

Engine Controls - Troubleshooting - 3.4L - Aztek & Rendezvous

TROUBLESHOOTING

SYMPTOMS - ENGINE CONTROLS

Important Preliminary Checks Before Starting

Before using the Symptom tables, use the following:

- Perform the **Diagnostic System Check - Vehicle** in Vehicle DTC Information and verify all of the following items:
 - Clear the DTCs.
 - Ensure that the scan tool data is within normal operating range. Refer to **Scan Tool Data List** .
- Verify the customer complaint.
- Perform the Visual/Physical Check.

Locate the correct symptom in the list at the end of this section. Follow the procedures in the appropriate diagnostic table. If the condition can not be duplicated, or is determined to be intermittent, refer to **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 inspection. This can lead to correcting a condition without further tests and can save valuable time. This inspection should include the following areas:

- Inspect the powertrain control module (PCM) grounds for being clean, tight, and in their proper location. Refer to **Master Electrical Component List** and Power and Grounding Connector End Views in Wiring Systems.
- Inspect the vacuum hoses for splits, kinks, and proper connections, as shown on Vehicle Emission

Control Information label. Inspect thoroughly for any type of leak or restriction. Refer to **Emission Hose Routing Diagram** .

- Inspect the air intake ducts for being collapsed, damaged areas, looseness, improper installation, or leaking, especially between the mass air flow (MAF) sensor and the throttle body.
- Inspect for air leaks at throttle body mounting area, MAF sensor and intake manifold sealing surfaces.
- Inspect the wiring harness for poor connections, pinches, cuts, or other damage.
- Inspect for loose, damaged, or missing sensors/components.

Use the following tables when diagnosing a symptom complaint:

- **Hard Start**
- **Surges/Chuggles**
- **Lack of Power, Sluggishness, or Sponginess**
- **Detonation/Spark Knock**
- **Hesitation, Sag, Stumble**
- **Cuts Out, Misses**
- **Poor Fuel Economy**
- **Poor Fuel Fill Quality**
- **Rough, Unstable, or Incorrect Idle and Stalling**
- **Dieseling, Run-On**
- **Backfire**
- **Malfunction Indicator Lamp (MIL) Inoperative**
- **Malfunction Indicator Lamp (MIL) Always On**
- **Engine Cranks but Does Not Run**

INTERMITTENT CONDITIONS

Intermittent Conditions

Inspection/Test	Action
DEFINITION: The condition is not currently present but is indicated in DTC History. OR There is a customer complaint, but the symptom can not currently be duplicated, if the condition is not DTC related.	
Preliminary	Perform the <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information before starting.
Harness/Connector	Many intermittent open or shorted circuits come and go with harness/connector movement caused by vibration, engine torque, bumps/rough pavement, etc. Test for this type of condition by performing the applicable procedure from the following list: • Move related connectors and wiring while monitoring the appropriate scan tool data.

	• Move related connectors and wiring with the component commanded ON, and OFF, with the scan tool. Observe the component operation. • With the engine running, move related connectors and wiring while monitoring engine operation. If harness or connector movement affects the data displayed, component/system operation, or engine operation, inspect and repair the harness/connections as necessary. Refer to Electrical Connections or Wiring.
Electrical Connections or Wiring	• Poor electrical connections/terminal tension or wiring conditions cause most intermittents. Perform a careful inspection of the suspected circuit for the following: ○ Inspect for poor mating of the connector halves, or terminals not fully seated in the connector body (backed-out). ○ Inspect for improperly formed or damaged terminals. Test for poor terminal tension. ○ Inspect for poor terminal to wire connections including terminals crimped over insulation. This requires removing the terminal from the connector body. ○ Inspect for corrosion/water intrusion. Pierced or damaged insulation can allow moisture to enter the wiring. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits. ○ Inspect for wires that are broken inside the insulation. ○ Inspect the harness for pinched, cut, or rubbed through wiring. ○ Ensure that the wiring does not come in contact with hot exhaust components. • Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems.
Control Module Power and Grounds Component Power and Grounds	Poor power or ground connections can cause widely varying symptoms. • Test all control module power circuits. Many vehicles have multiple circuits supplying power to the control module. Other components in the system may have separate power circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the power source and the module/component. A test lamp or a DMM may indicate that

	voltage is present, but neither tests a circuit ability to carry sufficient current. Ensure that the circuit can carry the current necessary to operate the component. Refer to <u>Power Distribution Schematics</u> in Wiring Systems. • Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point. Inspect the connections at the component and in splice packs, where applicable. Ensure that the circuit can carry the current necessary to operate the component. Refer to <u>Ground Distribution Schematics</u> in Wiring Systems.
Temperature Sensitivity	• An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot. • Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable. • If the intermittent is related to heat, review the data for a relationship with the following: ○ High ambient temperatures ○ Underhood/engine generated heat ○ Circuit generated heat due to a poor connection, or high electrical load ○ Higher than normal load conditions (towing, etc.) • If the intermittent is related to cold, review the data for the following: ○ Low ambient temperatures-In extremely low temperatures, ice may form in a connection or component. Test for water intrusion. ○ The condition only occurs on a cold start. ○ The condition goes away when the vehicle warms up. • Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
Electromagnetic Interference (EMI) and Electrical Noise.	Some electrical components/circuits are sensitive to electromagnetic interference (EMI) or other types of electrical noise. Inspect for the following conditions: • A misrouted harness that is too close to high voltage/high current devices such as secondary ignition components, motors, generator etc. These components may induce electrical noise on a circuit that could interfere with normal circuit operation.

	• Electrical system interference caused by a malfunctioning relay, powertrain control module (PCM) driven solenoid or switch. These conditions can cause a sharp electrical surge. Normally, the condition occurs when the malfunctioning component is operating. • Improper installation of non-factory or aftermarket add-on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. these accessories may lead to an emission related on-board diagnosis (OBD) II failure while in use, but do not fail when the accessories are not in use. Refer to <u>Checking Aftermarket Accessories</u> in Wiring Systems. If a DTC is determined to be intermittent, and the tests in this section do not reveal a condition, refer to Vehicle Data Recorder. • Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode. • Test the generator for a bad rectifier bridge that may be allowing AC noise into the electrical system.
Incorrect PCM Programming	• There are only a few situations where reprogramming a PCM is appropriate: ◦ A new service PCM is installed. ◦ A PCM from another vehicle is installed. ◦ Revised software/calibration files have been released for this vehicle. IMPORTANT: DO NOT re-program the PCM with the SAME software/calibration files that are already present in the PCM. This is not an effective repair for any type of driveability condition. • Verify that the PCM contains the correct software/calibration. If incorrect programming is found, reprogram the PCM with the most current software/calibration. Refer to <u>Service Programming System (SPS)</u> in Programming and Setup.
Duplicating Failure Conditions	• If none of the previous tests are successful, attempt to duplicate and/or capture the failure conditions. • Freeze Frame/Failure Records, where applicable, contains the conditions that were present when the DTC set. 1. Review and record Freeze Frame/Failure Records data. 2. Clear the DTCs using the scan tool. 3. Turn the key to OFF and wait 15 seconds. 4. Operate the vehicle under the same conditions that were

	noted in Freeze Frame/Failure Records data, as closely as possible. The vehicle must also be operating within the Conditions for Running the DTC. Refer to Conditions for Running the DTC in the supporting text of the DTC being diagnosed. 5. Monitor DTC Status for the DTC being tested. The scan tool indicates Ran, when the enabling conditions have been satisfied long enough for the DTC to run. The scan tool also indicates whether the DTC passed or failed. • An alternate method is to drive the vehicle with the DMM connected to a suspected circuit. An abnormal reading on the DMM when the condition occurs, may help you locate the condition.
Scan Tool Snapshot	The scan tool can be setup to take a Snapshot of the parameters available via serial data. The Snapshot function records live data over a period of time. The recorded data can be played back and analyzed. The scan tool can also graph parameters singly or in combinations of parameters for comparison. The Snapshot can be triggered manually at the time the symptom is noticed, or setup in advance to trigger when a DTC sets. An abnormal value captured in the recorded data may point to a system or component that needs to be investigated further. Refer to the scan tool user instructions for more information on the Snapshot function.
Vehicle Data Recorder	The J 42598 Vehicle Data Recorder is connected to the data link connector (DLC) and sent with the customer.Special Tools . The J 42598 captures data for later retrieval and analysis by the technician.Special Tools . Refer to the Vehicle Data Recorder user instructions for more information.

HARD START

Hard Start

Inspection/Test	Action
DEFINITION: Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately stalls.	
Preliminary	Perform the Diagnostic System Check - Vehicle in Vehicle DTC Information.
Sensor/System	• Test engine coolant temperature (ECT) sensor for being shifted in value. Connect a scan tool and compare ECT with intake air temperature (IAT) on a cold engine. The ECT and IAT should be within +/- 3°C (5°F) of each other. Test the resistance of the ECT sensor if the temperature is out of range with the IAT sensor. Refer to Temperature vs Resistance . If the ECT sensor resistance is not within the specification, refer to DTC P0117 or

	DTC P0113 . • Monitor the 24X crank sensor and camshaft position (CMP) sensor signal present parameters on a scan tool. If both are not responding, test the sensor feed circuit. Both sensors use a separate feed circuit but are internally connected to power. Test all crankshaft position (CKP) sensor A and CMP sensor circuits for intermittents. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems. • Monitor the 3X crank sensor parameter on the scan tool. If the 3X crank sensor parameter is not responding, inspect the CKP sensor B and circuits for intermittents. Inspect the ignition control (IC) circuit, IC timing control circuit, low resolution engine speed signal circuit and the low reference circuit for intermittents. If these circuits become open, or shorted, they may not set a DTC immediately, but are capable of causing driveability complaints. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems. • Inspect the mass air flow (MAF) sensor for proper installation and conditions. A MAF sensor with a damaged honeycomb may cause a hard start. Inspect the air intake ducts for being collapsed, damaged areas, looseness, improper installation, or leaking, especially between the MAF sensor and the throttle body. • Using a scan tool, test the idle air control (IAC) operation. Command the engine RPM to 1,500 RPM and back to the starting RPM. If the engine RPM does not change when commanded refer to <u>DTC P0506</u> and <u>DTC P0507</u> to diagnose the IAC system. • Inspect the exhaust gas recirculation (EGR) system for proper operation, if applicable.
Fuel System	• Test the fuel system circuits for proper operation. Refer to <u>Fuel Pump Electrical Circuit Diagnosis</u>. • Test for low fuel pressure. Refer to <u>Fuel System Diagnosis</u>. • Test for faulty fuel injectors. Refer to <u>Fuel Injector Balance Test with Special Tool</u>, <u>Fuel Injector Balance Test with Tech 2</u>, <u>Fuel Injector Coil Test</u> test procedures. • Inspect for fuel contamination. Refer to <u>Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)</u> or <u>Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)</u>.
Ignition System	• Inspect for proper ignition voltage output using the following

steps:

1. Attach the **J 26792** Spark Tester to engine ground. **Special Tools** .
 2. Connect the spark plug end of the spark plug wire to the **J 26792** . **Special Tools** . Connect the other end of the spark plug wire to the coil being tested.
 3. Connect the spark plug end of the companion spark plug wire to ground. The companion spark plug wire is the wire attached to the corresponding coil tower.
 4. Crank the engine while observing the **J 26792** . **Special Tools** . A spark should be observed.
 5. Repeat the above steps for each coil.
- If spark is not present at the coils, inspect for the following conditions:
 - Coils-Cracks, carbon tracking/arcing, or a resistance value outside the specified range.

Coil Resistance: 5,000-8,000 ohms

- Spark Plug wires-signs of arcing, cross firing, cracks, carbon tracking, plug boot damage, pinched, improper routing, or a resistance value outside the specified range.

Spark Plug Wire Resistance: 9,842 ohms per meter
(3,000 ohms per foot)

IMPORTANT:

Spraying the secondary ignition wires with a light mist of water may help locate an intermittent condition. Ignition voltage arcs to ground when a secondary component is faulty.

- Defective ignition module
 - Ignition system wiring-Loose ignition module feed or ground connection, or damaged system wiring.
- Remove spark plugs and inspect for the following conditions:
 - Fouled plugs
 - Cracks
 - Wear
 - Improper gap
 - Burned or damaged electrodes
 - Improper heat range or reach

	• If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <u>Spark Plug Inspection</u> .
Engine Mechanical	• Excessive oil in combustion chamber-Leaking valve seals. Refer to <u>Oil Consumption Diagnosis</u> in Engine Mechanical. • Low cylinder compression. Refer to <u>Engine Compression Test</u> in Engine Mechanical. • Inspect for incorrect engine parts, such as the following basic components: ○ The cylinder heads ○ The camshaft and valve train components ○ The pistons, etc. Refer to <u>Symptoms - Engine Mechanical</u> in Engine Mechanical.

SURGES/CHUGGLES

Surges/Chuggles

Inspection/Test	Action
DEFINITION: Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal.	
Preliminary	• Perform the <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information. • Refer to <u>Intermittent Conditions</u>. • Search for bulletins. • Be sure driver understands transmission torque converter clutch (TCC), and A/C compressor operation as explained in the owners manual. Inform customer how TCC and the A/C clutch operates.
Sensor/System	NOTE: Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices. • Monitor the heated oxygen sensors (HO2S). The heated oxygen sensors should respond quickly to different throttle positions. If not, inspect the HO2S for silicon or other contaminants from fuel or use of improper RTV sealant. The sensors may have a white powdery coating. Silicon contamination causes a high but false HO2S signal voltage which is a rich exhaust indication. The powertrain control module (PCM) will reduce the amount of fuel delivered to the engine, causing a severe driveability problem. • Inspect the mass air flow (MAF) sensor and related wiring.

	• Inspect the air intake ducts for being collapsed, damaged areas, looseness, improper installation, or leaking especially between the MAF sensor and the throttle body. • Monitor the 24X crank sensor and the camshaft position (CMP) sensor signal present parameters on the scan tool. If both sensors are not responding, test each sensor feed circuit. Each sensor uses a separate supply circuit but are internally connected to power. Test all crankshaft position (CKP) sensor A and CMP sensor circuits for intermittents. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems. • Monitor the 3X crank sensor parameter on the scan tool. If the 3X crank sensor parameter is not responding, inspect the CKP sensor B and related circuits for intermittents. Inspect the ignition control (IC) circuit, IC timing control circuit, low resolution engine speed signal circuit and the low reference circuit for intermittents. If these circuits become open, or shorted may not set a DTC immediately, but are capable of causing driveability complaints. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems. • Test the CKP sensor B for an internal short. Refer to <u>Electronic Ignition (EI) System Diagnosis</u>. • Test the exhaust gas recirculation (EGR) system for proper operation, if applicable.
Fuel System	• Test the fuel pressure. Refer to <u>Fuel System Diagnosis</u>. • Inspect for contaminated fuel. Refer to <u>Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)</u> or <u>Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)</u>. • Ensure each fuel injector harness is connected to the correct fuel injector/cylinder. • Inspect any items which may cause an engine to run rich, long term fuel trim is significantly in the negative range. Refer to Diagnostic Aids for <u>DTC P0172</u> . • Inspect any items that may cause an engine to run lean, long term fuel trim is significantly in the positive range. Refer to Diagnostic Aids for <u>DTC P0171</u> .
Ignition System	• Inspect for proper ignition voltage output using the following steps: 1. Attach the <u>J 26792 Spark Tester</u> to engine ground.<u>Special Tools</u> . 2. Connect the spark plug end of the spark plug wire to the <u>J 26792 .Special Tools</u> . Leave the other end of the spark plug wire connected to the coil being tested. 3. Connect the spark plug end of the companion spark plug

	wire to ground. The companion spark plug wire is the wire attached to the corresponding coil tower. 4. Crank the engine while observing the J 26792 .<u>Special Tools</u> . A spark should be observed. 5. Repeat the above steps for each coil. • If spark is not present at the coils, inspect for the following conditions: ○ Coils-Cracks, carbon tracking/arcing, or a resistance value outside the specified range Coil Resistance: 5000-8000 ohms (5K-8K ohms) ○ Spark plug wires-Signs of arcing, cross firing, cracks, carbon tracking, plug boot damage, pinched, improper routing, or a resistance value outside the specified range Spark Plug Wire Resistance: 9 686 ohms per meter (3,000 ohms per foot) IMPORTANT: Spraying the secondary ignition wires with a light mist of water may help locate an intermittent problem. Ignition voltage will arc to ground when a secondary component is faulty. ○ Defective ignition module ○ Ignition system wiring-Loose ignition module voltage supply or ground connection, or damaged system wiring • Remove spark plugs and inspect for the following conditions: ○ Fouled plugs ○ Cracks ○ Wear ○ Improper gap ○ Burned or damaged electrodes ○ Improper heat range or reach • If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <u>Spark Plug Inspection</u> .
Additional	• Test the TCC operation. • Inspect the exhaust system for possible restriction: ○ Inspect exhaust system for damaged or collapsed pipes. ○ Inspect muffler for heat distress or possible internal failure.

- Test for possible plugged catalytic converter by testing the exhaust system back pressure.

