

2006 ENGINE**Engine Controls - 3.4L - Troubleshooting - Equinox & Torrent****SYMPTOMS - ENGINE CONTROLS****IMPORTANT PRELIMINARY INSPECTIONS BEFORE STARTING**

Before using the Symptom tables, perform the following:

- Perform **Diagnostic System Check - Vehicle** and verify all of the following items:
 - Ensure that the engine control module and malfunction indicator lamp (MIL) are operating correctly.
 - Ensure that there are no diagnostic trouble codes (DTCs) that are stored.
 - Scan tool data is within a normal operating range. Refer to **Scan Tool Data List** .
- Verify the customer concern.
- Perform the Visual/Physical Inspection in this section. The visual/physical inspection is extremely important, and can lead to correcting a condition without additional testing. It may also help reveal the cause of an intermittent condition.
- Locate the correct symptom. Perform the tests and inspections associated with the symptom.

IDENTIFYING INTERMITTENT CONDITIONS

Many intermittent conditions occur with harness or connector movement due to engine torque, rough pavement, vibration or physical movement of a component. Refer to the following for a list to help determine an intermittent condition:

- Moisture, and water intrusion in connectors, terminals, and components
- Connector mating
- Terminal contact
- High circuit or component resistance - High resistance can include any resistance, regardless of the amount, which can interrupt the operation of the component.
- Harness that is located too tight, or chaffed circuits
- High or low ambient temperature
- High or low engine coolant temperatures
- High underhood temperatures
- Heat build up in component or circuit due to circuit resistance, poor terminal contact, or high electrical load
- High or low system voltage
- High vehicle load conditions

- Rough road surface
- Electro-magnetic Interference (EMI)/circuit interference from relays, solenoids or other electrical surge
- Incorrect installation of non-factory, aftermarket, and after factory add on accessories

If an intermittent is determined, refer to **Testing for Intermittent Conditions and Poor Connections** for specific strategies in diagnosing intermittent conditions.

VISUAL/PHYSICAL CHECK

NOTE: Use the connector test adapter kit J 35616-A for any test that requires probing the following items:

- The PCM harness connectors
- The electrical center fuse/relay cavities
- The component terminals
- The component harness connector

Using this kit will prevent damage caused by the improper probing of connector terminals.

Several of the symptom procedures call for a careful visual and physical inspection. This can lead to correcting a condition without further tests and can save time. This inspection should include the following areas:

- Ensure that the control module grounds are clean, tight, and correctly located. Refer to **Master Electrical Component List** and **Power and Grounding Connector End Views** .
- Inspect vacuum hoses for splits, kinks, and proper connections, as shown on the Vehicle Emission Control Information label. Inspect thoroughly for any type of a leak or a restriction.
- Inspect for a dirty or restricted air filter.
- Inspect for water intrusion in the mass air flow/intake air temperature (MAF/IAT) sensor connector, heated oxygen sensor (HO2S) connectors, control module connectors or any other harness connectors.
- Inspect the air intake ducts, particularly between the MAF sensor and the throttle body for the following conditions:
 - Collapsed
 - Damaged areas
 - Looseness

- Incorrect installation
- Leaking
- Inspect for air leaks at the throttle body mounting area, the mass air flow (MAF) sensor and intake manifold sealing surfaces.
- Inspect the wiring harness for the following conditions:
 - poor connections
 - pinches
 - cuts
- Inspect for loose, damaged, unseated, or missing sensors/components.
- Inspect terminals for corrosion and correct contact.

SYMPTOMS

Hard Start

Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately stalls.

Surges/Chuggles

Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down without a change in the accelerator pedal position.

Lack of Power, Sluggishness, or Sponginess

The engine delivers less than expected power. Little increase in speed, or a total lack of acceleration when the accelerator pedal is pushed down part way.

Detonation/Spark Knock

A mild to severe ping which usually occurs worse while under acceleration. The engine makes sharp metallic knocks that change with throttle opening.

Hesitation, Sag, Stumble

Momentary lack of response as the accelerator is pushed down. This condition can occur at any vehicle speed. This condition is usually more pronounced when first trying to make the vehicle move, as from a stop sign. This condition may cause the engine to stall if severe enough.

Cuts Out, Misses

A steady pulsation or jerking that follows engine speed, which is usually more

pronounced as the engine load increases. This condition is not normally felt above 1,500 RPM or 48 km/h (30 mph). The exhaust has a steady spitting sound at idle or at low speed.

Poor Fuel Economy

Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, the fuel economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test.

Rough, Unstable, or Incorrect Idle and Stalling

The engine runs unevenly at idle. If severe, the engine or the vehicle may shake. Engine idle may vary in speed. Either condition may be severe enough to stall the engine.

Dieseling, Run-On

The engine continues to run after the key is turned OFF, but runs very rough. If the engine runs smooth, inspect the ignition switch and the ignition switch adjustment.

Backfire

Fuel ignites in the intake manifold or in the exhaust system, making a loud popping noise.

Use the following symptoms in order to isolate possible systems that are associated with the condition:

Symptoms

Symptoms	Action/System
Find the symptom in the left column and perform the test/inspection procedure in the right column.	
• Hard Start • Backfire	• <u>Symptoms - Ignition System</u> • <u>Symptoms - Fuel System</u> • <u>Symptoms - Sensors/Systems</u> • Engine Exhaust-Refer to <u>Symptoms - Engine Exhaust</u> . • Inspect the engine mechanical for oil consumption, correct engine compression and correct base engine timing-Refer to <u>Symptoms - Engine Mechanical</u> . • Backfire - inspect the intake and exhaust system and associated passages for casting flash.

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	• Inspect the engine cooling system for correct level and operation-Refer to <u>Symptoms - Engine Cooling</u> . • Inspect the engine electrical system for correct operation-Refer to <u>Charging System Test</u> .
Surges/Chuggles	• <u>Symptoms - Ignition System</u> • <u>Symptoms - Fuel System</u> • <u>Symptoms - Sensors/Systems</u> • Inspect the engine mechanical for oil consumption, correct engine compression and correct base engine timing-Refer to <u>Symptoms - Engine Mechanical</u> . • Inspect the engine electrical system for correct operation-Refer to <u>Charging System Test</u> . • Engine Exhaust-Refer to <u>Restricted Exhaust</u> . • Ensure the customer understands the operation of the Automatic Transmission including the Tap shift option if applicable. Inspect the automatic transmission for proper shifting and Torque Converter Clutch (TCC) engagement-Refer to <u>Symptoms - Automatic Transmission</u> . • HVAC System operation. Ensure the customer understands the operation of the HVAC system-Refer to the following: ○ <u>Air Conditioning (A/C) System Performance Test</u> ○ <u>Symptoms - HVAC Systems - Manual</u>
Lack of Power, Sluggishness, or Sponginess	• <u>Symptoms - Ignition System</u> • <u>Symptoms - Fuel System</u> • <u>Symptoms - Sensors/Systems</u> • Inspect for a restricted air intake system. • Inspect for a dirty or restricted air filter. • Inspect the engine mechanical for oil consumption, correct engine compression and correct base engine timing-Refer to <u>Symptoms - Engine Mechanical</u> . • Inspect the engine electrical system for correct operation-Refer to <u>Charging System Test</u> . • Engine Exhaust-Refer to <u>Restricted Exhaust</u> .

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	• Ensure the customer understands the operation of the Automatic Transmission including the Tap shift option if applicable. Inspect the automatic transmission for proper shifting and Torque Converter Clutch (TCC) engagement-Refer to Symptoms - Automatic Transmission . • Torque Management System, if applicable-Refer to <u>ABS Description and Operation</u> and <u>Symptoms - Antilock Brake System</u> . • HVAC System operation-Refer to the following: ◦ <u>Air Conditioning (A/C) System Performance Test</u> ◦ <u>Symptoms - HVAC Systems - Manual</u>
Hesitation, Sag, Stumble Cuts Out, Misses Rough, Unstable, or Incorrect Idle and Stalling	• <u>Symptoms - Ignition System</u> • <u>Symptoms - Fuel System</u> • <u>Symptoms - Sensors/Systems</u> • Inspect for a restricted air intake system. • Inspect for a dirty or restricted air filter. • Inspect the engine mechanical for oil consumption, correct engine compression and correct base engine timing-Refer to <u>Symptoms - Engine Mechanical</u> . • Inspect the engine electrical system for correct operation-Refer to <u>Charging System Test</u> . • Engine Cooling System-Refer to <u>Symptoms - Engine Cooling</u> . • Engine Exhaust-Refer to <u>Restricted Exhaust</u> . • Inspect the engine mounts. Refer to <u>Engine Mount Inspection</u> . • Inspect the crankcase ventilation system-Refer to <u>Crankcase Ventilation System Inspection/Diagnosis</u> . • Inspect the air intake system for leaks and unmetered air. • HVAC System operation-Refer to the following: ◦ <u>Air Conditioning (A/C) System Performance Test</u> ◦ <u>Symptoms - HVAC Systems - Manual</u>

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	• Inspect the automatic transmission for proper shifting and Torque Converter Clutch (TCC) engagement-Refer to Symptoms - Automatic Transmission . • Inspect the transmission range switch for proper operation. Refer to Range Selector Displays Incorrect Range . • Inspect the transmission mounts. Refer to Transmission Mount Inspection .
Detonation/Spark Knock	• Excessive heavy loads or review owner's driving habits-Consult the Vehicle Owner's Manual. • Ensure quality fuel is used-Consult the Vehicle Owner's Manual. • <u>Symptoms - Ignition System</u> • <u>Symptoms - Fuel System</u> • Inspect the engine mechanical for the following: ○ Oil consumption ○ Carbon build up or other hot point within the combustion chamber ○ Correct engine compression ○ Correct base engine timing Refer to <u>Symptoms - Engine Mechanical</u> . • Engine Cooling System-Refer to <u>Engine Overheating</u> . • Inspect the automatic transmission for proper shifting and Torque Converter Clutch (TCC) engagement-Refer to Symptoms - Automatic Transmission .
Poor Fuel Economy	• Proper tire inflation-Refer to Tires in Service and Appearance Care in the vehicle Owner's Manual. • Inspect for a dirty or restricted air filter. • Fuel Quality-Refer to the following: ○ <u>Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)</u><u>Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool)</u> ○ Fuel Service and Appearance Care in the vehicle Owner's Manual • <u>Symptoms - Ignition System</u> • <u>Symptoms - Fuel System</u>

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- **Symptoms - Sensors/Systems**

- Inspect the engine mechanical for oil consumption, correct engine compression and correct base engine timing-Refer to **Symptoms - Engine Mechanical** .
- Inspect the crankcase ventilation system-Refer to **Crankcase Ventilation System Inspection/Diagnosis** .
- Inspect the engine cooling system for correct level and operation-Refer to **Symptoms - Engine Cooling** .
- Engine Electrical System operation-Refer to **Charging System Test** .
- Engine Exhaust-Refer to **Symptoms - Engine Exhaust** .
- HVAC System operation. Ensure the customer understands the operation of the HVAC system-Refer to the following:
 - **Air Conditioning (A/C) System Performance Test**
 - **Symptoms - HVAC Systems - Manual**
- Ensure the customer understands the operation of the Automatic Transmission including the Tap shift option if applicable.

Inspect the automatic transmission for proper shifting and Torque Converter Clutch (TCC) engagement-Refer to **Symptoms - Automatic Transmission** .

- Inspect the Braking System-Refer to **Brakes Drag** .

Dieseling/Run-On

- **Symptoms - Ignition System**
- **Symptoms - Fuel System**

- Inspect the engine mechanical for the following:
 - Carbon build up or other hot point within the combustion chamber
 - Correct engine compression
 - Correct base engine timing

Refer to **Symptoms - Engine Mechanical** .

- Inspect the intake and exhaust system and associated

passages for casting flash.

