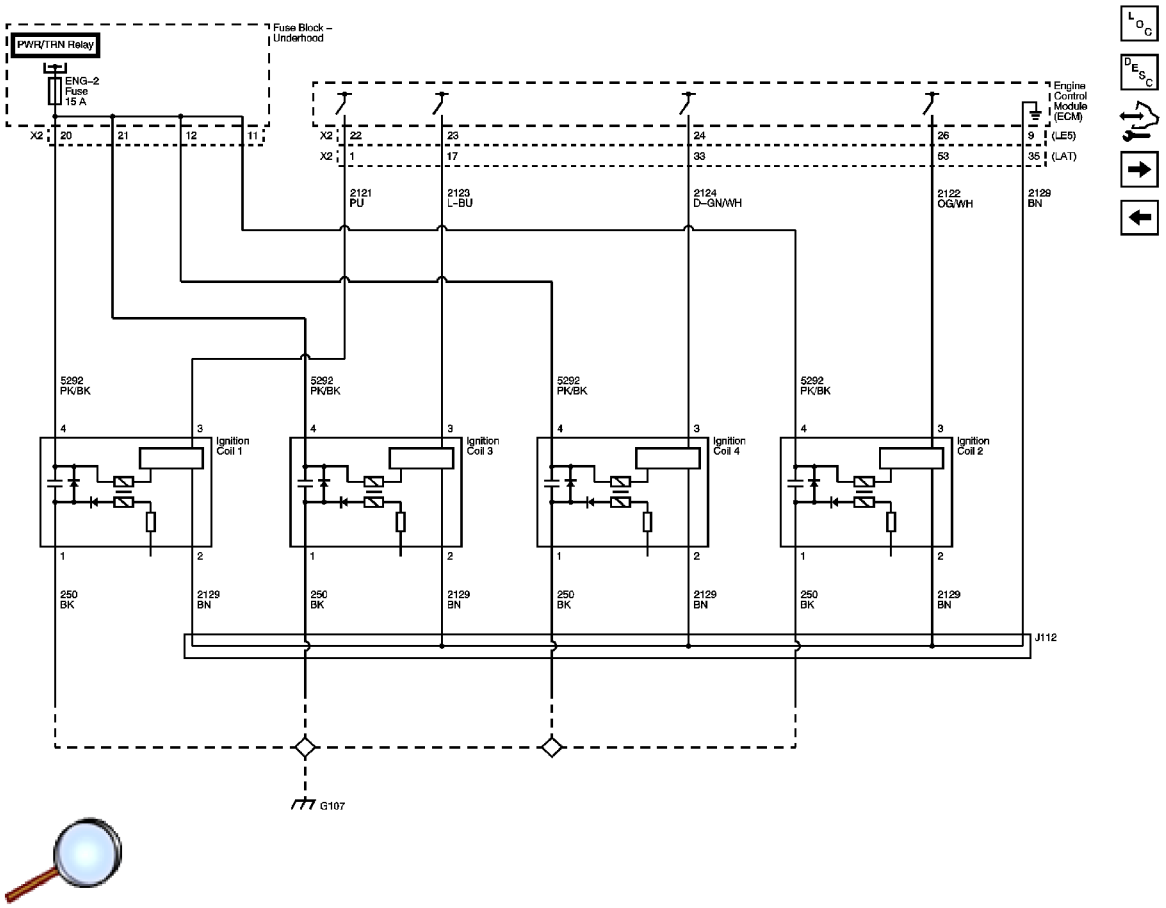
Ignition Controls - Ignition System (LAT/LE5)



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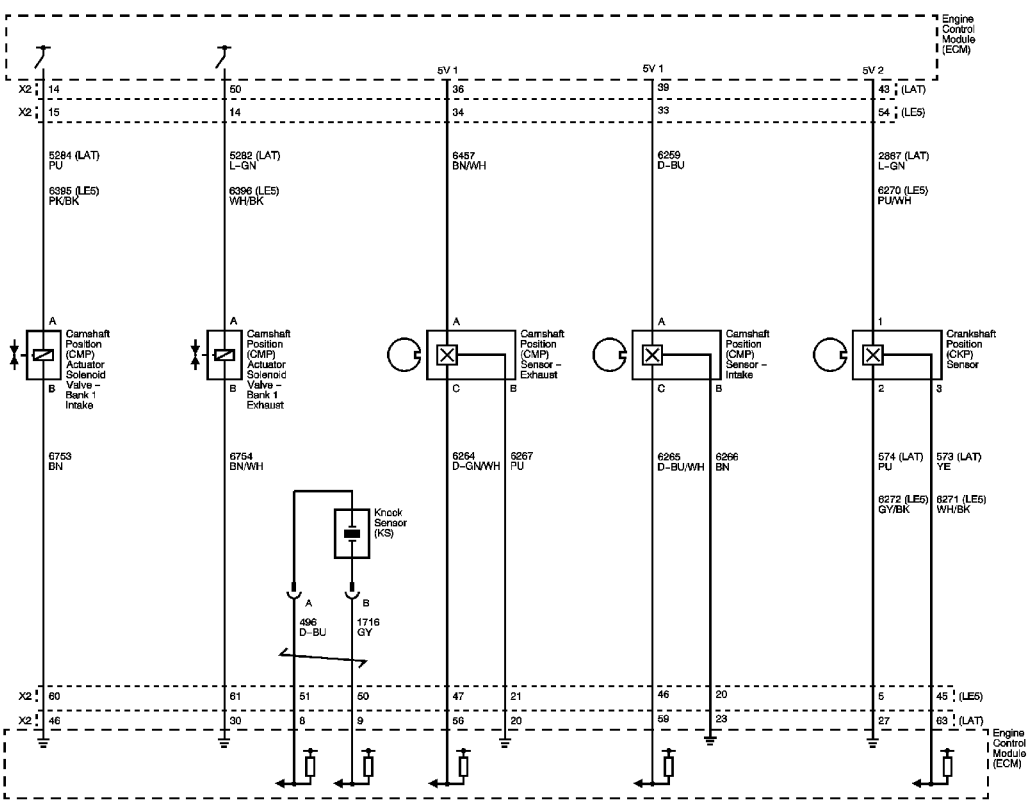
Ignition Controls - Camshaft (CMP), Crankshaft (CKP) and Knock (KS) Sensors (LAT/LE5)



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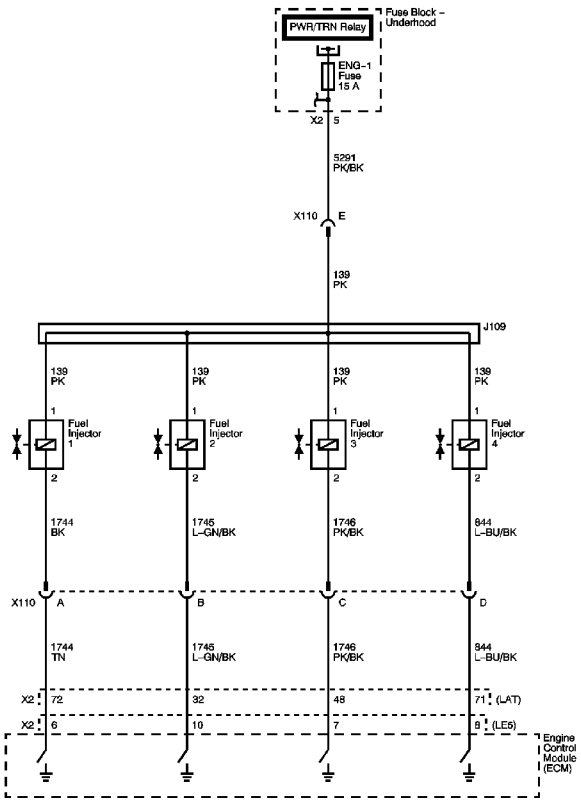
Fuel Controls - Fuel Injectors (LAT/LE5)



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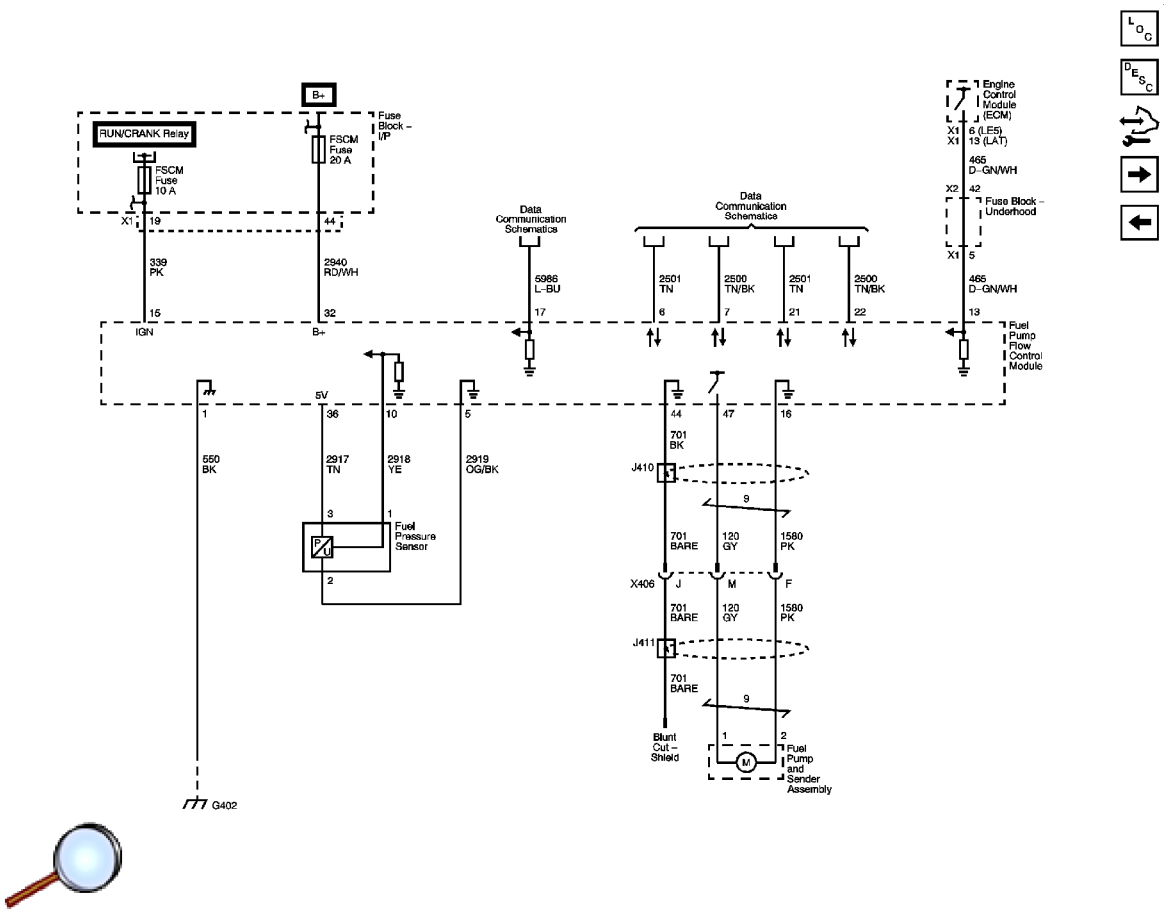
Fuel Controls - Fuel Pump Control Module (LAT/LE5)



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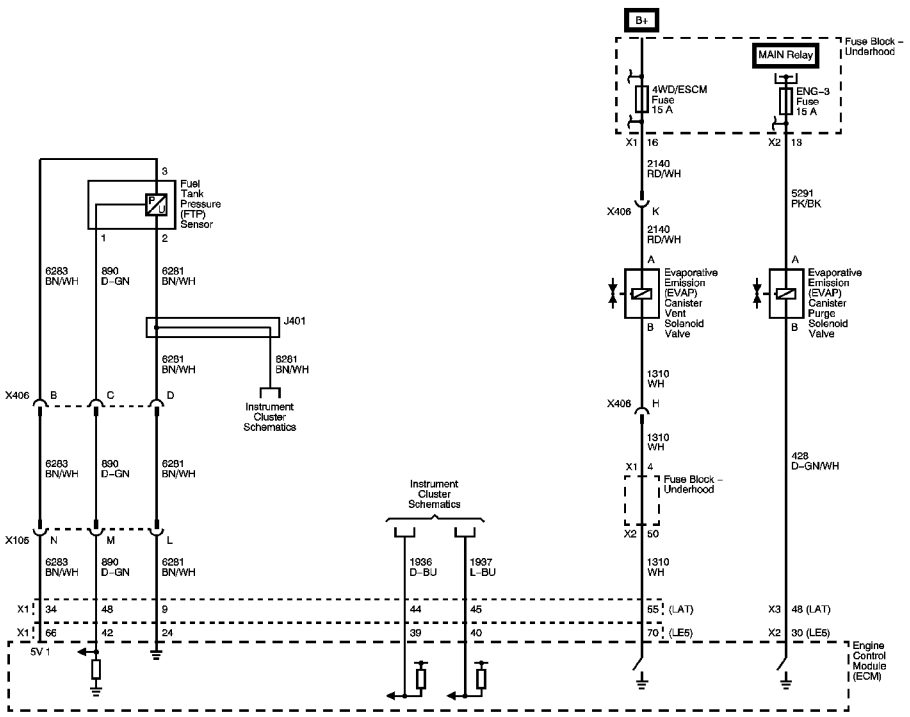
Fuel Controls - Evaporative Emissions (EVAP) Controls (LAT/LE5)



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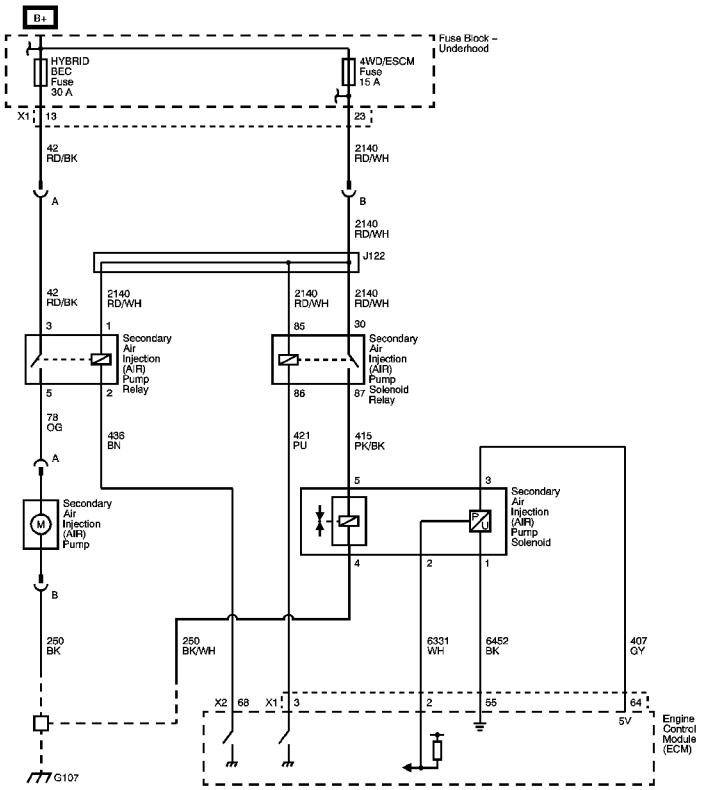
Secondary Air Injection (AIR) Pump



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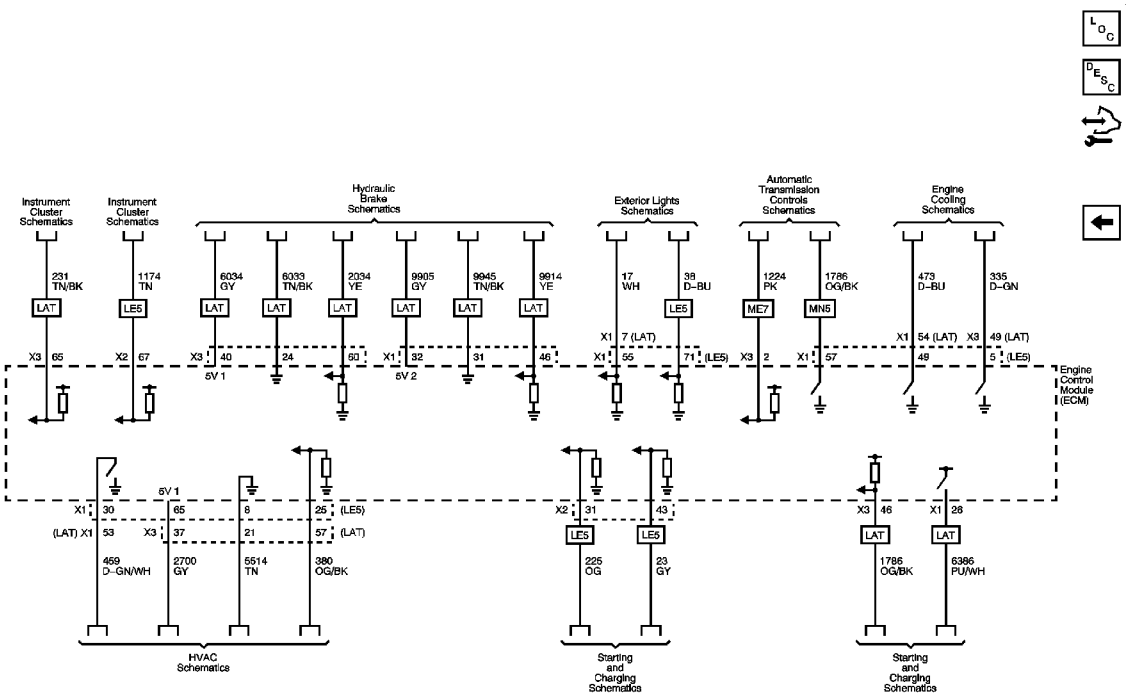
Controlled / Monitored Subsystem References (LAT / LE5)



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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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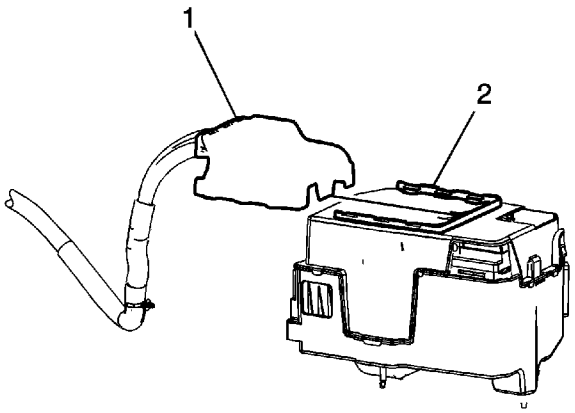
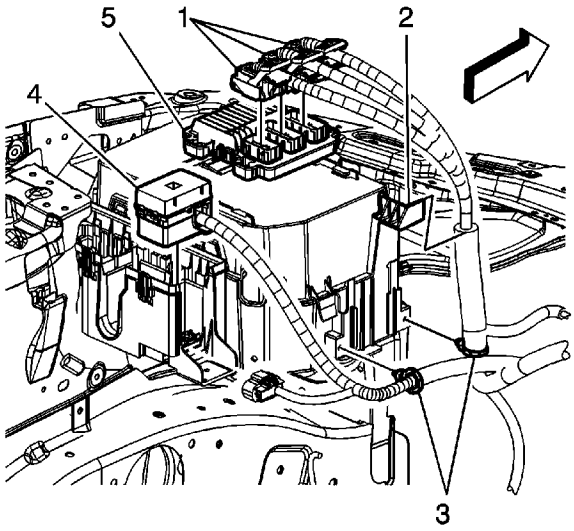
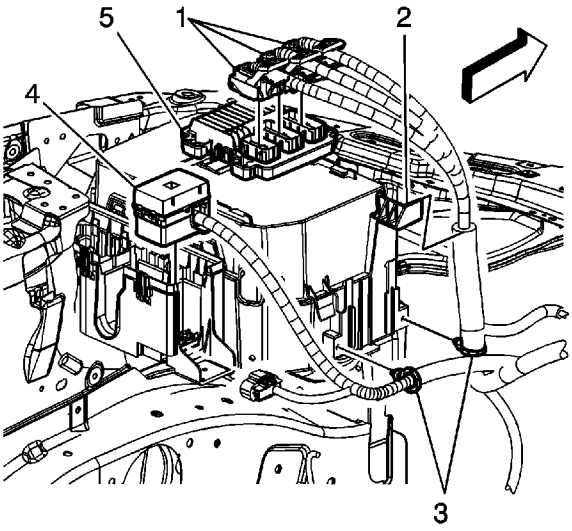


1. Using a scan tool, retrieve the percentage of remaining engine oil and the remaining automatic transmission fluid life. Record the remaining engine oil and the remaining automatic transmission fluid life.
2. Release the electronic control module (ECM) bracket (1) from the battery cover (2).

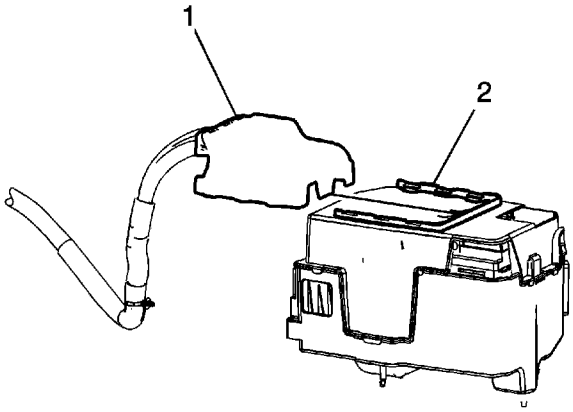


3. Release the retaining tabs on the ECM bracket and slide the ECM out of it.
4. Disconnect the engine wiring harness electrical connectors (1) from the ECM (5).

Installation Procedure



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.

Crankshaft Position System Variation Learn

Note: The crankshaft position (CKP) system variation learn procedure is required when the following service procedures have been performed, regardless of whether DTC P0315 is set:

- Engine replacement
- Engine control module (ECM) replacement
- Crankshaft damper replacement
- Crankshaft replacement
- CKP sensor replacement
- Any engine repairs which disturb the crankshaft to CKP sensor relationship

Note: The scan tool 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 monitors the following components:

- CKP sensor 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. Observe the fuel cut-off for the applicable engine.
   - 3.2. Block the drive wheels.
   - 3.3. Set the parking brake.
   - 3.4. Place the vehicle's transmission in Park or Neutral.
   - 3.5. Turn the air conditioning (A/C) OFF.
   - 3.6. Cycle the ignition from OFF to ON.
   - 3.7. Apply and hold the brake pedal for the duration of the procedure.
   - 3.8. Start and idle the engine.
   - 3.9. Accelerate to wide open throttle (WOT). The engine should not accelerate beyond the calibrated fuel cut-off RPM value noted in step 3.1. Release the throttle immediately if the value is exceeded.

     Note: 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.

   - 3.10. Release the throttle when 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, refer to DTC P0315. If any other DTCs set, refer to Diagnostic Trouble Code (DTC) List - Vehicle for the applicable DTC that set.

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5. Turn OFF the ignition for 30 seconds after the learn procedure is completed successfully.

Throttle Learn

Description

The engine control module (ECM) learns the idle position of the throttle plate 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

- DTCs P0101, P0102, P0103, P0107, P0108, P0111, P0112, P0113, P0506, and P0507 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

1. Ignition ON, engine OFF. With a scan tool, perform the Idle Learn Reset in Module Setup.
2. Start the engine, monitor the TB Idle Airflow Compensation parameter. The TB Idle Airflow Compensation parameter value should equal 0 percent and the engine should be idling at a normal idle speed.

   If the engine is not idling normally, proceed with the Learn portion of the diagnostic.
3. Clear the DTCs and return to the diagnostic that referred you here.

Without Scan Tool-Learn

Important: Do NOT perform the Without Scan Tool-Learn procedure if DTCs are set. Refer to Diagnostic Trouble Code (DTC) List - Vehicle.

1. The engine speed is between 450-4,000 RPM.
2. The manifold absolute pressure (MAP) is greater than 5 kPa.
3. The mass air flow (MAF) is greater than 2 g/s.
4. The ignition 1 voltage is greater than 10 volts.
5. Start and idle the engine in Park for 3 minutes.

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6. With a scan tool, monitor desired and actual RPM.
7. The ECM will start to learn the new idle cells and Desired RPM should start to decrease.
8. Ignition OFF for 60 seconds.
9. Start and idle the engine in Park for 3 minutes.

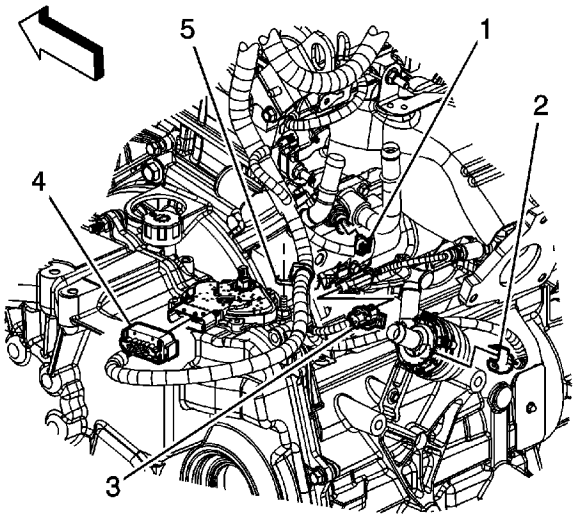
Important: During the drive cycle the check engine light may come on with idle speed DTCs. If idle speed codes are set, clear codes so the ECM can continue to learn.

10. After the 3 minute run time the engine should be idling normal.
    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.
11. 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.
12. Once the engine speed has returned to normal, clear DTCs.

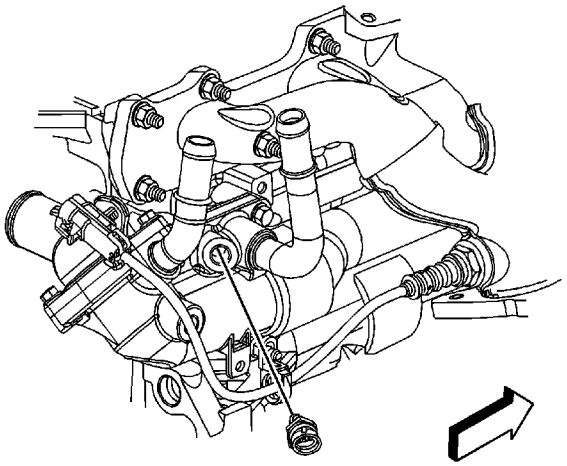
Engine Coolant Temperature Sensor Replacement

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. Disconnect the engine wiring harness electrical connector (1) from the engine coolant temperature (ECT) sensor.



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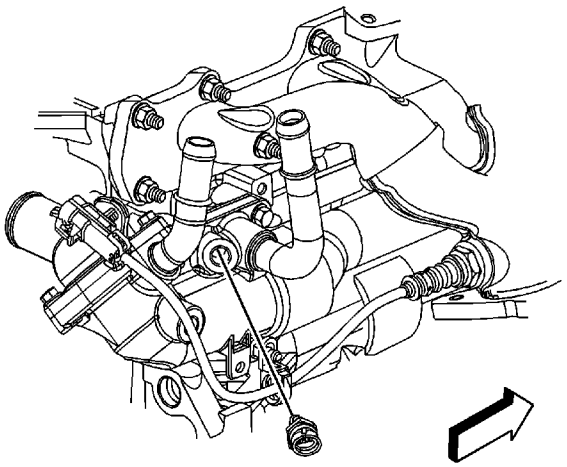
3. Remove the ECT sensor.

Installation Procedure

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

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

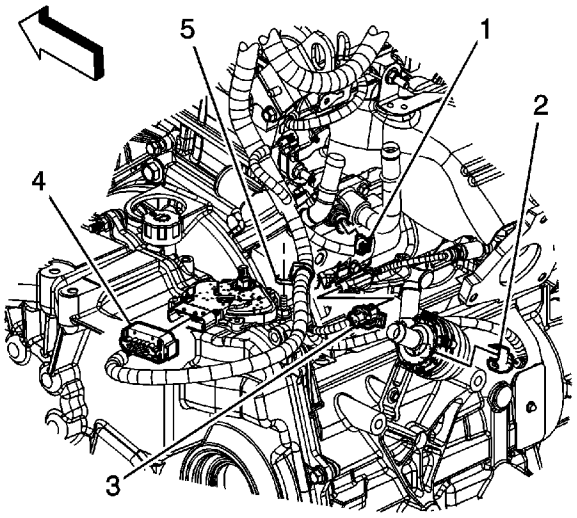


1. If reinstalling the original ECT sensor, or if installing a NEW ECT sensor without a sealer, coat the threads with sealant. Refer to Adhesives, Fluids, Lubricants, and Sealers.

   Caution: Refer to Fastener Caution in the Preface section.

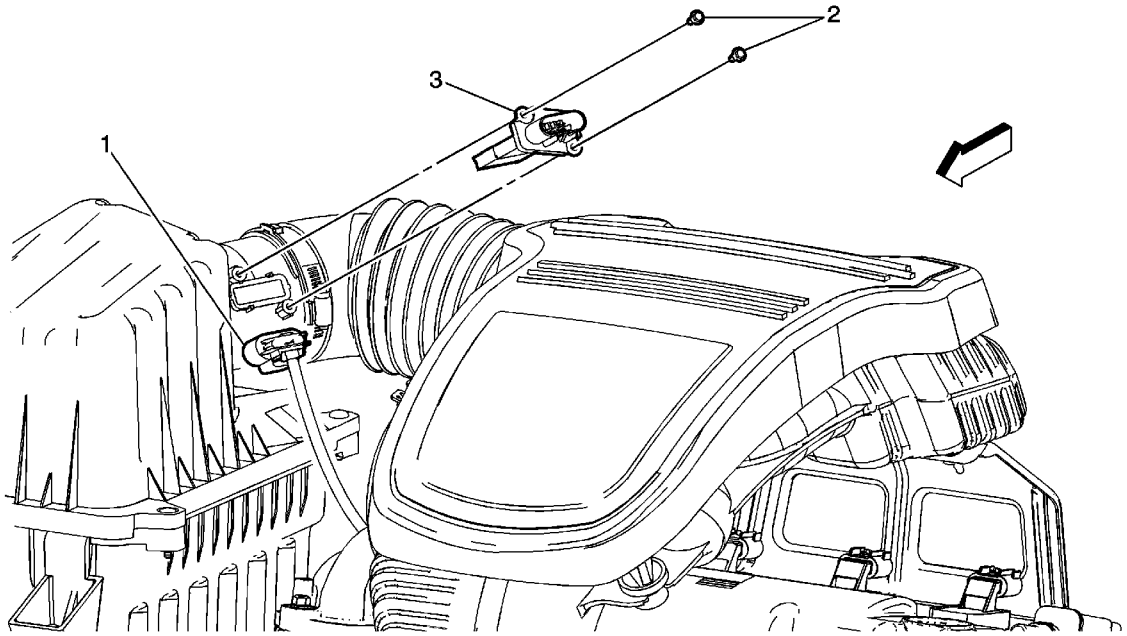
2. Install the ECT sensor.

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



3. Connect the engine wiring harness electrical connector (1) to the ECT sensor.
4. Fill the cooling system. Refer to Cooling System Draining and Filling.

