

Temperature Versus Resistance

°C	°F	ECT Ohms	IAT Ohms
Temperature vs Resistance Values (Approximate)			
100	212	177	187
90	194	241	246
80	176	332	327
70	158	467	441
60	140	667	603
50	122	973	837
45	113	1188	991
40	104	1459	1180
35	95	1802	1412
30	86	2238	1700
25	77	2796	2055
20	68	3520	2500
15	59	4450	3055
10	50	5670	3760
5	41	7280	4651
0	32	9420	5800
-5	23	12300	7273
-10	14	16180	9200
-15	5	21450	9200
-20	-4	28680	15080
-30	-22	52700	25600
-40	-40	100700	45300

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

Ignition System Specifications

Application	Specification	
	Metric	English
Firing Order	1-3-4-2	
Spark Plug Wire Resistance	2,000-12,000 ohms	
Spark Plug Gap	1.0-1.1 mm	0.039-0.043 in
Spark Plug Torque	25 N·m	18 lb ft
Spark Plug Type	Woojin - BKR6E-11	

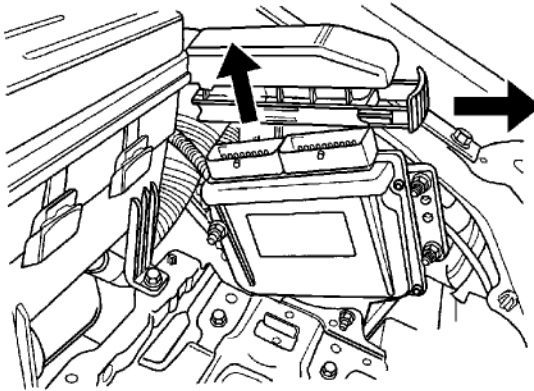
Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accessory Mounting Bracket Bolts	37 N·m	27 lb ft
Camshaft Position Sensor Bolts	12 N·m	106 lb in
Crankshaft Position Sensor Retaining Bolt	6.5 N·m	58 lb in
Electronic Ignition System Ignition Coil Retaining Bolts	10 N·m	89 lb in
Engine Control Module Bolts	4 N·m	35 lb in
Engine Coolant Temperature Sensor Bolt	20 N·m	15 lb ft
Evaporative Emission Canister Flange Bolt	20 N·m	15 lb ft
Evaporative Emission Canister Protective Cover	8 N·m	71 lb in
Evaporative Emission Canister Purge Solenoid Bracket Bolt	5 N·m	44 lb in
Evaporative Emission Vent Solenoid Bolt	8.5 N·m	75 lb in
Exhaust Gas Recirculation Valve Retaining Bolts	30 N·m	22 lb ft
Fuel Filter Mounting Bracket Assembly Bolt	4 N·m	35 lb in
Fuel Pressure Regulator Retaining Screw	12 N·m	106 lb in
Fuel Rail Retaining Bolts	25 N·m	18 lb ft
Fuel Tank Retaining Bolts	20 N·m	15 lb ft
Idle Air Control Valve Retaining Bolts	3 N·m	27 lb in
Knock Sensor Bolt	20 N·m	15 lb ft
Manifold Absolute Pressure Sensor Mounting Bracket Bolt	4 N·m	35 lb in
Manifold Absolute Pressure Sensor Retaining Bolts and Nuts	8 N·m	71 lb in
Oxygen Sensor Bolt	42 N·m	31 lb ft
Rear A/C Compressor Mounting Bracket Bolts	35 N·m	26 lb ft
Spark Plug Cover Bolts	3 N·m	27 lb in
Throttle Body Retaining Nuts	15 N·m	11 lb ft
Throttle Position Sensor Retaining Bolts	2 N·m	18 lb in
Variable Geometry Induction System Solenoid	10 N·m	89 lb in

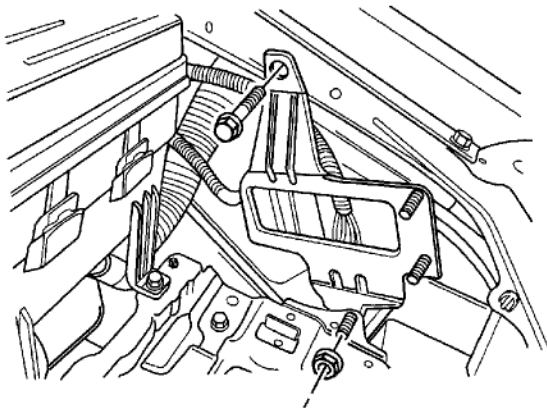
Engine Control Module Replacement

Removal Procedure

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



1. Disconnect the negative battery cable.
2. Disconnect the engine control module (ECM) wiring harness connector.
3. Remove the nuts from the ECM mounting bracket.

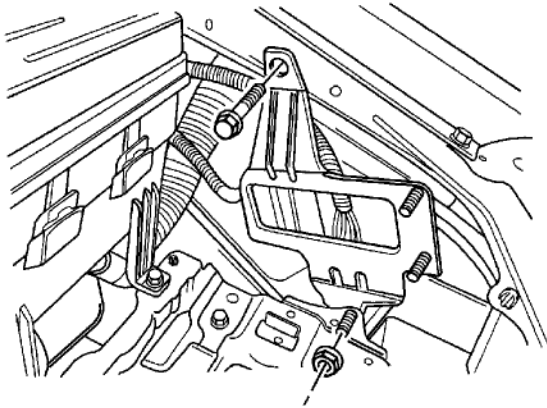


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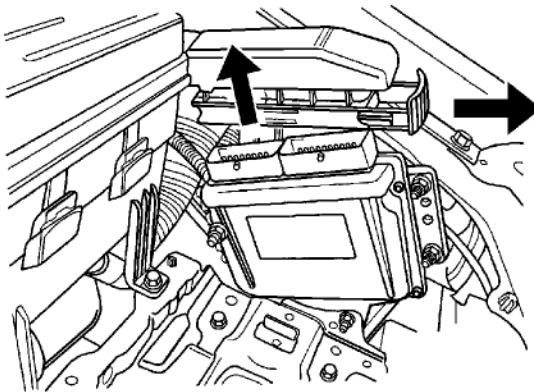
4. Remove the ECM mounting bracket with the bolt and the nut.

Installation Procedure

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



1. Install the ECM mounting bracket with the bolt and the nut and tighten to **12 N·m (9 lb ft)**.



2. Install the ECM with the nuts and tighten to **12 N·m (9 lb ft)**.
3. Refer to [Control Module References](#) for programming and setup information.

Crankshaft Position System Variation Learn

Important: If the crankshaft position variation learn procedure has not learned, a false misfire could be detected and DTC P0300 may set. If sent here from DTC P0300, proceed with the crankshaft position variation learn procedure.

1. Monitor the engine control module (ECM) for DTCs with a scan tool. If other DTCs are set, except DTC P0300, or P1336, refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for the applicable DTC.
2. Select the crankshaft position variation learn procedure with a scan tool.
3. The scan tool instructs you to perform the following:
 - 3.1. Accelerate to wide open throttle (WOT).
 - 3.2. Release throttle when fuel cut-off occurs.
 - 3.3. Observe fuel cut-off for applicable engine.
 - 3.4. Engine should not accelerate beyond calibrated RPM value.
 - 3.5. Release throttle immediately if value is exceeded.
 - 3.6. Block drive wheels.
 - 3.7. Set parking brake.
 - 3.8. DO NOT apply brake pedal.
 - 3.9. Cycle ignition from OFF to ON.
 - 3.10. Apply and hold brake pedal.
 - 3.11. Start and idle engine.
 - 3.12. Turn A/C OFF.

Vehicle must remain in Park or Neutral.

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

- Crankshaft position (CKP) sensors activity--If there is a CKP sensor condition, refer to the applicable DTC.
 - Camshaft position (CMP) signal activity--If there is a CMP signal condition, refer to the applicable DTC.
 - 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.
4. Enable the CKP system variation learn procedure with the scan tool and perform the following:

Important: While the CKP variation learn procedure is in progress, hold the throttle at WOT for 5 fuel-cutoffs. The learn procedure must determine there has been 5 fuel-cutoffs to properly perform the test.

- Accelerate to WOT.

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- Hold throttle while fuel cut-off occurs.
5. The scan tool displays Learn Status: Learned this ignition. If the scan tool indicates that DTC P1336 ran and passed, the CKP variation learn procedure is complete. If the scan tool indicates DTC P1336 failed or did not run, refer to [DTC P1336](#) . If any other DTCs set, refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) for the applicable DTC.
 6. Turn OFF the ignition for 30 seconds after the learn procedure is completed successfully.

The CKP system variation learn procedure is also required when the following service procedures have been performed, regardless of whether or not DTC P1336 is set:

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

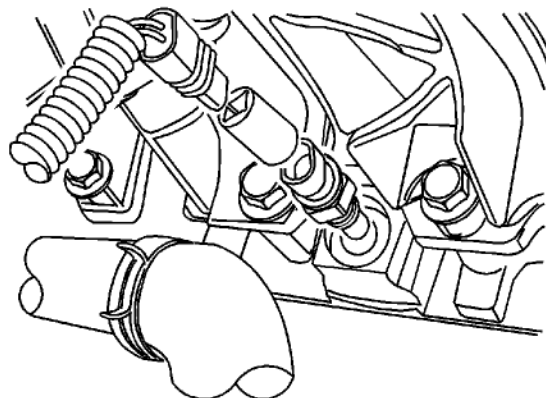
Idle Learn

The Idle Learn Procedure listed below must be performed whenever the following occurs:

- The throttle body assembly is replaced
 - The throttle body is cleaned
 - The engine control module (ECM) is replaced
 - The idle air control valve (IAC) is replaced
 - Power disconnection (battery cable, ECM fuse, etc.) (Delphi ECM only)
1. Turn the ignition ON.
 2. Turn the ignition OFF for 15 seconds.
 3. Turn the ignition ON for 5 seconds.
 4. Turn the ignition OFF for 15 seconds.
 5. Start the engine in park/neutral.
 6. Allow the engine to run until the engine coolant temperature is greater than 85°C (185°F).
 7. Turn the A/C ON for 10 seconds, if equipped.
 8. If the vehicle is equipped with an automatic transaxle, apply the parking brake. While pressing the brake pedal, place the transaxle in drive (D) for 10 seconds.
 9. Turn the A/C OFF for 10 seconds, if equipped.
 10. If the vehicle is equipped with an automatic transaxle, while pressing the brake pedal, place the transaxle in park/neutral.
 11. Turn the ignition OFF. The idle learn procedure is complete.

Engine Coolant Temperature Sensor Replacement

Removal Procedure



1. Relieve the coolant system pressure.

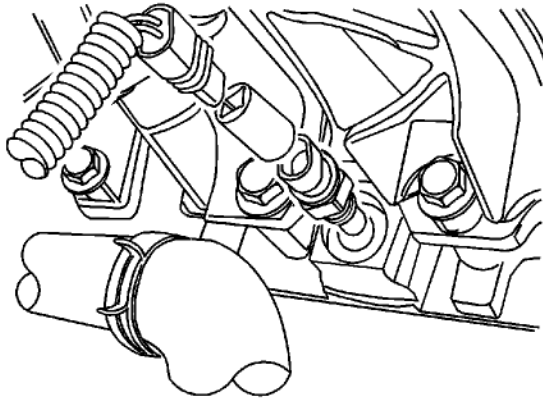
Warning: Refer to [Battery Disconnect Warning](#) in the Preface section.

2. Disconnect the negative battery cable.

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

3. Disconnect the engine coolant temperature (ECT) sensor connector.
4. Carefully remove the ECT sensor from the cylinder head underneath the electronic ignition (EI) system ignition coil.

Installation Procedure



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

1. Coat the threads on the ECT sensor with sealer.

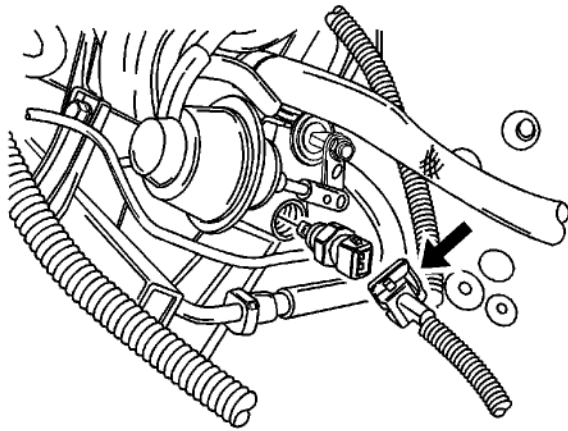
Caution: Refer to [Fastener Caution](#) in the Preface section.