SYMPTOMS - IGNITION SYSTEM

Ignition System

Symptoms	Ignition System
Find the symptom in the left column and perform the test/inspection procedure in the right column, be sure to review each cell of the table to identify all tests for a symptom.	
• Hard Start • Surges/Chuggles • Lack of Power, Sluggishness, or Sponginess • Detonation/Spark Knock • Hesitation, Sag, Stumble • Cuts Out, Misses • Poor Fuel Economy • Rough, Unstable, or Incorrect Idle and Stalling • Dieseling, Run-On • Backfire	• Inspect for proper Ignition System operation. Refer to <u>Electronic Ignition (EI) System Diagnosis</u>. • Inspect spark plugs and spark plug wires. Refer to <u>Spark Plug Wire Inspection</u> and <u>Spark Plug Inspection</u>. • Inspect the spark plugs for correct application. Refer to <u>Ignition System Specifications</u>.
• Hard Start • Surges/Chuggles • Lack of Power, Sluggishness, or Sponginess • Hesitation, Sag, Stumble • Cuts Out, Misses • Poor Fuel Economy • Rough, Unstable, or Incorrect Idle and Stalling • Backfire	Inspect the crankshaft position (CKP) sensor for the following: • CKP sensor for damage and proper installation. Refer to <u>Crankshaft Position (CKP) Sensor Replacement</u>. • Inspect the CKP Sensor and corresponding harness for electro-magnetic interference (EMI).

SYMPTOMS - FUEL SYSTEM

Fuel System

Symptoms	Fuel System
Find the symptom in the left column and perform the test/inspection procedure in the right column, be sure to review each cell of the table to identify all tests for a symptom.	
• Hard Start • Surges/Chuggles • Lack of Power, Sluggishness, or Sponginess • Detonation/Spark Knock • Hesitation, Sag, Stumble • Cuts Out, Misses • Poor Fuel Economy • Rough, Unstable, or Incorrect Idle and Stalling • Backfire	• Test the fuel system for correct operation, restriction, volume, and pressure. Refer to <u>Fuel Pump Electrical Circuit Diagnosis</u> and <u>Fuel System Diagnosis</u>. • Inspect for a contaminated fuel condition. Refer to <u>Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)</u> or <u>Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool)</u>. • Inspect the throttle body for coking. • Inspect for lean or rich conditions. Refer to P0171, P0172 conditions for running the DTC.
Dieseling/Run On	Test the fuel system for excessive fuel pressure. Refer to <u>Fuel System Diagnosis</u> .
• Hard Start • Surges/Chuggles • Lack of Power, Sluggishness, or Sponginess • Detonation/Spark Knock • Hesitation, Sag, Stumble • Cuts Out, Misses • Poor Fuel Economy • Rough, Unstable, or Incorrect Idle and Stalling • Dieseling, Run-On	Test for proper operation of the fuel injectors. Refer to the following diagnostics: • <u>Fuel Injector Balance Test with Special Tool</u>, OR • <u>Fuel Injector Balance Test with Tech 2</u>

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• Surges/Chuggles • Lack of Power, Sluggishness, or Sponginess • Hesitation, Sag, Stumble • Cuts Out, Misses • Rough, Unstable, or Incorrect Idle and Stalling	Inspect the EVAP system for the following: • (EVAP) System for excess fuel in the EVAP lines and/or in the EVAP canister. Refer to <u>Evaporative Emissions (EVAP) Hose Routing Diagram</u> . • EVAP system for integrity. Refer to System Testing in <u>DTC P0442</u> .
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SYMPTOMS - SENSORS/SYSTEMS

Sensor/System

Symptoms	Sensor/System
Find the symptom in the left column and perform the test/inspection procedure in the right column, be sure to review each cell of the table to identify all tests for a symptom.	
• Hard Start • Surges/Chuggles • Hesitation, Sag, Stumble • Cuts Out, Misses • Poor Fuel Economy • Rough, Unstable, or Incorrect Idle and Stalling • Backfire	• Inspect the mass air flow (MAF) sensor for proper installation, obstruction, contamination, and damage. • Inspect the MAF Sensor for proper seating of the connector and terminals. • Inspect the manifold absolute pressure (MAP) sensor for proper installation, obstruction, and damage. • Ensure the quality of the MAP Sensor vacuum source.
• Hard Start • Detonation/Spark Knock • Hesitation, Sag, Stumble • Poor Fuel Economy • Rough, Unstable, or Incorrect Idle and Stalling	• Inspect for vacuum leaks and other unmetered air. • Test the engine coolant temperature (ECT) sensor for being shifted in value. Refer to the <u>Temperature vs Resistance</u> .
• Surges/Chuggles	Monitor the Knock Sensor (KS) System for excessive spark retard activity. Refer to the Knock Sensor

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• Lack of Power, Sluggishness, or Sponginess • Detonation/Spark Knock • Poor Fuel Economy • Backfire	description within in the Electronic Ignition (EI) System Description .
Hesitation, Sag, Stumble	Inspect the accelerator pedal position (APP) sensor and the related wiring. Inspect the Throttle Actuator Control (TAC) System for proper operation.
• Surges/Chuggles • Lack of Power, Sluggishness, or Sponginess • Hesitation, Sag, Stumble • Cuts Out, Misses • Poor Fuel Economy • Rough, Unstable, or Incorrect Idle and Stalling • Backfire	Inspect for contaminated oxygen sensor (O2S).
Poor Fuel Economy	Inspect for proper operation of the speedometer.

MALFUNCTION INDICATOR LAMP (MIL) DIAGNOSIS

DIAGNOSTIC FAULT INFORMATION

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

CIRCUIT/SYSTEM DESCRIPTION

Ignition voltage is supplied to the malfunction indicator lamp (MIL). The engine control module (ECM) turns the MIL ON by grounding the MIL control circuit.

REFERENCE INFORMATION

Schematic Reference

Engine Controls Schematics

Connector End View Reference

- **Powertrain Control Module (PCM) Connector End Views**
- **Engine Controls Connector End Views**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

CIRCUIT/SYSTEM VERIFICATION

The MIL should turn ON and OFF when commanded with a scan tool.

CIRCUIT/SYSTEM TESTING

1. Turn OFF the ignition.
2. Disconnect the ECM.
3. Turn ON the ignition with the engine OFF.
 - If the MIL is still ON, test the MIL control circuit for a short to ground.
 - If the MIL control circuit tested OK and the MIL stayed ON, replace the instrument panel cluster (IPC).
 - If the MIL control circuit tested OK and the MIL went out when the ECM was disconnected, replace the ECM.
4. Measure for 12 volts from the MIL ignition voltage circuit in the ECM harness connector to a ground.
 - If there is less than 12 volts, test the MIL ignition voltage circuit for an open, or a short to ground and an open fuse.
5. Remove the fuse that supplies voltage to the MIL.
6. Measure for less than 1 volt from the MIL control circuit in the ECM harness connector to ground.
 - If there is more than 1 volt, test the MIL control circuit for a short to voltage.
7. Install the fuse that supplies voltage to the MIL.
8. The MIL should illuminate with a 3-amp fused jumper wire connected between the MIL control circuit in the ECM harness connector and a ground.

- If the MIL does not illuminate, test the MIL control circuit for an open or high resistance.
- If the MIL control circuit tests OK, replace the IPC.
- If the MIL does illuminate, but does not when commanded ON with a scan tool, replace the ECM.

REPAIR PROCEDURES

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Control Module References** for ECM replacement, setup and programming
- **Instrument Panel Cluster (IPC) Replacement**

ENGINE CRANKS BUT DOES NOT RUN

DIAGNOSTIC FAULT INFORMATION

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

CIRCUIT/SYSTEM DESCRIPTION

This Engine Cranks but Does Not Run is an organized approach to identify a condition which causes the engine to crank but not start. This diagnostic directs the technician to the appropriate system diagnosis.

This diagnostic assumes the system voltage levels are adequate for starter motor operation. Refer to **Battery Inspection/Test**, and **Engine Cranks Slowly**. Fuel level and fuel quality should be determined for correct diagnosis.

REFERENCE INFORMATION

Schematic Reference

Engine Controls Schematics

Connector End View Reference

- Powertrain Control Module (PCM) Connector End Views
- Engine Controls Connector End Views

Electrical Information Reference

- **Circuit Testing**

- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**

CIRCUIT/SYSTEM VERIFICATION

Attempt to start the engine. Engine should start and run.

CIRCUIT/SYSTEM TESTING

1. Crank the engine for up to 30 seconds.
2. Observe the Engine DTC information with a scan tool.
 - If any of the following DTCs are set refer to **Diagnostic Trouble Code (DTC) List - Vehicle** : P0201-P0206, P0335, P0336, P0351-P0353, P0601, p0602, P0604, P0685, P1516, P2610
3. Observe the engine speed parameter while cranking the engine.
 - If engine RPM is not indicated, refer to **Electronic Ignition (EI) System Diagnosis**.
4. Install a spark tester.
5. Crank the engine for 15 seconds. Spark should be observed from the Spark Tester.
 - If spark is not observed refer to **Electronic Ignition (EI) System Diagnosis**.
6. With the ignition ON and the engine OFF, test the fuses that are supplied by the powertrain relay for voltage. The test lamp should illuminate at each test point for the following fuses:
 - Emission Fuse
 - Ignition 1 Fuse
 - If the test lamp does not illuminate on at least one side of each fuse refer to **DTC P0685** .

IMPORTANT: Additional DTCs may set when using the fuel pump output control.

7. Command the fuel pump ON and OFF. Fuel pump should energize when commanded ON and De-energize when commanded OFF
 - If the fuel pump does not respond refer to **Fuel Pump Electrical Circuit Diagnosis**.

8. Turn OFF the ignition.
9. Install the **J 34730-1A** Fuel Pressure Gage. See **Special Tools** . Turn ON the ignition and command the fuel pump ON while observing the **J 34730-1A** . See **Special Tools** . The fuel pressure should be between 380-410 kPa (55-60 psi).
 - If the fuel pressure is not within 380-410 kPa (55-60 psi) refer to **Fuel System Diagnosis**.
10. Inspect for the following conditions:
 - Compare the actual engine coolant temperature to the ECT parameter. Refer to DTC P0125.
 - Air filter and air intake system for restrictions and obstructions
 - Test the fuel for contamination. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** or **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool)**.
 - Inspect the spark plug and spark plug wires. Refer to **Spark Plug Wire Inspection** and **Spark Plug Inspection** .
 - Test the exhaust system for restrictions. Refer to **Restricted Exhaust** .

REPAIR PROCEDURES

IMPORTANT: Always perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

IGNITION RELAY DIAGNOSIS

CIRCUIT DESCRIPTION

The ignition relay is normally an open relay. The relay armature is held in the open position by spring tension. When the ignition switch is turned to the Run or Start position, current will flow through the relay coil. A wire connected to the other end of the relay coil completes the path to ground. The electromagnetic field created by the relay coil overcomes the spring tension and moves the armature, allowing the relay contacts to close. The closed relay contacts allow current to flow from the battery to the following fuses:

- The Eng Controls fuse
- The Fuel INJ fuse
- The Elec Eng fuse
- The O2 Sensors fuse
- The Trans Sol fuse
- The ABS fuse
- The AWD fuse

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When the ignition switch is turned to the OFF position, the electromagnetic field collapses. This action allows the spring tension to move the armature away from the relay contacts, which interrupts current flow to the fuses.

If the ignition relay fails to close, the engine will crank but will not run. The class 2 communications will be available with the use of a scan tool.

The ignition relay table assumes that the vehicle battery is fully charged. Refer to **Battery Inspection/Test** in Engine Electrical.

Ignition Relay Diagnosis

Step	Action	Yes	No
Schematic Reference: Ground Distribution Schematics and Power Distribution Schematics in Wiring Systems, and Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information
2	1. Turn ON the ignition, with the engine OFF. 2. Remove the underhood junction block cover. 3. Probe the following fuses with a test lamp that is connected to a good ground. • The Eng Controls fuse • The Fuel INJ fuse • The Elec Eng fuse • The O2 Sensors fuse • The Trans Sol fuse • The ABS fuse • The AWD fuse Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp in Wiring Systems.		