LACK OF POWER, SLUGGISHNESS, OR SPONGINESS

Lack of Power, Sluggishness, or Sponginess

Inspection/Tests	Action
DEFINITION: Engine delivers less than expected power. Little or no increase in speed when the accelerator pedal is pushed down part way.	
Preliminary	• Perform the <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information. • Refer to <u>Intermittent Conditions</u> before beginning. • Search for bulletins.
Fuel System Test	• Test the fuel system circuits for proper operation. Refer to <u>Fuel Pump Electrical Circuit Diagnosis</u>. • Test for low fuel pressure. Refer to <u>Fuel System Diagnosis</u>. • Test for faulty fuel injectors. Refer to <u>Fuel Injector Balance Test with Special Tool</u>, <u>Fuel Injector Balance Test with Tech 2</u>, <u>Fuel Injector Coil Test</u> test procedures. • Inspect for fuel contamination. Refer to <u>Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)</u> or <u>Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)</u>. • Inspect any items which may cause an engine to run rich, long term fuel trim is significantly in the negative range. Refer to Diagnostic Aids for <u>DTC P0172</u> . • Inspect any items which may cause an engine to run lean, long term fuel trim is significantly in the positive range. Refer to Diagnostic Aids for <u>DTC P0171</u> .
Sensor/System	• Test the crankshaft position (CKP) sensor B for an internal short. Refer to <u>Electronic Ignition (EI) System Diagnosis</u>. • Using a scan tool, monitor knock sensor (KS) system for excessive spark retard activity. Refer to <u>Knock Sensor (KS) System Description</u> . • If knock retard is above 10-12 degrees, disconnect the KS, and ground the sensor harness connector. Monitor knock retard on the scan tool. There should be no knock retard present. If knock retard is still present, replace the powertrain control module (PCM). Refer to <u>Powertrain Control Module (PCM) Replacement</u> . • Inspect the exhaust gas recirculation (EGR) system for proper operation, if applicable. • Inspect the air intake ducts for being collapsed, damaged areas,

	looseness, improper installation, or leaking especially between the mass air flow (MAF) sensor and the throttle body.
Ignition System	• Inspect for proper ignition voltage output using the following steps: 1. Attach the J 26792 Spark Tester to engine ground.<u>Special Tools</u> . 2. Connect the spark plug end of the spark plug wire to the J 26792 .<u>Special Tools</u> . Leave the other end of the spark plug wire connected to the coil being tested. 3. Connect the spark plug end of the companion spark plug wire to ground. The companion spark plug wire is the wire attached to the corresponding coil tower. 4. Crank the engine while observing the J 26792 .<u>Special Tools</u> . A spark should be observed. 5. Repeat the above steps for each coil. • If spark is not present at the coils, inspect for the following conditions: ○ Coils-Cracks, carbon tracking/arcing, or a resistance value outside the specified range Coil Resistance: 5000-8000 ohms (5K-8K ohms) ○ Spark plug wires-Signs of arcing, cross firing, cracks, carbon tracking, plug boot damage, pinched, improper routing, or a resistance value outside the specified range Spark Plug Wire Resistance: 9 686 ohms per meter (3,000 ohms per foot) IMPORTANT: Spraying the secondary ignition wires with a light mist of water may help locate an intermittent problem. Ignition voltage will arc to ground when a secondary component is faulty. ○ Defective ignition module ○ Ignition system wiring-Loose ignition module feed or ground connection, or damaged system wiring • Remove spark plugs and inspect for the following conditions: ○ Fouled plugs ○ Cracks ○ Wear ○ Improper gap

	○ Burned or damaged electrodes ○ Improper heat range or reach ● If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <u>Spark Plug Inspection</u> .
Engine Mechanical	● Excessive oil in combustion chamber-Leaking valve seals. Refer to <u>Oil Consumption Diagnosis</u> in Engine Mechanical. ● Low cylinder compression-Refer to <u>Engine Compression Test</u> in Engine Mechanical. ● For incorrect basic engine parts-Inspect the following conditions: ○ Cylinder heads ○ Camshaft and valve train components ○ Pistons, etc.
Additional	Inspect the exhaust system for any possible restrictions: ● Inspect exhaust system for damaged or collapsed pipes. ● Inspect mufflers for heat distress or possible internal failure. ● For possible plugged catalytic converter ● Test for proper torque converter clutch (TCC) operation.

DETONATION/SPARK KNOCK

Detonation/Spark Knock

Inspection/Test	Action
DEFINITION: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening.	
Preliminary	● Perform the <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information. ● Refer to <u>Intermittent Conditions</u> before starting. ● Search for bulletins.
Fuel System	● Test the fuel system circuits for proper operation. Refer to <u>Fuel Pump Electrical Circuit Diagnosis</u>. ● Test for low fuel pressure. Refer to <u>Fuel System Diagnosis</u>. ● Test for faulty fuel injectors. Refer to <u>Fuel Injector Balance Test with Special Tool</u>, <u>Fuel Injector Balance Test with Tech 2</u>, <u>Fuel Injector Coil Test</u> test procedures. ● Inspect for fuel contamination. Refer to <u>Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)</u> or <u>Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)</u>. ● Inspect any items which may cause an engine to run rich, long

	term fuel trim is significantly in the negative range. Refer to Diagnostic Aids for <u>DTC P0172</u> . • Inspect any items which may cause an engine to run lean, long term fuel trim is significantly in the positive range. Refer to Diagnostic Aids for <u>DTC P0171</u> .
Ignition System	Inspect the spark plugs for proper heat range and reach. Refer to <u>Ignition System Specifications</u> . • Inspect for proper ignition voltage output using the following steps: 1. Attach the J 26792 Spark Tester to engine ground.<u>Special Tools</u> . 2. Connect the spark plug end of the spark plug wire to the J 26792 .<u>Special Tools</u> . Leave the other end of the spark plug wire connected to the coil being tested. 3. Connect the spark plug end of the companion spark plug wire to ground. The companion spark plug wire is the wire attached to the corresponding coil tower. 4. Crank the engine while observing the J 26792 .<u>Special Tools</u> . A spark should be observed. 5. Repeat the above steps for each coil. • If spark is not present at the coils, inspect for the following conditions: ○ Coils-Cracks, carbon tracking/arcing, or a resistance value outside the specified range Coil Resistance: 5000-8000 ohms (5K-8K ohms) ○ Spark plug wires-Signs of arcing, cross firing, cracks, carbon tracking, plug boot damage, pinched, improper routing, or a resistance value outside the specified range Spark Plug Wire Resistance: 9 686 ohms per meter (3,000 ohms per foot) IMPORTANT: Spraying the secondary ignition wires with a light mist of water may help locate an intermittent problem. Ignition voltage will arc to ground when a secondary component is faulty. ○ Defective ignition module ○ Ignition system wiring-Loose ignition module feed or ground connection, or damaged system wiring

	- Remove spark plugs and inspect for the following conditions: - Fouled plugs - Cracks - Wear - Improper gap - Burned or damaged electrodes - Improper heat range or reach - If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <u>Spark Plug Inspection</u> .
Engine Cooling System	Inspect for obvious overheating problems: - Low engine coolant - Restricted air flow to radiator, or restricted water flow through the radiator - Inoperative electric cooling fan circuits - Correct coolant solution should be a 50/50 mix. Refer to <u>Cooling System Description and Operation</u> in Engine Cooling.
Engine Mechanical	- Excessive oil in combustion chamber-Leaking valve seals. Refer to <u>Oil Consumption Diagnosis</u> in Engine Mechanical. - Low cylinder compression-Refer to <u>Engine Compression Test</u> in Engine Mechanical. - For incorrect basic engine parts-Inspect the following conditions: - Cylinder heads - Camshaft and valve train components - Pistons, etc.
Additional	- Test the crankshaft position (CKP) sensor B for an internal short. Refer to <u>Electronic Ignition (EI) System Diagnosis</u>. - Test for proper exhaust gas recirculation (EGR) system operation, if applicable. - Inspect the Transaxle Range Switch input with the vehicle in drive and the gear selector in drive or overdrive. - Test the torque converter clutch (TCC) operation. TCC applying too soon can cause the engine to spark knock. - If the scan tool readings are normal and there are no engine mechanical faults, fill the fuel tank with a known quality gasoline that has a minimum octane reading of 87 and re-evaluate vehicle performance.

Hesitation, Sag, Stumble

Inspection/Test	Action
DEFINITION: Momentary lack of response as the accelerator is pushed down. Can occur at any vehicle speed. Usually more pronounced when first trying to make the vehicle move, as from a stop sign. May cause the engine to stall if severe enough.	
Preliminary	• Perform the <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information. • Refer to <u>Intermittent Conditions</u> before starting. • Search for bulletins.
Sensor/System	NOTE: Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices. • Monitor the heated oxygen sensors (HO2S). The heated oxygen sensors should respond quickly to different throttle positions. If not, inspect the HO2S for silicon or other contaminants from fuel or use of improper RTV sealant. The sensors may have a white powdery coating. Silicon contamination causes a high but false HO2S signal voltage, rich exhaust indication. The powertrain control module (PCM) will reduce the amount of fuel delivered to the engine, causing a severe driveability problem. • Monitor the 24X crank sensor and the camshaft position (CMP) sensor signal present parameters on the scan tool. If both are not responding, test the sensor feed circuit. Both sensors use a separate feed circuit but are internally connected to power. Test all crankshaft position (CKP) A and CMP sensor circuits for intermittents. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems. • Monitor the 3X crank sensor parameter on the scan tool. If the 3X crank sensor parameter is not responding, inspect the CKP sensor B and circuits for intermittents. Inspect the ignition control (IC) circuit, IC timing control circuit, low resolution engine speed signal circuit and the 3X low reference circuit for intermittents. If these circuits become open or shorted they may not set a diagnostic trouble code (DTC) immediately, but are capable of causing driveability complaints. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems. • Test the CKP sensor B for an internal short. Refer to <u>Electronic Ignition (EI) System Diagnosis</u>. • Inspect the throttle position (TP) sensor and related wiring. • Inspect the mass air flow (MAF) sensor and related wiring. Inspect the air intake ducts for being collapsed, damaged areas, looseness, improper installation, or leaking especially between

	the MAF sensor and the throttle body. • Test the exhaust gas recirculation (EGR) system for proper operation, if applicable. • Test the TP sensor and related wiring. • Test the MAF sensor and related wiring.
Fuel System	• Test the fuel system circuits for proper operation. Refer to <u>Fuel Pump Electrical Circuit Diagnosis</u>. • Test for low fuel pressure. Refer to <u>Fuel System Diagnosis</u>. • Test for faulty fuel injectors. Refer to <u>Fuel Injector Balance Test with Special Tool, Fuel Injector Balance Test with Tech 2, Fuel Injector Coil Test</u> test procedures. • Inspect for fuel contamination. Refer to <u>Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)</u> or <u>Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)</u>. • Inspect any items which may cause an engine to run rich, long term fuel trim is significantly in the negative range. Refer to Diagnostic Aids for <u>DTC P0172</u> . • Inspect any items which may cause an engine to run lean, long term fuel trim is significantly in the positive range. Refer to Diagnostic Aids for <u>DTC P0171</u> .
Ignition System	• Inspect for proper ignition voltage output using the following steps: 1. Attach the <u>J 26792</u> Spark Tester to engine ground.<u>Special Tools</u> . 2. Connect the spark plug end of the spark plug wire to the <u>J 26792</u> .<u>Special Tools</u> . Leave the other end of the spark plug wire connected to the coil being tested. 3. Connect the spark plug end of the companion spark plug wire to ground. The companion spark plug wire is the wire attached to the corresponding coil tower. 4. Crank the engine while observing the <u>J 26792</u> .<u>Special Tools</u> . A spark should be observed. 5. Repeat the above steps for each coil. • If spark is not present at the coils, inspect for the following conditions: ○ Coils-Cracks, carbon tracking/arcing, or a resistance value outside the specified range Coil Resistance: 5000-8000 ohms (5K-8K ohms) ○ Spark plug wires-Signs of arcing, cross firing, cracks, carbon tracking, plug boot damage, pinched, improper

	routing, or a resistance value outside the specified range. Spark Plug Wire Resistance: 9 686 ohms per meter (3,000 ohms per foot) IMPORTANT: Spraying the secondary ignition wires with a light mist of water may help locate an intermittent problem. Ignition voltage will arc to ground when a secondary component is faulty. ○ Defective ignition module ○ Ignition system wiring-Loose ignition module feed or ground connection, or damaged system wiring ● Remove spark plugs and inspect for the following conditions: ○ Fouled plugs ○ Cracks ○ Wear ○ Improper gap ○ Burned or damaged electrodes ○ Improper heat range or reach ● If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs.
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CUTS OUT, MISSES

Cuts Out, Misses

Inspection/Test	Action
DEFINITION: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases.	
Preliminary	● Perform the Diagnostic System Check - Vehicle in Vehicle DTC Information. ● Refer to Intermittent Conditions before starting. ● Search for bulletins.
Fuel System	● Test the fuel system circuits for proper operation. Refer to Fuel Pump Electrical Circuit Diagnosis. ● Test for low fuel pressure. Refer to Fuel System Diagnosis. ● Test for faulty fuel injectors. Refer to Fuel Injector Balance Test with Special Tool, Fuel Injector Balance Test with Tech 2, Fuel Injector Coil Test test procedures. ● Inspect for fuel contamination. Refer to Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool) or

	<u>Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool).</u> • Inspect any items which may cause an engine to run rich, long term fuel trim is significantly in the negative range. Refer to Diagnostic Aids for <u>DTC P0172</u> . • Inspect any items which may cause an engine to run lean, long term fuel trim is significantly in the positive range. Refer to Diagnostic Aids for <u>DTC P0171</u> .
Sensor/System	• Inspect for conditions which may cause an incorrect idle speed: ○ Throttle body tampering, excessive deposits, or damage- Refer to <u>Fuel System Description</u> . ○ Restricted air intake system ○ Large vacuum leak ○ Inspect the air intake ducts for being collapsed, damaged areas, looseness, improper installation, or leaking especially between the mass air flow (MAF) sensor and the throttle body. • Inspect the throttle position (TP) sensor and related circuit wiring. Refer to <u>DTC P0123</u> . • Monitor the 24X crank sensor and the camshaft position (CMP) sensor signal parameters on the scan tool. If both are not responding, test the sensor feed circuit. Both sensors use a separate feed circuit but are internally connected to power. Test all crankshaft position (CKP) sensor A and CMP sensor circuits for intermittents. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems. • Monitor the 3X crank sensor parameter on the scan tool. If the 3X crank sensor parameter is not responding, inspect the CKP sensor B and circuits for intermittents. Inspect the ignition control (IC) circuit, IC timing control circuit, low resolution engine speed signal circuit and the low reference circuit for intermittents. If these circuits become open, or shorted, they may not set a diagnostic trouble code (DTC) immediately, but are capable of causing driveability complaints. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems. • Test the CKP sensor B for an internal short. Refer to <u>Electronic Ignition (EI) System Diagnosis</u>. • Test the exhaust gas recirculation (EGR) system for proper operation, if applicable. • Test the positive crankcase ventilation (PCV) valve for proper operation. • Inspect the Transaxle Range Switch input with the vehicle in drive and the gear selector in drive or overdrive.

	• Inspect the following for damage: ○ Bent balancer interrupter rings ○ Damaged crankshaft position sensor
Ignition System	• Inspect for proper ignition voltage output using the following steps: 1. Attach the J 26792 Spark Tester to engine ground.<u>Special Tools</u> . 2. Connect the spark plug end of the spark plug wire to the J 26792 .<u>Special Tools</u> . Leave the other end of the spark plug wire connected to the coil being tested. 3. Connect the spark plug end of the companion spark plug wire to ground. The companion spark plug wire is the wire attached to the corresponding coil tower. 4. Crank the engine while observing the J 26792 .<u>Special Tools</u> . A spark should be observed. 5. Repeat the above steps for each coil. • If spark is not present at the coils, inspect for the following conditions: ○ Coils-Cracks, carbon tracking/arcing, or a resistance value outside the specified range Coil Resistance: 5000-8000 ohms (5K-8K ohms) ○ Spark plug wires-Signs of arcing, cross firing, cracks, carbon tracking, plug boot damage, pinched, improper routing, or a resistance value outside the specified range Spark Plug Wire Resistance: 9 686 ohms per meter (3,000 ohms per foot) IMPORTANT: Spraying the secondary ignition wires with a light mist of water may help locate an intermittent problem. Ignition voltage will arc to ground when a secondary component is faulty. ○ Defective ignition module ○ Ignition system wiring-Loose ignition module feed or ground connection, or damaged system wiring • Remove spark plugs and inspect for the following conditions: ○ Fouled plugs ○ Cracks

	○ Wear ○ Improper gap ○ Burned or damaged electrodes ○ Improper heat range or reach ● If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <u>Spark Plug Inspection</u> .
Engine Mechanical	● Inspect engine mechanical for the following conditions: ○ Test the compression-Refer to <u>Engine Compression Test</u> in Engine Mechanical. ○ Sticking or leaking valves ○ Worn camshaft lobes ○ Valve timing ○ Bent push rods ○ Worn rocker arms ○ Broken valve springs ○ Excessive oil in combustion chamber-Leaking valve seals ○ Low cylinder compression ● For incorrect basic engine parts-Inspect the following components: ○ Camshaft ○ Cylinder heads ○ Pistons, etc. Refer to <u>Symptoms - Engine Mechanical</u> in Engine Mechanical.
Additional	● Inspect the exhaust system for possible restrictions: ○ Inspect exhaust system for damaged or collapsed pipes. ○ Inspect mufflers for heat distress or possible internal failure. ○ For possible plugged catalytic converter ● An engine miss condition can be caused by electromagnetic interference (EMI) on the reference circuit. EMI can usually be detected by monitoring engine RPM with a scan tool. A sudden increase in RPM with little change in actual engine RPM change, indicates EMI is present. If a problem exists, inspect routing of secondary ignition wires, high voltage components, near the ignition control circuits.

Poor Fuel Economy

Inspection/Test	Action
DEFINITION: Fuel economy, as measured by an actual road test is noticeably lower than expected. Also, the economy is noticeably lower than the economy was on this vehicle at one time, as previously shown by an actual road test.	
Preliminary	• Perform the <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information. • Refer to <u>Intermittent Conditions</u> before starting. • Search for bulletins. • Observe the owner's driving habits. ○ Is the A/C ON full time, defroster mode ON? ○ Are tires at correct pressure? ○ Are tires and wheels the correct size? ○ Are excessively heavy loads being carried? ○ Is acceleration too much, too often?
Fuel System	• Test the fuel system circuits for proper operation. Refer to <u>Fuel Pump Electrical Circuit Diagnosis</u>. • Test for low fuel pressure. Refer to <u>Fuel System Diagnosis</u>. • Test for faulty fuel injectors. Refer to <u>Fuel Injector Balance Test with Special Tool</u>, <u>Fuel Injector Balance Test with Tech 2</u>, <u>Fuel Injector Coil Test</u> test procedures. • Inspect for fuel contamination. Refer to <u>Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)</u> or <u>Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)</u>. • Ensure that each injector harness is connected to the correct injector/cylinder. • Inspect for fuel in the pressure regulator vacuum hose.
Sensor/System	• Observe the 24X crank sensor and the camshaft position (CMP) sensor signal present parameters on the scan tool. If both are not responding, inspect the sensor feed circuit. Both sensors use a common feed circuit. • Inspect the air intake system and crankcase for air leaks. Inspect the air intake ducts for being collapsed, damaged areas, looseness, improper installation, or leaking, especially between the mass air flow (MAF) sensor and the throttle body. • Inspect for proper operation of the speedometer. Refer to <u>Symptoms - Instrument Panel, Gages and Console</u> in Instrument Panel, Gages, and Console.
Ignition System	• Inspect for proper ignition voltage output using the following

steps:

1. Attach the **J 26792** Spark Tester to engine ground. **Special Tools** .
 2. Connect the spark plug end of the spark plug wire to the **J 26792** . **Special Tools** . Connect the other end of the spark plug wire to the coil being tested.
 3. Connect the spark plug end of the companion spark plug wire to ground. The companion spark plug wire is the wire attached to the corresponding coil tower.
 4. Crank the engine while observing the **J 26792** . **Special Tools** . A spark should be observed.
 5. Repeat the above steps for each coil.
- If spark is not present at the coils, inspect for the following conditions:
 - Coils-Cracks, carbon tracking/arcing, or a resistance value outside the specified range.