Mass Airflow Sensor with Intake Air Temperature Sensor Replacement



Callout	Component Name
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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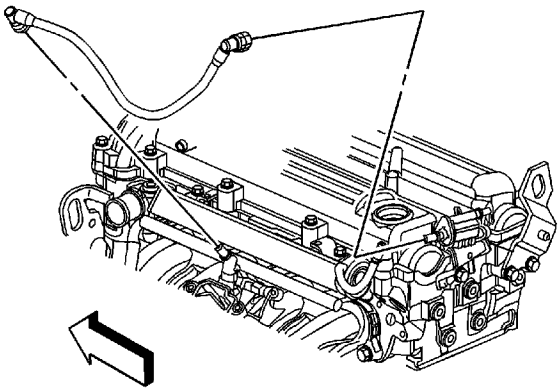
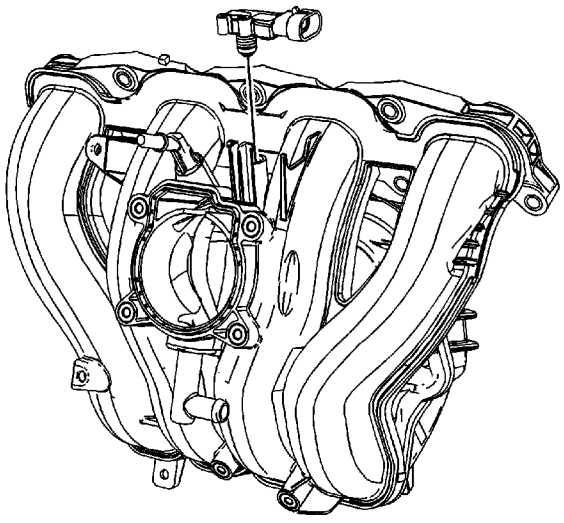
Manifold Absolute Pressure Sensor Replacement

Removal Procedure

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



2. Remove the evaporative emission (EVAP) canister purge tube from the intake manifold. Refer to Plastic Collar Quick Connect Fitting Service .
3. Reposition the EVAP canister purge tube out of the way.
4. Disconnect and reposition the fuel injector wiring harness out of the way .



5. Disconnect the engine harness electrical connector from the manifold absolute

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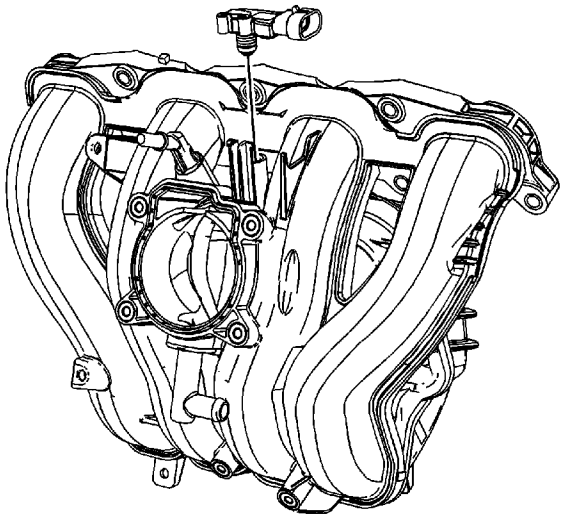
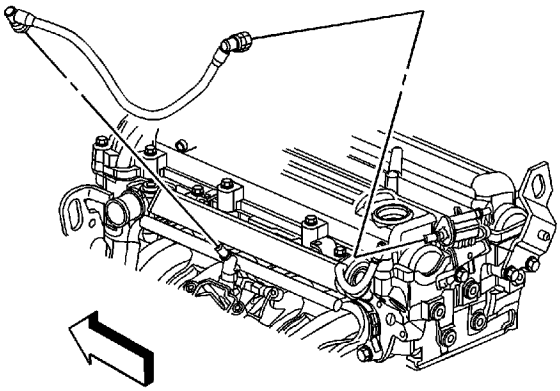
pressure (MAP) sensor.
6. Remove the MAP sensor and seal.

Installation Procedure



1. Lubricate the NEW MAP sensor seal with clean engine oil.
2. Install the MAP sensor into the intake manifold.
3. Connect the engine harness electrical connector to the MAP sensor.
4. Position and connect the fuel injector wiring harness.



5. Position the EVAP canister purge tube to the intake manifold.
6. Connect the EVAP canister purge tube to the intake manifold. Refer to Plastic Collar Quick Connect Fitting Service .

7. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement

Heated Oxygen Sensor Replacement - Sensor 1

Special Tools

J 39194-C Oxygen Sensor Wrench

Removal Procedure

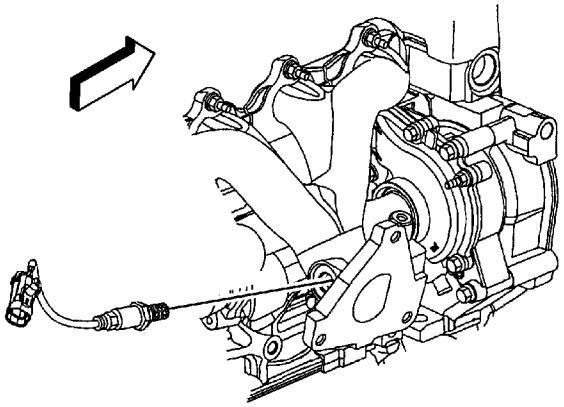
Caution: The oxygen sensor uses a permanently attached pigtail and connector. Do not remove the pigtail from the oxygen sensor. Damage to or removal of the pigtail connector could affect proper operation of the oxygen sensor.

Caution: The use of excessive force may damage the threads in the exhaust manifold/pipe.

Note:

- The in-line connector and louvered end must be kept clear of grease, dirt or other contaminants. Avoid using cleaning solvents of any type. DO NOT drop or roughly handle the heated oxygen sensor (HO2S).
- The HO2S may be difficult to remove when the engine temperature is less than 48°C (120°F).

1. Hoist and raise the vehicle. Refer to Lifting and Jacking the Vehicle.
2. Remove the connector position assurance (CPA) tab from the HO2S electrical connection.
3. Disconnect the engine wiring harness electrical connector from the HO2S electrical connector.
4. Remove the HO2S electrical connector from the thermostat housing.



5. Remove the HO2S using wrench J 39194-C .

Installation Procedure

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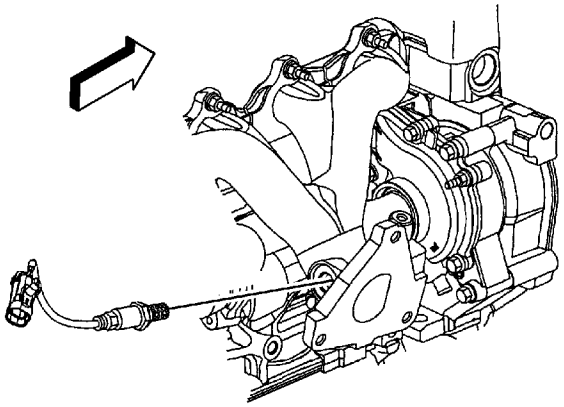
Note: A special anti-seize compound is used on the heated oxygen sensor threads. The compound consists of a liquid graphite and glass beads. The graphite will burn away, but the glass beads will remain, making the heated oxygen sensor easier to remove. New or service replacement heated oxygen sensors will have the compound applied to the threads. If a heated oxygen sensor is removed and is to be reinstalled without replacement then the threads must have an appropriate anti-seize compound applied prior to installation.



1. If necessary, coat the threads of the HO2S with anti-seize compound Saturn P/N 21485279 or equivalent.

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the HO2S using wrench J 39194-C .

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

3. Install the HO2S electrical connector to the thermostat housing.
4. Connect the engine wiring harness electrical connector to the HO2S electrical connector.
5. Install the CPA tab to the HO2S electrical connection.

Heated Oxygen Sensor Replacement - Sensor 2

Special Tools

J 39194-C Oxygen Sensor Wrench

Removal Procedure

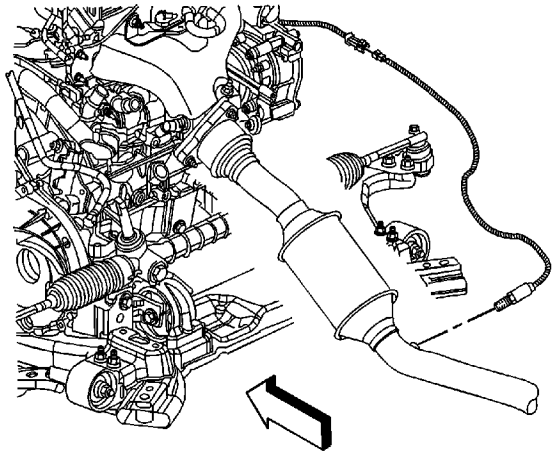
Caution: The oxygen sensor uses a permanently attached pigtail and connector. Do not remove the pigtail from the oxygen sensor. Damage to or removal of the pigtail connector could affect proper operation of the oxygen sensor.

Caution: The use of excessive force may damage the threads in the exhaust manifold/pipe.

Note:

- The in-line connector and louvered end must be kept clear of grease, dirt or other contaminants. Avoid using cleaning solvents of any type. DO NOT drop or roughly handle the heated oxygen sensor (HO2S).
- The HO2S may be difficult to remove when the engine temperature is less than 48°C (120°F).

1. Hoist and raise the vehicle. Refer to Lifting and Jacking the Vehicle.



2. Remove the connector position assurance (CPA) tab from the HO2S electrical connection.
3. Disconnect the engine wiring harness electrical connector from the HO2S electrical connector.
4. Remove the HO2S wiring from the exhaust heat shield.
5. Remove the HO2S using wrench J 39194 .

Installation Procedure

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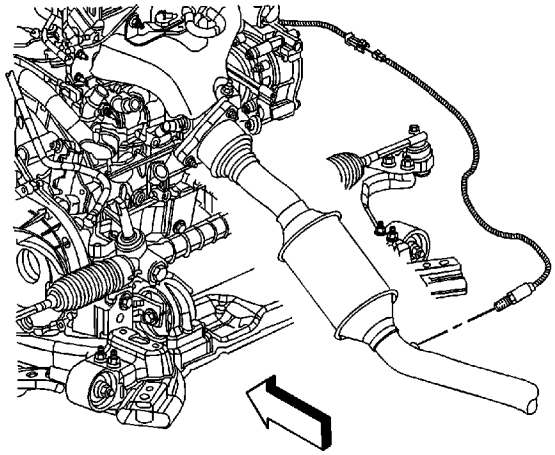
Note: A special anti-seize compound is used on the heated oxygen sensor threads. The compound consists of a liquid graphite and glass beads. The graphite will burn away, but the glass beads will remain, making the heated oxygen sensor easier to remove. New or service replacement heated oxygen sensors will have the compound applied to the threads. If a heated oxygen sensor is removed and is to be reinstalled without replacement then the threads must have an anti-seize compound applied prior to installation.



1. If necessary, coat the threads of the HO2S with anti-seize compound Saturn P/N 21485279 or equivalent.

   Caution: Refer to Fastener Caution in the Preface section.

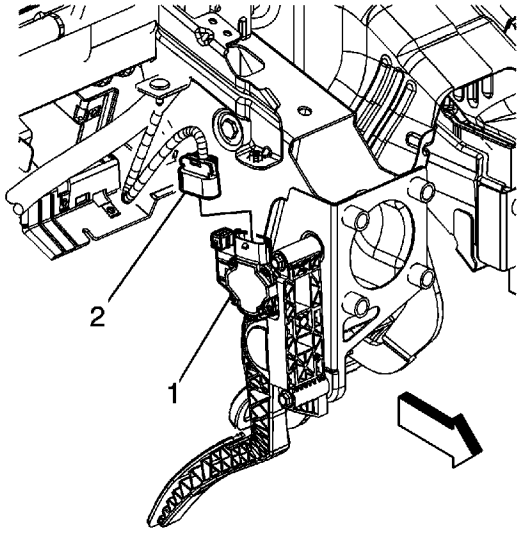
2. Install the HO2S using wrench J 39194-C .

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

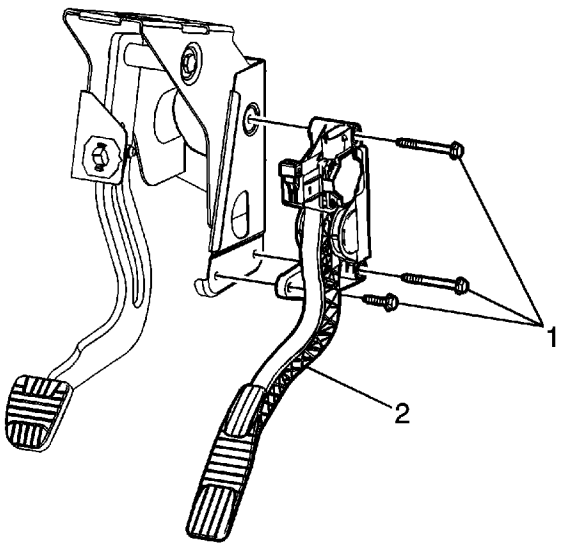
3. Install the HO2S wiring in the exhaust heat shield.
4. Connect the engine wiring harness electrical connector to the HO2S electrical connector.
5. Install the CPA tab to the HO2S electrical connection.

Accelerator Pedal with Position Sensor Assembly 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).



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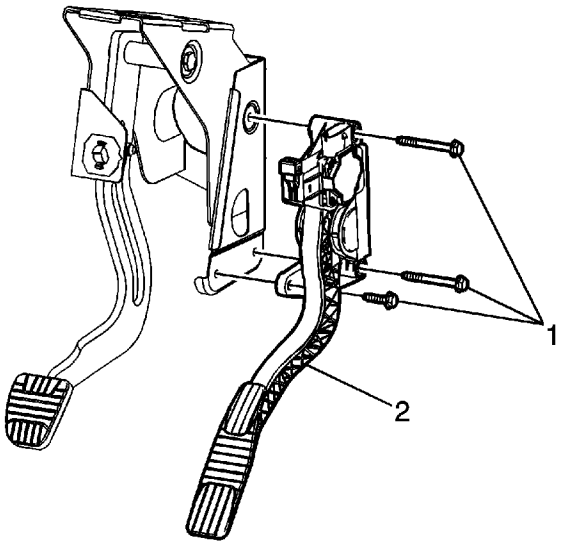
3. Remove the APP sensor bolts (1).
4. Remove the APP sensor (2).

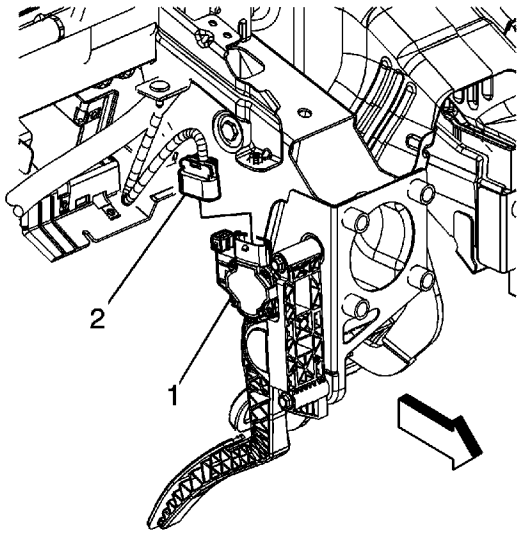
Installation Procedure



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) and tighten to **10 N·m (89 lb in)**.



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.

Throttle Body Assembly Replacement

Removal Procedure

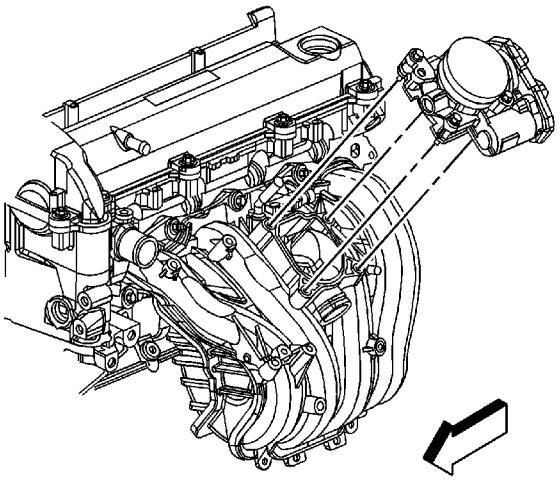
Caution: Do not use solvent of any type when cleaning the gasket surfaces on the intake manifold and the throttle body assembly, as damage to the gasket surfaces and throttle body assembly may result.

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

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

Note: DO NOT prop open the throttle blade with the ignition key in the ON position as it may set a diagnostic trouble code (DTC).

1. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
2. Disconnect the engine wiring harness electrical connector from the throttle body assembly.



3. Remove the throttle body assembly bolts.
4. Remove the throttle body assembly.
5. Inspect the throttle body assembly gasket, and replace it if necessary.

Installation Procedure

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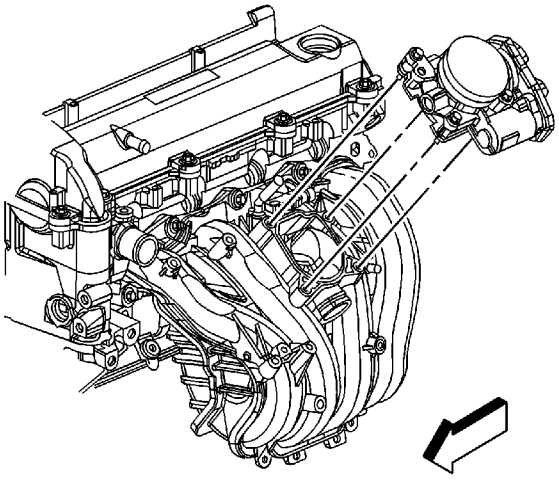

1. Install the throttle body assembly to the vehicle.

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the throttle body assembly bolts.

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

3. Connect the engine wiring harness electrical connector to the throttle body assembly.
4. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.

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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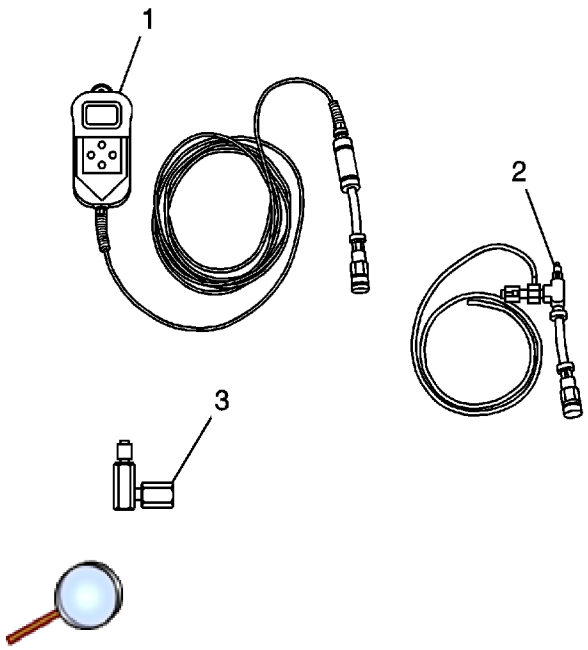
Fuel Pressure Relief (With CH 48027-100)

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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9. Close the valve on the CH-48027-2 (2).
10. Remove the hose on the CH-48027-2 (2) from the approved gasoline container.

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

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

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

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.

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

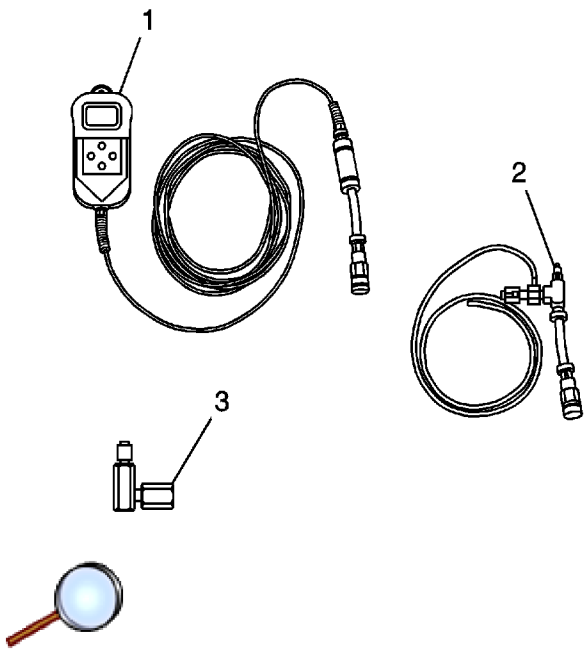
Special Tools

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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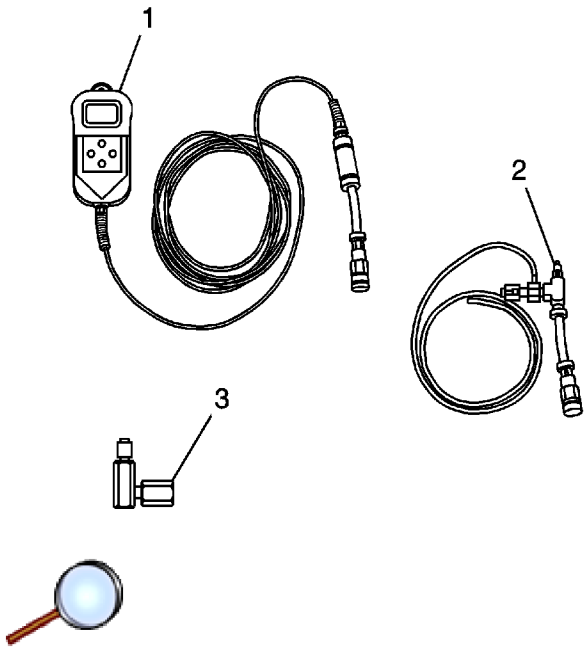


1. Relieve the fuel system pressure, if required. Perform the following steps:

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

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

   Caution: Clean all of the following areas before performing any disconnections in order to avoid possible contamination in the system:
   - The fuel pipe connections
   - The hose connections
   - The areas surrounding the connections

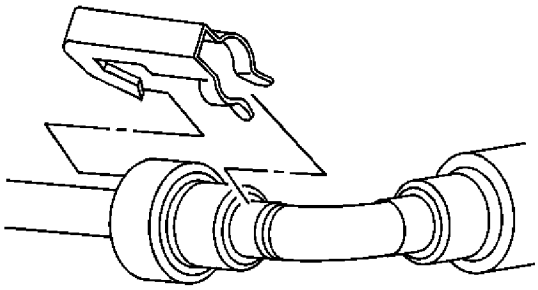
2. Disconnect the CH-48027-1 (1) from the CH-48027-2 (2).
3. Disconnect the CH-48027-2 (2) from the CH-48027-3 (3).
4. Disconnect the CH-48027-3 (3) from the fuel rail service port.
5. Install the fuel rail service port cap.
6. Install the engine cover, if required.
7. Tighten the fuel fill cap.

Metal Collar Quick Connect Fitting Service

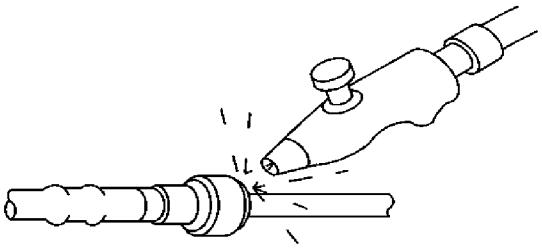
Special Tools

J 37088-A Fuel Line Disconnect Tool Set

Removal Procedure



1. Relieve the fuel system pressure before servicing any fuel system connection. Refer to Fuel Pressure Relief.
2. Remove the retainer from the quick connect fitting.



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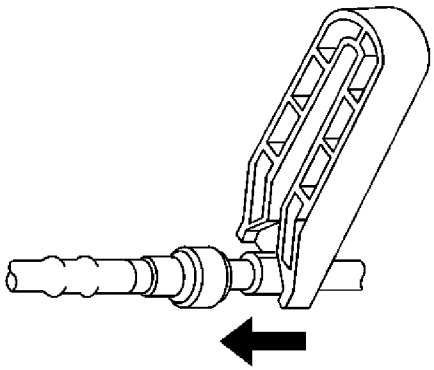
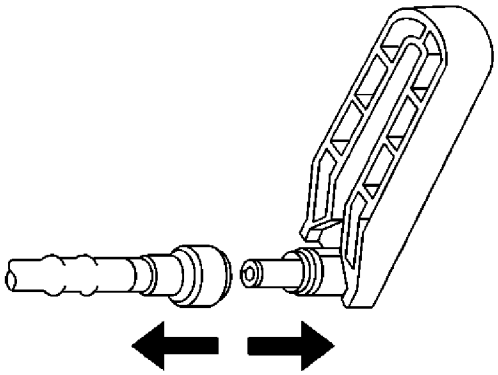
Warning: Wear safety glasses when using compressed air, as flying dirt particles may cause eye injury.

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.



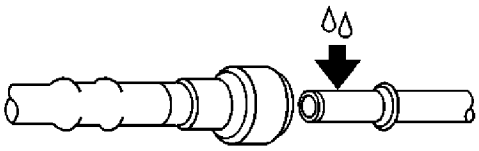
5. Pull the connection apart.

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

radial motion with the fuel pipe end in order to prevent damage to the O-ring sealing surface. Use a clean shop towel in order to wipe off the male tube ends. Inspect all the connections for dirt and burrs. Clean or replace the components and assemblies as required.

6. 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

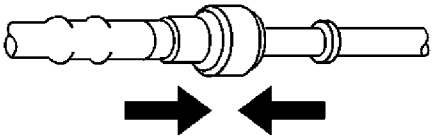


Warning: In order to reduce the risk of fire and personal injury, before connecting fuel pipe fittings, always apply a few drops of clean engine oil to the male pipe ends.

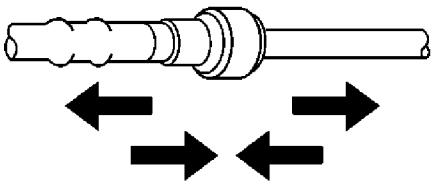
This will ensure proper reconnection and prevent a possible fuel leak.

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

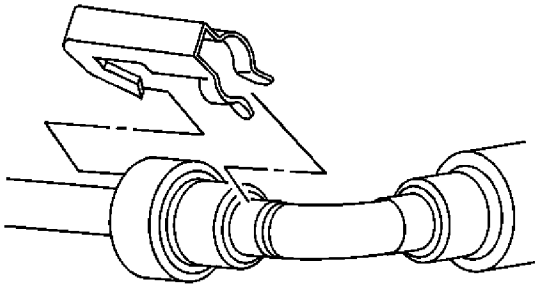
1. Apply a few drops of clean engine oil to the male pipe end.



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.

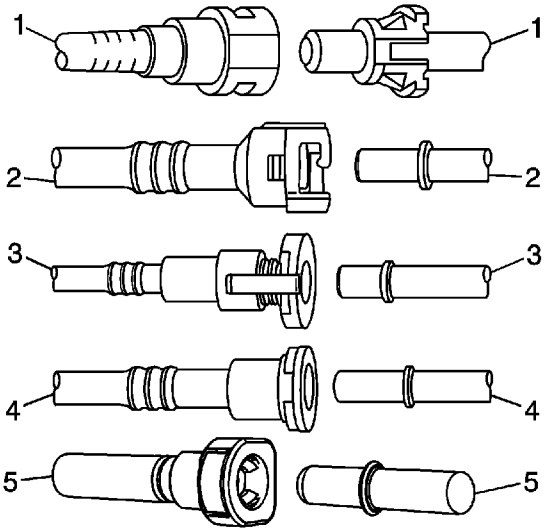


4. Install the retainer to the quick connect fitting.

Plastic Collar Quick Connect Fitting Service

Removal 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 that may be used on this vehicle.

- Bartholomew (1)
- Q release (2)
- Squeeze to release (3)
- Sliding retainer (4)
- Push down TI (5)

Note: The following instructions apply to all of these types of fittings except where indicated.

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

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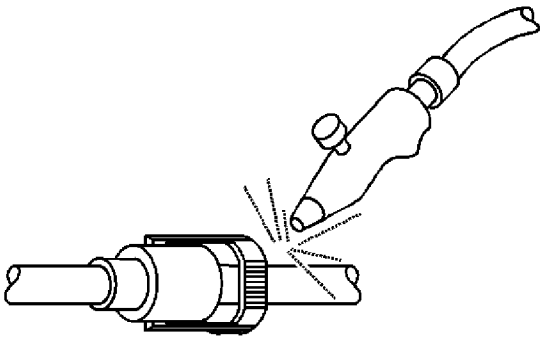
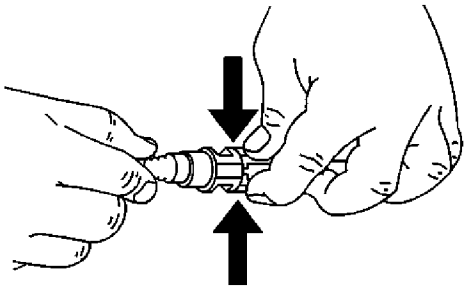
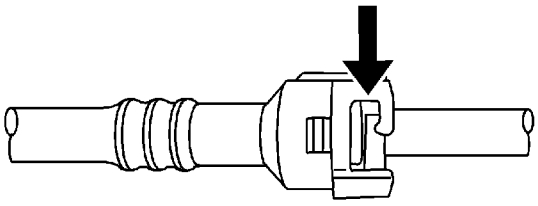


Warning: Wear safety glasses when using compressed air, as flying dirt particles may cause eye injury.

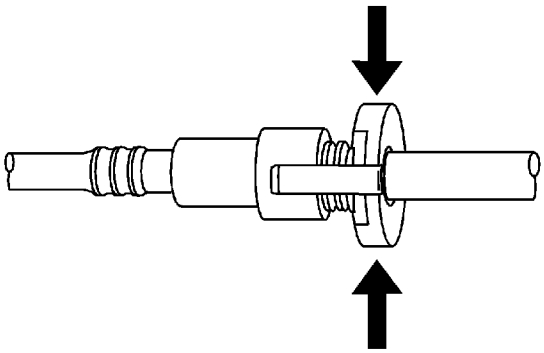
2. Using compressed air, blow any dirt out of the quick connect fitting.



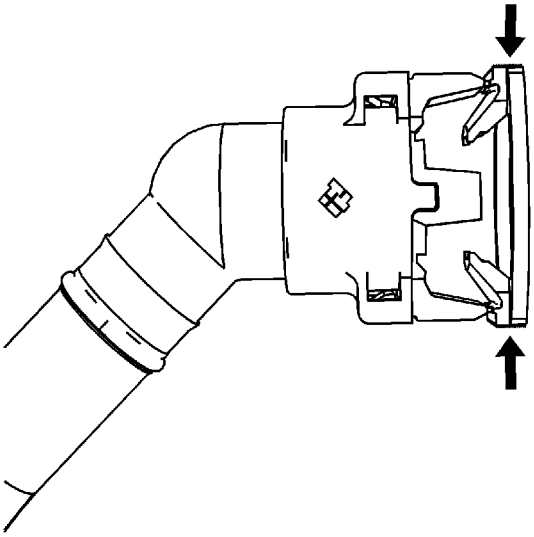
3. This step applies to the Bartholomew style connectors ONLY. Squeeze the plastic quick connect fitting release tabs.



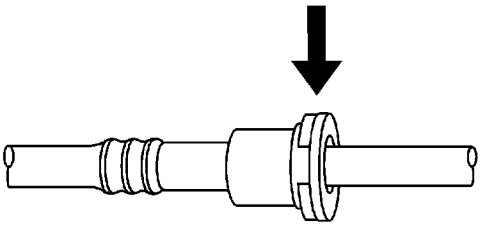
4. This step applies to the Q release type connectors ONLY. Release the fitting by pushing the tab toward the other side of the slot in the fitting.



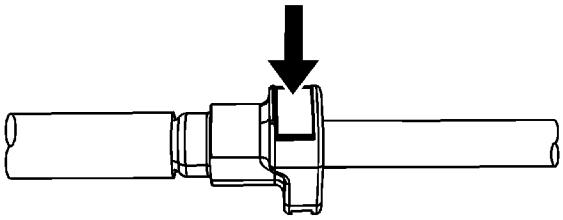
5. This step applies to the Squeeze to release style connectors ONLY. Squeeze where indicated by arrows on both sides of the plastic ring surrounding the quick connect fitting.