2. Install the ECT sensor into the cylinder head and tighten to **17.5 N·m (13 lb ft)**.
3. Connect the ECT sensor connector.
4. Fill the cooling system.
5. Connect the negative battery cable.

Intake Air Temperature Sensor Replacement

Removal Procedure

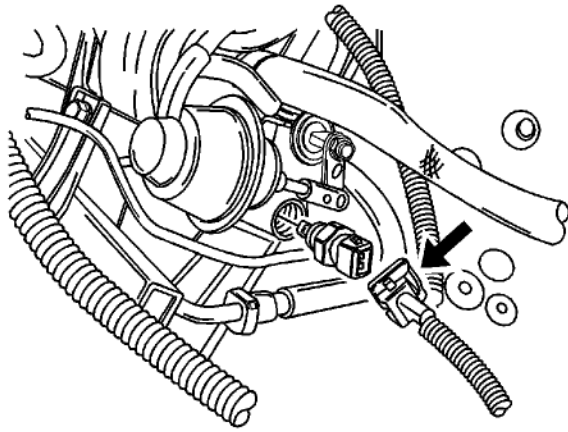
Warning: Refer to [Battery Disconnect Warning](#) in the Preface section.



1. Disconnect the negative battery cable.
2. Disconnect the intake air temperature (IAT) sensor connector.
3. Remove the IAT sensor.

Installation Procedure

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

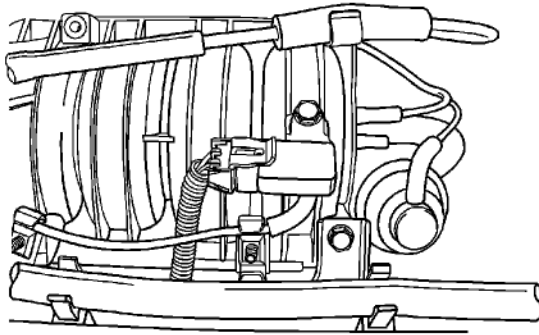


1. Insert the IAT sensor and tighten to **22 N·m (16 lb ft)**.
2. Connect the IAT sensor connector.
3. Connect the negative battery cable.

Manifold Absolute Pressure Sensor Replacement

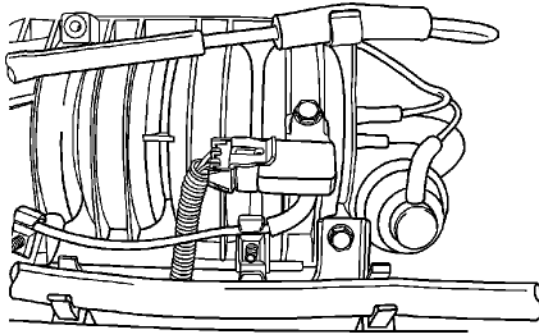
Removal Procedure

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



1. Disconnect the negative battery cable.
2. Disconnect the vacuum hose from the manifold absolute pressure (MAP) sensor.
3. Disconnect the MAP connector.
4. Remove the MAP sensor mounting bracket bolt.
5. Remove the bolts and nuts securing the MAP sensor to the mounting bracket.

Installation Procedure



1. Insert the MAP sensor into the mounting bracket.

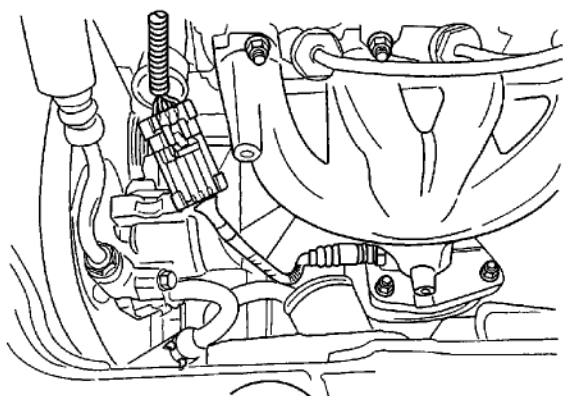
Caution: Refer to [Fastener Caution](#) in the Preface section.

2. Install the bolts through the MAP sensor and the bracket. Install the retaining nuts and tighten to **8 N·m (71 lb in)**.
3. Install the MAP sensor and the mounting bracket to the firewall with the mounting bracket bolt and tighten to **4 N·m (35 lb in)**.
4. Connect the MAP sensor connector.
5. Connect the vacuum hose to the MAP sensor.
6. Connect the negative battery cable.

Heated Oxygen Sensor Replacement - Sensor 1

Removal Procedure

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



1. Disconnect the negative battery cable.

Caution: Do not remove the pigtail from either the heated oxygen sensor (HO2S) or the oxygen sensor (O2S). Removing the pigtail or the connector will affect sensor operation.

Handle the oxygen sensor carefully. Do not drop the HO2S. Keep the in-line electrical connector and the louvered end free of grease, dirt, or other contaminants. Do not use cleaning solvents of any type.

Do not repair the wiring, connector or terminals. Replace the oxygen sensor if the pigtail wiring, connector, or terminal is damaged.

This external clean air reference is obtained by way of the oxygen sensor signal and heater wires. Any attempt to repair the wires, connectors, or terminals could result in the obstruction of the air reference and degraded sensor performance.

The following guidelines should be used when servicing the heated oxygen sensor:

- Do not apply contact cleaner or other materials to the sensor or vehicle harness connectors. These materials may get into the sensor causing poor performance.
- Do not damage the sensor pigtail and harness wires in such a way that the wires inside are exposed. This could provide a path for foreign materials to enter the sensor and

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cause performance problems.

- Ensure the sensor or vehicle lead wires are not bent sharply or kinked. Sharp bends or kinks could block the reference air path through the lead wire.
- Do not remove or defeat the oxygen sensor ground wire, where applicable. Vehicles that utilize the ground wired sensor may rely on this ground as the only ground contact to the sensor. Removal of the ground wire will cause poor engine performance.
- Ensure that the peripheral seal remains intact on the vehicle harness connector in order to prevent damage due to water intrusion. The engine harness may be repaired using Packard's Crimp and Splice Seals Terminal Repair Kit. Under no circumstances should repairs be soldered since this could result in the air reference being obstructed.

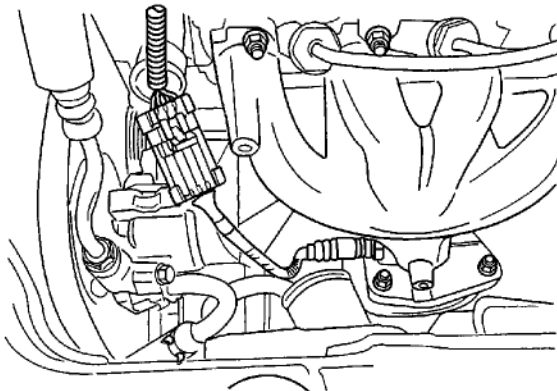
Caution: Do not solder heated oxygen sensor wires. Soldering the wires will result in the loss of the air reference to the sensor. Refer to Engine Electrical for proper wire and connection repair techniques.

2. Disconnect the front heated oxygen sensor (HO2S) 1 connector.

Caution: Remove oxygen sensors with the engine temperature above 48°C (120°F). Otherwise the oxygen sensors may be difficult to remove.

3. Carefully remove the HO2S1 from the exhaust manifold.

Installation Procedure



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

1. Coat the threads of the HO2S1 with an anti-seize compound, if needed.

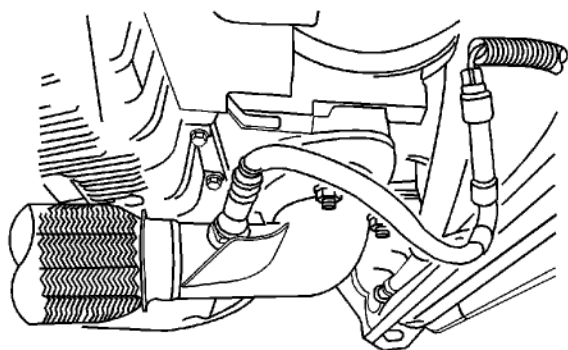
Caution: Refer to [Fastener Caution](#) in the Preface section.

2. Install the HO2S1 into the exhaust manifold and tighten to **42 N·m (31 lb ft)**.
3. Connect the HO2S1 connector.
4. Connect the negative battery cable.

Heated Oxygen Sensor Replacement - Sensor 2

Removal Procedure

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



1. Disconnect the negative battery cable.

Caution: Do not remove the pigtail from either the heated oxygen sensor (HO2S) or the oxygen sensor (O2S). Removing the pigtail or the connector will affect sensor operation.

Handle the oxygen sensor carefully. Do not drop the HO2S. Keep the in-line electrical connector and the louvered end free of grease, dirt, or other contaminants. Do not use cleaning solvents of any type.

Do not repair the wiring, connector or terminals. Replace the oxygen sensor if the pigtail wiring, connector, or terminal is damaged.

This external clean air reference is obtained by way of the oxygen sensor signal and heater wires. Any attempt to repair the wires, connectors, or terminals could result in the obstruction of the air reference and degraded sensor performance.

The following guidelines should be used when servicing the heated oxygen sensor:

- Do not apply contact cleaner or other materials to the sensor or vehicle harness connectors. These materials may get into the sensor causing poor performance.
- Do not damage the sensor pigtail and harness wires in such a way that the wires inside are exposed. This could provide a path for foreign materials to enter the sensor and

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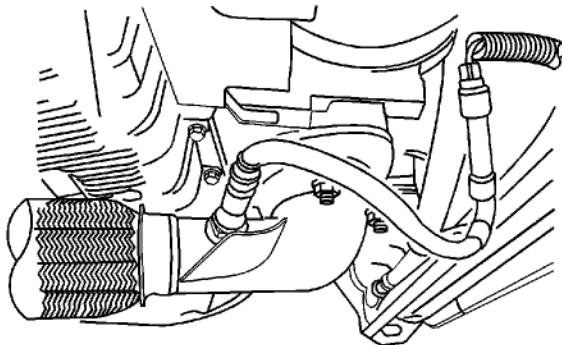
cause performance problems.

- Ensure the sensor or vehicle lead wires are not bent sharply or kinked. Sharp bends or kinks could block the reference air path through the lead wire.
- Do not remove or defeat the oxygen sensor ground wire, where applicable. Vehicles that utilize the ground wired sensor may rely on this ground as the only ground contact to the sensor. Removal of the ground wire will cause poor engine performance.
- Ensure that the peripheral seal remains intact on the vehicle harness connector in order to prevent damage due to water intrusion. The engine harness may be repaired using Packard's Crimp and Splice Seals Terminal Repair Kit. Under no circumstances should repairs be soldered since this could result in the air reference being obstructed.

Caution: Do not solder heated oxygen sensor wires. Soldering the wires will result in the loss of the air reference to the sensor. Refer to Engine Electrical for proper wire and connection repair techniques.

2. Disconnect the electrical connector.
3. Remove the heated oxygen sensor (HO2S) 2.

Installation Procedure



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

1. Coat the threads of the HO2S2 with an anti-seize compound, if needed.

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

2. Install the HO2S2.

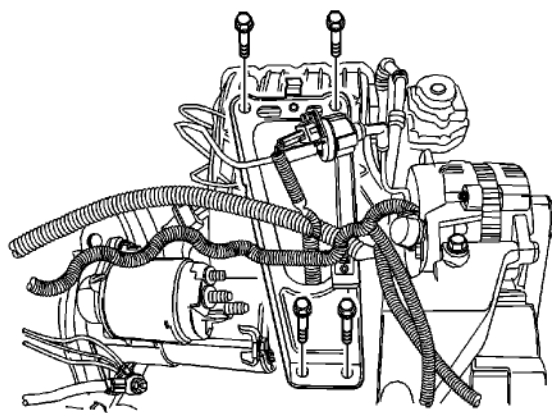
Tighten the heated oxygen sensor to **42 N·m (31 lb ft)**.