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	Does the test lamp illuminate on at least one test point of each fuse?	Go to Step 3	Go to Step 11
3	1. Turn OFF the ignition. 2. Probe both test points of the Fuel INJ fuse with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp in Wiring Systems. Does the test lamp illuminate on either test point of the fuse?	Go to Step 4	Go to Step 43
4	1. Turn OFF the ignition. 2. Remove the ignition relay from the underhood junction block with the J 43244 Relay Puller Pliers and Relay Replacement (Within an Electrical Center) or Relay Replacement (Attached to Wire Harness) in Wiring Systems. 3. Probe both test points of the 10-amp IGN 1 fuse in the underhood junction block with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp in Wiring Systems. Does the test lamp illuminate on any of the fuse test points?	Go to Step 7	Go to Step 5
5	Test the ignition relay load circuit bus bar of the underhood junction block between the ignition relay and the fuses to the circuit components for a short to battery positive voltage. Refer to Circuit Testing in Wiring Systems. Did you find and correct the condition?	Go to Step 42	Go to Step 6
	1. Turn OFF the ignition. 2. Remove the following fuses from the underhood junction block: • The Eng Controls fuse		

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6	• The Fuel INJ fuse • The Elec Eng fuse • The O2 Sensors fuse • The Trans Sol fuse • The ABS fuse • The AWD fuse 3. Probe all these fuse terminals in the underhood junction block with a test lamp that is connected to a good ground. Refer to <u>Probing Electrical Connectors and Troubleshooting with a Test Lamp</u> in Wiring Systems. Does the test lamp illuminate at any of the fuse terminals?	Go to <u>Diagnostic System Check - Vehicle in Vehicle DTC Information</u>	Go to Step 39
7	1. Turn OFF the ignition. 2. Disconnect the ignition switch electrical connector. 3. Connect a 20-amp fused jumper wire from the battery positive voltage wire terminal at the ignition switch harness connector to the battery positive voltage terminal at the ignition switch. Refer to <u>Using Fused Jumper Wires</u> in Wiring Systems. 4. Probe the ignition 1 voltage terminal of the ignition switch with a test lamp that is connected to a good ground. Refer to <u>Probing Electrical Connectors and Troubleshooting with a Test Lamp</u> in Wiring Systems. Does the test lamp illuminate?	Go to Step 40	Go to Step 8
	1. Turn OFF the ignition. 2. Disconnect the negative battery cable at the battery. Refer to <u>Battery Negative Cable Disconnect/Connect Procedure</u> in Engine Electrical. 3. Disconnect the console junction block electrical connector that contains the		

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8	ignition 1 voltage circuit from the ignition switch. - Connect the negative battery cable to the battery. - Probe the ignition 1 voltage circuit between the ignition switch and the console junction block at the console junction block electrical connector with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp in Wiring Systems Does the test lamp illuminate?	Go to Step 35	Go to Step 9
9	- Turn OFF the ignition. - Disconnect the negative battery cable at the battery. Refer to Battery Negative Cable Disconnect/Connect Procedure in Engine Electrical. - Disconnect the underhood junction block electrical connector that contains the ignition 1 voltage circuit for the ignition relay. - Connect the negative battery cable to the battery. - Probe the ignition 1 voltage circuit of the ignition relay at the underhood junction block electrical connector with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp in Wiring Systems Does the test lamp illuminate?	Go to Step 38	Go to Step 10
10	Test the ignition 1 voltage bus bar circuit for the ignition relay in the console junction block for a short to battery positive voltage. Refer to Circuit Testing in Wiring Systems. Did you find a condition?	Go to Step 41	Go to Step 42
	- Turn OFF the ignition. - Probe both test points of the 20-amp		

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11	IGN 3 fuse in the underhood junction block with a test lamp that is connected to a good ground. Refer to <u>Probing Electrical Connectors</u> and <u>Troubleshooting with a Test Lamp</u> in Wiring Systems. Does the test lamp illuminate on both test points of the fuse?	Go to Step 19	Go to Step 12
12	Does the test lamp illuminate on one test point of the 20-amp IGN 3 fuse?	Go to Step 13	Go to Step 28
13	Test the battery positive voltage circuit between the underhood junction block and the ignition switch for a short to ground. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 43	Go to Step 14
14	Test the ignition 1 voltage circuit between the ignition switch and the console junction block for a short to ground. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 43	Go to Step 15
15	Test the ignition 1 voltage circuit between the console junction block and the underhood junction block for a short to ground. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 43	Go to Step 16
16	Test the ignition 1 voltage bus bar circuit of the console junction block between the ignition switch and the underhood junction block for a short to ground. Refer to <u>Circuit Testing</u> in Wiring Systems. Did you find a condition?	Go to Step 41	Go to Step 17
17	Test the ignition 1 voltage bus bar circuit of the underhood junction block up to the 10-amp IGN 1 fuse for a short to ground. Refer to <u>Circuit Testing</u> in Wiring Systems. Did you find a condition?	Go to Step 42	Go to Step 18
18	Test the battery positive voltage bus bar circuit of the underhood junction block from the 20-amp IGN 3 fuse for a short to ground.		

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	Refer to Circuit Testing in Wiring Systems. Did you find a condition?	Go to Step 42	Go to Step 40
19	1. Turn ON the ignition, with the engine OFF. 2. Probe both test points of the 10-amp IGN 1 fuse in the underhood junction block with a test lamp that is connected to a good ground. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Does the test lamp illuminate on both test points of the fuse?	Go to Step 29	Go to Step 20
20	Does the test lamp illuminate on one test point of the 10-amp IGN 1 fuse?	Go to Step 27	Go to Step 21
21	1. Turn ON the ignition, with the engine OFF. 2. Probe the ignition 1 voltage circuit at the ignition switch electrical connector with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp in Wiring Systems. Does the test lamp illuminate?	Go to Step 24	Go to Step 22
22	Test the battery positive voltage circuit between the underhood junction block and the ignition switch for a high resistance or an open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct a condition?	Go to Step 43	Go to Step 23
23	1. Turn OFF the ignition. 2. Probe the mounting stud for the battery positive cable at the underhood junction block with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp in Wiring Systems. Does the test lamp illuminate?	Go to Step 40	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information

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24	1. Turn ON the ignition, with the engine OFF. 2. Probe the ignition 1 voltage circuit for the ignition relay at the console junction block electrical connector that leads from the ignition switch with a test lamp that is connected to a good ground. Refer to <u>Probing Electrical Connectors</u> and <u>Troubleshooting with a Test Lamp</u> in Wiring Systems.		
	Does the test lamp illuminate?	Go to Step 25	Go to Step 36
25	1. Turn ON the ignition, with the engine OFF. 2. Probe the ignition 1 voltage circuit for the ignition relay at the console junction block electrical connector that leads to the underhood junction block with a test lamp that is connected to a good ground. Refer to <u>Probing Electrical Connectors</u> and <u>Troubleshooting with a Test Lamp</u> in Wiring Systems.		
	Does the test lamp illuminate?	Go to Step 26	Go to Step 41
26	1. Turn OFF the ignition. 2. Disconnect the negative battery cable at the battery. Refer to <u>Battery Negative Cable Disconnect/Connect Procedure</u> in Engine Electrical. 3. Disconnect the underhood junction block electrical connector that contains the ignition 1 voltage circuit for the ignition relay. 4. Connect the negative battery cable at the battery. 5. Turn ON the ignition, with the engine OFF. 6. Probe the ignition 1 voltage circuit at the underhood junction block electrical connector with a test lamp that is		

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	connected to a good ground. Refer to <u>Probing Electrical Connectors</u> and <u>Troubleshooting with a Test Lamp</u> in Wiring Systems.		
	Does the test lamp illuminate?	Go to Step 42	Go to Step 37
27	Test the ignition 1 voltage bus bar circuit of the underhood junction block between the 10-amp IGN 1 fuse and the ignition relay for a short to ground. Refer to <u>Circuit Testing</u> in Wiring Systems. Did you find a condition?	Go to Step 42	Go to Step 39
28	1. Turn OFF the ignition. 2. Probe the mounting stud for the battery positive cable at the underhood junction block with a test lamp that is connected to a good ground. Refer to <u>Probing Electrical Connectors</u> and <u>Troubleshooting with a Test Lamp</u> in Wiring Systems. Does the test lamp illuminate?	Go to Step 42	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information
29	1. Turn OFF the ignition. 2. Remove the ignition relay with the J 43244 from the underhood junction block. 3. Probe the battery positive voltage circuit of the ignition relay at the underhood junction block with a test lamp that is connected to a good ground. Refer to <u>Probing Electrical Connectors</u> and <u>Troubleshooting with a Test Lamp</u> in Wiring Systems. Does the test lamp illuminate?	Go to Step 30	Go to Step 42
30	1. Turn ON the ignition, with the engine OFF. 2. Probe the ignition 1 voltage circuit of the ignition relay at the underhood junction block with a test lamp that is connected to a good ground. Refer to <u>Probing Electrical Connectors</u> and		

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<u>Troubleshooting with a Test Lamp</u> in Wiring Systems.			
	Does the test lamp illuminate?	Go to Step 31	Go to Step 42
31	1. Turn ON the ignition, with the engine OFF. 2. Probe the coil ground circuit of the ignition relay at the underhood junction block with a test lamp that is connected to battery voltage. Refer to <u>Probing Electrical Connectors</u> and <u>Troubleshooting with a Test Lamp</u> in Wiring Systems.		
	Does the test lamp illuminate?	Go to Step 33	Go to Step 32
32	1. Turn OFF the ignition. 2. Disconnect the negative battery cable at the battery. Refer to <u>Battery Negative Cable Disconnect/Connect Procedure</u> in Engine Electrical. 3. Disconnect the underhood junction block electrical connectors. 4. Test the coil ground circuit wire of the ignition relay at the underhood junction block electrical connector for a high resistance or an open. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems.		
	Did you find and correct the condition?	Go to Step 43	Go to Step 42
	1. Turn OFF the ignition. 2. Jumper the ignition relay battery positive voltage circuit and the ignition relay load circuit together at the underhood junction block with a 20-amp fused jumper wire. Refer to <u>Using Fused Jumper Wires</u> in Wiring Systems. 3. Probe the following fuses with a test lamp that is connected to a good ground:		

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33	• The Eng Controls fuse • The Fuel INJ fuse • The O2 Sensors fuse • The Trans Sol fuse • The ABS fuse • The AWD fuse Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp in Wiring Systems. Does the test lamp illuminate on at least one test point of each fuse?	Go to Step 34	Go to Step 42
34	Test for an intermittent and for a poor connection at the underhood junction block, ignition relay connector location. Refer to Testing for Intermittent Conditions and Poor Connections in Wiring Systems. Did you find a condition?	Go to Step 42	Go to Step 39
35	Repair the short to battery positive voltage in the ignition 1 voltage circuit between the ignition switch and the console junction block. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 43	-
36	Repair the high resistance or an open in the ignition 1 voltage circuit between the console junction block and the ignition switch. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 43	-
37	Repair the high resistance or an open in the ignition 1 voltage circuit between the console junction block and the underhood junction block. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 43	-
38	Repair the short to battery positive voltage in the ignition 1 voltage circuit between the console junction block and the underhood junction block electrical connector. Refer to		

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	Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 43	-
39	Replace the ignition relay. Refer to Circuit Protection - Fusible Links in Wiring Systems. Did you complete the replacement?	Go to Step 43	-
40	Replace the ignition switch. Refer to Ignition Switch Replacement in Steering Wheel and Column. Did you complete the replacement?	Go to Step 43	-
41	Replace the console junction block. Refer to Instrument Panel Electrical Center or Junction Block Replacement in Wiring Systems. Did you complete the replacement?	Go to Step 43	-
42	Replace the underhood junction center. Refer to Testing for Intermittent Conditions and Poor Connections in Wiring Systems. Did you complete the replacement?	Go to Step 43	-
43	1. Replace any open fuses. 2. Turn OFF the ignition for 30 seconds. 3. Attempt to start the engine. Does the engine start and run?	Go to Step 44	Go to Engine Cranks but Does Not Run
44	1. Clear the DTCs with a scan tool. 2. Operate the vehicle for 5 minutes. Does a DTC set during this ignition cycle?	Go to Diagnostic Trouble Code (DTC) List - Vehicle in Vehicle DTC Information	System OK

FUEL PUMP ELECTRICAL CIRCUIT DIAGNOSIS

CIRCUIT DESCRIPTION

When the ignition is turned ON, the powertrain control module (PCM) supplies battery voltage to the fuel pump relay, which turns ON the in-tank fuel pump. The in-tank fuel pump remains ON as long as the engine is cranking or running and the PCM is receiving reference pulses. If there are no reference pulses, the PCM turns the in-tank fuel pump OFF 2 seconds after the ignition is turned ON or 2 seconds after the PCM no longer receives reference pulses.