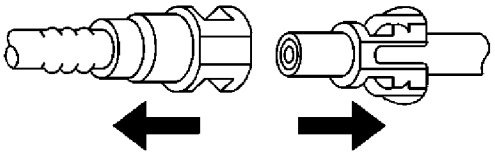
6. This step also applies to the Squeeze to release style connectors ONLY. Squeeze where indicated by the arrows on both sides of the plastic ring surrounding the quick connect fitting.



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

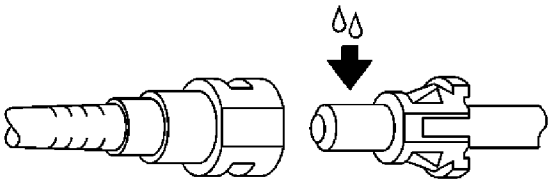


8. This step applies to the Push down TI style connectors ONLY. Release the fitting by pressing on the tabs indicated by the arrow.

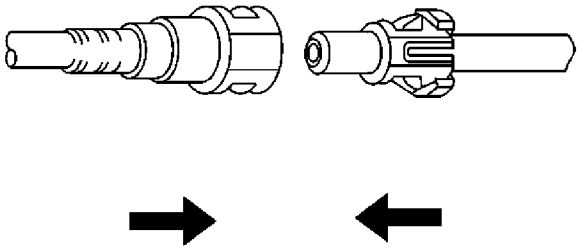


9. Pull the connection apart.
10. Wipe off the male pipe end using a clean shop towel.
11. Inspect both ends of the fitting for dirt and burrs.
12. Clean or replace the components as required.

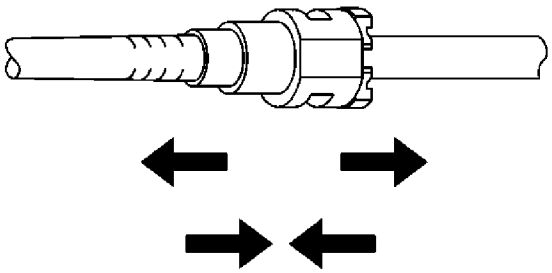
Installation Procedure



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



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



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

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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1. Connect a scan tool to the vehicle diagnostic connector and turn the ignition ON.
2. Relieve the fuel system pressure. Refer to Fuel Pressure Relief.

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

hose may pass through the check valve cage and then jam on attempted removal.

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.

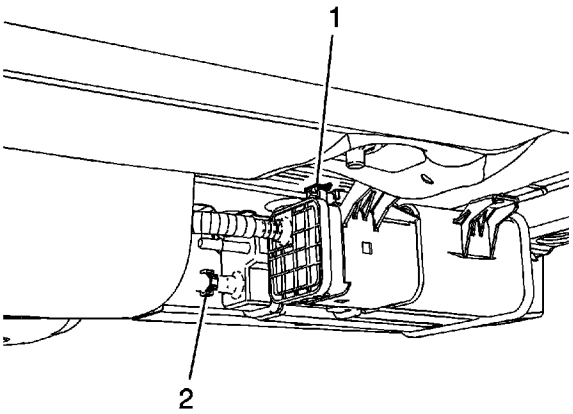
5. Begin the fuel siphoning process. Place the fuel into an approved fuel container.
6. Remove the siphon hose from the fuel fill pipe after draining is complete.

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.
2. Disconnect the fresh air tube quick disconnect (2).

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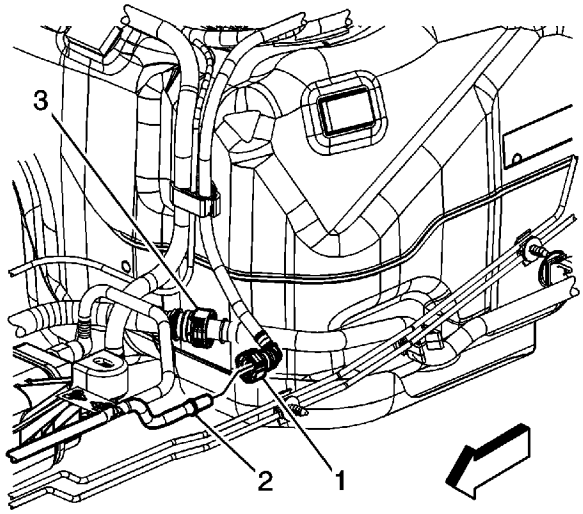
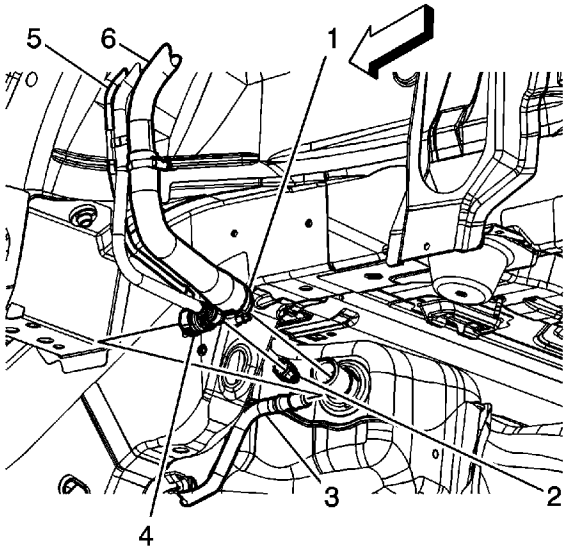


Warning: Whenever fuel lines are removed, catch fuel in an approved container. Container opening must be a minimum of 300 mm (12 in) diameter to adequately catch the fluid.

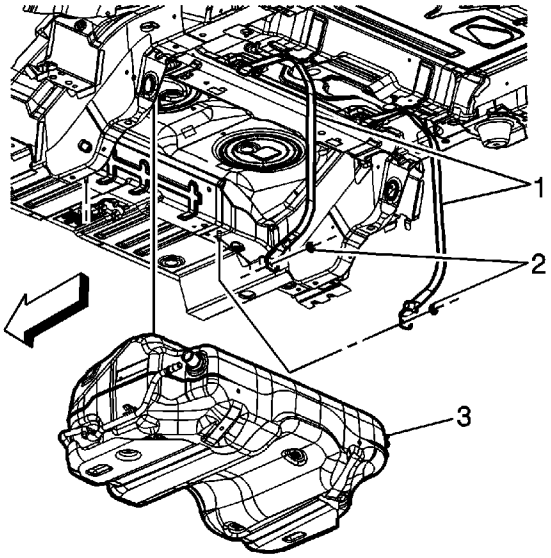
Caution: Clean all fuel pipe connections and surrounding areas before disconnecting the fuel pipes to avoid contamination of the fuel system.

3. 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.
4. Disconnect the fresh air tube quick disconnect (3).



5. 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.
6. 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.
7. Loosen the fuel fill pipe hose clamp (1) at the fuel tank.
8. Remove the fuel fill pipe (6) hose from the fuel tank.



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

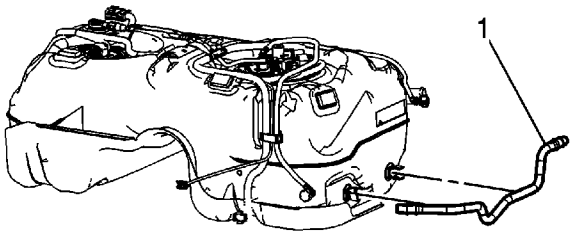
Caution: Do not bend the fuel tank straps. Bending the fuel tank straps may cause damage to the straps.

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

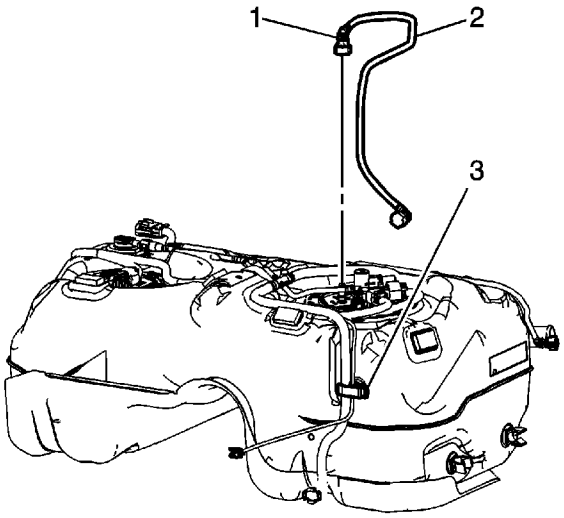
Note: It is not necessary to remove the rear drive module (RDM) in order to remove the fuel tank.

11. Using the adjustable jack, slowly lower and reposition the fuel tank (3) in order to remove the tank from the vehicle.
12. If replacing the fuel tank perform the following steps, otherwise proceed to the Installation Procedure.

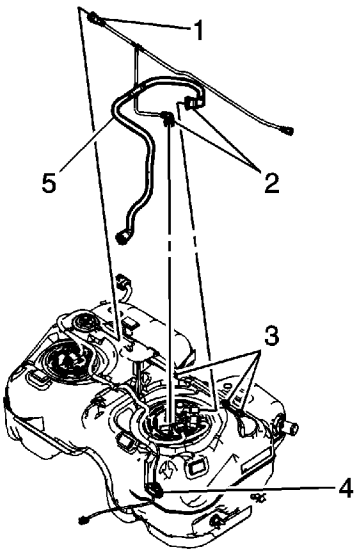
Disassembly Procedure



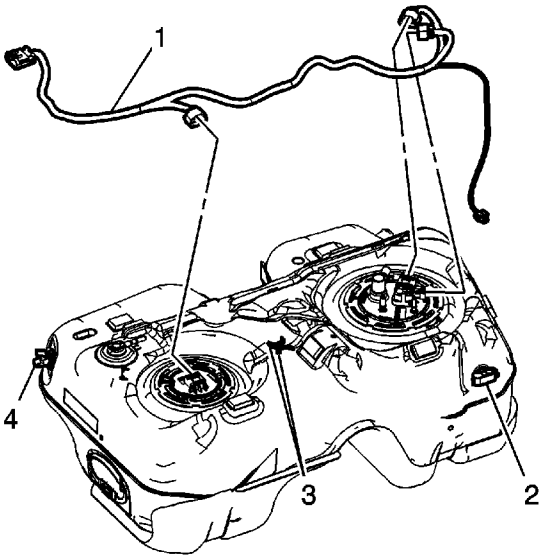
1. Disengage the fresh air line (1) from the fuel tank clips and remove the fresh air line.



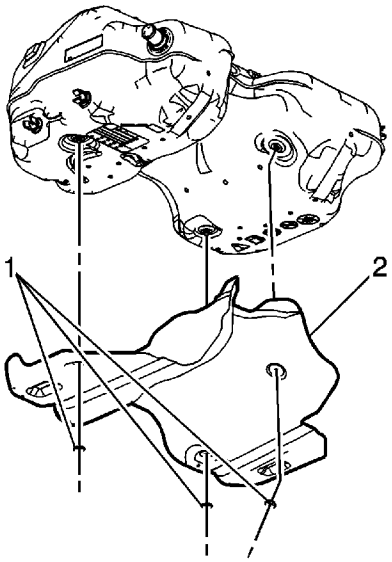
2. Disconnect the fuel feed line quick connect fitting (1) from the fuel tank fuel pump module. Refer to Plastic Collar Quick Connect Fitting Service.
3. Open the retaining clip (3) on the fuel tank and remove the fuel feed line (2).



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.

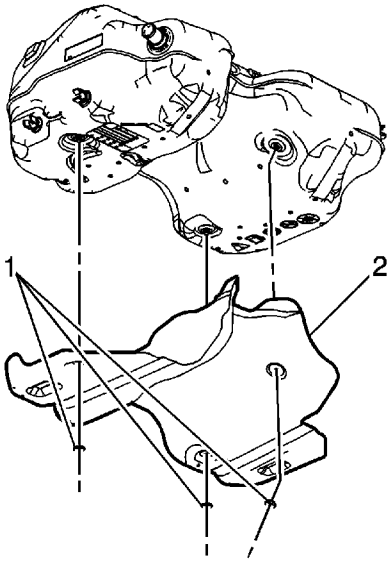


7. Disconnect the fuel tank wiring harness (1) electrical connectors from the following:
   - Primary fuel tank fuel pump module
   - Fuel tank pressure sensor
   - Secondary fuel tank fuel pump module
8. Remove the fuel tank wiring harness from the retaining clips (2 and 4) and the retaining features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

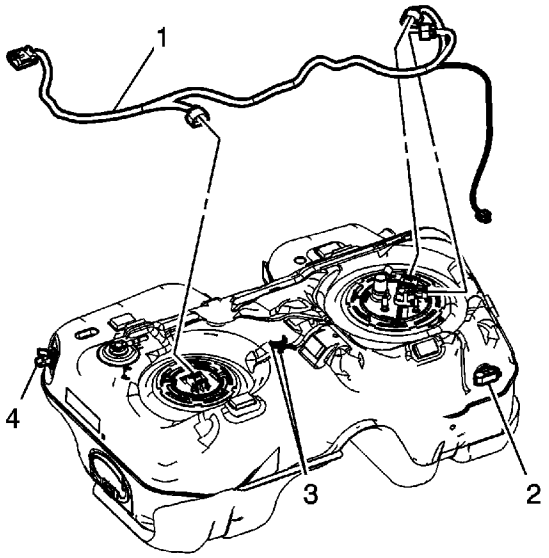


9. Remove the fuel tank shield retainers (1) and shield (2).
10. Remove the fuel tank fuel pump modules. Refer to Fuel Tank Fuel Pump Module Replacement and Fuel Tank Fuel Pump Module Replacement - Secondary.

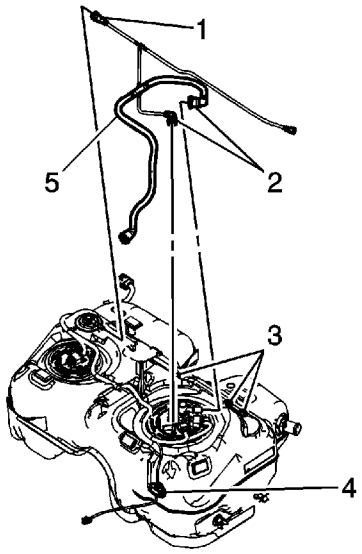
Assembly Procedure



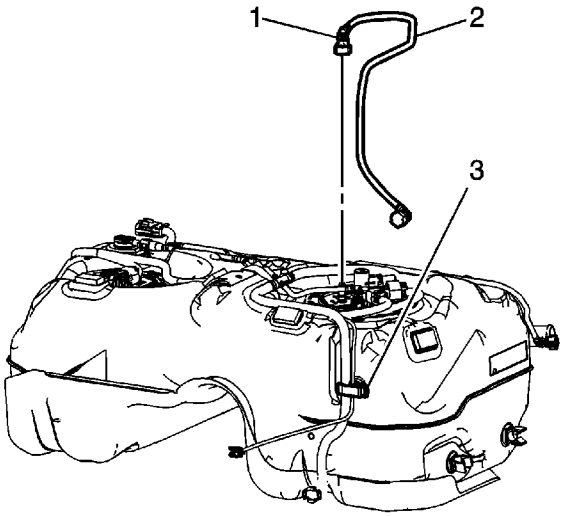
1. Install the fuel tank fuel pump modules. Refer to Fuel Tank Fuel Pump Module Replacement and Fuel Tank Fuel Pump Module Replacement - Secondary.
2. Install the fuel tank shield (2) and retainers (1).



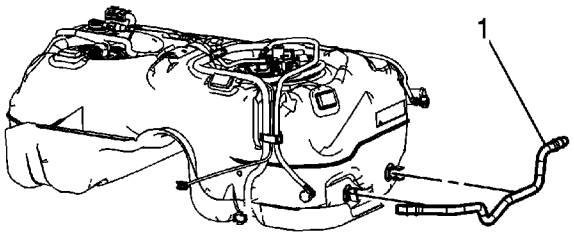
3. Connect the fuel tank wiring harness (1) electrical connectors to the following:
   - Secondary fuel tank fuel pump module
   - Fuel tank pressure sensor
   - Primary fuel tank fuel pump module
4. Install the fuel tank wiring harness to the retaining clips (2 and 4) and the retaining features (3)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

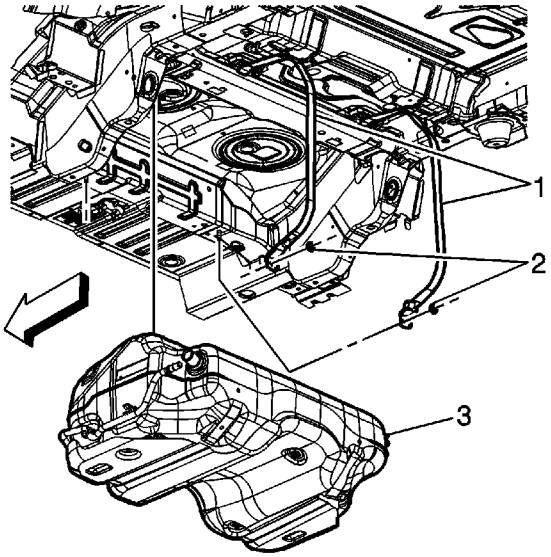


8. Lay the fuel feed line (2) into position and connect the fuel feed line quick connect fitting (1) to the fuel tank fuel pump module. Refer to Plastic Collar Quick Connect Fitting Service.
9. Close the retaining clip (3) on the fuel tank.



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

Installation Procedure



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

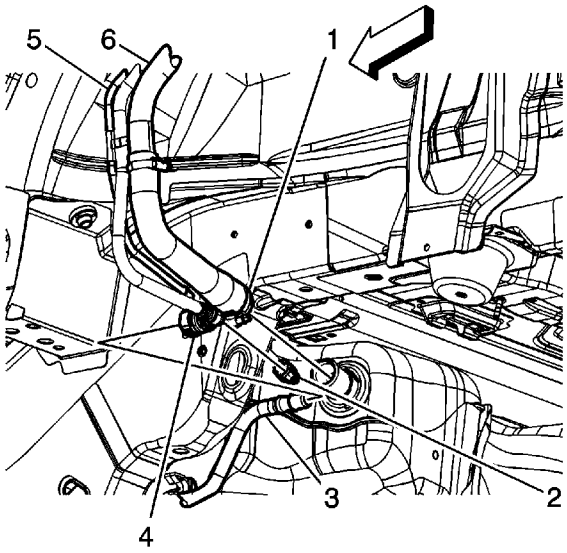
   Caution: Refer to Fastener Caution in the Preface section.

   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.

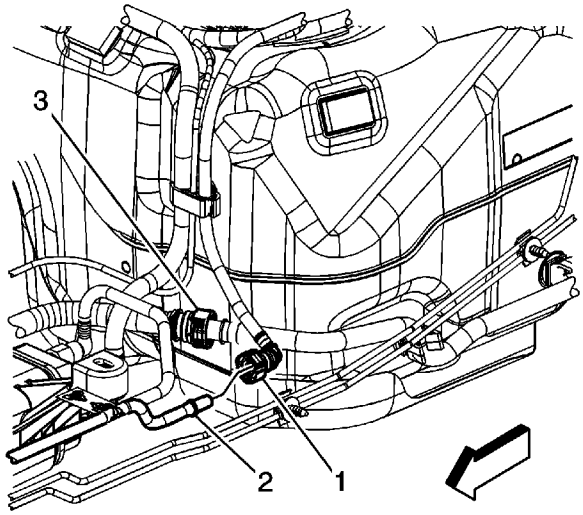


Note: Ensure that the notch in the fuel fill pipe hose aligns with the locating tab on the fuel tank.

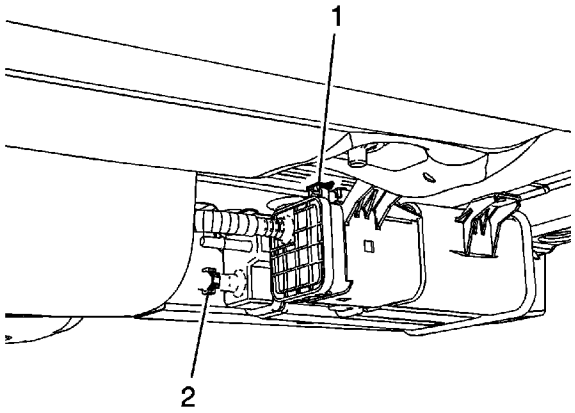
4. Install the fuel fill pipe (6) hose to the fuel tank.
5. Tighten the fuel fill pipe hose clamp (1) at the fuel tank.

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

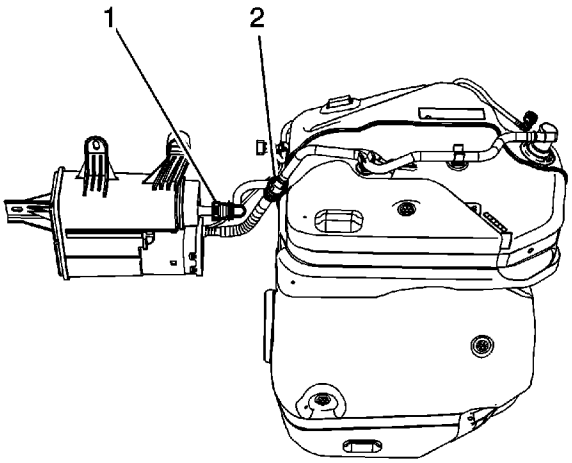
6. Connect the fuel tank vapor line quick connect fitting (2) to the fill pipe recirculation line (5). Refer to Plastic Collar Quick Connect Fitting Service.
7. Connect the fill pipe vent line quick connect fitting (4) to the fuel tank fresh air line (3). Refer to Plastic Collar Quick Connect Fitting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



10. Connect the fuel tank wiring harness electrical connector (1) to the EVAP canister vent solenoid valve.
11. Connect the fresh air tube quick disconnect (2).



12. 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.
13. Connect the fuel tank vapor line quick connect fitting (1) to the EVAP canister. Refer to Plastic Collar Quick Connect Fitting Service.
14. If equipped with AWD, install the propeller shaft. Refer to Propeller Shaft Replacement.
15. Install the muffler. Refer to Exhaust Muffler Replacement.
16. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
17. 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.
- Turn the ignition ON, with the engine OFF.
- Inspect for fuel leaks.

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

Fuel System Cleaning

Special Tools

SA9127E-7 Fuel Pressure/Flow Adapter

After it is determined that the fuel system is contaminated, the following procedure to clean it is recommended.

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. Place the vehicle on a hoist and open the hood.

   Warning: Refer to Battery Disconnect Warning in the Preface section.

   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.

2. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
3. Remove the fuel tank. Refer to Fuel Tank Replacement.
4. Disconnect the fuel feed line at the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
5. With compressed air, blow out the fuel feed. Catch the fuel in a container at the opposite end of the line.
6. Remove the fuel tank modules. Refer to Fuel Tank Fuel Pump Module Replacement and/or Fuel Tank Fuel Pump Module Replacement - Secondary.
7. Inspect the inlet filter on the primary pump. If plugged or damaged, the fuel pump module must be replaced.
8. Flush the tank with hot water for at least 6 minutes. Invert and drain. All metal chips/debris must be removed from the tank prior to installation.
9. Install the fuel pump modules to the fuel tank using a new fuel pump seal. Do not connect the fuel feed line to the new filter.
10. Install the fuel tank to the vehicle.

    Caution: Replace plastic fuel line retainers whenever the fuel supply or return line is disconnected at the fuel rail. Install the new retainer into the female cavity of the connection. Care must be taken to ensure that the locking tab is centered in the window of the female cavity. Firmly press the female connection onto the male end until a click is heard, then pull back to confirm engagement. Pinched, kinked, or damaged fuel lines must be replaced.

11. Connect the fuel line to the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
12. Put at least 22.7 liters (6 gallons) of clean fuel into the fuel tank.
13. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
14. Connect a scan tool to the vehicle and turn the ignition ON.
15. Raise the vehicle on a hoist and install the male quick connect adapter SA9127E-7 into the

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fuel feed line.

16. Install the drain hose to the adapter and place the other end in an approved container.
17. Energize the fuel pump with the scan tool for 1-2 minutes. Refer to Energizing the Fuel Pump. This will pump about 1.9 liters (2 quarts) of fuel and purge any debris in the fuel pump.
18. Disconnect the fuel drain hose adapter at the fuel feed line and connect the fuel line to the fuel filter.
19. Energize the fuel pump and check all connections for leaks.
20. De-energize the pump, lower the vehicle, and start the engine.

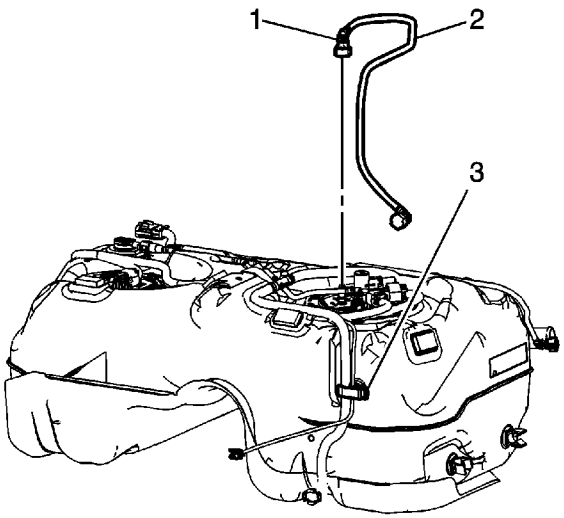
Fuel Tank Fuel Pump Module Replacement

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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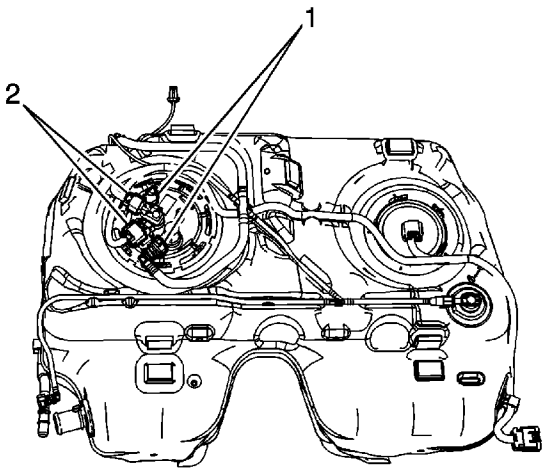
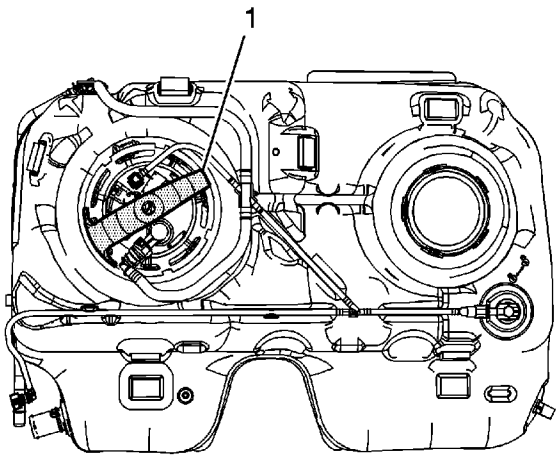
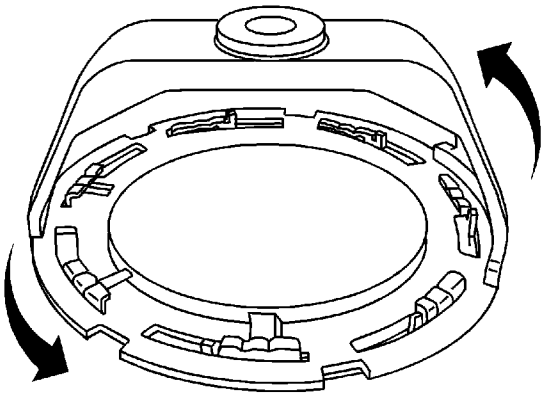


4. Disconnect the engine wiring harness electrical connectors (2) from the fuel tank fuel pump primary module and the fuel tank pressure sensor.
5. Disconnect the vapor line quick connect fittings (1) from the fuel tank fuel pump module. Refer to Plastic Collar Quick Connect Fitting Service.



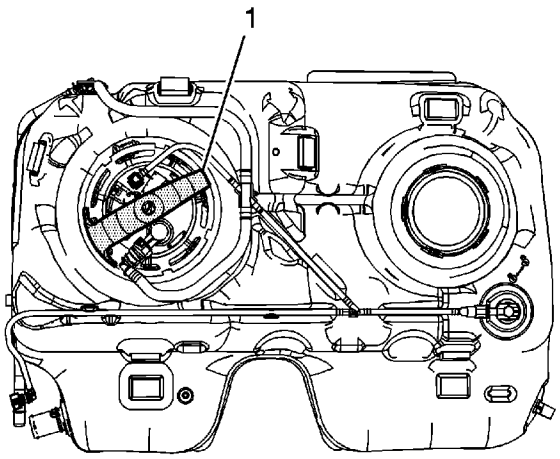
6. Install the J 45722 (1) to the fuel tank fuel pump module lock ring.



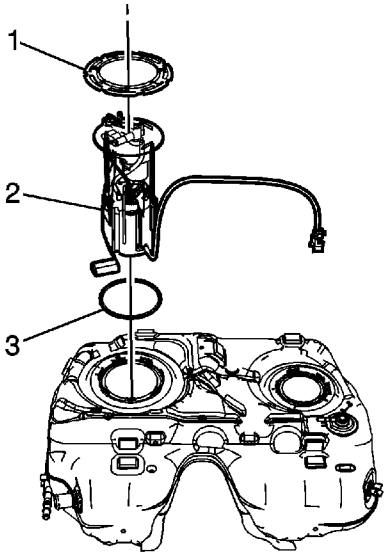
Caution: Avoid damaging the lock ring. Use only J-45722 to prevent damage to the lock ring.

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).



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.

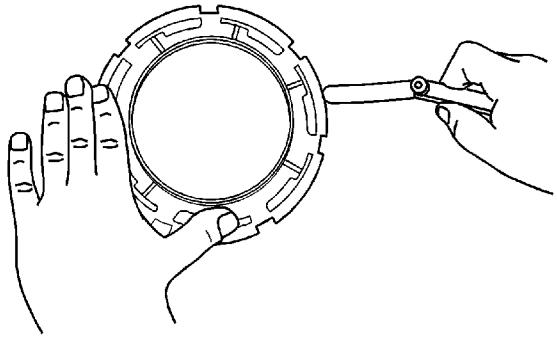
10. Slowly raise the module (2) until the fuel level sensor float arm is just visible.

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.

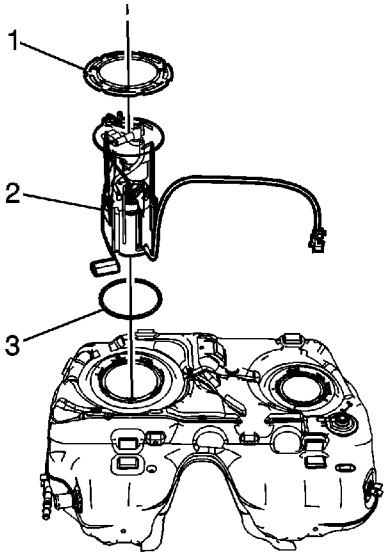


Note:

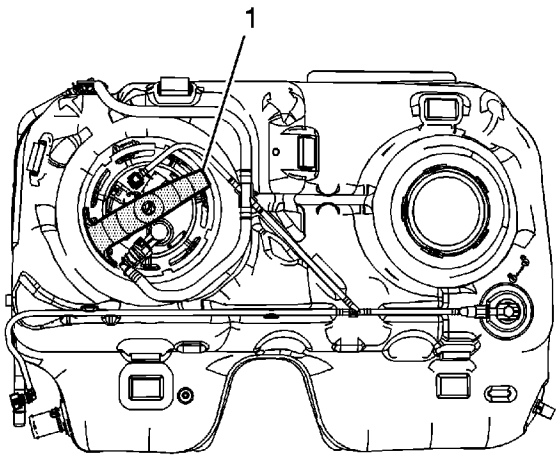
- Some lock rings were manufactured with "DO NOT REUSE" stamped into them. These lock rings may be reused if they are not damaged or warped.
- Inspect the lock ring for damage due to improper removal or installation procedures. If damage is found, install a NEW lock ring.
- Check the lock ring for flatness.