3. Connect the electrical connector.
4. Connect the negative battery cable.

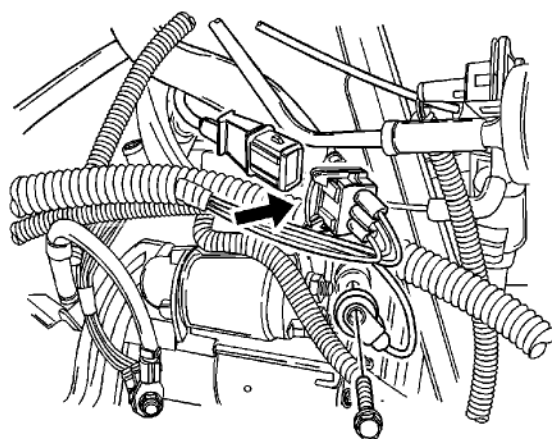
Knock Sensor Replacement

Removal Procedure

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



1. Disconnect the negative battery cable.
2. Remove the intake manifold support bracket bolts.
3. Remove the intake manifold support bracket.

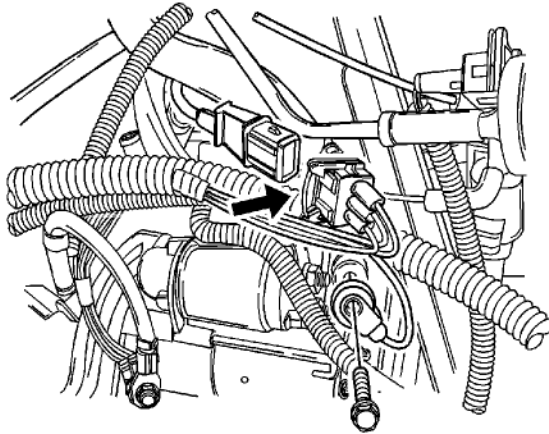


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4. Disconnect the knock sensor (KS) electrical connector.
5. Remove the KS bolt.
6. Remove the KS.

Installation Procedure

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

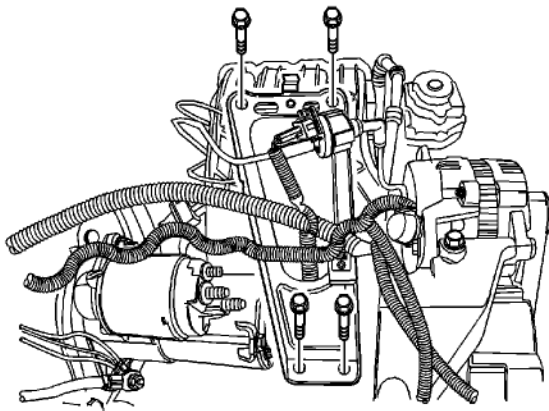


1. Install the KS with the bolt.

Tighten

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

2. Connect the KS electrical connector.





3. Install the intake manifold support bracket with the bolts.

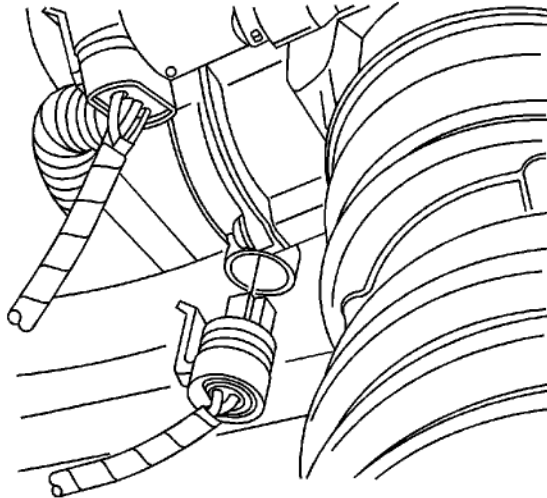
Tighten

- Tighten the intake manifold support bracket upper bolts to 25 N·m (18 lb ft).
 - Tighten the intake manifold support bracket lower bolts to 45 N·m (33 lb ft).
4. Connect the negative battery cable.

Throttle Position Sensor Replacement

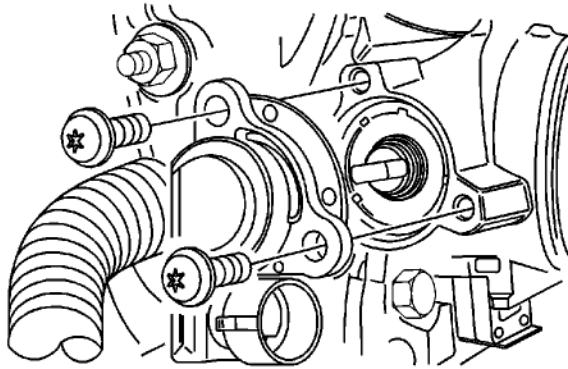
Removal Procedure

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



1. Disconnect the negative battery cable.
2. Disconnect the throttle position (TP) sensor connector.
3. Remove the TP sensor retaining bolts and the TP sensor.

Installation Procedure



1. With the throttle valve closed, position the TP sensor on the throttle shaft. Align the TP sensor with the bolt holes.

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

2. Install the TP sensor retaining bolts.

Tighten

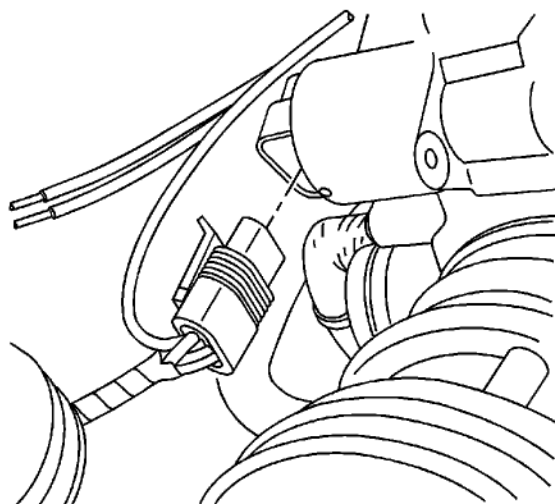
Tighten the throttle position sensor retaining bolts to 2 N·m (18 lb in).

3. Connect the TP sensor connector.
4. Connect the negative battery cable.

Idle Air Control Valve Replacement

Removal Procedure

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



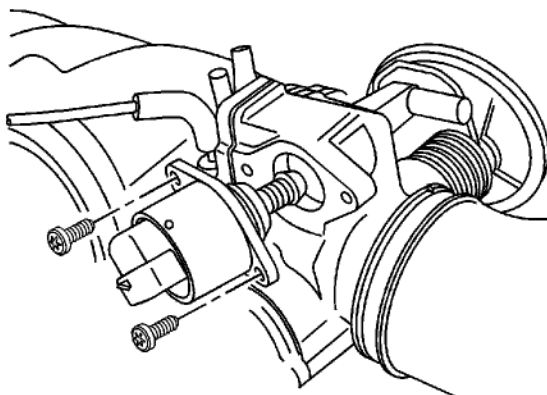
1. Disconnect the negative battery cable.
2. Disconnect the idle air control (IAC) valve connector.
3. Remove the IAC valve retaining bolts.

Caution:

- Do Not push or pull on the IAC valve pintle on IAC valves that have been in service. The force required to move the pintle may damage the threads on the worm drive.
- Do Not soak the IAC valve in any liquid cleaner or solvent, as damage may result.

4. Remove the IAC valve.
5. Clean the IAC valve O-ring seal area, the pintle valve seat, and the air passage with a suitable fuel system cleaner. Do not use methyl ethyl ketone.

Installation Procedure

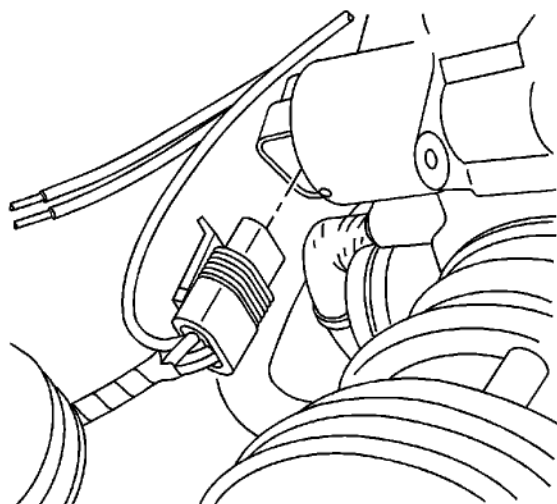


Important: If installing a new IAC valve, be sure to replace it with an identical part. The IAC valve pintle shape and diameter are designed for the specific application. Measure the distance between the tip of the IAC valve pintle and the mounting flange. If the distance is greater than 28 mm (1.1 in), use finger pressure to slowly retract the pintle.

The force required to retract the pintle will not damage the IAC valve. The purpose of the 28 mm (1.1 in) setting is to prevent the IAC pintle from bottoming out on the pintle seat. This 28 mm (1.1 in) setting is also an adequate setting for controlled idle on a restart.

1. Lubricate a new O-ring with engine oil. Install the new O-ring onto the valve.
2. Install the IAC valve into the throttle body.

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





3. Install the IAC valve retaining bolts.

Tighten

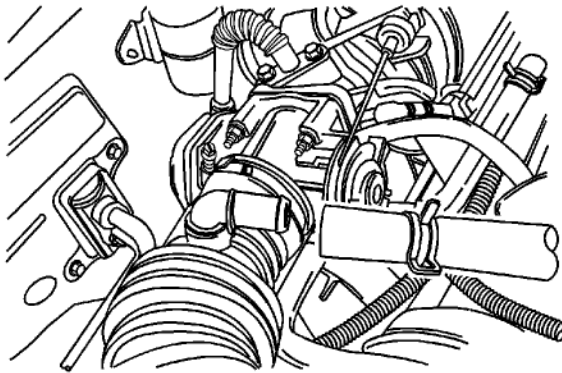
Tighten the idle air control valve retaining bolts to 3 N·m (27 lb in).

4. Connect the IAC valve connector.
5. Connect the negative battery cable.
6. Start the engine and check for the proper idle speed.

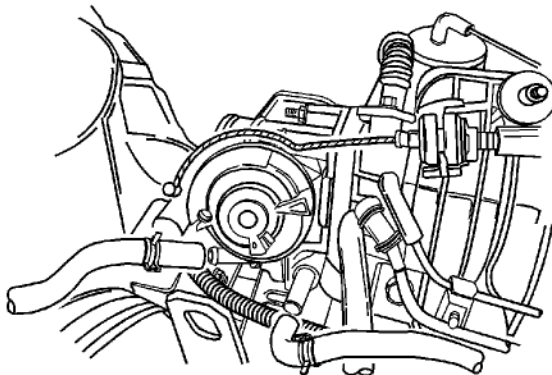
Throttle Body Assembly Replacement

Removal Procedure

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



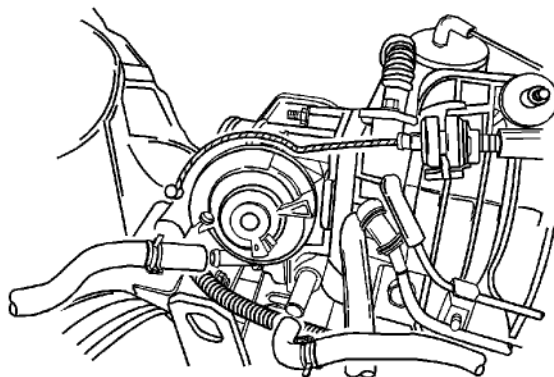
1. Disconnect the negative battery cable.
2. Remove the intake air tube.
3. Disconnect the breather hose.



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4. Disconnect the coolant hose from the throttle body.
5. Disconnect the throttle cables by opening the release slot.
6. Disconnect the main throttle idle actuator (MTIA) electrical connector.
7. Remove the throttle body bolt and the nuts.
8. Remove the throttle body.

Installation Procedure



1. Install the throttle body assembly to the intake manifold.

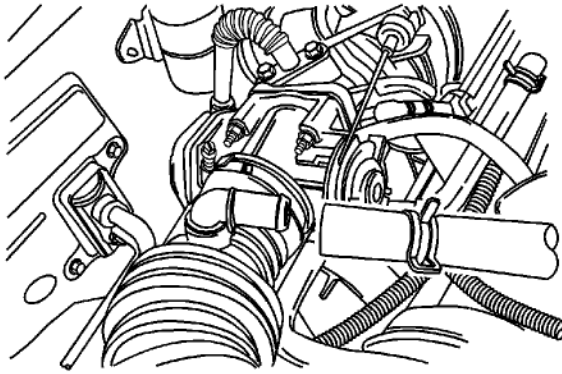
Caution: Refer to [Fastener Caution](#) in the Preface section.