DIAGNOSTIC AIDS

- Inspect the ground connection for the fuel pump. Ensure all ground connections are clean and tight.
- The following conditions may have caused the fuel pump fuse to open:
 - The fuse is faulty.
 - There is an intermittent short in the fuel pump power supply circuit.
 - The fuel pump has an intermittent internal problem.
- For an intermittent condition, refer to **Testing for Intermittent Conditions and Poor Connections**.

TEST DESCRIPTION

The numbers below refer to the step numbers on the diagnostic table.

3: This step determines if the condition is located on the coil side or the switch side of the circuit.

4: This step verifies that the PCM is providing voltage to the fuel pump relay.

5: This step tests for an open in the ground circuit to the fuel pump relay.

6: This step determines if a voltage is constantly being applied to the fuel pump relay.

13: This step determines if the condition with the circuit is intermittent. If the fuse does not open, inspect the supply voltage circuit between the fuse and the fuel pump for an intermittent condition.

Fuel Pump Electrical Diagnosis

Step	Action	Yes	No
Schematic Reference: <u>Engine Controls Schematics</u> Connector End View Reference: <u>Electrical Center Identification Views</u> in Wiring Systems, <u>Engine Controls Component Views</u>, or <u>Powertrain Control Module (PCM) Connector End Views</u>			
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information
2	1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump relay ON and OFF with a scan tool.	Go to Diagnostic	

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	Does the fuel pump turn ON and OFF?	Aids	Go to Step 3
3	Command the fuel pump relay ON and OFF with a scan tool. Do you hear a click when you command the fuel pump relay ON and OFF?	Go to Step 9	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the control circuit of the fuel pump relay with a test lamp that is connected to a good ground. 5. Command the fuel pump relay ON and OFF with a scan tool. Does the test lamp turn ON and OFF?	Go to Step 5	Go to Step 6
5	1. Connect a test lamp between the control circuit of the fuel pump relay and the ground circuit of the fuel pump relay. 2. Command the fuel pump relay ON and OFF with a scan tool. Does the test lamp turn ON and OFF?	Go to Step 19	Go to Step 22
6	Does the test lamp remain illuminated with each command?	Go to Step 7	Go to Step 8
7	Test the control circuit of the fuel pump relay for a short to voltage. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 27	Go to Step 26
8	Test the control circuit of the fuel pump relay for a short to ground or an open. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 27	Go to Step 20
9	Turn ON the ignition, with the engine OFF. Does the fuel pump operate continuously?	Go to Step 10	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the fuel pump relay. 3. Turn ON the ignition, with the engine		

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	OFF.		
	Does the fuel pump operate continuously?	Go to Step 21	Go to Step 25
11	Is the fuel pump fuse open?	Go to Step 12	Go to Step 14
12	1. Disconnect the fuel pump harness in-line connector located near the fuel tank. 2. Test the supply voltage circuit of the fuel pump for a grounded circuit between the fuel pump fuse and the fuel pump harness in-line connector. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. 3. Replace the fuel pump fuse.		
	Did you find and correct the condition?	Go to Step 27	Go to Step 13
13	1. Install the disconnected fuel pump harness in-line connector. 2. Turn ON the ignition, with the engine OFF 3. Command the fuel pump relay ON with a scan tool. 4. Inspect the fuel pump fuse.		Go to Testing for Intermittent Conditions and Poor Connections
	Is the fuel pump fuse open?	Go to Step 24	
14	1. Turn OFF the ignition. 2. Disconnect the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery voltage circuit of the fuel pump relay switch with a test lamp that is connected to a good ground.		
	Does the test lamp illuminate?	Go to Step 15	Go to Step 23
15	Connect a 10-amp fused jumper wire between the battery voltage circuit of the fuel pump relay switch and the supply voltage circuit of the fuel pump. Does the fuel pump operate?	Go to Step 19	Go to Step 16
	Test the supply voltage circuit of the fuel pump for an open or high resistance between the fuel pump relay and the fuel pump. Refer		

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16	to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 27	Go to Step 17
17	IMPORTANT: Inspect the ground circuit for being tight, corrosion on terminals, or damage to the wiring harness. Test the ground circuit of the fuel pump for an open or high resistance. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 27	Go to Step 18
18	Inspect for poor connections at the fuel pump. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 27	Go to Step 24
19	Inspect for poor connections at the fuel pump relay. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 27	Go to Step 25
20	Inspect for poor connections at the harness connector of the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 27	Go to Step 26
21	Repair the supply voltage circuit of the fuel pump for a short to voltage. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 27	-
22	Repair the open fuel pump relay ground circuit. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 27	-
23	Repair the battery voltage circuit of the fuel pump relay switch. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	Go to Step 27	-
	IMPORTANT: Inspect for poor connections at the fuel pump,		

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24	within the fuel tank, before replacing the fuel pump.		
	1. Replace the fuel pump. Refer to Fuel Tank Module Replacement - Primary . 2. Replace the fuel pump fuse if necessary.		
	Did you complete the replacement?	Go to Step 27	-
25	Replace the fuel pump relay. Did you complete the replacement?	Go to Step 27	-
26	Replace the PCM. Refer to Control Module References .		
	Did you complete the replacement?	Go to Step 27	-
27	Operate the system in order to verify the repair.		
	Did you correct the condition?	System OK	Go to Step 2

FUEL SYSTEM DIAGNOSIS

SYSTEM DESCRIPTION

The control module enables the fuel pump relay when the ignition switch is turned ON. The control module will disable the fuel pump relay within 2 seconds unless the control module detects ignition reference pulses. The control module continues to enable the fuel pump relay as long as ignition reference pulses are detected. The control module disables the fuel pump relay within 2 seconds if ignition reference pulses cease to be detected and the ignition remains ON.

The fuel system is a returnless on-demand design. The fuel pressure regulator is a part of the primary fuel tank module, eliminating the need for a return pipe from the engine. A returnless fuel system reduces the internal temperature of the fuel tank by not returning hot fuel from the engine to the fuel tank. Reducing the internal temperature of the fuel tank results in lower evaporative emissions.

An electric turbine style fuel pump attaches to the primary fuel tank module inside the fuel tank. The fuel pump supplies high pressure fuel through the fuel filter, past the fuel pressure regulator, and through the fuel feed pipe to the fuel injection system. The fuel pressure regulator has a T-joint that diverts the needed fuel to the fuel rail with the unused fuel dropping back into the reservoir of the primary fuel tank module. The primary fuel tank module contains a reverse flow check valve. The check valve and the fuel pressure regulator maintain fuel pressure in the fuel feed pipe and the fuel rail in order to prevent long cranking times.

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The primary fuel tank module also contains a primary jet pump and a secondary jet pump. Fuel pump flow loss, caused by vapor expulsion in the pump inlet chamber, is diverted to the primary jet pump and the secondary jet pump through a restrictive orifice located on the pump cover. The primary jet pump fills the reservoir of the primary fuel tank module. The secondary jet pump creates a venturi action which causes the fuel to be drawn from the secondary side of the fuel tank, through the fuel transfer pipe, to the primary side of the fuel tank.

Fuel System Diagnosis

Step	Action	Values	Yes	No
Schematic Reference: <u>Engine Controls Schematics</u>				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
2	IMPORTANT: Inspect the fuel system for damage or external leaks before proceeding with this diagnostic. 1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump relay ON with a scan tool. Does the fuel pump operate?	-	Go to Step 3	Go to <u>Fuel Pump Electrical Circuit Diagnosis</u>
3	IMPORTANT: Verify that adequate fuel is in the fuel tank before proceeding with this diagnostic. 1. Turn OFF the ignition. 2. Turn OFF all accessories. 3. Install a fuel pressure gage. Refer to <u>Fuel Pressure Gage Installation and Removal</u> . 4. Turn ON the ignition, with the engine OFF. IMPORTANT: • The fuel pump relay may need	384-425 kPa (50-60 psi)		

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	to be commanded ON a few times in order to obtain the highest possible fuel pressure. DO NOT start the engine.			
	5. Command the fuel pump relay ON with a scan tool. 6. Observe the fuel pressure gage with the fuel pump commanded ON.			
	Is the fuel pressure within the specified range?		Go to Step 4	Go to Step 8
4	IMPORTANT: The fuel pressure may vary slightly when the fuel pump stops operating. After the fuel pump stops operating, the fuel pressure should stabilize and remain constant. Observe the fuel pressure gage for 1 minute. Does the fuel pressure decrease by more than the specified value?	34 kPa (5 psi)	Go to Step 7	Go to Step 5
5	1. Relieve the fuel pressure to the first specified value. 2. Observe the fuel pressure gage for 5 minutes. Does the fuel pressure decrease by more than the second specified value?	69 kPa (10 psi) 14 kPa (2 psi)	Go to Step 12	Go to Step 6
6	1. Operate the vehicle within the conditions to reproduce the original symptoms. 2. Observe the O2 and the Fuel Trim parameters with a scan tool. Does the scan tool parameters indicate a lean condition?	-	Go to Step 9	Go to Symptoms - Engine Controls
	1. Turn OFF the ignition. 2. Relieve the fuel pressure. Refer to Fuel Pressure Relief Procedure. 3. Disconnect the chassis fuel hose from the engine compartment fuel			

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	pipe. Refer to Quick Connect Fitting(s) Service (Metal Collar) . 4. Install the J 37287 Fuel Line Shut-off Adapter between the chassis fuel hose and the engine compartment fuel pipe. See Special Tools . 5. Open the valve on the fuel pipe shut-off adapter. 6. Turn ON the ignition, with the engine OFF.			
7	7. Command the fuel pump relay ON with a scan tool. 8. Bleed the air from the fuel pressure gage. 9. Command the fuel pump relay ON and then OFF with a scan tool. 10. Close the fuel feed pipe shut-off valve. 11. Observe the fuel pressure gage for 1 minute. Does the fuel pressure remain constant?	-	Go to Step 12	Go to Step 11
8	Is the fuel pressure more than the specified value?	425 kPa (62 psi)	Go to Step 12	Go to Step 9
9	Inspect the fuel feed pipe for a restriction. Did you find and correct the condition?	-	Go to Step 13	Go to Step 10
10	Inspect the harness connectors and the ground circuits of the fuel pump for poor connections. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 13	Go to Step 12
	1. Turn OFF the ignition. 2. Raise the fuel rail, with the fuel lines connected. Refer to Fuel Rail Assembly Replacement .			

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11	3. Turn ON the ignition, with the engine OFF. 4. Command the fuel pump relay ON with a scan tool. 5. Locate and replace the leaking fuel injector. Refer to Fuel Injector Replacement . Did you complete the replacement?	-	Go to Step 13	-
12	Replace the primary fuel tank module. Refer to Fuel Tank Module Replacement - Primary . Did you complete the replacement?	-	Go to Step 13	-
13	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to Step 3

FUEL INJECTOR COIL TEST

CIRCUIT DESCRIPTION

The powertrain control module (PCM) enables the appropriate fuel injector on the intake stroke for each cylinder. Ignition voltage is supplied directly to the fuel injectors. The PCM controls each fuel injector by grounding the control circuit via a solid state device called a driver. A fuel injector coil winding resistance that is too high or low will affect engine driveability. A fuel injector control circuit DTC may not set, but a misfire may be apparent. The fuel injector coil windings are affected by temperature. The resistance of the fuel injector coil windings will increase as the temperature of the fuel injector increases.

DIAGNOSTIC AIDS

- Monitoring the misfire current counters, or misfire graph, may help isolate the fuel injector that is causing the condition.
- Operating the vehicle over a wide temperature range may help isolate the fuel injector that is causing the condition.
- Perform the fuel injector coil test within the conditions of the customers concern. A fuel injector condition may only be apparent at a certain temperature, or under certain conditions.
- If the fuel injector coil test does not isolate the condition perform the fuel injector balance test. Refer to **Fuel Injector Balance Test with Special Tool** or **Fuel Injector Balance Test with Tech 2**.