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.

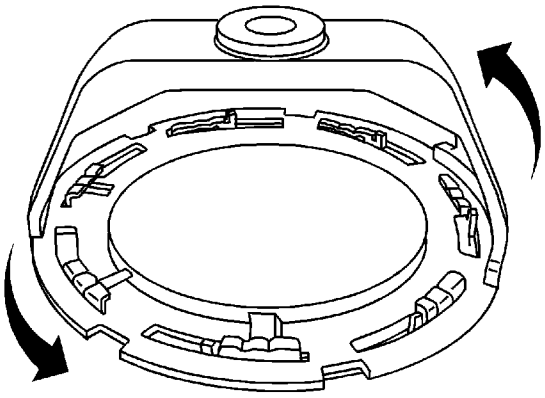
Installation Procedure



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).



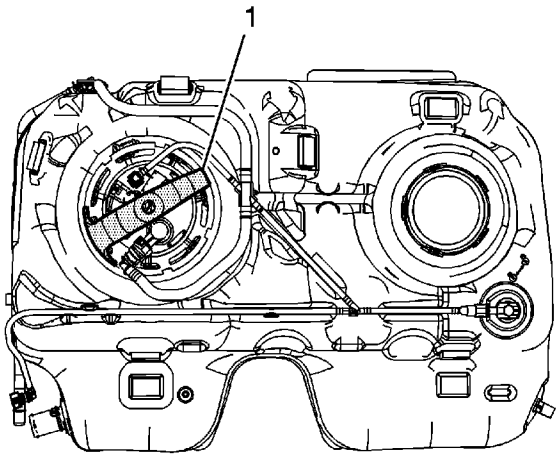
6. Install the J 45722 to the fuel tank fuel pump module lock ring.



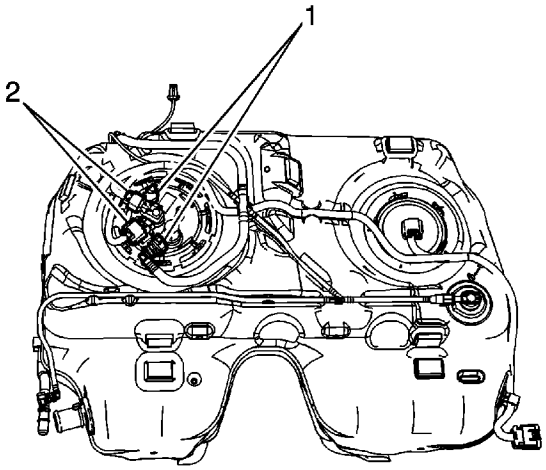
Note: Always replace the fuel tank module seal when installing the fuel tank module. Replace the lock ring if necessary. DO NOT apply any type of lubrication in the seal groove.

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

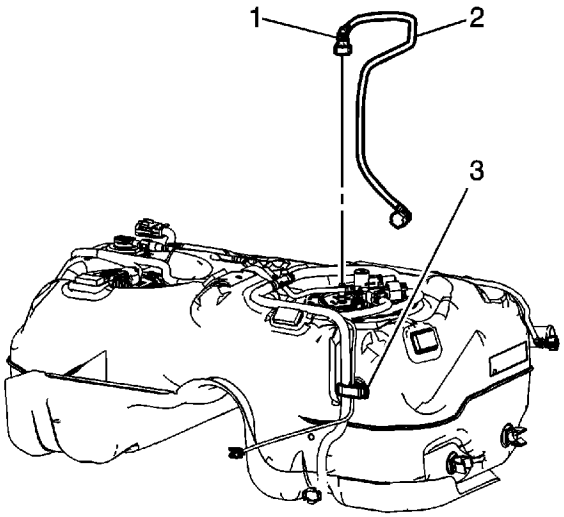
7. Use the J 45722 and a long breaker bar, rotate the lock ring clockwise locking the fuel tank module lock ring.



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



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.



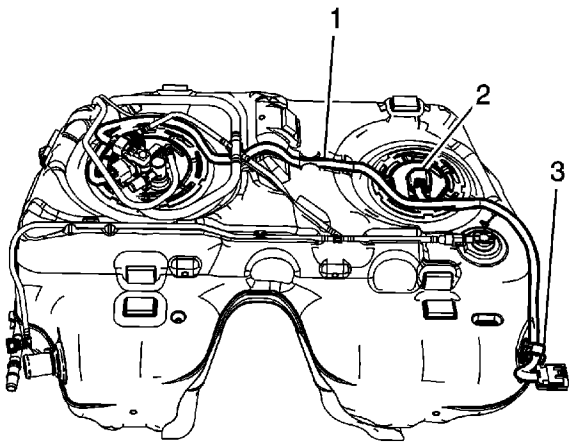
11. Lay the fuel feed line (2) into position and connect the fuel feed line quick connect fitting (1) to the fuel tank fuel pump module. Refer to Plastic Collar Quick Connect Fitting Service.
12. Close the retaining clip (3) on the fuel tank.
13. Install the secondary fuel tank fuel pump module. Refer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

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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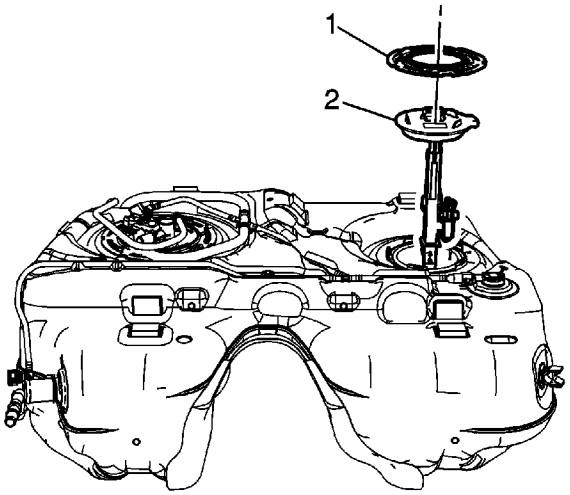
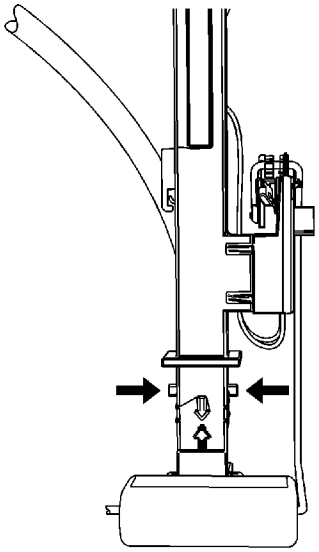
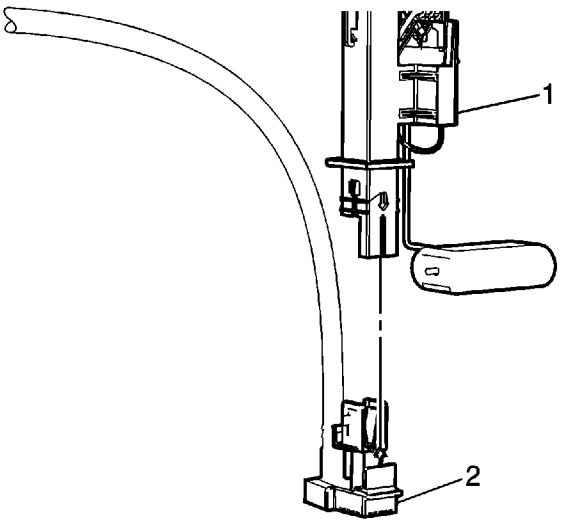


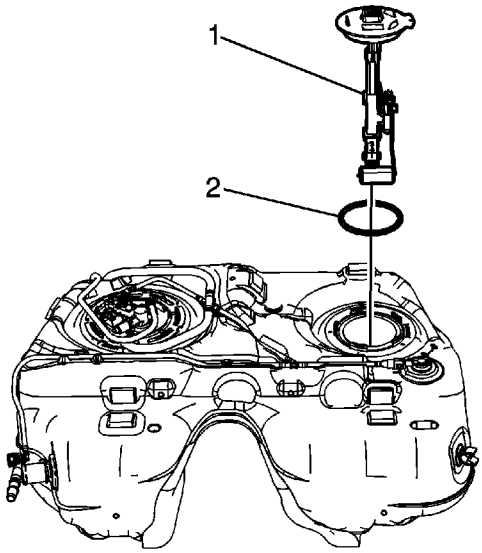
8. Remove the fuel tank module lock ring (1).
9. Slowly raise the fuel tank fuel pump module (2) until the fuel level sensor float arm and primary fuel tank fuel pump module suction port are just visible.



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.

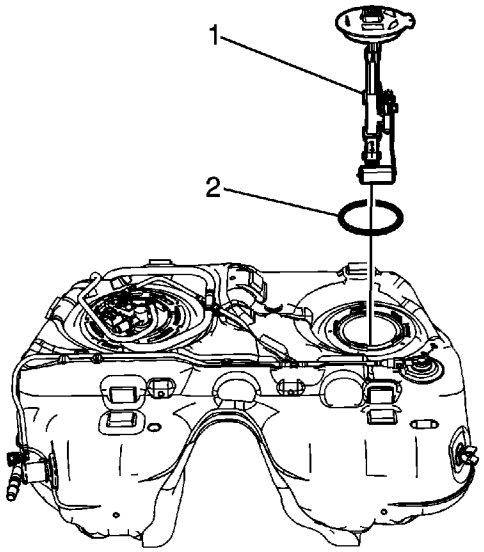


11. Remove the primary fuel tank fuel pump module suction port (2) from the secondary fuel tank fuel pump module (1).

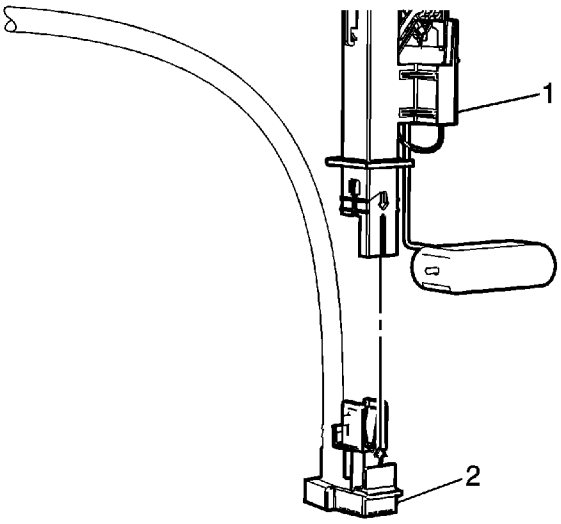


12. Tilt the module toward the rear of the fuel tank to allow the level sensor float arm to clear the tank opening. Remove the module (1) from the tank.
13. Remove and discard the fuel tank module O-ring seal (2).
14. If the secondary fuel tank fuel pump module is being replaced, remove the secondary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

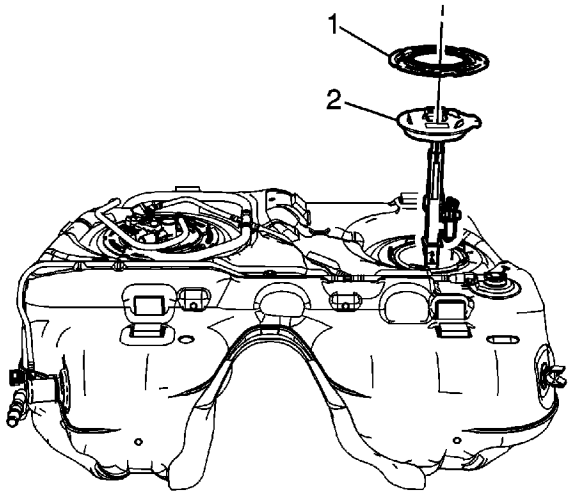
Installation Procedure



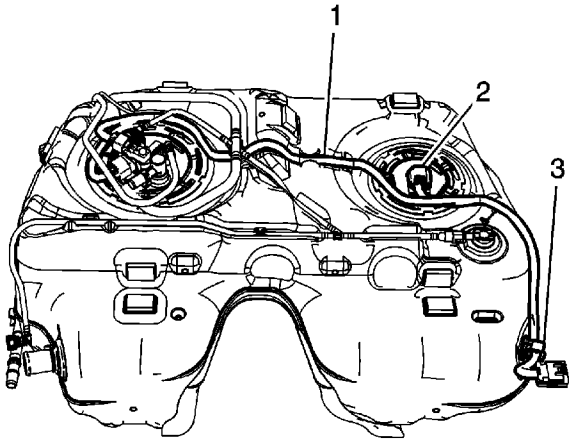
1. If the secondary fuel tank fuel pump module was replaced, install the secondary fuel level sensor, if required. Refer to Secondary Fuel Level Sensor Replacement .
2. Install a NEW fuel tank module O-ring seal (2) onto the fuel tank.
3. Tilt the module toward the rear of the fuel tank to allow the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



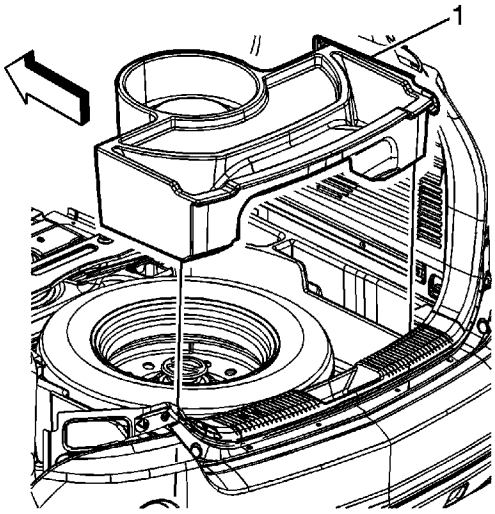
5. Lower the fuel tank fuel pump module (2) into the fuel tank.
6. Install the fuel tank module lock ring (1).



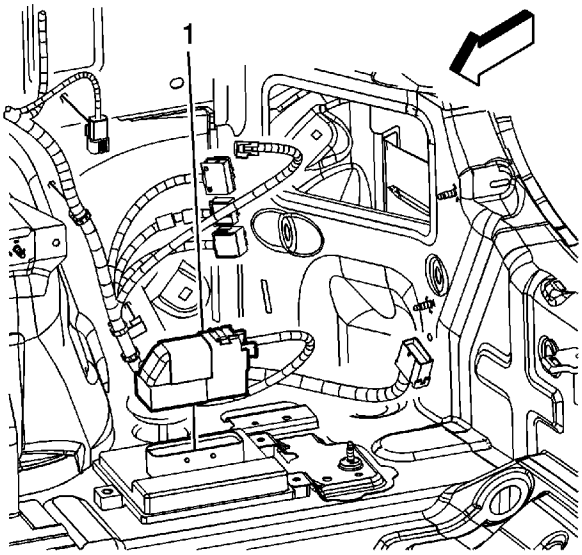
7. Install the CH-48482 to the fuel tank fuel pump module lock ring.
8. Using the CH-48482 and a long breaker bar, rotate the lock ring clockwise locking the fuel tank fuel pump module lock ring.
9. Remove the CH-48482 from the fuel tank fuel pump module lock ring.
10. Position the fuel tank wiring harness (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 .

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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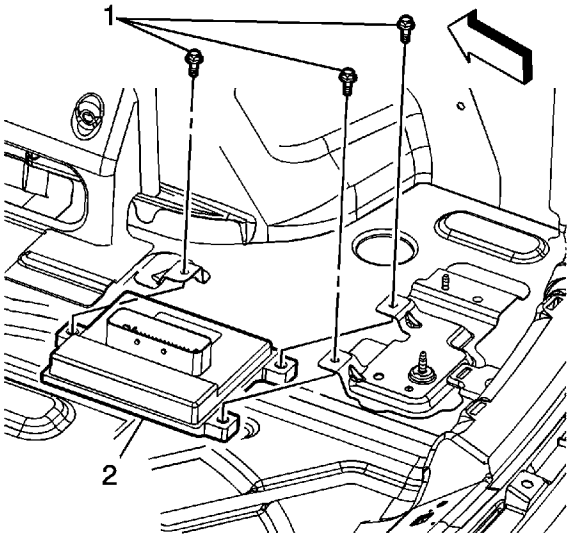
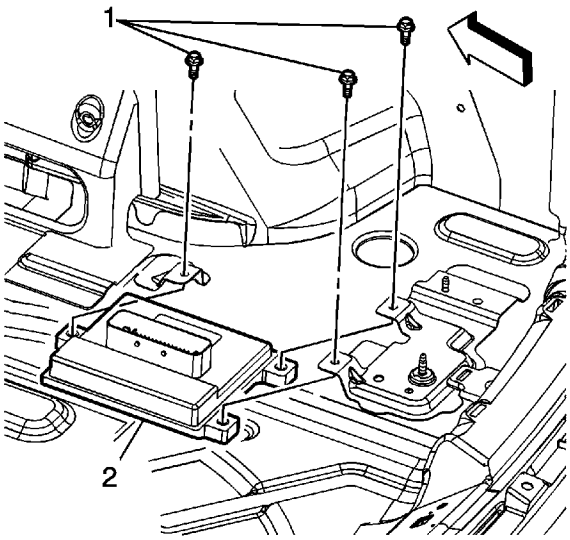
module.



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

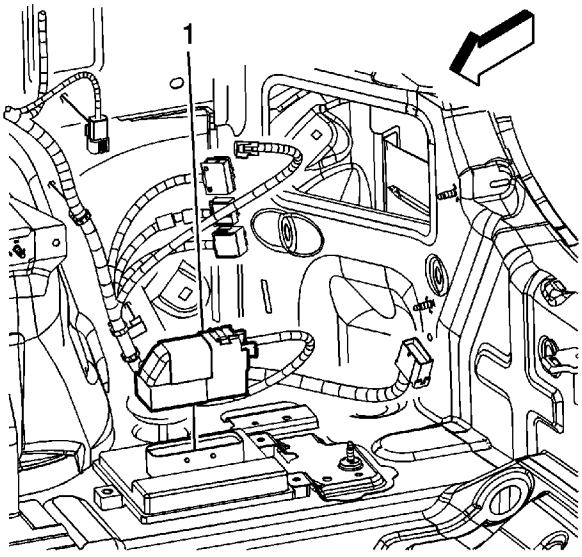


1. Install the fuel pump flow control module (2) to the vehicle.
2. Slide the fuel pump flow control module towards the passenger side of the vehicle.

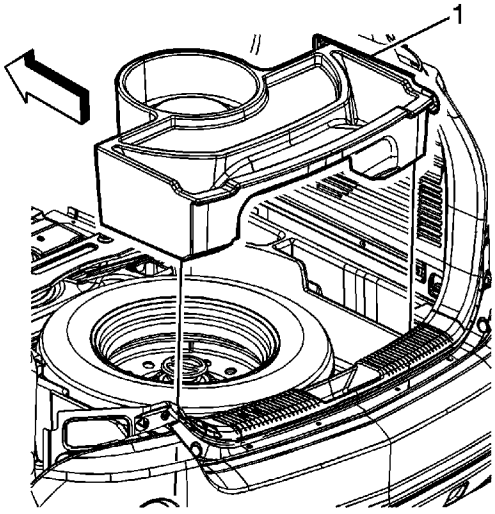
Caution: Refer to Fastener Caution in the Preface section.

3. Install the fuel pump flow control module bolts (1).

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



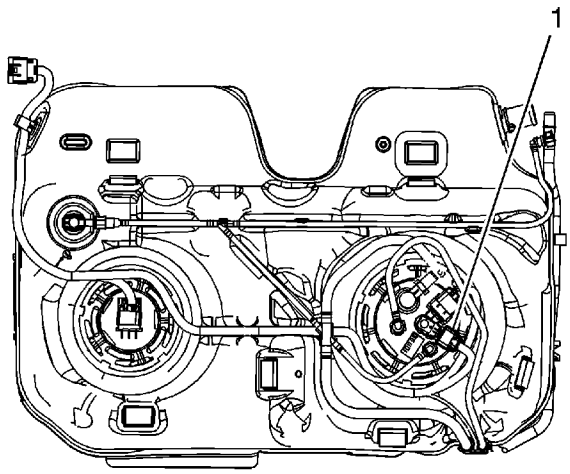
4. Connect the body wiring harness electrical connector (1) to the fuel pump flow control module.



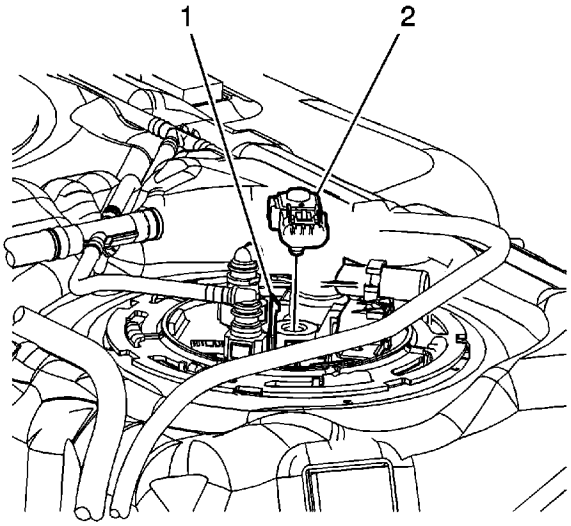
5. Install the rear compartment floor stowage compartment. Refer to Rear Compartment Floor Stowage Compartment Replacement.
6. Install the spare tire spacer (1).
7. Close the rear compartment floor stowage compartment cover.
8. Program the fuel pump flow control module. Refer to Control Module References.

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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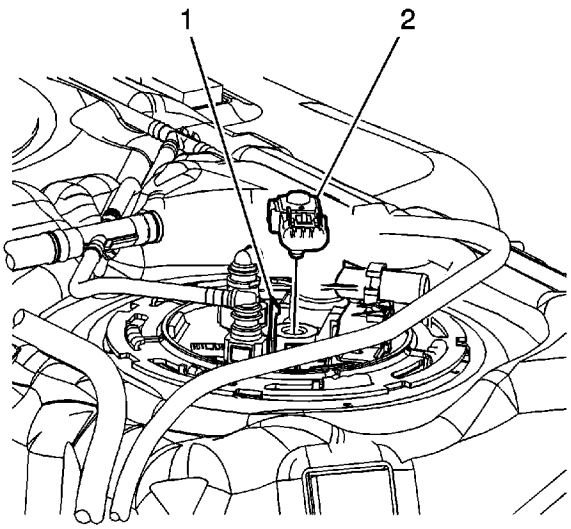
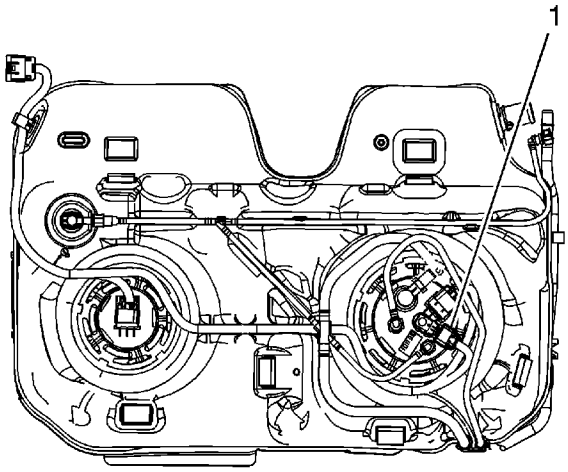
Installation Procedure



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

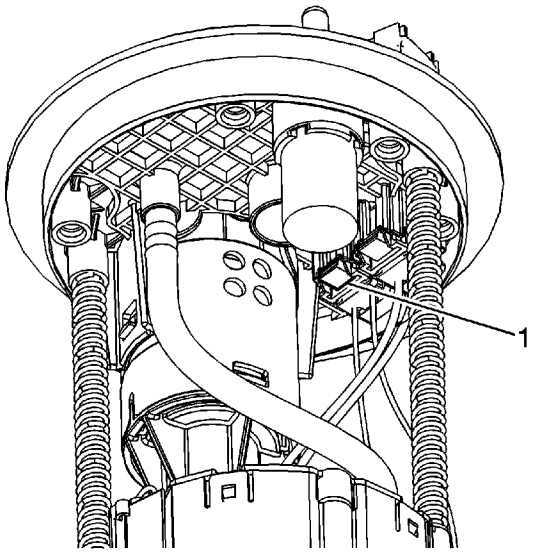


2. Connect the fuel tank wiring harness electrical connector (1) to the fuel tank pressure sensor.
3. Install the fuel tank. Refer to Fuel Tank Replacement.

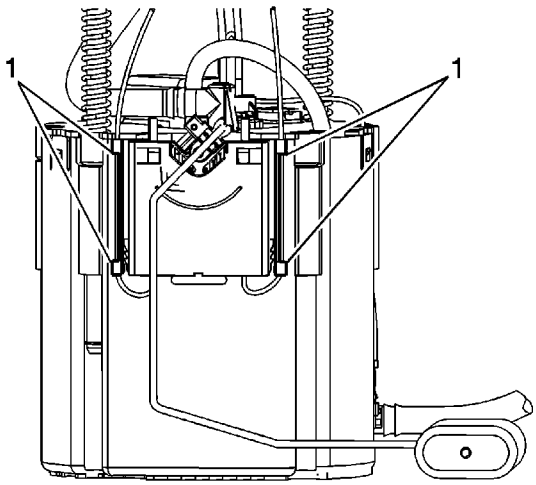
Fuel Level Sensor Replacement

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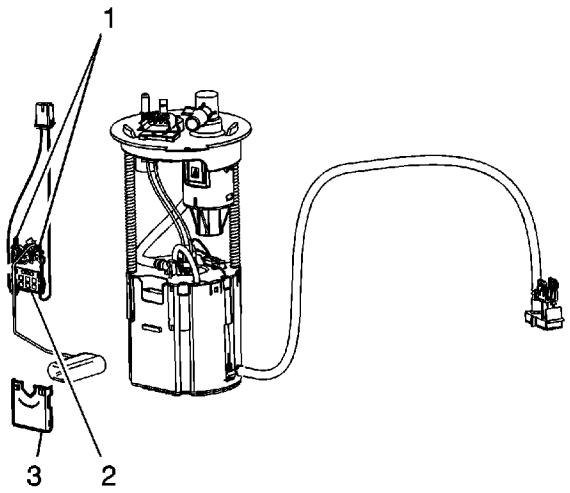
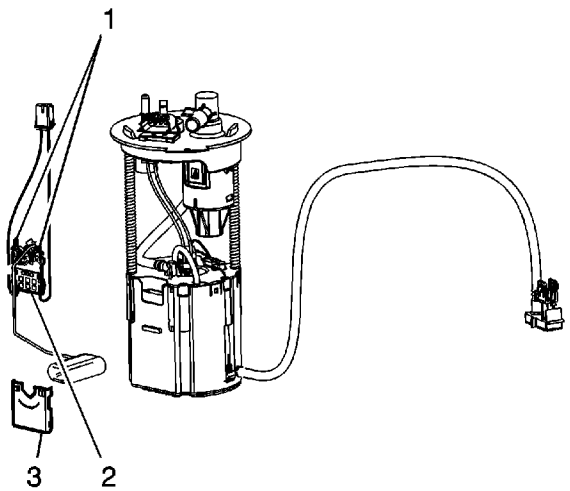
3. Remove the fuel level sensor wiring from behind the retaining features (1) molded into the fuel tank fuel pump module reservoir.

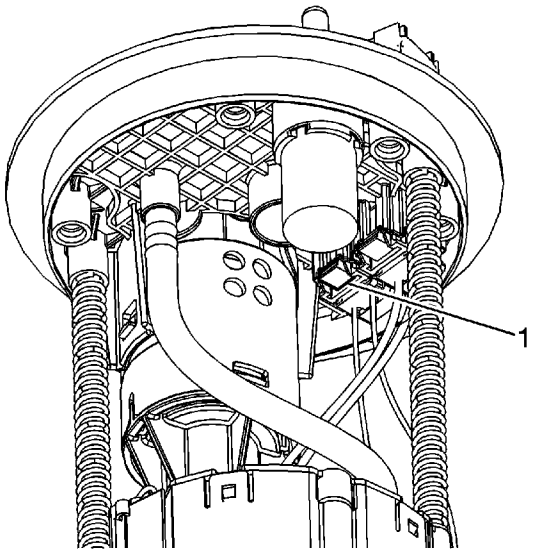


4. Slide the fuel level sensor up and remove the sensor from the fuel tank fuel pump module.
5. Place the fuel level sensor on a clean work surface.
6. Push in the fuel level sensor retainers (1), in order to remove the sensor from the cover.
7. Remove the fuel level sensor (2) from the cover (3).

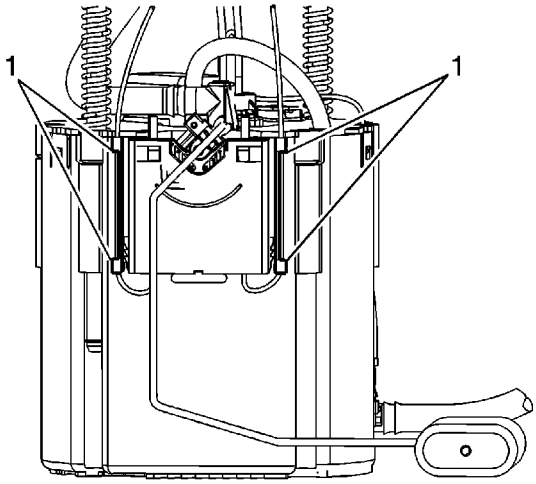
Installation Procedure



1. Install the fuel level sensor cover (3) to the fuel level sensor (2).
2. Ensure that the fuel level sensor retainers (1) are fully engaged to the cover.
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.

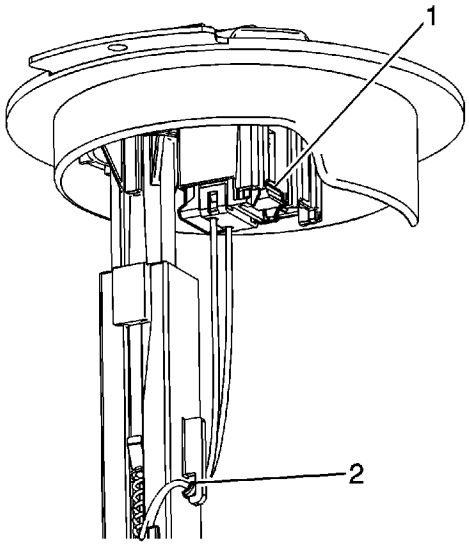


5. Install the fuel level sensor wiring behind the retaining features (1) molded into the fuel tank fuel pump module reservoir.
6. Install the fuel pump module. Refer to Fuel Tank Fuel Pump Module Replacement.