2. Install the throttle body retaining nuts and the bolt.

Tighten

Tighten the throttle body retaining nuts and the bolt to 15 N·m (11 lb ft).

3. Connect the throttle cable.
4. Connect the coolant hoses.



5. Connect the breather hose.
6. Install the intake air tube.
7. Connect the negative battery cable.

Fuel Pressure Relief

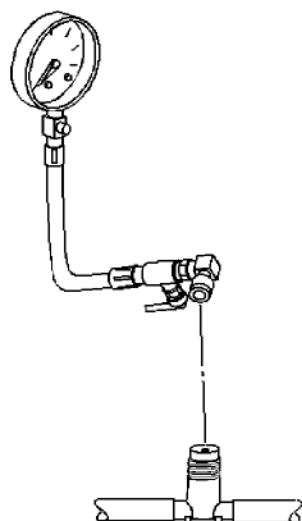
1. Remove the fuel cap.
2. Remove the fuel pump fuse EF10 from the engine fuse box.
3. Start the engine and allow the engine to stall.
4. Crank the engine for an additional 10 seconds.

Fuel Pressure Gage Installation and Removal

Installation Procedure

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

1. Remove the left fuel rail cover.



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.

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. Install the fuel pressure gage to the fuel pressure service connection, located on the fuel rail.
3. Turn ON the ignition.

Warning: Do not drain the fuel into an open container. Never store the fuel in an open container due to the possibility of a fire or an explosion.

4. Place the bleed hose of the fuel pressure gage into an approved gasoline container.
5. Open the bleed valve on the fuel pressure gage in order to bleed the air from the fuel pressure gage.
6. Command the fuel pump ON with a scan tool.

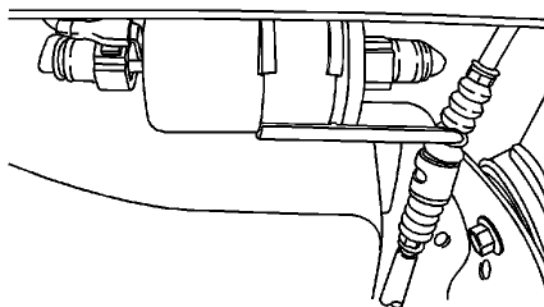
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7. Close the bleed valve on the fuel pressure gage.
8. Inspect for fuel leaks.

Fuel Filter Replacement

Removal Procedure

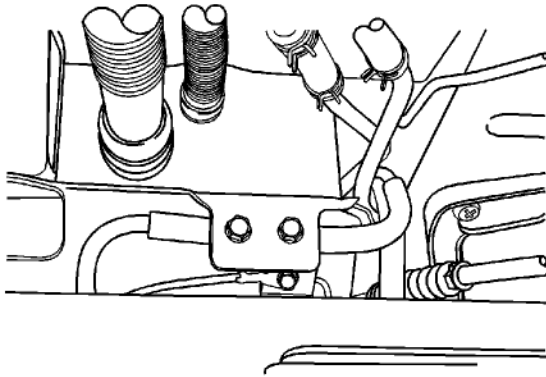
Caution: Refer to [Fuel Pressure Caution](#) in the Preface section.



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

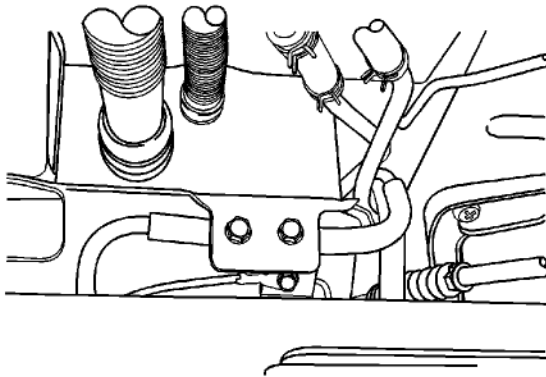
Warning: Refer to [Battery Disconnect Warning](#) in the Preface section.

2. Disconnect the negative battery cable.
3. Disconnect the inlet/outlet fuel lines by moving the line connector lock forward and pulling the hose off of the fuel filter tube.
4. Disconnect the fuel filter ground.



5. Remove the fuel filter bracket bolts.
6. Pull the fuel filter out of the retaining clamp.

Installation Procedure



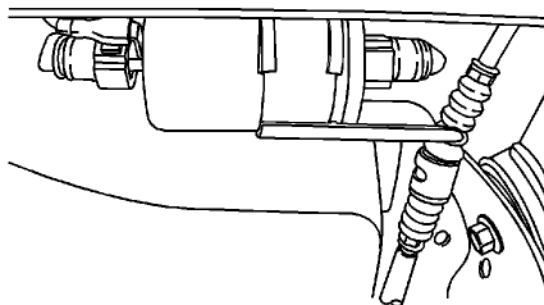
1. Install the new fuel filter into the retaining clamp. Note the flow direction.

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

2. Install the fuel filter bracket bolts.

Tighten

Tighten the fuel filter bracket bolts to 4 N·m (35 lb in).

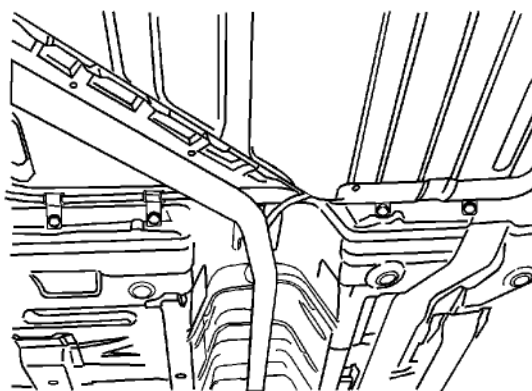


3. Connect the inlet/outlet lines. Secure the lines with the connector lock.
4. Perform a leak test of the fuel filter.

Fuel Tank Replacement

Removal Procedure

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

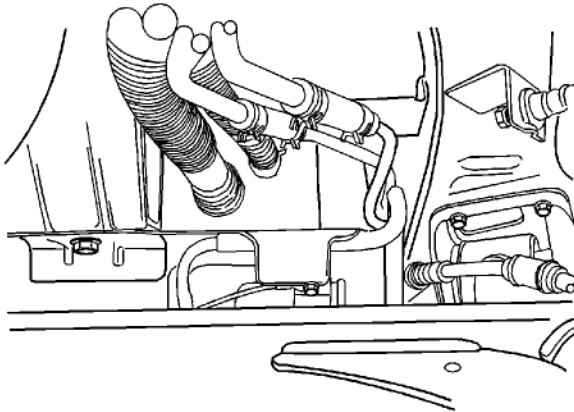


Warning: Gasoline or gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

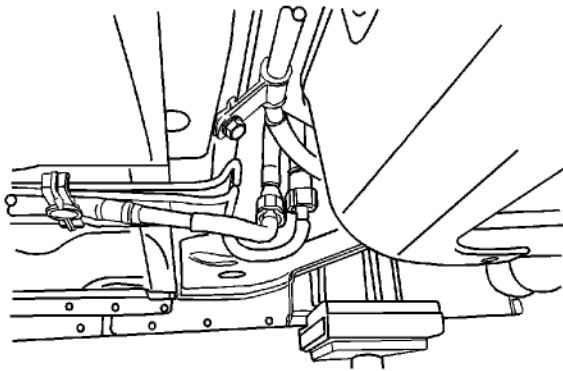
1. Relieve the fuel pressure. Refer to [Fuel Pressure Relief](#).

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

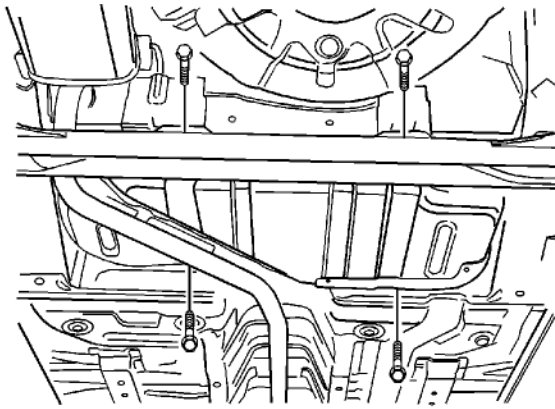
2. Disconnect the negative battery cable.
3. Drain the fuel tank.
4. Disconnect the parking brake cable retainer clamps and the support along the fuel tank to provide clearance for the tank.



5. Remove the fuel tank filler tube clamp at the fuel tank.
6. Disconnect the fuel tank filler tube.
7. Disconnect the fuel tank filler tube at the fuel tank.
8. Disconnect the canister vapor tube at the control valve vapor tube.

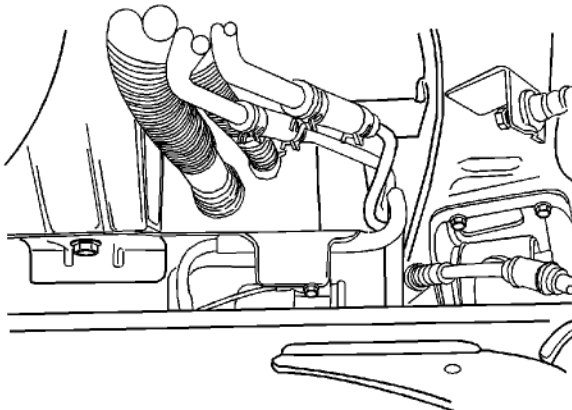


9. Disconnect the fuel pump harness connector at the right rear corner of the fuel tank.
10. Disconnect the fuel inlet line near the right front of the fuel tank.
11. Disconnect the wiring harness clips and the fuel line clips as needed.



12. Support the fuel tank.
13. Remove the fuel tank retaining bolts.
14. Carefully lower the fuel tank.
15. Remove the fuel tank.
16. Transfer any parts as needed.

Installation Procedure



1. Raise the fuel tank into position.

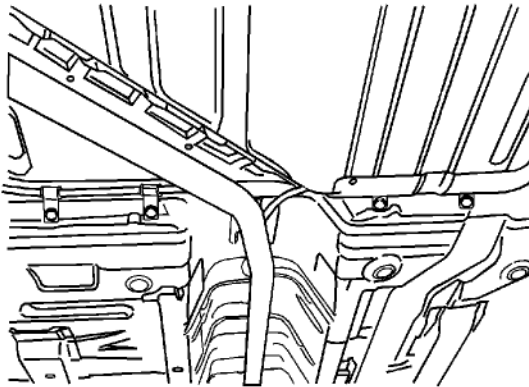
Caution: Refer to [Fastener Caution](#) in the Preface section.

2. Install the fuel tank mounting bolts.

Tighten

Tighten the fuel tank retaining bolts to 20 N·m (15 lb ft).

3. Connect the fuel outlet line.
4. Connect the wiring harness clips and the fuel line clips as needed.
5. Connect the fuel pump electrical connector.
6. Connect the fuel vapor line.
7. Connect the fuel tank filler tube and fuel tank vent tube.
8. Install the fuel tank filler tube clamp at the fuel tank.



9. Install the parking brake cable retainer clamps and the support.

Tighten

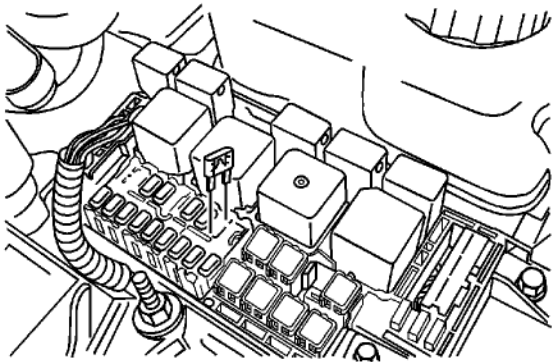
Tighten the parking brake cable retainer clamps to 10 N·m (89 lb in).

10. Connect the negative battery cable.
11. Fill the fuel tank.
12. Perform a leak check of the fuel tank and the fuel line connections.