TEST DESCRIPTION

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The numbers below refer to the step numbers on the diagnostic table.

3: This step tests each fuel injector resistance within a specific temperature range. If any of the fuel injectors display a resistance outside of the specified value, replace the fuel injector.

4: This step determines if all of the fuel injectors are within 3 ohms of each other. If the highest resistance value is within 3 ohms of the lowest resistance value, then all of the fuel injector coil windings are OK.

6: This step determines if the ignition 1 voltage circuit under the intake plenum is causing the concern.

8: This step determines which fuel injector is faulty. After subtracting the highest and lowest resistance values from the average value, replace the fuel injector that has the greatest resistance difference from the average.

Fuel Injector Coil Test

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to Step 2	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information
2	Observe the engine coolant temperature (ECT) with a scan tool. Is the ECT value within the specified range?	10-32°C (50-90°F)	Go to Step 3	Go to Step 4
3	1. Disconnect the fuel injector multi-way harness connector. 2. Measure the resistance of each fuel injector between the ignition feed circuit and the fuel injector control circuit, at the multi-way connector with a DMM. Refer to Testing for Continuity in Wiring Systems. Do any of the fuel injectors display a resistance outside the specified range?	11-14 ohms	Go to Step 5	Go to Diagnostic Aids

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4	1. Disconnect the fuel injector multi-way connector. 2. Measure the resistance of each fuel injector between the ignition feed circuit and the fuel injector control circuit, at the multi-way connector with a DMM. Refer to Testing for Continuity in Wiring Systems. 3. Record each fuel injector value. 4. Subtract the lowest resistance value from the highest resistance value. Is the difference equal to, or less than, the specified value?	3 ohms	Go to Fuel Injector Balance Test with Special Tool or Fuel Injector Balance Test with Tech 2	Go to Step 8
5	Remove the upper intake manifold. Refer to Intake Manifold Replacement - Upper in Engine Mechanical. Did you complete the action?	-	Go to Step 6	-
6	Measure the resistance of the ignition 1 voltage circuit between the multi-way connector and the affected fuel injector connector, with a DMM. Is the resistance more than the specified value?	5 ohms	Go to Step 7	Go to Step 9
7	Repair the open or high resistance in the ignition 1 voltage circuit. Did you complete the repair?	-	Go to Step 11	-
8	1. Add all of the fuel injector resistance values, to obtain a total resistance value. 2. Divide the total resistance value by the number of fuel injectors, to obtain an average resistance value. 3. Subtract the lowest and the highest individual fuel injector resistance values from the average resistance value.	-		

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	4. Replace the fuel injector that displays the greatest resistance difference, above or below the average. Refer to Fuel Injector Replacement .			
	Did you complete the replacement?		Go to Step 11	-
9	Test for an intermittent and for a poor connection at the affected fuel injector. Refer to Testing for Intermittent Conditions and Poor Connections in Wiring Systems. Did you find and correct the condition?	-	Go to Step 11	Go to Step 10
10	Replace any fuel injectors that are out of the specified range. Refer to Fuel Injector Replacement . Did you complete the replacement?	11-14 ohms	Go to Step 11	-
11	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to Step 2

FUEL INJECTOR BALANCE TEST WITH SPECIAL TOOL

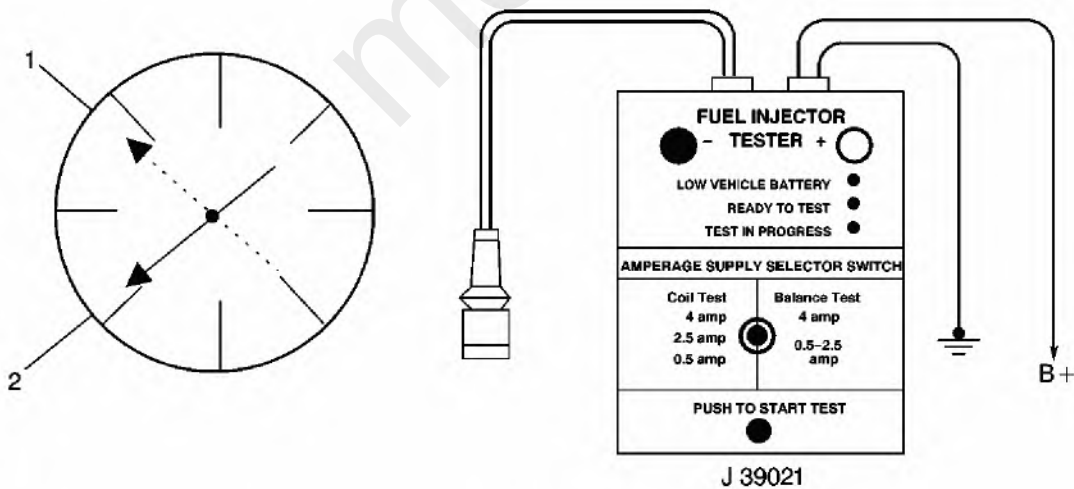


Fig. 1: Performing Fuel Injector Balance Test With Special Tool
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 24

Callout	Component Name

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1	First Fuel Pressure Gage Reading
2	Second Fuel Pressure Gage Reading

SYSTEM DESCRIPTION

The scan tool is first used to energize the fuel pump relay. The fuel injector tester is then used to pulse each injector for a precise amount of time, allowing a measured amount of fuel into the manifold. This causes a drop in system fuel pressure that can be recorded and used to compare each injector.

Fuel Injector Balance Test Example (Actual Results May Vary)

Cylinder	1	2	3	4
1st Reading	379 kPa (55 psi)	379 kPa (55 psi)	379 kPa (55 psi)	379 kPa (55 psi)
2nd Reading	280 kPa (41 psi)	310 kPa (45 psi)	340 kPa (49 psi)	317 kPa (46 psi)
Amount of Drop	99 kPa (14 psi)	69 kPa (10 psi)	39 kPa (6 psi)	62 kPa (9 psi)
Average Range: 47-87 kPa (6.8- 12.6 psi)	Replace fuel injector - too much fuel pressure drop	Injector OK	Replace fuel injector - too little fuel pressure drop	Injector OK

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: The engine coolant temperature (ECT) must be below the operating temperature in order to avoid irregular fuel pressure readings due to hot soak fuel boiling.

6: If the pressure drop value for each fuel injector is within 20 kPa (3 psi) of the average pressure drop value, the fuel injectors are flowing properly.

Fuel Injector Balance Test Procedure

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to Step 2	Go to Diagnostic System Check - Vehicle
2	Did you perform the Fuel Injector Coil Test?	-	Go to Step 3	Go to Fuel Injector Coil Test
3	IMPORTANT: Do not perform this test if the engine coolant temperature (ECT) is above 94°C (201°F).	94°C (201°		-

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	Observe the ECT parameter with a scan tool. Is the ECT parameter less than the specified value?	F)	Go to Step 4	
4	IMPORTANT: Verify adequate fuel in the fuel tank before proceeding with this diagnostic. 1. Turn OFF the ignition. 2. Install the J 34730-1A Fuel Pressure Gage and the fuel pressure gage fitting. See Special Tools . Refer to Fuel Pressure Gage Installation and Removal . 3. Turn ON the ignition, with the engine OFF. 4. Command the fuel pump relay ON with a scan tool. IMPORTANT: • You may need to command the fuel pump relay ON a few times, in order to obtain the highest possible fuel pressure. • Do not start the engine. 5. Observe the J 34730-1A , with the fuel pump relay commanded ON. See Special Tools . Is the fuel pressure within the specified range?	384-425 kPa (56-62 psi)	Go to Step 5	Go to Fuel System Diagnosis
5	IMPORTANT: The fuel pressure may vary slightly when the fuel pump stops operating. After the fuel pump stops operating, the fuel pressure should stabilize and remain constant. Monitor the J 34730-1A for 1 minute. See Special Tools . Does the fuel pressure decrease by more than the specified value?	34 kPa (5 psi)	Go to Fuel System Diagnosis	Go to Step 6
	1. Connect the J 39021 Fuel			

Injector Coil/Balancer Tester, **J 39021-210** Injector Selector Switch Box, and **J 39021-410** Fuel Injector Harness Adapter to the fuel injector multi-way connector.

2. Set the amperage supply selector switch on the fuel injector tester to the balance test 0.5-2.5 amp position.
3. Command the fuel pump relay ON and then OFF with a scan tool.
4. Record the fuel pressure indicated by the **J 34730-1A** after the fuel pressure stabilizes. See **Special Tools** . This is the first pressure reading.

IMPORTANT:

Record the fuel pressure value immediately after the fuel injector stops pulsing. The fuel pressure may rise after the fuel injector stops pulsing. Do not record the higher fuel pressure value.

20 kPa (3 psi)

5. Energize the fuel injector by depressing the Push to Start test button on the fuel injector tester.
6. Record the fuel pressure indicated by the **J 34730-1A** . See **Special Tools** . This is the second fuel pressure reading.
7. Repeat steps 1 through 6 for each fuel injector.
8. Subtract the second pressure reading from the first pressure reading for one fuel injector. The result is the pressure drop value.
9. Obtain a pressure drop value for each fuel injector.
10. Add all of the individual pressure

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	drop values. This is the total pressure drop. 11. Divide the total pressure drop by the number of fuel injectors. This is the average pressure drop. Does any fuel injector have a pressure drop value that is more than the average pressure drop or less than the average pressure drop by the specified value?			
			Go to Step 7	Go to Symptoms - Engine Controls
7	Clean the fuel injectors. Refer to Fuel Injector Cleaning Procedure . Did you complete the action?	-	Go to Step 8	-
8	Operate the vehicle in order to verify the repair. Does a driveability condition still exist?	-	Go to Symptoms - Engine Controls	System OK

FUEL INJECTOR BALANCE TEST WITH TECH 2

CIRCUIT DESCRIPTION

The scan tool first energizes the fuel pump and then the fuel injectors, for a precise amount of time, allowing a measured amount of fuel into the manifold. This causes a drop in system fuel pressure that can be recorded and used to compare each injector.

Fuel Injector Balance Test Example (Actual Results May Vary)

Cylinder	1	2	3	4
1st Reading	379 kPa (55 psi)	379 kPa (55 psi)	379 kPa (55 psi)	379 kPa (55 psi)
2nd Reading	280 kPa (41 psi)	310 kPa (45 psi)	340 kPa (49 psi)	317 kPa (46 psi)
Amount of Drop	99 kPa (14 psi)	69 kPa (10 psi)	39 kPa (6 psi)	62 kPa (9 psi)
Average Range: 47-87 kPa (6.8-12.6 psi)	Replace fuel injector - too much fuel pressure drop	Injector OK	Replace fuel injector - too little fuel pressure drop	Injector OK

Test Description

The number below refers to the step number on the diagnostic table.

3: The engine coolant temperature (ECT) must be below the operating temperature in order to avoid irregular fuel pressure readings due to hot soak fuel boiling.