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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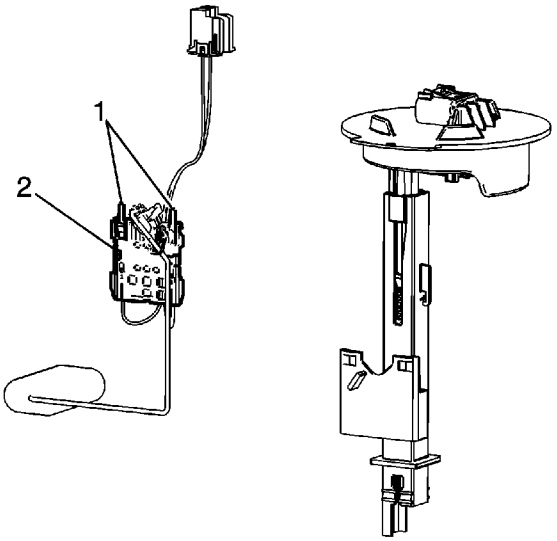
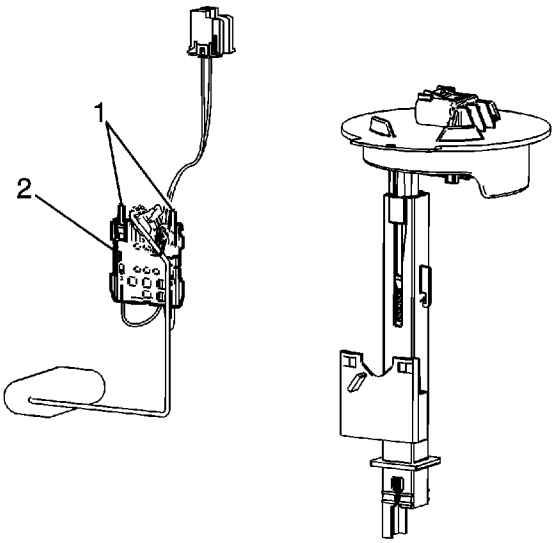
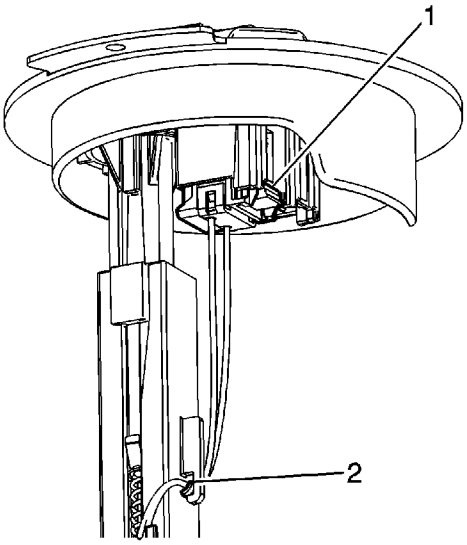


4. Push in the fuel level sensor retainers (1), in order to disengage the retainers from the module.
5. Slide the fuel level sensor (2) up, out of the fuel tank fuel pump module.

Installation Procedure



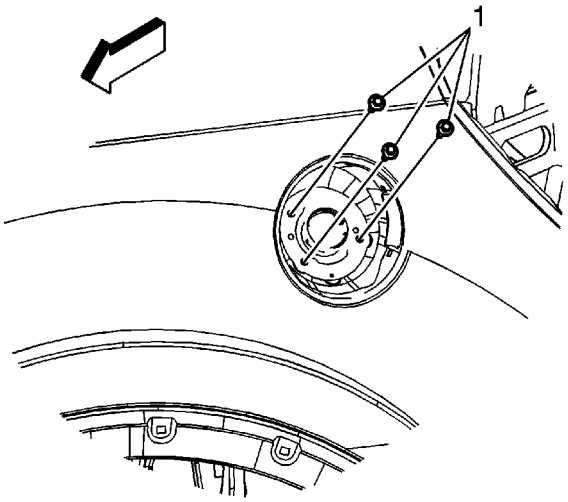
1. Position the fuel level sensor (2) to the fuel tank fuel pump module.
2. Push the fuel level sensor down until the retainers (1) engage the fuel tank fuel pump module.



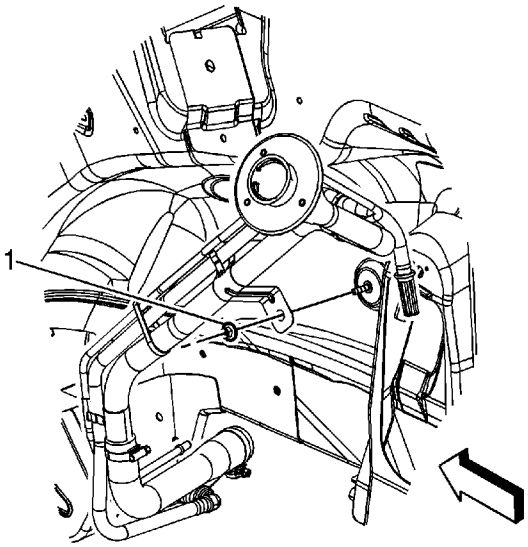
3. Connect the fuel level sender electrical connector (1) to the fuel tank fuel pump module cover.
4. Install the fuel level sensor wiring to the retaining feature (2) on the fuel tank fuel pump module.
5. Install the fuel pump module. Refer to Fuel Tank Fuel Pump Module Replacement - Secondary.

Fuel Tank Filler Pipe 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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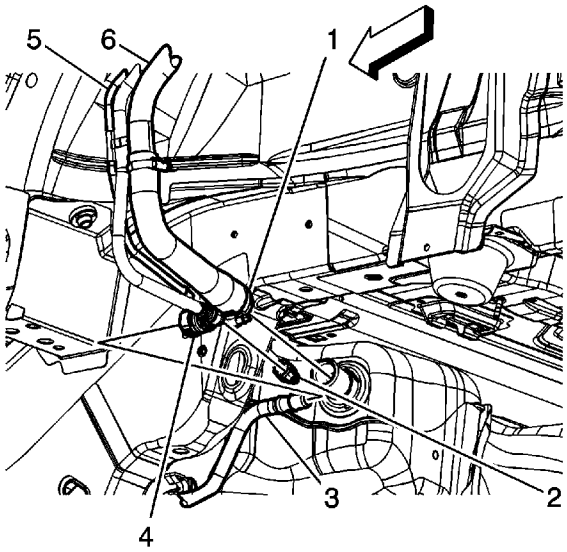
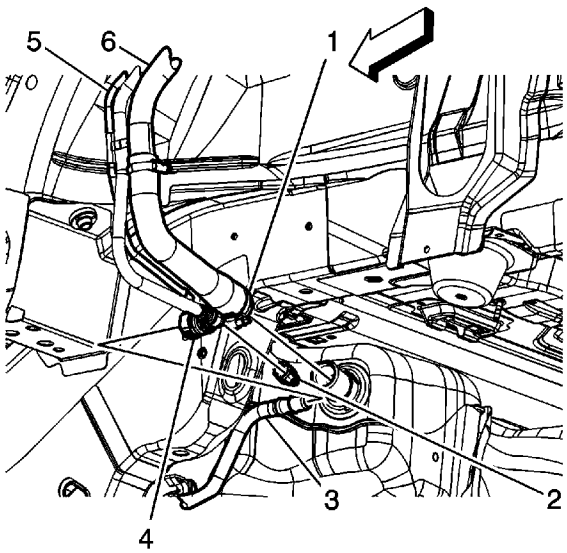
5. Remove the right rear wheelhouse liner. Refer to Rear Wheelhouse Panel Liner Replacement.
6. Remove the fuel fill pipe upper bracket nut (1).



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

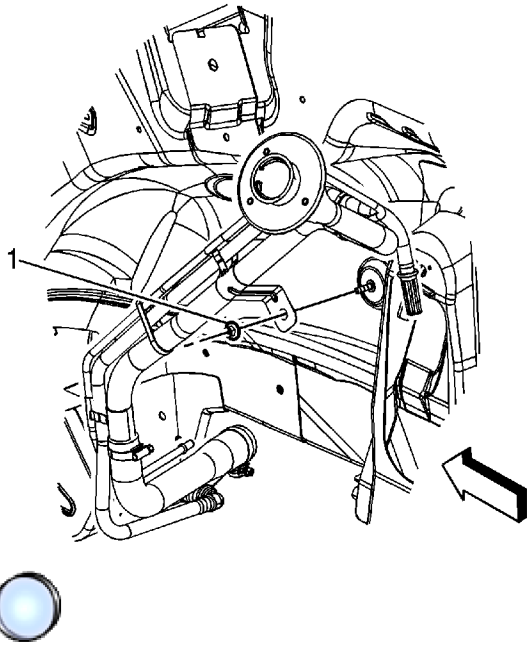


Note: Ensure that the notch in the fuel fill pipe hose aligns with the locating tab on the fuel tank.

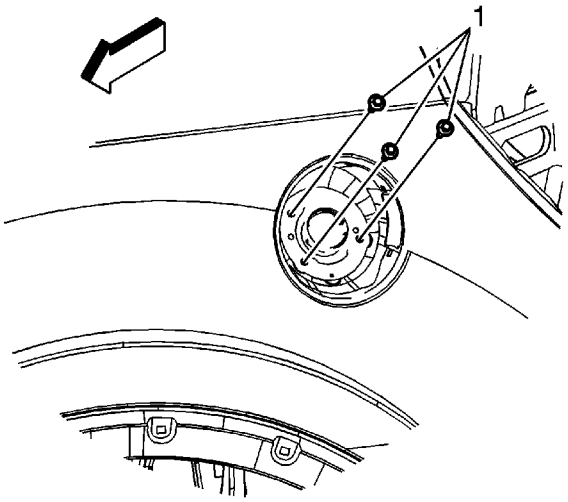
1. Install the fuel fill pipe (6) to the fuel tank.

Caution: Refer to Fastener Caution in the Preface section.

2. Tighten the fuel fill pipe hose clamp (1) to **5 N·m (44 lb in)** at the fuel tank.
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.



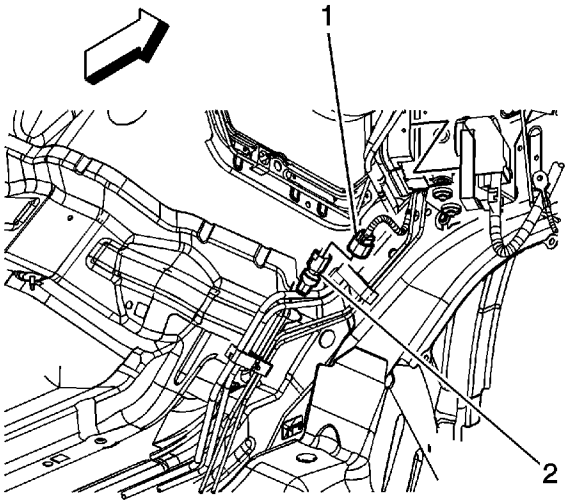
5. Install the fuel fill pipe upper bracket nut (1) to **4 N·m (35 lb in)**.
6. Install the right rear wheelhouse liner. Refer to Rear Wheelhouse Panel Liner Replacement.



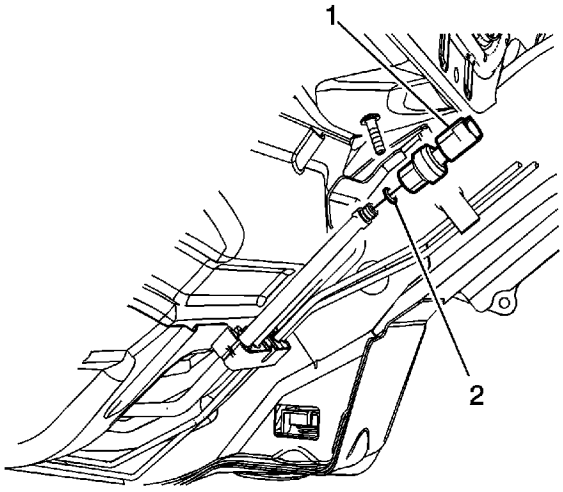
7. Install the fuel tank fill pipe housing to fuel tank fill pipe screws (1) and tighten to **10 N·m (89 lb in)**.
8. Install the fuel fill cap.
9. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.

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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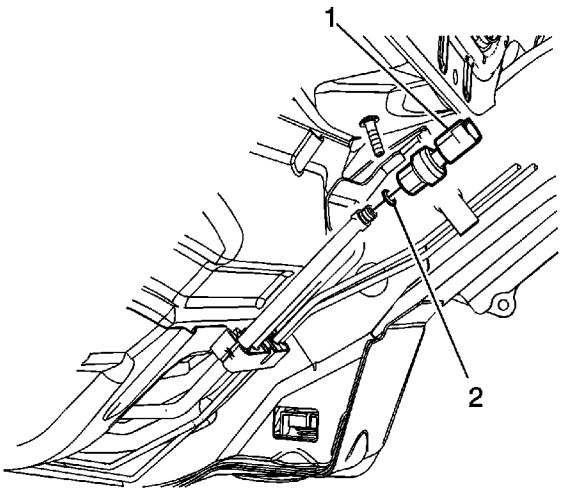
4. Remove the fuel pressure sensor (1) from the fuel line.
5. Remove and discard the fuel pressure sensor O-ring seal (2).

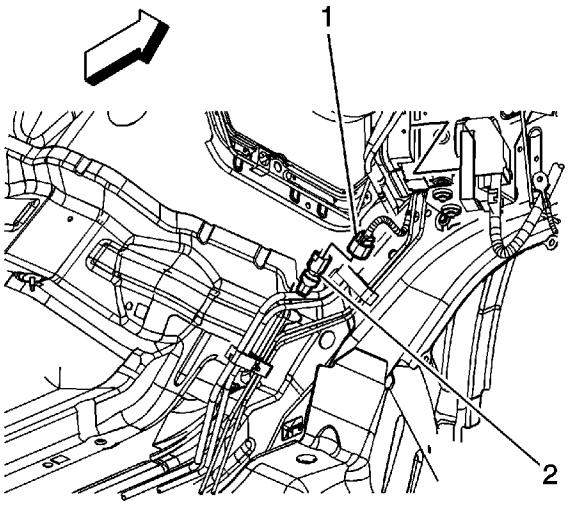
Installation Procedure



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)**.



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.

Fuel Hose / Pipes Replacement - Chassis

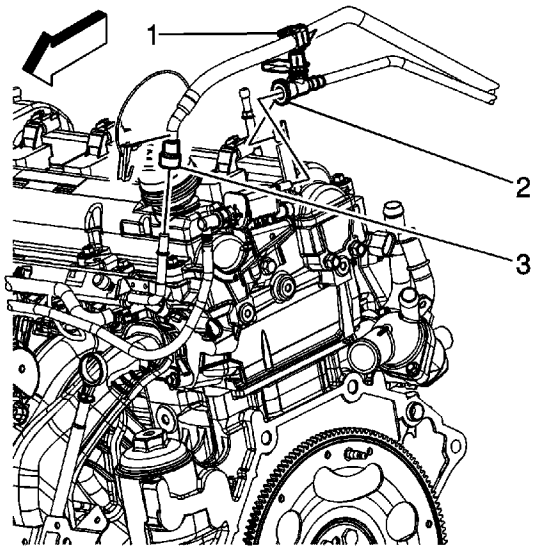
Removal Procedure

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. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.
5. Disconnect the chassis fuel feed line quick connect fitting (3) from the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
6. Disconnect the chassis evaporative emission (EVAP) line quick connect fitting (2) from the EVAP canister purge solenoid valve. Refer to Plastic Collar Quick Connect Fitting Service.
7. Remove the underhood electrical center, non LAT equipped. Refer to Underhood Electrical

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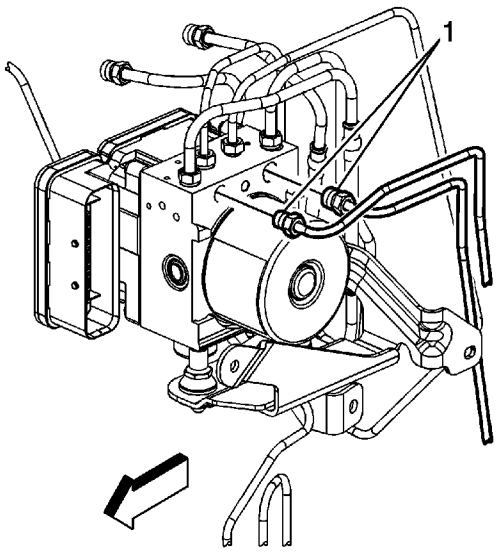
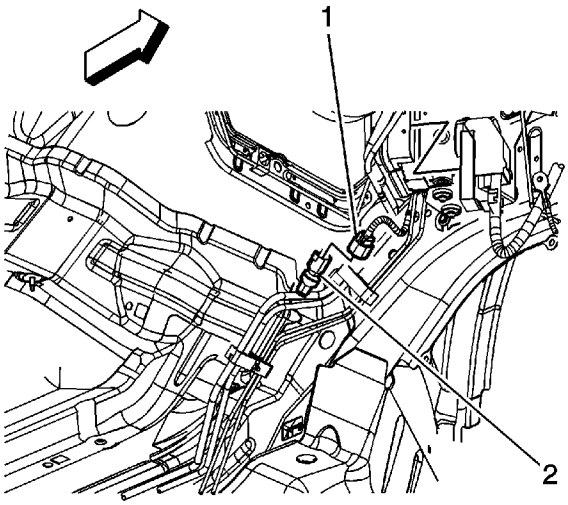
Center or Junction Block Replacement.

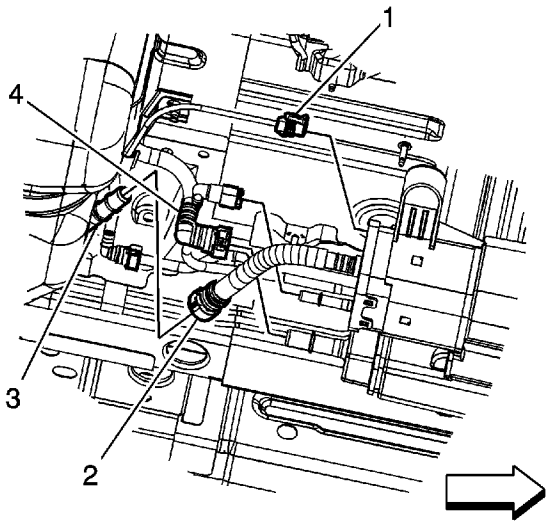
8. If equipped with LAT, remove the engine coolant surge tank. Refer to Radiator Surge Tank Replacement.
9. Remove chassis fuel feed line clip (1) from the fuel line bracket.



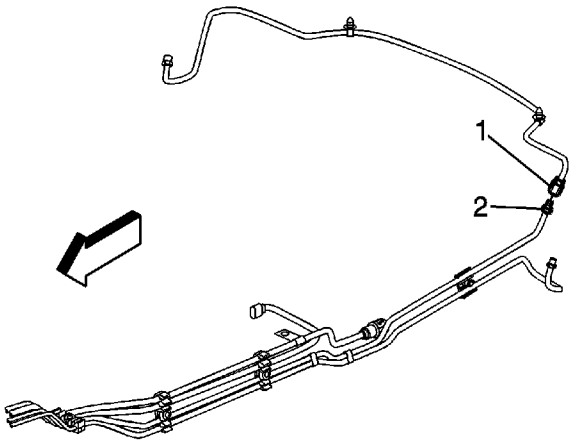
10. Remove the rear brake pipe fittings (1) from the brake pressure modulator valve (BPMV).
11. Cap the brake pipe fittings and plug the BPMV outlet ports in order to prevent brake fluid loss and contamination.



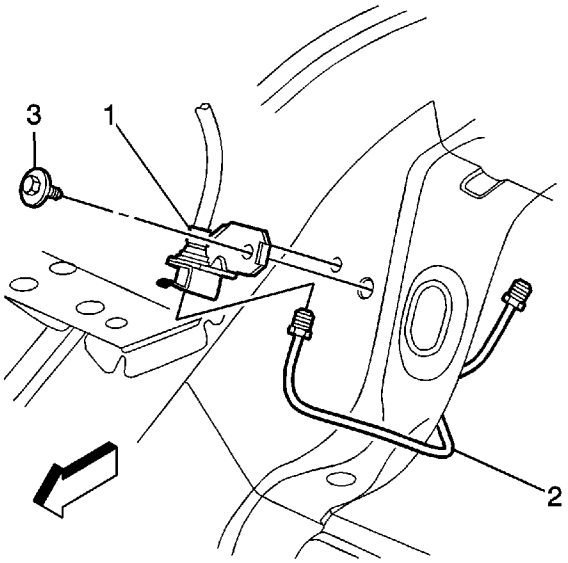
12. Remove the fuel tank. Refer to Fuel Tank Replacement.
13. Disconnect the body wiring harness electrical connector (1) from the fuel pressure sensor.



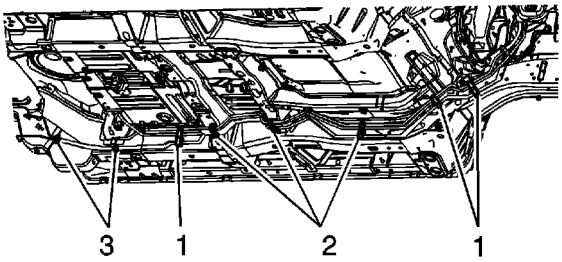
14. Disconnect the chassis EVAP line quick connect fitting (1) from the EVAP canister. Refer to Plastic Collar Quick Connect Fitting Service.



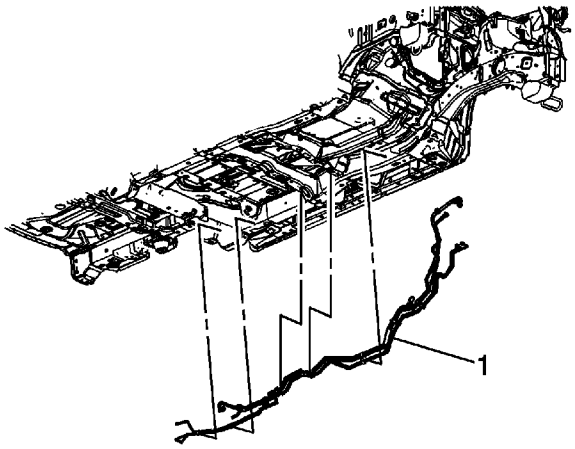
15. Remove the rear brake pipe fitting (2) from the rear brake crossover pipe fitting (1).
16. Cap the brake pipe fittings in order to prevent brake fluid loss and contamination.



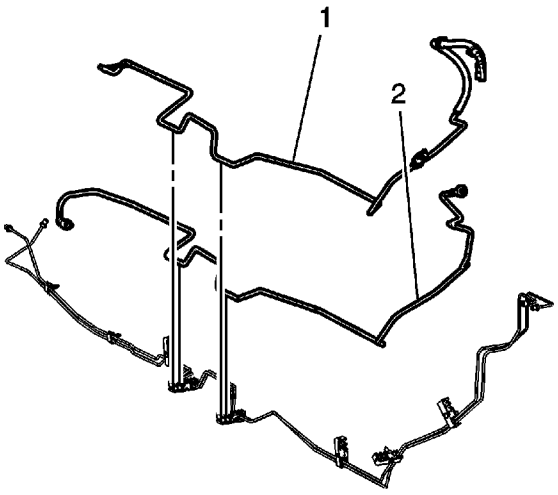
17. Remove the rear brake pipe (2) fitting from the rear brake hose fitting (1).
18. Cap the brake pipe fittings in order to prevent brake fluid loss and contamination.



19. Remove the brake, fuel and EVAP line retainers (1) from the underbody and side rail.
20. Remove the brake, fuel and EVAP line retainers (2) from the underbody studs.
21. Remove the brake line retainers (3) from the underbody side rail.

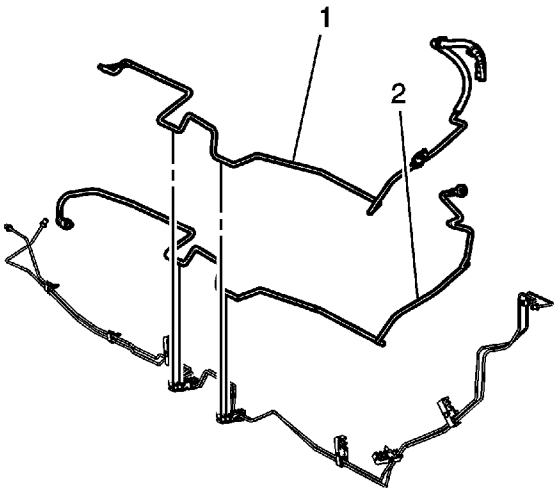


22. Remove the brake, fuel and EVAP line bundle (1) from the vehicle.

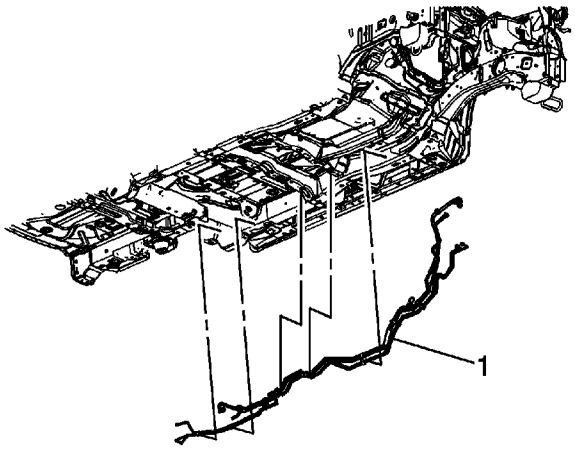


23. Remove the chassis fuel feed line (1) from the retainers.

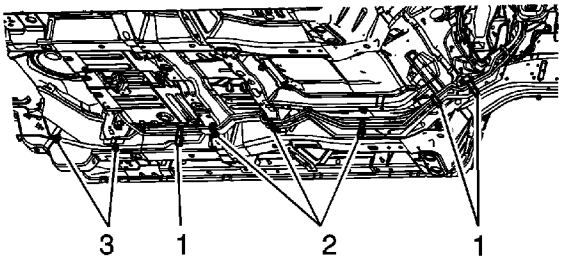
Installation Procedure



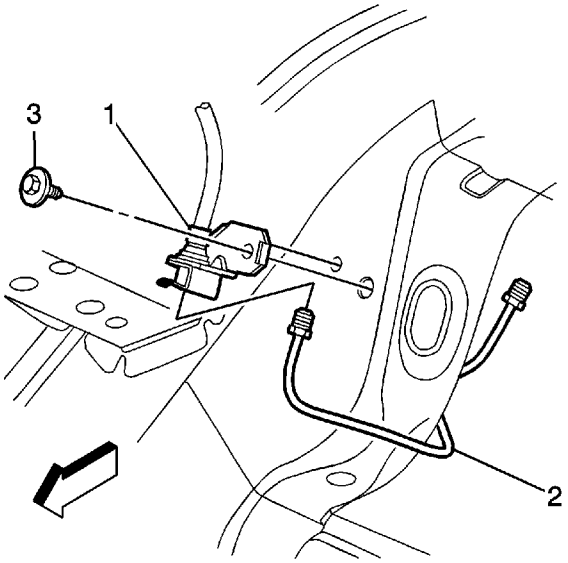
1. Install the chassis fuel feed line (1) to the retainers.



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



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

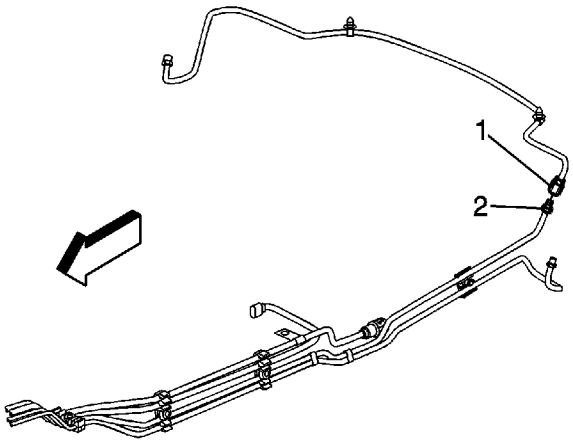


6. Remove the caps from the brake pipe fittings.

Caution: Refer to Fastener Caution in the Preface section.

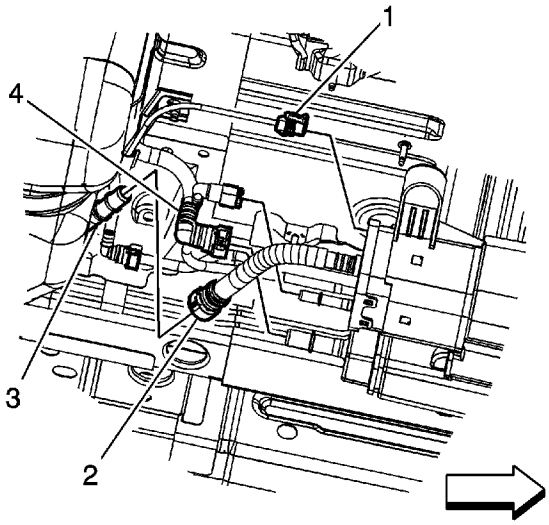
7. Install the rear brake pipe (2) fitting to the rear brake hose fitting (1).

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

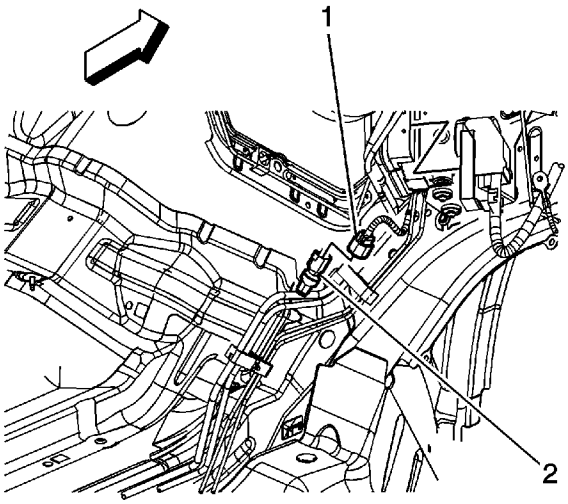


8. Remove the caps from the brake pipe fittings.
9. Install the rear brake pipe fitting (2) to the rear brake crossover pipe fitting (1).

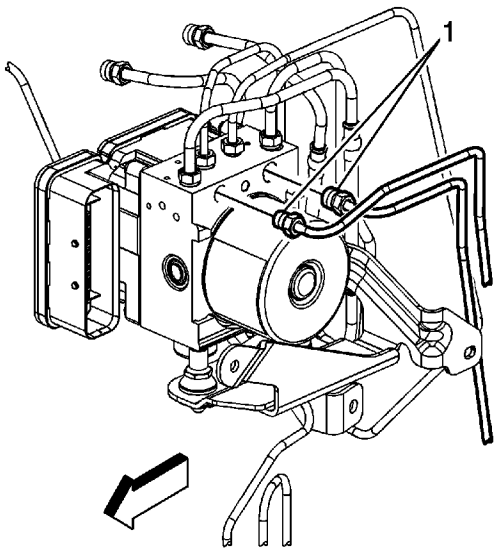
Tighten
Tighten the fitting to 18 N·m (13 lb ft).



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

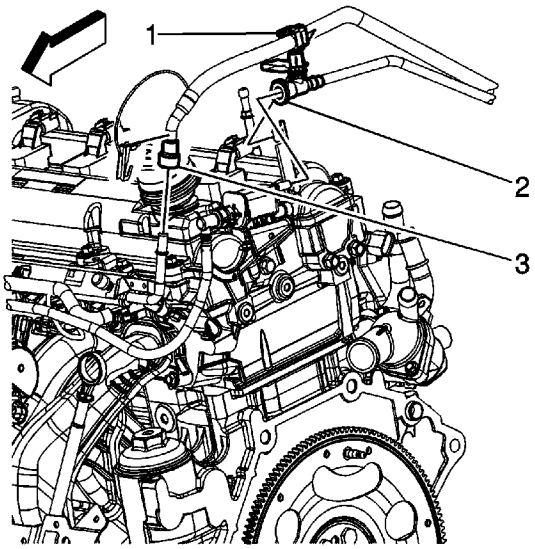


11. Connect the body wiring harness electrical connector (1) to the fuel pressure sensor.
12. Install the fuel tank. Refer to Fuel Tank Replacement.