Fuel Sender Assembly Replacement

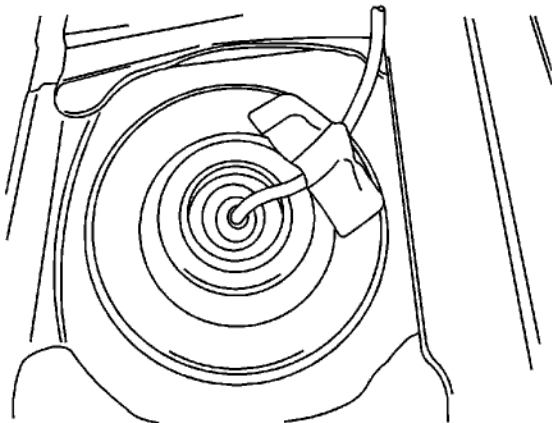
Removal Procedure

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



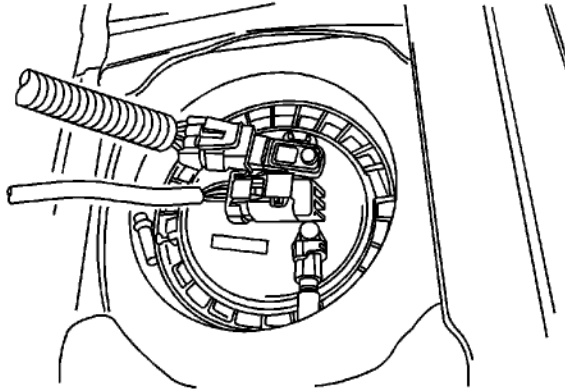
1. Relieve the fuel system pressure. Refer to [Fuel Pressure Relief](#).

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



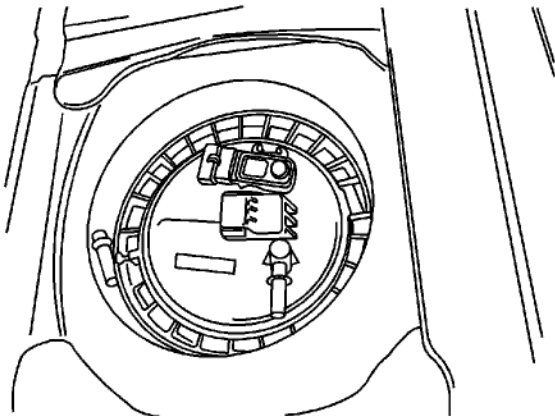


2. Disconnect the negative battery cable.
3. Remove the rear seat. Refer to [Rear Seat Cushion Replacement](#).
4. Remove the fuel pump access cover.



5. Disconnect the electrical connector at the fuel pump assembly.
6. Disconnect the fuel line.
7. Remove the fuel pump assembly clip.
8. Remove the fuel pump assembly from the tank.
9. Remove and discard the gasket.

Installation Procedure



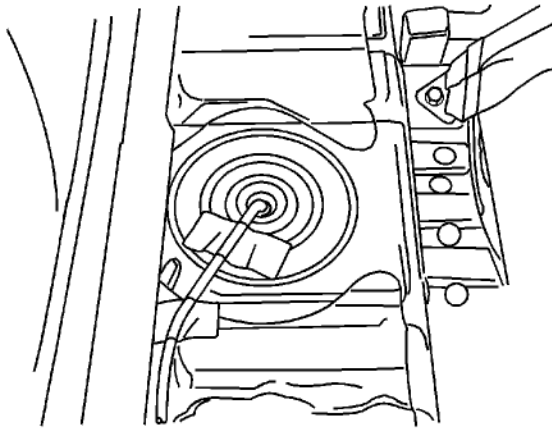


1. Clean the gasket mating surface on the fuel tank.
2. Position the new gasket in place.
3. Install the fuel pump into the fuel tank in the same location as removed for ease of line and connector installation.
4. Install the fuel pump assembly clip.
5. Connect the fuel pump assembly connector.
6. Install the fuel pump line.
7. Install the fuel pump access cover.
8. Install the EF10 fuse.
9. Connect the negative battery cable.
10. Perform an operational check of the fuel pump.
11. Install the rear seat. Refer to [Rear Seat Cushion Replacement](#).

Fuel Pump Replacement

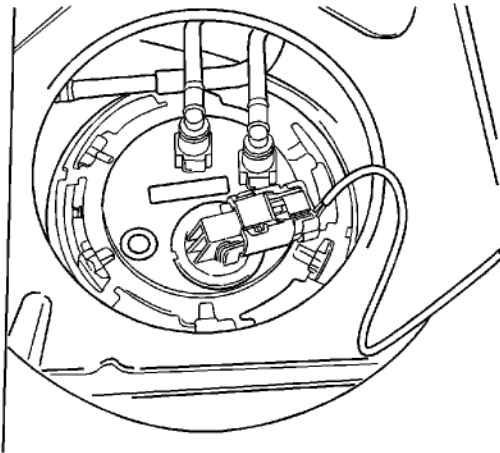
Removal Procedure

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



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

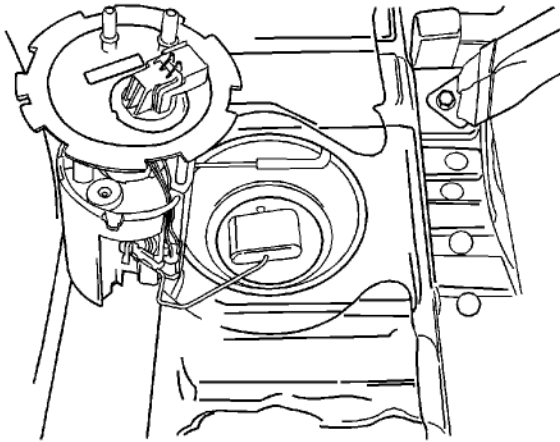
Warning: Refer to [Battery Disconnect Warning](#) in the Preface section.





2. Disconnect the negative battery cable.
3. Remove the rear seat.
4. Remove the fuel pump access cover.
5. Disconnect the electrical connector at the fuel pump assembly.
6. Disconnect the fuel outlet line.
7. Turn the lock ring counterclockwise to clear the tank tabs.
8. Remove the fuel pump assembly from the tank.
9. Remove and discard the gasket.

Installation Procedure

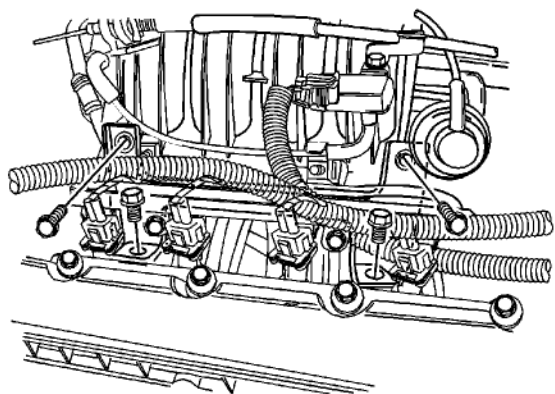


1. Clean the gasket mating surface on the fuel tank.
2. Position the new gasket in place.
3. Install the fuel pump into the fuel tank in the same location as removed for ease of line and connector installation.
4. Position the lock ring in place and turn it clockwise until it contacts the tank stop.
5. Connect the fuel pump assembly connector.
6. Install the fuel pump outlet line.
7. Install the pump access cover.
8. Connect the negative battery cable.
9. Perform an operational check of the fuel pump.
10. Install the rear seat.

Fuel Injection Fuel Rail Assembly Replacement

Removal Procedure

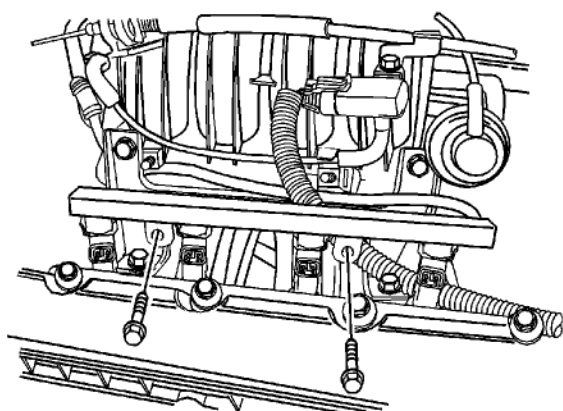
Warning: Refer to [Relieving Fuel Pressure Warning](#) in the Preface section.



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

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

2. Disconnect the negative battery cable.
3. Remove the intake manifold bracket bolts.
4. Remove the intake manifold bracket.
5. Disconnect the fuel injector harness connectors.



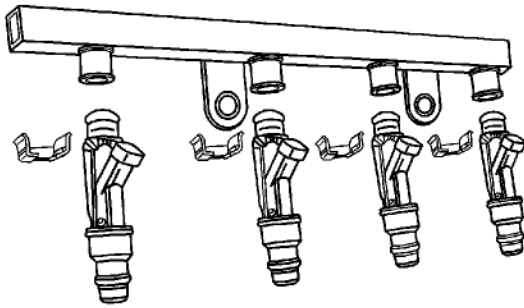
6. Remove the fuel feed line.
7. Remove the fuel rail mounting bolts.

Caution:

- Use care when servicing the fuel system components, especially the fuel injector electrical connectors, the fuel injector tips, and the injector O-rings. Plug the inlet and the outlet ports of the fuel rail in order to prevent contamination.
- Do not use compressed air to clean the fuel rail assembly as this may damage the fuel rail components.
- Do not immerse the fuel rail assembly in a solvent bath in order to prevent damage to the fuel rail assembly.

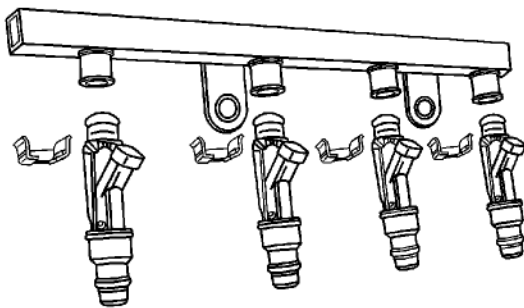
Note: If an injector becomes separated from the rail and remains in the cylinder head, replace the injector O-ring seals and the retaining clip.

8. Remove the fuel rail with the fuel injectors attached.



9. Remove the fuel injector retainer clips.
10. Remove the fuel injectors by pulling down and out.
11. Discard the fuel injector O-rings.

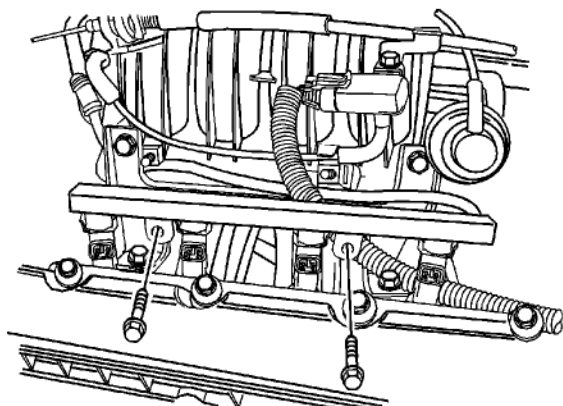
Installation Procedure



Note: Different injectors are calibrated for different flow rates. When ordering new fuel injectors, be certain to order the identical part number that is inscribed on the old injector.

1. Lubricate the new fuel injector O-rings with engine oil. Install the new O-rings on the fuel injectors.

2. Install the fuel injectors into the fuel rail sockets with the fuel injector terminals facing outward.



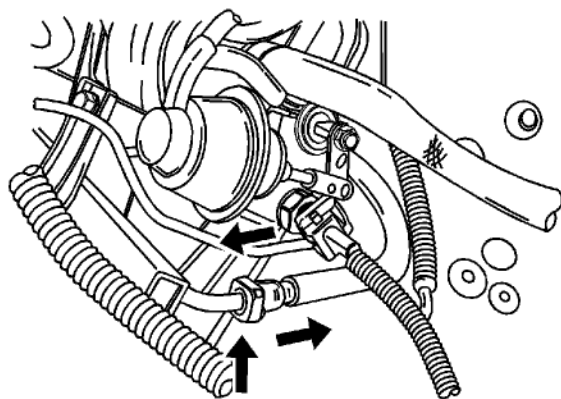
3. Install the fuel injector retainer clips onto the fuel injectors and the fuel rail ledge.
4. Make sure that the clip is parallel to the fuel injector harness connector.
5. Install the fuel rail assembly into the cylinder head.