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Fuel Injector Balance Test Procedure

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u>
2	Did you perform the Fuel Injector Coil Test?	-	Go to Step 3	Go to <u>Fuel Injector Coil Test</u>
3	IMPORTANT: Do not perform this test if the engine coolant temperature (ECT) is above 94°C (201°F). Observe the ECT parameter with a scan tool. Is the ECT parameter less than the specified value?	94°C (201°F)	Go to Step 4	-
4	IMPORTANT: Verify adequate fuel in the fuel tank before proceeding with this diagnostic. 1. Turn OFF the ignition. 2. Turn OFF all the accessories. 3. Install the J 34730-1A Fuel Pressure Gage and the fuel pressure gage fitting. See <u>Special Tools</u> . Refer to <u>Fuel Pressure Gage Installation and Removal</u> . 4. Turn ON the ignition, with the engine OFF. 5. Command the fuel pump ON with a scan tool. IMPORTANT: - You may need to command the fuel pump relay ON a few times in order to obtain the highest possible fuel pressure. - Do not start the engine. 6. Observe the J 34730-1A , with	384-425 kPa (56-62 psi)		

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	the fuel pump commanded ON. See Special Tools .			
	Is the fuel pressure within the specified value?		Go to Step 5	Go to Fuel System Diagnosis
5	IMPORTANT: The fuel pressure may vary slightly when the fuel pump stops operating. After the fuel pump stops operating, the fuel pressure should stabilize and remain constant. Monitor the J 34730-1A for 1 minute. See Special Tools .Does the fuel pressure decrease by more than the specified value?	34 kPa (5 psi)	Go to Fuel System Diagnosis	Go to Step 6
6	1. With a scan tool, select the Fuel Injector Balance Test function, within the Special Functions menu. 2. Select a fuel injector to be tested. 3. Press Enter in order to prime the fuel system. 4. Record the fuel pressure indicated by the J 34730-1A after the fuel pressure stabilizes. See Special Tools . This is the 1st pressure reading. IMPORTANT: Record the fuel pressure value immediately after the fuel injector stops pulsing. The fuel pressure may rise after the fuel injector stops pulsing. Do not record the higher fuel pressure value. 5. Energize the fuel injector by depressing the Pulse Injector button on the scan tool. This energizes the fuel injector and decreases the fuel pressure. 6. Record the fuel pressure indicated by the J 34730-1A after the fuel injector has stopped	20 kPa (3 psi)		

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	pulsing. See Special Tools . This is the 2nd pressure reading. - Press Enter again to bring you back to the Select Injector screen. - Repeat for each fuel injector. - Subtract the 2nd pressure reading from the 1st pressure reading for one fuel injector. The result is the pressure drop value. - Obtain a pressure drop value for each fuel injector. - Add all of the individual pressure drop values. This is the total pressure drop. - Divide the total pressure drop by the number of fuel injectors. This is the average pressure drop. Does any fuel injector have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by more than the specified value?			
			Go to Step 7	Go to Symptoms - Engine Controls
7	Clean the fuel injectors. Refer to Fuel Injector Cleaning Procedure . Did you complete the action?	-	Go to Step 8	-
8	Operate the vehicle in order to verify the repair. Does a driveability condition still exist?	-	Go to Symptoms - Engine Controls	System OK

ALCOHOL/CONTAMINANTS-IN-FUEL DIAGNOSIS (WITH SPECIAL TOOL)

TEST DESCRIPTION

Fuel quality can affect vehicle performance. Gasoline and gasoline blends that are contaminated or contain excessive amounts of alcohol can affect vehicle driveability, fuel economy, fuel system components, and emissions. Excessive alcohol in the fuel may cause fuel system corrosion, deterioration of rubber components, and subsequent fuel filter restriction. Some types of alcohol are more detrimental to fuel system components than others. Ethanol is commonly used in gasoline, but in concentrations of no more than 10 percent. Some fuels, such as E85, contain a very high percent of ethanol. Fuel with more

than 10 percent ethanol may cause driveability conditions in vehicles such as hesitation, lack of power, stalling, or no start. If excessive alcohol in the fuel is suspected, then use the following procedure to test the fuel quality.

TEST PROCEDURE

1. Turn ON the **J 44175** Fuel Composition Tester. See **Special Tools** .
2. Verify the fuel composition tester is operational by measuring the AC frequency output with a DMM. Refer to **Measuring Frequency** in Wiring Systems. A frequency without a fuel sample in the test cell indicates that the tester is working correctly.

CAUTION: 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.

3. Install the **J 34730-1A** Fuel Pressure Gage. See **Special Tools** . Refer to **Fuel Pressure Gage Installation and Removal** .

IMPORTANT: you will need to bleed the **J 34730-1A** a few times in order to obtain an accurate fuel sample. See **Special Tools** .

4. Close the bleed valve on the fuel pressure gage.

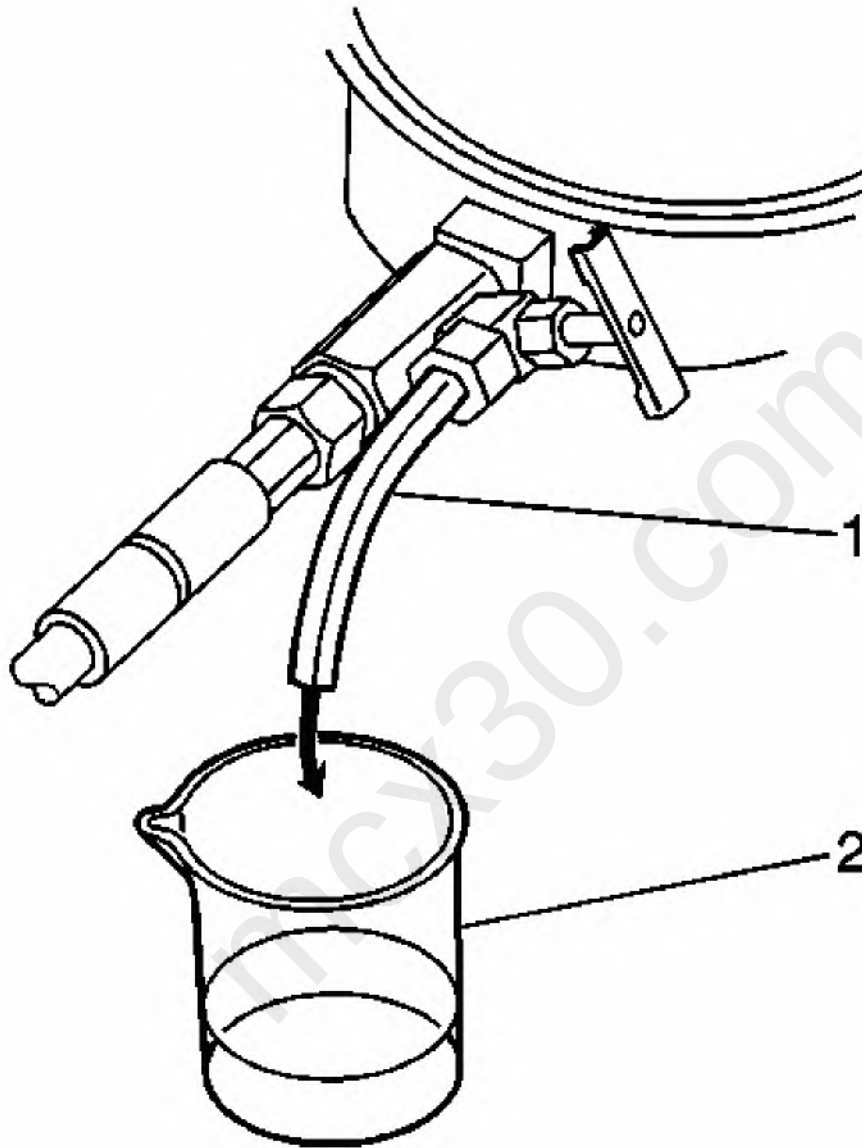


Fig. 2: Bleeding Fuel Pressure Gage Valve
Courtesy of GENERAL MOTORS CORP.

5. Place the bleed hose (1) of the fuel pressure gage into the 100 ml beaker (2).
6. Command the fuel pump relay ON with a scan tool.
7. Slowly open the bleed valve on the fuel pressure gage, until an adequate fuel sample is obtained.
8. If water appears in the fuel sample, clean the fuel system and replace the fuel in the

vehicle. Refer to **Fuel System Cleaning** .

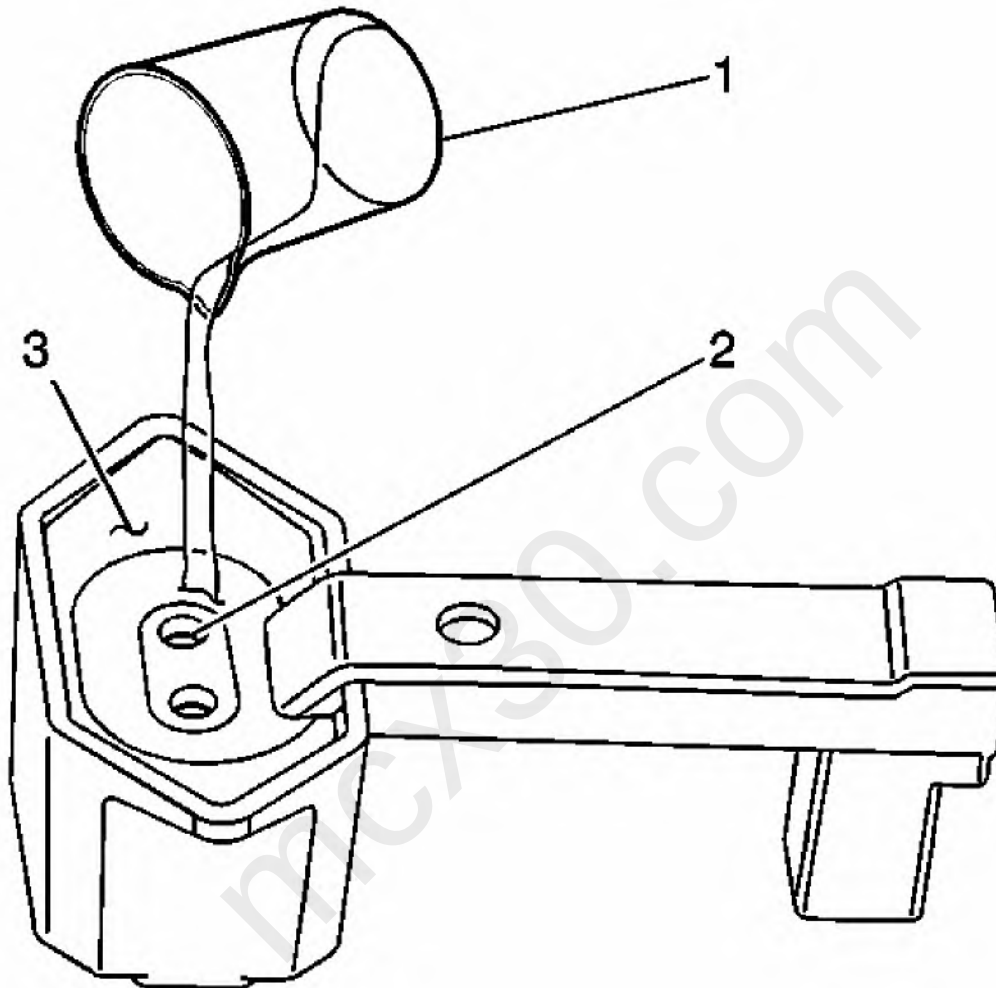


Fig. 3: Testing Fuel

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not allow any substances other than gasoline, ethanol/gasoline blends, air, or acetone into the test ports of the fuel composition tester. Contaminants in the fuel composition tester could result in misdiagnosis.

9. Pour the fuel sample from the beaker (1) into the **J 44175** , until the level of the fuel is at the top of each fuel test port (2). See **Special Tools** .
10. Observe the diagnostic LEDs on the fuel composition tester. If the red fuel diagnostic

LED is illuminated, a fuel contamination condition exists. Refer to **Fuel System Cleaning**.

11. Measure the output frequency of the fuel composition tester.
12. Subtract 50 from the reading on the DMM to obtain the percentage of alcohol in the fuel sample. Refer to the examples in the following table.
13. If the fuel sample contains more than 10 percent ethanol, replace the fuel in the vehicle.

Fuel Composition Test Examples

-	Frequency (Hz)	Subtract 50	Ethanol Percent
Example A	50 Hz	-50	0
Example B	65 Hz	-50	15
Example C	129 Hz	-50	79

ALCOHOL/CONTAMINANTS-IN-FUEL DIAGNOSIS (WITHOUT SPECIAL TOOL)

Water contamination in the fuel system may cause driveability conditions such as hesitation, stalling, no start, or misfires in one or more cylinders. Water may collect near a single fuel injector, at the lowest point in the fuel rail, and cause a misfire in that cylinder. If the fuel system is contaminated with water, inspect the fuel system components for rust, or deterioration.