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

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

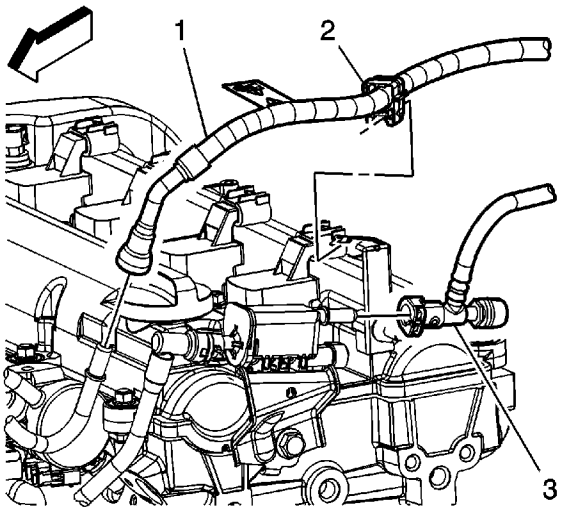


15. Connect the chassis fuel feed line quick connect fitting (3) to the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
16. Connect the chassis EVAP line quick connect fitting (2) to the EVAP canister purge solenoid valve. Refer to Plastic Collar Quick Connect Fitting Service.
17. If equipped with LAT, install the engine coolant surge tank. Refer to Radiator Surge Tank Replacement.
18. Install the underhood electrical center, non LAT equipped. Refer to Underhood Electrical Center or Junction Block Replacement.
19. Install the chassis fuel feed line clip (1) to the fuel line bracket.
20. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.
21. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement
22. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
23. Use the following procedure in order to inspect for leaks:
    - 23.1. Turn the ignition ON, with the engine OFF, for 2 seconds.
    - 23.2. Turn the ignition OFF for 10 seconds.
    - 23.3. Turn the ignition ON, with the engine OFF.
    - 23.4. Inspect for fuel leaks.

Fuel Injection Fuel Rail Assembly Replacement

Removal Procedure

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. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.



5. Disconnect the fuel feed line (1) quick connect fitting from the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
6. Disconnect the engine wiring harness electrical connector from the manifold absolute pressure (MAP) sensor.
7. Disconnect the fuel injector wiring harness electrical connector from the engine wiring harness electrical connector.

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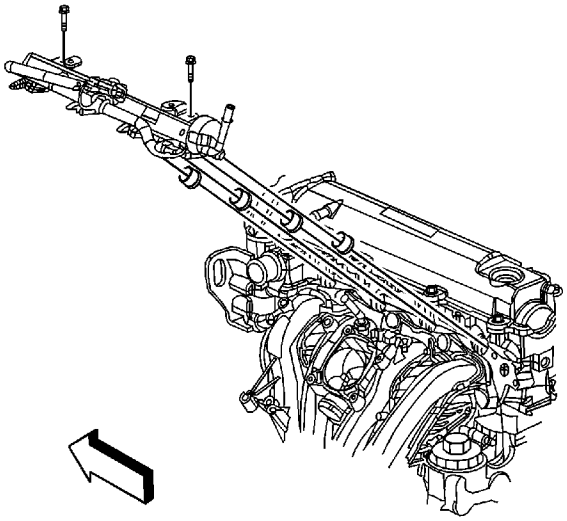
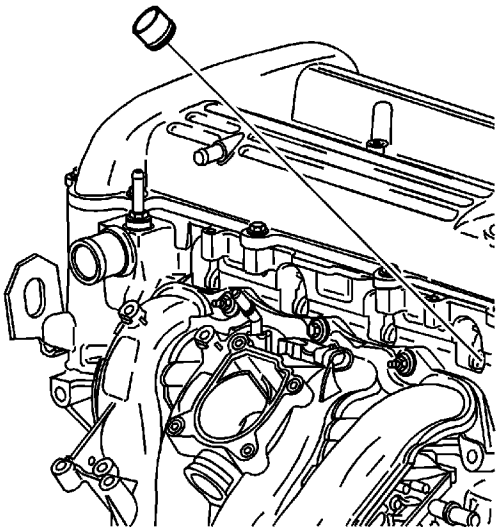


8. Remove the fuel injection fuel rail assembly bolts.

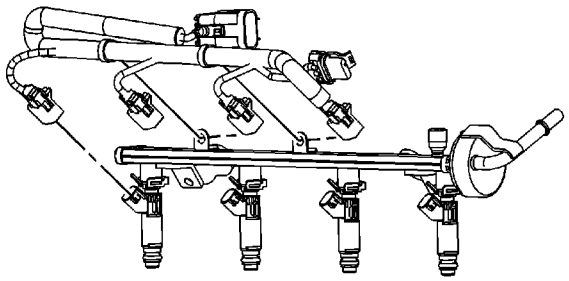
Note: Use care when removing the fuel injection fuel rail assembly in order to prevent damage to the fuel injector spray tips.

9. Pull the fuel injector fuel rail assembly back and upward in order to release the fuel injectors from the cylinder head ports.
10. Remove the fuel injection fuel rail assembly.



Note: The fuel injector spray tips may be located on the fuel injectors or may still be located in the cylinder head ports. Either way, ensure that all 4 fuel injector spray tips are removed and discarded.

11. Remove and discard the fuel injector spray tips.

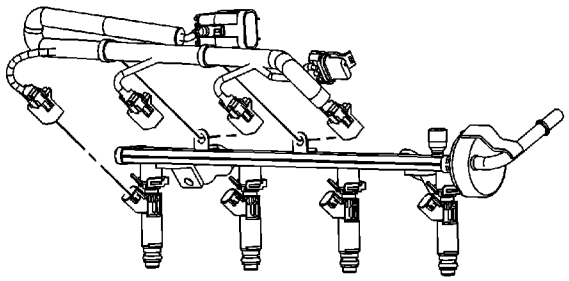


12. Disconnect the fuel injector wiring harness electrical connectors from the fuel injectors.
13. Remove the fuel injector wiring harness clips from the fuel injection fuel rail assembly.
14. Remove the fuel injector wiring harness from the fuel injection fuel rail assembly.
15. Remove the fuel injectors, if necessary. Refer to Fuel Injector Replacement.

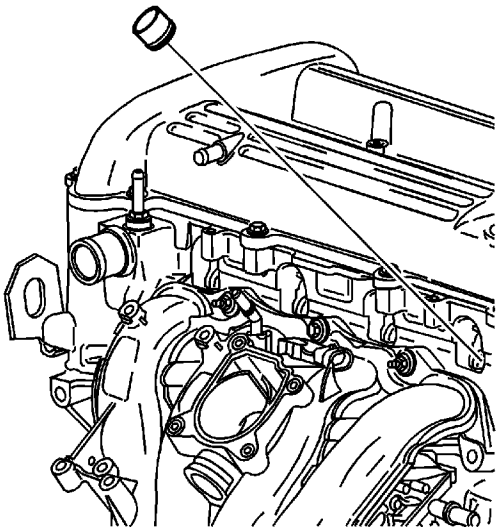
Installation Procedure

Note: If the fuel injection fuel rail assembly and fuel injectors were removed and re-installed without separating them then install NEW lower O-rings only. If the fuel injection fuel rail assembly was replaced then install NEW upper and lower O-rings.

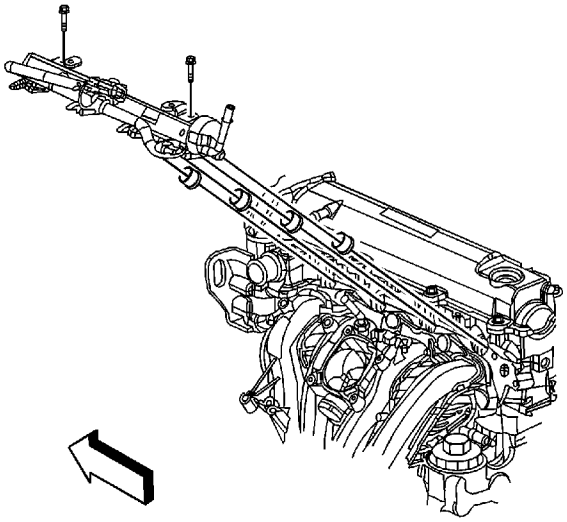
1. Install the fuel injectors, if necessary. Refer to Fuel Injector Replacement.



2. Install the fuel injector wiring harness to the fuel injection fuel rail assembly.
3. Install the fuel injector wiring harness clips to the fuel injection fuel rail assembly.
4. Connect the fuel injector wiring harness electrical connectors to the fuel injectors.



5. Lubricate the NEW fuel injector spray tips with clean engine oil.
6. Install the NEW fuel injector spray tips to the cylinder head ports.
7. Lubricate the fuel injector O-rings with clean engine oil.



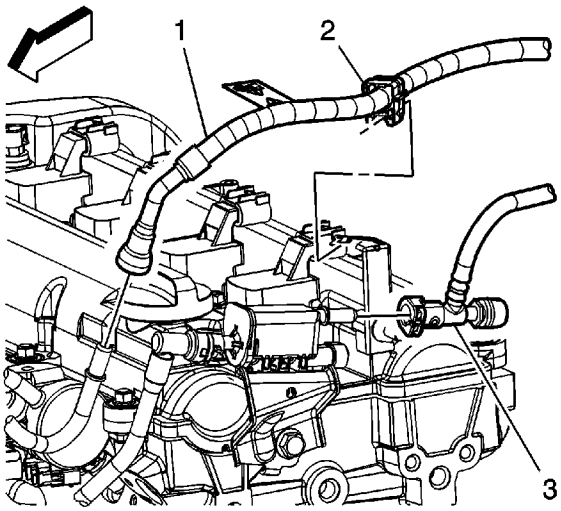
8. With the fuel injectors positioned downward, lower the fuel injectors into the cylinder head ports.
9. Carefully push down on the fuel injector fuel rail assembly in order to fully seat the fuel injectors into the cylinder head ports.

Caution: Refer to Fastener Caution in the Preface section.

10. Install the fuel injector fuel rail assembly bolts.

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

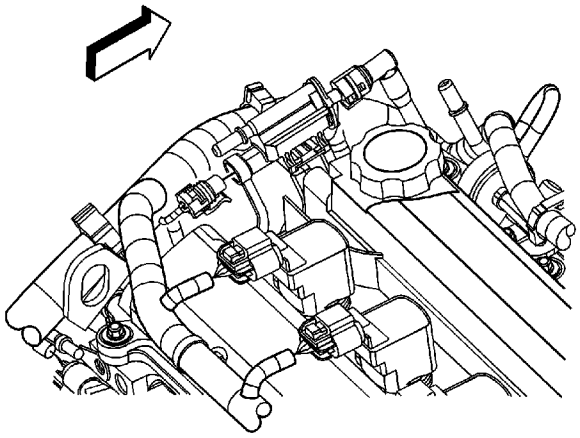
11. Connect the fuel injector wiring harness electrical connector to the engine wiring harness electrical connector.
12. Connect the engine wiring harness electrical connector to the manifold absolute pressure (MAP) sensor.



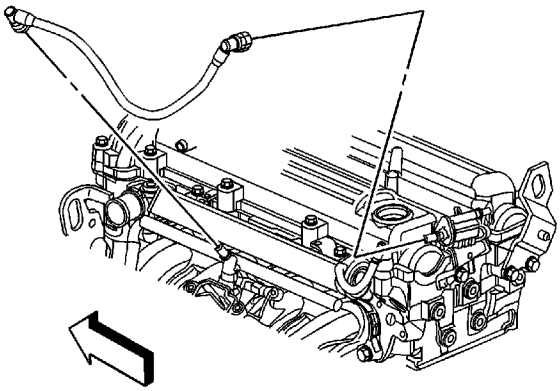
13. Connect the fuel feed line (1) quick connect fitting to the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
14. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.
15. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
16. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
17. Inspect for fuel leaks using the following procedure:
    17.1. Turn ON the ignition, with the engine OFF for 2 seconds.
    17.2. Turn OFF the ignition for 10 seconds.
    17.3. Turn ON the ignition.
    17.4. Inspect for fuel leaks.

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 from the evaporative emission (EVAP) canister purge valve.



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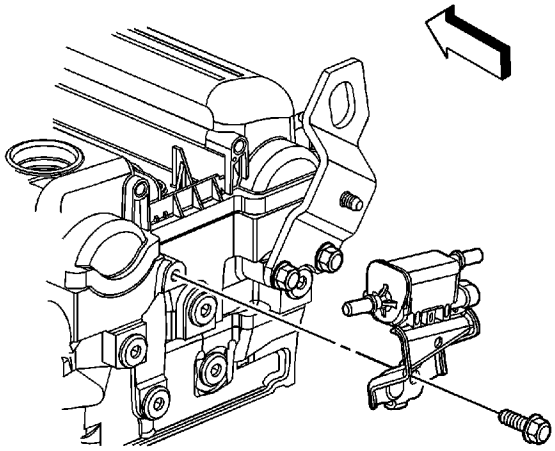
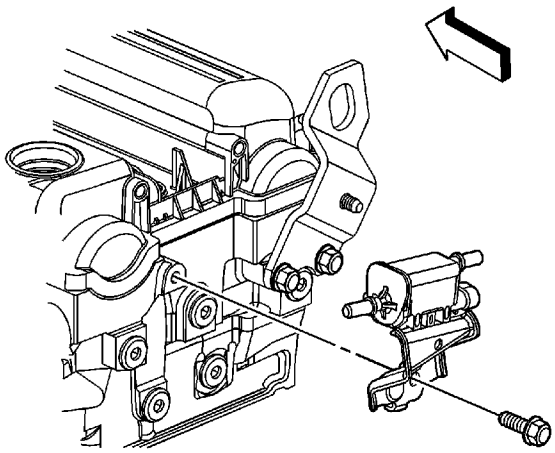
3. Disconnect the EVAP canister purge valve tube. Refer to Plastic Collar Quick Connect Fitting Service.
4. Disconnect the chassis EVAP vapor line from the EVAP canister purge valve. Refer to Plastic Collar Quick Connect Fitting Service.



5. Remove the EVAP canister purge valve bracket bolt.
6. Remove the EVAP canister purge valve with bracket.
7. Remove the EVAP canister purge valve from the bracket.
8. Inspect for carbon release in the EVAP canister purge valve ports. If there is any loose carbon, replace the EVAP canister and any components necessary to remove the carbon particles.

Installation Procedure

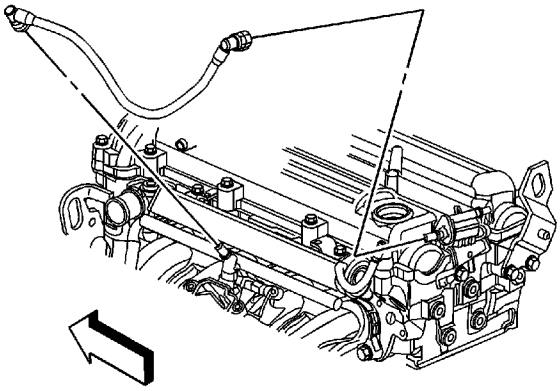


1. Install the EVAP canister purge valve to the bracket.
2. Position the EVAP canister purge valve with bracket to the cylinder head.

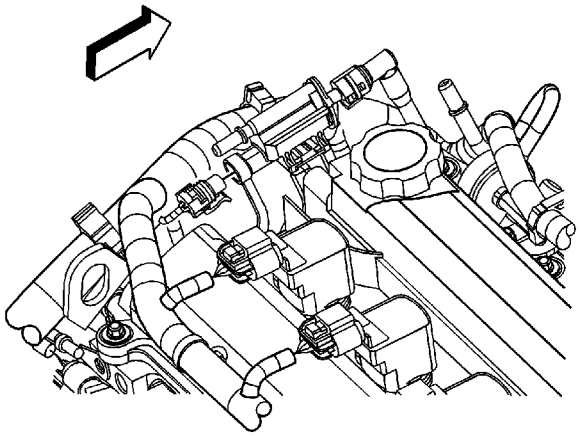
Caution: Refer to Fastener Caution in the Preface section.

3. Install the EVAP canister purge valve bracket bolt.

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



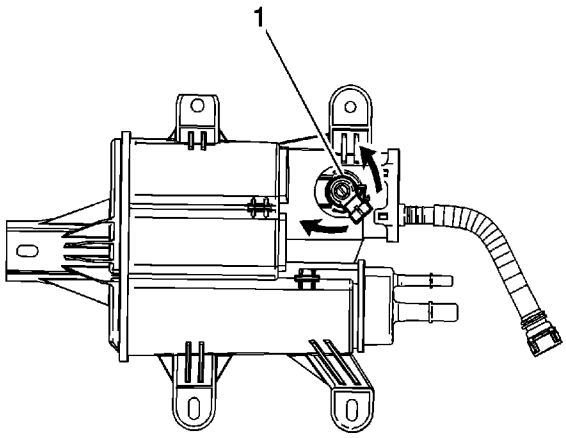
4. Connect the EVAP canister purge valve tube. Refer to Plastic Collar Quick Connect Fitting Service.
5. Connect the chassis EVAP vapor line to the EVAP canister purge valve. Refer to Plastic Collar Quick Connect Fitting Service.



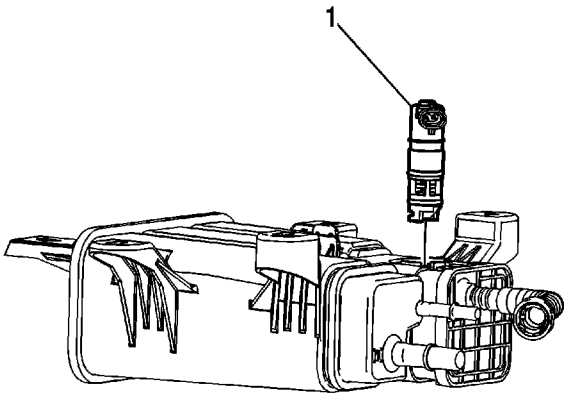
6. Connect the engine wiring harness electrical connector to the EVAP canister purge valve.
7. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.

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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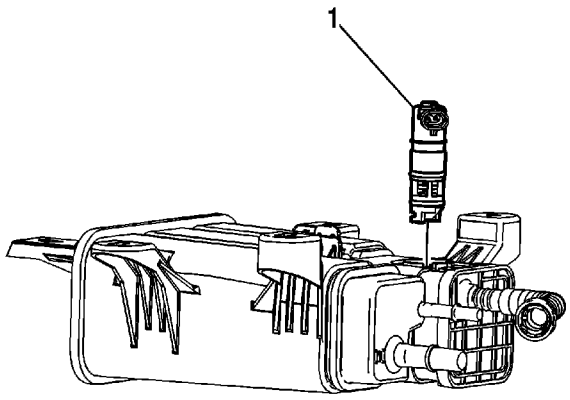
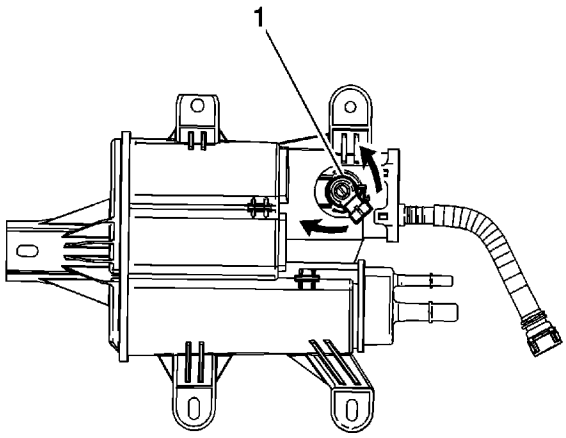
3. Remove the EVAP canister vent solenoid valve (1) from the EVAP canister.

Installation Procedure

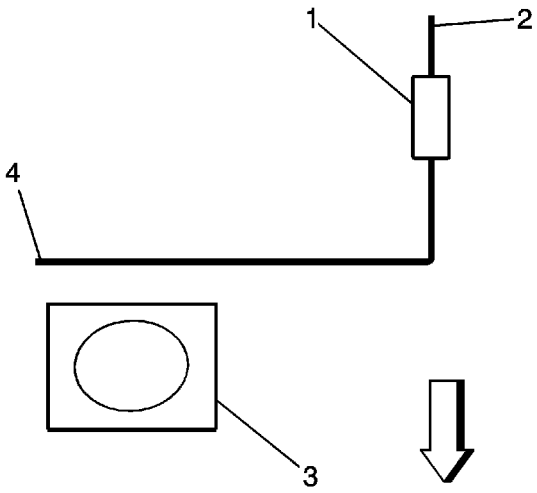


1. Install the EVAP canister vent solenoid valve (1) to the EVAP canister.



2. Rotate the EVAP canister vent solenoid valve (1) counterclockwise until it reaches the positive stop.
3. Install the EVAP canister. Refer to Evaporative Emission Canister Replacement .

Emission Hose Routing Diagram



(1) EVAP Canister Purge Solenoid Valve
(2) To EVAP Canister
(3) Throttle Body
(4) To Intake Manifold

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Evaporative Emission Hoses / Pipes Replacement - Engine / Chassis

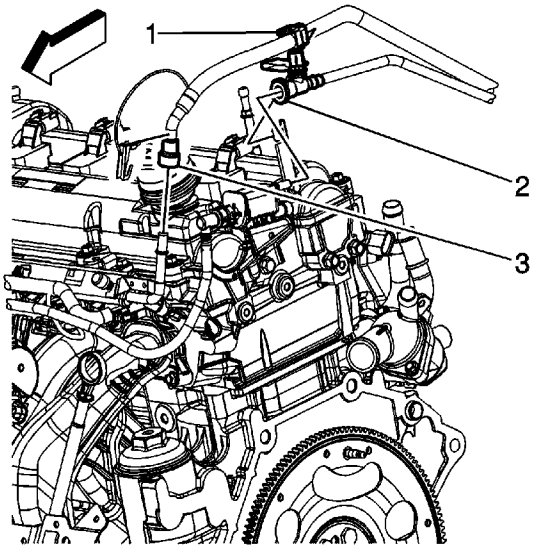
Removal Procedure

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. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.
5. Disconnect the chassis fuel feed line quick connect fitting (3) from the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
6. Disconnect the chassis evaporative emission (EVAP) line quick connect fitting (2) from the EVAP canister purge solenoid valve. Refer to Plastic Collar Quick Connect Fitting Service.
7. Remove the underhood electrical center, non-LAT equipped. Refer to Underhood Electrical

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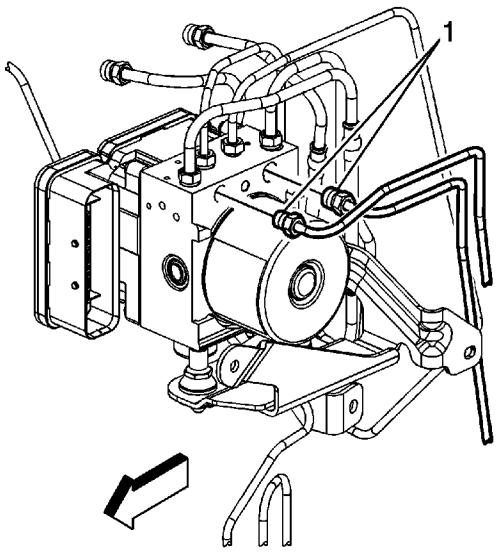
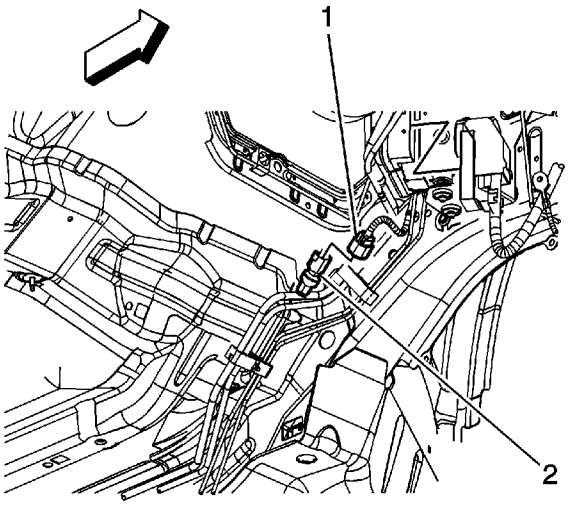
Center or Junction Block Replacement.

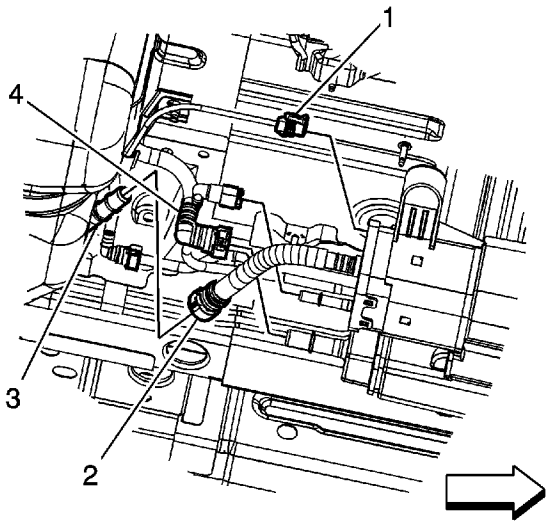
8. If equipped with LAT, remove the engine coolant surge tank. Refer to Radiator Surge Tank Replacement.
9. Remove chassis fuel feed line clip (1) from the fuel line bracket.



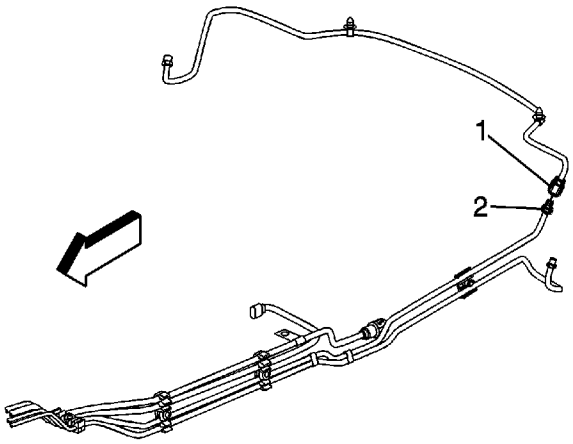
10. Remove the rear brake pipe fittings (1) from the brake pressure modulator valve (BPMV).
11. Cap the brake pipe fittings and plug the BPMV outlet ports in order to prevent brake fluid loss and contamination.



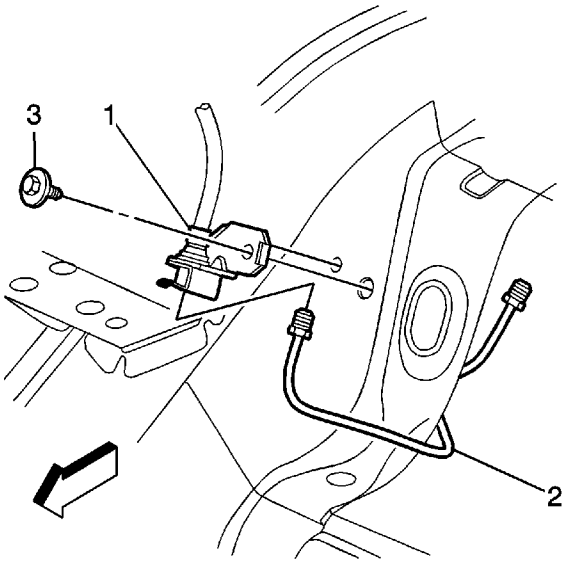
12. Remove the fuel tank. Refer to Fuel Tank Replacement.
13. Disconnect the body wiring harness electrical connector (1) from the fuel pressure sensor.



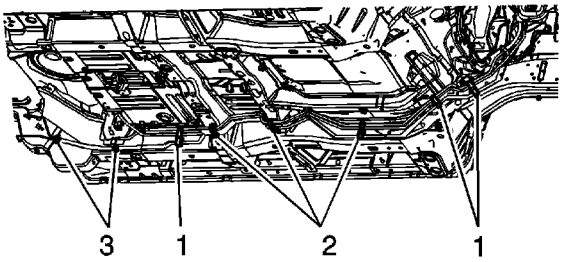
14. Disconnect the chassis EVAP line quick connect fitting (1) from the EVAP canister. Refer to Plastic Collar Quick Connect Fitting Service.



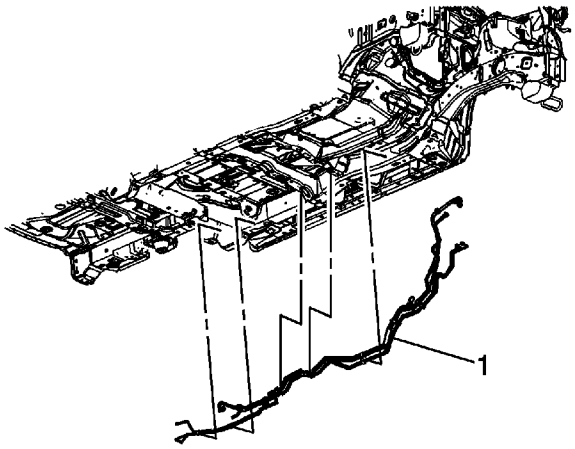
15. Remove the rear brake pipe fitting (2) from the rear brake crossover pipe fitting (1).
16. Cap the brake pipe fittings in order to prevent brake fluid loss and contamination.



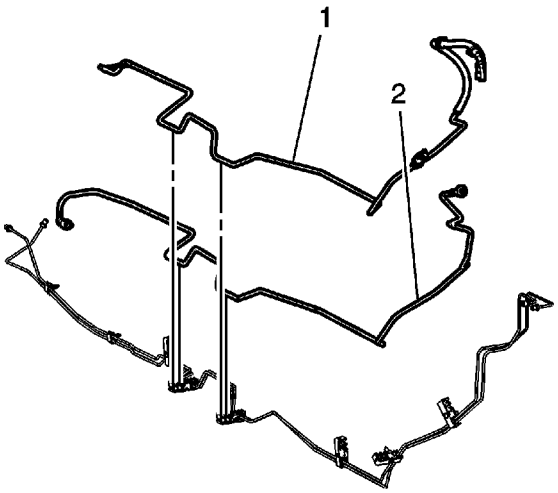
17. Remove the rear brake pipe (2) fitting from the rear brake hose fitting (1).
18. Cap the brake pipe fittings in order to prevent brake fluid loss and contamination.



19. Remove the brake, fuel and EVAP line retainers (1) from the underbody and side rail.
20. Remove the brake, fuel and EVAP line retainers (2) from the underbody studs.
21. Remove the brake line retainers (3) from the underbody side rail.