Coil Resistance: 5,000-8,000 ohms

- Spark plug wires-signs of arcing, cross firing, cracks, carbon tracking, plug boot damage, pinched, improper routing, or a resistance value outside the specified range.

Spark Plug Wire Resistance: 3,000 ohms per foot (9,842 ohms per meter).

IMPORTANT:

Spraying the secondary ignition wires with a light mist of water may help locate an intermittent problem. Ignition voltage arcs to ground when a secondary component is faulty.

- Defective ignition module
 - Ignition system wiring-Loose ignition module feed or ground connection, or damaged system wiring.
- Remove spark plugs and inspect for the following conditions:
 - Fouled plugs
 - Cracks
 - Wear
 - Improper gap
 - Burned or damaged electrodes
 - Improper heat range or reach

	• If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <u>Spark Plug Inspection</u> .
Engine Cooling System	• Inspect the engine coolant level for correct level. • Inspect for incorrect or faulty engine thermostat. Refer to <u>Thermostat Diagnosis</u> in Engine Cooling.
Engine Mechanical	• Inspect the engine for the following conditions: ○ Test the compression-Refer to <u>Engine Compression Test</u> in Engine Mechanical. ○ Sticking or leaking valves ○ Worn camshaft lobes ○ Valve timing ○ Bent push rods ○ Worn rocker arms ○ Broken valve springs ○ Excessive oil in combustion chamber-Leaking valve seals • Inspect for incorrect engine parts, such as the following basic components: ○ The camshaft ○ The cylinder heads ○ The pistons, etc. Refer to <u>Symptoms - Engine Mechanical</u> in Engine Mechanical.
Additional	• Test torque converter clutch (TCC) operation. • Inspect exhaust system for possible restriction: ○ Refer to <u>Restricted Exhaust</u> in Engine Exhaust. ○ Inspect exhaust system for damaged or collapsed pipes. ○ Inspect mufflers for heat distress or possible internal failure. ○ For possible plugged catalytic converter

POOR FUEL FILL QUALITY

Poor Fuel Fill Quality

Condition	Causes
Difficult to fill	• Fill limiter vent valve stuck closed • Evaporative emission (EVAP) canister restricted • EVAP vent valve stuck closed

	• Restricted vapor lines • High reid vapor pressure or high fuel temperature • Fuel filler hose is pinched or kinked • Ignition switch ON (vent valve closed)
Over fill	• Pressure relief valve is stuck open or leaking • Fill limiter vent valve stuck open or leaking
Pre-mature shut-off of the fuel dispensing nozzle	• Fill limiter vent valve stuck closed • EVAP canister restricted • EVAP vent valve stuck closed • Restricted vapor lines • High reid vapor pressure or high fuel temperature • Ignition switch ON (EVAP vent valve closed)
Fuel Spitback	• Restricted EVAP canister • High reid vapor pressure or high fuel temperature • Ignition switch ON (EVAP vent valve closed)
Liquid to EVAP canister.	• Fill limiter vent valve stuck open or leaking • Over filled fuel tank (cramming during fueling)
Liquid leak to ground	• Pressure relief valve is stuck open, or leaking • Fuel filler pipe loose or ruptured • Leaking fuel tank
Fuel Odor	• Pressure relief valve stuck open, or leaking • Saturated EVAP canister • Seepage from fuel lank

ROUGH, UNSTABLE, OR INCORRECT IDLE AND STALLING

Rough, Unstable, or Incorrect Idle and Stalling

Inspection/Test	Action
DEFINITION: Engine runs unevenly at idle. If severe, the engine or vehicle may shake. Engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.	
Preliminary	• Perform the Diagnostic System Check - Vehicle in Vehicle DTC Information. • Refer to Intermittent Conditions before starting. • Search for bulletins.
Fuel System	• Test the fuel system circuits for proper operation. Refer to Fuel Pump Electrical Circuit Diagnosis. • Test for low fuel pressure. Refer to Fuel System Diagnosis.

	• Test for faulty fuel injectors. Refer to <u>Fuel Injector Balance Test with Special Tool, Fuel Injector Balance Test with Tech 2, Fuel Injector Coil Test</u> test procedures. • Inspect for fuel contamination. Refer to <u>Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)</u> or <u>Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)</u>. • Inspect for fuel in the pressure regulator vacuum hose. • Ensure that each injector harness is connected to the correct injector/cylinder. • Inspect for any items which may cause an engine to run rich, long term fuel trim is significantly in the negative range. Refer to Diagnostic Aids for <u>DTC P0172</u> . • Inspect for any items which may cause an engine to run lean, long term fuel trim is significantly in the positive range. Refer to Diagnostic Aids for <u>DTC P0171</u> .
Sensor/System	• Test for conditions which cause an incorrect idle speed. ○ Throttle body tampering, excessive deposits, or damage- Refer to <u>Fuel System Description</u> . ○ Restricted air intake system ○ Large vacuum leak • Inspect the air intake ducts for being collapsed, damaged areas, looseness, improper installation, or leaking especially between the mass air flow (MAF) sensor and the throttle body. • Inspect crankcase ventilation valve for proper operation. • Inspect the throttle position (TP) sensor and related wiring. Refer to <u>DTC P0123</u> . • Monitor the 24X crank sensor and the camshaft position (CMP) sensor present parameters on the scan tool. If both are not responding, test the sensor feed circuit. Both sensors use a separate feed circuit but are internally connected to power. Test all crankshaft position (CKP) sensor A and CMP sensor circuits for intermittents. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems. • Monitor the 3X parameter on the scan tool. If the 3X is not responding, inspect the CKP sensor B and circuits for intermittents. Inspect the ignition control (IC) circuit, IC timing control circuit, low resolution engine speed signal circuit and the low reference circuit for intermittents. If these circuits become open, or shorted may not set a DTC immediately, but are capable of causing driveability complaints. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems. • Test the exhaust gas recirculation (EGR) system for proper

	operation, if applicable. • Inspect the transaxle range switch input with the vehicle in drive and the gear selector in drive or overdrive.
Ignition System	• Inspect for proper ignition voltage output using the following steps: 1. Attach the J 26792 Spark Tester to engine ground.<u>Special Tools</u> . 2. Connect the spark plug end of the spark plug wire to the J 26792 .<u>Special Tools</u> . Connect the other end of the spark plug wire to the coil being tested. 3. Connect the spark plug end of the companion spark plug wire to ground. The companion spark plug wire is the wire attached to the corresponding coil tower. 4. Crank the engine while observing the J 26792 .<u>Special Tools</u> . A spark should be observed. 5. Repeat the above steps for each coil. • If spark is not present at the coils, inspect for the following conditions: ○ Coils-Cracks, carbon tracking/arcing, or a resistance value outside the specified range. Coil Resistance: 5,000-8,000 ohms ○ Spark plug wires-signs of arcing, cross firing, cracks, carbon tracking, plug boot damage, pinched, improper routing, or a resistance value outside the specified range. Spark Plug Wire Resistance: 9,842 ohms per meter (3,000 ohms per foot) IMPORTANT: Spraying the secondary ignition wires with a light mist of water may help locate an intermittent condition. Ignition voltage arcs to ground when a secondary component is faulty. ○ Defective ignition module ○ Ignition system wiring-Loose ignition module feed or ground connection, or damaged system wiring. • Remove spark plugs and inspect for the following conditions: ○ Fouled plugs ○ Cracks

	○ Wear ○ Improper gap ○ Burned or damaged electrodes ○ Improper heat range or reach ● If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <u>Spark Plug Inspection</u> .
Engine Mechanical	● Inspect Engine Mechanical for the following conditions: ○ Test the compression-Refer to <u>Engine Compression Test</u> in Engine Mechanical. ○ Sticking or leaking valves ○ Worn camshaft lobes ○ Valve timing ○ Bent push rods ○ Worn rocker arms ○ Broken valve springs ○ Excessive oil in combustion chamber-Leaking valve seals ● Inspect for incorrect engine parts, such as the following basic components: ○ The camshaft ○ The cylinder heads ○ The pistons, etc. Refer to <u>Symptoms - Engine Mechanical</u> in Engine Mechanical.
Additional	Inspect the exhaust system for possible restrictions: ● Refer to <u>Restricted Exhaust</u> in Engine Exhaust. ● Inspect the exhaust system for damaged or collapsed pipes. ● Inspect the mufflers for heat distress or possible internal failure. ● Test for possible catalytic converter restrictions by testing the exhaust system back pressure. ● An engine miss condition can be caused by electromagnetic interference (EMI) on the reference circuit. EMI can usually be detected by monitoring engine RPM with a scan tool. A sudden increase in RPM with little change in actual engine RPM change, indicates EMI is present. If a condition exists, inspect the routing of secondary ignition wires, high voltage components, e.g. near ignition control circuits. ● Inspect for intake and exhaust manifold passages for casting

flash.

DIESELING, RUN-ON

Dieseling, Run-On

Inspection/Test	Action
DEFINITION: Engine continues to run after key is turned OFF, but runs very rough. If engine runs smooth, inspect the ignition switch and adjustment.	
Preliminary	• Perform the <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information • Refer to <u>Intermittent Conditions</u> before starting. • Search for bulletins.
Fuel System	• Test the fuel system circuits for proper operation. Refer to <u>Fuel Pump Electrical Circuit Diagnosis</u>. • Test for low fuel pressure. Refer to <u>Fuel System Diagnosis</u>. • Test for faulty fuel injectors. Refer to <u>Fuel Injector Balance Test with Special Tool, Fuel Injector Balance Test with Tech 2, Fuel Injector Coil Test</u> test procedures. • Inspect for fuel contamination. Refer to <u>Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)</u> or <u>Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)</u>. • Inspect for fuel in the pressure regulator vacuum hose. • Ensure that each injector harness is connected to the correct injector/cylinder.
Additional	Test for short between battery positive voltage and any of the ignition feed circuits. Refer to <u>Wiring Repairs</u> in Wiring Systems.

BACKFIRE

Backfire

Inspection/Test	Actions
DEFINITION: Fuel ignites in the intake manifold, or in the exhaust system, making loud popping noise.	
Preliminary	• Perform the <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information. • Refer to <u>Intermittent Conditions</u> before starting. • Search for bulletins.
Sensor/System	• Inspect for the following intermittent ignition system conditions: ◦ Monitor the 24X crank sensor and the camshaft position (CMP) sensor signal present parameters on the scan tool. If both are not responding, test the sensor feed circuit. Both sensors use a separate feed circuit but are internally

	connected to power. Test all crankshaft position (CKP) sensor A and CMP sensor circuits for intermittents. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems. ○ Monitor the 3X parameter on the scan tool. If the 3X is not responding, inspect the CKP sensor B and circuits for intermittents. Inspect the ignition control (IC) circuit, IC timing control circuit, low resolution engine speed signal circuit and the low reference circuit for intermittents. If these circuits become open, or shorted, they may not set a diagnostic trouble code (DTC) immediately, but are capable of causing driveability complaints. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems. ○ Test the CKP sensor B for an internal short. Refer to <u>Electronic Ignition (EI) System Diagnosis</u>. ● Inspect the mass air flow (MAF) sensor conditions. Ensure that the MAF sensor honeycomb is not damaged.
Fuel System	● Test for low fuel pressure. Refer to <u>Fuel System Diagnosis</u>. ● Test for contaminated fuel. Refer to <u>Alcohol/Contaminants-in-Fuel Diagnosis (Without Special Tool)</u> or <u>Alcohol/Contaminants-in-Fuel Diagnosis (With Special Tool)</u>. ● Ensure each injector harness is connected to the correct injector/cylinder.
Ignition System	● Inspect for proper ignition voltage output using the following steps: 1. Attach the J 26792 Spark Tester to engine ground.<u>Special Tools</u> . 2. Connect the spark plug end of the spark plug wire to the J 26792 .<u>Special Tools</u> . Leave the other end of the spark plug wire connected to the coil being tested. 3. Connect the spark plug end of the companion spark plug wire to ground. The companion spark plug wire is the wire attached to the corresponding coil tower. 4. Crank the engine while observing the J 26792 .<u>Special Tools</u> . A spark should be observed. 5. Repeat the above steps for each coil. ● If spark is not present at the coils, inspect for the following conditions: ○ Coils-Cracks, carbon tracking/arcing, or a resistance value outside the specified range Coil Resistance: 5000-8000 ohms (5K-8K ohms)

	○ Spark plug wires-Signs of arcing, cross firing, cracks, carbon tracking, plug boot damage, pinched, improper routing, or a resistance value outside the specified range Spark Plug Wire Resistance: 9 686 ohms per meter (3,000 ohms per foot) IMPORTANT: Spraying the secondary ignition wires with a light mist of water may help locate an intermittent problem. Ignition voltage will arc to ground when a secondary component is faulty. ○ Defective ignition module ○ Ignition system wiring-Loose ignition module feed or ground connection, or damaged system wiring ● Remove spark plugs and inspect for the following conditions: ○ Fouled plugs ○ Cracks ○ Wear ○ Improper gap ○ Burned or damaged electrodes ○ Improper heat range or reach ● If spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. Refer to <u>Spark Plug Inspection</u> .
Engine Mechanical	Inspect engine mechanical for the following conditions: ● Test compression ● Sticking or leaking valves ● Worn camshaft lobes ● Valve timing ● Bent push rods ● Worn rocker arms ● Broken valve springs ● Excessive oil in combustion chamber-Leaking valve seals ● Low cylinder compression ● For incorrect basic engine parts-Inspect the following components: ○ Camshaft

	○ Cylinder heads ○ Pistons, etc. ● Refer to <u>Base Engine Misfire without Internal Engine Noises</u> in Engine Mechanical.
Additional	● Inspect intake and exhaust manifolds for casting flash. ● Test the torque converter clutch (TCC) operation. ● Inspect the exhaust system for possible restriction: ○ Inspect exhaust system for damaged or collapsed pipes. ○ Inspect mufflers for heat distress or possible internal failure. ○ For possible plugged catalytic converter

MALFUNCTION INDICATOR LAMP (MIL) INOPERATIVE

Circuit Description

Ignition voltage is supplied to the malfunction indicator lamp (MIL). The powertrain control module (PCM) turns the MIL ON by grounding the MIL control circuit. There should be a steady MIL with the ignition ON and the engine OFF.

MIL Operation

The MIL is located on the instrument panel cluster (IPC).

MIL Function

- The MIL informs the driver that a malfunction has occurred and the vehicle should be taken in for service as soon as possible.
- The MIL illuminates during a bulb test and a system test.
- A DTC will be stored if a MIL is requested by the PCM.

MIL Illumination

- The MIL will illuminate with ignition switch ON and the engine not running.
- The MIL will turn OFF when the engine is started.
- The MIL will remain ON if the self-diagnostic system has detected a malfunction.
- The MIL may turn OFF if the malfunction is not present.
- If the MIL is illuminated and then the engine stalls, the MIL will remain illuminated so long as the ignition switch is ON.
- If the MIL is not illuminated and the engine stalls, the MIL will not illuminate until the ignition switch is cycled OFF, then ON.

Test Description

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

4: This step tests for a short to voltage on the MIL control circuit. With the fuse removed there should be no voltage on the MIL control circuit.

Malfunction Indicator Lamp (MIL) Inoperative

Step	Action	Values	Yes	No
Schematic Reference: <u>Engine Controls Schematics</u> Connector End View Reference: <u>Engine Controls Connector End 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 <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
2	1. Verify whether the instrument panel cluster (IPC) is operational. If the instrument panel (I/P) is completely inoperative, refer to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information. 2. Command the malfunction indicator lamp (MIL) ON and OFF with a scan tool. Does the MIL turn ON and OFF when commanded with a scan tool?	-	Go to <u>Intermittent Conditions</u>	Go to Step 3
3	Inspect the fuse that supplies ignition voltage to the cluster. Is the fuse open?	-	Go to Step 10	Go to Step 4
4	1. Turn OFF the ignition. 2. Remove the fuse that supplies voltage to the cluster. 3. Disconnect the powertrain control module (PCM). 4. Turn ON the ignition, with the engine OFF. 5. Measure the voltage from the MIL control circuit in the PCM harness connector to a good ground. Is the voltage less than the specified value?	0.3 V	Go to Step 5	Go to Step 11

5	1. Turn OFF the ignition. 2. Install the fuse that supplies voltage to the cluster. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the MIL control circuit in the PCM harness connector and a good ground. Is the MIL illuminated?	-	Go to Step 9	Go to Step 6
6	1. Turn OFF the ignition. 2. Remove the IPC. Refer to <u>Instrument Panel Cluster (IPC) Replacement</u> in Instrument Panel, Gages, and Console. 3. Probe the ignition voltage circuit of the IPC harness connector with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to Step 7	Go to Step 12
7	Test the MIL control circuit for an open or high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct a condition?	-	Go to Step 15	Go to Step 8
8	Test for an intermittent and for a poor connection at the IPC. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	-	Go to Step 15	Go to Step 13
9	Test for an intermittent and for a poor connection at the PCM. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	-	Go to Step 15	Go to Step 14
10	Repair the short to ground in the ignition voltage circuit. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	-	Go to Step 15	-
11	Repair the short to voltage in the MIL control circuit. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	-	Go to Step 15	-

12	Repair the open in the ignition voltage circuit. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	-	Go to Step 15	-
13	Replace the IPC. Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	-	Go to Step 15	-
14	Replace the PCM. Refer to Control Module References in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	-	Go to Step 15	-
15	Turn OFF the ignition for 30 seconds. Does the vehicle operate correctly, without any MIL illumination and without any stored DTCs?	-	System OK	Go to Diagnostic Trouble Code (DTC) List - Vehicle in Vehicle DTC Information

MALFUNCTION INDICATOR LAMP (MIL) ALWAYS ON

Circuit Description

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

MIL Operation

The MIL is located on the instrument panel (IPC).

MIL Function

- The MIL informs the driver that a malfunction has occurred and the vehicle should be taken in for service as soon as possible.
- The MIL illuminates during a bulb test and a system test.
- A DTC will be stored if a MIL is requested by the diagnostic.

MIL Illumination

- The MIL will illuminate with ignition switch ON and the engine not running.
- The MIL will turn OFF when the engine is started.
- The MIL will remain ON if the self-diagnostic system has detected a malfunction.
- The MIL may turn OFF if the malfunction is not present.
- If the MIL is illuminated and then the engine stalls, the MIL will remain illuminated so long as the ignition switch is ON.

- If the MIL is not illuminated and the engine stalls, the MIL will not illuminate until the ignition switch is cycled OFF, then ON.

Diagnostic Aids

If the problem is intermittent, refer to **Intermittent Conditions**.

Test Description

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

2: This step determines if the condition is with the MIL control circuit or the PCM.