Alcohol concentrations of 10 percent or greater in fuel can be detrimental to fuel system components. Alcohol contamination may cause fuel system corrosion, deterioration of rubber components, and subsequent fuel filter restriction. Fuel contaminated with alcohol may cause driveability conditions such as hesitation, lack of power, stalling, or no start. Some types of alcohol are more detrimental to fuel system components than others.

ALCOHOL IN FUEL TESTING PROCEDURE

The fuel sample should be drawn from the bottom of the tank so that any water present in the tank will be detected. The sample should be bright and clear. If alcohol contamination is suspected then use the following procedure to test the fuel quality.

1. Using a 100 ml specified cylinder with 1 ml graduation marks, fill the cylinder with fuel to the 90 ml mark.
2. Add 10 ml of water in order to bring the total fluid volume to 100 ml and install a stopper.
3. Shake the cylinder vigorously for 10-15 seconds.
4. Carefully loosen the stopper in order to release the pressure.
5. Re-install the stopper and shake the cylinder vigorously again for 10-15 seconds.
6. Put the cylinder on a level surface for approximately 5 minutes in order to allow

adequate liquid separation.

If alcohol is present in the fuel, the volume of the lower layer, which would now contain both alcohol and water, will be more than 10 ml. For example, if the volume of the lower layer is increased to 15 ml, this indicates at least 5 percent alcohol in the fuel. The actual amount of alcohol may be somewhat more because this procedure does not extract all of the alcohol from the fuel.

PARTICULATE CONTAMINANTS IN FUEL TESTING PROCEDURE

The fuel sample should be drawn from the bottom of the tank so that any water present in the tank will be detected. The sample should be bright and clear. If the sample appears cloudy, or contaminated with water, as indicated by a water layer at the bottom of the sample, use the following procedure to diagnose the fuel.

1. Using an approved fuel container, draw approximately 0.5 liter of fuel.
2. Place the cylinder on a level surface for approximately 5 minutes in order to allow settling of the particulate contamination.

Particulate contamination will show up in various shapes and colors. Sand will typically be identified by a white or light brown crystals. Rubber will appear as black and irregular particles. If particles are found clean the entire fuel system thoroughly. Refer to **Fuel System Cleaning** .

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR DIAGNOSIS

DIAGNOSTIC FAULT INFORMATION

IMPORTANT: Always perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

Manifold Absolute Pressure (MAP) Sensor Diagnosis

Circuit	Short to Ground	High Resistance	Open	Short to Voltage	Signal Performance
5-Volt reference	P0107, P0452, P0532,P0641	P0107	P0107	P0108, P0453, P0533, P0641	P0107
MAP Sensor Signal	P0107	P0107	P0107	P0108	P0107
Low Reference	-	P0108	P0108	-	P0108

TYPICAL SCAN TOOL DATA

MAP Sensor

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Circuit	Normal Range	Short to Ground	Open	Short to Voltage
5 Volt Reference	-	10 kPa	10 kPa	104 kPa
MAP Sensor Signal	12-103 kPa	10 kPa	10 kPa	104 kPa
Low Reference	-	36 kPa	93 kPa	-

CIRCUIT/SYSTEM DESCRIPTION

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- 5-volt reference circuit
- Low reference circuit
- MAP sensor signal circuit

The control module supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The control module also provides a ground on the low reference circuit. The MAP sensor provides a signal to the control module on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The control module should detect a low signal voltage at a low MAP, such as during an idle or a deceleration. The control module should detect a high signal voltage at a high MAP, such as the ignition is ON, with the engine OFF, or at a wide open throttle (WOT). The MAP sensor is also used in order to determine the barometric pressure (BARO). This occurs when the ignition switch is turned ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The control module monitors the MAP sensor signal for voltage outside of the normal range.

DIAGNOSTIC AIDS

Poor idle characteristics may be due to uncontrolled fueling caused by an open or high resistance in the HO2S 1 low signal circuit. Before replacing any component, ensure that this condition does not exist.

REFERENCE INFORMATION

Schematic Reference

Engine Controls Schematics

Connector End View Reference

- Powertrain Control Module (PCM) Connector End Views
- Engine Controls Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Scan Tool Data List

Special Tools Required

J 23738-A Mityvac

CIRCUIT/SYSTEM TESTING

Always perform the **Diagnostic System Check - Vehicle** .

1. Start the engine.
2. Monitor the diagnostic trouble code (DTC) information with the scan tool.
3. If DTC P0641 or P0651 is also set then correct DTC P0641 or P0651 first.
4. Inspect for the following conditions:
 - Disconnected, damaged, or incorrectly routed vacuum hoses.
 - Manifold absolute pressure (MAP) sensor disconnected from the vacuum source.
 - Restrictions in the MAP sensor vacuum source.
 - Intake manifold vacuum leaks.
 - Check for a properly functioning oxygen sensor.
5. Turn OFF the ignition.
6. Remove the MAP sensor from the engine vacuum source. Leave the MAP sensor connected to the engine harness.
7. Connect a **J 23738-A** Mityvac to the MAP sensor.
8. Turn ON the ignition, with the engine OFF.
9. Observe the MAP sensor pressure with the scan tool.
10. Apply vacuum to the MAP sensor with the **J 23738-A** in 1 inch Hg increments until 15 inches Hg is reached. Each 1 inch Hg should decrease MAP sensor pressure by 3-4 kPa. Monitor the MAP sensor pressure to see if the decrease in pressure is consistent.
 - If decrease in pressure is not consistent then, test for intermittent and poor connections at the MAP sensor.
11. Apply vacuum with the **J 23738-A** until 20 inches Hg is reached. Observe the MAP sensor pressure for less than 34 kPa.

- If more than 34 kPa, test for an intermittent and for a poor connection at the MAP sensor.
- 12. With the ignition ON, and the engine OFF.
- 13. Disconnect the manifold absolute pressure (MAP) sensor.
- 14. Measure for 4.8-5.2 volts from the 5-volt reference circuit of the MAP sensor to a good ground, with a DMM.
 - If more than specified value than test the circuit for a short to voltage or faulty control module.
 - If less than specified value than test the circuit for high resistance, an open, or an intermittent and poor connection or at the control module, or a faulty control module.
- 15. Disconnect the manifold absolute pressure (MAP) sensor
- 16. Use a scan tool and observe the MAP sensor for less than 12 kPa.
 - If the MAP sensor is more than 12 kPa then test the MAP sensor signal circuit for a short to voltage or a faulty control module.
- 17. Use a 3-amp fused jumper wire and connect it between the MAP sensor 5-volt reference circuit and the MAP sensor signal circuit.
- 18. Use a scan tool and observe the MAP sensor for more than 103 kPa.
 - If the MAP sensor is less than 103 kPa then test the MAP sensor signal circuit for high resistance or a faulty control module.
- 19. With the 3-amp fused jumper wire still connected between the 5-volt reference circuit of the MAP sensor and the signal circuit of the MAP sensor. Observe the MAP sensor parameter with the scan tool for 4.9V.
 - If more than 4.9V then replace the MAP sensor.
 - If less than 4.9V then, test the MAP sensor signal circuit between the control module and the MAP sensor for a short to ground, an open, or high resistance. Test for an intermittent and for a poor connection at the control module, if tests OK then replace the control module.
- 20. Turn OFF the ignition and allow the control module to power down.
- 21. With a DMM measure for less than 5 ohms of resistance between the low reference circuit of the MAP sensor and a good ground.
 - If the resistance is more than 5 ohms, then test the circuit for a high resistance or a faulty control module.
- 22. If the MAP sensor circuits test normal, then replace the MAP sensor.

REPAIR PROCEDURES

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- **Manifold Absolute Pressure (MAP) Sensor Replacement**
- **Control Module References**

ELECTRONIC IGNITION (EI) SYSTEM DIAGNOSIS

CIRCUIT DESCRIPTION

There are 3 dual-tower ignition coils that are part of the ignition control module (ICM). The ICM contains coil driver circuits that command the coils to operate. The ICM has the following circuits:

- An ignition voltage circuit
- A ground
- An IC 1 control circuit for the 1-4 ignition coil
- An IC 2 control circuit for the 2-5 ignition coil
- An IC 3 control circuit for the 3-6 ignition coil
- A low reference circuit

The powertrain control module (PCM) controls each dual-tower ignition coil by transmitting timing pulses on the IC control circuit to the ICM for the proper coil to enable a spark event.

Electronic Ignition (EI) System Diagnosis

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to Step 2	Go to <u>Diagnostic System Check - Vehicle</u>
2	1. Remove the fuel pump relay. IMPORTANT: Ensure the companion cylinder of the cylinder being tested is grounded. 2. Test for spark at each cylinder with a J 26792 Spark Tester. See <u>Special Tools</u> . Did you have spark on all cylinders?	-	Go to Step 4	Go to Step 3

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3	Is the no spark condition present on all cylinders?	-	Go to Step 8	Go to Step 6
4	Does the spark tester indicate a bright blue spark on all cylinders?	-	Go to Step 5	Go to Step 6
5	1. Remove the spark plugs. Refer to <u>Spark Plug Replacement</u> . 2. Examine the spark plugs for any abnormal conditions or damage. Refer to <u>Spark Plug Wire Inspection</u> . Are the spark plugs in good condition?	-	System OK	Go to Step 20
6	Test the spark plug wires for the following conditions: • Proper routing and correct firing order-Refer to <u>Spark Plug Replacement</u> and <u>Spark Plug Wire Replacement</u> . • Arching to ground • Proper resistance-Refer to <u>Ignition System Specifications</u> . IMPORTANT: If carbon tracking or corrosion is detected, replace both components that are affected. • Carbon tracking or corrosion Did you find and correct the condition?	-	Go to Step 23	Go to Step 7
7	1. Turn OFF the ignition. 2. Install the spark plugs. 3. Disconnect the harness connector of the ignition control module (ICM). 4. Connect the jumper wires from the harness connector of the ICM to the corresponding terminals of the ICM. 5. Using the jumper wires, exchange	-		

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	the IC control circuit of the ICM for the affected ignition coil with a known good IC control circuit of the ICM. 6. Exchange the spark plug wires of the coils mentioned above. 7. Start the engine. Does the cylinder misfire transfer with the suspected IC control circuit?		Go to Step 12	Go to Step 14
8	1. Turn OFF the ignition. 2. Disconnect the harness connector of the ICM. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition 1 voltage circuit of the ICM and good ground. Refer to Circuit Testing. Does the test lamp illuminate?	-	Go to Step 9	Go to Step 16
9	Connect a test lamp between the ground circuit of the ICM and battery voltage. Does the test lamp illuminate?	-	Go to Step 10	Go to Step 17
10	1. Turn OFF the ignition. 2. Remove the fuse that supplies ignition voltage to the ICM. 3. Measure the resistance of the ignition voltage circuit of the ICM from the fuse to the harness connector of the ICM. Refer to Circuit Testing. Is the resistance less than the specified value?	3 ohms	Go to Step 11	Go to Step 18
11	Measure the resistance of the ground circuit of the ICM from the harness connector of the ICM to a good ground. Refer to Circuit Testing. Is the resistance less than the specified	3 ohms	Go to Step	Go to Step

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	value?		14	19
12	Test the IC control circuit of the ICM for high resistance. Refer to Circuit Testing . Did you find and correct the condition?	-	Go to Step 23	Go to Step 13
13	Test the low reference circuit of the ICM for high resistance. Refer to Circuit Testing . Did you find and correct the condition?	-	Go to Step 23	Go to Step 15
14	Test for an intermittent and for a poor connection at the ICM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs . Did you find and correct the condition?	-	Go to Step 23	Go to Step 21
15	Test for an intermittent and for a poor connection at the powertrain control module (PCM). Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs . Did you find and correct the condition?	-	Go to Step 23	Go to Step 22
16	Repair an open or short to ground in the ignition 1 voltage circuit of the ICM. Refer to Wiring Repairs . Did you complete the repair?	-	Go to Step 23	-
17	Repair an open in the ground circuit of the ICM. Refer to Wiring Repairs . Did you complete the repair?	-	Go to Step 23	-
18	Repair the high resistance in the ignition voltage circuit of the ICM. Refer to Wiring Repairs . Did you complete the repair?	-	Go to Step 23	-
19	Repair the high resistance in the ground circuit of the ICM. Refer to Wiring Repairs . Did you complete the repair?	-	Go to Step 23	-
20	Replace the spark plugs. Refer to Spark Plug Replacement . Did you complete the replacement?	-	Go to Step 23	-
21	Replace the ICM. Refer to Ignition Coil/Control Module Replacement . Did you complete the replacement?	-	Go to Step 23	-

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22	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	-	Go to Step 23	-
23	1. Turn the ignition OFF for 30 seconds. 2. Start the engine and operate the vehicle. 3. Observe the vehicle performance and driveability. Does the vehicle operate normally?	-	System OK	Go to Step 3

INSPECTION/MAINTENANCE (I/M) SYSTEM CHECK

DIAGNOSTIC FAULT INFORMATION

IMPORTANT: Always perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.