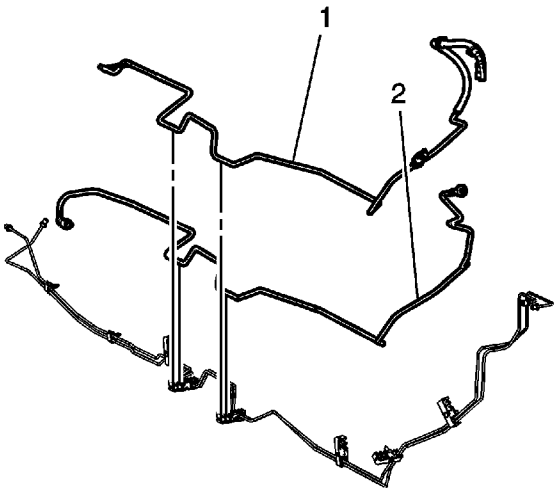


22. Remove the brake, fuel and EVAP line bundle (1) from the vehicle.

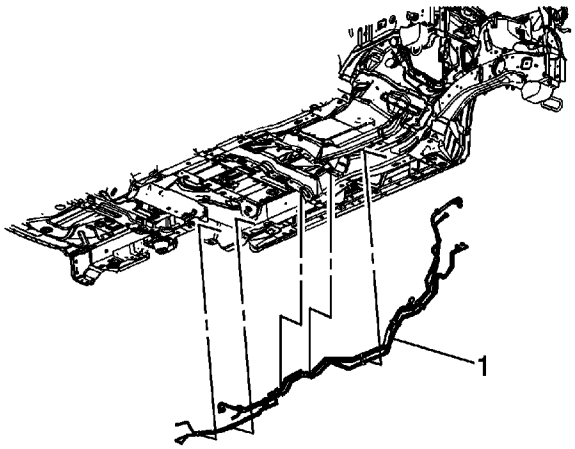


23. Remove the chassis EVAP line (2) from the retainers.

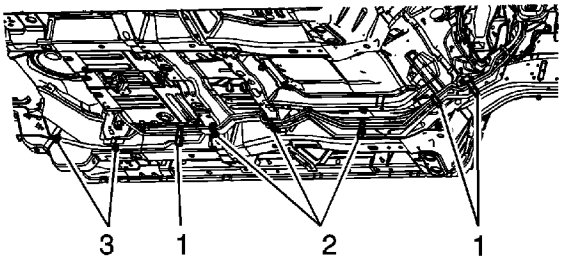
Installation Procedure



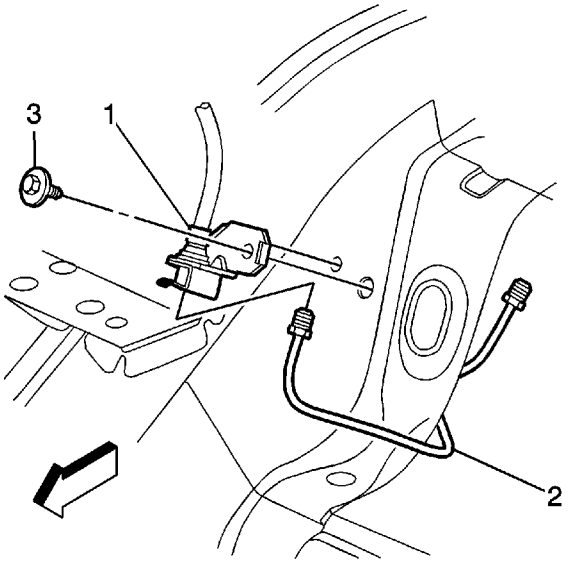
1. Install the chassis EVAP line (2) to the retainers.



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



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

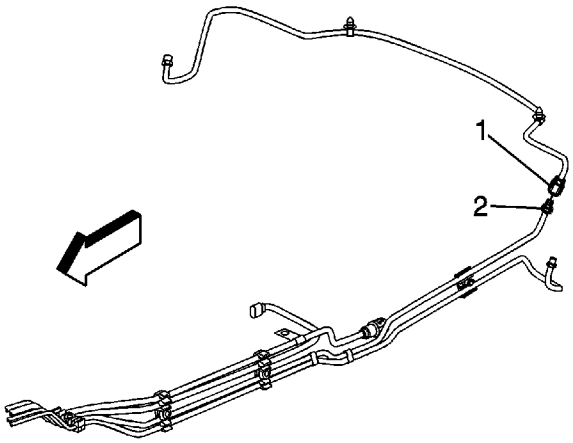


6. Remove the caps from the brake pipe fittings.

Caution: Refer to Fastener Caution in the Preface section.

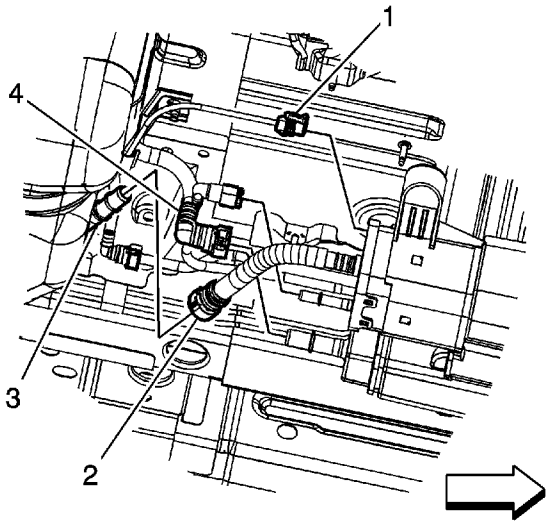
7. Install the rear brake pipe (2) fitting to the rear brake hose fitting (1).

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

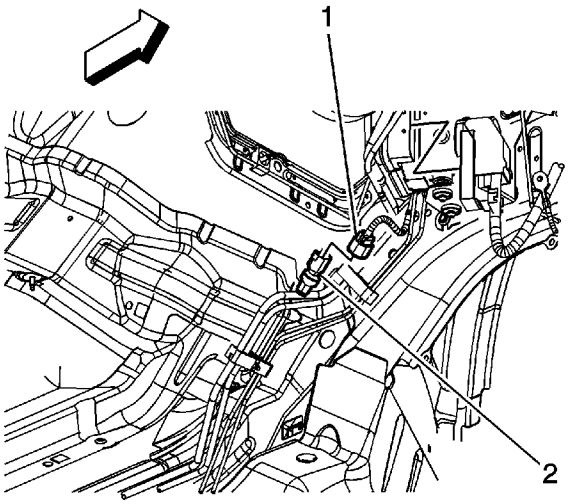


8. Remove the caps from the brake pipe fittings.
9. Install the rear brake pipe fitting (2) to the rear brake crossover pipe fitting (1).

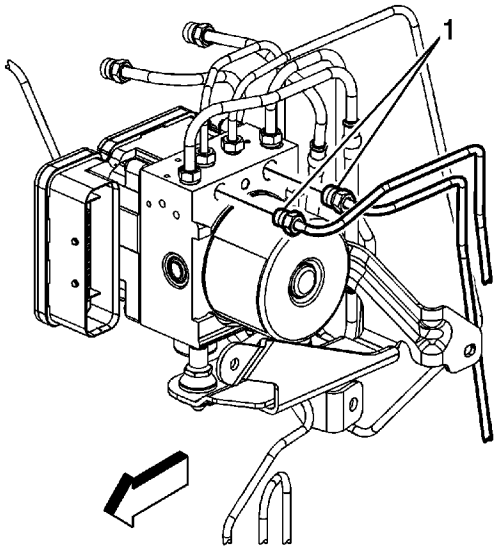
Tighten
Tighten the fitting to 18 N·m (13 lb ft).



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

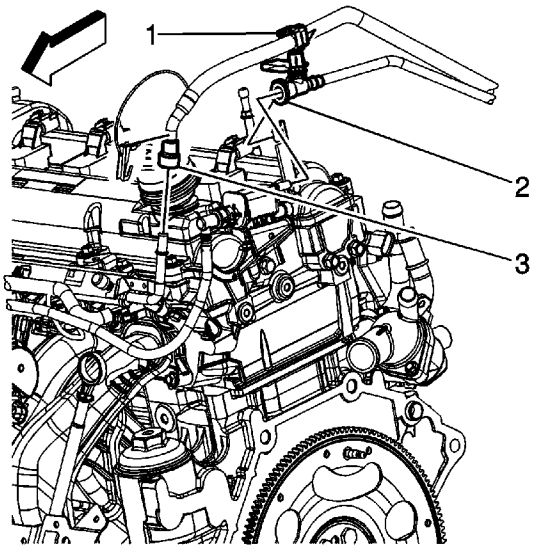


11. Connect the body wiring harness electrical connector (1) to the fuel pressure sensor.
12. Install the fuel tank. Refer to Fuel Tank Replacement.



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

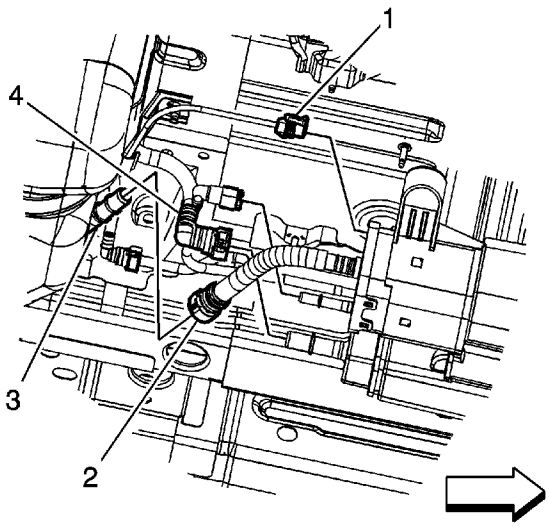
Tighten
Tighten the fittings to 21 N·m (16 lb ft).



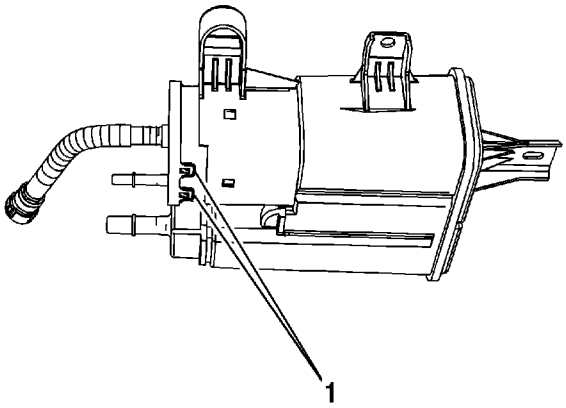
15. Connect the chassis fuel feed line quick connect fitting (3) to the fuel rail. Refer to Metal Collar Quick Connect Fitting Service.
16. Connect the chassis EVAP line quick connect fitting (2) to the EVAP canister purge solenoid valve. Refer to Plastic Collar Quick Connect Fitting Service.
17. If equipped with LAT, install the engine coolant surge tank. Refer to Radiator Surge Tank Replacement.
18. Install the underhood electrical center, non LAT equipped. Refer to Underhood Electrical Center or Junction Block Replacement.
19. Install the chassis fuel feed line clip (1) to the fuel line bracket.
20. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.
21. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
22. Connect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection.
23. Use the following procedure in order to inspect for leaks:
    - 23.1. Turn the ignition ON, with the engine OFF, for 2 seconds.
    - 23.2. Turn the ignition OFF for 10 seconds.
    - 23.3. Turn the ignition ON, with the engine OFF.
    - 23.4. Inspect for fuel leaks.

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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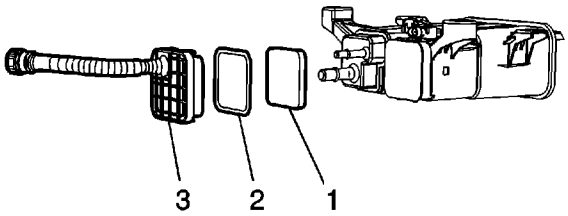
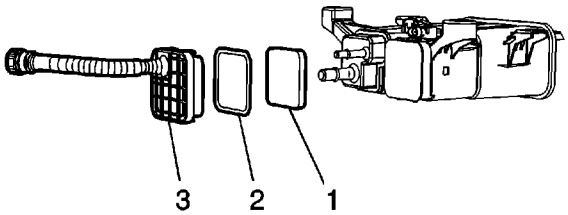
tabs (1).
5. Lift up the filter cover slightly in order to release the upper retaining tabs.

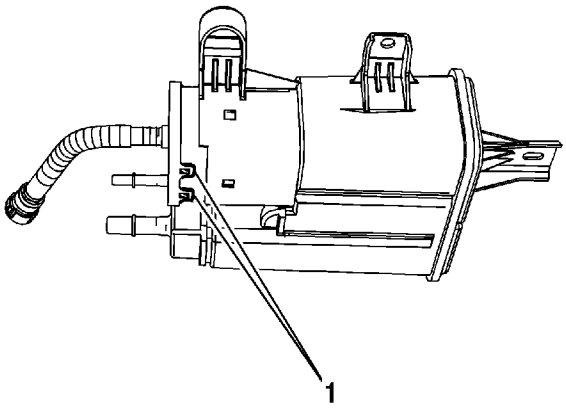


6. Remove the EVAP canister filter cover (3) from the EVAP canister.
7. Remove and discard the EVAP canister filter (1).
8. Remove and discard the filter cover seal (2).
9. Clean the inside of the EVAP canister filter housing with a clean shop towel.

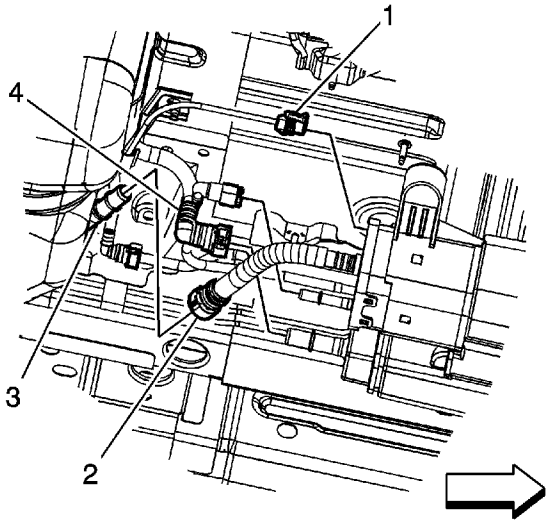
Installation Procedure



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.



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

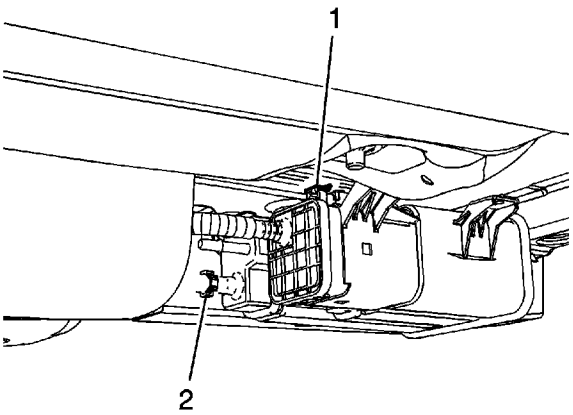


5. Connect the EVAP canister line quick connect fitting (2) to the fuel tank fresh air line (3). Refer to Plastic Collar Quick Connect Fitting Service.
6. Lower the vehicle.

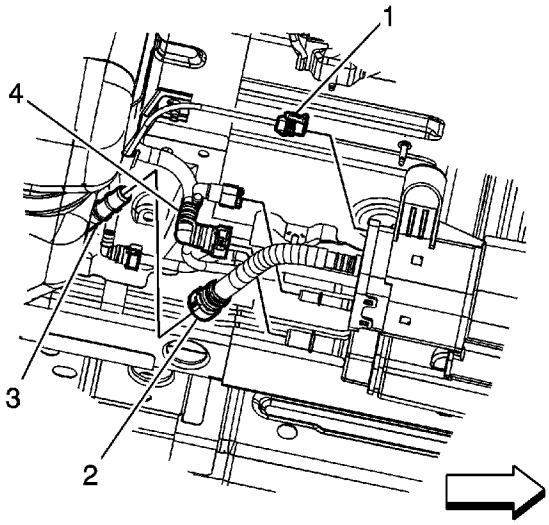
Evaporative Emission Canister Replacement

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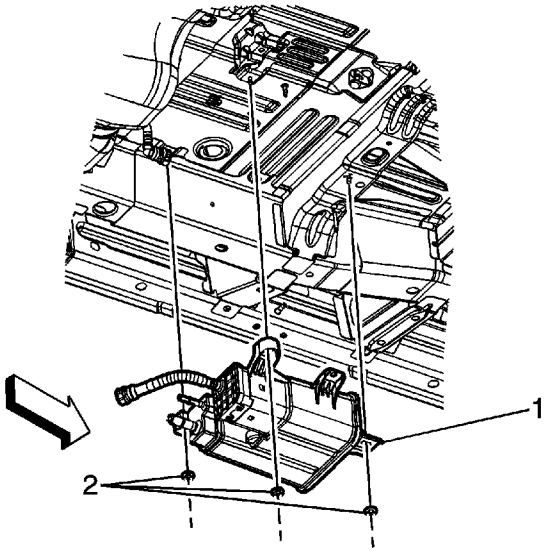
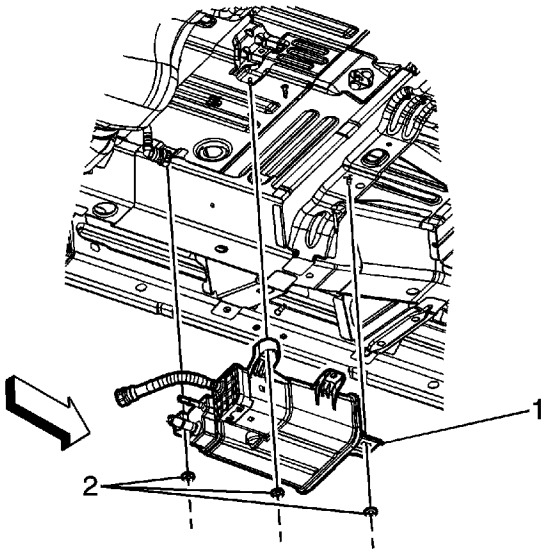
3. Disconnect the fuel tank vapor line quick connect fitting (4) from the EVAP canister. Refer to Plastic Collar Quick Connect Fitting Service.
4. Disconnect the chassis EVAP line quick connect fitting (1) from the EVAP canister. Refer to Plastic Collar Quick Connect Fitting Service.
5. Disconnect the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

Installation Procedure

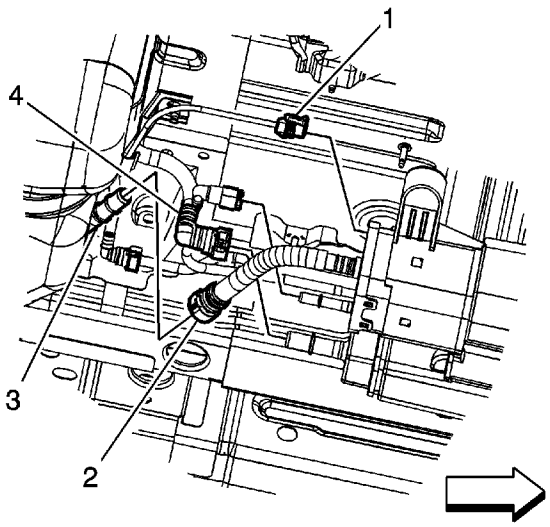


1. Position the EVAP canister to the underbody studs.

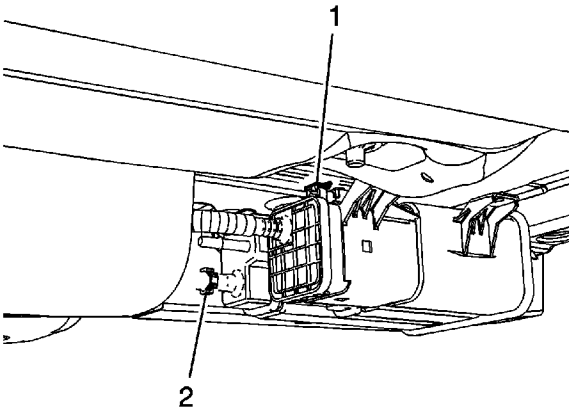
   Caution: Refer to Fastener Caution in the Preface section.

2. Install the EVAP canister nuts.

   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.



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

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 solenoid valve. Refer to Evaporative Emission Canister Purge Solenoid Valve Replacement.
3. Lightly tap the EVAP canister purge solenoid 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 solenoid 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 solenoid valve and no carbon particles were detected, replace the EVAP canister purge solenoid valve. Return to the published service procedure.

Cleaning Procedure

1. Raise and suitable 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 solenoid valve. Refer to Evaporative Emission Canister Purge Solenoid Valve Replacement.
13. Return to the diagnostic table that sent you here.

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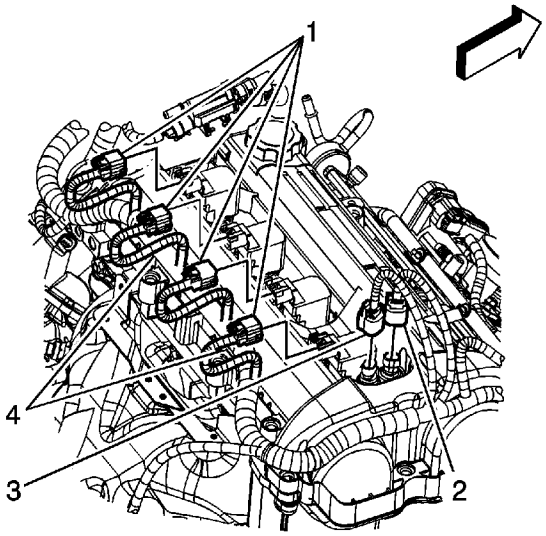
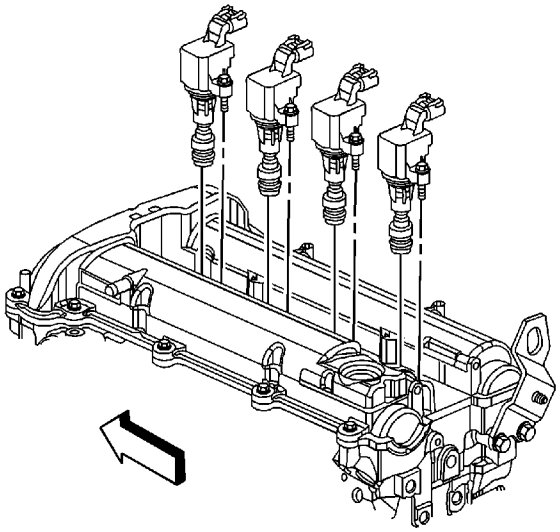
Ignition Coil Replacement

Removal Procedure

1. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
2. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.



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



4. Remove the ignition coil bolt(s).
5. Remove the ignition coil(s).

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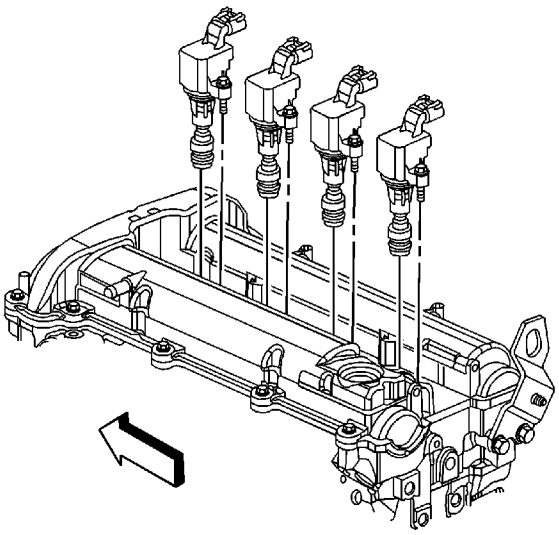
Installation Procedure

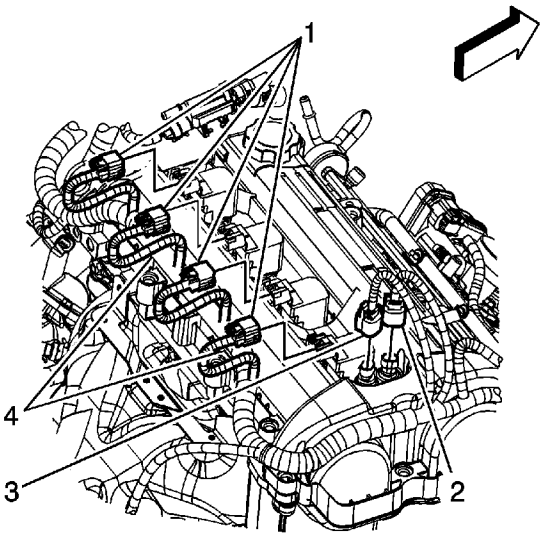


1. Install the ignition coil(s).

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the ignition coil bolt(s).

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

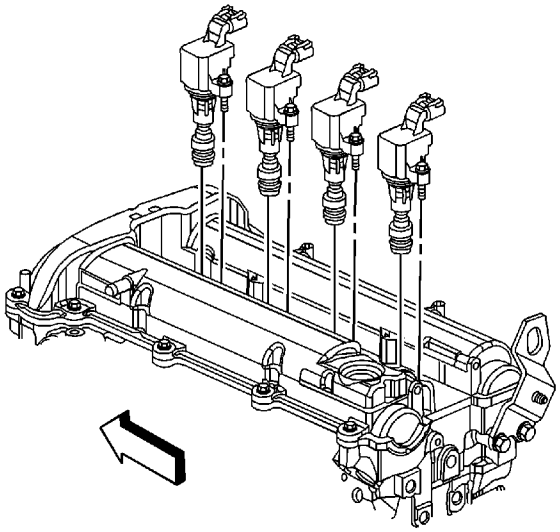


3. Connect the engine wiring harness electrical connector(s) (1) to the ignition coil(s).
4. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.
5. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.

Spark Plug Replacement

Removal Procedure

Caution: This engine has aluminum cylinder heads. Do not remove the spark plugs from a hot engine, allow it to cool first. Removing the spark plugs from a hot engine may cause spark plug thread damage or cylinder head damage.



1. Remove the ignition coil(s). Refer to Ignition Coil Replacement.

   Note: Make sure that any water and/or debris is blown out of the spark plug holes prior to removing the spark plugs.

2. Remove the spark plugs using a 5/8 inch spark plug socket.

Installation Procedure

Caution: Refer to Fastener Caution in the Preface section.

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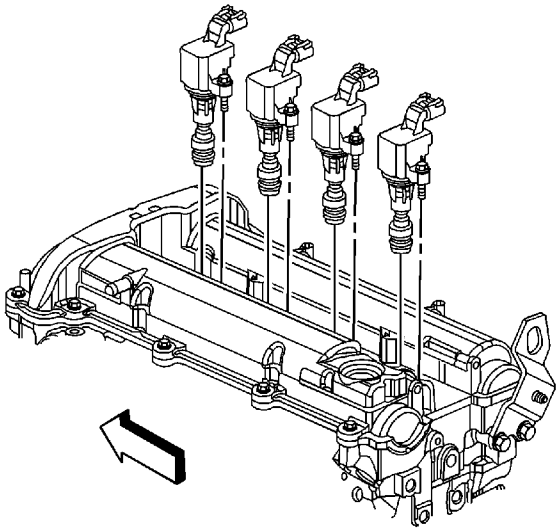


Caution: Do not coat spark plug threads with anti-seize compound. If anti-seize compound is used and spark plugs are over-torqued, damage to the cylinder head threads may result.

1. Install the spark plugs.

   Specification
   The spark plug gap is 1.0 mm (0.040 in).

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

2. Install the ignition coil(s). Refer to Ignition Coil Replacement.

Spark Plug Inspection

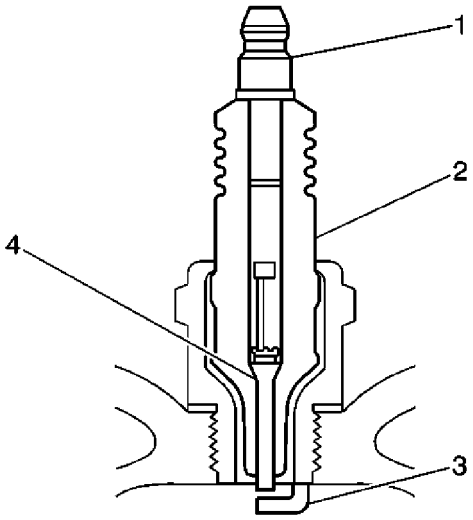
Spark Plug Usage

- 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.
- 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

-



- 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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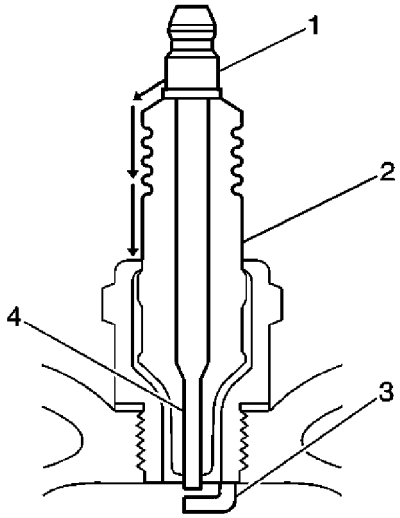
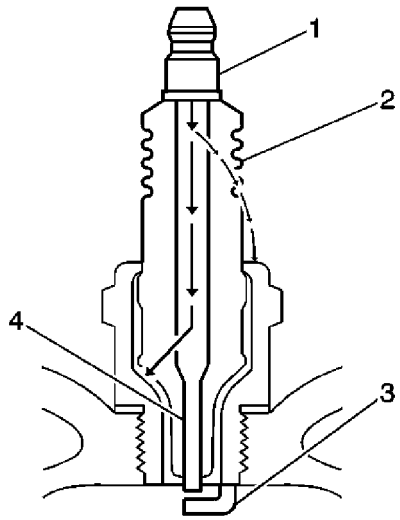
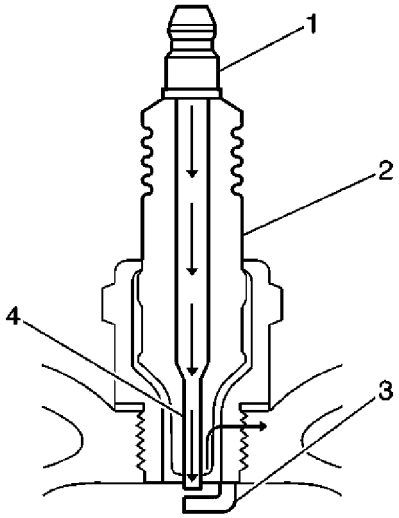


- Inspect the insulator (2) for flashover or carbon tracking, soot. This is caused by the electrical charge traveling across the insulator (2) between the terminal post (1) and ground. Inspect for the following conditions:

- 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.



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



- 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

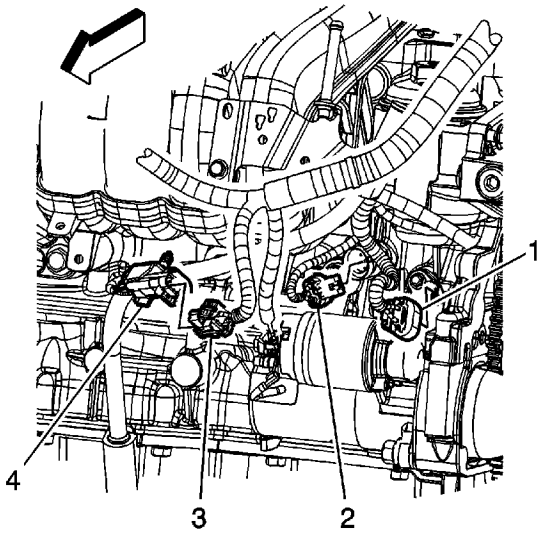
- Normal operation--Brown to grayish-tan with small amounts of white powdery deposits are normal combustion by-products from fuels with additives.
- Carbon Fouled--Dry, fluffy black carbon, or soot caused by the following conditions:
- Rich fuel mixtures
- Leaking fuel injectors

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

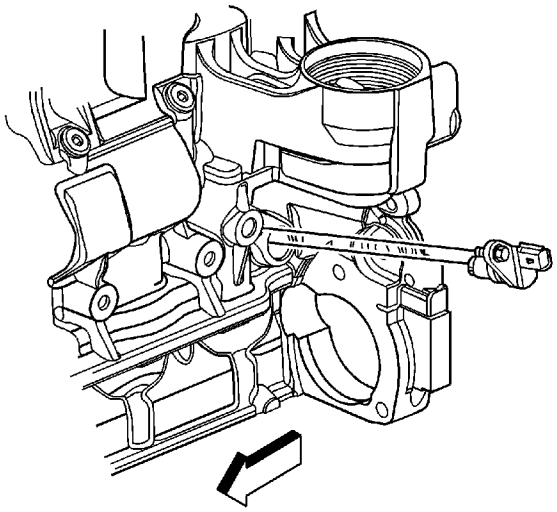
Crankshaft Position Sensor Replacement

Removal Procedure

1. Remove the starter motor. Refer to Starter Motor Replacement.



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



3. Remove the CKP sensor bolt.
4. Remove the CKP sensor.

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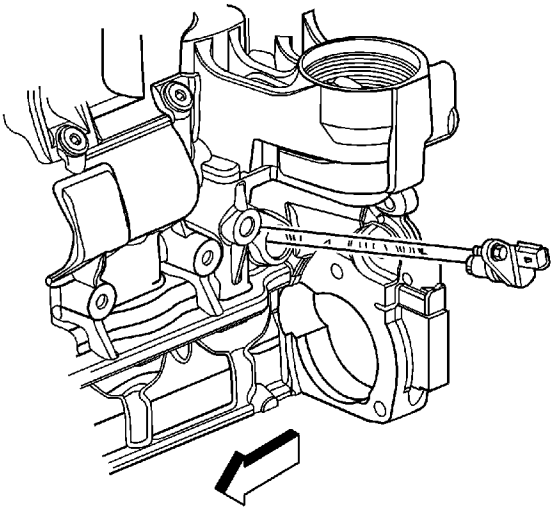
Installation Procedure

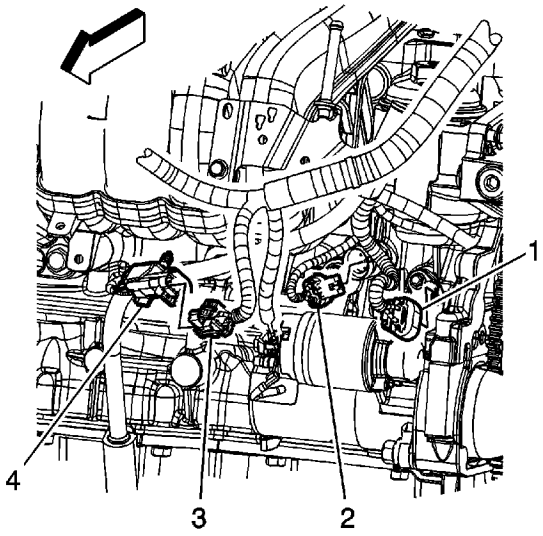


1. Lubricate the CKP sensor O-ring seal with clean engine oil.
2. Install the CKP sensor.

   Caution: Refer to Fastener Caution in the Preface section.