Malfunction Indicator Lamp (MIL) Always On

Step	Action	Yes	No
Schematic Reference: <u>Engine Controls Schematics</u> Connector End View Reference: <u>Engine Controls Connector End 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 OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Turn ON the ignition, with the engine OFF. 4. Observe the malfunction indicator lamp (MIL). Is the MIL illuminated?	Go to Step 3	Go to Step 5
3	1. Remove the instrument panel cluster (IPC). Refer to <u>Instrument Panel Cluster (IPC) Replacement</u> in Instrument Panel, Gages, and Console. 2. Test the MIL control circuit 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 6	Go to Step 4
4	Replace the IPC. Refer to <u>Control Module References</u> in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to Step 6	-
5	Replace the PCM. Refer to <u>Control Module References</u> in Computer/Integrating Systems for		-

	replacement, setup, and programming. Did you complete the replacement?	Go to Step 6	
6	1. Turn the ignition OFF for 30 seconds. 2. Start the engine. Does the vehicle operate correctly without any MIL illumination, and without any stored DTCs?	System OK	Go to <u>Diagnostic Trouble Code (DTC) List - Vehicle</u> in Vehicle DTC Information

ENGINE CRANKS BUT DOES NOT RUN

Description

The Engine Cranks but Does Not Run diagnostic table is an organized approach to identifying a condition that causes an engine not to start. The Engine Cranks but Does Not Run diagnostic table directs the service technician to the appropriate system diagnosis.

The Engine Cranks but Does Not Run diagnostic table assumes the following:

- The battery is completely charged. Refer to **Battery Inspection/Test** in Engine Electrical.
- The engine cranking speed is acceptable. Refer to **Engine Cranks Slowly** in Engine Electrical.
- There is adequate fuel in the fuel tank.

Test Description

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

- 3:** This step determines if the ignition relay is providing the listed fuses with voltage.
- 5:** This step determines if the fuel pump is operating electrically.
- 6:** If all the Cylinder Injector Circuit Status parameters display Fault, this indicates a condition with the injector supply voltage circuit.

Engine Cranks but Does Not Run

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> in Vehicle DTC Information
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the DTC information with a scan tool.	-	Go to <u>Diagnostic Trouble Code (DTC) List - Vehicle</u> in	

	Does the scan tool display DTC P0101, P0230, P0336, P0601, P0602, P1626, P1630, or P1631?		Vehicle DTC Information	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Probe both sides of the following fuses: • ELEC ENG • Fuel INJ Does the test lamp illuminate on at least one side of the fuses listed?	-	Go to Step 4	Go to <u>Ignition Relay Diagnosis</u>
4	1. Turn OFF the ignition. 2. Disconnect a spark plug wire. 3. Install the J 26792 Spark Tester to the spark plug wire.<u>Special Tools</u> . 4. Attempt to start the engine. Does the J 26792 spark?.<u>Special Tools</u> .	-	Go to Step 5	Go to <u>Electronic Ignition (EI) System Diagnosis</u>
5	Command the fuel pump ON with a scan tool. Does the fuel pump turn ON?	-	Go to Step 6	Go to <u>Fuel Pump Electrical Circuit Diagnosis</u>
6	While monitoring the Cylinder 1-6 Injector Circuit Status parameters with a scan tool, crank the engine. Do all of the Cylinder Injector Circuit Status parameters display OK while cranking the engine?	-	Go to Step 7	Go to <u>Fuel Injector Circuit Diagnosis</u>
7	1. Turn OFF the ignition. 2. Install all disconnected components. 3. Install the J 34730-1A Fuel Pressure Gage.<u>Special Tools</u> . Refer to <u>Fuel System Diagnosis</u>. 4. Turn ON the ignition, with the engine OFF. 5. Command the fuel pump ON with a scan tool. Is the fuel pressure within the specified range when the fuel pump is operating?	358-405 kPa (52-59 psi)	Go to Step 8	Go to <u>Fuel System Diagnosis</u>
	Inspect for the following conditions:			

8	- Collapsed air intake duct - Restricted air filter element-Refer to <u>Air Cleaner Element Replacement</u> . - Spark plugs for being gas or coolant fouled-Refer to <u>Spark Plug Inspection</u> . If the spark plugs are fouled, determine what caused the condition. - Engine mechanical condition, for example, worn timing chain and gears, low compression-Refer to <u>Symptoms - Engine Mechanical</u> and <u>Engine Compression Test</u> in Engine Mechanical. - Restricted exhaust system-Refer to <u>Restricted Exhaust</u> in Engine Exhaust. - The engine coolant temperature (ECT) sensor is NOT close to the actual engine temperature. Refer to <u>DTC P0128</u> . - Compare the manifold absolute pressure/barometric pressure (MAP/BARO) parameters to another vehicle. The parameters should be close in value. Refer to <u>Manifold Absolute Pressure (MAP) Sensor Diagnosis</u>. - Throttle position (TP) sensor for being stuck in range-Refer to <u>DTC P0121</u> .	-		
	Did you find and correct the condition?		Go to Step 9	Go to Diagnostic Aids
9	- Clear the DTCs with a scan tool. - Attempt to start the engine.	-		
	Does the engine start and continue to operate?		Go to Step 10	Go to Step 2
10	- Allow the engine to reach operating temperature. - Observe the DTC information with a scan tool.	-	Go to <u>Diagnostic Trouble Code (DTC) List - Vehicle</u> in Vehicle DTC Information	
	Are there any DTCs that have not been diagnosed?			System OK

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

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: <u>Ground Distribution Schematics</u> and <u>Power Distribution Schematics</u> in Wiring Systems, and <u>Engine Controls Schematics</u> Connector End View Reference: <u>Engine Controls Connector End 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. 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 <u>Probing Electrical Connectors</u> and <u>Troubleshooting with a Test Lamp</u> in Wiring Systems. 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 <u>Probing Electrical Connectors</u> and <u>Troubleshooting with a Test Lamp</u> 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 <u>Relay Replacement (Within an Electrical Center)</u> or <u>Relay Replacement (Attached to Wire Harness)</u> 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 <u>Probing Electrical Connectors</u> and <u>Troubleshooting with a Test Lamp</u> 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 <u>Circuit Testing</u> 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		

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</u> and <u>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</u> in Vehicle DTC Information	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</u> and <u>Troubleshooting with a Test Lamp</u> in Wiring Systems. Does the test lamp illuminate?	Go to Step 40	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the negative battery cable at the battery. Refer to <u>Battery Negative Cable Disconnect/Connect Procedure (LA1)</u> in Engine Electrical. 3. Disconnect the console junction block electrical connector that contains the ignition 1 voltage circuit from the ignition switch. 4. Connect the negative battery cable to the battery. 5. 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 <u>Probing Electrical Connectors</u> and <u>Troubleshooting with a Test Lamp</u> in Wiring Systems		
	Does the test lamp illuminate?	Go to Step 35	Go to Step 9
9	1. Turn OFF the ignition. 2. Disconnect the negative battery cable at the battery. Refer to <u>Battery Negative Cable Disconnect/Connect Procedure (LA1)</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 to the battery. 5. 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 <u>Probing Electrical Connectors</u> and <u>Troubleshooting with a Test Lamp</u> 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 <u>Circuit Testing</u> in Wiring Systems. Did you find a condition?		
		Go to Step 41	Go to Step 42
11	1. Turn OFF the ignition. 2. Probe both test points of the 20-amp 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 Circuit Testing and Wiring Repairs 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 Circuit Testing and Wiring Repairs 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 Circuit Testing 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 Circuit Testing 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. 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 <u>Circuit Testing</u> and <u>Wiring Repairs</u> 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 <u>Probing Electrical Connectors</u> and <u>Troubleshooting with a Test Lamp</u> in Wiring Systems. Does the test lamp illuminate?	Go to Step 40	Go to <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
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 (LA1)</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.		

	- Turn ON the ignition, with the engine OFF. - Probe the ignition 1 voltage circuit at the underhood junction block electrical connector 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 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	- Turn OFF the ignition. - 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	- Turn OFF the ignition. - Remove the ignition relay with the J 43244 from the underhood junction block. - 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	- Turn ON the ignition, with the engine OFF. - 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 <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 (LA1)</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
33	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: • The Eng Controls fuse • The Fuel INJ fuse • The O2 Sensors fuse • The Trans Sol fuse • The ABS fuse • The AWD fuse Refer to <u>Probing Electrical Connectors</u> and <u>Troubleshooting with a Test Lamp</u> 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 <u>Testing for Intermittent Conditions and Poor Connections</u> 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 <u>Wiring Repairs</u> 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 <u>Wiring Repairs</u> 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 <u>Wiring Repairs</u> 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 <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	Go to Step 43	-
39	Replace the ignition relay. Refer to <u>Circuit Protection - Fusible Links</u> in Wiring Systems. Did you complete the replacement?	Go to Step 43	-
40	Replace the ignition switch. Refer to <u>Ignition Switch Replacement</u> in Steering Wheel and Column. Did you complete the replacement?	Go to Step 43	-
41	Replace the console junction block. Refer to <u>Console Electrical Center or Junction Block Replacement</u> in Wiring Systems. Did you complete the replacement?	Go to Step 43	-
42	Replace the underhood junction center. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> 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.		Go to Engine

	Does the engine start and run?	Go to Step 44	<u>Cranks but Does Not Run</u>
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 <u>Diagnostic Trouble Code (DTC) List - Vehicle</u> in Vehicle DTC Information	System OK

FUEL PUMP ELECTRICAL CIRCUIT DIAGNOSIS

Circuit Description

When you turn ON the ignition switch, the control module enables the fuel pump relay which powers the fuel pump ON. The fuel pump remains ON as long as the engine is cranking or running and the control module receives ignition reference pulses. If there are no ignition reference pulses, the control module shuts the fuel pump OFF within 2 seconds after the ignition was switched to the ON position or if the engine stops.

Diagnostic Aids

- Listen for an audible hiss from the fuel pump when the fuel pump relay is commanded ON. A vibration in the fuel feed line when the fuel pump relay is commanded ON indicates that the fuel pump is operating.
- If the condition is intermittent, refer to **Intermittent Conditions**.

Test Description

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

- 2: Command both the ON and OFF states. Repeat the commands as necessary.
- 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 powertrain control module (PCM) is providing voltage to the fuel pump relay.
- 5: This step tests for an open in the fuel pump relay ground circuit.
- 6: This step determines if a voltage is constantly being applied to the fuel pump relay.
- 12: This tests for a grounded fuel pump supply voltage circuit. The fuel pump fuse supplies power to fuel pump. Disconnecting the fuel pump in-line harness connector isolates the fuel pump supply voltage circuit.
- 15: This step jumps the fuel pump relay in order to activate the fuel pump.
- 16: This step tests for an open in the fuel pump feed circuit between the in-line connector and the fuel pump relay.
- 17: This step tests for an open or high resistance in the fuel pump ground circuit.
- 20: 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 Circuit Diagnosis

Step	Action	Yes	No
Schematic Reference: <u>Engine Controls Schematics</u> Connector End View Reference: <u>Engine Controls Connector End 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 <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Command the fuel pump relay ON and OFF with a scan tool. Does the fuel pump turn ON and OFF?	Go to <u>Intermittent Conditions</u>	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 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 the 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 ON and OFF with a scan tool. Does the test lamp turn ON and OFF?	Go to Step 21	Go to Step 24
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 <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 29	Go to Step 28
	Test the control circuit of the fuel pump relay for a short to ground or an open. Refer to <u>Circuit Testing</u>		

8	and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	Go to Step 29	Go to Step 22
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 OFF. Does the fuel pump operate continuously?	Go to Step 23	Go to Step 27
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 fuel pump supply voltage circuit for a short to ground. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. 3. Replace the fuel pump fuse if necessary. Did you find and correct the condition?	Go to Step 29	Go to Step 13
13	1. Lower the fuel tank if necessary. Refer to Fuel Tank Replacement . 2. Test or inspect the fuel tank electrical harness for the following: • Damage to the harness • A grounded circuit-Refer to Circuit Testing and Wiring Repairs in Wiring Systems. 3. Replace the fuel pump fuse if necessary. Did you find and correct the condition?	Go to Step 29	Go to Step 20
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 positive voltage circuit of the fuel pump relay with a test lamp connected to a good ground. Does the test lamp illuminate?	Go to Step 15	Go to Step 25
15	Connect a 10-amp fused jumper wire between the battery positive voltage circuit and the fuel pump supply voltage circuit in the fuel pump cavity. Does the fuel pump operate?	Go to Step 21	Go to Step 16

16	1. Disconnect the fuel pump harness in-line connector located near the fuel tank. 2. Test the fuel pump supply voltage circuit for an open or high resistance between the fuel pump relay and the in-line connector. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 29	Go to Step 17
17	IMPORTANT: Inspect the ground circuit for being tight, corrosion on the terminals, or damage to the wiring harness. Test the ground circuit of the fuel pump for an open or high resistance between the body pass through connector and the 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 29	Go to Step 18
18	Inspect for poor connections at the fuel pump in-line connector to the body pass through connector. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Repairing Connector Terminals</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 29	Go to Step 19
19	1. Lower the fuel tank. Refer to <u>Fuel Tank Replacement</u>. 2. Test or inspect the fuel tank electrical harness for the following: • Damage to the harness • An open circuit-Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 29	Go to Step 26
20	1. Connect all disconnected components. 2. Install a new fuel pump fuse. 3. With a scan tool, command the fuel pump ON. Is the fuel pump fuse open?	Go to Step 26	Go to <u>Intermittent Conditions</u>
21	Inspect for poor connections at the fuel pump relay. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 29	Go to Step 27

22	Inspect for poor connections at the harness of the powertrain control module (PCM). Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 29	Go to Step 28
23	Repair the fuel pump supply voltage circuit for a short to voltage. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	Go to Step 29	-
24	Repair the fuel pump relay ground circuit for an open ground. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	Go to Step 29	-
25	Repair the battery positive voltage circuit of the fuel pump relay for an open. Refer to <u>Wiring Repairs</u> in Wiring Systems. Did you complete the repair?	Go to Step 29	-
26	IMPORTANT: Inspect for poor connections at the fuel pump, within the fuel tank, before replacing the fuel pump. 1. Replace the fuel pump. Refer to <u>Fuel Sender Assembly Replacement</u> . 2. Replace the fuel pump fuse, if necessary. Did you complete the replacement?	Go to Step 29	-
27	IMPORTANT: Before replacing the fuel pump relay, inspect the fuel pump prime circuit for a short to voltage. Replace the fuel pump relay.Did you complete the replacement?	Go to Step 29	-
28	Replace the PCM. Refer to <u>Control Module References</u> in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to Step 29	-
29	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to Diagnostic Trouble Code (DTC) List - Vehicle in Vehicle DTC Information	System OK

FUEL SYSTEM DIAGNOSIS

System Description

When the ignition is turned ON, the powertrain control module (PCM) will turn ON the in-tank fuel pump. The in-tank fuel pump will remain ON as long as the engine is cranking or running and the PCM is receiving ignition reference pulses. If there are no ignition reference pulses, the PCM will turn the in-tank fuel pump OFF 2 seconds after the ignition is turned ON, or 2 seconds after the engine stops running.

The in-tank fuel pump is an electric pump attached to the fuel sender assembly. The fuel pump is designed to provide fuel at a pressure above the pressure needed by the fuel injectors. A fuel pressure regulator, attached to the fuel rail, keeps the fuel available to the fuel injectors at a regulated pressure. Unused fuel is returned to the fuel tank by a separate fuel return pipe.

Test Description

- 2: This step verifies that the fuel pump is operating.
- 4: This step tests for an internal fuel leak. If the fuel pressure drops during this test, then an internal loss of pressure is indicated.
- 6: This step tests the fuel pressure regulator. The fuel pressure regulator is controlled by engine vacuum. With engine vacuum applied, the pressure should drop the specified value.
- 9: This step inspects the fuel pressure regulator for a fuel leak from the vacuum port. If fuel leaks from the fuel pressure regulator while the fuel pump is commanded ON, replace the fuel pressure regulator.
- 10: This step tests for a loss of fuel pressure between the fuel feed pipe shut off adapter and the fuel pump.
- 11: This step tests for a leaking fuel injector, or fuel pressure regulator. If the fuel pressure remains constant during this test, the fuel injectors are not leaking fuel.
- 14: This step tests for a restricted fuel return pipe. If the fuel pressure is within the specified values, a restriction in the fuel return pipe is indicated.
- 16: This step determines if the fuel pressure regulator, or the fuel pump, is the cause of the low fuel pressure. If the pressure rises above the specified value, the fuel pump is OK.
- 18: This step verifies that a circuit condition is not the cause of a fuel pressure concern. Inspect all fuel pump electrical circuits thoroughly.

Fuel System Diagnosis

Step	Action	Values	Yes	No
Schematic Reference: <u>Fuel System Description</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.	-		Go to Fuel

	2. Command the fuel pump ON with a scan tool. Does the fuel pump operate?		Go to Step 3	<u>Pump Electrical Circuit Diagnosis</u>
3	IMPORTANT: Verify there is adequate fuel in the fuel tank before proceeding with this diagnostic. 1. Turn OFF the ignition. 2. Turn OFF all accessories. 3. Install a J 34730-1A Fuel Pressure Gage and the fuel pressure gage fitting. <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: • The fuel pump runs for approximately 2 seconds. Command the fuel pump ON with a scan tool in order to obtain the highest possible fuel pressure. • DO NOT start the engine. 6. Observe the fuel pressure gage, with the fuel pump commanded ON. Is the fuel pressure within the specified value?	358-405 kPa (52-59 psi)	Go to Step 4	Go to Step 12
4	IMPORTANT: The fuel pressure may vary slightly when the fuel pump stops running. After the fuel pump stops running, the fuel pressure should stabilize and remain constant. Monitor the fuel pressure gage for one minuteDoes the fuel pressure drop more than the specified value?	34 kPa (5 psi)	Go to Step 9	Go to Step 5
5	1. Relieve the fuel pressure to the first specified value. 2. Monitor the fuel pressure gage for 5 minutes.	69 kPa (10 psi) 14 kPa (2 psi)		

	Does the fuel pressure drop more than the second specified value?		Go to Step 24	Go to Step 6
6	1. Turn OFF the ignition for 15 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Monitor the fuel pressure gage. 4. Start the engine. Does the fuel pressure drop the specified value when the engine is started?	21-69 kPa (3-10 psi)	Go to Step 7	Go to Step 8
7	1. Operate the vehicle within the conditions of the customers concern. 2. Monitor the fuel related parameters with a scan tool. Do any of the scan tool parameters indicate a lean condition?	-	Go to Step 17	Go to Symptoms - Engine Controls
8	1. Disconnect the vacuum hose from the fuel pressure regulator. 2. Monitor the fuel pressure gage. 3. Idle the engine. 4. Apply 34-47 kPa (12-14 in) of vacuum to the fuel pressure regulator with a hand held vacuum pump. Does the fuel pressure drop the specified value when the vacuum is applied?	21-69 kPa (3-10 psi)	Go to Step 21	Go to Step 23
9	1. Turn OFF the ignition. 2. Remove the vacuum hose from the fuel pressure regulator. 3. Turn ON the ignition, with the engine OFF. 4. Command the fuel pump ON with a scan tool. 5. Inspect for a fuel leak from the fuel pressure regulator vacuum port. Is the fuel pressure regulator leaking fuel?	-	Go to Step 23	Go to Step 10
	1. Turn OFF the ignition. 2. Relieve the fuel pressure. Refer to Fuel Pressure Relief Procedure . 3. Disconnect the fuel feed hose and the fuel return hose from the fuel rail pipes. Refer			

10	to Quick Connect Fitting(s) Service (Metal Collar) . - Install the J 37287 Fuel Line Shut-Off Adapters between the fuel hoses and the fuel rail pipes.Special Tools . - Open the valves on the fuel pipe shut off adapters. - Turn ON the ignition, with the engine OFF. - Command the fuel pump ON with a scan tool. - Bleed the air from the fuel pressure gage. IMPORTANT: Command the fuel pump ON with a scan tool in order to obtain the highest possible fuel pressure. - Close the fuel feed pipe shut off valve. - Monitor the fuel pressure gage for one minute. Does the fuel pressure remain constant?	-		
11	- Turn OFF the ignition. - Open the fuel feed pipe shut off valve. - Turn ON the ignition, with the engine OFF. - Command the fuel pump ON and then OFF with a scan tool. - Close the fuel return pipe shut off valve. - Monitor the fuel pressure gage for one minute. Does the fuel pressure remain constant?	-	Go to Step 19	Go to Step 11
12	Is the fuel pressure above the specified value?	427 kPa (59 psi)	Go to Step 14	Go to Step 13
13	Is the fuel pressure above the specified value?	0 kPa (0 psi)	Go to Step 16	Go to Step 17
	- Turn OFF the ignition. - Relieve the fuel pressure. Refer to Fuel Pressure Relief Procedure . - Disconnect the fuel return hose from the fuel rail return pipe. Refer to Quick Connect Fitting(s) Service (Metal Collar) .			