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

6. Install the fuel rail mounting bolts.

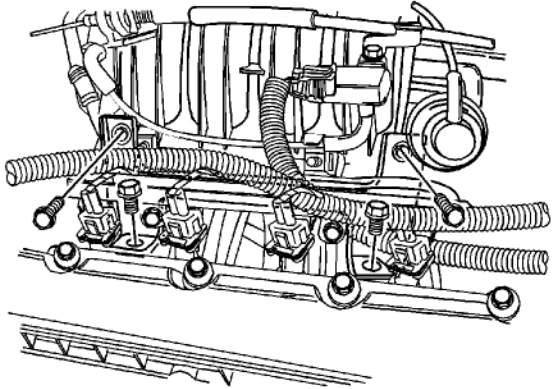
Tighten

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





7. Connect the fuel feed hose.

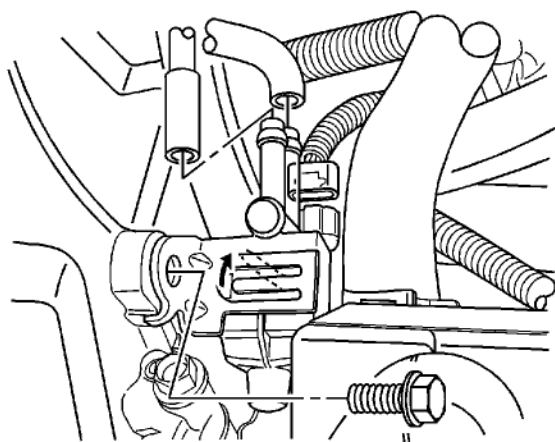


8. Connect the fuel injector harness connectors. Rotate each fuel injector as required to avoid stretching the wiring harness.
9. Install the intake manifold bracket with the bolts.
10. Connect the negative battery cable.
11. Perform a leak check of the fuel rail and fuel injectors.

Evaporative Emission Canister Purge Solenoid Valve Replacement

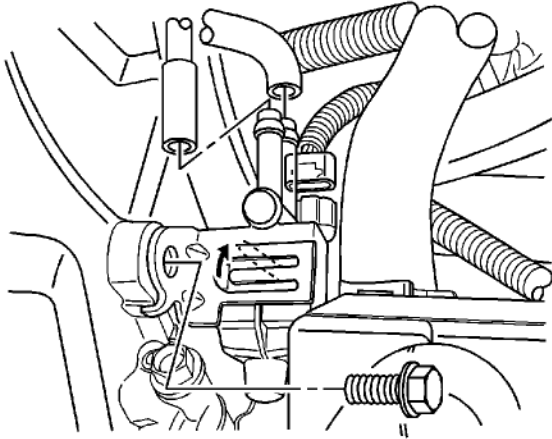
Removal Procedure

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



1. Disconnect the negative battery cable.
2. Disconnect the evaporative emission (EVAP) canister purge solenoid connector.
3. Disconnect the vacuum hoses from the EVAP canister purge solenoid.
4. Remove the EVAP canister purge solenoid bracket bolt from the intake manifold.
5. Unclip the EVAP canister purge solenoid from the mounting bracket.

Installation Procedure



1. Attach the EVAP canister purge solenoid to the mounting bracket.

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

2. Install the EVAP canister purge solenoid and the mounting bracket to the intake manifold with the bracket bolt.

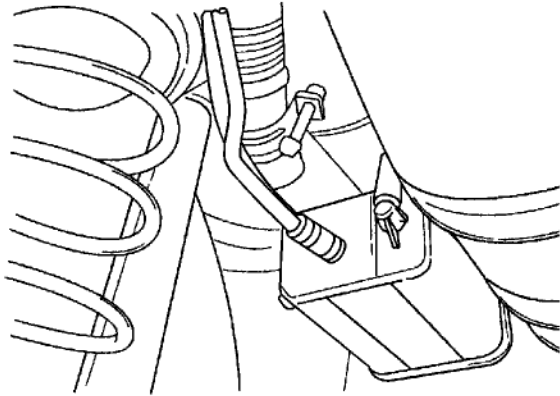
Tighten

Tighten the EVAP canister purge solenoid bracket bolt to 5 N·m (44 lb in).

3. Connect the vacuum hoses to the EVAP canister purge solenoid.
4. Connect the EVAP canister purge solenoid connector.
5. Connect the negative battery cable.

Evaporative Emission Canister Replacement

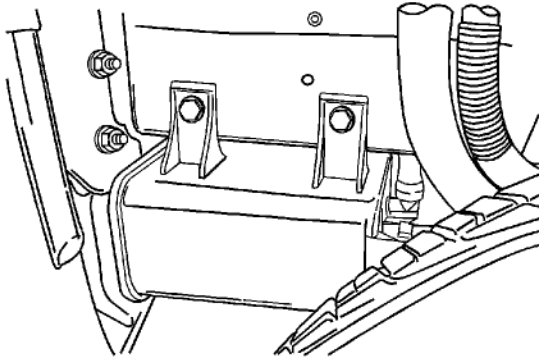
Removal Procedure



Warning: Do not breathe the air through the EVAP component tubes or hoses. The fuel vapors inside the EVAP components may cause personal injury.

1. Disconnect the evaporative emission (EVAP) canister fuel vapor hoses.
2. Remove the bolt securing the EVAP canister flange to the vehicle.
3. Slide the EVAP canister out of the track holder.
4. Remove the EVAP canister.

Installation Procedure



1. Insert the EVAP canister into the track and slide it into position.

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

2. Install the EVAP emission canister flange bolt.

Tighten

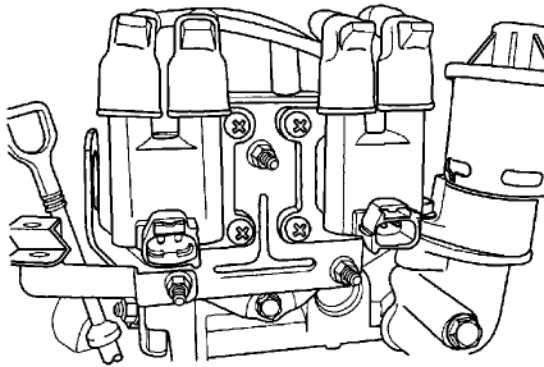
Tighten the evaporative emission canister flange bolt to 20 N·m (15 lb ft).

3. Connect the canister fuel vapor hoses.

Ignition Coil Replacement

Removal Procedure

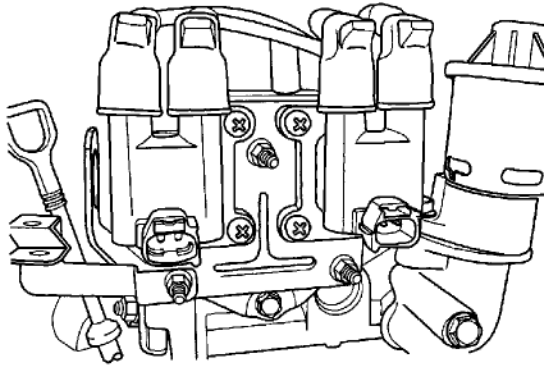
Warning: Refer to [Battery Disconnect Warning](#) in the Preface section.



1. Disconnect the negative battery cable.
2. Disconnect the electronic ignition (EI) system ignition coil connector.
3. Note the ignition wire location and remove the ignition wire.
4. Remove the EI system ignition coil retaining nuts.
5. Remove the EI system ignition coil.

Installation Procedure

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



1. Install the EI system ignition coil into the mounting location and install the retaining nuts.

Tighten

Tighten the EI system ignition coil retaining nuts to 10 N·m (89 lb in).

2. Connect the EI system ignition coil connector.
3. Connect the negative battery cable.

Spark Plug Wire Inspection

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

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

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

Spark Plug Wire Replacement

Removal Procedure

1. Turn OFF the ignition.
2. Disconnect the spark plug wire at each spark plug.
 - Twist each spark plug boot 1/2 turn before removing.
 - Pull only on the boot or use a tool designed for this purpose in order to remove the wire from each spark plug.
3. Disconnect the spark plug wire from the coil.
 - Twist each spark plug boot 1/2 turn before removing.
 - Pull only on the boot or use a tool designed for this purpose in order to remove the wires from the coil.

Installation Procedure

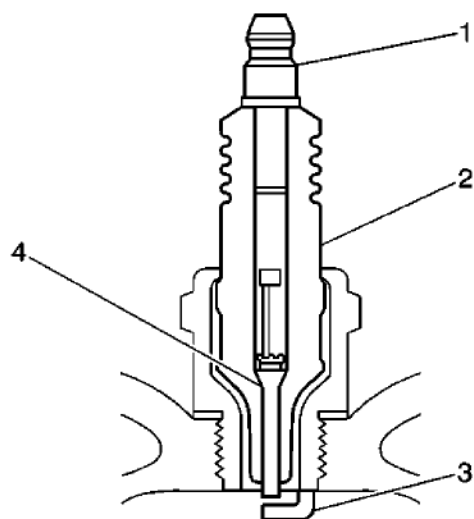
1. Install the spark plug wire on the coil.
2. Install the spark plug wire at each spark plug.
3. Inspect the wires for proper installation:
 - Push down on each boot in order to inspect the seating.
 - Reinstall any loose boot.
 - Wire routing must be kept intact during service and followed exactly when wires have been disconnected or when replacement of the wires is necessary. Failure to route the wires correctly can lead to radio interference and crossfire of the plugs, or shorting of the leads to the ground.
 - Any time the spark plug wires or boots are installed on the spark plugs, new dielectric grease needs to be applied inside the boot.

Spark Plug Inspection

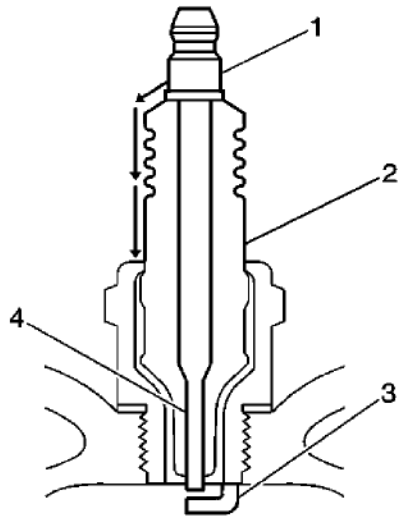
Spark Plug Usage

- Ensure that the correct spark plug is installed. An incorrect spark plug causes driveability conditions.
- 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

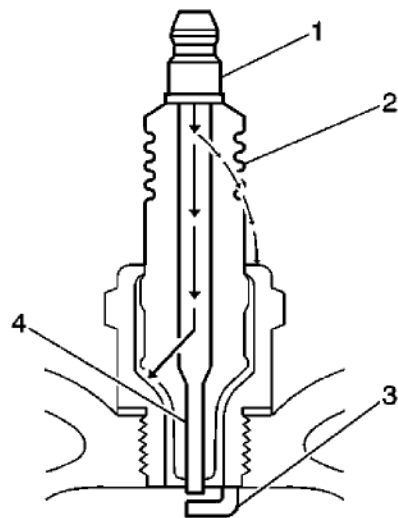
Spark Plug Inspection



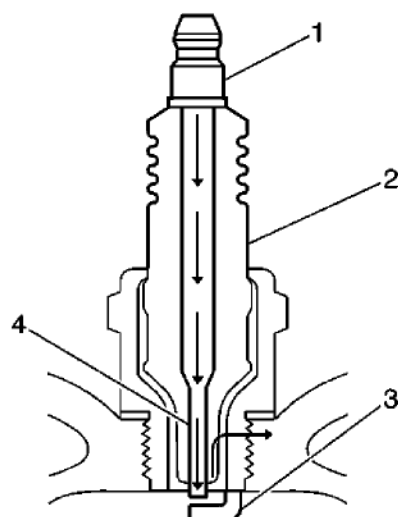
1. Inspect the terminal post (1) for damage.
 - Inspect for a bent or broken terminal post (1).
 - Test for a loose terminal post (1) by twisting and pulling the post. The terminal post (1) should NOT move.



2. 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.



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



4. Inspect (3) for evidence of improper arcing.
 - Measure the gap between the center electrode (4) and the side electrode (3) terminals. An excessively wide electrode gap can prevent correct spark plug operation.
 - Inspect for the correct spark plug torque. 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.
5. Inspect the spark plug recess area of the cylinder head for debris. Dirty or damaged threads can cause the spark plug not to seat correctly during installation.

Spark Plug Visual Inspection

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

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

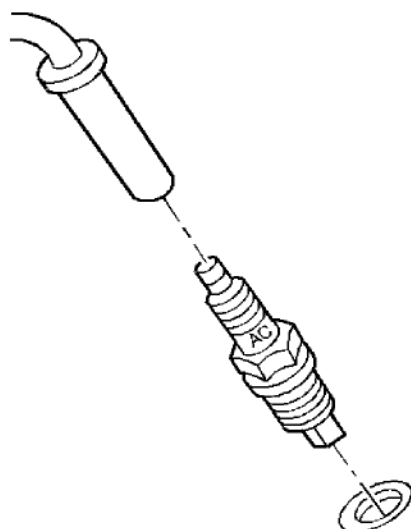
Spark Plug Replacement

Removal Procedure

Caution: Observe the following service precautions:

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

1. Turn OFF the ignition.



2. Remove the spark plug wires from the spark plugs. Refer to [Spark Plug Wire Replacement](#).
3. Remove the spark plugs from the engine.