3. Install the CKP sensor bolt.

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

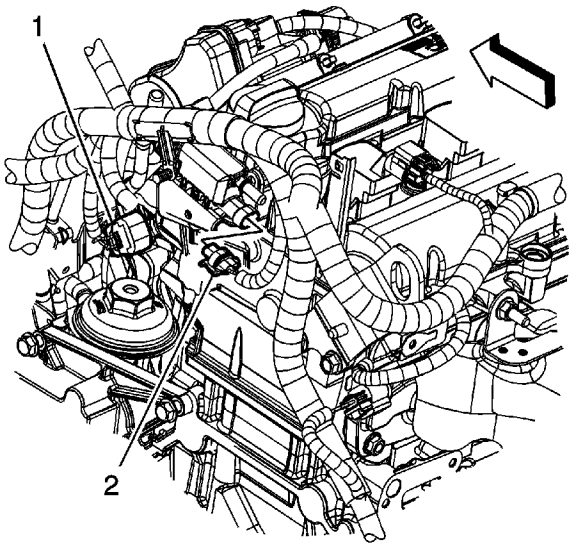


4. Connect the engine wiring harness electrical connector (1) to the CKP sensor.
5. Install the starter motor. Refer to Starter Motor Replacement.

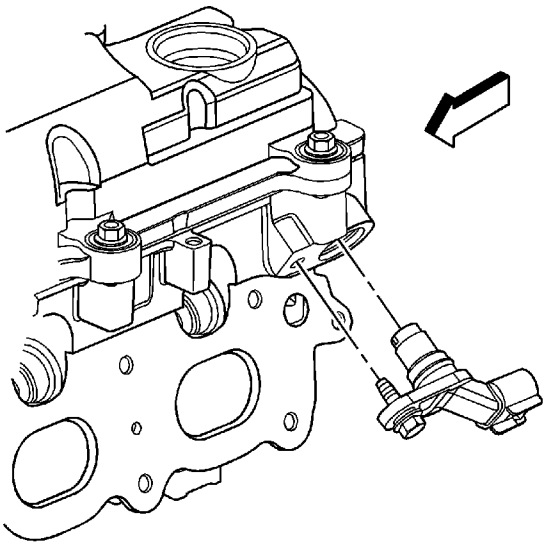
Camshaft Position Sensor Replacement - Intake

Removal Procedure

1. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
2. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.



3. Disconnect the engine wiring harness electrical connector (1) from the intake camshaft position (CMP) sensor.



4. Remove the intake CMP sensor bolt.
5. Remove the intake CMP sensor.

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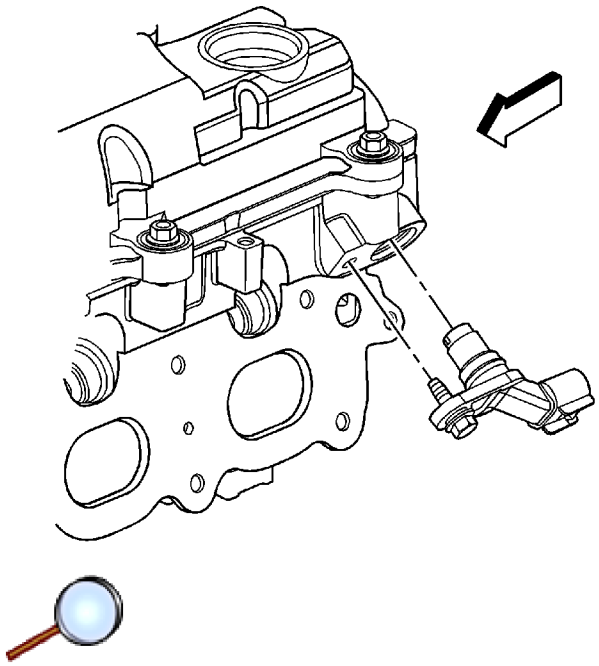
Installation Procedure



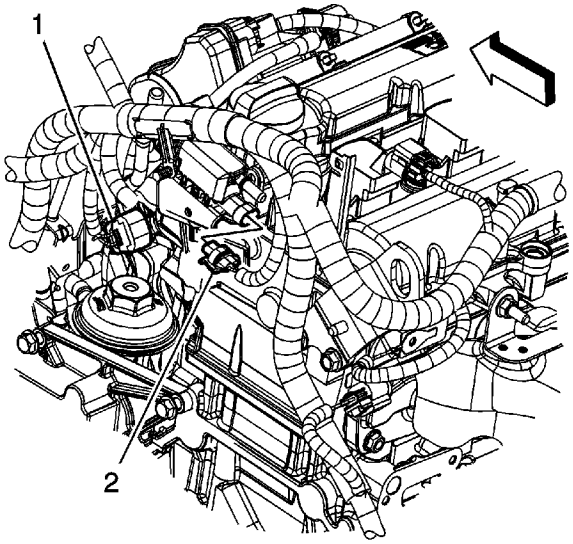
Note: Inspect the intake CMP sensor for damage, replace as necessary.

1. Lubricate the intake CMP sensor O-ring seal with clean engine oil.
2. Install the intake CMP sensor.

Caution: Refer to Fastener Caution in the Preface section.

3. Install the intake CMP sensor bolt.

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

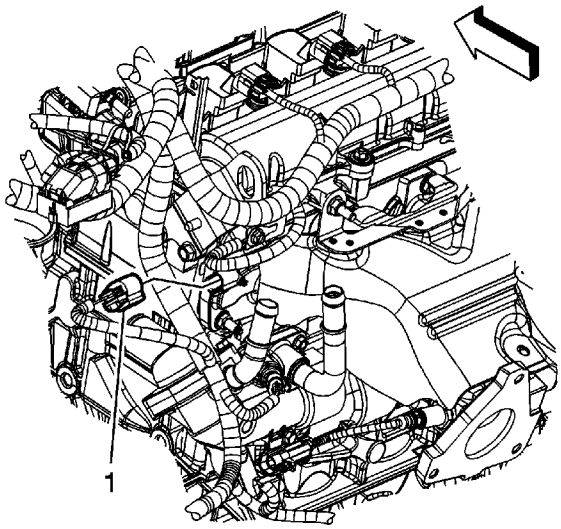


4. Connect the engine wiring harness electrical connector (1) to the intake CMP sensor.
5. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.
6. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.

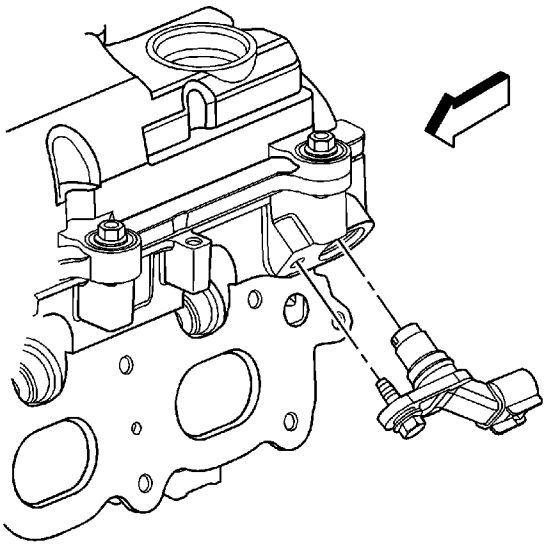
Camshaft Position Sensor Replacement - Exhaust

Removal Procedure

1. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
2. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.



3. Disconnect the engine wiring harness electrical connector (1) from the exhaust camshaft position (CMP) sensor.



4. Remove the exhaust CMP sensor bolt. (Intake CMP shown, exhaust CMP similar).
5. Remove the exhaust CMP sensor.

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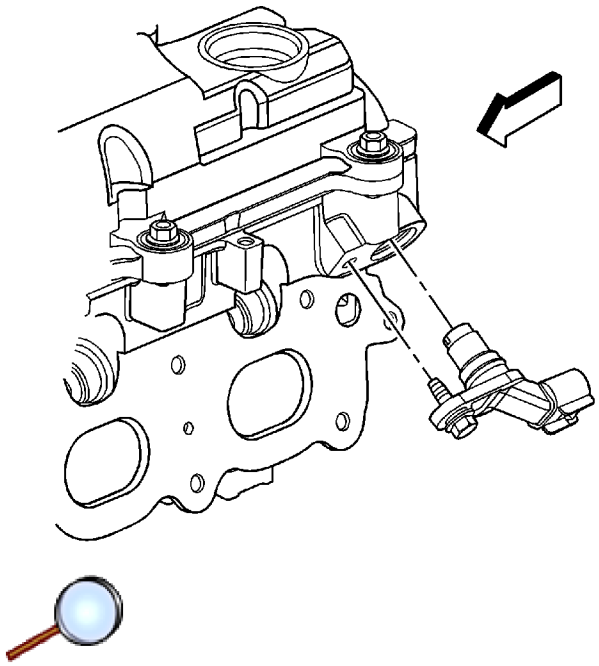
Installation Procedure



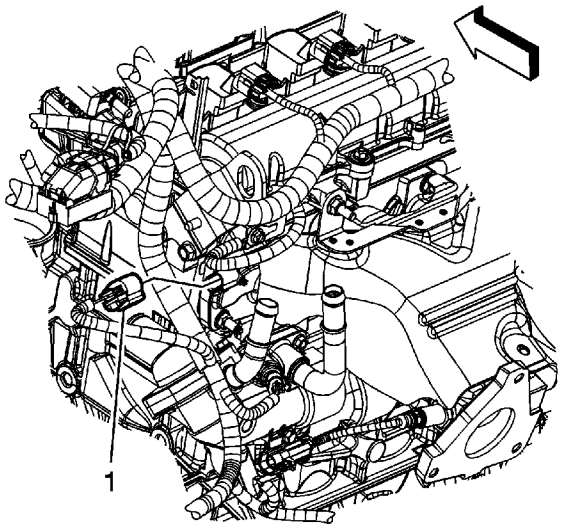
Note: Inspect the exhaust CMP sensor for damage, replace as necessary.

1. Lubricate the exhaust CMP sensor O-ring seal with clean engine oil.
2. Install the exhaust CMP sensor. (Intake CMP shown, exhaust CMP similar).

Caution: Refer to Fastener Caution in the Preface section.

3. Install the exhaust CMP sensor bolt.

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

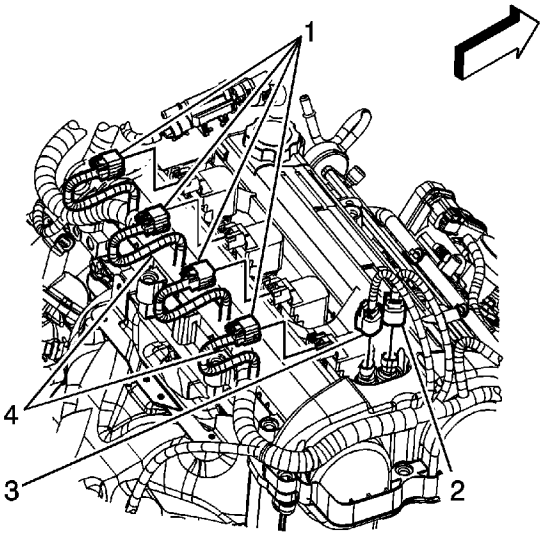


4. Connect engine wiring harness electrical connector (1) to the exhaust CMP sensor.
5. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.
6. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.

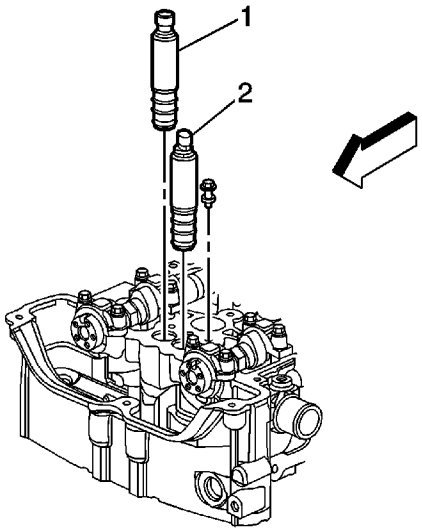
Camshaft Position Actuator Solenoid Valve Replacement

Removal Procedure

1. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.
2. Remove the intake manifold cover. Refer to Intake Manifold Cover Replacement.



3. Disconnect the engine wiring harness electrical connectors (2, 3) from the appropriate camshaft position (CMP) actuator solenoid valve.



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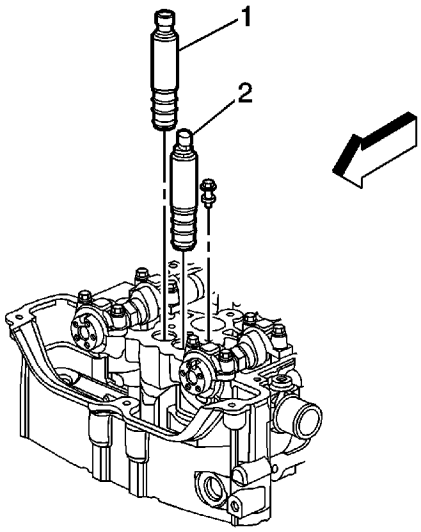
4. Remove the exhaust CMP actuator solenoid valve bolt and valve (1), if required.
5. Remove the intake CMP actuator solenoid valve bolt and valve (2), if required.
6. Inspect the CMP actuator solenoid valve O-ring seals for damage, replace as necessary.

Installation Procedure



1. Lubricate the CMP actuator solenoid valve O-ring seals with clean engine oil.

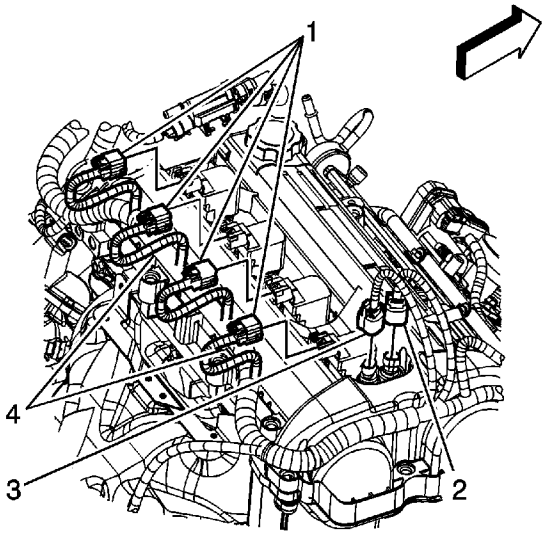
   Caution: Refer to Fastener Caution in the Preface section.

2. Install the intake CMP actuator solenoid valve (2) and bolt, if required.

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

3. Install the exhaust CMP actuator solenoid valve (1) and bolt, if required.

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

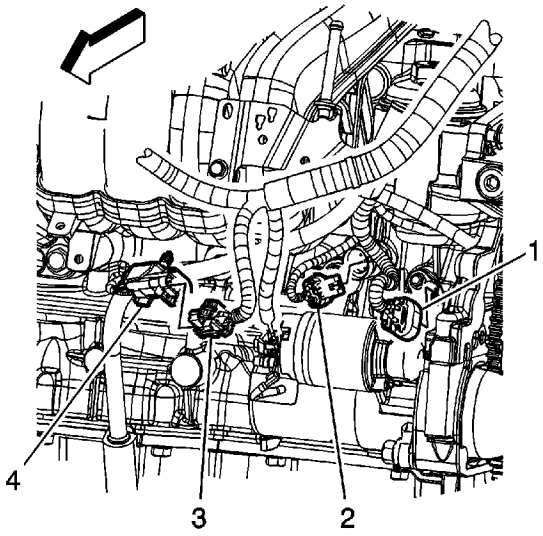


4. Connect the engine wiring harness electrical connectors (2, 3) to the appropriate CMP actuator solenoid valve.
5. Install the intake manifold cover. Refer to Intake Manifold Cover Replacement.
6. Install the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.

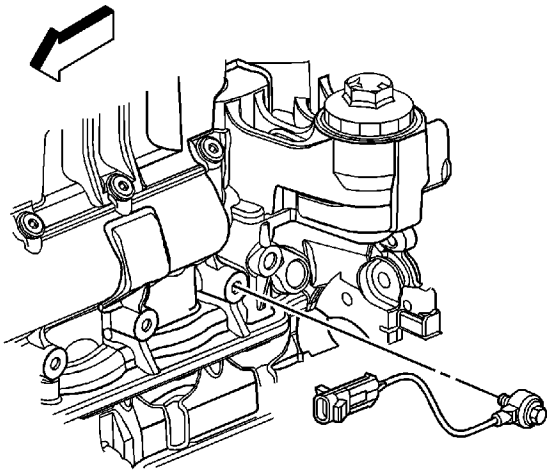
Knock Sensor Replacement

Removal Procedure

1. Hoist and raise the vehicle. Refer to Lifting and Jacking the Vehicle.



2. Disconnect the engine wiring harness electrical connector (3) from the knock sensor electrical connector (4).
3. Remove the knock sensor electrical connector (4) from the oil level indicator tube bracket.



4. Remove the knock sensor bolt.
5. Remove the knock sensor.

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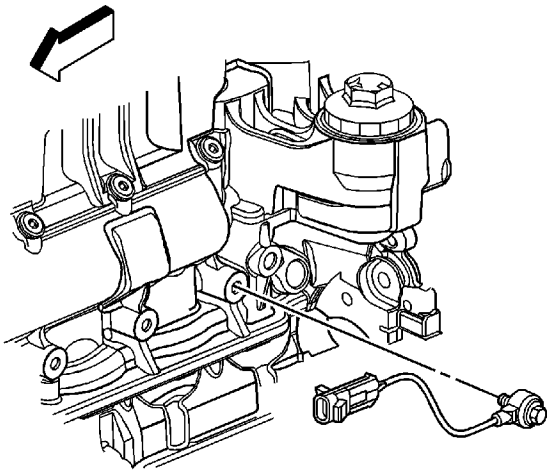
Installation Procedure

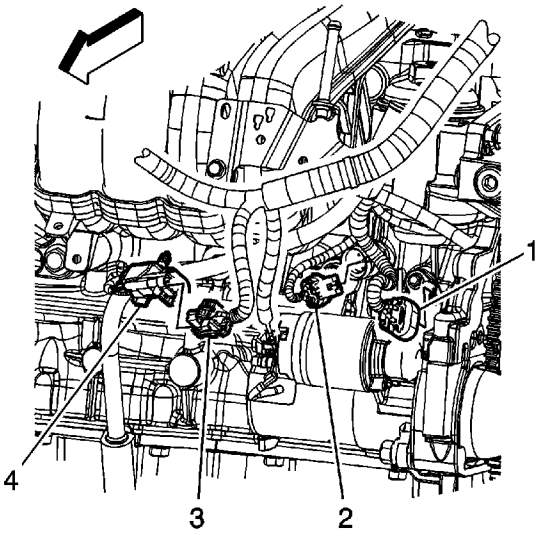


1. Install the knock sensor.

   Caution: Refer to Fastener Caution in the Preface section.

2. Install the knock sensor bolt.

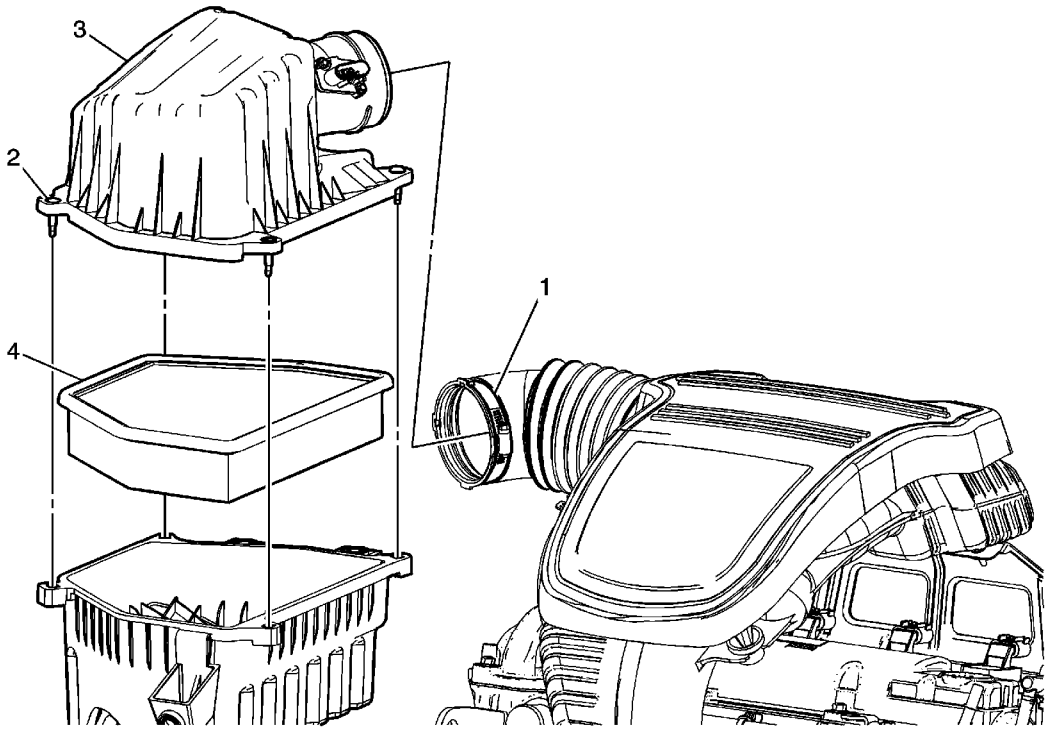
   Tighten
   Tighten the bolt to 25 N·m (18 lb ft).



Note: Rotate the knock sensor electrical connector 90 degrees from vertical before securing the fastener.

3. Install the knock sensor electrical connector (4) to the oil level indicator tube bracket.
4. Connect the engine wiring harness electrical connector (3) to the knock sensor electrical connector (4).

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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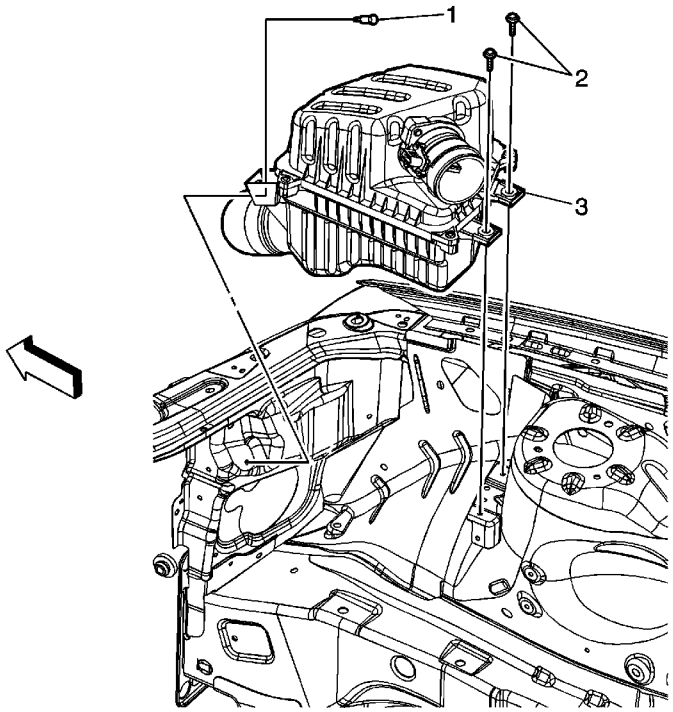
Air Cleaner Assembly Replacement



Callout	Component Name
Preliminary Procedures 1. Remove the underhood electrical center. Refer to Underhood Electrical Center or Junction Block Replacement. 2. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.	
1	Air Cleaner Assembly Bolt **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**

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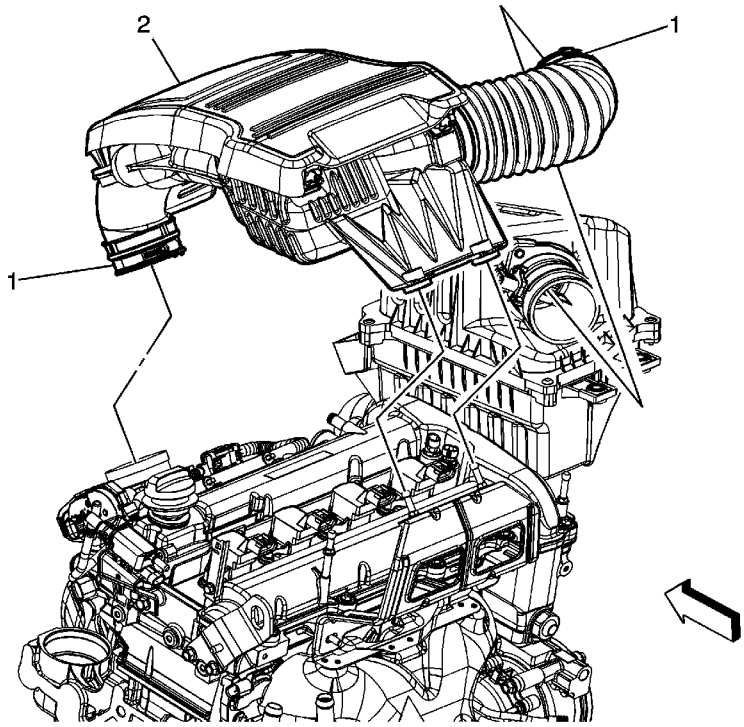
	1. Disconnect any electrical connectors as needed. 2. Transfer any parts as needed.

Air Cleaner Outlet Duct Replacement



Callout	Component Name
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	Air Cleaner Outlet Duct **Procedure** 1. Disengage the positive crankcase valve tube. 2. Pull the air cleaner outlet duct assembly upwards to disengage it from the air cleaner bracket studs.

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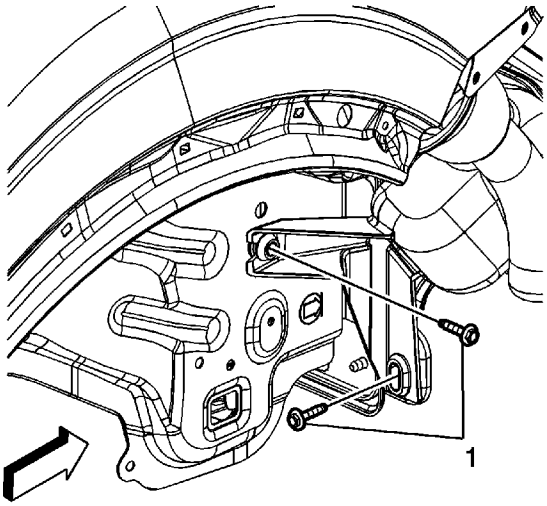
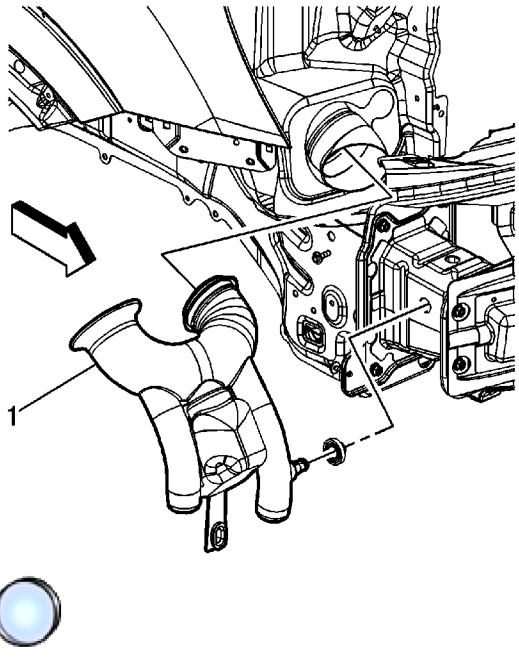
Air Cleaner Inlet Duct Replacement

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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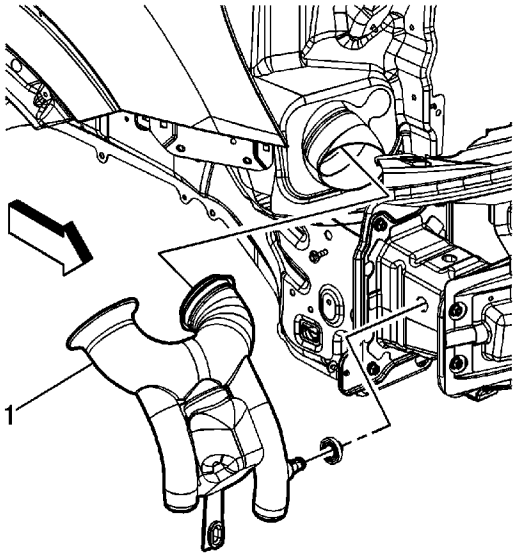
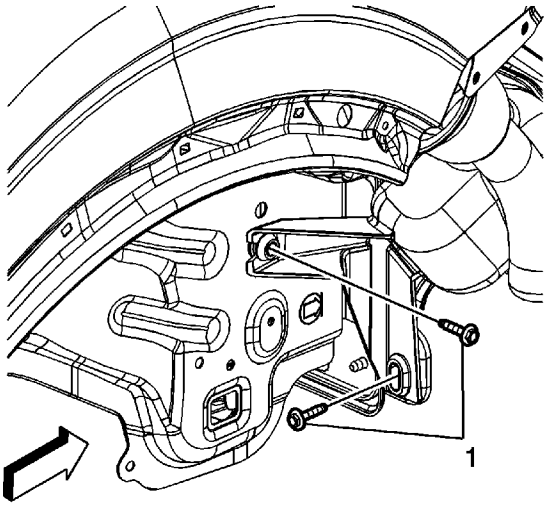
Installation Procedure



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).

3. Install the front bumper fascia. Refer to Front Bumper Fascia Replacement.