14	- Attach a length of flexible fuel hose to the fuel rail outlet passage. - Place the open end of the flexible fuel hose into an approved gasoline container. - Turn ON the ignition, with the engine OFF. - Monitor the fuel pressure gage while the fuel pump is operating. Is the fuel pressure within the specified value?	358-405 kPa (52-59 psi)		Go to Step 22
15	Inspect the fuel rail return pipe and fuel rail outlet passage for a restriction. Did you find and correct the condition?	-	Go to Step 25	Go to Step 23
16	- Turn OFF the ignition. - Relieve the fuel pressure. Refer to <u>Fuel Pressure Relief Procedure</u>. - Disconnect the fuel return hose from the fuel rail return pipe. Refer to <u>Quick Connect Fitting(s) Service (Metal Collar)</u>. - Install the J 37287 between the fuel return pipe and the fuel rail. <u>Special Tools</u>. - Open the valve in the fuel pipe shut off adapter. - Turn ON the ignition with the engine OFF. - Bleed the air from the fuel system. - Monitor the fuel pressure gage. NOTE: DO NOT allow the fuel pressure to exceed 517 kPa (75 psi). Excessive pressure may damage the fuel system. - Slowly close the valve in the fuel return pipe shut off adapter. - Command the fuel pump ON with a scan tool. Does the fuel pressure rise above the specified value?	358 kPa (52 psi)	Go to Step 23	Go to Step 17
	Inspect the following components for a restriction: The fuel filter			

17	The fuel feed pipe Did you find and correct the condition?	-	Go to Step 25	Go to Step 18
18	Inspect the harness connectors and ground circuits of the fuel pump for poor connections. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	-	Go to Step 25	Go to Step 19
19	- Remove the fuel sender assembly. Refer to <u>Fuel Sender Assembly Replacement</u>. - Inspect the following components: - The fuel pump flex hose for damage - The in tank fuel pump harness connectors for poor connections - The fuel strainer for a restriction - Contaminates in the fuel tank Did you find and correct the condition?	-	Go to Step 25	Go to Step 24
20	- Turn OFF the ignition. - Raise the fuel rail with the fuel lines connected. Refer to <u>Fuel Rail Assembly Replacement</u>. - Turn ON the ignition, with the engine OFF. - Command the fuel pump ON with a scan tool. - Locate and replace the leaking fuel injector. Refer to <u>Fuel Injector Replacement</u>. Did you complete the replacement?	-	Go to Step 25	-
21	Repair the vacuum source to the fuel pressure regulator. Did you complete the repair?	-	Go to Step 25	-
22	Locate and repair the restricted fuel return line. Did you complete the repair?	-	Go to Step 25	-
23	IMPORTANT: Inspect for a missing or damaged fuel pressure regulator O-ring before replacing the fuel pressure regulator. Replace the fuel pressure regulator. Refer to <u>Fuel</u>	-		-

	Pressure Regulator Replacement .Did you complete the replacement?		Go to Step 25	
24	Replace the fuel pump. Refer to Fuel Sender Assembly Replacement . Is the replacement complete?	-	Go to Step 25	-
25	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 control module enables the appropriate fuel injector on the intake stroke for each cylinder. Ignition voltage is supplied directly to the fuel injectors. The control module 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

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
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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> 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 <u>Testing for Continuity</u> 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
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 <u>Testing for Continuity</u> 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 <u>Fuel Injector Balance Test with Special Tool</u> or <u>Fuel Injector Balance Test with Tech 2</u>	Go to Step 8
5	Remove the upper intake manifold. Refer to <u>Intake Manifold Replacement - Upper</u> 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.	5 ohms		

	Is the resistance more than the specified value?		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. 4. Replace the fuel injector that displays the greatest resistance difference, above or below the average. Refer to <u>Fuel Injector Replacement</u> . 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 <u>Testing for Intermittent Conditions and Poor Connections</u> 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 <u>Fuel Injector Replacement</u> . 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

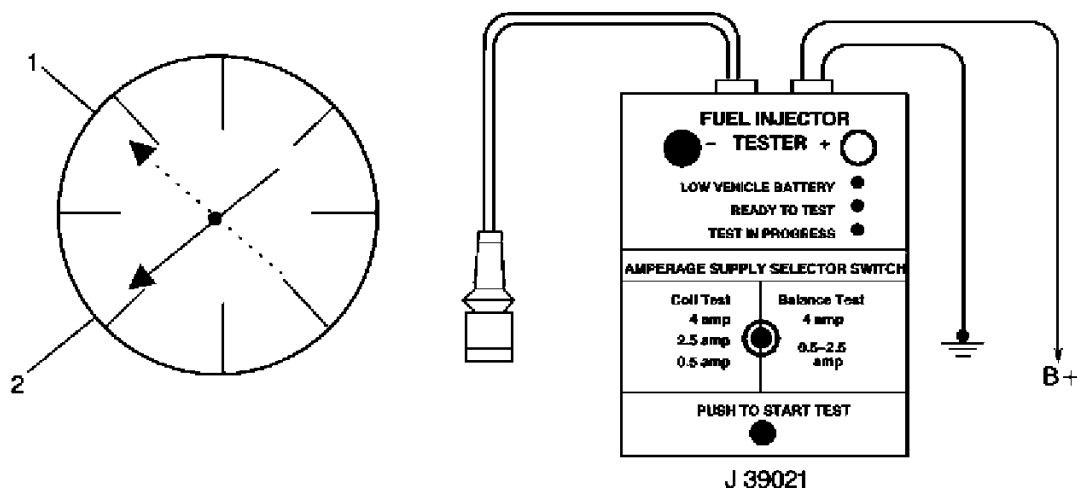


Fig. 1: Performing Fuel Injector Balance Test With Special Tool
 Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 28

Callout	Component Name
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 (Typical)

Cylinder	1	2	3	4
1st Reading	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)
2nd Reading	131 kPa (19 psi)	117 kPa (17 psi)	124 kPa (18 psi)	145 kPa (21 psi)
Amount of Drop	165 kPa (24 psi)	179 kPa (26 psi)	172 kPa (25 psi)	151 kPa (22 psi)
Average Range: 156-176 kPa (22.5-25.5 psi)	Injector OK	Replace fuel injector- too much fuel pressure drop	Injector OK	Replace fuel injector- too little fuel pressure drop

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 10 kPa (1.5 psi) of the average pressure drop value, the fuel injectors are flowing properly.

Fuel Injector Balance Test with Special Tool

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> in Vehicle DTC Information
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.Does the scan tool indicate that the ECT parameter is less than the specified value?	94°C (201°F)	Go to Step 4	-
4	IMPORTANT: Verify there is 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. <u>Special Tools</u> . Refer to <u>Fuel Pressure Gage Installation and Removal</u> . 3. Turn ON the ignition, with the engine OFF. 4. Command the fuel pump ON with a scan tool. IMPORTANT: • You may need to command the fuel pump 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	358-405 kPa (52-59 psi)		

	pump commanded ON.Special Tools . Is the fuel pressure within the specified range?		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.Special Tools .Does the fuel pressure drop more than the specified value?	34 kPa (5 psi)	Go to Fuel System Diagnosis	Go to Step 6
6	1. Connect the J 39021 Fuel Injector Coil/Balance Tester, .Special Tools .J 39021-210 Injector Test Adapter Box, and .Special Tools .J 39021-410 Fuel Injector Test Harness to the fuel injector multi-way connector.Special Tools . 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 ON and then OFF with a scan tool. 4. Record the fuel pressure indicated by the J 34730-1A after the fuel pressure stabilizes.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. 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 .Special Tools . This is the second fuel pressure reading. 7. Repeat steps 1-6 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	10 kPa (1.5 psi)		

	value. 9. Obtain a pressure drop value for each fuel injector. 10. Add all of the individual pressure 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 Symptoms - Engine Controls
7	Clean the fuel injectors. Refer to Fuel Injector Cleaning Procedure . Did you complete the action?	-	Go to Step 8	-
8	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to Diagnostic Trouble Code (DTC) List - Vehicle in Vehicle DTC Information	System OK

FUEL INJECTOR BALANCE TEST WITH TECH 2

Circuit Description

The scan tool first energizes the fuel pump and then the 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.

Test Description

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

- 3: The engine coolant temperature 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 10 kPa (1.5 psi) of the average pressure drop value, the fuel injectors are flowing properly.

Fuel Injector Balance Test with Tech 2

Step	Action	Values	Yes	No
	Did you perform the Diagnostic System Check - Vehicle?			Go to Diagnostic

1		-	Go to Step 2	System Check - Vehicle in Vehicle DTC Information
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). Observe the ECT parameter with a scan tool.Does the scan tool indicate that the ECT parameter is less than the specified value?	94°C (201°F)	Go to Step 4	-
4	IMPORTANT: Verify there is 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.<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: • It may be necessary to command the fuel pump 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 the fuel pump commanded ON.<u>Special Tools</u> . Is the fuel pressure within the specified value?	358-405 kPa (52-59 psi)	Go to Step 5	Go to Fuel System Diagnosis
	IMPORTANT: The fuel pressure may vary slightly when the fuel pump stops operating. After the fuel pump stops operating, the fuel pressure			

5	should stabilize and remain constant. Monitor the J 34730-1A for one minute.Special Tools .Does the fuel pressure drop more than the specified value?	34 kPa (5 psi)	Go to Fuel System Diagnosis	Go to Step 6
6	1. Select the Fuel Injector Balance Test function, within the Special Functions menu, with a scan tool. 2. Select an injector to be tested. 3. Press Enter. This will prime the fuel system. 4. Record the fuel pressure indicated by the J 34730-1A after the fuel pressure stabilizes.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 will energize the injector and decrease the fuel pressure. 6. Record the fuel pressure indicated by the J 34730-1A after the fuel injector has stopped pulsing.Special Tools . This is the 2nd pressure reading. 7. Press Enter again to bring you back to the Select Injector screen. 8. Repeat for each fuel injector. 9. Subtract the 2nd pressure reading from the 1st pressure reading for one fuel injector. The result is the pressure drop value. 10. Obtain a pressure drop value for each fuel injector. 11. Add all of the individual pressure drop values. This is the total pressure drop. 12. Divide the total pressure drop by the number of fuel injectors. This is the average pressure drop.	10 kPa (1.5 psi)		

	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 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 CIRCUIT DIAGNOSIS

Circuit Description

The powertrain control module (PCM) enables the appropriate fuel injector on the intake stroke for each cylinder. A 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.

Diagnostic Aids

- Monitoring the fuel injector circuit status with a scan tool, while moving the fuel injector harness, may help isolate an intermittent condition.
- Performing the Fuel Injector Coil Test may help isolate an intermittent condition. Refer to **Fuel Injector Coil Test**.
- For an intermittent condition, refer to **Intermittent Conditions**.

Test Description

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

- 4: This step tests for a short to ground on the ignition 1 voltage supply circuit of the fuel injector.
- 5: This step tests for a short to a PCM ground on the ignition 1 voltage supply circuit of the fuel injector.
- 6: This step tests for an open between the multi-way connector and the fuel injectors.
- 7: This step tests for an open or high resistance between the multi-way connector and the fuel injectors.

Fuel Injector Circuit 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				
	Did you perform the Diagnostic System Check - Vehicle?			Go to Diagnostic

1		-	Go to Step 2	System Check - Vehicle in Vehicle DTC Information
2	Are any fuel injector DTCs set?	-	Go to DTC P0201-P0206	Go to Step 3
3	Inspect the fuel injector fuse. Is the fuel injector fuse open?	-	Go to Step 4	Go to Step 6
4	1. Turn OFF the ignition. 2. Disconnect the multi-way harness connector of the fuel injectors. 3. Probe the ignition 1 voltage circuit of the fuel injector, fuse side, with a test lamp connected to B+.	-		
	Does the test lamp illuminate?		Go to Step 9	Go to Step 5
5	Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	-	Go to Step 13	Go to Step 8
6	1. Turn OFF the ignition. 2. Disconnect the multi-way harness connector of the fuel injectors. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 1 voltage circuit of the fuel injector, fuse side, with a test lamp connected to a good ground.	-		
	Does the test lamp illuminate?		Go to Step 7	Go to Step 10
7	Test for continuity between the ignition voltage terminal and a fuel injector terminal, at the multi-way harness connector, fuel injector side. Refer to Testing for Continuity in Wiring Systems. Does the DMM display a resistance above the specified value?	5 ohms		
			Go to Step 11	Go to Step 12
8	Test the ignition 1 voltage circuit of the fuel injector, between the multi-way harness connector and the fuel injectors for a short to ground. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-		
			Go to Step 14	Go to Intermittent Conditions
9	Repair the short to ground in the ignition voltage circuit of the fuel injector. Refer to Circuit Testing in Wiring Systems.	-		

	Did you complete the repair?		Go to Step 14	-
10	Repair the open in the ignition 1 voltage between UBEC and the multi-way connector. Refer to Circuit Testing in Wiring Systems. Did you complete the repair?	-	Go to Step 14	-
11	Repair the ignition 1 voltage circuit of the fuel injectors for an open and/or high resistance, between the multi-way connector and the splice. Refer to Circuit Testing in Wiring Systems. Did you complete the repair?	-	Go to Step 14	-
12	Repair the poor connection at the multi-way connector. Refer to Connector Repairs in Wiring Systems. Did you complete the repair?	-	Go to Step 14	-
13	Repair the short to a powertrain control module (PCM) ground in the ignition voltage circuit of the fuel injector. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	-	Go to Step 14	-
14	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to Step 3

FUEL TANK LEAK TEST

Description

The fuel tank leak test is used to locate any fuel or fuel vapor escaping the fuel tank area. Fuel vapors escaping above the fuel level will be detected when the evaporative emission (EVAP) diagnostics completes one test cycle. The malfunction indicator lamp (MIL) will illuminate after the EVAP diagnostics completes two test cycles.

Diagnostic Aids

- Operate the vehicle under the condition of the customers concern. Under high temperature conditions, fuel vapors may increase to the point of EVAP canister vapor saturation. Fuel vapors would then be released into the atmosphere. Once the engine is running and EVAP purge is enabled, all fuel vapor release would be eliminated.
- Test for fuel leaking in the following locations:
 - The fuel tank
 - The fuel feed and return pipes
- Test for fuel vapor leaks in the following locations:
 - The fuel tank, fill limiter vent valve, and rollover valves
 - The fuel fill pipe, hose, and fuel fill cap
 - The fuel sender housing and seal

- The fuel tank pressure (FTP) sensor seal
- The EVAP vapor pipe
- Movement of the EVAP pipes or fuel pipes may help find an intermittent condition.

Test Description

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

- 1:** Perform this procedure to determine that no EVAP DTC is present.
- 3:** This test is to locate fuel leakage in the fuel lines.
- 4:** This tests for fuel leaks below the fuel tank fuel level.
- 5:** This test is to locate fuel vapors escaping above the fuel level in the fuel tank.

Fuel Tank Leak Test

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Vehicle?	Go to Step 2	Go to Diagnostic System Check - Vehicle in Vehicle DTC Information
2	CAUTION: Gasoline or gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby. 1. Raise the vehicle. Refer to Lifting and Jacking the Vehicle in General Information. 2. Inspect the fuel tank and fuel pipes for damage or external leaks. Did you find fuel leaking from the fuel tank?	Go to Step 6	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump ON with a scan tool. 3. Inspect for fuel leaking from the fuel pipes. Did fuel leak from the fuel pipes?	Go to Step 7	Go to Step 4
	1. Turn OFF the ignition. 2. Install the J 41413-200 Evaporative Emissions System Tester (EEST) and the .Special Tools .J 41415-40 Fuel Tank Cap Adapter.Special Tools . 3. Test for a leak referring to the J 41413 Operator		

4	Manual. IMPORTANT: If the floating indicator registers any flow after stabilizing, a leak is evident. 4. Raise the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> in General Information. 5. Inspect for a fuel leak while the system is under pressure. Did fuel leak from the fuel tank?	Go to Step 6	Go to Step 5
5	1. Using the J 41413-200 and the J 41413-210 Operator Manual, introduce smoke into the evaporative emission (EVAP) system.<u>Special Tools</u> . IMPORTANT: It may be necessary to partially lower the fuel tank. Refer to <u>Fuel Tank Replacement</u> . 2. Inspect for leaks in any of the following locations: • The fuel tank, fill limiter vent valve, pressure relief valve, and rollover valves-Refer to <u>Fuel Tank Replacement</u> . • The fuel sender housing and fuel sender seal-Refer to <u>Fuel Sender Assembly Replacement</u> . • The fuel tank pressure (FTP) sensor seal-Refer to <u>Fuel Tank Pressure Sensor Replacement</u> . • The EVAP vapor pipes • The fuel fill pipe and hose-Refer to <u>Filler Tube Replacement</u> . Did you find and correct the condition?	Go to Step 8	Go to Diagnostic Aids
6	Replace the fuel tank. Refer to <u>Fuel Tank Replacement</u> . Did you complete the repair?	System OK	-
7	Replace the leaking fuel pipe. Refer to <u>Fuel Hose/Pipes Replacement - Filter to Engine</u> and <u>Fuel Hoses/Pipes Replacement - Filter to Tank</u> . Did you complete the replacement?	System OK	-

8	Operate the system under the condition of the customer concern in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2
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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, use the following procedure to test the fuel quality:

1. Fill the cylinder with fuel to the 90 ml mark using a 100 ml specified cylinder with 1 ml graduation marks.
2. Add 10 ml of water 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 to release the pressure.
5. 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 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. Draw approximately 0.5 liter of fuel using an approved fuel container.
2. Place the cylinder on a level surface for approximately 5 minutes to allow settling of the particulate contamination.