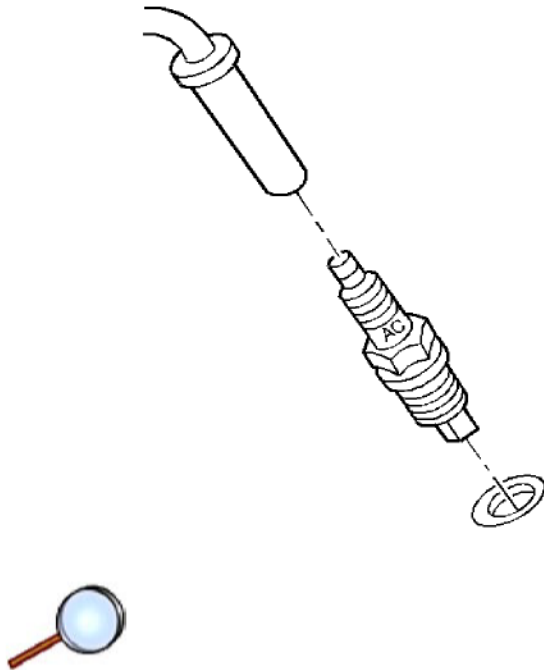
Installation Procedure

Caution: It is important to check the gap of all new and reconditioned spark plugs before installation. Pre-set gaps may have changed during handling. Use a round wire feeler gauge to be sure of an accurate check, particularly on used plugs. Installing plugs with the wrong gap can cause poor engine performance and may even damage the engine.

1. Gap the spark plugs to the specifications.

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



Caution: Be sure plug threads smoothly into cylinder head and is fully seated. Use a thread chaser if necessary to clean threads in cylinder head. Cross-threading or failing to fully seat spark plug can cause overheating of plug, exhaust blow-by, or thread damage. Follow the recommended torque specifications carefully. Over or under-tightening can also cause severe damage to engine or spark plug.

2. Install the spark plugs to the engine.

Tighten

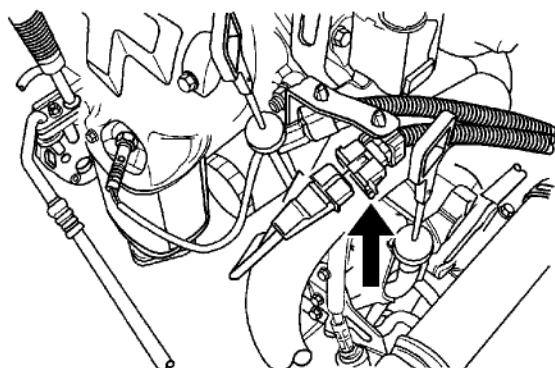
Tighten the spark plugs to 25 N·m (18 lb ft).

3. Install the spark plug wires to the spark plugs. Refer to [Spark Plug Wire Replacement](#).

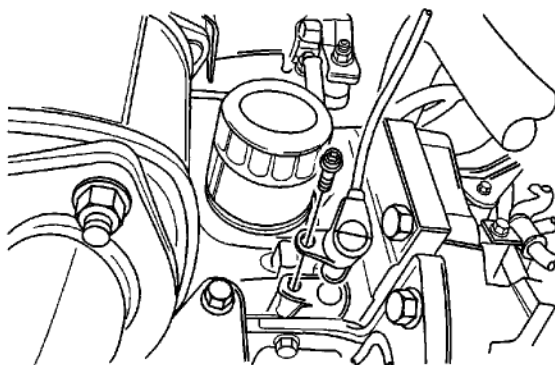
Crankshaft Position Sensor Replacement

Removal Procedure

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



1. Disconnect the negative battery cable.
2. Disconnect the crankshaft position (CKP) sensor electrical connector.



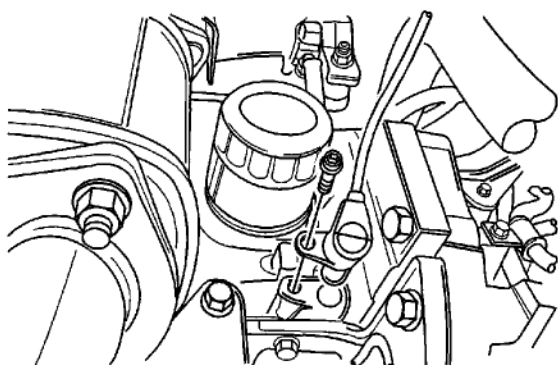
3. Remove the CKP sensor bolt.

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4. Remove the CKP sensor.

Installation Procedure

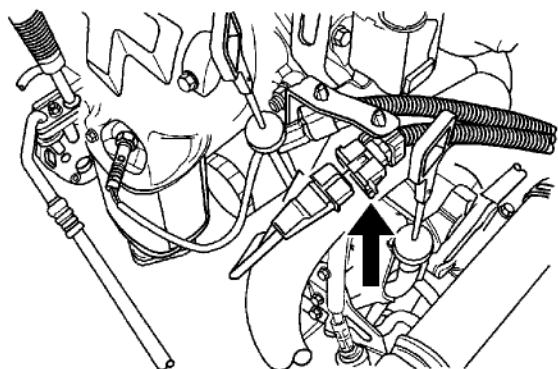
Caution: Refer to Fastener Caution in the Preface section.



1. Install the CKP sensor with the bolt.

Tighten

Tighten the CKP sensor bolt to 6.5 N·m (57 lb in).



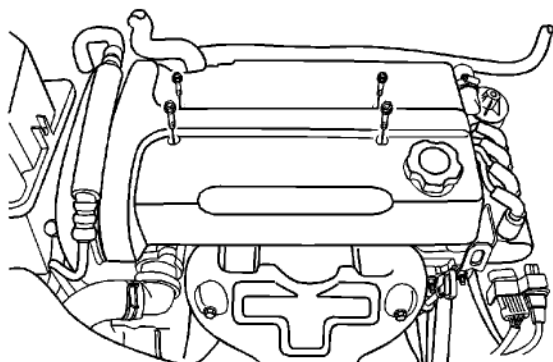


2. Connect the CKP sensor electrical connector.
3. Connect the negative battery cable.

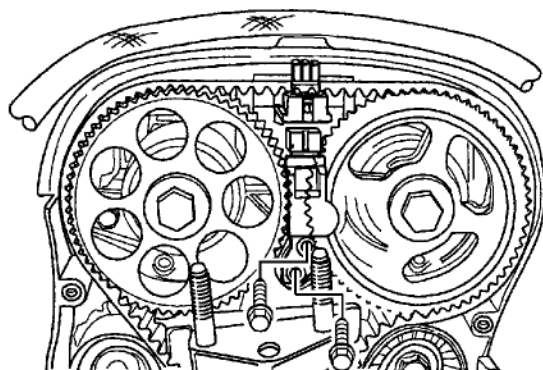
Camshaft Position Sensor Replacement

Removal Procedure

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



1. Disconnect the negative battery cable.
2. Remove the engine cover bolts and the nuts.
3. Remove the engine cover.

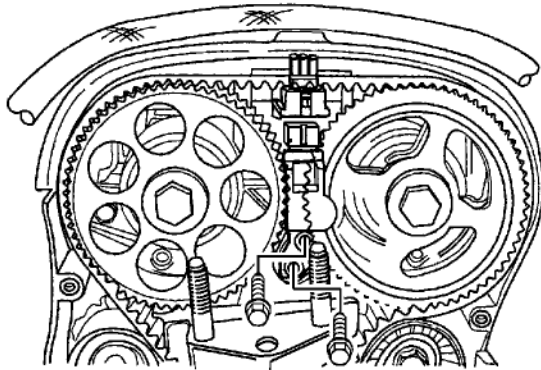


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4. Disconnect the camshaft position (CMP) sensor electrical connector.
5. Remove the timing belt front cover. Refer to [Timing Belt Cover Replacement](#).

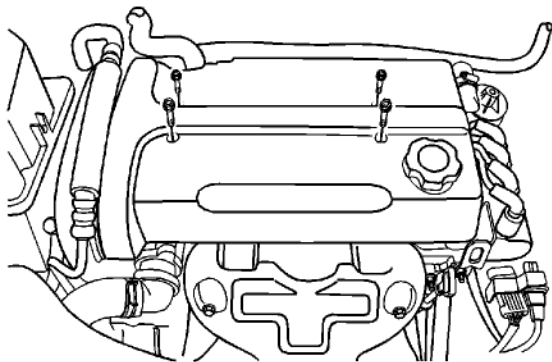
Installation Procedure

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



1. Install the CMP sensor and bolt.

Tighten the CMP sensor bolts to **7 N·m (62 lb in)**.



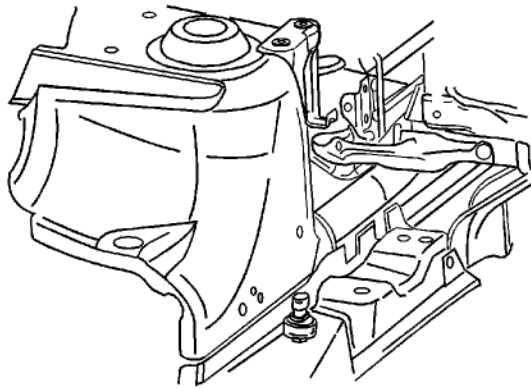


2. Install the timing belt front cover. Refer to [Timing Belt Cover Replacement](#).
3. Connect the CMP sensor electrical connector.
4. Install the engine cover.
5. Connect the negative battery cable.

Rough Road Sensor Replacement

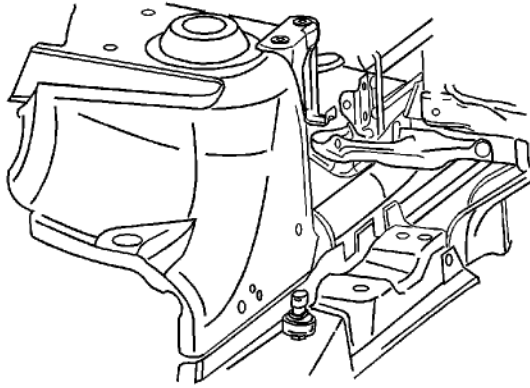
Removal Procedure

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



1. Disconnect the negative battery cable.
2. Disconnect the rough road sensor electrical connector and remove the rough road sensor.

Installation Procedure

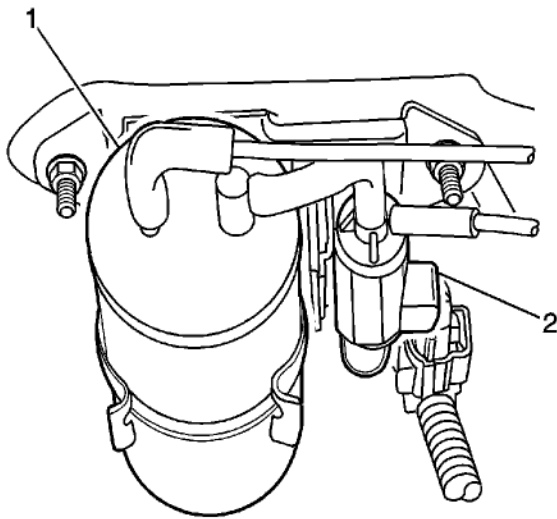


1. Install the rough road sensor and connect the electrical connector.
2. Connect the negative battery cable.

Intake Manifold Tuning Valve Actuator Solenoid Replacement

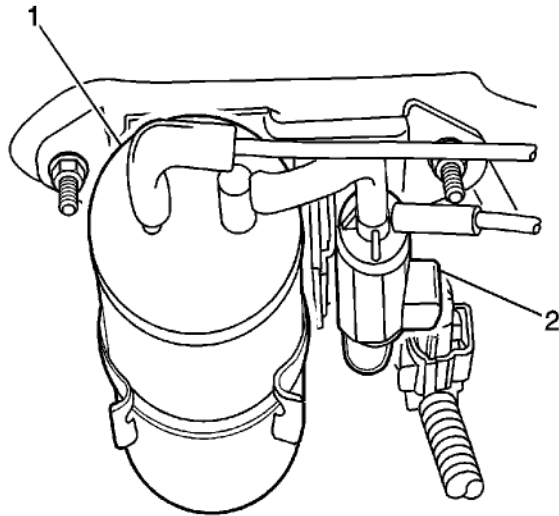
Removal Procedure

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



1. Disconnect the negative battery cable.
2. Disconnect the intake manifold tuning (IMT) valve solenoid (2) connector.
3. Disconnect the vacuum hoses from the IMT valve solenoid (2).
4. Remove the IMT valve solenoid (2).