DESCRIPTION

Several states require that a vehicle pass on-board diagnostic (OBD) system tests and the inspection/maintenance (I/M) emission inspection in order to renew license plates. This is accomplished by viewing the I/M System Status display on a scan tool. Using a scan tool, the technician can observe the I/M System Status in order to verify that the vehicle meets the criteria that comply with the local area requirements.

CONDITIONS FOR UPDATING THE I/M SYSTEM STATUS

Each system monitor requires at least one, and sometimes several diagnostic tests. The result of each test is reported by a diagnostic trouble code (DTC). A system monitor is complete when either all of the DTCs composing the monitor have Run and Passed, or when any one of the DTCs comprising the monitor has illuminated the malfunction indicator lamp (MIL). Once the system monitor is complete, the I/M System Status display will indicate YES in the Completed column.

For example, when the HO2S Heater Status indicates YES, either all of the oxygen sensor heater tests have passed or one of the tests has illuminated the MIL. If the vehicle has four heated oxygen sensors, either all four heater circuit tests have passed or one of the heater circuit tests has illuminated the MIL. The I/M System Status will indicate NO under the Completed column when any of the required tests for that system have not run. The following is a list of conditions that would set the I/M System Status indicator to NO:

- The vehicle is new from the factory and has not yet been driven through the necessary drive conditions to complete the tests.
- The battery has been disconnected or discharged below operating voltage.
- The control module power or ground has been interrupted.
- The control module has been reprogrammed.
- The control module DTCs have been cleared.

MONITORED EMISSION CONTROL SYSTEMS

The OBD II System monitors all emission control systems that are on-board. The OBD II regulations require monitoring of the following:

- The air conditioning system
- The catalytic converter efficiency
- Comprehensive component monitoring-Emission related inputs and outputs
- The evaporative emission (EVAP) system
- The fuel delivery system
- Heated catalyst monitoring
- Misfire monitoring
- The oxygen sensor system (O2S or HO2S)
- The oxygen sensor heater system (HO2S heater)

For the specific DTCs required for each system, refer to. Systems such as fuel delivery, misfire, and comprehensive components may not be listed in a system status list. These tests run continuously and do not require an I/M System Status indicator.

CIRCUIT/SYSTEM VERIFICATION

Review the I/M System Status indicators. All I/M System Status indicators should report YES.

CIRCUIT/SYSTEM TESTING

IMPORTANT: Many DTC related repairs will instruct the technician to clear the DTC information. Clearing the DTC will reset the I/M System Status indicators to NO. Performing the I/M Complete System Set Procedure will set each of the I/M System Status indicators to YES.

1. Observe the Engine DTC information with a scan tool.
 - If a DTC is set that would prevent the I/M System Status tests from completing,

diagnose that DTC before continuing. Refer to **Inspection/Maintenance (I/M) System DTC Table**.

2. Review applicable service bulletins for software updates that would prevent the I/M System Status tests from completing.
 - If a control module re-program or other repair is required, perform the **Inspection/Maintenance (I/M) Complete System Set Procedure**.
3. Observe the I/M System Status indicators.
 - If any I/M System Status indicators report NO, perform the **Inspection/Maintenance (I/M) Complete System Set Procedure**.

INSPECTION/MAINTENANCE (I/M) COMPLETE SYSTEM SET PROCEDURE

DIAGNOSTIC FAULT INFORMATION

IMPORTANT: Always perform the **Inspection/Maintenance (I/M) System Check** prior to using this diagnostic procedure.

DESCRIPTION

The purpose of the Inspection/Maintenance (I/M) complete system set procedure is to satisfy the enable criteria necessary to execute all of the I/M readiness diagnostics and complete the trips for those particular diagnostics. When all I/M monitored diagnostic tests are completed, the I/M System Status indicators are set to YES. Perform the Inspection/Maintenance (I/M) Complete System Set Procedure if any I/M System Status indicators are set to NO.

CONDITIONS FOR MEETING A COLD START

- The ignition voltage between 11.0 and 18.0 volts.
- The barometric pressure (BARO) is more than 75 kPa.
- The start-up engine coolant temperature (ECT) is between 4-30°C (39-86°F).
- The start-up intake air temperature (IAT) is between 4-30°C (39-86°F).
- The difference between the IAT and the ECT is 6°C (10.8°F)
- The ambient air temperature is between 4-30°C (39-86°F).
- Fuel level is between 15 and 85 percent
- Vehicle has NOT been refueled since the last cold start ignition cycle.

CIRCUIT/SYSTEM VERIFICATION

Review the Inspection/Maintenance (I/M) System Status indicators. All I/M System Status indicators should report YES.

INSPECTION/MAINTENANCE (I/M) SYSTEM SET PROCEDURE

IMPORTANT: Whenever the ignition is turned ON, ignition positive voltage is supplied to the heated oxygen sensor (HO2S) heaters. After verifying the enable criteria, turn OFF the ignition for approximately 5 minutes to allow the sensors to cool before continuing with the test. Once the engine is started, do NOT turn the engine OFF for the remaining portion of the set procedure.

1. Ensure that the vehicle meets the conditions for a cold start listed above.
 - If the EVAP I/M System Status indicator displays NO, perform the EVAP Service bay test if applicable.
 - If the EVAP Service bay test is NOT available, it may take up to 6 drive cycles, with 17 hours between drive cycles for the EVAP I/M System Status Indicator to transition to YES.

The EVAP I/M System Status indicator requires several drive and 17 hour key OFF cycles to complete before the indicator will transition.

- If the O2S Heater System Status indicator displays NO, ensure that the ignition has been turned OFF for at least 10 hours.
2. Turn OFF all accessories; HVAC system, other electrical loads, including aftermarket/add-on equipment, etc., and open the hood.
 3. Set the vehicle parking brake and ensure the vehicle is in park for automatic transmission or neutral for manual transmission.
 4. Turn the ignition ON with the engine OFF for 1 minute.
 5. Start and idle the engine for 2 minutes and until 65°C (149°F) is achieved.
 6. Run the engine for 6.5 minutes within the following conditions:
 - MAF parameter between 4-30 g/s
 - Engine speed steady between 1000-3000 RPM
 7. Return the engine to idle for 1 minute.
 8. Apply and hold brake pedal, and shift to Drive for automatic, or apply clutch pedal for manual and operate the vehicle within the following conditions for 2 minutes:
 - Depress the accelerator pedal until TP Sensor angle is more than 2 percent.
 - MAF signal between 15-30 g/s
 - RPM steady between 1200-2000 RPM

IMPORTANT: Do NOT touch the accelerator pedal until told to do so. A change in TP Sensor angle or an increase in engine speed may invalidate this portion of the test.

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9. Release the accelerator pedal and shift the vehicle to Park for automatic, or Neutral and release clutch pedal for manual, and allow the engine to idle for 2 minutes.
10. Quickly depress the accelerator pedal until TP Sensor Angle is more than 8 percent and return to idle, repeat 3 times.
11. Allow engine to idle for at least 2 minutes.

CAUTION: Refer to Road Test Caution .

12. Close the hood, release the parking brake and drive vehicle at 24 km/h (15 mph) or slower for 2 minutes.
13. Continue to drive the vehicle for at least 5.5 miles between 45-112 km/h (28-70 mph) with the vehicle reaching at least 80 km/h (50 mph).
14. Release the accelerator pedal for at least 3 seconds. This will allow the vehicle to enter the decel fuel cut off.
15. Depress the accelerator pedal until the TP Sensor angle is between 3-20 percent and maintain for 1 minute.
16. Safely stop the vehicle, with the engine in drive for automatic or neutral with the clutch pedal depressed and parking brake applied for manual. Allow the vehicle to idle for 2 minutes.

IMPORTANT: Do NOT disturb the vehicle or turn ON the ignition until told to do so. Disturbing the vehicle may invalidate this portion of the test.

17. Shift the vehicle to park for automatic and neutral for manual. Turn OFF the ignition and exit the vehicle. Do NOT disturb the vehicle for 45 minutes.
18. Observe the Inspection/Maintenance (I/M) System Status with a scan tool. All of the I/M System Status indicators should display YES.
 - If the EVAP I/M System Status indicator displays NO turn OFF the ignition for 17 hours, ensure that the vehicle meets the conditions for a cold start, and repeat steps 13-18 three more times, or until the EVAP I/M System Status indicator transitions to YES. If the indicator continues to display NO, refer to the **Inspection/Maintenance (I/M) System DTC Table** to identify the DTCs that did not run.
 - If any of the I/M System Status indicators display NO, refer to the **Inspection/Maintenance (I/M) System DTC Table** for the indicator which did not display YES. The I/M System DTC Table identifies the DTCs associated with each I/M System Status Indicator.

INSPECTION/MAINTENANCE (I/M) SYSTEM DTC TABLE

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Inspection/Maintenance (I/M) System DTC Table

System	DTCs Required to Set System Status to YES
If an I/M System Status indicator did NOT update to YES during the Inspection/Maintenance (I/M) System DTC Table , review each indicator and reference this table to determine each DTC associated with the I/M System Status Indicator. Each DTC listed below has specific conditions that must be met for the diagnostic to run. Included within the conditions are additional DTCs, which if set, may inhibit the DTCs listed below from running. Reviewing and operating the vehicle within the Conditions for Running for each DTC listed below will allow the I/M System Status Indicators to transition to YES.	
Catalyst Monitor	DTC P0420-Refer to DTC P0420 .
Evaporative Emission (EVAP)	• DTC P0442-Refer to DTC P0442 . • DTC P0446-Refer to DTC P0446 . • DTC P0455-Refer to DTC P0455 . • DTC P0496-Refer to DTC P0496 .
Oxygen Sensor	• DTC P0140-Refer to DTC P0140 . • DTC P1133-Refer to DTC P1133 . • DTC P2A01-Refer to DTC P2A01 .
Oxygen Sensor Heater	• DTC P0135-Refer to DTC P0135 . • DTC P0141-Refer to DTC P0140 .
EGR	• DTC P0401-Refer to DTC P0401 . • DTC P0403-Refer to DTC P0403 . • DTC P0404-Refer to DTC P0404 . • DTC P0405-Refer to DTC P0405 . • DTC P0406-Refer to DTC P0406 . • DTC P1404-Refer to DTC P1404 .

SERVICE BAY TEST

DESCRIPTION

The evaporative emission (EVAP) Service Bay Test raises the engine coolant temperature (ECT) threshold so that the temperature sensitive EVAP diagnosis tests can run while in service environments. When the EVAP tests are run the service bay test will indicate a pass or will indicate a specific DTC has failed. The EVAP service bay test can be used to verify an existing condition and verify that the EVAP system is OK after a repair is completed.

CONDITIONS FOR RUNNING THE TEST

IMPORTANT: The following conditions must be met in order to enable the

Service Bay Test:

- The ignition is ON.
- The battery voltage is between 9-18 volts.
- The engine coolant temperature (ECT) is less than 70°C (158°F).
- The fuel level is 15-85 percent of capacity.
- The vehicle speed is less than 4.8 km/h (3 mph).
- Stored DTCs have been cleared.

TEST PROCEDURE

1. Install a scan tool.
2. With a scan tool, select the service bay test in the special functions menu.
3. Follow the instructions on the scan tool.
4. Check DTCs with a scan tool.
5. Continue with the published service manual diagnostic DTC procedure.