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Particulate contamination will show up in various shapes and colors. Sand will typically be identified by 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** .

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

Description

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 injection system, and cause a misfire in that cylinder. If the fuel system is contaminated with water, inspect the fuel system components for rust or deterioration.

Ethanol concentrations of greater than 10 percent can cause driveability conditions and fuel system deterioration. Fuel with more than 10 percent ethanol could result in driveability conditions such as hesitation, lack of power, stalling, or no start. Excessive concentrations of ethanol used in vehicles not designed for it may cause fuel system corrosion, deterioration of rubber components, and fuel filter restriction.

Test Procedure

- 1. Test the fuel composition using **J 44175** Fuel Composition Tester and J44175-3 Instruction Manual. See **Special Tools** .
- 2. If water appears in the fuel sample, perform the following steps:
 - 1. Clean the fuel system. Refer to **Fuel System Cleaning** .
 - 2. Replace the fuel filter. Refer to **Fuel Filter Replacement** .
- 3. Subtract 50 from the reading on the DMM in order to obtain the percentage of alcohol in the fuel sample. Refer to the examples in the Fuel Composition Test Examples table.
- 4. If the fuel sample contains more than 15 percent ethanol, add fresh, regular gasoline to the vehicle's fuel tank.
- 5. Test the fuel composition.
- 6. If testing shows the ethanol percentage is still more than 15 percent, replace the fuel in the vehicle. Refer to **Fuel System Cleaning** .

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

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR DIAGNOSIS

Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in intake manifold pressure which gives an indication of the engine load. The MAP sensor has a 5-volt reference circuit, a low reference circuit, and a

signal circuit. The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit and provides a ground on the low reference circuit. The MAP sensor provides a signal to the PCM on the MAP sensor signal circuit, which is relative to the pressure changes in the manifold. With low MAP, such as during idle or deceleration, the PCM should detect a low MAP sensor signal voltage. With high MAP, such as ignition ON, engine OFF, or wide open throttle (WOT), the PCM should detect a high MAP sensor signal voltage. The MAP sensor is also used in order to calculate the barometric pressure (BARO) 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 PCM monitors the MAP sensor signal for voltage outside of the normal range. If the PCM detects a MAP sensor signal voltage that is excessively low, DTC P0107 sets. If the PCM detects a MAP sensor signal voltage that is excessively high, DTC P0108 sets.

Diagnostic Aids

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

Test Description

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

- 4: This step tests the MAP sensor's ability to correctly indicate BARO.
- 12: The measurement noted in this step will be used in subsequent steps if the measurement does not exceed the specified value.
- 15: This step calculates the resistance in the 5-volt reference circuit.
- 16: This step calculates the resistance in the low reference circuit.

Manifold Absolute Pressure (MAP) Sensor 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	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	-		

	Did you find and correct the condition?		Go to Step 30	Go to Step 3
3	IMPORTANT: The vehicle used for the comparison is not limited to the same type of vehicle as is being serviced. A vehicle known to provide an accurate reading is acceptable. Do you have access to another vehicle in which the MAP sensor pressure can be observed with a scan tool?	-	Go to Step 4	Go to Step 5
4	1. Turn ON the ignition, with the engine OFF. 2. Observe the MAP sensor pressure with a scan tool. 3. Observe the MAP sensor pressure in the known good vehicle with a scan tool. 4. Compare the values. Is the difference between the values less than the specified value?	3 kPa	Go to Step 6	Go to Step 10
5	IMPORTANT: The Altitude vs. Barometric Pressure table indicates a pressure range for a given altitude under normal weather conditions. Weather conditions consisting of very low or very high pressure and/or very low or very high temperature may cause a reading to be slightly out of range. 1. Turn ON the ignition, with the engine OFF. 2. Observe the MAP sensor pressure with a scan tool. Refer to Altitude vs Barometric Pressure . 3. The MAP sensor pressure should be within the range specified for your altitude. Does the MAP sensor indicate the correct barometric pressure?	-	Go to Step 6	Go to Step 10
6	1. Observe the MAP sensor pressure with a scan tool. 2. Start the engine.	-		

	Does the MAP sensor pressure change?		Go to Step 7	Go to Step 10
7	1. Turn OFF the ignition. 2. Remove the MAP sensor from the engine vacuum source. Leave the MAP sensor connected to the engine harness. 3. Connect a J 23738-A Mityvac to the MAP sensor.Special Tools . 4. Turn ON the ignition, with the engine OFF. 5. Observe the MAP sensor pressure with the scan tool. 6. Apply vacuum to the MAP sensor with the J 23738-A in 1 inch Hg increments until 15 inches Hg is reached.Special Tools . Each 1 inch Hg should decrease MAP sensor pressure by 3-4 kPa. Is the decrease in MAP sensor pressure consistent?	-	Go to Step 8	Go to Step 10
8	Apply vacuum with the J 23738-A until 20 inches Hg is reached.Special Tools . Is the MAP sensor pressure less than the specified value?	34 kPa	Go to Step 9	Go to Step 10
9	Disconnect the J 23738-A from the MAP sensor.Special Tools . Does the MAP sensor pressure return to the value observed in step 4 or 5?	-	System OK	Go to Step 26
10	Test for an intermittent and for a poor connection at the MAP sensor. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs . Did you find and correct the condition?	-	Go to Step 30	Go to Step 11
11	1. Disconnect the MAP sensor electrical connector. 2. Observe the MAP sensor parameter with the scan tool. Is the voltage less than the specified value?	0.1 V	Go to Step 12	Go to Step 18
12	Measure the voltage from the 5-volt reference circuit of the MAP sensor to a good ground with a DMM. Refer to Circuit Testing . Note the measurement as Supply Voltage. Is the voltage more than the specified value?	5.2 V	Go to Step 19	Go to Step 13
13	Is the voltage more than the specified value?	4.8 V	Go to Step 14	Go to Step 20

14	1. Disconnect the harness connector from the engine coolant temperature (ECT) sensor. 2. Connect a test lamp and a DMM in series between the 5-volt reference circuit and the low reference circuit of the MAP sensor, at the harness connector. 3. Measure the amperage, with the DMM. Note the measurement as Amperage. Is the amperage equal to the specified value?	0 mA	Go to Step 23	Go to Step 15
15	1. Remove the DMM from the circuit. 2. Connect the test lamp between the 5-volt reference circuit and the low reference circuit of the MAP sensor, at the harness connector. 3. Measure the voltage from the 5-volt reference circuit at the test lamp to a good ground, with the DMM. Note the measurement as Load Voltage Drop. IMPORTANT: Before any calculations are performed, ensure that all measurements are converted to like units. For example, volts/amps or millivolts/milliamps. 4. Subtract the Load Voltage Drop from the Supply Voltage. Note the result as Supply Voltage Drop. 5. Divide the Supply Voltage Drop by the Amperage. Is the result more than the specified value?	5 ohms	Go to Step 21	Go to Step 16
16	1. Measure the voltage from the low reference circuit of the MAP sensor at the test lamp to a good ground, with the DMM. Note the result as Low Reference Voltage Drop. IMPORTANT: Before any calculations are performed, ensure that all measurements are converted to like units. For example, volts/amps or millivolts/milliamps.	5 ohms		

	2. Divide the Low Reference Voltage Drop by the Amperage. Is the result more than the specified value?		Go to Step 24	Go to Step 17
17	1. Remove the test lamp. 2. Connect a 3-amp fused jumper wire between the 5-volt reference circuit and the signal circuit of the MAP sensor, at the harness connector. 3. Observe the MAP sensor parameter with the scan tool. Is the voltage more than the specified value?	4.9 V	Go to Step 26	Go to Step 22
18	Test the MAP sensor signal circuit between the powertrain control module (PCM) and the MAP sensor for a short to voltage. Refer to Circuit Testing and Wiring Repairs . Did you find and correct the condition?	-	Go to Step 30	Go to Step 25
19	Test the 5-volt reference circuit between the PCM and the MAP sensor for a short to voltage. Refer to Circuit Testing and Wiring Repairs . Did you find and correct the condition?	-	Go to Step 30	Go to Step 25
20	Test the 5-volt reference circuit between the PCM and the MAP sensor for an open or for a short to ground. Refer to Circuit Testing and Wiring Repairs . Did you find and correct the condition?	-	Go to Step 30	Go to Step 25
21	Test the 5-volt reference circuit between the PCM and the MAP sensor for high resistance. Refer to Circuit Testing and Wiring Repairs . Did you find and correct the condition?	-	Go to Step 30	Go to Step 25
22	Test the MAP sensor signal circuit between the PCM and the MAP sensor for an open or for a short to ground. Refer to Circuit Testing and Wiring Repairs . Did you find and correct the condition?	-	Go to Step 30	Go to Step 25
23	Test the low reference circuit between the PCM and the MAP sensor for an open. Refer to Circuit Testing and Wiring Repairs . Did you find and correct the condition?	-	Go to Step 30	Go to Step 25
24	Test the low reference circuit between the PCM and the MAP sensor for high resistance. Refer to Circuit Testing and Wiring Repairs . Did you find and correct the condition?	-	Go to Step 30	Go to Step 25
	Test for shorted terminals and for poor			

25	connections at the PCM. Refer to Testing for Intermittent Conditions and Poor Connections and Connector Repairs . Did you find and correct the condition?	-	Go to Step 30	Go to Step 27
26	Test the HO2S 1 low signal circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs . Did you find and correct the condition?	-	Go to Step 30	Go to Step 28
27	Test the HO2S 1 low signal circuit for an open or high resistance. Refer to Circuit Testing and Wiring Repairs . Did you find and correct the condition?	-	Go to Step 30	Go to Step 29
28	Replace the MAP sensor. Refer to Manifold Absolute Pressure (MAP) Sensor Replacement . Did you complete the replacement?	-	Go to Step 30	-
29	Replace the PCM. Refer to Control Module References for replacement, setup, and programming. Did you complete the replacement?	-	Go to Step 30	-
30	1. Reassemble the vehicle as necessary. 2. Clear the DTCs with the scan tool. 3. Start the engine. 4. Operate the system in order to verify the repair. Did you correct the condition?	-	Go to Step 31	Go to Step 2
31	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to Diagnostic Trouble Code (DTC) List - Vehicle	System OK

IDLE AIR CONTROL (IAC) SYSTEM DIAGNOSIS

Circuit Description

The engine idle speed is controlled by the idle air control (IAC) valve. The IAC valve is on the throttle body. The IAC valve pintle moves in and out of an idle air passage bore to control air flow around the throttle plate. The IAC valve consists of a movable pintle, driven by a gear attached to an electric motor called a stepper motor. The stepper motor is capable of highly accurate rotation, or of movement, called steps. The stepper motor has 2 separate windings that are called coils. Each coil is supplied current by 2 circuits from the powertrain control module (PCM). When the PCM changes polarity of a coil, the stepper motor moves one step. The PCM uses a predetermined number of counts to determine the IAC pintle position. Observe IAC counts with a scan tool. The IAC counts will increment up or down as the PCM attempts to change the IAC valve

pintle position. An IAC Reset will occur when the ignition key is turned OFF. First, the PCM will seat the IAC pintle in the idle air passage bore. Second, the PCM will retract the pintle a predetermined number of counts to allow for efficient engine start-up. If the engine idle speed is out of range for a calibrated period of time, an idle speed diagnostic trouble code (DTC) sets.

Diagnostic Aids

Inspect for the following conditions:

- High resistance in an IAC valve control circuit
- The correct positive crankcase ventilation (PCV) valve, properly installed and proper operation of the PCV valve
- Proper operation and installation of all air intake components
- Proper installation and operation of the mass air flow (MAF) sensor
- A tampered with or damaged throttle stop screw
- A tampered with or damaged throttle plate, throttle shaft, throttle linkage, or cruise control linkage
- A skewed high throttle position (TP) sensor
- Excessive deposits in the IAC passage or on the IAC pintle
- Excessive deposits in the throttle bore or on the throttle plate
- Vacuum leaks
- A high or unstable idle condition could be caused by a non-IAC system problem that can not be overcome by the IAC valve.
- If the problem is determined to be intermittent, refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Test Description

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

- 5: This test will determine the ability of the PCM and IAC valve control circuits to control the IAC valve.
- 7: This test will determine the ability of the PCM to provide the IAC control valve circuits with a ground. On a normally operating system, the test lamp should not flash while the IAC Counts are incrementing.

Idle Air Control (IAC) System Diagnosis

Step	Action	Yes	No
Schematic Reference: <u>Engine Controls Schematics</u> Connector End View Reference: <u>Engine Controls Connector End 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
	IMPORTANT:		

2	Ensure that the Engine Speed parameter stabilizes with each Commanded RPM change to determine if the engine speed stays within 100 RPM less than the Commanded RPM or within 150 RPM more than the Commanded RPM. 1. Set the parking brake and block the drive wheels. 2. Start the engine. 3. Turn OFF all accessories. 4. Slowly increment the engine speed to 1,700 RPM, then to 600 RPM, then to 1,700 RPM with the scan tool RPM Control function. 5. Exit the RPM Control function. Did the Engine Speed parameter stabilize within 100 RPM less than the commanded engine speed or within 150 RPM above the Commanded RPM?	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the idle air control (IAC) valve. 3. Connect an J 37027-1A IAC Motor Driver to the IAC valve.Special Tools . 4. Start the engine. 5. Command the IAC valve in until 600 RPM is reached with the J 37027-1A .Special Tools . 6. Command the IAC valve out until 1,700 RPM is reached with the J 37027-1A .Special Tools . 7. Return the engine speed to the Desired Idle Speed parameter. Did the Engine Speed parameter steadily decrease to 600 RPM and steadily increase to 1,700 RPM when the IAC valve was commanded in and out?	Go to Step 5	Go to Step 4
4	Did you observe an excessively high idle condition that could not be controlled with the IAC motor driver?	Go to Step 11	Go to Step 12
	1. Connect a test lamp between one of the IAC valve control circuits and a good ground. 2. Start the engine. 3. Observe the IAC Counts parameter with a scan tool. 4. Command high RPM with the J 37027-1A until the IAC Counts parameter starts to increment.Special Tools .		

5	- Command low RPM with the J 37027-1A until the IAC Counts parameter starts to increment.<u>Special Tools</u> . - Return the Engine Speed to the Desired Idle Speed parameter. - Repeat the above procedure for the other three IAC valve control circuits. Did the test lamp remain ON, never flashing, while the IAC Counts were incrementing for any of the IAC valve control circuits?	Go to Step 10	Go to Step 6
6	Did the test lamp remain OFF, never flashing, while the IAC Counts were incrementing for any of the IAC valve control circuits?	Go to Step 9	Go to Step 7
7	- Connect a test lamp between the IAC coil A low control circuit and the IAC coil A high control circuit. - Observe the IAC Counts parameter with a scan tool and the test lamp. - Command high RPM with the J 37027-1A until the IAC Counts parameter starts to increment.<u>Special Tools</u> . - Command low RPM with the J 37027-1A until the IAC Counts parameter starts to increment.<u>Special Tools</u> . - Return the Engine Speed parameter to the Desired Idle Speed parameter. - Repeat the above procedure with the test lamp connected between the IAC coil B low control circuit and the IAC coil B high control circuit. Did the test lamp stay illuminated, never flashing, while the IAC Counts were incrementing?	Go to Step 8	Go to Step 17
8	Test for an intermittent and for a poor connection at the IAC valve. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 13
	- Turn OFF the ignition. - Disconnect the powertrain control module (PCM). - Test the circuit where the test lamp remained OFF for the following conditions:		

9	• An open circuit • A short to ground • A short to another IAC valve control circuit-Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 13
10	1. Turn ON the ignition. 2. Test the IAC valve control circuit where the test lamp remained illuminated for the following conditions: • A short to voltage • A short to another IAC valve control circuit- Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 13
11	1. Inspect for the following: • Throttle body damage and tampering • Skewed throttle position (TP) sensor signal • Throttle lever screw tampering, if equipped • Vacuum leaks • Faulty, incorrectly installed positive crankcase ventilation (PCV) valve and hose, if equipped • Throttle shaft binding • Throttle linkage or cruise control linkage binding, if equipped 2. Remove the IAC valve. Refer to <u>Idle Air Control (IAC) Valve Replacement</u> . 3. Inspect for the following conditions: • Debris in the IAC passage • Excessive deposits on the throttle plate • Excessive deposits in the throttle bore • Excessive deposits on IAC valve pintle Did you find and correct the condition?	Go to Step 18	Go to Step 15
	1. Inspect for the following conditions: • Throttle body damage and tampering • Throttle lever screw tampering, if equipped		

12	- Excessive deposits on the throttle plate - Restricted air intake system-Inspect the following conditions: - A possible collapsed or clogged air intake duct, before and after the air filter element - A restricted air filter element - Restriction at the throttle body intake screen, if equipped - Remove the IAC valve. Refer to <u>Idle Air Control (IAC) Valve Replacement</u>. - Inspect for excessive deposits on the IAC valve pintle and in the IAC valve passage. Did you find and correct the condition?	Go to Step 18	Go to Step 15
13	Test for an intermittent and for a poor connection at the PCM. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and to <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 14
14	- Disconnect the PCM. - Test all IAC valve control circuits for high resistance. Refer to <u>Circuit Testing</u> and <u>Wiring Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 17
15	Test for an intermittent and for a poor connection at the IAC valve. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	Go to Step 18	Go to Step 16
16	Replace the IAC valve. Refer to <u>Idle Air Control (IAC) Valve Replacement</u>. Did you complete the replacement?	Go to Step 18	-
17	Replace the PCM. Refer to <u>Control Module References</u> in Computer/Integrating Systems for replacement, setup, and programming. Did you complete the replacement?	Go to Step 18	-
18	- Reassemble the vehicle as necessary. - Clear any DTCs with a scan tool. - Start the engine. - Operate the system to verify the repair.		