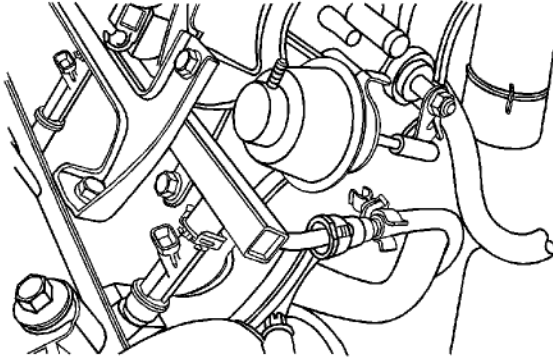
Installation Procedure



1. Install the IMT valve solenoid.
2. Connect the vacuum hoses to the IMT valve solenoid (2).
3. Connect the IMT valve solenoid (2) connector.
4. Connect the negative battery cable.

Intake Manifold Tuning Valve Actuator Replacement

Removal Procedure

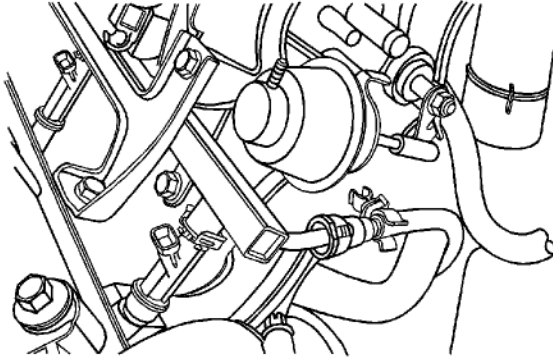


1. Disconnect the vacuum hose from the intake manifold tuning (IMT) valve actuator valve.

Note: Ensure the IMT valve is closed before removing the IMT valve actuator retaining bolts and valve.

2. Remove the IMT valve actuator valve bolts.
3. Remove the IMT valve actuator valve from the IMT valve.

Installation Procedure



1. Install the IMT valve actuator valve to the IMT valve.

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

2. Install the IMT valve actuator valve bolts.

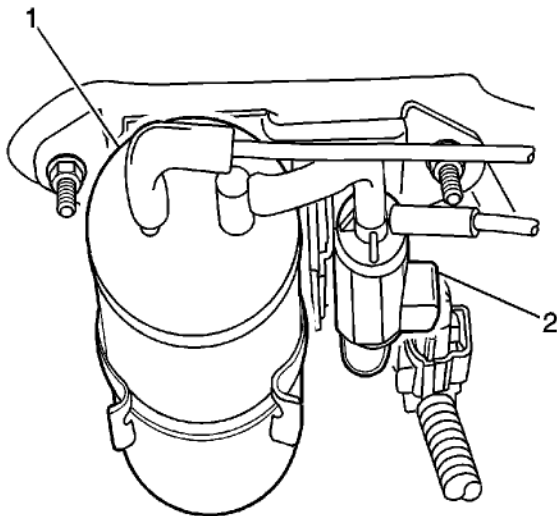
Tighten

Tighten the IMT valve actuator valve retaining bolts to 12 N·m (106 lb ft).

3. Connect the vacuum hose to the IMT valve actuator valve.

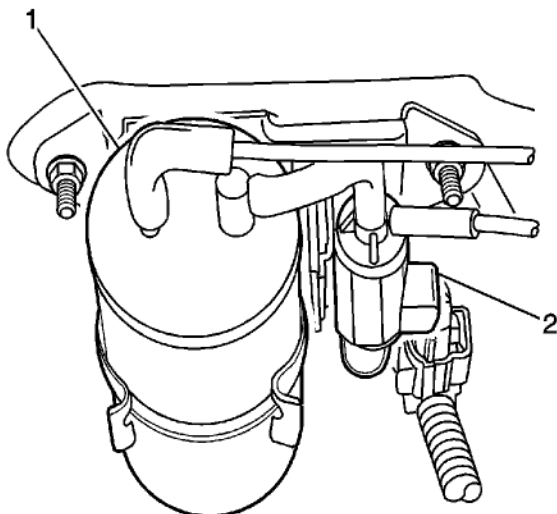
Intake Air Tuning Valve Vacuum Reservoir Replacement

Removal Procedure



1. Remove the vacuum hoses from the intake manifold (IMT) vacuum reservoir (1).
2. Remove the IMT valve reservoir (1).

Installation Procedure



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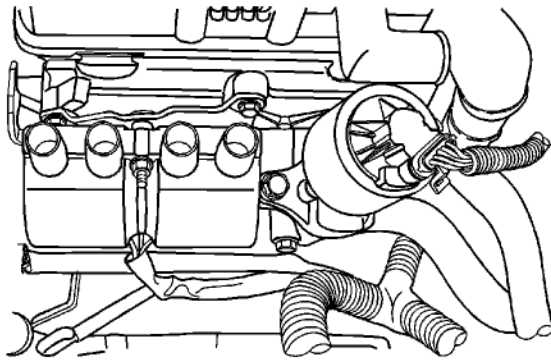


1. Install the IMT valve reservoir (1).
2. Install the vacuum hoses to the IMT valve reservoir (1).

Exhaust Gas Recirculation Valve Replacement

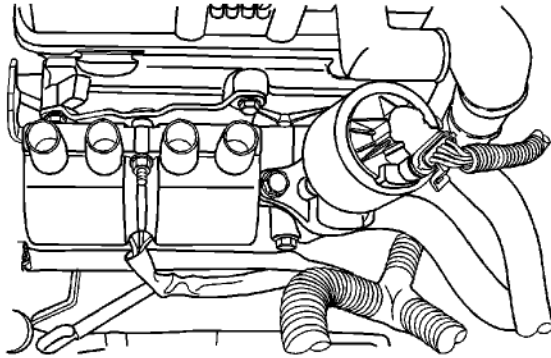
Removal Procedure

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



1. Disconnect the negative battery cable.
2. Disconnect the exhaust gas recirculation (EGR) valve electrical connector.
3. Remove the bolts and the EGR valve.

Installation Procedure



1. Clean the cylinder head mating surface.
2. Install a new EGR valve gasket.

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

3. Install the EGR valve with the retaining bolts.

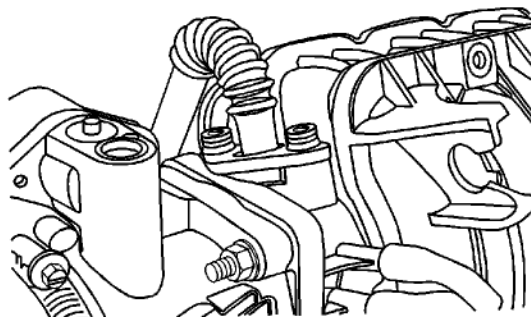
Tighten

Tighten the EGR valve retaining bolts to 30 N·m (22 lb ft).

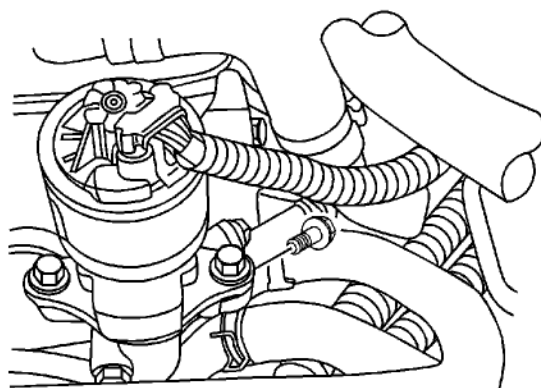
4. Connect the EGR valve electrical connector.
5. Connect the negative battery cable.

Exhaust Gas Recirculation Valve Pipe Replacement

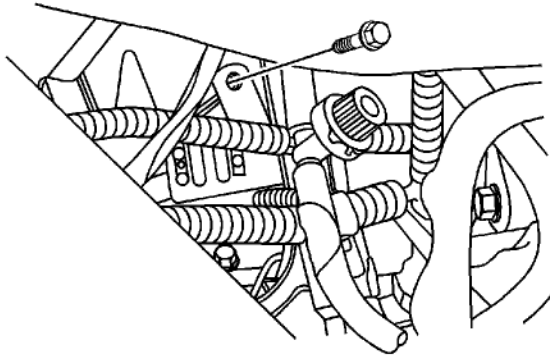
Removal Procedure



1. Remove the exhaust gas recirculation (EGR) pipe mounting bolts from the intake manifold.



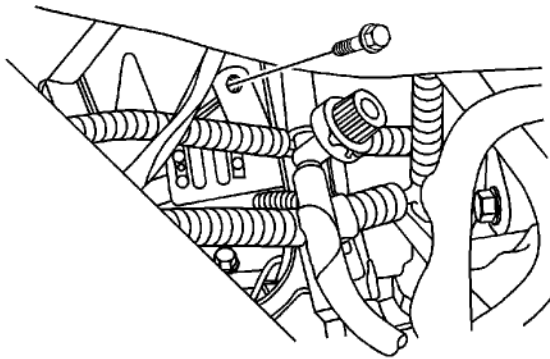
2. Remove the EGR pipe mounting bolts from the EGR valve.
3. Raise and suitably support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).



4. Remove the lower mounting bolt attaching the EGR pipe to the intake manifold.
5. Remove the EGR pipe.

Installation Procedure

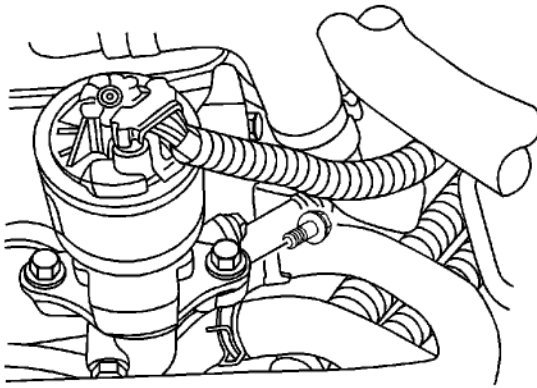
Caution: Refer to [Fastener Caution](#) in the Preface section.



1. Install the EGR pipe and the lower bolt attaching the EGR pipe to the intake manifold.

Tighten

Tighten the EGR pipe mounting bolt to 12 N·m (106 lb in).

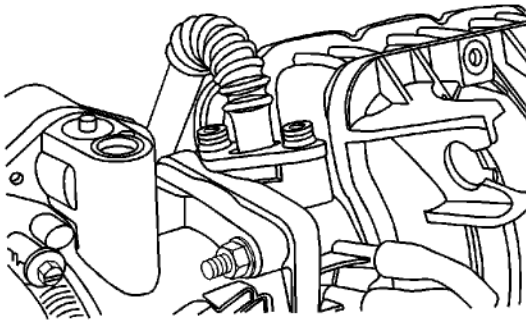


2. Install the EGR pipe mounting bolts to the EGR valve.

Tighten

Tighten the EGR pipe to EGR valve mounting bolts to 10 N·m (89 lb in).

3. Lower the vehicle.



4. Install the EGR pipe mounting bolts to the intake manifold.

Tighten

Tighten the EGR pipe to intake manifold mounting bolts to 12 N·m (106 lb in).

Air Cleaner Element Replacement

Removal Procedure

1. Loosen the air cleaner intake duct clamp at the air cleaner assembly.
2. Remove the air cleaner intake duct from the upper air cleaner cover.
3. Remove the upper air cleaner screws.
4. Remove the upper air cleaner cover from the lower air cleaner housing.
5. Remove the air cleaner filter from lower air cleaner housing.

Installation Procedure

1. Install the air cleaner filter into the lower air cleaner housing.
2. Install the upper air cleaner cover to lower air cleaner housing.

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

3. Install the upper air cleaner screws.

Tighten

Tighten the upper air cleaner cover screws to 3 N·m (27 lb in).

4. Install the intake duct to the upper air cleaner cover.

Tighten

Tighten the intake duct clamp to 3 N·m (27 lb in).