	Did you correct the condition?	Go to Step 19	Go to Step 2
19	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to <u>Diagnostic Trouble Code (DTC) List - Vehicle</u> in Vehicle DTC Information	System OK

ELECTRONIC IGNITION (EI) SYSTEM DIAGNOSIS

Circuit Description

The ignition control module (ICM) has independent power and ground circuits. The circuits between the ICM and the powertrain control module (PCM) consist of the following circuits:

- The ignition control (IC) timing signal
- The IC timing control
- The low-resolution engine speed signal
- A low reference

For a complete system description, refer to **Electronic Ignition (EI) System Description** .

Electronic Ignition (EI) System Diagnosis

Step	Action	Values	Yes	No
Schematic Reference: <u>Engine Controls Schematics</u> Connector End View Reference: <u>Powertrain Control Module (PCM) Connector End Views</u> or <u>Engine Controls Connector End Views</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	Inspect the fuse that supplies power on the ignition 1 voltage circuit to the ignition control module (ICM). Is the fuse open?	-	Go to Step 17	Go to Step 3
3	Test for an intermittent and for a poor connection at the power and ground 2-way connector of the ICM. Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems. Did you find and correct the condition?	-	Go to Step 24	Go to Step 4
	1. Disconnect the power and ground 2-way connector from the ICM.			

4	2. Probe the ignition 1 voltage circuit with a test lamp that is connected to the ground circuit, at the 2-way connector. Refer to <u>Probing Electrical Connectors</u> in Wiring Systems. Does the test lamp illuminate?	-	Go to Step 6	Go to Step 5	
5	Probe the ignition 1 voltage circuit at the 2-way connector, with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to Step 19	Go to Step 18	
6	1. Disconnect the crankshaft position (CKP) sensor A. 2. Observe the 3X crank sensor parameter with a scan tool. 3. Crank the engine. Does the scan tool indicate a 3X crank sensor signal present?	-	Go to Step 7	Go to <u>Crankshaft Position Sensor (CKP) System Diagnosis</u>	
7	1. Remove the fuel pump relay with the J 43244 Relay Puller Pliers. 2. Connect the CKP sensor A. 3. Test for spark at each cylinder with a J 26792 Spark Tester.<u>Special Tools</u> . Did you have spark on any of the cylinders?	-	Go to Step 8	Go to Step 16	
8	Did you have spark on all of the cylinders?	Go to Step 9			Go to Step 11
9	Does the spark tester indicate a bright blue spark on all cylinders?	-	Go to Step 10	Go to Step 11	
10	1. Remove the spark plugs. 2. Examine the spark plugs for any abnormal conditions or damage. Refer to <u>Spark Plug Inspection</u> . Are the spark plugs in good condition?	-	System OK	Go to Step 20	
	1. Turn OFF the ignition. 2. Connect the J 26792 to the spark				

11	plug wire of the inoperative cylinder.Special Tools . - Switch the inoperative spark plug wire connection with a known good cylinder at the ignition coils. - Crank the engine. Do you have spark on the inoperative cylinder?	-	Go to Step 12	Go to Step 14
12	- Disconnect the spark plug wires from the inoperative ignition coil. - Measure the secondary resistance of the ignition coil. Is the resistance within the specified range?	5,000-8,000 ohms	Go to Step 13	Go to Step 22
13	- Remove the inoperative ignition coil. - Connect a test lamp between the control circuits of the ignition coil on the ICM. - Crank the engine. Does the test lamp flash while the engine is being cranked?	-	Go to Step 15	Go to Step 23
14	Test the spark plug wires for the following conditions: - Proper routing and correct firing order-Refer to Ignition System Specifications . - Arching to ground 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 24	Go to Step 21
15	Test for an intermittent and for a poor connection at the ignition coil. 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 24	Go to Step 22
16	Test for an intermittent and for a poor connection at the ICM. 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 24	Go to Step 23
17	Test the ignition 1 voltage circuit of the ICM for a short to ground. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 24	Go to Step 23
18	Repair the open in the ignition 1 voltage circuit of the ICM. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	-	Go to Step 24	-
19	Repair the open in the ground circuit of the ICM. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	-	Go to Step 24	-
20	Replace the spark plugs. Refer to Spark Plug Replacement . Did you complete the replacement?	-	Go to Step 24	-
21	Replace the spark plug wires. Refer to Spark Plug Wire Replacement . Did you complete the replacement?	-	Go to Step 24	-
22	Replace the ignition coil. Refer to Ignition Coil(s) Replacement . Did you complete the replacement?	-	Go to Step 24	-
23	Replace the ICM. Refer to Ignition Control Module Replacement . Did you complete the replacement?	-	Go to Step 24	-
24	1. Reassemble the vehicle as necessary. 2. Turn the ignition OFF for 30 seconds. 3. Start the engine and operate the vehicle. 4. Observe the vehicle performance and driveability. Does the vehicle operate normally?	-	System OK	Go to Step 1

CRANKSHAFT POSITION SENSOR (CKP) SYSTEM DIAGNOSIS

Circuit Description

The crankshaft position (CKP) sensor B is a 7X variable reluctance sensor. This produces 7 digital ON/OFF pulses per engine revolution. These pulses occur when a reluctor wheel, mounted to the crankshaft and containing 6 slots evenly spaced 60 degrees apart and one slot spaced at 10 degrees, passes by the sensor. The 7X sensor is connected directly to the ignition control module (ICM). The sensor wiring includes 2 circuits, a CKP sensor signal circuit, and a low reference circuit. The ICM uses the 7X signal to determine the engine position and speed. There are no DTCs to diagnose the CKP sensor B. This CKP sensor system diagnosis is used to diagnose a fault with the CKP sensor B and the CKP sensor B circuits.

Crankshaft Position Sensor (CKP) System Diagnosis

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics Connector End View Reference: Engine Controls Component Views , 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> in Vehicle DTC Information
2	1. Disconnect the crankshaft position (CKP) sensor A. 2. Observe the 3X crank sensor parameter with a scan tool. 3. Crank the engine. Does the scan tool display a 3X crank sensor RPM ?	-	Go to <u>Intermittent Conditions</u>	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the CKP sensor B connector from the ignition control module (ICM). 3. Probe the CKP sensor signal circuit of the CKP sensor B with a test lamp connected to battery voltage. Refer to <u>Probing Electrical Connectors</u> in Wiring Systems. Does the test lamp illuminate?	-	Go to Step 7	Go to Step 4
4	1. Turn ON the ignition. 2. Probe the CKP sensor signal circuit of the CKP sensor B with a test lamp connected to a good ground. Refer to <u>Probing Electrical Connectors</u> in Wiring Systems.	-		

	Does the test lamp illuminate?		Go to Step 8	Go to Step 5
5	Measure the resistance from the CKP sensor signal circuit to the low reference circuit of the CKP sensor B with a DMM. Refer to Circuit Testing in Wiring Systems. Is the resistance within the specified range?	800-1200 ohms	Go to Step 10	Go to Step 6
6	Test the CKP sensor B circuits for high resistance. Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 16	Go to Step 9
7	Repair the short to ground in the CKP sensor signal circuit. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	-	Go to Step 16	-
8	Repair the short to voltage in the CKP sensor signal circuit. Refer to Wiring Repairs in Wiring Systems. Did you complete the repair?	-	Go to Step 16	-
9	Test the CKP sensor B circuits for the following conditions: • An open • The CKP sensor signal shorted to the low reference Refer to Circuit Testing and Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 16	Go to Step 11
10	Test for an intermittent and for a poor connection at the ICM. 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 16	Go to Step 12
11	Test for an intermittent and for a poor connection at the CKP sensor. 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 16	Go to Step 14
	1. Remove the CKP sensor B. Refer to Crankshaft Position (CKP) Sensor Replacement (24X CKP Sensor) . 2. Visually inspect the CKP sensor B for the following conditions:			

12	- Physical damage - Excessive play or looseness - Improper installation - Foreign material passing between the CKP sensor B and the reluctor wheel - Electromagnetic interference (EI) in the CKP sensor B circuits	-		
	Did you find and correct the condition?		Go to Step 16	Go to Step 13
13	Inspect the crankshaft reluctor wheel for the following conditions: - Physical damage - Excessive end play or looseness - Improper installation	-		
	Refer to <u>Crankshaft and Bearings Cleaning and Inspection</u> in Engine Mechanical. Did you find and correct the condition?		Go to Step 16	Go to Step 15
14	Replace the CKP sensor B. Refer to <u>Crankshaft Position (CKP) Sensor Replacement (24X CKP Sensor)</u> . Did you complete the replacement?	-	Go to Step 16	-
15	Replace the ICM. Refer to <u>Ignition Control Module Replacement</u> . Did you complete the replacement?	-	Go to Step 16	-
16	- Reassemble the vehicle as necessary. - Turn the ignition OFF for 30 seconds. - Start the engine and operate the vehicle. - Observe the malfunction indicator lamp (MIL), vehicle performance, and driveability.	-		
	Does the vehicle operate normally, with no MIL?		System OK	Go to Step 2

INSPECTION/MAINTENANCE (I/M) SYSTEM CHECK

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 DTC. A system monitor is complete when either all of the DTCs comprising 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 heated oxygen sensor (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 4 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. Not all vehicles have a full complement of emission control systems. For example, a vehicle may not be equipped with secondary air injection (AIR) or exhaust gas recirculation (EGR). 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 emissions (EVAP) system
- The EGR 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 **Inspection/Maintenance (I/M) System DTC Table**. 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.

Inspection/Maintenance (I/M) System Check

Step	Action	Yes	No
1	1. Perform the <u>Diagnostic System Check - Vehicle</u> in Vehicle DTC Information. IMPORTANT: Many DTC related repairs will instruct the technician to clear the DTC information. This procedure will reset ALL of the I/M System Status indicators to NO, and require performing the I/M Complete System Set Procedure. 2. Repair any DTCs or driveability concerns that would prevent the I/M System Status tests from completing. Did you find and repair a DTC or driveability concern?	Go to Step 3	Go to Step 2
2	1. Review any service bulletins for software updates that may prevent inspection/maintenance (I/M) readiness. 2. Perform any reprogramming or repairs indicated by the service bulletins. Was a reprogramming or repair service required?	Go to <u>Inspection/Maintenance (I/M) Complete System Set Procedure</u>	Go to Step 3
3	Observe the I/M System Status display with a scan tool. Is more than one test indicating a NO status?	Go to <u>Inspection/Maintenance (I/M) Complete System Set Procedure</u>	Go to the I/M System Set Procedure for the indicated system

INSPECTION/MAINTENANCE (I/M) COMPLETE SYSTEM SET 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 diagnostic tests are completed, the I/M System Status indicators are set to YES. Perform this test when more than one or all of the I/M System Status indicators are set to NO.

Conditions for Running

Cold Start

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- The barometric pressure (BARO) is more than 74 kPa.
- The engine coolant temperature (ECT) is below 35°C (95°F).
- The intake air temperature (IAT) is below 35°C (95°F).
- The difference between the IAT and the ECT is 6°C (10.8°F) or less.
- The battery voltage is between 10-18 volts.
- The fuel level is between 15-85 percent.

Diagnostic Aids

Rough road conditions may prevent some of the tests from running. Extreme high or low ambient temperatures may prevent tests such as heated oxygen sensor (HO2S) Heater and evaporative emission (EVAP) System from initiating. If a step is interrupted before completion, perform the remaining portion of the set procedures. Any portion of the set procedure that requires the engine at operating temperature may be repeated. This allows most of the diagnostics to run and the remaining tests can be performed using the individual System Set Procedures.

The scan tool can be used to monitor each of the I/M System Status indicators during the I/M complete system set procedure. When all of the indicators for a test step have updated to YES, testing can move on to the next step, even if the remaining portion of the test is not complete. For example, step 3 is designed to run the EVAP, secondary air injection (AIR), and HO2S tests. The procedure instructs the technician to operate the vehicle in the enable conditions for 6 minutes. If all 3 tests have updated to YES within 4 minutes, it is not necessary to continue with the enable conditions and testing can advance to the next step.

Test Description

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

- 2: This step is to run the HO2S Heater Tests and initiate the EVAP System Test. Preprogramming the scan tool will reduce the amount of time the oxygen sensor heaters operate while verifying the enable criteria.
- 3: This step is to run the EVAP, AIR and the Oxygen Sensor Tests. The EVAP Test begins once the engine coolant reaches a calibrated temperature. The AIR Test, if equipped, begins shortly after Closed Loop and the indicated speed is achieved. The Oxygen Sensor Tests begin once the engine is at operating temperature, in Closed Loop Fuel Control, and a calibrated amount of time has elapsed.
- 4: This step is to run the exhaust gas recirculation (EGR) Tests. The EGR Tests are run during a gradual deceleration with a closed throttle. The vehicle speed is required in order to maintain a high, steady manifold absolute pressure (MAP) signal.
- 5: This step is to run the Catalyst Tests. This test runs during the idle period immediately following a cruise period that meets a minimum calibrated RPM and time period.
- 7: The I/M System Status only reports on whether or not a diagnostic has run, not what the outcome of the test was. If any emission related DTC sets after the tests are complete, the DTC will require diagnosis.

Inspection/Maintenance (I/M) Complete System Set Procedure

Step	Action	Value(s)	Yes	No
	Did you perform the			Go to

1	Inspection/Maintenance (I/M) System Check?	-	Go to Step 2	Inspection/Maintenance (I/M) System Check
2	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. Preprogram the scan tool with the vehicle information before the ignition is turned ON. 2. Ensure the vehicle is within the Conditions for Running specified in the supporting text. 3. Turn OFF all of the accessories, e.g., A/C, blower fan, etc. 4. Set the vehicle parking brake. 5. Verify the transmission is in Park for automatic transmissions and Neutral for manual transmissions. 6. Start the engine and allow it to idle for the specified time. Is the action complete?	2 minutes	Go to Step 3	-
3	CAUTION: Refer to Road Test Caution in Cautions and Notices. In order for the next group of tests to run, the vehicle must operate in the following conditions: 1. Acceleration at part throttle to 72 km/h (45 mph) with this speed maintained until the engine reaches operating temperature-This may be up to 10 minutes depending on the start up coolant temperature.	-		

	2. Continued operation under these conditions for an additional 3 minutes			
	Is the action complete?		Go to Step 4	-
4	CAUTION: Refer to <u>Road Test Caution</u> in Cautions and Notices. In order for the next group of tests to run, the vehicle must operate in the following conditions: 1. Accelerate to 89 km/h (55 mph) with this speed maintained for one additional minute. 2. Decelerate to 48 km/h (30 mph) while the following criteria is maintained: • The throttle is closed • There is NO brake application on either manual or automatic transmission • There is NO clutch actuation on a manual transmission • There is NO manual downshift	-		
	Is the action complete?		Go to Step 5	-
5	CAUTION: Refer to <u>Road Test Caution</u> in Cautions and Notices. In order for the next group of tests to run, the vehicle must operate in the following conditions: 1. Acceleration at part throttle to 90 km/h (55 mph) with this speed maintained for 5 minutes. 2. Deceleration to 0 km/h (0 mph). 3. Engine idling for 2 minutes while the following criteria is maintained: • Service brake depressed	-		

	- Automatic transmission in drive - Manual transmission in neutral with the clutch pedal depressed			
	Is the action complete?		Go to Step 6	-
6	Observe the I/M System Status display with a scan tool. Did all of the I/M System Status indicators update to YES?	-	Go to Step 7	Go to the I/M System Set Procedure for the indicated systems that have not passed
7	Observe the Emission Related DTC portion of the I/M System Status display with a scan tool. Does the scan tool indicate any Emission Related DTCs set?	-	Go to <u>Diagnostic Trouble Code (DTC) List - Vehicle</u> in Vehicle DTC Information	System OK

INSPECTION/MAINTENANCE (I/M) SYSTEM DTC TABLE

IMPORTANT: Not all vehicles will have every diagnostic trouble code (DTC) listed in each section. For example, a vehicle may have only 2 oxygen sensors or 1 catalyst. Only those DTCs applicable to the vehicle are required to update each System Status to YES. Refer to the appropriate service manual to determine which DTCs are supported for each vehicle.

Inspection/Maintenance (I/M) System DTC Table

System	DTCs Required to Set System Status to YES
Catalyst	<u>DTC P0420</u> Catalyst System Low Efficiency
EVAP	<u>DTC P0442</u> Evaporative Emission (EVAP) System Small Leak Detected <u>DTC P0446</u> Evaporative Emission (EVAP) Vent System Performance <u>DTC P0455</u> Evaporative Emission (EVAP) System Large Leak Detected <u>DTC P0496</u> Evaporative Emission (EVAP) System Flow During Non-Purge
Oxygen Sensor	<u>DTC P0133</u> HO2S Slow Response Bank 1 Sensor 1 <u>DTC P0140</u> HO2S Circuit Insufficient Activity Bank 1 Sensor 2 <u>DTC P1133</u> HO2S Insufficient Switching Bank 1 Sensor 1 <u>DTC P1134</u> HO2S Transition Time Ratio Bank 1 Sensor 1 <u>DTC P2A01</u> HO2S Circuit Closed Loop (CL) Performance Bank 1 Sensor 2
Oxygen Sensor Heater	<u>DTC P0135</u> HO2S Heater Performance Bank 1 Sensor 1 <u>DTC P0141</u> HO2S Circuit Low Voltage Bank 1 Sensor 2

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

Description

The purpose of this test is to satisfy the enable criteria necessary to execute inspection/maintenance (I/M) readiness diagnostics for the catalyst system. The test may be used to set the I/M System Status indicators to YES. The I/M System Status display on the scan tool provides an indication of whether the control module has completed the required tests. The I/M System Status does not indicate that the tests have passed or failed. When all of the diagnostics for a specific system have run and passed, the I/M System Status will update to YES. If a test for a specific system has failed, the I/M System Status will update to YES, indicating a determination was made even if all of the other tests for that system have not run.

Conditions for Running

- The engine has been running longer than 10 minutes.
- The engine load must be stable.
- The idle air control (IAC) position parameter does not change more than 5 counts.
- The throttle position (TP) is below 1.5 percent.
- The short term fuel trim (FT) is between -20 and +20 percent.
- The transaxle is in drive for automatic transaxle, or in neutral for manual transaxle with the clutch pedal depressed.
- The barometric pressure (BARO) is more than 74 kPa.
- The engine coolant temperature (ECT) is between 75-126°C (167-258.8°F).
- The engine is in Closed Loop fuel control.
- The battery voltage is more than 10.7 volts.
- The intake air temperature (IAT) is between -20 and +100°C (-4 and +212°F).
- The difference between the engine speed and the desired engine speed is less than 200 RPM.
- The mass air flow (MAF) is between 3-10 grams per second.

Diagnostic Aids

The control module runs a maximum of 6 tests per trip until the Catalyst System Status updates to YES. If the status does not update, the test outlined in this procedure can be repeated until the I/M System Status updates to YES.

If there is an impending failure, the system may require more time to run the diagnostic than was allotted in the set procedure. If the test does not run after numerous attempts and no DTC is set, review the appropriate scan tool data list and the service information for an indication of why the test does not complete. Some tests may abort due to changes in the conditions while the test is running. For example, changes in engine load such as a cooling fan or A/C compressor clutch turning ON may cause the test to abort.

Inspection/Maintenance (I/M) Catalyst System Set Procedure

Step	Action	Yes	No
1	Did you perform the Inspection/Maintenance (I/M) System Check?	Go to Step 2	Go to Inspection/Maintenance (I/M) System Check
	1. Ensure the vehicle is within the Conditions		

2	for Running specified in the supporting text. 2. Turn OFF all of the accessories, e.g., A/C, blower fan, etc. 3. Start the engine and allow it to idle for 5 minutes. CAUTION: Refer to <u>Road Test Caution</u> in Cautions and Notices. IMPORTANT: In order for this test to run, the vehicle must operate in the following conditions: • Acceleration at part throttle to 90 km/h (55 mph) with this speed maintained for 5 minutes • Deceleration to 0 km/h (0 mph) • Engine idling for 2 minutes while the following criteria is maintained: ○ Service brake pressed ○ Automatic transmission in Drive 4. Observe the I/M System Status display with a scan tool. Did the catalyst System Status update to YES?	Go to Step 5	Go to Step 3
3	Observe the DTC Information with a scan tool. Does the scan tool indicate any failed DTCs?	Go to Diagnostic Trouble Code (DTC) List - Vehicle in Vehicle DTC Information	Go to Step 4
4	1. Refer to the Inspection/Maintenance (I/M) System DTC Table to determine which DTCs are required to run in order to complete this test. 2. Observe the Not Ran Since Code Cleared display with a scan tool. 3. Determine which of the DTCs required for a YES status has not run. 4. Enter the DTC number in the specific DTC menu of the scan tool. 5. Operate the vehicle within the Conditions for		

	Running the DTC, located in the supporting text for the diagnostic table of the DTC. 6. Repeat the procedure until the scan tool indicates the diagnostic test has run. 7. Repeat steps 4-6 for any additional required DTCs that have not run. 8. Observe the I/M System Status display with a scan tool.		
	Did the catalyst System Status update to YES?	Go to Step 5	Go to Diagnostic Aids
5	Observe the emission related DTC portion of the I/M System Status display with a scan tool. Does the scan tool indicate any emission related DTCs set?	Go to <u>Diagnostic Trouble Code (DTC) List - Vehicle</u> in Vehicle DTC Information	System OK

INSPECTION/MAINTENANCE (I/M) EXHAUST GAS RECIRCULATION (EGR) SYSTEM SET PROCEDURE

Description

The purpose of this test is to satisfy the enable criteria necessary to execute inspection/maintenance (I/M) readiness diagnostics for the exhaust gas recirculation (EGR) system. The test may be used to set the I/M System Status indicators to YES. The I/M System Status display on the scan tool provides an indication of whether the control module has completed the required tests. The I/M System Status does not indicate that the tests have passed or failed. When all of the diagnostics for a specific system have run and passed, the I/M System Status will update to YES. If a test for a specific system has failed, the I/M System Status will update to YES, indicating a determination was made even if all of the other tests for that system have not run.

Conditions for Running

- The barometric pressure is more than 74 kPa.
- The ignition 1 voltage is between 11-18 volts.
- The intake air temperature (IAT) is between 0-100°C (32-212°F).
- The A/C Relay Command parameter does not change.
- The Current Gear parameter does not change.
- The engine coolant temperature (ECT) is more than 75°C (167°F).
- The engine speed is between 1,050-1,400 RPM.
- The manifold absolute pressure (MAP) is between 15-70 kPa.
- The mass air flow (MAF) sensor does not change more than 2 grams per second.
- The throttle position (TP) sensor is less than one percent.
- The vehicle speed is more than 48 km/h (30 mph) during deceleration.
- The idle air control (IAC) position does not change more than 5 counts when the above conditions are

met.

Diagnostic Aids

The control module only runs the EGR Active Tests during a gradual deceleration with a closed throttle and a vehicle speed above 48 km/h (30 mph). Several deceleration cycles may be necessary in order to accumulate a sufficient number of EGR flow samples. The procedure outlined in the table is for a clear, flat road. If the procedure is performed on a road with a slight down hill grade, the test may acquire the necessary sample counters in one or two decel trips. If the test is interrupted during the procedure, it may take more than three deceleration cycles to complete the test. If the status does not update, the test outlined in this procedure can be repeated until the I/M System Status updates to YES.

If there is an impending failure, the system may require more time to run the diagnostic than was allotted in the set procedure. If the test does not run after numerous attempts and no DTC is set, review the appropriate scan tool data list and the service information for an indication of why the test does not complete. Some tests may abort due to changes in the conditions while the test is running. For example, changes in engine load such as a cooling fan or A/C compressor clutch turning ON may cause the test to abort.

If a diagnostic test is difficult to run, observe the I/M System Status display while maintaining the necessary enable conditions until the System Status updates to YES.

Inspection/Maintenance (I/M) Exhaust Gas Recirculation (EGR) System Set Procedure

Step	Action	Yes	No
1	Did you perform the Inspection/Maintenance (I/M) System Check?	Go to Step 2	Go to Inspection/Maintenance (I/M) System Check
2	1. Ensure the vehicle is within the Conditions for Running specified in the supporting text. 2. Turn OFF all of the accessories, e.g., A/C, blower fan, etc. 3. Start the engine and allow it to idle for 2 minutes. CAUTION: Refer to Road Test Caution in Cautions and Notices. IMPORTANT: In order for this test to run, the vehicle must operate in the following conditions: - Acceleration at part throttle to 89 km/h (55 mph) with this speed maintained for 1 minute - Decelerate to 48 km/h (30 mph) while the following criteria is maintained:		

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	○ The throttle is closed ○ There is NO brake application ○ There is NO clutch actuation on a manual transmission ○ There is NO manual downshift 4. Observe the I/M System Status display with a scan tool. Did the EGR System Status update to YES?	Go to Step 5	Go to Step 3
3	Observe the DTC Information with a scan tool. Does the scan tool indicate any failed DTCs?	Go to <u>Diagnostic Trouble Code (DTC) List - Vehicle</u> in Vehicle DTC Information	Go to Step 4
4	1. Refer to the <u>Inspection/Maintenance (I/M) System DTC Table</u> to determine which DTCs are required to run in order to complete this test. 2. With a scan tool, observe the Not Ran Since Code Cleared display. 3. Determine which of the DTCs required for a YES status has not run. 4. Enter the DTC number in the Specific DTC menu of the scan tool. 5. Operate the vehicle within the Conditions for Running the DTC, located in the supporting text for the diagnostic table of the DTC. 6. Repeat the procedure until the scan tool indicates the diagnostic test has run. 7. Repeat steps 4-6 for any additional required DTCs that have not run. 8. Observe the I/M System Status display with a scan tool. Did the EGR System Status update to YES?	Go to Step 5	Go to Diagnostic Aids
5	Observe the Emission Related DTC portion of the I/M System Status display with a scan tool. Does the scan tool indicate any Emission Related DTCs set?	Go to <u>Diagnostic Trouble Code (DTC) List - Vehicle</u> in Vehicle DTC Information	System OK

PROCEDURE

Description

The purpose of this test is to satisfy the enable criteria necessary to execute inspection/maintenance (I/M) readiness diagnostics for the evaporative emission (EVAP) system. The test may be used to set the I/M System Status indicators to YES. The I/M System Status display on the scan tool indicates whether or not the control module has completed the required test. The required test is complete when either all of the DTCs comprising the test have run and passed, or when any one of the DTCs comprising the test has illuminated the malfunction indicator lamp (MIL). Once the test is complete, the I/M System Status display will indicate YES in the completed column. Performing a visual inspection prior to running the EVAP test may prevent having to repeat the test due to the fact that a failed or aborted test will require the vehicle to cool down in order to meet the enable criteria to run another test.

Conditions for Running

- The barometric pressure (BARO) is more than 75 kPa.
- The engine coolant temperature (ECT) is between 4-30°C (39-86°F).
- The fuel level is between 15-85 percent.
- The battery voltage is between 10-18 volts.
- The intake air temperature (IAT) is between 4-30°C (39-86°F).
- The startup ECT and IAT are within 9°C (16°F) of each other.
- The vehicle speed sensor (VSS) is less than 121 km/h (75 mph).

Diagnostic Aids

Extreme high or low ambient temperatures may prevent the EVAP System Tests from initiating.

If there is an impending failure, the system may require more time to run the diagnostic than was allotted in the set procedure. If the test does not run after numerous attempts and no DTC is set, review the appropriate scan tool data list and the service information for an indication of why the test does not complete. Some tests may abort due to changes in the conditions while the test is running. For example, changes in engine load such as a cooling fan or A/C compressor clutch turning ON may cause the test to abort.

Inspection/Maintenance (I/M) Evaporative Emission (EVAP) System Set Procedure

Step	Action	Yes	No
1	Did you perform the Inspection/Maintenance (I/M) System Check?	Go to Step 2	Go to Inspection/Maintenance (I/M) System Check
2	Select Special Functions on a scan tool. Does the Special Functions list include Service Bay Tests?	Go to Step 3	Go to Step 5
3	Perform the Service Bay Test. Refer to Service Bay Test . Did the evaporative emission (EVAP) system		

	pass the Service Bay Test?	Go to Step 8	Go to Step 4
4	1. Observe the Service Bay Test on the scan tool for an indication of why the test did not pass, e.g., a failed DTC, test aborted, etc. 2. Refer to the appropriate service information for diagnosis and repair of the condition, as necessary. Is the action complete?	Go to <u>Inspection/Maintenance</u> <u>(I/M) Complete System</u> <u>Set Procedure</u>	-
5	1. Ensure the vehicle is within the Conditions for Running as specified in the supporting text. 2. Turn OFF all of the accessories, e.g., A/C, blower fan, etc. IMPORTANT: Once the engine is started, DO NOT turn the engine OFF for the remainder of the procedure until the test is complete. 3. Start the engine and idle for 2 minutes. CAUTION: Refer to <u>Road Test Caution</u> in Cautions and Notices. IMPORTANT: In order for this test to run, the vehicle must operate in the following conditions: 4. Acceleration at part throttle to 72 km/h (45 mph) with this speed maintained until the engine reaches operating temperature. This may be up to 10 minutes depending on the start up coolant temperature. 5. Continue the operating conditions for an additional 3 minutes after the engine reaches operating temperature, or until the I/M System Status indicator updates to YES.		

	Did the EVAP System Status update to YES?	Go to Step 8	Go to Step 6
6	Observe the DTC information with a scan tool. Does the scan tool indicate any failed DTCs?	Go to <u>Diagnostic Trouble Code (DTC)</u> List - Vehicle in Vehicle DTC Information	Go to Step 7
7	1. Refer to the <u>Inspection/Maintenance (I/M) System DTC Table</u> to determine which DTCs are required to run in order to complete this test. 2. Observe the Not Ran Since Code Cleared display with a scan tool. 3. Determine which of the DTCs required for a YES status has not run. 4. Enter the DTC number in the Specific DTC menu of the scan tool. 5. Operate the vehicle within the Conditions for Running the DTC, located in the supporting text for the diagnostic table of the DTC. 6. Repeat the procedure until the scan tool indicates the diagnostic test has run. 7. Repeat steps 4-6 for any additional required DTCs that have not run. 8. Observe the I/M System Status display with a scan tool. Did the EVAP System Status update to YES?		
8	Observe the Emission Related DTC portion of the I/M System Status display with a scan tool. Does the scan tool indicate any Emission Related DTCs set?	Go to <u>Diagnostic Trouble Code (DTC)</u> List - Vehicle in Vehicle DTC Information	Go to Diagnostic Aids System OK

INSPECTION/MAINTENANCE (I/M) HEATED OXYGEN SENSOR/OXYGEN SENSOR (HO2S/O2S) SYSTEM SET PROCEDURE

Description

The purpose of this test is to satisfy the enable criteria necessary to execute inspection/maintenance (I/M) readiness diagnostics for the oxygen sensor (O2S, HO2S) system. The test may be used to set the I/M System Status to YES. The I/M System Status display on the scan tool provides an indication of whether the control module has completed the required tests. The I/M System Status does not indicate that the tests have passed or failed. When all of the diagnostics for a specific system have run and passed, the I/M System Status will update to YES. If a test for a specific system has failed, the I/M System Status will update to YES, indicating a

determination was made, even if all of the other tests for that system have not run.

Conditions for Running

- The engine coolant temperature (ECT) is less than 35°C (95°F).
- The engine is running in Closed Loop fuel control.
- The engine has been running for more than 1 minute.
- The battery voltage is between 9-18 volts.
- The mass air flow (MAF) is between 15-31 grams per second.
- The engine speed is between 1,300-3,000 RPM.
- The throttle position (TP) sensor is more than 2 percent.
- The vehicle speed sensor (VSS) is between 33-120 km/h (20-75 mph).
- The short term fuel trim is between 97.5-102.5.
- The intake air temperature (IAT) is less than 35°C (95°F).
- The startup engine coolant temperature (ECT) and IAT are within 6°C (10.8°F) of each other.

Diagnostic Aids

If there is an impending failure, the system may require more time to run the diagnostic than was allotted in the set procedure. If the test does not run after numerous attempts and no DTC is set, review the appropriate scan tool data list and the service information for an indication of why the test does not complete. Some tests may abort due to changes in the conditions while the test is running. For example, changes in engine load such as a cooling fan or A/C compressor clutch turning ON may cause the test to abort.

Inspection/Maintenance (I/M) Heated Oxygen Sensor/Oxygen Sensor (HO2S/O2S) System Set Procedure

Step	Action	Yes	No
1	Did you perform the Inspection/Maintenance (I/M) System Check?	Go to Step 2	Go to Inspection/Maintenance (I/M) System Check
2	1. Ensure the vehicle is within the Conditions for Running specified in the supporting text. 2. Turn OFF all of the accessories, e.g., A/C, blower fan, etc. 3. Start the engine and allow it to idle for 1 minute. CAUTION: Refer to <u>Road Test Caution</u> in Cautions and Notices. IMPORTANT: In order for this test to run, the vehicle must operate in the following conditions:		

	4. Acceleration at part throttle to 75-90 km/h (45-55 mph) with this speed maintained for 6 minutes or until the I/M System Status updates to YES. Manual transmissions, either 5 or 6 speed, may require operation in 4th or 5th gear respectively, in order for this test to run. 5. Review the I/M System Status display with a scan tool. Did the HO2S/O2S System Status update to YES?	Go to Step 5	Go to Step 3
3	Observe the DTC Information with a scan tool. Does the scan tool indicate any failed DTCs?	Go to <u>Diagnostic Trouble Code (DTC) List - Vehicle</u> in Vehicle DTC Information	Go to Step 4
4	1. Refer to the <u>Inspection/Maintenance (I/M) System DTC Table</u> to determine which DTCs are required to run in order to complete this test. 2. Observe the Not Ran Since Code Cleared display with a scan tool. 3. Determine which of the DTCs required for a YES status has not run. 4. Enter the DTC number in the Specific DTC menu of the scan tool. 5. Operate the vehicle within the Conditions for Running the DTC, located in the supporting text for the diagnostic table of the DTC. 6. Repeat the procedure until the scan tool indicates the diagnostic test has run. 7. Repeat steps 4-6 for any additional required DTCs that have not run. 8. Observe the I/M System Status display with a scan tool. Did the HO2S/O2S System Status update to YES?	Go to Step 5	Go to Diagnostic Aids
5	Observe the Emission Related DTC portion of the I/M System Status display with a scan tool. Does the scan tool indicate any Emission Related DTCs set?	Go to <u>Diagnostic Trouble Code (DTC) List - Vehicle</u> in Vehicle DTC Information	System OK

INSPECTION/MAINTENANCE (I/M) HEATED OXYGEN SENSOR (HO2S) HEATER SYSTEM SET PROCEDURE

Description

The purpose of this test is to satisfy the enable criteria necessary to execute inspection/maintenance (I/M) readiness diagnostics for the heated oxygen sensor (HO2S) system. The test may be used to set the I/M System Status to YES. The I/M System Status display on the scan tool provides an indication of whether the control module has completed the required tests. The I/M System Status does not indicate that the tests have passed or failed. When all of the diagnostics for a specific system have run and passed, the I/M System Status will update to YES. If a test for a specific system has failed, the I/M System Status will update to YES, indicating a determination was made, even if all of the other tests for that system have not run.

Conditions for Running

- The engine coolant temperature (ECT) is less than 35°C (95°F).
- The intake air temperature (IAT) is less than 35°C (95°F).
- The difference between the IAT and the ECT is less than 6°C (10.8°F).
- The battery voltage is between 10-18 volts.
- The engine speed is between 600-3,000 RPM.
- The mass air flow (MAF) is between 4-26 grams per second.

Diagnostic Aids

The HO2S Heater Tests will normally run within the 2 minutes allotted in the procedure. If there is an indeterminate condition, the test may take up to 8 minutes on some vehicles before a decision of pass or fail is made. If the test does not update to YES, it may have failed or aborted due to the loss of enabling conditions. Extremely high ambient temperatures may prevent the HO2S Heater Test from initiating.

If there is an impending failure, the system may require more time to run the diagnostic than was allotted in the set procedure. If the test does not run after numerous attempts and no DTC is set, review the appropriate scan tool data list and the service information for an indication of why the test does not complete. Some tests may abort due to changes in the conditions while the test is running. For example, changes in engine load such as a cooling fan or A/C compressor clutch turning ON may cause the test to abort.

Inspection/Maintenance (I/M) Heated Oxygen Sensor (HO2S) Heater System Set Procedure

Step	Action	Value(s)	Yes	No
1	Did you perform the Inspection/Maintenance (I/M) System Check?	-	Go to Step 2	Go to <u>Inspection/Maintenance (I/M) System Check</u>
	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			

	diagnostic table of the DTC. 6. Repeat the procedure until the scan tool indicates the diagnostic test has run. 7. Repeat steps 4-6 for any additional required DTCs that have not run. 8. Observe the I/M System Status display with a scan tool.			
	Did the HO2S Heater System Status update to YES?		Go to Step 5	Go to Diagnostic Aids
5	Observe the Emission Related DTC portion of the I/M System Status display with a scan tool. Does the scan tool indicate any Emission Related DTCs set?	-	Go to Diagnostic Trouble Code (DTC) List - Vehicle in Vehicle DTC Information	System OK

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.